

Monolithic Digital IC

<b>SANYO</b>	No. 3976	<b>LB1857M</b>
	<b>Three-phase, Brushless-motor Driver</b>	

### 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.

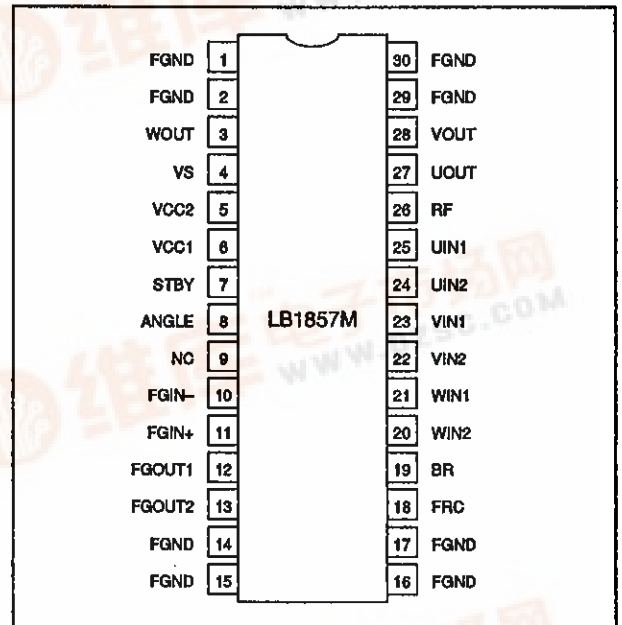
The LB1857M features 120° electrical phasing, torque ripple compensation and thermal shutdown circuits and an FG amplifier. It has a power-saving speed control, making it ideal for portable devices.

