Revised Date: Jan. 16, 2007

# QRZ-3000-PA ZigBee Transceiver

## Description

The QRZ-3000-PA is a miniature 2.4 GHz Direct Sequence Spread Spectrum ZigBee transceiver. It includes all RF hardware and a micro-controller to manage the communications link. The micro-controller manages all communications task including configuration, data packaging, and clear channel selection. The result is a complete wireless data communications solution.

The QRZ-3000-PA package is unique because of its small form factor (49.5 x 40 $mm^2$), It has an on-board chip antenna and the availability of external dipole antenna SMA connector. No competitive products can offer a solution as flexible, convenient, and easy to integrate,

There are four QRZ-3000 models; the QRZ-3000 with the on-board chip antenna and dipole antenna SMA connector, the QRZ-3000-PA with power amplifier, low noise amplifier and dipole antenna SMA connector. The power amplifier enhances the transmission power and low noise amplifier increase receiving signal sensitivity. The power amplifier, low noise amplifier while the QRZ-3000 lowers system cost and simplifies integration. Development Kits are available for each version. Two pin-compatible variants are also available, the QRZ-3000A and QRZ-3000A-PA, for applications with pre-loaded transceiver program requirements. The QRZ-3000A is same hardware as QRZ-3000 with pre-loaded transceiver program. The QRZ-3000A-PA is same hardware as QRZ-3000-PA with pre-loaded transceiver program.

## Models

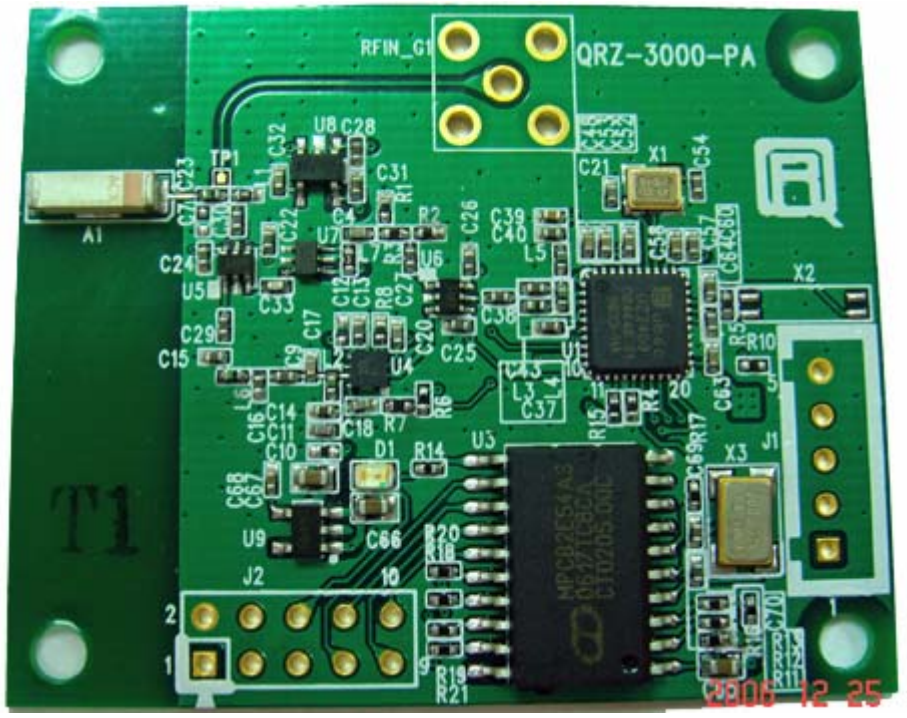
- QRZ-3000: Includes on-board chip antenna and Dipole Antenna Connector
- QRZ-3000-PA: Includes Power Amplifier, Low Noise Amplifier and Dipole Antenna Connector
- QRZ-3000A: Transceiver program pre-loaded QRZ-3000
- QRZ-3000A-PA: Transceiver program pre-loaded QRZ-3000A
- QRZ-2200K: 2 nodes Development Kit
- QRZ-2400K: 4 nodes Development Kit

