

# 10bit 6-channel D/A converter

## BU2507FV

BU2507FV is an IC that incorporates 10bit 6-channel D/A converter using the R-2R system. Each channel output incorporates a Rail to Rail type output with buffer amplifier. This IC utilizes the TTL level input method. RESET pin can keep the output voltage in the lower reference voltage range.

### ●Applications

DVD, CD-R, CD-RW, DVC, Digital camera, and other industrial equipments.

### ●Features

- 1) High-performance 10bit 6-channel D/A converter adopting the R-2R system.
- 2) Power supply voltage : 4.5~5.5V.
- 3) Each channel output incorporates a Rail to Rail type output with buffer amplifier.
- 4) RESET pin can keep output voltage of all channels within the lower reference voltage range.
- 5) Digital input compatible with TTL levels.
- 6) 10MHz input frequency.
- 7) 14bit 3wire serial data + RESET signal input. (4bit address + 10bit data)

### ●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Unit
Supply voltage	V <sub>CC</sub>	-0.3~+6.0	V
Upper reference voltage of D/A converter	V <sub>DD</sub>	-0.3~+6.0	V
Input voltage	V <sub>IN</sub>	-0.3~+6.0	V
Output voltage	V <sub>OUT</sub>	-0.3~+6.0	V
Power dissipation	P <sub>d</sub>	350*	mW
Operating temperature	T <sub>opr</sub>	-25~+85	°C
Storage temperature	T <sub>stg</sub>	-55~+125	°C

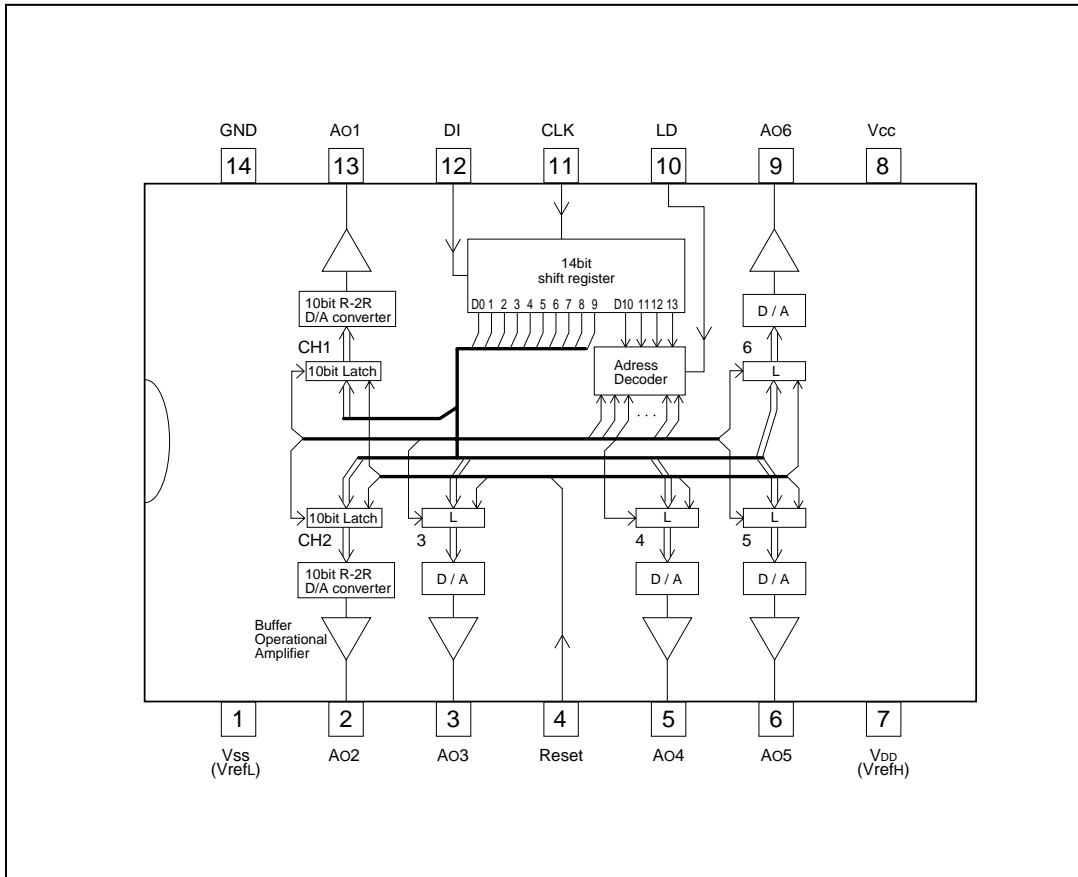
\* Operating at higher than Ta=25°C, 3.5mW shall be reduced per 1°C.

