

DC – 24 GHz 32 dBm Distributed Amplifier

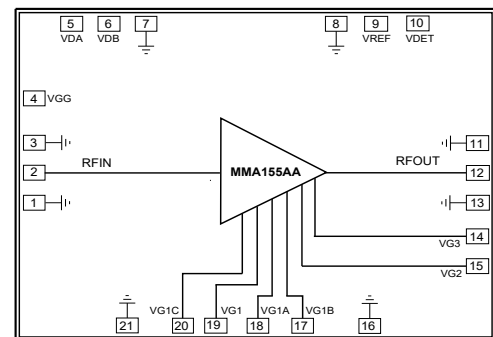
Product Overview

MMA155AA is a gallium arsenide (GaAs) monolithic microwave integrated circuit (MMIC) pseudomorphic high-electron-mobility transistor (pHEMT) distributed amplifier that operates between DC and 24 GHz. It is ideal for test instrumentation and wide-band military and space applications. The amplifier provides a gain of 15 dB and 32.5 dBm of output power at 3 dB gain compression with a nominal bias condition of 650 mA from a + 13V supply. Output IP3 is typically 35 dBm. The MMA155AA amplifier is DC coupled and features RF I/Os that are internally matched to 50 Ω .

Key Features

- Frequency range: DC to 24 GHz
- Gain: 15 dB
- Positive gain slope
- Flat power response to 20 GHz
- Low- IM3: -37 dBc at 18 dBm, 22 GHz
- Low noise figure: 3.0 dB at 10 GHz
- Supply: 650 mA @ + 13V
- Power level detector
- Passivated space-qualified process listed on EPPL007 – 38
- 50 Ω matched input/output
- Die size: 3.3 mm $\times$ 1.68 mm $\times$ 0.075 mm

Functional Block Diagram



Applications

- Test and measurement instrumentation
- Military and space
- Telecom infrastructure
- Wideband microwave radios
- Microwave and millimeter-wave communication systems

Table 1. Performance Overview

Parameter	Typ.	Units
Frequency range	DC – 24	GHz
Gain	15	dB
Gain flatness	± 1	dB
P1dB	32	dBm
Psat	32.5	dBm
IMD3 @ Pout = 18dBm	-40	dBc

Export Classification: EAR99

Gain, NF, OP1dB & OIP3 Performances

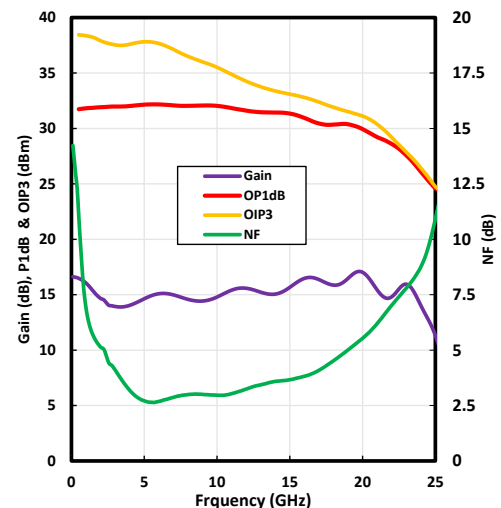


Table of Contents

Product Overview.....	1
1. Electrical Performances.....	3
1.1. Typical Electrical Performance.....	3
1.2. Typical Performance Curves.....	4
1.3. Absolute Maximum Ratings.....	9
2. Die Specifications.....	10
3. Application Circuits.....	11
4. Ordering, Shipping and Handling.....	13
4.1. Handling Recommendations.....	13
4.2. Ordering Information.....	13
4.3. Packing Information.....	13
5. Revision History.....	14
The Microchip Website.....	15
Product Change Notification Service.....	15
Customer Support.....	15
Product Identification System.....	16
Microchip Devices Code Protection Feature.....	16
Legal Notice.....	16
Trademarks.....	16
Quality Management System.....	17
Worldwide Sales and Service.....	18

1. Electrical Performances

1.1 Typical Electrical Performance

Table 1-1. Typical Electrical Performance at + 25 °C and 13V/650mA (Unless otherwise specified)

Parameter	Frequency Range	Min	Typ.	Max	Units
Frequency range		DC		22	GHz
Gain	DC – 6 GHz		14		dB
	6 – 18 GHz		15		dB
	18 – 22 GHz		15		dB
	22 – 24 GHz		14		dB
Gain flatness	DC – 6 GHz		± 0.5		dB
	6 – 18 GHz		± 1.0		dB
	18 – 22 GHz		± 1.5		dB
	22 – 24 GHz		± 1.5		dB
P1dB	DC – 6 GHz		32		dBm
	6 – 18 GHz		31		dBm
	18 – 22 GHz		29.5		dBm
	22 – 24 GHz		26.5		dBm
OIM3 @ Pout = +18 dBm	DC – 6 GHz		38		dBc
	6 – 18 GHz		34		dBc
	18 – 22 GHz		31		dBc
	22 – 24 GHz		28		
Noise Figure	2 – 6 GHz		4.5		dB
	6 – 18 GHz		4.0		dB
	18 – 22 GHz		6.5		dB
	22 – 24 GHz		8.5		dB
Input Return Loss	DC – 6 GHz		12.5		dB
	6 – 18 GHz		13.5		dB
	18 – 22 GHz		11.5		dB
	22 – 24 GHz		11.5		dB
Output Return Loss	DC – 6 GHz		8		dB
	6 – 18 GHz		8.5		dB
	18 – 22 GHz		6.5		dB
	22 – 24 GHz		6.5		dB
Vdd (Drain Voltage Supply)			13	15	V

.....continued					
Parameter	Frequency Range	Min	Typ.	Max	Units
I _{dd} (Drain Current)			650	750	mA

1.2 Typical Performance Curves

1.2.1 Typical Performance Curves at 11V

The following graphs show the typical performance curves of the MMA155AA device at 25 °C and 11V/550mA unless otherwise indicated.

