LH5047/LH5048 CMOS 6-Bit D/A Converter

Description

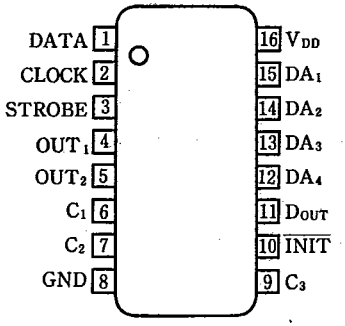
The LH5047/LH5048 is a CMOS LSI incorporating 4 ports/8 ports of 6-bit D/A converter designed to expand the output of 1-chip microcomputers.

Features

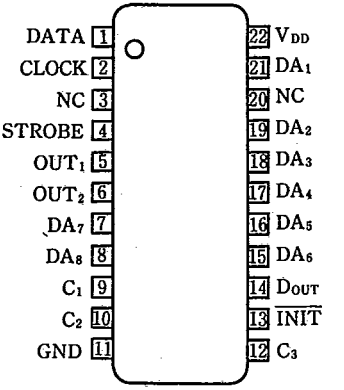
1. 6-bit D/A converter (Pulse modulation system)
2. Built-in CR oscillation circuit
   (External CR and external clock signal input)
3. No. of D/A output
   LH5047 : 4 ports
   LH5048 : 8 ports
4. Control output : 2 ports
5. D/A output N-channel open drain output
   (corresponding to 12V)
6. 12-bit serial data input
   4-bit···D/A converter selection data
   6-bit···D/A data
   2-bit···Spare output (OUT_1, OUT_2)
7. 16-pin dual-in-line package (LH5047)
   22-pin dual-in-line package (LH5048)

