



COAXIAL SOLID STATE

Digital Step Attenuator **ZX76-24G-30-S+**

50Ω 0 to 31.5 dB 0.5 dB Step 0.1 to 24 GHz SMA Female
6 Bit Parallel Control Interface Dual or Single Supply Voltage

THE BIG DEAL

- Wideband Coverage, 0.1 to 24 GHz
- Immune to Latch-Up
- High Input IP3, +50 dBm
- Good Return Loss, 15 dB Typ.
- Glitch-less Attenuation Transitions
- Dual +3.3 / -3.0 V or Single Supply Voltage of +3.3 to +5.4 V

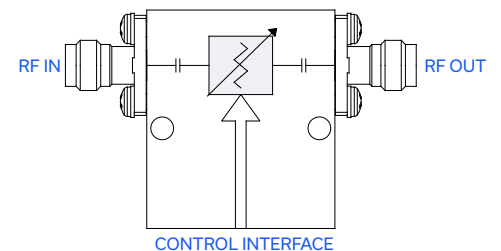


Generic photo used for illustration purposes only

APPLICATIONS

- Test and Measurement
- 4G LTE & 5G FR1
- WiFi6E, IoT, and SATCOM
- Radar, EW, and ECM Defense Systems
- X-Band, S-Band, C-Band, Ku-Band, and K-Band Radars

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

Mini-Circuits' ZX76-24G-30-S+ is a 50Ω digital step attenuator designed for wideband RF applications from 0.1 to 24 GHz. It provides programmable attenuation from 0 to 31.5 dB in 0.5 dB steps, enabling fine control over signal levels. Control is achieved through a simple 6-bit parallel digital interface that requires no external clock. The device supports both single positive-supply and dual-supply (positive and negative) configurations. For applications requiring low spurious signal performance, an external negative voltage should be supplied to disable the internal negative voltage generator. Housed in a custom, rugged package, the ZX76-24G-30-S+ is built for durability and consistent performance in challenging environments. Its robust design makes it ideal for use in demanding RF systems, including test instrumentation, communication infrastructure, and defense applications.

RF ELECTRICAL SPECIFICATIONS¹, 100 MHz - 24 GHz, $T_{AMB}=+25^{\circ}\text{C}$, $V_{DD}=+3.3\text{ V}$

Feature	Frequency (GHz)	Min.	Typ.	Max.	Units
Insertion Loss @ 0 dB Attenuation Setting	0.1 - 13	—	3.0	6.0	dB
	13 - 24	—	4.5	8.0	
Input IP3 ²	2 - 16	—	+50	—	dBm
Input Power @ 1 dB Compression	0.1 - 24	+22	—	—	dBm
Return Loss	0.1 - 24	—	17	—	dB

1. Attenuator RF ports are interchangeable, and support simultaneous, bidirectional signal transmission, however the specifications are guaranteed for the RF In and RF Out as noted on the label. There may be minor changes in performance when injecting signals into the RF Out port.

2. Tested with 1 MHz offset between signals.





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NOMINAL ATTENUATION & ATTENUATION ACCURACY, $T_{AMB}=+25^{\circ}\text{C}$, $V_{DD}=+3.3\text{ V}$

Attenuation Setting	Nominal Attenuation (dB Typ.)					Typical Attenuation Accuracy (dB) Relative to Nominal Attenuation				
	0.1 GHz	6 GHz	12 GHz	18 GHz	24 GHz	0.1 GHz	6 GHz	12 GHz	18 GHz	24 GHz
0.5 dB	0.48	0.44	0.49	0.42	0.32	±0.15	±0.15	±0.15	±0.20	±0.25
1 dB	0.90	0.82	0.92	0.81	0.67	±0.20	±0.20	±0.20	±0.25	±0.30
2 dB	2.20	2.32	2.15	2.20	2.31	±0.30	±0.30	±0.30	±0.53	±0.75
4 dB	4.21	4.13	4.20	4.10	4.01	±0.30	±0.42	±0.45	±0.48	±0.55
8 dB	8.12	8.05	8.21	8.18	8.17	±0.50	±0.60	±0.80	±0.85	±0.90
16 dB	16.20	16.12	16.44	16.46	16.39	±1.00	±1.20	±1.35	±1.40	±1.40
31.5 dB	32.04	31.95	32.12	32.02	32.03	±1.10	±1.20	±1.30	±2.00	±2.50

