

## DC – 25 GHz GaAs MMIC Distributed LNA

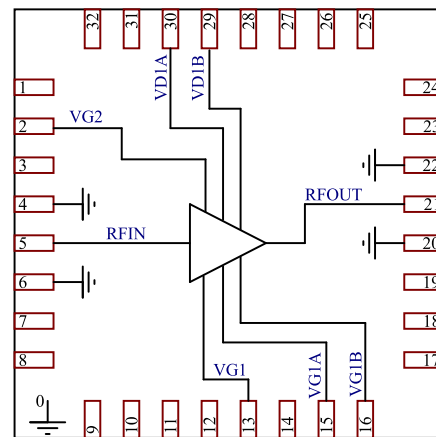
### Product Overview

MMA041PP5 is a gallium arsenide (GaAs) monolithic microwave integrated circuit (MMIC) pseudomorphic high-electron-mobility transistor (pHEMT) distributed low noise amplifier in a leadless 5 mm × 5 mm surface-mount package that operates between DC and 25 GHz. It is ideal for test instrumentation, wideband military and space applications. The amplifier provides a flat gain of 17 dB, 2.5 dB noise figure, and 21 dBm of output power at 1 dBm gain compression while requiring only 150 mA from a 7 V supply. Output IP3 is typically 35 dBm. The MMA041PP5 amplifier features RF I/Os that are internally matched to 50 Ω. It is also available in die form as the MMA041AA.

#### Key Features

- Broadband performance: DC to 26 GHz
- High gain: 18.5 dB
- Low noise figure: 3.2 dB
- High output IP3: + 36 dBm
- Positive supply : + 7V @ 150 mA
- 50Ω matched I/O
- Compact die size: 3 mm × 1.3 mm × 0.1 mm

**Amplifier Functional Diagram**



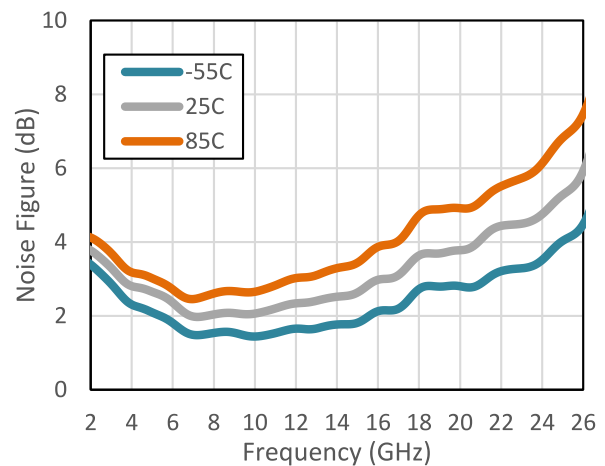
#### Applications

- Test and measurement instrumentation
- Military and space
- Wideband microwave radios
- Microwave and mm-Wave communication systems

#### Performance Overview

Parameter	Typ.	Units
Frequency range	DC – 26	GHz
Gain	18.5	dB
NF	2	dB
Output IP3	+ 36	dBm
P1dB	+ 22	dBm

**NF Performances**



**Export Classification: EAR99**

---

## Table of Contents

---

Product Overview.....	1
1. Electrical Specifications.....	3
1.1. Typical Electrical Performance.....	3
1.2. Typical Performance Curves.....	4
1.3. Absolute Maximum Ratings.....	7
2. Package Specifications.....	9
3. Evaluation PCB.....	11
4. Ordering, Shipping and Handling.....	14
4.1. Ordering Information.....	14
4.2. Packing Information.....	14
5. Revision History.....	15
The Microchip Website.....	16
Product Change Notification Service.....	16
Customer Support.....	16
Product Identification System.....	17
Microchip Devices Code Protection Feature.....	17
Legal Notice.....	17
Trademarks.....	17
Quality Management System.....	18
Worldwide Sales and Service.....	19

## 1. Electrical Specifications

### 1.1 Typical Electrical Performance

Table 1-1. Typical Electrical Performance at 25 °C,  $V_{DD} = +7V/150\text{ mA}$  and  $V_{GG} = -0.4V$  (Unless otherwise mentioned)

Parameter	Frequency Range	Min	Typ.	Max	Units
Frequency range		DC		25	GHz
Gain	DC – 6 GHz	17	18		dB
	6 – 12 GHz	16	17.5		dB
	12 – 20 GHz	15	17		dB
Gain flatness	4 – 12 GHz		± 0.5		dB
	12 – 20 GHz		± 0.5		dB
Noise Figure @ 5V / 150 mA	2 – 6 GHz		2.7		dB
	6 – 12 GHz		2.0		dB
	12 – 20 GHz		2.5		dB
OIP3	DC – 6 GHz		35		dBm
	6 – 12 GHz		36		dBm
	12 – 20 GHz		34		dBm
P1dB	DC – 6 GHz		21		dBm
	6 – 12 GHz	21	22		dBm
	12 – 20 GHz	17	19		dBm
Psat	DC – 6 GHz		24		dBm
	6 – 12 GHz		24		dBm
	12 – 20 GHz		21		dBm
Input Return Loss	DC – 6 GHz		15		dB
	6 – 12 GHz		18		dB
	12 – 20 GHz		13		dB
Output Return Loss	DC – 6 GHz		13		dB
	6 – 12 GHz		18		dB
	12 – 20 GHz		16		dB
$V_{DD}$ (Drain Voltage Supply)			+ 7		V
$I_{DD}$ (Drain Current)			150		mA
$V_{GG}$ (Gate Voltage Bias)		- 1.0	- 0.4	0	V

### 1.2 Typical Performance Curves

The following graphs show the typical performance curves of the MMA041PP5 device at + 25 °C and + 7V/150 mA unless otherwise indicated.

