Ordering number : ENA0167B

www.DataSheet4U.com

SANYO Semiconductors
DATA SHEET

# LV8054LP — Bi-CMOS IC For Digital Cameras Single-chip motor Driver IC

## Overview

LV8054LP is single-chip motor driver IC for digital cameras.

## Functions

- Integrates the digital camera actuator drivers on a single chip
- Four constant voltage output channels, two constant current output channels
- All actuators can be driven at the same time
- The AF and zoom stepping motors are driven by the clock signal
- Supports PWM control of a DC zoom motor.
- Can switch between an external input or an internal reference for the constant voltage output setting reference voltage
- The constant voltage output multiplier can be set to one of 16 levels
- The constant current output reference voltage can be set to one of 16 internal reference voltage levels
- Built-in photosensor drive transistor
- Three built-in Schmitt buffer circuits (the presence or absence of hysteresis can be set individually)

## Maximum Ratings at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Supply voltage 1 | $V_B$ max | | 6.0 | V |
| Supply voltage 2 | $V_{CC}$ max | | 6.0 | V |
| Peak output current | $I_O$ peak | OUT1 to 12 (t≤10mS, ON-duty≤20%) | 600 | mA |
| Continuous output current | $I_O$ max1 | OUT1 to 12 | 400 | mA |
| | $I_O$ max2 | PI | 85 | mA |
| Allowable power dissipation | Pd max | Mounted on a circuit board* | 1100 | mW |
| Operating temperature | Topr | | -20 to +85 | °C |
| Storage temperature | Tstg | | -55 to +150 | °C |

* Standard circuit board: 40×50× 0.8 $mm^3$ glass epoxy four-layer board

■ Any and all SANYO Semiconductor Co.,Ltd. products described or contained herein are, with regard to "standard application", intended for the use as general electronics equipment (home appliances, AV equipment, communication device, office equipment, industrial equipment etc.). The products mentioned herein shall not be intended for use for any "special application" (medical equipment whose purpose is to sustain life, aerospace instrument, nuclear control device, burning appliances, transportation machine, traffic signal system, safety equipment etc.) that shall require extremely high level of reliability and can directly threaten human lives in case of failure or malfunction of the product or may cause harm to human bodies, nor shall they grant any guarantee thereof. If you should intend to use our products for applications outside the standard applications of our customer who is considering such use and/or outside the scope of our intended standard applications, please consult with us prior to the intended use. If there is no consultation or inquiry before the intended use, our customer shall be solely responsible for the use.

■ Specifications of any and all SANYO Semiconductor Co.,Ltd. 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.
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

www.DataSheet4U.com

www.DataSheet4U.com

## Recommended Operating Conditions at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Supply voltage range 1 | $V_B$ | | 2.7 to 5.5 | V |
| Supply voltage range 2 | $V_{CC}$ | | 2.7 to 5.5 | V |
| Logic level input voltage | $V_{IN}$ | | 0 to $V_{CC}$+0.3 | V |
| Constant voltage setting input range | $V_C$ | | 0.1 to $V_{CC}$ | V |
| Clock frequency | $F_{CLK}$ | CLK1, CLK2/PWM | -64 | KHz |
| PWM frequency | $F_{PWM}$ | CLK2/PWM | -100 | KHz |

## Electrical Characteristics at Ta = 25°C, $V_B$ = 5V, $V_{CC}$ = 3.3V

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Quiescent current | $I_{CCO}$ | ST = low, BI1/2/3 = low | | | 1 | μA |
| Current drain 1 | $I_B$ | ST = high, IN51/52/61/62 = low, BI1/2/3 = low, With no output load | | 500 | 950 | μA |
| Current drain 2 | $I_{CC}$ | ST = high, IN51/52/61/62 = low, BI1/2/3 = low, With no output load | | 1.5 | 2.0 | mA |
| VCC low-voltage cutoff voltage | $V_{th}V_{CC}$ | | 2.1 | 2.35 | 2.6 | V |
| Low-voltage hysteresis | $V_{th}HYS$ | | 100 | 150 | 200 | mV |
| Thermal shutdown temperature | TSD | Design target value | 160 | 180 | 200 | °C |
| Thermal shutdown hysteresis | ΔTSD | Design target value | 20 | 40 | 60 | °C |
| AF/Zoom Motor Drivers (OUT1/2, OUT3/4, OUT5/6, OUT7/8) | | | | | | |
| Output on-resistance 1 | Ronu1 | Ta = 25°C, $I_O$ = 200mA, High side on-resistance | | 0.7 | 0.85 | Ω |
| | Rond1 | Ta = 25°C, $I_O$ = 200mA, Low side on-resistance | | 0.5 | 0.65 | Ω |
| Output leakage current 1 | $I_O$leak1 | | | | 1 | μA |
| Diode forward voltage 1 | $V_D1$ | $I_D$ = -400mA | 0.7 | 0.9 | 1.2 | V |
| Internal reference voltage | $V_{REF}$ | | 0.84 | 0.88 | 0.92 | V |
| Constant voltage output | $V_{OUT}1$ | $V_C$ = 0.88V | 4.2 | 4.4 | 4.6 | V |
| | $V_{OUT}2$ | $V_C$ = 0.88V (internal reference) | 4.2 | 4.4 | 4.6 | V |
| VC voltage divider voltage ratio | $V_{CR}1$ | (D3, D4, D5, D6) = (0, 0, 0, 0) | 95 | 100 | 105 | % |
| | $V_{CR}2$ | (D3, D4, D5, D6) = (1, 0, 0, 0) | 92.8 | 97.7 | 102.6 | % |
| | $V_{CR}3$ | (D3, D4, D5, D6) = (0, 1, 0, 0) | 90.7 | 95.5 | 100.2 | % |
| | $V_{CR}4$ | (D3, D4, D5, D6) = (1, 1, 0, 0) | 88.5 | 93.2 | 97.8 | % |
| | $V_{CR}5$ | (D3, D4, D5, D6) = (0, 0, 1, 0) | 86.4 | 90.9 | 95.5 | % |
| | $V_{CR}6$ | (D3, D4, D5, D6) = (1, 0, 1, 0) | 84.2 | 88.6 | 93.1 | % |
| | $V_{CR}7$ | (D3, D4, D5, D6) = (0, 1, 1, 0) | 82.0 | 86.4 | 90.7 | % |
| | $V_{CR}8$ | (D3, D4, D5, D6) = (1, 1, 1, 0) | 79.9 | 84.1 | 88.3 | % |
| | $V_{CR}9$ | (D3, D4, D5, D6) = (0, 0, 0, 1) | 77.7 | 81.8 | 85.9 | % |
| | $V_{CR}10$ | (D3, D4, D5, D6) = (1, 0, 0, 1) | 75.6 | 79.5 | 83.5 | % |
| | $V_{CR}11$ | (D3, D4, D5, D6) = (0, 1, 0, 1) | 73.4 | 77.3 | 81.1 | % |
| | $V_{CR}12$ | (D3, D4, D5, D6) = (1, 1, 0, 1) | 71.2 | 75.0 | 78.7 | % |
| | $V_{CR}13$ | (D3, D4, D5, D6) = (0, 0, 1, 1) | 69.1 | 72.7 | 76.4 | % |
| | $V_{CR}14$ | (D3, D4, D5, D6) = (1, 0, 1, 1) | 66.9 | 70.5 | 74.0 | % |
| | $V_{CR}15$ | (D3, D4, D5, D6) = (0, 1, 1, 1) | 64.8 | 68.2 | 71.6 | % |
| | $V_{CR}16$ | (D3, D4, D5, D6) = (1, 1, 1, 1) | 62.6 | 65.9 | 69.2 | % |

Continued on next page.

www.DataSheet4U.com

www.DataSheet4U.com

Continued from preceding page.

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Logic pin input current | $I_{IN}L$ | $V_{IN}$ = 0V (ST, CLK1, CLK2/PWM) | | | 1.0 | μA |
| | $I_{IN}H$ | $V_{IN}$ = 3.3V (ST, CLK1, CLK2/PWM) | | 33 | 50 | μA |
| High-level input voltage | $V_{IN}H$ | ST, CLK1, CLK2/PWM | 2.5 | | | V |
| Low-level input voltage | $V_{IN}L$ | ST, CLK1, CLK2/PWM | | | 1.0 | V |
| Shutter/AE Motor Drivers (OUT9-10, OUT11-12) | | | | | | |
| Output on-resistance 2 | Ronu2 | Ta = 25°C, $I_O$ = 200mA, High side on-resistance | | 0.7 | 0.85 | Ω |
| | Rond2 | Ta = 25°C, $I_O$ = 200mA, Low side on-resistance | | 0.5 | 0.65 | Ω |
| Output leakage current 2 | $I_O$leak2 | | | | 1 | μA |
| Diode forward voltage 2 | VD2 | $I_D$ = -400mA | 0.7 | 0.9 | 1.2 | V |
| Constant current output | $I_O$ | $R_f$ = 1Ω,<br>(D3, D4, D5, D6) = (0, 0, 0, 0) | 190 | 200 | 210 | mA |
| Internal current setting reference voltages | $V_{REF}1$ | (D3, D4, D5, D6) = (0, 0, 0, 0) | 0.190 | 0.200 | 0.210 | V |
| | $V_{REF}2$ | (D3, D4, D5, D6) = (1, 0, 0, 0) | 0.162 | 0.170 | 0.179 | V |
| | $V_{REF}3$ | (D3, D4, D5, D6) = (0, 1, 0, 0) | 0.157 | 0.165 | 0.173 | V |
| | $V_{REF}4$ | (D3, D4, D5, D6) = (1, 1, 0, 0) | 0.152 | 0.160 | 0.168 | V |
| | $V_{REF}5$ | (D3, D4, D5, D6) = (0, 0, 1, 0) | 0.147 | 0.155 | 0.163 | V |
| | $V_{REF}6$ | (D3, D4, D5, D6) = (1, 0, 1, 0) | 0.143 | 0.150 | 0.158 | V |
| | $V_{REF}7$ | (D3, D4, D5, D6) = (0, 1, 1, 0) | 0.138 | 0.145 | 0.152 | V |
| | $V_{REF}8$ | (D3, D4, D5, D6) = (1, 1, 1, 0) | 0.133 | 0.140 | 0.147 | V |
| | $V_{REF}9$ | (D3, D4, D5, D6) = (0, 0, 0, 1) | 0.128 | 0.135 | 0.142 | V |
| | $V_{REF}10$ | (D3, D4, D5, D6) = (0, 0, 0, 1) | 0.124 | 0.130 | 0.137 | V |
| | $V_{REF}11$ | (D3, D4, D5, D6) = (0, 1, 0, 1) | 0.119 | 0.125 | 0.131 | V |
| | $V_{REF}12$ | (D3, D4, D5, D6) = (1, 1, 0, 1) | 0.114 | 0.120 | 0.126 | V |
| | $V_{REF}13$ | (D3, D4, D5, D6) = (0, 0, 1, 1) | 0.109 | 0.115 | 0.121 | V |
| | $V_{REF}14$ | (D3, D4, D5, D6) = (1, 0, 1, 1) | 0.105 | 0.110 | 0.116 | V |
| | $V_{REF}15$ | (D3, D4, D5, D6) = (0, 1, 1, 1) | 0.100 | 0.105 | 0.110 | V |
| | $V_{REF}16$ | (D3, D4, D5, D6) = (1, 1, 1, 1) | 0.095 | 0.100 | 0.105 | V |
| Logic pin input current | $I_{IN}L$ | $V_{IN}$ = 0V (IN51, IN52, IN61, IN62) | | | 1.0 | μA |
| | $I_{IN}H$ | $V_{IN}$ = 3.3V (IN51, IN52, IN61, IN62) | | 33 | 50 | μA |
| High-level input voltage | $V_{IN}H$ | IN51, IN52, IN61, IN62 | 2.5 | | | V |
| Low-level input voltage | $V_{IN}L$ | IN51, IN52, IN61, IN62 | | | 1.0 | V |
| Photosensor peripheral circuits (PI, BI1, BO1, BI2, BO2, BI3, BO3) | | | | | | |
| Output on-resistance 3 | Ron3 | Ta=25°C, $I_O$= 60mA | | 2 | 2.5 | Ω |
| Output leakage current 3 | $I_O$leak3 | | | | 1 | μA |
| Schmitt buffer threshold level (hysteresis) | $V_{th}H$ | | 1.50 | 1.70 | 1.90 | V |
| | $V_{th}L$ | | 0.85 | 1.05 | 1.25 | V |
| Schmitt buffer hysteresis | $V_{th}$hys | | 0.5 | 0.7 | 0.9 | V |
| Schmitt buffer threshold level (no hysteresis) | $V_{th}$ | | 1.4 | 1.6 | 1.8 | V |

