Ordering number : ENN7189

SANYO Semiconductors

DATA SHEET

Bi-CMOS LSI

LV8206T — CD and MD System Motor Driver

Overview

The LV8206T is a motor driver system IC that integrates all the motor driver circuits required to implement CD and MD players. Since the LV8206T includes a 3-phase PWM spindle motor driver, a sled driver (3-phase stepping motor driver), and two PWM H-bridge motor driver circuits for the focus and tracking motors, it can contribute to miniaturization, thinner form factors, and lower power consumption in end products.

Direct PWM sensorless drive is adopted in the spindle and sled drivers for high-efficiency motor drive with a minimal number of external components.

Features

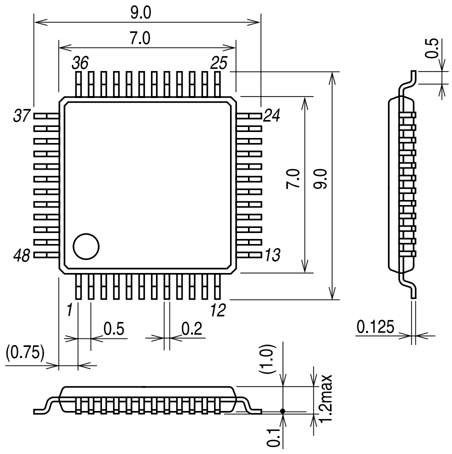
- Direct PWM drive (low side control)
- Three-phase full-wave sensorless drive (spindle block)
- Reverse torque braking (spindle block)
- Soft switching drive (spindle block)
- MOS output transistors structure
- Standby mode power saving functions
- FG output

Package Dimensions

unit: mm

3254-TQFP48

[LV8206T]



SANYO: TQFP48

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Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		5.0	V
Output block supply voltage	Vs max		4.5	V
Pre-drive voltage (Gate-voltage)	VG max		6.5	V
Output current	Io max		1.0	A
Allowable power dissipation 1	Pd max1	Independent IC	0.4	W
Allowable power dissipation 2	Pd max2	* Specified circuit board: 114.3 × 76.1 × 1.6 mm^3 Circuit board material: Glass epoxy	1.3	W
Operating temperature	Topr		–20 to +85	°C
Storage temperature	Tstg		–55 to +150	°C

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		1.9 to 4.0	V
Output block supply voltage	V_S		0 to VG – 3.0	V
Pre-drive voltage (Gate-voltage)	VG		V_S + 3 to V_S + 6.3	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 2.4 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply current 1	$I_{CC}1$	S/S: H		2.1	3.1	mA
Power supply current 2	$I_{CC}2$	S/S: L (Stand by)			20	μA
[Charge Pump Output]						
Output voltage	VG		5.5	6.0	6.3	V

Actuator Block at Ta = 25°C, V_{CC} = 2.4 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Position Detection Comparator]						
Input offset voltage	V_{AOFS}		–9		+9	mV
Common phase input voltage range	V_{ACM}		0		V_{CC}	V
High-level output voltage	V_{ACH}	I_O = –0.5 mA	V_{CC} – 0.5		V_{CC}	V
Low-level output voltage	V_{ACL}	I_O = 0.5 mA			0.5	V
[Actuator Input Pin]						
High-level input voltage range	V_{IH}		V_{CC} – 0.5		V_{CC}	V
Low-level input voltage range	V_{IL}		0		0.5	V
[Output Block]						
Output ON resistans	Ron1, 2, 3	I_O = 0.5 A, the sum of lower and upper outputs		0.8	1.2	Ω
Output delay time (H bridge)	T_{RISE}	Design target*		0.1	1.0	μs
	T_{FALL}	Design target*		0.1	0.7	μs
Minimum Input Pulse Width (H bridge)	tmin	Ch1, ch2 output pulse width ≥ 2/3 tmin Design target*	200			ns
[Mute Pin]						
High-level input voltage range	VMUH	Mute OFF	V_{CC} – 0.5		V_{CC}	V
Low-level input voltage range	VMUL	Mute ON	0		0.5	V

*: Since these values are design targets, they are not measured.

