

CMOS 4-Bit Microcontroller

TMP47C662AN, TMP47C862AN

The TMP47C662A/862A are high speed and high performance 4-bit single chip micro computers, integrating the 8 bit AD converter, 12-bit programmable pulse generator and high-breakdown voltage outputs based on the TLC5-470 series.

Part No.	ROM	RAM	Package	OTP
TMP47C662AN	6144 × 8-bit	384 × 4-bit	P-SDIP64-750-1.78	TMP47P862VN
TMP47C862AN	8192 × 8-bit	512 × 4-bit		

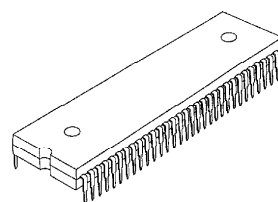
Features

- ◆ 4-bit single chip microcomputer
- ◆ Instruction execution time: 1.3 μ s (at 6 MHz), 244 μ s (at 32.8 kHz)
- ◆ 92 basic instructions
 - Table look-up instructions
 - 5-bit to 8-bit data conversion instruction
- ◆ Subroutine nesting: 15 levels max
- ◆ 6 interrupt sources (External: 2, Internal: 4)

All sources have independent latches each, and multiple interrupt control is available.
- ◆ I/O port (55 pins)
 - Input 2 ports 5 pins
 - Output 1 port 3 pins
 - I/O 12 ports 47 pins
- ◆ Interval Timer
- ◆ Two 12-bit Timer / Counters

Timer, event counter, and pulse width measurement mode
- ◆ Watchdog Timer
- ◆ Serial Interface with 8-bit buffer
 - Simultaneous transmission and reception capability
 - 8/4-bit transfer, external / internal clock, and leading / trailing edge shift mode

P-SDIP64-750-1.78



TMP47C662AN
TMP47C862AN
TMP47P862VN

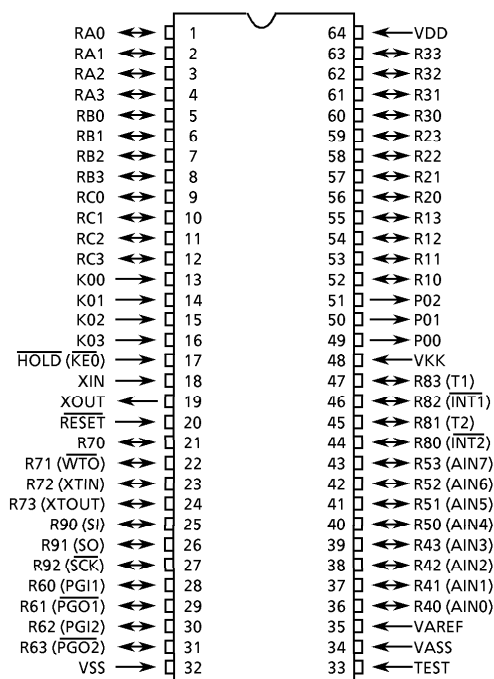
000707EBA1

- For a discussion of how the reliability of microcontrollers can be predicted, please refer to Section 1.3 of the chapter entitled Quality and Reliability Assurance / Handling Precautions.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

