



SANYO Semiconductors

## DATA SHEET

# LB8649FN — Monolithic Digital IC Motor Driver for DSCs

## Feature

- Actuator drivers for digital cameras embedded in one chip.
  1. Constant current output car stepping motor for SH/AE or  $VCM \times 2$
  2. Constant voltage output car stepping motor for ZOOM or DC motor driver (Normal rotation/Reverse rotation/Brake)
  3. Constant voltage output car stepping motor for AF
- No standby current consumption (or zero). (Direct battery connection possible.)
- 4 systems for independent power supply (SH/AE, AF, ZOOM or input logic system)
- Low voltage driving (Driving by two nickel hydride batteries possible)
- Built-in thermal protection circuitry

## Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

| Parameter                   | Symbol               | Conditions                  | Ratings     | Unit |
|-----------------------------|----------------------|-----------------------------|-------------|------|
| Max. Power Source Voltage   | VB max               | VB power supply             | 10.5        | V    |
|                             | VCC max              | VCC power supply            | 10.5        |      |
| Max. Input Applied Voltage  | V <sub>IN</sub> max  |                             | 10.5        | V    |
| Max. Output Applied Voltage | V <sub>OUT</sub> max |                             | 10.5        | V    |
| Max. Output Current         | I <sub>O</sub> max   | per CH                      | 600         | mA   |
| Allowable Power Consumption | Pd max               | Circuit board mounting (*1) | 1.0         | W    |
| Operating Temperature       | T <sub>opr</sub>     |                             | -20 to +80  | °C   |
| Storage Temperature         | T <sub>stg</sub>     |                             | -55 to +150 | °C   |

(\*1) Mounting circuit board : 50.0mm × 50.0mm × 0.8mm glass epoxy resin

■ Any and all SANYO Semiconductor products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO Semiconductor representative nearest you before using any SANYO Semiconductor products described or contained herein in such applications.

■ SANYO Semiconductor assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor products described or contained herein.

**SANYO Semiconductor Co., Ltd.**

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

## LB8649FN

### Allowable Operating Range at Ta = 25°C

| Parameter                            | Symbol           | Conditions | Ratings     | Unit |
|--------------------------------------|------------------|------------|-------------|------|
| Source Voltage Range                 | VB1, 2, 3        | (*2)       | 1.9 to 10   | V    |
|                                      | V <sub>CC</sub>  |            | 1.9 to 10   |      |
| Input Pin "H" Voltage                | V <sub>INH</sub> |            | 1.8 to 10   | V    |
| Input Pin "L" Voltage                | V <sub>INL</sub> |            | -0.3 to 0.4 | V    |
| Constant Voltage Setting Input Range | VOC              | VC1, VC2   | 0.1 to VB   | V    |
| Constant Current Setting Input Range | VO1              | IAE, ISH   | 0.1 to 1.0  | V    |

(\*2) There is no priority on each power supply ; VB1, 2, V<sub>DD</sub>, V<sub>CC</sub> and V<sub>IN</sub>.

Example1 : VB1 = VB2 = V<sub>DD</sub> = 2.4V (Battery power supply), V<sub>CC</sub> = 4V (Step-up power supply),

V<sub>IN</sub> (CPU power supply) = 5V

Example2 : VB1 = VB2 = 2.4V, V<sub>IN</sub> = 3.3V, V<sub>DD</sub> = V<sub>CC</sub> = 5V

