



## COAXIAL SOLID STATE

# Digital Step Attenuator **ZX76-65G-30-E+**

50Ω 0 to 31.5 dB 0.5 dB Step 0.1 to 65 GHz 1.85 mm Female  
6 Bit Parallel Control Interface Dual or Single Supply Voltage

### THE BIG DEAL

- Ultra-Wideband Coverage, 0.1 to 65 GHz
- Immune to Latch-Up
- High IIP3, +50 dBm
- Good Return Loss, 15 dB typ.
- Glitch-less Attenuation Transitions
- Dual +3.3, -3V or Single Supply Voltage +3.3V

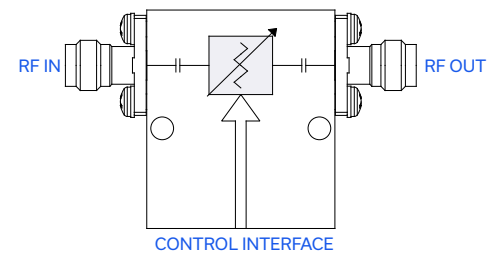


Generic photo used for illustration purposes only

### APPLICATIONS

- Test and Measurement
- 4G LTE & 5G FR1, FR2 & FR2+ Satellite Infrastructure Communications
- WiFi6E, IoT, UWB, and SATCOM
- Communications, Radar, EW, and ECM Defense Systems

### FUNCTIONAL DIAGRAM



### PRODUCT OVERVIEW

The ZX76-65G-30-E+ is a 50Ω Digital Step Attenuator that provides adjustable attenuation from 0 to 31.5 dB in 0.5 dB steps. The control is a 6-bit parallel interface, with a single positive or a dual, positive and negative supply voltage. The model is produced using a unique package design for ruggedness and operation in tough environments.

### KEY FEATURES

| Features                                                   | Advantages                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wideband operation, 0.1 to 65 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.                                                                                                                                                                                                                                                                                                                     |
| Good return loss, 15 dB typ.                               | Eases interfacing with adjacent components and results in low amplitude ripple.                                                                                                                                                                                                                                                                                                      |
| Glitch-less attenuation transitions                        | The ZX76-65G-30-E+ 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 is available                        | 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. For applications that require the lowest possible spur performance negative voltage can be applied externally to bypass the internal negative voltage generator. |
| Wide positive power supply +2.3 to +5.5 V                  | Model suitable for both +5 V and +3.3 V systems applications with no need for voltage dividers or multipliers.                                                                                                                                                                                                                                                                       |





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### RF ELECTRICAL SPECIFICATIONS<sup>1</sup>, 100 MHz - 65 GHz, $T_{AMB}=+25^{\circ}\text{C}$ , $V_{DD}=+3.3\text{ V}$

| Feature                                  | Frequency (GHz) | Min. | Typ. | Max. | Units |
|------------------------------------------|-----------------|------|------|------|-------|
| Insertion Loss @ 0dB Attenuation Setting | 0.1 - 15        | —    | 3.0  | 7.0  | dB    |
|                                          | 15 - 35         | —    | 5.5  | 8.5  |       |
|                                          | 35 - 50         | —    | 7.5  | 11.5 |       |
|                                          | 50 - 65         | —    | 9.5  | 13.5 |       |
| Input IP3 <sup>2</sup>                   | 2 - 16          | —    | +50  | —    | dBm   |
| Input Power @ 1 dB Compression           | 0.1 - 65        | +22  | —    | —    | dBm   |
| Return Loss                              | 0.1 - 65        | —    | 15   | —    | 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 to the RF Out port.

