




SKY65611-11: Low-Noise Amplifier (LNA) for GPS/GLONASS/Galileo/BDS Applications

Applications

- GPS/GLONASS/Galileo/BDS radio receivers
- Compass (Beidou)
- Smartphones
- Tablet/laptop PCs
- Personal navigation devices

Features

- Small signal gain: 16.5 dB typical
- Low noise figure: 0.65 dB typical
- Out-of-band IIP3: +4 dBm typical
- Low current consumption
- Output impedance internally matched to 50 Ω
- Single DC supply: 1.5 to 3.0 V
- LNA enable: 1.2 V
- Minimal number of external components required
- Small DFN 6-pin, 1.1 x 0.9 mm package (MSL1, 260°C per JEDEC J-STD-020)

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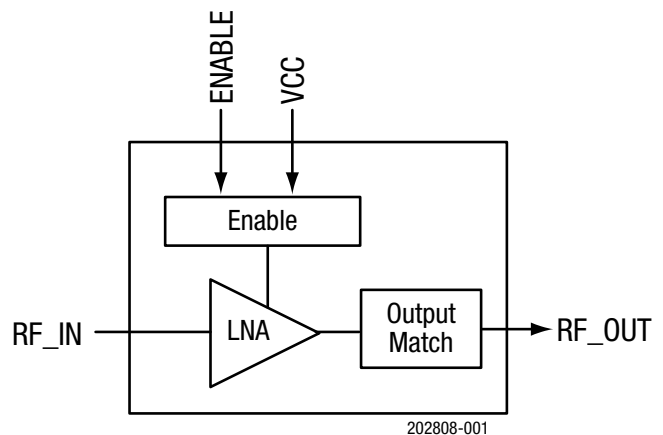


Figure 2. SKY65611-11 Block Diagram

Description

The SKY65611-11 is a Microwave Monolithic Integrated Circuit (MMIC) front-end low-noise amplifier (LNA) for Global Positioning System/Global Navigation Satellite System (GPS/GLONASS)/Galileo and Beidou Navigation Satellite System (BDS) receiver applications. The device provides high linearity, excellent gain, a high 1 dB input compression point (IP1dB), and 0.65 dB typical noise figure (NF). Output matching components are embedded inside the device, minimizing input matching components.

The SKY65611-11 is optimized to operate at 1559 to 1606 MHz, making it ideal for GPS/GLONASS/Galileo/BDS radio receiver applications.

The SKY65611-11 is fabricated using advanced SiGe BiCMOS technology. The LNA uses surface-mount technology (SMT) in a Dual Flat No-Lead (DFN) package, which allows for a highly manufacturable and low-cost solution. The pin configuration and package are shown in Figure 1. Pin assignments and descriptions are in Table 1.

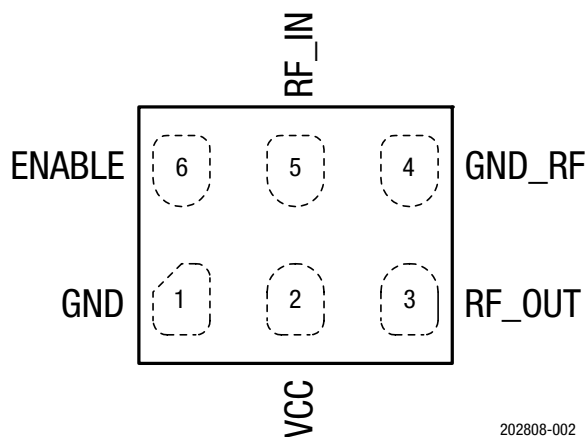


Figure 1. SKY65611-11 Pinout (Top View)

Table 1. SKY65611-11 Signal Descriptions

| Pin | Name | Description | Pin | Name | Description |
|-----|--------|----------------|-----|--------|-------------|
| 1 | GND | Ground | 4 | GND | Ground |
| 2 | VCC | Source voltage | 5 | RF_IN | RF input |
| 3 | RF_OUT | RF output | 6 | ENABLE | LNA enable |

Technical Description

The ENABLE signal (pin 6) enables or disables the LNA DC power. A logic high signal powers on the LNA and a logic low signal powers off the device.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65611-11 are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Tables 4 and 5.