Figure 1-1. Gain vs. Temperature

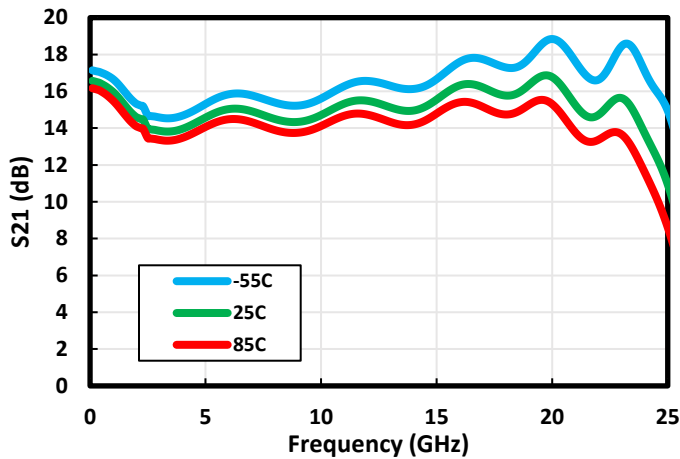


Figure 1-2. Output P1dB vs. Temperature

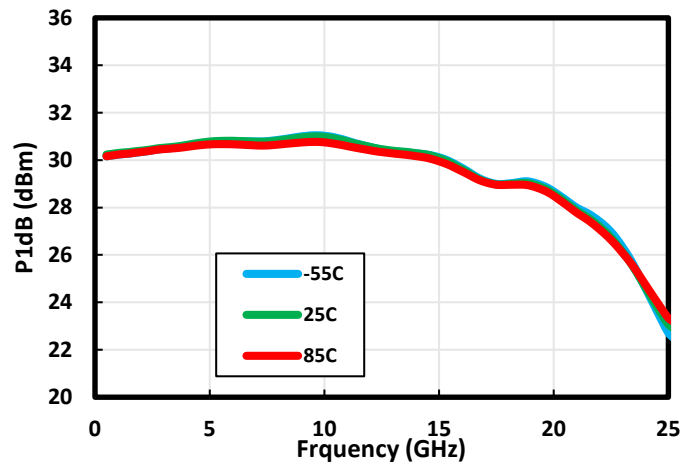


Figure 1-3. Output IP3 vs. Temperature

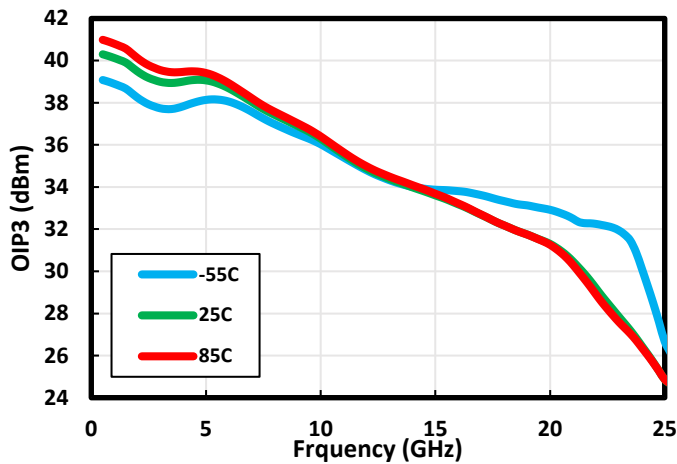
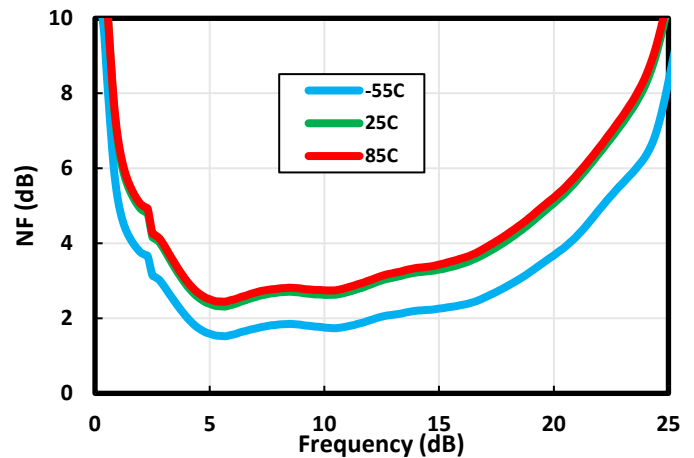


