

**A New Form of
Compression
Connector**

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Abstract

Compression connectors have been used in various applications for more than two decades. Originally appearing in the CATV/broadband arena, they offered very rapid assembly and low cost, with simplicity and reasonable quality. Certainly, the quality was no worse than the F connectors already in use, and in some cases a significant improvement.

The speed and simplicity of a one-piece connector became the driving factor in the introduction of BNC (and other connectors) using this technology. However, compared to professional BNC's, these compression connectors were marginal at best, and were relegated to the world of analog video, where the wavelength of a video signal is so long that the connector makes little or no difference. As long as continuity was established and maintained, the actual performance was of no concern.

With the rise of HD video in the professional space, with a bandwidth exceeding 2 GHz, compression connectors easily showed their lack of performance, and were generally ignored by the professional video and broadcast communities.

What is Required?

For a BNC to be acceptable, speed and simplicity are trumped by the overriding need to perform. It should be remembered that professional video producers originate content. Therefore, they often have only one chance to "get the shot" and an installation compromised by any part that is less than perfect cannot be tolerated. Clearly, these professionals will pay extra for any part of their infrastructure which will work to a given specification, consistently, and to maintain that consistency for the life of the plant.

But this begs the question, could a one-piece compression connector be made that exhibits these qualities, consistency, high performance, reliability, and STILL offer the speed and simplicity they originally offered?

We would suggest that the answer is 'yes' and the only reason that compression connectors, specifically compression BNC's, have not been made to this level of quality is that the early attempts were killed by stories of those professionals foolhardy enough to try them. To be sure, this is an industry that thrives on shared knowledge, and once a major customer is 'bitten', the entire industry is twice shy!

Electrical Performance

Belden, the manufacture of choice for cable, has recently entered the connector manufacturing market by acquiring two companies, ICM (Denver, CO), and the Communications connector division of Thomas Et Betts (Memphis, TN). Both these brands are very familiar with one-piece compression connectors, so it was logical that Belden would seek a compression connector design that equaled or surpassed its cable specification.

For example, the installation grade precision digital video cable made by Belden, such as 1694A, 1505A, 1855A etc., have a Return Loss guarantee of no worse than -23 dB, 5 MHz to 1.6 GHz, and -21 dB from 1.6 GHz to 4.5 GHz. In the following graphs, this cable specification is indicated by a red line at those values. As far as we are aware, while other manufacturers

sometimes address Return Loss, and even give typical or nominal numbers, Belden's is still the only industry guarantee out to 4.5 GHz. This bandwidth covers not only HD, but the next step, 3G (or 1080p/60).

Clearly, if Belden brought out a line of connectors, those connectors must complement if not exceed this cable specification. To that end, we spent a number of months testing a sample of the most popular professional BNC connectors in the domestic market. Thirty of each connector were purchased on the open market, attached to Belden 1694A, and tested, each connector swept five times.

Figures A through G show the results of the Return Loss testing.

