SANYO **SANYO Semiconductors**

DATA SHEET

LC863448C,LC863440C
LC863432C,LC863428C
LC863424C,LC863420C
LC863416C

CMOS IC
48K/40K/32K/28K/24K/20K/16K-byte ROM,
CGROM16K-byte
on-chip 640/512-byte RAM and 352x9 bit OSD RAM

8-bit 1-chip Microcontroller

Overview

The LC863448C/40C/32C/28C/24C/20C/16C are 8-bit single chip microcontrollers with the following on-chip functional blocks:

- CPU: Operable at a minimum bus cycle time of 0.424μs
- On-chip ROM capacity
   Program ROM: 48K/40K/32K/28K/24K/20K/16K bytes
   CGROM: 16K bytes
- On-chip RAM capacity: 640/512 bytes
- OSD RAM: 352×9 bits
- Closed-Caption TV controller and the on-screen display controller
- Closed-Caption data slicer
- Four channels×6-bit AD Converter
- Three channels×7-bit PWM
- 16-bit timer/counter, 14-bit base timer

Continued on next page.

Note : This product includes the IIC bus interface circuit. If you intend to use the IIC bus interface, please notify us of this in advance of our receiving your program ROM code order.
Purchase of SANYO IIC components conveys a license under the Philips IIC Patents Rights to use these components in an IIC system, provided that the system conforms to the IIC Standard Specification as defined by Philips.

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Continued from preceding page.

- IIC-bus compliant serial interface circuit (Multi-master type)
- ROM correction function
- 12-source 8-vectored interrupt system
- Integrated system clock generator and display clock generator
  Only one X'tal oscillator (32.768kHz) for PLL reference is used for both generators
  TV control and the Closed Caption function

All of the above functions are fabricated on a single chip.

Features

■Read-Only Memory (ROM): 49152×8 bits / 40960×8 bits / 32768×8 bits /
28672×8 bits / 24576×8 bits / 20480×8 bits /
16384×8 bits for program
16128×8 bits for CGROM

■Random Access Memory (RAM): 512×8 bits (working area) : LC863448C/40C
384×8 bits (working area) : LC863432C/28C/24C/20C/16C
128×8 bits (working or ROM correction function)
352×9 bits (for CRT display)

■OSD Functions
- Screen display : 36 characters×16 lines (by software)
- RAM : 352 words (9 bits per word)
  Display area : 36 words×8 lines
  Control area : 8 words×8 lines
- Characters
  Up to 252 kinds of 16×32 dot character fonts (4 characters including 1 test character are not programmable)
  Each font can be divided into two parts and used as two fonts (Ex. 16×16 dot character font×2)
  At least 111 characters need to be divide between a 16×17 dot and 8×9 dot character font to display
  the caption fonts.
- Various character attributes
  Character colors : 16colors (analog mode: lVp-p output) / 8colors (digital mode)
  Character background colors : 16colors (analog mode: lVp-p output) / 8colors (digital mode)
  Fringe / shadow colors : 16colors (analog mode: lVp-p output) / 8colors (digital mode)
  Full screen colors : 16colors (analog mode: lVp-p output) / 8colors (digital mode)
  Rounding
  Underline
  Italic character (slanting)
- Attribute can be changed without spacing
- Vertical display start line number can be set for each row independently (Rows can be overlapped)
- Horizontal display start position can be set for each row independently
- Horizontal pitch (9 to 16 dots)*1 and vertical pitch (1 to 32 dots) can be set for each row independently
- Different display modes can be set for each row independently
  Caption • Text mode / OSD mode 1 / OSD mode 2 (Quarter size) / Simplified graphic mode
- Ten character sizes *1
  Horez. × Vert. = (1×1), (1×2), (2×2), (2×4), (0.5×0.5)
               (1.5×1), (1.5×2), (3×2), (3×4), (0.75×0.5)
- Shuttering and scrolling on each row
- Simplified Graphic Display
  Note *1: range depends on display mode : refer to the manual for details.

■Data Slicer (closed caption format)
- Closed caption data and XDS data extraction
- NTSC/PAL, and extracted line can be specified

LC863448C/40C/32C/28C/24C/20C/16C

■Bus Cycle Time / Instruction-Cycle Time

Bus Cycle Time	Instruction Cycle Time	Clock Divider	System Clock Oscillation	Oscillation Frequency	Voltage
0.424μs	0.848μs	1/2	Internal VCO (Ref: X'tal 32.768kHz)	14.156MHz	4.5V to 5.5V
7.5μs	15.0μs	1/2	Internal RC	800kHz	4.5V to 5.5V
91.55μs	183.1μs	1/1	Crystal	32.768kHz	4.5V to 5.5V
183.1μs	366.2μs	1/2	Crystal	32.768kHz	4.5V to 5.5V

■Ports
- Input / Output Ports : 4 ports (23 terminals)
  Data direction programmable in nibble units : 1 port (8 terminals)
  (If the N-ch open drain output is selected by option, the corresponding port data can be read in output mode.)
  Data direction programmable for each bit individually: 3 ports (15 terminals)

■AD Converter
- 4 channels×6-bit AD converters

■Serial Interfaces
- IIC-bus compliant serial interface (Multi-master type)
  Consists of a single built-in circuit with two I/O channels. The two data lines and two clock lines can be connected internally.

