Datasheet

System Lens Drivers

μ-step System Lens Driver for Digital Still Cameras

BU24020GU

●General Description

BU24020GU is a system Lens Driver that uses μ-step driving to make the configuration of the sophisticated, high precision and low noise lens driver system possible. This IC has a built-in driver for both DC motor and voice coil motor and a μ-step controller that decreases CPU power. Therefore, multifunctional lens can be applied.

●Key Specifications

■ Digital Power Supply Voltage:	2.7V to 3.6V
■ Driver Power Supply Voltage:	2.7V to 5.5V
■ Output Current (1ch-4ch):	±500mA(Max)
■ Input Clock Frequency:	1MHz to 28MHz
■ FET ON Resistance (1ch-4ch):	1.5Ω(Typ)
■ Operating Temperature Range:	-20℃ to +85℃

●Package

VCSP85H2 2.60mm x 2.60mm x 1.00mm

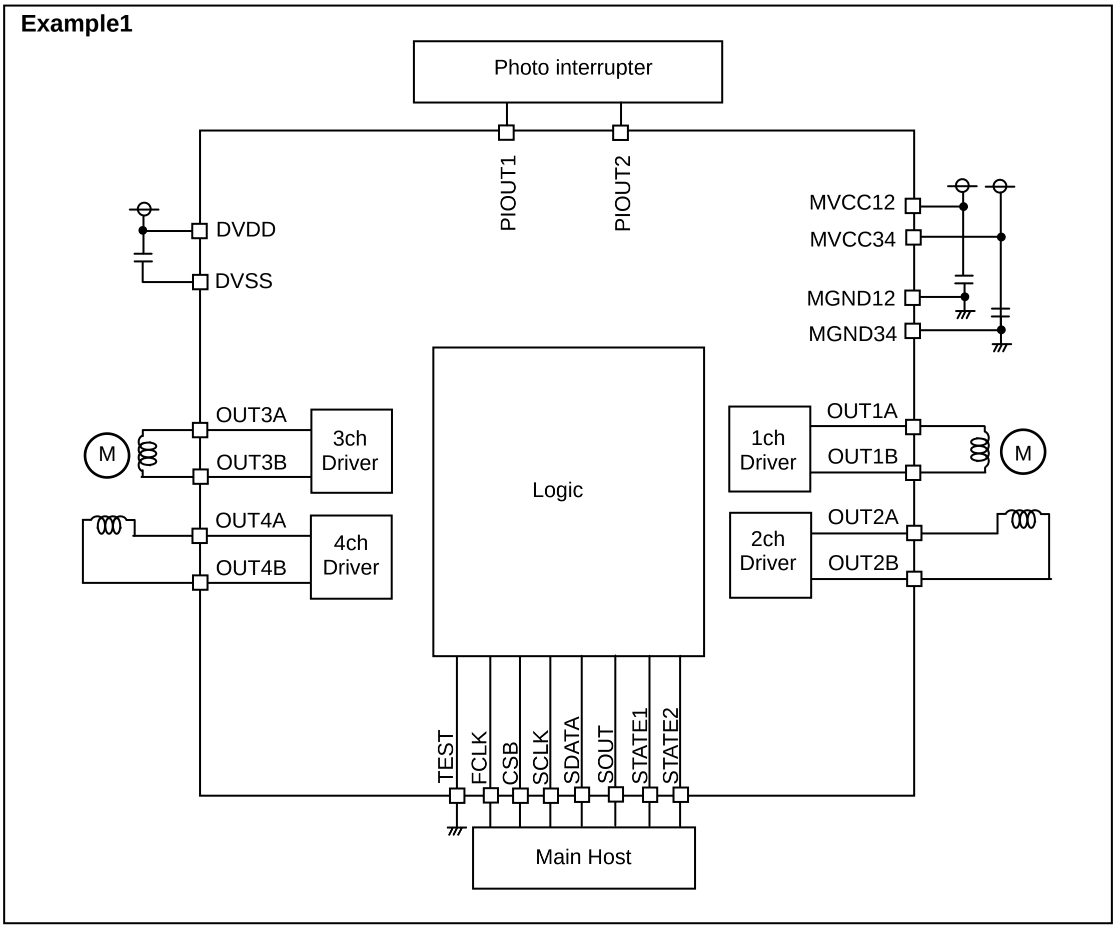
●Features

- Built-in 4channels Driver block.
  1ch-4ch: Voltage control type H-bridge
  (Adaptable to STM 2systems)
- Built-in 2 channels PI driving circuit
- Built-in PLL circuit

●Applications

- Digital still cameras

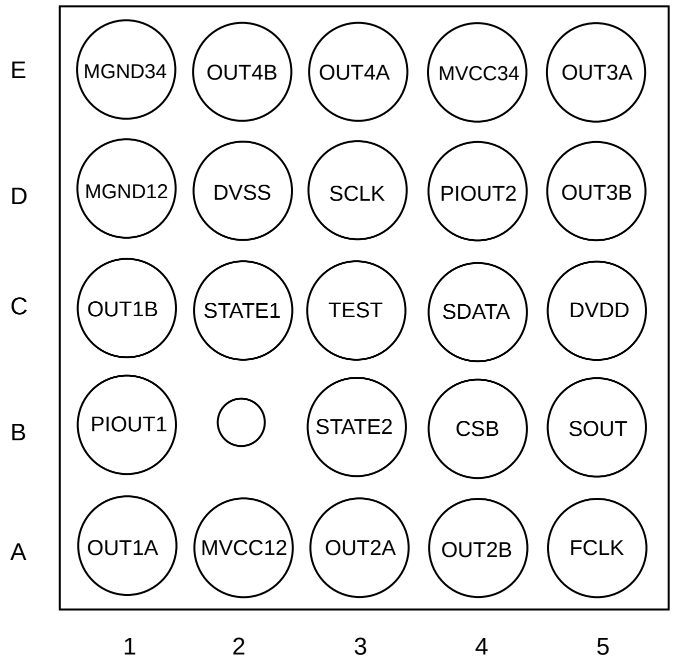
●Typical Application Circuit



○Product structure：Silicon monolithic integrated circuit ○This product is not designed for protection against radioactive rays

