

**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 Ta = 25°C**

			unit
Maximum Supply Voltage	V <sub>CC</sub> max	15	V
Output Transistor Voltage	V <sub>OTR</sub> max	30	V
Maximum Output Current	I <sub>M</sub> max	1.5	A
Allowable Power Dissipation	P <sub>d</sub> max	1	W
Operating Temperature	T <sub>opr</sub>	-20 to +80	°C
Storage Temperature	T <sub>stg</sub>	-40 to +125	°C

**Allowable Operating Conditions at Ta = 25°C**

			unit
Operating Voltage Range	V <sub>CC</sub> op	1.8 to 12	V

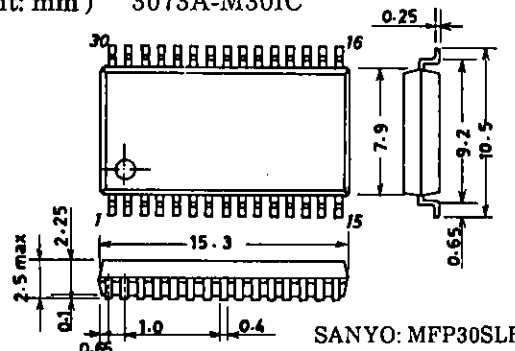
**Electrical Characteristics at Ta = 25°C, V<sub>CC</sub> = 10V unless otherwise specified**

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

Continued on next page.

**Package Dimensions**

(unit: mm) 3073A-M30IC

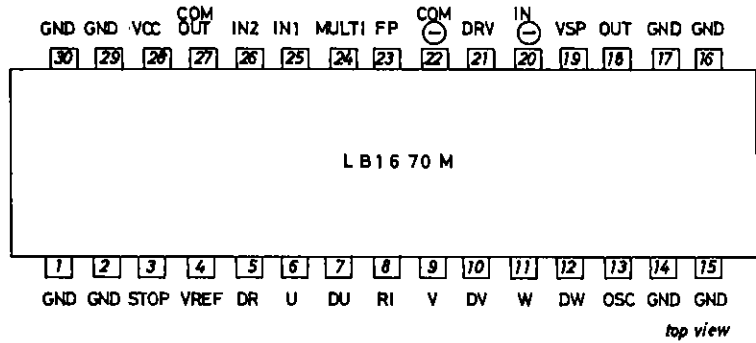


# LB1670M

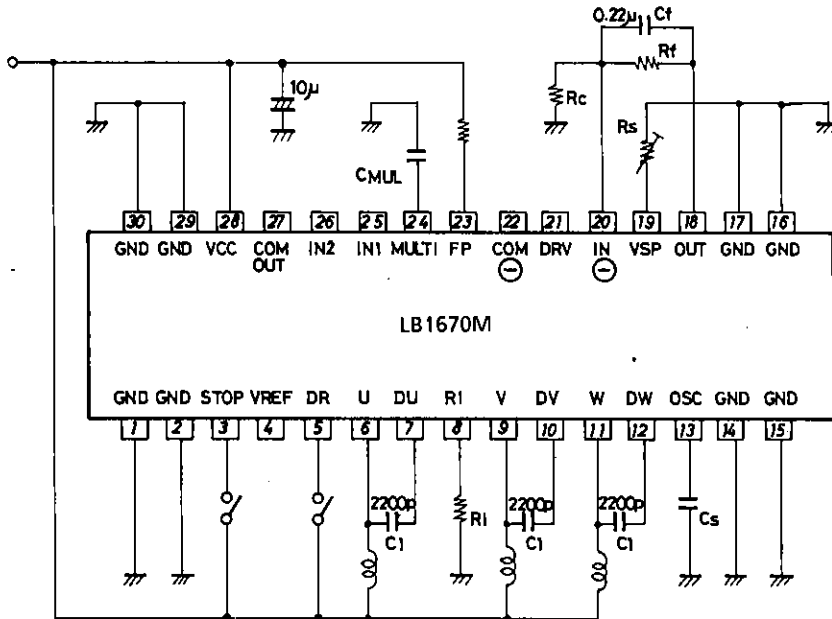
Continued from preceding page.

