BSW6550

High Isolation Absorptive SP5T RF Switch

5MHz-9000MHz

Preliminary Datasheet

Product Description

The BSW6550 is a 50-ohm matched absorptive SP5T RF switch that provides ultra-high isolation with frequency coverage up to 9 GHz.

The BSW6550 is designed with high linearity and reliability, making it suitable for wireless communication applications such as 4G/5G/6G infrastructure .

The BSW6550 operates over a wide VDD range of 2.7V to 5.5V and is controlled via 3 logic pins. Additionally, the BSW6550 has a bypass mode function that can disable the internal negative voltage, and an external negative Vss can be supplied through pin 20.

The BSW6550 is designed with ESD protection circuits at all pins and packaged in an industry standard, fully RoHS2-compliant, 24-Lead, 4mm x 4mm x 0.75mm QFN thin package.

The BSW6550 does not require blocking capacitors. If DC is presented at the RF port, add a blocking capacitor.

Block Diagram

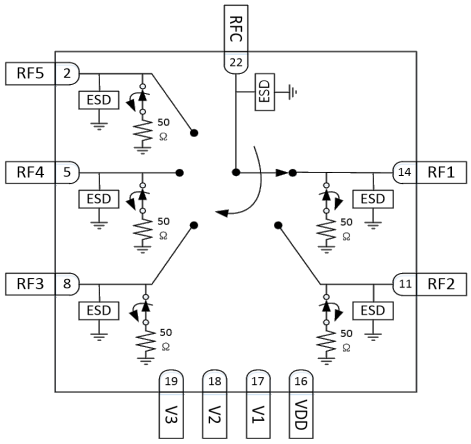


Figure 1. Functional Block Diagram

Applications

- Wireless Communication such as 4G/5G/6G
- Massive MIMO active Antenna Systems
- Repeaters
- Digital Pre-Distortion
- Military Systems
- UWB
- Test & Measurement

Package Type

4mm x 4mm x 0.75mm, 24-Lead QFN Package

Figure 2. Package Type

Device Features

- Output frequency range : 5 MHz to 9.0 GHz
- Supply Voltage : 2.7V to 5.5V
- Low Insertion Loss
  : 0.70dB @ 2GHz
  : 0.86dB @ 4GHz
  : 1.00dB @ 6GHz
- High Isolation
  - RFC to RFx
    : 66dB @ 2GHz
    : 59dB @ 4GHz
    : 52dB @ 6GHz
  - RFx to RFx
    : 59dB @ 2GHz
    : 54dB @ 4GHz
    : 52dB @ 6GHz
- High Input 1dB Compression
  : 34.8dBm @ 2.35GHz
  : 34.6dBm @ 3.5GHz
  : 34.4dBm @ 5.75GHz
- High IIP3
  : 63.5dBm @ 2.35GHz
  : 62.3dBm @ 3.5GHz
  : 63.2dBm @ 5.75GHz
- Fast Switching Time : 180ns
- Operating temperature range : -40°C to +125°C
- ESD, HBM : 1.0kV
- Optional External Negative Supply (Bypass Mode)
- 24-Lead QFN package : 4.0mm x 4.0mm x 0.75mm
- Lead-free/RoHS2-compliant QFN SMT package

Electrical Specifications

Typical conditions are Normal Mode[1](VDD = 5V, VSSEXT= 0V) or Bypass Mode[2](VDD = 5V, VSSEXT = -3.5V), T_A = 25°C,
Control Logic V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, Z_L = 50Ω, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Table 1. Electrical Specifications

Parameter	Path	Conditions	Min	Typ	Max	Unit
Operating Frequency			5		9000	MHz
Insertion Loss	RFC - RF1	1GHz 2GHz 3GHz 4GHz 5GHz 6GHz 7GHz 8GHz 9GHz		0.60 0.70 0.81 0.86 0.86 1.00 1.59 2.17 2.19		dB
	RFC - RF2	1GHz 2GHz 3GHz 4GHz 5GHz 6GHz 7GHz 8GHz 9GHz		0.60 0.70 0.81 0.88 0.87 0.99 1.64 2.27 2.21		dB
	RFC - RF3	1GHz 2GHz 3GHz 4GHz 5GHz 6GHz 7GHz 8GHz 9GHz		0.59 0.69 0.81 0.87 0.87 1.02 1.66 2.26 2.24		dB
	RFC - RF4	1GHz 2GHz 3GHz 4GHz 5GHz 6GHz 7GHz 8GHz 9GHz		0.59 0.69 0.79 0.85 0.87 0.99 1.48 2.12 2.13		dB
	RFC - RF5	1GHz 2GHz 3GHz 4GHz 5GHz 6GHz 7GHz 8GHz 9GHz		0.61 0.70 0.80 0.83 0.86 1.00 1.51 2.01 2.11		dB

1. Normal Mode : Single external positive supply voltage(VDD) inputted.
2. Bypass Mode : Both external positive supply voltage(VDD) and external negative voltage(VSSEXT) inputted.

Table 1. Electrical Specifications (Cont.)

Parameter	Path	Conditions	Min	Typ	Max	Unit
Return Loss (Active port)	RFC, RFx	5MHz - 6GHz 6GHz - 9GHz		15 8		dB
Return Loss (Terminated port)	RFC, RFx	5MHz - 9GHz		15		dB
Input P1dB	RFC - RFx	2.35GHz 3.5GHz 5.75GHz		34.8 34.6 34.4		dBm
Input IP2[3]	RFC - RFx	2.35GHz 3.5GHz 5.75GHz		110 112 107		dBm
Input IP3[3]	RFC - RFx	2.35GHz 3.5GHz 5.75GHz		64 62 63		dBm
2nd Harmonic[4]	RFC - RFx	2.35GHz 3.5GHz 5.75GHz		97 100 95		dBc
3rd Harmonic[4]	RFC - RFx	2.35GHz 3.5GHz 5.75GHz		101 97 100		dBc
Rising Time Falling Time	RFC - RFx	10% RF to 90% RF 90% RF to 10% RF		40 40		ns
Switching Time	RFC - RFx	50% CTRL to 90% RF 50% CTRL to 10% RF		180 100		ns
Settling Time	RFC - RFx	50% CTRL to 0.05dB final value Rising Edge 50% CTRL to 0.05dB final value Falling Edge		190 105		ns
Maximum Spurious Level		1MHz - 10MHz > 10MHz[5]		-127 < -140		dBm/10Hz

3. Tone Power is +18dBm and Tone spacing is 20kHz .
4. Tone Power is +18dBm.
5. No spurious signals were detected above 10MHz.

Isolation Matrix

Typical conditions are Normal Mode[1](VDD = 5V, VSSEXT= 0V) or Bypass Mode[2](VDD = 5V, VSSEXT = -3.5V), T_A = 25°C, Control Logic V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, Z_L = 50Ω, unless otherwise noted.

