DC Brushless Fan Motor Drivers

Multifunction Single-phase Full-wave Fan Motor Driver

BD6973FV-LB

General Description

This is the product guarantees long time support in Industrial market.
BD6973FV-LB is a pre-driver that controls the motor drive part composed of the power transistors. Moreover, a lot of functions are installed, and the pin is compatible with BD6974FV-LB (Lock alarm signal output).

Package

Package	W (Typ) x D (Typ) x H (Max)
SSOP-B16	5.00mm x 6.40mm x 1.35mm

SSOP-B16

Features

- Long Time Support Product for Industrial Applications
- Pre-driver for External Power Transistors
- Speed Controllable by DC / Direct PWM Input
- PWM Soft Switching
- Soft Start
- Quick Start
- Current Limit
- Lock Protection and Automatic Restart
- Rotation Speed Pulse Signal (FG) Output

Applications

- Industrial Equipment and Fan motors for general consumer equipment of desktop PC, and Server, etc.

Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Limit	Unit
Supply Voltage	Vcc	20	V
Power Dissipation	Pd	0.87 (Note 1)	W
Operating Temperature Range	Topr	–40 to +100	°C
Storage Temperature Range	Tstg	–55 to +150	°C
High Side Output Voltage	Voh	36	V
Low Side Output Voltage	Vol	15	V
Low Side Output Current	Iol	10	mA
Rotation Speed Pulse Signal (FG) Output Voltage	Vfg	20	V
Rotation Speed Pulse Signal (FG) Output Current	Ifg	10	mA
Reference Voltage (REF) Output Current	Iref	12	mA
Hall Bias (HB) Output Current	Ihb	12	mA
Input Voltage (H+, H–, TH, MIN, CS)	Vin	7	V
Junction Temperature	Tjmax	150	°C

(Note 1) Reduce by 7.0mW/°C over Ta=25°C. (On 70.0mm×70.0mm×1.6mm glass epoxy board)
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 (Ta=–40°C to +100°C)

Parameter	Symbol	Limit	Unit
Operating Supply Voltage Range	Vcc	4.3 to 17.0	V
Operating Input Voltage Range 1 (H+, H–) (More Than Vcc=9V)	Vin1	0 to 7	V
Operating Input Voltage Range 1 (H+, H–) (Less Than Vcc=9V)		0 to Vcc–2	V
Operating Input Voltage Range 2 (TH, MIN)	Vin2	0 to Vref	V

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

Pin Configuration

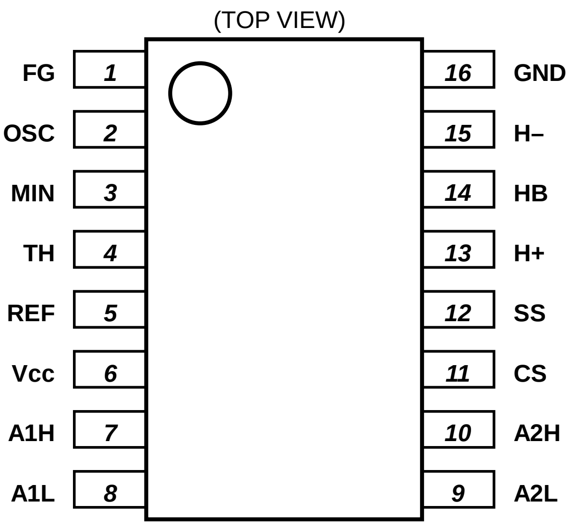


Figure 1. Pin Configuration

Pin Description

P/No.	P/Name	Function
1	FG	Speed pulse signal output pin
2	OSC	Oscillating capacitor connecting pin
3	MIN	Minimum output duty setting pin
4	TH	Output duty controllable input pin
5	REF	Reference voltage output pin
6	Vcc	Power supply pin
7	A1H	High side output 1 pin
8	A1L	Low side output 1 pin
9	A2L	Low side output 2 pin
10	A2H	High side output 2 pin
11	CS	Output current detection pin
12	SS	Soft start capacitor connecting pin
13	H+	Hall + input pin
14	HB	Hall bias pin
15	H–	Hall – input pin
16	GND	Ground pin

Block Diagram

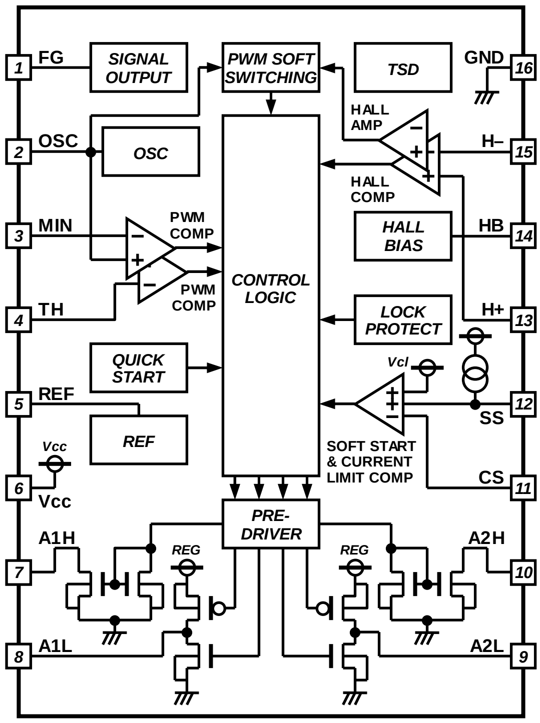


Figure 2. Block Diagram

I/O Truth Table

Hall Input		Driver Output				
H+	H–	A1H	A1L	A2H	A2L	FG
H	L	Hi-Z	H	L	L	Hi-Z
L	H	L	L	Hi-Z	H	L

H; High, L; Low, Hi-Z; High impedance
FG output is open-drain type.

Electrical Characteristics (Unless Otherwise Specified Ta=25°C, Vcc=12V)

Parameter	Symbol	Limit			Unit	Conditions	Ref. Data
		Min	Typ	Max			
Circuit Current	Icc	3	5	8	mA		Figure 3
Hall Input Hysteresis Voltage	Vhys	±5	±10	±15	mV		Figure 4
High Side Output Current	Ioh	9.0	12.0	16.5	mA	Voh=12V	Figure 5
High Side Output Leak Current	Iohl	-	-	10	μA	Voh=36V	Figure 6
Low Side Output High Voltage	Volh	9.3	9.5	-	V	Iol=–5mA	Figure 7, Figure 8
Low Side Output Low Voltage	Voll	-	0.5	0.7	V	Iol=5mA	Figure 9, Figure 10
Lock Detection ON Time	ton	0.20	0.30	0.45	s		Figure 11
Lock Detection OFF Time	toff	4.0	6.0	9.0	s		Figure 12
FG Output Low Voltage	Vfgl	-	-	0.3	V	Ifg=5mA	Figure 13, Figure 14
FG Output Leak Current	Ifgl	-	-	10	μA	Vfg=17V	Figure 15
OSC High Voltage	Vosch	2.3	2.5	2.7	V		Figure 16
OSC Low Voltage	Voscl	0.8	1.0	1.2	V		Figure 16
OSC Charge Current	Icosc	–55	–40	–25	μA		Figure 17
OSC Discharge Current	Idosc	25	40	55	μA		Figure 17
Output ON Duty 1	Poh1	75	80	85	%	Vth=Vref x 0.26 Pull up resistance 1kΩ, OSC=470pF	-
Output ON Duty 2	Poh2	45	50	55	%	Vth=Vref x 0.35 Pull up resistance 1kΩ, OSC=470pF	-
Output ON Duty 3	Poh3	15	20	25	%	Vth=Vref x 0.44 Pull up resistance 1kΩ, OSC=470pF	-
Reference Voltage	Vref	4.8	5.0	5.2	V	Iref=–2mA	Figure 18, Figure 19
Hall Bias Voltage	Vhb	1.10	1.26	1.50	V	Ihb=–2mA	Figure 20, Figure 21
Current Limit Setting Voltage	Vcl	120	150	180	mV		Figure 22
SS Charge Current	Iss	–300	–120	–50	nA	Vss=0V	Figure 23
TH Input Bias Current	Ith	-	-	–0.2	μA	Vth=0V	Figure 24
MIN Input Bias Current	Imin	-	-	–0.2	μA	Vmin=0V	Figure 25
CS Input Bias Current	Ics	-	-	–0.2	μA	Vcs=0V	Figure 26

About a current item, define the inflow current to IC as a positive notation, and the outflow current from IC as a negative notation.

