

For Digital Still and Single-lens Reflex Cameras System Lens Driver IC Series

5ch System Lens Drivers for Digital Still Cameras BD6370GUL, BD6758MWV, BD6758KN



Description

The BD6370GUL motor driver provides 3 Constant-Voltage Drive / Full-ON Drive H-bridge channels, 1 Constant-Voltage Drive / Linear Constant-Current Drive / Full-ON Drive H-bridge channel, and 1 Constant-Current Drive H-bridge channel, while the BD6758MWV and the BD6758KN provides 4 Full-ON Drive H-bridge channels and 1 Linear Constant-Current Drive H-bridge channel.

A Stepping motor can be used for auto focus and a DC motor for zoom and iris. ROHM offers both an advance type equipped with a D/A converter in all channels and a standard type, allowing selection of the ideal unit depending on the application.

Features

- 1) Subminiature 24PIN Wafer-level CSP (Chip Size Package): 2.6 x 2.6 x 0.55mm³ (BD6370GUL)
- 2) Resemblance 6ch drive function (BD6370GUL)
- 3) Drive type selection (BD6370GUL)
- 4) Low ON-Resistance Power CMOS output: All blocks (Const.-V/Full-ON Drive, Const.-V/Const.-C/Full-ON Drive, and Const.-Current Drive) with 1.4Ω Typ. (BD6370GUL) Full-ON Drive block with 1.2Ω Typ. and Linear Constant-Current Drive block with 1.0Ω Typ. (BD6758MWV / KN)
- 5) Serial interface 3-line bus control input (BD6370GUL)
- 6) Built-in Constant-Voltage control 6-bit D/A converter and Constant-Current control 6-bit D/A converter resolution (BD6370GUL)
- 7) Built-in ±5% high-precision Constant-Voltage Driver (BD6370GUL)
- 8) Built-in ±3% high-precision Linear Constant-Current Driver
- 9) Constant-Voltage Drive block and Constant-Current Drive block features phase compensation capacitor-free design
- 10) 1.2V±3% high-precision reference voltage output (BD6758MWV / KN)
- 11) Drive mode switching function (BD6758MWV / KN)
- 12) UVLO (Under Voltage Lockout Protection) function
- 13) Built-in TSD (Thermal Shut Down) circuit
- 14) Standby current consumption: 0µA Typ.

Absolute Maximum Ratings

Deremeter	Oursels al		1.114		
Parameter	Symbol	BD6370GUL	BD6758MWV	BD6758KN	Unit
Power supply voltage	VCC	-0.3 to +6.5	0 to +7.0	0 to +7.0	V
Motor power supply voltage	VM	-0.3 to +6.5	0 to +7.0	0 to +7.0	V
Control input voltage	VIN	-0.3 to VCC+0.3	0 to VCC	0 to VCC	V
Power dissipation	Pd	830 ^{×1}	880 ^{**2}	875 ^{**3}	mW
Operating temperature range	Topr	-25 to +85	-25 to +85	-25 to +85	°C
Junction temperature	Tjmax	+150	+150	+150	°C
Storage temperature range	Tstg	-55 to +150	-55 to +150	-55 to +150	°C
H-bridge output current	lout	-500 to +500 ^{**4}	-800 to +800 ^{**4}	-800 to +800 ^{**4}	mA/ch

^{**1} Reduced by 6.64mW/°C over 25°C, when mounted on a glass epoxy board (50mm × 58mm × 1.75mm; 8layers).

^{#2}Reduced by 7.0mW/°C over 25°C, when mounted on a glass epoxy board (74.2mm × 74.2mm × 1.6mm).

^{#3}Reduced by 7.0mW/°C over 25°C, when mounted on a glass epoxy board (70mm × 70mm × 1.6mm).

^{#4} Must not exceed Pd, ASO, or Tjmax of 150°C.

•Operating Conditions (Ta=-25 to +85°C)

Deremeter	Oursels al		Unit		
Parameter	Symbol	BD6370GUL	BD6758MWV	BD6758KN	
Power supply voltage	VCC	2.7 to 5.5	2.5 to 5.5	2.5 to 5.5	V
Motor power supply voltage	VM	2.7 to 5.5	2.5 to 5.5	2.5 to 5.5	V
Control input voltage	VIN	0 to VCC	0 to VCC	0 to VCC	V
Control input frequency	FIN	100 ^{**5}	100 ^{×5}	100 ^{**5}	kHz
Serial clock input frequency	FSCLK	10 ^{**5}	-	-	MHz
H-bridge output current	lout	-400 to +400 ^{**6}	-500 to +500 ^{**6}	-500 to +500 ^{**6}	mA/ch

**5 ON duty=50%

^{*6} Must not exceed Pd or ASO.

•Electrical Characteristics and Diagrams

1) BD6370GUL Electrical DC Characteristics (Unless otherwise specified, Ta=25°C, VCC=3.0V, VM=5.0V)

Deremeter	Sumbol	Limit		Linit	Conditions	
Parameter	Symbol	Min.	Тур.	Max.	Unit	Conditions
Overall						
Circuit current (Standby mode)	ICCST	-	0	3.0	μA	PS=0V
Circuit current (Active mode)	ICC	-	1.3	2.0	mA	PS=3V with no control signal, and no load
Control input (IN=PS, INPUT	1, 2, 34, 45,	STROBE, S	CLK, and SI	DATA)		· · · · ·
High level input voltage	VINH	2.0	-	VCC	V	
Low level input voltage	VINL	0	-	0.7	V	
High level input current 1	IINH1	15	30	60	μA	VINH1 (PS, INPUT1, 2, 34, 45) = 3V
High level input current 2	IINH2	7.5	15	30	μA	VINH2 (STROBE, SCLK, SDATA) =3V
Low level input current	IINL	-1	0	-	μA	VINL=0V
UVLO	1	1		11		
UVLO voltage	VUVLO	1.6	-	2.4	V	
Constant-Voltage Drive / Full	-ON Drive bl	ock (ch1 to d	ch3)			1
Output ON-Resistance	RON	-	1.40	1.75	Ω	$lo=\pm400$ mA on high and low sides in total
Output high voltage 1	VVOH1	1.35	1.50	1.65	V	DACx=6'b01_0100. RL=20Ω
Output high voltage 2	VVOH2	2.85	3.00	3.15	V	DACx=6'b10_1000, RL=20Ω
Output high voltage 3	VVOH3	4.49	4.725	4.96	V	DACx=6'b11_1111. RL=20Ω
DAC resolution	DVRES	-	6	_	BITS	75mV/LSB
Differential non-linear tolerance	DVDNL	-1	-	1	LSB	
Integral non-linear tolerance	DVINL	-2	-	2	LSB	
Min. voltage of DAC setting	DVRNG	1.5	-	_	V	DACx=6'b01 0100
Constant-Voltage Drive / Cor	nstant-Currer	nt Drive / Ful	I-ON Drive b	lock (ch4)		
Output ON-Resistance	RON	-	1.40	1.75	Ω	lo=+400mA on high and low sides in total
Constant-Voltage Drive bloc	k in ch4		-	-		5
Output high voltage 1	VVOH1	1.35	1.50	1.65	V	DACV4=6'b01_0100. RL=20Ω
Output high voltage 2	VVOH2	2.85	3.00	3.15	V	DACV4=6'b10_1000, RL=20Ω
Output high voltage 3	VVOH3	4.49	4,725	4.96	V	DACV4=6'b11_1111. RL=20Ω
DAC resolution	DVRES	-	6	-	BITS	75mV/LSB
Differential non-linear tolerance	DVDNL	-1	-	1	LSB	
Integral non-linear tolerance	DVINL	-2	-	2	LSB	
Min. voltage of DAC setting	DVRNG	1.5	-	_	V	DACV4=6'b01 0100
Constant-Current Drive bloc	k in ch4					
RNF voltage 1	VIRNF1	40	50	60	mV	DACI4=6'b00 1010. R _{RNE4} =0.5Ω. RL=10Ω
RNF voltage 2	VIRNF2	94	99	104	mV	DACI4=6'b01_0100, R _{RNF4} =0.5Ω, RL=10Ω
RNF voltage 3	VIRNF3	178	198	218	mV	DACI4=6'b10 1000, $R_{RNF4}=0.5\Omega$, RL=10 Ω
DAC resolution	DIRES	-	6	-	BITS	5mV/LSB
Differential non-linear tolerance	DIDNL	-1	-	1	LSB	
Integral non-linear tolerance	DIINL	-2	-	2	LSB	
Min. voltage of DAC setting	DIRNG	50	-	-	mV	DACI4=6'b00 1010
Constant-Current Drive block	(ch5)	1		I]		
Output ON-Resistance	RON	-	1.4	1.75	Ω	$lo=\pm400$ mA on high and low sides in total
RNF voltage 1	VIRNF1	38	48	58	mV	DAC5=6'b00 1010, R _{RNE5} =0.5Ω, RL=10Ω
RNF voltage 2	VIRNF2	91	96	101	mV	DAC5=6'b01 0100, R _{RNE5} =0.5Ω, RL=10Ω
RNF voltage 3	VIRNF3	172	192	212	mV	DAC5=6'b10 1000, R _{RNE5} =0.5Ω, RL=10Ω
DAC resolution	DIRES	-	6	-	BITS	5mV/LSB
Differential non-linear tolerance	DIDNL	-1	-	1	LSB	
Integral non-linear tolerance	DIINL	-2	-	2	LSB	
Min. voltage of DAC setting	DIRNG	50	-	-	mV	DAC5=6'b00_1010



Fig.10 Differential Non-Linear Tolerance (Const.-Current drive block, R_{RNFx} =1.0 Ω , RL=10 Ω)



BD6370GUI

Fig.11 Integral Non-Linear Tolerance (Const.-Current drive block, R_{RNFx} =1.0 Ω , RL=10 Ω)





Fig.12 RNF Voltage Accuracy (Const.-Current drive block, R_{RNFx}=1.0Ω, RL=10Ω)

3) BD6370GUL Electrical AC Characteristics (Unless otherwise specified, Ta=25°C, VCC=3.0V, VM=5.0V)