●Pin Configuration

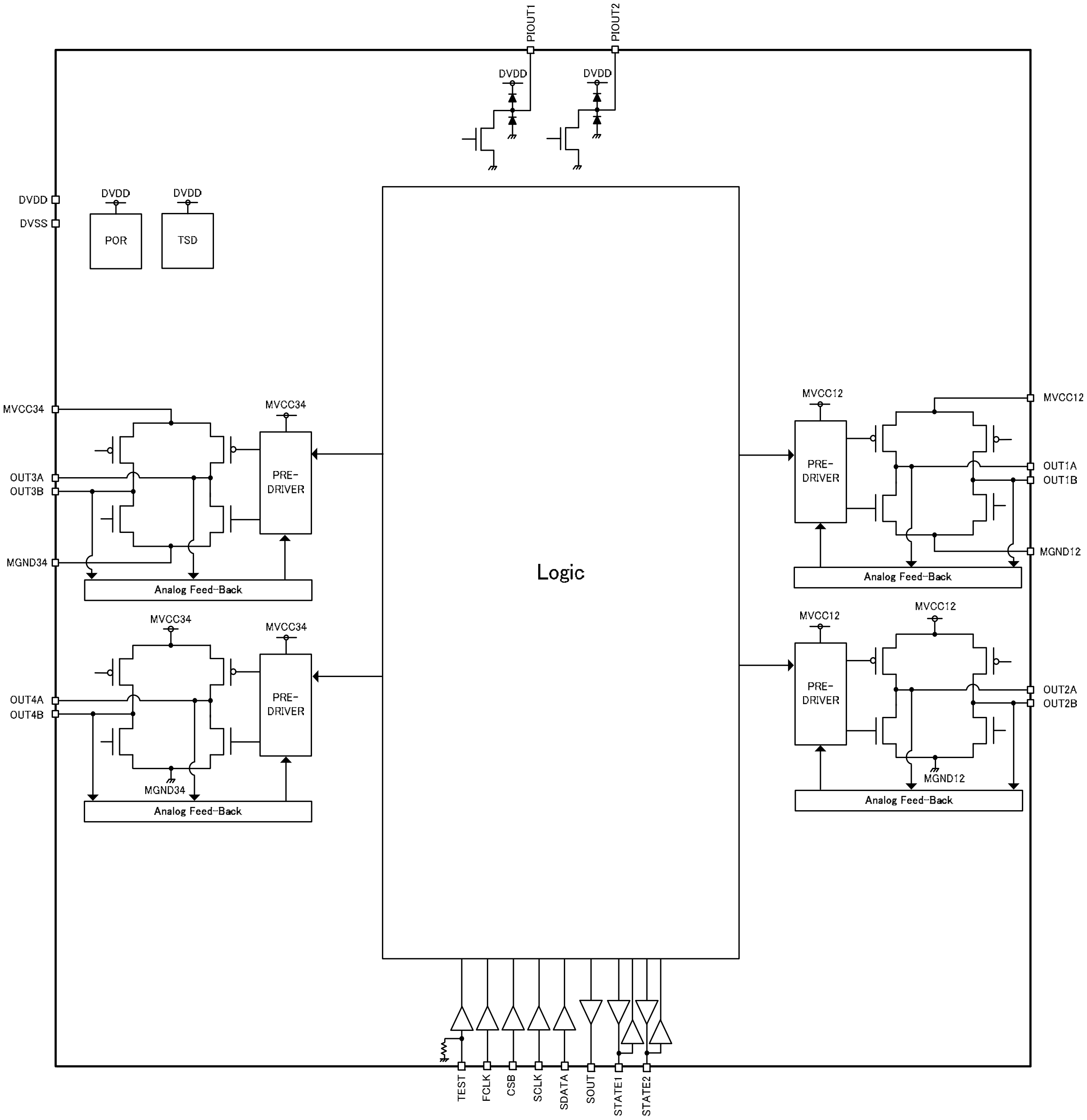
(Bottom view)



●Pin Description

Land Matrix No.	Pin Name	Power Supply	Function	Land Matrix No.	Pin Name	Power Supply	Function
C5	DVDD	-	Digital power supply	A2	MVCC12	-	1ch, 2ch Driver power supply
D2	DVSS	-	ground	D1	MGND12	-	1ch, 2ch Driver ground
A5	FCLK	DVDD	FCLK logic input	A1	OUT1A	MVCC12	1ch Driver A output
B4	CSB	DVDD	CSB logic input	C1	OUT1B	MVCC12	1ch Driver B output
D3	SCLK	DVDD	SCLK logic input	A3	OUT2A	MVCC12	2ch Driver A output
C4	SDATA	DVDD	SDATA logic input	A4	OUT2B	MVCC12	2ch Driver B output
B5	SOUT	DVDD	SOUT logic output	E4	MVCC34	-	3ch, 4ch Driver power supply
C2	STATE1	DVDD	STATE1 logic input/output	E1	MGND34	-	3ch, 4ch Driver ground
B3	STATE2	DVDD	STATE2 logic input/output	E5	OUT3A	MVCC34	3ch Driver A output
C3	TEST	DVDD	TEST logic input	D5	OUT3B	MVCC34	3ch Driver B output
B1	PIOUT1	DVDD	PI driving output 1	E3	OUT4A	MVCC34	4ch Driver A output
D4	PIOUT2	DVDD	PI driving output 2	E2	OUT4B	MVCC34	4ch Driver B output

●Block Diagram



●Description of Blocks

<u>Stepping Motor Driver (1ch-4ch Driver)</u>

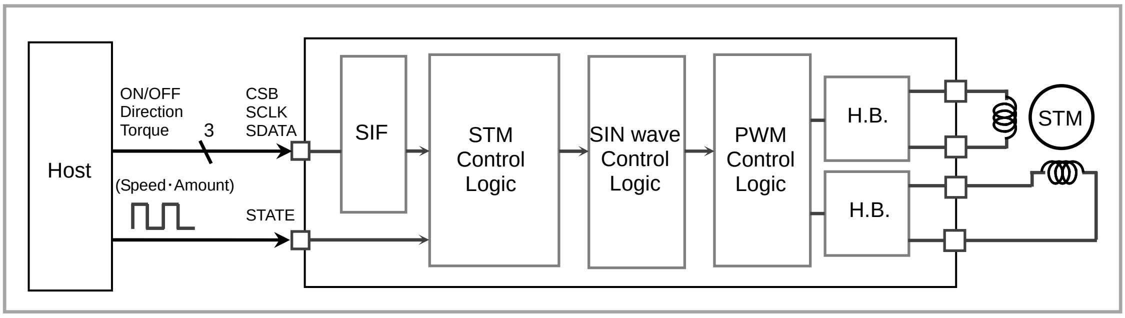
Built-in stepping motor driver of PWM driving type.
Maximum 2 stepping motors can be driven independently.
Built-in voltage feedback circuit of D-class type.
3ch/4ch drivers can also drive independently for DC motor or voice coil motor.

