LTCC SURFACE MOUNT

90° Hybrid

HPCJ-03-222+

50Ω 1.7 to 2.2 GHz 3 dB

THE BIG DEAL

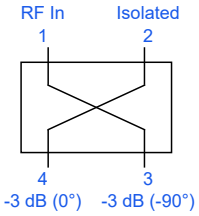
- Robust 50 W continuous wave (CW) power handling
- 1.7 – 2.2 GHz coverage
- Low insertion loss and excellent port balance
- Compact, integration-ready footprint

Generic photo used for illustration purposes only

APPLICATIONS

- Base stations and repeaters
- Power amplifier combining
- DAS and small cell deployments
- RF signal monitoring

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

Mini-Circuits' Model HPCJ-03-222+ is a high-power, 3 dB, 90° hybrid splitter/combiner that delivers reliable performance across the 1.7 – 2.2 GHz band, making it ideal for cellular infrastructure, DAS, test environments, and communication platforms. With 50 W CW power handling capability and excellent signal balance, it provides robust and precise splitting and combining for demanding RF chains. Its compact footprint and stable performance make it a dependable choice for modern broadband designs.

KEY FEATURES

Features	Advantages
High power handling, 50 W maximum	Supports robust operation in medium to high-power transmit chains and multi-carrier systems.
Low phase unbalance, ± 2° from 90°	Improved combining efficiency and higher cancellation of odd-order harmonic distortion products.
Low amplitude unbalance, ±0.8 dB	Ensures consistent signal integrity, superior power distribution and optimized efficiency for next-generation networks.
High isolation between output ports	Minimized signal leakage and enhanced performance in multi-path and multi-channel systems.
Splitter or combiner operation	Flexible use in power amplifier combining, antenna feed networks, and signal distribution stages.

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ELECTRICAL SPECIFICATIONS[1,2] AT +25°C, Z_0 = 50Ω

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Units
Frequency Range		1700	-	2200	MHz
Average Insertion Loss (above 3 dB)[3]	1700-2200	-	0.25	0.28	dB
	1805-1880	-	0.18	-	
	1930-1990	-	0.20	-	
	2110-2200	-	0.25	-	
Isolation	1700-2200	20	23	-	dB
	1805-1880	-	28	-	
	1930-1990	-	28	-	
	2110-2200	-	23	-	
Phase Unbalance (±) (Relative to 90°)	1700-2200	-	2	4	Degree
	1805-1880	-	2	-	
	1930-1990	-	2	-	
	2110-2200	-	2	-	
Amplitude Unbalance (±)	1700-2200	-	0.6	0.7	dB
	1805-1880	-	0.35	-	
	1930-1990	-	0.30	-	
	2110-2200	-	0.30	-	
Return Loss (Input, -3 dB (0°), -3 dB (-90°), Isolated)	1700-2200	20	21	-	dB
	1805-1880	-	26	-	
	1930-1990	-	25	-	
	2110-2200	-	20	-	

1. Tested on Evaluation Board TB-HPCJ-03222C+. De-embedded to the device reference plane using TRL.
2. Symmetrical, all ports are interchangeable. See Pad Description table and S-parameters for actual performance.
3. See Page 3 for insertion loss data vs. frequency

ABSOLUTE MAXIMUM RATINGS[4]

Parameter	Ratings
Operating Temperature	-55 °C to +125 °C
Storage Temperature	-55 °C to +125 °C
Input Power as a splitter[5]	50 W at +25 °C

4. Permanent damage may occur if any of these limits are exceeded.
5. At +25°C derate linearly to 7.3 W at +125 °C.

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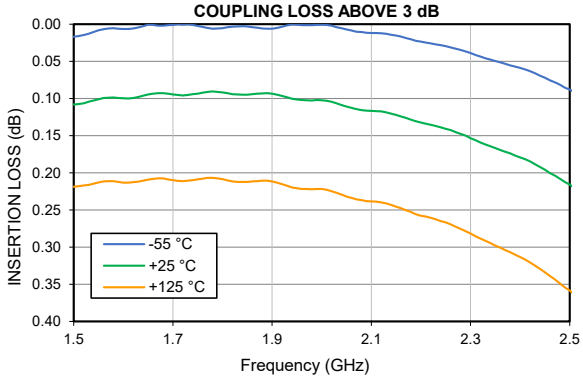
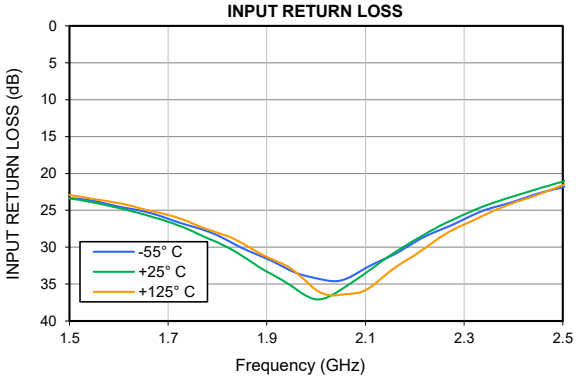
TYPICAL PERFORMANCE GRAPHS