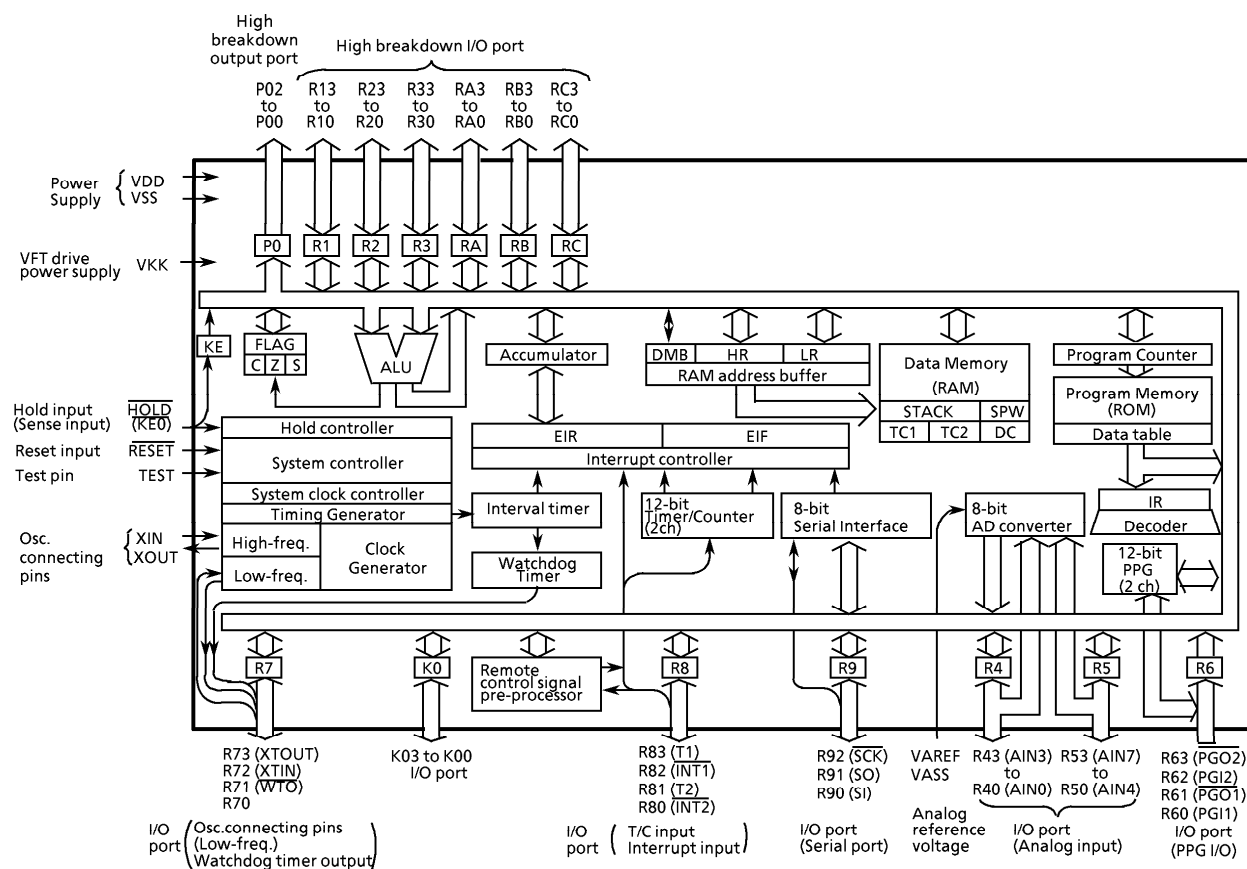
- ◆ Two 12-bit Programmable Pulse Generator
 - One-shot / continuous output, external / internal trigger, rising/falling edge trigger (external) mode
- ◆ 8-bit successive approximate type AD converter
 - With sample and hold
 - 8 analog inputs
 - Conversion time: 32 μ s (at 6 MHz)
- ◆ Remote control pulse detector
- ◆ High current outputs
 - LED direct drive capability (typ. 20 mA $\times$ 4 bits)
- ◆ High breakdown voltage outputs
 - VFT direct drive capability (max 42V $\times$ 27 bits)
- ◆ Dual-clock operation
 - High-speed/Low-power-consumption operating mode
- ◆ Hold function
 - Battery/Capacitor back-up
- ◆ Real Time Emulator: BM47C862N0A

Pin Assignment (Top View)