Typical Performance Curves (Reference Data)

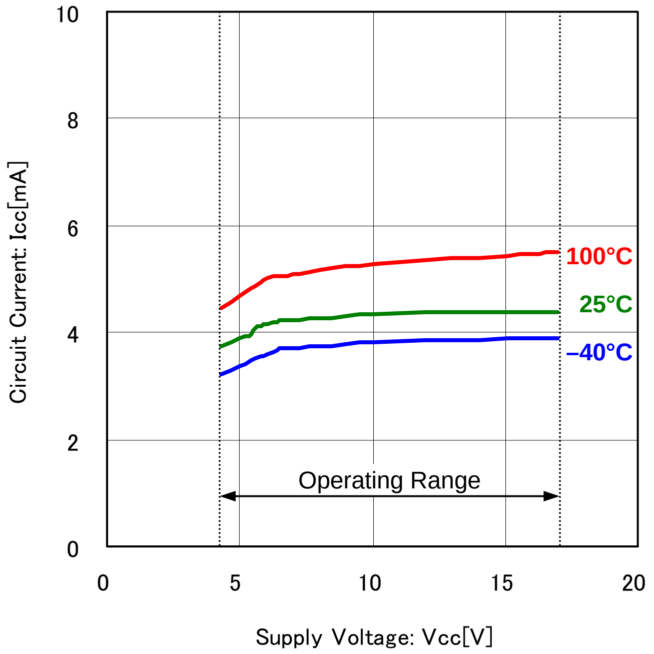


Figure 3. Circuit Current vs Supply Voltage

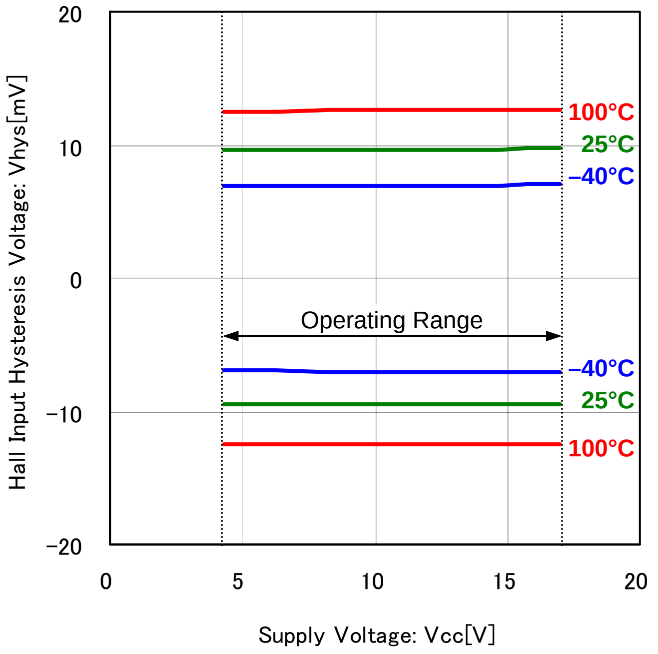


Figure 4. Hall Input Hysteresis Voltage vs Supply Voltage

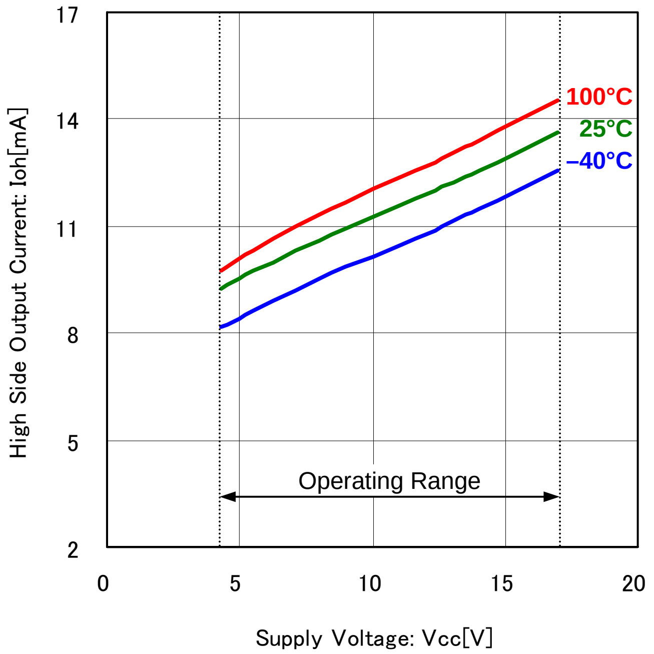


Figure 5. High Side Output Current vs Supply Voltage

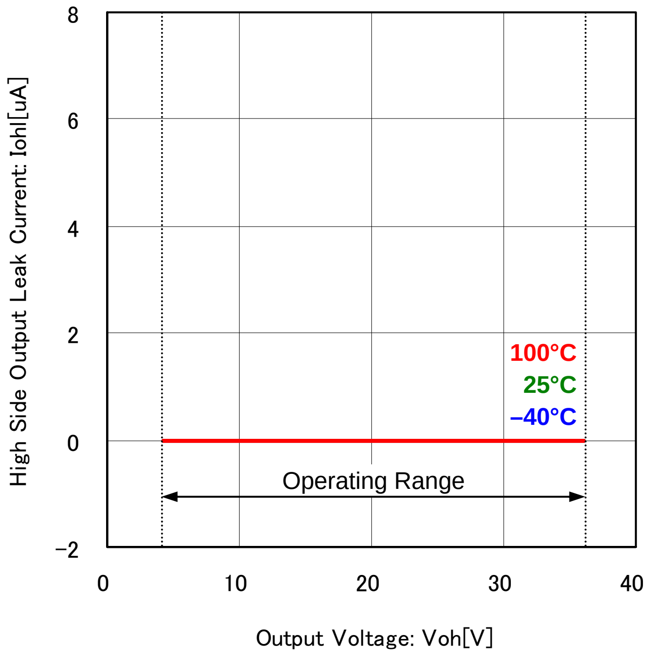


Figure 6. High Side Output Leak Current vs Output Voltage

Typical Performance Curves (Reference Data)

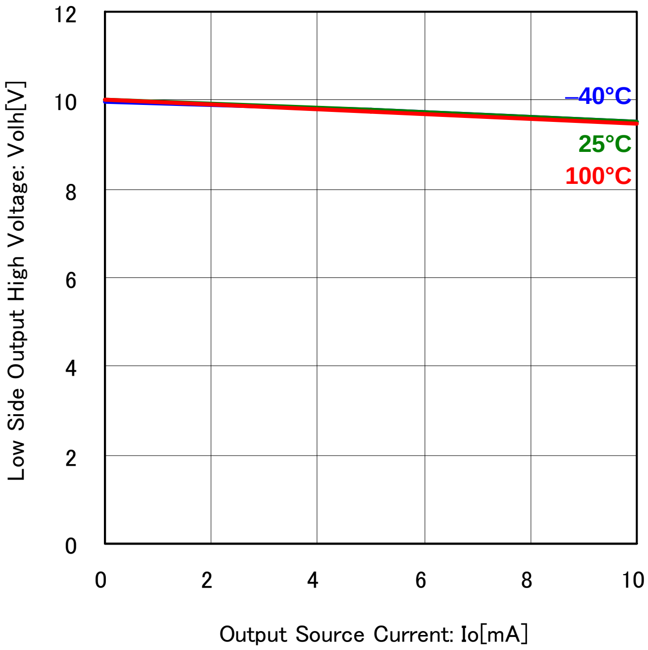


Figure 7. Low Side Output High Voltage vs Output Source Current (Vcc=12V)

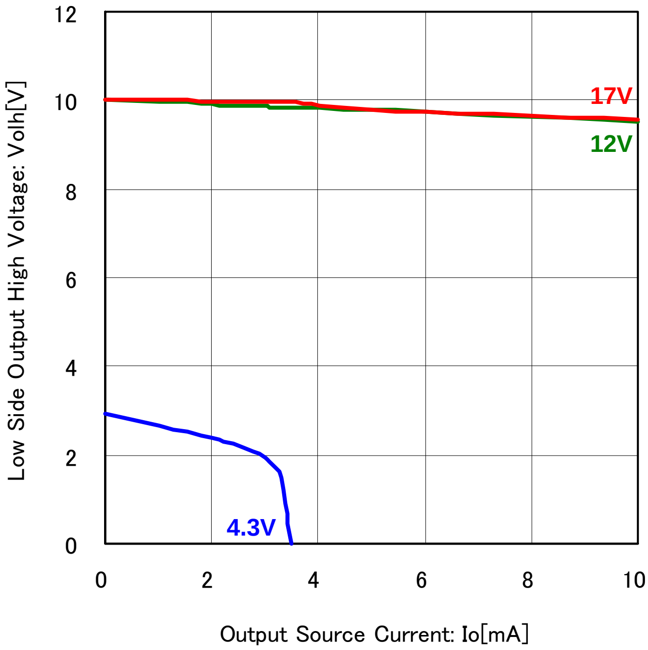


Figure 8. Low Side Output High Voltage vs Output Source Current (Ta=25°C)