Spindle motor driver block at Ta = 25°C, V_{CC} = 2.4 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Output Block]						
Source1	Ron (H1)	I_O = 0.5 A, V_S = 1.2 V, VG = 6 V, forward TR		0.4	0.6	Ω
Source2	Ron (H2)	I_O = 0.5 A, V_S = 1.2 V, VG = 6 V, reverse TR		0.4	0.6	Ω
Sink	Ron (L)	I_O = 0.5 A, V_S = 1.2 V, VG = 6 V		0.4	0.6	Ω
Source + Sink	Ron (H+L)	I_O = 0.5 A, V_S = 1.2 V, VG = 6 V		0.8	1.2	Ω
[Position Detection Comparator]						
Input offset voltage	V_{SOFS}	Design target*	–9		+9	mV
[VCO Pin]						
VCO high-level voltage	V_{COH}		0.6	0.8	1.0	V
VCO low-level voltage	V_{COL}		0.3	0.5	0.7	V
[S/S Pin]						
High-level input voltage range	V_{SSH}	Start	V_{CC} – 0.5		V_{CC}	V
Low-level input voltage range	V_{SSL}	Stop	0		0.5	V
[Current Limiter]						
Limiter voltage	V_{RF}		0.18	0.2	0.22	V
[Break Pin]						
High-level input voltage range	V_{BRH}	Brake OFF	V_{CC} – 0.5		V_{CC}	V
Low-level input voltage range	V_{BRL}	Brake ON	0		0.5	V
[PWM Pin]						
High-level input voltage range	V_{PWMH}		V_{CC} – 0.5		V_{CC}	V
Low-level input voltage range	V_{PWML}		0		0.5	V
PWM input frequency	V_{PWMIN}				190	kHz
[CLK Pin]						
High-level input voltage range	V_{CLKH}		V_{CC} – 0.5		V_{CC}	V
Low-level input voltage range	V_{CLKL}		0		0.5	V
[FG Output Pin]						
High-level output voltage	V_{FGH}	I_O = –0.5 mA	V_{CC} – 0.5		V_{CC}	V
Low-level output voltage	V_{FGL}	I_O = 0.5 mA			0.5	V

*: Since these values are design targets, they are not measured.

Actuator Control Truth Table

Focus and Tracking Blocks

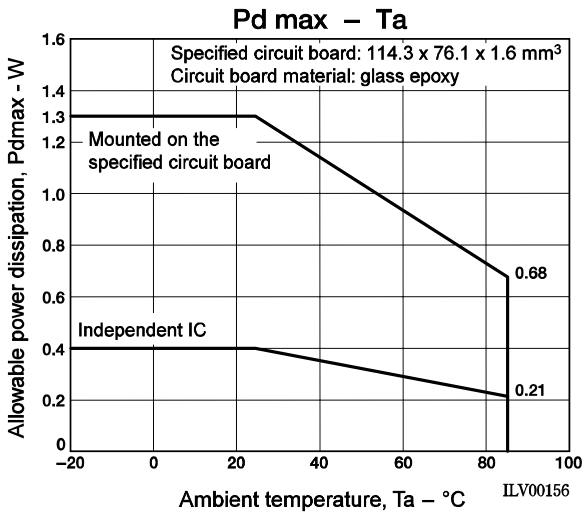
MUTE	IN1 , 2F	IN1, 2R	OUT1, 2F	OUT1, 2R
H	L	L	L	L
H	H	L	H	L
H	L	H	L	H
H	H	H	L	L
L	×	×	Z	Z