## Features

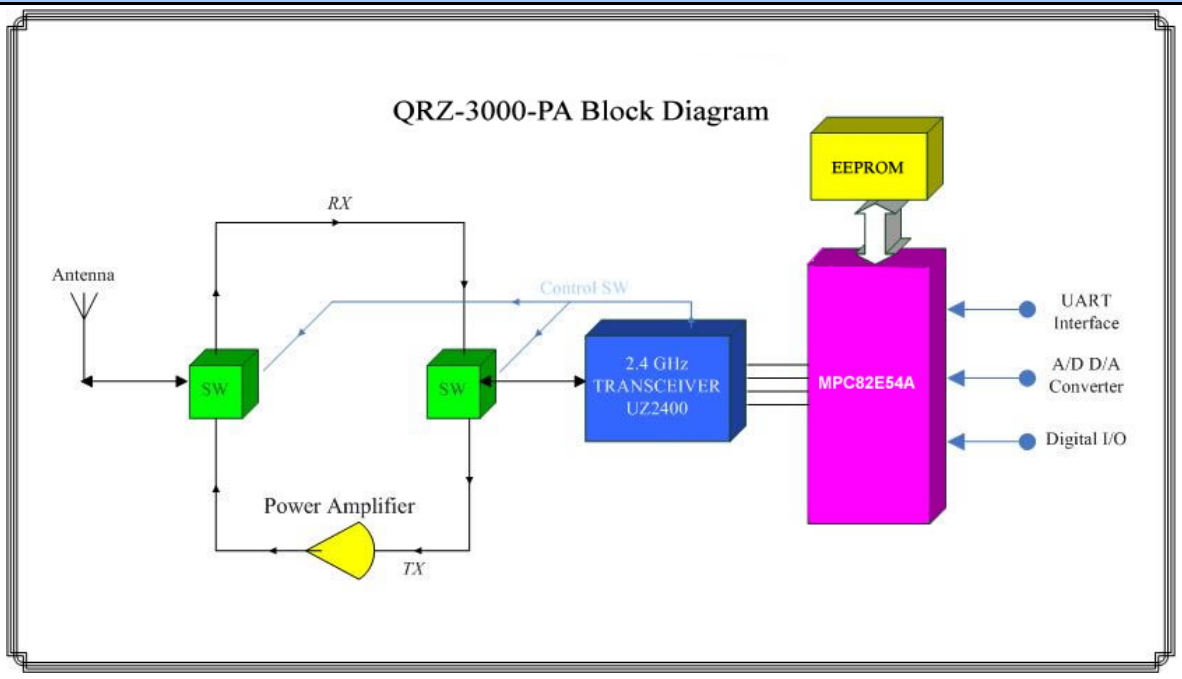
- 49.5 x 40 $mm^2$ PCBA package with 2 connectors
- Utilizes globally available 2.4 GHz ISM band
- Control and Configuration with AT commands.
- 65535 unique node addresses, IDs allow multiple large networks to coexist.
- Programmable Transmit Power Output, max. 15 dBm
- Complete IEEE 802.15.4 spec compliant

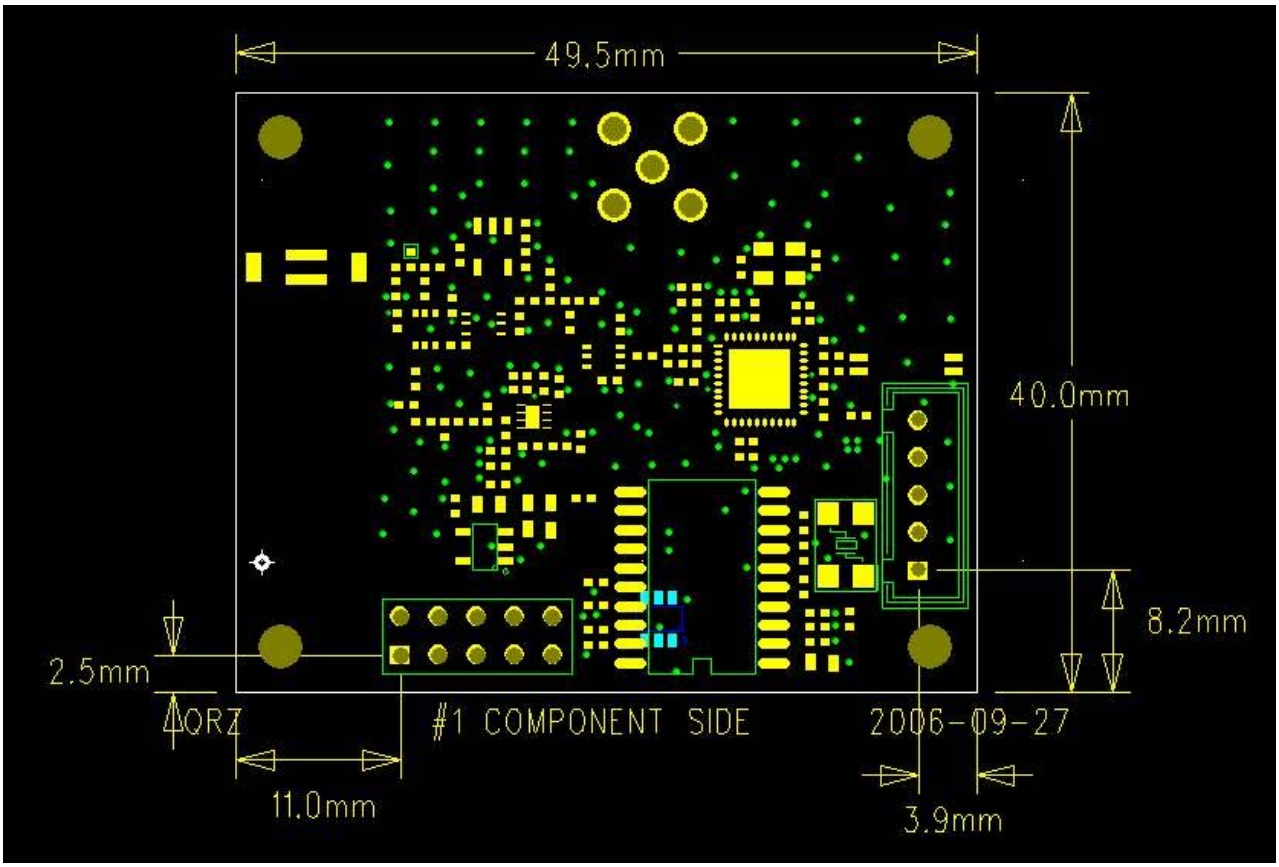
- Typical Receiver Sensitivity –95 dBm
- Typical Throughput rate 250,000 bps
- Obstructed signal range to 500 meters @ 15 dBm
- Multiple Low Power Operating modes

**QRZ-3000-PA ZigBee Transceiver Module**




## QRZ-3000-PA MECHANICAL SPECIFICATIONS






Note : The thickness of PCB board (including PCB and components) is 3.632 mm

## Using the QRZ-3000-PA Power Saving Modes

The QRZ-3000-PA includes several low power operating modes to permit the most efficient use of the available power. Below are descriptions of the available selections.

