



LB1817W

FDD Spindle Motor Driver

Overview

The LB1817W is a spindle motor driver for low-profile floppy disk drives.

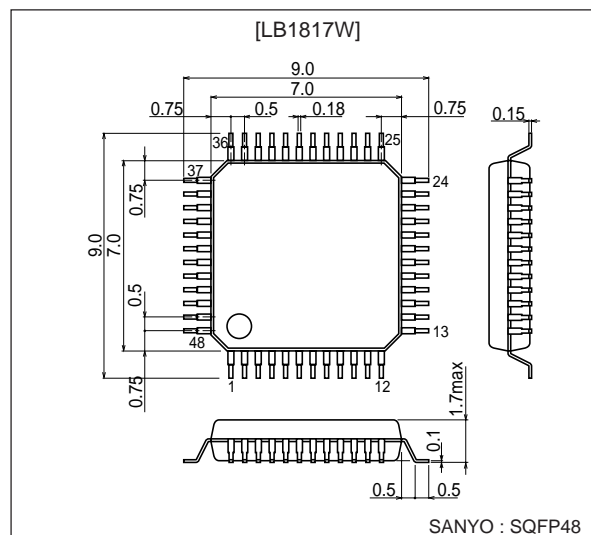
Functions and Features

- Three-phase full-wave linear drive (with external PNP transistor)
- Low saturation voltage
- Built-in digital speed control
- Start/stop circuit (Low active)
- Switchable rotation speed
- Current limiter circuit
- Built-in index processing circuit
- Index timing adjustable by VR
- AGC circuit
- Thermal protection circuit

Package Dimensions

unit: mm

3163A-SQFP48



Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|---------------------------------|---------------|----------------------|-------------|------------------|
| Maximum supply voltage | V_{CC} max | | 7.0 | V |
| Maximum output current | I_{CC} max1 | $t \leq 0.5\text{s}$ | 1.5 | A |
| Maximum constant output current | I_O max2 | | 1.0 | A |
| Allowable power dissipation | P_d max1 | IC only | 0.45 | W |
| Operating temperature | T_{opr} | | -20 to +80 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -40 to +150 | $^\circ\text{C}$ |

Allowable Operating Ranges at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|----------------------|----------|------------|------------|------|
| Power supply voltage | V_{CC} | | 4.2 to 6.5 | V |

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LB1817W

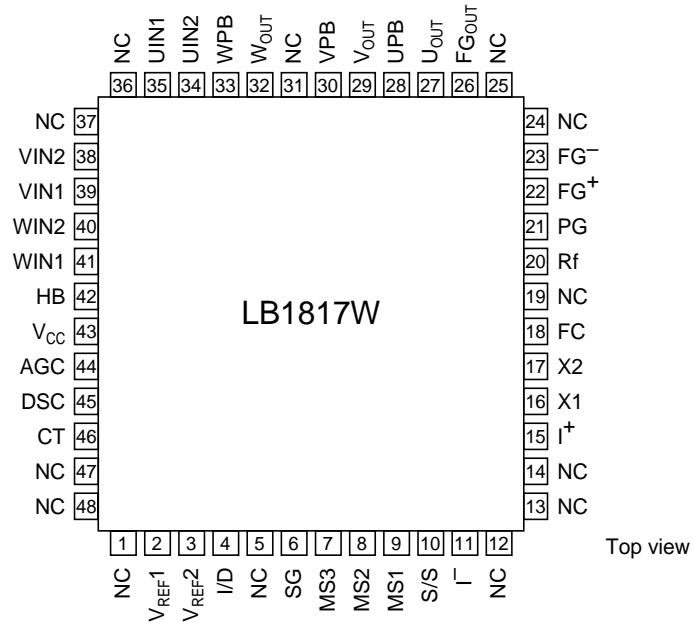
Electrical Characteristics at Ta = 25°C, V_{CC} = 5V

