

Motor Drivers for Digital Still Cameras

# 6-Channel System Lens Driver for Digital Still Cameras

BD6373GW

### General Description

The BD6373GW is a motor driver that integrates 6 Full-ON type H-Bridges. The device is intended to drive a stepping motor for auto focus system, and another stepping motor for either zoom or iris. It can also be used to drive an actuator of the new system like a lens barrier.

### Features

- Low ON-Resistance Power CMOS Output
- Drive Mode Switch Function
- Under Voltage Locked Out Protection & Thermal Shut Down Circuit

### Applications

- Mobile system
- Home appliance
- Amusement system, etc

### Key Specifications

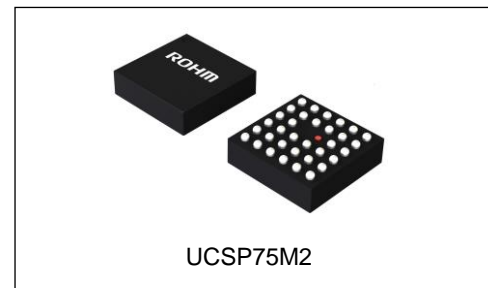
- Power Supply Voltage Range: 2.5V to 5.5V
- Motor Power Supply Voltage Range: 2.5V to 5.5V
- Circuit Current(No Signal & No Load): 1.0mA(Typ)
- Control Input Voltage: 0V to V<sub>CC</sub>V
- H-Bridge Output Current: -0.5A/ch to +0.5A/ch
- Output ON-Resistance(Each Channel): 1.2Ω(Typ)
- Operating Temperature Range: -25°C to +85°C

