CMOS 8-Bit Microcontroller

TMP87C800N, TMP87CH00N
TMP87C800F, TMP87CH00F
TMP87C800DF, TMP87CH00DF
TMP87CH00LF

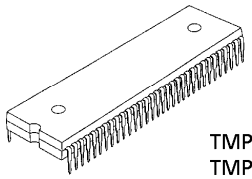
The 87C800/H00 are the high speed and high performance 8-bit single chip microcomputers. This MCU contains CPU core, ROM, RAM, input/output ports, six multi-function timer/counters, two serial interfaces, and two clock generators on a chip. The 87C800/H00 are standard type devices in the TLCS-870 Series, and provide high current output capability for LED direct drive.

Part No.	ROM	RAM	Package	OTP MCU	Operation Voltage Range
TMP87C800N	8K × 8-bit	256 × 8-bit	P-SDIP64-750-1.78	TMP87PH00N	2.7 V to 6.0 V / 32 kHz, 4.2 MHz 4.5 V to 6.0 V / 32 kHz, 8 MHz
TMP87C800F			P-QFP64-1420-1.00A	TMP87PH00F	
TMP87C800DF			P-QFP64-1414-0.80A	TMP87PH00DF	
TMP87CH00N	16K × 8-bit		P-SDIP64-750-1.78	TMP87PH00N	
TMP87CH00F			P-QFP64-1420-1.00A	TMP87PH00F	
TMP87CH00DF			P-QFP64-1414-0.80A	TMP87PH00DF	
TMP87CH00LF				TMP87PH00LF	1.8 V to 5.5 V /32 kHz, 4.2 MHz 4.5 V to 5.5 V /32 kHz, 8 MHz

Features

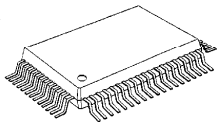
- ◆8-bit single chip microcomputer TLCS-870 Series
- ◆Instruction execution time: 0.5 μs (at 8 MHz), 122 μs (at 32.768 kHz)
- ◆412 basic instructions
  - Multiplication and Division (8 bits × 8 bits , 16 bits ÷ 8 bits)
  - Bit manipulations (Set/Clear/Complement/Move/Test/Exclusive or)
  - 16-bit data operations
  - 1-byte jump/subroutine-call (Short relative jump / Vector call)
- ◆15 interrupt sources (External: 6, Internal: 9)
  - All sources have independent latches each, and nested interrupt control is available.
  - 4 edge-selectable external interrupts with noise reject
  - High-speed task switching by register bank changeover
- ◆8 Input/Output ports (58 pins)
  - High current output: 8 pins (typ. 20 mA)
- ◆Two 16-bit Timer/Counters
  - Timer, Event counter, Programmable pulse generator output, Pulse width measurement, External trigger timer, Window modes
- ◆Two 8-bit Timer/Counters
  - Timer, Event counter, Capture (Pulse width/duty measurement), PWM output, Programmable divider output modes
- ◆Time Base Timer (Interrupt frequency: 1 Hz to 16 kHz)
- ◆Divider output function (frequency: 1 kHz to 8 kHz)
- ◆Watchdog Timer
  - Interrupt source/reset output (programmable)

P-SDIP64-750-1.78



TMP87C800N
TMP87CH00N
TMP87PH00N

P-QFP64-1420-1.00A



TMP87C800F
TMP87CH00F
TMP87PH00F

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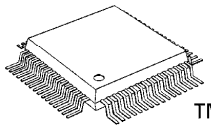


TMP87C800DF
TMP87CH00DF
TMP87PH00DF
TMP87CH00LF
TMP87PH00LF

980910EBP2

◆Two 8-bit Serial Interfaces
- With 8 bytes transmit/receive data buffer
- Internal/external serial clock, and 4/8-bit mode

◆Dual clock operation
- Single/Dual-clock mode (option)

