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# RF1140

## BROADBAND HIGH POWER SP4T SWITCH

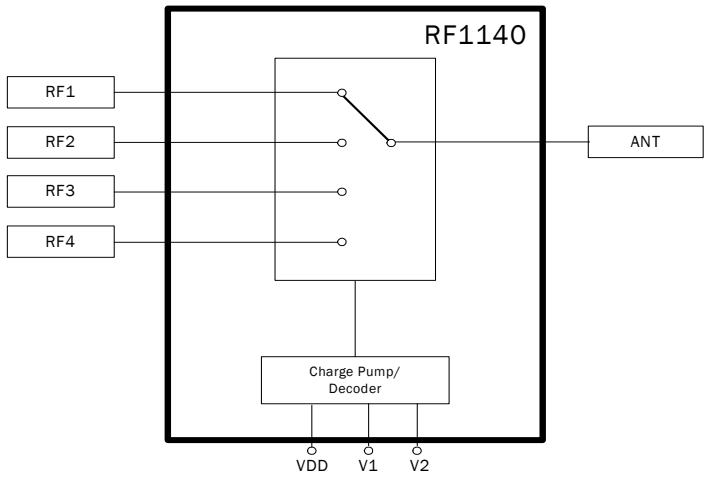
Package Style: QFN, 16-pin, 3mmx3mm


## Features

- Low Frequency - 2.5GHz
- Very Low Insertion Loss:
  Cell Band: 0.3dB (Typ.)
  PCS Band: 0.5dB (Typ.)
- High Isolation
  Cell Band: 28dB (Typ.)
  PCS Band: 21dB (Typ.)
- Compatible With Low Voltage Logic: $V_{HIGH}$=1.8V
- Excellent Linearity Performance (IIP2):
  Cell Band: 114dBm (Typ.)
  PCS Band: 115dBm (Typ.)
- Lowest BOM Cost and Small Solution Size

## Applications

- Antenna Tuning Applications
- IEEE802.11b/g WLAN Applications
- Multi-Mode GSM/WCDMA Handsets
- CDMA Primary Path Handsets




Functional Block Diagram

## Product Description

The RF1140 is a single-pole four-throw (SP4T) switch designed for general purpose switching applications which require very low insertion loss and high power handling capability. The RF1140 is ideally suited for battery operated applications requiring high performance switching with very low DC power consumption. The RF1140 features low insertion loss, low control voltage, high linearity, and very good harmonic characteristics. Additionally, RF1140 integrates decoding logic, which allows just two control lines needed for switch control. This part is based off RFMD's GaAs pHEMT and is packaged in a very compact 3.0mmx3.0mmx0.55mm, 16-pin, leadless QFN package. No DC-blocking capacitors are required on RF paths, when no DC is applied external to the device ports.

### Ordering Information

| | |
|---|---|
| RF1140 | Broadband High Power SP3T Switch |
| RF1140PCBA-410 | Fully Assembled Evaluation Board |

### Optimum Technology Matching® Applied

| | | | |
|---|---|---|---|
| ☐ GaAs HBT | ☐ SiGe BiCMOS | ☑ GaAs pHEMT | ☐ GaN HEMT |
| ☐ GaAs MESFET | ☐ Si BiCMOS | ☑ Si CMOS | ☐ RF MEMS |
| ☐ InGaP HBT | ☐ SiGe HBT | ☐ Si BJT | ☐ LDMOS |





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## Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|---|---|
| VDD, V1, V2 | 6.0 | V |
| Maximum Input Power (0.6GHz to 2.5GHz), RF2, RF3, RF4 | +38 | dBm |
| Operating Temperature | -30 to +85 | °C |
| Storage Temperature | -65 to +100 | °C |

**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.

RoHS status based on EUDirective2002/95/EC (at time of this document revision).



| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| | | | | | VDD=2.6V, V1, V2=High=1.8V, V1, V2=Low=0V, Temp=25°C |
| Operating Frequency | 450 | | 2500 | MHz | |
| **Insertion Loss** | | | | | |
| RF1-ANT, RF2-ANT, RF3-ANT, RF4 - ANT | | 0.25 | 0.40 | dB | RF ON, 50MHz to 450MHz |
| | | 0.30 | 0.45 | dB | RF ON, 824MHz to 960MHz |
| | | 0.50 | 0.65 | dB | RF ON, 1850MHz to 1990MHz |
| | | 0.70 | 0.75 | dB | RF ON, 2170MHz to 2500MHz |
| **Isolation** | | | | | |
| RF1-ANT, RF2-ANT, RF3-ANT, RF4 - ANT | 26 | 28 | | dB | RF ON, 824MHz to 960MHz |
| | 19 | 21 | | dB | RF ON, 1850MHz to 1990MHz |
| | 18 | 20 | | dB | RF ON, 2170MHz to 2500MHz |
| **880MHz Harmonics** | | | | | |
| Harmonic (2fo) | | -90 | -80 | dBc | $P_{IN}$=+35dBm, 880MHz |
| Third Harmonic (3fo) | | -97 | -80 | dBc | $P_{IN}$=+35dBm, 880MHz |
| **1800MHz Harmonics** | | | | | |
| Harmonic (2fo) | | -86 | -80 | dBc | $P_{IN}$=+32dBm, 1800MHz |
| Third Harmonic (3fo) | | -81 | --75 | dBc | $P_{IN}$=+32dBm, 1800MHz |
| **2500MHz Harmonics** | | | | | |
| Harmonic (2fo) | | -99 | -80 | dBc | $P_{IN}$=+32dBm, 2500MHz |
| Third Harmonic (3fo) | | --94 | -80 | dBc | $P_{IN}$=+32dBm, 2500MHz |
| **IIP2** | | | | | |
| IIP2 (IMT, PCS, AWS) | 105 | 112 | | dBm | Tone 1: +26dBm, Tone 2: -20dBm |
| IIP2 (Cell) | 105 | 110 | | dBm | Tone 1: +26dBm, Tone 2: -20dBm |
| **RF Port Return Loss** | | | | | |
| VSWR | | | 1.5:1 | | |



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| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| **Input Power at 0.1dB Compression Point** | | | | | |
| | 37 | 38 | | dBm | |
| **Switching Speed** | | | | | |
| | | 1 | 5 | us | 10% to 90% RF, 90% to 10% RF |
| **Triple Beat Ratio** | | | | | |
| TBR | 85 | 88 | | dBc | 650MHz to 900MHz[1, 2] |
| TBR | 95 | 100 | | dBc | AWS[1, 2] |
| TBR | 83 | 87 | | dBc | PCS[1, 2] |
| **DC Supply** | | | | | |
| $V_{DD}$ (Switch Supply) | 2.5 | 2.6 | 3.3 | V | |
| V1 and V2 (H) | 1.3 | 1.8 | 2.9 | V | |
| V1 and V2 (L) | 0 | | 0.4 | V | |
| Control Current | | | 1.5 | µA | |
| Supply Current | | | 0.8 | mA | $P_{IN}$=26dBm |

Notes: Parameters hold at 25°C and VDD=2.6V
1. Tested under load with VSWR of 2:1 at all phases
2. Temp= +15°C to +60°C

## Switch Control Settings

The switch is operable in four states (see truth table below). The switch is designed for two modes: Active and Stand-by. These modes are controlled by the VDD signal. When VDD is high, the switch is active.

