Motor Driver IC for camcorder and security-camera

FEATURES

- Voltage drive system 256-step microstep drivers
  (1 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.
- 24 pin Plastic Quad Flat Non-leaded Package
  (QFN Type with thermal pad)

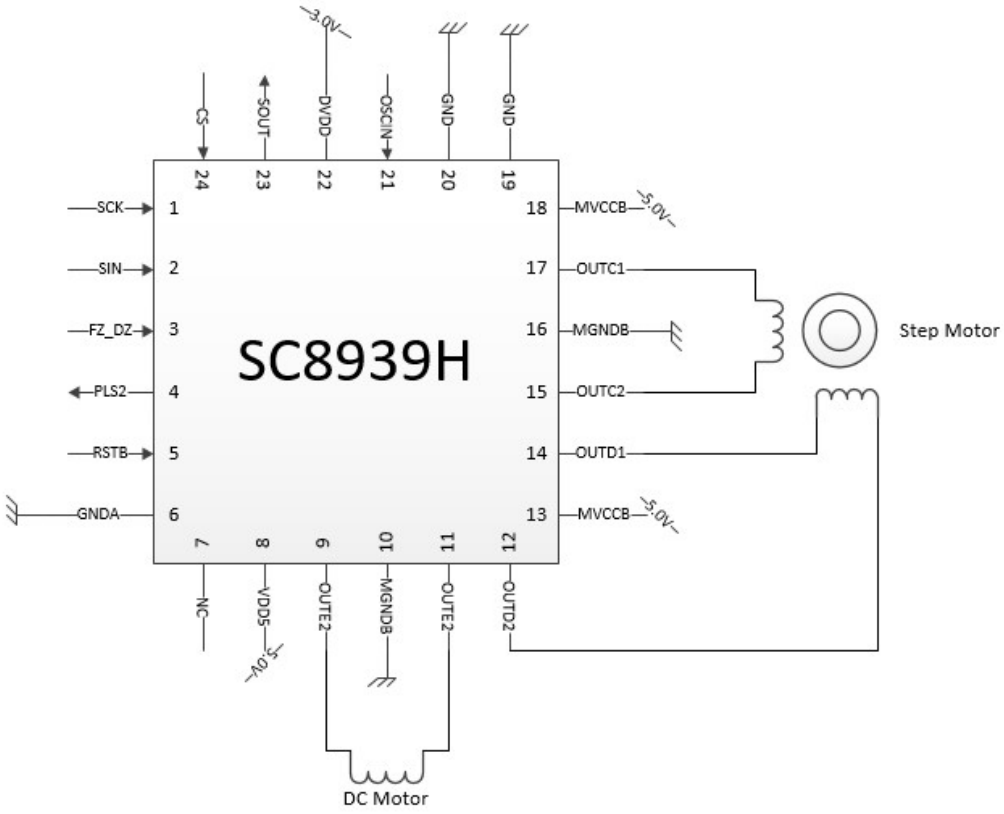
DESCRIPTION

SC8939H 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
DVDD	Analog and Controller supply voltage	-0.3		4.0	V	*1
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	-40		100	℃	*2, *4
Tj	Operating junction temperature	-40		125	℃	*2
Tstg	Storage temperature	-55		125	℃	*2
OUTA1, OUTA2 OUTB1, OUTB2	Motor driver 1 (focus, zoom) H bridge drive current (DC current)	-0.50		+0.50	A/ch	
OUTE1, OUTE2	Motor driver 2 (IR-cut) H bridge drive current (DC current)	-0.50		+0.50	A/ch	
IM(pulse)	Instantaneous H bridge drive current	-0.60		+0.60	A/ch	
OSCIN,CS, SCK, SIN VD_FZ, RSTB		-0.3		DVDD +0.3	V	*3
PLS2, SOUT		-0.3		DVDD +0.3	V	*3
ESD	HBM(Human Body Mode)		±2		kV	

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,

*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 VDD5	Supply voltage range	3.0	4.8	5.5	V	*1
DVDD		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 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		-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 = 3.3 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=200mA	1.0	1.5	2.0	Ω
I_{leakFZ}	H bridge 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		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 = 3.3 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 = 3.3 V T_a = 25℃±2℃

Symbol	Parameter	Condition	Limits			Unit	Note
			Min	Typ	Max		
Pulse generator							
$PL2_{wait}$	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

