

## УВЕЛИЧЕНИЕ ДЛИНЫ КАБЕЛЕЙ SPACEWIRE ДЛЯ ПРОЕКТИРОВАНИЯ БОЛЬШИХ КОСМИЧЕСКИХ АППАРАТОВ

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Nowadays expansion of SpaceWire cable is quite topical, because data transmission interfaces which are used on spacecraft's board are not sufficient for new requirements. Moreover standard SpaceWire cable has limited length.

Transmission data are essential to the success of every space mission. SpaceWire technology is one of the most perspective technologies for improving data transmission on the board.

Change to SpaceWire technology for designing of informational communication channels on the board of domestic satellites creates a new question set. For example, European standard ECSS-E-ST-50-12C sufficiently detailed determine requirements for cables with standard length from 1 to 10 m., however there aren't the same requirements for exceeding this length distances. At the same time for a large satellite design we need possibility to create systems with length of cable more than 10 meters.

Where can the high-length SpaceWire cable be used in large satellites? First of all it is interfaced between payload, for example high-resolution cameras. Also it can be used for radar sensor equipment, mass-memory unit and telemetry subsystem interconnections.

At present, there aren't domestic manufacturers of cables for SpaceWire on the market and there aren't firms, which apply it actively. Therefore it's reasonable to use foreign company data for analysis of more than 10m length cable application possibility. From foreign manufacturers of SpaceWire equipment we can mark out GORE company, because cable, which it produces are actively applied by American and European agencies.

American space agency specialists tested cables GORE GSC-05-81757, which correspond to SpaceWire standard requirements and GSC-05-82730, which have little more diameter of core in comparison to one required in SpaceWire standard. Characteristics of this cable are shown in table 1.

For some tests 20m cascade of cables was used, that is joined with Twinax connectors, as is shown on figure 1.

Table 1 – Cable characteristics

Characteristic	GSC-05-81757	GSC-05-82730
Core diameter	0,32	0,40
Operation temperature	from -200°C to +180°C	from -200°C to +180°C
Maximum temperature for small periods	200°C	200°C
Maximum weight, g/m	85	100
Signaling rate	400 Mbit/s	to 3 Gbit/s
Conductor to conductor maximum capacity pF/m	50	45
Conductor to screen maximum capacity, pF/m	90	79

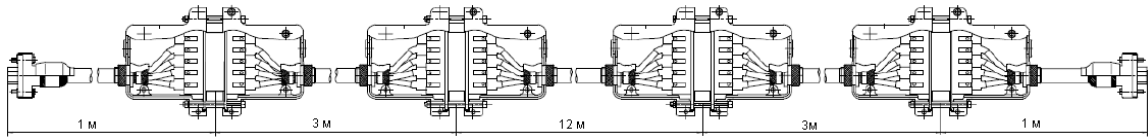


Figure 1 20 m cascade of cables with Twinax connectors

Results of comparison were carried out on data signaling rate 100 Mbit/s (figure 2) and 200 Mbit/s (figure 3). Dependence of losses bringing with cable from frequency is shown on figure 4.