### Package

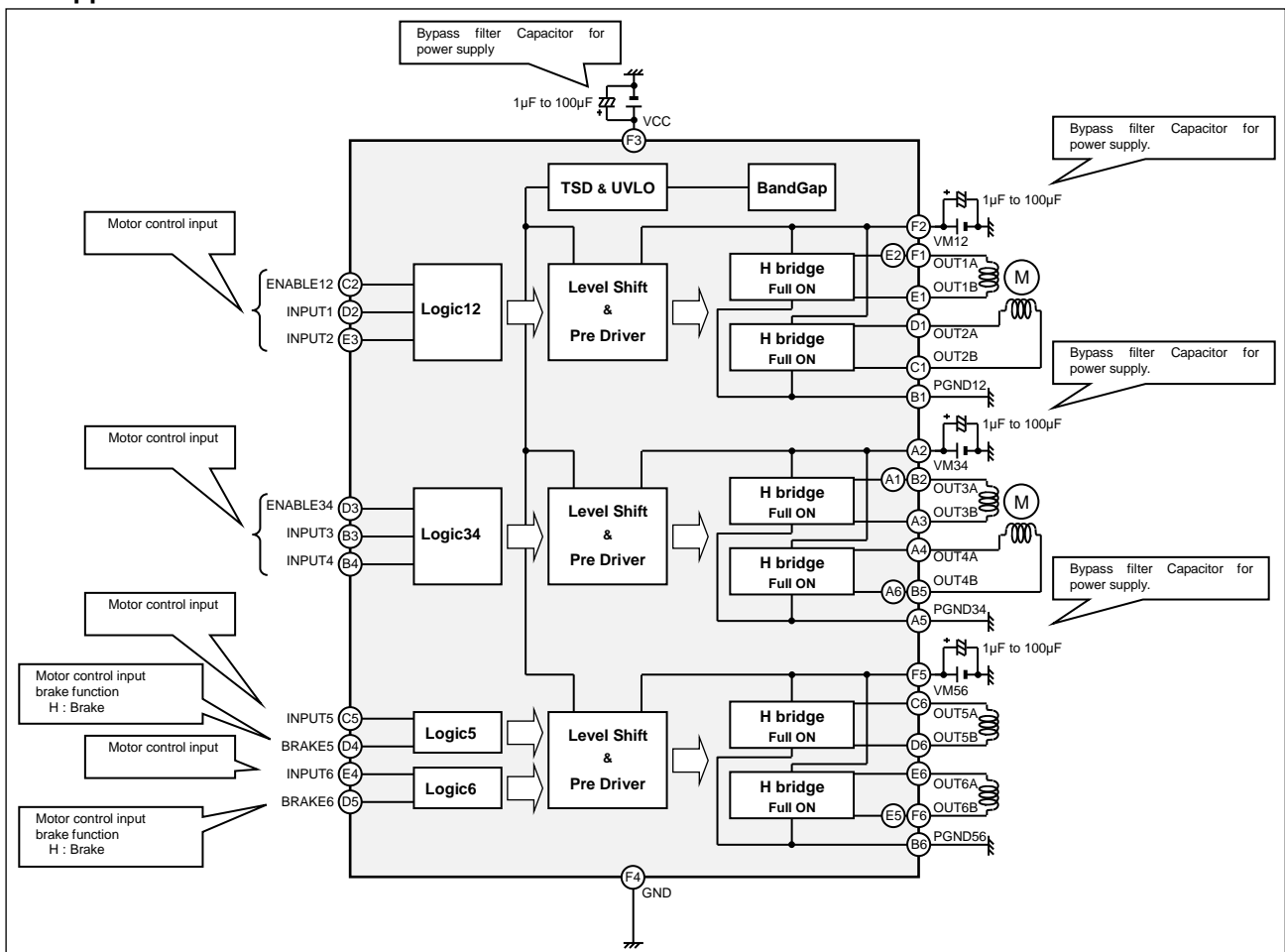
UCSP75M2

W(Typ) x D(Typ) x H(Max)

2.60mm x 2.60mm x 0.85mm



### Typical Application Circuit



○Product structure : Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

## Pin Configurations

(TOP VIEW)

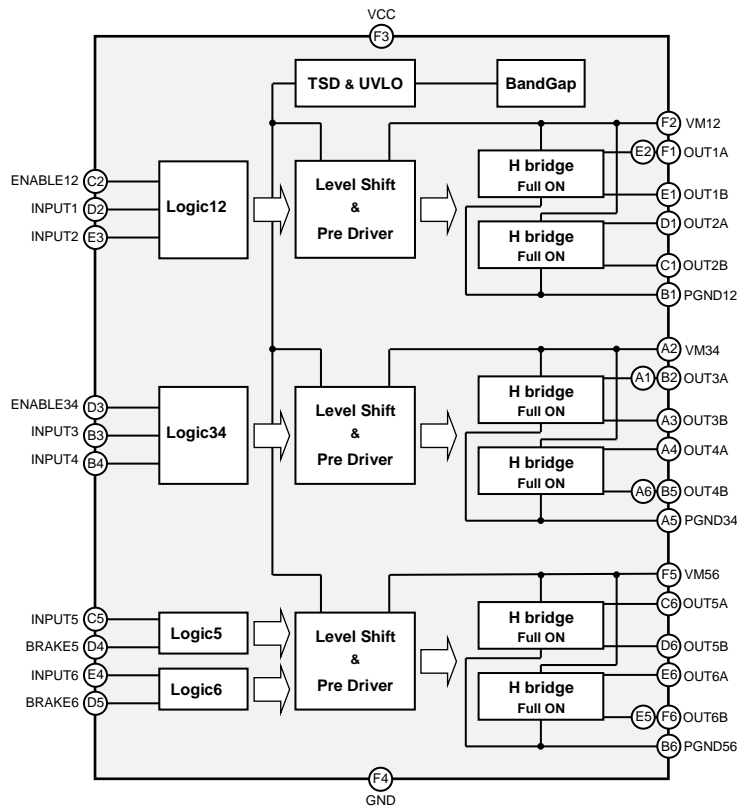
	1	2	3	4	5	6
A	OUT3A	VM34	OUT3B	OUT4A	PGND34	OUT4B
B	PGND12	OUT3A	INPUT3	INPUT4	OUT4B	PGND56
C	OUT2B	ENABLE12	INDEX POST		INPUT5	OUT5A
D	OUT2A	INPUT1	ENABLE34	BRAKE5	BRAKE6	OUT5B
E	OUT1B	OUT1A	INPUT2	INPUT6	OUT6B	OUT6A
F	OUT1A	VM12	VCC	GND	VM56	OUT6B

The pins of the same name, such as OUT3A, OUT4B, OUT1A, and OUT6B, must be shorted on printed circuit boards.

