

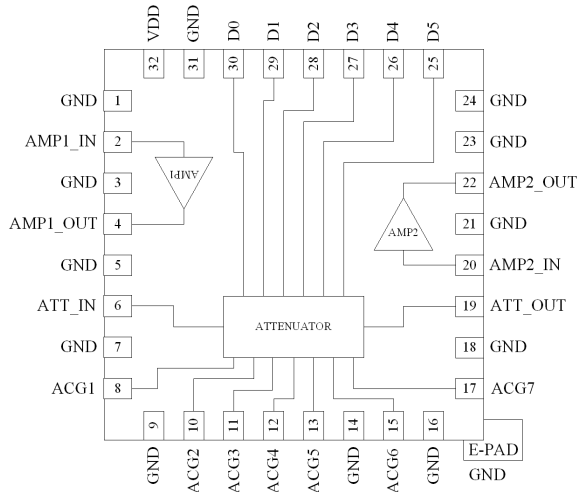


### Features

- Broadband 50MHz to 1000MHz Operation
- 6-Bit Digital Step Attenuator
- Parallel Mode Gain Programming
- Max Gain=38.8dB at 140MHz
- Gain Control Range=31.5dB (0.5dB Step Size)
- High OIP3/P1dB=+42/20dBm at 140MHz
- Single +5V Supply
- 3V or 5V Logic Level Compatible
- Small 32-Pin, 5.2mmx5.2mm, MCM
- Footprint Compatible with 5mmx5mm 32-Pin QFN

### Applications

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



Functional Block Diagram

RFMD's RDA2032Z is a digital controlled variable gain amplifier (DVGA) featuring high linearity over the entire gain control range. The attenuation of the 6-bit digital step attenuator is programmed with a parallel mode control interface. The RDA2032Z has two amplifier stages packaged in a small 5.2mmx5.2mm leadless laminate MCM containing plated through thermal vias for ultra low thermal resistance. The footprint for this module is directly compatible with a 5mmx5mm 32-pin QFN. This module is easy to use with no external matching components required.

### 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 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"/> LDMOS     |

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## Absolute Maximum Ratings

| Parameter                              | Rating         | Unit |
|--|----------------|------|
| Supply Voltage                         | 5.5            | V    |
| DC Supply Current                      | 228            | mA   |
| Power Dissipation                      | 1054           | mW   |
| Max Input RF Power                     | +24            | dBm  |
| Operating Temperature                  | -40 to +85     | °C   |
| Storage Temperature                    | -40 to +150    | °C   |
| Junction Temperature (T <sub>J</sub> ) | +150           | °C   |
| ESD Rating (HBM)                       | 500 (Class 1B) | V    |
| Moisture Sensitivity Level (MSL)       | 3              |      |



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 2002/95/EC (at time of this document revision).

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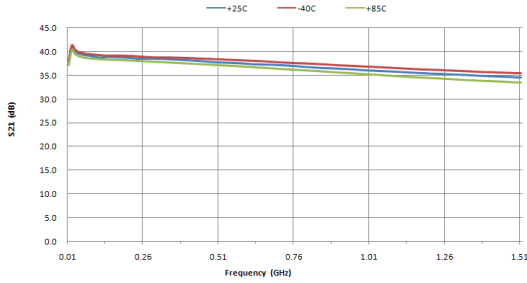
| Parameter                                    | Specification                    |      |      | Unit | Condition   |
|--|----------------------------------|------|------|------|---|
|  | Min.                             | Typ. | Max. |      |   |
| <b>Overall</b>                               |                                  |      |      |      | Temp=25 °C, V <sub>CC</sub> =V <sub>DD</sub> =5V, V <sub>CTL</sub> =TTL Logic, Tested With Evaluation Circuit |
| Frequency Range                              | 50                               |      | 1000 | MHz  |   |
| Gain Max at 140MHz                           |                                  | 38.8 |      | dBm  | Attenuation=0dB   |
| Gain Control Range                           |                                  | 31.5 |      | dB   | 0.5dB step  |
| Step Accuracy                                | ±(0.15 + 3% attenuation setting) |      |      | dB   | Major state max error up to 1000MHz   |
| OP1dB at 140MHz                              |                                  | 20   |      | dBm  | Attenuation=0dB   |
| OIP3 at 140MHz                               |                                  | 42   |      | dBm  | P <sub>OUT</sub> =0dBm/tone, 1MHz spacing   |
| Control Interface                            |                                  | 6    |      |      | Parallel mode 6-bit   |
| Settling Time                                |                                  | 220  |      | ns   | t <sub>ON</sub> , t <sub>OFF</sub> (10%/90% RF)   |
| NF at 140MHz                                 |                                  | 3.2  |      | dB   | Attenuation=0dB   |
| Input Return Loss at 140MHz                  |                                  | -30  |      | dB   | 50Ω system  |
| Output Return Loss at 140MHz                 |                                  | -25  |      | dB   | 50Ω system  |
| Amplifier Supply Voltage (V <sub>CC</sub> )  | 4.75                             | 5.0  | 5.25 | V    |   |
| Attenuator Supply Voltage (V <sub>DD</sub> ) | 3.0                              | 5    | 5.25 | V    |   |
| Total Supply Current                         | 164                              | 182  | 204  | mA   | Sum of currents from V <sub>DD</sub> and V <sub>CC</sub>  |
| Thermal Resistance                           |                                  | 39   |      | °C/W |   |

