Ordering number: EN3976

Monolithic Digital IC

SANYO

No. 3976

LB1857M

Three-phase, Brushless-motor Driver

OVERVIEW

The LB1857M is a three-phase, brushless-motor driver IC for video cassette recorder capstan and drum motors and digital audio tape (DAT) drive motors.

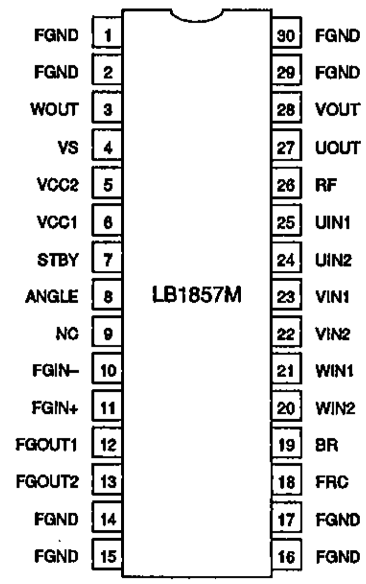
The LB1857M features 120° electrical phasing, torque ripple compensation and thermal shutdown circuits and an FG amplifier. It has a power-saving speed control, making it ideal for portable devices.

The LB1857M operates from 4 to 14 V motor drive and 4 to 6 V control supplies, and is available in 30-pin MFPs.

FEATURES

- 120° electrical phasing
- Power-saving motor speed control
- FG amplifier
- Standby mode
- Torque ripple compensation circuit
- Thermal shutdown circuit
- 4 to 14 V motor drive and 4 to 6 V control supplies
- 30-pin MFP