Pin Connections

LH5047

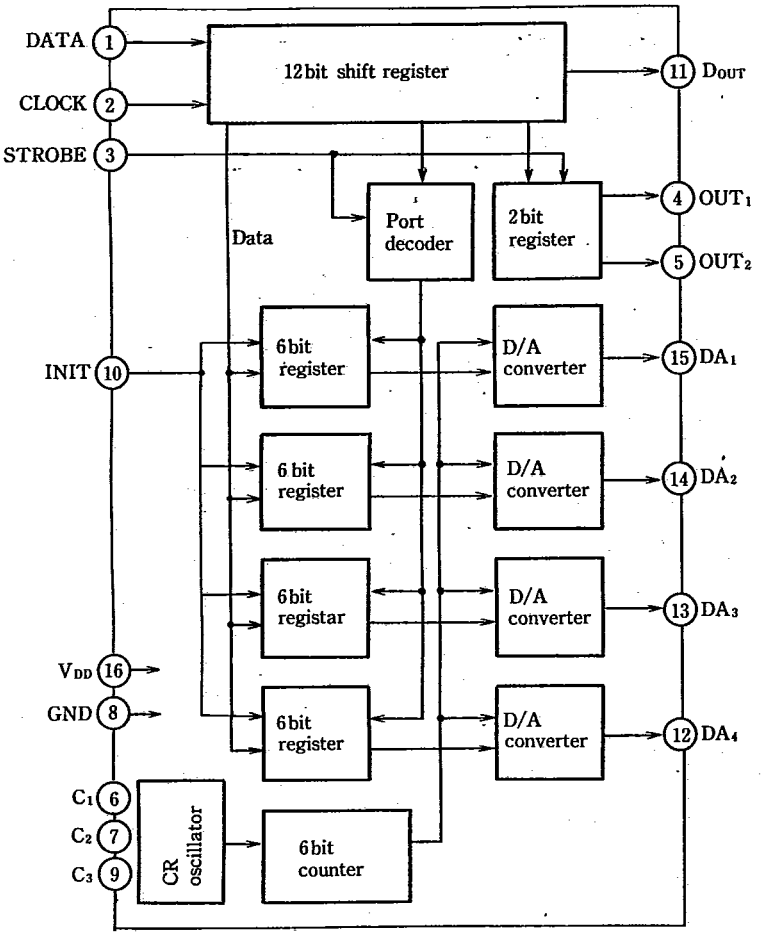


LH5048



Top View

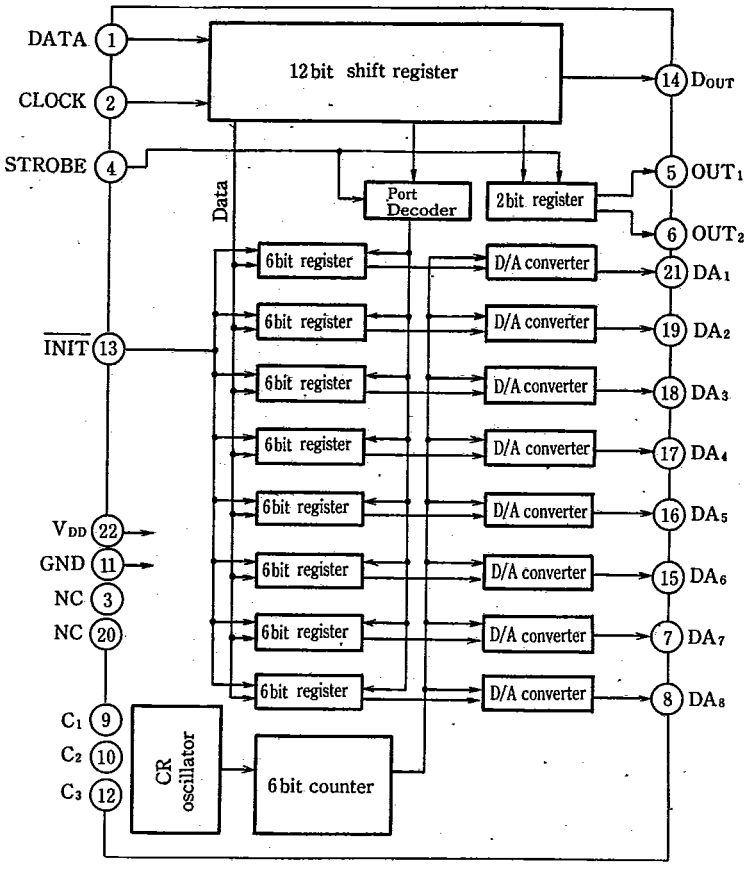
■ Block Diagram



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

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 resister is output.
5	6	O	P. P.	OUT_2	D_8 of shift resister 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.	$\overline{INIT}$	By putting the $\overline{INIT}$ 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

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	℃	
Open drain voltage	V_B	15	V	

Note 1 : Referenced to GND.

Recomended Operating Conditions

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

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

DC Characteristics

(f_{OSC}=50kHz, Ta=25℃, V_{DD}=5V)

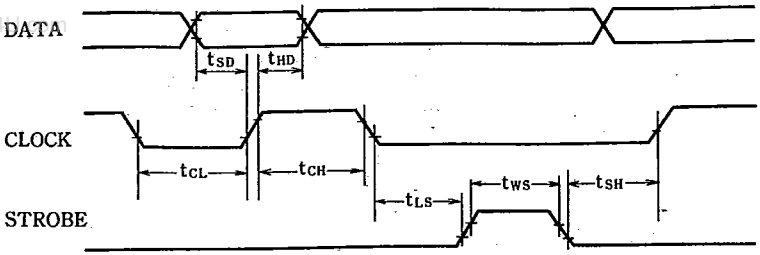
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Current consumption	I_{DD}	No load			1	mA
Input current (except $\overline{INIT}$ pin)	I_{IL}	V_{IL}=0V			−1.0	μA
	I_{IH}	V_{IH}=5V			1.0	
Input current ($\overline{INIT}$ pin)	I_{IL}	V_{IL}=0V			−50.0	μA
	I_{IH}	V_{IH}=5V			1.0	
Input voltage	V_{IL}				1.0	V
	V_{IH}		4.0			
Output voltage *	V_{OL}	I_{OL}=1.0mA			1.0	V
Output voltage (D_{OUT}, OUT_1, OUT_2)	V_{OL}	I_{OL}=1.0mA			1.0	V
	V_{OH}	I_{OH}=1.0mA	4.0			
Oscillation frequency	f_{OSC}	R=68kΩ, C=150pF	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 OUT_1 and OUT_2. By putting $\overline{INIT}$ input into "Low" OUT_1 and OUT_2 pins are initialized to "LOW", DA_1, DA_2, DA_5 and DA_6 pins to $32/64V_{DD}$, and DA_3, DA_4, DA_7 and DA_8 pins to $48/64\ V_{DD}$. The selected pin of DA_1 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 D_{12} is output at D_{OUT} pin, and the contents of shift registers D_7 and D_8 are output at OUT_1 and OUT_2 pins.

