NON-CATALOG

Digital Step Attenuator 50Ω DC-2400 MHz

31 dB, 1 dB Step
5 Bit, Parallel Control Interface, Dual Supply Voltage

Product Features
- Dual Supply Voltage: V_{DD}=+3V, V_{SS}=-3V
- Immune to latch up
- Excellent accuracy, 0.1 dB Typ
- Parallel control interface
- Fast switching control frequency, 1 MHz typ.
- Low Insertion Loss
- High IP3, +52 dBm Typ
- Very low DC power consumption
- Excellent return loss, 20 dB Typ
- Small size 4.0 x 4.0 mm

DAT-31-PN+

CASE STYLE: DG983-1

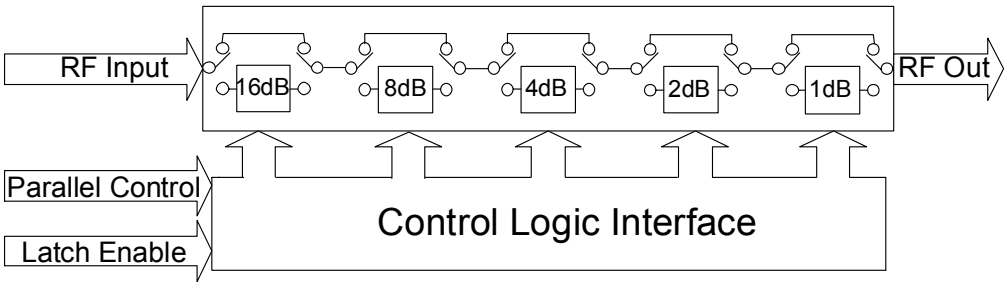
Typical Applications
- Base Station Infrastructure
- Portable Wireless
- CATV & DBS
- MMDS & Wireless LAN
- Wireless Local Loop
- UNII & Hiper LAN
- Power amplifier distortion canceling loops

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

Not recommended for new designs
Recommended replacement part:
DAT-31A-PN+

General Description
The DAT-31-PN+ is a 50Ω RF digital step attenuator that offers an attenuation range up to 31 dB in 1.0 dB steps. The control is a 5-bit parallel interface, operating on dual supply voltage: V_{DD}=+3V, V_{SS}=-3V. The DAT-31-PN+ is produced using a unique CMOS process on silicon, offering the performance of GaAs, with the advantages of conventional CMOS devices.

Simplified Schematic



Parameter	Freq. Range (GHz)	Min.	Typ.	Max.	Units
Accuracy @ **1 dB** Attenuation Setting	DC-1	—	0.02	0.1	dB
	1-2.4	—	0.05	0.15	dB
Accuracy @ **2 dB** Attenuation Setting	DC-1	—	0.05	0.15	dB
	1-2.4	—	0.15	0.25	dB
Accuracy @ **4 dB** Attenuation Setting	DC-1	—	0.07	0.2	dB
	1-2.4	—	0.15	0.25	dB
Accuracy @ **8 dB** Attenuation Setting	DC-1	—	0.03	0.2	dB
	1-2.4	—	0.15	0.25	dB
Accuracy @ **16 dB** Attenuation Setting	DC-1	—	0.1	0.3	dB
	1-2.4	—	0.15	0.3	dB
Insertion Loss (note 1) @ all attenuator set to 0dB	DC-1	—	1.3	1.9	dB
	1-2.4	—	1.6	2.4	dB
Input IP3 (note 2) (at Min. and Max. Attenuation)	DC-2.4	—	+52	—	dBm
Input Power @ 0.2 dB Compression (note 2) (at Min. and Max. Attenuation)	DC-2.4	—	+24	—	dBm
VSWR	DC-1	—	1.2	1.5	—
	1-2.4	—	1.2	1.5	—

DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
V_{DD}, Supply Voltage	2.7	3	3.3	V
V_{SS}, Supply Voltage	-3.3	-3	-2.7	V
I_{DD} (I_{SS}), Supply Current, quiescent (note 3)	—	—	100	μA
Control Input Low	—	—	0.3xV_{DD}	V
Control Input High	0.7xV_{DD}	—	—	V
Control Current	—	—	1	μA

Notes:
1. I. Loss values are de-embedded from test board Loss (test board's Insertion Loss: 0.10dB @100MHz, 0.35dB @1000MHz, 0.60dB @2400MHz, 0.75dB @4000MHz)
2. Input IP3 and 1dB compression degrades below 1 MHz.
3. During turn-on and transition between attenuation states, device may draw up to 2mA.

Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Switching Speed, 50% Control to 0.5dB of Attenuation Value	—	1.0	—	μSec
Switching Control Frequency	—	1.0	—	MHz

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
V_{DD}	-0.3V Min., 4V Max.
V_{SS}	-4V Min., 0.3V Max.
Voltage on any input	-0.3V Min., V_{DD}+0.3V Max.
ESD, HBM	500V
ESD, MM	100V
Input Power	+24dBm

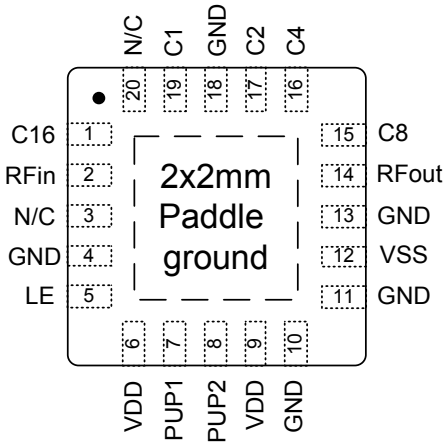
Permanent damage may occur if any of these limits are exceeded.

Pin Description

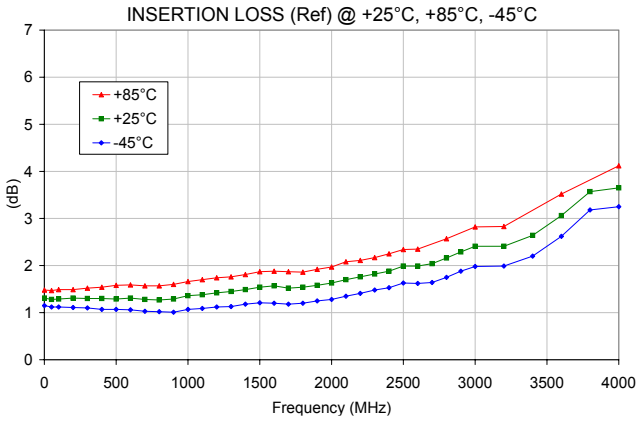
Function	Pin Number	Description
C16	1	Control for Attenuation bit, 16dB (Note 3)
RF in	2	RF in port (Note 1)
N/C	3	Not connected (Note 4)
GND	4	Ground connection
LE	5	Latch Enable Input (Note 2)
V_{DD}	6	Positive Supply Voltage
PUP1	7	Power-up selection
PUP2	8	Power-up selection
V_{DD}	9	Positive Supply Voltage
GND	10	Ground connection
GND	11	Ground connection
V_{SS}	12	Negative Supply Voltage
GND	13	Ground connection
RF out	14	RF out port (Note 1)
C8	15	Control for attenuation bit, 8 dB
C4	16	Control for attenuation bit, 4 dB
C2	17	Control for attenuation bit, 2 dB
GND	18	Ground Connection
C1	19	Control for attenuation bit, 1 dB
N/C	20	Not connected (Note 4)
GND	Paddle	Paddle ground (Note 5)

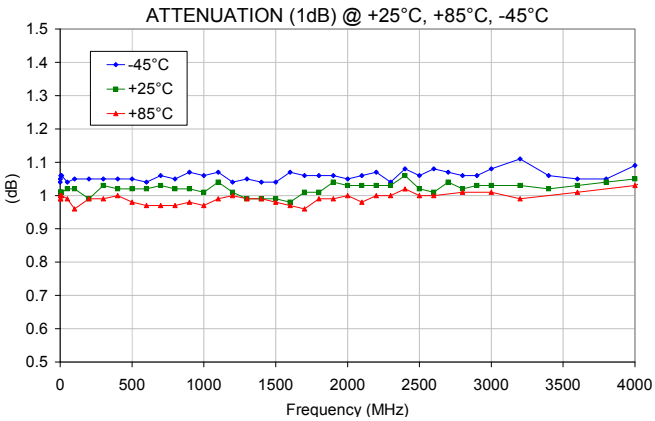
Notes:
1. Both RF ports must be held at 0VDC or DC blocked with an external series capacitor.
2. Latch Enable (LE) has an internal 100KΩ resistor to V_{DD}.
3. Place a 10KΩ resistor in series, as close to pin as possible to avoid freq. resonance.
4. Place a shunt 10KΩ resistor to GND
5. The exposed solder pad on the bottom of the package (See Pin configuration) must be grounded for proper device operation.

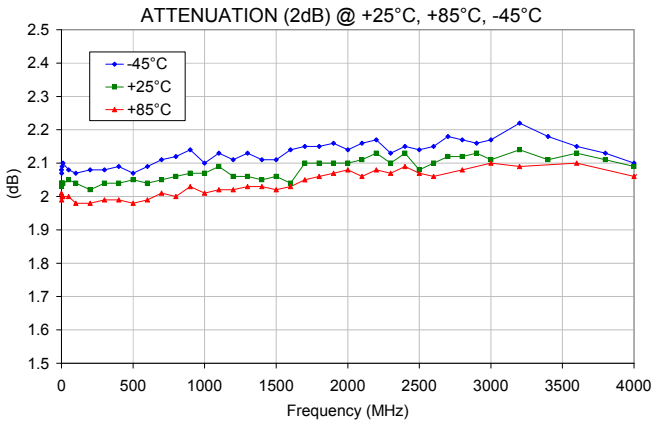
Pin Configuration (Top View)

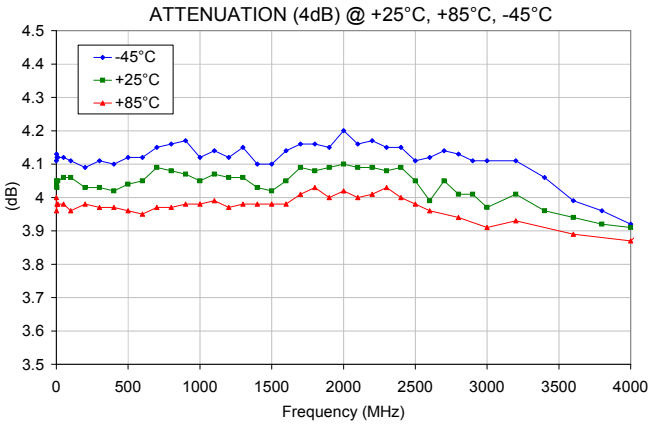


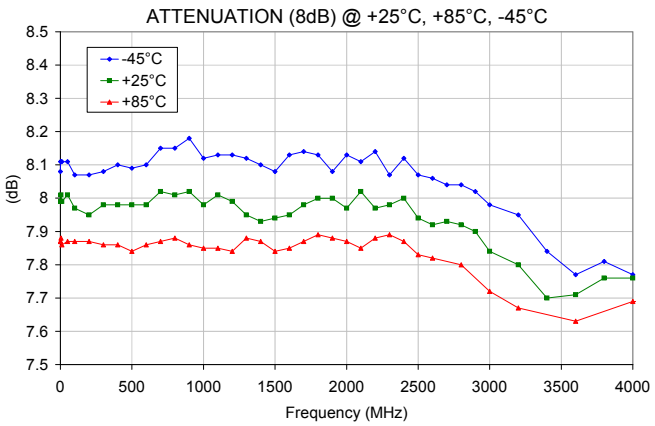
Typical Performance Curves

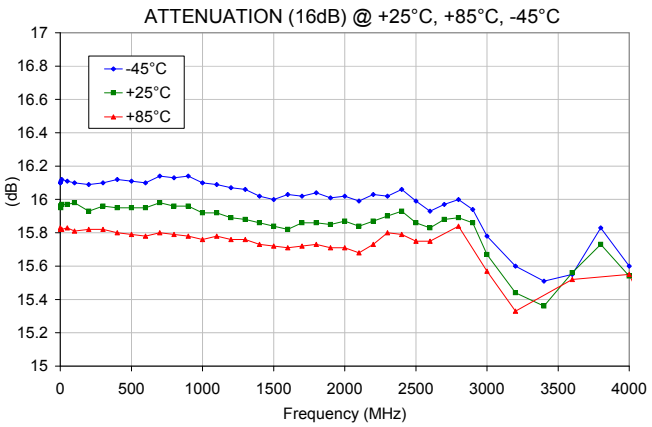












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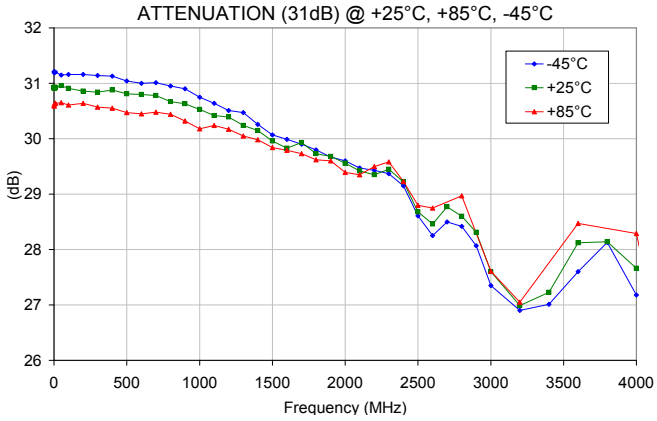

