BSW6421

High Isolation Reflective SPDT RF switch

5MHz-6000MHz

Product Description

The BSW6421 is a reflective SPDT RF switch that can be used in high power and good performance WiMAX 802.16, WLAN 802.11 a/b/g/n/ac/ax and DOCSIS 3.0/3.1 applications.
This device is packaged in RoHS-compliant with 1.5x1.5mm, 6-lead UDFN package. It must be used with back side ground soldering.
The BSW6421 has robust ESD protection circuits at all pins and temperature performance (operating temperature range : -40 ~ +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.
A functional block diagram is shown in Figure 1.

Block Diagram

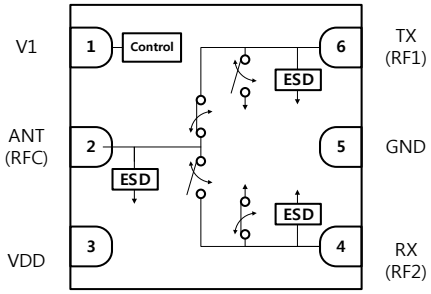


Figure 1 Functional Block Diagram

Applications

- WiMAX 802.16
- WLAN 802.11 a/b/g/n/ac/ax
- DOCSIS 3.0/3.1
- Drone
- NFC
- Bluetooth
- Smart Card
- Wireless Infrastructure
- Remote keyless entry
- Telematics / Infotainment
- Two-way radios
- Wireless control systems
- GPS/Navigation

Package Type

6-Lead 1.5x1.5mm, UDFN Package

Figure 2 Package Type

Device Features - Common

- Output frequency range : 5 MHz to 6.0 GHz
- Supply Voltage : 2.7V to 3.6V
- ESD protection : 2.5kV @ all pins
- 6-lead DFN package : 1.5mm x 1.5mm x 0.5mm
- Operating temperature range : -40°C - +85°C

Device Features - 50Ω

- Low insertion loss
  : 0.75dB @ 2.45GHz
  : 0.95dB @ 5.75GHz
- High isolation
  : 50dB @ 2.45GHz
  : 39dB @ 5.75GHz
- Input 1 dB output compression (ANT - Tx)
  : 39dBm @ 2.45GHz
  : 37dBm @ 5.75GHz
- High IIP3 (ANT - Tx)
  : 63dBm @ 2.45GHz
  : 68dBm @ 5.75GHz

Device Features - 75Ω

- Low insertion loss
  : 0.46dB @ 204MHz
- High isolation
  : 61dB @ 204MHz
- High IIP3
  : 69dBm @ 633MHz
- 2^{nd} / 3^{rd} Harmonic
  : 107dBc / 122dBc @ 633MHz

Electrical Specifications - 50Ω

Typical conditions are at VDD = 3.3V, T_A = 25°C, V1 Low = 0V, V1 High = 3.3V, Z_L = 50Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

Table 1 Electrical Specifications - 50Ω

Parameter	Path	Condition	Min	Typ	Max	Unit
Operating Frequency			5		6000	MHz
Insertion Loss	ANT - Tx ANT - Rx	13.56MHz 1GHz 2GHz 2.45GHz 3GHz 4GHz 5GHz 5.75GHz 6GHz		0.58 0.69 0.74 0.75 0.80 1.01 0.95 0.95 1.15		dB
Isolation	ANT - Tx ANT - Rx	13.56MHz 1GHz 2GHz 2.45GHz 3GHz 4GHz 5GHz 5.75GHz 6GHz		80 55 51 50 47 46 44 39 35		dB
Isolation	Tx - Rx Rx - Tx	13.56MHz 1GHz 2GHz 2.45GHz 3GHz 4GHz 5GHz 5.75GHz 6GHz		80 54 48 46 42 38 33 30 28		dB
Return Loss	ANT, Tx, Rx	5MHz – 6GHz (Active port)		20		dB
Input P1dB	ANT - Tx	13.56MHz 2.45GHz 5.75GHz		34 39 37		dBm
	ANT - Rx	13.56MHz 2.45GHz 5.75GHz		34 39 27		

* Tone Power is 18dBm and Tone spacing is 20KHz.

** DC transient test at RF all ports (ANT, Tx, Rx) when V1 is switched from High to Low or from Low to High in a 50Ω setup. Excluding SMA Connector and PCB loss. 1GHz (0.12dB), 2GHz (0.20dB), 3GHz (0.27dB), 4GHz (0.35dB), 5GHz (0.51dB), 6GHz (0.52dB)

Electrical Specifications - 50Ω

Typical conditions are at VDD = 3.3V, T_A = 25°C, V1 Low = 0V, V1 High = 3.3V, Z_L = 50Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

Table 2 Electrical Specifications - 50Ω

Parameter	Path	Condition	Min	Typ	Max	Unit
Input IP3*	ANT - Tx	2.45GHz		63		dBm
		5.75GHz		68		
	ANT - Rx	2.45GHz		56		
		5.75GHz		67		
Input IP2*	ANT - Tx	2.45GHz		105		dBm
		5.75GHz		110		
	ANT - Rx	2.45GHz		90		
		5.75GHz		105		
2nd Harmonic	ANT - Tx	2.45GHz		95		dBc
		5.75GHz		100		
	ANT - Rx	2.45GHz		78		
		5.75GHz		95		
3rd Harmonic	ANT - Tx	2.45GHz		100		dBc
		5.75GHz		110		
	ANT - Rx	2.45GHz		85		
		5.75GHz		105		
Video Feedthrough**		5ns rise-time pulse		25		mVpp
Switching Time	ANT - Tx	50% control to 90% RF		500		ns
	ANT - Rx	50% control to 10% RF		400		
Settling Time	ANT - Tx	50% CTRL to 0.05dB final value Rising Edge		530		ns
	ANT - Rx	50% CTRL to 0.05dB final value Falling Edge		470		

* Tone Power is 18dBm and Tone spacing is 20KHz.

