Ordering number : ENA1685

LV8711T

Bi-CMOS LSI

PWM Constant-Current Control Stepping Motor Driver

ON Semiconductor®

http://onsemi.com

Overview

The LV8711T is a PWM constant-current control stepping motor driver.

Features

- Two circuits of PWM constant-current control H-bridge drivers incorporated
- Control of the stepping motor to 1-2 phase excitations possible
- Reference voltage output: 1.0V
- Short circuit protection circuit incorporated
- Abnormal condition warning output pin incorporated
- Upper and lower regenerative diodes incorporated
- Thermal shutdown circuit incorporated

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage	VM max		18	V
Logic supply voltage	V_{CC} max		6	V
Logic input voltage	V_{IN}		6	V
Output peak current	I_O peak	Per ch, tw ≤ 10ms, duty 20%	1.0	A
Output continuous current	I_O max	Per ch	800	mA
Allowable power dissipation	Pd max	*	1.45	W
Operating temperature	Topr		-20 to +85	°C
Storage temperature	Tstg		-55 to +150	°C

* Specified circuit board : 57.0mm×57.0mm×1.7mm, glass epoxy printed circuit board.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage range	VM		4 to 16	V
Logic supply voltage range	V_{CC}		2.7 to 5.5	V
Logic input voltage range	V_{IN}		-0.3 to V_{CC}+0.3	V
VREF input voltage range	VREF		0 to V_{CC}-1.8	V

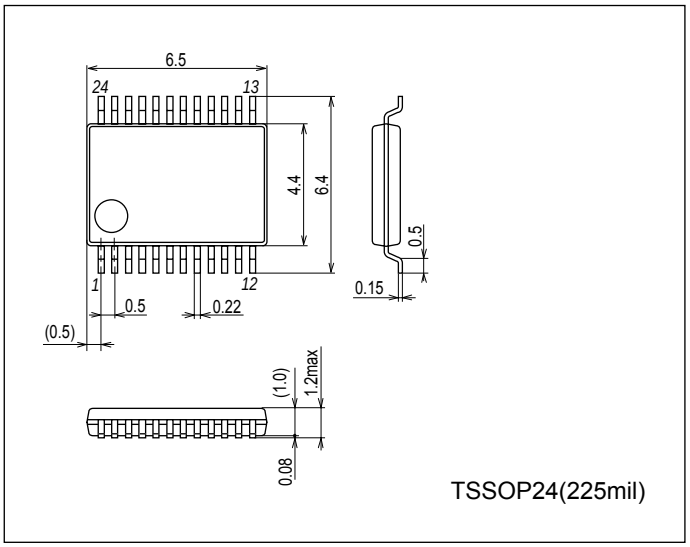
Electrical Characteristics at Ta = 25°C, VM = 12V, V_{CC} = 3.3, VREF = 1.0V

