



PRODUCT NAME

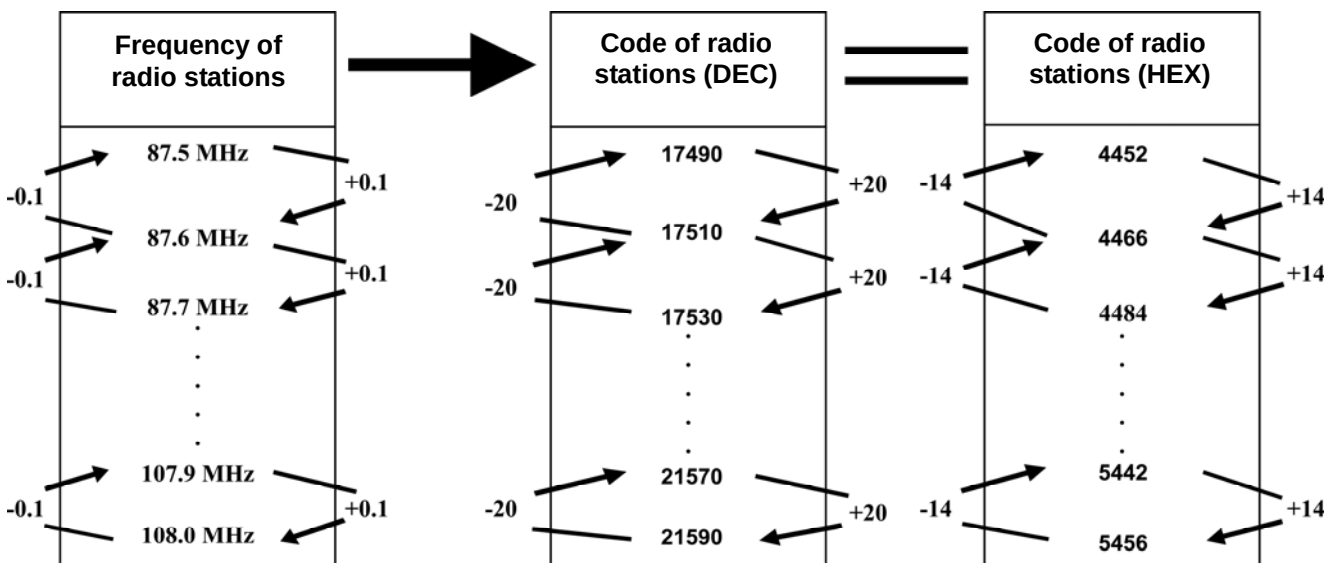
TR1001

TITLE

- I. The relationship between the values of programmable counter and the frequency of radio stations.
- II. The flow chart that shows the steps of searching radio stations within reception range.
- III. Using LD signals to tell whether a radio station has been successfully locked down.
- IV. Lowering the power consumption of MCU when shutting down the power of TR1001.