** DC transient test at RF all ports (ANT, Tx, Rx) when V1 is switched from High to Low or from Low to High in a 50Ω setup. Excluding SMA Connector and PCB loss. 1GHz (0.12dB), 2GHz (0.20dB), 3GHz (0.27dB), 4GHz (0.35dB), 5GHz (0.51dB), 6GHz (0.52dB)

Electrical Specifications - 75Ω

Typical conditions are at VDD = 3.3V, T_A = 25°C, V1 Low = 0V, V1 High = 3.3V, Z_L = 75Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

Table 3 Electrical Specifications - 75Ω

Parameter	Path	Condition	Min	Typ	Max	Unit
Operating Frequency	RFC - RFx		5		6000	MHz
Insertion Loss	RFC - RFx	5MHz 204MHz 1218MHz 1700MHz 1794MHz		0.44 0.46 0.63 0.61 0.58		dB
Isolation	RFC to RFx	5MHz 204MHz 612MHz 1218MHz 1794MHz		79 61 53 46 37		dB
Isolation	RFx to RFx	5MHz 204MHz 612MHz 1218MHz 1794MHz		83 60 52 50 47		dB
Return Loss	RFC	5MHz – 3GHz (Active port)	15	20		dB
	RFx	5MHz – 3GHz (Active port)	15	20		dB
Input P1dB	RFC - RFx	50Ω Impedance @2140MHz		33		dBm
Input IP3* (note)	RFC - RFx	633MHz (Pin=18dBm/tone)		69		dBm
Input IP2* (note)	RFC – RFx	633MHz (Pin=18dBm/tone)		108		dBm
2nd Harmonic	RFC – RFx	633MHz (Pin=25dBm)		107		dBc
3rd Harmonic	RFC – RFx	633MHz (Pin=25dBm)		122		dBc
Video Feedthrough**		5ns rise-time pulse		25		mVpp
Switching Time	RFC – RFx	50% control to 90% RF 50% control to 10% RF		500 400		ns

* Tone spacing is 20KHz.

** DC transient test at RF all ports (RFC, RF1, RF2) when V1 is switched from High to Low or from Low to High in a 75Ω setup. Excluding SMA Connector and PCB loss. 5MHz(0.02dB), 204MHz(0.05dB), 1218MHz(0.13dB), 1700MHz(0.17dB), 1794MHz(0.19dB)

Product Description

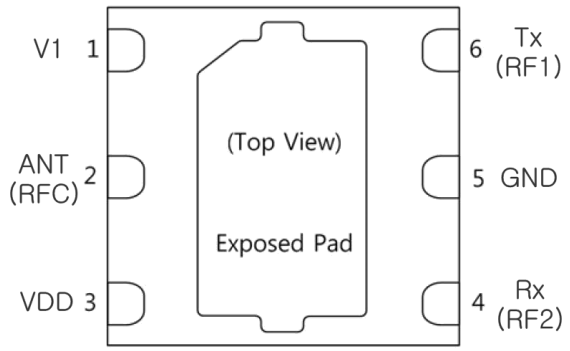


Figure 3 Functional Block Diagram

Table 4 Pin Descriptions

No.	Pin Name	Descriptions
1	V1	Digital Control Logic Input
2	ANT (RFC)	ANT RF port (RFC).
3	VDD	Supply Voltage (Typical 3.3V)
4	Rx (RF2)	Rx RF port (RF2).
5	GND	Ground
6	Tx (RF1)	Tx RF port (RF1).
Pad	Exposed Pad	Ground

Table 5 V1 Control Truth Table

V1	ANT - Tx	ANT - Rx
0	OFF	ON
1	ON	OFF

Table 6 Operating Ranges

Parameter		Symbol	Min	Typ	Max	Unit
Supply Voltage		VDD	2.7	3.3	3.6	V
Supply Current		IDD	-	140	-	μA
Digital Input Control (V1)		V1 High	1.0	-	3.3	V
		V1 Low	0	-	0.7	V
Operating Temperature Range		T_O	-40	+25	+85	°C
RF Input Power, CW Freq.=2.45GHz, 5.75GHz Z_L=50Ω	TX(RFC-RF1)		-	-	-	27	dBm
	RX(RFC-RF2)		-	-	-	15	dBm

Table 7 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
ESD	HBM	All pins	-	-	2500	V
	CDM	All pins	-	-	1000	V

