

Surface Mount

Voltage Variable Equalizer

VAEQ-1220+

50Ω

50 to 1220 MHz

The Big Deal

- Adjustable attenuation slope
- IP3 +55 dBm typical
- Minimal deviation from linear loss, ± 0.2 dB



CASE STYLE: HE1354

Product Overview

The VAEQ-1220+ is a 50Ω Voltage Variable Equalizer built into a shielded case (size of .394"x.394"x.150", 10 x 10 x 3.8 mm). This model offers excellent performance over a wide frequency range of 50 to 1220 MHz with the variable slope providing great flexibility in a small 10 mm package.

The VAEQ-1220+ is often used to compensate RF chain gain flatness or cable loss versus frequency.

Key Features

Feature	Advantages
Low power consumption: <ul style="list-style-type: none">• Supply voltage +5V_{DC} at max 15mA• Control voltage 0-7V at max 20mA	Allows for high layout density of circuit boards, while minimizing affects of parasitics.
Adjustable attenuation slope (Control voltage of 0V to 7V)	Allows adjusting the slope to compensate for the precise losses encountered.
High linearity (IP3 +55 dBm typ.)	Low distortion enabling improved system performance.
Minimal deviation from linear loss over frequency range: ± 0.2 dB	Provides low signal distortion over the passband.



Surface Mount Voltage Variable Equalizer

VAEQ-1220+

50Ω

50 to 1220 MHz

Features

- Wide bandwidth
- Low insertion loss
- Low deviation from linear loss, ± 0.2 dB typ.
- High IP3 +55 dBm typ.
- Shielded case
- Aqueous washable

Applications

- Cable loss compensation
- Instrumentation
- DOCSIS 3.1



CASE STYLE: HE1354

+RoHS Compliant

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

Electrical Specifications at 25°C, V+=5V_{DC} unless otherwise noted

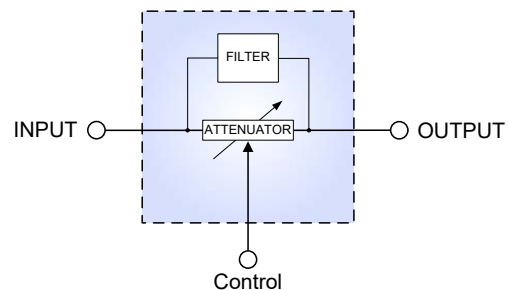
Parameter	Condition	Min.	Typ.	Max.	Units
Frequency Range		50		1220	MHz
Insertion Loss	50 MHz, Control Voltage, 0 - 7V 1220 MHz, Control Voltage, 0 - 7V		15.2 - 1.7 3.3 - 2.5		dB
Deviation from Linear Loss	50 - 1220 MHz, Control Voltage 0 - 7V		± 0.2		dB
IP3	50 - 1220 MHz, Control Voltage, 2.8 - 7V	+45	+55		dBm
1 dB Compression	50 - 1220 MHz, Control Voltage, 0 - 7V		+30		dBm
Input Return Loss	50 - 1220 MHz, Control Voltage, 0 - 7V		13		dB
Output Return Loss	50 - 1220 MHz, Control Voltage, 0 - 7V		11		dB
Supply Voltage (V+)	50 - 1220 MHz, Control Voltage, 0 - 7V	3.5	5	5.5	V
Supply Current	50 - 1220 MHz, Control Voltage 7V, 50 - 1220 MHz, Control Voltage 0V,		0 10	16	mA
Control Current	50 - 1220 MHz, Control Voltage 7V 50 - 1220 MHz, Control Voltage 2.8V		12 0	20	mA

Maximum Ratings

Parameter	Ratings
Operating Temperature	0°C to 85°C
Storage Temperature	-55°C to 100°C
Input Power	+23 dBm
Control voltage	11 V
Supply Voltage (V+)	7 V

Permanent damage may occur if any of these limits are exceeded.

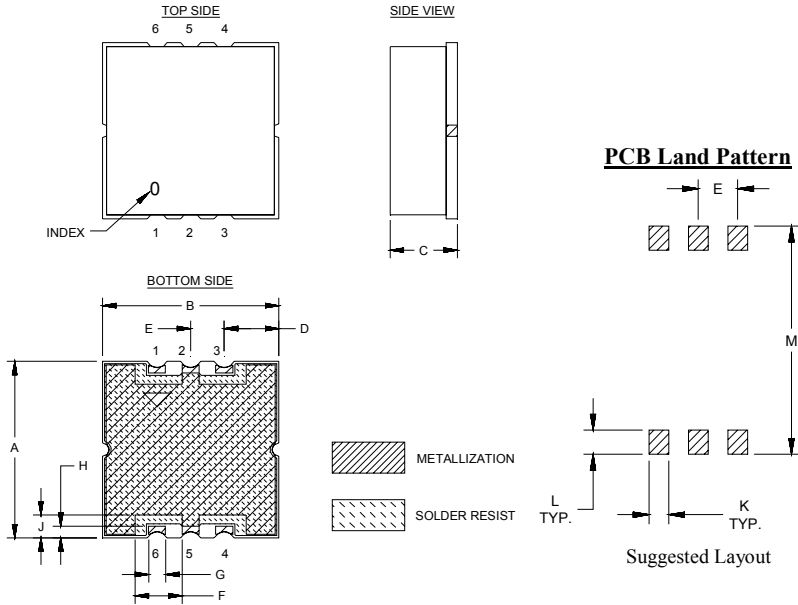
Simplified Functional Diagram



Pad Connections

Function	Pad Number
RF IN	1
RF OUT	6
V CONTROL	3
V+	4
GROUND	2,5

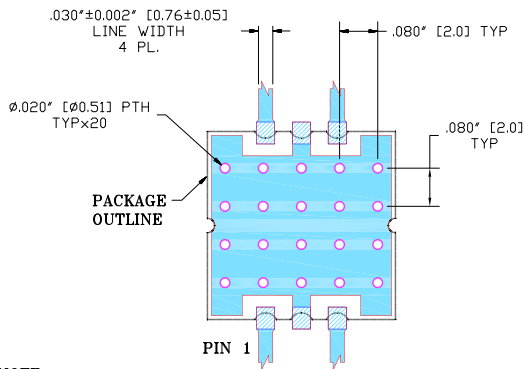
Outline Drawing



Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K	L	M	wt.
.394	.394	.150	.122	.075	.098	.038	.026	.051	.038	.046	.434	grams
10.01	10.01	3.81	3.10	1.90	2.49	0.97	0.66	1.29	0.97	1.17	11.02	0.7

