

# Voltage Variable Attenuator

## VACC-22+

50Ω 1600 to 2200 MHz



Generic photo used for illustration purposes only

CASE STYLE: GF995

**+RoHS Compliant**

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

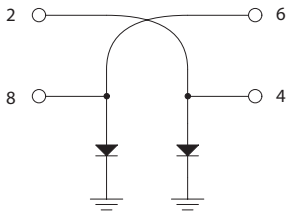
### Maximum Ratings

Operating Temperature	-45°C to 85°C
Storage Temperature	-55°C to 100°C
Absolute Max. Control Current	10mA
Absolute Max. RF Input Level	15dBm

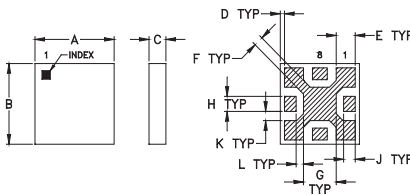
### Pin Connections

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

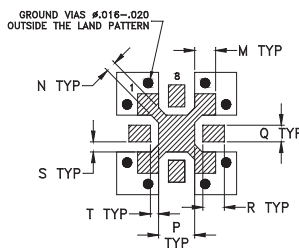
### Equivalent schematic of DUT



### Outline Drawing



### PCB Land Pattern



Suggested Layout,  
Tolerance to be within ±.002

### Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J
.150	.150	.050	.008	.036	.018	.062	.028	.022
3.81	3.81	1.27	0.20	0.91	0.46	1.57	0.71	0.56
K	L	M	N	P	Q	R	S	T
.017	.014	.036	.018	.062	.028	.037	.017	.014
0.43	0.36	0.91	0.46	1.57	0.71	0.94	0.43	0.36
								wt
								.014 grams
								0.06

### Features

- frequency range, 1600-2200 MHz
- IP3, 42 dBm typ.
- minimum current at min. attenuation
- low insertion loss
- aqueous washable
- protected by US Patent 7,030,713

### Applications

- variable gain amplifier
- feed forward amps
- ALC circuits

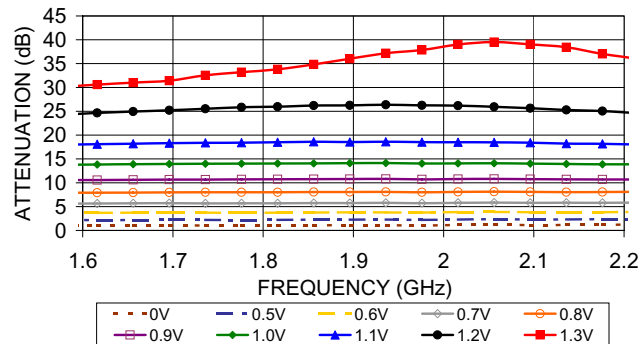
### Electrical Specifications

FREQ. (MHz)		INSERTION LOSS (dB) at 0V control voltage		ATTENUATION (dB)		IP3* (dBm)		RETURN LOSS (dB)		CONTROL VOLTAGE** (V)
Min.	Max.	Typ.	Max.	Typ.	Min.	Typ.	Min.	Typ.	Input	Output
1600	2220	1.2	1.5	25	23	42	38	20	20	0-5

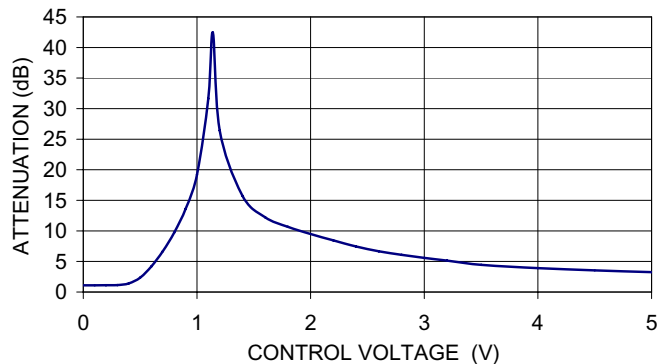
\* Input IP3 tested with two tones separated by 1 MHz at 7 dBm each and 0V control voltage.

\*\* Using recommended control port biasing.

