

## DATA SHEET

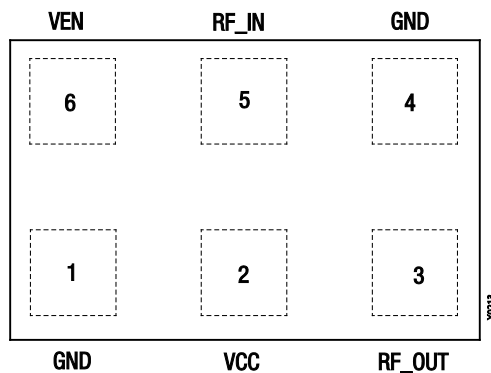
# SKY65605-21: BDS/GPS/GNSS Low-Noise Amplifier

## Applications

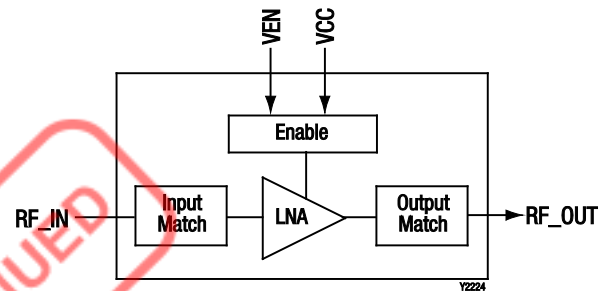
- BDS/GPS/GNSS radio receivers
- Global Navigation Satellite Systems (GLONASS)
- Smartphones
- Tablet/laptop PCs
- Personal navigation devices

## Features

- Small signal gain: 19 dB typical
- High in-band IIP3: -5 dBm
- Low noise figure: 0.6 dB typical
- High IP1dB: -14.5 dBm
- Low current consumption: 3.6 mA
- Output impedance internally matched to 50  $\Omega$
- Single DC supply: 1.8 to 2.85 V
- Minimal number of external components required
- Ultra-small QFN (6-pin, 0.7 x 1.1 mm) package (MSL1, 260 °C per JEDEC J-STD-020)
- For RoHS and other product compliance information, see the [Skyworks Certificate of Conformance](#)



**Figure 2. SKY65605-21 Pinout (Top View)**



**Figure 1. SKY65605-21 Block Diagram**

## Description

The SKY65605-21 is a Microwave Monolithic Integrated Circuit (MMIC) front-end low-noise amplifier (LNA) designed for BeiDou Satellite Navigation System/Global Positioning System/Global Navigation Satellite System (BDS/GPS/GNSS) receiver applications. The device provides high linearity, excellent gain, a high 1 dB input compression point (IP1dB), and a superior noise figure (NF).

The SKY65605-21 is optimized to operate from 1.559 to 1.606 GHz, which makes it ideal for BDS/GPS/GNSS radio receiver applications.

The SKY65605-21 is fabricated using advanced SiGe BiCMOS technology. The LNA uses surface-mount technology (SMT) in the form of a 0.7 x 1.1 mm Quad Flat No-Lead (QFN) package, which allows for a highly manufacturable and low-cost solution.

A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

**Table 1. SKY65605-21 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   | VEN   | LNA enable  |

## Technical Description

### Power Shutdown

The VEN 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 SKY65605-21 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. SKY65605-21 Absolute Maximum Ratings<sup>1</sup>**

| Parameter                  | Symbol           | Minimum | Maximum | Units |
|----------------------------|------------------|---------|---------|-------|
| RF input power             | P <sub>IN</sub>  |         | +10     | dBm   |
| Supply voltage             | V <sub>CC</sub>  | 0       | 3.1     | V     |
| Storage temperature        | T <sub>STG</sub> | -55     | +125    | °C    |
| Junction temperature       | T <sub>J</sub>   |         | +150    | °C    |
| Case operating temperature | T <sub>C</sub>   | -40     | +85     | °C    |

<sup>1</sup> 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.

