SC8919H

Motor Driver IC for camcorder and security-camera

FEATURES

- Voltage drive system 256-step microstep drivers
  (2 system)
  (Super low noise Zoom or Focus driver)
  (0.50-A Maximum drive current per H-bridge)
- Motor control by 4-line serial data communication
- Built-in dc motor driver
  (0.50-A Maximum drive current)
- PCB space saving.
- 2 systems of open-drain for driving LED
- 44 pin Plastic Quad Flat Non-leaded Package
  (QFN Type with thermal pad)

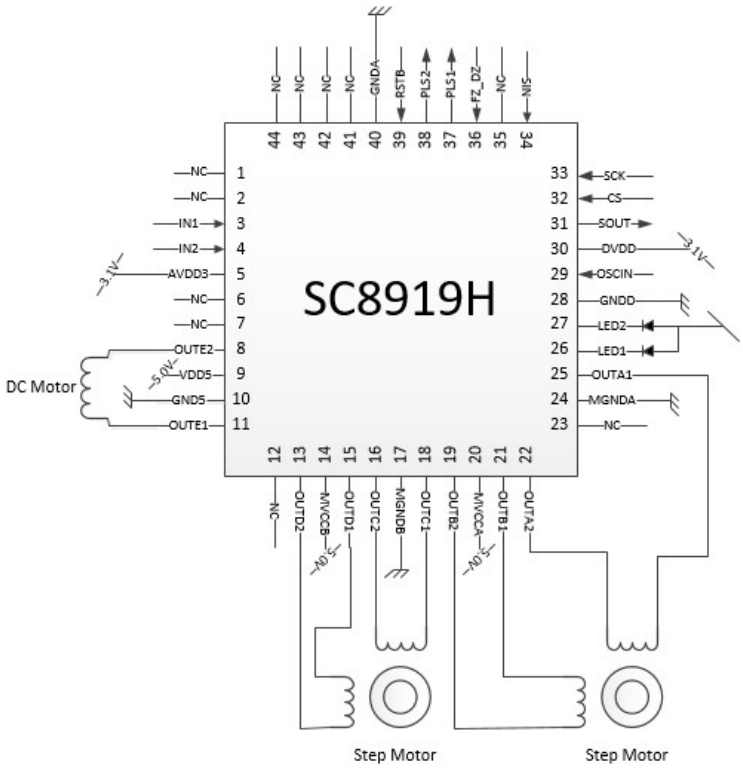
DESCRIPTION

SC8919H is a lens motor driver IC for camcorder and security-camera featuring the functions of IR-cut control. Voltage drive system and several torque ripple correction techniques enable super- low noise microstep drive.

APPLICATIONS

- Camcorder
- Security-camera
- Robot
- Precision industrial equipment

SIMPLIFIED APPLICATION



Notes):
This application circuit is an example. The operation of mass production set is not guaranteed. You should perform enough evaluation and verification on the design of mass production set. You are fully responsible for the incorporation of the above application circuit and information in the design of your equipment.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Typ	Max	Unit	Note
AVDD3 DVDD	Controller supply voltage	-0.3		4.0	V	*1
MVCCA MVCCB	Supply voltage for motor controller 1	-0.3		5.5	V	*1
VDD5	Supply voltage for motor controller 2	-0.3		5.5	V	*1
Topr	Operating ambient temperature	-20		85	℃	*2, *4
Tj	Operating junction temperature	-20		125	℃	*2
Tstg	Storage temperature	-55		125	℃	*2
OUTA1, OUTA2 OUTB1, OUTB2 OUTC1, OUTC2 OUTD1, OUTD2	Motor driver 1 (focus, zoom) H bridge drive current (DC current)	-0.5		+0.5	A/ch	
OUTE1, OUTE2	Motor driver 2 (ir-cut) H bridge drive current (DC current)	-0.5		+0.5	A/ch	
IM(pulse)	Instantaneous H bridge drive current	-0.6		+0.6	A/ch	
Itotal(max)		-0.8		+0.8	A	
OSCIN CS, SCK, SIN VD_FZ, RSTB	Input Voltage Range	-0.3		DVDD3 +0.3	V	*3
PLS1, PLS2, SOUT	Output Voltage Range	-0.3		DVDD3 +0.3	V	*3
LED1, LED2	Output Current Range		30		mA	

Notes):

This product may sustain permanent damage if subjected to conditions higher than the above stated absolute maximum rating. This rating is the maximum rating and device operating at this range is not guaranteeable as it is higher than our stated recommended operating range.

When subjected under the absolute maximum rating for a long time, the reliability of the product may be affected.

*1:The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

*2:Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for Ta = 25°C.

*3: (DVDD + 0.3) V must not be exceeded 4.0 V and (AVDD + 0.3) V must not be exceeded 4.0 V.