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--|--------------------------------|---|---------|--------|----------------------|-------|
| | | | min | typ | max | |
| Current drain | I _{CCO} | S/S = 5V (Standby) | | 70 | 100 | μA |
| | I _{CC} | S/S = 0V (Normal) | | 25 | 35 | mA |
| MS1 bias current | I _{MS1} | V _{MS1} = 5V | | 180 | 270 | μA |
| MS1 Low input voltage | V _{MS1L} | | 0.0 | | 0.8 | V |
| MS1 High input voltage | V _{MS1H} | | 2 | | V _{CC} | V |
| MS2 bias current | I _{MS2} | V _{MS2} = 5V | | 90 | 135 | μA |
| MS2 Low input voltage | V _{MS2L} | | 0.0 | | 0.8 | V |
| MS2 High input voltage | V _{MS2H} | | 2 | | V _{CC} | V |
| MS3 bias current | I _{MS3} | V _{MS3} = 5V | | 90 | 135 | μA |
| MS3 Low input voltage | V _{MS3L} | | 0.0 | | 0.8 | V |
| MS3 High input voltage | V _{MS3H} | | 2 | | V _{CC} | V |
| S/S bias current | I _{S/S} | | | | 20 | μA |
| S/S Low voltage | V _{S/SL} | | 0.0 | | 0.8 | V |
| S/S High voltage | V _{S/SH} | | 2 | | V _{CC} | V |
| Hall amplifier input bias current | I _{HB} | | | | 15 | μA |
| Common mode input voltage range | V _h | | 2.0 | | V _{CC} -0.7 | V |
| Differential input voltage range | V _{dif} | | 50 | | 200 | mVp-p |
| Input offset voltage | V _{ho} | * | | | ±10 | mV |
| Hall bias output voltage | V _H | I _H = 5 mA | 0.5 | 0.8 | 1.1 | V |
| Leakage current | V _{HL} | S/S = 5V | | | ±10 | μA |
| Output saturation voltage | V(sat) | I _O = 0.8A | | 0.45 | 0.64 | V |
| Output leakage current | I _{OL} | | | | 1 | mA |
| Current limiter | I _{lim} | R _F = 3 kΩ, R _{OUT} = 100Ω | 6.3 | 7.5 | 8.7 | mA |
| Control amplifier voltage gain | G _C | | -7.5 | -5.5 | -3.5 | dB |
| Voltage gain phase differential | ΔG _C | | | | ±1 | dB |
| V/I conversion source current | I ⁺ | | 19 | 28 | 37 | μA |
| V/I conversion sink current | I ⁻ | | -19 | -28 | -37 | μA |
| V/I conversion current ratio | I ⁺ /I ⁻ | | 0.8 | 1.0 | 1.2 | |
| DSC buffer input current | I _{DSC} | | | | 1 | μA |
| FG amplifier input voltage | V _{FG} | f _{FG} = 300 Hz | 2 | | 20 | mVp-p |
| FG amplifier voltage gain | G _{FG} | Open loop* | | 60 | | dB |
| FG amplifier input offset | V _{FGO} | * | | | ±10 | mV |
| FG amplifier internal reference voltage | V _{FGB} | | 2.2 | 2.5 | 2.8 | V |
| FG Schmitt hysteresis width | ΔV _{sh1} | High → Low* | | 25 | | mV |
| | ΔV _{sh2} | Low → High* | | 25 | | mV |
| Speed discriminator count | N | | | 1390/2 | | |
| Discriminator operating frequency | F _D | * | | | 1.1 | MHz |
| Oscillator frequency | F _{OSC} | * | | | 1.1 | MHz |
| Oscillator frequency tolerance | ΔF _{OSC} | | | | ±0.2 | % |
| Index output Low voltage | V _{IDL} | I _O = 2 mA | | | 0.4 | V |
| Index output leakage current | I _{IDL} | | | | ±10 | μA |
| Index amplifier common mode input voltage range | V _I | | 0.2 | | V _{CC} -0.7 | V |
| Index amplifier differential input voltage range | V _{DIF} | Hysteresis width < 25 mA | 25 | | 100 | mV |
| Index amplifier hysteresis set current | I _{HYS} | | 2.9 | 4.2 | 5.5 | μA |
| Timing adjustment at High level | V _{TH} | MS1 = L | 1.15 | 1.26 | 1.35 | V |
| Timing adjustment at Low level | V _{TL} | MS1 = L | 0.40 | 0.52 | 0.60 | V |
| Timing adjustment ratio | T _{HL} | V _{TH} (MS1 = L) / V _{TH} (MS1 = H) | | 1.148 | | |
| Reference voltage | V _{REF1} | | 2.20 | 2.50 | 2.80 | V |
| | V _{REF2} | | 1.85 | 2.15 | 2.45 | V |
| Thermal protection operating temperature | TSD | * | 150 | 180 | | °C |
| Hysteresis width | ΔTSD | * | | 10 | | °C |

