THB8128 Development Specification Proposal

1. Application: PWM current control stepping motor driver

2. Package: HZIP25 (See attached case outline dimensions.)

3. Features

- 1 channel PWM current control stepping motor driver
- BiCDMOS process IC
- Output on-resistance(High side 0.25 Ω, Low side 0.15 Ω, Total 0.40 Ω; Ta = 25°C, Io = 4.0 A)
- Selectable phase drive (1/2, 1/8, 1/16,1/32, 1/64，1/128， 1/10，1/20step)
- Advance the excitation step with the only step signal input
- Available forward reverse control
- Iomax=4.3A
- Over current protection circuit
- Thermal shutdown circuit
- Input pull down resistance
- With reset pin and enable pin

4. Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Ratings	Unit
Supply voltage	VMmax	50	V
Output current	Iomax	4.3	A
Logic input voltage	VINmax	6	V
VREF input voltage	VREFmax	6	V
MO input voltage	VMOmax	6	V
DOWN input voltage	VDOmax	6	V
Operating temperature	Topg	-30 to +85	°C
Storage temperature	Tstg	-55 to +150	°C

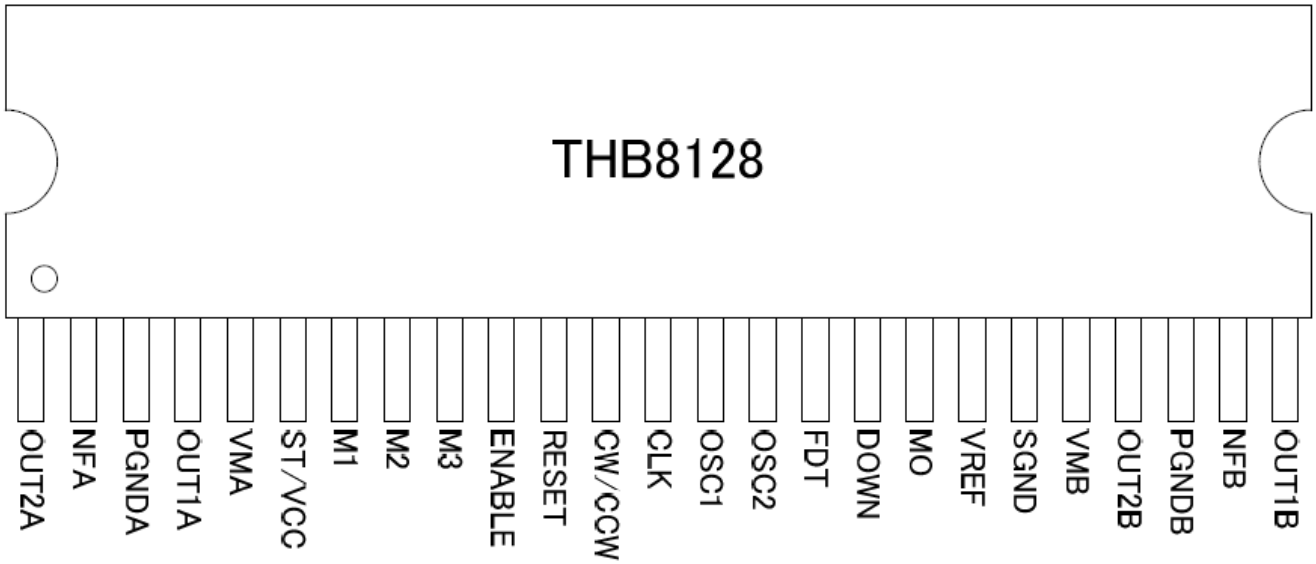
5. Recommended Operating Range at Ta=25°C

Parameter	Symbol	Ratings	Unit
Supply voltage range	VM	9 to 45	V
Logic input voltage range	VIN	0 to 5	V
VREF input voltage range	VREF	0 to 3	V

6. Electrical Characteristics at Ta =25°C, VM=24V, VREF=1.5V

Parameter	Symbol	Conditions	min	typ	max	Unit
Standby mode current drain	IMstn	ST="L"		100		μA
current drain	IM	ST="H",OE="H", no load		4		mA
Thermal shutdown temperature	TSD	Design guarantee	150	180	210	°C
Thermal hysteresis width	ΔTSD	Design guarantee		40		°C
Logic pin input current	IinL1	VIN=0.8V		8		μA
	IinH1	VIN=5V		50		μA
Logic input high-level voltage	Vinh		2.0			V
Logic input low-level voltage	Vinl				0.8	V
FDT pin high-level voltage	Vfdth		3.5			V
FDT pin middle-level voltage	Vfdtm		1.1		3.1	V
FDT pin low-level voltage	Vfdtl				0.8	V
Chopping frequency	Fch	Cosc1=100pF		100		KHz
OSC1 pin charge/discharge current	Iosc1			10		μA
Chopping oscillator circuit threshold voltage	Vtup1			1		V
	Vtdown1			0.5		V
VREF pin input voltage	Iref	VREF=1.5V	-0.5			μA
DOWN output residual voltage	VolDO	Idown=1mA			400	mV
MO pin residual voltage	VolMO	Imo=1mA			400	mV
Hold current switching frequency	Falert	Cosc2=1500pF		1.6		Hz
OSC2 pin charge/discharge current	Iosc2			10		μA
Hold current switching frequency threshold voltage	Vtup2			1		V
	Vtdown2			0.5		V
Blanking time	Tbl			1		uS
Output block						
Output on-resistance	Ronu	Io=4.0A, high-side ON resistance		0.25		Ω
	Rond	Io=4.0A, low-side ON resistance		0.15		Ω
Output leakage current	Ioleak	VM=50V			50	μA
Diode forward voltage	VD	ID=-4.0A		1		V
Current setting reference voltage	VRF	VREF=1.5V, Current ratio 100%		300		mV

