COAXIAL WIDEBAND

Digital Step Attenuator ZX76-31R75PP-S+

50Ω 0 to 31.5 dB, 0.25 dB Step 9 kHz to 6 GHz
7 Bit, Parallel Control Interface, Single Supply Voltage

THE BIG DEAL

- Wideband, operates up to 6 GHz
- Immune to latch up
- High IIP3, 53 dBm
- Good Return Loss, 15dB Typ
- Excellent Accuracy, 0.1 dB Typ
- Low Insertion Loss
- Glitch-less attenuation transitions
- Single Supply Voltage: V_{DD}=+3.3V or 5V

Generic photo used for illustration purposes only

Model No.	ZX76-31R75PP-S+
Case Style	HK1172
Connectors	SMA

APPLICATIONS

- Test Setup
- Lab
- Instrumentation

RoHS Compliant
See our website for RoHS Compliance methodologies and qualifications

PRODUCT OVERVIEW

The ZX76-31R75PP-S+ is a 50Ω Digital Step Attenuator that provides adjustable attenuation from 0 to 31.75 dB in 0.25 dB steps. The control is a 7-bit parallel interface, with a single positive supply voltage. Control lines are buffered by Schmitt Triggers to allow a wide range of control voltage levels. The model is produced using a unique unibody case package for ruggedness and operation in tough environments.

KEY FEATURES

Feature	Advantages
Wideband operation, specified from 9 kHz to 6 GHz	Can be used in multiple applications such as communications, satellite and defense, reducing part count.
Parallel control interface with wide control voltage range	Uses a simple parallel control interface with no clock required and can accept commands with '1' from 1.17V to 5V making it suitable for a wide range of applications.
Good VSWR, 1.45:1 typ.	Eases interfacing with adjacent components and results in low amplitude ripple.
Glitch-less attenuation transitions	The ZX76-31R75PP-S+ employs novel architecture to reduce the RF output power spikes during attenuation transition to 0.3 dB typ thus reducing noise in the system and eliminating the risk of a transient spike damaging sensitive components in the system.
Single positive supply	The use of a single positive supply simplifies power supply design. An internal negative voltage generator supplies the desired negative voltage. Single positive supply results in excellent spurious performance.
Power Supply +3 to +5.5 V	Model suitable for both 5V and 3.3V systems applications with no voltage dividers or multipliers needed.

Digital Step Attenuator ZX76-31R75PP-S+

RF ELECTRICAL SPECIFICATIONS, 9 KHz - 6 GHz, T_{AMB}=25°C, V_{DD}=+3.3V

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Units
Insertion Loss @ 0dB Attenuation Setting	0.009 - 3000	—	1.4	3.0	dB
	3000 - 4000	—	2.1	3.5	
	4000 - 6000	—	2.6	4.0	
Accuracy @ 0.25 dB Attenuation Setting	0.009 - 3000	—	± 0.02	± 0.20	dB
	3000 - 4000	—	± 0.03	± 0.25	
	4000 - 6000	—	± 0.08	± 0.25	
Accuracy @ 0.5 dB Attenuation Setting	0.009 - 3000	—	± 0.05	± 0.25	dB
	3000 - 4000	—	± 0.03	± 0.25	
	4000 - 6000	—	± 0.08	± 0.25	
Accuracy @ 1 dB Attenuation Setting	0.009 - 3000	—	± 0.04	± 0.20	dB
	3000 - 4000	—	± 0.05	± 0.25	
	4000 - 6000	—	± 0.10	± 0.30	
Accuracy @ 2 dB Attenuation Setting	0.009 - 3000	—	± 0.03	± 0.20	dB
	3000 - 4000	—	± 0.05	± 0.30	
	4000 - 6000	—	± 0.12	± 0.35	
Accuracy @ 4 dB Attenuation Setting	0.009 - 3000	—	± 0.09	± 0.25	dB
	3000 - 4000	—	± 0.12	± 0.35	
	4000 - 6000	—	± 0.29	± 0.60	
Accuracy @ 8 dB Attenuation Setting	0.009 - 3000	—	± 0.16	± 0.40	dB
	3000 - 4000	—	± 0.30	± 0.50	
	4000 - 6000	—	± 0.48	± 0.80	
Accuracy @ 16 dB Attenuation Setting	0.009 - 3000	—	± 0.30	± 0.60	dB
	3000 - 4000	—	± 0.45	± 0.80	
	4000 - 6000	—	± 0.75	± 1.05	
Input IP3 (at Min. and Max. Attenuation) [1]	1 - 6000	—	+53	—	dBm
Input Power @ 0.2dB Compression (at Min. and Max. Attenuation) [1,2]	1 - 6000	—	+30	—	
Input Operating Power	0.009 - 50	—	—	See note 2	dBm
	50 - 6000	—	—	+23	
Return Loss	0.009 - 3000	—	15.5	—	dB
	3000 - 4000	—	16.5	—	
	4000 - 6000	—	12	—	
Attenuation Transient Envelope	0.009 - 6000	—	0.3	—	dB

