Digital Step Attenuator 50Ω DC-2400 MHz

31.5 dB, 0.5 dB Step, 6 Bit, Serial Control Interface, Single Supply Voltage

Product Features

- Low Insertion Loss
- High IP3, +52 dBm Typ
- Excellent return loss, 20 dB Typ
- Excellent accuracy, 0.1 dB Typ
- Single Supply Voltage: +3V
- Control inputs buffered by Schmitt Triggers
- Rigid unibody case
- Protected by US patent 6,790,049

ZX76-31R5-SP+

CASE STYLE: HK1172

Connectors	Order P/N	Price	Qty.
SMA	ZX76-31R5-SP-S+	$79.95 ea.	(1-9)

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

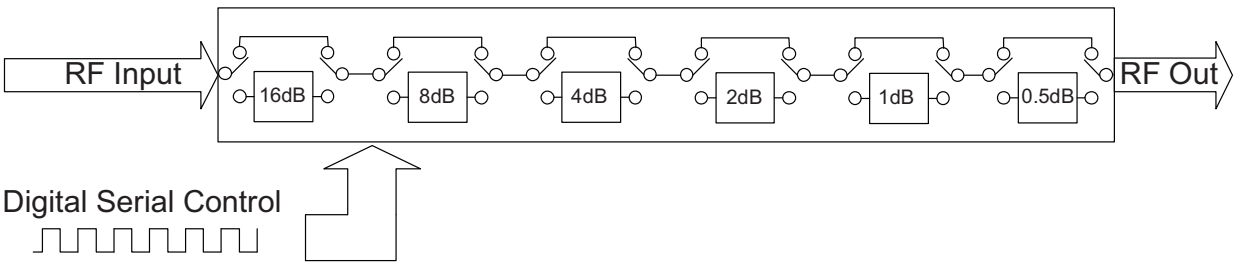
Typical Applications

- Lab
- Instrumentation
- Test equipment

General Description

The ZX76-31R5-SP+ is a 50Ω RF digital step attenuator that offers an attenuation range up to 31.5 dB in 0.5 dB steps. The control is a 6-bit serial interface. The model operates on a single +3 volt supply. See application note AN-70-004 for 5V supply voltage. The ZX76-31R5-SP+ is produced using a unique case package for ruggedness and operation in tough environments.

Simplified Schematic



RF Electrical Specifications, DC-2400 MHz, T_{AMB}=25°C, V_{DD}=+3V

Parameter	Freq. Range (GHz)	Min.	Typ.	Max.	Units
Accuracy @ **0.5 dB** Attenuation Setting	DC-1	—	0.03	0.1	dB
	1-2.4	—	0.05	0.15	dB
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	0.3	dB
Accuracy @ **16 dB** Attenuation Setting	DC-1	—	0.1	0.3	dB
	1-2.4	—	0.15	0.5	dB
Insertion Loss @ all attenuator set to 0dB	DC-1	—	1.5	2.2	dB
	1-2.4	—	2.0	3.0	dB
IP3 Input * (at Min. and Max. Attenuation)	DC-2.4	—	+52	—	dBm
Input Power @ 0.2dB Compression* (at Min. and Max. Attenuation)	DC-2.4	—	+24	—	dBm
VSWR	DC-1	—	1.2	1.5	—
	1-2.4	—	1.2	1.5	—

* IP3 and 1dB compression degrade below 1 MHz

DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
V_{DD}, Supply Voltage	2.7	3	3.3	V
I_{DD}, Supply Current	—	—	1.5	mA
Control Input Voltage Low	0	—	0.3xV_{DD}	V
Control Input Voltage High	0.7xV_{DD}	—	5V	V
Control Current	—	—	400	µA

Switching Specifications

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

Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-40°C to 85°C
V_{DD}, Supply Voltage	-0.3V Min., 4V Max.
Voltage on Control Input	-0.3V Min., 6V Max.
ESD, HBM	500V
ESD, MM	100V
Input Power	+24dBm

