MMA044AA

6 – 18 GHz GaAs pHEMT MMIC Wideband LNA

Product Overview

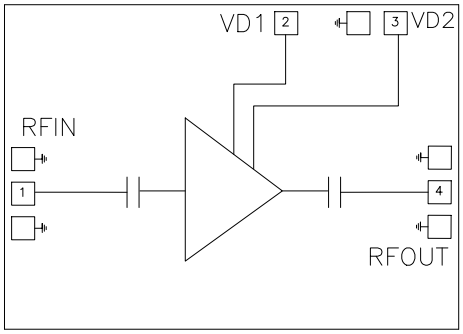
The MMA044AA is a gallium arsenide (GaAs) pseudomorphic high-electron mobility transistor (pHEMT) monolithic microwave integrated circuit (MMIC) low-noise wideband amplifier die that operates between 6 GHz and 18 GHz. The MMA044AA die provides 21 dB of small signal gain, 1.7 dB noise figure, and output IP3 of 30 dBm, while requiring only 102 mA from a 4 V supply. The P1dB output power of 16 dBm enables the LNA to function as an LO driver for balanced, in-phase quadrature (I/Q), or image reject mixers. The MMA044AA amplifier also features RF ports that are DC blocked and internally matched to 50Ω, which allows for easy integration into multi-chip modules (MCMs).

The following illustration shows the primary functional blocks of the MMA044AA device.

Key Features

- **Broadband performance: 6 to 18 GHz**
- **High Gain: 21 dB**
- **Low Noise figure: 1.7 dB**
- **High Output IP3: + 30 dBm**
- **Output P1dB power: + 16 dBm**
- **Maximum RF Input Power: + 24 dBm**
- **Single Postive Supply: + 4V @ 102 mA**
- **50Ω matched input/output**
- **Compact Die size: 1.12 mm X 1.35 mm X 0.1 mm**

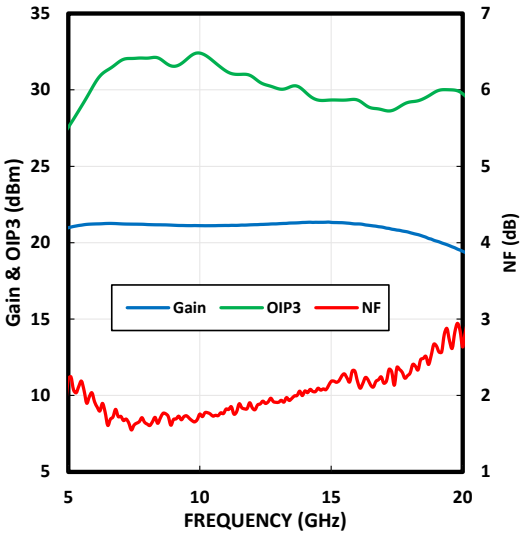
Amplifier Functional Diagram



Applications

- Test & Measurement instrumentation
- Military and space
- Point-to-point and point-to-multi-point Radios
- VSAT

Gain, NF & OIP3 Performances



Performance Overview

Parameter	Typ.	Units
Frequency range	6 – 18	GHz
Gain	21	dB
Gain variation over Temp	0.02	dB/°C
NF	1.7	dB
Output IP3	+ 30	dBm
Output P1dB	+ 16	dBm

Export Classification: EAR99

Table of Contents

1. Electrical Specifications

1.1 Typical Electrical Performance

Table 1-1. Typical Electrical Performance at 25 °C, Vdd = + 4V, Idd = 102 mA (Unless otherwise mentioned)

Parameter	Min	Typ.	Max	Units
Frequency range	6		18	GHz
Gain	20.8	21	21.4	dB
Gain variation over Temperature		0.02		dB/°C
Noise Figure	1.5	1.7	2.2	dB
Output P1dB	+ 15	+ 16	+ 18	dBm
Ouput IP3	+ 28	+ 30	+ 33	dBc
Input Return Loss	11.5	14		dB
Output Return Loss	12	14		dB
Drain SupplyVoltage (V_{D1} & V_{D2})		+ 4	+ 4.5	V
Drain Supply Current (I_{DD} = I_{D1} + I_{D2})		102		mA

1.2 Typical Performance Curves

The following graphs show the typical performance curves of the MMA0444A device at + 25 °C, + 4V and 102 mA unless otherwise indicated.

