STP cable in automotive environment

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1. About in-vehicle influence

2. NGAUTO current situation

3. STP cable
   ◆ In-vehicle influence
   ◆ Degradation of the transmission characteristics
   ◆ Structure and transmission characteristics more than 1 GHz

4. Summary

STP : Shielded Twisted Pair
1. About in-vehicle influence

- **Vehicle environment**
  - High temp. atmos. 105 °C
  - Low temp. atmos. -40 °C
  - High humidity atmos.
  - Life time etc.

- **W/H assembling and vehicle installation**
  - Tensile
  - Bending
  - Wire band etc.

Vehicle environment, W/H assembling and vehicles installation affect to transmission characteristics
2. NGAUTO current situation

- Initial data of components such as connector and cable are used.

- Link segment configuration

- PHY makers run simulation to decide what modulation should be used?

PAM-8 or PAM-16
2. NGAUTO current situation

- Running simulation using the initial data of components
  
  Considering the in-vehicle influence below
  - Vehicle environment
  - W/H assembling and vehicle installation

- Investigated link segment may not work in automotive environment

  As the result of simulation, eye pattern doesn’t open

Figure 8: PAM-16 eye pattern image
### 3. STP cable

**In-vehicle influence**

#### Insertion loss

Graph 1: Insertion loss

<table>
<thead>
<tr>
<th>Test item</th>
<th>Test description</th>
<th>Tough level</th>
</tr>
</thead>
<tbody>
<tr>
<td>High temp. atmos.</td>
<td>Measurement of transmission characteristic in 105 °C atmos.</td>
<td>✔️ ✔️</td>
</tr>
<tr>
<td>Low temp. atmos.</td>
<td>Measurement transmission characteristic in -40 °C atmos.</td>
<td></td>
</tr>
<tr>
<td>High temp. and high humidity atmos.</td>
<td>Measurement transmission characteristic in 85 °C, 85%</td>
<td></td>
</tr>
<tr>
<td>High temp. storage</td>
<td>Measurement transmission characteristic After 100°C, 3000 h aging</td>
<td>✔️</td>
</tr>
<tr>
<td>Tensile</td>
<td>Measure transmission characteristic with 100 N pulled</td>
<td></td>
</tr>
<tr>
<td>Bending</td>
<td>Measurement transmission characteristic with R = 5 times of wire diameter</td>
<td></td>
</tr>
<tr>
<td>Wire band</td>
<td>Measurement transmission characteristic with wire band</td>
<td></td>
</tr>
</tbody>
</table>

Tough levels:
- ✔️ Toughest
- ✔️ ✔️ Second Toughest
3. STP cable
◆ Degradation of transmission characteristics

STP cable is designed taking into consideration the degradation of transmission characteristics due to the influence of in-vehicle factors. The degradation of the transmission characteristics is assumed in the actual vehicles. Therefore, it is necessary to use cable data in consideration of the degradation in the simulation.

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3. STP cable
- Structure and transmission characteristics more than 1GHz

Cable structure

- Inner conductor (0.13sq)
- Insulation
- Outer conductor
- Sheath

**Graph 3: Insertion loss**

**Graph 4: Return loss**

- Suck-out can be shifted by cable structure
3. STP cable

◆ Structure and transmission characteristics more than 1GHz

The change rate of insertion loss increases according to frequency.

The maximum change rate is 24% (3.2 GHz).

**Graph 5: Insertion loss**

**Change rate**

\[
\text{Change rate} = \frac{(IL_{105 \, ^\circ C \text{ atmos.}} - IL_{\text{Initial value}})}{IL_{\text{Initial value}}}
\]
4. Summary

- With regard to the simulation for deciding the modulation method, it is necessary to consider degradation of the transmission characteristics of the cable due to the influence on the vehicle.

- The STP cable is designed with consideration of degradation of the transmission characteristics at the standard value of Ethernet 1 Gbps.

- The STP cable can secure bandwidth up to 3.2 GHz. Also it can shift bandwidth to high frequency band by cable structure.

- The change rate of insertion loss increase according to frequency. And the maximum change rate is 24% (3.2 GHz).
END
Thank you for your attention