Ordering number : EN7883A

SANYO Semiconductors
DATA SHEET

LB11884 — Monolithic Digital IC
Three-in-One Motor Driver for Portable VCR

DISCONTINUED PRODUCT

Overview

LB11884 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
  - Built-in over-voltage protection function
- 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.)
  - Over-voltage protection function
- Loading motor drive unit
  - H-bridge forward/reverse rotation
  - Motor voltage switch
  - Short brake
  - Input control for 3 values
  - Over-voltage protection function
- 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 source voltage	VREG max		6.5	V
Motor power source 1	C_V_{CC} max		18.0	V
Motor power source 2	DL_V_{CC} max		18.0	V
Applied input voltage	VI1 max		-0.3 to V_{CC}+0.3	V
Motor output current 1	ICOUT max		1.2	A
Motor output current 2	IDOUT max		0.8	A
Motor output current 3	ILOUT max		0.8	A
Allowable internal power dissipation	Pd max1	IC alone	0.6	W
	Pd max2	* Mounted on a specified board	1.8	W
Pin voltage range 1	VPIN max1	C_RSS, C_RSP, C_UOUT, C_VOUT, C_WOUT IVF = 1.2A	C_MGND-VF to C_V_{CC}+VF	V
Pin voltage range 2	VPIN max2	D_RF, D_COM, D_UOUT, D_VOUT, D_WOUT IVF = 0.8A	DL_GND-VF to D_V_{CC}+VF	V
Pin voltage range 3	VPIN max3	L_OUT1, L_OUT2 IVF = 0.8A	DL_GND-VF to L_V_{CC}+VF	V
Operating temperature	Topr		-20 to +75	°C
Storage temperature	Tstg		-55 to +150	°C

Note 1: If the current of maximum IC_V_{CC} rate or more flows while the regenerative diode for capstan motor is recovering, the IC will not be damaged.

*: Mounted on a specified board (114.3mm×76.1mm×1.6mm, glass epoxy)

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 16	V
Power source voltage e 3	DL_V_{CC}		8 to 16	V
Electric potential difference between MGND and SGND	ΔGND	(MGND)-(SGND)	-0.3 to +0.4	V

Note: Turning ON/OFF for C_V_{CC} and DL_V_{CC} must be performed while the VREG is OFF.

Electrical Characteristics

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Common Unit at Ta = 25°C, V_{CC} = 5V, CVCO = DLVCO = 12V						
Power source current 1	IREG	D_PGIN = C_FGIN = C_CNT = D_CNT = 0V		17	25	mA
Power source current 2	IC_V_{CC}	Same as above.		1	2	mA
Power source current 3	IDL_V_{CC}	Same as above.		2.6	4	mA
Power source current 4	IVCCQ	VREG = 0V, IC_V_{CC}+IDL_V_{CC}			100	μA
Thermal shutdown temperature	TSD	*Design Target	140	160	180	°C
Thermal shutdown hysteresis	ΔTSD	*Design Target		15		°C
Capstan Motor Unit at Ta = 25°C, VREG = 5V, C_V_{CC} = 12V						
Output saturation voltage	CVSAT	I_O = 1.0A, Source+Sink		2.4	3.5	V
Hall signal input level	VHALL		100			mVp-p
Hall in-phase input voltage	VCM		1.0		V_{CC} -1.7	V
C_ILM pin input voltage	VCILM		0		V_{CC}	V
C_ILM pin input current	ICILM	C_ILM = 3V, sink current		0.5	2.0	μA
C_ILM offset voltage	OCILM	VCRSP≥10mV	2.440	2.515	2.590	V
C_ILM gain	GCILM	C_CNT = 5V Calculation of OC_ILM+0.2V and OC_ILM +0.4V.	0.49	0.53	0.57	V/V
C_ILM pin short brake release voltage	BROFF1		1.1		1.4	V
Pin current at C_ILM pin short brake released	IBROFF1	Source current, C_ILM = 0V		0.1	0.3	μA

* 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 voltage	VCCNT		0		V_{CC}	V
C_CNT input current	ICCNT	C_CNT = 3V, sink current		0.5	2.0	µA
C_CNT offset voltage	OCCTL	VC_RFP≥10mV	2.440	2.515	2.590	V
C_CNT gain	GCCNT	C_ILM = 5V Calculation of “OCCNT+0.2V” and ”OCCNT+0.4V”.	0.49	0.53	0.57	V/V
C_CNT pin short brake release voltage	BROFF2		1.1		1.4	V
Pin current at C_CNT pin short brake released	IBROFF2	Source current, C_CNT = 0V		0.1	0.3	µA
F/R forward voltage	VFW		1.5		V_{CC}	V
F/R reverse voltage	VRW		0		1	V
F/R input current	IFR	C_FR = 3V, sink current		100	200	µA
FG amplifier reference voltage	VFGR		2.40	2.50	2.60	V
Linear amplifier gain DC 36kHz	GDC		29.5	31.1	32.7	fold
	G36		20.0	25.0	30.0	fold
Hysteresis amplifier output low level voltage	VHO	I_{HO} = 4mA		0.2	0.4	V
Hysteresis of hysteresis amplifier	VHS	Both hysteresis	60	72	80	mV
Hysteresis amplifier output duty ratio	FGDT	360Hz Fgin = 40mVp-p	49	50	51	%
PWM carrier frequency	FOSC	CPWM = 680pF	18.5	21.7	25.0	kHz
Internal current limiter setup voltage	CILM	C_RF = 100Ω	0.70	0.75	0.80	V
Drum Motor Unit at Ta = 25°C, VREG = 5V, DL_V_{CC} = 12V						
Output saturation voltage	DVSAT	I_O = 0.6A, Source+Sink		1.8	2.6	V
D_CNT input voltage	VDCNT		0		V_{CC}	V
D_CNT input current	IDCNT	D_CNT = 3V, sink current			0.5	µA
D_CNT offset voltage	ODCNT	VD_RF≥10mV	2.40	2.50	2.60	V
D_CNT gain	GDCTL	D_RF = 0.5Ω, Calculation of ODCTL+0.2V and ODCTL +0.4V	0.40	0.50	0.60	V/V
PCOUT output current 1	IPCOU	Source current *Design target	20	45		µA
PCOUT output current 2	IPCOD	Sink current *Design target	20	45		µA
D_VCOIN input current	IVCOIN	D_VCOIN = 3V, sink current			1	µA
Minimum VCO frequency	FVCO min	D_CX = 0.022µF, D_VCOIN = Open	330	410	500	Hz
Maximum VCO frequency	FVCO max	D_CX = 0.022µF, D_VCOIN = 5V	15.0	18.0	21.0	kHz
D_C1, D_C2 source current ratio	RSOURCE	1-(IC1SOURCE/IC2SOURCE)	-12	0	12	%
D_C1, D_C2 sink current ratio	RSINK	1-(IC1SINK/IC2SINK)	-12	0	12	%
D_C1 source/sink current ratio	RC1	IC1SOURCE/IC1SINK	40	50	60	%
D_C2 source/sink current ratio	RC2	IC2SOURCE/IC2SINK	40	50	60	%
D_FG output high level voltage	VFH		4.7			V
D_FG output low level voltage	VFL	-0.5mA load			0.4	V
D_PG amplifier reference voltage	VPGR		2.8	3.0	3.2	V
D_PG amplifier input offset	OPG		-4		+4	mV
D_PG amplifier input bias	IPG	D_PG- = 2.5V, source current			0.25	µA
Linear amplifier gain	G1	Freq = 1kHz	50			dB
Hysteresis amplifier threshold level 1	VHYS1		70	100	130	mV
Hysteresis amplifier threshold level 2	VHYS2		140	200	260	mV
D_PG output high level voltage	VPH	0.5mA load	4.7			V
D_PG output low lLevel voltage	VPL				0.2	V
FG/PG mix MID voltage	Vmid	D_PGO2 D_FGO short circuit	2.4	2.5	2.6	V
Internal current limiter setup voltage	DILM	D_RF = 100Ω	0.38	0.41	0.44	V