		Information ^{**7}					
Parameter	Symbol	ch1	ch2	ch3	Unit	Conditions	
Full-ON Drive Mode							
Turn on time	ton	1.11	1.04	1.10	μs		
Turn off time	toff	0.06	0.06	0.06	us.		
Rise time	tr	1.64	1.42	1.50	μs	DACx=6'b11_111, RL=20Ω	
Fall time	tf	0.01	0.01	0.01	μs		
Constant-Voltage Drive Mode	e	1		1			
Turn on time	ton	1.26	1.23	1.22	μs		
Turn off time	toff	0.04	0.04	0.04	μs		
Rise time	tr	1.31	1.35	1.30	μs	DACx=6'b10_1000, RL=20Ω	
Fall time	tf	0.02	0.02	0.02	μs	_	
Constant-Voltage / Constant-C	Current / Full-	ON Type Dr	ive block (ch	4)			
		21	Information*	7			
Parameter	Symbol	-	ch4	-	Unit	Conditions	
Full-ON Drive Mode							
Turn on time	ton	-	0.76	-	μs		
Turn off time	toff	-	0.05	-	us	– DACV4=6'b11_111,	
Rise time	tr	-	0.68	-	μs	DACI4=6'b11_1111,	
Fall time	tf	-	0.02	-	μs	RL=20Ω	
Constant-Voltage Drive Mode	e						
Turn on time	ton	-	1.19	-	μs		
Turn off time	toff	-	0.04	-	μs	DACV4=6'b10_1000,	
Rise time	tr	-	1.31	-	μs	DACI4=6'b11_1111,	
Fall time	tf	-	0.01	-	us	- RL=20Ω	
Constant-Current Drive Mode	e						
Turn on time	ton	-	0.83	-	μs	DACV4=6'b11 1111,	
Turn off time	toff	-	0.05	-	μs	DACI4=6'b10 1100 (I _o =400mA),	
Rise time	tr	-	0.89	-	μs	R _{RNFI4} =0.5Ω, RL=10Ω,	
Fall time	tf	-	0.03	-	μs	$R_{METALI4}=4m\Omega, R_{W}=40m\Omega$	
Turn on time	ton	-	0.69	-	μs	DACV4=6'b11 1111,	
Turn off time	toff	-	0.04	-	μs	DACI4=6'b10 1010 (I _o =200mA),	
Rise time	tr	-	0.29	-	μs	R _{RNFI4} =1.0Ω, RL=10Ω,	
Fall time	tf	-	0.03	-	μs	$R_{METALI4}$ =4mΩ, R_{W} =40mΩ	
Constant-Current Type Drive b	olock (ch5)	1					
			Information*	7			
Parameter	Symbol	-	ch5	-	Unit	Conditions	
Constant-Current Drive Mode	e	1			l	-	
Turn on time	ton	-	0.77	-	μs		
Turn off time	toff	-	0.04	-	μs	DAC5=6'b10_1101 (I_0 =400mA),	
Rise time	tr	-	0.47	-	μs	$=$ R _{RNF5} =0.5 Ω , RL=10 Ω ,	
Fall time	tf	-	0.04	-	μs	$R_{METAL5}=22m\Omega, R_{W}=40m\Omega$	
Turn on time	ton	-	0.69	-	μs		
Turn off time	toff	-	0.04	-	µs	DAC5=6'b10_1010 (l _o =200mA),	
Rise time	tr	-	0.24	-	μs	$=$ R _{RNF5} =1.0 Ω , RL=10 Ω ,	
Fall time	tf	-	0.02	-	μs	$R_{METAL5}=22m\Omega, R_{W}=40m\Omega$	



Fig.13 The Definition of I/O Switching Waveforms

CH4≅100m DC: 10:1

CH1=5V DC 10:1

CH1=5V DC: 10:

INPUT1,2,or34

voltage

[5V/div]

OUTxA-xB

[100mA/div]

INPUT1,2,or34

voltage [5V/div]

OUTxA-xB

[100mA/div]

INPUT34or45

voltage [5V/div]

current

current

BD6370GUL

[500nsec/div]

BD6370GUL

[20nsec/div]

BD6370GUL

CH4=100m DC 10:1

CH4=100mV DC_10:1

Fig.14 I/O AC Responses (ton, tr)

ch1 to ch3 Full-ON Drive Mode

DACx=6'b11_1111, RL=20Ω



Fig.16 I/O AC Responses (ton, tr) ch4 Full-ON Drive Mode DACV4=DACI4=6'b11_1111, RL=20Ω



[20nsec/div]

Fig.19 I/O AC Responses (toff, tf) ch4 Full-ON Drive Mode DACV4=DACI4=6'b11_1111, RL=20Ω



[500nsec/div]

Fig.22 I/O AC Responses (ton, tr) ch5 Constant-Current Drive Mode DAC5=6'b10_1101, R_{RNF5}=0.5Ω, RL=10Ω



Fig.25 I/O AC Responses (toff, tf) ch5 Constant-Current Drive Mode DAC5=6'b10_1101, R_{RNF5}=0.5Ω, RL=10Ω



Fig.15 I/O AC Responses (ton, tr) ch1 to ch3Constant-Voltage Drive Mode DACx=6'b10_1000, RL=20Ω







Fig.21 I/O AC Responses (ton, tr)

ch4 Constant-Current Drive Mode

DACV4=6'b11_1111, DACI4=6'b10_1100, R_{RNFI4}=0.5Ω, RL=10Ω

CH1=5V DC: 1R1

BD6370GUL

[20nsec/div]

CH4=200m// DC_10:1









INPUT34or45

voltage [5V/div]

OUT4A-4B

current [200mA/div]



Fig.17 I/O AC Responses (toff, tf)

ch1 to ch3 Full-ON Drive Mode

DACx=6'b11_1111, RL=20Ω

CH1=5V DC 10:1

Fig.20 I/O AC Responses (ton, tr) ch4 Constant-Voltage Drive Mode DACV4=6'b10_1000, DACI4=6'b11_1111, RL=20Ω





Fig.24 I/O AC Responses (toff, tf) ch4 Constant-Current Drive Mode DACV4=6'b11_1111, DACI4=6'b10_1100, R_{RNFI4}=0.5Ω, RL=10Ω

AC characteristics are reference values, then the performance of IC's characteristics is not guaranteed.

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CH1=5V DC; 10:1 BD6370GUL

CH4=200m// DC_10:1

Fig.26 I/O AC Responses (ton, tr) ch4 Constant-Current Drive Mode DACV4=6'b11_1111, DACI4=6'b10_1010, R_{RNFI4}=1.0Ω, RL=10Ω





Fig.27 I/O AC Responses (ton, tr) ch5 Constant-Current Drive Mode DAC5=6'b10_1010, R_{RNF5}=1.0Ω, RL=10Ω

Fig.28 I/O AC Responses (toff, tf) ch4 Constant-Current Drive Mode DACV4=6'b11_1111, DACI4=6'b10_1010, R_{RNFI4}=1.0Ω, RL=10Ω Fig.29 I/O AC Responses (toff, tf) ch5 Constant-Current Drive Mode DAC5=6'b10_1010, R_{RNF5}=1.0Ω, RL=10Ω

AC characteristics are reference values, then the performance of IC's characteristics is not guaranteed.

Deremeter	Symbol	Limit		Linit	Conditions		
Parameter	Symbol	Min.	Тур.	Max.	Unit	Conditions	
Overall							
Circuit current	ICCST		0	10		PS-01/	
during standby operation	10001	-	0	10	μΛ	1 3-00	
Circuit current	ICC	-	1.4	2.5	mA	PS=VCC with no signal	
Control input (IN=PS, IN1A to	o 5B, SEL1 t	o 2, BRK1 to	2, EN1, and	IN5)			
High level input voltage	VINH	2.0	-	-	V		
Low level input voltage	VINL	-	-	0.7	V		
High level input current	IINH	15	30	60	μA	VINH=3V	
Low level input current	IINL	-1	0	-	μA	IVINL=0V	
Pull-down resistor	RIN	50	100	200	kΩ		
UVLO							
UVLO voltage	VUVLO	1.6	-	2.4	V		
Full-ON Drive block (ch1 to c	:h4)						
Output ON-Resistance	RON	-	1.2	1.5	Ω	lo=±400mA on high and low sides in total	
Linear Constant-Current Driv	Linear Constant-Current Drive block (ch5)						
Output ON-Resistance	RON	-	1.0	1.25	Ω	lo=±400mA on high and low sides in total	
VREF output voltage	VREF	1.16	1.20	1.24	V	lout=0~1mA	
Output limit voltage	VOL	194	200	206	mV	RNF=0.5Ω, VLIM=0.2V	

5) BD6758MWV and BD6758KN Electrical Characteristics (Unless otherwise specified, Ta=25°C, VCC=3.0V, VM=5.0V)

6) BD6758MWV and BD6758KN Electrical AC Characteristic Diagrams









Power Dissipation Reduction









Fig.37 BD6370GUL Block Diagram

Fig.38 BD6370GUL Pin Arrangement (Top View) VCSP50L2 Package

BD6370GUL Pin Function Table

No.	Pin Name	Function	No.	Pin Name	Function
A1	RNF4	Resistance connection pin for output current detection ch4	D1	OUT5B	H-bridge output pin ch5 B
A2	OUT4A	H-bridge output pin ch4 A	D2	INPUT34	Control input pin ch3 or ch4
A3	VM	Motor power supply pin	D3	INPUT1	Control input pin ch1
A4	OUT1A	H-bridge output pin ch1 A	D4	SCLK	Serial clock input pin
A5	OUT1B	H-bridge output pin ch1 B	D5	OUT3A	H-bridge output pin ch3 A
B1	OUT4B	H-bridge output pin ch4 B	E1	RNF5	Resistance connection pin for output current detection ch5
B2	INDEX POST	-	E2	GND	Ground pin
B3	PS	Power-saving pin	E3	VCC	Power supply pin
B4	STROBE	Serial enable input pin	E4	OUT3B	H-bridge output pin ch3 B
B5	OUT2A	H-bridge output pin ch2 A	E5	PGND	Motor ground pin ch1 to ch3
C1	OUT5A	H-bridge output pin ch5 A			
C2	INPUT45	Control input pin ch4 or ch5			
C3	INPUT2	Control input pin ch2			
C4	SDATA	Serial data input pin			
C5	OUT2B	H-bridge output pin ch2 B			



Fig.39 BD6758KN Block Diagram



Fig.40 BD6758MWV / KN Pin Arrangement (Top View)
MWV=UQFN036V5050 Package
KN=VQFN36 Package