**ACTIVE:** In Active Mode, all QRZ-3000-PA circuits are powered and available for immediate action. This includes the RF receiver which actively monitors the air for an incoming communications request. Two sub-modes are classified as TX-ACTIVE and RX-ACTIVE. The current consumption of TX-ACTIVE is 22 mA while RX-ACTIVE is 18 mA.

**IDLE:** In Idle mode, all QRZ-3000-PA RF circuits are shut down but the communications controller remains active to accept AT commands. The QRZ-3000-PA cannot respond to incoming RF communications requests in Power-Down mode. If a transmit RF or receive RF command is received, The QRZ-3000-PA can activate the RF section in under 200 microseconds. Current draw in Idle Mode is less than 7.5 milliamps.

**STANDBY**: In Standby mode, all QRZ-3000-PA RF, MAC and Base Band circuits are powered-down with sleep clock remains active to minimize power consumption. The

QRZ-3000-PA cannot accept commands or respond to incoming RF communications requests from Standby mode. Any input on TXD awakens the transceiver. Current draw in Standby Mode is less than 3.5 uA.

**DEEP SLEEP**: In Deep Sleep Mode, all QRZ-3000-PA circuits are shutdown except digital-side power. Current draw in Deep Sleep Mode is only 2 uA.

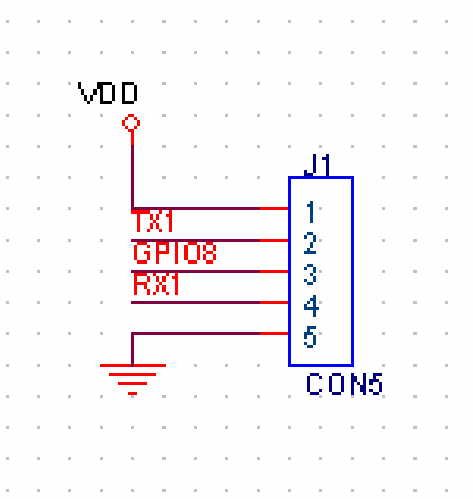
**WAKE-UP**: QRZ-3000-PA has two wake-up modes: timed wake-up and immediate wake-up. Timed wake-up has two sub-modes: beacon and non-beacon modes. However, if programmer sets both “main counter” and “remain counter” zero, QRZ-3000-PA will not wake up without immediate wake-up. QRZ-3000-PA can be wakened up externally. It can also be wakened up by setting internal register.

## QRZ-3000-PA CONNECTORS PIN CONFIGURATION

QRZ-3000-PA uses Megawin MPC82E54A as MCU. It is an 8051 base MCU and reserves 10 GPIO pins for external controlling by application. Each pin can be a general I/O pin and programmed it by user directly. Furthermore, most of these pins can be used as special purpose function. Thereof TX, RX pins can be programmed as UART for data communication. For example, user is easy to connect these pins with RS485 transceivers such as 75176, MAX485, or programs to a 10-bit ADC, or PCA.

QRZ-3000-PA ZigBee transceiver provides J1, J2 two connectors for application usage. The J1 connector circuit and pin configuration show as below in which VDD and GND are used for power supply. The TX and RX are used for UART transmitting and receiving data. But TX and RX are used in pair. That means you can’t use TX or RX only and use another pin as GPIO. The pin 3 is a MCU GPIO pin and defined as port 1.3. In programming stage, TX, VDD and GND of J1 are also defined as Megawin ISP programming interface for downloading the program

**Connector J1 Pin Configuration**

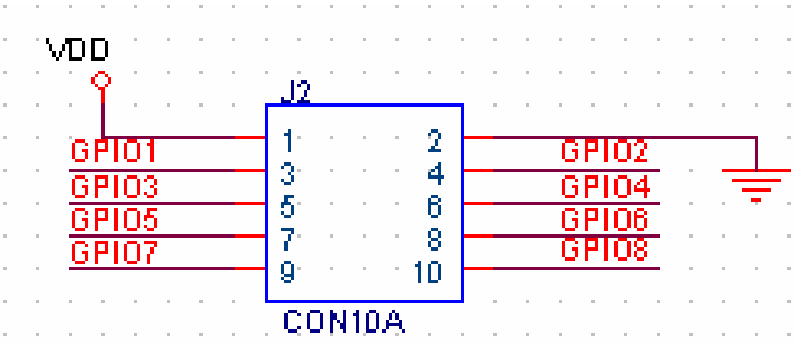



**Connector J1 Pin Configuration**

| Signal | Pin | Description |
|---|---|---|
| VDD | 1 | 3.3 Volt power for the QRZ-3000-PA |
| TX | 2 | GPIO, also used as UART TX, transmit Data is the data input to the QRZ-3000-PA |
| RX | 3 | GPIO, also used as UART RX, received Data is the data output from the QRZ-3000-PA. |
| P1.3 | 4 | GPIO8, also used as ADC3, this pin is same pin as J2 pin 10 |
| GND | 5 | Common voltage reference for the QRZ-3000-PA |