## Typical RF Performance at Key Operating Frequencies

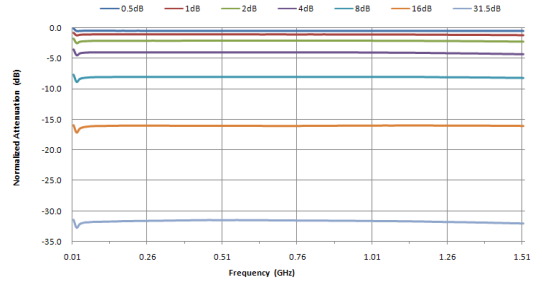
| Parameter             | Unit | 50MHz | 140MHz | 280MHz | 500MHz | 850MHz | 1000MHz |
|-----------------------|------|-------|--------|--------|--------|--------|---------|
| Max Small Signal Gain | dB   | 39.5  | 38.8   | 38.5   | 37.8   | 36.5   | 36.0    |
| OP1dB                 | dBm  | 19.5  | 20.0   | 20.0   | 20.0   | 19.8   | 19.6    |
| OIP3                  | dBm  | 40.0  | 42.0   | 42.0   | 39.5   | 36.0   | 35.0    |
| Input Return Loss     | dB   | -20   | -30    | -20    | -19    | -16    | -15     |
| Output Return Loss    | dB   | -30   | -28    | -23    | -20    | -11.5  | -10     |
| NF                    | dB   | 3.1   | 3.2    | 3.3    | 3.3    | 3.3    | 3.3     |

## Typical Performance

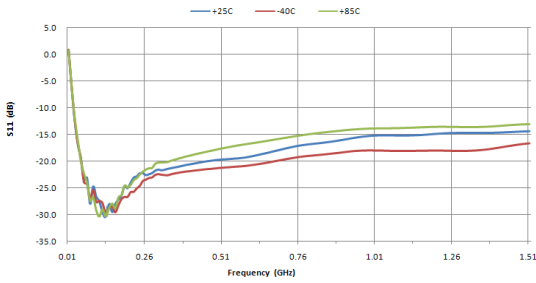
**Max Gain**



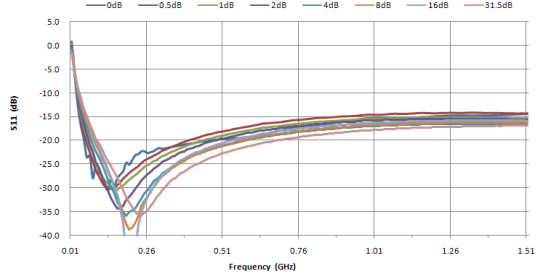
**Normalized Attenuation**



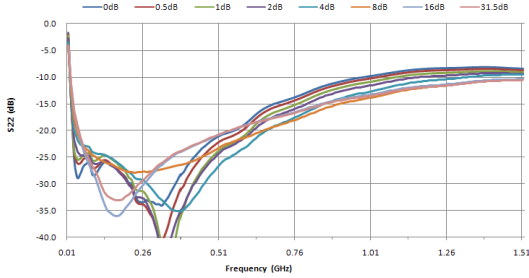
**Input Return Loss**



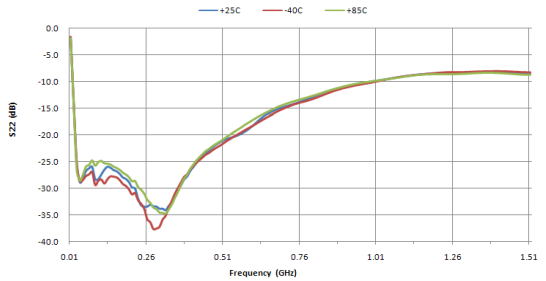
**Input Return Loss at Major Gain Steps**



