

CMOS 4-BIT MICROCONTROLLER

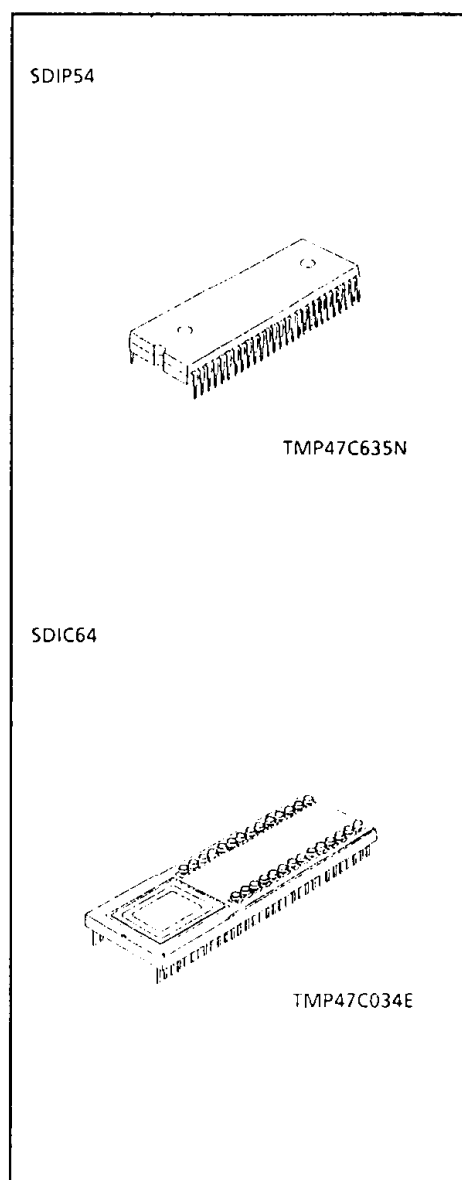
TMP47C635N

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.

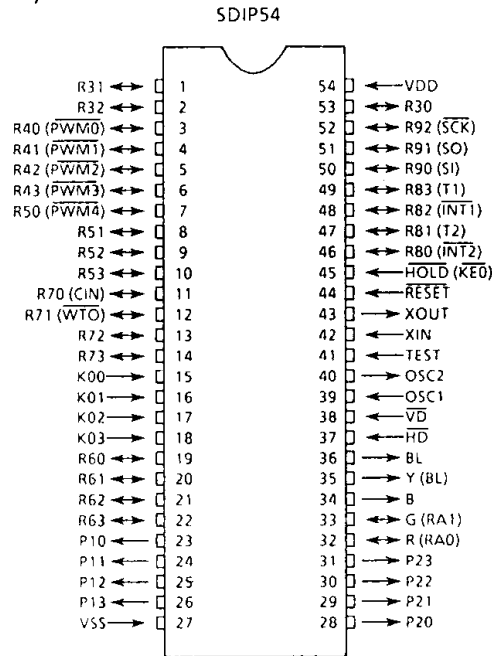
PART No	ROM	RAM	PACKAGE	PIGGYBACK (adapter socket)
TMP47C635N	6144 × 8-bit	384 × 4-bit	SDIP54	TMP47C034E (BM1106)

