



ON Semiconductor®

# ON Semiconductor DATA SHEET

## LB11983 — Monolithic Digital IC For Fan Motor Driver for Refrigerator 3-Phase Sensorless Motor Driver

### Overview

The LB11983 is a 3-phase full-wave current linear sensorless motor driver. It is optimal for refrigerator fan motor drive.

### Features

- Current linear driving technique.
- Current limiter circuit.
- Over saturation prevention circuit for output stage.
- Provides coil back EMF FG output.
- Thermal shutdown circuit.
- Beat lock pervention circuit.

### Specifications

#### Maximum Ratings at Ta = 25°C

| Parameter                   | Symbol              | Conditions     | Ratings                      | Unit |
|-----------------------------|---------------------|----------------|------------------------------|------|
| Supply voltage              | V <sub>CC</sub> max |                | 14.5                         | V    |
| Output application voltage  | V <sub>O</sub> max  |                | 14.5                         | V    |
| Input application voltage   | V <sub>I</sub> max  |                | -0.3 to V <sub>CC</sub> +0.3 | V    |
| Output current              | I <sub>O</sub> max  |                | 1.0                          | A    |
| Allowable power dissipation | P <sub>d</sub> max  | Independent IC | 1.0                          | W    |
| Operating temperature       | T <sub>opr</sub>    |                | -30 to +85                   | °C   |
| Storage temperature         | T <sub>stg</sub>    |                | -55 to +150                  | °C   |

#### Operating Conditions at Ta = 25°C

| Parameter      | Symbol          | Conditions | Ratings   | Unit |
|----------------|-----------------|------------|-----------|------|
| Supply voltage | V <sub>CC</sub> |            | 7 to 13.8 | V    |

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**Electrical Characteristics** at  $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 12\text{V}$

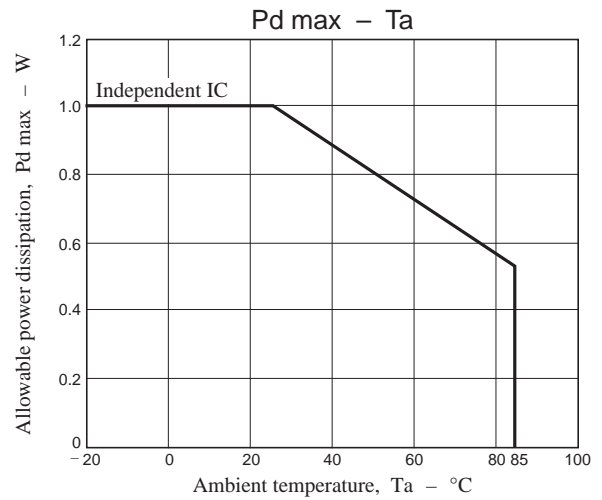
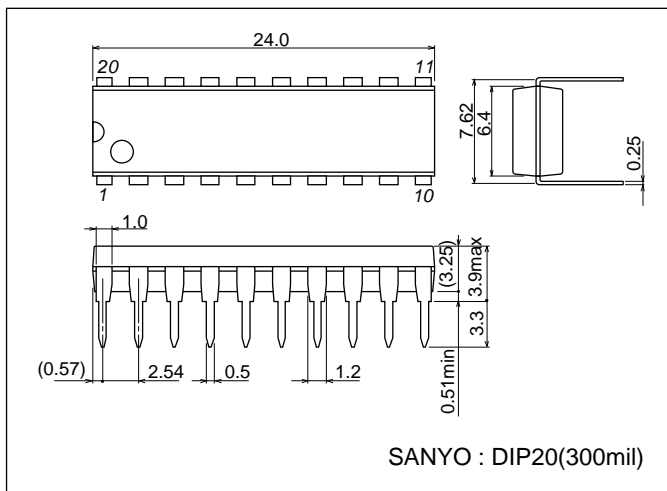
| Parameter                                | Symbol              | Conditions   | Ratings |      |            | Unit             |
|--|---------------------|--|---------|------|------------|------------------|
|  |                     |  | min     | typ  | max        |                  |
| Supply current                           | $I_{CC}$            | $V_C = V_{CC}$                                       |         | 20   | 30         | mA               |
| Output saturation voltage 1              | $V_{Osat1}$         | $I_O = 0.4\text{A}$ , Source + Sink                  |         | 1.4  | 2.0        | V                |
| Output saturation voltage 2              | $V_{Osat2}$         | $I_O = 0.8\text{A}$ , Source + Sink, $R_F = 0\Omega$ |         | 1.8  | 2.6        | V                |
| MCOM pin common-mode input voltage range | VIC                 |  | 0       |      | $V_{CC}-2$ | V                |
| PCOUT output current 1                   | IPCOU               | Source side  |         | -90  |            | $\mu\text{A}$    |
| PCOUT output current 2                   | IPCOD               | Sink side  |         | 90   |            | $\mu\text{A}$    |
| VCOIN input current                      | IVCOIN              | VCOIN = 5V   |         | 0.1  | 0.2        | $\mu\text{A}$    |
| VCO minimum frequency                    | fVCOMIN             | VCOIN = open   |         | 400  |            | Hz               |
| VCO maximum frequency                    | fVCOMAX             | VCOIN = 5V   |         | 18.5 |            | kHz              |
| C1, C2 source current ratio              | RSOURCE             | IC1SOURCE/IC2SOURCE                                  | -12     |      | +12        | %                |
| C1, C2 sink current ratio                | RSINK               | IC1SINK/IC2SINK                                      | -12     |      | +12        | %                |
| C1 source and sink current ratio         | RC1                 | IC1SOURCE/IC1SINK                                    | -35     |      | +15        | %                |
| C2 source and sink current ratio         | RC2                 | IC2SOURCE/IC2SINK                                    | -35     |      | +15        | %                |
| Counter FG output ON volt                | $V_{OL}$            |  |         |      | 0.4        | V                |
| Counter FG output OFF vol                | $V_{OH}$            |  | 4       |      |            | V                |
| Thermal shutdown operating temperature   | TTSD                | Design target value *                                | 150     | 180  | 210        | $^\circ\text{C}$ |
| Thermal shutdown hysteresis              | $\Delta\text{TTSD}$ | Design target value *                                |         | 15   |            | $^\circ\text{C}$ |

