

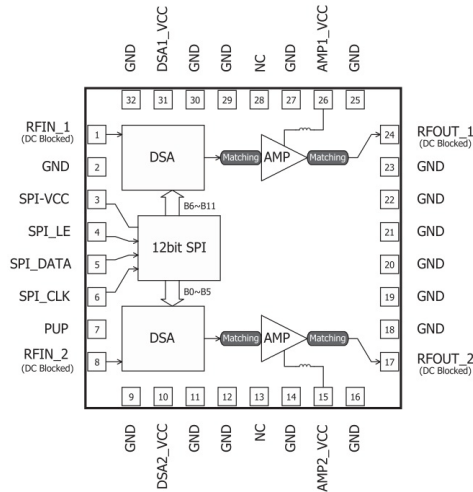


### Features

- Dual Channel VGA
- Frequency Range 400MHz to 2700MHz
- Full Internal Matching and No External Bias Inductors
- Two 6-Bit Digital Step Attenuators
- 12-Bit SPI Serial Control Programming
- High Channel Isolation = 50dBc
- Max Gain = 18.5dB at 900MHz
- Gain Control Range = 31.5dB (0.5dB Step Size)
- High OIP3/P1dB = +37dBm/19dBm at 900MHz
- Single + 5V Supply
- Small 32-Pin, 7.0mm x 7.0mm, MCM
- Power-up Programming

### Applications

- Cellular, 3G Infrastructure
- WiBro, WiMAX, LTE
- Microwave Radio
- High Linearity Power Control



Functional Block Diagram

### Product Description

RFMD's RFDA0057 is a dual-channel, digital controlled variable gain amplifier featuring high linearity over the entire gain control range with noise figure less than 7dB in its maximum gain state. The gains of two 6-bit digital step attenuators are programmed with a serial mode control interface (SPI). The RFDA0057 is packaged in a small 7.0mm x 7.0mm 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.

### Ordering Information

RFDA0057SR	7" Sample reel with 100 pieces
RFDA0057SQ	Sample bag with 25 pieces
RFDA0057TR7	7" Reel with 750 pieces
RFDA0057TR13	13" Reel with 2500 pieces
RFDA0057PCK-410	400MHz to 2700MHz PCBA with 5-piece sample bag

### Optimum Technology Matching® Applied

- |   |                                      |  |                                    |
|---|--------------------------------------|--|------------------------------------|
| <input type="checkbox"/> GaAs HBT             | <input type="checkbox"/> SiGe BiCMOS | <input checked="" type="checkbox"/> GaAs pHEMT | <input type="checkbox"/> GaN HEMT  |
| <input type="checkbox"/> GaAs MESFET          | <input type="checkbox"/> Si BiCMOS   | <input checked="" type="checkbox"/> Si CMOS    | <input type="checkbox"/> BIFET HBT |
| <input checked="" type="checkbox"/> InGaP HBT | <input type="checkbox"/> SiGe HBT    | <input type="checkbox"/> Si BJT                | <input type="checkbox"/> SOI       |

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## Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	+5.5	V <sub>DC</sub>
DS Supply Current	205	mA
Power Dissipation	1100	mW
Maximum Input RF Power	24	dBm
Operating Temperature (T <sub>CASE</sub> )	-40 to +85	°C
Storage Temperature	-40 to +150	°C
Junction Temperature	165	°C
ESD Rating (HBM)	1000 (Class 1C)	V
Moisture Sensitivity Level	MSL 3	

MTTF = 1.0E6 hours at 165 °C junction temperature



**Caution!** ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EU Directive 2011/65/EU (at time of this document revision).

