National Semiconductor

June 2005

LMS1585A/LMS1587
5A and 3A Low Dropout Fast Response Regulators

General Description

The LMS1585A and LMS1587 are low dropout positive regulators with output load current of 5A and 3A respectively. Their low dropout voltage (1.2V) and fast transient response make them an excellent solution for low voltage microprocessor applications.

The LMS1585A/87 are available in adjustable versions, which can set the output voltage with only two external resistors. In addition, they are also available in 1.5V and 3.3V fixed voltage versions (Note 9).

The LMS1585A/87 circuits include a zener trimmed bandgap reference, current limiting and thermal shutdown.

The LMS1585A/87 series are available in TO-220 and TO-263 packages.

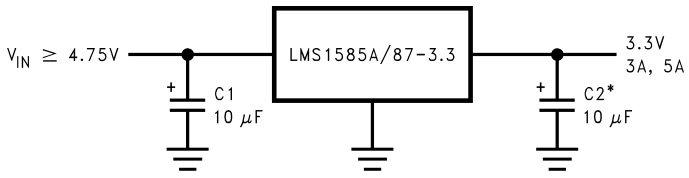
Features

- Fast transient response
- Available in Adjustable, 1.5V, and 3.3V versions
- Current limiting and thermal protection
- Commercial temp. range 0˚C to 125˚C
- Industrial temp. range –40˚C to 125˚C
- Line regulation 0.005% (typical)
- Load regulation 0.05% (typical)
- Direct replacement for LT™1585A/87

Applications

- Pentium™ processor supplies
- PowerPC™ supplies
- Other microprocessor supplies
- Low voltage logic supplies

Typical Application

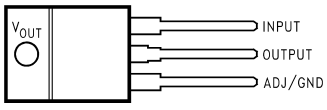


* REQUIRED FOR STABILITY

10119701

Connection Diagrams

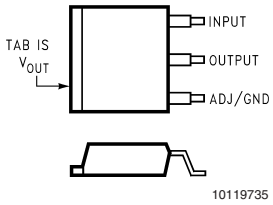
TO-220



10119736

Top View

TO-263



10119735

Top View

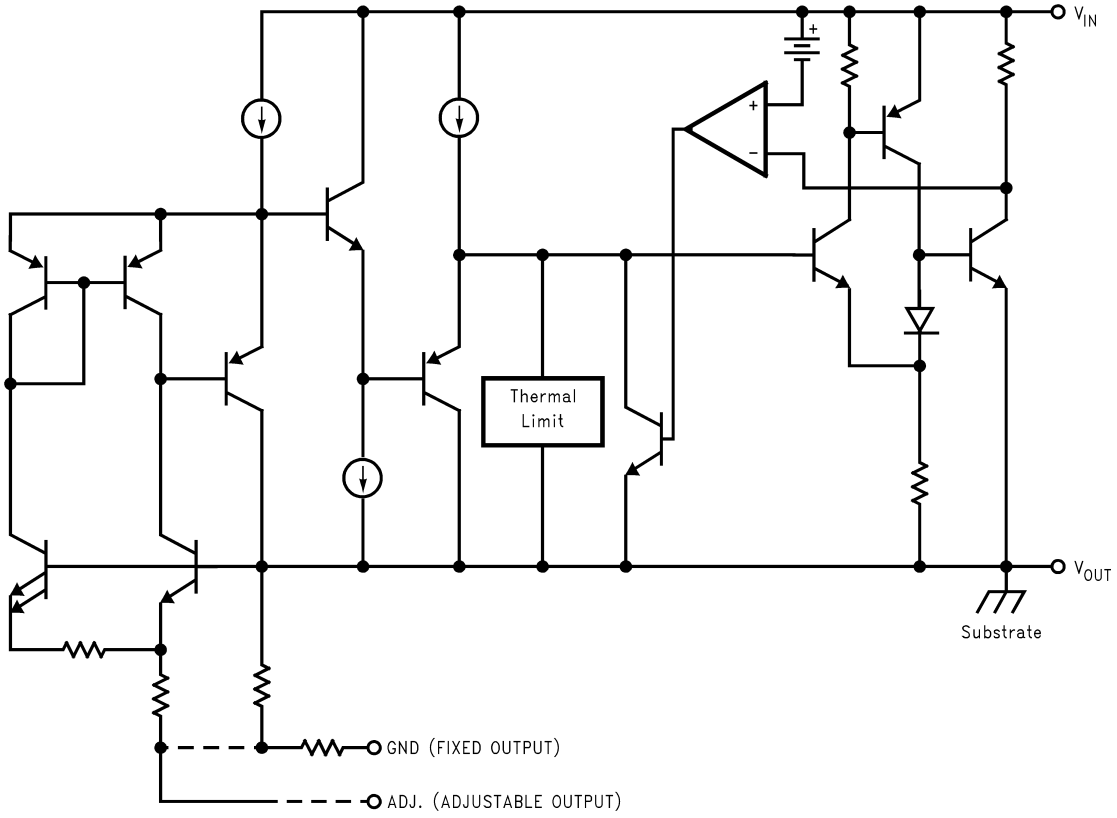
LT is a registered trademark of Linear Technology Corporation
Pentium is a registered trademark of Intel Corporation
PowerPC is a registred trademark of IBM