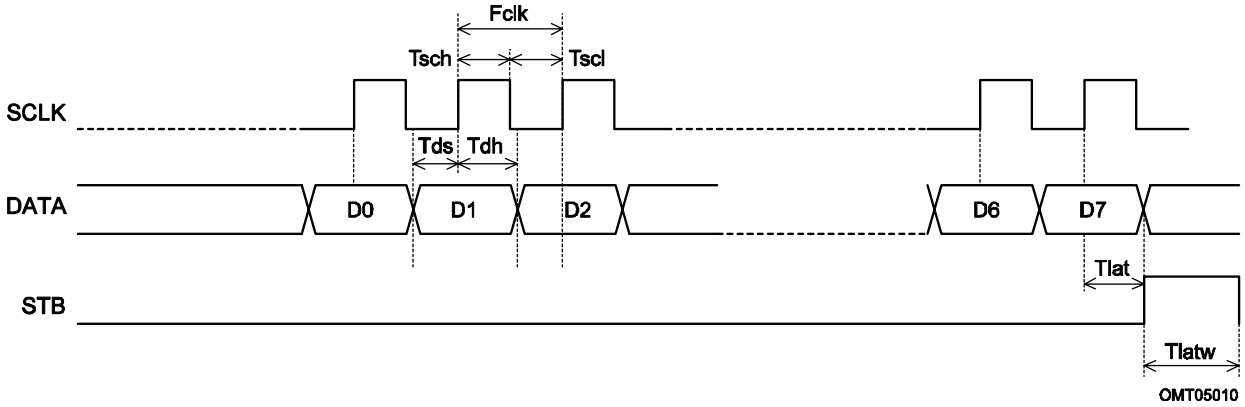
Continued on next page.

www.DataSheet4U.com

www.DataSheet4U.com

Continued from preceding page.

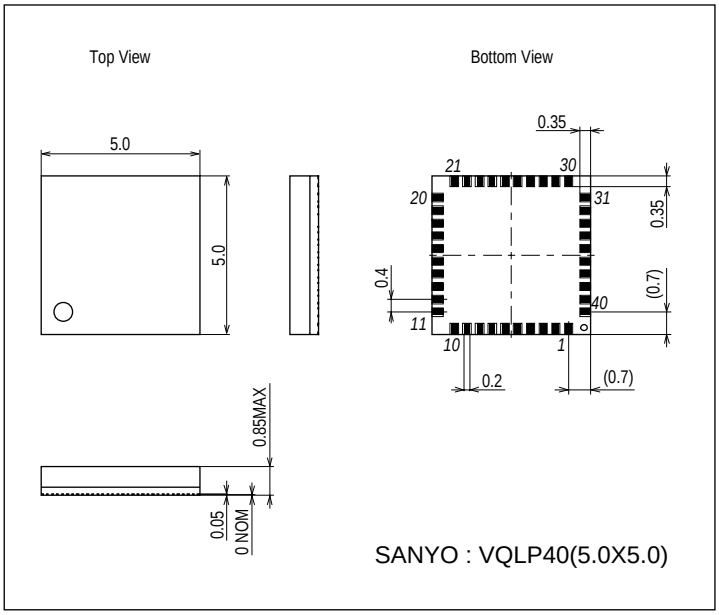
| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Serial Data Transfer Pins | | | | | | |
| Logic pin input current | $I_{IN}L$ | $V_{IN}$ = 0V (SCLK, DATA, STB) | | | 1.0 | μA |
| | $I_{IN}H$ | $V_{IN}$ = 3.3V (SCLK, DATA, STB) | | 33 | 50 | μA |
| High-level input voltage | $V_{IN}H$ | SCLK, DATA, STB | 2.5 | | | V |
| Low-level input voltage | $V_{IN}L$ | SCLK, DATA, STB | | | 1.0 | V |
| Minimum SCLK high-level pulse width | Tsch | | 0.125 | | | μS |
| Minimum SCLK low-level pulse width | Tscl | | 0.125 | | | μS |
| Stipulated STB time | Tlat | | 0.125 | | | μS |
| Minimum STB pulse width | Tlatw | | 0.125 | | | μS |
| Data setup time | Tds | | 0.125 | | | μS |
| Data hold time | Tdh | | 0.125 | | | μS |
| Maximum CLK frequency | Fclk | | | | 4 | MHz |




## Package Dimensions

unit : mm (typ)

