Motor Drivers for MDs

# Sensorless 4ch PWM System Motor Driver for MDs

## BD6641KUT/BD6643KN

### ●Description

1chip system spindle motor driver IC for playback in portable player drive. Supports spindle, sled, focus, and tracking functions.
The driver incorporates a charge pump, direct PWM soft switching drive for spindle, low ON resistance power DMOS driver, reducing power consumption and suppressing spindle motor driving noise.
The driver is has small, thin package making it idea for use in portable players.

### ●Features

1) Operates at low power supply voltage (2.1V min.)
2) Power DMOS output with low ON resistance (0.8Ω typ.)
3) Incorporates a charge pump circuit for VG boost
4) 3-phase full-wave PWM soft switching sensorless driver for spindle motor.
5) 3-level control 3-phase driver for sled (Built-in comparator for BEMF voltage detection)
6) 2ch, 3-level control H-bridges for focus/tracking

### ●Applications

Recording and playback MD

### ●Product lineup

| Parameter | BD6641KUT | BD6643KN |
|---|---|---|
| VCC operating power supply voltage range | 2.1～6.5V | 2.1～6.5V |
| VM operating power supply voltage range | 0～3V | 0～3V |
| Operating temperature range | -25～+75℃ | -25～+75℃ |
| Output current | 500mA | 500mA |
| Rotation speed | ～5000rpm（typ.） | ～2300rpm（typ.） |
| Package | TQFP64U | UQFN48 |
| Spindle/brake input | H: Brake ON | L: Brake ON |

Ver.B Oct.2005

## ●Absolute maximum ratings (Ta=25°C)

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Power supply voltage for control circuit | VCC | 7 | V |
| Power supply voltage for driver block | VM | 7 | V |
| Power supply voltage for pre-driver | VG | 14 | V |
| Output current | Iomax | *500 | mA |
| Power dissipation | Pd | **1375（BD6641KUT） | mW |
| | | ***760（BD6643KN） | |
| Operating temperature range | Topr | -25～+75 | ℃ |
| Storage temperature range | Tstg | -55～+150 | ℃ |
| Junction temperature | Tjmax | +150 | ℃ |

＊Must not exceed Pd or ASO.

＊＊Reduced by 11 mW/°C over 25°C, when mounted on a glass epoxy board (70mm×70 mm×1.6mm).

＊＊＊Reduced by 7.6mW/°C over Ta=25°C, when mounted on a glass epoxy board (70mm×70mm×1.6mm).

## ●Operating conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Power supply voltage | VCC | 2.1 | 2.2 | 6.5 | V |
| | VM | — | — | 3.0 | V |
| | VG | 3 | 6.5 | 13 | V |

## ●Electrical characteristics

(Unless otherwise specified, Ta=25°C, VCC=2.2V, VM=1.0V, fin=176kHz)

| Parameter | Symbol | Limit | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Circuit current | ICC | | 4.0 | 7.0 | mA | at operation in all blocks |
| | IST | - | 1 | 10 | μA | at stop in all blocks |
| STBY H level input voltage | VSTH | VCC-0.4 | - | VCC | V | at operation in all blocks |
| STBY L level input voltage | VSTL | 0 | - | 0.4 | V | at stop in all blocks |
| STBY H level input current | ISTH | - | 220 | 310 | μA | |
| STBY L level input current | ISTL | -1 | - | - | μA | |
| Output ON resistance | RON | — | 0.8 | 1.2 | Ω | upper and lower ON resistance in total |
| ～Boost circuit～ | | | | | | |
| Output voltage | VG1 | 5.5 | 6.5 | 6.7 | V | each input L |
| | VG2 | 4.4 | 5.2 | - | V | at operation in all blocks |

## ●Electrical characteristics

(Unless otherwise specified, Ta=25°C, VCC=2.2V, VM=1.0V, fin=176kHz)

| Parameter | Symbol | Limit | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| ～Spindle (3-phase full-wave sensorless driver)～ | | | | | | |
| Position detection comparator offset | VSOFS | -10 | - | 10 | mV | |
| Position detection comparator input range | VSD | 0 | - | VCC-1.0 | V | |
| Position detection comparator input current H | ISH | - | - | 2 | μA | input=VCC |
| Position detection comparator input current L | ISL | -2 | - | - | μA | input=0V |
| SLOPE charge current | ISLO | -12.8 | -9.8 | -6.8 | μA | |
| SLOPE discharge current | ISLI | 6.5 | 9.4 | 12.5 | μA | |
| SLOPE clamp H level | VSLH | 0.5 | 0.8 | 1.1 | V | |
| SLOPE clamp L level | VSLL | 0.3 | 0.46 | 0.6 | V | |
| OSC oscillating frequency | fOSC | 70 | 100 | 130 | kHz | OSC=200pF ISET=50kΩ |
| OSC charge current | IOSCO | -12.5 | -9.65 | -6.5 | μA | |
| OSC discharge current | IOSCI | 6.5 | 9.56 | 12.5 | μA | |
| OSC H level | VOSCH | 0.5 | 0.75 | 1.0 | V | |
| OSC L level | VOSCL | 0.35 | 0.53 | 0.70 | V | |
| ISET voltage | VSET | 350 | 505 | 650 | mV | ISET=50kΩ |
| PWM input frequency | f PWM | 60 | 132 | 200 | kHz | |
| PWM H level input voltage | VPWH | VCC-0.4 | - | VCC | V | |
| PWM L level input voltage | VPWL | 0 | - | 0.4 | V | |
| PWM H level input current | IPWH | - | - | 1 | μA | PWM=VCC |
| PWM L level input current | IPWL | -1 | - | - | μA | PWM=0V |
| BLAKE H level input voltage | VBKH | VCC-0.4 | - | VCC | V | Brake ON (BD6641KUT)<br>Brake OFF (BD6643KN) |
| BLAKE L level input voltage | VBKL | 0 | - | 0.4 | V | Brake OFF (BD6641KUT)<br>Brake ON (BD6643KN) |
| BLAKE H level input current | IBKH | - | - | 1 | μA | BRAKE=VCC |
| BLAKE L level input current | IBKL | -1 | - | - | μA | BRAKE=0V |
| FG H level output voltage | VFGH | VCC-0.4 | - | VCC | V | Io=-500μA |
| FG L level output voltage | VFGL | 0 | - | 0.4 | V | Io=500μA |
| ～Sled, focus, tracking (stepping, H-bridge × 2ch)～ | | | | | | |
| H level input voltage | VINH | VCC-0.4 | - | VCC | V | |
| L level input voltage | VINL | 0 | - | 0.4 | V | |
| H level input current | IINH | - | - | 1 | μA | VIN=VCC |
| L level input current | IINL | -1 | - | - | μA | VIN=0V |
| I/O propagation delay time (H-bridge) | TRISE | - | 0.2 | 1 | μs | |
| | TFALL | - | 0.1 | 0.7 | μs | |
| Short pulse input response (H-bridge) | tmin | 120 | - | - | ns | Input pulse width 200 ns |
| ～Sled, position detection comparator～ | | | | | | |
| Position detection comparator offset | VAOFS | -10 | - | 10 | mV | |
| Position detection comparator input range | VAD | 0 | - | VCC-1.0 | V | |
| Position detection comparator input current H | IAH | - | - | 2 | μA | |
| Position detection comparator input current L | IAL | -2 | - | - | μA | |
| Position detection comparator output voltage L | VAOL | - | 0.2 | 0.3 | V | Io=300μA |
| Position detection comparator output pull-up resistance | ROA | 10 | 20 | 30 | kΩ | |

◎This IC is not designed to be radiation-resistant.

