1 Experiment No. 5

2 Experiment Title

Observation & Verification of Fault Signal of an Integrated AM/FM Radio Trainer Base Station.

3 Objective

The objectives of this lab are as follows:

- To study and verify the basic working principles of an AM/FM radio trainer base station.
- To observe the transmission and reception of Frequency Modulated (FM) signals.
- To simulate different types of faults and observe their effects on signal quality and waveform behavior.

4 Theory

The Integrated AM/FM Radio Trainer Base Station is developed to demonstrate the complete process of radio signal reception, demodulation, and fault diagnosis. The trainer receives amplitude modulated (AM) or frequency modulated (FM) radio frequency (RF) signals from external transmitters (KL-93061 for AM and KL-93063 for FM).
These received signals are first filtered and tuned in the RF section, then converted into an intermediate frequency (IF) for stable and selective amplification. Afterward, the signal passes through a detector circuit that demodulates the signal and retrieves the original audio information from the modulated carrier wave. Finally, the audio amplifier drives the demodulated audio signal to an output device such as a speaker or headphone.
The system also incorporates a fault simulator module, which enables users to analyze and understand the effects of common faults at various stages of the radio circuit.

Figure 1: Integrated AM/FM Radio Trainer Base Station

Modulation and Transmission Process

The audio signal produced from a source serves as the modulating signal. Before modulation, the audio signal is typically processed using audio conditioning circuits that may include equalizers, compressors, and limiters to enhance sound quality and ensure signal consistency.
Following this, the processed audio signal is fed into a modulator, where it is combined with a high-frequency carrier wave using frequency modulation (FM). The carrier wave is generated by a stable carrier oscillator. The modulated signal, initially weak, is then amplified using a radio frequency (RF) power amplifier to achieve transmission-strength power levels.
The amplified signal is sent to the antenna system, which converts the electrical signal into electromagnetic waves and radiates them into free space. The antenna is carefully tuned to operate efficiently at the desired broadcast frequency.

Reception and Demodulation Process

The trainer base station is equipped with a complete FM superheterodyne receiver circuit. The reception process begins with the antenna capturing RF signals from the air. Due to their weak nature, these signals are first amplified using an RF amplifier, which also helps suppress unwanted noise.
Next, the signal is passed through a mixer, where it is combined with a locally generated oscillator signal. This process results in the conversion of the input signal to a fixed intermediate frequency (IF), making it easier to process and filter. The IF signal is further amplified to increase clarity and selectivity.
To recover the original audio, the signal undergoes FM demodulation using either a Foster–Seeley discriminator or a phase-locked loop (PLL) circuit. The extracted audio is then amplified by an audio amplifier and finally delivered to a speaker or headphones for listening.

Fault Detection

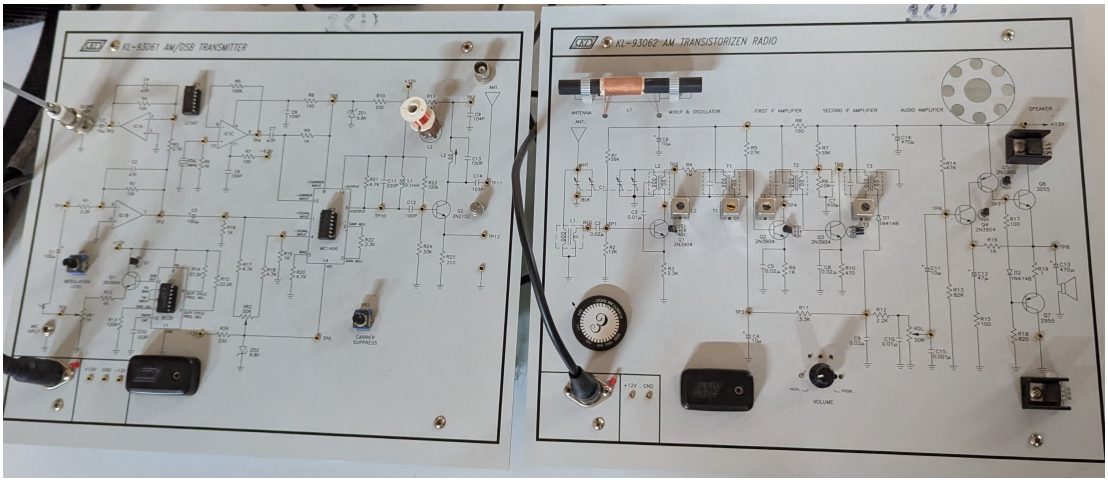
Fault was generated in the RADIO base station by pressing buttons from 1 to 10. The button F4 was pressed before doing every fault detection test because the integrated circuit was in such a manner that the base station normally detects weak signal. So the button is pressed first and then the observations of fault was seen.

5 Required Apparatus

1. Integrated AM/FM Radio Trainer Base Station (LABTECH ERT-AFS)
2. KL-93061 AM Transmitter Module
3. KL-93063 FM Transmitter Module
4. Power Supply
5. Connecting Wires & Probes

6 Experimental Setup

(a) Integrated AM/FM Radio Trainer Base Station



(b) AM Transmitter (KL-93061)

7 Experimental Procedure

1. **Initial Setup:**
   (a) The Integrated AM/FM Radio Trainer was placed on a flat surface.
   (b) The KL-93061 AM and KL-93063 FM transmitter modules were connected to the respective antenna inputs of the trainer.
   (c) The trainer and both transmitter modules were powered on.
2. **AM Reception Testing:**
   (a) The trainer was switched to AM mode.
   (b) The KL-93061 AM transmitter was enabled to transmit a modulated AM signal.
   (c) The AM dial was tuned until the modulated audio signal was received and heard.

(d) The test points were observed using a multimeter or oscilloscope to verify proper signal flow.

3. **Fault Simulation:**

   (a) Predefined faults were introduced using the fault simulator switches on the trainer.

   (b) Changes in the audio output and waveform were observed to identify the affected circuit stage.

   (c) The faulty block (RF, IF, detector, or amplifier) was diagnosed accordingly.

   (d) The trainer and transmitter modules were turned off.

   (e) All connecting wires and probes were carefully disconnected.

8 Observation

Table 5.1: Radio Receiver Fault Simulation List

Fault No:	Defective Circuit	Defective Components	Symptoms	Observation
1	DC power input	DC power line	System is not working	System is off
2	Stereo decoder	R9	Stereo indicator does not light	Light is off.
3	Audio output	C2	No left (L) audio signal	Left audio box is off.
4	Detector & MPX	IC1 pin6	Noises and weak signal output	weak
5	FM IF stages	CF2	Weak FM signal output	weak
6	AM IF stages	L1	No AM signal output	Not observable.
7	AM RF	R2	Weak AM signal	Not observable.
8	AM Oscillator	R1	Weak and noises AM signal	Not observable.
9	FM Tuner	R3	Can not receive FM signal	Not received.
10	AM AGC	C14	No AM signal output	Not observable.

9 Discussion

In this experiment, the fault characteristics of the AM/FM signal using Integrated AM/FM Radio Trainer were analyzed using predefined faults introduced via simulation switches.There were 10 faults that we had check. Faults were examined across key stages such as RF, IF, detector, and audio. Observations were made by monitoring the audio output and measuring signals at test points.

But out of ten,only five faults were successfully observed. Various symptoms were encountered, including weak signals, distorted or lost audio, and complete system shutdowns.Fault was generated in the RADIO base station by pressing buttons from 1 to 10. The button F4 was pressed before doing every fault detection test because the integrated circuit was in such a manner that the base station normally detects weak signal. So the button is pressed first and then the observations of fault was seen.