



LB1663, 1663M, 1666

2-Phase Unipolar Brushless Motor Drivers

Applications

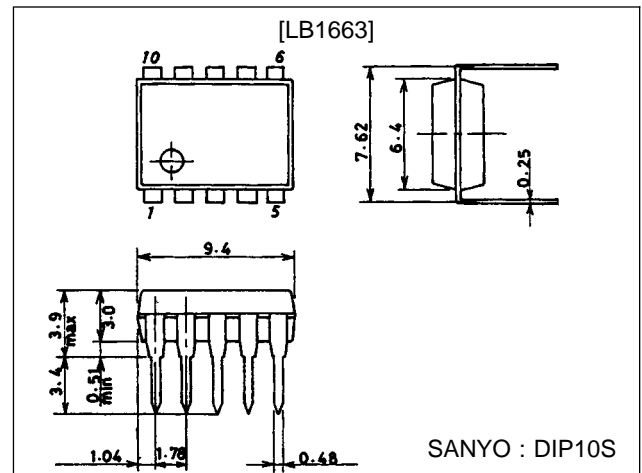
2-Phase unipolar brushless motor (ex. DC brushless fan motor) drivers

Features and Functions

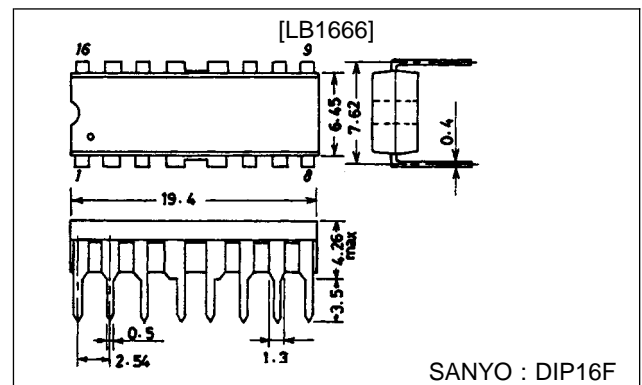
- Protection against motor lock and automatic return can be provided with a minimum number of external parts.
- The LB1663, LB1663M, LB1666 can be operated from either 12 V or 24 V power supply by changing an external resistor.
- Possible to connect a Hall element direct to the LB1663, LB1663M, LB1666.
- Built-in output transistors with output current 1.5 A.
- Built-in rotation detect function (Drive mode: "L", Stop mode: "H")
- Built-in thermal shutdown
- With radio noise reduction pin

Package Dimensions

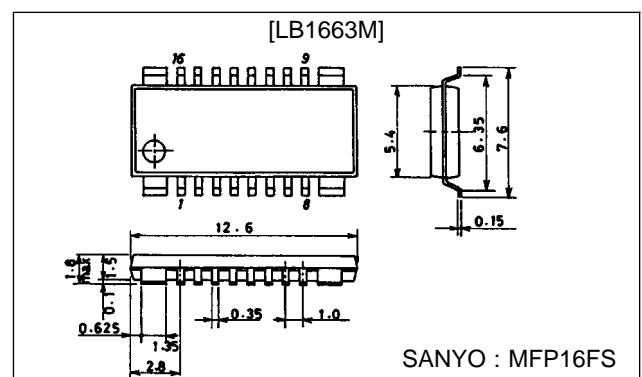
unit : mm
3098A - DIP10S



unit : mm
3054A - DIP16F



unit : mm
3097 - MFP16FS



Specifications

[LB1663]

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

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------|--------------|----------------|-------------|------------------|
| Maximum input current | I_{CC} max | $t \leq 20$ ms | 200 | mA |
| Output supply voltage | V_O max | | -0.3 to +85 | V |
| Maximum output current | I_O max | | 1.5 | A |
| RD flow-in current | I_{RD} | | 10 | mA |
| RD supply voltage | V_{RD} | | 50 | V |
| Allowable power dissipation | P_d max | | 1.2 | W |
| Operating temperature | T_{opr} | | -30 to +80 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -55 to +125 | $^\circ\text{C}$ |

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

| Parameter | Symbol | Conditions | Rating | Unit |
|---------------------------------|-----------|------------|---------------------|------|
| Input current range | I_{CC} | | 6.0 to 50.0 | mA |
| Common-mode input voltage range | V_{ICM} | | 0 to $V_{IN} - 1.5$ | V |

