

# BGS16GA14

SP6T Diversity Antenna Switch with GPIO Interface

## Data Sheet

Revision 3.0 - 2016-02-29

**Edition 2016-02-29**

**Published by Infineon Technologies AG  
81726 Munich, Germany**

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## Revision History

**Document No.:** BGS16GA14\_\_v3.0.pdf

**Revision History:** Rev. v3.0

**Previous Version:** 2.0

| Page | Subjects (major changes since last revision) |
|------|----------------------------------------------|
| 12   | Carrier tape drawing updated                 |
|      |                                              |
|      |                                              |

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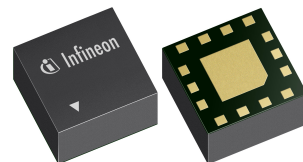
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## BGS16GA14

### 1 Features

- 6 high-linearity, interchangeable RX ports
- Low insertion loss
- Low harmonic generation
- High port-to-port-isolation
- Suitable for Edge / C2K / LTE / WCDMA Applications
- 0.1 to 3.8 GHz coverage
- No decoupling capacitors required if no DC applied on RF lines
- On chip control logic including ESD protection
- General Purpose Input-Output (GPIO) Interface
- Small form factor 2.0 mm x 2.0 mm
- No power supply blocking required
- High EMI robustness
- RoHS and WEEE compliant package