Figure 1-1. Gain vs. Temperature

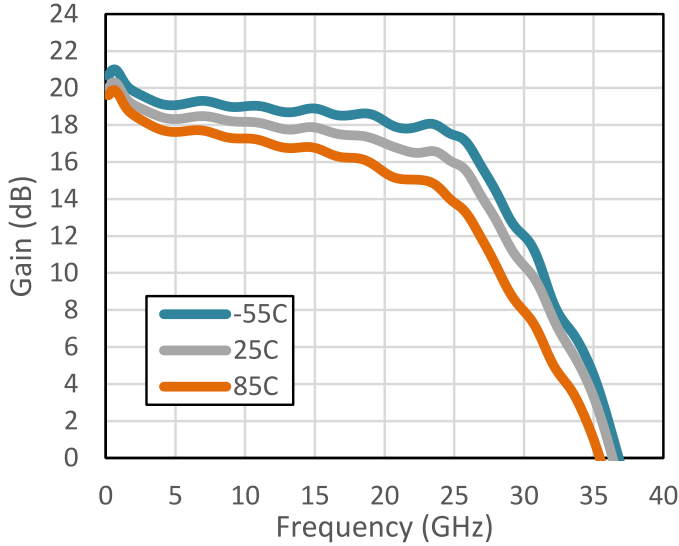


Figure 1-2. NF vs. Temperature

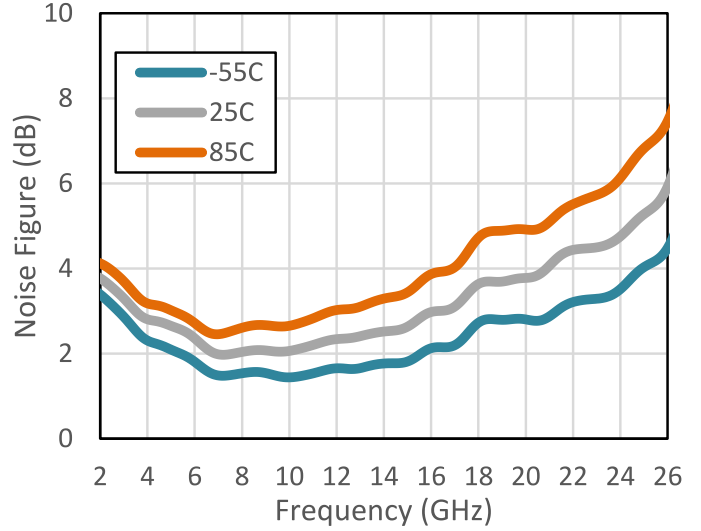


Figure 1-3. OIP3 vs. Temperature

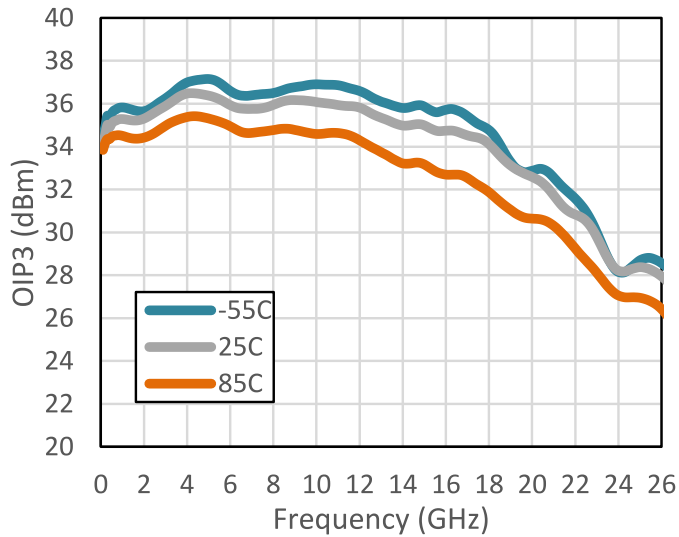
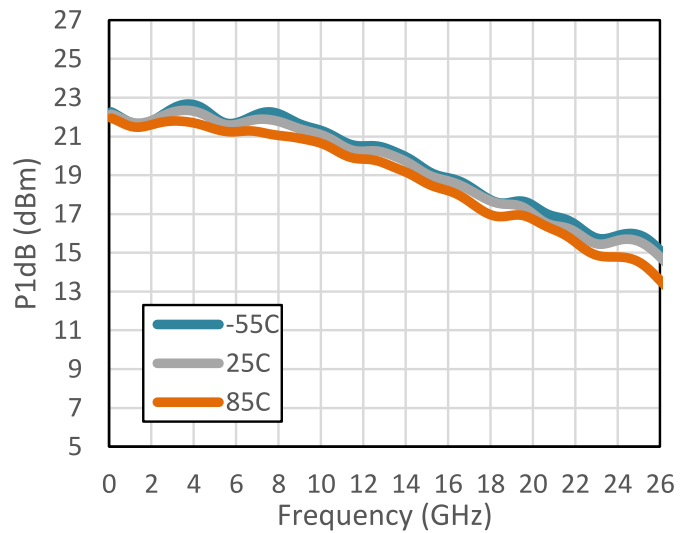
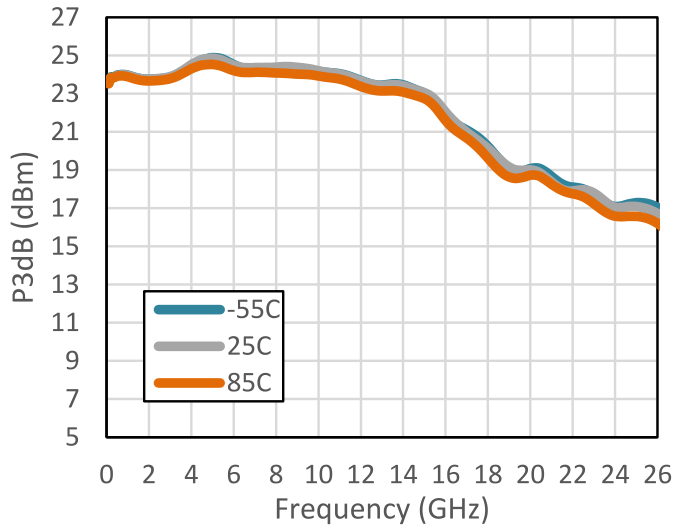