No.	Pin Name	Function	No.	Pin Name	Function
1	IN1B	Control input pin ch1 B	19	VLIM	Output current setting pin ch5
2	IN2A	Control input pin ch2 A	20	VREF	Reference voltage output pin
3	IN2B	Control input pin ch2 B	21	OUT5A	H-bridge output pin ch5 A
4	VCC	Power supply pin	22	SENSE	Output current detection ch5
5	GND	Ground pin	23	RNF	Resistance connection pin for output current detection ch5
6	IN3A	Control input pin ch3 A	24	VM3	Motor power supply pin ch5
7	IN3B	Control input pin ch3 B	25	OUT5B	H-bridge output pin ch5 B
8	IN4A	Control input pin ch4 A	26	IN5	Control input pin ch5 INPUT
9	IN4B	Control input pin ch4 B	27	EN1	Control input pin ch5 ENABLE
10	BRK1	Control input pin ch3 BRAKE	28	SEL1	Drive mode selection pin ch1 and ch2
11	BRK2	Control input pin ch4 BRAKE	29	OUT1A	H-bridge output pin ch1 A
12	OUT3A	H-bridge output pin ch3 A	30	OUT1B	H-bridge output pin ch1 B
13	OUT3B	H-bridge output pin ch3 B	31	VM1	Motor power supply pin ch1 and ch2
14	VM2	Motor power supply pin ch3 and ch4	32	PGND1	Motor ground pin ch1 and ch2
15	PGND2	Motor ground pin ch3 and ch4	33	OUT2A	H-bridge output pin ch2 A
16	OUT4A	H-bridge output pin ch4 A	34	OUT2B	H-bridge output pin ch2 B
17	OUT4B	H-bridge output pin ch4 B	35	PS	Power saving pin
18	SEL2	Drive mode selection pin ch3 and ch4	36	IN1A	Control input pin ch1 A



Fig.41 BD6370GUL Application Circuit Diagram

1)	Power saving and Serial Reset (BD6370GUL; PS)	
	(1) Function Explanation	p.11/32
2)	Control Input (BD6370GUL; INPUTx)	
	(1) Function Explanation	p.11/32
3)	H-bridge (BD6370GUL; VM, OUTxA, OUTxB, and RNFx)	
	(1) Function Explanation	p.11/32
	(2) The D/A Converter Settings of Constant-Voltage, Constant-Current, and Full-ON Mode	p.11/32
4)	Serial Input (BD6370GUL; STROBE, SCLK, and SDATA)	
	(1) Function Explanation	p.12/32
	(2) Serial Register Bit Map	p.12/32
5)	Serial Register Data Bit Function (BD6370GUL)	
	(1) Address Bit [000] Function Explanation	p.13/32 to p.14/32
	(2) Address Bit [001] Function Explanation	p.15/32
	(3) Address Bit [010] Function Explanation	p.16/32 to p.17/32
	(4) Address Bit [011] Function Explanation	p.18/32 to p.19/32
	(5) Address Bit [100] Function Explanation	p.20/32
6)	I/O Truth Table (BD6370GUL)	p.21/32 to p.23/32
7)	The More Precise Constant-Current Settings (BD6370GUL)	p.24/32 to p.23/32
8)	Application Control Sequence (BD6370GUL)	
	(1) Stepping Motor drive controlled by 2 phases mode	p.25/32 to p.26/32

1) Power-saving and Serial Reset (BD6370GUL; PS)

(1) Function Explanation

When Low-level voltage is applied to PS pin, the IC will be turned off internally and the circuit current will be $0\mu A$ (Typ.). During operating mode, PS pin should be High-level. (See the Electrical Characteristics; p.2/32)

Be cancelled power saving mode after turned on power supply VCC and VM, because of PS terminal combines power saving with serial reset function. If the case of power saving terminal always shorted power supply terminal, reset function may not be well, and it may cause the IC to malfunction. (See the Sequence of Serial Control Input; p.12/32)

2) Motor Control Input (BD6370GUL; INPUTx)

(1) Function Explanation

These pins are used to program and control the motor drive modes. So INPUTx switches CW or CCW, CW or Brake, and CCW or Brake, using serial function. (See the Electrical Characteristics; p.2/32 and I/O Truth Table; p.21/32 to p.23/32) INPUT34 and INPUT45 pins drive ch3 or ch4, and ch4 or ch5, respectively. The driven channel is selected using serial function. (See the Driven Outputs for INPUT Terminal Table; p.14/32)

3) H-bridge (BD6370GUL; VM, OUTxA, OUTxB, and RNFx)

(1) Function Explanation

The H-bridge output transistors of BD6370GUL are Power CMOS Drivers. The total H-bridge ON-Resistance on the high and low sides varies with the VM voltage. The system must be designed so that the maximum H-bridge current for each channel is 500mA or below.

The 3 H-bridges of ch1 to ch3 can be driven as the resemblance 4-channels. For this reason, it is possible to drive the 2 Stepping Motors by ch1 to ch3 as long as the 2 motors don't move simultaneously. The selection of resemblance drive mode for ch1 to ch3 is set using serial function. (See the Driven Outputs for INPUT Terminal Table; p.14/32)

The 2 control input terminals of INPUT34 and INPUT45 drive the 3 H-bridges of ch3 to ch5. Use caution because it is impossible to drive all 3 H-bridges simultaneously.

(2) The D/A Converter Settings of Constant-Voltage, Constant-Current, and Full-ON Mode

The ch1 to ch3 enable Constant-Voltage or Full-ON Driving, and the ch4 enables Constant-Voltage, Constant-Current, or Full-ON Driving, while the ch5 is Constant-Current Driving.

In the case of Full-ON mode for ch1 to ch3, input serial data of each Constant-Voltage setting D/A Converter (DAC12 and DAC3) to be full bits high.

In the ch4, as it set Constant-Voltage mode, input serial data of Constant-Current setting D/A Converter (DACl4) to be full bits high. As it set Constant-Current mode, input serial data of Constant-Voltage setting D/A Converter (DACV4) to be full bits high, while as it set Full-ON mode, input serial data of both D/A Converters to be full bits high. In the settings of Constant-Voltage or Full-ON mode, no need to connect the external resistance for output current detection in RNF4 pin.

The selection of drive mode for ch1 to ch4 is set using serial function. (See the serial settings of the drive mode in each channel; p.13/32 and p.15/32)

(a) Constant-Voltage mode (ch1 to ch4)

Output high voltage; VVOHx[V] = $8 \times V_{DACx}[V]$	$(8 \times V_{DACx} \leq VM[V], x = 12, 3, and V4)$	•••••(1)
VVOHx[V] = VM[V]	$(8 \times V_{DACx} > VM[V], x = 12, 3, and V4)$	•••••(2)
D/A Converter setting value; $8 \times V_{\text{DACx}}[V]$ = 1.5 to (4.725 (DACx = 6'b01_0100 to 6'b11_1111, x = 12, 3,	and V4)
In the ch4, set DACI4 = 6'b11_111.		

(b) Constant-Current mode (ch4 and ch5)

Output current; Ioutx[A] = $V_{DACx}[V] \div (R_{METALx}[\Omega] + R_{RNFx}[\Omega])$ (x = I4 and 5)(.....(3)D/A Converter setting value; $V_{DACx}[V] = 0.05$ to 0.315 (DACx = 6'b00_1010 to 6'b11_1111, x = I4 and 5)

 R_{METALx} ; metal impedance of BD6370GUL's inside (ch4; $R_{METALI4}[\Omega] = 0.004(Typ.)$, ch5; $R_{METALI5}[\Omega] = 0.022(Typ.)$) R_{RNFx} ; Resistance to connect RNFx pin for output current detection

(x = 12, 3, V4, and I4)

In the ch4, set DACV4 = 6'b11 1111.

(c) Full-ON mode (ch1 to ch4)

D/A Converter setting value; DACx = 6'b11_111

4) Serial Input (BD6370GUL; STROBE, SCLK, and SDATA)

(1) Function Explanation

The BD6370GUL provides a 3-line serial interface for setting output modes and D/A converters.

SDATA is sent to the internal shift register during the STROBE low interval at the SCLK rising edge. Shift register data (Bit[B] to Bit[0]) is written to the IC's internal 12-bit memory at the STROBE rising edge, according to the addresses stored in Bit[E], Bit[D], and Bit[C]. The serial data input order is Bit[E] to Bit[0].

In the case of the resemblance drive mode (MODE13=1 and/or MODE23=1), input the serial data to be the same condition of DAC12 and DAC3.

Be cancelled power saving mode after turned on power supply VCC and VM. Serial settings are reset when the PS pin changes to Low-level control voltage, because of PS terminal combines power saving with serial reset function. Serial settings are also reset when the UVLO or TSD circuit operates.



Fig.42 Sequence of Serial Control Input

(2) Serial Register Bit Map

Bit Map is consisted of 5 addresses and 60 data. It is the prohibited bit of MODExx input. Don't input the prohibited bit at all times. A low level should be input to the TEST bit at all times. A high signal may cause the IC to malfunction.