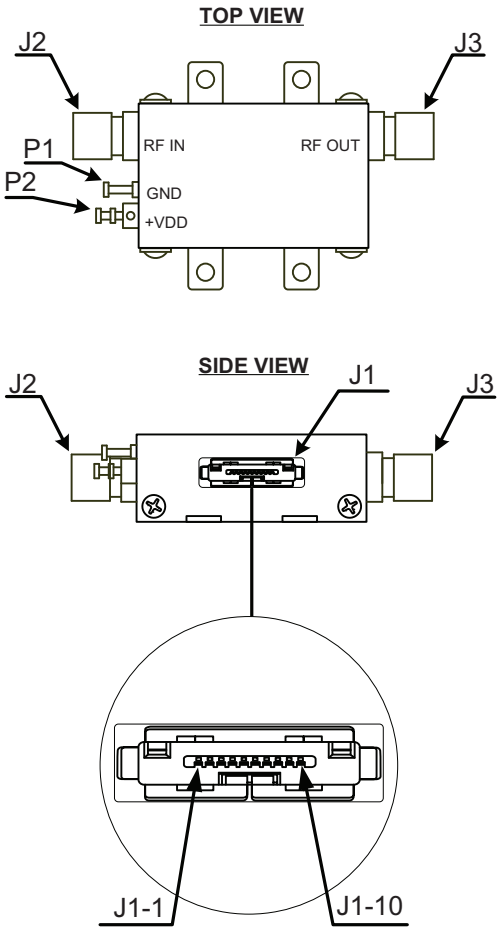
Permanent damage may occur if any of these limits are exceeded

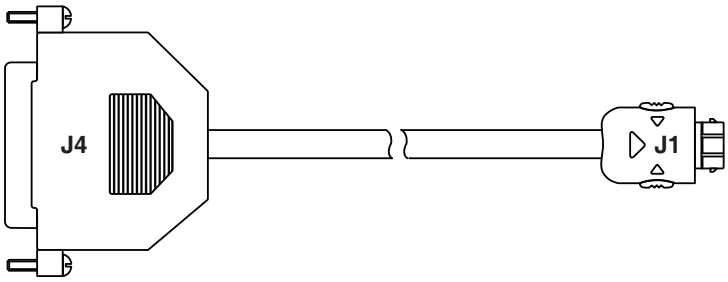
Pin Description

Function	Pin Number	Description
N/C	J1-1	Not Connected
GND	J1-2	Ground connection
LE	J1-3	Latch Enable Input
N/C	J1-4	Not Connected
GND	J1-5	Ground connection
N/C	J1-6	Not Connected
Clock	J1-7	Serial Interface clock Input
GND	J1-8	Ground connection
Data	J1-9	Serial Interface data Input
N/C	J1-10	Not Connected
RF in	J2	RF in port (Note 1)
RF out	J3	RF out port (Note 1)
GND	P1	Ground connection
V_{DD}	P2	Positive Supply Voltage

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

Pin Configuration





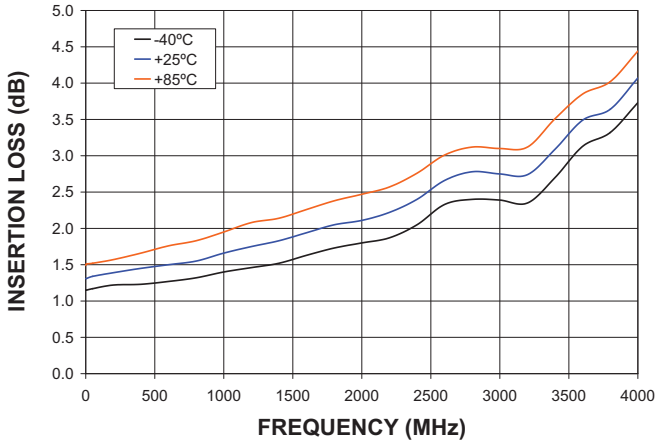
Cable Pin Description

J1-Pin Number	J4-Pin Number	Function	Description	Wire Color
J1-2	J4-18	GND	Ground connection	BLACK
J1-3	J4-4	LE	Latch Enable Input	GREEN
J1-5	J4-19	GND	Ground connection	BLUE
J1-7	J4-2	Clock	Serial Interface clock Input	RED
J1-8	J4-20	GND	Ground connection	ORANGE
J1-9	J4-3	Data	Serial Interface data Input	WHITE

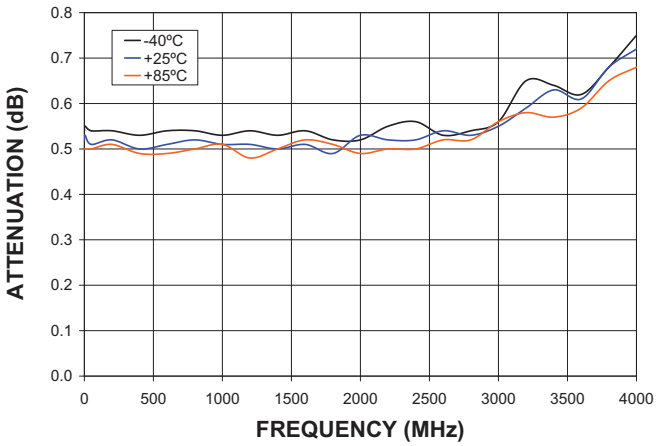
Note: Other pins not connected. Cable shield connected to case ground.