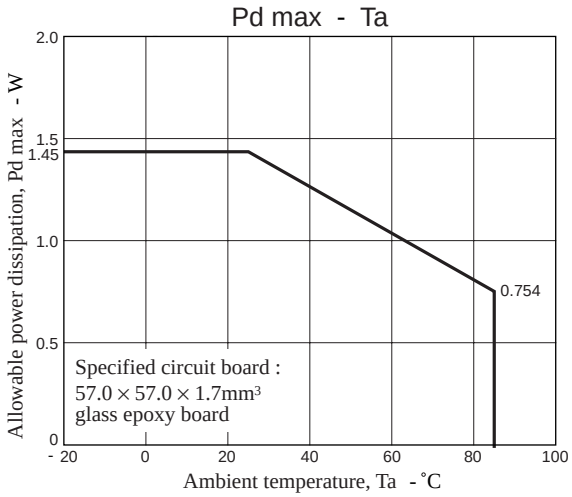
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
General						
Standby mode current drain	IMstn	PS = "L", no load			1	μA
	I_{CC}stn	PS = "L", no load			1	μA
Current drain	IM	PS = "H", no load		1.0	1.5	mA
	I_{CC}	PS = "H", no load		1.7	3.0	mA
Thermal shutdown temperature	TSD	Design guarantee	150	180		°C
Thermal hysteresis width	ΔTSD	Design guarantee		40		°C
V_{CC} low voltage cutting voltage	VthV_{CC}		2.1	2.4	2.7	V
Low voltage hysteresis voltage	VthHYS		100	130	160	mV
Reference voltage						
REG5 output voltage	VREG5		4.5	5	5.5	V
Output						
Output on resistance	RonU	I_O = -800mA, Source-side		0.78	1.0	Ω
	RonD	I_O = 800mA, Sink-side		0.32	0.43	Ω
Output leakage current	$I_O$leak	V_O = 15V			10	μA
Diode forward voltage	VD	ID = -800mA		1.0	1.2	V
Logic input						
Logic pin input current	I_{IN}L	V_{IN} = 0.8V	4	8	12	μA
	I_{IN}H	V_{IN} = 3.3V	22	33	45	μA
Logic high-level input voltage	V_{IN}H		2.0			V
Logic low-level input voltage	V_{IN}L				0.8	V
Constant-current control						
REG1 output voltage	VREG1		0.95	1.0	1.05	V
VREF input current	I_{REF}	VREF = 1.0V	-0.5			μA
Current setting reference voltage	Vtatt00	VREF = 1.0V	0.192	0.200	0.208	V
	Vtatt01	VREF = 1.0V	0.152	0.160	0.168	V
	Vtatt10	VREF = 1.0V	0.092	0.100	0.108	V
	Vtatt11	VREF = 1.0V	0.032	0.040	0.048	V
Chopping frequency	Fchop	Cchop = 220pF	36	45	54	kHz
CHOP pin threshold voltage	V_{CHOP}H		0.6	0.7	0.8	V
	V_{CHOP}L		0.17	0.2	0.23	V
CHOP pin charge/discharge current	Ichop		7	10	13	μA
Output short-circuit protection						
EMO pin saturation voltage	VsatEMO	I_{EMO} = 1mA		250	400	mV

Package Dimensions

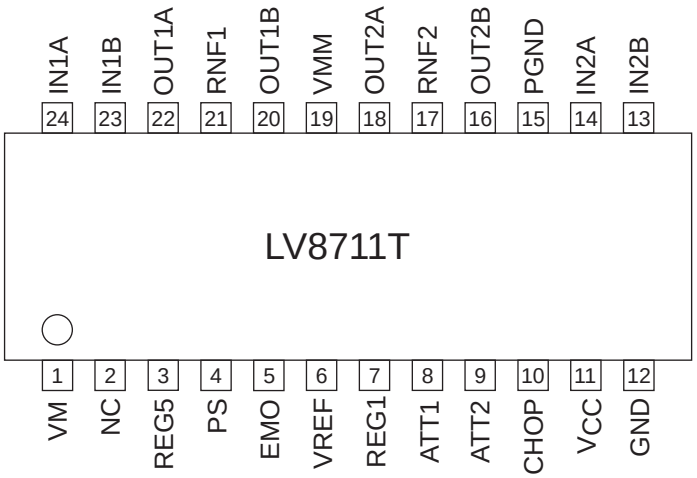
unit : mm (typ)

