STRUCTURE Silicon monolithic integrated circuits

PRODUCT SERIES 2-in-1 motor driver for VTR

TYPE **BD6904FP**

FUNCTION
- VTR cylinder motor driver (Sensorless 3-phase full-wave soft switching drive system)
- VTR loading motor driver

○Absolute maximum ratings (Ta=25℃)

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Supply voltage | VCC | 7 | V |
| | VM | 15 | V |
| | VG | 20 | V |
| Power dissipation | Pd | 1450※1 | mW |
| Operating temperature range | Topr | -20～+75 | ℃ |
| Storage temperature range | Tstg | -55～+150 | ℃ |
| Maximum output current (cylinder block) | Iomax1 | 800※2 | mA |
| Maximum output current (loading block) | Iomax2 | 800※2 | mA |
| Junction temperature | Tjmax | +150 | ℃ |

※1 90mm×90mm×1.6mm glass epoxy board. Derating in done at 11.6mW/℃ for operating above Ta=25℃.

※2 Do not, however exceed Pd, ASO and Tjmax=150℃.

○Recommended operating conditions (Ta= -25～+75℃)

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Supply voltage | VCC | 4.5 | 5 | 5.5 | V |
| | VM | 9 | 12 | 14 | V |
| | VG | VM+2 | 17 | 19 | V |
| COM input in-phase voltage range | VCOMD | 0 | - | VM-2.5 | V |
| PG amp in-phase input voltage range | VPD | 1.5 | - | 3.7 | V |

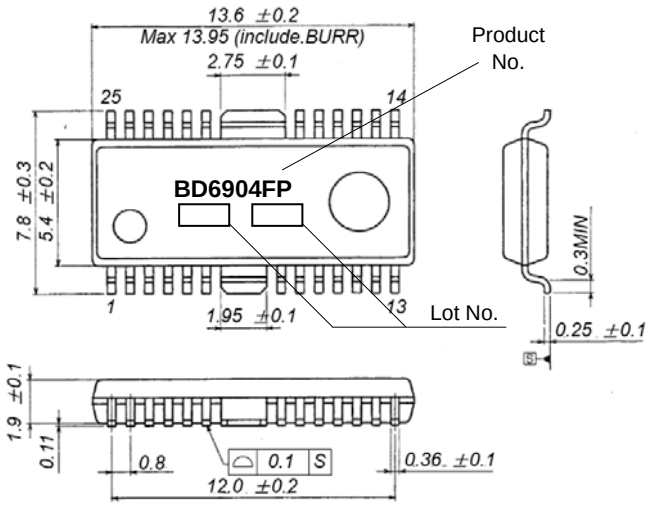
This product described in this specification isn't judged whether it applies to COCOM regulations.
Please confirm in case of export.
This product isn't designed for protection against radioactive rays.

○Electrical characteristics (Unless otherwise specified, Ta=25℃, VCC=5V, VM1=VM2=12V, VG=17V)

| Parameter | Symbol | Limit | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| **Overall** | | | | | | |
| VCC total supply current | ICC | - | 9 | 13 | mA | |
| **Output** | | | | | | |
| High-side output saturation voltage | VOH | - | 0.4 | 0.7 | V | Io=-300mA |
| Low-side output saturation voltage | VOL | - | 0.55 | 0.85 | V | Io=300mA |
| **BEMF comparator** | | | | | | |
| BEMF comparator hysteresis width + | VHYSB+ | +24 | +36 | +48 | mV | |
| BEMF comparator hysteresis width - | VHYSB- | -59 | -43 | -27 | mV | |
| **Torque reference** | | | | | | |
| Torque reference start voltage | VECR | 2.35 | 2.5 | 2.65 | V | |
| Torque reference I/O gain | Gio | 0.80 | 1.06 | 1.33 | A/V | EC=2.3V-2.2V<br>Gain output (HLM) RRNF=0.68Ω |
| Current limit voltage | VCL | 239 | 295 | 345 | mV | RRNF=0.68Ω |
| **Soft switch** | | | | | | |
| CT1, CT2 charge current | ICTD | -53 | -39 | -25 | μA | |
| CT1, CT2 discharge current | ICTI | 29 | 45 | 61 | μA | |
| High CT1, CT2 clamp voltage | VCTH | 3.4 | 3.8 | 4.2 | V | |
| Low CT1, CT2 clamp voltage | VCTL | 0.85 | 1.05 | 1.25 | V | |
| **Startup control logic** | | | | | | |
| CST charge current | ICSTO | -20 | -14 | -8 | μA | |
| CST discharge current | ICSTI | 2 | 5.5 | 9 | μA | |
| High CST clamp voltage | VCSTH | 2.4 | 2.8 | 3.2 | V | |
| Low CST clamp voltage | VCSTL | 0.8 | 1.0 | 1.2 | V | |
| CST off voltage | VCSTO | 3.6 | 3.8 | 4.0 | V | |
| **PG amp** | | | | | | |
| Input bias current | IPG- | - | 1 | 3 | μA | PG-=2.5V |
| Input offset voltage | VIOP | -8 | - | +8 | mV | |
| DC bias voltage | VBP | 2.25 | 2.5 | 2.75 | V | |
| Voltage gain 1 | AV1 | 50 | 71 | - | dB | f=1kHz |
| High output voltage | VOHP | 3.4 | 3.75 | - | V | IOH=-1mA |
| Low output voltage | VOLP | - | 1.2 | 1.6 | V | IOL=1mA |
| **PFG output** | | | | | | |
| PG detection level | VPGTH | VBP-0.075 | VBP-0.1 | VBP-0.125 | V | |
| High output voltage | VPFGH | 3.5 | - | - | V | IO=-30μA |
| Middle output voltage | VPFGM | 2.1 | - | 2.9 | V | IO=±10μA |
| Low output voltage | VPFGL | - | - | 0.9 | V | IO=30μA |
| **Loading** | | | | | | |
| High-level FIN input | VFINH | 3.5 | - | - | V | |
| High-level RIN input | VRINH | 3.5 | - | - | V | |
| Low-level FIN input | VFINL | - | - | 1.5 | V | |
| Low-level RIN input | VRINL | - | - | 1.5 | V | |
| Output saturation voltage | VCE | - | 0.3 | 0.6 | V | IO=200mA,<br>total of output transistor high-side and low-side voltage |

