

**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

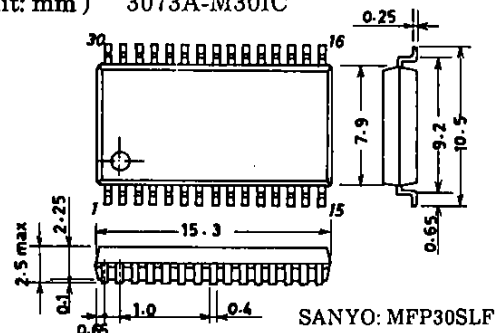
**Electrical Characteristics at Ta = 25°C, V<sub>CC</sub> = 10V unless otherwise specified**

			min	typ	max	unit
Current Dissipation	I <sub>CC1</sub>	STOP pin Low		9.5	13.5	mA
	I <sub>CC2</sub>	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	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta T_a$	T <sub>a</sub> = -20 to +80°C		0.01		%/°C

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**Package Dimensions**

(unit: mm) 3073A-M30IC



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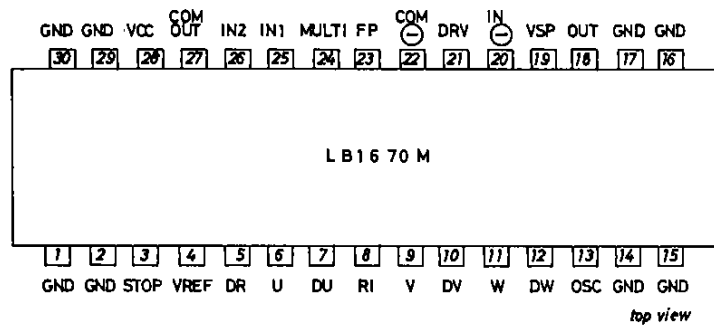
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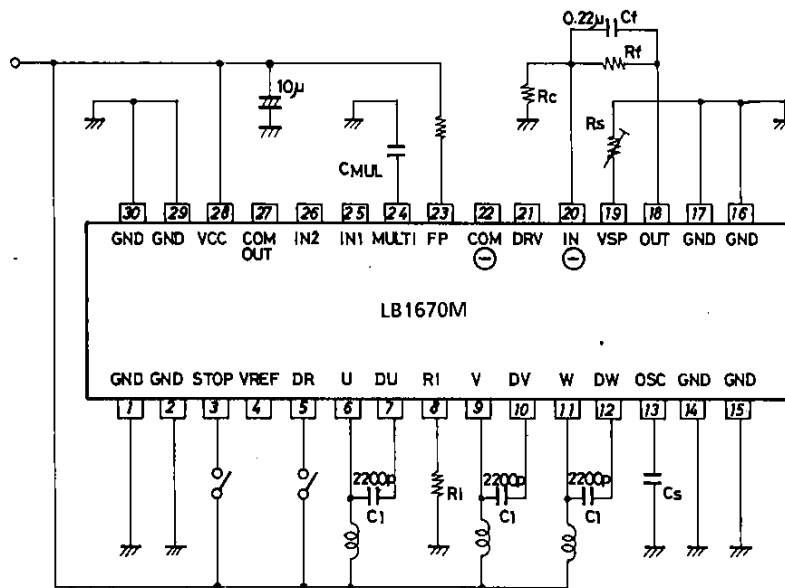
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			min	typ	max	unit
Speed Signal Detection Accuracy	$V_{sp}$	$V_{IN}=1.0V$	470	500	540	mV
Difference between Two Phases of Speed Signal Voltage			-5		5	%
Voltage Characteristic of Speed Signal	$\frac{\Delta V_{sp}}{V_{sp}} / \Delta V_{CC}$			0.15	0.3	%/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	$T_s$	$C_s=1\mu F$		40		ms
Voltage Drop at COM $\ominus$	$V_{COM\ominus}$		0.255	0.325	0.405	A
Monostable Multivibrator Output Current	$I_{MUL}$		9	13	16.5	$\mu A$
Comparator Offset Voltage	$V_{OFF}$		-10	0	10	mV