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RFMD Green: RoHS compliant per EU Directive 2011/65/EU, halogen free per IEC 61249-2-21, < 1000 ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

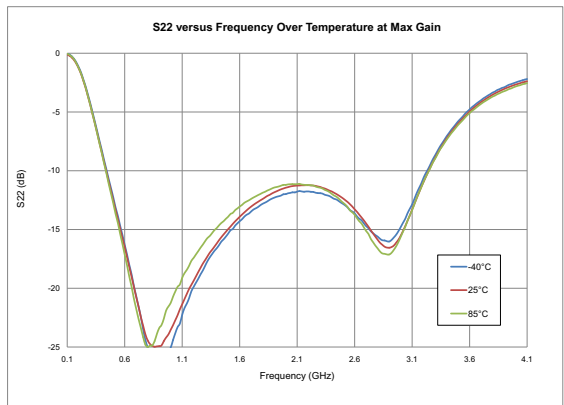
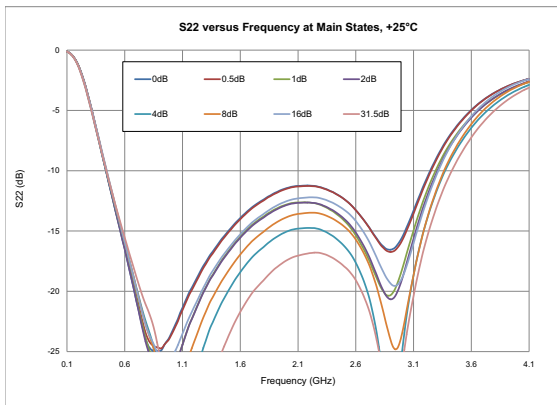
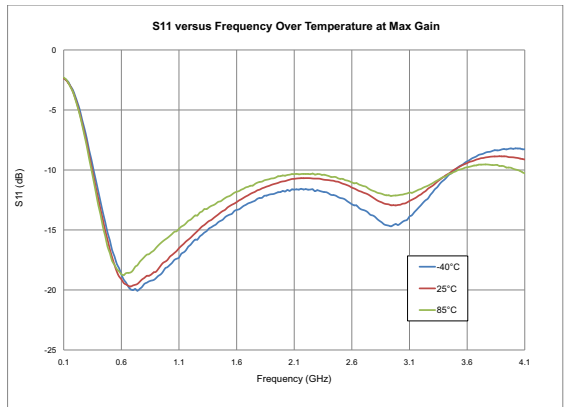
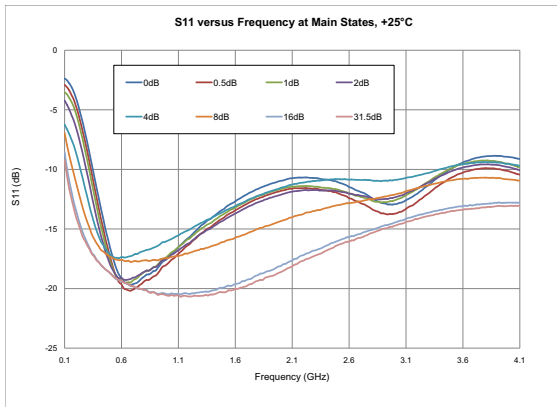
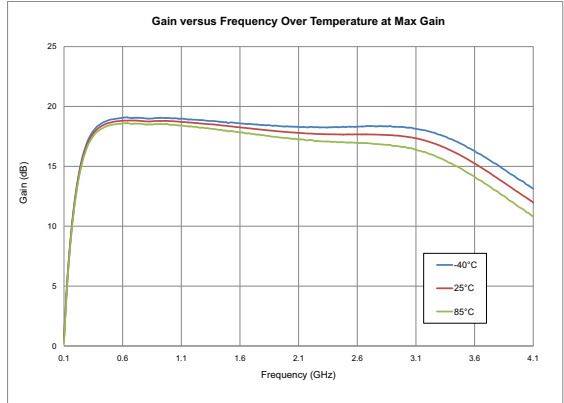
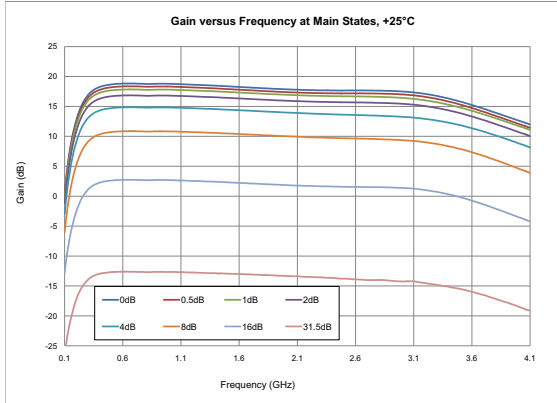
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall</b>					Temp = 25 °C, V <sub>CC</sub> = V <sub>DD</sub> = 5V, standard application circuit
Frequency	400		2700	MHz	
Max Gain		18.5		dB	Attenuation = 0dB
Gain Control Range		31.5		dB	
Step Accuracy	+/- (0.15+5% attenuation setting)			dB	Major state error up to 2700MHz
P1dB		19		dBm	Attenuation = 0dB at 900MHz
Output IP3		37		dBm	P <sub>OUT</sub> = 0dBm/tone, 1MHz spacing at 900MHz
Control Interface		12		bit	SPI interface
Settling Time		250		ns	t <sub>ON</sub> , t <sub>OFF</sub> (10%/90% RF)
Noise Figure		7		dB	Attenuation = 0dB
Channel-to-Channel Isolation		50		dB	Input at RFIN1 (or RFIN2), the isolation between two outputs
Impedance		50		Ω	
Input Return Loss		-15		dB	900MHz
Output Return Loss		-15		dB	900MHz
Total Supply Voltage	4.75	5.0	5.25	V	
Supply Current		155		mA	From V <sub>CC-SPI</sub> , V <sub>CC-AMP1</sub> and V <sub>CC-AMP2</sub>
Thermal Resistance		40		°C/W	Junction to backside of device