*4:The power dissipation shown is the value at Ta = 85°C for the independent (unmounted) IC package without a heat sink.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit	Note
MVCCB MVCCA VDD5	Supply voltage range	3.0	4.8	5.5	V	*1
DVDD AVDD3		2.7	3.1	3.6	V	*1
VOSCIN VCS VSCK VSIN VVD_FZ VRSTB	Input Voltage Range	-0.3		DVDD+0.3	V	*2
VPLS2 VPLS1 VSOUT	Output Voltage Range	-0.3		DVDD+0.3	V	*2
IOUTE2 IOUTE1	Output Current Range	-0.50		+0.50	A	*1
IOUTD2 IOUTD1 IOUTC2 IOUTC1 IOUTB2 IOUTB1 IOUTA2 IOUTA1		-0.50		+0.50	A	*1
Ta^{opr}	Operating ambient temperature	-40		100	℃	

Note):

*1 : The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

*2 : (DVDD + 0.3) V must not be exceeded 4.0 V.

ELECRTRICAL CHARACTERISTICS

VDD5 = MVCCB = 4.8 V, DVDD = 3.1 V T_a = 25℃±2℃

Symbol	Parameter	Condition	Limits			Unit
			Min	Typ	Max	
Current circuit, Common circuit						
$I_{Omdisable}$	MVCC supply current on Reset	No load, no 27 MHz input		0	3.0	μA
$I_{menable}$	MVCC supply current on Enable	Output open		0.5	1.5	mA
$I_{cc3reset}$	3V supply current on Reset	No 27 MHz input		0	10.0	μA
$I_{cc3enable}$	3V supply current on Enable	Output open		3.6	20.0	mA
$I_{cc5reset}$	VDD5 supply current on Reset	No 27 MHz input		0	3.0	μA
$I_{cc5enable}$	VDD5 supply current on Enable	Output open		0.3	1.0	mA
$I_{ccstandby}$	Supply current on Standby	RSTB = High, output open, 27 MHz input, Total current		5.0	10.0	mA
I_{ccps}	Supply current when FZ is Enable	RSTB=High, output open, 27MHz input, FZ=Enable, Total current		6.0	12.0	mA
Digital input / output						
$V_{in(H)}$	High-level input	RSTB	0.48x DVDD		DVDD+ 0.3	V
$V_{in(L)}$	Low-level input	RSTB	-0.3		0.2x DVDD	V
$V_{out(H):SDATA}$	SOUT High-level output	[SOUT] 1mA source	DVDD- 0.5			V
$V_{out(L):SDATA}$	SOUT Low-level output	[SOUT] 1mA Sink			0.5	V
$V_{out(H):MUX}$	PLS1 to 2 High-level output		0.9*VDD			V
$V_{out(L):MUX}$	PLS1 to 2 Low-level output				0.1*VDD	V
$R_{pullret}$	Input pull-down resistance	RSTB	50	100	200	KΩ
Motor driver 1 (focus, zoom)						
R_{onFZ}	H bridge ON resistance	IM=100mA	0.6	0.8	1.4	Ω
I_{leakFZ}	H bridge leak current				0.8	μA
LED driver						
R_{onLED}	Output ON resistance	I=20mA, 5V cell		15	20	Ω
I_{leakIR}	Output leak current				0.8	μA
Motor driver 2 (ir-cut) VDD5 = 5 V, RL = 20 Ω, TA = 25°C, unless otherwise noted						
R_{oncut}	H bridge ON resistance	IM=300mA		2.0	2.5	Ω
$I_{leakcut}$	H bridge leak current				0.8	μA
t_r	Rise time		30		188	ns
t_f	Fall time		30		188	ns
t_d	Delay time from SPI in to OUTE on			25* T_{SCK}		s

ELECRTRICAL CHARACTERISTICS (continued)

VDD5 = MVCCB = 4.8 V, DVDD = 3.1 V T_a = 25℃±2℃

Symbol	Parameter	Condition	Limits			Unit	Note
			Min	Typ	Max		
Serial port input							
Sclock	Serial clock		1		5	MHz	*1
T1	SCK low time		100			ns	*1
T2	SCK high time		100			ns	*1
T3	CS setup time		60			ns	*1
T4	CS hold time		60			ns	*1
T5	CS disable high time		100			ns	*1
T6	SIN setup time		50			ns	*1
T7	SIN hold time		50			ns	*1
T8	SOUT delay time				60	ns	*1
T9	SOUT hold time		60			ns	*1
T10	SOUT Enable-Hi-Z time				60	ns	*1
T11	SOUT Hi-Z-Enable time				60	ns	*1
Tsc	SOUT C load				40	pF	*1
Digital input / output							
V_{INH}	High-level input threshold voltage	SCK, SIN, CS, VD_FZ		1.6		V	*1
V_{INL}	Low-level input threshold voltage	SCK, SIN, CS, VD_FZ		1.02		V	*1
V_{OSC}	OSCIN DC voltage	OSCIN floating		1.3		V	*1
V_{OSCDC}	OSCIN DC input coupling voltage		1.4			V	*1
V_{OSCAC}	OSCIN AC input coupling voltage	C_{COUP} =0.1μF	1.3			V	*1
T_{rst}	RSTB signal pulse width		100			μs	*1
V_{hysin}	Input hysteresis width	SCK, SIN, CS, VD_FZ		0.34		V	*1
VD_W	Video sync. signal width		80			μs	*1
$T_{(VD-CS)}$	CS signal wait time 1		400			ns	*1
$T_{(CS-DT1)}$	CS signal wait time 2		5			μs	*1

Note):

*1 Typical Value checked by design.

