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LB11899J

Monolithic Digital IC

Three-in-One Motor Driver for Portable VCR

ON Semiconductor®

http://onsemi.com

Overview

LB11899J is a three-in-one motor driver for portable VCR.

Function

- 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
    - Over voltage protection function Built-in
- 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 Built-in
- Loading motor drive unit
    - H-bridge forward/reverse rotation
    - Motor voltage switch
    - Short brake
    - Input control for 3 values
    - Over voltage protection function Built-in
- Common unit
    - Over-heat protection function (Thermal Shut Down)
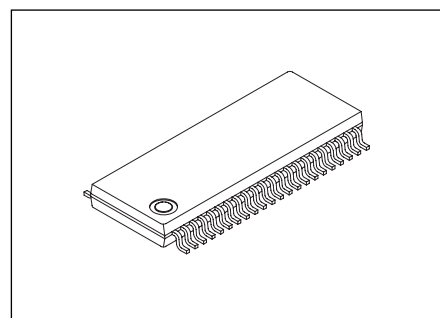
SSOP44J(275mil)

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
IC power source voltage	VCC max		6.5	V
Motor power source 1	CV_{CO} max		30.0	V
Motor power source 2	DV_{CO} max		30.0	V
Motor power source 2	LV_{CO} max		30.0	V
Applied input voltage	VI1 max		-0.3 to V_{CC}+0.3	V
Motor output current1	ICOUT max	Peak current	1.1	A
Motor output current2	IDOUT max	Peak current (within 2sec)	0.65	A
	IDOUT2max	Constant current	0.2	A
Motor output current3	ILOUT max	Peak current (within 2sec)	0.65	A
	ILOUT2max	Constant current	0.2	A

Continued on next page.

ORDERING INFORMATION

See detailed ordering and shipping information on page 16 of this data sheet.

LB11899J

Parameter	Symbol	Conditions	Ratings	Unit
Allowable internal power dissipation	Pd max1	IC alone	0.6	W
	Pd max2	Specified board	1.8	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	VCC		4 to 6	V
Power source voltage 2	CV_{CO}		8 to 28	V
Power source voltage 3	DV_{CO}		8 to 16	V
Power source voltage 4	LV_{CO}		8 to 16	V
Electric potential difference between MGND and SGND	ΔGND	(MGND)-(SGND)	-0.3 to +0.4	V

Electrical Characteristics

| Parameter	Symbol	Conditions	min	typ	max	Unit
Common Unit at Ta = 25°C, VCC = 5V, CV_{CO} = DV_{CO} = LV_{CO} = 12V						
Power source current 1	ICC			17	25	mA
Power source current 2	ICVCO			0.15	2	mA
Power source current 3	IDVCO			0.53	2	mA
Power source current 4	ILV_{CO}			1	2	mA
Power source current 5	$IV_{CC}Q$	VCC = 0V, ICV_{CO}+IDV_{CO}+ILV_{CO}		100	200	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, VCC = 5V, CV_{CO} = 12V						
Output saturation voltage 1	CVSAT	I_O = 0.8A, 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
CILM pin input voltage range	VCLIM		0		VCC	V
CILM pin input current	ICLIM	CILM = 3V		0.5	2.0	μA
CILIM control start voltage	VCLIMST	CRSS = 0.5Ω, VCRSP ≥ 10mV	2.44	2.515	2.590	V
CILIM gain	GCLIM	CCTL = 5V, CRSS = 0.5Ω	0.49	0.53	0.57	V/V
CILIM pin short brake release voltage	BROFF1		1.1		1.4	V
CCTL input voltage range	VCCTL		0		VCC	V
CCTL input current	ICCTL	CCTL = 3V		0.5	2.0	μA
CCTL control start voltage	OCCTL	CRSS = 0.5Ω, VCRSP ≥ 10mV	2.44	2.515	2.590	V
CCTL gain	GCCTL	CILIM=5V, CRSS = 0.5Ω	0.49	0.53	0.57	V/V
CCTL pin short brake release voltage	BROFF1		1.1		1.4	V
CCTL pin short brake flow current	IBROFF1			0.1	0.3	μA
F/R forward voltage	VFW		1.5		VCC	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	
F/R reverse voltage		VRW		0		1	V
F/R input current		IFR	FRC = 3V		100	200	μA
FG amplifier reference voltage		VFGR		2.40	2.50	2.60	V
Linear amplifier gain DC		GDC		29.5	31.1	32.7	times
36kHz		G36		20.0	25.0	30.0	times
Hysteresis amplifier output voltage		VHO	I_{HO} = 4mA		0.2	0.4	V
Hysteresis of hysteresis amplifier		VHS	Both hysteresis	56	72	86	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
Over voltage protection current		IPROTC	VCC=0V	1			mA
MGND –SGND Resistance		RMSUB			10	30	Ω
Internal current limiter setup voltage		CLIM	RS = 100Ω	0.58	0.63	0.68	V
Drum Motor Unit at Ta = 25°C, VCC = 5V, DV_{CO} = 12V							
Output saturation voltage 2		DVSAT	IO=0.5A, Source+Sink		1.8	2.6	V
DCTL input voltage range		VDCTL		0		VREG	V
DCTL input current		IDCTL	DCTL = 3V			0.5	μA
DCTL control start voltage		ODCTL	VDRS ≥ 10mV	2.40	2.50	2.60	V
DCTL gain		GDCTL	DRS=0.5Ω,	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	15.0	18.0	21.0	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		-4		+4	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
Over voltage protection current		IPROTD	VCC=0V	1			mA
Internal current limiter setup voltage		DILM	RS = 100Ω	0.30	0.33	0.37	V
Loading Unit at Ta = 25°C, VCC = 5V, LV_{CO} = 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		$IL_{IN}0$	L_{IN} = 0V, source side		130	200	μA
		$I_{LIN}5$	L_{IN} = 5V, sink side		130	200	μA

