

CMOS 4-BIT MICROCONTROLLER

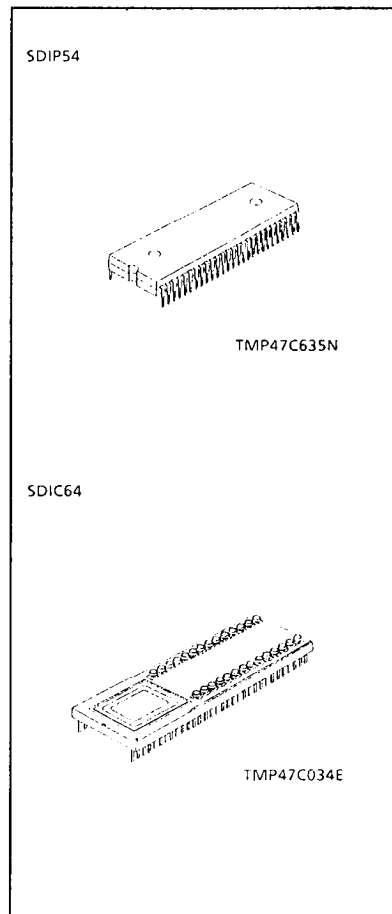
TMP47C635N

The 47C635 is based on the TLC5-470 CMOS series. The 47C635 has on-screen display circuit (OSD) to display characters and marks which indicate channel or time on TV screen, A/D converter input, D/A converter output such as TV. The 47C635 is the chip with extension I/O ports for the 47C634.

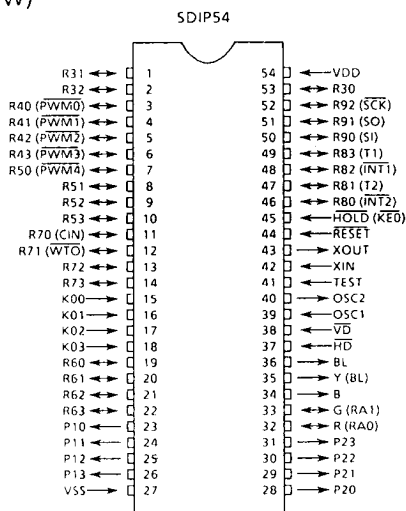
PART No	ROM	RAM	PACKAGE	PIGGYBACK (adapter socket)
TMP47C635N	6144 × 8-bit	384 × 4-bit	SDIP54	TMP47C034E (BM1106)

