इरिसेट
गाड़ी डिटेक्शन प्रयोगशाला
प्रयोग सं : टी डी एल - 07

IRISET
TRAIN DETECTION LABORATORY
EXPERIMENT NO : TDL – 07

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

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

प्राप्तांक
Marks Awarded :

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

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

अनुदेशक के आद्यक्षर
Instructor Initial :

Audio Frequency Track Circuit - ALSTOM (DTC 24, F3 - 2.9 KHz)
(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 and non-electrified sections.

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

EQUIPMENT:

Indoor Equipment:

a) Evaluator
b) Protection against lightning (LD)
c) Power supply unit (PSU)

Outdoor Equipment:

a) Tuning Unit (TU)
b) ‘S’ bond, ‘α’ bond & ‘Shunt’ bond
c) Quad cable connection in between indoor and outdoor equipments

WORKING PRINCIPLE:

- ALSTOM audio frequency track circuit operates at one of 14 basic carrier frequencies. These frequencies are arranged in two groups. Groups as per lower and higher frequencies.

- Higher frequencies are for shorter length track circuits. (DTC 921)

DTC 921	**F7 = 9.5 KHz** **F8 = 11.1 KHz** **F9 = 12.7 KHz** **F10 = 14.3 KHz** **F11 = 15.9 KHz** **F12 = 17.5 KHz** **F13 = 19.1 KHz** **F14 = 20.7 KHz**	**Frequency at gap of 1.6 KHz**

- Lower frequencies are for longer length track circuits. (DTC 24)

DTC 24	**F1 = 2.1 KHz** **F2 = 2.5 KHz** **F3 = 2.9 KHz** **F4 = 3.3 KHz** **F5 = 3.7 KHz** **F6 = 4.1 KHz**	**Frequency at gap of 0.4 KHz**

- The AFTC transmitter generates a power-limited sinusoidal signal, at one of the above 14 basic frequencies:
- The basic frequency is encoded by "shifting" (MSK principle).
- "Shifting" consists of switching two frequencies with a modulation depth Δf = 100 Hz.
- (Basic frequency) ± 100 Hz
- Basic + Δf' and 'Basic – Δf' these frequencies are detected independently and a number of other checks are performed to ensure safety and against false operation.
- Modulation rate is 200 Hz. and Baud rate = 400 bits/second
- Modulation is included to provide greater security and to enable the information to be passed along the track without being distorted.
- This method prevents the dangerous interference by harmonics of the traction return current
- The operating frequency is keyed between the upper and lower frequency limit according to an individual bit pattern which is cyclically repeated. The continuous transmission of a bit pattern between transmitter and receiver of track circuit ensures the unmistakable correspondence of transmission and reception equipment.
- 3 different bit patterns are available for coding for each frequency.(Total no of codes 42)

- During track clear detection process, the RX, RT board and MODEM board will check the following steps: -
  a) Frequency check
  b) Amplitude assessment
  c) Demodulation/coding check

SYSTEM DESCRIPTION :

- ALSTOM AFTC is designed to detect presence of vehicle on the track.
- It is coded AFTC
- It is used to install on straight portion of track in 'station section' or 'block section', point zone area, straight portion on more than two parallel lines.
- It is recommended by Railway Board remote feeding shall be within 3 km.(0.9mm dia quad cable) **{Ref: RB's letter no. 2007/Sig/W/5/I-(AFTC) dated 26.07.2007}**
- It can be configured in three types of installation
  - End fed TC (DTC 921) {Length of track circuit (min:30 m, max:400 m)}
    End fed TC (DTC 24) {Length of track circuit (min: 100 m, max: 700 m)}
  - Centre fed TC (DTC 24) {Length of track circuit (min:100 m, max 1000 m)}
  - Point zone –max 3 receivers
    {Ref: OEM documentation}
- System consists of outdoor equipment at track side and indoor equipments in relay room on a special rack.

EQUIPMENT DESCRIPTION :

- **Evaluator**

  It consists of following boards. (This configuration will change according to installation)
  a) Transmitter Board
  b) Receiver Board
  c) Modem Board.
  d) Power supply RT Board

  The Diagnostic LED indications and measuring sockets are provided on each board of evaluator

- **Modem Board**
  a) P1-P4, P12-P14 are set for generating required frequency. P10, P11 Jumpers are set according to code plan as per the frequency allocation for the given track circuit.
  b) After setting of jumpers modem board is plugged in the evaluator.

c) Frequency of track circuit as per frequency plan is adjusted with the help of two trimmers F1 & F2, and adjusted frequency can be measured at sockets given below these trimmers.

d) After generation of code bits in code generator, these code bits are also sent to comparator circuit for comparison at track code in RT board.

e) Carrier frequency will get modulate as per code bit set and this modulated carrier is sent in transmitter board for further process.