## ●Reference data

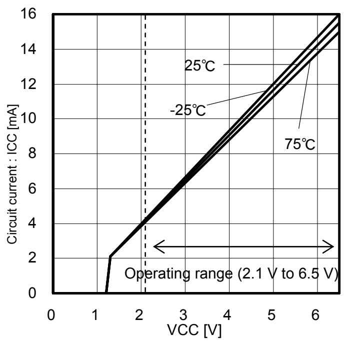



Fig. 1 Circuit current
(at operation in all blocks)

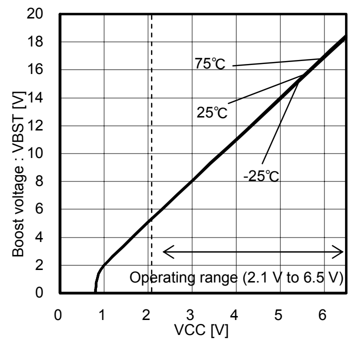



Fig. 2 Boost circuit output voltage
(each input L)

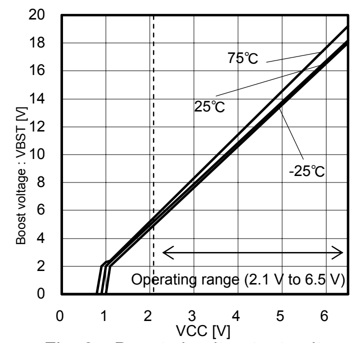



Fig. 3 Boost circuit output voltage
(at operation in all blocks)

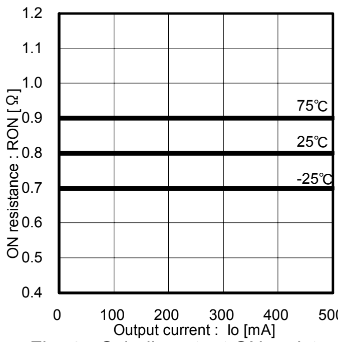



Fig. 4 Spindle output ON resistance

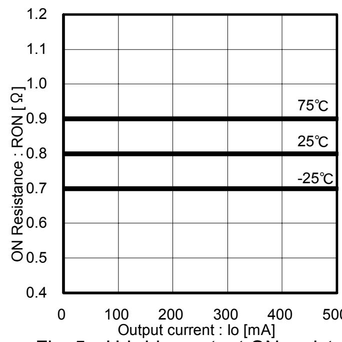



Fig. 5 H-bridge output ON resistance

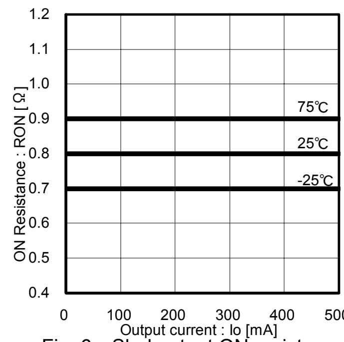



Fig. 6 Sled output ON resistance

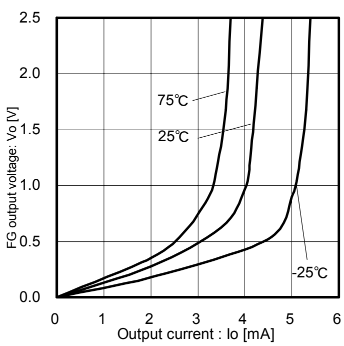



Fig. 7 FG output L voltage

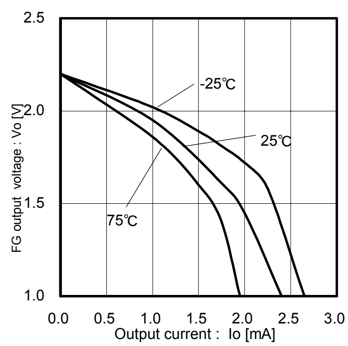
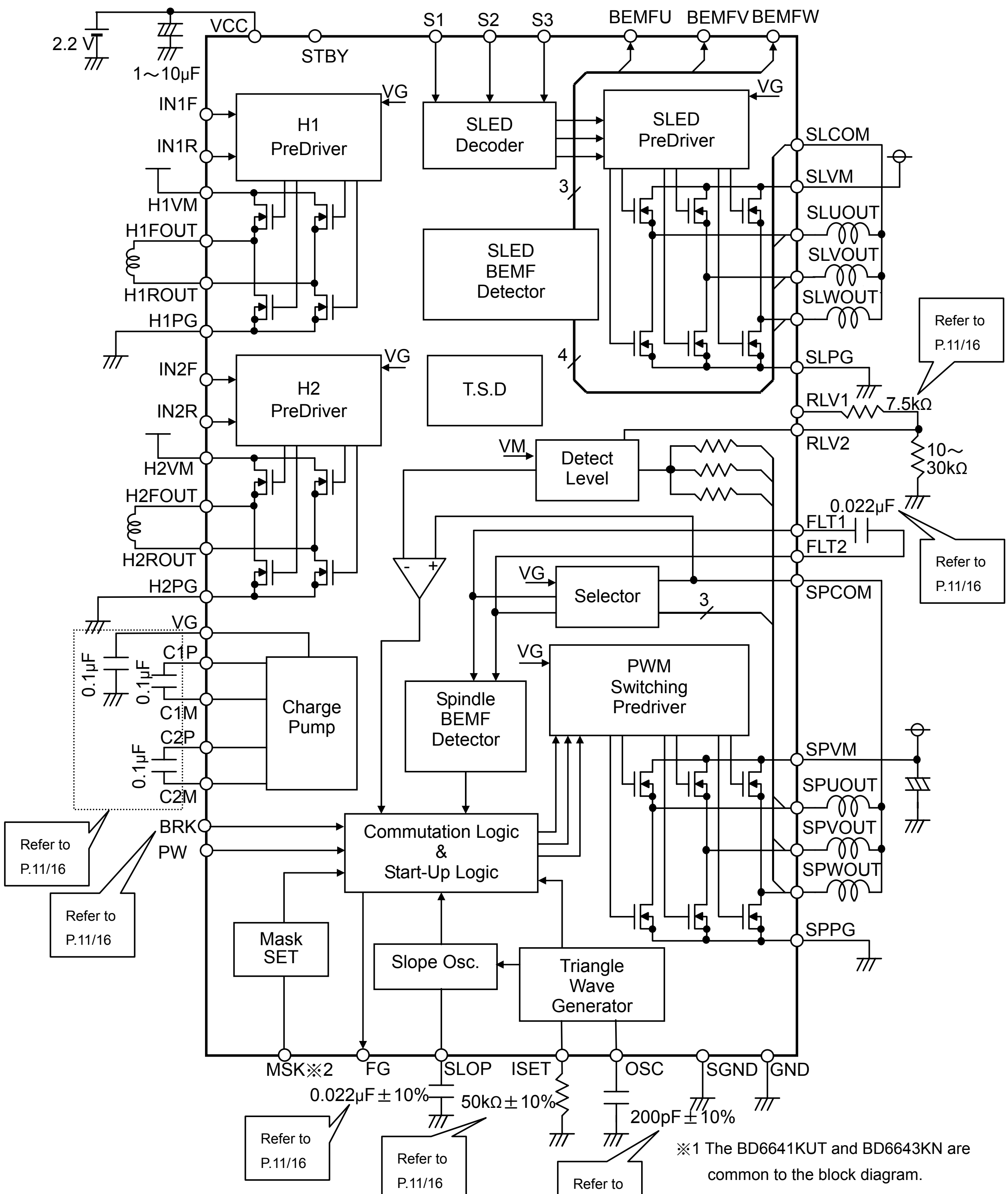



Fig. 8 FG output H voltage
(VCC=2.2 V)

●**Block diagram / Recommended circuit diagram**




※1 The BD6641KUT and BD6643KN are common to the block diagram.

