



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. Summery

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.



Figure 1: Tensile



Figure 2: Bending
on jig board



Figure 3: Bending in-vehicle



Figure 4: Wire band

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

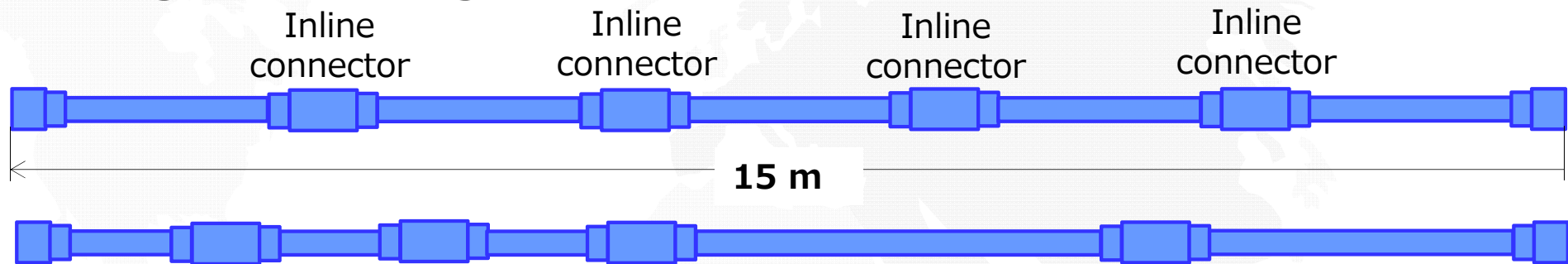
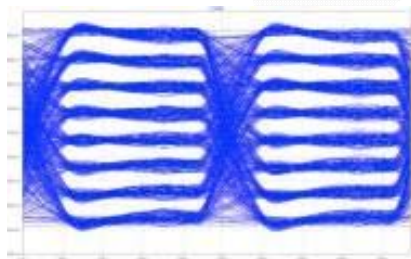


Figure 5: Link segment image

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



PAM-8 or PAM-16

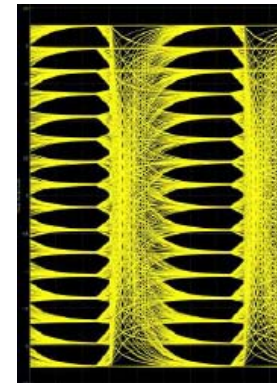


Figure 6: PAM-8 eye pattern image

Figure 7: PAM-16 eye pattern image

2. NGAUTO current situation

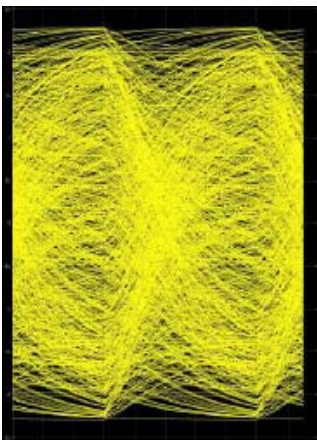
➤ Running simulation using the initial data of components



Considering the in-vehicle influence below

- Vehicle environment
- W/H assembling and vehicle installation

➤ Investigated link segment may not work in automotive environment



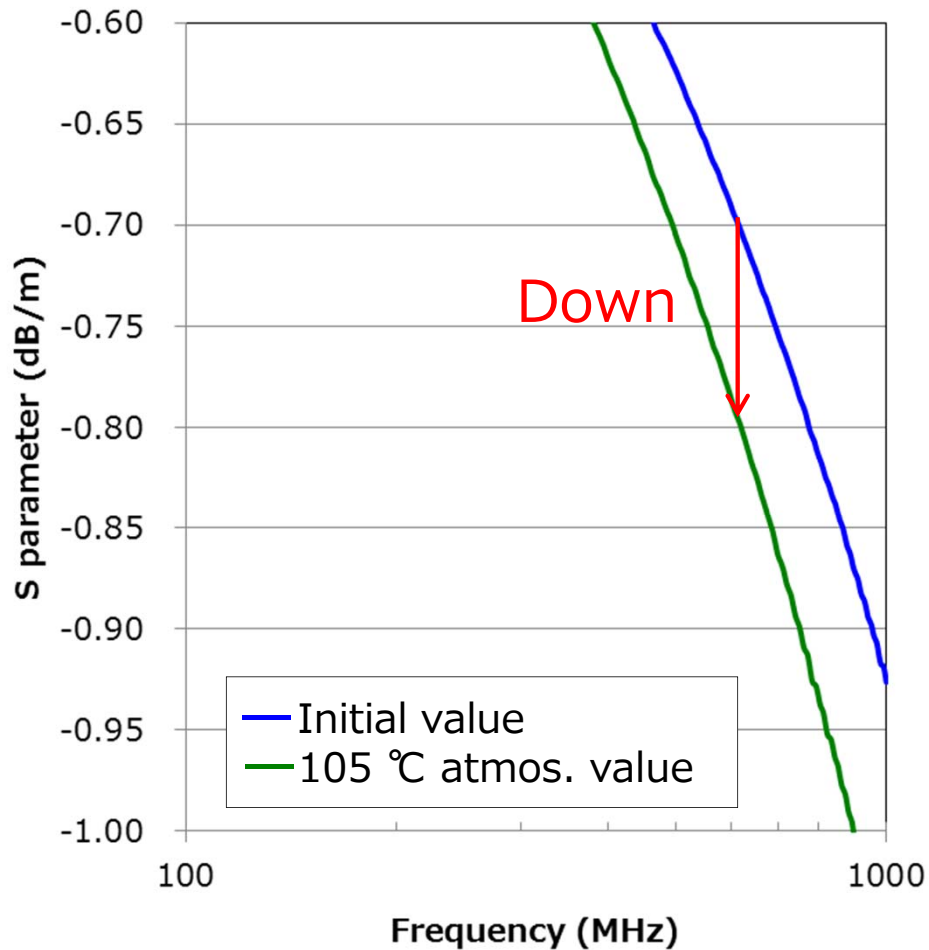
As the result of simulation,
eye pattern doesn't open