FEATURES

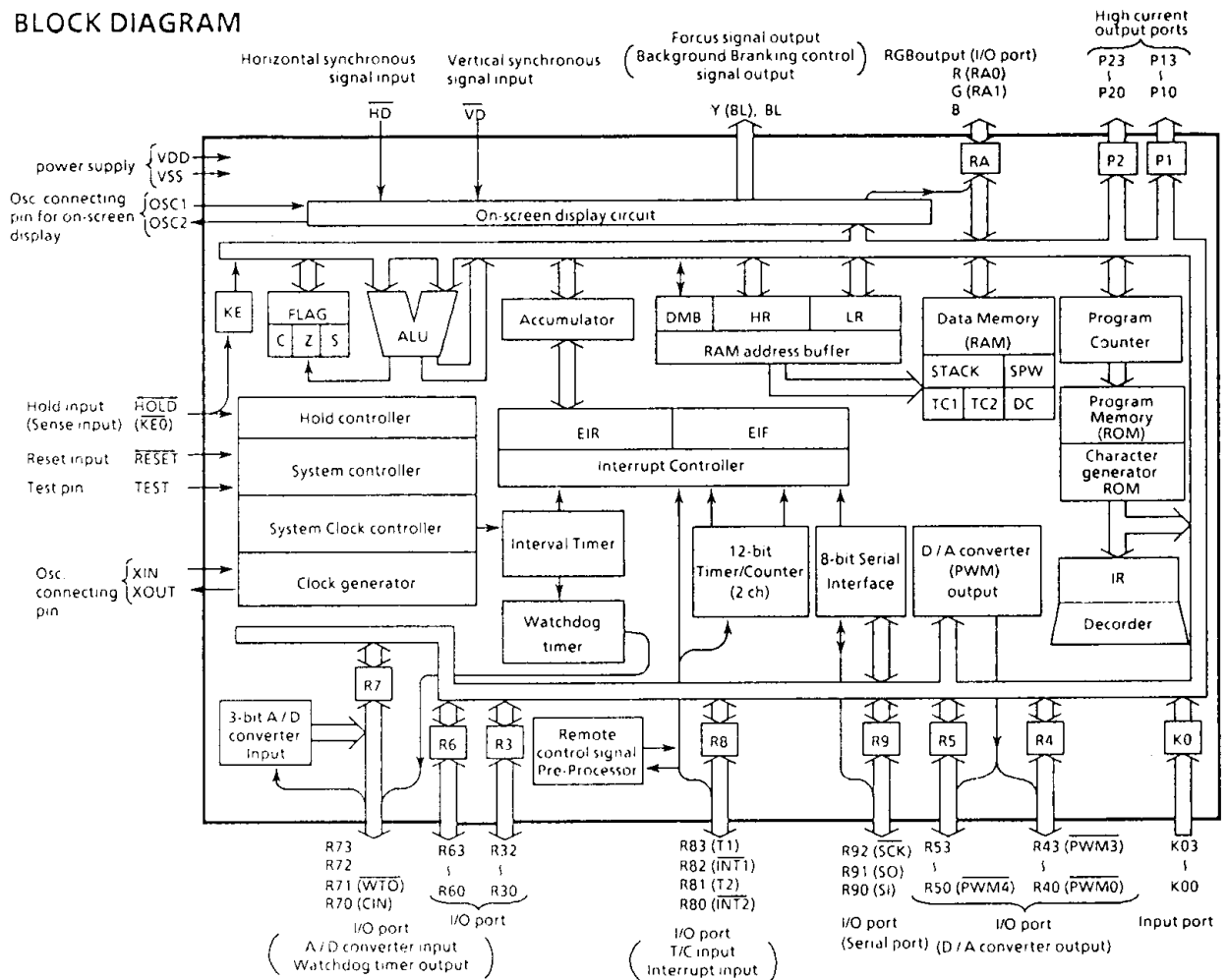
- ◆ 4-bit single chip microcomputer
- ◆ Instruction execution time : 1.9 μ s (at 4.2MHz)
- ◆ 92 basic instructions
- ◆ Table look-up instructions
- ◆ 5-bit to 8-bit data conversion instruction
- ◆ Subroutine nesting : 15 levels max.
- ◆ 6 interrupt sources (External : 2, Internal : 4)
 - All sources have independent latches each, and multiple interrupt control is available
- ◆ I/O port (41 pins)
 - Input 2 ports 5 pins
 - I/O 8ports 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)	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
R40 (PWM0)			14-bit D/A converter (PWM) output
R53 - R51	I/O		
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. When used as input port watchdog, output pin, or A/D converter input pin, the latch must be set to "1".	
R71 (\overline{WTO})	I/O (Output)		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 ($\overline{INT1}$)			External interrupt 1 input
R81 (T2)			Timer/Counter 2 external input
R80 ($\overline{INT2}$)			External interrupt 2 input
R92 (\overline{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			
Y (BL), BL	Output (Output)	Focus signal output	Background blanking control signal output
\overline{HD} , \overline{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 ($\overline{KE0}$)	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".