Demo Board MCL P/N: TB-474+ Suggested PCB Layout (PL-285)



NOTE:

- TRACE WIDTH IS SHOWN FOR R04350 WITH DIELECTRIC THICKNESS. $.030 \pm .002$ ". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
 - 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 SOLDERMASK

Pad Connections

Function	Pad Number
RF IN	1
RF OUT	6
V CONTROL	3
V+	4
GROUND	2,5

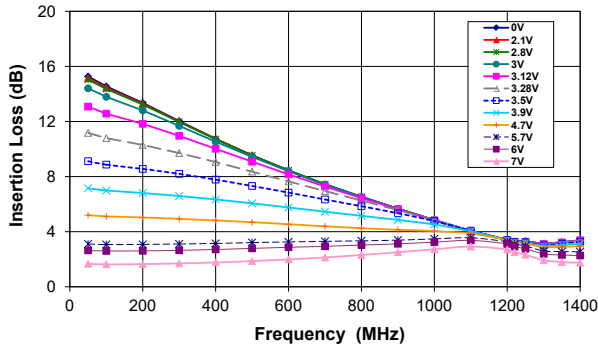
@ $V_{Control}=0V$ & $V_{Control}=2.8V$

Frequency (MHz)	Insertion Loss (dB)		Input Return Loss (dB)		Output Return Loss (dB)		Deviation from Linear Loss (dB)		Insertion Phase (deg)		Input IP3 (dBm)	
	Vcontrol		Vcontrol		Vcontrol		Vcontrol		Vcontrol		Vcontrol	
	0V	2.8V	0V	2.8V	0V	2.8V	0V	2.8V	0V	2.8V	0V	2.8V
50	15.24	14.99	15.49	15.50	18.70	16.28	0.71	0.57	18.49	17.34	49.76	54.29
100	14.53	14.33	15.91	15.93	18.36	16.16	0.51	0.42	8.30	7.28	57.99	52.36
150	13.96	13.79	15.77	15.80	17.75	15.75	0.45	0.38	3.05	2.00	57.23	54.13
200	13.35	13.22	15.49	15.53	17.00	15.20	0.35	0.32	1.54	2.59	59.02	52.17
300	12.05	11.99	14.72	14.76	15.47	14.05	0.07	0.09	11.90	12.83	57.39	53.58
400	10.77	10.76	13.79	13.83	13.95	12.86	0.19	0.14	24.30	25.02	56.24	56.11
450	10.13	10.12	13.29	13.33	13.24	12.28	0.32	0.27	31.25	31.87	55.89	57.31
500	9.58	9.59	12.82	12.86	12.55	11.71	0.36	0.30	38.43	38.93	55.54	58.51
550	8.98	9.00	12.32	12.35	11.91	11.18	0.44	0.39	46.06	46.44	55.96	58.71
600	8.49	8.51	11.86	11.90	11.28	10.65	0.43	0.38	53.89	54.16	56.37	58.90
700	7.48	7.50	10.95	10.98	10.13	9.68	0.41	0.37	70.41	70.49	56.43	59.48
800	6.57	6.59	10.17	10.19	9.13	8.81	0.30	0.28	87.77	87.71	55.25	54.59
900	5.72	5.73	9.58	9.58	8.34	8.13	0.13	0.14	105.82	105.67	53.79	53.13
950	5.36	5.36	9.38	9.38	8.05	7.90	0.02	0.00	115.24	115.06	53.80	52.89
1000	4.89	4.89	9.27	9.27	7.87	7.75	0.06	0.04	124.60	124.41	53.80	52.64
1100	4.09	4.09	9.39	9.38	7.96	7.91	0.27	0.24	144.82	144.62	55.18	49.92
1150	3.87	3.87	9.70	9.69	8.30	8.29	0.57	0.52	156.56	156.37	53.30	53.22
1200	3.44	3.45	10.19	10.18	8.99	9.00	0.65	0.60	167.08	166.89	54.02	54.12
1220	3.31	3.32	10.44	10.43	9.33	9.35	0.72	0.67	172.56	172.36	56.27	56.88

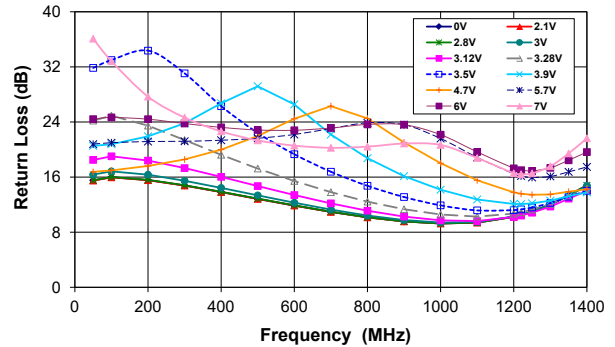
@ $V_{Control}=5.7V$ & $V_{Control}=7V$

Frequency (MHz)	Insertion Loss (dB)		Input Return Loss (dB)		Output Return Loss (dB)		Deviation from Linear Loss (dB)		Insertion Phase (deg)		Input IP3 (dBm)	
	Vcontrol		Vcontrol		Vcontrol		Vcontrol		Vcontrol		Vcontrol	
	5.7V	7V	5.7V	7V	5.7V	7V	5.7V	7V	5.7V	7V	5.7V	7V
50	3.11	1.68	20.68	36.88	26.50	38.44	0.11	0.29	5.89	5.95	50.77	54.99
100	3.07	1.64	20.94	33.26	27.42	34.74	0.04	0.18	14.10	14.42	55.12	58.23
150	3.07	1.64	21.13	30.36	27.18	30.27	0.02	0.12	21.87	22.44	56.50	60.40
200	3.08	1.65	21.15	27.97	26.38	27.02	0.00	0.07	29.48	30.27	56.90	64.36
300	3.10	1.69	21.22	24.88	24.48	23.30	0.02	0.02	44.53	45.78	58.37	60.50
400	3.15	1.77	21.38	22.85	22.72	20.86	0.02	0.07	59.44	61.17	56.51	58.09
450	3.17	1.80	21.53	22.07	22.00	19.99	0.02	0.11	66.99	68.95	56.52	57.75
500	3.20	1.87	21.68	21.53	21.27	19.14	0.02	0.11	74.27	76.49	56.52	57.41
550	3.22	1.90	21.93	21.05	20.67	18.49	0.02	0.14	81.74	84.19	57.01	58.53
600	3.26	1.98	22.23	20.77	20.04	17.86	0.01	0.12	89.03	91.73	57.50	59.64
700	3.30	2.12	23.12	20.45	18.91	16.89	0.01	0.11	103.72	106.83	56.46	57.25
800	3.34	2.30	24.03	20.64	17.73	16.14	0.02	0.07	118.40	121.72	55.63	54.62
900	3.39	2.50	23.93	21.15	16.40	15.57	0.01	0.00	133.03	136.14	54.94	53.70
950	3.45	2.63	23.13	21.25	15.66	15.24	0.02	0.06	140.34	143.19	55.00	52.82
1000	3.48	2.71	22.04	21.05	14.85	14.79	0.03	0.08	147.37	149.90	55.06	51.93
1100	3.58	2.92	19.28	19.17	13.13	13.48	0.08	0.17	160.61	162.43	57.27	51.60
1150	3.61	3.00	17.94	17.86	12.42	12.83	0.09	0.17	167.15	168.42	53.78	54.05
1200	3.32	2.76	16.78	16.83	12.16	12.66	0.22	0.13	172.40	172.77	54.27	54.59
1220	3.15	2.56	16.43	16.64	12.24	12.82	0.41	0.35	175.57	175.50	56.40	54.95