Figure 8: PAM-16 eye pattern image

3. STP cable

◆ In-vehicle influence

Insertion loss



Graph 1: Insertion loss

In-vehicle influence test

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

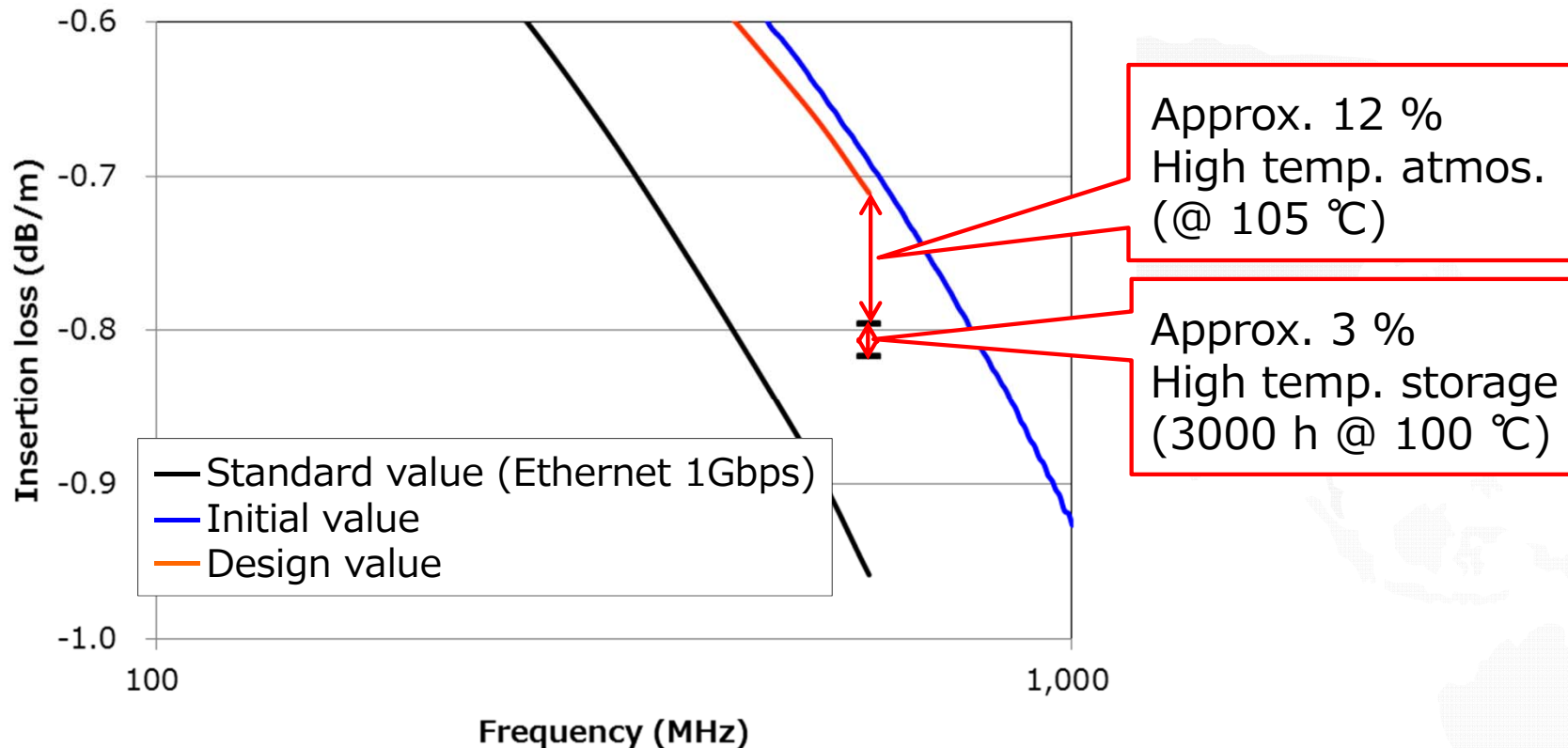
✓✓ Toughest

✓ 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



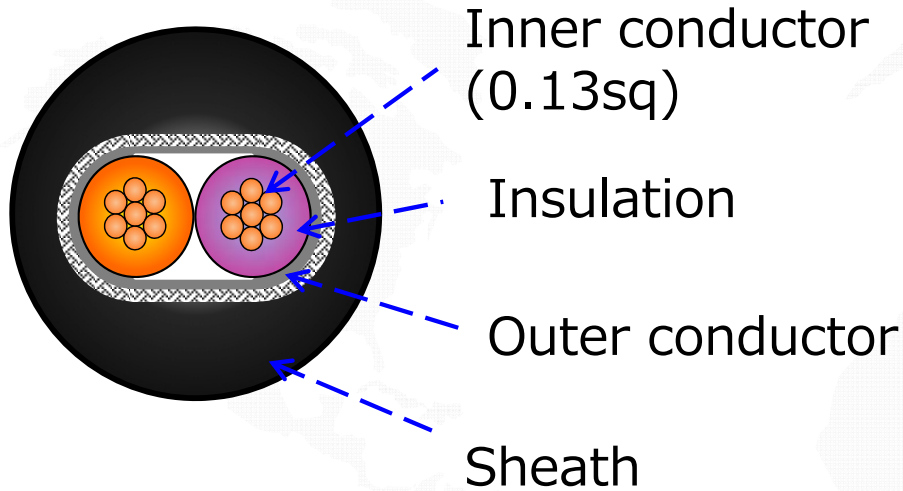
Graph 2: Insertion loss

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.