- **Transmitter Board**

a) In this board the modulated carrier frequency received from modem card gets amplified and filtered.

b) These filtered signals are sent to tuning unit, further these signals are injected in rails through bonds which are connected to the rails.

c) Gain setting arrangement is provided in this card.

d) With the help of jumpers provided gain can be set to required level.

e) After adjusting the gain setting, TSR test is compulsory.

- **Receiver Board**

a) In this board the modulated carrier frequency received from rails through tuning unit gets filtered and amplified.

b) If track circuit is clear These amplified signals are sent to demodulation in modem board. Where these demodulated data is sent to comparator circuit for comparison with available data.

c) Amplified DC output is also sent to MSR circuit in RT board for evaluation of amplitude of signals.

d) Gain setting arrangement is provided in this card.

e) After adjusting the gain setting, TSR test is compulsory.

- **RT Board**

a) In this board the demodulated data received from modem board is fed to comparator circuit. It is fail-safe comparator.

b) In comparator circuit data will be compared if ok then only,
20 KHz signals generated are amplified and fed to the MSR circuit through delay circuit.

c) MSR circuit – one direct input from RX board and other 20 KHz signals input through comparator comparison.

d) MSR circuit having dynamic AND gate with the two inputs it generates 24 V DC supply and energies(pick up) the track relay.

- **Magneto static relay working MSR**

The MSR-transfers the alternating signal from the first input to the output as and when a continuous voltage having an amplitude greater than a certain threshold present on the second input. The outgoing signal from the Receiver Amplifier is rectified to supply the RMS continuous input. The RMS threshold level is guaranteed intrinsically by its construction characteristics. The RMS output is rectified to enter into the Delay-2 circuit, the output of which generates the occupied / vacant signal.

- **Role of delay circuit**

a) The function of the Delay-1 and Delay-2 circuits is to avoid the undue temporary clearance of the track circuit ensuring, in safety, that the signal clears the track circuit only after the characteristic delay timing.

b) The comparator supplies the Delay 1 circuit. The function of this circuit is to delay the Energisation of the 20 KHz generator for about 1 second only after the continuous comparison of the data transmitted and received.

c) In addition, the delay 1 sets its output almost immediately to zero. If negative pulses of the comparator's output are detected when the bits do not correspond. The magnetic threshold supplies the delay 2 circuits. The function of the circuit is to delay for about 1 sec. The Energisation of the vital output of the equipment (occupied/ vacant) after application of the 20 KHz signal and the level of the signal received at the magnetic threshold.

d) The overall Energisation delay is about 2 seconds in case of Normal layout branch and it is 1 Sec in case of Switch branch.

e) Moreover, the function of the delay-2 is to supply an output of zero or maximum (**12 V** per vital input and **24 V DC** per relay coil) without intermediate values versus user.

- **MSK** - **Minimum Shift Keying**

a) Minimum Shift Keying technique is used.

b) This means that the digital data is divided into even and odd stream.

c) The odd stream consists of b1, b3, b5 bits and even stream consists of b0, b2, b4, and b6 bits. Each bit in both streams is held for two bits interval.

d) In correspondence to "0" bit, the "f - Δf" frequency is transmitted and in correspondence to "1" bit, the "f + Δf" frequency is transmitted by the MSK modulator.

e) Δf = 100 Hz. Data transmission rate is 400 Bits/seconds (Baud).

Track Relay: (TR)

a) Rated voltage is 24 V DC

b) Plug -in-type

c) Non proved type (Metal to carbon relay)

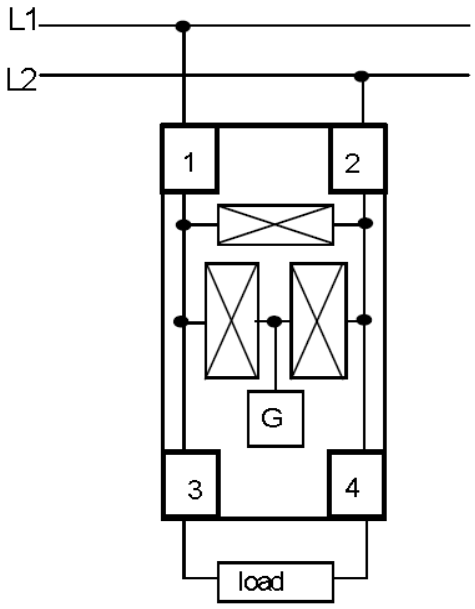
d) Ordinary 'Q' series line Relay QN1

e) Contact configuration 6F/6B.

- **Protection against lightning**

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) This protection is provided by lightning arrester as shown in fig.



- **Power supply unit**

a) The manufacturer will supply the Power supply unit with the input voltage option of either 230 V AC ±10%, 50 Hz ±2% or 110 V AC ±10%, 50 Hz ±2% as per the customer requirement.

b) For each track circuit there is a separate power supply unit, which is mounted at the rear of the rack

c) OUTPUTS-(10 V DC or 50 V DC for TX board),24 V DC DIGI, 24 V DC LOC,19 V DC

d) Only one option from 10 V DC or 50 V DC for TX board is used.

e) Both fuses '10 V DC & 50 V DC' for TX board shall not be plugged in simultaneously.

