

### Product Description

The BSW7221V is a reflective SPDT RF switch that can be used in high power and good performance for Automotive, WLAN 802.11 a/b/g/n/ac/ax/be Networks, Bluetooth, Ultra-Wide-Band (UWB) and Wireless Communication applications.

This device is packaged in RoHS2-compliant with 1.5mm x 1.5mm x 0.5mm, 6-Lead UDFN package. It must be used with back side ground soldering.

The BSW7221V has robust ESD protection circuits at all pins and temperature performance. (Operating temperature range : -40 to +105°C)

This switch does not require blocking capacitors. If DC is presented at the RF port, add a blocking capacitor. This device also has a high linearity performance over all temperature range such as IIP3, IIP2. AEC-Q100 Grade 2 was conditionally qualified with 1<sup>st</sup> lot.

### Block Diagram

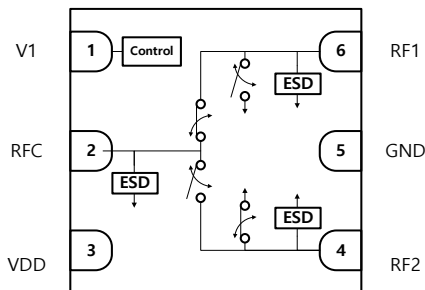


Figure 1. Functional Block Diagram

### Applications

- Automotive
- WLAN 802.11 a/b/g/n/ac/ax/be
- Ultra-Wide-Band (UWB)
- Drone
- Bluetooth
- NFC / Smart Card
- Wireless Infrastructure
- Remote keyless entry
- Telematics / Infotainment
- Two-way radios
- Wireless control systems
- GPS/Navigation

### Package Type



1.5mm x 1.5mm x 0.5mm, 6-Lead UDFN Package

Figure 2. Package Type

### Device Features

- AEC-Q100 Grade 2 Qualified (1<sup>st</sup> Lot)
- Frequency range : 5 MHz to 8.5 GHz
- Fast Switching Time : 90 to 135 ns
- Supply Voltage : 2.7V to 3.6V
- Low insertion loss
  - : 0.37dB @ 2.45GHz
  - : 0.59dB @ 5.75GHz
- High isolation
  - : 44dB @ 2.45GHz
  - : 29dB @ 5.75GHz
- Input 1 dB output compression
  - : 37dBm @ 2.45GHz
  - : 35dBm @ 5.75GHz
  - : 34dBm @ 8.00GHz
- High IIP3
  - : 65dBm @ 2.45GHz
  - : 62dBm @ 5.75GHz
- ESD protection
  - : HBM 2.0kV
  - : CDM 1.0kV
- 6-Lead UDFN package : 1.5mm x 1.5mm x 0.5mm
- Operating temperature range : -40°C to +105°C
- Lead-free/RoHS2-compliant UDFN package

**Electrical Specifications**

VDD = 3.3V, T<sub>A</sub> = 25°C, V1 Low = 0V, V1 High = 3.3V, Z<sub>L</sub> = 50Ω, Excluding SMA Connector and PCB loss\*, unless otherwise noted.

**Table 1. Electrical Specifications**

Parameter	Path	Condition	Min	Typ	Max	Unit
Operating Frequency			5		8500	MHz
Insertion Loss	RFC - RFx	13.56MHz		0.29		dB
		1GHz		0.32		
		2GHz		0.36		
		3GHz		0.38		
		4GHz		0.42		
		5GHz		0.47		
		6GHz		0.61		
		7GHz		0.53		
		8GHz		0.57		
Isolation	RFC - RFx	13.56MHz		83		dB
		1GHz		52		
		2GHz		47		
		3GHz		39		
		4GHz		34		
		5GHz		31		
		6GHz		30		
		7GHz		27		
		8GHz		24		
Isolation	RFx - RFx	13.56MHz		79		dB
		1GHz		45		
		2GHz		36		
		3GHz		33		
		4GHz		30		
		5GHz		28		
		6GHz		25		
		7GHz		23		
		8GHz		21		
8.5GHz		20				
Return Loss	RFC, RF1, RF2	5MHz – 8.5GHz (Active port)		20		dB

\* Excluding SMA Connector and PCB loss.