Figure 1-1. Gain vs. Temperature

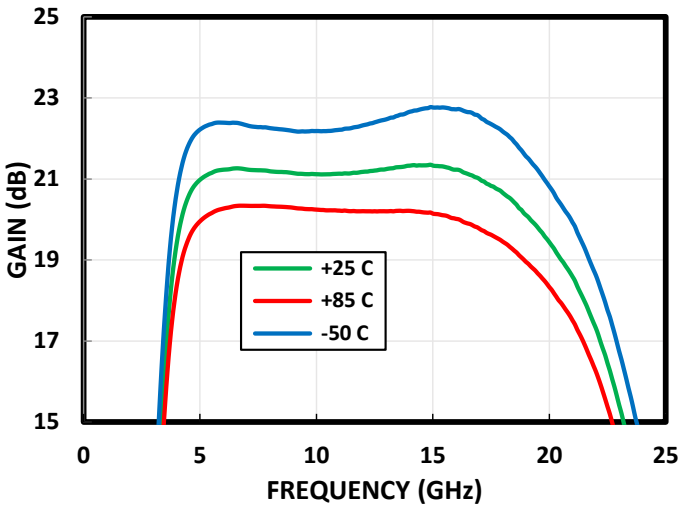


Figure 1-2. NF vs. Temperature

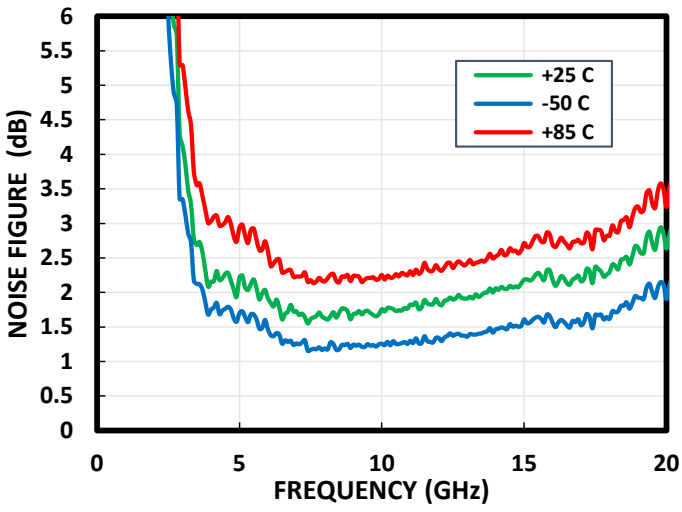


Figure 1-3. Input RL vs. Temperature

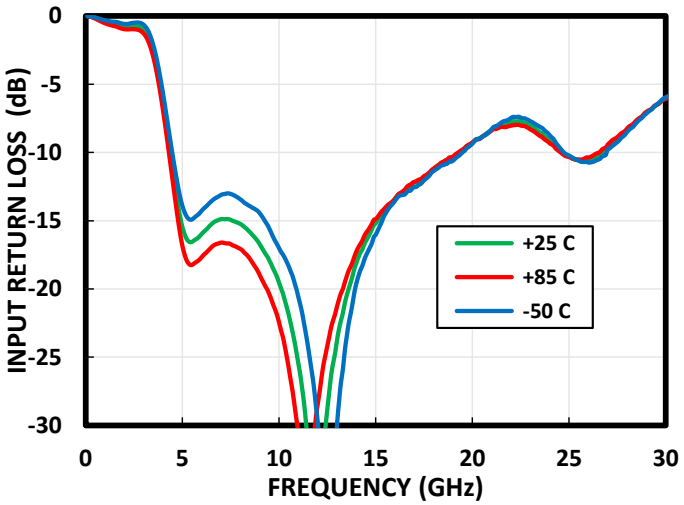


Figure 1-4. Output RL vs. Temperature

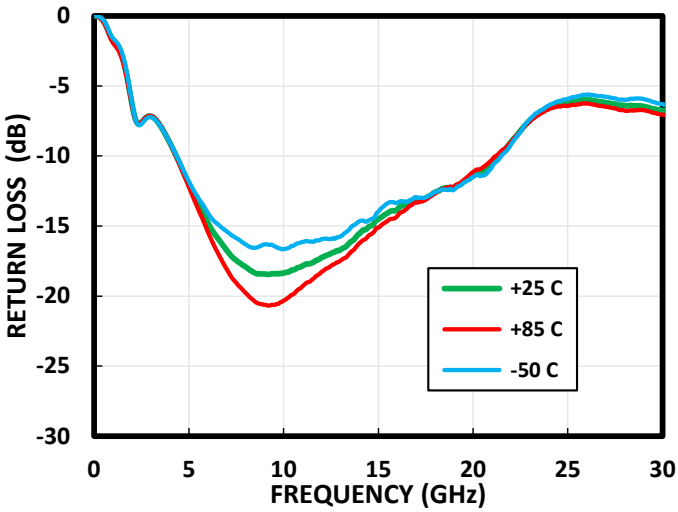


Figure 1-5. P1dB vs. Temperature

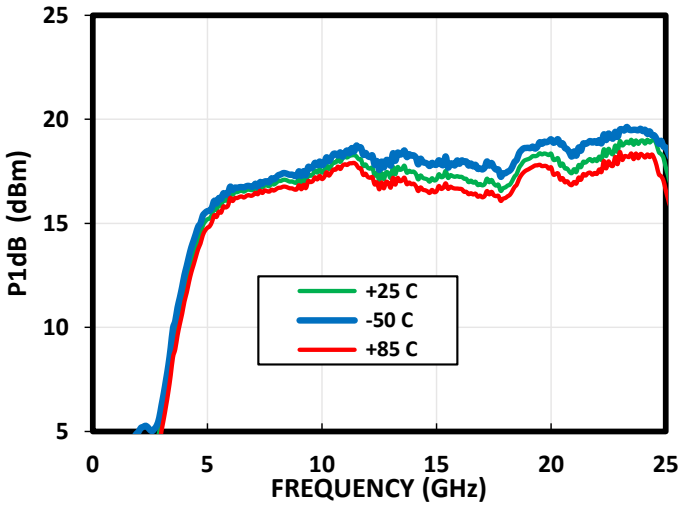
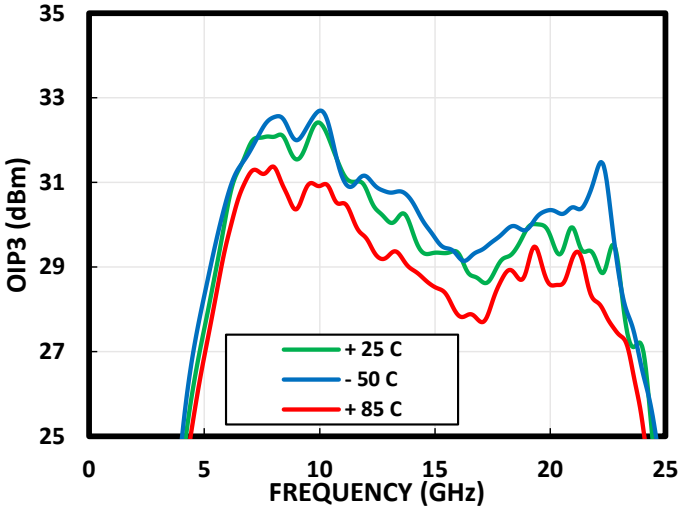


Figure 1-6. Output IP3 vs. Temperature



1.3 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMA044AA device at 25 °C, unless otherwise specified. Exceeding one or any of the maximum ratings potentially could cause damage or latent defects to the device.

Table 1-2. Absolute Maximum Ratings

Parameter	Rating
Drain bias voltage (V_{D1} and V_{D2})	+ 4.5V
RF input power (P_{IN})	+ 24 dBm
Channel Temperature (T_J)	+ 150 °C
Storage Temperature (T_S)	– 65 to + 150 °C
Operating Temperature (T_A)	– 55 to + 85 °C

ESD Sensitive Device

2. Die Specifications

The following illustration shows the chip outline of the MMA044AA device. Dimensions are shown in inches and millimeters. The minimum bond pad size is 100 µm × 100 µm. Both the bond pad surface and the backside metal are 3 µm gold. The die thickness is 100 µm. The backside is the DC/RF ground. The airbridge keepout region is in crosshatch, and the unlabeled pads should not be bonded.

