TENTATIVE

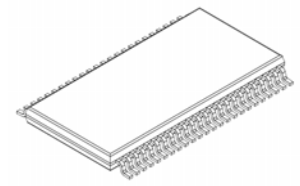
TOSHIBA BiCD Integrated Circuit Silicon Monolithic

TB62213FNG

BiCD Constant-Current Two-Phase Bipolar Stepping Motor Driver IC

The TB62213FNG is a two-phase bipolar stepping motor driver using a PWM chopper.
Fabricated with the BiCD process, the TB62213FNG is rated at 40 V/3.0 A .
The on-chip voltage regulator allows control of a stepping motor with a single V_M power supply.
The TB62213FNG is RoHS-compatible.

Features



- Bipolar stepping motor driver
- PWM constant-current drive
- Allows two-phase, 1-2-phase and W1-2 phase excitations.
- BiCD process: Uses DMOS FETs as output power transistors.
- High voltage and current: 40 V/3.0 A (absolute maximum ratings)
- Thermal shutdown (TSD), overcurrent shutdown (ISD), and power-on resets (PORs)
- Packages: HTSSOP48-P-300-0.50

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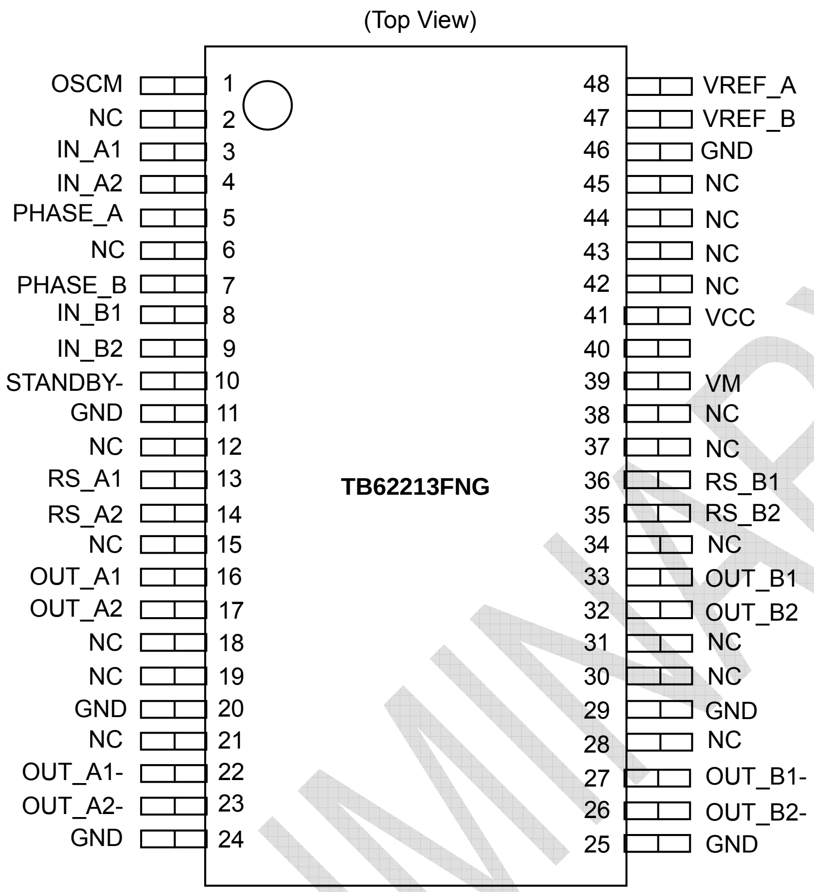
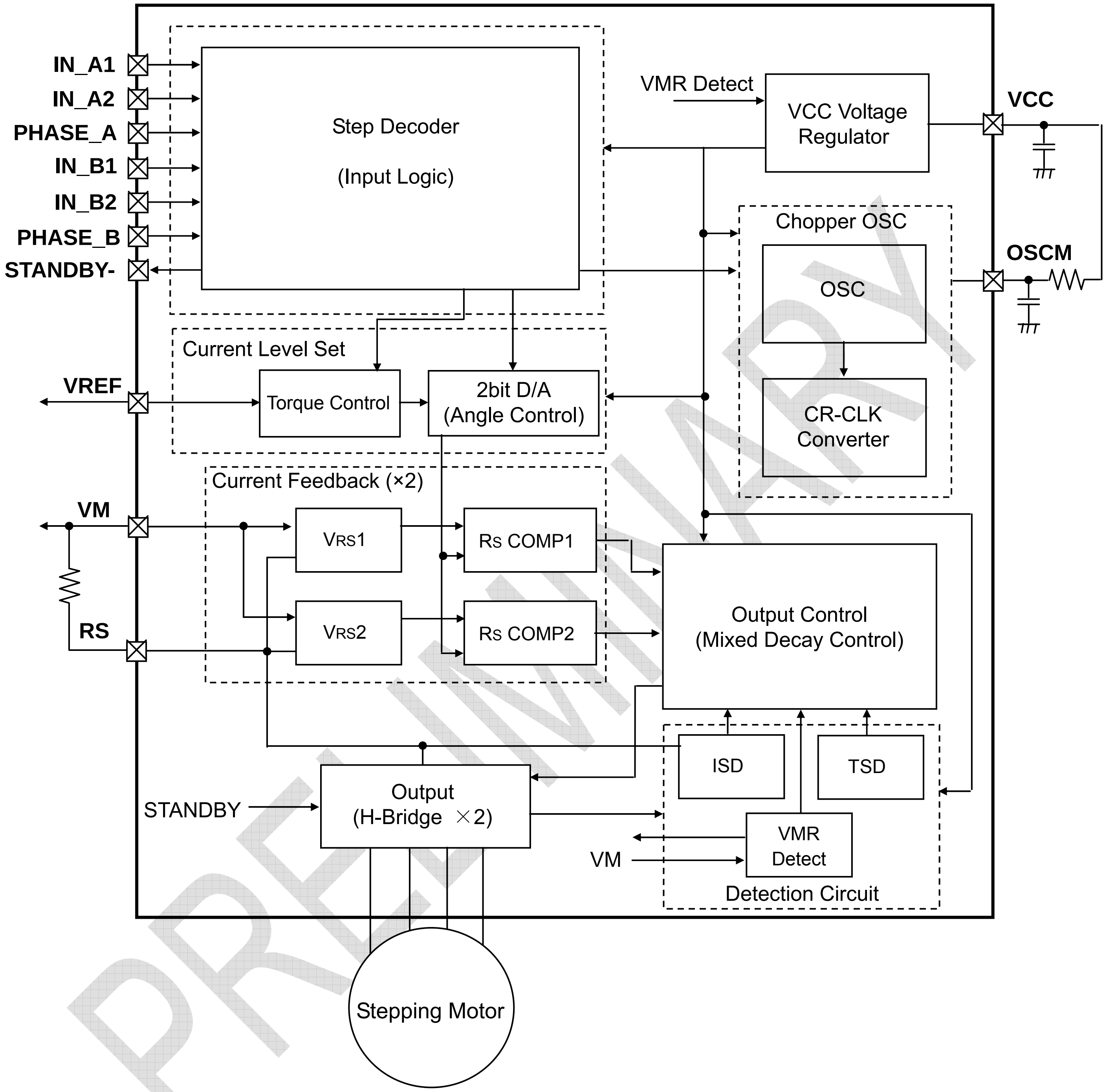
Pin Assignment