ELECRTRICAL CHARACTERISTICS (continued)

VDD5 = MVCCB = 4.8 V, DVDD = 3.1 V T_a = 25℃±2℃

Symbol	Parameter	Condition	Limits			Unit	Note
			Min	Typ	Max		
Pulse generator							
$PL1_{wait}$	Pulse start resolution for pulse 1	OSCIN = 27MHz		20.1		μs	*1
$PL1_{width}$	Pulse resolution for pulse 1	OSCIN = 27MHz		1.20		μs	*1
$PL2_{wait}$	Pulse start resolution for pulse 2	OSCIN = 27MHz		20.1		μs	*1
Thermal Shutdown							
T_{tsd}	Thermal shutdown operation temperature	Die temperature TJ		145		℃	*1
ΔT_{TSD}	Thermal shutdown hysteresis width			35		℃	*1
Supply voltage monitor circuit							
V_{rston}	3.3 V Reset operation			2.48		V	*1
V_{rsthys}	3.3 V Reset hysteresis			0.20		V	*1
$V_{rstFZon}$	MVCCB Reset operation			2.42		V	*1
$V_{rstFZhys}$	MVCCB Reset hysteresis			0.21		V	*1
$V_{rstlSon}$	VDD5 Reset operation			2.42		V	*1
$V_{rstlShys}$	VDD5 Reset hysteresis			0.21		V	*1

Note) :
*1 Typical Value checked by design.

