Aim ↬ To perform sampling and verify sampling theorem using trainer kit.

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

Theory ↬

Sampling is the process of converting a continuous analog signal into a discrete digital signal by capturing its values at specific intervals, enabling digital processing of real-world signals like sound and images. According to the Sampling Theorem, also known as the Nyquist-Shannon Theorem, a signal can be fully represented and reconstructed if sampled at a frequency at least twice the highest frequency in the signal (the Nyquist rate). Sampling below this rate leads to aliasing, where signal frequencies overlap and cause distortion.

Aliasing occurs when a signal is undersampled, meaning the sampling rate is too low to capture the changes in the signal accurately. This effect can cause higher-frequency components to appear as lower frequencies in the sampled signal, leading to errors and loss of information. Proper sampling prevents aliasing, ensuring that the original signal can be faithfully reconstructed from its samples.

Importance of Sampling ↴

Sampling is fundamental in converting analog signals into digital data, widely used in:

1. **Digital Media:** Converts audio and video into digital formats for CDs, streaming, and broadcasting.
2. **Data Acquisition:** Measures physical quantities in scientific and industrial applications for analysis.
3. **Telecommunications:** Enables digital transmission of voice and data over networks like mobile phones and the Internet.

The CM2 panel helps illustrate the practical aspects of the Sampling Theorem by enabling users to sample analog signals at different rates and observe the effects. This hands-on approach allows users to understand the importance of proper sampling rates and the consequences of aliasing.

Sampling is crucial for accurate digital representation of analog signals, ensuring reliable communication and processing across various technological fields by adhering to the principles of the Sampling Theorem.

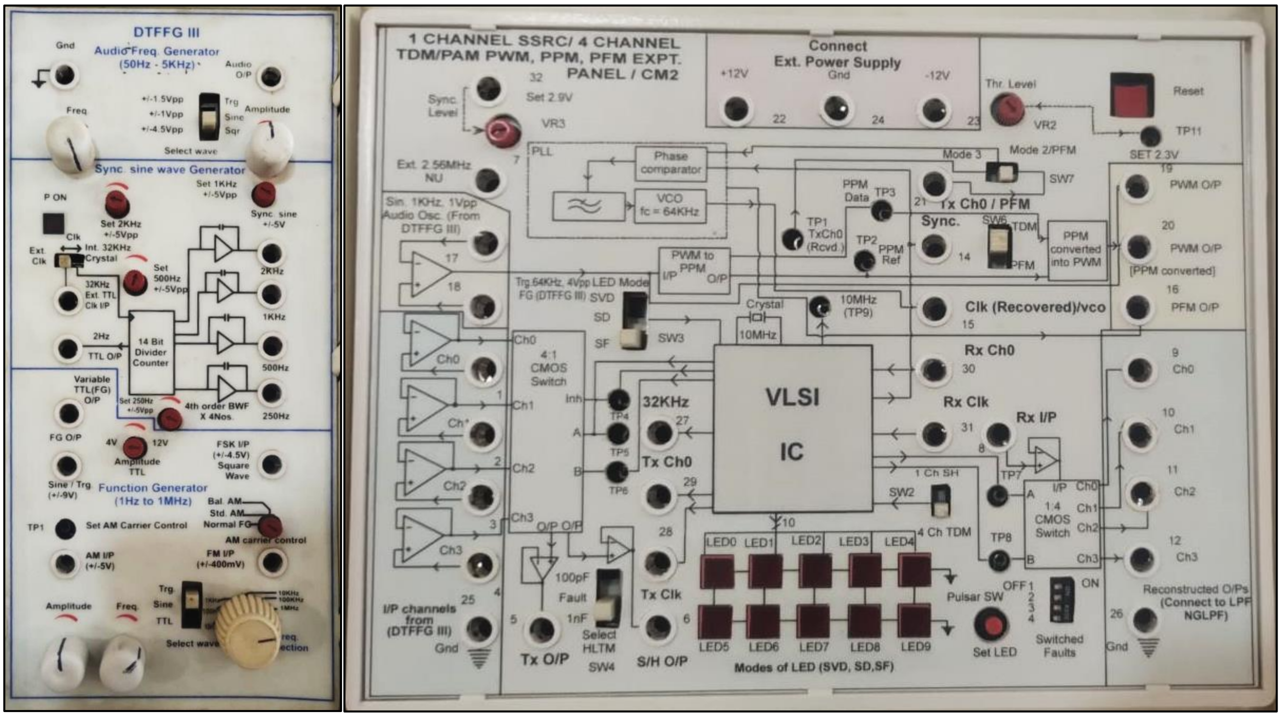

Fig. i) CM2 Panel

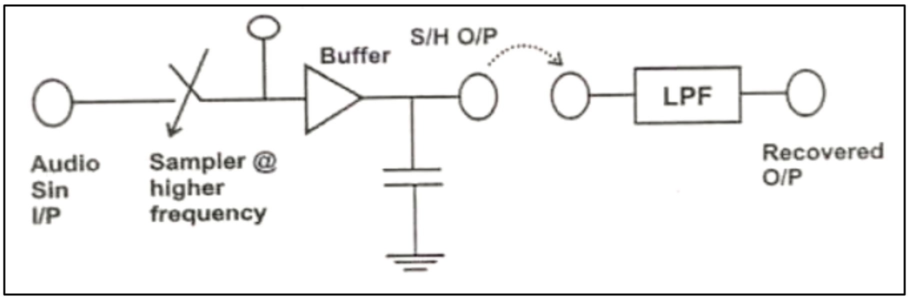

Fig. ii) Block Diagram for single channel sampling

Procedure ↬

i. Set SW3 to the lower position (SF mode).
ii. Measure 10 MHz frequency at TP9.
iii. Press pulsar switch to set LED0; measure 62.5 KHz at Socket 28 (TX CLK).
iv. Observe 32 KHz at Socket 27; connect to EXT CLK input (DTFFG III); set Ext clk switch to LHS.
v. Set SW2 to the upper position (CHO mode, 1CHSH).
vi. Feed 1 KHz, 1 Vpp sync sine wave from DTFFG III to Socket 1.
vii. Observe TX output at Socket 5 and S/H output at Socket 6.