(1) Control

It corresponds to both Clock IN and Autonomous control.

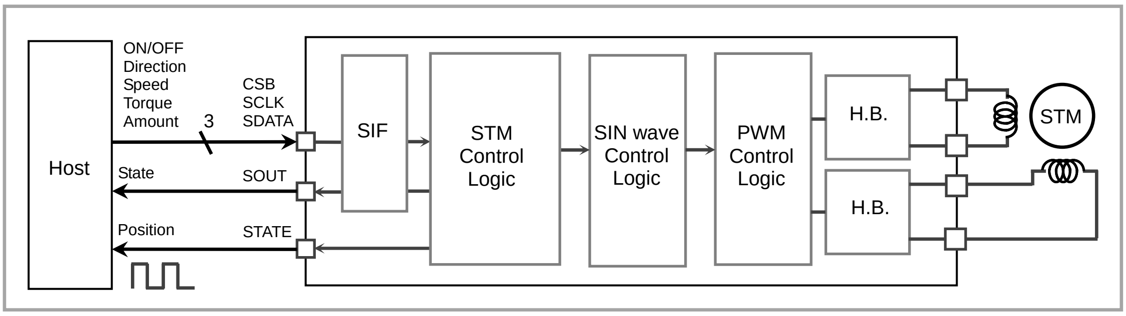
(i)Clock IN Control

Set the resistors for the stepping motor control.
The stepping motor is rotated and synchronized with the input clock in the STATE pin.
It is possible to select the mode of stepping motor control from μ-step, 1-2 phase excitation, 2 phase excitation and the number of edge for electrical angle cycle from 4, 8, 32, 64, 128, 256, 512 or 1024.



(ii)Autonomous Control

The stepping motor is rotated by setting the resistors for the stepping motor control.
The state of rotation command (executing:1, finished:0), Cache resistor and motor position are the output from the serial output (SOUT pin). Also, the signal (MO output) which is synchronized with the motor rotation is the output from STATE pin.
It is possible to select the mode of stepping motor control from μ-step (1024 portion), 1-2 phase excitation and 2 phase excitation.
Built-in Cache resistors.
Cache resistors enable the setting of subsequent process while the motor is in operation. Through these registers, operations are done continuously.



●Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Limit	Unit	Remark
Power Supply Voltage	DVDD	-0.3 to +4.5	V	
	MVCC	-0.3 to +7.0	V	MVCC12, MVCC34
Input Voltage	VIN	-0.3 to supply voltage+0.3	V	
Input / Output Current *1	IIN	±500	mA	MVCC12, MVCC34
		+50	mA	by PIOUT pin
Storage Temperature Range	TSTG	-55 to +125	℃	
Operating Temperature Range	TOPE	-20 to +85	℃	
Permissible Dissipation *2	PD	800	mW	

*1 Must not exceed PD.
*2 To use at a temperature higher than Ta=25 °C, derate 8mW per 1 °C
(At mounting 50mm x 58mm x 1.75mm glass epoxy board.)

●Recommended Operating Rating (Ta=25℃)

Parameter	Symbol	Limit	Unit	Remark
Digital Power Supply Voltage	DVDD	2.7 to 3.6	V	DVDD≦MVCC
Driver Power Supply Voltage	MVCC	2.7 to 5.5	V	MVCC12, MVCC34
Clock Operating Frequency	FCLK	1 to 28	MHz	Reference clock

●**Electrical Characteristics**

(Unless otherwise specified, Ta=25°C, DVDD=3.0V, MVCC=5.0V, DVSS=MGND=0.0V)

Parameter	Symbol	Limit			Unit	Conditions
		MIN	TYP	MAX		
<Current Consumption>						
Quiescence (DVDD)	ISSD	-	50	95	μA	CMD_RS=0
(MVCC)	ISSM	-	0	10	μA	
Operation (DVDD)	IDDD	-	5	10	mA	CMD_RS=1 FCLK=24MHz CLK_DIV setting : 0h No load
<Logic Block>						
Low-level Input Voltage	VIL	DVSS	-	0.3DVDD	V	
High-level Input Voltage	VIH	0.7DVDD	-	DVDD	V	
Low-level Input Current	IIL	0	-	10	μA	VIL=DVSS
High-level Input Current	IIH	0	-	10	μA	VIH=DVDD
Low-level Output Voltage	VOL	DVSS	-	0.2DVDD	V	IOL=1.0mA
High-level Output Voltage	VOH	0.8DVDD	-	DVDD	V	IOH=1.0mA
<PI Driving Circuit>						
Output Voltage	PIVO	-	0.15	0.5	V	IIH=30mA
<Voltage Driver Block 1ch-4ch>						
ON-resistance	Ron	-	1.5	2.0	Ω	IO=±100mA (the sum of high and low sides)
OFF-leak Current	IOZ	-10	0	+10	μA	Output Hiz setting
Average Voltage Accuracy between different Output Pins	Vdiff	-5	-	+5	%	Vdiff setting : 2Bh

●**Typical Performance Curves**

(Unless otherwise specified, Ta=25°C, DVDD=3.0V, MVCC=5.0V, DVSS=MGND=0.0V)