■PWM Output
- 3 channels×7-bit PWM

■Timer
- Timer 0: 16-bit timer/counter
  With 2-bit prescaler + 8-bit programmable prescaler
    Mode 0: Two 8-bit timers with a programmable prescaler
    Mode 1: 8-bit timer with a programmable prescaler + 8-bit counter
    Mode 2: 16-bit timer with a programmable prescaler
    Mode 3: 16-bit counter
    The resolution of timer is 1 tCYC.
- Base Timer
  Generate every 500ms overflow for a clock application
  (using 32.768kHz crystal oscillation for the base timer clock)
  Generate every 976μs, 3.9ms, 15.6ms, 62.5ms overflow
  (using 32.768kHz crystal oscillation for the base timer clock)
  Clock for the base timer is selectable from 32.768kHz crystal oscillation, system clock or programmable prescaler output of Timer 0

■Remote Control Receiver Circuit (connected to the P73/INT3/T0IN terminal)
- Noise rejection function
- Polarity switching

■Watchdog Timer
  External RC circuit is required
  Interrupt or system reset is activated when the timer overflows

■ROM Correction Function
  Max 128 bytes / 2 addresses

■Interrupts
- 12 sources 8 vectored interrupts
  1. External Interrupt INT0
  2. External Interrupt INT1
  3. External Interrupt INT2, Timer/counter T0L (Lower 8 bits)
  4. External Interrupt INT3, base timer
  5. Timer/counter T0H (Upper 8 bits)
  6. Data slicer
  7. Vertical synchronous signal interrupt ($\overline{\text{VS}}$), horizontal line ($\overline{\text{HS}}$)
  8. IIC, Software
- Interrupt Priority Control
  Three interrupt priorities are supported (low, high and highest) and multi-level nesting is possible. Low or high priority can be assigned to the interrupts from 3 to 8 listed above. For the external interrupt INT0 and INT1, low or highest priority can be set.

■Sub-routine Stack Level
- A maximum of 128 levels (stack is built in the internal RAM)

■Multiplication/Division Instruction
- 16 bits×8 bits (7 instruction cycle times)
- 16 bits÷8 bits (7 instruction cycle times)

■3 Oscillation Circuits
- Built-in RC oscillation circuit used for the system clock
- Built-in VCO circuit used for the system clock and OSD
- X'tal oscillation circuit used for base timer, system clock and PLL reference

■Standby Function
- HALT mode
  The HALT mode is used to reduce the power dissipation. In this operation mode, the program execution is stopped. This mode can be released by the interrupt request or the system reset.
- HOLD mode
  The HOLD mode is used to stop the oscillations; RC (internal), VCO, and X'tal oscillations. This mode can be released by the following conditions.
    - Pull the reset terminal ($\overline{\text{RES}}$) to low level.
    - Feed the selected level to either P70/INT0 or P71/INT1.

■Package
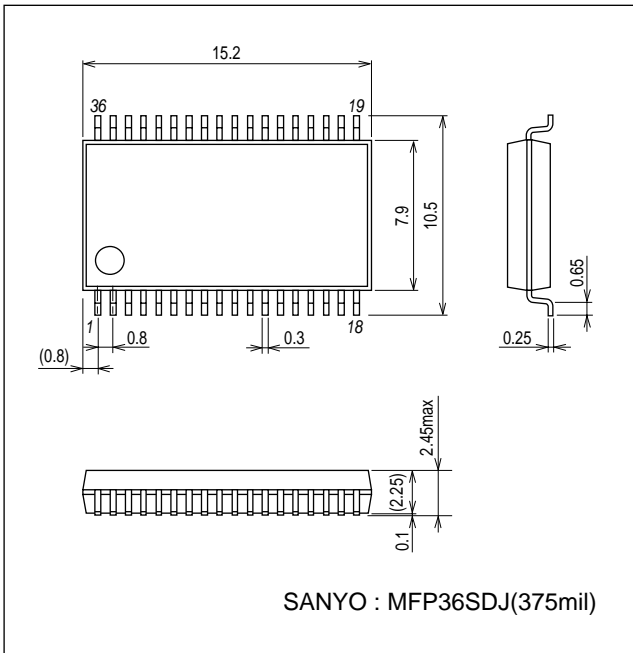- MFP36SDJ(375mil)   : Lead-free type
- DIP36S(400mil)   : Lead-free type

■Development Tools
- Flash EEPROM: LC86F3448B
- Evaluation chip: LC863096
- Emulator: EVA86000 (main) + ECB863200A (evaluation chip board)
                                       + SUB863400A (sub board)
                                       + POD36-CABLE (cable)
                                       + POD36-DIP (for DIP36S)
                                       or POD36-MFP (for MFP36SDJ)
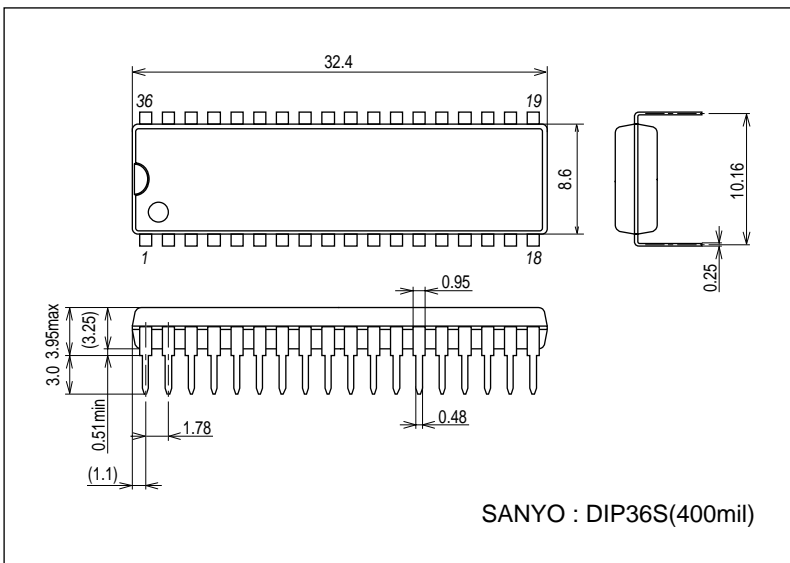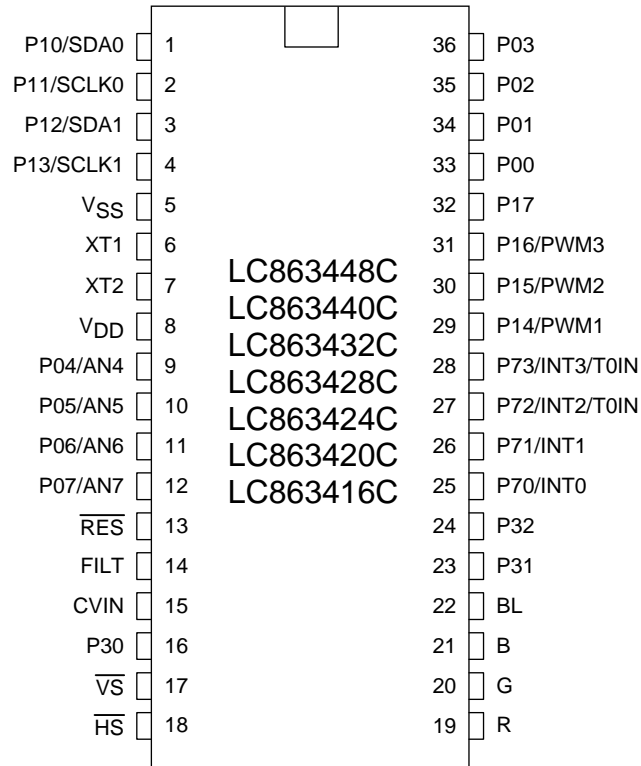
Package Dimensions

