

MC33460, MC33461

Under Voltage Detector Series

The MC33460 and MC33461 series are ultra-low power CMOS under-voltage detectors with very tight threshold accuracy specifically designed for accurate monitoring of power supplies. The devices are optimized for use in battery powered systems where low quiescent current and small packaging are required. The device generates an active-low signal whenever the input voltage falls below the factory set $\pm 2\%$ threshold. Hysteresis is provided to ensure reliable output switching.

The MC33460/1 series features a highly accurate voltage reference, a comparator with a precision voltage threshold, and built-in hysteresis to prevent erratic operation and a choice of output configurations between Open Drain (MC33460) and complementary push-pull (MC33461). The products are offered in 9 standard voltage thresholds ranging from 0.9V to 4.5V. Other threshold voltages from 1.0 to 5.0V are available in 100mV steps. The devices can operate to a very low input voltage level and are housed in the ultra-miniature SC-82AB package.

Features

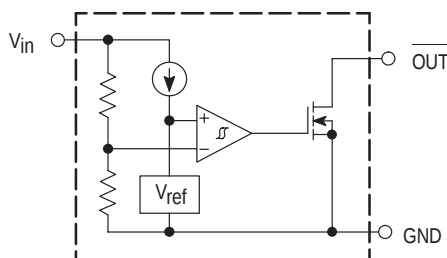
- Available in Open Drain or Push-Pull Output
- Output State Guaranteed to $V_{in} = 0.8\text{ V}$
- Tight Detector Voltage Accuracy ($\pm 2.0\%$)
- Extended Temperature Operation (-40°C to 85°C)
- Ultra Low Quiescent Current ($0.8\text{ }\mu\text{A}$ at $V_{in} = 1.5\text{ V}$ typical)
- Wide Range of Operating Voltage (0.7 V to 10 V)

Applications

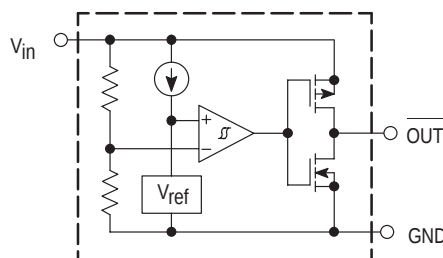
- Low Battery Detector
- Power-Fail Indicator
- Microprocessor Reset Generator
- Window Comparator
- Battery Backup Circuit