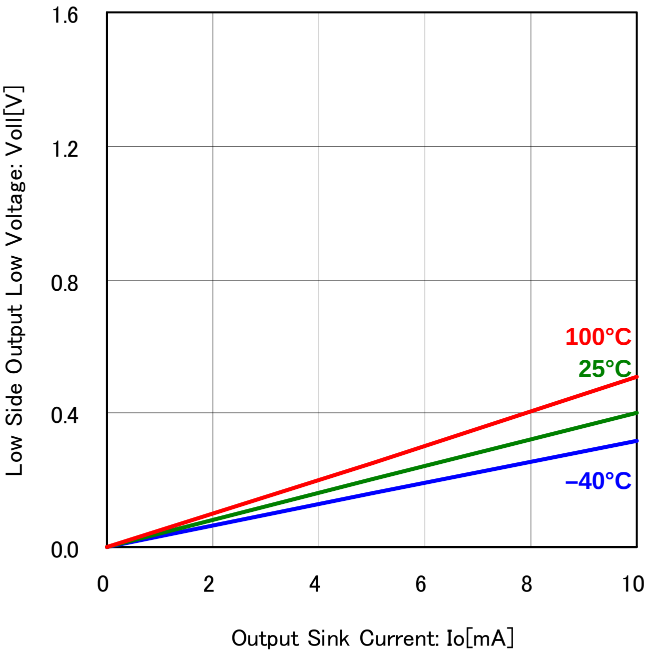


Figure 9. Low Side Output Low Voltage vs Output Sink Current (Vcc=12V)

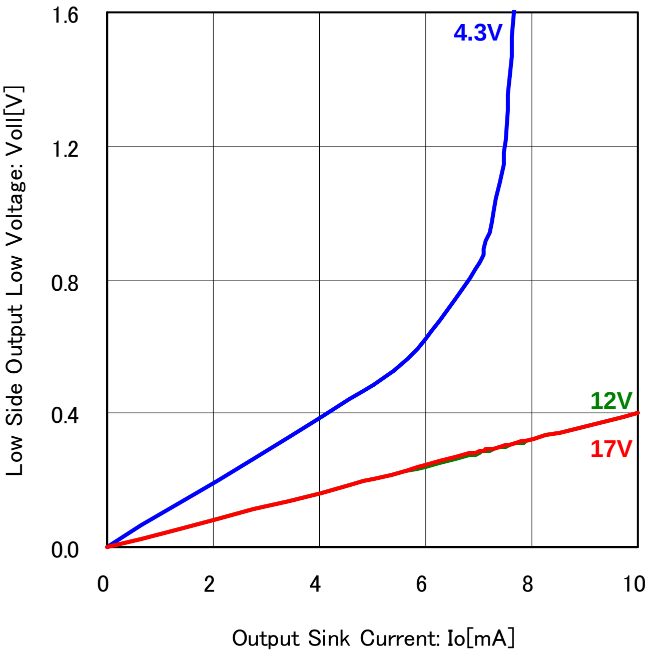


Figure 10. Low Side Output Low Voltage vs Output Sink Current (Ta=25°C)

Typical Performance Curves (Reference Data)

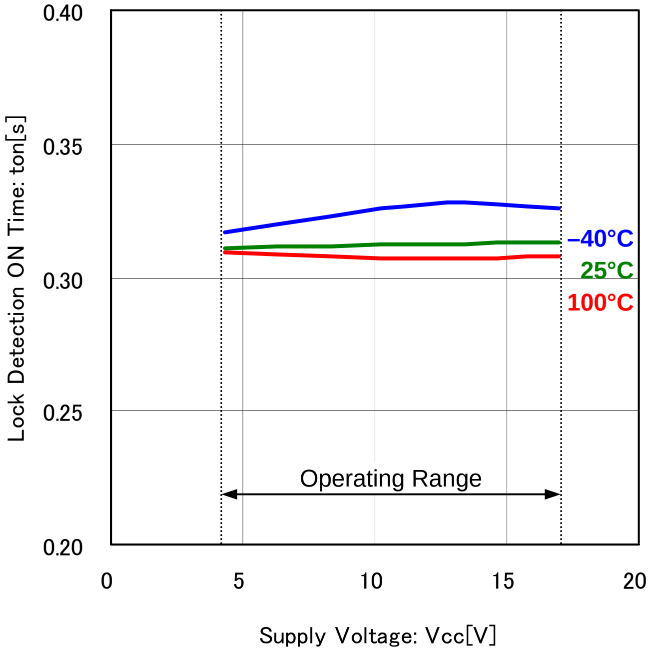


Figure 11. Lock Detection ON Time vs Supply Voltage

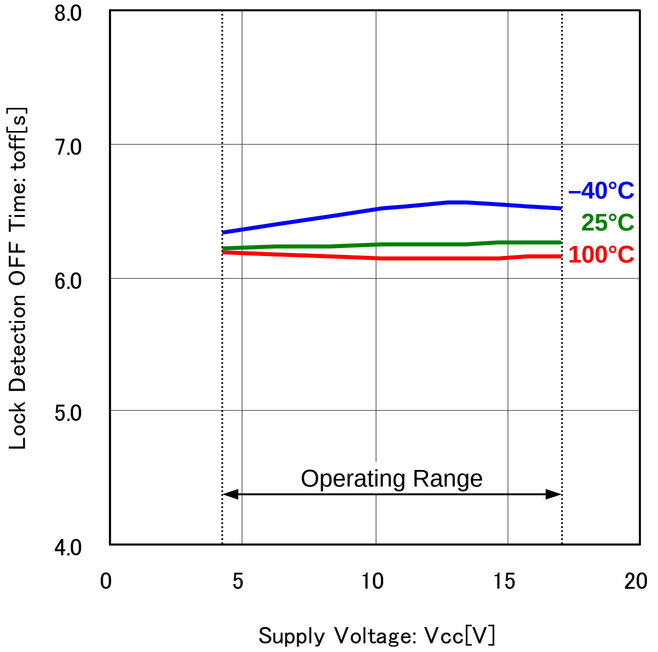


Figure 12. Lock Detection OFF Time vs Supply Voltage

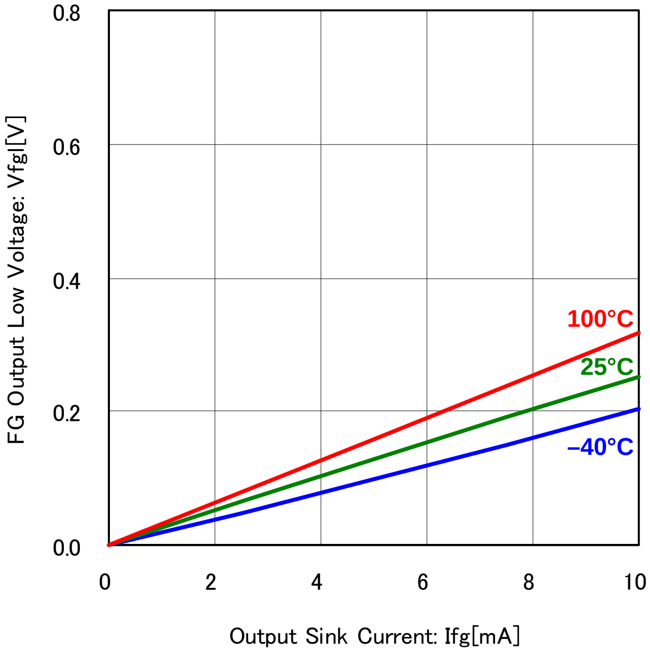


Figure 13. FG Output Low Voltage vs Output Sink Current (Vcc=12V)

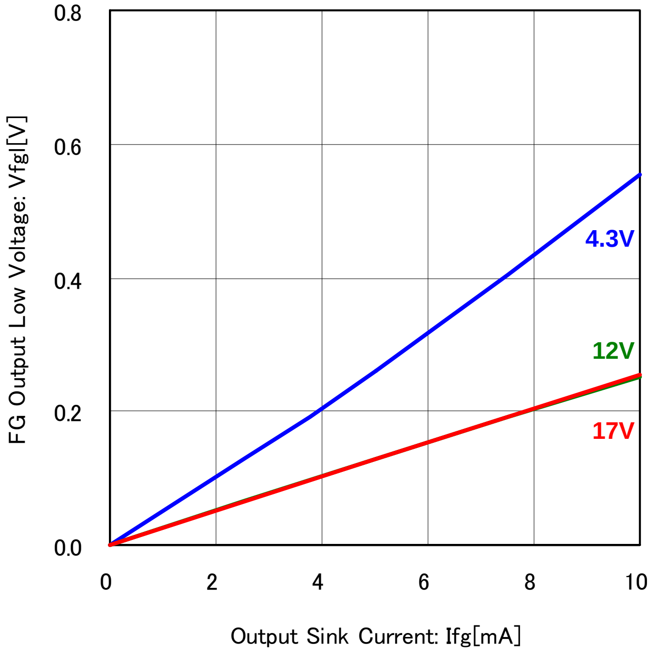


Figure 14. FG Output Low Voltage vs Output Sink Current (Ta=25°C)

