

# ATX LABS TECH BRIEF

## Modularity in Cable Assembly Produces a Sustainable Product with less E-Waste and Longer Operational Life

There are waste management benefits to sustainable test cable assemblies at the work bench, plus distinct cost and time savings, relative to assemblies without sustainable properties

The world wide market for microwave cable assemblies is a 120 billion dollar market that throws off considerable e-waste. According to *The Global E-waste Monitor* of the Institute for the Advanced Study of Sustainability, a component of United Nations University, while the global population from 2010 to 2018 grew by an estimated 10% to 7.4 billion inhabitants, the scale of e-waste grew by 47% from 34 billion metric tons to 50 billion metric tons. This is a staggering problem requiring sustained, serious redress.

Exacerbating the problem is an industry bias that only grows worse as the drive for profit eclipses prudent waste management. In the November 2017 edition of *Spectrum*, the journal of the IEEE and a popular voice of engineers world wide, Kyle Wiens and Gay Gordon-Byne observe in an article entitled *The Fight To Fix It* that "manufacturers would prefer to sell you their latest models rather than repair your old electronics, so they work to make fixing products too expensive or too impractical." Exemplary of this view, they report John Deere asserted that farmers – after buying a \$75,000 tractor – have only "an implied license for the life of a vehicle to operate the vehicle"- suggesting that repair is only the right of the company. Multiply this disposition by the scale of the global electronics industry, and you get a sense of the magnitude of the entrenched resistance to repair in favor of the greater rewards of replacement.

Velocity Microwave, a division of ATX Labs in Vineyard Haven Massachusetts, is addressing a subset of the e-waste problem relating to the manufacture of microwave cable assemblies for test and measurement by developing a *sustainable assembly architecture* that encourages material husbandry to achieve a small e-waste footprint. Velocity Microwave is attempting to reverse the trend of current manufacturers of cable assemblies who favor *replacement over*

*repair* as the primary vehicle for addressing cable failure – an approach especially problematic since a cable assembly consists of sub-components that do not age along a similar time line – therefore encouraging the disposal of the ensemble for the sake of a failing part.

The first step in sustainable cable design is on the level of appetite rather than intellect in the following sense: first there needs to be the will to create assemblies that have enduring properties, and only after the commitment has been made to concept can one begin exploring the nature of materials and assembly techniques that can create a system which is sustainable over time – a property that in turn chips away at the growing e-waste epidemic.

Velocity Microwave has developed a sustainable cable assembly built on what it calls a *canonical form* that is unique to all versions of an assembly up to 70 GHz. It is a framework that underlies all assemblies no matter how advanced they may appear.

Since all microwave cable assemblies consist of at least a *connector* and a *transmission line*, along with some *means to protect* the vulnerable union of the two – any sustainable solution must be based on a relatively straightforward way to uncouple the basic components for repair or even scaling (in the latter case to meet a new requirement for a different connector). Velocity Microwave's *canonical form* achieves that by building a *modular geometry* that can be decomposed into basic elements. No matter how complex the assembly, even one designed to meet demanding stability constraints relative to phase, amplitude and temperature, the *canonical form* can always be decomposed for sustainability and repair over time.

Further, a more complex

geometry can be built on top of the basic canonical form – thereby meeting additional mechanical needs with the robust addition of gripping features having different size, shape and material properties. Gripping features may even be given the ability to put a torquing load on the internal connector's threaded mating system to the transmission line, thereby enabling the separation or union of the two in the field or at the factory.

Transmission lines are almost universally coaxial cables based on an outer and inner conductor that range in cost from a few dollars per foot to over a hundred per foot for extremely stable constructions related to mechanical and electrical performance. Microwave connectors, commonly one of a number of species in the microwave industry referred to as SMA, 2.92mm, 3.5mm, 1.85mm, 2.4mm and Type N (where the number is the internal diameter of the outer coaxial body) range in cost from modest figures to far greater cost for precision connectors built to standards like laboratory grade IEEE287LPC. Velocity Microwave's modular geometry makes the connector and coaxial line separable with relative ease.

Given the *nonuniform nature of aging*, if a cable can be repaired by replacing a connector or a transmission line, that not only has cost/benefit implications when averaged over time, but also the obvious husbandry and waste implications. With regard to scaling, if an end user has a cable assembly dedicated to a particular need for specific connectors – and that need changes to meet a new requirement for different connectors – scaling between species of connectors on the *same transmission line* is facilitated by Velocity Microwave's *modular geometry*, and this too has obvious cost implications as well implications that encourage a more constrained e-waste footprint.

To meet the criteria for classification as a sustainable product, a

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system must be comprised of modular components and possess relative ease of decomposition for the purpose of repair or scaling. Only in this way can materials be husbanded, leaving a constrained and well managed waste footprint. As long as electrical performance is not sacrificed, and there exists no substantial cost penalty, a sustainable product will always yield a net benefit over time both operationally and environmentally.

Velocity Microwave is currently manufacturing a full line of sustainable assemblies up to 67 GHz that directly address the e-waste problem through careful husbandry and wear management.

*This work was done by Victor R. Spelman and Emily Milstein of ATX Labs, Vineyard Haven Massachusetts.*