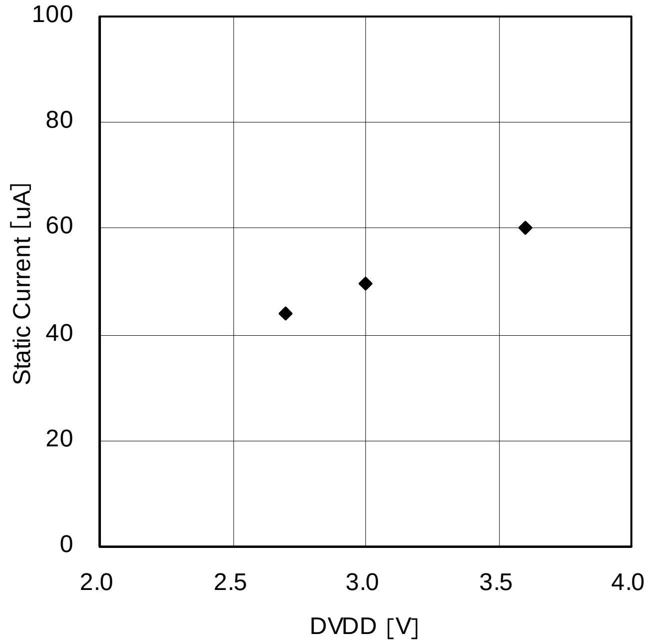


Figure 1. DVDD Static Current
Voltage Dependency

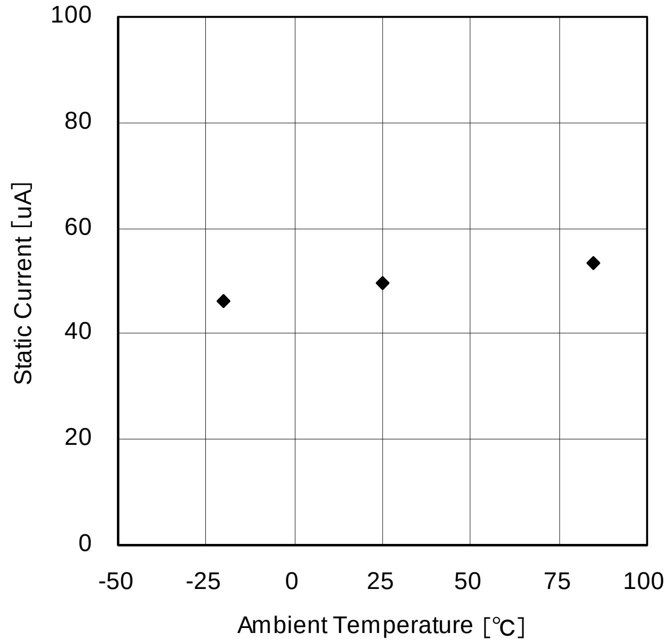


Figure 2. DVDD Static Current
Temperature Dependency

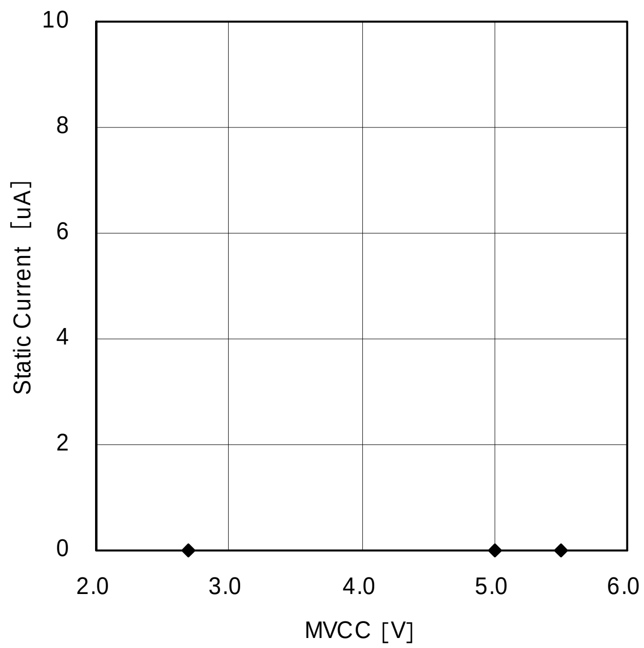


Figure 3. MVCC Static Current
Voltage Dependency

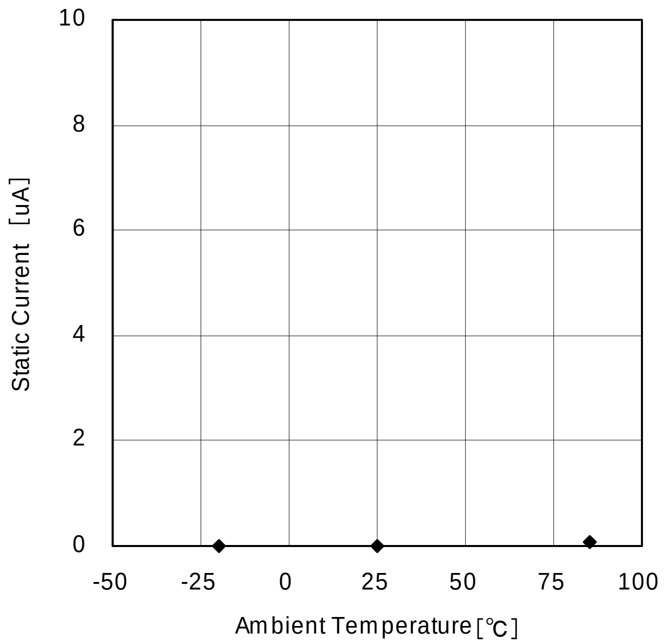


Figure 4. MVCC Static Current
Temperature Dependency

●**Typical Performance Curves**

(Unless otherwise specified, Ta=25°C, DVDD=3.0V, MVCC=5.0V, DVSS=MGND=0.0V)

