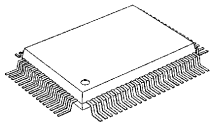
CMOS 4-Bit Microcontroller

# TMP47P847VF

The TMP47P847V is the system evaluation LSI of TMP47C647/847 with 64 Kbits one-time PROM. The TMP47P847V programs / verifies using an adapter socket to connect with PROM programmer, as it is in TMM2764AD.
In addition, the TMP47P847V and the TMP47C647/847 are pin compatible. The TMP47P847V operates as the same as TMP47C647/847 by programming to the internal PROM.

| Part No. | ROM | RAM | Package | Adapter Socket |
|---|---|---|---|---|
| TMP47P847VF | OTP<br>8192 × 8-bit | 512 × 4-bit | P-QFP80-1420-0.80B | BM1135 |

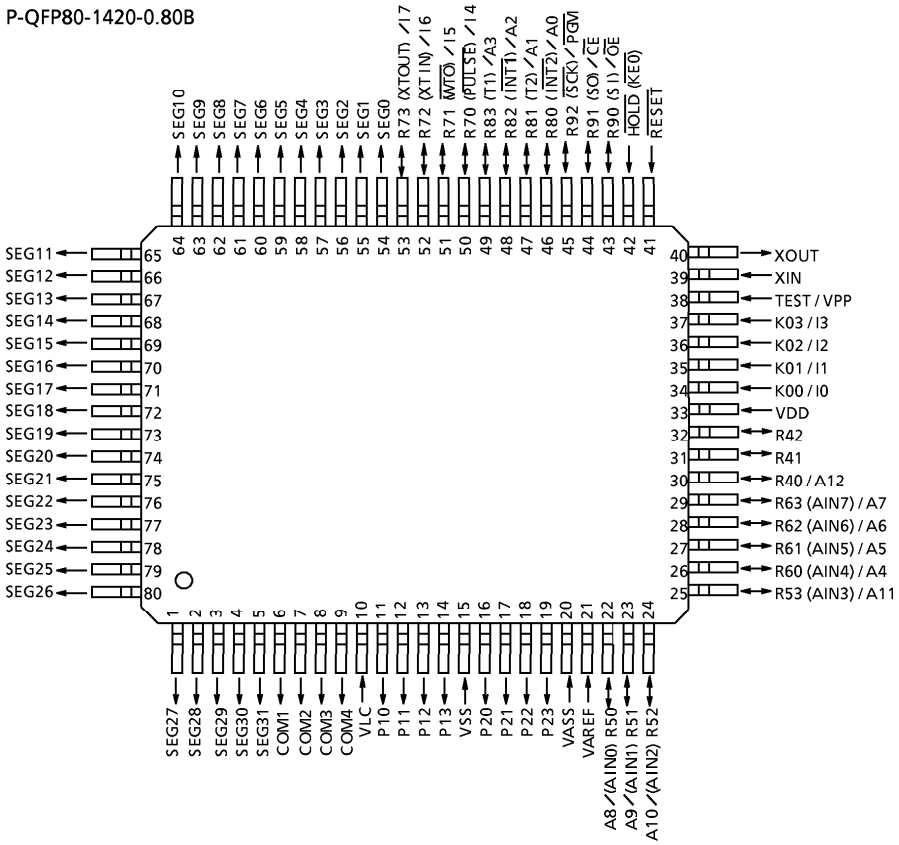
P-QFP80-1420-0.80B



TMP47P847VF

000707EBA1

## Pin Assignment (Top View)



## Pin Function

The TMP47P847V has MCU mode and PROM mode.

(1) MCU mode

The TMP47C847 and the TMP47P847V are pin compatible (TEST pin for out-going test, Be fixed to low level).

(2) PROM mode

| Pin Name | Input / Output | Functions | Pin Name (MCU Mode) |
|---|---|---|---|
| A12 | Input | Address inputs | R40 |
| A11 to A8 | | | R53 to R50 |
| A7 to A4 | | | R63 to R60 |
| A3 to A0 | | | R83 to R80 |
| I7 to I4 | I/O | Data inputs / outputs | R73 to R70 |
| I3 to I0 | | | K03 to K00 |
| $\overline{PGM}$ | Input | Program control input | R92 |
| $\overline{CE}$ | | Chip Enable input | R91 |
| $\overline{OE}$ | | Output Enable input | R90 |
| VPP | Power supply | + 12.5V / 5V (Program supply voltage) | TEST |
| VCC | | + 5V | VDD |
| VSS | | 0V | VSS |
| SEG31 to SEG0 | Output | Open | |
| COM4 to COM1 | | | |
| VLC | Power supply | | |
| P13 to P10 | I/O | Be fixed to low level | |
| P23 to P20 | | | |
| R42, R41 | | | |
| $\overline{RESET}$ | Input | PROM mode setting pins. Be fixed to low level. | |
| $\overline{HOLD}$ | Input | | |
| XIN | Input | Resonator connecting pins | |
| XOUT | Output | | |
| VAREF | Power supply | Be fixed to VSS level | |
| VASS | | | |

