



LB11880

Three-Phase Sensorless Motor Driver with Loading Motor Driver

Overview

The LB11880 is a sensorless motor driver that also includes a loading motor driver. It is ideal for drum motor drive in VCR products.

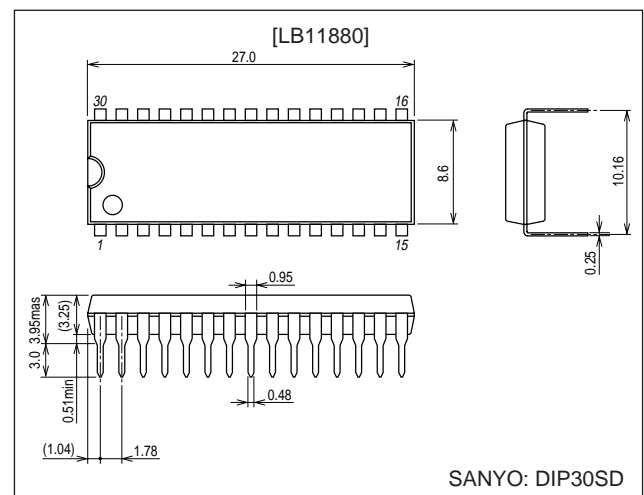
Functions and Features

- Soft switching drive
- No Hall sensors required
- No FG sensors required
- Built-in PG amplifier
- Built-in thermal shutdown circuit
- Current limiter circuit
- On-chip loading motor driver

Package Dimensions

unit: mm

3196A-DIP30SD



Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage 1	$V_{CC\text{ max}}$		14.5	V
Maximum supply voltage 2	$V_{CC\text{L max}}$		14.5	V
Maximum supply voltage 3	$V_{REG\text{ max}}$		7.0	V
Output voltage	V_{omax}		14.5	V
Input voltage	$V_{I1\text{ max}}$		-0.3 to $V_{REG} + 0.3$	V
Cylinder current	I_{omax}		1.0	A
Loading current	$I_{omax\text{ (AVE)}}$		0.4	A
	$I_{omax\text{ (peak)}}$		1.2	A
Allowable power dissipation	P_{dmax}	When mounted on the specified printed circuit board*	2.8	W
Operating temperature	T_{opr}		-20 to +75	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

Note: * Specified printed circuit board: 114.3 × 76.1 × 1.6 mm glass-epoxy board

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LB11880

Allowable Operating Ranges at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V_{CC}		8 to 13.8	V
Supply voltage 2	V_{CCL}		8 to 13.8	V
Supply voltage 3	VREG		4 to 6	V

Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = V_{CCL} = 12\text{ V}$, $V_{REG} = 5\text{ V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current 1	I_{CC}	$V_C = 0\text{ V}$, $XIN = YIN = 0\text{ V}$		3.5	5.0	mA
Supply current 2	I_{CCL}	$V_C = 0\text{ V}$, $XIN = YIN = 0\text{ V}$			1	mA
Supply current 3	I_{REG}	$V_C = 0\text{ V}$, $XIN = YIN = 0\text{ V}$		10	15	mA
Output saturation voltage 1	V_{Osat1}	$IO = 0.4\text{ A}$, source + sink		1.4	2.0	V
Output saturation voltage 2	V_{Osat2}	$IO = 0.8\text{ A}$, source + sink		1.8	2.6	V
MC pin common-mode input voltage range	V_{IC}		0		$V_{CC} - 2$	V
VC pin input bias current	I_{VC}	$V_C = 0\text{ V}$	-2	-1		μA
Control start voltage	VTHVC	$V_{RF} = 10\text{ mA}$	2.4	2.5	2.6	V
Closed-loop control gain	GMVC	$R_F = 0.5\ \Omega$	0.75	0.95	1.15	A/V
PCOUT output current 1	I_{PCOU}	Source side		-90		μA
PCOUT output current 2	I_{PCOD}	Sink side		90		μA
VCOIN input current	I_{VCOIN}	$V_{COIN} = 5\text{ V}$		0.1	0.2	μA
Minimum VCO frequency	$f_{VCO\text{MIN}}$	$CX = 0.022\ \mu\text{F}$, $V_{COIN} = \text{open}$		400		Hz
Maximum VCO frequency	$f_{VCO\text{MAX}}$	$CX = 0.022\ \mu\text{F}$, $V_{COIN} = 5\text{ V}$		18.5		kHz
C1/C2 source current ratio	R_{SOURCE}	$I_{C1\text{SOURCE}}/I_{C2\text{SOURCE}}$	-12		+12	%
C1/C2 sink current ratio	R_{SINK}	$I_{C1\text{SINK}}/I_{C2\text{SINK}}$	-12		+12	%
C1 source/sink current ratio	RC1	$I_{C1\text{SOURCE}}/I_{C1\text{SINK}}$	-35		+15	%
C2 source/sink current ratio	RC2	$I_{C2\text{SOURCE}}/I_{C2\text{SINK}}$	-35		+15	%
Thermal shutdown operating temperature	T-TSD	*	150	180	210	$^\circ\text{C}$
Thermal shutdown hysteresis	ΔT_{TSD}	*		15		$^\circ\text{C}$