unit : mm (typ)
3263

SANYO : MFP36SDJ(375mil)

Package Dimensions

unit : mm (typ)
3170A

SANYO : DIP36S(400mil)

Pin Assignment

P10/SDA0	1	36	P03
P11/SCLK0	2	35	P02
P12/SDA1	3	34	P01
P13/SCLK1	4	33	P00
V_{SS}	5	32	P17
XT1	6	31	P16/PWM3
XT2	7	30	P15/PWM2
V_{DD}	8	29	P14/PWM1
P04/AN4	9	28	P73/INT3/T0IN
P05/AN5	10	27	P72/INT2/T0IN
P06/AN6	11	26	P71/INT1
P07/AN7	12	25	P70/INT0
$\overline{RES}$	13	24	P32
FILT	14	23	P31
CVIN	15	22	BL
P30	16	21	B
$\overline{VS}$	17	20	G
$\overline{HS}$	18	19	R

LC863448C
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Top view

SANYO: MFP36SDJ(375mil) "Lead-free Type"
SANYO: DIP36S(400mil)   "Lead-free Type"

System Block Diagram
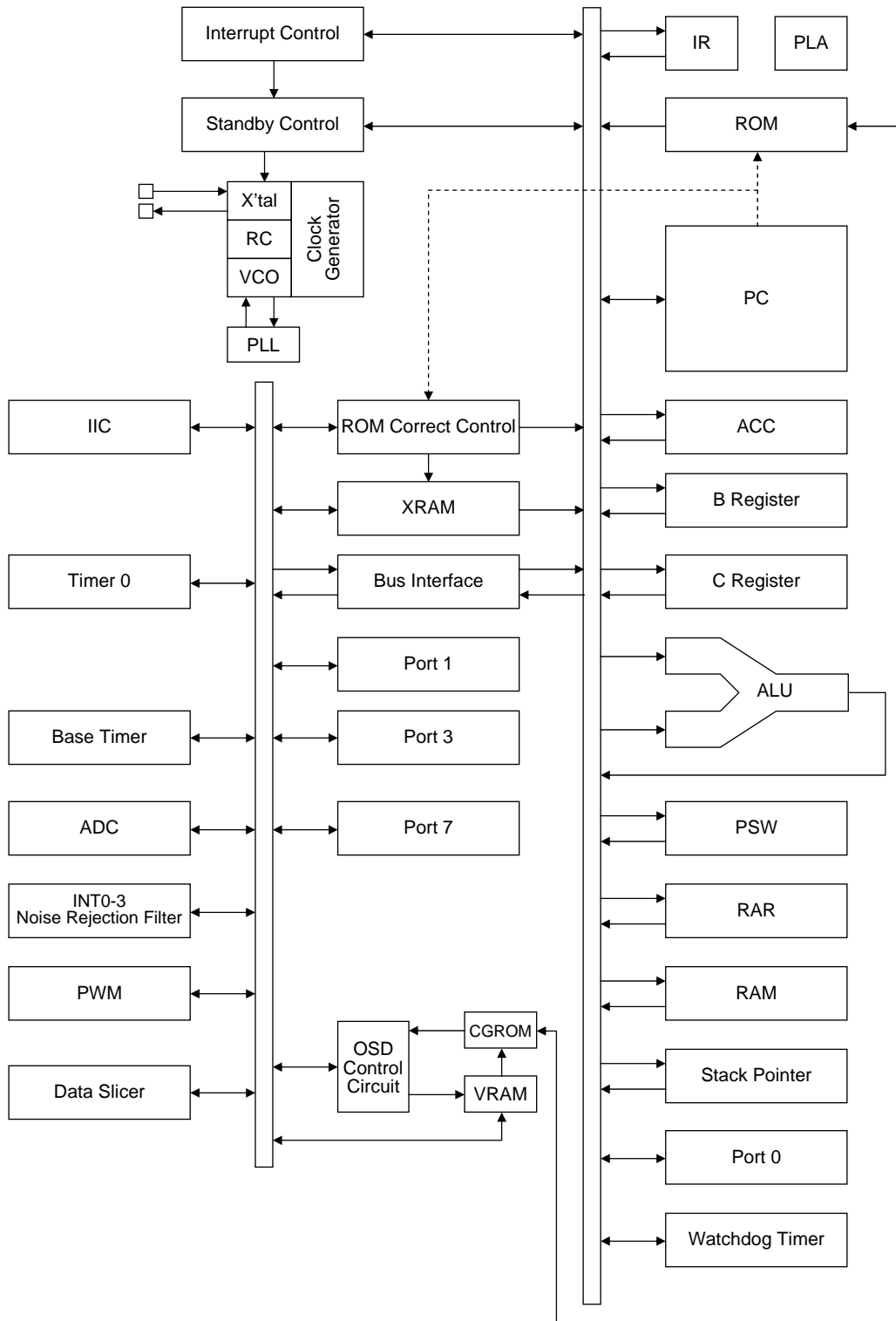
Pin Description

Pin Description Table

Terminal	I/O	Function Description	Option
V_{SS}	-	Negative power supply	
XT1	I	Input terminal for crystal oscillator	
XT2	O	Output terminal for crystal oscillator	
V_{DD}	-	Positive power supply	
$\overline{RES}$	I	Reset terminal	
FILT	O	Filter terminal for PLL	
CVIN	I	Video signal input terminal	
$\overline{VS}$	I	Vertical synchronization signal input terminal	
$\overline{HS}$	I	Horizontal synchronization signal input terminal	
R	O	Red (R) output terminal of RGB image output	
G	O	Green (G) output terminal of RGB image output	
B	O	Blue (B) output terminal of RGB image output	
BL	O	Fast blanking control signal Switch TV image signal and caption/OSD image signal	

Port 0
P00 to P07
	I/O	• 8-bit input/output port,
		  Input/output can be specified in nibble unit
		  (If the N-ch open drain output is selected by option, the corresponding port data
		  can be read in output mode.)
		• Other functions
		  AD converter input port (P04 to P07: 4 channels)
			Pull-up resistor
			provided/not provided
			Output Format
			CMOS/Nch-OD

Port 1
P10 to P17
	I/O	• 8-bit input/output port
		  Input/output can be specified for each bit
		  (programmable pull-up resister provided)
		• Other functions
		
		  P10 IIC0 data I/O
		  P11 IIC0 clock output
		  P12 IIC1 data I/O
		  P13 IIC1 clock output
		  P14 PWM1 output
		  P15 PWM2 output
		  P16 PWM3 output
			Output Format
			CMOS/Nch-OD

Port 3
P30 to P32
	I/O	• 3-bit input/output port
		  Input/output can be specified for each bit
		  (CMOS output/input with programmable pull-up resister)	

Port 7
P70
P71 to P73
	I/O	• 4-bit input/output port
		  Input or output can be specified for each bit
		  P70: I/O with programmable pull-up resister