## Operational Description

The following is an explanation of hardware configuration and operation in relation to the TMP47P847V. The TMP47P847V is the same as the TMP47C647/847 except that an EPROM or OTP is used instead of a Mask ROM.

### 1. Operation Mode

The TMP47P847V has an MCU mode and a PROM mode.

### 1.1 MCU mode

The MCU mode is set by fixing the TEST / VPP pin at the "L" level. Operation in the MCU mode is the same as for the TMP47C647/847, except that the TEST / VPP pin does not have pull-down resistor and cannot be used open.

#### 1.1.1 Program memory

The program storage area is the same as for the TMP47C847. Data conversion tables must be set in two locations when using the TMP47P847V to check TMP47C647 operation.

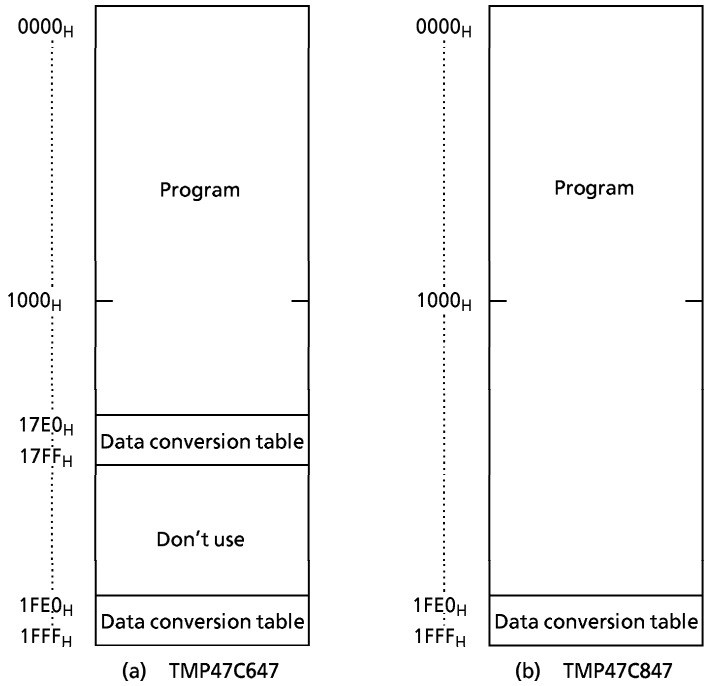



Figure 1-1. Program area

#### 1.1.2 Data memory

The TMP47P847V has 512x4-bit data memory banks (RAM).

When using the TMP47P847V as a TMP47C647 evaluator, do not write data to address $80_H$ and following, even though the bank1 addresses are 00 to $FF_H$. There is no necessary to take into consideration a special function Shared area because one is built in bank0.

## Electrical Characteristics

### Absolute Maximum Ratings ($V_{SS}$ = 0 V)

| Parameter | Symbol | Pins | Ratings | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | | – 0.3 to 7 | V |
| Program Voltage | $V_{PP}$ | TEST / VPP pin | – 0.3 to 13.0 | V |
| Input Voltage | $V_{IN}$ | | – 0.3 to $V_{DD}$ + 0.3 | V |
| Output Voltage | $V_{OUT1}$ | R4, R5, R7, Push-pull ports | – 0.3 to $V_{DD}$ + 0.3 | V |
| | $V_{OUT2}$ | P1, P2, R6, R8, R9 ports | – 0.3 to 10 | |
| Output Current (per 1 pin) | $I_{OUT1}$ | Ports P1, P2 | 15 | mA |
| | $I_{OUT2}$ | Ports R4 to R9 | 3.2 | |
| Output Currnent (Total) | $\Sigma I_{OUT}$ | Ports P1, P2 | 60 | mA |
| Power Dissipation [Topr = 70°C] | PD | | 600 | mW |
| Soldering Temperature (time) | Tsld | | 260 (10 s) | °C |
| Storage Temperature | Tstg | | – 55 to 125 | °C |
| Operating Temperature | Topr | | – 40 to 70 | °C |

