

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.



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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

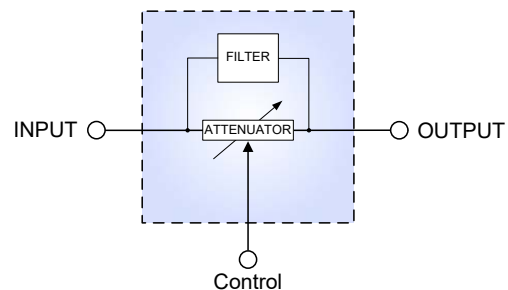
Parameter	Condition	Min.	Typ.	Max.	Units
Frequency Range		50		1220	MHz
Insertion Loss	50 MHz, Control Voltage, 0 - 7V 1220 MHz, Control Voltage, 0 - 7V		15.2 - 1.7 3.3 - 2.5		dB
Deviation from Linear Loss	50 - 1220 MHz, Control Voltage 0 - 7V		± 0.2		dB
IP3	50 - 1220 MHz, Control Voltage, 2.8 - 7V	+45	+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.

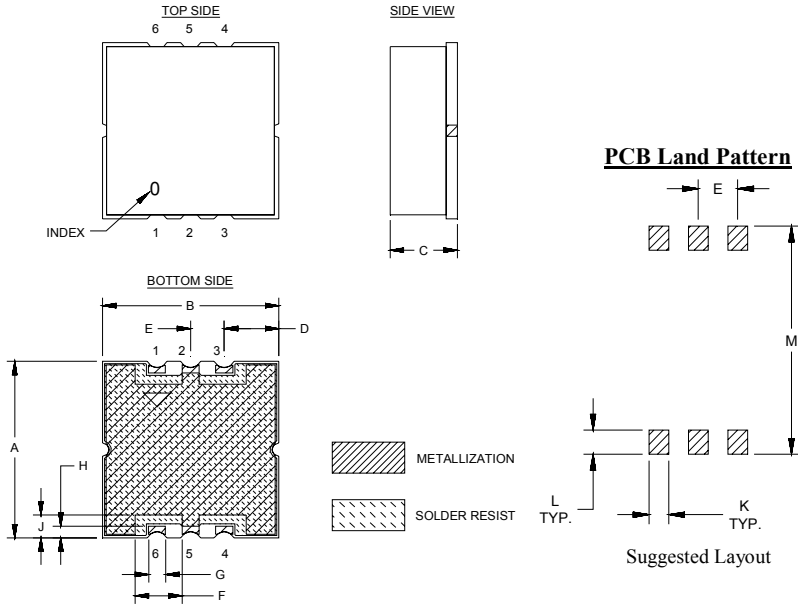
Simplified Functional Diagram



Pad Connections

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

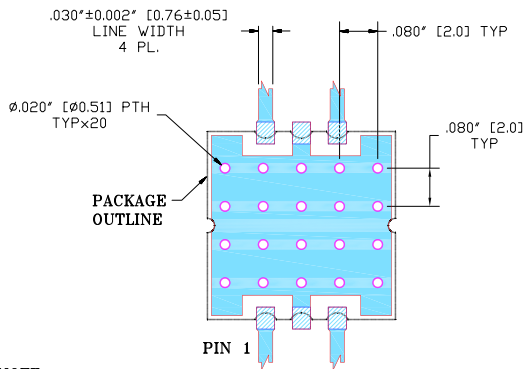
Outline Drawing



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. $.030 \pm 0.002$ ". 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

