इरिसेट

गाड़ी डिटेक्शन प्रयोगशाला

प्रयोग **सं :** टी डी एल **- 06**

IRISET

TRAIN DETECTION LABORATORY

EXPERIMENT NO : TDL – 06

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

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

प्राप्तांक
Marks Awarded :

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

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

अनुदेशक के आद्यक्षर
Instructor Initial :

Audio Frequency Track Circuit - SIEMENS (FTGS-46, F9- 4.75 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 sections and non-electrified sections.

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

EQUIPMENT:

Indoor Equipment:

a) Evaluator
b) Protection against lightning (GD/LA)
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:

- SIEMENS audio frequency track circuit operates at one of 12 basic carrier frequencies. These frequencies are arranged in two groups. Groups as per lower and higher frequencies.

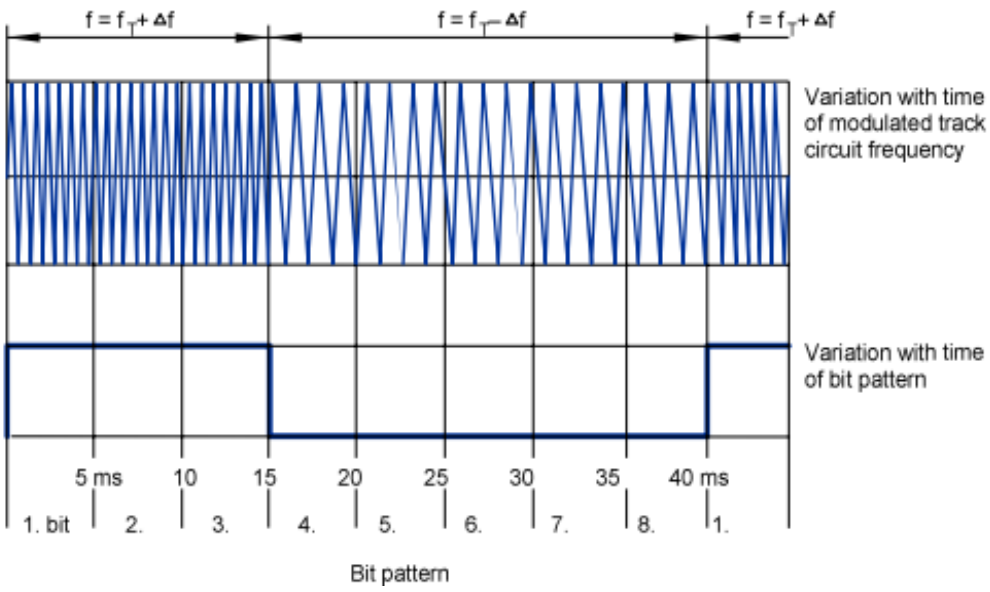
- Higher frequencies are for shorter length track circuits. (FTGS -917)

FTG-S 917	**F1 = 9.5 KHz** **F2 = 10.5 KHz** **F3 = 11.5 KHz** **F4 = 12.5 KHz** **F5 = 13.5 KHz** **F6 = 14.5 KHz** **F7 = 15.5 KHz** **F8 = 16.5 KHz**	**Frequency at gap of 1 KHz**

- Lower frequencies are for longer length track circuits. (FTGS -46)

FTG-S 46	**F9 = 4.75 KHz** **F10 = 5.25 KHz** **F11 = 5.75 KHz** **F12 = 6.25 KHz**	**Frequency at gap of 0.5 KHz**

- The TC transmitter generates a power-limited sinusoidal signal, at one of the above 12 basic frequencies:
- The basic frequency is encoded by "shifting" (FSK principle).
- "Shifting" consists of switching two frequencies with a modulation depth Δf = 64 Hz.
- (Basic frequency) ± 64 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 100 Hz.
- Baud rate = 200 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 of 8 bit 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.
- 15 different bit patterns are available for coding.
- FSK signals are shown in fig given below



- During track clear detection process, the receiving unit will check the following steps: -
  a) Frequency check
  b) Amplitude assessment
  c) Modulation and code check

SYSTEM DESCRIPTION :

- SIEMENS AFTC is designed to detect presence of vehicle on the track.
- It is coded AFTC
- FTGS –(F = Remote Fed, Coded, T = Audio Frequency, G = Track Circuit, S = Siemens)
- 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.
- Frequency plan for more than two parallel lines require interlacing of FTGS 46 and FTGS -917 **{Ref: RB's letter no. 2007/Sig/W/5/I-(AFTC) dated 26.07.2007}**
- 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 (FTGS 917) {Length of track circuit (min:30 m, max:250 m)}
    End fed TC (FTGS 46) {Length of track circuit (min: 250 m, max: 350 m)}
  - Centre fed TC (FTGS 46) {Length of track circuit (min:500 m, max 800 m)}
  - Point zone –max 3 receivers
    {Ref: RB's letter no. 2008/SIG/PER/2 dated 4.09.2008}
- System consists of outdoor equipment at track side and indoor equipments in relay room on a Siemens rack.