3260A

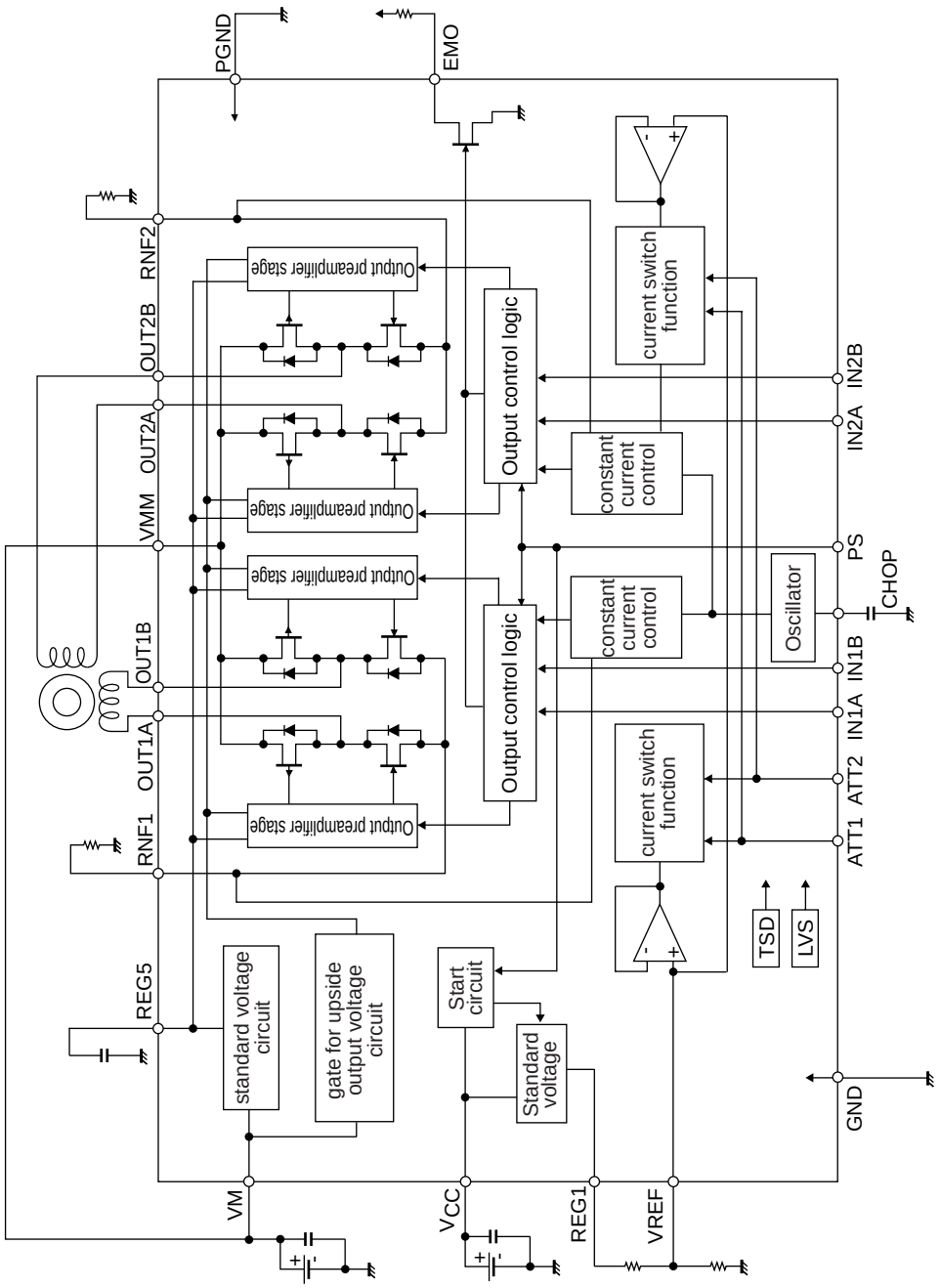




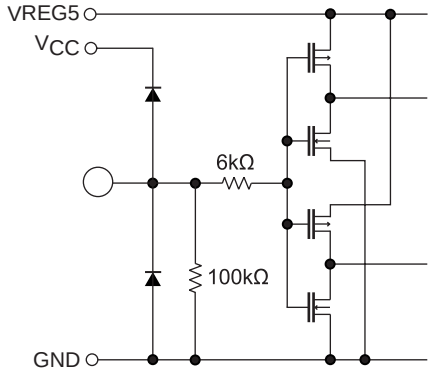
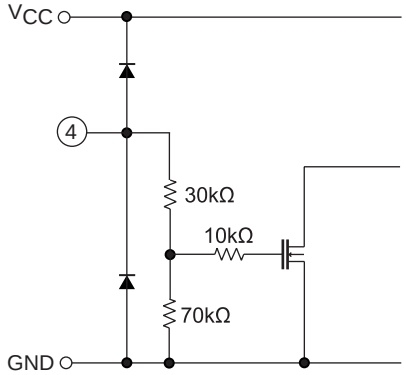
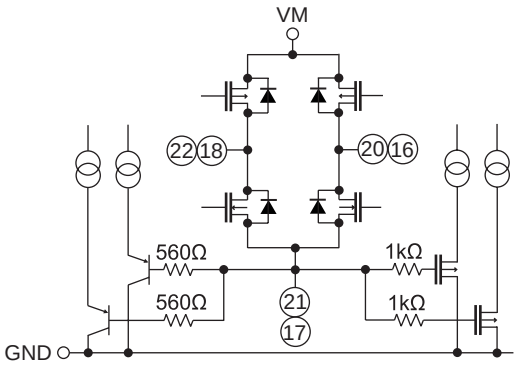
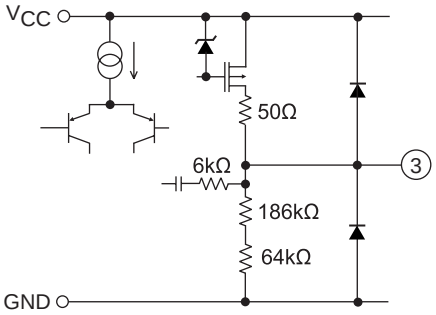
Pin Assignment



Block Diagram



Pin Functions

Pin No.	Pin Name	Pin Function	Equivalent Circuit
8 9 13 14 23 24	ATT1 ATT2 IN2B IN2A IN1B IN1A	Energization current switching pin 1. Energization current switching pin 2 Channel 2 driver output control input pin. Channel 2 driver output control input pin. Channel 1 driver output control input pin. Channel 1 driver output control input pin.	
4	PS	Enable input pin.	