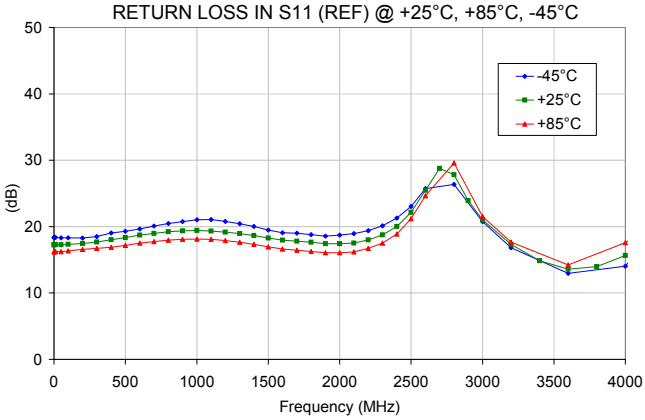

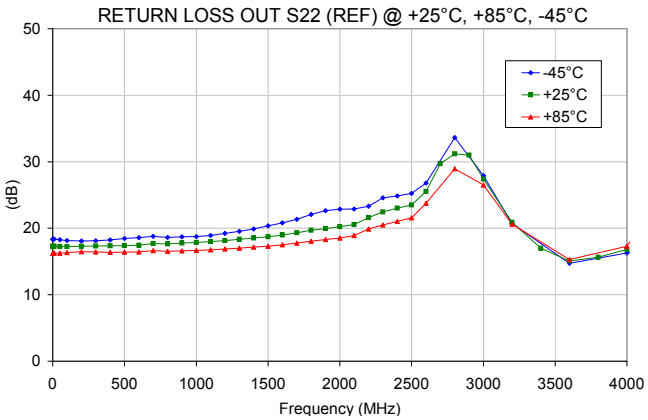

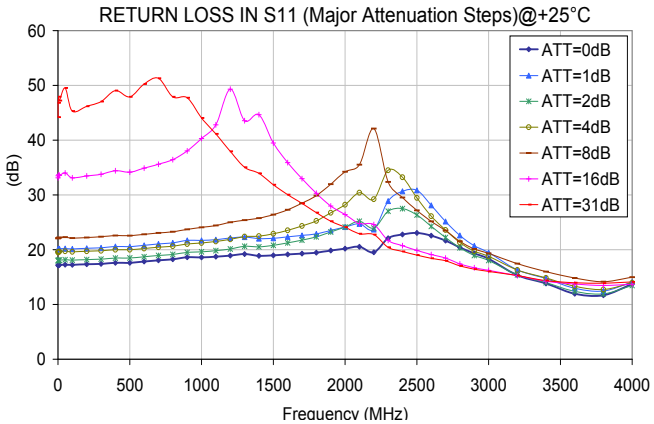

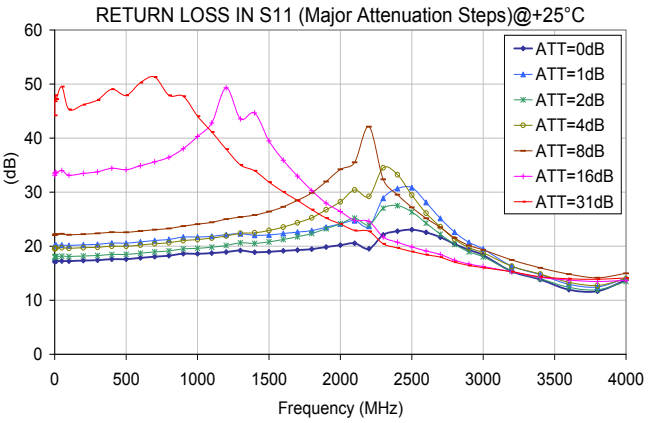

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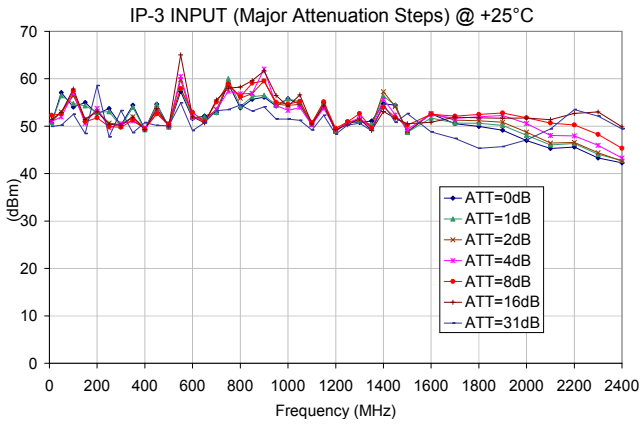
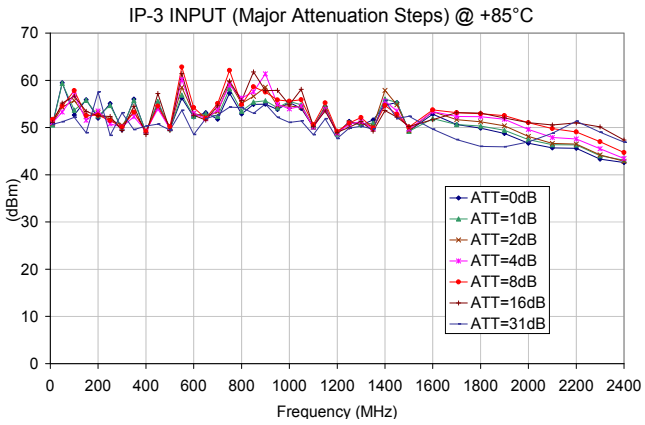
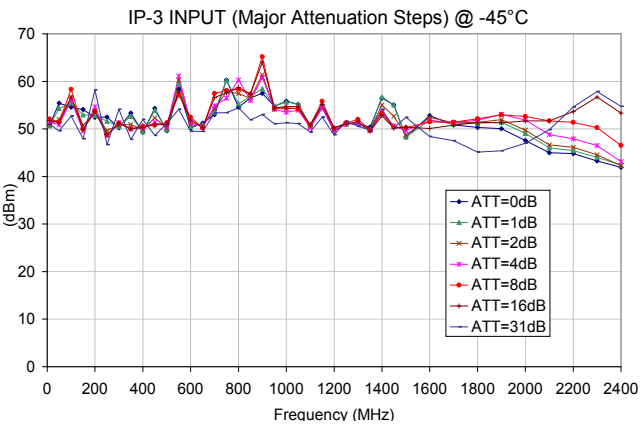
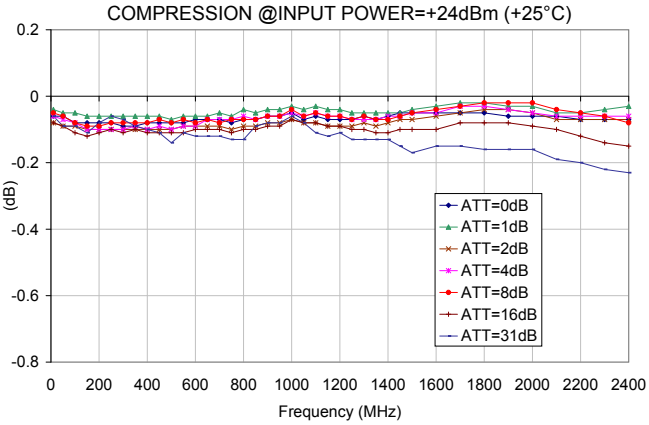
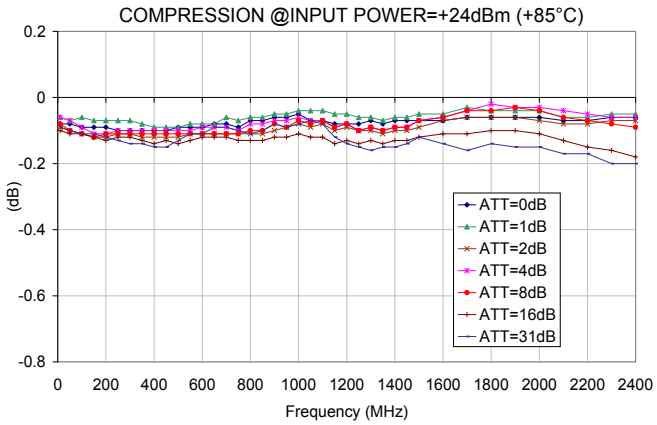
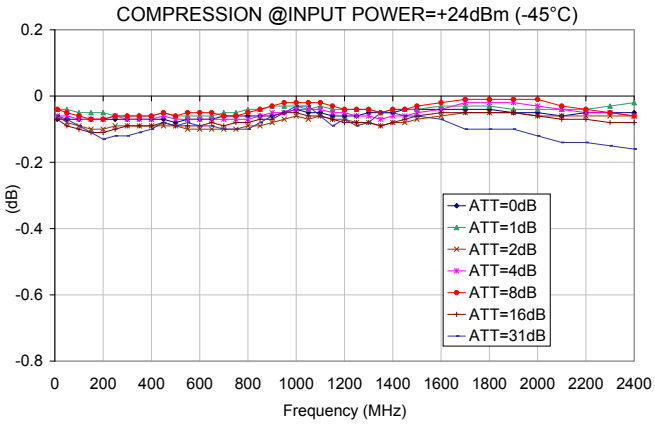




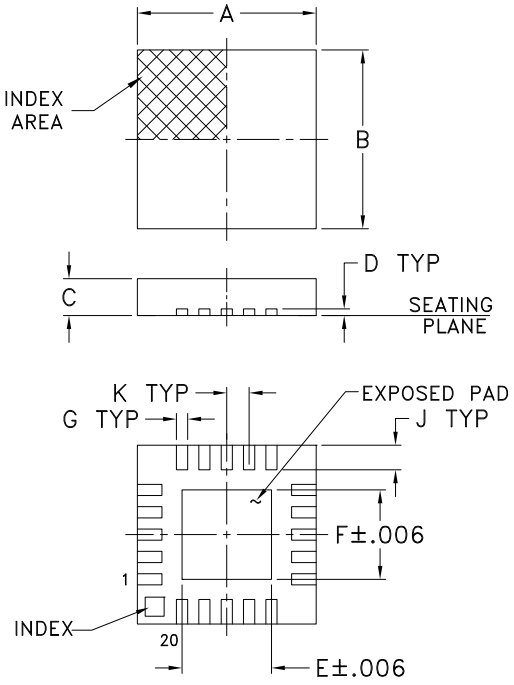




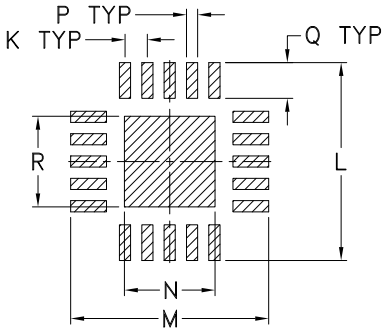




Outline Drawing (DG983-1)