Block Diagram

In the block diagram, part of the functional blocks or constants may be omitted or simplified for explanatory purposes.



Note: All the grounding wires of the TB62213FNG must run on the solder mask on the PCB and be externally terminated at only one point. Also, a grounding method should be considered for efficient heat dissipation.

Application Notes

Careful attention should be paid to the layout of the output, V_{DD} (V_M) and GND traces, to avoid short-circuits across output pins or to the power supply or ground. If such a short-circuit occurs, the TB62213FNG may be permanently damaged.

Also, utmost care should be taken for pattern designing and implementation of the TB62213FNG since it has the power supply pins (V_M, R_S, OUT, GND) particularly a large current can run through. If these pins are wired incorrectly, an operation error or even worse a destruction of the TB62213FNG may occur.

The logic input pins must be correctly wired, too; otherwise, the TB62213FNG may be damaged due to a current larger than the specified current running through the IC.

Pin Function

TB62213FNG (HTSSOP48)

This table is a function explanation from the terminal number 1 to 28.

Pin No.	Pin Name	Function
1	OSCM	Oscillator pin for PWM choppers
2	NC	No-connect
3	IN_A1	A-phase excitation control input
4	IN_A2	A-phase excitation control input
5	PHASE_A	Current direction signal input for A phase
6	NC	No-connect
7	PHASE_B	Current direction signal input for B phase
8	IN_B1	B-phase excitation control input
9	IN_B2	B-phase excitation control input
10	STANDBY-	Output; Wait for power saving by disabling OSCM
11	GND	Logic ground
12	NC	No-connect
13	RS_A1(Note1)	The sink current sensing of A-phase motor coil
14	RS_A2(Note1)	The sink current sensing of A-phase motor coil
15	NC	No-connect
16	OUT_A1(Note1)	A-phase positive driver output
17	OUT_A2(Note1)	A-phase positive driver output
18	NC	No-connect
19	NC	No-connect
20	GND	Motor power ground
21	NC	No-connect
22	OUT_A1-(Note1)	A-phase negative driver output
23	OUT_A2-(Note1)	A-phase negative driver output
24	GND	Motor power ground
25	GND	Motor power ground
26	OUT_B2-(Note1)	B-phase negative driver output
27	OUT_B1-(Note1)	B-phase negative driver output
28	NC	No-connect

This table is a function explanation from the terminal number 29 to 48.

Pin No.	Pin Name	Function
29	GND	Motor power ground
30	NC	No-connect
31	NC	No-connect
32	OUT_B2(Note1)	B-phase positive driver output
33	OUT_B1(Note1)	B-phase positive driver output
34	NC	No-connect
35	RS_B2(Note1)	The sink current sensing of B-phase motor coil
36	RS_B1(Note1)	The sink current sensing of B-phase motor coil
37	NC	No-connect
38	NC	No-connect
39	VM	Power supply
40	NC	No-connect
41	VCC	Smoothing filter for logic power supply
42	NC	No-connect
43	NC	No-connect
44	NC	No-connect
45	NC	No-connect
46	GND	Logic ground
47	VREF_B	Tunes the current level for B-phase motor drive.
48	VREF_A	Tunes the current level for A-phase motor drive.

・Please use the pin of NC with Open.

Note 1: Be short-circuited of two or more existing pins of TB62213FNG in the terminal neighborhood.

Output Function Table

Operation explanation

IOUT: The current which flows OUT_X to OUT_X- is defined plus current. The current which flows OUT_X- to OUT_X is defined minus current.

<Two-Phase>

PHASE A				PHASE B			
Input			Output	Input			Output
PHASE_A	IN_A1	IN_A2	I_{OUT}(A)	PHASE_B	IN_B1	IN_B2	I_{OUT}(B)
H	H	H	100%	H	H	H	100%
L	H	H	-100%	H	H	H	100%
L	H	H	-100%	L	H	H	-100%
H	H	H	100%	L	H	H	-100%

Please make IN_A1, IN_A2, IN_B1, and IN_B2 Low when you turn on the power supply.

<1-2-phase >

PHASE A				PHASE B			
Input			Output	Input			Output
PHASE_A	IN_A1	IN_A2	I_{OUT}(A)	PHASE_B	IN_B1	IN_B2	I_{OUT}(B)
H	H	H	100%	H	H	H	100%
X	L	L	0%	H	H	H	100%
L	H	H	-100%	H	H	H	100%
L	H	H	-100%	X	L	L	0%
L	H	H	-100%	L	H	H	-100%
X	L	L	0%	L	H	H	-100%
H	H	H	100%	L	H	H	-100%
H	H	H	100%	X	L	L	0%

X : Don't care

<W1-2 phase>

PHASE A				PHASE B			
Input			Output	Input			Output
PHASE_A	IN_A1	IN_A2	I_{OUT}(A)	PHASE_B	IN_B1	IN_B2	I_{OUT}(B)
H	H	L	71%	H	H	L	71%
H	L	H	38%	H	H	H	100%
X	L	L	0%	H	H	H	100%
L	L	H	-38%	H	H	H	100%
L	H	L	-71%	H	H	L	71%
L	H	H	-100%	H	L	H	38%
L	H	H	-100%	X	L	L	0%
L	H	H	-100%	L	L	H	-38%
L	H	L	-71%	L	H	L	-71%
L	L	H	-38%	L	H	H	-100%
X	L	L	0%	L	H	H	-100%
H	L	H	38%	L	H	H	-100%
H	H	L	71%	L	H	L	-71%
H	H	H	100%	L	L	H	-38%
H	H	H	100%	X	L	L	0%
H	H	H	100%	H	L	H	38%