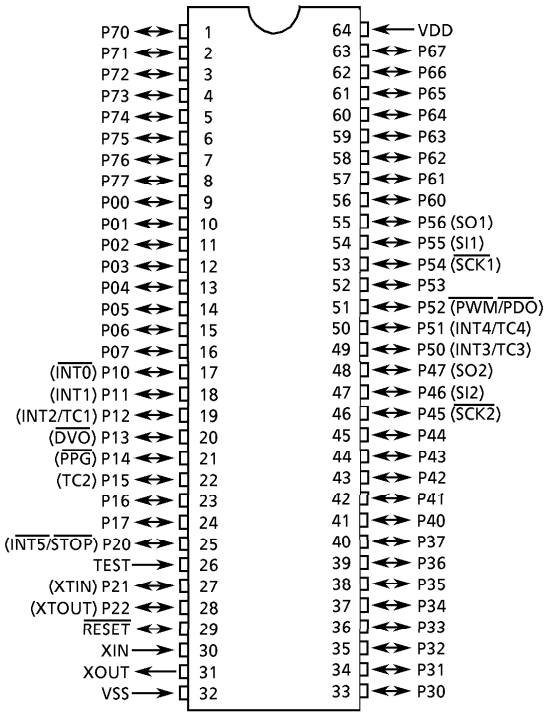
◆Five Power saving operating modes
- STOP mode: Oscillation stops. Battery/Capacitor back-up, port output hold/high-impedance.
- SLOW mode: Low power consumption operation using low-frequency clock (32.768 kHz).
- IDLE1 mode: CPU Stops, and Peripherals operate on high-frequency clock. Release by interrupts.
- IDLE2 mode: CPU Stops, and Peripherals operate on high and low frequency clock. Release by interrupts.
- SLEEP mode: CPU Stops, and Peripherals operate on low-frequency clock. Release by interrupts.

◆Wide operating voltage: 2.7 to 6 V at 4.19 MHz / 32.768 kHz, 4.5 to 6 V at 8 MHz / 32.768 kHz (87C800/CH00)
1.8 to 6 V at 4.19 MHz / 32.768 kHz, 4.5 to 6 V at 8 MHz / 32.768 kHz (87CH00L)

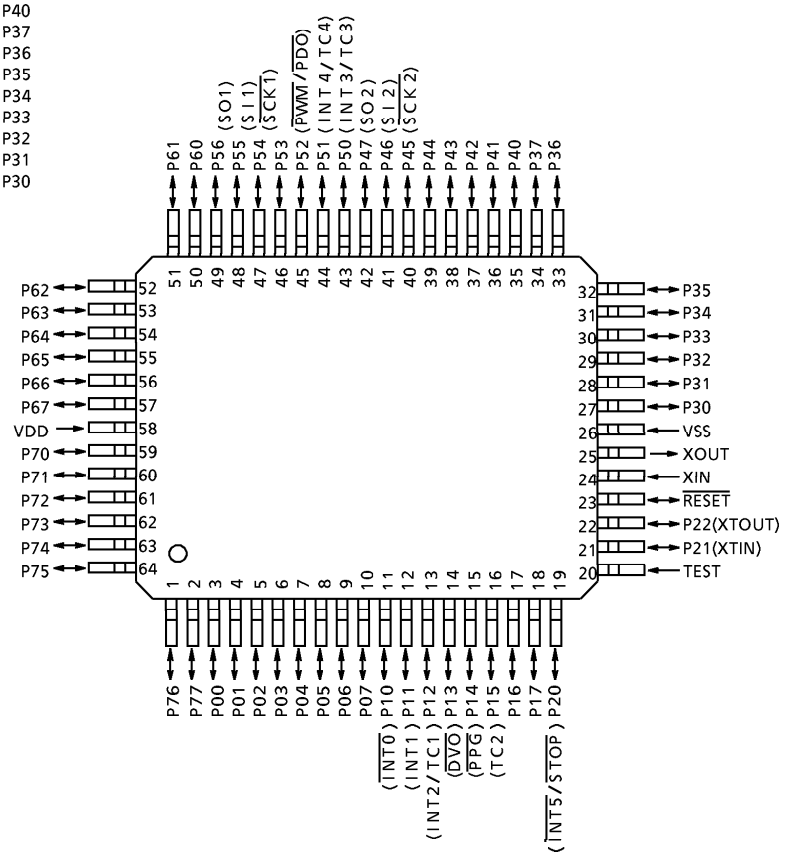
◆Emulation Pod: BM87CH00N0B

Pin Assignments (Top View)