### Electrical Characteristics at Ta = 25°C, VB1 = VB2 = V<sub>DD</sub> = V<sub>CC</sub> = 2.4V, R<sub>f</sub> = 1Ω

| Parameter                                                       | Symbol            | Conditions                                                | Ratings |      |      | Unit |
|-----------------------------------------------------------------|-------------------|-----------------------------------------------------------|---------|------|------|------|
|                                                                 |                   |                                                           | min     | typ  | max  |      |
| Standby Current Consumption                                     | I <sub>CC0</sub>  | VB1 = VB2 = V <sub>DD</sub> = V <sub>CC</sub> = 8.0V (*3) |         | 0.1  | 5.0  | μA   |
| Operating Current Consumption                                   | I <sub>CC1</sub>  | IN1 or IN2 or IN3 or IN4 = H (*3)                         |         | 6    | 9    | mA   |
|                                                                 | I <sub>CC2</sub>  | IN5 or IN6 or IN7 or IN8 = H (*3)                         |         | 14   | 19   |      |
|                                                                 | I <sub>CC3</sub>  | IN9 or IN10 or IN11 or IN12 = H (*3)                      |         | 18   | 25   |      |
| Reference Voltage                                               | V <sub>ref1</sub> | I <sub>ref</sub> = -1mA, INHD = L                         | 0.95    | 1.0  | 1.05 | V    |
|                                                                 | V <sub>ref2</sub> | I <sub>ref</sub> = -1mA, INHD = H                         | 0.64    | 0.67 | 0.70 |      |
| Control Pin Input Current                                       | I <sub>IN</sub>   | V <sub>IN</sub> = 5.0V                                    |         | 60   | 90   | μA   |
| Overheat Protection Detection Temperature                       | THD               | Design guaranteed (*4)                                    | 160     | 180  | 200  | °C   |
| [Constant voltage stepping motor driver for AF] (OUT1, 2, 3, 4) |                   |                                                           |         |      |      |      |
| Output Constant Voltage 1                                       | VO1               | VC1 = 0.30V                                               | 1.46    | 1.53 | 1.60 | V    |
| Output Saturation Voltage 1                                     | VSAT1             | I <sub>O</sub> = 0.2A (upper and lower)                   | 0.27    | 0.37 | 0.50 | V    |
| [Constant voltage driver for ZOOM] (OUT5, 6, 7, 8)              |                   |                                                           |         |      |      |      |
| Output Constant Voltage 2                                       | VO2               | VC2 = 0.30V                                               | 1.46    | 1.53 | 1.60 | V    |
| Output Saturation Voltage 2                                     | VSAT2             | I <sub>O</sub> = 0.2A (upper and lower)                   | 0.27    | 0.37 | 0.50 | V    |
| [Constant current driver for SH/AE] (OUT9, 10, 11, 12)          |                   |                                                           |         |      |      |      |
| Output Constant Current                                         | I <sub>O</sub>    | R <sub>f</sub> = 1Ω, ISH = 0.3V                           | 271     | 285  | 302  | mA   |
| Output Saturation Voltage 3                                     | VSAT3             | I <sub>O</sub> = 0.3A (upper and lower)                   | 0.33    | 0.44 | 0.60 | V    |

(\*3) Measures by summation of current dissipation for each line of VB1, VB2, V<sub>DD</sub> and V<sub>CC</sub>.

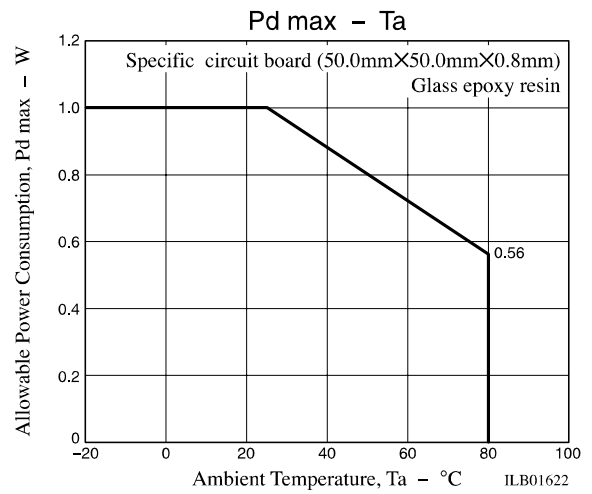
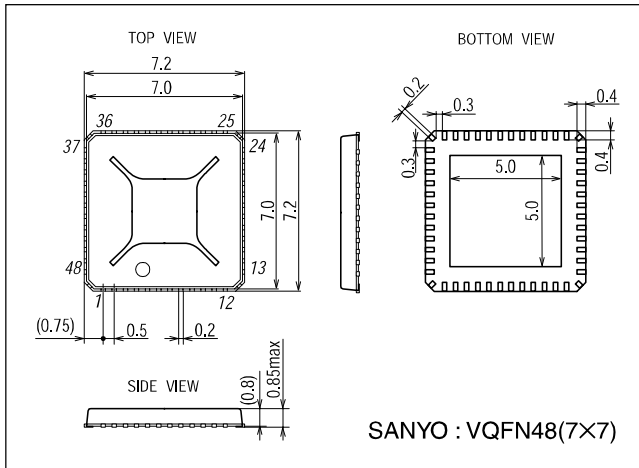
(\*4) For the characteristic within the guaranteed temperature range, shipment check is performed at Ta = 25°C.