X : Don't care

Other Functions

Pin Name	H	L	Notes
IN X	Outputs enabled	Outputs disabled	When IN_X is deasserted Low (where a letter X that indicates a phase), its outputs assume the high-impedance state, regardless of the state of that phase.
PHASE X	OUT_X: H	OUT_X (–) : H	When PHASE_X is High, a current normally flows from OUT_X to OUT_X (–).
STANDBY-	Normal operation mode	Standby mode	When STANDBY- is Low, both the oscillator and output drivers are disabled. The TB62213FNG can not drive a motor.

Protection Features

(1) Thermal shutdown (TSD)
The thermal shutdown circuit turns off all the outputs when the junction temperature (T_j) exceeds 150°C (typ.). The outputs retain the current states.
The TB62213FNG exits TSD mode and resume normal operation when the TB62213FNG is rebooted or the STANDBY pin is changed from High to Low and then to High.

(2) Power-ON-resets (PORs) for VMR and VCCR (V_M and V_{CC} voltage monitor)
The outputs are forced off until V_M and V_{CC} reach the rated voltages.

(3) Overcurrent shutdown (ISD)

Each phase has an overcurrent shutdown circuit, which turns off the corresponding outputs when the output current exceeds the shutdown trip threshold (above the maximum current rating: 3.1A minimum). The TB62213FNG exits ISD mode and resume normal operation when the STANDBY pin is changed from High to Low and then to High.

This circuit provides protection against a short-circuit by temporarily disabling the device. Important notes on this feature will be provided later.

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Motor power supply		V_M	40	V
Motor output voltage		V_{OUT}	40	V
Motor output current		I_{OUT}	3.0	A per phase
Logic power supply		V_{CC}	6.0	V
Logic input voltage		V_{IN}	6.0	V
Power dissipation	HTSSOP48	P_D	1.3	W
Operating temperature		T_{opr}	−20 to 85	°C
Storage temperature		T_{str}	−55 to 150	°C
Junction temperature		$T_{j\ (MAX)}$	150	°C

Note 1: The absolute maximum rating is 3.0A.

Note 2: Stand-alone (Ta = 25°C)

Ta: Ambient temperature

T_{opr}: Ambient temperature while the TB62213FNG is active.

T_j: Junction temperature while the TB62213FNG is active. The maximum junction temperature is limited by the thermal shutdown (TSD) circuitry.
When Ta exceeds 25℃, it is necessary to do the derating with 10.4mW/℃.

Note: The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
The value of even one parameter of the absolute maximum ratings should not be exceeded under any circumstances. The TB62213FNG does not have overvoltage protection. Therefore, the device is damaged if a voltage exceeding its rated maximum is applied.

All voltage ratings including supply voltages must always be followed. The other notes and considerations described later should also be referred to.

Operating Ranges (Note:1)

Characteristics	Symbol	Min	Typ.	Max	Unit	Remarks
Motor power supply	V_M	10.0	24.0	38.0	V	—
Motor output voltage	I_{OUT}	—	1.8	2.4	A	Per phase
Logic input viltage	$V_{IN(H)}$	2.0	3.3	5.5	V	Logic high level
	$V_{IN(L)}$	GND	-	0.8	V	Logic low level
PHASE signal input frequency	f_{PHASE}	1.0	-	150	kHz	—
Chopper frequency	f_{chop}	40	100	150	kHz	—
V_{ref} reference voltage	V_{ref}	GND	3.0	4.0	V	—

Electrical Characteristics 1 (Ta = 25°C, V_M = 24 V, unless otherwise specified)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Digital input voltage	High	V_{IN}	Digital input pins (Note)	2	3.3	5.0	V
	Low			GND	—	0.8	
Input hysteresis voltage		$V_{IN\ (HIS)}$	Digital input pins (Note)	100	200	300	mV
Digital input current	High	$I_{IN\ (H)}$	V_{IN} = 5 V at the digital input pins under test	35	50	75	μA
	Low	$I_{IN\ (L)}$	V_{IN} = 0 V at the digital input pins under test	—	—	1	
Power consumption		I_{M1}	Outputs open, $\overline{\text{STAND BY}}$ = Low	—	2	3	mA
		I_{M2}	Outputs open, $\overline{\text{STAND BY}}$ = High	—	3.5	5	
		I_{M3}	Outputs open (two-phase excitation)	—	5	7	
Output leakage current	High-side	I_{OH}	V_{RS} = V_M = 40 V: V_{OUT} = 0 V	—	—	1	μA
	Low-side	I_{OL}	V_{RS} = V_M = V_{OUT} = 40 V	1	—	—	
Chanel-to-channel current differential		ΔI_{OUT1}	Channel-to-channel error	−5	0	5	%
Output current error relative to the predetermined value		ΔI_{OUT2}	I_{OUT} = 1 A	−5	0	5	%
R_S pin current		I_{RS}	V_{RS} = V_M = 24 V	0	—	10	μA
Drain-source ON-resistance of the output transistors (upper and lower sum)		$R_{ON\ (D-S)}$	I_{OUT} = 2.0 A, T_j = 25°C	TBD (0.4)	0.6	TBD (0.8)	Ω
Chopping current		Phase	Step0 (Note 2)	-	0	-	%
			Step1 (Note 2)	33	38	43	%
			Step2 (Note 2)	66	71	76	%
			Step3 (Note 2)	-	100	-	%

Note: $V_{IN\ (L \rightarrow H)}$ is defined as the V_{IN} voltage that causes the outputs to change when a pin under test is gradually raised from 0 V. $V_{IN\ (H \rightarrow L)}$ is defined as the V_{IN} voltage that causes the outputs to change when the pin is then gradually lowered.
The difference between $V_{IN\ (L \rightarrow H)}$ and $V_{IN\ (H \rightarrow L)}$ is defined as the input hysteresis.