3302A

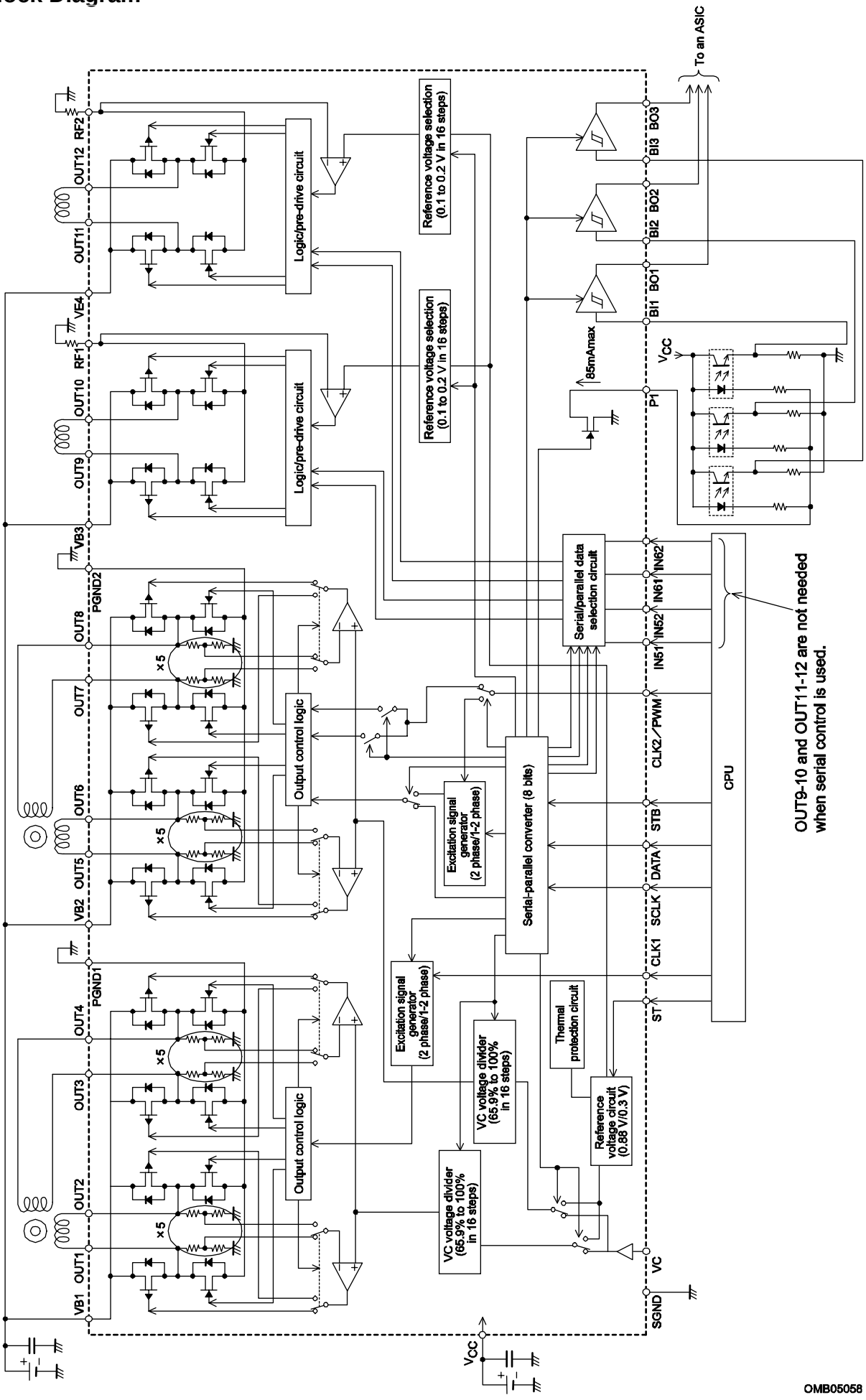




www.DataSheet4U.com

www.DataSheet4U.com

## Block Diagram



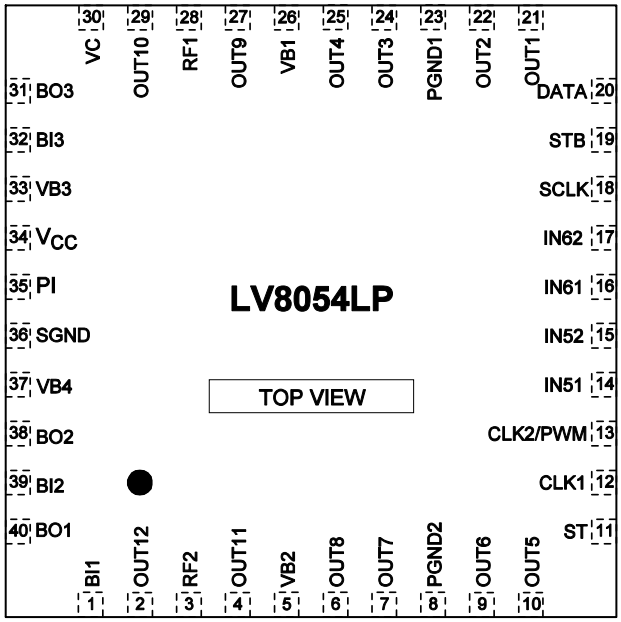

www.DataSheet4U.com

www.DataSheet4U.com

## Pin Functions

| Pin No. | Symbol | Description | Pin No. | Symbol | Description |
|---|---|---|---|---|---|
| 26 | VB1 | Power supply for OUT1-4 | 4 | OUT11 | Motor driver output |
| 5 | VB2 | Power supply for OUT5-8 | 2 | OUT12 | Motor driver output |
| 33 | VB3 | Power supply for OUT9-10 | 30 | VC | External reference voltage input for the OUT1-8 constant current output |
| 37 | VB4 | Power supply for OUT11-12 | 11 | ST | Chip enable |
| 34 | VCC | Control system power supply | 12 | CLK1 | Stepping motor clock for OUT1-4 |
| 23 | PGND1 | Power system ground for OUT1-4 | 18 | SCLK | Serial data transfer clock |
| 8 | PGND2 | Power system ground for OUT5-8 | 20 | DATA | Serial data |
| 28 | RF1 | Current detection connection for OUT9-10 | 19 | STB | Serial data latch pulse input |
| 3 | RF2 | Current detection connection for OUT11-12 | 13 | CLK2/PWM | Stepping motor clock/PWM signal input for OUT5-8 |
| 36 | SGND | Control system ground | 14 | IN51 | Control input for OUT9-10 |
| 21 | OUT1 | Motor driver output | 15 | IN52 | Control input for OUT9-10 |
| 22 | OUT2 | Motor driver output | 16 | IN61 | Control input for OUT11-12 |
| 24 | OUT3 | Motor driver output | 17 | IN62 | Control input for OUT11-12 |
| 25 | OUT4 | Motor driver output | 35 | PI | Photosensor drive output |
| 10 | OUT5 | Motor driver output | 1 | BI1 | Schmitt buffer input 1 |
| 9 | OUT6 | Motor driver output | 40 | BO1 | Schmitt buffer output 1 |
| 7 | OUT7 | Motor driver output | 39 | BI2 | Schmitt buffer input 2 |
| 6 | OUT8 | Motor driver output | 38 | BO2 | Schmitt buffer output 2 |
| 27 | OUT9 | Motor driver output | 32 | BI3 | Schmitt buffer input 3 |
| 29 | OUT10 | Motor driver output | 31 | BO3 | Schmitt buffer output 3 |

## Pin Assignment

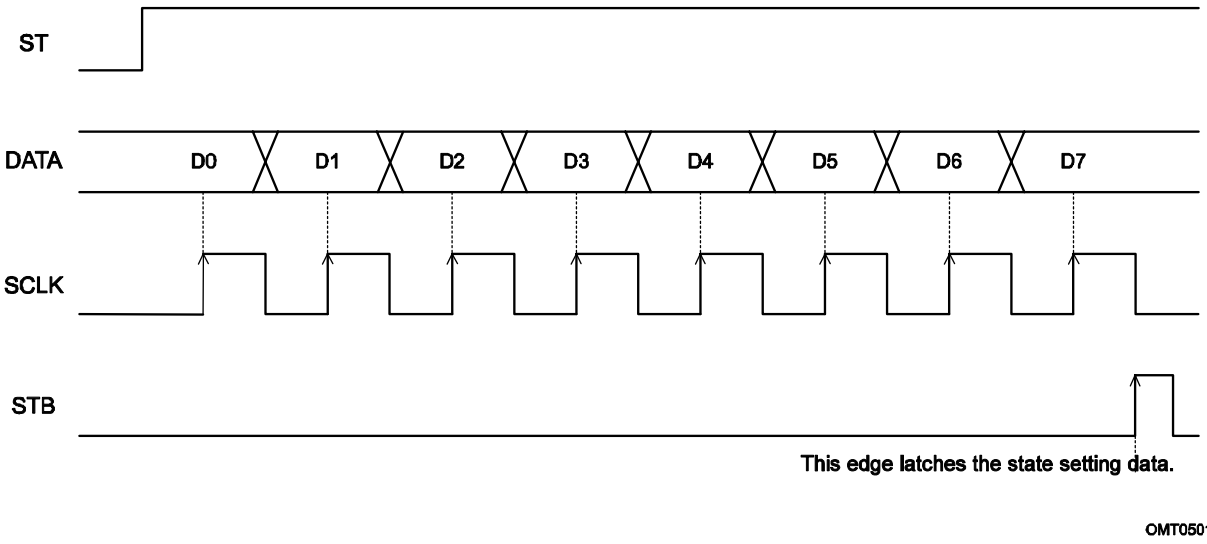



www.DataSheet4U.com

www.DataSheet4U.com

## Serial Data Input Overview

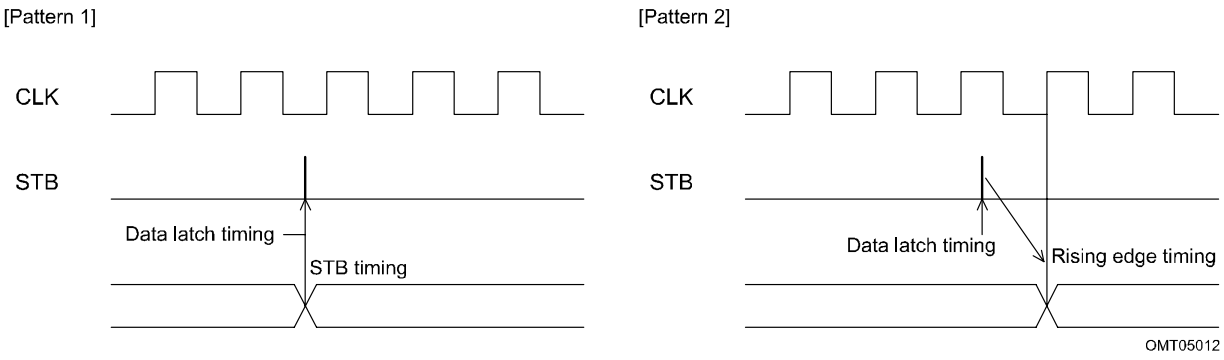
### Serial Data Input Timing Chart




Data is input in order from D0 to D7. Data is transferred on the SCLK rising edge and, after all data has been transferred, the data is latched by the rising edge of the STB signal.
Note that the IC internal circuits will not accept the SCLK signal while the STB signal is high.

### Timing with which the Serial Data is Reflected in the Outputs

Basically, the new values are reflected in the output at the point the data is latched with the STB signal. → Pattern 1
However, the "Excitation direction" and "Excitation mode" settings used in stepping motor clock drive mode for channels 1 through 4 are an exception. In this case only, after the data is latched with the STB signal, the new values are reflected on the next rising edge of the CLK signal. → Pattern 2





www.DataSheet4U.com

www.DataSheet4U.com

## Detailed Description of Serial Data Input

Note: This IC's channels are assigned as follows.

| | | |
|---|---|---|
| OUT1/OUT2 | → | Channel 1 |
| OUT3/OUT4 | → | Channel 2 |
| OUT5/OUT6 | → | Channel 3 |
| OUT7/OUT8 | → | Channel 4 |
| OUT9/OUT10 | → | Channel 5 |
| OUT11/OUT12 | → | Channel 6 |

### Stepping motor excitation type for channels 1 through 4

This IC supports connecting stepping motors to channels 1 and 2 and to channels 3 and 4. Either of these stepping motors can be controlled by a single clock signal.

When this capability is used, the clock signal input pins and the channels as associated as shown below.

| | |
|---|---|
| CLK1: | Controls channel 1 and 2 drive. |
| CLK2/PWM: | Controls channel 3 and 4 drive |

The following state settings related to control of these stepping motors are set using the serial data. (See subsection, Serial Logic Table 1, in section ,Truth Tables, for a detailed description of this data.)

- Excitation mode: 2-phase excitation or 1-2 phase excitation
- Excitation direction: CW (clockwise) or CCW (counterclockwise)
- Step/Hold: Clear or Hold
- Counter reset: Normal Operation or Reset
- Output enable: Output Off or Output On
- VC voltage divisor: Selects one of 16 values
- VC voltage selection: Internal or External

