# RFFM6201

## 2.0V TO 3.6V, 2.4GHZ FRONT END MODULE

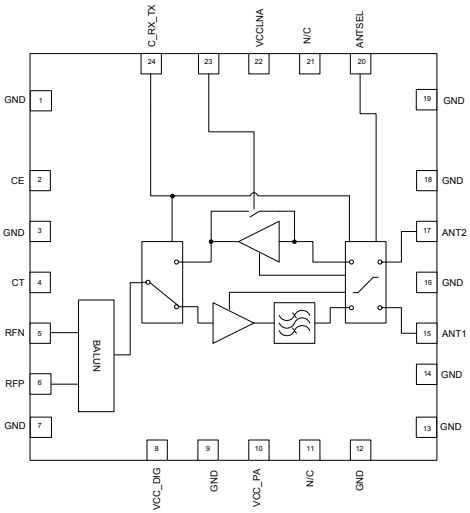
Package Style: Laminate, 24-Pin, 5mm x 5mm x 1mm

## Features

- Tx Output Power=23dBm
- Integrated RF Front End Module with Balun, PA, filter, LNA with Bypass mode and DP2T switch.
- Single Bidirectional Differential Transceiver interface.
- Voltage range=2.0 to 3.6V.

## Applications

- ZigBee® 802.15.4 Based Systems for Remote Monitoring and Control
- 2.4GHz ISM Band Applications
- AA Battery Operation
- Smart Meters for Energy Management




Functional Block Diagram

## Product Description

The RFFM6201 integrates a complete solution in a single Front End Module (FEM) for WiFi and ZigBee applications in the 2.4GHz band. This FEM integrates the PA plus harmonic filter in the transmit path. The RFFM6201 also integrates a Low Noise Amplifier (LNA) with bypass mode and a balun. The RFFM6201 provides a single balanced TDD access for Rx and Tx paths along with two ports on the output for connecting a diversity solution or a test port. The device is provided in a 5mm x 5mm x 1mm, 24 pin laminate package.

### Ordering Information

| | |
|---|---|
| RFFM6201 | 3.3V Front End Module for AMR systems in the 2.4GHz to 2.5GHz Band |
| RFFM6201SQ | Standard 25 piece bag |
| RFFM6201SR | Standard 100 piece reel |
| RFFM6201TR13 | Standard 2500 piece reel |
| RFFM6201PCK-410 | Fully assembled evaluation board and 5 loose pieces |

### 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 |

RF MICRO DEVICES®, RFMD®, Optimum Technology Matching®, Enabling Wireless Connectivity™, PowerStar®, POLARIS™ TOTAL RADIO™ and UltimateBlue™ are trademarks of RFMD, LLC. BLUETOOTH is a trademark owned by Bluetooth SIG, Inc., U.S.A. and licensed for use by RFMD. All other trade names, trademarks and registered trademarks are the property of their respective owners. ©2006, RF Micro Devices, Inc.



7628 Thorndike Road, Greensboro, NC 27409-9421 · For sales or technical support, contact RFMD at (+1) 336-678-5570 or customerservice@rfmd.com.

## Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|---|---|
| DC Supply Voltage | 5.0 | V |
| DC Supply Current | 300 | mA |
| Maximum Tx Input Power | +5 | dBm |
| Maximum Rx Input Power | +5 | dBm |
| Operating Case Temperature | -40 to +85 | °C |
| Storage Temperature | -40 to +150 | °C |
| ESD HBM per ESDA/Jedec-JDS-001 | 1000 | V |
| ESD CDM per JESD22-C101 | 1000 | V |
| MSL | 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.