Table 2. RFC-to-RFx Isolation

"ON" Port	Frequency	RFC to RFx Isolation					Unit
		RF1	RF2	RF3	RF4	RF5	
RF1	1GHz	-	73	68	72	72	dB
	2GHz	-	66	62	67	66	
	3GHz	-	61	59	64	63	
	4GHz	-	59	58	63	60	
	5GHz	-	55	58	60	55	
	6GHz	-	52	59	55	49	
	7GHz	-	50	57	50	44	
	8GHz	-	47	52	45	40	
	9GHz	-	43	45	41	35	
RF2	1GHz	74	-	65	73	73	
	2GHz	70	-	59	68	67	
	3GHz	69	-	56	65	64	
	4GHz	79	-	55	64	60	
	5GHz	66	-	55	60	54	
	6GHz	57	-	58	55	49	
	7GHz	50	-	67	49	44	
	8GHz	45	-	57	45	39	
	9GHz	40	-	46	41	35	
RF3	1GHz	75	65	-	71	74	
	2GHz	71	59	-	67	68	
	3GHz	69	56	-	64	65	
	4GHz	77	54	-	65	60	
	5GHz	66	55	-	61	53	
	6GHz	59	57	-	55	48	
	7GHz	51	61	-	49	43	
	8GHz	47	69	-	44	39	
	9GHz	42	49	-	39	35	
RF4	1GHz	74	68	72	-	76	
	2GHz	69	62	66	-	70	
	3GHz	67	59	62	-	66	
	4GHz	72	57	59	-	60	
	5GHz	71	57	57	-	53	
	6GHz	61	57	53	-	47	
	7GHz	52	56	50	-	42	
	8GHz	48	54	47	-	38	
	9GHz	42	48	43	-	34	
RF5	1GHz	73	68	71	64	-	
	2GHz	68	62	65	58	-	
	3GHz	67	59	62	56	-	
	4GHz	69	58	59	55	-	
	5GHz	72	57	56	55	-	
	6GHz	62	56	54	58	-	
	7GHz	52	54	50	54	-	
	8GHz	47	51	47	47	-	
	9GHz	42	46	42	40	-	

Isolation Matrix

Typical conditions are Normal Mode[1](VDD = 5V, VSSEXT= 0V) or Bypass Mode[2](VDD = 5V, VSSEXT = -3.5V), T_A = 25°C, Control Logic V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, Z_L = 50Ω, unless otherwise noted.

Table 3. RFx-to-RFx Isolation

"ON" Port	Frequency	RFx to RFx Isolation					Unit
		RF1	RF2	RF3	RF4	RF5	
RF1	1GHz	-	64	73	68	67	dB
	2GHz	-	59	67	63	61	
	3GHz	-	56	64	61	59	
	4GHz	-	54	61	59	58	
	5GHz	-	53	58	60	58	
	6GHz	-	52	55	63	61	
	7GHz	-	53	51	58	55	
	8GHz	-	52	46	50	48	
	9GHz	-	50	41	44	41	
RF2	1GHz	65	-	71	68	66	
	2GHz	59	-	65	62	60	
	3GHz	57	-	59	60	58	
	4GHz	57	-	55	59	57	
	5GHz	59	-	51	59	58	
	6GHz	63	-	47	62	61	
	7GHz	54	-	44	59	55	
	8GHz	47	-	40	50	48	
	9GHz	42	-	37	44	41	
RF3	1GHz	68	71	-	65	65	
	2GHz	63	65	-	60	60	
	3GHz	60	59	-	57	57	
	4GHz	59	55	-	56	57	
	5GHz	61	51	-	58	58	
	6GHz	69	48	-	59	62	
	7GHz	61	44	-	53	54	
	8GHz	51	40	-	46	47	
	9GHz	45	37	-	40	40	
RF4	1GHz	69	72	65	-	62	
	2GHz	64	67	59	-	57	
	3GHz	61	63	56	-	55	
	4GHz	60	60	54	-	54	
	5GHz	63	58	54	-	58	
	6GHz	73	54	54	-	63	
	7GHz	60	50	55	-	50	
	8GHz	50	46	52	-	43	
	9GHz	44	42	47	-	37	
RF5	1GHz	69	72	68	73	-	
	2GHz	64	67	63	68	-	
	3GHz	62	63	59	62	-	
	4GHz	61	60	57	57	-	
	5GHz	64	58	56	51	-	
	6GHz	74	56	55	47	-	
	7GHz	59	52	55	42	-	
	8GHz	50	47	51	38	-	
	9GHz	44	43	47	34	-	

Product Description

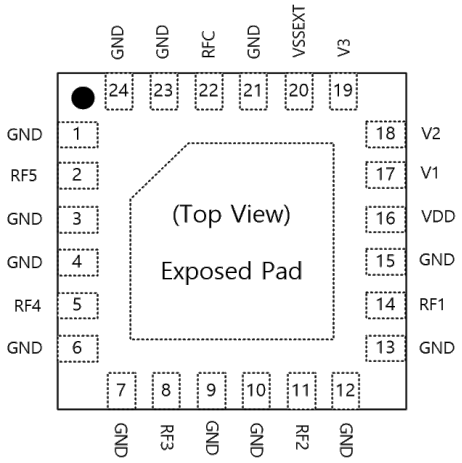


Figure 3. Pin Description

Table 4. Pin Descriptions

No.	Pin Name	Descriptions
16	VDD	Supply Voltage
20	VSSEXT	Ground or External negative Voltage
19	V3	Switch control input 3
18	V2	Switch control input 2
17	V1	Switch control input 1
2	RF5	RF5 Port
5	RF4	RF4 Port
8	RF3	RF3 Port
11	RF2	RF2 Port
14	RF1	RF1 Port
22	RFC	RFC Port
1,3,4,6, 7,9,10,12, 13,15,21,23,24	GND	Ground
Pad	Exposed Pad	Ground

Table 5. Control Truth Table

V3	V2	V1	RFC-RF1	RFC-RF2	RFC-RF3	RFC-RF4	RFC-RF5
0	0	0	OFF[1]	OFF[1]	OFF[1]	OFF[1]	OFF[1]
0	0	1	ON	OFF	OFF	OFF	OFF
0	1	0	OFF	ON	OFF	OFF	OFF
0	1	1	OFF	OFF	ON	OFF	OFF
1	0	0	OFF	OFF	OFF	ON	OFF
1	0	1	OFF	OFF	OFF	OFF	ON
1	1	0	OFF[1]	OFF[1]	OFF[1]	OFF[1]	OFF[1]
1	1	1	OFF[1]	OFF[1]	OFF[1]	OFF[1]	OFF[1]

