

CMOS 6-Bit D/A Converter

LH5047/LH5048

T-51-09-07

LH5047/LH5048 CMOS 6-Bit D/A Converter

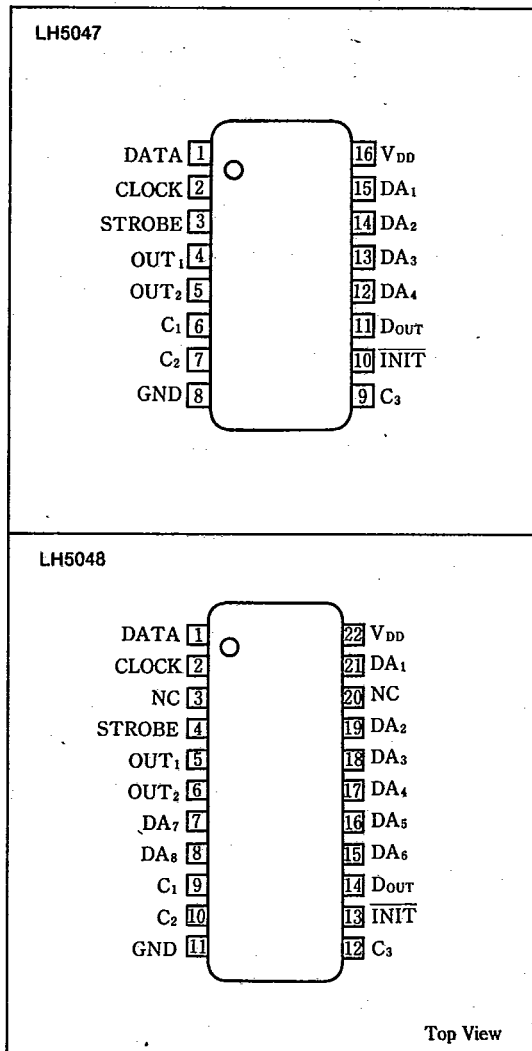
■ Description

The LH5047/LH5048 is a CMOS LSI incorporating 4 ports/8 ports of 6-bit D/A converter designed to expand the output of 1-chip microcomputers.

■ Features

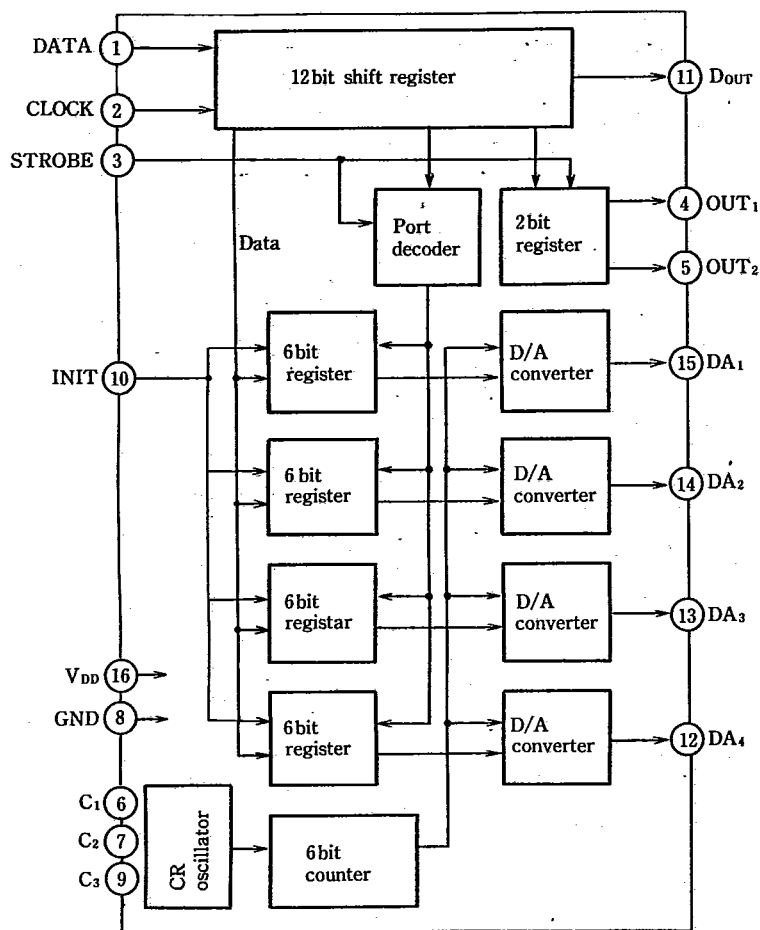
1. 6-bit D/A converter (Pulse modulation system)
2. Built-in CR oscillation circuit
(External CR and external clock signal input)
3. No. of D/A output
LH5047 : 4 ports
LH5048 : 8 ports
4. Control output : 2 ports
5. D/A output N-channel open drain output
(corresponding to 12V)
6. 12-bit serial data input
4-bit...D/A converter selection data
6-bit...D/A data
2-bit...Spare output (OUT₁, OUT₂)
7. 16-pin dual-in-line package (LH5047)
22-pin dual-in-line package (LH5048)