### ●Recommended operating conditions (Ta=25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V <sub>CC</sub>	4.5~5.5	V

Optical disc ICs

●Block diagram

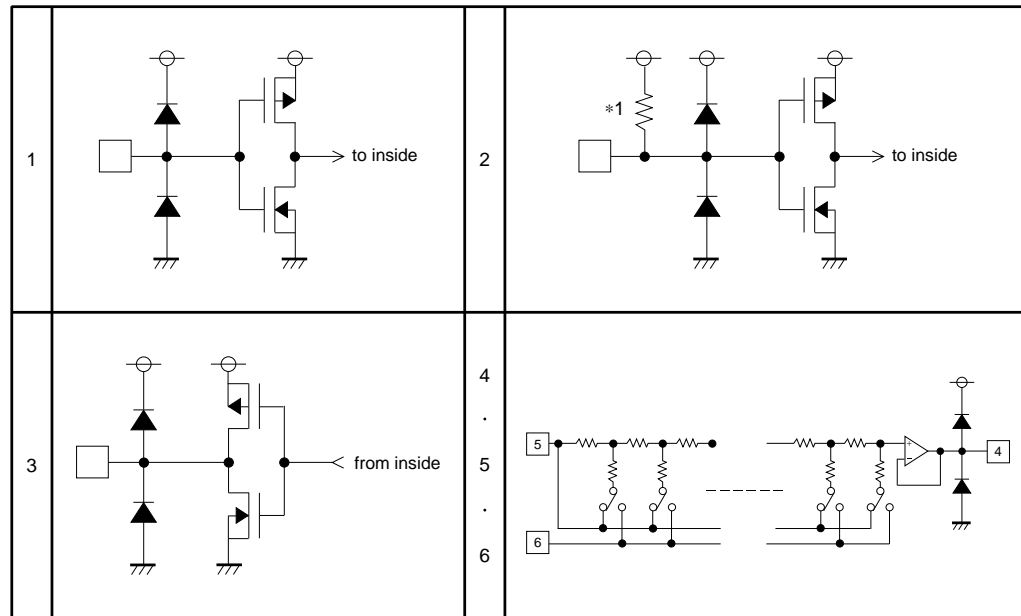


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●Pin descriptions

Pin No.	Pin name	Analog / Digital	I / O	Function	Equivalent Circuit
1	Vss	Analog	-	D/A converter lower reference voltage (VrefL) input terminal	6
2	Ao2	Analog	O	10bit D/A converter output terminal (CH2)	4
3	Ao3	Analog	O	10bit D/A converter output terminal (CH3)	4
4	Reset	Digital	I	The analog output of all channels is fixed for "L"	2
5	Ao4	Digital	O	10bit D/A converter output terminal (CH4)	4
6	Ao5	Analog	O	10bit D/A converter output terminal (CH5)	4
7	VDD	Analog	-	D/A converter upper reference voltage (VrefH) input terminal	5
8	Vcc	-	-	Power supply terminal	-
9	Ao6	Analog	O	10bit D/A converter output terminal (CH6)	4
10	LD	Digital	I	When H-level signal is input to this terminal, the value stored in 14-bit shift register is loaded in decoder and D/A converter output register	1
11	CLK	Digital	I	Shift clock input terminal. Input signal at DI pin is input to 14-bit shift register at rise of shift clock pulse	1
12	DI	Digital	I	Serial data input terminal to input 14-bit (address 4 bit + data 10bit) long serial data	1
13	Ao1	Analog	O	10bit D/A converter output terminal (CH1)	4
14	GND	-	-	GND terminal	-