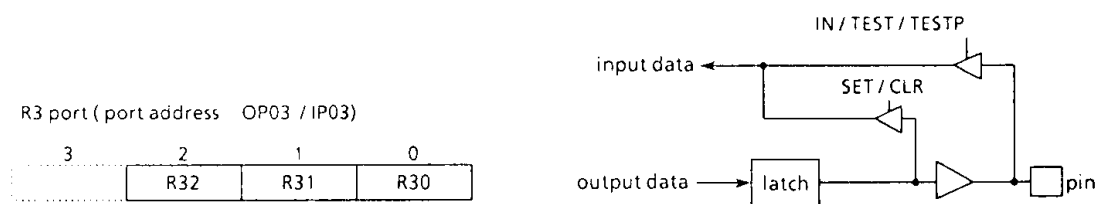


Figure 1-1. R3 port

Port Address (**)	Port		I/O instruction										
	Input (IP**)	Output (OP**)	IN %p, A	IN %p, @HL	OUT A, %p	OUT #k, %p	OUTB @HL	SET %p, b	CLR %p, b	TEST %p, b	SET @L	CLR @L	TEST @L
00 _H	K0 input port	Tri-state(R4 port) Control	○	○	○	○	○	○	○	○	○	○	○
01	P1 output latch	P1 output port	○	○	○	○	○	○	○	○	○	○	○
02	P2 output latch	P2 output port	○	○	○	○	○	○	○	○	○	○	○
03	R3 input port	R3 output port	○	○	○	○	○	○	○	○	○	○	○
04	R4 input port	R4 output port	○	○	○	○	○	○	○	○	○	○	○
05	R5 input port	R5 output port	○	○	○	○	○	○	○	○	○	○	○
06	R6 input port	R6 output port	○	○	○	○	○	○	○	○	○	○	○
07	R7 input port	R7 output port	○	○	○	○	○	○	○	○	○	○	○
08	R8 input port	R8 output port	○	○	○	○	○	○	○	○	○	○	○
09	R9 input port	R9 output port	○	○	○	○	○	○	○	○	○	○	○
0A	RA input port	RA output port	○	○	○	○	○	○	○	○	○	○	○
0B	—	—	○	○	○	○	○	○	○	○	○	○	○
0C	—	OSD command selector	○	○	○	○	○	○	○	○	○	○	○
0D	Remote control count value register	Remote control offset value register	○	○	○	○	○	○	○	○	○	○	○
0E	Status input (Note 2)	Remote control single preprocess circuit control	○	○	○	○	○	○	○	○	○	○	○
0F	Serial receive buffer	Serial transmit buffer	○	○	○	○	○	○	○	○	○	○	○
10 _H	Undefined	Hold operation mode	○	○	○	○	○	○	○	○	○	○	○
11	Undefined	—	○	○	○	○	○	○	○	○	○	○	○
12	Undefined	A/D converter input control	○	○	○	○	○	○	○	○	○	○	○
13	Undefined	Tri-state (R5 port) control	○	○	○	○	○	○	○	○	○	○	○
14	Undefined	—	○	○	○	○	○	○	○	○	○	○	○
15	Undefined	Watchdog timer control	○	○	○	○	○	○	○	○	○	○	○
16	Undefined	—	○	○	○	○	○	○	○	○	○	○	○
17	Undefined	PWM buffer selector	○	○	○	○	○	○	○	○	○	○	○
18	Undefined	PWM data transfer buffer	○	○	○	○	○	○	○	○	○	○	○
19	Undefined	Interval timer interrupt control	○	○	○	○	○	○	○	○	○	○	○
1A	Undefined	OSD control	○	○	○	○	○	○	○	○	○	○	○
1B	Undefined	—	○	○	○	○	○	○	○	○	○	○	○
1C	Undefined	Timer/Counter 1 control	○	○	○	○	○	○	○	○	○	○	○
1D	Undefined	Timer/Counter 2 control	○	○	○	○	○	○	○	○	○	○	○
1E	Undefined	SIO control 1	○	○	○	○	○	○	○	○	○	○	○
1F	Undefined	SIO control 2	○	○	○	○	○	○	○	○	○	○	○