■ Pin Connections



Block Diagram

LH5047

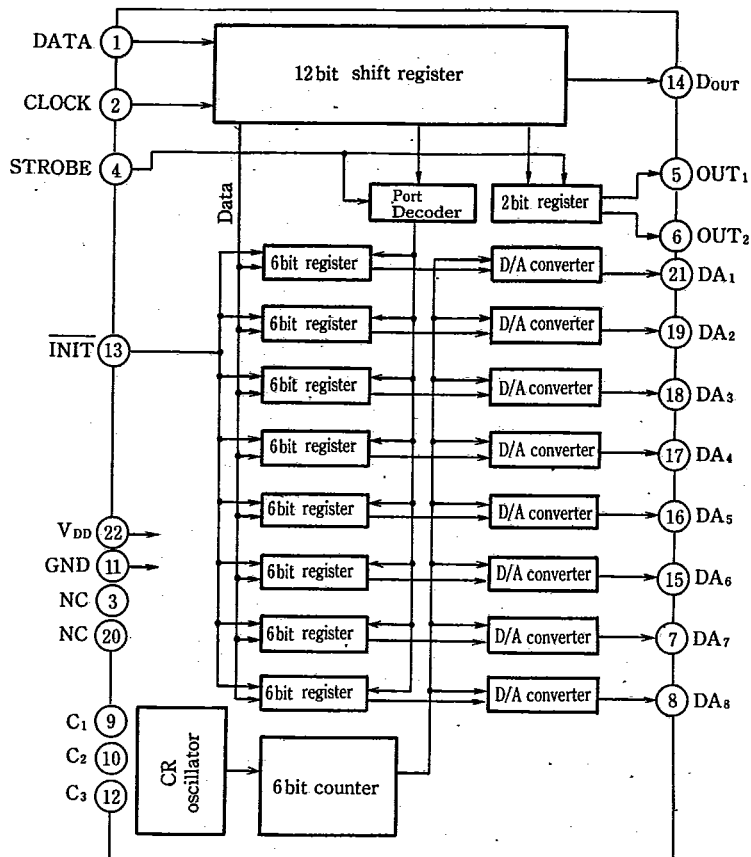


Pins 1, 2 and 3 : Open gate input
 Pin 10 : Pull-up input
 Pins 4, 5 and 11 : Push-pull output
 Pins 12, 13, 14 and 15 : Open drain output



Block Diagram

LH5048



Pins 1, 2 and 4 : Open gate input
 Pins 5 and 6 : Push-pull output
 Pin 13 : Pull-up input
 Pins 7, 8, 14, 15, 16, 17, 18, 19 and 21 : Open drain output