TYPICAL PERFORMANCE DATA AT $T_{AMB}=+25^{\circ}\text{C}$, $V_{DD}=+3.3\text{ V}$

Freq. (GHz)	Input Return Loss (dB) @ Attenuation Setting								Output Return Loss (dB) @ Attenuation Setting							
	0 dB	0.5 dB	1.0 dB	2.0 dB	4.0 dB	8.0 dB	16 dB	31.5 dB	0 dB	0.5 dB	1.0 dB	2.0 dB	4.0 dB	8.0 dB	16 dB	31.5 dB
0.1	17.4	20.5	26.4	11.8	19.2	37.2	38.8	38.3	17.2	19.9	22.9	12.7	29.9	20.6	37.5	33.6
0.5	16.7	19.7	25.0	11.6	18.8	35.4	38.7	38.5	16.6	19.3	22.0	12.6	28.5	20.2	33.9	34.3
1	16.4	19.5	24.4	11.7	18.7	37.5	36.7	36.5	16.7	19.2	21.8	12.7	28.5	20.1	32.2	33.2
5	19.8	24.0	32.0	13.1	20.6	40.0	35.5	35.7	19.2	22.0	24.2	14.0	27.9	19.8	30.9	36.6
10	20.8	20.8	21.0	16.3	21.5	18.6	18.1	18.0	19.2	18.8	17.3	20.4	23.7	19.7	18.8	20.0
15	21.2	25.0	26.2	14.8	23.2	36.5	41.4	39.2	18.6	19.8	18.8	15.8	22.1	17.5	26.9	27.8
20	19.3	17.6	15.8	32.1	19.9	15.8	15.9	15.7	32.8	25.9	22.7	31.6	29.0	22.4	17.7	21.8
24	12.2	11.7	10.8	19.3	14.8	12.7	13.3	13.3	14.1	14.6	16.3	13.3	13.9	17.9	13.9	13.9

DC ELECTRICAL SPECIFICATIONS

Parameter	Min.	Typ.	Max.	Units
Positive Supply Voltage, V_{DD}	+2.3 ³	+3.3	+5.4	V
Positive Supply Current, I_{DD}	—	170	250	μA
Negative Supply Voltage, V_{SS}	-3.3	-3.0	-2.7	V
Negative Supply Current, I_{SS}	-40	-16	—	μA
Control Input Low	-0.3	—	+0.6	V
Control Input High	+1.17	—	+3.5	V
Control Current	—	10	20	μA

3. Minimum positive supply voltage (V_{DD}) is +3.1V when negative supply voltage (V_{SS}) is applied externally.

SWITCHING SPECIFICATIONS

Parameter	Min.	Typ.	Max.	Units
Switching Speed, 50% Control to 0.5 dB of Attenuation Value	—	330	400	nsec

ABSOLUTE MAXIMUM RATINGS⁴

Parameter	Ratings
Operating Temperature	0°C to +50°C
Storage Temperature	-20°C to +85°C
V_{DD}	-0.3 V Min., +5.5 V Max.
V_{SS}	-3.6 V Min., +0.3 V Max.
Voltage on any control input	-0.3 V Min., +3.6 V Max.
ESD, HBM ⁵	+1000 V
Maximum Input Power ⁶	+28 dBm

4. 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.