P-SDIP64-750-1.78

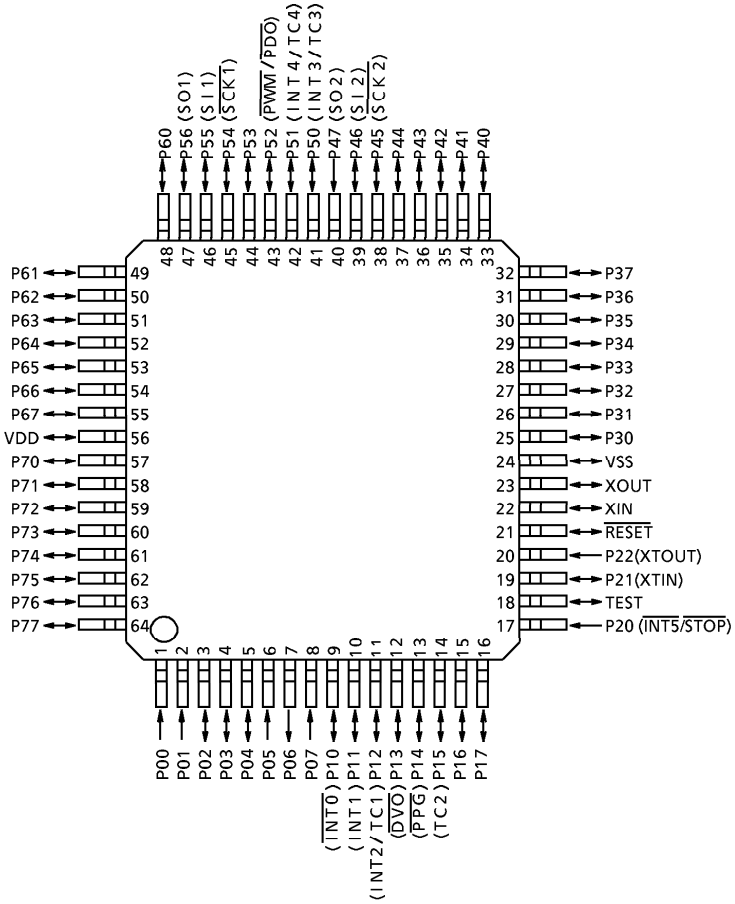


P-QFP64-1420-1.00A

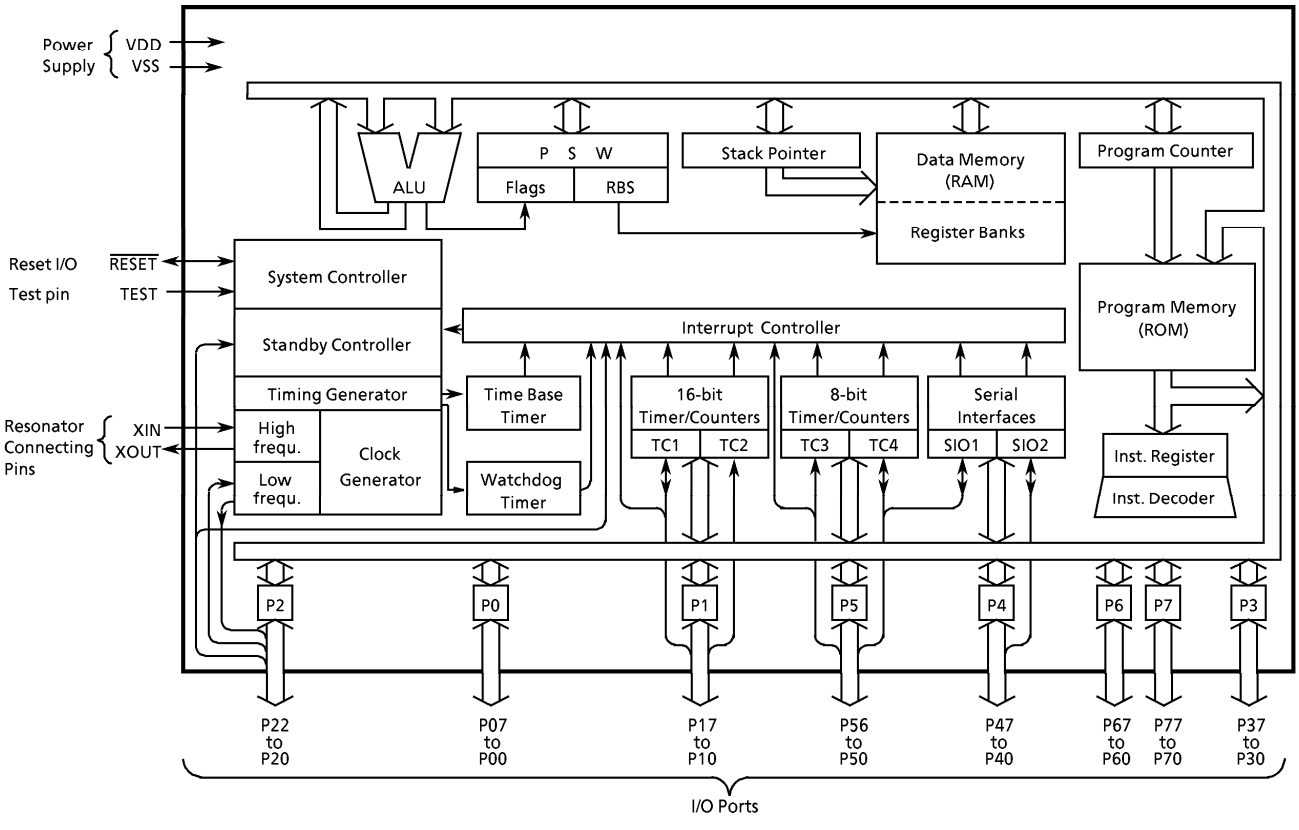


Pin Assignments (Top View)