Representative Block Diagrams

MC33460
Nch Open Drain Configuration



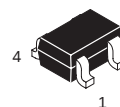
MC33461
CMOS Configuration



ON Semiconductor

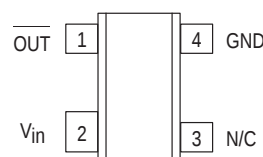
Formerly a Division of Motorola

<http://onsemi.com>



SC-82AB
SQ SUFFIX
CASE 419C

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

MC33460, MC33461

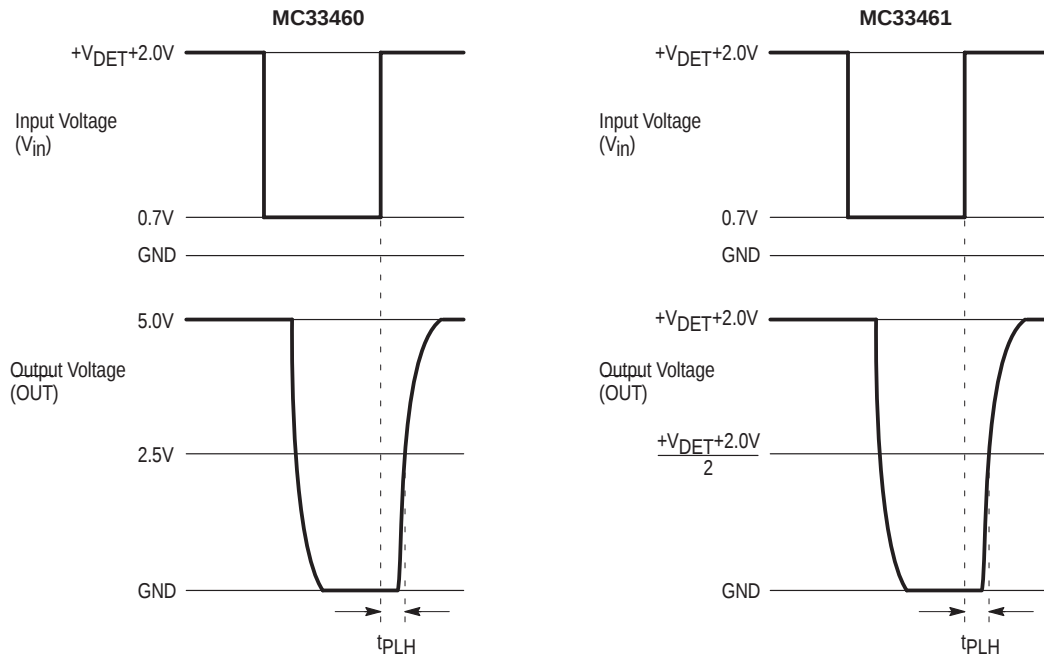
ORDERING INFORMATION

Device	Threshold Voltage	Type	Marking	Package (Qty/Reel)
MC33460SQ-09ATR	0.9	Nch Open Drain	K9	3000 Units on 7 inch Reel
MC33460SQ-20ATR	2.0		M0	
MC33460SQ-27ATR	2.7		M7	
MC33460SQ-28ATR	2.8		M8	
MC33460SQ-30ATR	3.0		N0	
MC33460SQ-32ATR	3.2		N2	
MC33460SQ-41ATR	4.1		P1	
MC33460SQ-42ATR	4.2		P2	
MC33460SQ-43ATR	4.3		P3	
MC33460SQ-45ATR	4.5		P5	
MC33461SQ-09CTR	0.9	CMOS	T9	
MC33461SQ-20CTR	2.0		V0	
MC33461SQ-27CTR	2.7		V7	
MC33461SQ-28CTR	2.8		V8	
MC33461SQ-30CTR	3.0		W0	
MC33461SQ-32CTR	3.2		W2	
MC33461SQ-41CTR	4.1		X1	
MC33461SQ-42CTR	4.2		X2	
MC33461SQ-43CTR	4.3		X3	
MC33461SQ-45CTR	4.5		X5	

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage	V_{in}	12	V
Output Voltage (CMOS)	V_{OUT1}	-0.3 to $V_{in}+0.3$	V
Output Voltage (Nch Open Drain)	V_{OUT2}	-0.3 to 12	V
Output Current	I_{OUT}	70	mA
Power Dissipation	P_D	150	mW
Operating Ambient Temperature	T_A	-40 to +85	°C
Storage Temperature Range	T_{stg}	-40 to +125	°C
Lead Temperature (Soldering)	T_{solder}	260°C, 10 s	—

MC33460, MC33461



Note: Measured with 470k pullup resistor from OUT to +5V.

Figure 1. T_{pd} Measurement Conditions

MC33460, MC33461

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 0.9					
Detector Threshold (V_{in} Falling)	V_{DET-}	0.882	0.900	0.918	V
Detector Threshold Hysteresis	V_{HYS}	0.027	0.045	0.063	V
Supply Current ($V_{in} = 0.8\text{ V}$) ($V_{in} = 2.9\text{ V}$)	I_{in}	– –	0.8 1.0	2.4 3.0	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 0.85\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 0.05 1.0	0.05 0.50 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 2.0					
Detector Threshold (V_{in} Falling)	V_{DET-}	1.96	2.00	2.04	V
Detector Threshold Hysteresis	V_{HYS}	0.06	0.10	0.14	V
Supply Current ($V_{in} = 1.9\text{ V}$) ($V_{in} = 4.0\text{ V}$)	I_{in}	– –	0.9 1.1	2.7 3.3	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 1.0 1.0	0.05 2.0 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

MC33460, MC33461

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 2.7					
Detector Threshold (V_{in} Falling)	V_{DET-}	2.646	2.700	2.754	V
Detector Threshold Hysteresis	V_{HYS}	0.081	0.135	0.189	V
Supply Current ($V_{in} = 2.6\text{ V}$) ($V_{in} = 4.7\text{ V}$)	I_{in}	– –	0.9 1.1	2.7 3.3	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 1.0 1.0	0.05 2.0 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 2.8					
Detector Threshold (V_{in} Falling)	V_{DET-}	2.744	2.800	2.856	V
Detector Threshold Hysteresis	V_{HYS}	0.084	0.140	0.196	V
Supply Current ($V_{in} = 2.7\text{ V}$) ($V_{in} = 4.8\text{ V}$)	I_{in}	– –	0.9 1.1	2.7 3.3	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 1.0 1.0	0.05 2.0 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

MC33460, MC33461

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 3.0					
Detector Threshold (V_{in} Falling)	V_{DET-}	2.94	3.00	3.06	V
Detector Threshold Hysteresis	V_{HYS}	0.09	0.15	0.21	V
Supply Current ($V_{in} = 2.87\text{ V}$) ($V_{in} = 5.0\text{ V}$)	I_{in}	– –	1.0 1.2	3.0 3.6	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 1.0 1.0	0.05 2.0 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 3.2					
Detector Threshold (V_{in} Falling)	V_{DET-}	3.136	3.200	3.264	V
Detector Threshold Hysteresis	V_{HYS}	0.096	0.160	0.224	V
Supply Current ($V_{in} = 3.07\text{ V}$) ($V_{in} = 5.2\text{ V}$)	I_{in}	– –	1.0 1.2	3.0 3.6	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 1.0 1.0	0.05 2.0 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