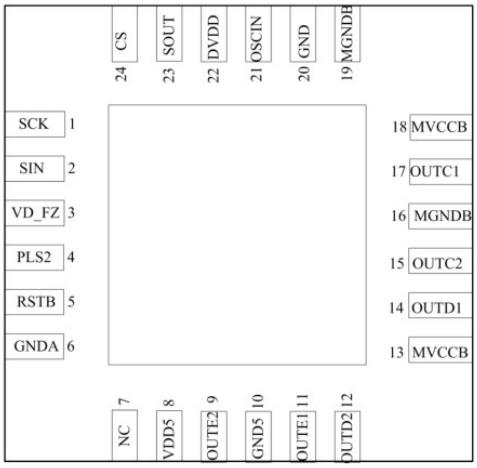
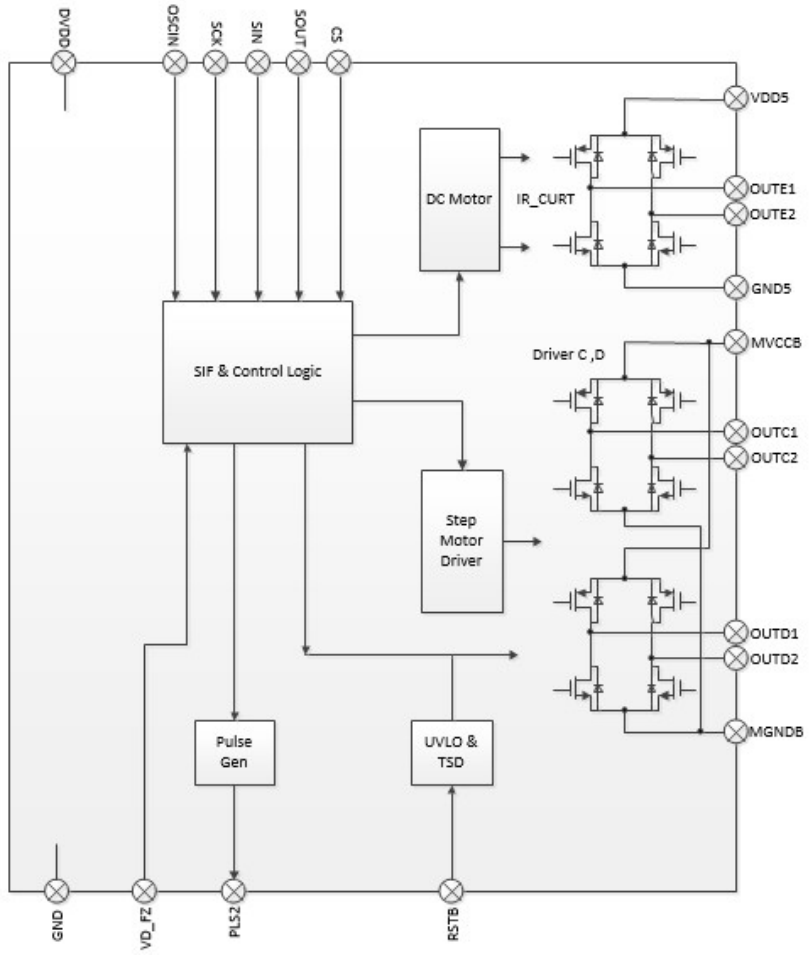


Fig.2 SC8939H pin configuration

PIN FUNCTIONS

Pin No.	Pin name	Type	Description
1	SCK	Input	Serial clock input
2	SIN	Input	Serial data input
3	VD_FZ	Input	Focus zoom sync. signal input
4	PLS2	Output	Pulse 2 output
5	RSTB	Input	Reset signal input
6	GNDA	GND	3 V analog GND
7	NC	-	NC
8	VDD5	Power supply	Power supply for IR-cut
9	OUTE2	Output	Motor output E2
10	GND5	GND	GND for IR-cut
11	OUTE1	Output	Motor output E1
12	OUTD2	Output	Motor output D2
13	MVCCB	Power supply	Power supply for motor B
14	OUTD1	Output	Motor output D1
15	OUTC2	Output	Motor output C2
16	MGNDB	GND	GND for motor B
17	OUTC1	Output	Motor output C1
18	MVCCB	Power supply	Power supply for motor B
19	MGNDB	GND	GND for motor B
20	GND	GND	Digital GND
21	OSCIN	Input	OSCIN input
22	DVDD	Power supply	3 V digital power supply
23	SOUT	Output	Serial data output
24	CS	Input	Chip select signal input

