

50Ω 250 to 450 MHz

The Big Deal

- Termination insensitive
- Low Insertion Loss: 1.3 dB
- Large attenuation range: 35 dB



CASE STYLE: CZ682

Product Overview

The Mini-Circuits HVA series, surface mount, constant impedance voltage variable attenuators provide excellent attenuation and linearity performance while maintaining constant RF impedance across the attenuation range. Built using Mini-Circuits proven shielded module construction technology, these models integrate dual pin diodes along with internal 90 degree hybrids. This termination insensitive approach allows more flexibility so designers can locate the attenuators anywhere in their lineup, including cascading VVAs for true attenuation addition without VSWR interaction degrading the usable attenuation range.

Key Features

Feature	Advantages
Constant Impedance (Termination insensitive)	The HVA series VVA incorporates 90° hybrids to buffer internal circuits from source and load mismatch. This unique feature enables the HVA series to maintain performance independent of source and load impedance, and allows units to be cascaded with true additive attenuation.
Excellent flatness	Typical attenuation flatness less than 1 dB typ. across the full band from 0 to 30 dB attenuation is great for feed forward applications.
Monotonic Response	Monotonic response (0 to +2.5V, typ.) makes a great selection for ALC circuits
Return Loss	22 dB typ return loss across frequency and control voltage ranges provides an excellent match under all operating conditions allowing straightforward cascading.
High IP3	High +50 dBm IP3 typ. at min attenuation and +40 dBm typ. up to +2.5V, typ. allows flexibility to locate VVA in lineup where attenuation is required the most without degrading system linearity.

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-Circuit's 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/MCLStore/terms.jsp



Voltage Variable Attenuator

HVA-451+

50Ω 250 to 450 MHz

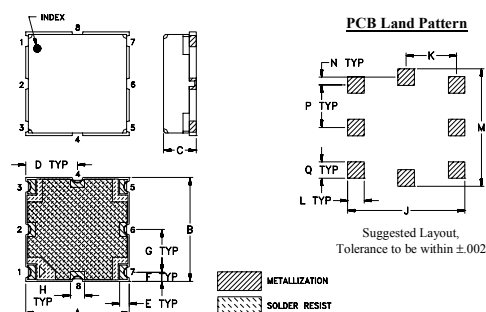
Maximum Ratings

Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Absolute Max. Control Current	10 mA
Absolute Max. RF Input Level	+15 dBm
Permanent damage may occur if any of these limits are exceeded.	

Pin Connections

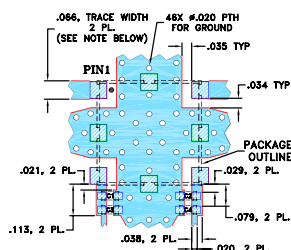
RF IN	1
V CONTROL 1	3
V CONTROL 2	5
RF OUT	7
GROUND	2,4,6,8

Outline Drawing



Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H
.375	.375	.131	.188	.035	.033	.154	.050
9.52	9.52	3.33	4.77	0.89	0.84	3.91	1.27
J	K	L	M	N	P	Q	wt
.425	.183	.060	.425	.028	.154	.060	grams
10.80	4.65	1.52	10.80	0.71	3.91	1.52	0.60

Demo Board MCL P/N: TB-511+
Suggested PCB Layout (PL-323)CAPACITORS C1, C2: 1000 pF, 0603 SIZE;
C3, C4: 68 pF, 0603 SIZE;

NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 0.002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Features

- low insertion loss, 1.3 dB typ.
- high attenuation, 32 dB typ.
- excellent return loss, 22 dB typ.

Applications

- variable gain amplifier
- feed forward amps
- ALC circuits



Generic photo used for illustration purposes only

CASE STYLE: CZ682

+RoHS Compliant

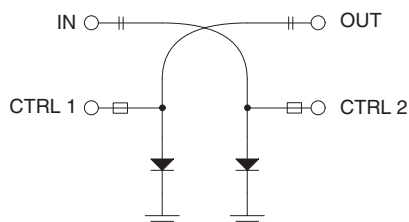
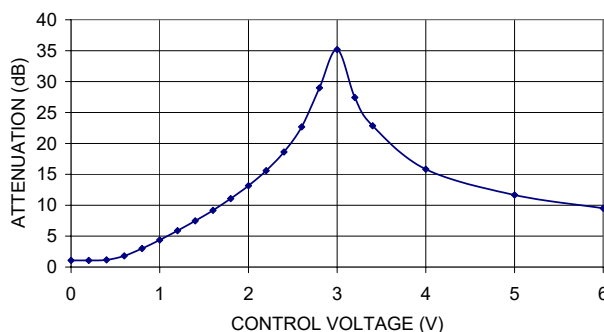
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Electrical Specifications

Parameter	Condition	Min.	Typ.	Max.	Units
Frequency Range		250	—	450	MHz
Insertion Loss	at 0V Control Voltage	—	1.2	1.9	dB
Attenuation		27	32	—	dB
IP3 ¹	at 0V Control Voltage	43	50	—	dBm
Input Return Loss		—	22	—	dB
Output Return Loss		—	21	—	dB
Control Voltage ²		0-6			V

1. Input IP3 tested with two tones separated by 0.1 MHz at 0 dBm each and 0V control voltage.
2. Performance measured with CTRL1 and CTRL2 connected together (refer to TB-511+ for recommended biasing.)

