Ordering number: EN 2552C

Monolithic Digital IC

LB1663, 1663M, 1666

2-Phase Unipolar Brushless Motor Drivers

Applications

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

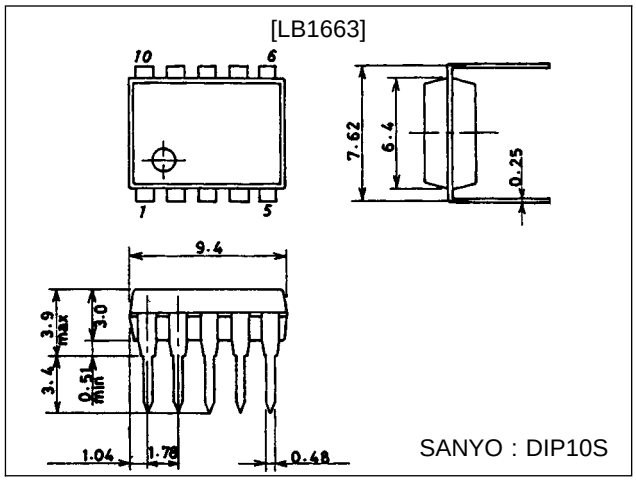
Features and Functions

- 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

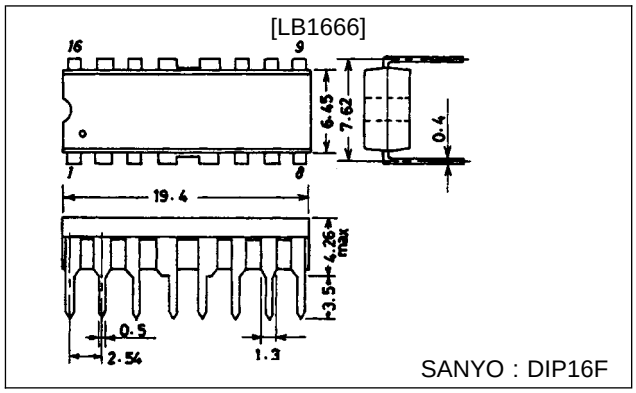
unit : mm

3098A - DIP10S



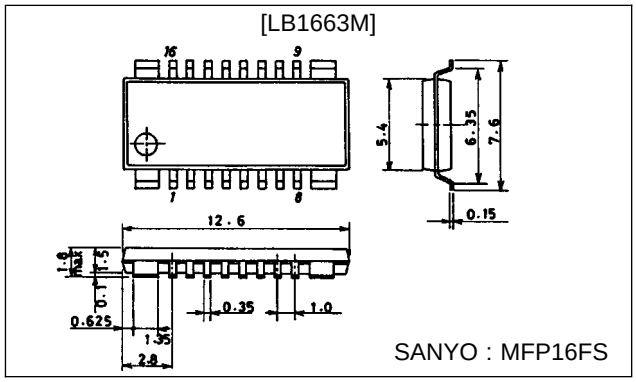
unit : mm

3054A - DIP16F



unit : mm

3097 - MFP16FS



Specifications

[LB1663]

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum input current	I_{CC} max	t ≦ 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	Pd max		1.2	W
Operating temperature	Topr		–30 to +80	°C
Storage temperature	Tstg		–55 to +125	°C

Allowable Operating Ranges at Ta = 25°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 Ta = 25°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	$V_{TH}1$		0.77	0.8 V_{IN}	0.83	V
	$V_{TH}2$		0.42	0.45 V_{IN}	0.48	V

[LB1663M] = Preliminary

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum input current	I_{CC} max	t ≦ 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	Pd max		0.9	W
		* With specified board	1.2	W
Operating temperature	Topr		–30 to +80	°C
Storage temperature	Tstg		–55 to +125	°C

* Note: $20 \times 30 \times 1.5$ mm^3 glass epoxy board

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	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 Ta = 25°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_{TH}1		0.77	0.8 V_{IN}	0.83	V
	V_{TH}2		0.42	0.45 V_{IN}	0.48	V

[LB1666]

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum input current	I_{CC} max	t ≦ 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	Pd max		2.0	W
Operating temperature	Topr		–30 to +80	°C
Storage temperature	Tstg		–55 to +125	°C

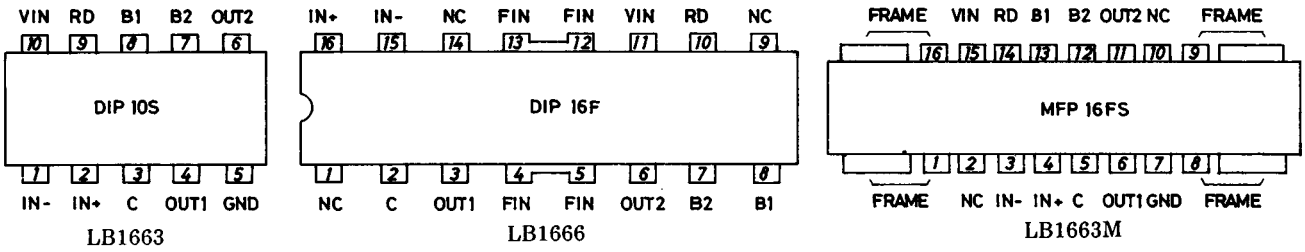
Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	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 Ta = 25°C, I_{CC} = 10 mA

