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**SANYO Semiconductors**
**DATA SHEET**

An ON Semiconductor Company

# LV8415CB

Bi-CMOS integrated circuit  
**Blurring correction driver IC for DSC**  
**H bridge × 2ch driver**

## Overview

LV8415CB is blurring correction driver IC for DSC.

## Functions

- Actuator driver (saturation drive H bridge) × 2ch
- Constant current hall bias circuit × 2ch
- With built-in for PWM signal generation logic circuit × 2ch
- 8bitDAC for hall amplifier offset adjustment × 2ch
- Two systems in power supply ( $V_M$ : for actuator,  $V_{CC}$ )
- With built-in low voltage malfunction prevention circuit
- Hall Amplifier × 2ch
- General-purpose amplifier × 2ch
- 8bitDAC for hall bias × 2ch
- Three line serial input
- With built-in thermal protection circuit

## Specifications

**Maximum Ratings** at  $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	$V_M$ max		6	V
Supply voltage 2	$V_{CC}$ max		6	V
Output peak current	$I_O$ peak	OUT1 to 2 ( $t \leq 10\text{msec}$ , duty $\leq 20\%$ )	600	mA
Output current	$I_O$ max	OUT1 to 2	350	mA
Hall bias current	$I_{HB}$ max		5	mA
Allowable power dissipation	$P_d$ max	On a specified board *	1	W
Operating temperature	$T_{opr}$		-20 to +85	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-55 to +150	$^\circ\text{C}$

\* Specified board: 40.0mm×50.0mm×0.8mm, Four layers fiberglass epoxy circuit board.

**Allowable Operating Ratings** at  $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage range 1	$V_M$		2.7 to 5.5	V
Supply voltage range 2	$V_{CC}$		2.7 to 5.5	V
Logic input voltage	$V_{IN}$		0 to $V_{CC}+0.3$	V