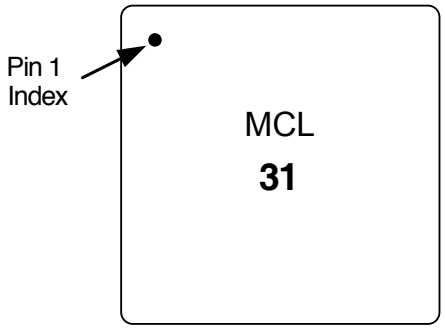


PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

Device Marking

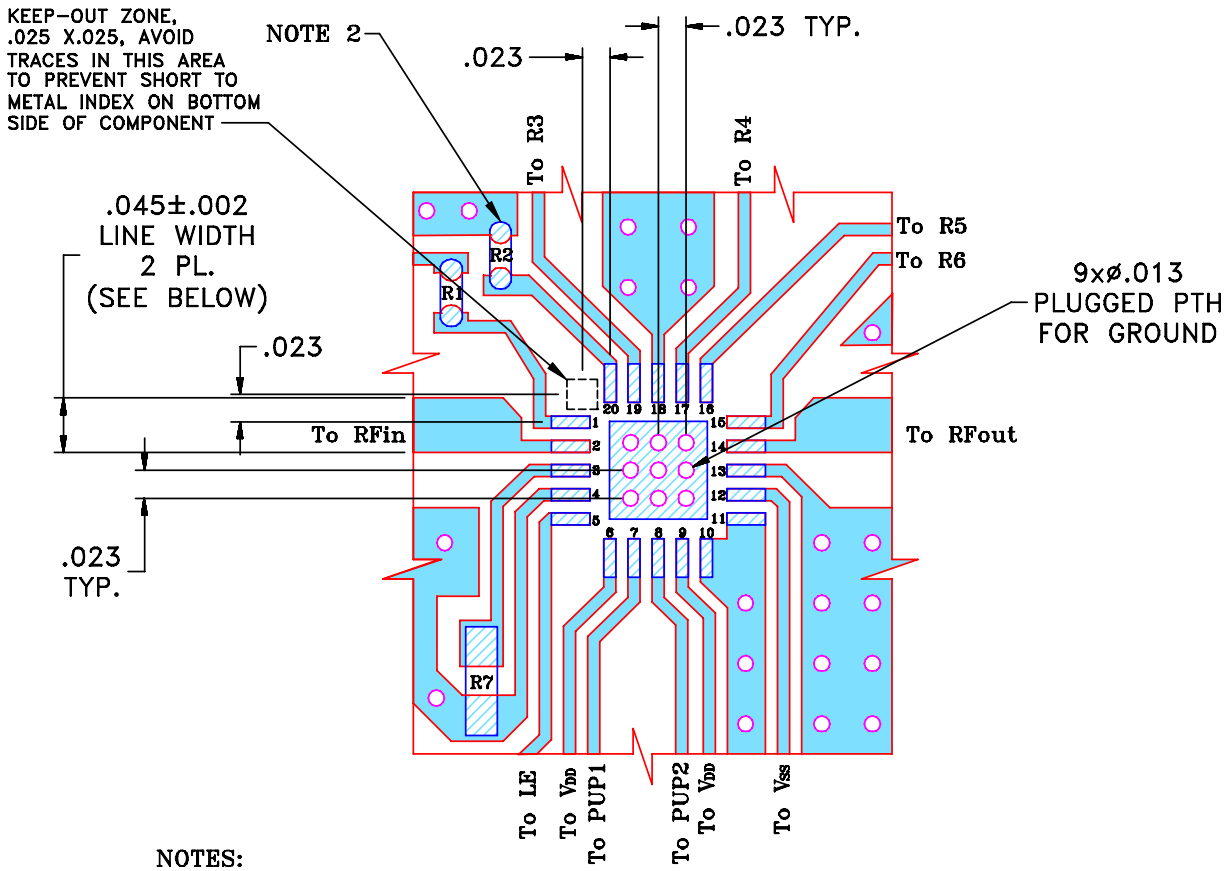


Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	WT. GRAMS
.157	**.157**	**.035**	**.008**	**.081**	**.081**	**.010**	—	**.022**	**.020**	**.177**	**.177**	**.081**	**.010**	**.032**	**.081**	.04
4.00	4.00	0.90	0.20	2.06	2.06	0.25	—	0.56	0.50	4.50	4.50	2.06	0.25	0.81	2.06	

Suggested Layout for PCB Design (PL-188)

The suggested Layout shows only the footprint area of the DAT, and the components located near this area (i.e.: R1, R2, R7). For the complete Layout, see photo and schematic diagram on page 11 of 12.



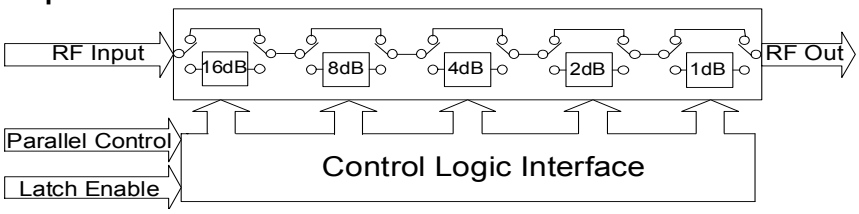
NOTES:

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. 0603, 0402 SIZES CHIP FOOT PRINTS SHOWN FOR REFERENCE, VALUES OF RESISTORS WILL VARY BASED ON APPLICATION.
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

Simplified Schematic



The DAT-31-PN+ parallel interface consists of 5 control bits that select the desired attenuation state, as shown in Table 1: Truth Table

Table 1. Truth Table

Attenuation State	C16	C8	C4	C2	C1
Reference	0	0	0	0	0
1 (dB)	0	0	0	0	1
2 (dB)	0	0	0	1	0
4 (dB)	0	0	1	0	0
8 (dB)	0	1	0	0	0
16 (dB)	1	0	0	0	0
31 (dB)	1	1	1	1	1
Note: Not all 32 possible combinations of C1 - C16 are shown in table					

The parallel interface timing requirements are defined by Figure 1 (Parallel Interface Timing Diagram) and Table 2 (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 hardwire, switches, or jumpers).

Figure 1: Parallel Interface Timing Diagram

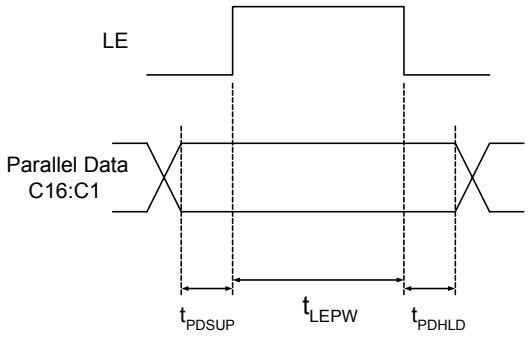


Table 2. Parallel Interface AC Characteristics

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

Pin 20 must always be low to prevent the attenuator from entering an unknown state.

Power-up Control Settings

The DAT-31-PN+ 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 automatically set to one of four possible values .These four values are selected by the two power-up control bits,PUP1 and PUP2 ,as shown in Table 3: (Power-Up Truth Table, Parallel Mode).

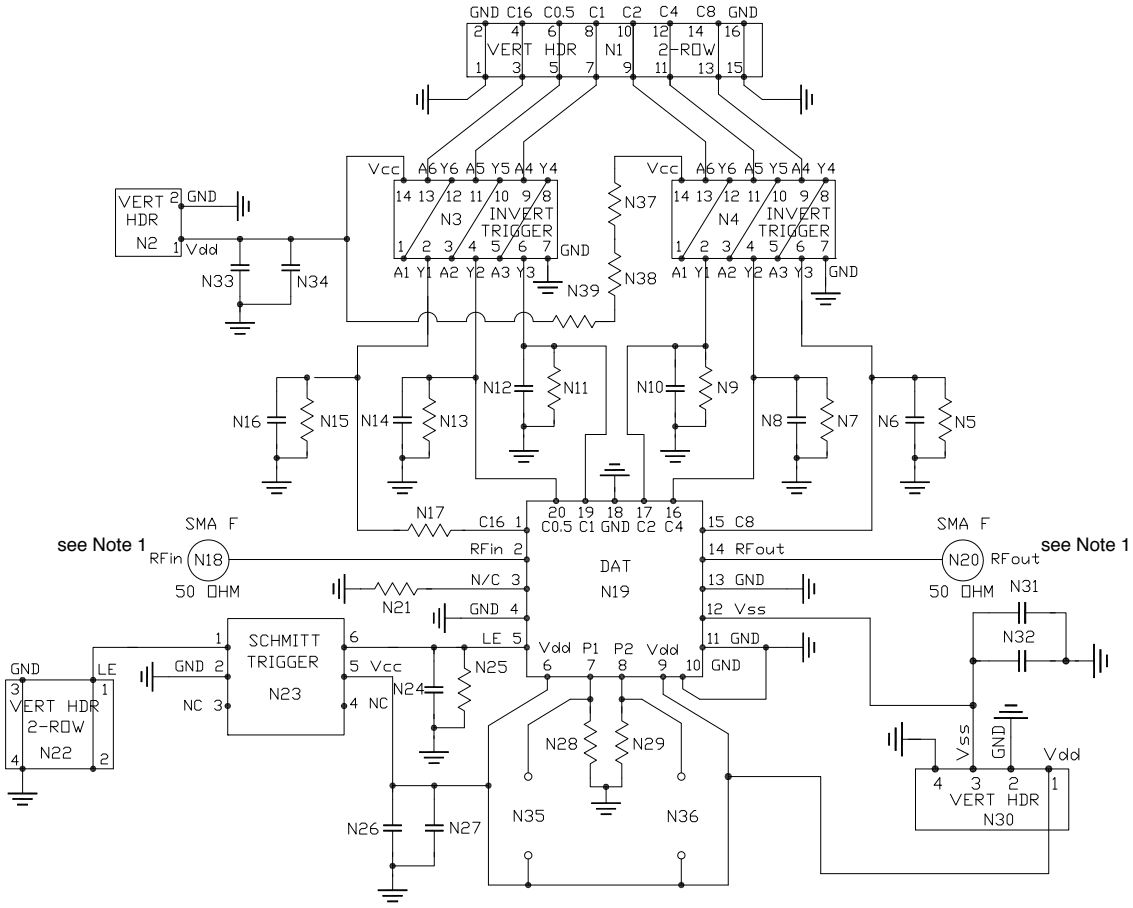
Table 3. Power-Up Truth Table, Parallel Mode

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 C1-C16 (See Table 1-Truth Table)	X (Note 1)	X (Note 1)	1

Note 1: PUP1 and PUP2 Connection may be 0, 1, GROUND, or not connect, without effect on attenuation state.

Power-Up with LE=1 provides normal parallel operation with C1-C16, and PUP1 and PUP2 are not active.

TB-340 Evaluation Board Schematic Diagram



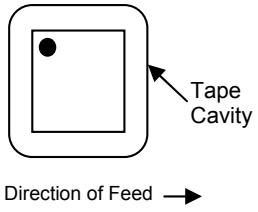
Note 1: Both RF ports must be held at 0VDC or DC blocked with an external series capacitor.