Note: * These values are design guarantee values, and are not tested.

FG/PG Amplifier Block at $T_a = 25^\circ\text{C}$, $V_{CC} = V_{CCL} = 12\text{ V}$, $V_{REG} = 5\text{ V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Back EMF FG]						
Output on voltage	V_{OL}				0.4	V
Output off voltage	V_{OH}		4.5			V
[PG Amplifier]						
Input offset voltage	V_{IO}		-8		+8	mV
Input bias current	I_{BIN-}		-250			nA
Common-mode input voltage range	V_{ICOM}	*	1		3.5	V
Open-loop gain	GVPG	$f = 1\text{ kHz}$		55		dB
Output on voltage	V_{OL}				0.4	V
Output off voltage	V_{OH}		4.5			V
Schmitt amplifier hysteresis	V_{Shys}		70	93	115	mV

Note: * These values are design guarantee values, and are not tested.

LB11880

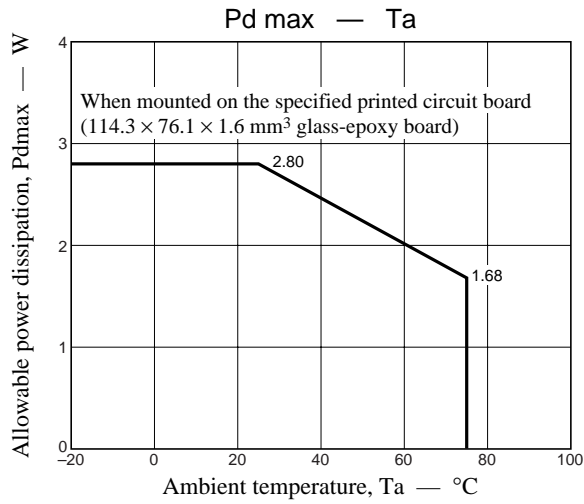
Loading Block at $T_a = 25^\circ\text{C}$, $V_{CC} = V_{CCL} = 12\text{ V}$, $V_{REG} = 5\text{ V}$

Parameter		Symbol	Conditions	Ratings			Unit
				min	typ	max	
Input voltage	1 (high)	V_{IN1}		3.5		5	V
	2 (low)	V_{IN2}		0		0.8	V
Input current		I_{IN}	Sink $V_{IN} = 3.5\text{ V}$		30	50	μA
Input hysteresis		ΔVT			0.7		V
Saturation voltage	$V_{sat\ U-1}$		$V_{ref} = VS$, between the output and VS $I_O = 0.2\text{ A}$, CW/CCW mode		1.5	2.1	V
	$V_{sat\ L-1}$		$V_{ref} = VS$, between the output and ground $I_O = 0.2\text{ A}$, CW/CCW mode		0.2	0.3	V
	$V_{sat\ U-1'}$		$V_{ref} = VS$, between the output and VS $I_O = 0.4\text{ A}$, CW/CCW mode		1.6	2.2	V
	$V_{sat\ L-1'}$		$V_{ref} = VS$, between the output and ground $I_O = 0.4\text{ A}$, CW/CCW mode		0.3	0.5	V
Upper side residual voltage	$V_{satU-1''}$		$V_{ref} = 8\text{ V}$, between the output and ground $I_O = 0.2\text{ A}$, CW/CCW mode	7.2	8.0	8.8	V
	$V_{satL-1''}$		$V_{ref} = 8\text{ V}$, between the output and ground $I_O = 0.4\text{ A}$, CW/CCW mode	7.2	8.0	8.8	V
Output transistor leakage current	Upper	ILU				50	μA
	Lower	ILL				50	μA
Diode forward voltage	Uper	VFU	$I_F = 0.4\text{ A}$		1.3		V
	Lower	VFL	$I_F = 0.4\text{ A}$		1.0		V
Control supply current		I_{ref}		-5	-2		μA

