

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

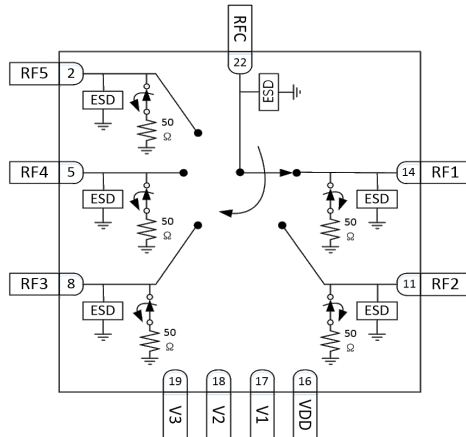


Figure 1. Functional Block Diagram

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
 - : 0.67dB @ 2GHz
 - : 0.90dB @ 4GHz
 - : 1.01dB @ 6GHz
- High Isolation
 - RFC to RFx
 - : 70dB @ 2GHz
 - : 59dB @ 4GHz
 - : 50dB @ 6GHz
 - RFx to RFx
 - : 61dB @ 2GHz
 - : 56dB @ 4GHz
 - : 54dB @ 6GHz
- High Input 1dB Compression
 - : 35.1dBm @ 2.35GHz
 - : 35.4dBm @ 3.5GHz
 - : 35.7dBm @ 5.75GHz
- High IIP3
 - : 64dBm @ 2.35GHz
 - : 63dBm @ 3.5GHz
 - : 63dBm @ 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 Mode¹(VDD = 5V, VSSEXT= 0V) or Bypass Mode²(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		0.59		dB
		2GHz		0.67		
		3GHz		0.82		
		4GHz		0.90		
		5GHz		0.91		
		6GHz		1.01		
		7GHz		1.44		
		8GHz		2.22		
		9GHz		2.42		
	RFC - RF2	1GHz		0.56		dB
		2GHz		0.65		
		3GHz		0.78		
		4GHz		0.83		
		5GHz		0.88		
		6GHz		0.99		
		7GHz		1.35		
		8GHz		2.13		
		9GHz		2.43		
	RFC - RF3	1GHz		0.56		dB
		2GHz		0.65		
		3GHz		0.78		
		4GHz		0.84		
		5GHz		0.87		
		6GHz		0.99		
		7GHz		1.36		
		8GHz		2.21		
		9GHz		2.53		
	RFC - RF4	1GHz		0.55		dB
		2GHz		0.64		
		3GHz		0.77		
		4GHz		0.82		
		5GHz		0.86		
		6GHz		0.94		
		7GHz		1.28		
		8GHz		2.06		
		9GHz		2.27		
	RFC - RF5	1GHz		0.58		dB
		2GHz		0.67		
		3GHz		0.79		
		4GHz		0.85		
		5GHz		0.87		
		6GHz		0.96		
		7GHz		1.25		
		8GHz		1.93		
		9GHz		2.24		

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		35.1 35.4 35.7		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 63 63		dBm
2 nd Harmonic ⁴	RFC - RFx	2.35GHz 3.5GHz 5.75GHz		97 100 95		dBc
3 rd 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. The each-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 Mode¹(VDD = 5V, VSSEXT= 0V) or Bypass Mode²(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	-	80	74	85	84	dB
	2GHz	-	70	68	77	72	
	3GHz	-	64	66	70	65	
	4GHz	-	59	65	63	58	
	5GHz	-	54	65	57	52	
	6GHz	-	50	58	51	48	
	7GHz	-	47	52	47	43	
	8GHz	-	44	48	43	39	
	9GHz	-	40	42	39	36	
RF2	1GHz	87	-	69	88	81	
	2GHz	80	-	64	76	71	
	3GHz	70	-	61	68	64	
	4GHz	62	-	61	62	57	
	5GHz	56	-	64	56	52	
	6GHz	51	-	69	51	47	
	7GHz	46	-	57	47	43	
	8GHz	43	-	49	43	39	
	9GHz	39	-	43	39	36	
RF3	1GHz	86	69	-	84	79	
	2GHz	77	64	-	77	70	
	3GHz	69	61	-	69	63	
	4GHz	62	60	-	63	57	
	5GHz	57	63	-	56	51	
	6GHz	52	76	-	50	47	
	7GHz	47	60	-	46	42	
	8GHz	44	52	-	42	39	
	9GHz	40	45	-	38	35	
RF4	1GHz	94	74	83	-	78	
	2GHz	82	68	72	-	69	
	3GHz	72	66	65	-	63	
	4GHz	64	64	60	-	56	
	5GHz	58	63	55	-	51	
	6GHz	53	58	51	-	46	
	7GHz	47	53	47	-	42	
	8GHz	44	49	44	-	38	
	9GHz	41	44	40	-	35	
RF5	1GHz	98	75	83	67	-	
	2GHz	87	69	73	62	-	
	3GHz	73	66	66	60	-	
	4GHz	65	64	61	59	-	
	5GHz	58	62	56	58	-	
	6GHz	53	56	52	56	-	
	7GHz	47	51	48	50	-	
	8GHz	44	47	44	45	-	
	9GHz	40	42	40	39	-	