1. Input IP3 and 1dB compression degrade below 1 MHz. Input power not to exceed max operating specification for continuous operation.
2. Derate linearly from +23 dBm at 50 MHz to +9 dBm at 1 MHz. Power handling below 1 MHz remains constant at +9 dBm.

DC ELECTRICAL SPECIFICATIONS

Parameter	Min.	Typ.	Max.	Units
Supply Voltage, V_{DD}	+3.0	+3.3	+5.5	V
Supply Current, I_{DD}	—	—	3500	µA
Control Input Low	-0.3	—	+0.6	V
Control Input High	+1.17	—	+5.5	V
Control Current	—	—	400	µA

SWITCHING SPECIFICATIONS

Parameter	Min.	Typ.	Max.	Units
Switching Speed, 50% Control to 0.5dB of Attenuation Value	—	300	—	nsec
Switching Control Frequency	—	25	—	kHz

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ABSOLUTE MAXIMUM RATINGS

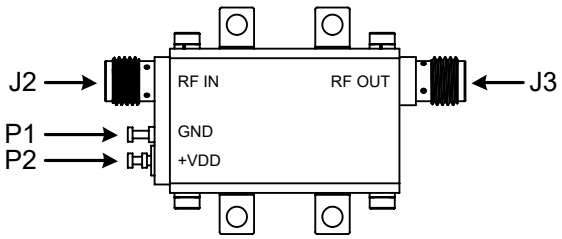
Parameter		Ratings
Operating Temperature		-40°C to 85°C
Storage Temperature		-40°C to 85°C
V_{DD}		-0.3V Min., +6V Max.
Voltage on any control input		-0.3V Min., +6V Max.
ESD, HBM		500V
ESD, MM		100V
Input Power	DC to 1 MHz	+12dBm
	1 to 50 MHz	Derate linearly from +26 dBm at 50 MHz to +12 dBm at 1 MHz
	50 to 6000 MHz	+31dBm [3]

Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

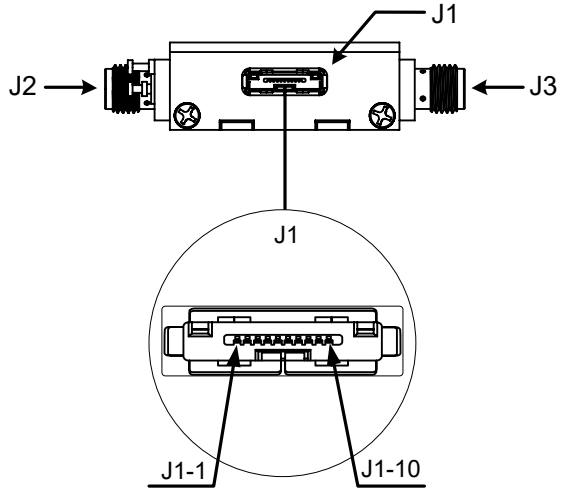
[3] There is a discontinuity in Absolute Maximum power at 50 MHz changing from +26 dBm to +31 dBm.

