



Package: 20-Pin, 4.5mmx4.5mmx0.975mm

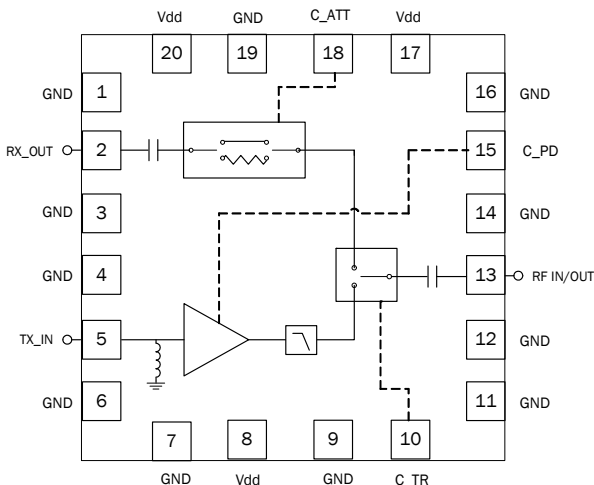


## Features

- Integrated 50Ω Input/Output Match
- Power Down Control
- TX OIP3 39dBm
- OP1dB 25dB
- 15dB RX Step Attenuator

## Applications

- MoCA
- Satellite Set Top Boxes



Functional Block Diagram

## Product Description

The RF5604 is a 475MHz to 625MHz Front-End Module (FEM) for the distribution of digital video within the home through existing coaxial cable. The FEM contains a linear GaAs Heterojunction Bipolar Transistor (HBT) Power Amplifier (PA) with a pHEMT Single-pole Double-throw (SPDT) switch, and a 1 bit step attenuator. The device is fully integrated with 50Ω input and output terminals with no external matching components required. The RF5604 is assembled in a small footprint 4.5mmx4.5mm RoHS package.

## Ordering Information

|               |                                                  |
|---------------|--------------------------------------------------|
| RF5604        | 5V, 475MHz to 625MHz FEM, Standard 25-Piece Bag  |
| RF5604SB      | 5-Piece Bag                                      |
| RF5604SR      | Standard 100-Piece Reel                          |
| RF5604TR13    | Standard 2500-Piece Reel                         |
| RF5604PCK-410 | Fully Assembled Evaluation Board and 5-Piece Bag |

## Optimum Technology Matching® Applied

|                                              |                                      |                                                |                                   |
|----------------------------------------------|--------------------------------------|------------------------------------------------|-----------------------------------|
| <input checked="" 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"/> RF MEMS  |
| <input type="checkbox"/> InGaP HBT           | <input type="checkbox"/> SiGe HBT    | <input type="checkbox"/> Si BJT                | <input type="checkbox"/> LDMOS    |

## Absolute Maximum Ratings

| Parameter                        | Rating                  | Unit            |
|----------------------------------|-------------------------|-----------------|
| Supply Voltage                   | +5.5                    | V <sub>DC</sub> |
| Power Control Voltage (C_PD)     | +5.5                    | V <sub>DC</sub> |
| DC Supply Current                | 260                     | mA              |
| PA Input RF Power                | +20*                    | dBm             |
| Operating Ambient Temperature    | 0 to +70                | °C              |
| Reduced Performance Temperatures | -40 to 0 and +70 to +85 | °C              |
| Storage Temperature              | -40 to +150             | °C              |
| Moisture Sensitivity             | MSL3                    |                 |

\*Maximum PA Input RF Power with a 50Ω load.