●Input / Output terminal equivalent circuit



\*1 At the time of Vcc=5.0V, 25kΩ. (It alters by the applied voltage.)

## Optical disc ICs

## ● Electrical characteristics

- Digital characteristics (unless otherwise noted,  $V_{CC}=5V$ ,  $V_{refH}=5V$ ,  $V_{refL}=0V$ ,  $T_a=25^\circ C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Power supply current	$I_{CC}$	–	0.85	2.8	mA	CLK=10MHz operation, $V_{CC}=5V$ , $I_{AO}=0\mu A$
Input leak current	$I_{ILK}$	–5	–	5	$\mu A$	$V_{IN}=0-V_{CC}$
Input low voltage	$V_{IL}$	–	–	0.8	V	
Input high voltage	$V_{IH}$	2.0	–	–	V	
Output low voltage	$V_{OL}$	0	–	0.4	V	$I_{OL}=2.5mA$
Output high voltage	$V_{OH}$	4.6	–	5	V	$I_{OH}=-2.5mA$

- Analog characteristics (unless otherwise noted,  $V_{CC}=5V$ ,  $V_{refH}=5V$ ,  $V_{refL}=0V$ ,  $T_a=25^\circ C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Consumption current	$I_{refH}$	–	4.5	7.5	mA	$V_{refH}=5V$ , $V_{refL}=0V$ Data condition : Maximum Current	
D/A converter upper reference voltage range	$V_{refH}$	3.0	–	5	V	Reference voltage can not always be set to any value in this range, because it is restricted to the buffer amplifier output voltage range.	
D/A converter lower reference voltage range	$V_{refL}$	0	–	1.5	V		
Buffer amplifier output voltage range	$V_O$	0.1	–	4.9	V	$I_O=\pm 100\mu A$	
		0.2	–	4.75		$I_O=+1.0mA$	
Buffer amplifier output drive range	$I_O$	–2	–	2	mA	Upper saturation voltage=0.35V Lower saturation voltage=0.23V	
Accuracy	Differential nonlinearity error	SDL	–1.0	–	1.0	LSB	$V_{refH}=4.796V$ , $V_{refL}=0.7V$ $V_{CC}=5.5V$ (4mV / LSB) Without load ( $I_O=+0mA$ )
	Nonlinearity error	SL	–3.5	–	3.5		
	Zero code error	SZERO	–25	–	25	mV	
	Full scale error	SFULL	–25	–	25		
Buffer amplifier output impedance	$R_O$	–	5	15	$\Omega$		
Pull-up I/O-cell internal R value	$R_{up}$	12.5	25	37.5	k $\Omega$	$V_{in} : 0V$ (Resistance value alters by the applied voltage)	

© This product is not designed for protection against radioactive rays.

Optical disc ICs

• AC characteristics (unless otherwise noted,  $V_{CC}=5V$ ,  $V_{refH}=5V$ ,  $V_{refL}=0V$ ,  $T_a=25^\circ C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Reset "L" pulse width	tRTL	50	-	-	ns	
Clock "L" pulse width	tCKL	50	-	-		
Clock "H" pulse width	tCKH	50	-	-		
Clock rise time	tcr	-	-	50		
Clock fall time	tcf	-	-	50		
DATA set up time	tDCH	20	-	-		
DATA hold time	tCHD	40	-	-		
LD set up time	tCHL	50	-	-		
LD hold time	tLDC	50	-	-		
LD "H" pulse duration	tLDH	50	-	-		
D / A output setting time	tLDD	-	7	20	$\mu S$	$C_L \leq 1000pF$ $V_O : 0.5V \rightleftharpoons 4.5V$ The time until the becomes the final value of 1/2 LSB.