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

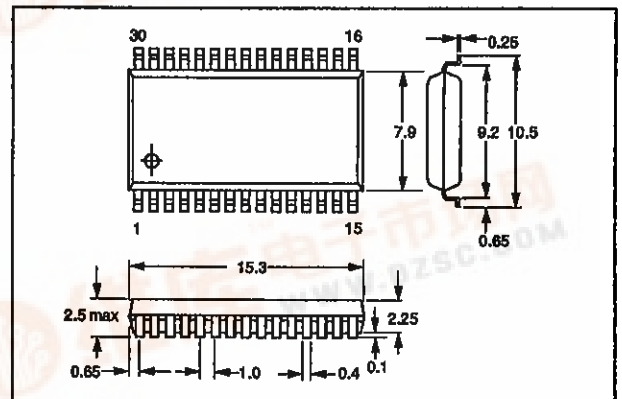
### PINOUT



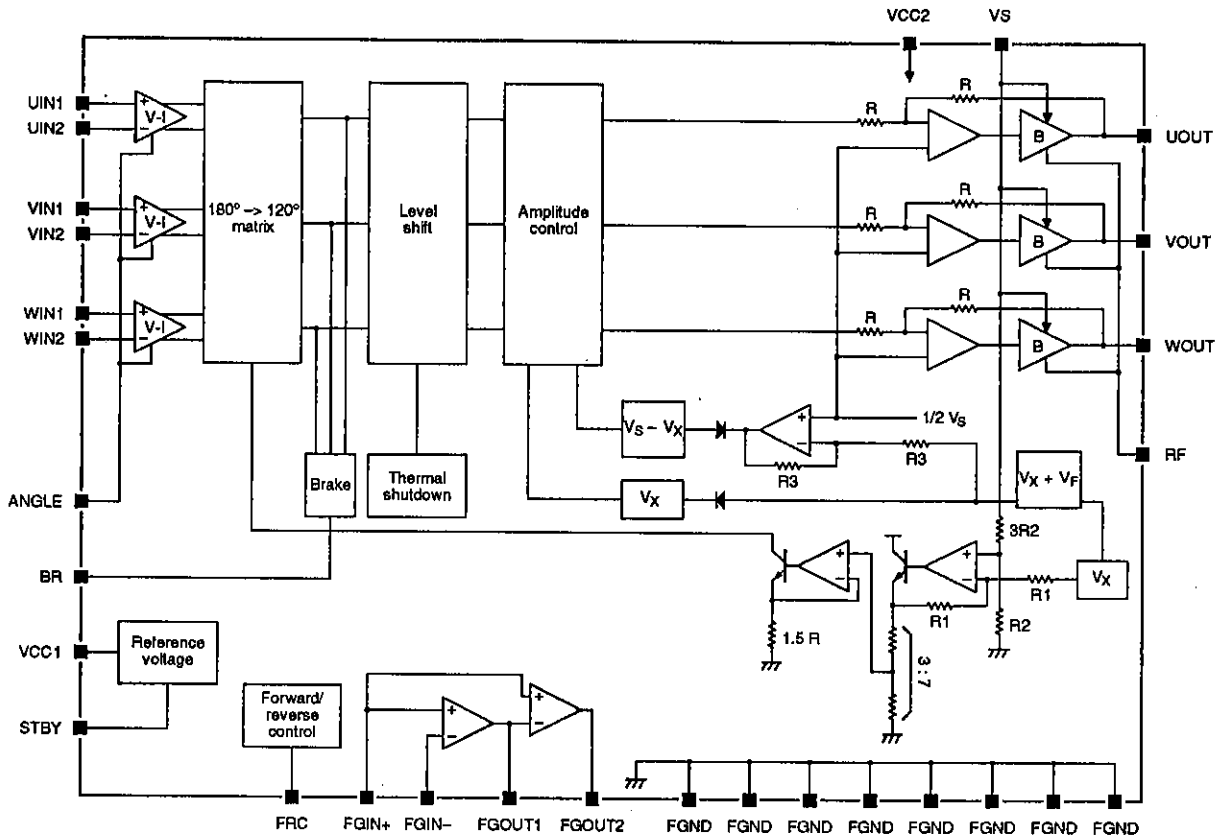
### PACKAGE DIMENSIONS

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 Vcc2 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

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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

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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		V-phase, Hall-effect transducer amplifier inputs
22	VIN2		U-phase, Hall-effect transducer amplifier inputs
23	VIN1		
24	UIN2		
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	$T_{opr}$	-20 to 75	°C
Storage temperature range	$T_{stg}$	-55 to 125	°C

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### Recommended Operating Conditions

$T_a = 25\text{ }^\circ\text{C}$

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

$V_{CC1} = 5\text{ V}$ ,  $V_{CC2} = 7\text{ V}$ ,  $V_S = 3\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$  unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Control supply current	$I_{CC1}$	$V_{BR} = 5\text{ V}$	–	4.5	6.5	mA
Power amplifier supply current	$I_{CC2}$	$V_{BR} = 5\text{ V}$	–	15	20	mA
Output transistor supply current	$I_S$	$V_{BR} = 0\text{ V}$ , $R_L = \infty$	–	6.5	9.0	mA
Power amplifier quiescent supply current	$I_{CCOQ}$	$V_{STBY} = 0\text{ V}$	–	–	180	$\mu\text{A}$
Output transistor quiescent supply current	$I_{SOQ}$	$V_{STBY} = 0\text{ V}$ , $R_L = \infty$	–	–	150	$\mu\text{A}$
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	$V_{Osat}$	$I_O = 0.5\text{ A}$	–	–	2.3	V
Output TRS sustaining voltage	$V_{OTrs}$	$I_O = 20\text{ mA}$ . See note.	16	–	–	V
Quiescent output voltage	$V_{OQ}$	$V_{BR} = 5\text{ V}$	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	$G_{VHO}$	$R_{ANGLE} = 8.2\text{ k}\Omega$	32	35	38	dB
Upper-side residual voltage	$V_{XH}$	$I_O = 100\text{ mA}$ , $V_{CC2} = 6\text{ V}$ , $V_S = 2\text{ V}$ .	0.32	–	0.49	V
Lower-side residual voltage	$V_{XL}$	$I_O = 100\text{ mA}$ , $V_{CC2} = 6\text{ V}$ , $V_S = 2\text{ V}$	0.39	–	0.48	V
Overlap capacity	Over	$V_{CC2} = 6\text{ V}$ , $V_S = 3\text{ V}$	60	70	80	%
BR and FRC input current	$I_I$		–	–	100	$\mu\text{A}$
BR and FRC leakage current	$I_{leak}$		–	–	–30	$\mu\text{A}$
STBY input bias current	$I_{BIAS}$	$V_{STBY} = 0\text{ V}$	–	–	10	$\mu\text{A}$
Thermal shutdown temperature	$T_{SD}$	See note.	150	180	210	$^\circ\text{C}$
Thermal shutdown hysteresis	$\Delta T_{SD}$	See note.	–	15	–	$^\circ\text{C}$

