



# RFDA0026

## Digital Controlled Variable Gain Amplifier 600MHz to 1035MHz, 6-Bit 0.5dB LSB Control

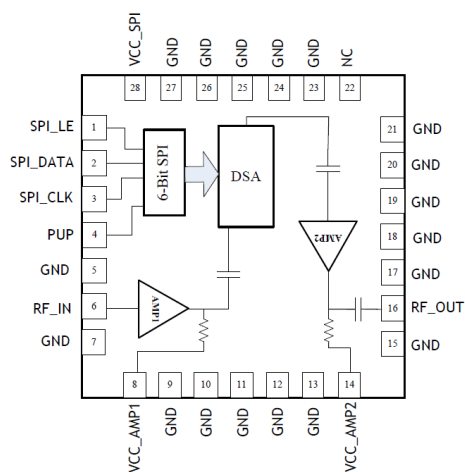
MCM 28 Pin 6x6 mm Leadless Package

### Product Description

The Qorvo® RFDA0026 is a digital controlled variable gain amplifier featuring high linearity over the entire gain control range with noise figure less than 4.1dB in its maximum gain state. The gain of the 6-bit digital step attenuator is programmed with a serial mode control interface (SPI). The RFDA0026 is packaged in a small 6.0mmx6.0mm leadless laminate MCM, which contains plated through thermal vias for ultra low thermal resistance. This module is easy to use with no external matching components required.



### Functional Block Diagram



Top View

### Feature Overview

- 600-1035 MHz frequency range
- Fully internal matching and no external Bias inductors required
- 6-Bit digital step attenuator
- SPI serial control programming
- Max Gain = 32dB at 900MHz
- Gain control range = 31.5dB (0.5dB step size)
- High OIP3/P1dB=+40/23dBm
- Single +5V Supply
- Small 28-Pin, 6.0mmx6.0mm, MCM Package
- Power-up programming

### Applications

- Wireless Infrastructure
- WiBro, WiMax, LTE
- Microwave radio
- High linearity power control

### Ordering Information

PART NUMBER	DESCRIPTION
RFDA0026SQ	Sample bag with 25 pieces
RFDA0026SR	7" Sample reel with 100 pieces
RFDA0026TR7	7" Reel with 750 pieces
RFDA0026TR13	13" Reel with 2500 pieces
RFDA0026PCK-410	800MHz to 1035MHz PCBA with 5 piece sample bag
RFDA0026PCK-411	650MHz to 850MHz PCBA with 5 piece sample bag

## Absolute Maximum Ratings

PARAMETER	CONDITIONS	RATING
Supply Voltage (V <sub>CC</sub> , V <sub>DD</sub> )		+5.5V
DC Supply Current		300mA
Power Dissipation (P <sub>DISS</sub> )		1500mW
Max. RF Input Power		+12 dBm
Storage Temperature		-40 to +150 °C

Operation of this device outside the parameter ranges given above may cause permanent damage.

## Recommended Operating Conditions

PART NUMBER	MIN.	TYP.	MAX.	UNITS
Supply Voltage V <sub>CC</sub>	+4.75	+5	+5.25	V
Total Supply Current		192		mA
Operating Temperature (T <sub>CASE</sub> )	-40		+85	°C
T <sub>j</sub> for >1.7E6 hours MTTF			+170	°C

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

## Electrical Specifications

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operational Frequency Range		600		1035	MHz
Gain, Max.	Attenuation 0dB		32		dB
Gain, Control Range			31.5		dB
Gain Control Step Accuracy	Major state error up to 1035MHz	±(0.1 + 5% attenuation setting)			dB
P1dB	Attenuation 0dB		23.8		dBm
Output IP3	P <sub>OUT</sub> 5dBm/tone, 1MHz spacing		40		dBm
Control Interface	SPI		6		bit
Setting Time	t <sub>ON</sub> , t <sub>OFF</sub> (10%/90% RF)		250		ns
Noise Figure	Attenuation 0dB		4.1		dB
Input Return Loss	50Ω system Impedance		15		dB
Output Return Loss	50Ω system Impedance		11		dB
Thermal Resistance	Junction to backside of device		46.2		°C/W

## Typical RF Performance

PARAMETER	700MHz <sup>2</sup>	850MHz	900MHz	970MHz	1040MHz	Units
Gain, Max	34.1	33.4	33.2	33.0	32.5	MHz
Output P1dB	24.0	23.8	23.8	23.7	23.7	dBm
Output IP3 <sup>1</sup>	40.7	39.4	40.2	41.1	41.6	dBm
Input Return Loss	13.2	15.7	17.1	18.6	19.8	dB
Output Return Loss	12	10.1	10.3	10.2	10.1	dB
Noise Figure	4.0	4.0	4.1	4.0	4.1	dB

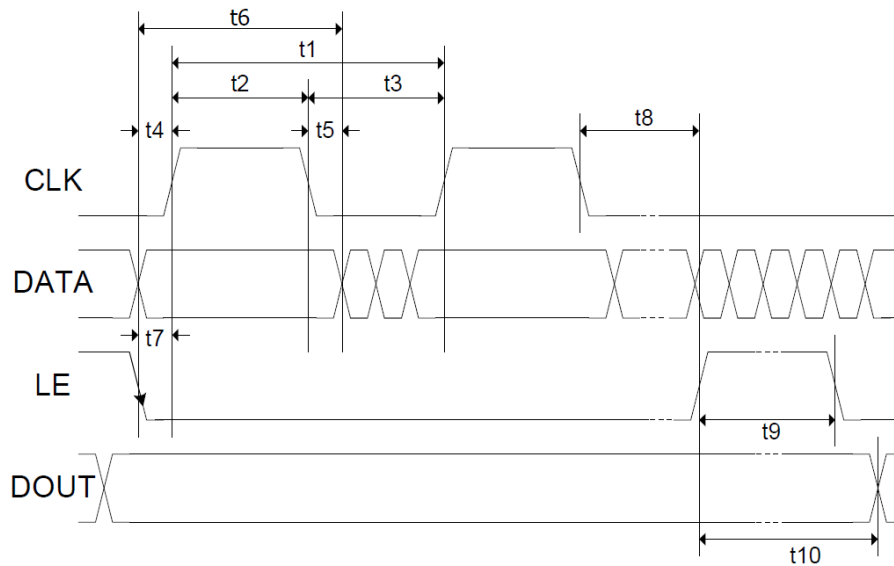
Notes:

1. OIP3 is tested at P<sub>OUT</sub> +5dBm/tone and 1MHz spacing
2. Based on 650MHz to 850MHz application circuit

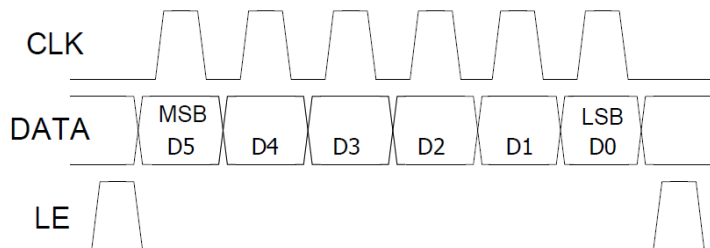
Gain Control Truth Table

GAIN Relative to Maximum Gain	CONTROL BIT					
	D5	D4	D3	D2	D1	D0
0 dB	1	1	1	1	1	1
-0.5 dB	1	1	1	1	1	0
-1 dB	1	1	1	1	0	1
-2 dB	1	1	1	0	1	1
-4 dB	1	1	0	1	1	1
-8 dB	1	0	1	1	1	1
-16 dB	0	1	1	1	1	1
-31.5 dB	0	0	0	0	0	0

SPI Timing Diagram



Programming Example – 6 Bit



## SPI Timing Specifications

PARAMETER	LIMIT	COMMENT
t1	25 MHz max.	CLK Frequency
t2	20 nS min.	CLK High
t3	20 nS min.	CLK Low
t4	5 nS min.	DATA to CLK Setup Time
t5	5 nS min.	DATA to CLK Hold Time
t6	30 nS min.	DATA Valid
t7	5 nS min.	LE to CLK Setup Time
t8	5 nS min.	CLK to LE Setup Time
t9	10 nS min.	LE Pulse Width
t10	20 nS max.	Output Set

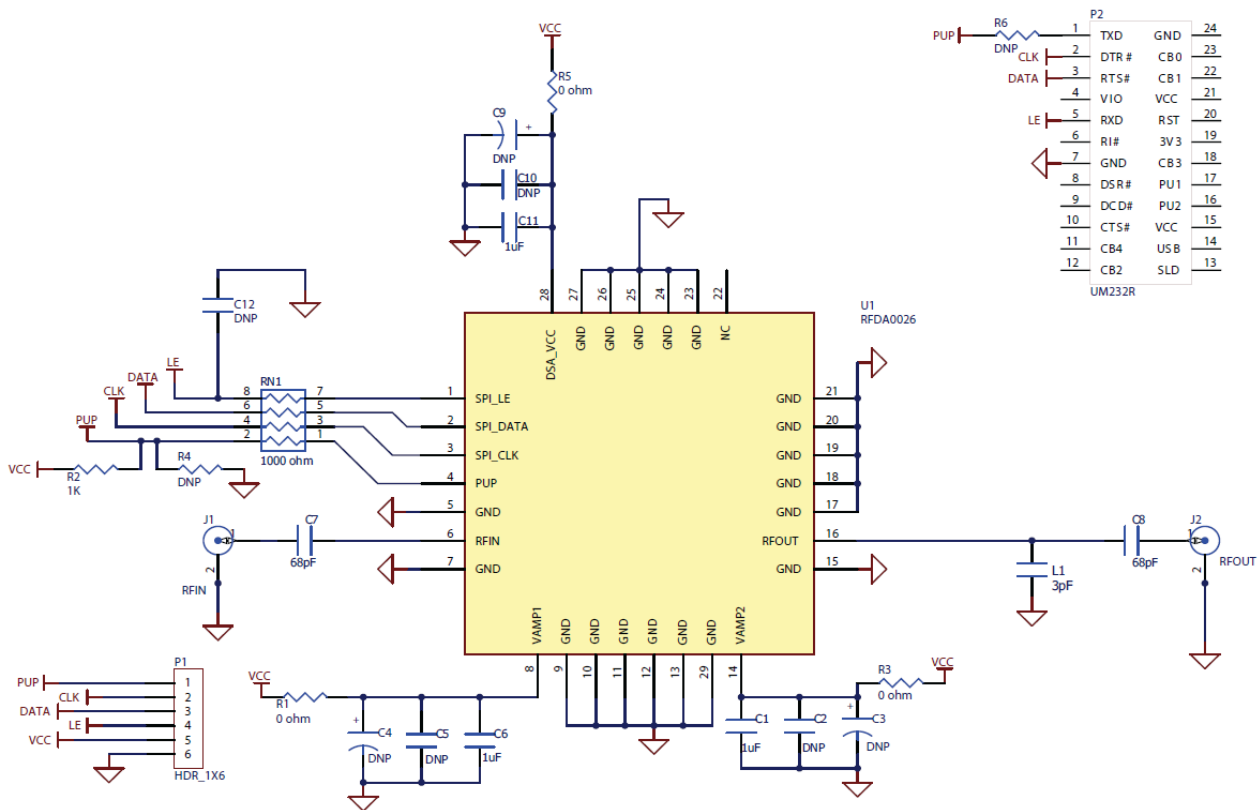
## Logic Voltage Level

LOGIC STATE	VOLTAGE
Low	0.0V to 0.8V
High	2.0V to 5.0V

## Power-up Programming (PUP)

PUP STATE	ATTENUATOR SETTING	COMMENT
Low	0 dB	Minimum Attenuation
High	31.5 dB	Maximum Attenuation