1GHz (0.15dB), 2GHz (0.23dB), 3GHz (0.31dB), 4GHz (0.39dB), 5GHz (0.45dB), 6GHz (0.53dB), 7GHz (0.67dB), 8GHz (0.73dB)

Preliminary Datasheet

**Electrical Specifications**

VDD = 3.3V, T<sub>A</sub> = 25°C, V1 Low = 0V, V1 High = 3.3V, Z<sub>L</sub> = 50Ω, Excluding SMA Connector and PCB loss\*, unless otherwise noted.

**Table 2 Electrical Specifications**

Parameter	Path	Condition	Min	Typ	Max	Unit
Operating Frequency			5		8500	MHz
Input P1dB	RFC - RFx	13.56MHz 2.45GHz 5.75GHz 8.00GHz		33 37 35 34		dBm
Input IP3**	RFC - RFx	2.45GHz 5.75GHz		65 62		dBm
Input IP2**	RFC - RFx	2.45GHz 5.75GHz		110 90		dBm
2 <sup>nd</sup> Harmonic***	RFC - RFx	2.45GHz 5.75GHz		95 75		dBc
3 <sup>rd</sup> Harmonic***	RFC - RFx	2.45GHz 5.75GHz		100 95		dBc
Switching Time	RFC - RFx	50% control to 90% RF 50% control to 10% RF		135 90		ns
Settling Time	RFC - RFx	50% CTRL to 0.05dB final value Rising Edge 50% CTRL to 0.05dB final value Falling Edge		145 110		ns

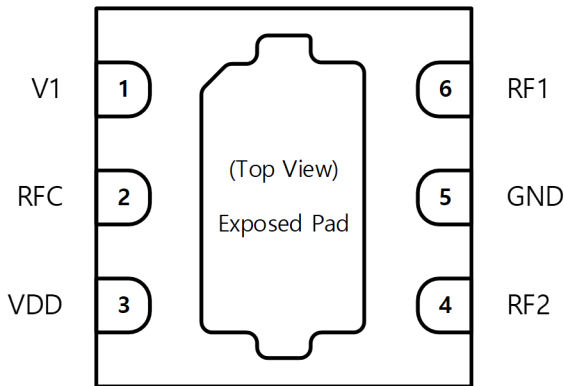
The typical spurious performance of the BSW7221V is -115dBm / 10Hz or less @ Over 10MHz

\* Excluding SMA Connector and PCB loss.

1GHz (0.15dB), 2GHz (0.23dB), 3GHz (0.31dB), 4GHz (0.39dB), 5GHz (0.45dB), 6GHz (0.53dB), 7GHz (0.67dB), 8GHz (0.73dB)

\*\* The two-tone Power is 18dBm each and Tone spacing is 20KHz.

\*\*\* Tone Power is 18dBm.

**Pin Configurations**

**Figure 3 . Pin Configurations (Top View)**
**Table 3. Pin Descriptions**

No.	Pin Name	Descriptions
1	V1	Digital Control Logic Input
2	RFC	RF Common port
3	VDD	Supply Voltage
4	RF2	RF2 port
5	GND	Ground
6	RF1	RF1 port
Pad	Exposed Pad	Ground

**Table 4. V1 Control Truth Table**

V1	RFC-RF1	RFC-RF2
0	OFF	ON
1	ON	OFF

**Table 5. Recommended Operation Conditions\***

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	VDD	2.7	3.3	3.6	V
Supply Current	IDD	-	170	350	μA
Digital Input Control (V1)	V1 High	1.0	-	3.3	V
	V1 Low	0	-	0.7	V
Operating Temperature Range	To	-40	+25	+105	°C
RF Input Power, CW Freq.=2.45GHz, 5.75GHz any port, Zi=50Ω	-	-	-	30	dBm