Figure 1-4. NF vs. Temperature



MMA155AA

Electrical Performances

Figure 1-5. Output P3dB vs. Temperature

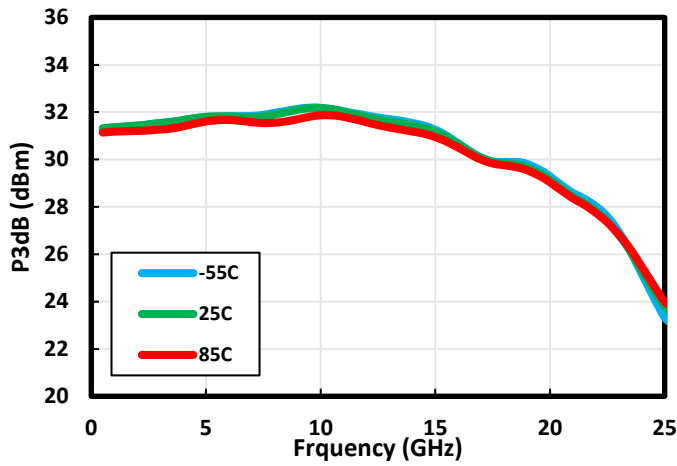


Figure 1-6. S12 vs. Temperature

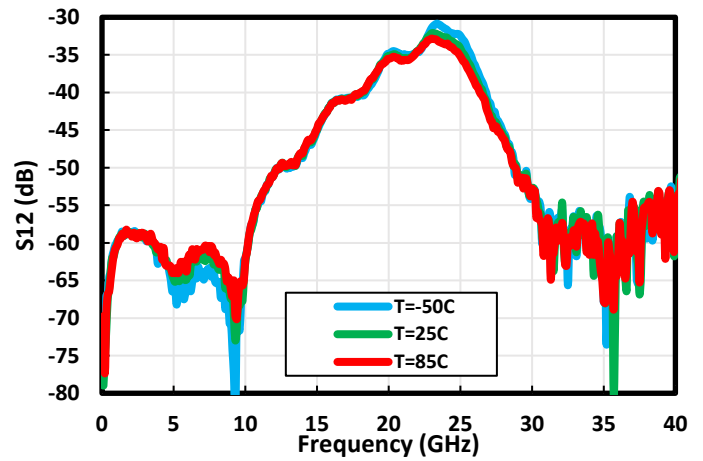


Figure 1-7. Input RL vs. Temperature

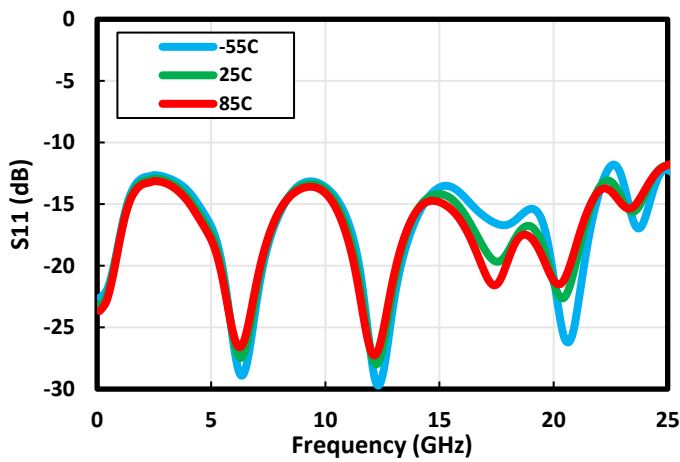


Figure 1-8. Output RL vs. Temperature

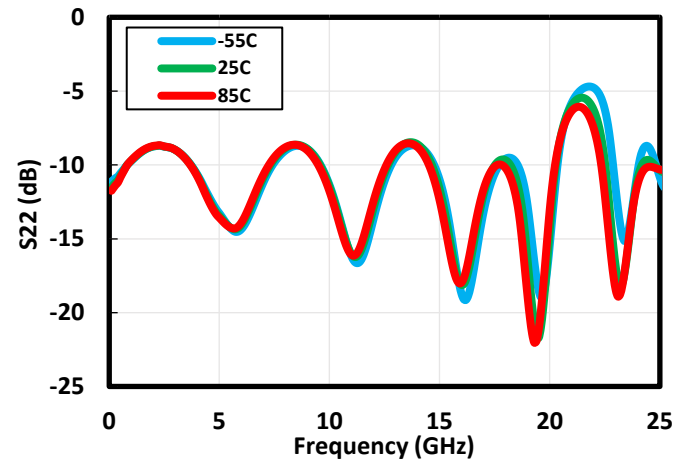


Figure 1-9. IM3 vs. Output Power @ 11V/470mA

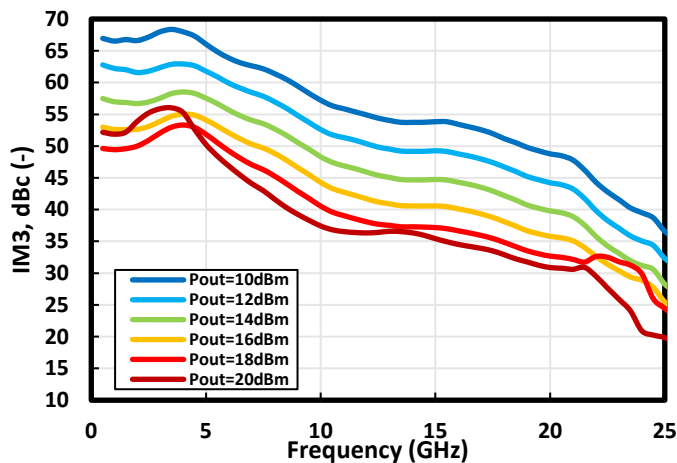
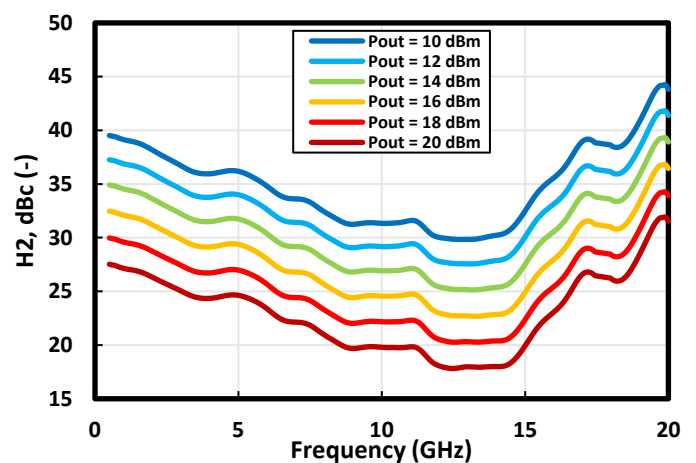


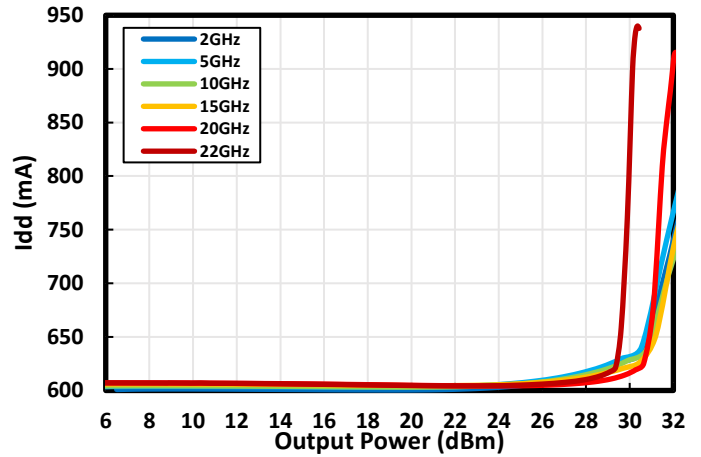
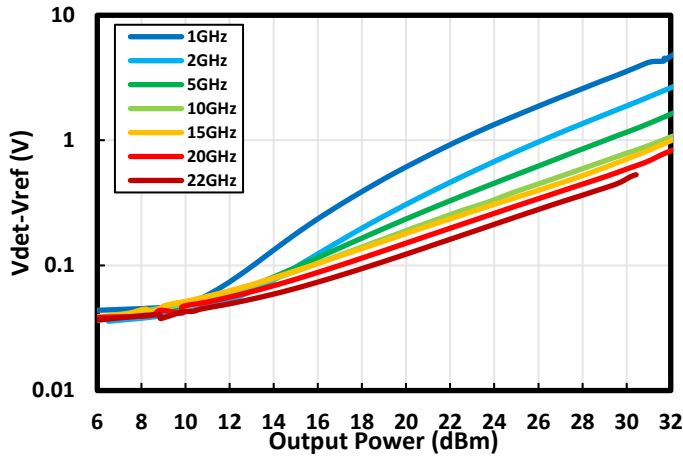
Figure 1-10. H2 vs. Output Power @ 11V/470mA