Fig. 9

※2 The BD6643KN does not have MSK pin.

●**Pin assignment table / Pin arrangement diagram** (BD6641KUT)

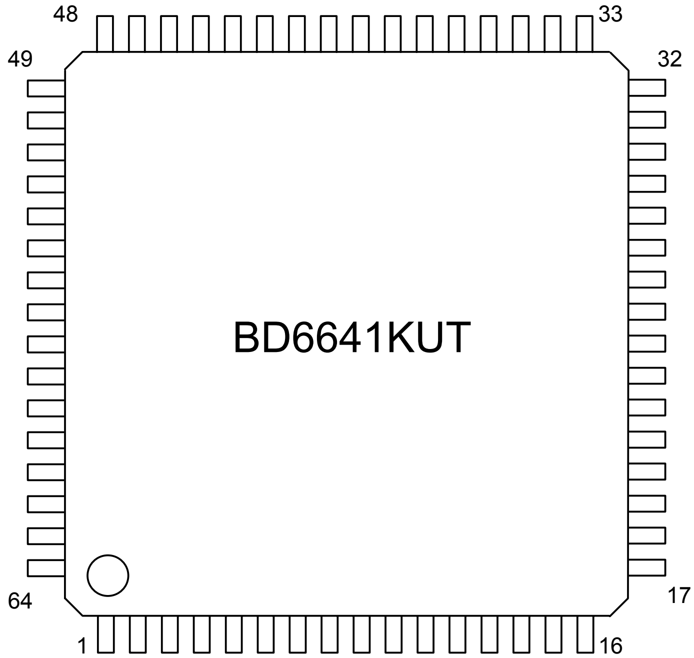



Fig. 10

| NO. | Pin name | Pin function | NO. | Pin name | Pin function |
|---|---|---|---|---|---|
| 1 | S2 | Stepping decoder 2 input pin | 33 | BRK | Brake signal input pin |
| 2 | S3 | Stepping decoder 3 input pin | 34 | SPCOM | Spindle motor coil neutral point input pin |
| 3 | VG | Charge pump output pin | 35 | SLOPE | Slope capacitor connection pin |
| 4 | N.C | | 36 | N.C | |
| 5 | H2VM | H-bridge 2 power block power supply pin | 37 | SPVM | Spindle power block power supply pin |
| 6 | N.C | | 38 | MSK | Mask time setting pin |
| 7 | C2M | Charge pump capacitor 2 connection pin − | 39 | ISET | OSC/SLOPE charge/discharge current setting pin |
| 8 | C2P | Charge pump capacitor 2 connection pin + | 40 | VCC | Power supply pin for small signal block |
| 9 | GND | Small signal block GND pin | 41 | N.C | |
| 10 | C1M | Charge pump capacitor 1 connection pin − | 42 | OSC | OSC capacitor connection pin |
| 11 | N.C | | 43 | N.C | |
| 12 | H1VM | H-bridge 1 power block power supply pin | 44 | SLVM | Stepping power block power supply pin |
| 13 | N.C | | 45 | FG | FG output pin |
| 14 | C1P | Charge pump capacitor 1 connection pin + | 46 | FLT1 | Filter capacitor connection pin 1 |
| 15 | BEMFU | Stepping detection comparator output (phase U) | 47 | FLT2 | Filter capacitor connection pin 2 |
| 16 | BEMFV | Stepping detection comparator output (phase V) | 48 | RLV2 | Rotor position detection level setting pin 2 |
| 17 | BEMFW | Stepping detection comparator output (phase W) | 49 | SGND | Substrate GND pin |
| 18 | IN1F | H-bridge 1 forward input pin | 50 | RLV1 | Rotor position detection level setting pin 1 |
| 19 | IN1R | H-bridge 1 reverse input pin | 51 | SLCOM | Stepping motor coil midpoint input pin |
| 20 | H1FOUT | H-bridge 1 forward output pin | 52 | SLUOUT | Stepping motor output (phase U) |
| 21 | H1PG | H-bridge1 power block GND | 53 | SLPG | Stepping power block GND pin |
| 22 | H1ROUT | H-bridge 1 reverse output pin | 54 | SLVOUT | Stepping motor output (phase V) |
| 23 | N.C | | 55 | N.C | |
| 24 | N.C | | 56 | SLWOUT | Stepping motor output (phase W) |
| 25 | SPUOUT | Spindle motor output pin (phase U) | 57 | N.C | |
| 26 | N.C | | 58 | N.C | |
| 27 | SPVOUT | Spindle motor output pin (phase V) | 59 | H2FOUT | H-bridge 2 forward output pin |
| 28 | SPPG | Spindle power block GND pin | 60 | H2PG | H-bridge 2 power block GND |
| 29 | SPWOUT | Spindle motor output pin (phase W) | 61 | H2ROUT | H-bridge 2 reverse output pin |
| 30 | N.C | | 62 | IN2F | H-bridge 2 forward input pin |
| 31 | PWM | PWM input pin | 63 | IN2R | H-bridge 2 reverse input pin |
| 32 | STBY | Standby pin | 64 | S1 | Stepping decoder 1 input pin |

●**Pin assignment table / Pin arrangement diagram** (BD6643KN)