© 2005 National Semiconductor Corporation

Ordering Information

Output Current	Package	Temperature Range	Part Number	Transport Media	NSC Drawing
3A	TO-263	0˚C to 125˚C	LMS1587CS-ADJ	Rails	TS3B
			LMS1587CSX-ADJ	Tape and Reel	
			LMS1587CS-1.5	Rails	
			LMS1587CSX-1.5	Tape and Reel	
			LMS1587CS-3.3	Rails	
			LMS1587CSX-3.3	Tape and Reel	
		−40˚C to 125˚C	LMS1587IS-ADJ	Rails	
			LMS1587ISX-ADJ	Tape and Reel	
			LMS1587IS-1.5	Rails	
			LMS1587ISX-1.5	Tape and Reel	
			LMS1587IS-3.3	Rails	
			LMS1587ISX-3.3	Tape and Reel	
	TO-220	0˚C to 125˚C	LMS1587CT-ADJ	Rails	T03B
			LMS1587CT-1.5	Rails	
			LMS1587CT-3.3	Rails	
		−40˚C to 125˚C	LMS1587IT-ADJ	Rails	
			LMS1587IT-1.5	Rails	
			LMS1587IT-3.3	Rails	
5A	TO-263	0˚C to 125˚C	LMS1585ACS-ADJ	Rails	TS3B
			LMS1585ACSX-ADJ	Tape and Reel	
			LMS1585ACS-1.5	Rails	
			LMS1585ACSX-1.5	Tape and Reel	
			LMS1585ACS-3.3	Rails	
			LMS1585ACSX-3.3	Tape and Reel	
		−40˚C to 125˚C	LMS1585AIS-ADJ	Rails	
			LMS1585AISX-ADJ	Tape and Reel	
			LMS1585AIS-1.5	Rails	
			LMS1585AISX-1.5	Tape and Reel	
			LMS1585AIS-3.3	Rails	
			LMS1585AISX-3.3	Tape and Reel	
	TO-220	0˚C to 125˚C	LMS1585ACT-ADJ	Rails	T03B
			LMS1585ACT-1.5	Rails	
			LMS1585ACT-3.3	Rails	
		−40˚C to 125˚C	LMS1585AIT-ADJ	Rails	
			LMS1585AIT-1.5	Rails	
			LMS1585AIT-3.3	Rails	

Simplified Schematic



10119714

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Maximum Input to Output Voltage (V_{IN} to GND)	13V
Power Dissipation (Note 2)	Internally Limited
Junction Temperature (T_J) (Note 2)	150˚C
Storage Temperature Range	-65˚C to 150˚C
Lead Temperature	260˚C, 10 sec
ESD Tolerance (Note 3)	2000V

Electrical Characteristics

Typicals and limits appearing in normal type apply for T_J = 25˚C. Limits appearing in **Boldface** type apply over the entire junction temperature range for operation, 0˚C to 125˚C for commercial grade and –40˚C to 125˚C for industrial grade.