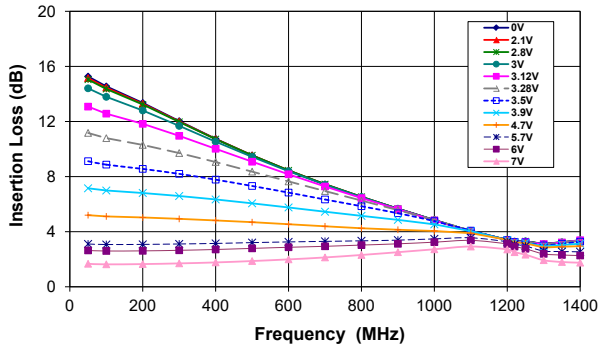
@ $V_{Control}=0V$ & $V_{Control}=2.8V$

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

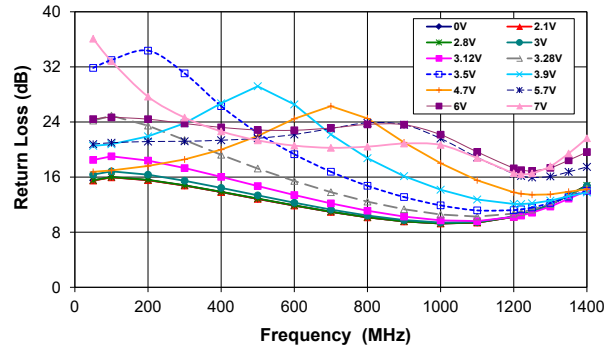
@ $V_{Control}=5.7V$ & $V_{Control}=7V$

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

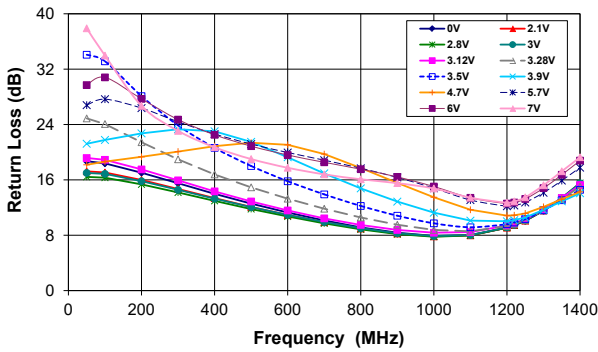
**VAEQ-1220+
INSERTION LOSS Vs. FREQUENCY
OVER CONTROL VOLTAGES**



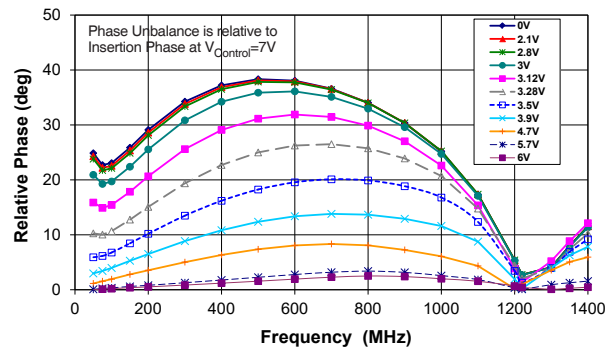
**VAEQ-1220+
INPUT RETURN LOSS Vs. FREQUENCY
OVER CONTROL VOLTAGES**



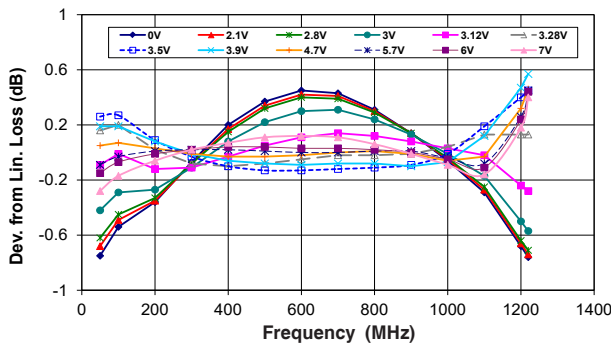
**VAEQ-1220+
OUTPUT RETURN LOSS Vs. FREQUENCY
OVER CONTROL VOLTAGES**



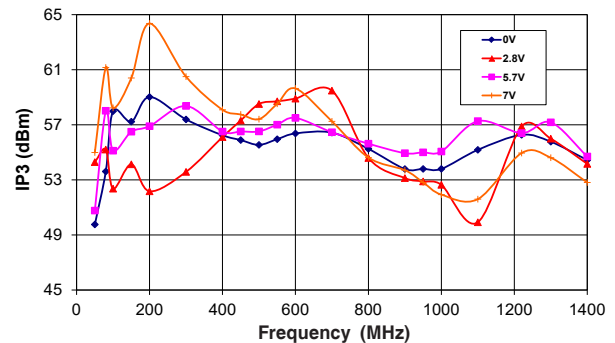
**VAEQ-1220+
PHASE UNBALANCE Vs. FREQUENCY
OVER CONTROL VOLTAGES**



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



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



Additional Notes

- 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.
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