VACC-22+  
ATTENUATION Vs. FREQUENCY Vs.  
CONTROL VOLTAGE



VACC-22+  
TYPICAL ATTENUATION AT 1900 MHz

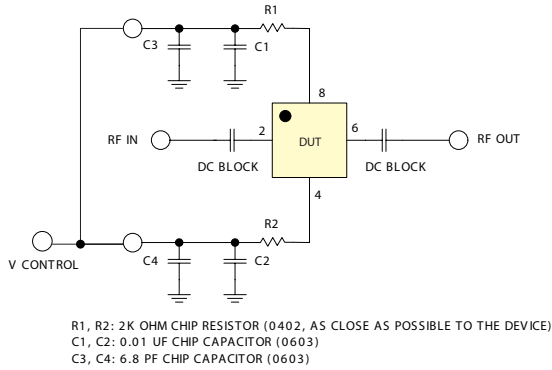


### Notes

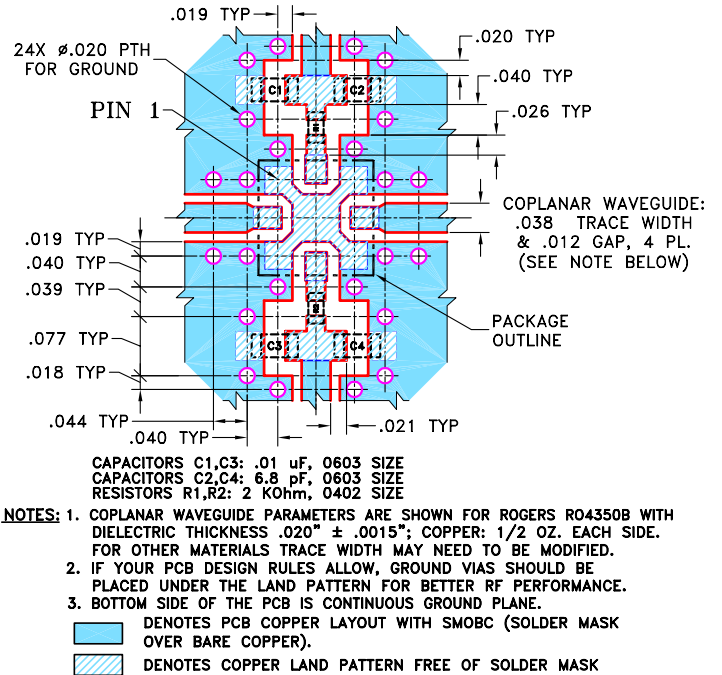
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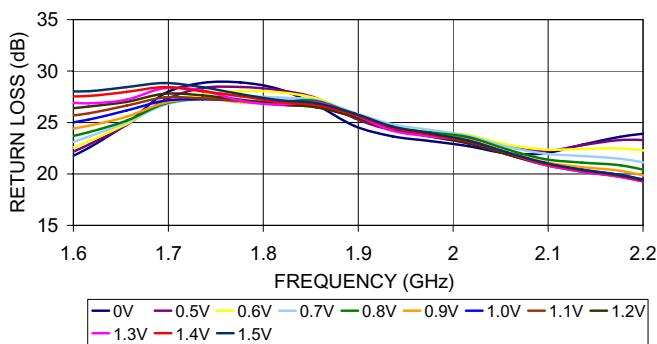
## Recommended control port biasing configuration



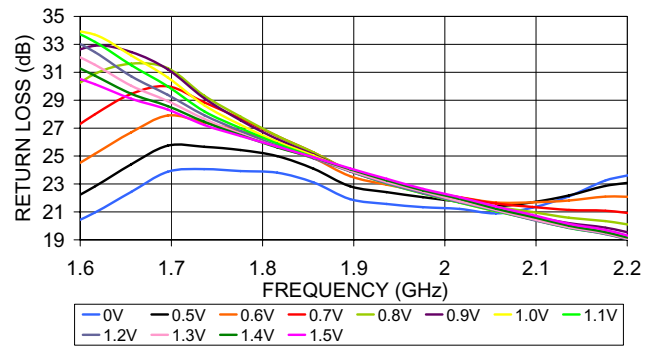
## Demo Board MCL P/N: TB-250 Suggested PCB Layout (PL-148)



