Ordering number : EN7461A

SANYO Semiconductors
DATA SHEET

LV8210W — Bi-CMOS IC
A Spindle + CD-ROM Actuator

Overview

The LV8210W is a DVD-ROM system motor driver.

Features

- Bi-CDMOS
  Spindle motor driver
  - PWM sensorless
  - Built-in short brake
  - V-type control amplifier
  - Actuator with anti reverse circuit

  Actuator
  - DWM BTL 3ch built-in

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	V_{CC} max		6	V
Output block power supply voltage	VS max		6	V
Predriver voltage (gate voltage)	VG max		10	V
Output current	I_O max		1.0	A
Allowable power dissipation	Pd max	Independent IC	0.45	W
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-55 to +150	°C

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Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	V_{CC}		4.5 to 5.5	V
Output block power supply voltage	VS		0 to V_{CC}	V
Predrive voltage (gate voltage)	VG		VS+3.5 to 9.8	V

Electrical Characteristics Ta = 25°C, V_{CC} = 5V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply current 1	$I_{CC}1$	S/S pin H MUTE pin L		4.5	6.0	mA
Power supply current 2	$I_{CC}2$	S/S pin H MUTE pin H		9.0	11.5	mA
Power supply current 3	$I_{CC}3$	S/S pin L (in standby mode)			20	μA
Charge pump output						
Output voltage	VCP			9.5	9.8	V
Internal oscillator circuit						
Internal oscillation frequency	fclk			3.2	4.0	MHz
Overheat protection circuit						
Thermal protection circuit operating temperature	TSD	*Design target	150	180		°C
Temperature hysteresis width	ΔTSD	*Design target		40		°C
Actuator block [Control]						
Output offset voltage	VOFS	VCREF = VCTL = 1.65V	-60		+60	mV
Actuator input pin						
Input voltage range	V_{IN}	VCREF = 1.65V	0		V_{CC}	V
Current feedback output pin						
SOURCE	ISO		45	50	65	μA
SINK	ISI		45	50	65	μA
Output side						
Focus output ON resistance	Ron1, 2	I_O = 0.5A sum of upper and lower outputs		1.5	1.8	Ω
Sled output ON resistance	Ron3	I_O = 0.5A sum of upper and lower outputs		1.0	1.3	Ω
Internal oscillation circuit (triangular wave)						
Oscillation frequency	f	VCREF = 1.65V	200	240	270	kHz
Spindle motor driver [Output block]						
SOURCE1	Ron (H1)	I_O = 0.5A, VS = 5V, VG = 9.5V forward Tr		0.25	0.40	Ω
SINK	Ron (L)	I_O = 0.5A, VS = 5V, VG = 9.5V		0.25	0.40	Ω
SOURCE+SINK	Ron (H+L)	I_O = 0.5A, VS = 5V, VG = 9.5V		0.5	0.80	Ω
Position detection comparator						
Input offset voltage 1	VOFS1-1	*Design target, V_{CC} = 5.0V, VCOM = 2.5V	-5		5	mV
Control						
VCREF input voltage range	VCREF		1.55	1.65	1.75	V
VCTL input voltage range	VCTL		0		V_{CC}	V
Current control circuit						
Forward rotation drive gain	GDF^+		0.20	0.25	0.30	times
Reverse rotation drive gain	GDF^-		-0.30	-0.25	-0.20	times
Dead zone width	VDZ		110	150	190	mV
Limiter voltage	VRf			0.20	0.30	V
VCO pin						
VCO "H" level voltage	VCOH		0.9	1.0	1.1	V
VCO "L" level voltage	VCOL		0.4	0.5	0.6	V
S/S pin						
"H" level input voltage range	VSSH	Start	2.7		V_{CC}	V
"L" level input voltage range	VSSL	Stop	0		0.6	V

* Design target value and no measurement is performed.

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
BRK SEL pin						
"H" level input voltage range	VBRH	Short brake	2.7		V_{CC}	V
"L" level input voltage range	VBRL	Reverse torque brake	0		0.6	V
FG1 output, FG3 output pin						
"L" level output voltage	VFGL	I_O = 0.5mA	0		0.5	V
Amplifier block						
Input offset voltage	VIOER		-10		10	mV
Input bias current	IBER		-1.0		1.0	µA
Common phase input voltage range	VERCM		0		V_{CC}-1.0	V
Output "H" level voltage	VEROH	IERO = -350µA	V_{CC}-0.5			V
Output "L" level voltage	VEROL	IERO = 350µA			0.5	V

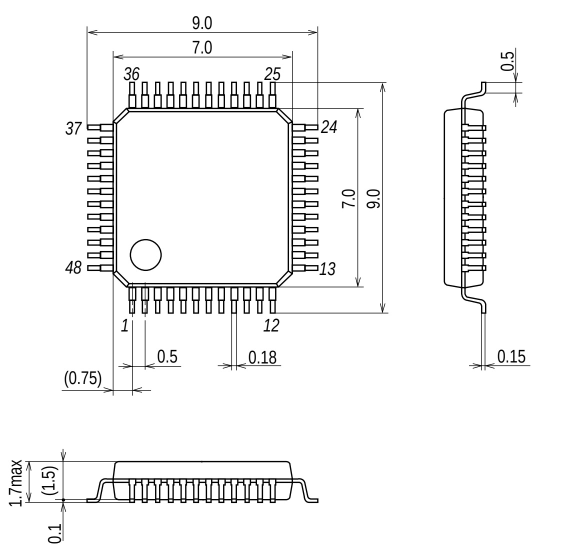
Spindle and Actuator Control Truth Table

S/S	Mute	Spindle	H-bridge1	H-bridge2	H-bridge3
H	H	Active	Active	Active	Active
L	H	Mute	Mute	Mute	Mute
H	L	Active	Mute	Mute	Mute
L	L	Mute	Mute	Mute	Mute

