Monolithic Digital IC

# LB1877M

## Brushless Motor Driver with Speed Control for Portable Cassette Recorders

## Overview

The LB1877M is a motor driver well suited for driving motors of minicassette recorders, headphone stereos, and microcasette recorders that use a 3V power supply.

## Package Dimensions
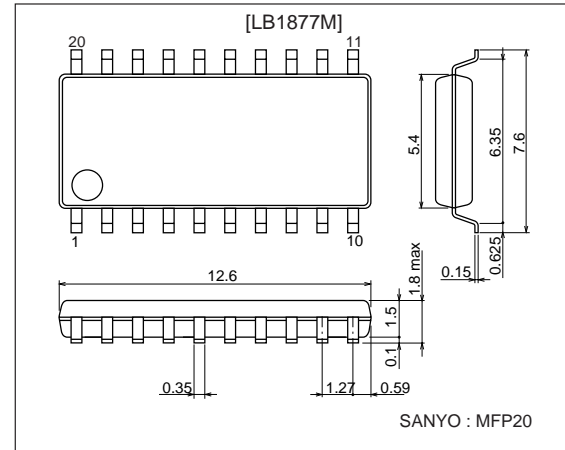
unit: mm

### 3036B-MFP20



[LB1877M]

SANYO : MFP20

## Functions and Features

- Brushless sensorless motor drive (3-phase half-wave drive)
- Forward/reverse drive possible
- Built-in speed control function (voltage servo)
- Built-in reference voltage (0.9V)
- Soft switching

## Specifications

### Absolute Maximum Ratings at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Maximum supply voltage | $V_{CC}$ max | | 6.0 | V |
| Maximum output current | IO max | | 0.5 | A |
| Allowable power dissipation | Pd max | | 0.5 | W |
| Operating temperature | Topr | | −10 to +80 | °C |
| Storage temperature | Tstg | | −40 to +150 | °C |

### Allowable Operating Ranges at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| Power supply voltage | $V_{CC}$ | | 1.8 to 5.0 | V |

## Electrical Characteristics at Ta = 25°C, $V_{CC}$ = 2.4V

| Parameter | Symbol | Conditions | Ratings | | | Unit | Measurement circuit |
|---|---|---|---|---|---|---|---|
| | | | min | typ | max | | |
| Power supply current | ICC1 | S/S pin High level | | 4.0 | | mA | 1 |
| | ICC2 | S/S pin Low level (standby) | | | 20 | μA | 2 |
| [S/S pin] | | | | | | | |
| S/S pin High level | SSH | Start | 1.5 | | $V_{CC}$ | V | 3 |
| S/S pin Low level | SSL | Stop | 0 | | 0.3 | V | 4 |
| [DR pin] | | | | | | | |
| DR pin High level | DRH | Reverse | 1.5 | | $V_{CC}$ | V | 9 |
| DR pin Low level | DRL | Normal direction | 0 | | 0.3 | V | 10 |
| [Internal reference voltage] | | | | | | | |
| Internal reference voltage | VREF | Output current 0 μA | 0.8 | 0.9 | 1.0 | V | 11 |
| Output current | IREF | Output current 250 μA | | | 25 | mV/250 μA | 12 |
| Reference voltage to power supply voltage characteristics | $\Delta$VREF/$\Delta V_{CC}$ | $V_{CC}$ = 1.8 to 5.0V | | | 5 | mV/V | 13 |
| Reference voltage to temperature characteristics | $\Delta$IREF/$\Delta$Ta | $V_{CC}$ = 2.4V | − 0.1 | | 0.3 | mV/°C | Target |
| [OSC pin] | | | | | | | |
| Charge current | Isc | | 3.0 | 4.5 | 6.0 | μA | 14 |
| [COM pin] | | | | | | | |
| Sink current | ICOM | | 17 | 24 | 33 | μA | 15 |
| [LB pin] | | | | | | | |
| Charge current | ILB | | 4.5 | 6.5 | 9.0 | μA | 16 |
| [VSP pin] | | | | | | | |
| Input voltage range | VIN | $V_{CC}$ = 2.4V | 0.15 | | 1.8 | V | 17 |
| Speed signal detection precision | VSP | VIN = 1V | 420 | 500 | 580 | mV | 18 |
| Speed signal relative precision | RSP | | − 6 | | 6 | % | Target |
| Speed signal to power supply voltage characteristics | $\Delta$VSP/$\Delta V_{CC}$ | $V_{CC}$ = 1.8 to 5.0V | | | 2.5 | mV/V | 19 |
| Speed signal to temperature characteristics | $\Delta$VSP/$\Delta$Ta | | − 0.1 | | 0.2 | mV/°C | Target |
| [IN+ pin] | | | | | | | |
| Input voltage range | VIN+ | $V_{CC}$ = 2.4V | 0.1 | | $V_{CC}$ − 0.7 | V | 20 |
| [OUT pin] | | | | | | | |
| Output current | IOUT | VIN+ = 1V | 25 | 30 | 47.3 | μA | 21 |
| [RI pin] | | | | | | | |
| Current detection precision | VRI | RI = 10 kΩ U, V, Wout = 2.3V | 10 | 20 | 35 | mV | 22 |
| [U, V, WOUT pins] | | | | | | | |
| Output saturation voltage | Vsat | IO = 200 mA | | | 0.25 | V | 23 |
| [Thermal] | | | | | | | |
| Thermal protection trigger temperature | TTSD | | | 180 | | °C | Target |
| Temperature hysteresis width | $\Delta$TTSD | | | 15 | | °C | Target |