P-QFP64-1414-0.80A



Block Diagram



Pin Function

Pin Name	Input / Output	Function	
P07 to P00	I/O	8-bit programmable input/output ports (tri-state). Each bit of the port can be individually configured as an input or an output under software control. During reset, all bits are configured as input. When used as a divider output or a PPG output, the latch must be set to "1".	
P17, P16	I/O		
P15 (TC2)	I/O (Input)		Timer/Counter 2 input
P14 ($\overline{\text{PPG}}$)	I/O (Output)		Programmable pulse generator output
P13 ($\overline{\text{DVO}}$)			Divider output
P12 (INT2 / TC1)	I/O (Input)		External interrupt input 2 or Timer/Counter 1 input
P11 (INT1)			External interrupt input 1
P10 ($\overline{\text{INT0}}$)			External interrupt input 0
P22 (XTOUT)	I/O (Output)	3-bit input/output port with the latch. When used as an input port, the latch must be set to "1".	Resonator connecting pins (32.768 kHz). For inputting external clock, XTIN is used and XTOUT is opened.
P21 (XTIN)	I/O (Input)		
P20 ($\overline{\text{INT5}}$ / $\overline{\text{STOP}}$)			External interrupt input 5 or STOP mode release signal input
P37 to P30	I/O	8-bit input/output port (high current output) with the latch. When used as an input port, the latch must be set to "1".	
P47 (SO2)	I/O (Output)	8-bit input/output port with the latch. When used as an input port or a SIO input/output, the latch must be set to "1".	SIO2 serial data output
P46 (SI2)	I/O (Input)		SIO2 serial data input
P45 ($\overline{\text{SCK2}}$)	I/O (I/O)		SIO2 serial clock input/output
P44 to P40	I/O		
P56 (SO1)	I/O (Output)	7-bit input/output port with the latch. When used as an input port, a SIO input/output, an external interrupt input, or a $\overline{\text{PWM}}$/$\overline{\text{PDO}}$ output, the latch must be set to "1".	SIO1 serial data output
P55 (SI1)	I/O (Input)		SIO1 serial data input
P54 ($\overline{\text{SCK1}}$)	I/O (I/O)		SIO1 serial clock input/output
P53	I/O		
P52 ($\overline{\text{PWM}}$/$\overline{\text{PDO}}$)	I/O (Output)		8-bit PWM output or 8-bit programmable divider output
P51 (INT4/TC4)	I/O (Input)		External interrupt input 4 or Timer/Counter 4 input
P50 (INT3/TC3)			External interrupt input 3 or Timer/Counter 3 input
P67 to P60	I/O	8-bit programmable input/output ports (tri-state). Each bit of the port can be individually configured as an input or an output under software control. During reset, all bits are configured as input.	
P77 to P70			
XIN, XOUT	Input, Output	Resonator connecting pins for high-frequency clock. For inputting external clock, XIN is used and XOUT is opened.	
$\overline{\text{RESET}}$	I/O	Reset signal input or watchdog timer output/address-trap-reset output/system-clock-reset output.	
TEST	Input	Test pin for out-going test. Be fixed to low level.	
VDD, VSS	Power Supply	+ 5 V, 0 V (GND)	

Operational Description

1. CPU Core Functions

The CPU core consists of a CPU, a system clock controller, an interrupt controller, and a watchdog timer. This section provides a description of the CPU core, the program memory (ROM), the data memory (RAM), and the reset circuit.

1.1 Memory Address Map

The TLCS-870 Series is capable of addressing 64 Kbytes of memory. Figure 1-1 shows the memory address maps of the 87C800/H00. In the TLCS-870 Series, the memory is organized 4 address spaces (ROM, RAM, SFR, and DBR). It uses a memory mapped I/O system, and all I/O registers are mapped in the SFR / DBR address spaces. There are 16 banks of general-purpose registers. The register banks are also assigned to the first 128 bytes of the RAM address space.