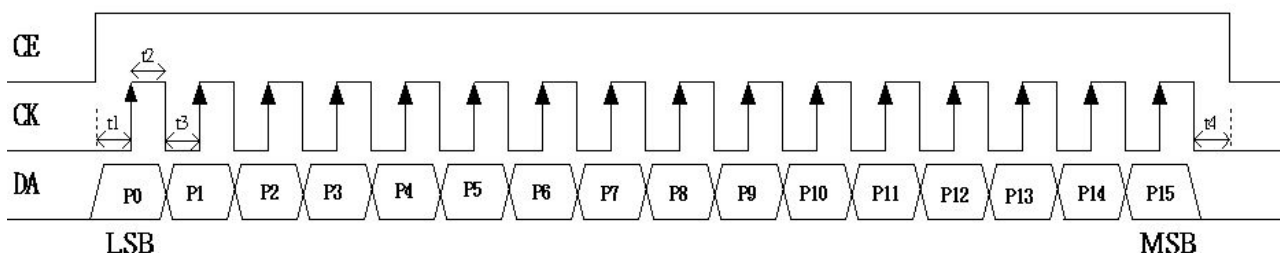
APPLICATION NOTE

- I. **The relationship between the values of programmable counter and the frequency of radio stations:**
 1. The voltage range for the operation of TR1001 is $V_{DD} = 2.4V \sim 3.6V$, and the crystal within the range of $1MHz \sim 12MHz$ can be used.
 2. The frequency of the radio stations can be configured to within the range between $87.5 MHz$ to $108.0 MHz$, and the interval in the frequency of the radio stations is $0.1 MHz$, so a total of 206 radio stations can be configured. (The actual operational frequency of TR1001 is between $87.45 MHz$ to $107.95 MHz$. For the conversion of operational frequency, please refer to [5. Instruction on the configuration of the programmable counter]).
 3. For the radio frequency between $87.5 MHz$ to $108.0 MHz$, the range of programmable counter that needs to be configured is $17490 \sim 21590$, when the frequency interval is $\pm 0.1MHz$, the variation value for the programmable counter is ± 20 . An example is provided below:



4. Serial data transfer format :

Using the serial I/O of TR1001 to transfer the values of programmable counter.



- (1). CE signal: The period of time from the beginning of signals (rising) to the end of signals (falling) must include 16 CK clock.
 - (2). CK signal: DA signals will latch into TR1001 at the CK rising edge.
 - (3). DA signal: When sending the values of programmable counter, it needs to start from LSB.
 - (4). t_1, t_2, t_3, t_4 time: $> 4\mu s$
 - (5). After completing the sending of 16 bits data, the signals of CE, CK, and DA must be kept at the low status.
5. How to calculate the configurable values of programmable counter:
 $[P15.....P0] = N$ (the configurable value of programmable counter:
 $1600(\text{dec}) < N < 65280(\text{dec})$)

For example:

If $N=17490$;

Crystal frequency = 4MHz;

Reference frequency = $4\text{MHz}/800(\text{fixed}) = 5\text{kHz}$.

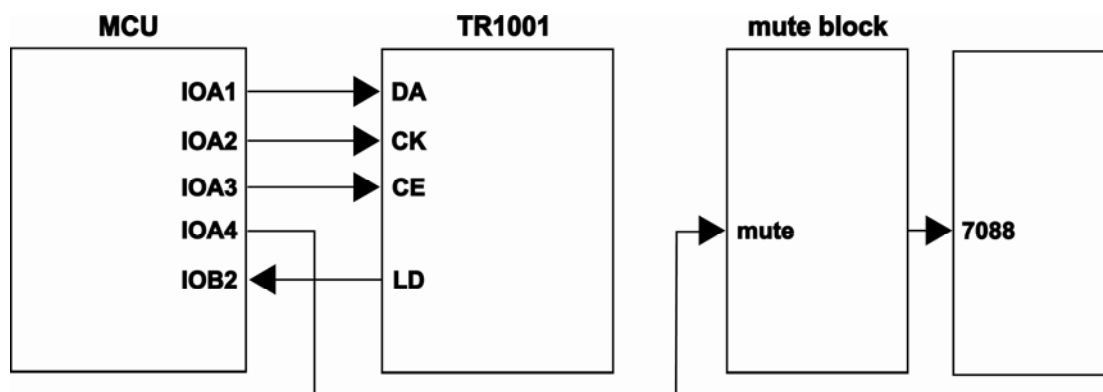
Synthesis frequency $f = 5\text{kHz} \times N = 5\text{kHz} \times 17490 = 87.45\text{MHz}$

Note:

In the application of TR1001 + 7088, the intermediate frequency we used is
 $F_{if} = 87.5\text{MHz} - 87.45\text{MHz} = 50\text{KHz}$

6. Hardware: (as the diagram shown below)

MCU is used to control TR1001 in order to gain further control of 7088 tuner IC.