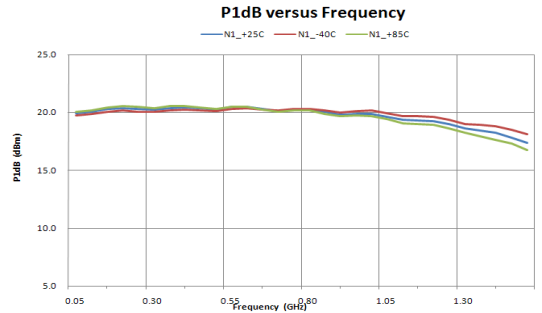
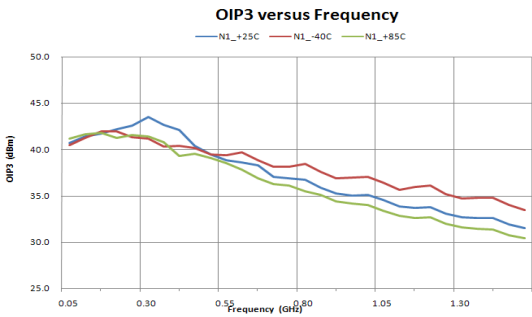
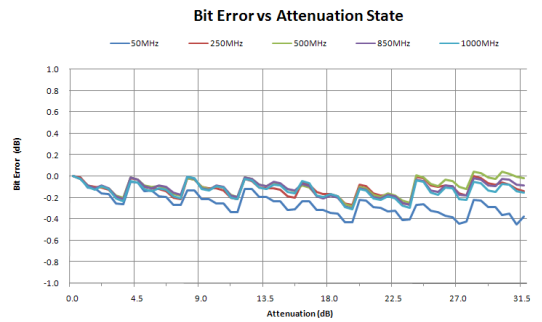
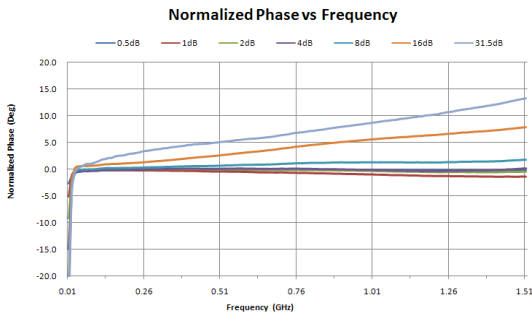
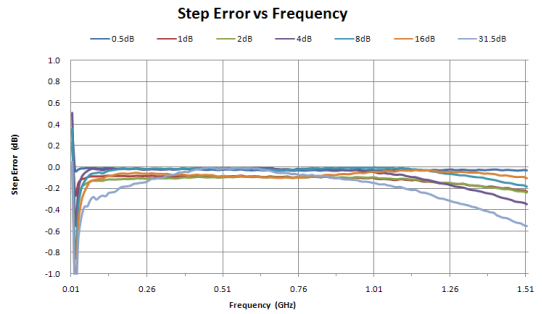
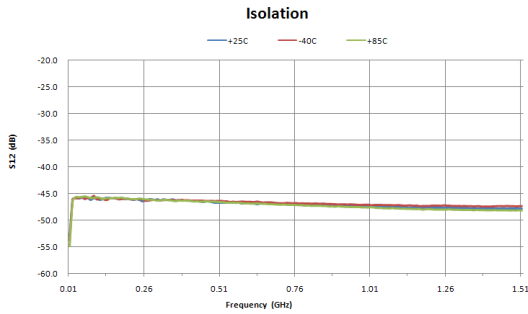
**Output Return Loss at Major Gain Steps**