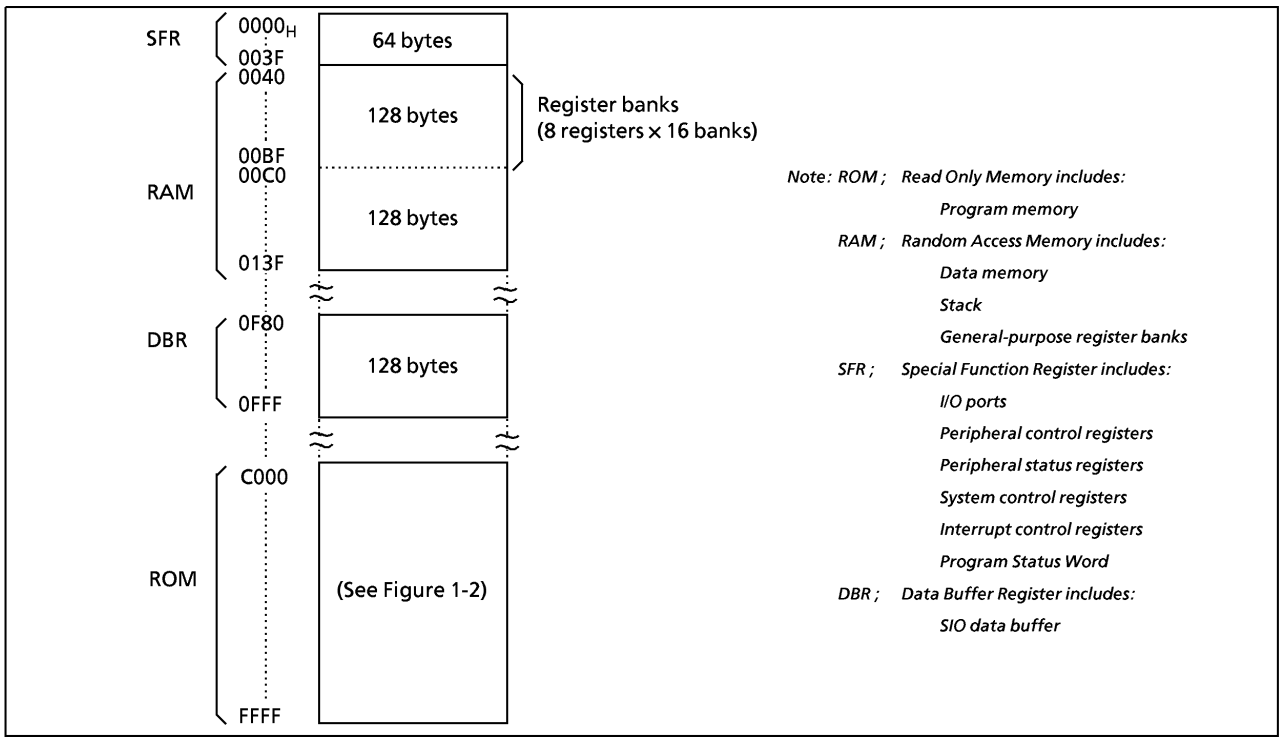


Figure 1-1. Memory Address Map

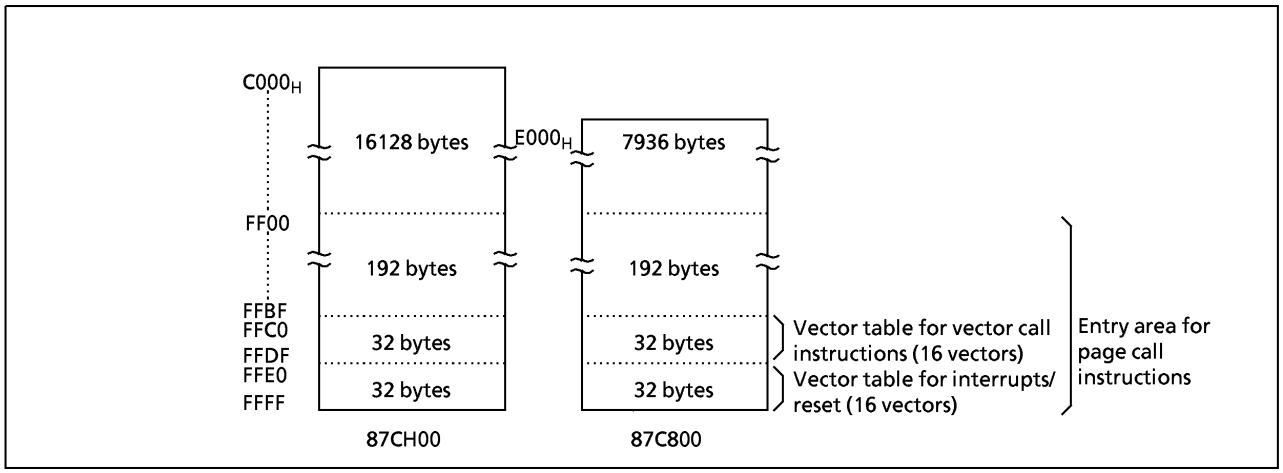


Figure 1-2. ROM Address Maps

Electrical Characteristics

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

Parameter	Symbol	Conditions	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}	Except sink open drain pin , but include P2 and $\overline{RESET}$	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	Sink open drain pin except port P2, $\overline{RESET}$	– 0.3 to 10	
Output Current (Per 1 pin)	I_{OUT1}	Ports P0, P1, P2, P4, P5, P6, P7	3.2	mA
	I_{OUT2}	Port P3	30	
Output Current (Total)	ΣI_{OUT1}	Ports P0, P1, P2, P4, P5, P6, P7	120	mA
	ΣI_{OUT2}	Port P3	120	
Power Dissipation [Topr = 70°C]	PD	TMP87C800N / CH00N	600	mW
		TMP87C800F / CH00F / C800DF / CH00DF	350	
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 30 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 = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions		Min	Max	Unit
Supply Voltage	V_{DD}		fc = 8 MHz	NORMAL1, 2 mode	4.5	6.0	V
				IDLE1, 2 mode			
			fc = 4.2 MHz	NORMAL1, 2 mode	2.7		
				IDLE1, 2 mode			
			fs = 32.768 kHz	SLOW mode			
				SLEEP mode			
				STOP mode	2.0		
Input High Voltage	V_{IH1}	Except hysteresis input	$V_{DD} \geqq 4.5$ V		$V_{DD} \times 0.70$	V_{DD}	V
	V_{IH2}	Hysteresis input			$V_{DD} \times 0.75$		
	V_{IH3}		$V_{DD} < 4.5$ V		$V_{DD} \times 0.90$		
Input Low Voltage	V_{IL1}	Except hysteresis input	$V_{DD} \geqq 4.5$ V		0	$V_{DD} \times 0.30$	V
	V_{IL2}	Hysteresis input				$V_{DD} \times 0.25$	
	V_{IL3}		$V_{DD} < 4.5$ V			$V_{DD} \times 0.10$	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5 to 6 V		0.4	8.0	MHz
			V_{DD} = 2.7 to 6 V			4.2	
	fs	XTIN, XTOUT			30.0	34.0	kHz

Note: 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.