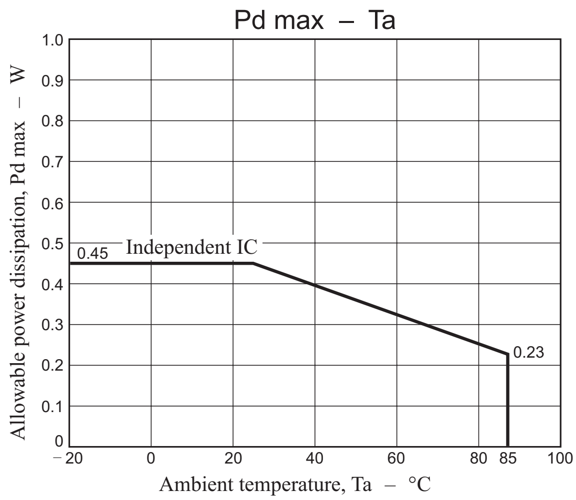
Package Dimensions

unit : mm (typ)

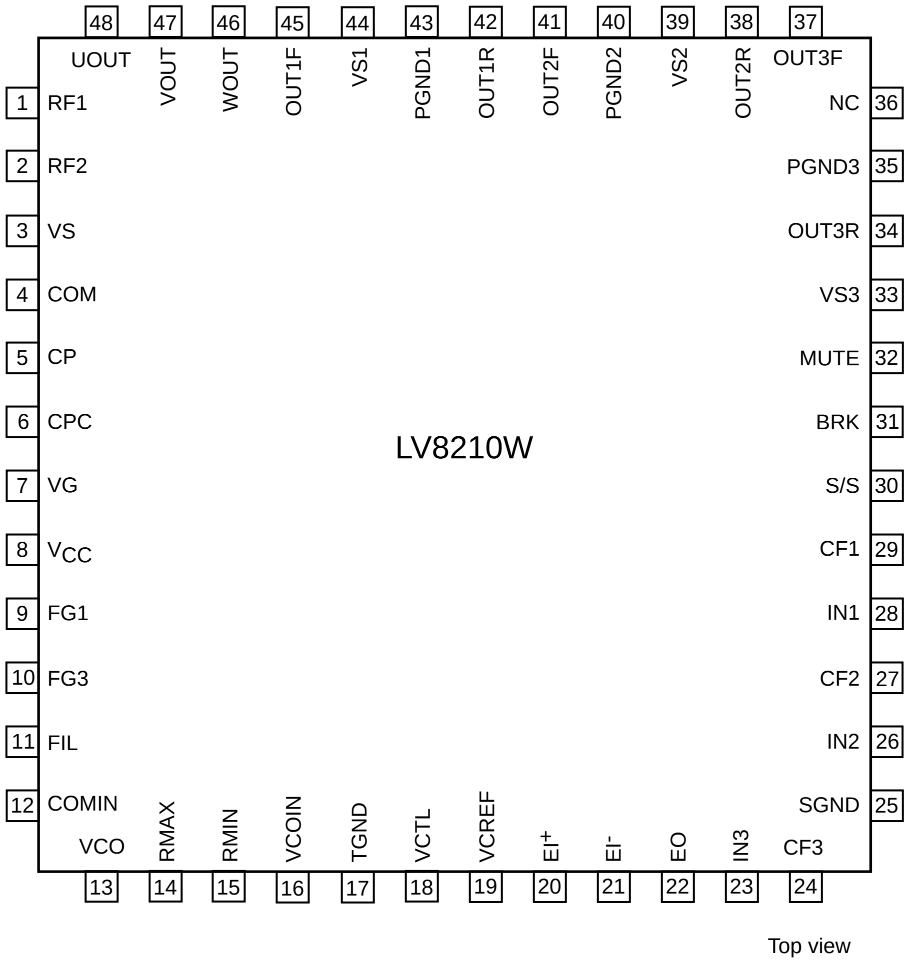
3163B



SANYO : SQFP48(7X7)



Pin Assignment



Pin Functions

Pin No.	Pin name	Function
1	RF1	Output current detection pin. The drive current is detected using the low resistance resistor inserted between this pin and ground.
2	RF2	Output current detection signal input pin. Short-circuit this pin to RF1 pin (pin 1).
3	VS	Spindle motor drive power supply. Insert a capacitor between this pin and ground.
4	COM	Spindle motor common point connection.
5	CP	Charge pump stepped-up voltage pulse output. Insert a capacitor between this pin and CPC (pin 6).
6	CPC	Charge pump stepped-up voltage connection. Insert a capacitor between this pin and CP (pin 5).
7	VG	Charge pump stepped-up voltage output. Insert a capacitor between this pin and ground.
8	V_{CC}	Power supply. Insert a capacitor between this pin and ground.
9	FG1	FG pulse output pin (MOS output). Outputs a pulse signal equivalent to a one Hall sensor system pulse out put.
10	FG3	FG pulse output pin (MOS output). Outputs a pulse signal equivalent to a three Hall sensor system pulse out put.
11	FIL	Motor position detection comparator filter. Insert a capacitor between this pin and COMIN (pin 12).
12	COMIN	Motor position detection comparator filter. Insert a capacitor between this pin and FIL (pin 11).
13	VCO	VCO connection. Insert a capacitor between this pin and ground. The VCO frequency follows the motor speed as indicated by the VCOIN pin voltage.
14	RMAX	VCO maximum frequency setting. Insert a resistor between this pin and ground. Making the value of the resistor smaller increases the frequency. Set the frequency so that the VCO oscillator frequency when the VCOIN pin voltage is V_{CC} - 1V is over 48 times the switching frequency at the maximum motor speed.
15	RMIN	VCO minimum frequency setting Making the value of the resistor smaller increases the frequency.

