

AN8470NSA

Spindle motor driver IC for optical disk

■ Overview

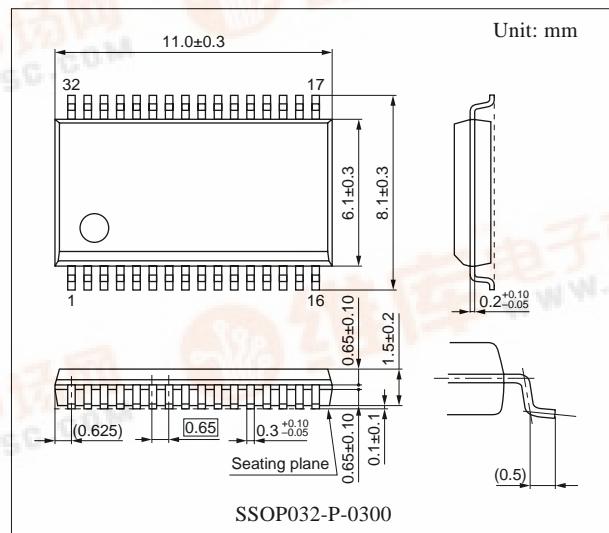
The AN8470NSA is a high performance IC suited for driving a spindle motor of an optical disk such as CD-ROM, PD, DVD, CD-R, CD-RW, etc.

■ Features

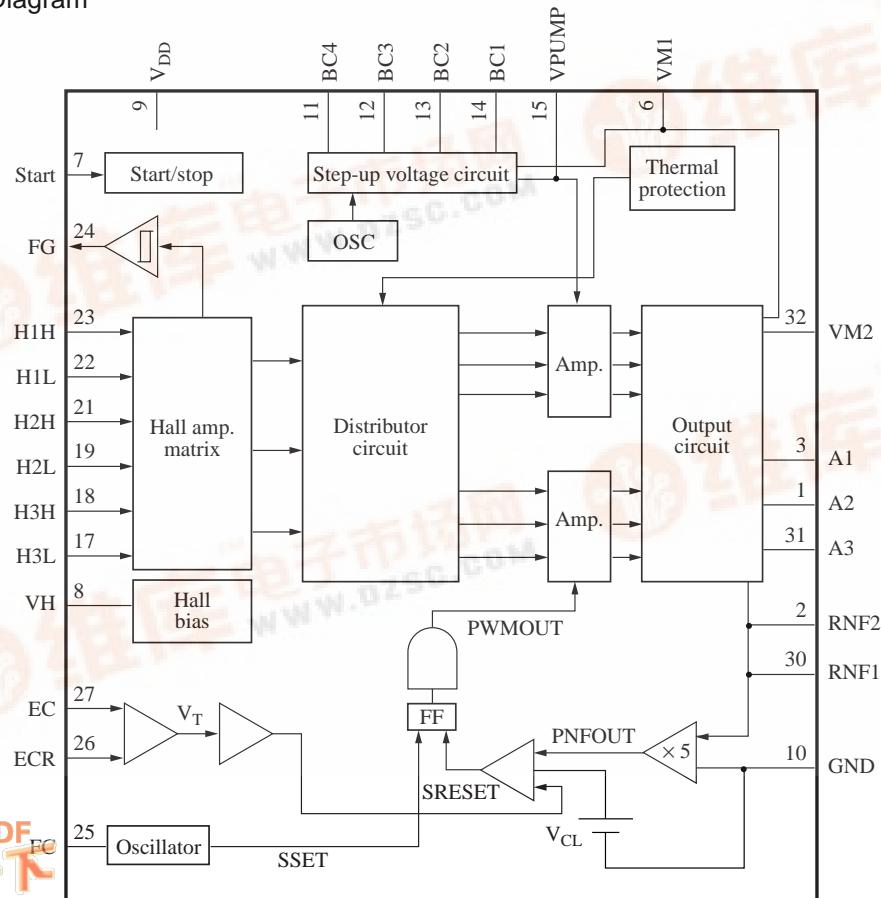
- Low power consumption due to a direct PWM system
 - With start and stop pin
 - Reverse breaking by EC/ECR voltage
 - With Hall bias pin
 - Surface-mount small package

