Aim ↬ To perform Time Division Multiplexing using trainer kit.

Apparatus Required ↬ CM2 Panel [1 Channel SSRC/ 4channel TOM/PAM PWM, PPM, PFM EXPT. PANEL], DSO and connecting wires.

Theory ↬

Time Division Multiplexing is a method used in digital communication to send multiple signals over a single channel by dividing time into specific slots. Each signal gets its own time slot, allowing them to share the same channel without mixing with each other. TDM improves channel efficiency, making it popular in telecommunications, data transmission, and digital audio/video broadcasting.

Working Principle ↴

i. **Time Slot Allocation ↪** Each signal is assigned a unique time slot within a repeating cycle. If there are N signals, each signal occupies one of the N time slots in each frame, given by:

$$Frame\ Duration = N \times Time\ Slot\ Duration$$

During its slot, the signal is transmitted, and when the slot ends, the next signal is sent.

ii. **Multiplexer and Demultiplexer ↪** A multiplexer (MUX) at the sender combines all signals into one, represented mathematically as:

$$M(t) = \sum_{i=1}^{N} S_i(t).\, g_i(t)$$

where $S_i(t)$ is the i-th signal and $g_i(t)$ is a gating function that controls the time slot for each signal. At the receiver, a demultiplexer (DEMUX) separates the signals based on their time slots.

iii. **Synchronization ↪** To keep signals organized, synchronization between the sender and receiver is crucial. It ensures that each signal appears in the correct time slot, maintaining the order of transmission.

TDM is widely used in telephone networks, digital TV, and data communications to make the best use of bandwidth and avoid the need for multiple channels.

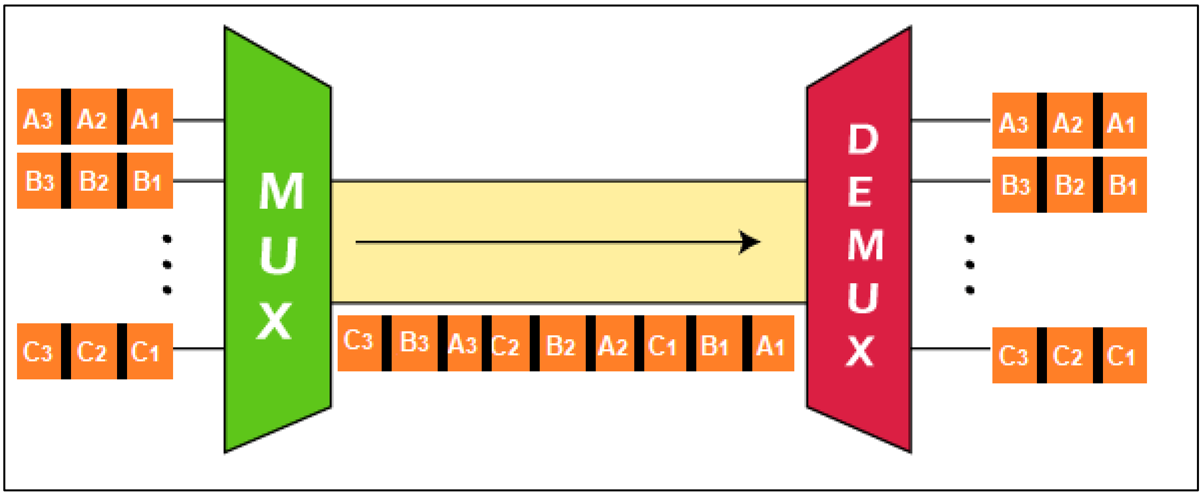

Fig. i) Time Division Multiplexing

Inner Working of CM2 Panel in TDM Experiment ↴

The CM2 Panel performs TDM by generating modulated signals (PAM, PWM, PPM, PFM) and combining them into a single stream using a multiplexer. Internal timing circuits ensure synchronized time slot allocation, and the resulting multiplexed signal is visualized on a DSO, showing efficient channel sharing in real-time.