Symbol	Parameter	Conditions	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Units
V_{REF}	Reference Voltage	LMS1585A-ADJ				
		$V_{IN}-V_{OUT}$ = 3V, I_{OUT} = 10mA	1.238	1.25	1.262	V
		10mA ≤ I_{OUT} ≤ 5A, 1.5V ≤ $V_{IN}-V_{OUT}$ ≤ 5.75V	**1.225**	**1.250**	**1.275**	V
		LMS1587-ADJ				
		10mA ≤ I_{OUT} ≤ 3A, 1.5V ≤ $V_{IN}-V_{OUT}$ ≤ 5.75V	**1.225**	1.250	**1.275**	V
V_{OUT}	Output Voltage	LMS1585A-1.5				
		I_{OUT} = 0mA, V_{IN} = 5V	1.485	1.500	1.515	V
		0 ≤ I_{OUT} ≤ 5A, 3V ≤ V_{IN} ≤ 7V	**1.470**		**1.530**	V
		LMS1585A-3.3				
		I_{OUT} = 0mA, V_{IN} = 5V	3.267	3.300	3.333	V
		0 ≤ I_{OUT} ≤ 5A, 4.75V ≤ V_{IN} ≤ 7V	**3.235**	3.300	**3.365**	V
		LMS1587-1.5				
		V_{IN} = 5V, I_{OUT} = 0mA, T_J = 25˚C	1.485	1.500	1.515	V
		0≤ I_{OUT} ≤ 3A, 3V ≤ V_{IN} ≤ 7V	**1.470**	1.500	**1.530**	V
		LMS1587-3.3				
		0 ≤ I_{OUT} ≤ 3A, 4.75V ≤ V_{IN} ≤ 7V	**3.235**	3.300	**3.365**	V
ΔV_{OUT}	Line Regulation (Note 6)	LMS1585A/87-ADJ				
		I_{OUT} = 10mA, 2.75V ≤ V_{IN} ≤ 7V		0.005	**0.2**	%
		LMS1585A/87-3.3				
		I_{OUT} = 0mA, 4.75V ≤ V_{IN} ≤ 7V		0.005	**0.2**	%
		LMS1585A/87-1.5				
		I_{OUT} = 0mA, 3V ≤ V_{IN} ≤ 7V		0.005	0.2	%
ΔV_{OUT}	Load Regulation (Note 6)	LMS1585A-ADJ			0.3	%
		$V_{IN}-V_{OUT}$ = 3V, 10mA ≤ I_{OUT} ≤ 5A		0.05	**0.5**	
		LMS1585A-1.5/LMS1585A-3.3		0.05	0.3	%
		V_{IN} = 5V, 0 ≤ I_{OUT} ≤ 5A		0.05	**0.5**	
		LMS1587-ADJ		0.05	0.3	
		$V_{IN}-V_{OUT}$ = 3V, 10mA ≤ I_{OUT} ≤ 3A		0.05	**0.5**	%
		LMS1587-1.5/LMS1587-3.3		0.05	0.3	%
		V_{IN} = 5V, 0 ≤ I_{OUT} ≤ 3A		0.05	**0.5**	%
$V_{IN}-V_{OUT}$	Dropout Voltage	LMS1585A-ADJ/LMS1587-ADJ				
		ΔV_{REF} = 1%, I_{OUT} = 3A		1.15	**1.3**	V
		LMS1585A-3.3/LMS1587-3.3/ LMS1585A-1.5/LMS1587-1.5				
		ΔV_{OUT} = 1%, I_{OUT} = 3A		1.15	**1.3**	V
		LMS1585A-ADJ				
		ΔV_{REF} = 1%, I_{OUT} = 5A		1.2	**1.4**	V
		LMS1585A-1.5/LMS1585A-3.3				
		ΔV_{OUT} = 1%, I_{OUT} = 5A		1.2	**1.4**	V

Electrical Characteristics (Continued)

Typicals and limits appearing in normal type apply for T_J = 25˚C. Limits appearing in **Boldface** type apply over the entire junction temperature range for operation, 0˚C to 125˚C for commercial grade and –40˚C to 125˚C for industrial grade.