The J2 connector circuit and the pin configuration show as below in which VDD and GND are used for power supply. The pin 3 to P10 are MCU GPIO pins and defined as port 1.0~port 1.3, port3.3~port3.5, port3.7 respectively. These GPIO pins can interface with other devices such as sensor, LED, host controller, push button, joystick or power relays through a 5x2 connector. All of these GPIO pins can be programmed as other functions such as external interrupt, 10-bit ADC (3 sets), timer (16-bit), PGA(Programmable Counter Array) etc. The detail function definitions have showed as below.

**Connector J2 Pin Configuration**




**Connector J2 Pin Configuration**

| Signal | Pin | Description |
|---|---|---|
| VDD | 1 | 3.3 Volt power for the QRZ-3000-PA |
| GND | 2 | Common voltage reference for the QRZ-3000-PA |
| GPIO1 | 3 | GPIO port 3.3, may be programmed as either a digital input or digital output. It also can be programmed as external interrupt |
| GPIO2 | 4 | GPIO port 3.4, may be programmed as either a digital input or digital output. It also can be programmed as external clock input to PCA as alternative clock input to timer-0 |
| GPIO3 | 5 | GPIO port 3.5, may be programmed as either a digital input or digital output. It also can be programmed as external clock input to PCA as alternative clock input to timer-1 |
| GPIO4 | 6 | GPIO port 3.7, may be programmed as either a digital input or digital output. It also can be programmed as external clock input to PCA |
| GPIO5 | 7 | GPIO port 1.0, may be programmed as either a digital input or digital output. It also can be programmed as analog to digital converter (ADC0) |
| GPIO6 | 8 | GPIO port 1.1, may be programmed as either a digital input or digital output. It also can be programmed as analog to digital converter (ADC1) |
| GPIO7 | 9 | GPIO port 1.2, may be programmed as either a digital input or digital output. It also can be programmed as analog to digital converter (ADC2) |
| GPIO8 | 10 | GPIO port 1.3, may be programmed as either a digital input or digital output. It also can be programmed as analog to digital converter (ADC3) |

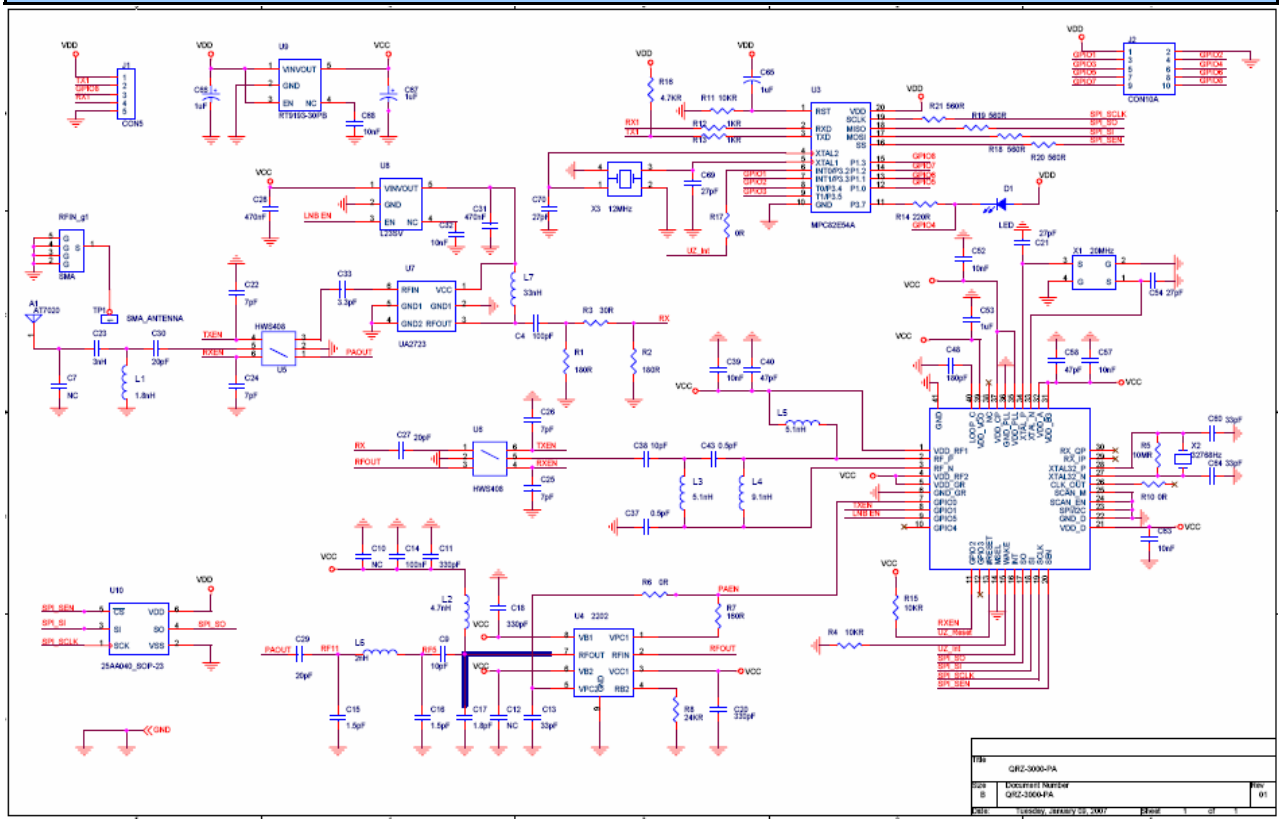
| Absolute Maximum Rating | |
|---|---|
| VCC | 3.6V |
| Storage temperature | -40°C to +120°C |
| Operating temperature Range | -30°C to +80°C |