Electrical Characteristics at $T_a = 25^\circ\text{C}$, $I_{CC} = 10$ mA

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|------------------------------------|----------------|-------------------|------|---------------|------|---------------|
| Output withstand voltage 1 | V_{OR} | | 80 | | | V |
| Output withstand voltage 2 | V_O (sus) | $I_O = 0.1$ A | 65 | | | V |
| Output saturation voltage | V_O (sat)1 | $I_O = 0.5$ A | | 0.95 | 1.20 | V |
| | V_O (sat)2 | $I_O = 1.0$ A | | 1.15 | 1.50 | V |
| | V_O (sat)3 | $I_O = 1.5$ A | | 1.40 | 2.00 | V |
| V_{IN} input voltage | V_{IN} | $I_{CC} = 7.0$ mA | 6.4 | 6.7 | 7.0 | V |
| Amp input offset voltage | V_{off} | | -7 | 0 | +7 | mV |
| Amp input bias current | I_{BA} | | -250 | | | nA |
| RD output saturation voltage | V_{RD} (sat) | $I_{RD} = 5$ mA | | 0.1 | 0.2 | V |
| C flow-out current | I_{C1} | | 2.1 | 3.0 | 3.9 | μA |
| C discharge current | I_{C2} | | 0.31 | 0.44 | 0.59 | μA |
| Comparator input threshold voltage | V_{TH1} | | 0.77 | $0.8 V_{IN}$ | 0.83 | V |
| | V_{TH2} | | 0.42 | $0.45 V_{IN}$ | 0.48 | V |

[LB1663M] = Preliminary

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

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------|--------------|------------------------|-------------|------------------|
| Maximum input current | I_{CC} max | $t \leq 20$ ms | 200 | mA |
| Output supply voltage | V_O max | | -0.3 to +85 | V |
| Maximum output current | I_O max | | 1.5 | A |
| RD flow-in current | I_{RD} | | 10 | mA |
| RD supply voltage | V_{RD} | | 50 | V |
| Allowable power dissipation | P_d max | | 0.9 | W |
| | | * With specified board | 1.2 | W |
| Operating temperature | T_{opr} | | -30 to +80 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -55 to +125 | $^\circ\text{C}$ |

* Note: $20 \times 30 \times 1.5$ mm³ glass epoxy board

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| Input current range | I_{CC} | | 6.0 to 50.0 | mA |
| Common-mode input voltage range | V_{ICM} | | 0 to $V_{IN}-1.5$ | V |

Electrical Characteristics at $T_a = 25^\circ\text{C}$, $I_{CC} = 10\text{ mA}$

| Parameter | Symbol | Conditions | min | typ | max | Unit |
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| Output withstand voltage 2 | V_O (sus) | $I_O = 0.1\text{ A}$ | 65 | | | V |
| Output saturation voltage | V_O (sat)1 | $I_O = 0.5\text{ A}$ | | 0.95 | 1.20 | V |
| | V_O (sat)2 | $I_O = 1.0\text{ A}$ | | 1.15 | 1.50 | V |
| | V_O (sat)3 | $I_O = 1.5\text{ A}$ | | 1.40 | 2.00 | V |
| V_{IN} input voltage | V_{IN} | $I_{CC} = 7.0\text{ mA}$ | 6.4 | 6.7 | 7.0 | V |
| Amp input offset voltage | V_{off} | | -7 | 0 | +7 | mV |
| Amp input bias current | I_{BA} | | -250 | | | nA |
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| C discharge current | I_{C2} | | 0.31 | 0.44 | 0.59 | μA |
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[LB1666]

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| RD supply voltage | V_{RD} | | 50 | V |
| Allowable power dissipation | P_d max | | 2.0 | W |
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Allowable Operating Ranges at $T_a = 25^\circ\text{C}$