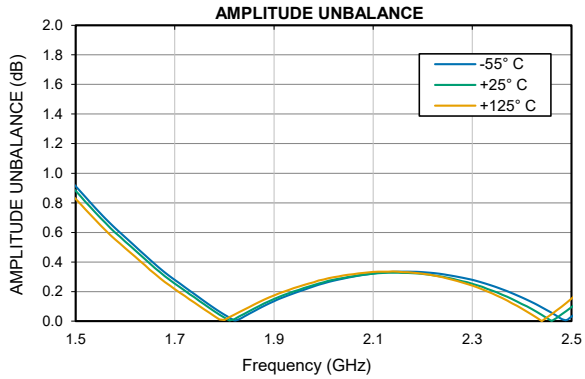
COUPLING LOSS ABOVE 3 dB



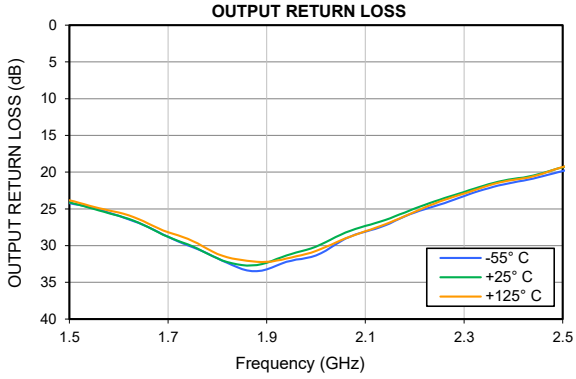
INPUT RETURN LOSS



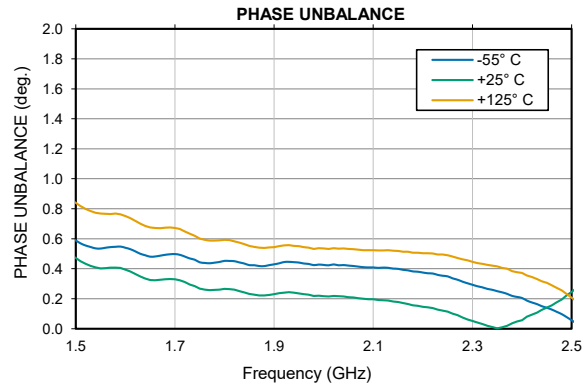
AMPLITUDE UNBALANCE



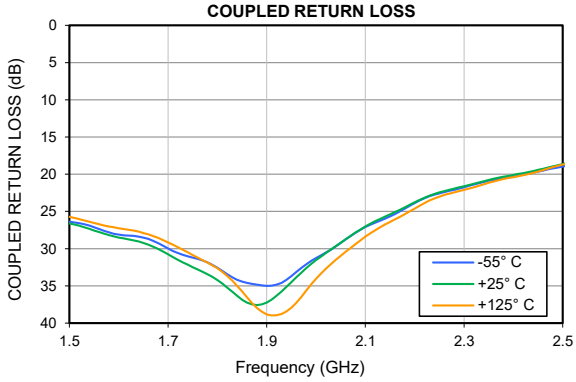
OUTPUT RETURN LOSS



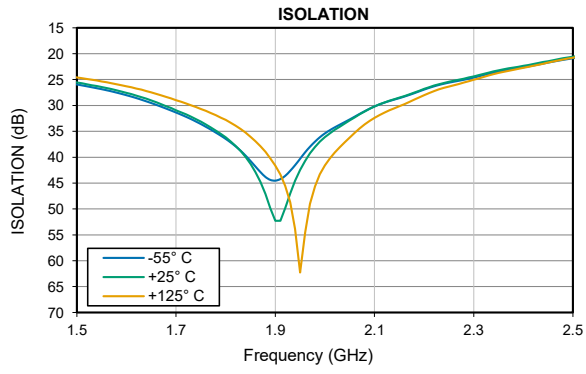
PHASE UNBALANCE



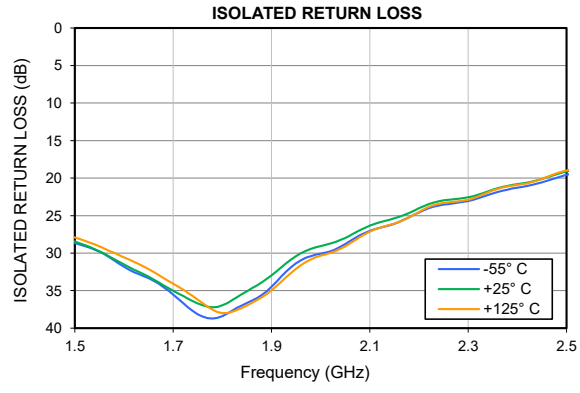
COUPLED RETURN LOSS



ISOLATION



ISOLATED RETURN LOSS



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FUNCTIONAL DIAGRAM

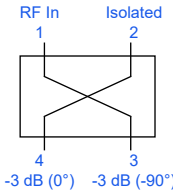
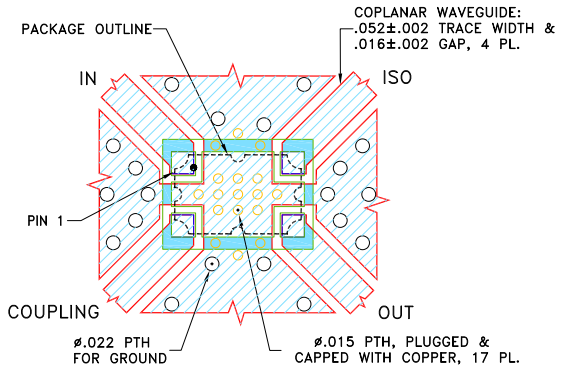


