

### Features

- 2.4 - 2.485GHz Frequency Range
- High Efficiency Optimized for Battery Operation
- Delivers up to +23dBm Output Power at 3.3V
- 160mA at +23dBm Output Power at 3.3V
- 1.6dB LNA Noise Figure at High current mode
- 2.7 - 4.0V Operation
- Single-Ended Transceiver Interface
- -40°C to 125°C Extended Temperature Range
- 3mm x 3mm x 0.45mm 16-Pin QFN Package

### Applications

- Bluetooth® Low Energy (BLE) Mesh Networks
- 802.15.4 Zigbee, RF4CE, Proprietary ISM
- IoT (Internet of Things) / M2M Connectivity
- Smart Home Hubs and Gateways
- Consumer Electronics, Smart Appliances
- Smart Lighting, Smart Metering
- Drone, Toy, Media Remote Controller
- Industrial Wireless Sensor Networks
- Home, Industrial, Factory Automation
- Wireless Sensor Nodes & Networks
- Wireless Audio & Video

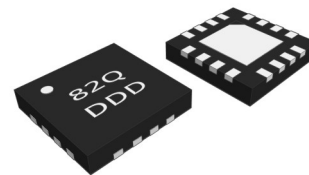
### Description

The 8TR8219 is a compact, multi-function Front-End RFIC (Radio Frequency Integrated Circuit) intended for 802.15.4 ZigBee™ / Thread, Bluetooth® Smart, and proprietary ISM wireless protocol systems in the 2.4GHz band.

The 8TR8219 is optimized for battery operation with enhanced efficiency, operating over a wide voltage supply range from 2.7V to 4.0V, suited for a wide array of applications including battery-powered wireless systems.

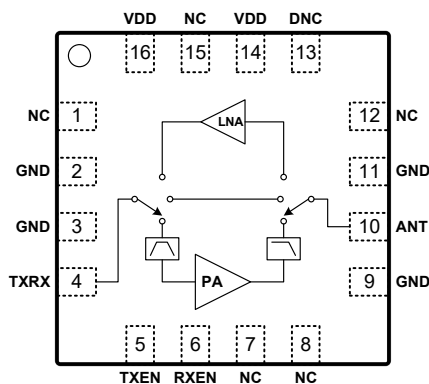
The 8TR8219 combines a transmit power amplifier (PA), receive low noise amplifier (LNA), a single pole, double throw (SPDT) transmit / receive (T/R) switch (Figure 1) in a 3mm x 3mm x 0.45mm 16-pin QFN package. It also comes integrated with filter networks and input/output matching circuitry. The device delivers up to +23dBm saturated output power at a supply voltage of 3.3V.

The 8TR8219 is RoHS compliant, halogen-free, and REACH Compliant. It is rated for Moisture Sensitivity Level 1 (MSL1), reflow at 260°C per JEDEC J-STD-020. Refer to IPC/JEDEC J-STD-020 for detailed solder reflow temperature and profile.



16-Lead 3mm x 3mm x 0.45mm, QFN Package

**Figure 2: Package Type**

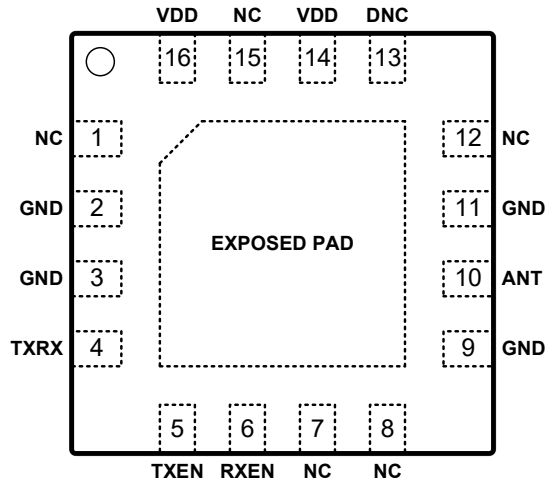


**Figure 1: Functional Block Diagram**

### Ordering Information

| Part Number | Description   |
|-------------|---|
| 8TR8219     | 2.4GHz Front-End RFIC<br>2500pieces per Tape and Reel |
| 8TR8219-EVB | Fully Tested and Characterize<br>Evaluation Board     |
| 8TR8219-DWF | 2.4GHz Front-End RFIC Die<br>in Wafer Form            |

