



SANYO Semiconductors

## DATA SHEET

An ON Semiconductor Company

Bi-CMOS LSI

# LV8741V — PWM Current Control Stepping Motor Driver

## Overview

The LV8741V is a PWM current-control stepping motor driver IC.

## Features

- Single-channel PWM current control stepping motor driver (selectable with DC motor driver channel 2) incorporated.
- BiCDMOS process IC
- On resistance (upper side :  $0.5\Omega$  ; lower side :  $0.5\Omega$  ; total of upper and lower :  $1.0\Omega$  ;  $T_a = 25^\circ\text{C}$ ,  $I_O = 1.5\text{A}$ )
- Excitation mode can be set to 2-phase, 1-2 phase full torque, 1-2 phase or W1-2 phase
- Excitation step proceeds only by step signal input
- Motor holding current selectable in four steps
- $I_O \text{ max} = 1.5\text{A}$
- Output-stage push-pull structure enabling high-speed operation
- Output short-circuit protection circuit (selectable from latch-type or auto reset-type) incorporated
- Thermal shutdown circuit and power supply monitor circuit incorporated
- Supports control power supply  $V_{CC} = 3.3\text{V}$

## Specifications

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

| Parameter           | Symbol               | Conditions                       | Ratings                       | Unit |
|---------------------|----------------------|----------------------------------|-------------------------------|------|
| Supply voltage 1    | $V_M \text{ max}$    |                                  | 38                            | V    |
| Supply voltage 2    | $V_{CC} \text{ max}$ |                                  | 6                             | V    |
| Output peak current | $I_O \text{ peak}$   | $tw \leq 10\text{ms}$ , duty 20% | 1.75                          | A    |
| Output current      | $I_O \text{ max}$    |                                  | 1.5                           | A    |
| Logic input voltage | $V_{IN}$             |                                  | $-0.3 \text{ to } V_{CC}+0.3$ | V    |
| EMO input voltage   | VEMO                 |                                  | $-0.3 \text{ to } V_{CC}+0.3$ | V    |

Continued on next page.

■ 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

# LV8741V

Continued from preceding page.

| Parameter                     | Symbol  | Conditions                                   | Ratings     | Unit |
|-------------------------------|---------|----------------------------------------------|-------------|------|
| Allowable power dissipation 1 | Pd max1 | Independent IC                               | 0.55        | W    |
| Allowable power dissipation 2 | Pd max2 | * Our recommended two-layer substrate *1, *2 | 2.9         | W    |
| Operating temperature         | Topr    |                                              | -20 to +85  | °C   |
| Storage temperature           | Tstg    |                                              | -55 to +150 | °C   |

\*1 Specified circuit board : 90×90×1.7mm<sup>3</sup> : glass epoxy printed circuit board

\*2 For mounting to the backside by soldering, refer the precautions.

## Recommended Operating Conditions at Ta = 25°C

| Parameter                | Symbol          | Conditions | Ratings                   | Unit |
|--------------------------|-----------------|------------|---------------------------|------|
| Supply voltage range 1   | V <sub>M</sub>  |            | 9.5 to 35                 | V    |
| Supply voltage range 2   | V <sub>CC</sub> |            | 2.7 to 5.5                | V    |
| VREF input voltage range | VREF            |            | 0 to V <sub>CC</sub> -1.8 | V    |

## Electrical Characteristics at Ta = 25°C, V<sub>M</sub> = 24V, V<sub>CC</sub> = 5V, VREF = 1.5V

| Parameter                                  |                               | Symbol                          | Conditions                                            | Ratings |       |       | Unit |
|--------------------------------------------|-------------------------------|---------------------------------|-------------------------------------------------------|---------|-------|-------|------|
|                                            |                               |                                 |                                                       | min     | typ   | max   |      |
| Standby mode current drain 1               |                               | IMstn                           | ST = "L"                                              |         | 150   | 200   | μA   |
| Current drain 1                            |                               | IM                              | ST = "H", OE = "H", no load                           |         | 0.75  | 1     | mA   |
| Standby mode current drain 2               |                               | I <sub>CC</sub> stn             | ST = "L"                                              |         | 110   | 160   | μA   |
| Current drain 2                            |                               | I <sub>CC</sub>                 | ST = "H", OE = "H", no load                           |         | 2.5   | 3     | mA   |
| V <sub>CC</sub> low-voltage cutoff voltage |                               | V <sub>th</sub> V <sub>CC</sub> |                                                       | 2.2     | 2.35  | 2.5   | V    |
| Low-voltage hysteresis voltage             |                               | V <sub>th</sub> HIS             |                                                       | 100     | 150   | 200   | mV   |
| Thermal shutdown temperature               |                               | TSD                             | Design guarantee                                      |         | 180   |       | °C   |
| Thermal hysteresis width                   |                               | ΔTSD                            | Design guarantee                                      |         | 40    |       | °C   |
|                                            |                               |                                 |                                                       |         |       |       |      |
| Output on-resistance                       |                               | R <sub>onu</sub>                | I <sub>O</sub> = 1.5A, Upper-side on resistance       |         | 0.5   | 0.7   | Ω    |
|                                            |                               | R <sub>ond</sub>                | I <sub>O</sub> = 1.5A, Lower-side on resistance       |         | 0.5   | 0.6   | Ω    |
| Output leakage current                     |                               | I <sub>O</sub> leak             |                                                       |         |       | 50    | μA   |
| Diode forward voltage 1                    |                               | V <sub>D</sub> 1                | I <sub>D</sub> = -1.0A                                |         | 1     | 1.3   | V    |
| Diode forward voltage 2                    |                               | V <sub>D</sub> 2                | I <sub>D</sub> = -1.5A                                |         | 1.1   | 1.5   | V    |
| Logic pin input current                    |                               | I <sub>IN</sub> L               | V <sub>IN</sub> = 0.8V                                | 3       | 8     | 15    | μA   |
|                                            |                               | I <sub>IN</sub> H               | V <sub>IN</sub> = 5V                                  | 30      | 50    | 70    | μA   |
| Logic high-level input voltage             |                               | V <sub>IN</sub> H               |                                                       | 2.0     |       |       | V    |
| Logic low-level input voltage              |                               | V <sub>IN</sub> L               |                                                       |         |       | 0.8   | V    |
| Current selection reference voltage level  | W1-2-phase drive              |                                 | Step 0(When initialized : channel 1 comparator level) | 0.485   | 0.5   | 0.515 | V    |
|                                            |                               |                                 | Step 1 (Initial state+1)                              | 0.485   | 0.5   | 0.515 | V    |
|                                            |                               |                                 | Step 2 (Initial state+2)                              | 0.323   | 0.333 | 0.343 | V    |
|                                            |                               |                                 | Step 3 (Initial state+3)                              | 0.155   | 0.167 | 0.179 | V    |
|                                            | 1-2 phase drive               |                                 | Step 0 (When initialized: channel 1 comparator level) | 0.485   | 0.5   | 0.515 | V    |
|                                            |                               |                                 | Step 2 (Initial state+1)                              | 0.323   | 0.333 | 0.343 | V    |
|                                            | 1-2 phase (full torque) drive |                                 | Step 0 (Initial state, channel 1 comparator level)    | 0.485   | 0.5   | 0.515 | V    |
|                                            |                               |                                 | Step 2 (Initial state+1)                              | 0.485   | 0.5   | 0.515 | V    |
|                                            | 2 phase drive                 |                                 | Step 2                                                | 0.485   | 0.5   | 0.515 | V    |
|                                            |                               |                                 |                                                       |         |       |       |      |
| Chopping frequency                         |                               | Fchop                           | RCHOP = 20kΩ                                          | 45      | 62.5  | 75    | kHz  |
| Current setting reference voltage          |                               | VRF00                           | ATT1 = L, ATT2 = L                                    | 0.485   | 0.5   | 0.515 | V    |
|                                            |                               | VRF01                           | ATT1 = H, ATT2 = L                                    | 0.323   | 0.333 | 0.343 | V    |
|                                            |                               | VRF10                           | ATT1 = L, ATT2 = H                                    | 0.237   | 0.25  | 0.263 | V    |
|                                            |                               | VRF11                           | ATT1 = H, ATT2 = H                                    | 0.155   | 0.167 | 0.179 | V    |
| VREF pin input current                     |                               | Iref                            | VREF = 1.5V                                           | -0.5    |       |       | μA   |

Continued on next page.

LV8741V

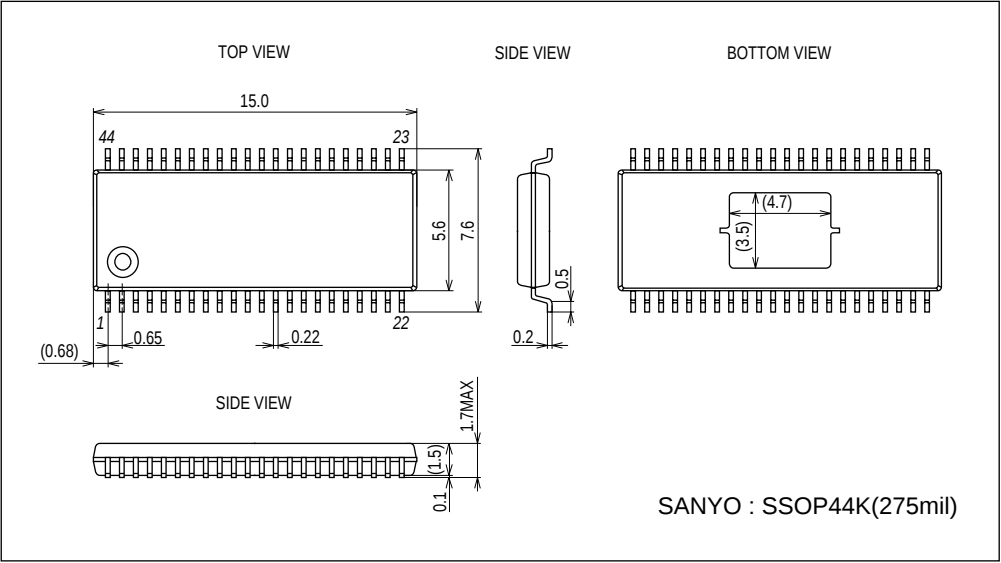
Continued from preceding page.