2. Tested with 1 MHz offset between signals, +18 dBm per tone.

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

| Attenuation Setting | Nominal Attenuation (typ.) |        |        |        |        | Typical Attenuation Accuracy Relative to Nominal Attenuation |        |        |        |        |
|---------------------|----------------------------|--------|--------|--------|--------|--------------------------------------------------------------|--------|--------|--------|--------|
|                     | 0.1 GHz                    | 15 GHz | 30 GHz | 45 GHz | 65 GHz | 0.1 GHz                                                      | 15 GHz | 30 GHz | 45 GHz | 65 GHz |
| 0.5 dB              | 0.47                       | 0.45   | 0.30   | 0.36   | 0.32   | ±0.15                                                        | ±0.15  | ±0.25  | ±0.20  | ±0.20  |
| 1 dB                | 0.90                       | 0.88   | 0.70   | 0.50   | 0.57   | ±0.20                                                        | ±0.20  | ±0.30  | ±0.35  | ±0.25  |
| 2 dB                | 2.20                       | 2.1    | 2.5    | 2.8    | 2.3    | ±0.30                                                        | ±0.30  | ±0.75  | ±0.60  | ±0.55  |
| 4 dB                | 4.1                        | 4.2    | 4.0    | 4.0    | 4.3    | ±0.30                                                        | ±0.45  | ±0.55  | ±0.80  | ±0.85  |
| 8 dB                | 8.20                       | 8.3    | 8.4    | 8.7    | 8.5    | ±0.50                                                        | ±0.80  | ±0.90  | ±1.00  | ±1.00  |
| 16 dB               | 16.30                      | 16.7   | 16.7   | 17.7   | 18.1   | ±1.00                                                        | ±1.40  | ±1.40  | ±1.50  | ±1.80  |
| 31.5 dB             | 32.20                      | 32.6   | 32.8   | 32.9   | 33.6   | ±1.10                                                        | ±1.30  | ±2.50  | ±2.80  | ±3.20  |

### DC ELECTRICAL SPECIFICATIONS

| Parameter                         | Min.              | Typ. | Max. | Units |
|-----------------------------------|-------------------|------|------|-------|
| Positive Supply Voltage, $V_{DD}$ | +2.3 <sup>3</sup> | +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             | —    | +5.3 | 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 RATINGS<sup>4</sup>

| Parameter                        | Ratings                |
|----------------------------------|------------------------|
| Operating Temperature            | 0°C to 50°C            |
| Storage Temperature              | -20°C to 85°C          |
| $V_{DD}$                         | -0.3V Min., +5.5V Max. |
| $V_{SS}$                         | -3.6V Min., +0.3V Max. |
| Voltage on any control input     | -0.3V Min., +3.6V Max. |
| ESD, HBM <sup>6</sup>            | 1000 V                 |
| Maximum Input Power <sup>7</sup> | +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.