7. PIN ARRANGEMENT (Proposal)



8. Pin Functions

Pin No.	Pin symbol	Pin Functions
17	DOWN	Holding current output
20	SGND	Signal GND
14	OSC1	Chopping frequency setting capacitor connection
16	FDT	Decay mode select voltage input
19	VREF	Constant-current control reference voltage input
21	VMB	B phase motor supply connection
7	M1	Excitation-mode switching pin
8	M2	Excitation-mode switching pin
9	M3	Excitation-mode switching pin
22	OUT2B	B phase OUTB output
24	NFB	B phase current sense resistance connection
25	OUT1B	B phase OUTA output
23	PGNDB	B phase power GND
1	OUT2A	A phase OUTB output
2	NFA	A phase current sense resistance connection
4	OUT1A	A phase OUTA output
3	PGNDA	A phase power GND
10	ENABLE	Output enable signal input
11	RESET	RESET signal input
5	VMA	A phase motor supply connection
13	CLK	Clock pulse signal input
12	CW/CCW	Forward/Reverse signal input
15	OSC2	Holding current detection time setting capacitor connection
18	MO	Position detecting monitor
6	ST/VCC	Chip enable input

9. Description of functions

9-1) Stand-by function

When ST/VCC pin is at low levels, the IC enters stand-by mode, all logic is reset and output is turned OFF.

When ST/VCC pin is at high levels, the stand-by mode is released.

9-2) Step pin function

CLK pin step signal input allows advancing excitation step.

Input		Operation
ST/VCC	CLK	
L	*	Stand-by mode
H		Excitation step feed
H		Excitation step hold

9-3) Excitation setting method

Set the excitation setting as shown in the following table by setting M1 pin, M2 pin and M3 pin.

Input			Mode (Excitation)	Initial position	
M3	M2	M1		A phase current	B phase current
L	L	L	1/2	100%	0%
L	L	H	1/8	100%	0%
L	H	L	1/16	100%	0%
L	H	H	1/32	100%	0%
H	L	L	1/64	100%	0%
H	L	H	1/128	100%	0%
H	H	L	1/10	100%	0%
H	H	H	1/20	100%	0%

The initial position is also the default state at start-up and excitation position at counter-reset in each excitation mode.

9-4) Output current setting

Output current is set as shown below by the VREF pin (applied voltage) and a resistance value between NFA (B) pin and GND.

Iout = (VREF / 5)/ NFA (B) resistance

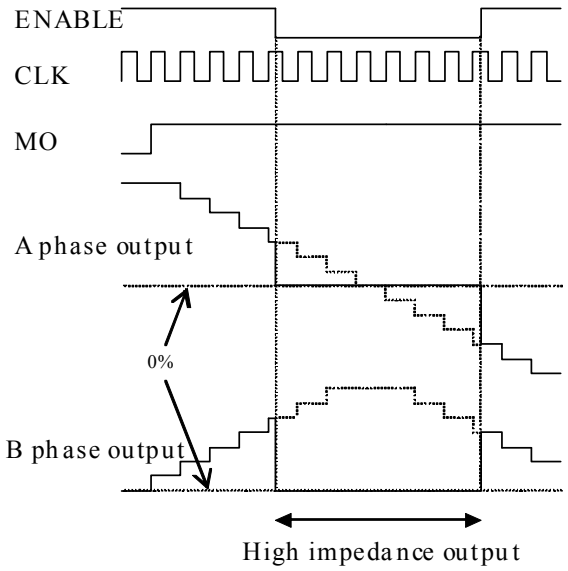
※* The setting value above is a 100% output current in each excitation mode.

(Example) When VREF=1.5V and NFA (B) resistance is 0.3 Ω, the setting current is shown below.

Iout = (1.5 V / 5) / 0.3 Ω = 1.0 A

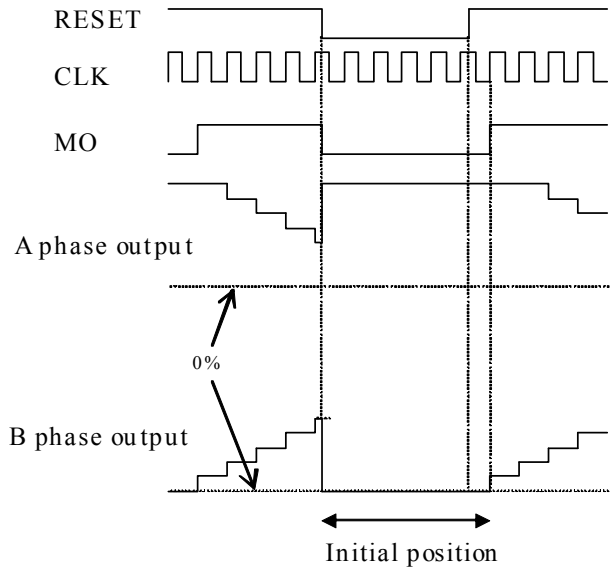
9-5) Output enable function

When the ENABLE 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 CLK is input. Therefore, when ENABLE pin is returned to High, the output level conforms to the excitation position proceeded by the CLK input.



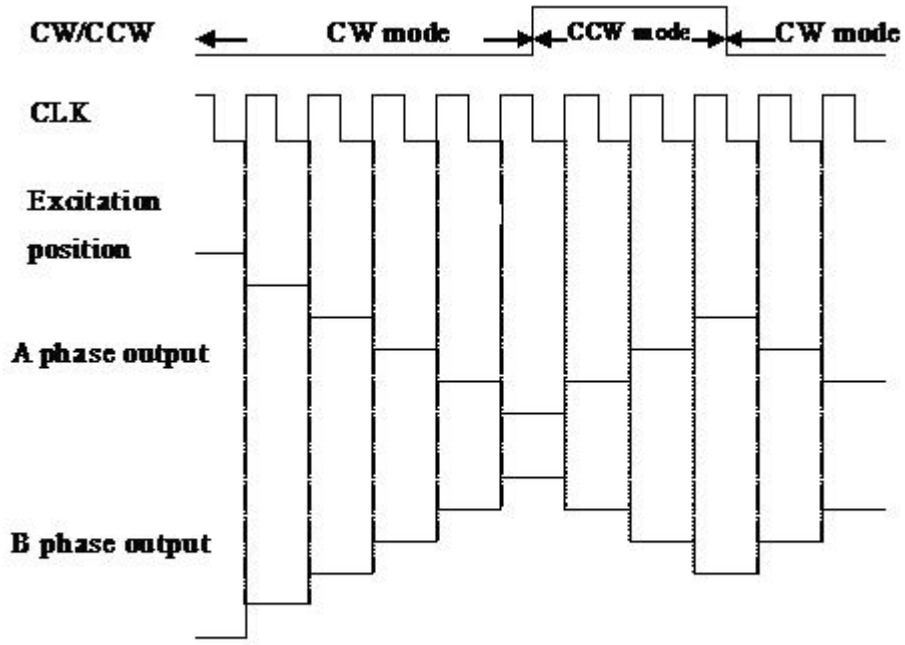
9-6) Reset function

When the RESET pin is set Low, the output goes to initial mode and the excitation position is fixed in the initial position for CLK pin and CW/CCW pin input. MO pin outputs at low levels at the initial position. (Open drain connection)