Typical Performance Curves

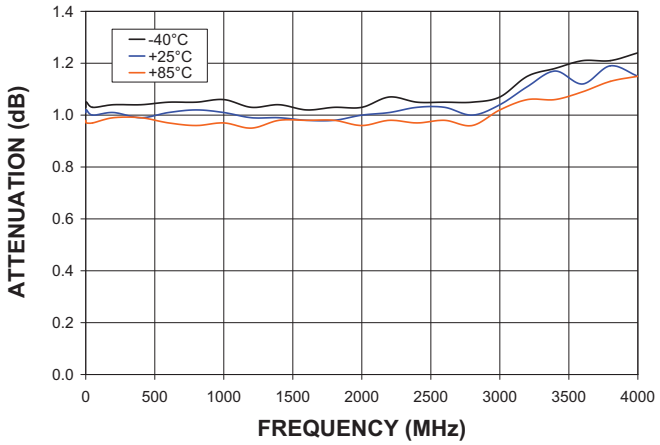
INSERTION LOSS (Ref)



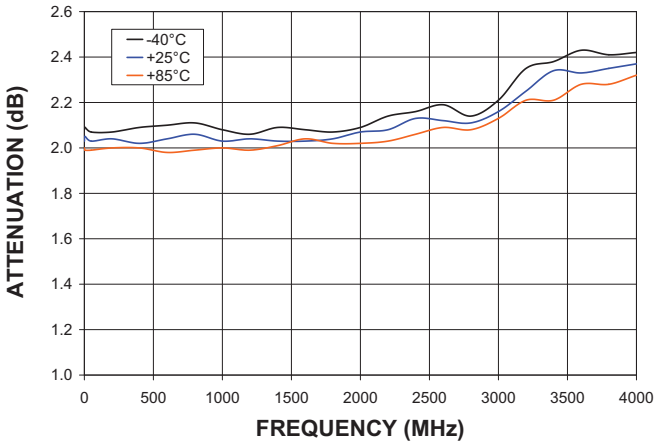
ATTENUATION (0.5 dB)



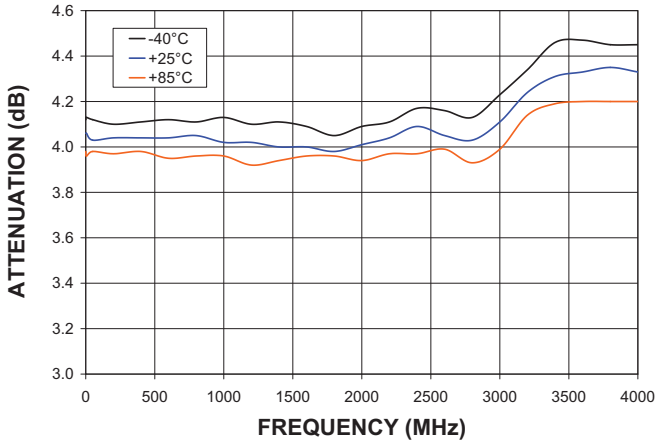
ATTENUATION (1 dB)



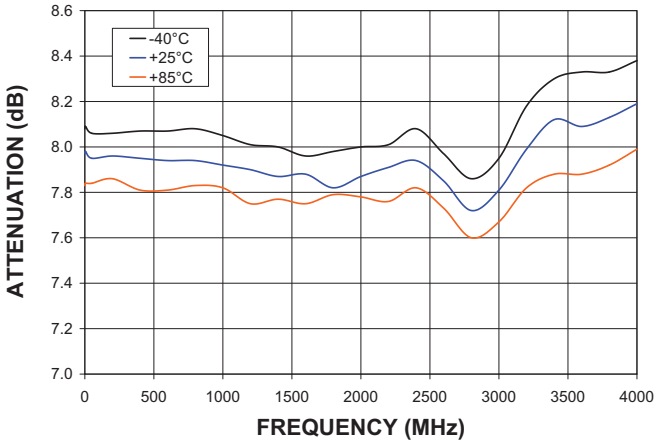
ATTENUATION (2 dB)



ATTENUATION (4 dB)