Equivalent Schematic of DUT

HVA-451+
TYPICAL ATTENUATION AT 340 MHz

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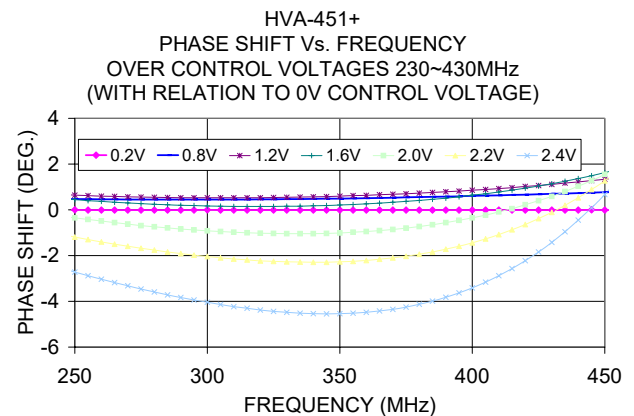
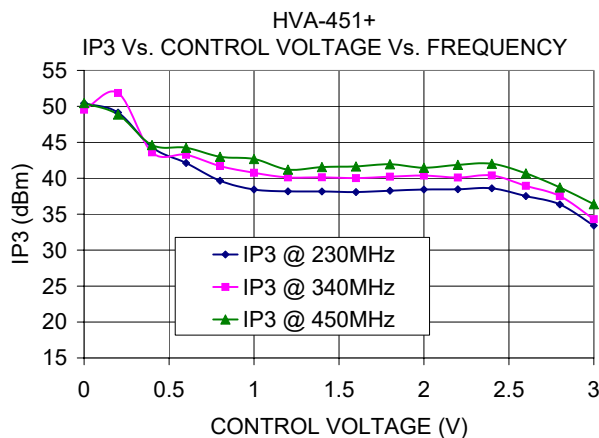
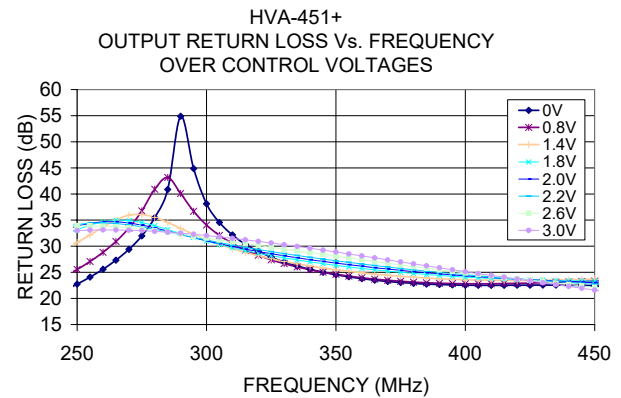
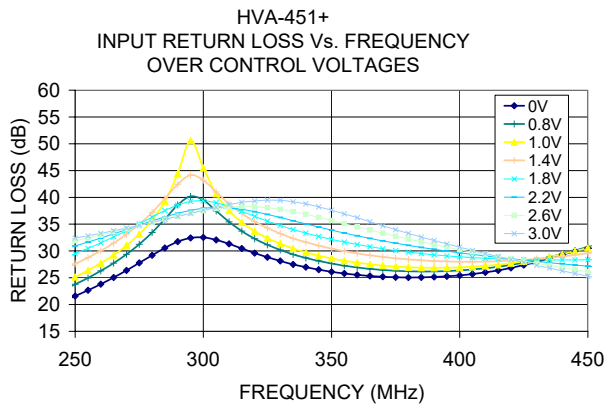
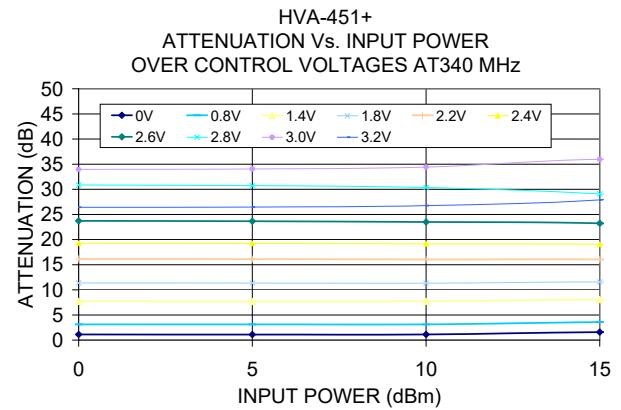
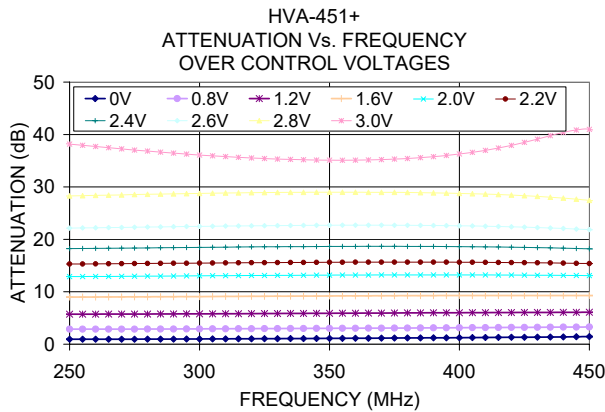
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HVA-451+
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Typical Performance Data

Frequency (MHz)	ATTENUATION vs. FREQUENCY OVER V CTRL (dB)										
	@V Ctrl 0V	@V Ctrl 1.0V	@V Ctrl 1.6V	@V Ctrl 2.0V	@V Ctrl 2.2V	@V Ctrl 2.4V	@V Ctrl 2.6V	@V Ctrl 2.8V	@V Ctrl 3.0V	@V Ctrl 3.2V	@V Ctrl 3.4V
250.0	0.95	4.24	8.99	12.90	15.30	18.23	22.15	28.28	38.18	28.63	23.44
255.0	0.95	4.24	9.00	12.91	15.31	18.25	22.18	28.33	37.94	28.53	23.38
260.0	0.95	4.24	9.00	12.92	15.32	18.27	22.21	28.39	37.71	28.42	23.33
265.0	0.96	4.25	9.01	12.93	15.34	18.30	22.24	28.44	37.48	28.32	23.27
270.0	0.96	4.25	9.02	12.95	15.36	18.32	22.28	28.48	37.26	28.23	23.23
275.0	0.96	4.26	9.03	12.96	15.38	18.34	22.32	28.55	37.04	28.13	23.18
280.0	0.97	4.27	9.04	12.98	15.40	18.37	22.35	28.59	36.84	28.05	23.14
285.0	0.97	4.27	9.05	12.99	15.42	18.40	22.38	28.64	36.64	27.96	23.09
290.0	0.98	4.28	9.06	13.01	15.44	18.42	22.41	28.68	36.45	27.89	23.06
295.0	0.99	4.29	9.07	13.03	15.45	18.45	22.45	28.73	36.27	27.82	23.02
300.0	1.00	4.30	9.08	13.04	15.47	18.47	22.48	28.77	36.09	27.75	22.99
305.0	1.01	4.31	9.10	13.06	15.49	18.49	22.50	28.80	35.94	27.69	22.96
310.0	1.02	4.32	9.11	13.07	15.51	18.51	22.54	28.84	35.79	27.63	22.93
315.0	1.03	4.33	9.12	13.09	15.53	18.54	22.56	28.87	35.65	27.58	22.91
320.0	1.04	4.34	9.13	13.10	15.54	18.56	22.59	28.90	35.53	27.53	22.89
325.0	1.05	4.35	9.14	13.11	15.56	18.58	22.61	28.92	35.42	27.50	22.87
330.0	1.06	4.36	9.16	13.13	15.58	18.59	22.63	28.94	35.32	27.46	22.86
335.0	1.07	4.37	9.17	13.14	15.59	18.61	22.65	28.97	35.25	27.44	22.85
340.0	1.08	4.38	9.18	13.16	15.60	18.62	22.67	28.98	35.19	27.43	22.85
345.0	1.09	4.39	9.19	13.17	15.62	18.63	22.68	28.99	35.14	27.42	22.85
350.0	1.11	4.41	9.20	13.18	15.63	18.65	22.69	29.00	35.11	27.42	22.85
355.0	1.12	4.42	9.22	13.19	15.64	18.65	22.70	29.00	35.10	27.43	22.87
360.0	1.13	4.43	9.22	13.20	15.65	18.66	22.70	28.99	35.11	27.45	22.88
365.0	1.14	4.44	9.23	13.20	15.65	18.67	22.70	28.98	35.16	27.48	22.91
370.0	1.16	4.45	9.24	13.21	15.66	18.67	22.70	28.97	35.21	27.52	22.93
375.0	1.17	4.46	9.25	13.22	15.66	18.67	22.69	28.96	35.31	27.58	22.97
380.0	1.19	4.47	9.26	13.22	15.66	18.66	22.68	28.94	35.42	27.65	23.01
385.0	1.20	4.48	9.26	13.22	15.66	18.66	22.66	28.90	35.58	27.73	23.07
390.0	1.22	4.49	9.27	13.22	15.65	18.65	22.65	28.86	35.77	27.83	23.13
395.0	1.23	4.51	9.28	13.22	15.65	18.63	22.62	28.83	36.00	27.96	23.20
400.0	1.25	4.52	9.28	13.22	15.64	18.62	22.58	28.77	36.28	28.10	23.29
405.0	1.26	4.53	9.28	13.21	15.63	18.59	22.55	28.71	36.60	28.26	23.38
410.0	1.28	4.54	9.29	13.21	15.62	18.57	22.50	28.63	36.98	28.46	23.49
415.0	1.30	4.55	9.29	13.20	15.60	18.54	22.46	28.55	37.42	28.67	23.61
420.0	1.32	4.56	9.29	13.19	15.58	18.51	22.40	28.45	37.93	28.94	23.75
425.0	1.33	4.57	9.29	13.18	15.56	18.47	22.33	28.33	38.5	29.22	23.91
430.0	1.35	4.59	9.29	13.16	15.53	18.42	22.26	28.2	39.13	29.56	24.09
435.0	1.37	4.6	9.29	13.15	15.5	18.38	22.17	28.05	39.78	29.96	24.29
440.0	1.39	4.61	9.29	13.13	15.47	18.32	22.08	27.87	40.4	30.4	24.51
445.0	1.42	4.62	9.29	13.11	15.43	18.26	21.97	27.67	40.85	30.91	24.77
450.0	1.44	4.64	9.28	13.08	15.39	18.19	21.86	27.45	40.99	31.51	25.05