Bill of Materials	
N5, N7, N9, N11, N13, N15, N21 & N25	Resistor 0603 10 KOhm +/- 1%
N28 & N29	Resistor 0603 475 Ohm +/- 1%
N37 - N39	Resistor 0603 0 Ohm
N17	Resistor 0402 10 KOhm +/- 1%
N6, N8, N10, N12, N14, N16, N24, N26, N31 & N33	NPO Capacitor 0603 100pF +/- 5%
N27, N32 & N34	Tantalum Capacitor 0805 100nF +/- 10%
N3 & N4	Hex Invert Trigger MSL1
N23	Dual Schmitt Trigger Buffer SC-70 MSL1

TB-340

Tape and Reel Packaging Information

Table T&R

TR No.	No. of Devices	Reel Size	Tape Width	Pitch	Unit Orientation
F87	Small quantity standards 20, 50, 100, 200	7 inch	12 mm	8 mm	
	3000 (Standard)	13 inch			

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

Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=-45degC

FREQUENCY (MHz)	STEP ATTENUATION* AT TTL CONTROL STATE (dB)						
	00000 THRU LOSS	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	1.15	1.04	2.08	4.11	8.08	16.10	31.21
1	1.14	1.05	2.07	4.13	8.11	16.10	31.19
5	1.14	1.06	2.09	4.12	8.11	16.11	31.20
10	1.15	1.06	2.10	4.12	8.11	16.12	31.20
50	1.17	1.04	2.08	4.12	8.11	16.11	31.15
100	1.20	1.05	2.07	4.11	8.07	16.10	31.16
200	1.23	1.05	2.08	4.09	8.07	16.09	31.16
300	1.25	1.05	2.08	4.11	8.08	16.10	31.14
400	1.26	1.05	2.09	4.10	8.10	16.12	31.13
500	1.29	1.05	2.07	4.12	8.09	16.11	31.04
600	1.31	1.04	2.09	4.12	8.10	16.10	31.00
700	1.29	1.06	2.11	4.15	8.15	16.14	31.01
800	1.31	1.05	2.12	4.16	8.15	16.13	30.95
900	1.32	1.07	2.14	4.17	8.18	16.14	30.90
1000	1.40	1.06	2.10	4.12	8.12	16.10	30.75
1100	1.44	1.07	2.13	4.14	8.13	16.09	30.64
1200	1.50	1.04	2.11	4.12	8.13	16.07	30.51
1300	1.53	1.05	2.13	4.15	8.12	16.06	30.47
1400	1.61	1.04	2.11	4.10	8.10	16.02	30.26
1500	1.67	1.04	2.11	4.10	8.08	16.00	30.07
1600	1.68	1.07	2.14	4.14	8.13	16.03	29.99
1700	1.70	1.06	2.15	4.16	8.14	16.02	29.90
1800	1.73	1.06	2.15	4.16	8.13	16.04	29.80
1900	1.80	1.06	2.16	4.15	8.08	16.01	29.67
2000	1.85	1.05	2.14	4.20	8.13	16.02	29.60
2100	1.93	1.06	2.16	4.16	8.11	15.99	29.47
2200	2.00	1.07	2.17	4.17	8.14	16.03	29.43
2300	2.08	1.04	2.13	4.15	8.07	16.02	29.37
2400	2.15	1.08	2.15	4.15	8.12	16.06	29.15
2500	2.26	1.06	2.14	4.11	8.07	15.99	28.61
2600	2.27	1.08	2.15	4.12	8.06	15.93	28.25
2700	2.31	1.07	2.18	4.14	8.04	15.97	28.50
2800	2.45	1.06	2.17	4.13	8.04	16.00	28.42
2900	2.60	1.06	2.16	4.11	8.02	15.94	28.07
3000	2.72	1.08	2.17	4.11	7.98	15.78	27.35
3200	2.79	1.11	2.22	4.11	7.95	15.60	26.90
3400	3.05	1.06	2.18	4.06	7.84	15.51	27.01
3600	3.53	1.05	2.15	3.99	7.77	15.55	27.60
3800	4.15	1.05	2.13	3.96	7.81	15.83	28.13
4000	4.29	1.09	2.10	3.92	7.77	15.60	27.18

* Step Attenuation above Thru Loss (TTL Logic 00000).

Notes: 1. Performance and quality attributes and conditions not expressly stated in this specification sheet are intended to be excluded and do not form a part of this specification sheet. 2. Electrical specifications and performance data contained herein are based on Mini-Circuit's applicable established test performance criteria and measurement instructions. 3. The parts covered by this specification sheet 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.

Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=-45degC

FREQUENCY (MHz)	INPUT RETURN LOSS AT TTL CONTROL STATE (dB)						
	00000 0 dB	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	18.35	22.46	20.34	23.23	29.32	31.25	27.22
1	18.37	22.49	20.37	23.25	29.37	31.24	27.23
5	18.41	22.55	20.40	23.29	29.41	31.26	27.21
10	18.39	22.53	20.40	23.29	29.40	31.26	27.23
50	18.32	22.37	20.25	23.06	28.89	32.01	27.72
100	18.30	22.25	20.15	22.84	28.27	33.22	28.43
200	18.28	22.08	20.09	22.67	27.68	32.69	28.34
300	18.52	22.50	20.64	23.54	29.11	29.05	25.97
400	19.03	23.46	21.44	24.78	31.82	27.55	24.80
500	19.30	23.94	21.81	25.38	33.53	27.28	24.59
600	19.64	24.51	22.24	26.01	35.10	26.73	24.19
700	20.10	25.26	22.84	26.91	38.22	26.04	23.68
800	20.48	25.92	23.28	27.55	41.70	25.67	23.42
900	20.74	26.38	23.62	28.08	45.67	25.28	23.18
1000	21.05	26.94	23.97	28.65	50.13	24.78	22.82
1100	21.07	26.92	23.93	28.42	42.57	24.70	22.81
1200	20.77	26.26	23.50	27.68	39.67	24.88	23.06
1300	20.43	25.65	23.11	27.04	38.00	25.27	23.39
1400	20.02	24.94	22.68	26.46	36.91	25.95	23.99
1500	19.49	24.02	22.21	25.91	36.03	26.83	24.68
1600	19.09	23.42	21.95	25.60	35.56	27.14	24.87
1700	19.02	23.32	22.08	25.92	36.95	26.70	24.54
1800	18.79	23.00	22.11	26.18	36.83	26.41	24.23
1900	18.57	22.70	22.14	26.33	35.64	25.82	23.72
2000	18.72	23.01	22.66	27.35	35.28	24.63	22.79
2100	18.96	23.44	23.34	28.68	34.08	23.43	21.78
2200	19.38	24.18	24.41	30.77	31.73	22.19	20.73
2300	20.11	25.43	26.13	34.19	28.90	20.84	19.62
2400	21.29	27.83	28.99	42.20	26.61	19.53	18.45
2500	23.04	32.77	32.35	37.46	24.67	18.36	17.44
2600	25.73	43.49	31.70	29.23	22.68	17.31	16.53
2700	26.36	26.16	23.28	22.08	19.35	15.46	14.94
2800	20.74	19.50	18.14	17.65	16.50	13.75	13.45
2900	16.82	16.14	15.23	15.16	14.74	12.63	12.47
3000	12.95	12.70	12.14	12.29	12.52	11.23	11.29
3200	14.03	13.28	12.72	12.55	12.48	10.97	11.11
3400	27.51	25.09	23.54	21.13	18.27	13.36	13.04
3600	20.73	28.11	28.43	25.49	19.04	13.24	12.64
3800	15.05	15.71	15.61	16.57	15.57	11.75	11.49
4000	8.43	8.75	8.87	9.63	10.04	7.89	7.66

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Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=-45degC

FREQUENCY (MHz)	OUTPUT RETURN LOSS AT TTL CONTROL STATE (dB)						
	00000 0 dB	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	18.35	19.77	26.14	37.74	63.05	38.96	25.69
1	18.37	19.78	26.13	37.71	72.12	38.86	25.74
5	18.40	19.84	26.20	37.89	63.77	39.03	25.71
10	18.38	19.82	26.19	37.82	64.34	38.98	25.73
50	18.28	19.67	25.80	36.29	51.42	37.04	26.24
100	18.16	19.49	25.40	34.75	44.76	35.07	26.94
200	18.07	19.36	24.93	32.15	36.00	33.32	26.90
300	18.11	19.56	25.18	31.45	33.30	34.85	25.08
400	18.24	19.81	25.86	32.74	33.42	37.72	24.23
500	18.47	20.08	26.49	34.13	33.68	40.40	23.94
600	18.59	20.25	26.93	35.36	34.13	44.75	23.87
700	18.77	20.47	27.39	35.85	33.53	45.93	23.53
800	18.63	20.32	27.03	34.74	32.84	44.68	23.52
900	18.73	20.45	27.14	33.81	31.83	42.92	23.24
1000	18.75	20.50	27.19	33.08	30.96	41.65	23.01
1100	18.89	20.67	27.44	32.27	29.93	39.37	22.66
1200	19.23	21.06	28.00	31.62	28.95	37.37	22.18
1300	19.54	21.40	28.42	30.73	28.13	35.93	21.85
1400	19.88	21.83	28.82	29.32	26.87	33.74	21.28
1500	20.35	22.46	29.18	27.92	25.71	31.69	20.65
1600	20.80	23.06	29.55	27.01	24.82	30.16	20.10
1700	21.35	23.86	29.58	25.97	23.95	28.62	19.53
1800	22.08	24.89	29.56	25.01	23.07	27.15	18.97
1900	22.63	25.81	29.25	24.33	22.52	26.19	18.57
2000	22.86	26.28	28.97	23.97	22.18	25.60	18.35
2100	22.88	26.47	28.74	23.71	21.92	25.13	18.15
2200	23.32	27.29	28.96	23.47	21.67	24.46	17.90
2300	24.58	29.70	26.80	21.74	20.14	22.27	16.80
2400	24.85	30.19	25.70	20.89	19.35	21.17	16.24
2500	25.24	31.18	25.36	20.53	18.94	20.46	15.88
2600	26.79	35.89	27.81	21.36	19.32	20.18	15.86
2700	33.64	30.50	24.15	19.49	17.60	17.47	14.65
2800	27.91	25.67	22.92	19.11	17.15	16.50	14.19
2900	20.72	20.88	22.22	20.06	17.96	16.46	14.48
3000	14.74	15.02	17.45	19.19	18.96	16.40	15.72
3200	16.29	16.04	18.25	19.61	19.69	17.13	17.12
3400	19.78	17.98	18.55	17.50	16.67	15.08	14.83
3600	19.05	17.29	17.72	16.67	15.68	14.26	13.75
3800	13.53	12.48	12.39	11.72	10.80	9.35	9.49
4000	9.80	10.22	11.35	12.60	12.66	10.59	11.11

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Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=+25degC

FREQUENCY (MHz)	STEP ATTENUATION* AT TTL CONTROL STATE (dB)						
	00000 THRU LOSS	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	1.31	1.01	2.04	4.05	7.99	15.96	30.92
1	1.31	1.01	2.03	4.04	7.99	15.96	30.91
5	1.31	1.01	2.04	4.03	8.01	15.95	30.93
10	1.32	1.01	2.04	4.05	7.99	15.97	30.92
50	1.33	1.02	2.05	4.06	8.01	15.97	30.96
100	1.37	1.02	2.04	4.06	7.97	15.98	30.91
200	1.43	0.99	2.02	4.03	7.95	15.93	30.86
300	1.45	1.03	2.04	4.03	7.98	15.96	30.84
400	1.49	1.02	2.04	4.02	7.98	15.95	30.88
500	1.51	1.02	2.05	4.04	7.98	15.95	30.81
600	1.56	1.02	2.04	4.05	7.98	15.95	30.80
700	1.54	1.03	2.05	4.09	8.02	15.98	30.78
800	1.56	1.02	2.06	4.08	8.01	15.96	30.67
900	1.60	1.02	2.07	4.07	8.02	15.96	30.63
1000	1.69	1.01	2.07	4.05	7.98	15.92	30.53
1100	1.73	1.04	2.09	4.07	8.01	15.92	30.42
1200	1.80	1.01	2.06	4.06	7.99	15.89	30.39
1300	1.85	0.99	2.06	4.06	7.95	15.88	30.24
1400	1.92	0.99	2.05	4.03	7.93	15.86	30.15
1500	2.00	0.99	2.06	4.02	7.94	15.84	29.96
1600	2.05	0.98	2.04	4.05	7.95	15.82	29.83
1700	2.04	1.01	2.10	4.09	7.98	15.86	29.93
1800	2.07	1.01	2.10	4.08	8.00	15.86	29.73
1900	2.13	1.04	2.10	4.09	8.00	15.85	29.68
2000	2.20	1.03	2.10	4.10	7.97	15.87	29.56
2100	2.28	1.03	2.11	4.09	8.02	15.84	29.42
2200	2.35	1.03	2.13	4.09	7.97	15.87	29.35
2300	2.42	1.03	2.10	4.08	7.98	15.90	29.45
2400	2.50	1.06	2.13	4.09	8.00	15.93	29.22
2500	2.62	1.02	2.08	4.05	7.94	15.86	28.68
2600	2.64	1.01	2.10	3.99	7.92	15.83	28.46
2700	2.71	1.04	2.12	4.05	7.93	15.88	28.77
2800	2.86	1.02	2.12	4.01	7.92	15.89	28.60
2900	3.01	1.03	2.13	4.01	7.90	15.86	28.31
3000	3.15	1.03	2.11	3.97	7.84	15.67	27.60
3200	3.21	1.03	2.14	4.01	7.80	15.44	26.99
3400	3.49	1.02	2.11	3.96	7.70	15.36	27.23
3600	3.97	1.03	2.13	3.94	7.71	15.56	28.12
3800	4.54	1.04	2.11	3.92	7.76	15.73	28.14
4000	4.69	1.05	2.09	3.91	7.76	15.54	27.66

* Step Attenuation above Thru Loss (TTL Logic 00000).

