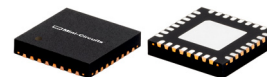


# Digital Controlled Variable Gain Amplifier DVGA1-242APP+

50Ω 0.45 to 2.4 GHz  
31.5 dB, 0.5 dB Step, 6 Bit Parallel Control

## The Big Deal

- Integrated Amplifier and Digital Attenuator
- 30 dB Gain / 31.5 dB Gain Control
- High Output IP3, 34-37 dBm



CASE STYLE: DG1677

## Product Overview

The DVGA1-242APP+ is a 50Ω RF Digital Variable Gain Amplifier that offers an attenuation of 31.5 dB in 0.5 dB steps using a 6-bit parallel interface attenuator and 30dB gain using a E-PHEMT amplifier. Step attenuator used in DVGA1-242APP+ is produced using a unique combination of CMOS process on silicon, offering the performance of GaAs, with the advantages of conventional CMOS devices.

## Key Features

Feature	Advantages
31.5 dB attenuation in 0.5 dB step size	Combining high gain and a wide range of gain control makes the DVGA1-242APP+ an ideal building block for any RF chain where level setting control is required in fast speed of parallel control interface.
High Gain, 30 dB	Incorporating multiple stages of amplification, the DVGA1-242APP+ provides high gain reducing cost and PCB board space
High IP3, +34 dBm at 1.0 GHz Low Noise Figure, 2.4 dB at 1.0 GHz	Combining Low Noise and High IP3 makes this MMIC amplifier ideal for Low Noise Receiver Front End (RFE) giving the user advantages at both ends of the dynamic range: sensitivity & two-tone IM dynamic range.
Output Power, +22.7 dBm at 2.4 GHz	The DVGA1-242APP+ maintains consistent output power capability over the full operating temperature range making it ideal to be used in remote applications such as LNB's as the L Band driver stage.
MCLP Package	Low Inductance, repeatable transitions, excellent thermal pad.
Max Input Power, +24 dBm	Ruggedized design operates up to input powers often seen at Receiver inputs.
Attenuation Step size, 0.5 dB, accuracy 0.1 dB typ. Total attenuation, 31.5 dB	Enables precise control of gain in 0.5 dB steps up to 31.5 dB.
External Jumper	Customer access is provided between the digital attenuator and the RF amplifier to allow the user to integrate external circuit elements if desired.

# Digital Controlled Variable Gain Amplifier

50Ω 450-2400 MHz

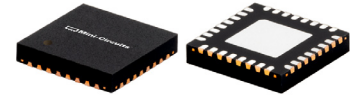
30 dB Gain, 0.5 dB Step, 31.5 dB Attenuation,  
6 Bit Parallel Control

## Product Features

- 31.5 dB Gain control 0.5dB step size
- Gain, 30 dB nominal at 0dB attenuation and 1 GHz
- Excellent accuracy, 0.1 dB typ
- Parallel control interface
- Small size 5.0 x 5.0 mm

## Typical Applications

- Base Station Infrastructure
- GPS
- LTE
- WCDMA



Generic photo used for illustration purposes only

CASE STYLE: DG1677

## DVGA1-242APP+

**+RoHS Compliant**

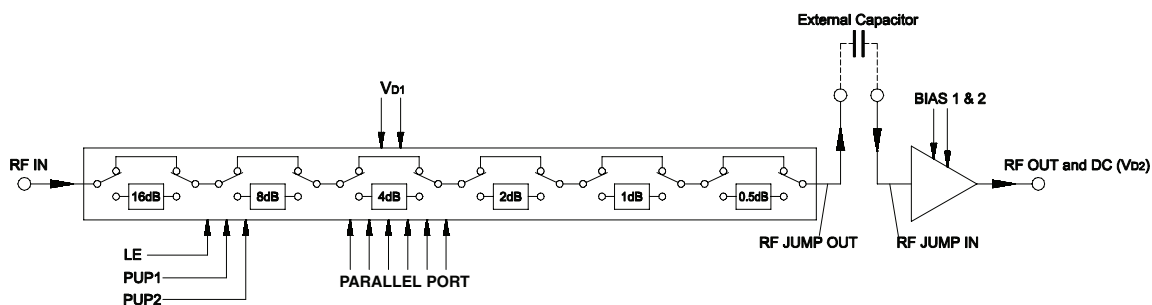
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

## General Description

The DVGA1-242APP+ is a 50Ω RF Digital Variable Gain Amplifier that offers an attenuation of 31.5 dB in 0.5 dB steps using a 6-bit parallel interface attenuator and 30dB gain using a E-PHEMT amplifier. Step attenuator used in DVGA1-242APP+ is produced using a unique combination of CMOS process on silicon, offering the performance of GaAs, with the advantages of conventional CMOS devices.

### Simplified Schematic

(Refer to Table 1 for Pad description)



## RF Electrical Specifications<sup>(1)</sup> at 25°C, 50Ω With $V_{D1}=+3.0V$ , $V_{D2}=+5V$

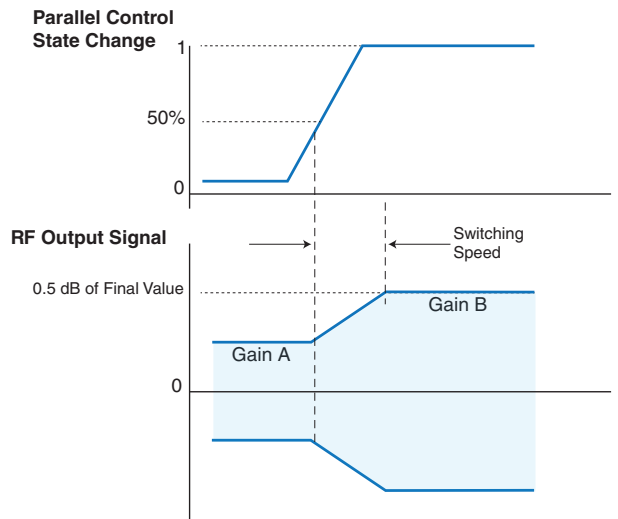
Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		0.45		2.4	GHz
Gain (at 0 dB attenuation)	.45	—	29.7	—	dB
	1.0	—	30.4	—	
	1.4	26.5	29.3	32.4	
	2.0	—	23.9	—	
	2.4	—	20.7	—	
Input Return Loss (all states)	.45	—	16.2	—	dB
	1.0	—	21.5	—	
	1.4	—	7.2	—	
	2.0	—	6.5	—	
	2.4	—	9.4	—	
Output Return Loss (all states)	.45	—	21.5	—	dB
	1.0	—	15.1	—	
	1.4	—	15.6	—	
	2.0	—	9.1	—	
	2.4	—	9.6	—	
Output Power @ 1 dB compression (at min and max attenuation)	.45	—	22.0	—	dBm
	1.0	—	22.4	—	
	1.4	20.0	22.8	—	
	2.0	—	22.7	—	
	2.4	—	22.5	—	
Output IP3 (all states)	.45	—	35.4	—	dBm
	1.0	—	34.5	—	
	1.4	—	35.5	—	
	2.0	—	37.0	—	
	2.4	—	37.3	—	
Noise Figure (at 0 dB attenuation)	.45	—	2.2	—	dB
	1.0	—	2.4	—	
	1.4	—	2.6	3.7	
	2.0	—	2.9	—	
	2.4	—	3.1	—	
Accuracy @ 0.5 dB Attenuation Setting	.45 - 1.0	—	0.03	0.12	dB
	1.0 - 2.4	—	0.09	0.18	
Accuracy @ 1 dB Attenuation Setting	.45 - 1.0	—	0.03	0.13	dB
	1.0 - 2.4	—	0.14	0.2	
Accuracy @ 2 dB Attenuation Setting	.45 - 1.0	—	0.05	0.25	dB
	1.0 - 2.4	—	0.25	0.37	
Accuracy @ 4 dB Attenuation Setting	.45 - 1.0	—	0.07	0.37	dB
	1.0 - 2.4	—	0.34	0.45	
Accuracy @ 8 dB Attenuation Setting	.45 - 1.0	—	0.14	0.4	dB
	1.0 - 2.4	—	0.50	0.7	
Accuracy @ 16 dB Attenuation Setting	.45 - 1.0	—	0.18	0.6	dB
	1.0 - 2.4	—	0.80	1.2	

1. Measured in Mini-Circuits characterization test board TB-681A+. See characterization Test Circuit (Fig. 2)

## Attenuation Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Switching Speed, 50% Control to 0.5dB of Attenuation Value	—	1.0	—	μSec
Switching Rep Rate	—	—	25	KHz

**Figure 1. Switching Speed**



## DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
Supply Voltage, $V_{D1}$	2.7	3.0	3.3	V
$V_{D2}$	4.75	5.0	5.25	V
Supply Current, $I_{D1}$	—	—	200	μA
$I_{D2}$	—	154	186	mA
Control Input Low	-0.3	—	0.6	V
Control Input High	1.17	—	3.6	V
Control Current*	—	—	20	μA