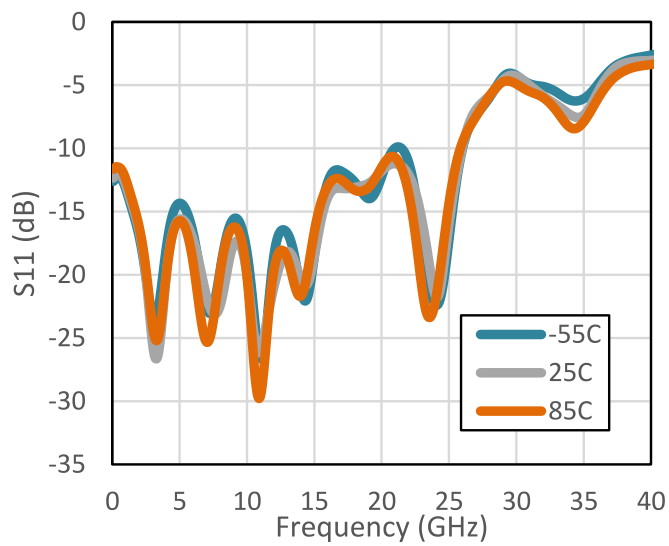
Figure 1-4. P1dB vs. Temperature



**Figure 1-5. P3dB vs. Temperature**



**Figure 1-6. S11 vs. Temperature**



**Figure 1-7. S22 vs. Temperature**

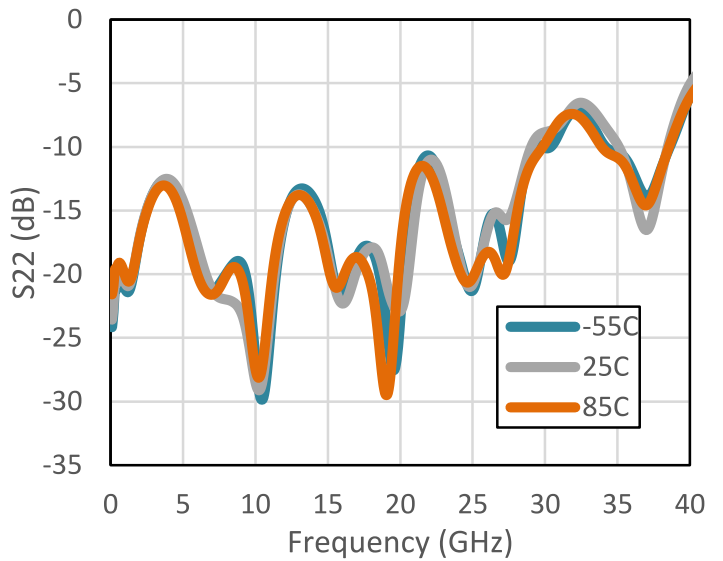


Figure 1-8. Gain vs. VDD

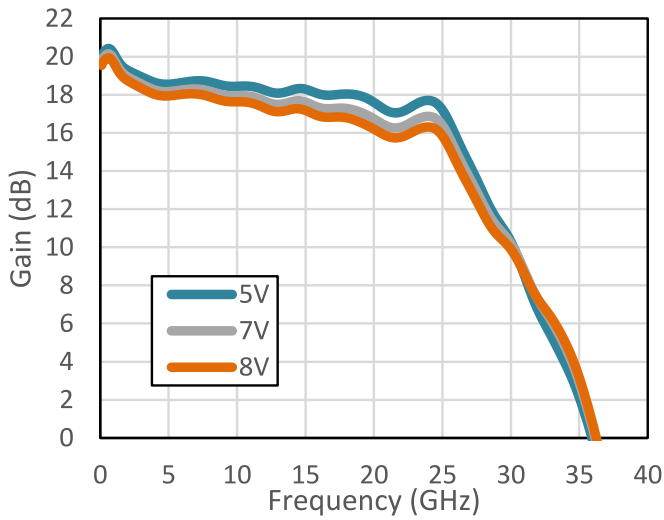


Figure 1-9. NF. vs. VDD

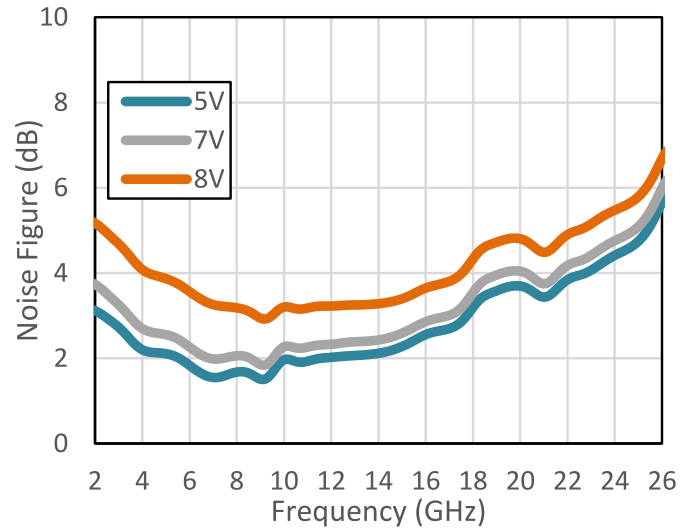


Figure 1-10. OIP3 vs. VDD

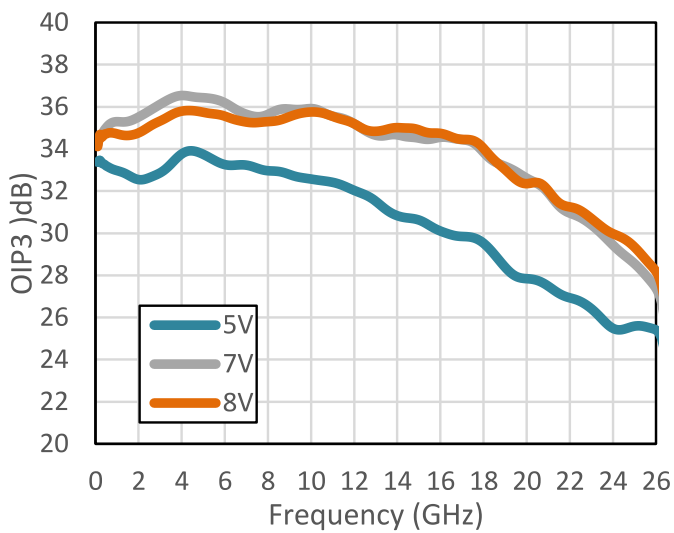


Figure 1-11. P1dB vs. VDD