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Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=+25degC

FREQUENCY (MHz)	INPUT RETURN LOSS AT TTL CONTROL STATE (dB)						
	00000 0 dB	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	17.24	20.17	18.05	19.56	22.11	32.70	43.95
1	17.28	20.19	18.08	19.59	22.16	32.79	44.22
5	17.31	20.24	18.12	19.63	22.20	32.85	44.41
10	17.30	20.23	18.12	19.62	22.21	32.87	44.46
50	17.26	20.19	18.09	19.60	22.17	32.70	43.86
100	17.32	20.26	18.15	19.66	22.26	32.87	43.85
200	17.46	20.41	18.29	19.81	22.42	33.28	43.90
300	17.69	20.70	18.56	20.12	22.79	34.47	44.63
400	18.02	21.11	18.90	20.50	23.27	36.27	44.52
500	18.36	21.55	19.24	20.87	23.74	38.39	43.76
600	18.72	22.03	19.60	21.25	24.23	40.83	42.28
700	18.97	22.36	19.87	21.55	24.65	43.62	40.38
800	19.23	22.67	20.11	21.82	25.03	43.52	38.87
900	19.36	22.83	20.23	21.96	25.21	40.78	37.92
1000	19.42	22.87	20.26	21.97	25.20	38.80	37.52
1100	19.33	22.71	20.20	21.85	25.03	37.17	37.84
1200	19.16	22.45	20.06	21.70	24.83	36.50	38.62
1300	18.95	22.12	19.90	21.53	24.56	36.33	40.64
1400	18.66	21.69	19.73	21.34	24.31	36.48	44.61
1500	18.29	21.15	19.49	21.09	23.96	36.68	57.74
1600	17.97	20.74	19.31	20.96	23.84	36.94	51.80
1700	17.82	20.56	19.40	21.14	24.06	39.22	41.85
1800	17.64	20.31	19.46	21.33	24.27	39.63	35.73
1900	17.43	20.05	19.55	21.49	24.47	36.78	32.21
2000	17.42	20.05	19.86	22.00	25.08	33.82	29.45
2100	17.52	20.25	20.38	22.78	25.90	30.53	26.96
2200	18.01	20.90	21.37	24.15	27.08	27.67	24.82
2300	18.77	21.93	22.76	26.11	28.17	25.29	22.99
2400	20.02	23.84	25.00	29.53	29.11	23.33	21.44
2500	22.14	27.43	28.84	38.12	28.74	21.58	20.08
2600	25.48	35.49	33.65	38.13	26.47	20.00	18.84
2700	28.78	41.22	29.50	28.57	23.96	18.59	17.71
2800	27.81	28.16	24.26	23.72	21.61	17.37	16.70
2900	23.91	23.08	20.78	20.54	19.59	16.26	15.84
3000	21.01	20.26	18.58	18.48	18.06	15.35	15.08
3200	17.32	16.98	15.77	15.88	16.04	14.06	14.01
3400	14.87	14.85	13.88	14.15	14.61	13.16	13.26
3600	13.60	13.59	12.77	13.01	13.59	12.45	12.71
3800	13.98	13.80	13.03	13.15	13.60	12.35	12.64
4000	15.65	15.04	14.19	14.06	14.26	12.62	12.90

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Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=+25degC

FREQUENCY (MHz)	OUTPUT RETURN LOSS AT TTL CONTROL STATE (dB)						
	00000 0 dB	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	17.24	17.97	22.25	26.40	27.38	24.00	45.36
1	17.26	18.00	22.27	26.42	27.39	24.03	45.39
5	17.29	18.04	22.34	26.49	27.45	24.07	45.11
10	17.29	18.04	22.33	26.47	27.44	24.08	45.18
50	17.26	18.01	22.25	26.36	27.33	24.03	45.64
100	17.24	17.99	22.22	26.33	27.33	24.04	44.59
200	17.28	18.04	22.28	26.33	27.35	24.09	41.24
300	17.33	18.11	22.35	26.41	27.49	24.27	38.78
400	17.34	18.12	22.36	26.41	27.51	24.38	37.09
500	17.39	18.19	22.45	26.46	27.55	24.52	35.58
600	17.44	18.26	22.49	26.51	27.56	24.60	34.91
700	17.69	18.53	22.87	26.94	28.00	25.08	32.93
800	17.64	18.49	22.76	26.68	27.60	25.05	31.71
900	17.76	18.59	22.86	26.60	27.39	25.14	30.52
1000	17.86	18.72	22.98	26.53	27.24	25.29	29.47
1100	17.99	18.87	23.07	26.41	26.99	25.49	28.35
1200	18.16	19.04	23.20	26.23	26.61	25.72	27.25
1300	18.33	19.24	23.28	25.92	26.21	26.01	26.16
1400	18.52	19.49	23.40	25.61	25.74	26.47	25.02
1500	18.71	19.76	23.48	25.20	25.26	27.02	24.02
1600	18.98	20.12	23.64	24.79	24.80	27.76	23.06
1700	19.32	20.60	23.76	24.32	24.24	28.52	22.14
1800	19.69	21.12	23.80	23.76	23.63	29.22	21.30
1900	19.96	21.59	23.69	23.18	23.05	29.67	20.53
2000	20.24	22.05	23.57	22.69	22.57	30.08	19.94
2100	20.56	22.60	23.79	22.57	22.38	30.57	19.50
2200	21.59	24.13	24.86	22.85	22.50	30.82	19.11
2300	22.45	25.62	24.50	21.84	21.36	27.34	18.07
2400	23.03	26.57	24.47	21.52	20.87	25.79	17.62
2500	23.50	27.60	25.13	21.69	20.87	25.06	17.48
2600	25.53	31.18	28.95	23.15	21.70	24.11	17.60
2700	29.71	36.70	28.59	22.36	20.68	21.57	16.88
2800	31.20	32.90	27.78	22.00	20.22	20.42	16.59
2900	31.00	29.98	26.80	21.63	19.80	19.58	16.29
3000	27.39	27.09	27.20	22.18	20.10	19.28	16.36
3200	20.91	21.23	25.28	23.62	21.27	18.77	16.76
3400	17.00	17.35	21.07	23.11	22.08	18.20	17.57
3600	15.06	15.24	18.42	21.05	21.77	17.61	18.60
3800	15.63	15.56	18.62	21.11	22.21	17.90	19.98
4000	16.81	16.62	19.90	22.66	23.99	18.81	21.38

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Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=+85degC

FREQUENCY (MHz)	STEP ATTENUATION* AT TTL CONTROL STATE (dB)						
	00000 THRU LOSS	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	1.48	1.00	2.01	4.00	7.87	15.83	30.61
1	1.49	0.99	1.99	3.96	7.87	15.82	30.59
5	1.49	0.99	2.00	3.98	7.88	15.82	30.63
10	1.51	1.00	2.00	3.98	7.86	15.82	30.64
50	1.52	0.99	2.00	3.98	7.87	15.83	30.65
100	1.57	0.96	1.98	3.96	7.87	15.81	30.61
200	1.61	0.99	1.98	3.98	7.87	15.82	30.64
300	1.67	0.99	1.99	3.97	7.86	15.82	30.57
400	1.73	1.00	1.99	3.97	7.86	15.80	30.55
500	1.80	0.98	1.98	3.96	7.84	15.79	30.47
600	1.84	0.97	1.99	3.95	7.86	15.78	30.45
700	1.83	0.97	2.01	3.97	7.87	15.80	30.48
800	1.86	0.97	2.00	3.97	7.88	15.79	30.44
900	1.91	0.98	2.03	3.98	7.86	15.78	30.32
1000	1.99	0.97	2.01	3.98	7.85	15.76	30.18
1100	2.05	0.99	2.02	3.99	7.85	15.78	30.24
1200	2.12	1.00	2.02	3.97	7.84	15.76	30.17
1300	2.16	0.99	2.03	3.98	7.88	15.76	30.05
1400	2.24	0.99	2.03	3.98	7.87	15.73	29.98
1500	2.33	0.98	2.02	3.98	7.84	15.72	29.84
1600	2.36	0.97	2.03	3.98	7.85	15.71	29.79
1700	2.39	0.96	2.05	4.01	7.87	15.72	29.73
1800	2.39	0.99	2.06	4.03	7.89	15.73	29.62
1900	2.47	0.99	2.07	4.00	7.88	15.71	29.60
2000	2.54	1.00	2.08	4.02	7.87	15.71	29.39
2100	2.66	0.98	2.06	4.00	7.85	15.68	29.35
2200	2.70	1.00	2.08	4.01	7.88	15.73	29.50
2300	2.77	1.00	2.07	4.03	7.89	15.80	29.58
2400	2.87	1.02	2.09	4.00	7.87	15.79	29.23
2500	2.97	1.00	2.07	3.98	7.83	15.75	28.80
2600	3.00	1.00	2.06	3.96	7.82	15.75	28.75
2700	3.27	1.01	2.08	3.94	7.80	15.84	28.97
2800	3.56	1.01	2.10	3.91	7.72	15.57	27.61
2900	3.63	0.99	2.09	3.93	7.67	15.33	27.05
3000	4.43	1.01	2.10	3.89	7.63	15.52	28.47
3200	5.16	1.03	2.06	3.87	7.69	15.55	28.29
3400	4.41	1.12	2.20	4.06	7.68	14.60	22.31
3600	4.67	1.27	2.40	4.25	7.85	15.00	23.08
3800	5.66	1.37	2.39	4.04	7.58	15.02	22.87
4000	7.01	1.25	2.26	3.76	7.11	14.66	21.97

* Step Attenuation above Thru Loss (TTL Logic 00000).

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Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=+85degC

FREQUENCY (MHz)	INPUT RETURN LOSS AT TTL CONTROL STATE (dB)						
	00000 0 dB	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	16.20	18.35	16.26	17.07	18.43	23.07	25.55
1	16.22	18.37	16.28	17.09	18.44	23.07	25.54
5	16.26	18.42	16.31	17.12	18.46	23.09	25.58
10	16.24	18.41	16.31	17.12	18.48	23.10	25.60
50	16.23	18.42	16.34	17.16	18.55	23.24	25.77
100	16.35	18.58	16.51	17.39	18.83	23.76	26.45
200	16.58	18.88	16.77	17.69	19.24	24.45	27.42
300	16.72	18.96	16.81	17.66	19.14	24.12	26.89
400	16.90	19.09	16.87	17.64	19.00	23.71	26.31
500	17.18	19.35	17.06	17.78	19.08	23.71	26.27
600	17.53	19.73	17.33	18.02	19.29	23.98	26.59
700	17.75	19.98	17.53	18.20	19.46	24.17	26.85
800	17.96	20.19	17.68	18.32	19.56	24.24	26.88
900	18.08	20.28	17.80	18.41	19.62	24.25	26.87
1000	18.14	20.30	17.87	18.48	19.69	24.29	26.95
1100	18.08	20.21	17.89	18.50	19.71	24.30	26.87
1200	17.90	19.98	17.83	18.48	19.68	24.27	26.80
1300	17.65	19.70	17.71	18.38	19.61	24.16	26.63
1400	17.33	19.30	17.55	18.25	19.48	24.00	26.28
1500	16.95	18.81	17.32	18.07	19.30	23.74	25.77
1600	16.62	18.43	17.19	17.97	19.24	23.72	25.63
1700	16.45	18.23	17.21	18.07	19.39	24.02	25.75
1800	16.26	17.98	17.24	18.17	19.50	24.33	25.67
1900	16.05	17.77	17.29	18.31	19.68	24.65	25.56
2000	16.06	17.77	17.59	18.72	20.16	25.37	25.73
2100	16.20	17.96	18.06	19.35	20.84	26.16	25.62
2200	16.74	18.59	18.99	20.45	21.94	26.96	25.29
2300	17.52	19.53	20.25	21.93	23.35	26.97	24.50
2400	18.89	21.20	22.26	24.41	25.46	26.34	23.55
2500	21.20	24.23	25.73	28.98	28.30	24.90	22.37
2600	24.64	29.20	31.45	41.24	29.93	23.09	21.16
2700	29.60	31.02	25.50	25.82	24.56	19.63	18.75
2800	21.53	21.19	19.14	19.38	19.74	17.04	16.80
2900	17.69	17.70	16.21	16.54	17.26	15.47	15.54
3000	14.24	14.49	13.41	13.73	14.64	13.69	14.15
3200	17.57	17.11	15.89	15.77	16.25	14.41	14.90
3400	24.51	33.15	31.74	32.47	29.20	19.15	18.83
3600	22.98	35.51	36.27	30.11	22.38	16.05	15.24
3800	15.88	16.23	15.25	15.84	15.88	12.70	12.59
4000	8.82	9.31	9.04	9.70	10.47	8.88	8.78