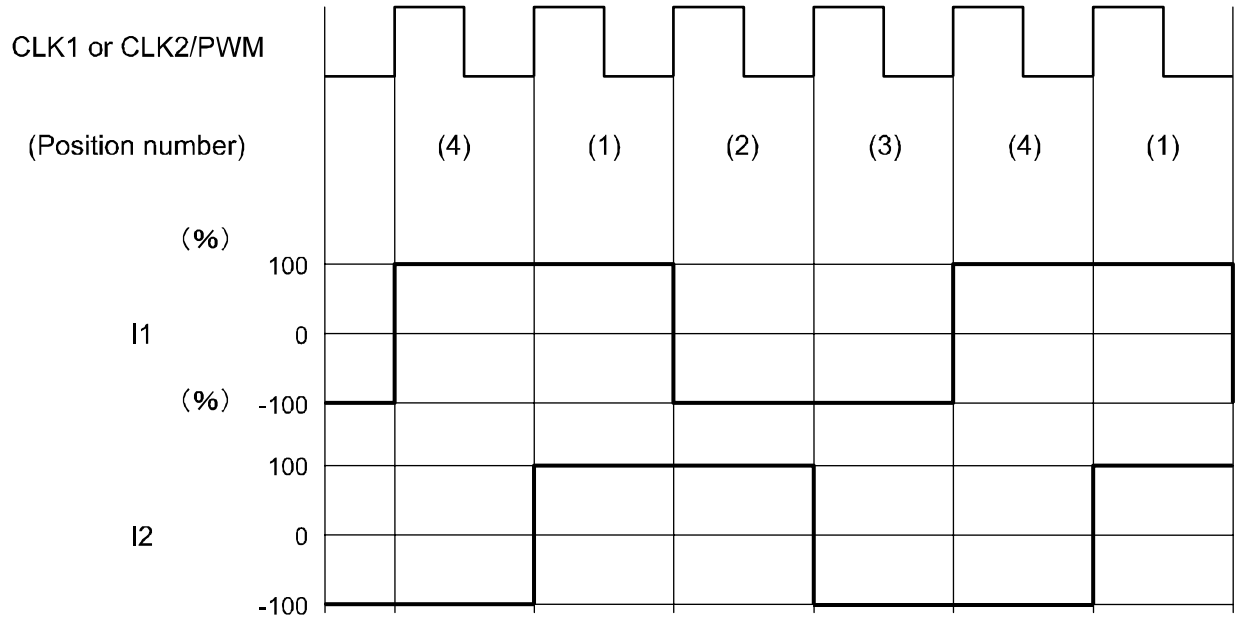
www.DataSheet4U.com

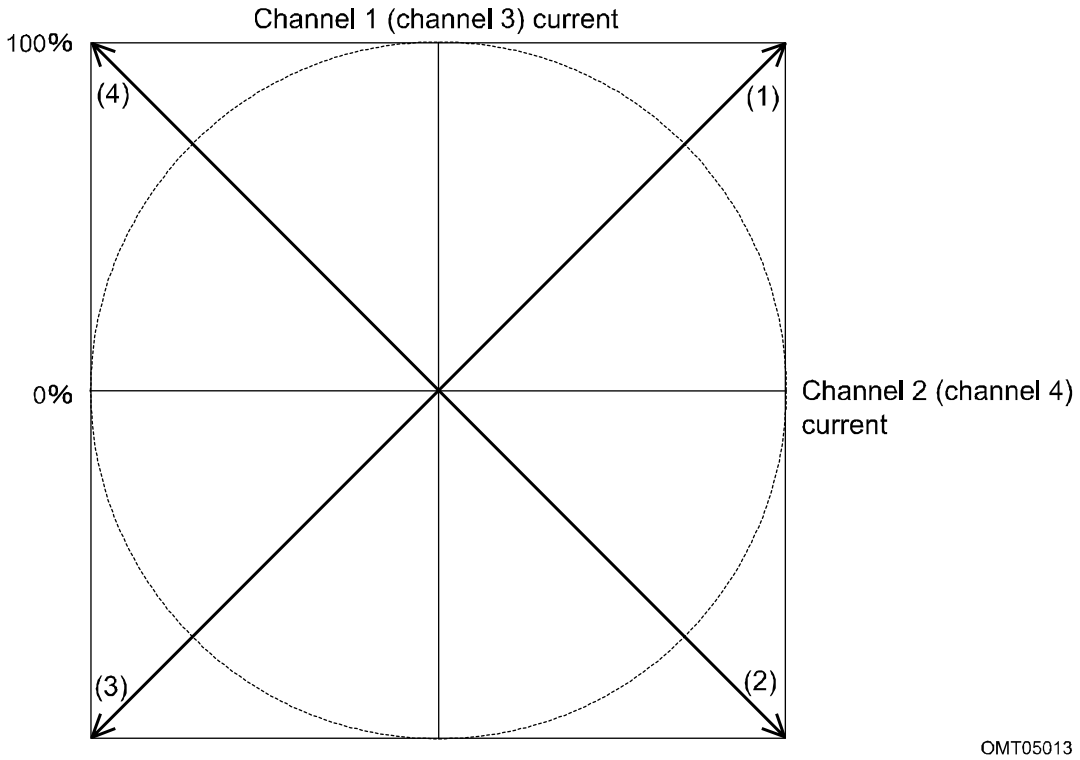
www.DataSheet4U.com

## Excitation Mode Setting

This section presents the timing charts for each excitation mode.