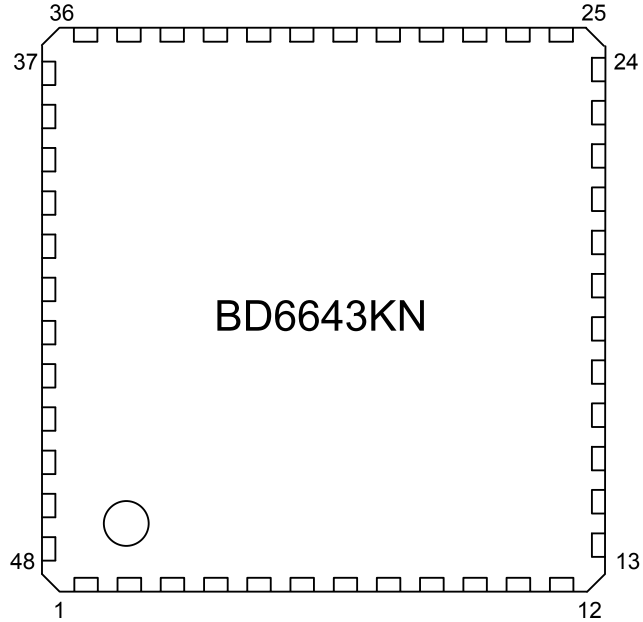



Fig. 11

◎Pin function table

| NO. | Pin name | Pin function | NO. | Pin name | Pin function |
|---|---|---|---|---|---|
| 1 | S2 | Stepping decoder 2 input pin | 25 | BRK | Brake signal input pin |
| 2 | S3 | Stepping decoder 3 input pin | 26 | SPCOM | Spindle motor coil neutral point input pin |
| 3 | VG | Charge pump output pin | 27 | SLOPE | Slope capacitor connection pin |
| 4 | H2VM | H-bridge 2 power block power supply pin | 28 | SPVM | Spindle power block power supply pin |
| 5 | C2M | Charge pump capacitor 2 connection pin - | 29 | ISET | OSC/SLOPE charge/discharge current setting pin |
| 6 | C2P | Charge pump capacitor 2 connection pin + | 30 | VCC | Power supply pin for small signal block |
| 7 | GND | Small-signal block GND pin | 31 | OSC | OSC capacitor connection pin |
| 8 | C1M | Charge pump capacitor 1 connection pin - | 32 | SLVM | Stepping power block power supply pin |
| 9 | H1VM | H-bridge 1 power block power supply pin | 33 | FG | FG output pin |
| 10 | C1P | Charge pump capacitor 1 connection pin + | 34 | FLT1 | Filter capacitor connection pin 1 |
| 11 | BEMFU | Stepping detection comparator output (phase U) | 35 | FLT2 | Filter capacitor connection pin 2 |
| 12 | BEMFV | Stepping detection comparator output (phase V) | 36 | RLV2 | Rotor position detection level setting pin 2 |
| 13 | BEMFW | Stepping detection comparator output (phase W) | 37 | RLV1 | Rotor position detection level setting pin 1 |
| 14 | IN1F | H-bridge 1 forward input pin | 38 | SLCOM | Stepping motor coil neutral point input pin |
| 15 | IN1R | H-bridge 1 reverse input pin | 39 | SLUOUT | Stepping motor output (phase U) |
| 16 | H1FOUT | H-bridge 1 forward output pin | 40 | SLPG | Stepping power block GND pin |
| 17 | H1PG | H-bridge 1 power block GND | 41 | SLVOUT | Stepping motor output (phase V) |
| 18 | H1ROUT | H-bridge 1 reverse output pin | 42 | SLWOUT | Stepping motor output (phase W) |
| 19 | SPUOUT | Spindle motor output pin (phase U) | 43 | H2FOUT | H-bridge 2 forward output pin |
| 20 | SPVOUT | Spindle motor output pin (phase V) | 44 | H2PG | H-bridge 2 power block GND |
| 21 | SPPG | Spindle power block GND pin | 45 | H2ROUT | H-bridge 2 reverse output pin |
| 22 | SPWOUT | Spindle motor output pin (phase W) | 46 | IN2F | H-bridge 2 forward input pin |
| 23 | PWM | PWM input pin | 47 | IN2R | H-bridge 2 reverse input pin |
| 24 | STBY | Standby pin | 48 | S1 | Stepping decoder 1 input pin |

●Description of each block operation

・Spindle BEMF Detector (spindle)
Comparator to detect BEMF voltage generated in rotating motor coil.

・Commutation Logic & Start-up Logic (spindle)
This logic generates the motor startup sequence and motor driving waveforms.
Operates based on the CLK (100kHz typ.) generated by the Triangle Wave Generator.
Generates soft switching drive waveforms with the OSC triangle waveform and SLOPE waveform.
Control the motor’s rotation speed external PWM signal input. The brake (deceleration) ON/OFF can be switched by external BRK signal input.

・Mask Set (BD6641KUT/spindle)
The FG maximum frequency can be set to 700Hz/1090Hz/1515Hz by setting the MSK pin to OPEN/GND/VCC. (The setting maximum frequency may not be reached for some motors.)

・Triangle Wave Generator (spindle)
Generates a triangle waveform (100kHz) that is used in generating the logic CLK and soft switching waveforms, as well as for the Charge Pump clock. The triangle waveform frequency is set with the ISET resistor (50kΩ typ.) and the OSC capacity (200pF typ.). It is not recommended to use values other than the typ. because this waveform is used as the CLK for the entire IC system (100kHz typ.).
It is recommended to use the ISET resistor and the OSC capacity network with low temperature characteristics.

・Slope OSC (spindle)
Generates the slope waveform which is used in generating the soft switching drive waveform.

・Charge Pump (common to all blocks)
Boost circuit for each block’s power output pre-driver VG power supply. The generated VG voltage is three times the VCC. Therefore, use caution when using a VCC that exceeds the standard.

・SLED BEMF Detector (Sled)
Comparator to detect the BEMF voltage generated in rotating motor coil.
Negative input pins are connected in common (SLCOM), and positive input pins are connected to each output (SLUOUT, SLVOUT, SLWOUT).

・TSD (common to all blocks)
Thermal shutdown circuit. Turns off all driver output when the chip temperature Tj reaches approximately 175°C (typ.). The circuit returns to normal operation at approximately 20°C of hysteresis.

・H-bridge/Sled truth table

H-bridge block for focus and tracking motor

| STBY | IN1,2F | IN1,2R | H1,2FOUT | H1,2ROUT |
|---|---|---|---|---|
| H | L | L | L | L |
| H | H | L | H | L |
| H | L | H | L | H |
| H | H | H | L | L |
| L | X | X | Z | Z |

Z : High-Impedance , X : Don't care

Stepping block for sled motor

| STBY | S3 | S2 | S1 | SLUOUT | SLVOUT | SLWOUT |
|---|---|---|---|---|---|---|
| H | L | L | L | H | L | Z |
| H | L | L | H | H | Z | L |
| H | L | H | L | Z | H | L |
| H | L | H | H | L | H | Z |
| H | H | L | L | L | Z | H |
| H | H | L | H | Z | L | H |
| H | H | H | X | Z | Z | Z |
| L | X | X | X | Z | Z | Z |

Z : High-Impedance , X : Don't care

●Timing chart

Description of basic spindle driver operation

1) Startup from the stop condition of the motor

Generally, the appropriate motor driving logic is unclear because no BEMF voltage is generated in the stopping motor coil. For the BD6641KVT/BD6643KN, appropriate driving logic can be obtained by input of a driving waveform, (as shown in Fig. 12) to the motor, allowing the motor to be started up efficiently (Fig. 13).

Although the FG edge usually switches each time a zero cross is detected, the first 4 to 5 FG edges are cancelled only at startup, as unstable FG edge is not output immediately after startup.

If no zero cross detection occurs during 300ms (typ.), the driving logic is forced to move forward to vibrate the motor and detect a zero cross. In this case, the motor may startup after vibrating briefly in the reverse direction.

This vibration occurs because the driving logic has been forcefully inputted without regard to the rotor position.