Typical Performance Data

Frequency (MHz)	INPUT RETURN LOSS vs. FREQUENCY OVER V CTRL (dB)										
	@V Ctrl 0V	@V Ctrl 1.0V	@V Ctrl 1.6V	@V Ctrl 2.0V	@V Ctrl 2.2V	@V Ctrl 2.4V	@V Ctrl 2.6V	@V Ctrl 2.8V	@V Ctrl 3.0V	@V Ctrl 3.2V	@V Ctrl 3.4V
250.0	21.58	25.14	28.60	30.28	30.94	31.48	31.89	32.21	32.40	32.49	32.53
255.0	22.66	26.37	29.68	31.13	31.66	32.09	32.42	32.68	32.84	32.93	32.99
260.0	23.80	27.72	30.85	32.01	32.41	32.73	32.96	33.15	33.29	33.37	33.45
265.0	25.04	29.26	32.14	32.95	33.20	33.39	33.54	33.67	33.77	33.85	33.94
270.0	26.36	31.02	33.56	33.92	34.00	34.06	34.12	34.19	34.28	34.35	34.44
275.0	27.76	33.15	35.12	34.92	34.81	34.76	34.73	34.75	34.79	34.87	34.97
280.0	29.20	35.77	36.78	35.90	35.60	35.41	35.32	35.29	35.33	35.41	35.51
285.0	30.56	39.26	38.55	36.82	36.36	36.08	35.93	35.86	35.90	35.99	36.11
290.0	31.74	44.42	40.05	37.62	37.02	36.68	36.50	36.42	36.46	36.57	36.69
295.0	32.42	50.58	40.97	38.20	37.58	37.23	37.03	36.98	37.03	37.18	37.35
300.0	32.52	45.50	40.80	38.46	37.95	37.64	37.51	37.51	37.61	37.79	38.00
305.0	32.07	40.66	39.87	38.43	38.09	37.92	37.91	37.98	38.15	38.40	38.68
310.0	31.33	37.53	38.56	38.06	38.02	38.04	38.16	38.37	38.65	38.98	39.35
315.0	30.46	35.35	37.24	37.56	37.77	38.01	38.30	38.66	39.08	39.53	40.03
320.0	29.61	33.69	36.00	36.88	37.32	37.78	38.24	38.77	39.33	39.94	40.56
325.0	28.83	32.40	34.95	36.19	36.81	37.41	38.08	38.77	39.48	40.24	41.05
330.0	28.13	31.36	34.03	35.51	36.24	36.99	37.77	38.57	39.45	40.34	41.30
335.0	27.48	30.45	33.19	34.80	35.61	36.45	37.32	38.22	39.17	40.17	41.27
340.0	26.97	29.75	32.49	34.19	35.04	35.93	36.83	37.80	38.80	39.88	41.06
345.0	26.51	29.12	31.85	33.58	34.45	35.35	36.26	37.23	38.22	39.32	40.46
350.0	26.11	28.61	31.30	33.02	33.89	34.79	35.67	36.61	37.62	38.65	39.73
355.0	25.80	28.18	30.81	32.50	33.35	34.22	35.08	35.98	36.92	37.89	38.86
360.0	25.53	27.81	30.38	32.02	32.84	33.67	34.50	35.33	36.20	37.09	37.94
365.0	25.34	27.52	29.99	31.58	32.35	33.14	33.91	34.67	35.45	36.24	36.99
370.0	25.18	27.27	29.65	31.16	31.88	32.61	33.32	34.02	34.71	35.40	36.04
375.0	25.08	27.08	29.36	30.77	31.45	32.11	32.76	33.38	33.98	34.57	35.10
380.0	25.04	26.95	29.10	30.42	31.05	31.65	32.22	32.76	33.29	33.77	34.21
385.0	25.06	26.87	28.89	30.09	30.66	31.18	31.69	32.16	32.59	32.99	33.36
390.0	25.14	26.85	28.72	29.80	30.31	30.77	31.20	31.59	31.95	32.26	32.54
395.0	25.26	26.87	28.58	29.54	29.97	30.36	30.72	31.03	31.31	31.56	31.76
400.0	25.44	26.93	28.47	29.29	29.65	29.96	30.24	30.49	30.70	30.86	31.00
405.0	25.69	27.05	28.39	29.07	29.35	29.59	29.80	29.96	30.10	30.20	30.29
410.0	26.01	27.22	28.34	28.87	29.07	29.23	29.36	29.45	29.52	29.56	29.59
415.0	26.37	27.43	28.31	28.67	28.79	28.87	28.92	28.95	28.95	28.93	28.90
420.0	26.84	27.72	28.33	28.50	28.54	28.53	28.51	28.46	28.40	28.33	28.24
425.0	27.36	28.05	28.38	28.35	28.29	28.20	28.10	27.99	27.86	27.74	27.61
430.0	27.95	28.43	28.44	28.20	28.05	27.87	27.69	27.51	27.32	27.14	26.97
435.0	28.63	28.90	28.54	28.08	27.82	27.56	27.30	27.05	26.81	26.58	26.36
440.0	29.29	29.40	28.65	27.95	27.59	27.24	26.90	26.59	26.29	26.01	25.75
445.0	29.95	29.96	28.81	27.84	27.37	26.93	26.52	26.14	25.78	25.46	25.16
450.0	30.49	30.57	29.00	27.74	27.16	26.63	26.13	25.69	25.28	24.92	24.58

