Ordering number: EN 3120

Monolithic Digital IC

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_{CC} max	15	V
Output Transistor Voltage	V_{OTR} max	30	V
Maximum Output Current	I_M max	1.5	A
Allowable Power Dissipation	Pd max	1	W
Operating Temperature	**Topr**	−20 to +80	°C
Storage Temperature	Tstg	−40 to +125	°C

Allowable Operating Conditions at Ta = 25°C

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

Electrical Characteristics at Ta = 25°C, V_{CC} = 10V unless otherwise specified

			min	typ	max	unit
Current Dissipation	$I_{CC}1$	STOP pin Low		9.5	13.5	mA
	$I_{CC}2$	STOP pin High		0.5	1.0	mA
Reference Voltage	Vref		0.475	0.5	0.535	V
Voltage Characteristic of Reference Voltage	$\frac{\Delta Vref}{Vref}/\Delta V_{CC}$	V_{CC} = 1.8 to 12V		0.07	0.15	%/V
Load Characteristic of Reference Voltage	$\frac{\Delta Vref}{Vref}$	Iref = 0 to −300μA	−0.5	−0.2		%
Temperature Characteristic of Reference Voltage	$\frac{\Delta Vref}{Vref}/\Delta T_a$	Ta = −20 to +80°C		0.01		%/°C

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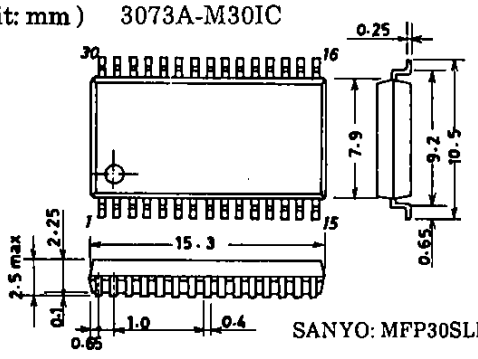
Package Dimensions

(unit: mm) 3073A-M30IC



SANYO: MFP30SLF

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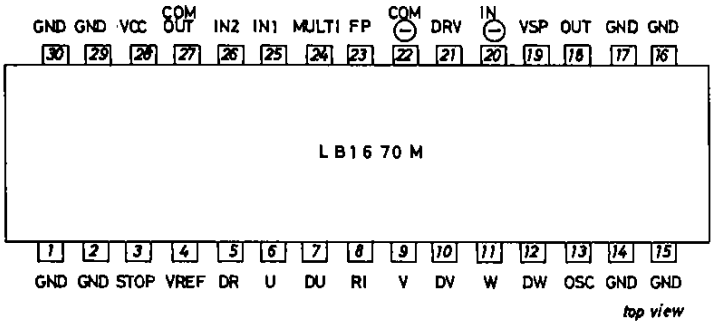
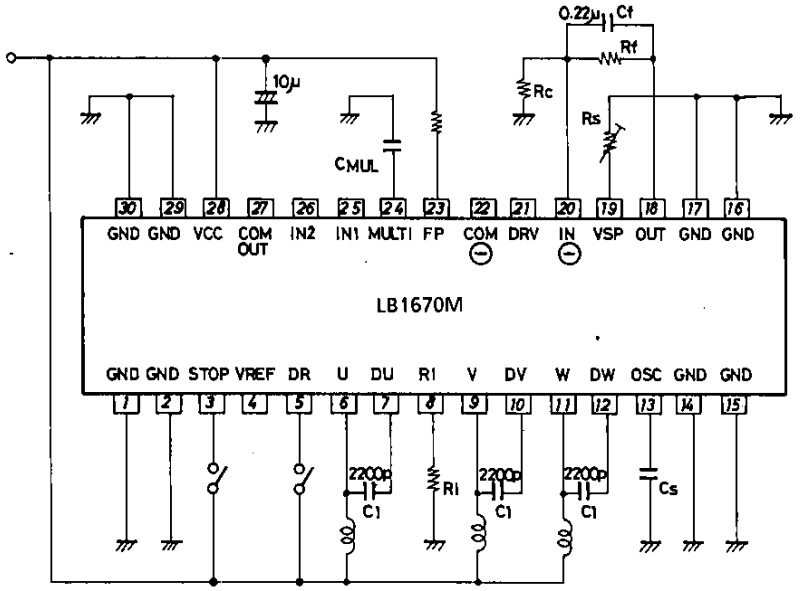
			min	typ	max	unit
Speed Signal Detection Accuracy	Vsp	$V_{IN}=1.0V$	470	500	540	mV
Difference between Two Phases of Speed Signal Voltage			−5		5	%
Voltage Characteristic of Speed Signal	$\frac{\Delta Vsp}{Vsp}/\Delta V_{CC}$			0.15	0.3	%/V
Temperature Characteristic of Speed Signal	$\frac{\Delta Vsp}{Vsp}/\Delta T_a$			0.05		%/°C
Output Saturation Voltage	Vsat	$I_M=0.3A, V_{CC}=1.8V$		0.15	0.3	V
Starting Pulse Time	Ts	Cs=1μF		40		ms
Voltage Drop at COM ⊖	$V_{COM}\ominus$		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

