

## F5701

24.25GHz – 29.5GHz RF, 2.5GHz – 6GHz IF Upconverter/Downconverter

The F5701 is a highly integrated RF upconverter/downconverter used in 5G beamforming applications targeting the n257/n261 and n258 bands. The device uses classic TX and RX heterodyne architectures to convert 2.5GHz to 6GHz IF signals to the 5G NR (new radio) millimeter-wave bands spanning the 24.25GHz to 29.5GHz spectrum. Low-side Local Oscillator (LO) injection is used with the TX and RX mixer cores supporting internal LO frequencies ranging between 18.25GHz and 27GHz. LO feed requirements are eased by two sequential on-chip LO frequency doublers that yield net multiplicative factors of either 2x or 4x. The F5701 supports programmability between separate RF ports for TX and RX, and a single RF input/output port with a low insertion loss TRX switch integrated on the chip, therefore, eliminating the need for an off-chip TRX switch for TDD applications. The F5701 provides real IF RX and TX ports with on-chip I/Q combination, resulting in much more relaxed requirements for IF routing, IF VGAs and data converters, compared to those of the up-down converters with complex I/Q IF interfaces. On-chip 9-bit DACs provide fine control for image-rejection calibration.

All RF, IF, and LO ports employ single-ended 50Ω impedances for ease of integration into the signal path. Each device uses a 2.5V analog supply and a programmable 2.5V–3.3V PA supply to provide a wide range of TX output power levels with high efficiency. The digital core and SPI use a 1.8V supply generated by an on-chip LDO.

### Competitive Advantage

- Compact and highly-integrated design with low DC power consumption simplifies beamforming applications
- RF port programmability between RX/TX and TRX with integrated TRX switch provides ultimate flexibility and reduces RF routing and BOM cost
- On-chip I/Q combination with excellent sideband suppression and image rejection halves IF routing, VGAs, and data converters
- Industry-leading TX linearity allows a single transceiver to drive up to 64 elements

- Two sequential LO frequency doublers eliminate the need to route troublesome high-frequency LO signals on printed circuit board (PCB)
- Advanced LO leakage calibration mechanism for industry-leading performance

### Features

#### General

- RF range: 24.25GHz to 29.5GHz (n257/n258)
- IF range: 2.5GHz to 6GHz
- Two integrated LO frequency doublers
- Analog supply voltage: +2.4V to +2.6V
- Dedicated PA supply voltage: selectable between +2.4V to +2.6V and +3.0V to +3.3V
- Operating temperature (T<sub>A</sub>) range: -40°C to +95°C
- 4.0 × 4.5 mm 49-BGA package

#### Transmit Mode (Typical Across RF/IF Bands)

- > 29.5dB conversion gain from the IF/RF amplifiers and single-sideband (SSB) mixer core
- > +20dBm OP1dB and > +28.8dBm OIP3
- 30dB of Glitch-Free™ gain adjustment
- < -23.7dBc LO leakage and > 29.6dBc of sideband suppression across the frequency band
- Envelope detector provided for accurate LO leakage estimation and calibration loop-back

#### Receive Mode (Typical Across RF/IF Bands)

- > 22.5dB conversion gain from the RF/IF amplifiers and image-reject mixer (IRM) core
- < 5.6dB noise figure (5.5dB for the RX2 path)
- > -17.6dBm IP1dB and > -8.5dBm IIP3
- 30dB of Glitch-Free gain adjustment
- > 22.9dBc image rejection over voltage/temperature and the RF frequency band
- Several additional knobs to trade-off NF with IIP3