1. Logic state 000, 110 and 111 are all path OFF mode.

Table 6. Recommended Operating Conditions

	Parameter	Symbol	Min	Typ	Max	Unit
Normal Mode[1]	Supply Voltage	VDD	2.7	5	5.5	V
	Supply Current	IDD	-	200		μA
Bypass Mode[2]	Supply Voltage	VDD	2.7	5	5.5	V
	Supply Current	IDD		160		μA
	Negative Supply Voltage	VSSEXT		-3.5	-3.2	V
Digital Input Voltage (V1/V2/V3)		VIH	1.17	-	3.6	V
		VIL	0	-	0.6	V
Digital Input Current (V1/V2/V3)		ICTRL	-	-	10	uA
Operating Temperature Range		T_A	-40	+25	+125	°C
RF Input Power, CW (Active Port, +25°C)		$P_{Max,Active\_+25℃}$	-	-	31	dBm
RF Input Power, CW (Active Port, +125°C)		$P_{Max,Active\_+125℃}$	-	-	31	dBm
RF Input Power, CW (Terminated Port, +25°C)		$P_{Max,Term\_+25℃}$	-	-	27	dBm
RF Input Power, CW (Terminated Port, +125°C)		$P_{Max,Term\_+125℃}$	-	-	24	dBm

* Specifications are not guaranteed over all recommended operating conditions.
1. Normal Mode : Single external positive supply voltage(VDD) is inputted.
2. Bypass Mode : Both external positive supply voltage(VDD) and external negative voltage(VSSEXT) are inputted.

Table 7. Absolute Maximum Ratings

Parameter			Symbol	Min	Max	Unit
Supply Voltage			VDD	-0.3	5.5	V
Digital Input Voltage			V1/V2/V3	-0.3	3.6	V
Maximum Input Power, CW (+25°C)			$P_{max\_abs\_+25℃}$	-	35	dBm
Maximum Input Power, CW (+125°C)			$P_{max\_abs\_+125℃}$	-	33	dBm
Storage Temperature range			-	-65	+150	°C
ESD	HBM[1]	All pins	-	-	1000	V
	CDM[2]	All pins	-	-	1000	V

1. HBM Standard : JS-001-2017
2. CDM Standard : JS-002-2018

Typical Performances

Typical conditions are Normal mode, VDD = 5V, T_A = 25°C, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, Z_L = 50Ω, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Figure 4. Insertion Loss vs Frequency

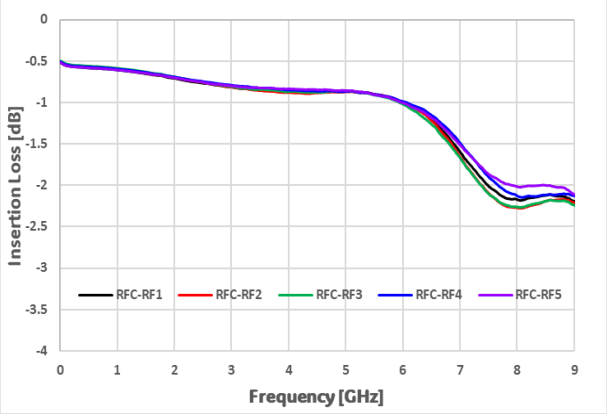


Figure 5. Insertion Loss vs VDD (RFC-RF1)

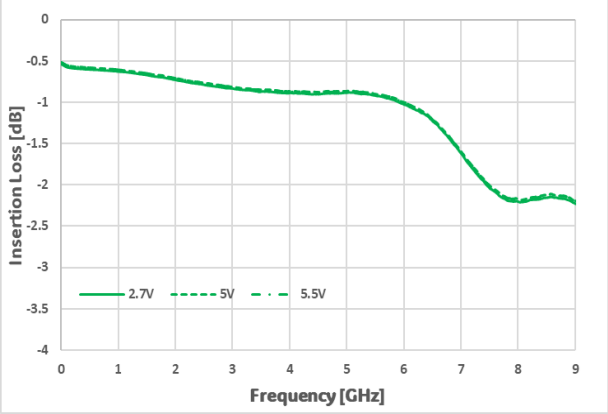


Figure 6. Insertion Loss vs Temp (RFC-RF1)

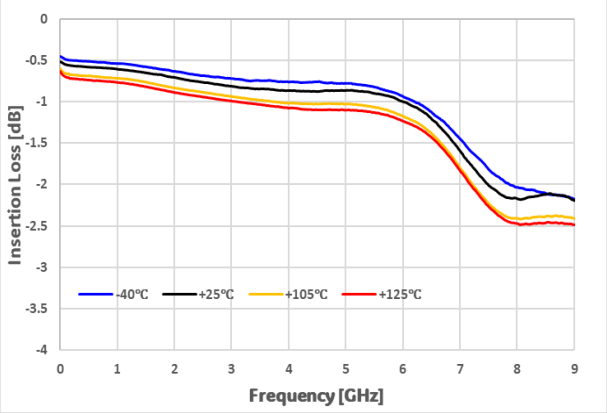


Figure 7. Return Loss vs Frequency (RFC Port)

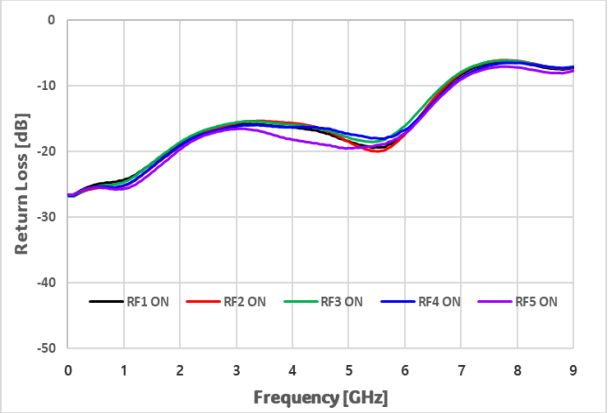


Figure 8. Return Loss vs VDD (RFC Port)