LSB											MSB
D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	D_{12}

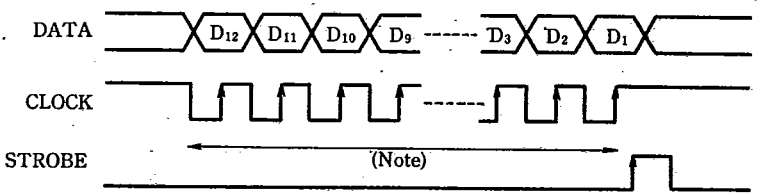
D/A input data bit — Output port — Specified bit — General control output bit

D_9	D_{10}	D_{11}	D_{12}	Ports to be selected	
				LH5047	LH5048
1	0	0	0	DA_1	DA_1
0	1	0	0	DA_2	DA_2
1	1	0	0	DA_3	DA_3
0	0	1	0	DA_4	DA_4
1	0	1	0		DA_5
0	1	1	0		DA_6
1	1	1	0		DA_7
0	0	0	1		DA_8
For other combination, Don't care					

D_7	D_8	OUT_1	OUT_2
0	0	"Low"	"Low"
1	0	"High"	"Low"
0	1	"Low"	"High"
1	1	"High"	"High"

D_1	D_2	D_3	D_4	D_5	D_6	D/A OUT
0	0	0	0	0	0	V_{DD}
1	0	0	0	0	0	$63/64\ V_{DD}$
0	1	0	0	0	0	$62/64\ V_{DD}$
∫	∫	∫	∫	∫	∫	∫
1	0	1	1	1	1	$3/64\ V_{DD}$
0	1	1	1	1	1	$2/64\ V_{DD}$
1	1	1	1	1	1	$1/64\ V_{DD}$

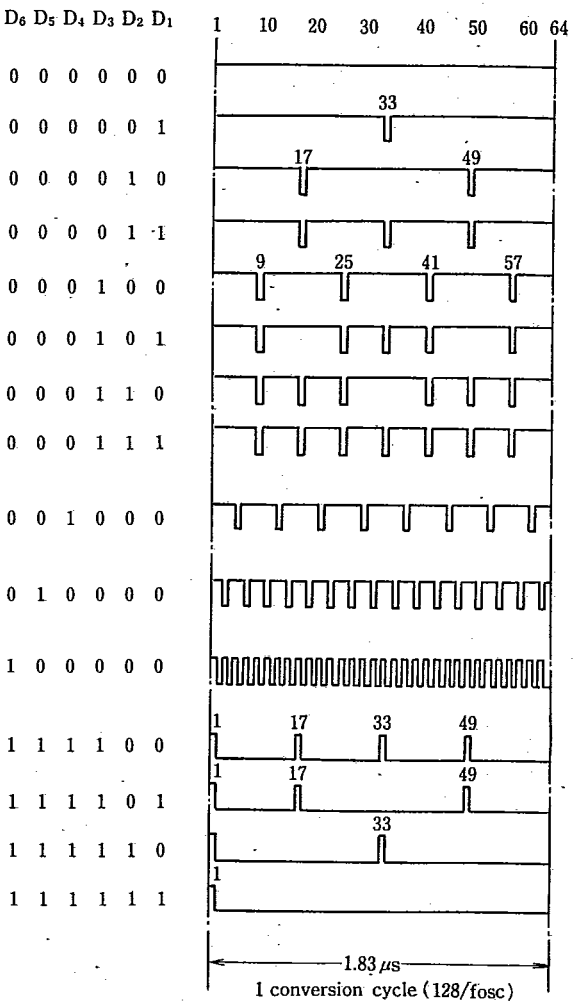
Timing Diagram (Data read)



