Ordering number : EN7884A

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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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_V_{CC} max		30.0	V
Motor power source 2	D_V_{CC} max		30.0	V
Motor power source 3	L_V_{CC} max		30.0	V
Applied input voltage	VI1 max		-0.3 to V_{CC}+0.3	V
Motor output current	IC_V_{CC} max		1.2	A
Motor output current	ID_V_{CC} max		0.75	A
Motor output current	IL_V_{CC} 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 CV_{CC}+VF	V
Pin voltage range 2	VPIN max2	DRS, DCOM, DUOUT, DVOUT, DWOUT	DMGND-VF to DV_{CC}+VF	V
Pin voltage range 3	VPIN max3	LOUT1, LOUT2	LGND-VF to LV_{CC}+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_V_{CC}		8 to 28	V
Power source voltage 3	D_V_{CC}		8 to 28	V
Power source voltage 4	L_V_{CC}		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_V_{CC} = D_V_{CC} = L_V_{CC} = 12V						
Power source current 1	IVREG			17	25	mA
Power source current 2	IC_V_{CC}			0.3	2	mA
Power source current 3	ID_V_{CC}			0.6	1	mA
Power source current 4	IL_V_{CC}			2	3	mA
Power source current 5	$IV_{CC}Q$	VREG = 0V, IC_V_{CC}+ID_V_{CC}+IL_V_{CC}			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_V_{CC} = 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		V_{CC}-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 Fgin = 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)	$V_{IN}H$		4		5
	2 (Middle)	$V_{IN}M$		2		3
	3 (LOW)	$V_{IN}L$		0		1

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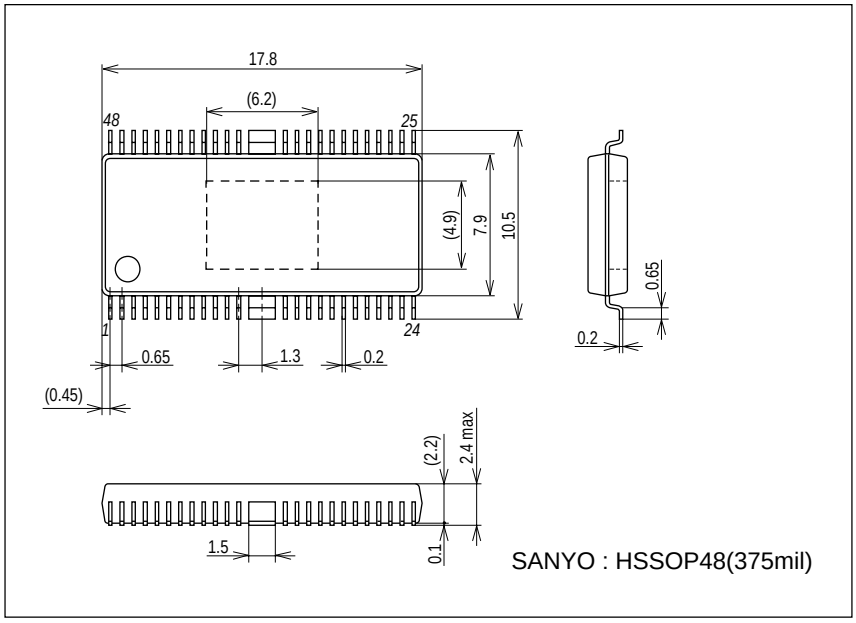
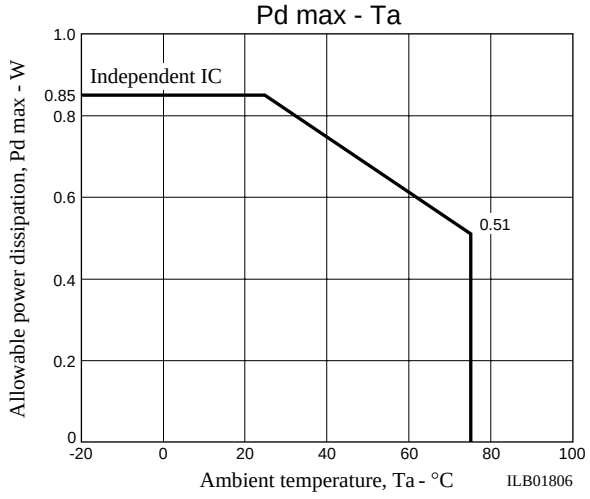
Parameter	Symbol		Conditions	Ratings			Unit
				min	typ	max	
Input current	$IL_{IN}0$		L_{IN} = 0V, source side		130	200	μA
	$I_{LIN}5$		L_{IN} = 5V, sink side		130	200	μA
Saturation voltage	VSAT U-1		L_VREF = LV_{CC} Between output and LV_{CC} I_O = 0.6A, CW/CCW mode		1.9	2.4	V
	VSAT L-1		L_VREF = LV_{CC} 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