Z: Open

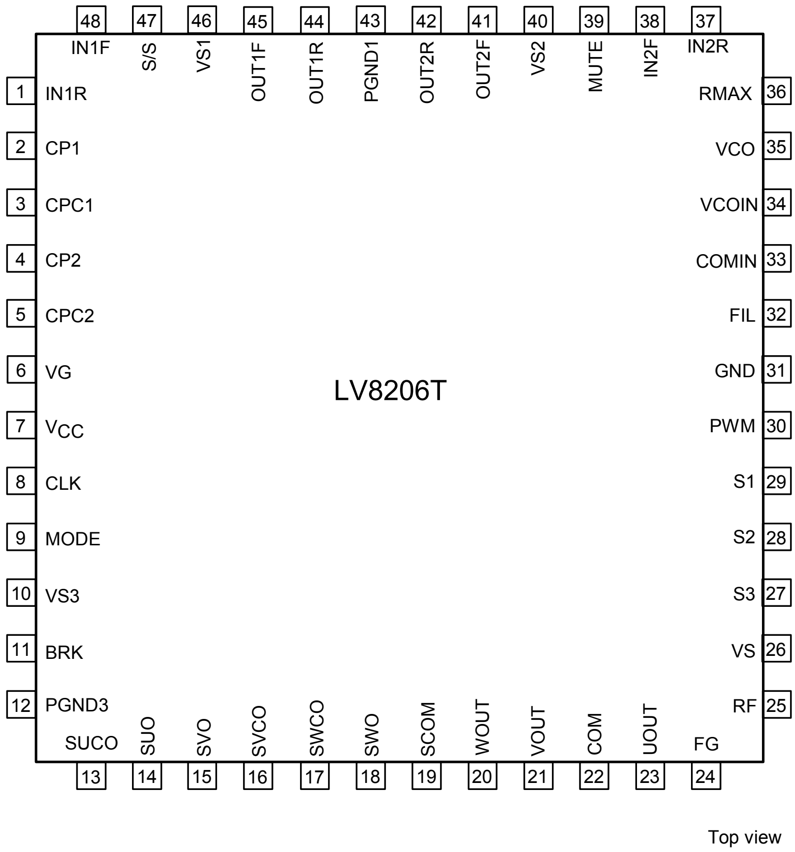
Sled Motor Stepping Block

MUTE	S1	S2	S3	SUO	SVO	SWO
H	L	L	L	H	L	Z
H	H	L	L	H	Z	L
H	L	H	L	Z	H	L
H	H	H	L	L	H	Z
H	L	L	H	L	Z	H
H	H	L	H	Z	L	H
H	L	H	H	Z	Z	Z
H	H	H	H	Z	Z	Z
L	×	×	×	Z	Z	Z