Procedure ↬

i. Set S3 to SF mode (Select Frequency).
ii. Measure 10 MHz at TP9 and 62.5 KHz at Socket 28 (TX CLK).
iii. Connect 32 KHz from Socket 27 to EXT CLK input on DTFFG III.
iv. Set S2 to TDM mode (lower position).
v. Adjust VR3 to 2.9 VDC for the sync level and connect it to Socket 1.
vi. Feed 5Vpp sine waves (500 Hz to Socket 2, 1 KHz to Socket 3, 2 KHz to Socket 4).
vii. Connect TX output (Socket 5) to RX input (Socket 8), and set S7 to Mode 3 and S6 to TDM mode.
viii. Connect SYNC (Socket 14) to RX CHO (Socket 30), VCO (Socket 15) to RX CLK (Socket 31), and Sockets 9-12 to LPF inputs. Observe CH0, CH1, CH2, and CH3 at 2P or 4P of the LPF. Set VR2 and VR3 to fully counterclockwise.

Output ↬

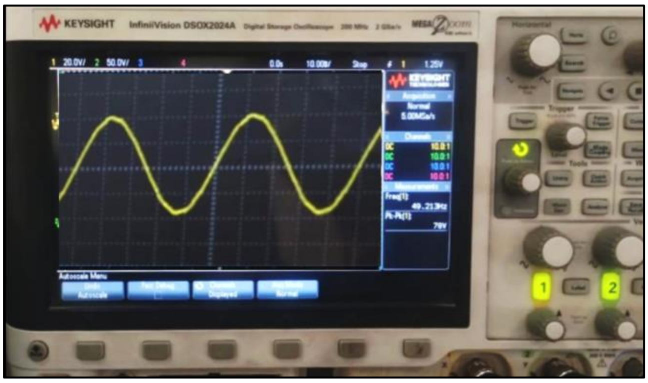

Fig. ii) Sine signal

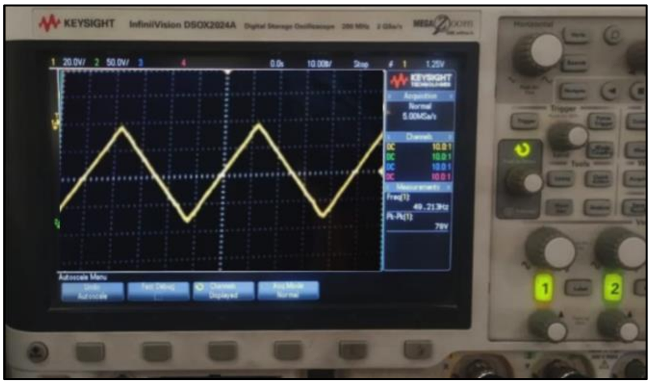

Fig. iii) Triangle signal

Fig. iv) Time Domain Multiplexing

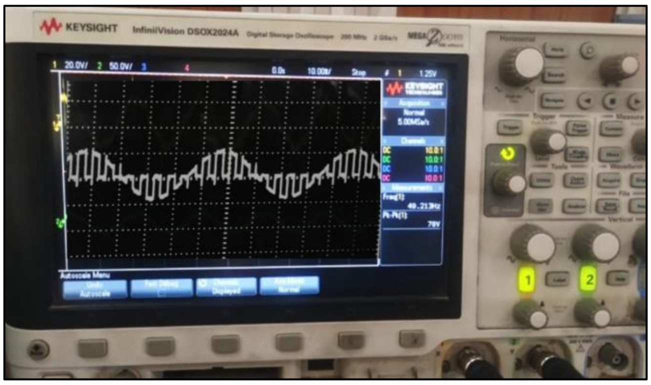

Fig. v) TDM after passing through LPF

Result ↬

The experiment successfully demonstrated Time Division Multiplexing (TDM) using the CM2 Panel. The observed waveforms for the transmitted signals (CH0, CH1, CH2, CH3) and their reconstructed outputs at 2P and 4P of the LPF verified proper multiplexing and demultiplexing.

Conclusion ↬

The experiment confirmed that TDM efficiently combines multiple signals into a single channel, with accurate time slot allocation and signal reconstruction. Synchronization and correct settings are crucial for optimal performance.

Precautions ↬

- Ensure all connections and settings match the procedure to avoid errors.
- Verify signal levels and timings for accurate waveform display.
- Adjust VR3 carefully to ensure stable waveforms on the DSO.