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

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





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

| Freq.<br>(GHz) | Input Return Loss (dB)<br>@ Attenuation Setting |        |        |        |        |        |       |         | Output Return Loss (dB)<br>@ 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                                            | 21.2   | 27.9   | 12.1   | 20.1   | 38.7   | 33.0  | 32.7    | 17.5                                             | 20.7   | 24.2   | 13.1   | 33.1   | 22.0   | 48.8  | 30.0    |
| 0.5            | 16.7                                            | 20.3   | 25.9   | 11.9   | 19.5   | 39.3   | 34.0  | 33.8    | 17.0                                             | 20.0   | 23.1   | 13.0   | 30.9   | 21.5   | 36.3  | 30.4    |
| 1              | 16.7                                            | 20.2   | 25.8   | 11.9   | 19.5   | 38.3   | 33.5  | 33.3    | 17.1                                             | 20.0   | 23.0   | 13.1   | 31.3   | 21.5   | 34.6  | 30.1    |
| 5              | 17.3                                            | 20.1   | 24.8   | 11.9   | 17.8   | 28.6   | 29.3  | 29.5    | 18.5                                             | 20.3   | 20.7   | 13.8   | 25.9   | 17.4   | 22.9  | 30.3    |
| 10             | 21.6                                            | 21.9   | 22.4   | 16.2   | 20.8   | 18.9   | 18.1  | 18.1    | 23.3                                             | 21.9   | 19.7   | 24.6   | 22.9   | 23.8   | 19.2  | 18.4    |
| 15             | 24.3                                            | 24.7   | 25.6   | 16.6   | 21.6   | 20.3   | 19.5  | 19.3    | 15.3                                             | 15.8   | 14.9   | 15.5   | 22.3   | 15.5   | 19.6  | 29.0    |
| 20             | 18.8                                            | 17.4   | 15.6   | 40.0   | 20.0   | 15.1   | 15.1  | 14.8    | 23.2                                             | 20.5   | 19.4   | 27.4   | 22.1   | 18.5   | 14.7  | 17.9    |
| 25             | 10.8                                            | 10.6   | 9.7    | 13.8   | 12.3   | 10.6   | 11.0  | 11.1    | 14.9                                             | 15.9   | 17.2   | 13.0   | 13.0   | 15.0   | 16.7  | 13.5    |
| 30             | 14.3                                            | 15.3   | 15.8   | 10.9   | 13.3   | 14.2   | 13.9  | 14.1    | 14.1                                             | 13.6   | 13.2   | 19.4   | 17.8   | 16.9   | 19.8  | 20.5    |
| 35             | 12.2                                            | 12.5   | 14.1   | 10.2   | 13.2   | 16.1   | 16.0  | 15.7    | 12.5                                             | 12.2   | 11.9   | 16.4   | 14.3   | 15.9   | 16.7  | 16.9    |
| 40             | 14.6                                            | 14.6   | 16.2   | 13.5   | 16.3   | 20.9   | 21.9  | 21.3    | 13.6                                             | 13.1   | 13.4   | 16.0   | 14.2   | 16.4   | 14.9  | 16.2    |
| 45             | 24.7                                            | 22.7   | 25.2   | 18.2   | 22.1   | 35.2   | 34.4  | 32.1    | 21.4                                             | 20.8   | 23.2   | 15.8   | 20.1   | 15.8   | 12.8  | 16.8    |
| 50             | 15.1                                            | 14.6   | 16.2   | 13.5   | 14.7   | 19.1   | 19.1  | 18.2    | 16.4                                             | 16.2   | 17.3   | 13.1   | 14.8   | 13.1   | 11.3  | 13.2    |
| 55             | 15.0                                            | 14.4   | 14.4   | 21.3   | 14.1   | 16.5   | 16.2  | 17.1    | 11.9                                             | 12.3   | 11.5   | 12.2   | 14.6   | 12.8   | 11.5  | 14.2    |
| 60             | 15.9                                            | 15.1   | 14.9   | 21.2   | 14.2   | 17.1   | 16.6  | 17.4    | 13.7                                             | 13.5   | 13.3   | 15.5   | 13.4   | 13.8   | 16.6  | 14.3    |
| 65             | 18.6                                            | 18.0   | 18.2   | 36.1   | 20.7   | 22.3   | 23.0  | 23.1    | 10.0                                             | 10.2   | 10.2   | 9.4    | 9.5    | 10.6   | 9.7   | 9.4     |

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

| Frequency<br>(GHz) | Insertion Loss<br>(dB) | Attenuation Relative to Insertion Loss (dB)<br>@ Attenuation Setting |        |        |        |        |        |         |
|--------------------|------------------------|----------------------------------------------------------------------|--------|--------|--------|--------|--------|---------|
|                    |                        | 0 dB                                                                 | 0.5 dB | 1.0 dB | 2.0 dB | 4.0 dB | 8.0 dB | 31.5 dB |
| 0.1                | 1.36                   |                                                                      | 0.47   | 0.89   | 2.18   | 4.22   | 8.18   | 32.31   |
| 0.5                | 1.51                   |                                                                      | 0.48   | 0.90   | 2.17   | 4.23   | 8.19   | 32.29   |
| 1                  | 1.61                   |                                                                      | 0.48   | 0.91   | 2.16   | 4.23   | 8.20   | 32.31   |
| 5                  | 2.37                   |                                                                      | 0.41   | 0.80   | 2.31   | 4.13   | 8.09   | 32.17   |
| 10                 | 3.46                   |                                                                      | 0.46   | 0.87   | 2.19   | 4.18   | 8.18   | 32.43   |
| 15                 | 3.89                   |                                                                      | 0.48   | 0.91   | 2.10   | 4.16   | 8.33   | 32.59   |
| 20                 | 4.66                   |                                                                      | 0.41   | 0.83   | 2.05   | 4.03   | 8.26   | 32.67   |
| 25                 | 5.44                   |                                                                      | 0.28   | 0.71   | 2.41   | 4.17   | 8.45   | 32.89   |
| 30                 | 5.70                   |                                                                      | 0.28   | 0.62   | 2.54   | 4.05   | 8.36   | 32.71   |
| 35                 | 6.27                   |                                                                      | 0.29   | 0.62   | 2.47   | 4.01   | 8.40   | 32.74   |
| 40                 | 7.00                   |                                                                      | 0.33   | 0.61   | 2.31   | 3.93   | 8.28   | 32.49   |
| 45                 | 7.33                   |                                                                      | 0.35   | 0.50   | 2.68   | 4.00   | 8.65   | 32.88   |
| 50                 | 8.16                   |                                                                      | 0.34   | 0.51   | 2.63   | 4.05   | 8.71   | 34.46   |
| 55                 | 8.82                   |                                                                      | 0.32   | 0.68   | 2.29   | 4.06   | 8.88   | 34.59   |
| 60                 | 9.59                   |                                                                      | 0.40   | 0.59   | 2.45   | 4.50   | 9.02   | 33.29   |
| 65                 | 11.11                  |                                                                      | 0.32   | 0.61   | 2.34   | 4.37   | 8.72   | 32.49   |



