



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.

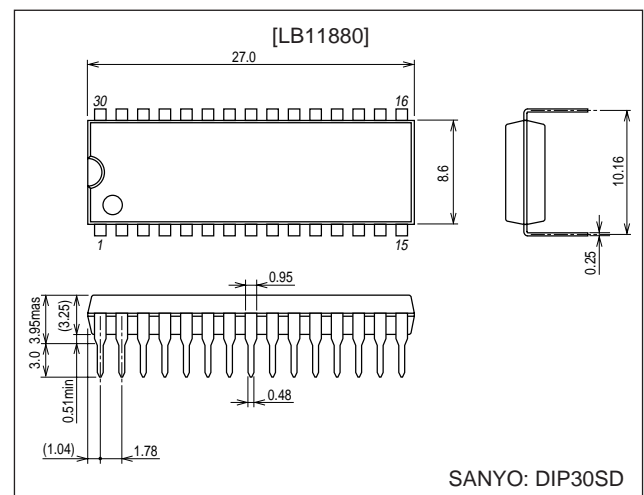
Functions and Features

- 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	$V_{CC\ max}$		14.5	V
Maximum supply voltage 2	$V_{CC\ L\ max}$		14.5	V
Maximum supply voltage 3	$V_{REG\ max}$		7.0	V
Output voltage	V_{omax}		14.5	V
Input voltage	$V_{I1\ max}$		-0.3 to $V_{REG} + 0.3$	V
Cylinder current	I_{omax}		1.0	A
Loading current	$I_{omax\ (AVE)}$		0.4	A
	$I_{omax\ (peak)}$		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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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}	$V_C = 0\text{ V}$, $X_{IN} = Y_{IN} = 0\text{ V}$		3.5	5.0	mA
Supply current 2	I_{CCL}	$V_C = 0\text{ V}$, $X_{IN} = Y_{IN} = 0\text{ V}$			1	mA
Supply current 3	I_{REG}	$V_C = 0\text{ V}$, $X_{IN} = Y_{IN} = 0\text{ V}$		10	15	mA
Output saturation voltage 1	$V_{O\text{sat}1}$	$I_O = 0.4\text{ A}$, source + sink		1.4	2.0	V
Output saturation voltage 2	$V_{O\text{sat}2}$	$I_O = 0.8\text{ A}$, 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	$f_{VCO\text{MIN}}$	$C_X = 0.022\ \mu\text{F}$, $V_{COIN} = \text{open}$		400		Hz
Maximum VCO frequency	$f_{VCO\text{MAX}}$	$C_X = 0.022\ \mu\text{F}$, $V_{COIN} = 5\text{ V}$		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	$I_{B\text{IN-}}$		-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.

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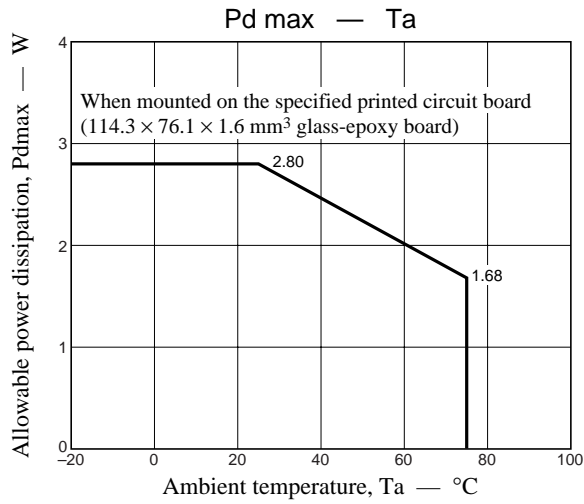
Loading Block at $T_a = 25^\circ\text{C}$, $V_{CC} = V_{CCL} = 12\text{ V}$, $V_{REG} = 5\text{ V}$

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

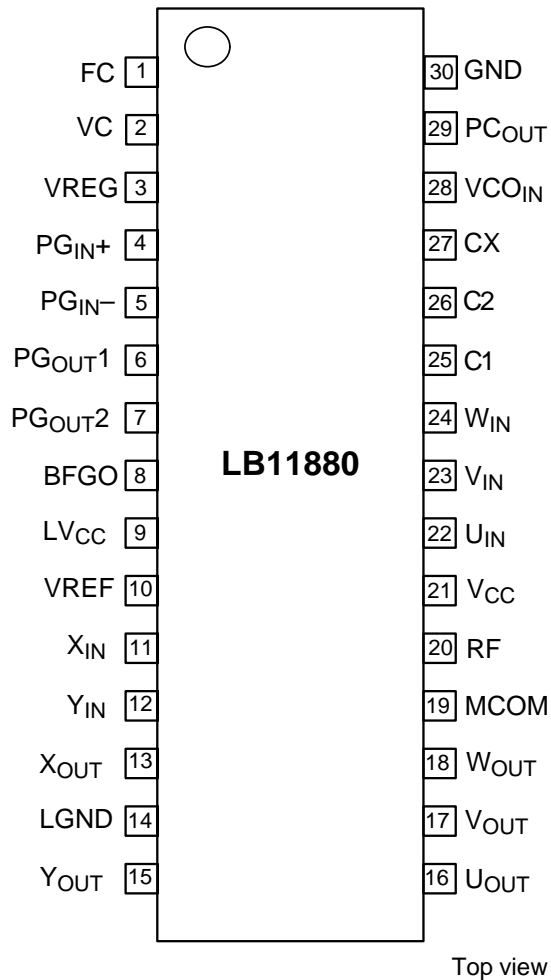
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Loading Motor Truth Table