**ESD HANDLING:** Although this device is designed to be as robust as possible, electrostatic discharge (ESD) can damage this device. This device must be protected at all times from ESD when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.

**Table 3. SKY65605-21 Recommended Operating Conditions**

| Parameter                                                      | Symbol                 | Min  | Typ  | Max             | Units |
|----------------------------------------------------------------|------------------------|------|------|-----------------|-------|
| Frequency range                                                | f                      | 1559 | 1575 | 1606            | MHz   |
| Supply voltage (measured at terminals of the Evaluation Board) | V <sub>CC</sub>        | 1.50 | 1.80 | 2.85            | V     |
| LNA enable:                                                    |                        |      |      |                 |       |
| Enable (high)                                                  | LNA <sub>ENABLE</sub>  | 1.5  |      | V <sub>CC</sub> | V     |
| Disable (low)                                                  | LNA <sub>DISABLE</sub> | 0    |      | 0.3             | V     |

**Table 4. SKY65605-21 Electrical Specifications<sup>1</sup>****(V<sub>CC</sub> = 2.85 V, V<sub>EN</sub> = 1.5 V, f = 1575 MHz, T<sub>c</sub> = +25 °C, Unless Otherwise Noted)**

| Parameter                                     | Symbol            | Test Condition                                                                                             | Min | Typ              | Max | Units |
|-----------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------|-----|------------------|-----|-------|
| Small signal gain                             | S <sub>21</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  | 17  | 19               | 21  | dB    |
| 1 dB input compression point                  | IP1dB             |                                                                                                            |     | -14.5            |     | dBm   |
| Noise figure                                  | NF                |                                                                                                            |     | 0.6 <sup>2</sup> |     | dB    |
| In-band third order input intercept point     | IIP3              | f <sub>1</sub> = 1575 MHz, P <sub>1</sub> = -30 dBm<br>f <sub>2</sub> = 1574 MHz, P <sub>2</sub> = -30 dBm |     | -5               |     | dBm   |
| Out-of-band third order input intercept point | OOB-IIP3          | f <sub>1</sub> = 1713 MHz, P <sub>1</sub> = -20 dBm<br>f <sub>2</sub> = 1851 MHz, P <sub>2</sub> = -20 dBm |     | -2               |     | dBm   |
| Reverse isolation                             | S <sub>12</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  |     | 37               |     | dB    |
| Input return loss                             | S <sub>11</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  |     | 7.5              |     | dB    |
| Output return loss                            | S <sub>22</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  |     | 10               |     | dB    |
| Supply current                                | I <sub>CC</sub>   |                                                                                                            |     | 3.5              | 4.5 | mA    |
| Shutdown current                              | I <sub>LEAK</sub> |                                                                                                            |     | 0.1              | 1.0 | μA    |

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.<sup>2</sup> 0.1 dB has been de-embedded for input connector and trace loss.**Table 5. SKY65605-21 Electrical Specifications<sup>1</sup>****(V<sub>CC</sub> = 1.8 V, V<sub>EN</sub> = 1.5 V, f = 1575 MHz, T<sub>c</sub> = +25 °C, Unless Otherwise Noted)**