MMA155AA

Electrical Performances

Figure 1-11. Detector Output vs. Output Power & Frequency @ 11V/470mA



1.2.2 Typical Performance Curves at 13V

The following graphs show the typical performance curves of the MMA155AA device at 25 °C and 13V/650mA unless otherwise indicated.

Figure 1-13. Gain vs. Temperature

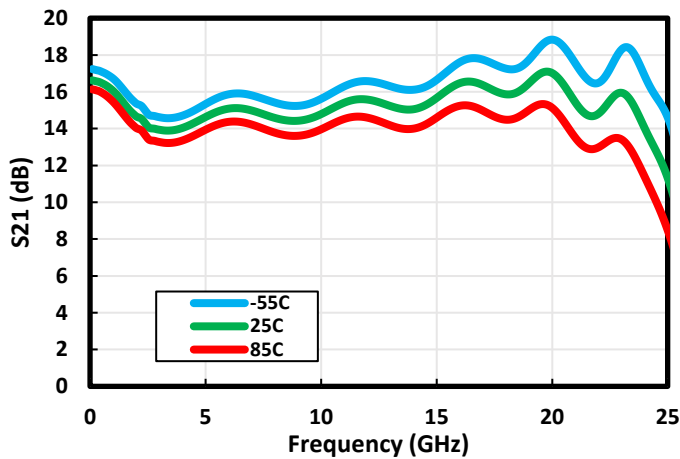


Figure 1-14. Output P1dB vs. Temperature

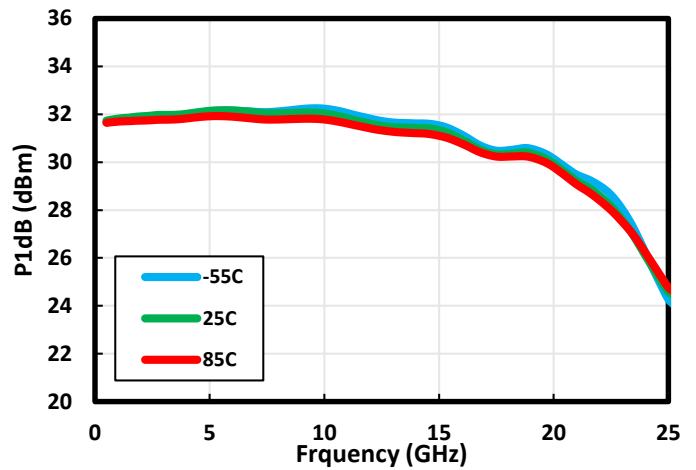


Figure 1-15. Output IP3 vs. Temperature

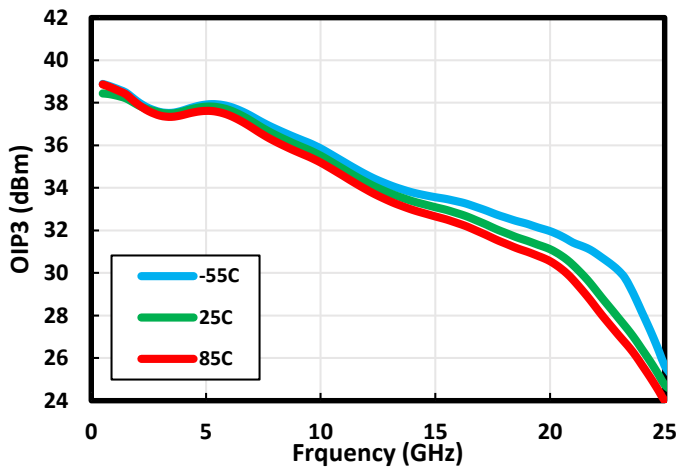


Figure 1-16. Noise Figure vs. Temperature

