IEEE 802.3cy Greater than 10 Gb/s Electrical Automotive Ethernet TF

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EMC Ingress Into Shielded Connection Systems

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APTIV

Disclaimers

- Only One;
  - Lab.
  - Test.
  - Sample.
  - Test Method.
  - Operator.
  - Set Of Measurements.
- Only Performed Repeatability Of The Measurements Over 10-Day period Of Specific Setup, Need Tear Down And Setup.
- Only Measured A Prototype In Line As Example (this part not rated to 6 GHz; measured As & Ac to 6 GHz).

Bottom Line: We Need More Measurements

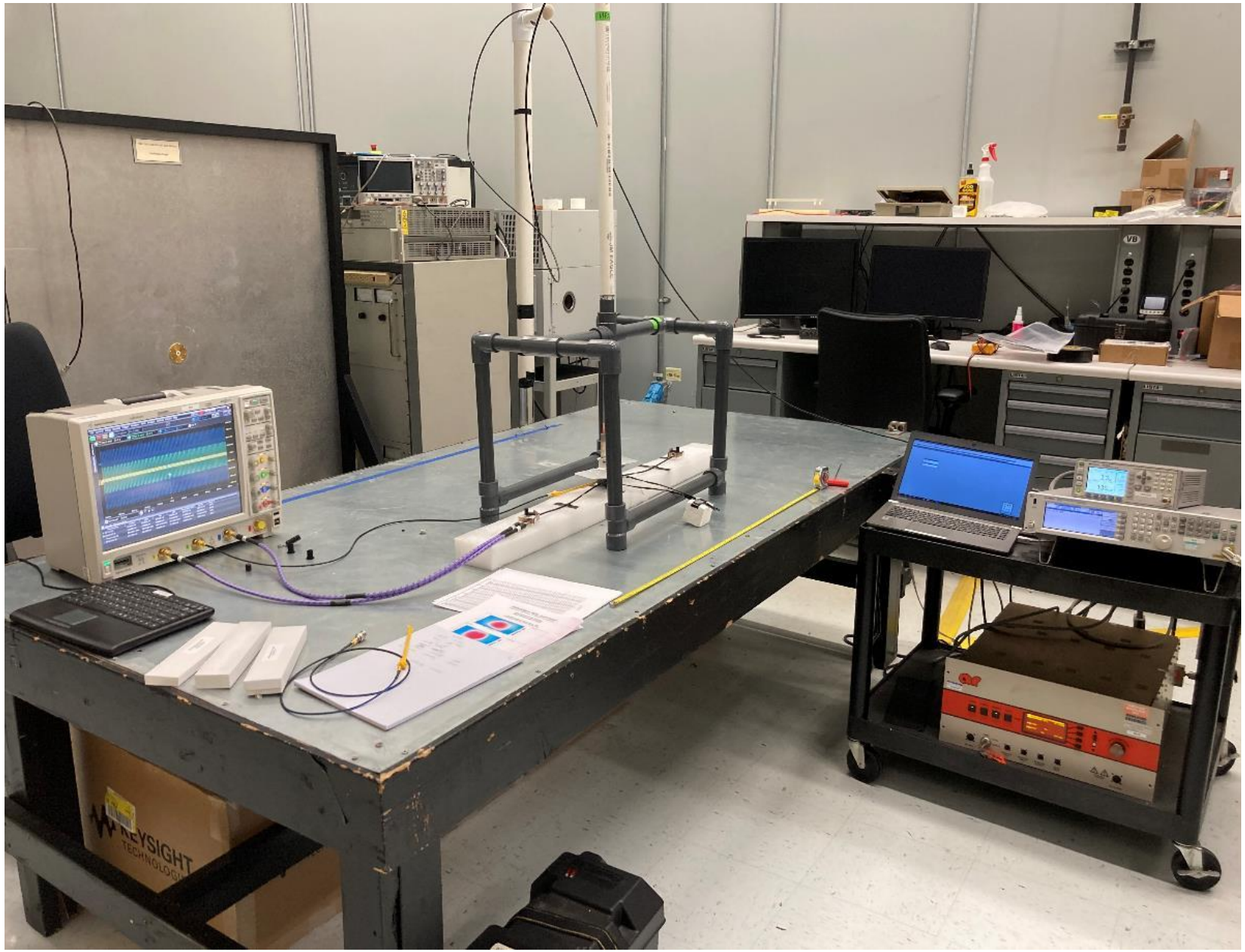
Motivation

- Correlate automotive shield performance results (e.g. IEC62153-4-7) of shielded connection systems to automotive immunity testing.
- Determine voltages coupled into the system during testing.
- Improve EMC performance of high speed data comm. in vehicles.
- Understand more about immunity into high speed diff. pairs.
- Help in determining necessary SNR for 802.3cy.
- Better understand the effects of coupling attenuation (Ac) and shielding attenuation (As) during RI testing.
- Assist in the determination of needed shield performance for 802.3cy.

Details of the Testing

- Frequency range of interest focused on 500 MHz to 3 GHz.
- In line connector measured before RI test as;
  - Coupling Attenuation (Ac) of -65 dB @ 900 MHz; -50 dB @ 2.6 GHz
  - Shielding Attenuation (As) of -40 dB @ 900 MHz; -28 dB @ 2.6 GHz
- Typical automotive OEM requirements for;
  - Net power levels for the maximum immunity levels.
  - Antenna spacing of antenna (50 mm).
  - Test methodologies to determine max. ingress.
  - In line would not be tested; only modules (header conn.). Chose to start with in line as more controlled and this was just measured for Ac & As.
- Tested shielded differential pairs.
- 20 Gsa/s, 4 GHz DSA. Note: 80 Gsa/s, 16 GHz Digital Signal Analyzer out for cal.