P-SDIP64-750-1.78



Block Diagram



Pin Function

Pin Name	Input / Output	Functions	
K03 to K00	Input	4-bit input port	
R53 (AIN7) to R40 (AIN0)	I/O (Input)	4-bit I/O port with latch. When using as input port, watchdog timer output, analog input, PPG (programmable pulse generator) output, or PPG trigger input, the latch must be set to "1". Set to Dual-clock operating mode, when R73, R72 pin use as clock generator. Can be set, cleared, and tested for each bit as specified by L register indirect addressing bit manipulation instructions.	AD converter analog input
R63 ($\overline{\text{PGO2}}$)	I/O (Output)		PPG2 output
R62 (PGI2)	I/O (Input)		PPG2 input
R61 ($\overline{\text{PGO1}}$)	I/O (Output)		PPG1 output
R60 (PGI1)	I/O (Input)		PPG1 input
R73 (XTOUT)	I/O (Output)		Resonator connecting pin (Low-freq.). For inputting external clock, XTIN is used and XTOUT is opened.
R72 (XTIN)	I/O (Input)		
R71 (WTO)	I/O (Output)		Watchdog timer output
R70	I/O		
R83 (T1)	I/O (Input)	4-bit I/O port with latch. When using as input port, external interrupt input pin, or timer/counter external input pin, the latch must be set to "1".	Timer / Counter 1 external input
R82 (INT1)			External interrupt 1 input
R81 (T2)			Timer / Counter 2 external input
R80 (INT2)			External interrupt 2 or REMO-CON input
R92 ($\overline{\text{SCK}}$)	I/O (I/O)	3-bit I/O port with latch. When using as input port or serial port, the latch must be set to "1".	Serial clock I/O
R91 (SO)	I/O (Output)		Serial data output
R90 (SI)	I/O (Input)		Serial data input
P02 to P00	Output	3-bit high breakdown voltage output port with latch	
R13 to R10	I/O	4-bit high breakdown voltage I/O port with latch.	
R23 to R20		8-bit data are output by the 5-bit to 8-bit data conversion instruction [OUTB @HL]. When using as input port, the latch must be cleared to "0".	
R33 to R30	I/O	4-bit high breakdown voltage I/O port with latch.	
RA3 to RA0		When using as input port, the latch must be cleared to "0".	
RB3 to RB0			
RC3 to RC0			
XIN, XOUT	Input, Output	Resonator connecting pin (High-frequency) . For inputting external clock, XIN is used and XOUT is opened.	
$\overline{\text{RESET}}$	Input	Reset signal input	
$\overline{\text{HOLD}}$ (KE0)	Input (Input)	Hold request/release signal input	Sence input
TEST	Input	Test pin for out-going test. Be opened or fixed to low level.	
VDD, VSS	Power supply	+ 5 V, 0 V (GND)	
VAREF, VASS		AD converter analog reference voltage	
VKK		VFT drive power supply	

Operational Description

Concerning the TMP47C662A/862A the configuration and functions of hardwares are described. As the description has been provided with priority on those parts differing from the TMP47C660/860, the technical data sheets for the TMP47C660/860 shall also be referred to.

1. System Configuration

◆ Internal CPU Function

They are the same as those of the TMP47C660/860.

◆ Peripheral Hardware Function

- ① I/O Port
- ② Interval Timer
- ③ Timer / Counters (TC1, TC2)
- ④ Watchdog Timer
- ⑤ Remote control pulse detector
- ⑥ AD converter
- ⑦ Programmable Pulse Generator
- ⑧ Serial Interface

The description has been provide with priority on functions (① and ⑦) added to and changed from the TMP47C660/860.

2. Peripheral Hardware Function

2.1 I/O Ports

TMP47C662A/862A have 15 I/O ports (55pins) each as follows:

- ① K0 ; 4-bit input
- ② P0 ; 3-bit output
- ③ R1, R2 ; 4-bit input / output
- ④ R4, R5 ; 4-bit input / output (shared with AD converter analog inputs)
- ⑤ R6 ; 4-bit input / output (shared with programmable pulse generator I/O)
- ⑥ R7 ; 4-bit input / output (shared with the low-frequency resonator connecting pins and the watchdog timer output)
- ⑦ R8 ; 4-bit input / output (shared with external interrupt request input and timer / counter input)
- ⑧ R9 ; 3-bit input / output (shared with serial port)
- ⑨ R3, RA, RB, RC ; 4-bit input / output
- ⑩ KE ; 1-bit sense input (shared with hold request/release signal input)

This section describes ports of ②, ③, ⑤ and ⑨ which are changed from the TMP47C660/860.

Table 2-1 lists the port address assignments and the I/O instructions that can access the ports.

(1) Ports P0 (P02 to P00)

Ports P0 is 3-bit high breakdown voltage output ports with latch. The latch is initialized to "0" during reset.