Isolation Matrix

Typical conditions are Normal Mode¹(VDD = 5V, VSSEXT= 0V) or Bypass Mode²(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	-	67	87	74	69	dB
	2GHz	-	61	75	70	64	
	3GHz	-	58	67	68	62	
	4GHz	-	56	61	68	61	
	5GHz	-	55	56	69	62	
	6GHz	-	54	52	60	61	
	7GHz	-	53	47	52	52	
	8GHz	-	49	43	46	46	
	9GHz	-	46	39	42	40	
RF2	1GHz	68	-	78	73	68	
	2GHz	63	-	67	68	63	
	3GHz	61	-	59	66	61	
	4GHz	62	-	54	66	60	
	5GHz	65	-	49	68	61	
	6GHz	56	-	46	60	62	
	7GHz	49	-	42	53	53	
	8GHz	43	-	38	47	46	
	9GHz	39	-	35	42	41	
RF3	1GHz	73	77	-	67	67	
	2GHz	68	66	-	62	62	
	3GHz	67	59	-	60	60	
	4GHz	70	54	-	60	59	
	5GHz	80	49	-	59	62	
	6GHz	61	46	-	54	62	
	7GHz	53	42	-	48	52	
	8GHz	47	39	-	43	46	
	9GHz	42	35	-	39	40	
RF4	1GHz	74	85	67	-	64	
	2GHz	70	74	62	-	59	
	3GHz	70	66	59	-	57	
	4GHz	75	61	57	-	58	
	5GHz	74	56	56	-	64	
	6GHz	60	52	54	-	58	
	7GHz	52	47	51	-	48	
	8GHz	46	43	47	-	42	
	9GHz	42	39	42	-	37	
RF5	1GHz	76	86	74	82	-	
	2GHz	72	75	68	69	-	
	3GHz	71	68	65	60	-	
	4GHz	79	62	62	54	-	
	5GHz	70	57	60	49	-	
	6GHz	59	53	57	45	-	
	7GHz	52	48	53	41	-	
	8GHz	45	44	48	37	-	
	9GHz	41	40	44	34	-	

Product Description

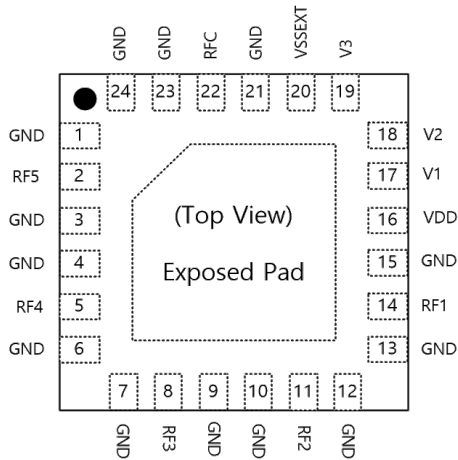


Figure 3. Pin Description

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)		V _{IH}	1.17	-	3.6	V
		V _{IL}	0	-	0.6	V
Digital Input Current (V1/V2/V3)		I _{CTRL}	-	-	10	uA
Operating Temperature Range		T _{OP}	-40	+25	+125	°C
RF Input Power, CW (Active Port, +25°C)		P _{Max,Act_+25°C}	-	-	31	dBm
RF Input Power, CW (Active Port, +125°C)		P _{Max,Act_+125°C}	-	-	31	dBm
RF Input Power, CW (Terminated Port, +25°C)		P _{Max,Term_+25°C}	-	-	27	dBm
RF Input Power, CW (Terminated Port, +125°C)		P _{Max,Term_+125°C}	-	-	24	dBm

* Specifications are not guaranteed over all recommended operating conditions.

1. Normal Mode : Single external positive supply voltage(VDD) is inputted.

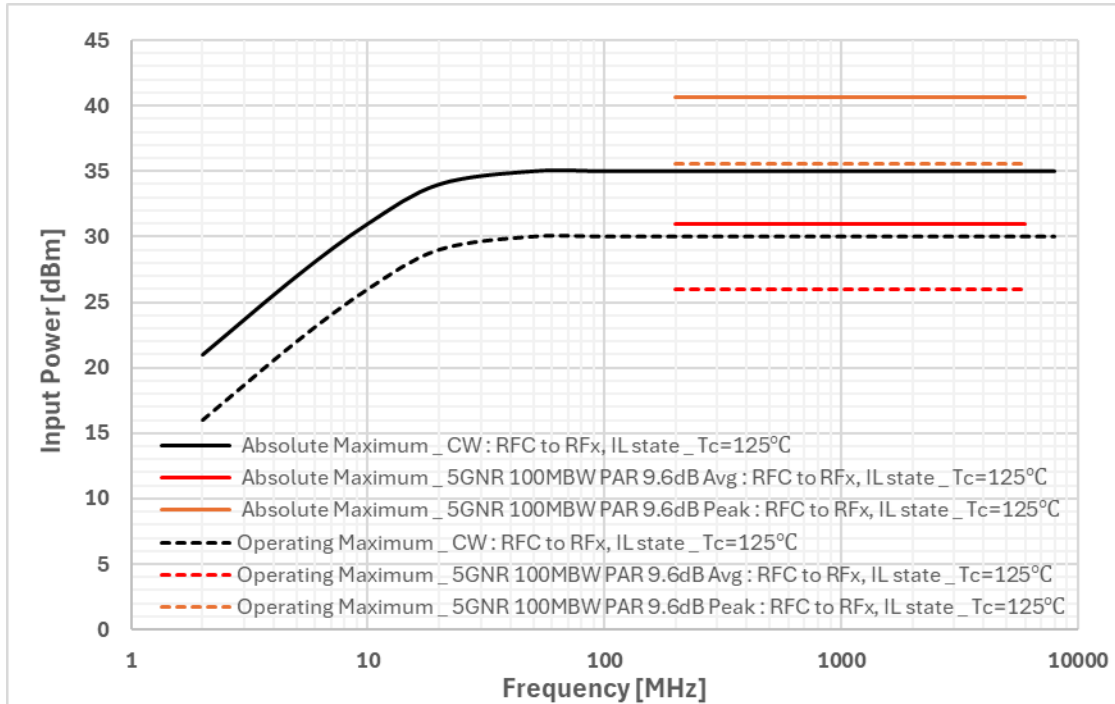
2. Bypass Mode : Both external positive supply voltage(VDD) and external negative voltage(VSSEXT) are inputted.