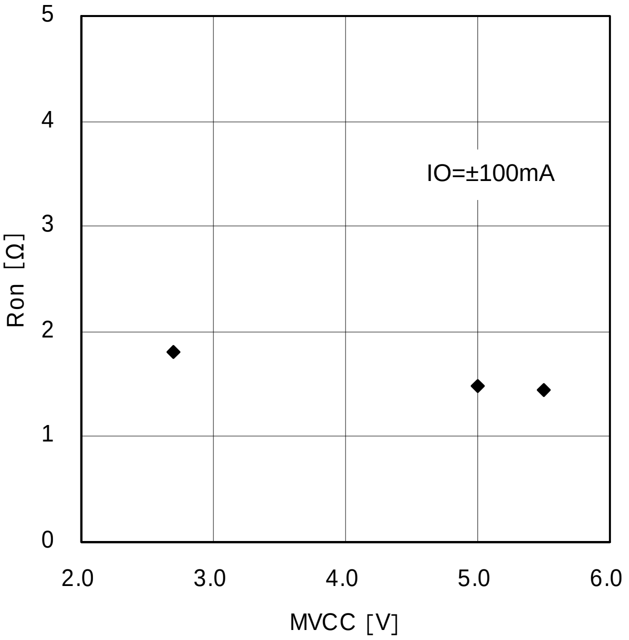


Figure 5. Output ON-Resistance
MVCC Dependency
(Voltage driver block)

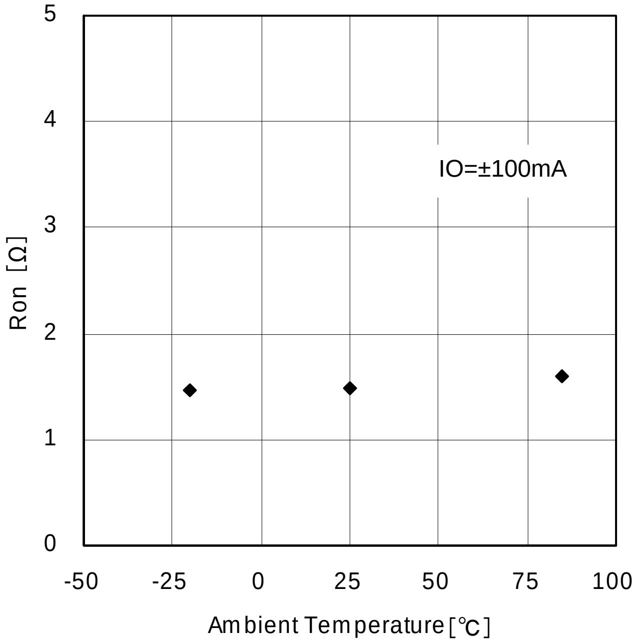


Figure 6. Output ON-Resistance
Temperature Dependency
(Voltage driver block)

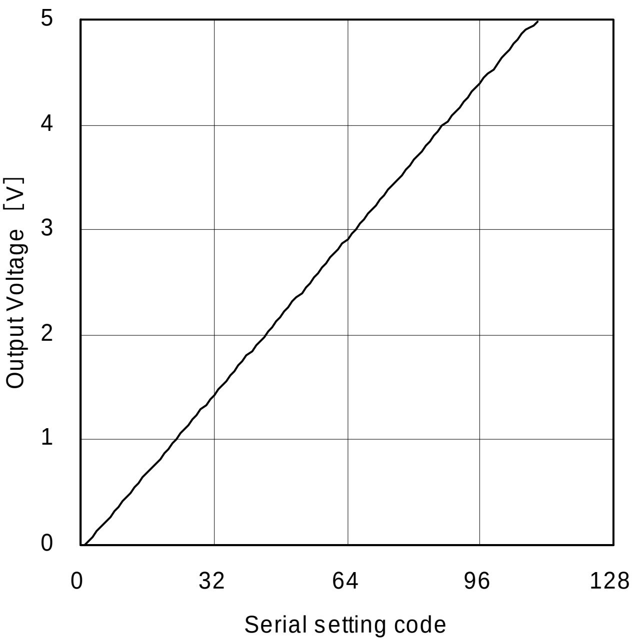


Figure 7. Average Voltage Accuracy
between different output pins
(Voltage driver block)

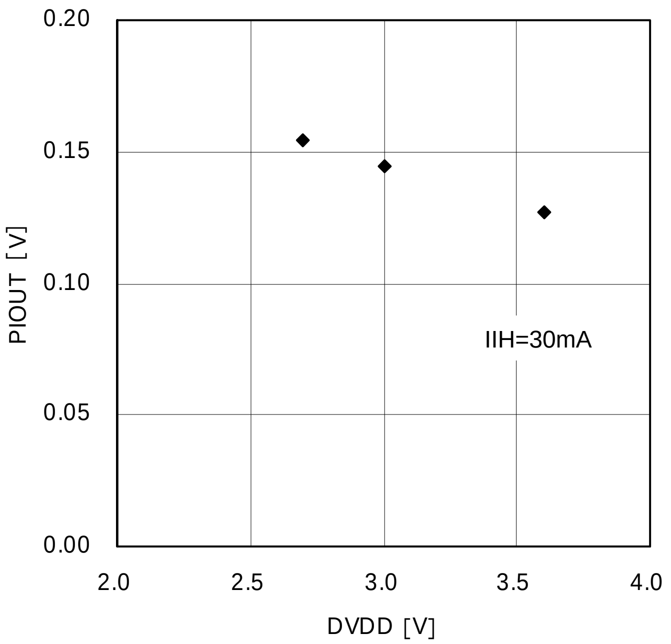


Figure 8. Output Voltage
DVDD Dependency
(PI driving circuit)

●**Typical Performance Curves**

(Unless otherwise specified, Ta=25°C, DVDD=3.0V, MVCC=5.0V, DVSS=MGND=0.0V)