\* Except 30 μA typ. for C0.5, C16

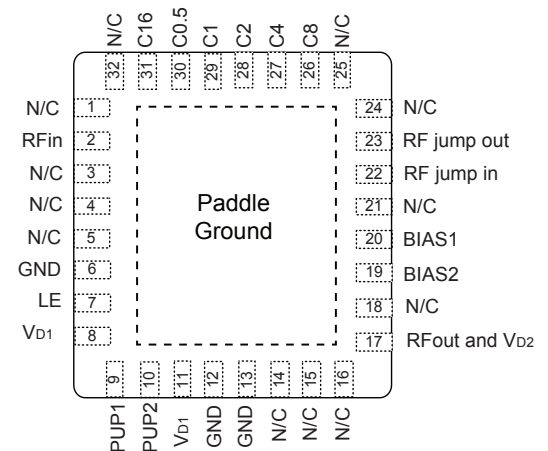
## Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-65°C to 150°C
$V_{D1}$	-0.3V Min., 5.5V Max.
$V_{D2}$	6.0V
Voltage on any control input**	-0.3V Min., $V_{D1}+0.3V$ Max.
Input Power	+24dBm

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

Table 1. Pad Description

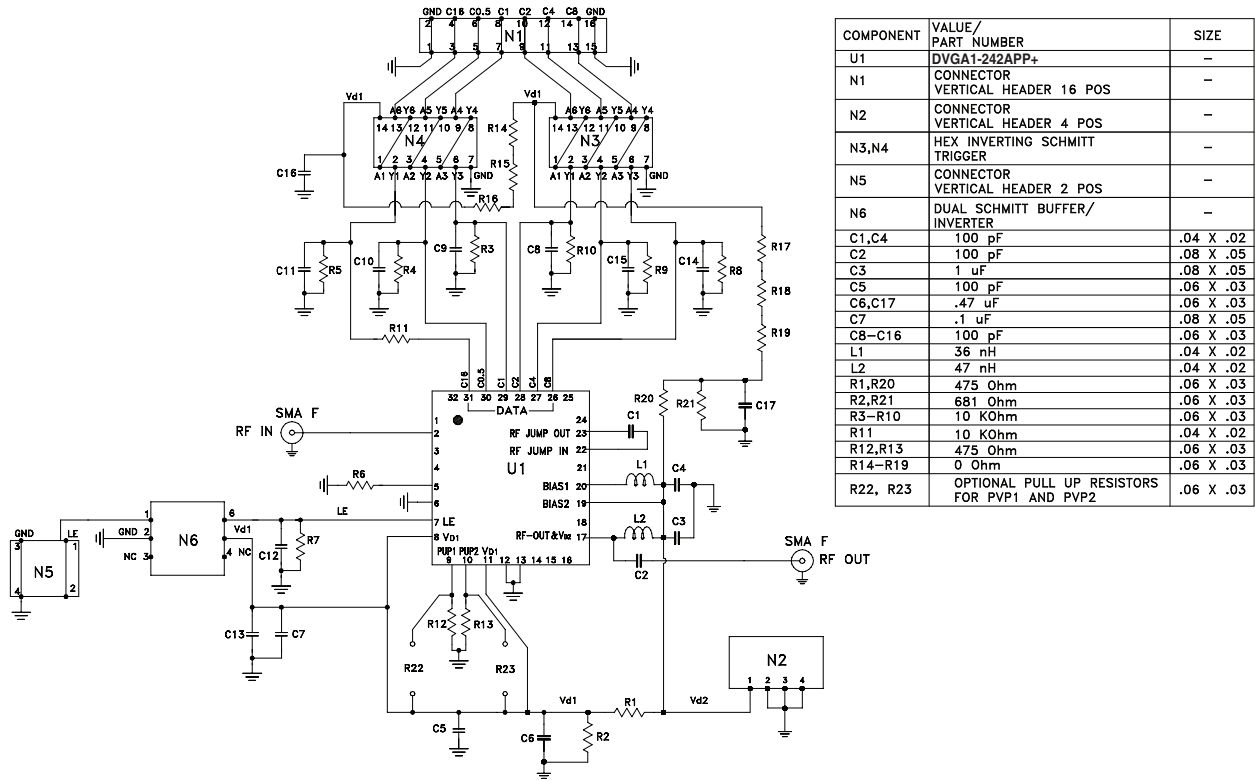
Pin Number	Function	Description
1	N/C	Not Connected
2	RF IN	RF Input Port (Note 1)
3	N/C	Not Connected
4	N/C	Not Connected
5	N/C	Not Connected (Note 4)
6	GND	Ground
7	LE	Latch Enable Input (Note 2)
8	V <sub>D1</sub>	V <sub>D1</sub> Power Supply Input
9	PUP1	Power-up Selection
10	PUP2	Power-up Selection
11	V <sub>D1</sub>	V <sub>D1</sub> Power Supply Input
12	GND	Ground
13	GND	Ground
14	N/C	Not Connected
15	N/C	Not Connected
16	N/C	Not Connected
17	RF OUT & V <sub>D2</sub>	RF output and V <sub>D2</sub> on same pad (external Bias Tee) (Note1,6)
18	N/C	Not Connected
19	BIAS 2	Amplifier Bias 2 connects to V <sub>D2</sub>
20	BIAS 1	Amplifier Bias 1 connects to V <sub>D2</sub> via inductor(Note1,6)
21	N/C	Not Connected
22	RF JUMP IN	Interstage RF Jumper Input (Note 1)
23	RF JUMP OUT	Interstage RF Jumper Output (Note 1)
24	N/C	Not Connected
25	N/C	Not Connected
26	C8	Control for 8dB Att. Bit (Note 4)
27	C4	Control for 4dB Att. Bit (Note 4)
28	C2	Control for 2dB Att. Bit (Note 4)
29	C1	Control for 1dB Att. Bit (Note 4)
30	C0.5	Control for 0.5dB Att. Bit (Note 4)
31	C16	Control for 16dB Att. Bit (Note 3,4)
32	N/C	Not Connected
PADDLE	GND	Ground (Note5)



Notes:

1. All RF input and output ports shall be AC coupled with external blocking capacitor.
2. Latch Enable (LE) has an internal 2MΩ pull-up resistor to V<sub>D1</sub>.
3. Place a 10KΩ resistor in series, as close to pin as possible to avoid freq. resonance (see layout drawing PL-382).
4. Place a 10KΩ resistor to ground.
5. The exposed solder pad on the bottom of the package (See Pin Configuration) must be grounded for proper device operation
6. See application and characterization test circuit and layout drawing PL-382.

## Application and Characterization Test Circuit

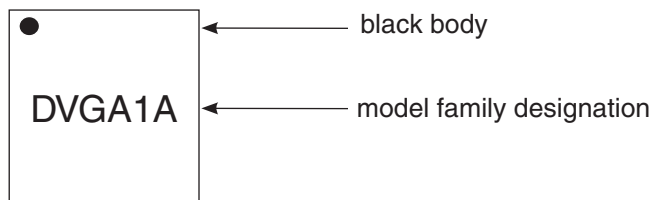


### Conditions:

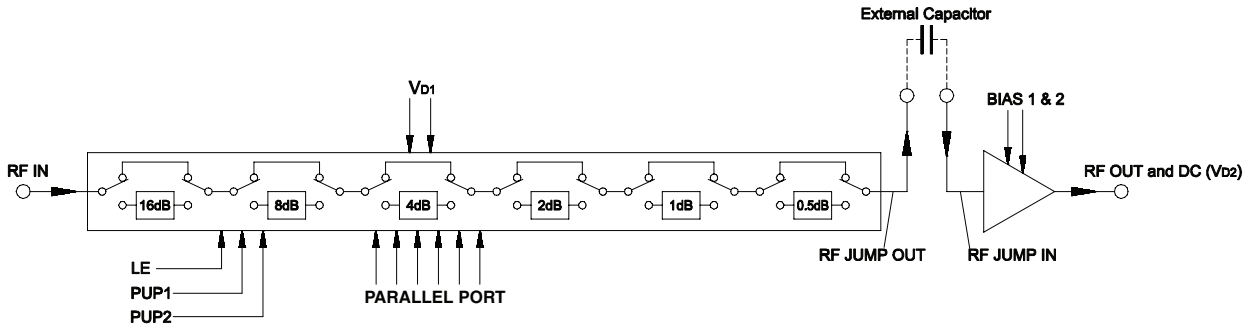
1. Gain:  $P_{in} = -25$  dBm
2. Output IP3 (OIP3): two tones, spaced 1 MHz apart +5 dBm/ tone at output.
3. Schmitt trigger used in characterization circuit. Not required when application circuit includes recommended level settings.

**Figure 2.** Schematic of Test Circuit used for Characterization. (DUT soldered on Mini-Circuits Characterization Test Board TB-861A+). Gain, output power at 1 dB compression (P1dB) Output IP3 (OIP3), Noise Figure are measured using Agilent's N5242A PNA-X Microwave Network Analyzer.

## Product Marking



Simplified Schematic



**Figure 3.** The DVGA1-242APP+ Parallel interface consists of 6 control bits that select the desired attenuation state, as shown in Table 2 Truth Table.