VACC-22+  
INPUT RETURN LOSS vs. FREQUENCY vs. CONTROL VOLTAGE



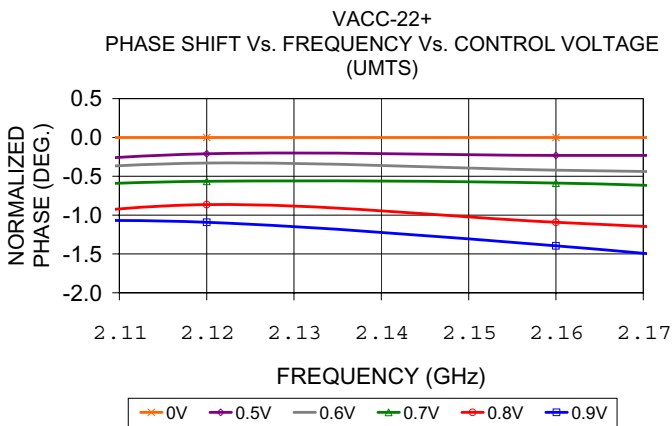
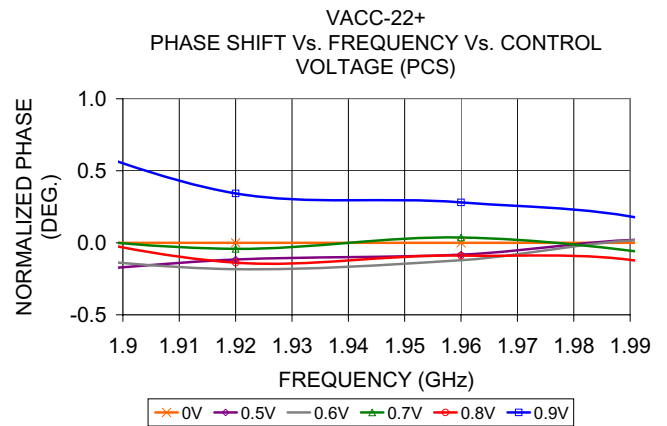
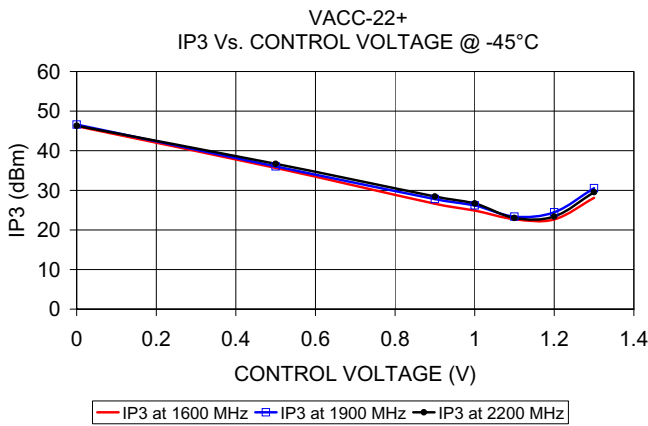
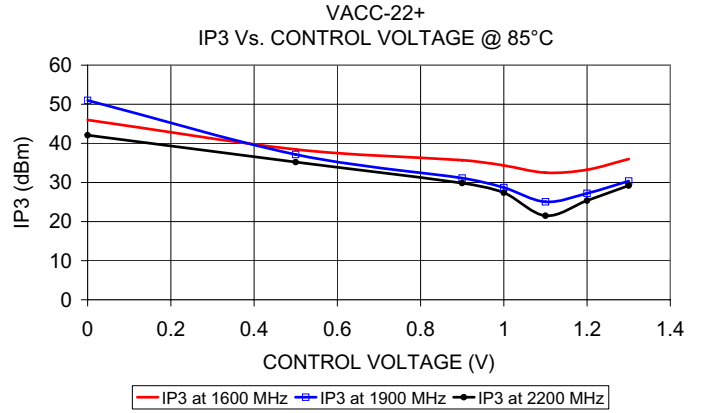
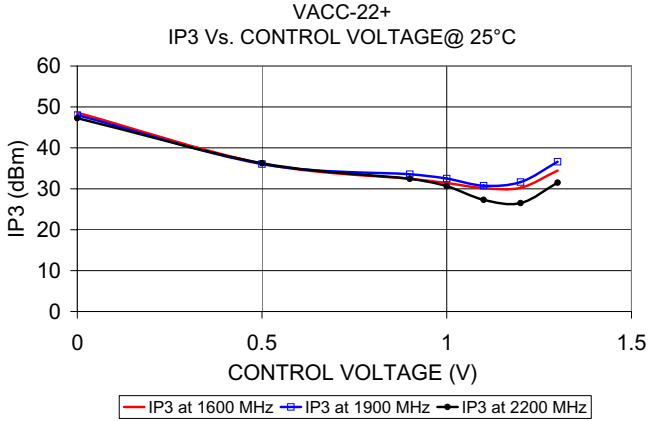
VACC-22+  
OUTPUT RETURN LOSS vs. FREQUENCY vs. CONTROL VOLTAGE



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# Voltage Variable Attenuator

# VACC-22+

## Typical Performance Data

V CONTROL (V)	ATTENUATION @ 1900 MHz (dB)
0.00	1.10
0.20	1.11
0.50	2.36
0.70	6.69
0.90	13.59
1.00	19.20
1.10	31.64
1.14	42.45
1.20	26.42
1.40	15.75
1.60	12.22
1.80	10.67
2.00	9.50
2.40	7.45
2.80	6.08
3.00	5.59
4.00	3.91
5.00	3.25

FREQ. (MHz)	ATTENUATION Vs. V CONTROL (dB)					
	@V Control 0V	@V Control 0.5V	@V Control 0.7V	@V Control 1.0V	@V Control 1.2V	@V Control 1.3V
	1500	1.07	2.23	5.61	13.62	23.70
1536	1.10	2.24	5.64	13.70	24.02	29.49
1576	1.05	2.22	5.63	13.77	24.29	30.10
1616	1.03	2.17	5.64	13.82	24.65	30.60
1656	1.04	2.20	5.69	13.89	24.95	31.01
1696	1.05	2.23	5.71	13.95	25.22	31.42
1736	1.03	2.21	5.67	14.00	25.52	32.55
1776	1.03	2.20	5.69	14.02	25.85	33.19
1816	1.02	2.22	5.70	14.04	25.97	33.81
1856	1.08	2.26	5.74	14.06	26.22	34.83
1896	1.12	2.28	5.75	14.11	26.26	36.03
1936	1.11	2.29	5.79	14.13	26.37	37.19
1976	1.04	2.22	5.71	14.04	26.25	37.85
2016	1.17	2.30	5.78	14.07	26.19	39.01
2056	1.18	2.35	5.84	14.09	25.93	39.52
2096	1.14	2.30	5.80	14.03	25.65	39.04
2136	1.16	2.32	5.82	13.95	25.30	38.44
2176	1.21	2.36	5.78	13.89	25.05	37.03
2216	1.23	2.37	5.84	13.87	24.61	35.95
2256	1.22	2.37	5.80	13.80	24.24	34.52
2296	1.19	2.33	5.70	13.61	23.64	33.06
2300	1.17	2.31	5.69	13.56	23.56	33.02

REV. X1  
VACC-22+  
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# Voltage Variable Attenuator

