



# QPB9337

## Dual-Channel Switch LNA Module

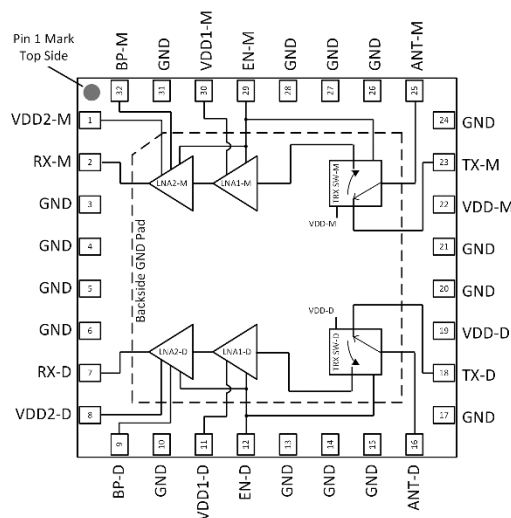
### Product Overview

The QPB9337 is a highly integrated front-end module targeted for TDD base stations. The switch LNA module integrates a two-stage LNA and a high power switch in a dual channel configuration. The second stage LNA has integrated bypass mode. Power down and bypass capability for the LNAs can be controlled with control pins on the module.

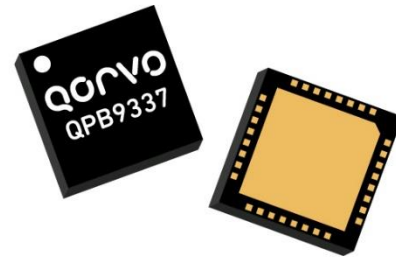
The QPB9337 can be utilized across the 2.3–3.8 GHz range to provide 1.3 dB noise figure for operation in the receive mode at 3.5 GHz and 0.8 dB insertion loss in the transmit mode. The LNAs utilize Qorvo's high performance E-pHEMT process while the SOI technology based switch supports input RF power signals of 8W average power. The product only needs a +5V supply to operate the high power switch and the LNAs.

The QPB9337 is packaged in a RoHS-compliant, compact 6 mm x 6 mm surface-mount leadless package. The switch LNA module is targeted for wireless infrastructure applications configured for TDD-based MIMO architectures. The module can be used for next generation 5G or pre-5G solutions or small cell base-station applications.

### Functional Block Diagram



Top View



32 Pin 6 mm x 6 mm leadless SMT Package

### Key Features

- 2.3 - 3.8 GHz Frequency Range
- 1.3 dB Noise Figure
- Second LNA with Bypass mode
- Pin (Tx mode): 8W Pavg
- 35.6 dB Gain (Rx mode, High Gain state)
- 18 dB Gain (RX mode, Low Gain state)
- +31 dBm OIP3 (Rx mode, High Gain state)
- 1.8V Logic Compatibility
- 3 to 5V Operational for Switch and LNAs

### Applications

- Wireless Infrastructure
- Small Cell BTS
- Pre-5G / 5G Massive MIMO systems
- TDD-based architectures

### Ordering Information

| Part No.      | Description            |
|---------------|------------------------|
| QPB9337TR13   | 2500 pcs on a 13" reel |
| QPB9337EVB-01 | Evaluation Board       |

## Absolute Maximum Ratings

| Parameter                                                                   | Rating         |
|-----------------------------------------------------------------------------|----------------|
| Storage Temperature                                                         | -65 to +150 °C |
| Supply Voltage<br>(Pins 1, 8, 11, 19, 22, 30)                               | +6 V           |
| Pin at ANT, Rx mode, Average<br>(8 dB PAR, 100% Duty Cycle, 105°C)          | 19 dBm         |
| Pin at ANT, Tx mode, Average<br>(8dB PAR, 88% Duty Cycle, 8.8ms max, 105°C) | 39 dBm         |

Operation of this device outside the parameter ranges given above may cause permanent damage.

## Recommended Operating Conditions

| Parameter                                                             | Min | Typ | Max   | Units |
|-----------------------------------------------------------------------|-----|-----|-------|-------|
| LNA Voltage                                                           | +3  | +5  | +5.25 | V     |
| Switch V <sub>DD</sub>                                                | +3  | +5  | +5.5  | V     |
| T <sub>CASE</sub>                                                     | -40 |     | +105  | °C    |
| T <sub>j</sub> <sup>(1)</sup> Rx Mode                                 |     |     | +190  | °C    |
| T <sub>j</sub> <sup>(1)</sup> Tx Mode Pin 5W at max T <sub>CASE</sub> |     |     | +125  | °C    |

Notes:

1. MTTF > 1e6 hours

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

## Electrical Specifications

| Parameter                                                 | Conditions <sup>(1)</sup>             | Min   | Typ   | Max                  | Units |
|-----------------------------------------------------------|---------------------------------------|-------|-------|----------------------|-------|
| Operational Frequency Range                               |                                       | 2300  |       | 3800                 | MHz   |
| Test Frequency                                            |                                       |       | 3500  |                      | MHz   |
| Gain <sup>(2)</sup>                                       | Rx mode, High Gain state              | 34    | 35.6  | 39                   | dB    |
|                                                           | Rx mode, Low Gain state               | 17    | 18    | 22                   | dB    |
| Gain Flatness                                             | Rx mode, Any 100 MHz BW within band   |       | 0.3   |                      | dB    |
| Noise Figure <sup>(2)</sup>                               | Rx mode, High Gain state              |       | 1.3   | 1.55                 | dB    |
| Output IP3 <sup>(3)</sup>                                 | Rx mode, High Gain state              | 27    | 31    |                      | dBm   |
|                                                           | Rx mode, Low Gain state               | 24    | 29    |                      | dBm   |
| OP1dB <sup>(2)</sup>                                      | Rx mode, High Gain state              | 18    | 19    |                      | dBm   |
|                                                           | Rx mode, Low Gain state               | 10    | 12    |                      | dBm   |
| Insertion Loss <sup>(2)</sup>                             | Tx mode                               |       | 0.8   | 1.5                  | dB    |
| VSWR                                                      | ANT Port, and TX Port                 |       | 1.5:1 | 2.0:1                | --    |
| Switch Isolation                                          | ANT to TX in Rx mode                  |       | 25    |                      | dB    |
| Switch Isolation                                          | ANT to RX in Tx mode                  |       | 40    |                      | dB    |
| Channel Isolation                                         | Rx mode, High Gain state              |       | 39    |                      | dB    |
|                                                           | Tx mode                               |       | 40    |                      | dB    |
| LNA Supply Voltage                                        |                                       |       | +5    |                      | V     |
| LNA Current                                               | Rx mode, High gain state, Per channel |       | 113   | 150                  | mA    |
|                                                           | Rx mode, Low gain state, Per channel  |       | 54    | 75                   | mA    |
| LNA Shutdown Current                                      | Per channel                           |       | 9     |                      | mA    |
| LNA and Switch Control Voltage<br>(Pins 9, 12, 29 and 32) | V <sub>LOW</sub>                      | 0     |       | +0.63                | V     |
|                                                           | V <sub>HIGH</sub>                     | +1.17 |       | V <sub>DD</sub> +0.3 | V     |
| Switch Current                                            | Tx mode                               |       | 0.50  |                      | mA    |
| Switching Time                                            | ANT-TX ON                             |       | 0.90  |                      | μs    |
|                                                           | ANT-TX OFF                            |       | 0.50  |                      | μs    |
|                                                           | ANT-RX ON                             |       | 1.00  |                      | μs    |
|                                                           | ANT-RX OFF                            |       | 0.05  |                      | μs    |
| Thermal Resistance                                        | Tx Mode                               |       |       | 22.7                 | °C/W  |
|                                                           | Rx High Gain Mode                     |       |       | 23.0                 | °C/W  |

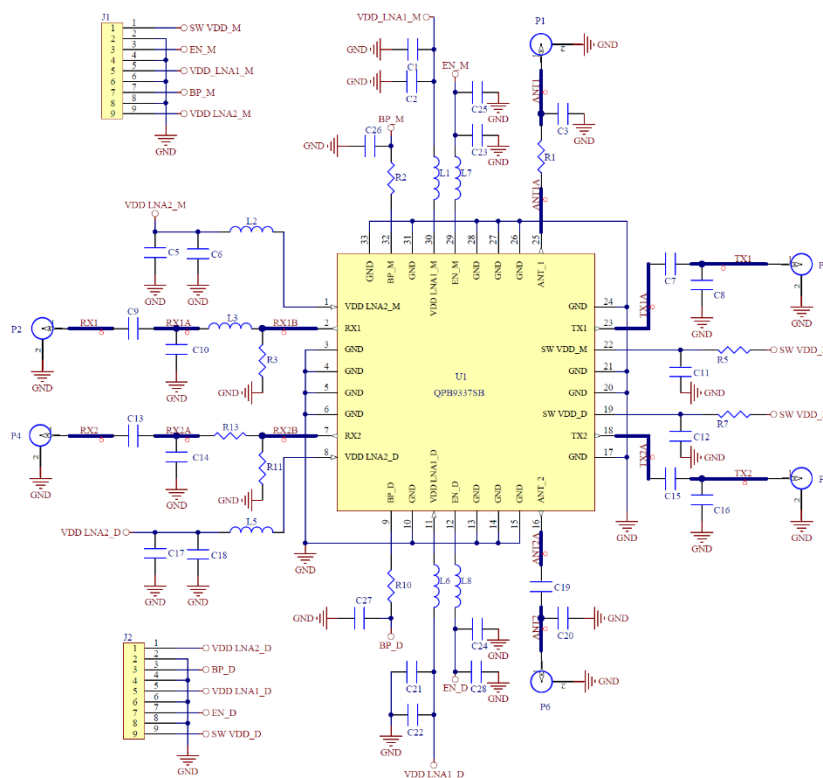
Notes:

1. Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system.
2. Trace loss de-embedded.
3. Pout/tone = +3dBm, Δf = 1MHz

## Control Logic for Switch State and Rx LNA Gain

| State                     | EN-M & EN-D (switch control)<br>Pins 12 & 29 (J1-3 & J2-7 on EVB) | BP-M & BP-D (LNA bypass control)<br>Pins 9 & 32 (J1-7 & J1-3 on EVB) |
|---------------------------|-------------------------------------------------------------------|----------------------------------------------------------------------|
| RX mode (high gain state) | 0                                                                 | 0                                                                    |
| RX mode (low gain state)  | 0                                                                 | 1                                                                    |
| TX mode                   | 1                                                                 | Do not care                                                          |