FUNCTIONAL BLOCK DIAGRAM



Note):

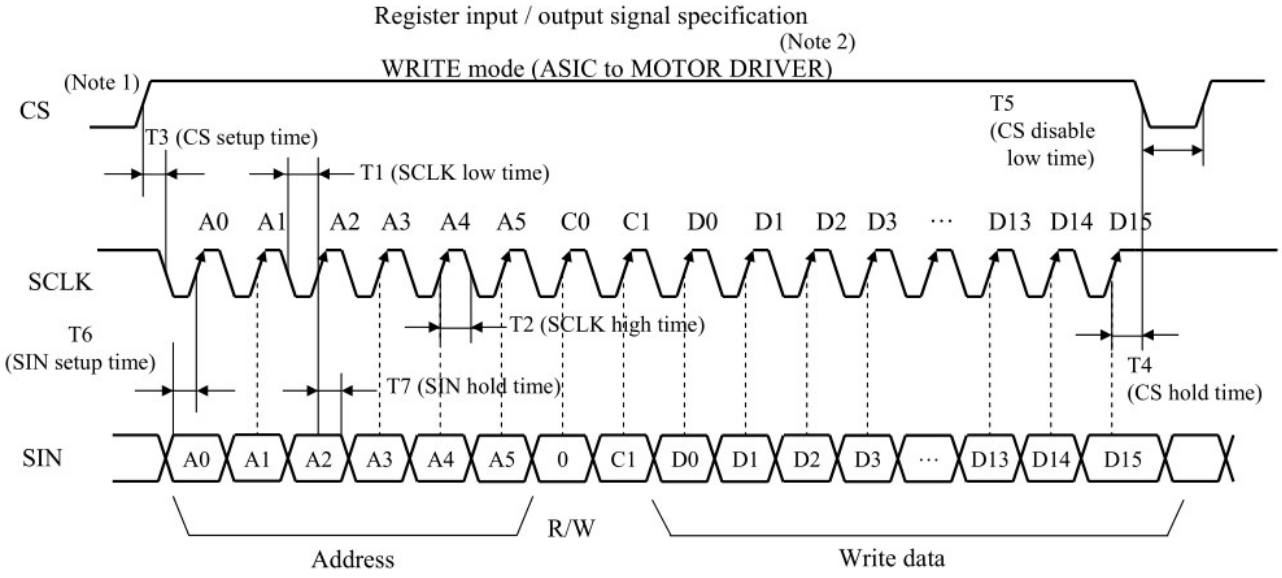
This block diagram is for explaining functions. The part of the block diagram may be omitted, or it may be simplified.

