

CMOS 4-Bit Microcontroller

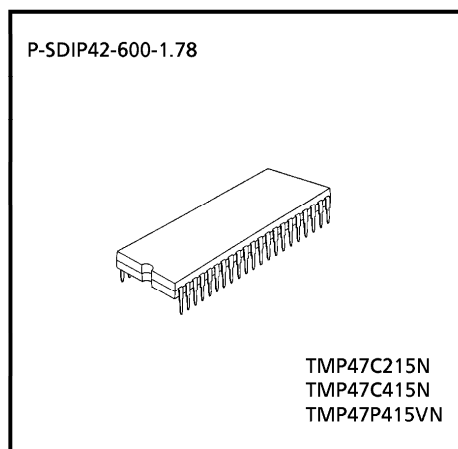
TMP47C215N
TMP47C415N

The TMP47C215/415 is a high speed and high performance 4-bit single chip microcomputer, integrating high current output port and the 4 bit AD conversion input based on the TLC5-470 series.

Part No.	ROM	RAM	Package	OTP
TMP47C215N	2048 × 8-bit	128 × 4-bit	P-SDIP42-600-1.78	TMP47P415VN
TMP47C415N	4096 × 8-bit	256 × 4-bit		

Features

- ◆ 4-bit single chip microcomputer
- ◆ Instruction execution time: 1.0 μ s (at 8 MHz),
244 μ s (at 32.8 kHz)
- ◆ 90 basic instructions
 - Table look-up instructions
 - 5-bit to 8-bit data conversion instruction
- ◆ Subroutine nesting: 15 levels max.
- ◆ 5 interrupt sources (External: 1, Internal: 4)
All sources have independent latches each, and multiple interrupt control is available.
- ◆ I/O port (36 pins)
 - Input 1 ports 4 pins
 - Output 3 ports 12 pins
 - I/O 6 ports 20 pins
- ◆ Interval Timer
- ◆ Two 12-bit Timer / Counters
Timer, event counter, and pulse width measurement mode
- ◆ Watchdog Timer
- ◆ Serial Interface with an 8-bit buffer
 - Simultaneous transmission and reception capability
 - External / internal clock, leading / trailing edge shift, and 4/8-bit mode
- ◆ 4-bit AD conversion input 4 channels



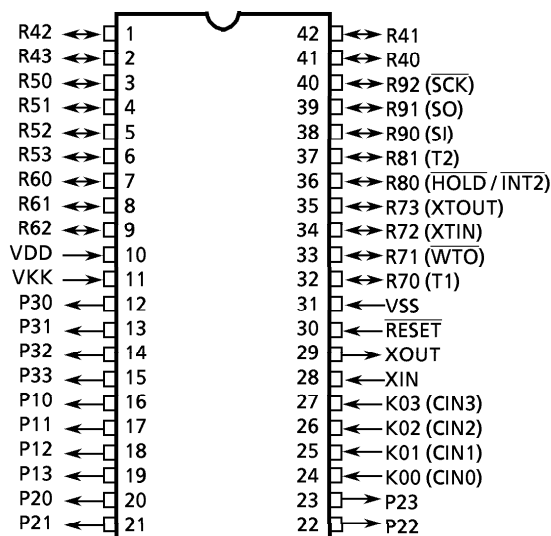
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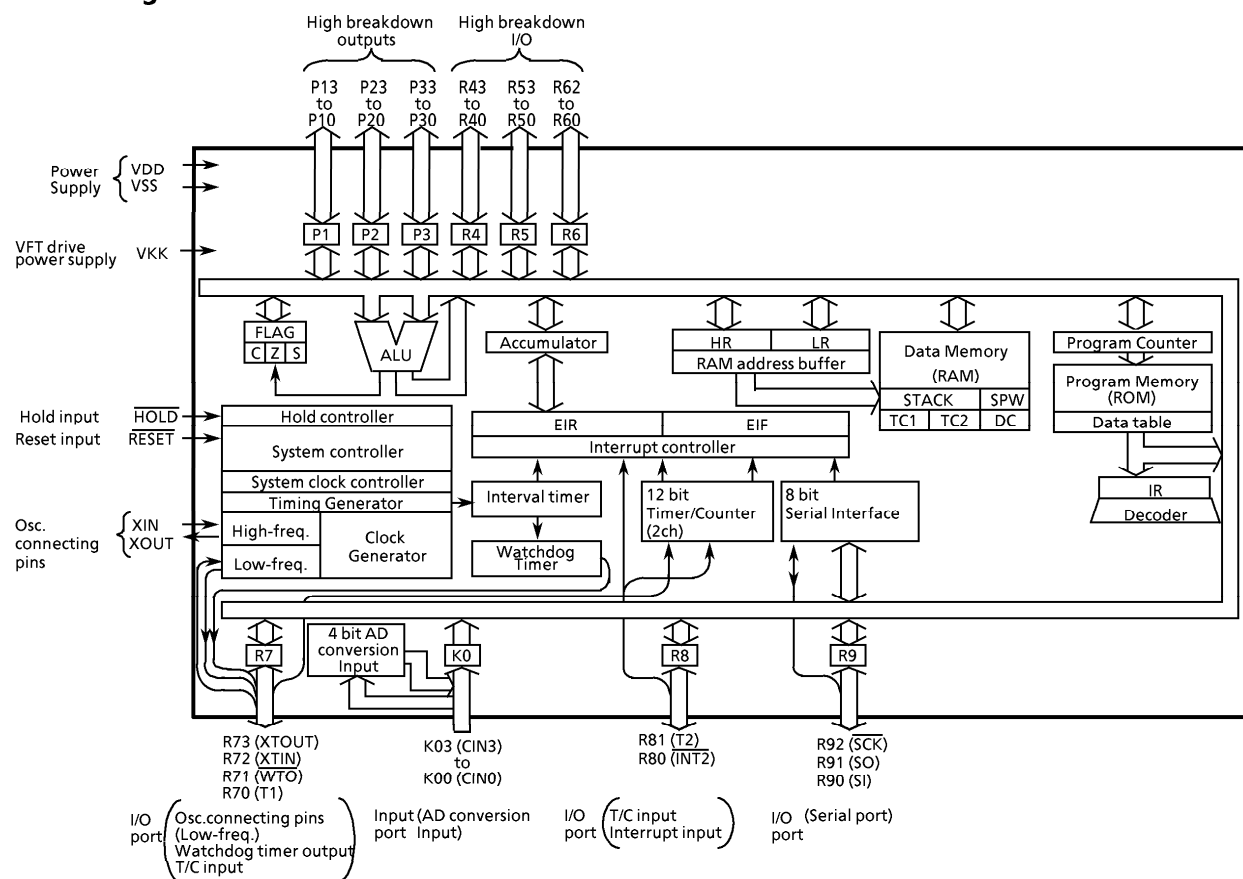
- ◆ High break down voltage outputs
VFT direct drive capability (23 bit)
- ◆ High current outputs
LED direct drive capability (typ. 15 mA × 1 bits).
- ◆ Dual-clock operation
High-speed / Low-power-consumption operating mode
- ◆ Hold function
Battery/Capacitor back-up
- ◆ Real Time Emulator: BM47C415N0A