		  P71 to P73: CMOS output/input with programmable pull-up resister
		• Other functions
		
		  P70 INT0 input/HOLD release input/
		        Nch-Tr. output for watchdog timer
		  P71 INT1 input/HOLD release input
		  P72 INT2 input/Timer 0 event input
		  P73 INT3 input (noise rejection filter connected)/
		        Timer 0 event input
		
		Interrupt receiver format, vector addresses	

	Rising	Falling	Rising/ Falling	H level	L level	Vector
INT0	enable	enable	disable	enable	enable	03H
INT1	enable	enable	disable	enable	enable	0BH
INT2	enable	enable	enable	disable	disable	13H
INT3	enable	enable	enable	disable	disable	1BH

Note: A capacitor of at least 10µF must be inserted between V_{DD} and V_{SS} when using this IC.

- Output form and existence of pull-up resistor for all ports can be specified for each bit.
- Programmable pull-up resistor is always connected regardless of port option, CMOS or N-ch open drain output in port 1.

- Port status in reset

Terminal	I/O	Pull-up resistor status at selecting CMOS output option
Port 0	I	Pull-up resistor OFF, ON after reset release
Port 1	I	Programmable pull-up resistor OFF

Absolute Maximum Ratings at $Ta = 25°C$, $V_{SS} = 0V$

Parameter		Symbol	Pins	Conditions	$V_{DD}[V]$	Ratings min	Ratings typ	Ratings max	unit
Maximum supply voltage		V_{DD} max	V_{DD}			-0.3		+6.5	V
Input voltage		$V_I(1)$	$\overline{RES}$, $\overline{HS}$, $\overline{VS}$, CVIN			-0.3		V_{DD}+0.3	
Output voltage		$V_O(1)$	R, G, B, BL, FILT			-0.3		V_{DD}+0.3	
Input/output voltage		V_{IO}	Ports 0, 1, 3, 7			-0.3		V_{DD}+0.3	
High level output current	Peak output current	IOPH(1)	Ports 0, 1, 3, 7	•CMOS output •For each pin.		-4			mA
		IOPH(2)	R, G, B, BL	•CMOS output •For each pin.		-5			
	Total output current	ΣIOAH(1)	Ports 0, 1	Total of all pins.		-20			
		ΣIOAH(2)	Ports 3, 7	Total of all pins.		-10			
		ΣIOAH(3)	R, G, B, BL	Total of all pins.		-12			
Low level output current	Peak output current	IOPL(1)	Ports 0, 1, 3	For each pin.				20	
		IOPL(2)	Port 7	For each pin.				15	
		IOPL(3)	R, G, B, BL	For each pin.				5	
	Total output current	ΣIOAL(1)	Ports 0, 1	Total of all pins.				40	
		ΣIOAL(2)	Ports 3, 7	Total of all pins.				20	
		ΣIOAL(3)	R, G, B, BL	Total of all pins.				12	
Maximum power dissipation		Pd max	MFP36SDJ(375mil)	Ta=-10 to +70°C				360	mW
			DIP36S(400mil)					610	
Operating temperature range		Topr				-10		+70	°C
Storage temperature range		Tstg				-55		+125	

