इरिसेट

गाड़ी डिटेक्शन प्रयोगशाला

प्रयोग **सं :** टी डी एल **- 05**

IRISET

TRAIN DETECTION LABORATORY

EXPERIMENT NO : TDL – 05

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

प्राप्तांक
Marks Awarded :

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुदेशक के आद्यक्षर
Instructor Initial :

Audio Frequency Track Circuit - UM71 (V1-F2: 2300Hz)

(RDSO/SPN/146/2001**)**

INTRODUCTION

AFTC is a joint-less electronic track circuit, specially designed to meet the immunity level required in AC/DC electrified sections. Block joints need not be provided for straight track circuits. In this system, sensitive track relays are not required & integrity of the rails is ensured. It is a universal track circuit suitable in all type of electrified sections and non-electrified sections.

The AFTC of UM71 make is designed to minimize periodic maintenance. But Periodical checks and measurements are recommended.

EQUIPMENT:

Indoor Equipment:

a) Transmitter
b) Receiver
c) Track Relay (24 V DC plug in type Relay).
d) Protection against lightning (LD)
e) Power supply unit

Outdoor Equipment:

a) Tuning Unit (TU)
b) Matching Unit (MU)
c) The Air core Inductor (ACI)
d) Quad cable connection in between indoor and outdoor equipments.

WORKING PRINCIPLE:

- A UM71 track circuit operates at one of four basic carrier frequencies. These frequencies are arranged in two pairs.
- One pair is assigned to track 1:
  - 'Track 1' frequency 1: 1700 Hz (V1-F1)
  - 'Track 1' frequency 2: 2300 Hz (V1-F2)
- One pair is assigned to track 2:
  - 'Track 2' frequency 1: 2000 Hz (V2-F1)
  - 'Track 2' frequency 2: 2600 Hz (V2-F2)
- The TC transmitter generates a power-limited sinusoidal signal, at one of the four F_0 basic frequencies: 1700 Hz, 2000 Hz, 2300 Hz or 2600 Hz.
- The F_0 basic frequency is encoded by "shifting" (FSK principle).
- "Shifting" consists of switching two frequencies with a modulation depth ΔF = 11 Hz.
- $F_0 + \Delta F$ and $F_0 - \Delta F$, (Basic frequency) $\pm$ 11 Hz.
- Modulation rate is set by division of 128 of the basic frequency.

Sr no	Pair of frequency	Frequency	Modulation rate = F_0 divided by 128
1	V1 - F1	1700 Hz	1700 Hz / 128 = 13.3 Hz.
2	V1 - F2	2300 Hz	2300 Hz / 128 = 18.0 Hz
3	V2 - f1	2000 Hz	2000 Hz / 128 = 15.6 Hz.
4	V2 - f2	2600 Hz	2600 Hz / 128 = 20.3 Hz

SYSTEM DESCRIPTION :

- UM71 TC is designed to detect presence of vehicle on the track.
- It is non coded AFTC
- It is used to install on straight portion of track in 'station limit' or 'block section'.
- Mostly installed in auto section.
- It is recommended by railway board **not** to install on point zone area.*
- It is recommended by railway board remote feeding shall be within 3 km.*

  * {Ref: RB's letter no. 2007/Sig/W/5/I-(AFTC) dated 26.07.2007}
- It can be configured in two types of installation
  - End Transmission TC {Length of track circuit (min:100 m, max:750 m)}
  - Intermediate Transmission TC {Length of track circuit (min:2 X 100 m, max 2 X 750 m)}
- System consists of outdoor equipment at track side and indoor equipments in relay room on a special frame.

EQUIPMENT DESCRIPTION :