## Pin Descriptions

Pin No.	Pin Name	Function	Pin No.	Pin Name	Function
A1	OUT3A	H-bridge output 3A	D1	OUT2A	H-bridge output 2A
A2	VM34	Motor power supply ch.3 & ch.4	D2	INPUT1	Control logic input 1
A3	OUT3B	H-bridge output 3B	D3	ENABLE34	Control logic input ch.3 & ch.4
A4	OUT4A	H-bridge output 4A	D4	BRAKE5	Control logic input ch.5
A5	PGND34	Motor ground ch.3 & ch.4	D5	BRAKE6	Control logic input ch.6
A6	OUT4B	H-bridge output 4B	D6	OUT5B	H-bridge output 5B
B1	PGND12	Motor ground ch.1 & ch.2	E1	OUT1B	H-bridge output 1B
B2	OUT3A	H-bridge output 3A	E2	OUT1A	H-bridge output 1A
B3	INPUT3	Control logic input 3	E3	INPUT2	Control logic input 2
B4	INPUT4	Control logic input 4	E4	INPUT6	Control logic input 6
B5	OUT4B	H-bridge output 4B	E5	OUT6B	H-bridge output 6B
B6	PGND56	Motor ground ch.5 & ch.6	E6	OUT6A	H-bridge output 6A
C1	OUT2B	H-bridge output 2B	F1	OUT1A	H-bridge output 1A
C2	ENABLE12	Control logic input ch.1 & ch.2	F2	VM12	Motor power supply ch.1 & ch.2
C3	INDEX POST		F3	VCC	Power supply
C4	-		F4	GND	Ground
C5	INPUT5	Control logic input 5	F5	VM56	Motor power supply ch.5 & ch.6
C6	OUT5A	H-bridge output 5A	F6	OUT6B	H-bridge output 6B

## Block Diagram



## Description of Blocks

## 1. Motor Control Input

## (a) ENABLE12, ENABLE34, INPUT1 to INPUT6 Pins

Logic level controls the output logic of H-Bridge.

(See the Electrical Characteristics; p.4/12, and I/O Truth Table; p.5/12)

## (b) BRAKE5 &amp; BRAKE6 Pins

Logic high puts the device in short brake mode.

(See the Electrical Characteristics; p.4/12 and I/O Truth Table; p.5/12)

## 2. H-Bridge

Each H-bridge can be controlled independently. It is therefore possible to drive the H-bridges simultaneously, as long as the package thermal tolerances are not exceeded. Because the respective output transistors consist of power CMOS which consumes a motor power supply  $V_M$ , the ON-Resistance value of high and low-side total is dependent on  $V_M$  voltage. Further, the whole application must be designed so that the maximum current of each channel may be 500mA or below. (See the Recommended Operating Conditions; p.4/12)

**Absolute Maximum Ratings (Ta=25°C)**

Parameter	Symbol	Limit	Unit
Power Supply Voltage	V <sub>CC</sub>	-0.5 to +6.5	V
Motor Power Supply Voltage	V <sub>M</sub>	-0.5 to +6.5	V
Control Input Voltage	V <sub>IN</sub>	-0.5 to +V <sub>CC</sub> +0.5	V
Power Dissipation	P <sub>d</sub>	0.94 (Note 1)	W
H-bridge Output Current	I <sub>OUT</sub>	-0.8 to +0.8 (Note 2)	A/ch
Storage Temperature Range	T <sub>stg</sub>	-55 to +150	°C
Junction Temperature	T <sub>jmax</sub>	150	°C

(Note 1) Reduced by 7.52mW/°C over 25°C, when mounted on a glass epoxy board (50mm x 58mm x 1.75mm; 8layers)

(Note 2) Must not exceed P<sub>d</sub>, A<sub>SO</sub>, or T<sub>jmax</sub> of 150°C

**Caution:** Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

**Recommended Operating Conditions**

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V <sub>CC</sub>	2.5	-	5.5	V
Motor Power Supply Voltage	V <sub>M</sub>	2.5	-	5.5	V
Control Input Voltage	V <sub>IN</sub>	0	-	V <sub>CC</sub>	V
H-bridge Output Current <sup>(Note 3)</sup>	I <sub>OUT</sub>	-0.5	-	+0.5	A/ch
Operating Temperature Range	T <sub>opr</sub>	-25	-	+85	°C

(Note 3) Must not exceed P<sub>d</sub>, A<sub>SO</sub>, or T<sub>jmax</sub> of 150°C