For all temperature range, it is design guaranteed.

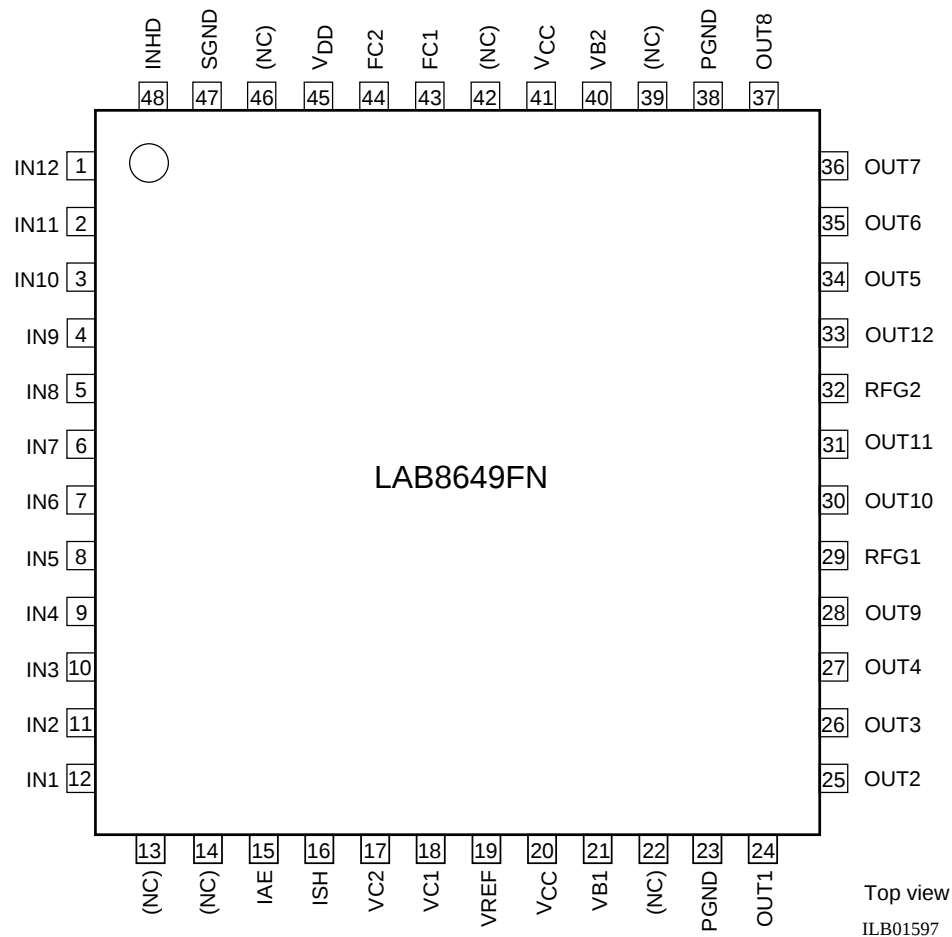
## Package Dimensions

unit : mm

3272



## Pin Assignment



(Note) PGND is connected with both 2 pins.