D.C. Characteristics

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

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis inputs	V_{DD} = 5.0 V	–	0.9	–	V
Input Current	I_{IN1}	TEST	V_{DD} = 5.5 V V_{IN} = 5.5 V / 0 V	–	–	± 2	μA
	I_{IN2}	Open drain ports and tri-state ports					
	I_{IN3}	$\overline{RESET}$, $\overline{STOP}$					
Input Low Current	I_{IL}	Push-pull ports	V_{DD} = 5.5 V, V_{IN} = 0.4 V	–	–	– 2	mA
Input Resistance	R_{IN1}	Port 7 with Pull-up resistor	V_{DD} = 5.0 V	30	70	150	KΩ
	R_{IN2}	$\overline{RESET}$	V_{DD} = 5.0 V	100	220	450	
Output Leakage Current	I_{LO1}	Open drain ports and	V_{DD} = 5.5 V, VOUT = 5.5 V	–	–	2	μA
	I_{LO2}	Tri-state ports	V_{DD} = 5.5 V, VOUT = 5.5 V / 0 V	–	–	± 2	
Output High Voltage	V_{OH1}	Push-pull ports	V_{DD} = 4.5 V, I_{OH} = – 200 μA	2.4	–	–	V
	V_{OH2}	Tri- state ports	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	
Output Low Voltage	V_{OL}	Except XOUT and port P3	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	V
Output Low Current	I_{OL3}	Port P3	V_{DD} = 4.5 V, V_{OL} = 1.0 V	–	20	–	mA
Supply Current in NORMAL 1 , 2 mode	I_{DD}		V_{DD} = 5.5 V fc = 8 MHz fs = 32.768 kHz V_{IN} = 5.3V / 0 .2V	–	7	10	mA
Supply Current in IDLE 1, 2 mode				–	3.5	5	
Supply Current in NORMAL 1 , 2 mode			V_{DD} = 3.0 V fc = 4.19 MHz fs = 32.768 kHz V_{IN} = 2.8V / 0 .2V	–	2.5	3.5	mA
Supply Current in IDLE 1, 2 mode				–	1.5	2.0	
Supply Current in SLOW mode			V_{DD} = 3.0 V fs = 32.768 kHz V_{IN} = 2.8V / 0 .2V	–	30	60	μA
Supply Current in SLEEP mode				–	15	30	μA
Supply Current in STOP mode			V_{DD} = 5.5 V V_{IN} = 5.3V / 0 .2V	–	0.5	10	μA

Note 1: Typical values show those at Topr = 25°C .
Note 2: Input Current ; The current through pull-up or pull-down resistor is not included.