Note : \* These items are design target values and are not tested.

## Package Dimensions

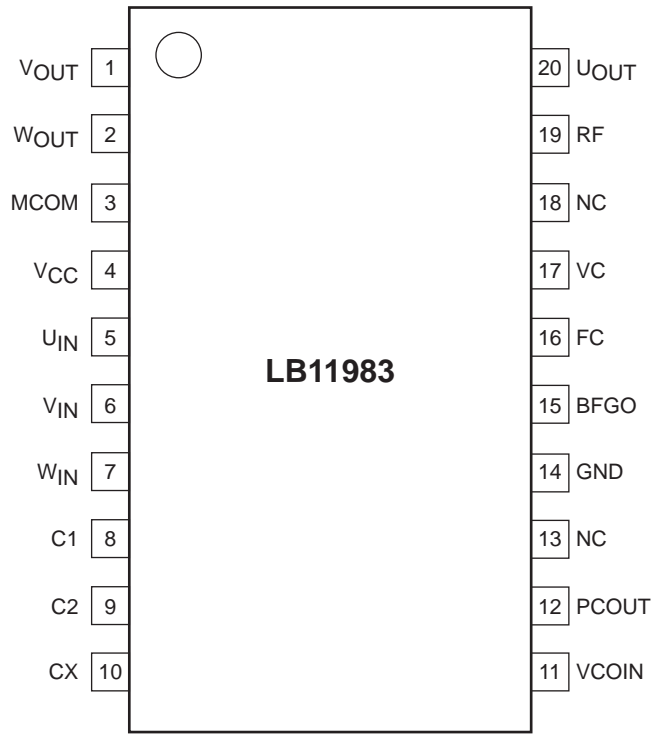
unit : mm (typ)

