RFI TECHNOTE 028

BEAM LINE BLM LOG AMPLIFIER EVALUATION FOR BOONE

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INTRODUCTION

The Boone project requested a BLM with a pulse response capable of resolving losses at a 15 Hz repetition rate. They also require the dynamic range of a Log Amplifier. This is a report of tests on the Beamline BLM log amp to see if it will meet Boone's requirements or if modification are required to make it work at 15 Hz.

THE CIRCUIT AND MODIFICATION

The Beamline BLM uses a Burr Brown Log-100 chip. The full scale output of the Log amp is 10 Volts and covers 6 decades of range. The transfer function of this chip is:

$$V_{out} = K \log I_{in}/I_{ref}$$

Where $k = 1.66 V/decade$
$I_{ref} = .1 uA$
$I_{in} = 100 pA$ to $100 uA$

I tested four methods of speeding up the amp:

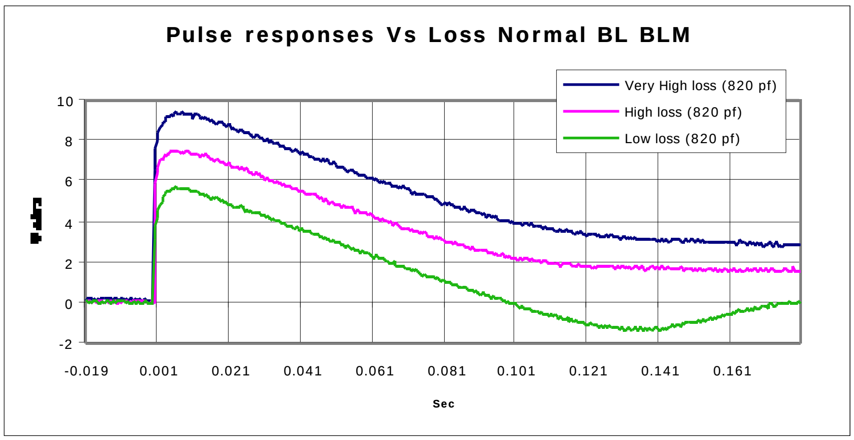
1. Increase the frequency response changing the reference current to 1.0 uA.
2. Change the frequency compensation capacitor from 820pf to 100pf
3. Decrease the input resistance from 100 k to 10k to 1k.
4. A combination of 2 and 3 with 1k and 100pf.

CONCLUSION

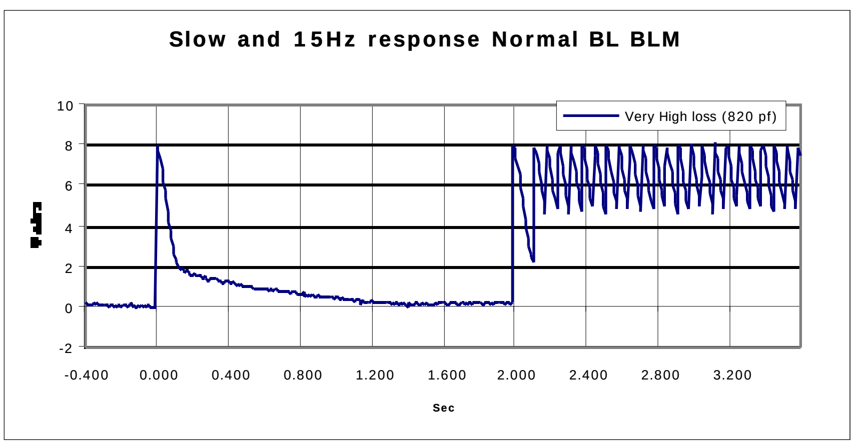
The Beamline BLM daughter card will work for Boone without any modifications. At first it appeared that the circuits inability to decay to zero between high loss pulses that occurred at a 15Hz rate was going to be a problem. Tests show that this was not so because the peak amplitude of a string of 15Hz pulses is the same as that of a single isolated pulse. Tests were conducted anyway to see if improvements could be achieved. It was found that Method 2 got the best results of the four tests. This configuration increased the frequency response but also changed the scale factor. The improvement is not worth the trouble of having two different types of cards and two sets of scale factors.