■ Applications

- High speed CD-ROM drive
PD, DVD, CD-R, CD-RW drives



■ Block Diagram



■ Pin Descriptions

| Pin No. | Symbol | Description | Pin No. | Symbol | Description |
|---------|-----------------|------------------------------------|---------|--------|------------------------------------|
| 1 | A2 | Drive output 2 | 17 | H3L | Hall element-3 negative input pin |
| 2 | RNF2 | Current det. pin 2 | 18 | H3H | Hall element-3 positive input pin |
| 3 | A1 | Drive output 1 | 19 | H2L | Hall element-2 negative input pin |
| 4 | N.C. | N.C. | 20 | N.C. | N.C. |
| 5 | N.C. | N.C. | 21 | H2H | Hall element-2 positive input pin |
| 6 | VM1 | Motor supply voltage pin 1 | 22 | H1L | Hall element-1 negative input pin |
| 7 | Start | Start/stop changeover pin | 23 | H1H | Hall element-1 positive input pin |
| 8 | VH | Hall bias pin | 24 | FG | FG signal output pin |
| 9 | V _{DD} | Supply voltage pin | 25 | FC | Oscillator pin |
| 10 | GND | Ground pin | 26 | ECR | Torque command reference input pin |
| 11 | BC4 | Booster capacitor connection pin 4 | 27 | EC | Torque command input pin |
| 12 | BC3 | Booster capacitor connection pin 3 | 28 | N.C. | N.C. |
| 13 | BC2 | Booster capacitor connection pin 2 | 29 | N.C. | N.C. |
| 14 | BC1 | Booster capacitor connection pin 1 | 30 | RNF1 | Current det. pin 1 |
| 15 | VPUMP | Booster pin | 31 | A3 | Drive output 3 |
| 16 | N.C. | N.C. | 32 | VM2 | Motor supply voltage pin 2 |

■ Absolute Maximum Ratings

| Parameter | Symbol | Rating | Unit |
|---|------------------|----------------------|------|
| Supply voltage ^{*2} | V _{DD} | 6.0 | V |
| | V _{M1} | | |
| | V _{M2} | | |
| Drive output voltage ^{*5} | V _(m) | 15.0 | V |
| Control signal input voltage ^{*6} | V _(n) | 0 to V _{DD} | V |
| Supply current | I _{DD} | 30.0 | mA |
| Drive output current ^{*4} | I _(o) | ±1 200 | mA |
| Hall bias current | I _{HB} | 30.0 | mA |
| Power dissipation ^{*3} | P _D | 293 | mW |
| Operating ambient temperature ^{*1} | T _{opr} | -20 to +70 | °C |
| Storage temperature ^{*1} | T _{stg} | -55 to +150 | °C |

Note) Do not apply external currents or voltages to any pins not specifically mentioned.

For circuit currents, '+' denotes current flowing into the IC, and '-' denotes current flowing out of the IC.

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

*2: The voltage in the step-up voltage circuit exceeds the supply voltage.

For the allowable value of the step-up voltage, refer to "■ Electrical Characteristics".

*3: For 70°C and IC alone.

*4: o = 1, 2, 3, 6, 30, 31, 32

*5: m = 1, 3, 31

*6: n = 7, 17, 18, 19, 21, 22, 23, 26, 27

■ Recommended Operating Range

| Parameter | Symbol | Range | Unit |
|----------------|-----------------|------------|------|
| Supply voltage | V _{DD} | 4.5 to 5.5 | V |
| | V _{M1} | | |
| | V _{M2} | | |