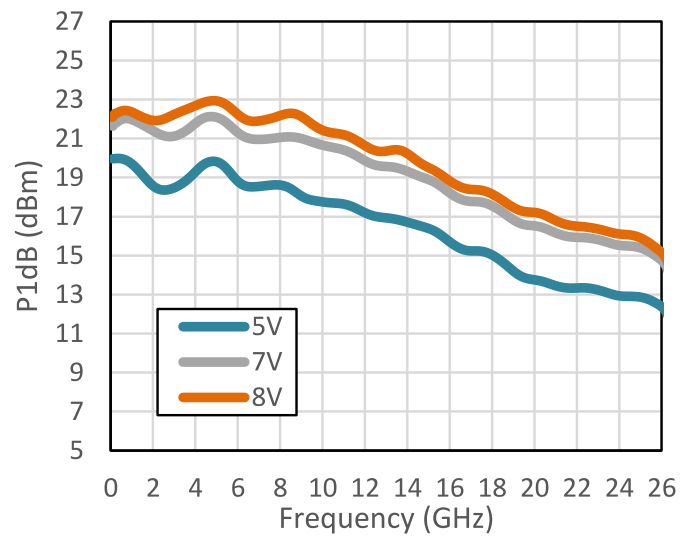


Figure 1-12. Gain vs. IDD

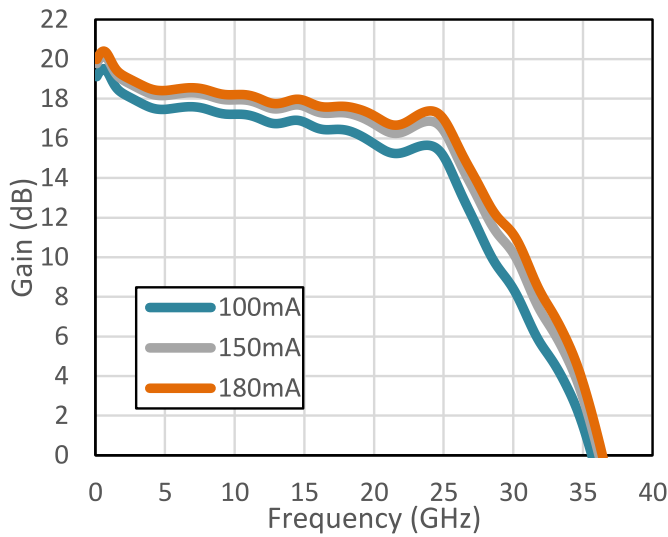


Figure 1-13. NF vs. IDD

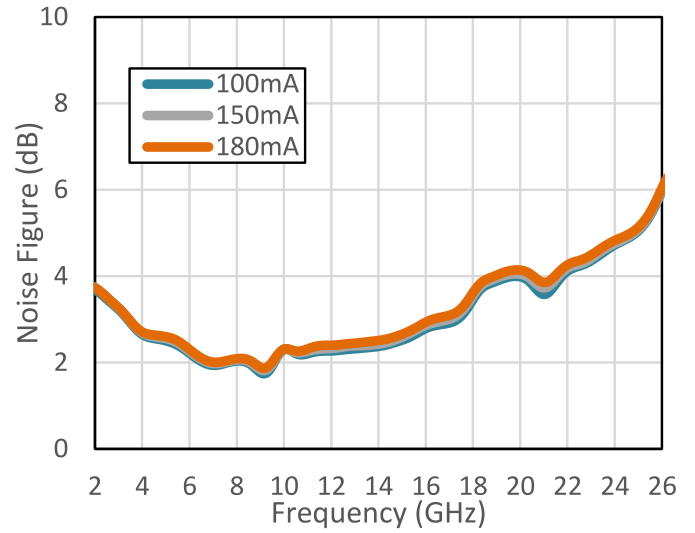
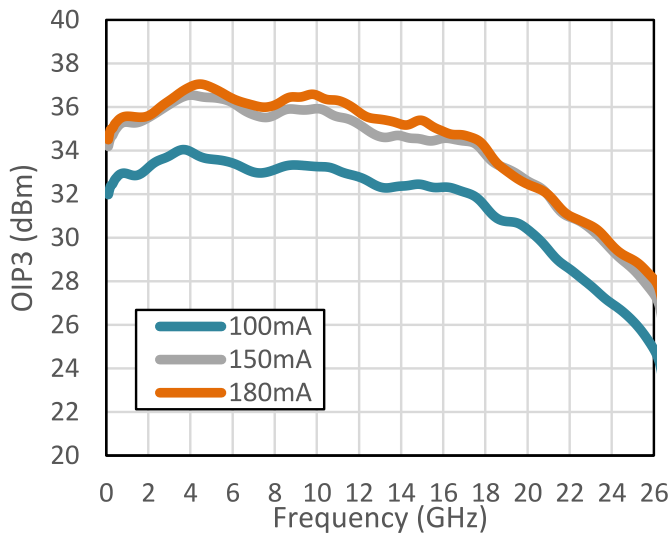


Figure 1-14. OIP3 vs. IDD



### 1.3 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMA041PP5 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 ( $V_{DD}$ )	+ 8V
$V_D$ Current ( $I_{DD}$ )	300 mA
DC Power Dissipation ( $T = + 85\text{ }^\circ\text{C}$ )	2.4W
