Lab 1: Time Division Multiplexing

Objective

In this experiment, the aim is to study the Time Division Multiplexing of two band-limited sinusoidal signals.

Theory

Time-division multiplexing (TDM) is a method of transmitting and receiving independent signals over a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern. It is used when the bit rate of the transmission medium exceeds that of the signal to be transmitted. This form of signal multiplexing was developed in telecommunications for telegraphy systems in the late 19th century, but found its most common application in digital telephony in the second half of the 20th century. In Digital Multiplexing, several low bit-rate signals can be multiplexed or combined, to form one high bit-rate signal, to be transmitted over a high frequency medium. Because the medium is time-shared by various incoming signals, this is a case of TDM. Multiplexing can be done on a bit-by-bit basis (known as digit interleaving), or on a word-by-word basis (known as byte or word-interleaving).

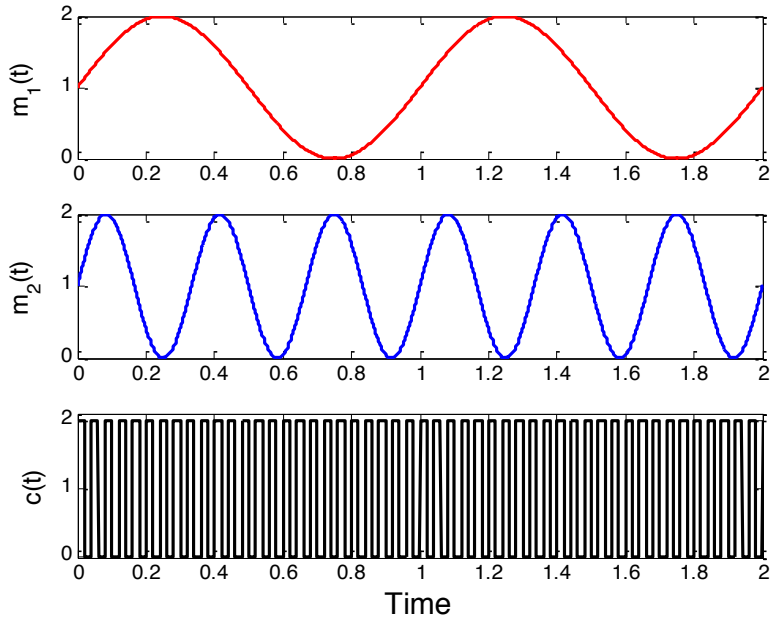

Figure 1.1 (a): Two input sinusoidal signals to be combined in time and a carrier signal

At the receiving terminal, the incoming digit stream must be divided and distributed to the appropriate output channel. For this purpose, the receiving terminal must be able to correctly identify each bit. This requires the receiving system to uniquely synchronize in time with the beginning of each frame, with each slot in a frame and with each bit within a slot. This is accomplished by adding framing and synchronization bits to the data bits. These bits are part of the so-called overhead bits.

Figure 1.1 (a) and (b) shows the inputs signals and their corresponding TDM signal.