FEATURES

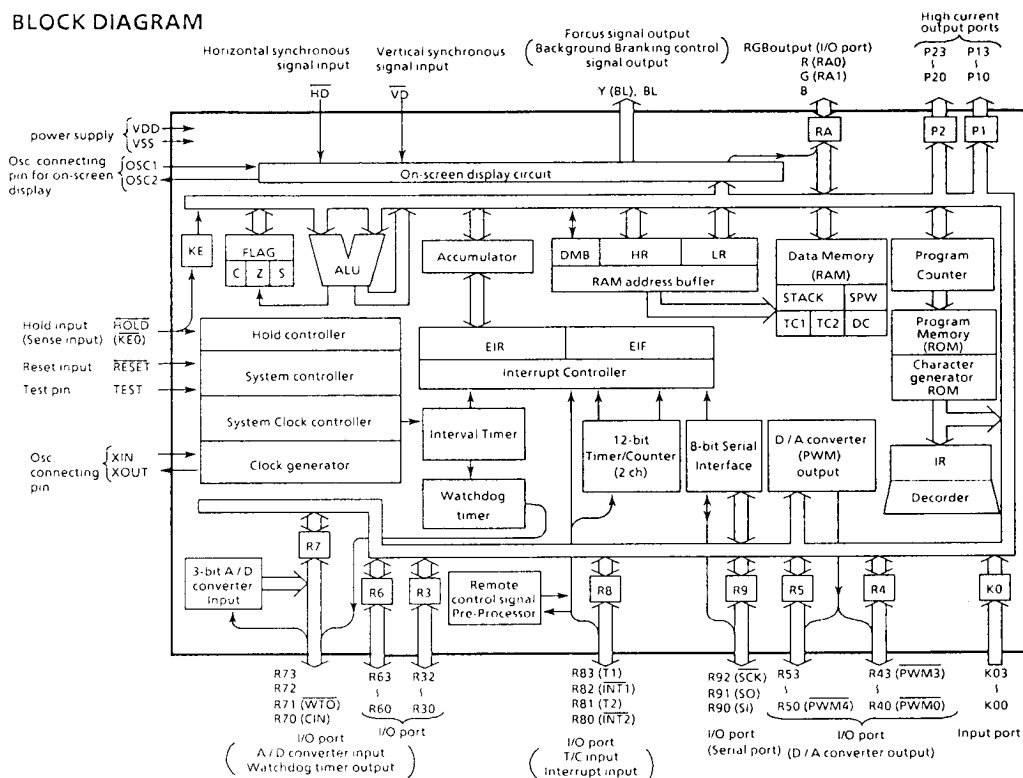
- ◆ 4-bit single chip microcomputer
- ◆ Instruction execution time : 1.9 μ s (at 4.2MHz)
- ◆ 92 basic instructions
- ◆ Table look-up instructions
- ◆ 5-bit to 8-bit data conversion instruction
- ◆ Subroutine nesting : 15 levels max.
- ◆ 6 interrupt sources (External : 2, Internal : 4)
All sources have independent latches each, and multiple interrupt control is available
- ◆ I/O port (41 pins)
 - Input 2 ports 5 pins
 - I/O 8 ports 28 pins
 - Output 2 ports 8 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
 - External/internal clock, leading/trailing edge shift, 4/8-bit
- ◆ On-screen display circuit
 - Character patterns : 48 characters
 - Characters displayed : 16 columns × 2 lines
 - Composition : 8 × 8 dots (smoothing function)
 - Size of character : 2 kinds (line by line)
 - Color of character : 7 kinds (character by character)
 - Variable display position : Horizontal 64 / Vertical 64 steps
- ◆ D/A converter (Pulse width modulation) outputs
 - 14-bit resolution 1 channel
 - 6-bit resolution 4 channels
- ◆ 3-bit A/D converter input
Auto frequency control signal (S-shaped curve) detection
- ◆ Horizontal synchronous signal is detected by timer/counter
- ◆ Remote control signal preprocessing capability
- ◆ High current outputs
LED direct drive capability (typ. 20mA × 8 bits)
- ◆ Hold function : Battery/Capacitor back-up
- ◆ Real Time Emulator : BM47C834A



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) - R41 (PWM1) R40 (PWM0)	I/O (Output)	4-bit I/O port with latch. When used as input port or D/A converter outputs pins, the latch must be set to "1".	6-bit D / A converter (PWM) output
R53 - R51	I/O		14-bit D / A converter (PWM) output
R50 (PWM4)	I/O (Output)		6-bit D / A converter (PWM) output
R32 - R30	I/O	3-bit I/O port with latch. When used as input port, the latch must be set to "1".	
R63 - R60	I/O	4-bit I/O port with latch. When used as input port, the latch must be set to "1".	
R73 - R72	I/O	4-bit I/O port with latch.	
R71 (WTO)	I/O (Output)	When used as input port watchdog, output pin, or A/D converter input pin, the latch must be set to "1".	Watchdog timer output
R70 (CIN)	I/O (Input)		3-bit A/D converter input
R83 (T1)	I/O (Input)	4-bit I/O port with latch. When used 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 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 input port or serial port, the latch must be set to "1".	Serial data output
R90 (SI)	I/O (Input)		Serial data input
G (RA1)	Output (I/O)	RGB output	2-bit I/O port with latch. When used as input port, the latch must be set to "1".
R (RA0)			
B	Output		
Y (BL), BL	Output (Output)	Focus signal output	Background blanking control signal output
HD, VD	Input	Horizontal synchronous signal input, Vertical synchronous signal output.	
OSC1, OSC2	Input, Output	Resonator connecting pin of on-screen display circuit.	
XIN, XOUT	Input, Output	Resonator connecting pin. 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 47C635 is the same as the 47C634 except for the addition of input and output ports. All other functions and operation are exactly the same. Refer to the technical data sheets for the 47C434/634 and 47C660/860.

1. I/O Ports

The 47C635 has 12 ports (41 pins) each as follows. This section describes ports, which are addition to the 47C634.