**Table 2. Truth Table**

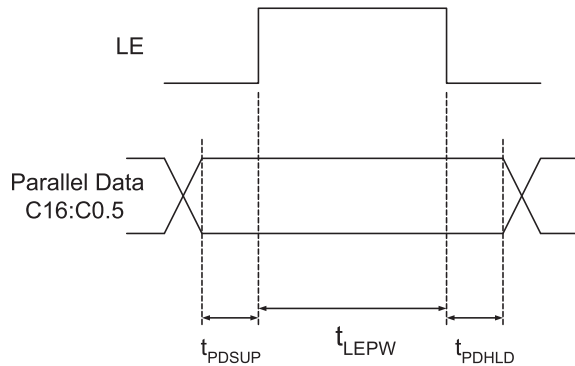
Attenuation State	C16	C8	C4	C2	C1	C0.5
Reference	0	0	0	0	0	0
0.5 (dB)	0	0	0	0	0	1
1 (dB)	0	0	0	0	1	0
2 (dB)	0	0	0	1	0	0
4 (dB)	0	0	1	0	0	0
8 (dB)	0	1	0	0	0	0
16 (dB)	1	0	0	0	0	0
31.5 (dB)	1	1	1	1	1	1

Note: Not all 64 possible combinations of C0.5 - C16 are shown in table

The parallel interface timing requirements are defined by Figure 4 (Parallel Interface Timing Diagram) and Table 3 (Parallel Interface AC Characteristics), and switching speed.

For latched parallel programming the Latch Enable (LE) should be held LOW while changing attenuation state control values, then pulse LE HIGH to LOW (per Figure 1) to latch new attenuation state into device.

For direct parallel programming, the Latch Enable (LE) line should be pulled HIGH. Changing attenuation state control values will change device state to new attenuation. Direct mode is ideal for manual control of the device (using hardware, switches, or jumpers).



**Figure 4. Parallel Interface Timing Diagram**

**Table 3. Parallel Interface AC Characteristics (V<sub>D1</sub>=3V)**

Symbol	Parameter	Min.	Max.	Units
$t_{LEPW}$	LE minimum pulse width	10		ns
$t_{PDSUP}$	Parallel data set-up time before clock rising edge of LE	10		ns
$t_{PDHLD}$	Parallel data hold time after clock falling edge of LE	10		ns

**Power-up Control Settings**

The DVGA1-242APP+ always assumes a specifiable attenuation setting on power-up, allowing a known attenuation state to be established before an initial parallel control word is provided. When the attenuator powers up with LE=0, the control bits are set to one of four possible values. These values are selected by the two power up control bits; PUP1 and PUP2, as shown in Table 4 (Power-Up Truth table, Parallel Mode)

Attenuation State	PUP1	PUP2	LE
Reference	0	0	0
8 (dB)	0	1	0
16 (dB)	1	0	0
31 (dB)	1	1	0
Defined by C0.5-C16 (See Table 1 - Truth Table)	X (Note 1)	X (Note1)	1

Note 1: PUP1 and PUP2 Connection may be 0, 1, GROUND, or No connection without effect on attenuation state.

Power-Up LE=1 provides normal parallel operation with C0.5-C16, and PUP1 and PUP2 are not active.



<b>Additional Detailed Technical Information</b> <i>additional information is available on our dash board. To access this information <a href="#">click here</a></i>	
<b>Performance Data</b>	Data Table
	Swept Graphs
	S-Parameter (S2P Files) Data Set (.zip file)
<b>Case Style</b>	DG1677 Plastic package, exposed paddle, lead finish: Ni/Pd/Au
<b>Tape &amp; Reel</b> Standard quantities available on reel	F68 7" reels with 20,50,100,200, 500 or 1K devices
<b>Suggested Layout for PCB Design</b>	PL-382
<b>Evaluation Board</b>	TB-681A+
<b>Environmental Ratings</b>	ENV66

**ESD Rating**

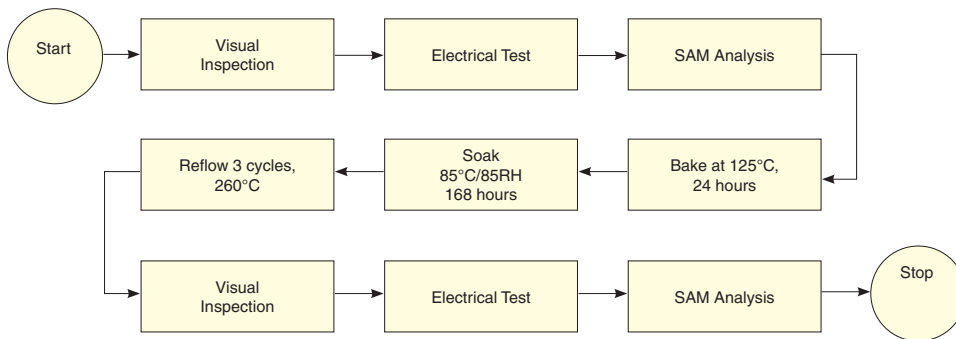
Human Body Model (HBM): Class 1A (250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M1 (40V) in accordance with ANSI/ESD STM5.2-1999

**MSL Rating**

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

**MSL Test Flow Chart**



**Additional 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](http://www.minicircuits.com/MCLStore/terms.jsp)

# Digital Variable Gain Amplifier

# DVGA1-242APP+

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = +25degC

FREQ	GAIN @ 0dB Step	STEP ATTENUATION @							Output IP3 @ 0dB Step	Pout at 1dB Comp @ 0dB Step	Noise Figure @ 0dB Step
		0.5 dB	1.0 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB			
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dBm)	(dBm)	(dB)
400	29.40	0.51	1.01	1.96	3.93	7.87	15.81	31.19	36.18	21.88	2.23
500	30.05	0.52	1.02	2.01	4.01	7.98	15.93	31.34	36.06	22.63	2.08
600	30.12	0.52	1.02	2.03	4.04	8.04	16.01	31.41	36.13	22.50	2.46
700	30.16	0.52	1.03	2.01	4.02	8.04	16.04	31.39	35.92	22.59	2.11
800	30.26	0.52	1.03	1.99	4.01	8.03	16.05	31.37	35.76	22.68	2.14
900	30.40	0.52	1.03	1.97	3.99	8.02	16.06	31.35	35.90	22.92	2.19
1000	30.51	0.52	1.03	1.96	3.97	7.99	16.02	31.32	35.42	22.79	2.23
1200	30.31	0.51	1.00	1.93	3.90	7.84	15.78	31.17	36.03	22.89	2.40
1400	29.27	0.49	0.95	1.92	3.82	7.66	15.44	30.97	36.41	23.12	2.51
1600	27.53	0.49	0.93	1.95	3.84	7.64	15.34	30.90	37.04	23.03	2.57
1800	25.62	0.50	0.96	2.03	3.96	7.82	15.57	31.05	37.40	22.95	2.73
2000	23.75	0.53	1.02	2.11	4.10	8.06	15.90	31.27	38.01	22.80	2.82
2200	22.07	0.56	1.09	2.19	4.24	8.31	16.26	31.52	37.85	22.66	2.92
2400	20.51	0.59	1.14	2.25	4.34	8.50	16.55	31.69	37.98	22.67	3.03



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IF/RF MICROWAVE COMPONENTS

REV. OR  
 DVGA1-242APP+  
 5/9/2016

Page 1 of 9

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = -40degC

FREQ	GAIN @ 0dB Step	STEP ATTENUATION @							Output IP3 @ 0dB Step	Pout at 1dB Comp @ 0dB Step	Noise Figure @ 0dB Step
		0.5 dB	1.0 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB			
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dBm)	(dBm)	(dB)
400	29.63	0.53	1.03	1.98	3.96	7.93	15.86	31.34	40.00	22.86	1.81
500	30.62	0.54	1.05	2.05	4.07	8.09	16.04	31.55	39.87	23.25	1.61
600	30.91	0.55	1.06	2.08	4.13	8.18	16.14	31.66	39.81	22.94	1.98
700	31.09	0.54	1.06	2.07	4.10	8.18	16.16	31.65	39.47	23.02	1.58
800	31.27	0.54	1.05	2.03	4.07	8.13	16.13	31.58	39.24	23.11	1.56
900	31.48	0.53	1.05	2.00	4.03	8.09	16.10	31.52	39.44	23.35	1.57
1000	31.63	0.53	1.04	1.97	3.98	8.03	16.03	31.45	38.96	23.20	1.66
1200	31.55	0.52	1.02	1.95	3.91	7.91	15.83	31.32	39.71	23.33	1.76
1400	30.65	0.51	0.99	1.97	3.93	7.84	15.63	31.21	40.36	23.56	1.85
1600	28.94	0.51	0.99	2.04	4.00	7.92	15.64	31.22	40.38	23.47	1.94
1800	27.02	0.54	1.03	2.15	4.16	8.15	15.91	31.39	40.79	23.42	2.01
2000	25.19	0.56	1.09	2.25	4.32	8.40	16.25	31.60	41.16	23.31	2.06
2200	23.50	0.60	1.15	2.32	4.46	8.64	16.58	31.80	41.34	23.27	2.16
2400	21.93	0.63	1.21	2.39	4.57	8.84	16.87	31.95	41.08	23.32	2.29