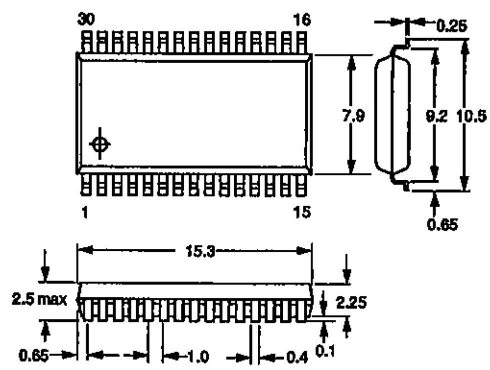
PINOUT



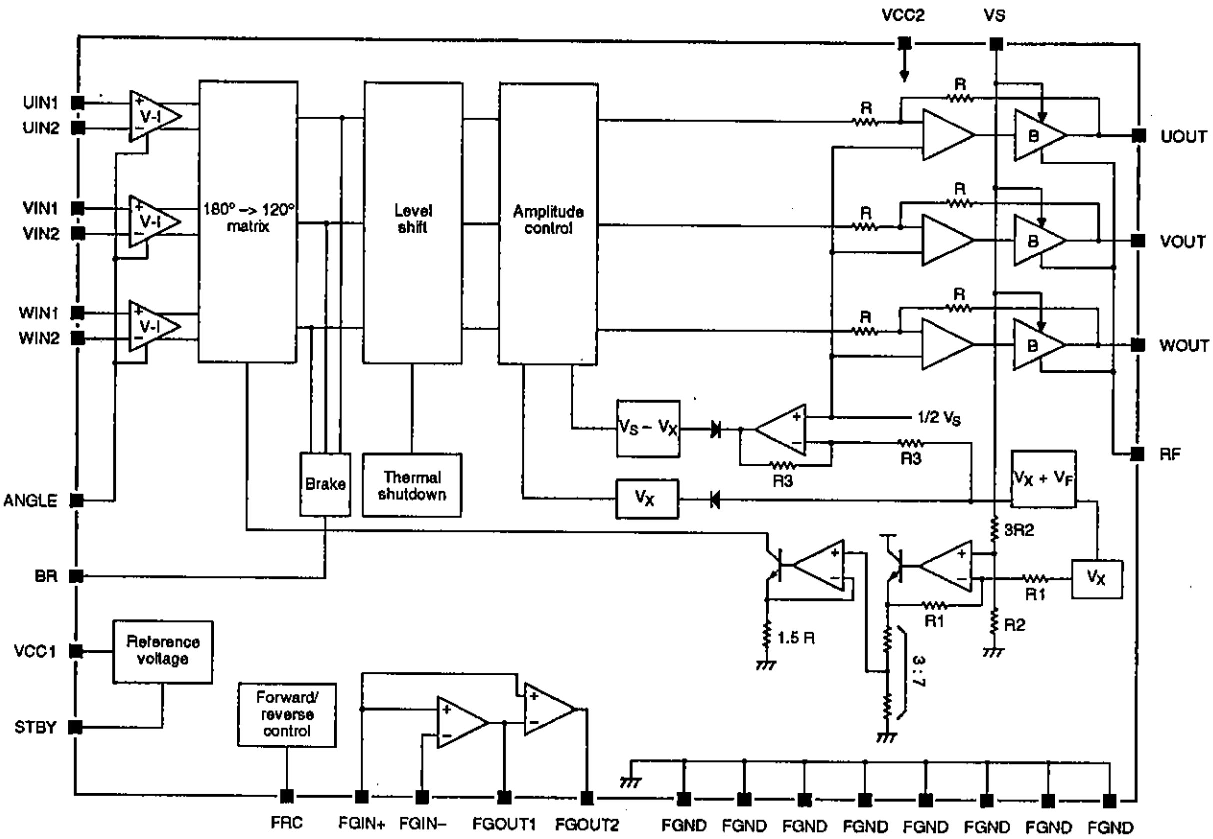
PACKAGE DIMENSIONS

Unit: mm

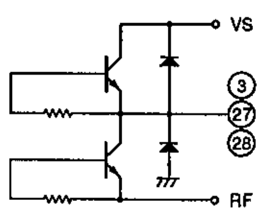
3073A-MFP30S

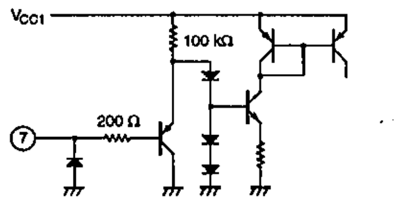
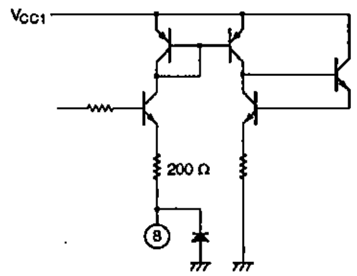
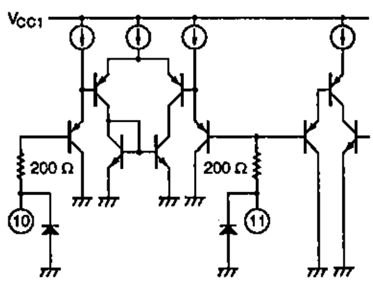
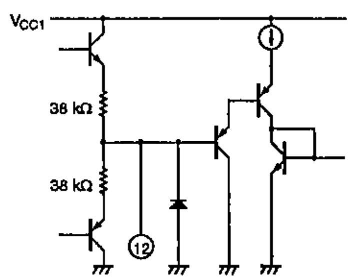
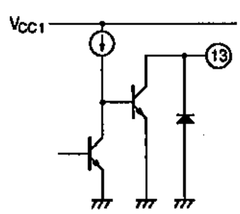


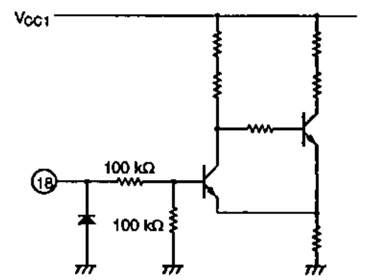
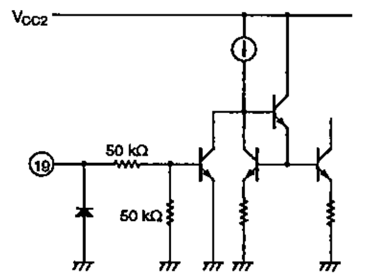
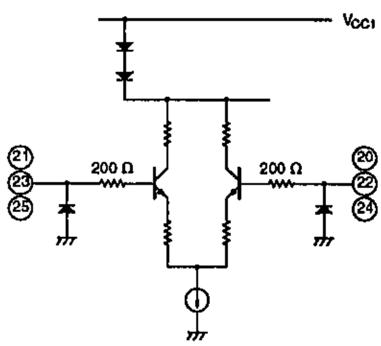
BLOCK DIAGRAM