PIN CONFIGURATION

TOP VIEW



SIDE VIEW



PIN DESCRIPTION

Function	Pin Number	Description
LE	J1-1	Latch Enable Input
C1	J1-2	Control for attenuation bit, 1.0 dB
C0.5	J1-3	Control for attenuation bit, 0.5 dB
C0.25	J1-4	Control for attenuation bit, 0.25 dB
C16	J1-5	Control for attenuation bit, 16 dB
GND	J1-6	Ground Connection
GND	J1-7	Ground Connection
C4	J1-8	Control for attenuation bit, 4 dB
C8	J1-9	Control for attenuation bit, 8 dB
C2	J1-10	Control for attenuation bit, 2 dB
RF in	J2	RF in port [4]
RF out	J3	RF out port [4]
GND	P1	Ground Connection
Vdd	P2	Positive Supply Voltage

[4] Both RF ports must be held at 0VDC or DC blocked with an external series capacitor.

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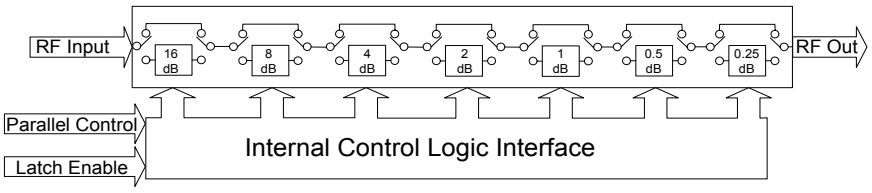
SIMPLIFIED SCHEMATIC



The ZX76-31R75PP-S+ parallel interface consists of 7 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	C0.5	C0.25
Reference	0	0	0	0	0	0	0
0.25 (dB)	0	0	0	0	0	0	1
0.5 (dB)	0	0	0	0	0	1	0
1 (dB)	0	0	0	0	1	0	0
2 (dB)	0	0	0	1	0	0	0
4 (dB)	0	0	1	0	0	0	0
8 (dB)	0	1	0	0	0	0	0
16 (dB)	1	0	0	0	0	0	0
31.75 (dB)	1	1	1	1	1	1	1

Note: Not all 128 possible combinations of C0.25 - 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 the switching speed.

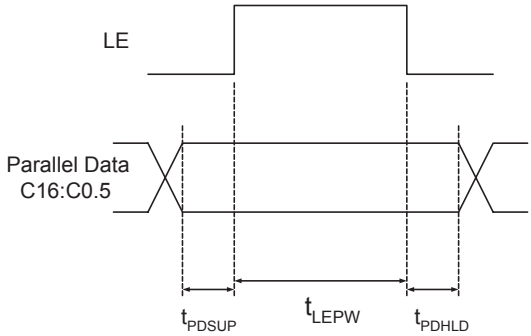
For latched parallel programming the Latch Enable (LE) should be held LOW while changing attenuation state control values, then pulse LE HIGH to LOW (per Figure 1) to latch new attenuation state into the device.

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

TABLE 2. PARALLEL INTERFACE AC CHARACTERISTICS

Symbol	Parameter	Min.	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

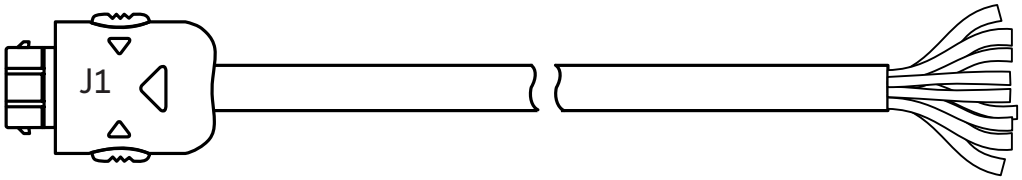
FIGURE 1: PARALLEL INTERFACE TIMING DIAGRAM



POWER-UP STATE

When the attenuator powers up and LE is logic low, the nominal attenuation is set on 0 dB. When LE is logic high, the nominal attenuation selected upon control logics (see Table 1).

CBL-5FT-MPD+ CONTROL CABLE



RECOMMENDED ACCESSORIES

An optional CBL-5FT-MPD+ is a "Pigtail" connector. CBL-5FT-MPD+ is a shielded cable with stripped wires (#32AWG) on one end and a connector on the other end designed to mate to the ZX76-31R75PP-S+. These bare wires enable the customer to assemble their own cable as required to interface with the ZX76-31R75PP-S+ (cable length is 4.9ft/ 1.5meters).