(a) The Prohibited Input of MODE Bit

(MODE45, MODE34, MODE23, MODE13) = (0, 0, 0, 1), (0, 0, 1, 0), (0, 0, 1, 1), (1, 0, 0, 1), (1, 0, 1, 0), (1, 0, 1, 1), (1, 1, 0, 0), (1, 1, 0, 1), (1, 1, 1, 0), (1, 1, 1, 1)

	······································														
	AD	DRESS	BIT		DATA BIT										
NO.	Bit[E]	Bit[D]	Bit[C]	Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
00H	0	0	0	TEST	TEST	MODE45	MODE34	MODE23	MODE13	MODE3C	MODE3B	MODE3A	MODE12C	MODE12B	MODE12A
01H	0	0	1	DAC12[5]	DAC12[4]	DAC12[3]	DAC12[2]	DAC12[1]	DAC12[0]	MODE5B	MODE5A	MODE4D	MODE4C	MODE4B	MODE4A
02H	0	1	0	DAC5[5]	DAC5[4]	DAC5[3]	DAC5[2]	DAC5[1]	DAC5[0]	DAC3[5]	DAC3[4]	DAC3[3]	DAC3[2]	DAC3[1]	DAC3[0]
03H	0	1	1	DACV4[5]	DACV4[4]	DACV4[3]	DACV4[2]	DACV4[1]	DACV4[0]	DACI4[5]	DACI4[4]	DACI4[3]	DACI4[2]	DACI4[1]	DACI4[0]
04H	1	0	0	TEST	TEST	IN5B	IN5A	IN4B	IN4A	IN3B	IN3A	IN2B	IN2A	IN1B	IN1A
	BD6370GUL Serial Register Bit Function														

Bit Name	Function	Bit Name	Function			
MODE13	OUT1A-OUT3A resemblance drive select	MODExA	Control input mode select ch1 to ch5 (x=1 to 5)			
MODE23	OUT2A-OUT3B resemblance drive select	MODExB	Control input mode select ch1 to ch5 (x=1 to 5)			
MODE34	INPUT34 terminal select ch3 or ch4	MODENC	Output drive select Constant-Voltage / Full-ON			
MODE45	INPUT45 terminal select ch4 or ch5	WODEXC	mode ch1 to ch3 (x=1 to 3)			
INxA	Control input mode select ch1 to ch5 (x=1 to 5)	MODExC	Output drive select Constant-Voltage /			
INxB	Control input mode select ch1 to ch5 (x=1 to 5)	MODExD	Constant-Current / Full-ON mode ch4 (x=4)			
TEAT		DAGetal	6Bit D/A Converter output select ch1 to ch5			
TEST	IESI BII (Low level input fixed)	DACX[Y]	(x=12 to 5 v=0 to 5)			

5) Serial Register Data Bit Function (BD6370GUL)

(1) ADDRESS BIT [000] Function Explanation

No.	ADDRESS BIT			DATA BIT											
	Bit[E]	Bit[D]	Bit[C]	Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
00H	0	0	0	TEST	TEST	MODE45	MODE34	MODE23	MODE13	MODE3C	MODE3B	MODE3A	MODE12C	MODE12B	MODE12A

(a) TEST; test bit for shipment inspection

A low signal should be input to the TEST bit at all times. A high signal may cause the IC to malfunction.

(b) MODE3C and MODE12C; output drive mode select for ch1, ch2, and ch3

Bit[5]	Bit[2]	drive	rminal	Nata	
MODE3C	MODE12C	ch3	ch2	ch1	Note
0	-	Full-ON	-	-	set DAC3=6'b11_1111
1	-	Constant-Voltage	-	-	
-	0	-	Full-ON	Full-ON	set DAC12=6'b11_111
-	1	-	Constant-Voltage	Constant-Voltage	

(c) MODE3B, MODE3A, MODE12B, and MODE12A; control input mode select for ch3, ch2, and ch1, respectively Refer to I/O Truth Table (p.21/32 to p.22/32) for the detail logic of MODE3B, MODE3A, MODE12B, and MODE12A. (d) MODE45, MODE34; input terminal select for ch3, ch4, and ch5, and MODE23, MODE13; resemblance drive select for ch1, ch2, and ch3

Bit[9]	Bit[8]	Bit[7]	Bit[6]	drive	n outputs fo	r INPUTx tei	minal	Note	
MODE45	MODE34	MODE23	MODE13	INPUT45	INPUT34	INPUT2	INPUT1	output terminal of OPEN mode	Ref No.
0	0	0	0	OUT4A-OUT4B	OUT3A-OUT3B	OUT2A-OUT2B	OUT1A-OUT1B	OUT5A, OUT5B	1
0	0	0	1	OUT4A-OUT4B	OUT3B	OUT2A-OUT2B	OUT1A-OUT3A	OUT1B, OUT5A, OUT5B	-
0	0	1	0	OUT4A-OUT4B	OUT3A	OUT2A-OUT3B	OUT1A-OUT1B	OUT2B, OUT5A, OUT5B	-
0	0	1	1	OUT4A-OUT4B	don't care	OUT2A-OUT3B	OUT1A-OUT3A	OUT1B, OUT2B, OUT5A, OUT5B	-
0	1	0	0	OUT5A-OUT5B	OUT4A-OUT4B	OUT2A-OUT2B	OUT1A-OUT1B	OUT3A, OUT3B	2
0	1	0	1	OUT5A-OUT5B	OUT4A-OUT4B	OUT2A-OUT2B	OUT1A-OUT3A	OUT1B, OUT3B	3
0	1	1	0	OUT5A-OUT5B	OUT4A-OUT4B	OUT2A-OUT3B	OUT1A-OUT1B	OUT2B, OUT3A	4
0	1	1	1	OUT5A-OUT5B	OUT4A-OUT4B	OUT2A-OUT3B	OUT1A-OUT3A	OUT1B, OUT2B	5
1	0	0	0	OUT5A-OUT5B	OUT3A-OUT3B	OUT2A-OUT2B	OUT1A-OUT1B	OUT4A, OUT4B	6
1	0	0	1	OUT5A-OUT5B	OUT3B	OUT2A-OUT2B	OUT1A-OUT3A	OUT1B, OUT4A, OUT4B	-
1	0	1	0	OUT5A-OUT5B	OUT3A	OUT2A-OUT3B	OUT1A-OUT1B	OUT2B, OUT4A, OUT4B	-
1	0	1	1	OUT5A-OUT5B	don't care	OUT2A-OUT3B	OUT1A-OUT3A	OUT1B, OUT2B, OUT4A, OUT4B	-
1	1	0	0	don't care	don't care	OUT2A-OUT2B	OUT1A-OUT1B	OUT3A, OUT3B, OUT4A, OUT4B, OUT5A, OUT5B	-
1	1	0	1	don't care	don't care	OUT2A-OUT2B	OUT1A-OUT3A	OUT1B, OUT3B, OUT4A, OUT4B, OUT5A, OUT5B	-
1	1	1	0	don't care	don't care	OUT2A-OUT3B	OUT1A-OUT1B	OUT2B, OUT3A, OUT4A, OUT4B, OUT5A, OUT5B	-
1	1	1	1	don't care	don't care	OUT2A-OUT3B	OUT1A-OUT3A	OUT1B, OUT2B, OUT4A, OUT4B, OUT5A, OUT5B	-

Gray lines are prohibition serial bit; don't input their bits at all times

ATTENTION in the case of resemblance drive mode (MODE23=1 and/or MODE13=1)

MODE3B, MODE3A, IN3B, and IN3A bits are "don't care". Because OUT1A-OUT3A is driven by MODE12B, MODE12A, IN1B, and IN1A bits, and INPUT1 terminal control. In the same condition, MODE12B, MODE12A, IN2B, and IN2A bits, and INPUT2 terminal drive OUT2A-OUT3B. And set the serial data as DAC12 = DAC3, if not, Output high voltage is different value between OUT1A and OUT3A, and/or OUT2A and OUT3B.



Fig.43 Example of Standard Model (ref No. 1, 2, and 6)



Fig.44 Example of High Performance Model (ref No.2 and 5)



Fig.45 Example of Standard Model and 1 Actuator (ref No.3 and 6) Fig.46 Example of Standard Model and 1 Actuator (ref No.4 and 6)

C.V.=Constant-Voltage drive mode, Full ON=Full-ON drive mode, and C.C.=Constant-Current drive mode STM=Stepping Motor, DCM=DC Motor, and VCM=Voice Coil Motor

Examples of Applications above are typical. BD6370GUL is not limited to these applications.

(2) ADDRESS BIT [001] Function Explanation

No.	ADDRESS BIT				DATA BIT										
	Bit[E]	Bit[D]	Bit[C]	Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
01H	0	0	1	DAC12[5]	DAC12[4]	DAC12[3]	DAC12[2]	DAC12[1]	DAC12[0]	MODE5B	MODE5A	MODE4D	MODE4C	MODE4B	MODE4A
(a) DAC12[5] to DAC12[0]; D/A Converter setting for output high voltage of Constant-Voltage mode in ch1 and ch2															

Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	DAC12 setting	Output high
DAC12[5]	DAC12[4]	DAC12[3]	DAC12[2]	DAC12[1]	DAC12[0]	voltage; V _{DAC12} [V]	voltage; VVOH [V]
0	1	0	1	0	0	0.188	1.500
0	1	0	1	0	1	0.197	1.575
0	1	0	1	1	0	0.206	1.650
0	1	0	1	1	1	0.216	1.725
0	1	1	0	0	0	0.225	1.800
0	1	1	0	0	1	0.234	1.875
0	1	1	0	1	0	0.244	1.950
0	1	1	0	1	1	0.253	2.025
0	1	1	1	0	0	0.263	2.100
0	1	1	1	0	1	0.272	2.175
0	1	1	1	1	0	0.281	2.250
0	1	1	1	1	1	0.291	2.325
1	0	0	0	0	0	0.300	2.400
1	0	0	0	0	1	0.309	2.475
1	0	0	0	1	0	0.319	2.550
1	0	0	0	1	1	0.328	2.625
1	0	0	1	0	0	0.338	2.700
1	0	0	1	0	1	0.347	2.775
1	0	0	1	1	0	0.356	2.850
1	0	0	1	1	1	0.366	2.925
1	0	1	0	0	0	0.375	3.000
1	0	1	0	0	1	0.384	3.075
1	0	1	0	1	0	0.394	3.150
1	0	1	0	1	1	0.403	3.225
1	0	1	1	0	0	0.413	3.300
1	0	1	1	0	1	0.422	3.375
1	0	1	1	1	0	0.431	3.450
1	0	1	1	1	1	0.441	3.525
1	1	0	0	0	0	0.450	3.600
1	1	0	0	0	1	0.459	3.675
1	1	0	0	1	0	0.469	3.750
1	1	0	0	1	1	0.478	3.825
1	1	0	1	0	0	0.488	3.900
1	1	0	1	0	1	0.497	3.975
1	1	0	1	1	0	0.506	4.050
1	1	0	1	1	1	0.516	4.125
1	1	1	0	0	0	0.525	4.200
1	1	1	0	0	1	0.534	4.275
1	1	1	0	1	0	0.544	4.350
1	1	1	0	1	1	0.553	4.425
1	1	1	1	0	0	0.563	4.500
1	1	1	1	0	1	0.572	4.575
1	1	1	1	1	0	0.581	4.650
1	1	1	1	1	1	0.591	4.725

(b) MODE4D and MODE4C; output drive mode select for ch4

Bit[3]	Bit[2]	drive mede for oht	Noto
MODE4D	MODE4C	drive mode for ch4	Note
0	0	Full-ON	set DACV4=DACI4=6'b11_111, and RNF4 terminal to ground
0	1	Full-ON	set DACV4=DACI4=6'b11_111, and RNF4 terminal to ground
1	0	Constant Voltage	set DACI4=6'b11_1111, and RNF4 terminal to ground
1	1	Constant Current	set DACV4=6'b11_1111, and RNF4 terminal with resistance to ground

(c) MODE5B, MODE5A, MODE4B, and MODE4A; control input mode select for ch5 and ch4, respectively Refer to I/O Truth Table (p.23/32) for the detail logic of MODE5B, MODE5A, MODE4B, and MODE4A.