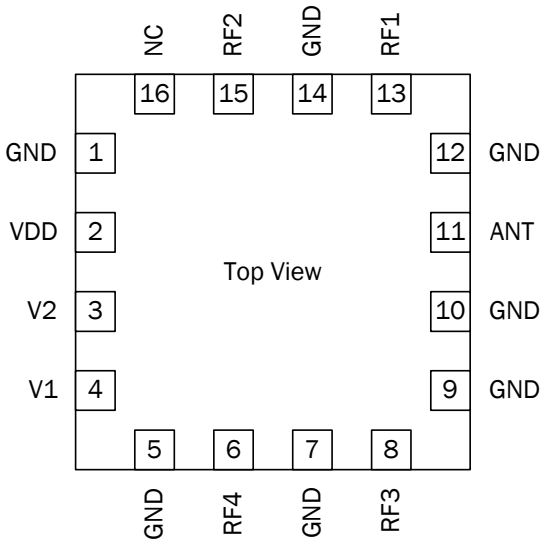
| Signal Paths | Control Signals | | | | | |
|---|---|---|---|---|---|---|
| **Mode** | **V1** | **V2** | **S1** | **S2** | **S3** | **S4** |
| ANT - RF1 | Low | Low | ON | OFF | OFF | OFF |
| ANT - RF2 | High | Low | OFF | ON | OFF | OFF |
| ANT - RF3 | Low | High | OFF | OFF | ON | OFF |
| ANT - RF4 | High | High | OFF | OFF | OFF | ON |

**Electrical Test Methods:**
The electrical parameters for the switch were measured on the test evaluation board provided by the switch supplier. The test evaluation board includes means for decoupling RF signals from the control signal port (shunt capacitor at control signal ports).

All measurements were done with the calibration plane at switch pins. The effect of the test board losses and phase delay has been removed from the results.

| Pin | Function | Description |
|---|---|---|
| 1 | GND | Ground. |
| 2 | VDD | DC Voltage Supply. |
| 3 | V2 | Voltage Control 2. |
| 4 | V1 | Voltage Control 1. |
| 5 | GND | Ground. |
| 6 | RF4 | RF Output 4. |
| 7 | GND | Ground. |
| 8 | RF3 | RF Output 3. |
| 9 | GND | Ground. |
| 10 | GND | Ground. |
| 11 | ANT | RF Input. Connected to antenna. |
| 12 | GND | Ground. |
| 13 | RF1 | RF Output 1. |
| 14 | GND | Ground. |
| 15 | RF2 | RF Output 2. |
| 16 | NC | Can be left floating or grounded. |