THE TEST SETUP
For these tests I simulated a beam loss by discharging a capacitor through a relay into a Beamline BLM daughter card. Values of capacitance and voltage levels were chosen to result in peak output pulses of approximately 6, 8 and 10 volts.
I first tested the modification at a repetition rate of about 2 seconds to observe the decay rates. I then tested at a 15 Hz pulse rate to simulate losses at the Booster cycle rate.

THE STARTING POINT
The response curve of a normal Beam Line BLM to various loss levels. Note the rate of decay change at .11 seconds on the higher loss traces. This is due to a characteristic of the Burr Brown Log100 chip and cannot be corrected.

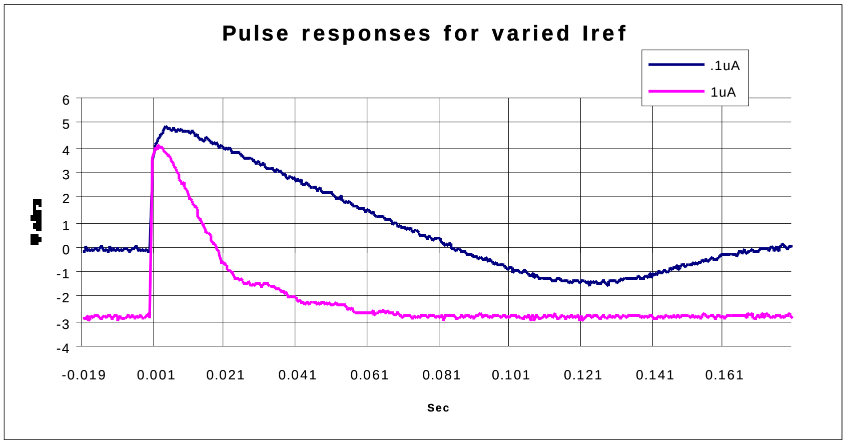


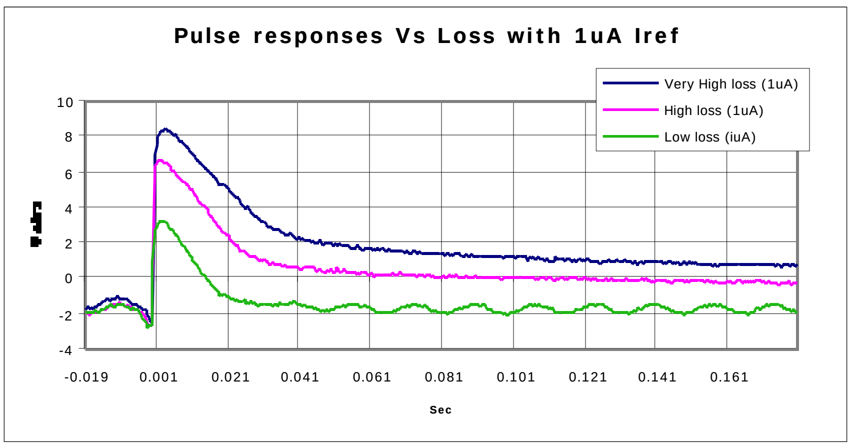
The response of an unmodified BL BLM daughter card. Note the loss level of a string of 15Hz pulses is the same as that of a single isolated pulse. This indicates that it is not necessary for the log amp to return to zero between 15 Hz cycles.