■ Electrical Characteristics at T_a = 25°C

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|--------------------------------------|--------------------|---|------|------|------|---------|
| Overall | | | | | | |
| Circuit current 1 | I _{DD1} | V _{DD} = 5 V in power save mode | — | 0 | 0.1 | mA |
| Circuit current 2 | I _{DD2} | V _{DD} = 5 V | — | 9 | 14 | mA |
| Start/stop | | | | | | |
| Start voltage | V _{START} | Voltage with which a circuit operates at V _{DD} = 5 V and L → H | 2.7 | — | — | V |
| Stop voltage | V _{STOP} | Voltage with which a circuit becomes off at V _{DD} = 5 V and H → L | — | — | 0.7 | V |
| Hall bias | | | | | | |
| Hall bias voltage | V _{HB} | V _{DD} = 5 V, I _{HB} = 20 mA | 0.7 | 1.1 | 1.6 | V |
| Hall amplifier | | | | | | |
| Input bias current | I _{BH} | V _{DD} = 5 V | — | 1 | 5 | µA |
| In-phase input voltage range | V _{HBR} | V _{DD} = 5 V, except for H2H, H2L | 1.5 | — | 4.0 | V |
| Minimum input level | V _{INH} | V _{DD} = 5 V | 60 | — | — | mV[p-p] |
| Torque command | | | | | | |
| In-phase input voltage range | EC | V _{DD} = 5 V | 0.5 | — | 3.9 | V |
| Offset voltage | EC _{OF} | V _{DD} = 5 V | -100 | 0 | 100 | mV |
| Dead zone | EC _{DZ} | V _{DD} = 5 V | 0 | 75 | 150 | mV |
| Input current | EC _{IN} | V _{DD} = 5 V, EC = ECR = 2.5 V | -5 | -1 | — | µA |
| Input/output gain | A _{CS} | V _{DD} = 5 V, R _{CS} = 0.33 Ω | 0.36 | 0.48 | 0.60 | A/V |
| Output | | | | | | |
| High-level output saturation voltage | V _{OH} | V _{DD} = 5 V, I _O = -500 mA | — | 0.25 | 0.50 | V |
| Low-level output saturation voltage | V _{OL} | V _{DD} = 5 V, I _O = 500 mA | — | 0.25 | 0.50 | V |
| Torque limit current | I _{TL} | V _{DD} = 5 V, R _{CS} = 0.33 Ω | 455 | 570 | 685 | mA |
| OSC | | | | | | |
| Charging current | I _{CH} | V _{DD} = 5 V | -65 | -50 | -35 | µA |
| Upper threshold voltage | V _{CH} | V _{DD} = 5 V | 1.75 | 2.50 | 3.25 | V |
| Lower threshold voltage | V _{CL} | V _{DD} = 5 V | 0.35 | 0.50 | 0.65 | V |

■ Electrical Characteristics at $T_a = 25^\circ\text{C}$ (continued)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|------------------------------|--------------------------|--|-----|-----|-----|------|
| FG | | | | | | |
| FG output high-level | FG_H | $\text{V}_{\text{DD}} = 5 \text{ V}$, $I_{\text{FG}} = -0.01 \text{ mA}$ | 3 | — | — | V |
| FG output low-level | FG_L | $\text{V}_{\text{DD}} = 5 \text{ V}$, $I_{\text{FG}} = 0.01 \text{ mA}$ | — | — | 0.5 | V |
| In-phase input voltage range | V_{FGR} | $\text{V}_{\text{DD}} = 5 \text{ V}$ | 1.5 | — | 3.0 | V |
| FG hysteresis width | H_{FG} | $\text{V}_{\text{DD}} = 5 \text{ V}$ | 5 | 10 | 20 | mV |
| Step-up circuit | | | | | | |
| Step-up voltage | V_{PUMP} | $\text{V}_{\text{DD}} = 5 \text{ V}$, $\text{V}_{\text{M}1} = \text{V}_{\text{M}2} = 5 \text{ V}$ | 9.5 | — | 15 | V |