# VACC-22+

## Typical Performance Data

FREQ. (MHz)	INPUT RETURN LOSS Vs. V CONTROL					
	(dB)					
	@V Control 0V	@V Control 0.5V	@V Control 0.7V	@V Control 1.0V	@V Control 1.2V	@V Control 1.3V
1500	17.65	18.23	19.98	22.97	24.87	25.48
1536	19.08	19.58	21.17	23.86	25.63	26.45
1576	20.75	21.20	22.39	24.64	26.16	27.00
1616	22.52	22.84	23.62	25.27	26.55	26.86
1656	24.86	24.76	25.03	26.17	27.00	27.22
1696	27.82	27.18	26.71	27.12	27.80	28.33
1736	28.84	28.35	27.33	27.25	27.64	28.11
1776	28.89	28.46	27.54	27.12	27.22	27.11
1816	28.26	28.15	27.43	26.78	26.77	26.74
1856	26.71	27.36	27.18	26.58	26.48	26.96
1896	24.66	25.43	25.94	25.55	25.56	25.77
1936	23.66	24.25	24.83	24.39	24.32	24.20
1976	23.19	23.88	24.26	23.70	23.65	23.65
2016	22.70	23.51	23.70	23.08	22.97	23.24
2056	22.01	22.69	22.67	21.96	21.92	22.09
2096	22.01	22.22	21.98	20.98	20.89	20.90
2136	22.84	22.79	21.75	20.41	20.22	20.23
2176	23.61	23.30	21.47	19.91	19.72	19.71
2216	24.12	23.26	20.89	19.15	18.95	18.92
2256	24.99	23.18	20.21	18.31	18.02	18.01
2296	26.69	23.57	19.78	17.75	17.41	17.38
2300	26.78	23.62	19.79	17.70	17.38	17.33

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## Typical Performance Data

FREQ. (MHz)	OUTPUT RETURN LOSS Vs. V CONTROL					
	(dB)					
	@V Control 0V	@V Control 0.5V	@V Control 0.7V	@V Control 1.0V	@V Control 1.2V	@V Control 1.3V
1500	17.08	18.63	22.89	31.21	35.84	35.77
1536	18.40	20.02	24.50	32.92	35.43	34.67
1576	19.70	21.39	26.23	33.89	33.84	32.86
1616	20.95	22.83	27.99	33.69	32.45	31.54
1656	22.44	24.41	29.45	32.20	30.71	30.04
1696	23.88	25.75	30.00	30.63	29.38	28.94
1736	24.06	25.66	28.85	28.65	27.93	27.67
1776	23.92	25.44	27.68	27.23	26.79	26.60
1816	23.81	25.00	26.43	26.03	25.73	25.65
1856	23.11	24.09	25.25	25.02	24.83	24.88
1896	21.92	22.84	23.95	23.94	23.90	23.95
1936	21.57	22.42	23.23	23.05	23.06	23.14
1976	21.34	22.06	22.54	22.32	22.35	22.45
2016	21.22	21.72	22.04	21.68	21.71	21.77
2056	20.89	21.43	21.61	21.05	21.10	21.14
2096	21.31	21.69	21.36	20.51	20.43	20.49
2136	22.11	22.18	21.14	19.95	19.86	19.90
2176	23.25	22.87	21.08	19.59	19.41	19.47
2216	24.02	23.31	20.84	19.02	18.80	18.85
2256	26.45	24.71	20.79	18.59	18.33	18.34
2296	30.27	25.97	20.56	18.13	17.85	17.85
2300	30.76	25.98	20.51	18.08	17.76	17.79

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# Voltage Variable Attenuator

# VACC-22+

## Typical Performance Data

FREQ. (MHz)	INPUT IP3 Vs. V CONTROL (dBm)					
	@V Control 0V	@V Control 0.5V	@V Control 0.9V	@V Control 1.0V	@V Control 1.2V	@V Control 1.3V
1600	48.60	36.15	32.45	31.40	30.25	34.45
1900	48.00	36.05	33.55	32.50	31.65	36.60
2200	47.25	36.25	32.45	30.65	26.50	31.50

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# Voltage Variable Attenuator

# VACC-22+

## Typical Performance Data

FREQ. (MHz)	PHASE SHIFT Vs. V CONTROL (RELATIVE TO V CONTROL=0 V)					
	(deg)					
	@V Control 0.5V	@V Control 0.6V	@V Control 0.7V	@V Control 0.9V	@V Control 1.0V	@V Control 1.1V
1600	-0.10	0.08	0.38	2.34	4.74	9.64
1640	-0.08	0.30	0.70	2.53	4.81	9.26
1680	-0.13	0.13	0.50	2.04	4.21	8.54
1720	0.12	0.10	0.41	1.93	3.68	7.76
1760	0.07	0.17	0.42	1.79	3.50	7.04
1800	-0.08	0.09	0.28	1.46	2.94	6.27
1840	-0.14	-0.03	0.21	1.18	2.49	5.33
1880	-0.21	-0.08	0.06	0.80	1.68	4.17
1920	-0.12	-0.18	-0.04	0.34	1.16	3.07
1960	-0.08	-0.12	0.04	0.28	0.92	2.36
2000	0.02	0.02	-0.10	0.09	0.39	1.36
2040	-0.28	-0.35	-0.37	-0.70	-0.52	-0.05
2080	-0.42	-0.50	-0.66	-1.04	-1.26	-1.43
2120	-0.21	-0.33	-0.56	-1.09	-1.46	-2.16
2160	-0.23	-0.42	-0.59	-1.40	-1.94	-3.20
2200	-0.22	-0.48	-0.73	-1.81	-2.68	-4.25