Continued from preceding page.

Parameter	Symbol		Conditions	Ratings			Unit
				min	min	max	
Saturation voltage	VSAT U-1		L_VREF = LV$_{CC}$ Between output and LV$_{CC}$ I$_O$ = 0.6A, CW/CCW mode		2.0	2.5	V
	VSAT L-1		L_VREF = LV$_{CC}$ Between output and LV$_{CC}$ I$_O$ = 0.6A, CW/CCW mode		1.3	1.8	V
	VSATIL		L_VREF = LV$_{CC}$ SINK+SOURCE I$_O$ = 0.4A, CW/CCW mode		2.8	3.5	V
Output transistor leak current	Upper	ILU	V$_{CC}$ = 0V			50	μA
	Lower	ILL	V$_{CC}$ = 0V			50	μA
Over voltage protection current	IPROTL		VCC=0V	1			mA

Pd max - Ta

Block Diagram

Pin Assignment

HU+	1	44	HV−
HU−	2	43	HV+
CVCO	3	42	HW−
CRSS	4	41	HW+
CRSP	5	40	FRC
CMGND	6	39	CFGS
CWOUT	7	38	CFGOUT
CVOUT	8	37	CFGIN−
CUOUT	9	36	CILIM
LOUT2	10	35	PWM
LGND	11	34	VCC
LVCO	12	33	SGND
LOUT1	13	32	C1
DUOUT	14	31	C2
DVOUT	15	30	DFC
DWOUT	16	29	CX
DCOM	17	28	CCTL
DRF	18	27	LIN
DVCO	19	26	BFGO
PGO1	20	25	PGO2
PGIN−	21	24	DCTL
PGIN+	22	23	VCOIN
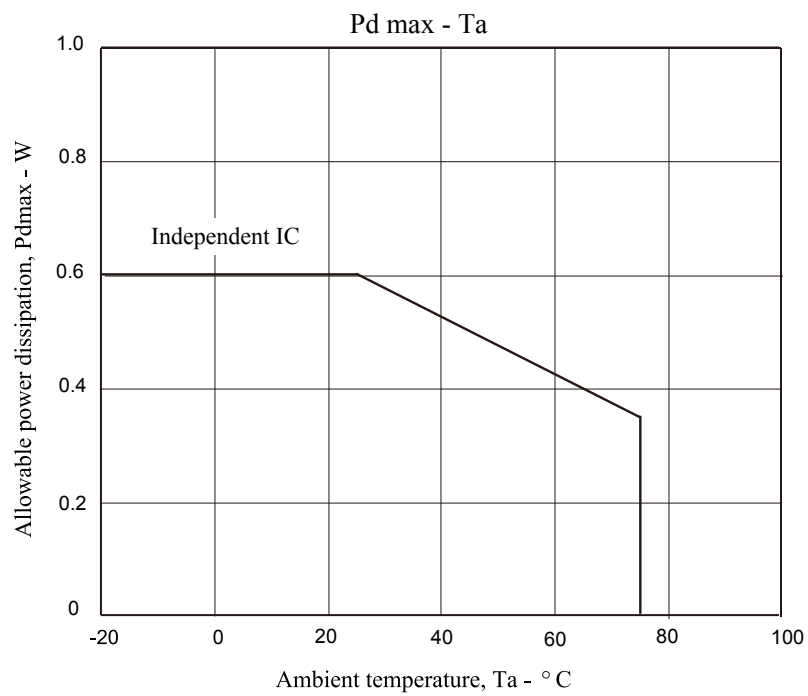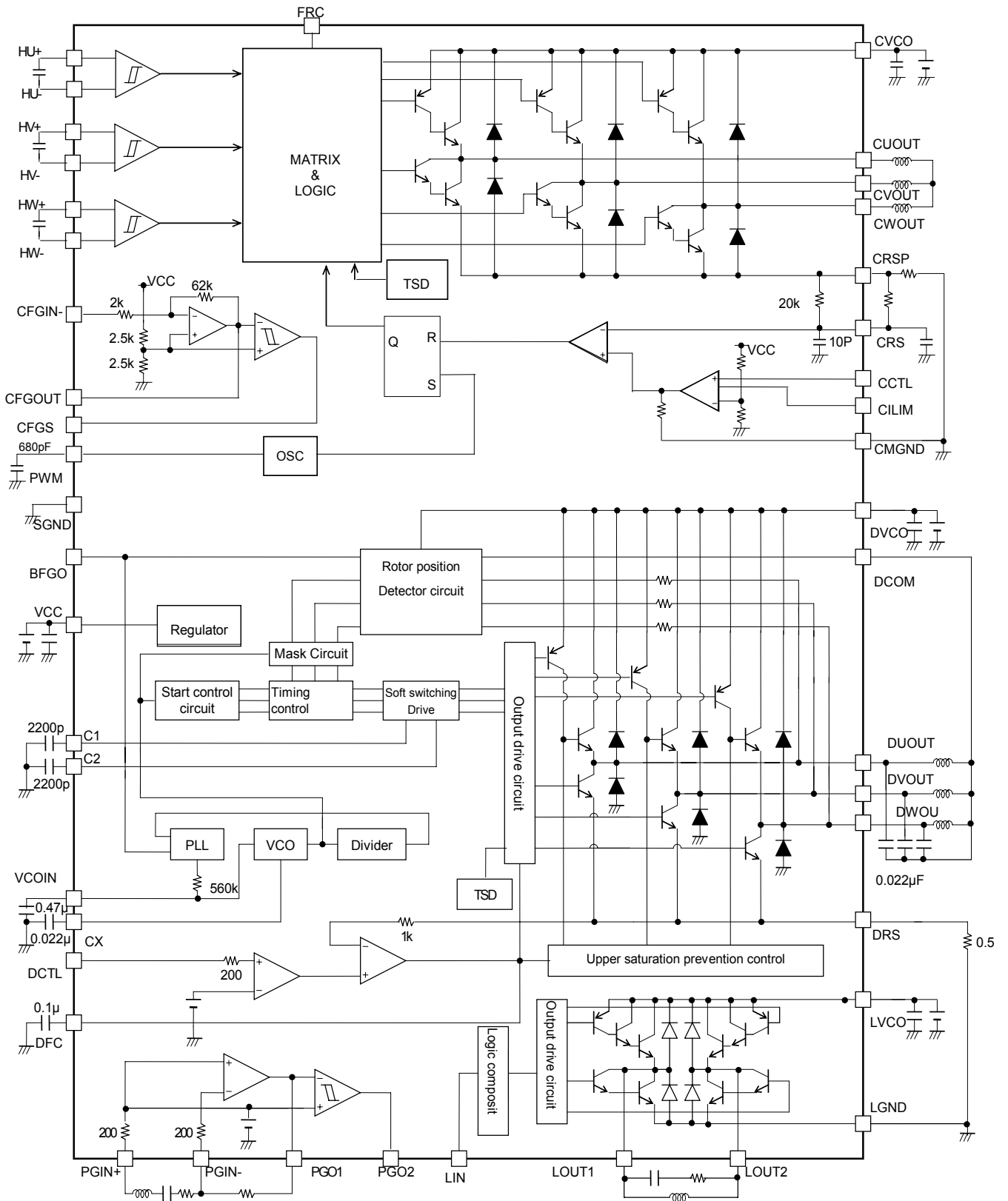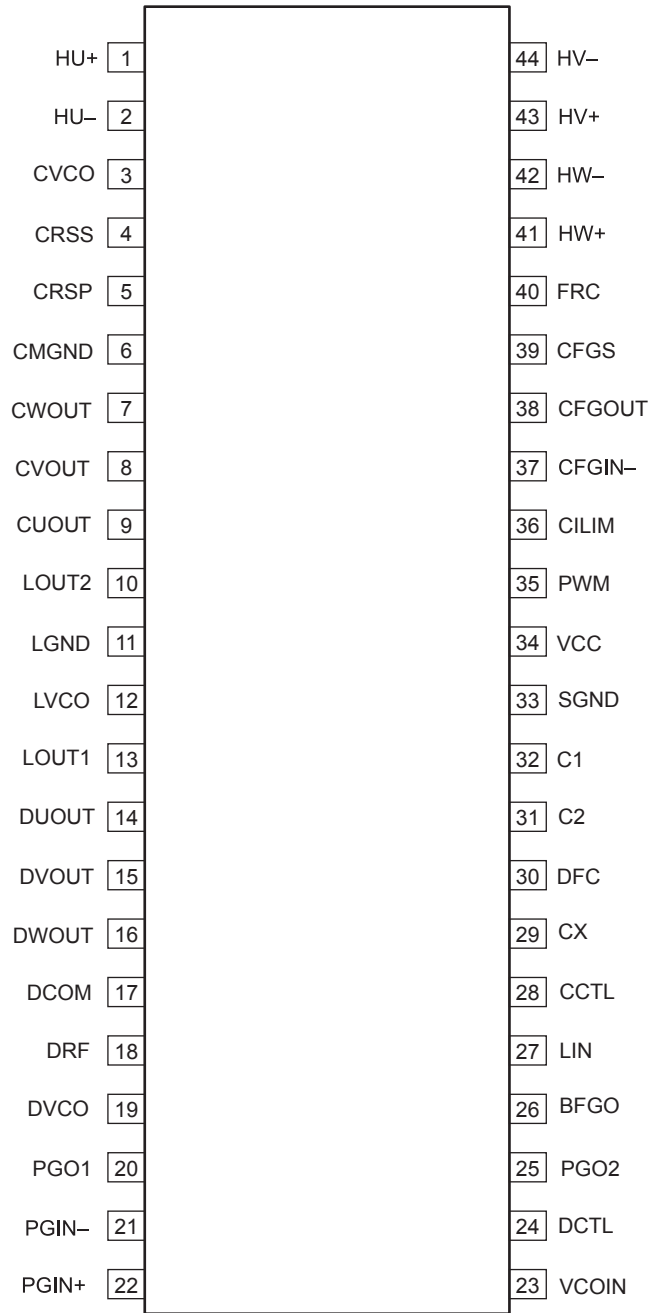
TOP VIEW