9-7) Forward/reverse switching function

CW/CCW	Operation
L	CW
H	CCW



The internal D/A converter proceeds by a bit on the rising edge of the step signal input to the CLK pin. In addition, CW and CCW mode are switched by CW and CCW pin setting.

In CW mode, the B phase current is delayed by 90°relative to the A phase current. In CCW mode, the B phase current is advanced by 90°relative to the A phase current.

9-8) DECAY mode setting

Current DECAY method is selectable as shown below by applied voltage to the FDT pin.

FDT voltage	DECAY method
3.5V to	SLOW DECAY
1.1V to 3.1V or OPEN	MIXED DECAY
to 0.8V	FAST DECAY

9-9) DOWN, MO output pin

Output pin is an open drain connection. Each pin is turned ON at predetermined state and outputs at low levels.

Pin state	DOWN	MO
Low	Holding current state	Initial position
OFF	Normal state	Non initial position

9-10) Chopping frequency setting function

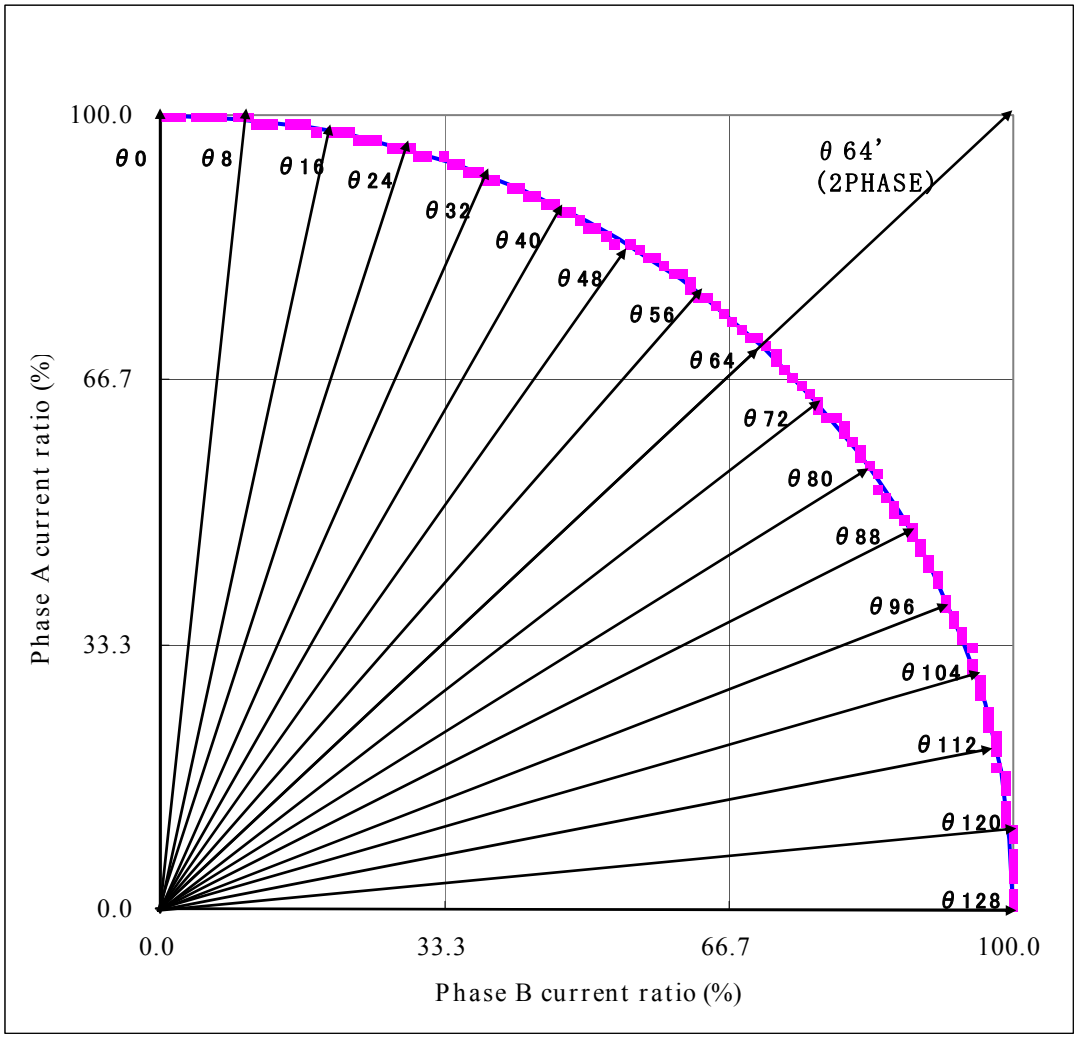
Chopping frequency is set as shown below by a capacitor between OSC1 pin and GND.

$$Fcp = 1 / (Cosc1 / 10\times10^{-6}) \text{ (Hz)}$$

(Example) When Cosc1=100pF, the chopping frequency is shown below.