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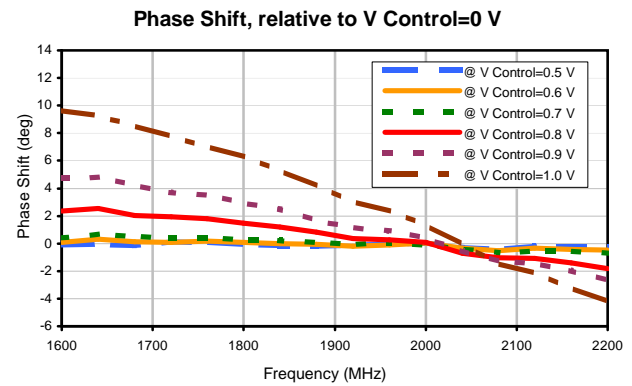
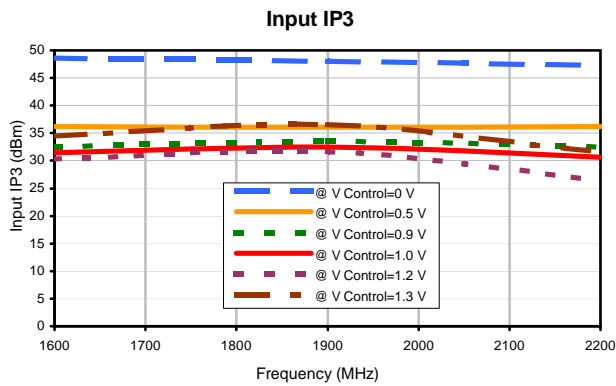
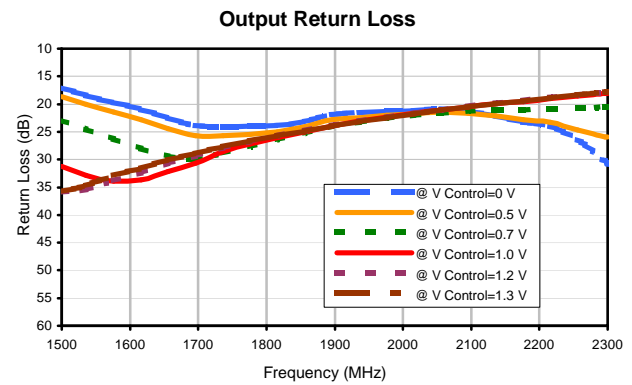
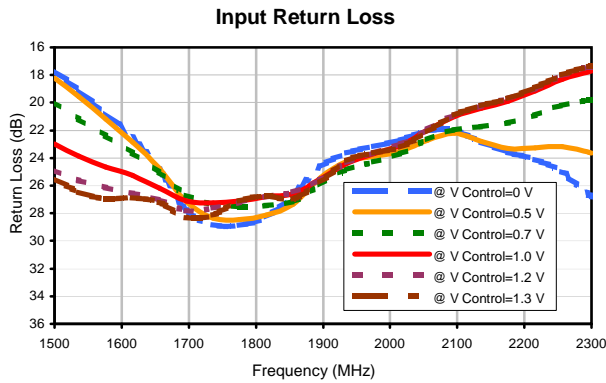
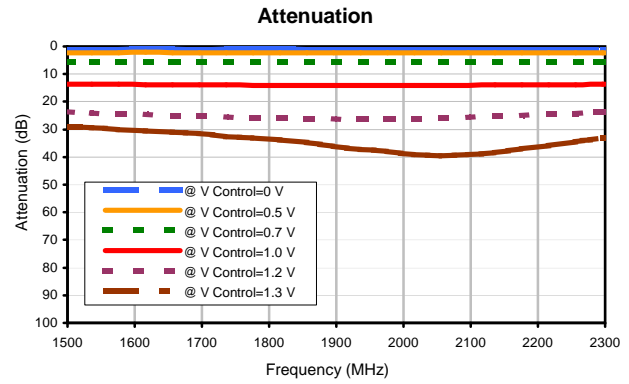
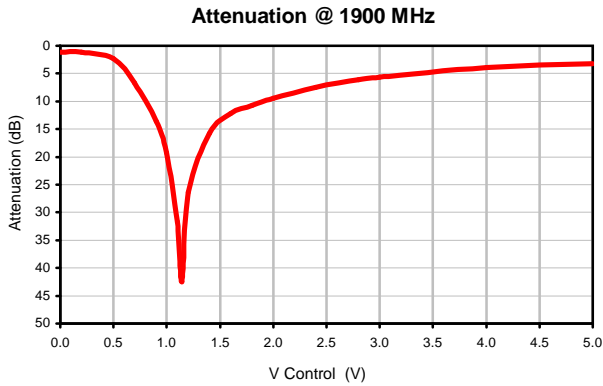