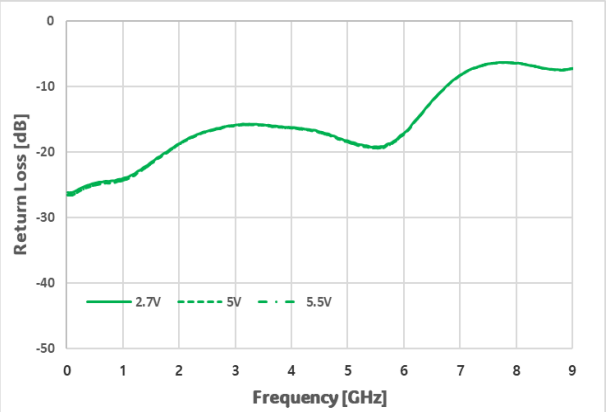
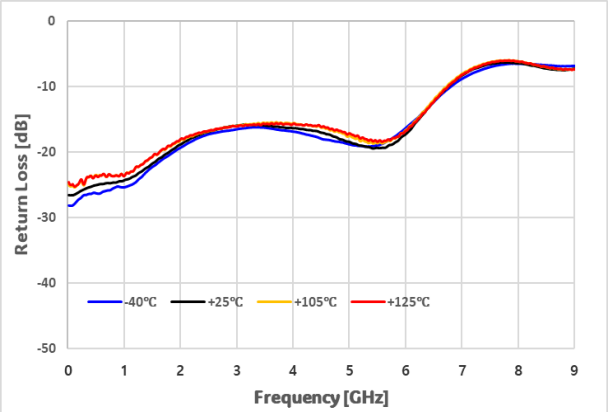


Figure 9. Return Loss vs Temp (RFC Port)



Typical Performances

Typical conditions are Normal mode, VDD = 5V, T_A = 25°C, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, Z_L = 50Ω, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Figure 10. Return Loss vs Frequency (Active Port)

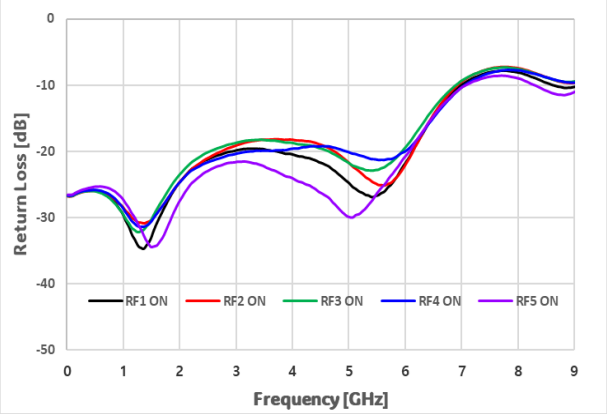


Figure 11. Return Loss vs VDD (Active Port)

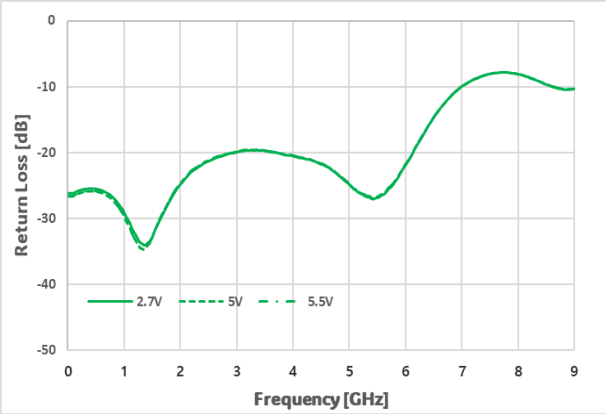


Figure 12. Return Loss vs Temp (Active Port)

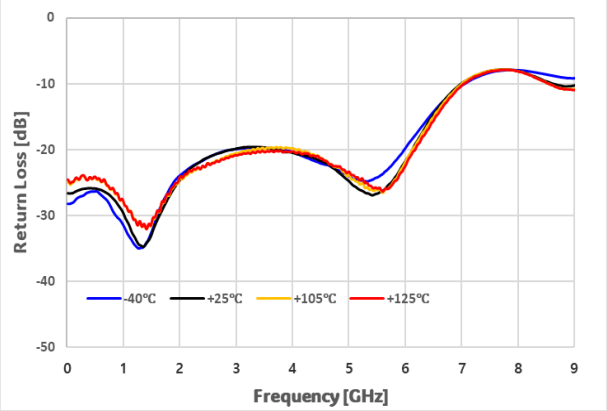


Figure 13. Return Loss vs Frequency (Terminated Port)

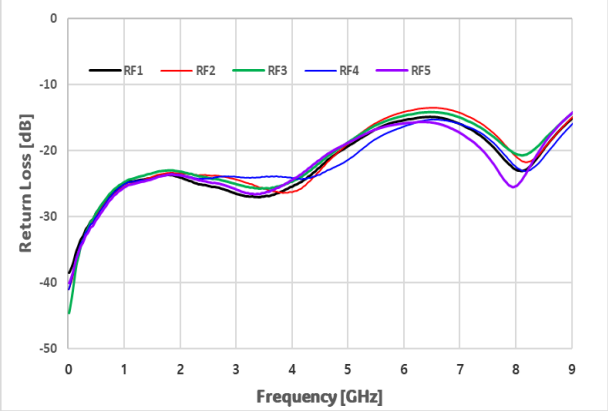


Figure 14. Return Loss vs VDD (Terminated Port)

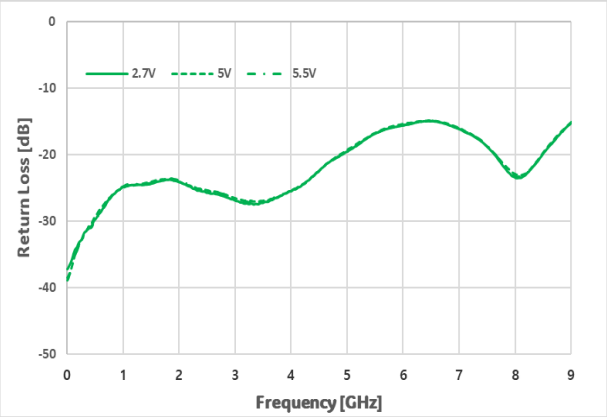
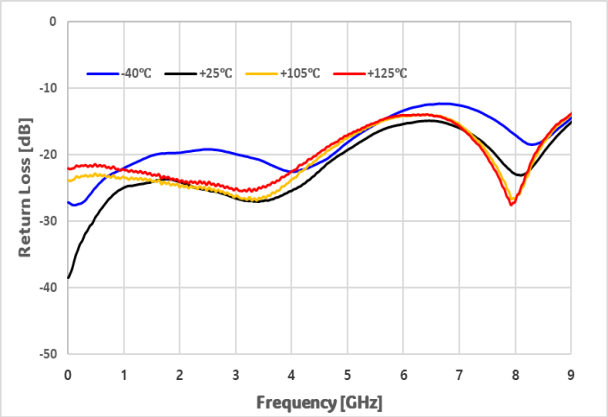


Figure 15. Return Loss vs Temp (Terminated Port)



Typical Performances

Typical conditions are Normal mode, VDD = 5V, T_A = 25°C, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, Z_L = 50Ω, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Figure 16. Isolation vs Frequency (RFC to RFx)

