# DATA SHEET

| Part No. | AN41252A |
|---|---|
| Package Code No. | TQFP064-P-0707 |

Contents

# AN41252A

## Optical disc motor drive IC

### ■ Overview

AN41252A is a single-chip IC that uses low-noise direct PWM (Pulse Width Modulation) drive in the spindle motor drive block and incorporates a PWM 9-channel driver necessary for optical pickup and mechanism driving.
It is effective in reducing noise, vibration and current dissipation of laptop computers.

### ■ Features

- The spindle motor drive block adopts a single hall sensor, 3-phase full-wave and low-noise direct PWM drive technique.
- The actuator (focus, tracking, tilt) drive blocks use dead zone less, linear input and direct PWM drive technique.
- The stepping motor drive block uses sense resistor less, peak current sense feedback, linear input and direct PWM drive technique.
- Linear input and direct PWM drive technique for only beam expander drive block.
- Linear input and direct PWM drive technique for only loading drive block.
- Independent power supply pins are provided for each of the spindle, actuator, and stepping motor drive channels.
- Compact package: Less area 9.0 mm □ (Pins included)
  Slim package 1.0 t [mm]
  High power dissipation: On standard board (one side): 1.203 W (Glass-Epoxy: 50 × 50 × 0.8 t [mm])
- Functions: Spindle motor drive
  Actuator (focus, tracking, tilt) drive
  Stepping motor drive
  Beam expander drive
  Loading motor drive
- Drive voltages: 5 V
- Additional functions: Short brake / Reverse brake / Auto brake selection function
  Spindle motor drive gain selection function
  FG output frequency 1 time / 3 times selection function
  Standby mode switch
  Output reset function at $V_{REF}$ down
  Thermal shutdown circuit

### ■ Applications

- Slim type
- Blu-Ray, HD-DVD, CD-R/RW, DVD-W
- DVD recording, various combination types
- 5 V system CD/DVD player

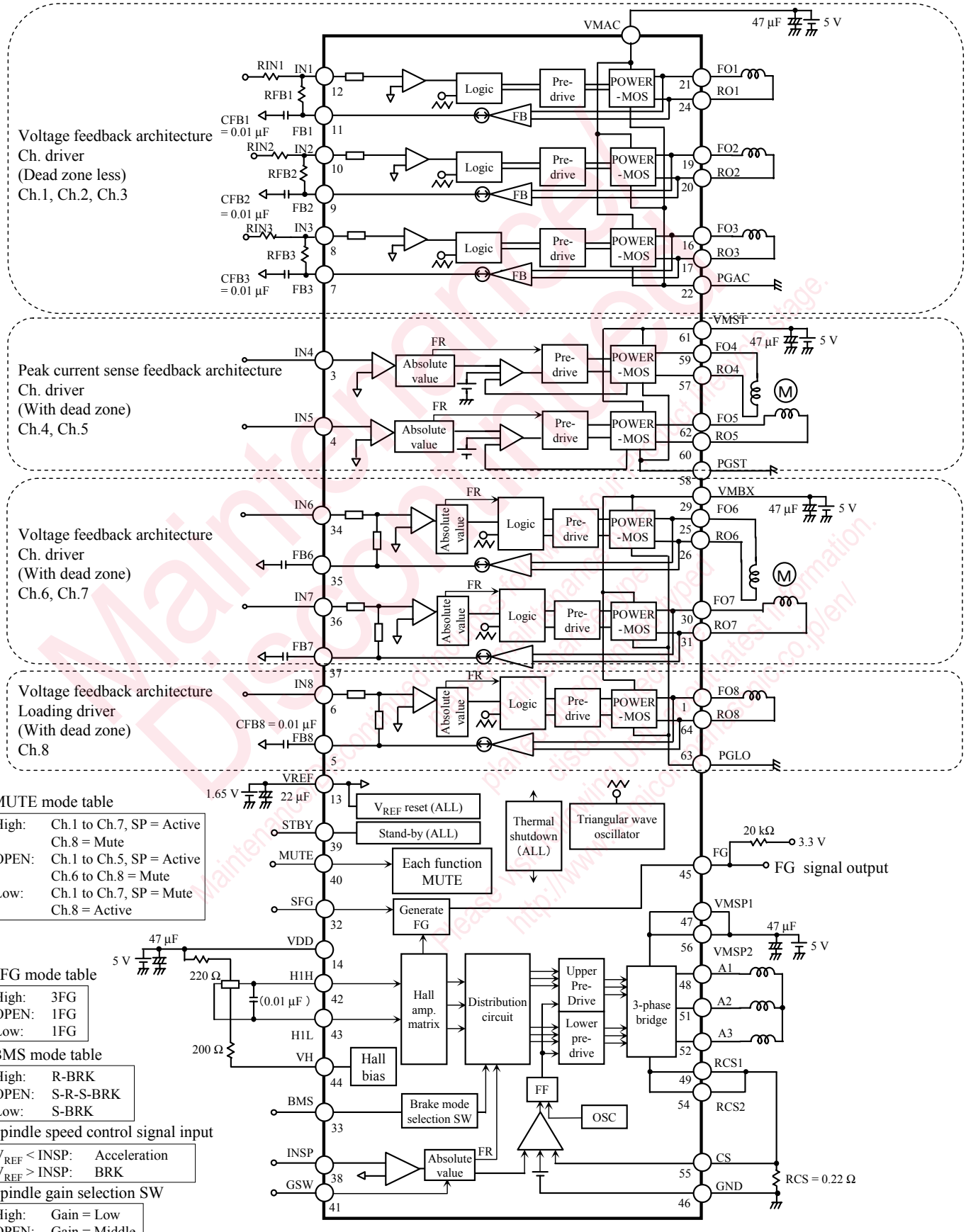
### ■ Package

- 64 pin plastic thin quad flat package (QFP Type)