## Typical RF Performance at Key Operating Frequencies

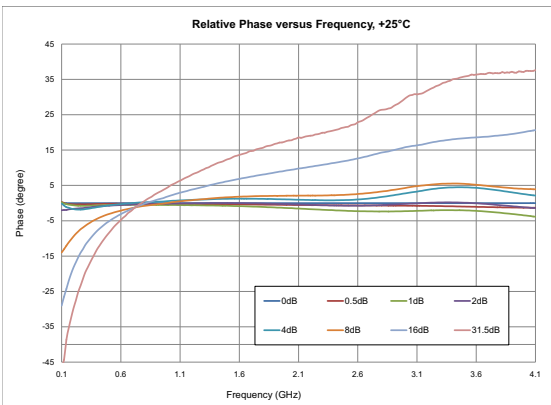
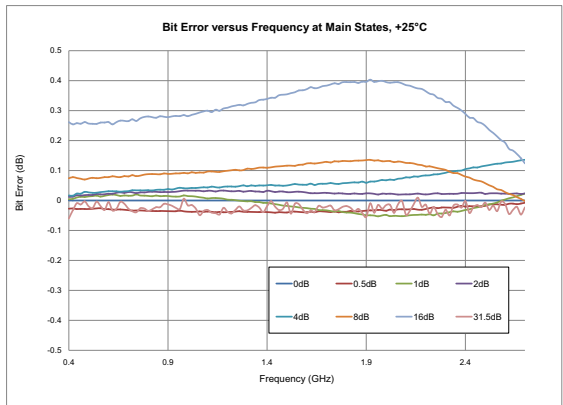
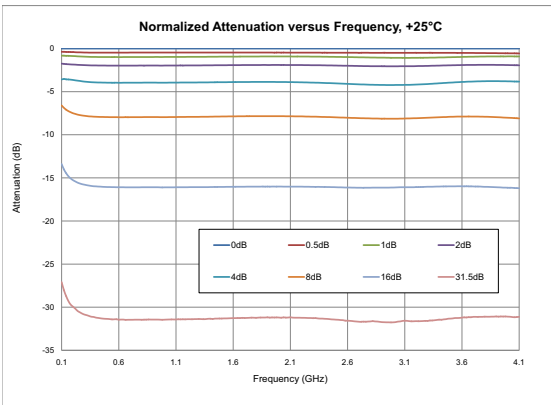
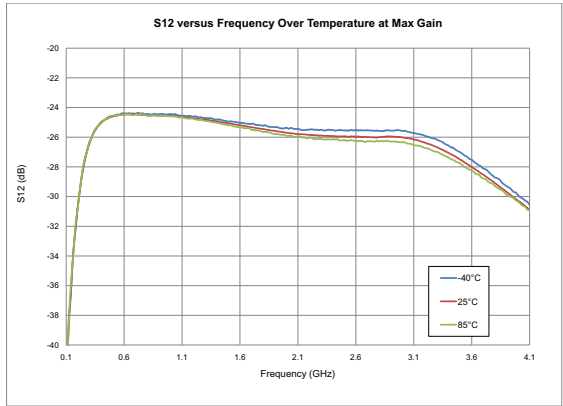
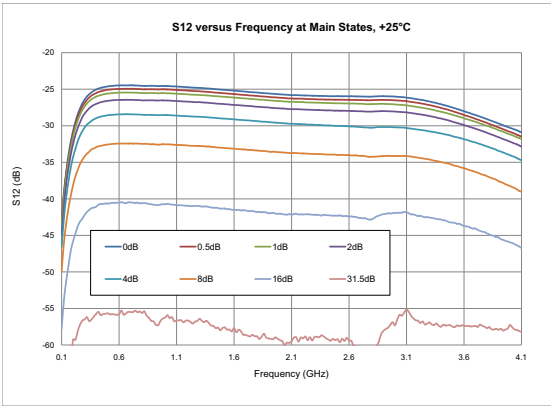
Parameter	Unit	700MHz	900MHz	1700MHz	2300MHz	2500MHz	2700MHz
Max Small Signal Gain	dB	18.5	18.5	18	17.5	17.5	17.5
Output P1dB	dBm	19	19	19	19	18.5	18.5
Output IP3*	dBm	38	37	34.5	32.5	32	31.5
Noise Figure	dB	5.7	5.7	6.5	7	6.9	7.2