### Two-Phase Excitation Timing Chart



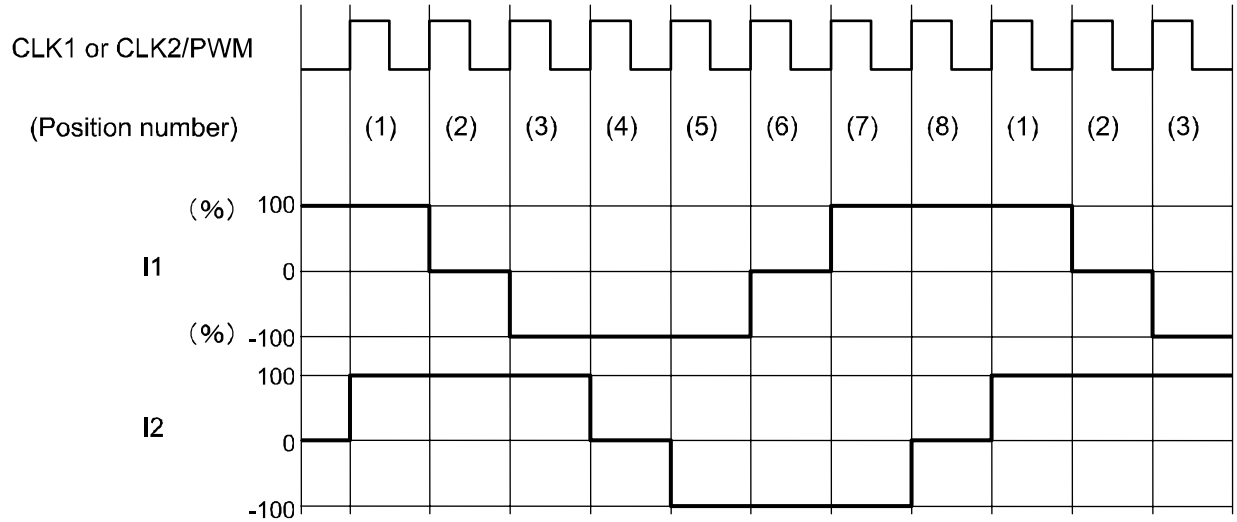



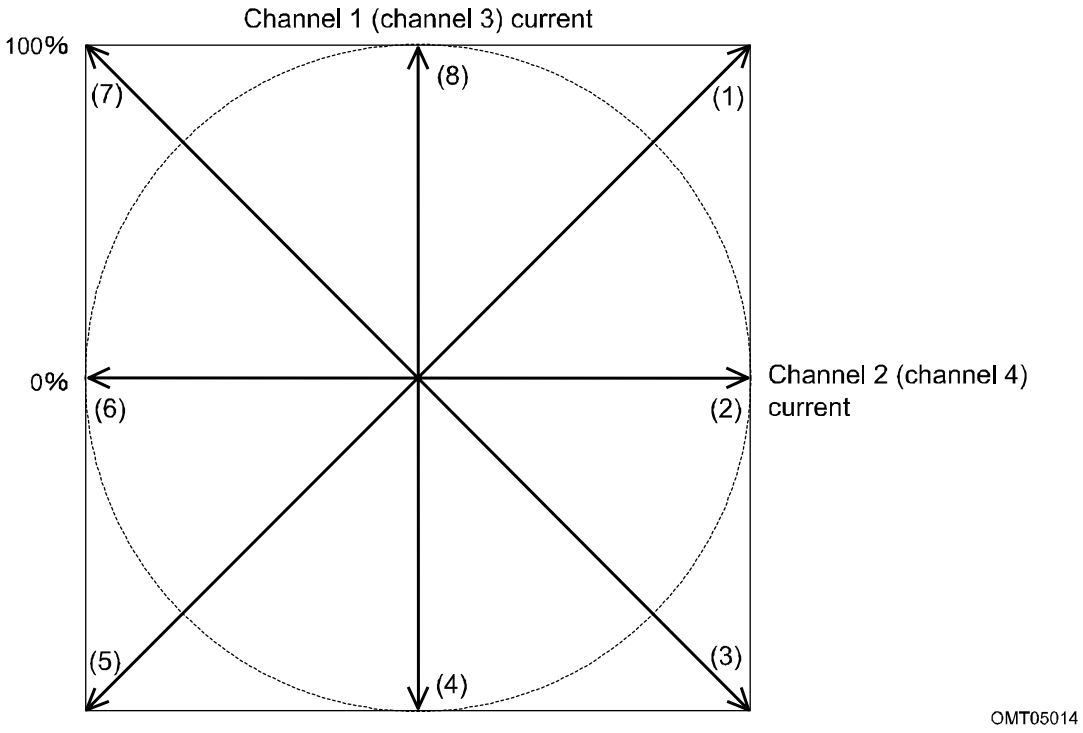


www.DataSheet4U.com

www.DataSheet4U.com

**1-2 Phase Excitation Timing Chart**



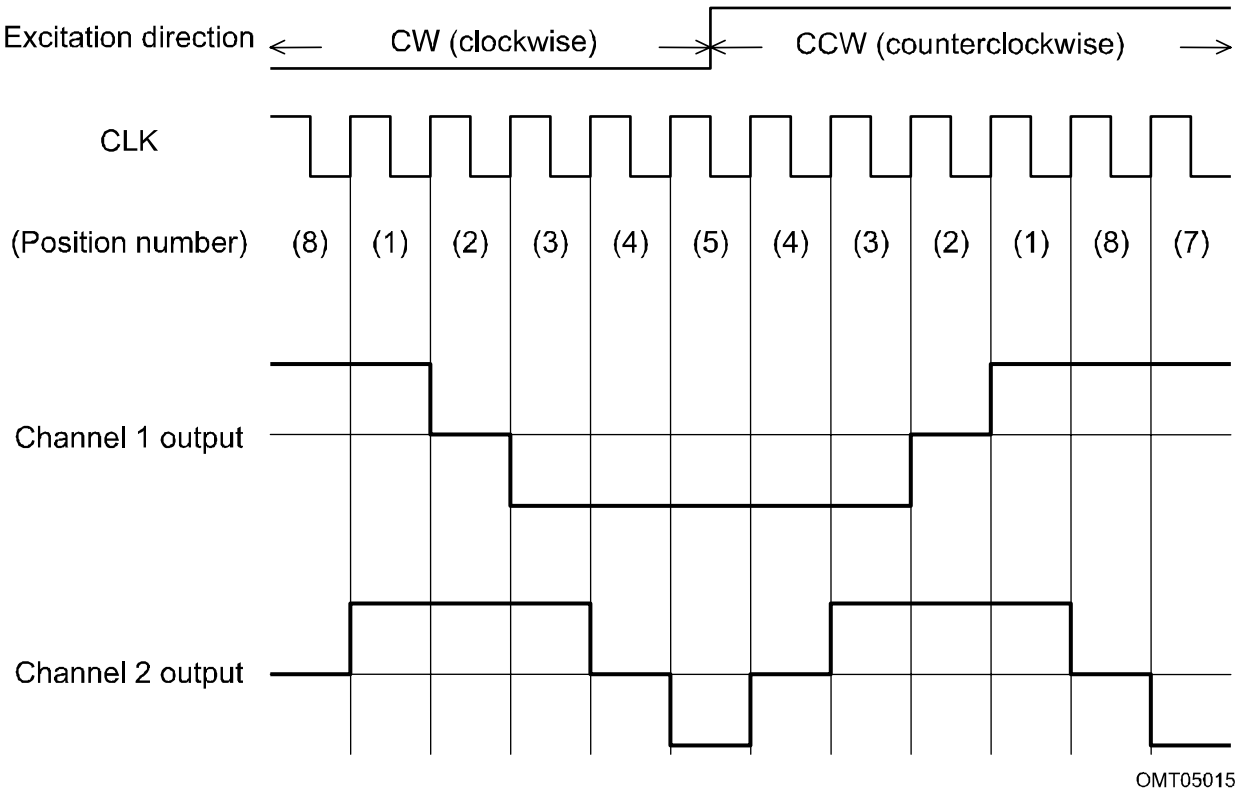


www.DataSheet4U.com

www.DataSheet4U.com

**Sample Timing Chart for the Excitation Direction Setting**

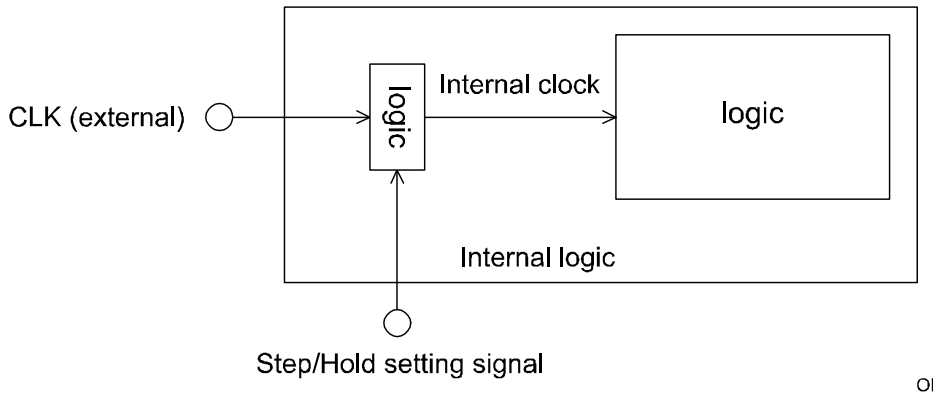
The excitation direction setting sets the excitation (rotation) direction of the stepping motor.
With the CW (clockwise) setting, the phase of the channel 2 current is delayed from that of the channel 1 current by 90°.
With the CCW (counterclockwise) setting, the phase of the channel 2 current leads that of the channel 1 current by 90°.




www.DataSheet4U.com

www.DataSheet4U.com

## Step/Hold Operation Overview

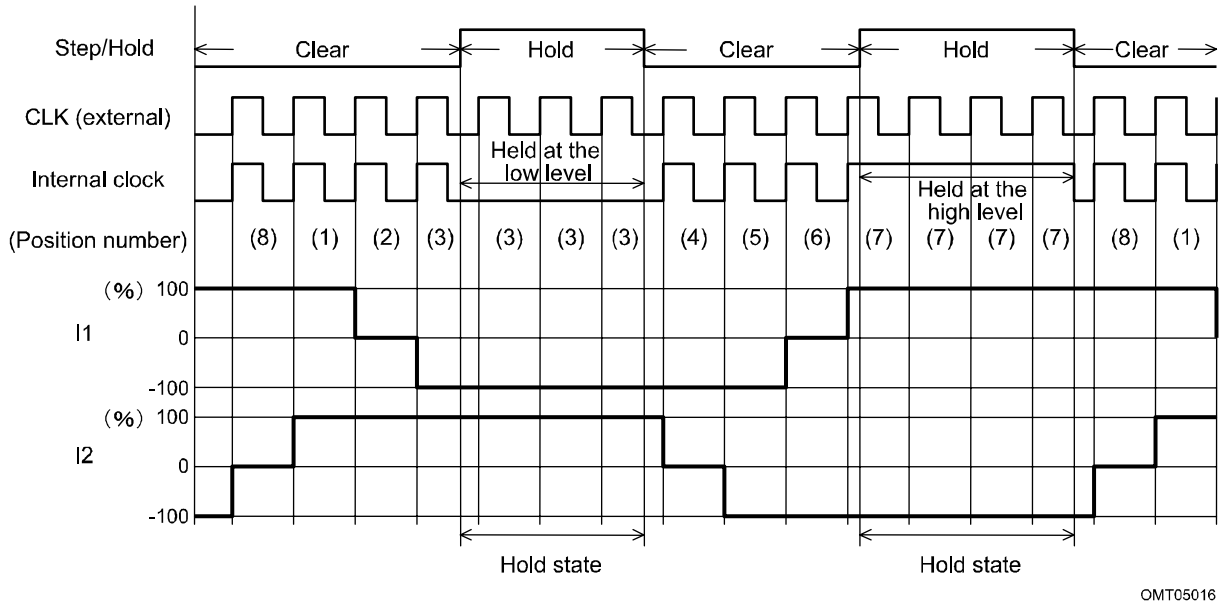



## Sample Timing Chart for the Step/Hold Setting

When the Step/Hold data is set to the Hold state, the state of the external clock signal (CLK) at that time is latched and held as the internal clock signal.

At the timing with which Step/Hold is set to the Hold state for the first time in the figure below, the internal clock signal will be held at the low level because the external clock (CLK) was at the low level. In contrast, at the timing with which Step/Hold is set to the Hold state for the second time, the internal clock signal will be held at the high level because the external clock (CLK) was at the high level.

When Step/Hold is set to the Clear state, the internal clock is synchronized with the external clock (CLK). The output holds the state it was in at the point Step/Hold is set to the Hold state, and advances on the next clock signal rising edge after Step/Hold is set to the Clear state.
As long as Step/Hold is in the Hold state, the position number does not advance even if an external clock (CLK) signal is applied.



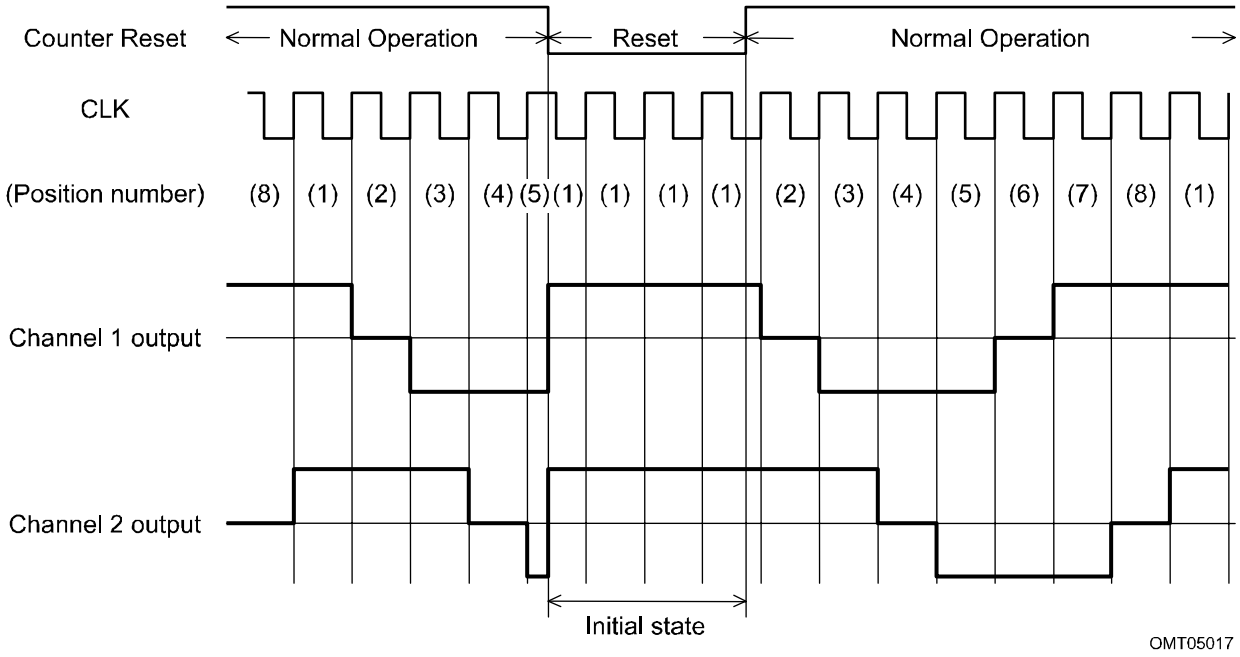


www.DataSheet4U.com

www.DataSheet4U.com

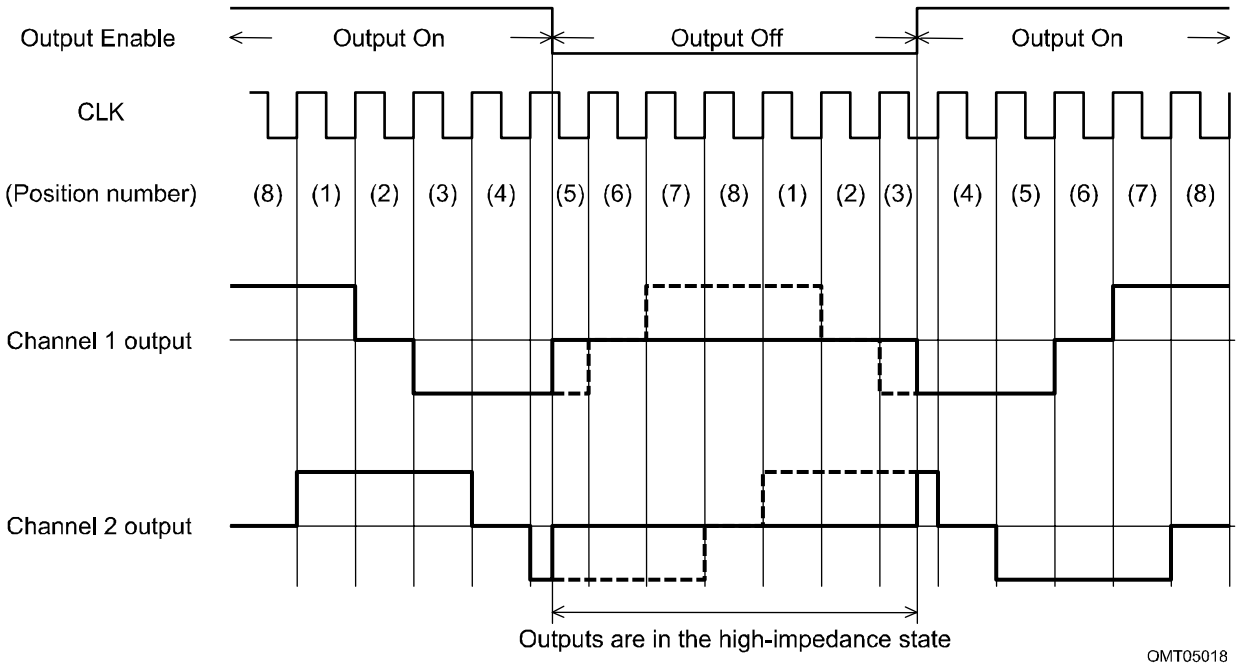
### Sample Timing Chart for the Counter Reset Setting

When the Counter Reset setting is set to the Reset state, the output goes to the initial state on the rising edge of the STB signal. Then, when the Counter Reset setting is set to the Normal Operation (cleared) state, the output begins to advance the position number on the rising edge of the CLK signal following the rise of the STB signal.