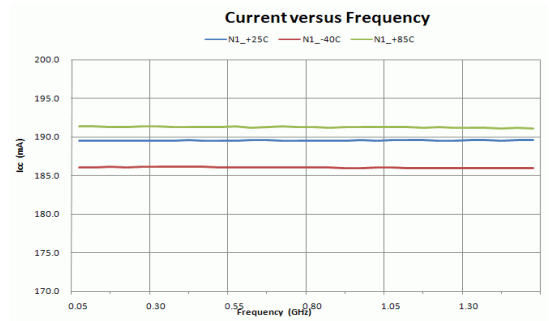
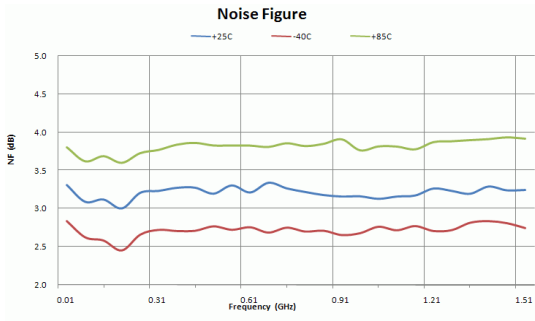
**Output Return Loss**



## Typical Performance



**Typical Performance**

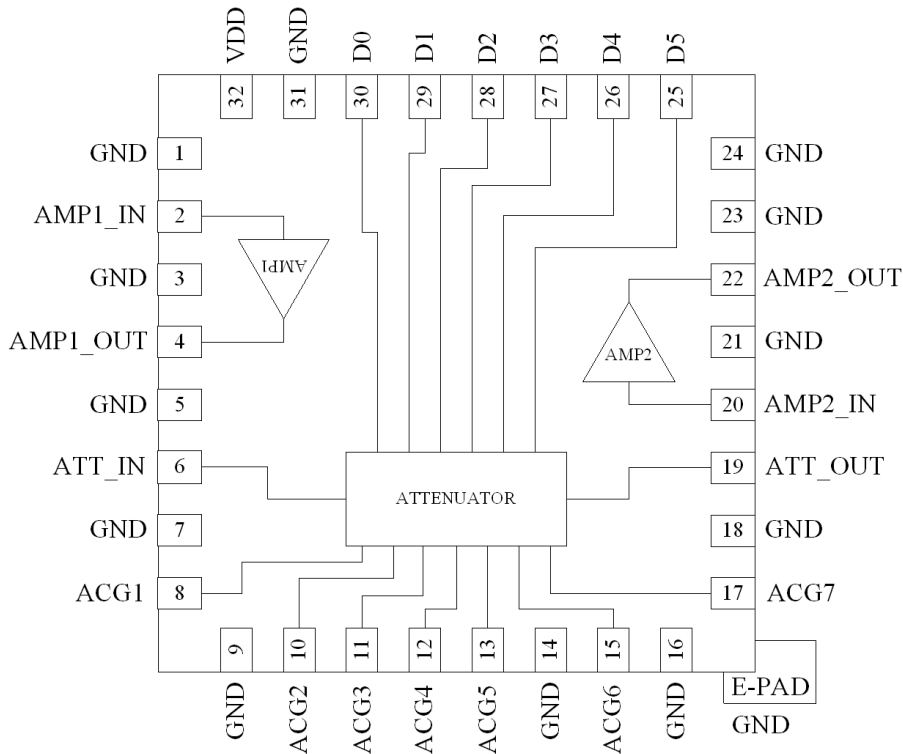


## Truth Table

| 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                       |

| Logic Voltage Levels |                         |                        |
|----------------------|-------------------------|------------------------|
| State                | V <sub>DD</sub> =+3.3V  | V <sub>DD</sub> =+5V   |
| Low                  | 0V to 0.8V              | 0V to 0.8V             |
| High                 | 2.0V to V <sub>DD</sub> | 2.0 to V <sub>DD</sub> |