Typical Performance Data

Frequency (MHz)	OUTPUT RETURN LOSS vs. FREQUENCY OVER V CTRL (dB)										
	@V Ctrl 0V	@V Ctrl 1.0V	@V Ctrl 1.6V	@V Ctrl 2.0V	@V Ctrl 2.2V	@V Ctrl 2.4V	@V Ctrl 2.6V	@V Ctrl 2.8V	@V Ctrl 3.0V	@V Ctrl 3.2V	@V Ctrl 3.4V
250.0	22.74	27.33	32.07	33.84	34.15	34.12	33.87	33.48	33.00	32.51	32.03
255.0	24.08	28.95	33.29	34.36	34.40	34.20	33.89	33.50	33.08	32.66	32.25
260.0	25.59	30.77	34.37	34.65	34.45	34.17	33.83	33.48	33.12	32.76	32.43
265.0	27.32	32.91	35.14	34.67	34.33	34.02	33.70	33.39	33.11	32.83	32.58
270.0	29.39	35.35	35.43	34.45	34.07	33.77	33.52	33.27	33.07	32.88	32.69
275.0	31.97	37.88	35.19	34.05	33.69	33.45	33.27	33.10	32.97	32.86	32.76
280.0	35.46	39.35	34.55	33.50	33.23	33.08	32.97	32.90	32.85	32.82	32.79
285.0	40.87	38.47	33.68	32.90	32.73	32.66	32.65	32.65	32.68	32.73	32.77
290.0	54.89	36.39	32.77	32.27	32.20	32.23	32.30	32.38	32.49	32.61	32.71
295.0	44.86	34.36	31.88	31.64	31.69	31.79	31.94	32.10	32.28	32.47	32.62
300.0	38.13	32.60	31.04	31.05	31.18	31.36	31.57	31.79	32.04	32.28	32.50
305.0	34.54	31.15	30.27	30.49	30.69	30.94	31.21	31.50	31.79	32.07	32.34
310.0	32.16	29.95	29.57	29.96	30.23	30.53	30.85	31.18	31.52	31.84	32.15
315.0	30.37	28.93	28.94	29.45	29.78	30.12	30.49	30.86	31.22	31.59	31.92
320.0	29.02	28.08	28.38	29.00	29.37	29.74	30.14	30.54	30.93	31.31	31.68
325.0	27.89	27.33	27.86	28.56	28.96	29.37	29.78	30.21	30.62	31.01	31.39
330.0	26.99	26.69	27.39	28.16	28.58	29.01	29.44	29.87	30.29	30.70	31.07
335.0	26.22	26.13	26.97	27.78	28.22	28.66	29.09	29.54	29.96	30.36	30.73
340.0	25.57	25.64	26.58	27.42	27.87	28.32	28.76	29.20	29.62	30.01	30.38
345.0	25.03	25.22	26.23	27.09	27.53	27.98	28.43	28.86	29.26	29.65	30.00
350.0	24.54	24.83	25.90	26.77	27.21	27.65	28.09	28.50	28.90	29.26	29.60
355.0	24.14	24.50	25.60	26.46	26.90	27.33	27.76	28.15	28.53	28.88	29.19
360.0	23.79	24.21	25.32	26.17	26.60	27.02	27.42	27.79	28.15	28.47	28.76
365.0	23.50	23.95	25.06	25.89	26.30	26.69	27.08	27.43	27.76	28.05	28.32
370.0	23.25	23.73	24.83	25.63	26.02	26.39	26.75	27.07	27.38	27.65	27.89
375.0	23.05	23.55	24.62	25.38	25.74	26.09	26.43	26.71	26.99	27.24	27.45
380.0	22.89	23.39	24.42	25.14	25.48	25.81	26.10	26.37	26.61	26.83	27.01
385.0	22.75	23.26	24.25	24.92	25.23	25.52	25.79	26.02	26.23	26.42	26.58
390.0	22.66	23.17	24.10	24.71	24.99	25.25	25.48	25.69	25.86	26.02	26.15
395.0	22.59	23.09	23.96	24.51	24.76	24.98	25.18	25.35	25.49	25.62	25.72
400.0	22.54	23.05	23.84	24.33	24.54	24.72	24.88	25.01	25.13	25.21	25.29
405.0	22.52	23.03	23.75	24.16	24.32	24.48	24.59	24.69	24.76	24.83	24.87
410.0	22.52	23.03	23.67	24.00	24.13	24.24	24.31	24.37	24.41	24.44	24.45
415.0	22.52	23.05	23.61	23.85	23.94	24.00	24.03	24.05	24.06	24.05	24.03
420.0	22.53	23.09	23.56	23.72	23.75	23.77	23.76	23.74	23.71	23.67	23.63
425.0	22.54	23.16	23.53	23.58	23.57	23.54	23.49	23.43	23.36	23.28	23.21
430.0	22.55	23.23	23.51	23.46	23.39	23.31	23.21	23.12	23.01	22.90	22.79
435.0	22.56	23.33	23.51	23.34	23.22	23.09	22.94	22.80	22.66	22.51	22.38
440.0	22.53	23.43	23.51	23.23	23.05	22.86	22.67	22.48	22.30	22.13	21.95
445.0	22.49	23.54	23.53	23.12	22.88	22.64	22.40	22.17	21.94	21.74	21.54
450.0	22.40	23.66	23.55	23.02	22.71	22.41	22.12	21.84	21.59	21.34	21.11