CBL-5FT-MPD+ WIRING INFORMATION

J1 Pin Number	Function	Description	Wire Color
1	LE	Latch Enable Input	Green
2	C1	Control for attenuation bit, 1.0 dB	Green/Black
3	C0.5	Control for attenuation bit, 0.5 dB	Red
4	C0.25	Control for attenuation bit, 0.25 dB	Orange
5	C16	Control for attenuation bit, 16 dB	Orange/Black
6	GND	Ground Connection	Black
7	GND	Ground Connection	Red/Black
8	C4	Control for attenuation bit, 4.0 dB	Blue
9	C8	Control for attenuation bit, 8.0 dB	White
10	C2	Control for attenuation bit, 2.0 dB	White/Black
Shield	-	Shield Braid/ Drain	-

Note: Cable shield connected to case ground.

Digital Step Attenuator ZX76-31R75PP-S+

TYPICAL PERFORMANCE DATA (AT 25°C)

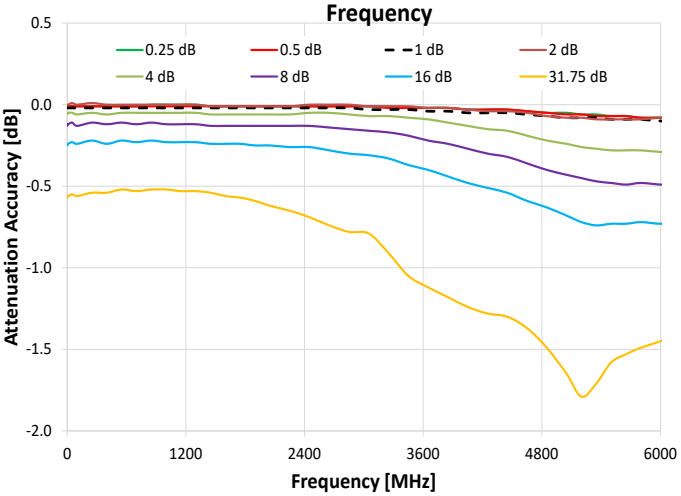
Freq. [MHz]	I.Loss [dB]	Attenuation relative to Insertion Loss [dB] @ Attenuation setting [dB]							
		0.25	0.5	1	2	4	8	16	31.75
0.1	-0.94	-0.01	-0.01	-0.02	0.00	-0.06	-0.12	-0.24	-0.56
10	-0.97	-0.01	-0.01	-0.02	0.00	-0.05	-0.12	-0.24	-0.56
100	-1.00	-0.01	-0.01	-0.02	0.00	-0.06	-0.13	-0.24	-0.56
400	-1.11	-0.01	-0.01	-0.02	0.00	-0.06	-0.12	-0.24	-0.54
700	-1.23	-0.01	-0.01	-0.02	0.00	-0.05	-0.12	-0.23	-0.53
1000	-1.35	0.00	-0.01	-0.02	0.00	-0.05	-0.12	-0.23	-0.52
1150	-1.40	0.00	-0.01	-0.02	0.00	-0.05	-0.12	-0.23	-0.53
1450	-1.50	-0.01	-0.01	-0.02	-0.01	-0.06	-0.13	-0.24	-0.54
1600	-1.54	-0.01	-0.01	-0.02	-0.01	-0.06	-0.13	-0.24	-0.56
1900	-1.63	-0.01	-0.01	-0.02	-0.01	-0.06	-0.13	-0.25	-0.59
2050	-1.69	-0.01	-0.01	-0.02	-0.01	-0.06	-0.13	-0.25	-0.62
2450	-1.82	-0.01	-0.01	-0.02	0.00	-0.05	-0.13	-0.26	-0.69
2650	-1.88	-0.01	-0.01	-0.02	0.00	-0.05	-0.14	-0.28	-0.74
3050	-1.99	-0.01	-0.01	-0.03	-0.01	-0.07	-0.16	-0.31	-0.79
3250	-2.04	-0.01	-0.02	-0.03	-0.01	-0.07	-0.17	-0.33	-0.91
3650	-2.14	-0.02	-0.02	-0.04	-0.02	-0.09	-0.22	-0.40	-1.12
3850	-2.19	-0.02	-0.02	-0.04	-0.02	-0.11	-0.24	-0.44	-1.18
4250	-2.29	-0.03	-0.03	-0.05	-0.04	-0.15	-0.30	-0.51	-1.28
4450	-2.35	-0.03	-0.03	-0.05	-0.04	-0.16	-0.32	-0.54	-1.30
4850	-2.47	-0.05	-0.05	-0.07	-0.07	-0.22	-0.40	-0.63	-1.49
5050	-2.56	-0.05	-0.06	-0.08	-0.08	-0.24	-0.43	-0.68	-1.65
5350	-2.69	-0.06	-0.07	-0.08	-0.09	-0.27	-0.47	-0.74	-1.71
5500	-2.78	-0.07	-0.07	-0.09	-0.09	-0.28	-0.48	-0.73	-1.58
5800	-2.93	-0.08	-0.08	-0.09	-0.09	-0.28	-0.48	-0.72	-1.49
6000	-3.03	-0.08	-0.08	-0.10	-0.08	-0.29	-0.49	-0.73	-1.45