### Applications

- 5G Phased Arrays and Massive MIMO

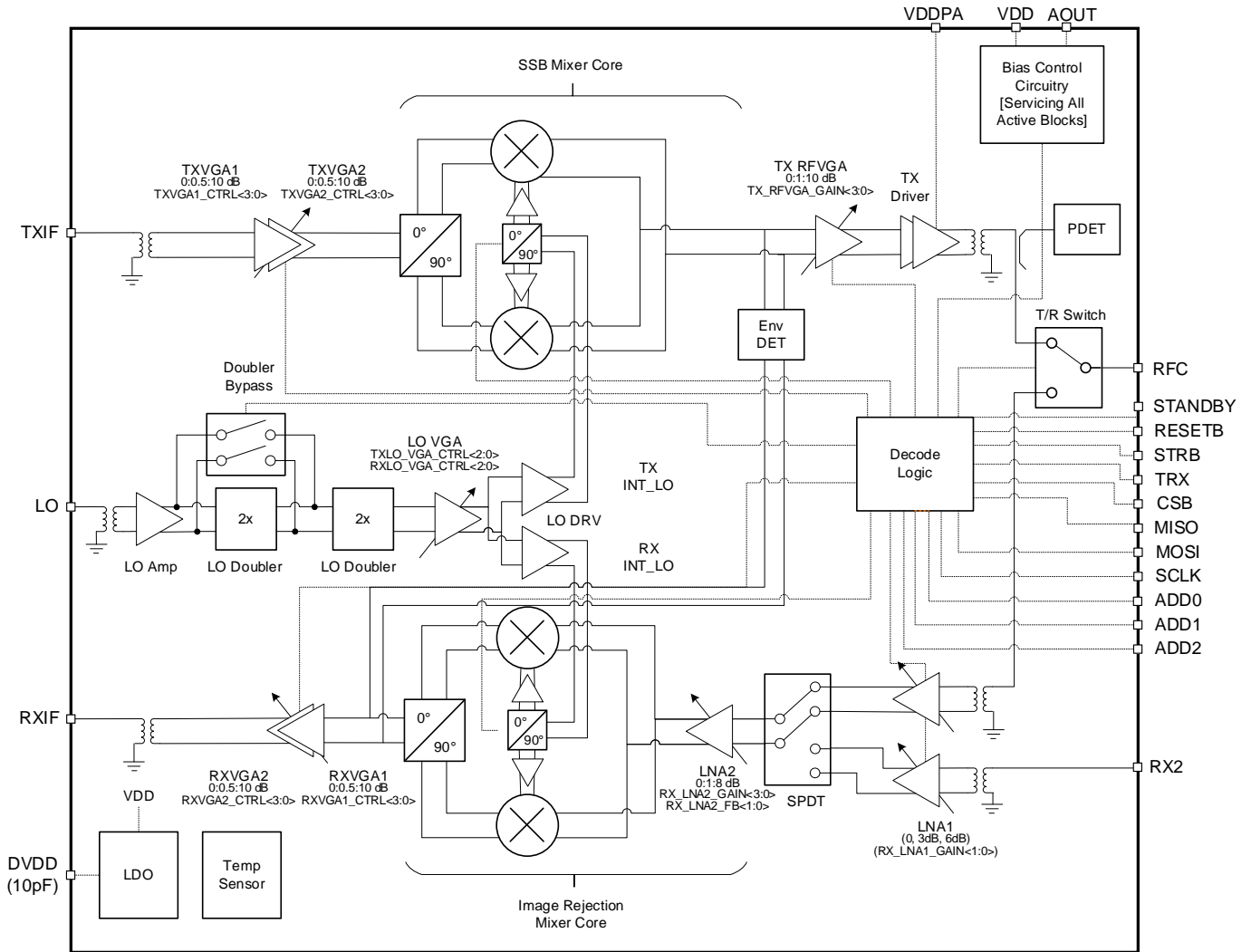
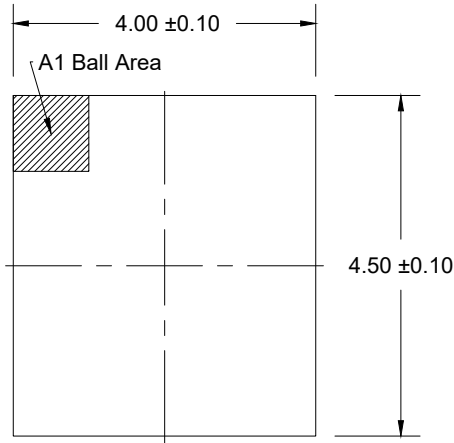