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Pin Description

LH5047 Pin No.	LH5048 Pin No.	I/O	Termination	Pin name	Function
1	1	I	O. G.	DATA	The DATA is a control input pin. Data is read synchronizing with the rising edge of shift clock applied to CLOCK pin.
2	2	I	O. G.	CLOCK	The CLOCK is a clock input pin for data read. The data being applied to DATA pin at the rising of clock is read.
3	4	I	O. G.	STROBE	The data after serial data input is read into 6-bit register, 2-bit register of OUT ₁ and OUT ₂ of D/A converter at the rising edge of STROBE input.
4	5	O	P. P.	OUT ₁	D ₇ of shift register is output.
5	6	O	P. P.	OUT ₂	D ₈ of shift register is output.
—	7	O	O. D.	DA ₇	D/A converter output.
—	8	O	O. D.	DA ₈	D/A converter output.
6	9	—	—	C ₁	For CR oscillator. The C ₁ pin generates basic signals used for composition of modulation signal.
7	10	—	—	C ₂	For CR oscillator. The C ₂ pin generates basic signals used for composition of modulation signal.
8	11	—	—	GND	Ground
9	12	—	—	C ₃	The C ₃ pin is used for CR oscillator and generates basic signals used for composition of modulation signal.
10	13	I	P. U.	INIT	By putting the INIT input to "Low", D _{OUT1} and D _{OUT2} become "Low", DA ₁ , DA ₂ , DA ₅ , and DA ₆ become 32/64 V _{DD} , and DA ₃ , DA ₄ , DA ₇ and DA ₈ become 48/64 V _{DD} .
11	14	O	O. D.	D _{OUT}	The D _{OUT} pin outputs the content of final stage of 12-stage shift register in the IC.
—	15	O	O. D.	DA ₆	D/A converter output
—	16	O	O. D.	DA ₅	D/A converter output
12	17	O	O. D.	DA ₄	D/A converter output
13	18	O	O. D.	DA ₃	D/A converter output
14	19	O	O. D.	DA ₂	D/A converter output
15	21	O	O. D.	DA ₁	D/A converter output
16	22	—	—	V _{DD}	Power supply

O. G. : Open gate, P. P. : push-pull, P. U. pull-up, O. D. : open drain



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■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit	Note
Supply voltage	V_{DD}	-0.3 to +6.0	V	1
Input voltage	V_{IN}	-0.3 to $V_{DD}+0.3$	V	1
Output voltage	V_{OUT}	-0.3 to $V_{DD}+0.3$	V	1
Storage temperature	T_{stg}	-55 to +150	°C	
Open drain voltage	V_B	15	V	

Note 1 : Referenced to GND.

■ Recommended Operating Conditions

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Note
Supply voltage	V_{DD}	4.5	5.0	5.5	V	
Operating temperature	T_a	-20		+60	°C	
External clock	f_{in}	1		1000	kHz	1

Note 1 : Duty should be within 50%, rising/falling time within 100ns.