MC33460, MC33461

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 4.1					
Detector Threshold (V_{in} Falling)	V_{DET-}	4.018	4.1	4.182	V
Detector Threshold Hysteresis	V_{HYS}	0.135	0.225	0.315	V
Supply Current ($V_{in} = 3.94\text{ V}$) ($V_{in} = 6.1\text{ V}$)	I_{in}	– –	1.1 1.3	3.3 3.9	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 6.9\text{V}$, $V_{in} = 8.0\text{V}$)	I_{OUT}	0.01 1.0 1.5	0.05 2.0 3.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 4.2					
Detector Threshold (V_{in} Falling)	V_{DET-}	4.116	4.2	4.284	V
Detector Threshold Hysteresis	V_{HYS}	0.126	0.210	0.296	V
Supply Current ($V_{in} = 4.04\text{ V}$) ($V_{in} = 6.2\text{ V}$)	I_{in}	– –	1.1 1.3	3.3 3.9	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 1.0 1.0	0.05 2.0 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

MC33460, MC33461

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 4.3					
Detector Threshold (V_{in} Falling)	V_{DET-}	4.214	4.300	4.386	V
Detector Threshold Hysteresis	V_{HYS}	0.129	0.215	0.301	V
Supply Current ($V_{in} = 4.14\text{ V}$) ($V_{in} = 6.3\text{ V}$)	I_{in}	– –	1.1 1.3	3.3 3.9	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 2.4\text{V}$, $V_{in} = 4.5\text{V}$)	I_{OUT}	0.01 1.0 1.0	0.05 2.0 2.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$, unless otherwise noted.)

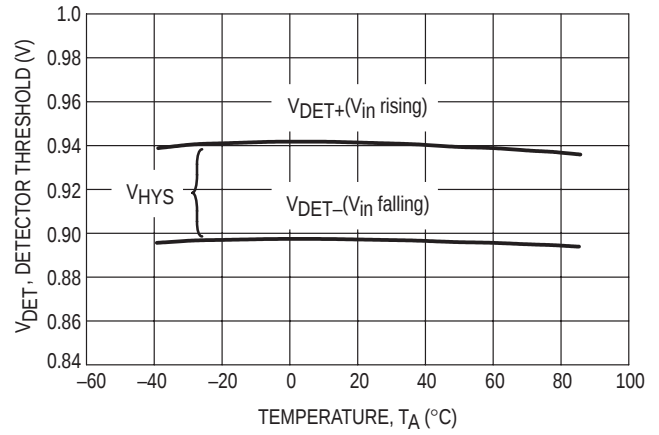
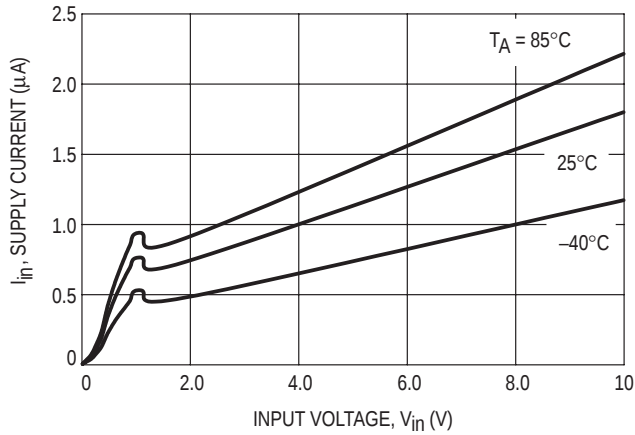
Characteristic	Symbol	Min	Typ	Max	Unit
MC33460/461 – 4.5					
Detector Threshold (V_{in} Falling)	V_{DET-}	4.410	4.500	4.590	V
Detector Threshold Hysteresis	V_{HYS}	0.135	0.225	0.315	V
Supply Current ($V_{in} = 4.34\text{ V}$) ($V_{in} = 6.5\text{ V}$)	I_{in}	– –	1.1 1.3	3.3 3.9	μA
Maximum Operating Voltage	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Output Current (OUT) Nch ($V_{out} = 0.05\text{V}$, $V_{in} = 0.70\text{V}$) ($V_{out} = 0.50\text{V}$, $V_{in} = 1.5\text{V}$) CMOS Output High ($V_{out} = 5.9\text{V}$, $V_{in} = 8.0\text{V}$)	I_{OUT}	0.01 1.0 1.5	0.05 2.0 3.0	– – –	mA mA mA
Output Delay Time (Note 1)	t_{pd}	–	–	100	μs
Detector Threshold Temperature Coefficient ($-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$)	$\Delta V_{DET-}/\Delta T$	–	± 100	–	PPM/ $^\circ\text{C}$

NOTES: 1. Refer to Figure 1 for test conditions for measurement.