Pin Description

Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
3	CV$_{CO}$	8V to 28V	Power pin of capstan motor driver	
19	DV$_{CO}$	8V to 28V	Power pin of drum motor driver	
12	LV$_{CO}$	8V to 28V	Power pin of loading motor driver	
34	VCC	4V to 6V	Power pin to provide all voltages other than the output transistor and pre-drive	
6	CMGND		Capstan motor GND	
33	SGND		GND for all other than output	
1	HU+	1.5V to V$_{CC}$-1.5V	U-phase Hall element input pin HU+>HU- state for logic H	
2	HU-			
43	HV+		V-phase Hall element input pin. HV+>HV- state for logic H	
44	HV-			
41	HW+		W-phase Hall element input pin. HW+>HW- state for logic H	
42	HW-			
37	CFGIN-	1V to V$_{CC}$-1.5V	Capstan FGAMP reverse input pin	
38	CFGOUT		Capstan FGMP linear output pin Return resistor is incorporated with the amplification degree of about 31-fold.	
39	CFGS		FG Schmidt amp output pin of capstan block	
40	FRC	0V to V$_{CC}$	Capstan forward/reverse control pin	

Continued from preceding page.

Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
5	CRSS		Capstan current detection filter pin Connect the current detected at C-RFP to this pin after passing through the CR filter.	
35	PWM		Capacitor connection pin for PWM oscillation at capstan	
36	CILIM	0V to V_{CC}	Capstan current limit setting pin	
28	CCTL	0V to V_{CC}	Capstan speed control voltage application pin	
7	CWOUT		Capstan W-phase output pin	
8	CVOUT		Capstan V-phase output pin	
9	CUOUT		Capstan U-phase output pin	
5	CRSP		PWRTR GND and current return resistor connection pin	

LB11899J

Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
30	DFC		Drum frequency characteristics compensation pin. Insertion of a capacitor to GND stops oscillation of the closed loop of current control system	
24	DCTL	0V to V_{CC}	Drum speed control pin. Control is the constant current control to which current return is applied from DRS.	
22	PGIN+		Drum PG amplifier non-inverted input pin Biased internally to $(3/5) \times V_{CC}$	
21	PGIN-		Drum PG amplifier inverted input pin	
20	PGO1		Drum PG amplifier linear output pin	

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Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
25	PGO2		Drum PG Schmidt amplifier output pin	
26	BFGO		Drum motor reverse counter-electromotive voltage detection output pin (three-phase synthesizing)	
23	VCOIN		VCO circuit voltage input pin of drum block. The PCOUT pin voltage is input via CR filter.	
14	DUOUT		Drum motor driver output pin	
15	DVOUT			
16	DWOUT			
18	DRF		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	DCOM		Motor coil neutral point input pin. The coil voltage waveform is detected with reference to this voltage.	

Continued from preceding page.

Pin No	Symbol	Pin voltage	Pin Description	Equivalent Circuit
32	C1		Triangular wave generating capacitor connection pin of drum block. This triangular wave performs soft- switching of the coil output waveform.	
31	C2			
29	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.	
27	LIN	0V to V_{CC}	Loading logic input pin	
13	LOUT1		Loading motor driver output pin	
10	LOUT2			
11	LGND		Loading output transistor GND pin	