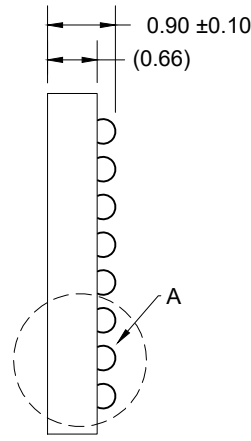
Figure 1. Block Diagram

## Ordering Information

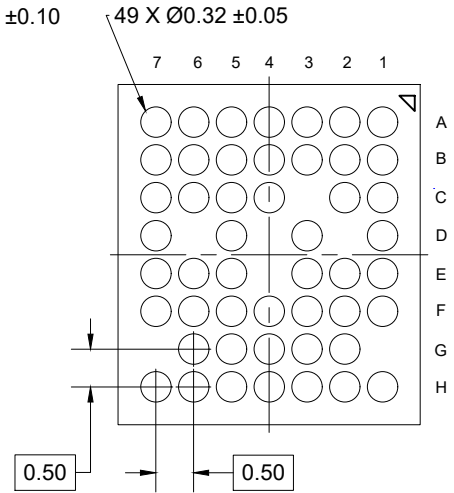
Part Number	Package Description	MSL Rating	Carrier Type	Temp. Range
RA81F5701GBX#BC0	4.0 x 4.5 mm, <a href="#">49-BGA</a>	3	Tray	-40°C to +95°C
RA81F5701GBX#HC0	4.0 x 4.5 mm, <a href="#">49-BGA</a>	3	Reel	-40°C to +95°C
RTKA81F5701000RU	F5701 24GHz to 30GHz Evaluation Board			



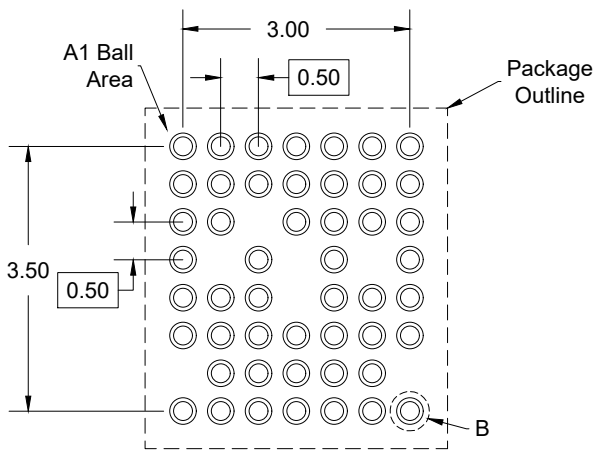
TOP VIEW



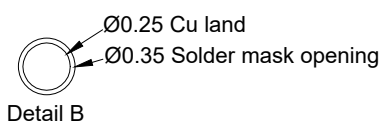
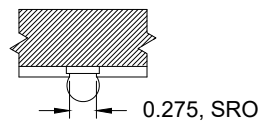
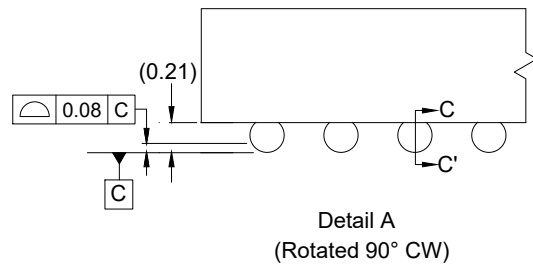
SIDE VIEW



BOTTOM VIEW



RECOMMENDED LAND PATTERN  
(PCB Top View, NSMD Design)



NOTES:

1. JEDEC compatible.
2. All dimensions are in mm and angles are in degrees.
3. Use  $\pm 0.05$  mm for the non-toleranced dimensions.
4. Numbers in ( ) are for references only.
5. Pre-reflow solderball diameter is  $\text{Ø}0.3$  mm.

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