Table 2. SKY65611-11 Absolute Maximum Ratings^{1, 2}

| Parameter | Symbol | Minimum | Maximum | Units |
|---|--------|---------|--------------|--------|
| RF input power | Pin | | 0 | dBm |
| Supply voltage | Vcc | 0 | 3.1 | V |
| Storage temperature | Tstg | -55 | +125 | °C |
| Junction temperature | Tj | | +125 | °C |
| Electrostatic discharge: Charged Device Model (CDM), Class C3 Human Body Model (HBM), Class 2 | ESD | | 1000 2000 | V V |

1. Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.
2. Specifications are based on simulations.

ESD Handling: Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.

Table 3. SKY65611-11 Recommended Operating Conditions¹

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|--|--------|---------|---------|---------|-------|
| Frequency range | f | 1559 | 1575 | 1606 | MHz |
| Supply voltage (measured at terminals of Evaluation Board) | Vcc | 1.5 | 1.8 | 3.0 | V |
| Case operating temperature | Tc | -40 | | +85 | °C |

1. Enable OFF voltage: 0.3 V (highest)
Enable ON voltage: Vcc-0.3 V (lowest)

Table 4. SKY65611-11 Electrical Specifications¹
(f = 1575 MHz, VCC = 1.8 V, VEN = 1.8 V, Tc = +25 °C, Unless Otherwise Noted)

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|-------------------|---|-----|---------|-----|-------|
| Small signal gain | S21 | PIN = -30 dBm | 14 | 15.5 | 18 | dB |
| 1 dB input compression point | IP1dB | | | -15.5 | | dBm |
| Noise figure | NF | | | 0.65 | | dB |
| In-band third order input intercept point | IIP3 | f1 = 1575 MHz @ PIN = -30 dBm f2 = 1576 MHz @ PIN = -30 dBm | | -7.5 | | dBm |
| Out-of-band third order input intercept point | OOB-IIP3 | f1 = 1713 MHz @ PIN = -20 dBm f2 = 1851 MHz @ PIN = -65 dBm IMD3 @ 1575 MHz = -93 dBm at output | | +2.5 | | dBm |
| Reverse isolation | S12 | PIN = -30 dBm | | 30 | | dB |
| Input return loss | S11 | PIN = -30 dBm | | 7 | | dB |
| Output return loss | S22 | PIN = -30 dBm | | 12 | | dB |
| Supply current | Icc | No RF | | 3.5 | 4.5 | mA |
| Shut down current | I _{LEAK} | No RF, VEN = 0 V | | | 1 | µA |
| 2nd harmonic of 787 MHz | HD2_787 | PIN = -25 dBm, f1 = 787 MHz, measure output at 1574 MHz | | -28 | | dBm |
| Power gain settling time | | | | 1.33 | | µs |

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

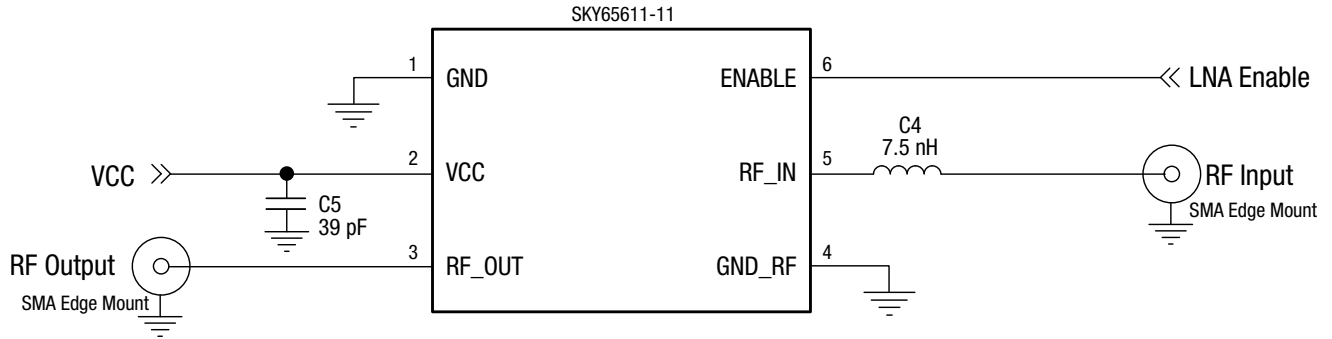
Table 5. SKY65611-11 Electrical Specifications¹
(f = 1575 MHz, VCC = 2.8 V, VEN = 2.8 V, Tc = +25 °C, Unless Otherwise Noted)