Electrical Characteristics 2 (Ta = 25°C, V_M = 24 V, unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Supply voltage for internal circuitry	V_{CC}	I_{CC} = 5.0 mA	4.75	5.00	5.25	V
Supply current for internal circuitry	I_{CC}	TBD	-	2.5	5.0	mA
V_{ref} input voltage range	V_{ref}	V_M = 24V, STANDBY = H, f_{PHASE} = 1 kHz	GND	3.0	4.0	V
V_{ref} input current	I_{ref}	Output non-operation V_{ref} = 3.0 V		0	1.0	μA
V_{ref} decay rate	$V_{ref\ (GAIN)}$	V_{ref} = 2.0 V	1/4.8	1/5.0	1/5.2	—
TSD threshold (Note 1)	T_{jTSD}	—	140	150	170	°C
V_M recovery voltage	V_{MR}	—	7.0	8.0	9.0	V
Overcurrent trip threshold (Note 2)	ISD	—	3.0	4.0	5.0	A
Voltage across the current-sensing resistor pins	V_{RS}	Spec is a standard as for the voltage of the terminal VM.	0.9	1.5	TBD	V

Note 1: Thermal shutdown (TSD) circuitry
When the junction temperature of the device has reached the threshold, the TSD circuitry is tripped, causing the internal reset circuitry to turn off the output transistors.
The TSD circuitry is tripped at a temperature between 140°C (min) and 170°C (max). Once tripped, the TSD circuitry keeps the output transistors off until STANDBY is deasserted High or the IC is restarted.

Note 2: Overcurrent shutdown (ISD) circuitry
When the output current has reached the threshold, the ISD circuitry is tripped, causing the internal reset circuitry to turn off the output transistors.
To prevent the ISD circuitry from being tripped due to switching noise, it has a masking time of four CR oscillator cycles. Once tripped, it takes a maximum of four cycles to exit ISD mode and resume normal operation.
The ISD circuitry remains active until the STANDBY pin is changed from Low to High again or the IC is restarted.
The TB62213FNG remains in Standby mode while in ISD mode.

Back-EMF

While a motor is rotating, there is a timing at which power is fed back to the power supply. At that timing, the motor current recirculates back to the power supply due to the effect of the motor back-EMF.

If the power supply does not have enough sink capability, the power supply and output pins of the device might rise above the rated voltages. The magnitude of the motor back-EMF varies with usage conditions and motor characteristics. It must be fully verified that there is no risk that the TB62213FNG or other components will be damaged or fail due to the motor back-EMF.

Cautions on Overcurrent Shutdown (ISD) and Thermal Shutdown (TSD)

- The ISD and TSD circuits are only intended to provide temporary protection against irregular conditions such as an output short-circuit; they do not necessarily guarantee the complete IC safety.
- If the device is used beyond the specified operating ranges, these circuits may not operate properly: then the device may be damaged due to an output short-circuit.
- The ISD circuit is only intended to provide a temporary protection against an output short-circuit. If such a condition persists for a long time, the device may be damaged due to overstress. Overcurrent conditions must be removed immediately by external hardware.

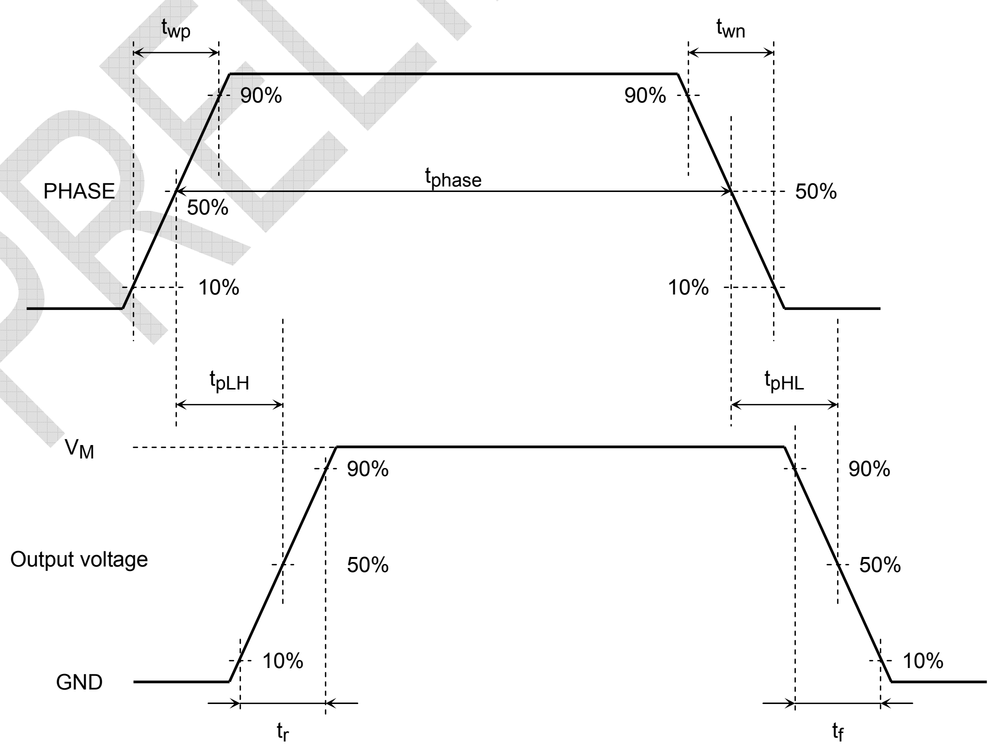
IC Mounting

Do not insert devices in the wrong orientation or incorrectly. Otherwise, it may cause the device breakdown, damage and/or deterioration.