RF Input Power ( $P_{in}$ )	+ 19 dBm
First Gate bias voltage ( $V_{G1}$ )	- 2V to + 0.5V
Second Gate bias voltage ( $V_{G2}$ )	$V_D \pm 20\%$
Channel Temperature	150 °C
Thermal Resistance	18 °C/W
Operating Temperature	- 55 °C to + 85 °C
Storage Temperature	- 65 °C to + 150 °C



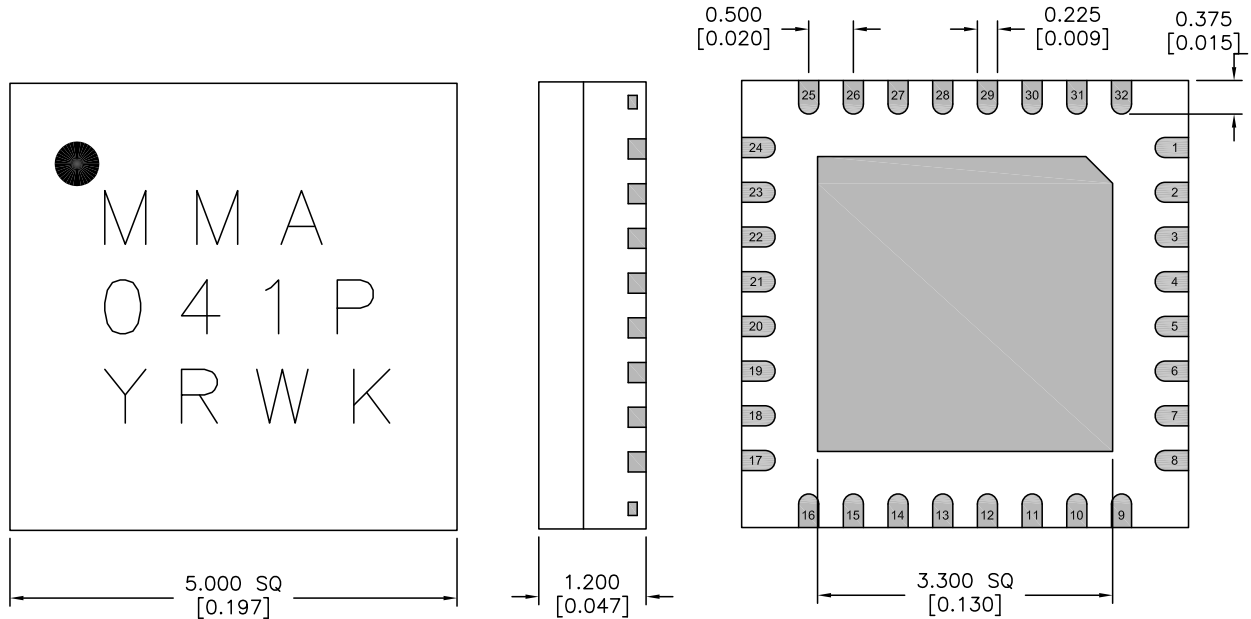
ESD Sensitive Device



## 2. Package Specifications

The following illustration shows the package outline of the MMA041PP5 device. Dimensions are in millimeters [inches].