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

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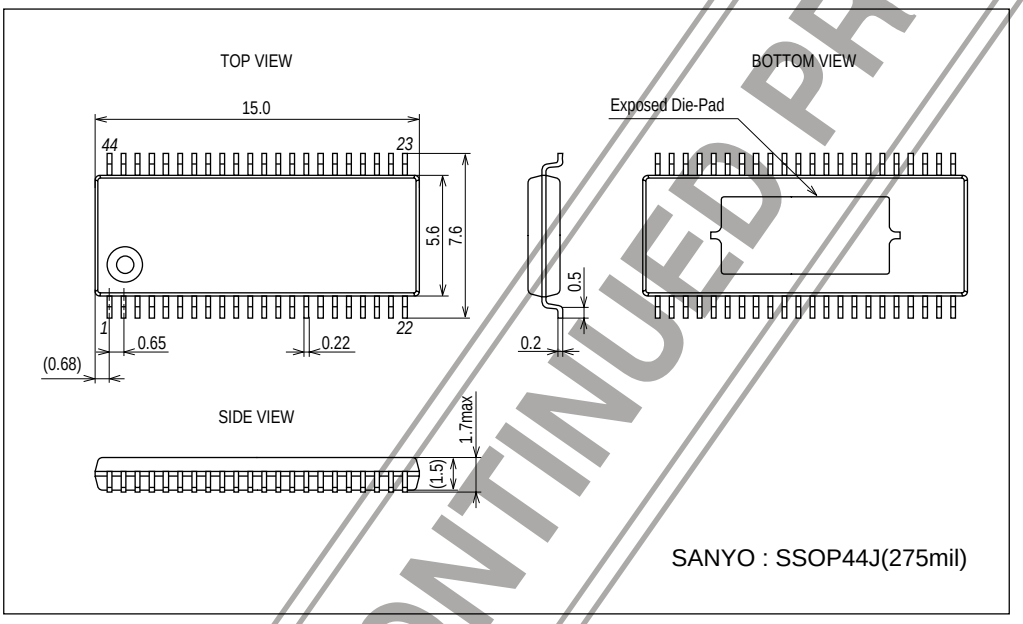
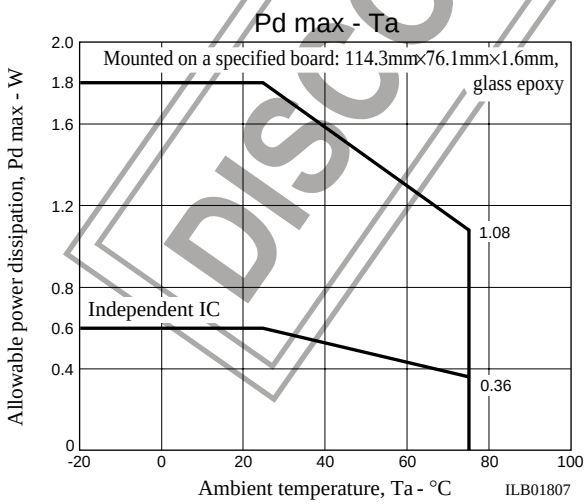
Parameter		Symbol		Conditions	Ratings min	Ratings typ	Ratings max	Unit
Loading Unit at Ta = 25°C, VREG = 5V, DL_V_{CC} = 12V								
Input voltage	1 (HIGH)	$V_{IN}H$			4		5	V
	2 (Middle)	$V_{IN}M$			2		3	V
	3 (LOW)	$V_{IN}L$			0		1	V
Input current		ILIN0		L_IN = 0V, source side		130	200	µA
		ILIN5		L_IN = 5V, sink side		130	200	µA
Saturation voltage		VSAT U-1		Between output and DL_V_{CC} I_O = 0.6A, CW/CCW mode		1.9	2.4	V
		VSAT L-1		Between output and DL_GND I_O = 0.6A, CW/CCW mode		1.2	1.7	V
		VSAT UL		SINK+SOURCE I_O = 0.4A, CW/CCW mode		2.8	3.4	V
Output transistor leak current		Upper	ILU	VREG = 0V			50	µA
		Lower	ILL	VREG = 0V			50	µA

Package Dimensions

unit : mm (typ)