## Evaluation Board Schematic



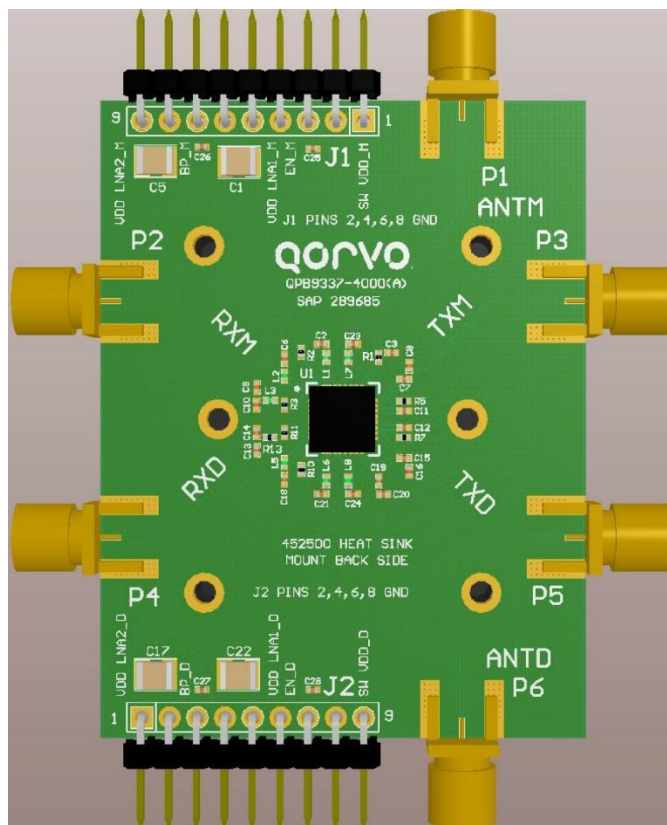
## Bill of Material – Evaluation Board

| Reference Des.                                                        | Value       | Description                               | Manuf.    | Part Number          |
|-----------------------------------------------------------------------|-------------|-------------------------------------------|-----------|----------------------|
| U1                                                                    |             | Module, Dual-Channel Switch-LNA           | Qorvo     | QPB9337              |
| PCB                                                                   |             | PCB, QPB9337                              | Qorvo     | 289685               |
| C2, C6, C7, C9, C13, C15, C18, C19, C21, C23, C24, C25, C26, C27, C28 | 100 pF      | CAP, 100 pF, 5%, 50V, COG, 0402           | MURATA    | GRM1555C1H101JA01D   |
| C1, C5, C17, C22                                                      | 2.2 $\mu$ F | CAP, 2.2 $\mu$ F, 10%, 100V, X7R, 1210    | TDK       | C3225X7R2A225K       |
| J1, J2                                                                | 9 Pin       | CONN, HDR, RT ANG, 9-PIN, 0.100", T/H     | MOLEX     | 22-05-2091           |
| L3                                                                    | 1.3 nH      | IND, 1.3 nH, +/-0.2nH, 3150mA, W/W, 0402  | MURATA    | LQW15AN1N3C80D       |
| L2                                                                    | 10 nH       | IND, 10 nH, $\pm$ 2%, 500mA, 5.5GHz, 0402 | MURATA    | LQW15AN10NG00D       |
| L1, L6, L7, L8                                                        | 33 nH       | IND, 33 nH, 3%, W/W, 0402                 | MURATA    | LQW15AN33NH00D       |
| L5                                                                    | 22 nH       | IND, 22 nH, $\pm$ 5%, 300mA, 1.9GHz, 0402 | MURATA    | LQG15HS22NJ02D       |
| R1, R13                                                               | 0 $\Omega$  | RES, 0 $\Omega$ , 1/10W, 0402             | Kamaya    | RMC1/16SJPTH         |
| R2, R5, R7, R10                                                       | 0 $\Omega$  | RES, 0 $\Omega$ , 1/10W, 0402, Jumper     | Panasonic | ERJ2GE0R00X          |
| P1 – P6                                                               | SMA         | CONN, END LAUCH 0070 PIN                  | Radial    | 9602-1111-018+RADIAL |

Note:

1. Heatsink is recommended on the board when operating at high power levels when in Tx mode.

## Evaluation Board Assembly



Top View

## Typical Performance

Test conditions unless otherwise noted:  $V_{DD}=+5\text{ V}$ ,  $\text{Temp}=+25^{\circ}\text{C}$

| Parameter                     | Conditions                    | Typical Values |      |      | Units |
|-------------------------------|-------------------------------|----------------|------|------|-------|
| Frequency                     |                               | 3400           | 3600 | 3800 | MHz   |
| Gain                          | Rx High Gain Mode             | 37.0           | 35.7 | 33.5 | dB    |
|                               | Rx Low Gain Mode              | 19.4           | 18.8 | 18.1 | dB    |
| Input Return Loss             | Rx High Gain Mode             | 18.8           | 23.0 | 20.2 | dB    |
|                               | Rx Low Gain Mode              | 19.3           | 23.5 | 20.5 | dB    |
| Output Return Loss            | ANT-RX Path, High Gain Mode   | 9.2            | 9.2  | 7.0  | dB    |
|                               | ANT-RX Path, Low Gain Mode    | 25.0           | 12.6 | 9.6  | dB    |
| Output P1dB                   | Rx High Gain Mode             | 20.0           | 19.5 | 18.7 | dBm   |
|                               | Rx Low Gain Mode              | 12.4           | 12.0 | 12.0 | dBm   |
| OIP3 <sup>(2)</sup>           | Rx High Gain Mode             | 33.2           | 33.8 | 33.5 | dBm   |
|                               | Rx Low Gain Mode              | 29.7           | 30.0 | 29.2 | dBm   |
| Noise figure <sup>(1)</sup>   | Rx High Gain Mode             | 1.43           | 1.42 | 1.42 | dB    |
| Insertion Loss <sup>(3)</sup> | ANT-TX, Tx Mode               | 0.80           | 0.79 | 0.78 | dB    |
| Isolation                     | ANT-RX, Tx Mode, Rx High Gain | 83             | 65   | 66   | dB    |
|                               | ANT-TX, Rx Mode               | 28             | 28   | 27   | dB    |
|                               | RX-RX, Rx High Gain Mode      | 43             | 45   | 50   | dB    |
|                               | TX-TX, Tx Mode                | 58             | 58   | 57   | dB    |

