International Journal of Applied Engineering Research
ISSN 0973-4562 Volume 10, Number 9 (2015) pp. 22597-22602

http://www.ripublication.com

Generation of 3rd Order Intermodulation Products In RoF System and Its Use In Inter-Satellite Communication

Vignesh V, Sangeetha A
SENSE, VIT University, Vellore, India.
vigneshv.2013@vit.ac.in, asangeetha@vit.ac.in

Abstract

A multi-tone RoF system for three RF signals using external modulation with Erbium Doped Fiber Amplifier (EDFA) and Semiconductor Optical Amplifier(SOA) amplification techniques to generate the intermodulation products is designed. Then for inter-satellite communication we filter a particular intermodulation product according to the requirement (here we use 60 GHz) and use it as the carrier frequency for inter-satellite communication using Optical Wireless Channel (OWC).

Index terms –RoF-Radio over Fiber, SOA- Semiconductor Optical Amplifier, EDFA- Erbium Doped Fiber Amplifier, OWC- Optical Wireless Channel.

Introduction

The Radio over Fiber (RoF) is one of the best hope for future broadband wireless communication systems, as it operates at microwave frequency and millimetre-wave frequency bands since the optical fiber has ultra-low loss and ultra-wide bandwidth.Radio transmission over fiber is used mostly for applications like cable television (CATV) and satellite base stations, but the term RoF is usually applied when it is done for wireless access.

The intermodulation products are the distortion that are caused by the amplifiers and the components used for frequency conversion which exhibit non-linear amplification. Here we design a multi-tone RoF system using external modulation technique.

Optical Wireless Communication is a form of optical communication in which unguided visible, infrared or ultraviolet light is used to carry a signal. For terrestrial point to point communication OWC systems, they function at near IR frequency. They use laser transmitters and receivers to communicate.

Experimental Setup

Fig 1(i) and 1(ii) represents the schematic of the transmitter and the receiver section respectively. Thethree modulating tones are combined using the combiner and used to modulate the optical source.The frequency of separation between the modulating tones is kept as 10 GHz. The combined RF signal is modulated using external modulation technique over CW (Continuous Wave) Laser at 1550.5 nm with CW power of 10mW [1].

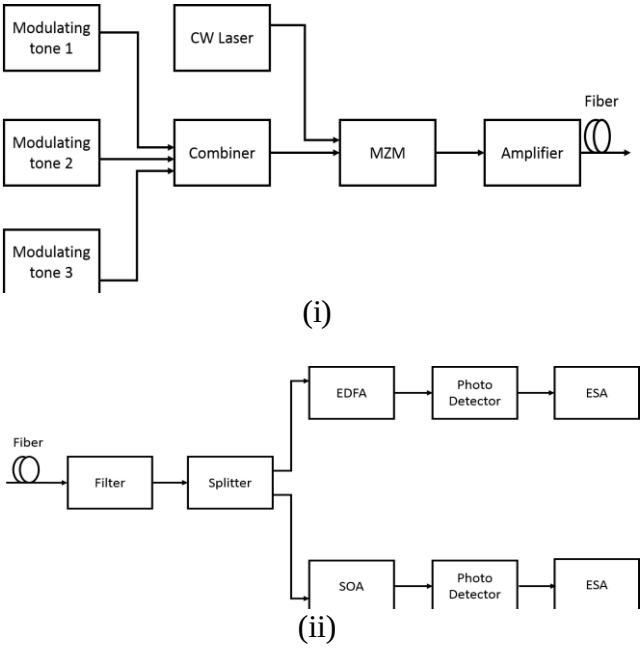


Figure 1: Schematic block diagram for 3-tone RoF system(i) Transmitter (ii) Receiver

At the receiver section, the transmitted signal is split and amplified with Erbium doped fiberamplifier (EDFA) or semiconductor optical amplifier (SOA). The amplified signal is visualised using an electric spectrum analyser (ESA).
Using a Band Pass Filter, the desired frequency (60 GHz) is filtered from the generated intermodulation product. This signal is used as the carrier frequency for the inter-satellite communication.