PIN DESCRIPTION

Number	Name	Equivalent circuit	Description
1, 2, 14 to 17, 29, 30	FGND		Frame ground. Ground for all circuits other than output transistors
3	WOUT		Motor phase outputs
27	UOUT		
28	VOUT		
4	VS		0 V to V_{CC2} output transistor supply
5	VCC2		4 to 14 V supply for circuits other than output transistors and circuits supplied by VCC1
6	VCC1		4 to 6 V input amplifier, forward/reverse control, FG amplifier and thermal shutdown circuit supply

Number	Name	Equivalent circuit	Description
7	STBY		Standby mode set input
8	ANGLE		Input amplifier gain set resistor connection
9	NC		No connection
10	FGIN–		FG signal inputs
11	FGIN+		
12	FGOUT1		FG amplifier 1 output
13	FGOUT2		FG Schmitt-trigger input amplifier 2 output

Number	Name	Equivalent circuit	Description
18	FRC		Motor forward/reverse control input
19	BR		Motor braking control input
20	WIN2		W-phase, Hall-effect transducer amplifier inputs
21	WIN1		
22	VIN2		V-phase, Hall-effect transducer amplifier inputs
23	VIN1		
24	UIN2		U-phase, Hall-effect transducer amplifier inputs
25	UIN1		
26	RF		Output transistor ground

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Control supply voltage	V_{CC1}	7	V
Power amplifier supply voltage	V_{CC2}	16	V
Output transistor supply voltage	V_S	V_{CC2}	V
U-, V- and W-phase output voltage	V_O	V_S + 2	V
Output current	I_O	1.5	A
Power dissipation	P_D	1	W
Operating temperature range	Topr	–20 to 75	°C
Storage temperature range	T_{stg}	–55 to 125	°C

Recommended Operating Conditions

T_a = 25 °C

Parameter	Symbol	Rating	Unit
Control supply voltage range	V_{CC1}	4 to 6	V
Power amplifier supply voltage range	V_{CC2}	4 to 14	V
Output transistor supply voltage range	V_S	0 to V_{CC2}	V

Electrical Characteristics

V_{CC1} = 5 V, V_{CC2} = 7 V, V_S = 3 V, T_a = 25 °C unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Control supply current	I_{CC1}	V_{BR} = 5 V	–	4.5	6.5	mA
Power amplifier supply current	I_{CC2}	V_{BR} = 5 V	–	15	20	mA
Output transistor supply current	I_S	V_{BR} = 0 V, R_L = ∞	–	6.5	9.0	mA
Power amplifier quiescent supply current	I_{CCOQ}	V_{STBY} = 0 V	–	–	180	µA
Output transistor quiescent supply current	I_{SOQ}	V_{STBY} = 0 V, R_L = ∞	–	–	150	µA
BR LOW-level input voltage	V_{IL1}		–	–	0.8	V
FRC LOW-level input voltage	V_{IL2}		–	–	1.2	V
STBY LOW-level input voltage	V_{IL3}		–0.2	–	0.1	V
BR HIGH-level input voltage	V_{IH1}		2	–	–	V
FRC HIGH-level input voltage	V_{IH2}		2.8	–	–	V
STBY HIGH-level input voltage	V_{IH3}		2	–	5	V
Output saturation voltage	V_{Osat}	I_O = 0.5 A	–	–	2.3	V
Output TRS sustaining voltage	V_{Osus}	I_O = 20 mA. See note.	16	–	–	V
Quiescent output voltage	V_{OQ}	V_{BR} = 5 V	1.4	1.5	1.6	V
Hall-effect transducer amplifier input offset voltage	V_{Hoff}	See note.	–5	–	5	mV
Hall-effect transducer amplifier common-mode input voltage	V_{Hch}		1.4	–	2.8	V
Hall-effect transducer amplifier gain	G_{VHO}	R_{ANGLE} = 8.2 kΩ	32	35	38	dB
Upper-side residual voltage	V_{XH}	I_O = 100 mA, V_{CC2} = 6 V, V_S = 2 V.	0.32	–	0.49	V
Lower-side residual voltage	V_{XL}	I_O = 100 mA, V_{CC2} = 6 V, V_S = 2 V	0.39	–	0.48	V
Overlap capacity	Over	V_{CC2} = 6 V, V_S = 3 V	60	70	80	%
BR and FRC input current	I_I		–	–	100	µA
BR and FRC leakage current	I_{leak}		–	–	–30	µA
STBY input bias current	I_{BIAS}	V_{STBY} = 0 V	–	–	10	µA
Thermal shutdown temperature	T_{SD}	See note.	150	180	210	°C
Thermal shutdown hysteresis	ΔT_{SD}	See note.	–	15	–	°C