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°C}	-	35	dBm
Maximum Input Power, CW (+125°C)			P _{Max,Abs_+125°C}	-	33	dBm
Storage Temperature range			T _{ST}	-65	+150	°C
ESD	HBM	All pins	V _{ESDHBM}	-	1000	V
	CDM	All pins	V _{ESDCDM}	-	1000	V

1. HBM Standard : JEDEC Standard JS-001-2017

2. CDM Standard : JEDEC Standard JS-002-2018

Figure 4. Power De-rating Curve


Typical Performances

Typical conditions are Normal mode, VDD = 5V, $T_A = 25^\circ\text{C}$, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, $Z_L = 50\Omega$, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Figure 5. Insertion Loss vs Frequency

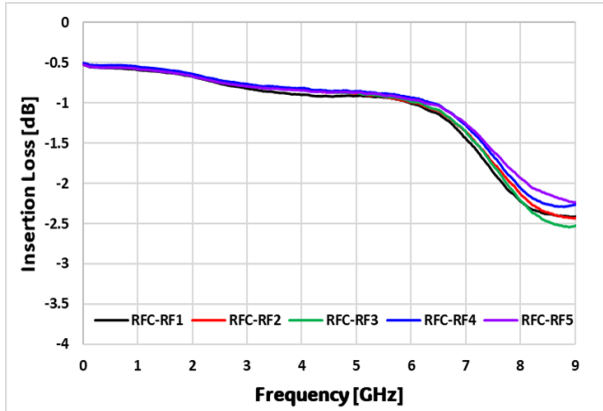


Figure 6. Insertion Loss vs VDD (RFC-RF1)

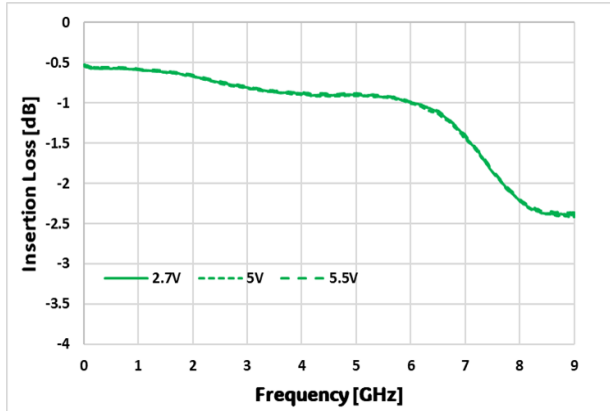


Figure 7. Insertion Loss vs Temp (RFC-RF1)

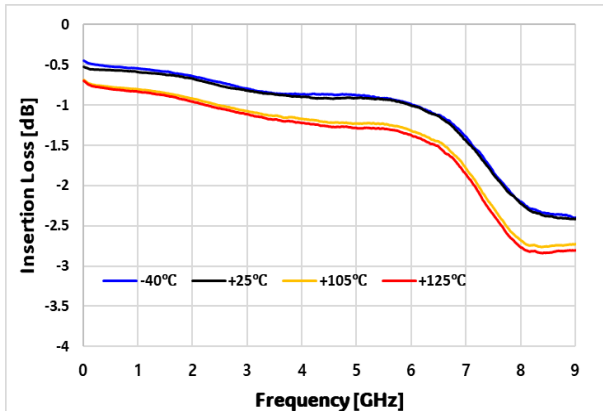


Figure 8. Return Loss vs Frequency (RFC Port)

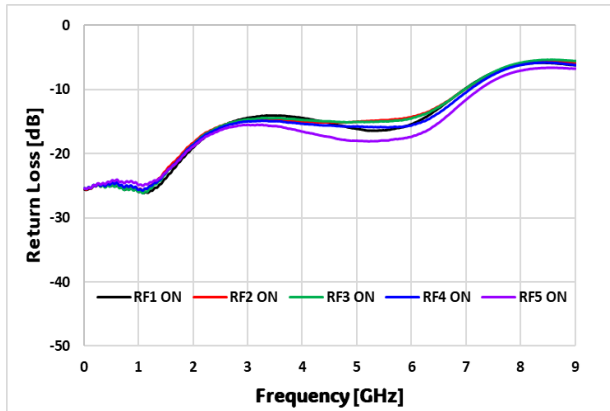


Figure 9. Return Loss vs VDD (RFC Port)

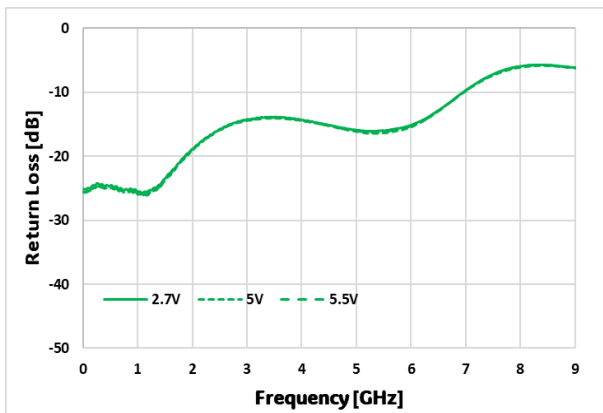
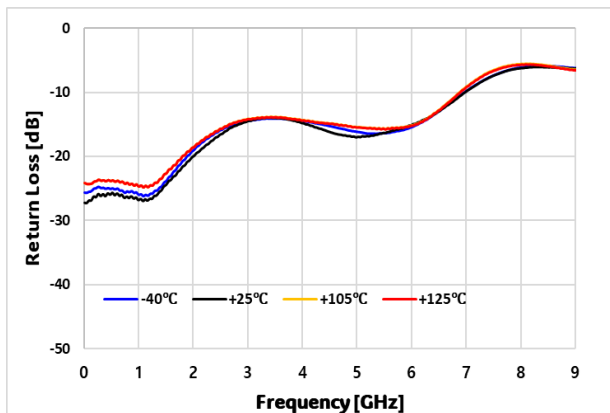


Figure 10. Return Loss vs Temp (RFC Port)



Typical Performances

Typical conditions are Normal mode, VDD = 5V, $T_A = 25^\circ\text{C}$, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, $Z_L = 50\Omega$, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Figure 11. Return Loss vs Frequency (Active Port)