*Note: The absolute maximum ratings are rated values which must not be exceeded during operation, even for an instant. Any one of the ratings must not be exceeded. If any absolute maximum rating is exceeded, a device may break down or its performance may be degraded, causing it to catch fire or explode resulting in injury to the user. Thus, when designing products which include this device, ensure that no absolute maximum rating value will ever be exceeded.*

### Recommended Opeating Conditions ($V_{SS}$ = 0 V, Topr = – 40 to 70°C)

| Parameter | Symbol | Pins | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | | In the Normal mode | 4.5 | 6.0 | V |
| | | | In the SLOW mode | 2.7 | | |
| | | | In the SLEEP mode | | | |
| | | | In the HOLD mode | 2.0 | | |
| Input High Voltage | $V_{IH1}$ | Except Hysteresis Input | $V_{DD} \geqq 4.5V$ | $V_{DD} \times 0.7$ | $V_{DD}$ | V |
| | $V_{IH2}$ | Hysteresis Input | | $V_{DD} \times 0.75$ | | |
| | $V_{IH3}$ | | $V_{DD} < 4.5V$ | $V_{DD} \times 0.9$ | | |
| Input Low Voltage | $V_{IL1}$ | Except Hysteresis Input | $V_{DD} \geqq 4.5V$ | 0 | $V_{DD} \times 0.3$ | V |
| | $V_{IL2}$ | Hysteresis Input | | | $V_{DD} \times 0.25$ | |
| | $V_{IL3}$ | | $V_{DD} < 4.5V$ | | $V_{DD} \times 0.1$ | |
| Clock Frequency | fc | XIN, XOUT | | 0.4 | 6.0 | MHz |
| | fs | XTIN, XTOUT | | 30.0 | 34.0 | kHz |

*Note 1: The recommended operating conditions for a device are operating conditions under which it can be guaranteed that the device will operate as specified. If the device is used under operating conditions other than the recommended operating conditions (supply voltage, operating temperature range, specified AC/DC values etc.), malfunction may occur. Thus, when designing products which include this device, ensure that the recommended operating conditions for the device are always adhered to.*

*Note 2: Input voltage $V_{IH3}$, $V_{IL3}$: In the SLOW or HOLD mode.*

DC Characteristics ($V_{SS}$ = 0 V, Topr = – 40 to 70°C)

| Parameter | Symbol | Pins | Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Hysteresis Voltage | $V_{HS}$ | Hysteresis Input | | — | 0.7 | — | V |
| Input Current | $I_{IN1}$ | Port K0, TEST, $\overline{RESET}$, $\overline{HOLD}$ | $V_{DD}$ = 5.5V, $V_{IN}$ = 5.5V / 0V | — | — | ± 2 | μA |
| | $I_{IN2}$ | Open drain R port | | | | | |
| Input Low Current | $I_{IL}$ | Push-pull R port | $V_{DD}$ = 5.5 V, $V_{IN}$ = 0.4 V | — | — | – 2 | mA |
| Input Registance | $R_{IN2}$ | $\overline{RESET}$ | | 100 | 220 | 450 | kΩ |
| Output Leakage Current | $I_{LO}$ | Open drain ports P, R | $V_{DD}$ = 5.5 V, $V_{OUT}$ = 5.5 V | — | — | 2 | μA |
| Output High Voltage | $V_{OH}$ | Push-pull R port | $V_{DD}$ = 4.5 V, $I_{OH}$ = – 200 μA | 2.4 | — | — | V |
| Output Low Voltage | $V_{OL2}$ | Except XOUT XTOUT and ports P1, P2 | $V_{DD}$ = 4.5 V, $I_{OL}$ = 1.6 mA | — | — | 0.4 | V |
| Output Low Current | $I_{OL1}$ | Ports P1, P2 | $V_{DD}$ = 4.5 V, $V_{OL}$ = 1.0 V | — | 10 | — | mA |
| Segment Output Low Registance | $R_{OS1}$ | SEG pin | $V_{DD}$ = 5 V, $V_{DD}$ – $V_{LC}$ = 3 V | — | 20 | — | kΩ |
| Segment Output Low Registance | $R_{OC1}$ | COM pin | | | | | |
| Common Output High Registance | $R_{OS2}$ | SEG pin | | — | 200 | — | |
| Common Output High Registance | $R_{OC2}$ | COM pin | | | | | |
| Segment/Common Output Registance | $V_{O2/3}$ | SEG / COM pin | | 3.8 | 4.0 | 4.2 | V |
| | $V_{O1/2}$ | | | 3.3 | 3.5 | 3.7 | |
| | $V_{O1/3}$ | | | 2.8 | 3.0 | 3.2 | |
| Supply Current (in the Normal mode) | $I_{DD}$ | | $V_{DD}$ = 5.5 V, fc = 4 MHz | — | 3 | 6 | mA |
| Supply Current (in the SLOW mode) | $I_{DDS}$ | | $V_{DD}$ = 3.0 V, fs = 32.768 kHz | — | 30 | 60 | μA |
| Supply Current (in the SLEEP mode) | $I_{DDL}$ | | | — | 15 | 30 | μA |
| Supply Current (in the HOLD mode) | $I_{DDH}$ | | $V_{DD}$ = 5.5 V | — | 0.5 | 10 | μA |