3285





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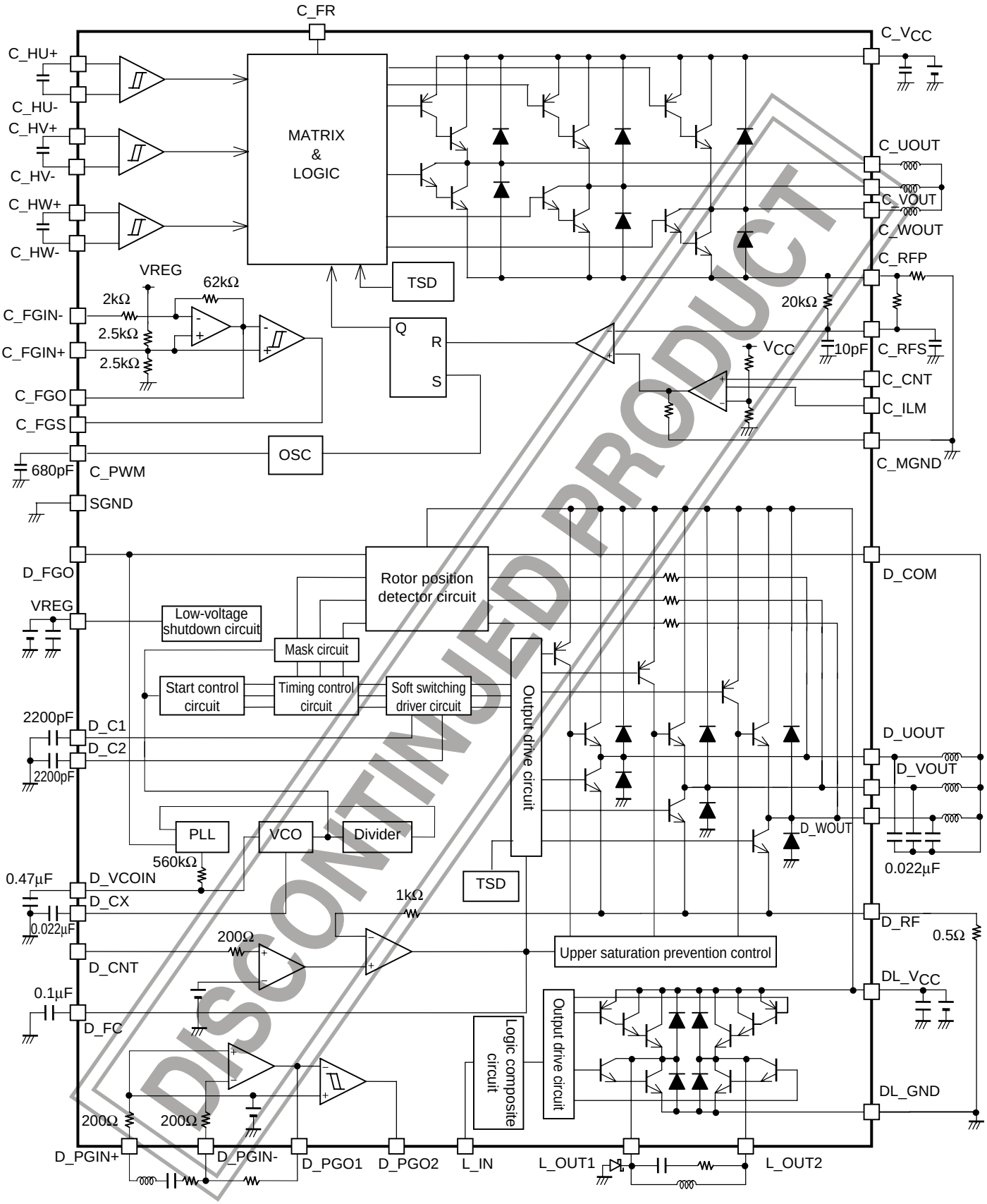
Block Diagram



