Reducing Overshoot and Ripple in Arbiter Products with High Drive Outputs

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Arbiter Systems, Inc.
1324 Vendels Circle, Suite 121
Paso Robles, CA 93446 U.S.A.
(805) 237-3831, (800) 321-3831
http://www.arbiter.com
mailto: techsupport@arbiter.com

Introduction

This paper covers a method of reducing the undesired overshoot and ripple in Arbiter products with high drive outputs. The overshoot is the consequence of using semiconductors with extremely fast rise times capable of driving a lot of current to connected loads. Applying a terminating resistor reduces the overshoot somewhat, however it may not reduce the overshoot sufficiently to satisfy some sensitive equipment.

Filtering with Series Inductance

Improved low pass filtering of the unwanted overshoot and ripple can be provided by placing an inductor in series with the output. In practice, the required inductance varies from 1 to 4.7 μH depending on the load current, which is the sum of currents drawn by the connected devices. Additionally, choose an inductor that can support the current drawn by the connected loads; 500mA should be sufficient. The benefits of using an inductor are (1) no real loss of output voltage from the clock, and (2) reduced overshoot. However, the downside of using a series inductor are (1) increasing rise time with the attached inductor, and (2) the extra work required to connect an inductor to the output of the clock drive.

Test Results with Model 1094B Outputs

The test results in Table 1 below show that by using the optimum inductance, you can reduce overshoot with acceptable rise time. Inductors used had current ratings of at least 350 mA.

Inductance, μH	Load Resistance, Ohms	Ripple, Vpp	Trise, ns
0*	50	2.8	5
1	100	0.8	8
1	50	0.3	16
1	22	$\sim$0.0	52
2.2	100	0.2	18
2.2	220	0.8	14
4.7	220	0.2	18

Table 1: Measured Overshoot and Rise Time with Series Inductors

*no inductor

Adding a Series Inductor

There are two possible connector styles involved with adding a series inductor to the output of Arbiter timing products: (1) outputs with terminals, and (2) outputs with BNC connectors. Prior to actually installing a series inductor, make sure to evaluate the collective load current of the circuit. Knowing the collective load current will help you select an optimum inductor value.

If the collective load current is fairly low (e.g. less than 100 mA), it would be advisable to install a 50-ohm load at the far end of the circuit. This will further reduce any overshoot and ripple.

Connecting to Output Terminals

To add a series inductor to output terminals (see Figure 1):

1. Solder the inductor to the plus (+) wire connecting to the clock.
2. Cover joint with heat shrink tubing.
3. Insert the inductor in the plus (+) terminal on the clock and tighten.
4. Insert the negative, or return, lead into the negative terminal and tighten.

Outputs with BNC Connectors

To add a series inductor to a BNC output requires a bit more work and cost (see Figure 1). Most likely you can solder a suitable inductor into a small breakout box that has two BNC connectors. For example, see Pomona Electronics, part number 3752[1]. Note that this part has one male BNC and one female BNC.

1. Open the breakout box and solder the inductor across the two center terminals of the two BNC connectors.
2. Replace the cover to the breakout box.
3. Connect the male BNC to the BNC output on the clock, and the transmission cable to the female connector on the breakout box.

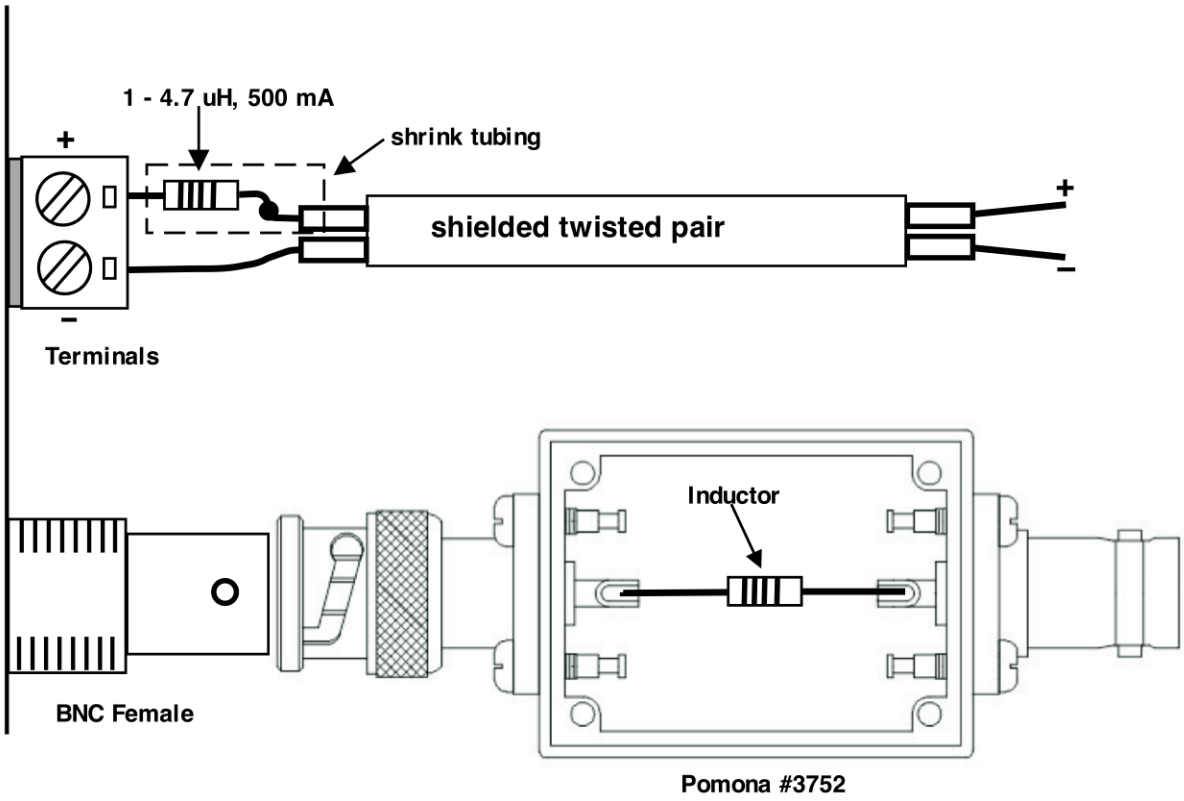

Figure 1: Connecting an Inductor to Output with Terminals & BNC Connector

[1]see http://www.pomonaelectronics.com