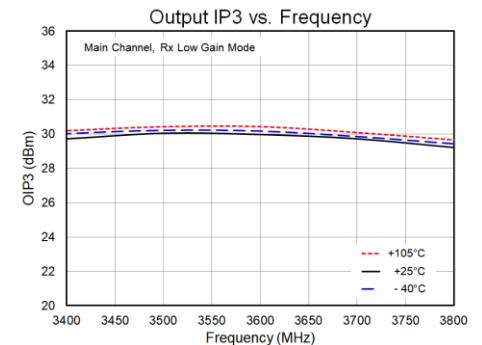
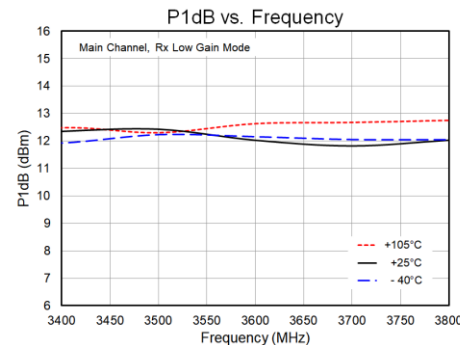
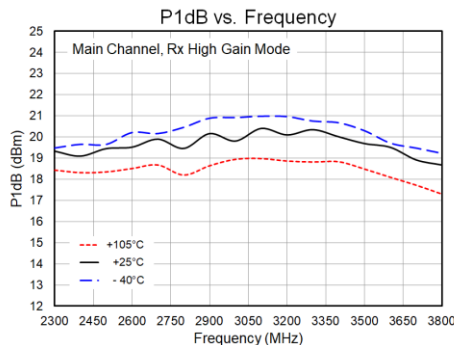
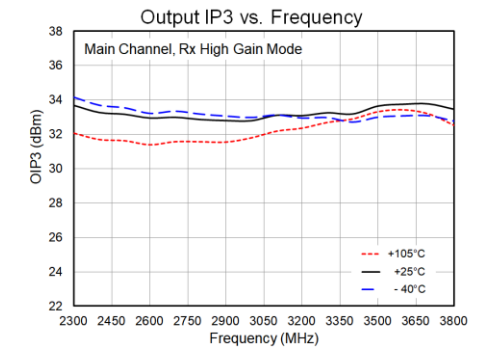
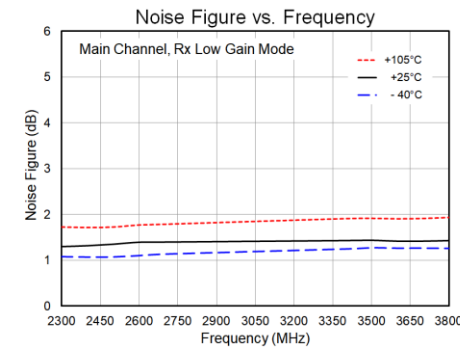
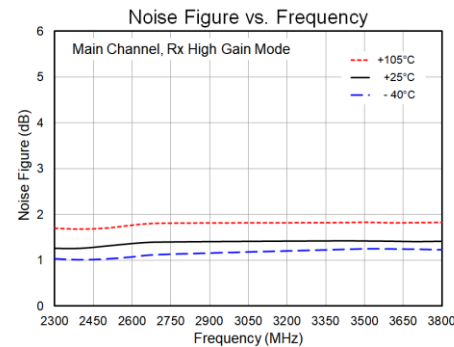
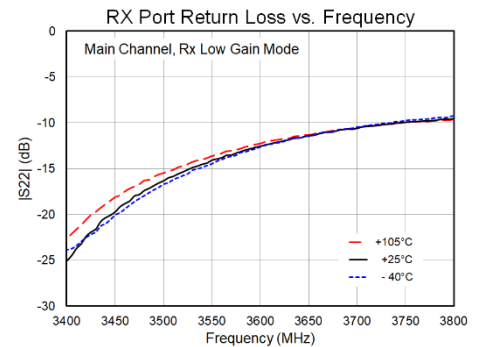
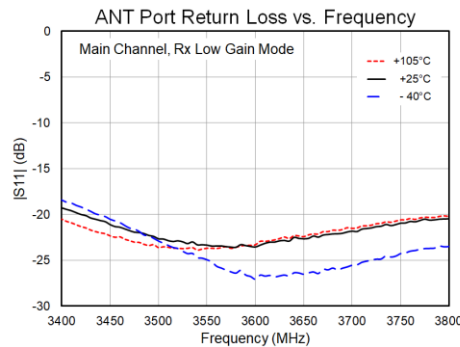
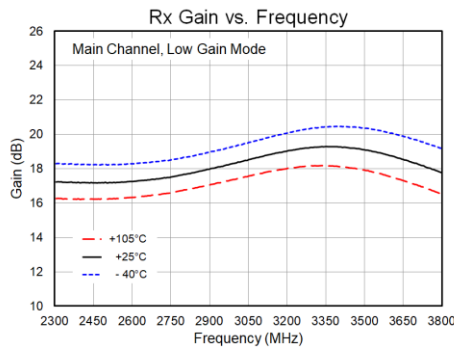
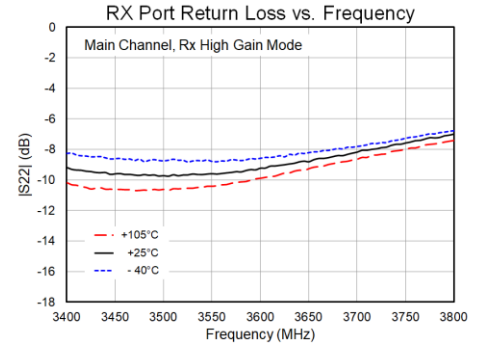
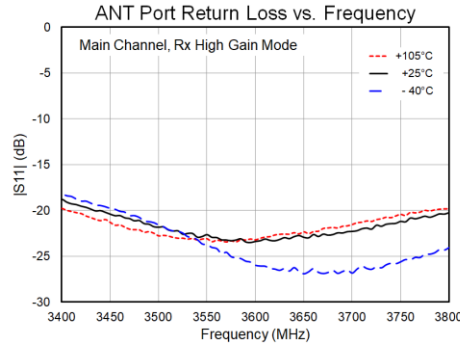
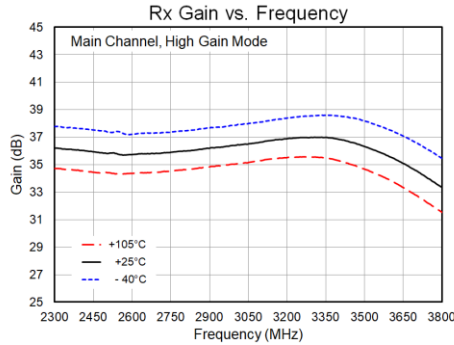
Note: 1) Noise figure data has input trace loss de-embedded. Insertion Loss has both Input and Output trace losses deducted.