PIN CONFIGURATION

Top View

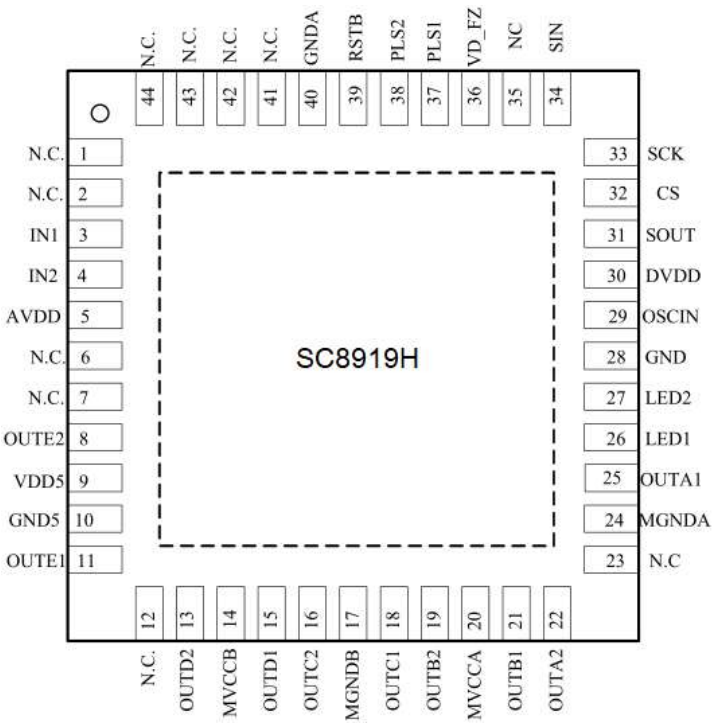


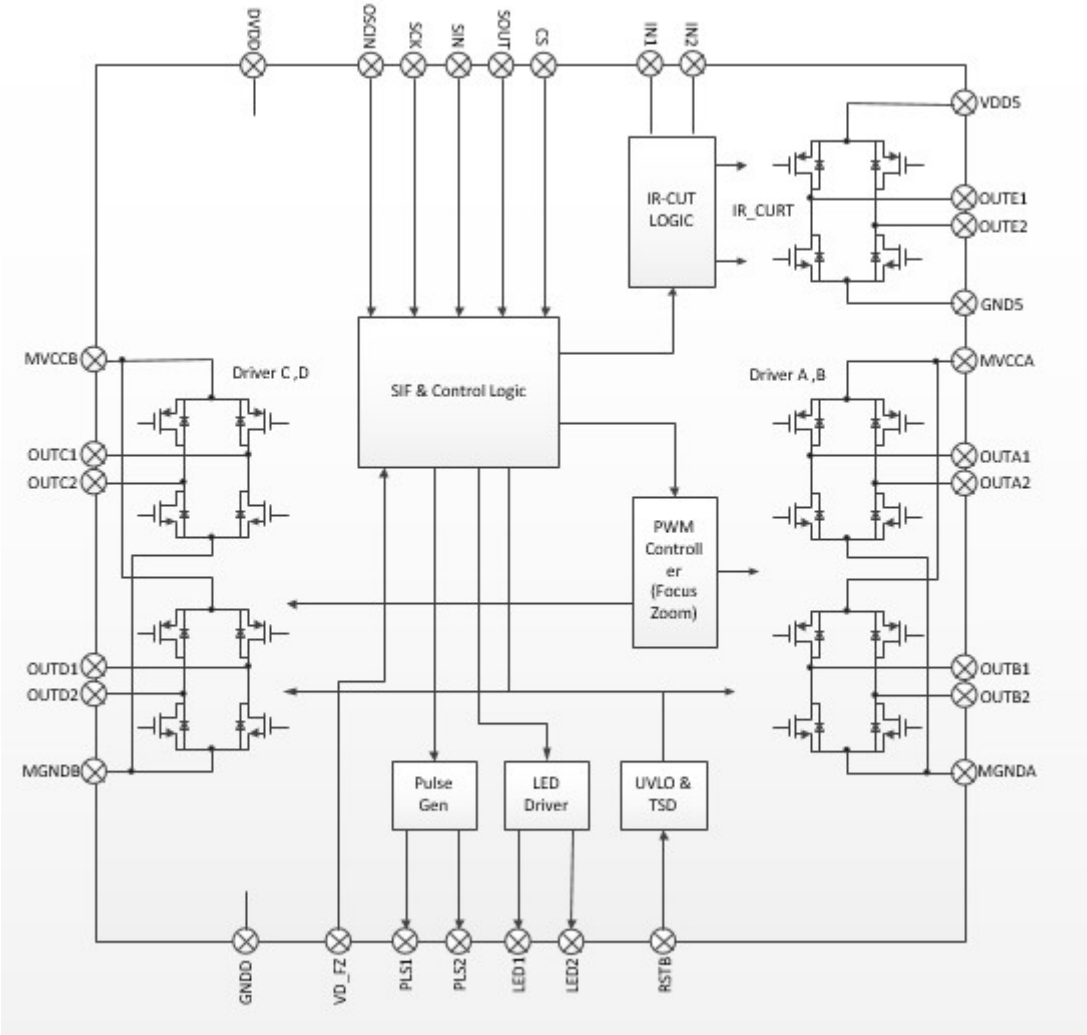
Fig.2 SC8919H pin configuration

PIN FUNCTIONS

Pin No.	Pin name	Type	Description
1	NC	-	NC
2	NC	-	NC
3	IN1	Input	Motor IN1 input
4	IN2	Input	Motor IN2 input
5	AVDD	Power supply	3 V analog power supply
6	NC	-	NC
7	NC	-	NC
8	OUTE2	Output	Motor output E2
9	VDD5	Power supply	Power supply for Iris
10	GND5	GND	GND for Iris
11	OUTE1	Output	Motor output E1
12	NC	-	NC
13	OUTD2	Output	Motor output D2
14	MVCCB	Power supply	Power supply for motor B
15	OUTD1	Output	Motor output D1

16	OUTC2	Output	Motor output C2
17	MGNDB	GND	GND for motor B
18	OUTC1	Output	Motor output C1
19	OUTB2	Output	Motor output B2
20	MVCCA	Power supply	Power supply for motor A
21	OUTB1	Output	Motor output B1
22	OUTA2	Output	Motor output A2
23	NC	-	NC
24	MGNDA	GND	GND for motor A
25	OUTA1	Output	Motor output A1
26	LED1	Input	Open-drain 1 for driving LED
27	LED2	Input	Open-drain 2 for driving LED
28	GNDD	GND	Digital GND
29	OSCIN	Input	OSCIN input
30	DVDD	Power supply	3 V digital power supply
31	SOUT	Output	Serial data output
32	CS	Input	Chip select signal input
33	SCK	Input	Serial clock input
34	SIN	Input	Serial data input
35	NC	-	NC
36	VD_FZ	Input	Focus zoom sync. signal input
37	PLS1	Output	Pulse 1 output
38	PLS2	Output	Pulse 2 output
39	RSTB	Input	Reset signal input
40	GNDA	GND	3 V analog GND
41	NC	-	NC
42	NC	-	NC
43	NC	-	NC
44	NC	-	NC

FUNCTIONAL BLOCK DIAGRAM



Note):