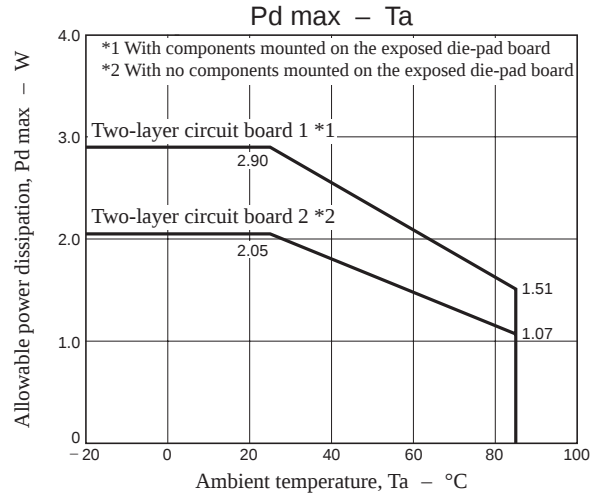
| Parameter                       | Symbol | Conditions             | Ratings |      |      | Unit |
|---------------------------------|--------|------------------------|---------|------|------|------|
|                                 |        |                        | min     | typ  | max  |      |
| Charge pump                     |        |                        |         |      |      |      |
| VREG5 output voltage            | Vreg5  | I <sub>O</sub> = -1mA  | 4.5     | 5    | 5.5  | V    |
| VG output voltage               | VG     |                        | 28      | 28.7 | 29.8 | V    |
| Rise time                       | tONG   | VG = 0.1μF             |         |      | 0.5  | ms   |
| Oscillator frequency            | Fosc   | RCHOP = 20kΩ           | 90      | 125  | 150  | kHz  |
| Output short-circuit protection |        |                        |         |      |      |      |
| EMO pin saturation voltage      |        | I <sub>emo</sub> = 1mA |         | 50   | 100  | mV   |

Package Dimensions

unit : mm (typ)

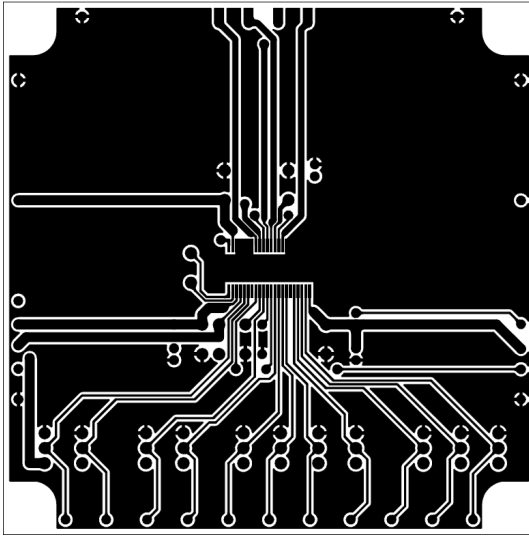
3333



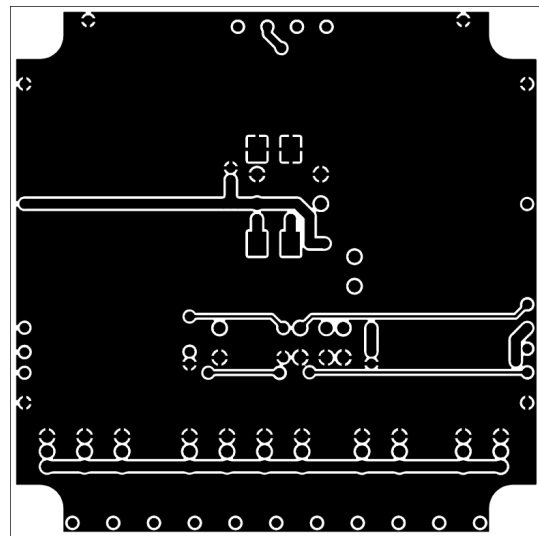


## Substrate Specifications (Substrate recommended for operation of LV8741V)

Size : 90mm × 90mm × 1.7mm (two-layer substrate [2S0P])  
 Material : Glass epoxy  
 Copper wiring density : L1 = 90% / L2 = 95%



L1 : Copper wiring pattern diagram



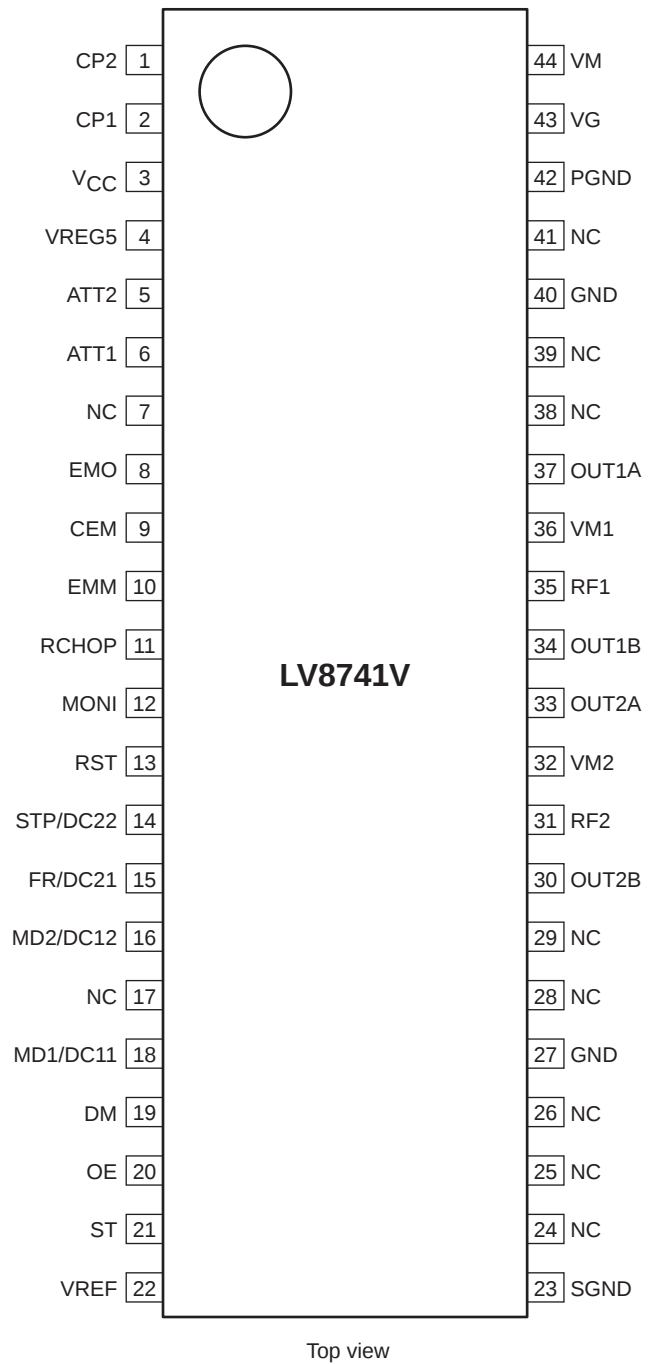
L2 : Copper wiring pattern diagram

## Cautions

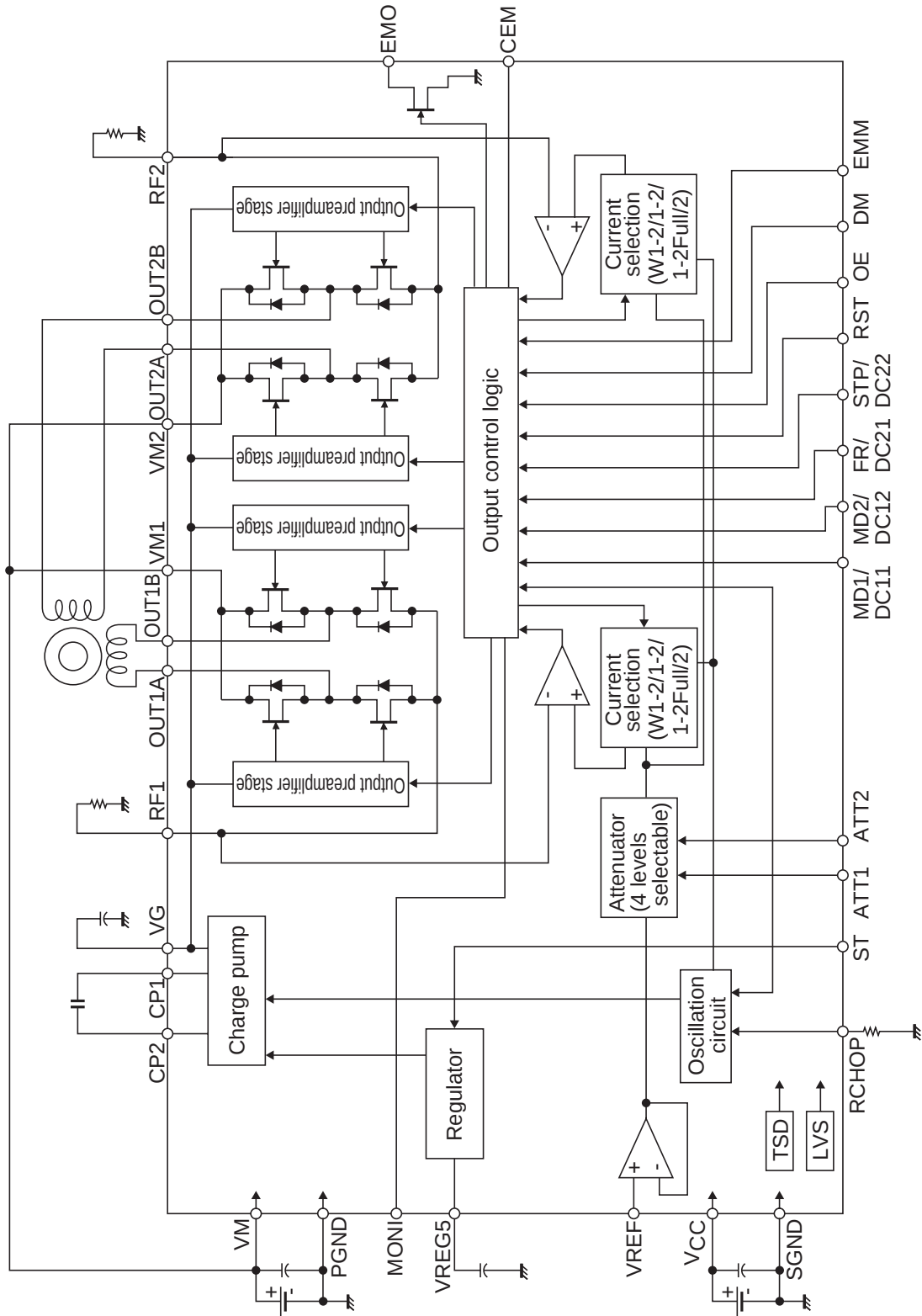
- 1) The data for the case with the Exposed Die-Pad substrate mounted shows the values when 95% or more of the Exposed Die-Pad is wet.
- 2) For the set design, employ the derating design with sufficient margin.  
 Stresses to be derated include the voltage, current, junction temperature, power loss, and mechanical stresses such as vibration, impact, and tension.  
 Accordingly, the design must ensure these stresses to be as low or small as possible.  
 The guideline for ordinary derating is shown below :  
 (1)Maximum value 80% or less for the voltage rating  
 (2)Maximum value 80% or less for the current rating  
 (3)Maximum value 80% or less for the temperature rating
- 3) After the set design, be sure to verify the design with the actual product.  
 Confirm the solder joint state and verify also the reliability of solder joint for the Exposed Die-Pad, etc.  
 Any void or deterioration, if observed in the solder joint of these parts, causes deteriorated thermal conduction, possibly resulting in thermal destruction of IC.

