



SANYO Semiconductors

DATA SHEET

LB11885 — Monolithic Digital IC

Three-in-One Motor Driver for Portable VCR

Overview

LB11885 is a three-in-one motor driver for portable VCR.

Features

- Capstan motor drive unit
 - 3-phase, 120 degrees full conducting, direct PWM drive
 - Built in PWM oscillator
 - Current limiter (It is fixed internally and setup externally.)
 - Forward/reverse rotation
 - 2 levels FG amplifier (Built-in gain resistor)
 - Control amplifier output pin
- Drum motor drive unit
 - 3-phase, 120 degrees full conducting soft switching sensorless drive
 - FG sensorless function
 - 2 levels PG amplifier
 - FG and PG mixing output (Separated output is also possible.)
- Loading motor drive unit
 - H-bridge forward/reverse rotation
 - Motor voltage switch
 - Short brake
 - Input control for 3 values
- Common unit
 - Over-heat protection function (Thermal Shut Down)

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LB11885

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
IC power source voltage	VREG max		6.5	V
Motor power source 1	C_VCC max		30.0	V
Motor power source 2	D_VCC max		30.0	V
Motor power source 3	L_VCC max		30.0	V
Applied input voltage	VI1 max		-0.3 to VCC+0.3	V
Motor output current	IC_VCC max		1.2	A
Motor output current	ID_VCC max		0.75	A
Motor output current	IL_VCC max		0.8	A
Allowable internal power dissipation	Pd max1	IC alone	0.85	W
	Pd max2			W
Pin voltage range 1	VPIN max1	CRSS, CRSP, CUOUT, CVOUT, CWOUT	CMGND-VF to CVCC+VF	V
Pin voltage range 2	VPIN max2	DRS, DCOM, DUOUT, DVOUT, DWOUT	DMGND-VF to DVCC+VF	V
Pin voltage range 3	VPIN max3	LOUT1, LOUT2	LGND-VF to LVCC+VF	V
Operating temperature	Topr		-20 to +75	°C
Storage temperature	Tstg		-55 to +150	°C

Allowable Operating Range at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power source voltage 1	VREG		4 to 6	V
Power source voltage 2	C_VCC		8 to 28	V
Power source voltage 3	D_VCC		8 to 28	V
Power source voltage 4	L_VCC		8 to 28	V
Electric potential difference between MGND and SGND	ΔGND	(MGND)-(SGND)	-0.3 to +0.4	V

Electrical Characteristics

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Common Unit at Ta = 25°C, VREG = 5V, C_VCC = D_VCC = L_VCC = 12V						
Power source current 1	IVREG			17	25	mA
Power source current 2	IC_VCC			0.3	2	mA
Power source current 3	ID_VCC			0.6	1	mA
Power source current 4	IL_VCC			2	3	mA
Power source current 5	IVCCQ	VREG = 0V, IC_VCC+ID_VCC+IL_VCC			100	μA
Thermal shutdown temperature	TSD	*Design Target Value	140	160	180	°C
Thermal shutdown hysteresis	ΔTSD	*Design Target Value		15		°C
Capstan Motor Unit at Ta = 25°C, VREG = 5V, C_VCC = 12V						
Output saturation voltage 1	VOSAT	I_O = 1.0A, Source+Sink		2.6	4.0	V
Hall signal input level	VHALL		60			mVp-p
Hall in-phase input voltage	VCM		1.0		VCC-1.7	V
C_ILM pin input voltage range	VCLIM		0		VREG	V
C_ILM pin input current	ICLIM	C_LIM = 3V			2.0	μA
C_LIM control start voltage	VCLIMST	C_RF = 0.5Ω	2.4	2.5	2.6	V
C_LIM gain	GCLIM	C_CNT = 5V, C_RF = 0.5Ω	0.49	0.53	0.57	V/V
C_LIM pin short brake release voltage	BROFF1		1.1		1.4	V
C_CNT input voltage range	VCCNT		0		VREG	V

* Note: Thermal design must be set for a junction temperature of 140°C.

* It is a design target value and measurement is not carried out.