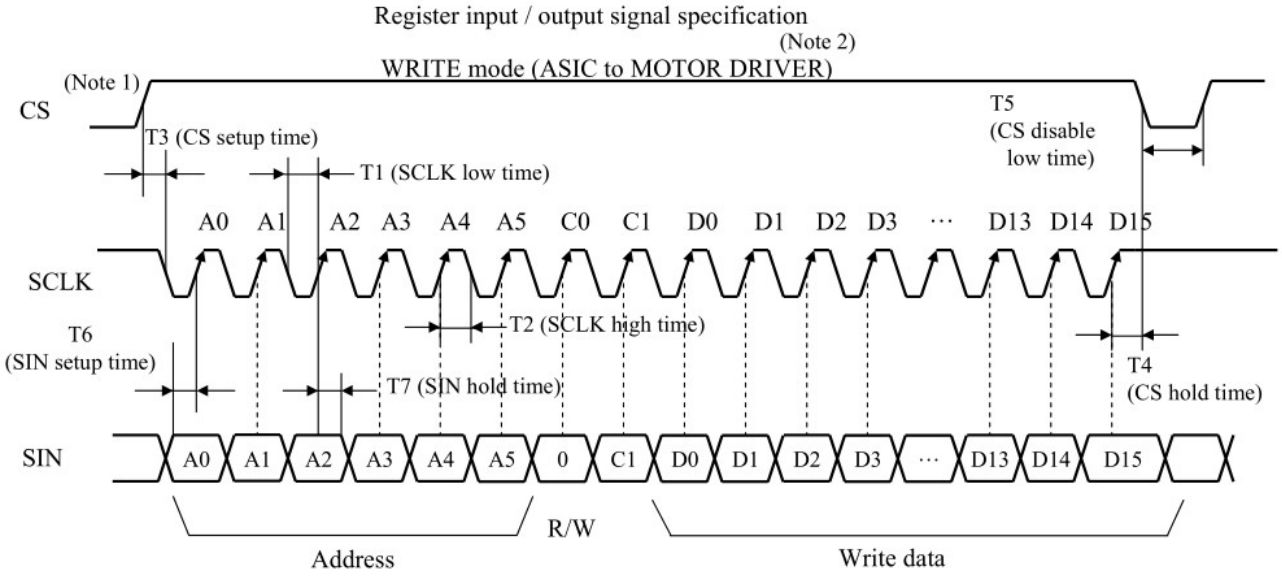
This block diagram is for explaining functions. The part of the block diagram may be omitted, or it may be simplified.

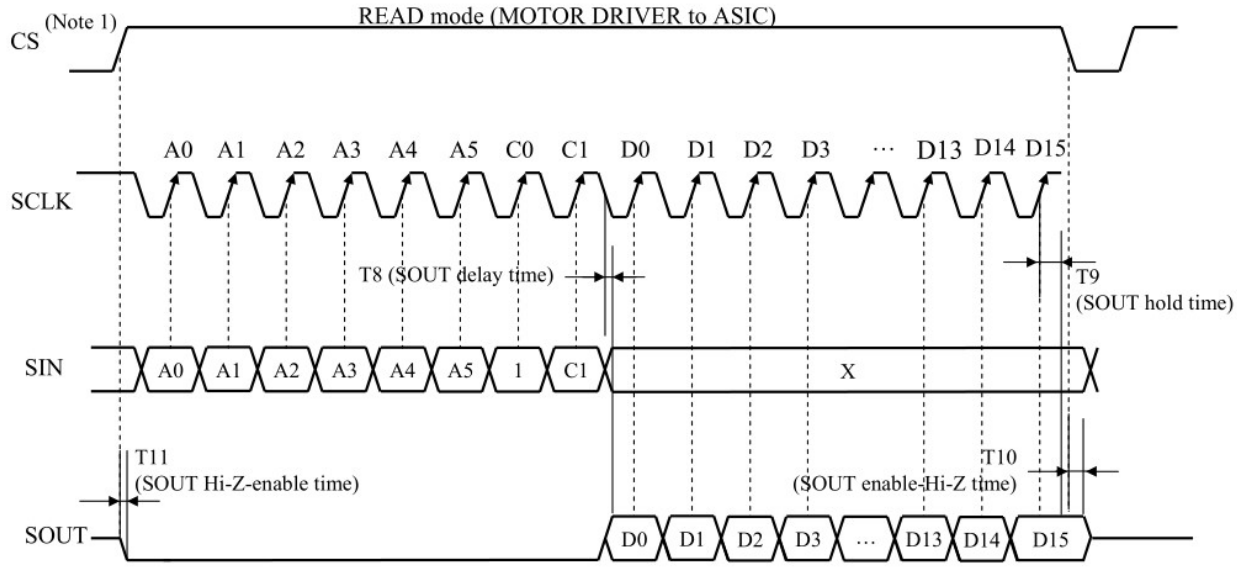
APPLICATIONS INFORMATION

1. Serial Interface

Timing Chart

Note) The characteristics listed below are reference values derived from the design of the IC and are not guaranteed.





Note)：

1.CS default value of each cycle (Write / Read mode) starts from Low-level.

2.It is necessary to input the system clock OSCIN at write mode.

Electrical Characteristics (Reference values for design) at VDD5 = MVCCB = 4.8 V, DVDD = 3.3 V

Symbol	Parameter	Condition	Limits			Unit
			Min	Typ	Max	
Sclock	Serial clock		1		5	MHz
T1	SCK low time		100			ns
T2	SCK high time		100			ns
T3	CS setup time		60			ns
T4	CS hold time		60			ns
T5	CS disable high time		100			ns
T6	SIN setup time		50			ns
T7	SIN hold time		50			ns
T8	SOUT delay time				60	ns
T9	SOUT hold time		60			ns
T10	SOUT Enable-Hi-Z time				60	ns
T11	SOUT Hi-Z-Enable time				60	ns
Tsc	SOUT C load				40	pF

Notes):

Ta = 25°C±2°C unless otherwise specified.