## Pin Descriptions



**Figure 3: Pin Description (Top View)**

**Table 1: 8TR8219 Pin Signal Descriptions**

| Pin         | Name | Description                                  | Pin | Name | Description   |
|-------------|------|--|-----|------|---|
| 1           | NC   | Not connected internally                     | 9   | GND  | Ground  |
| 2           | GND  | Ground                                       | 10  | ANT  | Antenna Port<br>(DC shorted to GND)                                 |
| 3           | GND  | Ground                                       | 11  | GND  | Ground  |
| 4           | TXRX | Transmit/Receive Port<br>(DC shorted to GND) | 12  | NC   | Not connected internally  |
| 5           | TXEN | Control Logic Pin                            | 13  | DNC  | Do Not connect  |
| 6           | RXEN | Control Logic Pin                            | 14  | VDD  | Alternate DC Voltage supply pin<br>(Internally connected to pin 16) |
| 7           | NC   | Not connected internally                     | 15  | NC   | Not connected internally  |
| 8           | NC   | Not connected internally                     | 16  | VDD  | DC Voltage Supply   |
| EXPOSED PAD |      | Exposed pad should be connected to GND.      |     |      |   |

## General Specifications

**Table 2: 8TR8219 Absolute Maximum Ratings**

| Parameter                            |                  | Units | Minimum | Maximum | Remark   |
|--------------------------------------|------------------|-------|---------|---------|--|
| Supply Voltage (VDD)                 |                  | V     | 0       | 4.4     |  |
| Control Logic Pin (TXEN, RXEN)       |                  | V     | 0       | VDD     |  |
| Transmit Output Power at ANT Port    |                  | dBm   |         | 24.5    |  |
| Transmit Input Power at TXRX Port    |                  | dBm   |         | 10      |  |
| Receive Input power at ANT Port      |                  | dBm   |         | 15      |  |
| Bypass Input power at ANT Port       |                  | dBm   |         | 20      |  |
| Storage Temperature                  |                  | °C    | -40     | 150     |  |
| ESD - HBM*                           | VDD (Pin 14, 16) | V     |         | ±500    |  |
|                                      | All other pins   | V     |         | ±3000   |  |
| ESD - HBM with application circuits* | All pins         | V     |         | ±4000   | VDD to GND: with shunt TVS Diode and 1uF capacitor** |

Note: Sustained operation at or above the Absolute Maximum Ratings for any single or combinations of the parameters above may result in permanent damage to the device and is not recommended. All Maximum RF Input Power Ratings assume 50Ω terminal impedance.

\*Electrostatic discharge Human Body Model(HBM) Reference Document: ANSI/ESDA/JEDEC JS-001-2017

\*\*For more details, see the application note 8TR8219\_AN230214.

**Table 3: 8TR8219 Recommended Operating Conditions**

| Parameter                                     | Units | Minimum | Typical | Maximum |
|---|-------|---------|---------|---------|
| Supply Voltage (VDD, recommended)             | V     | 2.7     | 3.3     | 4       |
| Supply Voltage (VDD, extend supply voltage)** | V     | 2.2     |         | 4       |
| Control Pin - Logic High State (TXEN, RXEN)   | V     | 1.2     |         | VDD*    |
| Control Pin - Logic Low State (TXEN, RXEN)    | V     | 0       |         | 0.4     |
| Operating Frequency Range                     | GHz   | 2.4     |         | 2.485   |
| Operating Temperature                         | °C    | -40     | 25      | 125     |

\*For Control Voltages > 3.0V, a 10kΩ series resistor should be used at the Control Logic Pins.

\*\*Functional working with degraded performance for the supply voltage range 2.2V to 2.7V.

**Table 4: 8TR8219 Transmit Electrical Specifications**

(VDD = 3.3V, TXEN = High, RXEN = Low or High, T<sub>Ambient</sub> = 25°C, Excluding PCB and Connector Loss, Unless Otherwise Noted)

| Parameter                | Units   | Min | Typ  | Max | Test Conditions  |
|--------------------------|---------|-----|------|-----|--|
| Saturated Output Power   | dBm     |     | 23   |     |  |
| Large-Signal Gain        | dB      |     | 24   |     | +23dBm Pout  |
| Current Consumption      | mA      |     | 95   |     | +20dBm Pout  |
|                          |         |     | 160  |     | +23dBm Pout  |
| Tx Quiescent Current     | mA      |     | 20   |     | No RF applied  |
| Second Harmonic          | dBm/MHz |     | -10  |     | +22dBm Pout<br>IEEE 802.15.4 OQPSK signal                      |
| Third Harmonic           | dBm/MHz |     | -15  |     |  |
| Input Return Loss        | dB      |     | -15  |     |  |
| Output Return Loss       | dB      |     | -10  |     |  |
| Load VSWR for Stability  |         |     | 6:1  |     | All Non-harmonic Spurs<br>Less than -43dBm/MHz<br>Up to +23dBm |
| Load VSWR for Ruggedness |         |     | 10:1 |     | No Damage  |

