

## CMOS 4-BIT MICROCONTROLLER

## TMP47C232AN, TMP47C432AN

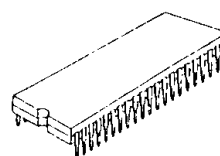
The 47C232A/432A are the high speed and high performance 4-bit single chip microcomputers based on the TLC5-47 CMOS series with D/A converter (Pulse width modulation) output and Auto frequency control signal input, and are suitable application in digital tuning systems for TV sets.

| PART No.    | ROM          | RAM         | PACKAGE | PIGGYBACK   |
|-------------|--------------|-------------|---------|-------------|
| TMP47C232AN | 2048 × 8-bit | 128 × 4-bit | SDIP42  | TMP47C932AE |
| TMP47C432AN | 4096 × 8-bit | 256 × 4-bit |         |             |

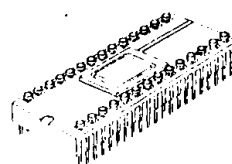
## FEATURES

- ◆ 4-bit single chip microcomputer
- ◆ Instruction execution time: 1.9  $\mu$ s (at 4.2 MHz)
- ◆ 90 basic instructions
- ◆ Table look-up instructions
- ◆ 5-bit to 8-bit data conversion instruction
- ◆ Subroutine nesting: 15 levels max.
- ◆ 5 interrupt sources (External: 2, Internal: 3)  
All sources have independent latches each,  
and multiple interrupt control is available.
- ◆ I/O port (36 pins)
  - Input 2 ports 5 pins
  - Output 2 ports 8 pins
  - I/O 6 ports 23 pins
- ◆ Interval Timer
- ◆ Two 12-bit Timer/Counters  
Timer, event counter, and pulse width measurement mode
- ◆ D/A converter (Pulse width modulation) outputs
  - 14-bit resolution 1 channel
  - 6-bit resolution 3 channels
- ◆ Three levels input 1 pin  
Auto frequency control signal (S-shaped curve) detection
- ◆ High current outputs  
LED direct drive capability (typ. 20 mA × 8 bits)
- ◆ Hold function  
Battery/Capacitor back - up
- ◆ Real Time Emulator: BM47217A

