Frequency division Multiplexing

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Abstract: Frequency division multiplexing is a technique by which the total bandwidth available in a communication medium is divided into a series of non-overlapping frequency bands, each of which is used to carry a separate signal. This allows a single transmission medium such as a cable or optical fiber to be shared by multiple independent signals. Another use is to carry separate serial bits or segments of a higher rate signal in parallel.

Introduction: Frequency division multiplexing is a method that allows to transmit high data rates over extremely hostile channels at a comparatively low complexity than the traditional single carrier techniques. The new digital world creates an increasing demand for broad band communication systems. The technical requirements for related products are very high but it is desired that the solutions must be cheap to implement, feasible or lead to sub optimal results.

The most natural example of frequency division multiplexing is radio and television broadcasting, in which multiple radio signals at different frequencies pass through the air at the same time. Another example is cable television in which many television channels are carried simultaneously on a single cable. FDM is also used by telephone systems to transmit multiple telephone calls through high capacity trunklines, communications satellites to transmit multiple channels of data on uplink and downlink radio beams, and broadband dSL modems to transmit large amount of computer data through twisted pair lines, among many other uses.

Component:

1. MC1496 IC
2. Resistor(1k,3.9k,10k,6.8k,100k,50ohm,50k variable resistor)
3. Capacitor(.1 micro faraday,.1 nano faraday)
4. 741 IC
5. Connecting wire
6. Breadboard

Circuit diagram:

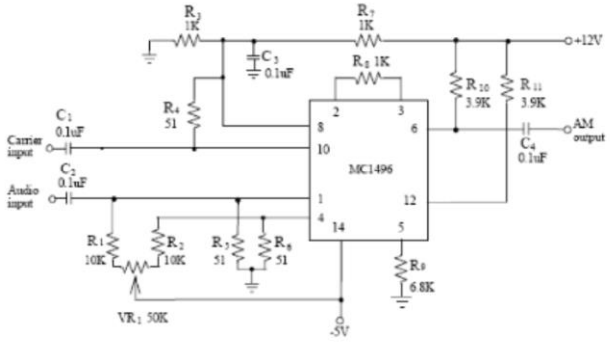

Fig 01: AM modulation circuit

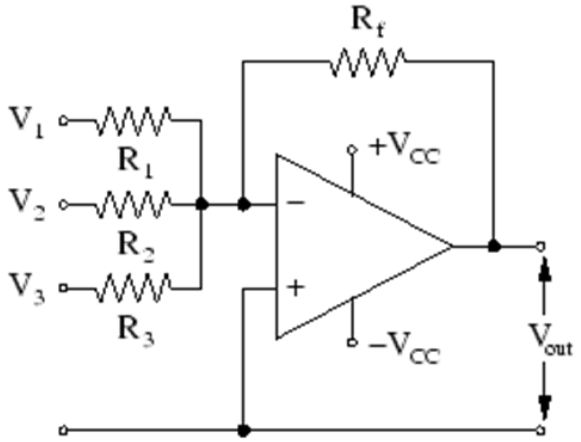

Fig 02: summing amplifier circuit

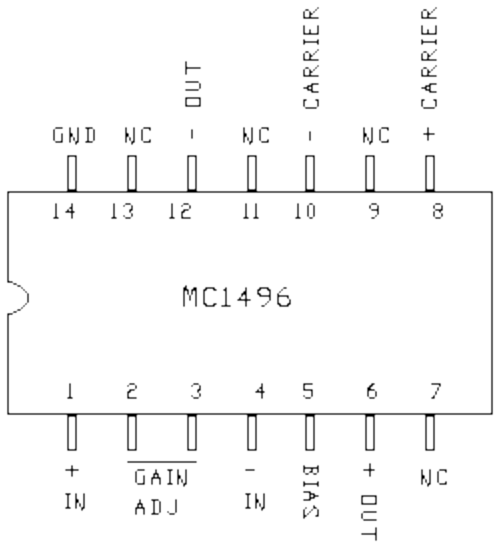

Fig 03: MC1496 pin diagram

Circuit operation: The multiple separate information signals that are sent over an FDM systems are called baseband signals .At the source end , for each frequency channels , an electronic oscillator generates a carrier signal , a steady oscillating waveform at a single frequency that serves to carry information. The carrier is much higher in frequency than the baseband signal . The carrier signal and baseband signal are combined in a modulator circuit. The modulator alters some aspect of the carrier signal such as its amplitude, frequency or phase with the baseband signal.

