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Maximizing Baseband Modem Communication Distance is a Marriage of Art and Science

*How Do Patton's Engineers Coax Every Possible Meter out of the Patton Model 1090
KiloModem PS?*

by Jim Fowler, Patton Electronics Company

Designing a successful baseband modem is quite a challenge. It must be able to operate at a variety of data rates, over a variety of distances, and be able to use several different gauges of wire. Furthermore, in each application a successful baseband modem must support error-free communication at the greatest distance possible. The design engineers at Patton Electronics Company (Gaithersburg, MD, USA) have met this challenge with the Patton Model 1090 *KiloModem PS*TM. The Patton Model 1090 supports point-to-point synchronous communication over two twisted pair wires in gauges ranging from .4mm to .7mm. Supported distances range from 4.9 km at 160 kbps using .4mm twisted pair all the way up to 17.8 km at 56 kbps using .7mm twisted pair. How do Patton engineers achieve these results without using extra signal boosters or line drivers along the way?

A Little Brain, a Little Heart

According to Patton senior design engineer Vladimir Herman, "We add a little bit of our brain and a little bit of our heart... analog design is *art*." A less philosophical engineer might have said that designing the Model 1090 blended a little intuition with a lot of painstaking *calculation*. However it is described, the process involved attaining the maximum signal amplification, with the minimum noise, at all frequencies, distances and wire gauges. The difficulty in broadband communication (the type employed by the Patton Model 1090) is in that all frequencies in the communication spectrum must be treated differently—*simultaneously*—in order to achieve maximum distance. How did Patton accomplish this feat?

Three Different Circuits

Without divulging anything of a proprietary nature, we can say that Patton's engineers have used three types of special circuits to achieve the Model 1090's remarkable distance specifications. The first special circuit is an impedance matching circuit. This circuit matches the impedance properly between the transmitter and the twisted pair, as well as the receiver and the twisted pair, for each frequency band. Every time the quality, distance and gauge of wire is altered, this special circuit compensates for it. The second special circuit reduces the Model 1090's signal-to-noise ratio. In order to achieve great distances the signal must be amplified great-

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ly. But if the noise is amplified too much along with the signal, communication-garbling errors result. The Model 1090's noise reduction circuit lowers the "floor" of the noise level, effectively raising the "ceiling" so that there is more "headroom" for signal amplification. It performs roughly the same function for the Model 1090 that a Dolby™ or DBX™ noise reduction circuit performs for a home stereo system. The third special circuit used in the Model 1090 is an auto-equalization circuit. This circuit also operates in a way that home stereo enthusiasts would recognize. Audio enthusiasts know that it takes a lot more power to amplify a low frequency to a particular decibel level than it does for a high frequency. The same is true in broadband communication. The Model 1090's auto-equalization circuit adjusts the level of signal amplification (dynamically) to match the frequency being amplified. The result is a more uniform signal across the frequency spectrum., which helps maximize distance.

Conclusion

Combining impedance matching, noise reduction and auto-equalization circuits (along with a more than a little "art"), Patton's design engineers have given the Patton Model 1090 some impressive speed and distance capabilities. What this means to end users of datacom and telecom equipment is that the Patton Model 1090 base-band modem can provide *reliable* communication at high data rates/distances not normally associated with *affordable* "short range" solutions.

About Patton

Patton Electronics Company is a leading US manufacturer and marketer of data communications equipment, including last mile access products, remote access products, short range modems, interface converters and network surge protectors. Patton products are available through a worldwide network of Authorized Patton Distributors, as well as through Patton's own Datacom *Direct* Catalog.

The Patton Electronics Web site (www.patton.com) features product information, technical documentation and articles covering many facets of data communications. Patton Electronics is an ISO 9001 certified and BABT approved manufacturer. Patton products are CE marked for sale in EC member countries. For more information or a free data communications catalog, please contact Patton Electronics Company, 7622 Rickenbacker Drive, Gaithersburg, MD, 20879, USA. Phone (301) 975-1000. Fax (301) 869-9293. Email sales@patton.com. World Wide Web <http://www.patton.com>.

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