

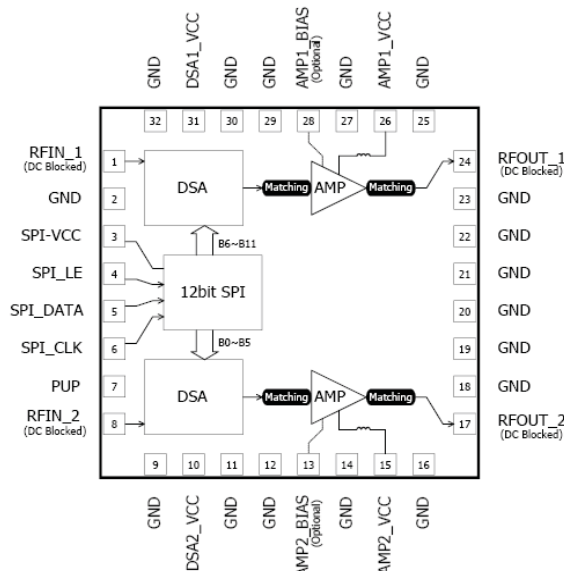


Features

- Dual Channel VGA
- Frequency Range 1700MHz to 2400MHz
- 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=12.2dB@1800MHz
- Gain Control Range=31.5dB (0.5dB step size)
- High OIP3/P1dB= +41/24.5dBm @1800MHz
- Single +5V Supply
- Small 32-Pin, 7.0mmx7.0mm, MCM
- Power Up Programming

Applications

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



Functional Block Diagram

Product Description

RFMD's RFDA2077 is a dual channel digital controlled variable gain amplifier featuring high linearity over the entire gain control range with noise figure less than 6.5dB in its maximum gain state. The gains of two 6 bit digital step attenuators are programmed with a serial mode control interface (SPI). The RFDA2077 is packaged in a small 7.0mmX7.0mm 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

RFDA2077TR13	13" Reel with 2500 pieces
RFDA2077TR7	7" Reel with 750 pieces
RFDA2077SR	7" Sample Reel with 100 pieces
RFDA2077SQ	Sample bag with 25 pieces
RFDA2077PCK-410	1700MHz to 2400MHz PCBA with 5-piece sample bag

Optimum Technology Matching® Applied

☒ GaAs HBT	☐ SiGe BiCMOS	☒ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	☒ Si CMOS	☐ BiFET HBT
☐ InGaP HBT	☐ SiGe HBT	☐ Si BJT	☐ LDMOS

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	+5.5	V _{DC}
DC Supply Current	480	mA
Power Dissipation	2700	mW
Max RF Input Power	20	dBm
Operating Temperature (Tcase)	-40 to +85	°C
Storage Temperature	-40 to +150	°C
Junction Temperature	150	°C
ESD Rating (HBM)	500 (Class 1B)	V
Moisture Sensitivity Level	MSL3	



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.

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RFMD Green: RoHS compliant per EU Directive 2002/95/EC, halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