**Electrical Characteristics (Unless otherwise specified V<sub>CC</sub>=3.0V, V<sub>M</sub>=5.0V, Ta=25°C)**

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
All Circuits						
Circuit Current	I <sub>CC</sub>	-	1.0	1.9	mA	No signal and no load
Control Input (IN=ENABLE12, ENABLE34, INPUT1 to INPUT6, BRAKE5, BRAKE6)						
High-Level Input Voltage	V <sub>INH</sub>	2.0	-	V <sub>CC</sub>	V	
Low-Level Input Voltage	V <sub>INL</sub>	0	-	0.7	V	
High-Level Input Current	I <sub>INH</sub>	15	30	60	μA	V <sub>IN</sub> =3V
Low-Level Input Current	I <sub>INL</sub>	-1	0	-	μA	V <sub>IN</sub> =0V
Under Voltage Locked Out (UVLO)						
UVLO Voltage	V <sub>UVLO</sub>	1.6	-	2.4	V	
Full ON Type H-Bridge Driver (Each Channel)						
Output ON-Resistance 1	R <sub>ON1</sub>	-	1.2	1.5	Ω	I <sub>OUT</sub> =±400mA, V <sub>M</sub> =5.0V, total
Output ON-Resistance 2	R <sub>ON2</sub>	-	1.5	2.0	Ω	I <sub>OUT</sub> =±400mA, V <sub>M</sub> =3.0V, total
Turn ON Time	t <sub>ON</sub>	-	0.55	1.95	μs	R <sub>L</sub> =20Ω
Turn OFF Time	t <sub>OFF</sub>	-	0.08	0.5	μs	R <sub>L</sub> =20Ω
Rise Time	t <sub>R</sub>	0.1	0.15	1.0	μs	R <sub>L</sub> =20Ω
Fall Time	t <sub>F</sub>	-	0.03	0.2	μs	R <sub>L</sub> =20Ω

Typical Performance Curves (Reference Data)