EQUIPMENT DESCRIPTION :

- **Evaluator**

It consists of following boards. (This configuration will change according to type of FTGS)

a) Filter Board
b) Amplifier Board.
c) Transmitter Board
d) Receiver-1 Board
e) Demodulator Board.
f) Receiver-2 Board
g) Relay Board

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

The transmitter board

a) It comprises a quartz oscillator which controls frequency generation and modulation.
b) The track circuit frequency is generated by programmable counters, which are gated by the quartz oscillator (16.336 MHz). The dividing ratio of the counters is preset by means of a PROM, the inputs of which are linked with a frequency coding plug.
c) The nominal frequency of the track circuit is determined by a corresponding coding plug. Bit coding plug is used to set the bit pattern
d) The track circuit frequency is switched over by frequency shift keying in accordance with the bit pattern.
e) The time-multiplex output signal is passed to the trackside feed-in point via the amplifier and filter.

Receiver-1 Board

a) The receiver-1 board receives the particular track frequency with in the range its band pass filter evaluates the amplitude of the track signal. When the track is clear, the board passes signal to the demodulator board and electrically isolated DC voltages to the receiver-2 board.
b) On account of the multi-stage input filter, there is a specific circuit board for each frequency.

Demodulator Board

a) The function of the demodulator is to evaluate the bit pattern of the signal received.
b) The demodulator is activated by receiver 1 after the evaluation of the amplitude of the track voltage

c) The demodulator board has a dual-channel design throughout. The two channels of the demodulator are identical in their dynamic behaviour, but have an exactly opposite structure.

d) The two channels differ in the following respects:
   - The logical signals are inverse.
   - The counters run counter to each other.
   - The PROMs are inversely programmed.
   - The input signal is conditioned and triggered in reverse directions.
   - The flip-flops are logically inverse in their operation.

e) These measures prevent common-mode interference which would lead to a false concordance of the two channels.

Receiver-2 Board

a) The receiver-2 board combines the output signals of the receiver-1 board (amplitude frequency and evaluation) and demodulator board (bit pattern check).

b) The resulting outputs signal of this dynamic 'AND' operation is amplified and controls the downstream relay board.

c) For signalling safety reasons, the circuit board is of dual-channel design; the two channels are identical.

d) Each channel comprises three functional units:
   - Clock pulse amplifier:
   - Dynamic AND operation:
   - Output stage for relay

e) The output voltage provides the supply voltage for the relay board and is indicated by LEDs I.L7 and II.L7 respectively

Relay Board

a) The relay board constitutes the interface between the FTG S indoor equipment and the interlocking.

b) It passes the track clear or occupied indication of the track section to the interlocking.

c) Two Siemens K-50 relays are used for this purpose

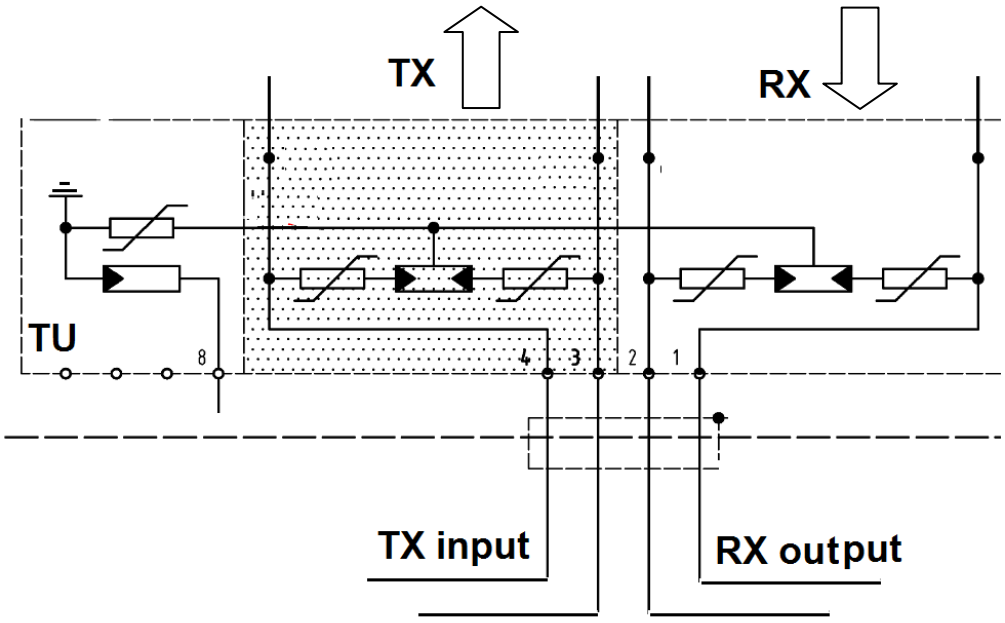
d) Contact configuration 4F/2B. Front contacts of both relays are used in series for final track repeater relay (TPR).

e) Rated voltage 16 V DC

- **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 and connected to the mounting frame via four plug-in cables

c) OUTPUTS - (12 V DC, 5 V DC).

d) For each output sockets are provided with LED indications.

e) Separate fuses for each output with given capacity written on it.