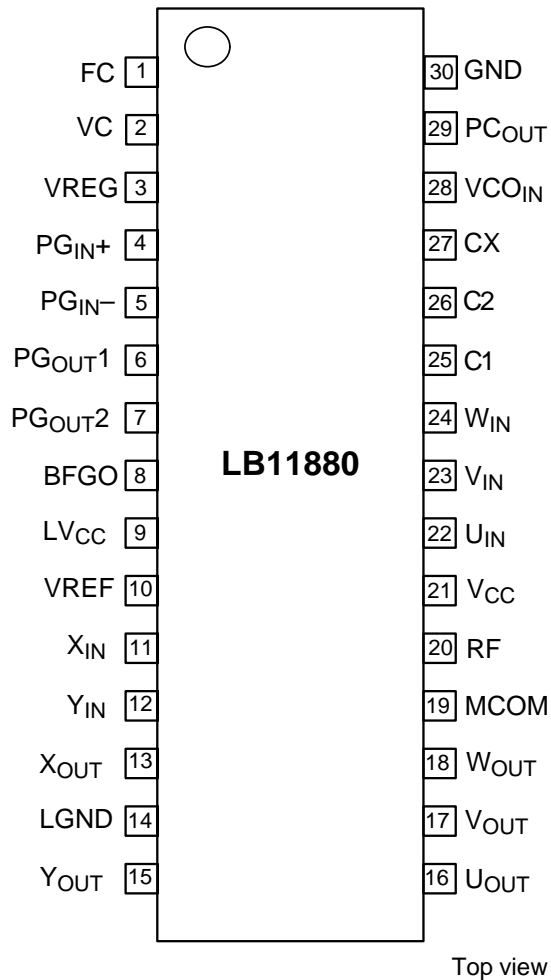
LB11880

Loading Motor Truth Table

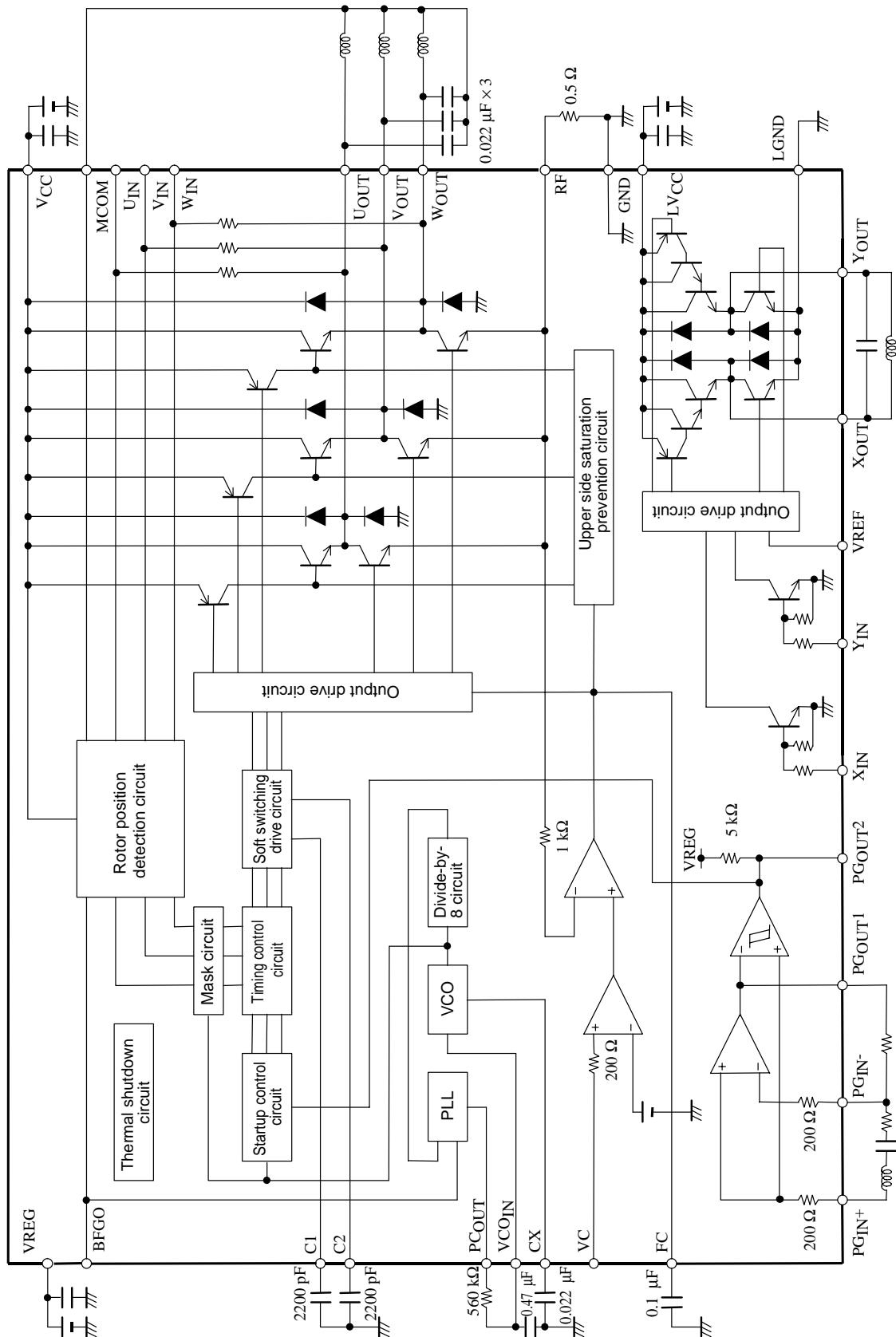
Input		Output		Mode
X _{IN}	Y _{IN}	X _{OUT}	Y _{OUT}	
L	L	Off	Off	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	L	L	Brake