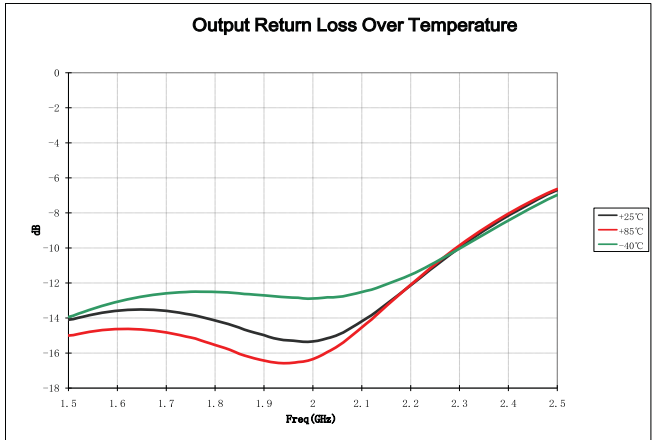
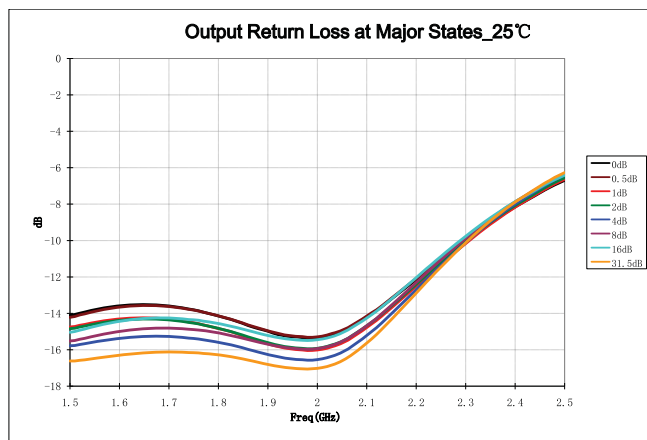
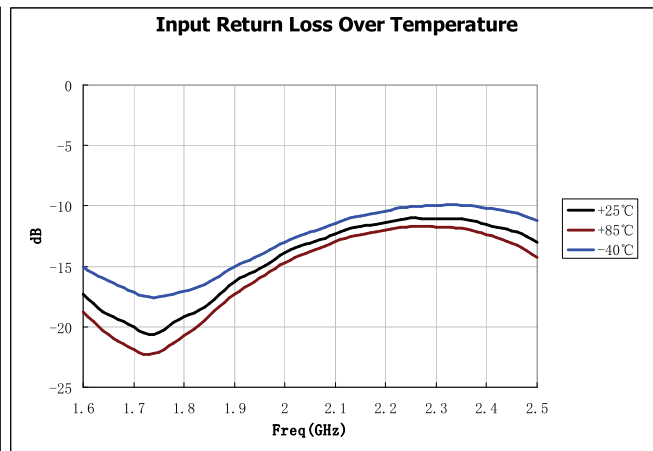
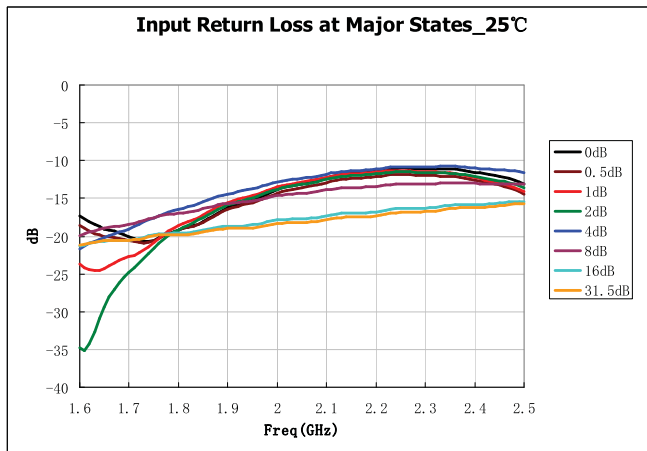
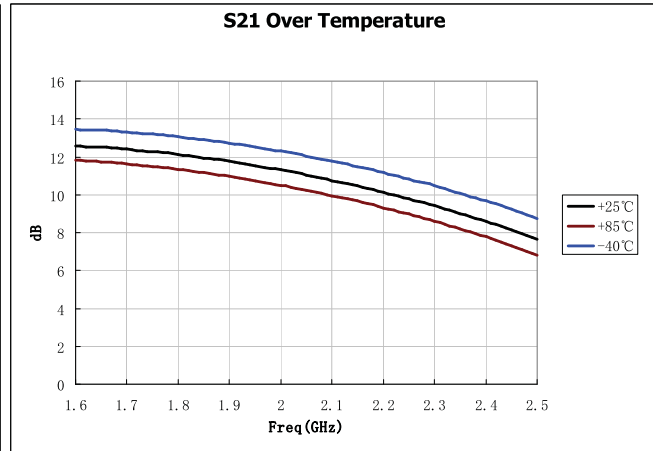
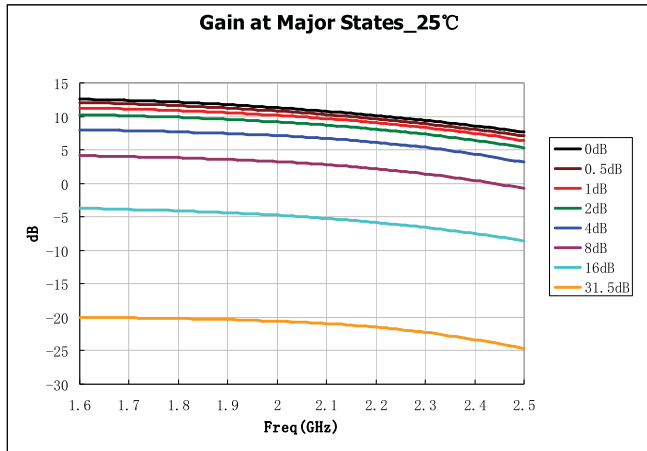
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall					T=25 °C, V _{CC} =V _{DD} =5V, standard application circuit.
Frequency Range	1700		2400	MHz	
Max Gain		12.0		dB	Attenuation=0dB
Gain Control Range		31.5		dB	
Step Accuracy	+/- (0.2+5% attenuation setting)			dB	Major state error up to 2700MHz
P1dB		24.5		dBm	Attenuation=0dB @ 1800MHz
Output IP3		41		dBm	P _{OUT} =5dBm/tone, 1MHz spacing @ 1800MHz
Control Interface		12		bit	SPI interface
Settling Time		250		ns	t _{ON} , t _{OFF} (10%/90% RF)
Noise Figure		7		dB	Attenuation=0dB
Channel-to-channel		50		dB	Input at RFIN1 (or RFIN2), the isolation between two channels
Impedance		50		Ω	
Input Return Loss		-18		dB	1800MHz
Output Return Loss		-13		dB	1800MHz
Total Supply Voltage	4.75	5.0	5.25	V	
Supply Current		220		mA	From Vcc_SPI, Vcc_AMP1 and Vcc_AMP2
Thermal Resistance		44		°C/W	