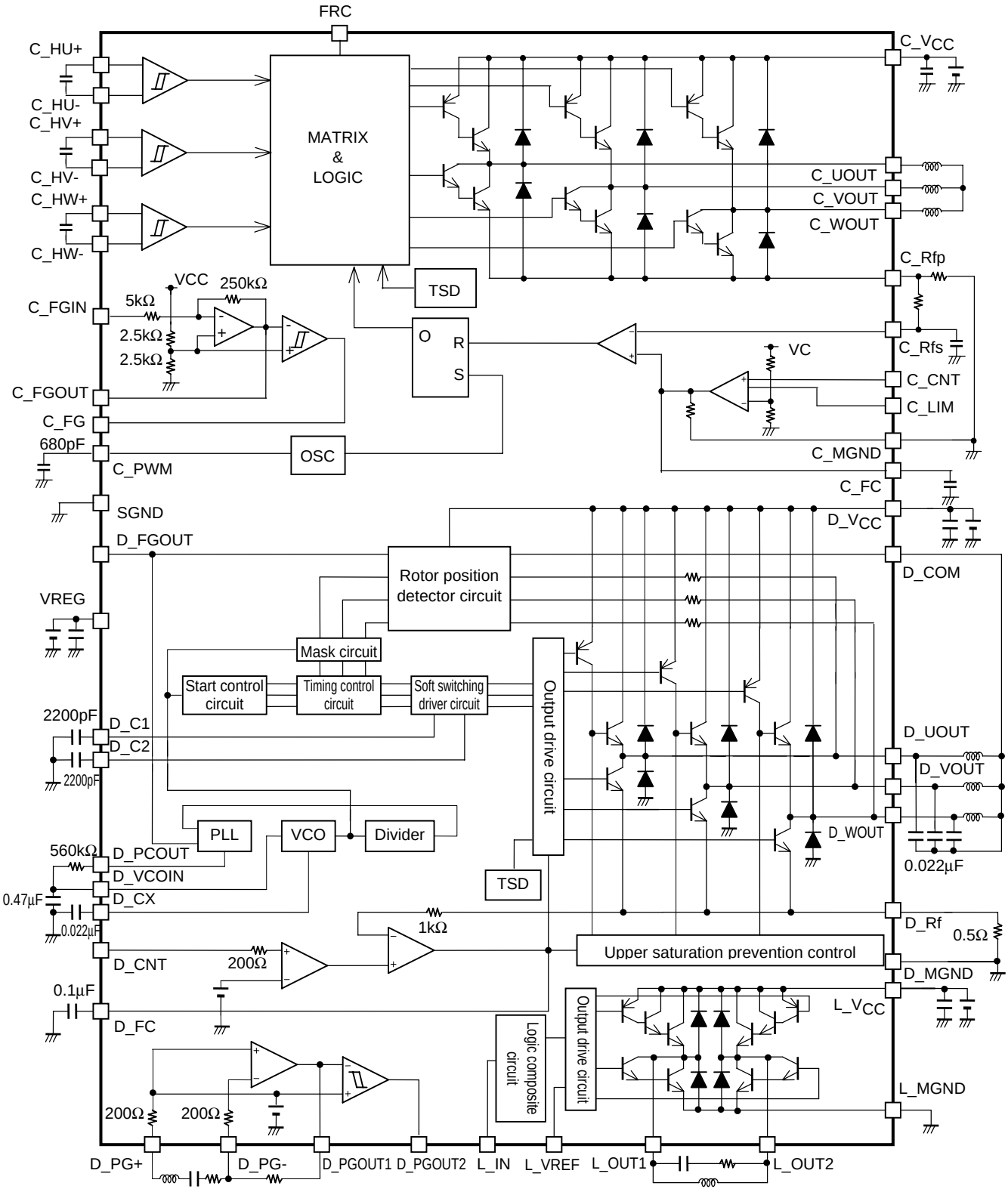
unit : mm (typ)