Timing Chart and Truth Table

1. Capstan Motor Driver Drive waveform (FRC = L)
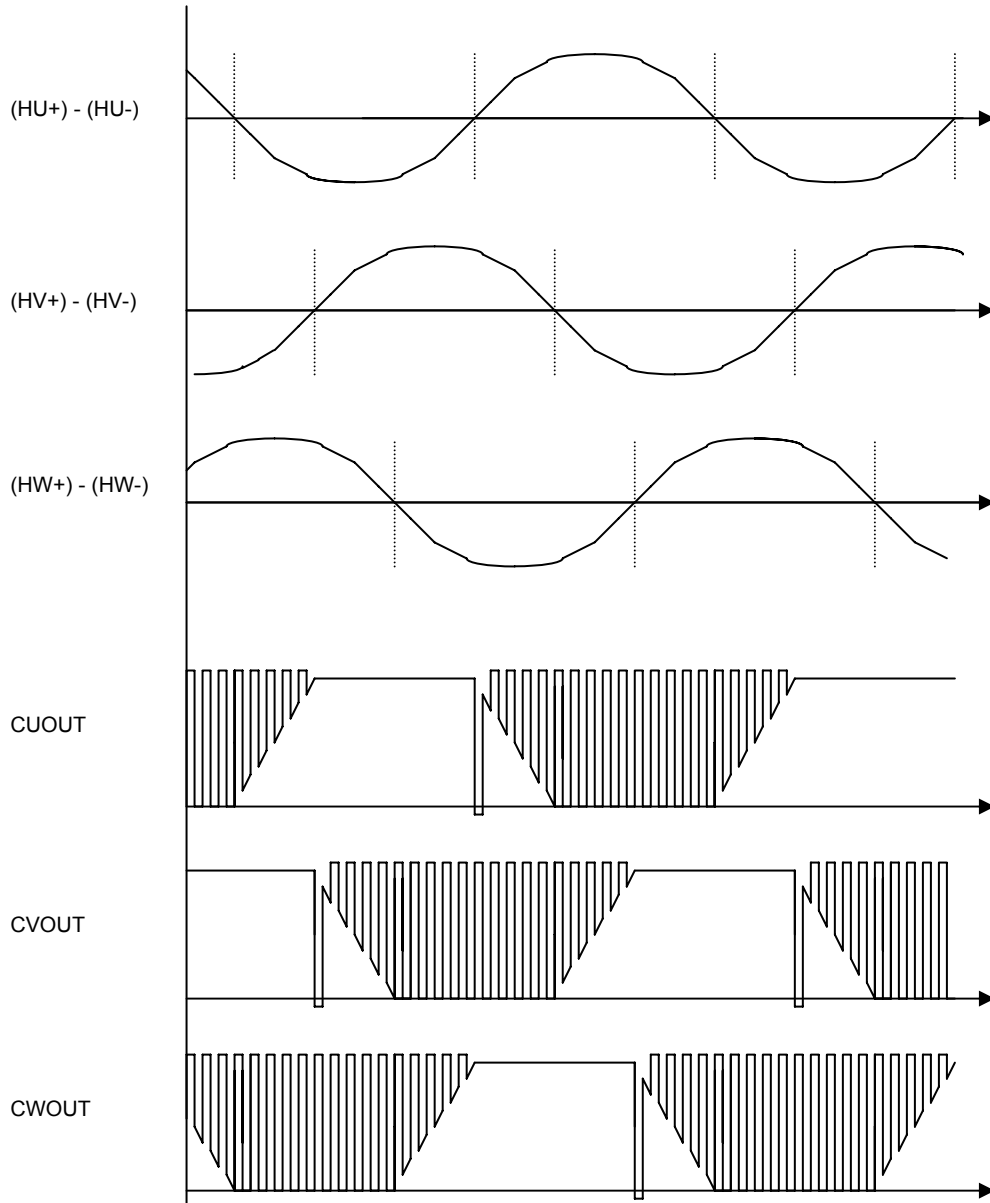