■ DC Characteristics

 $(f_{osc}=50\text{kHz}, T_a=25^\circ\text{C}, V_{DD}=5\text{V})$

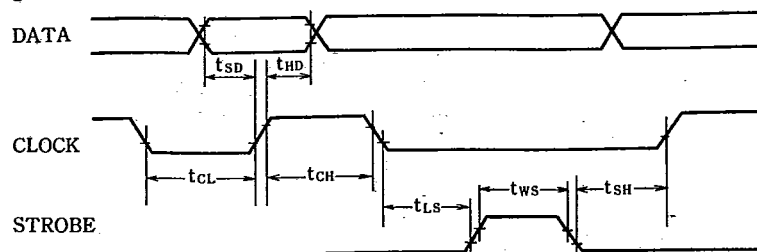
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Current consumption	I_{DD}	No load			1	mA
Input current (except $\overline{\text{INIT}}$ pin)	I_{IL}	$V_{IL}=0\text{V}$			-1.0	μA
	I_{IH}	$V_{IH}=5\text{V}$			1.0	μA
Input current ($\overline{\text{INIT}}$ pin)	I_{IL}	$V_{IL}=0\text{V}$			-50.0	μA
	I_{IH}	$V_{IH}=5\text{V}$			1.0	μA
Input voltage	V_{IL}				1.0	V
	V_{IH}		4.0			V
Output voltage *	V_{OL}	$I_{OL}=1.0\text{mA}$			1.0	V
Output voltage (D_{OUT} , OUT_1 , OUT_2)	V_{OL}	$I_{OL}=1.0\text{mA}$			1.0	V
	V_{OH}	$I_{OH}=1.0\text{mA}$	4.0			V
Oscillation frequency	f_{osc}	$R=68\text{k}\Omega, C=150\text{pF}$	30	50	70	kHz

* DA_1 - DA_4 : LH5047, DA_1 - DA_8 : LH5048

■ AC Characteristics

Parameter	Symbol	MIN.	MAX.	Unit
Data setup time	t_{SD}	2		μs
Data hold time	t_{HD}	10		μs
Clock "Low" width	t_{CL}	10		μs
Clock "High" width	t_{CH}	4		μs
Clock fall to strobe rise	t_{LS}	10		μs
Strobe "High" width	t_{WS}	4		μs
Strobe fall to clock rise	t_{SH}	10		μs
Maximum input rise time	t_r		1.0	μs
Maximum input fall time	t_f		1.0	μs

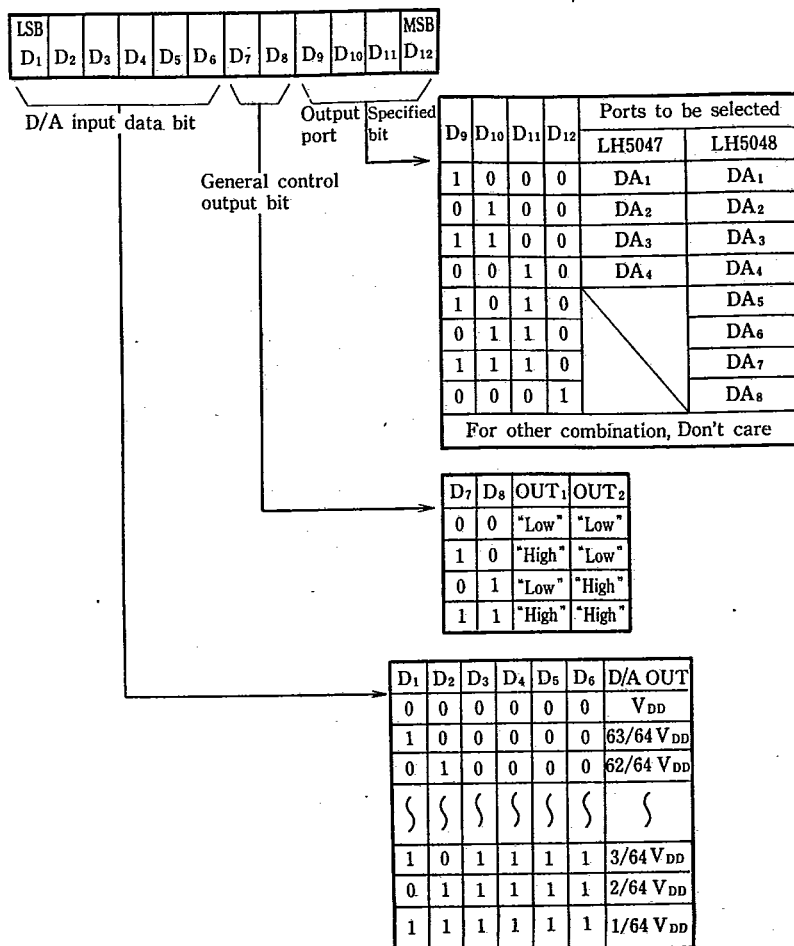
Timing Diagram (Data read timing)