Typical Performance Curves (Reference Data)

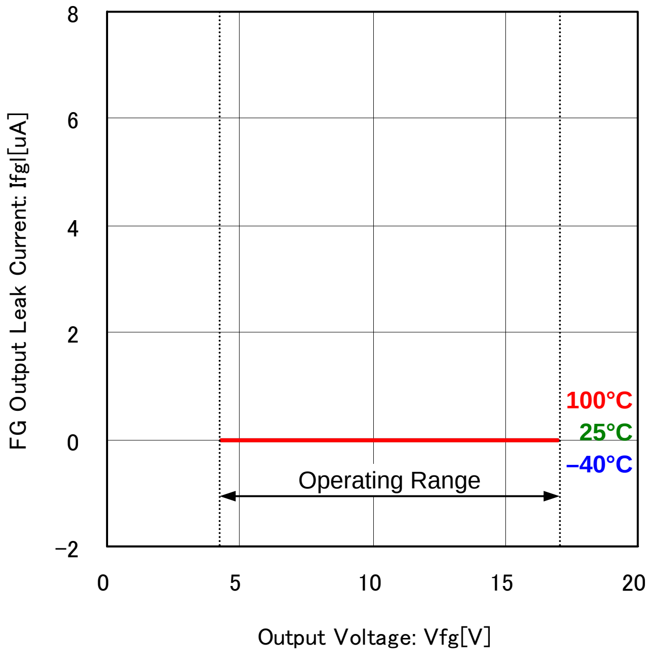


Figure 15. FG Output Leak Current vs Output Voltage

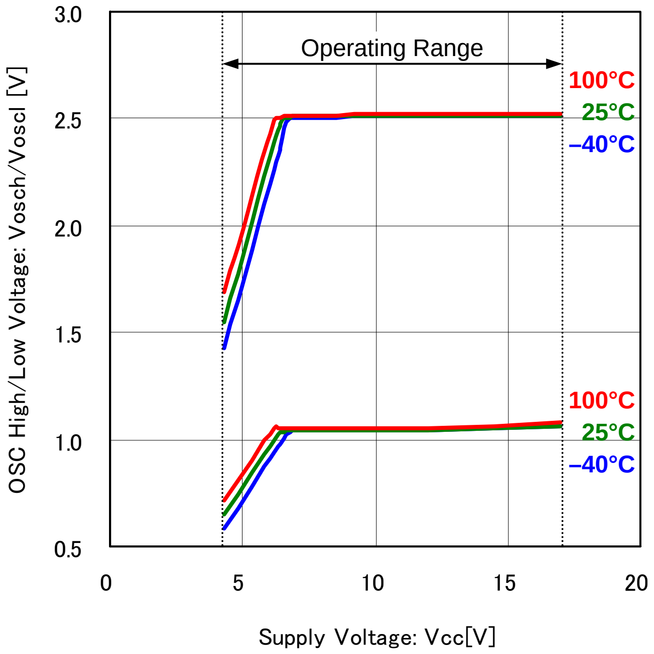


Figure 16. OSC High/Low Voltage vs Supply Voltage

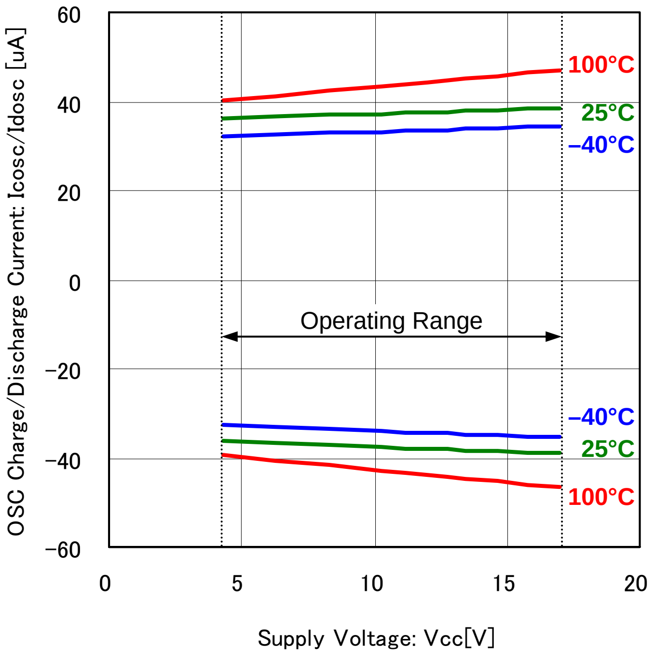


Figure 17. OSC Charge/Discharge Current vs Supply Voltage

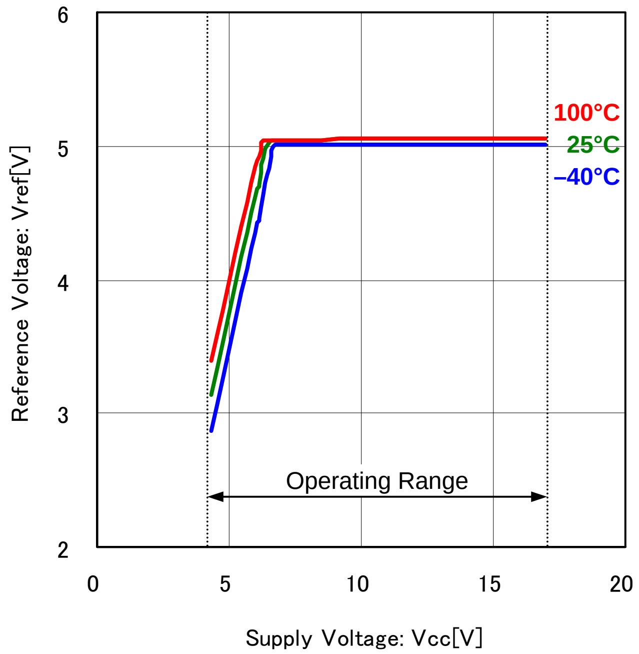


Figure 18. Reference Voltage vs Supply Voltage

Typical Performance Curves (Reference Data)

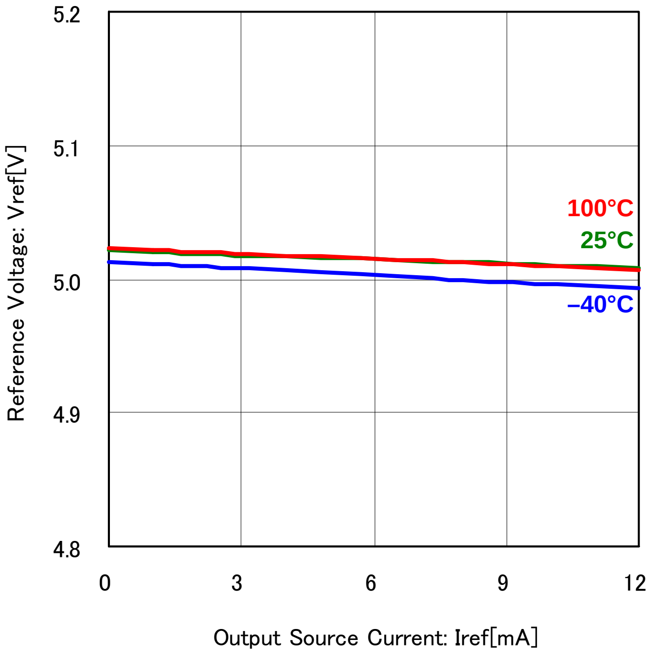


Figure 19. Reference Voltage vs Output Source Current (Vcc=12V)