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = +85degC

FREQ	GAIN @ 0dB Step	STEP ATTENUATION @							Output IP3 @ 0dB Step	Pout at 1dB Comp @ 0dB Step	Noise Figure @ 0dB Step
		0.5 dB	1.0 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB			
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dBm)	(dBm)	(dB)
400	28.91	0.50	0.99	1.94	3.90	7.82	15.76	31.05	32.76	20.20	2.75
500	29.29	0.50	0.99	1.98	3.96	7.91	15.85	31.16	32.83	21.08	2.68
600	29.21	0.51	1.00	1.99	3.98	7.95	15.92	31.21	33.11	21.12	2.99
700	29.16	0.51	1.00	1.98	3.98	7.97	15.97	31.22	32.95	21.23	2.73
800	29.21	0.51	1.01	1.97	3.98	8.00	16.03	31.23	33.09	21.37	2.79
900	29.31	0.51	1.03	1.97	3.99	8.01	16.07	31.25	33.10	21.55	2.82
1000	29.39	0.52	1.03	1.96	3.98	8.01	16.06	31.25	32.72	21.44	2.92
1200	29.13	0.50	1.00	1.93	3.90	7.84	15.79	31.10	33.24	21.64	3.11
1400	28.07	0.48	0.93	1.89	3.78	7.58	15.35	30.83	33.85	22.05	3.20
1600	26.34	0.46	0.90	1.88	3.74	7.47	15.16	30.69	34.53	22.17	3.31
1800	24.45	0.47	0.92	1.94	3.82	7.61	15.34	30.81	35.14	22.18	3.46
2000	22.59	0.50	0.97	2.01	3.94	7.82	15.65	31.02	35.44	22.04	3.57
2200	20.90	0.53	1.04	2.09	4.06	8.05	15.99	31.27	35.31	21.78	3.66
2400	19.33	0.56	1.09	2.14	4.16	8.24	16.27	31.46	34.83	21.50	3.79

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = +25degC

FREQ	INPUT RETURN LOSS @							
	0 dB	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
400	16.81	17.95	18.98	19.55	21.44	25.12	33.97	31.97
500	15.27	16.54	17.68	17.75	19.60	23.37	33.19	34.59
600	13.99	15.23	16.36	16.65	18.66	22.38	32.48	40.80
700	14.45	15.68	16.80	17.27	19.21	22.44	31.81	49.33
800	16.45	17.72	18.88	19.79	21.47	23.41	31.16	36.75
900	20.00	21.31	22.41	26.05	26.26	24.61	29.77	30.97
1000	21.04	21.56	22.19	31.64	28.97	24.26	27.49	27.13
1200	11.28	11.81	12.43	14.02	16.15	18.70	22.64	22.12
1400	6.82	7.46	8.07	9.14	11.17	14.49	18.91	18.81
1600	5.49	6.15	6.75	7.66	9.53	12.76	16.58	16.33
1800	5.51	6.20	6.80	7.58	9.30	12.23	15.03	14.43
2000	6.46	7.16	7.74	8.37	9.87	12.25	13.82	12.90
2200	7.76	8.45	8.95	9.43	10.61	12.30	12.78	11.69
2400	9.21	9.80	10.14	10.47	11.24	12.14	11.82	10.71

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = -40degC

FREQ	INPUT RETURN LOSS @							
	0 dB	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
400	22.09	23.02	23.36	26.66	30.99	34.77	23.57	21.54
500	20.15	22.24	24.09	24.18	27.85	35.71	23.71	21.69
600	16.91	18.69	20.36	20.75	24.24	33.41	25.16	22.88
700	16.92	18.56	19.96	21.06	24.68	33.51	25.88	23.57
800	18.85	20.32	21.31	23.64	27.88	37.83	27.70	25.03
900	21.57	22.05	22.27	29.16	41.85	42.88	28.39	25.42
1000	18.81	18.76	18.88	22.99	26.25	28.62	27.39	24.76
1200	10.18	10.72	11.28	12.85	15.41	19.35	23.06	21.90
1400	6.18	6.89	7.59	8.75	11.12	15.21	19.65	19.17
1600	4.94	5.73	6.44	7.46	9.68	13.45	16.90	16.33
1800	5.06	5.92	6.66	7.56	9.63	12.88	14.99	14.15
2000	6.15	7.06	7.82	8.55	10.32	12.71	13.41	12.42
2200	7.63	8.57	9.26	9.72	11.04	12.36	12.08	11.06
2400	9.37	10.22	10.69	10.81	11.41	11.64	10.75	9.82

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = +85degC

FREQ	INPUT RETURN LOSS @							
	0 dB	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
400	13.95	14.94	15.86	15.98	17.24	19.33	24.71	29.09
500	12.67	13.70	14.60	14.58	15.88	18.09	23.10	26.66
600	12.09	13.11	14.04	14.15	15.49	17.66	22.25	25.32
700	12.79	13.84	14.79	14.90	16.04	17.66	21.50	23.79
800	14.96	16.14	17.19	17.19	17.75	18.22	21.02	22.64
900	19.14	20.70	22.17	22.02	20.42	18.82	20.54	21.46
1000	24.28	26.05	27.95	32.63	22.40	18.83	19.87	20.34
1200	12.36	12.85	13.44	14.76	15.87	16.46	18.21	18.26
1400	7.43	7.97	8.50	9.44	11.07	13.40	16.41	16.49
1600	5.88	6.43	6.93	7.72	9.29	11.87	15.05	14.98
1800	5.80	6.36	6.85	7.53	8.98	11.44	14.12	13.73
2000	6.60	7.15	7.61	8.17	9.45	11.63	13.50	12.69
2200	7.71	8.25	8.61	9.11	10.20	11.97	12.97	11.85
2400	8.93	9.38	9.62	10.11	10.96	12.25	12.44	11.22

# Digital Variable Gain Amplifier

# DVGA1-242APP+

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = +25degC

FREQ	OUTPUT RETURN LOSS @							
	0 dB	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
400	22.79	22.76	22.73	22.91	22.91	22.85	22.63	22.81
500	20.33	20.34	20.39	20.24	20.34	20.60	21.02	20.79
600	17.03	17.05	17.11	16.95	17.06	17.32	17.75	17.52
700	15.65	15.67	15.76	15.58	15.70	15.94	16.37	16.17
800	14.90	14.97	14.99	14.82	14.91	15.12	15.49	15.35
900	14.57	14.59	14.66	14.50	14.58	14.74	15.03	15.02
1000	14.74	14.78	14.82	14.67	14.72	14.80	14.99	15.13
1200	16.51	16.52	16.51	16.30	16.24	16.11	16.06	16.56
1400	16.07	16.00	16.02	15.72	15.65	15.53	15.56	16.11
1600	13.75	13.69	13.64	13.39	13.25	13.04	12.94	13.38
1800	11.19	11.13	11.06	10.94	10.78	10.54	10.34	10.74
2000	9.97	9.91	9.84	9.82	9.69	9.46	9.23	9.59
2200	9.51	9.47	9.43	9.49	9.43	9.27	9.10	9.42
2400	9.84	9.83	9.81	9.94	9.94	9.85	9.72	10.03



# Digital Variable Gain Amplifier

# DVGA1-242APP+

## Typical Performance Data

TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = -40degC

FREQ	OUTPUT RETURN LOSS @							
	0 dB	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
400	20.50	20.48	20.48	20.69	20.73	20.70	20.51	20.68
500	20.12	20.12	20.14	20.06	20.12	20.30	20.58	20.43
600	16.61	16.61	16.65	16.47	16.54	16.73	17.10	16.89
700	15.13	15.21	15.17	15.01	15.07	15.27	15.65	15.42
800	14.29	14.27	14.34	14.05	14.10	14.29	14.68	14.48
900	13.48	13.49	13.53	13.30	13.33	13.47	13.83	13.71
1000	13.35	13.34	13.37	13.10	13.09	13.17	13.45	13.42
1200	13.69	13.65	13.65	13.35	13.25	13.18	13.28	13.49
1400	13.36	13.31	13.25	12.98	12.86	12.74	12.80	13.15
1600	12.06	11.99	11.94	11.66	11.51	11.30	11.22	11.55
1800	10.09	10.03	9.97	9.82	9.69	9.50	9.34	9.67
2000	9.34	9.28	9.22	9.17	9.06	8.88	8.69	8.99
2200	8.90	8.87	8.83	8.88	8.84	8.73	8.59	8.86
2400	8.99	8.99	8.98	9.09	9.10	9.05	8.95	9.20