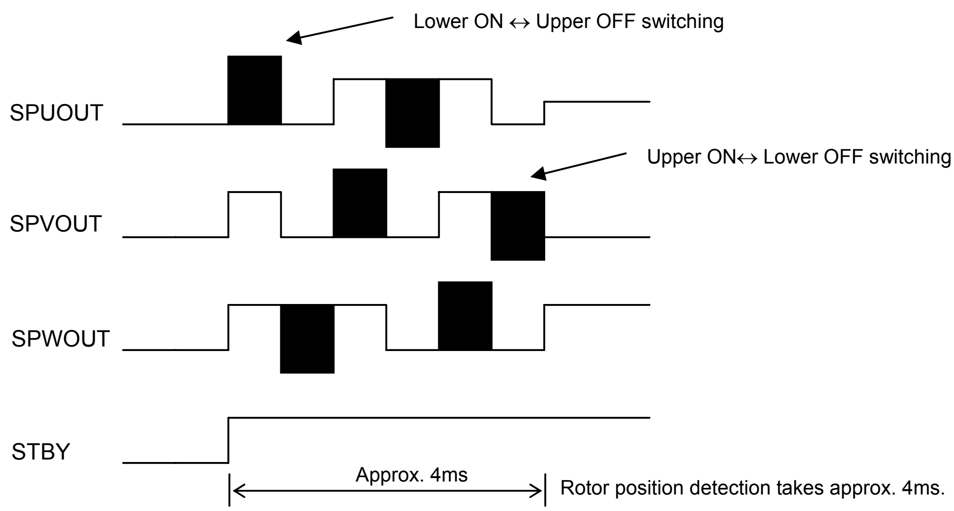



Fig. 12 Startup from the stopping condition① (PWM=H)

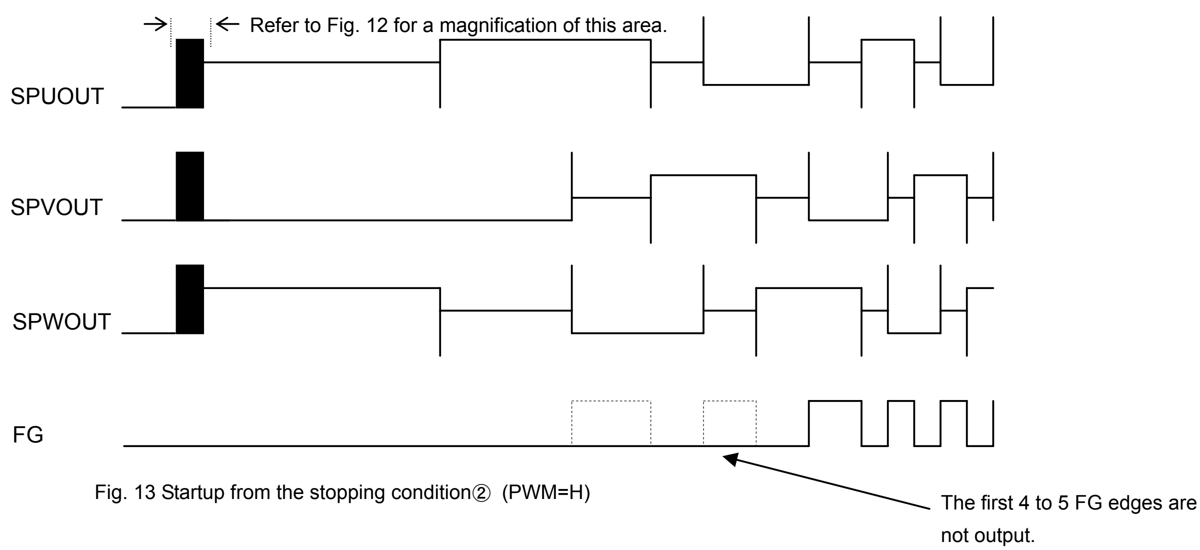



Fig. 13 Startup from the stopping condition② (PWM=H)

2) Operation at normal rotation (Fig. 14)

For a sensorless system, the rotor position detection (zero cross detection) is performed by comparing the BEMF voltage generated in the Hi-Impedance (upper and lower Tr are off) phase to the coil's neutral point voltage with a comparator and the driving waveform of the motor is composed.

In soft switching operation, the waveform generated by comparing the SLOPE pin waveform and the OSC pin triangle waveform with a comparator is overlaid on each output waveform. This causes the output current to rise and fall gently, reducing drive noise.

When the PWM pin is H (full torque) or L (output OFF), zero cross detection is timed using the internal CLK (the peaks of the OSC triangle waveform). At PWM control, zero cross detection is timed to the PWM falling edge.

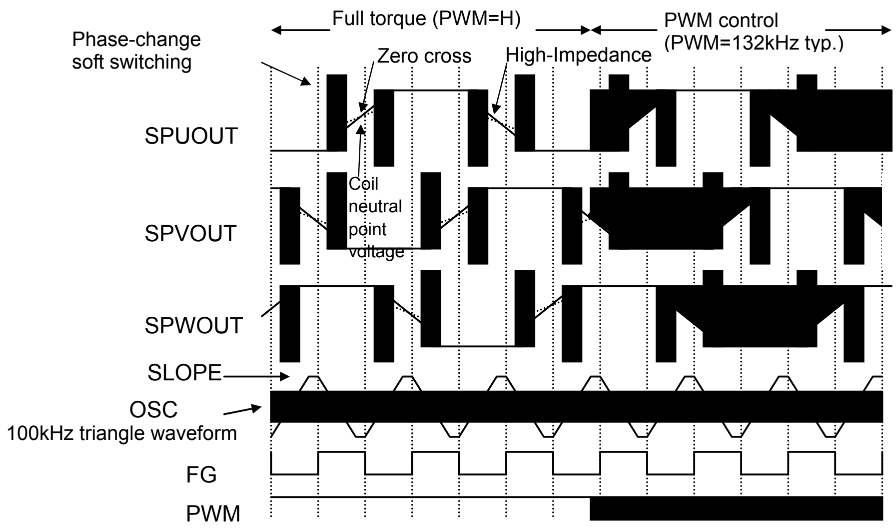



Fig. 14 Each pin waveform at normal rotation (Full Torque & PWM)

3) Brake operation (Fig. 15)

Brake operation applies a reverse torque to the motor by setting the output phases from H to L and L to H. The zero cross detection during brake operation is performed as in normal rotation. A strong brake is applied by continuously keeping reverse torque according to the rotor position. Although most motors will not rotate in reverse, some motors may do so. In brake operation at high speed rotation, some motors may generate a significant BEMF voltage, causing the logic to malfunction.

Because the SLOPE waveform is rising during brake operation, brake driving noise may become noticeable. This serves to prevent the error zero cross detection during brake operation. To reduce brake driving noise, limit the output current by PWM control.

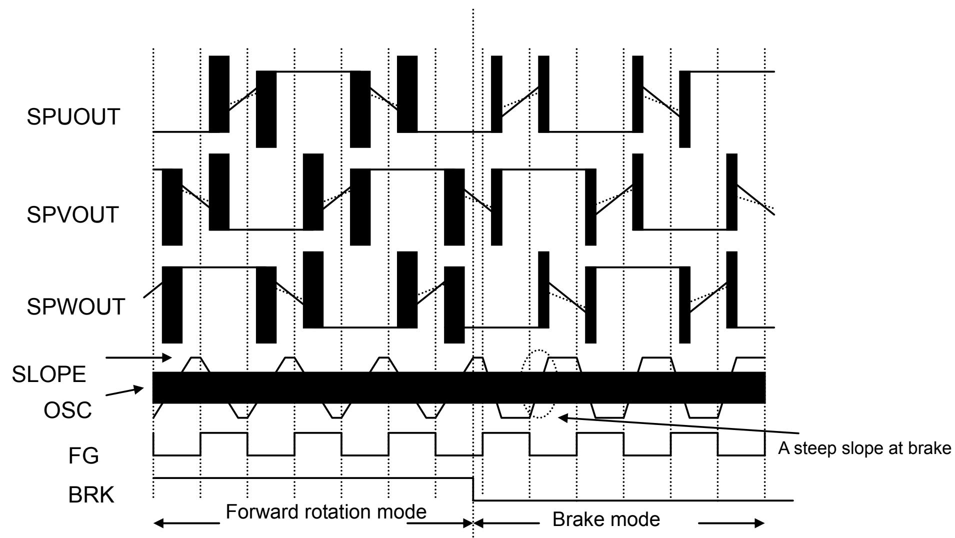



Fig. 15 Each pin waveform at brake (Same as at PWM.)