2. Capstan Motor Driver Drive waveform (FRC = H)
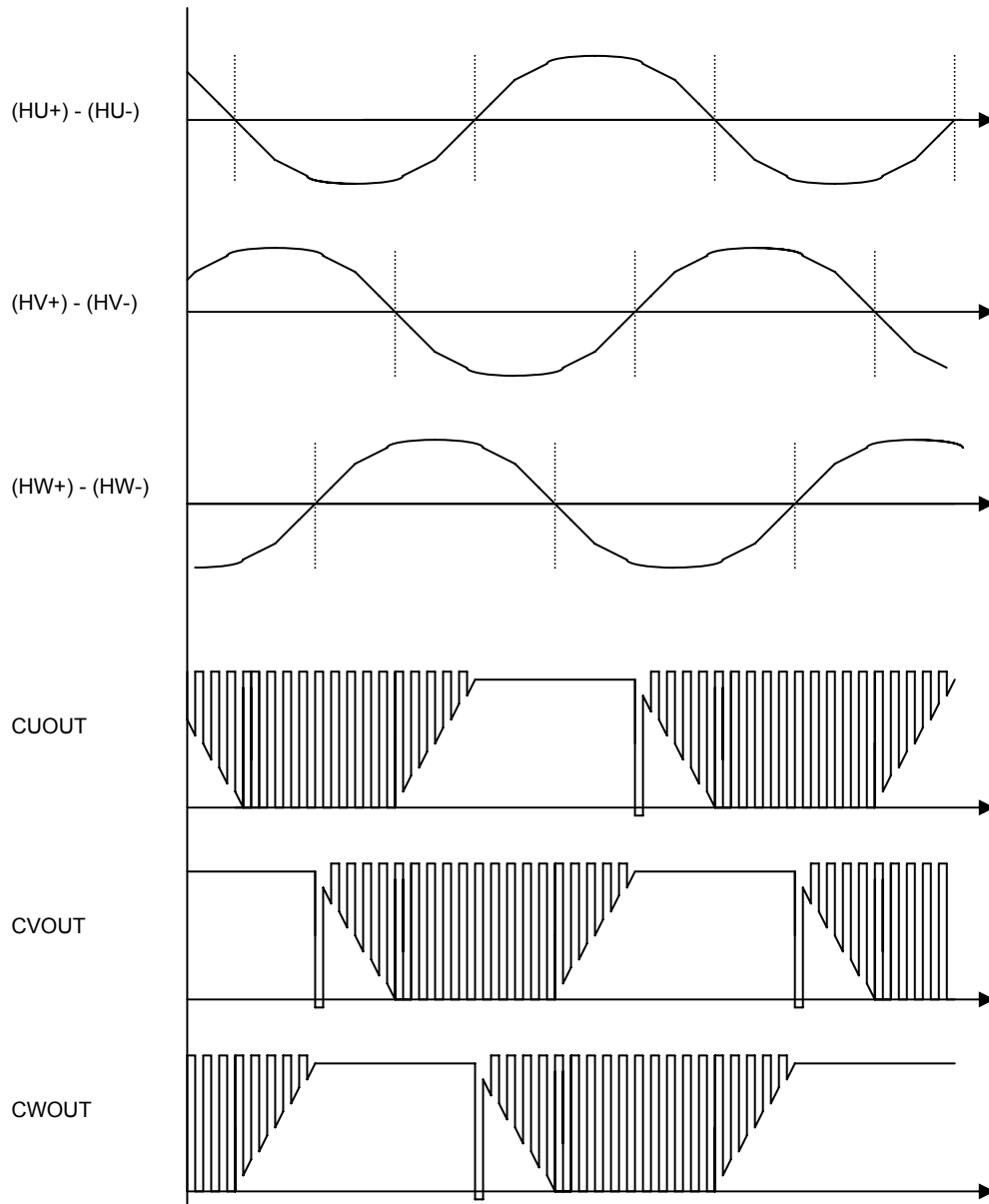
3. Capstan Motor Driver Truth Table & Control Functions