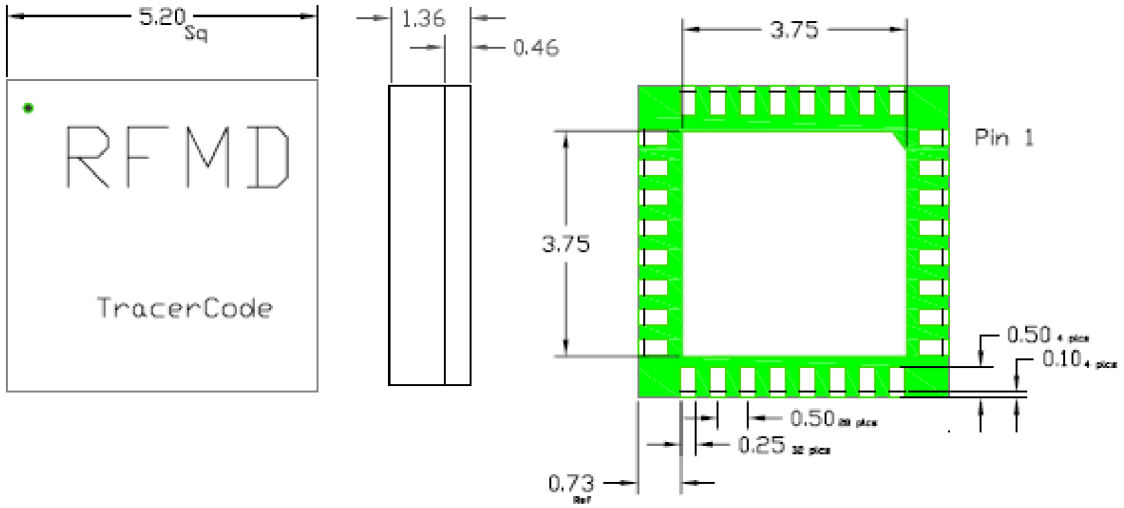
## Functional Block Diagram



| Pin | Function | Description   |
|-----|----------|---|
| 1   | GND      | RF/DC Ground Connection.                              |
| 2   | AMP1_IN  | RF Amplifier 1 Input. DC block required.              |
| 3   | GND      | RF/DC Ground Connection.                              |
| 4   | AMP1_OUT | RF Amplifier 1 Output. DC block required.             |
| 5   | GND      | RF/DC Ground Connection.                              |
| 6   | ATT_IN   | Digital Attenuator Input. DC block required.          |
| 7   | GND      | RF/DC Ground Connection.                              |
| 8   | ACG1     | Place external capacitor to ground.                   |
| 9   | GND      | RF/DC Ground Connection.                              |
| 10  | ACG2     | Place external capacitor to ground.                   |
| 11  | ACG3     | Place external capacitor to ground.                   |
| 12  | ACG4     | Place external capacitor to ground.                   |
| 13  | ACG5     | Place external capacitor to ground.                   |
| 14  | GND      | RF/DC Ground Connection.                              |
| 15  | ACG6     | Place external capacitor to ground.                   |
| 16  | GND      | RF/DC Ground Connection.                              |
| 17  | ACG7     | Place external capacitor to ground.                   |
| 18  | GND      | RF/DC Ground Connection.                              |
| 19  | ATT_OUT  | Digital Attenuator Output. DC block required.         |
| 20  | AMP2_IN  | RF Amplifier 2 Input. DC block required.              |
| 21  | GND      | RF/DC Ground Connection.                              |
| 22  | AMP2_OUT | RF Amplifier 2 Output. DC block required.             |
| 23  | GND      | RF/DC Ground Connection.                              |
| 24  | GND      | RF/DC Ground Connection.                              |
| 25  | D5       | Digital attenuator parallel control line: 16 dB bit.  |
| 26  | D4       | Digital attenuator parallel control line: 8 dB bit.   |
| 27  | D3       | Digital attenuator parallel control line: 4 dB bit    |
| 28  | D2       | Digital attenuator parallel control line: 2 dB bit.   |
| 29  | D1       | Digital attenuator parallel control line: 1 dB bit.   |
| 30  | D0       | Digital attenuator parallel control line: 0.5 dB bit. |
| 31  | GND      | RF/DC Ground Connection.                              |
| 32  | VDD      | Digital attenuator supply Voltage.                    |