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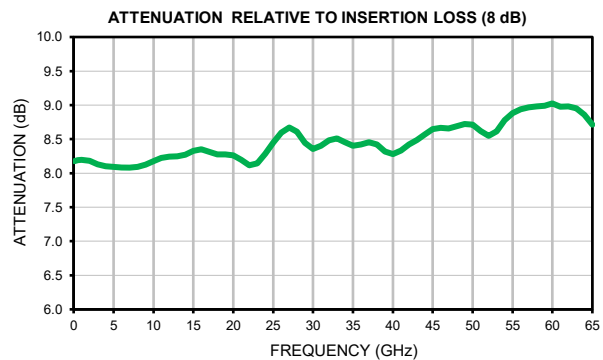
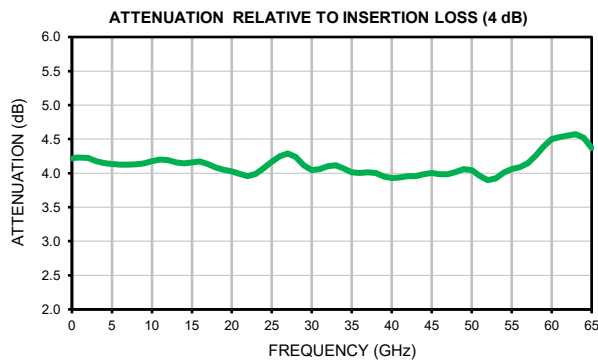
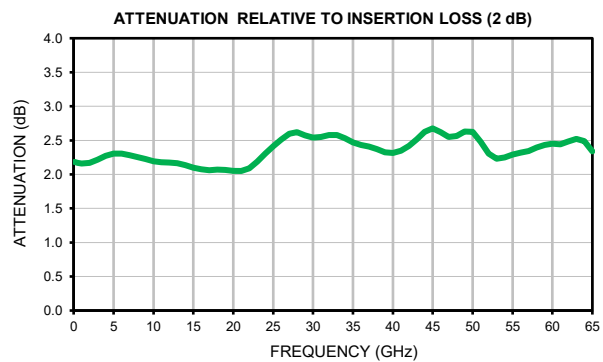
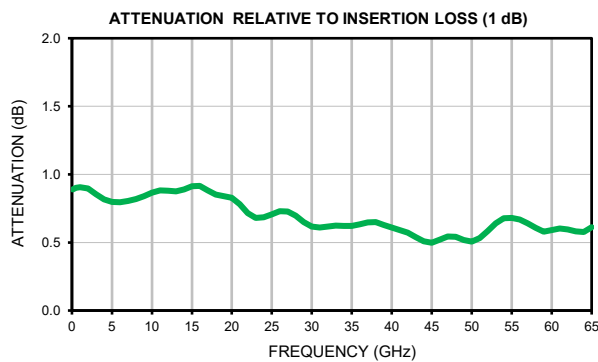
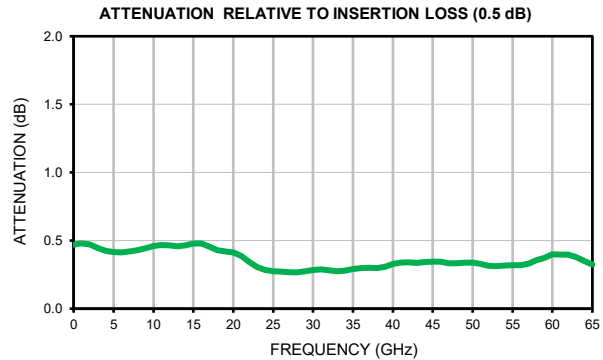
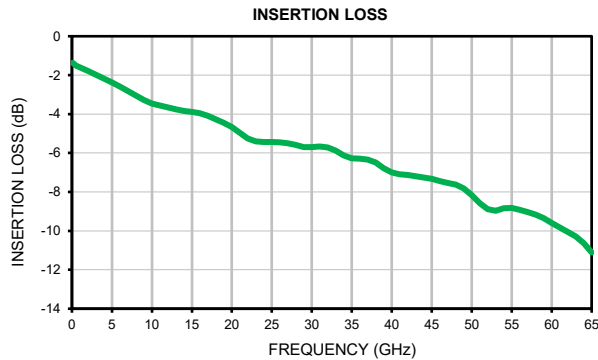
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TYPICAL PERFORMANCE DATA AT  $T_{AMB}=+25^{\circ}\text{C}$ ,  $V_{DD}=+3.3\text{ V}$