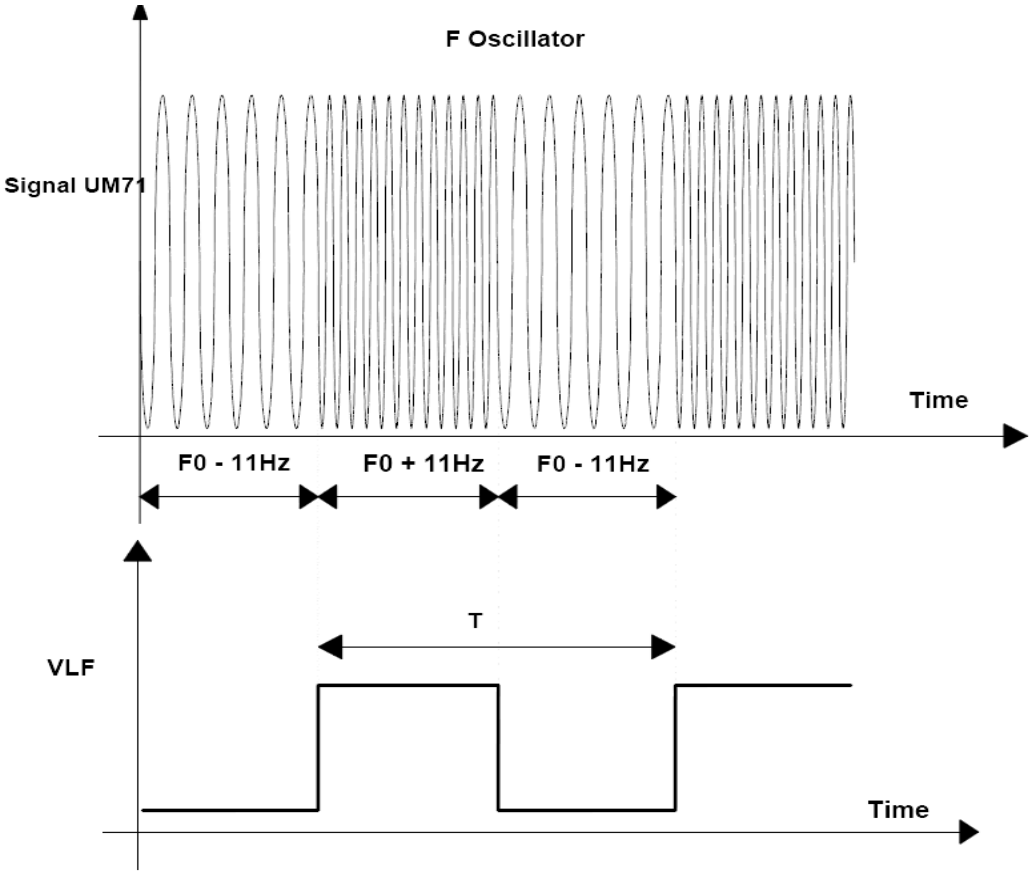
- **Transmitter (Tx) :**

a) The transmitter generates a power limited sinusoidal signal, at one of the four basic frequencies (F_o) 1700 Hz; 2000 Hz; 2300 Hz; 2600 Hz.

b) The basic frequency is encoded by shifting which is switching two frequencies with a modulation depth, ΔF = 11 Hz.

c) The basic frequency is modulated at a rate set by division by 128 of this basis frequency (F_o).

d) Modulation is shown in fig as below.



e) The TC transmitter block diagram shown on board comprises the following functional circuits:

- A stabilized power supply,
- An oscillator,
- An amplifier,
- A frequency divider,
- A current regulator