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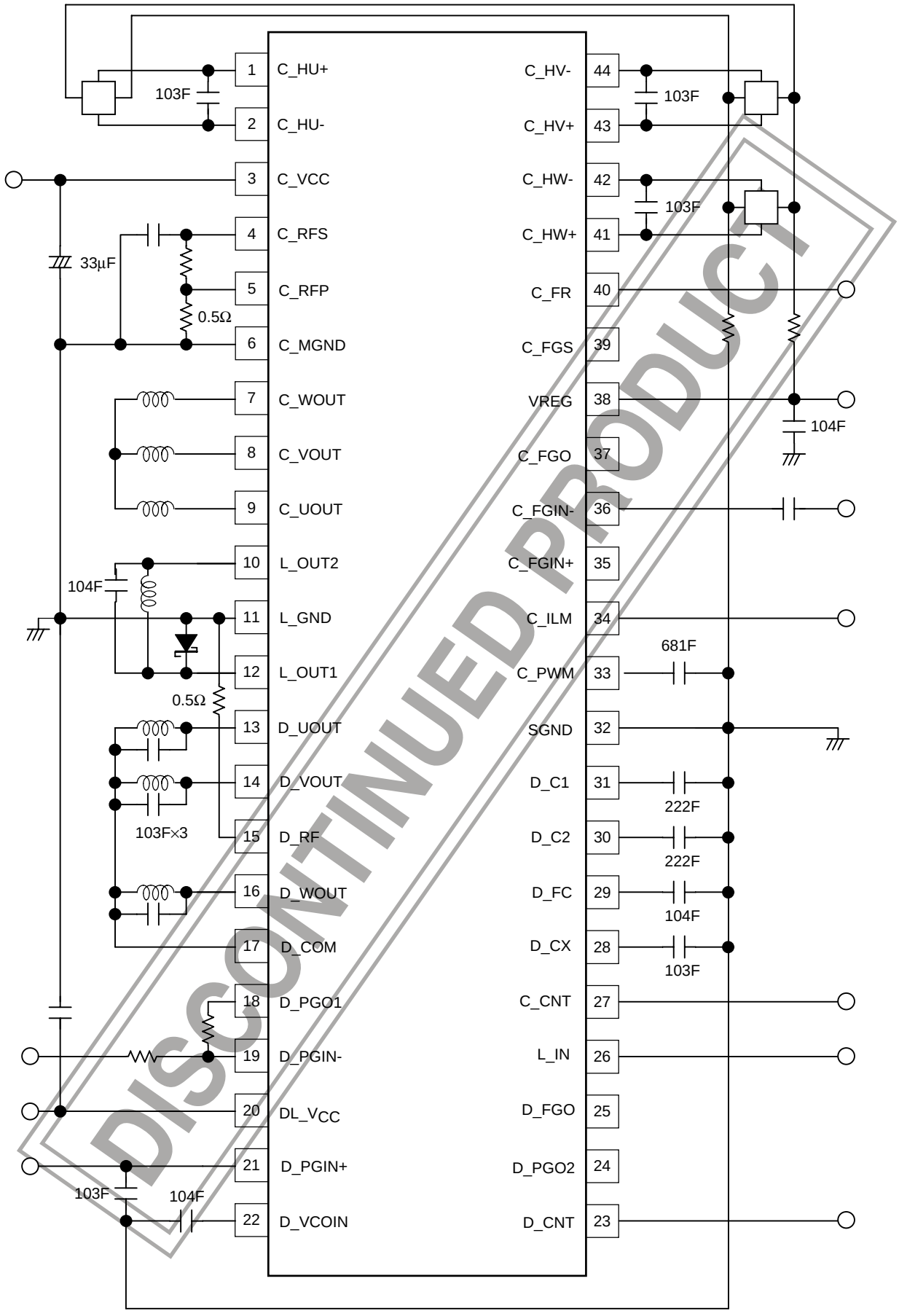
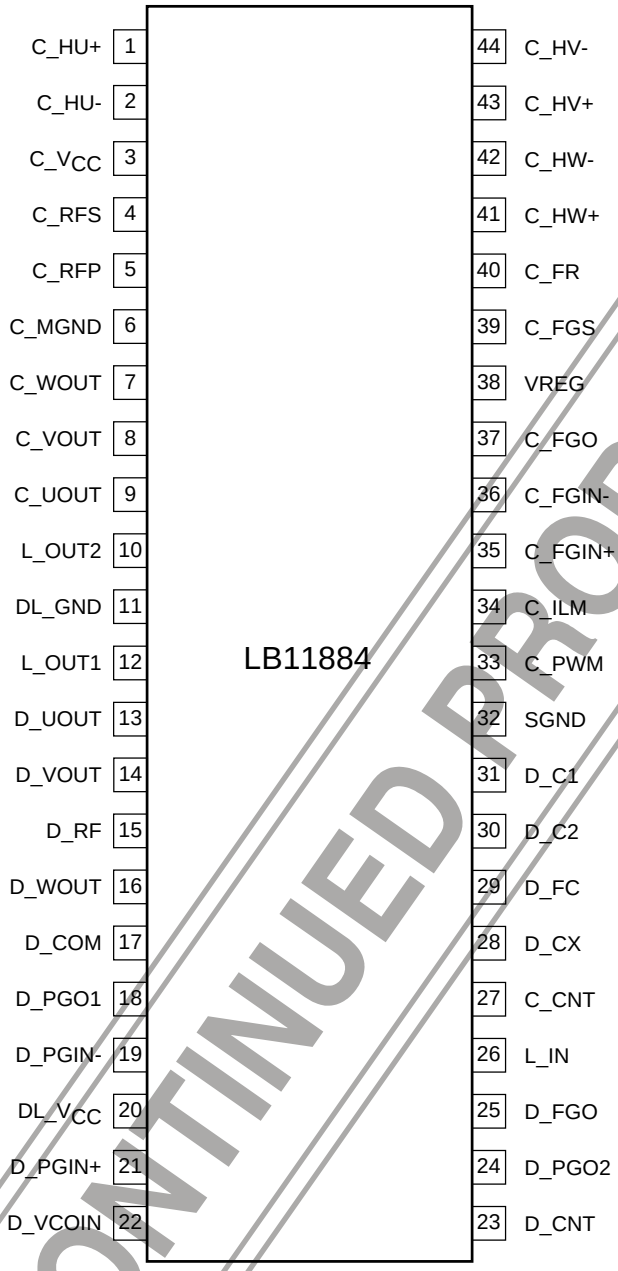
Sample Application Circuit



Note) The sample application circuit is for reference only and the optimum constant may differ depending on motor characteristics.

Pin Assignment



Top view

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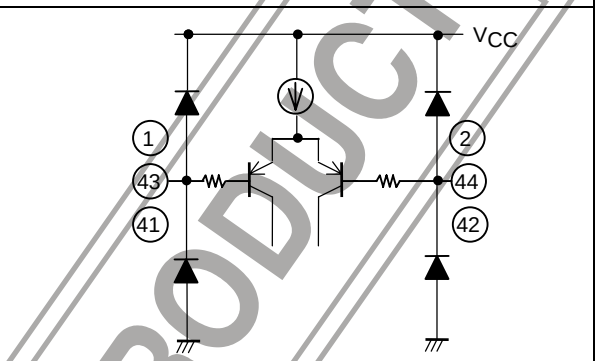
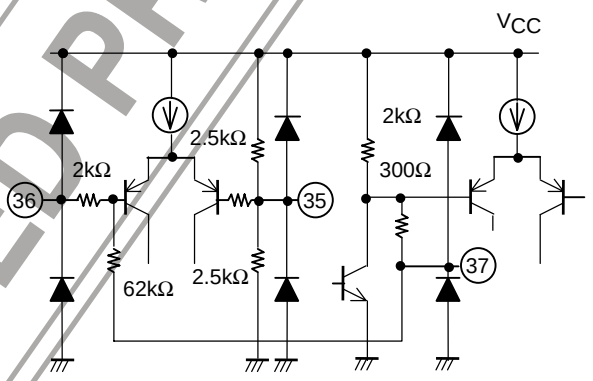
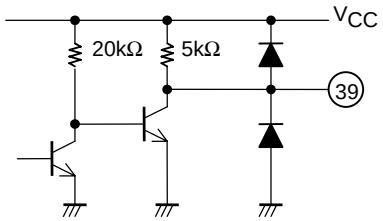
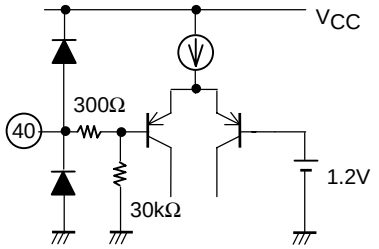
Pin Description

Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
3	C_V_{CC}	8V to 16V	Power pin of capstan motor driver	
20	DL_V_{CC}	8V to 16V	Power pin of drum and loading motor driver	
38	VREG	4V to 6V	Power pin to provide all voltages other than the output transistor and pre-drive.	
6	C_MGND		Capstan motor GND	
32	SGND		GND for all other than output	
1	C_HU+	1.0V to V_{CC}-1.7	U-phase Hall element input pin. C_HU+>C_HU- state for logic H	
2	C_HU-			
43	C_HV+		V-phase Hall element input pin. C_HV+>C_HV-state for logic H	
44	C_HV-			
41	C_HW+		W-phase Hall element input pin. C_HW+>C_HW-state for logic H	
42	C_HW-			
36	C_FGIN-		Capstan FGAMP reverse input pin	
35	C_FGIN+		Capstan FGAMP non-inverted pin	
37	C_FGO		Capstan FGMP linear output pin Return resistor is incorporated with the amplification degree of about 31-fold.	
39	C_FGS		FG Schmidt amp output pin of capstan block	
40	C_FR	0V to V_{CC}	Capstan forward/reverse control pin	

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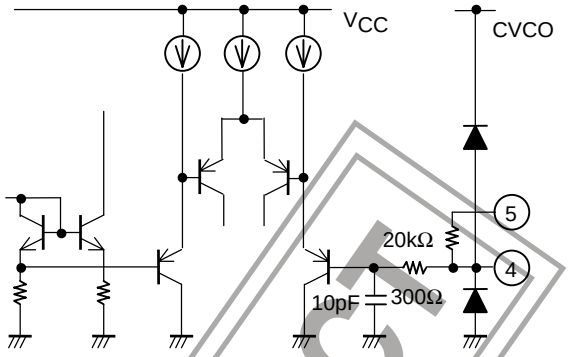
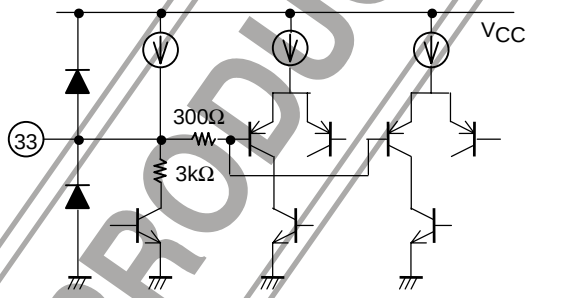
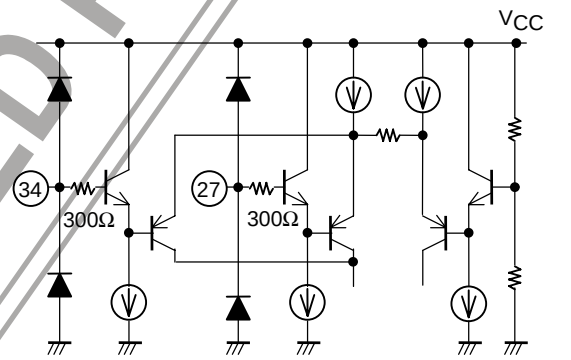
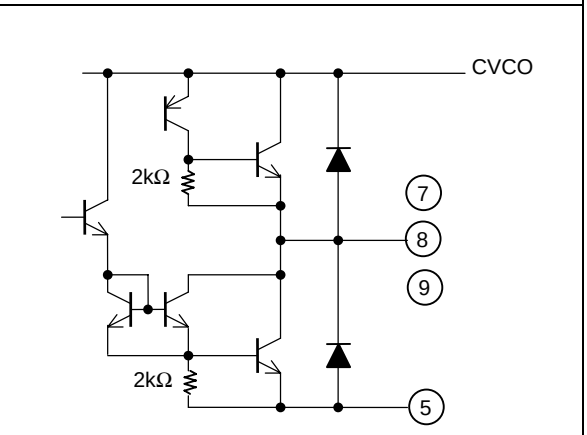
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
4	C_RFS		Capstan current detection filter pin. Connect the current detected at C_RFP to this pin after passing through the CR filter.	
33	C_PWM		Capacitor connection pin for PWM oscillation at capstan	
34	C_ILM	0V to V_{CC}	Capstan current limit setting pin	
27	C_CNT	0V to V_{CC}	Capstan speed control voltage application pin	
7	C_WOUT		Capstan W-phase output pin	
8	C_VOUT		Capstan V-phase output pin	
9	C_UOUT		Capstan U-phase output pin	
5	C_RFP		PWRTR GND and current return resistor connection pin	

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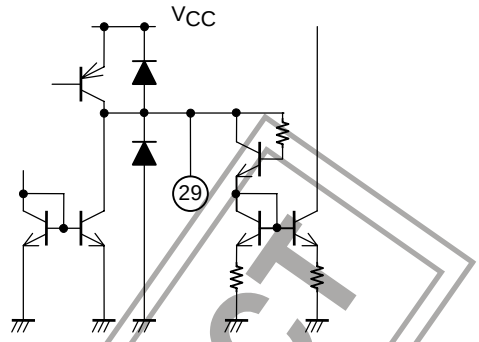
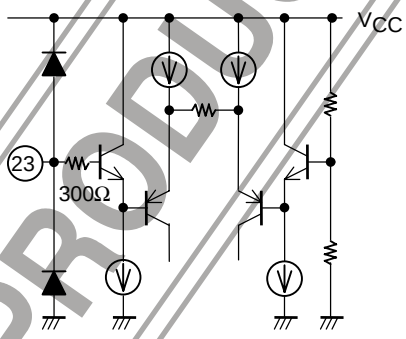
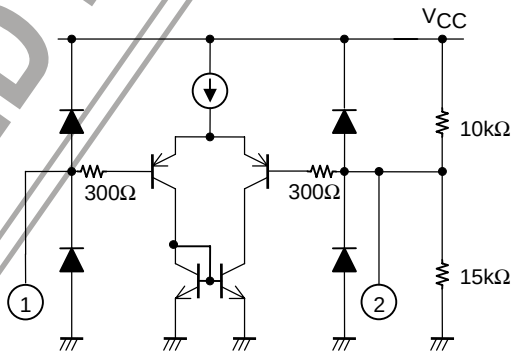
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
29	D_FC		Drum frequency characteristics compensation pin. Insertion of a capacitor to GND stops oscillation of the closed loop of current control system.	
23	D_CNT	0V to V_{CC}	Drum speed control pin. Control is the constant current control to which current return is applied from D_RF.	
21	D_PGIN+	0.5V to V_{CC}	Drum PG amplifier non-inverted input pin. Biased internally to (3/5)×VREG.	
19	D_PGIN-		Drum PG amplifier inverted input pin	