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 _{slid}		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 $70^{\circ}C$)
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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	k Ω
	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)	$V_{DD} = 4.5V$, $I_{OH} = -200\mu A$	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 $T_{opr} = 25^{\circ}C$, $V_{DD} = 5V$.

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 : $V_{IN} = 5.3V / 0.2V$
 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	–			–	–	$\pm \frac{1}{4}$	LSB

A.C. CHARACTERISTICS

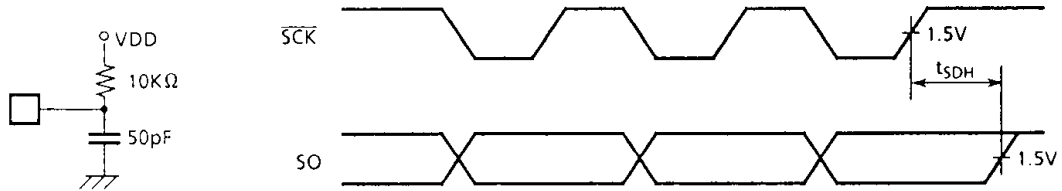
($V_{SS} = 0V$, $V_{DD} = 4.5$ to $6.0V$, $T_{opr} = -30$ to $70^{\circ}C$)

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 \overline{SCK} pin and SO pin.

Serial port (completion of transmission)



RECOMMENDED OSCILLATING CONDITIONS

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

(1) 4MHz

Ceramic Resonator

CSA4.00MG (MURATA)

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

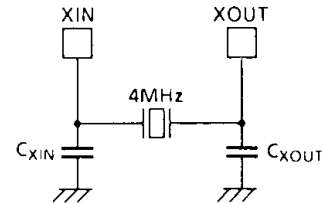
KBR-4.00MS (KYOCERA)

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

Crystal Oscillator

204B-6F 4.0000 (TOYOCOM)

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



(2) 400KHz

Ceramic Resonator

CSB400B (MURATA)

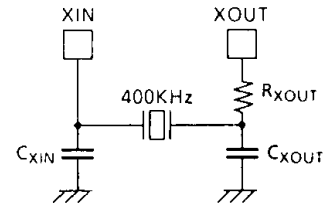
$C_{XIN} = C_{XOUT} = 220pF$,

KBR-400B (KYOCERA)