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
C_CNT input current	ICCTL	C_CNT = 3V			2.0	μA
C_CNT control start voltage	VCCNTST	C_RF = 0.5Ω	2.4	2.5	2.6	V
C_CNT gain	GCCNT	C_RF = 0.5Ω	0.49	0.53	0.57	V/V
C_CNT pin short brake release voltage	BROFF2		1.1		1.4	V
F/R forward voltage	VFW		1.5		VREG	V
F/R reverse voltage	VRW		0		1	V
F/R input current	IFR	C_FR = 3V		100	200	μA
FG amplifier reference voltage	VFGR		2.40	2.50	2.60	V
Linear amplifier gain DC	GDC		47	50	53	fold
Hysteresis amplifier output voltage	VHO	I _{HO} = 4mA		0.2	0.4	V
Hysteresis of hysteresis amplifier	VHS	Both hysteresis	60	75	90	mV
Hysteresis amplifier output duty ratio	FGDT	360Hz F _{gin} = 40mVp-p	49	50	51	%
PWM carrier frequency	FOSC	C_PWM = 680pF	18.5	21.7	25.0	kHz
Internal current limiter setup voltage	CLIM	RF = 100Ω	0.60	0.675	0.75	V
Drum Motor Unit at Ta = 25°C, VREG = 5V, DV _{CC} = 12V						
Output saturation voltage 2	DVSAT2	0.6A, Source+Sink		1.8	2.6	V
D_CNT input voltage range	VD_CNT		0		VREG	V
D_CNT input current	IC_CNT	D_CNT = 3V			0.5	μA
D_CNT control start voltage	D_CNTST		2.40	2.50	2.60	V
D_CNT gain	GD_CNT		0.40	0.50	0.60	V/V
PCOUT output current 1	IPCOU	Source side	20	45		μA
PCOUT output current 2	IPCOD	Sink side	20	45		μA
VCOIN input current	IVCOIN	VCOIN = 3V, sink current			1	μA
Minimum VCO frequency	FVCO min	CX = 0.022μF, VCOINN = Open	330	410	500	Hz
Maximum VCO frequency	FVCO max	CX = 0.022μF, VCOIN = 5V	18.3	22.8	27.4	kHz
C1/C2 source current ratio	RSOURCE	1-(IC1SOURCE/IC2SOURCE)	-12	0	12	%
C1/C2 sink current ratio	RSINK	1-(IC1SINK/IC2SINK)	-12	0	12	%
C1 source/sink current ratio	RC1	IC1SOURCE/IC1SINK	40	50	60	%
C2 source/sink current ratio	RC2	IC2SOURCE/IC2SINK	40	50	60	%
FGO output high level voltage	VFGH		4.7			V
FGO output low level voltage	VFGL				0.4	V
PG amplifier reference voltage	VPGREF		2.8	3.0	3.2	V
PG amplifier input offset	OPG		-5		+5	mV
PG amplifier input bias	IPG	PG- = 2.5V, source current			0.25	μA
Linear amplifier gain	GAMP	Freq = 1kHz	50			dB
Hysteresis amplifier threshold level 1	VHYS1		70	100	130	mV
Hysteresis amplifier threshold level 2	VHYS2		140	200	260	mV
PG output high level voltage	VPH		4.7			V
PG output low level voltage	VPL				0.2	V
FG/PG mix MID voltage	Vmid		2.4	2.5	2.6	V
Internal current limiter setup voltage	DLIM	RF = 100Ω	0.30	0.33	0.36	V
Loading Unit at Ta = 25°C, VREG = 5V, LV _{CC} = 12V						
Input voltage	1 (HIGH)	V _{INH}		4		5
	2 (Middle)	V _{INM}		2		3
	3 (LOW)	V _{INL}		0		1

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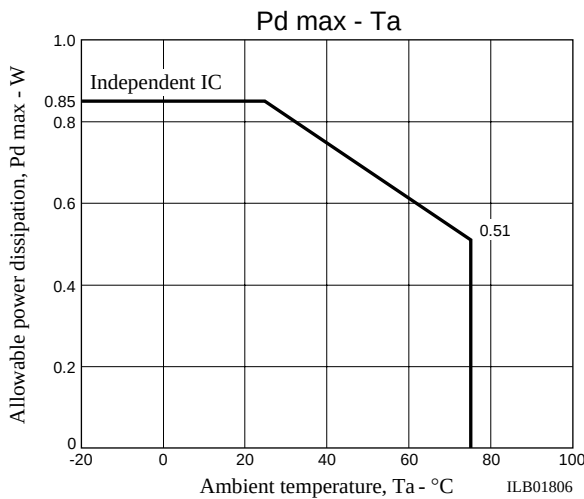
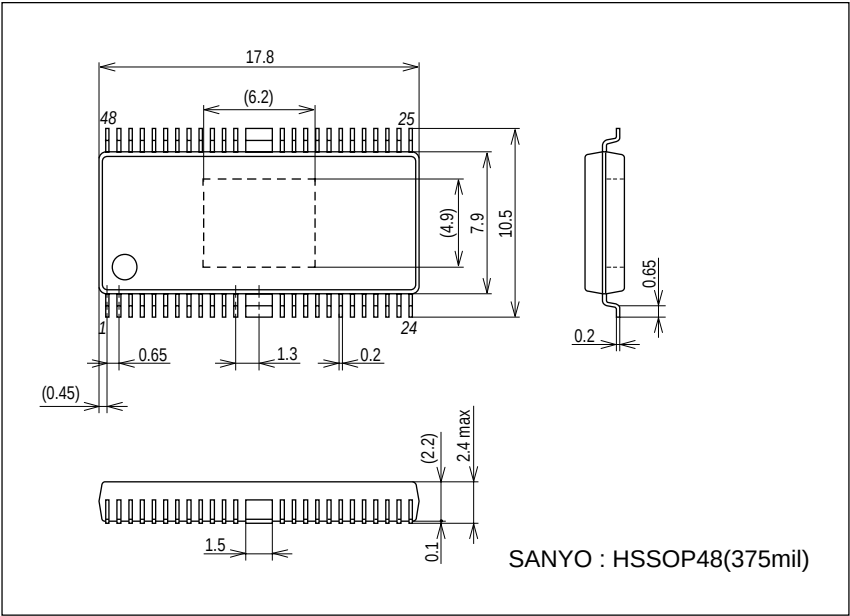
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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Input current	IL _{IN} 0	L _{IN} = 0V, source side		130	200	μA
	I _{LIN} 5	L _{IN} = 5V, sink side		130	200	μA
Saturation voltage	VSAT U-1	L _{VREF} = LV _{CC} Between output and LV _{CC} I _O = 0.6A, CW/CCW mode		1.9	2.4	V
	VSAT L-1	L _{VREF} = LV _{CC} Between output and LV _{CC} I _O = 0.6A, CW/CCW mode		1.2	1.7	V
	VSATIL	L _{VREF} = LV _{CC} SINK+SOURCE I _O = 0.4A, CW/CCW mode		2.8	3.5	V
Residual voltage of upper side	VSAT U-1	L _{VREF} = 8V Between output and L _{MGND} I _O = 0.6A, CW/CCW mode	7.2	8.0	8.8	V
Output transistor leak current	Upper ILU	V _{CC} = 0V			50	μA
	Lower ILL	V _{CC} = 0V			50	μA
L _{VREF} current	IVREF	L _{VREF} = LV _{CC} , source side L _{IN} = 0.5V		2	5	μA