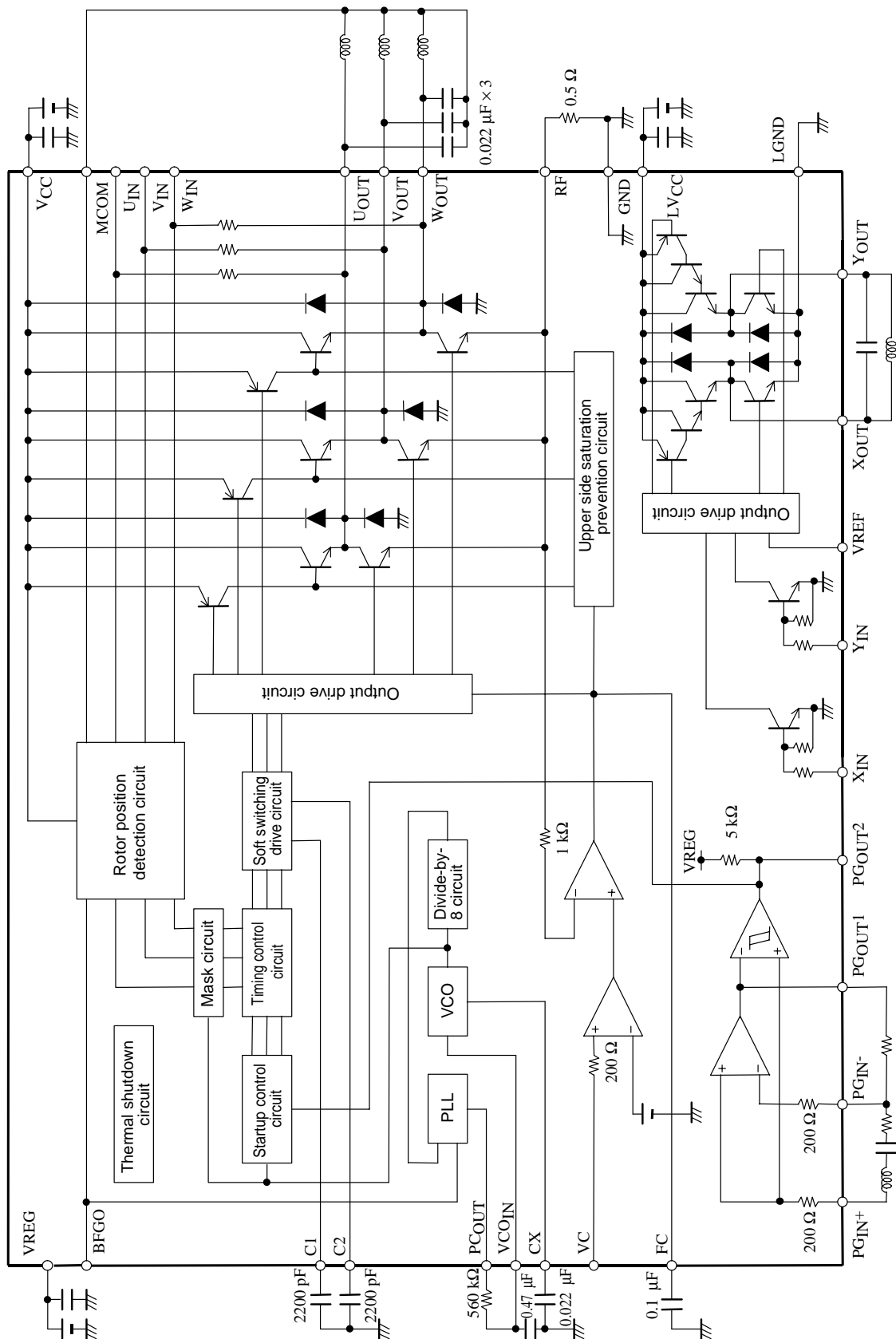
Input		Output		Mode
X _{IN}	Y _{IN}	X _{OUT}	Y _{OUT}	
L	L	Off	Off	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	L	L	Brake



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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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		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.	

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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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