**Table 5: 8TR8219 Receive Electrical Specifications**

(VDD = 3.3V, TXEN = Low, RXEN = High, T<sub>Ambient</sub> = 25°C, Excluding PCB and Connector Loss, Unless Otherwise Noted)

| Parameter           | Units | Min | Typ  | Max | Test Conditions                 |
|---------------------|-------|-----|------|-----|---------------------------------|
| Small-Signal Gain   | dB    |     | 16.5 |     |                                 |
| Current Consumption | mA    |     | 5.5  |     |                                 |
| Noise Figure        | dB    |     | 1.9  |     |                                 |
| Input P1dB          | dBm   |     | -11  |     |                                 |
| Input IP3           | dBm   |     | -2   |     | Pin = -35dBm/Tone, 1MHz spacing |
| Input Return Loss   | dB    |     | -7   |     |                                 |
| Output Return Loss  | dB    |     | -10  |     |                                 |

**Table 6: 8TR8219 Bypass Mode Specifications**

(VDD = 3.3V, TXEN = Low, RXEN = Low, T<sub>Ambient</sub> = 25°C, Excluding PCB and Connector Loss, Unless Otherwise Noted)

| Parameter      | Units | Min | Typ | Max | Test Conditions |
|----------------|-------|-----|-----|-----|-----------------|
| Bypass Current | uA    |     | 3.5 |     |                 |
| Insertion Loss | dB    |     | 1.7 |     |                 |

**Table 7: 8TR8219 Switching Time Specifications**(VDD = 3.3V, T<sub>Ambient</sub> = 25°C, Unless Otherwise Noted)

| Parameter    | Units | Min | Typ | Max | Test Conditions                      |
|--------------|-------|-----|-----|-----|--------------------------------------|
| TX to RX     | nsec  |     | 800 |     | From 50% of RXEN to 90% of RX power  |
| TX to Bypass | nsec  |     | 250 |     | From 50% of MODE to 90% Bypass power |
| RX to TX     | nsec  |     | 850 |     | From 50% of TXEN to 90% of TX power  |
| RX to Bypass | nsec  |     | 250 |     | From 50% of MODE to 90% Bypass power |
| Bypass to TX | nsec  |     | 850 |     | From 50% of TXEN to 90% of TX power  |
| Bypass to RX | nsec  |     | 800 |     | From 50% of RXEN to 90% of RX power  |

**Table 8: 8TR8219 Control Logic**

"1" = Logic High, "0" = Logic Low, All Control logic pins must have a state defined as either "0" or "1".

| TXEN | RXEN | Operational Mode |
|------|------|------------------|
| 0    | 0    | Bypass Mode      |
| 0    | 1    | RX Mode          |
| 1    | 0    | TX Mode          |
| 1    | 1    | TX Mode          |

### Application Notes

The 8TR8219 Application note provides detailed descriptions and test data over various operating conditions. Visit [www.berex.com](http://www.berex.com) or contact BeRex at [sales@berex.com](mailto:sales@berex.com) to request additional documentation.

