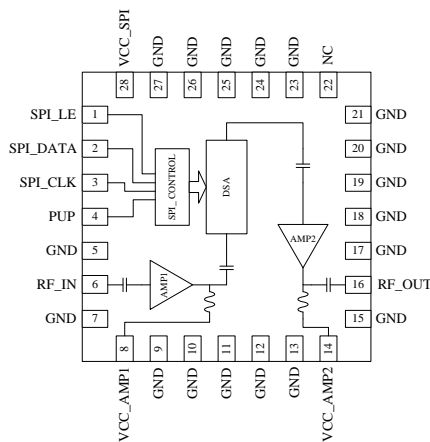


RFDA2046

Digital Controlled Variable Gain Amplifier
1800MHz to 2800MHz

The RFDA2046 is a digital controlled variable gain amplifier featuring high linearity over the entire gain control range with noise figure less than 5.2dB in its maximum gain state. The gain of the 6-bit digital step attenuator is programmed with a serial mode control interface (SPI). The RFDA2046 is packaged in a small 6.0mm x 6.0mm leadless laminate MCM, which contains plated through thermals vias for ultra-low thermal resistance. This module is easy to use with no external matching components required.



Functional Block Diagram

Ordering Information

| | |
|-----------------|---|
| RFDA2046SQ | Sample bag with 25 pieces |
| RFDA2046SR | 7" Reel with 100 pieces |
| RFDA2046TR7 | 7" Reel with 500 pieces |
| RFDA2046TR13 | 13" Reel with 2500 pieces |
| RFDA2046PCK-410 | 1800MHz to 2800MHz PCBA with 5-piece sample bag |



Package: MCM, 28-Pin,
6.0mm x 6.0mm

Features

- Frequency Range 1800MHz to 2800MHz
- Full Internal Matching and No External Bias Inductors
- 6-Bit Digital Step Attenuator
- SPI Serial Control Programming
- Max gain = 41dB at 2.6GHz
- Gain Control Range = 31.5dB (0.5dB Step Size)
- High OIP3/P1dB = +41dBm/ 28dBm
- Single +5V Supply
- Small 28-Pin, 6.0mm x 6.0mm, MCM
- Power-up Programming

Applications

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

Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|-----------------|-----------------|
| Supply Voltage | +5.5 | V _{DC} |
| DC Supply Current | 760 | mA |
| Power Dissipation | 3200 | mW |
| Max RF Input Power for Long Term Operation (50Ω) | -5 | dBm |
| Max RF Input Power for Short Term Operation (50Ω) | +20 | dBm |
| Operating Temperature (T _{CASE}) | -40 to +85 | °C |
| Storage Temperature | -40 to +150 | °C |
| Junction Temperature | +165* | °C |
| ESD Rating (HBM) | 1000 (Class 1C) | V |
| Moisture Sensitivity Level | MSL3 | |

*MTTF = 1.0E6 hours at 165°C junction temperature



Caution! ESD sensitive device.



RoHS (Restriction of Hazardous Substances): Compliant per EU Directive 2011/65/EU

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.