	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

Control characteristics CILM = 5V

VCRF

Gm = 0.53V/Vtyp
2.5 Vtyp

CCTL

0   1   2   3   4   5

Current limiting characteristics CCTL = 5V

VCRF

Gradient = 0.53V/Vtyp

CILM

0   1   2   3   4

2.5 Vtyp

VCRF

Peak value

0V

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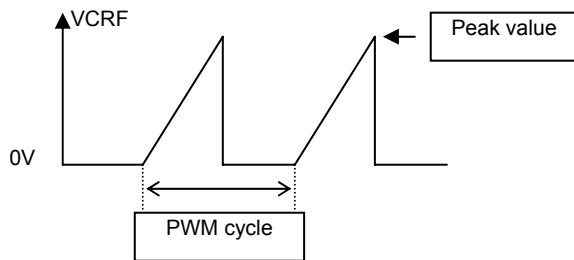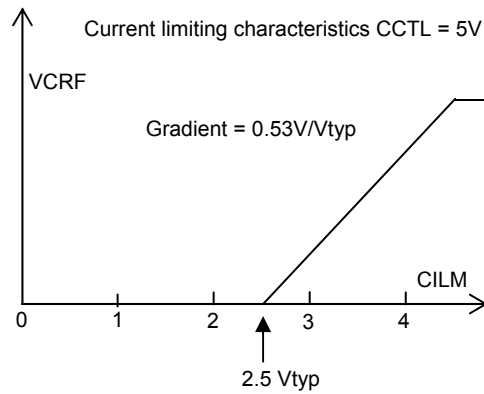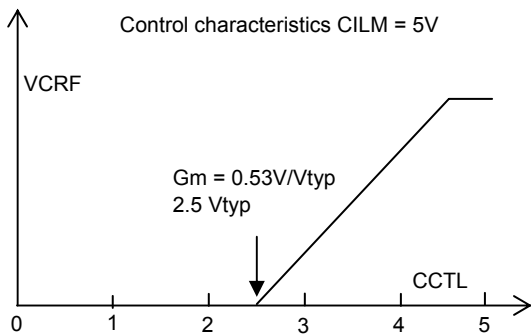
Caution: For the VCRF voltage of control characteristics, the peak value is to be measured.