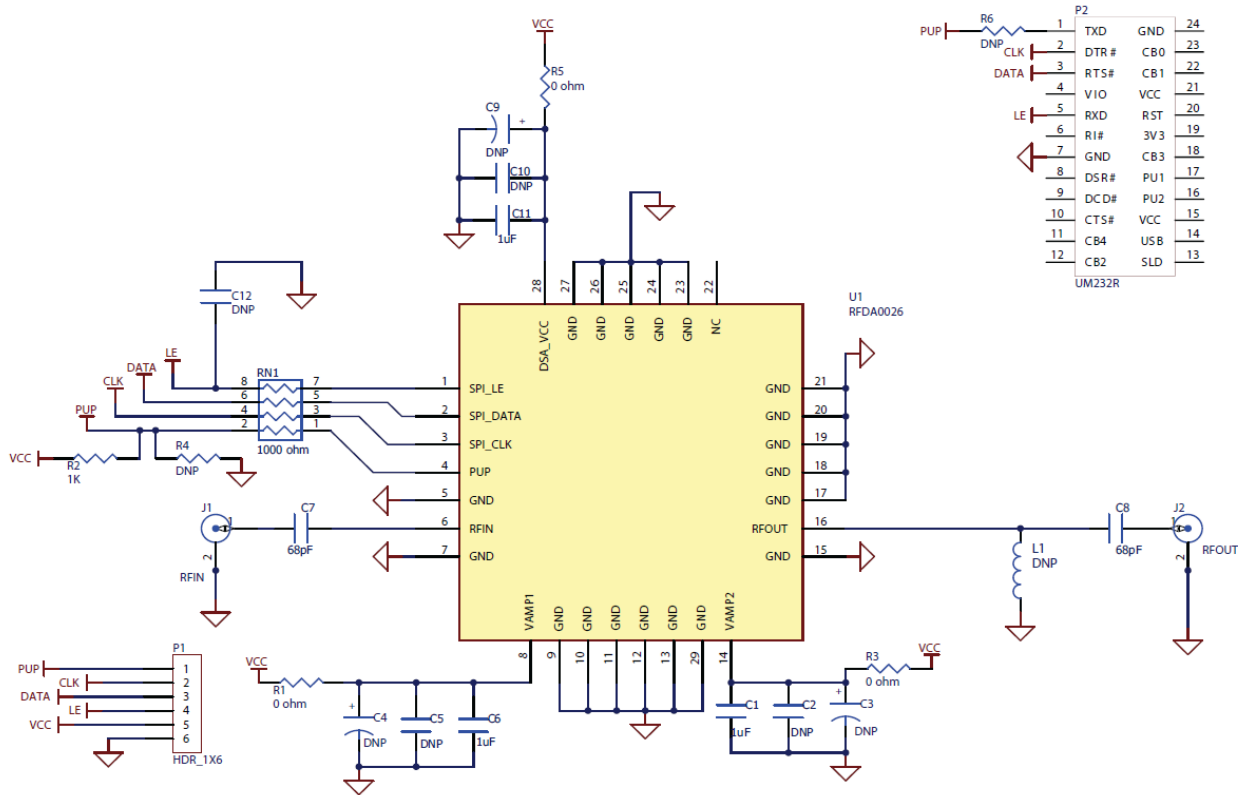
## Application Circuit Schematic, 650MHz to 850MHz



## EV B Bill of Material, 650MHz to 850MHz

REF. DES.	VALUE	DESCRIPTION	MANUF.	PART NUMBER
n/a	n/a	Printed Circuit Board	Viasystems	RFDA2026-411(B)
U1	RFDA0026	Digital Controlled Variable Gain Amplifier	Qorvo	RFDA0026SB
R1, R3, R5	0 Ω	Resistor, 0 Ω, 0603	KOA	RK73Z1JLTD
R2	1 KΩ	Resistor, 1 KΩ, 5%, 1/16W, 0603	Various	
RN1	1 KΩ	Resistor, Array, 4-element, 1 KΩ, 5%, SMD 4x0402	KOA	CN1E4KTTD102J
C1, C6, C11	1 μF	Capacitor, 1μF, 10%, 10V, 0402, X5R	muRata	GRM155R61A105KE15D
C7, C8	68 pF	Capacitor, 68pF, 5%, 50V, 0402, C0G	muRata	GRM1555C1H680JZ01D
J1, J2	SMA	Connector, SMA, End Launch, Flat 0.062"	Emerson	142-0701-821
P1	6-Pin	Connector, Header, Streat, Plorized 6 Pin. 0.100"	AMP	640454-6
P2	27-Pin	Connector, Socket, 27 Pin DIP, .600". Through Hole	Aries Electronics	24-6518-10
L1	3pF	Capacitor, 3.0pF, ±0.1pF, 250V, 0603, Hi-Q	muRata	GQM1875C2E3R0BB12D

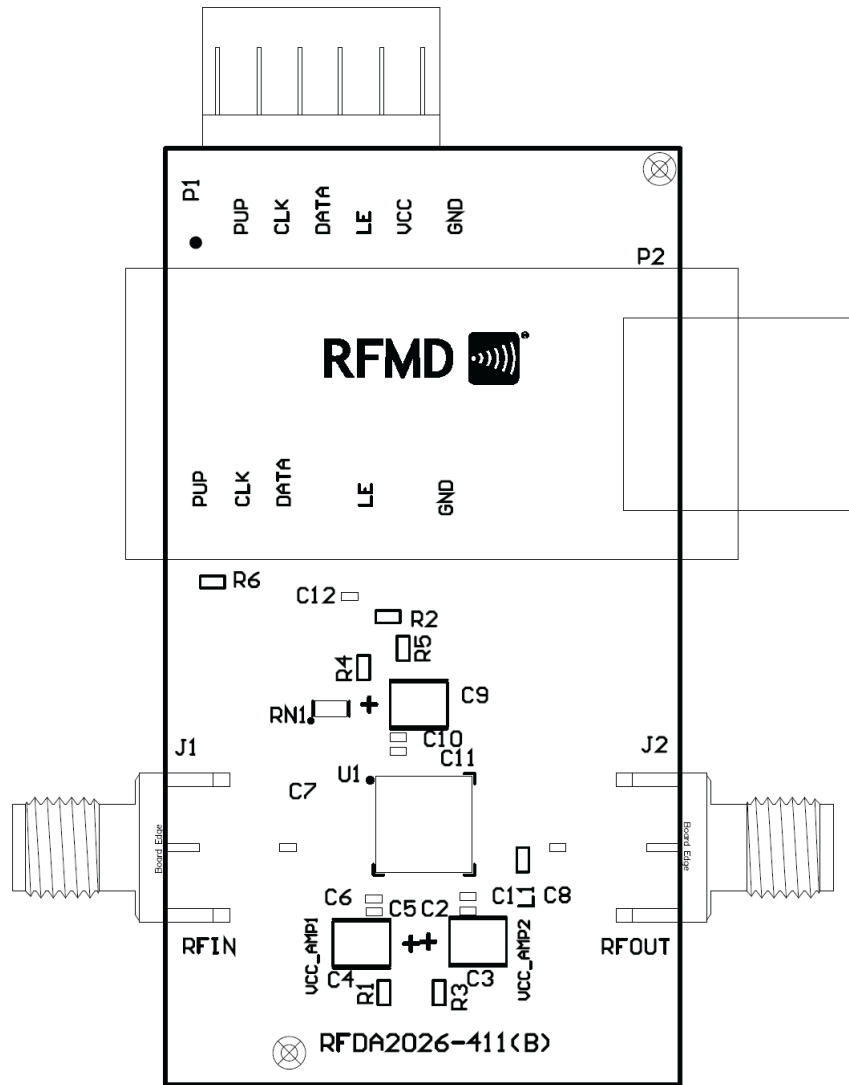
### Application Circuit Schematic, 800MHz to 1035MHz



