

## AN33: Application Note

### Summary

Peregrine Semiconductor Application Note AN33 demonstrates socket and software compatibility of the 5 bit and 6 bit digital step attenuators products. This family offers high performance attenuation accuracy and linearity using only a single 3 volt supply.

### 1. Introduction

Typical digital step attenuators (DSA) in GaAs technology require either a single or bipolar 5 Volt supply, and either a +5 or -5 Volt control interface. Peregrine DSA's require only one +3 volt supply to deliver extremely high linearity and high accuracy. Other features include default power-up attenuation state, user selectable serial, parallel, and direct mode programming,, 3 volt CMOS interface, 50 and 75 ohm variations, and very low power consumption. This document describes forward / backward compatibility of the 5 bit and 6 bit models.

### 5 bit & 6 bit RF Digital Step Attenuator Compatibility

#### Features

- 5 & 6 bit models
- Common flexible parallel and serial programming interfaces
- Unique power-up state selection
- Positive CMOS control logic
- High attenuation accuracy and Linearity over temperature and frequency
- Very low power consumption
- Single-supply operation
- 50Ω impedance
- Packaged in a 20 Lead 4x4mm QFN

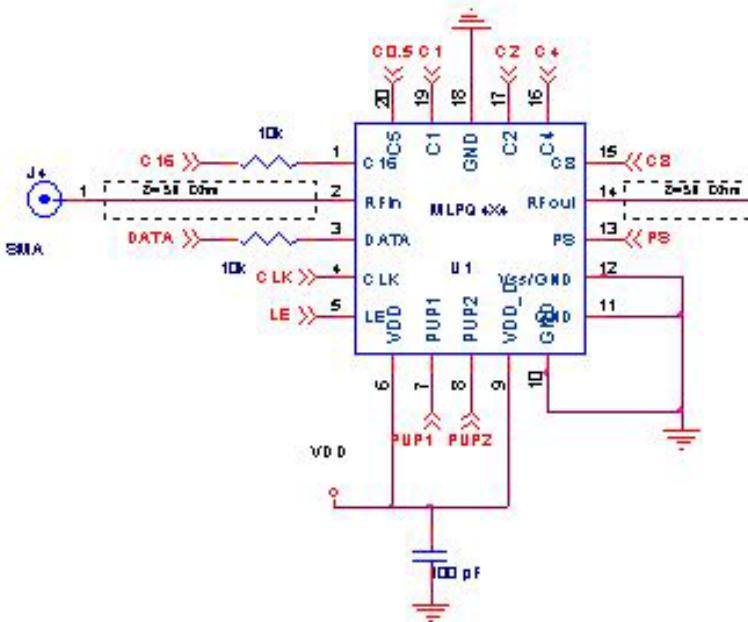


Figure 1. Typical 6 bit evaluation schematic

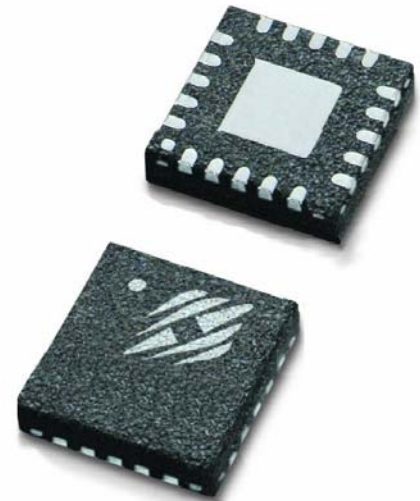
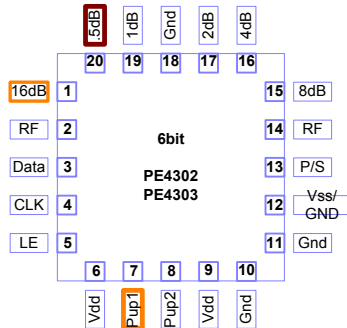


Figure 2. 20 pin / 4x4 QFN

P/S	C16	C8	C4	C2	C1	C0.5	Attenuation State
0	0	0	0	0	0	0	Reference Loss
0	0	0	0	0	0	1	0.5 dB
0	0	0	0	0	1	0	1 dB
0	0	0	0	1	0	0	2 dB
0	0	0	1	0	0	0	4 dB
0	0	1	0	0	0	0	8 dB
0	1	0	0	0	0	0	16 dB
0	1	1	1	1	1	1	31.5 dB

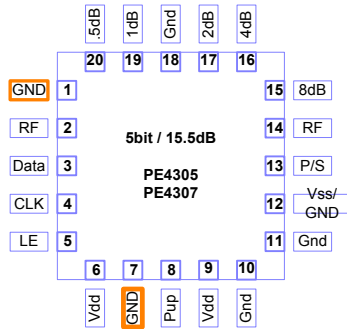
Note: Not all 64 possible combinations of C0.5-C16 are shown in



A 6 bit attenuator can be installed in a 5 bit design. The highlighted pins are different for 5 bit users as explained below.