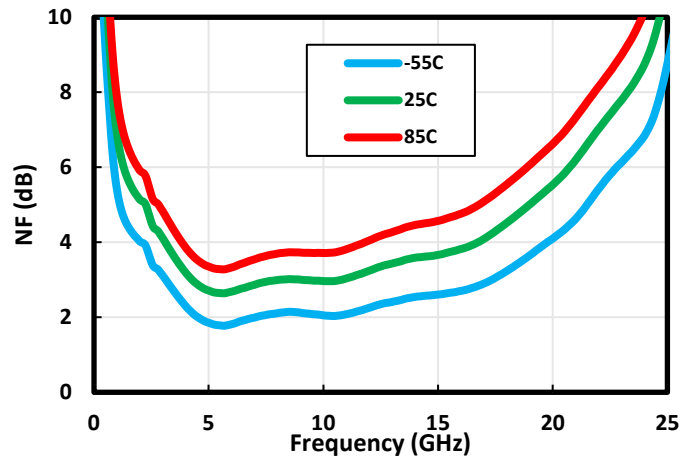


Figure 1-17. Output P3dB vs. Temperature

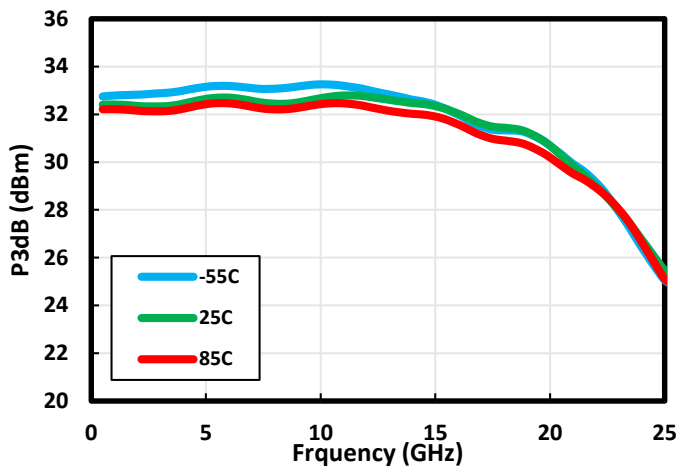


Figure 1-18. H2 vs. Output Power @ 13V/600mA

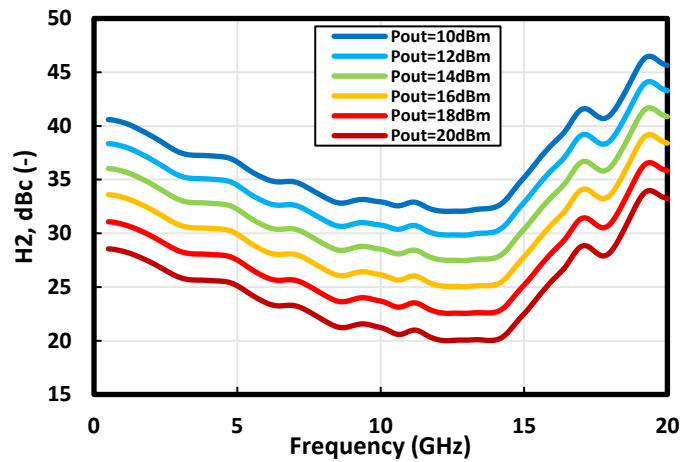


Figure 1-19. Input RL vs. Temperature

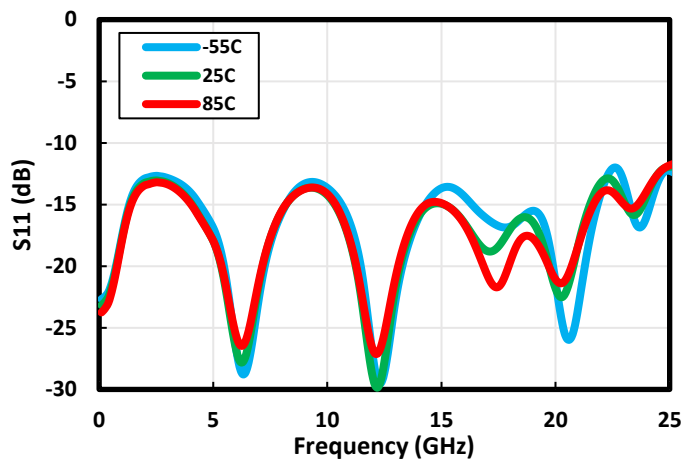
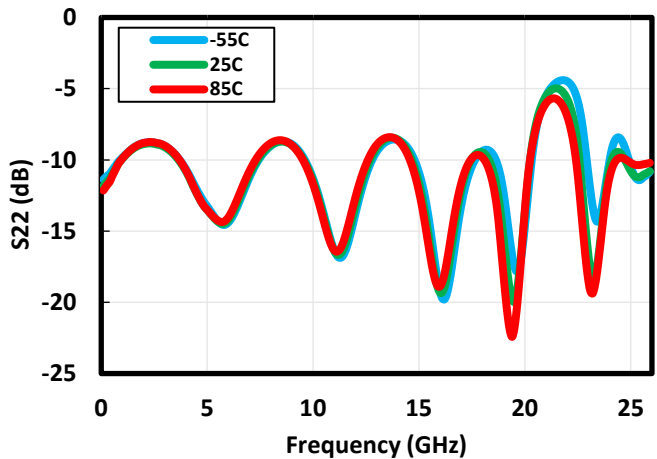


Figure 1-20. Output RL vs. Temperature



1.2.3 Typical Performance Curves at 15V

The following graphs show the typical performance curves of the MMA155AA device at 25 °C and 15V/750mA unless otherwise indicated.