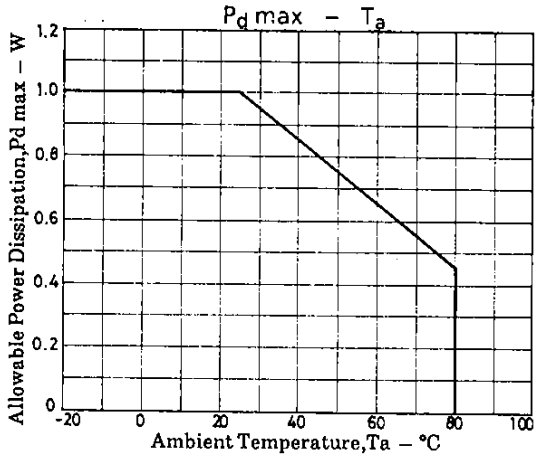
Pin Assignment



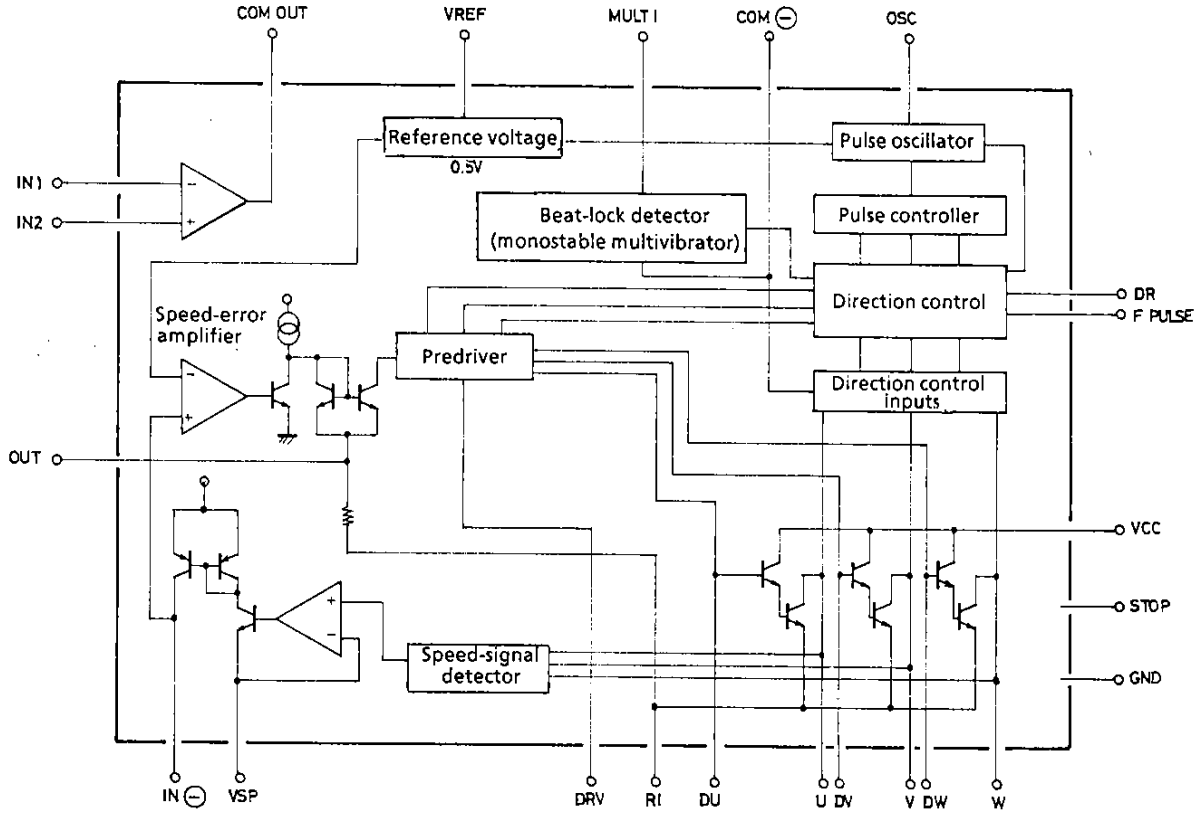
Sample Application Circuit



Unit (capacitance: F)



Equivalent Circuit Block Diagram



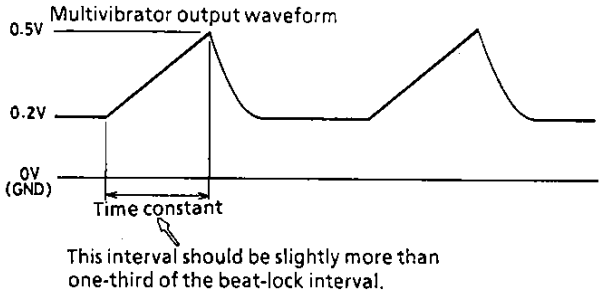
Pin Descriptions

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
Vref	0.5V reference for speed control
OSC	Capacitor connected to this pin determines the starting pulse frequency.
Vsp	Induced voltage detector. Level is approximately half that of the motor's induced voltage.
IN⊖	Input to the speed error amplifier. Connected to Vsp through a 1:1 current mirror circuit.
OUT	Output from the speed error amplifier. A resistor connectes it to RI, 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 20kΩ 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⊖	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)

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⊖. This resistance is in the 10kΩ to 50kΩ range.
R_p	Speed detector. The chip generates a pulse at F-PULSE each time the conducting phase chages. This resistance should be at least 20kΩ.
C_M	Beat lock detector. The larger this capacitance, the greater the monostable multivibrator's time constant. A capacitance of 0.1μF, 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 1μF, for example, results in an interval of 40ms.
R_C	Speed control. The ratio of this resistance to Sr determines the motor speed. The resistance should be in the 5kΩ to 20kΩ 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.

$$\frac{\Delta N}{N} = \frac{1}{K_T} \cdot \frac{1}{V_{ref}} \cdot \frac{R_C R_i}{R_f} \times 100\ (\%)$$

$$= \frac{1}{K_T} \cdot \frac{1}{0.5V} \cdot \frac{R_C R_i}{R_f} \times 100\ (\%)$$

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