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|-------------------|---|-----|---------|-----|-------|
| Small signal gain | S21 | PIN = -30 dBm | 15 | 16.5 | 19 | dB |
| 1 dB input compression point | IP1dB | | | -14.5 | | dBm |
| Noise figure | NF | | | 0.65 | | dB |
| In-band third order input intercept point | IIP3 | f1 = 1575 MHz @ PIN = -30 dBm f2 = 1576 MHz @ PIN = -30 dBm | | -7.5 | | dBm |
| Out-of-band third order input intercept point | OOB-IIP3 | f1 = 1713 MHz @ PIN = -20 dBm f2 = 1851 MHz @ PIN = -65 dBm IMD3 @ 1575 MHz = -96 dBm at output | | +4 | | dBm |
| Reverse isolation | S12 | PIN = -30 dBm | | 30 | | dB |
| Input return loss | S11 | PIN = -30 dBm | | 7 | | dB |
| Output return loss | S22 | PIN = -30 dBm | | 14 | | dB |
| Supply current | Icc | No RF | | 4 | 5 | mA |
| Shut down current | I _{LEAK} | No RF, VEN = 0 V | | | 1 | µA |
| 2nd harmonic of 787 MHz | HD2_787 | PIN = -25 dBm, f1 = 787 MHz, measure output at 1574 MHz | | -27 | | dBm |
| Power gain settling time | | | | 1.33 | | µs |

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Evaluation Board Description

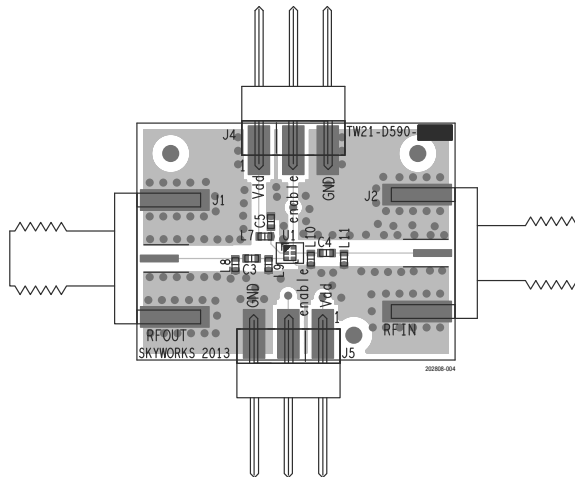
The SKY65611-11 Evaluation Board is used to test the performance of the SKY65611-11 LNA. An application schematic diagram is shown in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4. Table 6 provides the Bill of Materials (BOM) list for Evaluation Board, layer details are shown in Figure 5, and the layer physical characteristics are shown in Figure 6.



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DNI components and 0 Ω resistors are not shown.

Figure 3. SKY65611-11 Application Schematic



Note: Evaluation Board Gerber files are available on request.