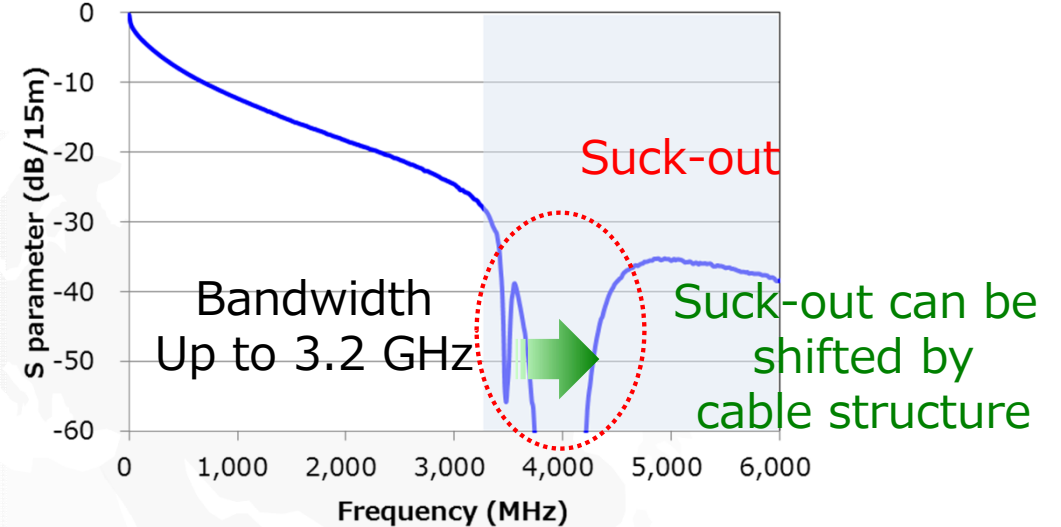
3. STP cable

◆ Structure and transmission characteristics more than 1GHz

Cable structure

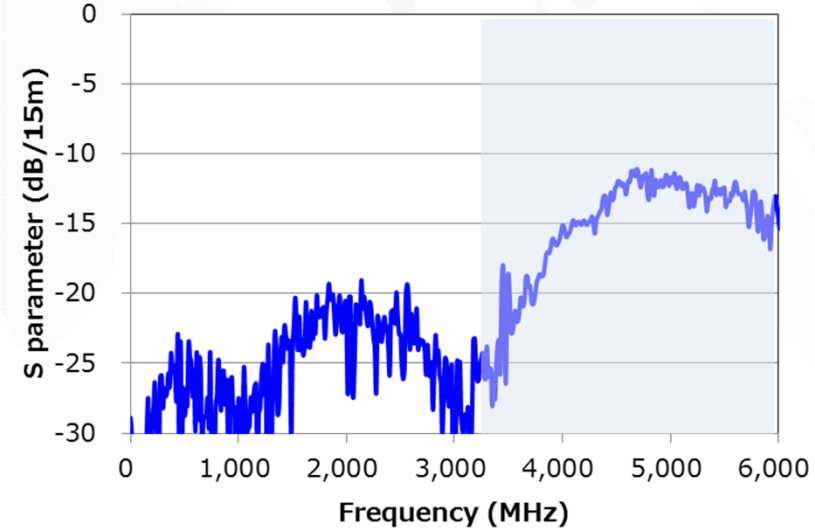


Insertion loss



Graph 3: Insertion loss

Return loss

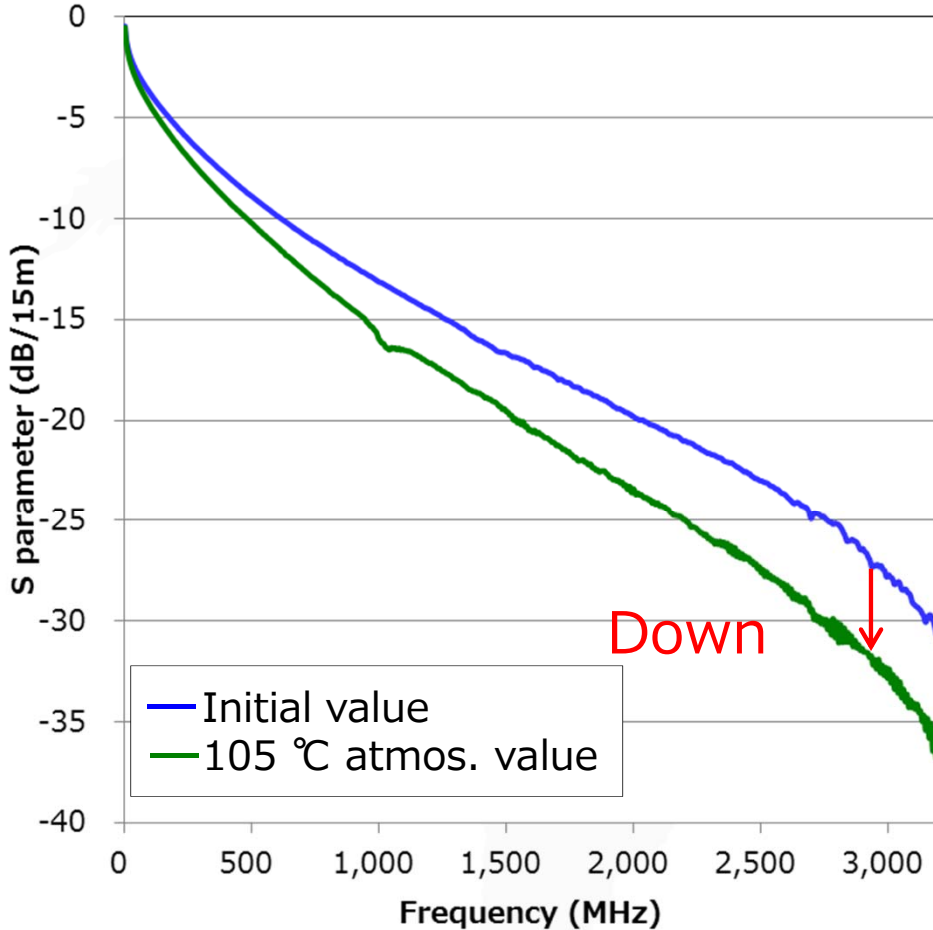


Graph 4: Return loss

3. STP cable

◆ Structure and transmission characteristics more than 1GHz

Insertion loss



Graph 5: Insertion loss

Frequency MHz	Initial value	105 °C atmos.	
	IL dB / 15m	IL dB / 15m	Change rate %
10	-1.46	-1.63	11.2
100	-3.95	-4.39	11.1
1000	-13.5	-16.0	18.5
2000	-19.8	-23.4	18.0
3000	-28.5	-32.7	14.4
3200	-29.1	-36.1	24.0

$$\text{Change rate} = \frac{(IL_{105\text{ °C atmos.}} - IL_{\text{Initial value}})}{IL_{\text{Initial value}}}$$

- The change rate of insertion loss increases according to frequency
- The maximum change rate is 24 % (3.2 GHz)

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