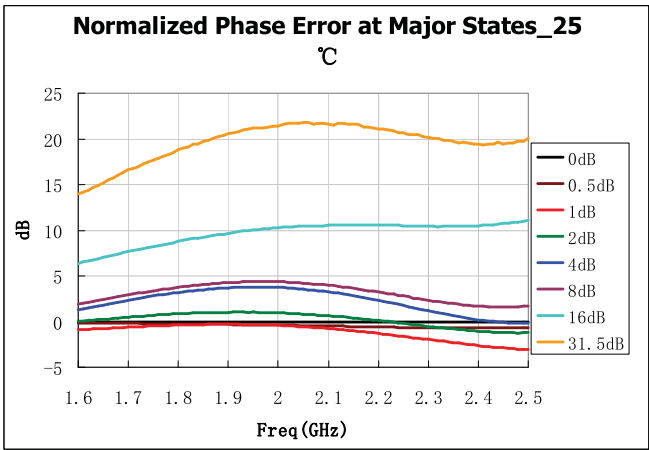
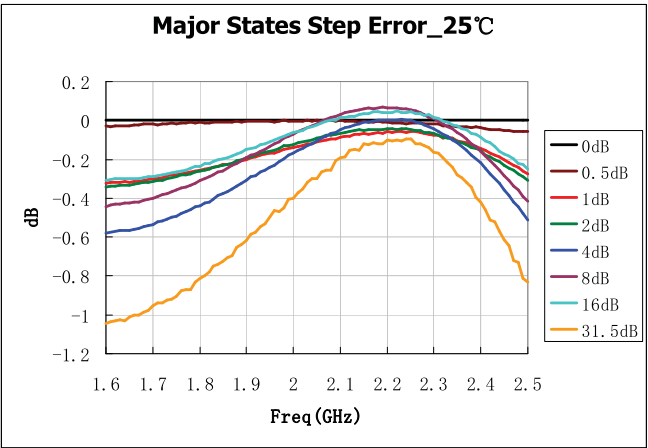
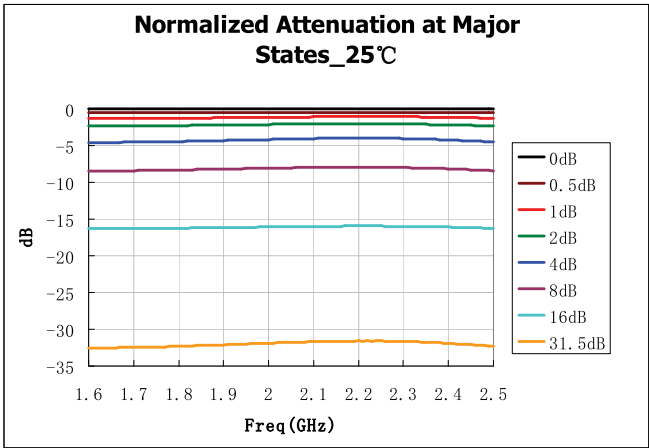
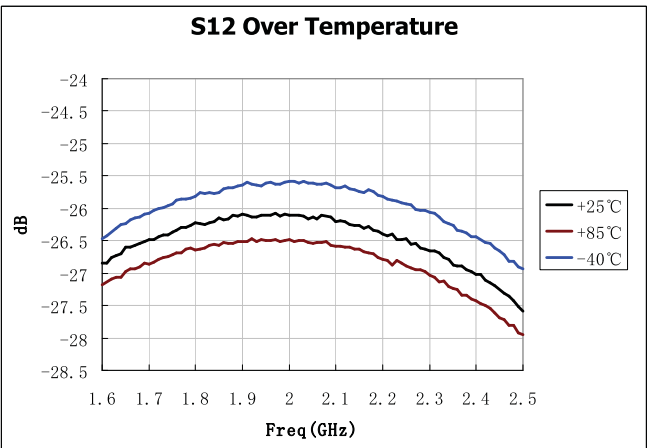
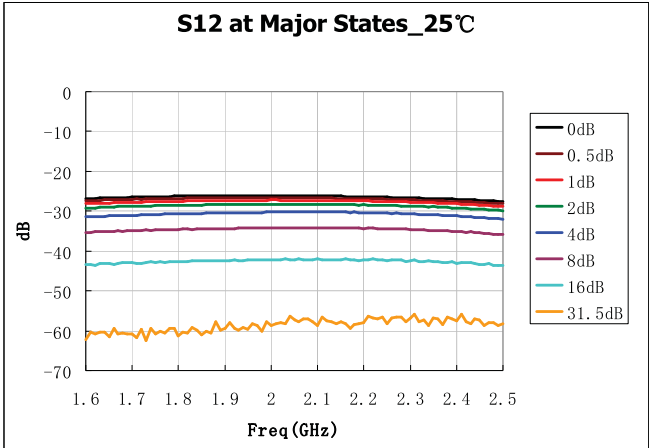
Typical RF Performance at Key Operating Frequencies