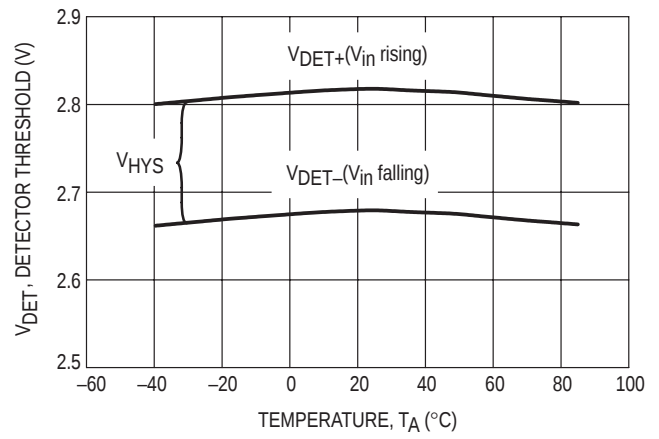
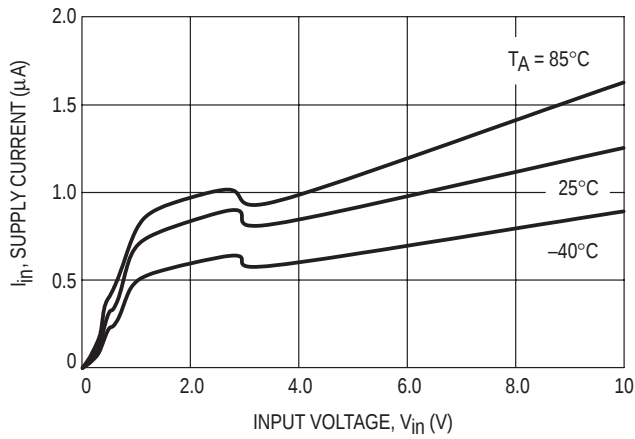
MC33460, MC33461

TYPICAL CHARACTERISTICS

MC33461-0.9



MC33461-2.7



MC33461-4.5

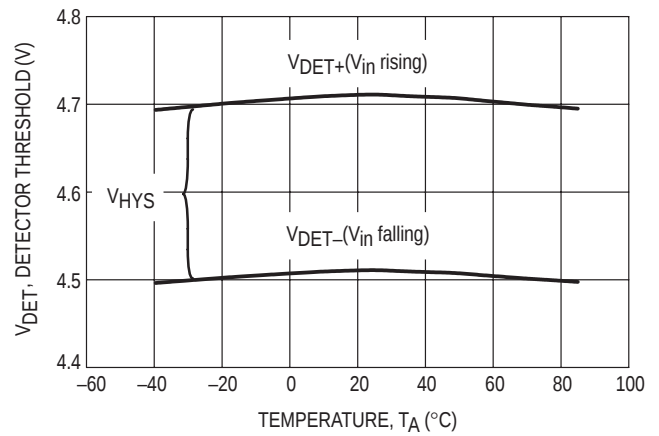
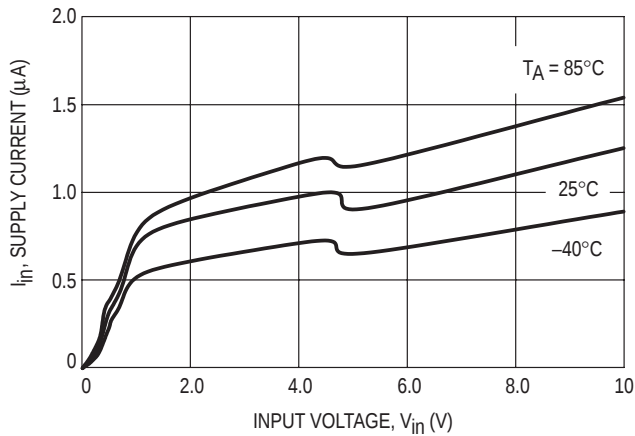
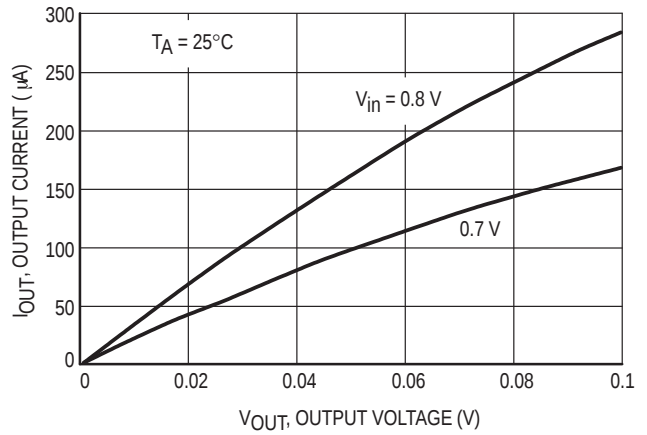
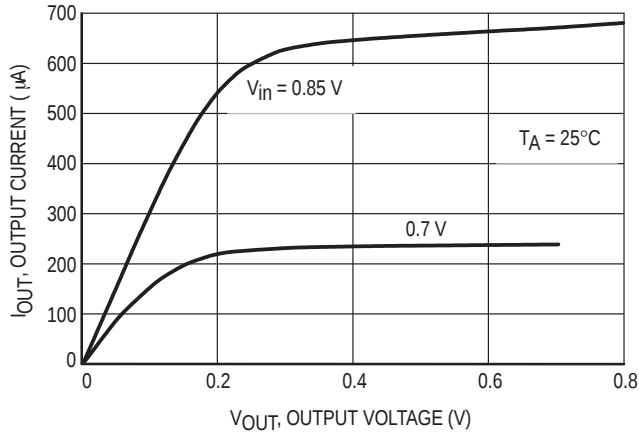