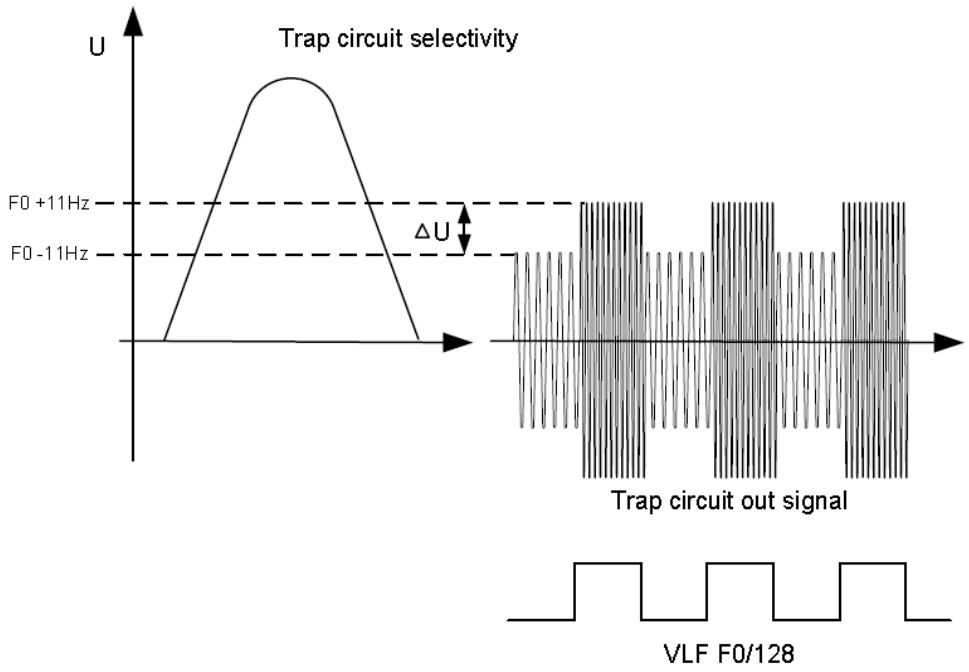
- **Receiver: (Rx)**

a) The Receiver detects the presence of the train in the associated track section.

b) The receiver must recognize the carrier signal in quality (modulated frequency) and in quantity (level).

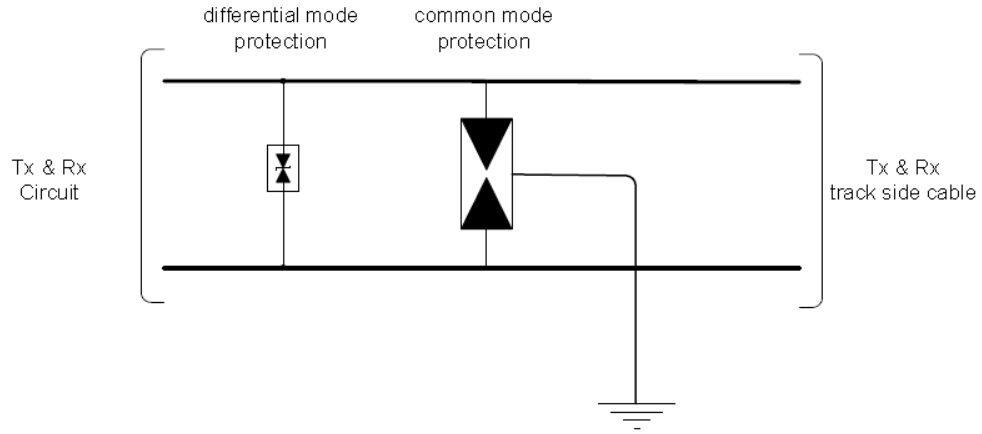
c) The TC receiver block diagram as on board comprises the following functional circuits:
   - Input transformer, for adjustment of the TC (KRV),
   - Band-pass carrier filter used for spurious signal suppression,
   - Trigger providing the threshold function,
   - Demodulator used to search for the modulation VLF signal,
   - VLF amplifier,
   - VLF rectifier and filter circuit,
   - Delayed threshold oscillator, which transforms the VLF energy into a 15 kHz signal, and also provides the relay pick-up time delay function,
   - Amplifier which delivers the power necessary to pick-up and maintain a 24 V/250 Ω signalling relay energized.

d) Demodulation is as shown in fig as below



e) Pick-up time-delay is provided by linking terminals C and C2 (t = 2.3 s). This time-delay prevents premature pick-up of the relay in the event of a short duration shunting loss.

- **Track Relay: (TR)**
  a) Rated voltage is 24 V DC
  b) Plug -in-type
  c) Non proved type
  d) Ordinary 'Q' series line Relay QN1
  e) Approximately at 300 mA, track relay gets energized.
- **Protection against lightning (LA)**
  a) In a relay room as well as in a signal location box, protection against atmospheric voltage surges shall be installed on each pair of conductors providing a link to the outside environment in order to limit the harmful effects of lightning on electronic equipment.



  b) Two levels of protection shall be provided by the lightning arrestor:
    - Common Mode Protection
    - Differential Mode Protection
- **Power supply unit**
  a) Input 110 V AC ± 25%
  b) Output 24 V DC ±1V
  c) One LED indication for output
  d) Switch for input
  e) PSU to TX/RX - flexible copper cable
  f) 3 A fuse
  g) Current :
    - Transmitter : 1 A max if set to low-power operation or
      2 A max if set to high-power operation
    - Receiver : 0.3 A
  h) Maximum Ripple: 1 V peak to peak.