2)  $P_{out}=+3\text{ dBm/tone}$ ,  $\Delta f=1\text{ MHz}$

3) De-embedded and mismatch losses removed

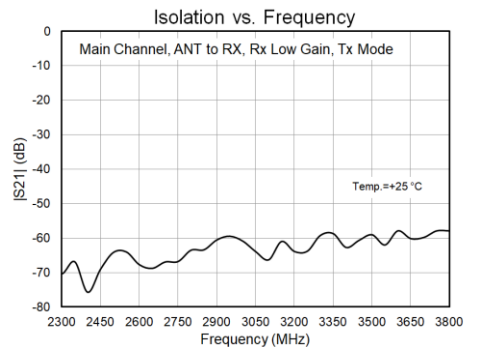
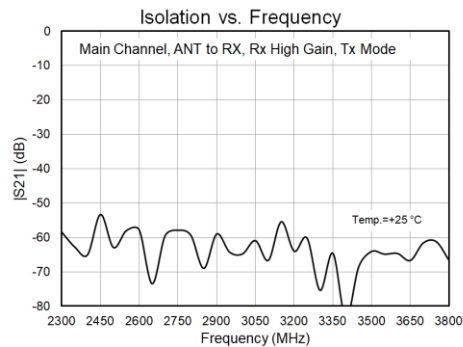
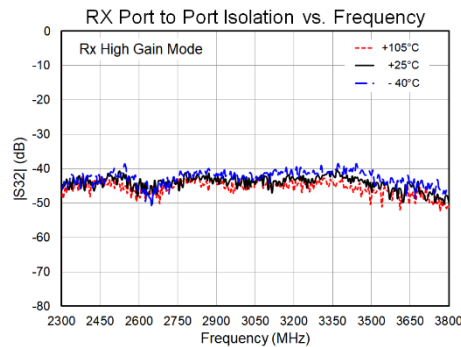
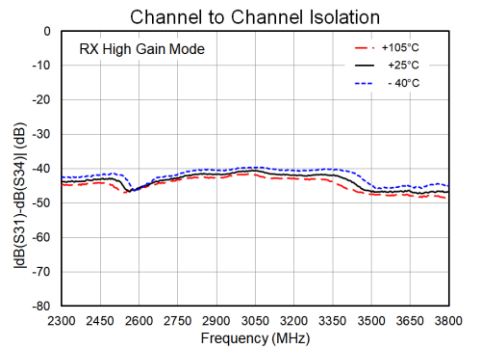
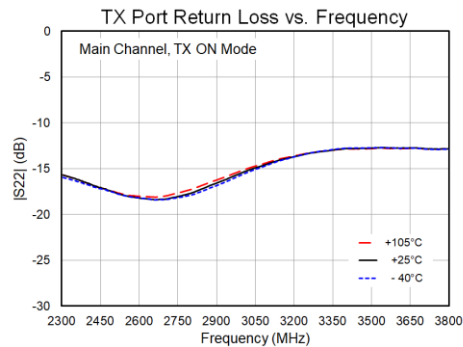
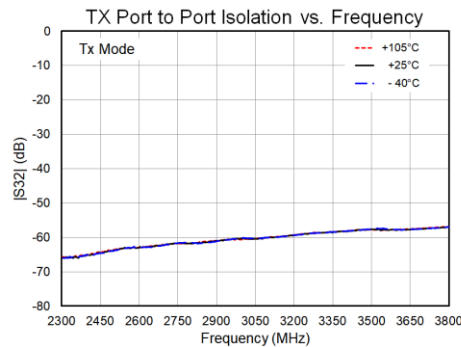
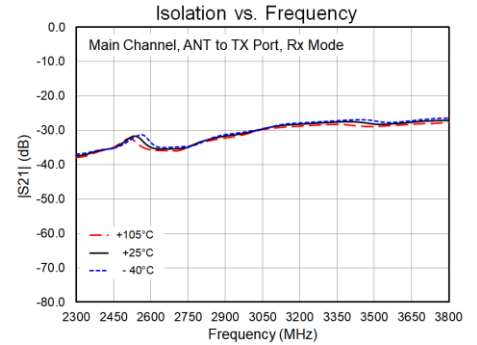
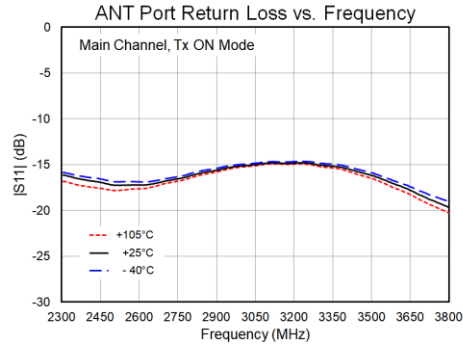
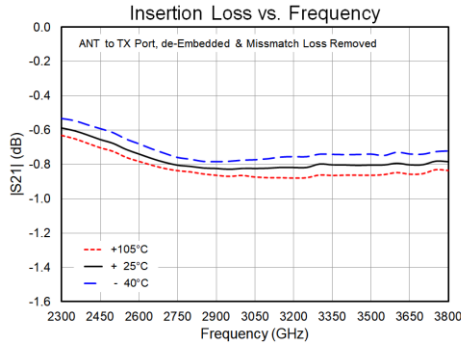
## Performance Plots

Test conditions unless otherwise noted:  $V_{DD} = +5\text{ V}$ , Temp. =  $+25^\circ\text{C}$

