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Author: Mr. Oleg Ivanenko
Yaliny, Russian Federation

Mr. Ivan Demidov
Yaliny, Russian Federation
Mr. Vadim Teplyakov
Yaliny, Russian Federation
Mr. Alexander Kharlan
Yaliny, Russian Federation

OPTICAL INTERSATELLITE LASER COMMUNICATION LINK FOR LOW-ORBIT COMMUNICATION SATELLITE SYSTEMS

Abstract

The majority of modern intersatellite laser communication systems (ISLCS) are used for communication between a geostationary spacecraft and a low-earth orbit (LEO) spacecraft. Typical distance for these links is no less than 40000 km, and angular coverage zone for their pointing devices almost reaches hemisphere. High data transfer rates demands (about 1Gbps) exclude pulse modulation usage, while power of modern laser amplifiers (dozens of Watts) leads to the necessity of using very narrow directional patterns (several seconds of arc). In such a situation service terminals conducting the communication are significantly complicated, their mass and power consumption being vast, so the payoff of using laser instead of radio bands is nearly negligible.

At the same time carrying capacities of satellite communication networks are requested to be higher, which leads to inevitability of using ISLCS in them. Decreasing distances in these communication systems down to 3000-5000 km we can gain an opportunity to work with slightly bigger angles in the directional patterns (near 1 minute of arc). With relatively stable positioning of satellites in such systems provides low angular velocity of the line of sight, not exceeding that of the residual oscillations of the stabilized spacecraft. In this case pointing and tracking systems are relatively simple.

Yaliny Engineering is currently developing ISLCS terminals for its LEO global satellite communication system.

Limited distance allows building up a powerful laser emitter for transferring information as the following patter suggests: master oscillator - power fiber amplifier. This emitter structure provides modulation bitrate of the signal of 1 Gbps, pulse power of the optical signal being no less than 20W, with overall efficiency around 30%.

Directional pattern of the transmitter and the receiver of the information signal should be in-line with high angular precision. These requirements are stricter than other disturbances of those patterns, caused by temperature fluctuations, vibrations, and deterioration. That's why the corrector of optical axis is used in optical arrangement of the transmitter lens, making sure that optical axis of transmitter and reciever are in-line with the needed accuracy of several seconds of arc.

In optical arrangement of the terminal receiving lens of the information channel and receiving lens of direction-finder channel are combined in one mirror lens. Separation of the channels is done by beam-splitter mirror. This makes the terminal much lighter and smaller and allows creating a focal node that provides axis stability for the receiving channel relating direction-finder matrix.