Figure 2. Supply Current vs. Input Voltage

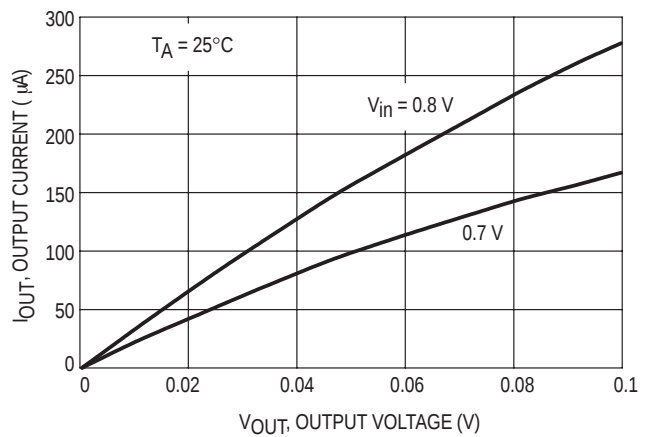
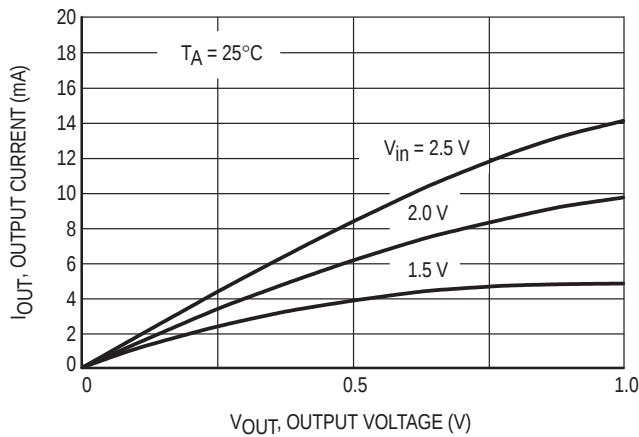
Figure 3. Detector Threshold Hysteresis vs. Temperature