### Application Schematic and PCB Layout

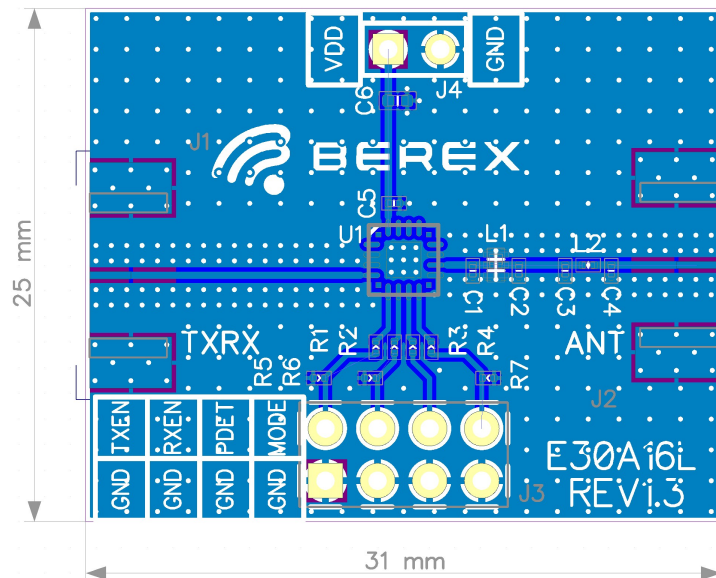
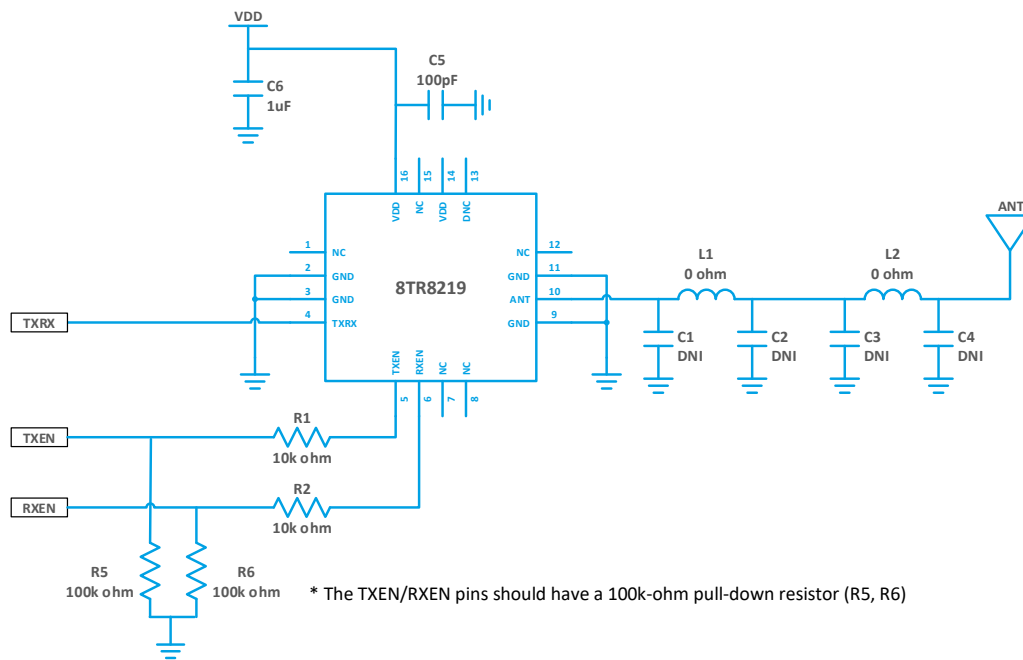
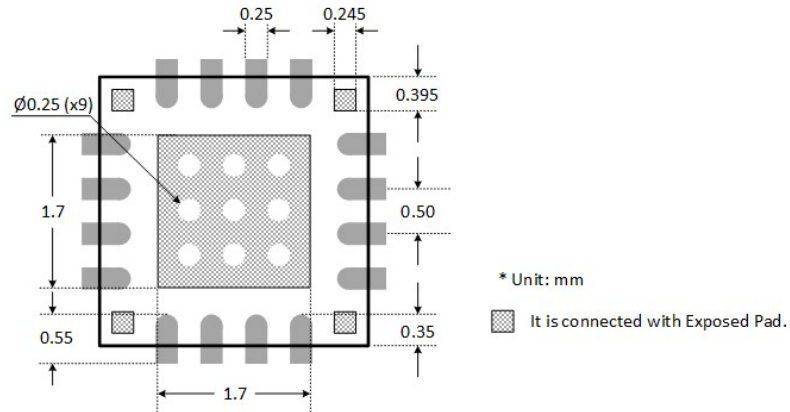
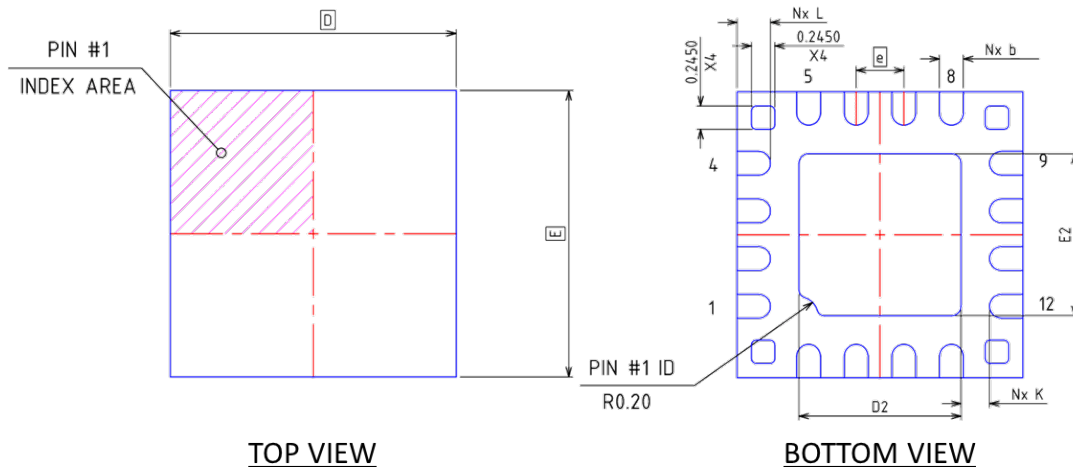