The information in this publication is believed to be accurate and reliable. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents, or other rights of third parties, resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

RFMD Green: RoHS compliant per EU Directive 2011/65/EU, 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. | | |
| **Conditions** | | | | | Specifications must be met across supply voltage, control voltage, and temperature ranges unless otherwise specified. |
| $V_{BATT}$ | 2 | 3.3 | 3.6 | V | |
| Operating Temperature Range | -40 | 25 | 85 | °C | |
| $Z_O$ | | 50 | | Ω | |
| Off mode current (All controls LOW) | | 0.5 | 1 | µA | All logic low, Temp= 25 °C; Over Voltage |
| Current sourced through CT pin | | | 18 | mA | |
| Voltage drop from CT pin to RFN/RFP | | | 0.1 | V | |
| **Tx Path** | | | | | Nominal Conditions: T= 25 °C, $V_{BATT}$= 3.3, Control Voltage= $V_{BATT}$ -0.2V unles otherwise noted |
| Frequency | 2405 | | 2480 | MHz | |
| Input Return Loss | | 15 | | dB | Pins 5, 6 (RFN, RFP) 100Ω differential |
| Balanced input impedance | | 100 | | Ω | |
| Amplitude Imbalance | -1 | | 1 | dB | |
| Phase Imbalance | -15 | | 15 | deg | |
| Output Return Loss | 10 | | | dB | |
| Transmit Path Gain | 22 | 25 | | dB | At rated power, nominal conditions |
| Transmit Path Gain | 15.5 | 24 | | dB | At rated power, 3.3V to 3.6V, all temperatures |
| Gain flatness | -0.3 | | 0.3 | dB | At rated power, nominal conditions |
| Rated Output Power | | 23 | | dBm | $V_{BATT}$=3.6V, all conditions |
| | 22 | | | | $V_{BATT}$=3.0V, all conditions |
| | 20 | | | dBm | $V_{BATT}$ to 2.7V, all temperatures |
| | 18 | | | dBm | $V_{BATT}$ to 2.0V, all temperatures |
| Supply current | | 170 | 200 | mA | At rated power, nominal conditions ($V_{BATT}$=3.3V, 25 °C), 802.15.4 OQPSK |
| | | 180 | 220 | mA | At rated power, 3.0V to 3.6V, all temperatures, 802.15.4 OQPSK |
| Thermal Resistance | | 88 | | °C/W | 3.6$V_{CC}$; $P_{OUT}$ = 23dBm; Tref = 85 °C |



7628 Thorndike Road, Greensboro, NC 27409-9421 · For sales or technical support, contact RFMD at **(+1) 336-678-5570** or **customerservice@rfmd.com**.

| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| **Tx Path (continued)** | | | | | |
| 2nd harmonic level | | -45 | -42 | dBm/MHz | At rated power, 802.15.4 OQPSK, all conditions |
| 3rd harmonic level | | -45 | -42 | dBm/MHz | At rated power, 802.15.4 OQPSK, all conditions |
| 4rd harmonic level | | -45 | -42 | dBm/MHz | At rated power, 802.15.4 OQPSK, all conditions |
| 5th harmonic level | | -45 | -42 | dBm/MHz | At rated power, 802.15.4 OQPSK, all conditions |
| VSWR Stability and load mismatch susceptibility | 4:1 | | | | |
| VSWR No damage | 8:1 | | | | |
| Gain settling time | | 1 | 10 | µS | |
| Amplitude imbalance | -1 | | 1 | dB | |
| Phase imbalance | -15 | | 15 | deg | |
| **Rx Path to LNA Mode** | | | | | Nominal Conditions: T= 25 °C, $V_{BATT}$= 3.3, Control Voltage= $V_{BATT}$ -0.2V unles otherwise noted |
| Frequency | 2405 | | 2480 | MHz | |
| Gain | 8 | 9 | | dB | |
| Noise Figure | | 3 | | dB | Nominal Conditions |
| Current | 3.2 | 5 | | mA | |
| IIP3 | 4 | 8 | | dBm | Across all voltage and temperature conditions |
| Gain flatness | -0.3 | | 0.3 | dB | |
| Input return loss | 12 | 15 | | dB | |
| Output return loss | 12 | | | dB | Pins 5, 6 (RFN, RFP) 100Ω differential |
| Balanced output impedance | | 100 | | Ω | |
| Amplitude imbalance | -1 | | 1 | dB | |
| Phase imbalance | -15 | | 15 | deg | |
| **Rx Path to Bypass Mode** | | | | | |
| Frequency | 2405 | | 2480 | MHz | |
| In-band attenuation/noise figure | | 6 | | dB | SW 1dB, Bypass 3.5dB, Balun 1.5dB |
| Current | | 200 | | µA | |
| IIP3 | 17 | 25 | | dBm | Across all voltage and temperature conditions |
| Gain flatness | -0.5 | | 0.5 | dB | |
| Input return loss | | 18 | | dB | |
| Output return loss | | 10 | | dB | Pins 5, 6 (RFN, RFP) 100Ω differential |
| Amplitude imbalance | -1 | | 1 | dB | |
| Phase imbalance | -15 | | 15 | deg | |
| Maximum input power | 10 | | | dBm | |
| **Antenna Switch** | | | | | |
| RF-to-Control Isolation | 50 | | | dB | |
| RF-to-ANT Isolation | 17 | 20 | | dB | |
| RF-to-RF Isolation | 18 | 20 | | dB | |
| T/R switching time | | | 1 | µS | |
| **Logic** | | | | | |
| Logic Level "High" | $V_{BATT}$ - 0.3 | $V_{BATT}$ - 0.2 | $V_{BATT}$ | V | |
| Logic Level "Low" | 0 | | 0.2 | V | |
| Input Source Current Logic Level "High" | | 100 | 130 | µA | |
| Input Source Current Logic Level "Low" | | | 1 | µA | |