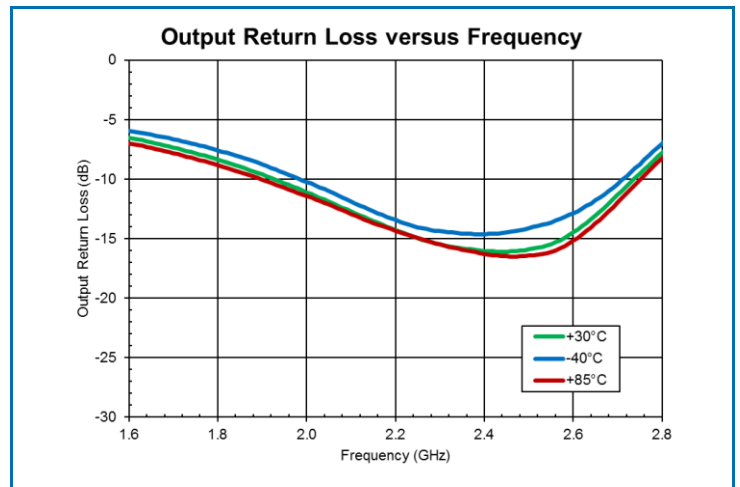
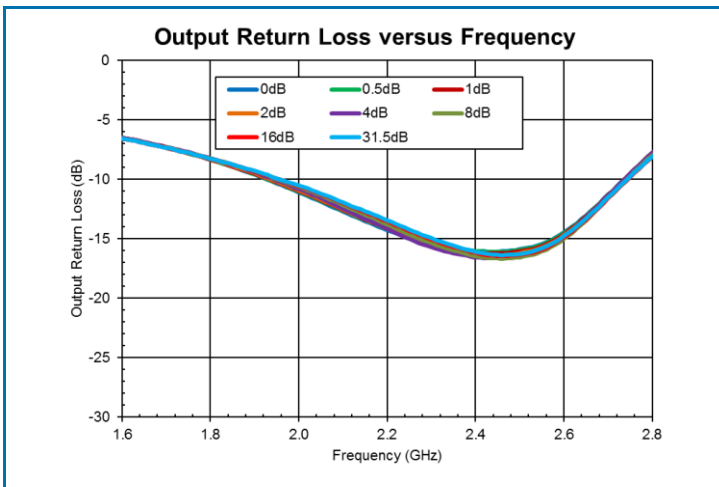
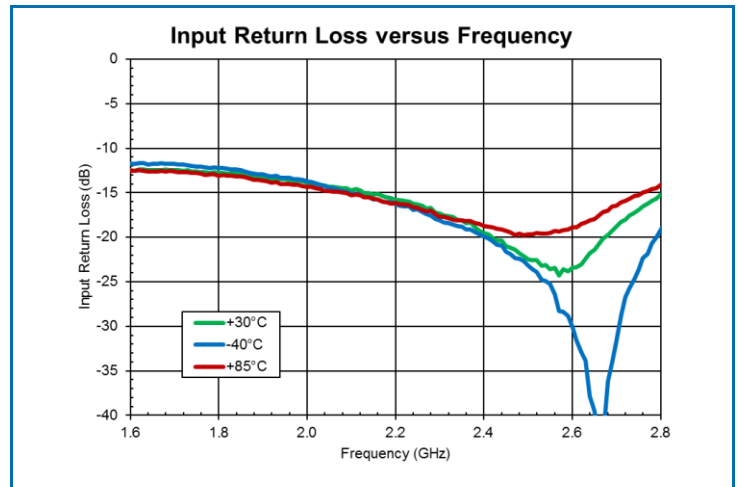
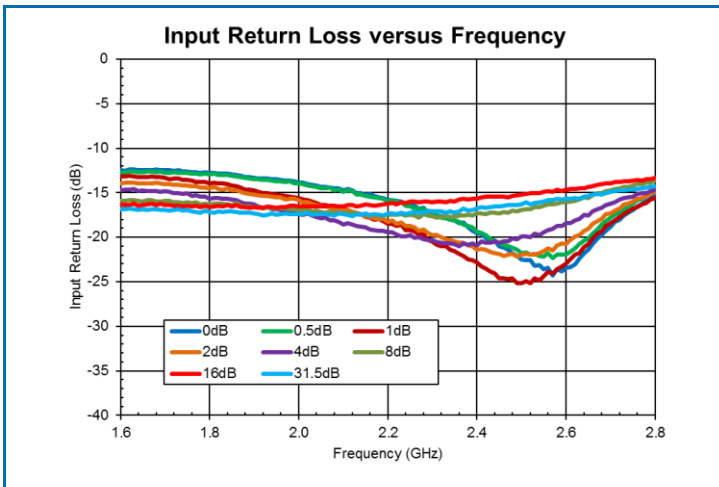
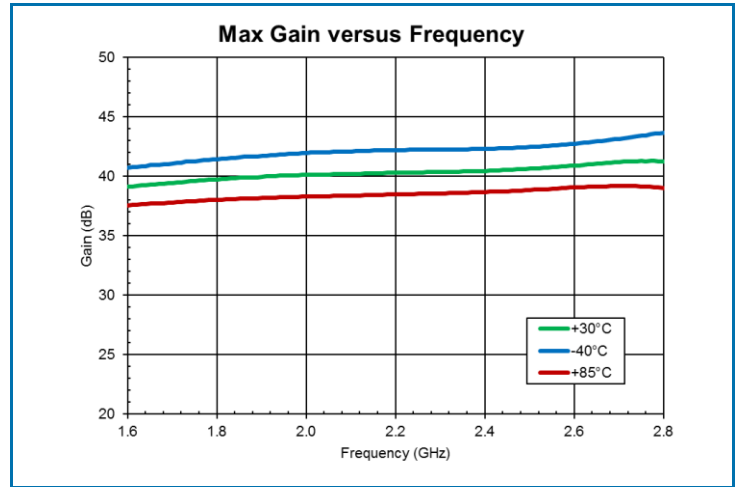
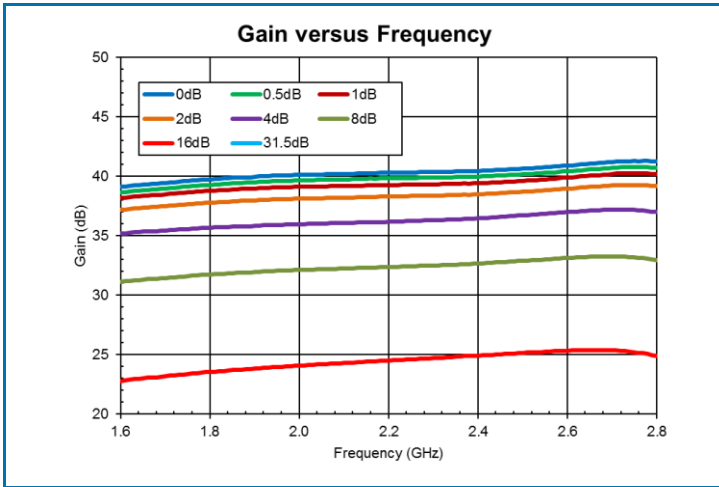
| Parameter | Specification | | | Unit | Condition |
|----------------------|----------------------------------|------|------|------|--|
| | Min | Typ | Max | | |
| Overall | | | | | T = 25°C, V_{CC} = V_{DD} = 5V, standard application circuit, measured at 2600MHz |
| Frequency Range | 1800 | | 2800 | MHz | |
| Max Gain | | 41 | | dB | Attenuation = 0dB |
| Gain Control Range | | 31.5 | | dB | |
| Step Accuracy | +/- (0.1+5% attenuation setting) | | | dB | Major state error up to 2800MHz |
| P1dB | | 28 | | dBm | Attenuation = 0dB |
| Output IP3 | | 41 | | dBm | P _{OUT} = 19dBm/tone, 1MHz spacing |
| Control Interface | | 6 | | Bit | SPI interface |
| Settling Time | | 250 | | ns | t _{ON} , t _{OFF} (10%/90% RF) |
| Noise Figure | | 5.2 | | dB | Attenuation = 0dB |
| Impedance | | 50 | | Ω | |
| Input Return Loss | | 15 | | dB | |
| Output Return Loss | | 12 | | dB | |
| Total Supply Voltage | 4.75 | 5 | 5.25 | V | |
| Supply Current | | 360 | | mA | From V _{CC_SPI} , V _{CC_AMP1} and V _{CC_AMP2} |
| Thermal Resistance | | 17.7 | | °C/W | Junction to backside of device |