Recommended Operating Range at Ta = -10°C to +70°C, $V_{SS} = 0V$

Parameter	Symbol	Pins	Conditions	Ratings				unit
				V_{DD}[V]	min	typ	max	
Operating supply voltage range	$V_{DD}(1)$	V_{DD}	$0.844\mu s \leq tCYC \leq 0.852\mu s$		4.5		5.5	V
	$V_{DD}(2)$		$4\mu s \leq tCYC \leq 400\mu s$		4.5		5.5	
Hold voltage	VHD	V_{DD}	RAMs and the registers data are kept in HOLD mode.		2.0		5.5	
High level input voltage	$V_{IH}(1)$	Port 0	Output disable	4.5 to 5.5	$0.6V_{DD}$		V_{DD}	
	$V_{IH}(2)$	• Ports 1, 3 (Schumitt) • Port 7 (Schumitt) port input/interrupt • $\overline{HS}$, $\overline{VS}$, $\overline{RES}$ (Schumitt)	Output disable	4.5 to 5.5	$0.75V_{DD}$		V_{DD}	
	$V_{IH}(3)$	Port 70 Watchdog timer input	Output disable	4.5 to 5.5	V_{DD}-0.5		V_{DD}	
Low level input voltage	$V_{IL}(1)$	Port 0	Output disable	4.5 to 5.5	V_{SS}		$0.2V_{DD}$	
	$V_{IL}(2)$	• Ports 1, 3 (Schumitt) • Port 7 (Schumitt) port input/interrupt • $\overline{HS}$, $\overline{VS}$, $\overline{RES}$ (Schumitt)	Output disable	4.5 to 5.5	V_{SS}		$0.25V_{DD}$	
	$V_{IL}(3)$	Port 70 Watchdog timer input	Output disable	4.5 to 5.5	V_{SS}		$0.6V_{DD}$	
CVIN	VCVIN	CVIN		5.0	0.7Vp-p	1Vp-p	1.4Vp-p	Vp-p*
Operation cycle time	tCYC(1)		• All functions operating	4.5 to 5.5	0.844	0.848	0.852	μs
	tCYC(2)		• OSD and Data slicer are not operating	4.5 to 5.5	0.844		400	
Oscillation frequency range	FmRC		Internal RC oscillation	4.5 to 5.5	0.4	0.8	3.0	MHz

* Vp-p: Peak-to-peak voltage

Electrical Characteristics at Ta = -10°C to +70°C, $V_{SS} = 0V$

Parameter	Symbol	Pins	Conditions	V_{DD}[V]	min	typ	max	unit
High level input current	$I_{IH}(1)$	Ports 0, 1, 3, 7	•Output disable •Pull-up MOS Tr. OFF •$V_{IN}=V_{DD}$ (including the off-leak current of the output Tr.)	4.5 to 5.5			1	μA
	$I_{IH}(2)$	• $\overline{RES}$ • $\overline{HS}$, $\overline{VS}$	•$V_{IN}=V_{DD}$	4.5 to 5.5			1	
Low level input current	$I_{IL}(1)$	Ports 0, 1, 3, 7	•Output disable •Pull-up MOS Tr. OFF •$V_{IN}=V_{SS}$ (including the off-leak current of the output Tr.)	4.5 to 5.5	-1			
	$I_{IL}(2)$	• $\overline{RES}$ • $\overline{HS}$, $\overline{VS}$	$V_{IN}=V_{SS}$	4.5 to 5.5	-1			
High level output voltage	$V_{OH}(1)$	• CMOS output of ports 0, 1, 3, 71 to 73	I_{OH}=-1.0mA	4.5 to 5.5	V_{DD}-1			V
	$V_{OH}(2)$	R, G, B, BL	I_{OH}=-0.1mA R. G. B: digital mode	4.5 to 5.5	V_{DD}-0.5			
Low level output voltage	$V_{OL}(1)$	Ports 0, 1, 3, 71 to 73	I_{OL}=10mA	4.5 to 5.5			1.5	
	$V_{OL}(2)$	Ports 0, 3, 71 to 73	I_{OL}=1.6mA	4.5 to 5.5			0.4	
	$V_{OL}(3)$	• R, G, B, BL • Port 1	I_{OL}=3.0mA R. G. B: digital mode	4.5 to 5.5			0.4	
	$V_{OL}(4)$	Port 70	I_{OL}=1mA	4.5 to 5.5			0.4	
Pull-up MOS Tr. resistance	Rpu	Ports 0, 1, 3, 7	V_{OH}=0.9V_{DD}	4.5 to 5.5	13	38	80	kΩ
Bus terminal short circuit resistance (SCL0-SCL1, SDA0-SDA1)	RBS	• P10 to P12 • P11 to P13		4.5 to 5.5		130	300	Ω
Hysteresis voltage	VHYS	• Ports 1, 3, 7 • $\overline{RES}$ • $\overline{HS}$, $\overline{VS}$	Output disable	4.5 to 5.5		0.1V_{DD}		V
Input clump voltage	VCLMP	CVIN		5.0	2.3	2.5	2.7	
Pin capacitance	CP	All pins	• f=1MHz • Every other terminals are connected to V_{SS}. • Ta=25ºC	4.5 to 5.5		10		pF