# Digital Variable Gain Amplifier

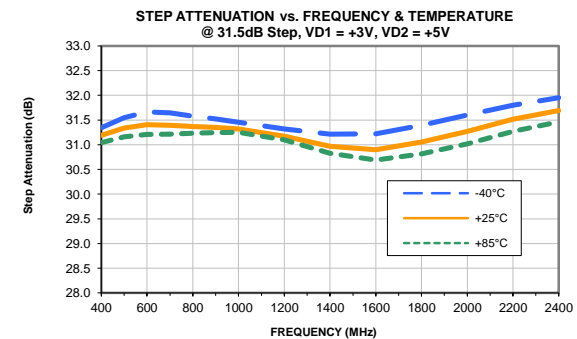
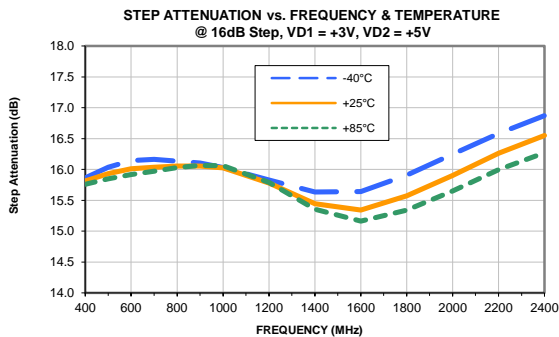
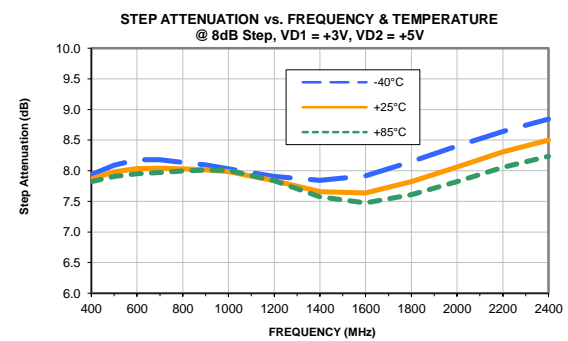
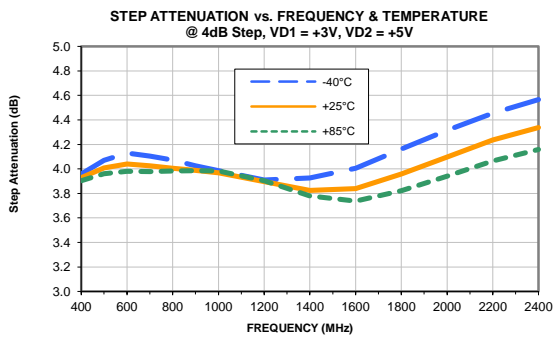
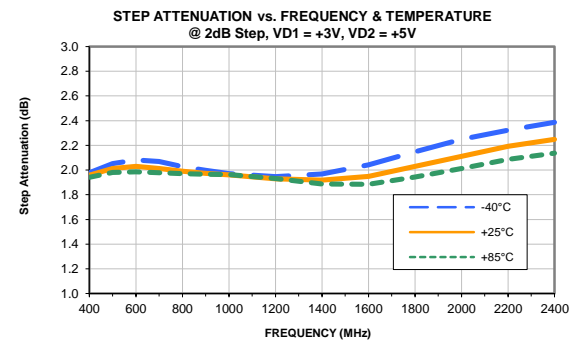
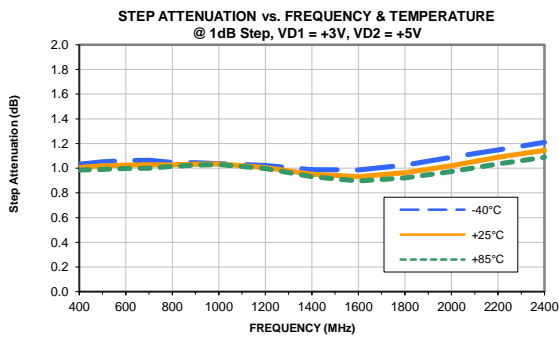
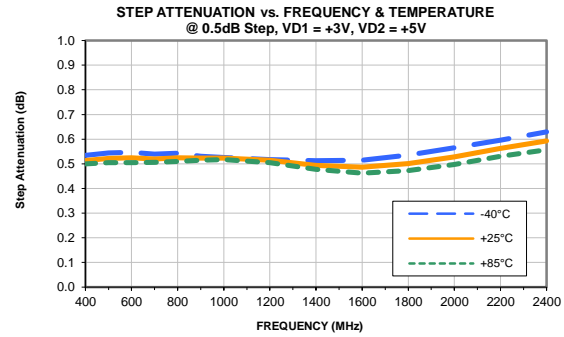
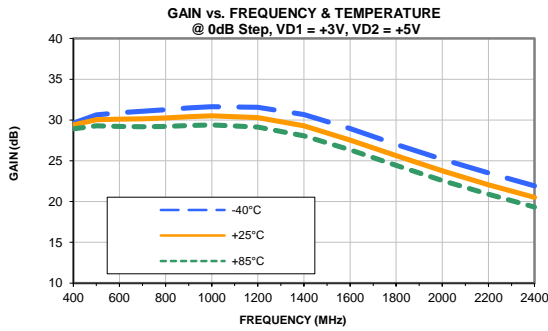
# DVGA1-242APP+

## Typical Performance Data

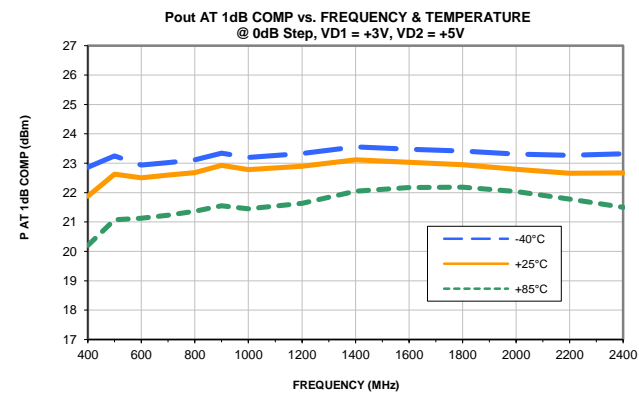
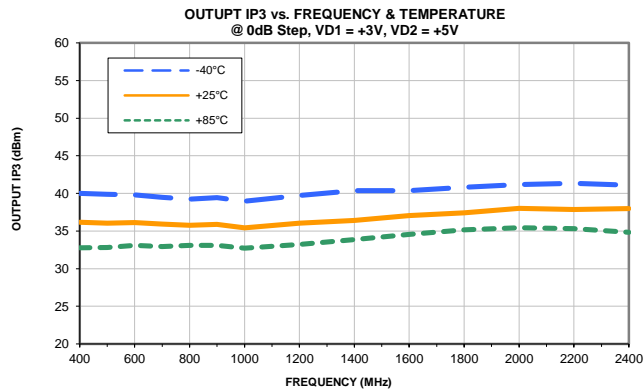
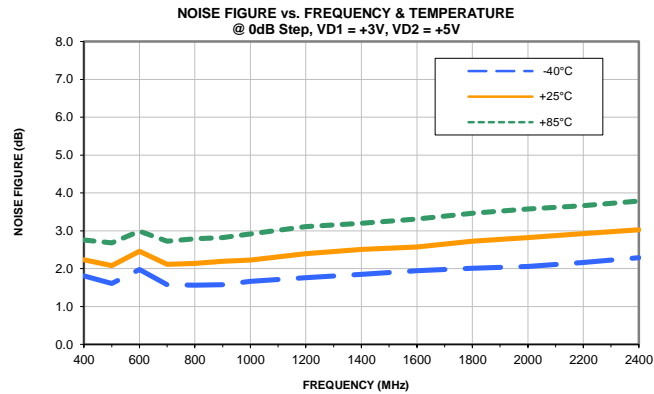
TEST CONDITIONS: Vd1 = +3V, Vd2 = +5V @ Temperature = +85degC

FREQ	OUTPUT RETURN LOSS @							
	0 dB	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB	31.5 dB
(MHz)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)
400	25.00	25.00	25.00	25.16	25.19	25.19	25.07	25.23
500	19.89	19.94	20.02	19.87	20.02	20.32	20.80	20.54
600	16.93	16.99	17.06	16.94	17.09	17.36	17.78	17.58
700	15.67	15.73	15.80	15.70	15.85	16.10	16.47	16.35
800	15.10	15.16	15.22	15.13	15.24	15.41	15.67	15.64
900	15.08	15.12	15.17	15.10	15.18	15.26	15.39	15.52
1000	15.67	15.70	15.73	15.70	15.73	15.71	15.69	16.02
1200	19.25	19.23	19.17	19.12	18.96	18.56	18.09	19.01
1400	18.88	18.93	18.96	18.70	18.70	18.58	18.52	19.45
1600	15.05	15.04	15.02	14.80	14.70	14.51	14.40	14.94
1800	11.95	11.90	11.83	11.73	11.58	11.31	11.07	11.56
2000	10.60	10.54	10.47	10.47	10.32	10.06	9.80	10.22
2200	10.13	10.09	10.04	10.12	10.04	9.85	9.65	10.02
2400	10.61	10.59	10.57	10.71	10.69	10.57	10.41	10.75