Typical Performance Data

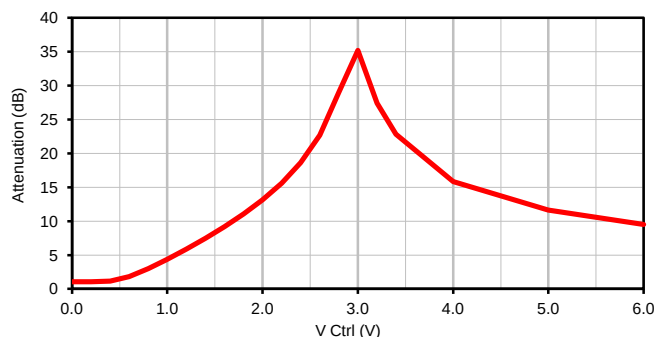
Frequency (MHz)	PHASE SHIFT vs. FREQUENCY OVER V CTRL (Deg.)									
	@V Ctrl 1.0V	@V Ctrl 1.6V	@V Ctrl 2.0V	@V Ctrl 2.2V	@V Ctrl 2.4V	@V Ctrl 2.6V	@V Ctrl 2.8V	@V Ctrl 3.0V	@V Ctrl 3.2V	@V Ctrl 3.4V
250.0	0.60	0.45	-0.35	-1.19	-2.72	-5.91	-15.35	-90.24	-157.12	-165.94
255.0	0.59	0.40	-0.42	-1.30	-2.88	-6.17	-15.97	-91.90	-156.88	-165.74
260.0	0.57	0.37	-0.49	-1.40	-3.03	-6.43	-16.58	-93.32	-156.61	-165.54
265.0	0.56	0.33	-0.56	-1.50	-3.18	-6.68	-17.19	-94.81	-156.38	-165.34
270.0	0.56	0.30	-0.62	-1.59	-3.32	-6.93	-17.78	-95.97	-156.11	-165.14
275.0	0.55	0.27	-0.69	-1.68	-3.46	-7.18	-18.35	-97.06	-155.88	-164.94
280.0	0.54	0.24	-0.74	-1.76	-3.59	-7.41	-18.94	-98.28	-155.64	-164.74
285.0	0.54	0.22	-0.79	-1.84	-3.72	-7.64	-19.49	-99.14	-155.38	-164.54
290.0	0.54	0.20	-0.84	-1.91	-3.83	-7.86	-20.07	-100.00	-155.14	-164.34
295.0	0.54	0.19	-0.88	-1.98	-3.94	-8.06	-20.56	-100.75	-154.91	-164.14
300.0	0.54	0.17	-0.92	-2.04	-4.04	-8.26	-21.09	-101.55	-154.69	-163.95
305.0	0.54	0.16	-0.95	-2.10	-4.14	-8.45	-21.57	-102.17	-154.45	-163.76
310.0	0.54	0.15	-0.98	-2.15	-4.23	-8.61	-22.00	-102.54	-154.23	-163.58
315.0	0.54	0.15	-1.00	-2.19	-4.30	-8.77	-22.42	-103.11	-154.03	-163.40
320.0	0.55	0.15	-1.02	-2.23	-4.38	-8.91	-22.82	-103.48	-153.81	-163.22
325.0	0.55	0.15	-1.03	-2.25	-4.44	-9.05	-23.15	-103.84	-153.63	-163.06
330.0	0.56	0.16	-1.04	-2.27	-4.48	-9.14	-23.44	-104.00	-153.42	-162.90
335.0	0.57	0.16	-1.04	-2.28	-4.52	-9.23	-23.68	-104.14	-153.26	-162.75
340.0	0.58	0.18	-1.04	-2.29	-4.54	-9.30	-23.91	-104.34	-153.10	-162.62
345.0	0.59	0.19	-1.03	-2.29	-4.55	-9.33	-24.02	-104.28	-152.94	-162.50
350.0	0.60	0.21	-1.01	-2.27	-4.54	-9.35	-24.10	-104.27	-152.83	-162.40
355.0	0.61	0.23	-0.98	-2.25	-4.52	-9.33	-24.09	-104.02	-152.71	-162.30
360.0	0.63	0.26	-0.95	-2.21	-4.48	-9.29	-24.05	-103.93	-152.62	-162.24
365.0	0.64	0.29	-0.91	-2.16	-4.42	-9.21	-23.89	-103.58	-152.54	-162.19
370.0	0.66	0.33	-0.86	-2.10	-4.35	-9.09	-23.63	-103.06	-152.51	-162.16
375.0	0.68	0.37	-0.80	-2.03	-4.25	-8.95	-23.32	-102.61	-152.50	-162.16
380.0	0.70	0.41	-0.73	-1.94	-4.13	-8.76	-22.88	-101.92	-152.50	-162.19
385.0	0.72	0.46	-0.65	-1.84	-3.99	-8.53	-22.38	-101.13	-152.57	-162.26
390.0	0.74	0.51	-0.56	-1.72	-3.82	-8.26	-21.72	-100.09	-152.68	-162.37
395.0	0.76	0.57	-0.46	-1.59	-3.63	-7.94	-20.96	-98.93	-152.84	-162.51
400.0	0.78	0.64	-0.35	-1.44	-3.41	-7.57	-20.13	-97.58	-153.04	-162.71
405.0	0.81	0.70	-0.23	-1.27	-3.16	-7.15	-19.13	-95.69	-153.32	-162.97
410.0	0.83	0.78	-0.09	-1.08	-2.88	-6.68	-18.02	-93.60	-153.70	-163.28
415.0	0.86	0.86	0.05	-0.87	-2.57	-6.14	-16.76	-91.07	-154.16	-163.66
420.0	0.89	0.95	0.22	-0.64	-2.22	-5.55	-15.39	-87.78	-154.73	-164.13
425.0	0.92	1.04	0.40	-0.38	-1.84	-4.89	-13.87	-83.59	-155.45	-164.70
430.0	0.95	1.14	0.59	-0.11	-1.42	-4.17	-12.22	-78.26	-156.34	-165.36
435.0	0.98	1.25	0.80	0.20	-0.96	-3.40	-10.46	-71.57	-157.44	-166.16
440.0	1.02	1.37	1.03	0.53	-0.45	-2.54	-8.55	-62.70	-158.79	-167.11
445.0	1.05	1.49	1.28	0.89	0.09	-1.63	-6.54	-51.98	-160.52	-168.22
450.0	1.09	1.63	1.55	1.27	0.67	-0.65	-4.41	-38.86	-162.69	-169.56

