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OneCell® Next Generation Radio Module, Radio Description

The OneCell® RP5000 Radio Module is a 2x2 MIMO, Single band radio operating in LTE band, 5 The RP5000 supports bandwidths of 5,10,15 & 20 MHz. The frequencies supported are shown in the table below.

FDD LTE Bands & Frequencies					
LTE Band	Downlink	Uplink	Bandwidth DL/UL MHz	Duplex Spacing MHz	Band Gap MHz
66	2110 – 2200	1710 – 1780	90/70	400	330

Figures 1 show the block diagram of the RF portion of the radio module. It consists of identical transmit/receive chains to form a 2x2 MIMO system. A single design supports an entire LTE RF band (e.g., B66, B2, etc.). The entire radio module is field replaceable, including antenna assembly.

A single AD9363 transceiver chip accepts digital IQ data (JESD 207 format), provides digital transmit and receive FIR filtering, contains transmit and receive local oscillator synthesizers and zero IF modulators/demodulators. A single transceiver chip supports up to 2x2 MIMO configuration. The functional block diagram of this device is also shown in Figure 1.

On the transmit side, the output of the AD9363 is an LTE waveform (5, 10, 15 or 20MHz bandwidth), at a nominal maximum power level of approximately -7dBm. This differential RF output is converted to single-ended and applied to a power amplifier chain consisting of a buffer amplifier and a power amplifier. The transmit signal is applied to a duplexer to enable FDD duplexing. The nominal maximum output power (per MIMO chain) of the at the antenna port is +24.0dBm. A 2x2 MIMO antenna assembly is fitted onto the radio module. This is shown in picture Figure 2.

On the receiver side, the signal from the antenna port connector is applied to the antenna port of the duplexers. An LNA sets the receiver noise figure, followed by a receive band BPF to reduce cross-modulation products from the transmit signal. The receive signal is converted to baseband by a zero-IF I/Q modulator, applied to an ADC converter followed by the receive FIR filter chain.

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Protection of the radio module is accomplish using a series of measures. The radio receives 12 VDC from the host as primary power. The +12 VDC is converted to +4.2 VDC using a Texas Instrument SWIFT™ Synchronous Step-Down Converter, TPS548A20. All other required voltages are derived from the output of this power supply with exception of temperature sensor and EE-Prom which are derived directly from the +12VDC.

- Over Voltage Protection - The radio is protected from over voltage by the DC-DC converter using a power good signal that is pulled low if the voltage goes outside of the ±16% of the target value and the supply causing the +4.2 VDC output to be removed.
- Over Current protection – The radio is protected from over current by the DC-DC converter. The DC-DC converter monitors the inductor current during the off state and the converter maintains the OFF state during the period that the inductor current is larger than the overcurrent trip level. In an overcurrent condition, the current to the load exceeds the current to the output capacitor thus the output voltage decreases the output voltage crosses the undervoltage-protection threshold and shuts down the DC-DC converter.
- Over temperature protection – The radio is protected from excess temperature in two ways.
    - The DC-DC converter has integrated thermal shutdown. If the temperature exceeds the threshold value TPS548A20 shuts off.
    - On board temperature sensor, On-Semi NCT75 – The temperature sensor is monitored by the host device. When the temperature sensor approaches the over temperature threshold the radio RF power is reduced to lower the temperature as the main heat source is the power amps. If the temperature continues to rise above the threshold, the NCT75 temperature alarm signal disables the DC-DC converter via it enable pin and power is removed from the radio.
- RF Power Control – The radio module does not provide RF power detection circuitry, however, as RF power increases the PA temperature increases. Since the temperature sensor monitors the PA temperatures the RF power is monitored indirectly. If the PA temperature increases above the threshold the over temperature protection as described above is applied.
- Antenna type(s) and maximum antenna gain(s) - Internal, embedded antennas (shown in drawing). Maximum Gain is +3dBi.
- Type or types of emission - FCC emission code supported 4M54G7D, 9M02G7D, 13M5G7D, & 18M0G7D.
- Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power (see above – RF Power Control). Maximum power rating **+23.63±0.5** dBm.
- Modulation system to be used - The modulating waveform is 4G LTE Downlink.