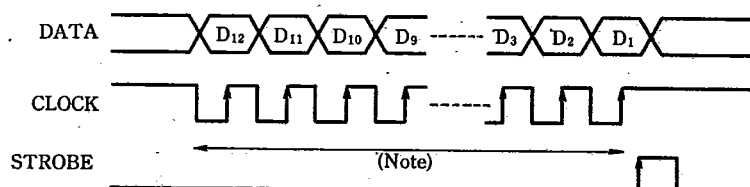
Functional Description

4 bits of the input data (12 bits) are used for designation of D/A converter output, 2 bits are assigned for control, and remaining 6 bits are used for D/A converter input. Input data is read at the rising edge of CLOCK, data after serial data entry, at the falling edge of STROBE, is taken into 6-bit register of a D/A converter and 2-bit register of OUT₁ and OUT₂. By putting INIT input into "Low" OUT₁ and

OUT₂ pins are initialized to "LOW", DA₁, DA₂, DA₅ and DA₆ pins to 32/64V_{DD}, and DA₃, DA₄, DA₇ and DA₈ pins to 48/64 V_{DD}. The selected pin of DA₁ output pins (i=1 to 4 for LH5047, i=1 to 8 for LH5048) outputs modulated pulse. The content of the least significant bit (LSB) of D₁₂ is output at DOUT pin, and the contents of shift registers D₇ and D₈ are output at OUT₁ and OUT₂ pins.

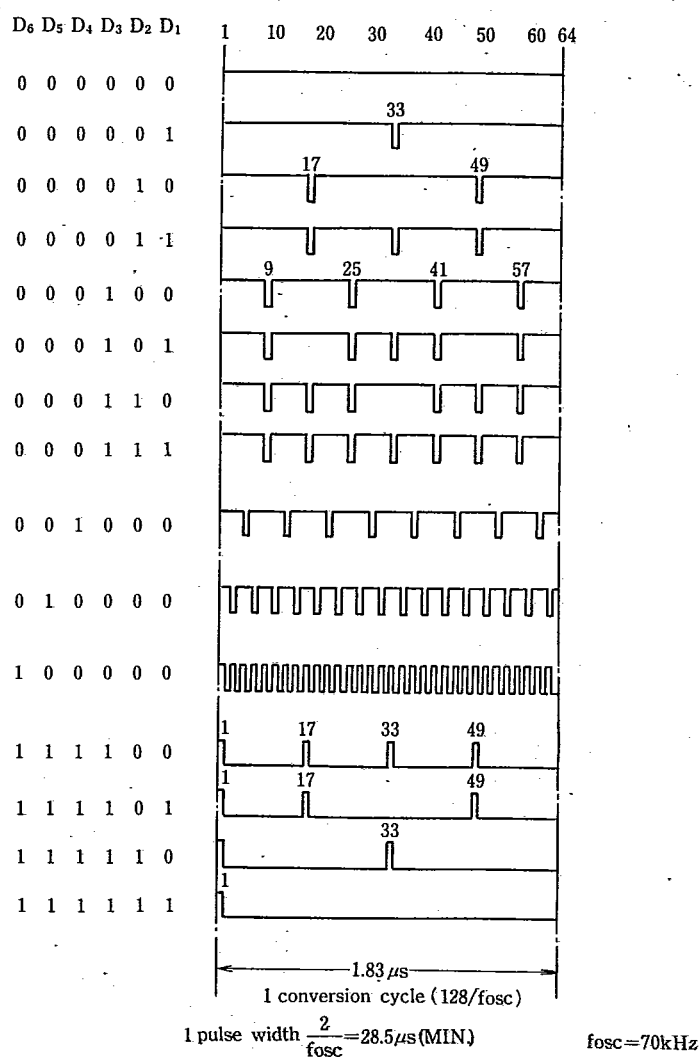


■ Timing Diagram (Data read)



