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दिनांक			अनुदेशक का आधाक्षर
Date	:	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _	Instructor Initial:

EXPERIMENT No. CT -2

Study of DTMF Way Station Equipment

Objective : To study the features and working of the Way Station Equipment used in railway control communication.

Function : The function of this equipment is to provide

- DTMF 2-digit code detection and buzzer operation
- Control telephone facility to the SM/ASM etc.

Description: The DTMF way station equipment comprises of

- The DTMF selective call decoder and buzzer
- The control Telephone and
- Power supply unit.

The DTMF Selective Call (code) Decoder

It is a solid state digital circuit using CMOS ICs. It consists of the following components: (Ref. M/s Tummala Equipment)

1) Two Matching Transformers TR1 & TR2.

TR1 - This connects controller's speech on Tx pair to way station Receive and

TR2 - This connects way station speech Trans onto controller's Rx pair.

2) IC 8870 - DTMF Tone decoder.

This converts the digit information received in Dual Tone- form into 4-bit binary.

3) IC 4514 - 4 bit Decoder.

This converts the 4 bit binary value from 8870 into discrete form and outputs onto one of the 16 output lines.

4) Two DIP switches (10 -way)

The 2 digit way station code (viz., 01 through 99) is set by using these two DIP switches, one for each digit. The first 10 outputs of IC 4514 are connected to both of these switches in parallel.

5) IC 4538 / 74C221 – Dual Mono-shot

The decoded first digit signal of the received station code, from IC 4514, is connected to the Trig- input of one of these Mono-shots through the closed contact of the First-digit (FD) DIP switch. This gives a time delay of nearly 0.5 seconds.

6) IC 4027 Dual J-K Flip-flop or 4013- Dual D Flip-Flop.

The decoded First -digit (FD) signal in the form of Mono-shot outputs, Q and $\overline{Q}$ of IC 4538, is connected respectively to the J & K inputs of one J-K Flip-flop in this IC . The decoded second digit signal , from IC 4514, is connected through the closed contact of the Second-digit (SD) DIP switch to the Clock-in of the same J-K Flip-flop as clock pulse for setting the flip-flop.

Similarly, a 2 digit Group-call code (viz., AA, BB, CC and DD) through a single 4-way DIP switch or the 2 digit General-call code (GG) ,directly, is applied to the second pair of Mono-shot and J-K flip-flop in the ICs 4538 and 4027.

The Q outputs of the two J-K flip-flops in IC 4027, are diode- OR-ed and connected to a mono in another IC4538. The Q output of this mono gives a timing pulse of 3 to 5 seconds for ringing a Buzzer and also for enabling an RBT (ring back tone) for the controller and its Q output resets the J-K flip –flops.

7) IC 4093 – Quad 2-input NAND Gate.

This is used as an RBT (ring back tone) generator

8) LM 386 – Dual Op-amp.

One each of these Op-amps is for both Tx and Rx speech amplification.

9) IC 7805 – 5V DC Regulator.

Provides 5V DC for all ICs except for LM386, which uses 12VDC

10) Relay 12 V DC

This relay operates when PTT switch, on the handset of the way station Control

Telephone, is pressed and connects SM's speech to Controller's Rx pair. In Tummala make equipment it is a miniature DIP relay.

NOTE : If more than one contact is ON in any DIP switch

- The code becomes invalid and ringing does not take place in M/s Tummala make equipment.
- But, in case of other makes the ringing takes place with both the codes