### Sample Timing Chart for the Output Enable Setting

When the Output Enable setting is set to the Output Off state, the outputs are turned off and set to the high-impedance state on the rising edge of the STB signal.
Note, however, that since the internal clock continues to operate, the position number advances as long as a clock signal (CLK) is input. Therefore, when the Output Enable setting is next set to the Output On (cleared) state, the output is turned on at the STB signal rising edge and the output levels at that time will be those for the position number to which the state has advanced due to the CLK signal input.





www.DataSheet4U.com

www.DataSheet4U.com

## DC Motor and Voice Coil Motor Drive Methods (Channels 3 and 4)

When channels 3 and 4 are used to drive a DC or voice coil motor, the drive polarity is set with the serial data. The procedure for setting the drive polarity is shown below.
(See subsection, Serial Logic Table 2, in section, Truth Tables, for a detailed description of this data.)

### Setting Procedure

(1) Select PWM signal input with the CLK2/PWM selection item in the serial data.
→ This sets up the signal input to the CLK2/PWM pin to be accepted as a PWM signal for channel 3 or channel 4. (In this case, it is not used as a clock signal.)
(2) If the output is to be controlled by PWM control, set up PWM mode and PWM signal allocation with the serial data.
(3) Set the drive polarity for each channel with the serial data.
(4) If the output is to be controlled by PWM control, input the PWM signal to the CLK2/PWM pin.
The following tables describe the correspondence between the PWM signal and the output logic.

### Operation in Slow Decay Mode (forward/reverse ↔ brake)

| Serial input | | | | PWM input | Output | | | | Mode |
|---|---|---|---|---|---|---|---|---|---|
| D4 | D5 | D6 | D7 | CLK2/PWM | OUT5 | OUT6 | OUT7 | OUT8 | |
| 0 | 0 | | | L | OFF | OFF | | | Standby mode |
| 1 | 0 | | | | H | L | | | OUT5 → OUT6 |
| 0 | 1 | | | | L | H | | | OUT6 → OUT5 |
| 1 | 1 | | | | L | L | | | Brake mode |
| | | 0 | 0 | | | | OFF | OFF | Standby mode |
| | | 1 | 0 | | | | H | L | OUT7 → OUT8 |
| | | 0 | 1 | | | | L | H | OUT8 → OUT7 |
| | | 1 | 1 | | | | L | L | Brake mode |
| 0 | 0 | | | H | OFF | OFF | | | Standby mode |
| 1 | 0 | | | | L | L | | | Brake mode |
| 0 | 1 | | | | L | L | | | Brake mode |
| 1 | 1 | | | | L | L | | | Brake mode |
| | | 0 | 0 | | | | OFF | OFF | Standby mode |
| | | 1 | 0 | | | | L | L | Brake mode |
| | | 0 | 1 | | | | L | L | Brake mode |
| | | 1 | 1 | | | | L | L | Brake mode |


www.DataSheet4U.com

www.DataSheet4U.com

### Operation in Fast Decay Mode (forward/reverse ↔ standby mode)

| Serial input | | | | PWM input | Output | | | | Mode |
|---|---|---|---|---|---|---|---|---|---|
| D4 | D5 | D6 | D7 | CLK2/PWM | OUT5 | OUT6 | OUT7 | OUT8 | |
| 0 | 0 | | | L | OFF | OFF | | | Standby mode |
| 1 | 0 | | | | H | L | | | OUT5 → OUT6 |
| 0 | 1 | | | | L | H | | | OUT6 → OUT5 |
| 1 | 1 | | | | L | L | | | Brake mode |
| | | 0 | 0 | | | | OFF | OFF | Standby mode |
| | | 1 | 0 | | | | H | L | OUT7 → OUT8 |
| | | 0 | 1 | | | | L | H | OUT8 → OUT7 |
| | | 1 | 1 | | | | L | L | Brake mode |
| 0 | 0 | | | H | OFF | OFF | | | Standby mode |
| 1 | 0 | | | | OFF | OFF | | | Standby mode |
| 0 | 1 | | | | OFF | OFF | | | Standby mode |
| 1 | 1 | | | | L | L | | | Brake mode |
| | | 0 | 0 | | | | OFF | OFF | Standby mode |
| | | 1 | 0 | | | | OFF | OFF | Standby mode |
| | | 0 | 1 | | | | OFF | OFF | Standby mode |
| | | 1 | 1 | | | | L | L | Brake mode |

### Constant Voltage Control Setup Procedure for Channels 1 to 4

The constant voltage set value for channels 1 to 4 can be set separately for channels 1 and 2 and for channels 3 and 4. (See subsections, Serial Logic Table 3, and, Serial Logic Table 4, in section, Truth Tables, for a detailed description of this data.)

The reference voltage used as the basis for operation can be selected to be either the internal reference voltage (0.88V) or the external input voltage (the voltage applied to the VC pin).
The reference voltage selected as described above is voltage divided by the ratio set by the VC voltage divisor set by the serial data. The result of that voltage division operation is multiplied by five by the output constant voltage circuit and then output.
The following formulas can be used to calculate the output constant voltage for the individual cases.

When the internal reference voltage is used:
(output constant voltage) = (internal reference voltage (0.88 V)) × (VC voltage divisor) × 5

When the external reference voltage (VC input voltage) is used:
(output constant voltage) = (VC input voltage) × (VC voltage divisor) × 5

www.DataSheet4U.com

www.DataSheet4U.com

### Voice Coil Motor and Stepping Motor Drive Methods (Channels 5 and 6)

When channel 5 or 6 is used to drive either a voice coil motor or stepping motor, the drive polarity can be set with either serial data or parallel data (the IN51, IN52, IN61, and IN62 input signals).
This section describes the procedures used for these settings.
(See subsection, Serial Logic Table 2, in section, Truth Tables, for a detailed description of this data.)

### Setting Procedure Using Serial Data

A: Channel 5
1. Set the IN51 and IN52 pins to the low level. (Alternative, they may be left open.)
2. Set the drive polarity with the serial data

B: Channel 6
1. Set the IN61 and IN62 pins to the low level. (Alternative, they may be left open.)
2. Set the drive polarity with the serial data

### Setting Procedure Using Parallel Data

The IN51 and IN52 pins are used to set the channel 5 drive polarity and the IN61 and IN62 pins are used to set the channel 6 drive polarity.

The truth table for this function is shown below.

| Parallel inputs | | | | Outputs | | | | Mode | |
|---|---|---|---|---|---|---|---|---|---|
| IN51 | IN52 | IN61 | IN62 | OUT9 | OUT10 | OUT11 | OUT12 | | |
| L | L | | | L | L | | | Standby mode | Serial priority |
| L | H | | | L | H | | | OUT10 → OUT9 | Parallel priority |
| H | L | | | H | L | | | OUT9 → OUT10 | |
| H | H | | | L | L | | | Brake | |
| | | L | L | | | L | L | Standby mode | Serial priority |
| | | L | H | | | L | H | OUT12 → OUT11 | Parallel priority |
| | | H | L | | | H | L | OUT11 → OUT12 | |
| | | H | H | | | L | L | Brake | |

### Constant Current Control Settings (channels 5 and 6)

The constant current settings for channels 5 and 6 are set individually for each channel.
(See subsection, Serial Logic Table 5, in section, Truth Tables, for a detailed description of this data.)

The output constant current is set by the constant current reference voltage set with the serial data and the resistor (RF) connected between the RF1 and RF2 pins.
The following formula can be used to calculate the output constant current.

(output constant current) = (constant current reference voltage) / (value of the resistor RF)

### PI Output Drive Method

When the PI output is used to drive a photosensor, the drive on/off state is set from the serial data.
(See subsection, Serial Logic Table 5, in section, Truth Tables, for a detailed description of this data.)

### Schmitt Buffer Hysteresis Setting

The presence or absence of hysteresis in the BO1, BO2, and BO3 Schmitt buffer outputs can be set individually with the serial data.
(See subsection, Serial Logic Table 5, in section, Truth Tables, for a detailed description of this data.)


www.DataSheet4U.com

www.DataSheet4U.com

# Truth Tables

## Serial Logic Table 1

| Input | | | | | | | | Setting mode | Content set | Notes | Channels set | | | | | | PI | Serial data activation timing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | | | | 1ch | 2ch | 3ch | 4ch | 5ch | 6ch | | CLK1 | CLK2 | STB |
| 0 | 0 | 0 | 0 | * | * | * | * | AF Excitation Direction | CW (clockwise) | | ○ | ○ | | | | | | ○ | | |
| | | | 1 | * | * | * | * | | CCW (counterclockwise) | | | | | | | | | | | |
| | | | * | 0 | * | * | * | AF Excitation mode | 2-phase excitation | | | | | | | | | | | |
| | | | * | 1 | * | * | * | | 1-2 phase excitation | | | | | | | | | | | |
| | | | * | * | 0 | * | * | AF Step/Hold | Clear | | | | | | | | | | | ○ |
| | | | * | * | 1 | * | * | | Hold | | | | | | | | | | | |
| | | | * | * | * | 0 | * | AF Counter Reset | Reset | | | | | | | | | | | |
| | | | * | * | * | 1 | * | | Clear | | | | | | | | | | | |
| | | | * | * | * | * | 0 | AF Output Enable | Output Off | | | | | | | | | | | |
| | | | * | * | * | * | 1 | | Output On | | | | | | | | | | | |
| 1 | 0 | 0 | 0 | * | * | * | * | Zoom Excitation Direction | CW (clockwise) | | | | ○ | ○ | | | | | ○ | |
| | | | 1 | * | * | * | * | | CCW (counterclockwise) | | | | | | | | | | | |
| | | | * | 0 | * | * | * | Zoom Excitation Mode | 2-phase excitation | | | | | | | | | | | |
| | | | * | 1 | * | * | * | | 1-2 phase excitation | | | | | | | | | | | |
| | | | * | * | 0 | * | * | Zoom Step/Hold | Clear | | | | | | | | | | | ○ |
| | | | * | * | 1 | * | * | | Hold | | | | | | | | | | | |
| | | | * | * | * | 0 | * | Zoom Counter Reset | Reset | | | | | | | | | | | |
| | | | * | * | * | 1 | * | | Clear | | | | | | | | | | | |
| | | | * | * | * | * | 0 | Zoom Output Enable | Output Off | | | | | | | | | | | |
| | | | * | * | * | * | 1 | | Output On | | | | | | | | | | | |