Pin Assignment



Block Diagram (Note that the values of the external components depend on the motor used.)



Pin Description

Pin No.	Pin	Pin voltage	Function	Equivalent circuit
1	FC		<p>Frequency characteristics compensation</p> <p>Oscillation in the current control system closed loop can be prevented by connecting a capacitor between this pin and ground.</p>	
2	VC	0 V to VREG	<p>Speed control</p> <p>This circuit implements constant-current control in which current feedback is applied from the RF system.</p>	
3	VREG	4 V to 6 V	<p>Control system power supply</p> <p>This power supply must be stabilized so that ripple and noise do not enter the IC.</p>	
4	PG _{IN+}		<p>PG amplifier plus side input</p> <p>This pin is biased to 1/2 VREG internally.</p>	
5	PG _{IN-}		<p>PG amplifier minus side input</p>	
6	PG _{OUT1}		<p>PG amplifier linear output</p>	

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LB11880

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
7	PG _{OUT2}		PG Schmitt amplifier output	
8	BFGO		Motor back EMF voltage detection FG output (synthesized from three phases)	
9	LV _{CC}	8 to 13.8 V	Loading motor driver output transistor power supply	
10	VREF	0 to V _{CC} L	Loading motor driver output voltage setting	
11	X _{IN}	0 V to VREG	Loading motor driver logic input	
12	Y _{IN}			
13	X _{OUT}		Loading motor driver output	
15	Y _{OUT}			
14	LGND		Loading motor driver output transistor ground	

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
16	U _{OUT}		Drum motor driver output	
17	V _{OUT}			
18	W _{OUT}			
20	RF	8 to 13.8 V	<p>Lowest potential of the drum motor driver output transistor</p> <p>This IC implements constant-current control by detecting this voltage.</p> <p>The current limiter also operates by detecting this voltage.</p>	
21	V _{CC}	8 to 13.8 V	Internal reference voltage and power supply for both the drum motor driver output block and the coil waveform detection circuit.	
19	MCOM		Motor coil center input	
22	U _{IN}		Coil waveform detection comparator input	
23	V _{IN}		Each phase output is connected by an internal 10 kΩ resistor.	
24	W _{IN}			
25	C1		Triangular wave generating capacitor connection	
26	C2		This triangular wave is used to implement soft switching in the coil output waveform.	
27	CX		<p>The value of the capacitor connected between this pin and ground determines the operating frequency range and the minimum operating frequency of the VCO circuit.</p>	

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
28	VCO _{IN}		VCO circuit voltage input The PCOUT pin voltage is filtered by an RC circuit and input to this pin.	
29	PC _{OUT}		VCO circuit PLL output	
30	GND		Ground for all circuits other than the drum and loading driver output transistors.	

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