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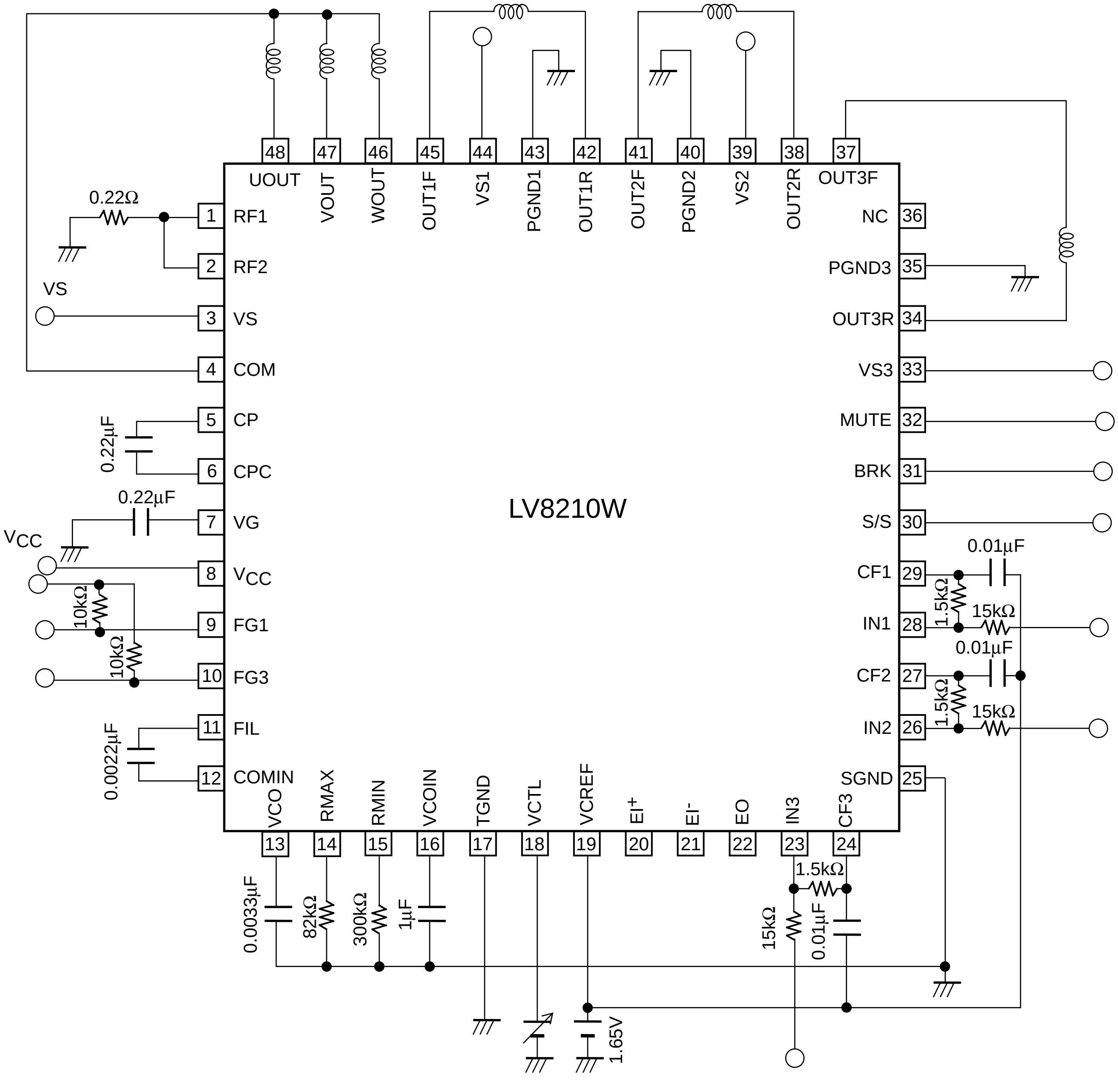
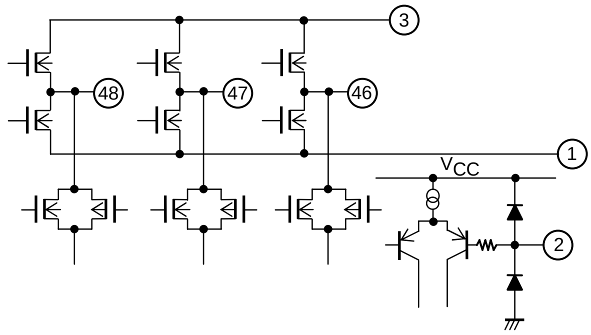
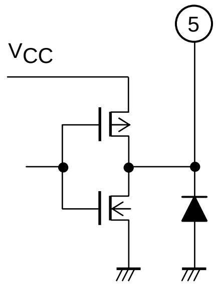
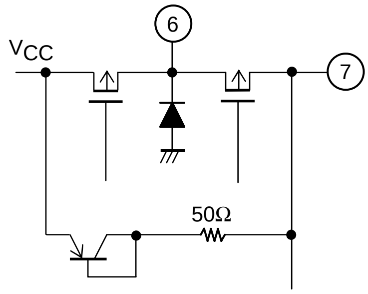
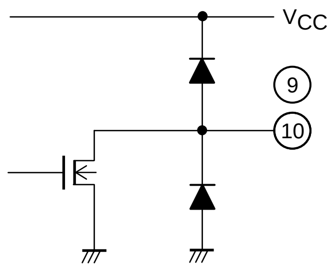
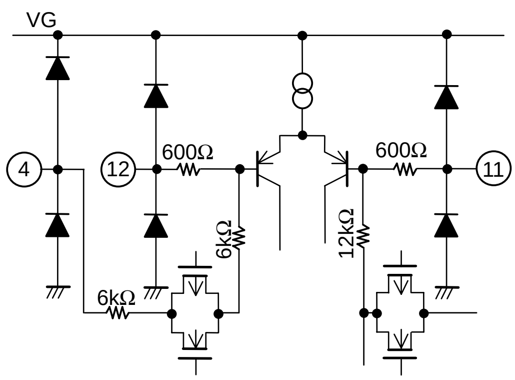
Pin No.	Pin name	Function
16	VCOIN	VCO control voltage input. Insert a capacitor between this pin and ground. A control output proportional to the motor speed is generated in the logic block, and that output charges and discharges the capacitor inserted between this pin and ground. The VCO frequency is controlled by the voltage on this pin.
17	TGND	GND pin.
18	VCTL	Spindle speed control pin. Positive torque control is applied when greater than VCREF.
19	VCREF	Spindle and actuator control reference voltage input pin (1.65V).
20	EI^{+}	Amplifier non-inverting input.
21	EI^{-}	Amplifier inverting input.
22	EO	Amplifier output pin.
23	IN3	H-bridge 3 control signal input. Outputs are on pin 34 pin 37. Hduty of OUT3R and OUT3F will be OUT3R<OUT3F when the voltage level at the IN pin is greater than VCREF.
24	CF3	Output pin for H-bridge 3 current feedback circuit.
25	SGND	GND pin.
26	IN2	H-bridge 2 control signal input. Outputs are on pin 38 pin 41. Hduty of OUT2R and OUT2F will be OUT2R<OUT2F when the voltage level at the IN pin is greater than VCREF.
27	CF2	Output pin for H-bridge 2 current feedback circuit.
28	IN1	H-bridge 1 control signal input. Outputs are on pin 42 pin 45. Hduty of OUT1R and OUT1F will be OUT1R<OUT1F when the voltage level at the IN pin is greater than VCREF.
29	CF1	Output pin for H-bridge 1 current feedback circuit.
30	S/S	Spindle motor block and actuator block start/stop pin. A high-level input : Start
31	BRK	Spindle motor block brake control. Reverse torque braking is applied when this pin is low-level short braking is applied when this pin is high-level.
32	MUTE	Sets actuator output to the open state. All outputs are in the open state when this pin is low-level.
33	VS3	H-bridge 1 motor power supply. Insert a capacitor between this pin and ground.
34	OUT3R	H-bridge 1 reverse output.
35	PGND3	H-bridge 1 output block ground.
36	NC	
37	OUT3F	H-bridge 1 forward output.
38	OUT2R	H-bridge 2 reverse output.
39	VS2	H-bridge 2 motor power supply. Insert a capacitor between this pin and ground.
40	PGND2	H-bridge 2 output block ground.
41	OUT2F	H-bridge 2 forward output.
42	OUT1R	H-bridge 1 reverse output.
43	PGND1	H-bridge 1 output block ground.
44	VS1	H-bridge 1 motor power supply. Insert a capacitor between this pin and ground.
45	OUT1F	H-bridge 1 forward output.
46	WOUT	Output pin. Motor coil is connected to this pin.
47	VOUT	
48	UOUT	