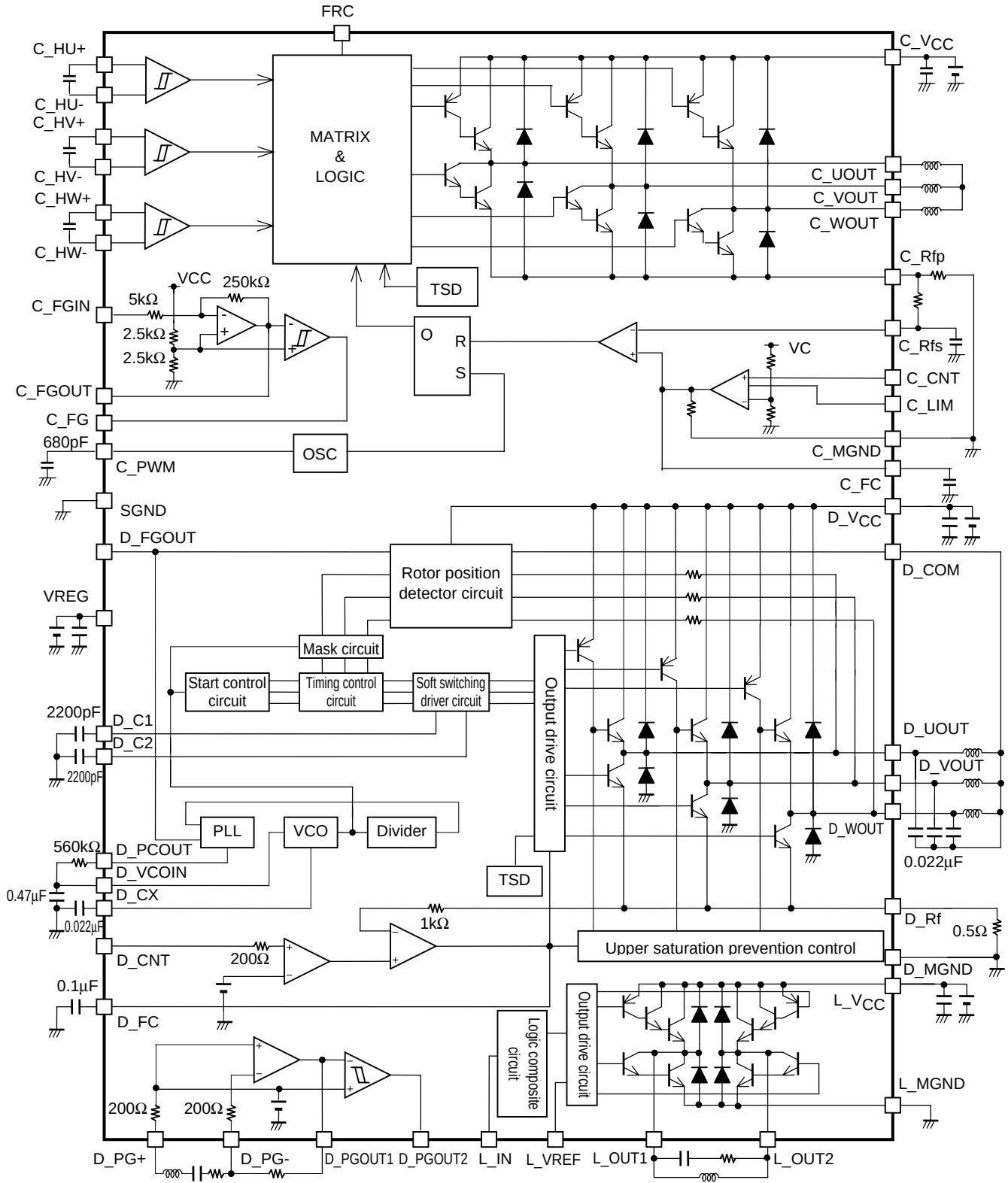
Package Dimensions

unit : mm (typ)