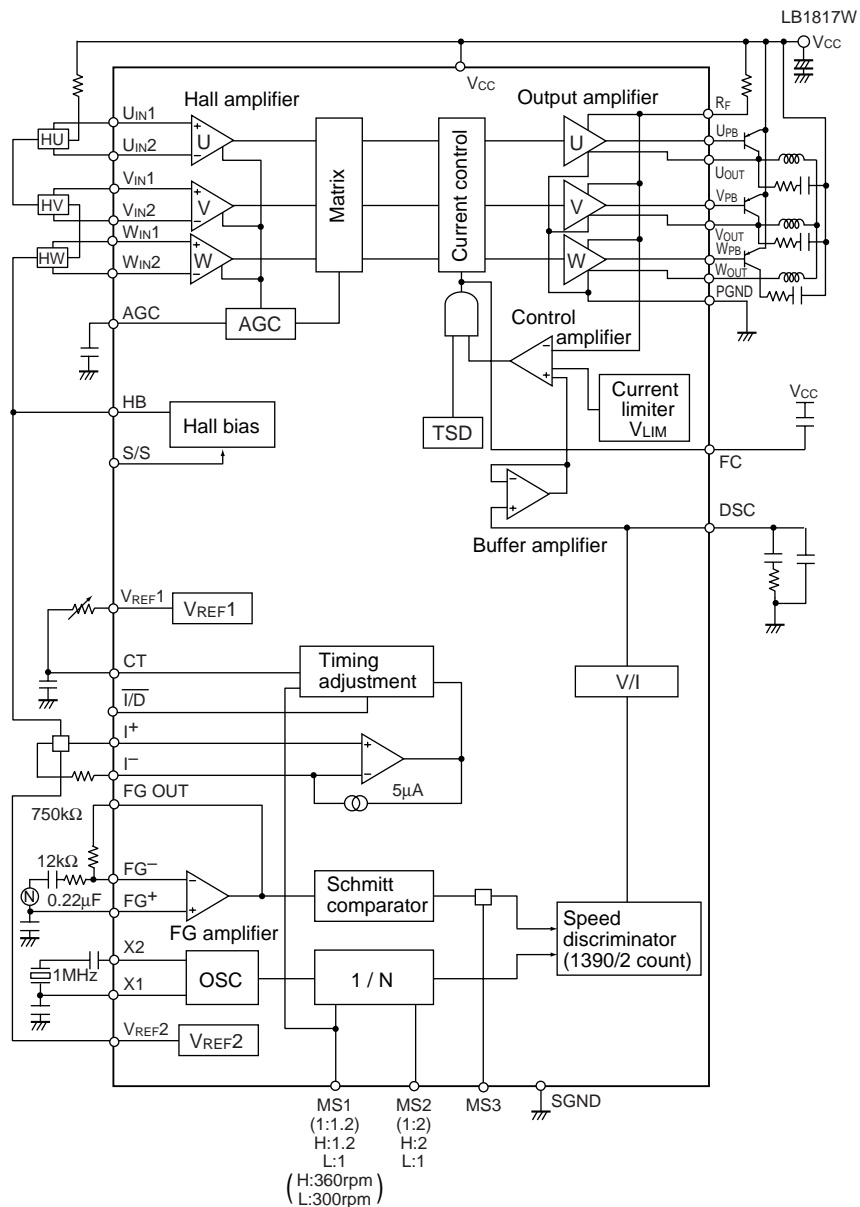
Note: Items shown to be "*" are not measured.