### EV B Bill of Material, 800MHz to 1035MHz

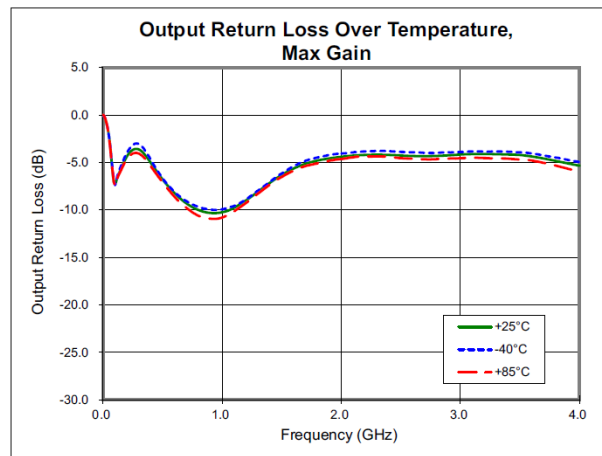
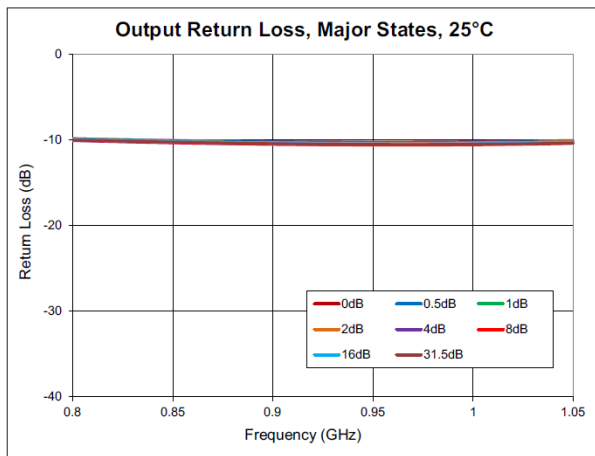
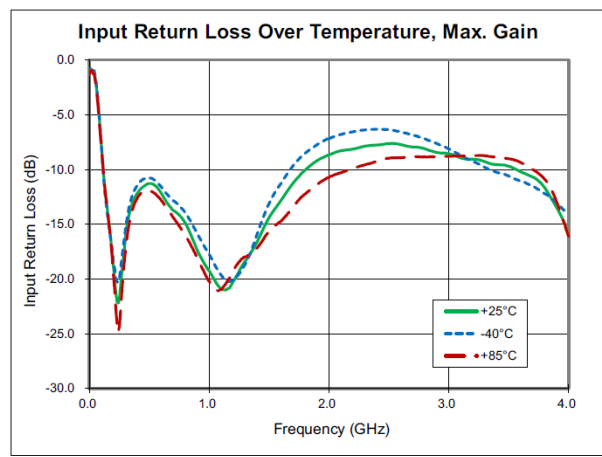
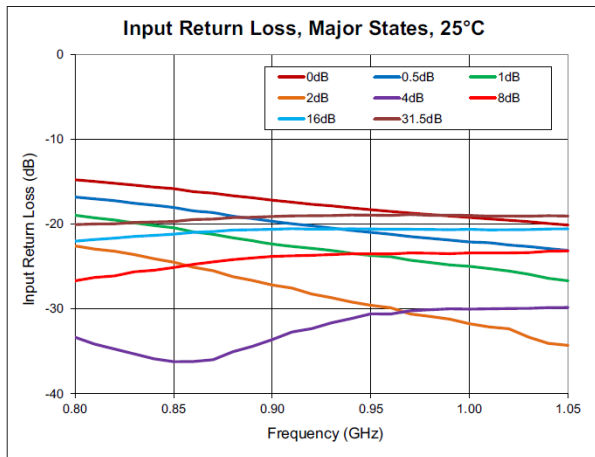
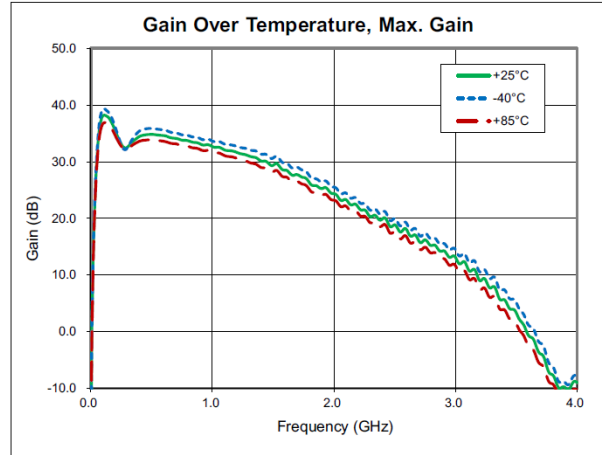
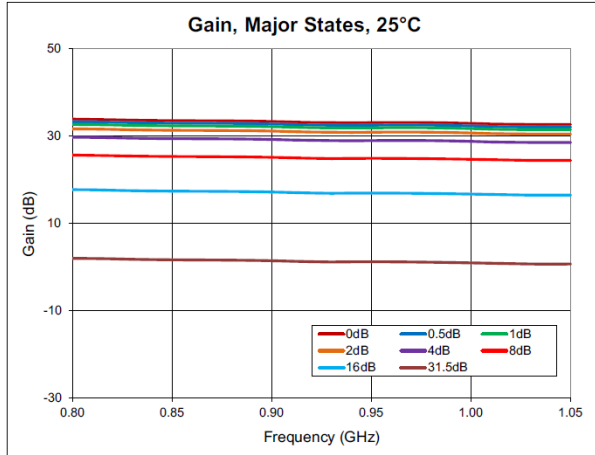
REF. DES.	VALUE	DESCRIPTION	MANUF.	PART NUMBER
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R2	1 KΩ	Resistor, 1 KΩ, 5%, 1/16W, 0603	Various	
RN1	1 KΩ	Resistor, Array, 4-element, 1 KΩ, 5%, SMD 4x0402	KOA	CN1E4KTTD102J
C1, C6, C11	1 μF	Capacitor, 1μF, 10%, 10V, 0402, X5R	muRata	GRM155R61A105KE15D
C7, C8	68 pF	Capacitor, 68pF, 5%, 50V, 0402, C0G	muRata	GRM1555C1H680JZ01D
J1, J2	SMA	Connector, SMA, End Launch, Flat 0.062"	Emerson	142-0701-821
P1	6-Pin	Connector, Header, Streat, Plorized 6 Pin. 0.100"	AMP	640454-6
P2	27-Pin	Connector, Socket, 27 Pin DIP, .600". Through Hole	Aries Electronics	24-6518-10