Pin Assignments (Top View)

P-SDIP42-600-1.78



Block Diagram



Pin Function

Pin Name	Input / Output	Function	
K03 (CIN3) to K00 (CIN0)	Input (Input)	4-bit input port	AD Conversion (comparator) Input
P13 to P10	Output	4-bit high breakdown voltage output port with latch 8-bit data are output by the 5-bit to 8-bit data conversion instruction [OUTB @ HL.]	
P23 to P20			
P33 to P30	Output	4-bit high breakdown voltage output port with latch	
R43 to R40	I/O	4-bit high breakdown voltage I/O port with latch	
R53 to R50			
R62 to R60		3-bit high breakdown voltage I/O port with latch	
R73 (XTOUT)	I/O (Output)	4-bit I/O port with latch.	Resonator connecting pin (Low-freq.) For inputting external clock, XTIN is used and XTOUT is opened.
R72 (XTIN)	I/O (Input)	When using as the input port or watchdog timer output, the latch must be set to "1".	
R71 (WTO)	I/O (Output)	Set to Dual-clock operating mode, when R73, R72 pin use as clock generator.	Watchdog timer output
R70 (T1)	I/O (Input)		Timer / Counter 1 external input
R81 (T2)	I/O (Input)	2-bit I/O port with latch. When used as the input port, external interrupt input pin, or timer / counter external input pin, the latch must be set to "1".	Timer / Counter 2 external input
R80 (INT2) / HOLD	I/O (Input)		External interrupt 2 or hold request / release signal input
R92 (SCK)	I/O (I/O)	3-bit I/O port with latch.	Serial clock I/O
R91 (SO)	I/O (Output)	When used as the input port or serial port, the latch must be set to "1".	Serial data output
R90 (SI)	I/O (Input)		Serial data input
XIN	Input	Resonator connecting pin (High-frequency).	
XOUT	Output	For inputting external clock, XIN is used and XOUT is opened.	
RESET	Input	Reset signal input	
VDD	Power Supply	+ 5 V	
VSS		0 V (GND)	
VKK		VFT drive power supply	

Operational Description

Concerning the TMP47C215/415 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 except program memory (ROM), data memory (RAM) system clock controller and interrupt function.