WARNING: Exceeding any of these ratings will void the warranty and may damage the device

## QRZ-3000-PA ELECTRICAL SPECIFICATIONS

| Parameters | Min | Typ | Max | Units |
|---|---|---|---|---|
| Supply Voltage for RF, analog and digital circuits | 2.4 | | 3.6 | V |
| Supply Voltage for Digital I/O | 2.4 | 3.3 | 3.6 | V |
| Current Consumption | | | | |
| ACTIVE TX Mode @ 15 dBm | | 77 | | mA |
| ACTIVE RX Mode | | 18 | | mA |
| IDLE Mode | | 7.5 | | mA |
| STANDBY Mode | | 3.5 | | uA |
| DEEP SLEEP Mode | | 2 | | uA |
| Output Power | -23.75 | 15 | | dBm |
| Wireless Receive Sensitivity | | -95 | | dBm |
| Range thru no Physical Obstructions @ 15 dBm | | 500 | | meter |
| Selectable Channels | | 16 | | channel |
| Frequency Band | 2.400 | | 2.4835 | GHz |
| Antenna Output Impedance | | 50 | | Ohms |

## QRZ-3000-PA CIRCUIT DIAGRAM



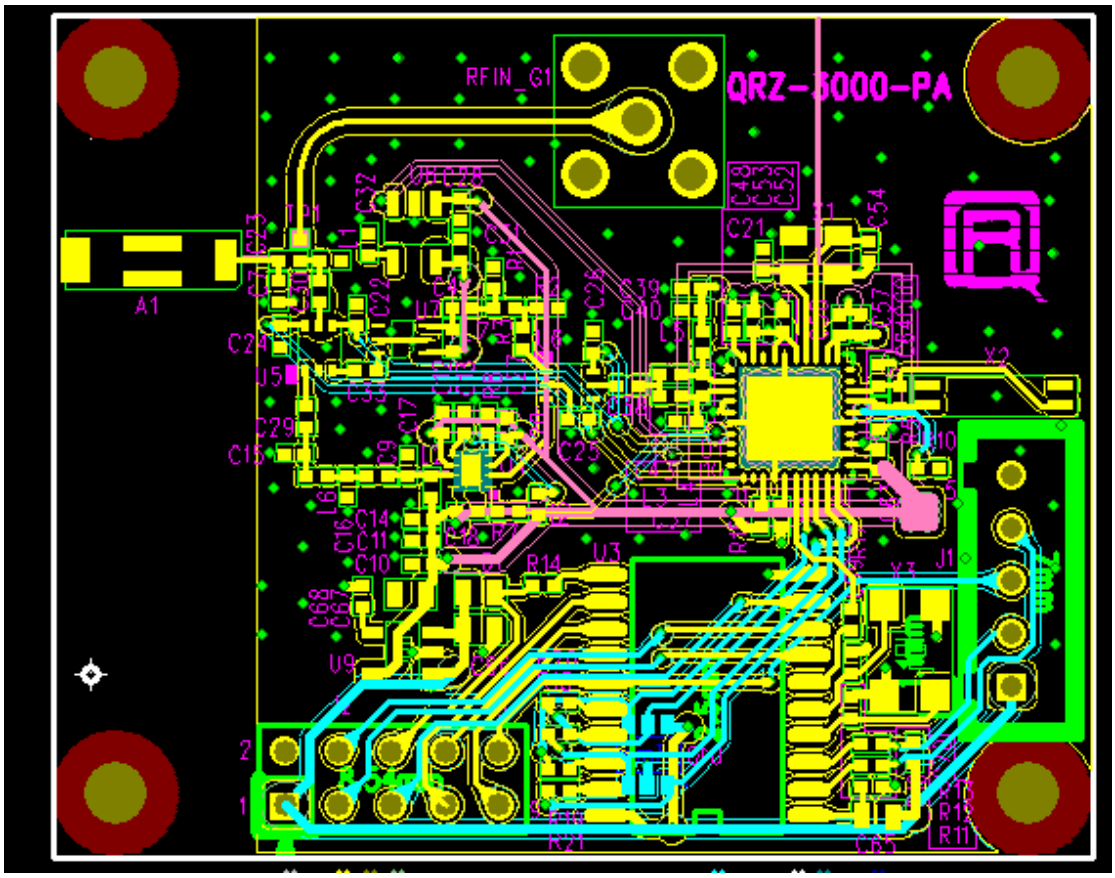
## PART LIST OF QRZ-3000-PA CIRCUIT DIAGRAM