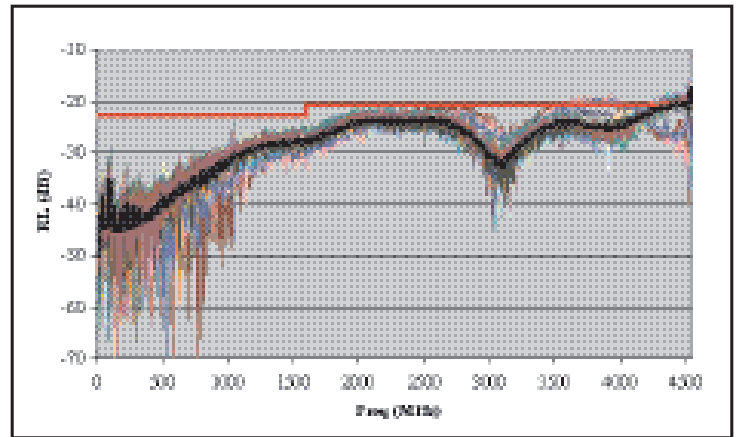


Figure A

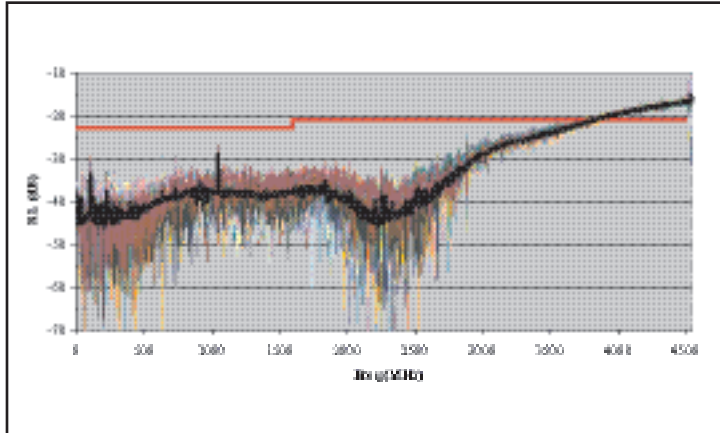


Figure B

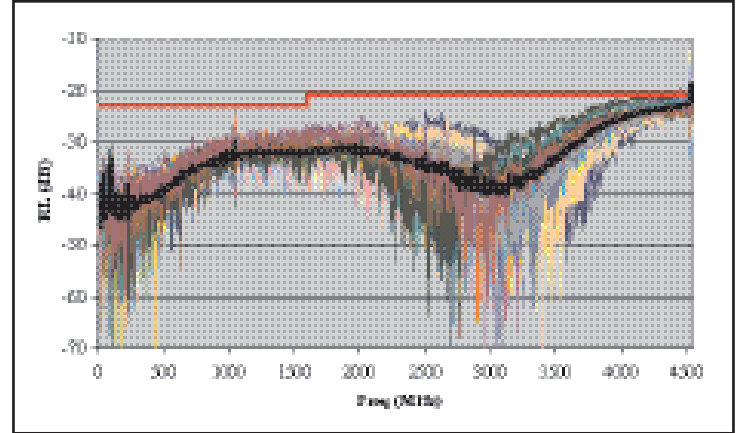


Figure C

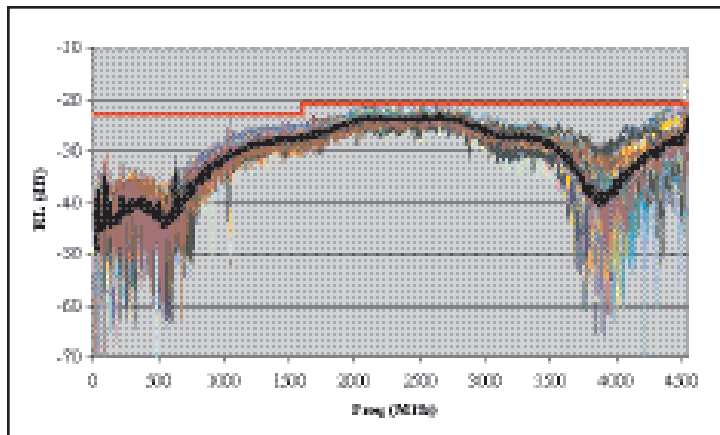


Figure D

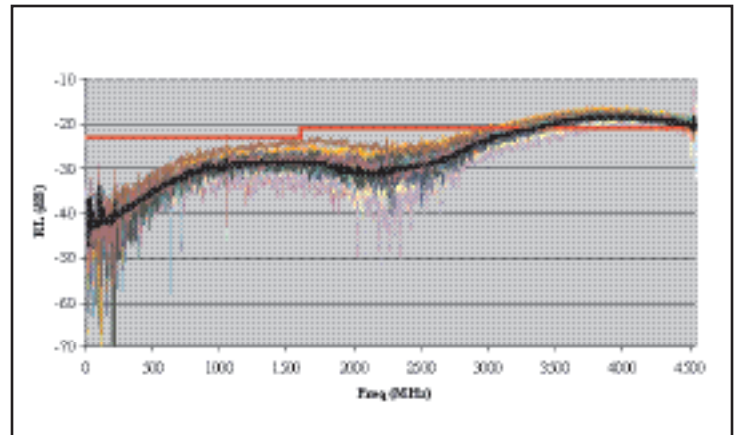


Figure E

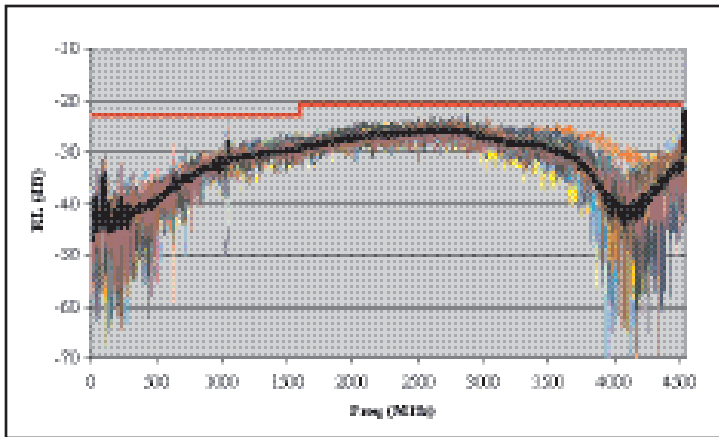


Figure F

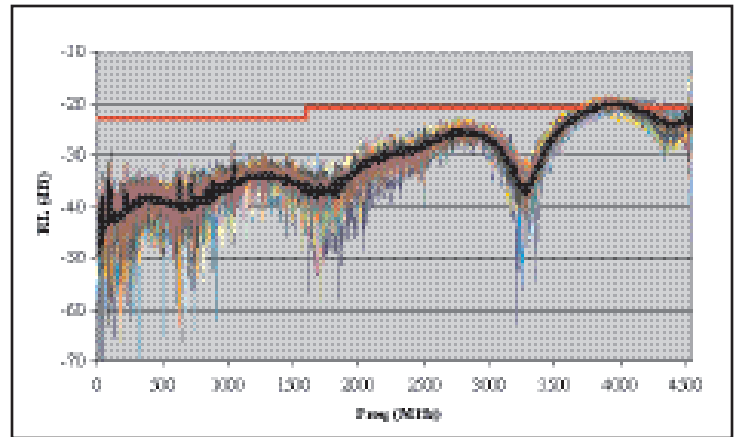


Figure G

As you can see we have not identified each one by manufacturer, and we would urge the reader to study these results with one question: two of these connectors are one-piece compression connectors. Pick out which ones you think they are.

The truth is, in the graphs above, there is not one but three different Belden connectors. Figure G is a Belden three-piece design, with a crimped center pin and a crimped collar, the common industry standard.

Figure A is a one-piece Belden compression connector, which is really the focus of this white paper.

Figure D is also a one-piece Belden compression connector, but with an added feature. The knurled ring actually is threaded and when turned, 'locks' the body of the connector together. You will note the superior return loss performance in that figure from this approach. For those interested in uncompromised performance at extremely

high frequencies, these 'locking one-piece' connectors should definitely be considered.

Pull Strength

One area where compression connectors did not fare well in the past against other types was in pull tension or pull strength, the amount of force required to pull the connector off. Most top-quality BNC's approach 70 lbs. of pull strength.

During our development, this too was tested. We were amazed that the average pull strength of the one-piece compression connector was in excess of 100 lbs. This value will change with different cables, smaller cables having smaller amounts of pull strength.

It should be noted that the maximum pull tension on 1694A, as shown on the Tech Data sheet for that cable on the Belden website, is 69 lbs. What that means is, by the time you have succeeded in pulling off the connector, you have long since

compromised the performance of the cable itself. This is true for every Belden cable-to-connector combination we have tried so far.

What is Available