LV8741V

Pin Assignment



# Block Diagram



# LV8741V

## Pin Functions

| Pin No.                                        | Pin name        | Description                                                                    |
|------------------------------------------------|-----------------|--------------------------------------------------------------------------------|
| 36                                             | VM1             | Channel 1 motor power supply pin                                               |
| 37                                             | OUT1A           | Channel 1 OUTA output pin                                                      |
| 34                                             | OUT1B           | Channel 1 OUTB output pin                                                      |
| 35                                             | RF1             | Channel 1 current-sense resistor connection pin                                |
| 32                                             | VM2             | Channel 2 motor power supply connection pin                                    |
| 33                                             | OUT2A           | Channel 2 OUTA output pin                                                      |
| 30                                             | OUT2B           | Channel 2 OUTB output pin                                                      |
| 31                                             | RF2             | Channel 2 current-sense resistor connection pin                                |
| 42                                             | PGND            | Power system ground                                                            |
| 12                                             | MONI            | Position detection monitor pin                                                 |
| 14                                             | STP/DC22        | STM STEP signal input pin/DCM2 output control input pin                        |
| 22                                             | VREF            | Constant current control reference voltage input pin                           |
| 18                                             | MD1/DC11        | STM excitation mode switching pin/DCM1 output control input pin                |
| 16                                             | MD2/DC12        | STM excitation mode switching pin/DCM1 output control input pin                |
| 13                                             | RST             | Reset signal input pin                                                         |
| 20                                             | OE              | Output enable signal input pin                                                 |
| 15                                             | FR/DC21         | STM forward/reverse rotation signal input pin/DCM2 output control input pin    |
| 6                                              | ATT1            | Motor holding current switching pin                                            |
| 5                                              | ATT2            | Motor holding current switching pin                                            |
| 21                                             | ST              | Chip enable pin                                                                |
| 44                                             | VM              | Motor power supply connection pin                                              |
| 3                                              | V <sub>CC</sub> | Logic power supply connection pin                                              |
| 23                                             | SGND            | Signal system ground                                                           |
| 11                                             | RCHOP           | Chopping frequency setting resistor connection pin                             |
| 19                                             | DM              | Drive mode (STM/DCM) switching pin                                             |
| 4                                              | VREG5           | Internal power supply capacitor connection pin                                 |
| 2                                              | CP1             | Charge pump capacitor connection pin                                           |
| 1                                              | CP2             | Charge pump capacitor connection pin                                           |
| 43                                             | VG              | Charge pump capacitor connection pin                                           |
| 8                                              | EMO             | Output short-circuit state warning output pin                                  |
| 10                                             | EMM             | Overcurrent mode switching pin                                                 |
| 9                                              | CEM             | Pin to connect the output short-circuit state detection time setting capacitor |
| 27,40                                          | GND             | Ground                                                                         |
| 7, 17, 24,<br>25, 26, 28,<br>29, 38, 39,<br>41 | NC              | No Connection<br>(No internal connection to the IC)                            |

Equivalent Circuits

| Pin No.                                                      | Pin                                                                                         | Equivalent Circuit |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------|
| 5<br>6<br>10<br>13<br>14<br>15<br>16<br>18<br>19<br>20<br>21 | ATT2<br>ATT1<br>EMM<br>RST<br>STP/DC22<br>FR/DC21<br>MD2/DC12<br>MD1/DC11<br>DM<br>OE<br>ST |                    |
| 30<br>31<br>32<br>33<br>34<br>35<br>36<br>37<br>42           | OUT2B<br>RF2<br>VM2<br>OUT2A<br>OUT1B<br>RF1<br>VM1<br>OUT1A<br>PGND                        |                    |
| 1<br>2<br>43<br>44                                           | CP2<br>CP1<br>VG<br>VM                                                                      |                    |

Continued on next page.

LV8741V

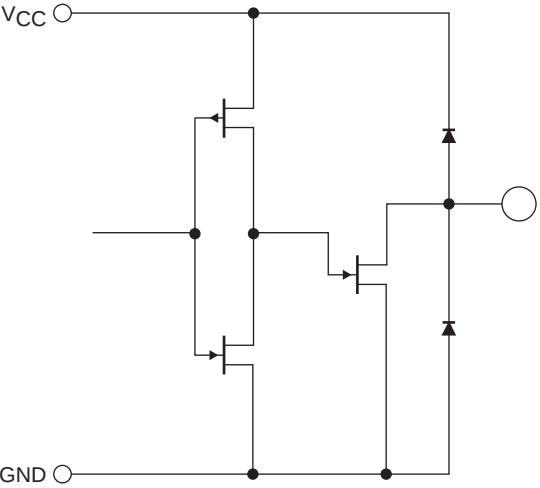
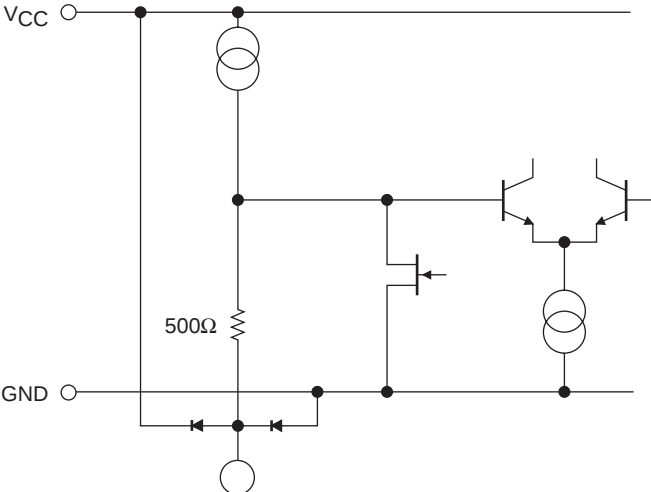
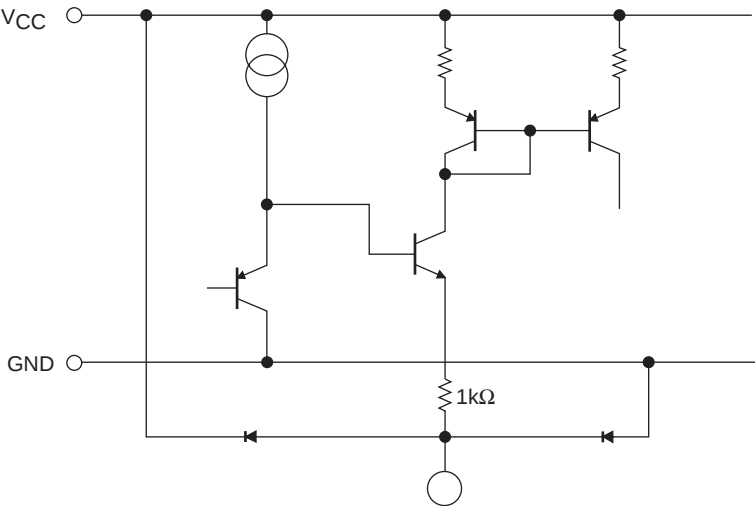
Continued from preceding page.

| Pin No. | Pin   | Equivalent Circuit |
|---------|-------|--------------------|
| 22      | VREF  |                    |
| 4       | VREG5 |                    |
| 12      | MONI  |                    |

Continued on next page.

LV8741V

Continued from preceding page.

| Pin No. | Pin   | Equivalent Circuit                                                                   |
|---------|-------|--------------------------------------------------------------------------------------|
| 8       | EMO   |    |
| 9       | CEM   |   |
| 11      | RCHOP |  |

## Input Pin Function

### (1) Chip enable function

This IC is switched between standby and operating mode by setting the ST pin. In standby mode, the IC is set to power-save mode and all logic is reset. In addition, the internal regulator circuit and charge pump circuit do not operate in standby mode.

| ST          | Mode           | Internal regulator | Charge pump |
|-------------|----------------|--------------------|-------------|
| Low or Open | Standby mode   | Standby            | Standby     |
| High        | Operating mode | Operating          | Operating   |

### (2) Drive mode switching pin function

The IC drive mode is switched by setting the DM pin. In STM mode, stepping motor channel 1 can be controlled by the CLK-IN input. In DCM mode, DC motor channel 2 or stepping motor channel 1 can be controlled by parallel input. Stepping motor control using parallel input is 2-phase or 1-2 phase full torque.

| DM          | Drive mode | Application                                               |
|-------------|------------|-----------------------------------------------------------|
| Low or Open | STM mode   | Stepping motor channel 1 (CLK-IN)                         |
| High        | DCM mode   | DC motor channel 2 or stepping motor channel 1 (parallel) |

STM mode (DM = Low or Open)

### (1) STEP pin function

| Input |                                                                                     | Operating mode           |
|-------|-------------------------------------------------------------------------------------|--------------------------|
| ST    | STP                                                                                 |                          |
| Low   | *                                                                                   | Standby mode             |
| High  |   | Excitation step proceeds |
| High  |  | Excitation step is kept  |

### (2) Excitation mode setting function

| MD1  | MD2  | Excitation mode                    | Initial position |           |
|------|------|------------------------------------|------------------|-----------|
|      |      |                                    | Channel 1        | Channel 2 |
| Low  | Low  | 2 phase excitation                 | 100%             | -100%     |
| High | Low  | 1-2 phase excitation (full torque) | 100%             | 0%        |
| Low  | High | 1-2 phase excitation               | 100%             | 0%        |
| High | High | W1-2 phase excitation              | 100%             | 0%        |

This is the initial position of each excitation mode in the initial state after power-on and when the counter is reset.