Note: Items shown to be Target are not measured.

### Pd max – Ta



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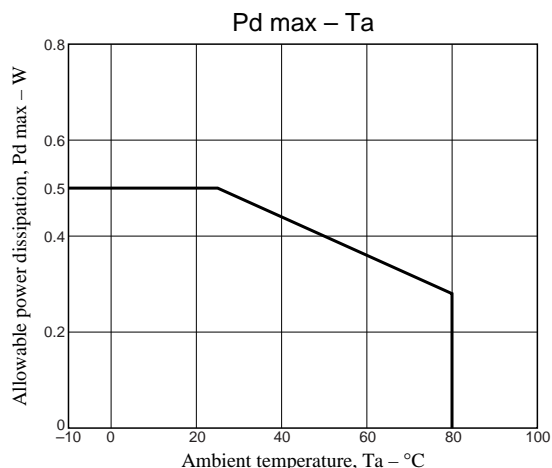
## Pin Function

| Pin number | Pin name | Function |
|---|---|---|
| 20 | UOUT | U-phase output |
| 1 | VOUT | V-phase output |
| 2 | WOUT | W-phase output |
| 6 | UB | U-phase base of 3-phase differential |
| 5 | VB | V-phase base of 3-phase differential |
| 4 | WB | W-phase base of 3-phase differential |
| 18 | VCC | Power supply |
| 7 | OSC | Startup oscillator pin |
| 8 | COM | Output waveform detection comparator voltage |
| 3 | P – GND | Output transistor and predriver ground |
| 9 | GND | Ground pin |
| 11 | S/S | Start/stop pin |
| 19 | DR | Forward/reverse pin |
| 12 | VREF | Reference voltage 0.9V |
| 14 | VSP | Output waveform peak detection pin |
| 13 | IN+ | Error amp non-inverted pin |
| 15 | OUT | Error amp output pin |
| 10 | RI | Current feedback resistor connection pin |
| 16 | FC | Frequency response adjustment pin |
| 17 | LB | Motor start lockup prevention.  Connect to GND via capacitor |