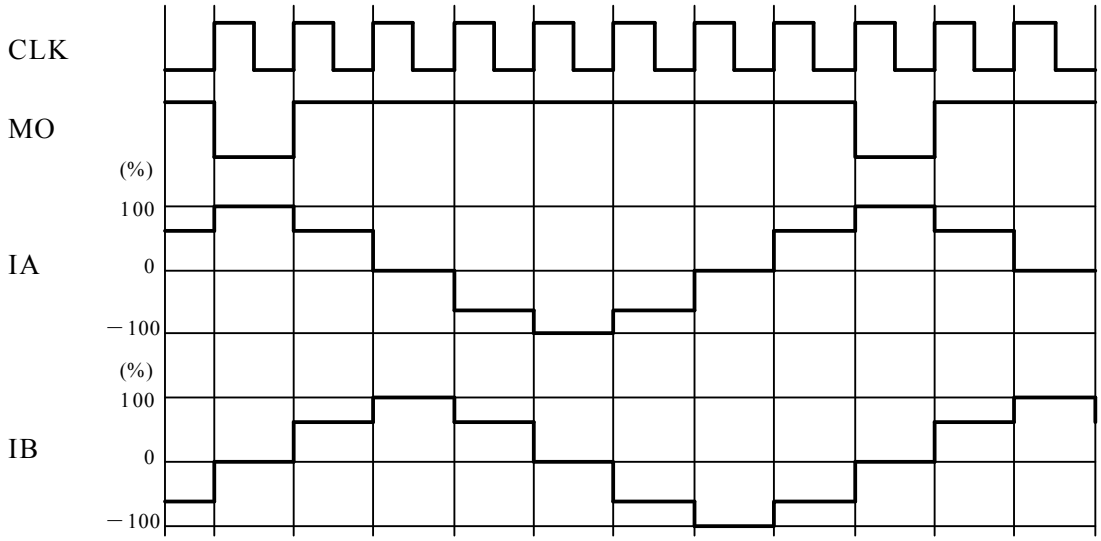
$$Fcp = 1 / (100\times10^{-12} / 10\times10^{-6}) = 100 \text{ (kHz)}$$

9-11) Output current vector locus (1 step normalized 90°)

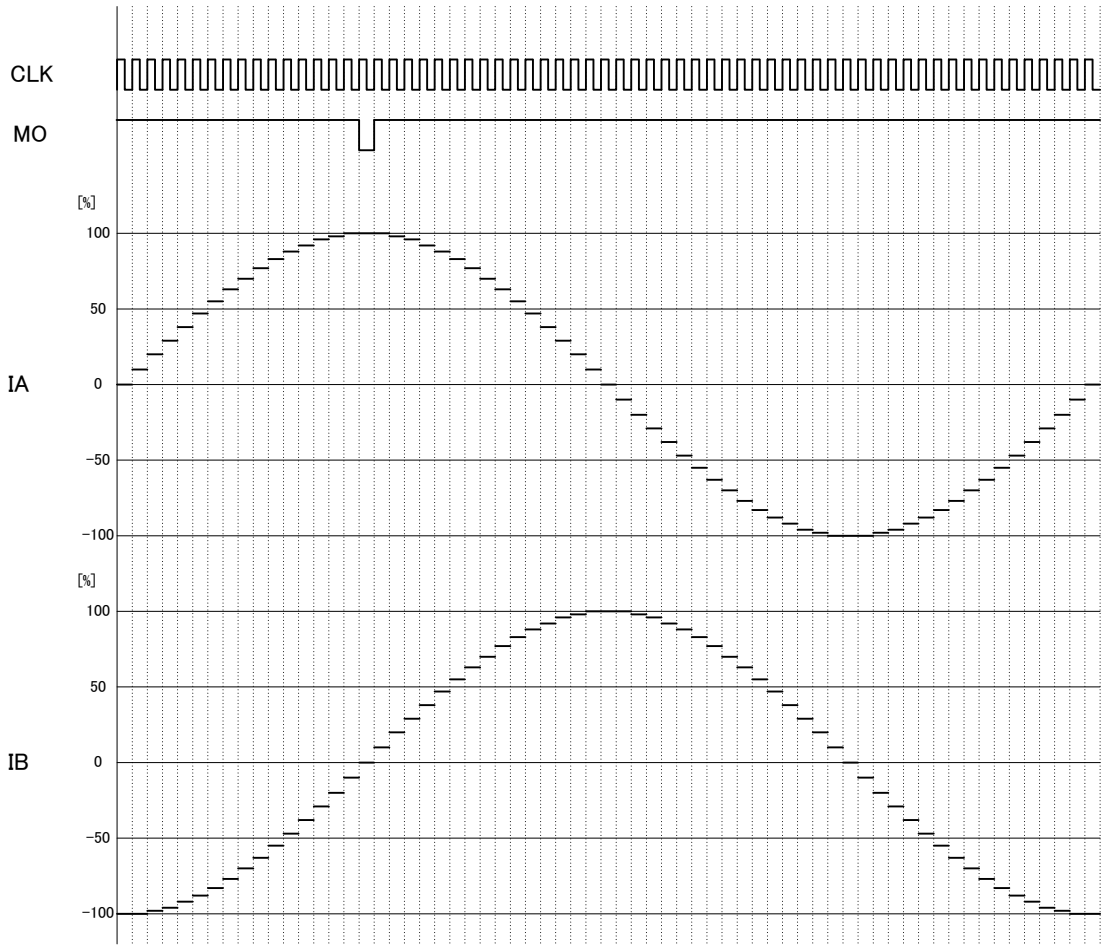


9-12) Current wave example in each excitation mode (1/2, 1/16 step mode)

1/2- step mode (CW mode)



1/16 - step mode (CW mode)



9-13) Output short-circuit protection circuit

Build-in output short-circuit protection circuit makes output to enter in stand-by mode. This function prevents the IC from damaging when the output shorts circuit by a voltage short or a ground short, etc. When output short state is detected, short-circuit detection circuit starts the operating and output is once turned OFF. After the timer latch time (typ: 256us), output is turned ON again. Still the output is at short state, the output is turned OFF and fixed in stand-by mode.

When output is fixed in stand-by mode by output short protection circuit, output is released the latch by setting ST/VCC="L".

9-14) Open-drain pin for switching holding current

The output pin is an open drain connection.

This pin is turned ON when no rising edge of CLK between the input signals while a period determined by a capacitor between OSC2 and GND, and outputs at low levels.

The open-drain output in once turned ON, is turned OFF at the next rising edge of CLK.

Holding current switching time (Tdown) is set as shown below by a capacitor between OSC2 pin and GND.

$$Tdown = Cosc2 \times 0.4 \times 10^{9} \text{ (s)}$$

(Example) When Cosc2=1500pF, the holding current switching time is shown below.