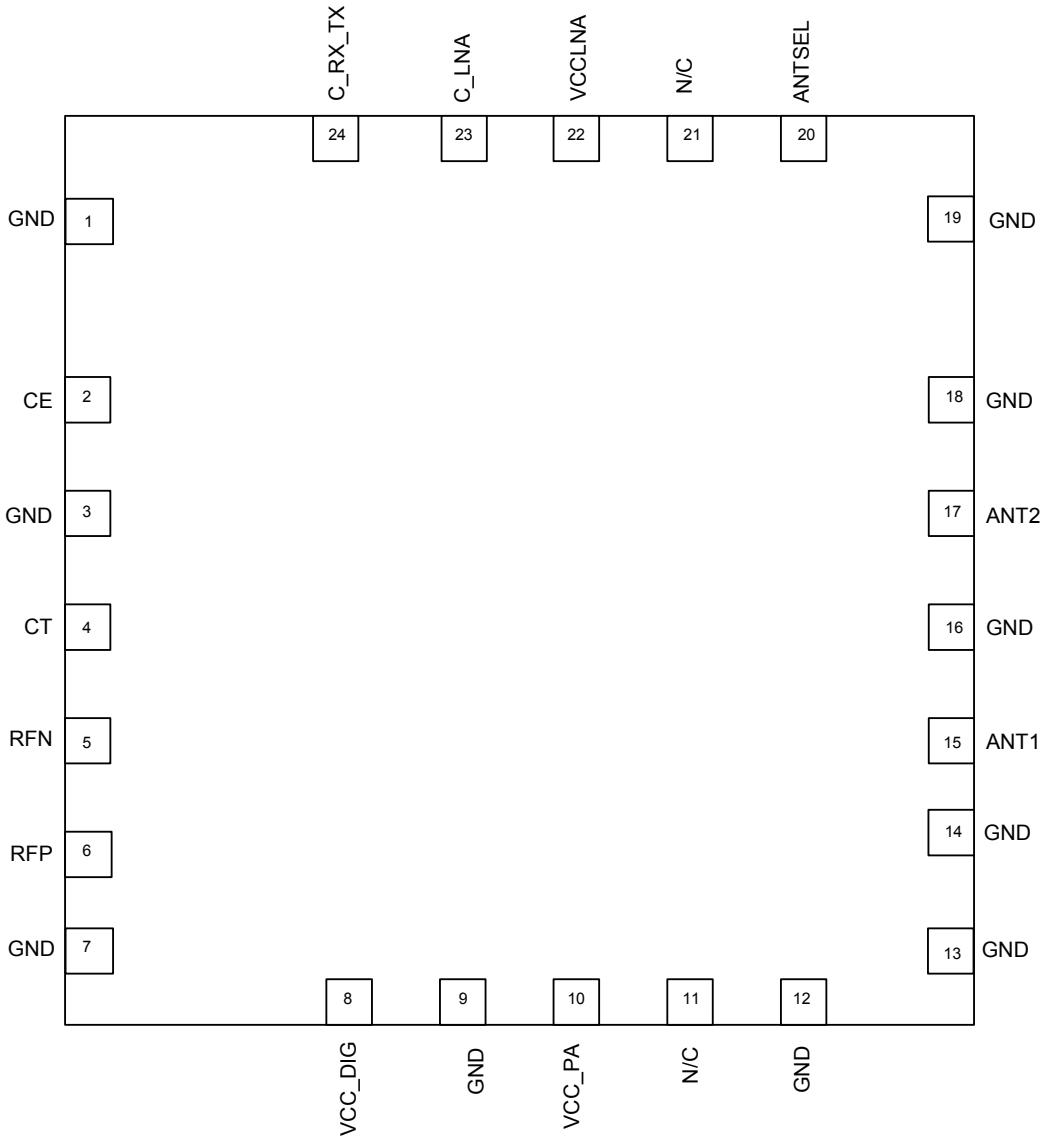
| Mode | Control Logic | | | |
|---|---|---|---|---|
| | CE | C_RX_TX | C_LNA | ANTSEL |
| TX to ANT1 | High | High | Low | Low |
| TX to ANT2 | High | High | Low | High |
| RX to ANT1 LNA | High | Low | Low | Low |
| RX to ANT1 BYP | High | Low | High | Low |
| RX to ANT2 LNA | High | Low | Low | High |
| RX to ANT2 BYP | High | Low | High | High |
| Power Down | Low | Low | Low | Low |