\*Note: OIP3 is tested at P<sub>OUT</sub> = 0dBm/Tone and 1MHz spacing

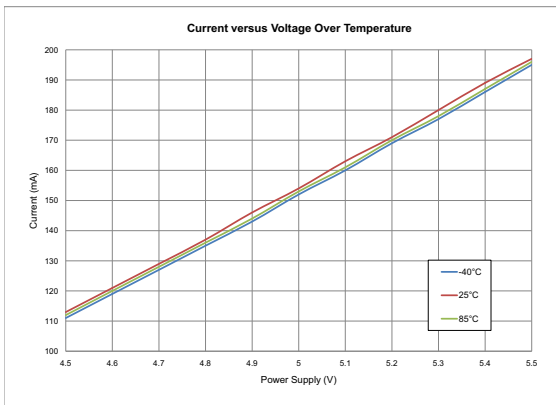
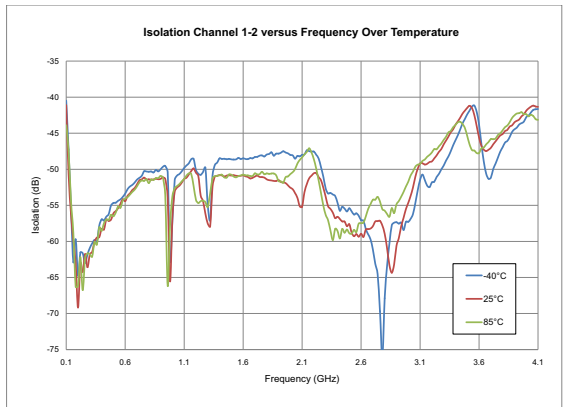
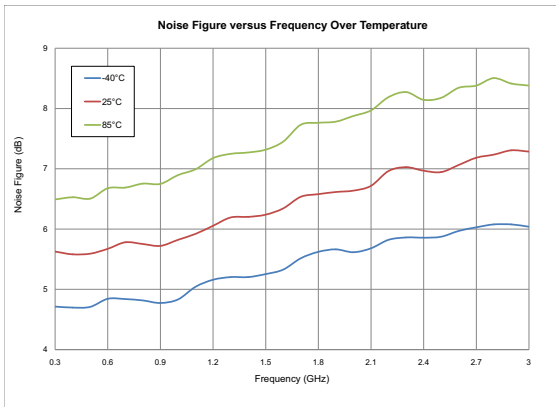
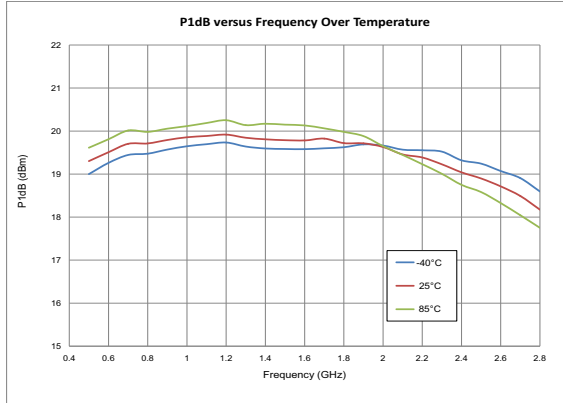
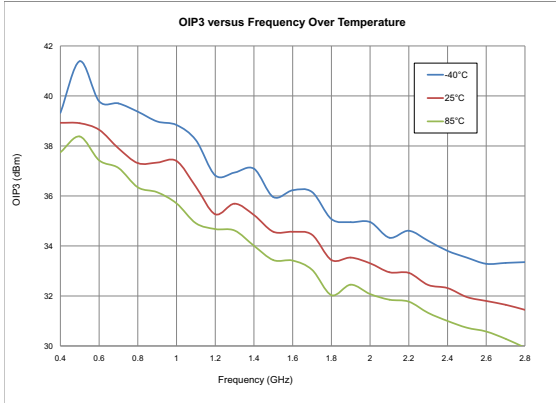
## Typical Broadband Performance $V_{CC} = 5.0V$ , $I_{CC} = 155mA$