7. In the example of programming shown below, the 4 bit MCU of tenx technology inc. is utilized to control TR1001 in locking down the radio frequency at 87.5 MHz [4452(hex)] (using the IOA port to transfer CE, CK, and DA signals, while also defining IOA3=CE, IOA2=CK and IOA1=DA)

```
.data
    data0    equ    00h           ;defining four registers, which are
                                   data0~data3, for saving the code of radio
                                   stations
    data1    equ    01h           ;data3 is MSB ; data0 is LSB
    data2    equ    02h
    data3    equ    03h

    serial_signal equ    04h       ;defining the transfer of CE, CK, DA signals
    data_times  equ    05h
    data_buff 0 equ    06h
    data_buff 1 equ    07h
    .endd

.code
Start:
    lds    data0 , 02H           ;initializing data0~data3(4452)
    lds    data1 , 05H
    lds    data2 , 04H
    lds    data3 , 04H

    lds    serial_signal, 00h     ;initializing CE=0, CK=0, DA=0, and send out
                                   signals from IOA port

    opa    serial_signal,
    spa    1fh

    lds    70H, 00h              ;moving the content of data0 register to the
                                   data_buff0 register

    mvl    70H
    mvh    71H
    mvu    70H
    lda#    @hl
    sta    data_buff0
    lds    data_times,04H        ;code data total 16 bit
    lds    data_buff1,04H        ;set data_times *data_buff1=16
    call    send_clk

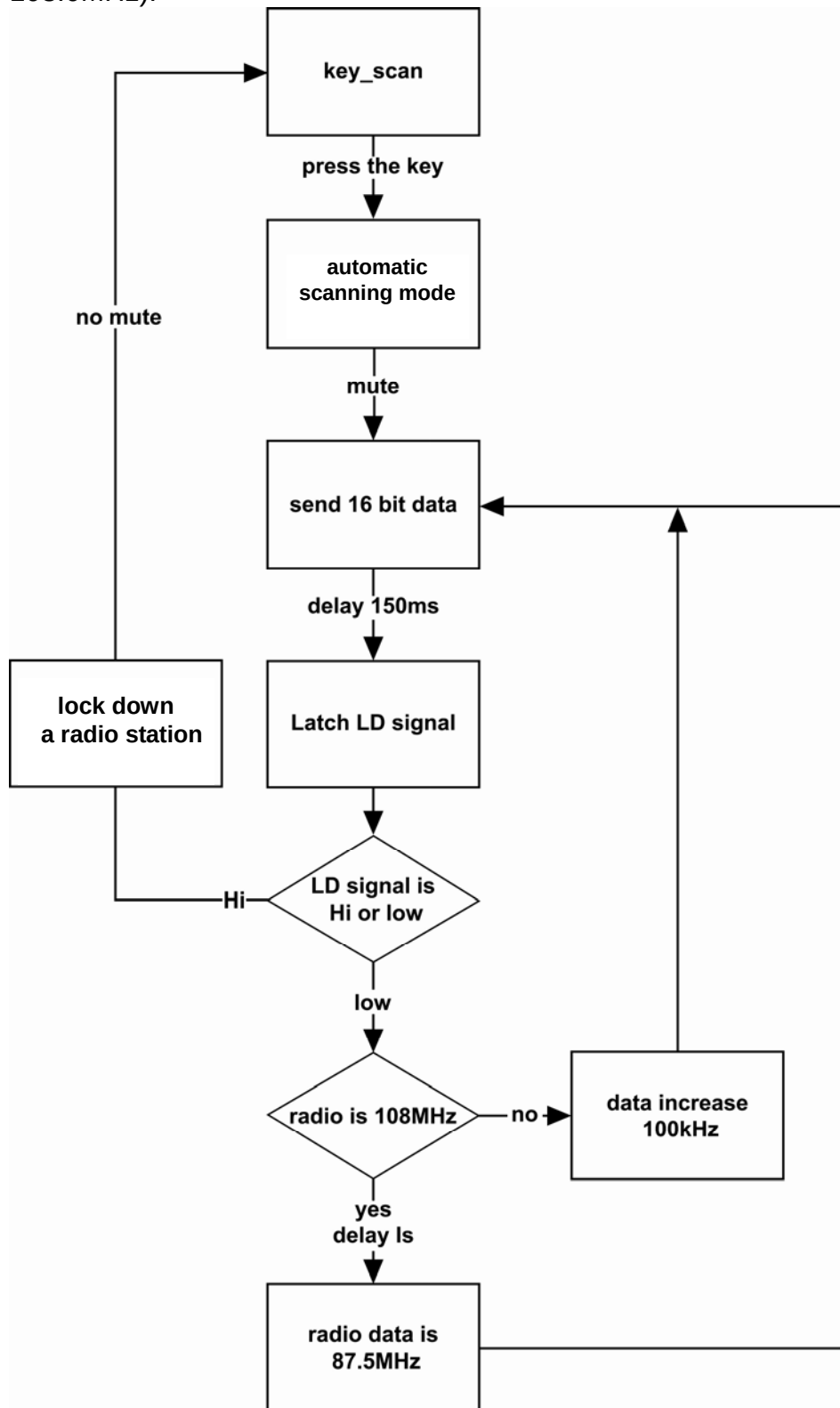
    .endc
;*****
send_clk:                          ;the send_clk subroutine function sends out
                                   the content of data0~data3 registers from
                                   IOA port in the method of serial mode.

send_clk0:
    lda    data_buff0
    jb0    send_clk1
    lds    serial_signal,04h
```