(3) ADDRESS BIT [010] Function Explanation

No.	ADDRESS BIT			DATA BIT											
	Bit[E]	Bit[D]	Bit[C]	Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
02H	0	1	0	DAC5[5]	DAC5[4]	DAC5[3]	DAC5[2]	DAC5[1]	DAC5[0]	DAC3[5]	DAC3[4]	DAC3[3]	DAC3[2]	DAC3[1]	DAC3[0]

(a) DAC5[5] to DAC5[0]; D/A Converter setting for output current (DAC5 setting voltage) of Constant-Current mode in ch5

As regards how to calculate the output current setting, refer to p.11/32 and p.24/32

Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	DAC5 setting	R _{RNF5} =0.5Ω	R _{RNF5} =1.0Ω
DAC5[5]	DAC5[4]	DAC5[3]	DAC5[2]	DAC5[1]	DAC5[0]	voltage; V _{DAC5} [mV]	Output current [mA]	Output current [mA]
0	0	1	0	1	0	50	96	49
0	0	1	0	1	1	55	105	54
0	0	1	1	0	0	60	115	59
0	0	1	1	0	1	65	125	64
0	0	1	1	1	0	70	134	68
0	0	1	1	1	1	75	144	73
0	1	0	0	0	0	80	153	78
0	1	0	0	0	1	85	163	83
0	1	0	0	1	0	90	172	88
0	1	0	0	1	1	95	182	93
0	1	0	1	0	0	100	192	98
0	1	0	1	0	1	105	201	103
0	1	0	1	1	0	110	211	108
0	1	0	1	1	1	115	220	113
0	1	1	0	0	0	120	230	117
0	1	1	0	0	1	125	239	122
0	1	1	0	1	0	130	249	127
0	1	1	0	1	1	135	259	132
0	1	1	1	0	0	140	268	137
0	1	1	1	0	1	145	278	142
0	1	1	1	1	0	150	287	147
0	1	1	1	1	1	155	297	152
1	0	0	0	0	0	160	307	157
1	0	0	0	0	1	165	316	161
1	0	0	0	1	0	170	326	166
1	0	0	0	1	1	175	336	171
1	0	0	1	0	0	180	345	176
1	0	0	1	0	1	185	355	181
1	0	0	1	1	0	190	364	186
1	0	0	1	1	1	195	374	191
1	0	1	0	0	0	200	383	196
1	0	1	0	0	1	205	393	201
1	0	1	0	1	0	210		205
1	0	1	0	1	1	215		210
1	0	1	1	0	0	220		216
1	0	1	1	0	1	225		220
1	0	1	1	1	0	230		225
1	0	1	1	1	1	235		230
1	1	0	0	0	0	240		235
1	1	0	0	0	1	245		240
1	1	0	0	1	0	250		245
1	1	0	0	1	1	255		250
1	1	0	1	0	0	260	Over Operating	254
1	1	0	1	0	1	265	Condition	259
1	1	0	1	1	0	270		264
1	1	0	1	1	1	275		269
1	1	1	0	0	0	280		2/4
1	1	1	0	0	1	285		279
1	1	1	0	1	0	290		284
1	1	1	0	1	1	295		289
1	1	1	1	0	0	300		294
1	1	1	1	0	1	305		298
1	1	1	1	1	0	310		303
1	1	1	1	1	1	315		308

(b) DAC3[5] to DAC3[0]: D/A Converter	r setting for output high	voltage of Constant-V	oltage mode in ch3
	i setting for output night	voltage of Constant-v	onage mode in cho

Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]	DAC3 setting	Output high
DAC3[5]	DAC3[4]	DAC3[3]	DAC3[2]	DAC3[1]	DAC3[0]	voltage; V _{DAC3} [V]	voltage; VVOH [V]
0	1	0	1	0	0	0.188	1.500
0	1	0	1	0	1	0.197	1.575
0	1	0	1	1	0	0.206	1.650
0	1	0	1	1	1	0.216	1.725
0	1	1	0	0	0	0.225	1.800
0	1	1	0	0	1	0.234	1.875
0	1	1	0	1	0	0.244	1.950
0	1	1	0	1	1	0.253	2.025
0	1	1	1	0	0	0.263	2.100
0	1	1	1	0	1	0.272	2.175
0	1	1	1	1	0	0.281	2.250
0	1	1	1	1	1	0.291	2.325
1	0	0	0	0	0	0.300	2.400
1	0	0	0	0	1	0.309	2.475
1	0	0	0	1	0	0.319	2.550
1	0	0	0	1	1	0.328	2.625
1	0	0	1	0	0	0.338	2.700
1	0	0	1	0	1	0.347	2.775
1	0	0	1	1	0	0.356	2.850
1	0	0	1	1	1	0.366	2.925
1	0	1	0	0	0	0.375	3.000
1	0	1	0	0	1	0.384	3.075
1	0	1	0	1	0	0.394	3.150
1	0	1	0	1	1	0.403	3.225
1	0	1	1	0	0	0.413	3.300
1	0	1	1	0	1	0.422	3.375
1	0	1	1	1	0	0.431	3.450
1	0	1	1	1	1	0.441	3.525
1	1	0	0	0	0	0.450	3.600
1	1	0	0	0	1	0.459	3.675
1	1	0	0	1	0	0.469	3.750
1	1	0	0	1	1	0.478	3.825
1	1	0	1	0	0	0.488	3.900
1	1	0	1	0	1	0.497	3.975
1	1	0	1	1	0	0.506	4.050
1	1	0	1	1	1	0.516	4.125
1	1	1	0	0	0	0.525	4.200
1	1	1	0	0	1	0.534	4.275
1	1	1	0	1	0	0.544	4.350
1	1	1	0	1	1	0.553	4.425
1	1	1	1	0	0	0.563	4.500
1	1	1	1	0	1	0.572	4.575
1	1	1	1	1	0	0.581	4.650
1	1	1	1	1	1	0.591	4.725

(4) ADDRESS BIT [011] Function Explanation

ADDRESS BIT DATA BIT														
INO.	Bit[E]	Bit[D]	Bit[C]	Bit[B]	Bit[B] Bit[A] Bit[9] Bit[8] Bit[7] Bit[6] Bit[5] Bit[4] Bit[3] Bit[2] Bit[2]								Bit[1]	Bit[0]
03H	0	1	1	DACV4[5]	ACV4[5] DACV4[4] DACV4[3] DACV4[2] DACV4[1] DACV4[0] DACI4[5] DACI4[4] DACI4[3] DACI4[2] DACI4[1] DACI4[1]									DACI4[0]
(a) D	(a) DACV4[5] to DACV4[0]; D/A Converter setting for output high voltage of Constant-Voltage mode in ch4													

Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	DACV4 setting	Output high
DACV4[5]	DACV4[4]	DACV4[3]	DACV4[2]	DACV4[1]	DACV4[0]	voltage; V _{DACV4} [V]	voltage; VVOH [V]
0	1	0	1	0	0	0.188	1.500
0	1	0	1	0	1	0.197	1.575
0	1	0	1	1	0	0.206	1.650
0	1	0	1	1	1	0.216	1.725
0	1	1	0	0	0	0.225	1.800
0	1	1	0	0	1	0.234	1.875
0	1	1	0	1	0	0.244	1.950
0	1	1	0	1	1	0.253	2.025
0	1	1	1	0	0	0.263	2.100
0	1	1	1	0	1	0.272	2.175
0	1	1	1	1	0	0.281	2.250
0	1	1	1	1	1	0.291	2.325
1	0	0	0	0	0	0.300	2.400
1	0	0	0	0	1	0.309	2.475
1	0	0	0	1	0	0.319	2.550
1	0	0	0	1	1	0.328	2.625
1	0	0	1	0	0	0.338	2.700
1	0	0	1	0	1	0.347	2.775
1	0	0	1	1	0	0.356	2.850
1	0	0	1	1	1	0.366	2.925
1	0	1	0	0	0	0.375	3.000
1	0	1	0	0	1	0.384	3.075
1	0	1	0	1	0	0.394	3.150
1	0	1	0	1	1	0.403	3.225
1	0	1	1	0	0	0.413	3.300
1	0	1	1	0	1	0.422	3.375
1	0	1	1	1	0	0.431	3.450
1	0	1	1	1	1	0.441	3.525
1	1	0	0	0	0	0.450	3.600
1	1	0	0	0	1	0.459	3.675
1	1	0	0	1	0	0.469	3.750
1	1	0	0	1	1	0.478	3.825
1	1	0	1	0	0	0.488	3.900
1	1	0	1	0	1	0.497	3.975
1	1	0	1	1	0	0.506	4.050
1	1	0	1	1	1	0.516	4.125
1	1	1	0	0	0	0.525	4.200
1	1	1	0	0	1	0.534	4.275
1	1	1	0	1	0	0.544	4.350
1	1	1	0	1	1	0.553	4.425
1	1	1	1	0	0	0.563	4.500
1	1	1	1	0	1	0.572	4.575
1	1	1	1	1	0	0.581	4.650
1	1	1	1	1	1	0.591	4.725

(b) DACI4[5] to DACI4[0]; D/A Converter setting for output current (DACI4 setting voltage) of Constant-Current mode in ch4
As regards how to calculate the output current setting, refer to p.11/32 and p.24/32