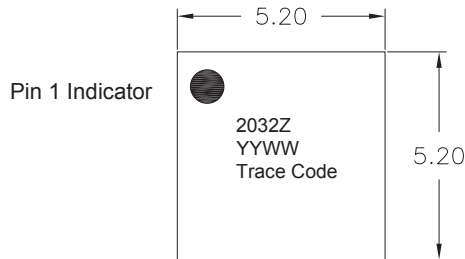
## Package Drawing

5.2mmx5.2mm Laminate Module



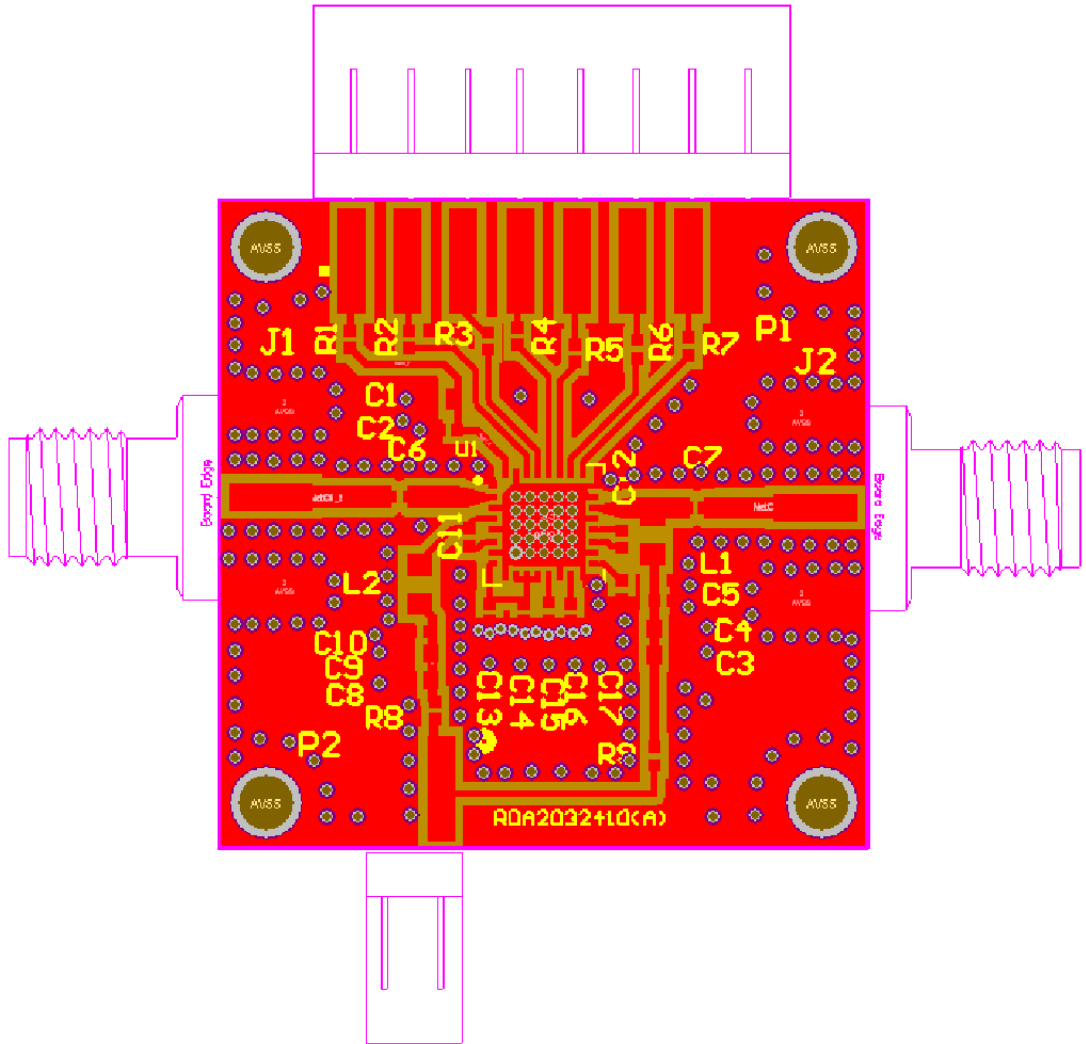
Note: Module thickness tolerance =  $\pm 0.04$  mm. Other dimension tolerances =  $\pm 0.075$  mm.