The result of modulating the carrier with the baseband signal is to generate sub-frequencies near the carrier frequency, at the sum (f_C+f_B) or subtract (f_C-f_B).Similarly additional baseband signal are used to modulate carriers at other frequencies, creating other channels of information.

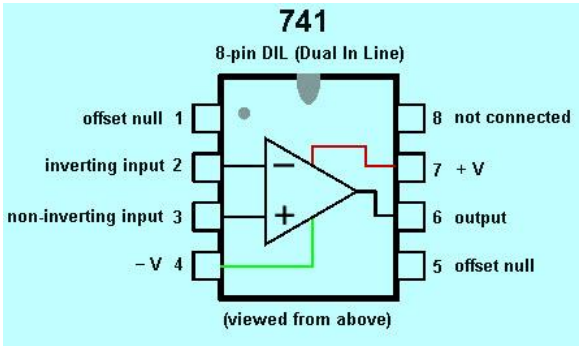

Fig 04: IC 741 pin diagram

The carriers are spaced far enough apart in frequency that the band of frequencies occupied by each channel, the passbands of the separate channels, do not overlap. All the channels are sent through the transmission medium, such as a coaxial cable, optical fiber, or through the air. And

the carrier signal was sent about 100 kHz another is 200kHz.And the message signal is about 1kHz.The given power supply is +12 volt and – 5volt.

Output: The final output waveform of frequency division multiplexing.

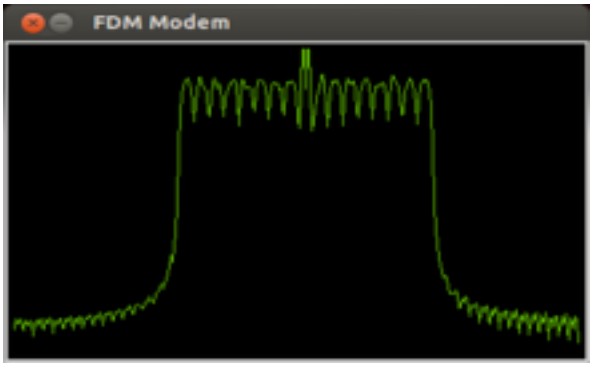

Fig 05: FDM Output

Advantages Of FDM:

I. The frequency division multiplexing does not need any synchronization between its transmitter and receiver for proper operation.
II. A large number of signals (channels) can be transmitted simultaneously.
III. Due to slow narrow band fading only a single channel gets affected.
IV. The demodulation process of frequency division multiplexing is easy.
V. No dynamic coordination necessary, i.e sync and framing
VI. Works also for analog signals
VII. Low bit rates-chapper, delay spread.

Disadvantages of FDM:

I. All the frequency division multiplexing channels get affected due to wideband fading.
II. A large number of modulators and filters are required.
III. The communication channel must have a very large bandwidth.
IV. The FDM suffers from the problem of crosstalk.
V. Intermodulation distortion takes place.

Application:

I. FDM is commonly used in TV networks.
II. FDM is commonly used for FM & AM radio broadcasting.
III. First generation cellular telephone also uses FDM
IV. Digital Audio Broadcasting
V. Digital video broadcasting

Limitation:

Communication line capacity can be enhanced by using the method of non-orthogonal discrete frequency modulation (N–OFDM) based on frequency division multiplexing of channels by way of transmitting the carriers on non-orthogonal frequencies.

Realization of this method by using the classic Fourier transform gives rise to a number of difficulties among which one should note the computational complexity taking into account the complex form of representation of numbers. The application of the Hartley transform (HT) makes it possible to renounce the complex form of data recording and simplify the hardware implementation of the N–OFDM method .

Conclusion: FDM is the frequency translation of a number of individual standard telephony channels so that they can be stacked side by side and from a single wide band single. A number of different transmission media are available such as open wire cable, coaxial cable, and radio or satellite systems, all with different bandwidth capability. The multiplexing schemes use a hierarchy of building blocksto construct systems to the required bandwidth. Many stages of translation may be required with the final stages of modulation only being specific to the particular transmission medium. Channel

spacing is standardized on 4khz. This provides enough space between the voice frequencies(.3 to 3.4 khz)to economically filter the carrier , plots, outband signaling toes, super group level, different administration have adopted different hterarchies to build large system.

References:

I. V. I. Slyusar and V. G. Smolyar, “Multifrequency Operation of Communication Channels Based on Super-Rayleigh Resolution of Signals,” Izv. Vyssh. Uchebn. Zaved., Radioelektron. 46(7), 30 (2003).

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