3278

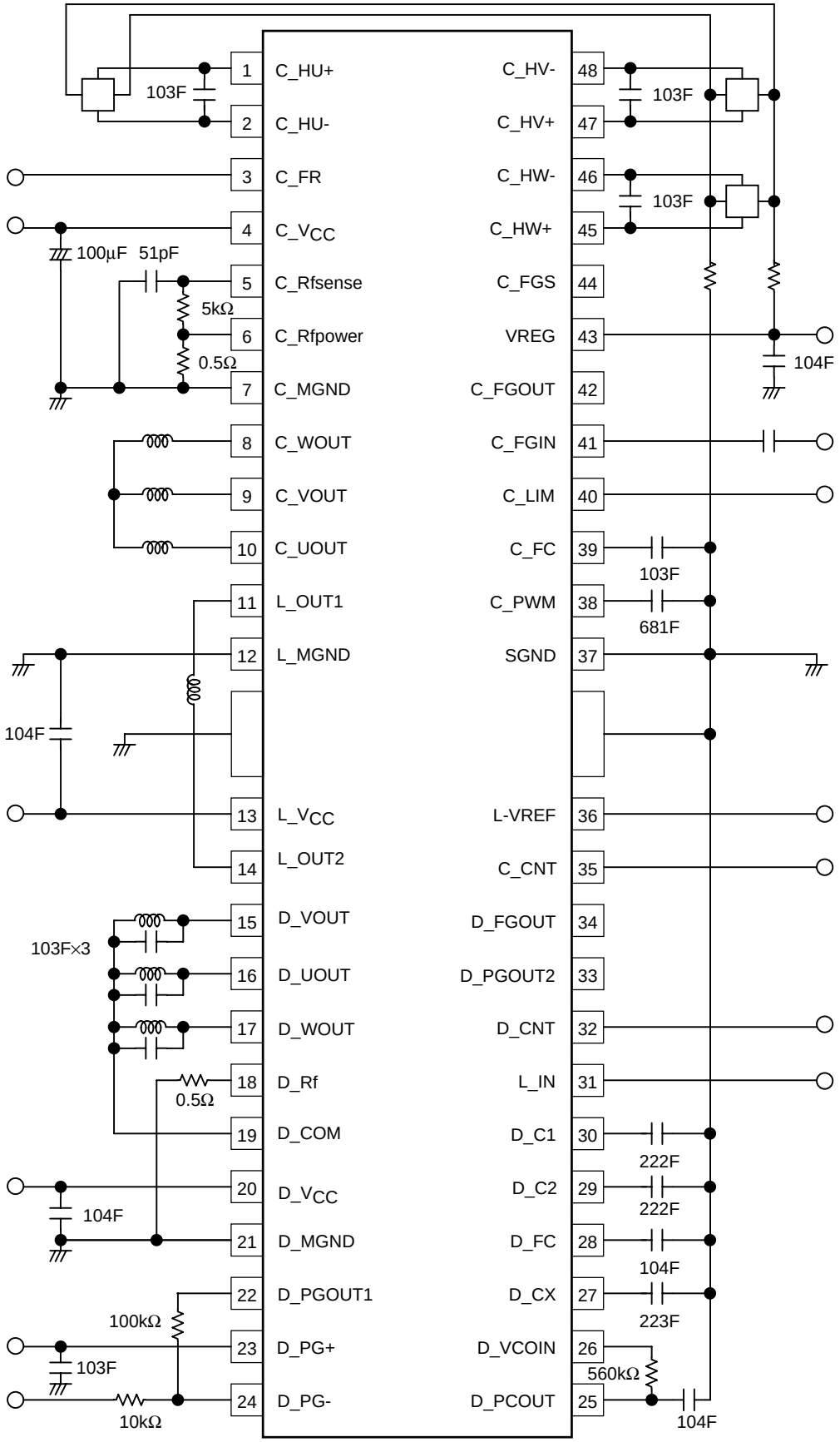




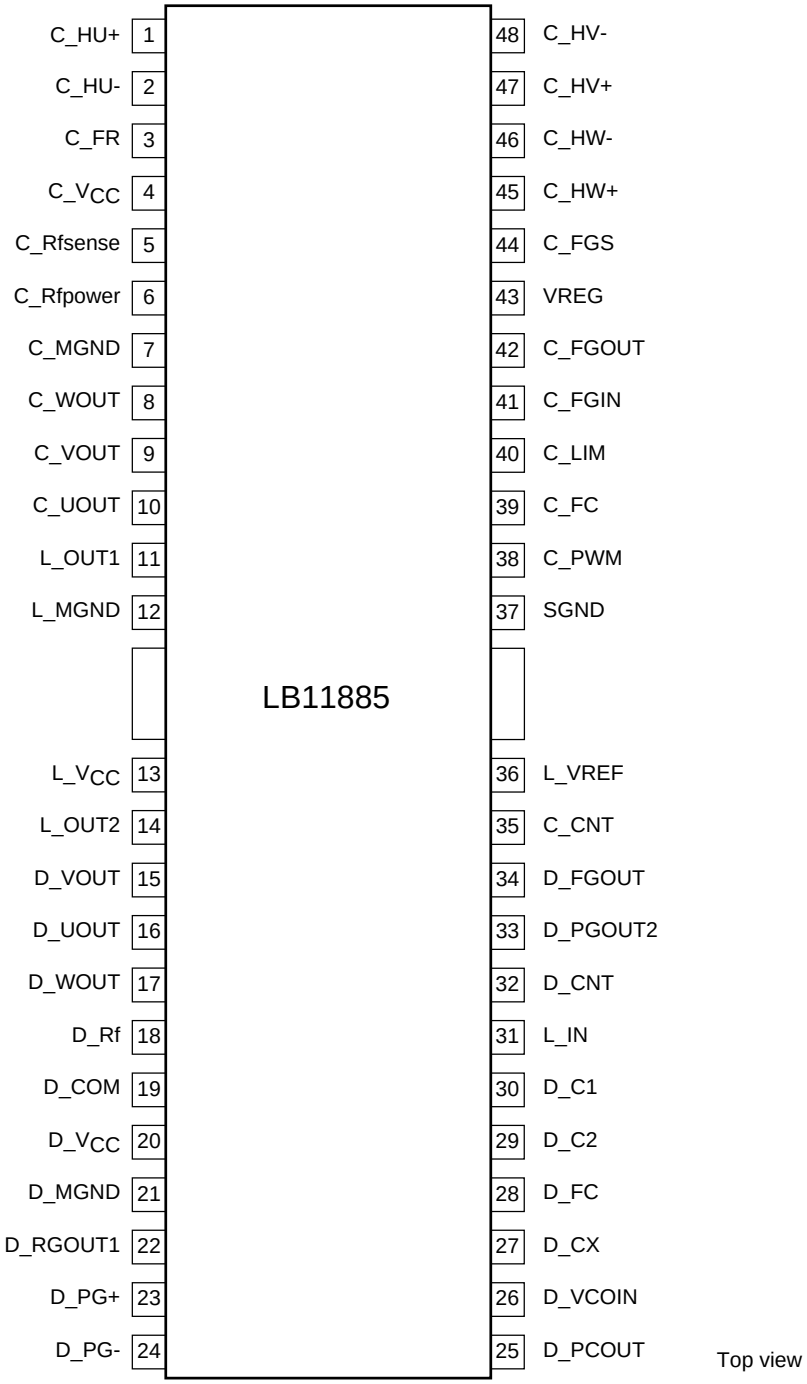
Block Diagram



Sample Application Circuit