Figure 4: 8TR8219 Reference Design Schematic and PCB Layout

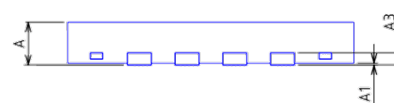
### Package Dimensions



**Figure 5: 8TR8219 Recommended PCB Layout Footprint**

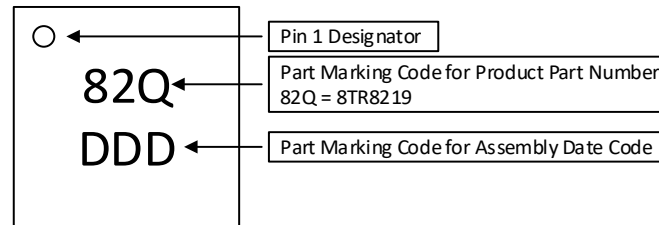


|    | MIN.     | NOM.      | MAX. |
|----|----------|-----------|------|
| A  | 0.41     | 0.45      | 0.50 |
| A1 | 0.00     | 0.02      | 0.05 |
| A3 | ---      | 0.127 Ref | ---  |
| b  | 0.18     | 0.25      | 0.30 |
| D  | 3.00 BSC |           |      |
| E  | 3.00 BSC |           |      |
| e  | 0.50 BSC |           |      |
| D2 | 1.55     | 1.70      | 1.80 |
| E2 | 1.55     | 1.70      | 1.80 |
| K  | 0.20     | ---       | ---  |
| L  | 0.25     | 0.35      | 0.45 |
| N  | 16       |           |      |



**Figure 6: 8TR8219 Package Dimension**

## Package Marking



Note: The part marking: 82Q represents the Product Part Number: 8TR8219.

Due to the size limitations of this package, only three (3) characters can be marked on each of two (2) rows.  
Therefore the Product Part Number is represented in the part marking by a 3-character code.