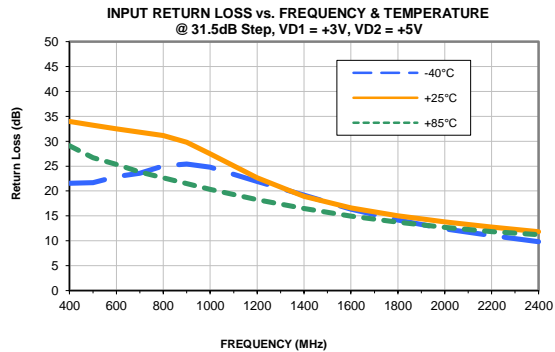
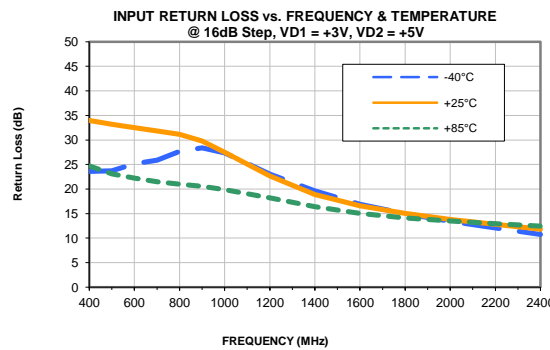
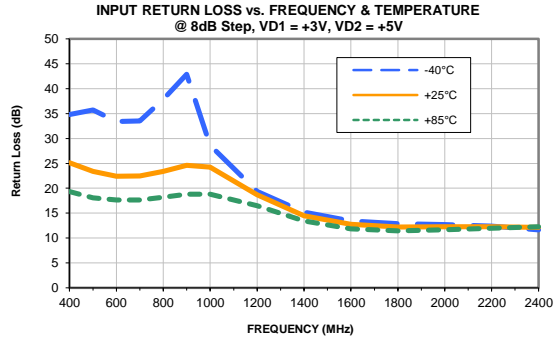
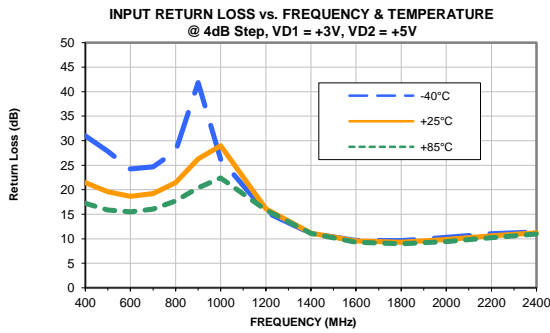
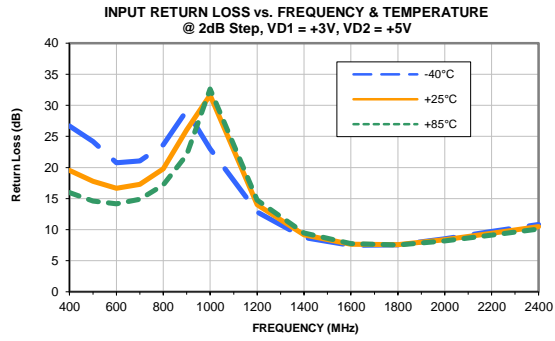
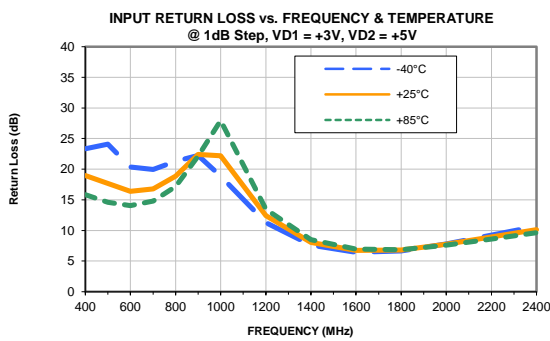
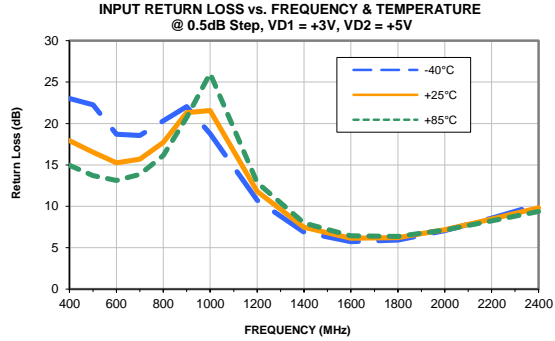
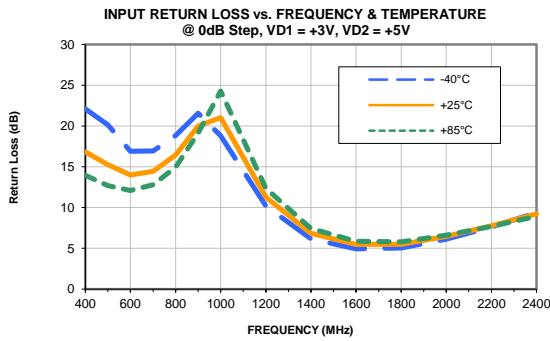
## Typical Performance Curves



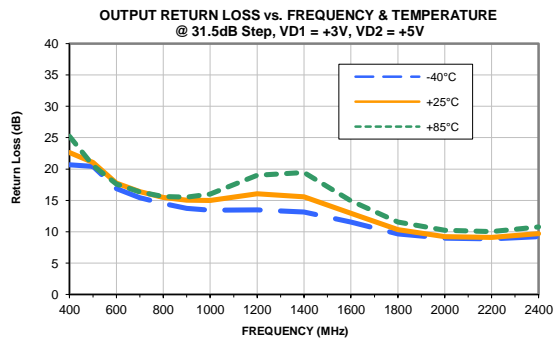
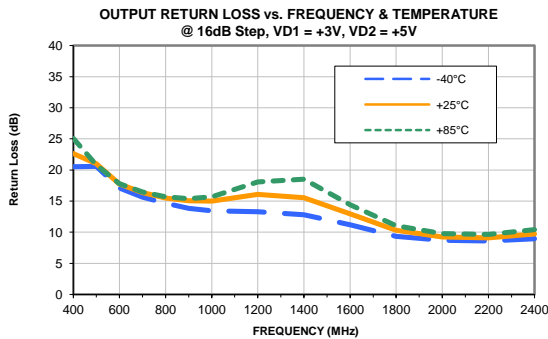
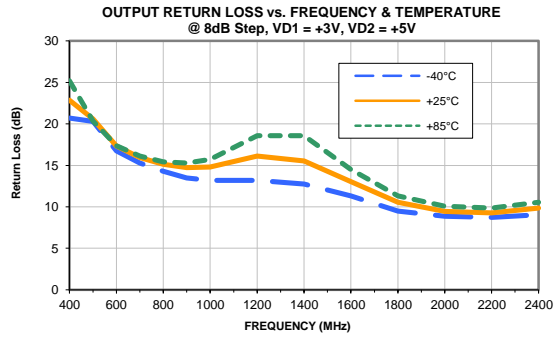
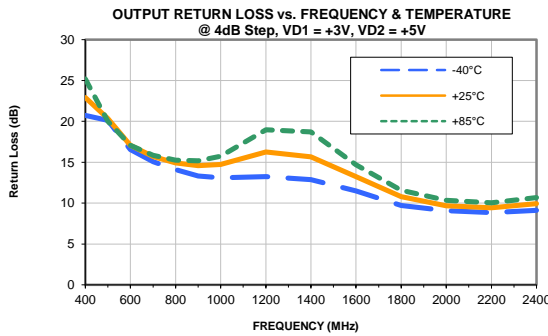
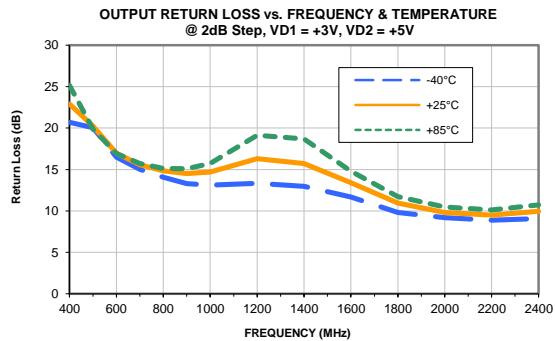
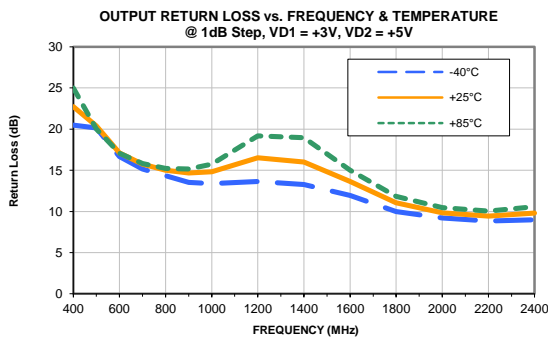
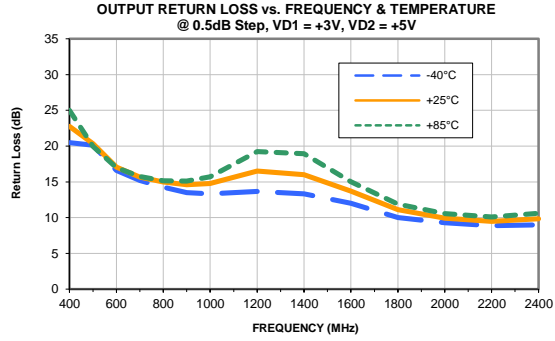
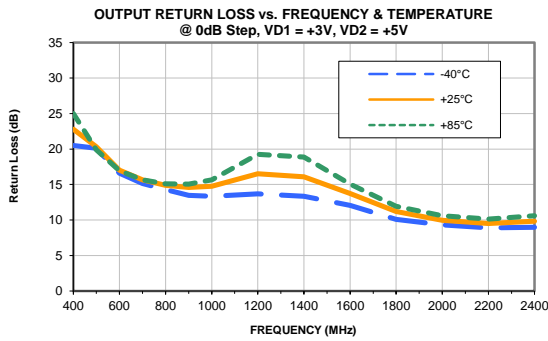
## Typical Performance Curves