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Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

Digital Step Attenuator DAT-31-PN+

Typical Performance Data

TEST CONDITIONS: INPUT POWER=-10dBm, Vdd=+3V, TEMPERATURE=+85degC

FREQUENCY (MHz)	OUTPUT RETURN LOSS AT TTL CONTROL STATE (dB)						
	00000 0 dB	00001 1 dB	00010 2.0 dB	00100 4.0 dB	01000 8.0 dB	10000 16.0 dB	11111 31 dB
0.5	16.20	16.50	19.65	21.87	21.60	19.03	28.54
1	16.21	16.50	19.65	21.84	21.59	19.02	28.47
5	16.26	16.55	19.70	21.89	21.63	19.06	28.53
10	16.25	16.55	19.69	21.88	21.62	19.06	28.51
50	16.25	16.55	19.71	21.91	21.68	19.14	28.62
100	16.33	16.68	19.92	22.25	22.08	19.45	29.54
200	16.48	16.85	20.18	22.64	22.50	19.79	30.67
300	16.42	16.74	19.94	22.25	22.10	19.44	29.54
400	16.36	16.63	19.72	21.83	21.57	19.03	28.13
500	16.40	16.63	19.67	21.68	21.37	18.87	27.43
600	16.42	16.66	19.66	21.59	21.27	18.83	27.00
700	16.61	16.84	19.84	21.75	21.40	18.96	26.94
800	16.54	16.76	19.66	21.43	21.08	18.78	26.00
900	16.58	16.81	19.63	21.31	20.92	18.77	25.29
1000	16.67	16.91	19.66	21.24	20.84	18.88	24.76
1100	16.74	17.02	19.69	21.17	20.82	19.05	24.22
1200	16.87	17.18	19.80	21.14	20.81	19.30	23.74
1300	17.00	17.37	19.87	21.14	20.85	19.59	23.24
1400	17.16	17.58	20.00	21.15	20.89	19.97	22.77
1500	17.29	17.79	20.04	21.03	20.85	20.35	22.23
1600	17.51	18.09	20.19	20.99	20.87	20.87	21.70
1700	17.76	18.45	20.35	20.94	20.87	21.45	21.20
1800	18.06	18.86	20.47	20.87	20.84	22.20	20.67
1900	18.29	19.25	20.51	20.67	20.77	22.97	20.15
2000	18.52	19.64	20.58	20.60	20.80	23.99	19.86
2100	18.92	20.25	21.04	20.91	21.22	25.67	19.80
2200	19.90	21.61	22.04	21.48	21.82	29.06	19.64
2300	20.49	22.59	22.13	21.14	21.44	30.82	18.83
2400	21.02	23.44	22.50	21.14	21.39	31.61	18.56
2500	21.58	24.28	23.55	21.85	22.01	33.36	18.70
2600	23.76	27.33	27.30	23.91	23.56	31.28	19.07
2700	28.94	32.61	31.39	24.30	22.94	24.12	18.36
2800	26.50	27.20	33.42	25.49	23.41	22.29	18.40
2900	20.60	20.96	27.83	28.57	25.76	20.96	19.31
3000	15.31	15.41	19.16	22.66	24.52	18.34	22.66
3200	17.29	17.12	21.22	25.35	28.32	19.74	28.51
3400	32.79	26.60	27.53	23.33	22.47	20.73	18.75
3600	20.47	17.81	18.30	17.01	16.32	14.25	14.84
3800	14.29	13.38	14.09	13.78	12.94	10.65	11.44
4000	9.49	9.76	11.27	12.71	13.17	10.52	13.01

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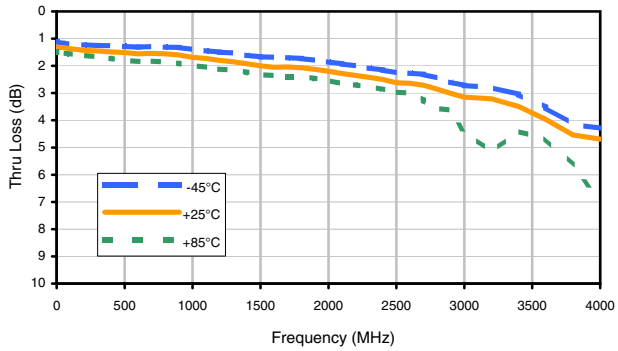
Not recommended for new designs.
Recommended replacement part: DAT-31A-PN+

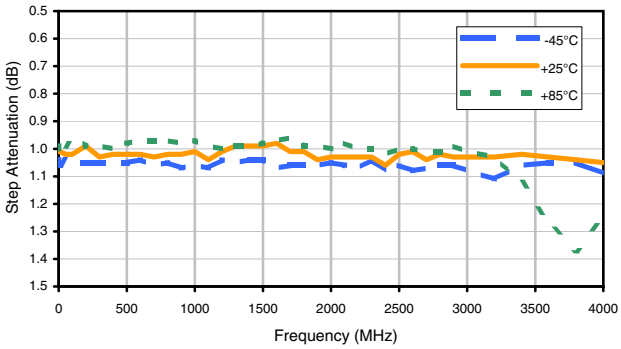
Digital Step Attenuator DAT-31-PN+

Typical Performance Curves

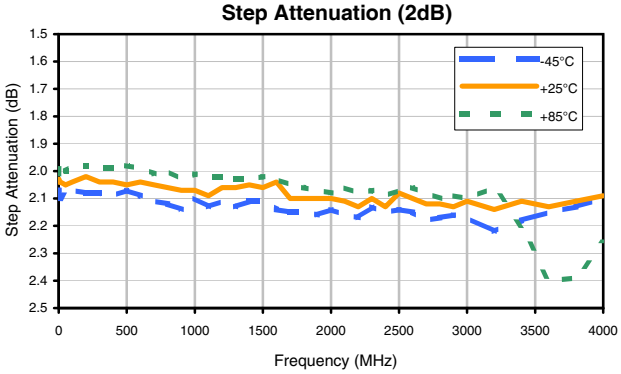
Thru Loss



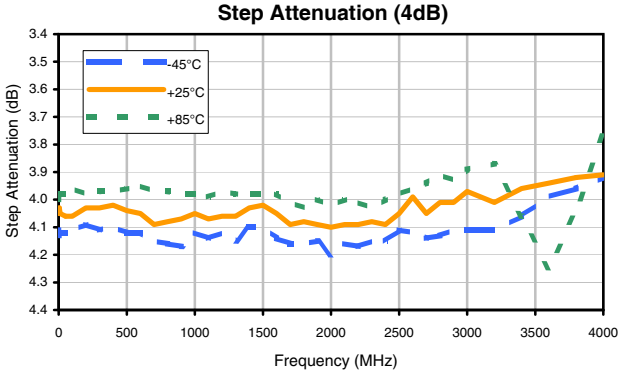
Step Attenuation (1dB)



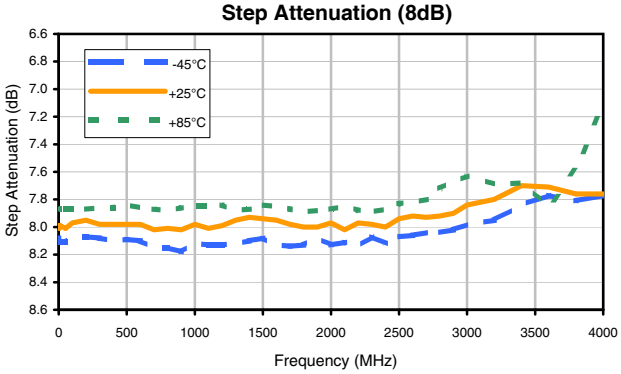
Step Attenuation (2dB)



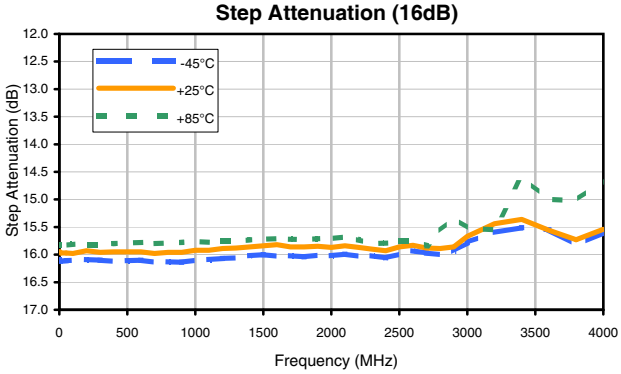
Step Attenuation (4dB)



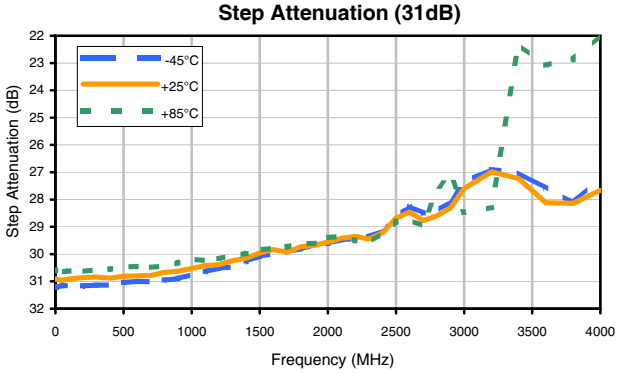
Step Attenuation (8dB)



Step Attenuation (16dB)



Step Attenuation (31dB)



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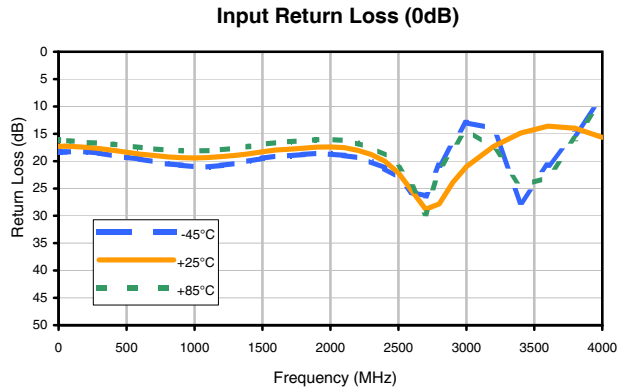
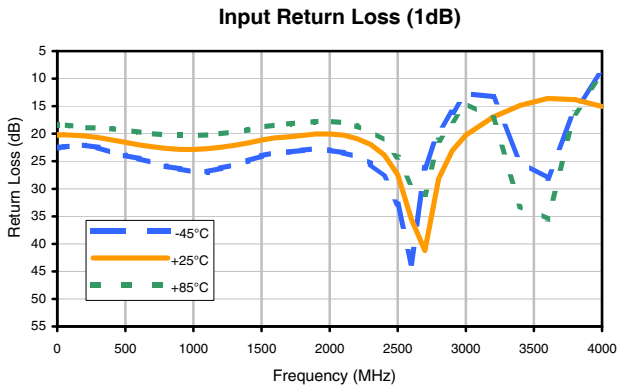
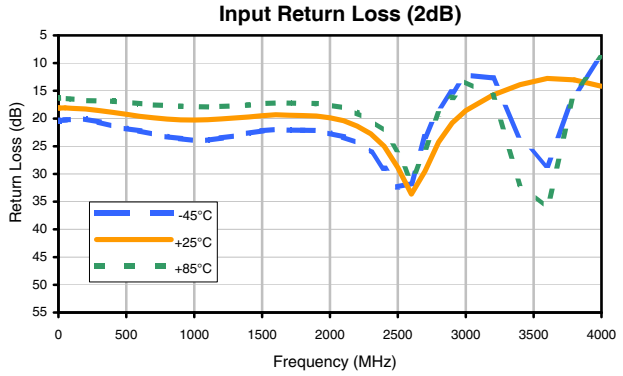
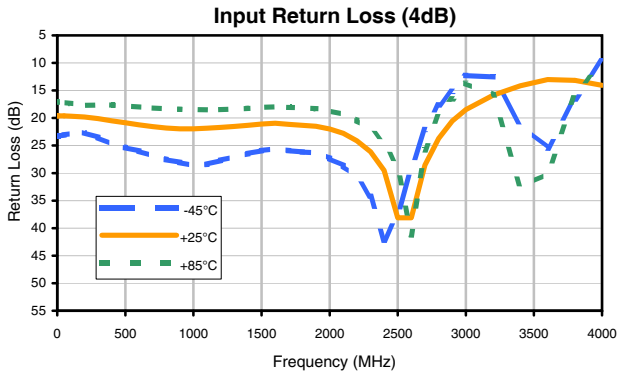
Digital Step Attenuator DAT-31-PN+

