

GigaBaudics

6 GHz, 4 CHANNEL PROGRAMMABLE DELAY LINE - MODEL QPADL6



FEATURES

- High-speed TTL programming
- 50 ohm matched I/O
- DC to 6 GHz bandwidth
- Passive switched-line delays
- >63 dB isolation
- 7 Bit (128 step) range
- Extended range option
- 5 ps step size
- Time or phase shifting
- Precise repeatability

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PRODUCT DESCRIPTION

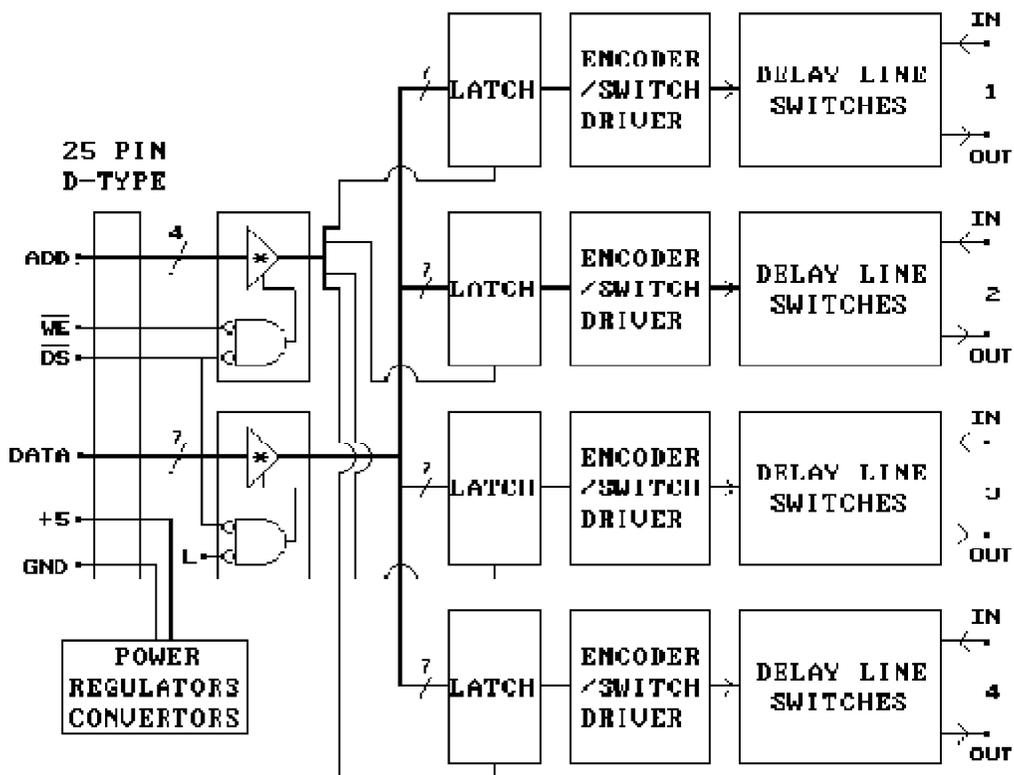
The QPADL6 is a programmable delay line instrument with 4 independent channels designed for adjusting the time delay or phase of radio, microwave or even digital signals with bandwidths from DC to 6 GHz.

This instrument can be an attractive alternative to either the manually operated, hand-cranked, line stretchers which are very time consuming when delays have to be changed frequently or 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.

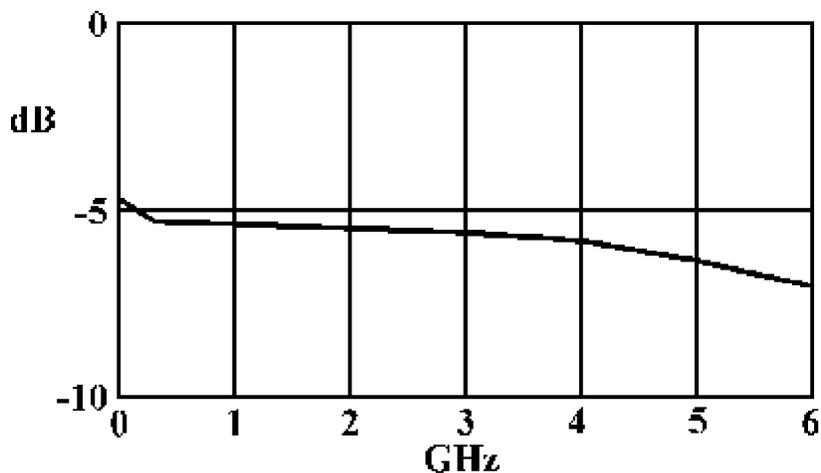
The QPADL6 programmable delay lines employ all GaAs passive microwave switched-line techniques. Lines are switched in a series configuration so that each delay occurs additively with any other switched-in delay. The signal is DC coupled therefore has no lower band limit. Since no active elements are 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 25 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' the range is $2^8-1=255$ 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 $2.78 \text{ ps} = 1 \text{ deg/GHz}$. The QPADL6 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.