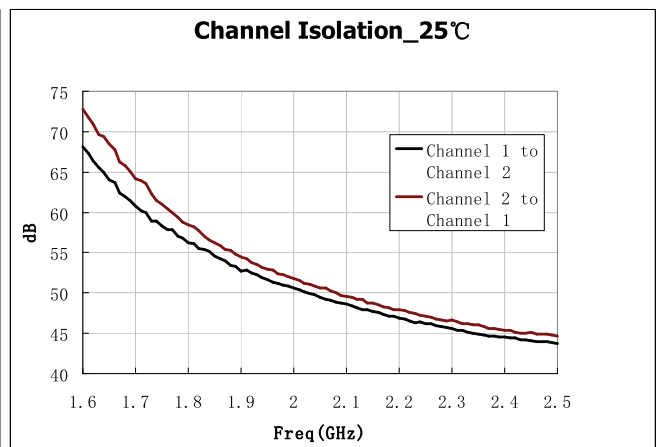
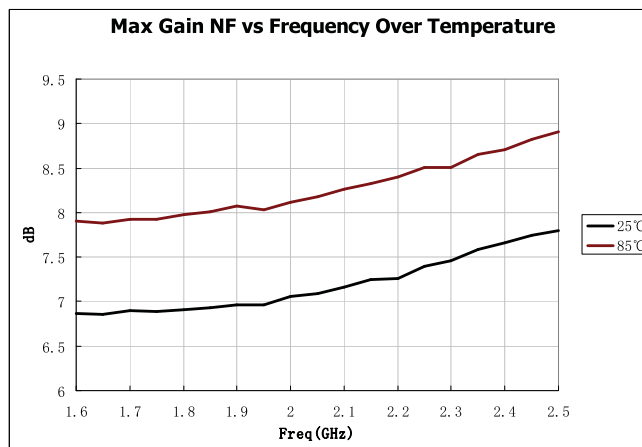
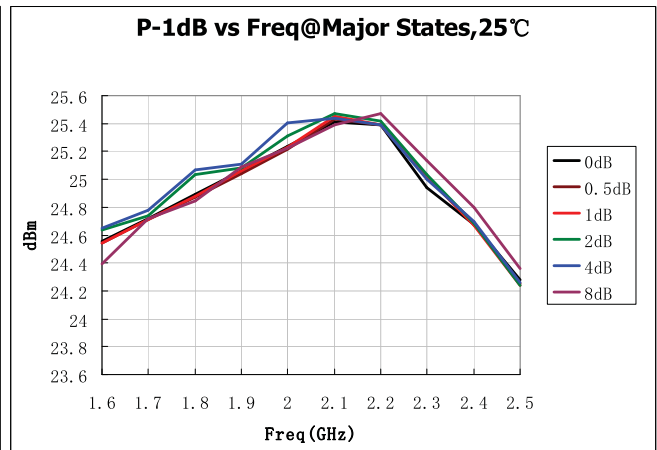
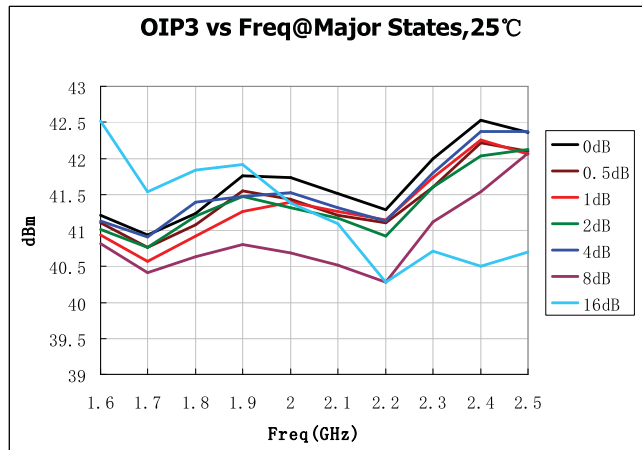
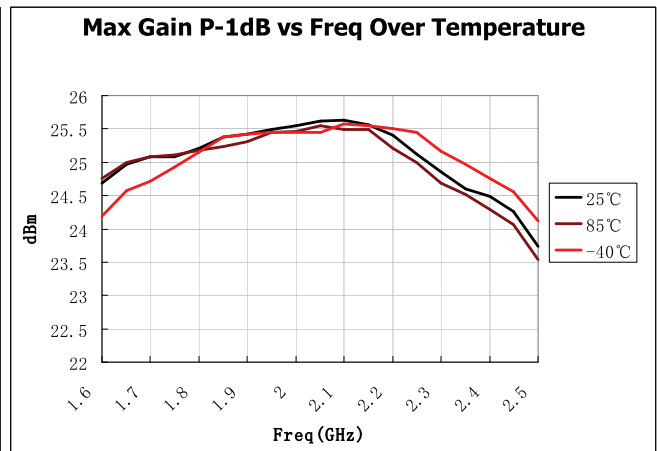
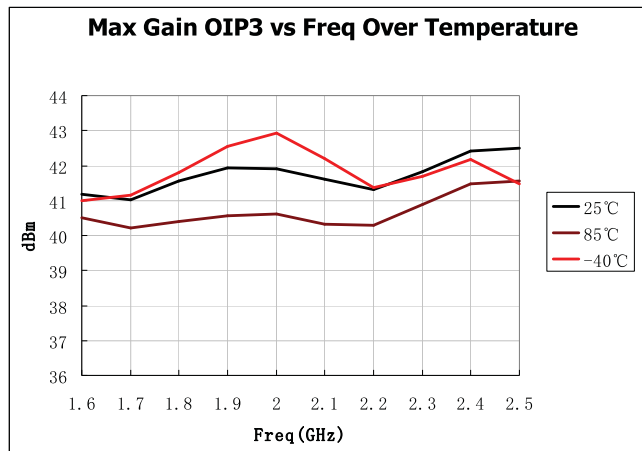
Parameter	Unit	1700MHz	1800MHz	1900MHz	2000MHz	2100MHz	2300MHz
Max Small Signal Gain	dB	12.4	12.2	11.8	11.3	10.8	9.5
Output P1dB	dBm	24.7	24.8	25	25.2	25.4	24.9
Output IP3 [1]	dBm	41	41.2	41.7	41.7	41.5	42
Noise Figure	dB	6.8	6.9	6.9	7.0	7.1	7.5