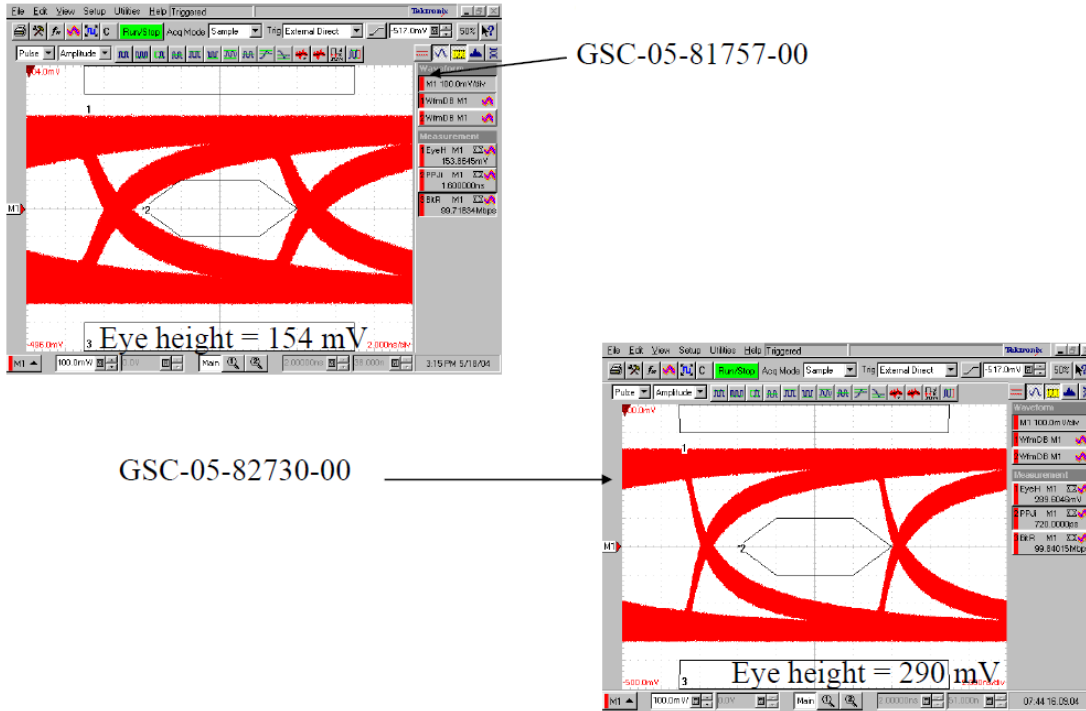


Figure 2 Signals diagramm on 100 Mbit/s signaling rate

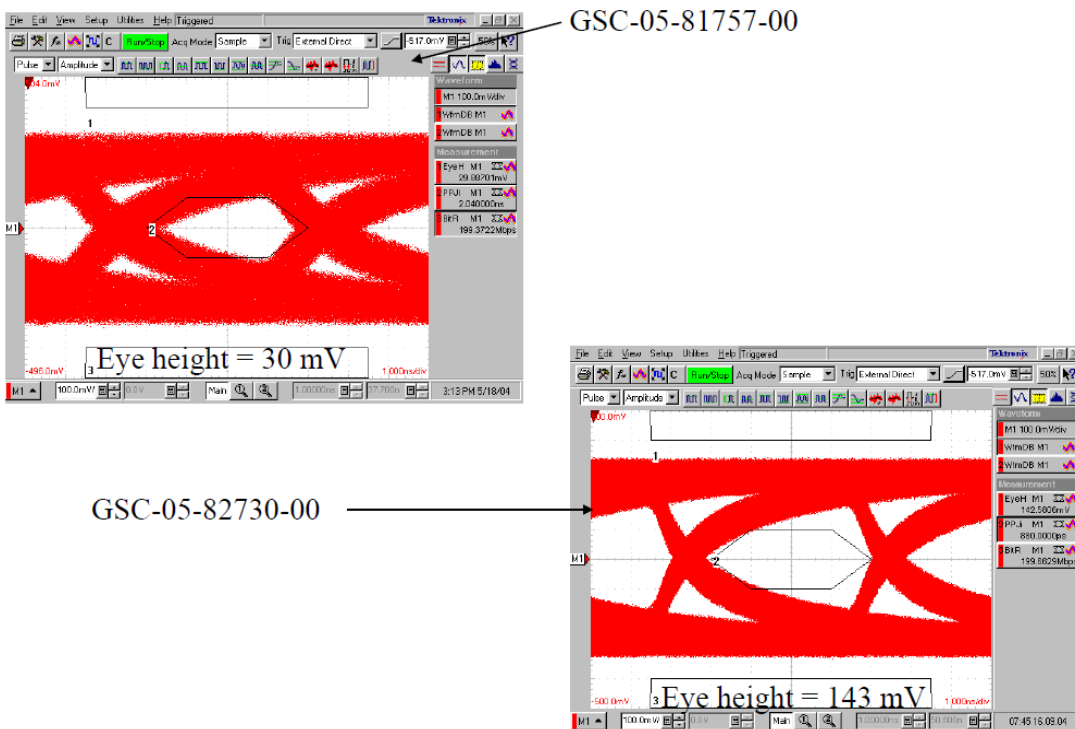
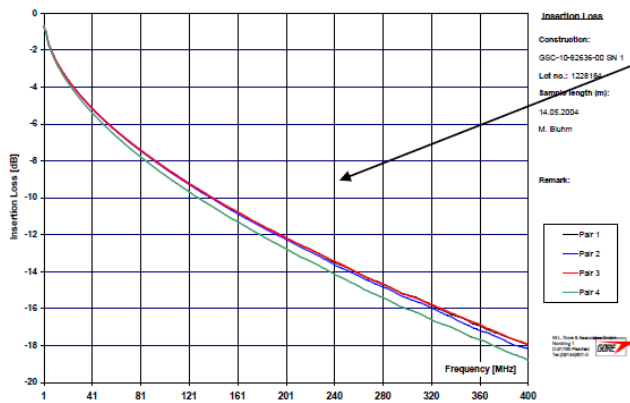


Figure 3 Signals diagramm on 200 Mbit/s signaling rate



GSC-05-81757-00

Потери вносимые кабелем дБ/20м			
Частота МГц	70	250	400
GSC-05-82730-00	-4.96	-9.69	-12.71
GSC-05-81757-00	-7.23	-14.46	-18.81

GSC-05-82730-00

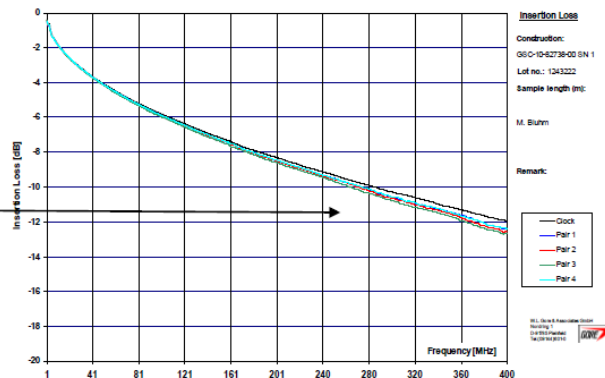


Figure 4 – Dependence of losses bringing with cable from frequency

Thereby using core with 0,4 mm diameter instead of standard one with diameter 0,32 improves channel electric characteristics greatly, notably signal quality and losses bringing with cable. Results of same tests give possibility to use SpaceWire for lengths, which exceed determined in standard even in case of cascade cable connection. In addition such cable has better skew, attenuation, electromagnetic performance and improved reliability from rugged materials used in construction.

In conclusion we'd like to say that we should find a compromise between electric characteristics of cable and its weight for design of large satellites. By changing core diameter of Spacewire cable we can get improved electrical characteristics and oblong cable. However the volume of innovative technologies experienced with spacecrafts must be justified.