VDD : Input, reference voltage, logic power supply

VCC : Constant current control part, output (OUT9, 10, 11, 12) part power supply

VB1 : Constant voltage control part, output (OUT1, 2, 3, 4) part power supply

VB2 : Constant voltage control part, output (OUT5, 6, 7, 8) part power supply

## Truth Table

### 1. Stepping motor constant voltage control for AF

| Input |     |     |     |      | Output |      |      |      |       | Mode                 |
|-------|-----|-----|-----|------|--------|------|------|------|-------|----------------------|
| IN1   | IN2 | IN3 | IN4 | INHD | OUT1   | OUT2 | OUT3 | OUT4 | Vref  |                      |
| L     | L   | L   | L   | L    | -      | -    | -    | -    | -     | Stand-by             |
| H     | L   | L   | L   | L    | H      | L    | -    | -    | 1.0V  | 1-2 phase excitation |
| H     | L   | H   | L   |      | H      | L    | H    | L    |       |                      |
| L     | L   | H   | L   |      | -      | -    | H    | L    |       |                      |
| L     | H   | H   | L   |      | L      | H    | H    | L    |       |                      |
| L     | H   | L   | L   |      | L      | H    | -    | -    |       |                      |
| L     | H   | L   | H   |      | L      | H    | L    | H    |       |                      |
| L     | L   | L   | H   |      | -      | -    | L    | H    |       |                      |
| H     | L   | L   | H   |      | H      | L    | L    | H    |       |                      |
| H     | H   | *   | *   |      | -      | -    |      |      |       | Output OFF           |
| *     | *   | H   | H   |      |        |      | -    | -    |       |                      |
| *     | *   | *   | *   | L    |        |      |      |      | 1.0V  |                      |
|       |     |     |     | H    |        |      |      |      | 0.67V |                      |

- ( - ) is output OFF.
- When setting output to “H”, the output voltage is 5.1 times the VC1.

### 2. Stepping motor constant voltage control for ZOOM or DC motor drive

| Input |     |     |     |      | Output |      |      |      |       | Mode                 |
|-------|-----|-----|-----|------|--------|------|------|------|-------|----------------------|
| IN5   | IN6 | IN7 | IN8 | INHD | OUT5   | OUT6 | OUT7 | OUT8 | Vref  |                      |
| L     | L   | L   | L   | L    | -      | -    | -    | -    | -     | Stand-by             |
| H     | L   | L   | L   | L    | H      | L    | -    | -    | 1.0V  | 1-2 phase excitation |
| H     | L   | H   | L   |      | H      | L    | H    | L    |       |                      |
| L     | L   | H   | L   |      | -      | -    | H    | L    |       |                      |
| L     | H   | H   | L   |      | L      | H    | H    | L    |       |                      |
| L     | H   | L   | L   |      | L      | H    | -    | -    |       |                      |
| L     | H   | L   | H   |      | L      | H    | L    | H    |       |                      |
| L     | L   | L   | H   |      | -      | -    | L    | H    |       |                      |
| H     | L   | L   | H   |      | H      | L    | L    | H    |       |                      |
| H     | H   | *   | *   |      | H      | H    |      |      |       | Brake                |
| *     | *   | H   | H   |      |        |      | H    | H    |       |                      |
| *     | *   | *   | *   | L    |        |      |      |      | 1.0V  |                      |
|       |     |     |     | H    |        |      |      |      | 0.67V |                      |

- ( - ) is output OFF, and ( \* ) is “Don’t care”.
- When setting output to “H”, the output voltage is 5.1 times the VC2.

3. VCM constant current control for SH/AE, or stepping motor drive.

| Input |      |      |      |      | Output |       |       |       |       |                             | Mode      |
|-------|------|------|------|------|--------|-------|-------|-------|-------|-----------------------------|-----------|
| IN9   | IN10 | IN11 | IN12 | INHD | OUT9   | OUT10 | OUT11 | OUT12 | Vref  | ISH                         |           |
| L     | L    | L    | L    | L    | -      | -     | -     | -     | -     | -                           | Stand-by  |
| H     | L    | *    | *    |      | H      | L     |       |       | 1.0V  | Setting<br>voltage<br>state | SH & AE   |
| L     | H    | *    | *    |      | L      | H     |       |       |       |                             |           |
| *     | *    | H    | L    |      |        |       | H     | L     |       |                             |           |
| *     | *    | L    | H    |      |        |       | L     | H     | 0.67V |                             | Hold      |
| H     | L    | *    | *    | H    | H      | L     |       |       |       |                             |           |
| L     | H    | *    | *    |      | L      | H     |       |       |       |                             |           |
| *     | *    | H    | L    |      |        |       | H     | L     |       |                             |           |
| *     | *    | L    | H    |      |        |       | L     | H     |       |                             |           |
| L     | L    | L    | L    |      |        | -     | -     | -     | -     |                             | Discharge |