Symbol	Parameter	Conditions	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Units
I_{LIMIT}	Current Limit	LMS1585A-ADJ/LMS1585A-3.3/LMS1585A-1.5 $V_{IN}–V_{OUT}$ = 5.5V	**5.0**	6.6		A
		LMS1587-ADJ/LMS1587-3.3/LMS1587-1.5 $V_{IN}–V_{OUT}$ = 5.5V	**3.1**	4.3		A
	Minimum Load Current (Note 7)	LMS1585A/87-ADJ 1.5V ≤ $V_{IN}–V_{OUT}$ ≤ 5.75V		2.0	**10.0**	mA
	Quiescent Current	LMS1585A-3.3/LMS1587-3.3/ LMS1585A-1.5/LMS1587-1.5 V_{IN} = 5V		7.0	**13.0**	mA
	Thermal Regulation	T_A = 25˚C, 30ms Pulse		0.003		%/W
	Ripple Rejection	LMS1585A-ADJ f_{RIPPLE} = 120Hz, $V_{IN}–V_{OUT}$ = 3V, I_{OUT} = 5A, C_{OUT} = 25µF Tantalum		72		dB
		LMS1585A-1.5 f_{RIPPLE} = 120Hz, C_{OUT} = 25µF Tantalum, I_{OUT} = 5A, V_{IN} = 4.5V	**60**	72		dB
		LMS1585A-3.3 f_{RIPPLE} = 120Hz, C_{OUT} = 25µF Tantalum, I_{OUT} = 5A, V_{IN} = 6.3V		72		dB
		LMS1587-ADJ f_{RIPPLE} = 120Hz, $V_{IN}–V_{OUT}$ = 3V, I_{OUT} = 3A C_{OUT} = 25µF Tantalum		72		dB
		LMS1587-1.5 f_{RIPPLE} = 120Hz, C_{OUT} = 25µF Tantalum, I_{OUT} = 3A, V_{IN} = 4.5V	**60**	72		dB
		LMS1587-3.3 f_{RIPPLE} = 120Hz, C_{OUT} = 25µF Tantalum, I_{OUT} = 3A, V_{IN} = 6.3V		72		dB
	Adjust Pin Current			55	**120**	µA
	Adjust Pin Current	10mA ≤ I_{OUT} ≤ $I_{FULLLOAD}$, 1.5V ≤ $V_{IN}–V_{OUT}$ ≤ 5.75V (Note 8)		0.2		µA
	Temperature Stability			0.5		%
	Long Term Stability	T_A = 125˚C, 1000Hrs		0.03		%
	RMS Output Noise (% of V_{OUT})	10Hz ≤ f ≤ 10kHz		0.003		%
	Thermal Resistance Junction-to-Case	3-Lead TO-263: Control/Output Section 3-Lead TO-220: Control/Output Section			0.65/2.7 0.65/2.7	˚C/W ˚C/W

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2: The maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)}–T_A)/\theta_{JA}$. All numbers apply for packages soldered directly into a PC board.

Note 3: For testing purposes, ESD was applied using human body model, 1.5kΩ in series with 100pF.

Note 4: Typical Values represent the most likely parametric norm.

Note 5: All limits are guaranteed by testing or statistical analysis.

Note 6: Load and line regulation are measured at constant junction temperature, and are guaranteed up to the maximum power dissipation of 30W. Power dissipation is determined by the input/output differential and the output current. Guaranteed maximum power dissipation will not be available over the full input/output range.