**Application Circuit Assembly**



Typical Performance – 800MHz to 1035MHz Broadband Application Circuit

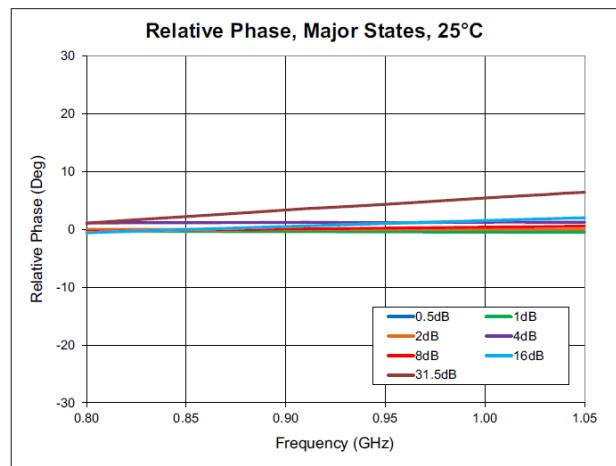
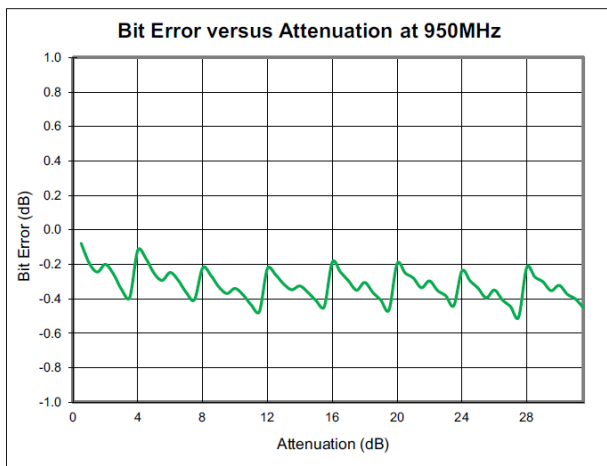
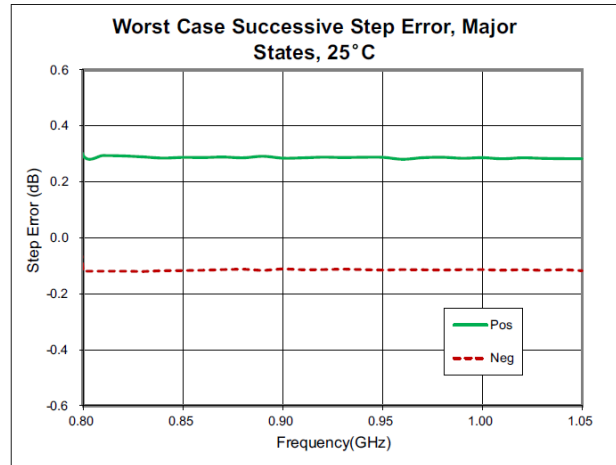
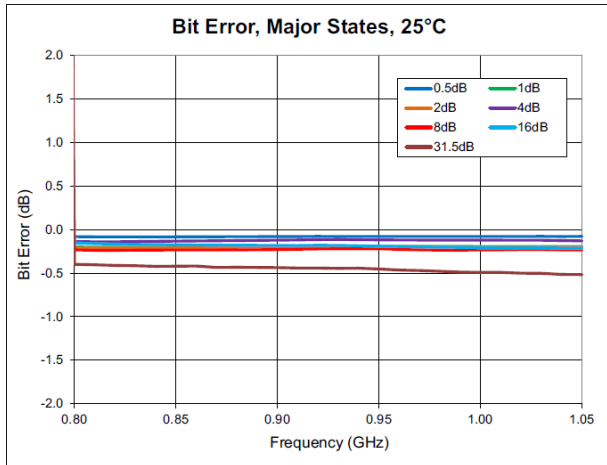
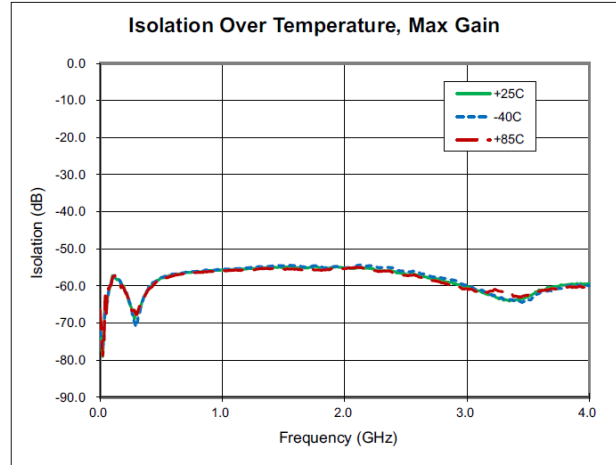
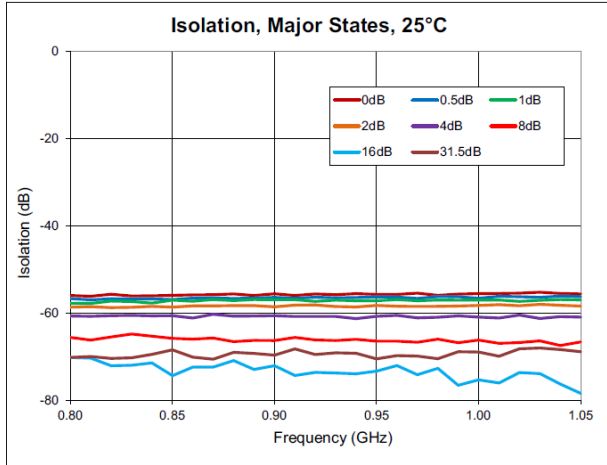
Test conditions unless otherwise noted:  $V_{CC} = +5.0$  V, Temp. = +25 °C