**Figure 7: 8TR8219 Typical Part Marking**

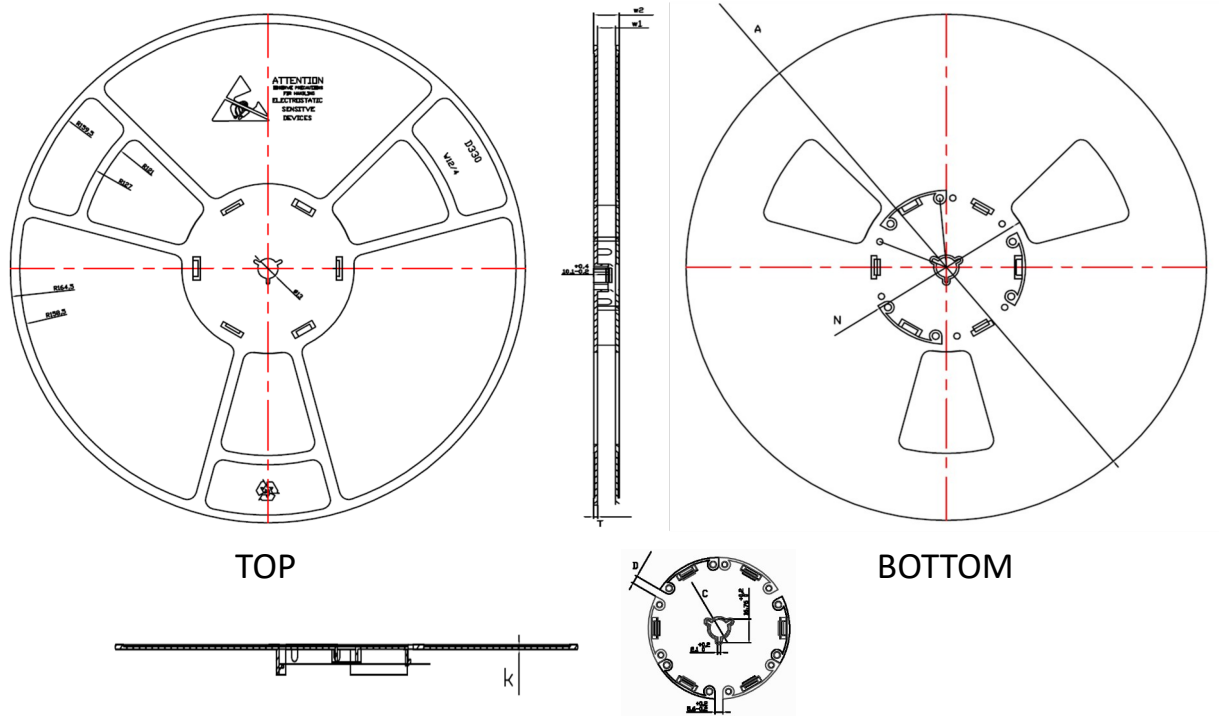
## ESD Handling Information

Electro Static Discharge (ESD) can cause immediate (or latent) failures in semiconductor Integrated Circuits (ICs). BeRex, Inc. RFIC products are designed with integral ESD protection structures, and all IC products are tested to meet industry standards for ESD event survival. Users must adhere to all precautions for handling ESD sensitive devices throughout the manufacturing, test, shipping, handling, or operational processes, and during field service operations in order to achieve optimum system performance and life expectancy. Production quantities of this product are shipped in a standard tape and reel format.

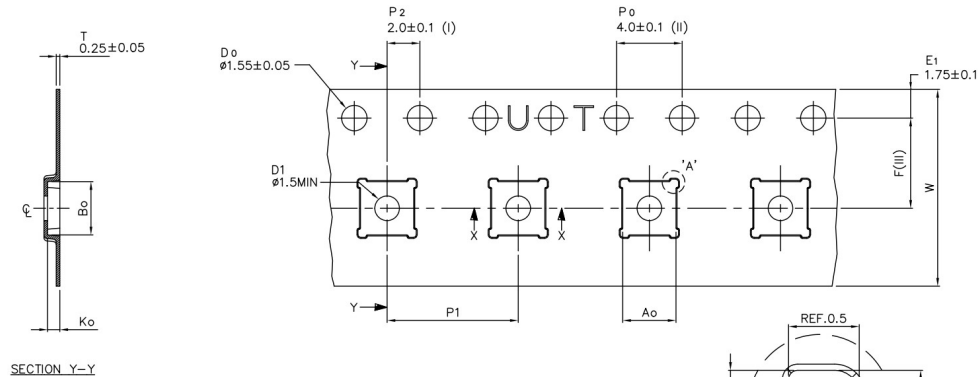
## RoHS Compliance

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

This part is lead-free, halogen-free and compliant with a concentration of the Substances of Very High Concern (SVHC) candidate list which are contained in a quantity of less than 0.1%(w/w) in each component of a product and/or its packaging placed on the European Community market by the BeRex and Suppliers.

**Tape & Reel**


| TYPE | A                    | N                    | C                         | D                   | w1               | w2               | T              | k                    |
|------|----------------------|----------------------|---------------------------|---------------------|------------------|------------------|----------------|----------------------|
| 12MM | $\phi 330^{+2}_{-2}$ | $\phi 100^{+2}_{-2}$ | $\phi 13.1^{+0.2}_{-0.2}$ | $5.6^{+0.5}_{-0.5}$ | $12.4^{+2}_{-0}$ | $16.6^{+2}_{-0}$ | $2.1 \pm 0.15$ | $1.4^{+0.15}_{-0.1}$ |



|    |               |
|----|---------------|
| A0 | 3.25 +/ -0.1  |
| B0 | 3.25 +/ -0.1  |
| K0 | 0.75 +/ -0.1  |
| F  | 5.50 +/ -0.1  |
| P1 | 8.00 +/ -0.1  |
| W  | 12.00 +/ -0.3 |



- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .
- (III) Measured from centreline of sprocket hole to centreline of pocket.
- (IV) Other material available.

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

**Figure 8: 8TR8219 Tape and Reel Dimension**