16 17 18 20 21 22	OUT2B RNF2 OUT2A OUT1B RNF1 OUT1A	Channel 2 OUTB output pin. Channel 2 current sensing resistor connection pin. Channel 2 OUTA output pin. Channel 1 OUTB output pin. Channel 1 current sensing resistor connection pin. Channel 1 OUTA output pin.	
3	REG5	Internal reference voltage output pin.	

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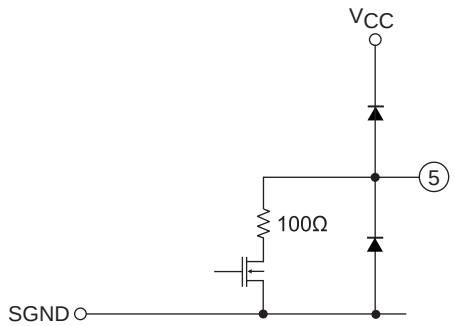
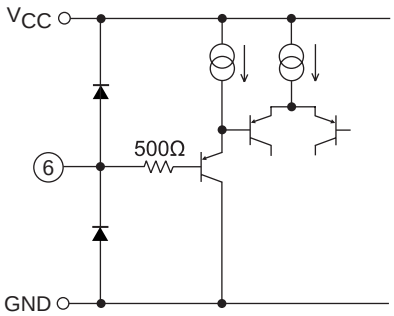
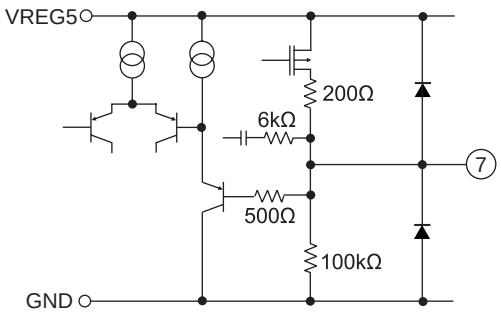
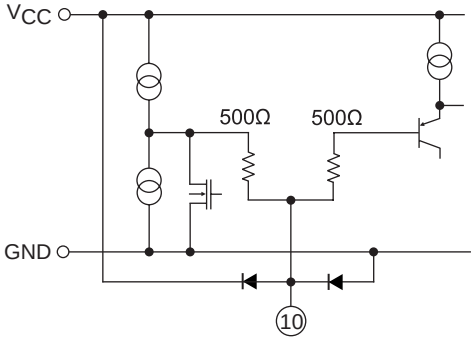
Pin No.	Pin Name	Pin Function	Equivalent Circuit
5	EMO	Abnormal condition warning output pin.	
6	VREF	Channel 1 and 2 current setting reference voltage input pin.	
7	REG1	Current setting reference voltage output pin.	
10	CHOP	Chopping frequency setting capacitor connection pin.	