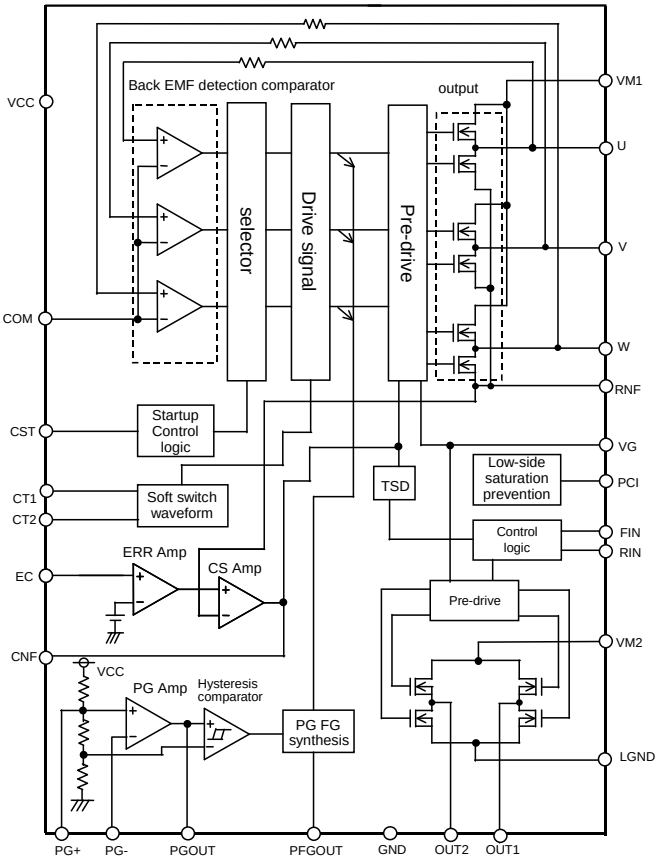
※Source currents are treated as negative while sinking currents are treated as positive.

○Package outline




HSOP-25 (Unit:mm)

○Block diagram




○Pin No. / Pin name

| Pin No. | Pin name |
|---|---|
| 1 | VM2 |
| 2 | OUT1 |
| 3 | LGND |
| 4 | OUT2 |
| 5 | FIN |
| 6 | RIN |
| 7 | VG |
| 8 | GND |
| 9 | CST |
| 10 | CT1 |
| 11 | CT2 |
| 12 | PCI |
| 13 | CNF |
| 14 | EC |
| 15 | PG+ |
| 16 | PG- |
| 17 | PGOUT |
| 18 | PFGOUT |
| 19 | VCC |
| 20 | COM |
| 21 | VM1 |
| 22 | U |
| 23 | V |
| 24 | RNF |
| 25 | W |

○Operation Notes

(1) Absolute maximum ratings

Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range (Topr) may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. The implementation of a physical safety measure such as a fuse should be considered when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.

(2) Power supply lines

Regenerated current may flow as a result of the motor's back electromotive force. Insert capacitors between the power supply and ground pins to serve as a route for regenerated current. Determine the capacitance in full consideration of all the characteristics of the electrolytic capacitor, because the electrolytic capacitor may loose some capacitance at low temperatures. If the connected power supply does not have sufficient current absorption capacity, regenerative current will cause the voltage on the power supply line to rise, which combined with the product and its peripheral circuitry may exceed the absolute maximum ratings. It is recommended to implement a physical safety measure such as the insertion of a voltage clamp diode between the power supply and GND pins.

(3) Ground potential

Ensure a minimum GND pin potential in all operating conditions.

(4) Setting of heat

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

(5) Actions in strong magnetic field

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

(6) ASO

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

(7) Thermal shutdown circuit

This IC incorporates a TSD (thermal shutdown) circuit (TSD circuit). If the temperature of the chip reaches the following temperature, the motor coil output will be opened.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.

| TSD on temperature [°C] (typ.) | Hysteresis temperature [°C] (typ.) |
|---|---|
| 170 | 20 |

(8) Ground Wiring Pattern

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external components, either.

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