Typical Performances - 50Ω

Typical conditions are at VDD = 3.3V, T_A = 25°C, V1 Low = 0V, V1 High = 3.3V, Z_L = 50Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

Figure 4 Insertion Loss vs. Vdd (RFC – RFx)

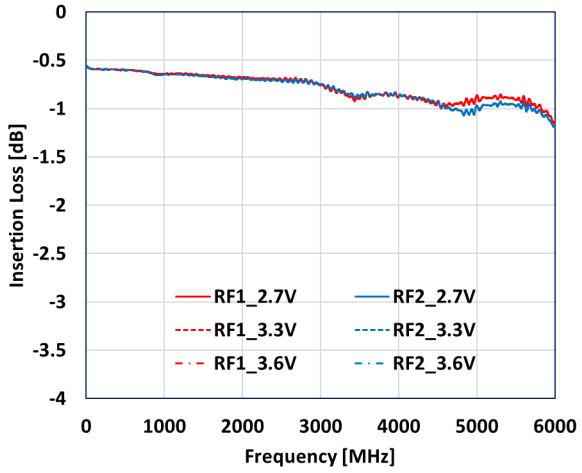


Figure 5 Insertion Loss vs. Temp (RFC - RFx)

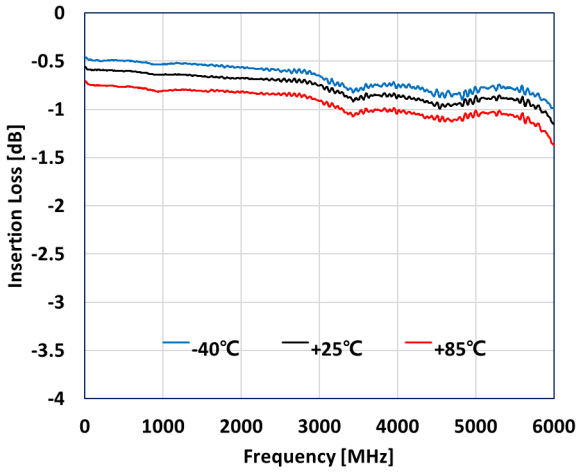


Figure 6 Return Loss (RFC,RFx)

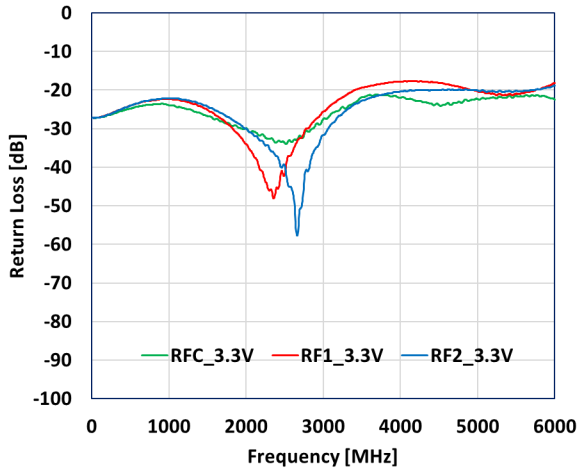
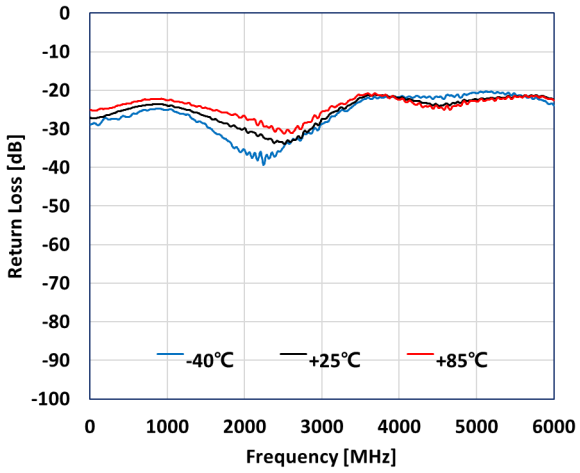


Figure 7 Return Loss vs. Temp (RFC)



Typical Performances - 50Ω

Typical conditions are at VDD = 3.3V, T_A = 25°C, V1 Low = 0V, V1 High = 3.3V, Z_L = 50Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

Figure 8 Isolation vs. Vdd (RFC - RFx)

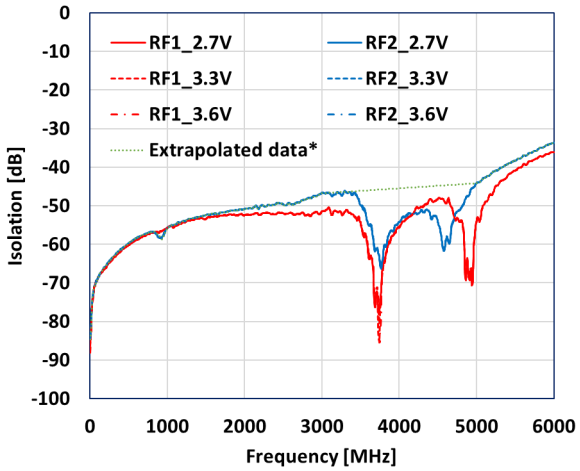
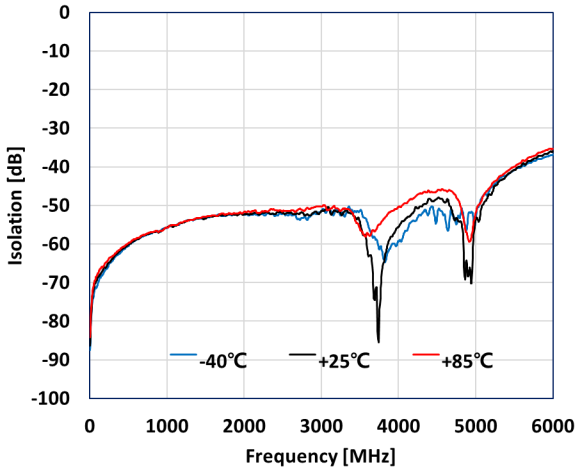