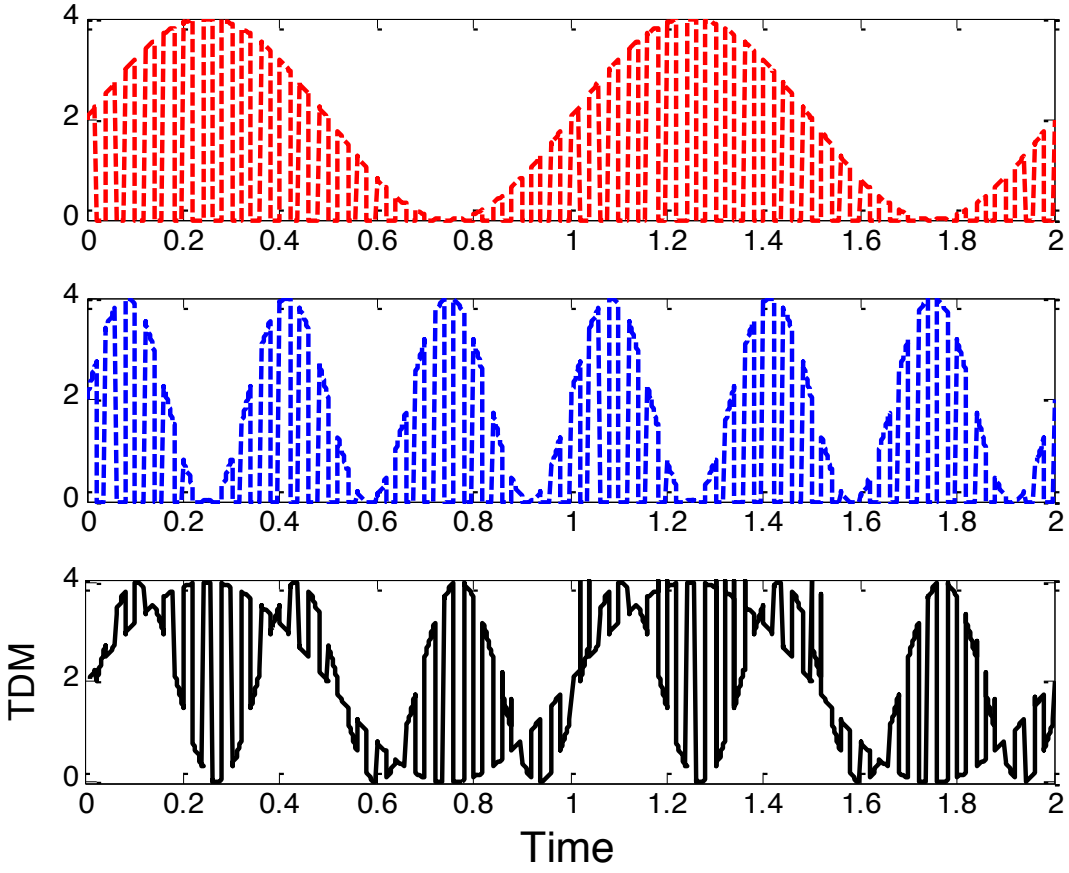

Figure 1.1(b): Demonstration of two signals sampled and multiplexed in time

Procedure

1. Connections are made as shown in Figure 1.2.
2. Apply a square wave (TTL) carrier signal of 2 kHz (or >2 kHz) of 5V amplitude.
3. Apply $m_1(t)$ and $m_2(t)$ whose frequencies are f_1 (200 Hz, with DC offset) and f_2 (400 Hz, with DC offset).
4. Observe TDM waveform at pin number 3 of IC CD4051.