IIC Input/Output Conditions at Ta = -10°C to +70°C, V_{SS} = 0V

Parameter	Symbol	Standard		High speed		unit
		min	max	min	max	
SCL Frequency	fSCL	0	100	0	400	kHz
BUS free time between stop - start	tBUF	4.7	-	1.3	-	μs
HOLD time of start, restart condition	tHD;STA	4.0	-	0.6	-	μs
L time of SCL	tLOW	4.7	-	1.3	-	μs
H time of SCL	tHIGH	4.0	-	0.6	-	μs
Set-up time of restart condition	tSU;STA	4.7	-	0.6	-	μs
HOLD time of SDA	tHD;DAT	0	-	0	0.9	μs
Set-up time of SDA	tSU;DAT	250	-	100	-	ns
Rising time of SDA, SCL	tR	-	1000	20+0.1Cb	300	ns
Falling time of SDA, SCL	tF	-	300	20+0.1Cb	300	ns
Set-up time of stop condition	tSU;STO	4.0	-	0.6	-	μs

Refer to figure 8

Note 1: Cb: Total capacitance of all BUS (unit : pF)

Pulse Input Conditions at Ta = -10°C to +70°C, V_{SS} = 0V

Parameter	Symbol	Pins	Conditions		Ratings			unit
				V_{DD}[V]	min	typ	max	
High/low level pulse width	tPIH(1) tPIL(1)	• INT0, INT1 • INT2/T0IN	•Interrupt acceptable •Timer0-countable	4.5 to 5.5	1			tCYC
	tPIH(2) tPIL(2)	INT3/T0IN (1tCYC is selected for noise rejection clock.)	•Interrupt acceptable •Timer0-countable	4.5 to 5.5	2			
	tPIH(3) tPIL(3)	INT3/T0IN (16tCYC is selected for noise rejection clock.)	•Interrupt acceptable •Timer0-countable	4.5 to 5.5	32			
	tPIH(4) tPIL(4)	INT3/T0IN (64tCYC is selected for noise rejection clock.)	•Interrupt acceptable •Timer0-countable	4.5 to 5.5	128			
	tPIL(5)	$\overline{RES}$	Reset acceptable	4.5 to 5.5	200			μs
	tPIH(6) tPIL(6)	$\overline{HS}$, $\overline{VS}$	•Display position controllable •The active edge of $\overline{HS}$ and $\overline{VS}$ must be apart at least 1tCYC. •Refer to figure 4.	4.5 to 5.5	3			
Rising/falling time	tTHL tTLH	$\overline{HS}$	Refer to figure 4.	4.5 to 5.5			500	ns

AD Converter Characteristics at Ta = -10°C to +70°C, V_{SS} = 0V

Parameter	Symbol	Pins	Conditions		Ratings			unit
				V_{DD}[V]	min	typ	max	
Resolution	N			4.5 to 5.5		6		bit
Absolute precision	ET		(Note 2)				±1	LSB
Conversion time	tCAD	Vref selection to conversion finish	1 bit conversion time=2×Tcyc			1.69		μs
Analog input voltage range	VAIN	AN4 to AN7			V_{SS}		V_{DD}	V
Analog port input current	IAINH		VAIN=V_{DD}				1	μA
	IAINL		VAIN=V_{SS}		-1			

Note 2: Absolute precision does not include quantizing error (1/2LSB).

Analog Mode RGB Characteristics at Ta = -10°C to +70°C, V$_{SS}$ = 0V

Parameter	Symbol	Pins	Conditions	Ratings				
				V$_{DD}$[V]	min.	typ.	max.	unit
Analog output voltage		R.G.B Analog output mode	Low level output	5.0	0.45	0.5	0.55	V
			Intensity output		0.90	1.0	1.10	
			Hi level output		1.35	1.5	1.65	
Time setting		R.G.B	70% 10pf load				50	ns

Sample Current Dissipation Characteristics at Ta = -10°C to +70°C, V$_{SS}$ = 0V

The sample current dissipation characteristics is the measurement result of Sanyo provided evaluation board when the recommended circuit parameters shown in the sample oscillation circuit characteristics are used externally.

The currents through the output transistors and the pull-up MOS transistors are ignored.

Parameter	Symbol	Pins	Conditions	Ratings				unit
				V$_{DD}$[V]	min	typ	max	
Current dissipation during basic operation (Note 3)	IDDOP(1)	V$_{DD}$	• FmX'tal=32.768kHz X'tal oscillation • System clock : VCO • VCO for OSD operating • OSD is Digital mode • Internal RC oscillation stops	4.5 to 5.5		11	25	mA
	IDDOP(2)	V$_{DD}$	• FmX'tal=32.768kHz X'tal scillation • System clock: VCO • VCO for OSD operating • OSD is Analog mode • Internal RC oscillation stops	4.5 to 5.5		20	35	
	IDDOP(3)	V$_{DD}$	• FmX'tal=32.768kHz X'tal scillation • System clock : X'tal (Instruction cycle time: 366.2µs) • VCO for system VCO for OSD, internal RC oscillation stop • Data slicer, AD converters stop	4.5 to 5.5		65	300	µA
Current dissipation in HALT mode (Note 3)	IDDHALT(1)	V$_{DD}$	• HALT mode • FmX'tal=32.768kHz X'tal oscillation • System clock : VCO • VCO for OSD stops • Internal RC oscillation stops	4.5 to 5.5		3	9	mA
	IDDHALT(2)	V$_{DD}$	• HALT mode • FmX'tal=32.768kHz X'tal oscillation • VCO for system stops • VCO for OSD stops • System clock : Internal RC	4.5 to 5.5		300	1000	µA
	IDDHALT(3)	V$_{DD}$	• HALT mode • FmX'tal=32.768kHz X'tal oscillation • VCO for system stops • VCO for OSD stops • System clock: X'tal (Instruction cycle time: 366.2µs)	4.5 to 5.5		57	200	
Current dissipation in HOLD mode (Note 3)	IDDHOLD	V$_{DD}$	• HOLD mode • All oscillation stops.	4.5 to 5.5		0.05	20	µA

Note 3: The currents through the output transistors and the pull-up MOS transistors are ignored.