Figure 9 Isolation vs. Temp (RFC-RFx)



* Extrapolated data is the actual performance of part excluding the resonance of the evaluation board.

Figure 10 Isolation vs. Vdd (RFx - RFx)

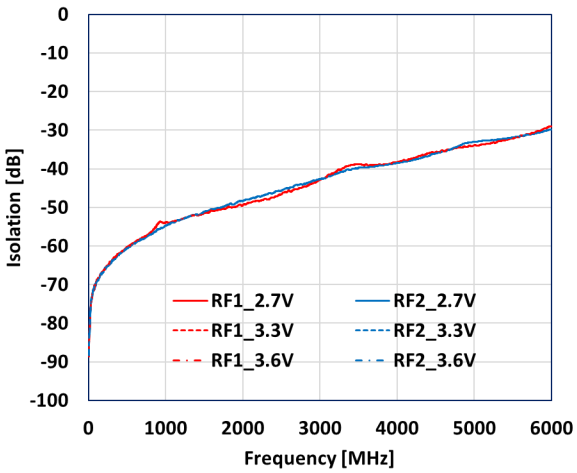
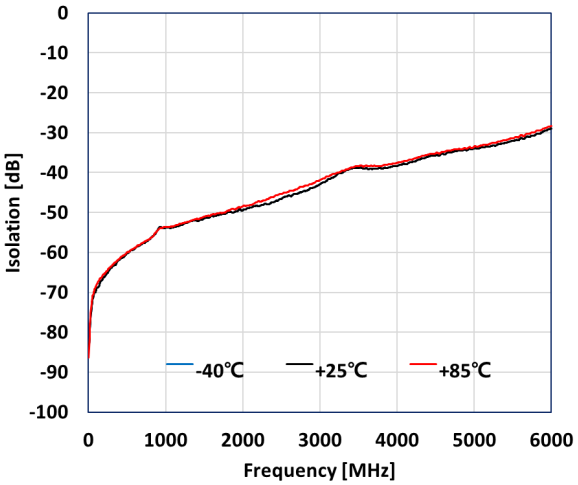


Figure 11 Isolation vs. Temp (RFx - RFx)



Typical Performances - 75Ω

Typical conditions are at VDD = 3.3V, T_A = 25°C, V1 Low = 0V, V1 High = 3.3V, Z_L = 75Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

Figure 12 Insertion Loss (RFC – RFx)

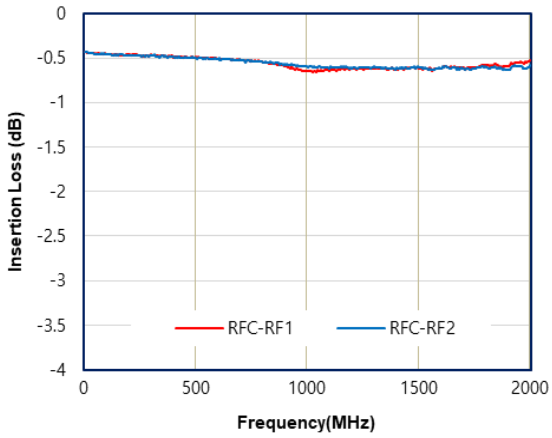


Figure 13 Insertion Loss vs. Temp (RFC - RFx)

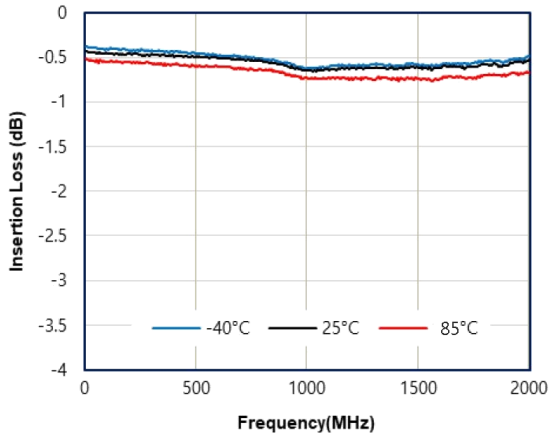


Figure 14 Return Loss (RFC,RFx)