*Note 1: Typ. values show those at $T_{opr}$ = 25°C, $V_{DD}$ = 5 V.*

*Note 2: Input Current $I_{IN1}$ ; The current through resistor is not included, when the input resistor (pull-up/pull-down) is contained.*

*Note 3: Output Resistance $R_{os}$, $R_{oc}$ ; Shows on-resistance at the level switching.*

*Note 4: $V_{O2/3}$ ; Shows 2/3 level output voltage, when the 1/4 or 1/3 duty LCD is used.*

*Note 5: $V_{O1/2}$ ; Shows 1/2 level output voltage, when the 1/2 duty or static LCD is used.*

*Note 6: $V_{O1/3}$ ; Shows 1/3 level output voltage, when the 1/4 or 1/3 duty LCD is used.*

*Note 7: Supply Current $I_{DD}$, $I_{DDH}$ ; $V_{IN}$ = 5.3 V / 0.2 V*
*The K0 port is open when the input resistor is contained.*
*The voltage applied to the R port is within the valid range.*

*Note 8: Supply Current $I_{DDS}$, $I_{DDL}$ ; $V_{IN}$ = 2.8 V / 0.2 V.*
*Only low frequency clock is only osillated (connecting XTIN, XTOUT).*

*Note 9: When using LCD, it is necessary to consider values of $R_{OS1/2}$ and $R_{OC1/2}$.*

*Note 10: Times for SEG / COM output switching on ; $R_{OS1}$, $R_{OC1}$: 2/fs (s)*
*$R_{OS2}$, $R_{OC2}$: 1/(n · $f_F$)*
*(1/n: duty, $f_F$: frame frequency)*

## AD Conversion Characterristics

($T_{opr}$ = – 40 to 70°C)

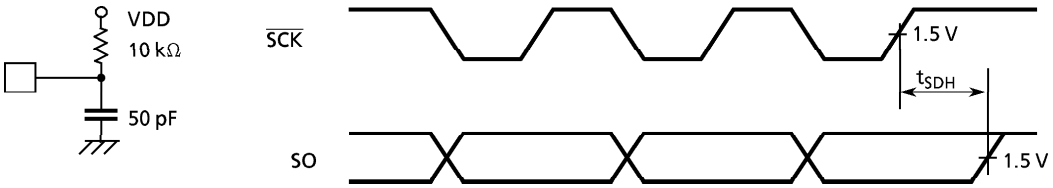
| Parameter | Symbol | Conditions | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Analog Reference | $V_{AREF}$ | | $V_{DD}$ – 1.5 | — | $V_{DD}$ | V |
| | $V_{ASS}$ | | $V_{SS}$ | — | 1.5 | |
| Analog Reference Voltage Range | $\Delta V_{AREF}$ | $V_{AREF} - V_{ASS}$ | 2.5 | — | — | V |
| Analog input Voltage | $V_{AIN}$ | | $V_{ASS}$ | — | $V_{AREF}$ | V |
| Analog Supply Current | $I_{REF}$ | | — | 0.5 | 1.0 | mA |
| Nonlinearity Error | | $V_{DD}$ = 4.5 to 6.0 V, $V_{SS}$ = 0.0 V<br>$V_{AREF} = V_{DD} \pm 0.001$ V<br>$V_{ASS}$ = 0.000 V | — | — | ± 1 | LSB |
| Zero pornt Error | | | — | — | ± 1 | |
| Full scale Error | | | — | — | ± 1 | |
| Totar Error | | | — | — | ± 2 | |