						2 1/02		
Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]	DACI4 setting	$R_{RNFI4}=0.5\Omega$	$R_{RNFI4}=1.0\Omega$
DACI4[5]	DACI4[4]	DACI4[3]	DACI4[2]	DACI4[1]	DACI4[0]	voltage; V _{DACI4} [mV]	Output current [mA]	Output current [mA]
0	0	1	0	1	0	50	99	50
0	0	1	0	1	1	55	109	55
0	0	1	1	0	0	60	119	60
0	0	1	1	0	1	65	129	65
0	0	1	1	1	0	70	139	70
0	0	1	1	1	1	75	149	75
0	1	0	0	0	0	80	159	80
0	1	0	0	0	1	85	169	85
0	1	0	0	1	0	90	179	90
0	1	0	0	1	1	95	188	95
0	1	0	1	0	0	100	198	100
0	1	0	1	0	1	105	208	105
0	1	0	1	1	0	110	200	110
0	1	0	1	1	0	110	210	110
0	1	0	1	1	1	115	220	115
0	1	1	0	0	0	120	238	120
0	1	1	0	0	1	125	248	125
0	1	1	0	1	0	130	258	129
0	1	1	0	1	1	135	268	134
0	1	1	1	0	0	140	278	139
0	1	1	1	0	1	145	288	144
0	1	1	1	1	0	150	298	149
0	1	1	1	1	1	155	308	154
1	0	0	0	0	0	160	317	159
1	0	0	0	0	1	165	327	164
1	0	0	0	1	0	170	337	169
1	0	0	0	1	1	175	347	174
1	0	0	1	0	0	180	357	179
1	0	0	1	0	1	185	367	184
1	0	0	1	1	0	190	377	189
1	0	0	1	1	1	195	387	194
1	0	1	0	0	0	200	397	199
1	0	1	0	0	1	205	001	204
1	0	1	0	1	0	200		204
1	0	1	0	1	1	210		205
1	0	1	0	0	0	215		214
1	0	1	1	0	0	220		219
1	0	1	1	0	1	225		224
	0	1	1	1	U	230		229
1	U	1	1	1	1	235		234
1	1	0	0	0	0	240		239
1	1	0	0	0	1	245		244
1	1	0	0	1	0	250		249
1	1	0	0	1	1	255	Over Operating	254
1	1	0	1	0	0	260	Condition	259
1	1	0	1	0	1	265		264
1	1	0	1	1	0	270		269
1	1	0	1	1	1	275		274
1	1	1	0	0	0	280		279
1	1	1	0	0	1	285		284
1	1	1	0	1	0	290		289
1	1	1	0	1	1	295		294
1	1	1	1	0	0	300		299
1	1	1	1	0	1	305		304
1	1	1	1	1	0	310		309
1	1	1	1	1	1	315		314
	I	I	I	I	I	515		514

(5) ADDRESS BIT [100] Function Explanation

No	AD	DRESS	BIT		DATA BIT										
INO.	Bit[E]	Bit[D]	Bit[C]	Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
04H	1	0	0	TEST	TEST	IN5B	IN5A	IN4B	IN4A	IN3B	IN3A	IN2B	IN2A	IN1B	IN1A

(a) TEST; test bit for shipment inspection

A low signal should be input to the TEST bit at all times. A high signal may cause the IC to malfunction.

(b) IN5B to IN1A; control input mode select for ch1 to ch5, respectively

Refer to I/O Truth Table (p.21/32 to p.23/32) for the detail logic of IN1A to IN5B.

6) I/O Truth Table (BD6370GUL)

	Serial interf	ace input bit		Terminal	Output	terminal	MODE
MODE12B	MODE12A	INxB	INxA	INPUTx	OUTxA	OUTxB	MODE
PWM Drive	Mode by INI	PUTx termina	al				
0	0	0	0	Х	Z	Z	OFF
0	0	0	1	L	L	L	Brake
0	0	0	1	Н	Н	L	CW
0	0	1	0	L	L	L	Brake
0	0	1	0	Н	L	Н	CCW
0	0	1	1	Х	L	L	Brake
PWM Drive	Mode by INI	PUTx termina	al				
0	1	0	0	Х	Z	Z	OFF
0	1	0	1	L	Н	L	CW
0	1	0	1	Н	L	L	Brake
0	1	1	0	L	L	Н	CCW
0	1	1	0	Н	L	L	Brake
0	1	1	1	Х	L	L	Brake
CW / CCW	Drive Mode	by INPUTx te	erminal				
1	0	Х	0	Х	Z	Z	OFF
1	0	0	1	L	L	Н	CCW
1	0	0	1	Н	Н	L	CW
1	0	1	1	Х	L	L	Brake
CW / CCW	Drive Mode	by INPUTx te	erminal				
1	1	Х	0	Х	Z	Z	OFF
1	1	0	1	L	Н	L	CW
1	1	0	1	Н	L	Н	CCW
1	1	1	1	Х	L	L	Brake

H; High level, L; Low level, Z; Hi impedance, X; Don't care

At CW, current flows from OUTxA to OUTxB. At CCW, current flows from OUTxB to OUTxA.

(2) I/O truth table for ch3, in the case of MODE34=0, MODE13=0, and MOE)E23=0
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	Serial interfa	ace input bit		Terminal	Output	terminal	MODE
MODE3B	MODE3A	IN3B	IN3A	INPUT34	OUT3A	OUT3B	MODE
PWM Drive	Mode by INF	PUT34 termir	nal				
0	0	0	0	Х	Z	Z	OFF
0	0	0	1	L	L	L	Brake
0	0	0	1	Н	Н	L	CW
0	0	1	0	L	L	L	Brake
0	0	1	0	Н	L	Н	CCW
0	0	1	1	Х	L	L	Brake
PWM Drive	Mode by INF	PUT34 termir	nal				
0	1	0	0	Х	Z	Z	OFF
0	1	0	1	L	Н	L	CW
0	1	0	1	Н	L	L	Brake
0	1	1	0	L	L	Н	CCW
0	1	1	0	Н	L	L	Brake
0	1	1	1	Х	L	L	Brake
CW / CCW	Drive Mode I	by INPUT34	terminal				
1	0	Х	0	Х	Z	Z	OFF
1	0	0	1	L	L	Н	CCW
1	0	0	1	Н	Н	L	CW
1	0	1	1	Х	L	L	Brake
CW / CCW	Drive Mode I	by INPUT34	terminal				
1	1	Х	0	Х	Z	Z	OFF
1	1	0	1	L	Н	L	CW
1	1	0	1	Н	L	Н	CCW
1	1	1	1	Х	L	L	Brake

H; High level, L; Low level, Z; Hi impedance, X; Don't care

At CW, current flows from OUT3A to OUT3B. At CCW, current flows from OUT3B to OUT3A.

(3) I/O truth table for ch1, ch3, in the case of MODE13=1 (OUT1A-OUT3A resemblance drive mode)

	Serial interf	ace input hit	•	Terminal	Output	terminal	,
MODE12B	MODE12A	IN1B	IN1A	INPUT1	OUT1A	OUT3A	MODE
PWM Drive	Mode by INI	PUT1 termina	al	_			1
0	0	0	0	Х	Z	Z	OFF
0	0	0	1	L	L	L	Brake
0	0	0	1	Н	Н	L	CW
0	0	1	0	L	L	L	Brake
0	0	1	0	Н	L	Н	CCW
0	0	1	1	Х	L	L	Brake
PWM Drive	Mode by INI	PUT1 termina	al	•			
0	1	0	0	Х	Z	Z	OFF
0	1	0	1	L	Н	L	CW
0	1	0	1	Н	L	L	Brake
0	1	1	0	L	L	Н	CCW
0	1	1	0	Н	L	L	Brake
0	1	1	1	Х	L	L	Brake
CW / CCW	Drive Mode	by INPUT1 te	erminal				
1	0	Х	0	Х	Z	Z	OFF
1	0	0	1	L	L	Н	CCW
1	0	0	1	Н	Н	L	CW
1	0	1	1	Х	L	L	Brake
CW/CCW	Drive Mode	by INPUT1 te	erminal				
1	1	Х	0	Х	Z	Z	OFF
1	1	0	1	L	Н	L	CW
1	1	0	1	Н	L	Н	CCW
1	1	1	1	Х	L	L	Brake

H; High level, L; Low level, Z; Hi impedance, X; Don't care, OUT1B; Hi impedance

At CW, current flows from OUT1A to OUT3A. At CCW, current flows from OUT3A to OUT1A.

(4) I/O truth table for ch2, ch3, in the case of MODE23=1 (OUT2A-OUT3B resemblance drive mode)

	Serial interf	ace input bit	:	Terminal	Output	terminal	MODE
MODE12B	MODE12A	IN2B	IN2A	INPUT2	OUT2A	OUT3B	MODE
PWM Drive	Mode by INI	PUT2 termina	al				
0	0	0	0	Х	Z	Z	OFF
0	0	0	1	L	L	L	Brake
0	0	0	1	Н	Н	L	CW
0	0	1	0	L	L	L	Brake
0	0	1	0	Н	L	Н	CCW
0	0	1	1	Х	L	L	Brake
PWM Drive	Mode by INI	PUT2 termina	al				
0	1	0	0	Х	Z	Z	OFF
0	1	0	1	L	Н	L	CW
0	1	0	1	Н	L	L	Brake
0	1	1	0	L	L	Н	CCW
0	1	1	0	Н	L	L	Brake
0	1	1	1	Х	L	L	Brake
CW / CCW	Drive Mode	by INPUT2 te	erminal				
1	0	Х	0	Х	Z	Z	OFF
1	0	0	1	L	L	Н	CCW
1	0	0	1	Н	Н	L	CW
1	0	1	1	Х	L	L	Brake
CW / CCW	Drive Mode	by INPUT2 te	erminal				
1	1	Х	0	Х	Z	Z	OFF
1	1	0	1	L	Н	L	CW
1	1	0	1	Н	L	Н	CCW
1	1	1	1	Х	L	L	Brake

H; High level, L; Low level, Z; Hi impedance, X; Don't care, OUT2B; Hi impedance

At CW, current flows from OUT2A to OUT3B. At CCW, current flows from OUT3B to OUT2A.

ATTENTION in the case of resemblance drive mode (MODE23=1 and/or MODE13=1)

MODE3B, MODE3A, IN3B, and IN3A bits are "don't care". Because OUT1A-OUT3A is driven by MODE12B, MODE12A, IN1B, and IN1A bits, and INPUT1 terminal control. In the same condition, MODE12B, MODE12A, IN2B, and IN2A bits, and INPUT2 terminal drive OUT2A-OUT3B. And set the serial data as DAC12 = DAC3, if not, Output high voltage is different value between OUT1A and OUT3A, and/or OUT2A and OUT3B.