Note: [1] OIP3 is tested at P_{OUT}=5dBm/Tone and 1MHz spacing

Typical Broadband Performance $V_{CC}=5.0V$, $I_{CC}=220mA$







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

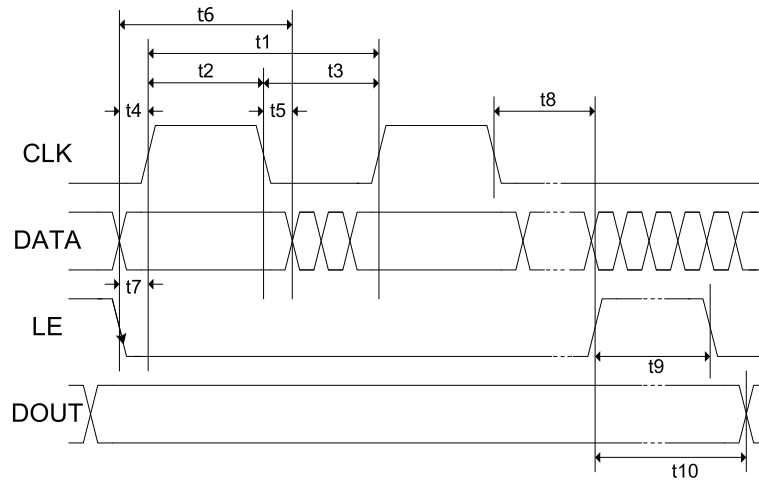
Channel 2 Control Bit						Gain Relative to Maximum Gain
D5	D4	D3	D2	D1	D0	
1	1	1	1	1	1	0dB
1	1	1	1	1	0	-0.5dB
1	1	1	1	0	1	-1dB
1	1	1	0	1	1	-2dB
1	1	0	1	1	1	-4dB
1	0	1	1	1	1	-8dB
0	1	1	1	1	1	-16dB
0	0	0	0	0	0	-31.5dB

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

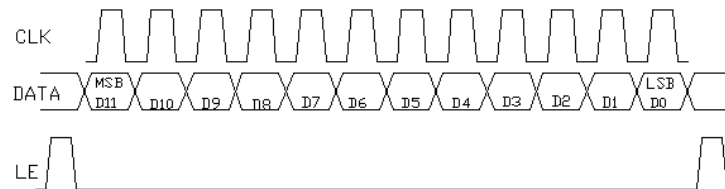
Serial Port Interface:

SPI Timing Diagram



Programming Example - 12-Bit

Programming Example - 12 Bit



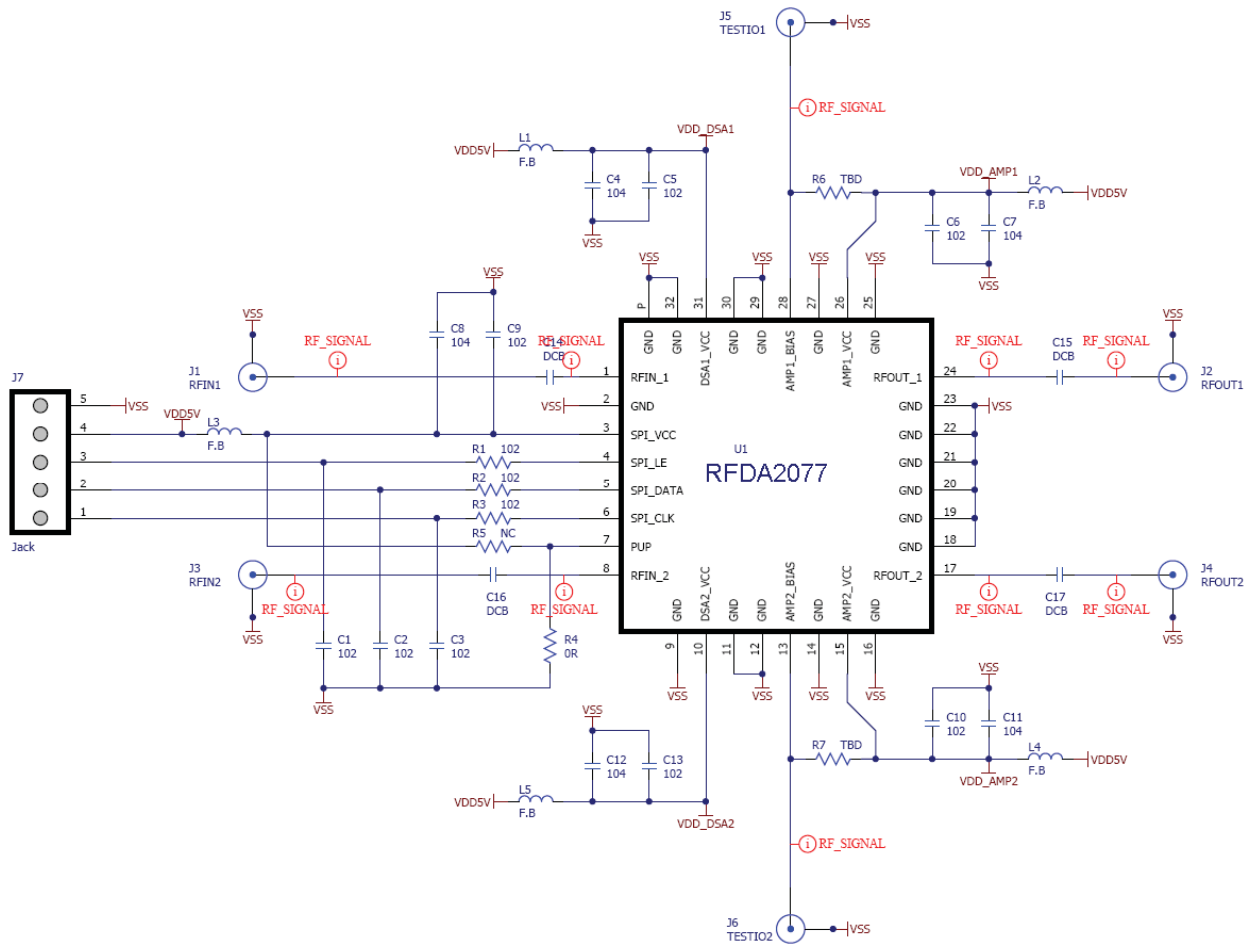
SPI Timing Diagram Specifications

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	Function	Description
1	RFIN_1	AMP 1 RF Input
2	GND	RF/DC Ground Connection
3	SPI_VCC	Supply Voltage for SPI Chip
4	SPI_LE	Serial Latch Enable Input
5	SPI_DATA	Serial Data Input
6	SPI_CLK	Serial Clock Input
7	PUP	Power-up Programming Pin
8	RFIN_2	AMP 2 RF Input
9	GND	RF/DC Ground Connection
10	DSA2_VCC	Supply Voltage for DSA2 Chip
11	GND	RF/DC Ground Connection
12	GND	RF/DC Ground Connection
13	AMP2_BIAS	AMP2 Bias Current Control PIN
14	GND	RF/DC Ground Connection
15	AMP2_VCC	Supply Voltage for Amplifier 2
16	GND	RF/DC Ground Connection
17	RFOUT_2	AMP 2 RF Output
18	GND	RF/DC Ground Connection
19	GND	RF/DC Ground Connection
20	GND	RF/DC Ground Connection
21	GND	RF/DC Ground Connection
22	GND	RF/DC Ground Connection
23	GND	RF/DC Ground Connection
24	RFOUT_1	AMP 1 RF Output
25	GND	RF/DC Ground Connection
26	AMP1_VCC	Supply Voltage for Amplifier 1
27	GND	RF/DC Ground Connection
28	AMP1_BIAS	AMP1 Bias Current Control PIN
29	GND	RF/DC Ground Connection
30	GND	RF/DC Ground Connection
31	DSA1_VCC	Supply Voltage for DSA1 Chip
32	GND	RF/DC Ground Connection