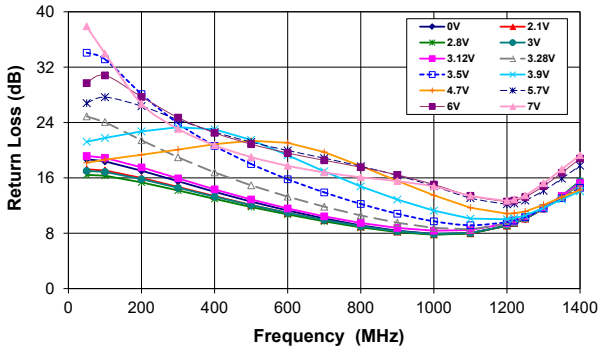
**VAEQ-1220+
INSERTION LOSS Vs. FREQUENCY
OVER CONTROL VOLTAGES**



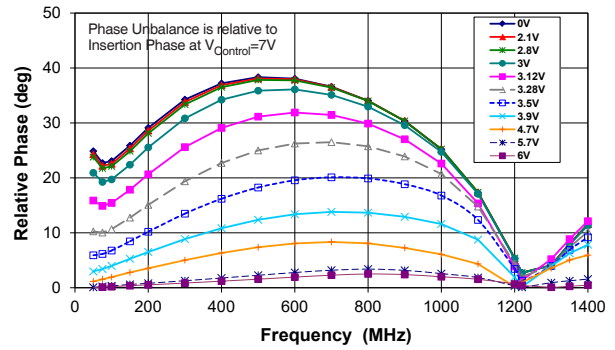
**VAEQ-1220+
INPUT RETURN LOSS Vs. FREQUENCY
OVER CONTROL VOLTAGES**



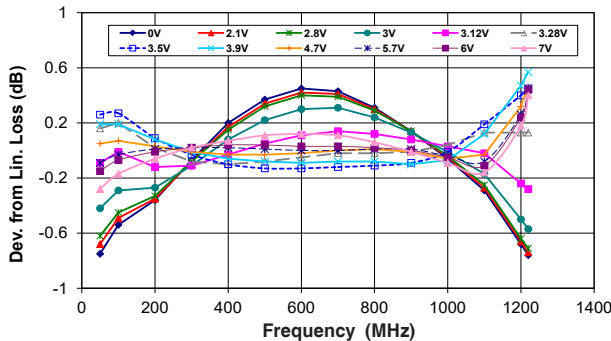
**VAEQ-1220+
OUTPUT RETURN LOSS Vs. FREQUENCY
OVER CONTROL VOLTAGES**



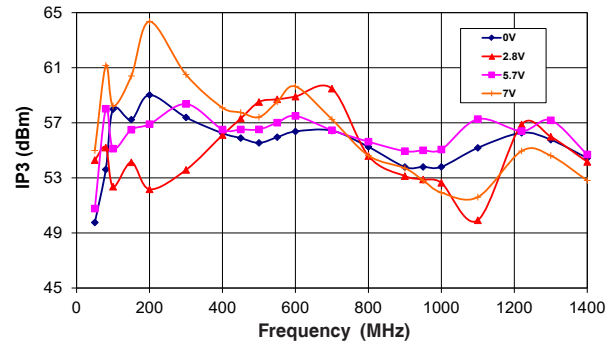
**VAEQ-1220+
PHASE UNBALANCE Vs. FREQUENCY
OVER CONTROL VOLTAGES**



**VAEQ-1220+
DEVIATION FROM LINEAR LOSS Vs. FREQUENCY
OVER CONTROL VOLTAGES**



**VAEQ-1220+
IP3 Vs. FREQUENCY
OVER CONTROL VOLTAGES**



Additional Notes

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- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- 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 Equalizer, 50Ω