5. Human body model (MIL-STD 883 Method 3015)

6. $T_{ambient} = +25^{\circ}\text{C}$, derate to +26 dBm @ +50°C





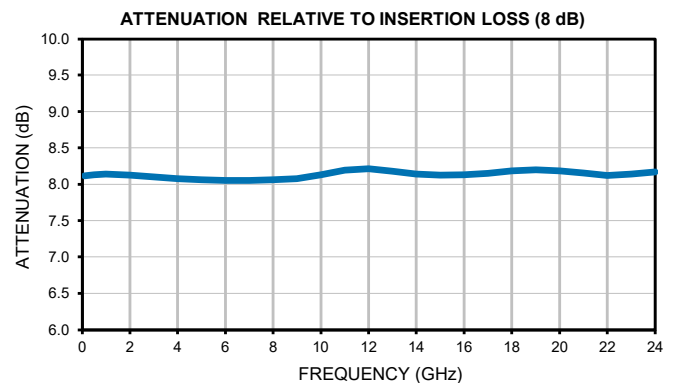
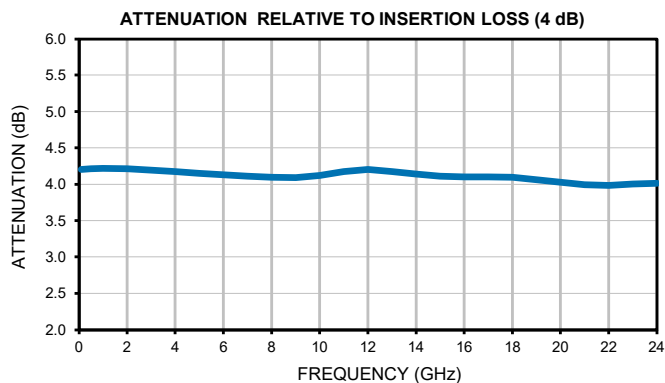
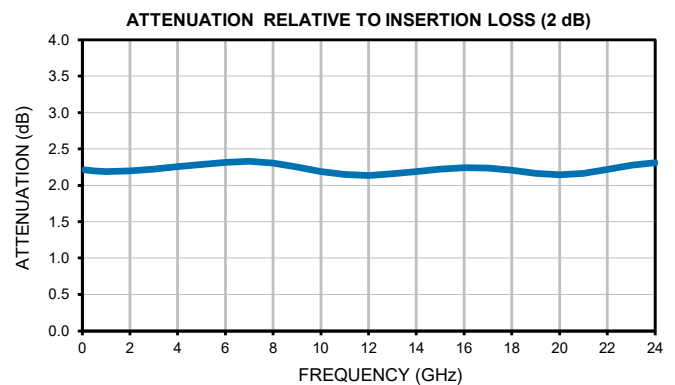
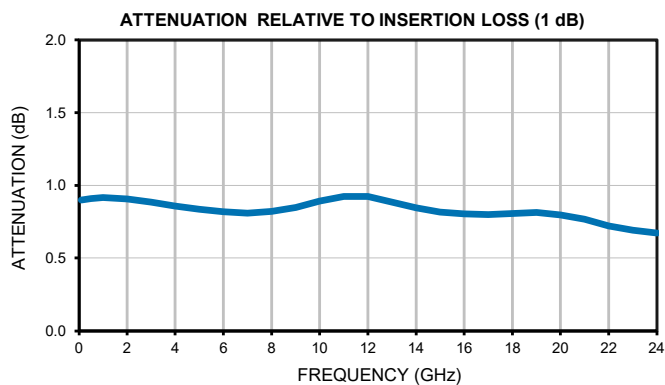
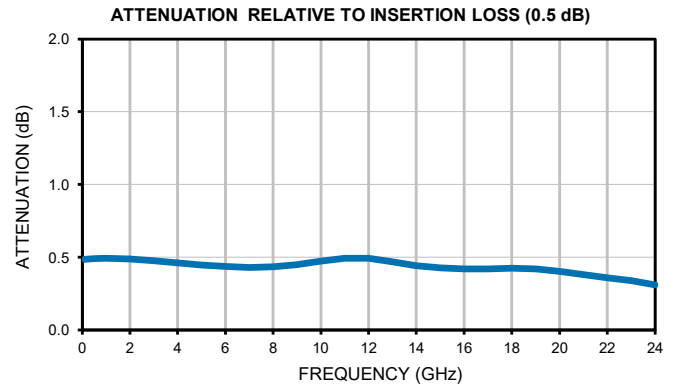
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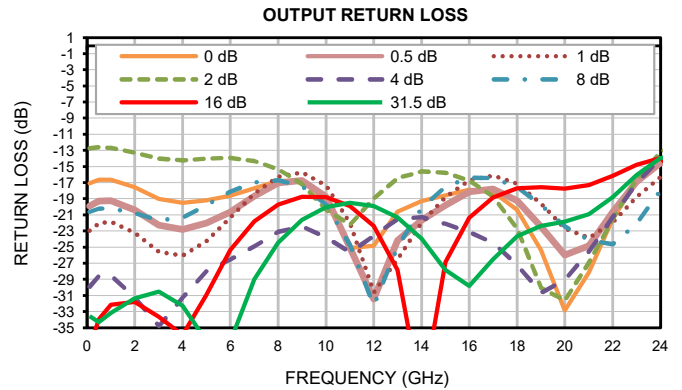