## Pin Configuration





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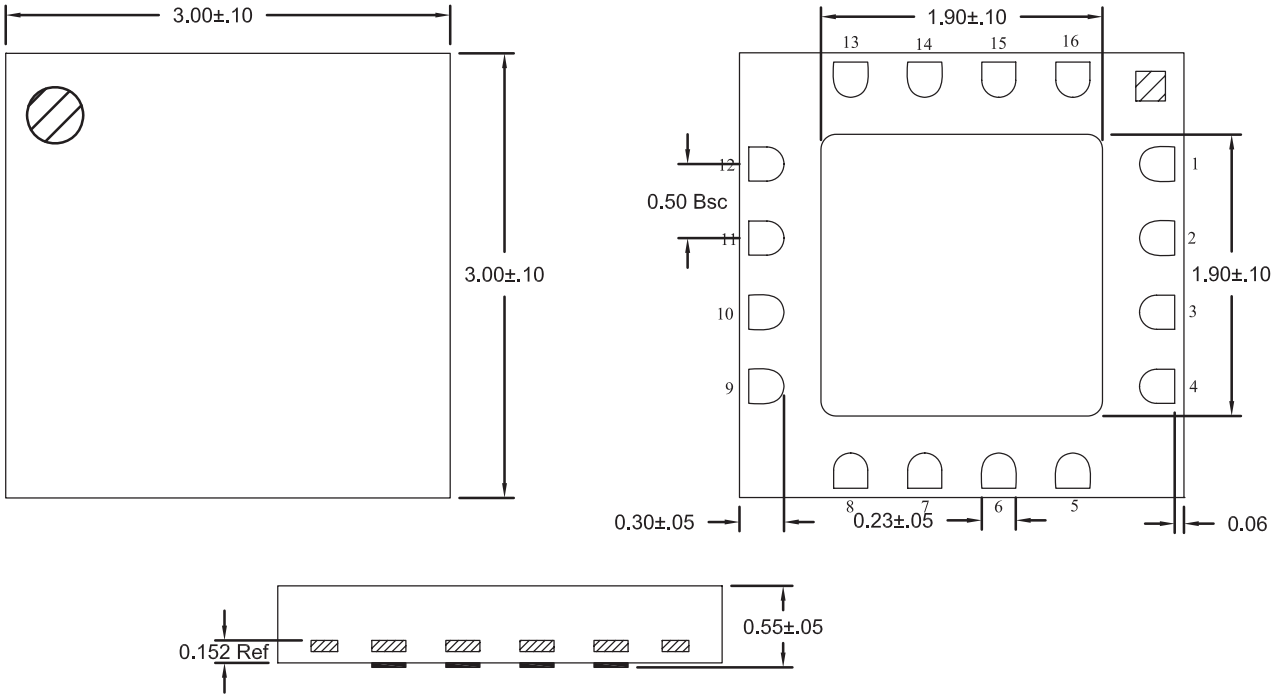
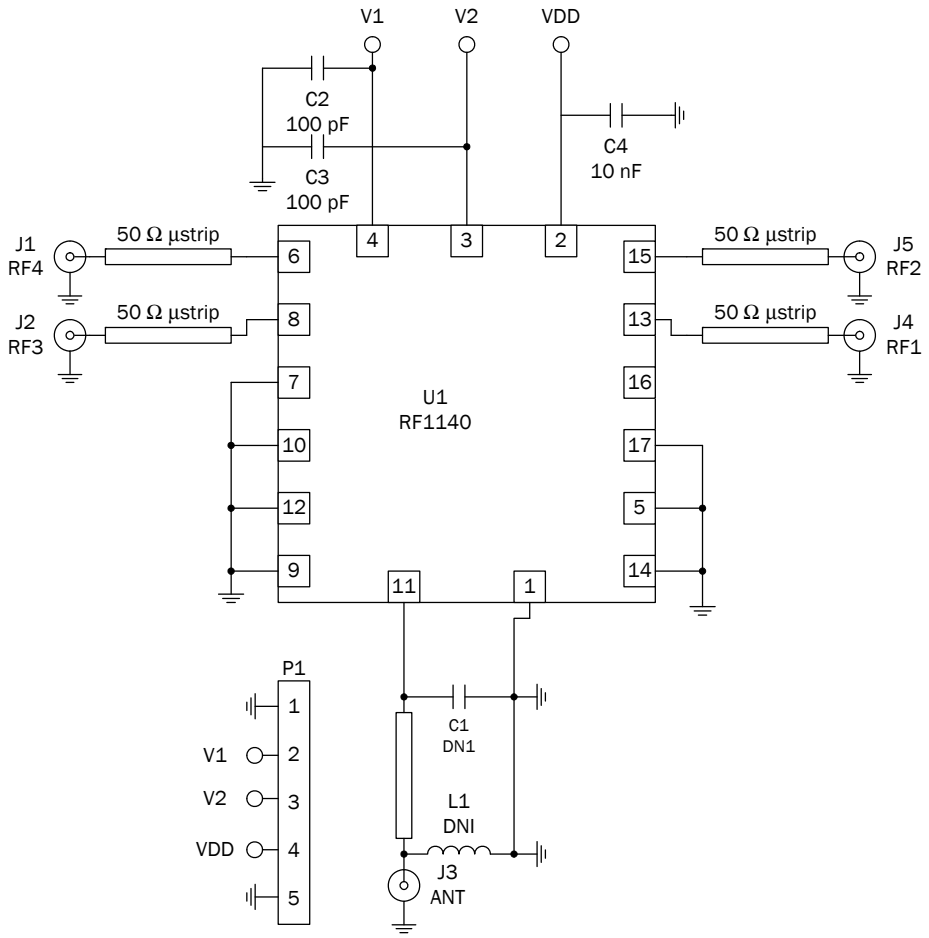
## Package Outline