Sample Application Circuit



* Insert a capacitor between VS and GND between V_{CC} and GND.

Pin Functions

Pin No.	Pin name	Function	Equivalent circuit
3	VS	Power supply pin for sled motor driver. A capacitor must be connected between this pin and GND.	
46 47 48	WOUT VOUT UOUT	Output pin. Connect the spindle motor coil.	
1 2	RF1 RF2	Output current detection pin. Drive current is detected when a resistor with a small value is connected between this pin and GND.	
5	CP	Charge pump pulse output pin. A capacitor must be connected between this pin and CPC (pin 30).	
6	CPC	Pin for charge pump. A capacitor must be connected between this pin and CP (pin 29).	
7	VG	Pin for charge pump. A capacitor must be connected between this pin and GND.	
8	V_{CC}	Power supply pin to supply to the small signal system circuit A capacitor must be connected between this pin and GND.	
9	FG1	FG1 pulse output pin. The pulse of one hall sensor is outputted.	
10	FG3	FG3 pulse output pin. The pulse of three hall sensor is outputted.	
12	COMIN	Differential input pin of Position detection comparator. A capacitor must be connected between this pin and FIL (pin 14).	
11	FIL	Waveform synthesis signal filter pin. A capacitor is connected between this pin and COMIN (pin 13).	
4	COM	Spindle motor common point connection connect to COM.	

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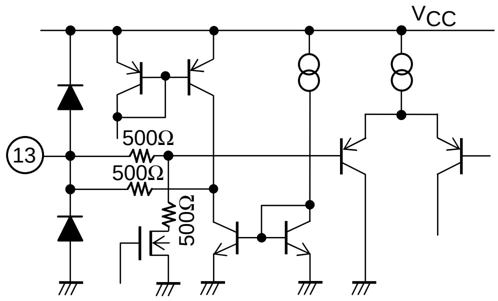
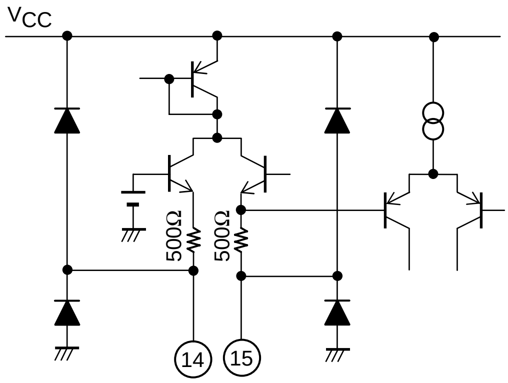
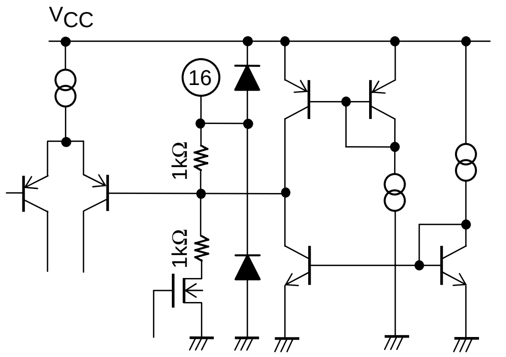
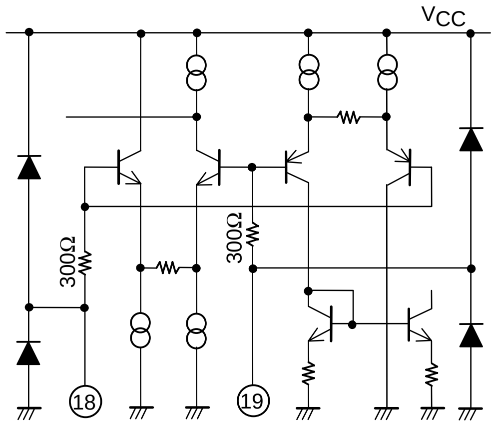
Pin No.	Pin name	Function	Equivalent circuit
13	VCO	Oscillation frequency of VCO pin. A capacitor must be connected between this pin and GND. The VCO oscillation frequency changes in correspondence to the spindle motor rotation speed.	
14	RMAX	Sets the maximum frequency of VCO pin. With the resistance of a resistor connected to GND reduced, the higher frequency can be set. Set the frequency so that the VCO oscillator frequency when the VCOIN pin voltage is V_{CC} - 1V is over 96 times the switching frequency at the maximum motor speed.	
15	RMIN	VCO minimum frequency setting pin Making the value of the resistor smaller increases the frequency.	
16	VCOIN	Pin to control the voltage of VCO pin. A capacitor must be connected between this pin and GND.	
17	TGND	GND pin of small signal system.	
18	VCTL	Speed control input pin	
19	VCREF	Reference voltage pin for speed control	