Figure 1-21. Gain vs. Temperature

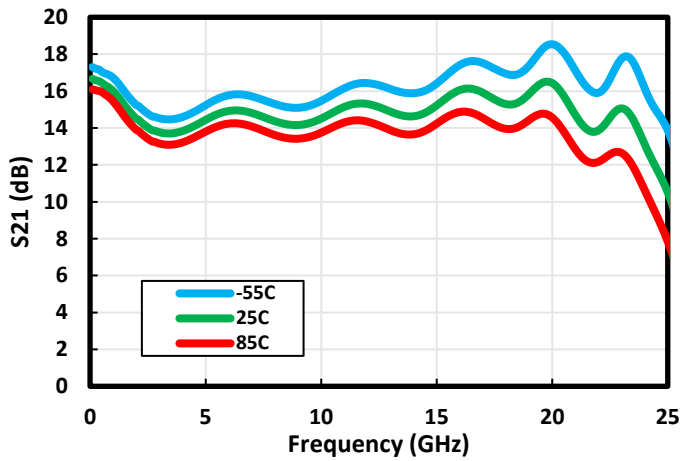


Figure 1-22. Output P1dB vs. Temperature

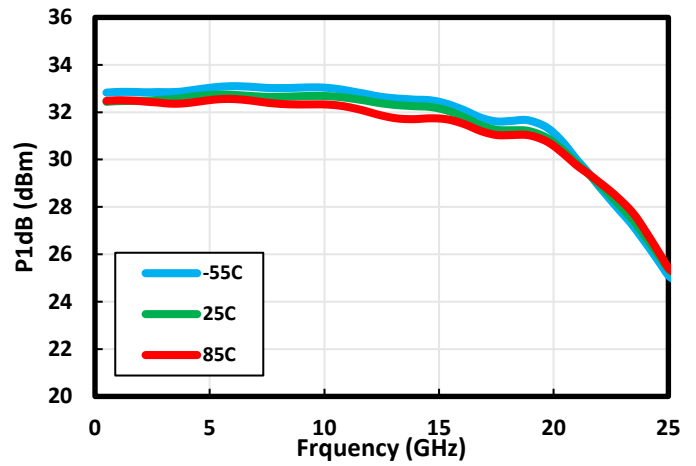


Figure 1-23. Output IP3 vs. Temperature

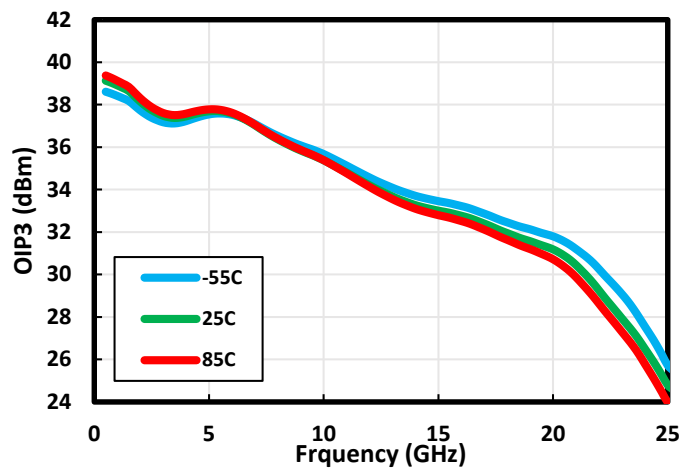


Figure 1-24. Noise Figure vs. Temperature

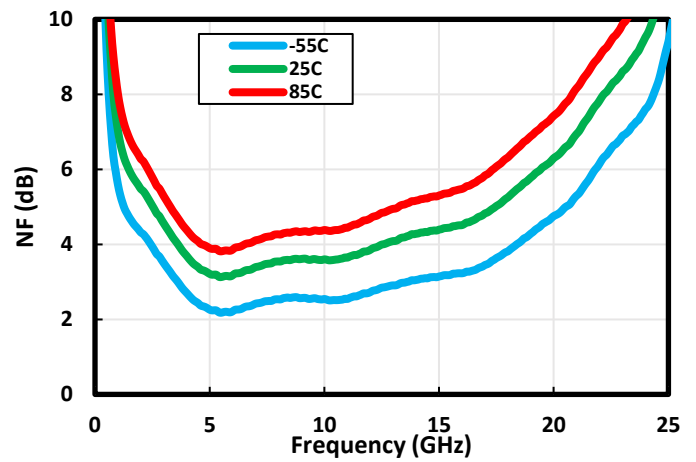


Figure 1-25. Output P3dB vs. Temperature

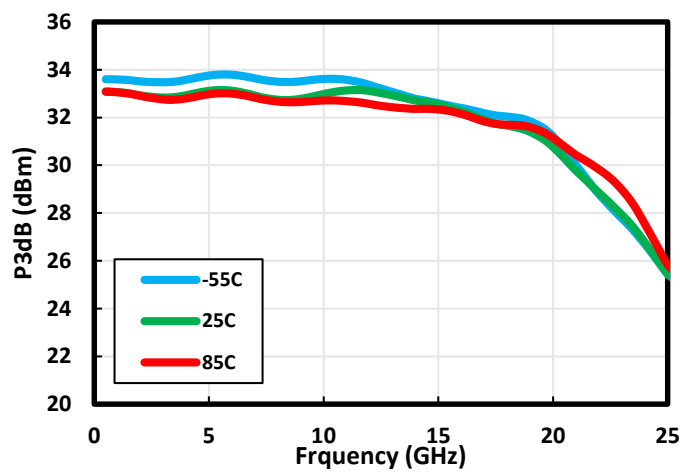


Figure 1-26. Input RL vs. Temperature

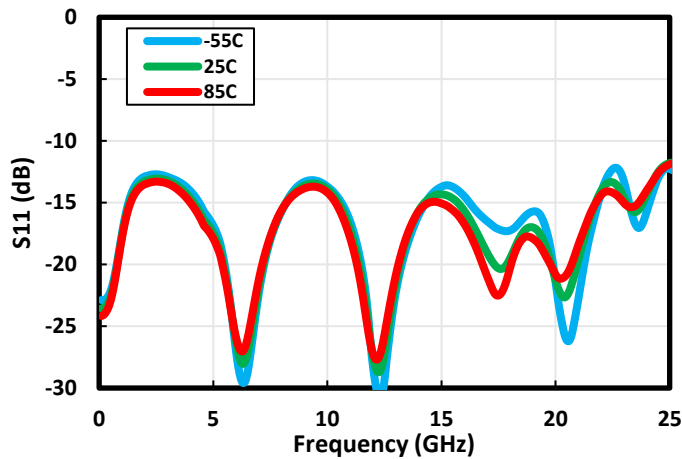
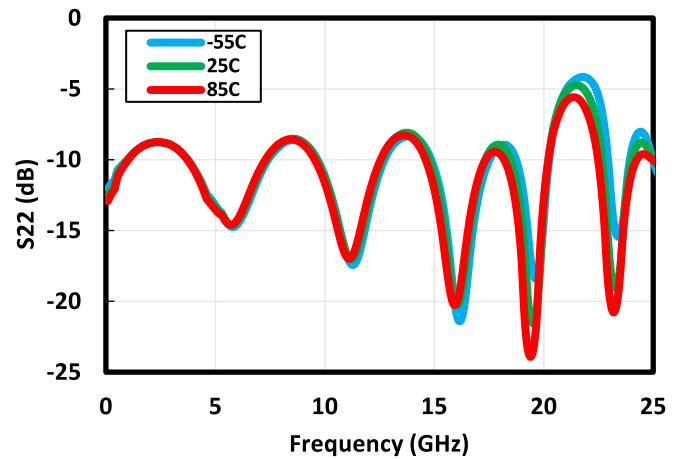


Figure 1-27. Output RL vs. Temperature



1.3 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the MMA155AA 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 (Vdd)	18V
Vdd current (Idd)	800 mA
Gate bias voltage (VG)	-2V to +0.5V
RF input power (Pin)	+25 dBm (or 6 dB gain compression)
DC power dissipation (T = +85 °C) at Psat	9.4W
DC power dissipation (T = +85 °C) at Low Power	12.1W
Thermal Resistance at Psat	9.6 °C/W
Thermal Resistance at Low Power	7.4 °C/W
Channel Temperature	+175 °C
Operating Temperature	-55 °C to +85 °C
Storage Temperature	-65 °C to +150 °C



ESD Sensitive Device

2. Die Specifications

The following illustration shows the chip outline of the MMA155AA device. Dimensions are shown millimeters. The minimum bond pad size is 100 μm $\times$ 100 μm . The die thickness is 80 μm . The backside is the DC/RF ground.