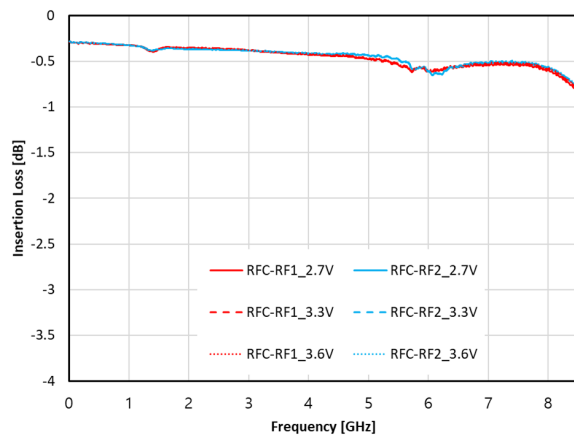
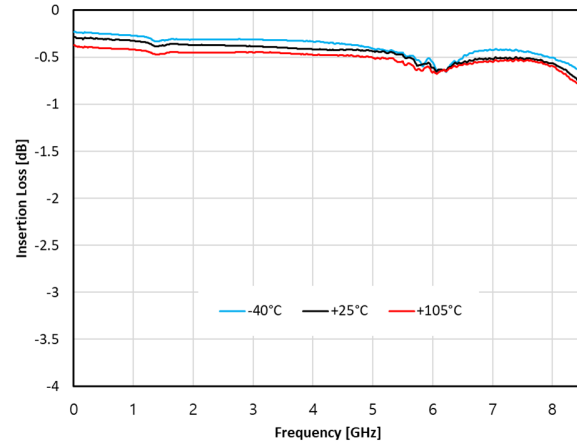
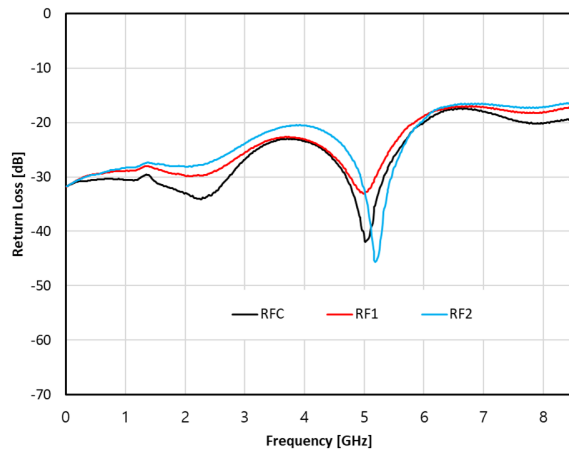
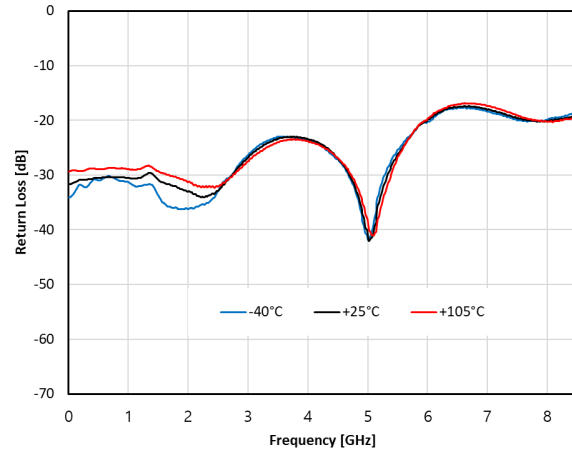
\*Specifications are not guaranteed over all recommended operating conditions.