Recommended Oscillation Circuit and Sample Characteristics

The sample oscillation circuit characteristics in the table below is based on the following conditions:
Recommended circuit parameters are verified by an oscillator manufacturer using a Sanyo provided oscillation evaluation board.
Sample characteristics are the result of the evaluation with the recommended circuit parameters connected externally.

Recommended oscillation circuit and sample characteristics (Ta = -10°C to +70°C)

Frequency	Manufacturer	Oscillator	Recommended circuit parameters				Operating supply voltage range	Oscillation stabilizing time		Notes
			C1	C2	Rf	Rd		typ	max	
32.768kHz	EPSON TOYOCOM	MC-306	18pF	18pF	OPEN	390kΩ	4.5 to 5.5V	1.0s	1.5s	Applicable CL value=12.5pF SMD type

Notes: The oscillation stabilizing time period is the time until the VCO oscillation for the internal system becomes stable after the following conditions. (Refer to Figure 2.)
  1. The V_{DD} becomes higher than the minimum operating voltage after the power is supplied.
  2. The HOLD mode is released.

The sample oscillation circuit characteristics may differ applications. For further assistance, please contact with oscillator manufacturer with the following notes in your mind.
  • Since the oscillation frequency precision is affected by wiring capacity of the application board, etc., adjust the oscillation frequency on the production board.
  • The above oscillation frequency and the operating supply voltage range are based on the operating temperature of -10°C to +70°C. For the use with the temperature outside of the range herein, or in the applications requiring high reliability such as car products, please consult with oscillator manufacturer.
  • When using the oscillator which is not shown in the sample oscillation circuit characteristics, please consult with Sanyo sales personnel.

Since the oscillation circuit characteristics are affected by the noise or wiring capacity because the circuit is designed with low gain in order to reduce the power dissipation, refer to the following notices.
  • The distance between the clock I/O terminal (XT1 terminal XT2 terminal) and external parts should be as short as possible.
  • The capacitors' V_{SS} should be allocated close to the microcontroller's GND terminal and be away from other GND.
  • The signal lines with rapid state changes or with large current should be allocated away from the oscillation circuit.
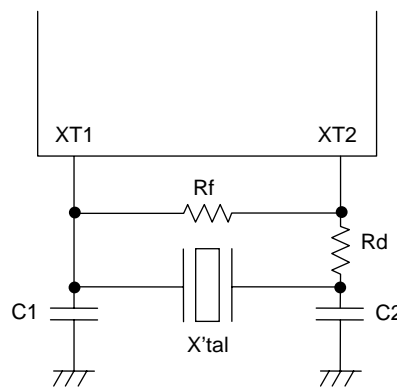
Figure 1 Recommended Oscillation Circuit
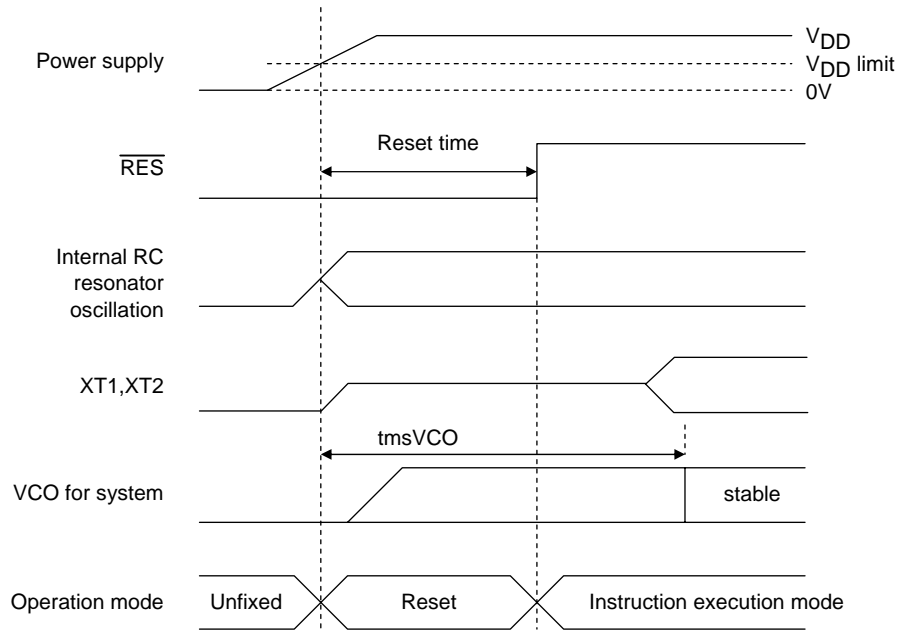
Reset Time and Oscillation Stabilizing Time
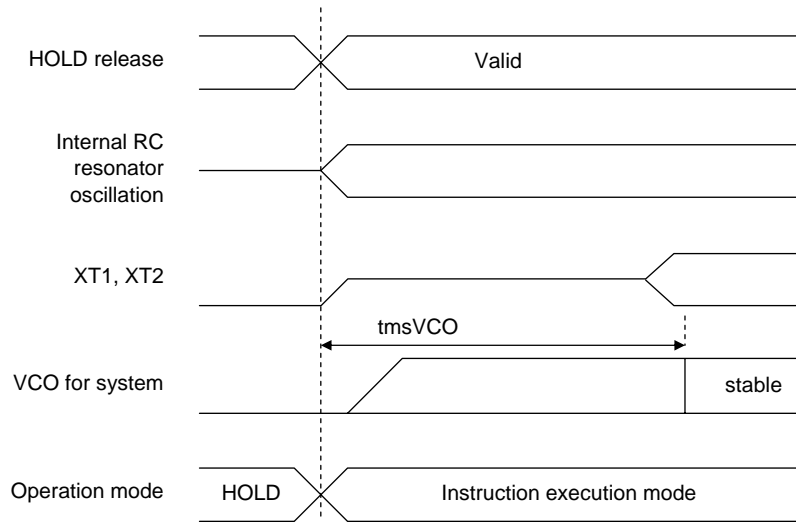
HOLD Release Signal and Oscillation Stabilizing Time