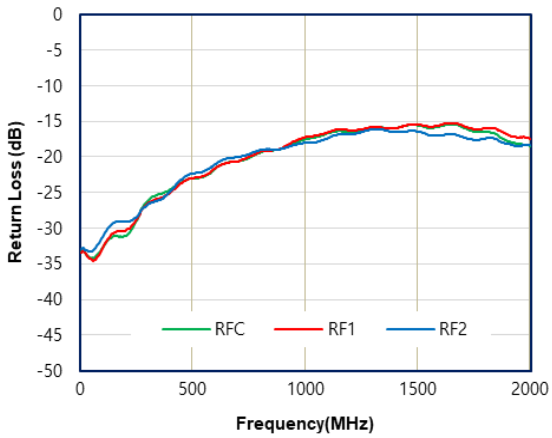
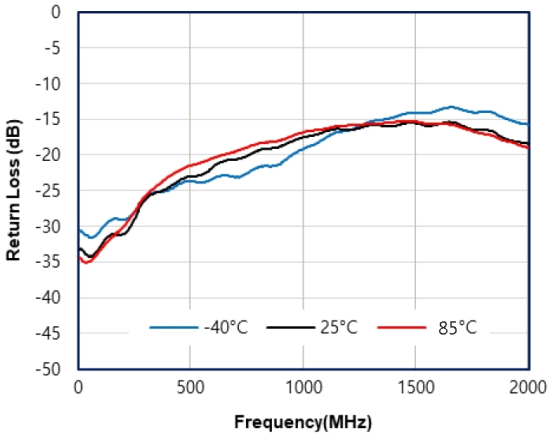


Figure 15 Return Loss vs. Temp (RFC)



Typical Performances - 75Ω

Typical conditions are at VDD = 3.3V, T_A = 25°C, V1 Low = 0V, V1 High = 3.3V, Z_L = 75Ω, Excluding SMA Connector and PCB loss, unless otherwise noted.

Figure 16 Isolation (RFC - RFx)

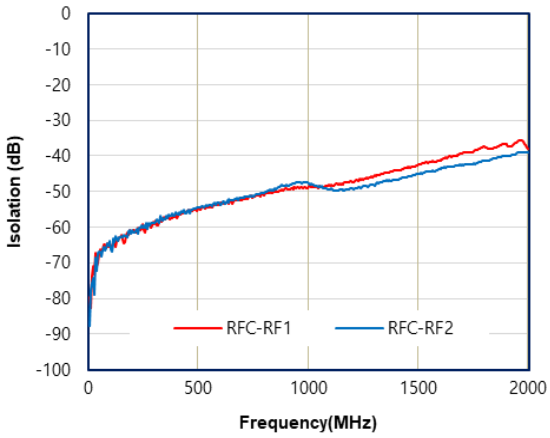


Figure 17 Isolation vs. Temp (RFC-RFx)

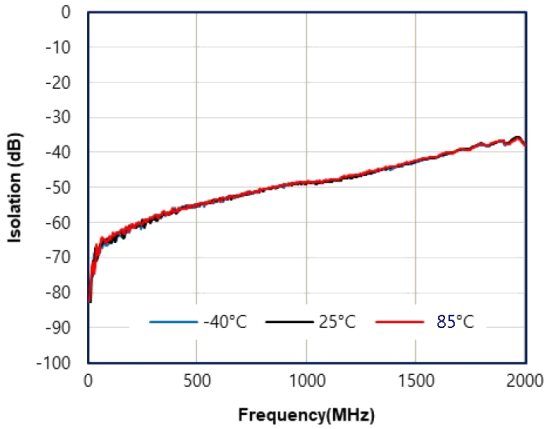


Figure 18 Isolation (RFx - RFx)

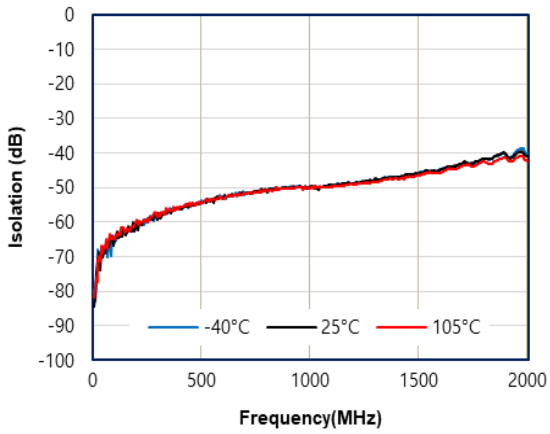
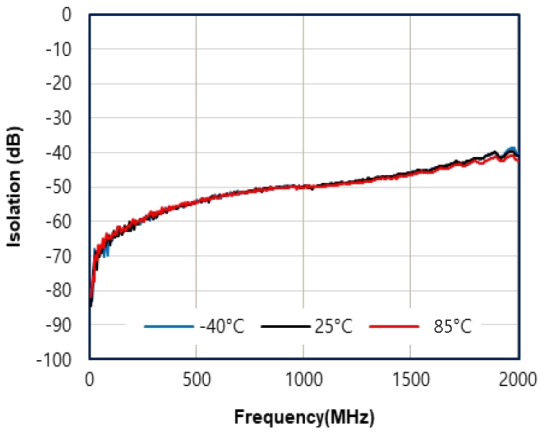


Figure 19 Isolation vs. Temp (RFx - RFx)