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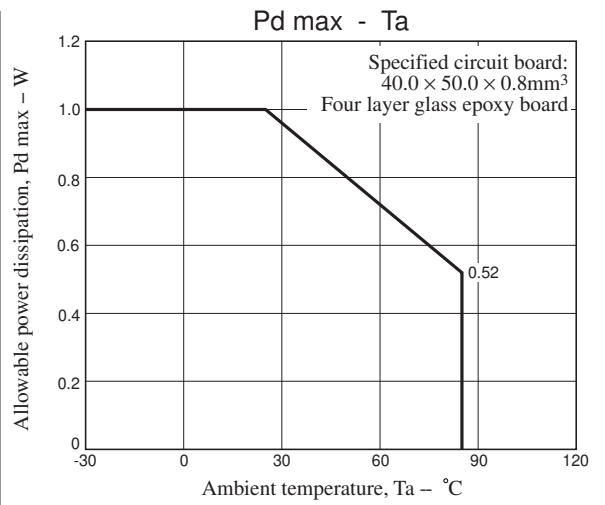
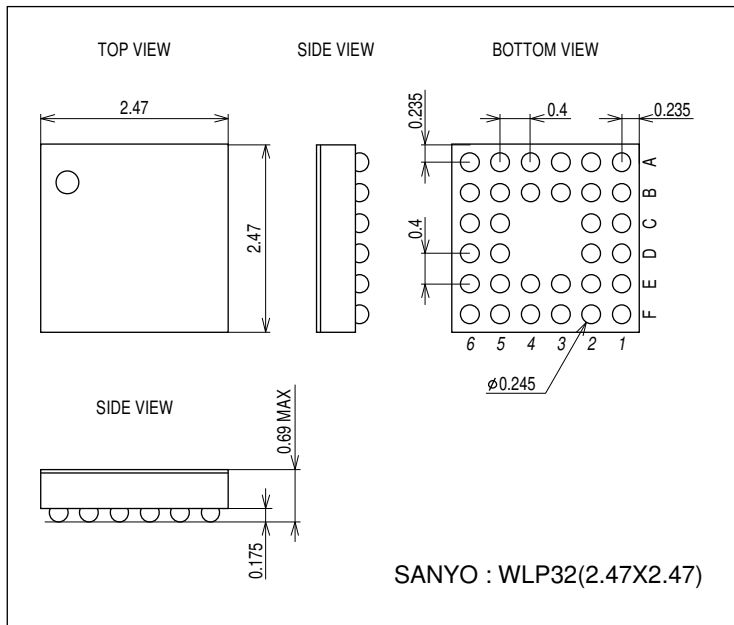
**Electrical Characteristics** at Ta = 25°C, VCC = 3.3V, VM = 5.0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current consumption when standing by	I <sub>CCO</sub>	ST = "L"			1.0	μA
VM current consumption	I <sub>M</sub>	V <sub>M</sub> = 5.0V, ST = "H", no load			10	μA
V <sub>CC</sub> current consumption	I <sub>CC</sub>	ST = "H", no load		2	3.2	mA
V <sub>CC</sub> low voltage cutting voltage	V <sub>THVCC</sub>		2.1	2.4	2.6	V
Low voltage hysteresis voltage	V <sub>THHYS</sub>		100	150	200	mV
Thermal shutdown temperature	TSD	Design guarantee	155	175	195	°C
Thermal hysteresis width	ΔTSD	Design guarantee	15	35	55	°C
<b>H bridge output (OUT1-2)</b>						
Output on resistance	R <sub>onU</sub>	I <sub>O</sub> = 100mA, Upper-side on resistance		0.7	0.98	Ω
	R <sub>onD</sub>	I <sub>O</sub> = 100mA, Under-side on resistance		0.5	0.7	Ω
Output leakage current	I <sub>O leak</sub>				1	μA
Diode forward voltage	V <sub>D</sub>	I <sub>D</sub> = -100mA		0.7		V
<b>Operational amplifier (OP-AMP1-4)</b>						
Input offset voltage	OP_VIO			±1	±5	mV
Input offset current	OP_IIO			±5	±50	nA
Input bias current	OP_IB			30	250	nA
Equal phase input voltage range	VICM		0		V <sub>CC</sub>	V
Equal phase signal removal ratio	CMR		60	80		dB
Large amplitude voltage range	VG	R <sub>L</sub> = 20kΩ, V <sub>IN</sub> = 1mV(open loop gain)	1	10		V/mV
Output voltage range	V <sub>OH</sub>	R <sub>L</sub> = 20kΩ	V <sub>CC</sub> -0.2			V
	V <sub>OL</sub>	R <sub>L</sub> = 20kΩ			0.2	V
Power supply change removal ratio	SVR		65	85		dB
Output current (sink/source)	OP_IO		1	2		mA
<b>Hall bias (HB1-2)</b>						
Output current	I <sub>HB</sub>	R <sub>HG</sub> = 1kΩ, V <sub>HBIN</sub> = 1.0V	0.95	1.00	1.05	mA
Output saturation voltage	V <sub>SATHB</sub>	I <sub>HB</sub> = 1mA	V <sub>CC</sub> -0.2			V
<b>Standard voltage</b>						
Standard voltage	V <sub>REF</sub>		1.60	1.65	1.70	V
Standard voltage load characteristic	V <sub>Rref</sub>	I <sub>REF</sub> = 100μA	1.60	1.65	1.70	V
<b>Internal CLK frequency for PWM drive</b>						
CLK frequency	F <sub>clk</sub>		13.5	15	17.25	MHz
<b>Control pin (ST, SCLK, DATA, STB)</b>						
Built-in pull-down resistance	R <sub>in</sub>		50	100	200	kΩ
Input current	I <sub>INL</sub>	V <sub>IN</sub> = 0V			1.0	μA
	I <sub>INH</sub>	V <sub>IN</sub> = 3.3V	20	33	50	μA
Input "L" level voltage	V <sub>INL</sub>				1.0	V
Input "H" level voltage	V <sub>INH</sub>		2.5			V