AC Electrical Characteristics (Ta = 25°C, V_M = 24 V, 6.8 mH/5.7 Ω)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Phase frequency	f_{PHASE}	AC	f_{OSC} = 1600 kHz	—	—	150	kHz
Minimum phase pulse width	t_{PHASE}	AC	—	100	—	—	ns
	t_{wp}	AC		50	—	—	
	t_{wn}	AC		50	—	—	
Output transistor switching characteristics	t_r	AC	—	150	200	250	ns
	t_f	AC		100	150	180	
	t_{pLH} (P) MAX	AC	PHASE to OUT	500	850	1200	
	t_{pHL} (P) MAX	AC		500	850	1200	
	t_{pLH} (P) MIN	AC		250	600	950	
	t_{pHL} (P) MIN	AC		250	600	950	
Blanking time for current spike prevention	t_{BLANK}	AC	I_{OUT} = 1.0 A	300	400	500	ns
OSC oscillation reference frequency	f_{CR}	AC	C_{OSC} = 270 pF, R_{OSC} = 3.6 kΩ	1200	1600	2000	kHz
Chopper frequency range	$f_{chop\ (RANGE)}$	AC	V_M = 24 V, outputs enabled ACTIVE (I_{OUT} = 1.0 A)	40	100	150	kHz
Predefined chopper frequency	f_{chop}	AC	Outputs enabled (I_{OUT} = 1.0 A), C_R = 1600 kHz	—	100	—	kHz
ISD masking time	$t_{ISD\ (Mask)}$	AC	After ISD threshold is exceeded due to an output short-circuit to power or ground	—	4	—	CR-CLK
ISD on-time	t_{ISD}	AC	After ISD threshold is exceeded due to an output short-circuit to power or ground	4	—	8	CR-CLK

Timing Charts of Output Transistors Switching



Calculation of the Predefined Output Current

For PWM constant-current control, the TB62213FNG uses a clock generated by the CR oscillator. The peak output current can be set via the current-sensing resistor (R_{RS}) and the reference voltage (V_{ref}), as follows:

$I_{OUT} = V_{ref}/5 \div R_{RS}$ (Ω)

where, 1/5 is the V_{ref} decay rate, $V_{ref\,(GAIN)}$. For the value of $V_{ref\,(GAIN)}$, see the Electrical Characteristics table.

For example, when V_{ref} = 3 V, to generate an output current (I_{OUT}) of 1.8 A, R_{RS} is calculated as:

$RRS = (V_{ref}/5) \div I_{OUT} = (3/5) \div 1.8 = 0.33Ω$. (≥ 1.1 W)

Calculation of the OSCM oscillation frequency (chopper reference frequency)

OSCM oscillation frequency (fOSCM) and chopper frequency (fchop) are computable in the following expressions.

fOSCM=1/[0.60x{Cx(R1+500)}] ………C,R1 : External constant for OSCM (C=270pF , R1=3.6kΩ)

fchop = fOSCM / 16

Because the loss of the gate in IC rises, generation of heat grows though wavy reproducibility goes up because the pulsating flow of the current decreases when the chopper frequency is raised.

There is a possibility that the current pulsating flow increases though a decrease in generation of heat can be expected by lowering the chopper frequency.

The thing set within the range of the frequency from 40 to about 100kHz based on the frequency of about generally 70 the kHz is recommended.

IC Power Consumption

The power consumed by the TB62213FNG is approximately the sum of the following two: 1) the power consumed by the output transistors, and 2) the power consumed by the digital logic and pre-drivers.

- The power consumed by the output transistors is calculated, using the R_{ON} (D-S) value of 1.5 Ω.
- Whether in Charge, Fast Decay or Slow Decay mode, two of the four transistors comprising each H-bridge contribute to its power consumption at a given time.

Thus the power consumed by each H-bridge is given by:

$$P\text{ (out)} = I_{OUT}\text{ (A)} \times V_{DS}\text{ (V)} = 2 \times I_{OUT}^2 \times R_{ON} \quad \text{......(1)}$$

In two-phase excitation mode (in which two phases have a phase difference of 90°), the average power consumption in the output transistors is calculated as follows:

R_{ON} = 0.8 Ω (2.0 A)
I_{OUT} (Peak: max) = 1.8 A
V_M = 24 V

$$P\text{ (out)} = 2\text{Hsw} \times 1.8^2\text{ (A)} \times 0.8\ (\Omega) = 5.2\text{ (W)} \quad \text{......(2)}$$

The power consumption in the IM domain is calculated separately for normal operation and standby modes:

Normal operation mode: I (I_{M3}) = 15.0 mA (typ.)
Standby mode: I (I_{M1}) = 3.5 mA (typ.)

The current consumed in the digital logic portion of the TB62213FNG is indicated as I_{Mx}. The digital logic operates off a voltage regulator that is internally connected to the V_M power supply. It consists of the digital logic connected to V_M (24 V) and the network affected by the switching of the output transistors. The total power consumed by I_{Mx} can be estimated as:

$$P\ (I_M) = 24\text{ (V)} \times 0.005\text{ (A)} = 0.12\text{(W)} \quad \text{......(3)}$$

Hence, the total power consumption of the TB62213FNG is:

$$P = P\text{ (out)} + P\ (I_M) = 5.32\text{(W)}$$

The standby power consumption is given by:

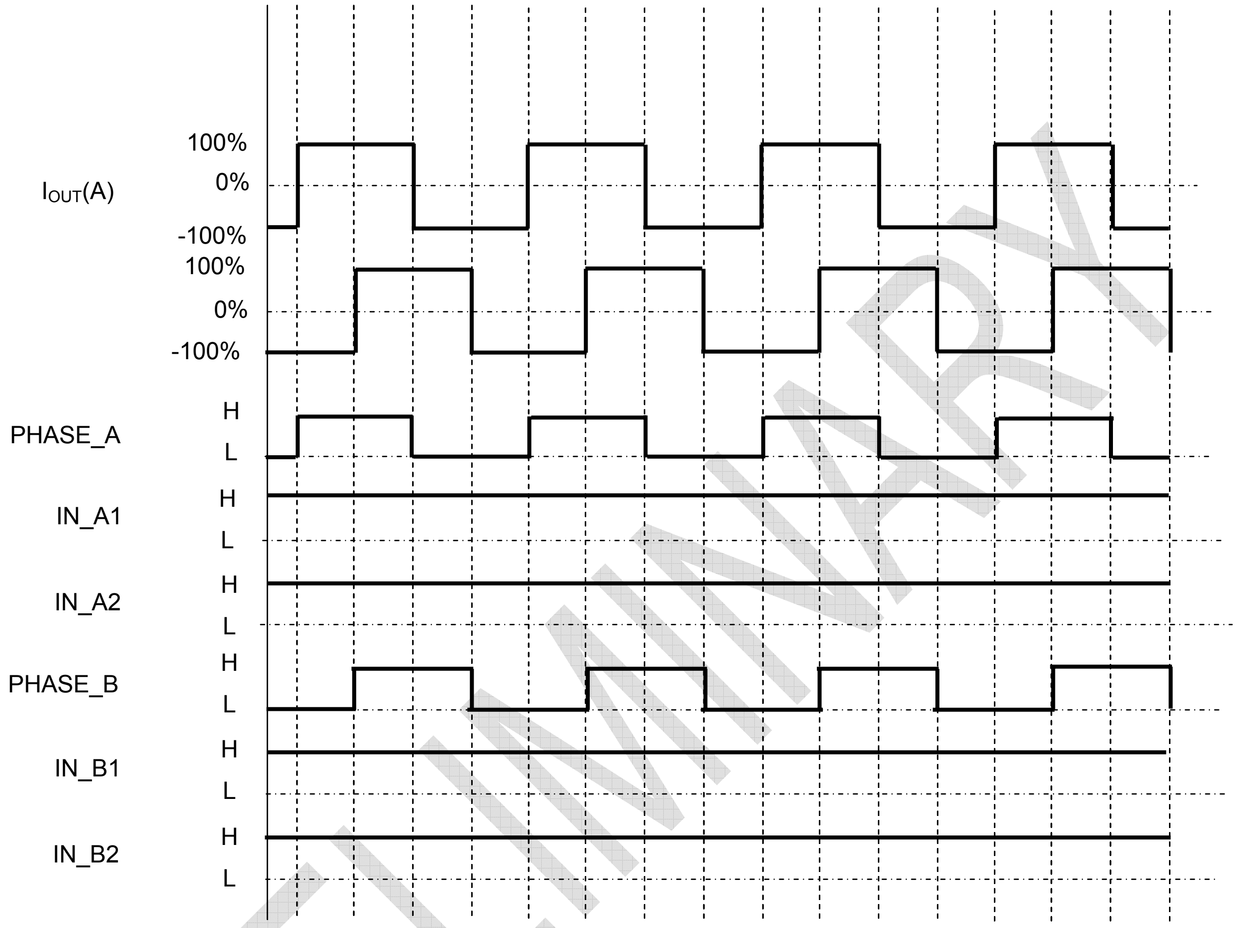
$$P\text{ (Standby)} + P\text{ (out)} = 24\text{ (V)} \times 0.0035\text{ (A)} = 0.084\text{ (W)}$$

Board design should be fully verified, taking thermal dissipation into consideration.

Phase Sequences

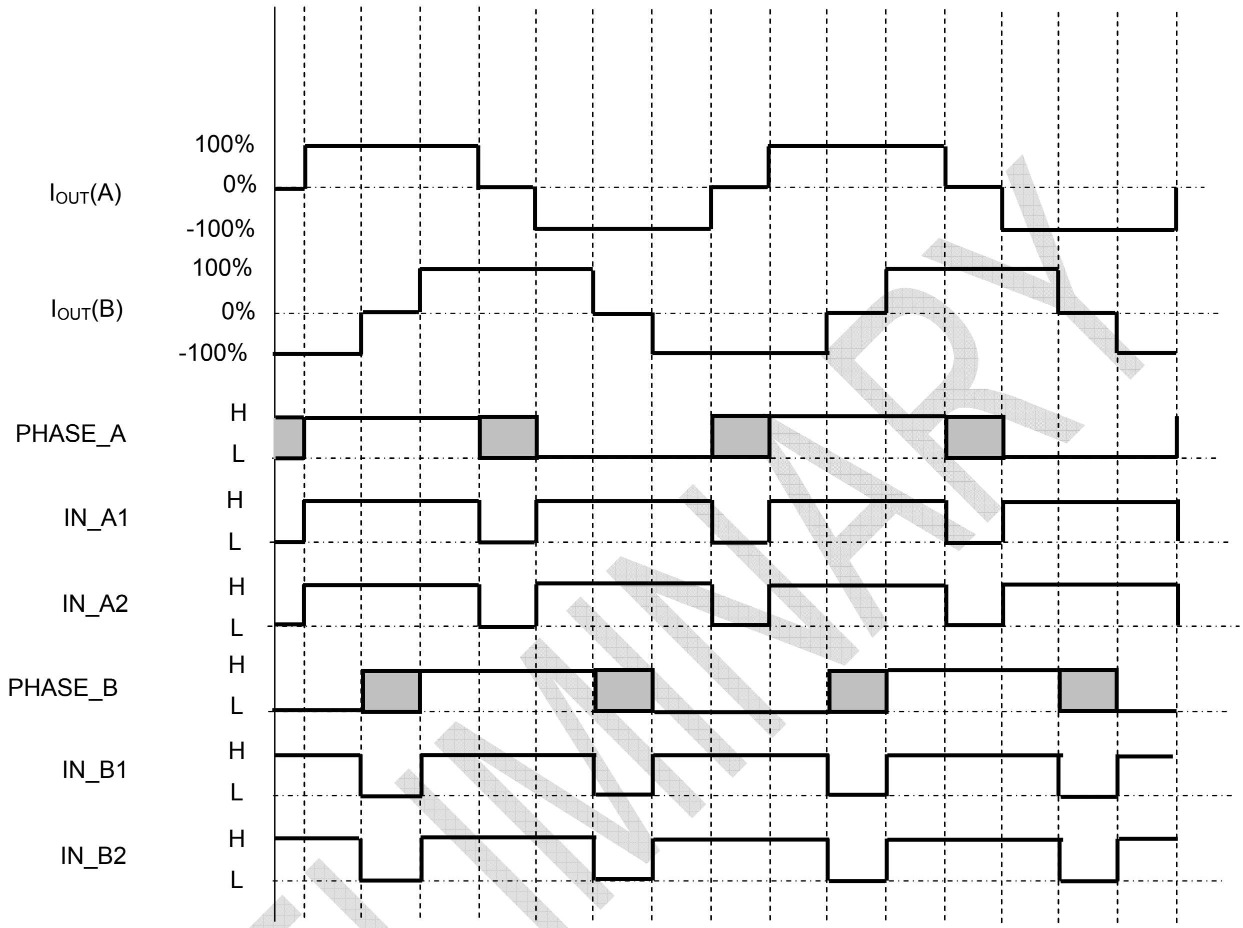
2-Phase Excitation Mode

Timing charts may be simplified for explanatory purposes.