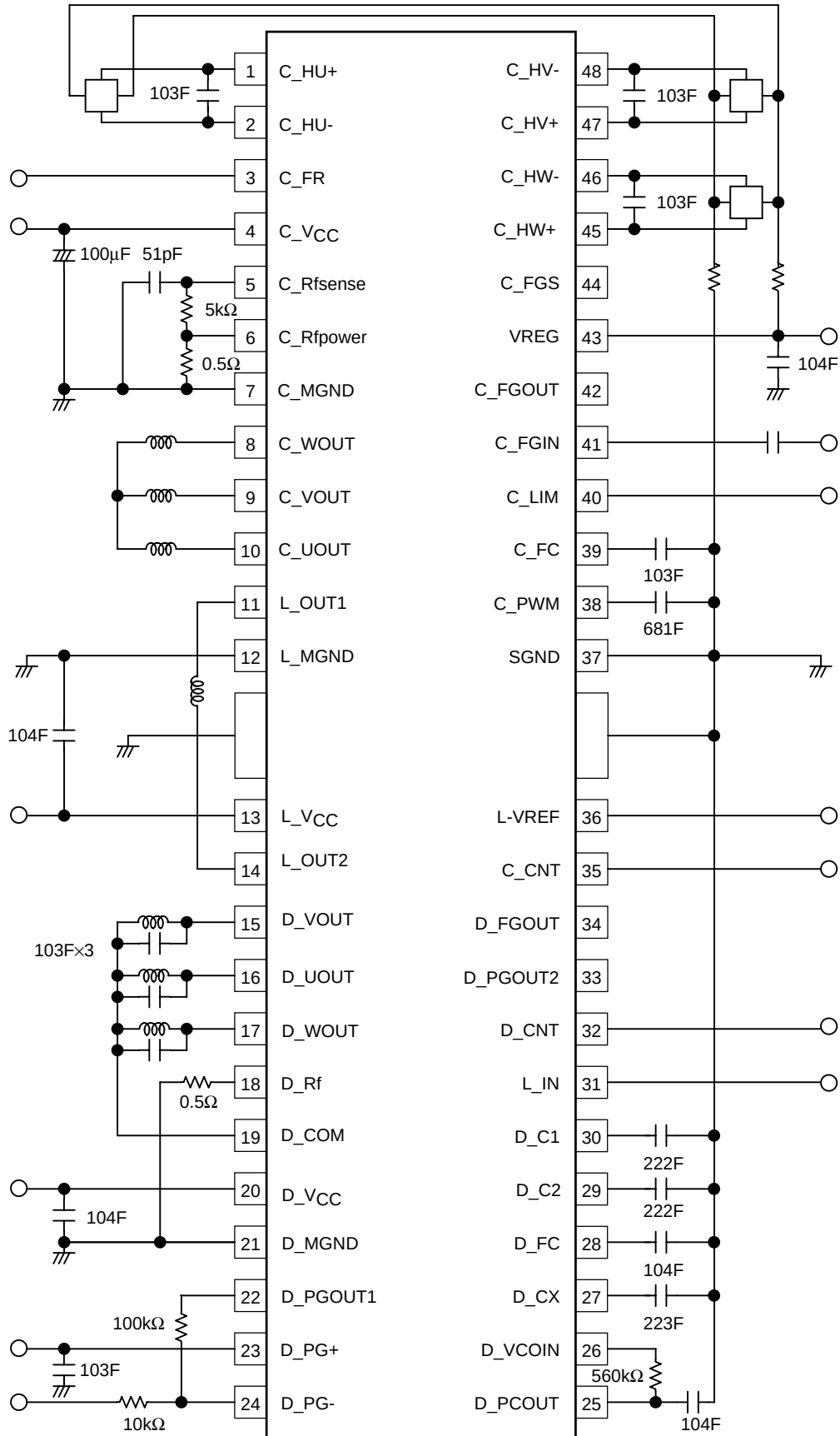
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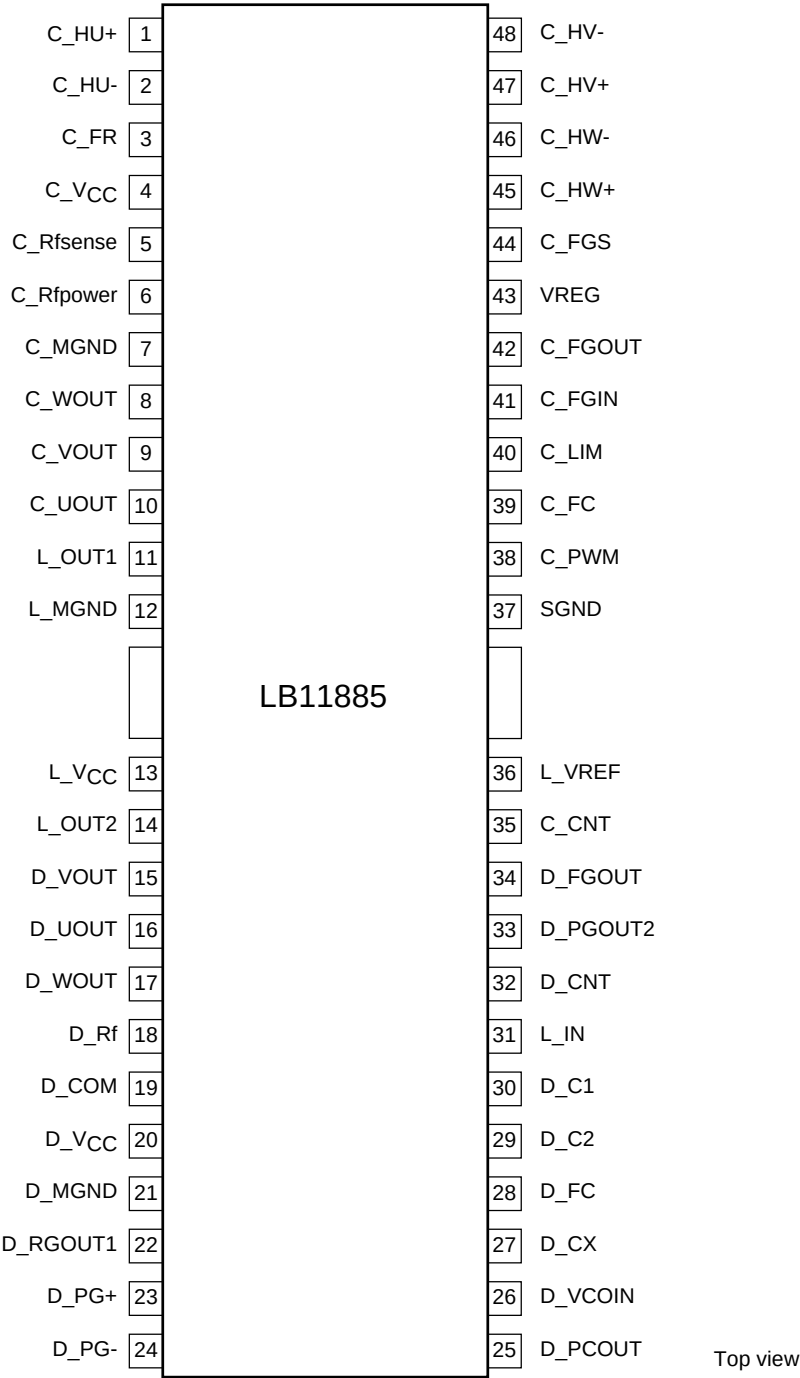
Block Diagram