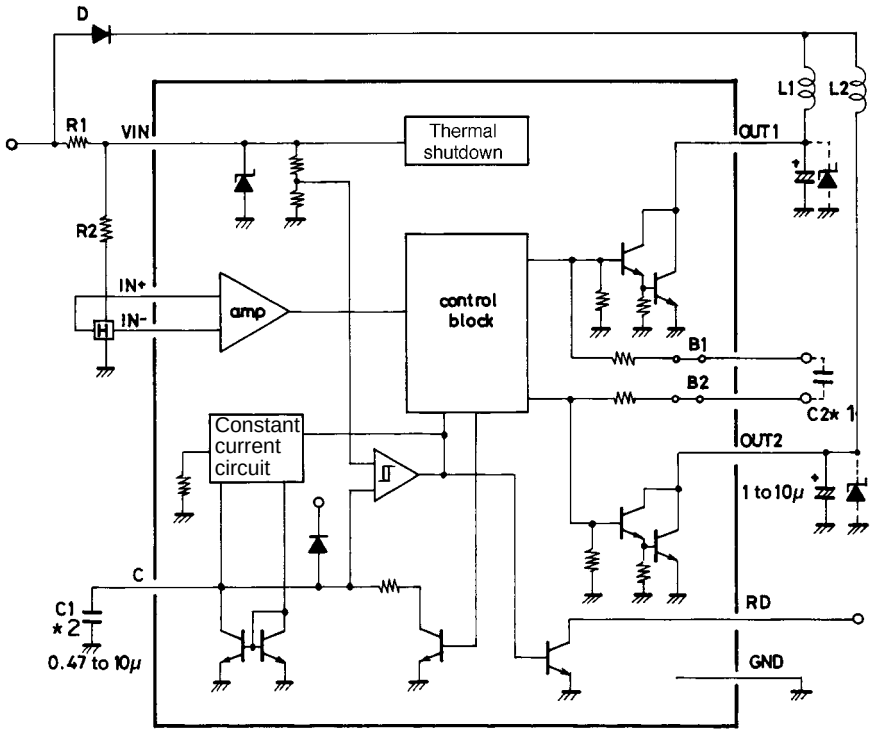
Parameter	Symbol	Conditions	min	typ	max	Unit
Output withstand voltage 1	V_{OR}		80			V
Output withstand voltage 2	V_O (sus)	I_O = 1.0 A	65			V
Output saturation voltage	V_O (sat)1	I_O = 0.5 A		0.95	1.20	V
	V_O (sat)2	I_O = 1.0 A		1.15	1.50	V
	V_O (sat)3	I_O = 1.5 A		1.40	2.00	V
V_{IN} input voltage	V_{IN}	I_{CC} = 7.0 mA	6.4	6.7	7.0	V
Amp input offset voltage	Voff		–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		0.21	0.30	0.39	µA
Comparator input threshold voltage	V_{TH}1		0.77	0.8 V_{IN}	0.83	V
	V_{TH}2		0.42	0.45 V_{IN}	0.48	V

Pin Assignment



Top view

Equivalent Circuit Block Diagram and Sample Application Circuit

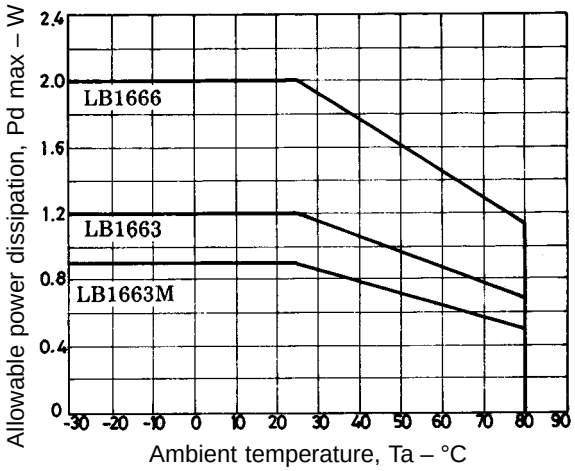


(Note) *1: Radio noise reduction capacitor: 0.01 to 0.1 μF.
*2: Use a less leaky capacitor.

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

Pd max – Ta

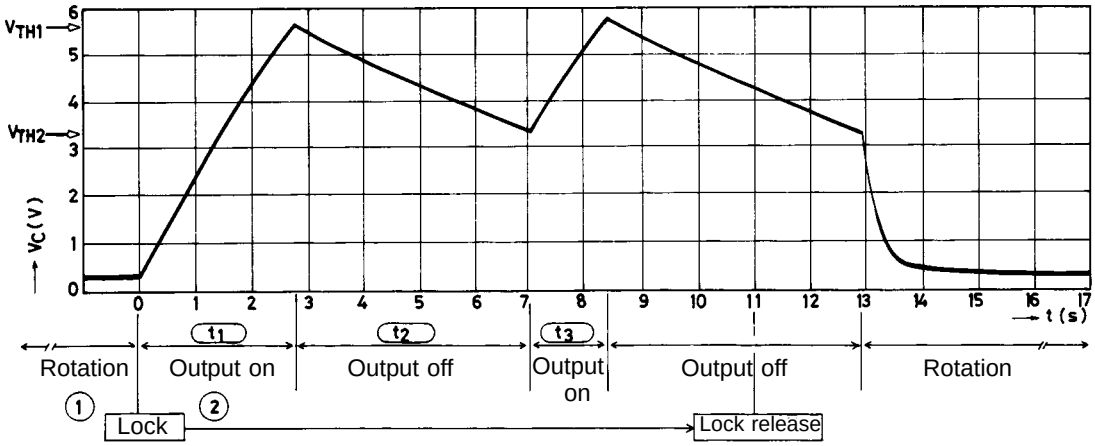


Output Protection

For C marked with 1 µF	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



Automatic return circuit C pin voltage

① When a fan is rotating, the capacitor is charged at 3 μA (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 μA (typ). If the lock is not released when the C voltage drops to $V_{TH}2$, the capacitor is charged to $V_{TH}1$ 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 $V_{TH}2$, the output is turned ON, starting rotation.