◆ Peripheral Hardware Function

- ① Input / Output Ports
- ② Interval Timer
- ③ Timer / Counters (TC1, TC2)
- ④ Watchdog Timer
- ⑤ AD Conversion (Comparator) input
- ⑥ Serial Interface

The description has been provide with priority on functions (① and ⑤) added to and changed form TMP47C660/860.

2. Internal CPU Function

2.1 Program Memory (ROM)

The TMP47C215 has 2048 × 8 bits (addresses 000_H through 7FF_H) of program memory (mask ROM), the TMP47C415 has 4096 × 8 bits (addresses 000_H through FFF_H).

Figure 2-1 shows the program memory map. Address 000_H to 086_H and FE0_H to FFF_H (000_H to 086_H and 7E0_H to 7FF_H for the TMP47C215) of the program memory are also used for special purposes.

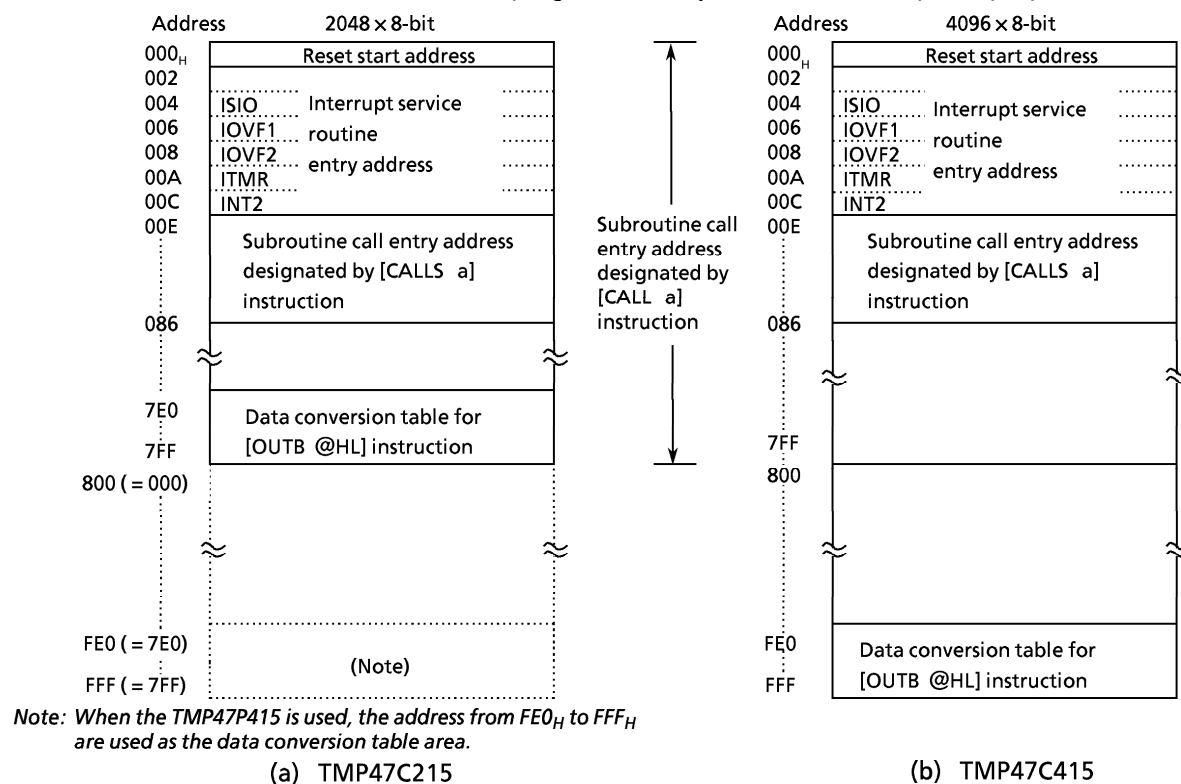


Figure 2-1. Program memory map

Electrical Characteristics

Absolute Maximum Ratings

(V_{SS} = 0 V)

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V _{DD}		– 0.3 to 6.5	V
Input Voltage	V _{IN}		– 0.3 to V _{DD} + 0.3	V
Output Voltage	V _{OUT1}	R7, R8, R9, XOUT	– 0.3 to V _{DD} + 0.3	V
	V _{OUT2}	P1, P2, P3, R4, R5, R6	V _{DD} – 40 to V _{DD} + 0.3	
Output Current (per 1 pin)	I _{OUT1}	R70	30	mA
	I _{OUT2}	R71 to R73, R80, R81, R9	3.2	
	I _{OUT3}	P1, P2, P3	– 12	
	I _{OUT4}	R4, R5, R6	– 25	
Output Current (Total)	Σ I _{OUT1}	P1, P2, P3	– 80	mA
	Σ I _{OUT2}	R4, R5, R6	– 100	
Power Dissipation [Topr = 70°C]	PD		600	mW
Soldering Temperature (time)	T _{sld}		260 (10 s)	°C
Storage Temperature	T _{stg}		– 55 to 125	°C
Operating Temperature	Topr		– 30 to 70	°C

Note 1: 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.