Way Station DTMF Decoder Circuit

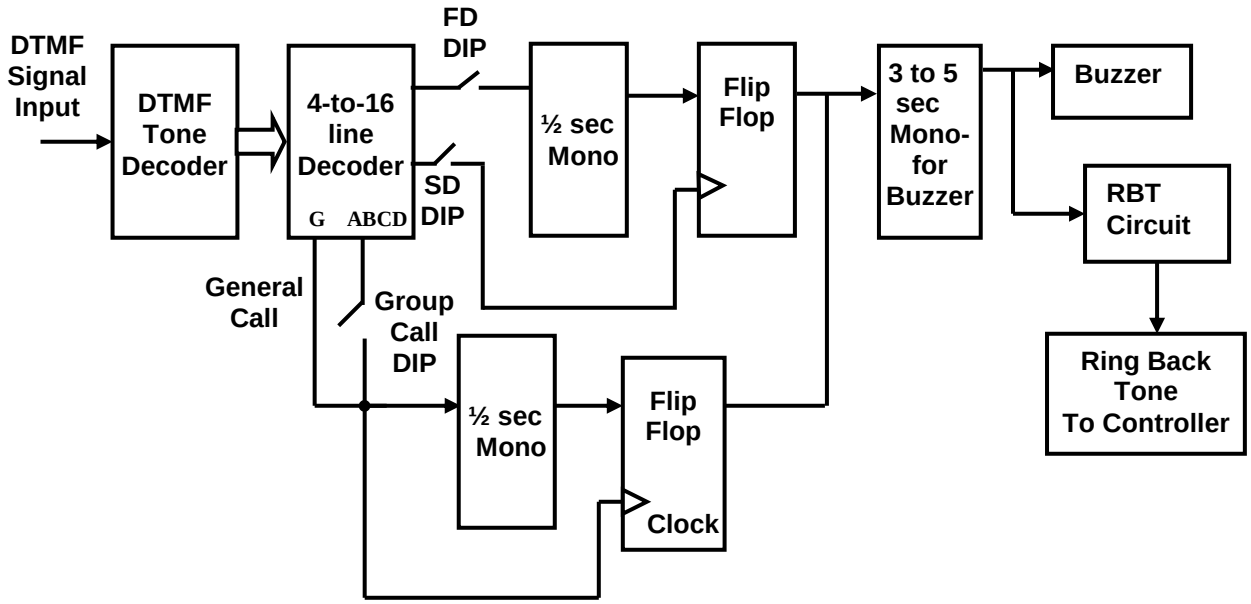

Fig.1 - Block Diagram of Way Station DTMF Decoder Circuit

The Way Station Control Telephone

This telephone instrument consists of

1) A Handset with
   - (a) a *Carbon microphone* for Transmitter and
   - (b) a *Split armature* type Receiver
2) A telephone unit with
   - (a) a Piezo buzzer and
   - (b) an LED for visual indication

In case of a call from the controller in addition to the audible buzzer there is a visual indication of either

- (a) a **flashing** *LED* as in Tummala make or
- (b) a **steady light** *LED* as in Epsilon make

In Tummala make for providing flashing indication a circuit with 555 timer

and an SCR is used, inside the telephone

NOTE: Both these units ie., the way station DTMF signaling decoder and Control telephone can be either 2w or 4w type

Power Supply Unit

This provides 12 V DC @ 100 mA . It consists a rectifier and charger with a built-in 12 V maintenance-free battery. On the front panel indications are provided for AC mains

1) Charging of battery and
2) Battery low

Specifications of Way Station Equipment

1) Operating Voltage : 12 V DC ±10%
2) Operating Current : 20 – 60 mA
3) Signaling : Standard DTMF Signaling
4) Code Setting : Using two DIP switches
5) Min. Detectable signal level : -25 dBm

Speech characteristics

1) Trans output : 0 dBm (nominal)
2) Trans gain variation : 12 dB from nominal
3) Insertion Loss (Trans) : 2.0 dB max.
4) Receive min. level : - 30 dBm
5) Receive max. level : + 10 dBm
6) Rec. Level adjustment : 12 dB from nominal
7) Insertion Loss (Rec) : Less than 0.5 dB

Exercise:

1) Call a way station with a Group-Code and observe
   (a) Whether ringing at the way station takes place only on receiving the first digit of group code? If not explain why when there is only one DIP switch used for both FD and SD digits, in the group call circuit?

Review Questions

2) What is need of mono-shots in the way station DTMF decoder unit?
3) Why RBT signal is required in the way station equipment?
4) Suppose an SM wants more ringing period in his control telephone, can you provide it ? If yes how? And if no why?