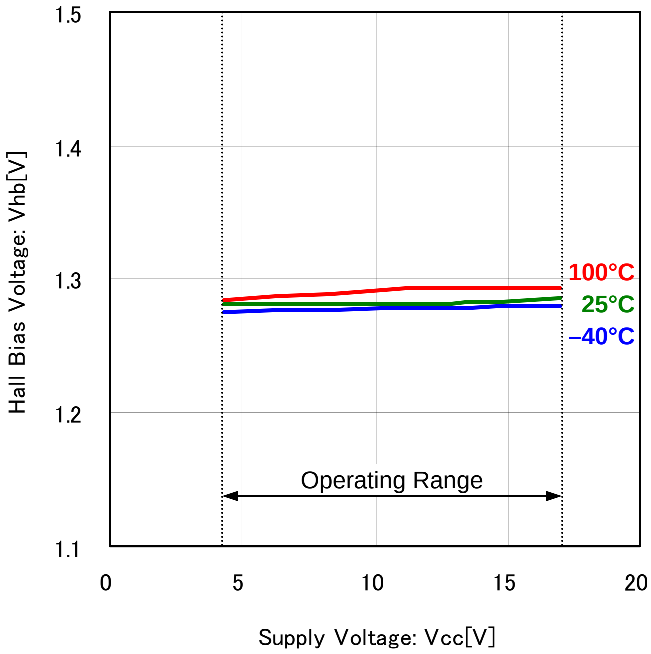


Figure 20. Hall Bias Voltage vs Supply Voltage

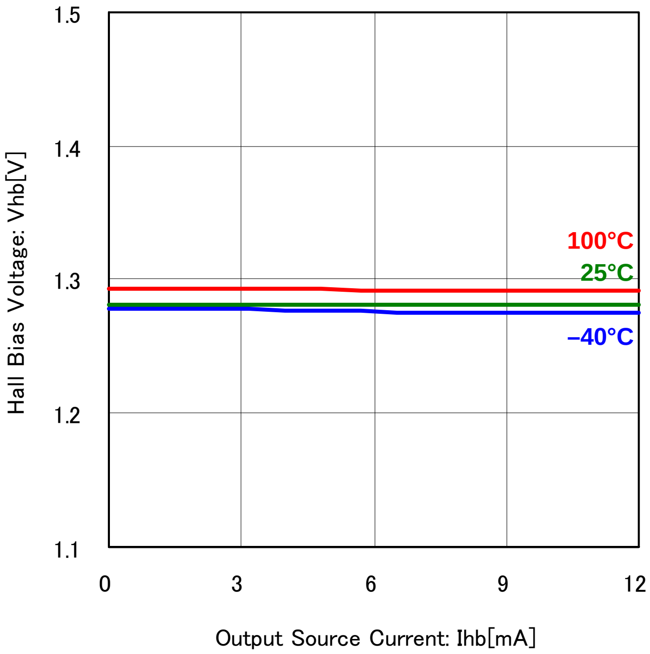


Figure 21. Hall Bias Voltage vs Output Source Current (Vcc=12V)

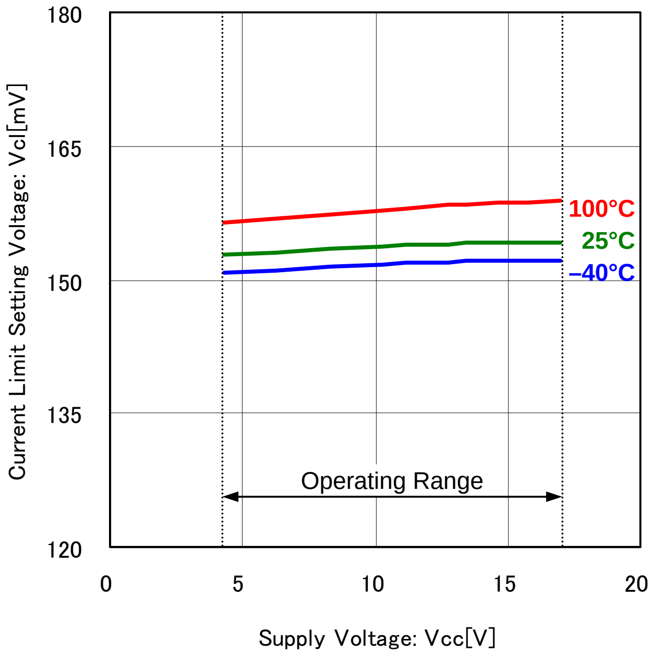


Figure 22. Current Limit Setting Voltage vs Supply Voltage

Typical Performance Curves (Reference Data)

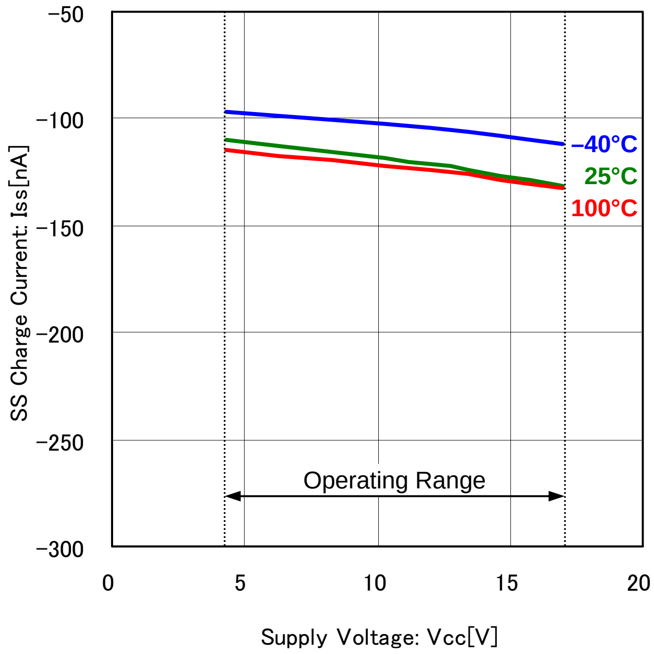


Figure 23. SS Charge Current vs Supply Voltage

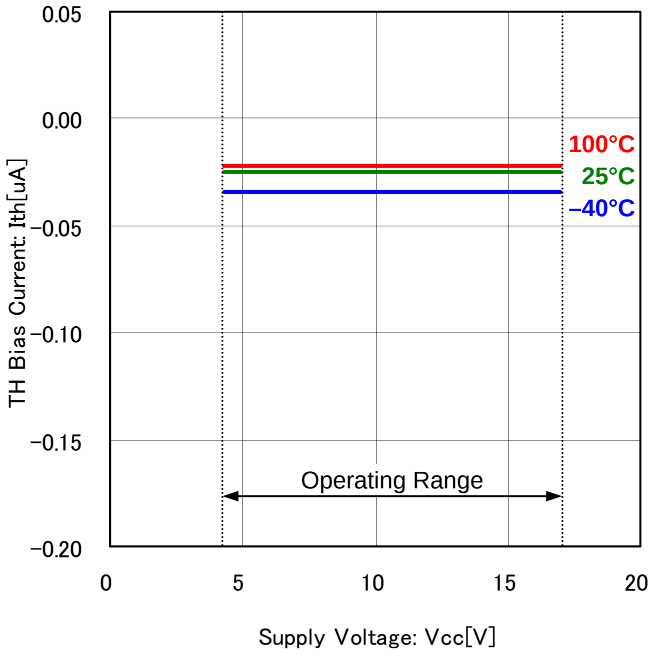


Figure 24. TH Bias Current vs Supply Voltage

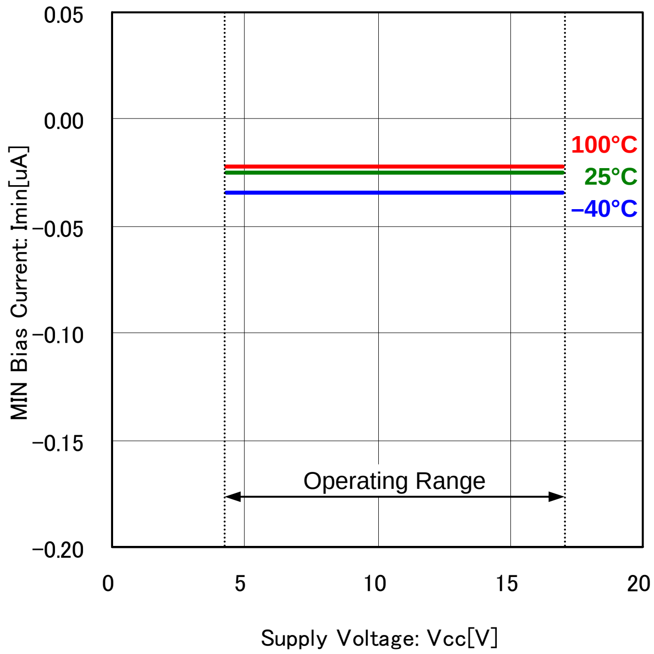


Figure 25. MIN Bias Current vs Supply Voltage

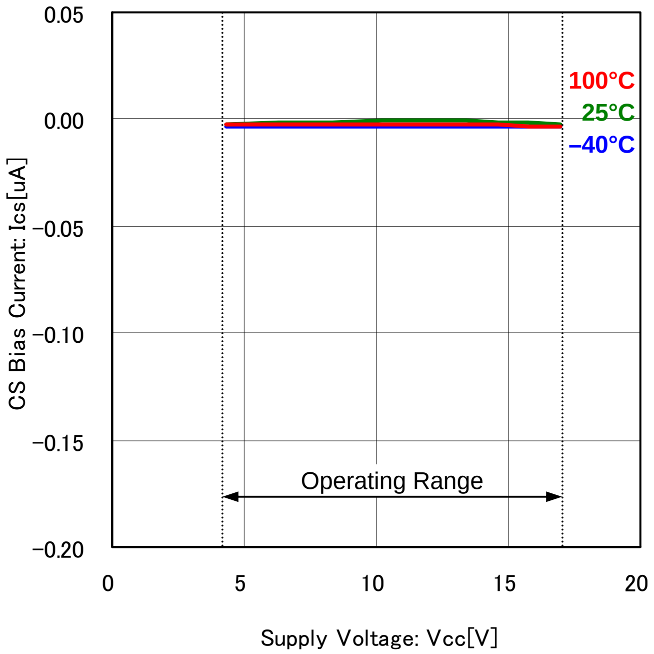


Figure 26. CS Bias Current vs Supply Voltage

Application Example (Constant values are for reference)