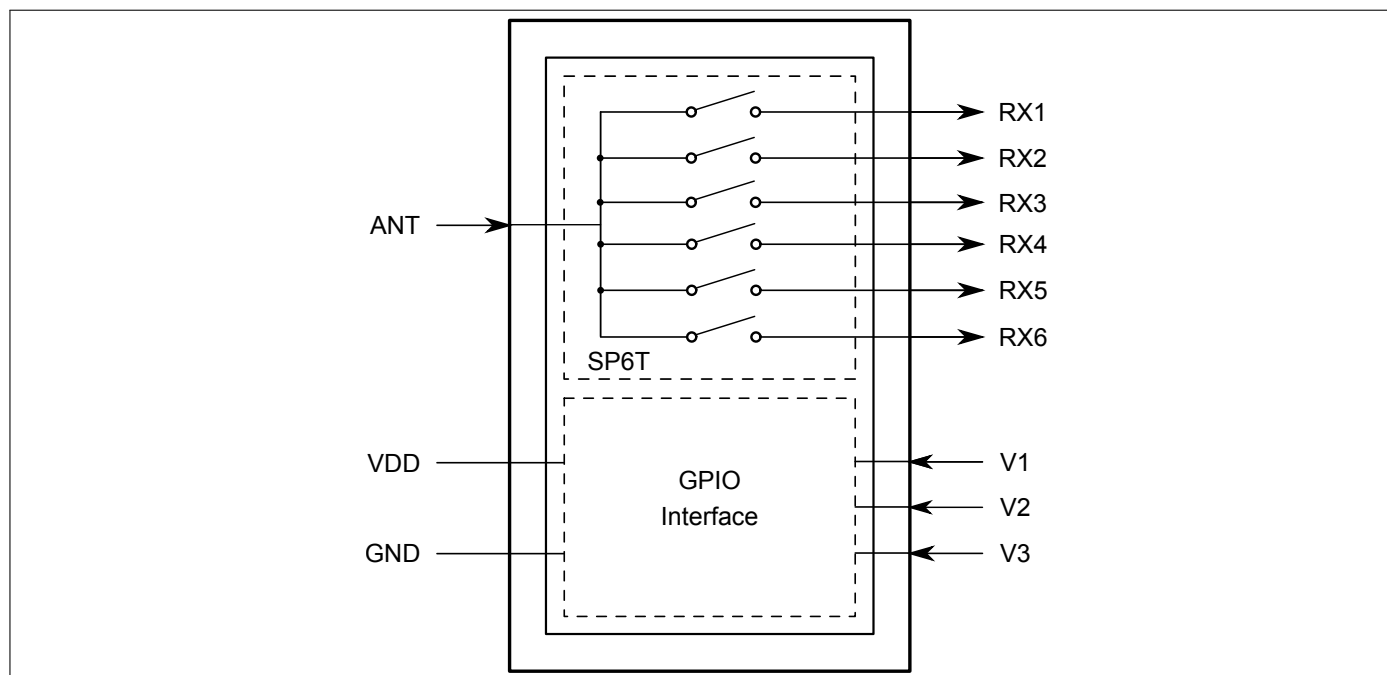
### 2 Product Description

The BGS16GA14 is a Single Pole Eight Throw (SP8T) Diversity Switch Module optimized for wireless applications up to 3.8 GHz. As part of a pin- and functional-compatible SP3T-SP8T product family it has been designed to meet the requirements of chipset reference designs. The module comes in a miniature ATSLP package and comprises of a high power CMOS SP8T switch with integrated GPIO interface. This RF switch is a perfect solution for multimode handsets based on LTE and WCDMA. The switch device configuration is shown in Fig. 1.

The switch is controlled via a GPIO interface. It features DC-free RF ports and unlike GaAs technology, external DC blocking capacitors at the RF ports are only required if DC voltage is applied externally.

**Table 1: Ordering Information**

| Type      | Package  | Marking |
|-----------|----------|---------|
| BGS16GA14 | ATSLP-14 | G6      |



**Figure 1:** BGS16GA14 block diagram

### 3 Maximum Ratings

**Table 2: Maximum Ratings, Table I** at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

| Parameter                                  | Symbol       | Values |      |      | Unit             | Note / Test Condition                            |
|--------------------------------------------|--------------|--------|------|------|------------------|--------------------------------------------------|
|                                            |              | Min.   | Typ. | Max. |                  |                                                  |
| Frequency Range                            | $f$          | 0.1    | –    | –    | GHz              | <sup>1)</sup>                                    |
| Supply voltage                             | $V_{dd}$     | -0.5   | –    | 3.6  | V                | –                                                |
| Storage temperature range                  | $T_{STG}$    | -55    | –    | 150  | $^\circ\text{C}$ | –                                                |
| Junction temperature                       | $T_j$        | –      | –    | 125  | $^\circ\text{C}$ | –                                                |
| RF input power at all Rx ports             | $P_{RF\_Rx}$ | –      | –    | 32   | dBm              | CW                                               |
| ESD capability, CDM <sup>2)</sup>          | $V_{ESDCDM}$ | –500   | –    | +500 | V                | All pins                                         |
| ESD capability, HBM <sup>3)</sup>          | $V_{ESDHBM}$ | –1     | –    | +1   | kV               | Digital, digital versus RF                       |
|                                            |              | –1     | –    | +1   | V                | RF                                               |
| ESD capability, system level <sup>4)</sup> | $V_{ESDANT}$ | –8     | –    | +8   | kV               | ANT versus system GND, with 27 nH shunt inductor |

<sup>1)</sup> There is also a DC connection between switched paths. The DC voltage at RF ports  $V_{RFDC}$  has to be 0V.

<sup>2)</sup> Field-Induced Charged-Device Model JESD22-C101. Simulates charging/discharging events that occur in production equipment and processes. Potential for CDM ESD events occurs whenever there is metal-to-metal contact in manufacturing.

<sup>3)</sup> Human Body Model ANSI/ESDA/JEDEC JS-001-2012 ( $R = 1.5\text{ k}\Omega$ ,  $C = 100\text{ pF}$ ).

<sup>4)</sup> IEC 61000-4-2 ( $R = 330\text{ }\Omega$ ,  $C = 150\text{ pF}$ ), contact discharge.