**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.            |      |                                                                                                                               |
| <b>Operating Conditions</b>                             |               |       |                 |      | T=25 °C, V <sub>CC</sub> =5.0V <sub>DC</sub> , C_PD=2.9V <sub>DC</sub> , Freq=550MHz, circuit per evaluation board schematic. |
| Supply Voltage (V <sub>DD</sub> )                       | 4.75          | 5.0   | 5.25            | V    |                                                                                                                               |
| Operating Ambient Temperature Range (T <sub>AMB</sub> ) | 0             |       | 70              | °C   |                                                                                                                               |
| <b>DC Electrical Specifications</b>                     |               |       |                 |      |                                                                                                                               |
| Supply Current (I <sub>DD</sub> )                       |               |       | 200             | mA   | V <sub>DD</sub> =5.0V                                                                                                         |
| Input Logic High (V <sub>IH</sub> )                     | 2.8           |       | V <sub>DD</sub> | V    | For C_PD; I <sub>S</sub> ≤3mA (sink current)                                                                                  |
|                                                         | 1.7           |       | V <sub>DD</sub> | V    | For C_TR and C_ATT; I <sub>S</sub> ≤100uA (sink current)                                                                      |
| Input Logic Low (V <sub>IL</sub> )                      | -0.5          |       | +0.4            | V    | For C_PD                                                                                                                      |
|                                                         | -0.5          |       | +0.05           | V    | For C_TR and C_ATT I <sub>S</sub> ≤100uA (source current)                                                                     |
| Shutdown Current                                        |               | 0.6   | 1.0             | mA   | C_PD=0V                                                                                                                       |
|                                                         |               | 0.4   | 0.8             | mA   | C_PD=0V, C_ATT=C_TR=0V                                                                                                        |
| <b>RX Chain</b>                                         |               |       |                 |      |                                                                                                                               |
| Frequency Range                                         | 475           |       | 625             | MHz  |                                                                                                                               |
| Input Power Range                                       | -80           |       | 0               | dBm  | Receive Signal BW≤50MHz                                                                                                       |
| Receive Gain 1 (G <sub>R1</sub> )                       | -0.7          | -1.0  |                 | dB   | C_ATT=L                                                                                                                       |
| Receive Gain 2 (G <sub>R2</sub> )                       | -14.5         | -15.7 | -16.5           | dB   | C_ATT=H                                                                                                                       |
| Receive Gain Step Difference (ΔG <sub>R</sub> )         | 14.5          | 15.0  | 15.5            | dB   | G <sub>R1</sub> to G <sub>R2</sub> at any (single) Frequency                                                                  |
| Pass Band Ripple                                        |               |       | 0.2             | dB   | Over any 50MHz                                                                                                                |
| Switch Time                                             |               |       | 500             | ns   | G <sub>R2</sub> to G <sub>R1</sub> ; G <sub>R1</sub> to G <sub>R2</sub> ; 50% CTL to 10/90% RF                                |
| Impedance (Z <sub>IN</sub> /Z <sub>OUT</sub> )          |               |       | 50              | Ω    | Single Ended                                                                                                                  |
| Input Return Loss (S <sub>11</sub> )                    | 11            | 15    |                 | dB   |                                                                                                                               |
| Output Return Loss (S <sub>22</sub> )                   | 11            | 15    |                 | dB   |                                                                                                                               |
| Input Third Order Intercept Point (IIP3)                | 28            | 30    |                 | dBm  | G <sub>R1</sub>                                                                                                               |
|                                                         | 28            | 33    |                 | dBm  | G <sub>R2</sub>                                                                                                               |
| Input P1dB (IP1dB)                                      | 18            |       |                 | dBm  | G <sub>R1</sub>                                                                                                               |
|                                                         | 18            |       |                 | dBm  | G <sub>R2</sub>                                                                                                               |