### (3) Constant-current control reference voltage setting function

| ATT1 | ATT2 | Current setting reference voltage |
|------|------|-----------------------------------|
| Low  | Low  | VREF/3×100%                       |
| High | Low  | VREF/3×67%                        |
| Low  | High | VREF/3×50%                        |
| High | High | VREF/3×33%                        |

The voltage input to the VREF pin can be switched to four-step settings as the reference voltage for setting the output current. This is effective for reducing power consumption when motor holding current is supplied.

### Set current value calculation method

The reference voltage is set by the voltage applied to the VREF pin and the two inputs ATT1 and ATT2. The output current (output current at a constant-current drive current ratio of 100%) can be set from this reference voltage and the RF resistance value.

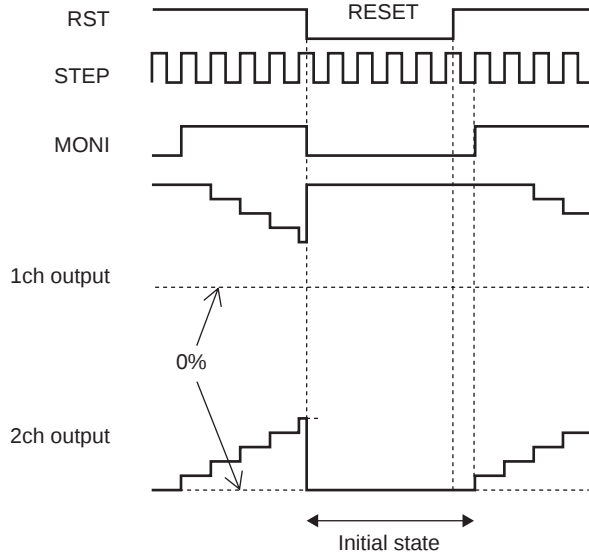
$$I_{OUT} = (VREF/3 \times \text{Voltage setting ratio})/R_F \text{ resistor}$$

(Example) When VREF = 1.5V, setting current ratio = 100% [(ATT1, ATT2) = (Low, Low)] and RF resistor = 0.5Ω, the following output current flows :

$$I_{OUT} = 1.5V/3 \times 100\%/0.5\Omega = 1A$$

(4) Reset function

| RST  | Operating mode   |
|------|------------------|
| High | Normal operation |
| Low  | Reset state      |

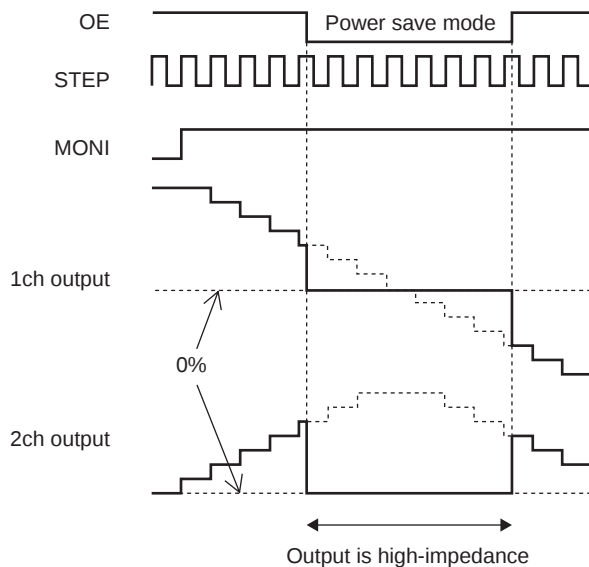


When the RST pin is set Low, the output excitation position is forced to the initial state, and the MONI output also goes Low.

When RST is set High after that, the excitation position proceeds to the next STEP input.

(5) Output enable function

| OE   | Operating mode |
|------|----------------|
| Low  | Output OFF     |
| High | Output ON      |

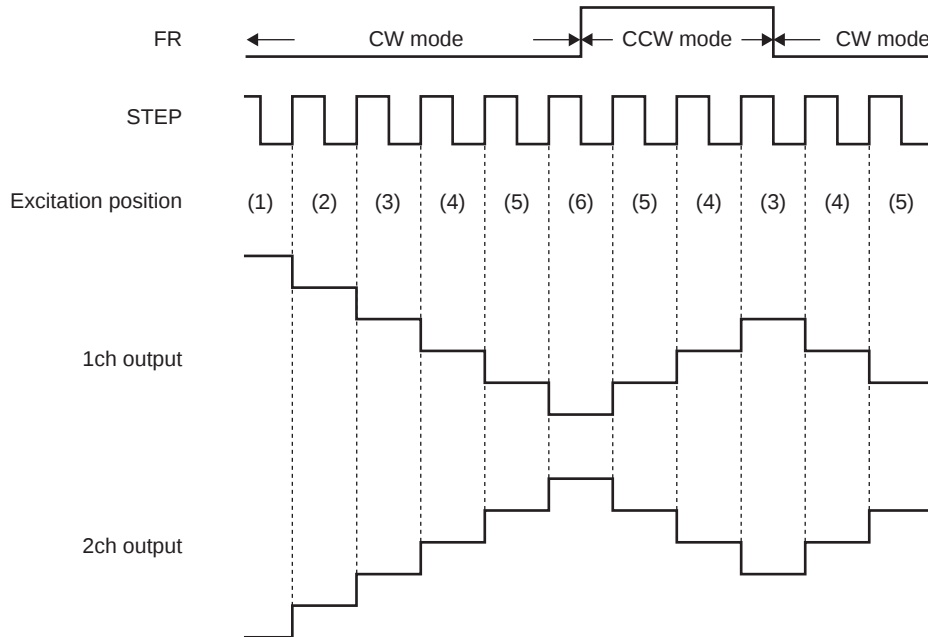


When the OE pin is set Low, the output is forced OFF and goes to high impedance.

However, the internal logic circuits are operating, so the excitation position proceeds when the STEP signal is input. Therefore, when OE is returned to High, the output level conforms to the excitation position proceeded by the STEP input.

(6) Forward/reverse switching function

| FR   | Operating mode          |
|------|-------------------------|
| Low  | Clockwise (CW)          |
| High | Counter-clockwise (CCW) |



The internal D/A converter proceeds by one bit at the rising edge of the input STEP pulse.

In addition, CW and CCW mode are switched by setting the FR pin.

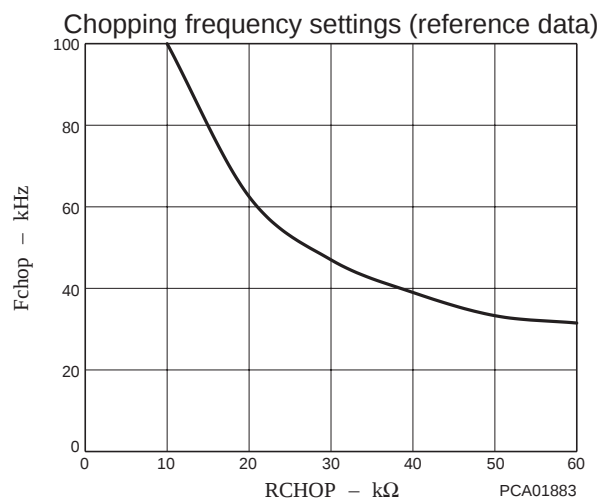
In CW mode, the channel 2 current phase is delayed by 90° relative to the channel 1 current.

In CCW mode, the channel 2 current phase is advanced by 90° relative to the channel 1 current.

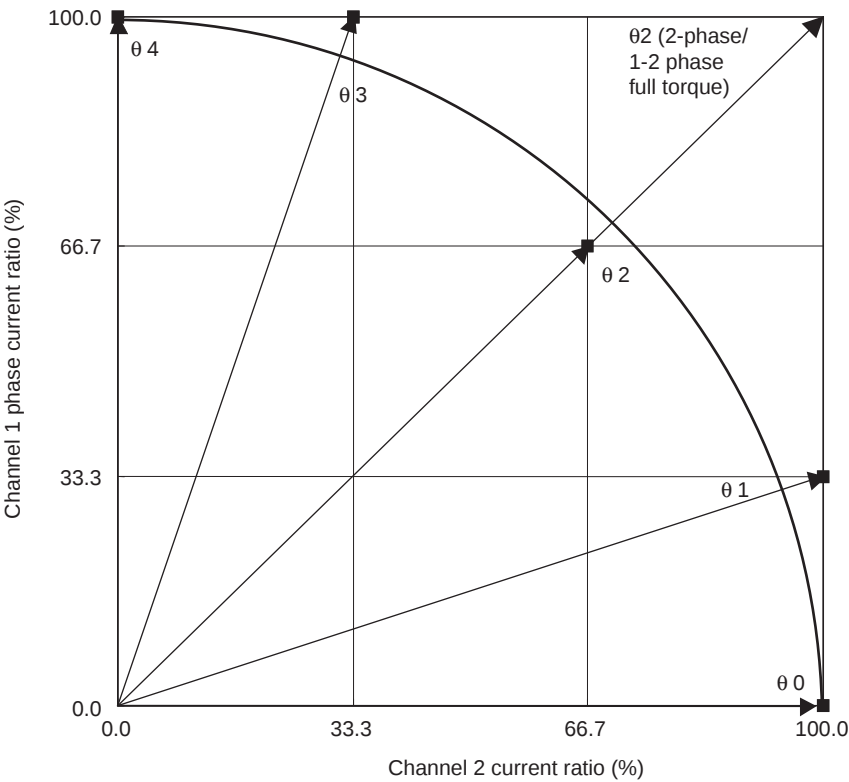
(7) Setting the chopping frequency

For constant-current control, chopping operation is made with the frequency determined by the external resistor (connected to the RCHOP pin).