$R_{XOUT} = 6.8K\Omega$

$C_{XIN} = C_{XOUT} = 100pF$,

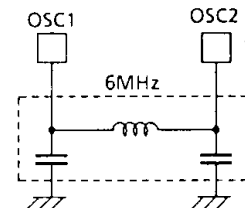
$R_{XOUT} = 10K\Omega$



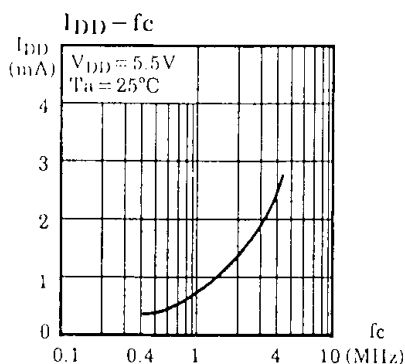
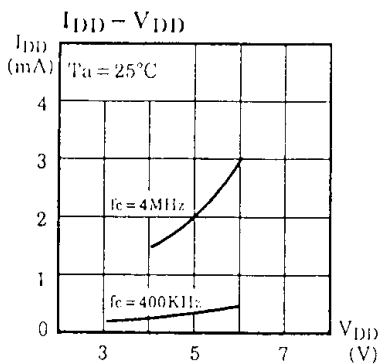
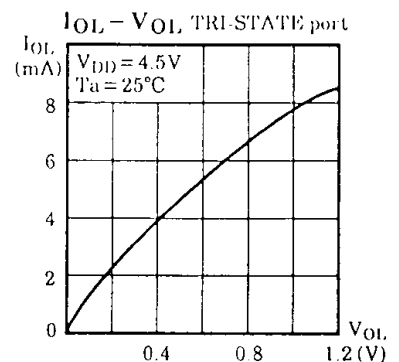
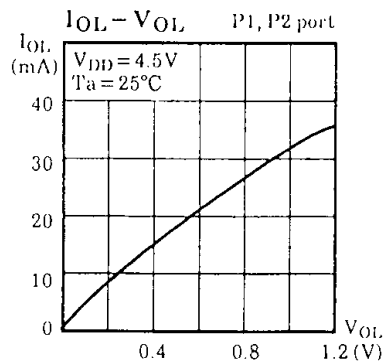
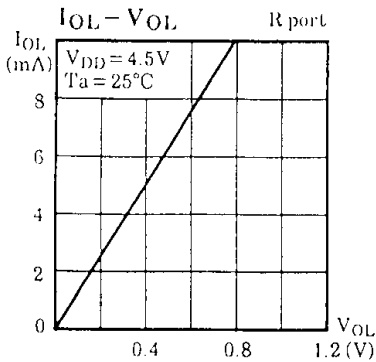
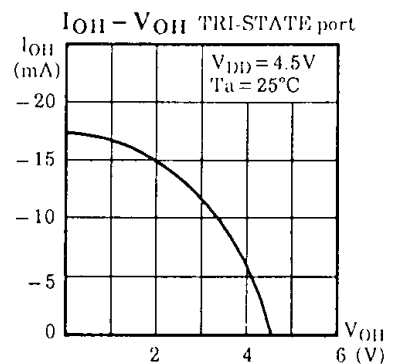
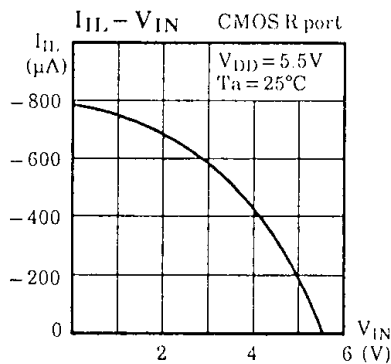
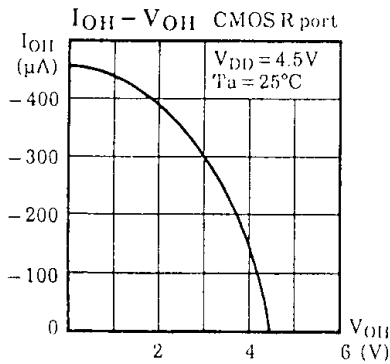
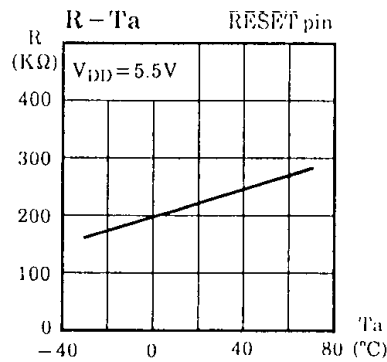
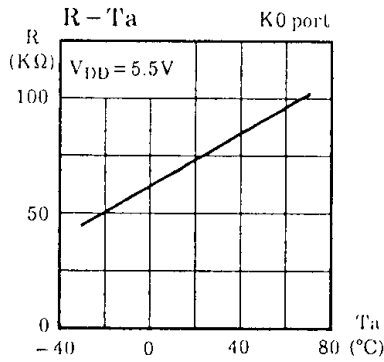
(3) 6MHz (for OSD)

LC Resonator

TBEKSES-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.)