Typical RF Performance at Key Operating Frequencies

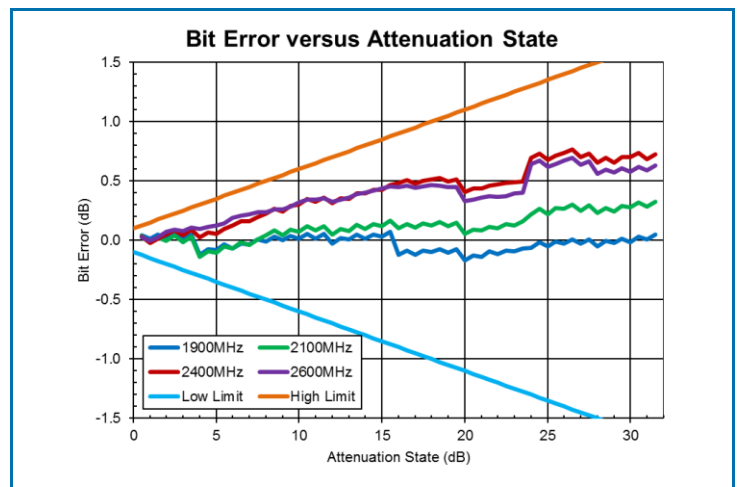
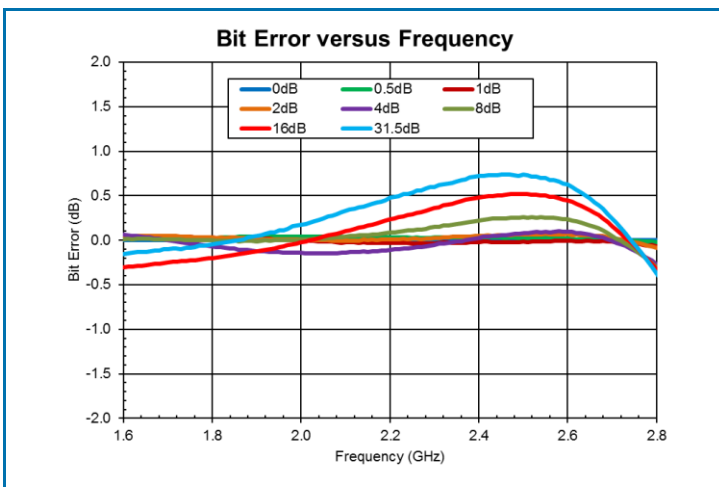
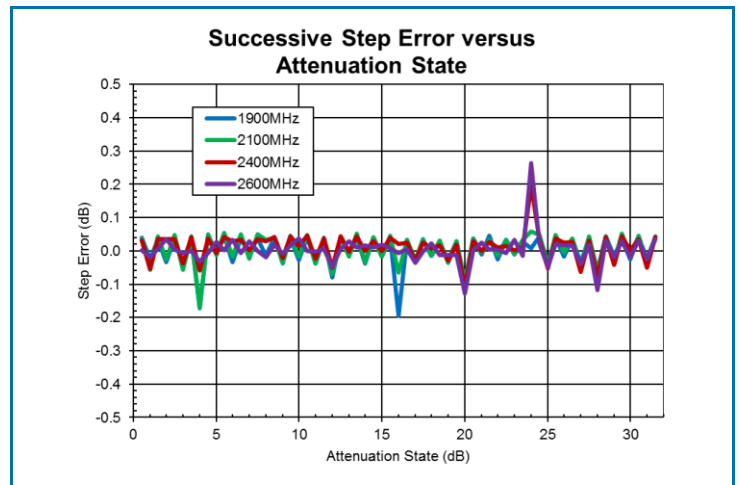
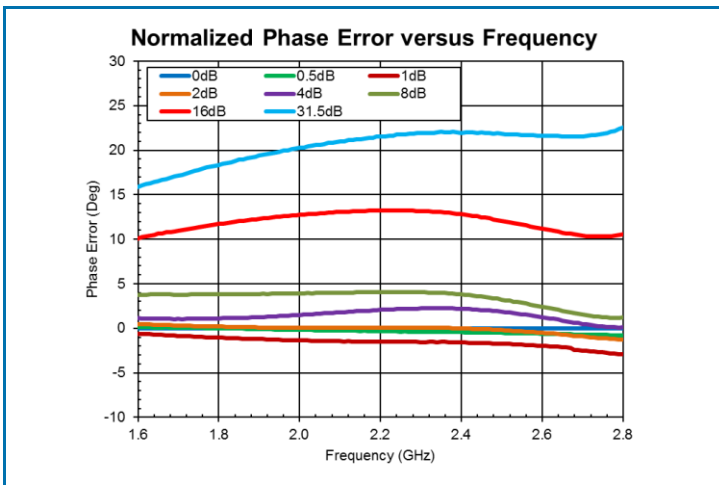
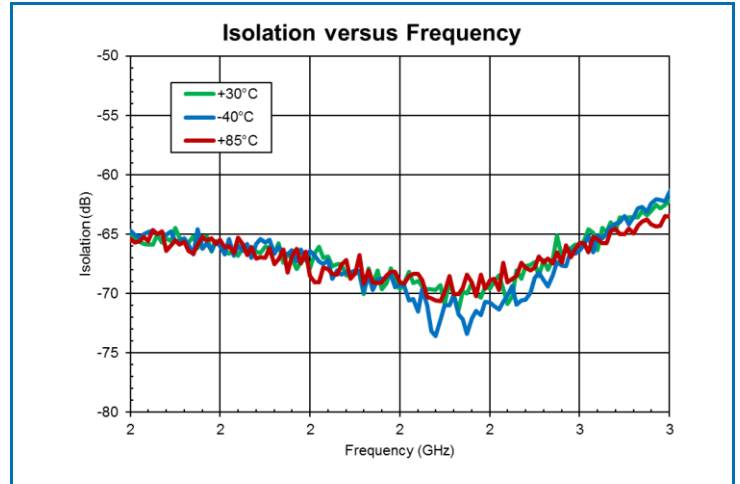
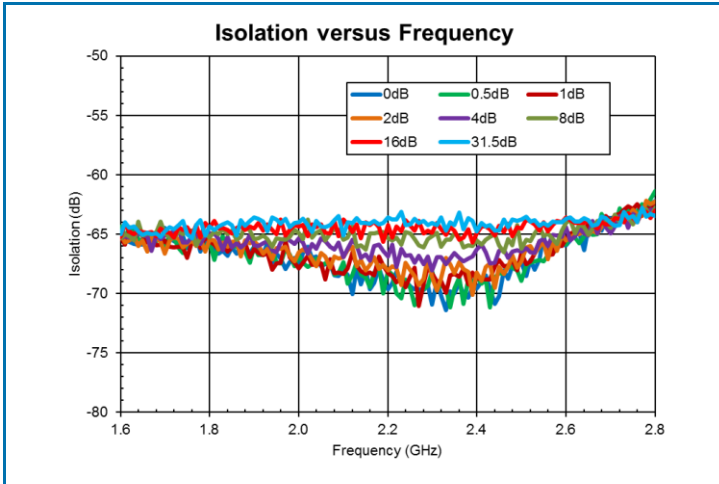
| Parameter | Unit | 1800MHz | 2000MHz | 2400MHz | 2500MHz | 2600MHz | 2700MHz | 2800MHz |
|-----------------------|------|---------|---------|---------|---------|---------|---------|---------|
| Max Small Signal Gain | dB | 39.5 | 40 | 40 | 40 | 41 | 41 | 41 |
| Output P1dB | dBm | 27.4 | 28 | 28 | 28 | 28 | 28 | 27.5 |
| Output IP3 (1) | dBm | 38 | 38 | 40 | 41 | 41 | 40 | 39 |
| Input Return Loss | dB | 13 | 14 | 15 | 15 | 15 | 15 | 15 |
| Output Return Loss | dB | 8.2 | 11 | 14 | 14 | 12 | 11 | 8 |
| Noise Figure | dB | 5.1 | 5.2 | 5.2 | 5.2 | 5.2 | 5.2 | 5.2 |