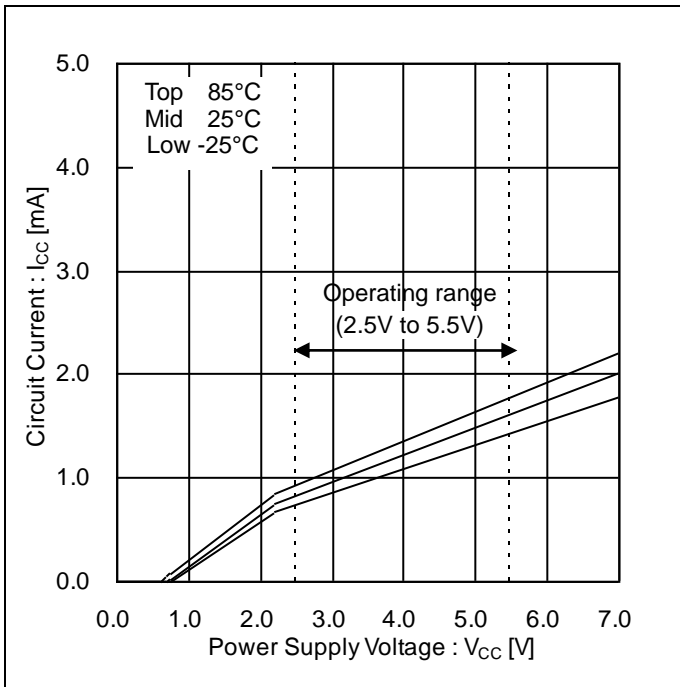


Figure 1.  
Circuit Current vs Supply Voltage

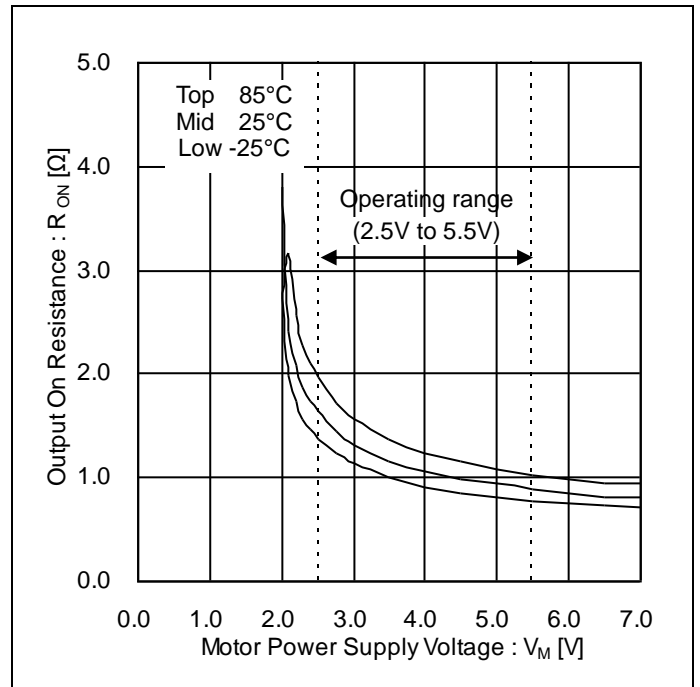


Figure 2.  
Output ON-Resistance vs Motor Power Supply Voltage

Timing Chart

Table 1. I/O Truth Table (Channel 1 & Channel 2)

Input Mode	INPUT		OUTPUT		
	ENABLE12	INPUTx	OUTxA	OUTxB	Output Mode <sup>(Note 4)</sup>
EN/IN	L	X	Z	Z	Open
	H	L	H	L	CW
	H	H	L	H	CCW

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

(Note 4) CW: Current flows from OUTxA to OUTxB, CCW: Current flows from OUTxB to OUTxA (x=1, 2)

Table 2. I/O Truth Table (Channel 3 & Channel 4)

Input Mode	INPUT		OUTPUT		
	ENABLE34	INPUTx	OUTxA	OUTxB	Output Mode <sup>(Note 5)</sup>
EN/IN	L	X	Z	Z	Open
	H	L	H	L	CW
	H	H	L	H	CCW

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

(Note 5) CW: Current flows from OUTxA to OUTxB, CCW: Current flows from OUTxB to OUTxA (x=3, 4)

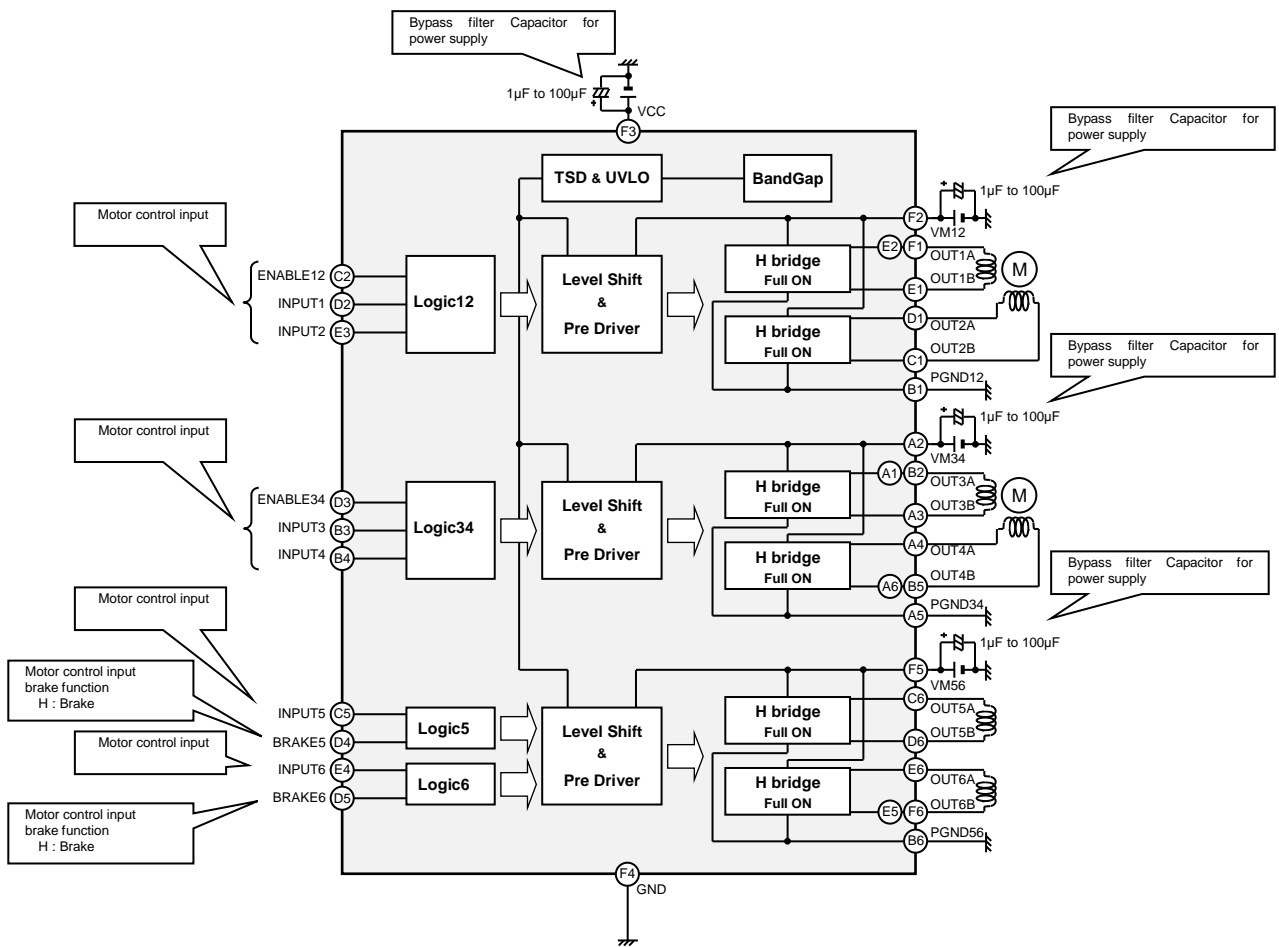
Table 3. I/O Truth Table (Channel 5 & Channel 6)