Input pin function

(1) Chip enable function

Standby mode / operating mode of the IC are switched by setting the PS pin. In the standby-state, the IC enters a power saving mode and all logic is reset. In the standby-state, internal regulator circuit is not operative.

PS	Condition	Internal regulator
Low or Open	Standby mode	Standby
High	Operating mode	Operating

(2) STM output control logic

Parallel input		Output		Current direction
IN1A(2A)	IN1B(2B)	OUT1A(2A)	OUT1B(2B)	
Low	Low	OFF	OFF	Output OFF
High	Low	High	Low	OUTA to OUTB
Low	High	Low	High	OUTB to OUTA
High	High	Low	Low	Brake(DCM mode)

(3) Constant-current setting

The constant-current control setting consist of the VREF voltage setting and resistor (RNF) connected between RNF and ground. The current is set according to the following equation.

$$I_{OUT}\ [A] = VREF\ [V] / 5 / RNF\ [\Omega]$$

Also, the voltage applied to the VREF pin can be switched to four stages settings by the state of two inputs of the ATT1 and ATT2 pins. This function is effective for power saving when the motor holding current is applied.

Attenuation function of the VREF input voltage

ATT1	ATT2	Current setting reference voltage attenuation ratio
Low	Low	100%
High	Low	80%
Low	High	50%
High	High	20%

The output current calculation method for using of attenuation function of the VREF input voltage is as below.

$$I_{OUT} = (VREF / 5) \times \text{Attenuation ratio} / RNF\ \text{resistance}$$

e.g. When the VREF is 1.0V and the set reference voltage is 100% [(ATT1, ATT2) = (Low, Low)] and the RNF resistance is 0.47Ω, the following output current is set.

$$I_{OUT} = 1.0V / 5 \times 100\% / 0.47\Omega = 425mA$$

In this conditions, when (ATT1, ATT2) is set to (High, High),

$$I_{OUT} = 425mA \times 20\% = 85mA$$

Therefore, the power saving is executable by attenuation of the output current when motor holding current is supplied.

(4) Setting the chopping frequency

For constant-current control, chopping operation is made with the frequency determined by the external capacitor (connected to the CHOP pin). The chopping frequency to be set with the capacitor connected to the CHOP pin (pin 10) is as shown below.

Chopping period: Tchop — $Tchop \approx C \times V \times 2 / I\ [s]$

V: Threshold voltage — Typ, 0.5V

I : Charge / discharge current — Typ. 10μA

Chopping frequency: Fchop — $Fchop \approx 1 / Tchop\ [Hz]$

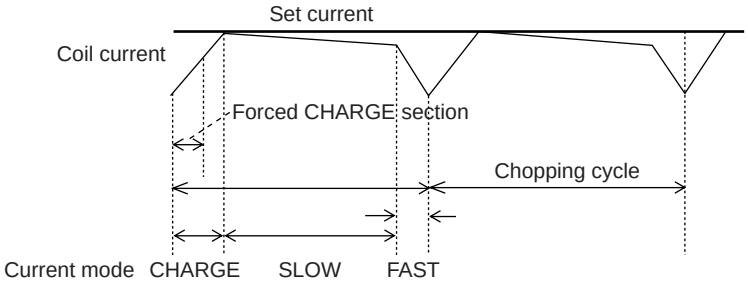
(5) Constant-current control time chart (chopping operate)

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

· At first of chopping cycle, the IC goes to CHARGE mode. (The Blanking section in which the CHARGE mode is forced regardless of the magnitudes of the coil current (I_{COIL}) and the set current (I_{REF}) exists for 1μs.)