Note: (1) Output IP3 is tested at $P_{OUT} = 19\text{dBm}/\text{tone}$ and 1MHz spacing

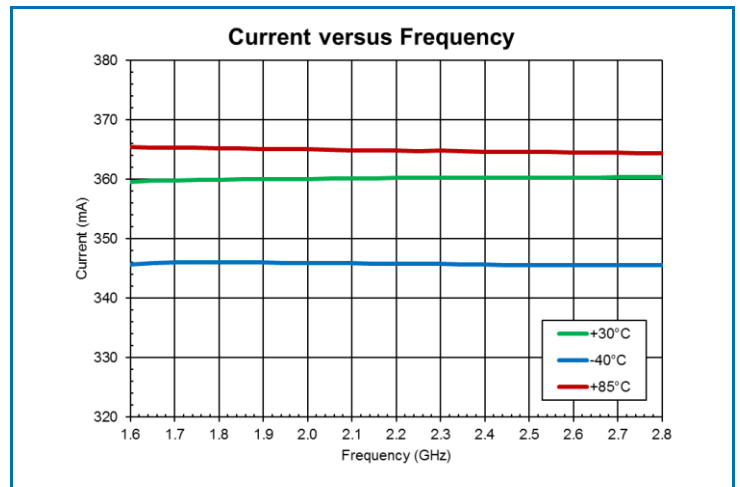
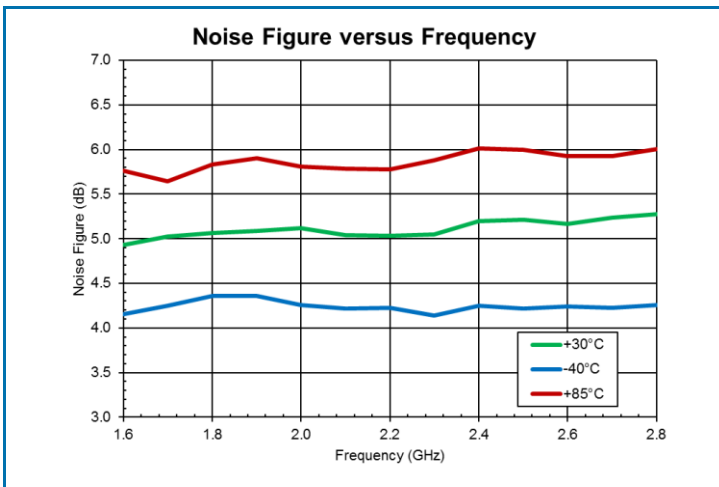
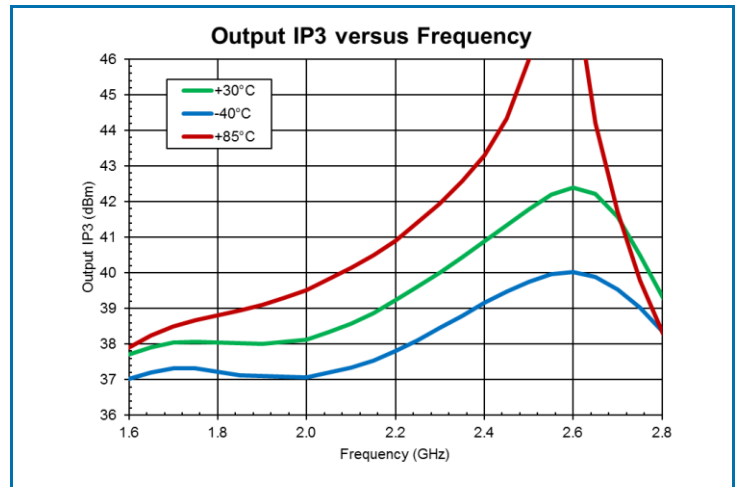