**Table 6. Absolute Maximum Ratings**

Parameter	Symbol	Min	Max	Unit	
Supply Voltage	VDD	-0.3	3.6	V	
Digital Input Voltage (V1)	V1	-0.3	3.6	V	
Maximum Input Power, CW (+25°C)	-	-	Input P1dB	dBm	
Storage Temperature range	-	-65	+150	°C	
Maximum Junction Temperature	-	-	+150	°C	
ESD	HBM	All pins	-	2000	V
	CDM	All pins	-	1000	V

**Typical Performances**

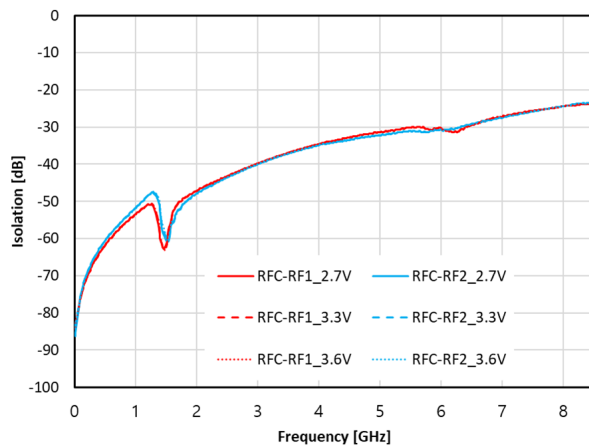
VDD = 3.3V, T<sub>A</sub> = 25°C, V1 Low = 0V, V1 High = 3.3V, Z<sub>L</sub> = 50Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

**Figure 4. Insertion Loss vs. Vdd (RFC - RFx)**

**Figure 5. Insertion Loss vs. Temp (RFC - RFx)**

**Figure 6. Return Loss (RFC, RFx)**

**Figure 7. Return Loss vs. Temp (RFC)**


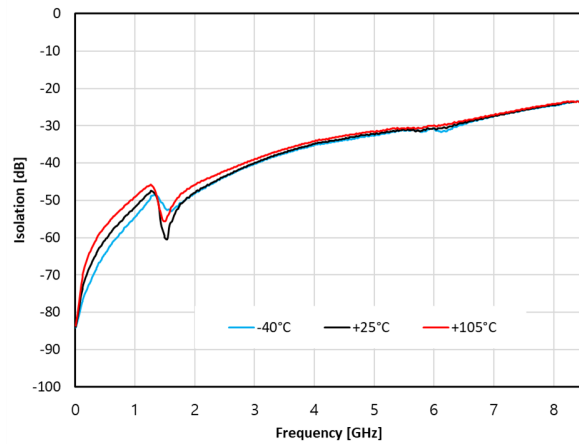
### Typical Performances

VDD = 3.3V,  $T_A = 25^\circ\text{C}$ , V1 Low = 0V, V1 High = 3.3V,  $Z_L = 50\Omega$ , Excluding SMA Connector and PCB loss, unless otherwise noted.

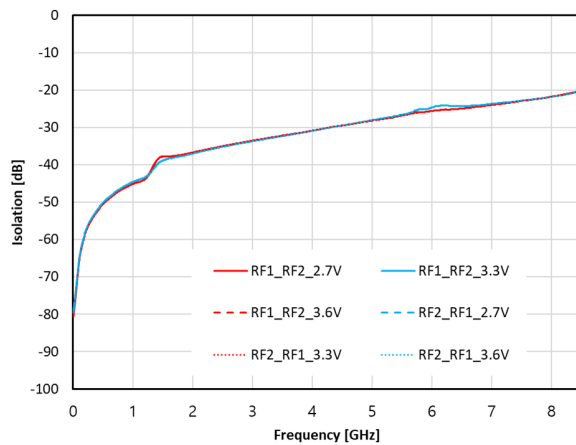
**Figure 8. Isolation vs. Vdd (RFC - RFx)**