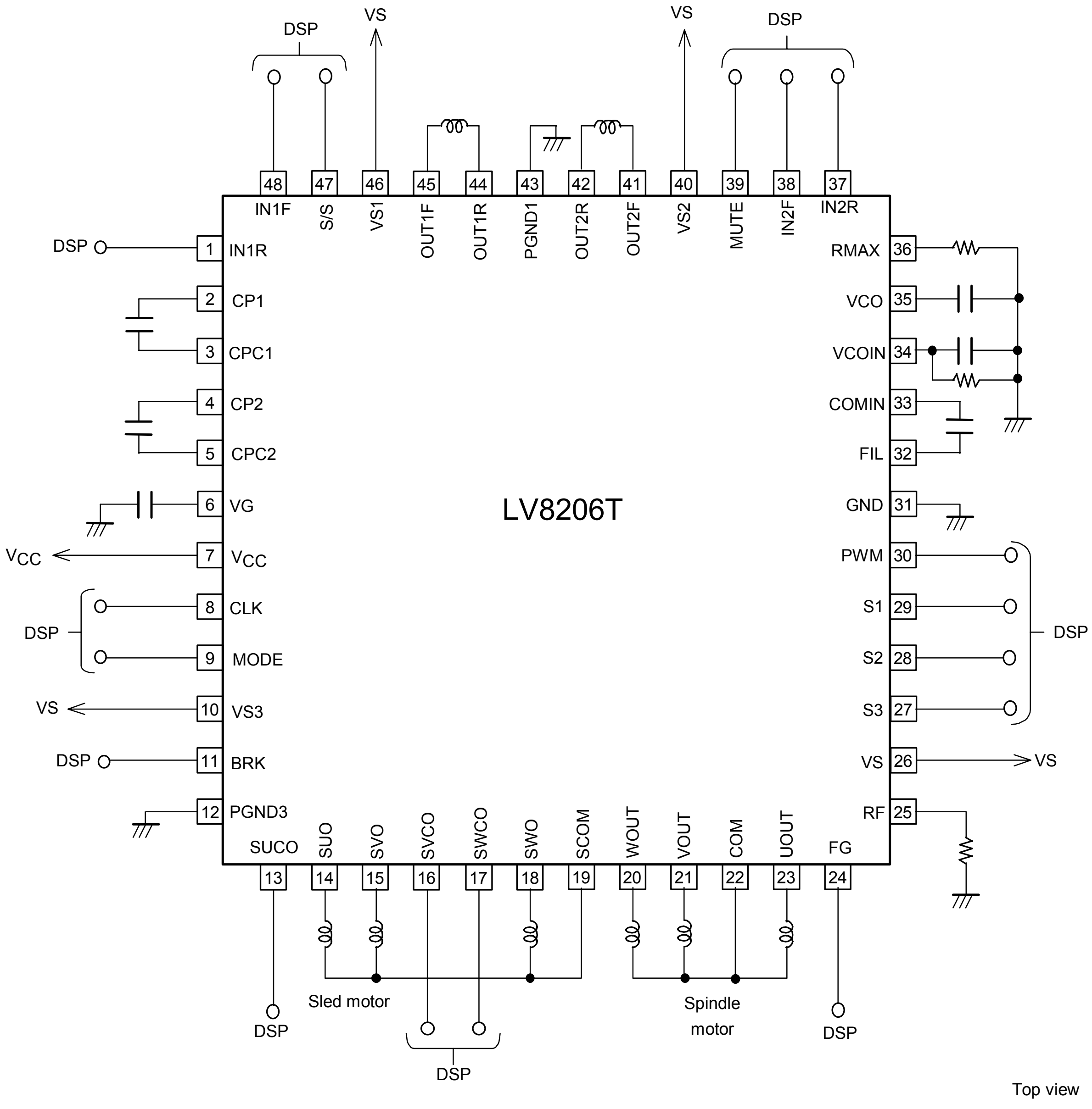
Z: Open



Pin Assignments



Test Circuit Diagram

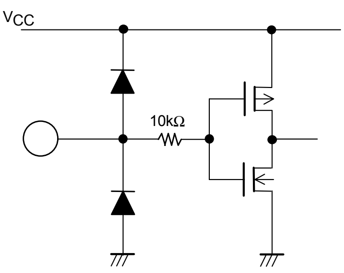
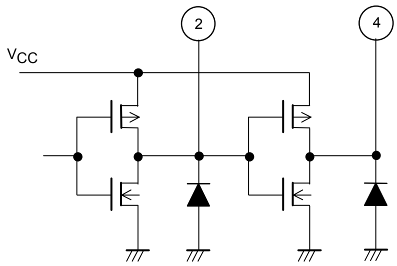
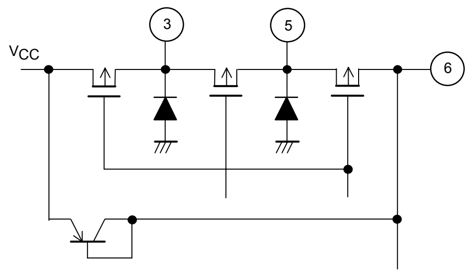


Insert capacitors between V_S and ground and between V_{CC} and ground.