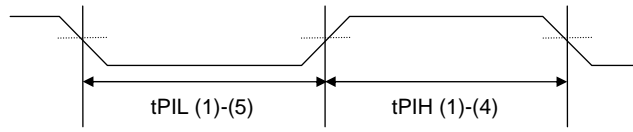Figure 2 Oscillation Stabilizing Time

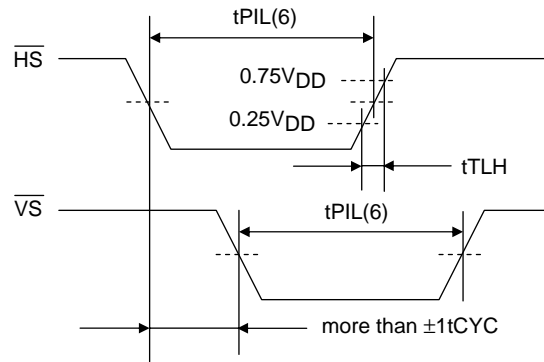Figure 3 Pulse Input Timing Condition - 1
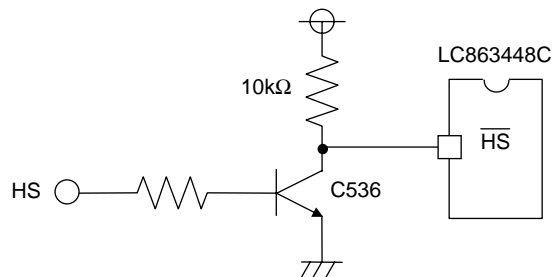

Figure 4 Pulse Input Timing Condition - 2

Figure 5 Recommended Interface Circuit

Noise filter

C-Video — 200Ω — 1000pF — 1µF — CVIN

Coupling capacitor
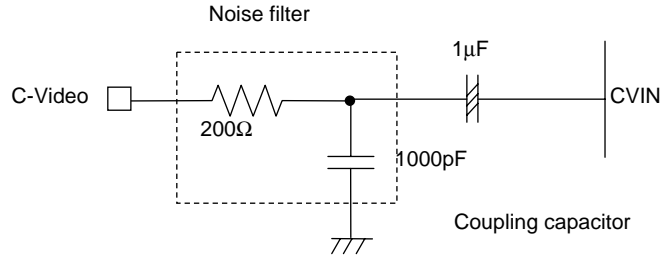
Output impedance of C-Video before Noise filter should be less then 100Ω.
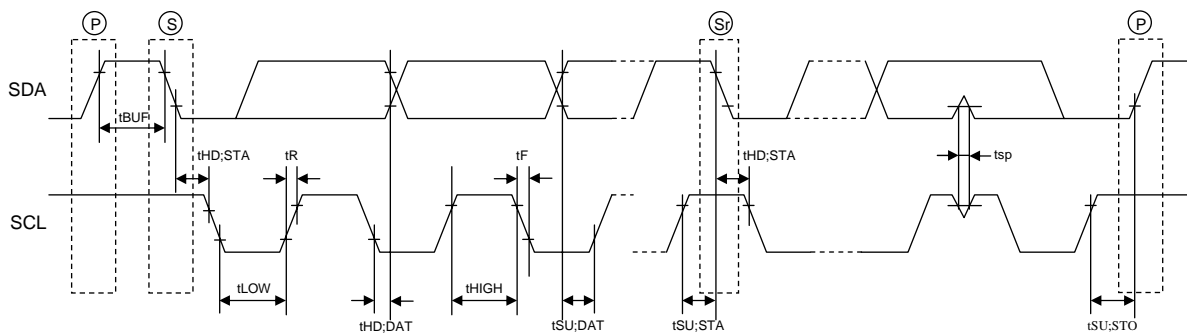
Figure 6 CVIN Recommended Circuit

100Ω

1MΩ — 2.2µF — 33000pF — FILT
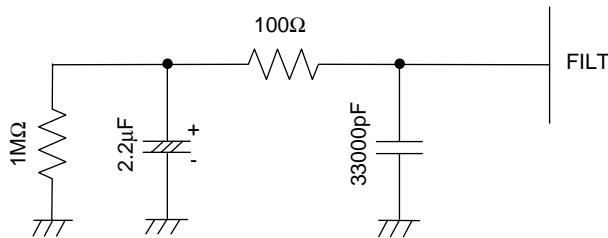
Figure 7 FILT Recommended Circuit
Note: Place FILT parts on board as close to the microcontroller as possible.

SDA

SCL

tBUF
tHD;STA
tR
tF
tHD;STA
tsp
tLOW
tHIGH
tHD;DAT
tSU;DAT
tSU;STA
tSU;STO

S : start condition   tsp : spike suppression   Standard mode : not exist
P : stop condition   High speed mode : less than 50ns
Sr : restart condition

Figure 8 IIC Timing

I≈1mA

I

I

R≈500Ω

PAD
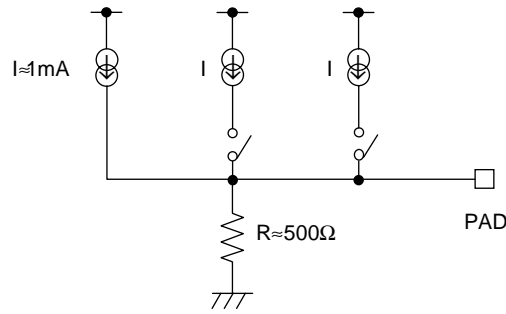
Figure 9 R.G.B. Analog Output Equivalent Circuit