- **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) The transformers provide electrical isolation. In addition, the choice of an appropriate tap allows the feed-out voltage to be matched to the length of cable to the indoor equipment.

e) By setting or removing jumpers, the tuning unit must be programmed according to the application variants feed-in or feed-out.(written on wall board)

- **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.

c) ESJ length varies in accordance with bond conductor cable size and metal of conductor, configuration of FTGS and type of bond.

d) This is failure prone area.

PSU & TU units READINGS:

POWER SUPPLY UNIT (INDOOR)				
S NO	Description of readings		Specified range	Actual readings
1	Power Supply Unit	Input V AC (At rear side terminals)	110 V AC ± 15%	
		Output V DC (At front panel)	12 V DC ± 1 V	
			5 V DC ± 0. 5 V	
		Output ripple content (At front panel)	< 2 V AC	
TUNNING UNIT & TRACK PARAMETERS (FIELD SIDE)				
S NO	Description of readings		terminals	Actual readings
2	Tunning unit (TU) at TX side	TX TU Input V AC	11 & 14	
		TX TU Output V AC	9 & 10	
3	On track (TX side)	TX rail connection V AC	Tx side RAILS	
4	On track (RX side)	RX rail connection V AC	Rx side RAILS	
5	Tunning unit (TU) at RX side	RX TU Input V AC	15 & 20	
		RX TU Output V AC	9 & 10	

- **Evaluator readings:**

FTGS-46 (Frequency 4.75 KHz) & Code M 3.3 (IN DOOR)					
S.NO	BOARD No.	DESCRIPTION	SOCKET No.	RANGE	ACTUAL READING
1	TX transmitter B-30-A2	Tx-board	LED's	L1-Steady L2 & L3 Flickering L8 – Steady L9– (ICSS) No light	Frequency = Code =
2	TX amplifier PB-41	Amplifier I/P V AC	1 and 2	9 to 12 V AC	
3	TX amplifier PB-41	Amplifier O/P V AC	3.1 and 4.1	60 to 90 V AC	
4	TX filter B-42	Filter board O/P V AC	3 and 4	30 to100 V AC To TXTU	
5	RX receiver-I B-33	RX-I I/P V AC	E-1 & E-2	From RXTU -------	
6	RX receiver-I B-33	RX-I CH I I/P V AC	I - 5 & II - 8	≥ 6.5 V AC with Track clear	
7	RX receiver-I B-33	RX-I CH II I/P V AC	II - 5 & II - 8	≥ 6.5 V AC with Track clear	
8	RX receiver-I B-33	RX-I CH I I/P V AC	I - 5 & II - 8	≤ 5 V AC with Track occupied	
9	RX receiver-I B-33	RX-I CH II I/P V AC	II - 5 & II - 8	≤ 5 V AC with Track occupied	
10	RX receiver-I B-33	RX-I CH I O/P V DC	I - 6 & II - 8	12 to 15 V DC	
11	RX receiver-I B-33	RX-I CH II O/P V DC	II - 6 & II - 8	12 to 15 V DC	
12	RX demodulator B-33	Demodulator Input – CH I V AC	I - 7 & II - 8	1. 3 to 2 V AC	
13	RX demodulator B-33	Demodulator Input – CH II V AC	II -7 & II - 8	1. 3 to 2 V AC	
14	RX receiver-II B-39/34	Relay voltage CH – I V DC	I - 11 & I - 12	16.5 ± 1 V DC	
15	RX receiver-II B-39/34	Relay voltage CH –II V DC	II-1& II-12	16.5 ± 1 V DC	

EXERCISE:

1) Draw the Block diagram from board.

2) Which modulation technique is used in SIEMENS AFTC?

3) In which board gain adjustment is provided?

4) Give details of connections provided in TU

   a) Standard looping in 46FTGS TX TU

   b) Standard looping in 46FTGS RX TU

   c) Standard looping in 917FTGS TX TU

   d) Standard looping in 917FTGS RX TU

   e) Voltage adjustment in RX TU
      - Low voltage ----------
      - Medium voltage ----------
      - High voltage ----------

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

Date: **Signature of the Trainee**