5. Observe the reconstructed message waveforms $m_1(t)$ and $m_2(t)$ at pin numbers 13 and 14 of 2nd IC CD4051.

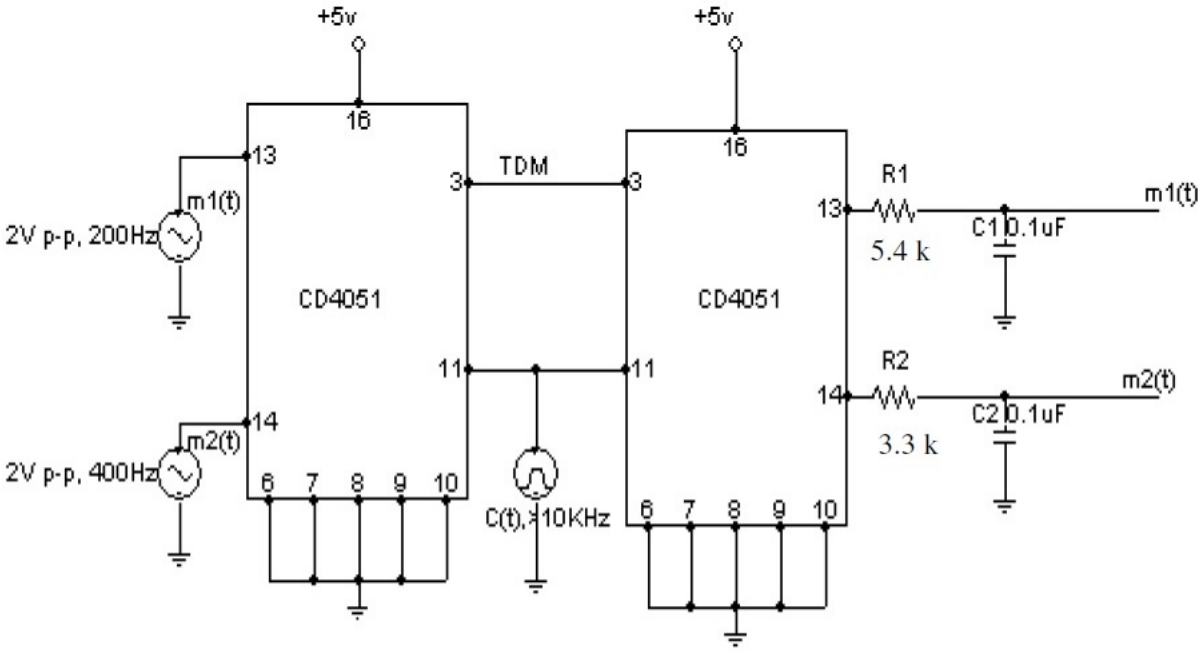

Figure 1.2 Time division multiplexing/demultiplexing circuit diagram

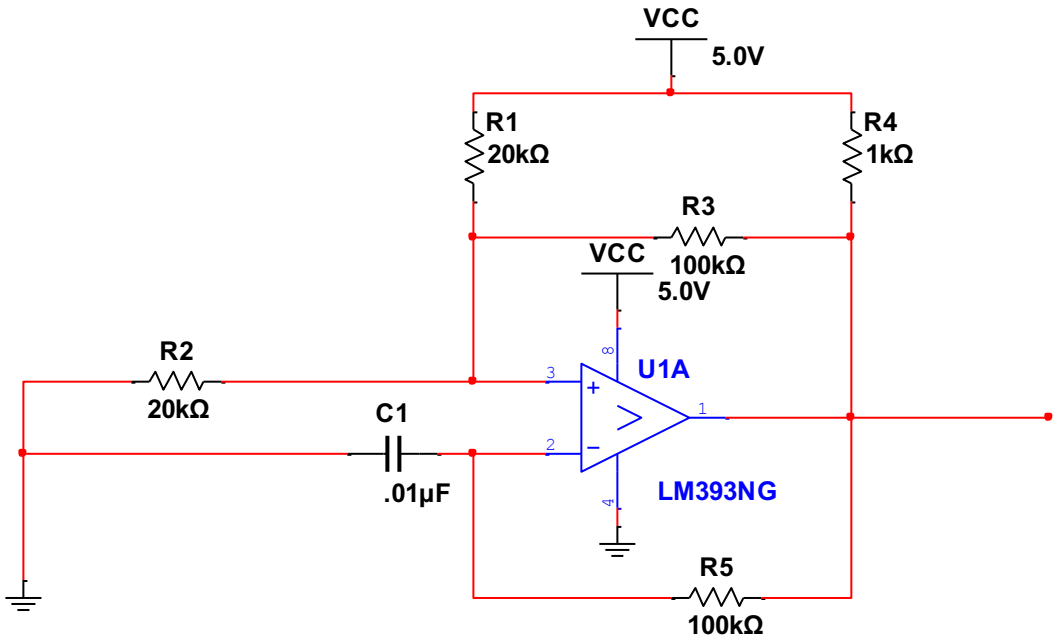

Figure 1.2 (b) Square wave clock generator to be connected to pin 11 to the CD4051 ICs.