VAEQ-1220+

Typical Performance Data @ V+=5V

Frequency (MHz)	Insertion Loss (dB) Vcontrol		Input Return Loss (dB) Vcontrol		Output Return Loss (dB) Vcontrol		Deviation from Linear Loss (dB) Vcontrol		Insertion Phase (Ph)0V Vcontrol	
	0V	2.8V	0V	2.8V	0V	2.8V	0V	2.8V	0V	2.8V
	10	20.79	20.39	11.64	11.71	16.04	13.59	-	-	-61.50
30	16.10	15.83	14.51	14.53	18.08	15.77	-	-	-29.93	-28.61
50	15.27	15.04	15.53	15.54	18.70	16.44	0.75	0.62	-18.89	-17.81
70	14.92	14.70	15.87	15.89	18.69	16.51	0.60	0.49	-13.39	-12.39
90	14.67	14.47	15.98	16.00	18.50	16.40	0.55	0.46	-9.96	-8.99
110	14.44	14.25	15.98	16.00	18.28	16.25	0.53	0.44	-7.45	-6.48
130	14.20	14.03	15.92	15.95	18.08	16.12	0.50	0.43	-5.35	-4.37
150	13.97	13.81	15.84	15.87	17.84	15.96	0.47	0.41	-3.42	-2.41
170	13.73	13.59	15.75	15.78	17.55	15.74	0.43	0.39	-1.57	-0.55
200	13.35	13.23	15.56	15.60	17.04	15.35	0.36	0.33	1.15	2.15
220	13.08	12.97	15.40	15.44	16.75	15.13	0.30	0.28	3.06	4.05
240	12.81	12.72	15.25	15.28	16.48	14.93	0.24	0.23	5.08	6.06
260	12.55	12.47	15.11	15.14	16.18	14.71	0.18	0.18	7.17	8.15
300	12.03	11.97	14.78	14.82	15.51	14.18	0.07	0.08	11.48	12.38
320	11.75	11.70	14.57	14.60	15.22	13.95	0.00	0.02	13.77	14.63
340	11.48	11.44	14.37	14.41	14.92	13.72	-0.07	-0.04	16.24	17.08
360	11.23	11.19	14.20	14.23	14.63	13.48	-0.12	-0.08	18.82	19.63
380	10.99	10.96	14.02	14.07	14.31	13.23	-0.15	-0.11	21.36	22.14
400	10.74	10.72	13.83	13.87	13.99	12.97	-0.20	-0.15	23.89	24.61
420	10.47	10.46	13.60	13.64	13.70	12.74	-0.26	-0.21	26.51	27.17
450	10.09	10.08	13.29	13.33	13.28	12.39	-0.33	-0.29	30.86	31.48
500	9.54	9.54	12.84	12.88	12.57	11.79	-0.37	-0.32	38.06	38.57
550	8.93	8.94	12.30	12.34	11.92	11.25	-0.46	-0.41	45.69	46.10
600	8.44	8.45	11.87	11.90	11.29	10.71	-0.45	-0.40	53.55	53.87
650	7.90	7.92	11.35	11.38	10.70	10.21	-0.47	-0.43	61.67	61.90
700	7.43	7.45	10.95	10.97	10.14	9.72	-0.43	-0.39	70.08	70.24
750	6.97	6.98	10.50	10.52	9.63	9.27	-0.38	-0.35	78.55	78.64
770	6.77	6.79	10.35	10.37	9.42	9.09	-0.36	-0.34	82.10	82.17
800	6.52	6.53	10.16	10.17	9.14	8.85	-0.31	-0.29	87.46	87.51
820	6.36	6.37	10.02	10.03	8.97	8.70	-0.26	-0.25	90.99	91.02
840	6.19	6.20	9.88	9.89	8.81	8.56	-0.23	-0.22	94.50	94.50
860	6.01	6.02	9.74	9.75	8.65	8.42	-0.20	-0.20	98.09	98.08
880	5.84	5.84	9.65	9.65	8.49	8.28	-0.17	-0.17	101.77	101.75
900	5.67	5.67	9.56	9.57	8.36	8.16	-0.14	-0.14	105.54	105.51
920	5.51	5.51	9.49	9.49	8.25	8.07	-0.09	-0.09	109.34	109.31
950	5.30	5.31	9.36	9.36	8.09	7.93	0.01	0.00	114.98	114.94
970	5.15	5.15	9.31	9.31	7.98	7.85	0.06	0.04	118.58	118.53
990	4.95	4.95	9.30	9.29	7.92	7.81	0.07	0.05	122.30	122.25
1000	4.84	4.84	9.27	9.26	7.90	7.79	0.06	0.04	124.37	124.32
1020	4.68	4.68	9.25	9.25	7.88	7.78	0.11	0.08	128.70	128.65
1040	4.58	4.58	9.26	9.26	7.87	7.78	0.22	0.19	132.89	132.84
1060	4.48	4.48	9.29	9.28	7.87	7.80	0.32	0.29	136.60	136.55
1100	4.04	4.04	9.40	9.40	8.01	7.97	0.29	0.25	144.65	144.60
1120	3.88	3.89	9.51	9.50	8.14	8.10	0.34	0.30	149.63	149.58
1140	3.84	3.84	9.65	9.64	8.30	8.28	0.50	0.46	154.33	154.29
1150	3.82	3.83	9.73	9.72	8.39	8.37	0.59	0.55	156.41	156.37
1180	3.62	3.63	10.00	9.99	8.76	8.75	0.69	0.65	162.27	162.23
1200	3.41	3.41	10.23	10.23	9.09	9.10	0.68	0.64	166.99	166.94
1220	3.28	3.29	10.49	10.49	9.45	9.46	0.76	0.71	172.44	172.40
1250	3.29	3.30	10.99	10.98	10.08	10.11	-	-	-179.95	-179.99
1300	3.10	3.12	12.01	12.01	11.53	11.60	-	-	-168.35	-168.40
1400	3.35	3.37	14.80	14.79	15.29	15.54	-	-	-142.80	-142.83

Frequency (MHz)	Input IP3 (dBm) Vcontrol	
	0V	2.8V
	10	43.13
30	46.03	47.62
50	49.76	54.29
80	53.61	55.20
100	57.99	52.36
150	57.23	54.13
200	59.02	52.17
300	57.39	53.58
400	56.24	56.11
450	55.89	57.31
500	55.54	58.51
550	55.96	58.71
600	56.37	58.90
700	56.43	59.48
800	55.25	54.59
900	53.79	53.13
950	53.80	52.89
1000	53.80	52.64
1100	55.18	49.92
1220	56.27	56.88
1300	55.77	55.99
1400	54.44	54.16
1500	54.29	53.81

Notes

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- 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-Circuit's 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-Circuit's website at www.minicircuits.com/MCLStore/terms.jsp