Figure 1. HPCJ-03-222+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description
RF Input	1	Connects to RF Input Port
Isolated	2	Connects to Isolated Port
-3 dB (-90°)	3	Connects to Quadrature Port
-3 dB (0°)	4	Connects to In-Phase Port

SUGGESTED PCB LAYOUT (PL-856)



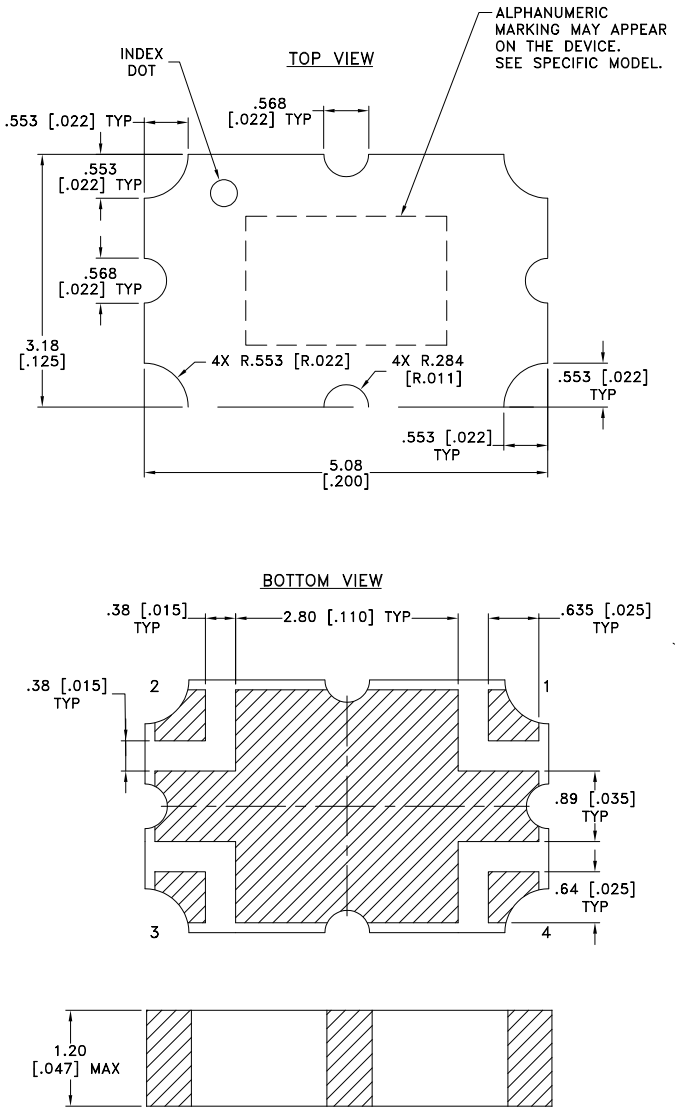
NOTES:
1. TRACE WIDTH & GAP ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS: .030±.002; COPPER: 1/2 OZ. ON EACH SIDE.
FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

Figure 2. Suggested PCB Layout PL-856

CASE STYLE DRAWING



DENOTES METALLIZATION

Weight: 0.049 grams
Dimensions are in mm [inches]. Tolerances: 2 Pl.±.025; 3 Pl. ±.0.127 mm

PRODUCT MARKING*: N/A

*Marking may contain other features or characters for internal lot control.

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD. CLICK HERE

Performance Data & Graphs	Data Graphs S-Parameter (S4P Files) Data Set (.zip file) De-embedded to device pads
Case Style	AAE3610-2 Lead Finish: Tin over Nickel Plating
RoHS Status	Compliant
Tape and Reel	F110
Suggested Layout for PCB Design	PL-856
Evaluation Board	TB-HPCJ-03222C+ Gerber File
Environmental Rating	ENV06T10

NOTES

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.

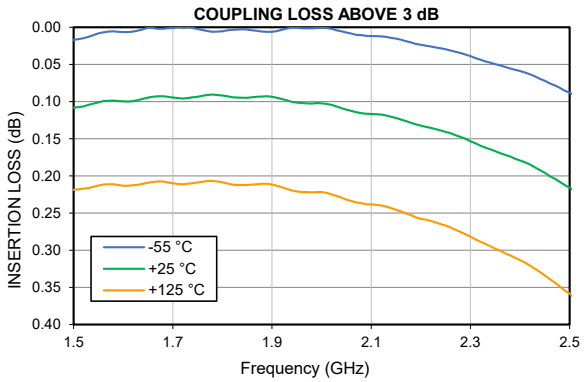
C. The parts covered by this specification document are subject to Mini-Circuits' standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html