## Typical Broadband Performance $V_{CC} = 5.0V$ , $I_{CC} = 155mA$



## Typical Broadband Performance $V_{CC} = 5.0V$ , $I_{CC} = 155mA$



## Truth Table

Channel 1 Control Bit						Gain Relative to Maximum Gain
D11	D10	D9	D8	D7	D6	
1	1	1	1	1	1	0dB
1	1	1	1	1	0	-0.5dB
1	1	1	1	0	1	-1dB
1	1	1	0	1	1	-2dB
1	1	0	1	1	1	-4dB
1	0	1	1	1	1	-8dB
0	1	1	1	1	1	-16dB
0	0	0	0	0	0	-31.5dB

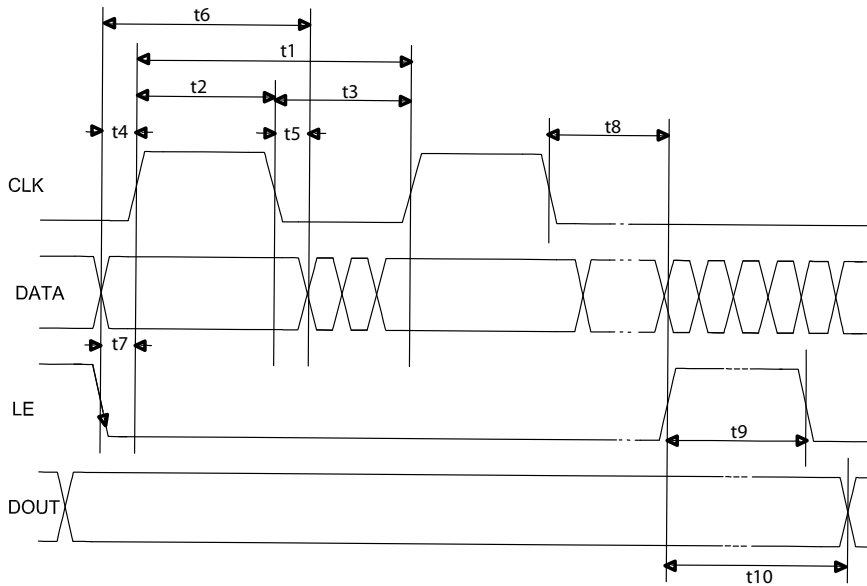
Channel 2 Control Bit						Gain Relative to Maximum Gain
D5	D4	D3	D2	D1	D0	
1	1	1	1	1	1	0dB
1	1	1	1	1	0	-0.5dB
1	1	1	1	0	1	-1dB
1	1	1	0	1	1	-2dB
1	1	0	1	1	1	-4dB
1	0	1	1	1	1	-8dB
0	1	1	1	1	1	-16dB
0	0	0	0	0	0	-31.5dB