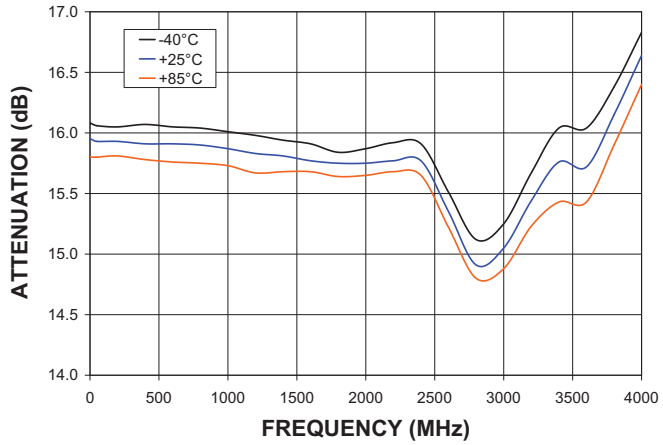


ATTENUATION (8 dB)

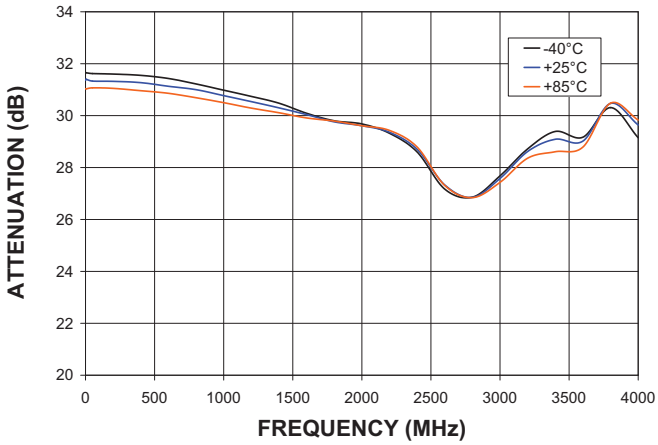


Typical Performance Curves

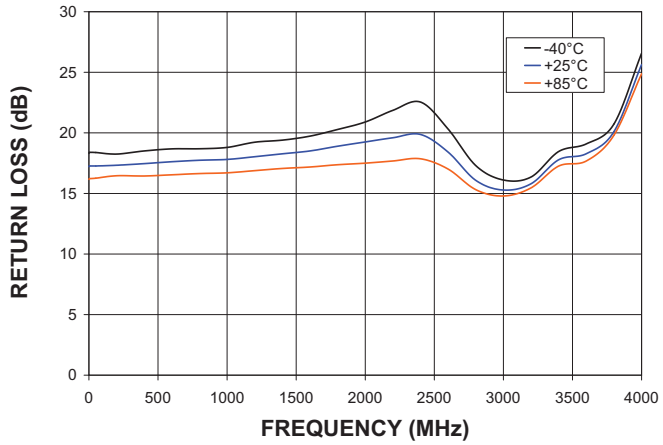
ATTENUATION (16 dB)



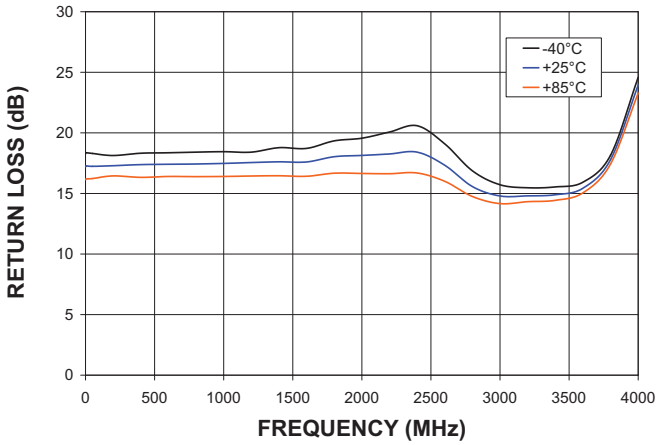
ATTENUATION (31.5 dB)



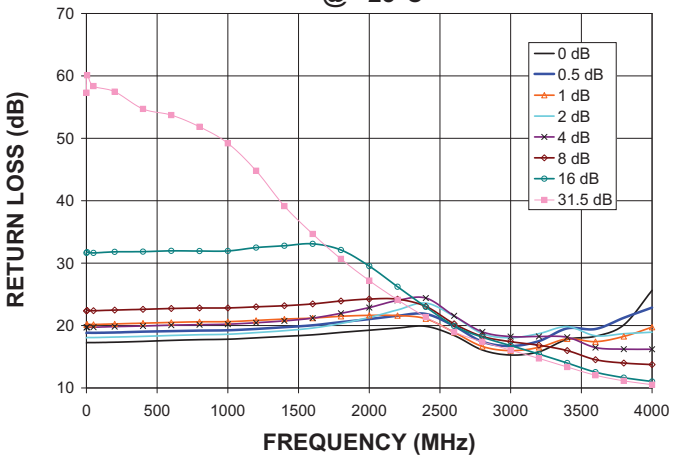
RETURN LOSS IN (Ref)