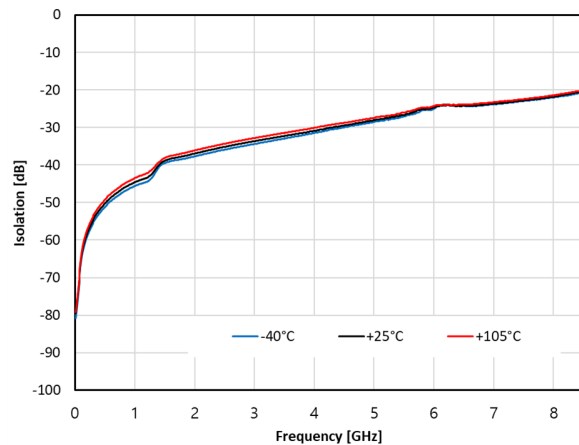
**Figure 9. Isolation vs. Temp (RFC - RFx)**



**Figure 10. Isolation vs. Vdd (RFx - RFx)**



**Figure 11. Isolation vs. Temp (RFx - RFx)**



### Evaluation Board

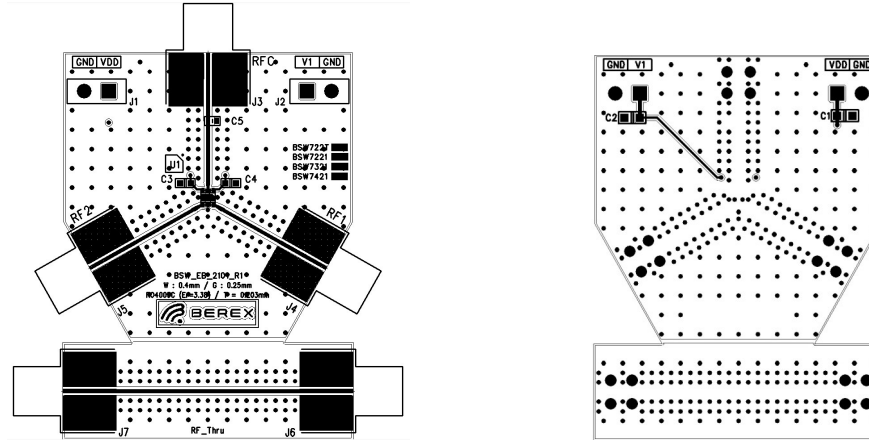


Figure 12. Evaluation Board Layout

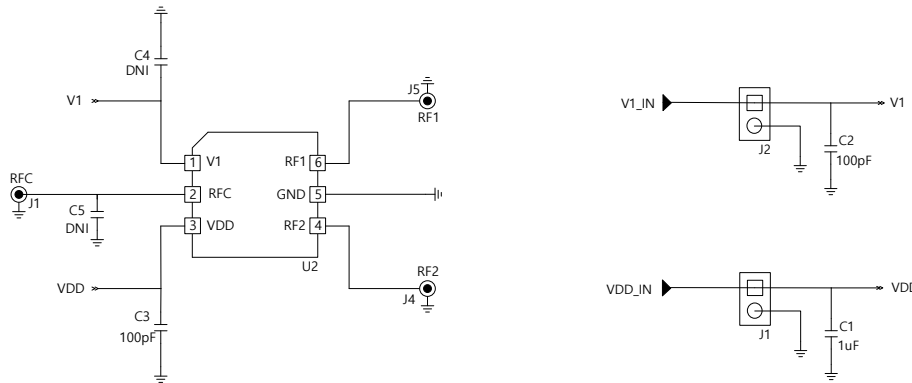


Figure 13. Evaluation Board Schematic

RO4003C Er : 3.38	COPPER : 1oz (0.035mm), Top Layer	<p>FINISH THICKNESS : 1.63T</p>
FR-4 Er : 4.5~4.8	RO4003C / 0.2mm	
FR-4 Er : 4.5~4.8	COPPER : 1oz (0.035mm), Inner 1 Layer	
	FR-4 / 0.36mm	
	COPPER : 1oz (0.035mm), Inner 2 Layer	
	FR-4 / 0.93mm	
	COPPER : 1oz (0.035mm), Bottom Layer	

Figure 14. Evaluation Board PCB Layer Information

No.	Ref Des	Part Qty	Part Number	Remark
1	C1	1	CAP 1005 1uF J 50V	
2	C2,C3*	2	CAP 1005 100pF J 50V	
3	C4	2	CAP 1005 DNI	
4	C5	1	CAP 0603 DNI	
6	J1,J2	2	2 Pin Header	
7	RFC, RF1, RF2	3	SMA_END_LAUNCH	
8	U1	1	BSW7221V	

\* C3 should be placed near the device.