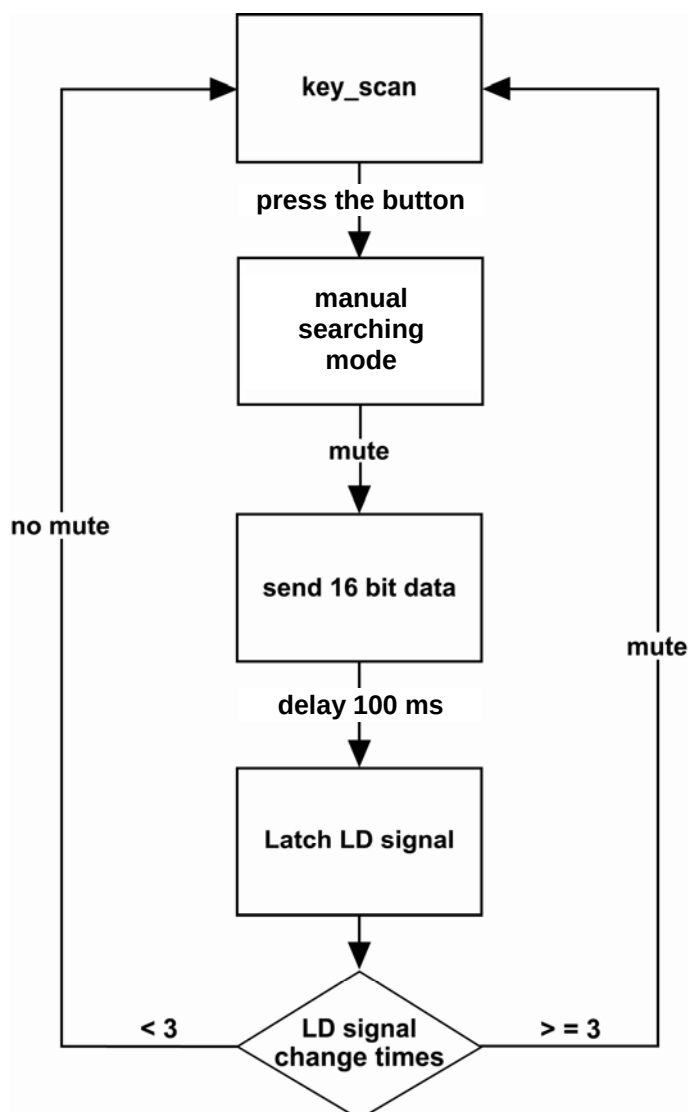
```
        opa    serial_signal
        lds    serial_signal,06h
        jmp    send_clk2
send_clk1:
        lds    serial_signal,05h
        opa    serial_signal
        lds    serial_signal,07h
        nop
send_clk2:
        dec*   data_buff1
        jz     send_clk3
        nop
        nop
        nop
        opa    serial_signal
        sr0    data_buff0
        nop
        nop
        jmp    send_clk0
send_clk3:
        lds    data_buff1,04h
        dec*   data_times
        jz     send_clk4
        opa    serial_signal
        lda#   @hl
        sta    data_buff0
        nop
        jmp    send_clk0
send_clk4:
        opa    serial_signal
        nop
        nop
        nop
        nop
        nop
        nop
        nop
        lds    70h,04h
        opa    70h
        nop
        nop
        nop
        nop
        nop
        nop
        nop
        lds    70h,00h
        opa    70h
        rts
```

II. The flow chart that shows the steps of searching radio stations within reception range.

1. The flow chart of the automatic scanning mode (it is recommended to start scanning frequency from 87.5MHz and continues upwards until it reaches 108.0MHz):