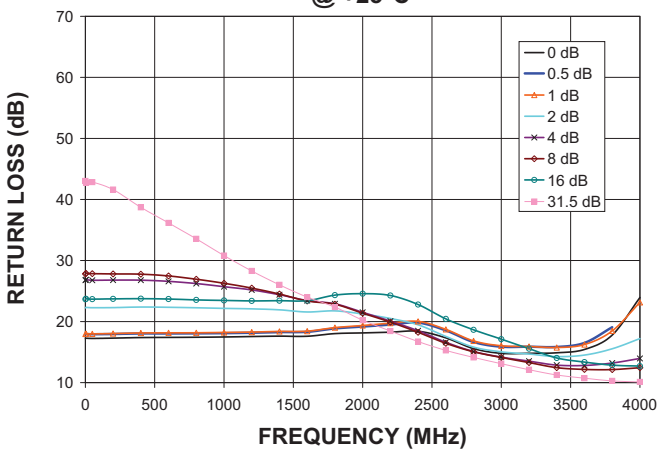
RETURN LOSS OUT (Ref)



RETURN LOSS IN (Major Atten. Steps) @ +25°C

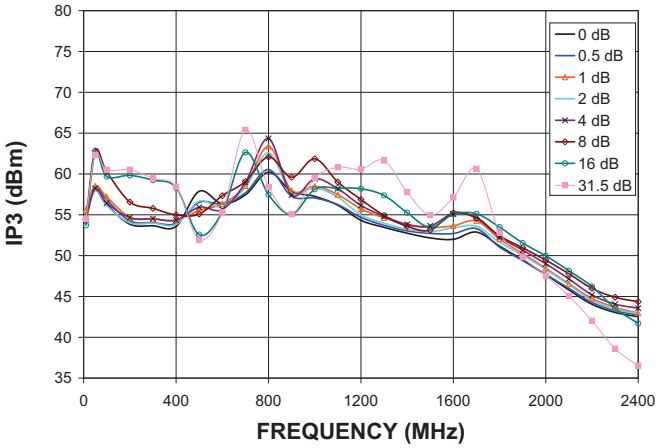


RETURN LOSS OUT (Major Atten. Steps) @ +25°C

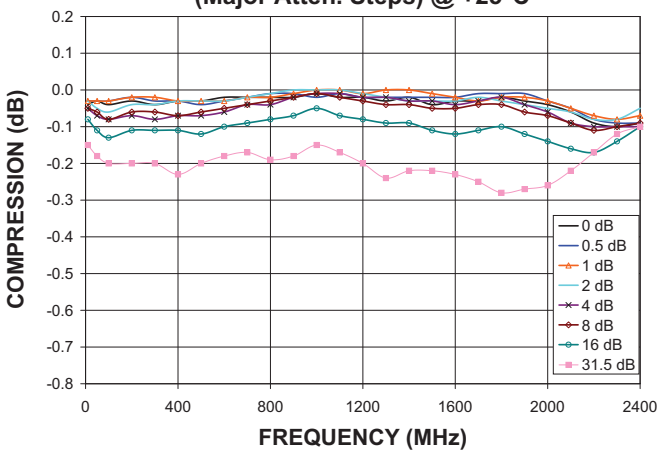


Typical Performance Curves

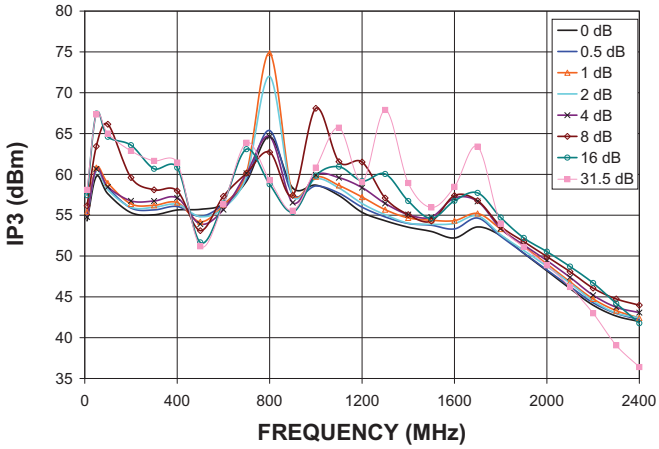