Voltage Variable Equalizer, 75Ω

VAEQ-1120-75+

Typical Performance Data @ $V_{+}=5V$

Frequency (MHz)	Insertion Loss (dB) Vcontrol		Input Return Loss (dB) Vcontrol		Output Return Loss (dB) Vcontrol		Deviation from Linear Loss (dB) Vcontrol		Insertion Phase (Ph)0V Vcontrol	
	5.7V	7V	5.7V	7V	5.7V	7V	5.7V	7V	5.7V	7V
	10	3.44	2.05	19.79	30.95	22.53	24.58	-	-	-3.35
30	3.17	1.74	20.57	36.23	25.92	33.10	-	-	2.18	2.10
50	3.11	1.67	20.78	36.09	26.80	37.90	0.09	0.28	5.90	5.98
70	3.08	1.65	20.89	34.91	27.30	37.83	0.06	0.23	9.26	9.47
90	3.07	1.64	20.96	33.52	27.57	35.12	0.04	0.19	12.51	12.81
110	3.07	1.63	21.03	32.22	27.69	33.02	0.02	0.16	15.67	16.06
130	3.07	1.63	21.12	31.05	27.58	31.46	0.01	0.13	18.79	19.27
150	3.07	1.64	21.19	30.01	27.27	29.89	0.01	0.11	21.85	22.45
170	3.07	1.64	21.19	29.02	26.87	28.40	0.00	0.09	24.89	25.59
200	3.08	1.65	21.16	27.68	26.37	26.69	-0.01	0.06	29.45	30.26
220	3.08	1.65	21.20	26.95	26.09	25.92	-0.01	0.04	32.49	33.39
240	3.09	1.66	21.27	26.34	25.73	25.25	-0.01	0.02	35.51	36.51
260	3.10	1.68	21.28	25.81	25.25	24.48	-0.01	0.01	38.49	39.61
300	3.11	1.70	21.20	24.64	24.39	23.08	-0.02	-0.02	44.46	45.74
320	3.11	1.70	21.24	24.10	24.08	22.63	-0.03	-0.04	47.47	48.83
340	3.12	1.72	21.33	23.72	23.73	22.14	-0.02	-0.05	50.49	51.96
360	3.14	1.74	21.39	23.38	23.37	21.67	-0.02	-0.06	53.47	55.06
380	3.15	1.76	21.39	23.05	22.96	21.17	-0.02	-0.06	56.41	58.10
400	3.15	1.77	21.35	22.64	22.62	20.71	-0.02	-0.07	59.33	61.10
420	3.15	1.78	21.37	22.24	22.34	20.37	-0.03	-0.09	62.32	64.16
450	3.17	1.81	21.53	21.87	21.95	19.89	-0.02	-0.11	66.86	68.87
500	3.21	1.87	21.64	21.33	21.17	19.01	-0.01	-0.11	74.13	76.40
550	3.22	1.91	21.90	20.84	20.59	18.38	-0.02	-0.13	81.58	84.08
600	3.26	1.99	22.18	20.57	19.95	17.75	0.00	-0.12	88.84	91.61
650	3.27	2.04	22.55	20.25	19.41	17.26	-0.01	-0.13	96.19	99.17
700	3.30	2.13	23.05	20.25	18.84	16.80	0.00	-0.11	103.49	106.68
750	3.32	2.22	23.41	20.15	18.26	16.41	-0.01	-0.09	110.76	114.09
770	3.32	2.25	23.65	20.24	18.02	16.27	-0.01	-0.08	113.70	117.06
800	3.34	2.31	23.87	20.42	17.67	16.09	-0.01	-0.06	118.12	121.51
820	3.36	2.35	23.87	20.45	17.44	15.98	0.00	-0.04	121.03	124.42
840	3.37	2.40	23.84	20.48	17.18	15.86	0.00	-0.02	123.91	127.28
860	3.37	2.43	23.80	20.56	16.91	15.75	-0.01	-0.01	126.82	130.13
880	3.38	2.47	23.75	20.72	16.63	15.64	-0.01	0.00	129.75	133.00
900	3.39	2.51	23.60	20.87	16.35	15.53	-0.01	0.01	132.71	135.87
920	3.41	2.56	23.35	20.95	16.08	15.43	0.00	0.03	135.65	138.72
950	3.45	2.63	22.70	20.89	15.62	15.22	0.03	0.07	139.99	142.89
970	3.47	2.68	22.29	20.85	15.27	15.03	0.04	0.09	142.77	145.55
990	3.48	2.71	21.90	20.79	14.96	14.86	0.04	0.10	145.53	148.18
1000	3.48	2.72	21.60	20.67	14.79	14.76	0.04	0.09	146.99	149.56
1020	3.49	2.76	21.08	20.45	14.46	14.54	0.05	0.10	149.96	152.39
1040	3.55	2.82	20.54	20.13	14.12	14.29	0.09	0.15	152.81	155.12
1060	3.60	2.90	19.98	19.72	13.76	14.01	0.14	0.20	155.33	157.54
1100	3.56	2.92	18.86	18.77	13.08	13.43	0.08	0.16	160.13	161.98
1120	3.54	2.92	18.33	18.29	12.78	13.16	0.05	0.13	162.92	164.51
1140	3.56	2.95	17.81	17.77	12.52	12.93	0.06	0.15	165.54	166.90
1150	3.57	2.98	17.55	17.51	12.41	12.82	0.07	0.15	166.66	167.90
1180	3.46	2.90	16.84	16.84	12.18	12.65	-0.06	0.04	169.55	170.33
1200	3.27	2.71	16.47	16.56	12.19	12.70	-0.26	-0.18	172.01	172.35
1220	3.09	2.51	16.16	16.42	12.30	12.89	-0.45	-0.40	175.25	175.16
1250	2.96	2.33	15.95	16.54	12.73	13.48	-	-	-179.82	179.74
1300	2.60	1.93	16.10	17.57	14.14	15.22	-	-	-171.53	-172.45
1400	2.54	1.75	17.48	21.64	17.77	19.27	-	-	-152.77	-154.34

Frequency (MHz)	Input IP3 (dBm) Vcontrol	
	5.7V	7V
	10	40.81
30	47.87	55.16
50	50.77	54.99
80	58.02	61.16
100	55.12	58.23
150	56.50	60.40
200	56.90	64.36
300	58.37	60.50
400	56.51	58.09
450	56.52	57.75
500	56.52	57.41
550	57.01	58.53
600	57.50	59.64
700	56.46	57.25
800	55.63	54.62
900	54.94	53.70
950	55.00	52.82
1000	55.06	51.93
1100	57.27	51.60
1220	56.40	54.95
1300	57.18	54.61
1400	54.70	52.81
1500	54.79	52.48

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.
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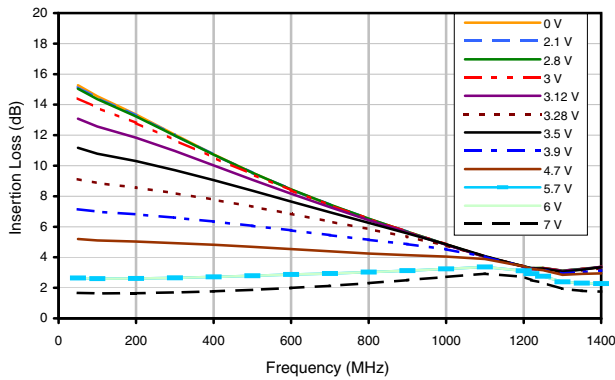