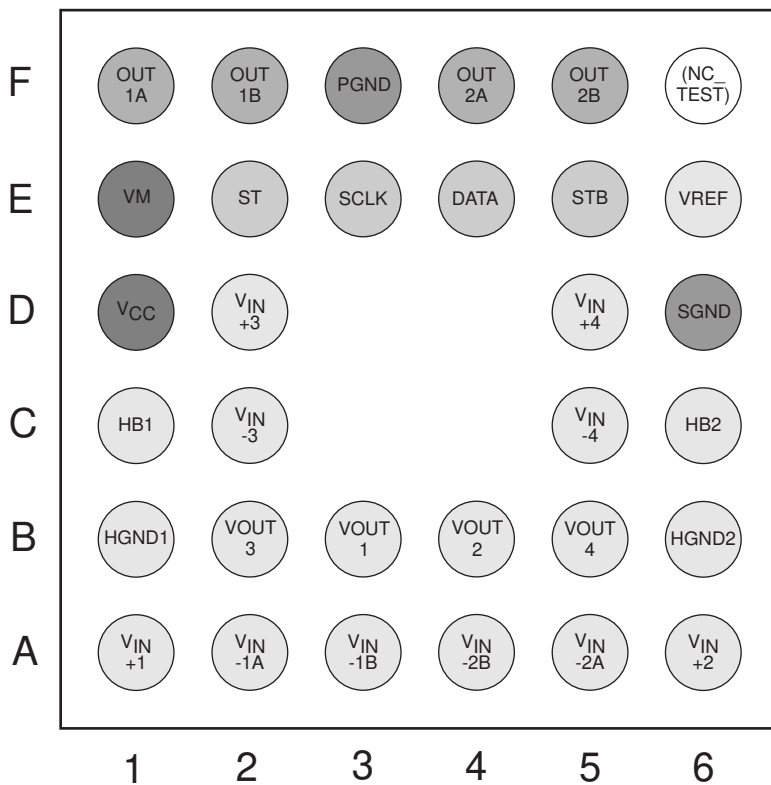
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## Package Dimensions

unit : mm (typ)  
3397



## Pin Assignment



(NC\_TEST) is pin only for the test. Please NC\_TEST pin connect GND line.

- Power supply pin
- GND pin
- Output pin
- Logic control pin
- Analog control pin

Ball side view

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## Pin function

Pin No.	Pin name	Pin function	Equivalent Circuit
E2 E3 E4 E5	ST SCLK DATA STB	Input pin. High level 2V to ( $V_{CC} = 3.3V$ ) Low level 0 to 0.5V ( $V_{CC} = 3.3V$ )	
F1 F2 F4 F5 E1 F3	OUT1A OUT1B OUT2A OUT2B VM PGND	Output pin. (PWM output) VM : POWER – Power supply pin. PGND : POWER – GND pin.	
D1 D6	$V_{CC}$ SGND	Signal system power supply pin Signal system GND pin	
C1 B1 C6 B6	HB1 HGND1 HB2 HGND2	HB1, 2 pin Hall bias source pin HGND1, 2 pin Hall bias current setting pin	
A1 A2 A3 A6 A5 A4	$V_{IN+1}$ $V_{IN-1A}$ $V_{IN-1B}$ $V_{IN+2}$ $V_{IN-2A}$ $V_{IN-2B}$	Hall amplifier input pin $V_{IN+}$ Hall amplifier+ input pin $V_{IN-A}$ Hall amplifier- input pin $V_{IN-B}$ LPF formation pin (The filter is formed for the noise removal.)	
B3 B4	VOUT1 VOUT2	Hall amplifier output pin. VOUT1 : Hall amplifier 1ch output pin. VOUT2 : Hall amplifier 2ch output pin.	