IP3 (Major Atten. Steps) @ +25°C



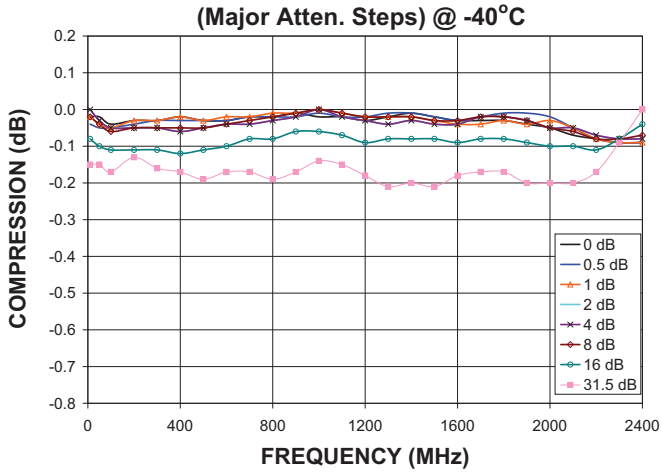
COMPRESSION @ INPUT POWER=+24dBm (Major Atten. Steps) @ +25°C



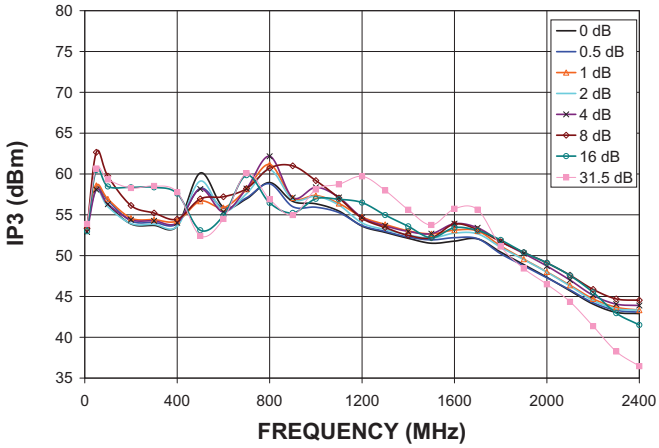
IP3 (Major Atten. Steps) @ -40°C



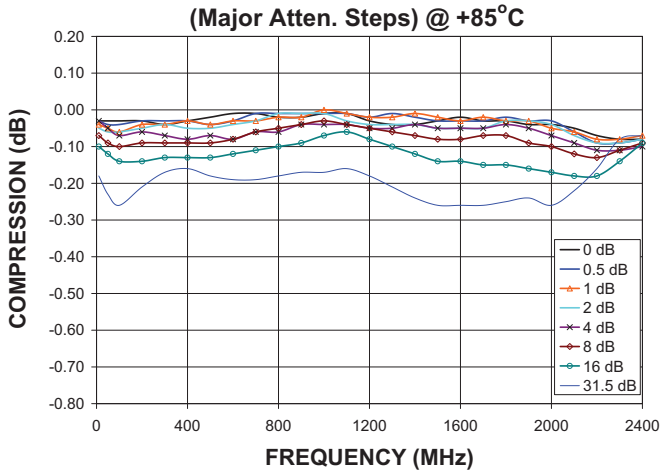
COMPRESSION @ INPUT POWER=+24dBm (Major Atten. Steps) @ -40°C