MC33460, MC33461

MC33461-0.9



MC33461-2.7



MC33461-4.5

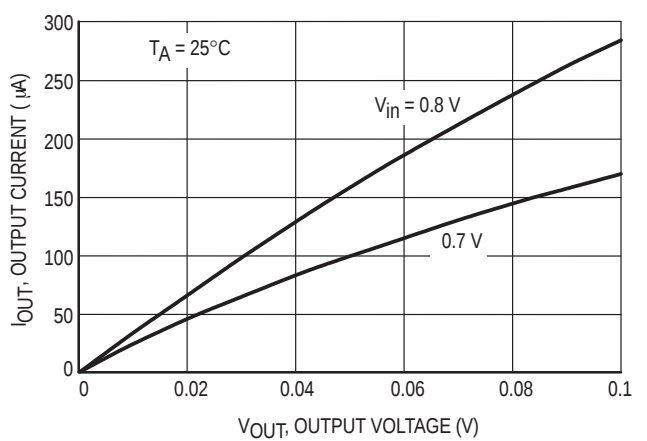
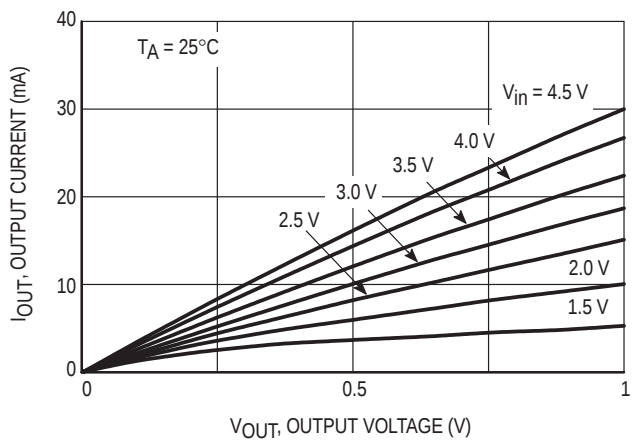
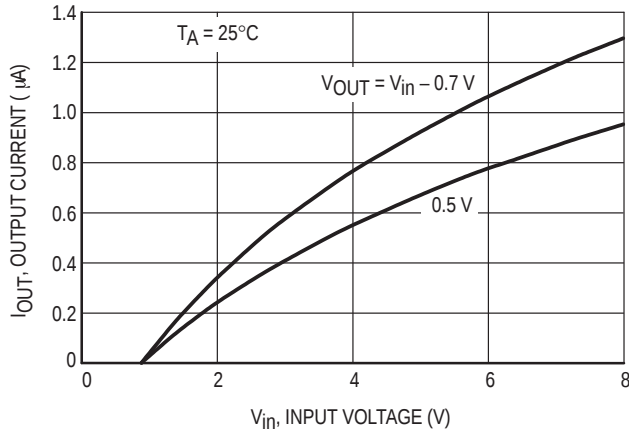


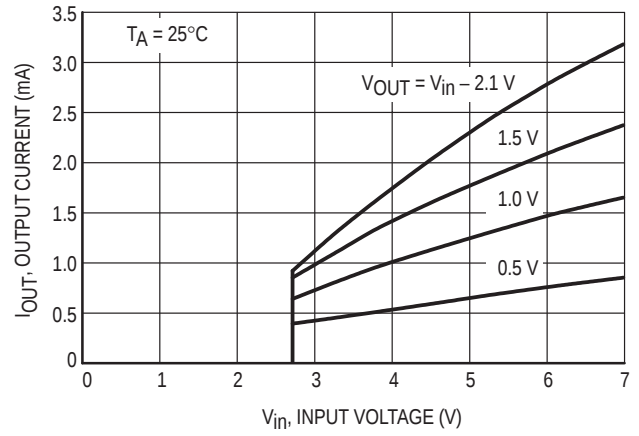
Figure 4. Nch Output Current versus V_{in}

MC33460, MC33461

MC33461-0.9



MC33461-2.7



MC33461-4.5

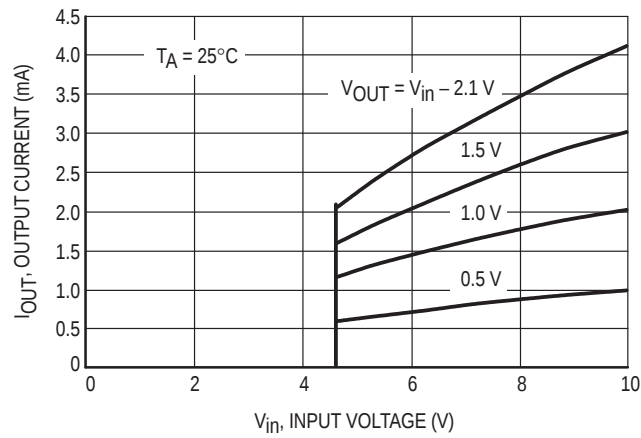
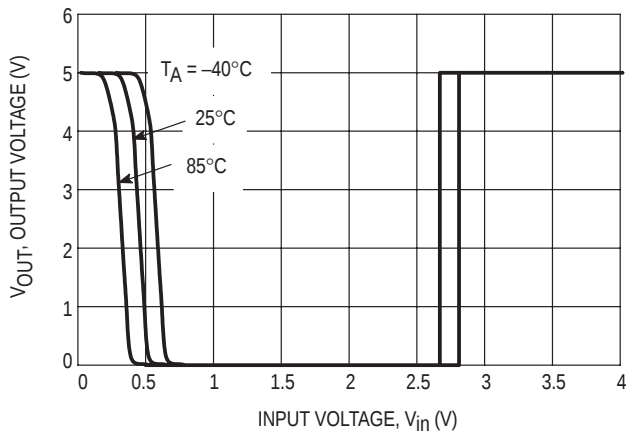