Power-up Programming Truth Table	
PUP	Attenuator Setting
High	Attenuation at min, 0dB
Low	Attenuation at max, 31.5dB

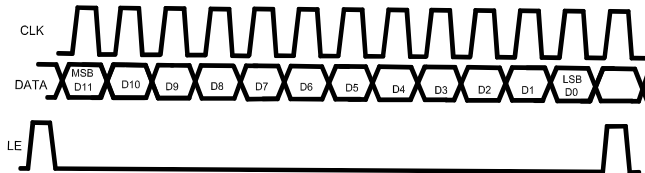
Logic Voltage Levels	
State	Logic
Low	0V to 0.8V
High	2.0V to 5.0V

## Serial Port Interface

### SPI Timing Diagram



### Programming Example - 12 Bit



### SPI Timing Diagram Specifications

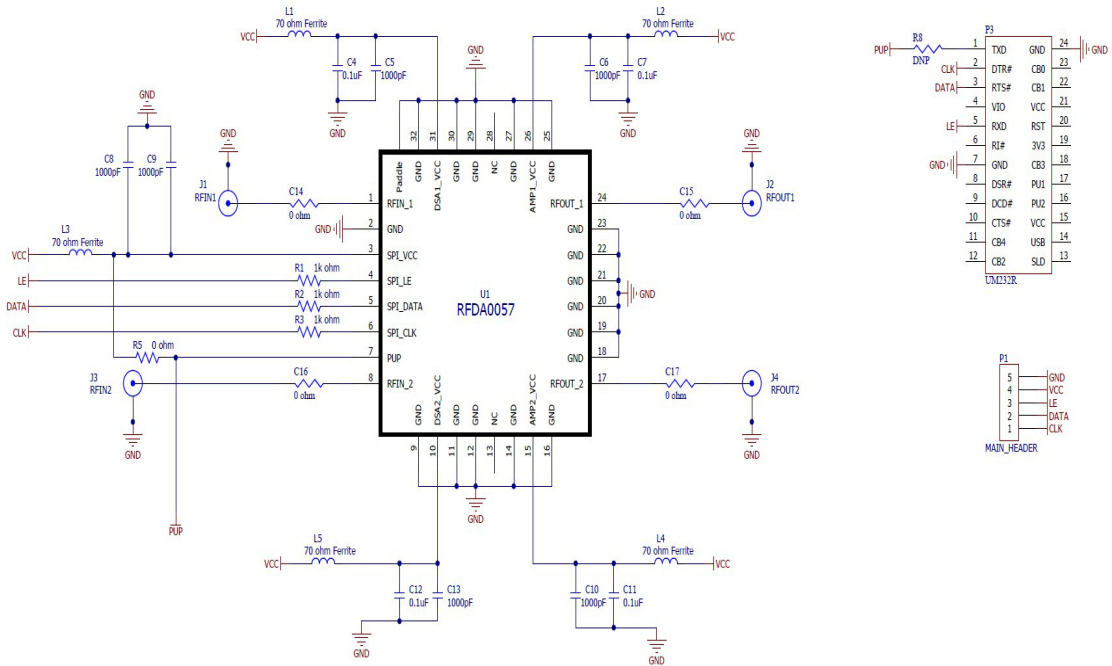
Parameter	Limit	Unit	Comment
$t_1$	25	MHz max	CLK Frequency
$t_2$	20	ns min	CLK High
$t_3$	20	ns min	CLK Low
$t_4$	5	ns min	DATA to CLK Setup Time
$t_5$	5	ns min	DATA to CLK Hold Time
$t_6$	30	ns min	DATA Valid
$t_7$	5	ns min	LE to CLK Setup Time
$t_8$	5	ns min	CLK to LE Setup Time
$t_9$	10	ns min	LE Pulse Width
$t_{10}$	20	ns max	Output Set