NOTES:
1) PIN 1 SHADED AREA

## Evaluation Board Schematic




**Application Diagram and Guidelines:**

The decoupling capacitors are an optional taken and, if necessary, may be used for noise reduction. Decoupling capacitors on the control pins protect the control circuitry from possible RF leakage. DC-blocking capacitors are not needed on the RF paths, as there is no DC on the RF path, however, care should be taken to ensure that DC is not injected in the switch from external circuitry. An ESD filter is needed to protect the switch from antenna ESD events. The filter is formed by LESD inductor and CESD capacitor. The switch has a supply input to feed the built-in logic decoding.

LESD value will depend on the level of ESD protection and the loss acceptable in a given application.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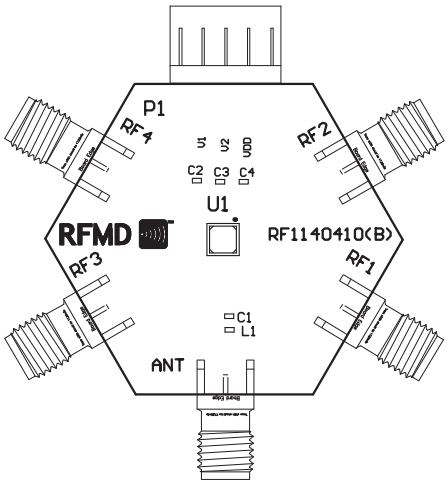
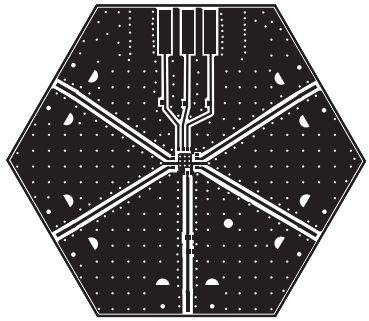
## Evaluation Board Layout