Freq. [MHz]	Return Loss In [dB] @ Attenuation setting [dB]									Return Loss Out [dB] @ Attenuation setting [dB]								
	0	0.25	0.5	1	2	4	8	16	31.75	0	0.25	0.5	1	2	4	8	16	31.75
0.1	-18.79	-20.44	-21.29	-22.58	-31.50	-29.93	-22.58	-18.98	-21.32	-20.40	-20.19	-20.07	-19.99	-19.54	-19.91	-20.26	-21.71	-26.97
10	-18.59	-20.41	-21.26	-22.56	-31.31	-30.00	-22.56	-19.00	-21.34	-20.27	-20.11	-20.01	-19.95	-19.58	-20.01	-20.42	-21.90	-27.01
100	-18.59	-20.28	-21.14	-22.43	-30.95	-30.25	-22.65	-19.06	-21.39	-20.08	-19.93	-19.84	-19.80	-19.46	-19.91	-20.35	-21.81	-26.75
400	-18.53	-20.71	-21.54	-22.87	-31.81	-29.77	-22.52	-19.05	-21.40	-20.52	-20.35	-20.28	-20.21	-19.92	-20.29	-20.69	-22.06	-26.34
700	-18.56	-21.62	-22.47	-23.96	-34.61	-28.20	-21.89	-18.71	-20.98	-21.31	-21.12	-21.07	-20.97	-20.79	-21.12	-21.51	-22.82	-26.24
1000	-18.58	-22.48	-23.32	-25.00	-37.55	-27.01	-21.39	-18.43	-20.65	-22.68	-22.48	-22.44	-22.26	-22.13	-22.36	-22.66	-23.84	-26.14
1150	-18.59	-23.00	-23.84	-25.63	-39.20	-26.41	-21.13	-18.29	-20.48	-23.29	-23.09	-23.07	-22.86	-22.77	-22.99	-23.28	-24.42	-26.13
1450	-18.46	-23.67	-24.46	-26.43	-37.44	-25.47	-20.79	-18.12	-20.30	-24.81	-24.52	-24.45	-24.18	-24.06	-24.23	-24.44	-25.44	-25.94
1600	-18.42	-23.58	-24.29	-26.28	-35.34	-25.16	-20.66	-18.03	-20.21	-25.62	-25.27	-25.19	-24.87	-24.74	-24.85	-25.00	-25.89	-25.76
1900	-18.23	-23.29	-23.85	-25.80	-31.35	-24.50	-20.57	-18.04	-20.25	-27.35	-26.87	-26.82	-26.42	-26.23	-26.26	-26.22	-26.72	-25.12
2050	-18.16	-22.84	-23.29	-25.13	-29.85	-24.43	-20.71	-18.18	-20.47	-28.37	-27.82	-27.79	-27.38	-27.13	-27.19	-27.08	-27.37	-24.85
2450	-18.22	-22.21	-22.52	-24.26	-28.09	-24.30	-21.00	-18.50	-20.94	-30.96	-29.94	-29.82	-29.62	-28.94	-29.19	-29.02	-28.78	-24.41