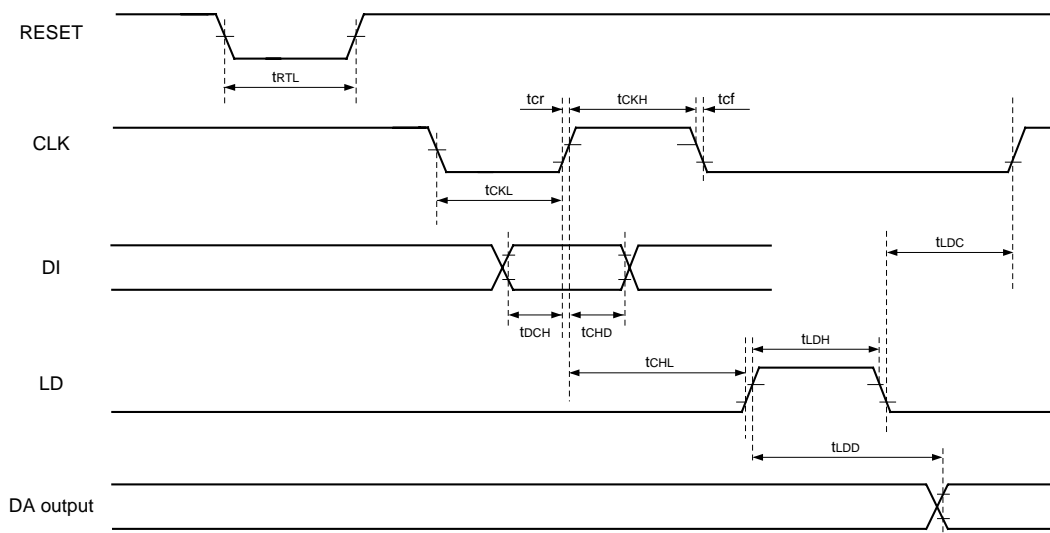
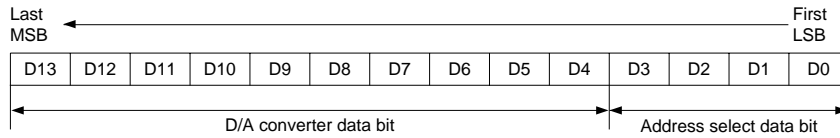


Fig.1

Optical disc ICs

●Circuit operations

- Digital data format (data : LSB first)



D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D/A output
0	0	0	0	0	0	0	0	0	0	VrefL
0	0	0	0	0	0	0	0	0	1	$(VrefH-VrefL) / 1024 \times 1 + VrefL$
0	0	0	0	0	0	0	0	1	0	$(VrefH-VrefL) / 1024 \times 2 + VrefL$
0	0	0	0	0	0	0	0	1	1	$(VrefH-VrefL) / 1024 \times 3 + VrefL$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1	1	1	1	1	1	1	1	1	0	$(VrefH-VrefL) / 1024 \times 1022 + VrefL$
1	1	1	1	1	1	1	1	1	1	$(VrefH-VrefL) / 1024 \times 1023 + VrefL$

\* VrefH=Vdd VrefL=Vss

D3	D2	D1	D0	Address selection
0	0	0	0	Don't Care
0	0	0	1	Don't Care
0	0	1	0	AO1 selection
0	0	1	1	AO2 selection
0	1	0	0	Don't Care
0	1	0	1	AO3 selection
0	1	1	0	AO4 selection
0	1	1	1	Don't Care
1	0	0	0	AO5 selection
1	0	0	1	AO6 selection
1	0	1	0	Don't Care
1	0	1	1	Don't Care
1	1	0	0	Don't Care
1	1	0	1	Don't Care
1	1	1	0	Command for test
1	1	1	1	Command for test