- (1) Ports P1 (P13-P10), P2 (P23-P20)

It is as same as the 47C800.

- (2) Port R3 (R32-R30)

3-bit I/O port with latch. When used as input port, the latch must be set to "1". The latch is initialized to "1" during reset. There isn't the R33 pin. If it accessed the latch must be set to "1".

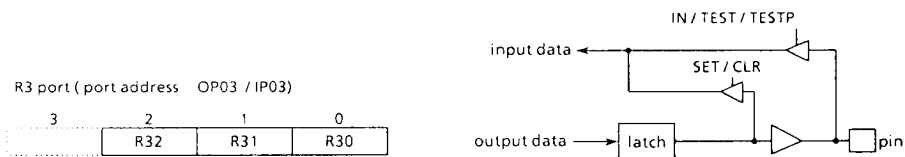


Figure 1-1. R3 port

Note 1. “—” means the reserved state. Unavailable for the user programs.
 Note 2. The status input of serial interface, clock generator, and HOLD (KE0) pin.
 Note 3. The 5-bit to 8-bit data conversion instruction [OUTB @HL], automatic access to ports P1 and P2.

Table 1-1. Port Address Assignments and Available I/O Instructions

ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS (V_{SS} = 0V)

PARAMETER	SYMBOL	PINS	RATING	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 port R7	- 0.3 to V _{DD} + 0.3	V
	V _{OUT2}	Sink open drain pin except R7 port	- 0.3 to 10	
Output Current (Per 1 pin)	I _{OUT1}	Ports P1, P2	30	mA
	I _{OUT2}	Ports R3, R6, R7, R8, R9	3.2	
Output Current (Total)	ΣI _{OUT1}	Ports P1, P2	120	mA
Power Dissipation	PD		600	mW
Soldering Temperature (time)	T _{sld}		260 (10sec)	°C
Storage Temperature	T _{stg}		- 55 to 125	°C
Operating Temperature	T _{opr}		- 30 to 70	°C

RECOMMENDED OPERATING CONDITIONS (V_{SS} = 0V, T_{opr} = - 30 to 70°C)

PARAMETER	SYMBOL	PINS	CONDITION	Min.	Max.	UNIT
Supply Voltage	V _{DD}		In the Normal mode	4.5	6.0	V
			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	4.2	MHz
	f _{OSD}	OSC1, OSC2		—	6.0	

Note. Input Voltage V_{IH3}, V_{IL3}: in the HOLD operating mode.

D.C. CHARACTERISTICS

(V_{SS} = 0V, T_{opr} = -30 to 70°C)

PARAMETER	SYMBOL	PINS	CONDITION	Min.	Typ.	Max.	UNIT
Hysteresis Voltage	V _{HS}	Hysteresis Input		—	0.7	—	V
Input Current	I _{IN1}	Port K0, TEST, RESET, HOLD	V _{DD} = 5.5V,	—	—	± 2	μA
	I _{IN2}	Port R (open drain)	V _{IN} = 5.5V / 0V				
Input Low Current	I _{IL}	Port R (push – pull)	V _{DD} = 5.5V, V _{IN} = 0.4V	—	—	– 2	mA
Input Resistance	R _{IN1}	Port K0 with pull-up/pull-down		30	70	150	KΩ
	R _{IN2}	RESET		100	220	450	
Output Leakage Current	I _{LO}	Tri-state port Ports R3, R6, R8, R9 (open drain)	V _{DD} = 5.5V, V _{OUT} = 5.5V	—	—	± 2	μA
Output High Voltage	V _{OH1}	Port R (push-pull)	V _{DD} = 4.5V, I _{OH} = – 200μA	2.4	—	—	V
	V _{OH2}	Port R (tri-state), OSD outputs	V _{DD} = 4.5V, I _{OH} = – 0.7mA	4.1	—	—	
Output Low Voltage	V _{OL1}	Ports R3, R6-R9	V _{DD} = 4.5V, I _{OL} = 1.6mA	—	—	0.4	V
	V _{OL2}	Port R (tri-state), OSD outputs	V _{DD} = 4.5V, I _{OL} = 0.7mA				
Output Low Current	I _{OL}	Ports P1, P2	V _{DD} = 4.5V, V _{OL} = 1.0V	—	20	—	mA
Supply Current (in the Normal mode)	I _{DD}		V _{DD} = 5.5V, f _c = 4MHz	—	3	6	mA
Supply Current (in the HOLD mode)	I _{DDH}		V _{DD} = 5.5V	—	0.5	10	μA

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

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

Note 3. Supply Current : V_{IN} = 5.3 V / 0.2 V

The K0 port is open when the pull – up / pull – down resistor is contained.