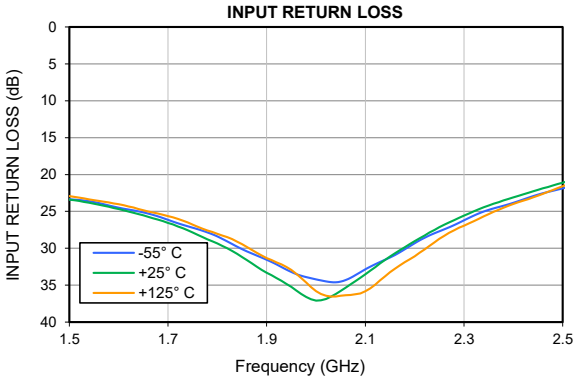
Directional Coupler HPCJ-03-222+

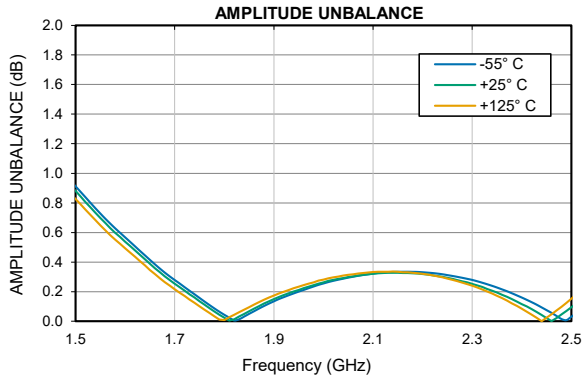
Typical Performance Data

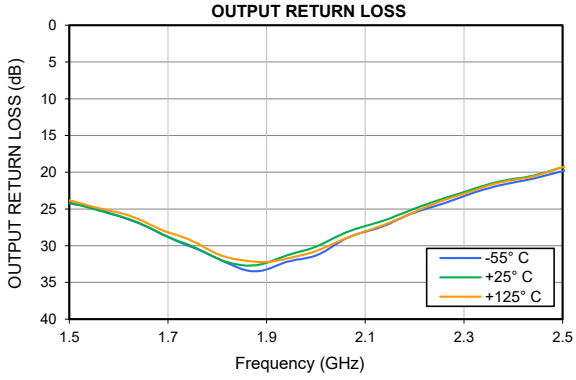
FREQUENCY (GHz)	AVERAGE INSERTION LOSS (dB)	AMPLITUDE UNBALANCE (dB)	PHASE UNBALANCE (dB)	ISOLATION (dB)	INPUT RETURN LOSS (dB)	OUTPUT RETURN LOSS (dB)	COUPLED RETURN LOSS (dB)	ISOLATED RETURN LOSS (dB)
0.20	0.048	16.612	1.115	29.068	26.491	26.056	27.591	27.344
0.40	0.095	10.734	1.465	23.777	21.949	21.319	23.157	23.036
0.60	0.135	7.411	1.559	21.510	19.723	19.366	20.880	21.057
0.80	0.149	5.164	1.384	20.928	18.961	18.608	20.019	20.409
1.00	0.141	3.515	1.066	21.536	19.637	19.257	20.907	21.275
1.10	0.136	2.841	0.937	21.986	20.297	19.960	21.960	22.186
1.20	0.132	2.250	0.825	22.473	20.934	20.701	23.111	23.256
1.30	0.125	1.731	0.700	23.215	21.510	21.636	24.297	24.498
1.40	0.116	1.276	0.583	24.164	22.369	22.895	25.096	25.804
1.50	0.108	0.880	0.471	25.552	23.394	24.133	26.605	28.458
1.60	0.100	0.538	0.394	27.561	24.685	25.944	28.508	31.513
1.70	0.095	0.254	0.329	30.916	26.549	28.807	30.764	35.008
1.80	0.092	0.023	0.266	36.188	29.348	31.738	34.206	36.951
1.90	0.093	0.149	0.230	52.260	33.312	32.329	37.237	32.961
2.00	0.102	0.263	0.217	36.111	37.092	30.130	31.536	29.049
2.10	0.117	0.321	0.197	30.192	33.520	27.329	27.020	26.337
2.20	0.132	0.319	0.147	26.811	29.042	24.958	23.778	24.021
2.30	0.153	0.253	0.052	24.371	25.566	22.694	21.611	22.568
2.40	0.179	0.116	0.057	22.355	23.106	20.921	20.096	20.796
2.50	0.216	0.095	0.245	20.580	21.098	19.332	18.649	19.107
2.60	0.271	0.387	0.549	18.935	19.045	17.563	17.269	17.628
2.70	0.343	0.778	1.031	17.402	17.080	15.905	15.814	16.141
2.80	0.438	1.267	1.804	16.061	15.205	14.387	14.160	14.495
3.00	0.724	2.534	4.782	13.966	11.754	11.291	11.072	11.627
3.20	1.105	4.121	10.398	12.762	9.219	8.995	8.738	9.449