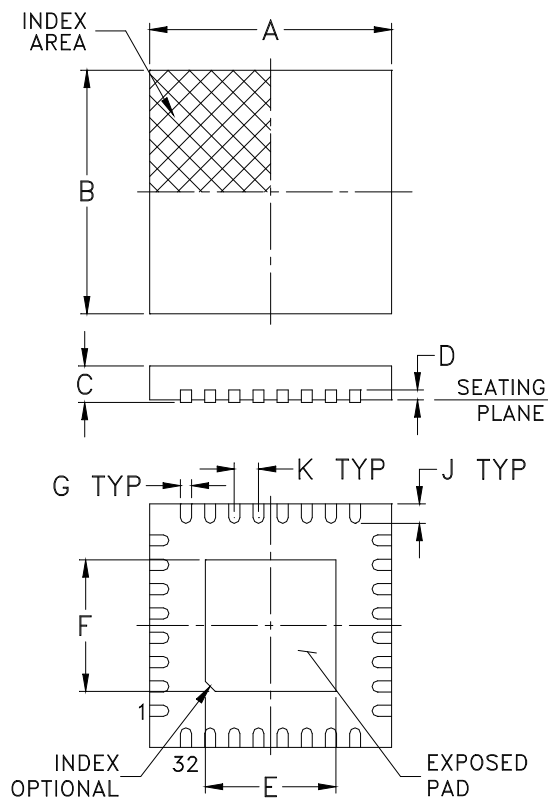
## Typical Performance Curves



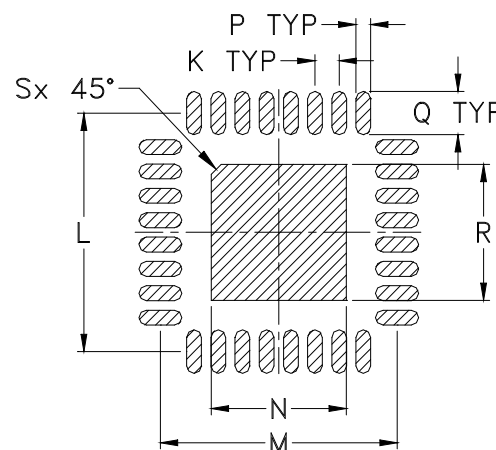
## Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm 0.002$

CASE #	A	B	C MAX	C MIN	D	E	F	G	H	J
DG1677	.197 (5.00)	.197 (5.00)	.039 (1.00)	.031 (0.80)	.008 (0.20)	.106 (2.70)	.106 (2.70)	.009 (0.23)	-	.016 (0.40)

CASE #	K	L	M	N	P	Q	R	S	WT. GRAM
DG1677	.020 (0.50)	.193 (4.90)	.193 (4.90)	.110 (2.79)	.012 (0.30)	.035 (0.89)	.110 (2.79)	.008 (0.20)	.05

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

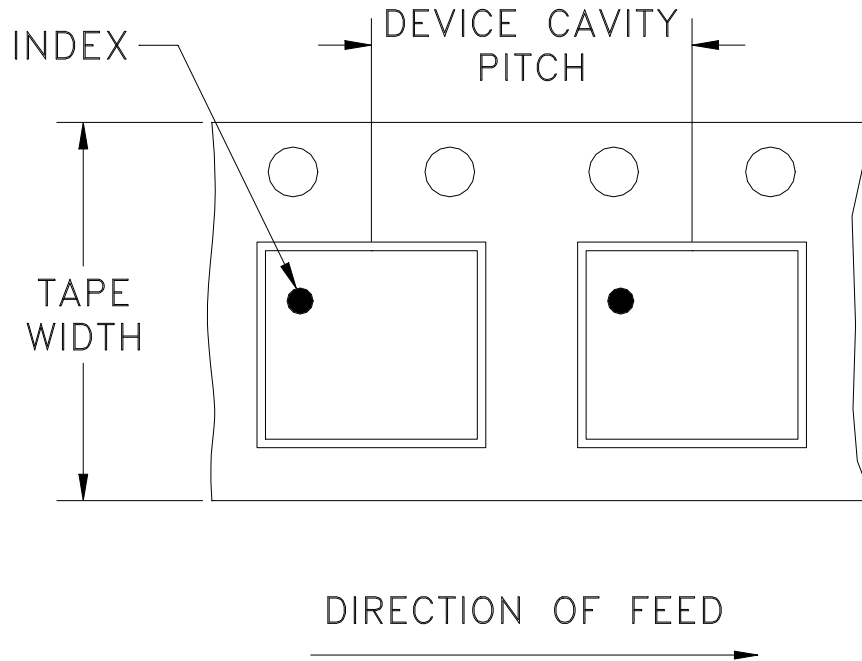
#### Notes:

1. Case material: Plastic.
2. Termination finish:

For RoHS Case Styles: Pre-plated (Ni Pd Au), transitioning to Matt-Tin. All models, (+) suffix.  
For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

# 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.

Go to: [www.minicircuits.com/pages/pdfs/tape.pdf](http://www.minicircuits.com/pages/pdfs/tape.pdf)



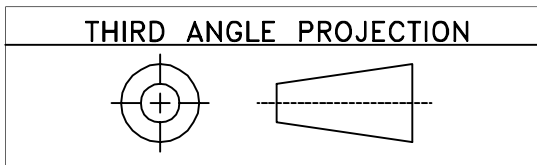
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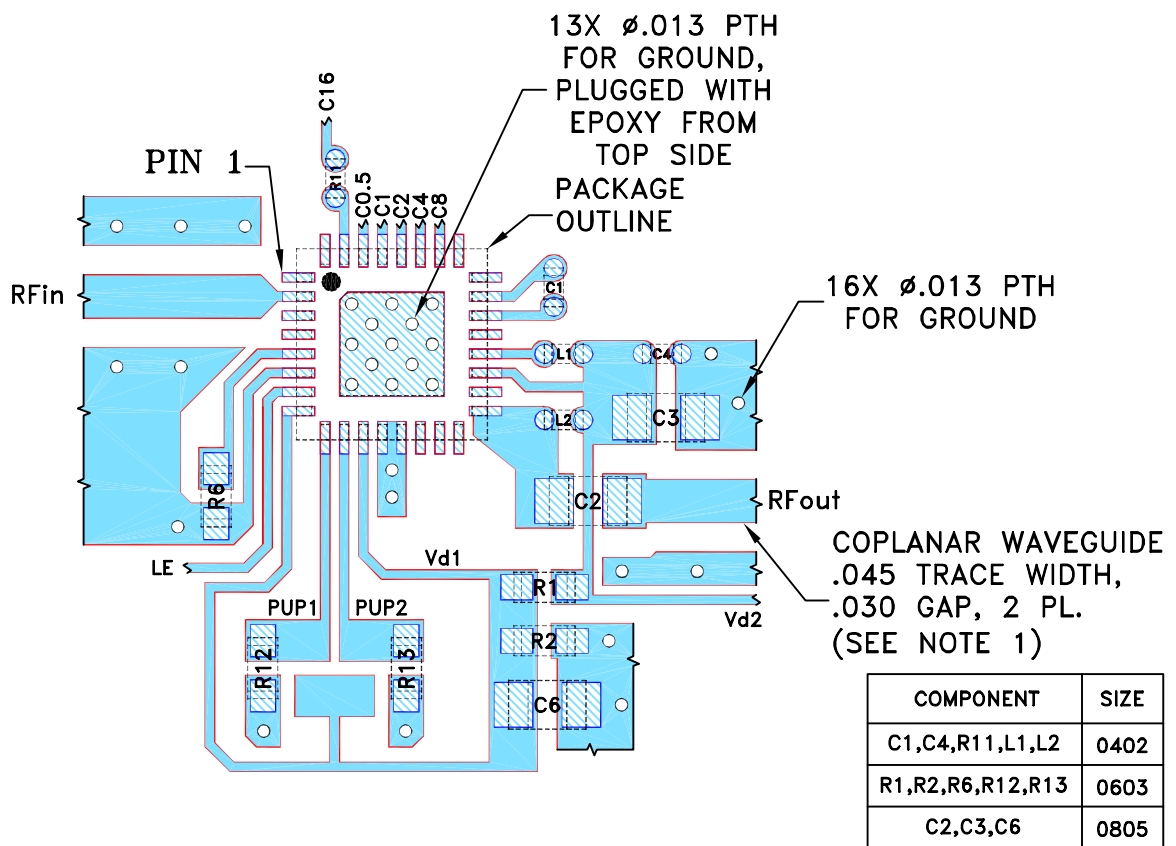
Mini-Circuits ISO 9001 & ISO 14001 Certified





REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M138582	NEW RELEASE	10/16/12	AV	RS

**SUGGESTED MOUNTING CONFIGURATION  
FOR DG1677 CASE STYLE, "32AM04" PIN CODE**



**NOTES:**

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR IT-180TC WITH DIELECTRIC THICKNESS .024" ± .002". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. CHIP COMPONENT FOOT PRINTS SHOWN FOR REFERENCE. FOR COMPONENT VALUES REFER TO TB-681+.
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
DRAWN	AV	10/08/12
CHECKED	IL	10/16/12
APPROVED	RS	10/16/12