## Pin Assignment



| | | | |
|---|---|---|---|
| VOUT | 1 | 20 | UOUT |
| WOUT | 2 | 19 | DR |
| PGND | 3 | 18 | VCC |
| WB | 4 | 17 | LB |
| VB | 5 | 16 | FC |
| UB | 6 | 15 | OUT |
| OSC | 7 | 14 | VSP |
| COM | 8 | 13 | IN+ |
| GND | 9 | 12 | VREF |
| RI | 10 | 11 | S/S |

LB1877M

Top view
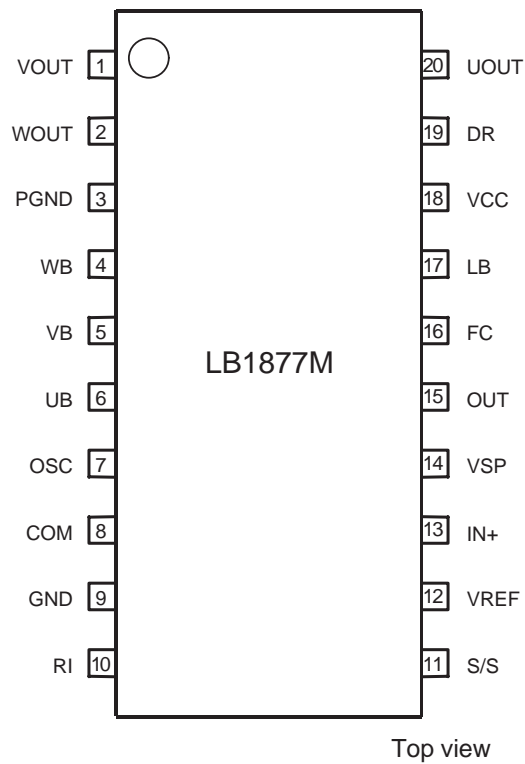
**Block Diagram**
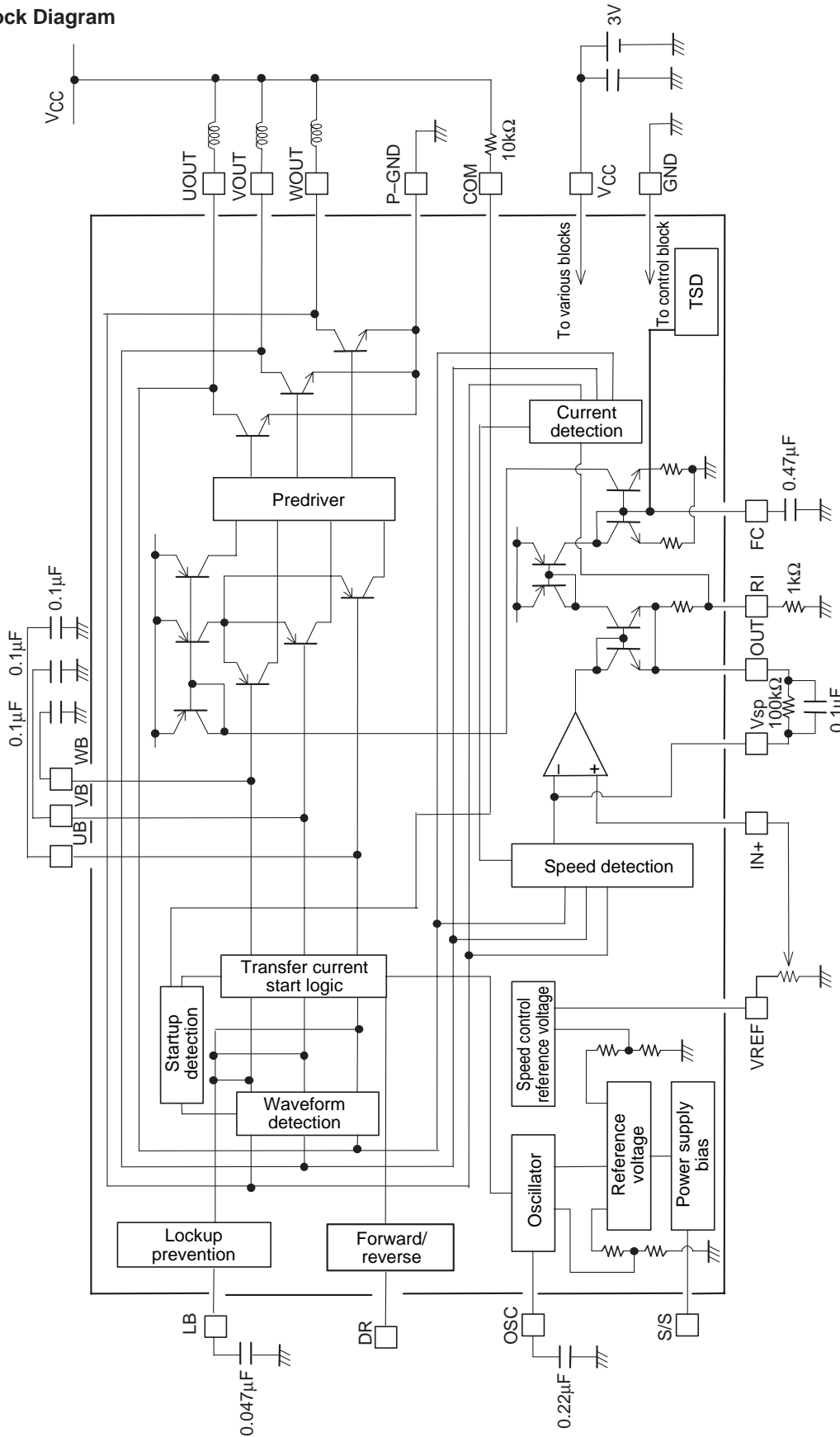