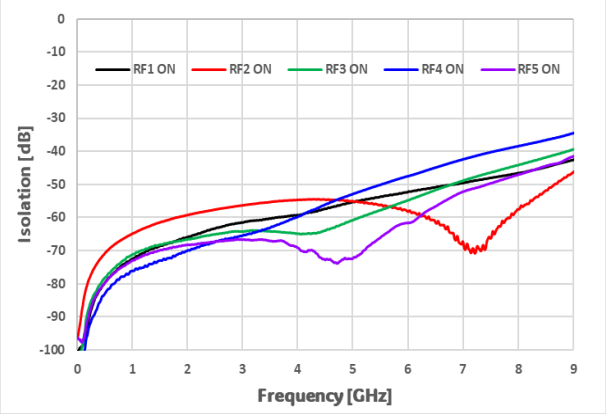


Figure 17. Isolation vs Frequency (RFC to RFx, RF1

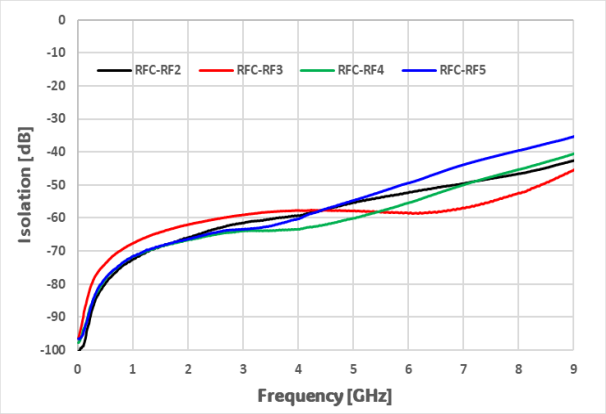


Figure 18. Isolation vs VDD (RFC to RF1, RF2 ON)

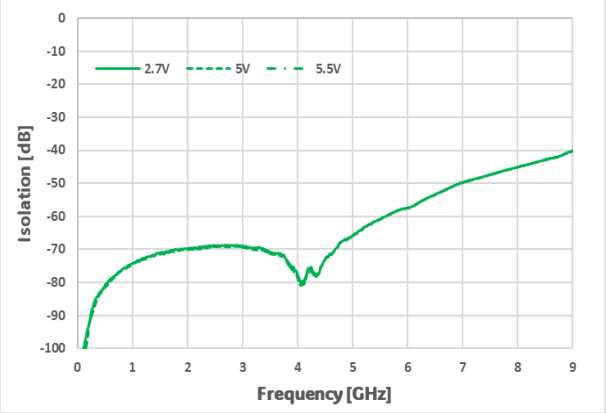


Figure 19. Isolation vs Temp (RFC to RF1, RF2 ON)

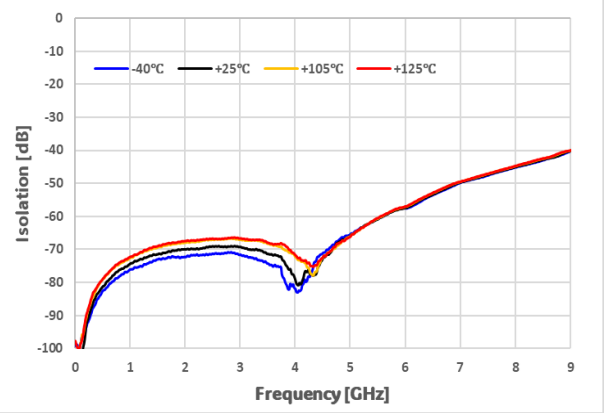


Figure 20. Isolation vs Frequency (RFx to RFx)

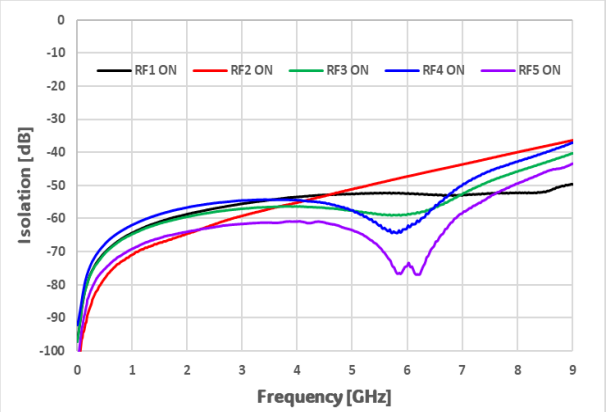
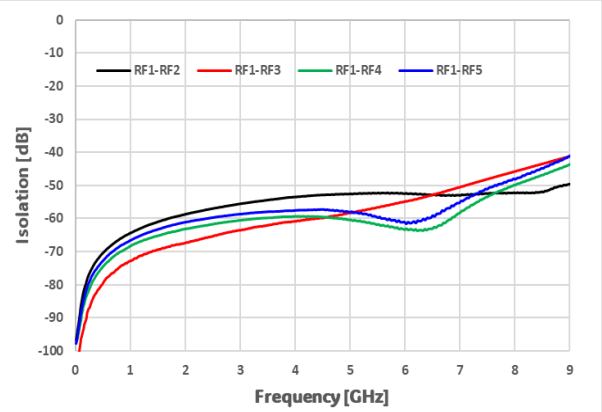


Figure 21. Isolation vs Frequency (RF1 to RFx, RF1



Typical Performances

Typical conditions are Normal mode, VDD = 5V, T_A = 25°C, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, Z_L = 50Ω, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Figure 22. Isolation vs VDD (RF1 to RF2, RF1 ON)

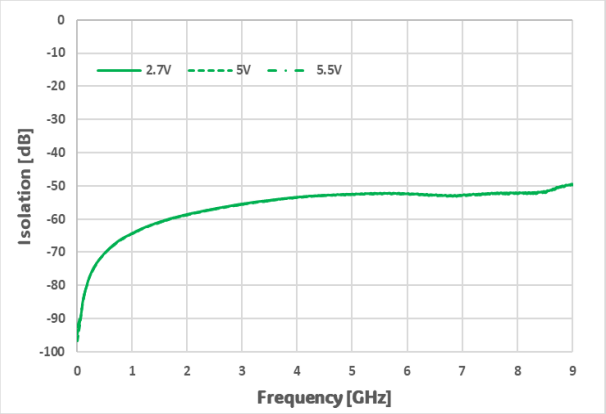


Figure 23. Isolation vs Temp (RF1 to RF2, RF1 ON)