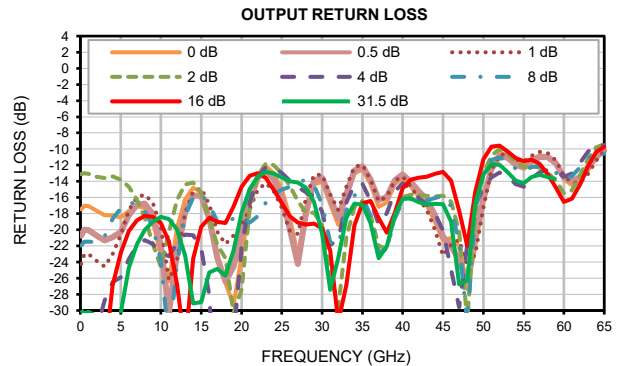
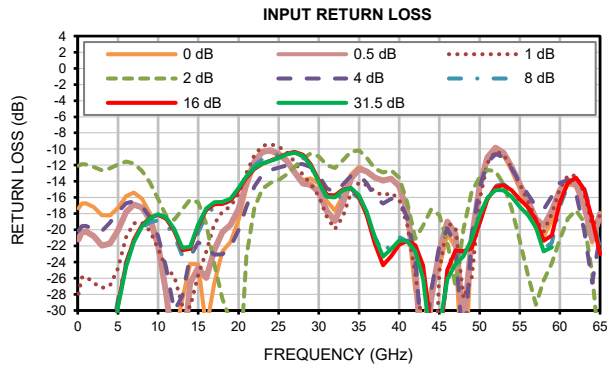
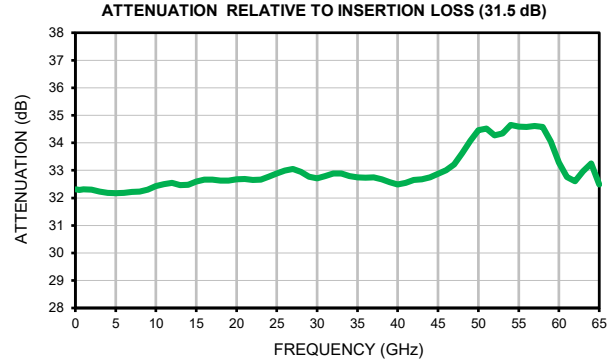
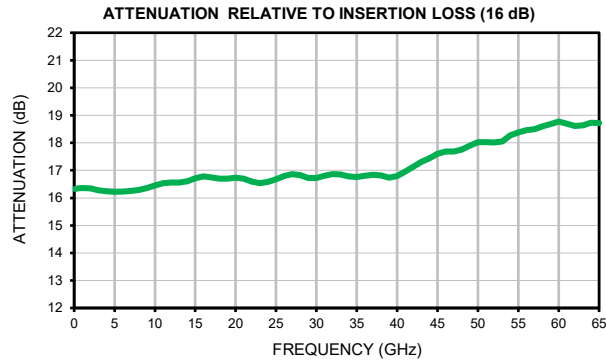
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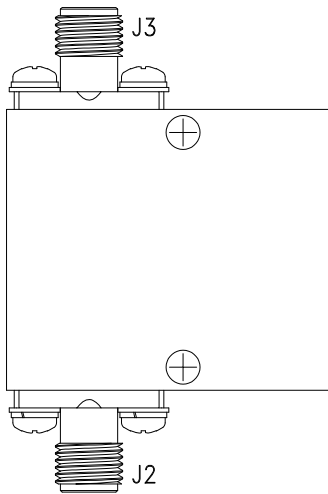
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### PIN CONFIGURATION (TOP VIEW)