- ( - ) is output OFF, and ( \* ) is “Don’t care”.
- OUT9 and OUT10 are used for the SH.  
Quick charge and quick discharge circuitry allows the stabilization of start-up characteristic.
- OUT10 and OUT11 are used for the AF.
- At the time of stand-by, ISH pin voltage becomes discharge state by the internal transistor and it is set to 0V.
- In addition, when IN1 to 8 are input, ISH pin is in discharge state (for start-up correction).
- When INHD = “L”, Vref voltage is 1.0V. When INHD = “H”, Vref voltage is 0.67V.

### Application Design Notes

1. Constant current setting (ISH, IAE, RFG1, 2, OUT9 to 12)

The constant current setting between pins OUT9 and OUT10 is determined from the ISH input voltage and the connecting resistor of RFG1. As shown in the block diagram, it is controlled in such a way so that the voltage generated at the resistor used for current detection connected between RFG1 and GND would be equal to the ISH input voltage. The formula for calculating the output current is as given below.

$$(\text{OUT9 to OUT10 Output Current}) = (\text{ISH Input Voltage}) \div (\text{RFG1 Resistor} + 0.05\Omega)$$

The 0.05Ω here is for a common impedance of the output Tr emitter which drives constant current in the RFG pin and the sensing wiring for the constant current control amplifier.

In the same way, the constant current setting between pins OUT11 and OUT12 is determined from the IAE input voltage and the connecting resistor of RFG2.

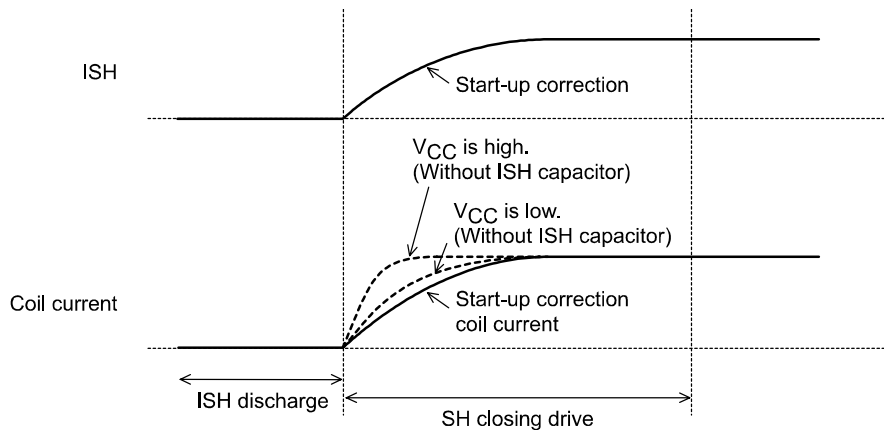
Furthermore, as the constant current control block within the IC is connected to PGND, when supplying voltage to the ISH pin or IAE pin which has been divided by resistors be sure to connect the ground side of these resistors to PGND.

2. Quick charge/discharge circuitry (FC1, OUT9, OUT10)

Quick discharge circuitry has been built in to the shutter control block (OUT9 to OUT10) to support high-speed shutter control, quick recharge, quick discharge and consecutive shots.

Quick recharge and quick discharge circuitry has not been built in to the AE control block (OUT11 to OUT12). Therefore, make sure to use the block (OUT9 to OUT10) for the shutter drive.

3. Start-up correction function (ISH, OUT9, OUT10)



ILB01613

The ISH pin input voltage is set with the decay time constant to be larger than the coil decay time constant by using the external CR and the start-up correction occurs with respect to the coil wave.