### ■ Type

- Silicon monolithic bipolar IC

## ■ Application Circuit Example (Block Diagram)




MUTE mode table

| | |
|---|---|
| High: | Ch.1 to Ch.7, SP = Active<br>Ch.8 = Mute |
| OPEN: | Ch.1 to Ch.5, SP = Active<br>Ch.6 to Ch.8 = Mute |
| Low: | Ch.1 to Ch.7, SP = Mute<br>Ch.8 = Active |

SFG mode table

| | |
|---|---|
| High: | 3FG |
| OPEN: | 1FG |
| Low: | 1FG |

BMS mode table

| | |
|---|---|
| High: | R-BRK |
| OPEN: | S-R-S-BRK |
| Low: | S-BRK |

Spindle speed control signal input

| | |
|---|---|
| $V_{REF}$ < INSP: | Acceleration |
| $V_{REF}$ > INSP: | BRK |

Spindle gain selection SW

| | |
|---|---|
| High: | Gain = Low |
| OPEN: | Gain = Middle |
| Low: | Gain = High |

Note) ⟵ Connect this part to VREF.

■ Pin Descriptions

| Pin No. | Pin name | Type | Description |
|---|---|---|---|
| 1 | FO8 | Output | Ch.8 non-inverted output |
| 2 | VMLO | Power supply | Ch.8 coil drive power supply |
| 3 | IN4 | Input | Ch.4 control signal input |
| 4 | IN5 | Input | Ch.5 control signal input |
| 5 | FB8 | Output | Ch.8 feedback output |
| 6 | IN8 | Input | Ch.8 control signal input |
| 7 | FB3 | Output | Ch.3 feedback output |
| 8 | IN3 | Input | Ch.3 control signal input |
| 9 | FB2 | Output | Ch.2 feedback output |
| 10 | IN2 | Input | Ch.2 control signal input |
| 11 | FB1 | Output | Ch.1 feedback output |
| 12 | IN1 | Input | Ch.1 control signal input |
| 13 | VREF | Input | Reference voltage input |
| 14 | VDD | Power supply | Control circuit power supply |
| 15 | VMAC1 | Power supply | Ch.1, Ch.2, Ch.3 coil drive power supply 1 |
| 16 | FO3 | Output | Ch.3 non-inverted output |
| 17 | RO3 | Output | Ch.3 inverted output |
| 18 | PGAC1 | Ground | Ch.1, Ch.2, Ch.3 coil drive GND |
| 19 | FO2 | Output | Ch.2 non-inverted output |
| 20 | RO2 | Output | Ch.2 inverted output |
| 21 | FO1 | Output | Ch.1 non-inverted output |
| 22 | PGAC2 | Ground | Ch.1, Ch.2, Ch.3 coil drive GND |
| 23 | VMAC2 | Power supply | Ch.1, Ch.2, Ch.3 coil drive power supply 2 |
| 24 | RO1 | Output | Ch.1 inverted output |
| 25 | FO6 | Output | Ch.6 non-inverted output |
| 26 | RO6 | Output | Ch.6 inverted output |
| 27 | N.C. | — | N.C. |
| 28 | PGBX | Ground | Ch.6, Ch.7 coil drive GND |
| 29 | VMBX | Power supply | Ch.6, Ch.7 coil drive power supply |
| 30 | FO7 | Output | Ch.7 non-inverted output |
| 31 | RO7 | Output | Ch.7 inverted output |
| 32 | SFG | Input | Spindle motor drive FG mode selection input |
| 33 | BMS | Input | Spindle motor drive brake mode selection input |
| 34 | IN6 | Input | Ch.6 control signal input |
| 35 | FB6 | Output | Ch.6 feedback output |

■ Pin Descriptions (continued)

| Pin No. | Pin name | Type | Description |
|---|---|---|---|
| 36 | IN7 | Input | Ch.7 control signal input |
| 37 | FB7 | Output | Ch.7 feedback output |
| 38 | INSP | Input | Spindle motor drive control signal input |
| 39 | STBY | Input | Total shutdown input |
| 40 | MUTE | Input | Mute control pin |
| 41 | GSW | Input | Spindle motor drive gain selection input |
| 42 | H1H | Input | Spindle motor drive hall element positive input |
| 43 | H1L | Input | Spindle motor drive hall element negative input |
| 44 | VH | Output | Spindle motor drive hall bias output |
| 45 | FG | Output | Spindle motor drive FG signal output (O.D. output) |
| 46 | GND | Ground | Control circuit GND |
| 47 | VMSP1 | Power supply | Spindle motor drive power supply 1 |
| 48 | A1 | Output | Spindle motor drive output 1 |
| 49 | RCS1 | Output | Spindle motor drive common source output 1 |
| 50 | N.C. | — | N.C. |
| 51 | A2 | Output | Spindle motor drive output 2 |
| 52 | A3 | Output | Spindle motor drive output 3 |
| 53 | N.C. | — | N.C. |
| 54 | RCS2 | Output | Spindle motor drive common source output 2 |
| 55 | CS | Input | Spindle motor drive output current detection |
| 56 | VMSP2 | Power supply | Spindle motor drive power supply 2 |
| 57 | RO4 | Output | Ch.4 inverted output |
| 58 | PGST | Ground | Ch.4, Ch.5 motor drive GND |
| 59 | FO4 | Output | Ch.4 non-inverted output |
| 60 | RO5 | Output | Ch.5 inverted output |
| 61 | VMST | Power supply | Ch.4, Ch.5 motor drive power supply |
| 62 | FO5 | Output | Ch.5 non-inverted output |
| 63 | PGLO | Ground | Ch.8 motor drive GND |
| 64 | RO8 | Output | Ch.8 inverted output |