Sample Application Circuit



Pin Assignment



Pin Description

Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
4	C-V _{CC}	8V to 28V	Power pin of capstan motor driver	
20	D-V _{CC}	8V to 28V	Power pin of drum motor driver	
13	L-V _{CC}	8V to 28V	Power pin of loading motor driver	
43	VREG	4V to 6V	Power pin to provide all voltages other than the output transistor and pre-drive	
7	C-MGND		Capstan motor GND	
37	SGND		GND for all other than output	
1	C-HU+	1.5V to V _{CC} -1.5V	U-phase Hall element input pin HU+>HU- state for logic H	
2	C-HU-			
47	C-HV+		V-phase Hall element input pin. HV+>HV- state for logic H	
48	C-HV-			
45	C-HW+		W-phase Hall element input pin. HW+>HW- state for logic H	
46	C-HW-			
41	C-FGIN	1V to V _{CC} -1.5V	Capstan FGAMP reverse input pin	
42	C-FGOUT		Capstan FGMP linear output pin Return resistor is incorporated with the amplification degree of about 50-fold.	
44	C-FGS		FG Schmidt amp output pin of capstan block	
3	C-FR	0V to V _{CC}	Capstan forward/reverse control pin	

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Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
39	C-FC		Capstan control loop frequency characteristics compensation pin	
5	C-RFS		Capstan current detection filter pin Connect the current detected at C-RFP to this pin after passing through the CR filter.	
38	C-PWM		Capacitor connection pin for PWM oscillation at capstan	
40	C-LIM	0V to V _{CC}	Capstan current limit setting pin	
35	C-CNT	0V to V _{CC}	Capstan speed control voltage application pin	
8	C-WOUT		Capstan W-phase output pin	
9	C-VOUT		Capstan V-phase output pin	
10	C-UOUT		Capstan U-phase output pin	
6	C-RFP		PWRTR GND and current return resistor connection pin	

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Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
28	D-FC		Drum frequency characteristics compensation pin. Insertion of a capacitor to GND stops oscillation of the closed loop of current control system	
32	D-CNT	0V to V _{CC}	Drum speed control pin. Control is the constant current control to which current return is applied from DRS.	
21	D-MGND		Drum current control sensing GND pin. Connect this pin to GND of the current detection resistor.	
23	D-PG+		Drum PG amplifier non-inverted input pin Biased internally to (3/5)×V _{CC}	
24	D-PG-		Drum PG amplifier inverted input pin	

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Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
22	D-PGOUT1		Drum PG amplifier linear output pin	
33	D-PGOUT2		Drum PG Schmidt amplifier output pin	
34	D-FGOUT		Drum motor reverse counter-electromotive voltage detection output pin (three-phase synthesizing)	
26	D-VCOIN		VCO circuit voltage input pin of drum block. The PCOUT pin voltage is input via CR filter.	
25	D-PCOUT		VCO circuit PLL output pin of drum block.	