Voltage Variable Equalizer, 50Ω

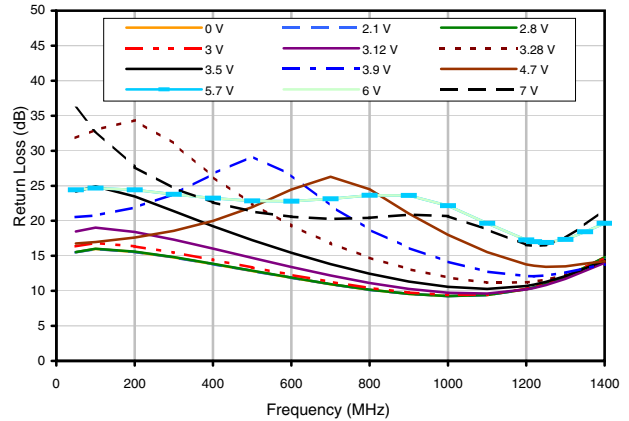
VAEQ-1220+

Typical Performance Curves @ $V_+ = 5V$

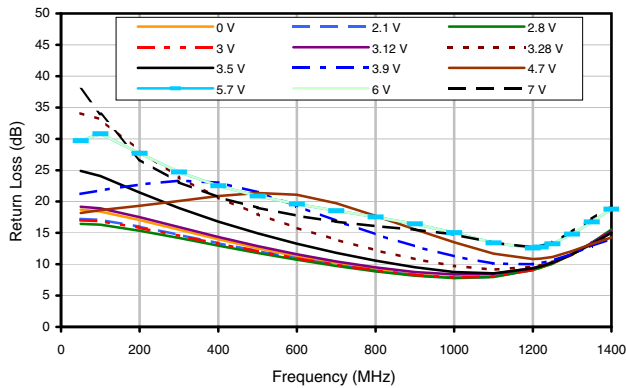
INSERTION LOSS
Vs.FREQUENCY OVER CONTROL VOLTAGES



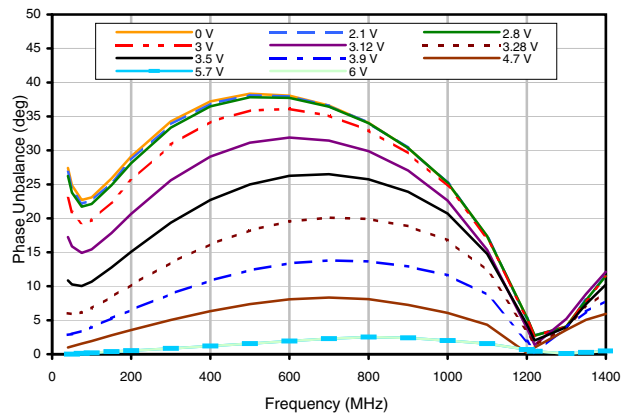
INPUT RETURN LOSS
Vs.FREQUENCY OVER CONTROL VOLTAGES



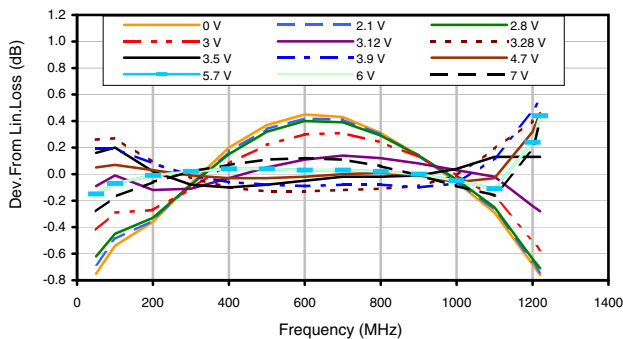
OUTPUT RETURN LOSS
Vs.FREQUENCY OVER CONTROL VOLTAGES



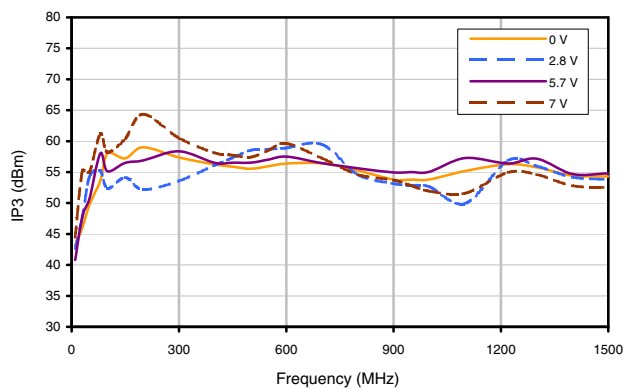
PHASE UNBALANCE
Vs.FREQUENCY OVER CONTROL VOLTAGES



DEVIATION FROM LINEAR LOSS
Vs.FREQUENCY OVER CONTROL VOLTAGES



IP3
Vs.FREQUENCY OVER CONTROL VOLTAGES