- **Tuning unit (TU):**

It is a passive device. It consists of a tuned circuit, which is used to form the 'Electronic Separation Joint. There is one tuning unit (TU) for each of the four frequencies used, where as matching unit is common for all the frequencies. There are two types of Tuning units: - F1 (V1 or V2) & F2 (V1 or V2)

A) For the track 1 frequency pair: F1 (V1 or V2) :This consists of LC (inductive Capacitance) series circuit tuned at a frequency close to F2. Its characteristics are:
   - Capacitive impedance at frequency F1
   - Low capacitive impedance at frequency F2

B) For the track 2 frequency pair: F2 (V1 or V2): This consists of a LC series circuit, tuned at a frequency close to F1, mounted in parallel with a high value capacitor. Its characteristics are
   - Low capacitive impedance at frequency F1, with the parallel capacitor shorted by the series branch tuned at F1,
   - Capacitive impedance at F2, resulting from the tuning of the three components. As frequency F2 is higher than frequency F1, the inductive series tuning is masked by the parallel capacitor.

- **Matching Unit (MU):**

Impedance matching between the items of the equipment installed at the track and those installed in the technical room (Relay room - TX and RX) is achieved by means of an auto matching unit.

- **Air Core Inductor (ACI):**

There are two types of ACI. 1) ACI 200 and 2) ACI 600

('O' BOND is provided in IRPMU PROJECT for UM71 installation.)

- **Electronic Separation Joint (ESJ):-**

a) For implementation of continuous track circuits, reliable separation of audio frequencies on all continuous track circuits (common to same ESJ). This can be achieved either conventionally through the use of insulated joints which break the rail electrical continuity or through 'Electronic Separation Joint' which do not require any continuity bonds.

b) The ESJ consists of a short track section limited at each end by a LC-type tuned circuit, known as TU. And on Electrified track, a non-saturable inductor, known as the ACI, is located at the centre of the ESJ

c) ESJ length varies from 20 to 29 meters in accordance with Rail type, sleeper type, Track gauge, Track electrified or non-electrified.

d) This is failure prone area.

READINGS

	UM 71 Frequency of track circuit = 2300Hz				
S NO	Description of readings		TERMINALS	Specified range	Actual readings
1	POWER SUPPLY	PSU Input V AC	0 V ● 110 V ●	110 V AC ± 25%	
		PSU Output V DC	+24 V ● 0 V ●	23 to 25 V DC	
		PSU O/P ripple content V AC	+24 V ● 0 V ●	< 1 V AC	
2	TX-Transmitter unit	TX Power I/P V DC	**Tx A+** & **A-**	23 to 25 V DC	
		TX Signal O/P V AC	**Tx V4 & V7** (out of V1 to V10)	25 to 50 V AC	
		TX output frequency HZ	**Tx V4 & V7** (out of V1 to V10)	Modulated	2300Hz ± 17 Hz
		TX side Gain details	V1 to V10 (KEM)	V1/ V4 & V7/V8 **KEM*** 3 to .7.75 @0.25 steps	
3	TU of TX side	Tx TU Input V AC	E1 & E2	25 to 50 V AC	
		Tx TU Output V AC	O/P_1 ● O/P_2 ●	1 to 5 V AC	
4	On track (TX side)	Signal voltage V AC	RAILS at TX side	1 to 5 V AC	
5	On track (RX side)	Signal voltage V AC	RAILS at RX side	0.2 to 0.8 V AC	
6	TU of RX side	RX TU Input V AC	I/P_1 ● I/P_2 ●	0.2 to 0.8 V AC	
		RX TU Output V AC	5 & 6	0.2 to 3 V AC	
7	RX-Receiver unit	RX Power I/P V DC	**Rx A+** & **A-**	23 to 25 V DC	
		RX signal I/P V AC	**Rx V1 & V2**	0.2 to 3 V AC	
		RX Input frequency HZ	**Rx V1 & V2**	Modulated	2300Hz ± 17 Hz
		RX side Gain details	R1 & R2, R3 to R10 (KRV)	**KRV*** 1 to 72 by using R3—R10	
		RX O/P V DC	**Rx L+** & **L-**	24 V DC	
8	Track Relay	TR input V DC	R1 & R2	24 V DC	

KEM* = Out put transformer of (TX) Transmitter

KRV* = Input transformer of (RX) Receiver

EXERCISE:

1) Draw the circuit diagram from board ?

2) Which modulation is used in UM71 make AFTC?

3) What is ACI?

4) Give details of connections provided in TX of TU & RX of TU of the model

5) What is length of ESJ?

Date: **Signature of the Trainee**