**Table 3: Maximum Ratings, Table II** at  $T_A = 25\text{ °C}$ , unless otherwise specified

| Parameter                                     | Symbol      | Values |      |              | Unit | Note / Test Condition              |
|-----------------------------------------------|-------------|--------|------|--------------|------|------------------------------------|
|                                               |             | Min.   | Typ. | Max.         |      |                                    |
| Thermal resistance junction - soldering point | $R_{thJS}$  | –      | 60   | –            | K/W  | –                                  |
| Maximum DC-voltage on RF-Ports and RF-Ground  | $V_{RFDC}$  | 0      | –    | 0            | V    | No DC voltages allowed on RF-Ports |
| GPIO control voltage levels                   | $V_{Ctrlx}$ | -0.7   | –    | $V_{dd}+0.7$ | V    | –                                  |

## 4 Operation Ranges

**Table 4: Operation Ranges**

| Parameter                      | Symbol        | Values |      |          | Unit | Note / Test Condition |
|--------------------------------|---------------|--------|------|----------|------|-----------------------|
|                                |               | Min.   | Typ. | Max.     |      |                       |
| Supply voltage                 | $V_{dd}$      | 2.4    | 3.0  | 3.4      | V    | –                     |
| Supply current                 | $I_{dd}$      | –      | 75   | 175      | μA   | –                     |
| GPIO control voltage high      | $V_{Ctrl\_H}$ | 1.35   | –    | $V_{dd}$ | V    | –                     |
| GPIO control voltage low       | $V_{Ctrl\_L}$ | 0      | –    | 0.45     | V    | –                     |
| GPIO control input capacitance | $C_{Ctrl}$    | –      | –    | 2        | pF   | –                     |
| Ambient temperature            | $T_A$         | -30    | 25   | 85       | °C   | –                     |

**Table 5: RF Input Power**

| Parameter       | Symbol       | Values |      |      | Unit | Note / Test Condition |
|-----------------|--------------|--------|------|------|------|-----------------------|
|                 |              | Min.   | Typ. | Max. |      |                       |
| Rx ports (50 Ω) | $P_{RF\_Rx}$ | –      | –    | 28   | dBm  | –                     |

## 5 RF Characteristics

**Table 6: RF Characteristics** at  $T_A = -30\text{ }^{\circ}\text{C} \dots 85\text{ }^{\circ}\text{C}$ ,  $P_{IN} = 0\text{ dBm}$ , Supply Voltage  $V_{dd} = 2.4\text{ V} \dots 3.4\text{ V}$ , unless otherwise specified

| Parameter                                                      | Symbol           | Values |      |      | Unit | Note / Test Condition              |
|----------------------------------------------------------------|------------------|--------|------|------|------|------------------------------------|
|                                                                |                  | Min.   | Typ. | Max. |      |                                    |
| Insertion Loss <sup>1)</sup>                                   |                  |        |      |      |      |                                    |
| All Rx Ports                                                   | IL               | –      | 0.23 | 0.36 | dB   | 698–960 MHz                        |
|                                                                |                  | –      | 0.36 | 0.56 | dB   | 1428–1990 MHz                      |
|                                                                |                  | –      | 0.43 | 0.58 | dB   | 1920–2170 MHz                      |
|                                                                |                  | –      | 0.47 | 0.62 | dB   | 2170–2690 MHz                      |
|                                                                |                  | –      | 0.50 | 0.71 | dB   | 3400–3600 MHz                      |