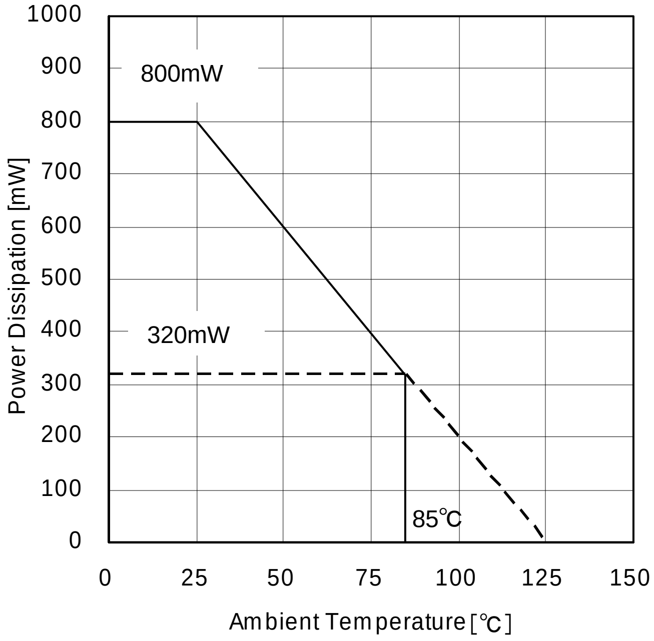
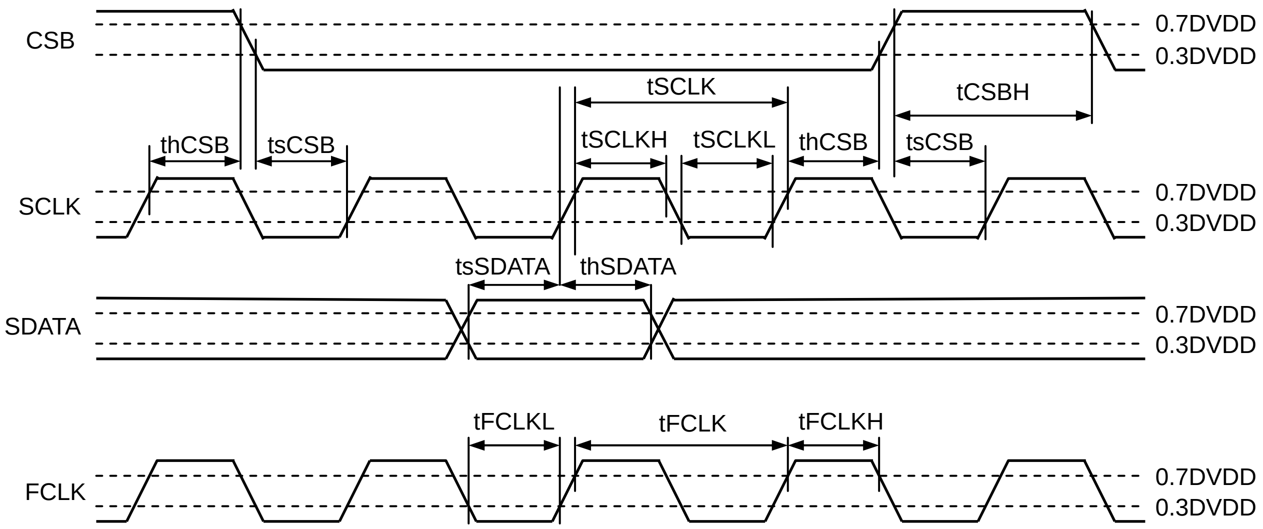


Figure 9. Power Dissipation Curve

●**Timing Chart**

(Unless otherwise specified, Ta=25°C, DVDD=3.0V)

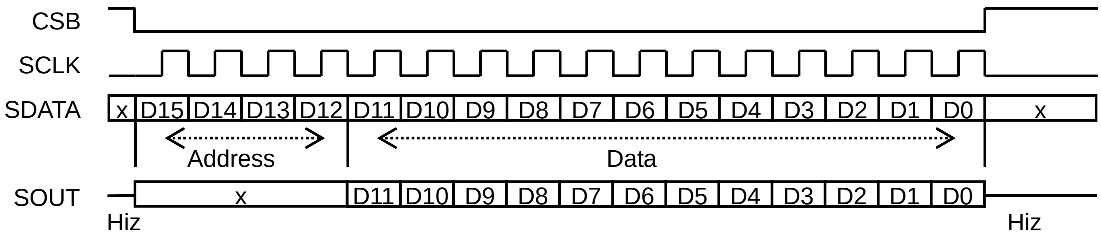
Parameter	Symbol	Specification
SCLK input cycle	tSCLK	More than 100 nsec
SCLK L-level input time	tSCLKL	More than 50 nsec
SCLK H-level input time	tSCLKH	More than 50 nsec
SDATA setup time	tsSDATA	More than 50 nsec
SDATA hold time	thSDATA	More than 50 nsec
CSB H-level input time	tCSBH	More than 380 nsec
CSB setup time	tsCSB	More than 50 nsec
CSB hold time	thCSB	More than 50 nsec
FCLK input cycle	tFCLK	More than 36 nsec
FCLK L-level input time	tFCLKL	More than 18 nsec
FCLK H-level input time	tFCLKH	More than 18 nsec



(note1) FCLK is asynchronous with SCLK.
(note2) Duty of FCLK, SCLK are free.

●Serial interface

Control commands are framed by a 16-bit serial input (MSB first) and are sent through CSB, SCLK, and SDATA pins. The 4 higher-order bits specify addresses, while the remaining 12 bits specify data. Data of every bit is sent through SDATA pin, which is retrieved during the rising edge of SCLK. Data becomes valid when CSB is Low is registered during the rising edge of CSB. Furthermore, the interface will be synchronized with the falling edges of SCLK to output the SOUT data of the 12 bits.