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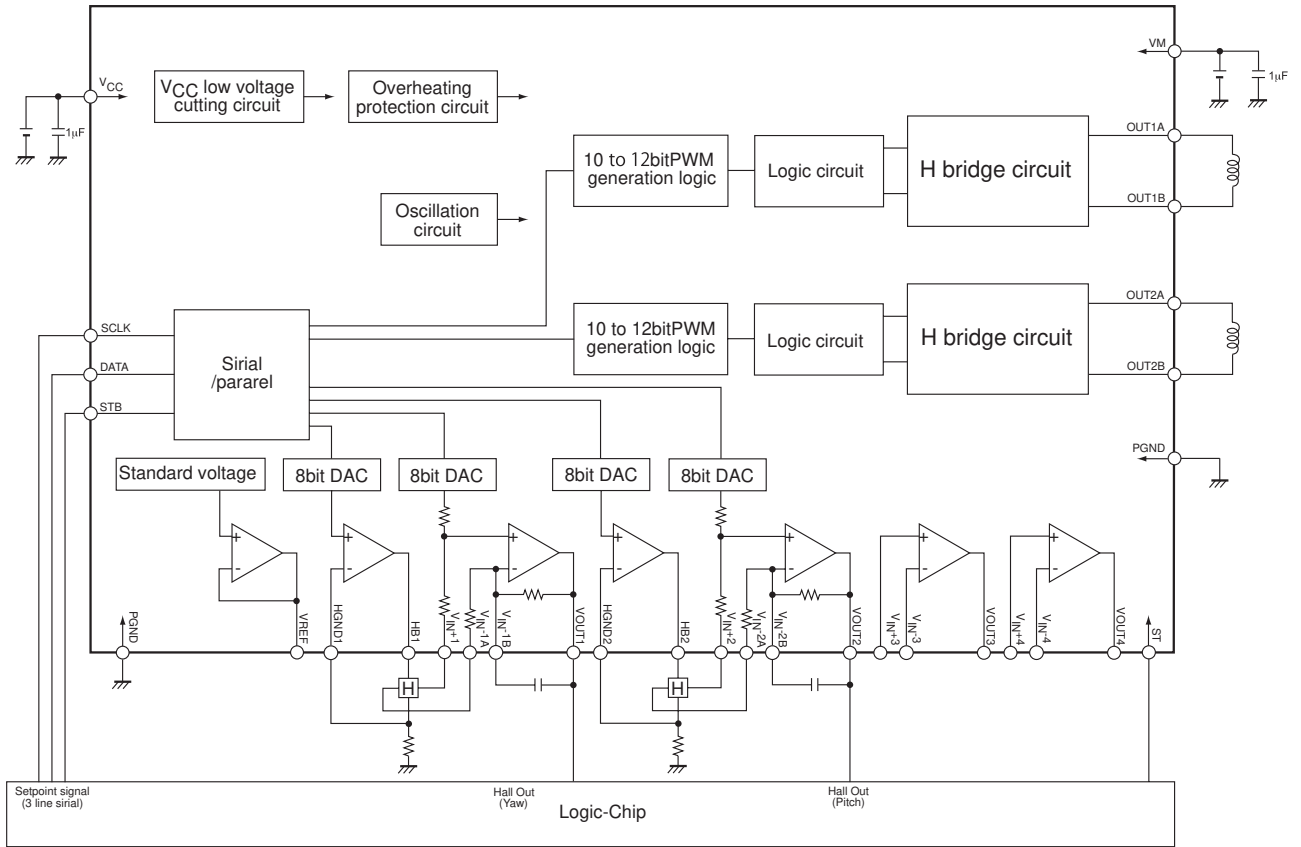
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Pin No.	Pin name	Pin function	Equivalent Circuit
D2 C2 D5 C5	$V_{IN+3}$ $V_{IN-3}$ $V_{IN+4}$ $V_{IN-4}$	General purpose amplifier input pin. $V_{IN+3}$ : 3ch general purpose amplifier+ input pin $V_{IN-3}$ : 3ch general purpose amplifier- input pin $V_{IN+4}$ : 4ch general purpose amplifier+ input pin $V_{IN-4}$ : 4ch general purpose amplifier- input pin	
B2 B5	$V_{OUT3}$ $V_{OUT4}$	General purpose amplifier output pin. $V_{OUT3}$ : 3ch general purpose amplifier output pin $V_{OUT4}$ : 4ch general purpose amplifier output pin	
E6	VREF	Internal standard voltage pin $V_{CC}/2$ output	
F6	NC-TEST	N.C. pin TEST pin Please NC_TEST pin connect GND line.	

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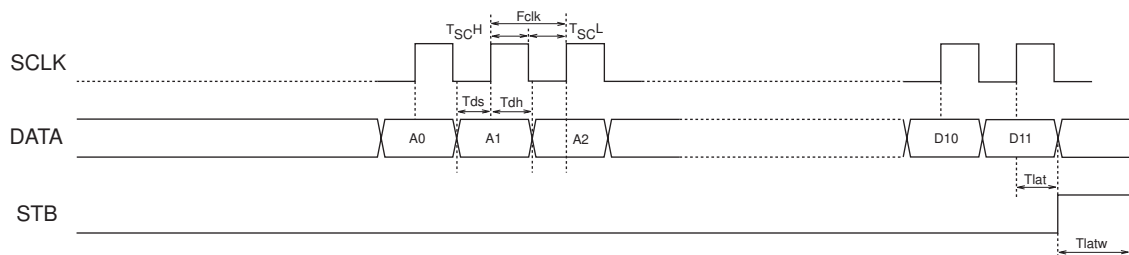
## Block Diagram