As of this writing, there are compression 1-piece, locking 1-piece and standard 3-piece Belden connectors for 1694A, 1505A and 1855A, the three most popular cables in the Belden video offering. We intend to bring out connector eventually for all seven sizes, and their plenum, water-blocked and other variations.

A Cautionary Note

There are many differences between CATV/broadband coax and precision digital video coax. But one that focuses on the connector is how the foil is arranged inside each cable. In the case of CATV/broadband coax, which is intended to have connectors 'slide' onto the cable, the foil inside is bonded (i.e. glued) to the core. Then it



is a simple matter to push the connector over that foil and crimp or compress in place.

But precision digital cable is different. There the foil is not bonded to the core but is loose between the core and the braid. This is by design. The earliest prototype of digital video cable did have bonded foil, and many broadcasters protested. If the stripping was not absolutely perfect on these cables, a small strip of the core can be left hanging. With bonded foil, this strip is conductive and can easily short out the BNC connector when it is attached. So the foil is purposely nonbonded in these cables.

This simply means, when a connector is pushed onto the cable, as these compression connectors are intended to do, one must make sure that the foil is flat against the cable before insertion. It is quite possible, if this step is not taken, that the foil will 'bunch up' inside the cable and the center pin will not fully extend and lock in the

front of the cable. Once a few connectors have been attempted, a simple twist with the fingers on the foil will assure that the foil lies flat and will allow perfect seating of the connector.

We intend to bring out BNC connectors for all six cables in the precision digital video line (179DT, 1855A, 1505A, 1694A, 1794A, 7731A) together with their flexible, plenum, water-blocked, shipboard, dual-link, multicore bundled and other variations.

Conclusion

It is Belden's belief that compression connector technology has reached a level of performance where these connectors can now compete with any BNC and offer the Broadcast market consistency,

quality, performance, reliability and significant cost advantages through labor-saving during installation.

Author

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