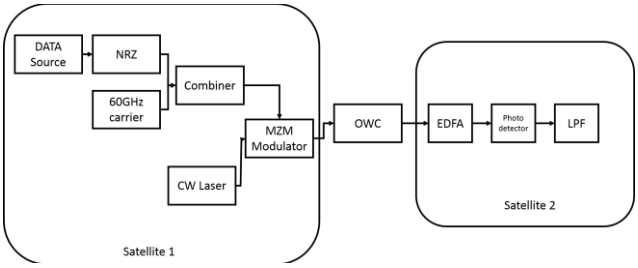


Figure 2: Schematic block diagram of inter-satellite communication

Fig 2 represents the schematic block diagram of the inter-satellite communication. The data that is to be sent from one satellite to the other is combined with the 60GHz carrier frequency that is filtered from the intermodulation products with the help of the combiner. This signal is modulated at 1552.5 nm using external modulation technique using CW laser and sent to the other satellite through the optical wireless channel (OWC). The optical wireless channel uses near-infrared frequency to communicate. The length of the OWC is considered as 500 km. At the receiver satellite, the signal is amplified using EDFA and filtered using the low pass filter (LPF) and the signal is recovered.

Results and Discussions

Fig 3 represents the combined input signal that is produced due to the combination of the three modulating tones that are combined at the input with the help of the combiner. This input signal is modulated using the external modulation technique and is sent through the optical fiber of length 100km.

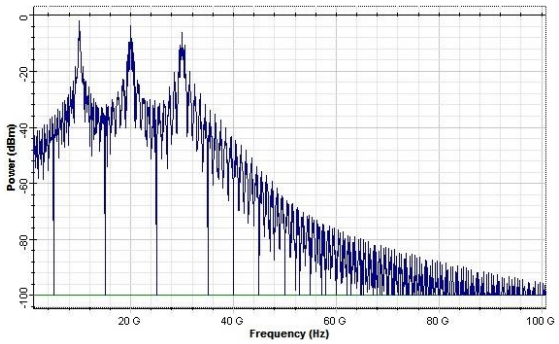
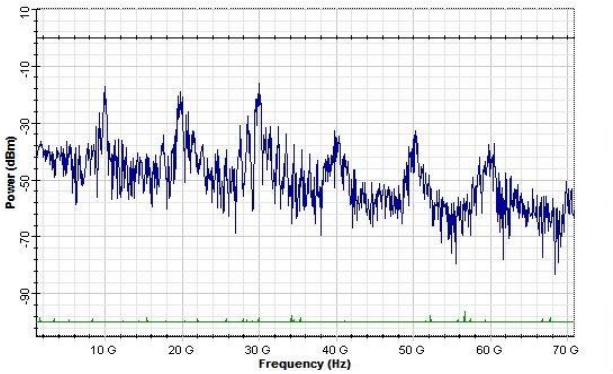
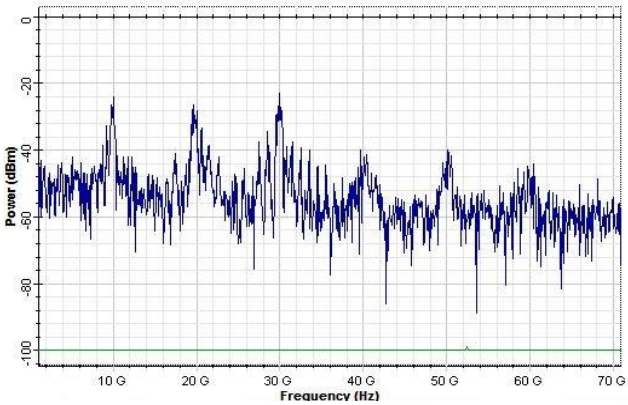


Figure 3: Combined input signal

Fig 4 represents the signal that is received at the receiver section. Fig 4(i) and (ii) denotes the signal that we get after amplification from SOA and EDFA respectively.