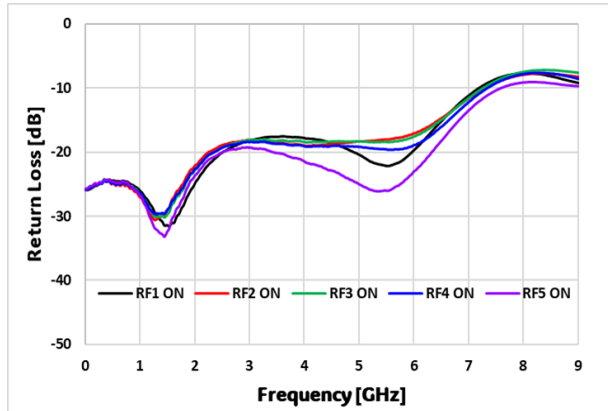


Figure 12. Return Loss vs VDD (Active Port)

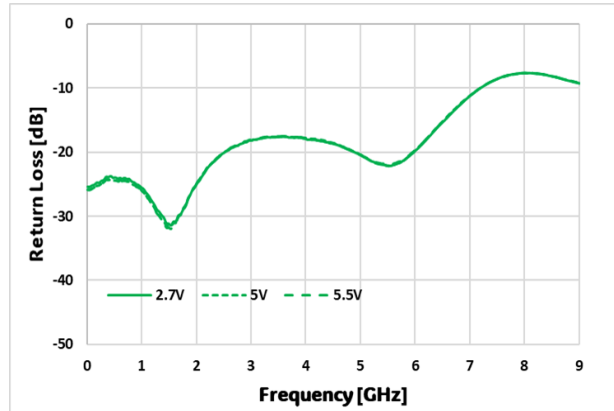


Figure 13. Return Loss vs Temp (Active Port)

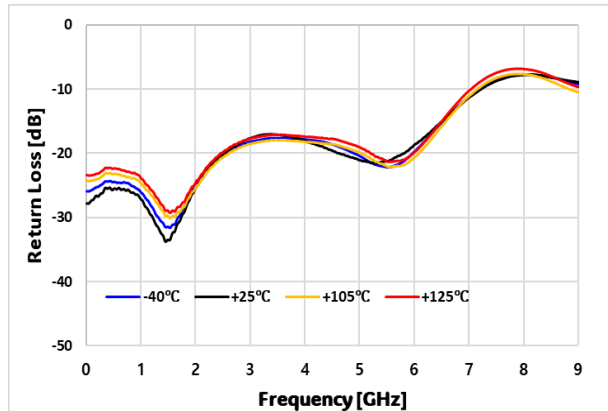


Figure 14. Return Loss vs Frequency (Terminated Port)

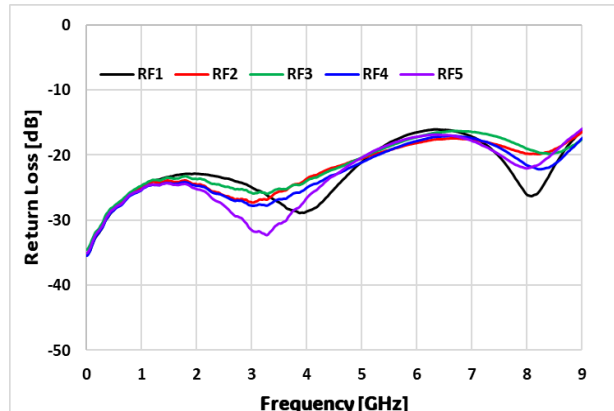


Figure 15. Return Loss vs VDD (Terminated Port)

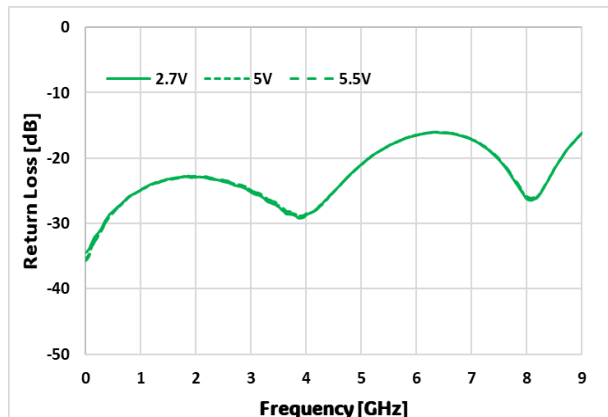
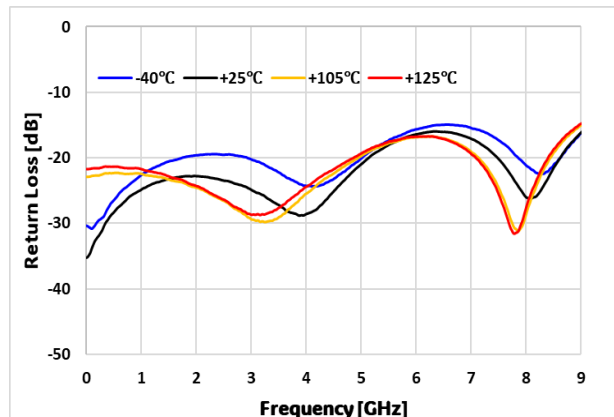


Figure 16. Return Loss vs Temp (Terminated Port)



Typical Performances

Typical conditions are Normal mode, VDD = 5V, $T_A = 25^\circ\text{C}$, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, $Z_L = 50\Omega$, PCB and RF Connector loss are de-embedded, unless otherwise noted.

Figure 17. Isolation vs Frequency (RFC to RFx)

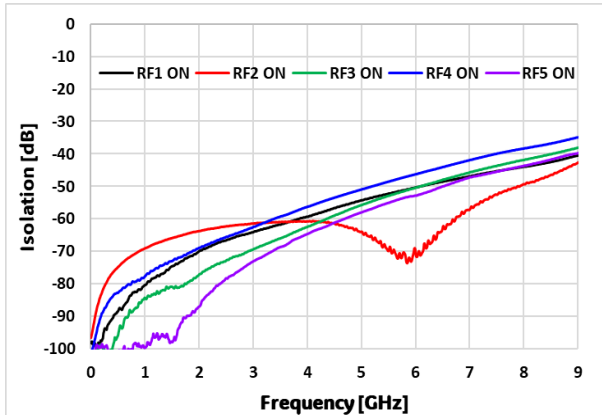


Figure 18. Isolation vs Frequency (RFC to RFx, RF1 ON)