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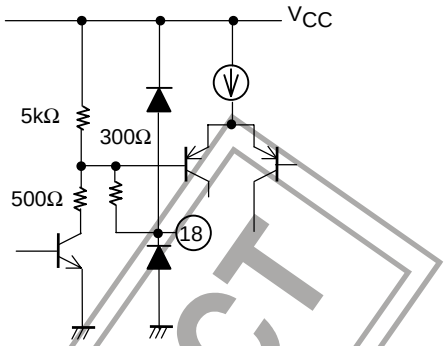
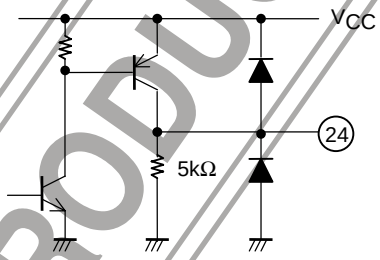
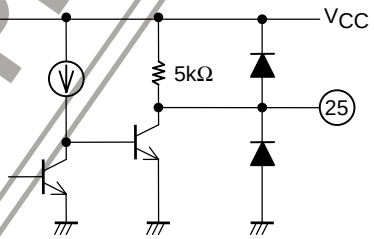
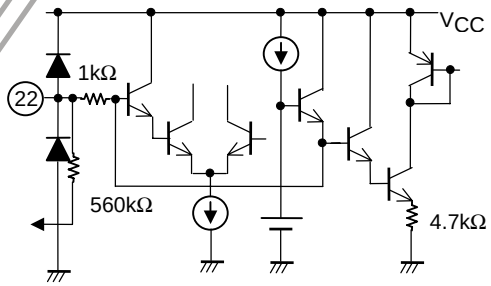
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
18	D_PGO1		Drum PG amplifier linear output pin	
24	D_PGO2		Drum PG Schmidt amplifier output pin	
25	D_FGO		Drum motor reverse counter-electromotive voltage detection output pin (three-phase synthesizing)	
22	D_VCOIN		VCO circuit voltage input pin of drum block. The PLL pin voltage is input via CR filter.	

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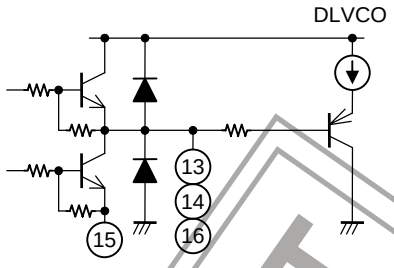
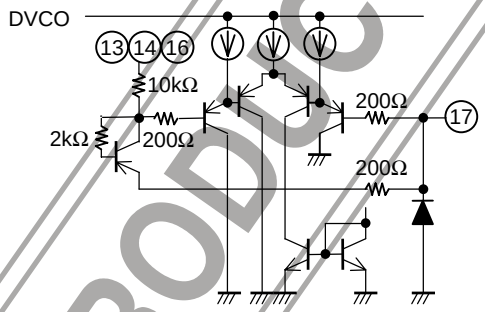
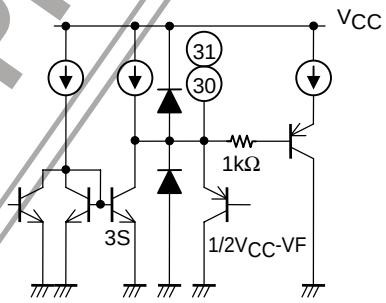
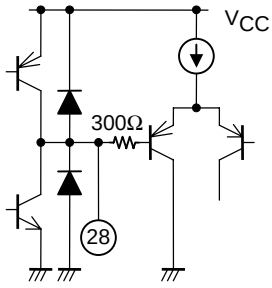
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
13	D_UOUT		Drum motor driver output pin	
14	D_VOUT			
16	D_WOUT			
15	D_RF		Minimum potential of drum motor driver output transistor. Constant-current control is made through detection of this voltage. The current limiter also functions by detecting this potential.	
17	D_COM		Motor coil neutral point input pin. The coil voltage waveform is detected with reference to this voltage.	
31	D_C1		Triangular wave generating capacitor connection pin of drum block. This triangular wave performs soft- switching of the coil output waveform.	
30	D_C2			
28	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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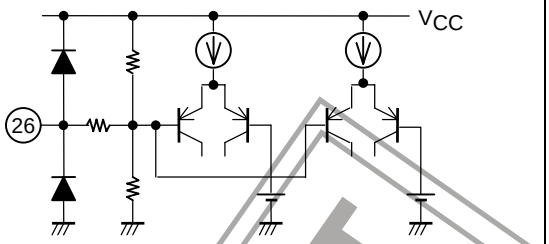
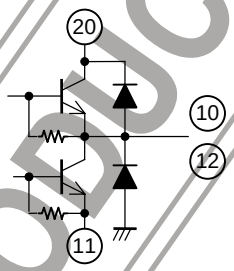
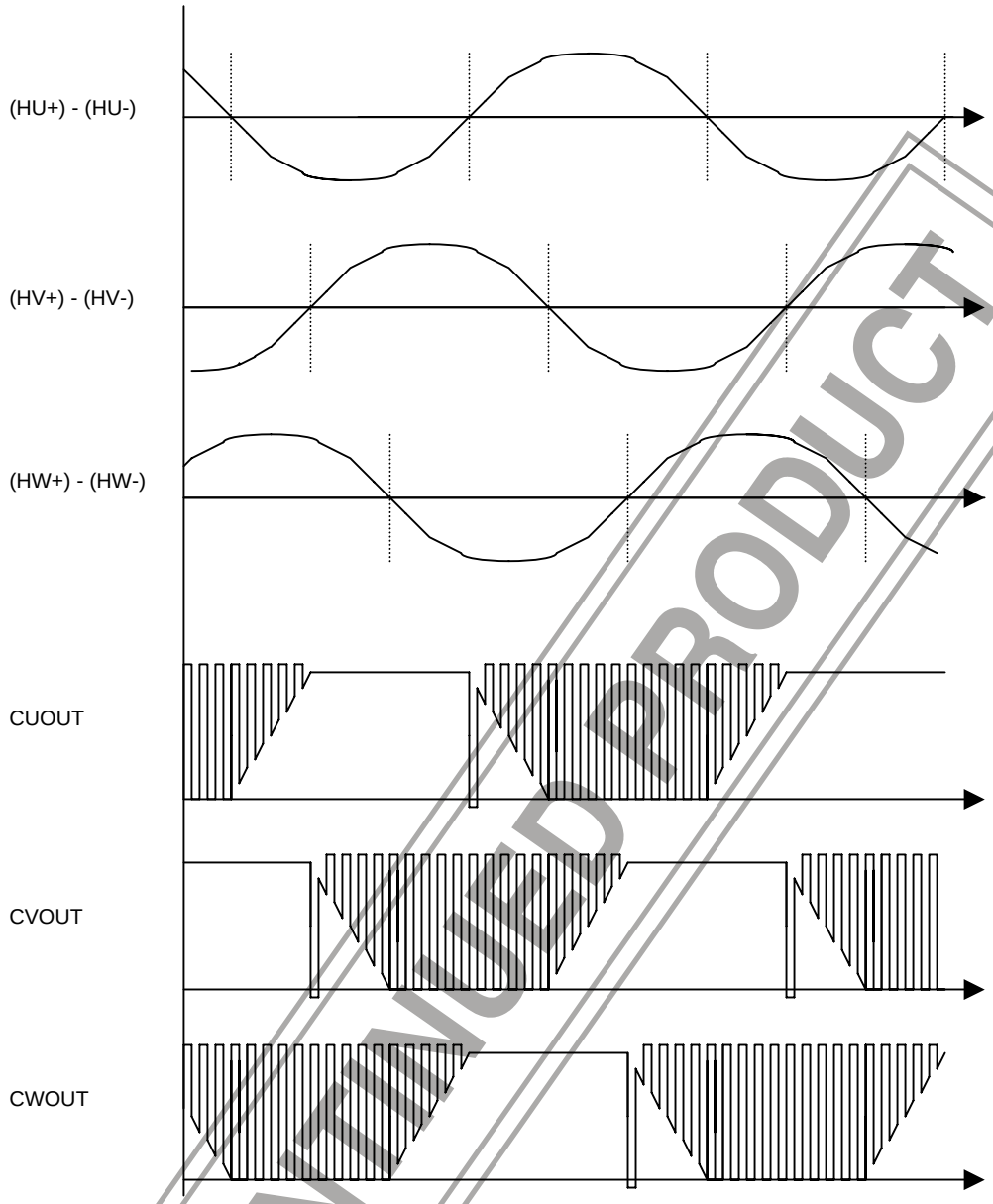
Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
26	L_IN	0V to V_{CC}	Loading logic input pin	
12	L_OUT1		Loading motor driver output pin	
10	L_OUT2			
11	DL_GND		Loading output transistor GND pin	