The chopping frequency to be set with the resistance connected to the RCHOP pin (pin 11) is as shown below.



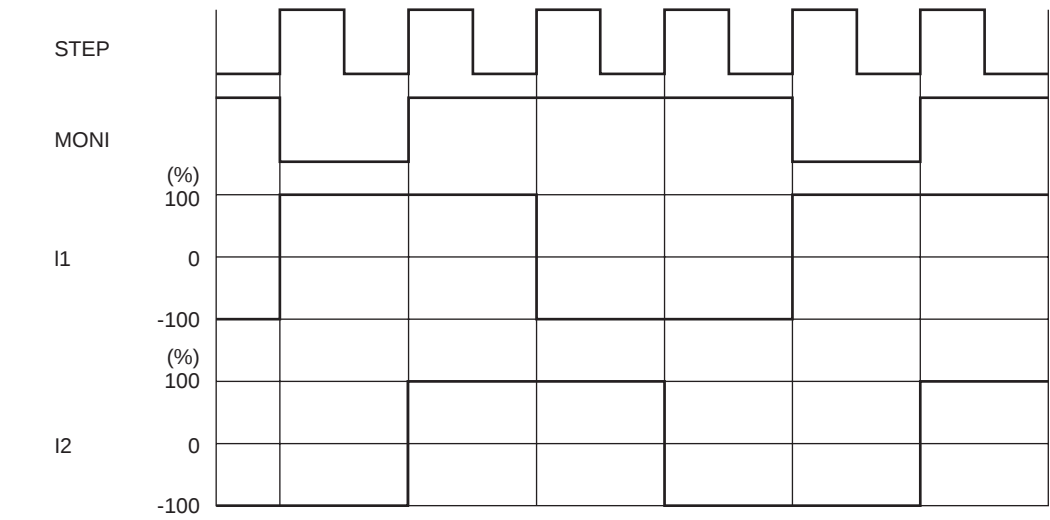
(8) Output current vector locus (one step is normalized to 90 degrees)



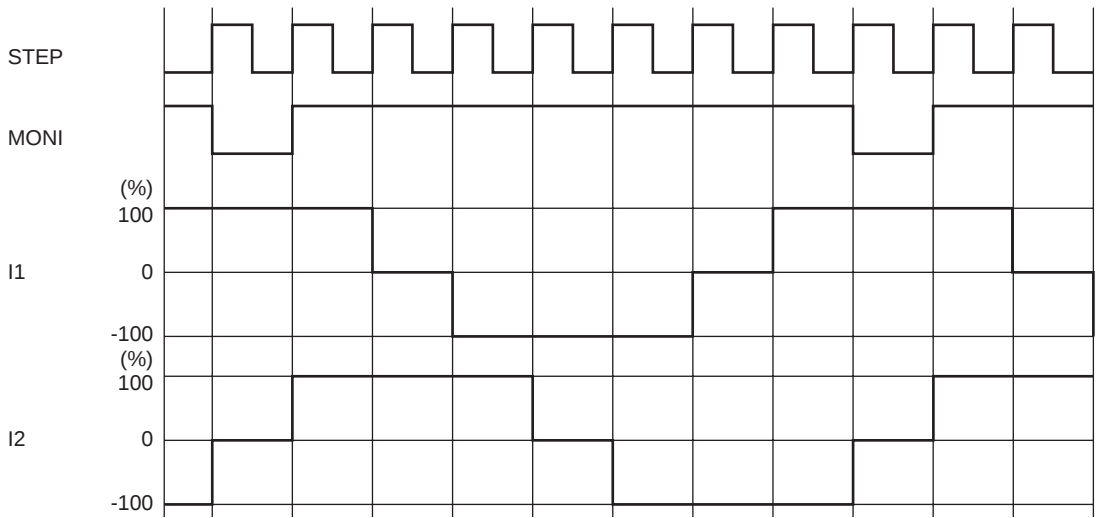
Setting current ration in each excitation mode

| STEP | W1-2 phase (%) |           | 1-2 phase (%) |           | 1-2 phase full torque (%) |           | 2-phase (%) |           |
|------|----------------|-----------|---------------|-----------|---------------------------|-----------|-------------|-----------|
|      | Channel 1      | Channel 2 | Channel 1     | Channel 2 | Channel 1                 | Channel 2 | Channel 1   | Channel 2 |
| θ0   | 0              | 100       | 0             | 100       | 0                         | 100       |             |           |
| θ1   | 33.3           | 100       |               |           |                           |           |             |           |
| θ2   | 66.7           | 66.7      | 66.7          | 66.7      | 100                       | 100       | 100         | 100       |
| θ3   | 100            | 33.3      |               |           |                           |           |             |           |
| θ4   | 100            | 0         | 100           | 0         | 100                       | 0         |             |           |

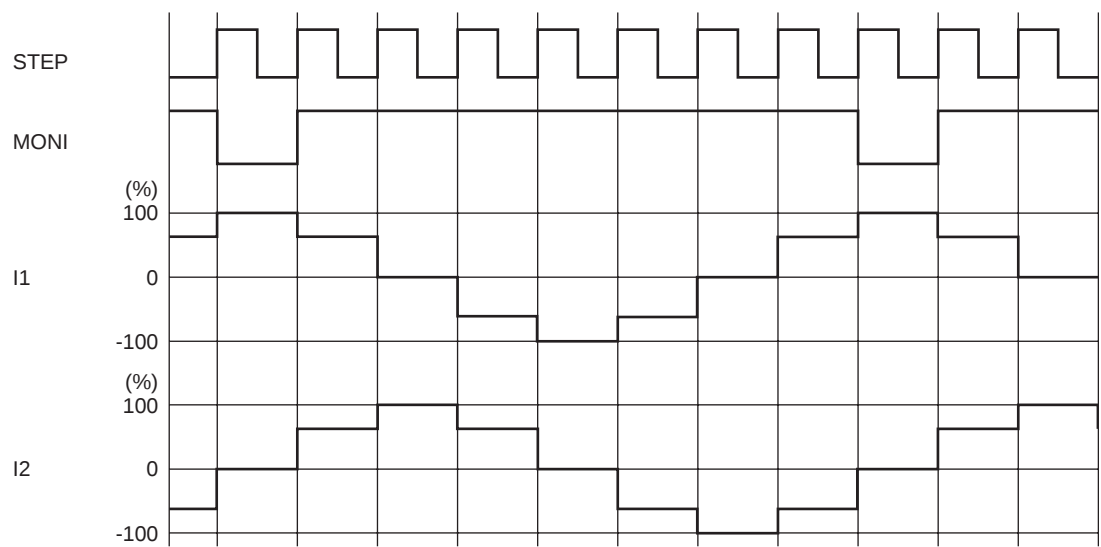
(9) Typical current waveform in each excitation mode  
2-phase excitation (CW mode)



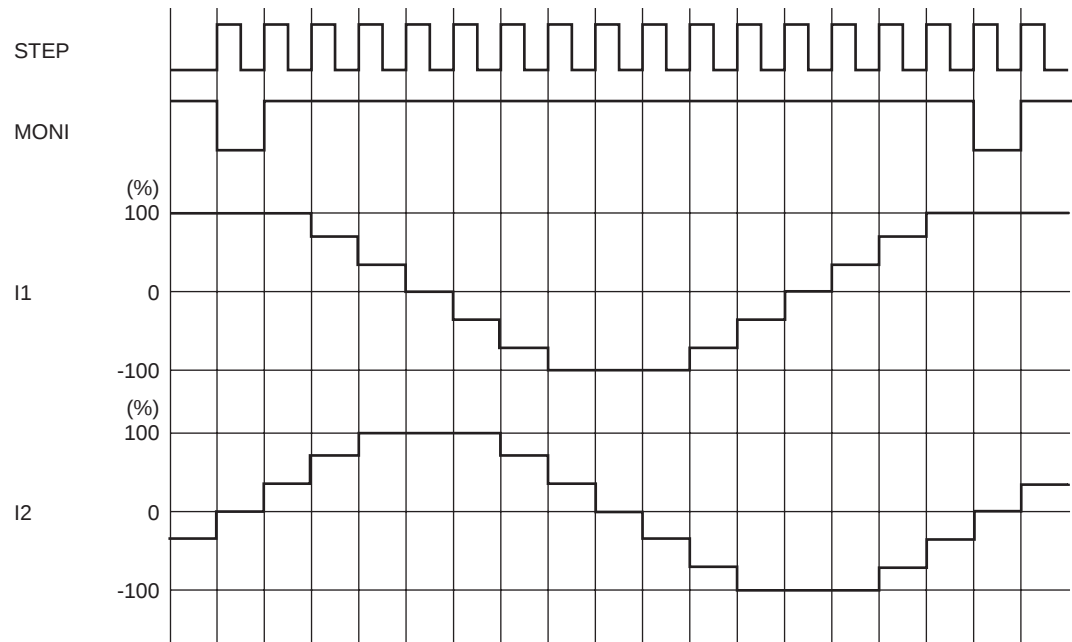
1-2 phase excitation full torque (CW mode)



1-2 phase excitation (CW mode)