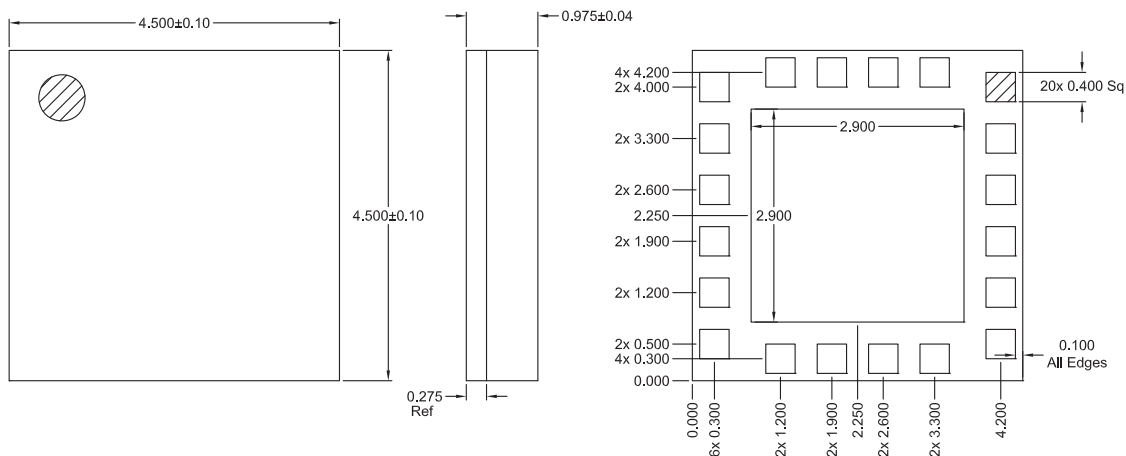
| Parameter                                | Specification |      |       | Unit   | Condition                                                            |
|------------------------------------------|---------------|------|-------|--------|----------------------------------------------------------------------|
|                                          | Min.          | Typ. | Max.  |        |                                                                      |
| RX Chain, cont.                          |               |      |       |        |                                                                      |
| Noise Figure (NF)                        | 0.7           | 1.0  |       | dB     | GR <sub>1</sub> ; Exclusive of PA contribution                       |
|                                          | 14.5          | 15.7 | 16.5  | dB     | GR <sub>2</sub> ; Exclusive of PA contribution                       |
| TX/RX Switch Time                        |               |      | 500   | ns     | 50% CTL to 10/90% RF; Receive mode C_TR=L; Transmit mode C_TR=H      |
| RX (added) Noise                         |               |      | -177  | dBm/Hz | Noise contribution of PA output to RX_OUT in RX Mode GR <sub>1</sub> |
| TX Chain                                 |               |      |       |        |                                                                      |
| Frequency Range                          | 475           |      | 625   | MHz    |                                                                      |
| Pass Band Ripple                         |               |      | 0.5   | dB     |                                                                      |
| Transmit Gain (G <sub>T</sub> )          | 16.0          | 17.5 | 19.0  | dB     | Temp Range 0 °C to +70 °C over any 50MHz                             |
| Maximum Transmit Power                   |               |      | 9.5   | dBm    |                                                                      |
| Minimum Transmit Power                   |               |      | -33   | dBm    |                                                                      |
| Input Third Order Intercept Point (IIP3) |               | 14   | 19    |        | Temp Range 0 °C to +70 °C; TX Power +1 > +9dBm                       |
| Input 1dB Compression Point (IP1dB)      | 5.5           | 8.5  |       | dBm    | Temp Range 0 °C to +70 °C; TX Power +1 > +9dBm                       |
| Noise Figure (NF)                        |               |      | 5     | dB     | G <sub>T</sub>                                                       |
| Input Impedance (Z <sub>IN</sub> )       |               |      | 50    | Ω      |                                                                      |
| Input Return Loss (S <sub>11</sub> )     | 10            | 15   |       | dB     |                                                                      |
| Output Impedance (Z <sub>OUT</sub> )     |               |      | 50    | Ω      |                                                                      |
| Output Return Loss (S <sub>22</sub> )    | 10            | 15   |       | dB     |                                                                      |
| TX/RX Switch Time                        |               |      | 500   | ns     | 50% CTL to 10/90% RF; Receive mode C_TR=L; Transmit mode C_TR=H      |
| Transmit Gain Drift versus Temperature   |               |      | 0.015 | dB/°C  |                                                                      |
| PA Output to RX Output Isolation         | 24            | 38   |       | dB     | TX Mode (C_TR=H; C_ATT=L)                                            |
| Spurious (2nd Harmonic)                  |               |      | -30   | dBm    | TX Power=9dBm; TX Mode                                               |
| Spurious (All Others)                    |               |      | -50   | dBm    | TX Power=9dBm; TX Mode                                               |

**Truth Table**

| Mode      | C_TR | C_PD | C_ATT |
|-----------|------|------|-------|
| TX        | H    | H    | L/H   |
| RX        | L    | H    | L     |
| RX_ATTEN  | L    | H    | H     |
| Shut Down | L/H  | L    | L/H   |

| Pin | Function | Description                                                                                                                                                                         |
|-----|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | GND      | Ground connection.                                                                                                                                                                  |
| 2   | RX OUT   | RF output, internally matched to 50Ω and DC blocked.                                                                                                                                |
| 3   | GND      | Ground connection.                                                                                                                                                                  |
| 4   | GND      | Ground connection.                                                                                                                                                                  |
| 5   | TX IN    | RF input, internally matched to 50Ω.                                                                                                                                                |
| 6   | GND      | Ground connection.                                                                                                                                                                  |
| 7   | GND      | Ground connection.                                                                                                                                                                  |
| 8   | VDD3     | Voltage supply for PA.                                                                                                                                                              |
| 9   | GND      | Ground connection.                                                                                                                                                                  |
| 10  | C_TR     | Control voltage for 1-bit switch between transmit and receive RF paths.                                                                                                             |
| 11  | GND      | Ground connection.                                                                                                                                                                  |
| 12  | GND      | Ground connection.                                                                                                                                                                  |
| 13  | RF I/O   | RF INPUT/OUTPUT, matched to 50Ω and DC blocked.                                                                                                                                     |
| 14  | GND      | Ground connection.                                                                                                                                                                  |
| 15  | C_PD     | Bias voltage for PA regulator.                                                                                                                                                      |
| 16  | GND      | Ground connection.                                                                                                                                                                  |
| 17  | VDD2     | Voltage supply for switch/regulator.                                                                                                                                                |
| 18  | C_ATT    | Control voltage for 1-bit attenuator between receive modes 1 and 2.                                                                                                                 |
| 19  | GND      | Ground connection.                                                                                                                                                                  |
| 20  | VDD1     | Voltage supply for attenuator.                                                                                                                                                      |
| 21  | GND      | Ground connection. The back side of the package should be connected to the ground plane through as short a connection as possible, e.g., PCB vias under the device are recommended. |