Note 2: Output voltage V_{OUT3}: The V_{OUT3} of OTP (TMP47P415VN) is from V_{DD} – 38 (V) to V_{DD} + 0.3 (V).

Recommended Operating Conditions

(V_{SS} = 0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Max	Unit
Supply Voltage	V _{DD}		In the Normal mode	4.5	5.5	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}	Except Hysteresis Input	V _{DD} ≥ 4.5V	0	V _{DD} × 0.3	V
	V _{IL2}	Hysteresis Input			V _{DD} × 0.25	
	V _{IL3}		V _{DD} < 4.5V		V _{DD} × 0.1	
Clock Frequency	f _c	XIN, XOUT		0.4	8.0	MHz
	f _s	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, T_{opr} = – 30 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, $\overline{\text{RESET}}$	V _{DD} = 5.5 V,	–	–	± 2	μA
	I _{IN2}	R ports (open drain)	V _{IN} = 5.5 V / 0 V				
Input Resistance	R _{IN1}	K0 port with pull-up/pull-down		30	70	150	kΩ
	R _{IN2}	$\overline{\text{RESET}}$		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} = –30 V	–	–	–2	
Output Level High Voltage	V _{OH}	P1, P2, P3	V _{DD} = 4.5 V, I _{OH} = –5 mA	2.4	–	–	V
Output Level Low Voltage	V _{OL}	R71 to R73, R80, R81, R9	V _{DD} = 4.5 V, I _{OL} = 1.6 mA	–	–	0.4	V
Output Level High Current	I _{OH}	R4, R5, R6	V _{DD} = 4.5 V, V _{OL} = 2.4 V	–	–15	–	mA
Output Level Low Current	I _{OL}	R70	V _{DD} = 4.5 V, V _{OL} = 1.0 V	–	15	–	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	60	μA
Supply Current (in the HOLD mode)	I _{DDH}		V _{DD} = 5.5 V	–	0.5	10	μA

Note 1: Typ. values show those when 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.

I_{DDS} ; V_{IN} = 2.8 V / 0.2 V, low frequency clock is only oscillated (connecting XTIN, XTOUT).
at comparator input is disabled.

AD Conversion Characteristics

(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, T_{opr} = – 30 to 70°C)

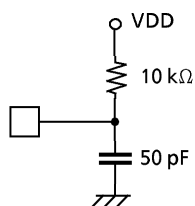
Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Analog Input Voltage	V _{AIN}	CIN3 to CIN0		V _{SS}	–	V _{DD}	V
AD conversion error				–	–	± $\frac{1}{2}$	LSB

AC Characteristics

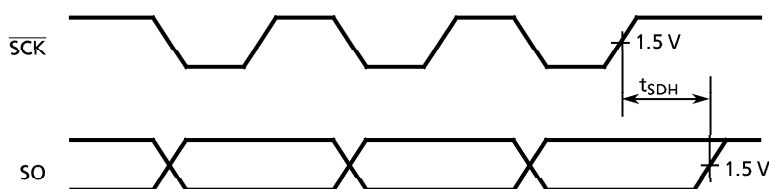
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, T_{opr} = -30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Instruction Cycle Time	t _{cy}	In the Normal mode	1.0	—	20	μs
		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}					
Shift Data Hold Time	t _{SDH}		0.5 t _{cy} - 0.3	—	—	μs

Note: 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} = -30 to 70°C)

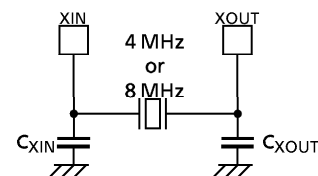
(1) 8 MHz

Ceramic Resonator

CSA8.00MT (MURATA)

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

KBR8.00M (KYOCERA)

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

(2) 4 MHz

Ceramic Resonator

CSA4.00MG (MURATA)

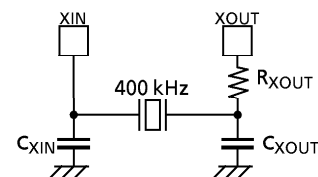
C_{XIN} = C_{XOUT} = 30 pF

KBR-4.00MS (KYOCERA)

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

Crystal Oscillator

204B-6F 4.0000 (TOYOCOM)

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

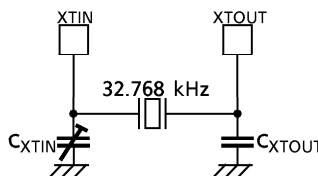
(3) 400 kHz

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} = 0 V, 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