Evaluation Board - 50Ω

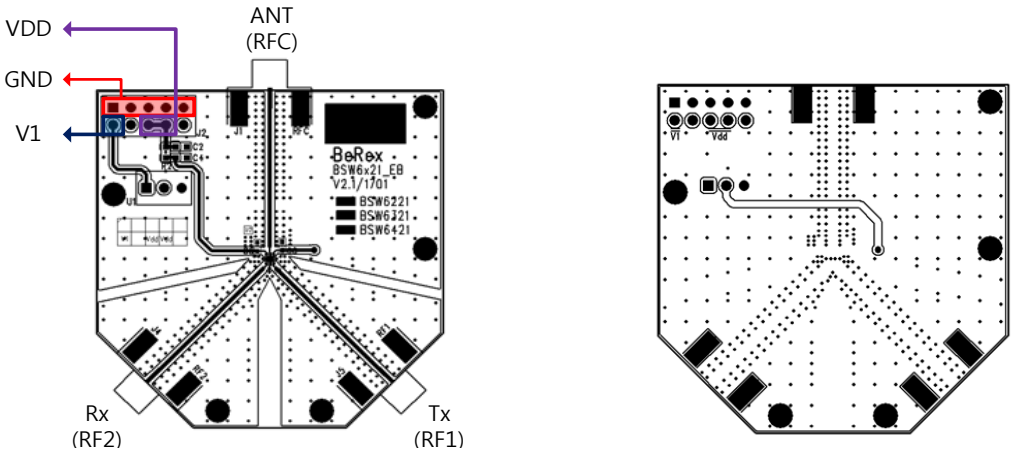


Figure 20 Evaluation Board Layout - 50Ω

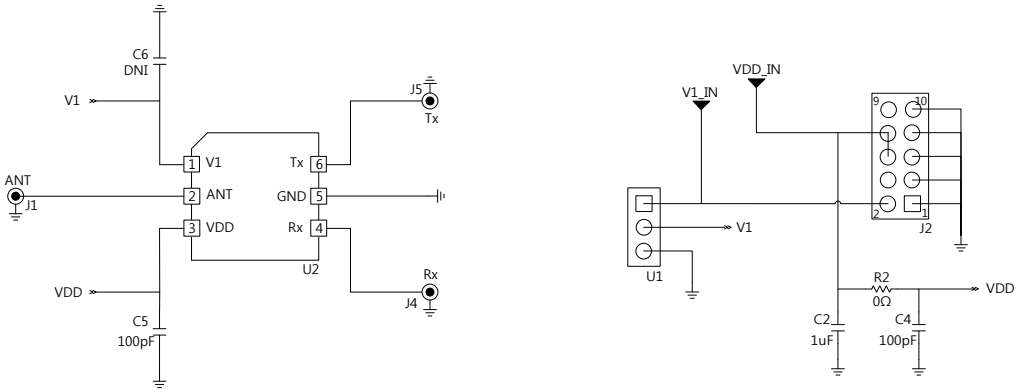


Figure 21 Evaluation Board Schematic - 50Ω

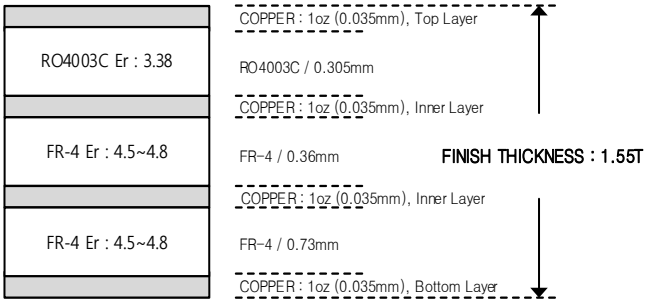


Figure 22 Evaluation Board PCB Layer Information 50Ω

Table 8 Bill of Material - Evaluation Board 50Ω

No.	Ref Des	Part Qty	Part Number	Remark
1	C2	1	CAP 1608 1uF J 50V	
2	C4	1	CAP 1608 100pF J 50V	
3	C5*	1	CAP 1005 100pF J 50V	
4	C6	1	CAP 1005 DNI	
5	R2	1	RES 1608 J 0ohm	
6	U1	1	3 Pin Header	
7	J2	1	10 Pin Header	
8	ANT, Tx, Rx	3	SMA_END_LAUNCH	
9	U2	1	1.5X1.5_6L_ BSW6421	

* C5 should be placed near the device.