# LV8415CB

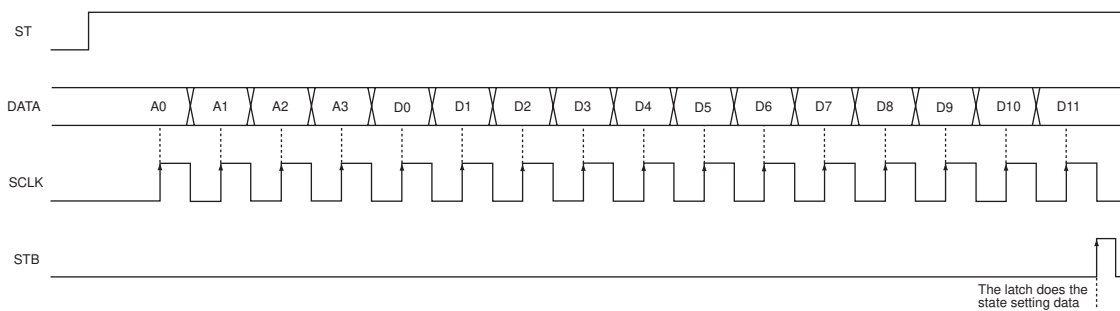
## 3 line serial communication electrical Characteristics at $T_a = 25^\circ\text{C}$ , $V_{CC} = 3.3\text{V}$ , $V_M = 5.0\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Serial data forwarding pin						
Logic pin input current	$I_{INL}$	$V_{IN}=0\text{V}(\text{SCLK, DATA, STB})$			1.0	$\mu\text{A}$
	$I_{INH}$	$V_{IN}=3.3\text{V}(\text{SCLK, DATA, STB})$		33	50	V
Input "H" level voltage	$V_{INH}$	SCLK, DATA, STB	2.5			V
Input "L" level voltage	$V_{INL}$	SCLK, DATA, STB			1.0	$\mu\text{s}$
Minimum SCLK "H" pulse width	$T_{SCH}$		0.1			$\mu\text{s}$
Minimum SCLK "L" pulse width	$T_{SCL}$		0.1			$\mu\text{s}$
STB regulation time	$T_{lat}$		0.1			$\mu\text{s}$
Minimum STB pulse width	$T_{latw}$		0.1			$\mu\text{s}$
Data set-up time	$T_{ds}$		0.1			$\mu\text{s}$
Data hold time	$T_{dh}$		0.1			$\mu\text{s}$
maximum CLK frequency	$F_{clk}$				4	MHz



### Serial data timing condition

#### Serial data input timing chart



It inputs it from A0 in order of D11. The data transfer is done by the rising edge, and after all data transfers, the latch does all data to SCLK by the STB signal standing up. The STB signal accepts and the internal logic of IC doesn't accept the SCLK signal during "H".