SDIP42

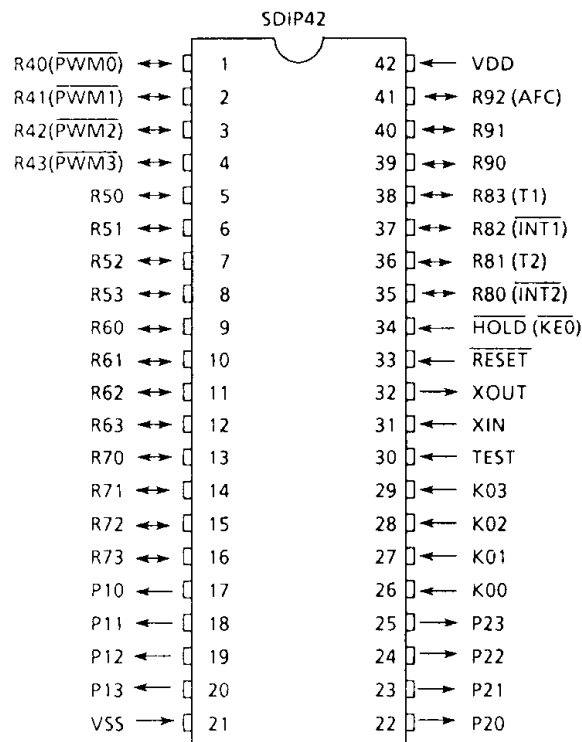
TMP47C232AN  
TMP47C432AN

SDIC42

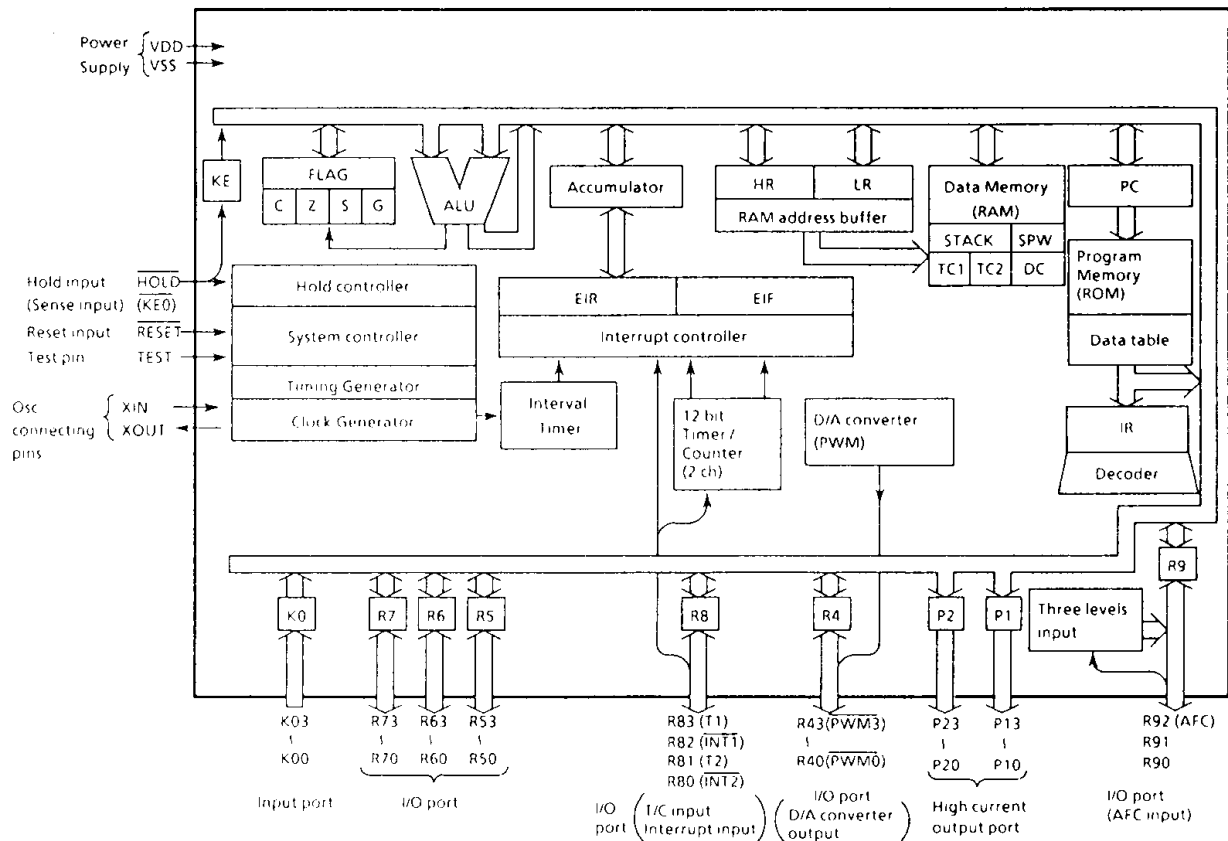


TMP47C932AE

## PIN ASSIGNMENT (TOP VIEW)



## BLOCK DIAGRAM



## PIN FUNCTION

| PIN NAME                   | Input / Output | FUNCTIONS                                                                                                                          |                                |
|----------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| K03 - K00                  | Input          | 4-bit input port                                                                                                                   |                                |
| P13 - P10                  | Output         | 4-bit output port with latch.                                                                                                      |                                |
| P23 - P20                  |                | 8-bit data are output by the 5-bit to 8-bit data conversion instruction [OUTB @HL]                                                 |                                |
| R43 (PWM3)<br>- R41 (PWM1) | I/O (Output)   | 4-bit I/O port with latch.<br>When used as input port<br>or pulse width modulation outputs pins,<br>the latch must be set to "1"   | 6-bit D/A converter output     |
| R40 (PWM0)                 |                |                                                                                                                                    | 14-bit D/A converter output    |
| R53 - R50                  | I/O            | 4-bit I/O port with latch.                                                                                                         |                                |
| R63 - R60                  |                | When used as input port, the latch must be set to "1"                                                                              |                                |
| R73 - R70                  |                | Every bit data is possible to be set, cleared and tested by the manipulation of the L - register indirect addressing.              |                                |
| R83 (T1)                   | I/O (Input)    | 4-bit I/O port with latch.                                                                                                         | Timer/Counter 1 external input |
| R82 (INT1)                 |                | When used as input port, external<br>interrupt input pin, or Timer/Counter<br>external input pin, the latch must be set<br>to "1". | External interrupt 1 input     |
| R81 (T2)                   |                |                                                                                                                                    | Timer/Counter 2 external input |
| R80 (INT2)                 |                |                                                                                                                                    | External interrupt 2 input     |
| R92 (AFC)                  | I/O(Input)     | 3-bit I/O port with latch.                                                                                                         | AFC input                      |
| R91 - R90                  | I/O            | When used as input port, the latch must<br>be set to "1".                                                                          |                                |
| XIN                        | Input          | Resonator connecting pins.                                                                                                         |                                |
| XOUT                       | Output         | For inputting external clock, XIN is used and XOUT is opened.                                                                      |                                |
| RESET                      | Input          | Reset signal input                                                                                                                 |                                |
| HOLD (KE0)                 | Input (Input)  | Hold request/release signal input                                                                                                  | Sense input                    |
| TEST                       | Input          | Test pin for out - going test. Be opened or fixed to low level.                                                                    |                                |
| VDD                        | Power supply   | + 5V                                                                                                                               |                                |
| VSS                        |                | 0V (GND)                                                                                                                           |                                |

## OPERATIONAL DESCRIPTION

The 47C232A/432A are similar to the 47C233A/433A except the port R4 ( $\overline{PWM}$ ) is Tri-state and the port R92 is the AFC port. And the notes for use of the 47C932A (PIGGYBACK) are the same as the 47C933A.