|                                                                |                  | –      | 0.50 | 0.74 | dB   | 3600–3800 MHz                      |
| Return Loss <sup>1)</sup>                                      |                  |        |      |      |      |                                    |
| All Rx Ports                                                   | RL               | 20     | 26   | –    | dB   | 698–960 MHz                        |
|                                                                |                  | 14     | 19   | –    | dB   | 1428–1990 MHz                      |
|                                                                |                  | 13     | 17   | –    | dB   | 1920–2170 MHz                      |
|                                                                |                  | 12     | 15   | –    | dB   | 2170–2690 MHz                      |
|                                                                |                  | 11     | 14   | –    | dB   | 3400–3600 MHz                      |
|                                                                |                  | 11     | 14   | –    | dB   | 3600–3800 MHz                      |
| Isolation <sup>1)</sup>                                        |                  |        |      |      |      |                                    |
| All Rx Ports                                                   | ISO              | 32     | 50   | –    | dB   | 698–960 MHz                        |
|                                                                |                  | 26     | 41   | –    | dB   | 1428–1990 MHz                      |
|                                                                |                  | 24     | 39   | –    | dB   | 1920–2170 MHz                      |
|                                                                |                  | 22     | 37   | –    | dB   | 2170–2690 MHz                      |
|                                                                |                  | 19     | 33   | –    | dB   | 3400–3600 MHz                      |
|                                                                |                  | 19     | 32   | –    | dB   | 3600–3800 MHz                      |
| Harmonic Generation (UMTS Band 1, Band 5) <sup>1)</sup>        |                  |        |      |      |      |                                    |
| 2 <sup>nd</sup> harmonic generation                            | P <sub>H2</sub>  | 92     | 105  | –    | dBc  | 25 dBm, 50 Ω, CW mode              |
| 3 <sup>rd</sup> harmonic generation                            | P <sub>H3</sub>  | 88     | 96   | –    | dBc  | 25 dBm, 50 Ω, CW mode              |
| Intermodulation Distortion (UMTS Band 1, Band 5) <sup>1)</sup> |                  |        |      |      |      |                                    |
| 2 <sup>nd</sup> order intermodulation                          | IMD2 low         | –      | -105 | -100 | dBm  | IMT, US Cell (see Tab. 7)          |
| 3 <sup>rd</sup> order intermodulation                          | IMD3             | –      | -110 | -105 | dBm  | IMT, US Cell (see Tab. 8)          |
| 2 <sup>nd</sup> order intermodulation                          | IMD2 high        | –      | -115 | -110 | dBm  | IMT, US Cell (see Tab. 7)          |
| Switching Time                                                 |                  |        |      |      |      |                                    |
| RF Rise Time                                                   | t <sub>RT</sub>  | –      | –    | 2    | μs   | 10 % to 90 % RF signal             |
| Switching Time                                                 | t <sub>ST</sub>  | –      | 2    | 4    | μs   | 50 % Ctrl signal to 90 % RF signal |
| Power Up Settling Time                                         | t <sub>PUp</sub> | –      | 10   | 25   | μs   | After power down mode              |