## ■ Absolute Maximum Ratings

| A No. | Parameter | Symbol | Rating | Unit | Note |
|---|---|---|---|---|---|
| 1 | Supply voltage | $V_{MSP}$, $V_{MST}$, $V_{MAC}$, $V_{MBX}$, $V_{MLO}$, $V_{DD}$ | 6.5 | V | *1 |
| 2 | Supply current | $I_{VMSP}$ | 1 200 | mA | *2 |
| | | $I_{VMST}$ | 2 000 | mA | *2 |
| | | $I_{VMAC}$ | 3 000 | mA | *2 |
| | | $I_{VMBX}$ | 1 000 | mA | *2 |
| | | $I_{VMLO}$ | 1 100 | mA | *2 |
| | | $I_{VDD}$ | 100 | mA | *2 |
| 3 | Power dissipation | $P_D$ | 290.2 | mW | *3 |
| 4 | Operating ambient temperature | $T_{opr}$ | −40 to +85 | °C | *4 |
| 5 | Storage temperature | $T_{stg}$ | −55 to +150 | °C | *4 |

Note) *1: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

*2: Make sure that each of Ch.1 to Ch.5 does not have a current flow exceeding 1 000 mA.
Make sure that each of Ch.6 to Ch.7 does not have a current flow exceeding 500 mA.
Make sure that Ch.8 does not have a current flow exceeding 1 100 mA.

*3: The power dissipation shown is the value at $T_a$ = 85°C for the independent (unmounted) IC package without a heat sink.
When using this IC, refer to the • $P_D$ – $T_a$ diagram in the ■ Technical Data and use under the condition not exceeding the allowable value.

*4: Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for $T_a$ = 25°C.

## ■ Operating Supply Voltage Range

| Parameter | Symbol | Range | Unit | Note |
|---|---|---|---|---|
| Supply voltage range | $V_{DD}$ | 4.0 to 5.5 | V | * |
| | $V_{MAC}$, $V_{MST}$, $V_{MSP}$, $V_{MBX}$, $V_{MLO}$ | 3.5 to $V_{DD}$ | | |

Note) *: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

■ Electrical Characteristics at $V_{DD}$ = $V_{MSP}$ = $V_{MAC}$ = $V_{MST}$ = $V_{MBX}$ = $V_{MLO}$ = 5 V, $V_{REF}$ = 1.65 V, STBY = 3.3 V

Note) $T_a$ = 25°C±2°C unless otherwise specified.

| B No. | Parameter | Symbol | Conditions | Limits | | | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Common block | | | | | | | | |
| Supply current | | | | | | | | |
| 1 | Power supply current in standby mode | $I_{VMS}$ | STBY = Low | — | — | 20 | µA | — |
| 2 | Supply current in standby mode | $I_{DDS}$ | STBY = Low | — | — | 20 | µA | — |
| 3 | Supply current under no input | $I_{DDA}$ | STBY = High | — | 12 | 16 | mA | — |
| Standby operation | | | | | | | | |
| 4 | High-level STBY input voltage | $V_{SBH}$ | (Active) | 1.8 | — | $V_{DD}$ | V | — |
| 5 | Low-level STBY input voltage | $V_{SBL}$ | (Standby) | — | — | 0.7 | V | — |
| Mute operation | | | | | | | | |
| 6 | High-level MUTE input voltage | $V_{MUTEH}$ | — | 2.2 | — | $V_{DD}$ | V | — |
| 7 | Low-level MUTE input voltage | $V_{MUTEL}$ | — | 0 | — | 0.5 | V | — |
| 8 | MUTE input current range for open operation | $I_{MUTE}$ | — | –5 | — | 5 | µA | — |
| VREF reset | | | | | | | | |
| 9 | High-level VREF reset input voltage | $V_{RRH}$ | (Reset) | 2.8 | — | $V_{DD}$ | V | — |
| 10 | Active VREF reset input voltage | $V_{RRM}$ | (Active) | 1.15 | — | 2.15 | V | — |
| 11 | Low-level VREF reset input voltage | $V_{RRL}$ | (Reset) | — | — | 0.5 | V | — |
| Spindle driver | | | | | | | | |
| Spindle motor drive hall bias | | | | | | | | |
| 12 | Hall bias resistance | $R_{HB}$ | $I_{HB}$ = 20 mA | 20 | 30 | 40 | Ω | — |
| Spindle motor drive hall signal comparator | | | | | | | | |
| 13 | Input bias current | $I_{BH}$ | — | –3 | — | 3 | µA | — |
| 14 | Common-mode input voltage range | $V_{BHR}$ | — | 1.5 | (2.5) | 4.0 | V | — |
| 15 | Minimum input amplitude | $V_{INH}$ | — | 80 | — | — | mV[p-p] | — |
| Spindle motor drive torque control | | | | | | | | |
| 16 | Input bias current | $I_{INSP}$ | — | – 1 | — | 1 | mA | — |
| 17 | Input dead zone (one side) | $INSP_{DZ}$ | — | 7 | 40 | 88 | mV | — |
| 18 | Input/output gain (High torque mode) | $A_{CS(High)}$ | GSW = 0 V, $R_{CS}$ = 0.22 Ω | 1.13 | 1.5 | 1.87 | A/V | — |
| 19 | Input/output gain (Middle torque mode) | $A_{CS(Mid)}$ | GSW = OPEN, $R_{CS}$ = 0.22 Ω | 0.565 | 0.75 | 0.935 | A/V | — |
| 20 | Input/output gain (Low torque mode) | $A_{CS(Low)}$ | GSW = 3.3 V, $R_{CS}$ = 0.22 Ω | 0.24 | 0.34 | 0.44 | A/V | — |
| 21 | Torque limit current (High torque mode) | $I_{TLH}$ | GSW = 0 V, $R_{CS}$ = 0.22 Ω, | 800 | 1 000 | 1 200 | mA | — |
| 22 | Torque limit current (Middle torque mode) | $I_{TLM}$ | GSW = OPEN, $R_{CS}$ = 0.22 Ω | 440 | 550 | 660 | mA | — |