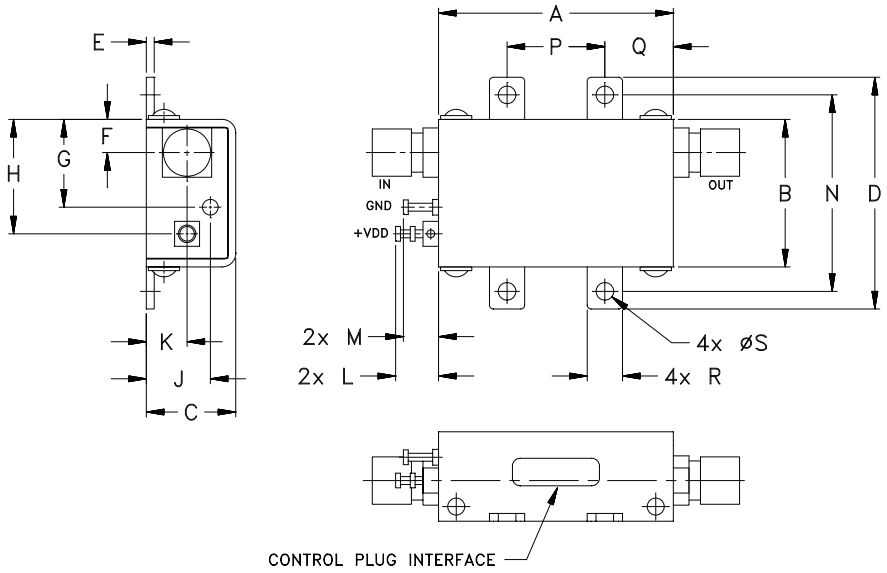
IP3 (Major Atten. Steps) @ +85°C



COMPRESSION @ INPUT POWER=+24dBm (Major Atten. Steps) @ +85°C



Outline Drawing



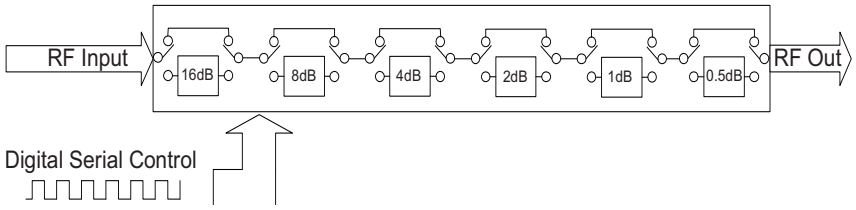
Outline Dimensions (inch/mm)

A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	WT. GRAMS
1.20	**.75**	**.46**	**1.18**	**.04**	**.17**	**.45**	**.59**	**.33**	**.21**	**.22**	**.18**	**1.00**	**.50**	**.35**	**.18**	**.106**	35
30.5	19.1	11.6	30.0	1.0	4.3	11.4	14.9	8.3	5.3	5.6	4.6	25.4	12.7	8.9	4.6	2.69	

Recommended Mounting Hardware:

Use UNC#2 pan head screws with internal tooth lock washers for unit mounting.

Simplified Schematic



The ZX76-31R5-SP+ Serial interface consists of 6 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
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 serial interface is a 6-bit serial in, parallel-out shift register buffered by a transparent latch. It is controlled by three CMOS-compatible signals: Data, Clock, and Latch Enable (LE). The Data and Clock inputs allow data to be serially entered into the shift register, a process that is independent of the state of the LE input.

The LE input controls the latch. When LE is HIGH, the latch is transparent and the contents of the serial shift register control the attenuator. When LE is brought LOW, data in the shift register is latched.

The shift register should be loaded while LE is held LOW to prevent the attenuator value from changing as data is entered. The LE input should then be toggled HIGH and brought LOW again, latching the new data. The timing for this operation is defined by Figure 1 (Serial Interface Timing Diagram) and Table 2 (Serial Interface AC Characteristics).

Control cables for programming and CD with software can be ordered separately. For details see page 10.

Figure 1: Serial Interface Timing Diagram

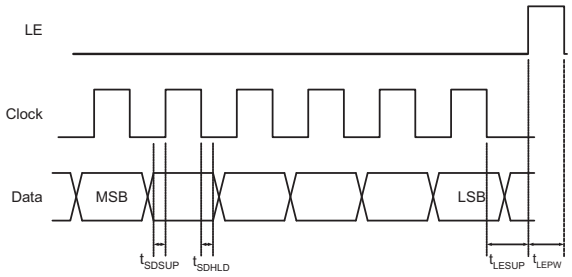


Table 2. Serial Interface AC Characteristics

Symbol	Parameter	Min.	Max.	Units
f_{clk}	Serial data clock frequency (Note 1)		10	MHz
t_{clkH}	Serial clock HIGH time	30		ns
t_{clkL}	Serial clock LOW time	30		ns
t_{LESUP}	LE set-up time after last clock falling edge	10		ns
t_{LEPW}	LE minimum pulse width	30		ns
t_{SDSUP}	Serial data set-up time before clock rising edge	10		ns
t_{SDHLD}	Serial data hold time after clock falling edge	10		ns

Note 1. fclk verified during the functional pattern test. Serial programming sections of the functional pattern are clocked at 10MHz to verify fclk specification.

The ZX76-31R5-SP+, uses a common 6-bit serial word format, as shown in Table 3: 6-Bit attenuator Serial Programming Register Map.

The first bit, the MSB, corresponds to the 16-dB Step and the last bit, the LSB, corresponds to the 0.5dB step.