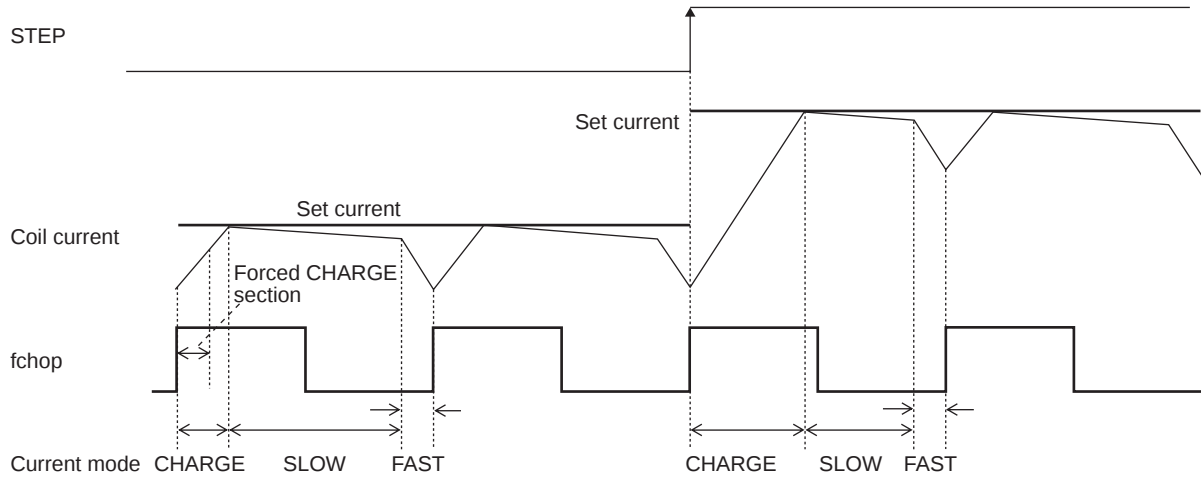


W1-2 phase excitation (CW mode)

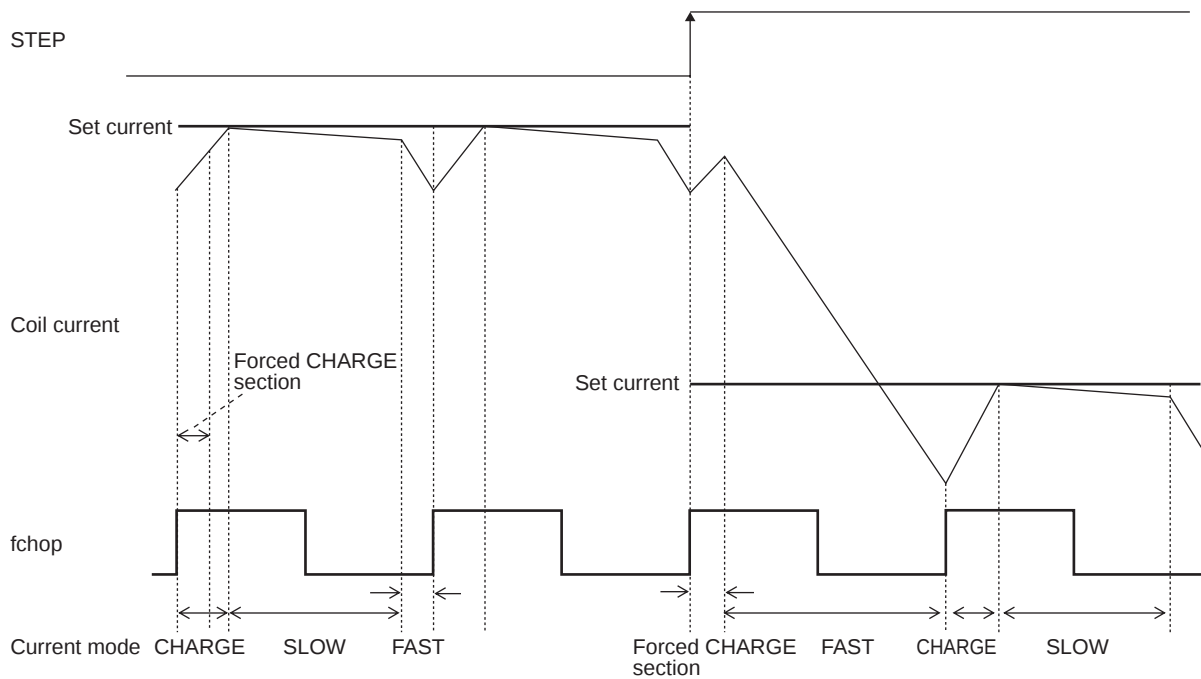


(10) Current control operation specification

(Sine wave increasing direction)



(Sine wave decreasing direction)



In each current mode, the operation sequence is as described below :

- At rise of chopping frequency, the CHARGE mode begins. (The section in which the CHARGE mode is forced regardless of the magnitude of the coil current (ICOIL) and set current (IREF) exists for 1/16 of one chopping cycle.)
- The coil current (ICOIL) and set current (IREF) are compared in this forced CHARGE section.

When  $(ICOIL < IREF)$  state exists in the forced CHARGE section ;

CHARGE mode up to  $ICOIL \geq IREF$ , then followed by changeover to the SLOW DECAY mode, and finally by the FAST DECAY mode for the 1/16 portion of one chopping cycle.

When  $(ICOIL < IREF)$  state does not exist in the forced CHARGE section;

The FAST DECAY mode begins. The coil current is attenuated in the FAST DECAY mode till one cycle of chopping is over.

Above operations are repeated. Normally, the SLOW (+FAST) DECAY mode continues in the sine wave increasing direction, then entering the FAST DECAY mode till the current is attenuated to the set level and followed by the SLOW DECAY mode.

## DCM Mode (DM-High)

### (1) DCM mode output control logic

| Parallel input |           | Output     |            | Mode          |
|----------------|-----------|------------|------------|---------------|
| DC11 (21)      | DC12 (22) | OUT1 (2) A | OUT1 (2) B |               |
| Low            | Low       | OFF        | OFF        | Standby       |
| High           | Low       | High       | Low        | CW (Forward)  |
| Low            | High      | Low        | High       | CCW (Reverse) |
| High           | High      | Low        | Low        | Brake         |

### (2) Reset function

| RST         | Operating mode                | MONI        |
|-------------|-------------------------------|-------------|
| High or Low | Reset operation not performed | High output |

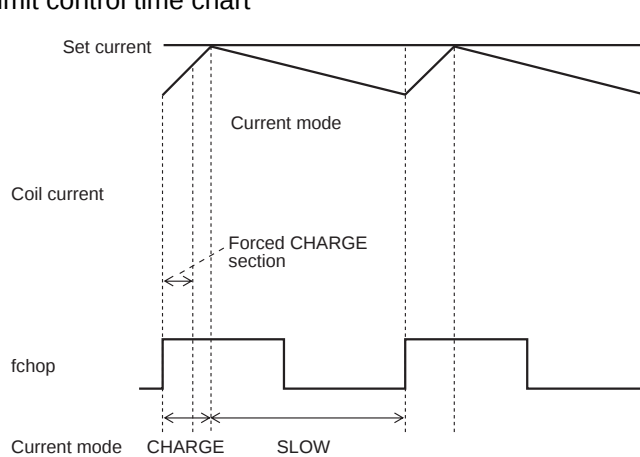
The reset function does not operate in DCM mode. In addition, the MONI output is High, regardless of the RST pin state.

### (3) Output enable function

| OE   | Operating mode |
|------|----------------|
| Low  | Output OFF     |
| High | Output ON      |

When the OE pin is set Low, the output is forced OFF and goes to high impedance. When the OE pin is set High, output conforms to the control logic.

### (4) Current limit control time chart



### (5) Current limit reference voltage setting function

| ATT1 | ATT2 | Current setting reference voltage |
|------|------|-----------------------------------|
| Low  | Low  | $V_{REF}/3 \times 100\%$          |
| High | Low  | $V_{REF}/3 \times 67\%$           |
| Low  | High | $V_{REF}/3 \times 50\%$           |
| High | High | $V_{REF}/3 \times 33\%$           |

The voltage input to the VREF pin can be switched to four-step settings as the reference voltage for setting the current limit.

### Set current calculation method

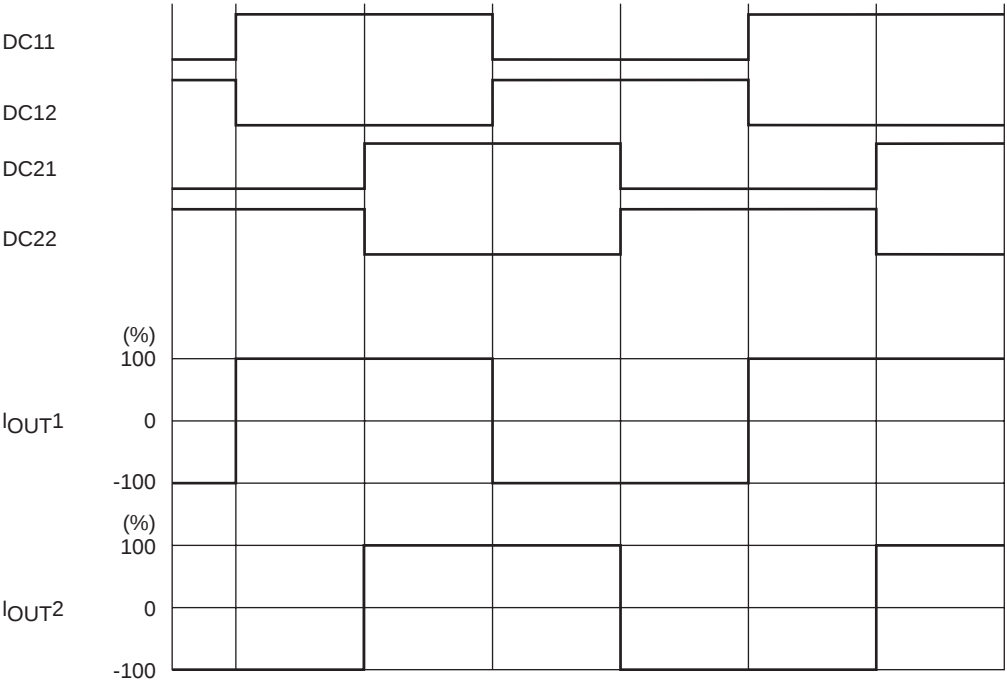
The reference voltage is set by the voltage applied to the VREF pin and the two inputs ATT1 and ATT2. The current limit can be set from this reference voltage and the RF resistance value.

$$I_{\text{limit}} = (V_{\text{REF}}/3 \times \text{Current setting ratio}) / R_F \text{ resistance}$$