■ Electrical Characteristics at $V_{DD} = V_{MSP} = V_{MAC} = V_{MST} = V_{MBX} = V_{MLO} = 5$ V, $V_{REF} = 1.65$ V, STBY = 3.3 V (continued)

Note) $T_a = 25°C \pm 2°C$ unless otherwise specified.

| B No. | Parameter | Symbol | Conditions | Limits | | | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Spindle motor drive output | | | | | | | | |
| 23 | Upper-side output ON resistance | $R_{OH}$ | $I_O = -1\,000$ mA | 0.13 | 0.25 | 0.37 | Ω | — |
| 24 | Lower-side output ON resistance | $R_{OL}$ | $I_O = +1\,000$ mA | 0.13 | 0.25 | 0.37 | Ω | — |
| Spindle motor drive PWM frequency | | | | | | | | |
| 25 | PWM frequency max. (High torque mode) | $PWM_H$ | INSP = 3.3 V, $V_{REF}$ = 1.65 V, GSW = 0 V | 105 | 150 | 195 | kHz | — |
| 26 | PWM frequency min. (High torque mode) | $PWM_L$ | INSP = $V_{REF}$ + INSPDZ + 10 mV, $V_{REF}$ = 1.65 V, GSW = 0 V | 10 | 20 | 30 | kHz | — |
| 27 | PWM frequency (Middle torque mode) | $PWM_M$ | INSP = 3.3 V, $V_{REF}$ = 1.65 V, GSW = OPEN | 90 | 125 | 160 | kHz | — |
| 28 | PWM frequency (Low torque mode) | $PWM_S$ | INSP = 3.3 V, $V_{REF}$ = 1.65V, GSW = 3.3 V | 14 | 20 | 26 | kHz | — |
| Spindle motor drive gain selection | | | | | | | | |
| 29 | High-level GSW input voltage | $V_{GSWH}$ | (Low torque mode) | 2.2 | — | $V_{DD}$ | V | — |
| 30 | Low-level GSW input voltage | $V_{GSWL}$ | (High torque mode) | 0 | — | 0.5 | V | — |
| 31 | GSW input current range for open operation | $I_{GSW}$ | (Middle torque mode) | –5 | — | 5 | µA | — |
| Spindle motor drive FG | | | | | | | | |
| 32 | High-level SFG input voltage | $V_{SFGH}$ | — | 2.2 | — | $V_{DD}$ | V | — |
| 33 | Low-level SFG input voltage | $V_{SFGL}$ | — | 0 | — | 0.5 | V | — |
| 34 | SFG input current range for open operation | $I_{SFG}$ | — | –5 | — | 5 | µA | — |
| 35 | High-level FG output voltage | $FG_H$ | $V_{FG} = 3.3$ V, $I_{FG} = -0.01$ mA, RFG = 20 kΩ | 2.6 | — | — | V | — |
| 36 | Low-level FG output voltage | $FG_L$ | $V_{FG} = 3.3$ V, $I_{FG} = +0.01$ mA, RFG = 20 kΩ | — | — | 0.2 | V | — |
| Spindle motor drive brake mode selection | | | | | | | | |
| 37 | High-level BMS input voltage | $V_{BMSH}$ | (Reverse brake) | 2.2 | — | $V_{DD}$ | V | — |
| 38 | Low-level BMS input voltage | $V_{BMSL}$ | (Short brake) | 0 | — | 0.5 | V | — |
| 39 | BMS input current range for open operation | $I_{BMS}$ | — | –5 | — | 5 | µA | — |

■ Electrical Characteristics at $V_{DD}$ = $V_{MSP}$ = $V_{MAC}$ = $V_{MST}$ = $V_{MBX}$ = $V_{MLO}$ = 5 V, $V_{REF}$ = 1.65 V, STBY = 3.3 V (continued)

Note) $T_a$ = 25°C±2°C unless otherwise specified.