DISCONTINUED PRODUCT

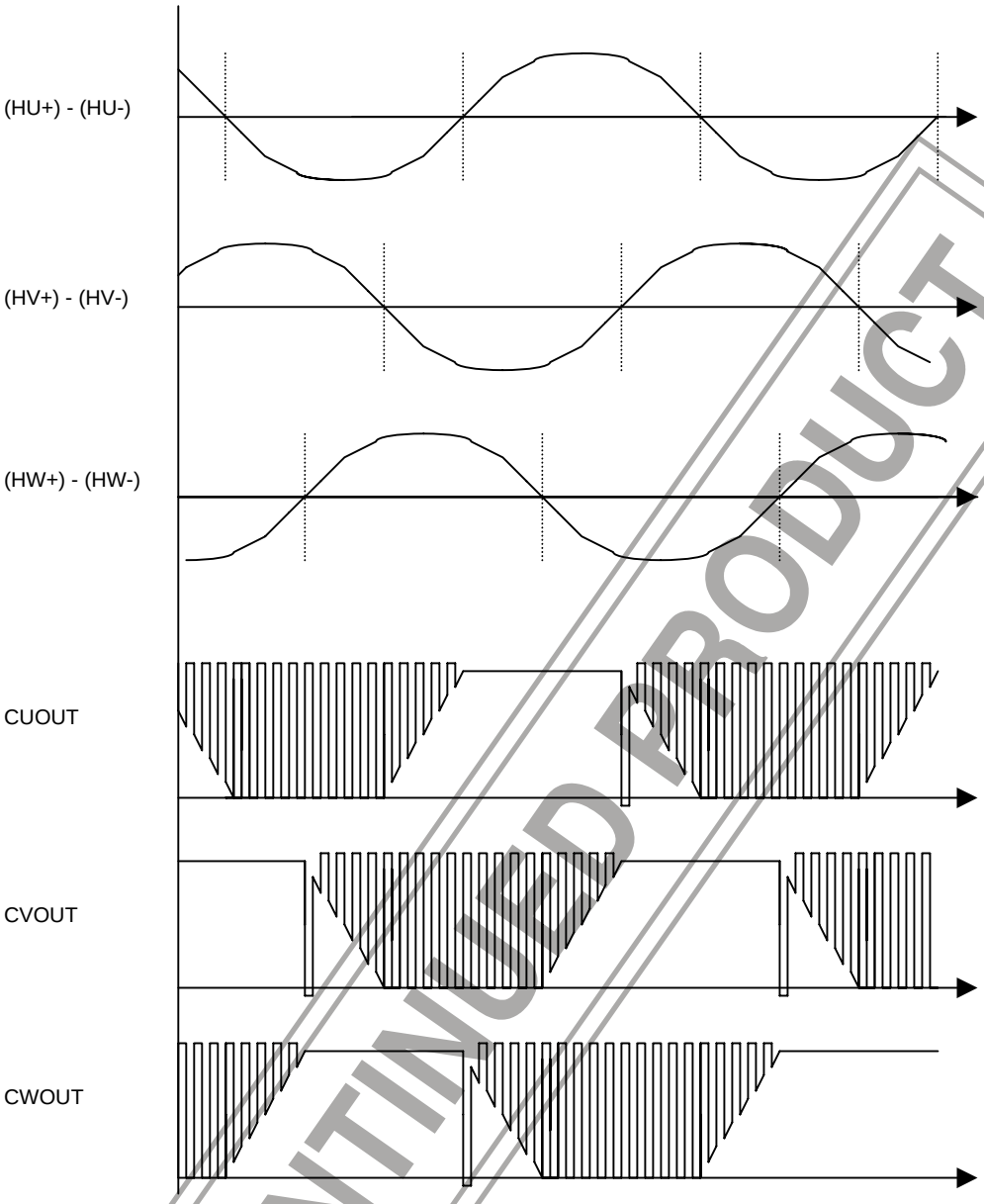
Timing Chart and Truth Table

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



DISCONTINUED PRODUCT

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



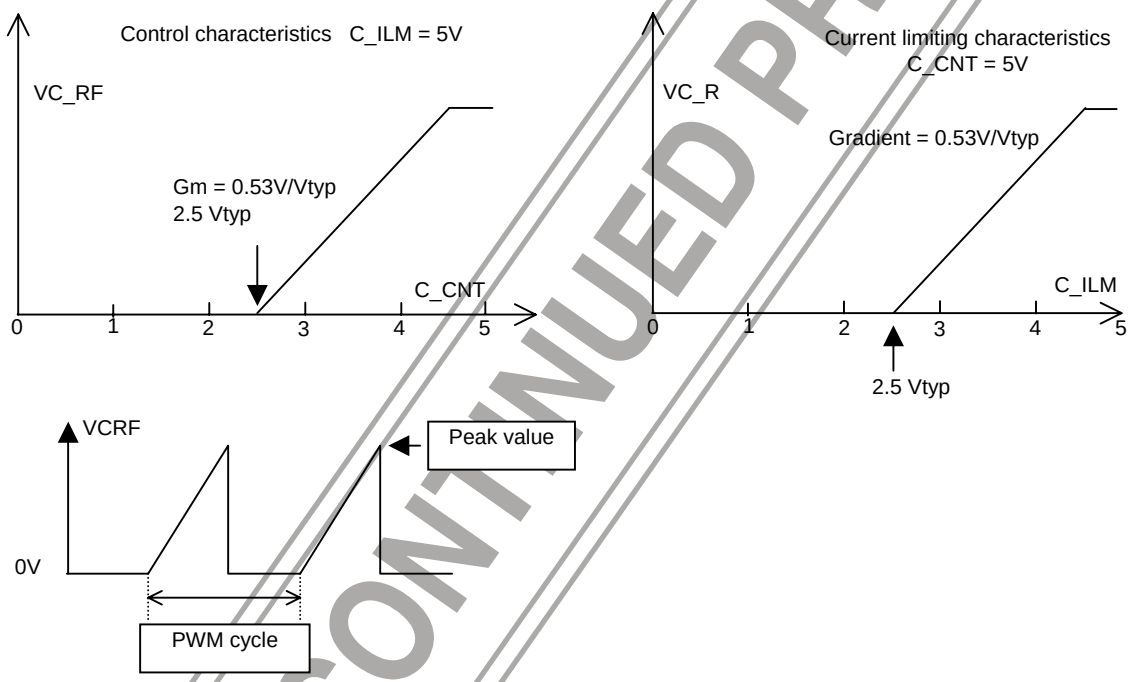
DISCONTINUED PRODUCT

3. Capstan Motor Driver Truth Table & Control Functions

	Source→Sink	Hall input			C_FR
		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.

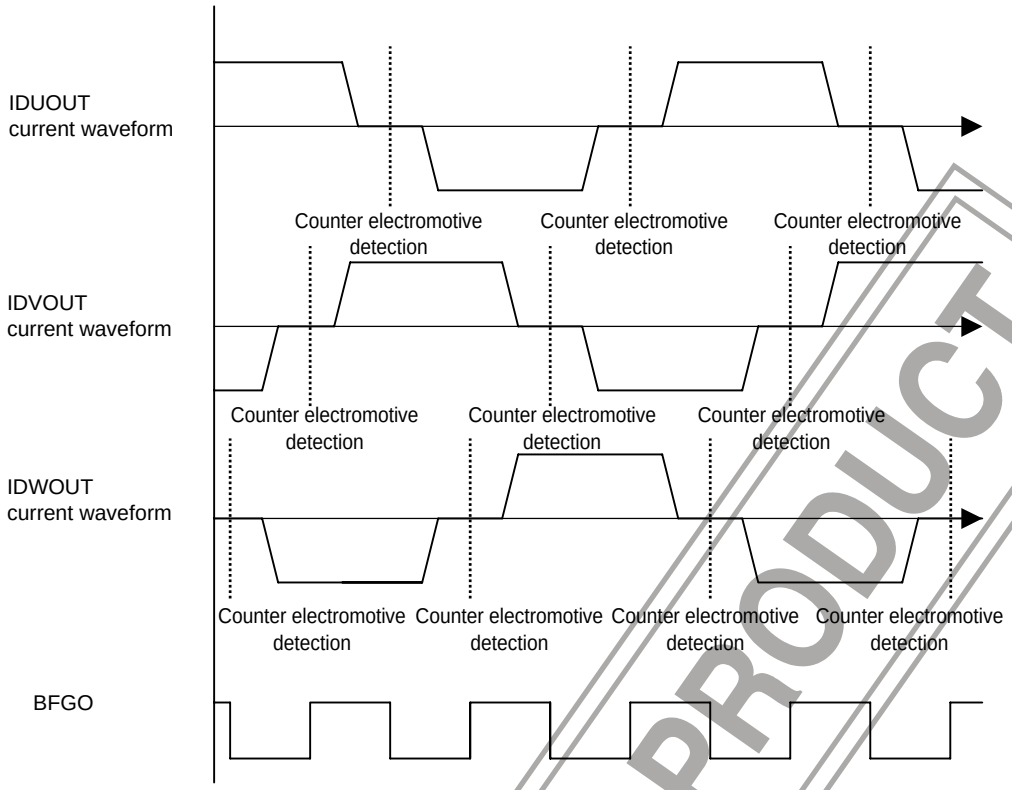
Control function & control limiting function



Caution: For the VCRF voltage of control characteristics, the peak value is to be measured.
Cautions for use)
1. Capstan short-brake safety conditions
   • C_V_{CC} = 14V or less • 1500 rpm or less. Limiter 1.1 to 2.6V. 33µF or more between C_V_{CC}-C_MGND
2. Capstan direct F/R safety conditions
   • C_V_{CC} = 16V or less • 2500 rpm or less. Limiter 2.6 to 3.0V. 33µF or more between C_V_{CC}-C_MGND

DISCONTINUED PRODUCT

4. Drum Motor Driver Drive current waveform



5. Loading Motor Truth table

Input	Output		Mode
L_IN	L_OUT1	L_OUT2	
L	L	H	Reverse
M (or OPEN)	L	L	Brake
H	H	L	Forward

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