## Pin Names and Description

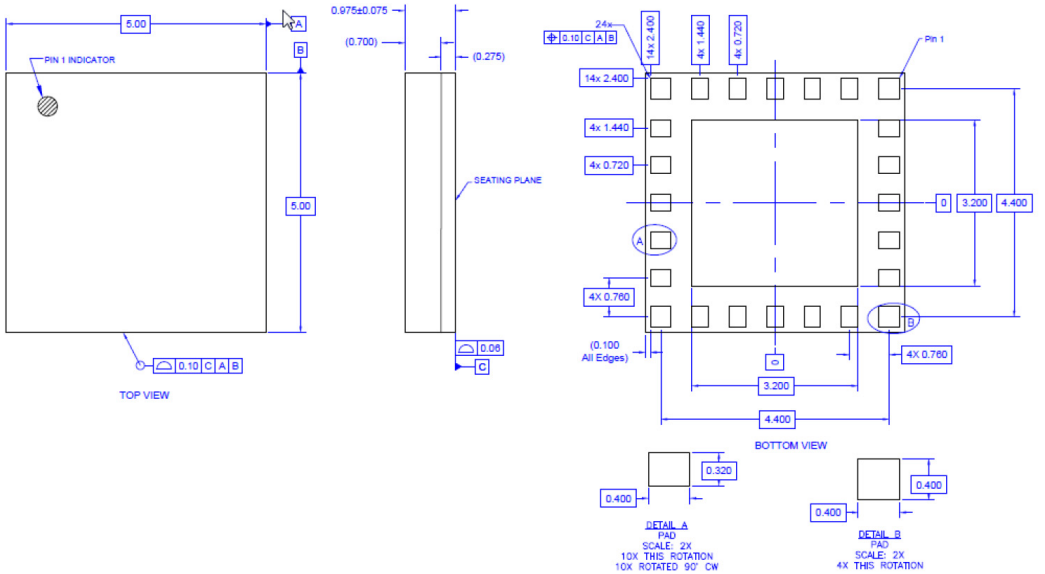
| Pin | Function | Description |
|---|---|---|
| 1 | GND | Ground. |
| 2 | CE | Control voltage pin for chip enable. See logic table. |
| 3 | GND | Ground. |
| 4 | CT | Center tap for passing DC voltage to RFN/RFP pins that connect to TXVR SoIC. |
| 5 | RFN | Differential bi-directional RF port. Matched to 50Ω single-ended, 100Ω differential. |
| 6 | RFP | Differential bi-directional RF port. Matched to 50Ω single-ended, 100Ω differential. |
| 7 | GND | Ground. |
| 8 | VCC_DIG | Voltage supply pin for Tx power amplifier. |
| 9 | GND | Ground. |
| 10 | VCC_PA | Voltage supply pin for Tx power amplifier. |
| 11 | N/C | Not connected. |
| 12 | GND | Ground. |
| 13 | GND | Ground. |
| 14 | GND | Ground. |
| 15 | ANT1 | Antenna port 1. Matched 50Ω and DC blocked internally. |
| 16 | GND | Ground. |
| 17 | ANT2 | Antenna port 2. Matched 50Ω and DC blocked internally. |
| 18 | GND | Ground. |
| 19 | GND | Ground. |
| 20 | ANTSEL | Control pin for antenna selection. See logic table. |
| 21 | N/C | Not connected. |
| 22 | VCC_LNA | Voltage supply pin for Rx low noise amplifier. |
| 23 | C_LNA | Control voltage pin for LNA/bypass modes. See logic table. |
| 24 | C_RX_TX | Control voltage pin for Tx/Rx modes. See logic table. |