# Voltage Variable Attenuator

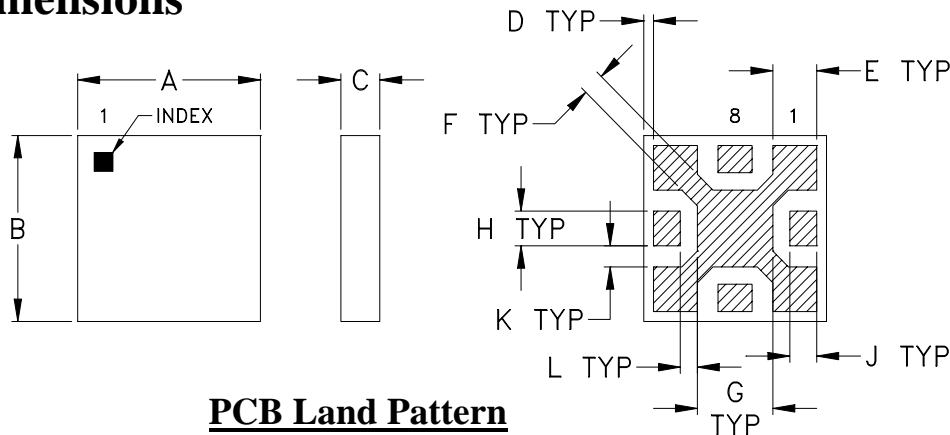
## Typical Performance Curves

# VACC-22+

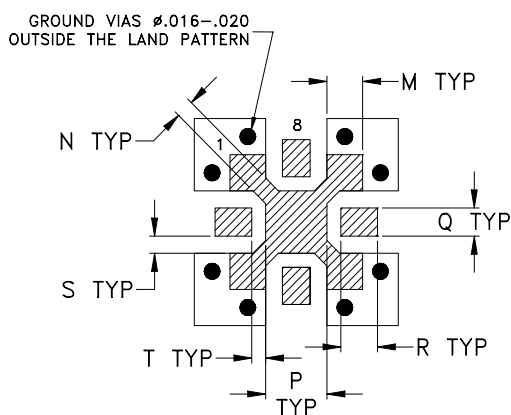


GF981  
GF995

## Outline Dimensions



## PCB Land Pattern



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

CASE #	A	B	C	D	E	F	G	H	J	K
GF981	.150 (3.81)	.150 (3.81)	.032 (0.81)	.008 (0.20)	.036 (0.91)	.018 (0.46)	.062 (1.57)	.028 (0.71)	.022 (0.56)	.017 (0.43)
GF995			.065 MAX (1.65)							

CASE #	L	M	N	P	Q	R	S	T	WT. GRAM
GF981	.014 (0.36)	.036 (0.91)	.018 (0.46)	.062 (1.57)	.028 (0.71)	.037 (0.94)	.017 (0.43)	.014 (0.36)	.05
GF995									.06

Dimensions are in inches (mm). Tolerances: 2Pl.  $\pm .01$ ; 3Pl.  $\pm .005$

### Notes:

1. Open style, Ceramic Base.
2. Termination finish: Palladium Silver.

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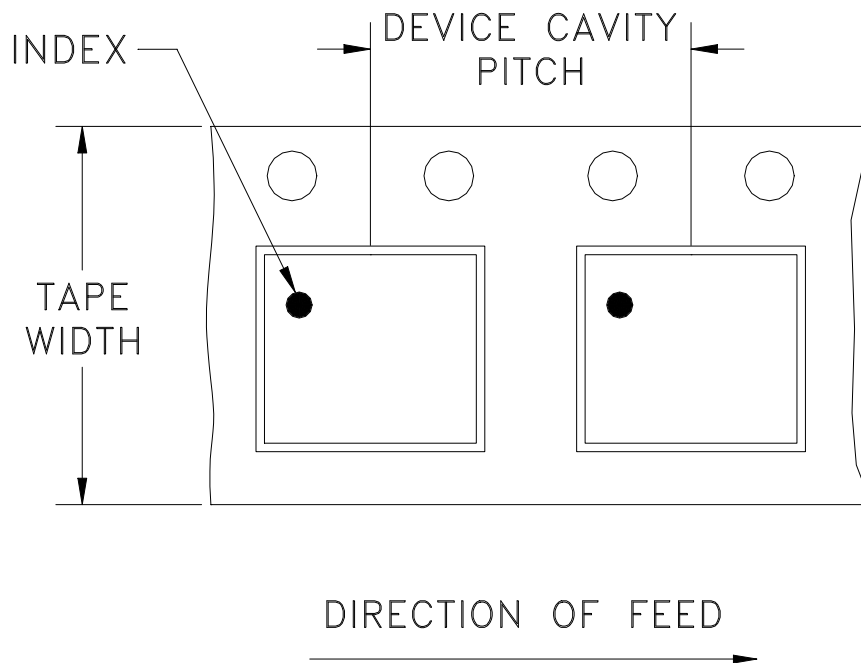
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# Tape & Reel Packaging TR-F68

## DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
12	8	7	Small quantity standard	20
				50
				100
				200
				500
		7	Standard	1000
		13	Standard	2000
				3000
4000				

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.