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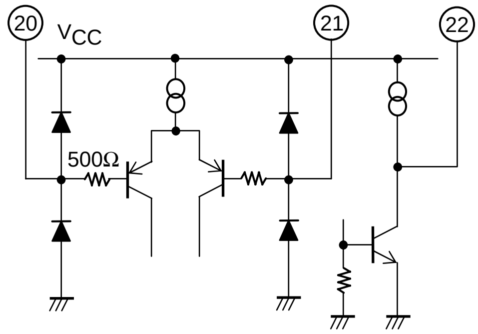
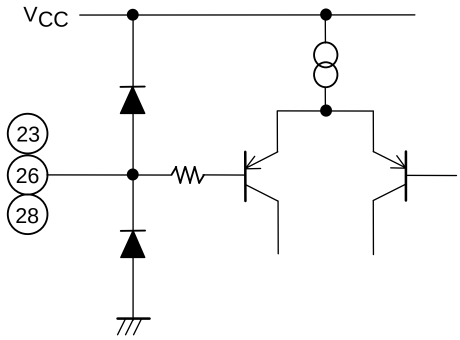
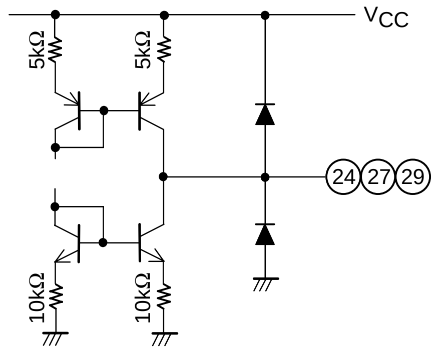
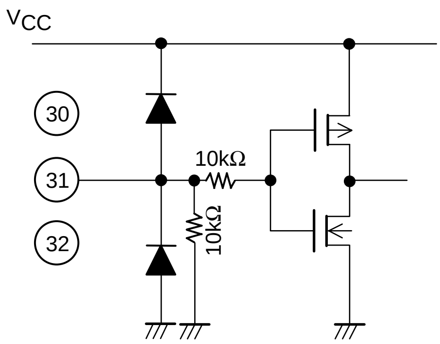
Pin No.	Pin name	Function	Equivalent circuit
20 21 22	EI^{+} EI^{-} EO	• Amplifier non-inverting input pin • Amplifier inverting input pin • Amplifier output pin	
23 26 28	IN3 IN2 IN1	• H-bridge 3 control signal input pin • H-bridge 2 control signal input pin • H-bridge 1 control signal input pin	
24 27 29	CF3 CF2 CF1	• Output pin for H-bridge 3 current feedback circuit • Output pin for H-bridge 2 current feedback circuit • Output pin for H-bridge 1 current feedback circuit	
25	SGND	GND pin of small signal system.	
11	S/S	Spindle motor block start/stop pin. High-level input : Start	
12	BRK	Brake pin of spindle motor block. High-level input : Forward torque Low-level input : Brake	
13	MUTE	Sets the actuator output in the open state. All outputs are in the open state when this pin is low-level.	
36	NC		