| B No. | Parameter | Symbol | Conditions | Limits | | | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Channel driver | | | | | | | | |
| Actuator drive block (Ch.1 to Ch.3) | | | | | | | | |
| 40 | Ch.1, Ch.2, Ch.3 output ON resistance (upper + lower) | $R_{ON1}$ $R_{ON2}$ $R_{ON3}$ | $I_O$ = ±500 mA | 0.4 | 0.9 | 1.2 | Ω | — |
| 41 | Ch.1,Ch.2, Ch.3 input/output gain (+) | G1,G2, G3 | $R_{L1-3}$ = 8 Ω, RIN1, 2, 3 = 15 kΩ | 15.5 | 17.5 | 19.5 | dB | — |
| 42 | (+)/(–) relative gain | GR | Ch.1 to Ch.3 $R_{L1-3}$ = 8 Ω | –1.5 | — | +1.5 | dB | — |
| 43 | Output offset voltage | $V_{OFS}$ | $R_{L1-3}$= 8 Ω $V_{IN}$ = $V_{REF}$ = 1.65 V | –50 | — | +50 | mV | — |
| 44 | PWM frequency | FTR | — | 150 | 200 | 250 | kHz | — |
| Stepping motor drive block (Ch.4, Ch.5) | | | | | | | | |
| 45 | Output ON resistance (upper + lower) | $R_{ON4}$ $R_{ON5}$ | $R_{L4-5}$ = 12 Ω, $I_O$ = ±500 mA | 0.4 | 1.0 | 1.3 | Ω | — |
| 46 | Input/output gain (+) | G4, G5 | $R_{L4-5}$ = 12 Ω | 0.45 | 0.6 | 0.75 | A/V | — |
| 47 | (+)/(–) relative gain | GR | Ch.4 to Ch.5 $R_{L4-5}$ = 12 Ω | –15 | — | 15 | % | — |
| 48 | Relative gain between Ch.4 and Ch.5 | GR45 | (G4/G5 – 1) × 100% | –15 | — | 15 | % | — |
| 49 | Input dead zone (one side) | $IN45_{DZ}$ | — | 5 | 20 | 40 | mV | — |
| 50 | Torque limit current | $I_{TL45}$ | — | 400 | 500 | 600 | mA | — |
| 51 | PWM frequency | FTR | — | 73 | 104 | 135 | kHz | — |
| 52 | Input bias current | $I_{B45}$ | — | –5 | — | 5 | µA | — |
| Beam expander drive block (Ch.6, Ch.7) | | | | | | | | |
| 53 | Output ON resistance (upper + lower) | $R_{ON6}$ | $R_{L6-7}$ = 30 Ω, $I_O$ = ±500 mA | 0.7 | 1.5 | 1.9 | Ω | — |
| 54 | Input/output gain (+) | G6 | $R_{L6-7}$ = 30 Ω | 15 | 17 | 19 | dB | — |
| 55 | (+)/(–) relative gain | GR | Ch.6 to Ch.7 $R_{L6-7}$ = 30 Ω | –1.5 | — | +1.5 | dB | — |
| 56 | Output offset voltage | $V_{OFS}$ | $R_{L6-7}$ = 30 Ω $V_{IN}$ = $V_{REF}$ = 1.65 V | –50 | — | +50 | mV | — |
| 57 | Input dead zone | VDZ3 | $R_{L6-7}$ = 30 Ω | 10 | 25 | 40 | mV | — |
| 58 | PWM frequency | FTR | — | 150 | 200 | 250 | kHz | — |

■ Electrical Characteristics at $V_{DD}$ = $V_{MSP}$ = $V_{MAC}$ = $V_{MST}$ = $V_{MBX}$ = $V_{MLO}$ = 5 V, $V_{REF}$ = 1.65 V, STBY = 3.3 V (continued)

Note) $T_a$ = 25°C±2°C unless otherwise specified.

| B No. | Parameter | Symbol | Conditions | Limits | | | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| Channel driver (continued) | | | | | | | | |
| Loading motor drive block (Ch.8) | | | | | | | | |
| 59 | Output ON resistance (upper + lower) | $R_{ON6}$ | $R_{L8}$ = 12 Ω, $I_O$ = ±500 mA | 0.4 | 0.9 | 1.2 | Ω | — |
| 60 | Input/output gain (+) | G6 | $R_{L8}$ = 12 Ω | 15 | 17 | 19 | dB | — |
| 61 | (+)/(–) relative gain | GR | Ch.8 $R_{L8}$ = 12 Ω | –1.5 | — | +1.5 | dB | — |
| 62 | Output offset voltage | $V_{OFS}$ | $R_{L8}$ = 12 Ω<br>$V_{IN}$ = $V_{REF}$ = 1.65 V | –50 | — | +50 | mV | — |
| 63 | Input dead zone | VDZ3 | $R_{L8}$ = 12 Ω | 10 | 25 | 40 | mV | — |
| 64 | PWM frequency | FTR | | 150 | 200 | 250 | kHz | — |

■ Electrical Characteristics (Reference values for design) at $V_{DD}$ = $V_{MSP}$ = $V_{MAC}$ = $V_{MST}$ = $V_{MBX}$ = $V_{MLO}$ = 5 V, $V_{REF}$ = 1.65 V, STBY = 3.3 V

Note) $T_a$ = 25°C±2°C unless otherwise specified.
The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.
If a problem does occur related to these characteristics, we will respond in good faith to user concerns.

| B No. | Parameter | Symbol | Conditions | Reference values | | | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | | |
| | | | | | | | | |
| 65 | Thermal shutdown circuit operating temperature | $T_{TSD}$ | — | — | 160 | — | °C | — |
| 66 | Thermal shutdown hysteresis width | $\Delta T_{TSD}$ | — | — | 30 | — | °C | — |