Figure 4. SKY65611-11 Evaluation Board Assembly Diagram

Table 6. SKY65611-11 Evaluation Board Bill of Materials

| Component | Size | Value |
|------------------|------|-------------------------------|
| C5 ¹ | 0402 | 39 pF |
| C4 | 0402 | 7.5 nH (Murata LQW04AN7N5D00) |
| L7, C3 | 0402 | 0 Ω |
| L8, L9, L10, L11 | 0402 | DNI |

1. C5 must be placed as close as possible to the device in the application circuit.

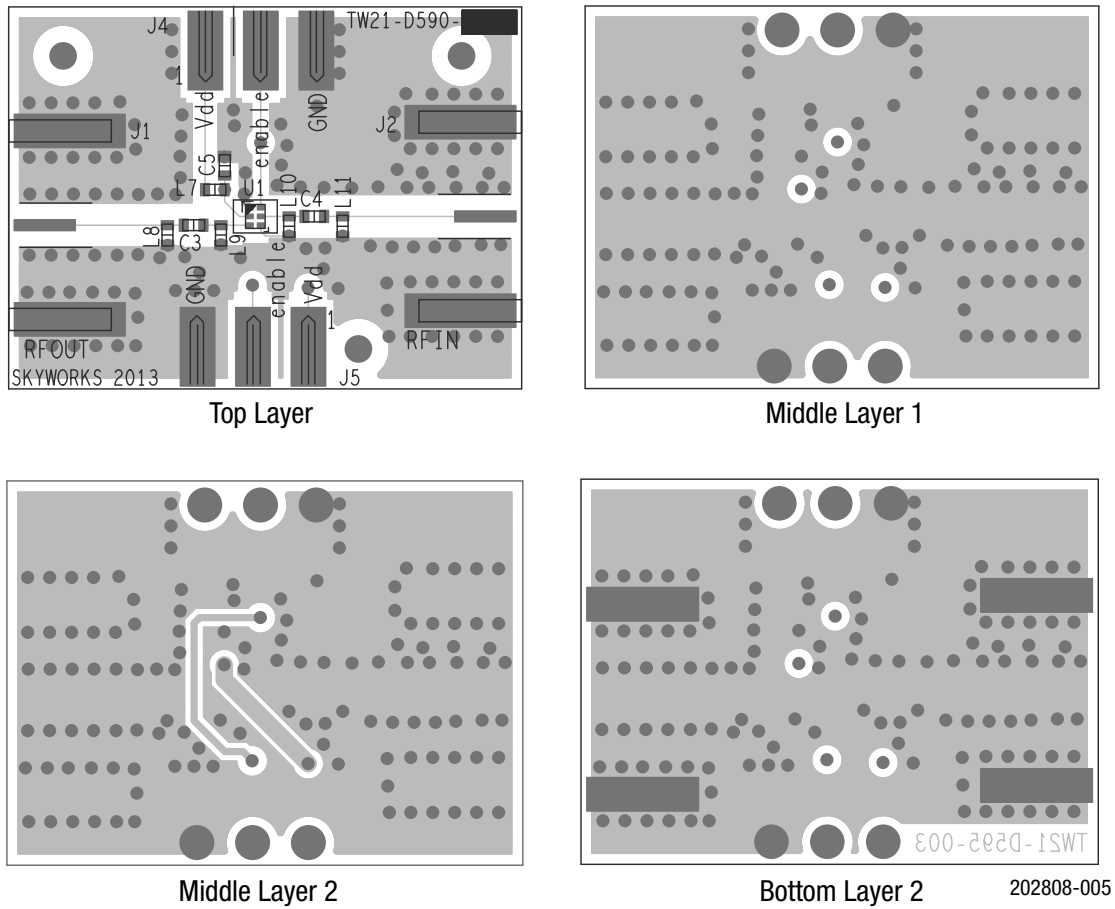
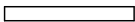
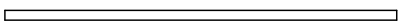
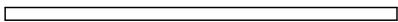