| Item | Quantity | Reference | Part | Description |
|---|---|---|---|---|
| 1 | 1 | A1 | AT7020 | LCC8 |
| 2 | 1 | C4 | 100pF | 0402 |
| 3 | 1 | C7 | NC | 0402 |
| 4 | 1 | C9 | 10pF | 0402 |
| 5 | 2 | C10,C12 | NC | 0402 |
| 6 | 3 | C11,C18,C20 | 330pF | 0402 |
| 7 | 1 | C13 | 33pF | 0402 |
| 8 | 1 | C14 | 100nF | 0402 |
| 9 | 2 | C16,C15 | 1.5pF | 0402 |
| 10 | 1 | C17 | 1.8pF | 0402 |
| 11 | 2 | C21,C54 | 27pF | 0402 |
| 12 | 4 | C22,C24,C25,C26 | 7pF | 0402 |
| 13 | 1 | C23 | 3nH | 0402 |
| 14 | 2 | C27,C29 | 20pF | 0402 |
| 15 | 2 | C31,C28 | 470nF | 0402 |

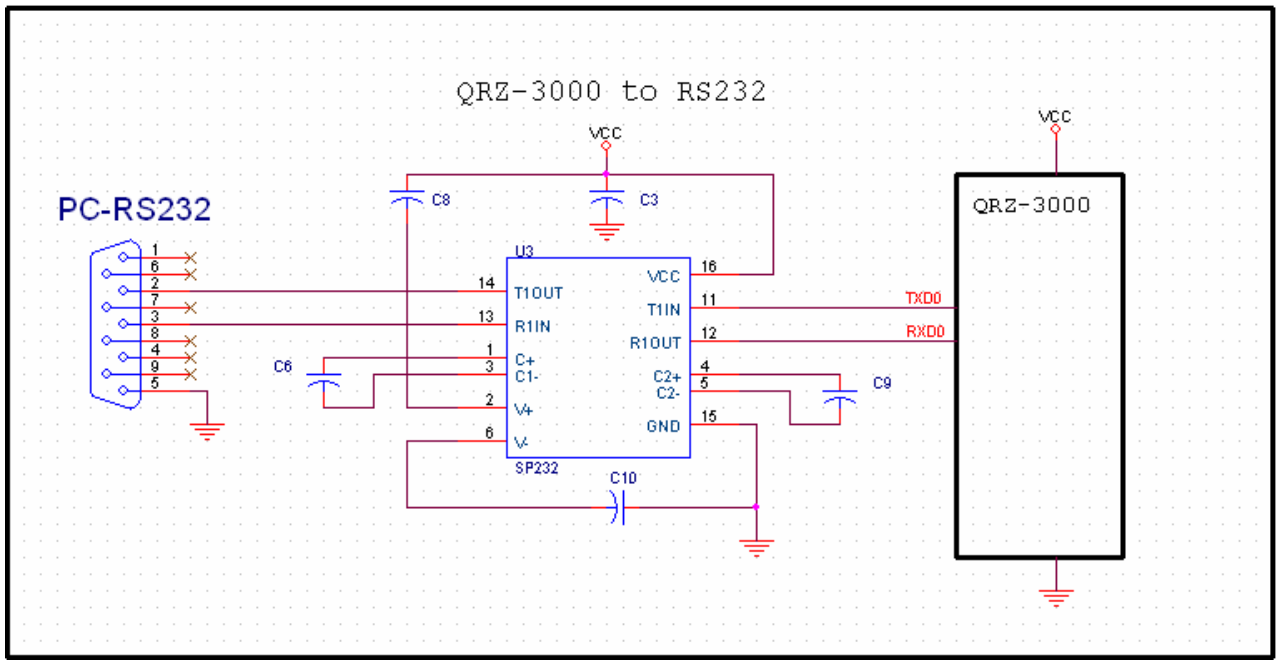
| | | | | |
|---|---|---|---|---|
| 16 | 1 | C30 | 20pF | 0402 |
| 17 | 1 | C32 | 10nF | 0402 |
| 18 | 1 | C33 | 3.3pF | 0402 |
| 19 | 2 | C37,C43 | 0.5pF | 0402 |
| 20 | 1 | C38 | 10pF | 0402 |
| 21 | 4 | C39,C52,C58,C63 | 10nF | 0402 |
| 22 | 2 | C57,C40 | 47pF | 0402 |
| 23 | 1 | C48 | 180pF | 0402 |
| 24 | 1 | C53 | 1uF | 0402 |
| 25 | 2 | C60,C64 | 33pF | 0402 |
| 26 | 3 | C65,C66,C67 | 1uF | 0805 |
| 27 | 1 | C68 | 10nF | 0402 |
| 28 | 2 | C69,C70 | 27pF | 0402 |
| 29 | 1 | D1 | LED | 0805 |
| 30 | 1 | J1 | CON5 | WAFER-A2501WV-5P |
| 31 | 1 | J2 | CON10A | HD5X2_2.54 |
| 32 | 1 | L1 | 1.8nH | 0402 |
| 33 | 1 | L2 | 4.7nH | 0402 |
| 34 | 2 | L5,L3 | 5.1nH | 0402 |
| 35 | 1 | L4 | 9.1nH | 0402 |
| 36 | 1 | L6 | 2nH | 0402 |
| 37 | 1 | L7 | 33nH | 0402 |
| 38 | 1 | RFIN_g1 | SMA | |
| 39 | 2 | R2,R1 | 180R | 0402 |
| 40 | 1 | R3 | 30R | 0402 |
| 41 | 1 | R4 | 10KR | 0402 |
| 42 | 1 | R5 | 10MR | 0402 |
| 43 | 2 | R6,R17 | 0R | 0402 |
| 44 | 1 | R7 | 160R | 0402 |
| 45 | 1 | R8 | 24KR | 0402 |
| 46 | 1 | R10 | 0R | 0402 |
| 47 | 2 | R15,R11 | 10KR | 0402 |
| 48 | 2 | R12,R13 | 1KR | 0402 |
| 49 | 1 | R14 | 220R | 0402 |
| 50 | 1 | R16 | 4.7KR | 0402 |
| 51 | 4 | R18,R19,R20,R21 | 560R | 0402 |