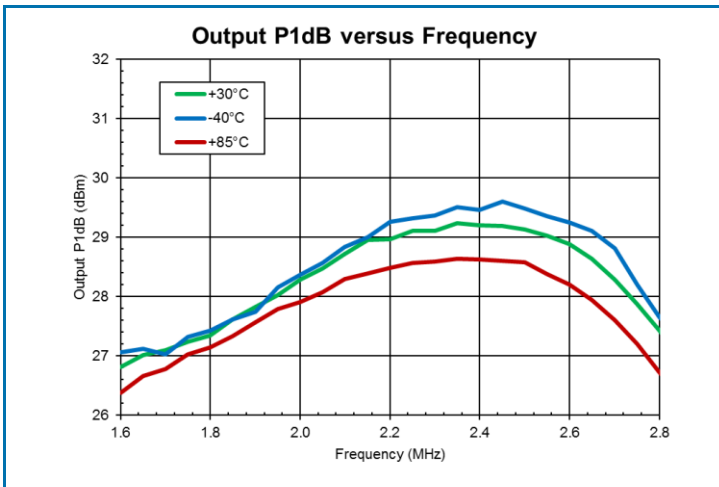
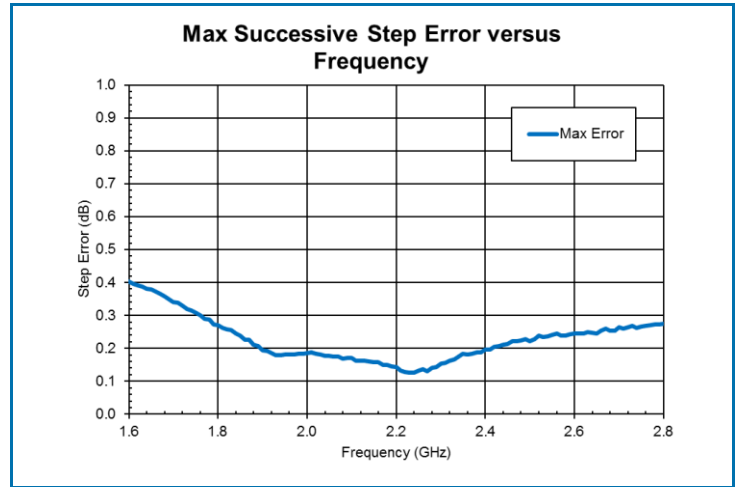
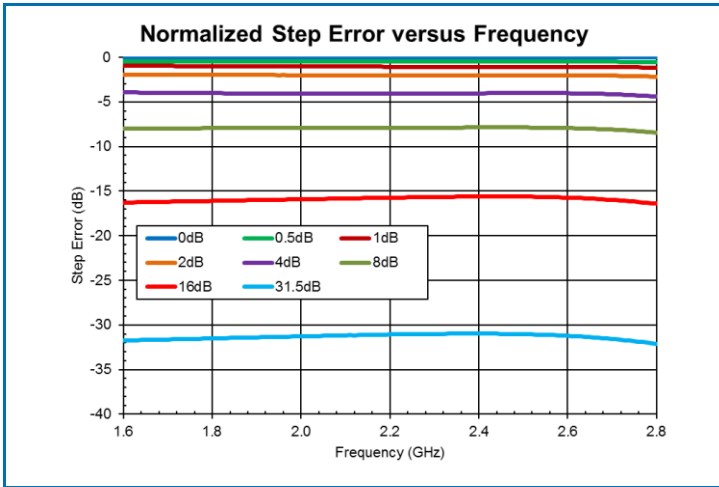
Typical Performance:



Typical Performance:



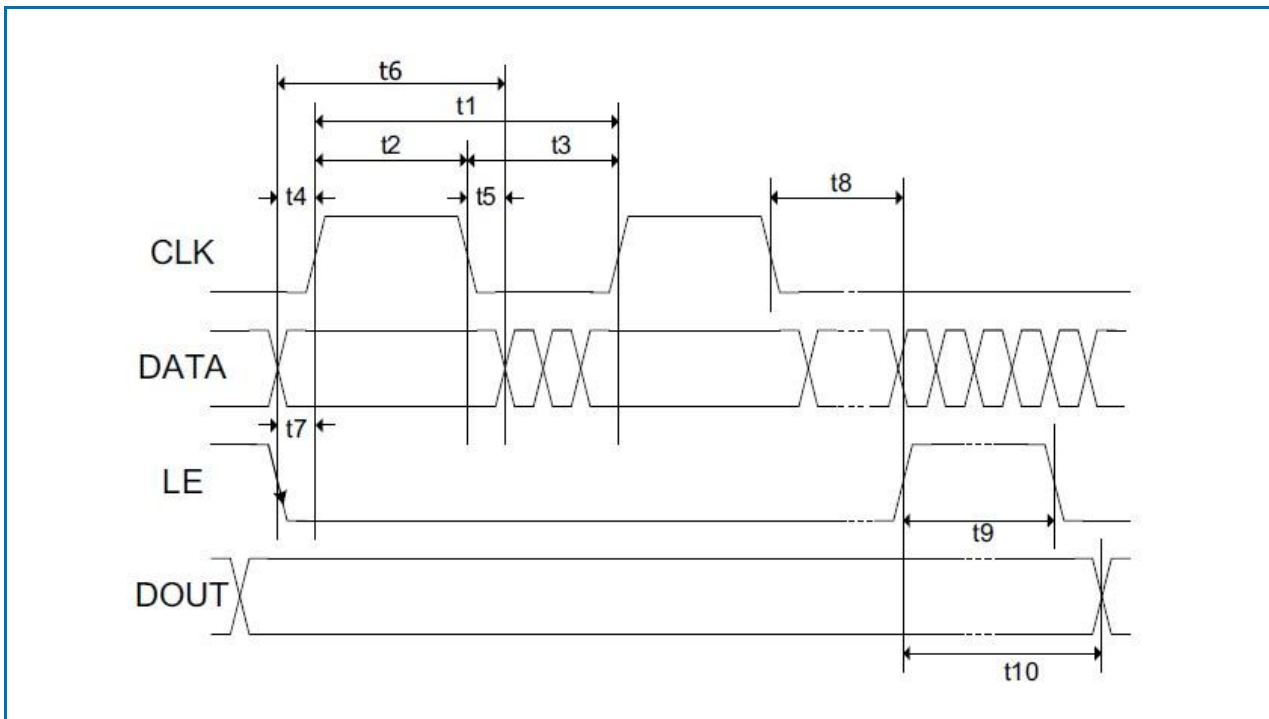
Typical Performance:



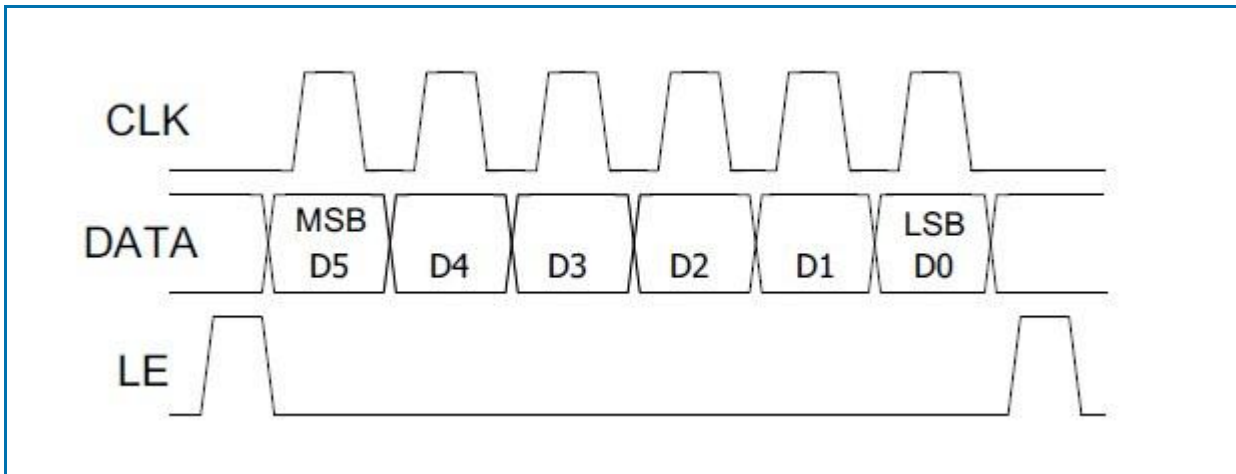
Truth Table

| 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 |

SPI Timing Diagram



Programming Example: 6-Bit



SPI Timing Diagram Specifications

| Parameter | Limit | Unit | 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 min | Output Set |