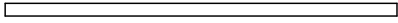

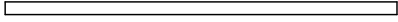





Figure 5. Evaluation Board Layer Details

| 50 Ω | CROSS SECTION | NAME | THICKNESS | MATERIALS |
|---|---|------------|-----------|---------------|
| W = 0.500 mm  |  | TMASK | 0.010 mm | SOLDER RESIST |
| |  | L1 | 0.025 mm | Cu – 1 oz |
| |  | DIELECTRIC | 0.250 mm | RO4350B |
| |  | L2 | 0.035 mm | Cu – 1 oz |
| |  | DIELECTRIC | 1.000 mm | FR4 |
| |  | L3 | 0.035 mm | Cu – 1 oz |
| |  | DIELECTRIC | 0.250 mm | FR4 |
| |  | L4 | 0.200 mm | Cu – 1 oz |
| |  | BMASK | 0.010 mm | SOLDER RESIST |

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Figure 6. Layer Detail Physical Characteristics

Package Dimensions

The PCB layout footprint for the SKY65611-11 is provided in Figure 7. Typical part marking for the SKY65611-11 is shown in Figure 8. Package dimensions are shown in Figure 9, and tape and reel dimensions are provided in Figure 10.

Package and Handling Information

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY65611-11 is rated to Moisture Sensitivity Level 1 (MSL1) at 260 C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, Solder Reflow Information, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

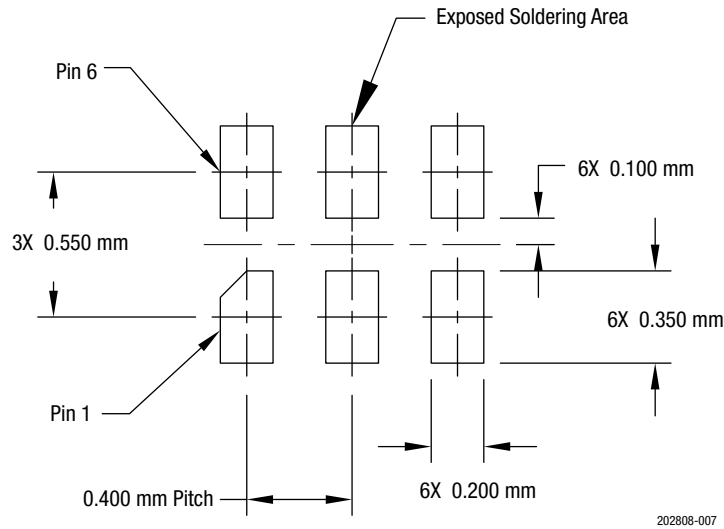


Figure 7. SKY65611-11 PCB Layout Footprint

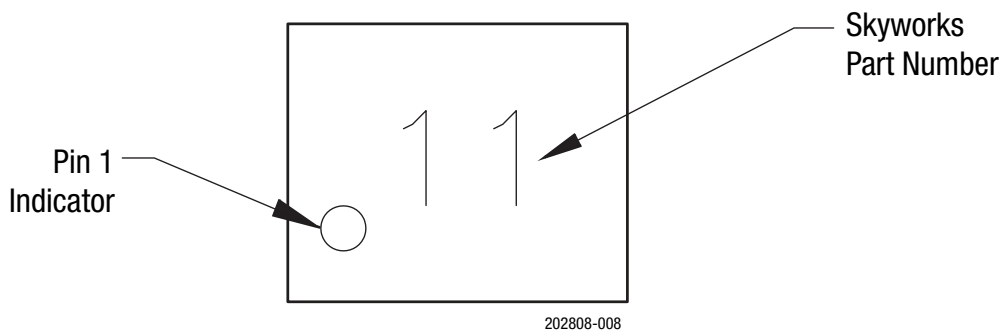
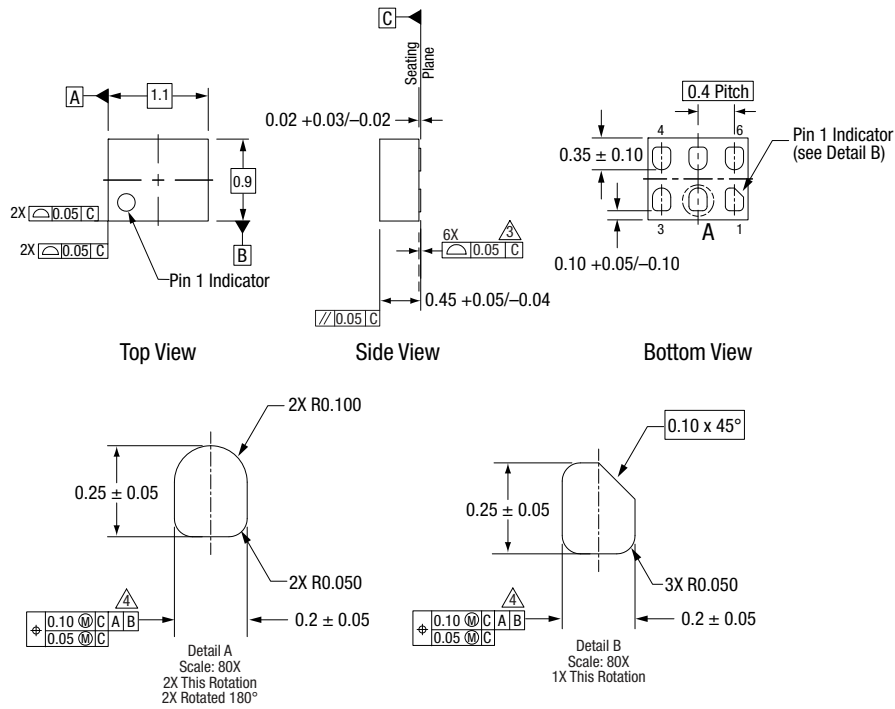