(5) I/O truth table for ch4, in the case of MODE45=0 (if MODE34=0, then x=45, else then x=34)

	Serial interfa	ace input bit	t	Terminal	Output	terminal	MODE
MODE4B	MODE4A	IN4B	IN4A	INPUTx	OUT4A	OUT4B	MODE
PWM Drive	Mode by INI	PUTx termina	al				•
0	0	0	0	Х	Z	Z	OFF
0	0	0	1	L	L	L	Brake
0	0	0	1	Н	Н	L	CW
0	0	1	0	L	L	L	Brake
0	0	1	0	Н	L	Н	CCW
0	0	1	1	Х	L	L	Brake
PWM Drive	Mode by INI	PUTx termina	al				
0	1	0	0	Х	Z	Z	OFF
0	1	0	1	L	Н	L	CW
0	1	0	1	Н	L	L	Brake
0	1	1	0	L	L	Н	CCW
0	1	1	0	н	L	L	Brake
0	1	1	1	Х	L	L	Brake
CW / CCW	Drive Mode	by INPUTx te	erminal				
1	0	Х	0	Х	Z	Z	OFF
1	0	0	1	L	L	Н	CCW
1	0	0	1	Н	Н	L	CW
1	0	1	1	Х	L	L	Brake
CW / CCW	Drive Mode	by INPUT te	erminal				
1	1	Х	0	Х	Z	Z	OFF
1	1	0	1	L	Н	L	CW
1	1	0	1	Н	L	Н	CCW
1	1	1	1	Х	L	L	Brake

H; High level, L; Low level, Z; Hi impedance, X; Don't care

At CW, current flows from OUT4A to OUT4B. At CCW, current flows from OUT4B to OUT4A.

(6) I/O truth table for ch5, in the case of MODE45=1, MODE34=0 (or MODE45=0, MODE34=1)

	Serial interf	ace input bit	t	Terminal	Output	terminal	MODE	
MODE5B	MODE5A	IN5B	IN5A	INPUT45	OUT5A	OUT5B	MODE	
PWM Drive	Mode by INI	PUT45 termir	nal					
0	0	0	0	Х	Z	Z	OFF	
0	0	0	1	L	L	L	Brake	
0	0	0	1	Н	Н	L	CW	
0	0	1	0	L	L	L	Brake	
0	0	1	0	Н	L	Н	CCW	
0	0	1	1	Х	L	L	Brake	
PWM Drive	Mode by INI	PUT45 termir	nal					
0	1	0	0	Х	Z	Z	OFF	
0	1	0	1	L	Н	L	CW	
0	1	0	1	Н	L	L	Brake	
0	1	1	0	L	L	Н	CCW	
0	1	1	0	Н	L	L	Brake	
0	1	1	1	Х	L	L	Brake	
CW/CCW	Drive Mode	by INPUT45	terminal					
1	0	Х	0	Х	Z	Z	OFF	
1	0	0	1	L	L	Н	CCW	
1	0	0	1	Н	Н	L	CW	
1	0	1	1	Х	L	L	Brake	
CW / CCW	Drive Mode	by INPUT45	terminal					
1	1	Х	0	Х	Z	Z	OFF	
1	1	0	1	L	Н	L	CW	
1	1	0	1	Н	L	Н	CCW	
1	1	1	1	Х	L	L	Brake	

H; High level, L; Low level, Z; Hi impedance, X; Don't care

At CW, current flows from OUT5A to OUT5B. At CCW, current flows from OUT5B to OUT5A.

7) The More Precise Constant-Current Settings (BD6370GUL)

Regarding Constant-Current Drive blocks (ch4 and ch5), there is the metal impedance of each RNF in BD6370GUL inside: $4m\Omega$ (Typ.) and $22m\Omega$ (Typ.), respectively. Then the metal impedances and the board patterning impedances of RNF4 and RNF5 lines considered, set each D/A Converter to drive the actuator in the more precise constant current.



R_{RNFx}; external component of output current detection

R_{METALx}; metal impedance of BD6370GUL's inside

R_{Wx_1, 2}; board patterning impedance

V_{DACx}; setting value of constant current

I_{OUTx}; current flowed through the motor

Fig.47 Metal Impedance and Board Patterning Impedance of Constant-Current block

The more correct D/A Converter settings of Constant-Current H-bridge (ch4 and ch5) Output current value; $I_{OUTx}[A] = V_{DACx}[V] \div (R_{RNFx}[\Omega] + R_{METALx}[\Omega] + R_{Wx_1}[\Omega] + R_{Wx_2}[\Omega])$

(ex.) If there are $V_{DACx}=0.1[V]$, $R_{RNFx}=0.5[\Omega]$, and $R_{Wx_1}+R_{Wx_2}=0[\Omega]$ (the ideal patterning condition), then

Output current value (**ch4**); $I_{OUT4}[A] = 0.1[V] \div (0.5[\Omega] + 0.004[\Omega] + 0[\Omega]) = 0.198$

Output current value (**ch5**); $I_{OUT5}[A] = 0.1[V] \div (0.5[\Omega] + 0.022[\Omega] + 0[\Omega]) = 0.191$

Else if there are V_{DACx} =0.1[V], R_{RNFx} = 0.5[Ω], and R_{Wx_1} + R_{Wx_2} =**0.05**[Ω] (the more closely real patterning condition; the value is different to the patterning), then

Output current value (ch4); $I_{OUT4}[A] = 0.1[V] \div (0.5[\Omega] + 0.004[\Omega] + 0.05[\Omega]) = 0.181$ Output current value (ch5); $I_{OUT6}[A] = 0.1[V] \div (0.5[\Omega] + 0.022[\Omega] + 0.05[\Omega]) = 0.175$ 8) Application control sequences (BD6370GUL)

(1) Stepping Motor drive controlled by 2 phases mode



Fig.48 Timing Chart of Stepping Motor Drive

Sequence of	Stepping	Motor Drive	
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	Seria	l interfa	ace inp	ut bit		Tern	ninal		Output	terminal		MODE			
MODE 12B	MODE 12A	IN2B	IN2A	IN1B	IN1A	INPUT1	INPUT2	OUT1A	OUT1B	OUT2A	OUT2B	ch1	ch2		Position
Contr	ol stand	dby													
1	0	0	0	0	0	Х	Х	Z	Z	Z	Z				
Start 2	2 phase	mode	driving												
1	0	0	1	0	1	Н	Н	Н	L	Н	L	CW	CW	1	
1	0	0	1	0	1	н	L	н	L	L	Н	CW	CCW	2	
1	0	0	1	0	1	L	L	L	Н	L	Н	CCW	CCW	3	Forward
1	0	0	1	0	1	L	Н	L	Н	Н	L	CCW	CW	4	
1	0	0	1	0	1	н	Н	Н	L	Н	L	CW	CW	1	
1	0	0	1	0	1	Н	Н	Н	L	Н	L	CW	CW	1	
1	0	0	1	0	1	L	н	L	н	н	L	CCW	CW	4	
1	0	0	1	0	1	L	L	L	н	L	Н	CCW	CCW	3	Reverse
1	0	0	1	0	1	н	L	Н	L	L	Н	CW	CCW	2	
1	0	0	1	0	1	Н	Н	Н	L	Н	L	CW	CW	1	
End ti	ming (c	ontrol	standby	y)											
1	0	0	0	0	0	Х	Х	Z	Z	Z	Z				

H; High level, L; Low level, Z; Hi impedance, X; Don't care

At CW, current flows from OUTxA to OUTxB. At CCW, current flows from OUTxB to OUTxA.

At Forward; position up from "1" to "4". At Reverse; position down from "4" to "1".



Fig.49 Torque Vector of 2 Phases Mode

Serial Control	Input from	Initial Set	Up (i) to	End Tim	ning (vii)
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No	AD	DRESS	BIT						DAT	A BIT					
INO.	Bit[E]	Bit[D]	Bit[C]	Bit[B]	Bit[A]	Bit[9]	Bit[8]	Bit[7]	Bit[6]	Bit[5]	Bit[4]	Bit[3]	Bit[2]	Bit[1]	Bit[0]
Initia	al set u	р													
(i)	(i) ADDRESS BIT [000]; set ch1 and ch2; Constant-Voltage drive mode														
				TEST	TEST	MODE45	MODE34	MODE23	MODE13	MODE3C	MODE3B	MODE3A	MODE12C	MODE12B	MODE12A
UUH	U	U	U	0	0	0	0	0	0	0	0	0	1	1	0
(ii) ADDI	RESS	BIT [00	01]; set O	utput hig	gh voltag	e=3.0V fc	or ch1 an	d ch2						
				DAC12[5]	DAC12[4]	DAC12[3]	DAC12[2]	DAC12[1]	DAC12[0]	MODE5B	MODE5A	MODE4D	MODE4C	MODE4B	MODE4A
01H	0	U	1	1	0	1	0	0	0	0	0	0	0	0	0
(ii	(iii) ADDRESS BIT [010]; in this case, don't care														
				DAC5[5]	DAC5[4]	DAC5[3]	DAC5[2]	DAC5[1]	DAC5[0]	DAC3[5]	DAC3[4]	DAC3[3]	DAC3[2]	DAC3[1]	DAC3[0]
02H	0 1 0	0	0	0	0	0	0	0	0	0	0	0	0	0	
(iv	(iv) ADDRESS BIT [011]; in this case, don't care														
				DACV4[5]	DACV4[4]	DACV4[3]	DACV4[2]	DACV4[1]	DACV4[0]	DACI4[5]	DACI4[4]	DACI4[3]	DACI4[2]	DACI4[1]	DACI4[0]
03H	0 1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
(v) ADDI	RESS	BIT [10	00]; set c	ontrol sta	andby mo	ode								
				TEST	TEST	IN5B	IN5A	IN4B	IN4A	IN3B	IN3A	IN2B	IN2A	IN1B	IN1A
04H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Star	t timin	g													
(v	i) ADD	RESS	BIT [1	00]											
				TEST	TEST	IN5B	IN5A	IN4B	IN4A	IN3B	IN3A	IN2B	IN2A	IN1B	IN1A
04H	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
End	timing	I													
(v	ii) ADD	DRESS	6 BIT [1	00]											
				TEST	TEST	IN5B	IN5A	IN4B	IN4A	IN3B	IN3A	IN2B	IN2A	IN1B	IN1A
04H	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The above Sequence is one example. BD6370GUL is not limited to this sequence.