2650	-18.22	-21.83	-22.12	-23.85	-27.80	-24.71	-21.42	-18.86	-21.45	-33.43	-31.95	-31.79	-31.57	-30.48	-30.68	-30.11	-29.06	-23.74
3050	-18.00	-22.18	-22.39	-24.25	-29.10	-25.65	-21.78	-19.17	-21.97	-43.60	-38.20	-38.03	-38.44	-35.43	-36.25	-34.59	-30.29	-22.57
3250	-17.52	-21.98	-22.23	-24.10	-29.73	-26.66	-22.10	-19.37	-22.27	-47.55	-39.92	-40.33	-45.13	-38.38	-41.83	-38.33	-30.35	-21.83
3650	-16.33	-22.23	-22.51	-24.64	-31.10	-26.10	-21.37	-18.89	-21.69	-34.84	-34.54	-34.56	-39.49	-34.43	-37.03	-39.43	-29.91	-20.69
3850	-15.94	-22.77	-23.07	-25.44	-33.02	-25.55	-20.77	-18.44	-21.10	-32.83	-32.51	-32.32	-35.58	-31.65	-32.70	-33.87	-28.68	-20.09
4250	-14.78	-24.19	-24.59	-27.95	-34.52	-22.84	-18.82	-16.94	-19.17	-28.12	-27.12	-26.94	-28.71	-25.88	-25.99	-26.50	-25.36	-18.91
4450	-14.38	-24.10	-24.29	-27.64	-30.59	-21.51	-18.02	-16.28	-18.37	-26.25	-25.09	-24.99	-26.43	-23.89	-23.87	-24.28	-23.82	-18.37
4850	-14.16	-22.92	-22.84	-25.25	-25.48	-19.29	-16.58	-15.11	-16.99	-22.14	-20.97	-20.78	-21.65	-19.84	-19.77	-20.11	-20.54	-17.26
5050	-13.95	-21.22	-21.14	-22.83	-22.73	-17.99	-15.77	-14.45	-16.20	-20.19	-19.14	-19.02	-19.75	-18.30	-18.33	-18.78	-19.57	-17.11
5350	-14.16	-18.00	-18.08	-19.31	-19.72	-16.77	-15.28	-14.11	-15.81	-17.41	-16.60	-16.60	-17.19	-16.17	-16.36	-16.94	-18.01	-16.64
5500	-13.86	-16.94	-17.05	-18.11	-18.56	-16.09	-14.90	-13.87	-15.55	-16.32	-15.60	-15.63	-16.17	-15.32	-15.57	-16.20	-17.37	-16.47
5800	-14.19	-14.57	-14.72	-15.54	-16.06	-14.57	-14.03	-13.24	-14.82	-14.49	-13.92	-13.94	-14.40	-13.81	-14.16	-14.88	-16.19	-16.11
6000	-16.22	-13.65	-13.88	-14.65	-15.23	-14.10	-13.85	-13.19	-14.77	-13.47	-12.97	-13.00	-13.43	-12.96	-13.37	-14.13	-15.52	-15.94