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)

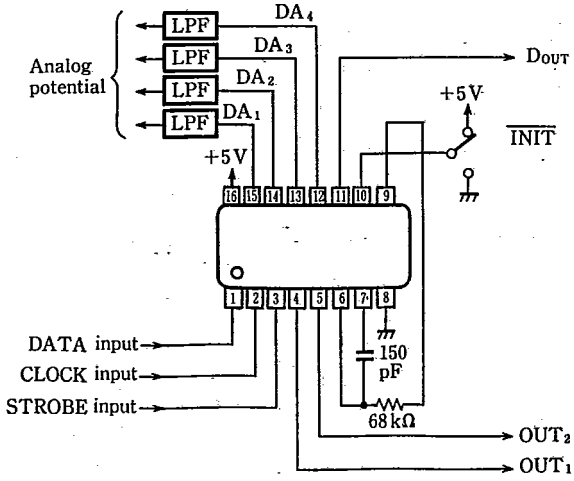


1 pulse width $\frac{2}{fosc}$ = 28.5 μs (MIN.)

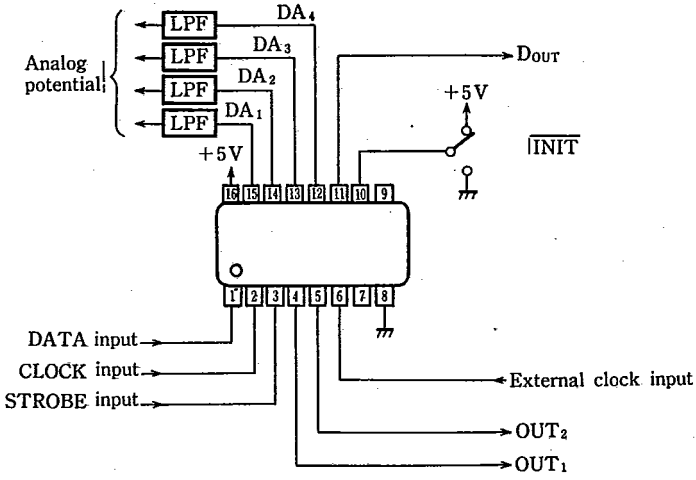
fosc = 70kHz

■ Basic Connection Diagram

(1) Application of self-oscillation circuit

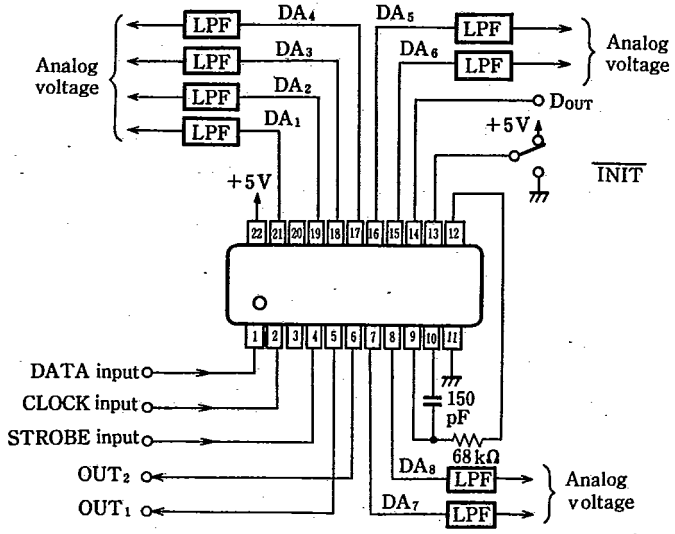


(2) Application of external clock



■ Basic Connection Diagram

(1) Application of self-oscillation circuit



(2) Application of external clock