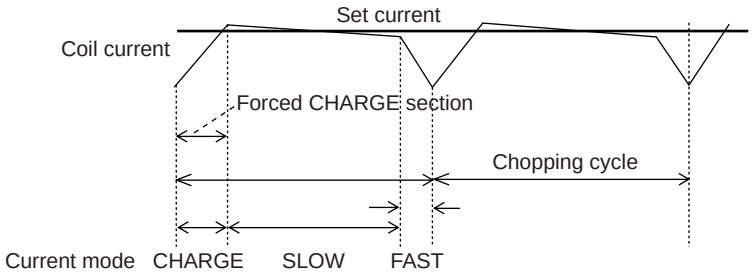
· In Blanking section, the IC compares the coil current (I_{COIL}) and the set current (I_{REF}).

If the $I_{COIL} < I_{REF}$ state is existent in Blanking section.



Charge mode continues until $I_{COIL} \geq I_{REF}$. After that the IC switches to SLOW DECAY mode and then switches to FAST DECAY mode for the last about 1μs.

If the $I_{COIL} < I_{REF}$ state is non-existent in Blanking section.



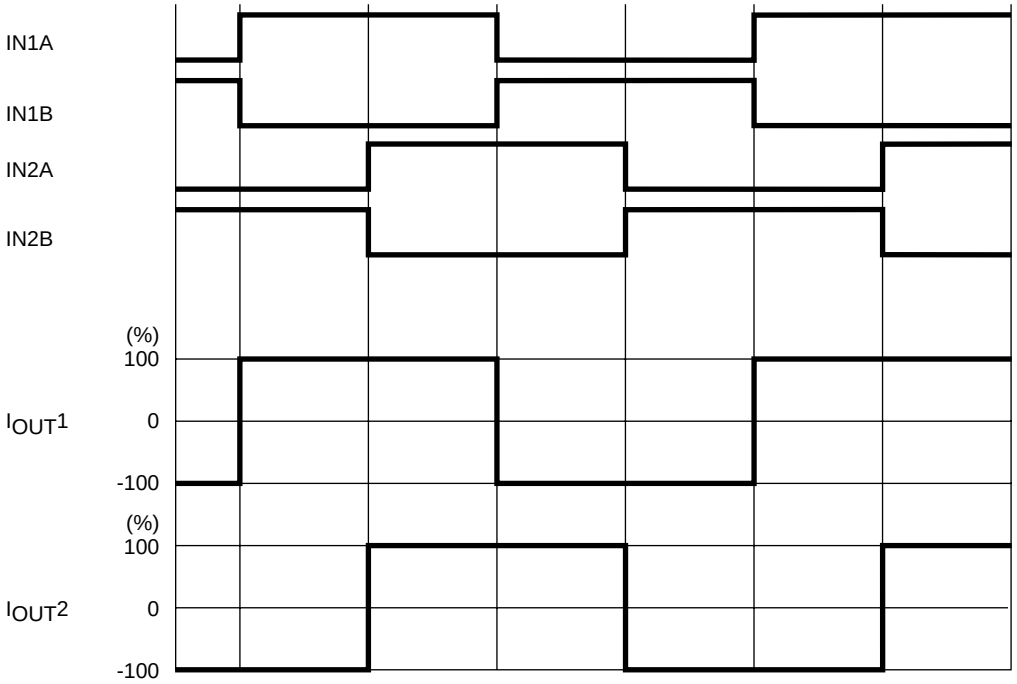
The IC switches to SLOW DECAY after Blanking section, and then switches to FAST DECAY mode for the last about 1μs.

The IC repeats the above operation.