### Pin Names and Descriptions

Pin	Name	Description
1	<b>RFIN_1</b>	AMP 1 RF Input
2	<b>GND</b>	RF/DC Ground Connection
3	<b>SPI_VCC</b>	Supply Voltage for SPI Chip
4	<b>SPI_LE</b>	Serial Latch Enable Input
5	<b>SPI_DATA</b>	Serial Data Input
6	<b>SPI_CLK</b>	Serial Clock Input
7	<b>PUP</b>	Power-up Programming Pin
8	<b>RFIN_2</b>	AMP 2 RF Input
9	<b>GND</b>	RF/DC Ground Connection
10	<b>DSA2_VCC</b>	Supply Voltage for DSA2 Chip
11	<b>GND</b>	RF/DC Ground Connection
12	<b>GND</b>	RF/DC Ground Connection
13	<b>NC</b>	No Connect
14	<b>GND</b>	RF/DC Ground Connection
15	<b>AMP2_VCC</b>	Supply Voltage for Amplifier 2
16	<b>GND</b>	RF/DC Ground Connection
17	<b>RFOUT_2</b>	AMP 2 RF Output
18	<b>GND</b>	RF/DC Ground Connection
19	<b>GND</b>	RF/DC Ground Connection
20	<b>GND</b>	RF/DC Ground Connection
21	<b>GND</b>	RF/DC Ground Connection
22	<b>GND</b>	RF/DC Ground Connection
23	<b>GND</b>	RF/DC Ground Connection
24	<b>RFOUT_1</b>	AMP 1 RF Output
25	<b>GND</b>	RF/DC Ground Connection
26	<b>AMP1_VCC</b>	Supply Voltage for Amplifier 1
27	<b>GND</b>	RF/DC Ground Connection
28	<b>NC</b>	No Connect
29	<b>GND</b>	RF/DC Ground Connection
30	<b>GND</b>	RF/DC Ground Connection
31	<b>DSA1_VCC</b>	Supply Voltage for DSA1 Chip
32	<b>GND</b>	RF/DC Ground Connection



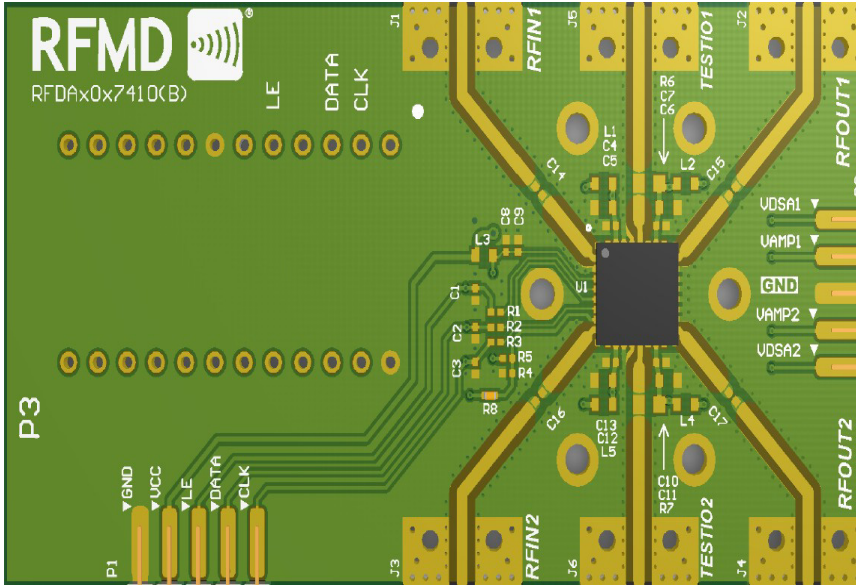
## Evaluation Schematic - 400MHz to 2700MHz Application Circuit