**Figure 2-1. Package Outline Drawing (mm[Inches])**



**Table 2-1. Package Information**

Package	5X5mm 32L Plastic QFN
Lead Frame	C194 Cu
Plating	Ni: 0.50 um min
	Pd: 0.02 um min
	Au: 0.05 um max
Package Body Material	RoHS Compliant Low-stress injection molded plastic

**Table 2-2. PIN Description**

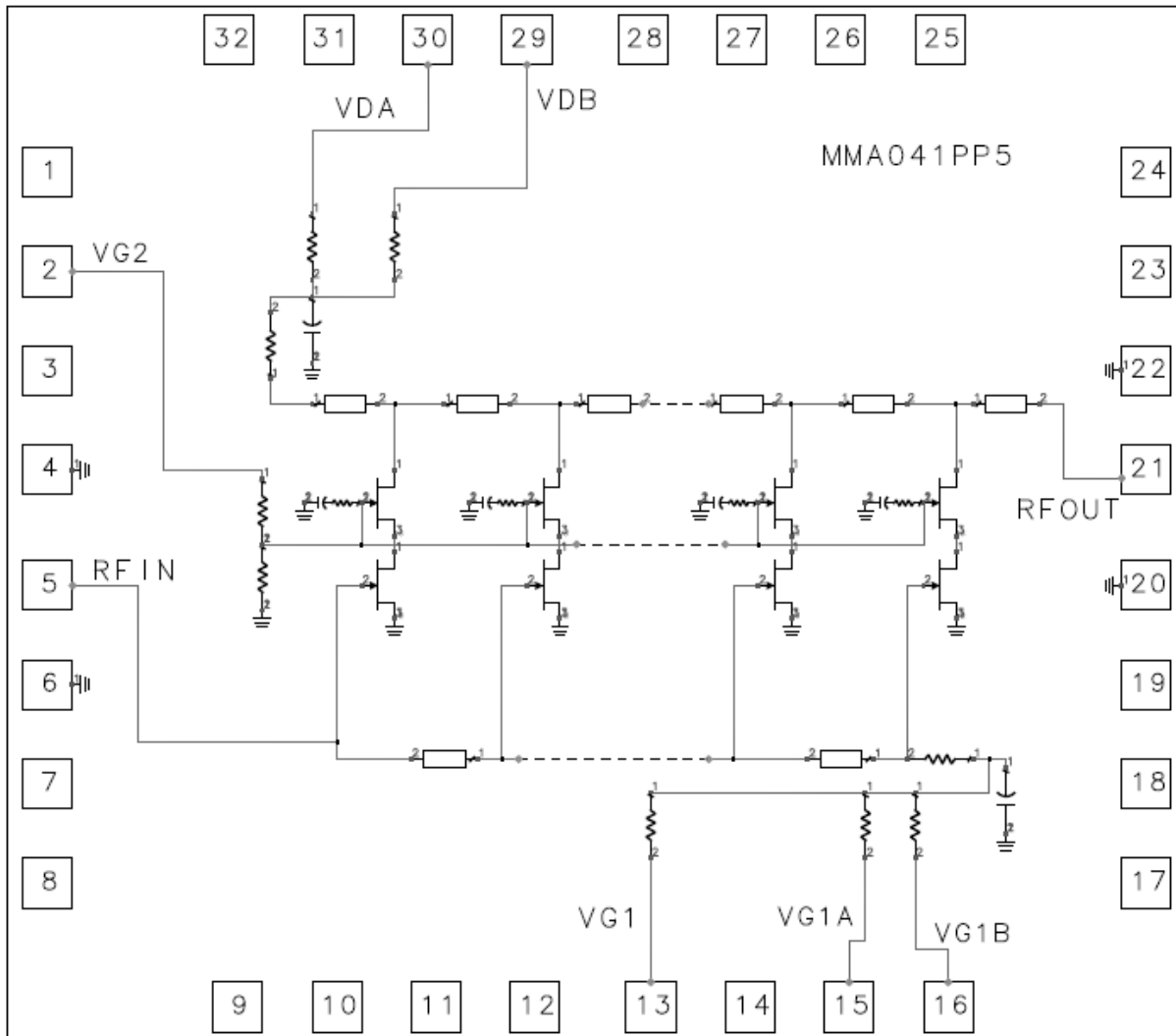
PIN Number	Pad Name	Pad Description
5	RF <sub>IN</sub>	DC – Coupled and matched to 50Ω. (Optional VG1 can be biased on this line.)
21	RF <sub>OUT</sub> + V <sub>DD</sub>	DC – Coupled and matched to 50Ω. (Used to bias V <sub>DD</sub> )
13	V <sub>G1</sub>	First Gate bias. Adjust to achieve specified I <sub>DD</sub>
15, 16	V <sub>G1A</sub> , V <sub>G1B</sub>	Low-frequency termination. Connect bypass capacitors per application circuit. (No bias required)
2	V <sub>G2</sub>	DC couple to V <sub>DA</sub> externally for nominal operation.
29, 30	V <sub>DB</sub> , V <sub>DA</sub>	Low-frequency termination. Connect bypass capacitors per application circuit. (No bias required)
4, 6, 20, 22	RF/DC GND	Should be connected to PCB RF/DC Ground