Port P0 (Port address: OP00)

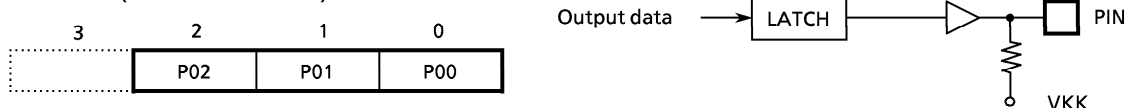


Figure 2-1. Ports P0

(2) Ports R1 (R13 to R10), R2 (R23 to R20)

The 4-bit high breakdown voltage I/O ports with latch, which can directly Vacume Fuolrescent Tubes (VFT) . The latch should be cleared to "0" when used as an inuput port. The latch is initialized to "0" during reset.

Electrical Characteristics

Absolute Maximum Ratings

(V_{SS} = 0 V)

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V _{DD}		– 0.3 to 7	V
Input Voltage	V _{IN}		– 0.3 to V _{DD} + 0.3	V
Output Voltage	V _{OUT1}	R4, R5, R7	– 0.3 to V _{DD} + 0.3	V
	V _{OUT2}	R6, R8, R9	– 0.3 to 10	
	V _{OUT3}	Source open drain pin	– 35 to V _{DD} + 0.3	
Output Current (per 1 pin)	I _{OUT1}	R6	30	mA
	I _{OUT2}	R4, R5, R7 to R9	3.2	
	I _{OUT3}	P0, R1, R2	– 10	
	I _{OUT4}	R3, RA, RB, RC	– 25	
Output Current (Total)	Σ I _{OUT1}	R6	60	mA
	Σ I _{OUT2}	R3, RA, RB, RC	– 100	
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 Operating 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 HOLD mode	2.0		
Input High Voltage	V _{IH1}	Except Hysteresis Input	V _{DD} ≥ 4.5V	V _{DD} × 0.7	V _{DD}	V
	V _{IH2}	Hysteresis Input		V _{DD} × 0.75		
	V _{IH3}		V _{DD} < 4.5V	V _{DD} × 0.9		
Input Low Voltage	V _{IL1}	XIN, XOUT	V _{DD} ≥ 4.5V	0	V _{DD} × 0.3	V
	V _{IL2}	XTIN, XTOUT			V _{DD} × 0.25	
	V _{IL3}		V _{DD} < 4.5V		V _{DD} × 0.1	
Clock Frequency	f _c			0.4	6.0	MHz
	f _s			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, T_{opr} = -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}	K0, TEST, RESET, HOLD	V _{DD} = 5.5 V, V _{IN} = 5.5 V / 0 V	—	—	± 2	μA
	I _{IN2}	R ports (open drain)					
Input Resistance	R _{IN1}	K0 port with pull-up/pull-down		30	70	150	kΩ
	R _{IN2}	RESET		100	220	450	
Pull-down resistance	R _K	source open drain	V _{DD} = 5.5 V, V _{KK} = -30 V	—	80	—	
Output Leakage Current	I _{LO1}	sink open drain	V _{DD} = 5.5 V, V _{IN} = 5.5 V	—	—	2	μA
	I _{LO2}	source open drain	V _{DD} = 5.5 V, V _{OUT} = -32 V	—	—	-2	
Output Level High Voltage	V _{OH}	P0, R1, R2	V _{DD} = 4.5 V, I _{OH} = -5 mA	2.4	—	—	V
Output Level Low Voltage	V _{OL}	R4, R5, R7-R9	V _{DD} = 4.5 V, I _{OL} = 1.6 mA	—	—	0.4	V
Output Level High Voltage	I _{OH}	R3, RA, RB, RC	V _{DD} = 4.5 V, V _{OH} = 2.4 V	—	-15	—	mA
Output Level Low Voltage	I _{OL}	R6	V _{DD} = 4.5 V, V _{OL} = 1.0 V	—	20	—	mA
Supply Current (in the Normal mode)	I _{DD}		V _{DD} = 5.5 V, f _c = 4 MHz	—	3	6	mA
Supply Current (in the SLOW mode)	I _{DDS}		V _{DD} = 3.0 V, f _s = 32.768 kHz	—	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: 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.