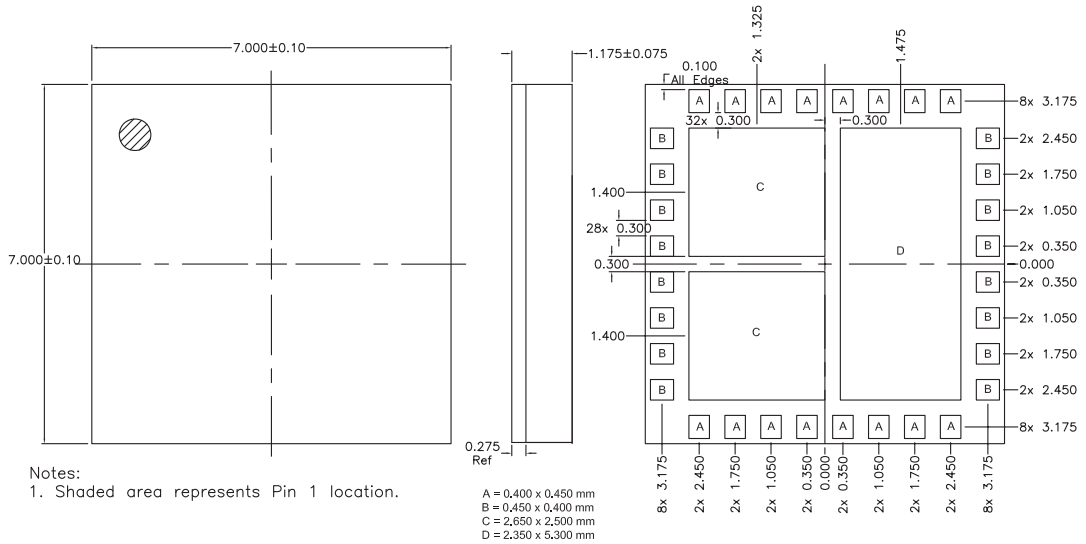
## Evaluation Board Build of Materials 400MHz to 2700MHz Application Circuit

Description	Reference Designator	Manufacturer	Manufacturer's P/N
RFDAx0x7, PCB		DDI	RFDAx0x7410
RFDA0057SB	U1	RFMD	RFDA0057
RES, 0Ω, 0402	C14-C17, R5	Kamaya, Inc	RMC1/16SJPTH
CAP, 1000pF, 10%, 50V, X7R, 0402	C1-C3, C5-C6, C8-C10, C13	Murata Electronics	GRM155R71H102KA01E
CAP, 0.1μF, 10%, 16V, X7R, 0603	C4, C7, C11-C12	Murata Electronics	GRM188R71C104KA01D
FER, BEAD, 70Ω, 4A, 0603	L1-L5	Murata Electronics	BLM18SG700TN1D
RES, 1K, 5%, 1/16W, 0402	R1-R3	KOA Speer	RK73B1ETTP102J
CONN, SMA, END LNCH, RND PIN, 0.059"	J1-J4	Gigalane	PSF-S01-006
CONN, HDR, ST, PLRZD, 5-PIN, 0.100"	P1	ITW Pancon	MPSS100-5-C

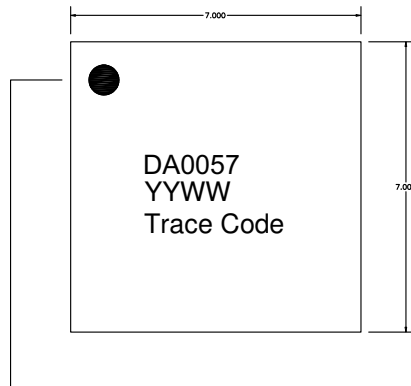
## Evaluation Board Assembly Drawing 400MHz to 2700MHz Application Circuit



## Package Drawing 7.0mm x 7.0mm Laminate Module



## Branding Drawing



Pin 1 Indicator

Fill in the YYWW Notation with the Date Code

YY = Year

WW = Week

Trace Code to be assigned by SubCon