The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection. If a problem does occur related to these characteristics, we will respond in good faith to user concerns.

Register Map

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
0BH	Reserved						MODESEL_FZ	Reserved	TESTEN 1			Reserved				
20H		PWMRES[1:0]		PWMMODE[4:0]					DT1[7:0]							
21H									TESTEN2			FZTEST[4:0]				
22H			PHMODAB[5:0]						DT2A[7:0]							
23H	PPWB[7:0]								PPWA[7:0]							
24H			MICROAB[1:0]		LEDB	ENDISAB	BRAKEAB	CCWCW_AB	PSUMAB[7:0]							
25H	INTCTAB[15:0]															
26H																
27H			PHMODCD[5:0]						DT2B[7:0]							
28H	PPWD[7:0]								PPWC[7:0]							
29H			MICROCD[1:0]		LEDA	ENDISCD	BRAKECD	CCWCW_CD	PSUMCD[7:0]							
2AH	INTCTCD[15:0]															
2BH																
2C														INSWICH	IN1	IN2

Register List

Address	Register name / Bit wide	Function
0Bh	TESTEN1	Test mode enable 1
	MODESEL_FZ	VD_FZ polarity selection
20h	DT1[7:0]	Start point wait time
	PWMMODE[4:0]	Micro step output PWM frequency
	PWMRES[1:0]	Micro step output PWM resolution
21h	FZTEST[4:0]	PLS1/2 pin output signal selection
	TESTEN2	Test mode enable 2
22h	DT2A[7:0]	α motor start point excitation wait time
	PHMODAB[5:0]	α motor phase correction
23h	PPWA[7:0]	Driver A peak pulse width
	PPWB[7:0]	Driver B peak pulse width
24h	PSUMAB[7:0]	α motor step count number
	CCWCWAB	α motor rotation direction
	BRAKEAB	α motor brake
	ENDISAB	α motor enable/disable control
	LEDB	LED B output control
	MICROAB[1:0]	α motor sine wave division number
25h	INTCTAB[15:0]	α motor step cycle
27h	DT2B[7:0]	β motor start point excitation wait time
	PHMODCD[5:0]	β motor phase correction
28h	PPWC[7:0]	Driver C peak pulse width
	PPWD[7:0]	Driver D peak pulse width
29h	PSUMCD[7:0]	β motor step count number
	CCWWCD	β motor rotation direction
	BRAKECD	β motor brake
	ENDISCD	β motor enable/disable control
	MICROCD[1:0]	β motor sine wave division number
2Ah	INTCTCD[15:0]	β motor step cycle
2Ch	INSWICH	DC Motor input mode select
	IN1	DC Motor input 1
	IN2	DC Motor input 2

All the SIF functions containing a data register are formatted at RSTB = 0.

Serial Interface Specifications

Data transfer starts at the rising edge of CS, and stops at the falling edge of CS.
One unit of data is 24 bits. (24 bits of the following format are called a data set in this book.)
Address and data are serially input from SIN pin in synchronization with the data clock SCK at CS = 1.
Data is retrieved at the rising edge of SCK.
Moreover, data is output from SOUT pin at data readout. (Data is output at the rising edge of SCK.)
SOUT outputs Hi-Z at CS = 0, and outputs "0" except data readout at CS = 1.
The control circuit of serial interface is reset at CS = 0.

Data Format

0	1	2	3	4	5	6	7
A0	A1	A2	A3	A4	A5	C0	C1

8	9	10	11	12	13	14	15
D0	D1	D2	D3	D4	D5	D6	D7

16	17	18	19	20	21	22	23
D8	D9	D10	D11	D12	D13	D14	D15

C0 : Register write / read selection 0 : write mode, 1 : read mode
C1 : Unused
A5 to A0 : Address of register
D15 to D0 : Data written in register

When C0 bit is "0", the write mode is selected. The address and data are retrieved from SIN in synchronization with the rising edge of data clock SCLK, and the data is stored in internal register in synchronization with the rising edge of CS.
SOUT outputs "0" in the write mode.

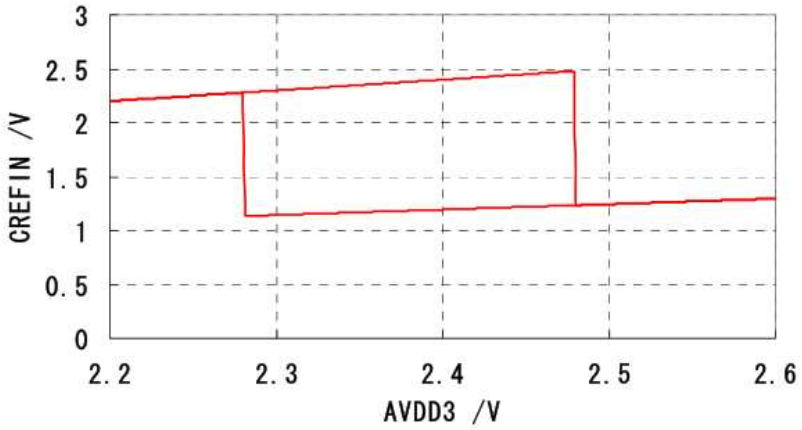
When the data which is 23 or less bits per 1 processing is received in the write mode, the received data becomes invalid.
The data of 25 or more bits is regarded as the continuous write mode, and the write operation is performed whenever the data of 24 bits is received. When the last data set is less than 24 bits in the continuous write mode, it becomes invalid. (The previous data set is valid.)
Even if noise occurs on SCK signal in the continuous write mode and the shifted data is received, pay attention to continue receiving or updating the shifted data.