Figure 5. Output Current High versus Input Voltage

MC33460-2.7



MC33461-2.7

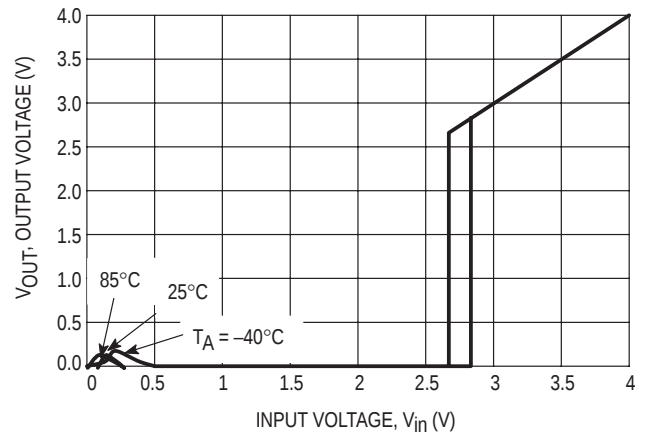
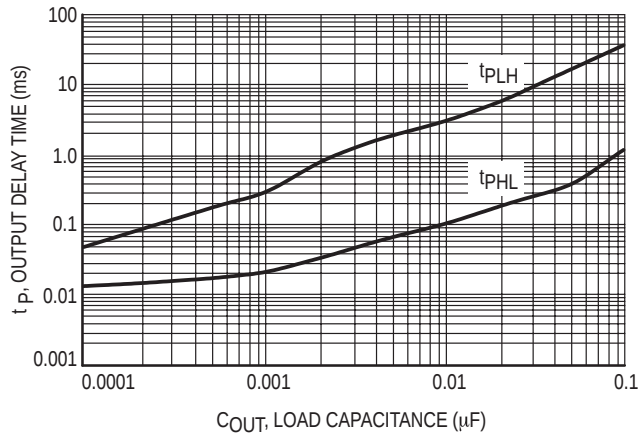