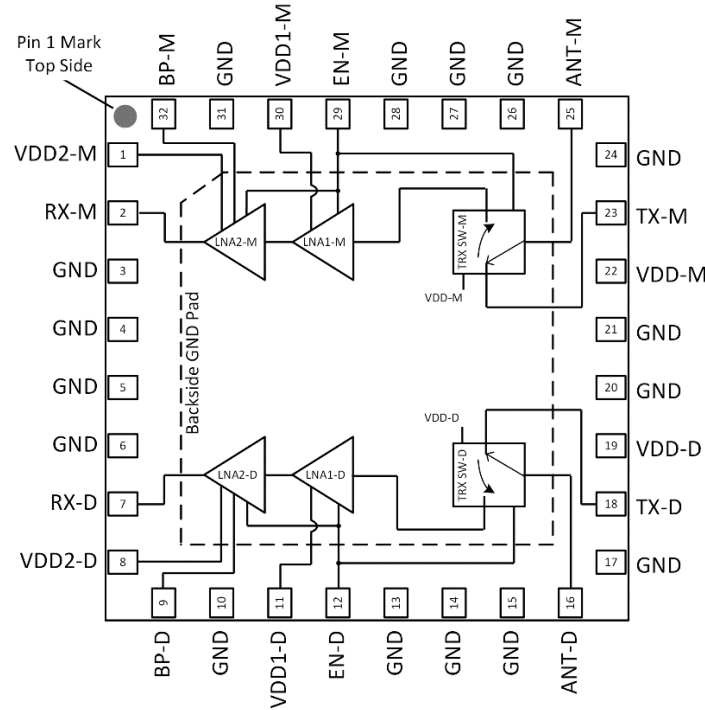


## Performance Plots Contd.

Test conditions unless otherwise noted:  $V_{DD} = +5$  V, Temp. = +25 °C



## Pin Configuration and Description

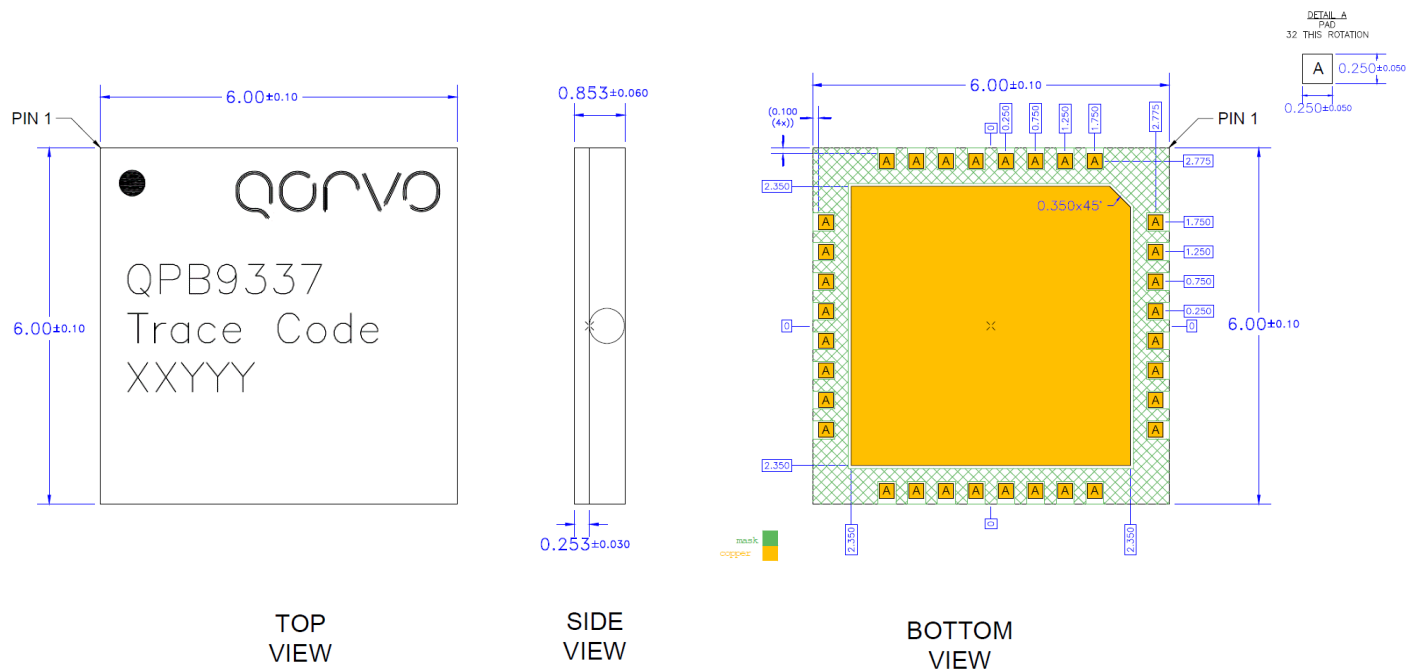


Top View

| Pin No.                                                                  | Label  | Description                                                                                                                                                                                    |
|--------------------------------------------------------------------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                                                        | VDD2-M | The 2 <sup>nd</sup> stage LNA DC power supply input of the main channel                                                                                                                        |
| 2                                                                        | RX-M   | Rx LNA RF output of the main channel                                                                                                                                                           |
| 7                                                                        | RX-D   | Rx LNA RF output of the diversity channel                                                                                                                                                      |
| 8                                                                        | VDD2-D | The 2 <sup>nd</sup> stage LNA DC power supply input of the diversity channel                                                                                                                   |
| 9                                                                        | BP-D   | The 2 <sup>nd</sup> stage LNA Bypass control input of the diversity channel. Enable (1) LNA low gain mode                                                                                      |
| 11                                                                       | VDD1-D | The 1 <sup>st</sup> stage LNA DC power supply input of the diversity channel                                                                                                                   |
| 12                                                                       | EN-D   | Tx or Rx mode control input of the diversity channel. Enabled (1) Tx mode.                                                                                                                     |
| 16                                                                       | ANT-D  | Antenna port of the diversity channel                                                                                                                                                          |
| 18                                                                       | TX-D   | Tx or Termination port of the diversity channel                                                                                                                                                |
| 19                                                                       | VDD-D  | TRX switch DC power supply input of the diversity channel                                                                                                                                      |