Note 7: The minimum output current required to maintain regulation.

Note 8: $I_{FULLLOAD}$ is 5A for LMS1585A and 3A for LMS1587.

Note 9: Consult factory for other fixed voltage options.

Application Note

OUTPUT VOLTAGE

The adjustable version develops at 1.25V reference voltage, (V_{REF}), between the output and the adjust terminal. As shown in *Figure 1*, this voltage is applied across resistor R1 to generate a constant current I1. This constant current then flows through R2. The resulting voltage drop across R2 adds to the reference voltage to sets the desired output voltage.

The current I_{ADJ} from the adjustment terminal introduces an output error. But since it is small (120µA max), it becomes negligible when R1 is in the 100Ω range.

For fixed voltage devices, R1 and R2 are integrated inside the devices.

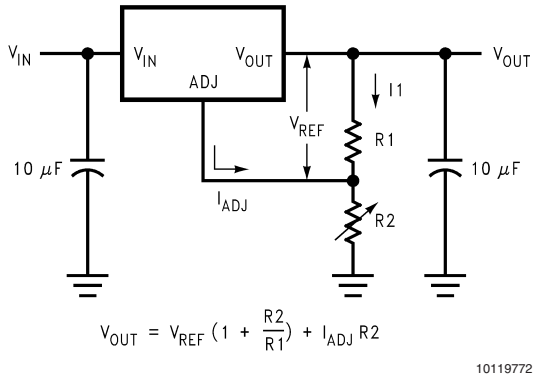
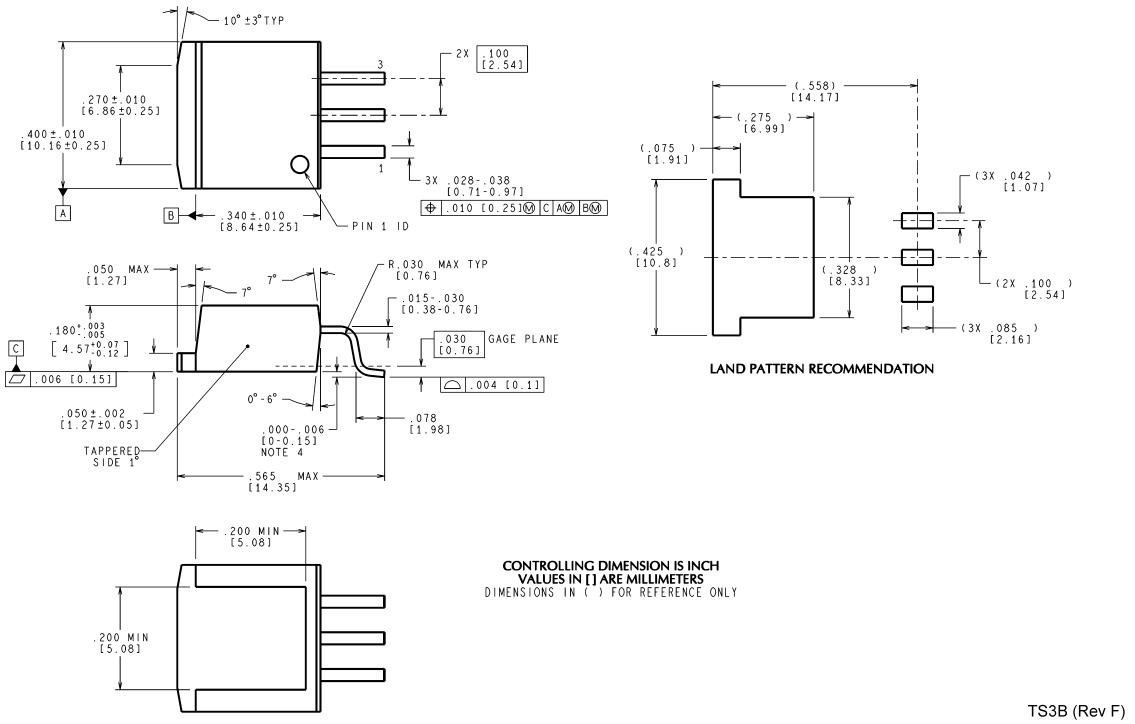


