

SANYO

No.3120

LB1670M**Driver for Brushless, Sensorless Motors****Applications**

- Rotational control of brushless, sensorless motors for use in audio applications such as headphone stereos, (CD) radio-cassette recorders, CD players and other general-purpose applications

Functions and Features

- Bidirectional motor driver
- Speed control function on-chip
- STOP/START pin on-chip
- Stable reference voltage on-chip (0.5V)
- One comparator on-chip (NPN open collector output)
- Wide operating voltage range (1.8 to 12V)

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

			unit
Maximum Supply Voltage	$V_{CC \text{ max}}$	15	V
Output Transistor Voltage	$V_{OTR \text{ max}}$	30	V
Maximum Output Current	$I_M \text{ max}$	1.5	A
Allowable Power Dissipation	$P_d \text{ max}$	1	W
Operating Temperature	T_{opr}	-20 to +80	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125	$^\circ\text{C}$

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

			unit
Operating Voltage Range	$V_{CC \text{ op}}$	1.8 to 12	V

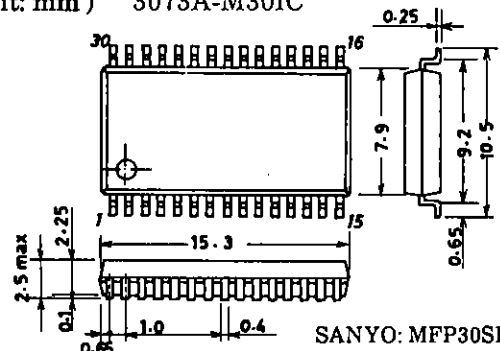
Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = 10\text{V}$ unless otherwise specified

			min	typ	max	unit
Current Dissipation	I_{CC1}	STOP pin Low		9.5	13.5	mA
		STOP pin High		0.5	1.0	mA
Reference Voltage	V_{ref}		0.475	0.5	0.535	V
Voltage Characteristic of Reference Voltage	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta V_{CC}$	$V_{CC} = 1.8 \text{ to } 12\text{V}$		0.07	0.15	%/V
Load Characteristic of Reference Voltage	$\frac{\Delta V_{ref}}{V_{ref}}$	$I_{ref} = 0 \text{ to } -300\mu\text{A}$		-0.5	-0.2	%
Temperature Characteristic of Reference Voltage	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta T_a$	$T_a = -20 \text{ to } +80^\circ\text{C}$		0.01		%/ $^\circ\text{C}$

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Package Dimensions

(unit: mm) 3073A-M30IC



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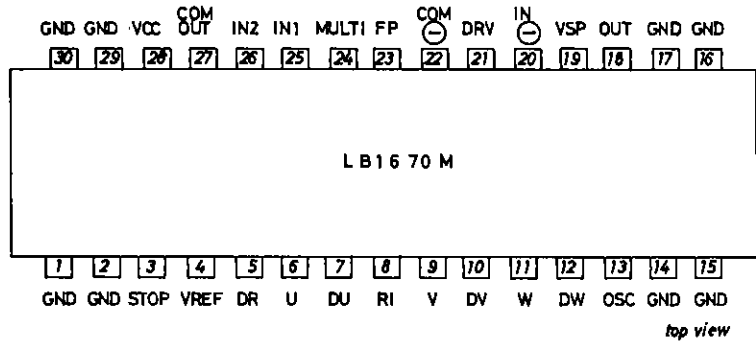
SANYO Electric Co., Ltd. Semiconductor Business Headquarters
 TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

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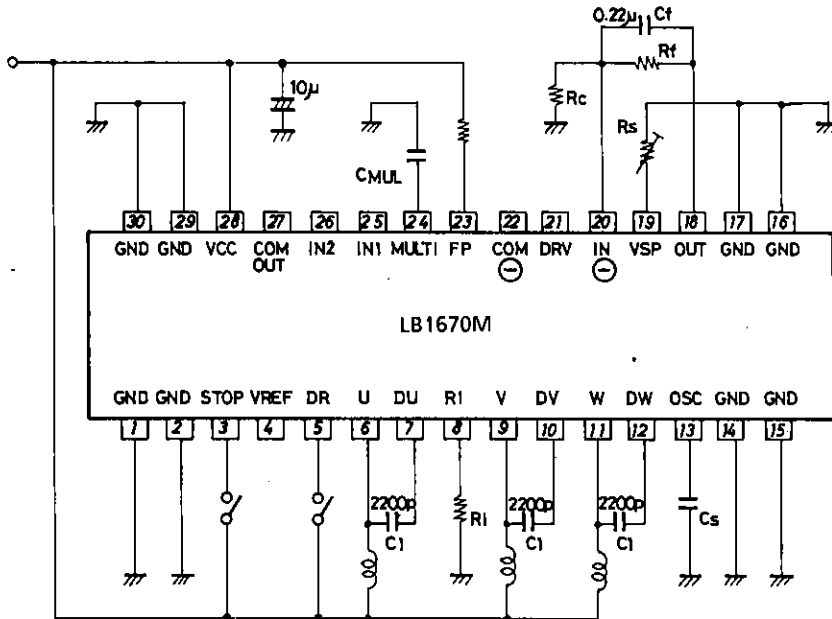
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			min	typ	max	unit
Speed Signal Detection Accuracy	V _{sp}	V _{IN} =1.0V	470	500	540	mV
Difference between Two Phases of Speed Signal Voltage			-5		5	%
Voltage Characteristic of Speed Signal	$\frac{\Delta V_{sp}}{V_{sp}} / \Delta V_{CC}$			0.15	0.3	%/V
Temperature Characteristic of Speed Signal	$\frac{\Delta V_{sp}}{V_{sp}} / \Delta T_a$			0.05		%/°C
Output Saturation Voltage	V _{sat}	I _M =0.3A, V _{CC} =1.8V		0.15	0.3	V
Starting Pulse Time	T _s	C _s =1μF		40		ms
Voltage Drop at COM ⊖	V _{COM⊖}		0.255	0.325	0.405	A
Monostable Multivibrator Output Current	I _{MUL}		9	13	16.5	μA
Comparator Offset Voltage	V _{OFF}		-10	0	10	mV