3.40	1.569	5.955	19.051	12.187	7.282	7.229	7.425	7.809
3.60	1.994	8.125	30.244	12.511	6.006	5.972	6.777	6.862
3.80	2.159	11.188	43.693	13.538	5.434	5.546	6.705	6.728
4.00	1.918	17.474	82.714	16.835	5.507	6.008	8.075	8.083
4.20	1.246	11.434	11.965	29.730	7.617	8.677	14.974	13.601
4.40	0.772	4.229	6.258	16.756	11.573	13.422	17.796	13.302
4.60	0.821	0.657	11.790	12.046	10.868	12.301	9.931	7.978
4.80	0.942	1.025	16.642	10.438	8.591	10.677	7.629	5.693
5.00	0.881	1.728	18.168	9.240	6.956	10.416	6.075	4.190
5.20	0.509	2.346	16.122	7.164	5.570	10.668	4.684	2.411
5.40	0.268	3.570	15.818	6.996	6.582	10.678	3.526	2.745
5.60	1.106	4.800	25.350	8.158	7.651	10.250	2.490	3.835
5.80	0.008	3.272	36.885	8.958	7.235	10.398	3.426	4.950
6.00	1.140	1.027	33.966	8.872	6.973	9.597	4.499	4.963
6.20	1.794	0.438	25.484	8.963	6.453	8.406	4.780	4.528
6.40	2.336	1.497	15.997	9.118	5.643	7.354	4.704	4.160
6.60	2.818	2.280	5.587	9.143	4.782	6.349	4.497	3.937
6.80	3.075	2.705	5.398	9.201	4.363	5.901	4.463	3.867
7.00	3.215	2.638	16.750	9.100	4.427	5.566	4.537	3.915
7.20	3.292	2.314	26.431	8.956	4.610	5.552	4.701	4.363
7.40	3.333	1.820	33.005	8.752	4.668	5.736	5.345	4.989
7.60	3.378	1.224	37.218	8.306	4.593	5.771	6.365	5.937
7.80	3.561	0.642	39.241	7.732	4.538	5.829	7.382	6.959
8.00	4.043	0.041	37.803	7.256	4.485	5.516	8.014	7.989
8.20	4.740	0.398	31.376	6.889	4.180	4.749	7.927	8.318
8.40	5.534	0.162	18.282	6.690	3.742	4.286	6.923	7.581
8.60	6.042	2.535	1.982	6.603	3.342	3.884	5.745	6.375
8.80	5.837	7.508	9.018	6.747	3.558	4.046	4.529	5.061
9.00	4.830	16.482	9.187	7.060	4.724	5.099	3.438	4.070
9.20	3.714	24.341	50.773	7.346	6.582	6.645	2.641	3.461
9.40	3.000	13.084	29.414	7.412	8.868	8.397	2.346	3.460
9.60	2.755	8.416	24.627	7.018	12.123	9.284	2.437	3.759
9.80	3.047	5.050	23.208	6.257	14.333	8.105	2.819	4.537
10.00	3.891	1.796	25.927	5.513	11.009	5.914	2.944	5.116