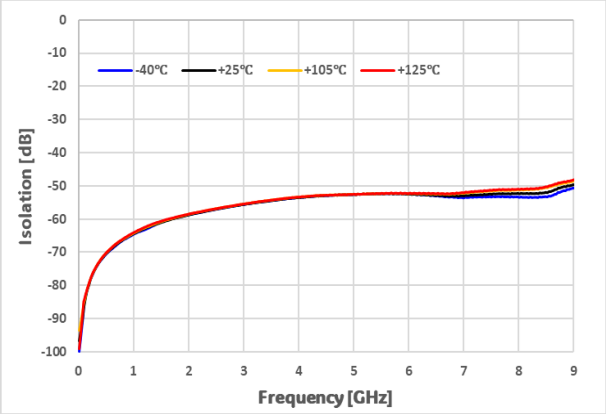


Figure 24. IIP3 vs RF Port

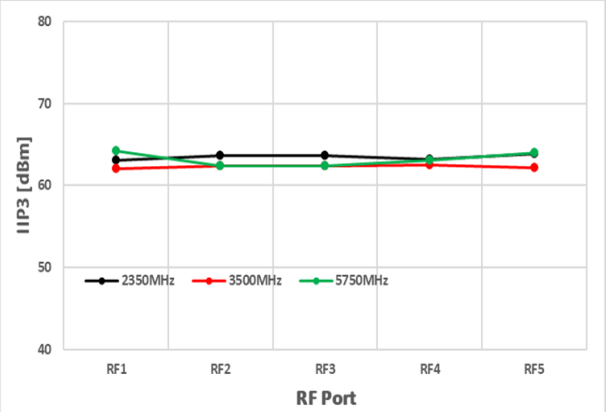
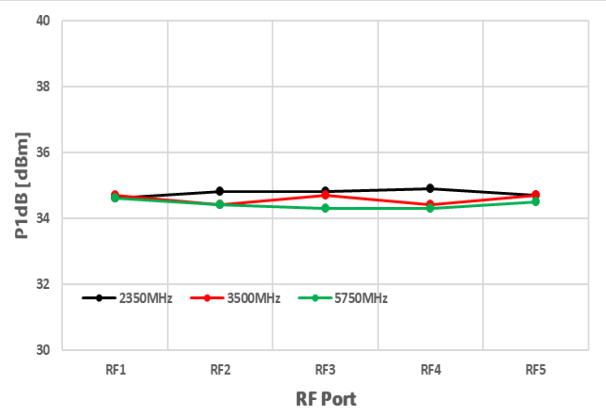
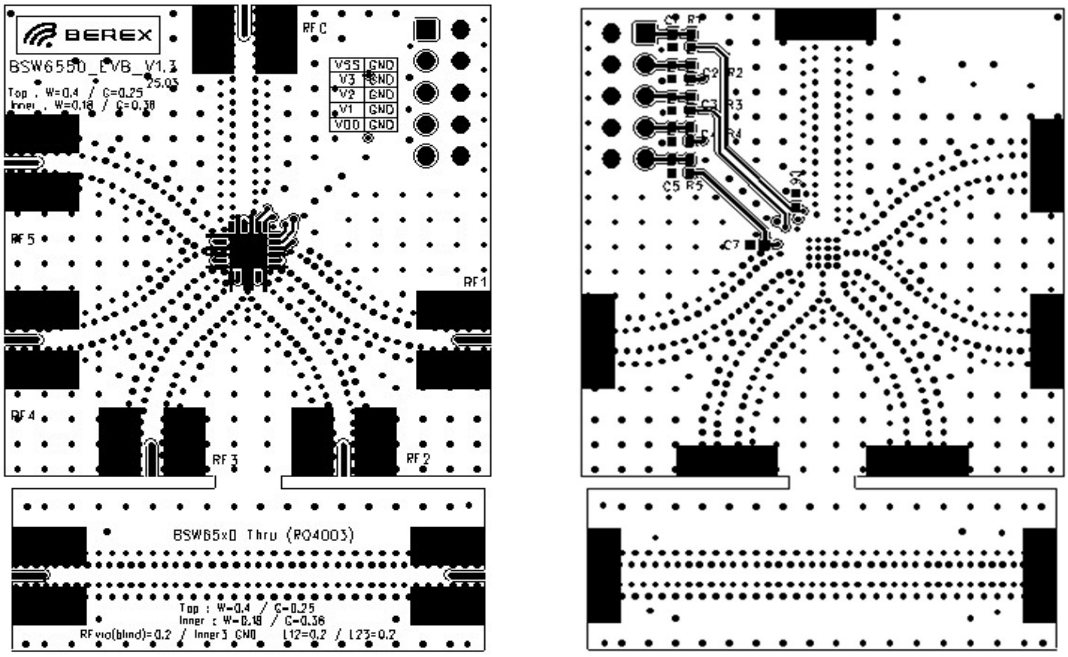


Figure 25. P1dB vs RF Port



Evaluation Board



[Top view] [Bottom view]