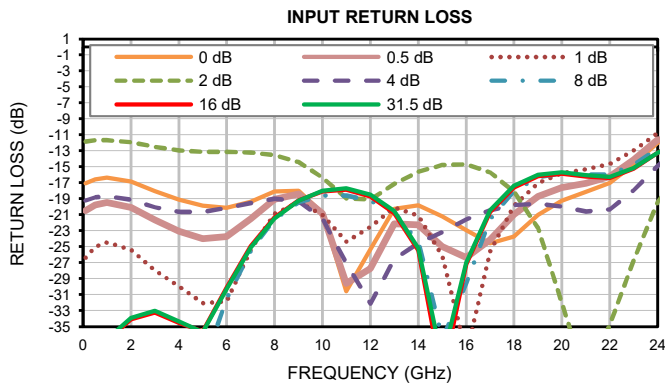
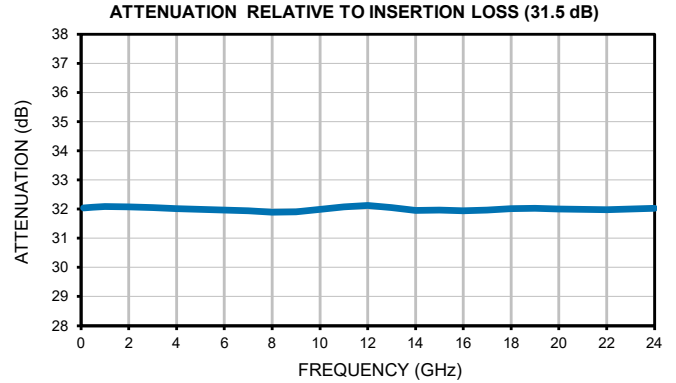
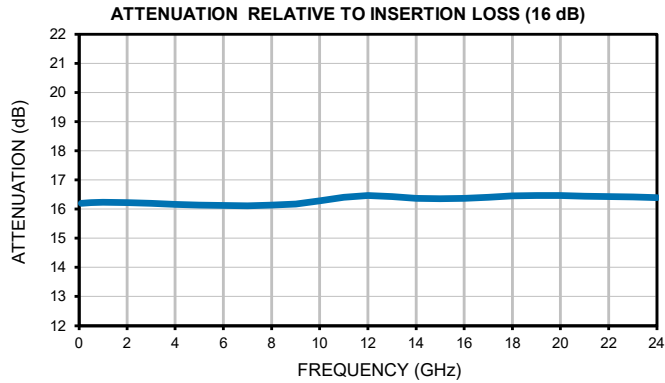
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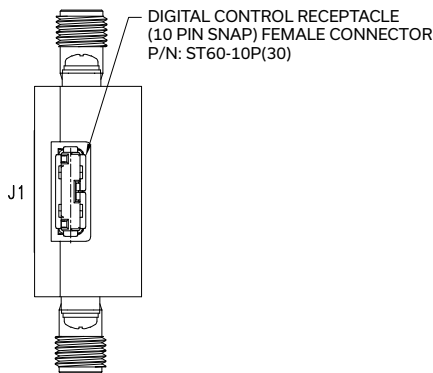
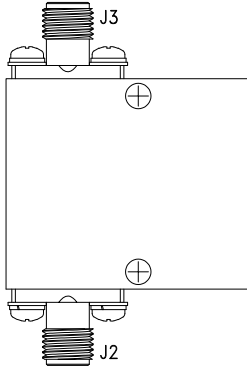
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PIN CONFIGURATION (TOP VIEW)