7628 Thorndike Road, Greensboro, NC 27409-9421 · For sales or technical support, contact RFMD at (+1) 336-678-5570 or customerservice@rfmd.com.

## Pin Out


C_RX_TX
C_LNA
VCCLNA
N/C
ANTSEL
24
23
22
21
20
GND 1
CE 2
GND 3
CT 4
RFN 5
RFP 6
GND 7
19 GND
18 GND
17 ANT2
16 GND
15 ANT1
14 GND
13 GND
8
9
10
11
12
VCC_DIG
GND
VCC_PA
N/C
GND

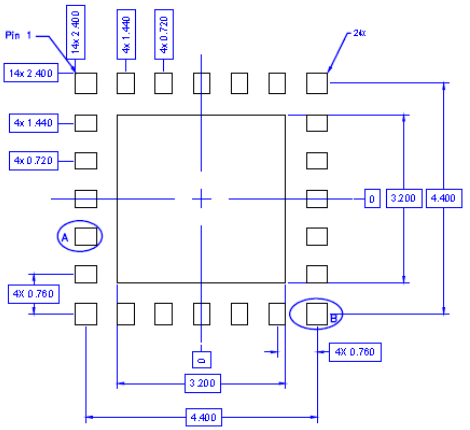
## Package Drawing



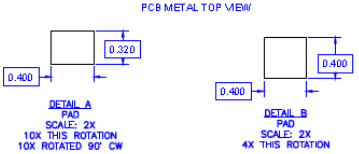



7628 Thorndike Road, Greensboro, NC 27409-9421 · For sales or technical support, contact RFMD at **(+1) 336-678-5570** or **customerservice@rfmd.com**.