## Branding Diagram

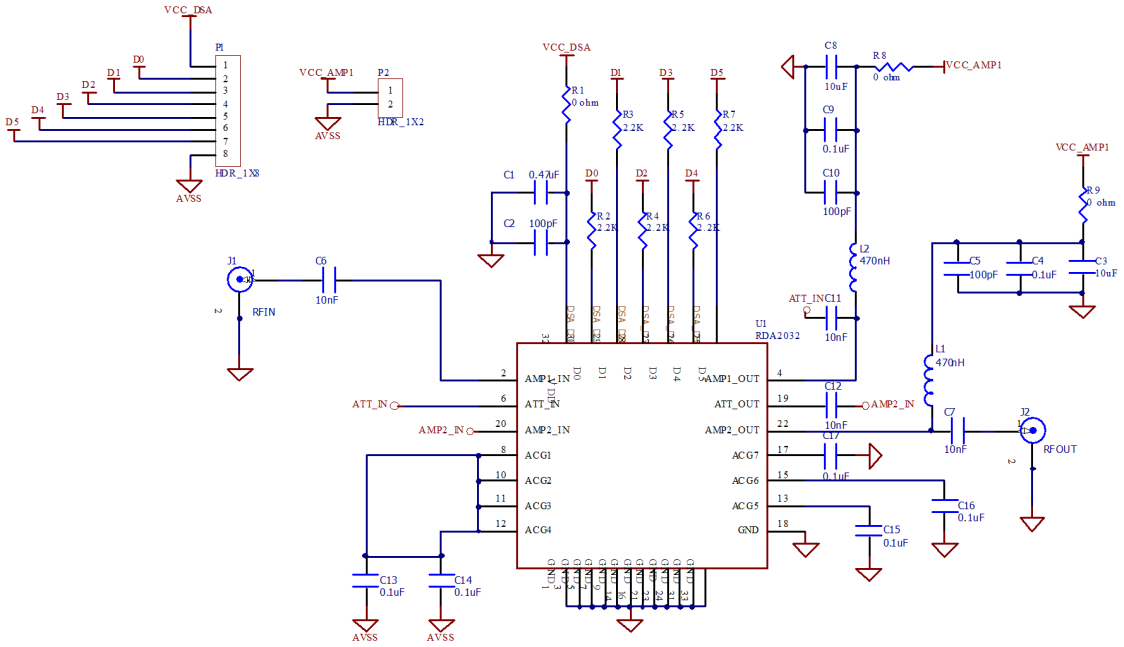




**Evaluation PCB**



## Evaluation Board Schematic



**Bill of Materials**

| Quantity | Description                       | Reference Designator    | Manufacturer       | Manufacturer's Part Number |
|----------|-----------------------------------|-------------------------|--------------------|----------------------------|
| 1        | CAP, 0.47uF, 10%, 10V, X5R, 0603  | C1                      | Murata Electronics | GRM188R61A47K61D           |
| 2        | CAP, 10uF, 20%, 6.3V, X5R, 0603   | C3, C8                  | Murata Electronics | GRM188R60J106ME47D         |
| 2        | CAP, 0.1uF, 10%, 16V, X7R, 0603   | C4, C9                  | Murata Electronics | GRM188R71C104KA01D         |
| 3        | CAP, 100pF, 5%, 50V, COG, 0402    | C2, C10, C5             | Panasonic          | ECJ-OEC1H101J              |
| 5        | CAP, 0.1uF, 10%, 10V, X5R, 0402   | C13, C14, C15, C16, C17 | Taiyo Yuden        | RM LMK105BJ104KV           |
| 4        | CAP, 10000pF, 10%, 16V, X7R, 0402 | C6, C7, C11, C12        | Taiyo Yuden        | RM EMK105BJ103KV-F         |
| 2        | IND, 470nH, 10%, W/W, 0805        | L1, L2                  | Coilcraft          | 0805LS-471XSLB             |
| 2        | JMPR, 0 OHM, 0402                 | R1, R8, R9              | Panasonic          | ERJ-2GE0R00                |
| 6        | RES, 2.2K, 5%, 1/16W, 0402        | R2, R3, R4, R5, R6, R7  | Panasonic          | ERJ-2GEJ222                |

**Ordering Information**

| Ordering Code   | Description                                   |
|-----------------|---|
| RDA2032ZSQ      | Sample bag with 25 pieces                     |
| RDA2032ZSR      | 7" Reel with 100 pieces                       |
| RDA2032ZTR7     | 7" Reel with 750 pieces                       |
| RDA2032ZTR13    | 13" Reel with 2500 pieces                     |
| RDA2032ZPCK-410 | 50MHz to 1000MHz PCBA with 5-piece sample bag |