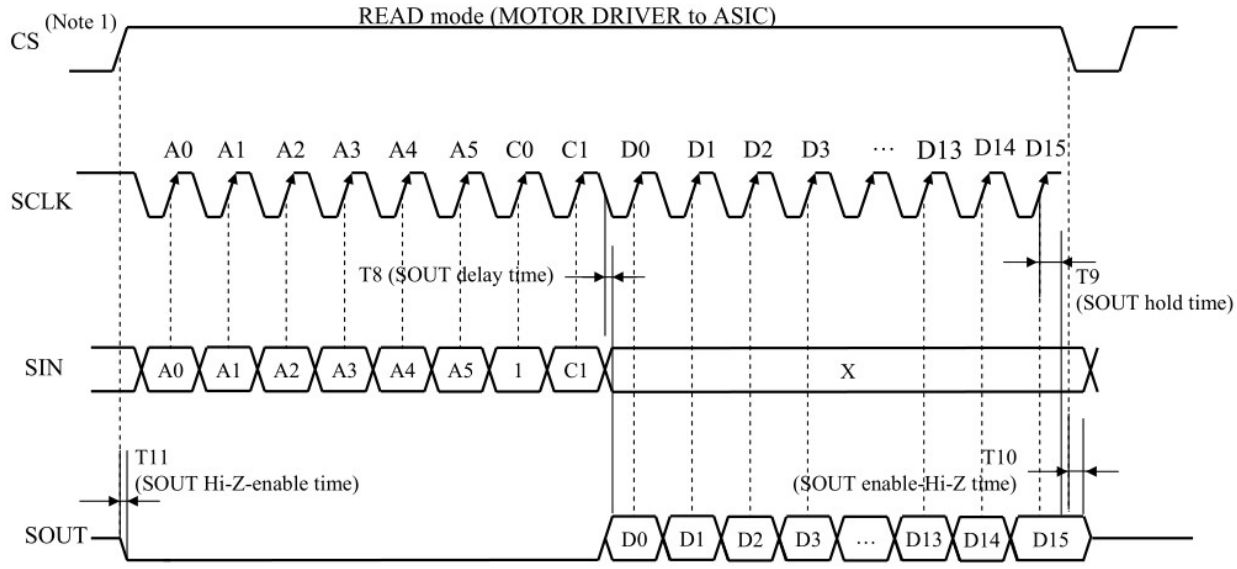
APPLICATIONS INFORMATION

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]				
27H			PHMODCD[5:0]						DT2B[7:0]							
28H	PPWD[7:0]								PPWC[7:0]							
29H			MICROCD[1:0]			ENDISCD	BRAKECD	CCWCW CD	PSUMCD[7:0]							
2AH	INTCTCD[15:0]															
2CH														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
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
0Bh	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.

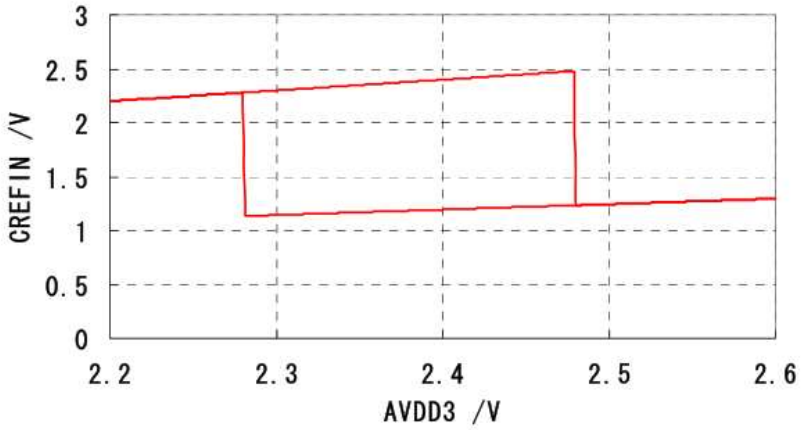
When the data which is 23 or less bits per 1 processing is received in the write mode, the received data becomes invalid.
The data of 25 or more bits is regarded as the continuous write mode, and the write operation is performed whenever the data of 24 bits is received. When the last data set is less 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.

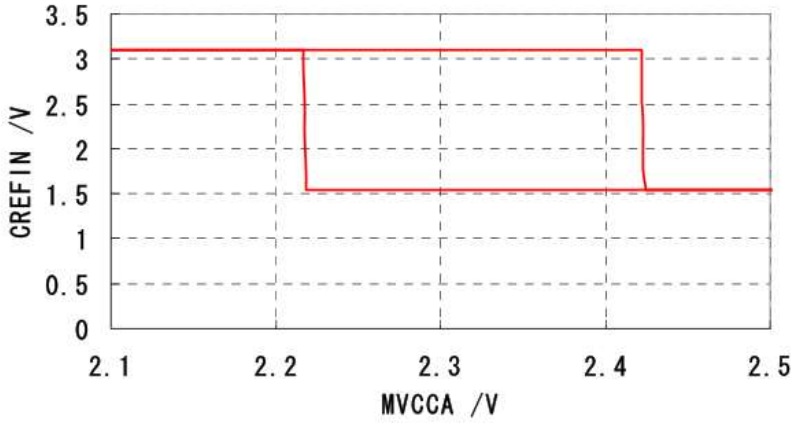
Formatting

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

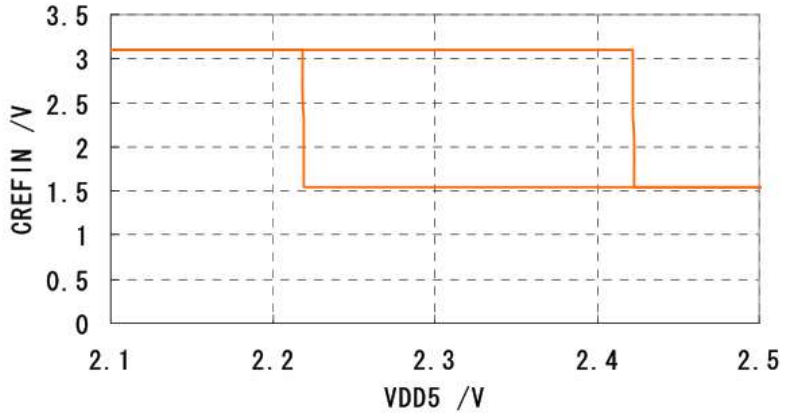
Characteristic of supply voltage monitor.