Voltage Variable Attenuator

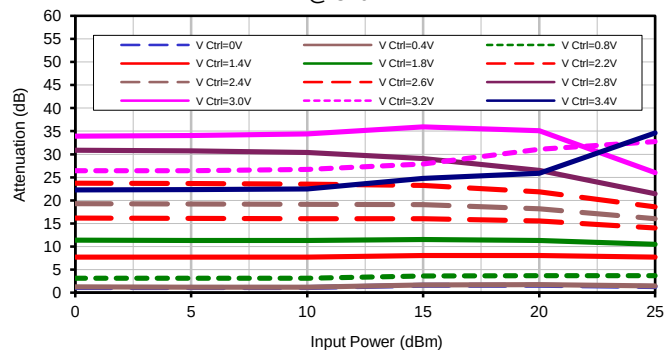
HVA-451+

Typical Performance Curves

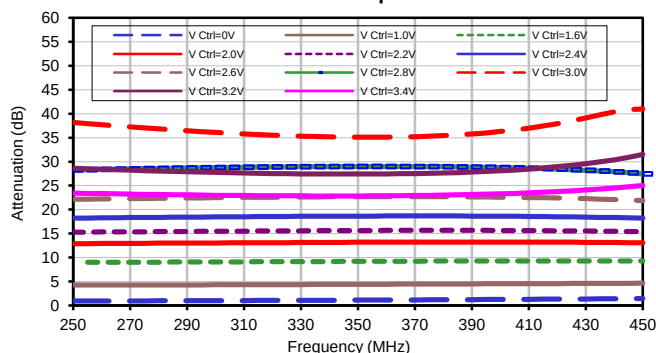
Attenuation Vs. V Ctrl @ 340 MHz



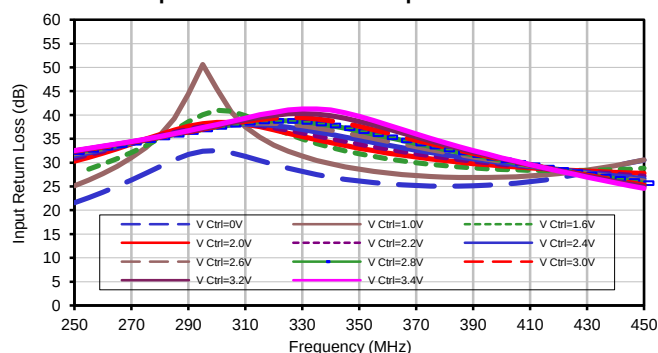
Attenuation Vs. Input Power over V Ctrl @ 340 MHz



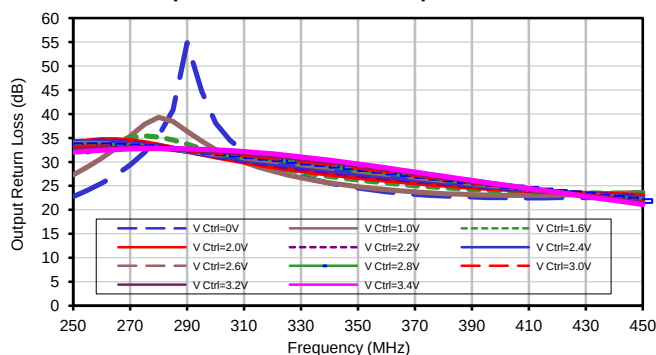
Attenuation Vs. Freq over V Ctrl



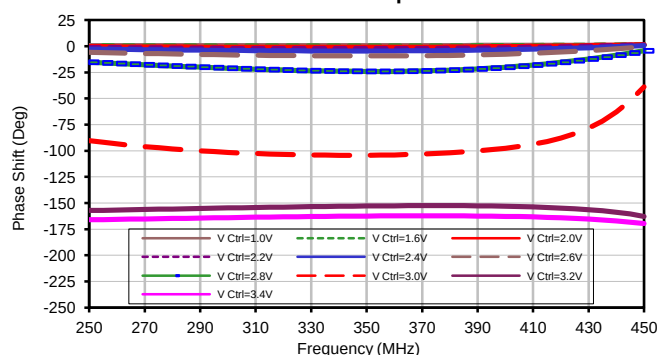
Input Return Loss Vs. Freq over V Ctrl



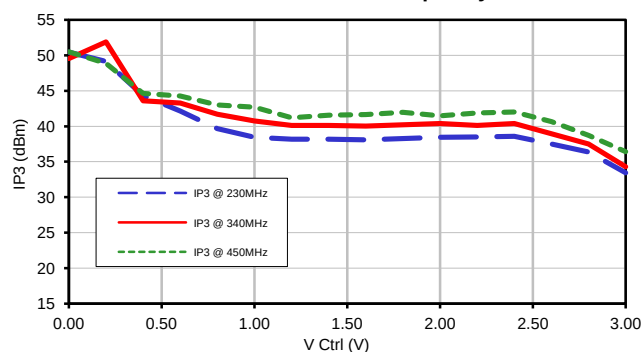
Output Return Loss Vs. Freq over V Ctrl



Phase Shift Vs. Freq over V Ctrl



IP3 Vs. V Ctrl Vs. Frequency



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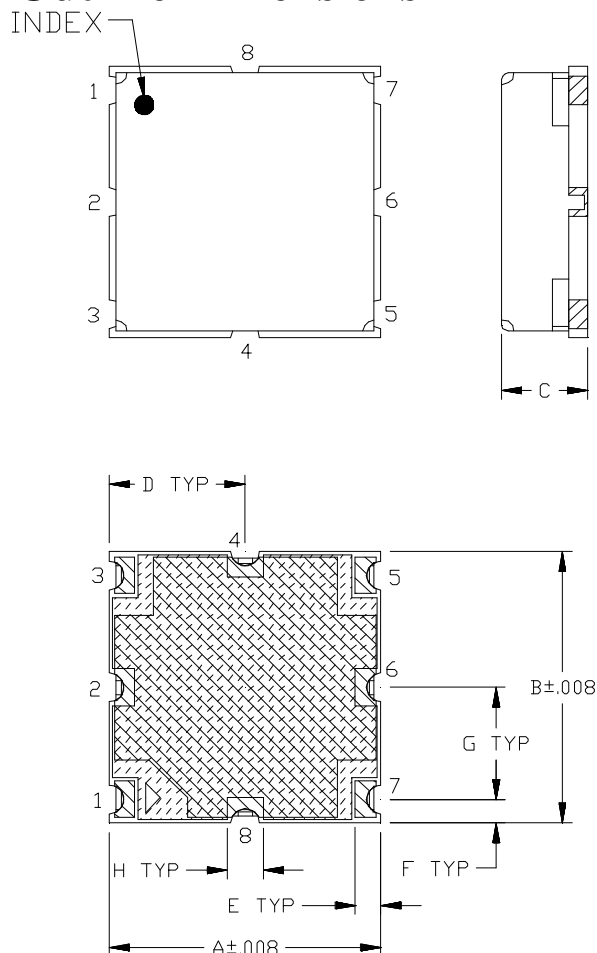
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The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