※Fig. 15 shows the waveforms for the BD6643KN. In BD6641KUT, only BRK signal is reversing.

4) FG signal output

FG signal is set by zero cross signal EX-OR composition. It has the width of electrical angle 60°. There is an edge in zero cross timing which can be used in servo systems as a rotation speed signal of the motor. When the motor is off, it is H and frequency that is in proportion to the rotation speed and is always output during braking. Therefore, it can be used in the same way as FG signal of external FG pattern. The edge chattering is removed by logic. Therefore, stable edge can be provided in case of unstable BEMF voltage, such as at low speed rotation. Furthermore, there is no need for an external filter.

●Selecting application components

| Design method | Design example |
|---|---|
| 1. Spindle block: SLOPE capacity<br>Smoothly set the slope of output current to reduce the motor's driving noise. A large capacitance can cause slope time noise and may cause malfunction.<br>A small capacitance results in a steep output current slope, increasing motor noise. | Set the following values as a standard.<br>・BD6641KUT<br>MSK pin=OPEN⇒0.022μF±10%<br>MSK pin=GND⇒0.014μF±10%<br>MSK pin=VCC⇒0.010μF±10%<br><br>・BD6643KN<br>0.022μF±10% |
| 2. Spindle block: ISET resistor<br>Set the charge and discharge current of the capacitor connected to the OSC pin.<br>$\frac{\text{ISET voltage}}{\text{ISET resistor}}$ = Charge and discharge current | Set the IC's system CLK (100kHz). The optimum value is 50kΩ±10%. |
| 3. Spindle block: OSC capacitor<br>Generate a triangle waveform (100kHz) using the charge and discharge current set by the ISET resistor. | Set the IC's system CLK (100kHz). Therefore, the optimum value is 200pF±10%. |
| 4. Spindle block: FLT capacity $C_{FLT}$<br>Comprise the filter for the noise elimination of BEMF comparator input signal with an internal input resistor (5kΩ typ.).<br><br>The cutoff frequency fc is given by the following formula:<br>$fc=1/(2\times\pi\times C_{FLT}\times 5.5k\Omega)$ | When $C_{FLT}$=0.022μF,<br>$fc=1/(2\times\pi\times 0.022\mu F\times 5.5k\Omega)$<br>=1.315kHz<br>Set fc=approx. several to several 10kHz.<br>Setting too large value of $C_{FLT}$ and too low value of fc may cause a deviation between the motor's rotor position and BEMF comparator detection timing, and may affect efficiency and driving noise. |
| 5. Spindle block: $R_{LV}$ resistor<br>Detect the rotor position and startup the motor at approximately 4ms after rising STBY pin.<br>Set the rotor position detection level (sensitivity) by the resistor connected to RLV1 and RLV2 pins. | Set the resistor between the RLV1 and RLV2 pins to 7.5kΩ and the resistor between the RLV2 and GND pins from 10kΩ to 30kΩ to startup well. Some motors may rotate in the reverse direction at startup. |
| 6. Charge pump<br>Boost to up three times the VCC voltage. Therefore, set the VCC voltage within a range where the VG does not exceed the rating. If the VG is input externally, without using an internal charge pump, disconnect the capacitor between the C1P and C1M, C2P and C2M. | The optimum capacitance is 0.1μF. |
| 7. Brake<br>Set on reverse torque brake and decelerate the spindle motor.<br>Do not apply on the brake to a stopping motor as some motors may rotate in the reverse direction | BD6641KUT: Brake ON at BRK pin voltage>VCC–0.4V.<br>BD6643KN: Brake ON at BRK pin voltage<0.4V. |

※The setting values of the data above are reference values. Board layout, wiring, and types of components to be used may cause characteristic variations in actual setting. Verify the setting in the actual application.

●**I/O equivalent circuit diagrams**

◎ I/O circuit diagram (Standard resistance value) ( ) : Pin No. for BD6641KUT, [ ] : Pin No. for BD6643KN