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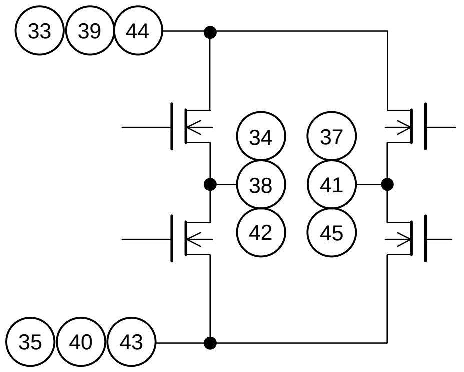
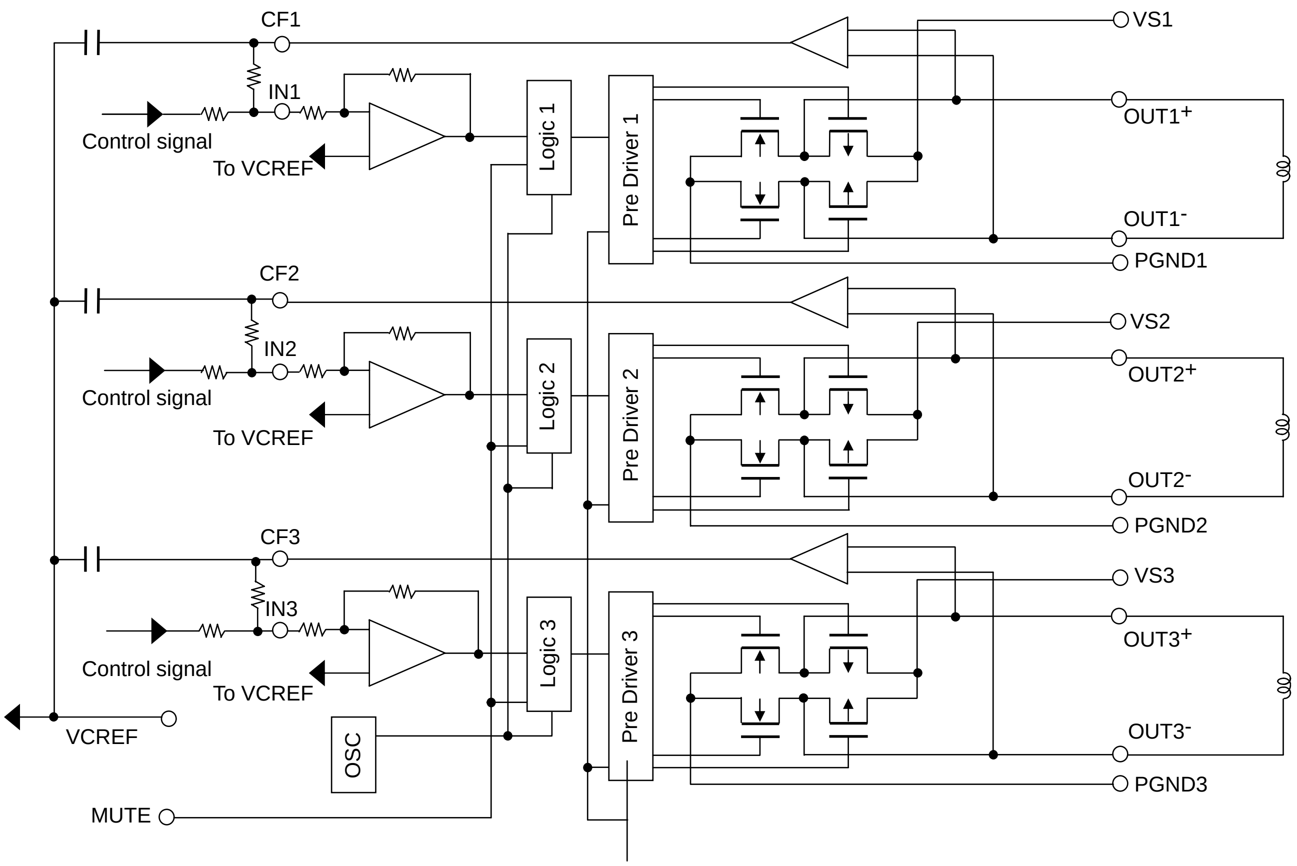
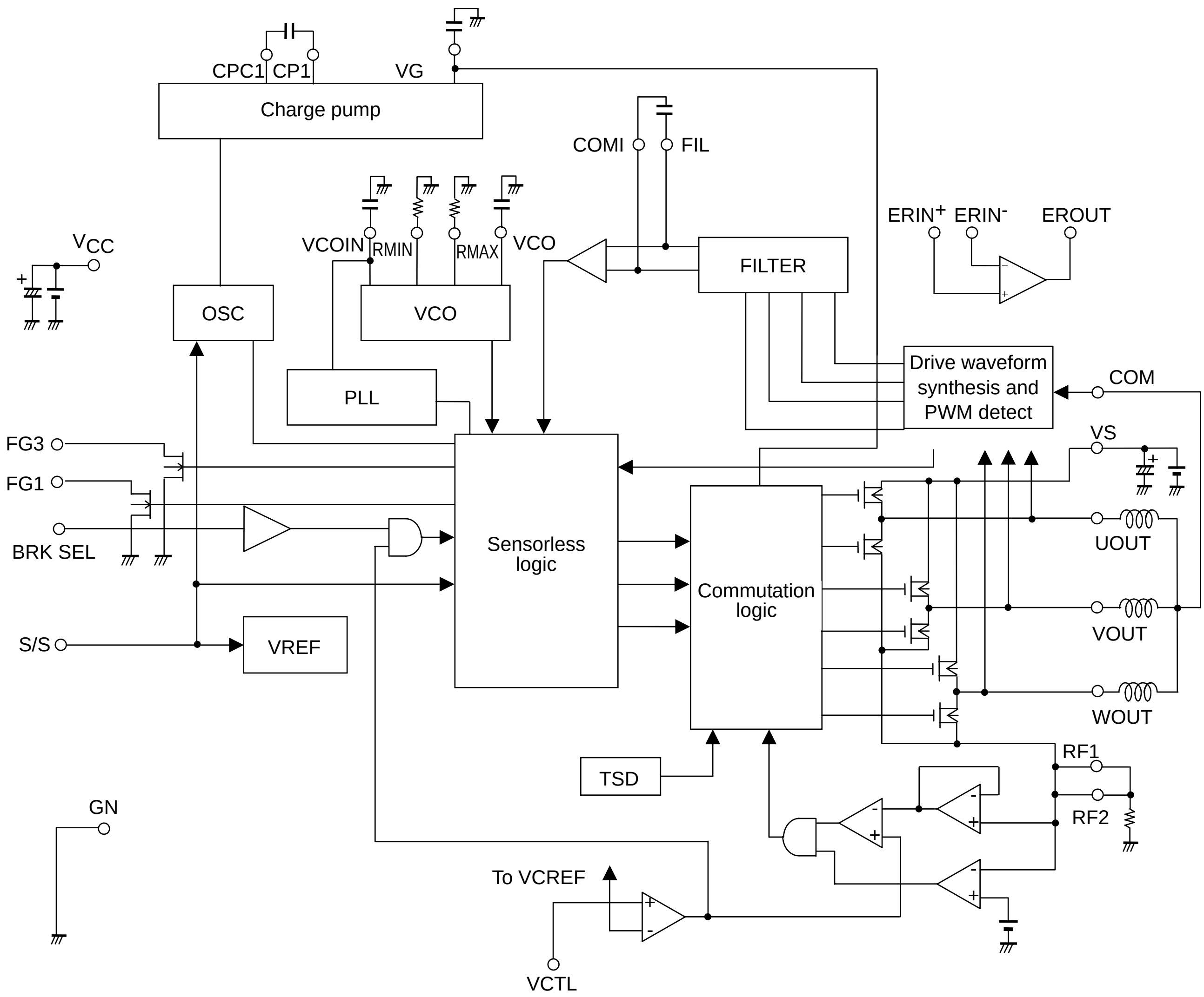
Pin No.	Pin name	Function	Equivalent circuit
33	VS3	H-bridge output block. Insert capacitors between VS1, VS2, VS3 and PGND1, PGND2, and PGND 3.	
39	VS2		
44	VS1		
37, 34	OUT3F/R		
41, 38	OUT2F/R		
45, 42	OUT1F/R		
35	PGND3		
40	PGND2		
43	PGND1		

Block Diagram



3ch Actuator Block



Spindle Motor Driver Block

LV8210W Functional Description and Notes on External Components

The LV8210W is a system motor driver IC that can implement, with just a single chip, the motor driver circuits required for CD and MD systems. Since the LV8210W provides not only a spindle driver, but drivers (with an H-bridge structure) for sled, focus, and tracking motors, it can contribute to miniaturization and thinner form factors in end products. Since the spindle and sled drivers adopt a direct PWM sensorless drive technique, they provide high efficiency motor drive with a minimal number of external components.
Read the following notes before designing driver circuits using the LV8210W to design a system with fully satisfactory characteristics.