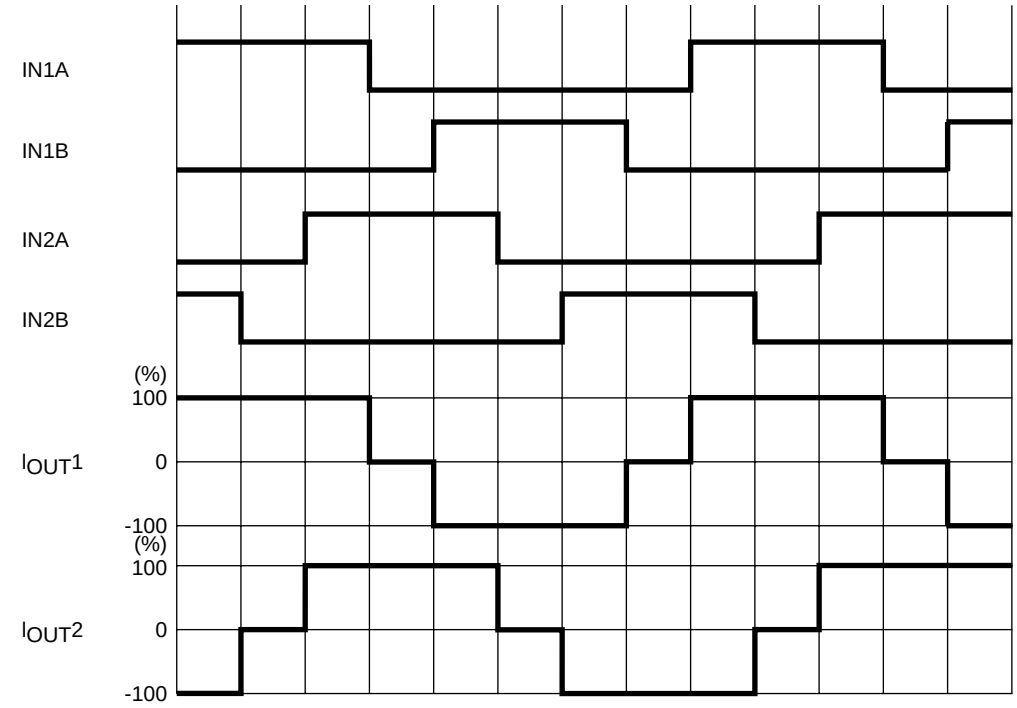
(6) Typical current waveform in each excitation mode

6-1) STM Drive mode

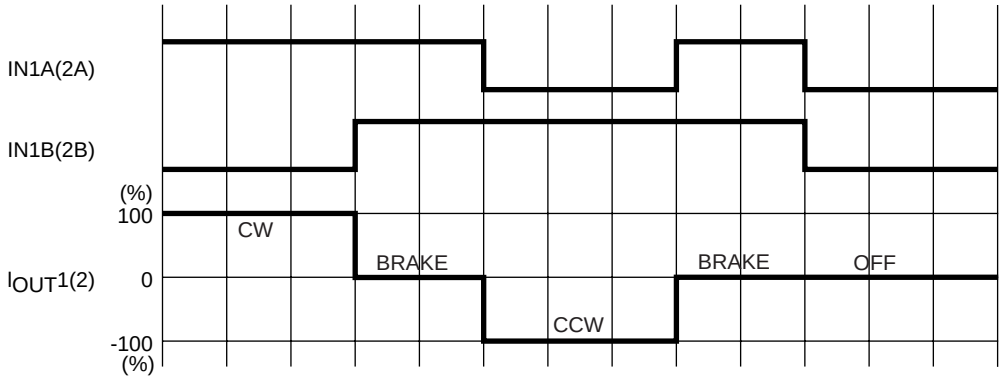
Two-phase excitation (CW mode)



1-2 phase excitation (CW mode)



6-2) DCM Drive mode



(7) Output short-circuit protection

To protect IC from damage due to short-circuit of the output caused by lightening or ground fault, the output short-circuit protection circuit to put the output in the OFF mode is incorporated.

7-1) Protective function operation (Latch method)

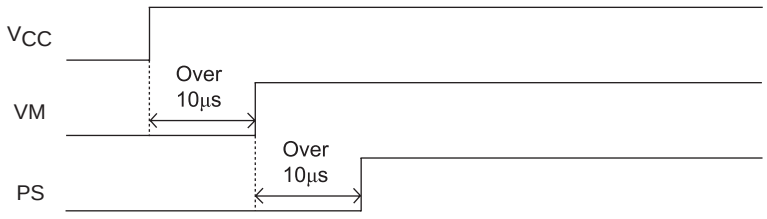
When detecting the output short-circuit state, the short-circuit protection circuit is activated.
When short-circuit state is detected ≈ 4μs (count by the internal timer), detected output is OFF at the time.
Then, when the output exceeds the timer latch time counted by the internal counter, the output is ON. Still, the short circuit state is detected, the IC switches all output to stand-by mode and keep the state.
This state is released by setting PS = Low