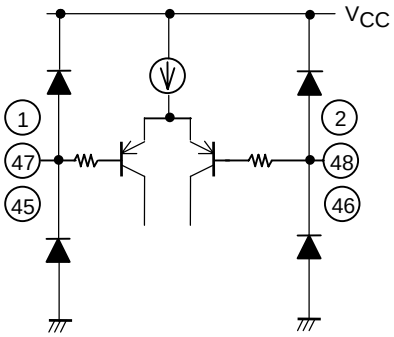
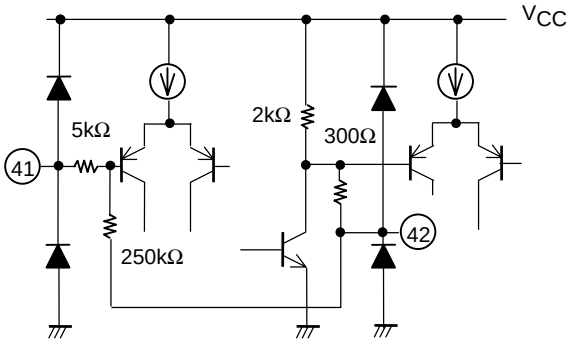
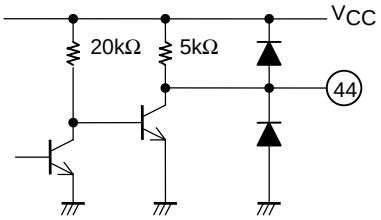
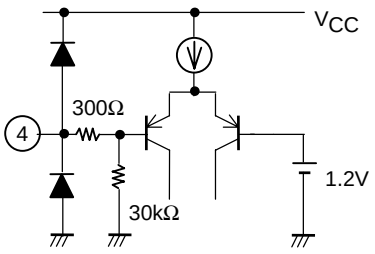