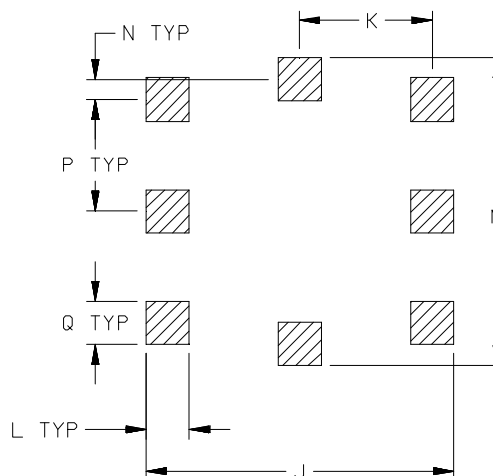
IF/RF MICROWAVE COMPONENTS

REV. OR
HVA-451+
2/26/2013
Page 1 of 1

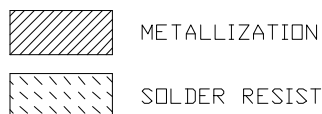
Outline Dimensions



PCB Land Pattern



Suggested Layout,
Tolerance to be within $\pm.002$



CASE #	A	B	C	D	E	F	G	H	J	K
CZ682	.375 (9.52)	.375 (9.52)	.131 (3.33)	.188 (4.77)	.035 (0.89)	.033 (0.84)	.154 (3.91)	.050 (1.27)	.425 (10.80)	.183 (4.65)

CASE #	L	M	N	P	Q	WT. GRAM
CZ682	.060 (1.52)	.425 (10.80)	.028 (0.71)	.154 (3.91)	.060 (1.52)	.60

Dimensions are in inches (mm). Tolerances: 2Pl. $\pm .03$; 3Pl. $\pm .010$

Notes:

1. Case material: Nickel-Silver alloy.
2. Base: Printed wiring laminate.
3. Termination finish:

For RoHS Case Styles: 3-5 μ inch (.08-.13 microns) Gold over 120-240 μ inch (3.05-6.10 microns) Nickel plate
For RoHS-5 Case Styles: Tin-Lead plate.

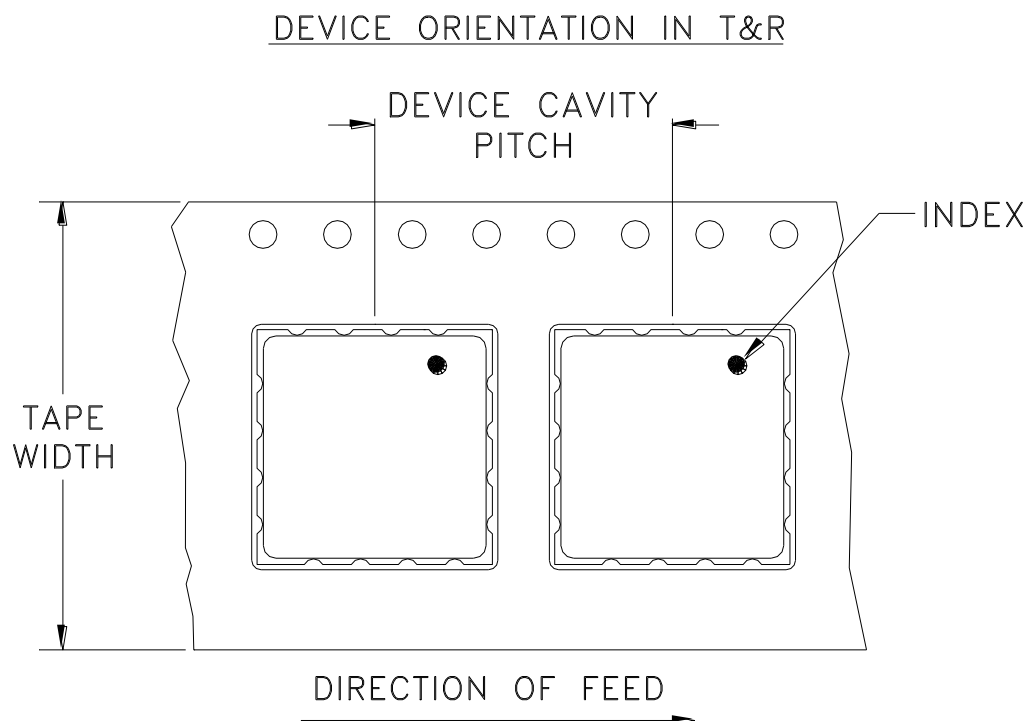


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Tape & Reel Packaging TR-F60



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
24	16	7	Small quantity standards (see note)	10
				20
				50
				100
		13	Standard	200
				500
				1000

Note: Please consult individual model data sheet 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



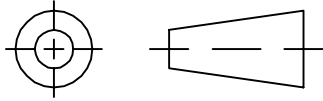
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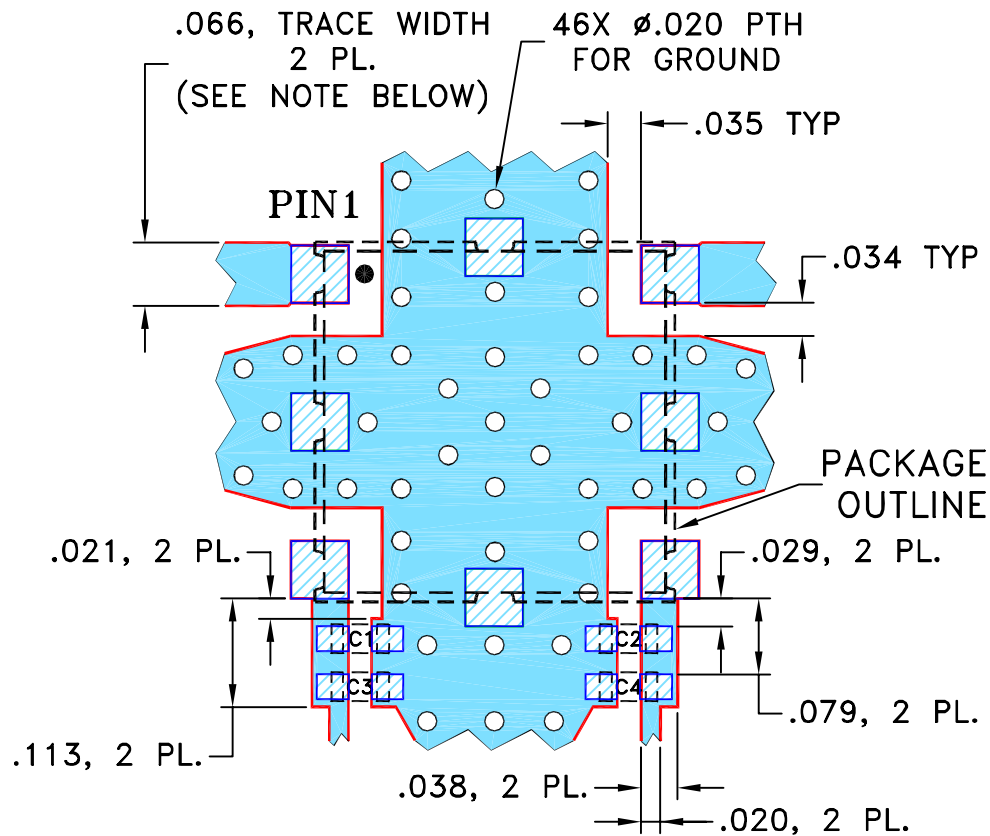
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M125690	NEW RELEASE	12/14/09	AV	DJ

SUGGESTED MOUNTING CONFIGURATION FOR CZ682 CASE STYLE, "08AV03" PIN CODE

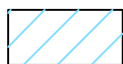


CAPACITORS C1, C2: 1000 pF, 0603 SIZE;
C3, C4: 68 pF, 0603 SIZE.

- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS $0.030'' \pm 0.002''$; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.



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

AV

12/11/09

TOLERANCES ON:

CHECKED

IL

12/14/09

2 PL DECIMALS $\pm$

APPROVED

DJ

12/14/09

3 PL DECIMALS $\pm$.005ANGLES $\pm$ FRACTIONS $\pm$

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



Mini-Circuits®

13 Neptune Avenue
Brooklyn NY 11235

PL, 08AV03, CZ682, TB-511+

SIZE
ACODE IDENT
15542

DRAWING NO:

98-PL-323

REV:

OR

FILE: 98PL323

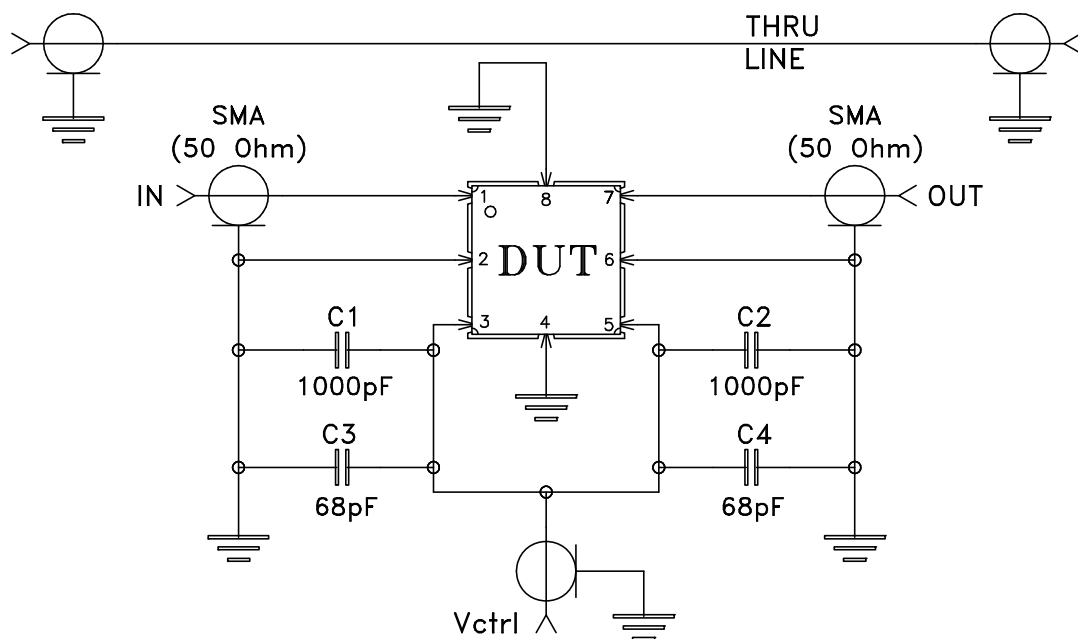
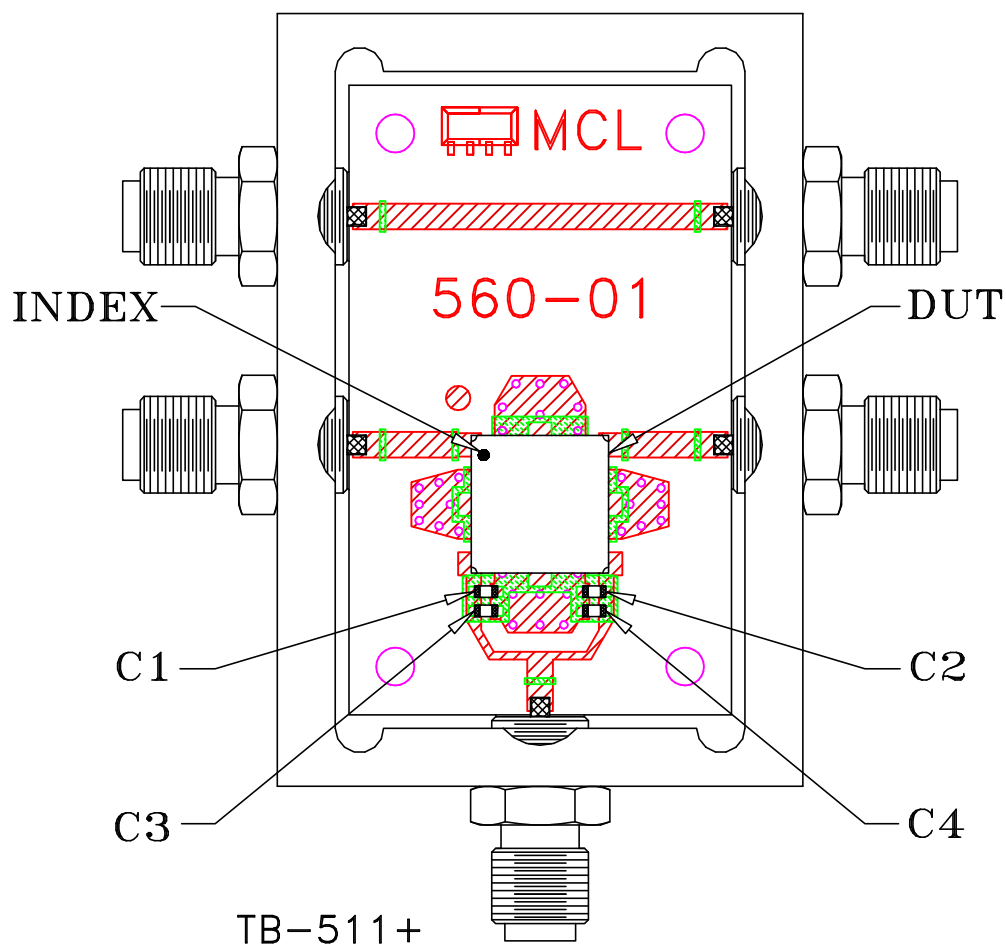
SCALE:

5:1

SHEET:

1 OF 1

Evaluation Board and Circuit



Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: RO4350 or equivalent,
Dielectric Constant=3.5, Thickness=.030 inch.

 **Mini-Circuits®**



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 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
HAST	130°C, 85% RH, 96 hours	JESD22-A110
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
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutectic Process: 225°C peak Pb-Free Process, 245°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Vibration (High Frequency)	20g peak, 20-2000 Hz, 4 times in each of three axes (total 12)	MIL-STD-883, Method 2007.3, Condition A
Mechanical Shock	50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes	MIL-STD-202, Method 213, Condition A
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215