When C0 bit is "1", the read mode is selected. The address is retrieved from SIN in synchronization with the rising edge of SCK, and then the register value of the address specified is output as LSB first from SOUT, in synchronization with the rising edge of SCK.
When C0 bit is "1", the values of D15 to D0 of SIN do not be cared.

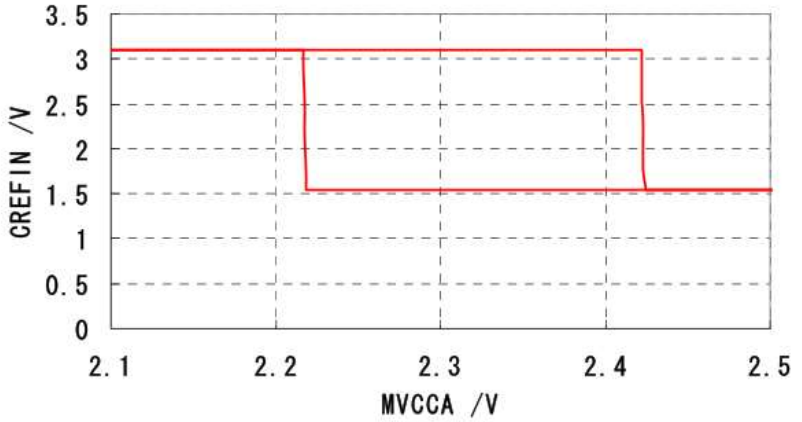
Formatting

All the SIF functions containing a data register are formatted at RSTB = 0.

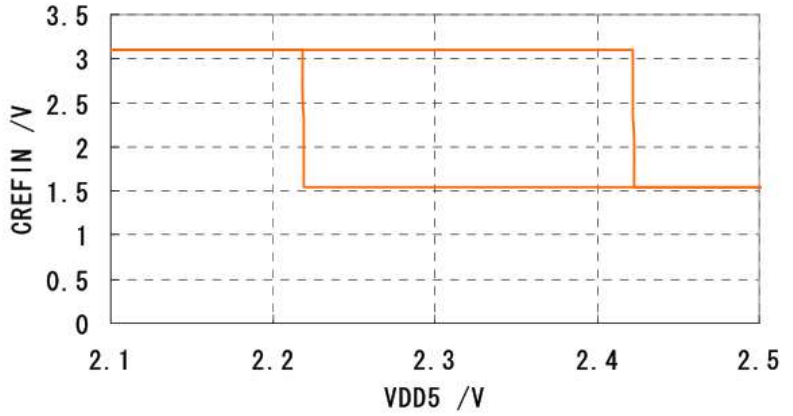
Characteristic of supply voltage monitor.