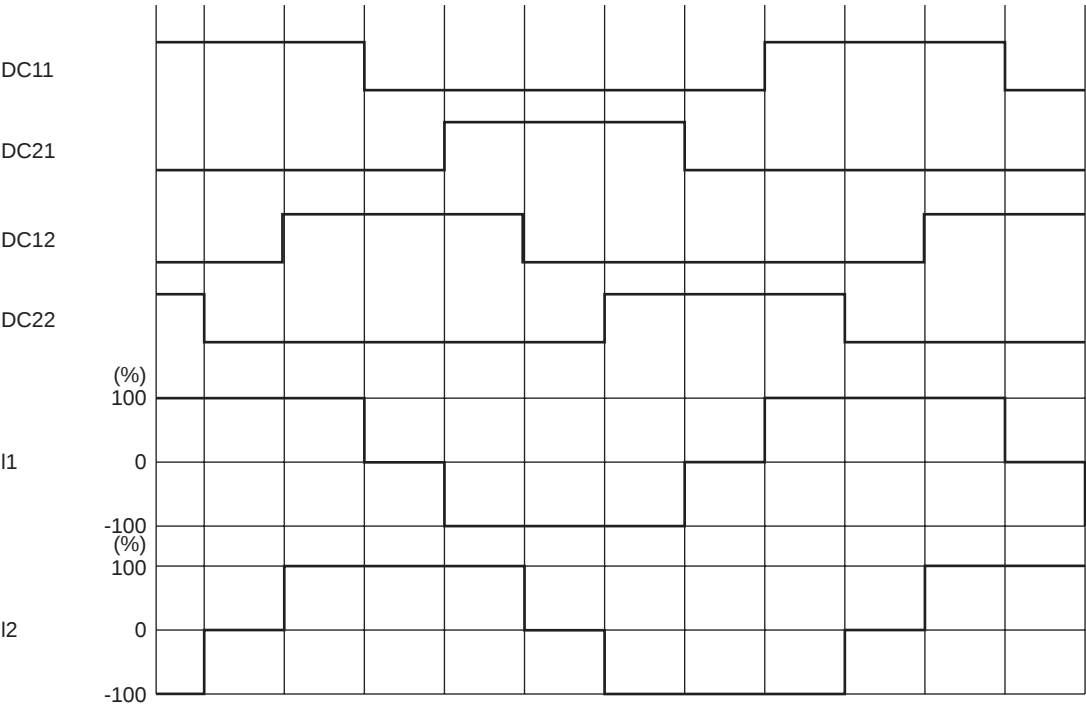
(Example) When  $V_{\text{REF}} = 1.5\text{V}$ , setting current ratio = 100% [(ATT1, ATT2) = (Low, Low)] and  $R_{\text{NF1}}(2) = 0.5\Omega$ , the current limit value is as follows :

$$I_{\text{limit}} = 1.5\text{V}/3 \times 100\%/0.5\Omega = 1\text{A}$$

(6) Typical current waveform in each excitation mode when stepping motor parallel input control  
2-phase excitation (CW mode)



1-2 phase excitation full torque (CW mode)



## Output short-circuit protection circuit

To protect the IC from damage due to short-circuit of the output caused by lightning or ground fault, the output short-circuit protection circuit to put the output in standby mode and turn on the alarm output is incorporated. Note that when the RF pin is short-circuited to GND, this output short-circuit protection is not effective against shorting to power.

### (1) Output short-circuit protection operation changeover function

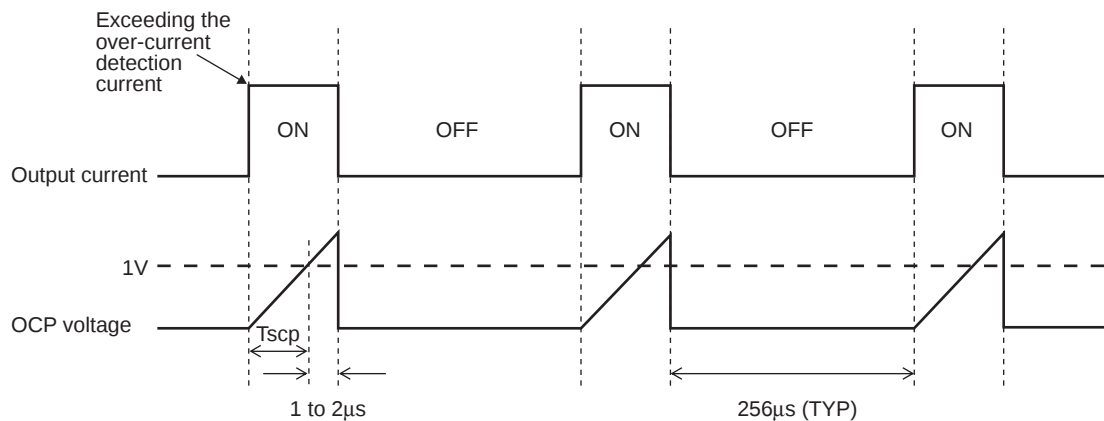
Changeover to the output short-circuit protection of IC is made by the setting of OCPM pin.

| EMM         | State             |
|-------------|-------------------|
| Low or Open | Auto reset method |
| High        | Latch method      |

### (2) Auto reset method

When the output current is below the output short-circuit protection current, the output is controlled by the input signal. When the output current exceeds the detection current, the switching waveform as shown below appears instead.

(When a 20kΩ resistor is inserted between RCHOP and GND)



When detecting the output short-circuit state, the short-circuit detection circuit is activated.

When the short-circuit detection circuit operation exceeds the timer latch time described later, the output is changed over to the standby mode and reset to the ON mode again in 256μs (TYP). In this event, if the overcurrent mode still continues, the above switching mode is repeated till the overcurrent mode is canceled.

### (3) Latch method

Similarly to the case of automatic reset method, the short-circuit detection circuit is activated when it detects the output short-circuit state.

When the short-circuit detection circuit operation exceeds the timer latch time described later, the output is changed over to the standby mode.

In this method, latch is released by setting PS = "L"

### (4) Output short-circuit condition warning output pin

EMO, warning output pin of the output short-circuit protection circuit, is an open-drain output.

EMO outputs ON when output short-circuit is detected.

(5) Timer latch time (Tscp)

The time to output OFF when an output short-circuit occurs can be set by the capacitor connected between the CEM pin and GND. The capacitor (C) value can be determined as follows :

Timer latch : Tscp

$$T_{scp} \approx T_d + C \times V/I \text{ [sec]}$$

Td : Internal delay time TYP 4μs

V : Threshold voltage of comparator TYP 1V

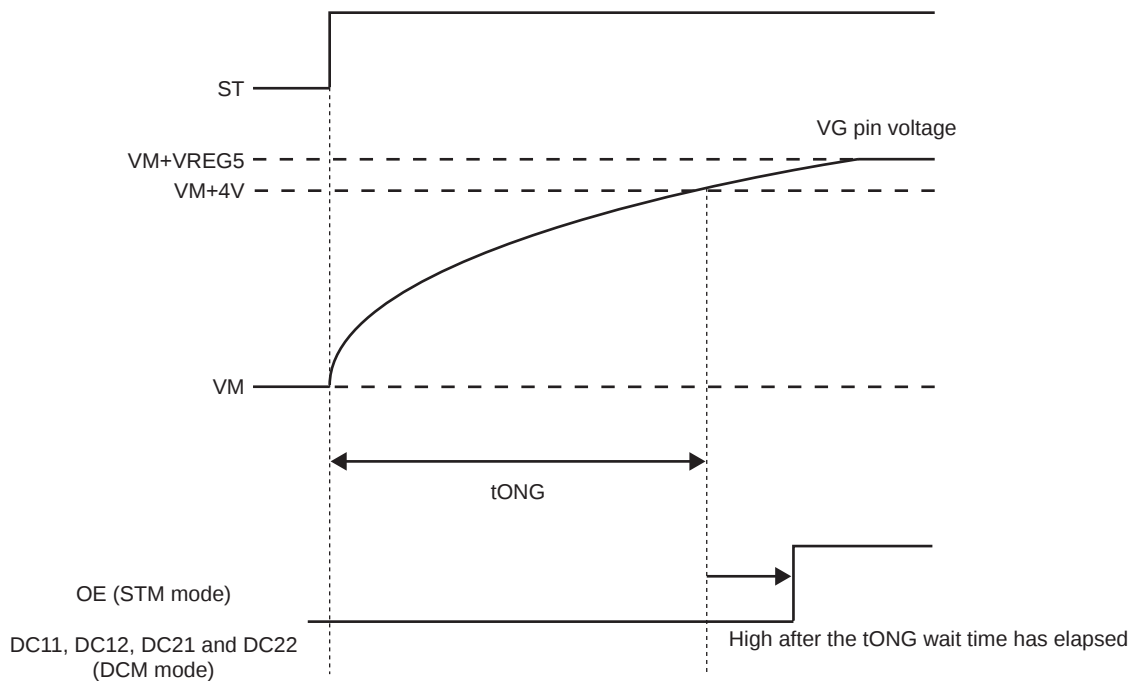
I : CEM charge current TYP 2.5μA

The Tscp time must be set so as not to exceed 80% of the chopping period.

The CEN pin must be connected to (S) GND when the output short protection function is not to be used.

**Charge Pump Circuit**

When the ST pin is set High, the charge pump circuit operates and the VG pin voltage is boosted from the VM voltage to the VM + VREG5 voltage. If the VG pin voltage is not boosted sufficiently, the output cannot be controlled, so be sure to provide a wait time of tONG or more after setting the ST pin High before starting to drive the motor.

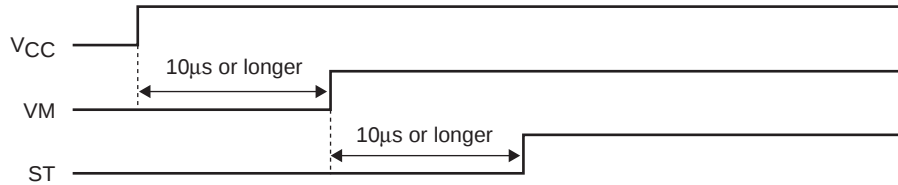


VG Pin Voltage Schematic View

When controlling the stepping motor driver with the CLK-IN input, set the ST pin High, wait for the tONG time duration or longer, and then set the OE pin High. In addition, when controlling the stepping motor and DC motor driver with parallel input, set the ST pin High, wait for the tONG time duration or longer, and then start the control for each channel.