| 22                                                                       | VDD-M  | TRX switch DC power supply input of the main channel                                                                                                                                           |
| 23                                                                       | TX-M   | Tx or Termination port of the main channel                                                                                                                                                     |
| 25                                                                       | ANT-M  | Antenna port of the main channel                                                                                                                                                               |
| 29                                                                       | EN-M   | Tx or Rx mode control input of the main channel. Enable (1) Tx mode.                                                                                                                           |
| 30                                                                       | VDD1-M | The 1 <sup>st</sup> stage LNA DC power supply input of the main channel                                                                                                                        |
| 32                                                                       | BP-M   | The 2 <sup>nd</sup> stage LNA Bypass control input of the main channel. Enable (1) LNA low gain mode                                                                                           |
| 3, 4, 5, 6, 10, 13, 14, 15, 17, 20, 21, 24, 26, 27, 28, 31, Package Base | GND    | RF/DC ground connection. The back side of the package should be connected to the ground plan though multiple connections as short as possible. PCB via holes under the device are recommended. |

### Package Marking and Dimensions

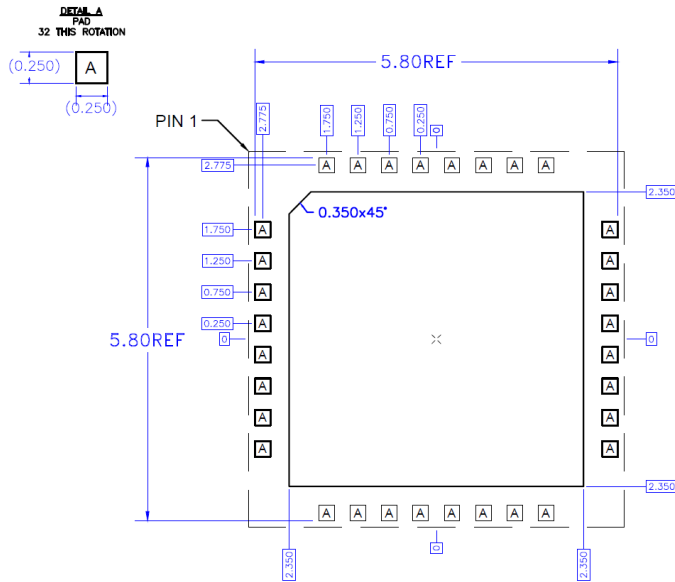
Marking: Part Number – QPB9337  
Trace Code – Assigned by Sub-Contractor  
XXYYY – Unit serialization



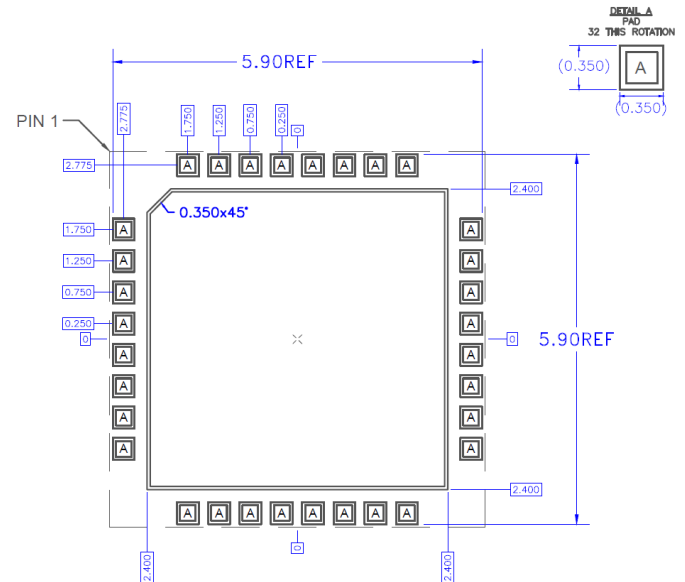
#### Notes:

1. All dimensions are in mm. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## PCB Mounting Pattern



RECOMMENDED  
LAND PATTERN



RECOMMENDED  
LAND PATTERN MASK

### Notes:

1. All dimensions are in mm. Angles are in degrees.
2. A heat sink underneath the area of the PCB for the mounted device is recommended for proper thermal operation.
3. Ground / thermal via holes are critical for the proper performance of this device. Via holes should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of .25 mm (.010").
4. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.

Technical drawing of a mechanical part, showing a perspective view and a cross-section A-A.

**Perspective View:**

- Part is blue.
- Top surface features a row of 10 circular holes.
- Bottom surface features 5 rectangular slots.
- A blue arrow indicates the "User Direction of Feed" pointing to the right.

**Cross-Section A-A:**

- Section A-A is a detailed view of the part's profile.
- Dimensions and tolerances shown:
  - 0.30  $\pm$  0.05
  - R 0.3 MAX
  - K0
  - 2.00  $\pm$  0.05 SEE NOTE 3
  - 4.00 SEE NOTE 1
  - $\phi$  1.5 +0.1/-0.0
  - 8.00
  - $\phi$  1.50 MIN
  - 1.75  $\pm$  0.10
  - 5.50  $\pm$  0.05 SEE NOTE 3
  - 12.0  $\pm$  0.3
  - .12
  - .12
  - R.25