LB1817W

Pin Assignment



Block Diagram



LB1817W

Pin Descriptions

| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|--|-------------------|----------------------------|--------------------|---|
| 1, 5 12, 13 14, 19 24, 25 31, 36 37, 47 48 | NC | | | <ul style="list-style-type: none"> Pins not used |
| 2 | V _{REF1} | 2.5V typ | | <ul style="list-style-type: none"> V_{REF1} pin. Used as power supply for external CR serving for index timing adjustment. |
| 3 | V _{REF2} | 2.15V typ | | <ul style="list-style-type: none"> V_{REF2} pin. Used as bias pin for external index sensor. |
| 4 | I/D | | | <ul style="list-style-type: none"> Index pulse output pin. |
| 6 | SG | | | <ul style="list-style-type: none"> Signal ground pin. Connect to ground together with pin 21. |
| 7 | MS3 | H: 2.0V min L: 0.8V max | | <ul style="list-style-type: none"> FG switching pin. High: FG set to through Low: FG set to 1-stage division |
| 8 | MS2 | H: 2.0V min L: 0.8V max | | <ul style="list-style-type: none"> CLK switching pin. High: Clock set to through Low: Clock set to 1-stage division |

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LB1817W

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| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|------------|----------------------------------|----------------------------|--------------------|--|
| 9 | MS1 | H: 2.0V min L: 0.8V max | | <ul style="list-style-type: none"> Rotation speed switching pin. High: 360 rpm Low: 300 rpm For details, see rotation speed switching table. |
| 10 | S/S | H: 2.0V min L: 0.8V max | | <ul style="list-style-type: none"> Start/stop switching pin. Low: active |
| 11 15 | I ⁻ I ⁺ | | | <ul style="list-style-type: none"> External index – input pin. External index + input pin. When I⁻ pin is High, constant current I1 flows. When pin is Low, constant current I1 is cut off. Resistor externally connected to I⁻ pin determines hysteresis width. |
| 16 | X1 | | | <ul style="list-style-type: none"> Reference clock generator pin. |
| 17 | X2 | | | |
| 18 | FC | | | <ul style="list-style-type: none"> Frequency characteristics compensation pin. To prevent current control loop oscillation, insert a capacitor between this pin and V_{CC}. |

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LB1817W

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| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|----------------------------------|--|-------------|--------------------|--|
| 20 | RF | | | <ul style="list-style-type: none"> Output current detection pin. To detect output current as a voltage, insert a resistor R_f between this pin and V_{CC}. The voltage is used for the current limiter. The detection level is about 1/50 of the output current. |
| 21 | PG | | | <ul style="list-style-type: none"> Output transistor ground pin. Connect to ground together with pin 6. |
| 22 23 | FG+ FG- | 2.5V typ | | <ul style="list-style-type: none"> FG amplifier + pin FG amplifier - pin |
| 26 | FGout | | | <ul style="list-style-type: none"> FG amplifier output pin. |
| 27 28 29 30 32 33 | U_{OUT} U_{PB} V_{OUT} V_{PB} W_{OUT} W_{PB} | | | <ul style="list-style-type: none"> U phase output pin. U phase external PNP transistor base connection. V phase output pin. V phase external PNP transistor base connection. W phase output pin. W phase external PNP transistor base connection. |
| 34 35 38 39 40 41 | U_{IN2} U_{IN1} V_{IN2} V_{IN1} W_{IN2} W_{IN1} | | | <ul style="list-style-type: none"> U phase Hall input pin. Logic High means $U_{IN1} > U_{IN2}$. V phase Hall input pin. Logic High means $V_{IN1} > V_{IN2}$. W phase Hall input pin. Logic High means $W_{IN1} > W_{IN2}$. |

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LB1817W

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| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|------------|-----------------|-------------|--------------------|---|
| 42 | HB | | | <ul style="list-style-type: none"> Hall bias negative-side pin. In stop mode, the pin is open and Hall bias is cut off. |
| 43 | V _{CC} | | | <ul style="list-style-type: none"> Power supply pin. The voltage supplied to this pin must be stabilized to prevent ripple noise or other noises from inputting to this pin. |
| 44 | AGC | | | <ul style="list-style-type: none"> AGC pin. Controls the Hall amplifier gain according to Hall input amplitude. An external capacitor is used. |
| 45 | DSC | | | <ul style="list-style-type: none"> Speed discriminator pin. |
| 46 | CT | | | <ul style="list-style-type: none"> Timing adjustment pin. External CR for time constant circuit is connected here. |

