

# GigaBaudics

## 6 GHz PROGRAMMABLE DELAY LINE - MODEL PADL6



### FEATURES

- High-speed TTL programming
- 50 ohm matched I/O
- DC to 6 GHz bandwidth
- Passive switched-line delays
- Low VSWR
- 7 Bit (127 step) range
- 8 bit extended range option
- 5 ps step size
- Time or phase shifting
- Precise repeatability

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### PRODUCT DESCRIPTION

The PADL6 is a programmable delay line instrument designed for adjusting the time delay or phase of radio, microwave or even digital signals with bandwidths from DC to 6 GHz. Delays are controlled via a TTL level bus.

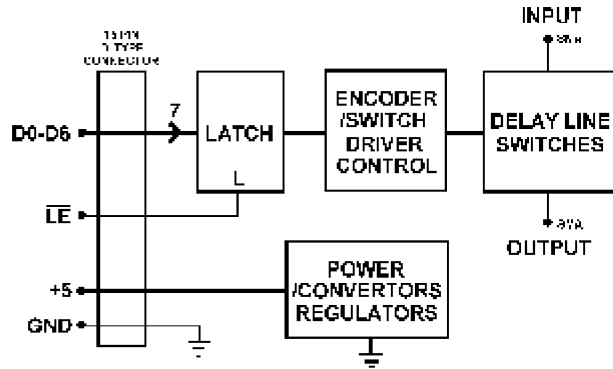
This instrument is an attractive alternative to either the manually operated, hand-cranked line stretchers which are very time consuming when delays have to be changed frequently and the servo controlled line stretchers which are expensive and wear out quickly. It also has the advantage of lower mismatch, higher bandwidth and higher range than delay lines that use lumped or distributed varactor elements.

The PADL6 programmable delay lines employ all GaAs passive microwave switched-line techniques. Lines are switched in a series configuration so that each delay occurs additively with any other switched-in delay. The signal is DC coupled therefore has no lower band limit. Since no active elements are used, input power as high as 24 dBm may be used and still yield less than 1 dB compression. The delay lines I/O provide a good match of 50 ohms relative to ground yielding a VSWR of less than 1.3 from DC to 5 GHz and less than 1.5 to 6 GHz. This enhances its usefulness in applications where the signal source and termination are not well matched. Poorly matched I/O terminations can generate reflections that may result in delay-shift aberrations when the incident signal and the reflected signal are coincident. Inputs and outputs are connected by SMA jacks. Data, control signals and power are connected by a standard 15 pin D-type subminiature connector plug.. This instrument is provided in low profile rugged aluminum housing and requires a single, low power, 5V power supply making this instrument easy to use. Internal voltages are regulated to eliminate supply noise coupling to the signal path.

Delays are controlled to precise 5 picosecond steps with a range of  $2^7-1=127$  delay steps or 635 picoseconds or with 'Option A'  $2^8-1=255$  delay steps or 1275 picoseconds . When this device is used as a programmable narrow-band phase shifter the phase shifts are proportional to

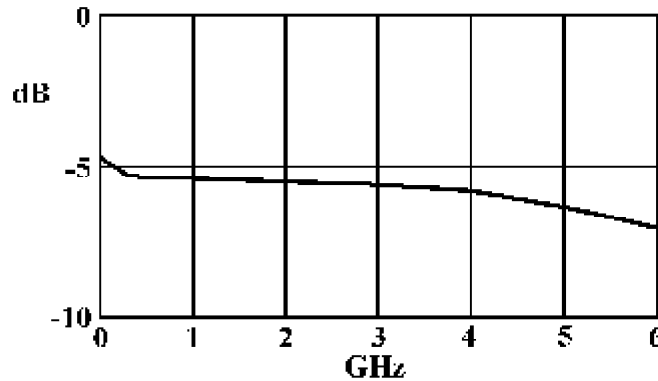
the frequency. The equivalent phase shift, per picosecond delay, is 0.36 deg./psGHz or 2.78 ps = 1 deg/GHz.. The PADL6 is calibrated to maintain a high degree of delay accuracy over the entire operating bandwidth. The accuracy is better than 1 LSB (+/-). This device has high monotonicity. The differential losses between delay elements are balanced so that the total loss does not vary widely between delay states.