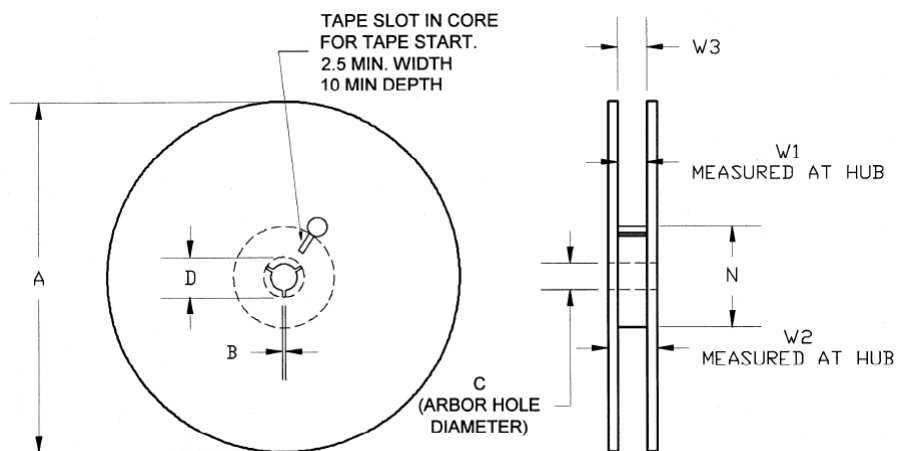
**Table:**

|      |      |
|------|------|
| A0 = | 6.40 |
| B0 = | 6.40 |
| K0 = | 1.50 |

| Feature             | Measure                                  | Symbol | Size (in) | Size (mm) |
|---------------------|------------------------------------------|--------|-----------|-----------|
| Cavity              | Length                                   | A0     | 0.252     | 6.40      |
|                     | Width                                    | B0     | 0.252     | 6.40      |
|                     | Depth                                    | K0     | 0.059     | 1.50      |
|                     | Pitch                                    | P1     | 0.315     | 8.00      |
| Centerline Distance | Cavity to Perforation - Length Direction | P2     | 0.079     | 2.00      |
|                     | Cavity to Perforation - Width Direction  | F      | 0.217     | 5.50      |
| Cover Tape          | Width                                    | C      | 0.362     | 9.20      |
| Carrier Tape        | Width                                    | W      | 0.472     | 12.00     |

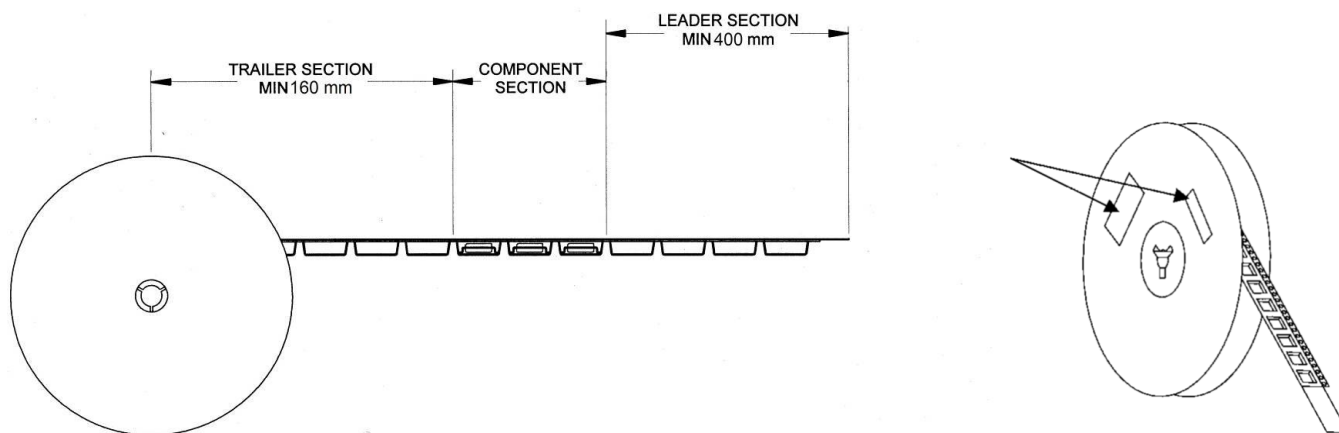
## Tape and Reel Information – Reel Dimensions (13")

Standard T/R size = 2,500 pieces on a 13" reel.



| Feature | Measure              | Symbol | Size (in) | Size (mm) |
|---------|----------------------|--------|-----------|-----------|
| Flange  | Diameter             | A      | 12.992    | 330.0     |
|         | Thickness            | W2     | 0.717     | 18.2      |
|         | Space Between Flange | W1     | 0.504     | 12.8      |
| Hub     | Outer Diameter       | N      | 4.016     | 102.0     |
|         | Arbor Hole Diameter  | C      | 0.512     | 13.0      |
|         | Key Slit Width       | B      | 0.079     | 2.0       |
|         | Key Slit Diameter    | D      | 0.787     | 20.0      |

## Tape and Reel Information – Tape Length and Label Placement



### Notes:

1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
2. Labels are placed on the flange opposite the sprockets in the carrier tape.

## Handling Precautions

| Parameter                        | Rating   | Standard                   |
|----------------------------------|----------|----------------------------|
| ESD – Human Body Model (HBM)     | Class 1B | ANSI / ESDA / JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | Class C2 | ANSI / ESDA / JEDEC JS-002 |
| MSL – Moisture Sensitivity Level | Level 3  | IPC/JEDEC J-STD-020        |



Caution!  
ESD-Sensitive Device

## Solderability

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes. Solder profiles available upon request.

Contact plating: NiPdAu (*Electroless Plating Thickness: Ni  $3.5 \pm 1.5 \mu\text{m}$  – Pd  $0.145 \pm 0.035 \mu\text{m}$  – Au  $0.095 \pm 0.025 \mu\text{m}$* )

## RoHS Compliance

This part is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU. This product also has the following attributes:

- Product uses RoHS Exemption 7c-I to meet RoHS Compliance requirements.
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free

## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: [www.qorvo.com](http://www.qorvo.com)

Tel: 1-844-890-8163

Email: [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

For technical questions and application information:

Email: [appsupport@qorvo.com](mailto:appsupport@qorvo.com)

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Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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