## AC Characteristics

($V_{SS}$ = 0 V, $V_{DD}$ = 4.5 to 6.0 V, Topr = – 40 to 70°C)

| Parameter | Symbol | Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Instruction Cycle Time | tcy | In the Normal mode | 1.3 | – | 20 | μs |
| | | In the SLOW mode | 235 | – | 267 | |
| High level Clock Pulse Width | $t_{WCH}$ | For external clock operation | 80 | – | – | ns |
| Low level Clock Pulse Width | $t_{WCL}$ | | | | | |
| AD Conversion Sampling Time | $t_{AIN}$ | fc = 4 MHz | – | 4 | – | μs |
| Shift Data Hold Time | $t_{SDH}$ | | 0.5 tcy – 0.3 | – | – | μs |

*Note: Shift data Hold Time:*
*External circuit for $\overline{SCK}$ pin and SO pin*




## Recommended Oscillating Conditions

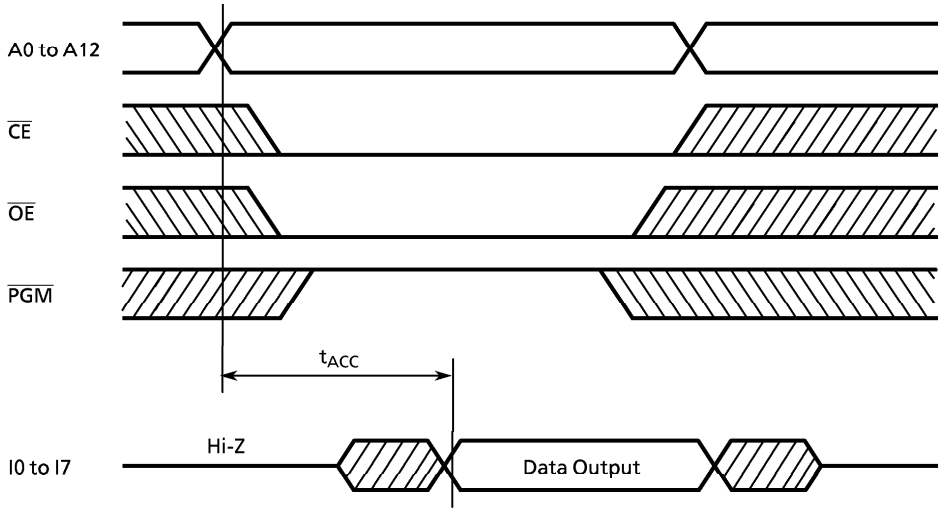
($V_{SS}$ = 0V, $V_{DD}$ = 4.5 to 6.0 V, Topr = – 40 to 70°C)

Recommended oscillating conditions of the TMP47P847V are equal to the TMP47C847's.

DC/AC Characteristics ($V_{SS}$ = 0 V)

(1) Read operation

| Parameter | Symbol | Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Output Level High Voltage | $V_{IH4}$ | | $V_{CC} \times 0.7$ | – | $V_{CC}$ | V |
| Output Level Low Voltage | $V_{IL4}$ | | 0 | – | $V_{CC} \times 0.1$ | V |
| Supply Voltage | $V_{CC}$ | | 4.75 | – | 6.0 | V |
| Programming Voltage | $V_{PP}$ | | | | | |
| Address Access Time | $t_{ACC}$ | $V_{CC}$ = 5.0 ± 0.25 V | 0 | – | 350 | ns |



(2) High speed programming operation

| Parameter | Symbol | Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Input High Voltage | $V_{IH4}$ | | $V_{CC} \times 0.7$ | – | $V_{CC}$ | V |
| Input Low Voltage | $V_{IL4}$ | | 0 | – | $V_{CC} \times 0.1$ | V |
| Supply Voltage | $V_{CC}$ | | 4.75 | – | 6.0 | V |
| $V_{PP}$ Power Supply Voltage | $V_{PP}$ | | 12.00 | 12.50 | 13.00 | V |
| Programming Pulse Width | $t_{PW}$ | $V_{CC}$ = 6.0 ± 0.25V | 0.95 | 1.0 | 1.05 | ms |