Figure 6. Typical Output Voltage versus Input Voltage

MC33460, MC33461

MC33460-0.9



MC33460-2.7

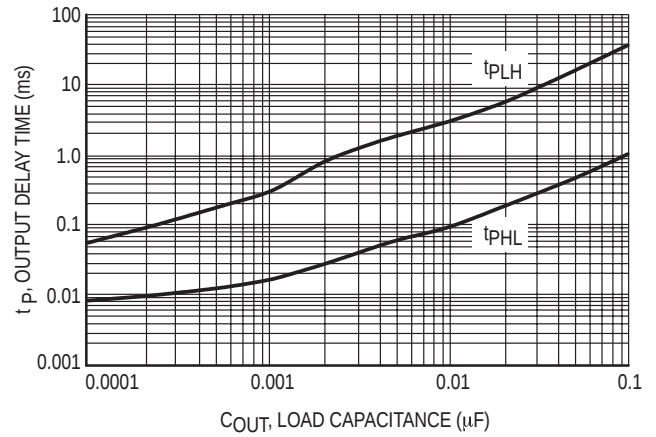


Figure 7. Output Delay Time versus Load Capacitance

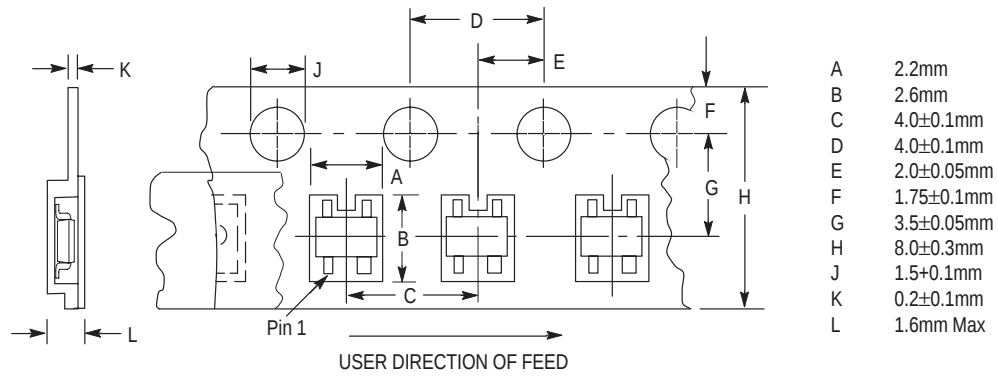


Figure 8. Taping Specifications

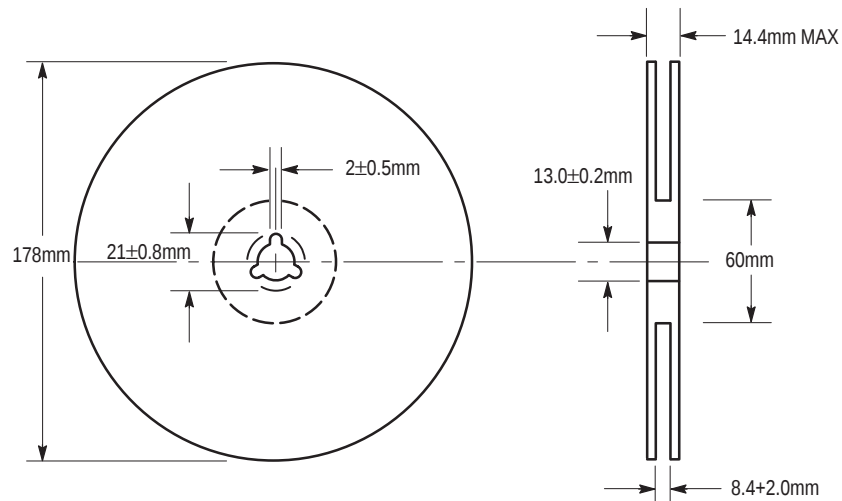


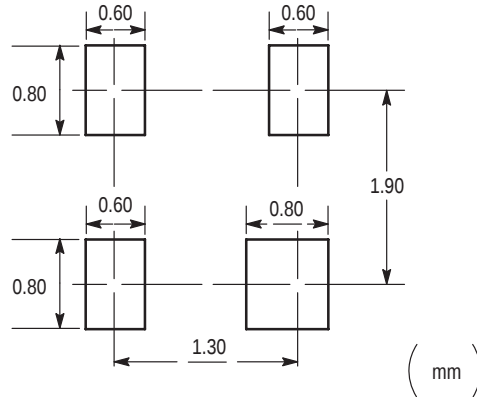
Figure 9. Reel Dimensions

INFORMATION FOR USING THE SC-82AB SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection

interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



SC-82AB

SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference shall be a maximum of 10°C.

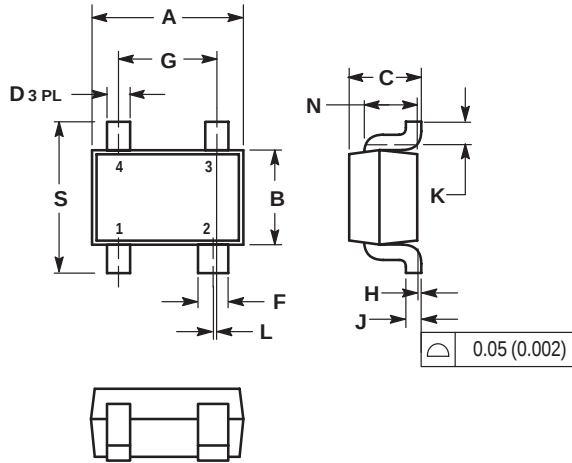
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

MC33460, MC33461

PACKAGE DIMENSIONS

(SC-82AB)
SQ SUFFIX
PLASTIC PACKAGE
CASE 419C-01
ISSUE O



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.8	2.2	0.071	0.087
B	1.15	1.45	0.045	0.057
C	0.8	1.1	0.031	0.043
D	0.2	0.4	0.008	0.016
F	0.3	0.5	0.012	0.020
G	1.1	1.5	0.043	0.059
H	0.0	0.1	0.000	0.004
J	0.10	0.26	0.004	0.010
K	0.1	—	0.004	—
L	0.05 BSC		0.002 BSC	
N	0.7 REF		0.028 REF	
S	1.8	2.4	0.07	0.09

Notes

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 (M-F 1:00pm to 5:00pm Munich Time)
Email: ONlit-german@hibbertco.com
French Phone: (+1) 303-308-7141 (M-F 1:00pm to 5:00pm Toulouse Time)
Email: ONlit-french@hibbertco.com
English Phone: (+1) 303-308-7142 (M-F 12:00pm to 5:00pm UK Time)
Email: ONlit@hibbertco.com

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

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

CENTRAL/SOUTH AMERICA:

Spanish Phone: 303-308-7143 (Mon-Fri 8:00am to 5:00pm MST)
Email: ONlit-spanish@hibbertco.com

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: 81-3-5740-2745
Email: r14525@onsemi.com

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

For additional information, please contact your local Sales Representative.