- **Tuning unit (TU)**

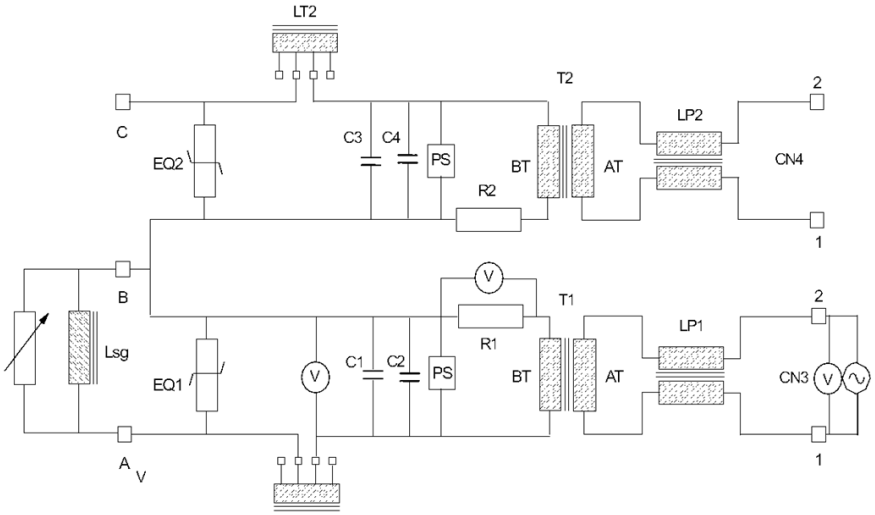
a) The tuning unit is used to tune the electrical separation joint (S bond, terminal bond, or shunt bond) to resonance.

b) For each track circuit frequency a special version is required because a directly adjacent audio-frequency track circuit also affects the tuning when using S bonds,

c) The frequencies of adjacent sections are taken into account when selecting the tuning units.

d) Block diagram of dual frequency TU is given below

Note: (lab TU is of single frequency)



e) CN3, CN4, A, B, C are the names of connections given in Tuning Unit.

- **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 insulation joints.

b) The ESJ consists of a short track section limited at each end by a LC-type tuned circuit, known as TU.

c) ESJ length varies in accordance with, configuration of ALSTOM frequencies and type of bond.

d) This is failure prone area

EVALUATOR READINGS:

	ALSTOM F3 (Frequency 2.9 KHz)			
Board	Description	TERMINALS	Range	Actual readings
TX BOARD	TX power supply input V DC	DC level (50 / 10 V Fuse) ● ●	45-58 V DC at 50V or 9.0 - 11 V DC at 10V	
	TX Square wave output. V AC	V TX ● ●	10-90 V AC at 50v or 4–7.5 V AC at 10v	
	TX Frequency HZ	V_{OUT} ● ●	F_c ±100 Hz	
	TX Filter output. V AC	V_{OUT} ● ●	2- 40 V AC	
RX BOARD	RX power input V DC	24 V DIG ● ●	22 - 28 V DC	
	RX signal input (from track) V AC	V_{IN} ● ●	> 0.300 V AC	
	VRx; when Track Vacant. V AC	VR_X ● ●	0.500 to 0.900 V AC Track vacant	
	VR_X ; when Track Occupied. V AC	VR_X ● ●	0.010 to 0.280 V AC Track occupied	
RT BOARD	+12 V DC	GND ● / +12 V DC ●	11.8 -12.2 V DC	
	-12 V DC	-12 V DC ●	12.2 to 11.8 V DC	
	+5 V DC	+5 V DC ●	4.9 - 5.1 V DC	
	24 V DC LOC	24 V DC LOC ● ●	22 - 27 V DC	
	OUT PUT; when Track Vacant. V DC	OUT PUT ● ●	20 - 28 V DC Track vacant	
	OUT PUT; when Track Occupied. V DC	OUT PUT ● ●	< 0.6 V DC Track occupied	
	OUT MSR; when Track Vacant. V DC	OUT MSR ● ●	4.8 - 7 VDC Track vacant	
	OUT MSR; when Track Occupied. V DC	OUT MSR ● ●	< 4.2 V DC Track occupied	
	20 KHz Voltage. V AC	20 KHz ● ●	25 - 32 V AC	
	Magneto Static relay (MSR)	MSR + ● / MSR - ●	9.8 - 20 V DC Track vacant	

EXERCISE:

1) Draw the Block diagram from board.

2) Which modulation technique is used in ALSTOM AFTC?

3) What is MSR? In which board it is provided?

4) Give details of connections provided in TU

5) Where ‘S’ bonds,’ ‘Alpha’ bonds and ‘Shunt’ bonds are provided?

Date: **Signature of the Trainee**