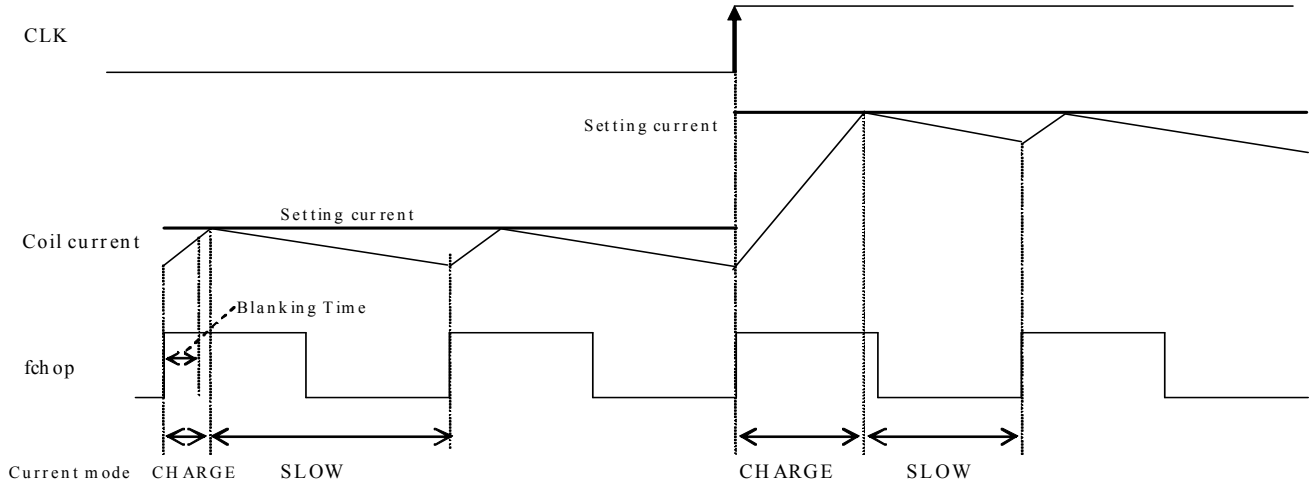
$$Tdown = 1500 \text{ pF} \times 0.4 \times 10^{9} = 0.6 \text{ (s)}$$

10. Current control operation

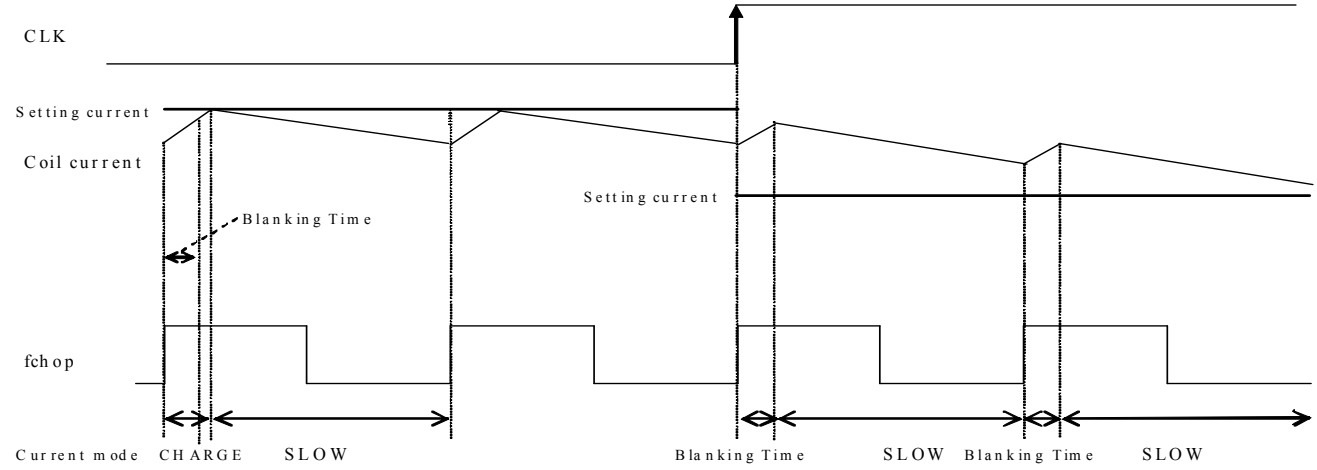
10-1) SLOW DECAY current control operation

When FDT pin voltage is a voltage over 3.5 V, the constant-current control is operated in SLOW DECAY mode.

(Sine-wave increasing direction)



(Sine-wave decreasing direction)



Each of current modes operates with the follow sequence.

- The IC enters CHARGE mode at a rising edge of the chopping oscillation.

(A period of CHARGE mode (Blanking Time) is forcibly present in approximately 1 μs, regardless of the current value of the coil current(ICOIL)and set current (IREF)).

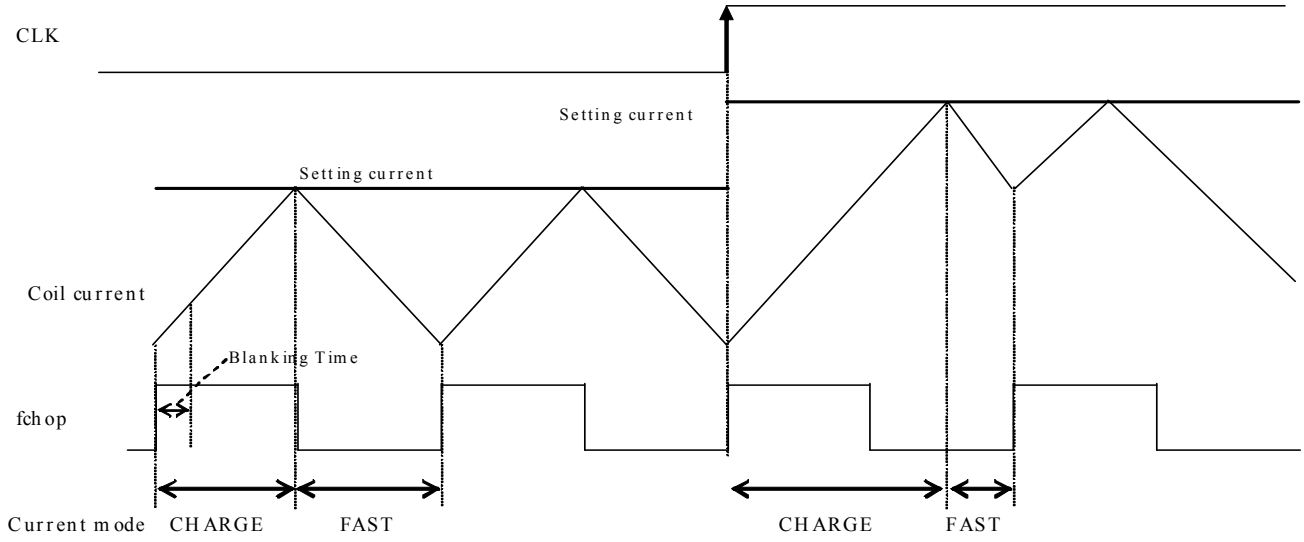
- After the period of the blanking time, the IC operates in CHARGE mode until ICOIL≥IREF. After that, the mode switches to the SLOW DECAY mode and the coil current is attenuated until the end of a chopping period.