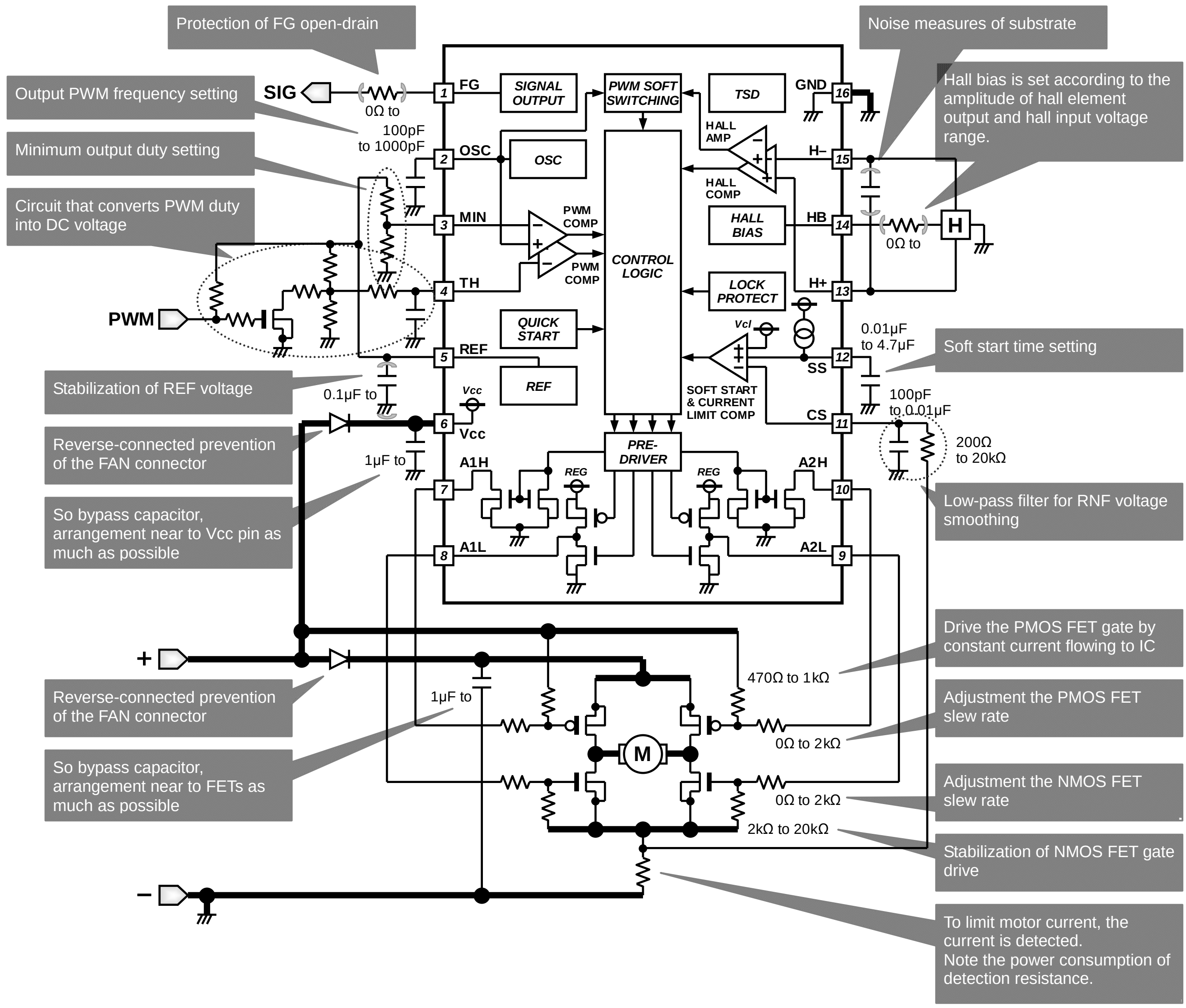


Figure 27. PWM Controllable 4 Wires Type Motor Application

Substrate Design Note

(a) Motor power and ground lines are made as fat as possible.
(b) IC power line is made as fat as possible.
(c) IC ground line is common with the application ground except motor ground (i.e. hall ground etc.), and arranged near to (–) land.
(d) The bypass capacitors (Vcc side and Vm side) are arrangement near to Vcc pin and FETs, respectively.
(e) H+ and H– lines are arranged side by side and made from the hall element to IC as shorter as possible, because it is easy for the noise to influence the hall lines.

Safety Measure

1. Measures against Reverse-connection of Power Supply
   Because the current flows in the reverse-connection of the power supply in different pathways when it is normal, it causes IC destruction or deterioration. When reverse-connection is possible, reverse connection protection diode must be added between power supply and Vcc.

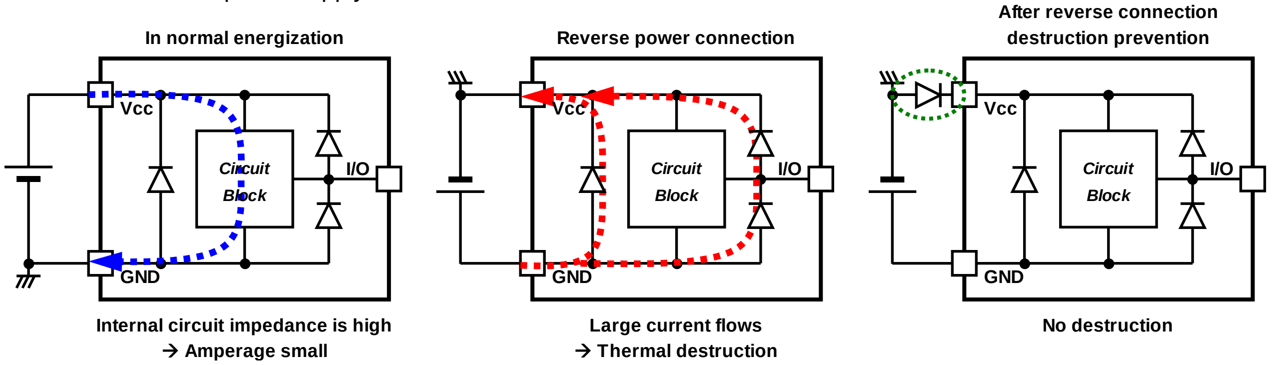


Figure 28. Flow of Current When Power Supply is Connected Reversely

2. Measure against Vcc Voltage Rise by Induction (Back) Electromotive Force
   Induction electromotive force (and/or Back electromotive force) generates regenerative current to power supply. However, when reverse connection protection diode is connected, or power supply doesn't have the current inflow ability with enough, Vcc and Motor driving outputs voltage rise at regenerative braking.

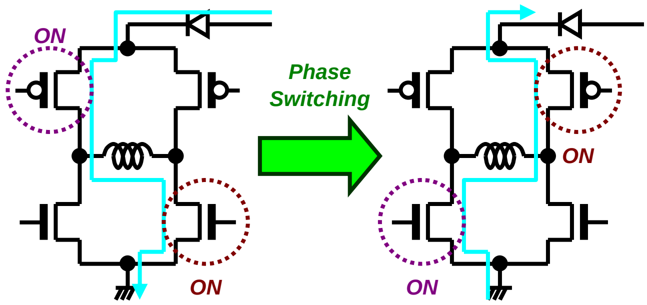


Figure 29. Vcc and Motor Driving Outputs Voltage Rise by Induction (Back) Electromotive Force

When the absolute maximum rated voltage may be exceeded due to voltage rise by induction electromotive force, place Capacitor or Zenner diode between Vcc and GND. If necessary, add both.