## Recommended Power-on Sequence

Provide a wait time of 10 $\mu$ s or more after the V<sub>CC</sub> power supply rises before supplying the motor power supply.  
Provide a wait time of 10 $\mu$ s or more after the motor power supply rises before setting the ST pin High.



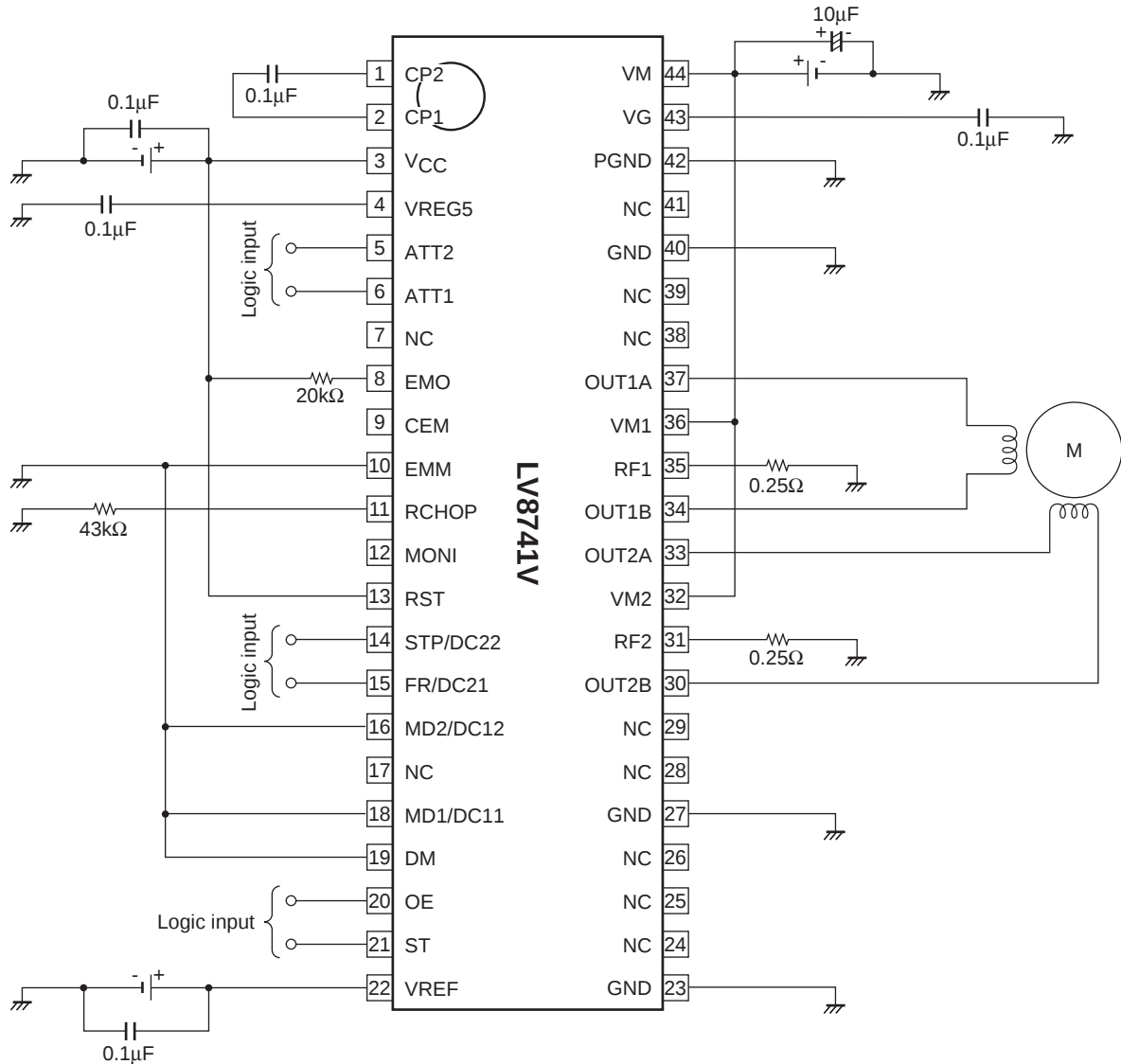
The above power-on sequence is only a recommendation, and there is no risk of damage to the IC even if this sequence is not followed.

## Notes on Board Design Layout

- Use thick GND lines and connect to GND stabilization points by the shortest distance possible to lower the impedance.
- Use thick VM, VM1 and VM2 lines, and short-circuit these lines to each other by a short distance.
- Place the capacitors connected to V<sub>CC</sub> and VM as close to the IC as possible, and connect each capacitor to a separate GND stabilization point using a thick independent line.
- Place the RF resistor as near to the IC as possible, and connect it to the GND stabilization point using a thick independent line.
- When thermal radiation is necessary for the exposed die-pad on the bottom of the IC, solder it to GND. Also, do not connect the exposed die-pad to other than GND.

## Application Circuits

- Stepping motor driver application circuit example



The setting conditions for the above circuit diagram example are as follows :

- 2-phase excitation (MD1/DC11 = Low, MD2/DC12 = Low)
- Auto recovery-type output short-circuit protection function (EMM = Low)
- Reset function fixed to normal operation (RST = High)
- Chopping frequency : 37kHz (RCHOP = 43kΩ)

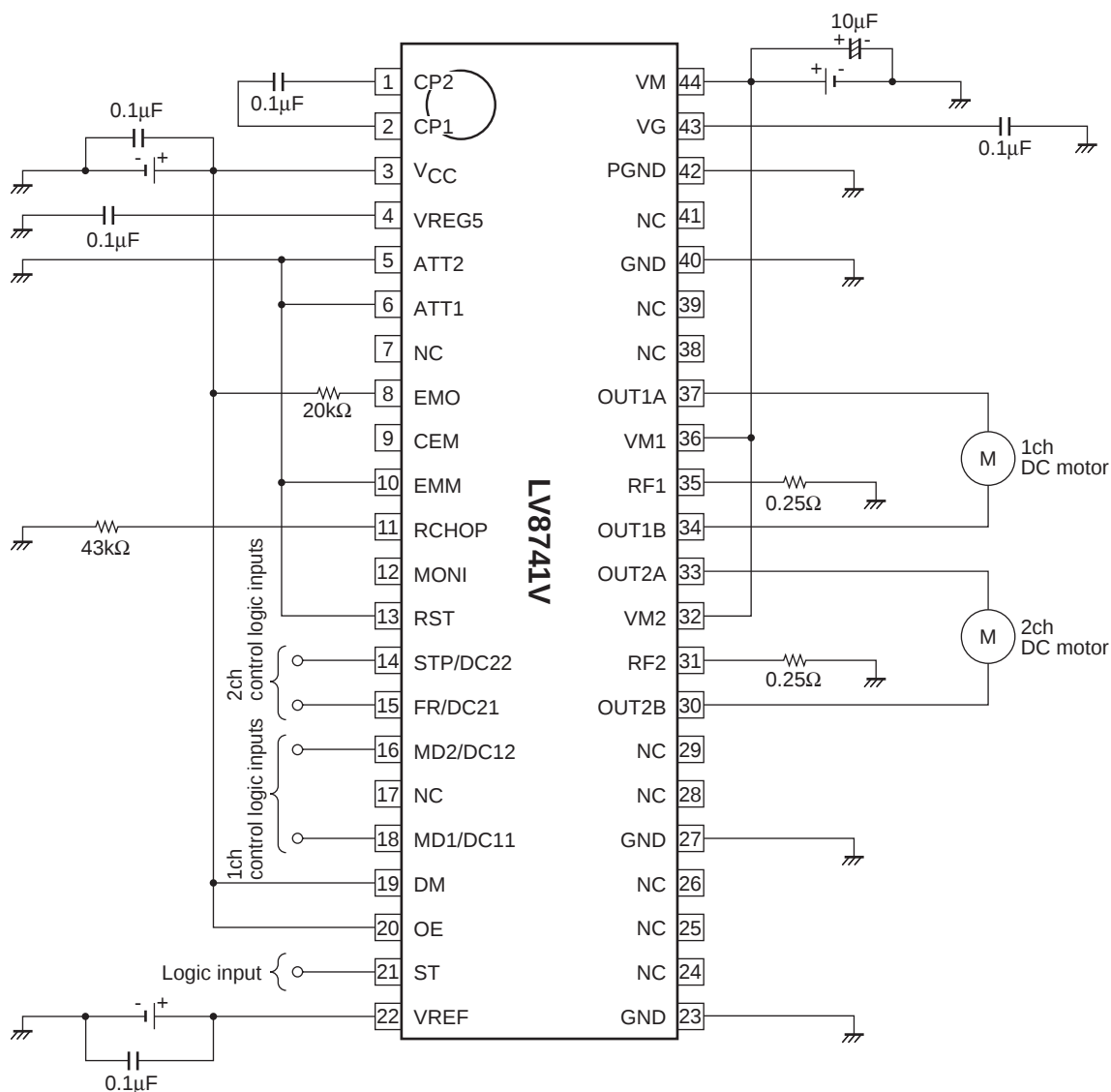
| ATT1 | ATT2 | Current setting reference voltage |
|------|------|-----------------------------------|
| L    | L    | $V_{REF}/3 \times 100\%$          |
| H    | L    | $V_{REF}/3 \times 67\%$           |
| L    | H    | $V_{REF}/3 \times 50\%$           |
| H    | H    | $V_{REF}/3 \times 33\%$           |

The set current value is as follows :

$$I_{OUT} = (V_{REF}/3 \times \text{Voltage setting ratio}) / 0.25\Omega$$

## LV8741V

### • DC motor driver application circuit example



The setting conditions for the above circuit diagram example are as follows :

- Auto recovery-type output short-circuit protection function (EMM = Low)
- Output enable function fixed to output ON state (OE = High)
- Current limit reference voltage setting = 100% (ATT1 = Low, ATT2 = Low)
- Chopping frequency : 37kHz (RCHOP = 43kΩ)

The current limit value is as follows :

$$I_{limit} = (VREF/3) / 0.25\Omega$$

- 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 intellectual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of January, 2008. Specifications and information herein are subject to change without notice.



**Стандарт  
Электрон  
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

**Наши контакты:**

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331