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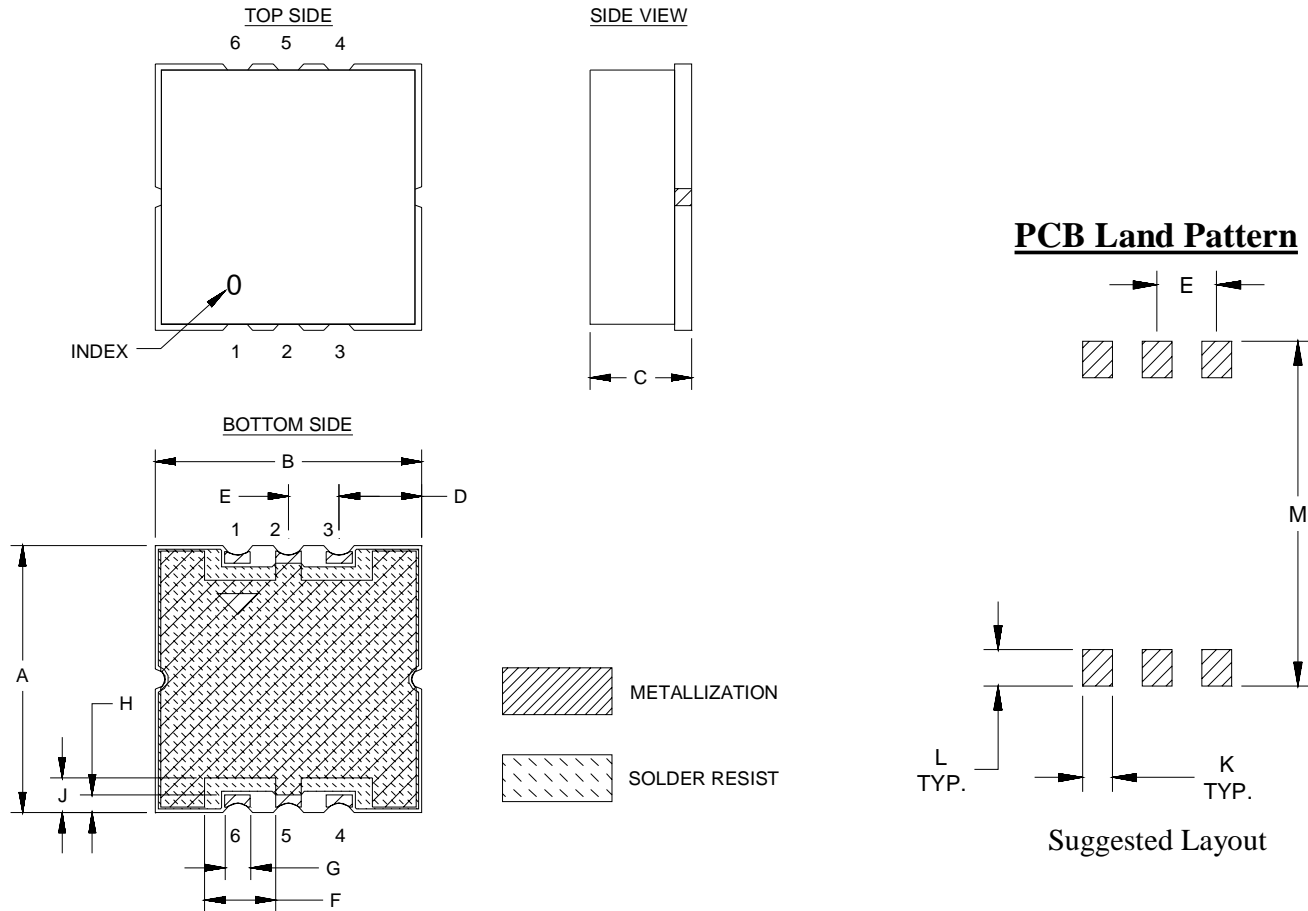


Case Style

HE

HE1354

Outline Dimensions



CASE #	A	B	C	D	E	F	G	H	J	K	L	M	WT. GRAMS
HE1354	.394 (10.01)	.394 (10.01)	.150 (3.81)	.122 (3.10)	.075 (1.90)	.098 (2.49)	.038 (0.97)	.026 (0.66)	.051 (1.29)	.038 (0.97)	.046 (1.17)	.434 (11.02)	0.7

Dimensions are in inches (mm). Tolerances: 2 Pl. $\pm .03$; 3 Pl. $\pm .015$

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.



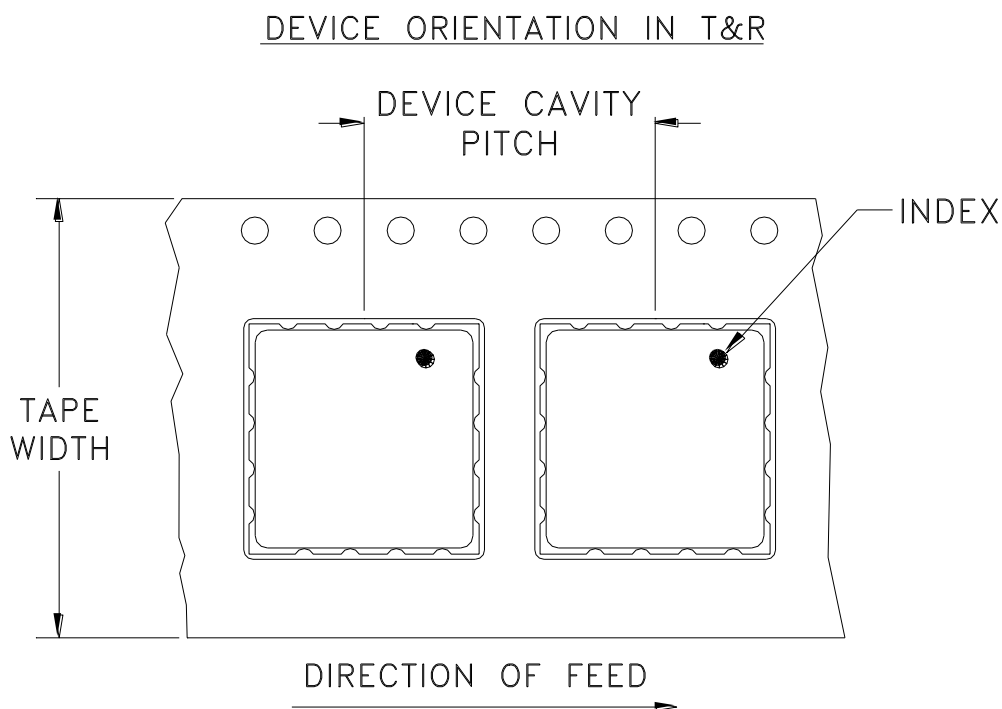
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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