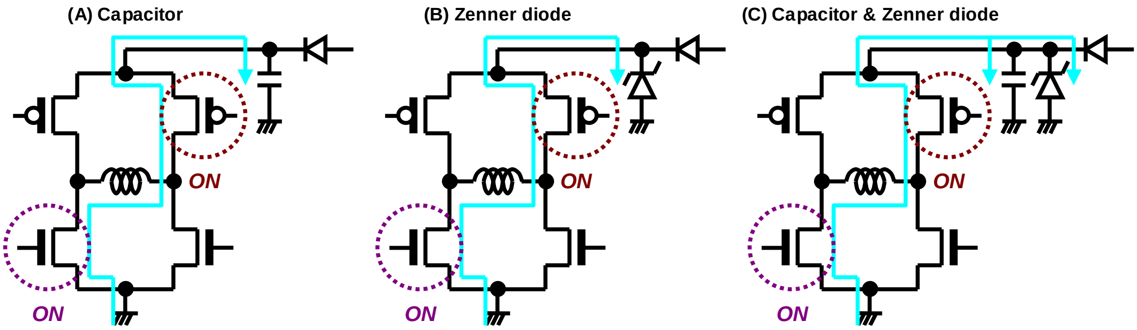


Figure 30. Measure against Vcc and Motor Driving Outputs Voltage Rise at Regenerative Braking

3. Problem of GND Line PWM Switching
   Do not perform PWM switching of GND line because GND pin potential cannot be kept to a minimum.

4. Protection of Rotation Speed Pulse (FG) and/or Lock Alarm (AL) Open-drain Output
   It is possible to protect it so as not to become destruction by putting the protection resistor in the motor unit when the connector is mistaken and it is connected directly with the power supply exceeding the absolute maximum rating.

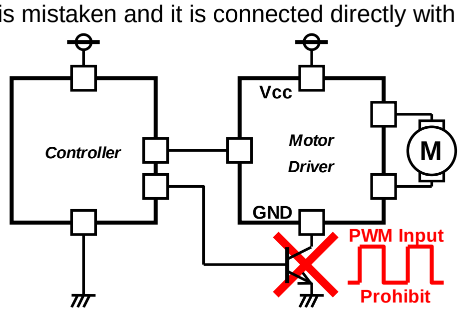


Figure 31. GND Line PWM Switching Prohibited

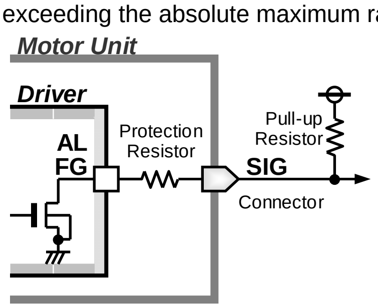


Figure 32. Protection of FG/AL Pin

Power Dissipation

1. Power Dissipation
   Power dissipation (total loss) indicates the power that can be consumed by IC at Ta=25°C (normal temperature). IC is heated when it consumes power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip into the package, that is junction temperature of the absolute maximum rating, depends on circuit configuration, manufacturing process, etc. Power dissipation is determined by this maximum joint temperature, the thermal resistance in the state of the substrate mounting, and the ambient temperature. Therefore, when a power dissipation that provides by the absolute maximum rating is exceeded, the operating temperature range is not a guarantee. The maximum junction temperature is in general equal to the maximum value in the storage temperature range.

2. Thermal Resistance
   Heat generated by consumed power of IC is radiated from the mold resin or lead frame of package. The parameter which indicates this heat dissipation capability (hardness of heat release) is called thermal resistance. In the state of the substrate mounting, thermal resistances from the chip junction to the ambience and to the package surface are shown respectively with θja[°C/W] and θjc[°C/W]. Thermal resistance is classified into the package part and the substrate part, and thermal resistance in the package part depends on the composition materials such as the mold resins and the lead frames. On the other hand, thermal resistance in the substrate part depends on the substrate heat dissipation capability of the material, the size, and the copper foil area etc. Therefore, thermal resistance can be decreased by the heat radiation measures to install the heat sink etc. in the mounting substrate.
   The thermal resistance model and calculations are shown in Figure 33, and Equation 1 and 2, respectively.

$$\theta ja = \frac{Tj - Ta}{P} \quad [^\circ\mathrm{C/W}] \text{ (Equation 1)}$$

$$\theta jc = \frac{Tj - Tc}{P} \quad [^\circ\mathrm{C/W}] \text{ (Equation 2)}$$

where:
θja is the thermal resistance from the chip junction to the ambience
θjc is the thermal resistance from the chip junction to the package surface
Tj is the junction temperature
Ta is the ambient temperature
Tc is the package surface temperature
P is the power consumption

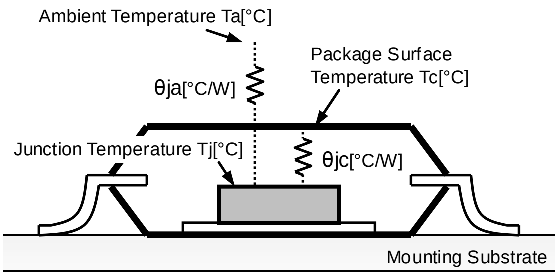


Figure 33. Thermal Resistance Model of Surface Mount

Even if it uses the same package, thermal resistance θja and θjc are changed depending on the chip size, power consumption, and the measurement environments of the ambient temperature, the mounting condition, and the wind velocity, etc. Thermal resistance under a certain regulated condition is shown in Table 1 as a reference data when the FR4 glass epoxy substrate (70mm x 70mm x 1.6mm and 3% or less in the area of the copper foil) is mounted.

Table 1. Thermal Resistance (Reference Data)

Rohm Standard (Note 1)	One-layer	Unit
θja	142.9	°C/W
θjc	36	°C/W

(Note 1) 70.0mm x 70.0mm x 1.6mm FR4 glass epoxy substrate

3. Thermal De-rating Curve
   Thermal de-rating curve indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC begins to attenuate at certain ambient temperature (25°C), and becomes 0W the maximum joint temperature (150°C). The inclination is reduced by the reciprocal of thermal resistance θja. The thermal de-rating curve under a certain regulated condition is shown in Figure 34.

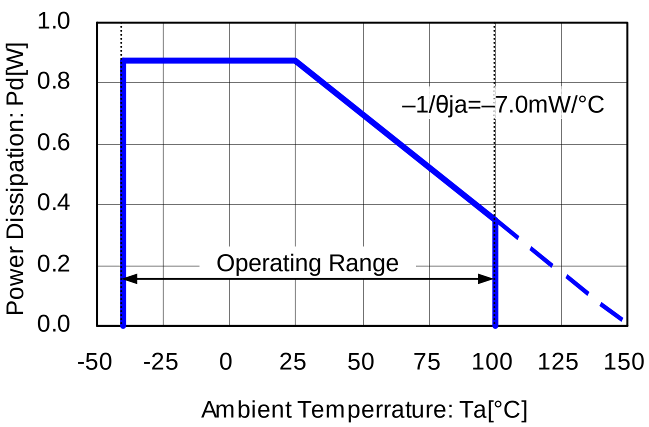
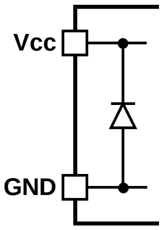


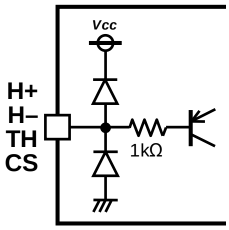
Figure 34. Power Dissipation vs Ambient Temperature
(70.0mm x 70.0mm x 1.6mm glass epoxy substrate)

I/O Equivalence Circuit (Resistance values are typical)

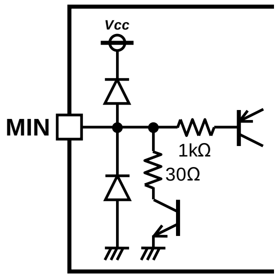
1. Power supply pin, and Ground pin



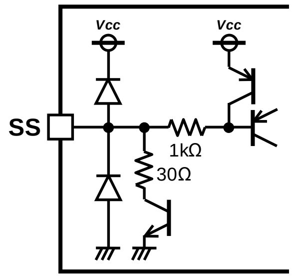
2. Hall input pins, Output duty controllable input pin, and Output current detection pin



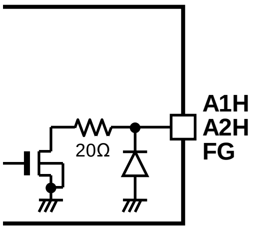
3. Minimum output duty setting pin



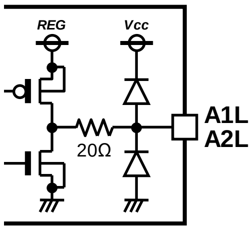
4. Soft start capacitor connecting pin



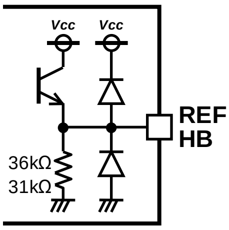
5. High side output 1, 2 pins, and Speed pulse signal output pin



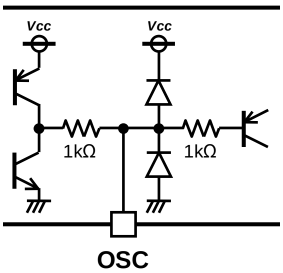
6. Low side output 1, 2 pins



7. Reference voltage output pin, and Hall bias pin



8. Oscillating capacitor connecting pin



Operational Notes

0. Datasheet
   Datasheet may simplify the block chart, the schematic diagram, the timing chart, and the sequence, etc. to describe the function of IC and the application to explain conveniently.