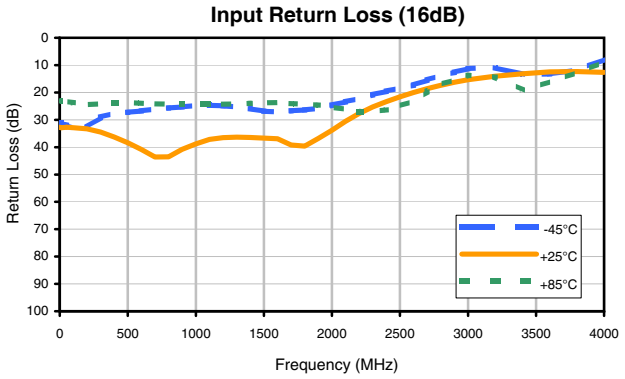
Typical Performance Curves











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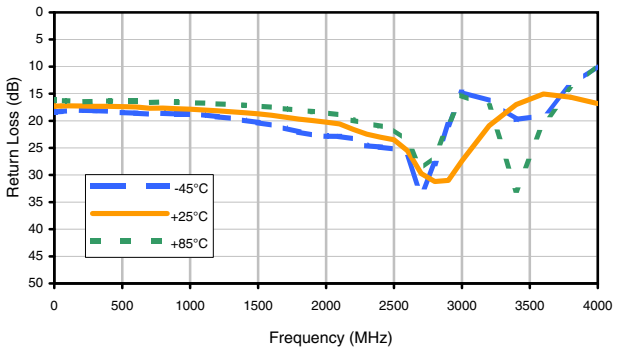
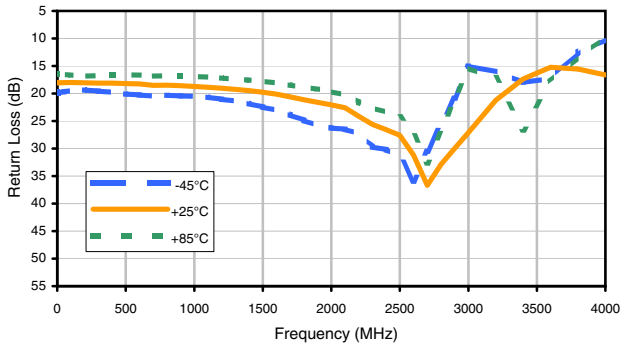
Digital Step Attenuator DAT-31-PN+

Typical Performance Curves

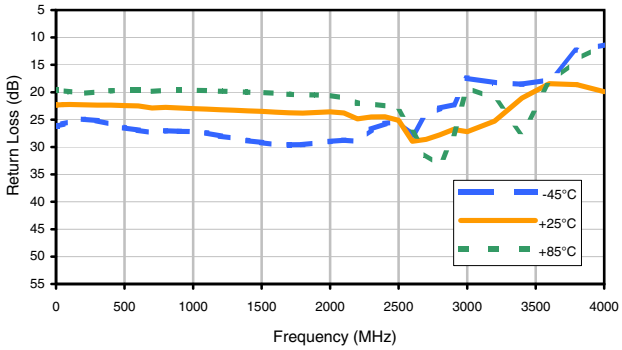
Output Return Loss (0dB)



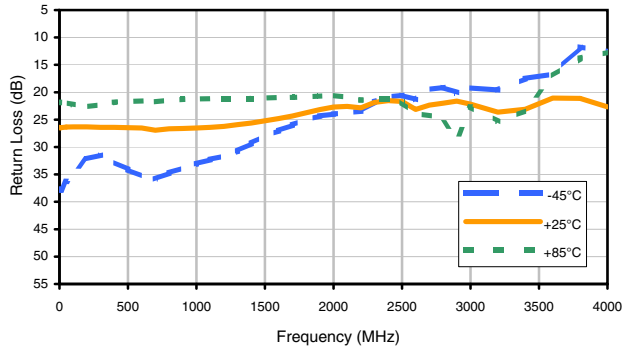
Output Return Loss (1dB)



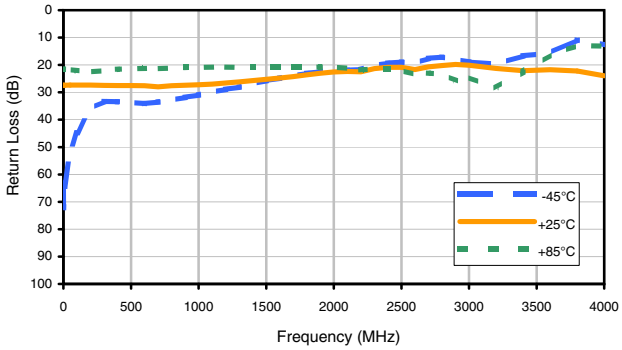
Output Return Losss (2dB)



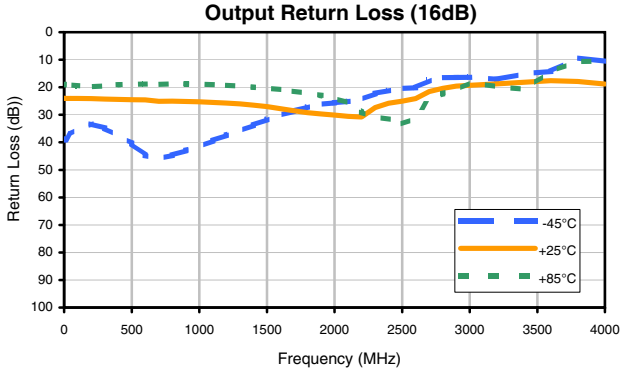
Output Return Loss (4dB)



Output Return Loss (8dB)



Output Return Loss (16dB)



Output Return Loss (31dB)

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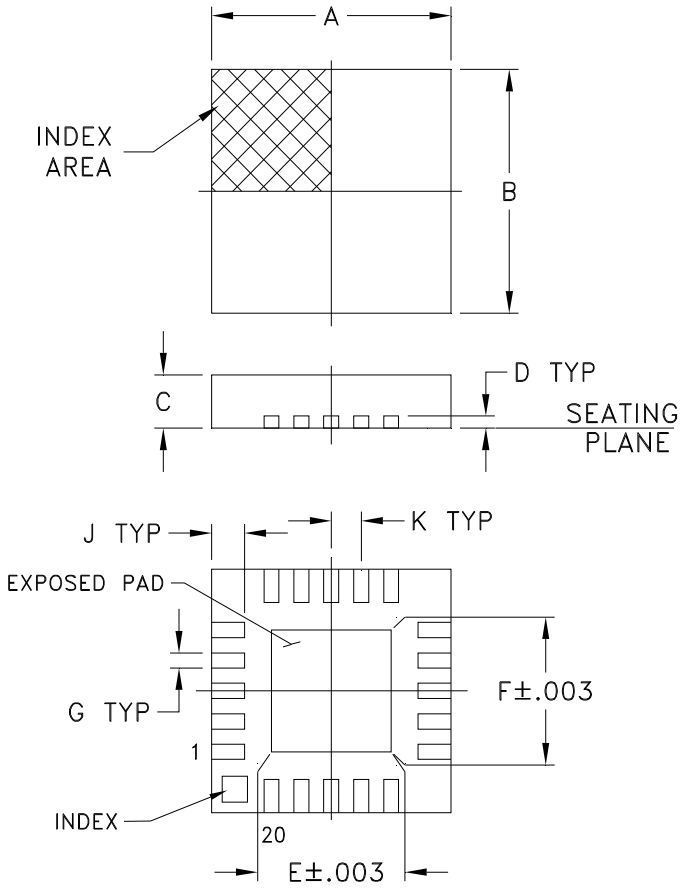
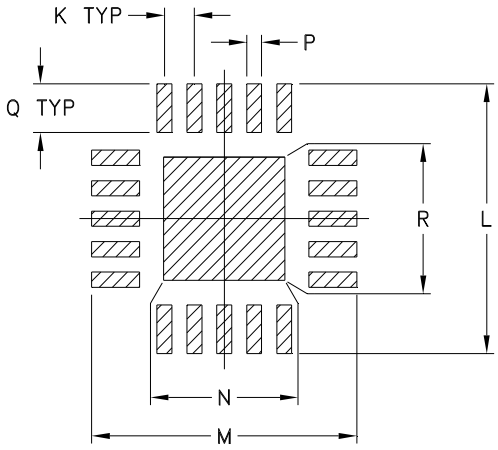
DG983-1

Outline Dimensions



PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

CASE #	A	B	C	D	E	F	G	H	J	K
DG983-1	.157 (4.00)	.157 (4.00)	.035 (0.90)	.008 (0.20)	.081 (2.06)	.081 (2.06)	.010 (0.25)	-- --	.022 (0.56)	.020 (0.50)

CASE #	L	M	N	P	Q	R	WT. GRAM
DG983-1	.177 (4.50)	.177 (4.50)	.081 (2.06)	.010 (0.25)	.032 (0.81)	.081 (2.06)	.04

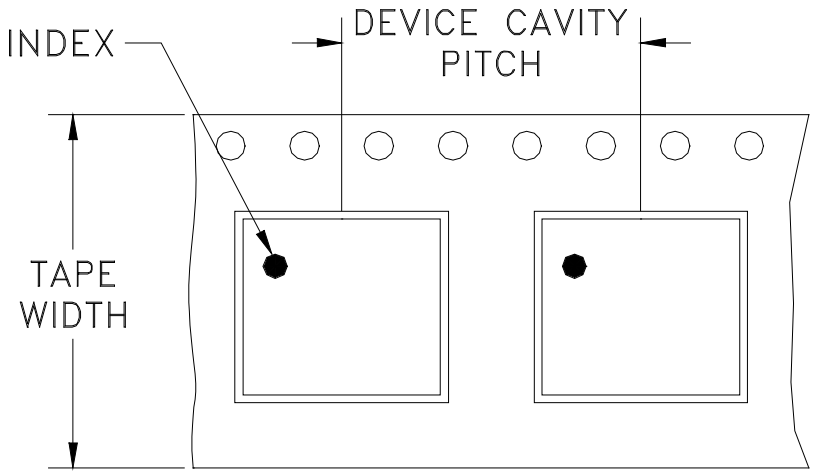
Dimensions are in inches (mm). Tolerances: 2 Pl. ± .01; 3 Pl. ± .005

Notes:

1. Case material: Plastic.
2. Termination finish:
   For RoHS Case Styles: Tin plate. All models, (+) suffix.
   For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

Tape & Reel Packaging TR-F87

DEVICE ORIENTATION IN T&R



DIRECTION OF FEED

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

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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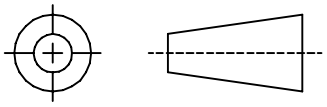
THIRD ANGLE PROJECTION