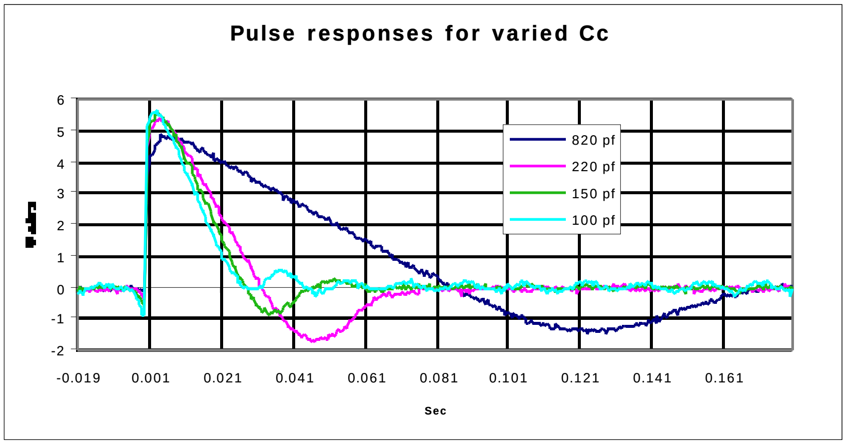
THE TEST DATA

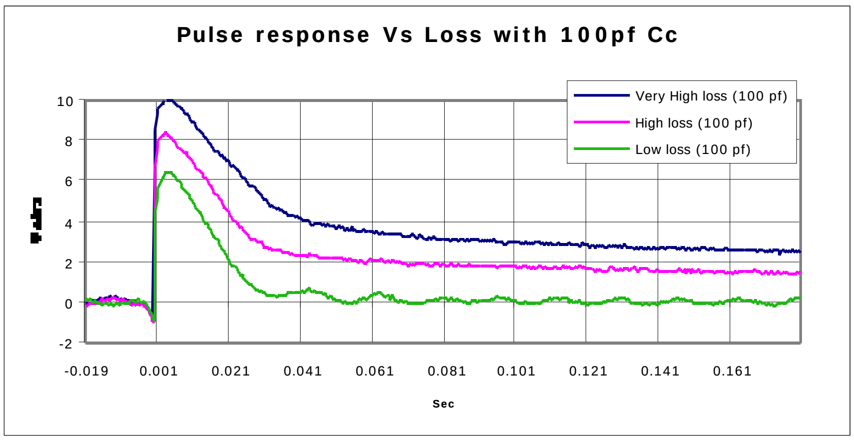
Method 1 is unacceptable because it shifts the entire curve negative and does not improve the response any better than other methods did.