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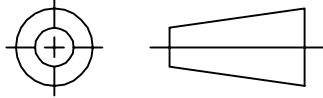
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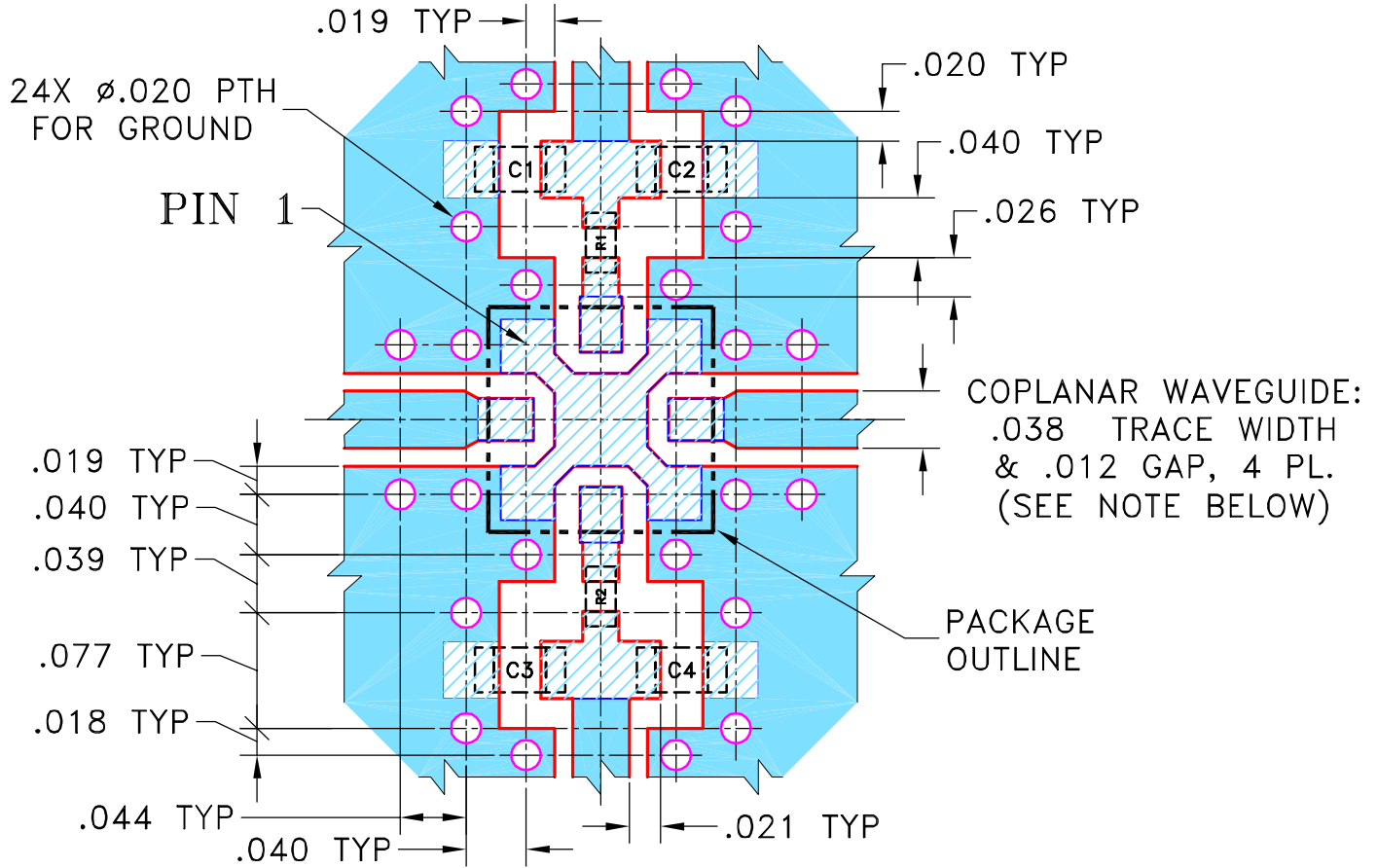
THIRD ANGLE PROJECTION



REVISIONS


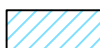
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M89321	NEW RELEASE	11/24/03	GF	ABD
A	M91387	"pj" PIN CONNECTION WAS "nz"	03/15/04	AV	LER(BC)
B	M102713	GF995 WAS GF981, UPDATED NOTES	01/12/06	GF	IL

SUGGESTED MOUNTING CONFIGURATION  
FOR GF995 CASE STYLE, "pj" PIN CONNECTION



CAPACITORS C1,C3: .01 uF, 0603 SIZE  
CAPACITORS C2,C4: 6.8 pF, 0603 SIZE  
RESISTORS R1,R2: 2 KOhm, 0402 SIZE

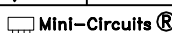
- NOTES:**
1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .020" ± .0015"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
  2. IF YOUR PCB DESIGN RULES ALLOW, GROUND VIAS SHOULD BE PLACED UNDER THE LAND PATTERN FOR BETTER RF PERFORMANCE.
  3. 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 GF	11/19/03
TOLERANCES ON:	CHECKED AV	11/24/03
2 PL DECIMALS ±	APPROVED ABD	11/24/03
3 PL DECIMALS ± .005		
ANGLES ±		
FRACTIONS ±		