Input Mode	INPUT		OUTPUT		
	INPUTx	BRAKEx	OUTxA	OUTxB	Output Mode <sup>(Note 6)</sup>
IN/IN	L	L	H	L	CW
	H	L	L	H	CCW
	X	H	L	L	Short Brake

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

(Note 6) CW: Current flows from OUTxA to OUTxB, CCW: Current flows from OUTxB to OUTxA (x=5, 6)

Application Example



Selection of Components Externally Connected

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.

Power Dissipation

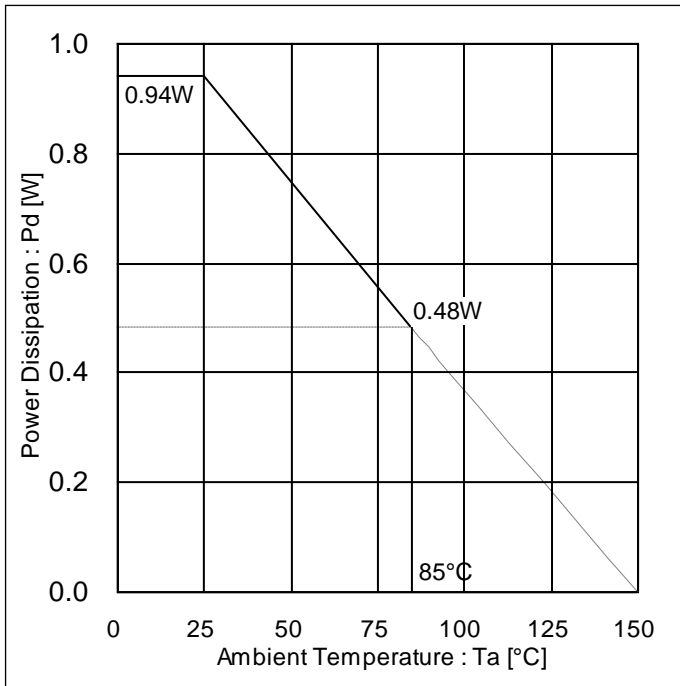
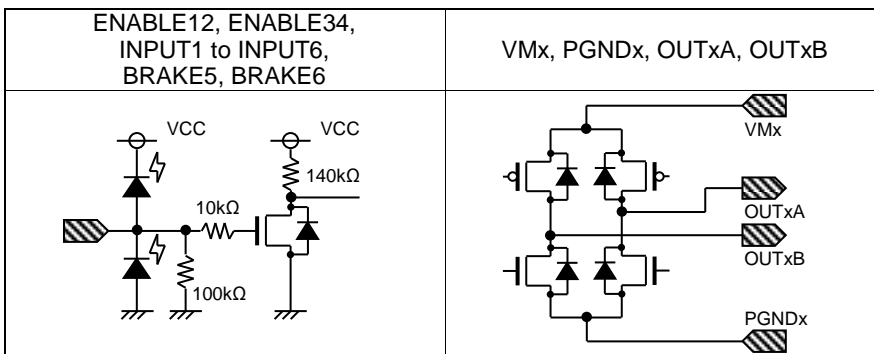