Test Setup (Only One Amp Shown)



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Summary of Data Gathered

- For 900 MHz band;
  - Differential mode = 9 mV_{rms} (-41 dBV)
  - Common mode = 154 mV_{rms} (-16 dBV)
- For the 2.6 GHz band (P_{NET} is -14 dB from 900 MHz band);
  - Differential mode = 11 mV_{rms} (-39 dBV) (** +15 dB)
  - Common mode = 126 mV_{rms} (-18 dBV) (** +12 dB)
- Verified dB relationship of P_{NET} and ingress voltage such that a 1 dB increase in net power yields 1 dB increase in ingress voltage.
- Relationship between that the Ac and As was consistentent with shield performance measurements.
- Do not have the why (*Yet*) of the As to ingress.

** Note: On Slide 4, Ac and As both worse at 2.6 GHz.

Data Calculated to 802.3ch In Line

- 802.3ch has;
  - Ac = -68.4 dB @ 900 MHz; -59.2 dB @ 2.6 GHz
  - As = -45 dB 30 MHz to 4 GHz
- Calculate improvement in dB from slide 4;
  - Ac = -3.4 dB @ 900 MHz; -9.2 dB @ 2.6 GHz (slide4; -65 dB @ 900 MHz; -50 dB @ 2.6 GHz)
  - As = -5 dB @ 900 MHz; -17 dB @ 2.6 GHz (slide4; -40 dB @ 900 MHz; -28 dB @ 2.6 GHz)
- For 900 MHz band then would yield;
  - Differential mode = 6 mV_{rms} (-39 dBV - 3.4 dB = -44.4 dBV)
  - Common mode = 89 mV_{rms} (-16 dBV - 5 dB = -21 dBV)
- For the 2.6 GHz band then would yield (P_{NET} is -14 dB from 900 MHz band);
  - Differential mode = 3.8 mV_{rms} (-39 dBV - 9.2 dB = -48.4 dBV)
  - Common mode = 17.8 mV_{rms} (-18 dBV - 17 dB = -35 dBV)

Next Steps

- *Is this type of information useful for 802.3cy? If yes then;*

- Need some 3D EM modeling performed.
- Repeat with test setup tear down of setup and different operators.
- Test;
  - to 6 GHz.
  - header rated for higher data rates.
  - headers with higher As and Ac more comparable to 802.3ch.
  - with different antennas.
  - with different method, ISO 11452-2 and reverb.
- Use higher sampling & BW DSA in order to properly analyze >3 GHz.
- Try a pattern generator as simulation of a source.