A.C. Characteristics

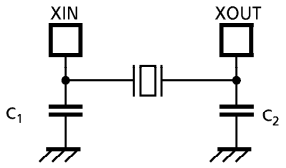
(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, T_{opr} = – 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL 1, 2 mode	0.5	–	10	μs
		In IDLE 1, 2 mode				
		In SLOW mode	117.6	–	133.3	
		In SLEEP mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input) , fc = 8 MHz	50	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input), fs = 32.768 kHz	14.7	–	–	μs
Low Level Clock Pulse Width	t_{WSL}					

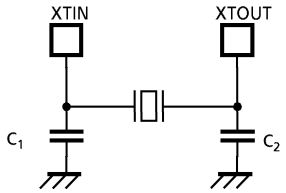
Recommended Oscillating Condition

(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, T_{opr} = – 30 to 70°C)

Parameter	Oscillator	Frequency	Recommended Oscillator		Recommended Conditions C_1	Recommended Conditions C_2
High-frequency	Ceramic Resonator	8 MHz	KYOCERA	KBR8.0M	30pF	30pF
		4 MHz	KYOCERA	KBR4.0MS		
			MURATA	CSA4.00MG		
	Crystal Oscillator	8 MHz	TOYOCOM	210B 8.0000	20pF	20pF
		4 MHz	TOYOCOM	204B 4.0000		
Low-frequency	Crystal Oscillator	32.768 kHz	NDK	MX-38T	15pF	15pF



(1) High-frequency



(2) Low-frequency

Note: An electrical shield by metal shield plate on the surface of the IC package should be recommendable in order to prevent the device from the high electric fiedstress applied from CRT (Cathode Ray Tube) for continuous reliable operation.

Electrical Characteristics

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

Parameter	Symbol	Conditions	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_{OUT}		– 0.3 to V_{DD} + 0.3	V
Output Current (Per 1 pin)	I_{OUT1}	Ports P0, P1, P2, P4, P5, P6, P7	3.2	mA
	I_{OUT2}	Port P3	30	
Output Current (Total)	ΣI_{OUT1}	Ports P0, P1, P2, P4, P5, P6, P7	120	mA
	ΣI_{OUT2}	Port P3	120	
Power Dissipation [Topr = 70°C]	PD		350	mW
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 30 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 = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions		Min	Max	Unit
Supply Voltage	V_{DD}		fc = 8 MHz	NORMAL1, 2 mode	4.5	5.5	V
				IDLE1, 2 mode			
			fc = 4.2 MHz	NORMAL1, 2 mode	1.8	4.5	
				IDLE1, 2 mode			
			fs = 32.768 kHz	SLOW mode		5.5	
				SLEEP mode			
				STOP mode			
Input High Voltage	V_{IH1}	Except Hysteresis inputs	$V_{DD} \geqq 4.5$ V		$V_{DD} \times 0.70$	V_{DD}	V
	V_{IH2}	Hysteresis inputs			$V_{DD} \times 0.75$		
	V_{IH3}		$V_{DD} < 4.5$ V		$V_{DD} \times 0.90$		
Input Low Voltage	V_{IL1}	Except Hysteresis inputs	$V_{DD} \geqq 4.5$ V		0	$V_{DD} \times 0.28$	V
	V_{IL2}	Hysteresis inputs				$V_{DD} \times 0.25$	
	V_{IL3}		$V_{DD} < 4.5$ V			$V_{DD} \times 0.10$	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5 to 5.5 V		0.4	8.0	MHz
			V_{DD} = 1.8 to 4.5 V			4.2	
	fs	XTIN, XTOUT			30.0	34.0	kHz

Note : 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.