(i)



(ii)

Figure 4: The output signal at (i) SOA (ii) EDFA

We can observe from the graph that in addition to the fundamental frequencies (input frequencies) we get extra frequencies other than that of the fundamental frequencies. These additional frequencies are called as the intermodulation products.
Then the 60GHz frequency that is generated as the intermodulation product is filtered using the Band Pass Filter. Fig 5 represents the filtered intermodulation product of 60GHz.

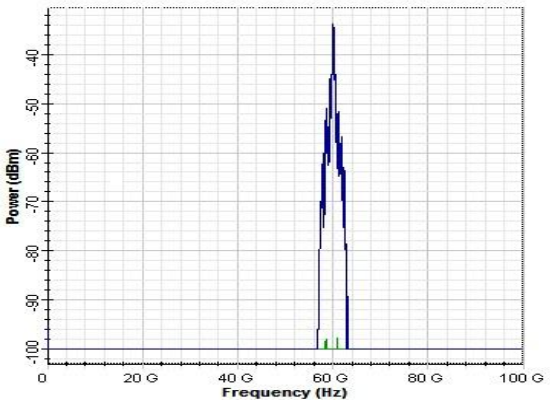
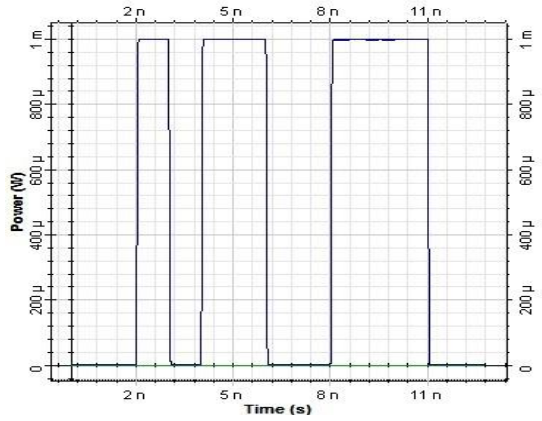
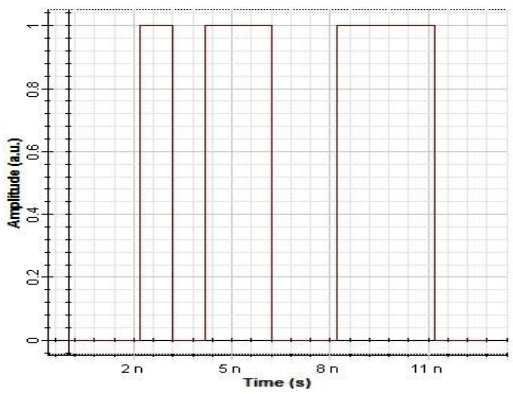


Figure 5: Filtered 60GHz frequency from the output signal

This 60 GHz frequency is used as the carrier frequency for transmission and reception of the signal during inter-satellite communication.
Fig 6(i) and 6(ii) represents the input sequence that is transmitted and the output sequence that is received respectively during the inter-satellite communication. The inter-satellite communication is performed with the help of Optical Wireless Channel (OWC).



(i)



(ii)

Figure 6: The (i) transmitted and (ii) received signal before and after inter-satellite communication.

Conclusion

We have successfully generated 3rd order intermodulation products in RoF system. The required frequency (60GHz) is filtered from the intermodulation products that is generated and is used as the carrier frequency to communicate between satellites using Optical Wireless Channel.

References

[1] Shelly Singla and Sandeep K. Arya, "Simulative investigation of third order-IM terms in multi-tone RoF systems", Optik 125 (2014) 3756-3758.

[2] Naresh Kumar, "Enhanced performance analysis of inter-satellite optical-wireless communication (IsOWC) system", Optik 125 (2014) 1945-1949.

[3] H. Smith Graham, Novak Dalma and Ahmed Zaheer, "Overcoming chromatic-dispersion effects in fiber-wireless systems incorporating external modulators", IEEE Trans. Microwave Theory Technol. 45 (1997) 1410-1415.

[4] X. Zhang, B. Liu, J. Yao, K. Wu and R. Kashyap, "A novel millimetre wave band radio over fiber system with dense wavelength division multiplexing bus architecture", IEEE Trans. Microwave Theory Technol. 54 (2006) 929-937.