P/S	Pin 1	C8	C4	C2	C1	C0.5	Attenuation State
0	0	0	0	0	0	0	Reference Loss
0	0	0	0	0	0	1	0.5 dB
0	0	0	0	0	1	0	1 dB
0	0	0	0	1	0	0	2 dB
0	0	0	1	0	0	0	4 dB
0	0	1	0	0	0	0	8 dB
0	0	1	1	1	1	1	15.5 dB

Note: Not all possible combinations of C0.5-C8 are shown



P/S	C16	C8	C4	C2	C1	Pin 20	Attenuation State
0	0	0	0	0	0	0	Reference Loss
0	0	0	0	0	1	0	1 dB
0	0	0	0	1	0	0	2 dB
0	0	0	1	0	0	0	4 dB
0	0	1	0	0	0	0	8 dB
0	1	0	0	0	0	0	16 dB
0	1	1	1	1	1	0	31.5 dB

Note: Not all possible combinations of C1-C16 are shown

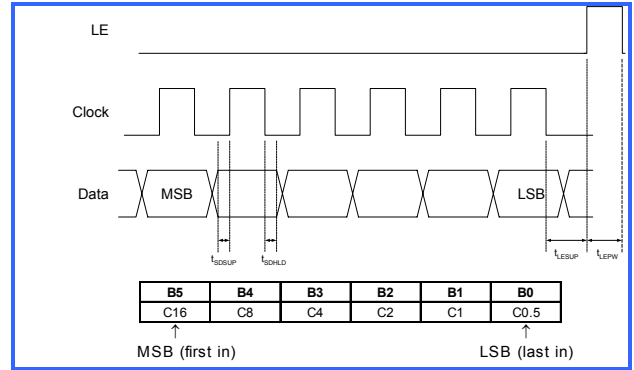
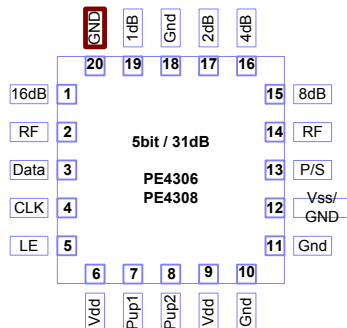


Figure 3. 6-bit 31.5 dB Serial Timing

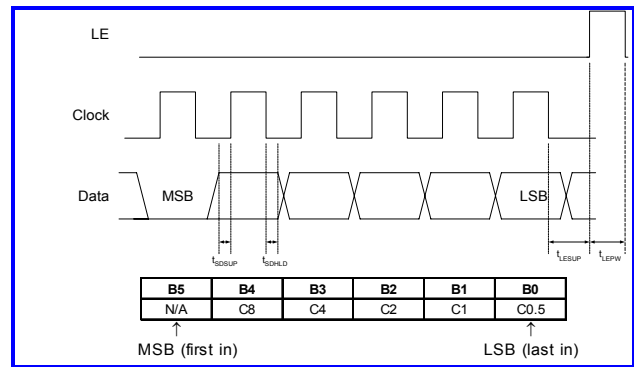


Figure 4. 5-bit 15.5 dB Serial Timing

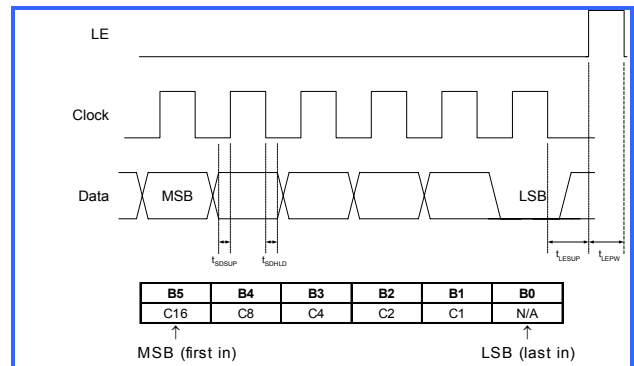


Figure 5. 5 bit 31 dB Serial Timing

## 2. Generic Hardware Design Consideration

The 5 bit and 6 bit parts share a common pinout. The only differences between the 5 and 6 bit parts are the two specific pins associated with the Direct Mode 0.5dB and 16 dB steps.

### Direct Mode

In Direct Mode the pin assigned to an unavailable step becomes a Don't Care.

5 Bit, 0.5 dB LSB      Pin 1, C16 on the 6 bit device, becomes inactive or Don't Care.  
5 Bit, 1 dB LSB        Pin 20, C0.5 on the 6 bit device, becomes inactive or Don't Care.

\*\*\*For the 6-bit part to emulate the 5-bit part, the "Don't Care" pin should be held Lo.

\*\*\*For designs that may upgrade from 5-bit to 6-bit, the "Don't Care" pins can be routed to zero ohm resistor initially hooked to ground, with provision to connect to controller.

### Serial Mode

The 5 and 6 bit parts use a common 6 bit serial word format. The first bit, the MSB, corresponds to the 16 dB step and the LSB corresponds to the 0.5 dB step.

5 Bit, 0.5 dB LSB      Device operates on either a 5 or 6 bit word. Optional 6<sup>th</sup> MSB is ignored and the state is set by the last 5 bits sent. If the designer anticipates a possible upgrade to a 6 bit, 31.5 dB part, then a 6 bit word preserves full software compatibility.

5 Bit, 1 dB LSB        Device requires 6 bit word. The 0.5 dB bit is received but ignored.

1. The 5-bit 31 dB part in **serial** mode uses a similar clock/data string. Use Figure 4, noting 6 clocks are required, and five data bits position as shown.
2. The 5-bit 31 dB part in **parallel** mode uses the table in Figure 4. Note data bit pin C0.5 is unused.
3. The 5-bit 15.5 dB part in **serial** mode uses a similar clock/data string. Use Figure 5, noting 6 clocks are required, and five data bits position as shown.
4. The 5-bit 15.5 dB part in **parallel** mode uses the table in Figure 5. Note data bit pin C16 is unused.

\*\*\* **NOTE:** Controlling the 6<sup>th</sup> bit position in a 5-bit attenuator will put the part into an unknown state.

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