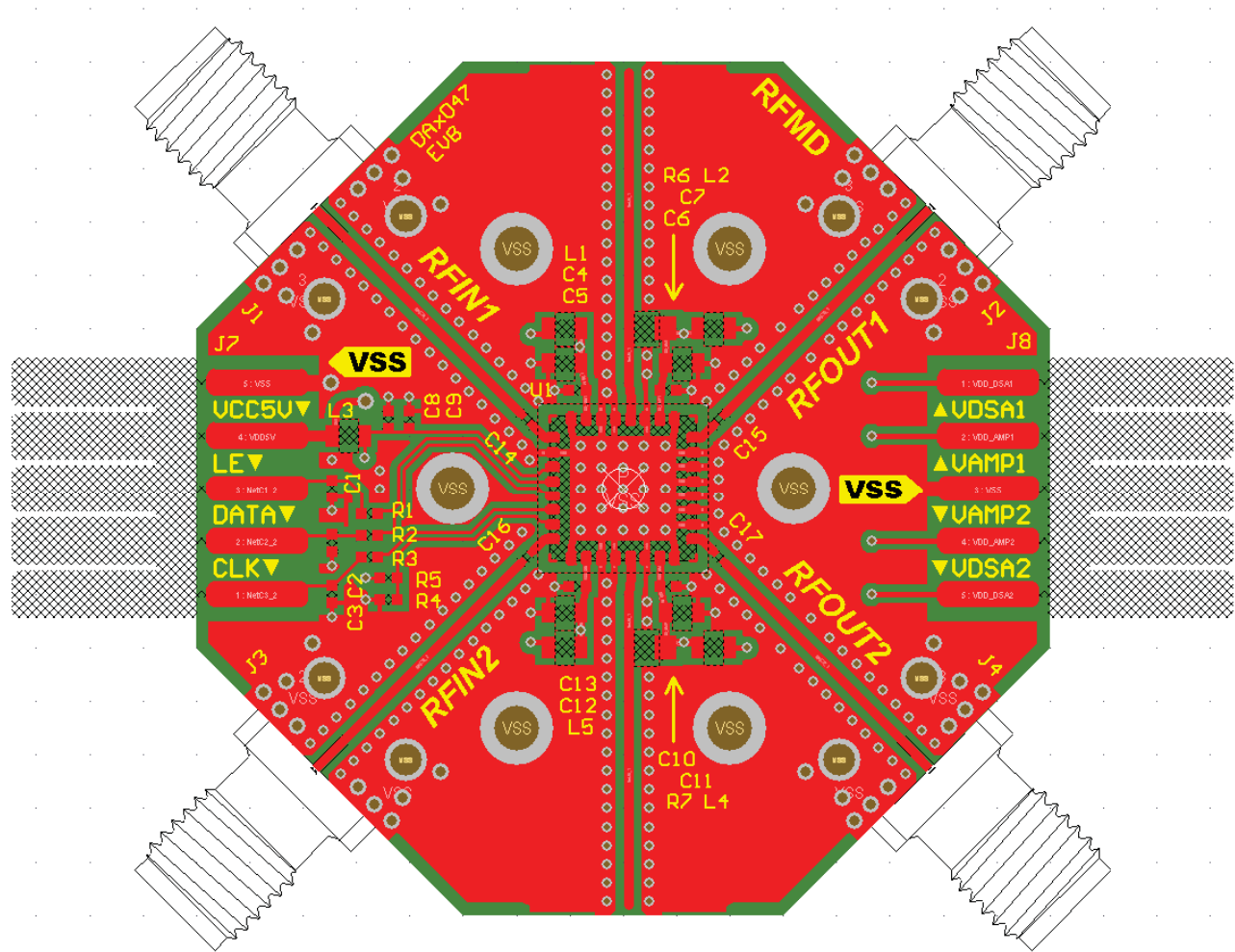
Evaluation Schematic - 1700MHz to 2400MHz Application Circuit



Bill of Materials - 1700MHz to 2400MHz Application Circuit

Reference Designator	Description/Value	Quantity
L1-5	RES, 0Ω, 0603	5
R1-3, R5	RES, 1kΩ, 0402	4
C14-17	RES, 0Ω, 0402	4
C1-13, R4, 6-7	No connection	16

Evlauation PCB - 1700MHz to 2400MHz Application Circuit



Package Drawing 7.0mmx7.0mm Laminate Module