Supply Current I_{DDS} ; V_{IN} = 2.8 V / 0.2 V

Low frequency clock is only osillated (connecting XTIN, XTOUT).

AD Conversion Characteristics

(T_{opr} = -40 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V _{AREF}		V _{DD} - 1.5	—	V _{DD}	V
	V _{ASS}		V _{SS}	—	1.5	
Analog Reference Voltage Range	ΔV _{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} = 5.0 V, V _{SS} = 0.0 V V _{AREF} = 5.000 V V _{ASS} = 0.000 V	—	—	± 1	LSB
Zero Point Error			—	—	± 1	
Full Scale Error			—	—	± 1	
Total Error			—	—	± 2	

AC Characteristics

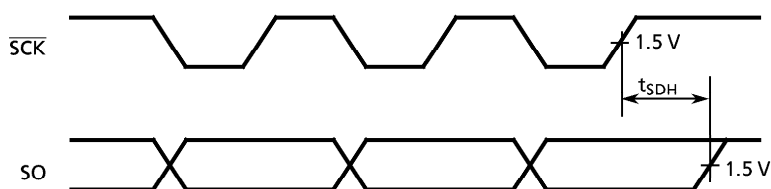
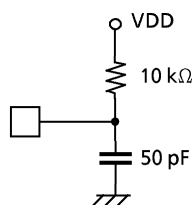
(V_{SS} = 0V, V_{DD} = 4.5 to 6.0V, T_{opr} = -40 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Instruction Cycle Time	t _{cy}	In the Normal mode	1.3	—	20	ns
		In the SLOW mode	235	—	267	
High level Clock pulse Width	t _{WCH}	External clock mode	80	—	—	ns
Low level Clock pulse Width	t _{WCL}					
AD Sampling Time	t _{AIN}	f _c = 4 MHz	—	4	—	μs
Shift Data Hold Time	t _{SDH}		0.5 t _{cy} - 0.3	—	—	μs

Note: Shift Data Hold Time

External circuit for $\overline{SCK}$ pin and SO pin

Serial port (completion of transmission)



Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, T_{opr} = -40 to 70°C)

(1) 6 MHz

Ceramic Resonator

CSA6.00MGU

(MURATA)

C_{XIN} = C_{XOUT} = 30 pF

KBR-6.00MS

(KYOCERA)

C_{XIN} = C_{XOUT} = 30 pF

(2) 4 MHz

Ceramic Resonator

CSA4.00MG

(MURATA)

C_{XIN} = C_{XOUT} = 30 pF

KBR-4.00MS

(KYOCERA)

C_{XIN} = C_{XOUT} = 30 pF

FCR4.0M5

(TDK)

C_{XIN} = C_{XOUT} = 33 pF

Crystal Oscillator

204B-6F 4.0000

(TOYOCOM)

C_{XIN} = C_{XOUT} = 20 pF

(3) 400 kHz

Ceramic Resonator

CSB400B

(MURATA)

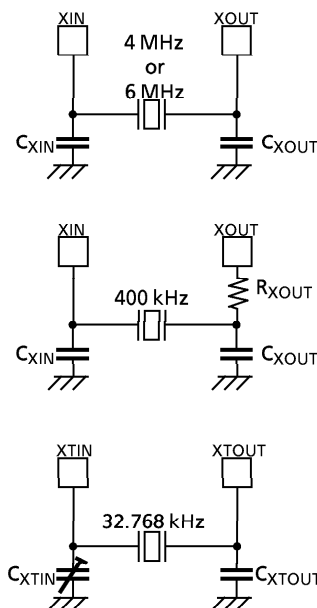
C_{XIN} = C_{XOUT} = 220 pF, R_{XOUT} = 6.8 kΩ

KBR-400B

(KYOCERA)

C_{XIN} = C_{XOUT} = 100 pF, R_{XOUT} = 10 kΩ(4) 32.768 kHz (V_{SS} = 0V, V_{DD} = 2.7 to 6.0 V, T_{opr} = -30 to 70°C)

Crystal Oscillator

C_{XTIN}, C_{XTOUT} ; 10 to 33 pF

Note: In order to get the accurate oscillation frequency, the adjustment of capacitors must be required.

Typical Characteristics