# MMA041PP5

## Package Specifications

.....continued		
PIN Number	Pad Name	Pad Description
1, 3, 7, 8, 9, 10, 11, 12, 14, 17, 18, 19, 23, 24, 25, 26, 27, 28, 31, 32	N/C	These pins are not connected internally. All data was measured with these pins connected to RF/DC ground externally.
Backside Paddle	RF/DC GND	Must be connected to RF/DC Ground

Amplifier Functional Schematic



### 3. Evaluation PCB

Figure 3-1. MMA041PP5E: Eval PCB

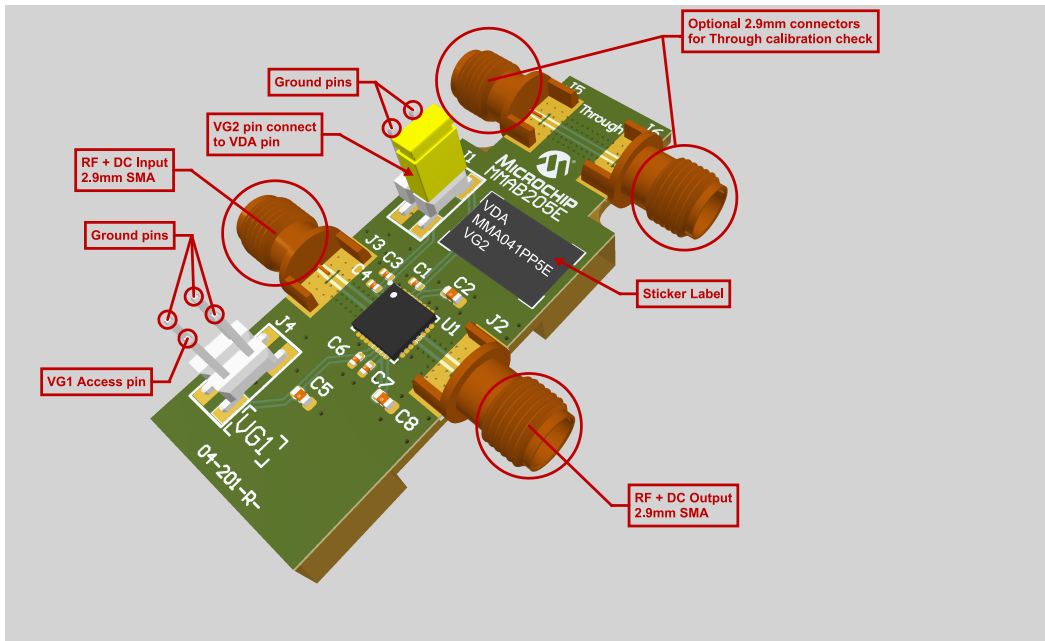
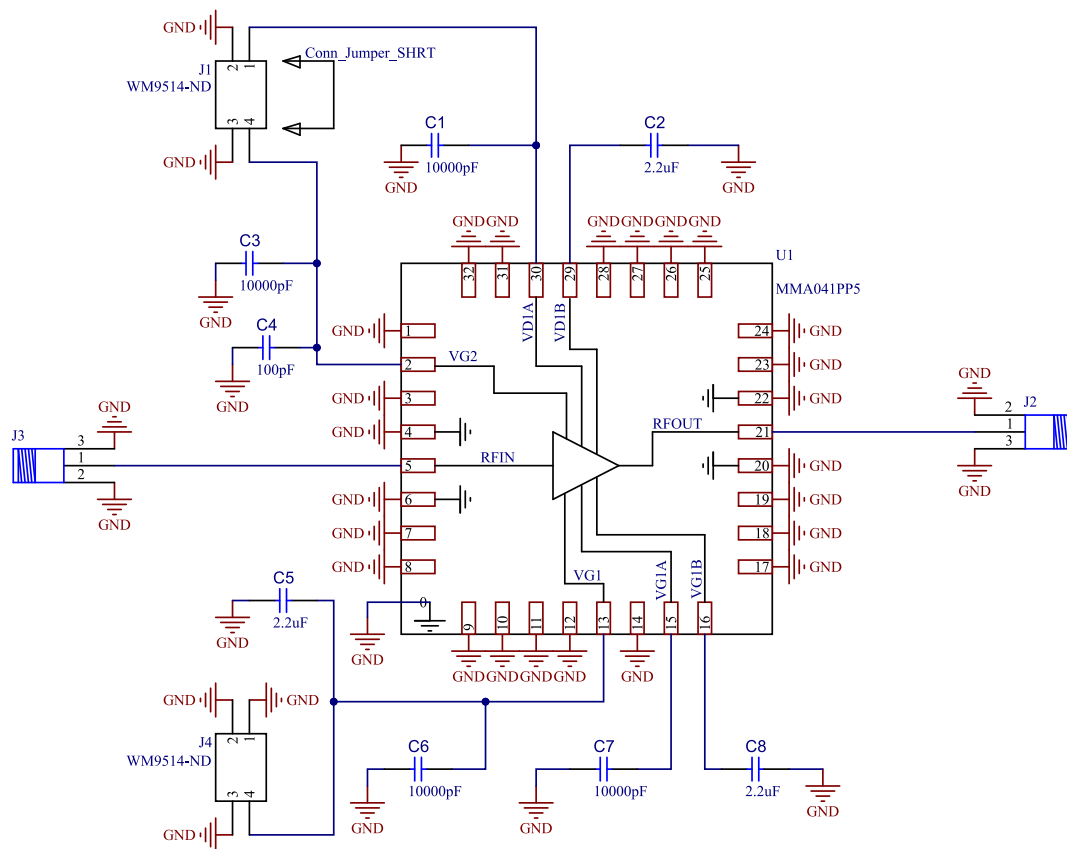