## PCB Patterns

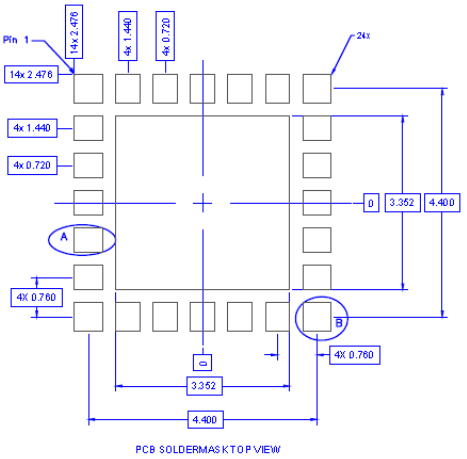



PCB METAL TOP VIEW

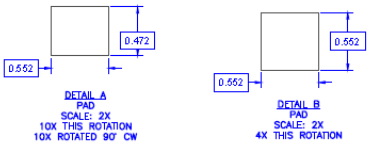



DETAIL A
PAD
SCALE: 2X
10X THIS ROTATION
10X ROTATED 90° CW

DETAIL B
PAD
SCALE: 2X
4X THIS ROTATION

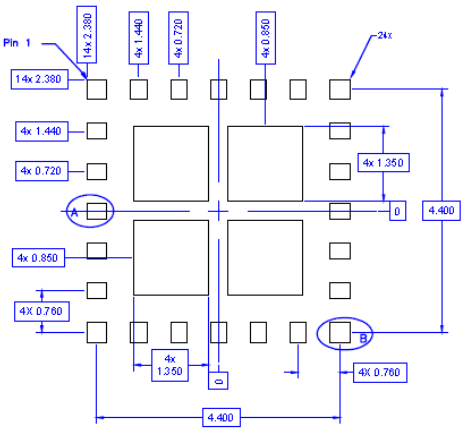



PCB SOLDERMASK TOP VIEW

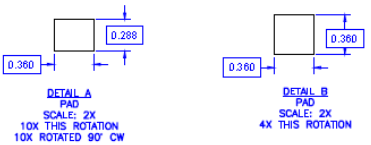



DETAIL A
PAD
SCALE: 2X
10X THIS ROTATION
10X ROTATED 90° CW

DETAIL B
PAD
SCALE: 2X
4X THIS ROTATION



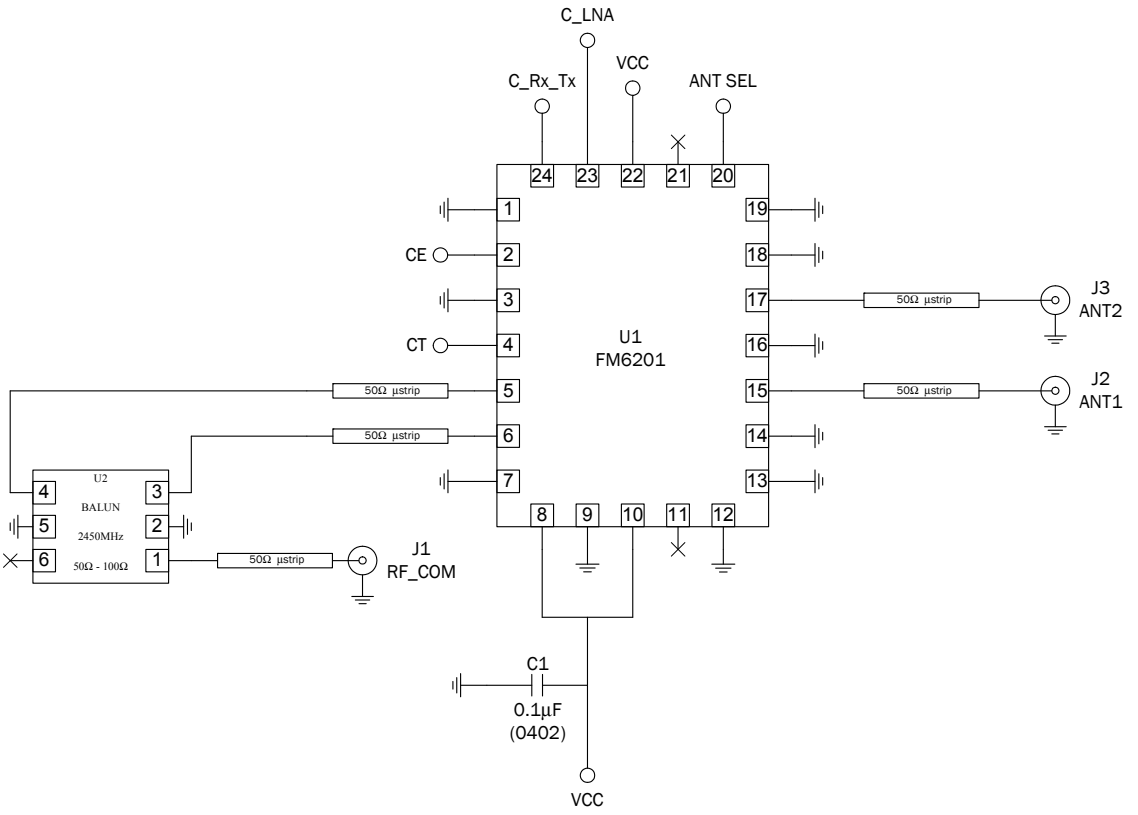

PCB STENCIL TOP VIEW



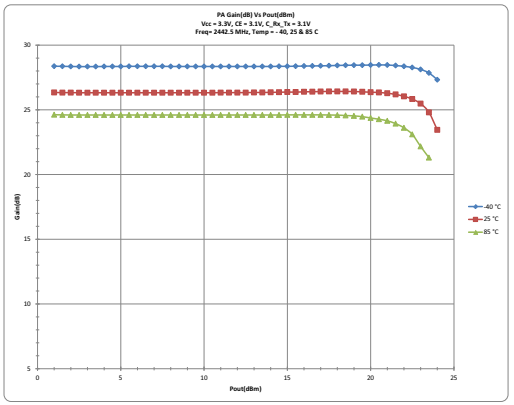