( 1 ) Logic input

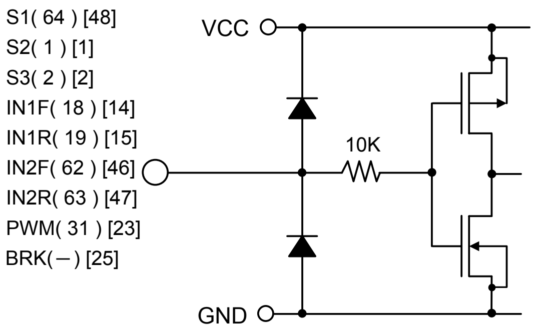



Fig. 16

( 2 ) Standby input

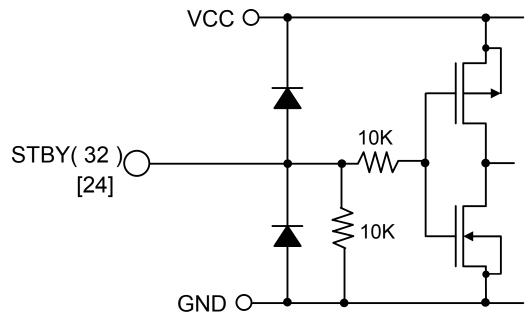



Fig. 17

( 3 ) Charge pump

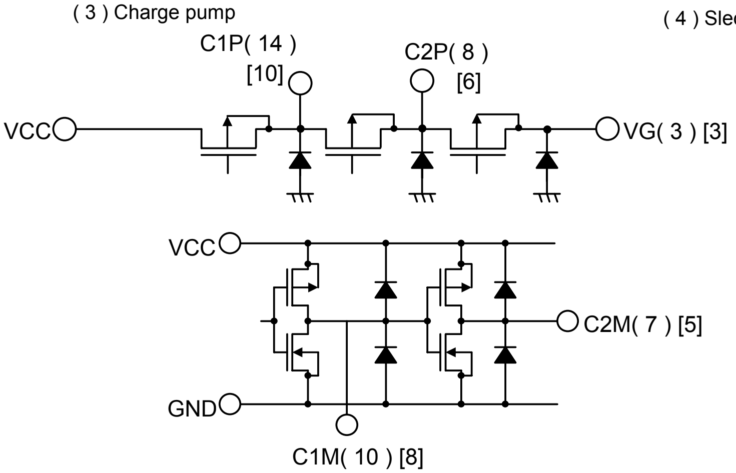



Fig. 18

( 4 ) Sled BEMF detection comparator output

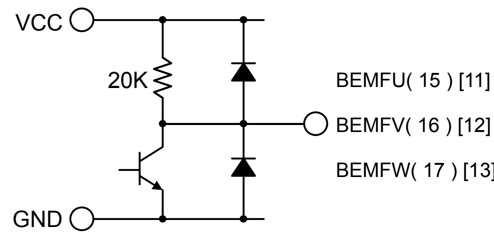



Fig. 19

( 5 ) H-bridge 2 output

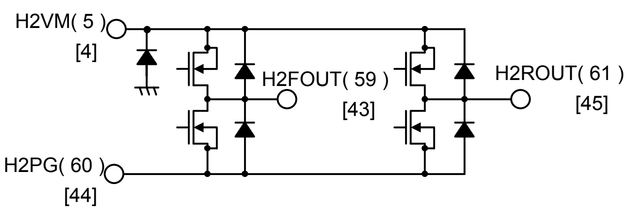



Fig. 20

( 6 ) H-bridge 1 output

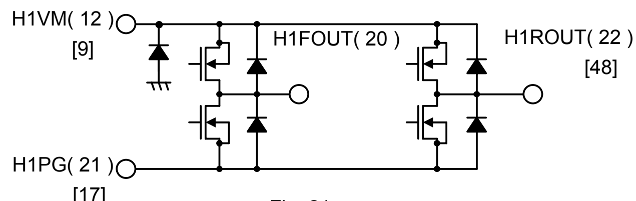



Fig. 21

( 7 ) Spindle output

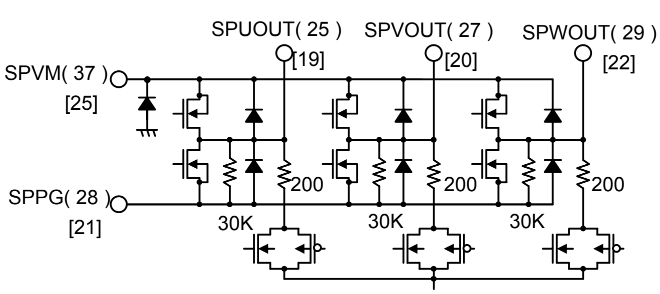



Fig. 22

( 8 ) Spindle BEMF detection comparator

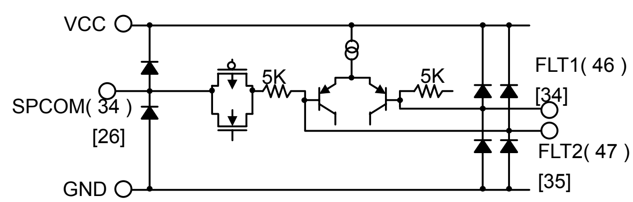



Fig. 23

(9) Spindle SLOPE pin

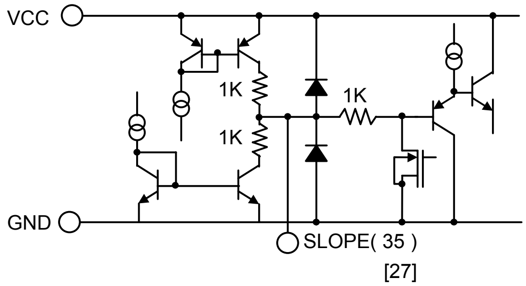



Fig. 24

(10) Spindle MSK pin

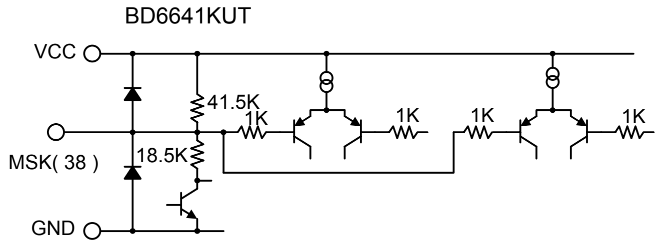



Fig. 25

(11) Spindle ISET pin

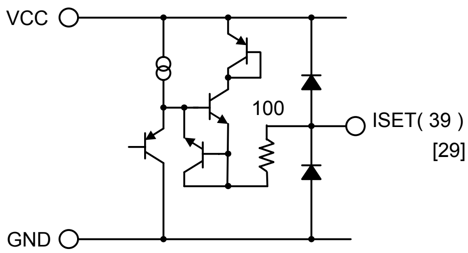



Fig. 26

(12) Spindle OSC pin

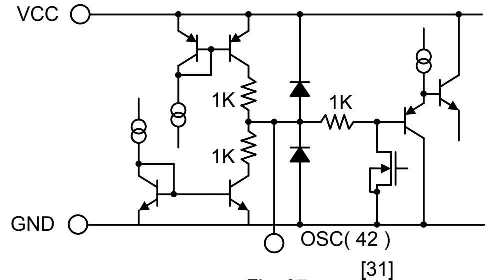



Fig. 27

(13) Spindle FG pin

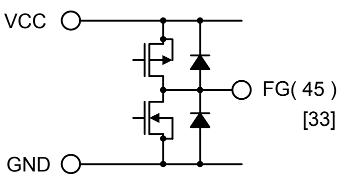



Fig. 28

(14) Spindle rotor position detection level setting pin

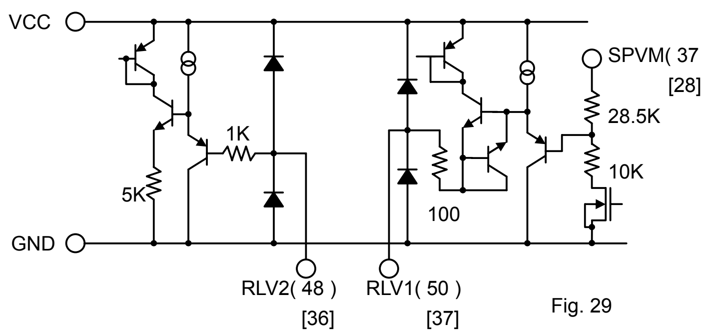



Fig. 29

(15) Sled output

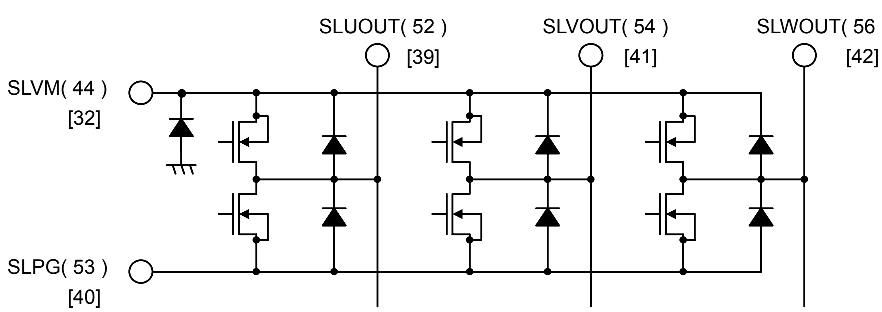
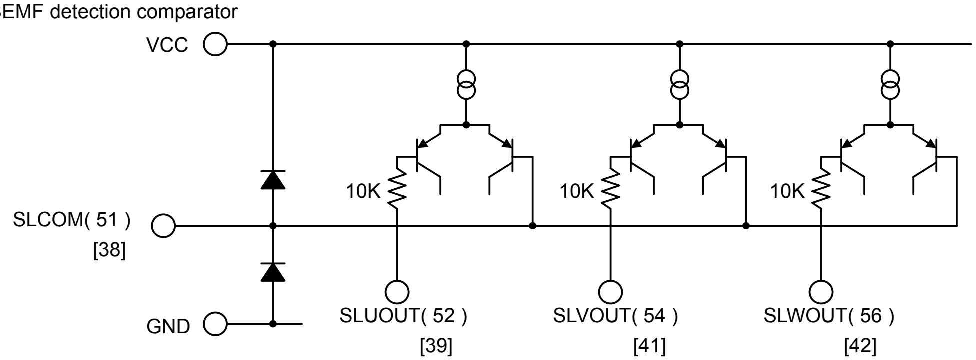



