Fraunhofer Institut
Integrierte Schaltungen

Low Cost Video and TV Transmission

Figure 1: Distribution of video signals with polymer fibers and glass fibers

Advantages of the Optical Transmission of Video and TV Signals

The transmission of video and TV signals with optical fibers instead of copper wires offers many advantages: immunity to electromagnetic interference, high bandwidth, high transmission distance, and the possible installation together with the electricity network in one hybrid cable.

While solutions based on commonly used single mode and multimode glass fibers are available, their main drawbacks are high component and system costs and the handling of the glass fiber.

We offer transmission systems based on polymer optical fiber (POF) and hard clad silica (HCS) fiber. These systems have significant cost advantages regarding the optoelectronic components and the installation of the fiber due to the large fiber cores and the resulting relaxed mechanical tolerances (HCS: 200 µm, POF: 1000 µm).

Video Transmission

All standard video signals (composite, 1 Vp-p, 75 Ω, with BNC or RCA connector) of CCD cameras, video cameras, observation cameras, DVD players, SAT receivers etc. can be transmitted. The required bandwidth is approx. 10 MHz and the maximum distance using standard POF (NA=0.5) is 150 m. Due to the lower attenuation of HCS the transmission distance using this fiber type is 500 m.

Aside from point-to-point video links, video distribution systems have also been realized using an optical splitter. This device splits the optical signal which carries the video signal and couples it into up to seven output fibers. A single video source can feed up to

Fraunhofer Institute for Integrated Circuits IIS

Director
Prof. Dr.-Ing. Heinz Gerhäuser

Am Wolfsmantel 33
91058 Erlangen, Germany
Phone +49 (0) 91 31 / 7 76-0
Fax +49 (0) 91 31 / 7 76-9 99
info@iis.fraunhofer.de
www.iis.fraunhofer.de

Contact
Project Group for
Optical Communications
Dipl.-Ing. Josef Sauerer
Dr.-Ing. Norbert Weber

Nordostpark 93
90411 Nürnberg, Germany
Phone +49 (0) 9 11 / 58 06-210
Fax +49 (0) 9 11 / 58 06-299
ccoc@iis.fraunhofer.de
www.iis.fraunhofer.de/ec/oc

2003-09 / eppelein

seven displays using this system. The maximum distance for each of the seven links is 30 m for POF or 500 m for HCS.

The transmitting device which converts the electrical video signal into an optical signal consists of a low cost red laser diode (650 nm) from mass production for DVD applications and a driver electronics that controls the bias and modulation current of the laser.

After the transmission using POF or HCS, the receiver converts the optical signal back into an electrical video signal. The optoelectronic conversion is done by a low cost photodiode for POF applications followed by a transimpedance amplifier with automatic gain control (AGC) so that no adjustment of the output signal level is necessary.

TV Transmission

The principle of transmitting TV signals is similar to transmitting video signals but the bandwidth requirements for the optical links are much higher. While the bandwidth of each TV channel is comparable to a composite video signal (approx. 8 MHz), the carrier frequencies are in the range of several hundred MHz (47-862 MHz).

POF is a promising candidate for home networks but has a limited bandwidth. The nominal bandwidth of 50 m of standard POF (NA=0.5) and low NA POF (NA=0.3) is 80 MHz and 200 MHz respectively. At first sight the transmission of HF signals carrying TV channels is therefore out of the question.

Figure 2:
Transmission of TV signals with 50 m of polymer optical fiber (POF)

But due to a particular physical effect, carrier frequencies above the 3 dB bandwidth of POF can also be transmitted if a special transmission technique is applied and the power of the light launched into the fiber is increased. This is easily achieved by using a laser diode (as described above) instead of a LED as a light source. The high modulation frequencies that are required for TV transmission exclude the usage of LEDs anyway, so the laser diode becomes an ideal choice. Due to the high attenuation of POF the accessible light power at the end of the optical link is low enough and eye safety regulations can be met.

In first experiments we demonstrated the transmission of two TV channels with carrier frequencies of 325 and 380 MHz with 50 m of standard step index POF. The picture quality was comparable to the TV image with a direct electrical connection. No interference between the two channels was observed.

The next steps will be the transmission of several channels of CATV simultaneously and the extension of the frequency range.

Applications

There are many applications where the usage of optical fibers instead of copper wires offers significant advantages like immunity to electromagnetic interference and thin, lightweight cables. Interesting applications for video transmission are in the field of factory automation, security systems, medical systems, and entertainment systems for vehicles and buildings, especially home networks.

While the transmission of Ethernet and telephone (or ISDN) requires comparable low data rates, the bandwidth for transmitting HF signals like CATV is significantly higher and a challenge if low cost networks based on POF are in the focus.

The new possibility to use POF also for the transmission of TV signals is an important feature for buildings and home networks.