1. Output Drive Circuits and Speed Control Methods
   The LV8210W adopts a synchronous commutation direct PWM drive method to minimize power loss in the output. Low on-resistance DMOS devices are used as the output transistors. (The upper and lower side output block device on-resistance is 0.5Ω (typical).)
   The LV8210W spindle drivers control system takes an analog input and uses a V-type control amplifier. The V-type control amplifier based speed control system (gain : 0.25typical) controls the speed by controlling the voltage of the VCTL pin (pin 18) and the VCREF pin (pin 19). The circuit provides positive torque when VCTL is greater than VCREF, and allows the application to select either reverse torque braking (when the BRK pin is low) or shortcircuit braking (when the BRK pin is high) when VCTL is less than VCREF. The PWM frequency is twice the frequency of the charge pump pulse rate (pin 5).

2. Soft Switching Circuit
   This IC performs “soft switching”, which is a technique that varies the duty and achieves quieter motor operation by reducing the level of motor drive noise. This IC provides a “current application on/off dual sided soft switching” type soft switching function.

3. Current Limiter Circuit
   The current limit value of the current limiter circuit is determined by RF in the equation I = VRF/Rf (here, VRF = 0.20V, typical).
   The current limiter circuit detects the RF1 pin (pin 1) peak current at the RF2 pin (pin 2) and turns the sink side transistor off.

4. VCO Circuit Constants
   The LV8210W spindle block adopts a sensorless drive technique. Sensorless drive is implemented by detecting the back EMF signal generated by the motor and setting the commutation timing accordingly. Thus the timing control uses the VCO signal. We recommend using the following procedure to determine the values of the VCO circuit’s external components.
   1) Connect components with provisional values.
      Connect a 2.2μF capacitor between the VCOIN pin (pin 16) and ground, connect a 68kΩ resistor between the RMAX pin (pin 14) and ground, and connect a 2200pF capacitor between the VCO pin (pin 15) and ground.
   2) Determine the value of the VCO pin (pin 13) capacitor.
      Select a value such that the startup time to the target speed is the shortest and such that the variations in startup time are minimized. If the value of this capacitor is too large, the variations in the startup time will be excessive, and if too small, the motor may fail to turn. Since the optimal value of the VCO pin constant differs with the motor characteristics and the startup current, the value of this component must be verified again if the motor used or any circuit specifications are changed.
   3) Determine the value of the RMAX pin (pin 14) resistor.
      Select a resistor value such that the VCOIN pin voltage is about V_{CC} – 1.1V or lower with the motor operating at the target maximum speed. If the value of this resistor is too large, the VCOIN pin voltage may rise excessively.
   4) Determine the value of the VCOIN pin (pin 16) capacitor.
      If the FG output (pin 9 and 10) pulse signal becomes unstable at the lowest motor speed that will be used, increase the value of the VCOIN pin capacitor.

5. S/S and MUTE Circuit
   The S/S pin (pin 30) functions as the spindle motor driver’s and the actuators motor driver’s start/stop pin ; a high-level input specifies that the operation is in the start state. The MUTE pin (pin 32) operates on all driver blocks other than the spindle block; a low-level input mutes these outputs. In the muted state, the corresponding drivers (H bridge) all go to the high-impedance state, regardless of the states of the logic inputs.
   A low level input must be applied to the S/S pin to set the IC to the standby state (power saving mode).
   When power is supplied to V_{CC}, set either S/S pin or MUTE pin (or both) to low-level.

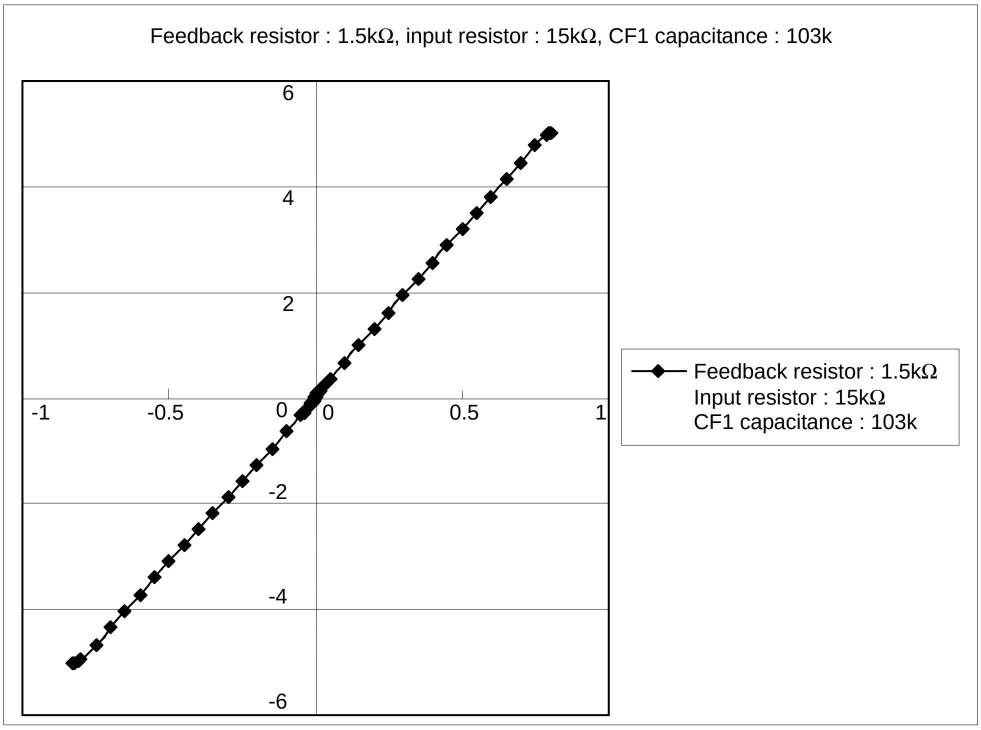
6. BRK Circuit
   The BRK pin (pin 31) switches between reverse torque and short-circuit braking; a high level selects short-circuit braking and a low level selects reverse torque breaking. When the motor speed becomes adequately slow in the reverse torque braking state, the application must switch to the short-circuit braking state to stop the motor. (Note: The IC must not be in the power saving state at this point.)
   When stopping the motor in the state where the control voltage, VCTL, is less than VCREF (when a low level is input to the BRK pin), if the timing of the switch to short-circuit braking is too early, and remaining motor rotation is a problem, reduce the value of the RMAX pin (pin 14) resistor. Also, if motor oscillation continues when the motor is nearly stopped, and a switch to short braking mode does not occur, insert a resistor with a value of a few kΩ at the COM pin. (Note: Verify that inserting this resistor does not adversely affect the startup characteristics.)