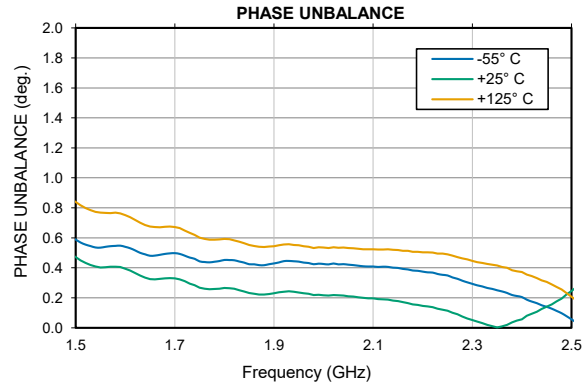
Typical Performance Curves

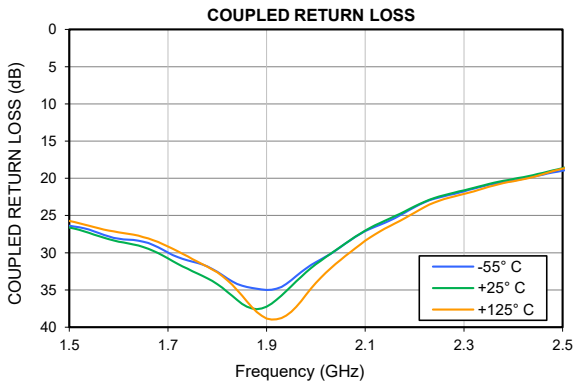


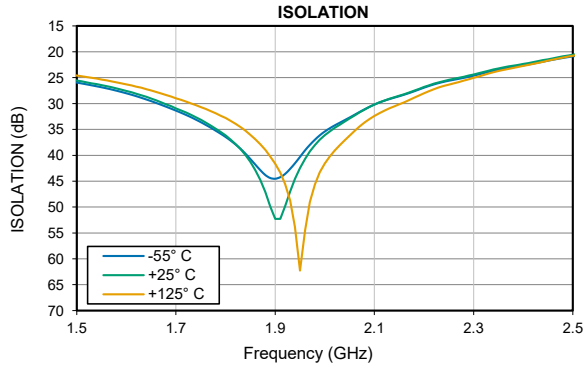


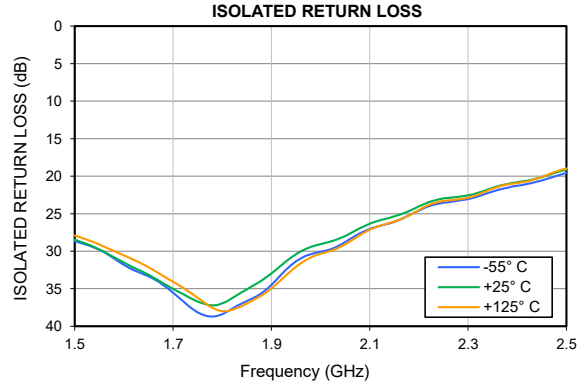






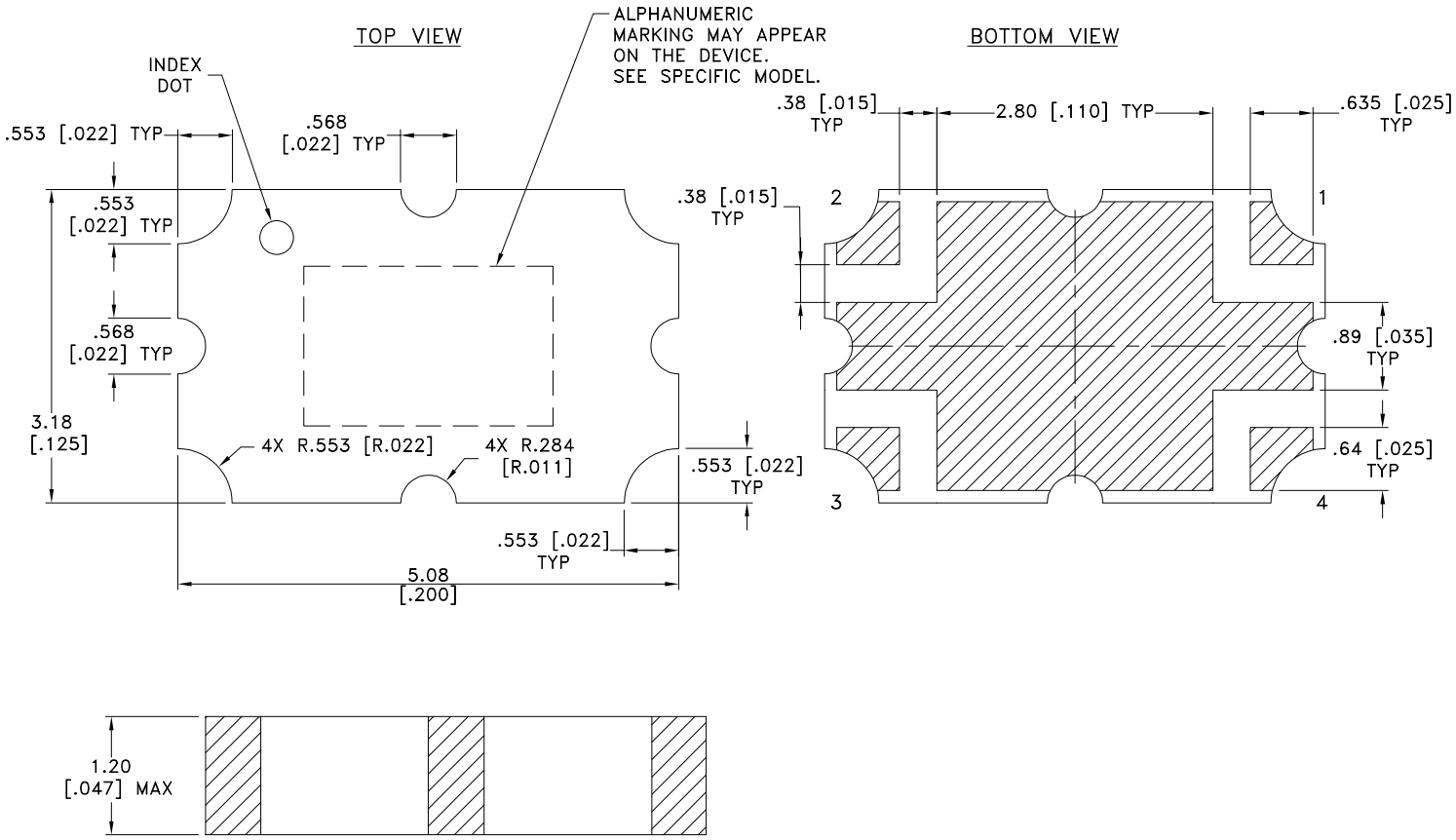






Case Style AAE

Outline Dimensions AAE3610-2



Weight: 0.049 grams

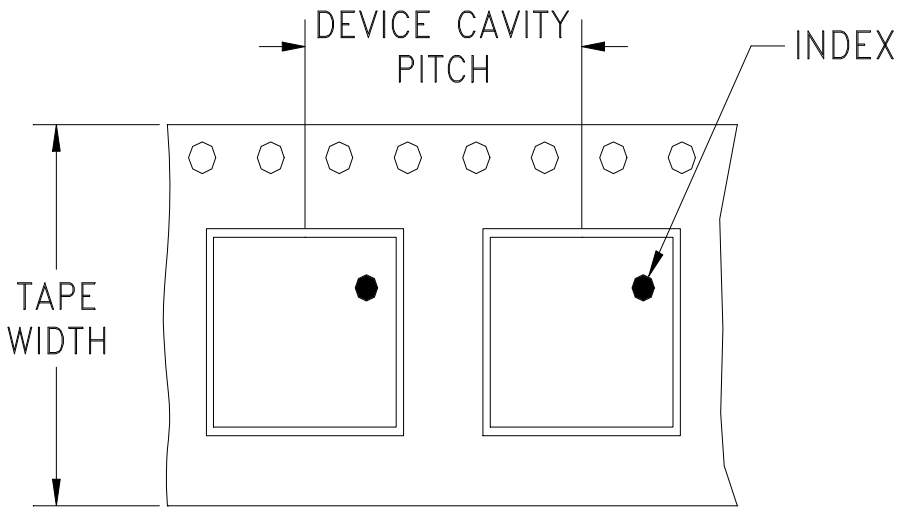
Dimensions are in mm [inches]. Tolerances: 2 PL ± 0.25; 3 Pl.± 0.127 mm

Notes:

1. Case material - Ceramic.
2. Termination finish - Tin over Nickel Plating.

Tape & Reel Packaging TR-F110

DEVICE ORIENTATION IN T&R



DIRECTION OF FEED

Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
12	8	7	Small quantity standard (see note)	20
				50
				100
				200
				500
		13	Standard (see note)	1000
				2000
				3000

Note: Please consult individual model datasheet to determine device per reel availability