Figure 3-2. MMA041PP5E: Eval PCB Schematic



**Table 3-1. Bias Sequence**

Setp	Bias Sequence
1	Make sure VG2 to VDA jumper is in place on J1 or, if using external power supply, VG2 power supply is connected to VG2 pin.
2	Make sure ESD precaution jumper from VG1 to GND on J4 header is removed.
3	Make sure all DC and RF connections are attached before activating any DC voltage power supplies.
	Note: DC supply for VG1 could be attached either through an external bias-T on the RF + DC input port (J3) or through the marked pin on J4. DC supply for VDD should be fed through an external bias-T on the RF + DC output port (J2).
4	Set VG1 at -1.0V
	Note: If using VG2 externally, it should be on soon after VG1. The range of VG2 should be at VDD +/-20%
5	Set VDD according to your applications plan with current compliance at 200mA
	Note: VG2 should be on
6	Power supply sequencing should always be VG1, (VG2 if used externally), then VDD (VDD is always last on and first off)
7	Adjust VG1 gradually increasing voltage by 0.01V steps until IDD reaches desired application range.
	Note: If external bias-T, used on the RF + DC Output (J2), is showing a very low cut-off frequency, precautions should be made to avoid fast changes of the IDD current otherwise DC spikes, caused by transitions, could exceed the VDD maximum level and damage the part.

**Table 3-2. Bill of Material**

Item Num.	Component designator	Description	Mnf. Part Num.	Mnf.	Qty.
1	U1	5 X 5 32 Leads QFN	MMA041PP5	Microchip	1
2	C4	100 pF ±10% 25V Ceramic Capacitor X7R 0402	C0402C101K3G ACTU	KEMET	1
3	C2, C5, C8	2.2 µF ±10% 16V Ceramic Capacitor X5R 0603	C1608X5R1C225 K080AB	TDK	3
4	C1, C3, C6, C7	10000 pF ±10% 50V Ceramic Capacitor X7R 0402	CC0402KRX7R9 BB103	Yageo	4
5	J2, J3, J5, J6	Connector, 2.9mm Jack PCB Edge Mount .012 pin	25-146-1000-90	Winchester Interconnect	4

.....continued

Item Num.	Component designator	Description	Mnf. Part Num.	Mnf.	Qty.
6	J1, J4	Connector Unshrouded Header, 2x2, 2.54mm	15-91-2040	Molex	2
7	JUMP1	Connector, 2 Position Shunt, Black, Closed Top 2.54mm	SPC02SYAN	Sullins	1

## 4. Ordering, Shipping and Handling

### 4.1 Ordering Information

For additional ordering information, contact your Microchip sales representative.

Part Number	Package	Note
MMA041PP5	5 mm × 5 mm, 32L Plastic QFN	
MMA041AA	Die	Refer to corresponding MMA041AA Datasheet
MMA041PP5E	Eval PCB	

### 4.2 Packing Information

Part Number	Description
MMA041PP5-TR	Tape and Reel

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

## 5. Revision History

Table 5-1. Revision History

Revision	Date	Description
B	03/2022	Document created.

## The Microchip Website

---

Microchip provides online support via our website at [www.microchip.com/](http://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](http://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](http://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 products:

- 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, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- 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. Microchip is committed to continuously improving the code protection features of our products.

---

## Legal Notice

---

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications 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. Contact your local Microchip sales office for additional support or, obtain additional support at [www.microchip.com/en-us/support/design-help/client-support-services](http://www.microchip.com/en-us/support/design-help/client-support-services).

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, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, 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.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC

Plus, ProASIC Plus logo, Quiet- Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICTail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, Symmcom, and Trusted Time are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2022, Microchip Technology Incorporated and its subsidiaries. All Rights Reserved.

ISBN:

AMBA, Arm, Arm7, Arm7TDMI, Arm9, Arm11, Artisan, big.LITTLE, Cordio, CoreLink, CoreSight, Cortex, DesignStart, DynamIQ, Jazelle, Keil, Mali, Mbed, Mbed Enabled, NEON, POP, RealView, SecurCore, Socrates, Thumb, TrustZone, ULINK, ULINK2, ULINK-ME, ULINK-PLUS, ULINKpro,  $\mu$ Vision, Versatile are trademarks or registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

## **Quality Management System**

---

For information regarding Microchip's Quality Management Systems, please visit [www.microchip.com/quality](http://www.microchip.com/quality).

## Worldwide Sales and Service

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