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Figure 1 below shows a typical radio module block diagram.

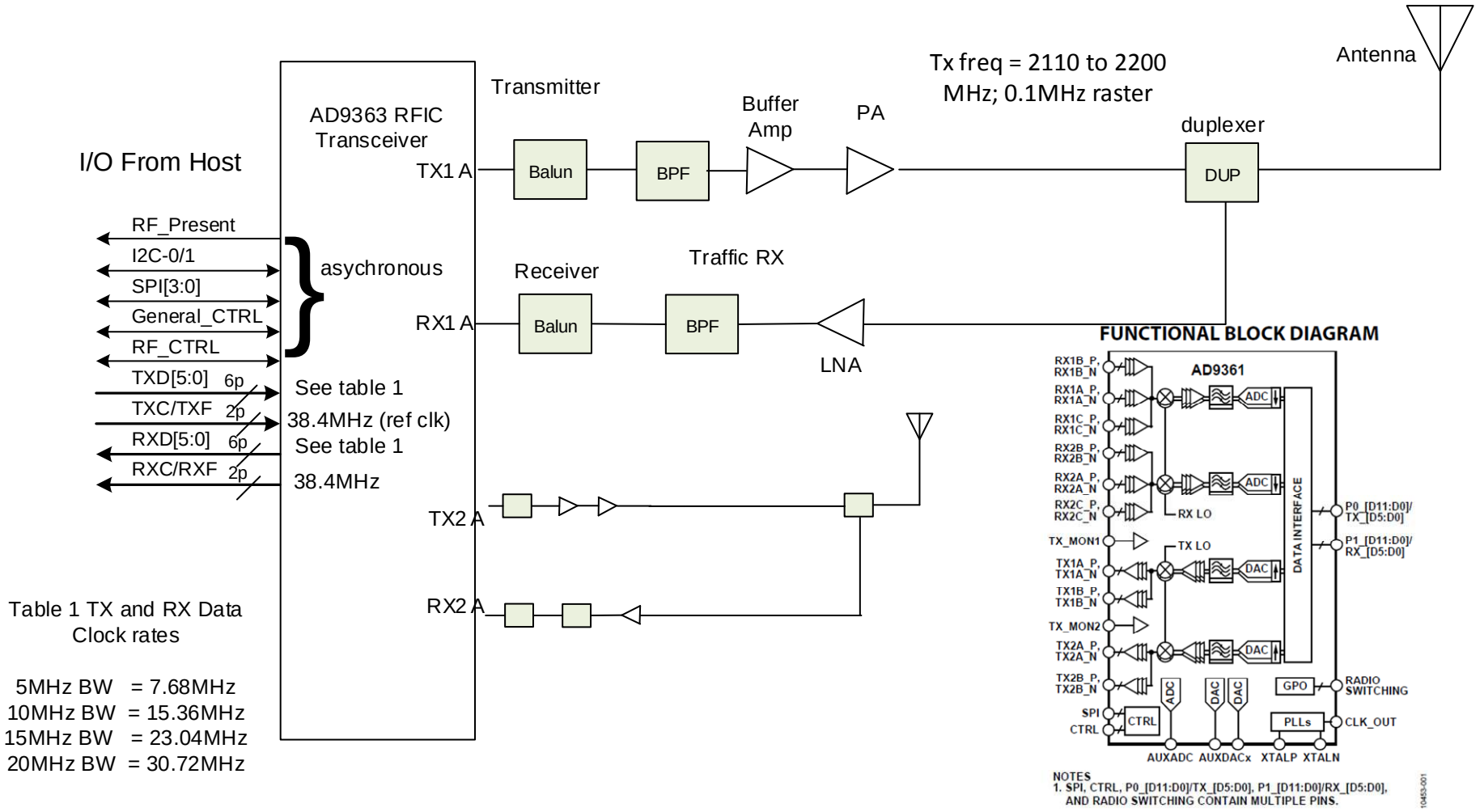

Figure 1b below shows a typical radio module block diagram.

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Figure 2 shows the mechanical view of the Radio Module