For additional packaging information, contact your Microchip sales representative.

Figure 2-1. Die Outline Drawing

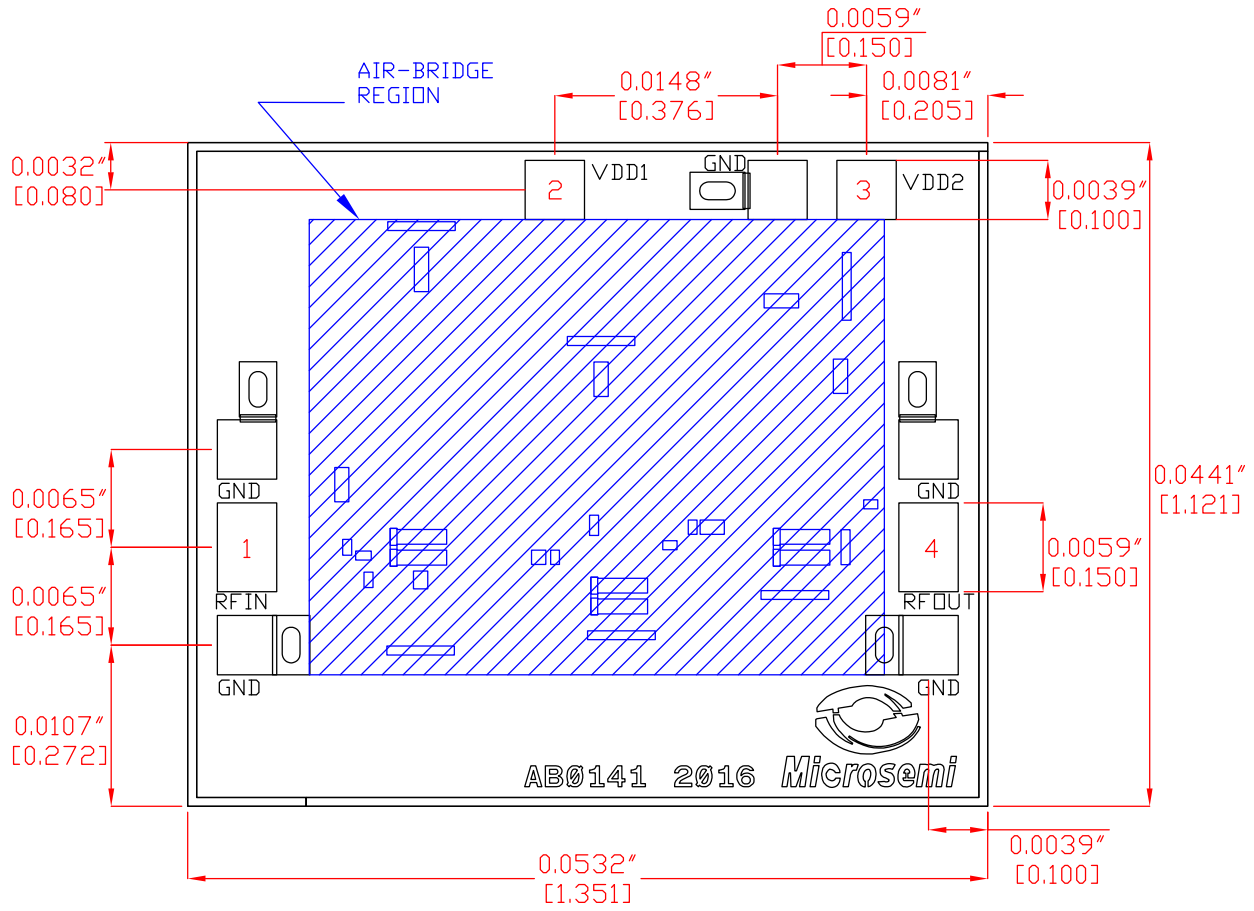


Table 2-1. I/O Pad Description

Pad Number	Pad Name	Pad Description
1	RFIN	AC coupled and matched to 50Ω.
4	RFOUT	AC coupled and matched to 50Ω
2, 3	VDD1, VDD2	Drain Supply Voltage for the Amplifier. See Assembly Diagram for required external components.
Backside Paddle	RF/DC GND	Must be connected to RF/DC Ground