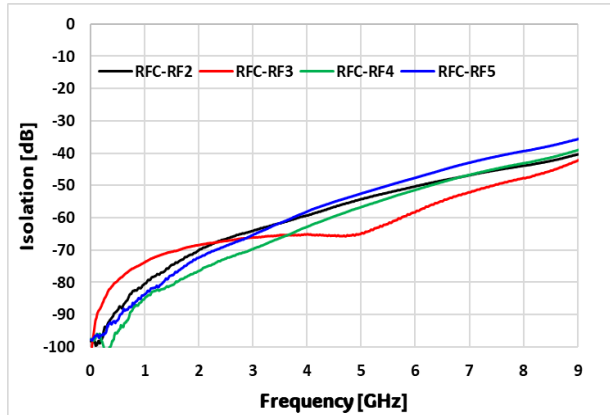


Figure 19. Isolation vs VDD (RFC to RF1, RF2 ON)

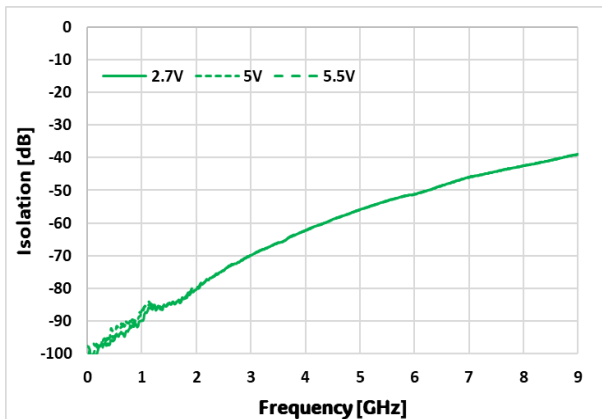


Figure 20. Isolation vs Temp (RFC to RF3, RF1 ON)

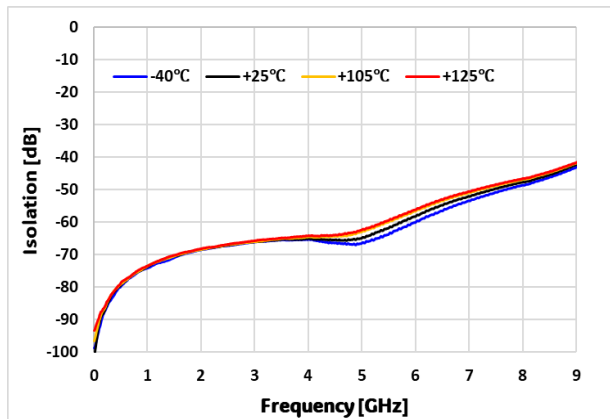


Figure 21. Isolation vs Frequency (RFx to RFx)

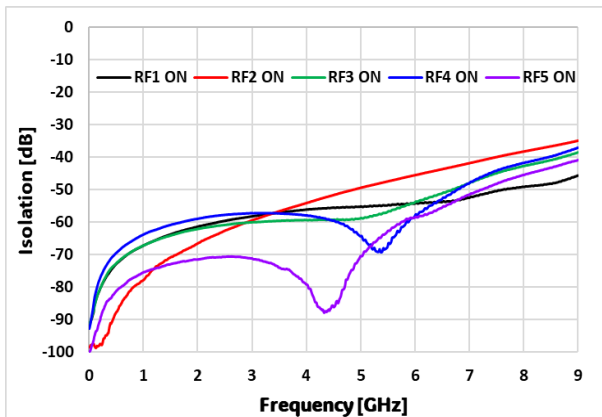
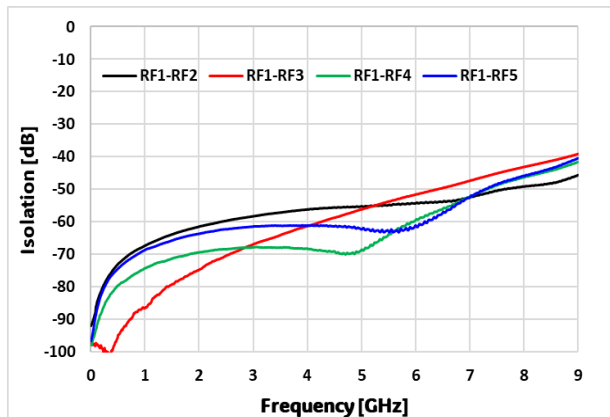


Figure 22. Isolation vs Frequency (RF1 to RFx, RF1 ON)



Typical Performances

Typical conditions are Normal mode, VDD = 5V, $T_A = 25^\circ\text{C}$, V1/V2/V3 Low = 0V, V1/V2/V3 High = 3.3V, $Z_L = 50\Omega$, PCB and RF Connector loss are de-embedded, unless otherwise noted.

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

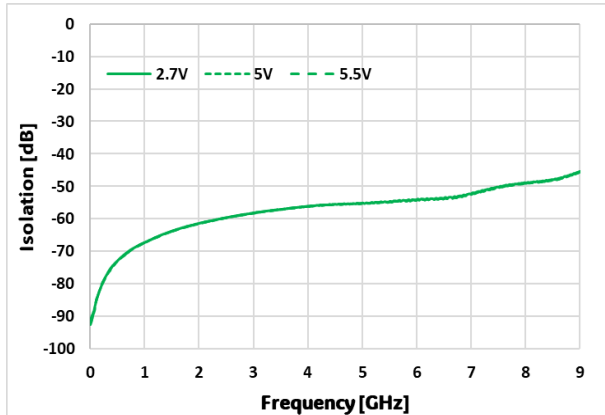


Figure 24. Isolation vs Temp (RF1 to RF2, RF1 ON)