Fig. 30

(16) Sled BEMF detection comparator



●**Notes on the use**

1) Absolute maximum ratings
An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2) Reverse polarity connection of the power supply
Connecting the of power supply in reverse polarity can damage IC. Take precautions when connecting the power supply lines. An external direction diode can be added.

3) Power supply lines
Design PCB layout pattern to provide low impedance GND and supply lines. To obtain a low noise ground and supply line, separate the ground section and supply lines of the digital and analog blocks. Furthermore, for all power supply terminals to ICs, connect a capacitor between the power supply and the GND terminal. When applying electrolytic capacitors in the circuit, note that capacitance characteristic values are reduced at low temperatures.

4) GND voltage
Ground-GND potential should maintain at the minimum ground voltage level. Furthermore, no terminals should be lower than the GND potential voltage including an electric transients.

5) Thermal design
Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

6) Inter-pin shorts and mounting errors
Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if positive and ground power supply terminals are reversed. The IC may also be damaged if pins are shorted together or are shorted to other circuit’s power lines.

7) Operation in a strong magnetic field
Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

8) ASO
When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

9) Thermal shutdown circuit (TSD)
When the chip temperature (Tj) becomes 175°C (Typ.), thermal shutdown circuit (TSD circuit) operates and makes the coil output to motor open. There is a temperature hysteresis of approx. 20°C (Typ.). The thermal shutdown circuit (TSD circuit) is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect the IC or guarantee its operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of this circuit is assumed.

10) Testing on application boards
When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to, or removing it from a jig or fixture, during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting and storing the IC.

11) Regarding input pin of the IC

This monolithic IC contains $P^+$ isolation and P substrate layers between adjacent elements to keep them isolated. P–N junctions are formed at the intersection of these P layers with the N layers of other elements, creating a parasitic diode or transistor. For example, the relation between each potential is as follows:

When GND > Pin A and GND > Pin B, the P–N junction operates as a parasitic diode.

When GND > Pin B, the P–N junction operates as a parasitic diode and transistor.

Parasitic elements can occur inevitably in the structure of the IC. The operation of parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.

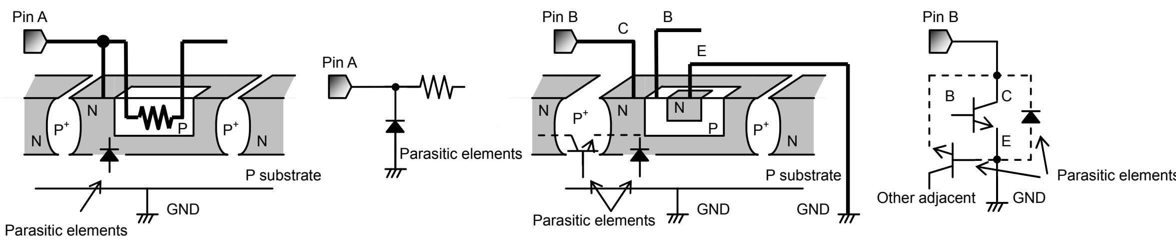
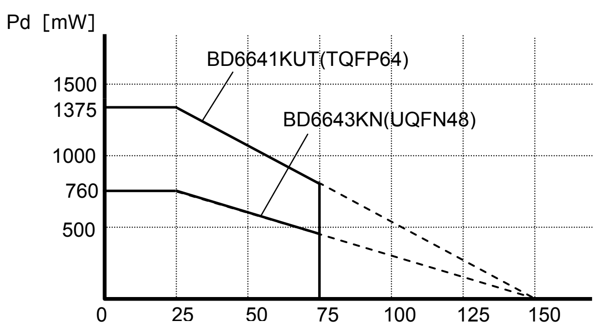



Fig.32 Example of a simple IC structure

12) Ground wiring patterns

The power supply and ground lines must be as short and thick as possible to reduce line impedance. Fluctuating voltage on the power ground line may damage the device.

●**Power dissipation characteristics**




＊Reduced by 11mW/°C (BD6641KUT) and by 7.6mW/°C (BD6643KN) over Ta=25°C, when mounted on a glass epoxy board (70mm×70mm×1.6mm).

Fig. 33

● **Selecting a Model Name When Ordering**

| B | D | | 6 | 6 | 4 | 1 | | K | U | T | – | E | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

ROHM model

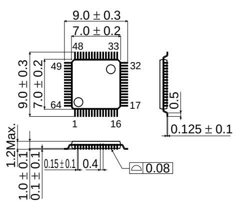
Part number
6641 = QFP package
6643 = QFN package

Package type
KUT = TQFP64U
KN = UQFN48

Taping type
E2 = Reel-wound embossed taping

## TOFP64U

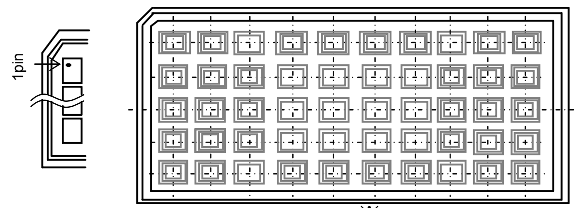
<Dimension>




(Unit:mm)

<Packing information>

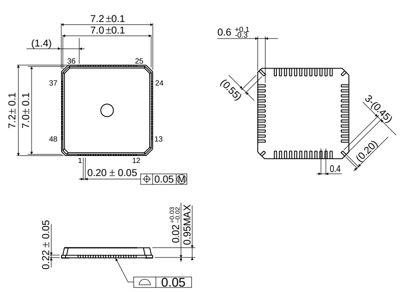
| | |
|---|---|
| Container | Tray(with dry pack) |
| Quantity | 1000pcs |
| Direction of feed | Direction of product is fixed in a tray. |




※Orders are available in complete units only.

## UQFN48

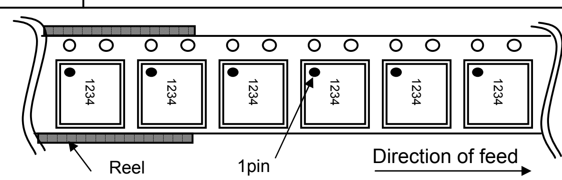
<Dimension>




(Unit:mm)

<Tape and Reel information>

| | |
|---|---|
| Tape | Embossed carrier tape(with dry pack) |
| Quantity | 2500pcs |
| Direction of feed | E2<br>(Correct direction: 1pin of product should be at the upper left when you hold reel on the left hand, and you pull out the tape on the right hand) |

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