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. However, pins that drive inductive loads (e.g. motor driver outputs, DC-DC converter outputs) may inevitably go below ground due to back EMF or electromotive force. In such cases, the user should make sure that such voltages going below ground will not cause the IC and the system to malfunction by examining carefully all relevant factors and conditions such as motor characteristics, supply voltage, operating frequency and PCB wiring to name a few.

4. Ground Wiring Pattern
   When using both small-signal and large-current ground 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. The absolute maximum rating of the power dissipation stated in this datasheet is when the IC is mounted on a 70mm x 70mm x 1.6mm glass epoxy board. In case of exceeding this absolute maximum rating, increase the board size and copper area to raise heat dissipation capability.

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, width of power and 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. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process.

10. Mounting Errors and Inter-pin Short
    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. Especially, if it is not expressed on the datasheet, 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.

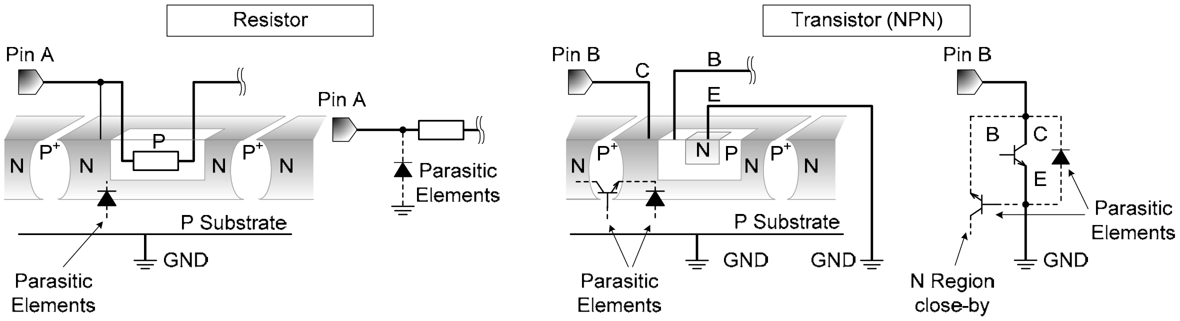


Figure 35. Example of Monolithic IC Structure

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 (TSD) Circuit

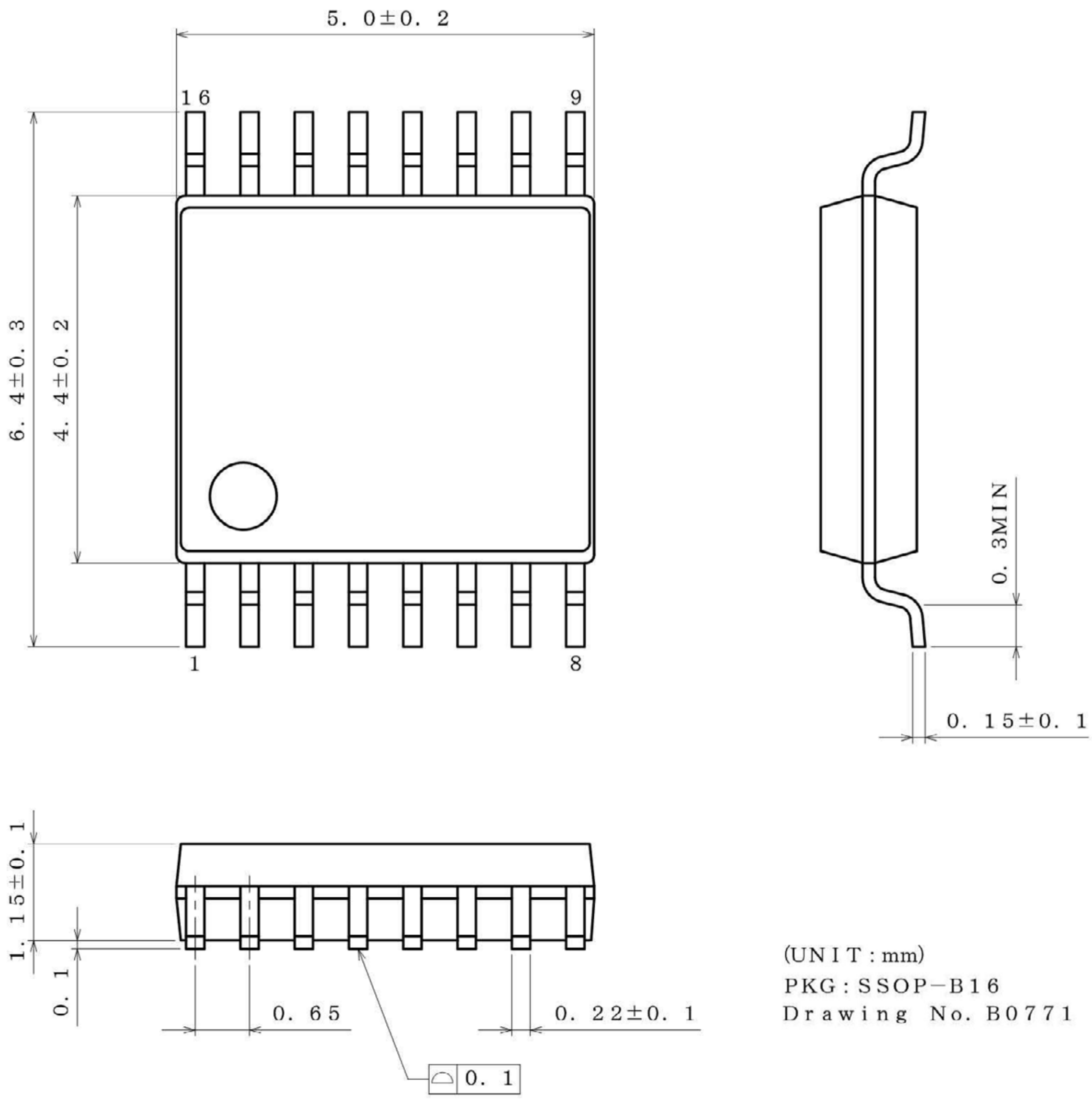
This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature will rise which will activate the TSD circuit that will turn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

Ordering Information

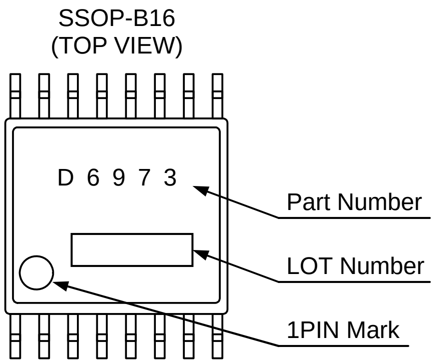
B D 6 9 7 3 F V — L B   E 2

Part Number	Package Type	Product Class	Packaging and Forming Specification
BD6973	FV; SSOP-B16	LB; Industrial Applications	E2; Embossed Tape and Reel

Physical Dimension



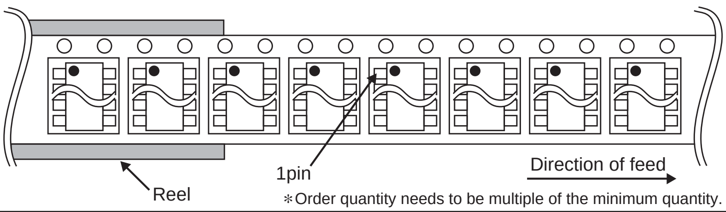
Marking Diagram



Tape and Reel Information

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin 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)



∗Order quantity needs to be multiple of the minimum quantity.

Revision History

Date	Revision	Comments
11.Sep.2013	001	New Release
27.Feb.2014	002	Delete sentence “and log life cycle” in General Description and Futures. Applied new style (change of the size of the title).

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, 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 not designed 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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