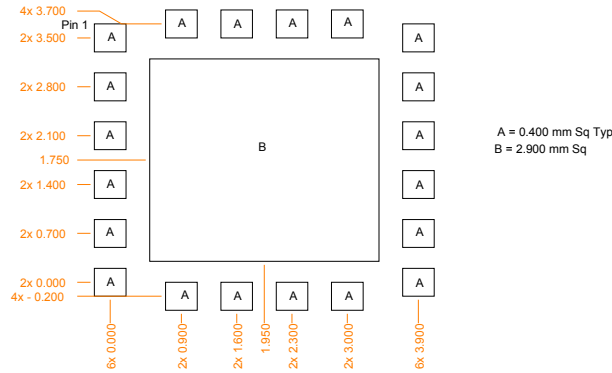
## Package Drawing 20-pin, 4.5mmx4.5mmx0.975mm



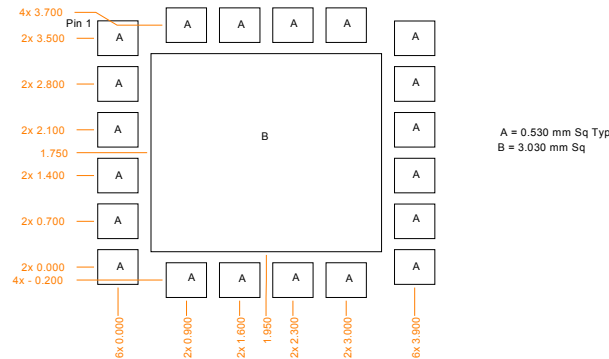
### Notes:

1. Shaded area represents Pin 1 location
2. Defining I/O Pad Center:  
To define center of the I/O pad opening, draw a right triangle in one corner of the I/O pad  
Then take the center of the hypotenuse to determine center of I/O pad

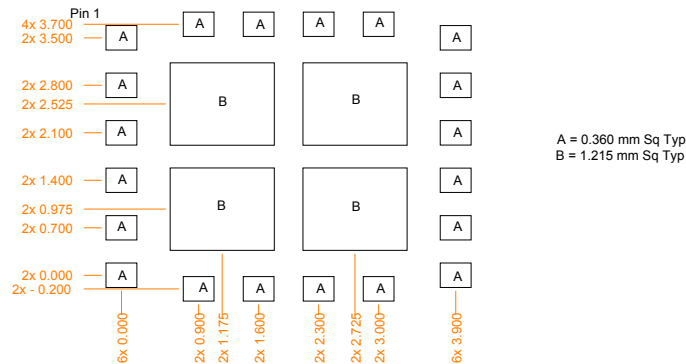
## PCB Metal Land Pattern (Top View)