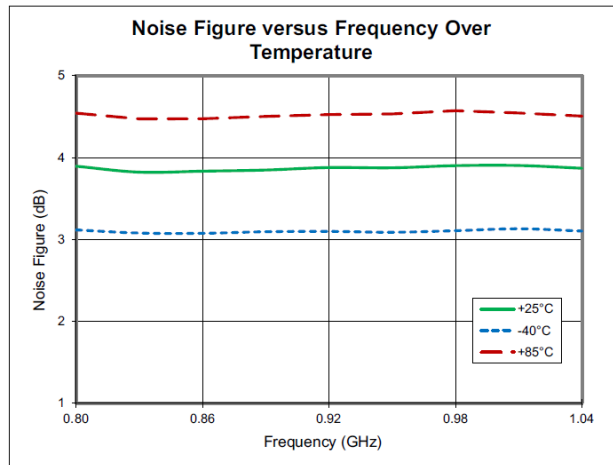
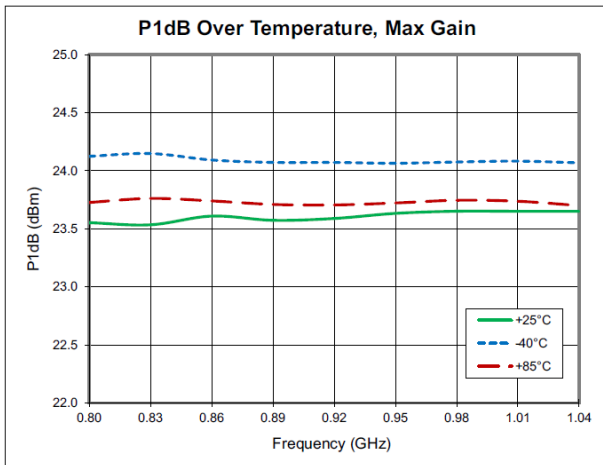
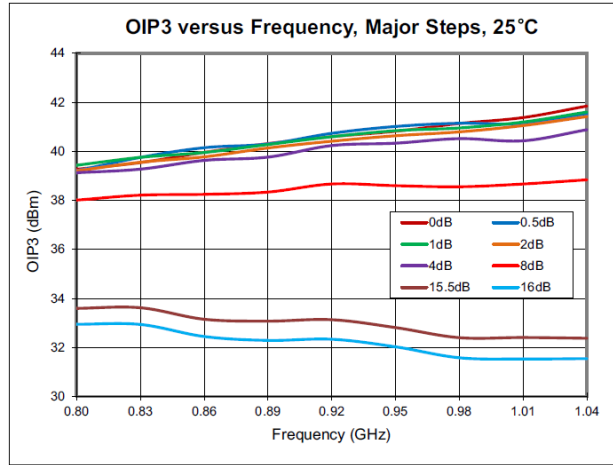
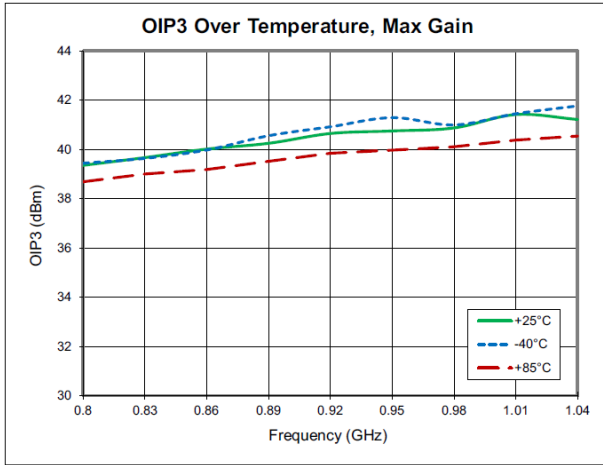
Typical Performance – 800MHz to 1035MHz Broadband Application Circuit

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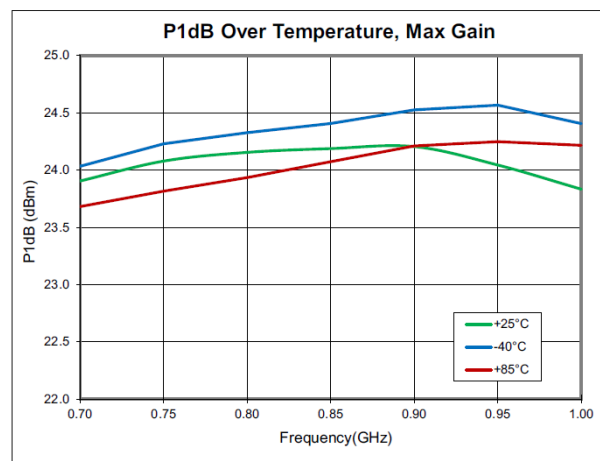
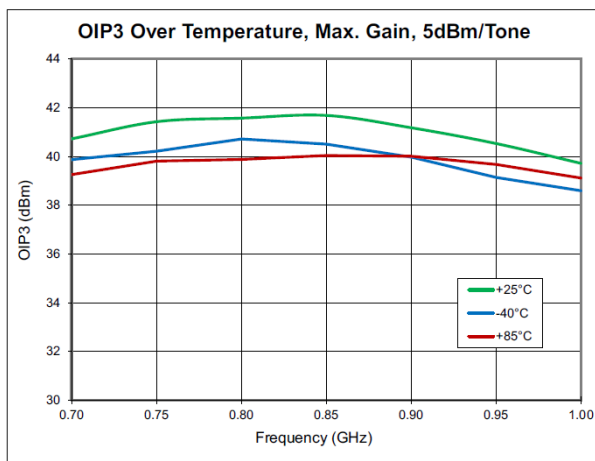
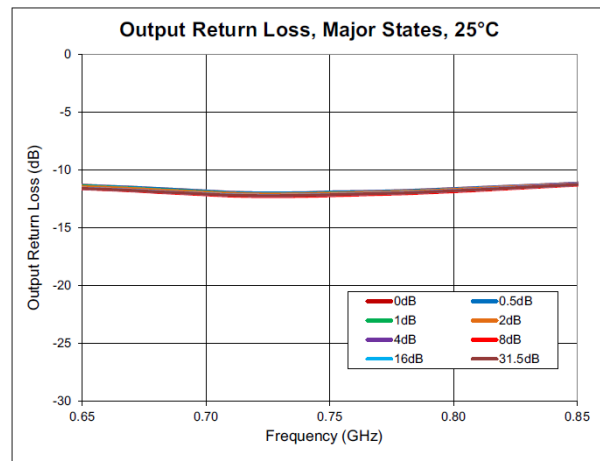
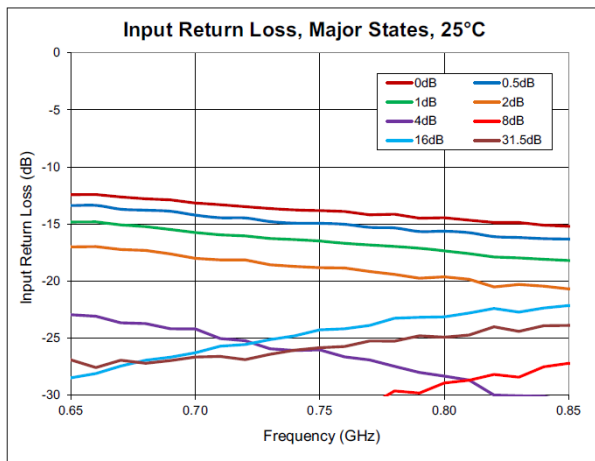
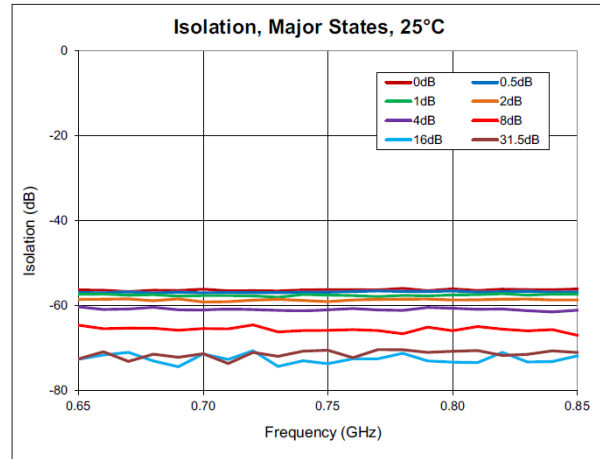
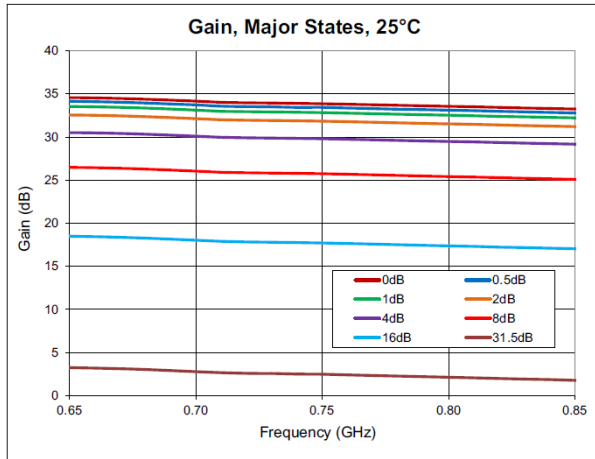
Typical Performance – 800MHz to 1035MHz Broadband Application Circuit

Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ , Temp. =  $+25\text{ }^{\circ}\text{C}$



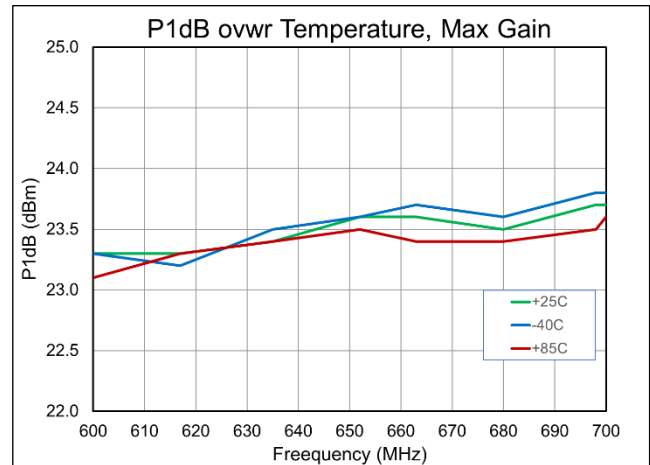
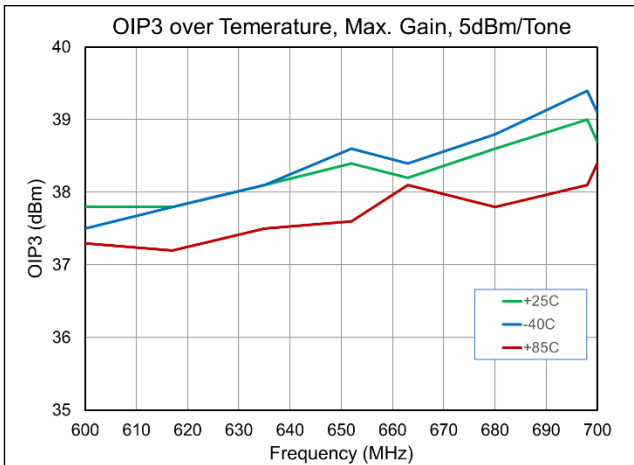
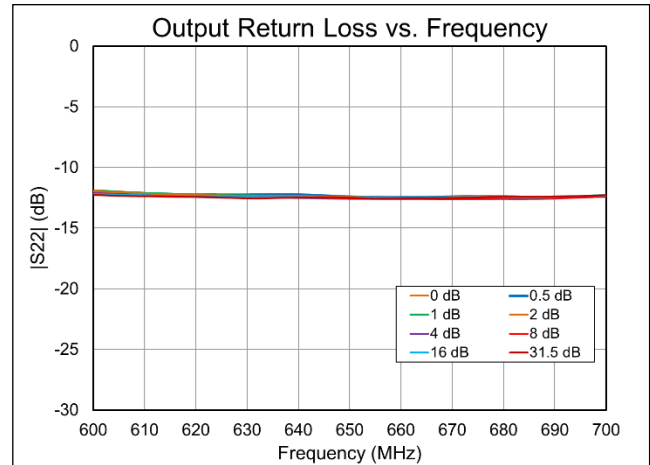
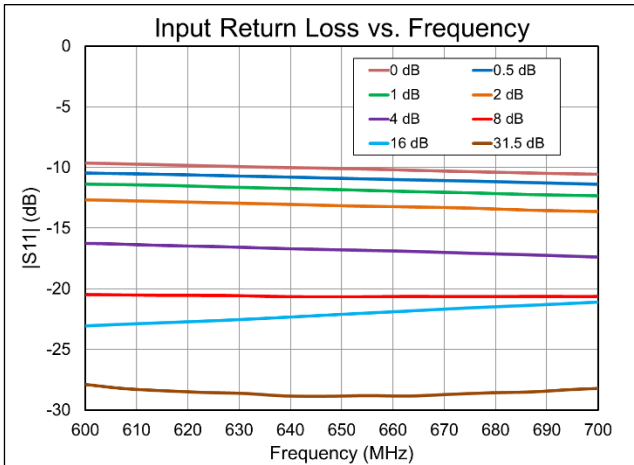
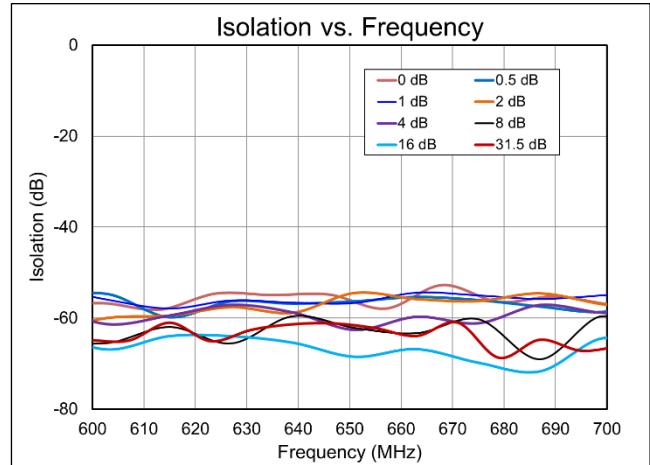
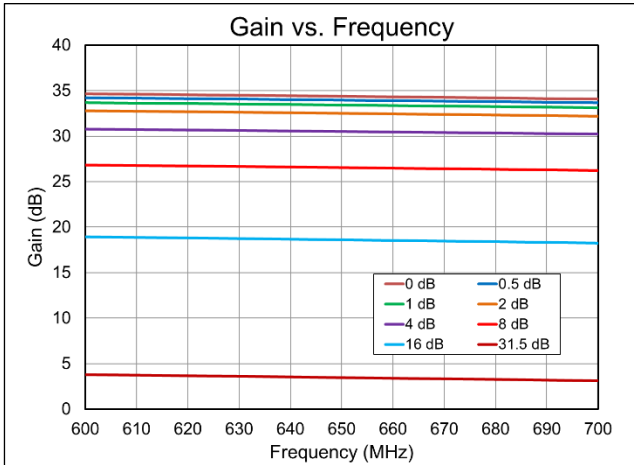
Typical Performance – 650MHz to 850MHz Broadband Application Circuit

Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ , Temp. =  $+25\text{ }^{\circ}\text{C}$

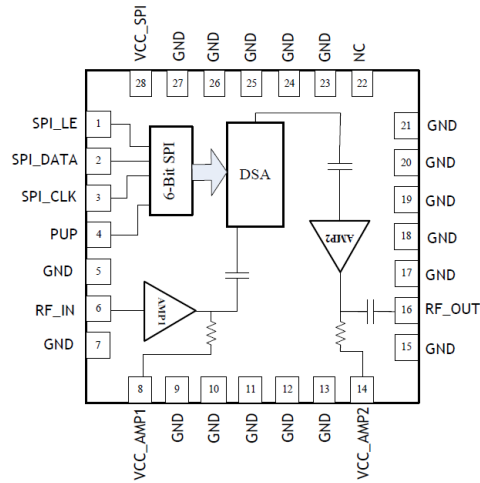


Typical Performance – 600MHz to 700MHz

Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ , Temp. =  $+25\text{ }^{\circ}\text{C}$ , on 650MHz to 850MHz Broadband Application Circuit



## Pin Configuration and Description



*Top View*

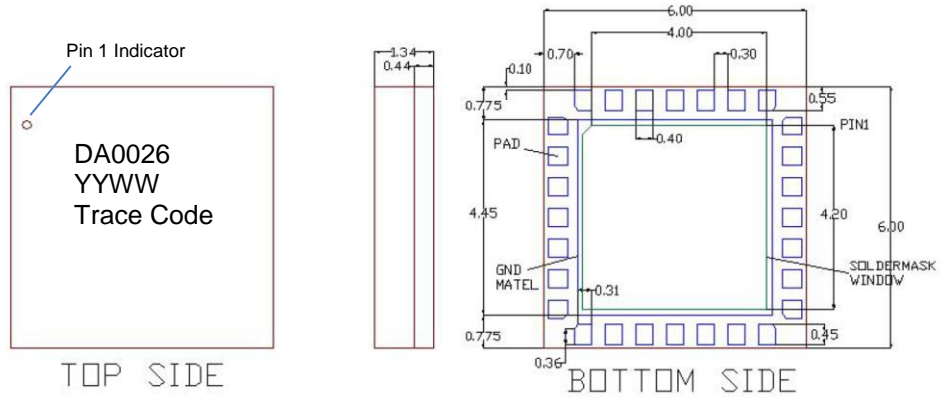
PIN NUMBER	LABEL	DESCRIPTION
1	SPI_LE	Serial Latch Enable Input
2	SPI_DATA	Serial Data Input
3	SPI_CLK	Serial Clock Input
4	PUP	Power-up Programming Pin
5	GND	RF/DC Ground Connection
6	RF_IN	RF Input, 50 Ω
7	GND	RF/DC Ground Connection
8	VCC_AMP1	Supply Voltage for Amplifier 1
9, 10, 11, 12, 13	GND	RF/DC Ground Connection
14	VCC_AMP2	Supply Voltage for Amplifier 2
15	GND	RF/DC Ground Connection
16	RF_OUT	RF Output 50 Ω
17, 18, 19, 20, 21	GND	RF/DC Ground Connection
22	NC	Do Not Connect, Leave Open Circuit
23, 24, 25, 26, 27	GND	RF/DC Ground Connection
28	VCC_SPI	Supply Voltage for SPI and DSA Chip
Backside Pad	GND	Ground/Thermal connection. The back side of the package should be connected to the ground plan though as short of a connection as possible. PCB vias under the device are required.

**Mechanical Information**

**Package Marking and Dimensions**

Marking: Part number – DA0026  
 Date Code: YY – Year; WW – Week  
 Trace Code: to be assigned by SubCon

6.0mmx6.0mm Laminate Module



The module thickness tolerance is: +/- .04mm. All other dim tolerances are +/- .075mm unless otherwise noted.

Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## Product Compliance Information

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### ESD Sensitivity Ratings



Caution! ESD sensitive device



#### ESD Rating: Class 1C

Value: Passes  $\geq$  1000V

Test: Human Body Model (HBM)

Standard: JEDEC Standard JS-001-2012

#### MSL Rating

MSL Rating: Level 3

Test: 260 °C convection reflow

Standard: JEDEC Standard IPC/JEDEC J-STD-020

## Solderability

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Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.

Package lead plating: Electrolytic plated Au over Ni

## RoHS Compliance

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This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead-free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free
- Qorvo Green



## Contact Information

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For the latest specifications, additional product information, worldwide sales and distribution locations:

**Web:** [www.qorvo.com](http://www.qorvo.com)

**Tel:** 1-844-890-8163

**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

For technical questions and application information

**Email:** [appsupport@qorvo.com](mailto:appsupport@qorvo.com)

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