By doing this, stable shutter operation can be carried out with respect to the power supply variations.

(Note) For the ISH pin start-up correction, check the coil current start-up wave for the  $V_{CC}$  reduced voltage when there is no ISH pin capacitor and choose a capacitance so that the decay time constant is lower than this wave. However, at times such as when the power supply voltage is stable or the start-up correction function is not required, such a start-up correction capacitor is not necessary.

4. Phase compensation capacitor (FC1, FC2)

See and check the capacitor value for FC1 and FC2 between 0.0015 to 0.033 $\mu$ F. Choose a capacitance value which does not cause oscillation problems for output. (In particular, when a coil with large inductance is used, it is necessary to choose a sufficiently large capacitance.) Also, as the constant current control block within the IC is connected to PGND, be sure to connect the ground side of the FC1 pin and FC2 pin capacitor to PGND.

5. Constant voltage control Oscillation-stopping capacitor (OUT1 to 8)

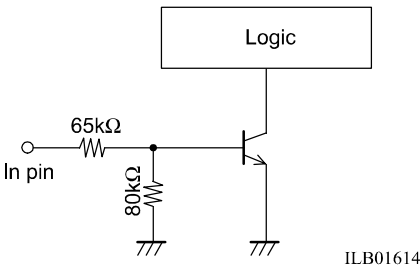
When controlling the constant voltages, it is necessary to place capacitors between the OUT pins to stop oscillation. See and check the capacitor value between 0.01 $\mu$ F to 0.1 $\mu$ F. Choose a capacitance value which does not cause oscillation problems for output. When driving at saturation, there is no need for such oscillation-stopping capacitor.

6. GND wiring and power line capacitors : (PGND, SGND,  $V_{CC}$ , VB1, 2,  $V_{DD}$ )

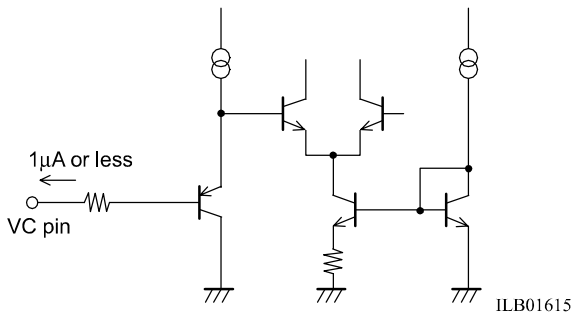
Connect PGND (2 places) and SGND near the IC, and place the capacitors as close as possible to each of the power pins.