1-2-Phase Excitation

Timing charts may be simplified for explanatory purposes.



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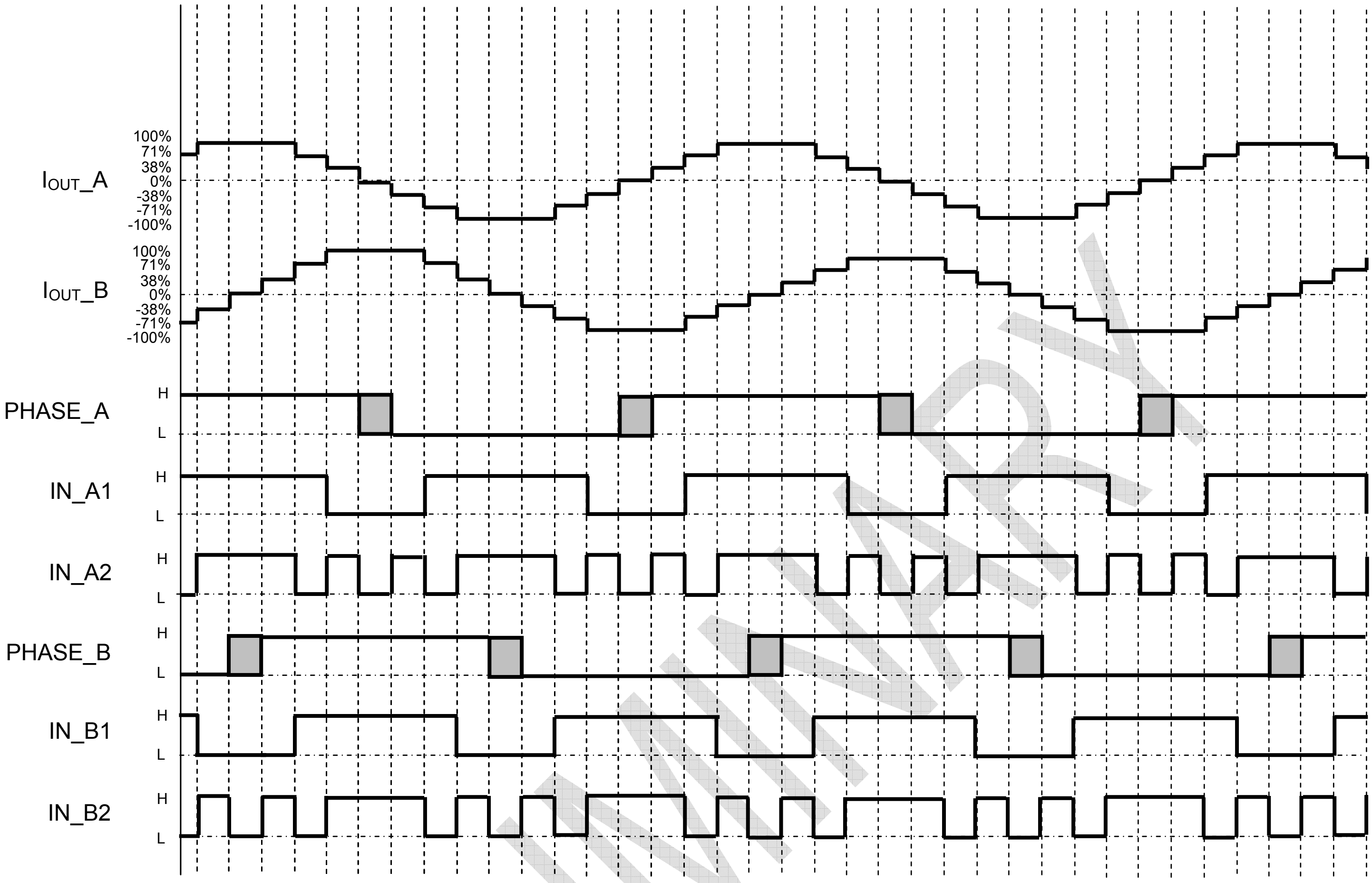
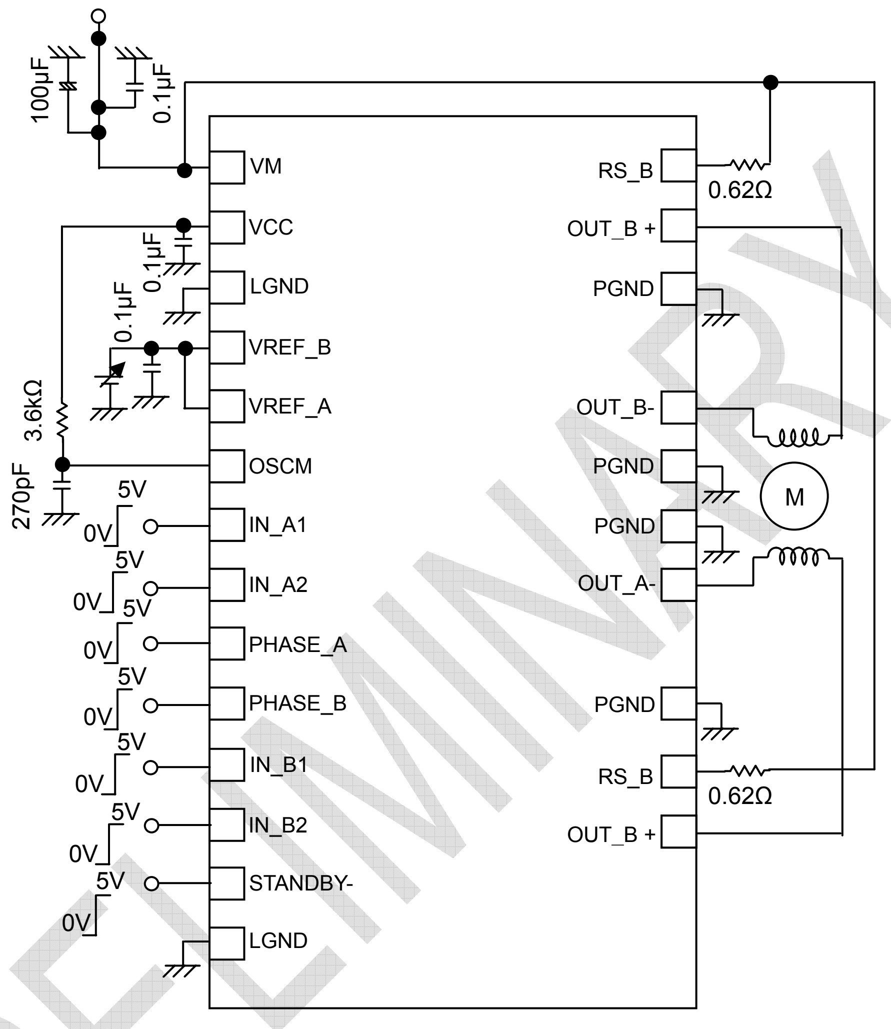
W1-2-Phase Excitation



Application Circuit Example

TB62213FNG

The values shown in the following figure are typical values. For input conditions, see Operating Ranges.