\* Constants given in the illustration are for reference only and are not guaranteed for all motors. Individual adjustment for each motor is required.

## Pin Description

Unit (resistance: Ω, capacitance: F)

| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|---|---|---|---|---|
| 18 | VCC | 1.8V to 5.0V | | Power supply for all circuits |
| 9 | GND | | | Ground for all circuits except FC and power block. |
| 12 | VREF | 0.7V to 0.9V |  | Internal reference voltage. Connected as speed control voltage to IN+ pin via external resistor. |
| 7 | OSC | 1V to Vcc |  | Startup oscillator pin. Adjusts self-excitation frequency via external capacitor. |
| 8 | COM | 1.3V to Vcc |  | Determines threshold voltage of waveform detection circuit. Connected to Vcc via an external resistor. Varies the startup threshold voltage. |
| 14 | VSP | 0.1V to Vcc – 0.7V |  | Peak detection circuit output pin. |
| 13 | IN+ | | | Error amplifier non-inverted pin. Controls rotation speed via input pin voltage. |
| 15 | OUT | | | Error amplifier output pin. Connect external resistor between Vsp pins for feedback. |
| 10 | RI | | | Current feedback output pin. Connect external resistor between this pin and ground for current feedback adjustment. |

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Unit (resistance: Ω, capacitance: F)

| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|---|---|---|---|---|
| 16 | FC | Voltage input not allowed | Drive current / 6k / 3S / 2k / To RI pin / 16 | Frequency characteristics adjustment pin. Connect to ground via capacitor. |
| 11 | S/S | 0 to Vcc | 80k / 50k / 50k / 11 | Start/stop pin. |
| 19 | DR | 0 to Vcc | 50k / 50k / 19 | Forward/reverse rotation pin. |
| 20 1 2 | UOUT VOUT WOUT | 0 to 8V | 20 1 2 / 100k | U, V, W phase output pins. Connect to motor coils |
| 17 | LB | 0 to 1V | 17 / 200 | Motor start lockup prevention. |
| 3 | P – GND | | | Power block ground. |

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| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|---|---|---|---|---|
| 4 | WB | Voltage | | Base pins for U, V, W |
| 5 | VB | input not | | differential. |
| 6 | UB | allowed | | Connect to ground via |
| | | | | capacitor for soft switching |



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