Pin Assignment

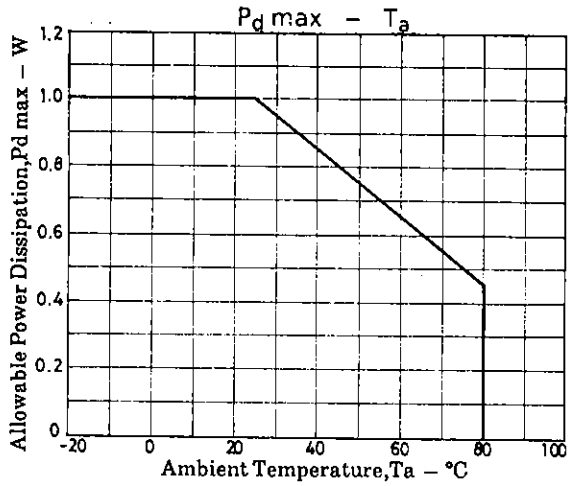


Sample Application Circuit

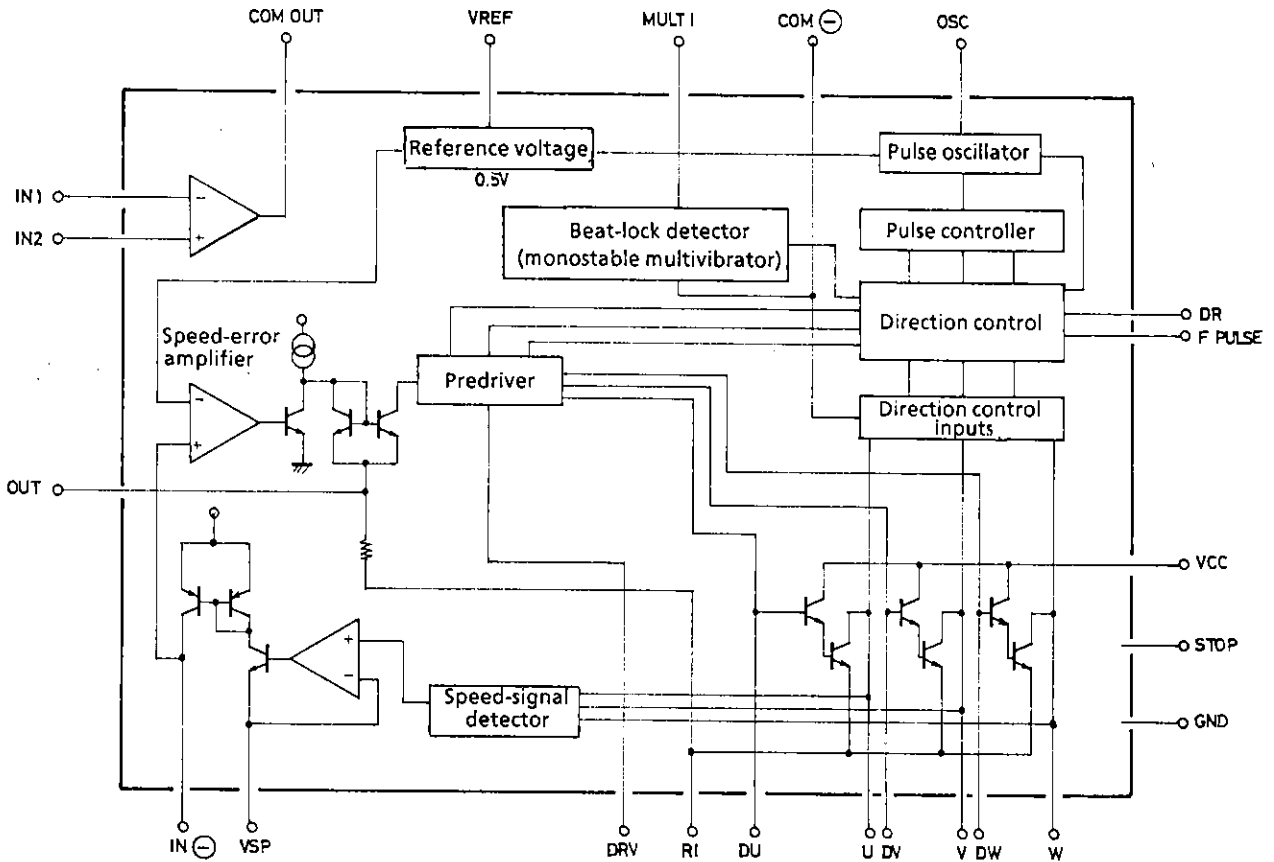


Unit (capacitance: F)

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Equivalent Circuit Block Diagram



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Pin Descriptions

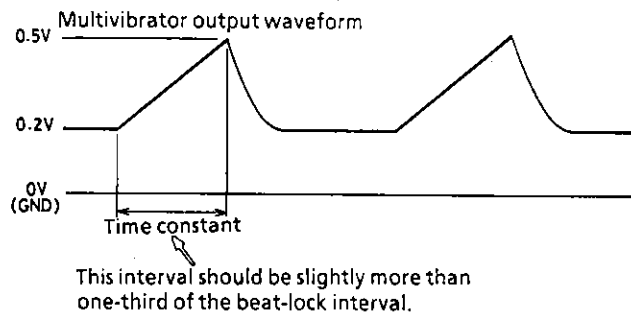
Pin Name	Description
V _{CC}	Power supply
GND	Ground for all pins, except output pins
R _i	Connected to a resistor which determines the response of the motor current detector circuit.
U (V,W)	Driver output pins
DU (DV,DW)	Base of power transistor. To connect capacitors to ground for suppress oscillation of circuit.
DR	Direction control. Threshold voltage : 1.5V
STOP	Halts all functions with setting High voltage. Threshold voltage : 1.5V
V _{ref}	0.5V reference for speed control
OSC	Capacitor connected to this pin determines the starting pulse frequency.
V _{sp}	Induced voltage detector. Level is approximately half that of the motor's induced voltage.
IN \ominus	Input to the speed error amplifier. Connected to V _{sp} through a 1:1 current mirror circuit.
OUT	Output from the speed error amplifier. A resistor connects it to R _i , forming a current feedback loop.
DRV	Input to the final stage of the predriver. The motor stops when this pin is grounded. Applying a voltage greater than V _{BE} (transistor base-emitter voltage) rotates the motor at high speed. Voltage should not exceed 0.8V.
F-PULSE	Frequency pulse. Connecting this pin to V _{CC} through a resistor of at least 20k Ω generates a pulse each time the conducting phase changes. These pulses form a rough measure of motor speed.
MULTI	Monostable multivibrator. The capacitor attached to this pin determines the time constant of the monostable multivibrator used to generate a signal to prevent beat lock.
COM \ominus	Commutator. Monitors the junction between the monostable multivibrator and the commutator to ensure that the former has the proper time constant.