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## Serial logic map

### PWMh - bridge relation serial map

				Input												Setting mode	Set content	Remarks				
A0	A1	A2	A3	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11							
0	0	0	0	*	*	0	0	0	0	0	0	0	0	0	0	0	1ch PWM Duty set	100%	Reverse			
				*	*	1	0	0	0	0	0	0	0	0	0	0		0		$511/512 \times 100\%$		
				*	*	0	1	0	0	0	0	0	0	0	0	0		0		$510/512 \times 100\%$		
																					...	
				*	*	0	1	1	1	1	1	1	1	1	1	1		1		0	$2/512 \times 100\%$	
				*	*	1	1	1	1	1	1	1	1	1	1	1		1		0	$1/512 \times 100\%$	
				*	*	0	0	0	0	0	0	0	0	0	0	0		0		1	0%	Middle point
				*	*	1	0	0	0	0	0	0	0	0	0	0		0		1	$1/512 \times 100\%$	Normal rotation
				*	*	0	1	0	0	0	0	0	0	0	0	0		0		1	$2/512 \times 100\%$	
																					...	
				*	*	1	0	1	1	1	1	1	1	1	1	1		1		1	$509/512 \times 100\%$	
				*	*	0	1	1	1	1	1	1	1	1	1	1		1		1	$510/512 \times 100\%$	
*	*	1	1	1	1	1	1	1	1	1	1	1	1	1	$511/512 \times 100\%$							
1	0	0	0	*	*	0	0	0	0	0	0	0	0	0	0	2ch PWM Duty set	100%	Reverse				
				*	*	1	0	0	0	0	0	0	0	0	0		0		$511/512 \times 100\%$			
				*	*	0	1	0	0	0	0	0	0	0	0		0		$510/512 \times 100\%$			
																				...		
				*	*	0	1	1	1	1	1	1	1	1	1		1		0	$2/512 \times 100\%$		
				*	*	1	1	1	1	1	1	1	1	1	1		1		0	$1/512 \times 100\%$		
				*	*	0	0	0	0	0	0	0	0	0	0		0		1	0%	Middle point	
				*	*	1	0	0	0	0	0	0	0	0	0		0		1	$1/512 \times 100\%$	Normal rotation	
				*	*	0	1	0	0	0	0	0	0	0	0		0		1	$2/512 \times 100\%$		
																				...		
				*	*	1	0	1	1	1	1	1	1	1	1		1		1	$509/512 \times 100\%$		
				*	*	0	1	1	1	1	1	1	1	1	1		1		1	$510/512 \times 100\%$		
*	*	1	1	1	1	1	1	1	1	1	1	1	1	$511/512 \times 100\%$								
0	1	0	0	0	0	0	0	0	0	0	0	0	*	*	*	*	1ch hall bias set (8bit DAC)	0V				
				1	0	0	0	0	0	0	0	0	*	*	*	*		$1/255 \times VREF$				
				0	1	0	0	0	0	0	0	0	*	*	*	*		$2/255 \times VREF$				
														*	*	*		*		...		
				1	0	1	1	1	1	1	1	1	*	*	*	*		$253/255 \times VREF$				
				0	1	1	1	1	1	1	1	1	*	*	*	*		$254/255 \times VREF$				
				1	1	1	1	1	1	1	1	1	*	*	*	*		VREF				
1	1	0	0	0	0	0	0	0	0	0	0	*	*	*	*	2ch hall bias set (8bit DAC)	0V					
				1	0	0	0	0	0	0	0	*	*	*	*		$1/255 \times VREF$					
				0	1	0	0	0	0	0	0	0	*	*	*		*		$2/255 \times VREF$			
														*	*		*		*	...		
				1	0	1	1	1	1	1	1	1	*	*	*		*		$253/255 \times VREF$			
				0	1	1	1	1	1	1	1	1	*	*	*		*		$254/255 \times VREF$			
				1	1	1	1	1	1	1	1	1	*	*	*		*		VREF			
0	0	1	0	0	0	0	0	0	0	0	0	*	*	*	*	1ch hall amplifier offset adjustment (8bit DAC)	0V					
				1	0	0	0	0	0	0	0	*	*	*	*		$1/255 \times V_{CC}$					
				0	1	0	0	0	0	0	0	0	*	*	*		*		$2/255 \times V_{CC}$			
														*	*		*		*	...		
				1	0	1	1	1	1	1	1	1	*	*	*		*		$253/255 \times V_{CC}$			
				0	1	1	1	1	1	1	1	1	*	*	*		*		$254/255 \times V_{CC}$			
1	0	1	0	0	0	0	0	0	0	0	0	*	*	*	*	2ch hall amplifier offset adjustment (8bit DAC)	0V					
				1	0	0	0	0	0	0	0	*	*	*	*		$1/255 \times V_{CC}$					
				0	1	0	0	0	0	0	0	0	*	*	*		*		$2/255 \times V_{CC}$			
														*	*		*		*	...		
				1	0	1	1	1	1	1	1	1	*	*	*		*		$253/255 \times V_{CC}$			
				0	1	1	1	1	1	1	1	1	*	*	*		*		$254/255 \times V_{CC}$			
											*	*	*	*	V <sub>CC</sub>							

The PWMh-bridge driver's ON/OFF operation is done with the ST pin.

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Hall amplifier gain setting range