 **Mini-Circuits®** 13 Neptune Avenue  
Brooklyn NY 11235

PL, pj, GF995, VACC, TB-250

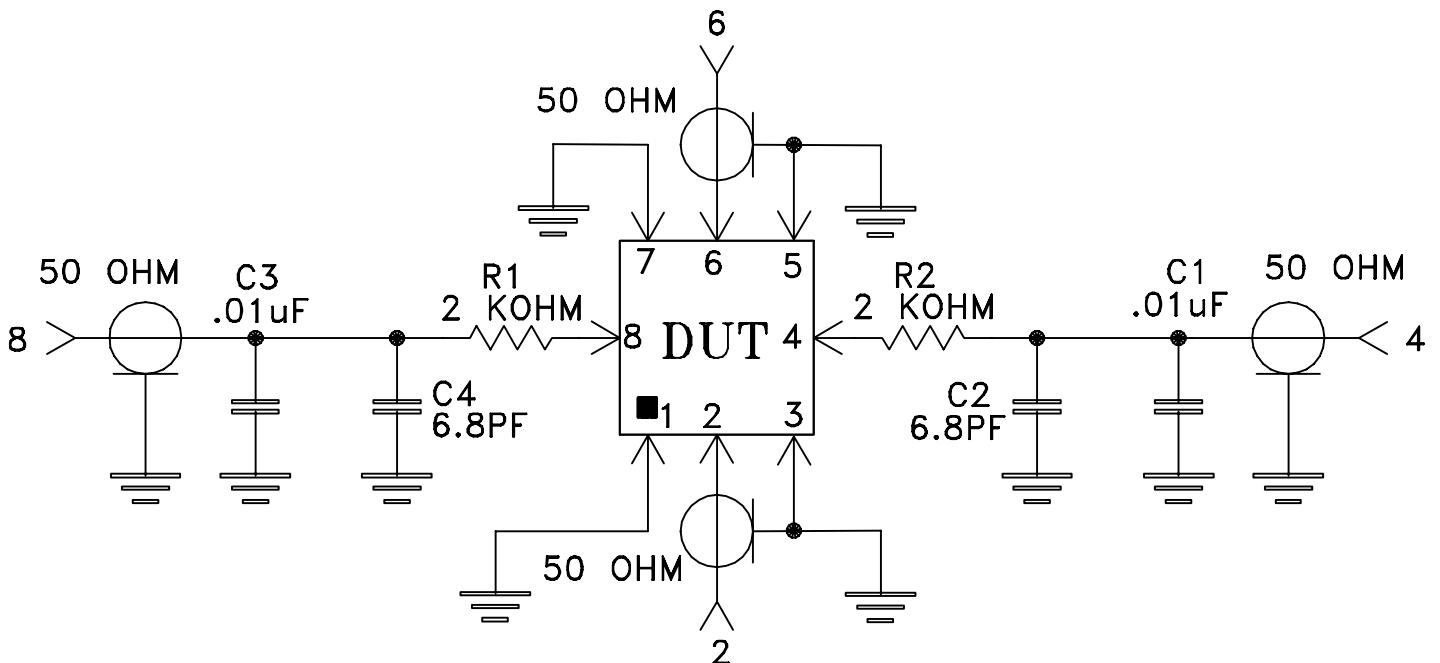
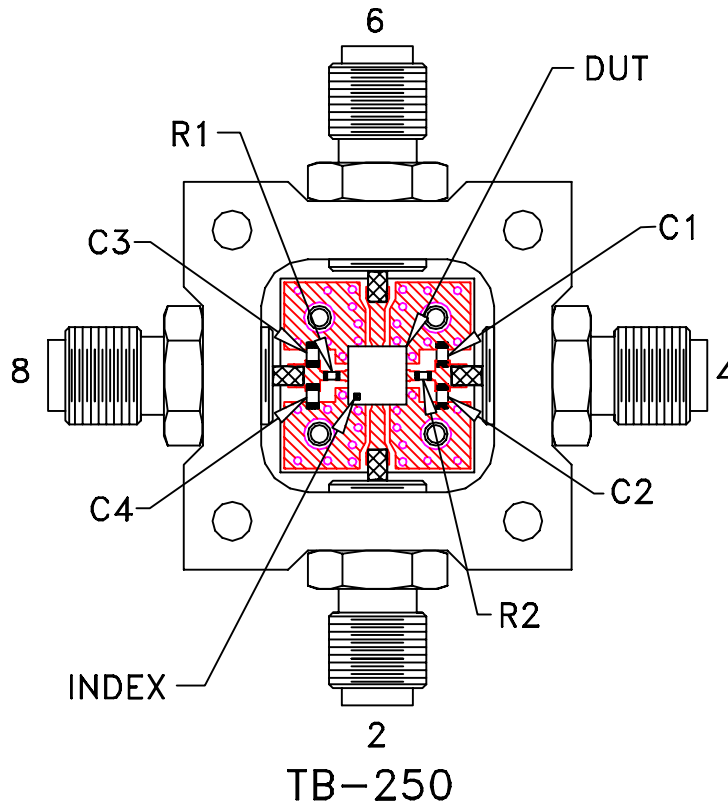
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ASHEETA1.DWG REV:A DATE:01/12/95

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-148	B
FILE:	98PL148	SCALE:	8:1
		SHEET:	1 OF 1

# Evaluation Board and Circuit


For Pin Connections refer to Data Sheet of the DUT



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent, Dielectric Constant=3.5, Thickness=.020 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	-45° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° 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
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutetic Process: 225°C peak Pb-Free Process 245° - 250°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, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)	MIL-STD-202, Method 204, Condition D
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