IN1	Negative input for drive circuit's built-in comparator.
IN2	Positive input for drive circuit's built-in comparator.
COM-OUT	Comparator output (open-collector NPN transistor output)

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Setting Circuit Constants

Circuit Constants	Setting
R_S	Speed adjustment. This resistance should be in the same range as R_C .
R_i	Motor current detector. The circuit feeds this current back to the servo circuit. Note that the relative sizes of R_i , R_f and R_c determine the motor's torque characteristics.
R_f	Feedback from R_i to $IN\ominus$. This resistance is in the 10k Ω to 50k Ω range.
R_p	Speed detector. The chip generates a pulse at F-PULSE each time the conducting phase changes. This resistance should be at least 20k Ω .
C_M	Beat lock detector. The larger this capacitance, the greater the monostable multivibrator's time constant. A capacitance of 0.1 μ F, for example, results in a time constant of 2.2ms. The time constant selected should be slightly more than one-third the frequency at which the motor fails to turn. To determine the time constant, examine the waveform at MULTI while the motor is turning.
C_S	Starting pulse timing. The starting pulse interval is proportional to this capacitance. A capacitance of 1 μ F, for example, results in an interval of 40ms.
R_C	Speed control. The ratio of this resistance to S_r determines the motor speed. The resistance should be in the 5k Ω to 20k Ω range.

Setting Multivibrator Time Constant



Calculating Torque Characteristics

For a servo application, the percentage change in motor speed per 1gcm of additional load is given by the following formula.

$$\begin{aligned} \frac{\Delta N}{N} &= \frac{1}{K_T} \cdot \frac{1}{V_{ref}} \cdot \frac{R_C R_i}{R_f} \times 100 (\%) \\ &= \frac{1}{K_T} \cdot \frac{1}{0.5V} \cdot \frac{R_C R_i}{R_f} \times 100 (\%) \end{aligned}$$

where K_T is the torque constant (in gcm/A).