### PADL6 DIAGRAM



The delay line consists of passive GaAs microwave transfer switches. The switch network series resistance losses are matched with shunt resistance to ground for improved wide-band matching.

### TRANSFER CHARACTERISTICS



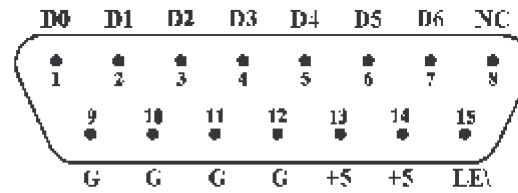
The diagram above shows the typical transfer characteristics. The differential loss between arbitrary delay states is less than  $\pm 0.3$  dB DC to 3 GHz,  $\pm 0.5$  dB from 3 to 5 GHz and  $\pm 0.8$  dB from 5 to 6 GHz.

### PROGRAMMING

Each of the 7 programming bits represents a binary number corresponding to a delay state equal to the binary number times the step size. This gives  $2^7=128$  possible combinations and a delay range equal to  $127 \times 5$ ps. The control word may be latched by using the "LE" latch line (see function diagram and pin-out diagram). The control word need not be latched if the user wishes to operate the latch transparently. Simply keep the latch line high and the delay state will follow the applied data.

### PIN DIAGRAM

- **Pin #** \_\_\_\_\_ **Function**
- 13-14 \_\_\_\_\_ +5.0V Power
- 1-7 \_\_\_\_\_ DO - D6 data, active high
- 8 \_\_\_\_\_ DNC
- 9-12 \_\_\_\_\_ Ground
- 15 \_\_\_\_\_ LE Latch line, active low



15 pin, male, D-type subminiature connector

## SPECIFICATIONS

- Bandwidth (4 dB): \_\_\_\_\_ 6.0 GHz
- Accuracy: \_\_\_\_\_ 1 LSB
- VSWR max: \_\_\_\_\_ 1.3 for DC to 5 GHz
- \_\_\_\_\_ 1.5 for 5 to 6 GHz
- Insertion loss: \_\_\_\_\_ <7 dB DC to 5 GHz
- \_\_\_\_\_ <8 dB 5 to 6 GHz
- Linearity: \_\_\_\_\_ +/-0.3 dB DC to 3 GHz
- \_\_\_\_\_ +/-0.4 dB 3 to 5 GHz
- \_\_\_\_\_ +/-0.7 dB 5 to 6 GHz
- Dispersion (1-4 GHz): \_\_\_\_\_ -0.0007 x (total delay)
- Insertion delay: \_\_\_\_\_ ~0.5 ns
- Control signal setup time for latching: \_\_\_\_\_ 1.5 ns
- Control signal hold time: \_\_\_\_\_ 4.5 ns
- Control propagation delay max.: \_\_\_\_\_ 9 ns
- Delay-state switch time: \_\_\_\_\_ 80 ns
- Input power: \_\_\_\_\_ to 20 dBm
- Supply voltage: \_\_\_\_\_ +5 (<50mV noise), <0.2 Amps
- Physical dimensions: \_\_\_\_\_ 2.72 x 1.75 x 0.6 inches (Excluding connectors)
- Outline drawing: \_\_\_\_\_ [PADL601.jpg](#)

## ABSOLUTE MAXIMUM RATINGS (beyond which damage may occur)

- Power at RF input or output: \_\_\_\_\_ 32 dBm
- DC voltage at RF input or output: \_\_\_\_\_ 8.5
- Voltage at TTL inputs: \_\_\_\_\_ -0.5 min, +7.0 max
- Supply voltage: \_\_\_\_\_ -0.5 min, +7.0 max
- Inputs and outputs are static sensitive. No warranty will be extended to damaged inputs or output drivers.

**Price:** \$ 1700 \_\_\_\_\_ Price and specifications subject to change without notice.

**Option A:** \$150 \_\_\_\_\_ Extended range, 8 bit programmable to 1275 ps with MSB on pin #8. Insertion loss increases by approximately 2 dB.

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