Figure 26. Evaluation Board Layout

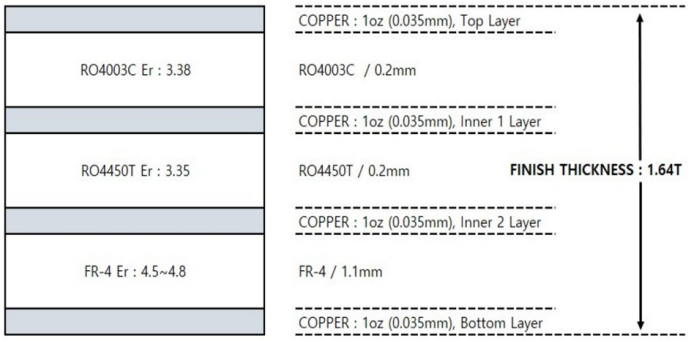


Figure 27. Evaluation Board PCB Layer Information

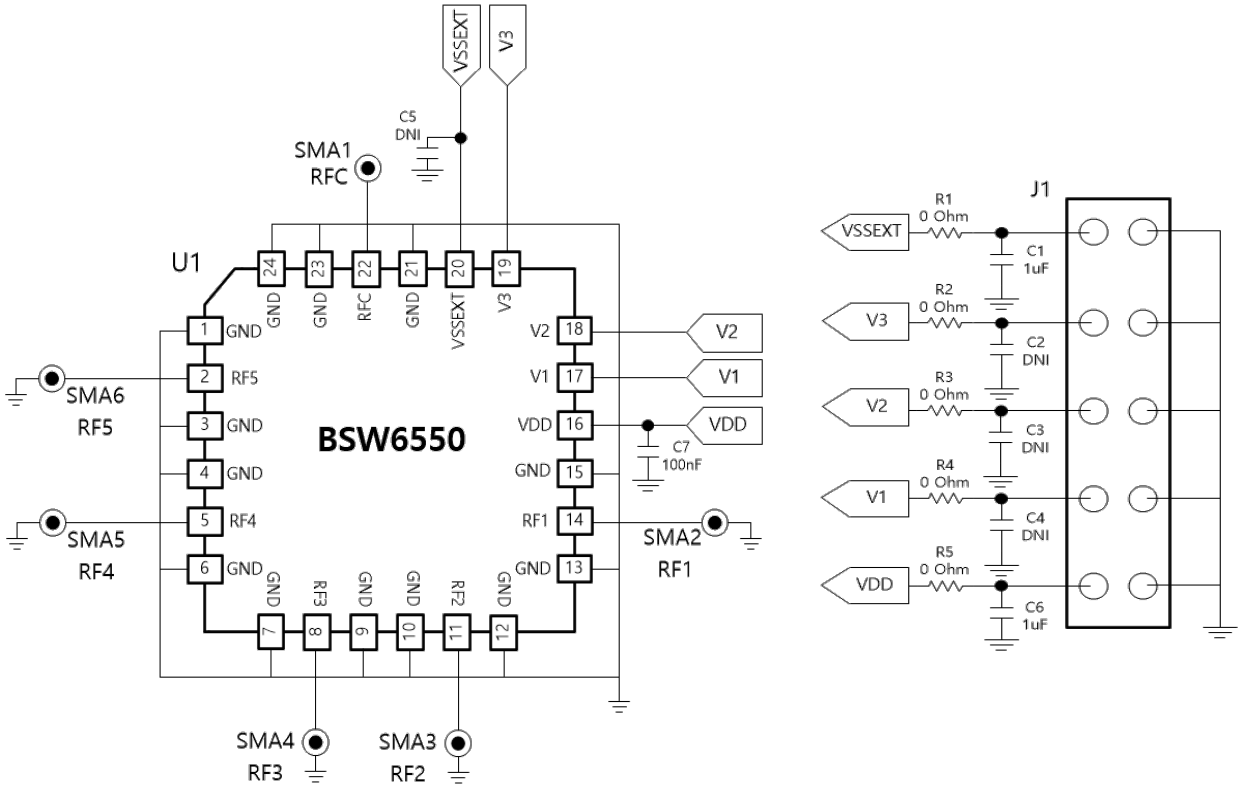
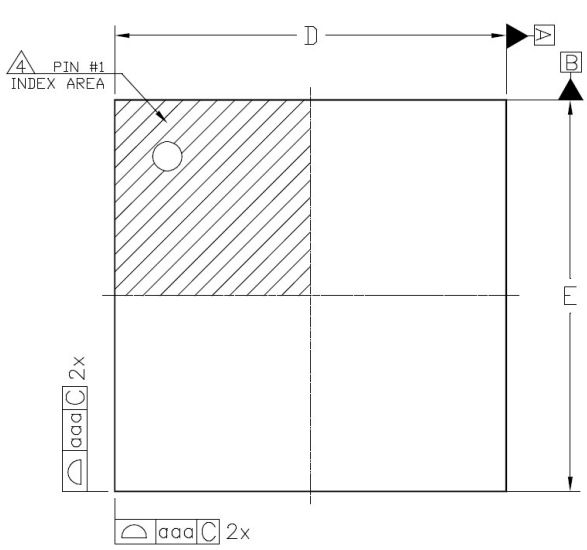


Figure 28. Evaluation Board Schematic

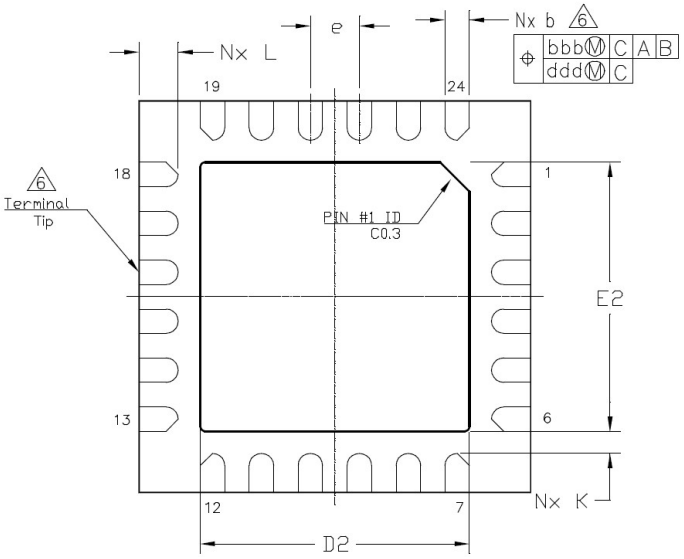
Table 8. Bill of Material - Evaluation Board

No.	Ref Des	Part Qty	Part Number	Remark
1	C1,C6	2	CAP 1005 1uF J 50V	
2	C7	1	CAP 1005 100nF J 50V	C7 should be placed near the BSW6550
3	C2,C3,C4,C5	4	CAP 1005 DNI	
4	R1,R2,R3,R4,R5	5	RES 1005 0 ohm J 50V	
5	J1	1	2x5 Pin Header	2.54mm pitch
6	RFC,RF1,RF2, RF3,RF4,RF5	6	SMA_END_LAUNCH	
7	U1	1	BSW6550	

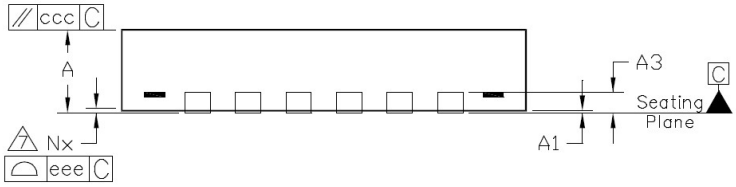
Package Outline Drawing



[Top View]



[Bottom View]



[Side View]

NOTES:

1. Dimensioning and tolerancing conform to ASME Y14.5–2009.
2. All dimensions are in millimeters.
3. N is the total number of terminals.
4. The location of the marked terminal #1 identifier is within the hatched area.
5. ND and NE refer to the number of terminals each D and E side respectively.
6. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.3mm from the terminal tip. If the terminal has a radius on the other end of it, dimension b should not be measured in that radius area.
7. Coplanarity applies to the terminals and all other bottom surface metallization.