FIGURE 1. Basic Adjustable Regulator

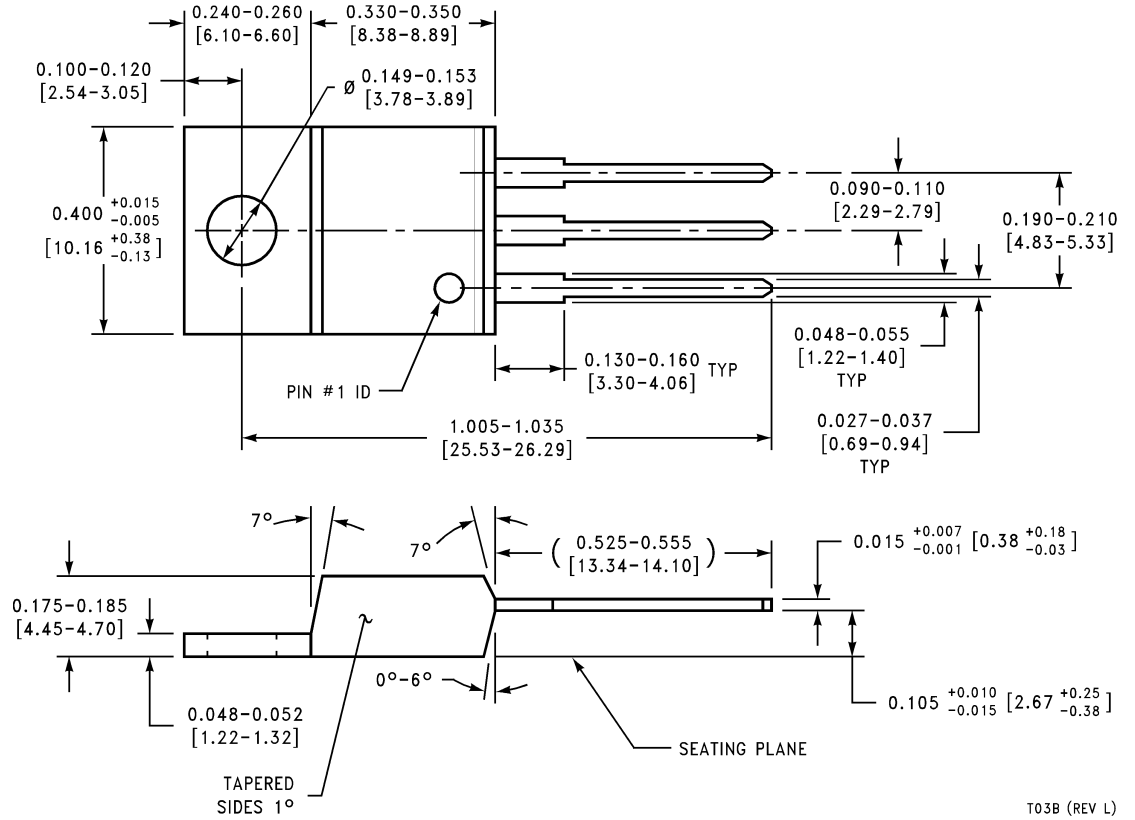
Physical Dimensions inches (millimeters)

unless otherwise noted



TS3B (Rev F)

3-Pin TO-263
NS Package Number TS3B



T03B (REV L)

3-Pin TO-220
NS Package Number T03B

Notes

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at www.national.com.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor manufactures products and uses packing materials that meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no ''Banned Substances'' as defined in CSP-9-111S2.

Leadfree products are RoHS compliant.

National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

www.national.com

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560