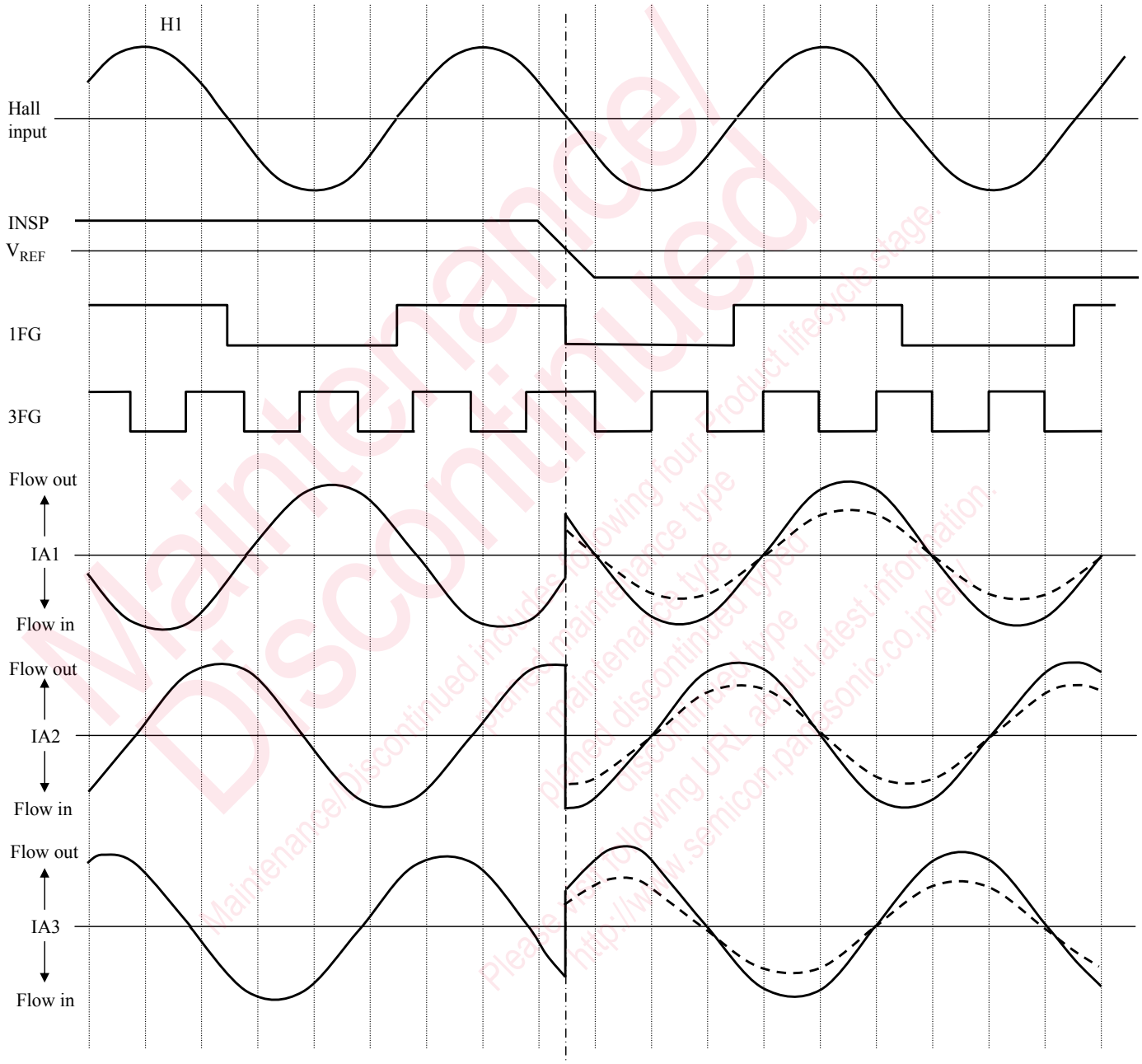
## ■ Control Pin Mode Table

Note) See parameters B No. 6 to 8, B No. 29 to 34 and B No. 37 to 39 in the ■ Electrical Characteristics for control voltage retention ranges.

| Pin No. | Description | Pin voltage | | | Remarks |
|---|---|---|---|---|---|
| | | Low | Open | High | |
| 41 | Spindle gain selection SW | High torque mode | Middle torque mode | Low torque mode | Torque mode control |
| 33 | Spindle brake mode selection SW | Short Brake | S-R-S-Brake | Reverse Brake | Brake mode control |
| 32 | Spindle FG mode selection SW | 1FG | 1FG | 3FG | FG control |
| 40 | Mute control pin | Ch.1-3 mute | Ch.1-3 active | Ch.1-3 active | Ch.1-8, SP control |
| | | Ch.4-5 mute | Ch.4-5 active | Ch.4-5 active | |
| | | Ch.6-7 mute | Ch.6-7 mute | Ch.6-7 active | |
| | | Ch.8 active | Ch.8 mute | Ch.8 mute | |
| | | SP mute | SP active | SP active | |