Hall amplifier relation serial map

Input								Setting mode	Hall amplifier magnification (Inside: Resistance)
A0	A1	A2	A3	D0	D1	D2	D3		
0	0	0	1	0	0	0	0	1ch hall amplifier gain setting (“3” Resistance ÷ “2” Resistance)	10 (36k//3.6k)
				1	0	0	0		20 (72k//3.6k)
				0	1	0	0		40 (144k//3.6k)
				1	1	0	0		50 (180k//3.6k)
				0	0	1	0		60 (216k//3.6k)
				1	0	1	0		70 (252k//3.6k)
				0	1	1	0		90 (324k//3.6k)
				1	1	1	0		100 (360k//3.6k)
				0	0	0	1		110 (396k//3.6k)
				1	0	0	1		120 (432k//3.6K)
				0	1	0	1		140 (504k//3.6k)
				1	1	0	1		150 (540k//3.6k)
				0	0	1	1		160 (570k//3.6k)
				1	0	1	1		170 (612k//3.6k)
				0	1	1	1		190 (684k//3.6k)
				1	1	1	1		200 (720k//3.6k)
1	0	0	1	0	0	0	0	2ch hall amplifier gain setting (“3” Resistance ÷ “2” Resistance)	10 (36k//3.6k)
				1	0	0	0		20 (72k//3.6k)
				0	1	0	0		40 (144k//3.6k)
				1	1	0	0		50 (180k//3.6k)
				0	0	1	0		60 (216k//3.6k)
				1	0	1	0		70 (252k//3.6k)
				0	1	1	0		90 (324k//3.6k)
				1	1	1	0		100 (360k//3.6k)
				0	0	0	1		110 (396k//3.6k)
				1	0	0	1		120 (432k//3.6K)
				0	1	0	1		140 (504k//3.6k)
				1	1	0	1		150 (540k//3.6k)
				0	0	1	1		160 (570k//3.6k)
				1	0	1	1		170 (612k//3.6k)
				0	1	1	1		190 (684k//3.6k)
				1	1	1	1		200 (720k//3.6k)
0	1	0	1	0	0	0	0	1ch hall amplifier offset resistance / input resistance (“1” Resistance ÷ “2” Resistance)	10 (36k//3.6k)
				1	0	0	0		20 (72k//3.6k)
				0	1	0	0		40 (144k//3.6k)
				1	1	0	0		50 (180k//3.6k)
				0	0	1	0		60 (216k//3.6k)
				1	0	1	0		70 (252k//3.6k)
				0	1	1	0		90 (324k//3.6k)
				1	1	1	0		100 (360k//3.6k)
				0	0	0	1		110 (396k//3.6k)
				1	0	0	1		120 (432k//3.6K)
				0	1	0	1		140 (504k//3.6k)
				1	1	0	1		150 (540k//3.6k)
				0	0	1	1		160 (570k//3.6k)
				1	0	1	1		170 (612k//3.6k)
				0	1	1	1		190 (684k//3.6k)
				1	1	1	1		200 (720k//3.6k)
1	1	0	1	0	0	0	0	2ch hall amplifier offset resistance / input resistance (“1” Resistance ÷ “2” Resistance)	10 (36k//3.6k)
				1	0	0	0		20 (72k//3.6k)
				0	1	0	0		40 (144k//3.6k)
				1	1	0	0		50 (180k//3.6k)
				0	0	1	0		60 (216k//3.6k)
				1	0	1	0		70 (252k//3.6k)
				0	1	1	0		90 (324k//3.6k)
				1	1	1	0		100 (360k//3.6k)
				0	0	0	1		110 (396k//3.6k)
				1	0	0	1		120 (432k//3.6K)
				0	1	0	1		140 (504k//3.6k)
				1	1	0	1		150 (540k//3.6k)
				0	0	1	1		160 (570k//3.6k)
				1	0	1	1		170 (612k//3.6k)
				0	1	1	1		190 (684k//3.6k)
				1	1	1	1		200 (720k//3.6k)

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## General-purpose amplifier ON/OFF setting

Input						Setting mode	Set content	Remarks
A0	A1	A2	A3	D0	D1			
0	0	1	1	0	*	General-purpose amplifier 1	Stand-by	
				1	*		Operate	
				*	0	General-purpose amplifier 2	Stand-by	
				*	1		Operate	

## PWM circuit accuracy setting

Input						Setting mode	Set content	Remarks
A0	A1	A2	A3	D0	D1			
1	0	1	1	0	0	PWM accuracy setting	10bit resolution	Initial value
				0	1		11bit resolution	
				1	0		12bit resolution	
				*	*		-	

## PWM pulse width of moving

### 1ch (X axis side)

Input [3:0]								Setting mode	Moving pulse number
A0	A1	A2	A3	D0	D1	D2	D3		
0	1	1	1	0	0	0	0	1ch (X axis) side width of moving	0 (Initialization)
				1	0	0	0		1
				0	1	0	0		2
				1	1	0	0		3
				0	0	1	0		4
				1	0	1	0		5
				0	1	1	0		6
				1	1	1	0		7
				0	0	0	1		8
				1	0	0	1		9
				0	1	0	1		10
				1	1	0	1		11
				0	0	1	1		12
				1	0	1	1		13
				0	1	1	1		14
1	1	1	1	15					

Note : 1 pulse = 1CLK

### 2ch (Y axis side)

Input [7:4]								Setting mode	Moving pulse number
A0	A1	A2	A3	D4	D5	D6	D7		
0	1	1	1	0	0	0	0	2ch (Y axis) side width of moving	0 (Initialization)
				1	0	0	0		1
				0	1	0	0		2
				1	1	0	0		3
				0	0	1	0		4
				1	0	1	0		5
				0	1	1	0		6
				1	1	1	0		7
				0	0	0	1		8
				1	0	0	1		9
				0	1	0	1		10
				1	1	0	1		11
				0	0	1	1		12
				1	0	1	1		13
				0	1	1	1		14
1	1	1	1	15					

Note : 1 pulse = 1CLK

The ON/OFF operation of the hall amplifier and the hall bias is done with the ST pin.