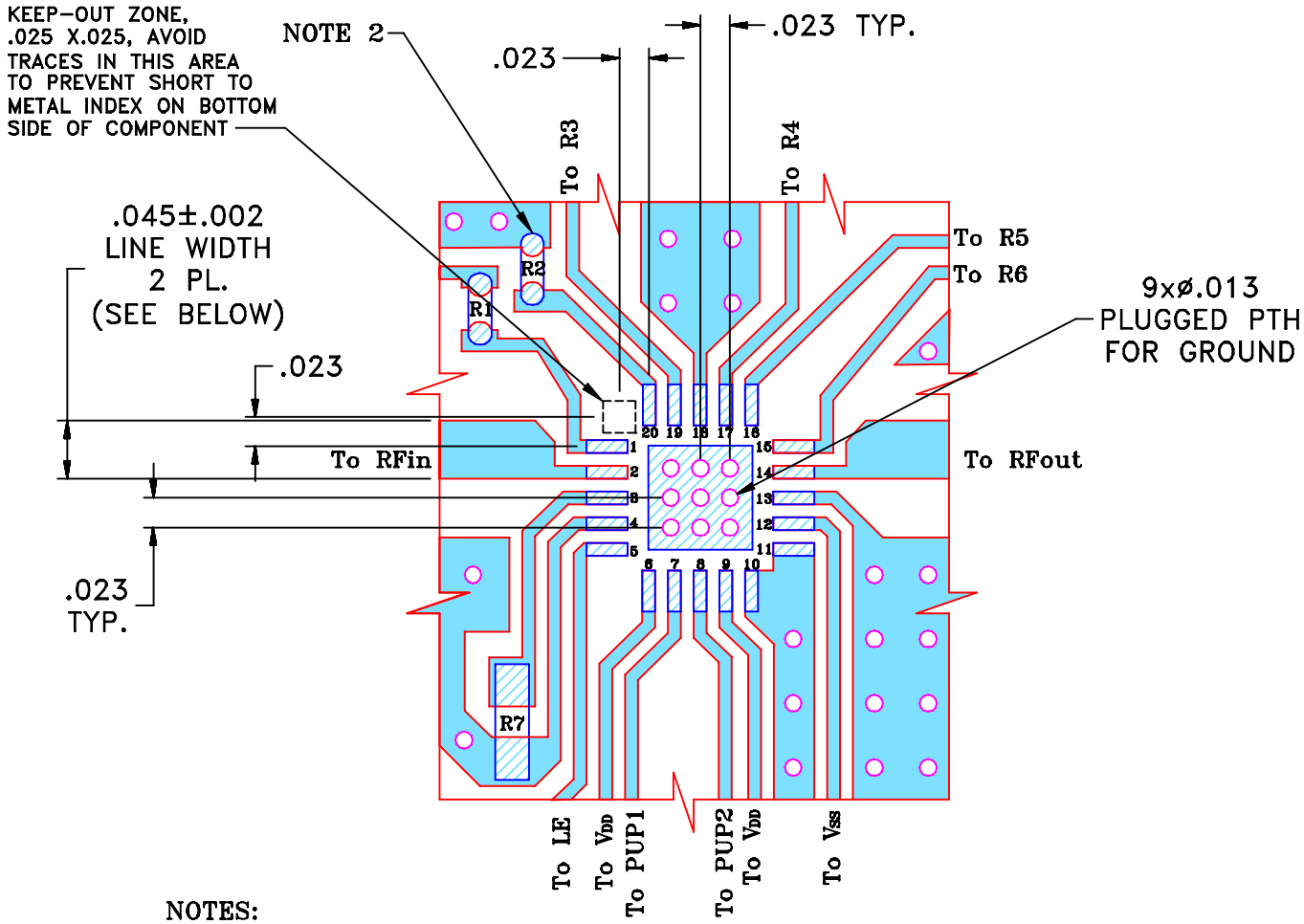


REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M97254	NEW RELEASE (FROM RAVON)	03/05	DK	HH
A	M102713	MODIFIED HATCH, NOTES & ADDED "...WITH SMOBC"	01/06	GT	IL
B	M103510	ADD R7 & CHANGE LOCATION DESIGNATORS	07/09	EM	KN
B	R63339	ADD R7 & CHANGE LOCATION DESIGNATORS	07/09	EM	KN

SUGGESTED MOUNTING CONFIGURATION

FOR DG983-1 CASE STYLE, qr PIN CONNECTIONS, 50 Ω.



NOTES:

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. 0603, 0402 SIZES CHIP FOOT PRINTS SHOWN FOR REFERENCE, VALUES OF RESISTORS WILL VARY BASED ON APPLICATION.
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	DK (RAVON)	08 MAR 05
TOLERANCES ON:	CHECKED	RZ (RAVON)	08 MAR 05
2 PL DECIMALS ±	APPROVED	HH (RAVON)	08 MAR 05
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

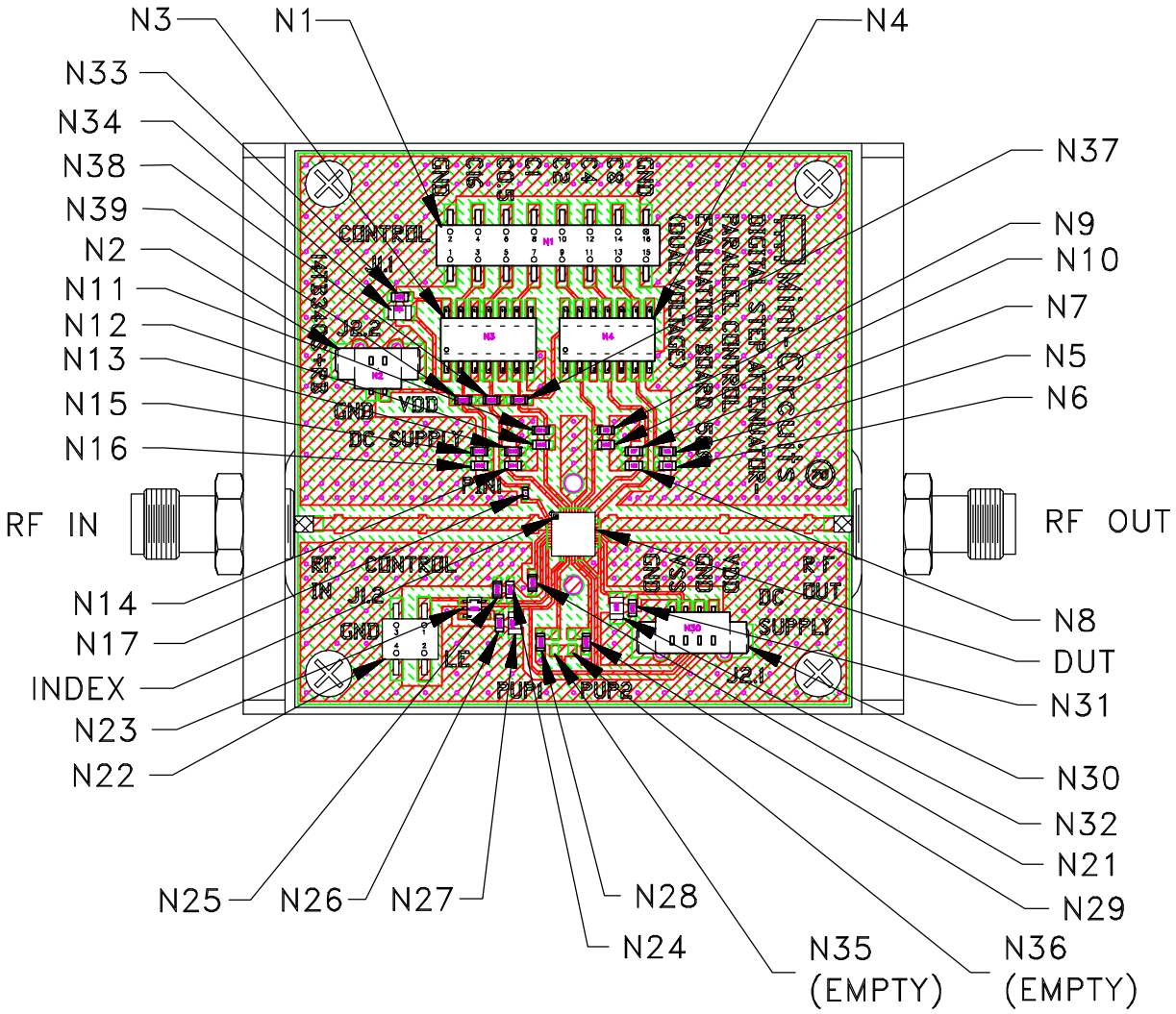
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, qr, DG983-1
TB-340 (50 Ω)

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-188	B

FILE:	SCALE:	SHEET:
98PL188	7:1	1 OF 1

Evaluation Board and Circuit



TB-340

Notes:

1. N-Type Female connectors.
2. PCB Material: FR4 Grade IT 180TC (ITEQ Corporation) or equivalent, Dielectric Constant=4.7, Thickness=.025 inch.

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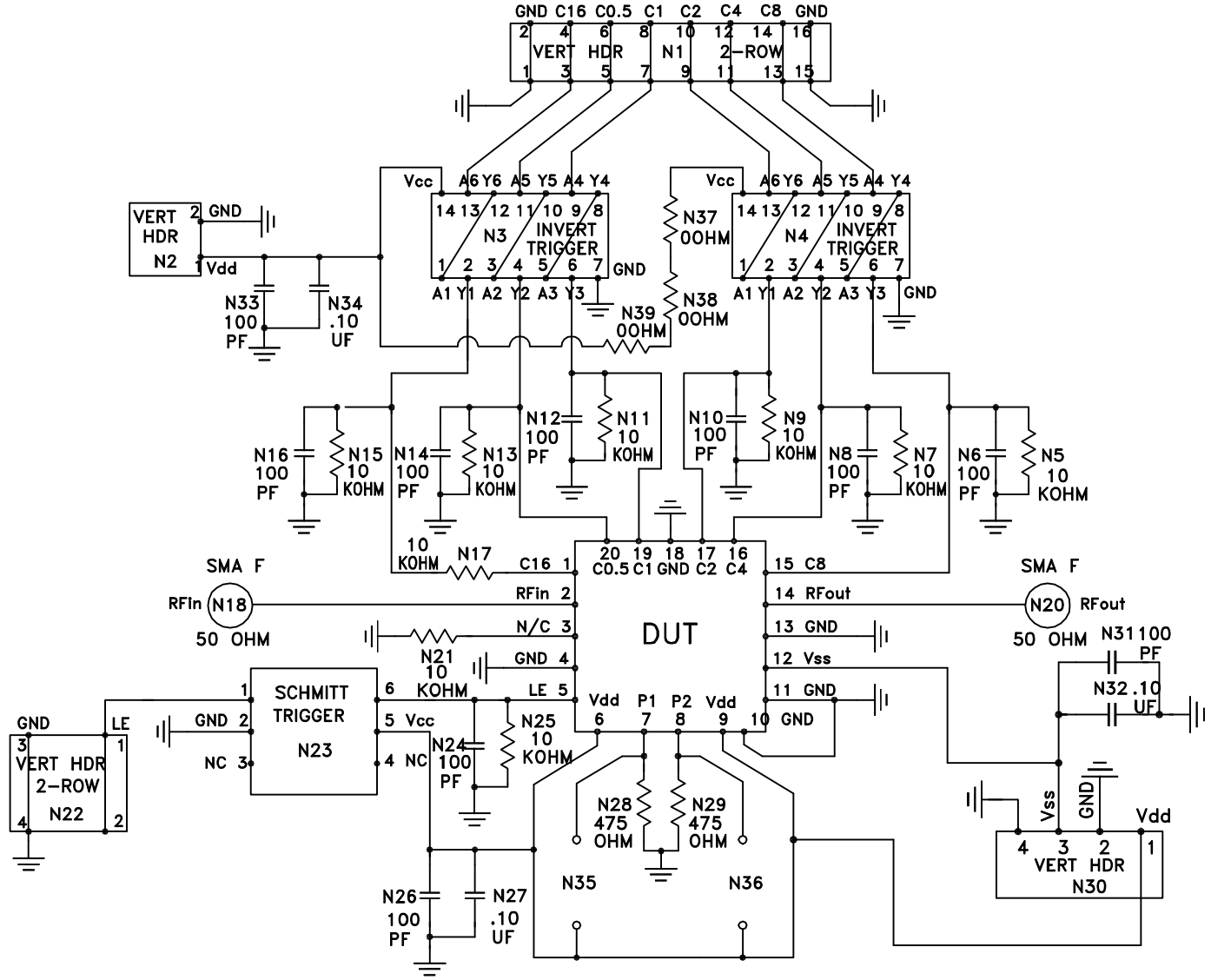

Schematic Diagram

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Environmental Specifications ENV33T1

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 or -40° to 105° C Ambient Environment	Refer to Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° C Ambient Environment	Refer to Individual Model Data Sheet
Temperature Humidity Bias	85°C, 85% RH, 96 hours	JESD22-A101B
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Pb-Free Process: 260°C peak	J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1
Solderability	10X magnification, 95% coverage	JESD22-B102, Method 1: Dip and Look Test
Marking Resistance to Solvents	Laser marked, visual observation	Mini-Circuits D4-Q4T0-04

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