			min	typ	max	unit
Speed Signal Detection Accuracy	V <sub>sp</sub>	V <sub>IN</sub> =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 <sub>sat</sub>	I <sub>M</sub> =0.3A, V <sub>CC</sub> =1.8V		0.15	0.3	V
Starting Pulse Time	T <sub>s</sub>	C <sub>s</sub> =1μF		40		ms
Voltage Drop at COM ⊖	V <sub>COM⊖</sub>		0.255	0.325	0.405	A
Monostable Multivibrator Output Current	I <sub>MUL</sub>		9	13	16.5	μA
Comparator Offset Voltage	V <sub>OFF</sub>		-10	0	10	mV

## Pin Assignment

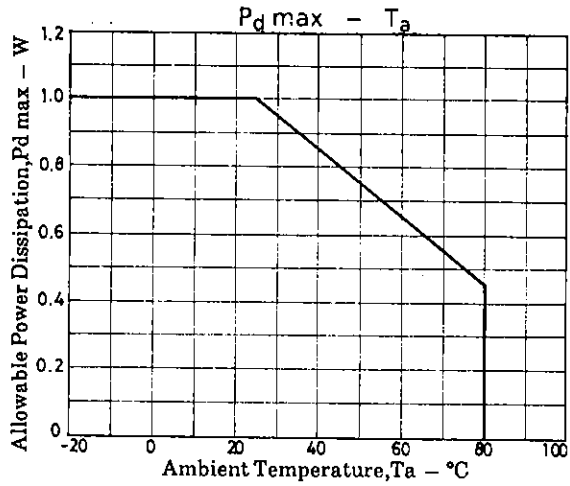


## Sample Application Circuit

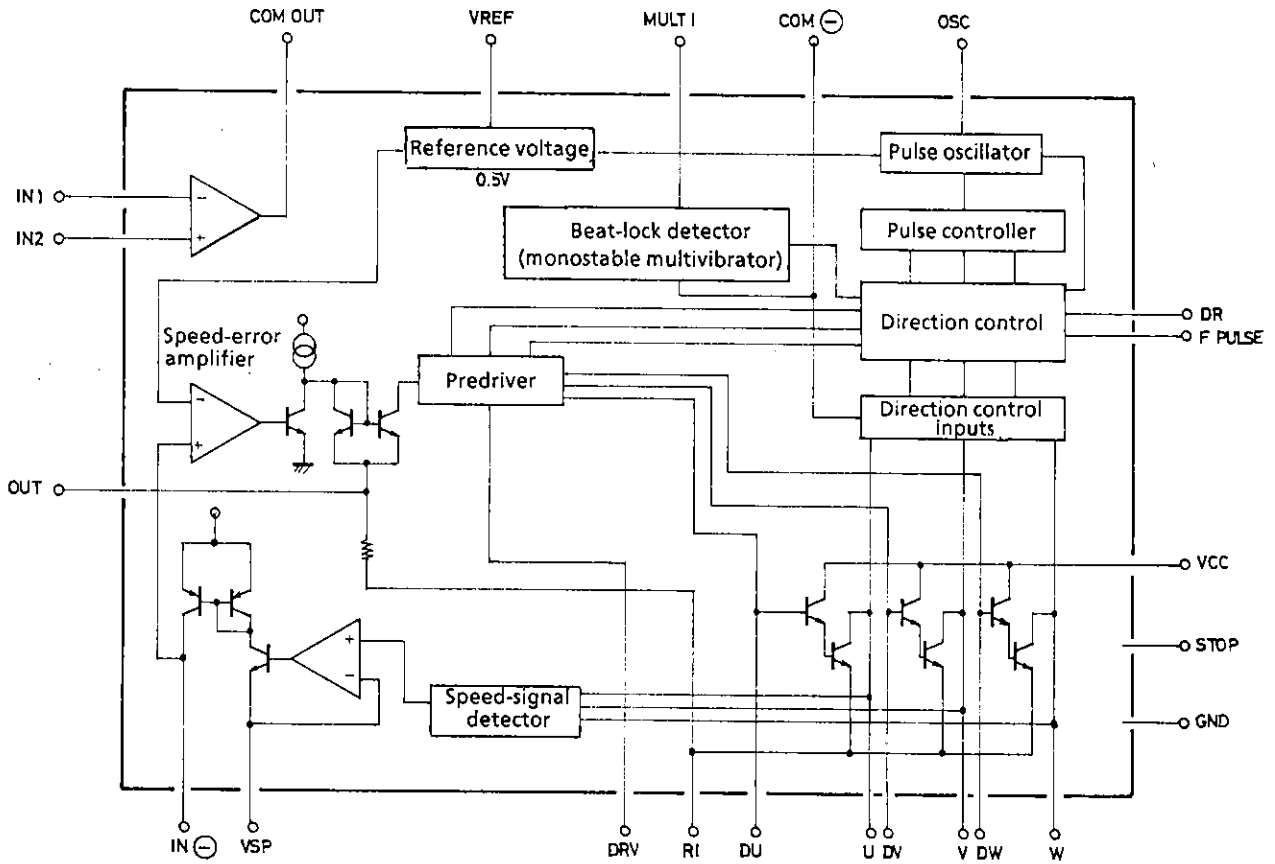


Unit ( capacitance: F )

# LB1670M



## Equivalent Circuit Block Diagram



## LB1670M

## Pin Descriptions

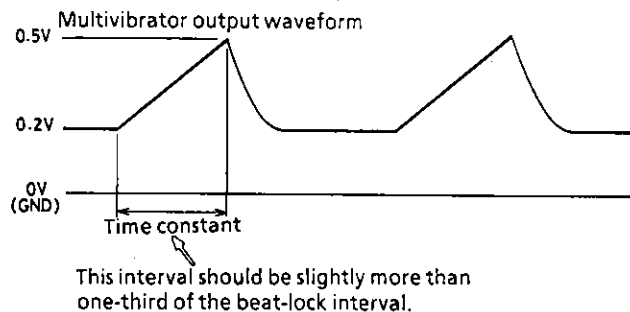
Pin Name	Description
V <sub>CC</sub>	Power supply
GND	Ground for all pins, except output pins
R <sub>i</sub>	Connected to a resistor which determines the response of the motor current detector circuit.
U (V,W)	Driver output pins
DU (DV,DW)	Base of power transistor. To connect capacitors to ground for suppress oscillation of circuit.
DR	Direction control. Threshold voltage : 1.5V
STOP	Halts all functions with setting High voltage. Threshold voltage : 1.5V
V <sub>ref</sub>	0.5V reference for speed control
OSC	Capacitor connected to this pin determines the starting pulse frequency.
V <sub>sp</sub>	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 <sub>sp</sub> through a 1:1 current mirror circuit.
OUT	Output from the speed error amplifier. A resistor connects it to R <sub>i</sub> , 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 <sub>BE</sub> (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 <sub>CC</sub> through a resistor of at least 20k $\Omega$ 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)

- No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.
- Anyone purchasing any products described or contained herein for an above-mentioned use shall:
  - ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors, and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use:
  - ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

## 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 $\Omega$ to 50k $\Omega$ 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 $\Omega$ .
$C_M$	Beat lock detector. The larger this capacitance, the greater the monostable multivibrator's time constant. A capacitance of 0.1 $\mu$ 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 $\mu$ 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 $\Omega$ to 20k $\Omega$ 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 gm/A).