(1) AVDD3
Operation voltage : 2.28V
Return voltage : 2.48V



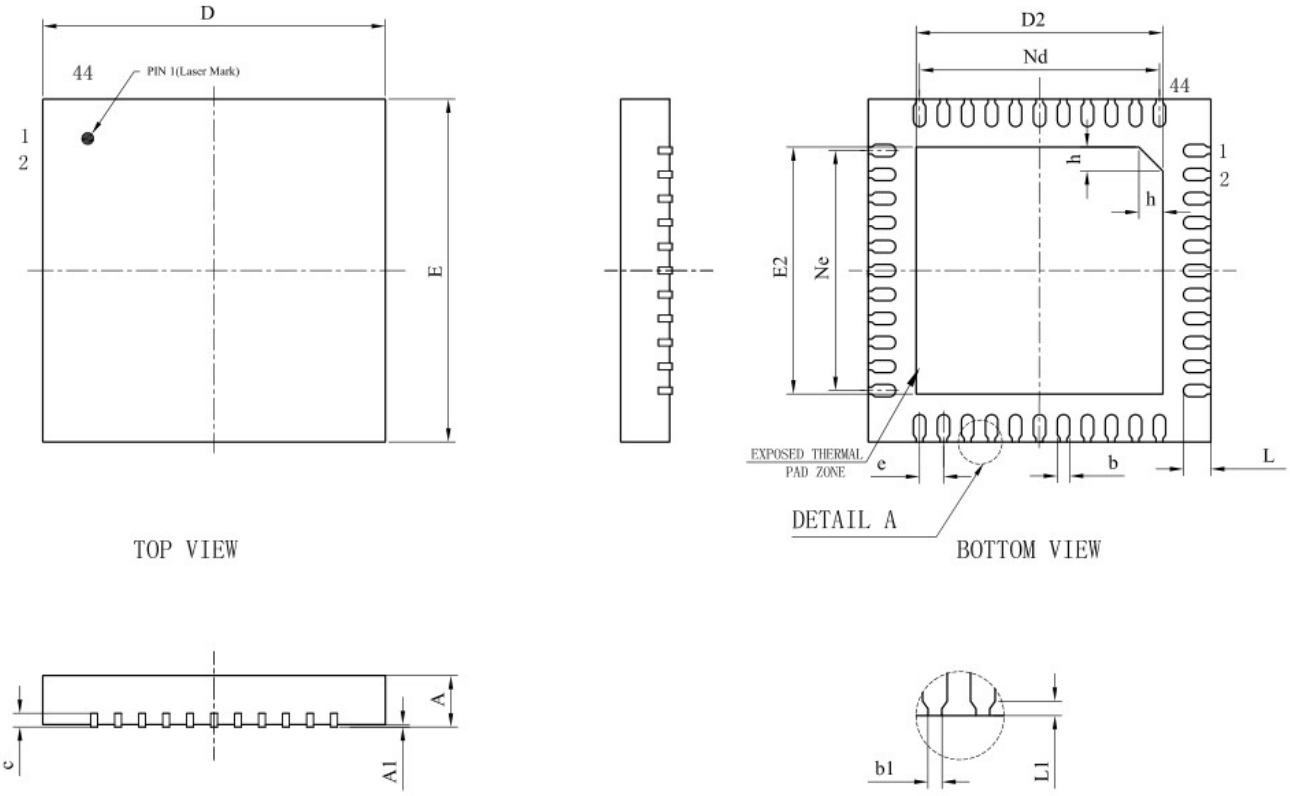
(2) MVCC
Operation voltage : 2.22V
Return voltage : 2.42V



(3) VDD5
Operation voltage : 2.22V
Return voltage : 2.42V

Package

QFN44 0404X0.75-0.35



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.13	0.18	0.23
b1	0.05	0.10	0.15
c	0.18	0.20	0.25
D	4.90	5.00	5.10
D2	3.50	3.60	3.70
e	0.35BSC		
Nd	3.50BSC		
E	4.90	5.00	5.10
E2	3.50	3.60	3.70
Ne	3.50BSC		
L	0.35	0.40	0.45
L1	0.10REF		
h	0.30	0.35	0.40
L/F载体尺寸 (mil)	150X150		

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2.When using the LSI for new models, verify the safety including the long-term reliability for each product.

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Be sure to read the notes to descriptions and the usage notes in the book.

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Any applications other than the standard applications intended.
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(2) Traffic control equipment (such as for automobile, airplane, train, and ship)
(3) Medical equipment for life support
(4) Submarine transponder
(5) Control equipment for power plant
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USAGE NOTES

1. When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.

   Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

2. Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.

3. Pay attention to the direction of LSI. When mounting it in the wrong direction onto the PCB (printed-circuit-board), it might smoke or ignite.

4. Pay attention in the PCB (printed-circuit-board) pattern layout in order to prevent damage due to short circuit between pins. In addition, refer to the Pin Description for the pin configuration.

5. Perform a visual inspection on the PCB before applying power, otherwise damage might happen due to problems such as a solder-bridge between the pins of the semiconductor device. Also, perform a full technical verification on the assembly quality, because the same damage possibly can happen due to conductive substances, such as solder ball, that adhere to the LSI during transportation.

6. Take notice in the use of this product that it might break or occasionally smoke when an abnormal state occurs such as output pin-VCC short (Power supply fault), output pin-GND short (Ground fault), or output-to-output-pin short (load short) .

   And, safety measures such as an installation of fuses are recommended because the extent of the above-mentioned damage and smoke emission will depend on the current capability of the power supply.

7. The protection circuit is for maintaining safety against abnormal operation. Therefore, the protection circuit should not work during normal operation.

   Especially for the thermal protection circuit, if the area of safe operation or the absolute maximum rating is momentarily exceeded due to output pin to VCC short (Power supply fault), or output pin to GND short (Ground fault), the LSI might be damaged before the thermal protection circuit could operate.

8. Unless specified in the product specifications, make sure that negative voltage or excessive voltage are not applied to the pins because the device might be damaged, which could happen due to negative voltage or excessive voltage generated during the ON and OFF timing when the inductive load of a motor coil or actuator coils of optical pick-up is being driven.

9. The product which has specified ASO (Area of Safe Operation) should be operated in ASO

10. Verify the risks which might be caused by the malfunctions of external components.

11. Take time to check the characteristics on use. When changing an external circuit constant for use, consider not only static characteristics, but also transient characteristics and external parts with respect to the characteristics difference among ICs so that you can get enough margin. Moreover, consider the influence of electric charge remaining in an external capacitor on rising/falling of power supply.

12. Apply voltage from a low-impedance to power supply pins and connect a bypass capacitor to the LSI as near as possible.