The voltage applied to the R port is within the valid range V_{IL} or V_{IH}.

A / D CONVERTER CHARACTERISTICS

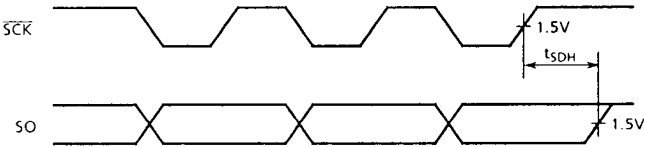
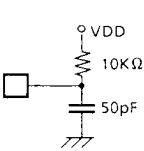
PARAMETER	SYMBOL	PINS	CONDITION	Min.	Typ.	Max.	UNIT
Analog input voltage	V _{AIN}	CIN		V _{SS}	—	V _{DD}	V
A / D conversion error	—			—	—	± $\frac{1}{4}$	LSB

A.C. CHARACTERISTICS

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

PARAMETER	SYMBOL	CONDITION	Min.	Typ.	Max.	UNIT
Instruction Cycle Time	t _{cy}		1.9	-	20	μs
High level Clock Pulse Width	t _{WCH}	For external clock operation	80	-	-	ns
Low level Clock Pulse Width	t _{WCL}					
Shift data Hold Time	t _{SDH}		0.5t _{cy} - 300	-	-	ns

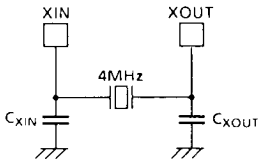
Note. Shift data Hold Time :
External circuit for SCK pin and SO pin.



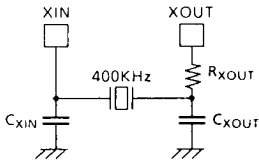
RECOMMENDED OSCILLATING CONDITIONS

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

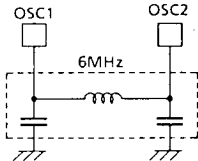
- (1) 4MHz
Ceramic Resonator
CSA4.00MG (MURATA) C_{XIN} = C_{XOUT} = 30pF
KBR-4.00MS (KYOCERA) C_{XIN} = C_{XOUT} = 30pF
Crystal Oscillator
204B-6F 4.0000 (TOYOCOM) C_{XIN} = C_{XOUT} = 20pF