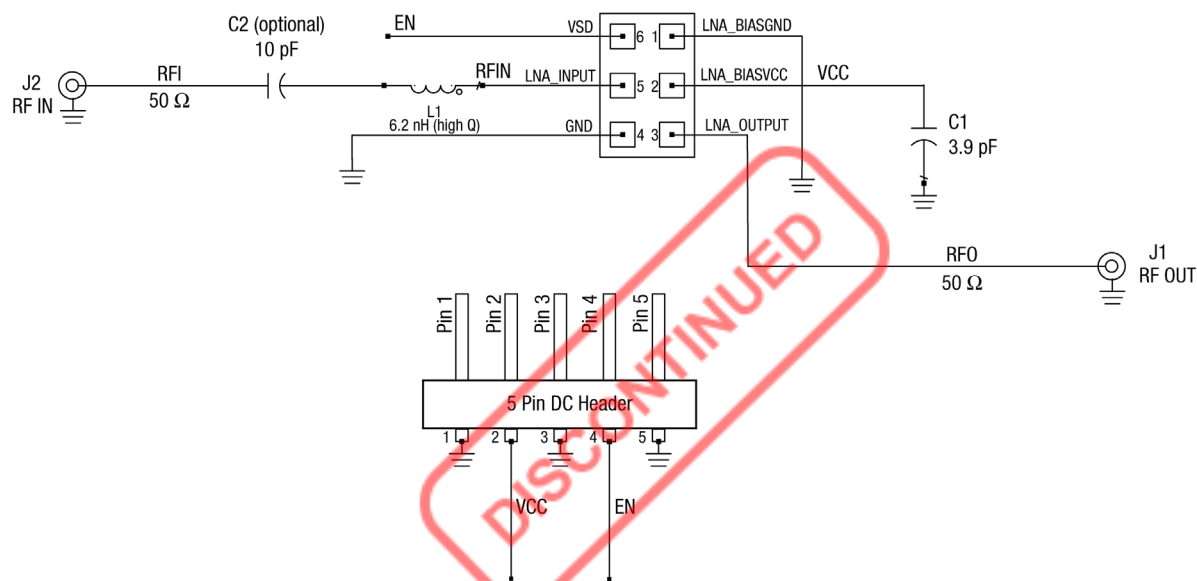
| Parameter                                     | Symbol            | Test Condition                                                                                             | Min | Typ          | Max  | Units |
|-----------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------|-----|--------------|------|-------|
| Small signal gain                             | S <sub>21</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  | 17  | 18.5         | 20.5 | dB    |
| 1 dB input compression point                  | IP1dB             | f = 1575.0 MHz                                                                                             |     | -16 (Note 2) |      | dBm   |
| Noise figure                                  | NF                |                                                                                                            |     | 0.65         |      | dB    |
| In-band third order input intercept point     | IIP3              | f <sub>1</sub> = 1575 MHz, P <sub>1</sub> = -30 dBm<br>f <sub>2</sub> = 1574 MHz, P <sub>2</sub> = -30 dBm |     | -7           |      | dBm   |
| Out-of-band third order input intercept point | OOB-IIP3          | f <sub>1</sub> = 1713 MHz, P <sub>1</sub> = -20 dBm<br>f <sub>2</sub> = 1851 MHz, P <sub>2</sub> = -20 dBm |     | -5           |      | dBm   |
| Reverse isolation                             | S <sub>12</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  |     | 37           |      | dB    |
| Input return loss                             | S <sub>11</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  |     | 7            |      | dB    |
| Output return loss                            | S <sub>22</sub>   | P <sub>IN</sub> = -30 dBm                                                                                  |     | 10           |      | dB    |
| Supply current                                | I <sub>CC</sub>   |                                                                                                            |     | 3.3          | 4.5  | mA    |
| Shutdown current                              | I <sub>LEAK</sub> |                                                                                                            |     | 0.1          | 1.0  | μA    |

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.<sup>2</sup> 0.1 dB has been de-embedded for input connector and trace loss.

Evaluation Board Description

The SKY65605-21 Evaluation Board is used to test the performance of the SKY65605-21 LNA. Figure 3 shows the Evaluation Board schematic, and Table 6 lists the

Bill of Materials (BOM) for the SKY65605-21. Figure 4 shows the Evaluation Board assembly drawing.