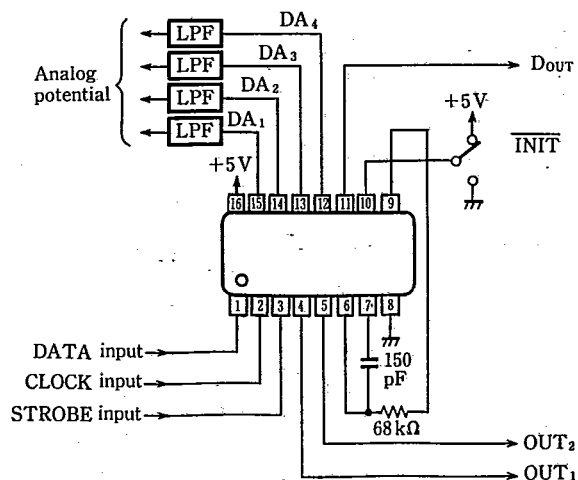
Note: The STROBE signal should be kept "Low" during data read.

- DATA is read at the rising edge of CLOCK.
- The shift register data is read at the rising edge of STROBE.

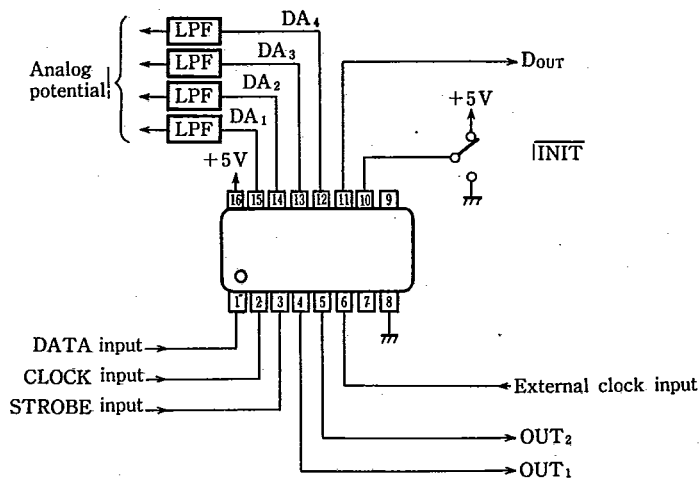
■ DA_i Output Waveform (i=1 to 4 for LH5047, i=1 to 8 for LH5048)

Basic Connection Diagram

(1) Application of self-oscillation circuit

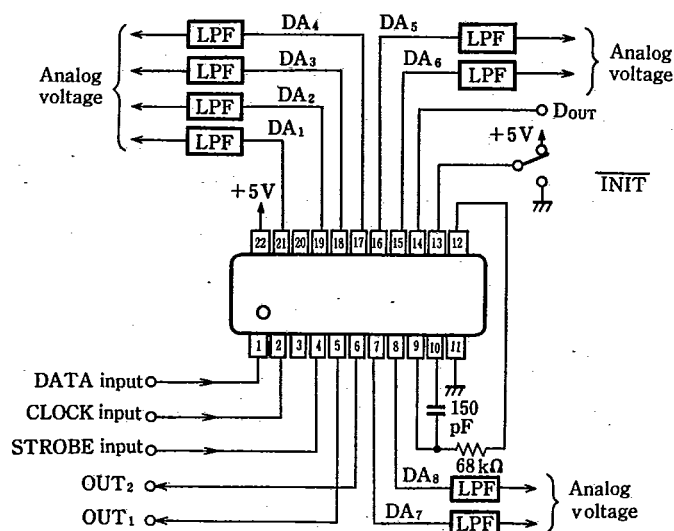


(2) Application of external clock



Basic Connection Diagram

(1) Application of self-oscillation circuit



(2) Application of external clock

