Independent Cable NEWS
Serving Independent Cable Operating Companies
September 2006

Technology

Return Loss Revisited

By Steven K Richey, President 4Cable TV Inc.

Many of us would think that Return Loss has been visited so many times in the past that it is a subject who's time has past and everyone knows all they need to know about the subject. I certainly thought so until I happened to be a part of a discussion when the subject of Return Loss came up and much to my surprise one of the answers was "Everyone knows what Return Loss is: it is the loss between the modem and the CMTS" and so after that I decided that Return Loss should be visited once again. I would ask that all non-technical readers please copy this article and see that it gets into the hands of all of your technical people.

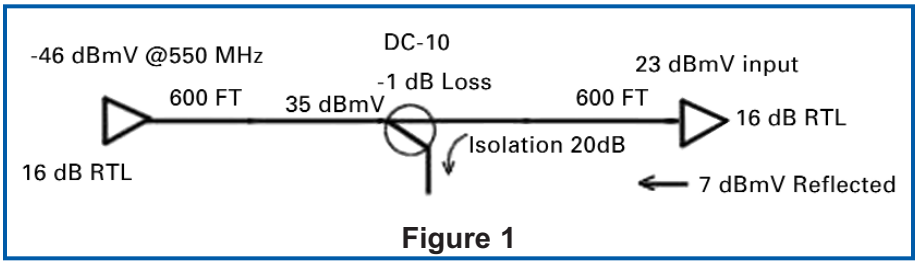

Figure 1

Analysis at 550 mHz			
Amp output level	46 dBmV	Loss	23 dB
2nd Amp input level	23 dBmV	Output level at tap	25 dBmV
In/Out Amp RTL	16 dB	Reflected signal From 2nd Amp	7 dB
Reflected signal at output of Tap	-4 dB	Tap Isolation	-20 dB
Reflected signal at Tap	-24 dB	Difference between desired signal and reflected	49 dB

Analysis at 54 mHz			
Amp output level	36 dBmV	Loss	7.5 dB
2nd Amp input level	28.5 dBmV	Output level at tap	32.75 dBmV
In/Out Amp RTL	16 dB (12 dB)	Reflected signal From 2nd Amp	12.5 dB (16.5)
Reflected signal at output of Tap	9.26 dB (13.26)	Tap Isolation	-20 dB
Reflected signal at Tap	-10.74 dB (-6.74)	Difference between desired signal and reflected	43.5 dB (39.49 dB)

When we launch a signal into a coaxial cable and the signal reaches the end of the cable it reacts in 3 absolute states. If the end of the cable is open, then 100% of the signal that reaches the end is reflected back to the source. If the end of the cable is shorted, then again 100 % of the signal is reflected back to the source. If the cable is terminated in (for 75 ohm cable) a perfect 75 ohm termination, then 0% of the signal is reflected back to the source.

Now we would characterize a 100% reflection as a return loss of 0 dB meaning that the reflected signal is attenuated by 0 dB by the state at the end of the line, and therefore all of the signal that is present at the end of the line is reflected.

We would characterize a 0% reflection as a return loss of infinite dB meaning that there is no reflected signal. In the real world this is not possible, so for this discussion we will look at a .1% reflec-

tion as about as good as you can get and that would be a return loss of 60 dB meaning that the reflected signal is 60 dB down from the signal that is at the end of the line. In other words if you measured 60 dBmV at the end of our theoretical line and you had a termination that had 60 dB return loss you would have 0 dBmV of signal reflected back towards the source.

Now that we have used over 400 words to describe Return Loss let's look at some real examples and discuss what it means in a real cable system.

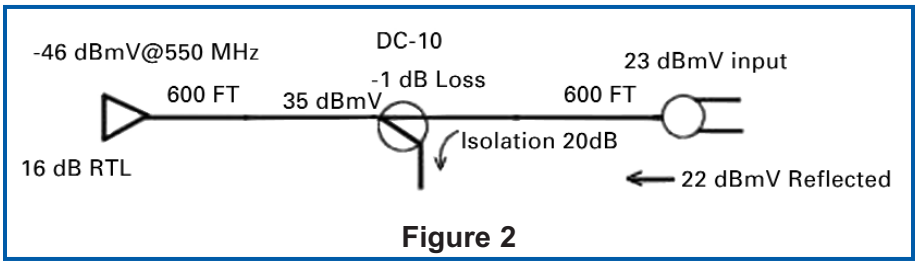

Figure 2

In a model system with two amplifiers and one directional coupler, which could also be a directional tap, we would have the system in Figure 1. We can analyze the signals in the tables above.

As we look at the charts, we quickly find that at 550 mHz the reflected signal is down 49 dB from the desired signal and is well into the non-visible range.

However when we look at the reflections at 54 mHz we find that we are only down 43.5 dB and are getting close to visible. If we go one step farther and change the spec of the amplifiers from 16 dB to 12 dB (a trend that we have noticed lately) then we would have the numbers as shown in the chart (in parentheses) and we find that our undesired signal is less that 40 dB below our desired signal and has moved into that area where it may start to become visible.

If we change the scenario a little bit, and instead of an amplifier, we put a 2 output terminating tap, which is nothing more that a two way splitter, as in Figure 2, at the end of the line and assume that neither output is terminated, either with a termination or with a customer, we get the data shown in the tables at left.

As we look at this analysis at 550 mHz we find that our reflected signal is only 34 dB down from the desired and well into the visible range — and at 54 mHz the reflected signal is only 28.49 dB down, which starts to become a major problem.

The reason I used this example is that there seems to be a common misconception out in CATV land that the termination tap is self terminating, **It is not!** I have read recently that other authors have given the un-terminated tap a RTL of 5 db which would make the above number 4 dB better but in actual test on my lab bench I found the return loss of a 4 db terminating tap to be 1 dB or less.

In this article we have only looked at the analog implications, but the problems caused in a digital signal are as bad and probably worse, with packet losses going way up because of micro-reflections.

The Bottom line is, be concerned about the return loss of you system and **terminate all your unused tap ports.**

Please remember to copy this article and see that it gets into the hands of all of your technical people. ❑

Next month we will explore Equalizers, the different methods of establishing value and the proper use of equalizers to maximize the SNR of your system.

Un-terminated 2 output terminating tap Analysis at 550 mHz

Amp output level	46 dBmV	Loss	23 dB
terminating tap input level	23 dBmV	Output level at tap	25 dBmV
RTL of terminating tap	1 dB	Reflected signal From terminating tap	22 dB
Reflected signal at output of Tap	11 dB	Tap Isolation	-20 dB
Reflected signal at Tap	-9 dB	Difference between desired signal and reflected	34 dB

Un-terminated 2 output terminating tap Analysis at 54 mHz

Amp output level	36 dBmV	Loss	7.5 dB
terminating tap input level	28.5 dBmV	Output level at tap	32.75 dBmV
RTL of terminating tap	1 dB	Reflected signal From terminating tap	27.5 dB
Reflected signal at output of Tap	24.26 dB	Tap Isolation	-20 dB
Reflected signal at Tap	4.26 dB	Difference between desired signal and reflected	28.49 dB

About The Author

Steven K. Richey, President and CEO of 4Cable TV, has over 42 years of varied CATV experience, including being in charge of repairs at a major manufacturer (Ameco) and former Chief Engineer at

CADCO. Prior to founding 4Cable TV, he was VP New Product Development at dB-tronics. He was the owner/operator of 8 CATV systems in Texas and Oklahoma, and has published over 20 technical articles. Steve can be reached at steve.richey@4cable.tv.