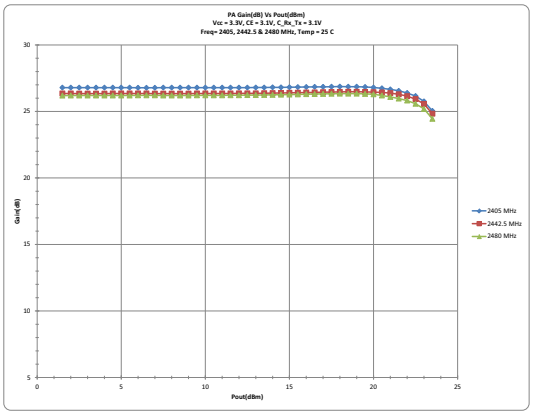
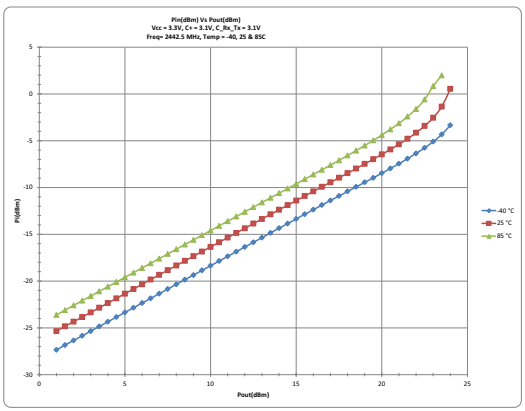
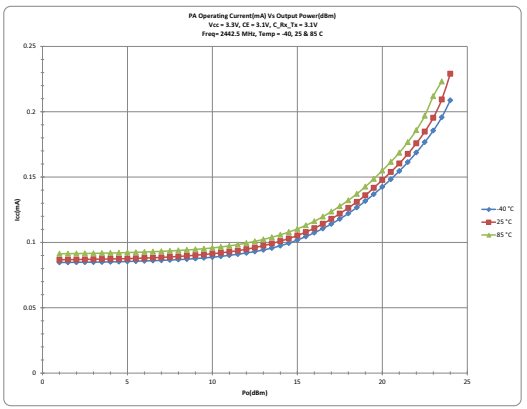
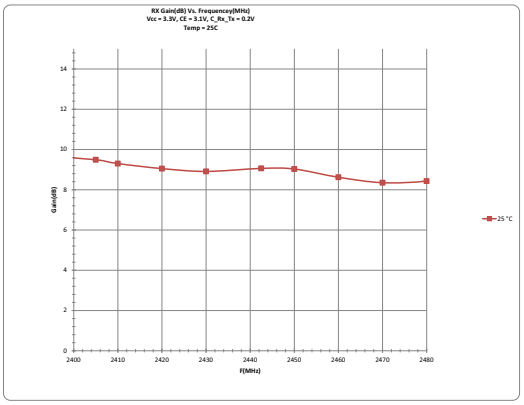
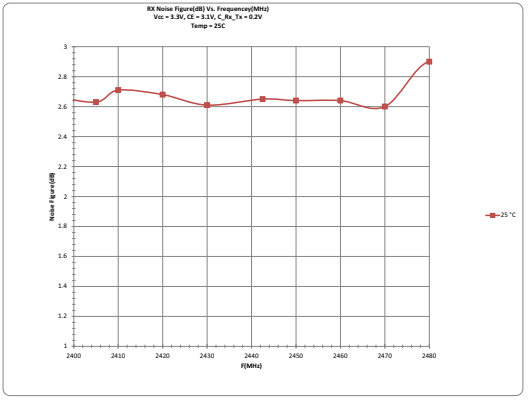

DETAIL A
PAD
SCALE: 2X
10X THIS ROTATION
10X ROTATED 90° CW

DETAIL B
PAD
SCALE: 2X
4X THIS ROTATION

## Application Schematic





7628 Thorndike Road, Greensboro, NC 27409-9421 · For sales or technical support, contact RFMD at (+1) 336-678-5570 or customerservice@rfmd.com.

# RFFM6201 2.4 GHz Front End Module