QPADL6 DIAGRAM



TRANSFER CHARACTERISTICS



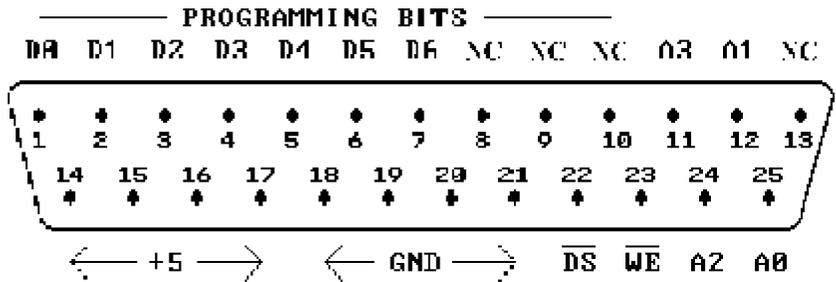
The diagram above shows the typical transfer characteristics. The differential loss between arbitrary delay states is less than $\pm 0.3 \text{ dB}$ DC to 3 GHz, $\pm 0.5 \text{ dB}$ from 3 to 5 GHz and $\pm 0.8 \text{ dB}$ from 5 to 6 GHz.

PROGRAMMING

Each of the 10 programming bits represent a binary number corresponding to a delay equal to the binary number times the step size. Each channel is addressed (selected) by a separate address line A0, A1, A2 and A3. This allows any combination of channels to be programmed simultaneously. The WE (write enable) line is activated (low) while data is valid. The DS (device select) line, active low, is useful for selecting a particular unit when more than one unit is used in conjunction. Data, address and DS should be held valid for at least 4 ns and should remain valid 3 ns after WE goes high. The control word need not be latched if the user wishes to operate the latches transparently. Simply keep the address line high, DS and WE low and the delay-state of the selected channel will follow the applied data.

PIN CONNECTIONS

- **Pin #** _____ **Function**
- 14-17 _____ +5.0V Power
- 1-7 _____ D0 - D6 respectively active high
- 8-10, 13 _____ NC
- 22 _____ DS = Device Select active low
- 23 _____ WE = Write Enable active low
- 18-21 _____ Ground
- 25 _____ A0 "1" Channel select, active high
- 12 _____ A1 "2" "
- 24 _____ A2 "3" "
- 11 _____ A3 "4" "



25 pin, male, D-type subminiature connector

Option A: \$400. 8 bit programmable to 1275 ps with MSB on pin #8. Insertion loss increases by approximately 2 dB.

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
- Isolation: _____ > 63 dB
- Control signal setup time for latching: _____ 0 ns
- Control propagation delay max.: _____ 12 ns
- Delay-state switch time: _____ 80 ns
- Input power: _____ to 20 dBm
- Supply voltage: _____ +5 (<50mV noise)
- Supply current: _____ <0.2 Amps
- Physical dimensions: _____ 3.8 x 2.75 x 0.6 inches (excluding connectors)
- Outline drawing: _____

POWER REQUIREMENTS

The QPADL6 uses a single 5V supply. The current requirement is about 100 mA but may increase up to 200 mA for rapid programming rates. Power dissipation is less than 1 watt. Internal supply voltages are regulated to eliminate supply noise coupling to the signal path. All internal voltages are generated from the single 5V supply, thereby simplifying power-up.

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: \$ 4000. _____ Price and specifications subject to change without notice.

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