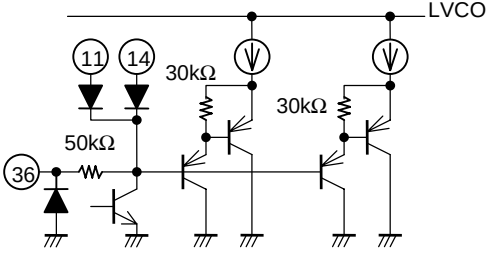
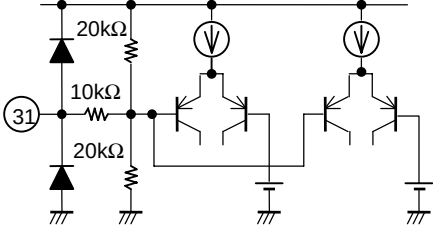
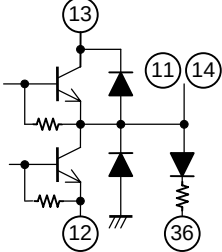
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Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
16	D-UOUT		Drum motor driver output pin	
15	D-VOUT			
17	D-WOUT			
18	D-RF		Minimum potential of drum motor driver output transistor. Constant-current control is made through detection of this voltage. The current limiter also functions by detecting this potential.	
19	D-COM		Motor coil neutral point input pin. The coil voltage waveform is detected with reference to this voltage.	
30	D-C1		Triangular wave generating capacitor connection pin of drum block. This triangular wave performs soft- switching of the coil output waveform.	
29	D-C2			
27	D-CX		In the VCO circuit, the operation frequency range and minimum operation frequency are determined by means of the capacitor value connected to this pin and GND.	