203118-003

Figure 3. SKY65605-21 Evaluation Board Schematic

Table 6. SKY65605-21 Bill of Materials for the Evaluation Board<sup>1,2</sup>

| Part Number   | Value  | Size | Manufacturer | Mfr Part Number    | Notes                   |
|---------------|--------|------|--------------|--------------------|-------------------------|
| C1            | 3.9 pF | 0402 | Murata       | GRM1555C1E3R9CA01D | Capacitor               |
| C2 (optional) | 10 pF  | 0402 | Murata       | GRM1555C1H101JA01D | Capacitor               |
| L1            | 6.2 nH | 0402 | Murata       | LQW15AN6N2C00D     | Wire-wound HiQ inductor |

<sup>1</sup> The C1 and C2 capacitors can use a 0201 size as an alternative.  
<sup>2</sup> The C2 capacitor is optional if there is no DC present at the RF input.

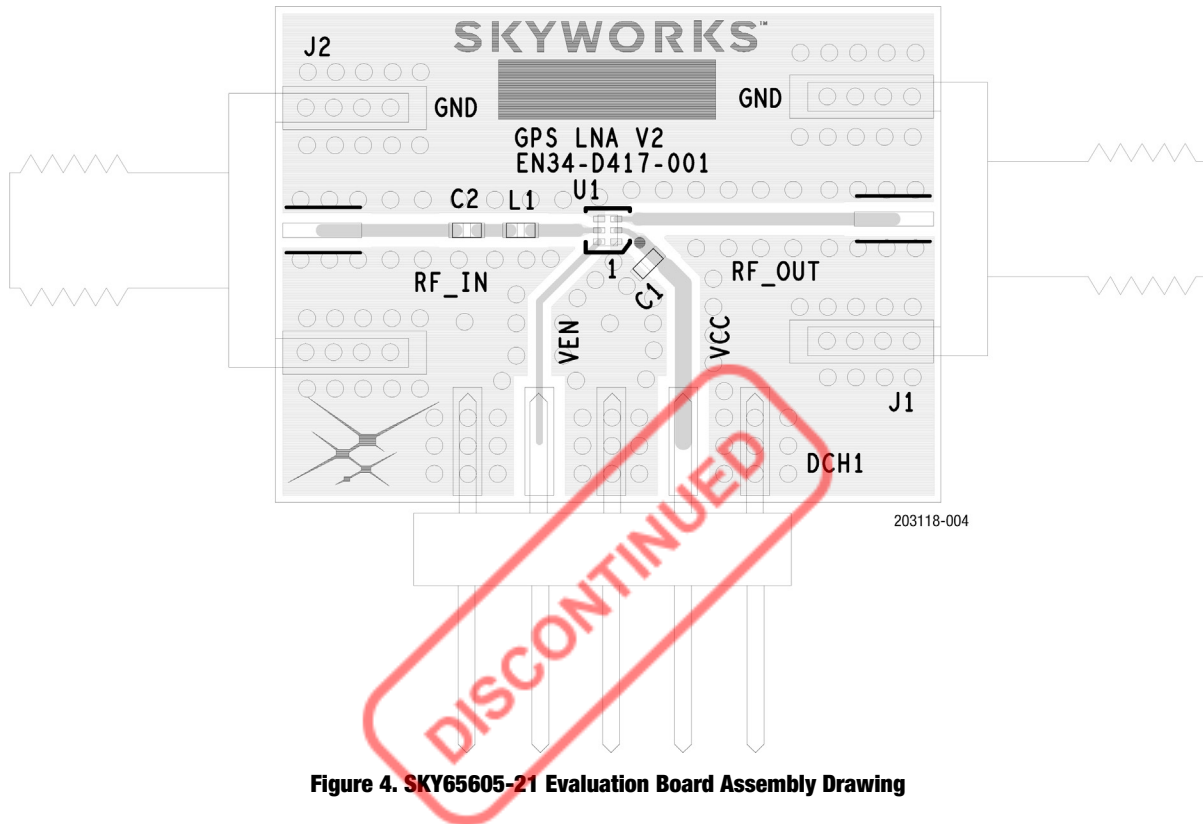


Figure 4. SKY65605-21 Evaluation Board Assembly Drawing

## Package Dimensions

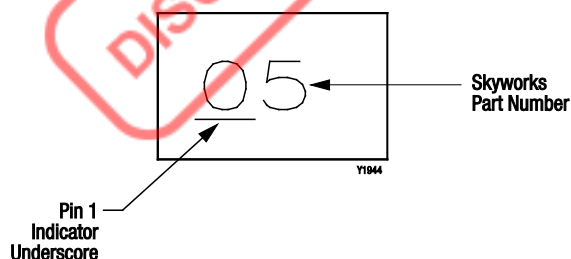
Typical part markings are shown in Figure 5. The PCB layout footprint is shown in Figure 6. Package dimensions for the SKY65605-21 are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

## Package and Handling Information

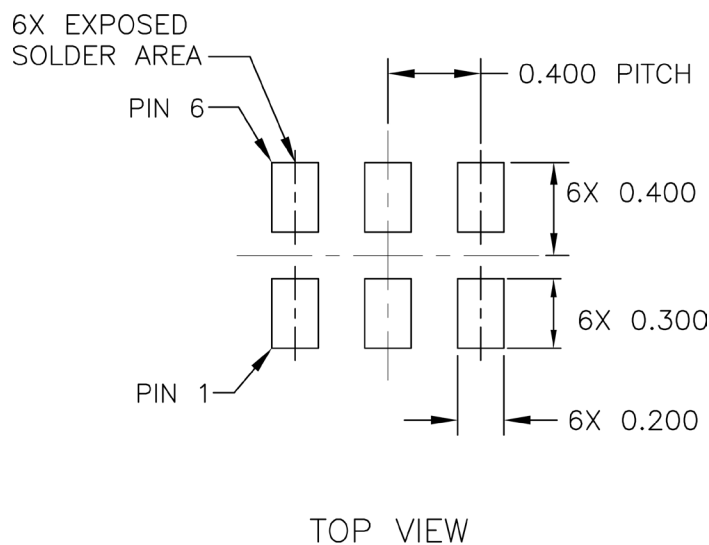
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY65605-21 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 5. SKY65605-21 Typical Part Marking**



TOP VIEW

All dimensions are in millimeters.