LB1817W

Truth Table

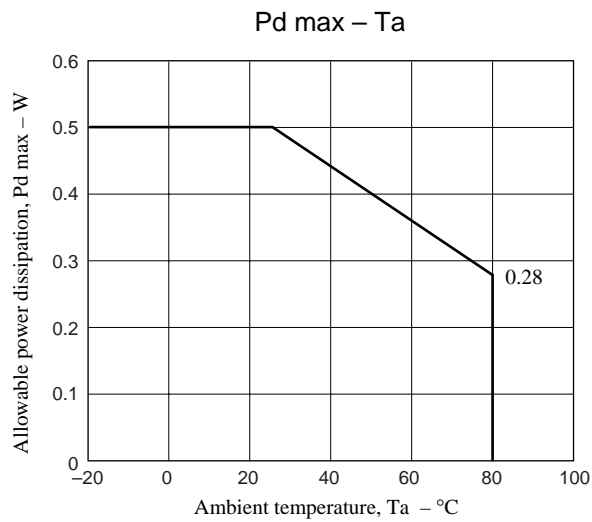
| | Source → Sink | Hall input | | |
|---|-------------------|------------|---|---|
| | | U | V | W |
| 1 | V phase → W phase | H | H | L |
| 2 | V phase → U phase | L | H | L |
| 3 | W phase → U phase | L | H | H |
| 4 | W phase → V phase | L | L | H |
| 5 | U phase → V phase | H | L | H |
| 6 | U phase → W phase | H | L | L |

Hall input pin High means $U_{IN1} > U_{IN2}$
 $V_{IN1} > V_{IN2}$
 $W_{IN1} > W_{IN2}$

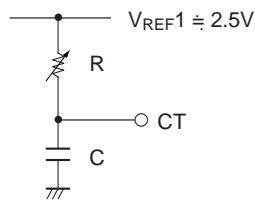
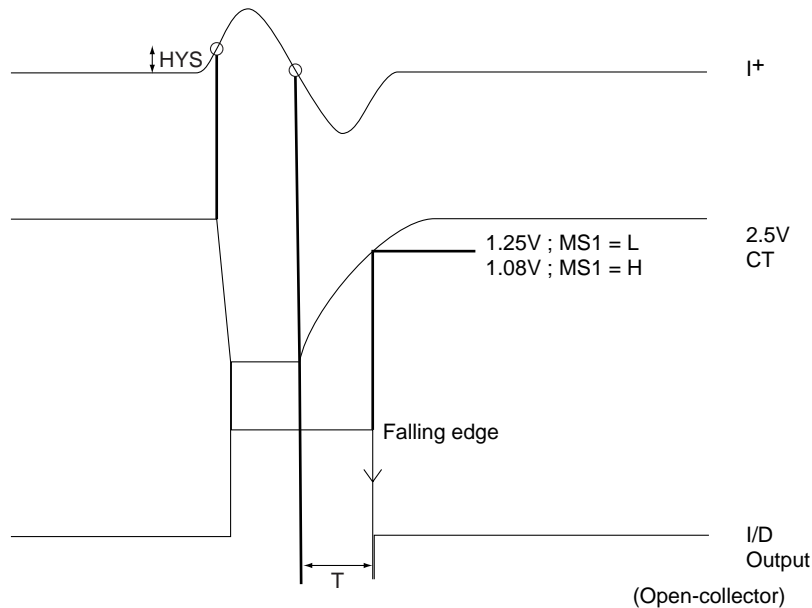
Rotation Speed Select Table

$f_{OSC} = 1 \text{ MHz}$

| MS1 | H | L | H | L | H | L | H | L |
|-----------------------|-----|-----|-----|-----|------|------|-----|-----|
| MS2 | H | | L | | H | | L | |
| MS3 | H | | L | | L | | H | |
| $f_{FG} \text{ [Hz]}$ | 720 | 600 | 720 | 600 | 1440 | 1200 | 360 | 300 |



Index and Timing Chart



$$T \cong 0.693CR \cdots MS1 = L$$

$$T \cong 0.578CR \cdots MS1 = H$$

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