www.DataSheet4U.com

www.DataSheet4

## Serial Logic Table 2

| Input | | | | | | | | Setting mode | Content set | Notes | Channels set | | | | | | PI | Serial data activation timing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | | | | 1ch | 2ch | 3ch | 4ch | 5ch | 6ch | | CLK1 | CLK2 | STB |
| 0 | 1 | 0 | 0 | 0 | 0 | * | * | OUT5-6 drive polarity (3ch) | OFF | | | | ○ | | | | | | | ○ |
| | | | | 1 | 0 | * | * | | OUT5 → OUT6 | *1 | | | | | | | | | | |
| | | | | 0 | 1 | * | * | | OUT6 → OUT5 | | | | | | | | | | | |
| | | | | 1 | 1 | * | * | | Brake | | | | | | | | | | | |
| | | | | * | * | 0 | 0 | OUT7-8 drive polarity (4ch) | OFF | | | | | ○ | | | | | | |
| | | | | * | * | 1 | 0 | | OUT7 → OUT8 | *1 | | | | | | | | | | |
| | | | | * | * | 0 | 1 | | OUT8 → OUT7 | | | | | | | | | | | |
| | | | | * | * | 1 | 1 | | Brake | | | | | | | | | | | |
| | | | 1 | 0 | 0 | * | * | OU9-10 drive polarity (5ch) | OFF | *2 | | | | | ○ | | | | | |
| | | | | 1 | 0 | * | * | | OUT9 → OUT10 | | | | | | | | | | | |
| | | | | 0 | 1 | * | * | | OUT10 → OUT9 | | | | | | | | | | | |
| | | | | 1 | 1 | * | * | | Brake | | | | | | | | | | | |
| | | | | * | * | 0 | 0 | OUT11-12 drive polarity (6ch) | OFF | *3 | | | | | | ○ | | | | |
| | | | | * | * | 1 | 0 | | OUT11 → OUT12 | | | | | | | | | | | |
| | | | | * | * | 0 | 1 | | OUT12 → OUT11 | | | | | | | | | | | |
| | | | | * | * | 1 | 1 | | Brake | | | | | | | | | | | |
| 1 | 1 | 0 | 0 | * | * | * | * | CLK2/PWM selection | CLK2 signal input | *4 | | | ○ | ○ | | | | | | ○ |
| | | | 1 | * | * | * | * | | PWM signal input | | | | | | | | | | | |
| | | | * | 0 | * | * | * | PWM mode | Slow Decay (Forward/reverse ↔ brake) | *5 | | | | | | | | | | |
| | | | * | 1 | * | * | * | | Fast Decay (Forward/reverse ↔ standby mode) | *6 | | | | | | | | | | |
| | | | * | * | 0 | 0 | * | PWM signal allocation | OFF | | | | | | | | | | | |
| | | | * | * | 1 | 0 | * | | Channel 3 only | | | | | | | | | | | |
| | | | * | * | 0 | 1 | * | | Channel 4 only | | | | | | | | | | | |
| | | | * | * | 1 | 1 | * | | Both channels 3 and 4 | | | | | | | | | | | |
| | | | * | * | * | * | 0 | (Dummy data) | | | | | | | | | | | | |
| | | | * | * | * | * | 1 | | | | | | | | | | | | | |

www.DataSheet4U.com

www.DataSheet4U.com

## Serial Logic Table 3

| Input | | | | | | | | Setting mode | Content set | Notes | Channels set | | | | | | PI | Serial data activation timing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | | | | 1ch | 2ch | 3ch | 4ch | 5ch | 6ch | | CLK1 | CLK2 | STB |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | * | VC voltage divisor (The values in parentheses indicate the output voltage value when the internal reference voltage (0.88V) is used.) | 100% (4.4V) | *7 | ○ | ○ | | | | | | | | ○ |
| | | | 1 | 0 | 0 | 0 | * | | 97.7% (4.3V) | | | | | | | | | | | |
| | | | 0 | 1 | 0 | 0 | * | | 95.5% (4.2V) | | | | | | | | | | | |
| | | | 1 | 1 | 0 | 0 | * | | 93.2% (4.1V) | | | | | | | | | | | |
| | | | 0 | 0 | 1 | 0 | * | | 90.9% (4.0V) | | | | | | | | | | | |
| | | | 1 | 0 | 1 | 0 | * | | 88.6% (3.9V) | | | | | | | | | | | |
| | | | 0 | 1 | 1 | 0 | * | | 86.4% (3.8V) | | | | | | | | | | | |
| | | | 1 | 1 | 1 | 0 | * | | 84.1% (3.7V) | | | | | | | | | | | |
| | | | 0 | 0 | 0 | 1 | * | | 81.8% (3.6V) | | | | | | | | | | | |
| | | | 1 | 0 | 0 | 1 | * | | 79.5% (3.5V) | | | | | | | | | | | |
| | | | 0 | 1 | 0 | 1 | * | | 77.3% (3.4V) | | | | | | | | | | | |
| | | | 1 | 1 | 0 | 1 | * | | 75.0% (3.3V) | | | | | | | | | | | |
| | | | 0 | 0 | 1 | 1 | * | | 72.7% (3.2V) | | | | | | | | | | | |
| | | | 1 | 0 | 1 | 1 | * | | 70.5% (3.1V) | | | | | | | | | | | |
| | | | 0 | 1 | 1 | 1 | * | | 68.2% (3.0V) | | | | | | | | | | | |
| | | | 1 | 1 | 1 | 1 | * | | 65.9% (2.9V) | | | | | | | | | | | |
| | | | * | * | * | * | 0 | VC voltage selection | Internal reference voltage (0.88V) | | | | | | | | | | | |
| | | | * | * | * | * | 1 | | VC input voltage | | | | | | | | | | | |

## Serial Logic Table 4

| Input | | | | | | | | Setting mode | Content set | Notes | Channels set | | | | | | PI | Serial data activation timing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | | | | 1ch | 2ch | 3ch | 4ch | 5ch | 6ch | | CLK1 | CLK2 | STB |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | * | VC voltage Divisor (The values in parentheses indicate the output voltage value when the internal reference voltage (0.88V) is used.) | 100% (4.4V) | *7 | | | ○ | ○ | | | | | | ○ |
| | | | 1 | 0 | 0 | 0 | * | | 97.7% (4.3V) | | | | | | | | | | | |
| | | | 0 | 1 | 0 | 0 | * | | 95.5% (4.2V) | | | | | | | | | | | |
| | | | 1 | 1 | 0 | 0 | * | | 93.2% (4.1V) | | | | | | | | | | | |
| | | | 0 | 0 | 1 | 0 | * | | 90.9% (4.0V) | | | | | | | | | | | |
| | | | 1 | 0 | 1 | 0 | * | | 88.6% (3.9V) | | | | | | | | | | | |
| | | | 0 | 1 | 1 | 0 | * | | 86.4% (3.8V) | | | | | | | | | | | |
| | | | 1 | 1 | 1 | 0 | * | | 84.1% (3.7V) | | | | | | | | | | | |
| | | | 0 | 0 | 0 | 1 | * | | 81.8% (3.6V) | | | | | | | | | | | |
| | | | 1 | 0 | 0 | 1 | * | | 79.5% (3.5V) | | | | | | | | | | | |
| | | | 0 | 1 | 0 | 1 | * | | 77.3% (3.4V) | | | | | | | | | | | |
| | | | 1 | 1 | 0 | 1 | * | | 75.0% (3.3V) | | | | | | | | | | | |
| | | | 0 | 0 | 1 | 1 | * | | 72.7% (3.2V) | | | | | | | | | | | |
| | | | 1 | 0 | 1 | 1 | * | | 70.5% (3.1V) | | | | | | | | | | | |
| | | | 0 | 1 | 1 | 1 | * | | 68.2% (3.0V) | | | | | | | | | | | |
| | | | 1 | 1 | 1 | 1 | * | | 65.9% (2.9V) | | | | | | | | | | | |
| | | | * | * | * | * | 0 | VC voltage selection | Internal reference voltage (0.88V) | | | | | | | | | | | |
| | | | * | * | * | * | 1 | | VC input voltage | | | | | | | | | | | |

www.DataSheet4U.com

www.DataSheet4U.com

## Serial Logic Table 5

| Input | | | | | | | | Setting mode | Content set | Notes | Channels set | | | | | | PI | Serial data activation timing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | | | | 1ch | 2ch | 3ch | 4ch | 5ch | 6ch | | CLK1 | CLK2 | STB |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | * | Constant current reference voltage | 0.200V | | | | | | ○ | ○ | | | | ○ |
| | | | 1 | 0 | 0 | 0 | * | | 0.170V | | | | | | | | | | | |
| | | | 0 | 1 | 0 | 0 | * | | 0.165V | | | | | | | | | | | |
| | | | 1 | 1 | 0 | 0 | * | | 0.160V | | | | | | | | | | | |
| | | | 0 | 0 | 1 | 0 | * | | 0.155V | | | | | | | | | | | |
| | | | 1 | 0 | 1 | 0 | * | | 0.150V | | | | | | | | | | | |
| | | | 0 | 1 | 1 | 0 | * | | 0.145V | | | | | | | | | | | |
| | | | 1 | 1 | 1 | 0 | * | | 0.140V | | | | | | | | | | | |
| | | | 0 | 0 | 0 | 1 | * | | 0.135V | | | | | | | | | | | |
| | | | 1 | 0 | 0 | 1 | * | | 0.130V | | | | | | | | | | | |
| | | | 0 | 1 | 0 | 1 | * | | 0.125V | | | | | | | | | | | |
| | | | 1 | 1 | 0 | 1 | * | | 0.120V | | | | | | | | | | | |
| | | | 0 | 0 | 1 | 1 | * | | 0.115V | | | | | | | | | | | |
| | | | 1 | 0 | 1 | 1 | * | | 0.110V | | | | | | | | | | | |
| | | | 0 | 1 | 1 | 1 | * | | 0.105V | | | | | | | | | | | |
| | | | 1 | 1 | 1 | 1 | * | | 0.100V | | | | | | | | | | | |
| | | | * | * | * | * | 0 | Channel selection | OUT9-10 (5ch) | | | | | | | | | | | |
| | | | * | * | * | * | 1 | | OUT11-12 (6ch) | | | | | | | | | | | |
| 1 | 1 | 1 | 0 | * | * | * | * | Photosensor drive | OFF | | | | | | | | ○ | | | ○ |
| | | | 1 | * | * | * | * | | ON | | | | | | | | | | | |
| | | | * | 0 | * | * | * | Buffer output hysteresis (BI1/BO1) | Absent | | | | | | | | | | | |
| | | | * | 1 | * | * | * | | Present | | | | | | | | | | | |
| | | | * | * | 0 | * | * | Buffer output hysteresis (BI2/BO2) | Absent | | | | | | | | | | | |
| | | | * | * | 1 | * | * | | Present | | | | | | | | | | | |
| | | | * | * | * | 0 | * | Buffer output hysteresis (BI3/BO3) | Absent | | | | | | | | | | | |
| | | | * | * | * | 1 | * | | Present | | | | | | | | | | | |
| | | | * | * | * | * | 0 | (Dummy data) | | | | | | | | | | | | |
| | | | * | * | * | * | 1 | | | | | | | | | | | | | |

### Notes

*1. The operating mode can be switched between forward (or reverse) ↔ brake mode and forward (or reverse) ↔ standby mode operation with the CLK2/PWM pin in combination with notes 5 and 6 below.