Pin Assignment



Top view

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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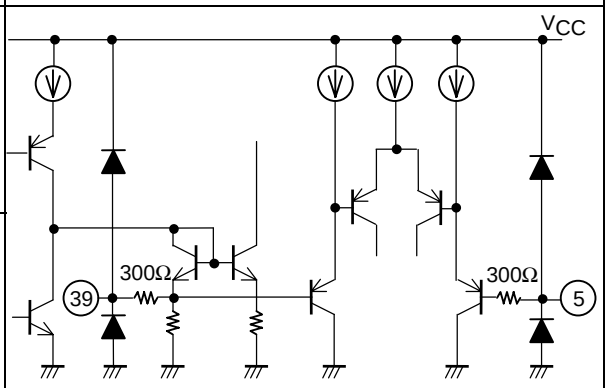
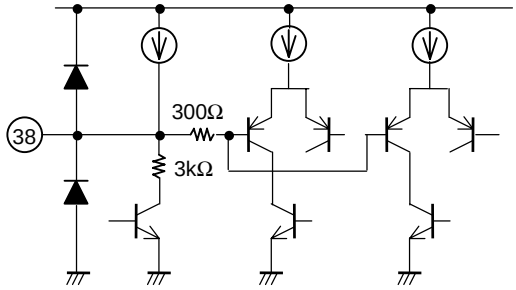
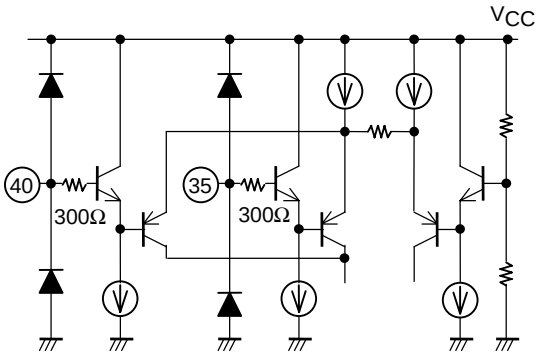
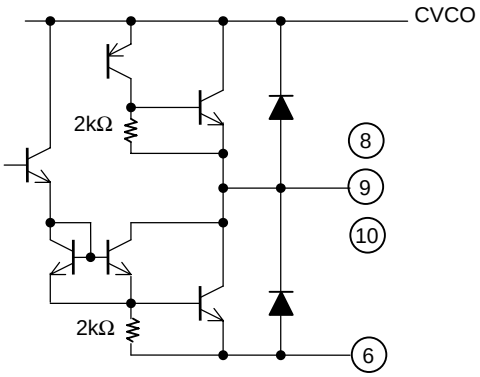
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
39	C-FC		Capstan control loop frequency characteristics compensation pin	
5	C-RFS		Capstan current detection filter pin Connect the current detected at C-RFP to this pin after passing through the CR filter.	
38	C-PWM		Capacitor connection pin 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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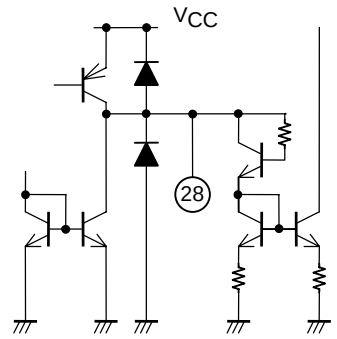
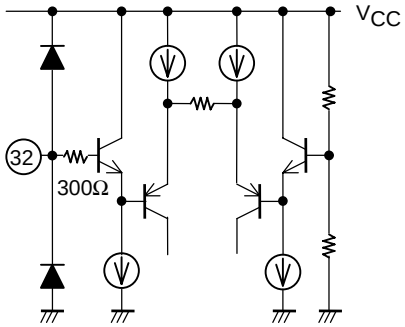
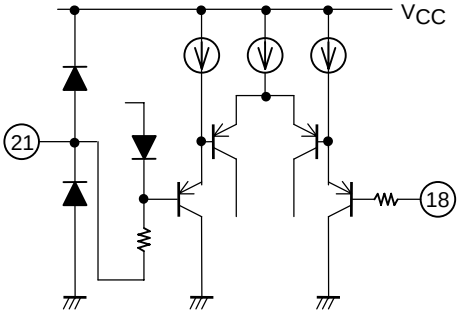
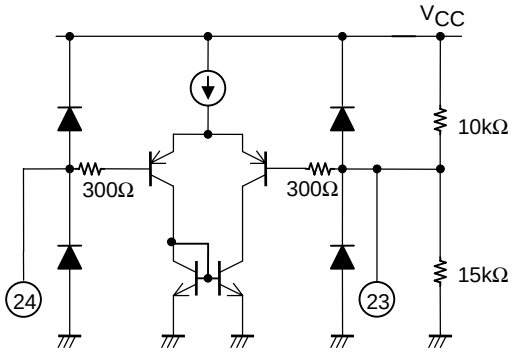
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