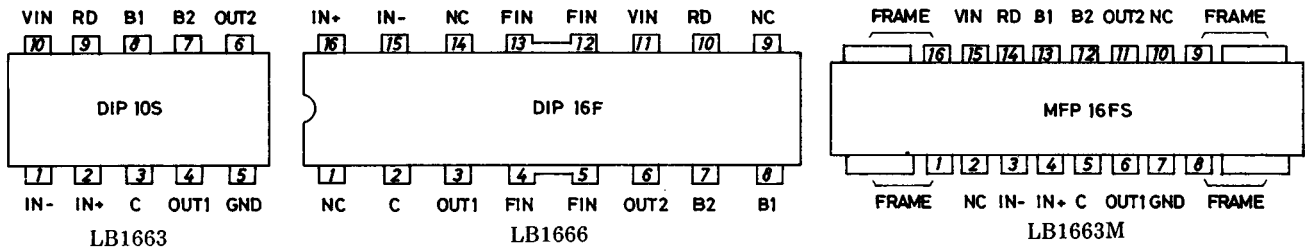
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| C discharge current | I_{C2} | | 0.21 | 0.30 | 0.39 | μA |
| Comparator input threshold voltage | V_{TH1} | | 0.77 | $0.8 V_{IN}$ | 0.83 | V |
| | V_{TH2} | | 0.42 | $0.45 V_{IN}$ | 0.48 | V |

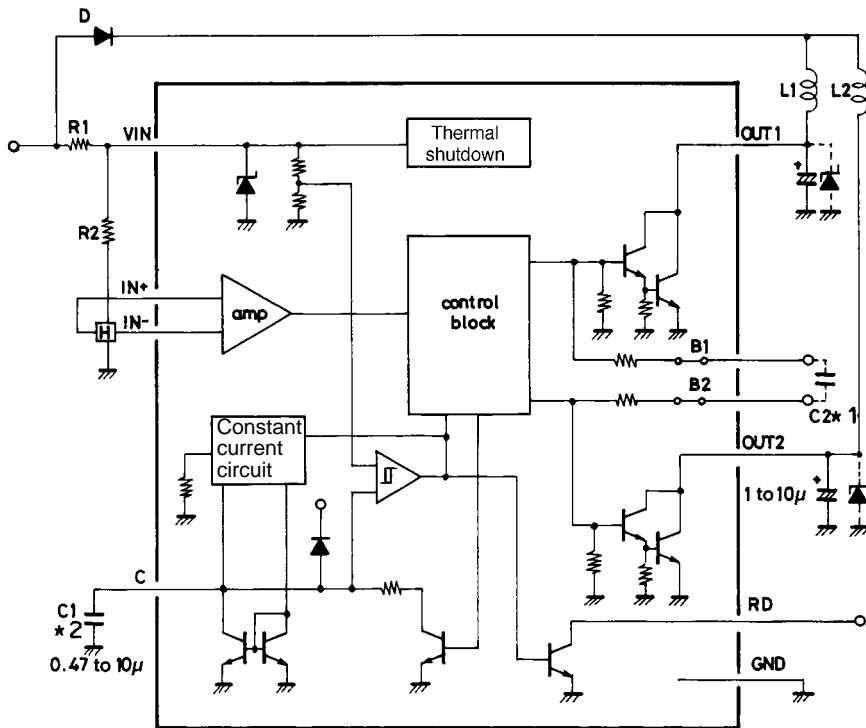
LB1663, 1663M, 1666

Pin Assignment



Top view

Equivalent Circuit Block Diagram and Sample Application Circuit

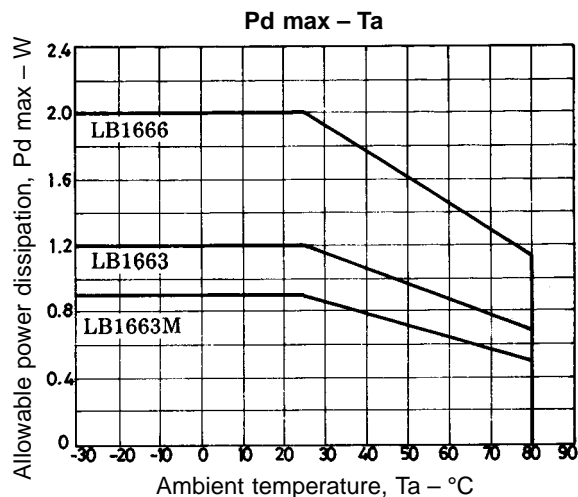


(Note) *1: Radio noise reduction capacitor: 0.01 to 0.1 μ F.
 *2: Use a less leaky capacitor.