Evaluation Board - 75Ω

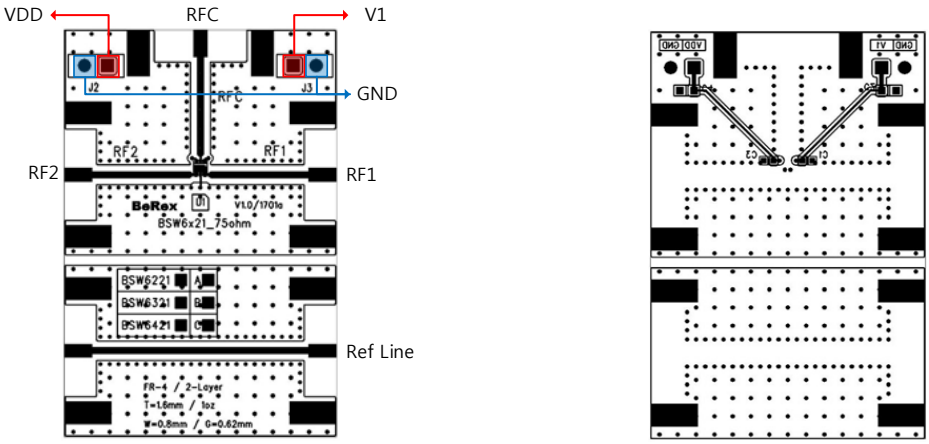


Figure 23 Evaluation Board Layout - 75Ω

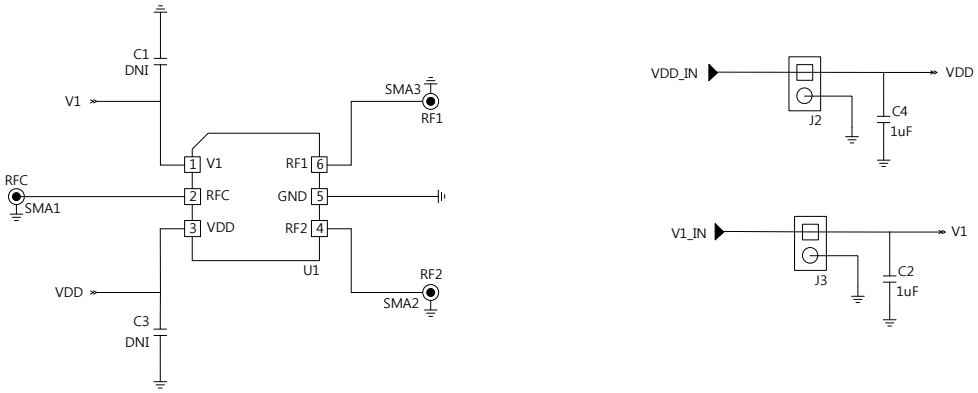


Figure 24 Evaluation Board Schematic - 75Ω

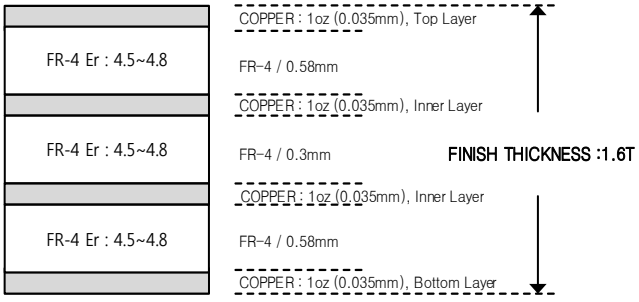
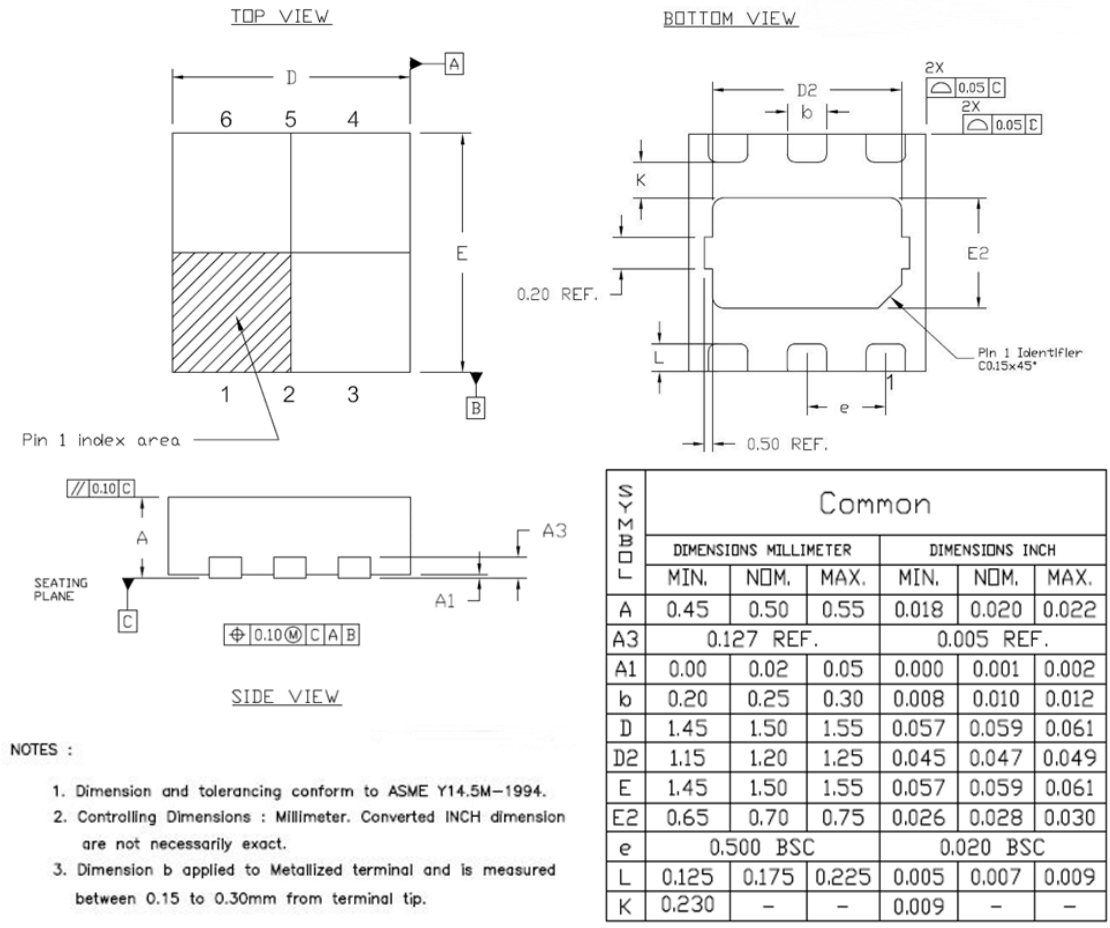