*2. These serial inputs are only accepted when the parallel inputs IN51 and IN52 are both at the low level. In all other states, the serial input will be ignored.

*3. These serial inputs are only accepted when the parallel inputs IN61 and IN62 are both at the low level. In all other states, the serial input will be ignored.

*4. Selects whether the CLK2/PWM input functions as a stepping motor clock (CLK2) or a DC motor PWM signal (PWM).

*5. Forcibly switches the logic of note 1 to brake mode when the CLK2/PWM input is high.

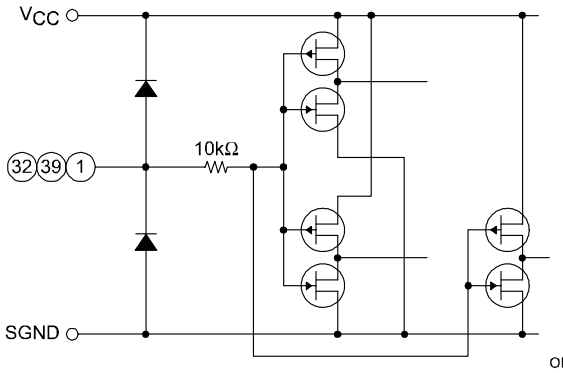
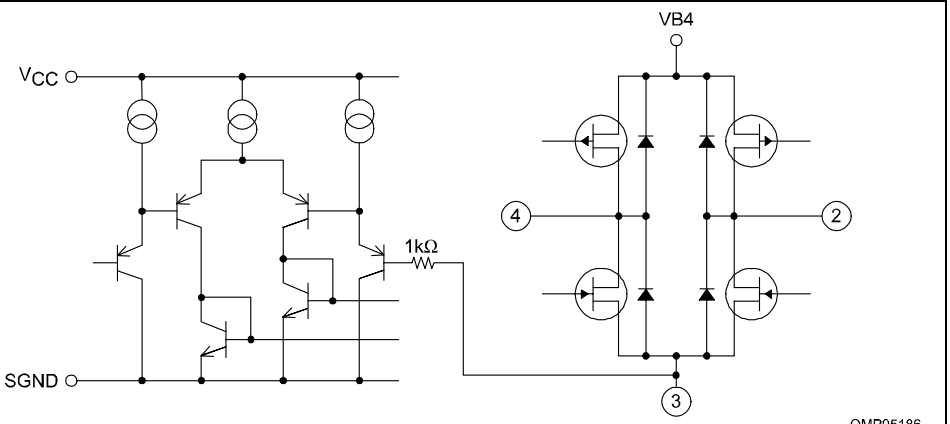
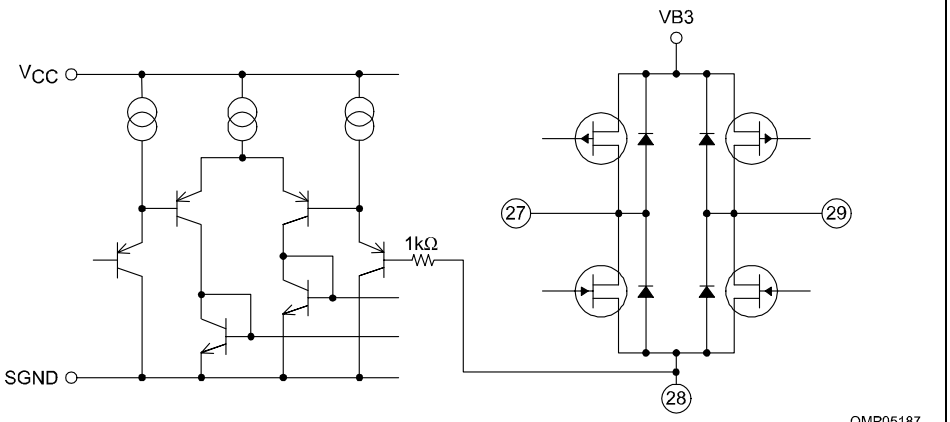
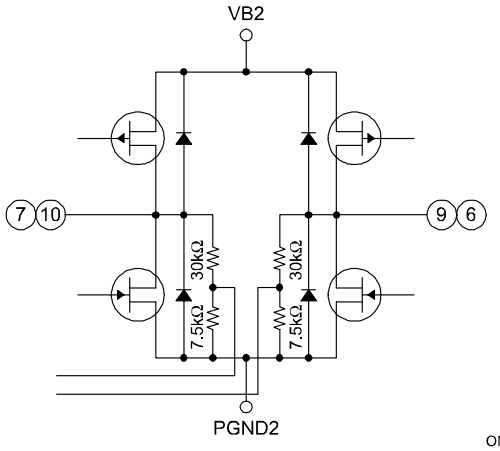
*6. Forcibly switches the logic of note 1 to standby mode when the CLK2/PWM input is high.

*7. Voltage divisor for the VC voltage divider circuit. After either the VC input voltage or the internal reference voltage is voltage divided by this ratio, the result of that division is multiplied by five by the output constant voltage circuit.

www.DataSheet4U.com

www.DataSheet4U.com

## Pin Internal Equivalent Circuits

| Pin No. | Symbol | Equivalent circuit |
|---|---|---|
| 1<br>39<br>32 | BI1<br>BI2<br>BI3 |  |
| 4<br>2<br>3 | OUT11<br>OUT12<br>RF2 |  |
| 27<br>29<br>28 | OUT9<br>OUT10<br>RF1 |  |
| 10<br>9<br>7<br>6 | OUT5<br>OUT6<br>OUT7<br>OUT8 |  |

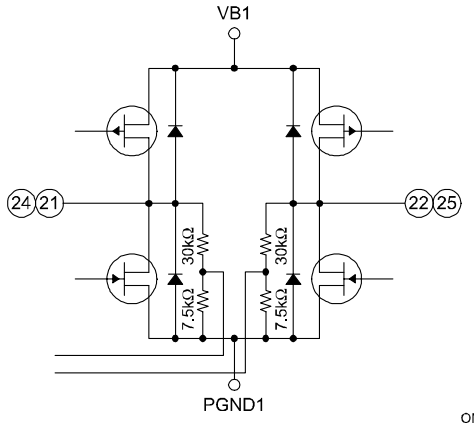
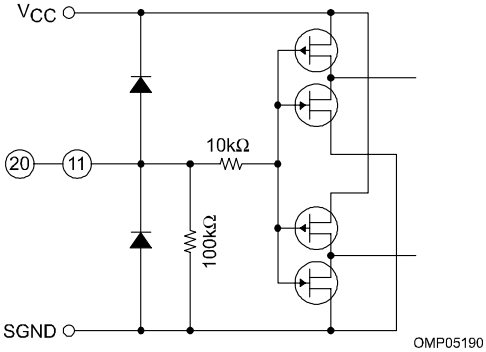
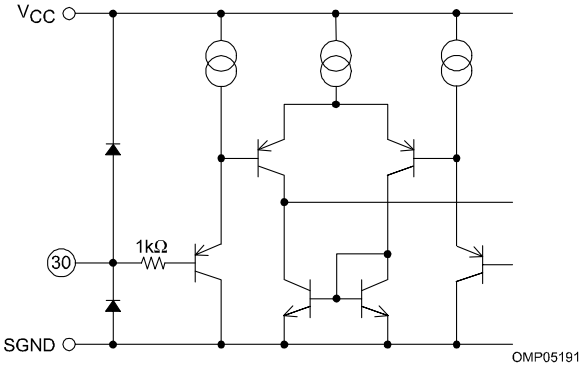
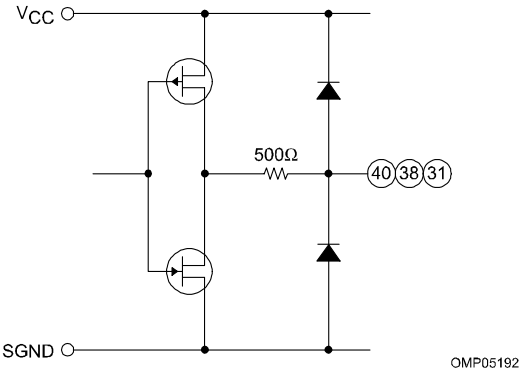
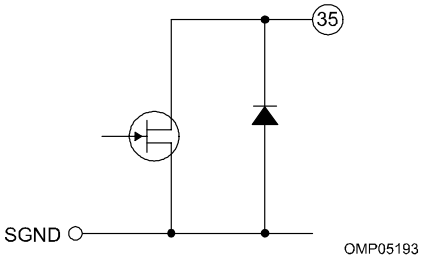
Continued on next page.



www.DataSheet4U.com

www.DataSheet4U.com

Continued from preceding page.

| Pin No. | Symbol | Equivalent circuit |
|---|---|---|
| 21<br>22<br>24<br>25 | OUT1<br>OUT2<br>OUT3<br>OUT4 |  |
| 11<br>12<br>13<br>14<br>15<br>16<br>17<br>18<br>19<br>20 | ST<br>CLK1<br>CLK2/PWM<br>IN51<br>IN52<br>IN61<br>IN62<br>SCLK<br>STB<br>DATA |  |
| 30 | VC |  |
| 40<br>38<br>31 | BO1<br>BO2<br>BO3 |  |
| 35 | PI |  |

www.DataSheet4U.com

www.DataSheet4U.com

- SANYO Semiconductor Co.,Ltd. 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 Co.,Ltd. products described or contained herein.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents 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 Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require 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 consent 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 Co.,Ltd. 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.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellctual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of July, 2007. Specifications and information herein are subject to change without notice.

www.DataSheet4U.com