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

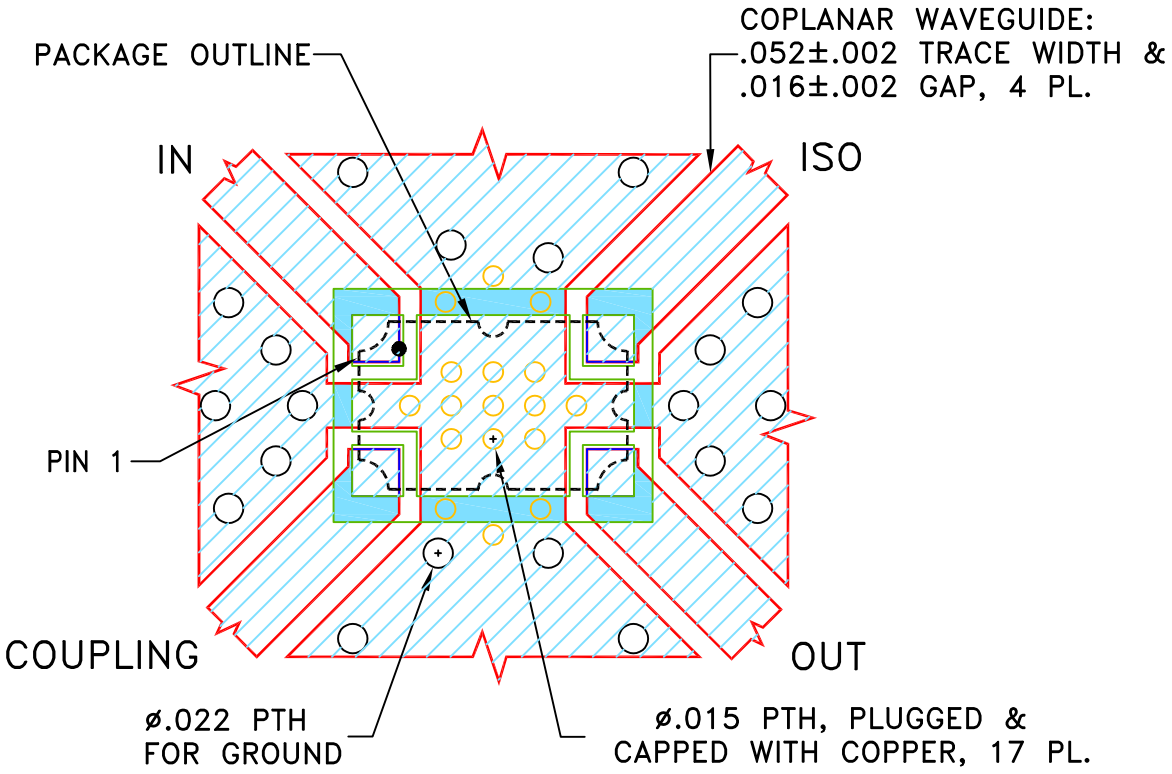
Go to: www.minicircuits.com/pages/pdfs/tape.pdf

Mini-Circuits®
INTERNET http://www.minicircuits.com
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010
Mini-Circuits ISO 9001 & ISO 14001 Certified

THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-028610	NEW RELEASE	02/24/26	ITG	IL

SUGGESTED MOUNTING CONFIGURATION FOR AAE3610-2 CASE STYLE



NOTES:

1. TRACE WIDTH & GAP ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS: .030±.002; COPPER: 1/2 OZ. ON EACH SIDE.
   FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	ITG	02/24/26
TOLERANCES ON:	CHECKED	np	02/24/26
2 PL DECIMALS ±	APPROVED	IL	02/24/26
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