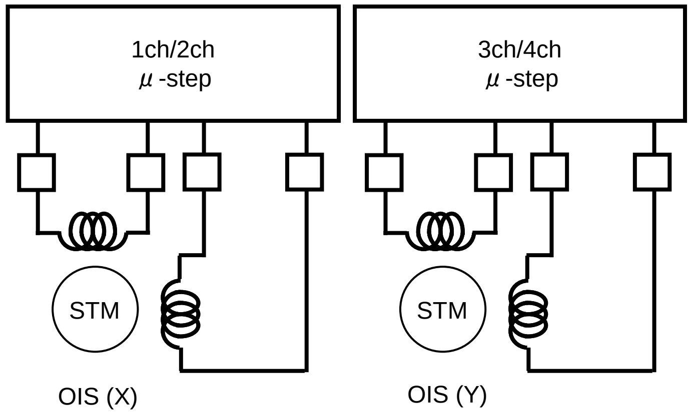


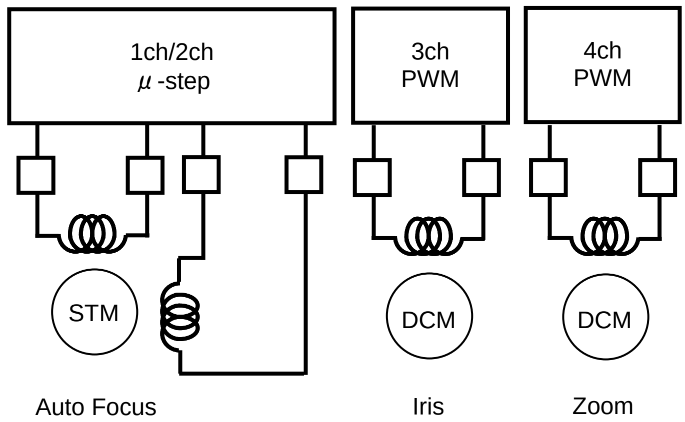
＜Register map＞

Address[3:0]				Data[11:0]											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	A_Mode[1:0]		A_SEL[2:0]			A_different_output_voltage[6:0]						
0	0	0	1	0	0	0	0	A_Cycle[5:0]						0	0
				0	0	1	0	A_Cycle[13:6]							
				0	1	1	0	A_BEXC	0	0	A_BSL	A_AEXC	0	0	A_ASL
				1	1	1	0	0	0	A_POS[1:0]		0	0	A_PS	A_Stop
0	0	1	0	A_EN	A_RT	A_Pulse[9:0]									
0	0	1	1	A_ACT	A_BUSY	B_ACT	B_BUSY	L	L	L	L	L	L	L	L
0	1	0	0	B_Mode[1:0]		B_SEL[2:0]			B_different_output_voltage[6:0]						
0	1	0	1	0	0	0	0	B_Cycle[5:0]						0	0
				0	0	1	0	B_Cycle[13:6]							
				0	1	1	0	B_BEXC	0	0	B_BSL	B_AEXC	0	0	B_ASL
				1	0	0	0	0	0	3_CHOP[1:0]		0	0	4_CHOP[1:0]	
				1	0	1	3_State_CTL[1:0]		3_PWM_Duty[6:0]						
				1	1	0	4_State_CTL[1:0]		4_PWM_Duty[6:0]						
				1	1	1	0	0	0	B_POS[1:0]		0	0	B_PS	B_Stop
0	1	1	0	B_EN	B_RT	B_Pulse[9:0]									
0	1	1	1	A_Position[9:6]				B_Position[9:6]				L	L	L	L
1	0	1	1	0	0	0	0	0	0	Edge	0	0	0	B_CTL	A_CTL
1	1	0	0	0	0	Chopping[1:0]		CacheM	0	0	CLK_EN	CLK_DIV[3:0]			
1	1	0	1	0	0	0	0	0	0	0	0	0	0	PI_CTL2	PI_CTL1
1	1	1	0	1	1	0	0	0	0	0	STB	0	0	STM_RS	CMD_RS
Addresses other than those above				Setting prohibited											

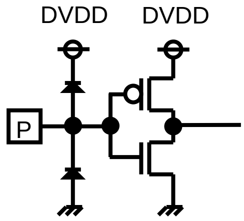
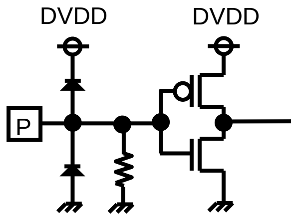
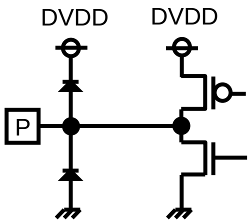
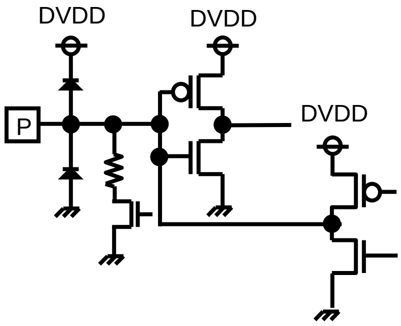
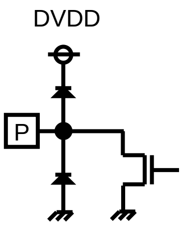
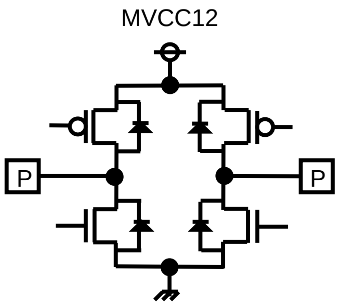
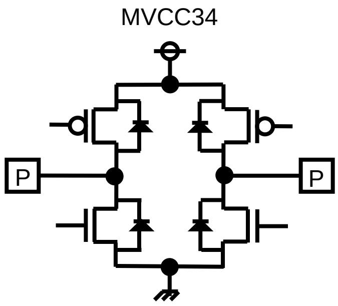
(Note1) The notations A B in the register map correspond to Ach and Bch respectively. Ach is defined as 1ch and 2ch driver, Bch as 3ch and 4ch driver,
(Note2) After reset (Power ON reset), the initial condition is saved in all registers
(Note3) The addresses 4'b0011, and 4'b0111 have data (ACT, BUSY, Position [9:6]), which are internal register values and output from SOUT pin.
(Note4) For Mode, different output voltage, Cycle, EN, and RT registers, data that are written before the access to the Pulse register becomes valid and determines the rising edge of CSB after the access to the Pulse register.
(The Mode, different output voltage, Cycle, EN, RT, and Pulse registers contain Cache registers. Any registers other than those do not contain Cache registers.)

●Application Example





●I/O Equivalence Circuit

Pin	Equivalent Circuit Diagram	Pin	Equivalent Circuit Diagram
FCLK CSB SCLK SDATA		TEST (note1)	
SOUT		STATE1 STATE2	
PIOUT1 PIOUT2		OUT1A OUT1B OUT2A OUT2B	
OUT3A OUT3B OUT4A OUT4B			

(note1) Short TEST pin to DVSS.