3. Application Ciruits

The following illustration shows the assembly diagram of the MMA044AA device. The carrier plate is gold plated. It is necessary to attach components using thermally conductive epoxy. The bypass chip caps are ceramic and must be assembled within 10 mils of the die. Use 1 mil Au bond wires

Figure 3-1. Assembly Diagram

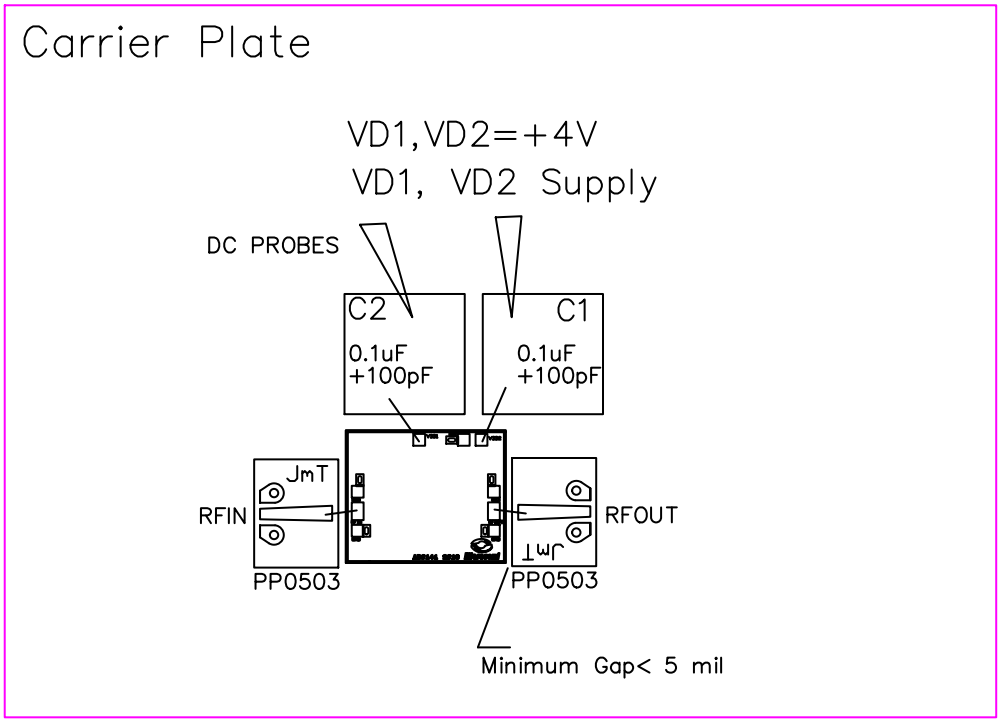


Table 3-1. Bill of material (BOM)

Component	Value	Part Number	Description
C1 & C2	0.1uF +/- 100 pF	MVB4040X104MEK5C1B	Presidio VB series dual caps. 40 mils X 40mils X17 mils

4. Ordering, Shipping and Handling

4.1 Handling Recommendations

Gallium arsenide integrated circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. It is recommended to follow all procedures and guidelines outlined in the Microsemi application note AN01: GaAs MMIC Handling and Die Attach Recommendations.

4.2 Ordering Information

For additional ordering information, contact your Microchip sales representative.

Part Number	Package
MMA044AA	Die

4.3 Packing Information

Standard Format
Gel Pack

Note: Contact your Microchip sales representative for the minimum quantity order

5. Revision History

Table 5-1. Revision History

Revision	Date	Description
A	08/2021	Document created.

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Product Identification System

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable." Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Legal Notice

Information contained in this publication is provided for the sole purpose of designing with and using Microchip products. Information regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGE, COST OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackeTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ISBN:

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Fax: 480-792-7277 Technical Support: www.microchip.com/support Web Address: www.microchip.com **Atlanta** Duluth, GA Tel: 678-957-9614 Fax: 678-957-1455 **Austin, TX** Tel: 512-257-3370 **Boston** Westborough, MA Tel: 774-760-0087 Fax: 774-760-0088 **Chicago** Itasca, IL Tel: 630-285-0071 Fax: 630-285-0075 **Dallas** Addison, TX Tel: 972-818-7423 Fax: 972-818-2924 **Detroit** Novi, MI Tel: 248-848-4000 **Houston, TX** Tel: 281-894-5983 **Indianapolis** Noblesville, IN Tel: 317-773-8323 Fax: 317-773-5453 Tel: 317-536-2380 **Los Angeles** Mission Viejo, CA Tel: 949-462-9523 Fax: 949-462-9608 Tel: 951-273-7800 **Raleigh, NC** Tel: 919-844-7510 **New York, NY** Tel: 631-435-6000 **San Jose, CA** Tel: 408-735-9110 Tel: 408-436-4270 **Canada - Toronto** Tel: 905-695-1980 Fax: 905-695-2078	**Australia - Sydney** Tel: 61-2-9868-6733 **China - Beijing** Tel: 86-10-8569-7000 **China - Chengdu** Tel: 86-28-8665-5511 **China - Chongqing** Tel: 86-23-8980-9588 **China - Dongguan** Tel: 86-769-8702-9880 **China - Guangzhou** Tel: 86-20-8755-8029 **China - Hangzhou** Tel: 86-571-8792-8115 **China - Hong Kong SAR** Tel: 852-2943-5100 **China - Nanjing** Tel: 86-25-8473-2460 **China - Qingdao** Tel: 86-532-8502-7355 **China - Shanghai** Tel: 86-21-3326-8000 **China - Shenyang** Tel: 86-24-2334-2829 **China - Shenzhen** Tel: 86-755-8864-2200 **China - Suzhou** Tel: 86-186-6233-1526 **China - Wuhan** Tel: 86-27-5980-5300 **China - Xian** Tel: 86-29-8833-7252 **China - Xiamen** Tel: 86-592-2388138 **China - Zhuhai** Tel: 86-756-3210040	**India - Bangalore** Tel: 91-80-3090-4444 **India - New Delhi** Tel: 91-11-4160-8631 **India - Pune** Tel: 91-20-4121-0141 **Japan - Osaka** Tel: 81-6-6152-7160 **Japan - Tokyo** Tel: 81-3-6880- 3770 **Korea - Daegu** Tel: 82-53-744-4301 **Korea - Seoul** Tel: 82-2-554-7200 **Malaysia - Kuala Lumpur** Tel: 60-3-7651-7906 **Malaysia - Penang** Tel: 60-4-227-8870 **Philippines - Manila** Tel: 63-2-634-9065 **Singapore** Tel: 65-6334-8870 **Taiwan - Hsin Chu** Tel: 886-3-577-8366 **Taiwan - Kaohsiung** Tel: 886-7-213-7830 **Taiwan - Taipei** Tel: 886-2-2508-8600 **Thailand - Bangkok** Tel: 66-2-694-1351 **Vietnam - Ho Chi Minh** Tel: 84-28-5448-2100	**Austria - Wels** Tel: 43-7242-2244-39 Fax: 43-7242-2244-393 **Denmark - Copenhagen** Tel: 45-4485-5910 Fax: 45-4485-2829 **Finland - Espoo** Tel: 358-9-4520-820 **France - Paris** Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79 **Germany - Garching** Tel: 49-8931-9700 **Germany - Haan** Tel: 49-2129-3766400 **Germany - Heilbronn** Tel: 49-7131-72400 **Germany - Karlsruhe** Tel: 49-721-625370 **Germany - Munich** Tel: 49-89-627-144-0 Fax: 49-89-627-144-44 **Germany - Rosenheim** Tel: 49-8031-354-560 **Israel - Ra'anana** Tel: 972-9-744-7705 **Italy - Milan** Tel: 39-0331-742611 Fax: 39-0331-466781 **Italy - Padova** Tel: 39-049-7625286 **Netherlands - Drunen** Tel: 31-416-690399 Fax: 31-416-690340 **Norway - Trondheim** Tel: 47-72884388 **Poland - Warsaw** Tel: 48-22-3325737 **Romania - Bucharest** Tel: 40-21-407-87-50 **Spain - Madrid** Tel: 34-91-708-08-90 Fax: 34-91-708-08-91 **Sweden - Gothenberg** Tel: 46-31-704-60-40 **Sweden - Stockholm** Tel: 46-8-5090-4654 **UK - Wokingham** Tel: 44-118-921-5800 Fax: 44-118-921-5820