Figure 3.  
Power Dissipation vs Ambient Temperature

I/O Equivalent Circuits



## Operational Notes

### 1. Reverse Connection of Power Supply

Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

### 2. Power Supply Lines

Design the PCB layout pattern to provide low impedance supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

### 3. Ground Voltage

Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

### 4. Ground Wiring Pattern

When using both small-signal(GND) and large-current ground(PGND) traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

### 5. Thermal Consideration

Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

### 6. Recommended Operating Conditions

These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

### 7. Inrush Current

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

### 8. Operation Under Strong Electromagnetic Field

Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

### 9. Testing on Application Boards

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

### 10. Inter-pin Short and Mounting Errors

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. 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.

### 11. Unused Input Pins

Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.



## Operational Notes – continued

**12. Regarding the Input Pin of the IC**

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

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

When  $GND > Pin B$ , the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

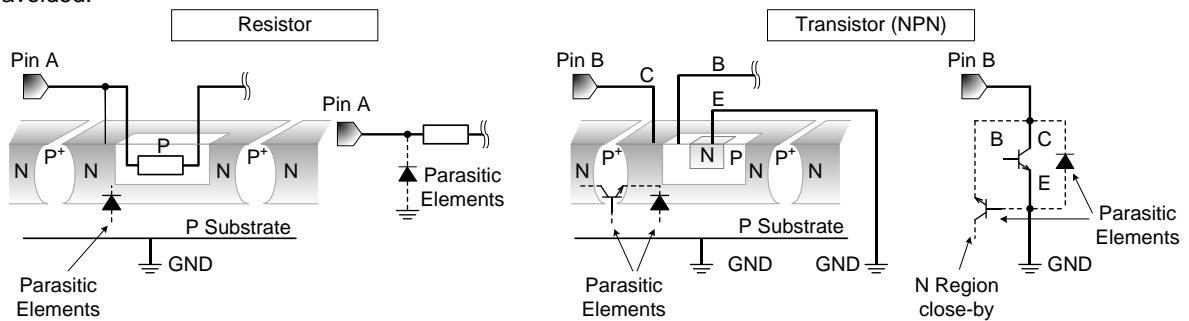


Figure 4.

Example of monolithic IC structure

**13. Ceramic Capacitor**

When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

**14. Area of Safe Operation (ASO)**

Operate the IC such that the output voltage, output current, and power dissipation are all within the Area of Safe Operation (ASO).

**15. Thermal Shutdown Circuit(TSD)**

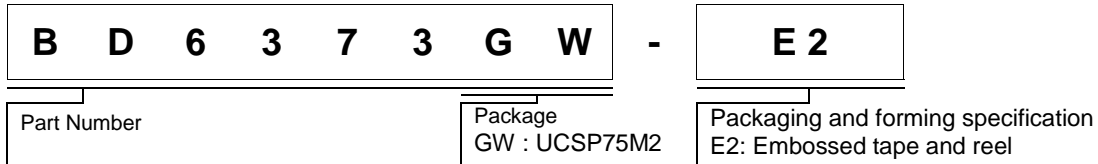
This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature ( $T_j$ ) will rise which will activate the TSD circuit that will turn OFF all output pins. When the  $T_j$  falls below the TSD threshold, the circuits are automatically restored to normal operation.

Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

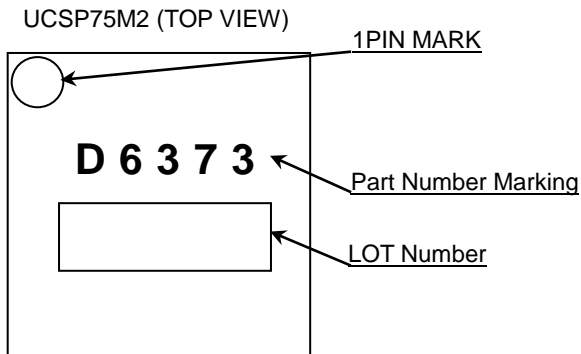
**16. Disturbance light**

In a device where a portion of silicon is exposed to light such as in a WL-CSP, IC characteristics may be affected due to photoelectric effect. For this reason, it is recommended to come up with countermeasures that will prevent the chip from being exposed to light.