28	D-FC		Drum frequency characteristics compensation pin. Insertion of a capacitor to GND stops oscillation of the closed loop of current control system	
32	D-CNT	0V to V_{CC}	Drum speed control pin. Control is the constant current control 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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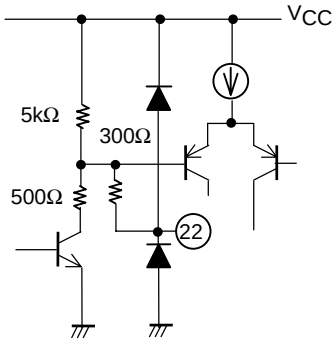
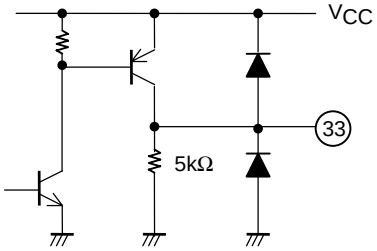
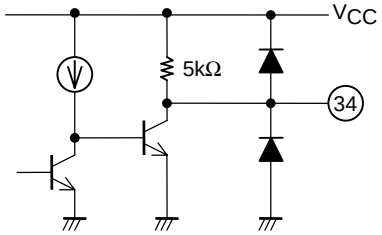
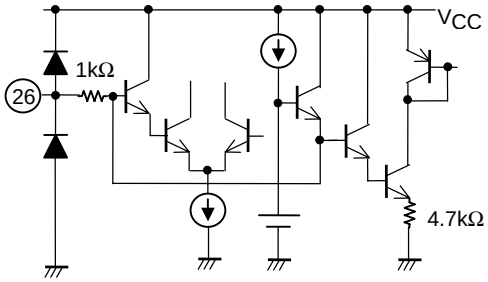
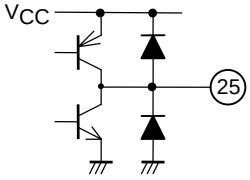
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
22	D-PGOUT1		Drum PG amplifier linear output pin	
33	D-PGOUT2		Drum PG Schmidt amplifier output pin	
34	D-FGOUT		Drum motor reverse counter-electromotive voltage detection output pin (three-phase synthesizing)	
26	D-VCOIN		VCO circuit voltage 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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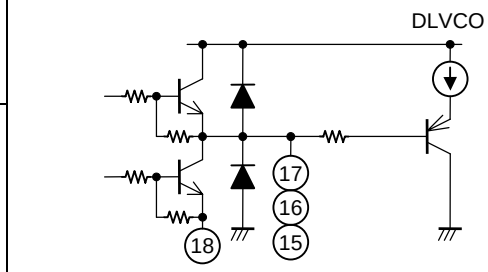
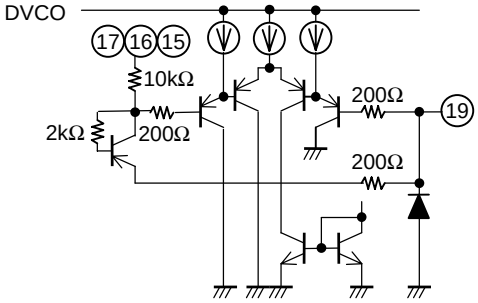