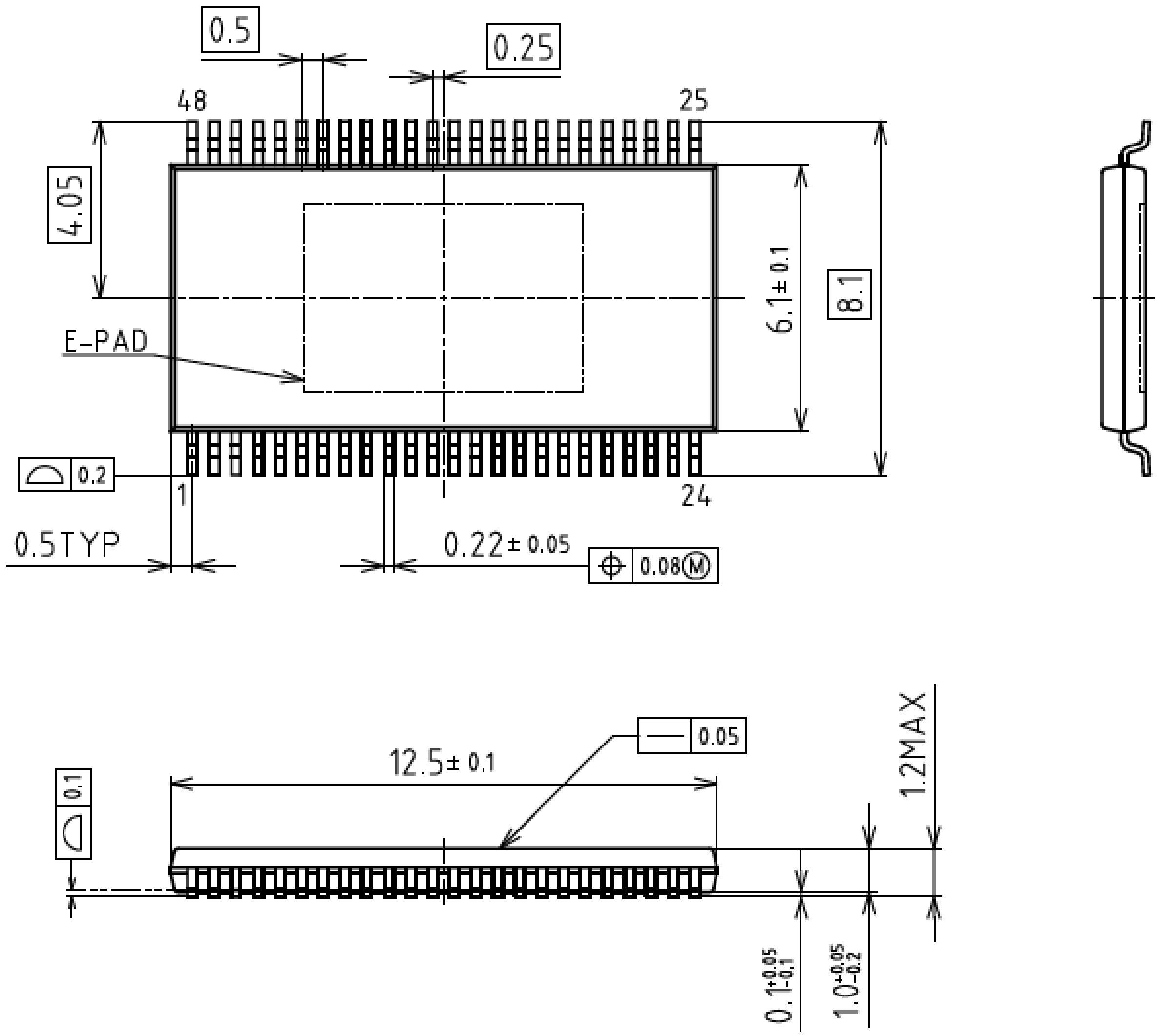


Note: I will recommend the addition of capacitor if necessary. The GND wiring must become one point as much as possible-earth.

The example of applied circuit is an example of the reference, and do an enough evaluation before the mass production design, please.
Moreover, it is not the one to permit the use of the industrial property.

Package Dimensions

HTSSOP48



Notes on Contents

1. Block Diagrams

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

2. Equivalent Circuits

The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Timing Charts

Timing charts may be simplified for explanatory purposes.

4. Application Circuits

The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

5. Test Circuits

Components in the test circuits are used only to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

IC Usage Considerations

Notes on handling of ICs

(4) The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

(5) Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

(6) If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

(7) Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

(8) Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.
If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

Points to remember on handling of ICs

(1) Over current Protection Circuit

Over current protection circuits (referred to as current limiter circuits) do not necessarily protect ICs under all circumstances. If the Over current protection circuits operate against the over current, clear the over current status immediately.
Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the over current protection circuit to not operate properly or IC breakdown before operation. In addition, depending on the method of use and usage conditions, if over current continues to flow for a long time after operation, the IC may generate heat resulting in breakdown.

(2) Thermal Shutdown Circuit

Thermal shutdown circuits do not necessarily protect ICs under all circumstances. If the thermal shutdown circuits operate against the over temperature, clear the heat generation status immediately. Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the thermal shutdown circuit to not operate properly or IC breakdown before operation.

(3) Heat Radiation Design

In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (TJ) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

(4) Back-EMF

When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor's power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device's motor power supply and output pins might be exposed to conditions beyond maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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