## Pin Assignment

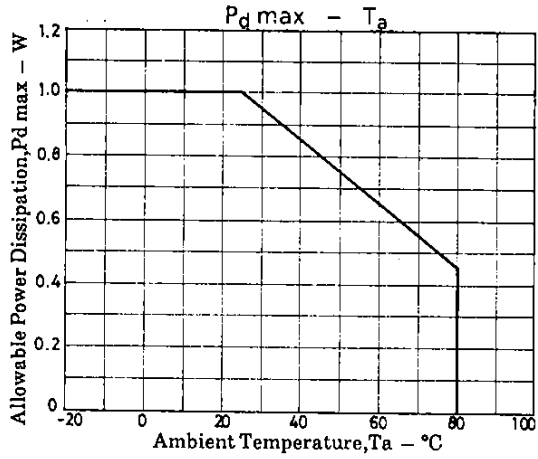


## Sample Application Circuit

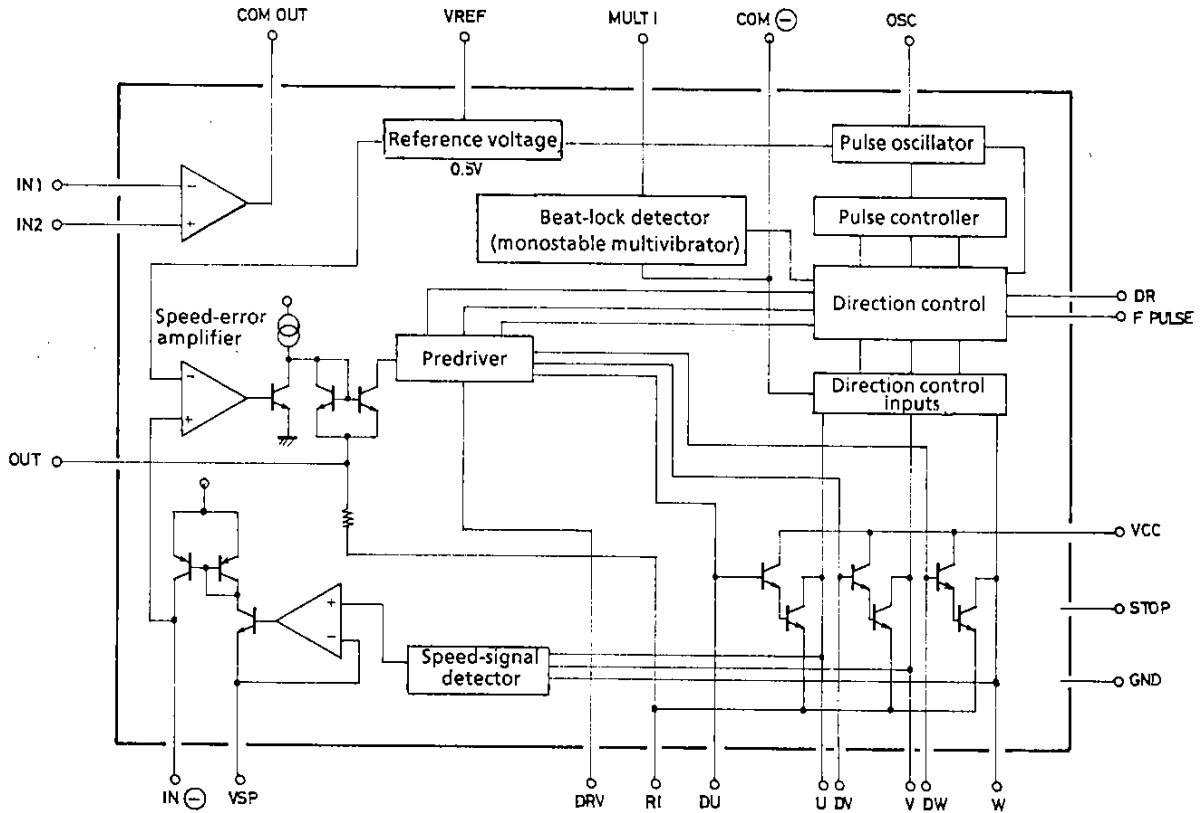


Unit (capacitance: F)

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## Equivalent Circuit Block Diagram



## Pin Descriptions

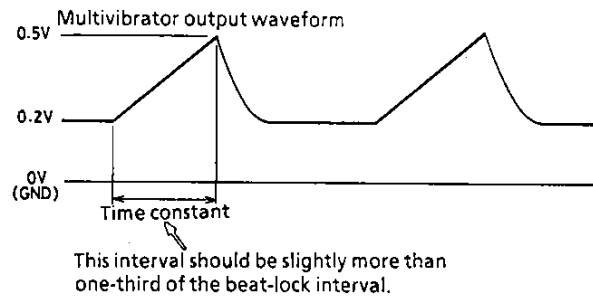
Pin Name	Description
V <sub>CC</sub>	Power supply
GND	Ground for all pins, except output pins
R <sub>i</sub>	Connected to a resistor which determines the response of the motor current detector circuit.
U (V,W)	Driver output pins
DU (DV,DW)	Base of power transistor. To connect capacitors to ground for 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)

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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 $10k\Omega$ 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  $gcm/A$ ).