RF/IF MICROWAVE COMPONENTS

Tape & Reel Packaging TR-F37



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				

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



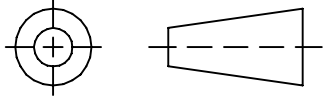
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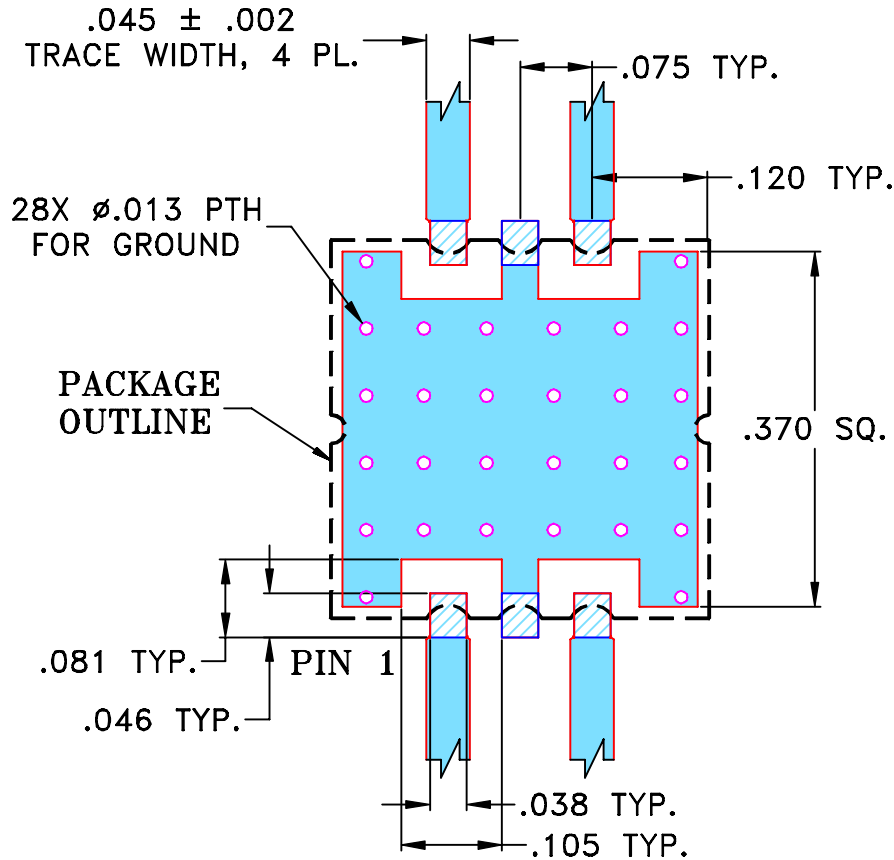
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M116338	NEW RELEASE (FROM RAVON)	03/08	DK	HH
OR	R72078	NEW RELEASE (FROM RAVON)	03/08	DK	HH

SUGGESTED MOUNTING CONFIGURATION FOR
HE1354 CASE STYLE, "qg" PIN CONNECTION, 50 Ω

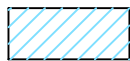


NOTE:

1. TRACE WIDTH IS SHOWN FOR FR4 WITH DIELECTRIC THICKNESS .025"±.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 TOLERANCES ON: 2 PL DECIMALS ± 3 PL DECIMALS ± .005 ANGLES ± FRACTIONS ±	DRAWN	DK (RAVON)	16 MAR 08
	CHECKED	RZ (RAVON)	16 MAR 08
	APPROVED	HH (RAVON)	16 MAR 08



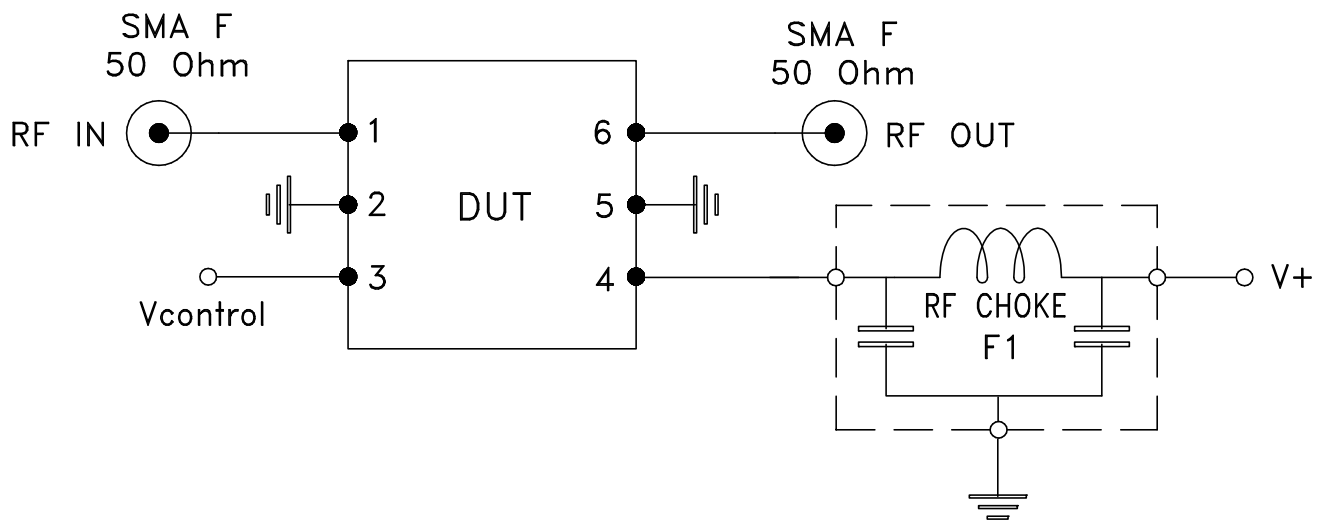
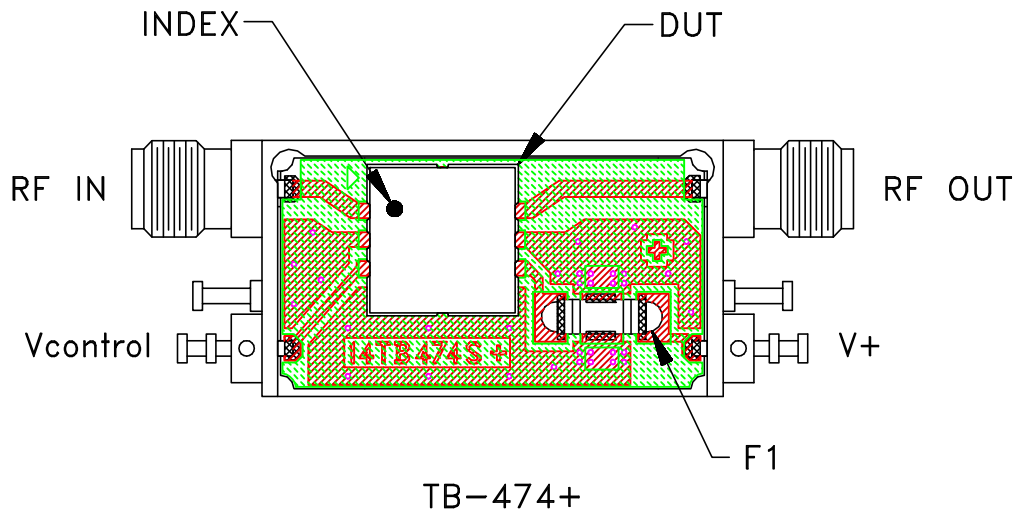
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Brooklyn NY 11235

PL, qg, HE1354, TB-474+

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SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-285	OR
FILE:	98PL285	SCALE:	SHEET:
		5:1	1 OF 1


Evaluation Board and Circuit



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: FR4 GRADE IT-180TC (ITEQ CORPORATION)
Dielectric Constant=4.5, Thickness=.025 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	0° 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