(8) Abnormal condition warning output pin

EMO, warning output pin of thermal shutdown circuit and the output short-circuit protection circuit, is an open-drain output. EMO outputs ON when output short-circuit is detected.
When detecting the output overdrive, the EMO outputs ON. If the junction temperature goes down at the time, EMO outputs OFF automatically.

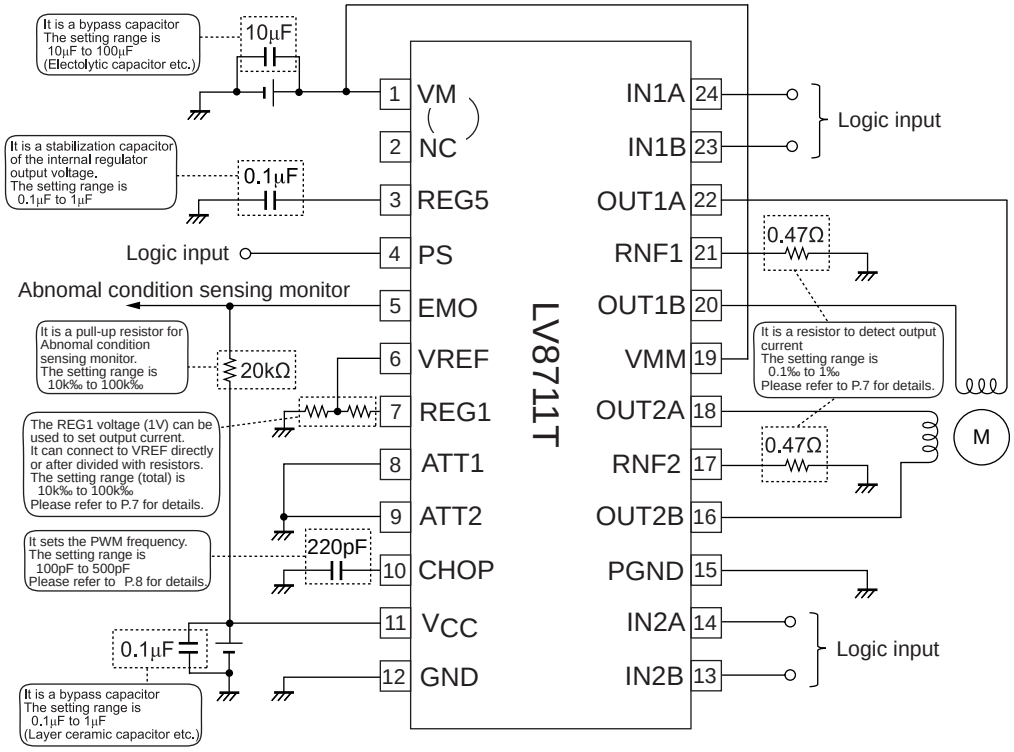
(9) Recommended power-on sequence

Provide a wait time of 10μs or more after V_{CC} power supply rises before supplying VM power supply.
Provide a wait time of 10μs or more after VM power supply raises before setting the PS pin High.



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

Application Circuit Example



Each constant setting method for the above circuit diagram example is as follows :

Current LIMIT (100%) set

VREF = 1.0V (when internal regulator output is connected)

I_{LIMIT} = VREF / 5 / RNF resistance

= 1.0V / 5 / 0.47Ω = 425mA

Chopping frequency setting

Fchop = Ichop / (Cchop × Vt × 2)

= 10μA/ (220pF × 0.5V × 2) = 45 kHz

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LV8711T-TLM-H

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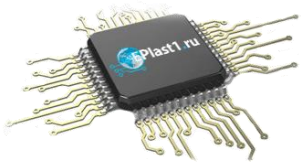

Как с нами связаться

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