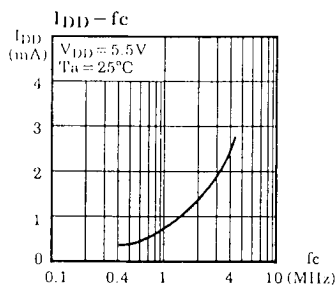
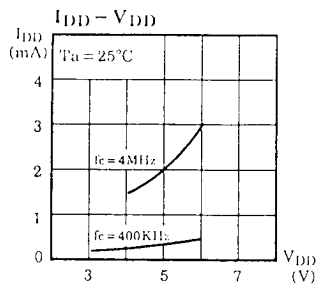
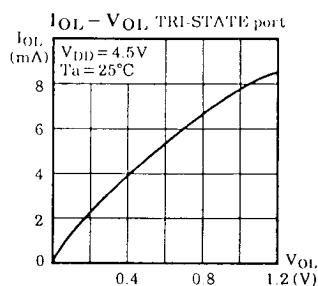
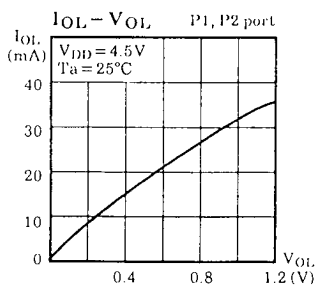
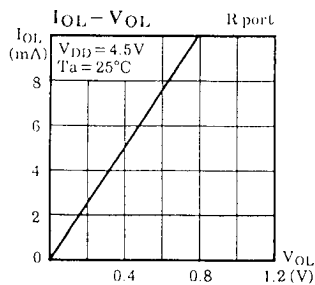
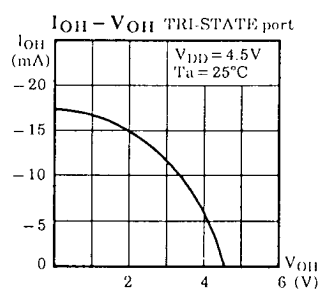
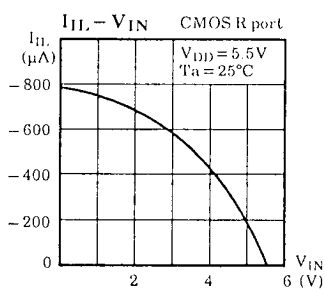
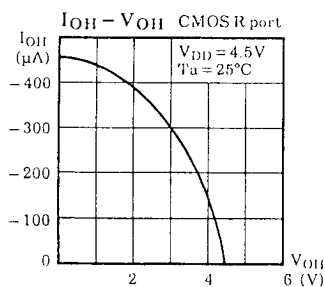
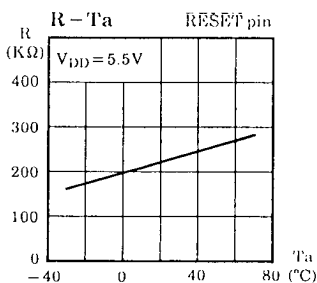
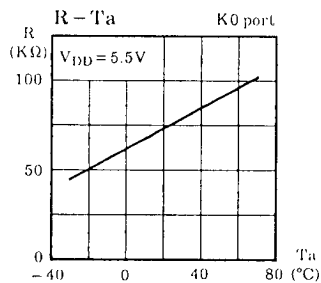
- (2) 400KHz
Ceramic Resonator
CSB400B (MURATA) C_{XIN} = C_{XOUT} = 220pF, R_{XOUT} = 6.8KΩ
KBR-400B (KYOCERA) C_{XIN} = C_{XOUT} = 100pF, R_{XOUT} = 10KΩ



- (3) 6MHz (for OSD)
LC Resonator
TBKSES-30361FBY (TOUKOU)



TYPICAL CHARACTERISTICS



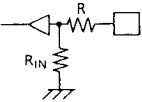
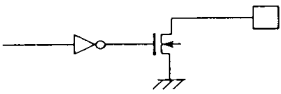
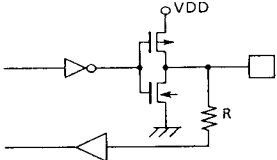
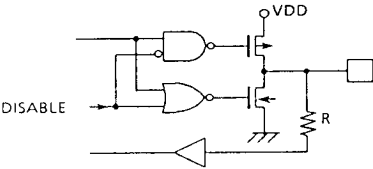
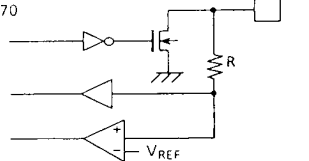
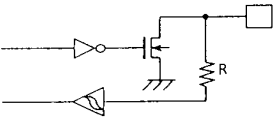
INPUT/OUTPUT CIRCUITRY

(1) Control pins

The input/output circuitries of the 47C635 control pins are similar to that of the 47C634/434.

(2) I/O ports

The input/output circuitries of the 47C635 I/O ports are shown below, designated by code (PC).

PORT	I/O	INPUT/OUTPUT CIRCUITRY (code : PC)	REMARKS
K0	Input		Pull-down resistor $R_{IN} = 70K\Omega$ (typ.) $R = 1K\Omega$ (typ.)
P1 P2	Output		Sink open drain Initial "Hi-Z" High drive current $I_{OL} = 20mA$ (typ.)
R3	I/O		Push-pull output initial "High" $R = 1K\Omega$ (typ.)
R4 R5 RA	I/O		Tri-state I/O Initial "Hi-Z" $R = 1K\Omega$ (typ.)
R6 R7	I/O		Sink open drain Initial "Hi-Z" and Comparator input (R70 pin) $R = 1K\Omega$ (typ.)
R8 R9	I/O		Sink open drain Initial "Hi-Z" Hysteresis input $R = 1K\Omega$ (typ.)