At the constant-current control in SLOW DECAY mode, following to the setting current from the coil current may take time (or not follow) for the current delay attenuation.

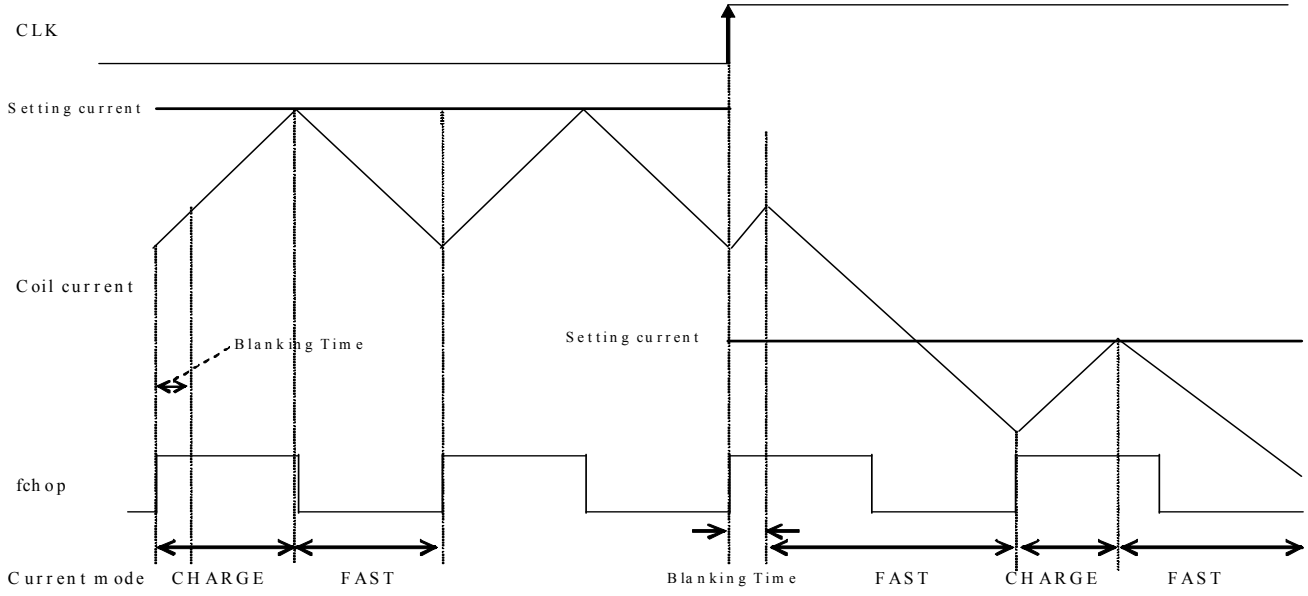
10-2) FAST DECAY current control operation

When FDT pin voltage is a voltage under 0.8V, the constant-current control is operated in FAST DECAY mode.

(Sine-wave increasing direction)



(Sine-wave decreasing direction)



Each of current modes operates with the follow sequence.

- The IC enters CHARGE mode at a rising edge of the chopping oscillation.

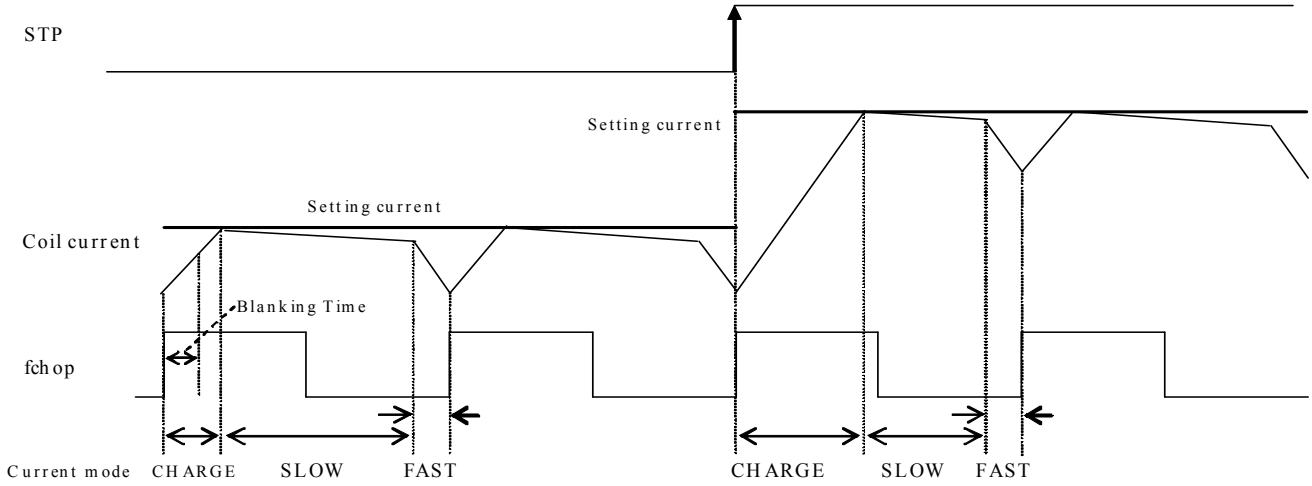
(A period of CHARGE mode (Blanking Time) is forcibly present in approximately 1 μs, regardless of the current value of the coil current (ICOIL) and set current (IREF)).