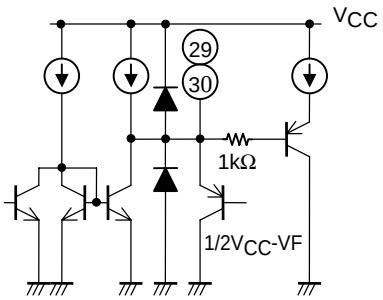
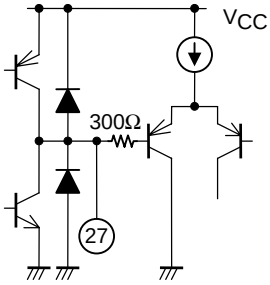
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
16	D-UOUT		Drum motor driver output pin	
15	D-VOUT			
17	D-WOUT			
18	D-RF		Minimum potential of drum motor driver output transistor. Constant-current control is made through detection of this voltage. The current limiter also functions by 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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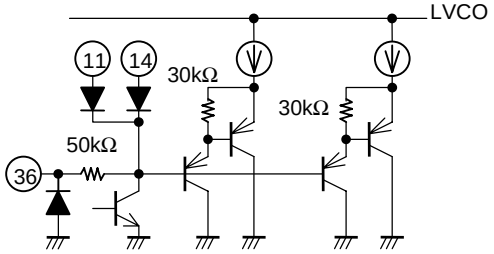
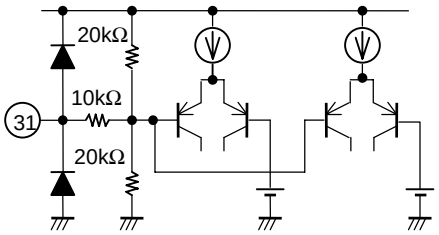
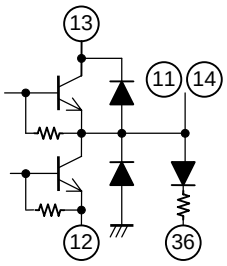
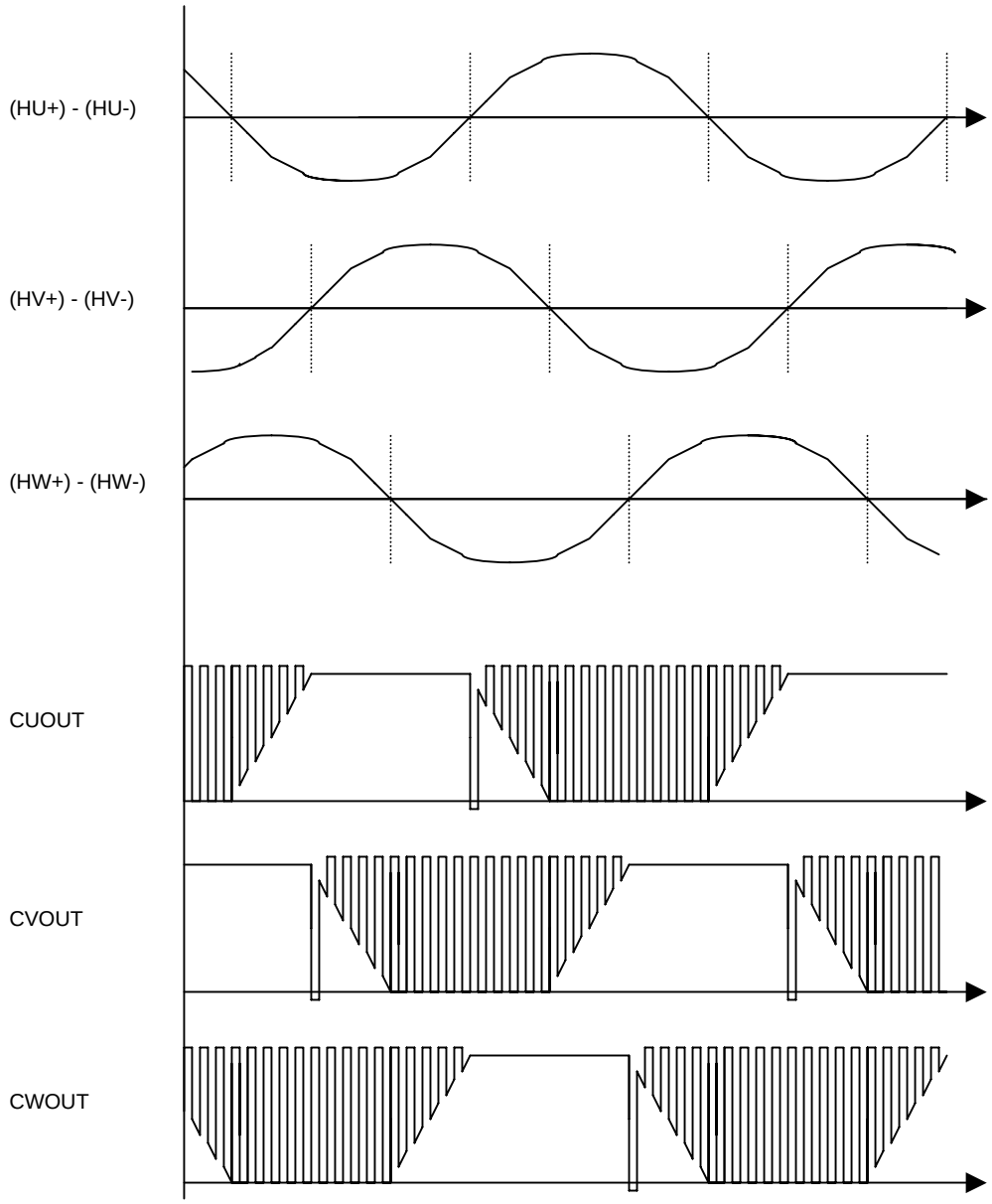
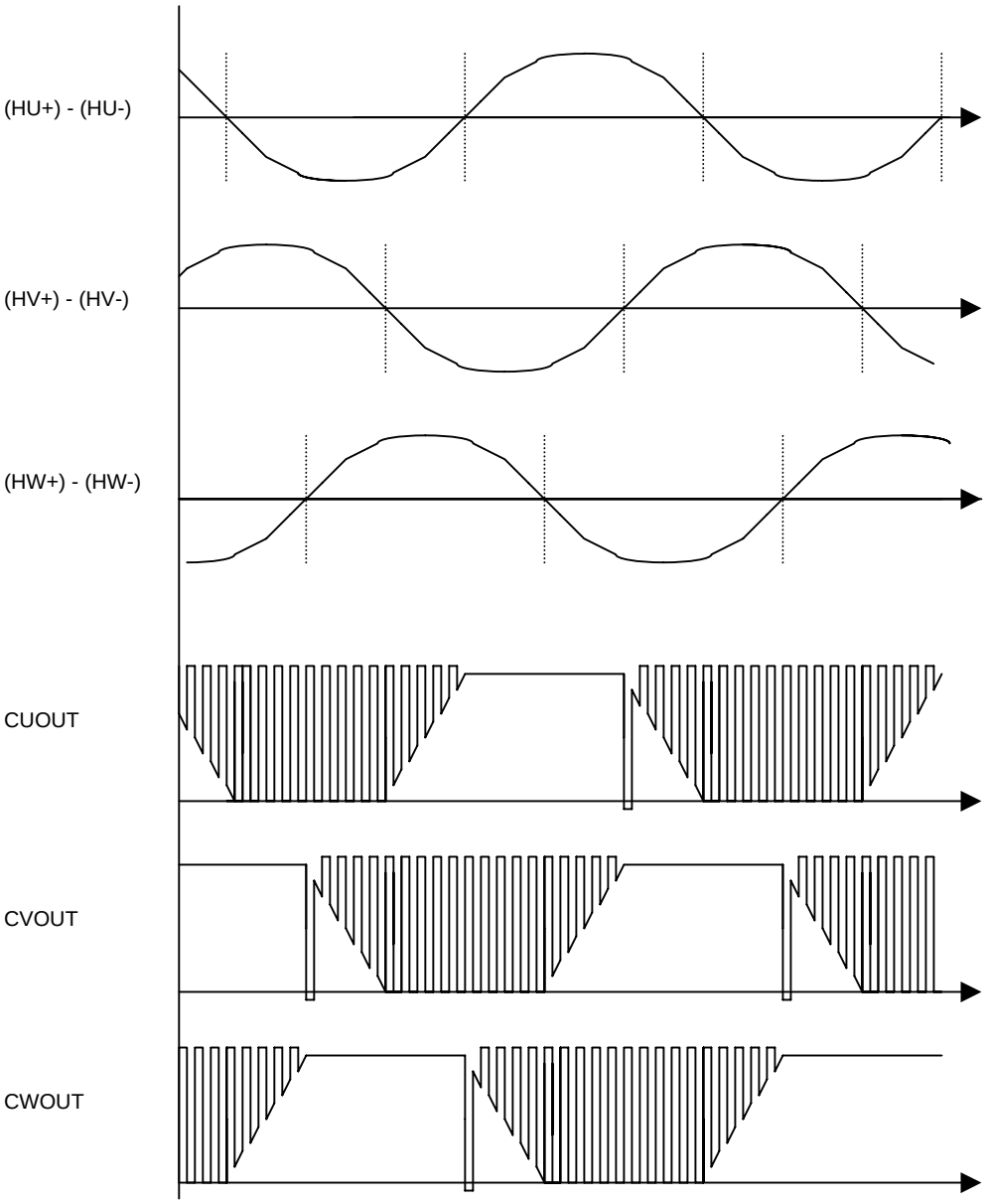
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
36	L-VREF	0 to LVCO	Loading output voltage setting pin	
31	L-IN	0V to V_{CC}	Loading logic input pin	
11	L-OUT1		Loading motor driver output pin	
14	L-OUT2			
12	L-MGND		Loading output transistor GND pin	