<sup>1)</sup>On application board without any matching components.

Table 7: IMD2 Testcases

| Band    | CW tone 1 (MHz) | CW tone 1 (dBm) | CW tone 2 (MHz)  | CW tone 2 (dBm) |
|---------|-----------------|-----------------|------------------|-----------------|
| IMT     | 1950            | 20              | 190 (IMD2 low)   | -15             |
|         |                 |                 | 4090 (IMD2 high) |                 |
| US Cell | 835             | 20              | 45 (IMD2 low)    | -15             |
|         |                 |                 | 1715 (IMD2 high) |                 |

Table 8: IMD3 Testcases

| Band    | CW tone 1 (MHz) | CW tone 1 (dBm) | CW tone 2 (MHz) | CW tone 2 (dBm) |
|---------|-----------------|-----------------|-----------------|-----------------|
| IMT     | 1950            | 20              | 1760            | -15             |
| US Cell | 835             | 20              | 790             | -15             |

## 6 GPIO Specification

Table 9: Modes of Operation (Truth Table)

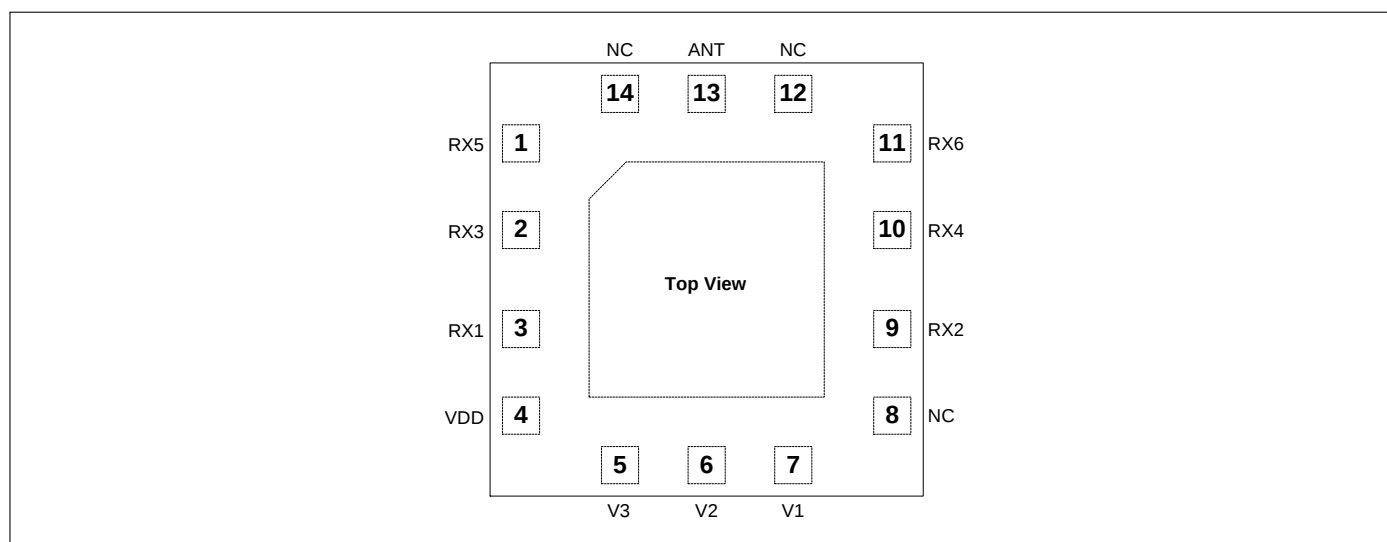
|       |             | Control Inputs |    |    |
|-------|-------------|----------------|----|----|