●Operational Notes

1) Absolute maximum ratings
If applied voltage, operating temperature range, or other absolute maximum ratings are exceeded, the LSI may be damaged. Do not apply voltages or temperatures that exceed the absolute maximum ratings. If you expect that any voltage or temperature could be exceeding the absolute maximum ratings, take physical safety measures such as fuses to prevent any conditions exceeding the absolute maximum ratings from being applied to the LSI.

2) GND potential
The voltage of the ground pin must be the lowest voltage of all pins of the IC at all operating conditions. Ensure that no pins are at a voltage below the ground pin at any time, even during transient condition.

3) Thermal design
Use a thermal design that allows for a sufficient margin by taking into account the permissible power dissipation (PD) in actual operating conditions.

4) Short circuit between pins and malfunctions
Ensure that when mounting the IC on the PCB the direction and position are correct. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

5) Operation in strong magnetic field
Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

6) Power ON sequence
To turn ON the DVDD, be sure to reset at CMD_RS register.

7) Thermal shutdown
The IC incorporates a built-in thermal shutdown circuit, which is designed to turn off the IC when the internal temperature of the IC reaches a specified value. It is not designed to protect the IC from damage or guarantee its operation. Do not continue to operate the IC after this function is activated. Do not use the IC in conditions where this function will always be activated.

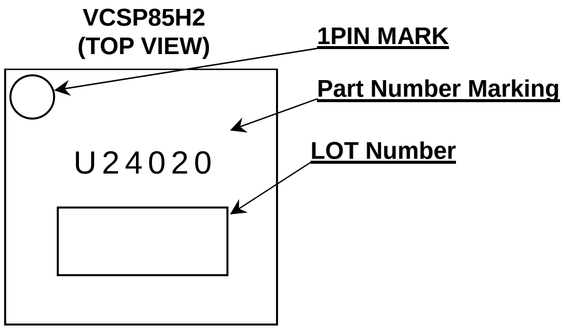
8) PI drive circuit
The output voltage of PIOUT should not exceed the voltage of the power supply voltage DVDD.

●Ordering Information

B U 2 4 0 2 0 G U - E 2

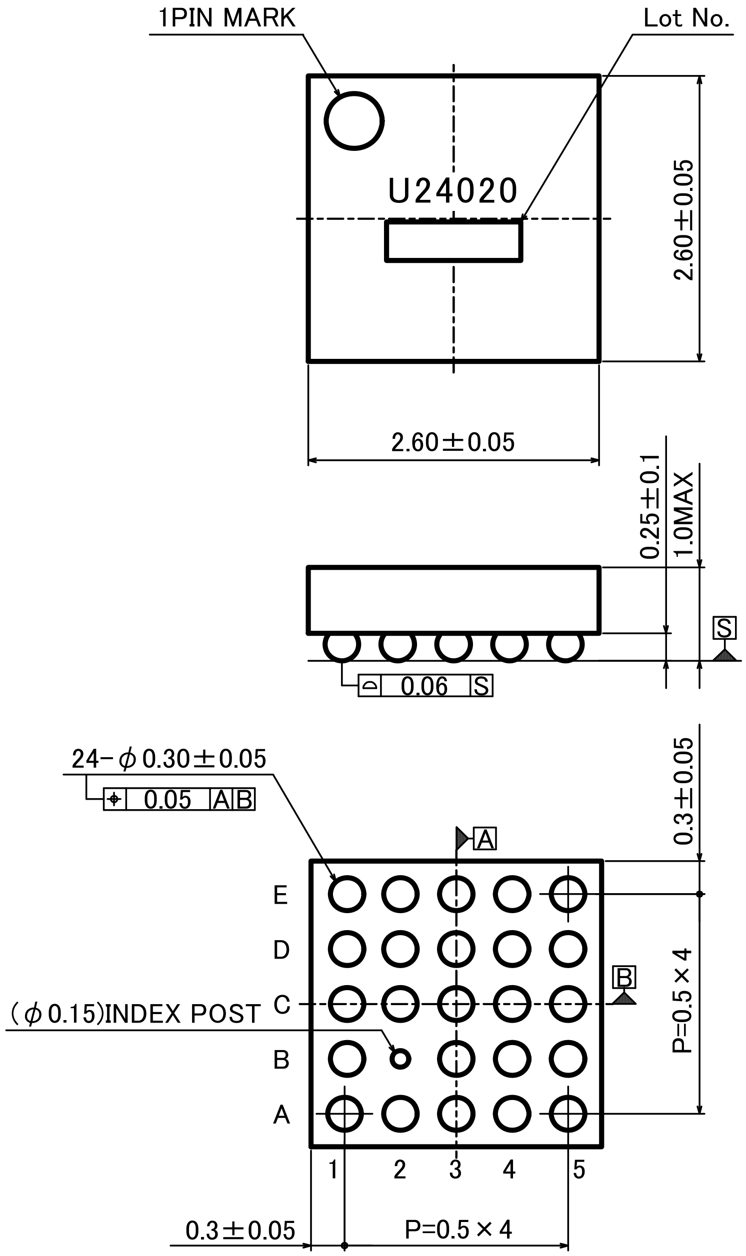
- Part Number: BU24020
- Package: GU : VCSP85H2
- Packaging and forming specification: E2: Embossed tape and reel

●Marking Diagram

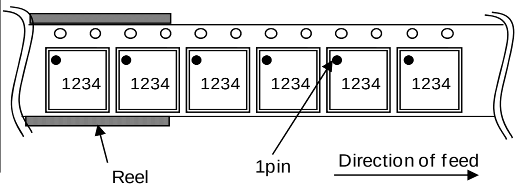


●**Physical Dimension Tape and Reel Information**

Package Name	VCSP85H2



Tape	Embossed carriertape
Quantity	3,000pcs/Real
Direction of feed	E2 (The direction is 1pin product is at the upper left when you hold reel on the hand and you pull out the tape on the right hand)



●Revision History

Date	Revision	Changes
26.Sep.2012	001	New Release
18.Apr.2013	002	Update some English words, sentences, descriptions, grammar and formatting.

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

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General Precaution

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LifeElectronics

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ООО «ЛайфЭлектроникс» "LifeElectronics" LLC

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- *Специальные условия для постоянных клиентов.*
- *Подбор аналогов.*
- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
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