Figure 8. SKY65611-11 Typical Part Marking (Top View)

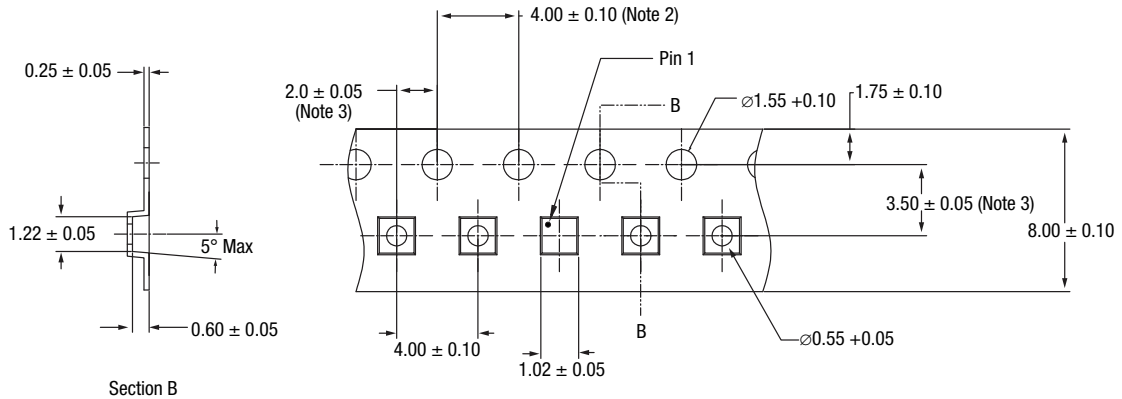


Notes:

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. Coplanarity applies to the terminals and all other bottom surface metallization.
4. Dimension applies to metallized terminal. If the terminal has a radius on its end, the dimension should not be measured in that radius area.

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Figure 9. SKY65611-11 Package Dimensions



Notes:

1. Carrier tape: black conductive polystyrene
2. 10 sprocket hole pitch cumulative tolerance: ±0.20 mm
3. Measured from center line of sprocket hole to center line of pocket
4. All dimensions are in millimeters

202808-010

Figure 10. SKY65611-11 Tape and Reel Dimensions

Ordering Information

| Part Number | Part Description | Evaluation Board Part Number |
|-------------|--|------------------------------|
| SKY65611-11 | Low-Noise Amplifier (LNA) for GPS/GLONASS/Galileo/BDS Applications | SKY65611-11-EVB |

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