| State | Mode        | V1             | V2 | V3 |
| 1     | RX1-ANT     | 0              | 0  | 0  |
| 2     | RX2-ANT     | 0              | 0  | 1  |
| 3     | RX3-ANT     | 0              | 1  | 0  |
| 4     | RX4-ANT     | 0              | 1  | 1  |
| 5     | RX5-ANT     | 1              | 0  | 0  |
| 6     | RX6-ANT     | 1              | 0  | 1  |
| 7     | RX3/RX5-ANT | 1              | 1  | 0  |
| 8     | Shutdown    | 1              | 1  | 1  |

## 7 Package related information

The switch has a package size of 2000 µm in x-dimension and 2000 µm in y-dimension with a maximum deviation of ±50 µm in each dimension. Fig. 2 shows the footprint from top view. The definition of each pin can be found in Tab. 11. In addition a recommendation for the land pattern is displayed in Fig. 4 followed by information regarding laser marking (see Fig. 5).

Table 10: Mechanical Data

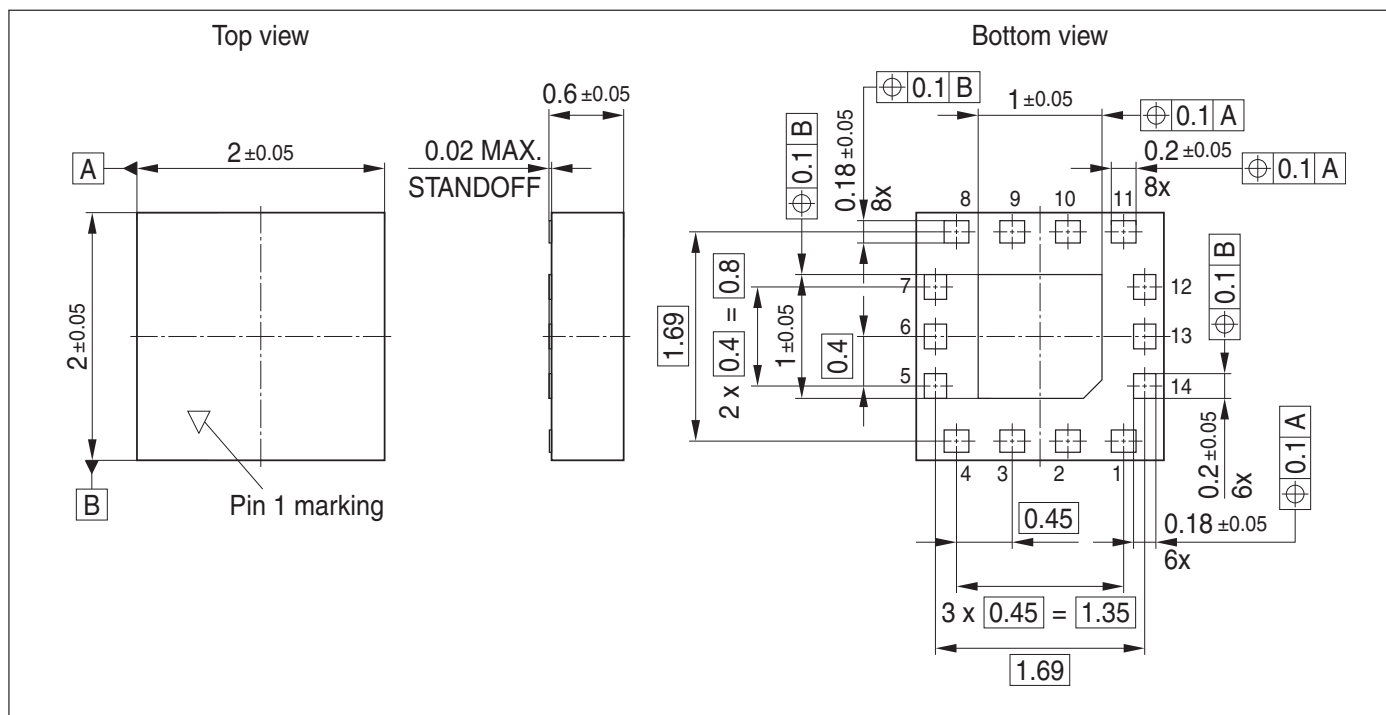
| Parameter           | Symbol | Value     | Unit |
|---------------------|--------|-----------|------|
| Package X-Dimension | X      | 2000 ± 50 | µm   |
| Package Y-Dimension | Y      | 2000 ± 50 | µm   |
| Package Height      | H      | 0.65 max  | µm   |