7. Input pin equivalent circuit

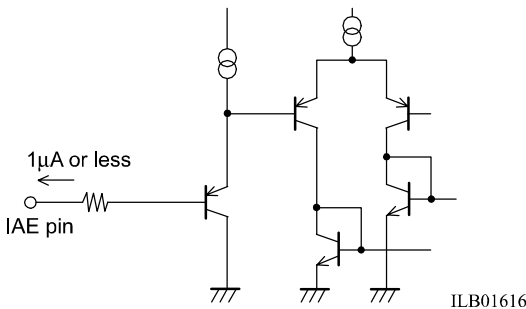
IN1 to 12, INHD pin



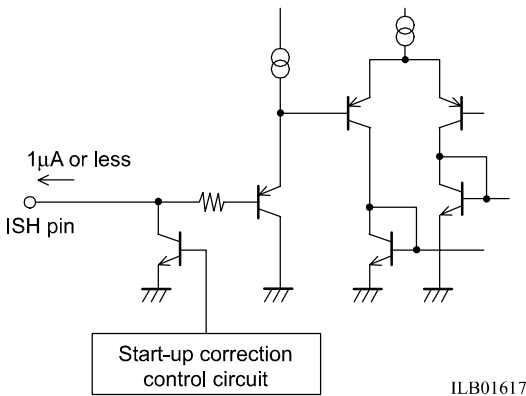
VC1, 2 pin



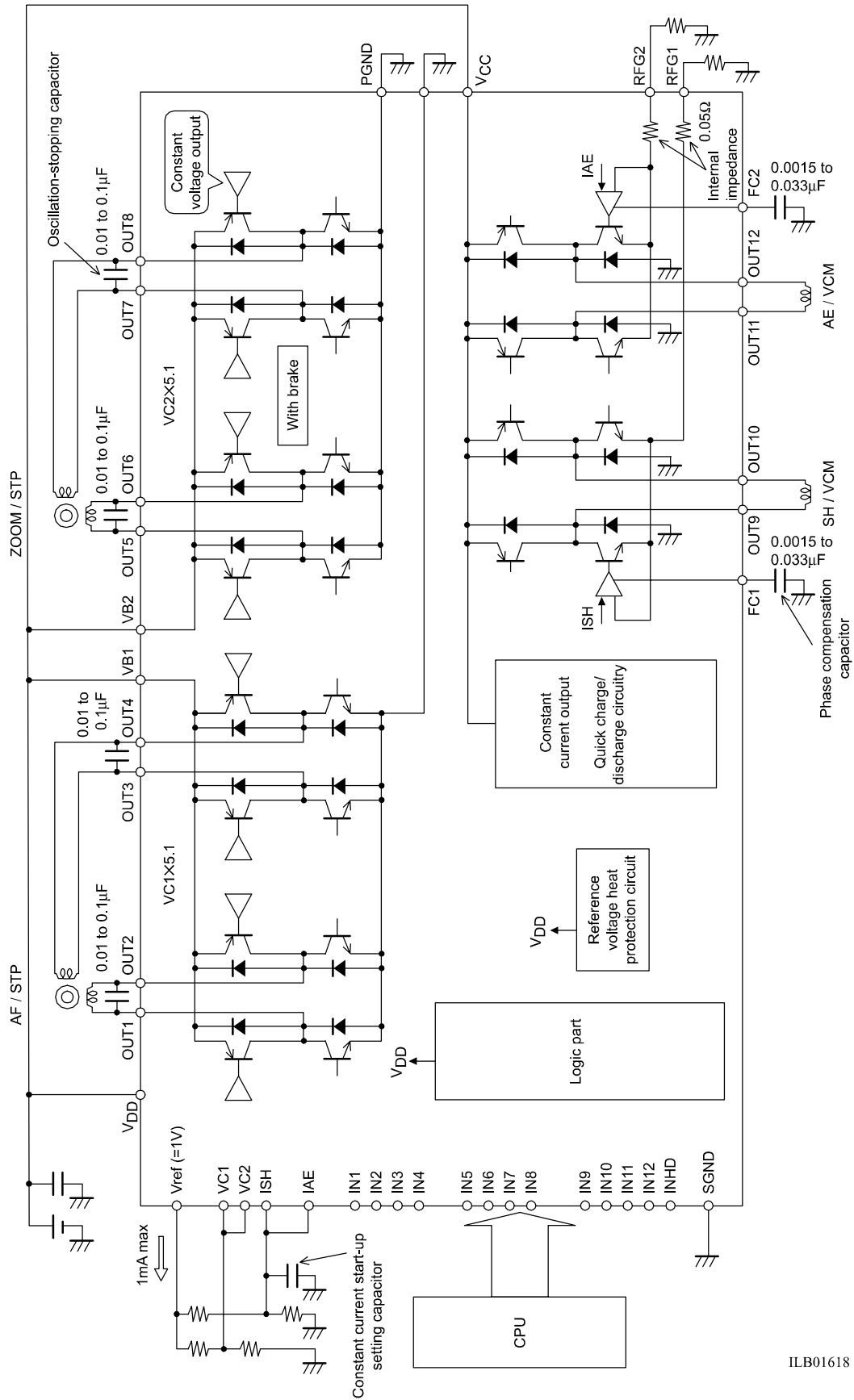
IAE pin



ISH pin



## Block Diagram



ILB01618

- Specifications of any and all SANYO Semiconductor products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- SANYO Semiconductor Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor products (including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of SANYO Semiconductor Co., Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO Semiconductor believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of August, 2004. Specifications and information herein are subject to change without notice.