- Timing chart (MODEL)

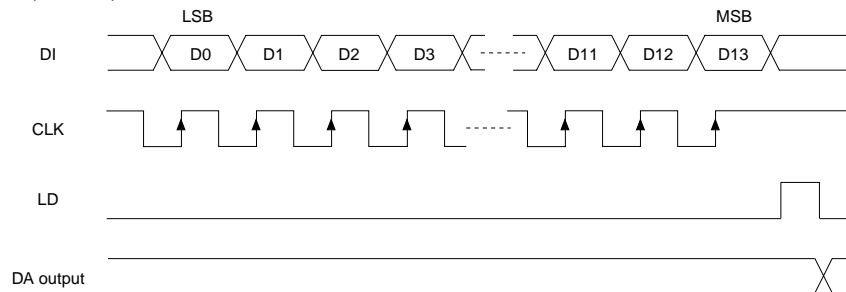
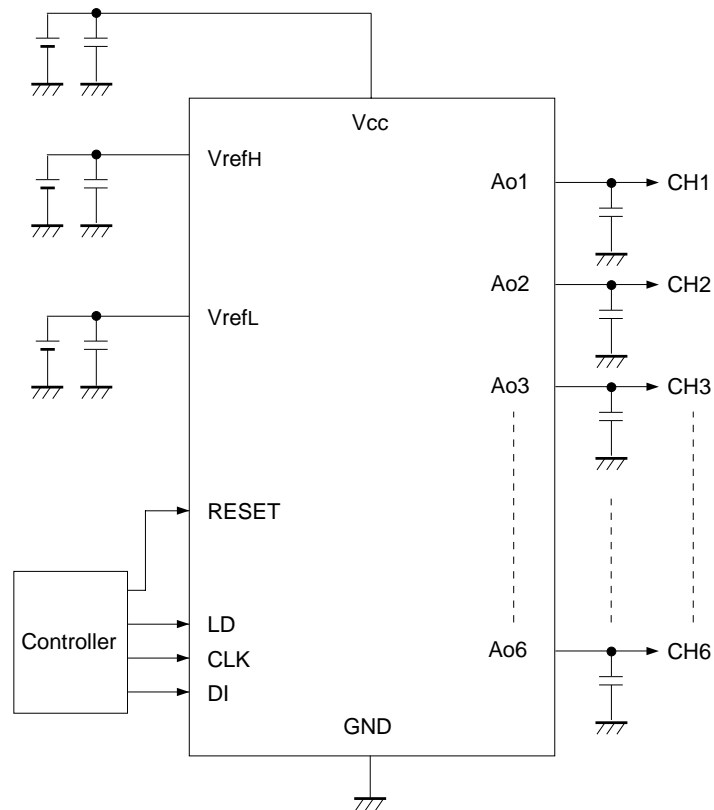


Fig.2

## Optical disc ICs

## ● Application circuit



## ● Operation notes

- There are 3 different type of power supply terminal and 1 type of GND terminal in this IC. Each of these terminals requires the constant power supply for operating.
- Pile up ripple and noise to these power supply terminals, it can't keep accuracy of the D/A converter. Therefore external bypass capacitor recommend to set as close as possible to the terminals between V<sub>DD</sub> and GND in order to stabilize the D/A converter.
- The capacitor between output and GND recommend to set under 100pF including parasitic capacitor in order to reduce jitter from layout of the output line and noise.
- RESET terminal uses the I/O-cell of the internal pull-up resistance, adding a capacitor between this terminal and GND, this IC will have equivalent function as power-on-reset, by making a time-delay. When a reset signal is inputted from the controller, it is possible that the output of all channels are fixed on Low-level in the "L" section on the pulse.

## Optical disc ICs

## ● External dimensions (Units : mm)