Fig.50 BD6758MWV / KN Application Circuit Diagram

1) Power-saving function (BD6758MWV / KN)

When Low-level voltage is applied to PS pin, the IC will be turned off internally and the circuit current will be $0\mu A$ (Typ.). During operating mode, PS pin should be High-level. (See the Electrical Characteristics; p.6/32)

2) Control input (BD6758MWV / KN)

(1) INxA, INxB, EN1 and IN5 pins

These pins are used to program and control the motor drive modes. (See the Electrical Characteristics; p.6/32 and I/O Truth Table; p.28/32)

(2) SELx pins

When the Low-level voltage is applied to the SEL pin, the I/O logic can be set to EN/IN mode. However, when the High-level voltage is applied, the I/O logic can be set to IN/IN mode. (See the Electrical Characteristics; p.6/32 and I/O Truth Table; p.28/32)

(3) BRKx pins

Applying the High-level voltage to the BRKx pin will set the brake mode. (See the Electrical Characteristics; p.6/32 and I/O Truth Table; p.28/32)

3) H-bridge (BD6758MWV / KN)

The 5-channel H-bridges can be controlled independently. For this reason, it is possible to drive the H-bridges simultaneously, as long as the package thermal tolerances are not exceeded.

The H-bridge output transistors of BD6758MWV and BD6758KN are Power CMOS Drivers. The total H-bridge ON-Resistance on the high and low sides varies with the VM voltage. The system must be designed so that the maximum H-bridge current for each channel is 800mA or below. (See the Operating Conditions; p.2/32)

4) Drive system of Linear Constant-Current H-bridge (BD6758MWV / KN: ch5)

BD6758MWV / KN (ch5) enable Linear Constant-Current Driving.

(1) Reference voltage output (with a tolerance of ±3%)

The VREF pin outputs 1.2V, based on the internal reference voltage. The output current of the Constant-Current Drive block is controllable by connecting external resistance to the VREF pin of the IC and applying a voltage divided by the resistor to the output current setting pins (VLIM pin). It is recommended to set the external resistance to $2k\Omega$ or above in consideration of the current capacity of the VREF pin, and $20k\Omega$ or below in order to minimize the fluctuation of the set value caused by the base current of the internal transistor of the IC.

(2) Output current detection and current settings

By connecting external resistor $(0.1\Omega \text{ to } 5.0\Omega)$ to the RNF pin of the IC, the motor drive current will be converted into voltage in order to be detected. The output current is kept constant by shorting the RNF and SENSE pins and comparing the voltage with the VLIM voltage. To perform output current settings more precisely, trim the external RNF resistance if needed, and supply a precise voltage externally to the VLIM pin of the IC. In that case, open the VREF pin.

Output current value Iout[A] =
$$\frac{VLIM[V]}{RNF[\Omega]}$$
(5)

The output current is 400mA \pm 3% if 0.2V is applied to the VLIM pin and a 0.5 Ω resistor is connected externally to the RNF pin.

If the VLIM pin is shorted to the VCC pin (or the same voltage level as the VCC is applied) and the SENSE and RNF pins are shorted to the ground, this channel can be used as a Full-ON Drive H-bridge like the other four channels of BD6758KN.

5) I/O truth table (BD6758MWV / KN)

Drivo modo		INPUT		OUT	PUT	Output mode
Drive mode	SEL1	INxA	INxB	OUTxA	OUTxB	Output mode
		Н	Х	Z	Z	Standby
EN/IN	L	L	L	Н	L	CW
		L	Н	L	Н	CCW
		L	L	Z	Z	Standby
		Н	L	Н	L	CW
IIN/IIN	н	L	Н	L	Н	CCW
		Н	Н	L	L	Brake

BD6758MWV / KN Full-ON Driver ch1 and ch2 I/O Truth Table

L: Low, H: High, X: Don't care, Z: High impedance

At CW, current flows from OUTA to OUTB. At CCW, current flows from OUTB to OUTA.

Drivo modo		INF	νUT		OUT	Output mod	
Drive mode	SEL2	INxA	INxB	BRKx	OUTxA	OUTxB	Output mou
		Н	Х	Х	Z	Z	Standby
	L	L	L	L	Н	L	CW
EN/IN		L	Н	L	L	Н	CCW
		L	Х	Н	L	L	Brake
		L	L	Х	Z	Z	Standby
	Ц	Н	L	Х	Н	L	CW
IIN/IIN	Н	L	Н	Х	L	н	CCW

Х

L

Brake

Т

BD6758MWV / KN Full-ON Driver ch3 and ch4 I/O Truth Table

L: Low, H: High, X: Don't care, Z: High impedance

Н

At CW, current flows from OUTA to OUTB. At CCW, current flows from OUTB to OUTA.

Н

BD6758MWV / KN Linear Constant-Current Driver ch5 I/O Truth Table

Drive mode	INF	OUT	PUT	Output mode	
	EN1	IN5	OUT5A	OUT5B	Output mode
	Н	Х	Z	Z	Standby
EN/IN	L	L	Н	L	CW
-	L	Н	L	Н	CCW

L: Low, H: High, X: Don't care, Z: High impedance

At CW, current flows from OUTA to OUTB. At CCW, current flows from OUTB to OUTA.

•I/O Circuit Diagram



Fig.51 BD6370GUL I/O Circuit Diagram (Resistance values are typical ones)





Operation Notes

- 1) Absolute maximum ratings
 - Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. The implementation of a physical safety measure such as a fuse should be considered when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.
- 2) Storage temperature range

As long as the IC is kept within this range, there should be no problems in the IC's performance. Conversely, extreme temperature changes may result in poor IC performance, even if the changes are within the above range.

3) Power supply pins and lines

None of the VM line for the H-bridges is internally connected to the VCC power supply line, which is only for the control logic or analog circuit. Therefore, the VM and VCC lines can be driven at different voltages. Although these lines can be connected to a common power supply, do not open the power supply pin but connect it to the power supply externally.

Regenerated current may flow as a result of the motor's back electromotive force. Insert capacitors between the power supply and ground pins to serve as a route for regenerated current. Determine the capacitance in full consideration of all the characteristics of the electrolytic capacitor, because the electrolytic capacitor may loose some capacitance at low temperatures. If the connected power supply does not have sufficient current absorption capacity, regenerative current will cause the voltage on the power supply line to rise, which combined with the product and its peripheral circuitry may exceed the absolute maximum ratings. It is recommended to implement a physical safety measure such as the insertion of a voltage clamp diode between the power supply and ground pins.

For this IC with several power supplies and a part consists of the CMOS block, it is possible that rush current may flow instantaneously due to the internal powering sequence and delays, and to the unstable internal logic, respectively. Therefore, give special consideration to power coupling capacitance, width of power and ground wirings, and routing of wiring.

4) Ground pins and lines

Ensure a minimum GND pin potential in all operating conditions. Make sure that no pins are at a voltage below the GND at any time, regardless of whether it is a transient signal or not.

When using both small signal GND and large current MGND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external components, either. The power supply and ground lines must be as short and thick as possible to reduce line impedance.

5) Thermal design

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

6) Pin short and wrong direction assembly of the device

Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if positive and ground power supply terminals are reversed. The IC may also be damaged if pins are shorted together or are shorted to other circuit's power lines. Actions in strong magnetic field

Use caution when using the IC in the presence of a strong magnetic field as doing so may cause the IC to malfunction.

7)

8) ASO

When using the IC, set the output transistor for the motor so that it does not exceed absolute maximum ratings or ASO.

9) Thermal shutdown circuit

If the junction temperature (Tjmax) reaches 175°C, the TSD circuit will operate, and the coil output circuit of the motor will open. There is a temperature hysteresis of approximately 25°C (BD6373GW and BD6873KN Typ.) and 25°C (BD6753KV Typ.). The TSD circuit is designed only to shut off the IC in order to prevent runaway thermal operation. It is not designed to protect the IC or guarantee its operation. The performance of the IC's characteristics is not guaranteed and it is recommended that the device is replaced after the TSD is activated.

10) Serial data input

In the BD6370GUL, SDATA input string start with MSB first. A low level should be input to the TEST bit at all times. A high signal may cause the IC to malfunction. The serial settings are reset during standby mode operation and whenever the UVLO or TSD circuits are operating.

It is the prohibited bit of MODExx input. Don't input the prohibited bit at all times. (See the Serial Register Bit Map; p.12/32)

In the case of the resemblance drive mode (MODE13=1 and/or MODE23=1), MODE3B, MODE3A, IN3B, and IN3A bits are "don't care". Because OUT1A-OUT3A is driven by MODE12B, MODE12A, IN1B, and IN1A bits, and INPUT1 terminal control. In the same condition, MODE12B, MODE12A, IN2B, and IN2A bits, and INPUT2 terminal drive OUT2A-OUT3B. And set the serial data as DAC12 = DAC3, if not, Output high voltage is different value between OUT1A and OUT3A, and/or OUT2A and OUT3B.

In the case of Full-ON mode for ch1 to ch3, input serial data of each Constant-Voltage setting D/A Converter (DAC12 and DAC3) to be full bits high. In the ch4, as it set Constant-Voltage mode, input serial data of Constant-Current setting D/A Converter (DAC14) to be full bits high. As it set Constant-Current mode, input serial data of Constant-Voltage setting D/A Converter (DACV4) to be full bits high, while as it set Full-ON mode, input serial data of both D/A Converters to be full bits high. In the settings of Constant-Voltage or Full-ON mode, no need to connect the external resistance for output current detection in RNF4 pin.

11) Power saving terminal

Be cancelled power saving mode after turned on power supply VCC and VM, because of PS terminal combines power saving with serial reset function. If the case of power saving terminal always shorted power supply terminal, reset function may not be well, and it may cause the IC to malfunction.

12) Testing on application board

When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to, or removing it from a jig or fixture, during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting and storing the IC.

13) Application example

The application circuit is recommended for use. Make sure to confirm the adequacy of the characteristics. When using the circuit with changes to the external circuit constants, make sure to leave an adequate margin for external components including static and transitional characteristics as well as dispersion of the IC.

14) Regarding input pin of the IC

This monolithic IC contains P^* isolation and P substrate layers between adjacent elements to keep them isolated. P-N junctions are formed at the intersection of these P layers with the N layers of other elements, creating a parasitic diode or transistor. For example, the relation between each potential is as follows:

When GND > Pin A, the P-N junction operates as a parasitic diode.

When GND > Pin B, the P-N junction operates as a parasitic diode and transistor. Parasitic elements can occur inevitably in the structure of the IC. The operation of parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic elements operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.





VCSP50L2



UQFN036V5050



VQFN36



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