#### Note

Estimated values

## LB1857M

### FG amplifier

$V_{CC1} = 5\text{ V}$ ,  $V_{CC2} = 7\text{ V}$ ,  $V_S = 3\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$

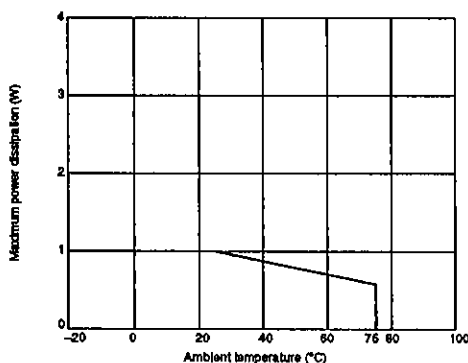
Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Input offset voltage	$V_{FGoH}$		-8	-	8	mV
Open-loop voltage gain	$G_{VFG}$	$f = 1\text{ kHz}$	-	60	-	dB
Output saturation voltage (source)	$V_{FGOU}$	$I_o = 2\text{ mA}$	3.7	-	-	V
Output saturation voltage (sink)	$V_{FGOD}$	$I_o = -2\text{ mA}$	-	-	1.3	V
Common-mode rejection ratio	CHR	See note.	-	80	-	dB
Common-mode input voltage	$V_{FGCH}$		0	-	3.5	V
Phase margin	$\Phi_{FG}$	See note.	-	20	-	°
Schmitt-trigger input threshold voltage	$V_{TH}$	$V_{FGIN+} = 2.5\text{ V}$ , $V_{FGOUT2}$ HIGH to LOW transition	2.45	2.50	2.55	V
Schmitt-trigger input hysteresis voltage	$V_H$	$V_{FGIN+} = 2.5\text{ V}$	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 connected between ANGLE and GND determines the Hall-effect transducer amplifier V-I characteristic and gain.

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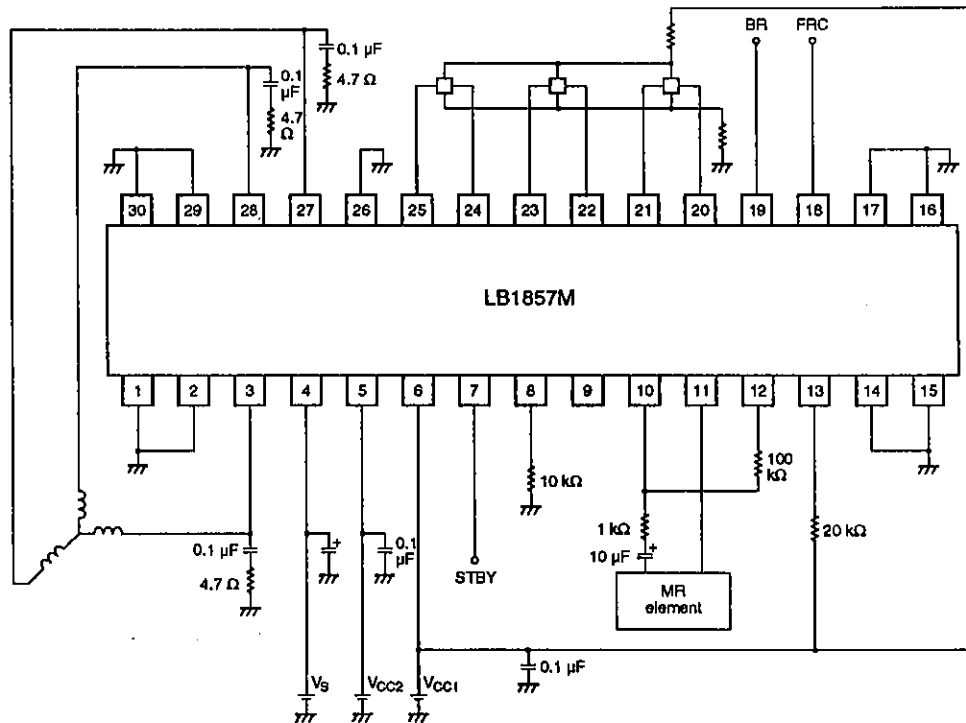
### Outputs

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



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