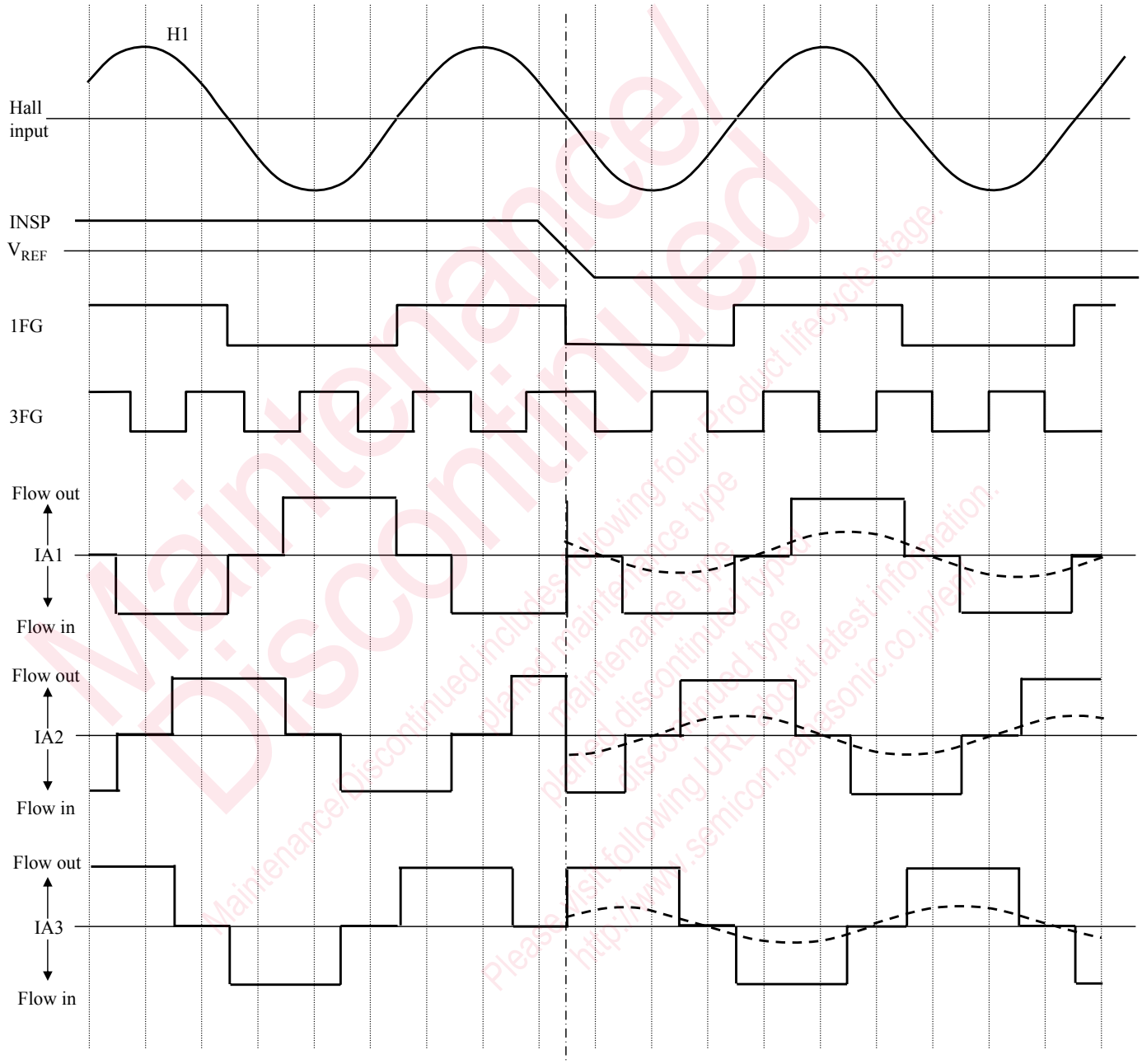
## ■ Technical Data

- Phase condition between hall input and output current (High torque mode, Middle torque mode)



## ■ Technical Data (continued)

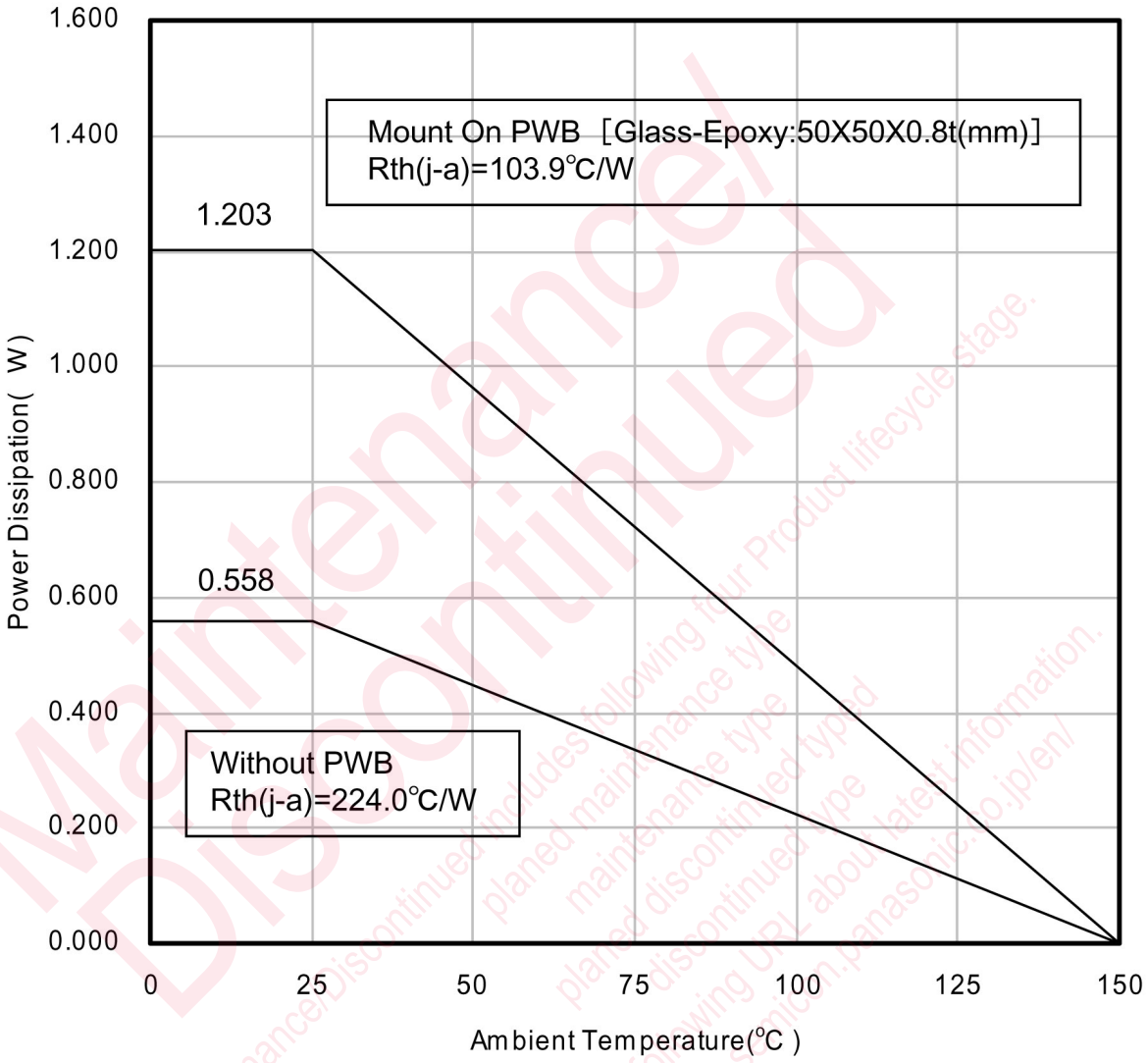
- Phase condition between hall input and output current (Low torque mode)




BMS = High : Reverse brake
BMS = Low : Short brake

■ Technical Data (continued)