Dimension Table (Notes 1,2)				
Symbol Thickness	Min	Nominal	Max	Note
A	0.70	0.75	0.80	
A1	0.00	0.02	0.05	
A3	---	0.203 Ref.	---	6
b	0.20	0.25	0.30	
D		4.00 BSC		
E		4.00 BSC		
e		0.50 BSC		
D2	2.65	2.70	2.75	
E2	2.65	2.70	2.75	
K	0.2	---	---	
L	0.30	0.40	0.50	
aaa		0.05		
bbb		0.10		
ccc		0.10		
ddd		0.05		
eee		0.08		
N		24		3
ND		6		5
NE		6		5

Figure 29. Package Outline Drawing

Recommended Land Pattern

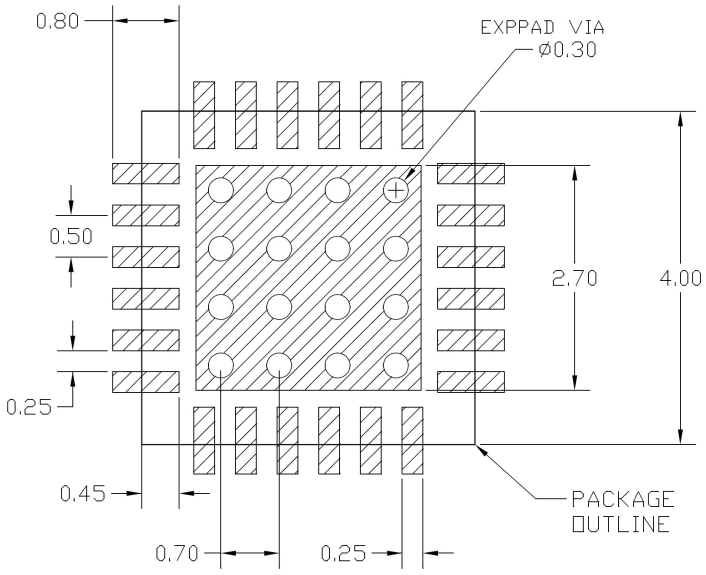


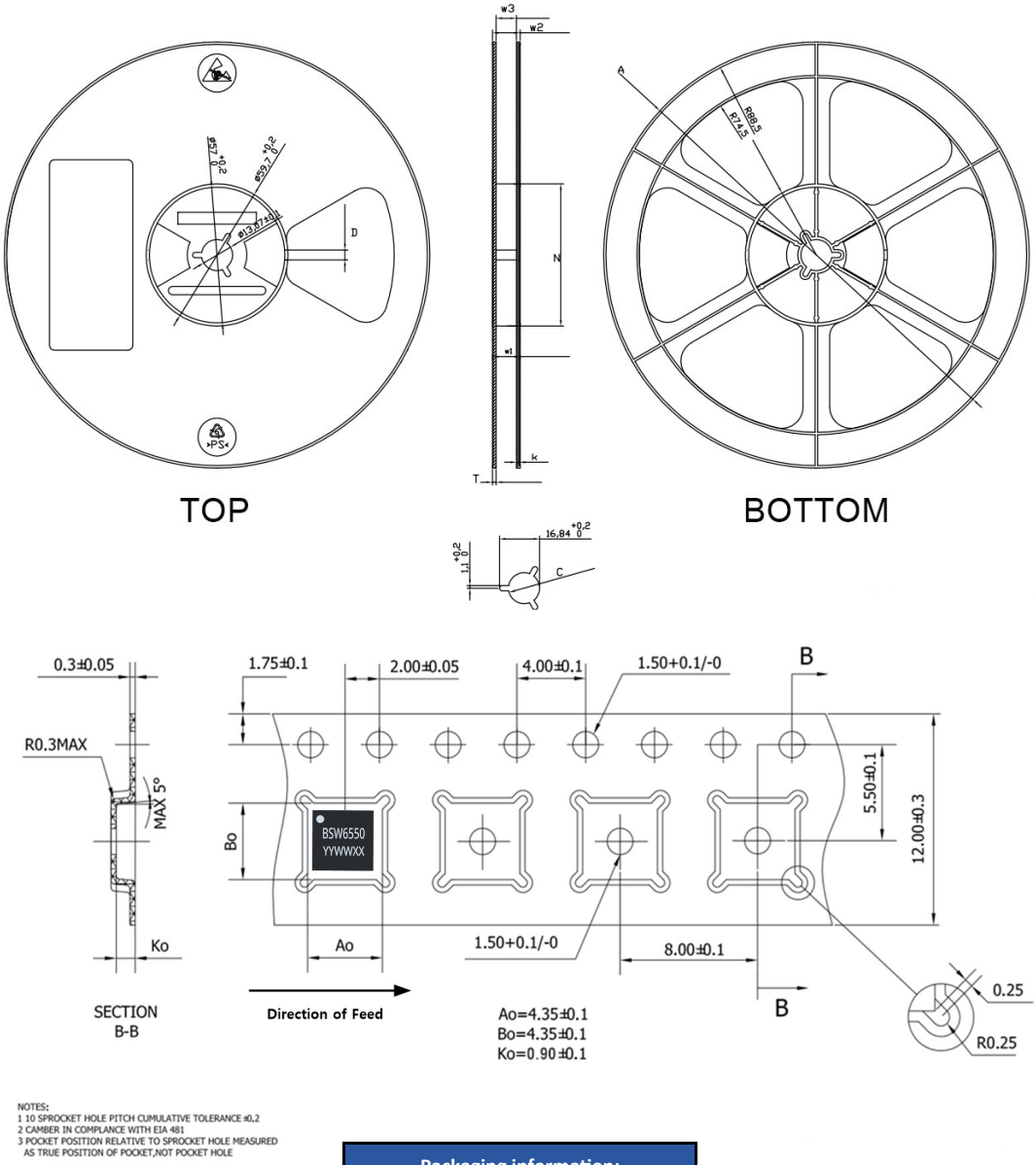
Figure 30. Recommended Land Pattern

Package Marking

Marking information:	
BSW	BeRex RF Switch
6550	The name of switch
YY	Year
WW	Work Week
XX	Wafer Run Number

Figure 31. Package Marking

Tape & Reel (TBD)



NOTES:
1 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2 CAMBER IN COMPLIANCE WITH EIA 481
3 POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET,NOT POCKET HOLE

Packaging information:	
Tape Width	12mm
Reel Size	7inch
Device Cavity Pitch	8mm
Device Per Reel	1000EA

Figure 32. Tape & Reel

Lead plating finish

100% Tin Matte finish

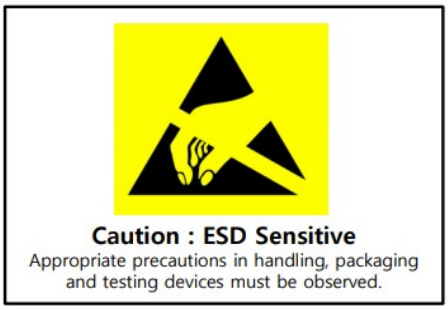
(All BeRex products undergoes a 1 hour, 150 degree C, Anneal bake to eliminate thin whisker growth concerns.)

ESD / MSL Rating

ESD information1 :	
Rating	**Class 1C** (1000V)
Test	Human Body Model (HBM)
Standard	JS-001-2017

ESD information2 :	
Rating	Class C3 (1000V)
Test	Charged Device Model (CDM)
Standard	JS-002-2018

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.

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 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