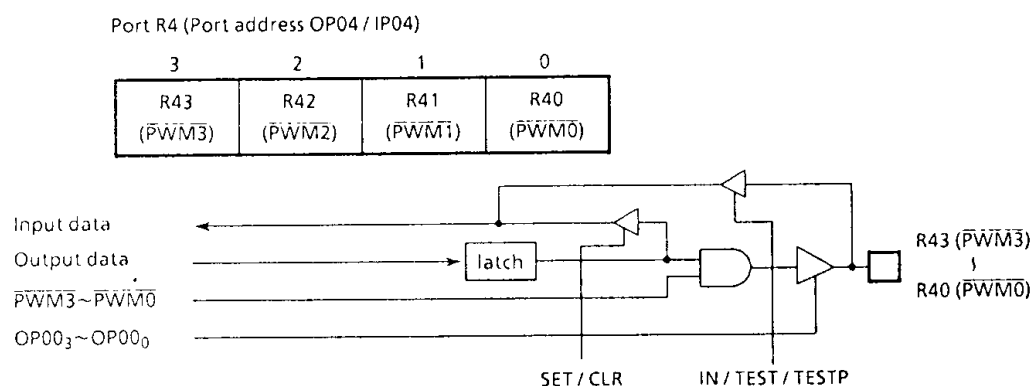
## (1) Port R4 (R43-R40)

This is a 4 bit I/O port with latch. It is a port common to D/A converter (pulse width modulation) output port. R4 port output buffers are Tri-state, and each bit of them can be controlled independently by the program.

Controlling the Tri-state is performed by the command register accessed as port address OP00.

When some bit of the OP00 is 0, the corresponding bit of the output buffers becomes high-impedance state. The command register should be set to "1111<sub>B</sub>" when the port is used as output port.

The output latch should be set to "1" when the port is used as  $\overline{PWM}$  output port, the  $\overline{PWM}$  output should be set to "H" level ( $\overline{PWM}$  data is all "0") when the port is used as R4 port. The output buffers should be set to high impedance state when the port is used as input port.

Figure 1. Port R4 ( $\overline{PWM}$ )

## (2) Port R9 (R92-R90)

The 3-bit I/O port with latch. The output latch should be set to "1" when the port is used as input port. The latch should be initialized to "1" during reset.

R92 (AFC) port is commonly used as R92 output and AFC input for the auto frequency control signal. AFC input is internally connected to two invertors, the threshold voltage of which are different from each other (the one is typically 2 volts, the other is typically 3 volts), and the outputs of these can be read through the higher 2 bits of port address IP09. Therefore, the input voltage of the AFC input can be recognized within the accuracy of 3 voltage ranges. The correspondence of the relation among the input voltage and two threshold voltages to the data of the higher 2 bits of IP09.

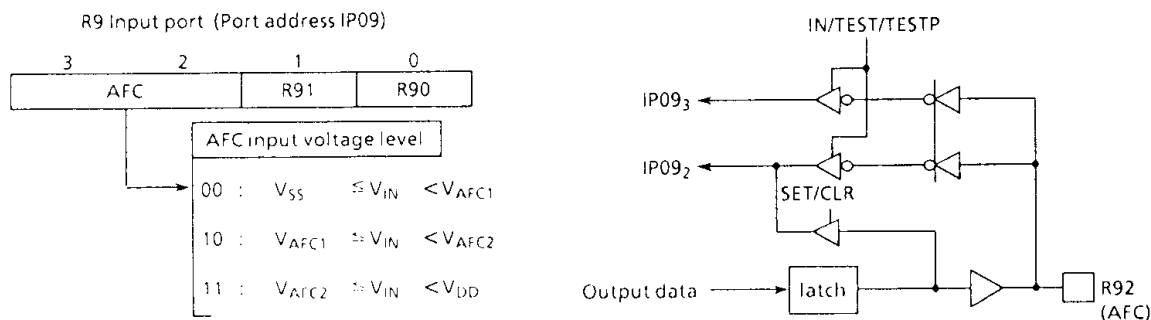


Figure 2. IP09 Input Data (the higher 2 bits) and AFC Input Voltage Level