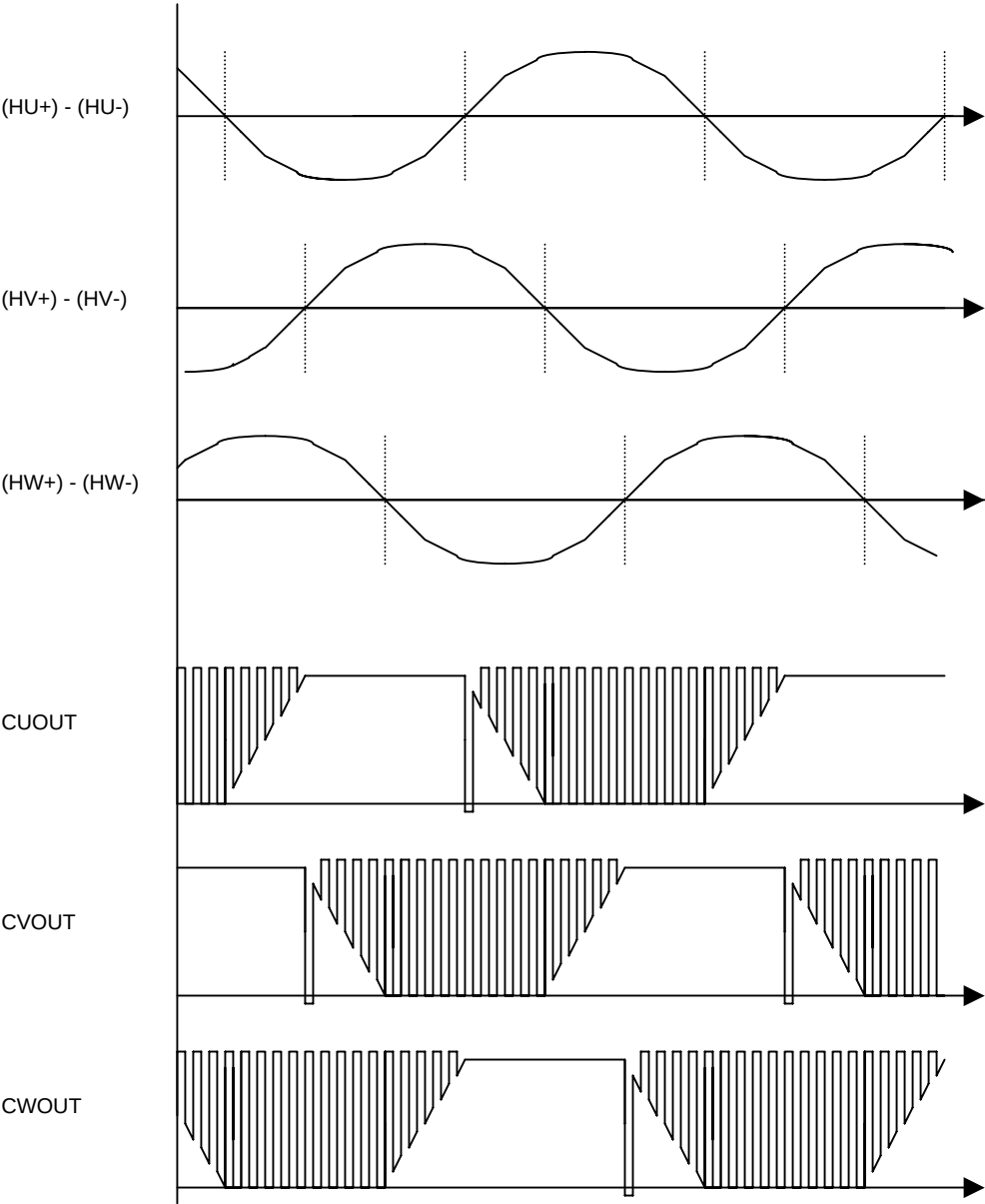
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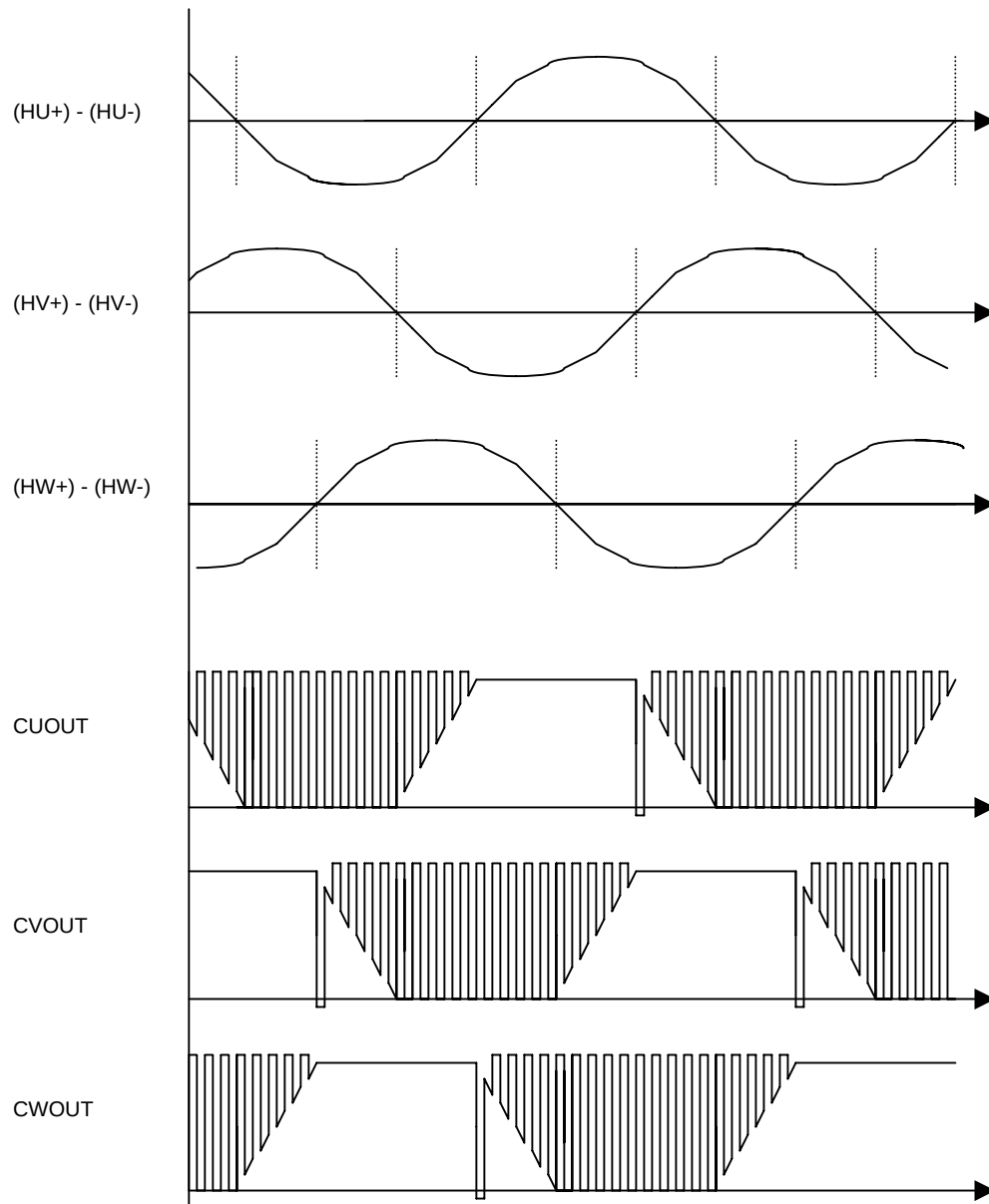
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
36	L-VREF	0 to LVCO	Loading output voltage setting pin	
31	L-IN	0V to VCC	Loading logic input pin	
11	L-OUT1		Loading motor driver output pin	
14	L-OUT2			
12	L-MGND		Loading output transistor GND pin	