For additional packaging information, contact your Microchip sales representative.

Figure 2-1. Die Outline Drawing

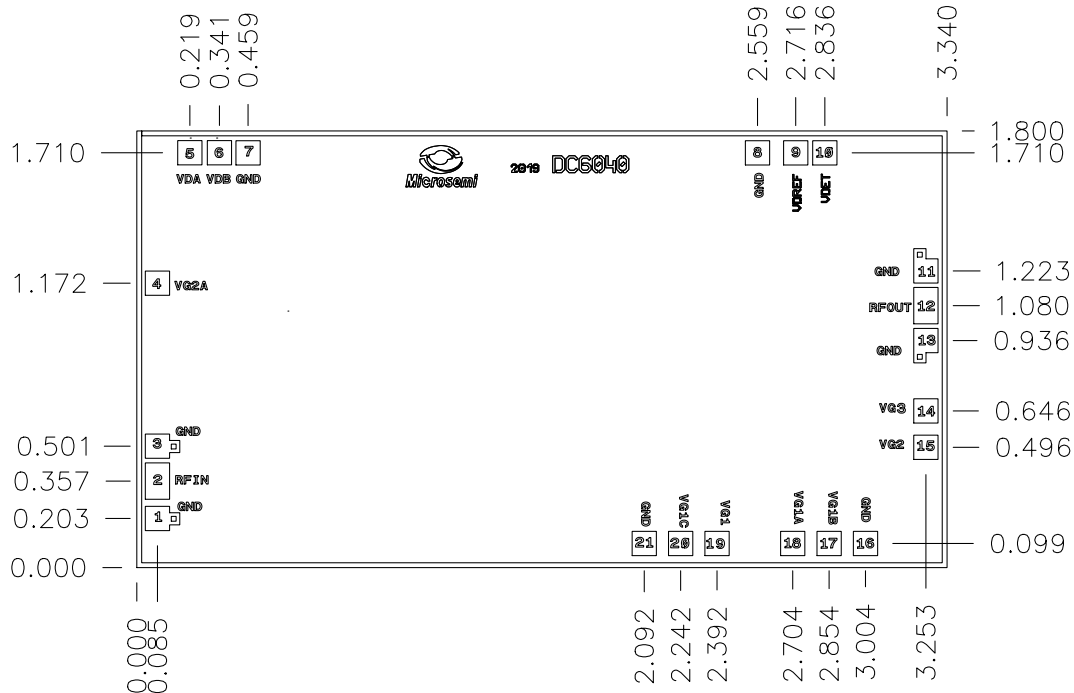


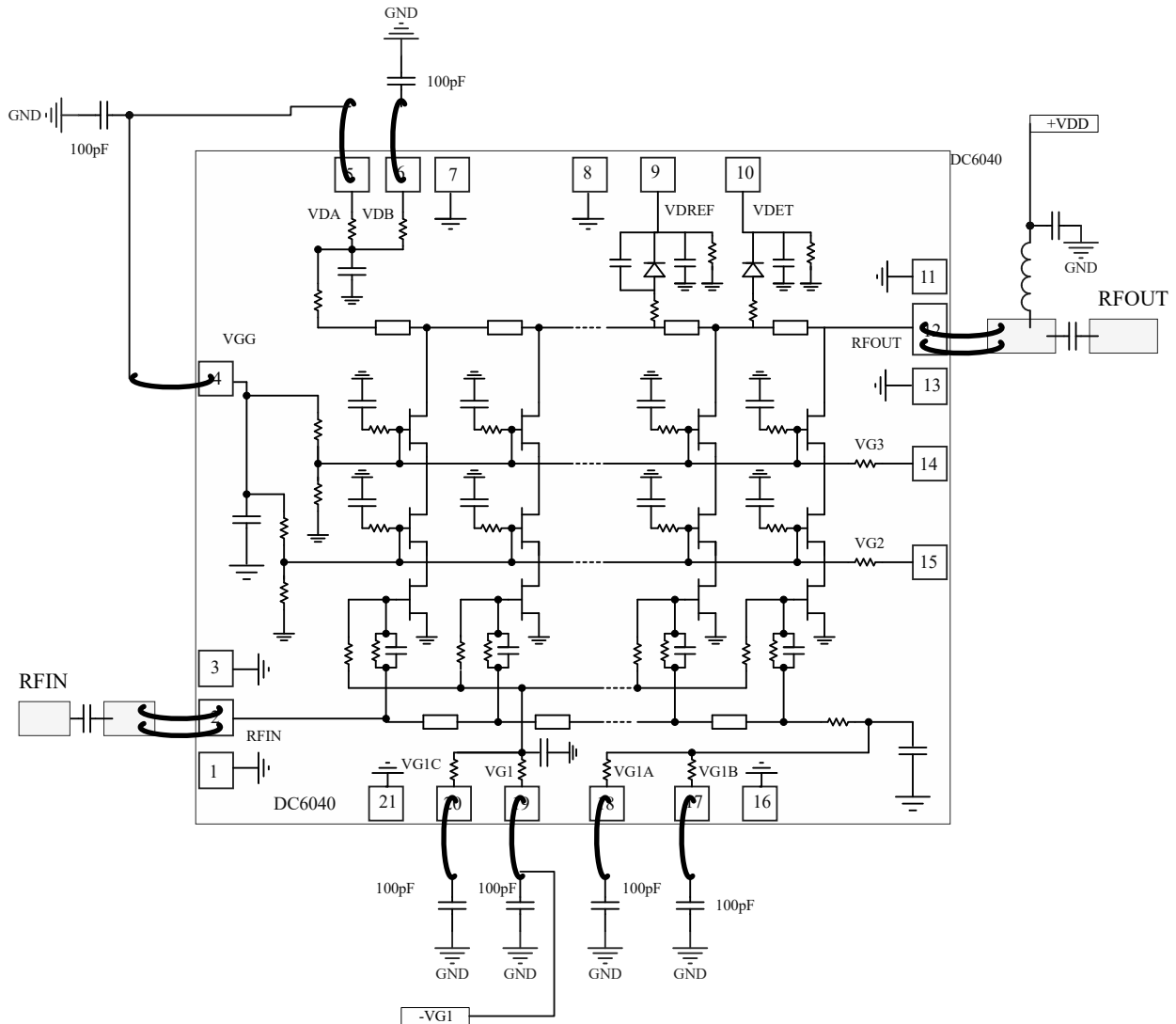
Table 2-1. I/O Pad Description

Pad Number	Pad Name	Pad Description
2	RFIN	RF Input, DC coupled to VDA and matched to 50Ω.
12	RFOUT	RF Output, DC coupled and matched to 50Ω. Used also to DC bias the Die through external Bias T
19	VG1	DC bias for Gate 1 (negative)
17, 18 & 20	VG1B, VG1A & VG1C	Complimentary Low Frequency terminations, for higher value capacitors connections, also DC coupled to VG1
15	VG2	2nd Gate Bias access, not used in normal operation
4	VG2A	2nd Gate Bias, have to be coupled to Vdd , for normal operation, use VDA (pad 6)
14	VG3	3rd Gate Bias access, not used in normal operation
5 & 6	VDA & VDB	Optional Low Frequency termination, connecting to high value cap, typically 10nF
10	VDET	Differential Detector Output voltage
9	VREF	Reference Voltage of the differential Detector
1, 3, 7, 8, 11, 13, 16 & 21	RF/DC GND	Must be connected to RF/DC Ground
Backside Paddle	RF/DC GND	Must be connected to RF/DC Ground

3. Application Circuits

Enter a short description of your topic here (optional).