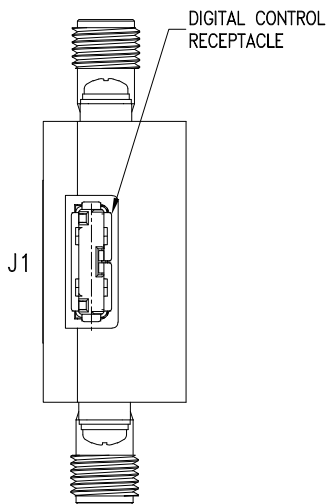
### PIN DESCRIPTION

| Connector                  | Function        | Pin Number | Description                                       |
|----------------------------|-----------------|------------|---------------------------------------------------|
| Digital Control Receptacle | LE              | J1-1       | Latch Enable Input                                |
|                            | P/S             | J1-2       | Logic Low (0V) <sup>3</sup>                       |
|                            | 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 <sub>DD</sub> | J1-9       | Positive Supply Voltage                           |
|                            | V <sub>SS</sub> | J1-10      | Negative Supply Voltage <sup>2</sup> (or ext gnd) |
| Coaxial                    | IN              | J2         | RF in port <sup>1</sup>                           |
|                            | OUT             | J3         | RF out port <sup>1</sup>                          |

Note 1: Both RF ports are DC blocked with internal series capacitors.

Note 2: The internal negative voltage is generated when Pin J1-10 is grounded.

Note 3: J1-2 Must be tied low before applying any control bit.