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



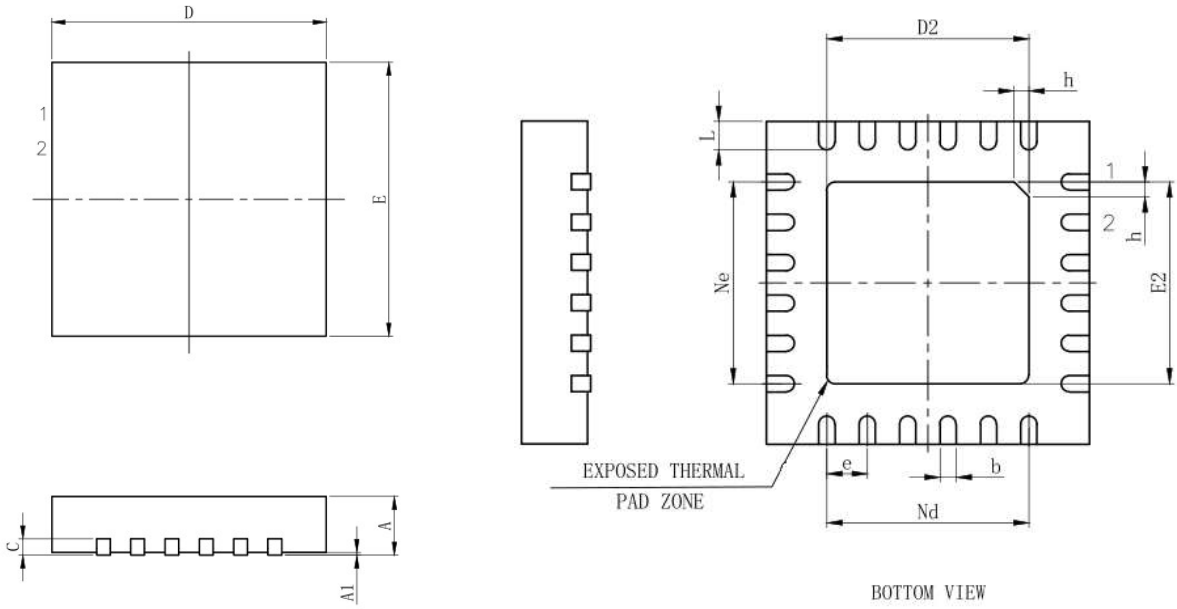
(2) MVCC
Operation voltage : 2.22V
Return voltage : 2.42V



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

Package

QFN24 0404X0.75-0.5



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0. 70	0.75	0. 80
	0.80	0.85	0. 90
	0.85	0.90	0. 95
A1	—	0.02	0. 05
b	0. 18	0.25	0. 30
c	0. 18	0.20	0. 25
D	3. 90	4. 00	4. 10
D2	2. 40	2. 50	2. 60
e	0. 50BSC		
Ne	2. 50BSC		
Nd	2. 50BSC		
E	3. 90	4. 00	4. 10
E2	2. 40	2. 50	2. 60
L	0. 35	0.40	0. 45
h	0. 30	0. 35	0. 40

IMPORTANT NOTICE

1.The products and product specifications described in this book are subject to change without notice for modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.

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

3.When the application system is designed by using this LSI, be sure to confirm notes in this book.
Be sure to read the notes to descriptions and the usage notes in the book.

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6.This IC is intended to be used for general electronic equipment [camcorder].
Consult our sales staff in advance for information on the following applications: Special applications in which exceptional quality and reliability are required, or if the failure or malfunction of this IC may directly jeopardize life or harm the human body.
Any applications other than the standard applications intended.
(1) Space appliance (such as artificial satellite, and rocket)
(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
(6) Disaster prevention and security device
(7) Weapon
(8) Others : Applications of which reliability equivalent to (1) to (7) is required
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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.