Timing Chart and Truth Table

1. Capstan Motor Driver Drive waveform (C_FR = L)



2. Capstan Motor Driver Drive waveform (FRC = H)



3. Capstan Motor Driver Truth Table & Control Functions

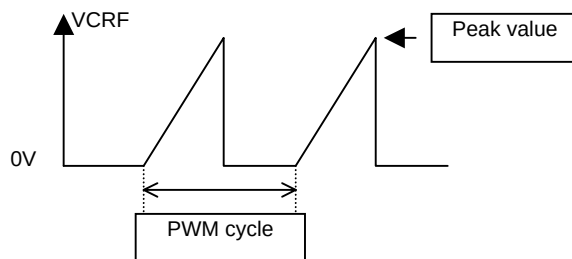
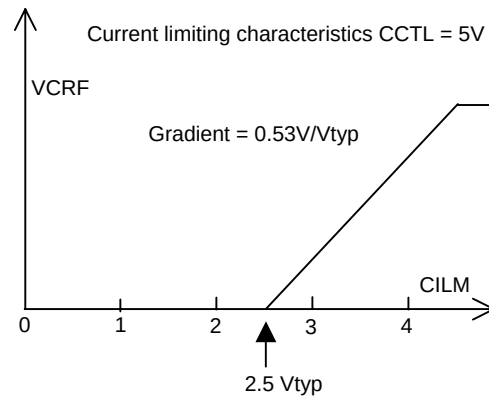
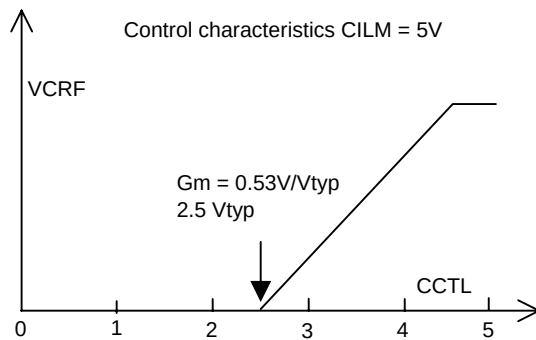
	Source→Sink	Hall input			FRC
		U	V	W	
1	V → W	H	H	L	H
	W → V				L
2	U → W	H	L	L	H
	W → U				L
3	U → V	H	L	H	H
	V → U				L
4	W → V	L	L	H	H
	V → W				L
5	W → U	L	H	H	H
	U → W				L
6	V → U	L	H	L	H
	U → V				L

Note) H of FRC means the voltage of 1.5V or more while L means the voltage of 1.0V or less. (At $V_{CC} = 5V$)

Note) For the Hall input, the input H means the condition in which (+) relative to each phase input (-) is higher by 0.1V.

The input L means the condition in which (+) relative to (-) is lower by 0.1V or more.

Control function & control limiting function

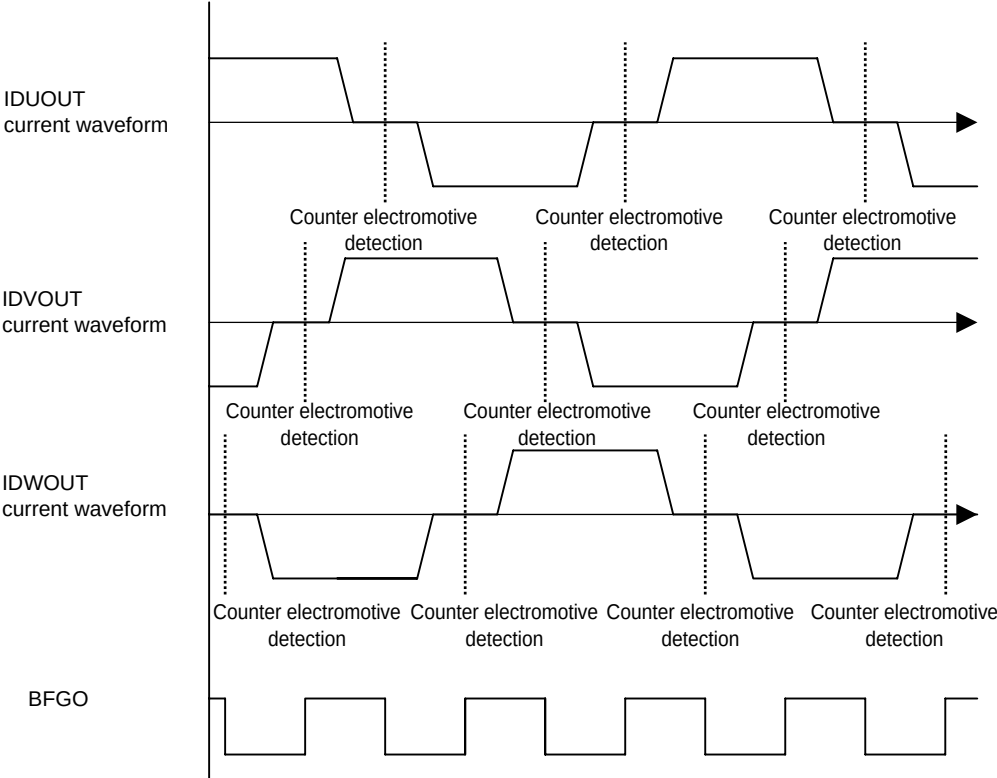


Caution: For the VCRF voltage of control characteristics, the peak value is to be measured.

Cautions for use)

- When the direct reversion brake is to be used, keep the voltage at the C_LIM terminal 3.1kV or less so that IOMAX is not exceeded.
- The capacitor to be used between power supply and GND should be an electrolytic capacitor of 47 μ F or more.

4. Drum Motor Driver Drive current waveform



5. Loading Motor Truth table

Input	Output		Mode
	LOUT1	LOUT2	
LIN			
L	L	H	Reverse
M (or OPEN)	L	L	Brake
H	H	L	Forward

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