Mini-Circuits®

ASHEETA1.DWG REV:A DATE:01/12/95

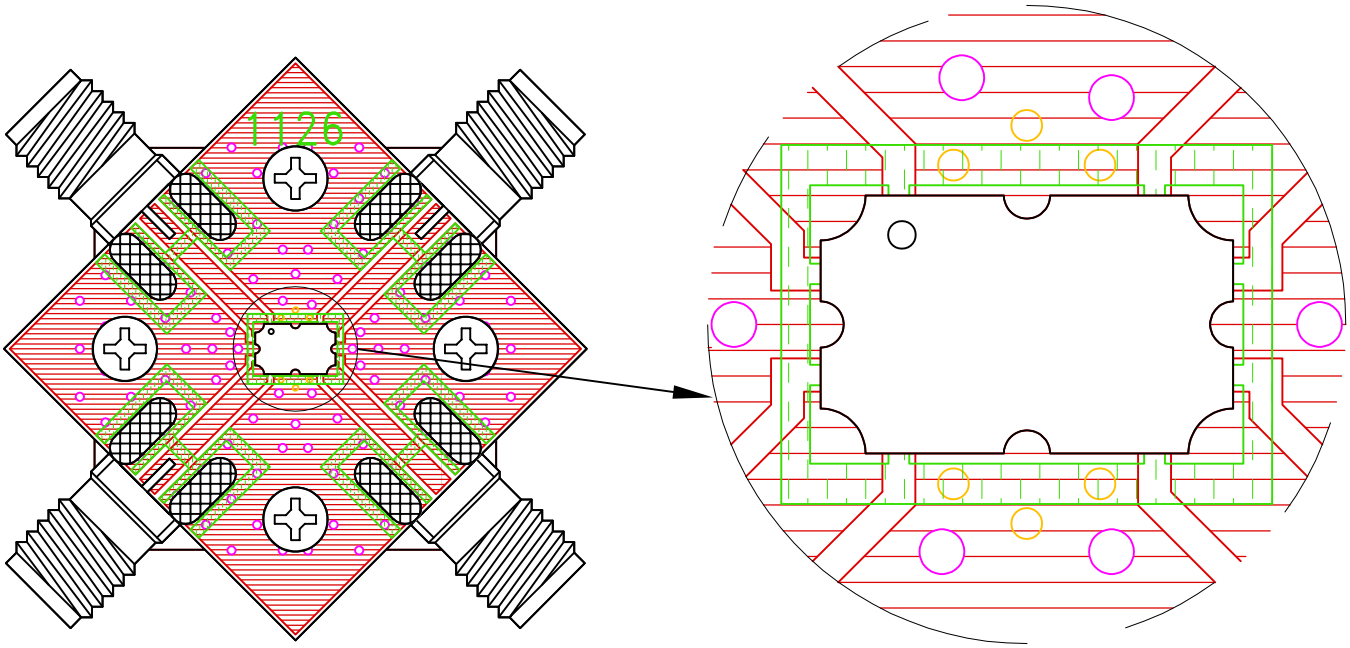
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, AAE3610-2, TB-HPCJ-03222C+

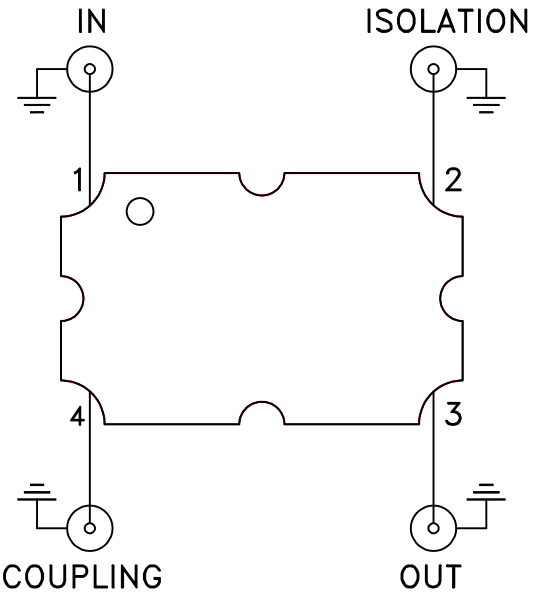
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-856	OR

FILE:	SCALE:	SHEET:
98PL856	7:1	1 OF 1

Evaluation Board and Circuit



TB-HPCJ-03222C+



Schematic Diagram

1. 50 Ohm SMA Female end Launch connectors.
2. PCB Material: ROGERS RO4350B or equivalent, Dielectric Constant= 3.48 Thickness=.030 inch.

Mini-Circuits®

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Environmental Specifications ENV06T10

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 125° C Ambient Environment	Individual Model Data Sheet
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Solder Reflow Heat	Sn-Pb Eutectic Process 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020C, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, Test B,B1, 95% Coverage
Thermal Shock	-55° to +125°C, 15 min dwell,250 cycles	MIL-STD-202, Method 107
Bend Test	1mm, deflection for 5 seconds Span of bending: 2.75"	--
High Temp Storage	125°C to 1000 Hrs	---