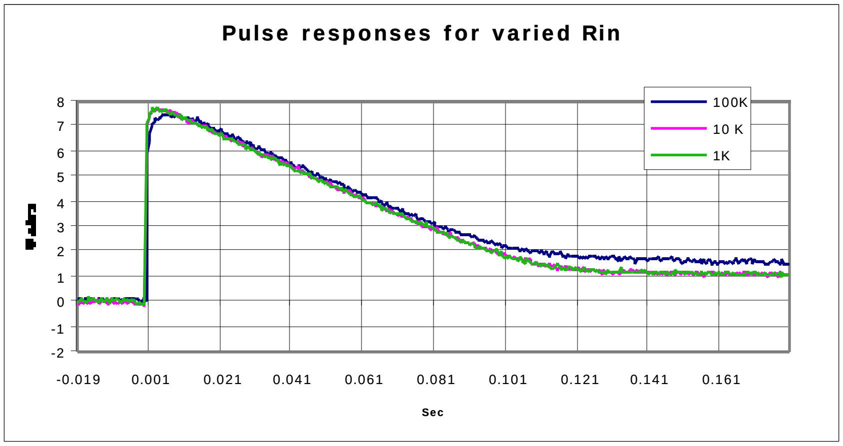


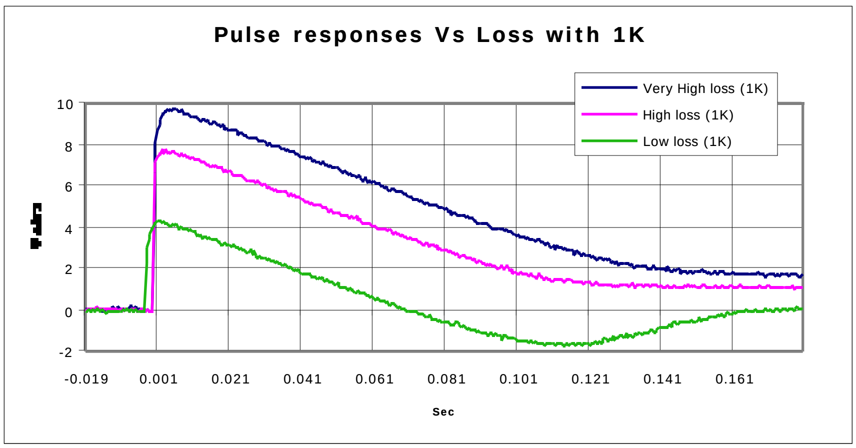
Method 2 Worked the best with a capacitance value of 100 pF. The response to low loss levels was improved but at higher loss levels the slow rate of decay was still present.



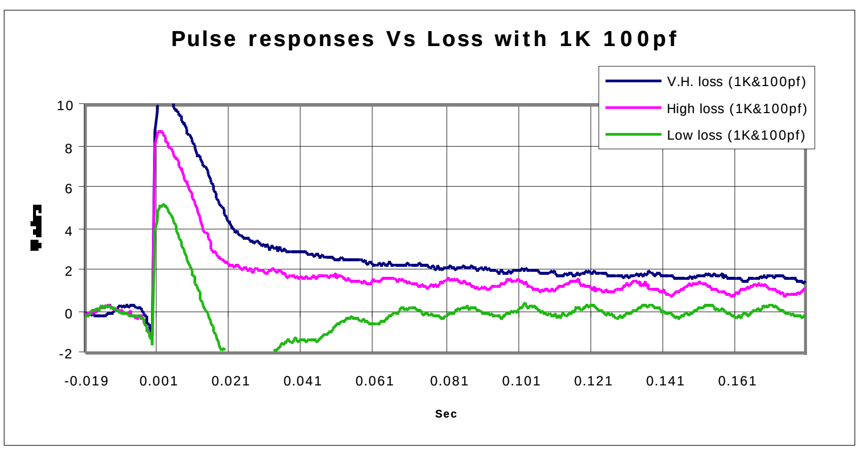


Method 3 did not increase the response at low input levels and only slightly at high levels. The slow decay rate was not improved.

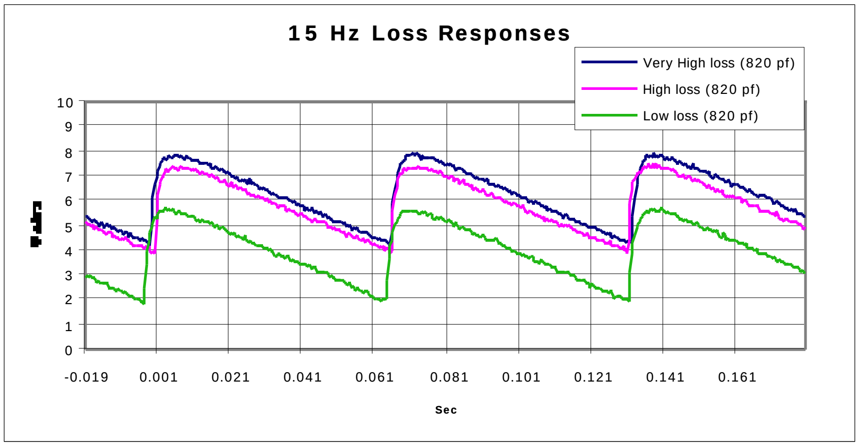




Method 4 improved the recovery the most but at low levels exhibited an undershoot. The reduced rate of decay was also present



15 Hz Response of normal BL BLM Log Amp



15 Hz response for 1K and 100 pf modification

15 Hz Response for 100 pf modification