Timing Chart and Truth Table

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



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

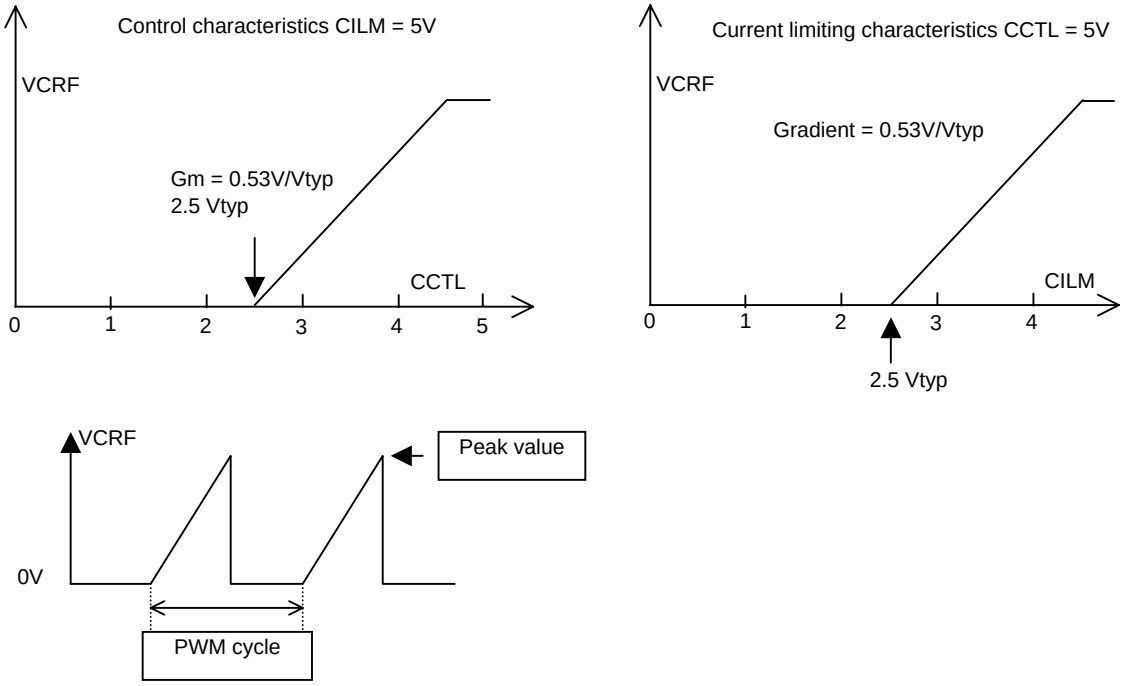


3. Capstan Motor Driver Truth Table & Control Functions

	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.

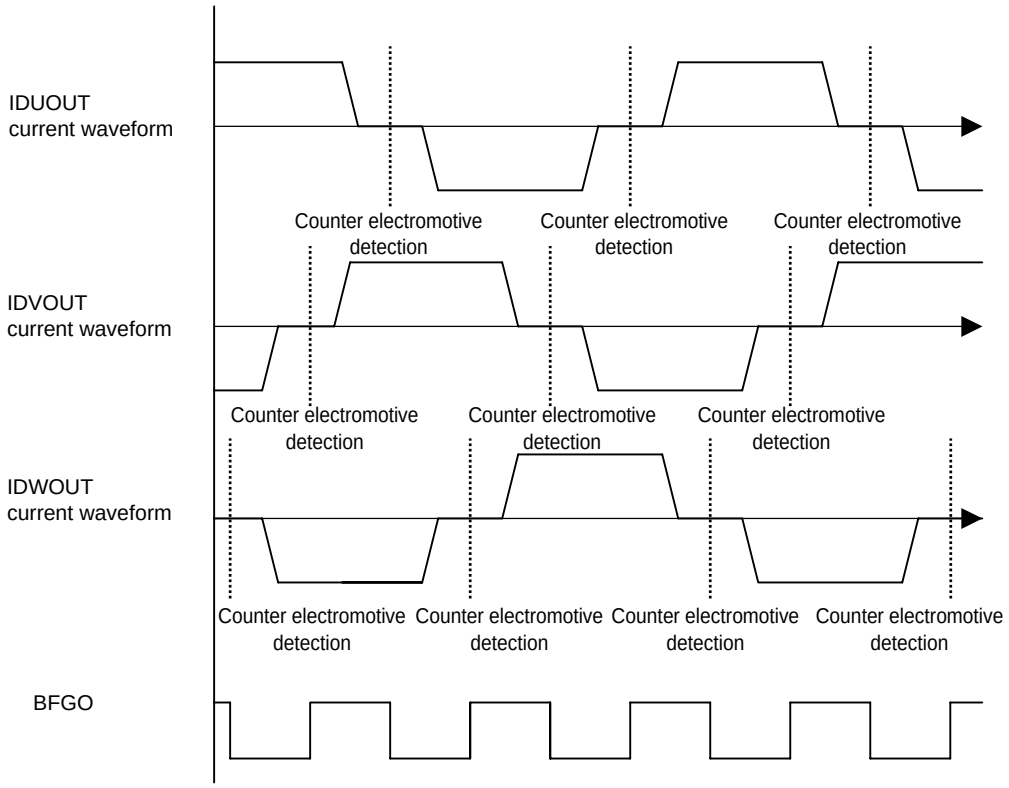
Control function & control limiting function



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 47μF or more.

4. Drum Motor Driver Drive current waveform



5. Loading Motor Truth table

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