7. FG Output Circuit
   The FG3 pin (pin 10) is the spindle block FG output pin. It provides a pulse signal equivalent to that provided by systems that use three Hall-effect sensors. The FG1 pin (pin 9) outputs a signal that follows the spindle output U phase back EMF voltage. The FG1 and the FG3 pins both have a MOS open-drain output circuit structure.
   This means that external pull-up resistors must be provided. Connect the power supply from the FG signal input side as the pull-up resistor power supply. We recommended using a resistor of about 10kΩ.

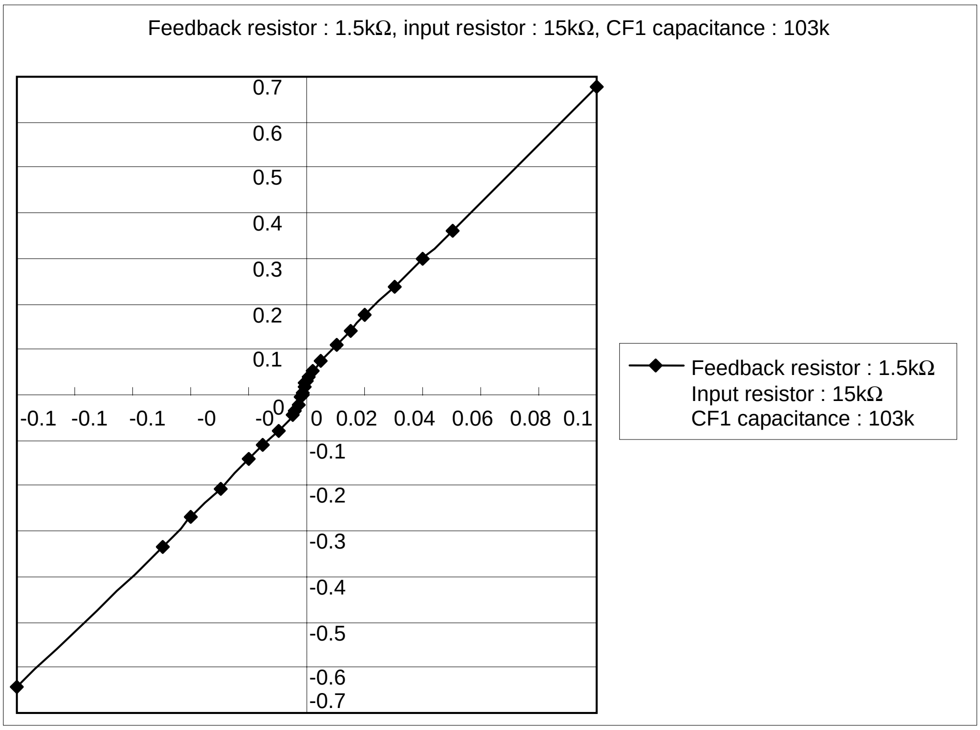
8. Spindle Block Position Sensor Comparator Circuit
The spindle block position sensor comparator circuit uses the back EMF signal generated by motor rotation to detect the rotor position. The output block power application timing is determined based on the position information acquired by this circuit. Startup problems due to noise on the comparator inputs can be ameliorated by inserting a capacitor (1000 to 4700pF) between the COMIN pin (pin 12) and the FIL pin (pin 11).

9. Charge Pump Circuit
Since the LV8210W has a DMOS (n-channel) output structure, it includes a charge pump based voltage step up circuit. When capacitors (recommended value : 0.22μF or higher) are connected between the CP and CPC pins, the IC generates a level that is twice the VCC voltage (or 9.5V). It is desirable that this IC be used with the voltage relationship between the stepped-up voltage (VG) and the motor supply voltage (VS) meeting the condition VG – VS ≥ 3.5V. Note that the stepped-up voltage (VG) is, by design, clamped at about 9.5V DC. If the stepped-up voltage (VG) exceeds 10V (VG max) due to ripple, the value of the VG pin capacitor must be increased.
Observe the following points if the VG voltage is supplied externally.
1) The externally applied VG voltage must not exceed VG max in the Absolute Maximum Ratings.
2) The capacitor between the CP and CPC pins (pins 5 and 6) is not required.
3) The sequence in which the VG voltage is applied requires care. The VG voltage must be applied after V_{CC}, and must be removed before V_{CC} is cut.
4) Since there is an internal diode between the V_{CC} and VG pins in the IC, a voltage such that V_{CC} > VG must never be applied to the VG pin.

10. Actuator Block
The LV8210W incorporates three H bridge channels for use as actuator drivers for the sled, focus, and tracking systems.
Hduty of OUTR and OUTF will be OUTR < OUTF when the voltage level at the IN pin is greater than VCREF.



Enlarged view of the area near VCTL = VCREF (VOFS = 33mV (reference data))



11. Notes on PCB Pattern Design

The LV8210W is a system driver IC implemented in a Bi-DMOS process; the IC chip includes bipolar circuits, MOS logic circuits, and MOS drive circuits integrated on the same chip. As a result, extreme care is required with respect to the pattern layout when designing application circuits.

(1) Ground and V_{CC}/VS wiring layout

The LV8210W ground and power supply pins are classified as follows.
Small-signal system ground pins → SGND (pin 25), TGND (pin 17)
Large-signal system ground pins → PGND1 (pin 43), PGND2 (pin 40), PGND3 (pin 35)
Small-signal system power supply pin → V_{CC} (pin 8)
Large-signal system power supply pins → VS (pin 3), VS1 (pin 44), VS2 (pin 39), VS3 (pin 33)
A capacitor must be inserted, as close as possible to the IC, between the small-signal system power supply pin (pin 8) and ground pins (pin 17, 25).
The large-signal system ground pins (PGND) must be connected with the shortest possible lines, and furthermore in a manner such that there is no shared impedance with the small-signal system ground lines. Capacitors must also be inserted, as close as possible to the IC, between the large-signal system power supply pins (VS) and the corresponding large-signal system ground pins.

(2) Positioning the small-signal system external components

The small-signal system external components that are also connected to ground must be connected to the small-signal system ground with lines that are as short as possible.

This catalog provides information as of July, 2007. Specifications and information herein are subject to change without notice.