3021C



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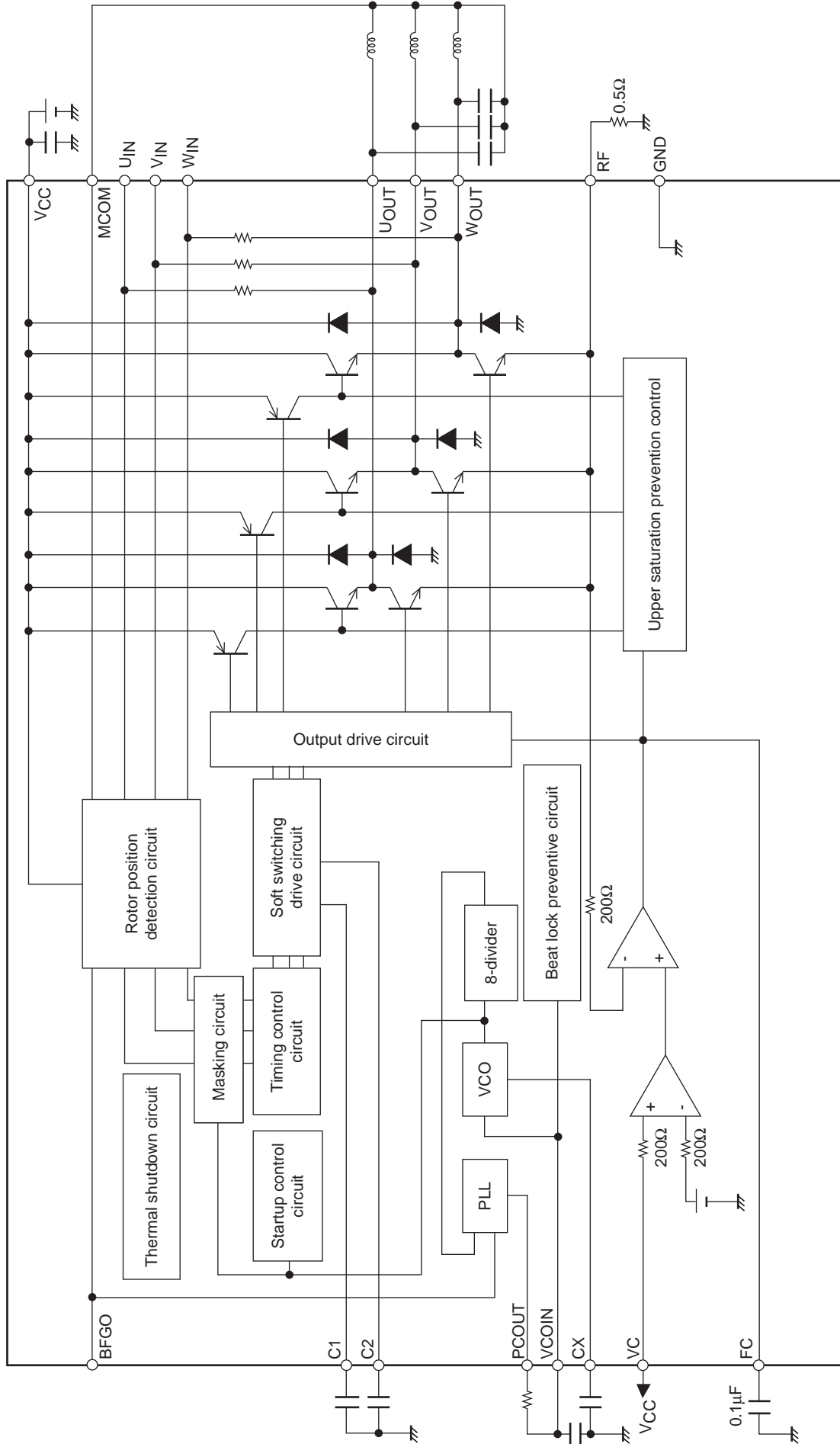
## Pin Assignment



Top view

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**Block Diagram** (External constant may vary depending on the motor used.)