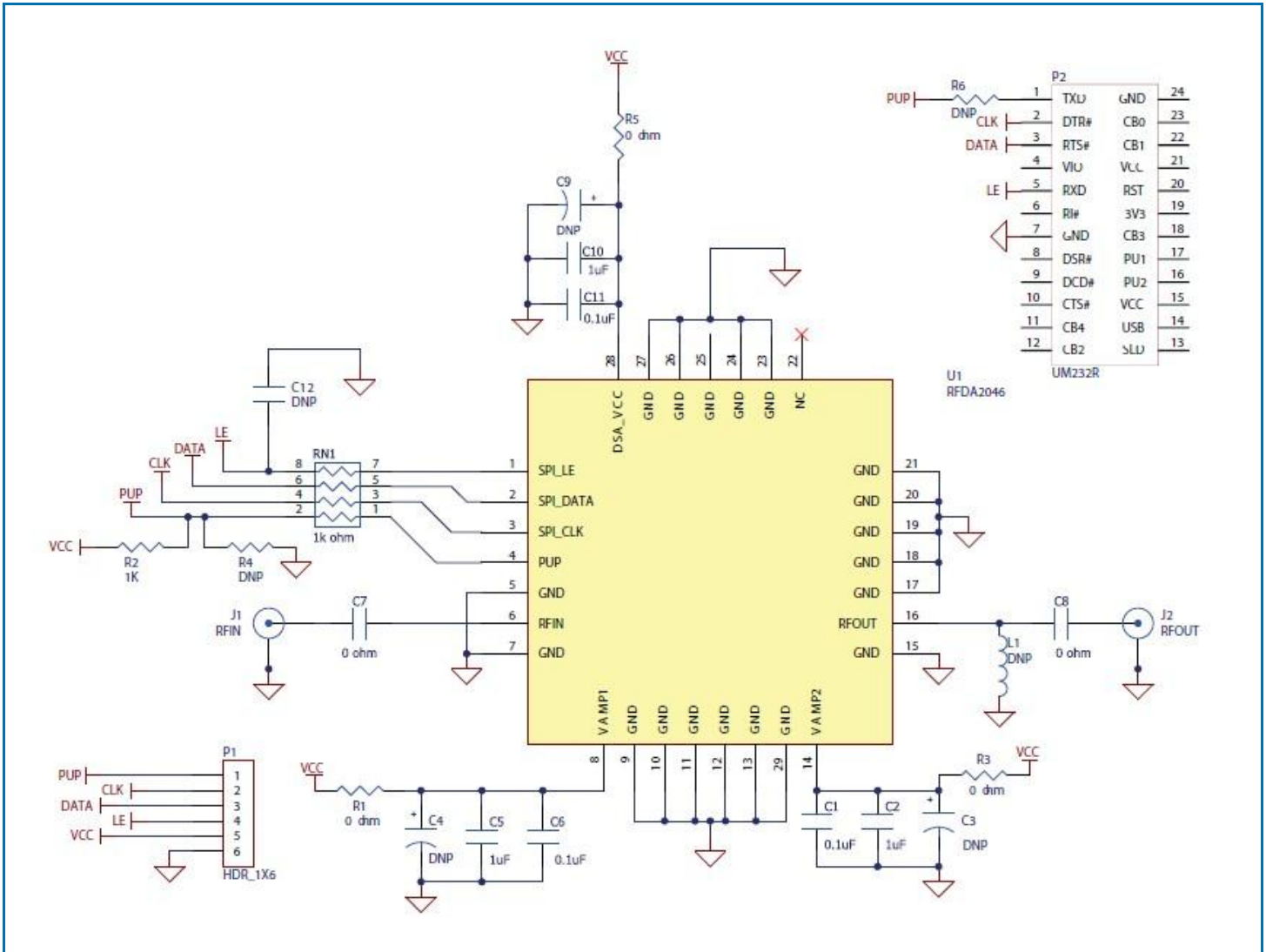
Power-up Programming Truth Table

| PUP | Attenuator Setting |
|------|----------------------------|
| Low | Attenuation at max, 31.5dB |
| High | Attenuation at min, 0dB |

Logic Voltage Levels

| State | Logic |
|-------|--------------|
| Low | 0V to 0.8V |
| High | 2.0V to 5.0V |

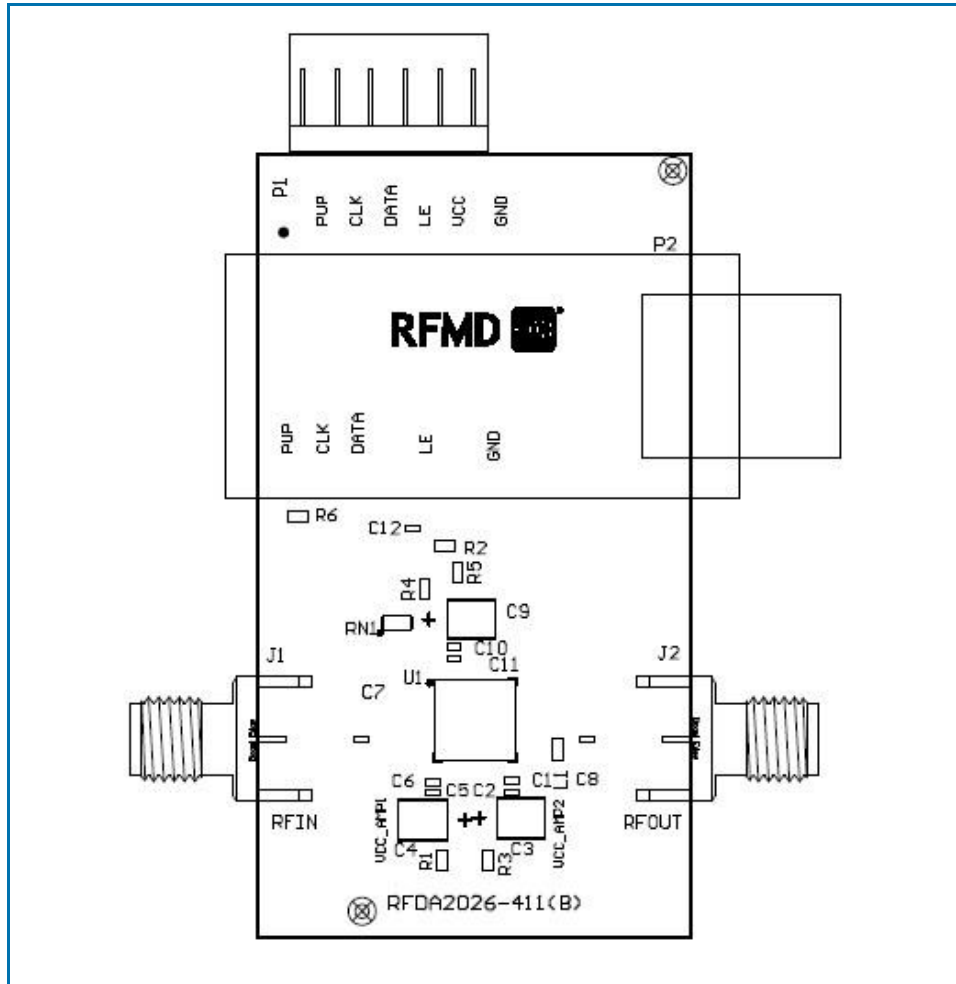
Evaluation Board Schematic



Evaluation Board Bill of Materials (BOM)