| | | | | |
|---|---|---|---|---|
| 52 | 1 | TP1 | SMA_ANTENNA | TP24S |
| 53 | 1 | U1 | UZ2400 | QFP40-0.5 |
| 54 | 1 | U3 | MPC82E54A | SOP20-7.5_1.27 |
| 55 | 1 | U4 | UP2202 | 2_2_8LEAD |
| 56 | 2 | U6,U5 | HWS408 | AS179 |
| 57 | 1 | U7 | UA2723 | SOT363 |
| 58 | 1 | U8 | L23SV | SOT23-5 |
| 59 | 1 | U9 | RT9193-30PB | SOT-23-5 |
| 60 | 1 | U10 | 25AA040_SOP-23 | SOT-23-6 |
| 61 | 1 | X1 | 20MHz | CX_101F |
| 62 | 1 | X2 | 32768Hz | OSC2 |
| 63 | 1 | X3 | 12MHz | XTAL-5X3.2-4P_S |

## QRZ-3000-PA PCB LAYOUT




## QRZ-3000-PA APPLICATION CIRCUIT DIAGRAM

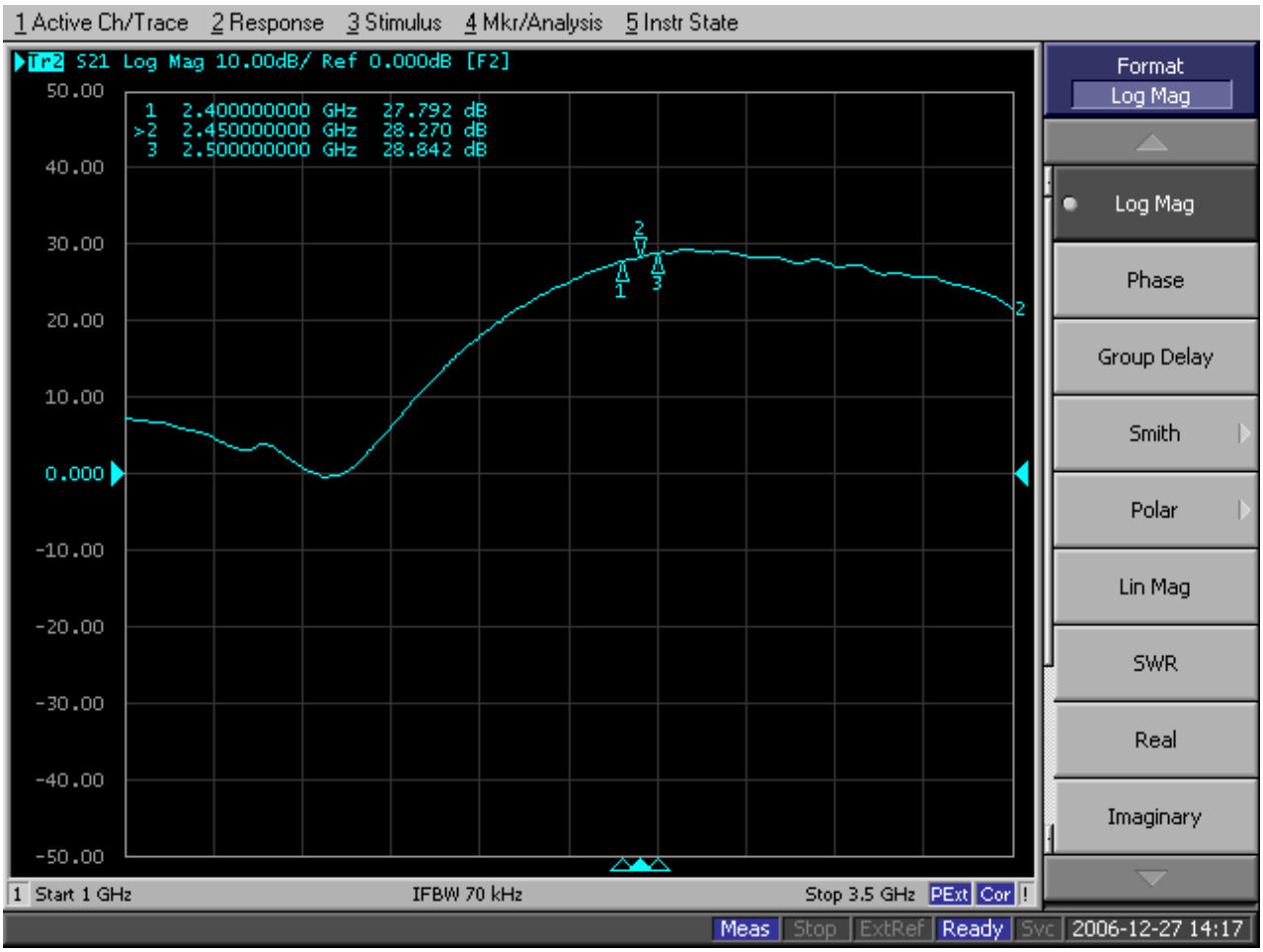