## PCB Solder Mask Pattern (Top View)

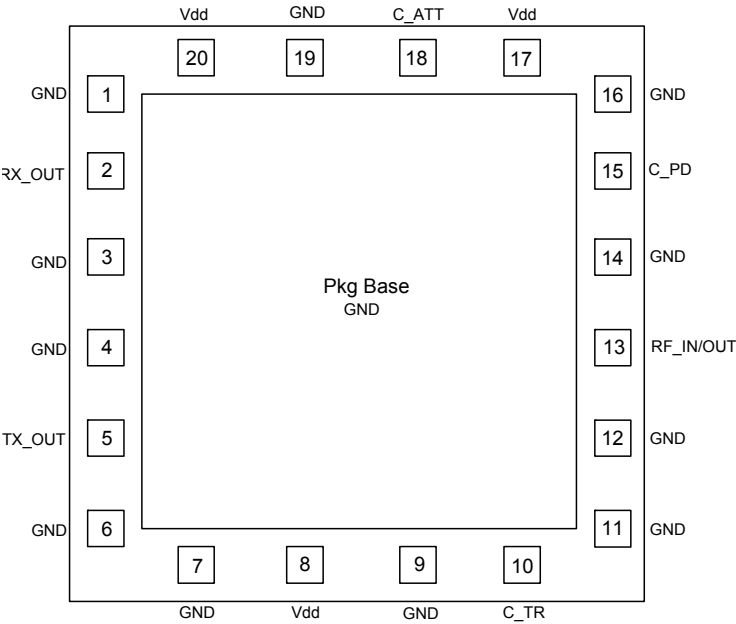


## PCB Stencil Pattern (Top View)

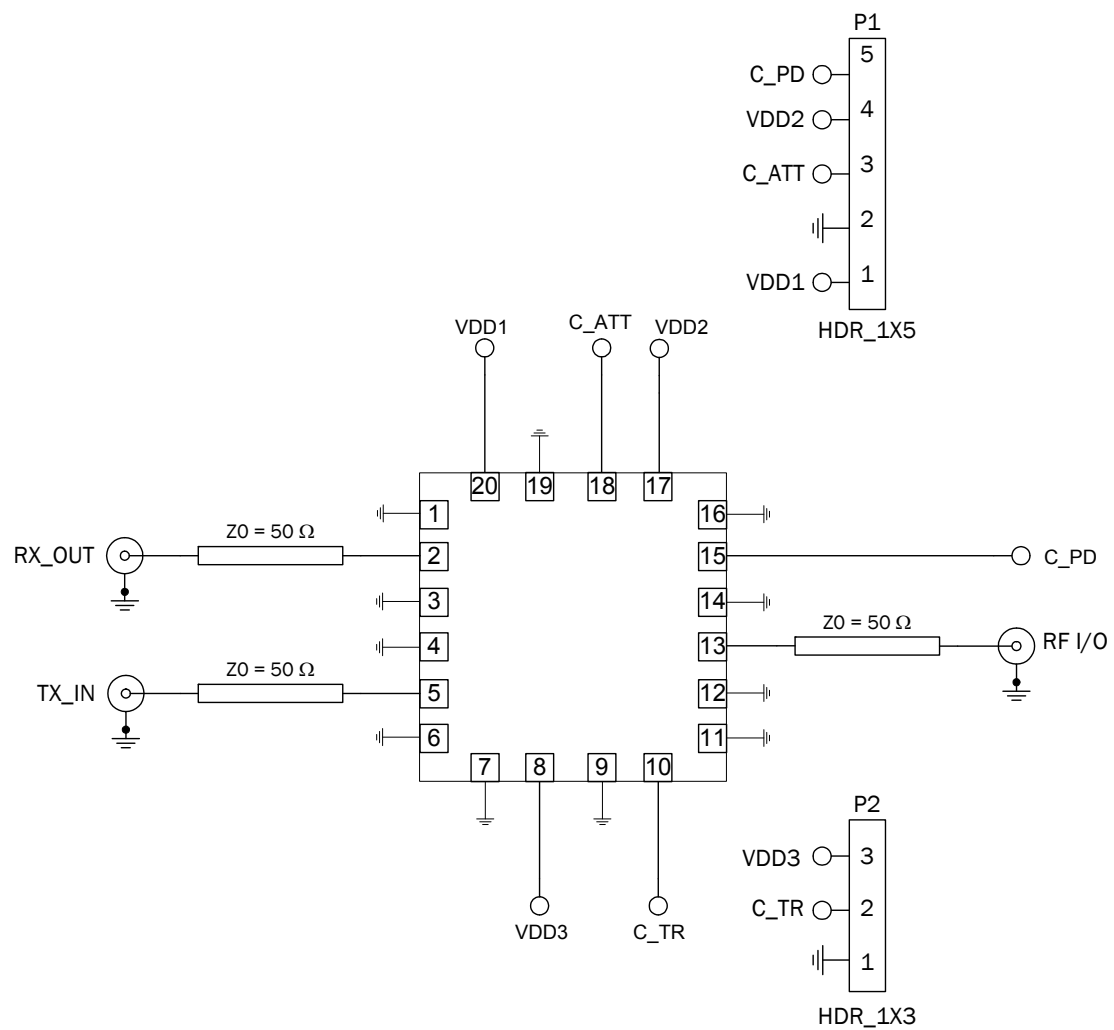


Note: Thermal vias for center slug "B" should be incorporated into the PCB design. The number and size of thermal vias will depend on the application. Example of the number and size of vias can be found on the RFMD evaluation board layout.

**Pin Out**



Evaluation Board Schematic



## Evaluation Board Layout