203118-006

**Figure 6. SKY65605-21 PCB Layout Footprint**

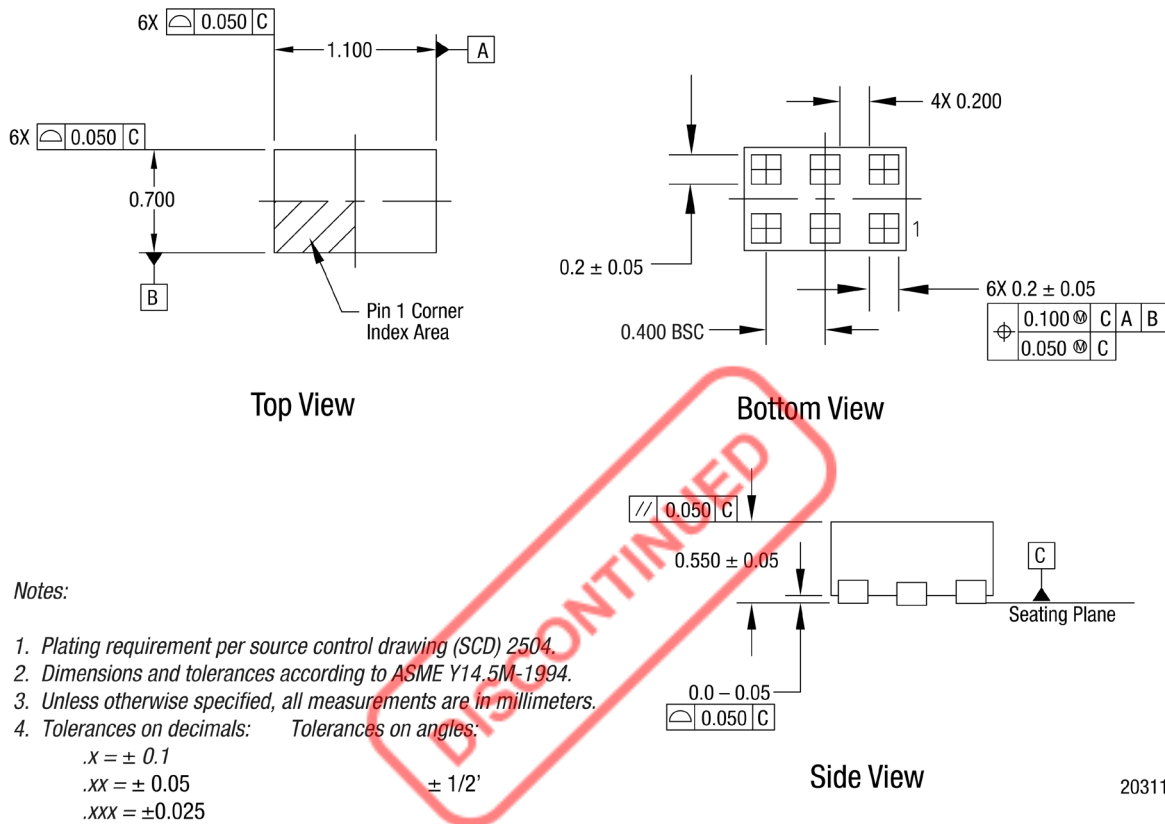


Figure 7. SKY65605-21 Package Dimensions

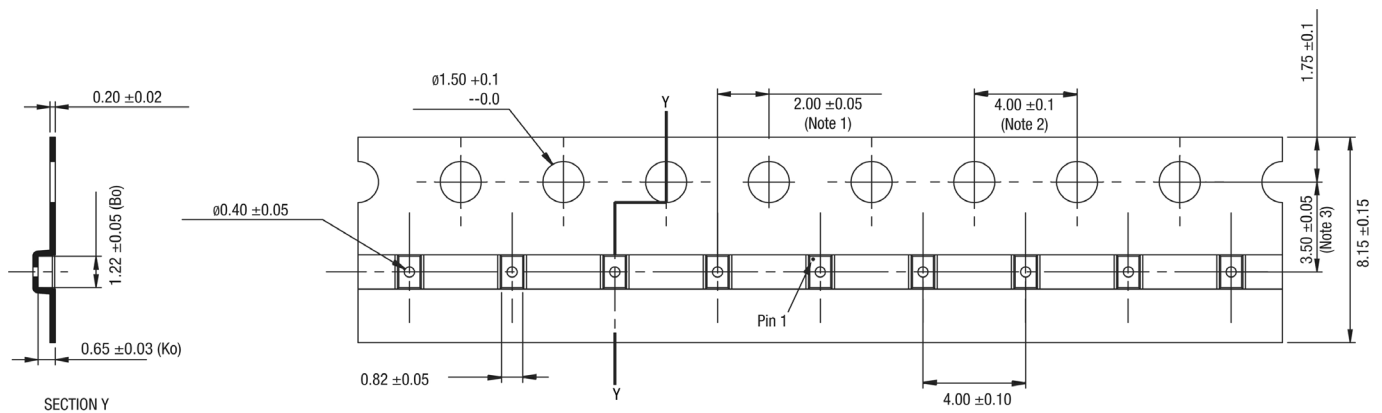


Figure 8. SKY65605-21 Tape and Reel Dimensions

## Ordering Information

| Part Number | Product Description              | Evaluation Board Part Number |
|-------------|----------------------------------|------------------------------|
| SKY65605-21 | BDS/GPS/GNSS Low-Noise Amplifier | 65605-21-EVB                 |



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