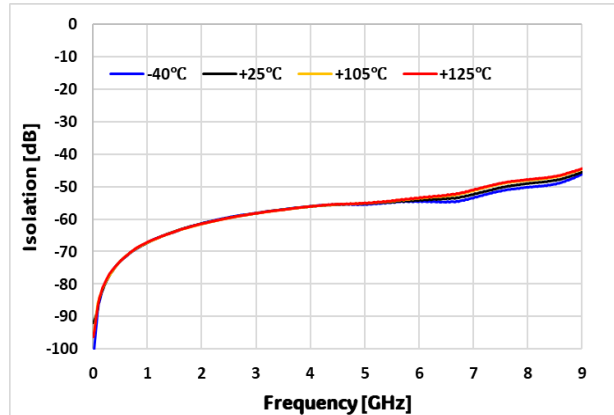


Figure 25. IIP3 vs RF Port

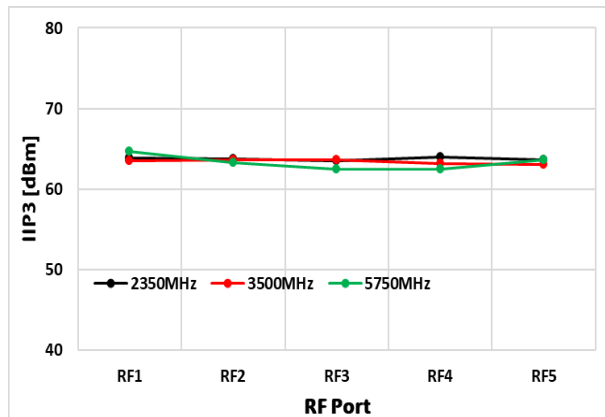
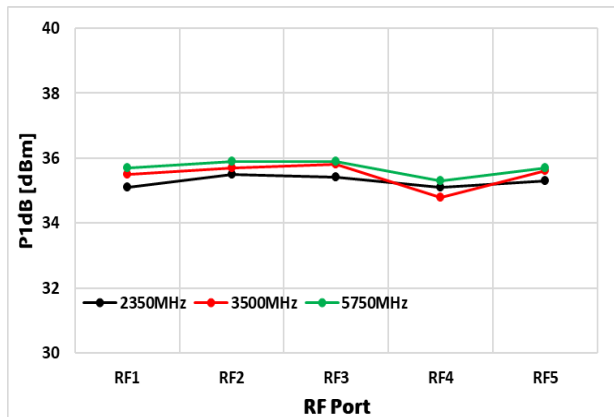


Figure 26. P1dB vs RF Port



Evaluation Board

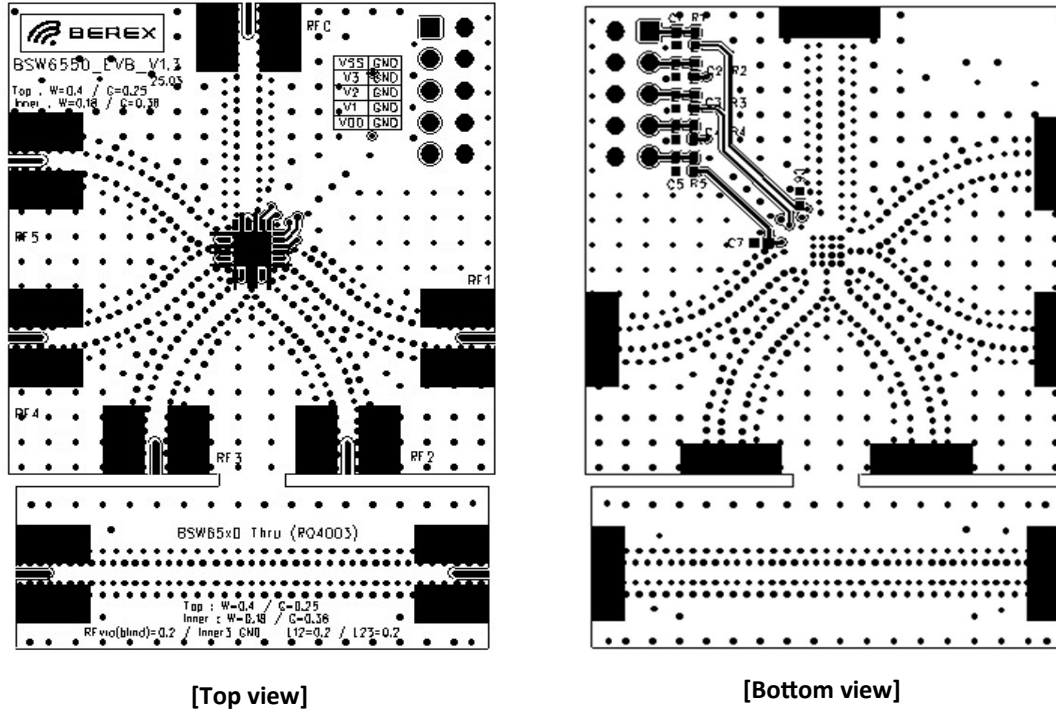


Figure 27. Evaluation Board Layout

	COPPER : 1oz (0.035mm), Top Layer	FINISH THICKNESS : 1.64T
RO4003C Er : 3.38	RO4003C / 0.2mm	
	COPPER : 1oz (0.035mm), Inner 1 Layer	
RO4450T Er : 3.35	RO4450T / 0.2mm	
	COPPER : 1oz (0.035mm), Inner 2 Layer	
FR-4 Er : 4.5~4.8	FR-4 / 1.1mm	
	COPPER : 1oz (0.035mm), Bottom Layer	