Note
Estimated values

FG amplifier

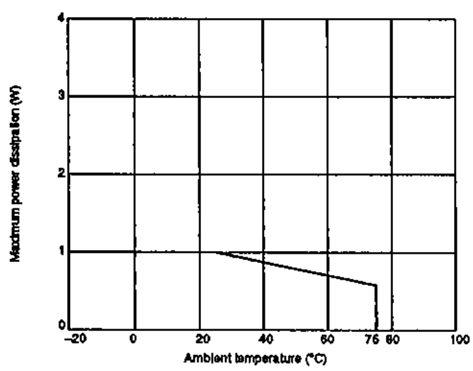
V_{CC1} = 5 V, V_{CC2} = 7 V, V_S = 3 V, T_a = 25 °C

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Input offset voltage	V_{FGoff}		−8	–	8	mV
Open-loop voltage gain	G_{VFG}	f = 1 kHz	–	60	–	dB
Output saturation voltage (source)	V_{FGOU}	I_O = 2 mA	3.7	–	–	V
Output saturation voltage (sink)	V_{FGOD}	I_O = −2 mA	–	–	1.3	V
Common-mode rejection ratio	CHR	See note.	–	80	–	dB
Common-mode input voltage	V_{FGCH}		0	–	3.5	V
Phase margin	Φ_{FG}	See note.	–	20	–	°
Schmitt-trigger input threshold voltage	V_{TH}	V_{FGIN+} = 2.5 V, V_{FGOUT2} HIGH to LOW transition	2.45	2.50	2.55	V
Schmitt-trigger input hysteresis voltage	V_H	V_{FGIN+} = 2.5 V	20	40	60	mV

Note
Estimated values

Typical Performance Characteristics

Maximum power dissipation vs. ambient temperature



FUNCTIONAL DESCRIPTION

Inputs

Motor driver operation is determined by the levels on STBY, BR and FRC. Standby mode is ON when STBY is LOW, and OFF when STBY is HIGH or open. Motor braking is ON when BR is HIGH. the motor is forward mode when FRC is LOW, and in reverse mode, when FRC is HIGH.

A Hall-effect transducer amplifier input is HIGH when input 1 is more than 0.2 V above input 2, and LOW when input 1 is more than 0.2 V below input 2. The resistor conected between ANGLE and GND determines the Hall-effect transducer amplifier V-I characteristic and gain.

Outputs

The motor driver output source and sink phases are selected by the voltages at the amplifier inputs and FRC as shown in table 1.

Table 1. Output phase control

Source phase	Sink phase	FRC	Hall-effect transducer amplifier inputs		
			U	V	W
W	V	LOW	HIGH	HIGH	LOW
V	W	HIGH			
W	U	LOW	HIGH	LOW	LOW
U	W	HIGH			
V	W	LOW	LOW	LOW	HIGH
W	V	HIGH			
U	V	LOW	LOW	HIGH	LOW
V	U	HIGH			
V	U	LOW	HIGH	LOW	HIGH
U	V	HIGH			
U	W	LOW	LOW	HIGH	HIGH
W	U	HIGH			

TYPICAL APPLICATION