Pin Functions

| Pin No. | Pin name         | Function   | Equivalent circuit |
|---------|------------------|--|--------------------|
| 20      | U <sub>OUT</sub> | Drum motor driver output pin.  |                    |
| 1       | V <sub>OUT</sub> |  |                    |
| 2       | W <sub>OUT</sub> |  |                    |
| 19      | RF               | Minimum potential of the drum motor driver output transistor. This voltage is detected for constant current control. The current limiter is also activated upon detection of this potential. |                    |
| 4       | V <sub>CC</sub>  | Power supply pin. (8 to 13.8V)   |                    |
| 3       | MCOM             | Middle point input pin of motor coil. The coil waveform is detected with reference to this voltage.  |                    |
| 5       | U <sub>IN</sub>  | Input pin of the coil waveform detection comparator. Connected to each phase output with a built-in resistor of 10kΩ   |                    |
| 6       | V <sub>IN</sub>  |  |                    |
| 7       | W <sub>IN</sub>  |  |                    |
| 8       | C1               | Triangular wave generating capacitor connection pin. This triangular wave causes soft switching of coil output waveform.   |                    |
| 9       | C2               |  |                    |
| 10      | CX               | The operating frequency range and minimum operating frequency are determined from the value of capacitor connected to this pin and GND in the VCO circuit.                                   |                    |
| 11      | VCOIN            | VCO circuit voltage input pin. Inputs the PCOUT pin voltage through CR filtering.  |                    |

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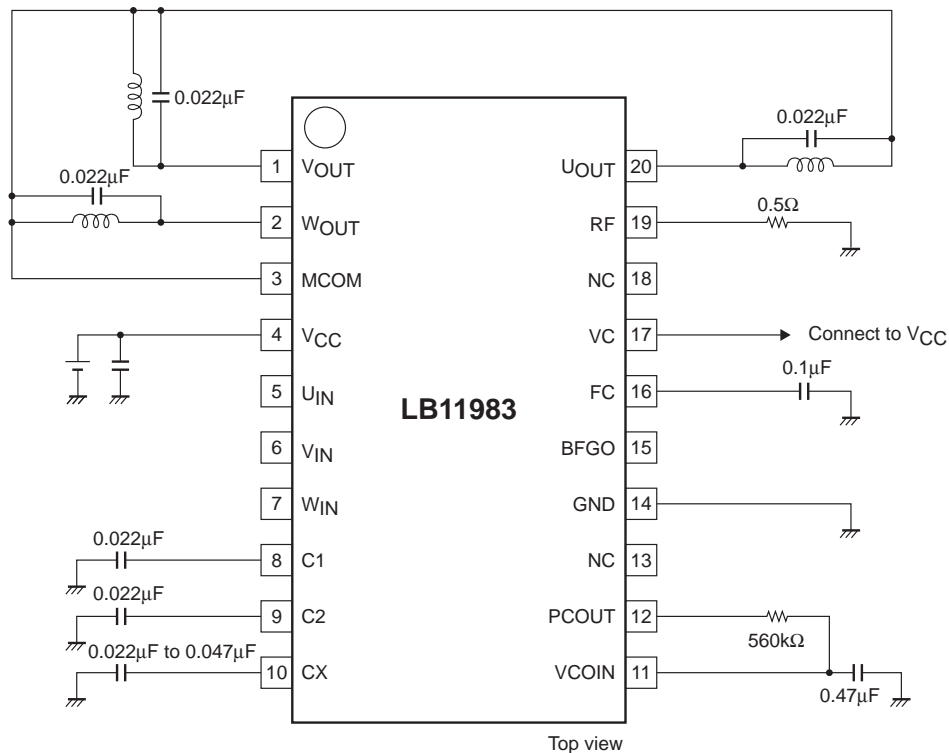
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| Pin No. | Pin name | Function   | Equivalent circuit |
|---------|----------|--|--------------------|
| 12      | PCOUT    | VCO circuit PLL output pin.  |                    |
| 14      | GND      | GND for others than the output transistor.   |                    |
| 15      | BFGO     | FG output to detect motor reverse feeder voltage. (Composition of three phases)  |                    |
| 16      | FC       | Frequency characteristics compensation pin. Insertion of a capacitor between this pin and GND stops oscillation of the current control closed loop.      |                    |
| 17      | VC       | Speed control pin. The control is a constant-current control under current feedback from RF. Normally, this pin is connected to V <sub>CC</sub> for use. |                    |

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## Sample Application Circuit (Reference)



- Notes
1. Be sure to connect the VC pin to VCC directly before use.
  2. For the constant of capacitor, etc., our value established through examination is given for reference. Adjust the value according to the motor to be used when considering this IC.
  3. If the output is not oscillated with the motor used, a capacitor inserted between output coil ends is not necessary.
  4. Pins 5 through 7 (UIN, VIN, and WIN) are not to be used by a user. These are connected inside IC and should always be kept independent and open.
  5. NC pins (14 and 18) are not connected inside IC and can be used as relay pins.

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