Cautions for use)

- When the direct reversion brake is to be used, keep the voltage at the CILIM terminal 3.1V 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

IDUOUT
current waveform

Counter electromotive detection

Counter electromotive detection

Counter electromotive detection

IDVOUT
current waveform

Counter electromotive detection

Counter electromotive detection

Counter electromotive detection

IDWOUT
current waveform

Counter electromotive detection

Counter electromotive detection

Counter electromotive detection

Counter electromotive detection

BFGO

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

PACKAGE DIMENSIONS

unit : mm

SSOP44J (275mil) Exposed Pad
CASE 940AG
ISSUE O

TOP VIEW

SIDE VIEW

15.45 MAX

15.0±0.1

44

0~10°

5.6±0.1

7.6±0.25

0.5±0.2

1 2

0.65

0.22 +0.1 −0.05

⊕ 0.12 Ⓜ

0.2 +0.1 −0.05

(0.68)

SIDE VIEW

1.7 MAX

(1.5)

0.1±0.1

△ 0.10

BOTTOM VIEW

(7.8)

(3.6)
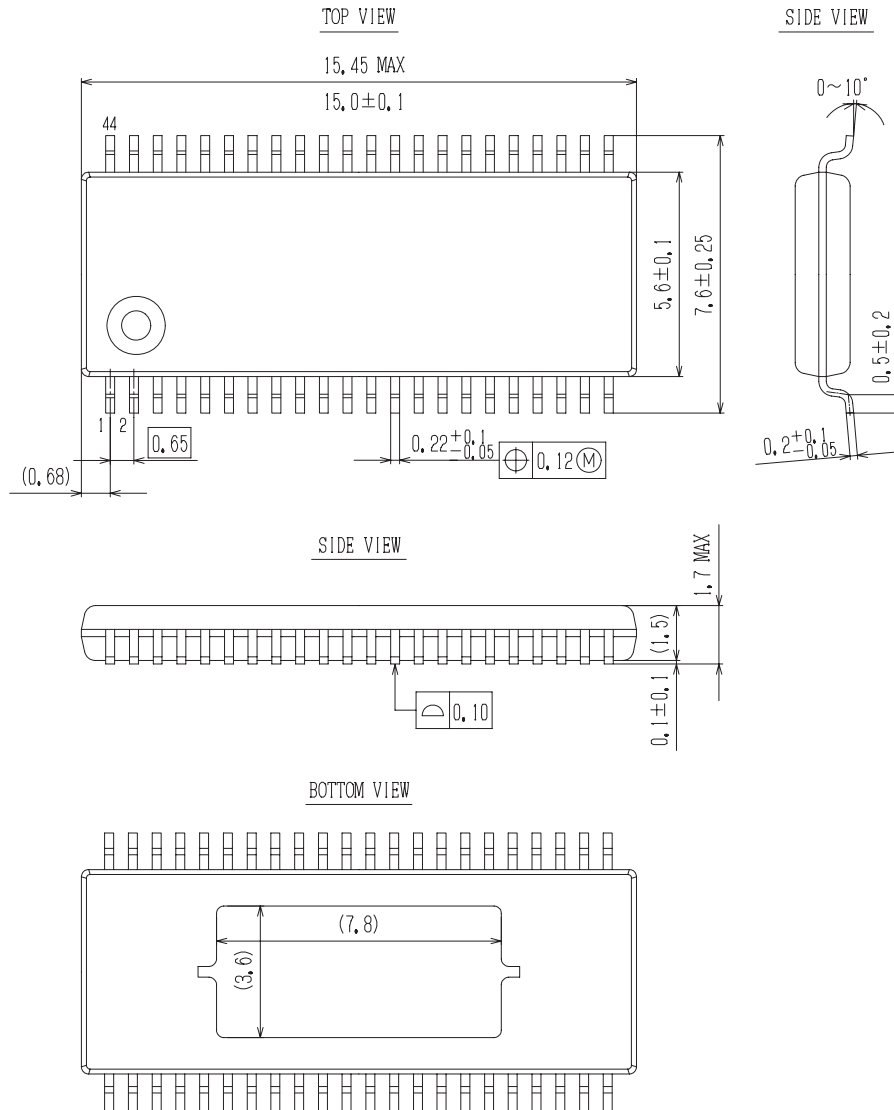
ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
LB11899J-MPB-E	SSOP44J (275mil) (Pb-Free)	30 / Fan-Fold
LB11899J-TRM-E	SSOP44J (275mil) (Pb-Free)	2000 / Tape & Reel