D.C. Characteristics

(V_{SS} = 0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis inputs	V_{DD} = 5.0 V	–	0.9	–	V
Input Current	I_{IN1}	TEST	V_{DD} = 5.5 V V_{IN} = 5.5 V / 0 V	–	–	± 2	μA
	I_{IN2}	Open drain ports and tri-state ports					
	I_{IN3}	$\overline{RESET}$, $\overline{STOP}$					
Input Low Current	I_{IL}	Push-pull ports	V_{DD} = 5.5 V, V_{IN} = 0.4 V	–	–	– 2	mA
Input Resistance	R_{IN1}	Port P7 with pull-up	V_{DD} = 5.0 V	30	70	150	kΩ
	R_{IN2}	$\overline{RESET}$	V_{DD} = 5.0 V	100	220	450	
Output Leakage Current	I_{LO1}	Open drain ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	–	–	2	μA
	I_{LO2}	Tri-state ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V / 0 V	–	–	± 2	
Output High Voltage	V_{OH1}	Push-pull ports	V_{DD} = 4.5 V, I_{OH} = – 200 μA	2.4	–	–	V
	V_{OH2}	Tri- state ports	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	
	V_{OH3}	Push- pull ports	V_{DD} = 1.8V, I_{OH} = – 5 μA	1.6	–	–	
	V_{OH4}	Tri- state ports	V_{DD} = 1.8V, I_{OH} = – 10 μA	1.6	–	–	
Output Low Voltage	V_{OL1}	Except XOUT and port P3	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	
	V_{OL2}	Except XOUT	V_{DD} = 1.8V, I_{OL} = 20 μA	–	–	0.2	
Output Low Current	I_{OL3}	Port P3	V_{DD} = 4.5 V, V_{OL} = 1.0 V	–	20	–	mA
Supply Current in NORMAL 1 , 2 mode	I_{DD}		V_{DD} = 5.5 V fc = 8 MHz fs = 32.768 kHz V_{IN} = 5.3 V / 0.2 V	–	7.0	10	
Supply Current in IDLE 1, 2 mode				–	3.5	5	
Supply Current in NORMAL 1 , 2 mode			V_{DD} = 3.0 V fc = 4.19 MHz fs = 32.768 kHz V_{IN} = 2.8 V / 0.2 V	–	2.5	3.5	
Supply Current in IDLE 1, 2 mode				–	1.5	2.0	
Supply Current in NORMAL 1 , 2 mode			V_{DD} = 1.8V fc = 4.19 MHz fs = 32.768 kHz V_{IN} = 1.7 V / 0 .1 V	–	1.0	2.0	
Supply Current in IDLE 1, 2 mode				–	0.5	1.0	
Supply Current in SLOW mode			V_{DD} = 3.0 V fs = 32.768 kHz V_{IN} = 2.8 V / 0 .2 V	–	30	60	μA
Supply Current in SLEEP mode				–	15	30	
Supply Current in SLOW mode			V_{DD} = 1.8 V fs = 32.768 kHz V_{IN} = 1.7 V / 0 .1 V	–	15	30	
Supply Current in SLEEP mode				–	10	20	
Supply Current in STOP mode			V_{DD} = 5.5 V V_{IN} = 5.3 V / 0 .2V	–	0.5	10	

Note 1: Typical values show those at Topr = 25°C .
Note 2: Input Current ; The current through pull-up or pull-down resistor is not included.

A.C. Characteristics

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

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL 1, 2 mode	0.5	–	10	μs
		In IDLE 1, 2 mode				
		In SLOW mode	117.6	–	133.3	
		In SLEEP mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input) , fc = 8.4 MHz	50	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input), fs = 32.768 kHz	14.7	–	–	μs
Low Level Clock Pulse Width	t_{WSL}					

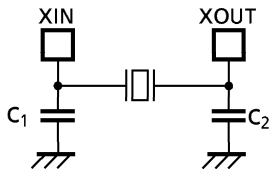
(V_{SS} = 0 V, V_{DD} = 1.8 to 4.5 V, Topr = – 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL 1, 2 mode	0.95	–	10	μs
		In IDLE 1, 2 mode				
		In SLOW mode	117.6	–	133.3	
		In SLEEP mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input) , fc = 4.2 MHz	110	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input), fs = 32.768 kHz	14.7	–	–	μs
Low Level Clock Pulse Width	t_{WSL}					

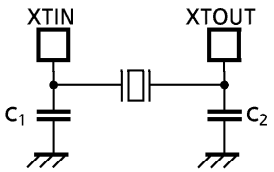
Recommended Oscillating Condition

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

Parameter	Oscillator	Frequency	Recommended Oscillator		Recommended Conditions C_1	Recommended Conditions C_2
High-frequency	Ceramic Resonator	4.19 MHz (VDD = 1.8 to 5.5 V)	MURATA	CSA4.19MG	30pF	30pF
			MURATA	CST4.19MGW	–	–
		8 MHz (VDD = 4.5 to 5.5 V)	MURATA	CSA8.00MTZ	15pF	15pF
			MURATA	CST8.00MTW	–	–
	Crystal Oscillator	8 MHz (VDD = 4.5 to 5.5 V)	NDK	AT-51	16pF	16pF
Low-frequency	Crystal Oscillator	32.768 kHz (VDD = 1.8 to 5.5 V)	NDK	MX-38T	12pF	12pF



(1) High-frequency



(2) Low-frequency

Note: An electrical shield by metal shield plate on the surface of the IC package should be recommendable in order to prevent the device from the high electric fiedstress applied from CRT (Cathode Ray Tube) for continuous reliable operation.