STANAG 7221 Physical Media Interfaces

Transmission Over Coax Cable

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EDGEWATER COMPUTER SYSTEMS, INC

Overview

STANAG 7221 Annex A describes transmission over 78 ohm shielded twisted pair (STP) wiring infrastructure.

The basic characteristics of this physical layer are:

- Bandwidth 25-65 MHz
- Differential signal
- High impedance presented at the sub-1MHz STANAG 3838 baseband frequencies
- Linear multi-drop network topology

A special purpose built Analog Front End (AFE) can be used for communication over single ended coax (centre conductor plus shield) rather than 78 ohm STP by using a Balun to convert the balanced differential signal to unbalanced.

Physical Layer Interface Solutions

There are two possible solutions for using the Edgewater Computer Systems, Inc. (ECSI) STANAG 7221-compliant product with a single ended (unbalanced) coax physical media:

1. Custom design an unbalanced input AFE
2. Use a balanced to unbalanced convertor (Balun)

In the interests of demonstration and expediency only the second solution was tested.

It should be noted that as the ECSI STANAG 7221-compliant product is designed to operate on a multi-drop network, it compensates for the frequency varying characteristics of the physical channel. The interface impedance varies with frequency, so interfacing to a non-matching impedance bus is not an impediment to proper operation.

Coax in Relation to MIL-STD-1760

An example of coax wiring infrastructure can be found on MIL-STD-1760 buses. There are two interfaces defined for coax: HB1 and HB3. HB1 is 50 ohm coax, and HB3 is 75 ohm coax.

For this test it is assumed that there are no other signals present on the coax during STANAG 7221 operation.

Results

Various test scenarios were run with different coax setups. All setups utilised an ECSI STANAG 7221-compliant Test Set with a 75 ohm balanced to 50 ohm unbalanced Balun at each end interfacing to either end of the coax. There were no other connections to the coax bus (i.e. it was configured point to point). The Baluns used were North Hills NH16251 devices which have a specified bandwidth of 30 KHz to 200 MHz.

The transmit power level of the STANAG 7221 terminal was set to the nominal value of 18 for short buses, and the lowest level of 0 for the longest buses to ensure there was “margin” for both combinations.

No transmission errors were observed, and the results exceeded the STANAG Bit Error Rate (BER) requirement. In all test cases the ECSI STANAG 7221-compliant Test Set operated at the maximum PHY rate possible of 100.6 Mbps.

Table 1: STANAG 7221 Over Coax Test Results

Coax Type	Nominal Impedance (ohms)	Length (ft / m)	TXREL Setting / Tx Power (dBm)	Baseband Signal	BER 10E-12 Test	Min. Test PHY rate (Mbps)
RG-58A/U	50	150 ft / 45.7m	18 / +14 dBm	None	Pass	100.6
RG-58C/U	50	446 ft / 136m)	18 / +14 dBm	None	Pass	100.6
RG-58A/U & RG-58C/U	50	596 ft / 181.7m	0 / -4 dBm	None	Pass	100.6
RG-59	75	80.1 ft / 24.4m	18 / +14 dBm	None	Pass	100.6

Summary

Test Summary

The ECSI STANAG 7221-compliant Test Sets were interfaced to both 50 and 75 ohm coax wiring infrastructure, with no baseband signals present. Extended tests were performed at higher and lower power levels to ensure that the STANAG 7221 10e-12 BER requirement was met. Zero errors were observed on all test runs.

Further Work

Signalling Coexistence

For further testing on coax wiring infrastructure it may be interesting to introduce possible coexisting and interfering signals on the coax wire. Good examples can be found in the MIL-STD-1760 world – the defined Type A and Type B signals. The stated characteristics of these signals sources are:

Type A

- 20 Hz to 20 MHz
- 1.3 Vpp within the range of +/- 1.55V steady state
- 14 dB/Octave PSD roll-off above 20 MHz, to 200 MHz

An example of a Type A signal is baseband video signal as defined by STANAG 3350 Class A. This standard is based on the RS-343 signalling, being 825 line analogue video with a 60 Hz rate and having a DC to 20 MHz maximum bandwidth requirement.

This band is just below the 25 MHz lower band edge of STANAG 7221 Annex A signal, and if it is properly bandlimited in a deployed system the two should coexist.

Type B

- 20 MHz to 1.6 GHz
- -20 dBm RMS Peak envelop power. Over all signals present

An example of a Type B signal would be a GPS RF signal. These can be very low amplitude signals in the 1.1 to 1.6 GHz band. As such the GPS and STANAG 7221 signalling are well separated in frequency and therefore would be expected to coexist.

There may also be other unknown interferers in a deployed system at lower frequencies that could co-interfere with STANAG 7221. System level analysis to identify any other potential interferers would be recommended.

STANAG 7221 Baseband Annex

If there is physical media that contains no baseband signalling, then moving the STANAG 7221 signal from the Annex A bandwidth of 25-65 MHz down to a baseband of 0-40 MHz is a viable system solution. This could be defined in a new STANAG 7221 annex. Further discussion of this option is beyond the scope of this white paper.