Figure 28. Evaluation Board PCB Layer Information

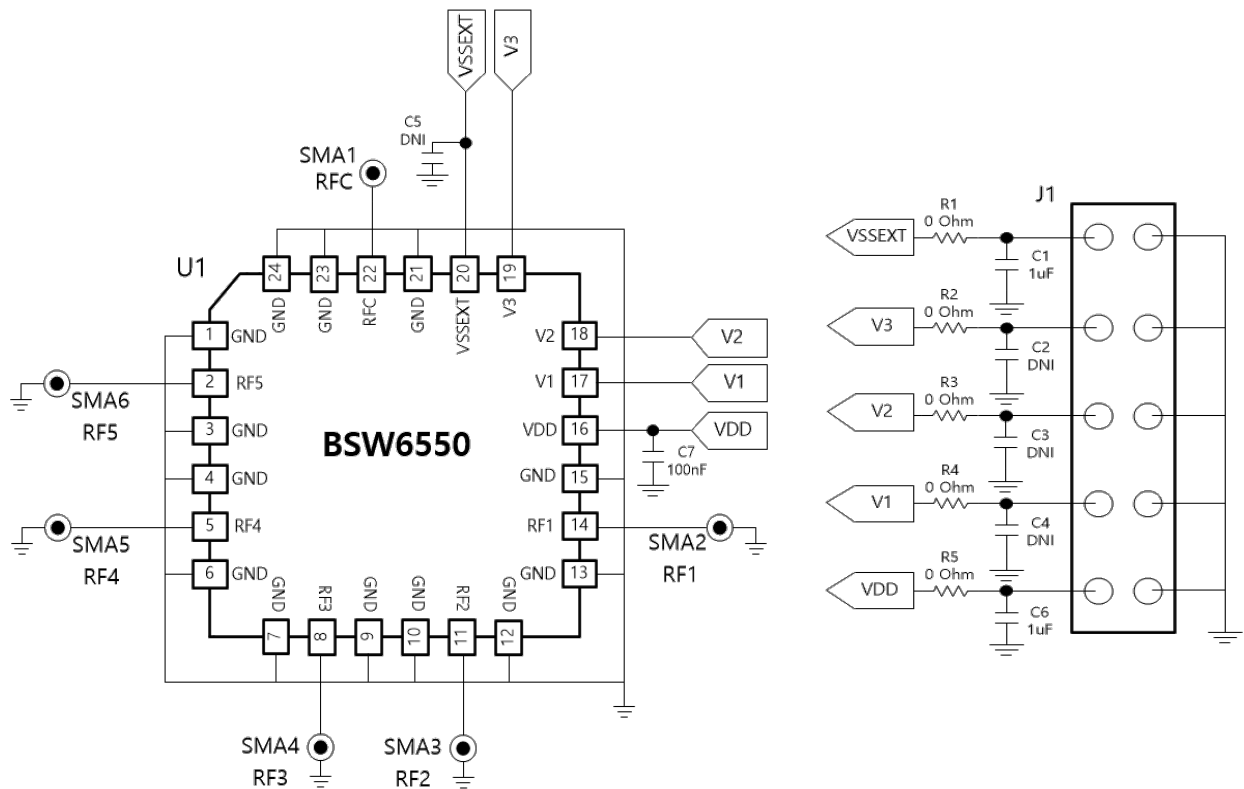


Figure 29. Evaluation Board Schematic

Table 8. Bill of Material - Evaluation Board

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

Package Outline Drawing

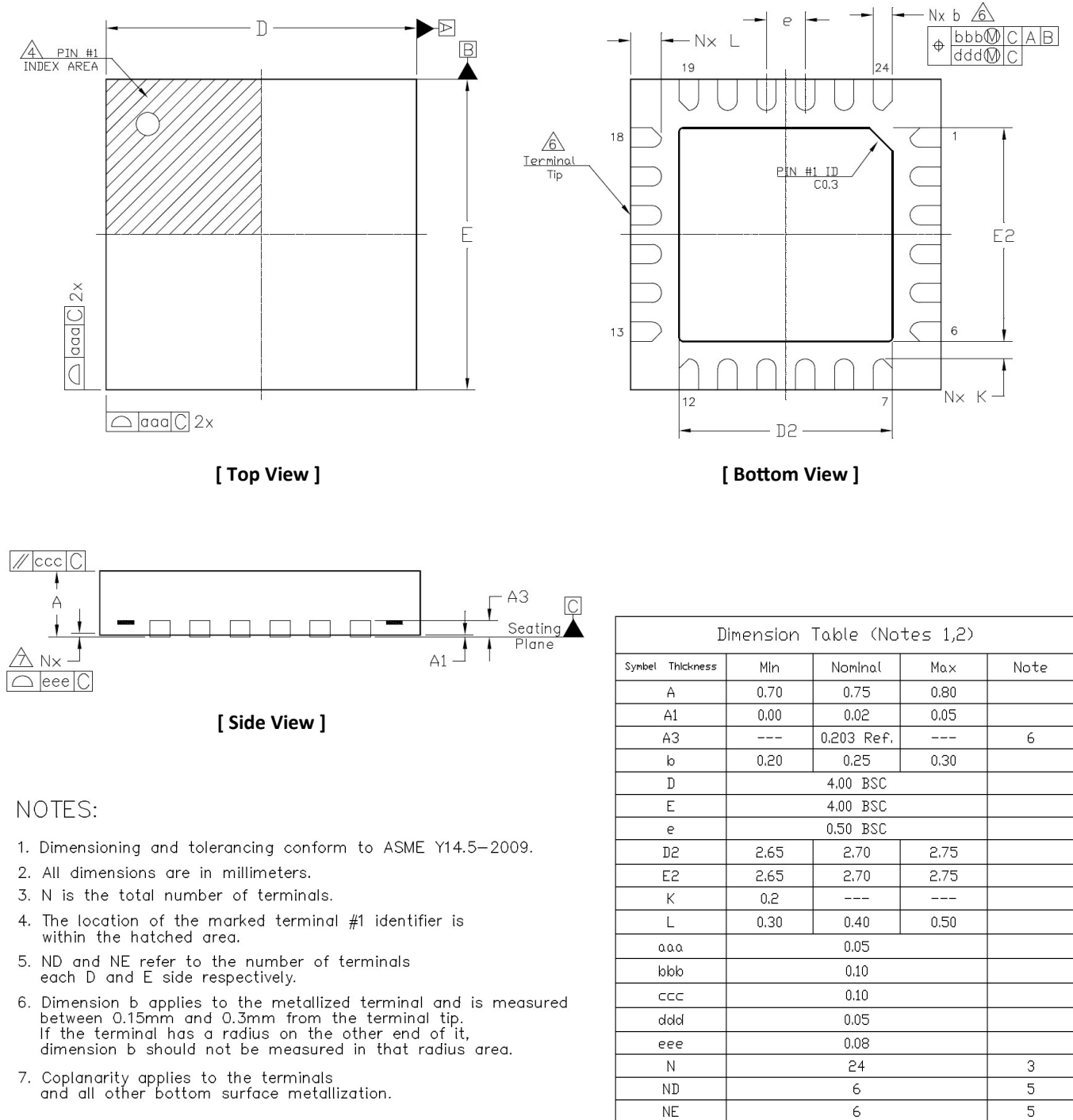


Figure 30. Package Outline Drawing

Recommended Land Pattern

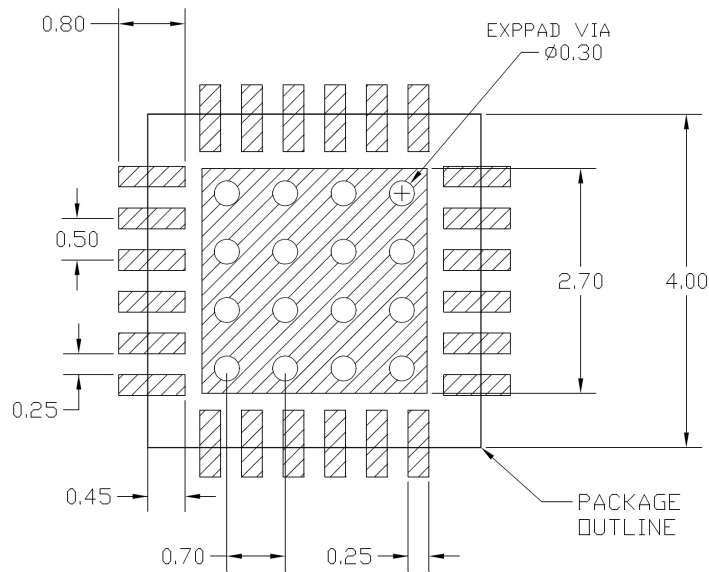


Figure 31. Recommended Land Pattern

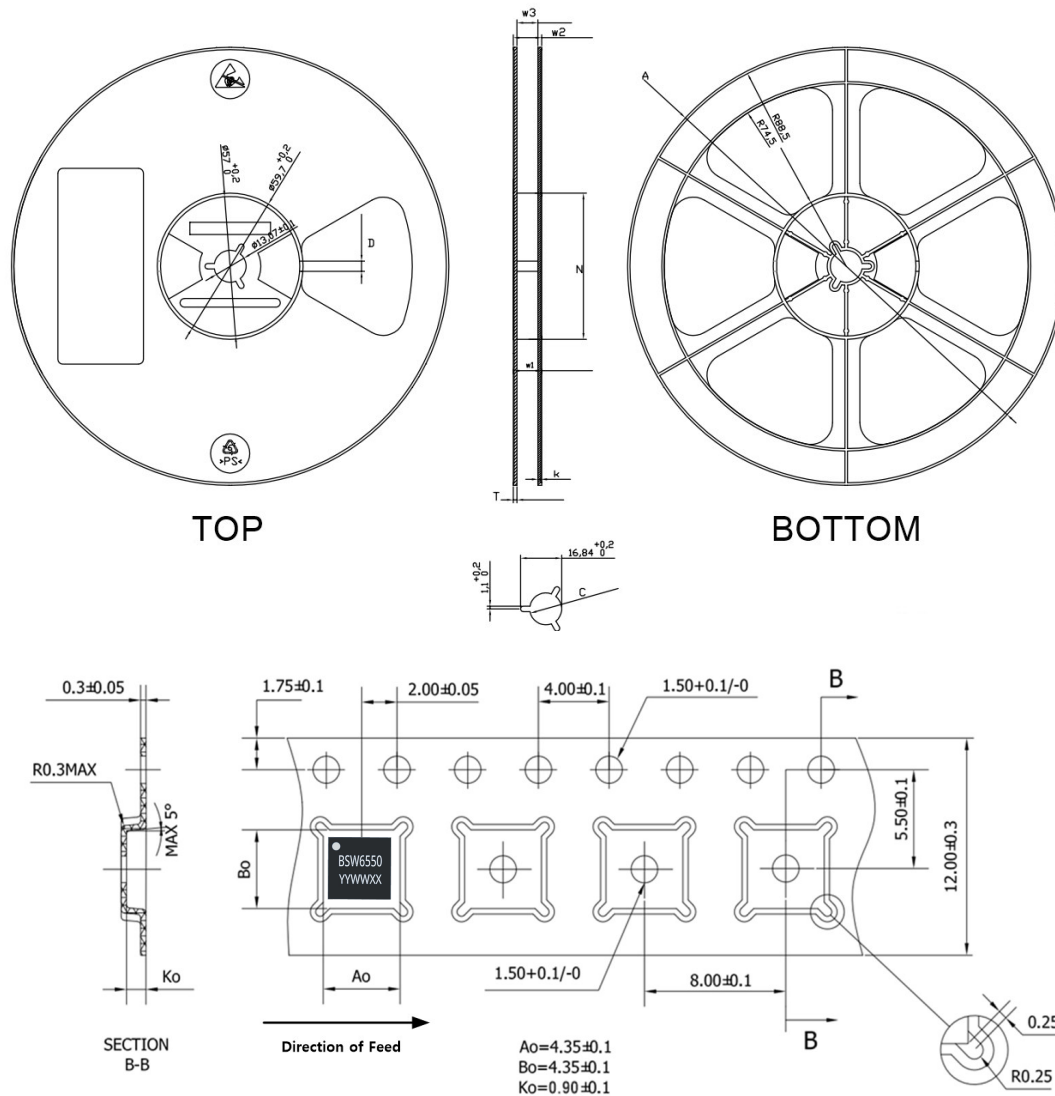
Package Marking



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

Figure 32. 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 33. Tape & Reel

Lead plating finish

100% Tin Matte finish

(All BeRex products undergo a 1 hour, 150°C, anneal bake to eliminate thin whisker growth concerns.)

ESD / MSL Rating

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

ESD information2 :	
Rating	Class C3 (1000V)
Test	Charged Device Model (CDM)
Standard	JEDEC 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
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