- Design reference data

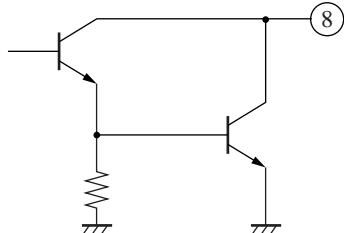
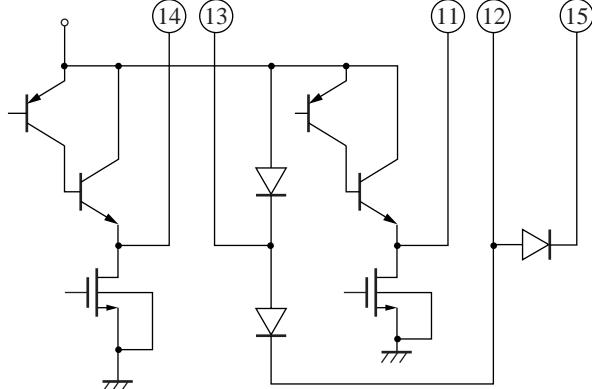
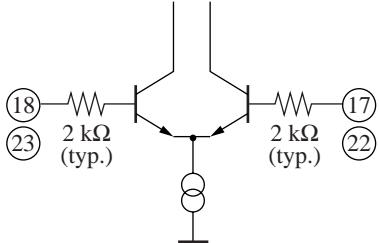
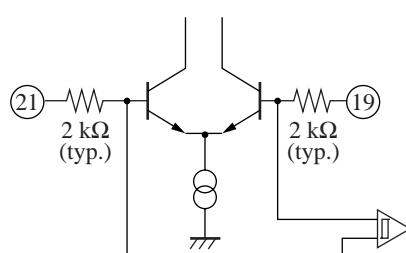
Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|--|------------------------|--------------------------------------|-----|-----|-----|------|
| Thermal protection | | | | | | |
| Thermal protection operating temperature | T_{SDON} | $\text{V}_{\text{DD}} = 5 \text{ V}$ | — | 170 | — | °C |
| Thermal protection hysteresis width | ΔT_{SD} | $\text{V}_{\text{DD}} = 5 \text{ V}$ | — | 45 | — | °C |

■ Terminal Equivalent Circuits

| Pin No. | Symbol | Equivalent circuit |
|---------|--------|--------------------|
| 1 | A2 | |
| 2 | RNF2 | |
| 3 | A1 | |
| 4 | N.C. | N.C. |
| 5 | N.C. | N.C. |
| 6 | VM1 | Refer to pin 1 |
| 7 | Start | |

■ Terminal Equivalent Circuits (continued)

| Pin No. | Symbol | Equivalent circuit |
|---------|-----------------|--|
| 8 | VH |  |
| 9 | V _{DD} | Supply voltage pin |
| 10 | GND | Ground pin |
| 11 | BC4 | |
| 12 | BC3 | |
| 13 | BC2 | |
| 14 | BC1 | |
| 15 | VPUMP |  |
| 16 | N.C. | N.C. |
| 17 | H3L | |
| 18 | H3H |  |
| 19 | H2L |  |
| 20 | N.C. | N.C. |

■ Terminal Equivalent Circuits (continued)