• $P_D$ — $T_a$ diagram



## ■ Usage Notes

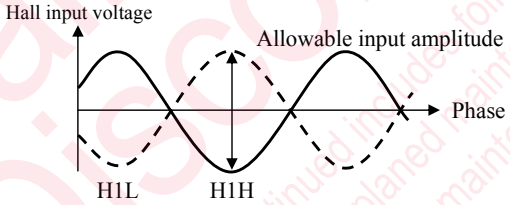
1. Standby operation, thermal shutdown (TSD), $V_{REF}$ reset operation

| STBY | TSD | $V_{REF}$ | MUTE | Ch.1 to Ch.3 | Ch.4, Ch.5 | Ch.6, Ch.7 | Ch.8 | SP |
|---|---|---|---|---|---|---|---|---|
| ≥ 1.8 V | ≤ 160°C | 1.15 V to 2.15 V | ≥ 2.2 V | Active | Active | Active | Hi-Z | Active |
| | | | OPEN | | | Hi-Z | | |
| | | | ≤ 0.5 V | Hi-Z | Hi-Z | | Active | Hi-Z |
| | | ≤ 0.5 V ≥ 2.8 V | — | Hi-Z | | | | |
| | ≥ 160°C | — | | | | | | |
| ≤ 0.7 V | — | | | Hi-Z, The current into the circuit is intercepted. | | | | |

2. Make sure to power ON/OFF at standby mode ($V_{STBY}$ : Low).

3. This IC is designed assuming the range of $V_{REF}$ is 1.15 V to 2.15 V under the conditions where the ambient temperature is 25°C±2°C and $V_{DD}$ is 5 V±10%.
   Before using the IC, ensure that fluctuation of the ambient temperature or the power supply voltage does not occur any problems.

4. The hall amp. allowable input amplitude indicates that shown in the figure below. Hall amplitude should be 80 mV[p-p] or more including the variation of hall elements and temperature characteristics under the temperature conditions you use.
   Hall input with 200 mV[p-p] or more is recommended in order to raise detection accuracy of hall position.




5. The PWM frequency of spindle motor drive is variable in the range between 20 kHz and 150 kHz continuously according to the torque control.

6. When using FG with ×3 frequency, keep SFG pin (Pin 32) open (Hi-Z).

7. When using brake at auto switching mode, keep BMS pin (Pin 33) open (Hi-Z).

8. Check the characteristics carefully before using this IC.
   Preserve sufficient margin in consideration of dispersion of external components and our ICs including not only static characteristics but transition characteristics when using this IC changing external circuit constants.

9. Apply voltage from a low-impedance source to $V_{REF}$ , $V_{DD}$ and connect a bypass capacitor to each as near the IC as possible.

10. It is not recommended to use solder dipping.

11. Each voltage to $V_{MSP}$ , $V_{MAC}$ , $V_{MST}$ , $V_{MBX}$ , $V_{MLO}$ should not exceed the voltage applied to $V_{DD}$ .

12. 180°C commutation mode for high (GSW = Low) and middle (GSW = OPEN) torque mode.
    120°C commutation mode for low torque mode (GSW = High).

## ■ Usage Notes (continued)

13. Notes of Power LSI

1) Please carry out the thermal design with sufficient margin such that the power dissipation will not be exceeded, based on the conditions of power supply, load and ambient temperature.

2) Protection circuit has been built-in to ensure the safety in the event of abnormal operation. Therefore, please design such that the protection circuit does not work during normal operation. Especially in the over-temperature protection circuit, if the area of safe operation or the absolute maximum rating is momentarily exceeded, as in the event of output pin to $V_{DD}$ short (Power supply fault), or output pin to GND short (Ground fault), then the LSI might be damaged before the over-temperature protection circuit could operate.

3) Pay attention in the pattern layout in order to prevent damage due to short circuit between pins. In addition, for the pin configuration, please refer to the ■ Pin Descriptions.

4) Unless specified in the product specifications, please make sure that negative voltage or excessive voltage are not applied to the pins because the device might be damaged, which could happen due to negative voltage or excessive voltage generated during the ON and OFF timing when the inductive load of a motor coil or actuator coils of optical pick-up is being driven.

5) Be sure not to mount the LSI in the reverse direction onto the PCB. It might be damaged when the electricity is turned on.

6) Perform a visual inspection on the printed-circuit-board before turning on the power supply, otherwise damage might happen due to problems such as a solder-bridge between the pins of the semiconductor device. Also, perform a full technical verification on the assembly quality, because the same damage possibly can happen due to conductive substances, such as solder ball, that adhere to the LSI during transportation.

7) Take notice in the use of this product that it might break or occasionally smoke when an abnormal state occurs such as output pin-$V_{DD}$ short, output pin-GND short, or output-to-output-pin short (load short). And, safety measures such as an installation of fuses are recommended because the extent of the above-mentioned damage and smoke emission will depend on the current capability of the power supply.

8) When using the LSI for model development or new products, perform fully the safety verification including the long-term reliability for each product.

9) Verify the risk due to the breakdown of external parts.

## Request for your special attention and precautions in using the technical information and semiconductors described in this book

(1) If any of the products or technical information described in this book is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially, those with regard to security export control, must be observed.

(2) The technical information described in this book is intended only to show the main characteristics and application circuit examples of the products, and no license is granted under any intellectual property right or other right owned by our company or any other company. Therefore, no responsibility is assumed by our company as to the infringement upon any such right owned by any other company which may arise as a result of the use of technical information described in this book.

(3) The products described in this book are intended to be used for standard applications or general electronic equipment (such as office equipment, communications equipment, measuring instruments and household appliances).
Consult our sales staff in advance for information on the following applications:
- Special applications (such as for airplanes, aerospace, automobiles, traffic control equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.
- Any applications other than the standard applications intended.

(4) The products and product specifications described in this book are subject to change without notice for modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.

(5) When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.
 Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

(6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.