| Description | Reference Designator | Manufacturer | Manufacturer's P/N |
|--|----------------------|-----------------------------|---------------------|
| RFDA2046, 6 x 6sq. mm, 28-PIN, LAMINATE | U1 | RFMD | RFMD2046 |
| RFDA2026-411(B) | | Viasystems | RFDA2026-411(B) |
| CONN, SMA, END LNCH, FLT, 0.062" | J1-J2 | Emerson Network Power | 142-0701-821 |
| CONN, HDR, ST, PLRZD, 6-PIN, 0.100" | P1 | AMP | 640454-6 |
| CONN, SKT, 24-PIN DIP, 0.600", T/H | P2 | Aries Electronics Inc. | 24-6518-10 |
| CAP, 0.1 μ F, 10%, 16V, X7R, 0402 | C1, C6, C11 | Murata Electronics | GRM1555R71C104KA88D |
| CAP, 1 μ F, 10%, 10V, X5R, 0402 | C2, C5, C10 | Murata Electronics | GRM155R61A105KE15D |
| RES, 0 Ω , 0402 | C7-C8 | Kamaya, Inc. | RMC1/16SJPTH |
| RES, 1K, 5%, 1/16W, 0603 | R2 | Panasonic Industrial Co. | ERJ-3GEYJ102 |
| RES ARRAY, 4-ELEM, 1K, 5%, SMD 4 x 00402 | RN1 | KOA Speer Electronics, Inc. | CN1E4KTTD102J |
| RES, 0 Ω , 0603 | R1, R3, R5 | KOA Speer Electronics, Inc. | RK73Z1JLTD |
| DNP | C3-C4, C9, C12 | N/A | N/A |
| DNP | R4, R6 | N/A | N/A |
| DNP | L1 | N/A | N/A |

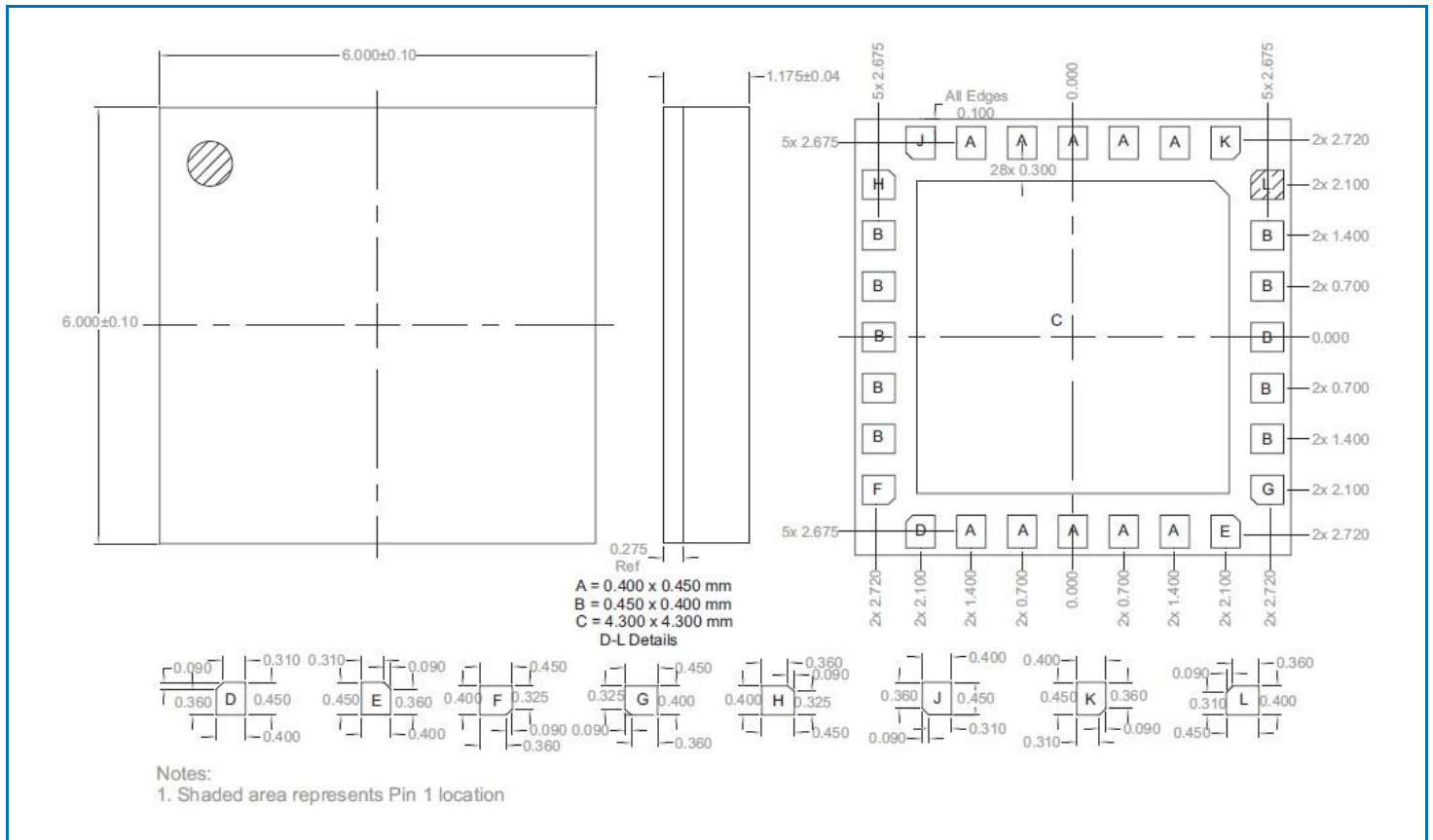
Evaluation Board Assembly Drawing



Pin Names and Descriptions

| Pin | Name | 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, with built-in DC block capacitor |
| 7 | GND | RF/DC ground connection |
| 8 | VCC_AMP1 | Supply voltage for amplifier 1 |
| 9 | GND | RF/DC ground connection |
| 10 | GND | RF/DC ground connection |
| 11 | GND | RF/DC ground connection |
| 12 | GND | RF/DC ground connection |
| 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, with built-in DC block capacitor |
| 17 | GND | RF/DC ground connection |
| 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 | NC | Do not connect, leave open circuit |
| 23 | GND | RF/DC ground connection |
| 24 | GND | RF/DC ground connection |
| 25 | GND | RF/DC ground connection |
| 26 | GND | RF/DC ground connection |
| 27 | GND | RF/DC ground connection |
| 28 | VCC_SPI | Supply voltage for SPI and DSA chip |

Package Outline Drawing (Dimensions in millimeters)



Branding Diagram