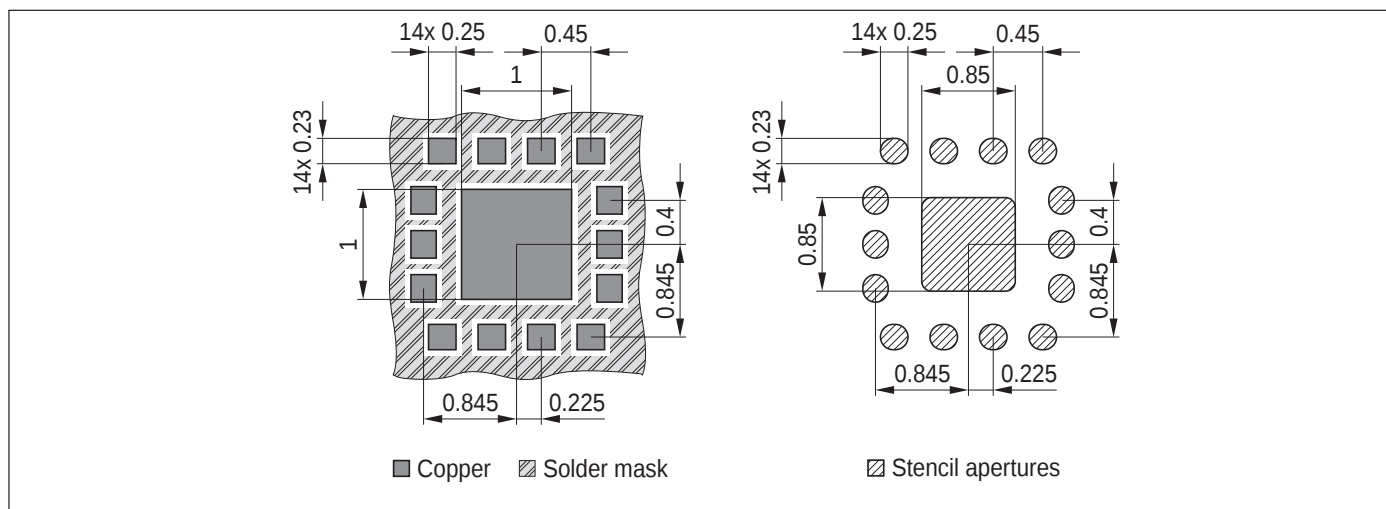
**Figure 2:** Footprint, top view

**Table 11: Pin Definition**

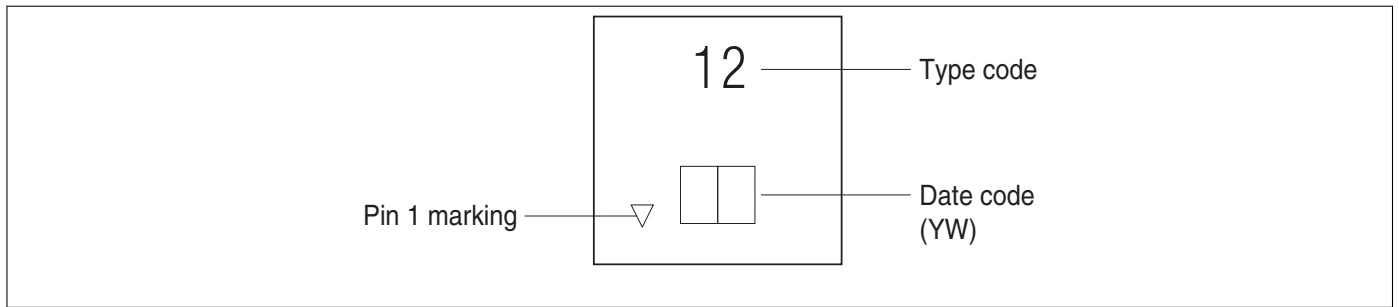
| No. | Name | Pin Type | Function           |
|-----|------|----------|--------------------|
| 0   | GND  | GND      | RF ground; die pad |
| 1   | RX5  | I/O      | RX port 5          |
| 2   | RX3  | I/O      | RX port 3          |
| 3   | RX1  | I/O      | RX port 1          |
| 4   | VDD  | PWR      | $V_{DD}$ supply    |
| 5   | V3   | I        | GPIO control pin   |
| 6   | V2   | I        | GPIO control pin   |
| 7   | V1   | I        | GPIO control pin   |
| 8   | NC   |          | Not connected      |
| 9   | RX2  | I/O      | RX port 2          |
| 10  | RX4  | I/O      | RX port 4          |
| 11  | RX6  | I/O      | RX port 6          |
| 12  | NC   |          | Not connected      |
| 13  | ANT  | I/O      | Antenna port       |
| 14  | NC   |          | Not connected      |



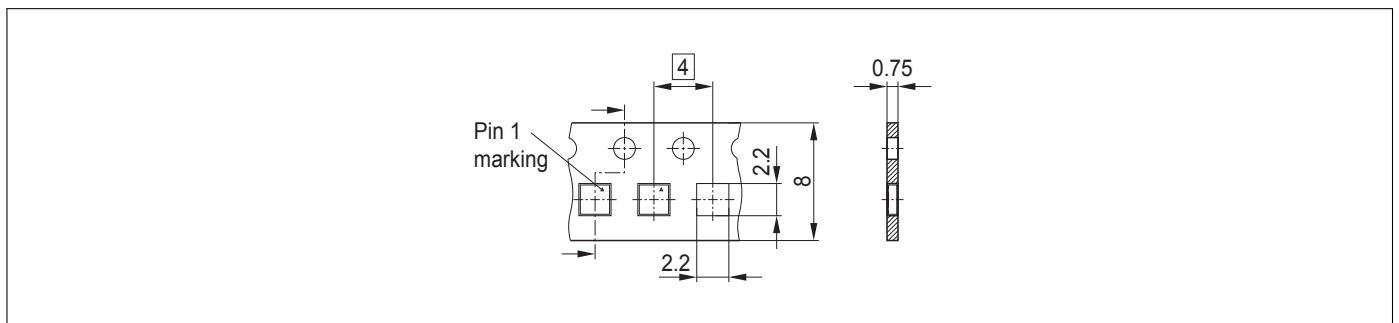
**Figure 3:** Package Outline Drawing



**Figure 4:** Land Pattern Drawing



**Figure 5:** Laser marking



**Figure 6:** Carrier Tape

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