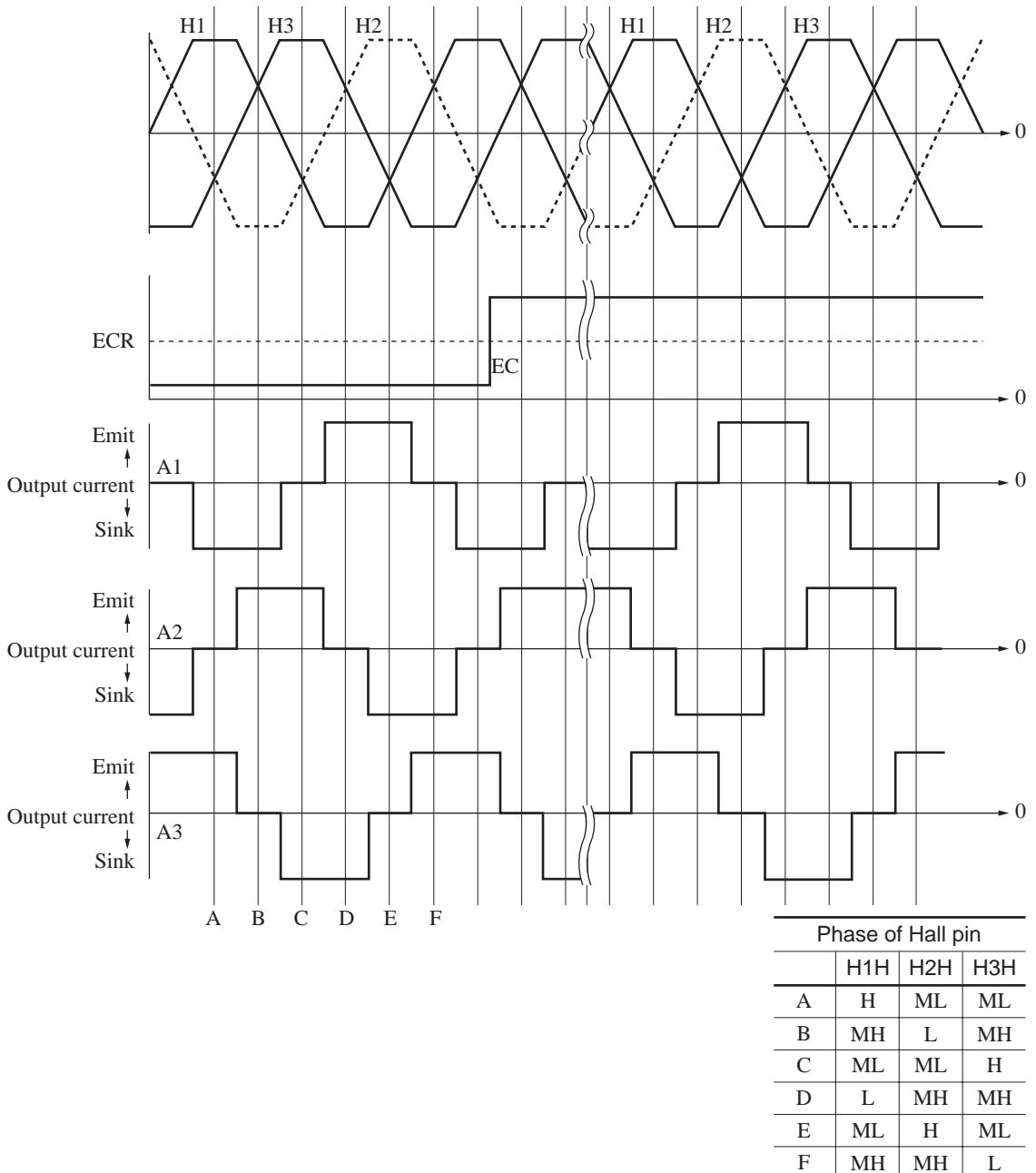
| Pin No. | Symbol | Equivalent circuit |
|---------|--------|--------------------|
| 21 | H2H | Refer to pin 19 |
| 22 | H1L | Refer to pin 17 |
| 23 | H1H | Refer to pin 17 |
| 24 | FG | |
| 25 | FC | |
| 26 | ECR | |
| 27 | EC | |
| 28 | N.C. | N.C. |
| 29 | N.C. | N.C. |
| 30 | RNF1 | Refer to pin 1 |
| 31 | A3 | Refer to pin 1 |
| 32 | VM2 | Refer to pin 1 |

■ Usage Notes

- Prevent this IC from being line-to-ground fault.
(To be concrete, do not short-circuit any of A1 (pin 3), A2 (pin 1) and A3 (pin 31) with GND pin (pin 10).)
- Be careful of the following three pins because their static breakdown voltages are low. ($C = 200 \text{ pF}$, $R = 0 \Omega$)
 - Pin 11: breakdown at 80 V
 - Pin 14: breakdown at 90 V
 - Pin 24: breakdown at 190 V

■ Application Note

- Phase conditions between Hall input and output current



■ Application Circuit Example