PIN DESCRIPTION

Connector	Function	Pin Number	Description
10 Pin Digital Control Snap Connector (Female) ¹⁰	LE	J1-1	Latch Enable Input
	P/S	J1-2	Logic Low (0V) ⁷
	C0.5	J1-3	Control for attenuation bit, 0.5 dB
	C1	J1-4	Control for attenuation bit, 1.0 dB
	C4	J1-5	Control for attenuation bit, 4.0 dB
	C2	J1-6	Control for attenuation bit, 2 dB
	C8	J1-7	Control for attenuation bit, 8 dB
	C16	J1-8	Control for attenuation bit, 16 dB
	V _{DD}	J1-9	Positive Supply Voltage
	V _{SS}	J1-10	Negative Supply Voltage ⁸ (or ext gnd)
Coaxial	IN	J2	RF in port ⁹
	OUT	J3	RF out port ⁹

7. J1-2 Must be tied low before applying any control bit.

8. The internal negative voltage is generated when Pin J1-10 is grounded.

9. Both RF ports are DC blocked with internal series capacitors.

10. Mating connector is Hirose ST40X-10S-CV(30).



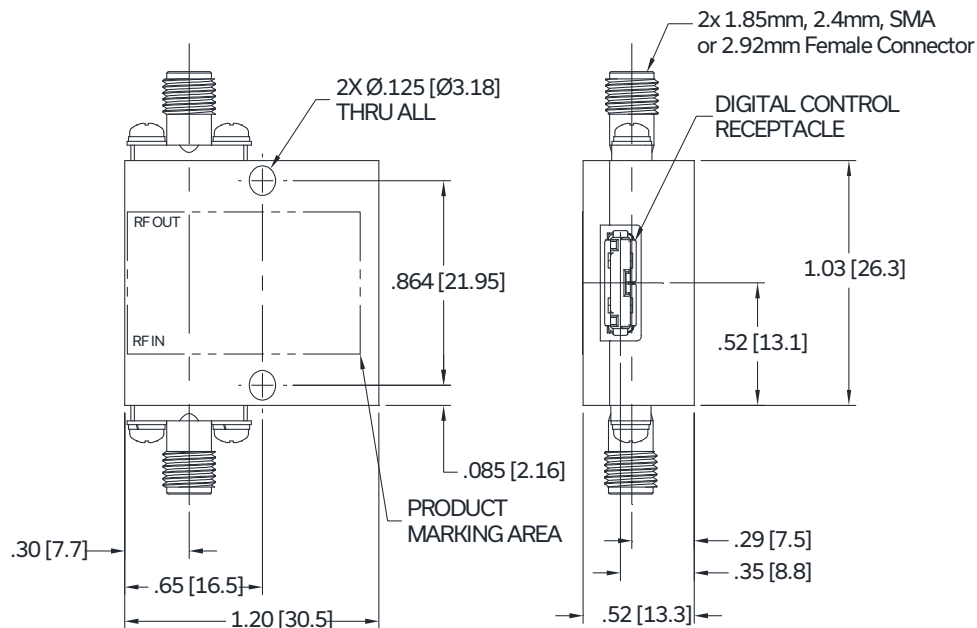
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CASE STYLE DRAWING



Weight: 45.36 grams

Dimensions are in inches (mm). Tolerances: 2Pl. ± .03; 3Pl. ± .015

PRODUCT MARKING

Product Marking: ZX76-24G-30-S+

Marking may contain other features or characters for internal lot control

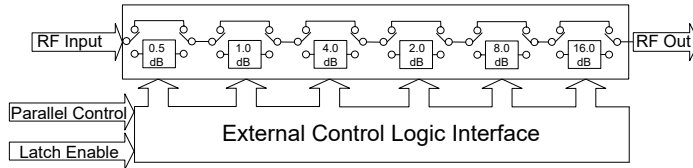


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SIMPLIFIED SCHEMATIC



The ZX76-24G-30-S+ parallel 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 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 hardware, switches, or jumpers).