- After the period of the blanking time, The IC operates in CHARGE mode until ICOIL ≥ IREF. After that, the mode switches to the FAST DECAY mode and the coil current is attenuated until the end of a chopping period.

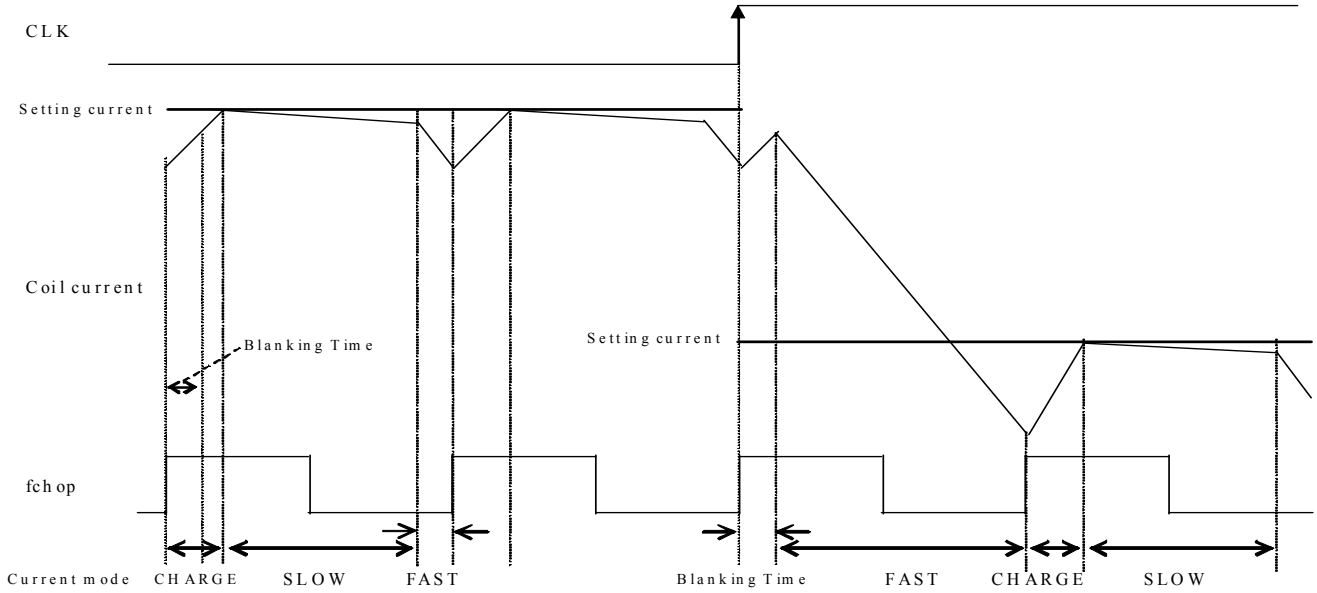
At the constant-current control in FAST DECAY mode, following to the setting current from the coil current takes short-time for the current fast attenuation, but, the current ripple value may be higher.

10-3) MIXED DECAY current control operation

When FDT pin voltage is a voltage between 1.1 V to 3.1 V or OPEN, the constant-current control is operated in MIXED DECAY mode. (Sine-wave increasing direction)



(Sine-wave decreasing direction)



Each of current modes operates with the follow sequence.

- The IC enters CHARGE mode at a rising edge of the chopping oscillation.

(A period of CHARGE mode (Blanking Time) is forcibly present in approximately 1 μs, regardless of the current value of the coil current (ICOIL) and set current (IREF)).

- In a period of Blanking Time, the coil current (ICOIL) and the setting current (IREF) are compared.

If an ICOIL < IREF state exists during the charge period:

The IC operates in CHAGE mode until ICOIL ≥ IREF. After that, it switches to SLOW DECAY mode and then switches to FAST DECAY mode in the last approximately 1 μs of the period.

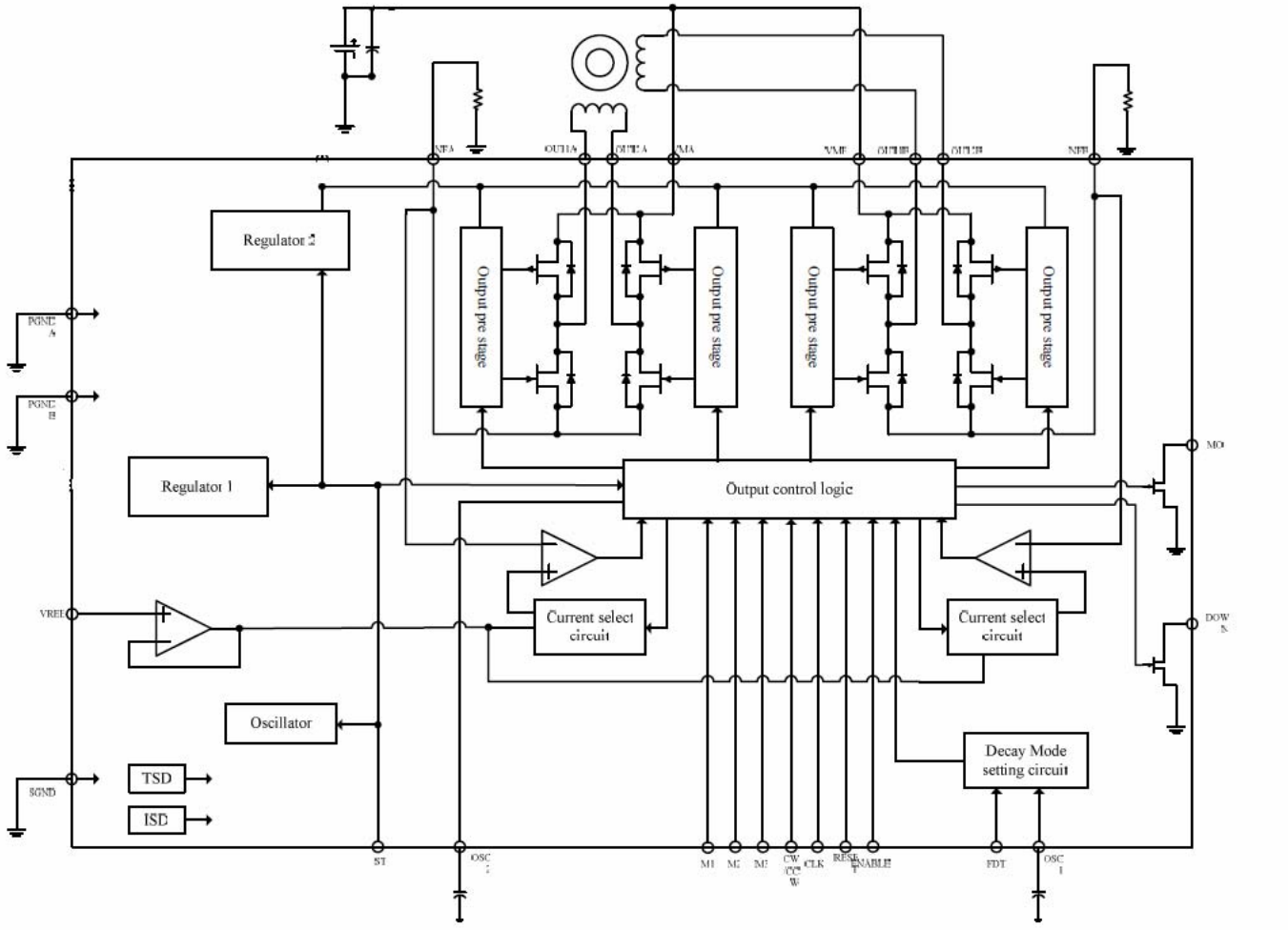
If no ICOIL < IREF state exists during the charge period:

The IC switches to FAST DECAY mode and the coil current is attenuated with the FAST DECAY operation until the end of a chopping period.

The above operation is repeated.

Normally, in the sine wave increasing direction the IC operates in SLOW (+FAST) DECAY mode, and in the sine wave decreasing direction the IC operates in FAST DECAY mode until the current is attenuated and reaches the set value and the IC operates in SLOW (+FAST) DECAY mode.

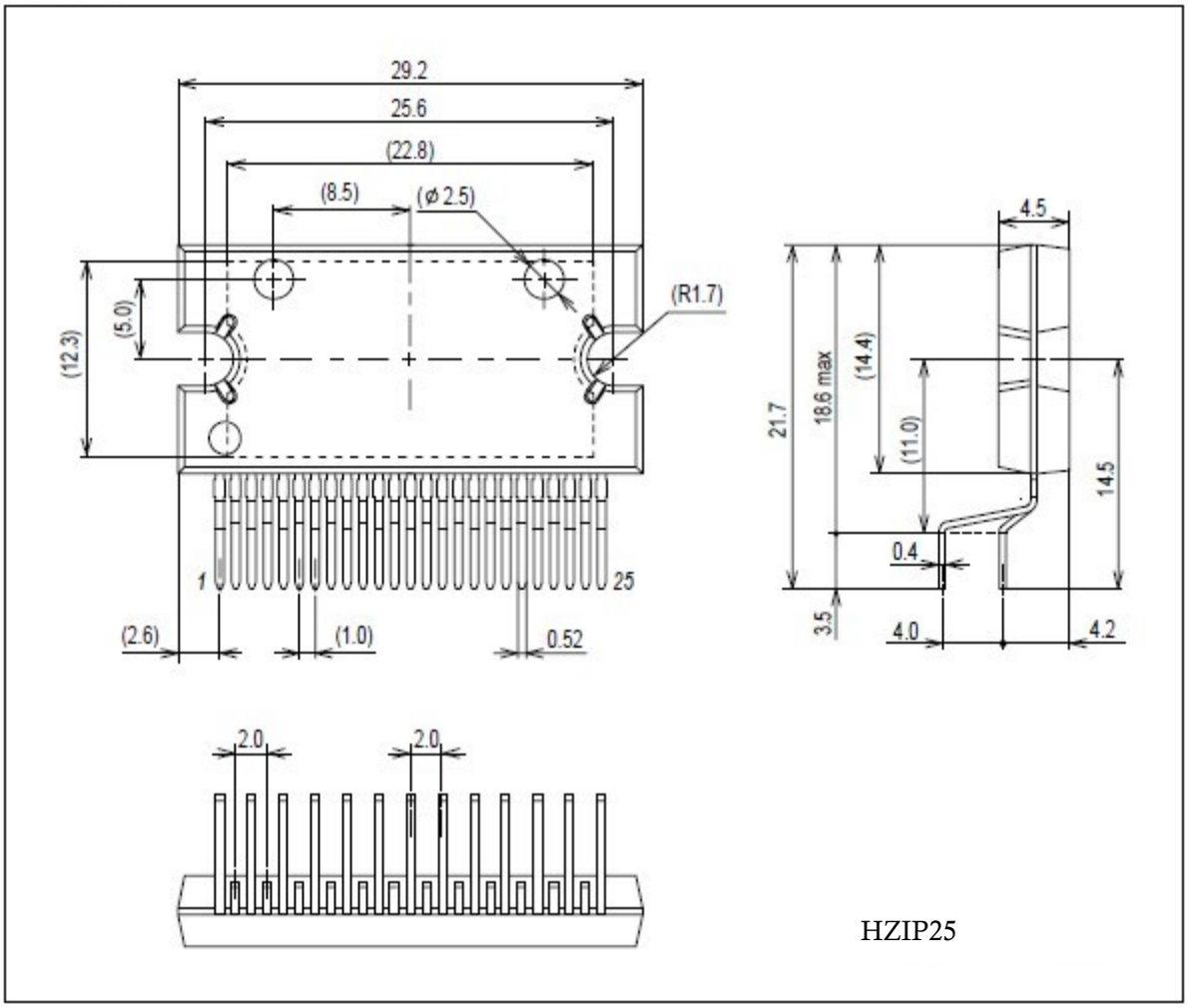
11. Block diagram



12.Package Dimensions

unit : mm (typ)

3236A



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