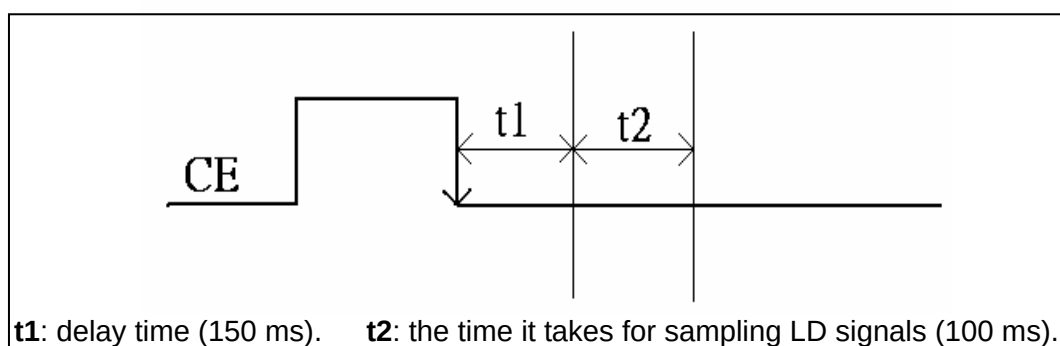
2. The flow chart that shows the steps of searching radio stations within reception range:



III. Using LD signals to tell whether a radio station has been successfully locked down:

1. The automatic scanning mode:

- (1). Before starting the automatic scanning mode for searching radio stations, please turn off the audio output first, and turn it on after a radio station has been locked down.
- (2). The sampling of LD signal cannot begin until the ending of CE signal (falling edge) has occurred and a delay of 150ms has passed.
- (3). The time it takes for sampling LD signal is configured at 100ms, within this period of time, it is necessary to execute the sampling of LD signal every 1ms on average (**Note 1**). If there was a single occurrence of “Low” for the outcome of LD signal sampling, it means no station has been locked down yet; but if the outcome of LD signal sampling is always “Hi”, it means a radio station has been locked down (Please refer to **FIG. 1**).



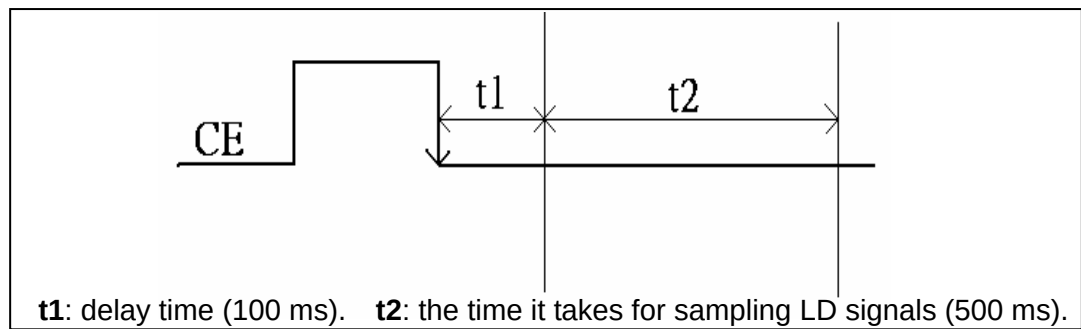
(FIG. 1)

Note 1:

The limit of 1ms is not fixed and can be adjusted by the customers on their own. But it should be noted that if the sampling time of 100ms is extended excessively, incidence of locking down the wrong radio stations could occur.

2. The manual searching mode:

- (1). The sampling of LD signal cannot begin until the ending of CE signal (falling edge) has occurred and a delay of 100ms has passed.
- (2). The time it takes for sampling LD signal is configured at 500ms, within this period of time, it is necessary to execute the sampling of LD signal every 1ms on average (**Note 2**). When sampling, it is necessary to determine the number of times the LD signal has changed from 1 $\rightarrow$ 0 or 0 $\rightarrow$ 1; if the number of such changes is more than 3 times, please turn off the audio output.
- (3). If the status of LD signal sampling has remained at “Low” in 500ms of sampling time (as in (2) described above), turn off the audio output (please refer to **FIG. 2**).



(FIG. 2)

Note 2:

The limit of 1ms is not fixed and can be adjusted by the customers on their own. But it should be noted that if the sampling time of 500ms is extended excessively, it becomes more difficult to solve the problem of noises (ie. radio cackle).

IV. Lowering the power consumption of MCU when shutting down the power of TR1001:

1. There are 5 signals that connect MCU to TR1001, they are CD, CK, DA, LD, and mute.
2. After switching off the power of TR1001, the status of the 5 signals between MCU and TR1001 can be set at "Low"; this can reduce unnecessary power consumption on the MCU I/O pins.