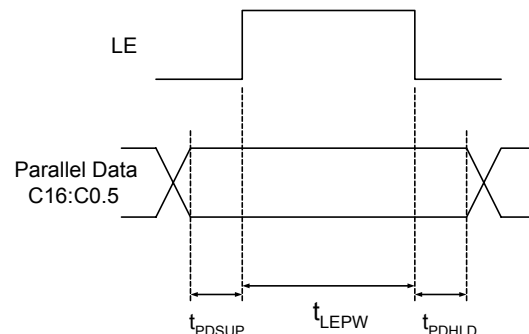
TABLE 2. PARALLEL INTERFACE AC CHARACTERISTICS

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

POWER-UP STATE

When the attenuator powers up and LE is logic low, the nominal attenuation is set to 31.5 dB. When LE is logic high, the nominal attenuation is selected based upon the preset control logic bits (see Table 1).

FIG. 1: PARALLEL INTERFACE TIMING DIAGRAM





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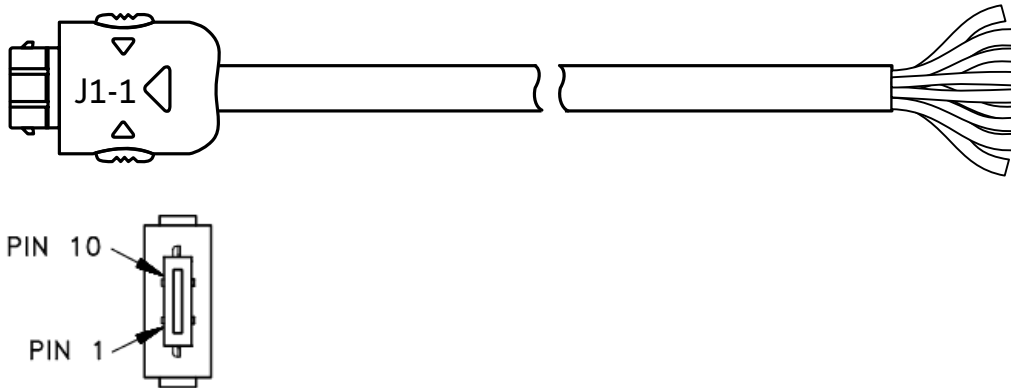
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INCLUDED ACCESSORY

CBL-5FT-MPD+ is a "Pigtail" connector included with every purchase of ZX76-24G-30-S+. 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 ZX76-24G-30-S+. These bare wires enable the customer to interface with the ZX76-24G-30-S+ (cable length is 4.9ft/ 1.5meters).

Connector P/N: Hirose ST40X-10S-CV(30)



CBL-5FT-MPD+ WIRING INFORMATION

J1-1 Pin Number	Function	Description	Wire Color
1	LE	Latch Enable Input	Green
2	P/S	Logic Low (0V)	Green/Black
3	C0.5	Control for attenuation bit, 0.5 dB	Red
4	C1	Control for attenuation bit, 1.0 dB	Orange
5	C4	Control for attenuation bit, 4.0 dB	Orange/Black
6	C2	Control for attenuation bit, 2.0 dB	Black
7	C8	Control for attenuation bit, 8.0 dB	Red/Black
8	C16	Control for attenuation bit, 16.0 dB	Blue
9	V _{DD}	Positive Supply Voltage	White
10	V _{SS}	Negative Supply Voltage (or ext ground)	White/Black
Shield	-	Shield Braid/ Drain	-

Note: Cable shield connected to case ground.





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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD

[CLICK HERE](#)

Performance Data & Graphs	Data
	Graphs
	S-Parameter (S2P Files) Data Set (.zip file)
Case Style	MS3009
RoHS Status	Compliant
Environmental Ratings	ENV55T1
Export Info	EAR99

INCLUDED ACCESSORY

Photo	
Part No.	CBL-5FT-MPD+
Description	5 ft. (1.5M) Control Cable
Quantity	1

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/terms/viewterm.html