**Board Thickness 0.0658”, Board Material FR-4**

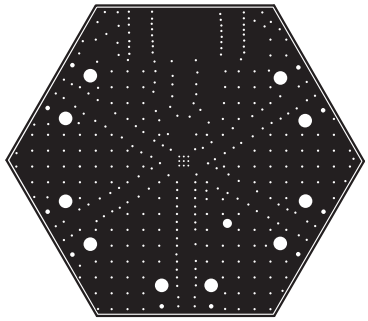
Component Layer



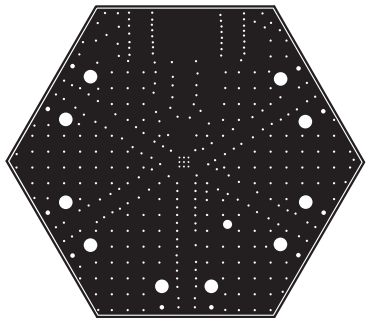

Topside RF Layer



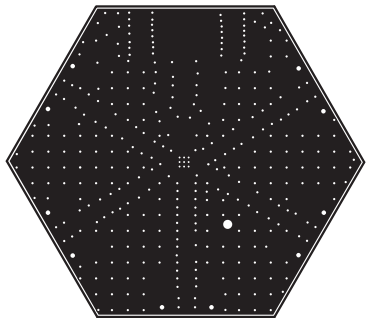
Inner Layer 1



Inner Layer 2



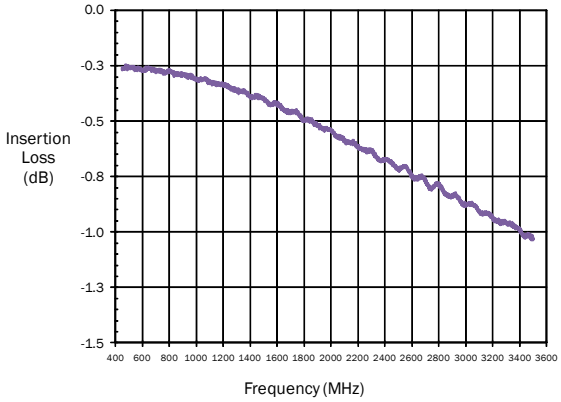
Ground Plane Layer



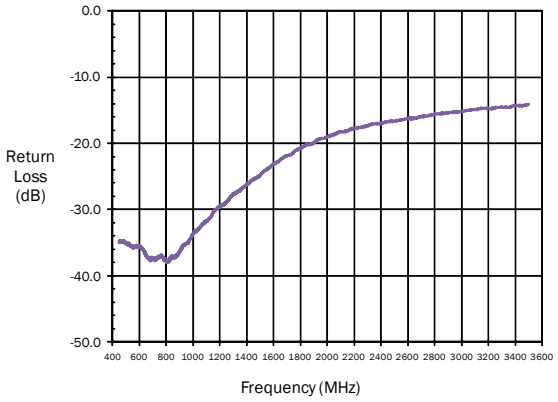
Typical Performance Data on Evaluation Board:

Fixture losses have de-embedded (Temp=25°C, VDD=2.75V, V1 =V2=High=1.8V, V1=V2=Low=0V)

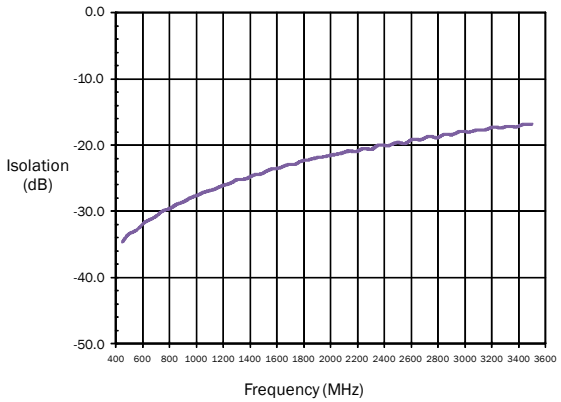
**Insertion Loss**



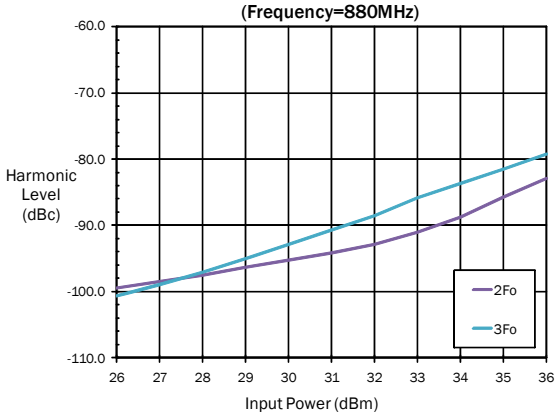

**Ant Port Return Loss**



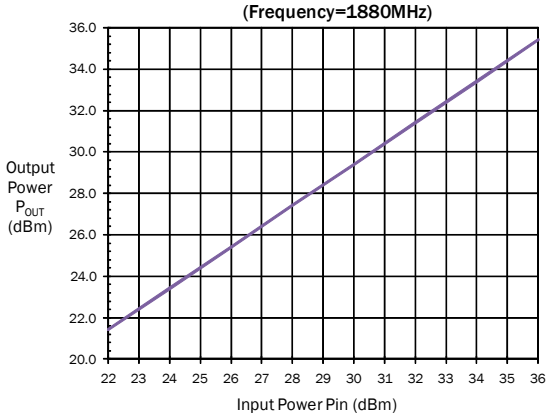

**Antenna to Port Isolation**




**Harmonics (Frequency=880MHz)**




**Output Power versus Input Power (Frequency=1880MHz)**



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