Note : An initial value of A0 to A3 = 1111 is a static test mode. Use it specifying data D0 for one.

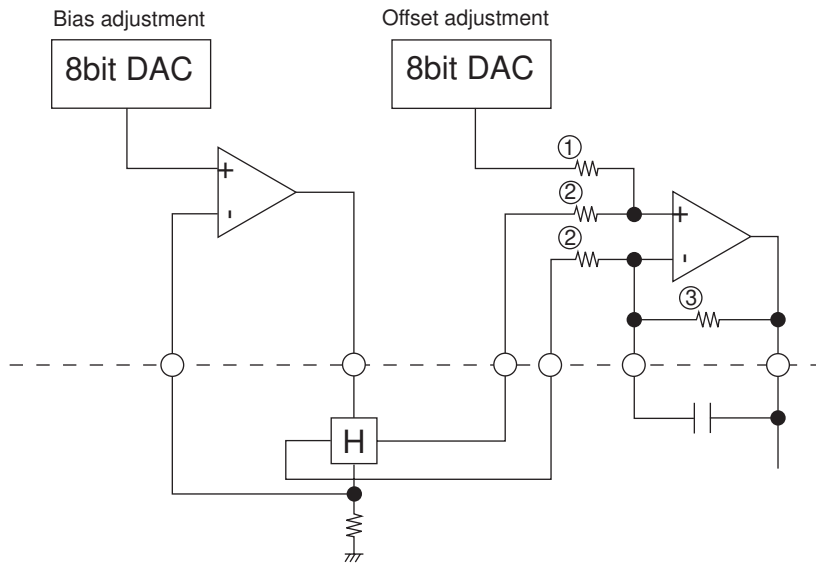
## TEST mode setting

Input					Setting mode	Content	Remarks
A0	A1	A2	A3	D0			
1	1	1	1	0	NC pin _ TEST mode	External CLK	It uses it by the shipment inspection.
				1		Internal CLK	

Note : External CLK mode is for the shipment inspection. Use it with internal CLK. Use it after it internal CLK switches because default is external CLK mode.

## LV8415CB

### Hall bias, Offset adjustment circuit configuration



Hall amplifier, Hall bias equivalent circuit

#### About the gain adjustment

The resistance ratio of “2” and “3” is adjusted in figure and the gain is set. Refer to the setting to the cereal map. The magnification can be set from ten by 200.

#### About the Offset adjustment

The resistance ratio of “1” and “2” is adjusted in figure and the Offset is set. Refer to the setting to the cereal map. The magnification can be set from ten by 200.

## Note in design

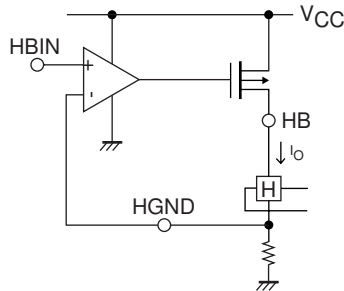
- Stand-by function

IC becomes a stand-by state at ST = "L", and IC enters the state of operation at ST = "H". Moreover, the register in IC is reset as for ST = "L" at times.

- Hall bias

The constant current output is built into for the hall element drive. The constant current value is set from detection resistance (RHG) connected from the HBIN pin impression voltage and the HGND pin between GND.

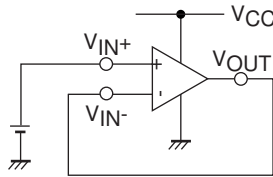
Constant current value ( $I_O$ ) = HBIN voltage ÷ Detection resistance



Constant current value ( $I_O$ ) becomes about 1mA when assuming HBIN pin impressed voltage = 1.0V and detection resistance = 1 k $\Omega$  from the above-mentioned calculation type. Moreover, the HGND pin must connect with the HB pin, and connect the detection resistance of a large value as much as possible when you do not use the hall bias circuit.

- Operation amplifier

Impress the bias to the  $V_{IN+}$  pin, and compose the buffer by the connection to the  $V_{OUT}$  pin in the  $V_{IN-}$  pin in the operational amplifier not used.



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