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Truth Table

| IN+ | IN- | C | OUT1 | OUT2 |
|-----|-----|---|------|------|
| H | L | L | H | L |
| L | H | L | L | H |
| H | L | H | H | H |
| L | H | H | H | H |

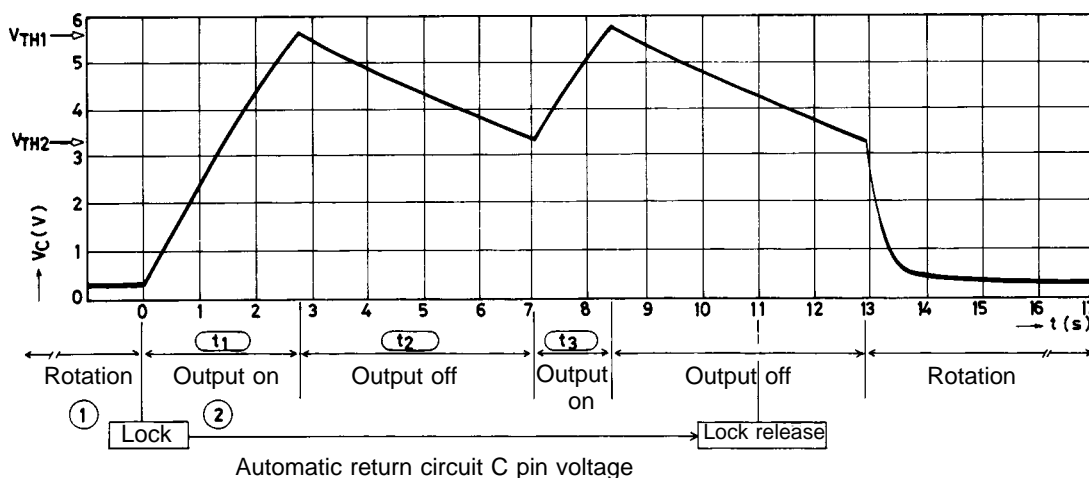


Output Protection

| | | |
|-----------------------------|--------------------------------|------------------|
| For C marked with 1 μ F | Lock detect time | Approximately 2s |
| | Lock protect time (output on) | Approximately 1s |
| | Lock protect time (output off) | Approximately 6s |

Pin Description

| Pin Name | Function |
|--------------|--|
| V_{IN} | A limiting resistor is connected across V_{CC} and V_{IN} to adjust the current flowing into V_{IN} to be 6 mA to 50 mA, which generates a voltage (6.7 V) on this pin and supplies a regulated voltage to the IC system and a Hall element. |
| IN+ IN- | Pins for accepting output from Hall element. Common-mode input voltage range: 0 to $V_{IN}-1.5$ V Offset voltage: ± 7 mV |
| OUT1 OUT2 | Output transistors of output pins are Darlington-connected. External capacitors or Zener diodes must be connected to protect output transistors. |
| RD | Open collector output (Drive mode - "L", Stop mode - "H") |
| B1 B2 | Base pins for output transistors of Darlington connection. A capacitor must be connected in an application where radio noise becomes a problem. |
| C | Capacitor pin for automatic return function When the rotation is stopped by an overload, the voltage on this pin is increased, turning OFF the output. Automatic return from output "stop" to "drive" occurs by making the load proper. The lock detect time can be set by changing the capacitor constant. |
| GND | Ground |



- ① When a fan is rotating, the capacitor is charged at 3 μ A (typ) and discharged through the C with pulses according to the rotational speed.
- ② When a fan is locked, no discharge occurs through the C and the C voltage rises, turning OFF the output at $0.8 \times V_{IN}$.
- ③ When the output is turned OFF, discharge occurs through the C at 0.44 μ A (typ). If the lock is not released when the C voltage drops to V_{TH2} , the capacitor is charged to V_{TH1} again. (At this moment, the output is turned ON.)
These operations ②, ③ repeated on a cycle of approximately t on : t off = 1 : 6 protect a motor.
- ④ If the lock is released when the C voltage drops to V_{TH2} , the output is turned ON, starting rotation.

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