## RF PERFORMANCE

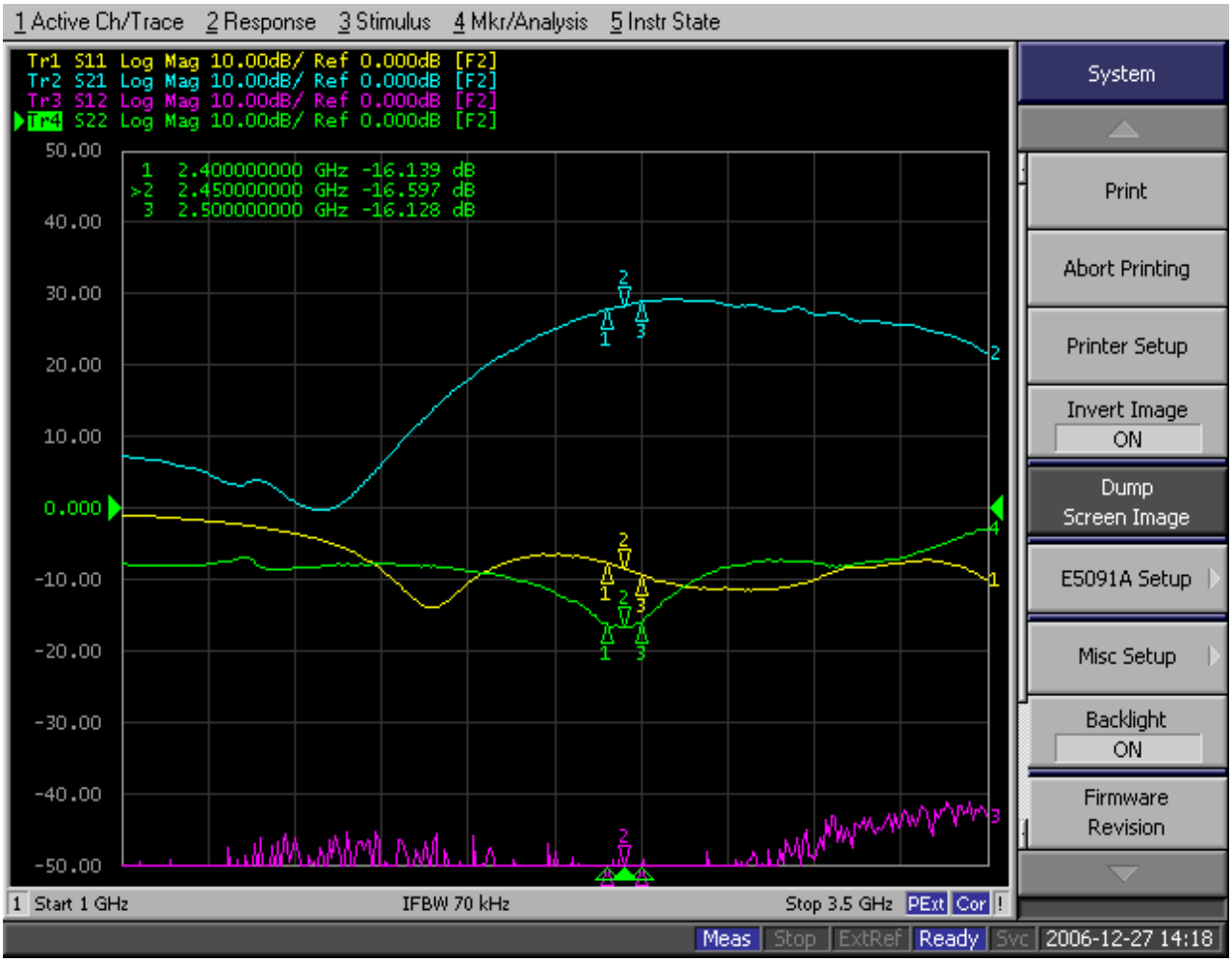
For an RF power amplifier, the performance degrades when output power reaches the non-linearity region. The maximum linear power of PA depends on P1dB point and signal complexity such as modulation, data length and data rate. For UP2202, linear gain is around 27dB and P1dB output power is 26 dBm. To optimize the maximum output power, the output power of UZ2400 (that is, the input power of UP2202) should be adjusted for various system needs.

## RF PERFORMANCE TEST DATA

Maximum PA output power 28.79dB



Return Loss: -16.5dB



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