Effect of Variable Frequency & Duty Cycle on TX Output:

viii. Connect CRO-CH1 (+) to Socket 5 (TX O/P) & CRO-CH2 (+) to Socket 28 (TX CLK); vary frequency using pulsar switch.

ix. Connect CRO-CH1 (+) to Socket 5 (TX O/P) & CRO-CH2 (+) to Socket 29 (TX CH0); vary duty cycle using pulsar switch.

Output ↬

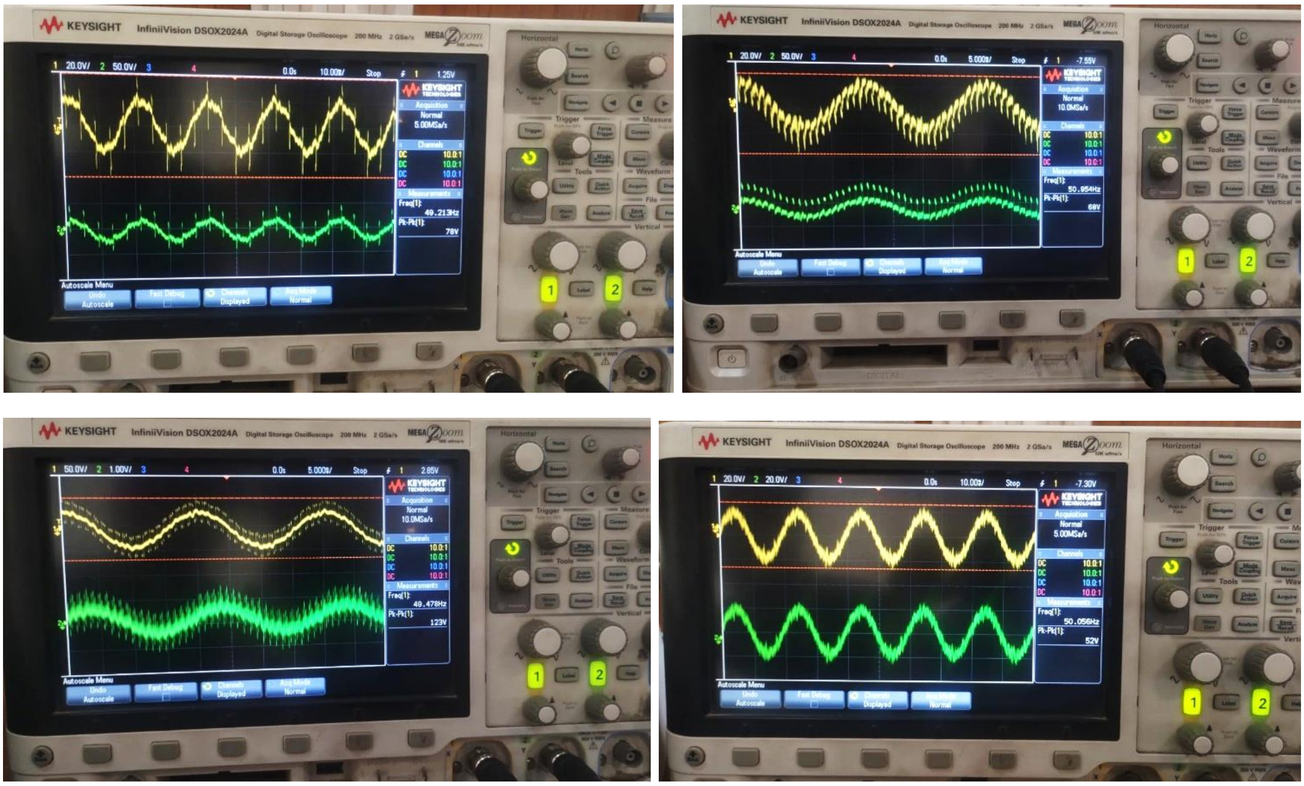

Fig. iii) DSO output of Sampling at various frequencies

Result ↬

The experiment successfully demonstrated the Sampling Theorem using the CM2 Panel. The effects of varying sampling frequency and duty cycle on the TX output were observed and verified, confirming the importance of correct sampling rates.

Conclusion ↬

The experiment highlighted the critical role of proper sampling frequency in accurately representing and reconstructing analog signals. It confirmed that adhering to the Sampling Theorem prevents aliasing, ensuring reliable signal transmission and processing in digital systems.

Precautions ↬

- Ensure all connections and settings are correct according to the procedure to avoid inaccurate results.

- Verify the signal levels and sampling rates to prevent aliasing and ensure correct waveform observation.
- Handle the pulsar switch carefully while adjusting frequency and duty cycle to observe stable output signals.