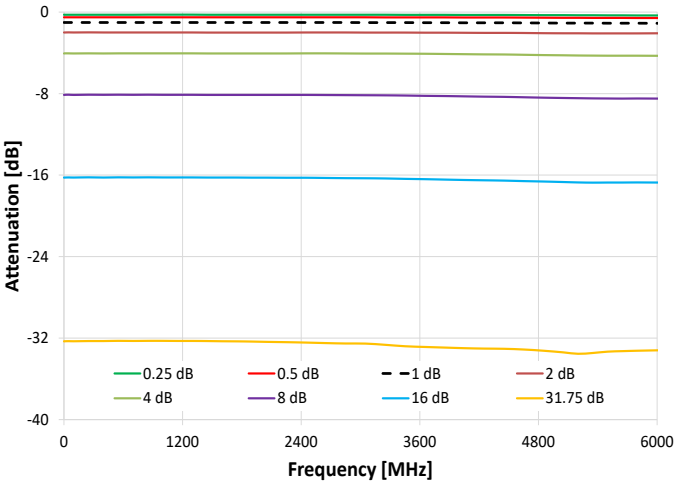
Digital Step Attenuator ZX76-31R75PP-S+

TYPICAL PERFORMANCE CURVES (AT 25°C)

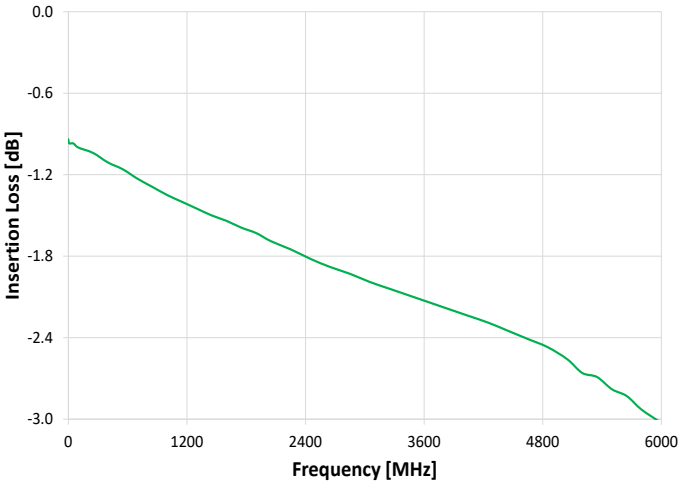
Attenuation Accuracy relative to Insertion Loss vs. Frequency



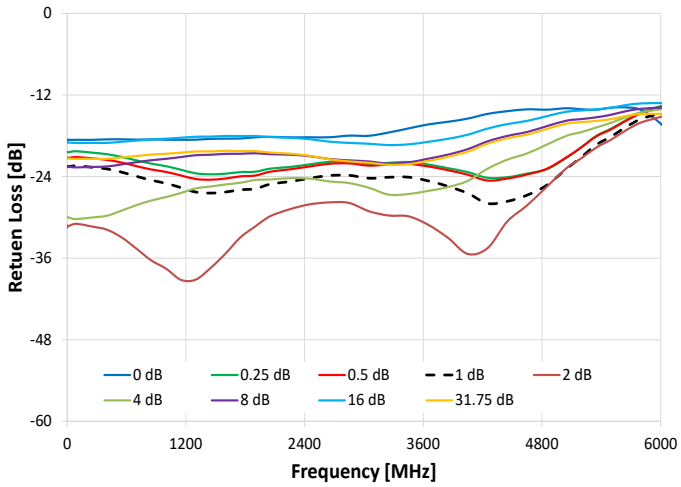
Attenuation relative to Insertion Loss vs. Frequency



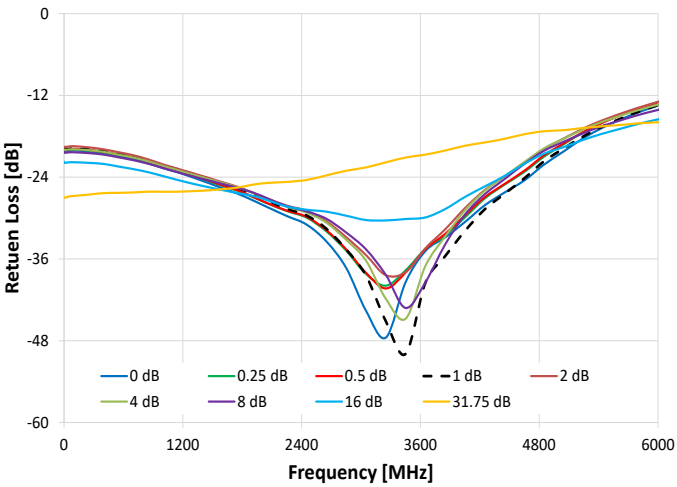
Insertion Loss vs. Frequency



R. Loss In vs. Frequency over Attenuation settings



R. Loss Out vs. Frequency over Attenuation settings



Digital Step Attenuator ZX76-31R75PP-S+

ORDERING INFORMATION

Model	Description
ZX76-31R75PP-S+	Digital attenuator - Parallel interface, Single Voltage (Positive)

RECOMMENDED ACCESSORIES

Recommended Accessories	Part No.	Description
	CBL-5FT-MPD+	5 ft. (1.5M) Control Cable

ADDITIONAL DETAILED TECHNICAL INFORMATION

Performance Data	Data Table
	Swept Graphs
	S-Parameter (S2P Files) Data Set (.zip.file)
Case Style	HK1149
Environmental Rating	ENV28T14

Additional information is available on our dash board. To access this information click here

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