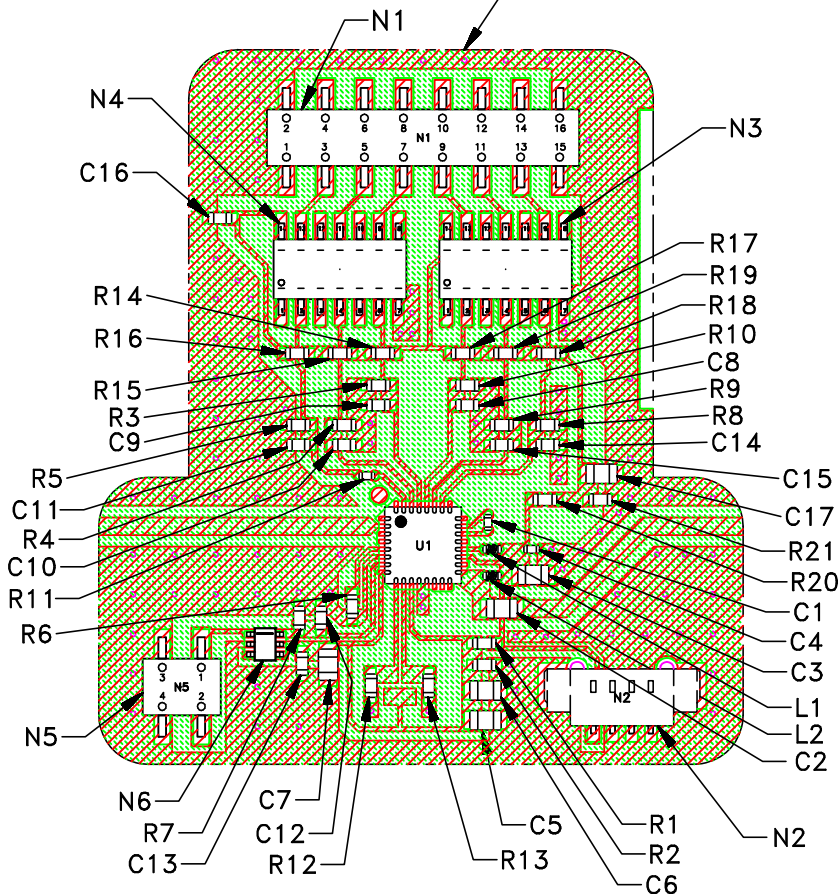
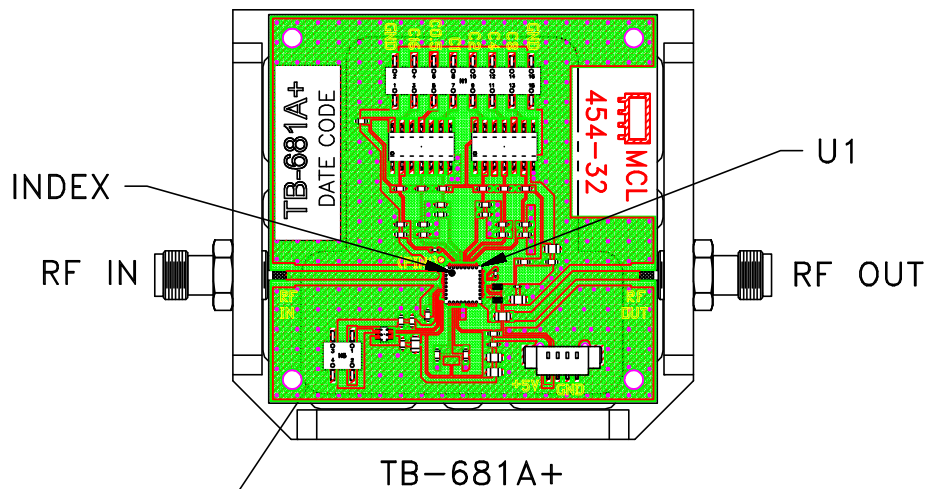
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Brooklyn NY 11235

**PL, 32AM04, DG1677, TB-681+**

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SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-382	REV: OR
FILE: 98PL382	SCALE: 5:1	SHEET: 1 OF 1	


# Evaluation Board and Circuit

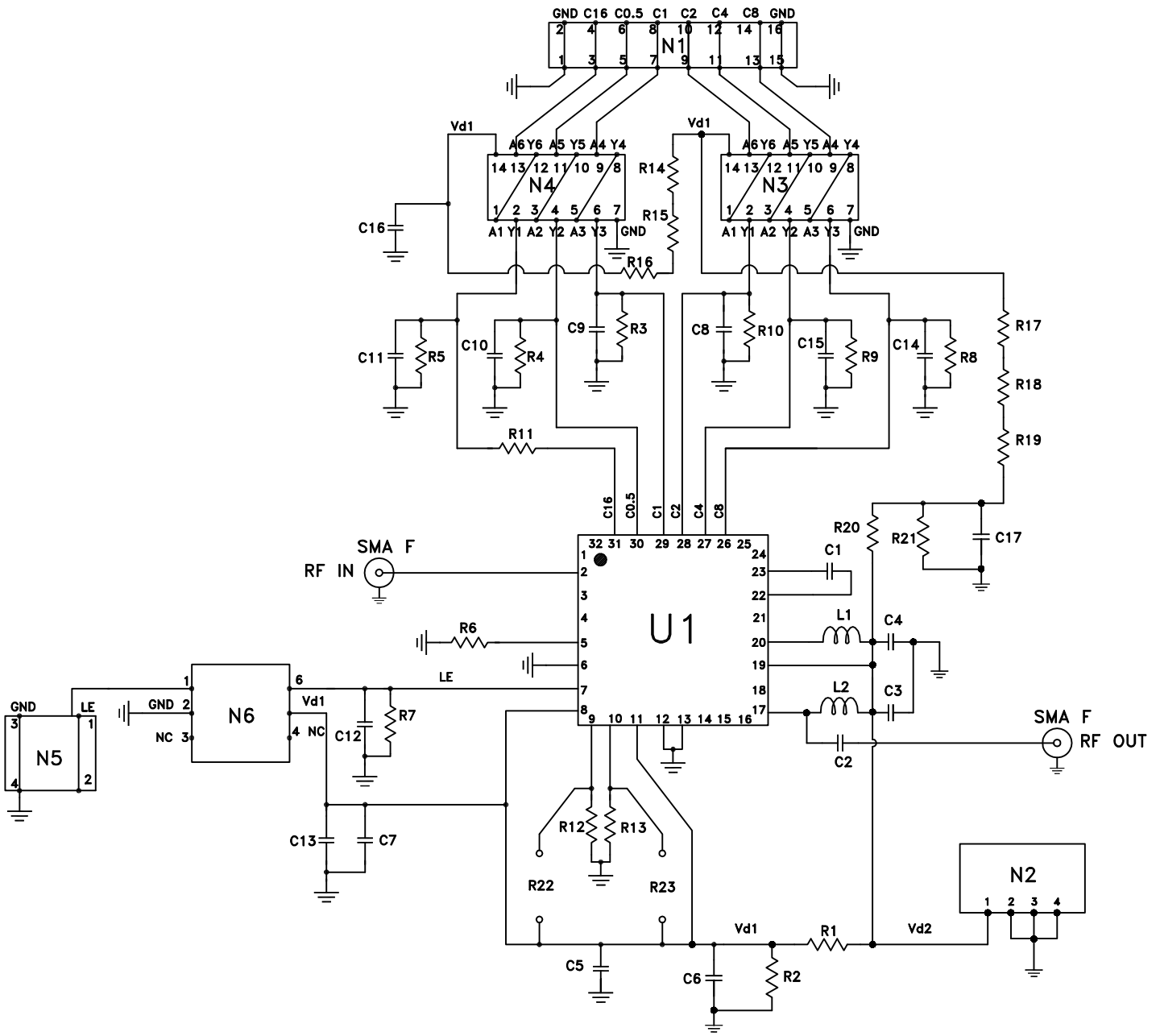


COMPONENT	VALUE/ PART NUMBER	SIZE
U1	DVGA1-242APP+	-
N1	CONNECTOR VERTICAL HEADER 16 POS	-
N2	CONNECTOR VERTICAL HEADER 4 POS	-
N3,N4	HEX INVERTING SCHMITT TRIGGER	-
N5	CONNECTOR VERTICAL HEADER 2 POS	-
N6	DUAL SCHMITT BUFFER/ INVERTER	-
C1,C4	100 pF	.04 X .02
C2	100 pF	.08 X .05
C3	1 uF	.08 X .05
C5	100 pF	.08 X .05
C6,C17	.47 uF	.08 X .05
C7	.1 uF	.08 X .05
C8-C16	100 pF	.06 X .03
L1	36 nH	.04 X .02
L2	47 nH	.04 X .02
R1,R20	475 Ohm	.06 X .03
R2,R21	681 Ohm	.06 X .03
R3-R10	10 KOhm	.06 X .03
R11	10 KOhm	.04 X .02
R12,R13	475 Ohm	.06 X .03
R14-R19	0 Ohm	.06 X .03

## Notes:

1. Test cables for connectors "N1,N2 & N3" are included in TB-681+ package.
2. Test software "Digital Step Attenuator & DVGA" is available for download from Mini-Circuits website: [http://www.minicircuits.com/support/software\\_download.html](http://www.minicircuits.com/support/software_download.html)
3. 50 Ohm SMA Female connectors.
4. PCB Material: FR4 or equivalent, Dielectric Constant=4.6, Thickness=.024 inch.

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Schematic Diagram

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	-40° to 85°C	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150°	Individual Model Data Sheet
Thermal Shock	-65° to 150°C, 1000 Cycles	JESD22-A104D, condition C
Autoclave	15 psig, 100% RH, 121°C, 168 hours	JESD22-A102D, Condition C
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Moisture Sensitivity: Level 1	Bake at 125°C for 24 hours. Soak at 85°C/85%RH for 168 hours Reflow 3 cycles at 260°C peak	J-STD-020D.01