Figure 25 Evaluation Board PCB Layer Information 75Ω

Table 9 Bill of Material - Evaluation Board 75Ω

No.	Ref Des	Part Qty	Part Number	Remark
1	C2,C4	2	CAP 0603 1uF 50V	
2	C1,C3	2	CAP 0402 DNI	
3	RFC,RF1,RF2	3	F Type_END_LAUNCH	
4	J2,J3	2	2 Pin Header	
5	U2	1	DFN 1.5X1.5_6L_ BSW6421	

Package Outline Drawing



SYMBOL	Common					
	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.45	0.50	0.55	0.018	0.020	0.022
A3	0.127 REF.			0.005 REF.		
A1	0.00	0.02	0.05	0.000	0.001	0.002
b	0.20	0.25	0.30	0.008	0.010	0.012
D	1.45	1.50	1.55	0.057	0.059	0.061
D2	1.15	1.20	1.25	0.045	0.047	0.049
E	1.45	1.50	1.55	0.057	0.059	0.061
E2	0.65	0.70	0.75	0.026	0.028	0.030
e	0.500 BSC			0.020 BSC		
L	0.125	0.175	0.225	0.005	0.007	0.009
K	0.230	–	–	0.009	–	–

NOTES :

1. Dimension and tolerancing conform to ASME Y14.5M–1994.
2. Controlling Dimensions : Millimeter. Converted INCH dimension are not necessarily exact.
3. Dimension b applied to Metallized terminal and is measured between 0.15 to 0.30mm from terminal tip.

Figure 26 Package Outline Drawing

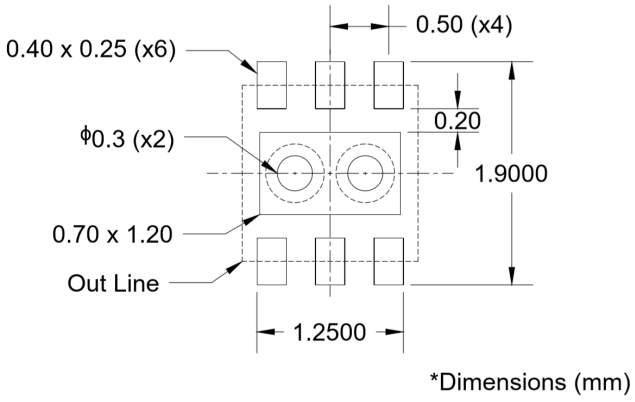
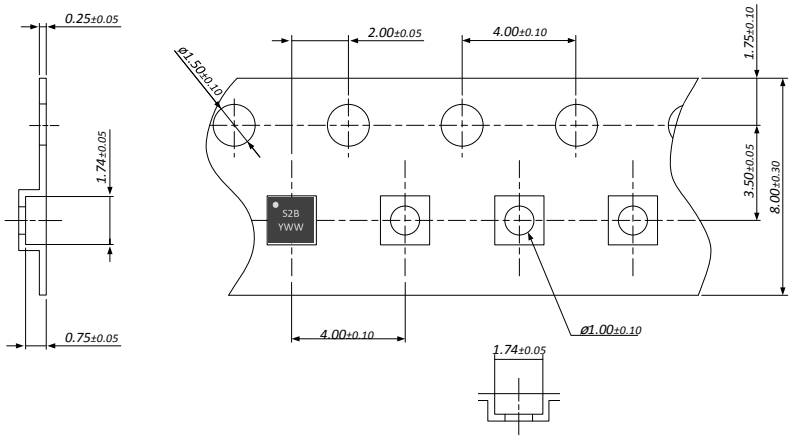


Figure 27 Recommended Land Pattern

Tape & Reel



Packaging information :

Tape Width (mm) : 8

Reel Size (inches) : 7

Device Cavity Pitch (mm) : 4

Device Per Reel : 3000EA

Package Marking

S : Switch
2 : The number of switch throw
B : Sequential Number
Y : Year
WW : Work Week

Figure 28 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 Rating: Class 2
Value: Passes < 2500V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114B

MSL Rating: Level 1 at +265°C convection reflow
Standard: JEDEC Standard J-STD-020

Proper ESD procedures should be followed when handling this device.

NATO CAGE code:

2	N	9	6	F