Ordering Information



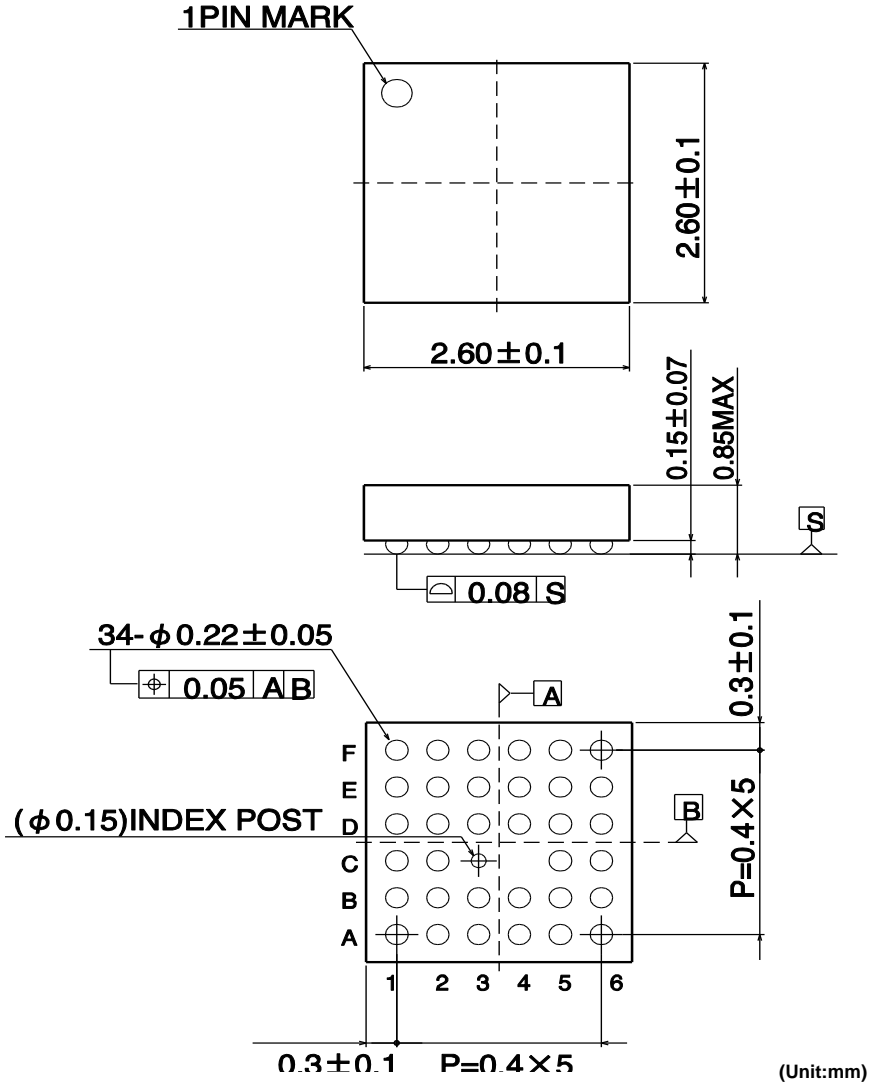
Marking Diagram



Part Number Marking	Package	Orderable Part Number
D6373	UCSP75M2	BD6373GW-E2

Physical Dimension, Tape and Reel Information

Package Name	UCSP75M2
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(Unit:mm)

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	E2 (The direction is the 1 pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

Reel → 1pin → Direction of feed →

\*Order quantity needs to be multiple of the minimum quantity.

**Revision History**

Date	Revision	Changes
09.Dec.2015	001	New Release

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CLASS IV		CLASS III	

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  - Use of the Products in places subject to dew condensation
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- Please verify and confirm characteristics of the final or mounted products in using the Products.
- 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.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

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1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
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  - [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.

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