Table 3. 6-Bit attenuator Serial Programming Register Map

B5	B4	B3	B2	B1	B0
C16	C8	C4	C2	C1	C0.5

MSB (first in)

LSB (last in)

Recommended Accessories

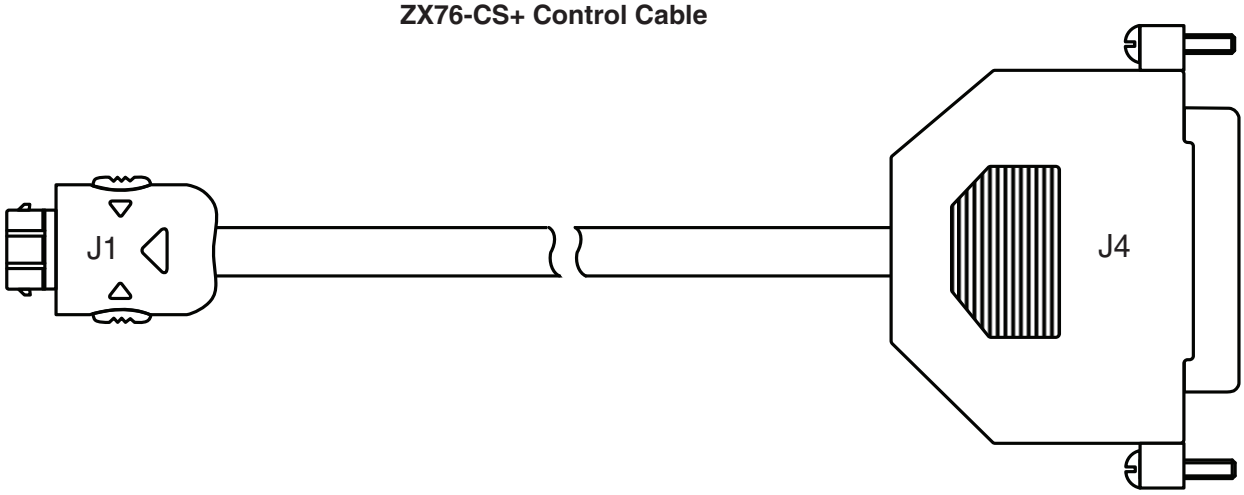
Two optional cable accessories with and without interface connector are available with ZX76-31R5-SP+, the ZX76-CS+ and ZX76-WS+. Cable length is 4.9 feet / 1.5 meters.

ZX76-CS+ shielded cable with interface 25 pin D-type connector J4 and supplied software are used to control the ZX76-31R5-SP+ digital attenuator from a computer, using LPT port.

ZX76-WS+ shielded cable without interface 25 pin D-type connector enables customer to use the ZX76-31R5-SP+ digital attenuator in his own application.

Note: Mini-Circuits can supply control cables with other options for the J4 connector and/or different cable lengths. Consult factory with your specific requirements.

ZX76-CS+ Control Cable

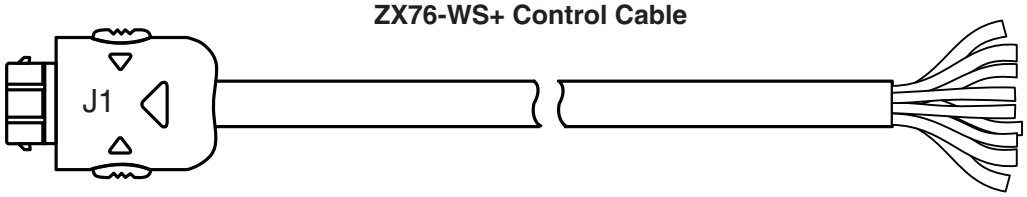


ZX76-CS+ wiring information

J1-Pin Number	J4-Pin Number	Function	Description	Wire Color
J1-2	J4-18	GND	Ground connection	BLACK
J1-3	J4-4	LE	Latch Enable Input	GREEN
J1-5	J4-19	GND	Ground connection	BLUE
J1-7	J4-2	Clock	Serial Interface clock Input	RED
J1-8	J4-20	GND	Ground connection	ORANGE
J1-9	J4-3	Data	Serial Interface data Input	WHITE

Note: Other pins not connected. Cable shield connected to case ground.

ZX76-WS+ Control Cable



ZX76-WS+ wiring information

J1-Pin Number	Function	Description	Wire Color
J1-2	GND	Ground connection	BLACK
J1-3	LE	Latch Enable Input	GREEN
J1-5	GND	Ground connection	BLUE
J1-7	Clock	Serial Interface clock Input	RED
J1-8	GND	Ground connection	ORANGE
J1-9	Data	Serial Interface data Input	WHITE

Note: Other pins not connected. Cable shield connected to case ground.

Ordering Information

Model Number	Description	Quantity Min. No. of Units	Price $ Ea.
ZX76-31R5-SP-S+	Digital attenuator - Serial interface Single Positive Supply Voltage	1-9	79.95
ZX76-CS+	Cable accessory with interface connector	1	24.95
ZX76-WS+	Cable accessory without interface connector	1	22.95
ZX76-CD*	CD ROM ZX76 programming software	1	No Charge

*Note: To receive the CD, request when placing order.