Table 7. Bill of Material - Evaluation Board

### Package Outline Drawing

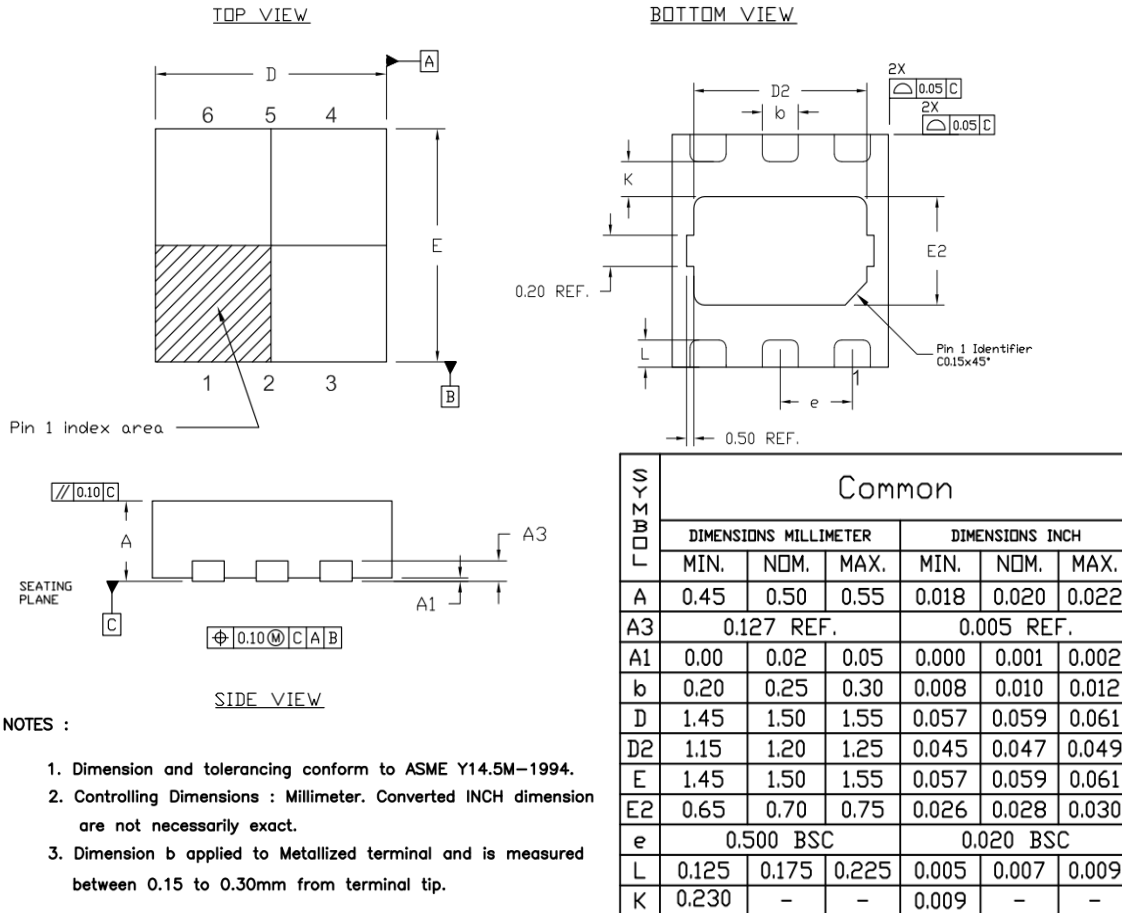


Figure 15. Package Outline Drawing

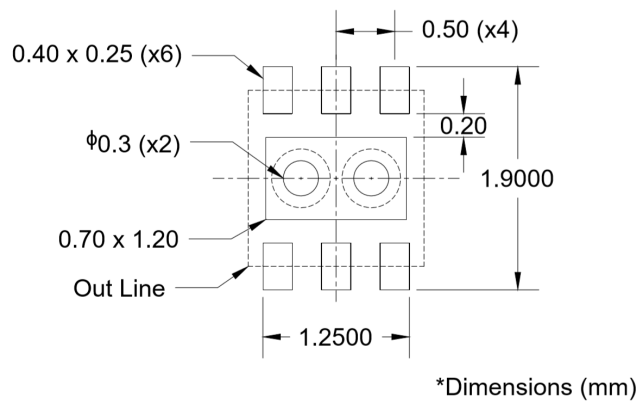
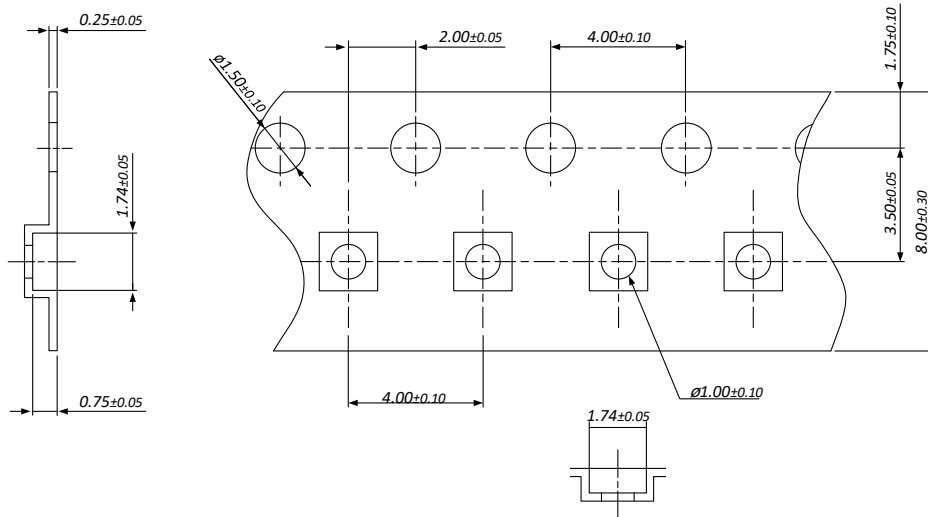
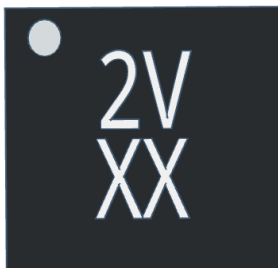


Figure 16. Recommended Land Pattern



**Tape & Reel**


Packaging information:	
Tape Width	8mm
Reel Size	7inch
Device Cavity Pitch	4mm
Device Per Reel	3000EA

**Figure 17. Tape & Reel**
**Package Marking**


Marking information:	
Marking Code	
2	The number of switch throw
V	Sequential Number
XX	Wafer Lot Number

**Figure 18. Package Marking**

**Lead plating finish**
**100% Tin Matte finish**

(All BeRex products undergoes a 1 hour, 150 degree C, Anneal bake to eliminate thin whisker growth concerns.)

**MSL / ESD Rating**

ESD information:	
Rating	Class 2 (2000V)
Test	Human Body Model (HBM)
Standard	AEC-Q100-002

ESD information:	
Rating	Class C3 (1000V)
Test	Charged Device Model (CDM)
Standard	AEC-Q100-011

MSL information:	
Rating	Level 1 at +260°C convection reflow
Standard	JEDEC Standard J-STD-020



Proper ESD procedures should be followed when handling the device.

**RoHS2 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 product also is 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 components of a product and/or its packaging placed on the European Community market by the BeRex and Suppliers.

**NATO CAGE code:**

2	N	9	6	F
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