Figure 3-1. Application Circuit: Schematic



The following illustration shows the assembly diagram of the MMA155AA device. The carrier plate is gold plated. It is necessary to attach components using 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 3-2. Test Circuit DC – 26 GHz: Assembly Drawing

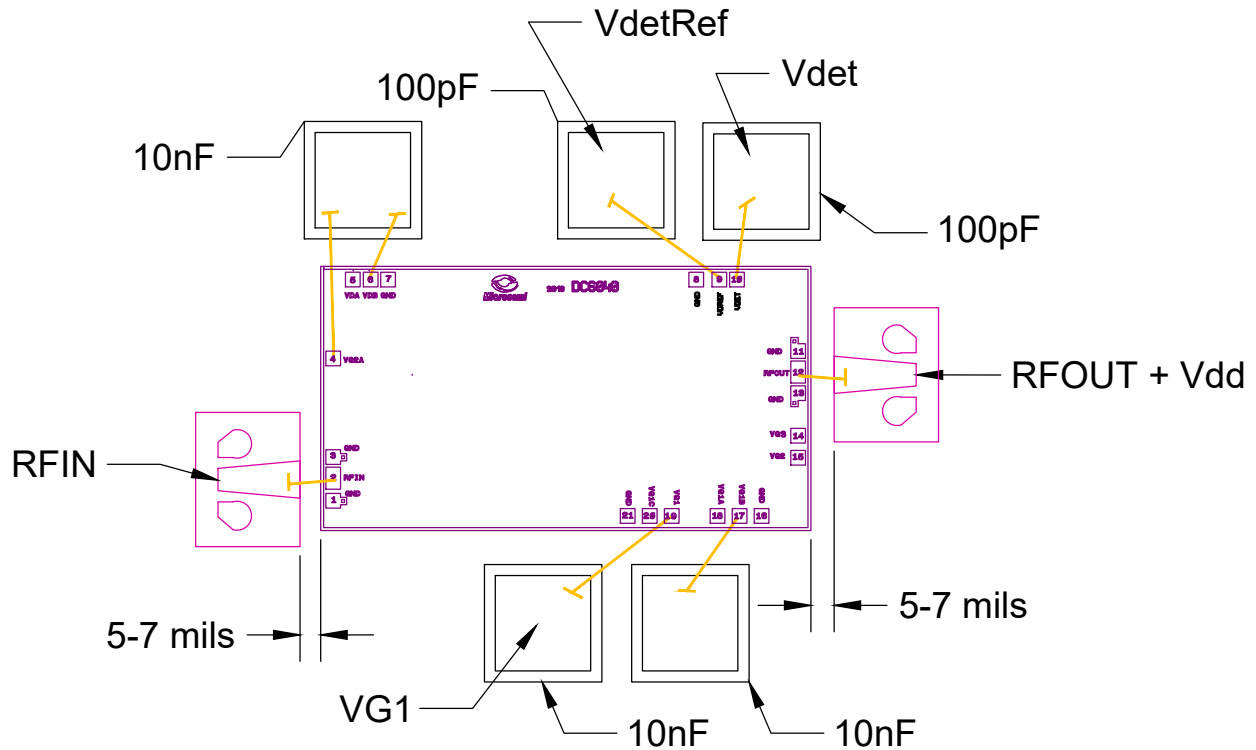


Table 3-1. Bill of material (BOM)

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
MMA155AA	Die

4.3 Packing Information

Standard Format
Gel Pack

Note: Contact your Microchip sales representative for the minimum Die 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 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.

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.

© 2021, 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, μ 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.

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	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

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Microchip:](#)

[AC164133](#) [DM330026](#) [DM330029](#) [EV14Y36A](#) [EV25U57A](#) [EV23R43A](#) [EV82S16A](#) [EV42P34A](#) [EV28J28A](#)