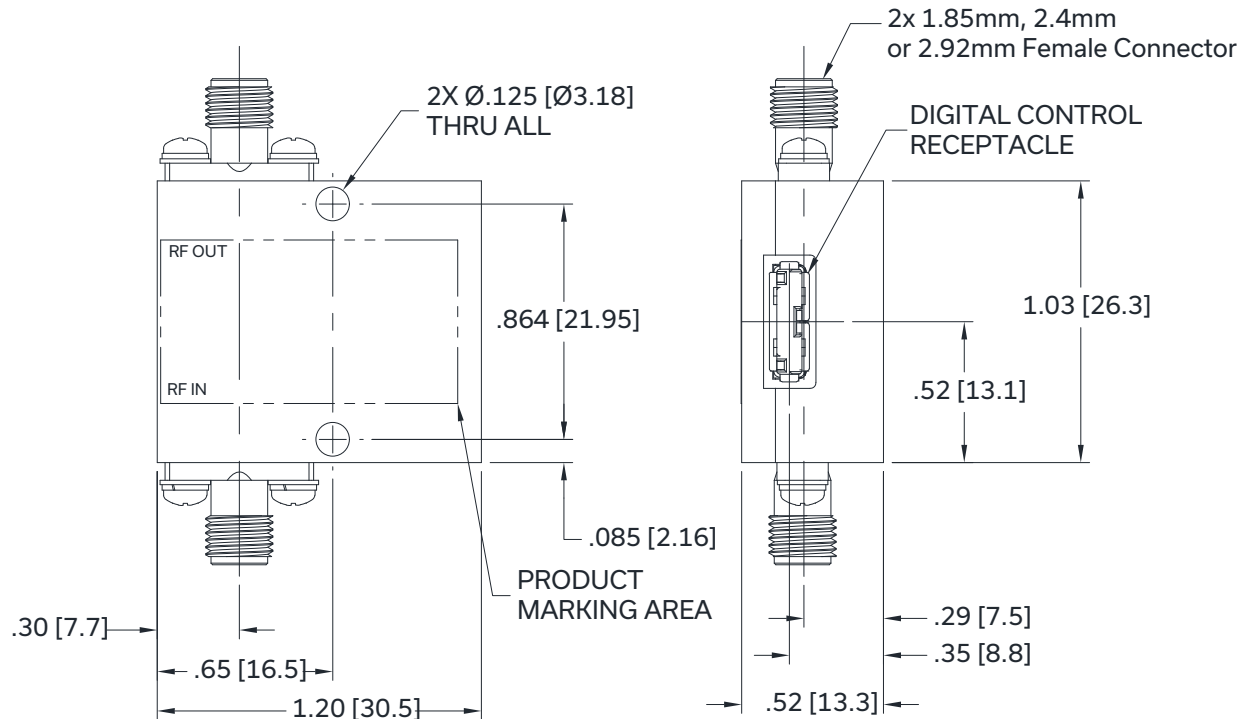


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## CASE STYLE DRAWING



Weight: 45.36 grams

Dimensions are in inches [mm]. Tolerances: 2Pl. ±.03; 3Pl. ± .015

## PRODUCT MARKING

Product Marking: ZX76-65G-30-E+

Marking may contain other features or characters for internal lot control



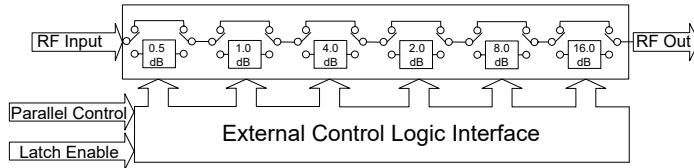
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## SIMPLIFIED SCHEMATIC



The ZX76-65G-30-E+ 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).

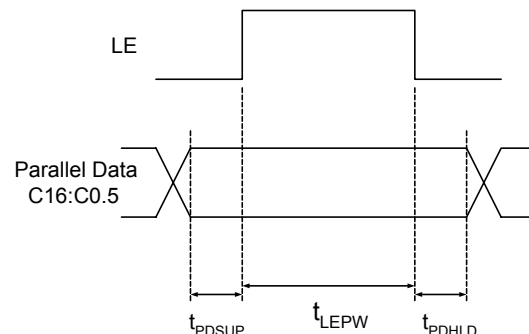
TABLE 2. PARALLEL INTERFACE AC CHARACTERISTICS

| 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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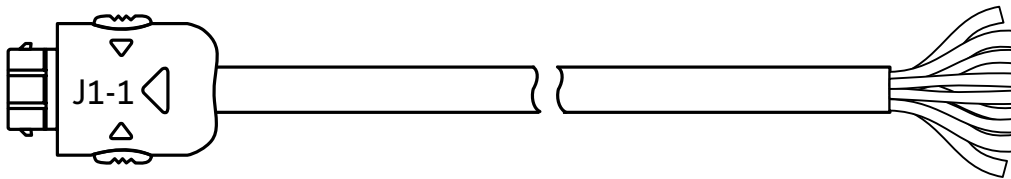
## COAXIAL SOLID STATE

# Digital Step Attenuator **ZX76-65G-30-E+**

50Ω 0 to 31.5 dB 0.5 dB Step 0.1 to 65 GHz 1.85 mm Female  
6 Bit Parallel Control Interface Dual or Single Supply Voltage

### INCLUDED ACCESSORY

CBL-5FT-MPD+ is a "Pigtail" connector included with every purchase of ZX76-65G-30-E+. 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 ZX76-65G-30-E+. These bare wires enable the customer to interface with the ZX76-65G-30-E+ (cable length is 4.9ft/ 1.5meters).



### CBL-5FT-MPD+ WIRING INFORMATION

| J1-1 Pin Number | Function        | Description                             | Wire Color   |
|-----------------|-----------------|-----------------------------------------|--------------|
| 1               | LE              | Latch Enable Input                      | Green        |
| 2               | P/S             | Latch Enable Input                      | 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 <sub>DD</sub> | Positive Supply Voltage                 | White        |
| 10              | V <sub>SS</sub> | 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 DASH BOARD

[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](http://www.minicircuits.com/terms/viewterm.html)



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