Pin Functions

Pin No.	Pin Name	Function
1	IN1R	H-bridge 1 logic system reverse input
2	CP1	Charge pump stepped-up voltage pulse output. Insert a capacitor between this pin and CPC1 (pin 3).
3	CPC1	Charge pump stepped-up voltage connection. Insert a capacitor between this pin and CP1 (pin 2)
4	CP2	Charge pump stepped-up voltage pulse output. Insert a capacitor between this pin and CPC2 (pin 5).
5	CPC2	Charge pump stepped-up voltage connection. Insert a capacitor between this pin and CP2 (pin 4)
6	VG	Charge pump stepped-up voltage output. Insert a capacitor between this pin and ground.
7	V_{CC}	Small signal system power supply. Insert a capacitor between this pin and ground.
8	CLK	Logic system reference clock input. Input a signal with a frequency either 32 or 64 times that of the spindle PWN frequency.
9	MODE	PWM frequency switching input. Set this pin high if the frequency input to the CLK pin (pin 8) is 32 times the spindle PWM frequency, and set this pin low if the input frequency is 64 times the spindle PWM frequency.
10	VS3	Three-phase sled drive power supply. Insert a capacitor between this pin and ground.
11	BRK	Spindle motor block brake control. Reverse torque braking is applied when this pin is low.
12	PGND3	Sled output block ground
13	SUCO	Sled driver block position detection comparator output
14	SUO	Three-phase sled driver U phase output
15	SVO	Three-phase sled driver V phase output
16	SVCO	Sled driver block position detection comparator output
17	SWCO	Sled driver block position detection comparator output
18	SWO	Three-phase sled driver W phase output
19	SCOM	Sled driver block position detection comparator common input
20	WOUT	Three-phase spindle driver W phase output. Connect the corresponding motor coil to this pin.
21	VOUT	Three-phase spindle driver V phase output. Connect the corresponding motor coil to this pin.
22	COM	Spindle motor common point connection
23	UOUT	Three-phase spindle driver U phase output. Connect the corresponding motor coil to this pin.
24	FG	FG pulse output (MOS output). This pin outputs a pulse signal equivalent to that output when three Hall-effect sensors are used.
25	RF	Output current detection pin. The drive current is detected using the low resistance resistor inserted between this pin and ground. Connect this pin to ground if the spindle block current limiter function will not be used.
26	VS	Spindle motor drive power supply. Insert a capacitor between this pin and ground.
27	S3	Logic inputs for the 3-phase sled block. The outputs are pins 14, 15, and 18.
28	S2	
29	S1	
30	PWM	PWM signal input. The output transistors are turned on when the input is set high.
31	GND	Small signal system ground
32	FIL	Spindle motor position detection comparator filter. Insert a capacitor between this pin and COMIN (pin 33).
33	COMIN	Spindle motor position detection comparator filter. Insert a capacitor between this pin and FIL (pin 32).
34	VCOIN	VCO control voltage input. Insert a capacitor and a resistor with a high resistance in parallel 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.
35	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.
36	RMAX	VCO maximum frequency setting. When the value of the connected resistor is reduced, the VCO frequency rises.
37	IN2R	H-bridge 2 logic system reverse input
38	IN2F	H-bridge 2 logic system forward input
39	MUTE	High bridge 1, 2, and three-phase sled mute pin. When a low level is applied to this pin, the output pins for the above mentioned drivers are set to the high-impedance state.
40	VS2	H-bridge 2 motor power supply. Insert a capacitor between this pin and ground.
41	OUT2F	H-bridge 2 forward output
42	OUT2R	H-bridge 2 reverse output
43	PGND1	H-bridge 1 and 2 output block ground
44	OUT1R	H-bridge 1 reverse output
45	OUT1F	H-bridge 1 forward output
46	VS1	H-bridge motor power supply. Insert a capacitor between this pin and ground.
47	S/S	Spindle motor block start/stop pin. A high-level input: Start
48	IN1F	H-bridge 1 logic system forward input

Pin Functions

Pin No.	Pin Name	Pin description	Equivalent circuit
48, 1 38, 37	IN1± IN2±	Logic input pin of the actuator high bridge block	
8	CLK	Input clock pin of the motor drive system	
9	MODE	PWM frequency switching pin of Spindle block. Input frequency relations with the CLK (pin 8) and PWM (pin 30) are as follows. When set high: $f_{PWM}=f_{CLK}/32$ When set low: $f_{PWM}=f_{CLK}/64$	
11	BRK	Brake pin of spindle motor block. High-level input: Forward torque Low-level input: Brake	
29 28 27	S1 S2 S3	Three-phase sled logic input pin	
30	PWM	PWM signal input pin of the spindle block. The output TR turns it on by a high level input on this pin.	
39	MUTE	High bridge and three-phase sled mute pin Low-level input: Mute	
47	S/S	Spindle motor block start/stop pin. High-level input: Start	
2	CP1	Charge pump pulse output pin. A capacitor must be connected between this pin and CPC1 (pin 3). This pin must be held open when used as voltage doubler.	
4	CP2	Charge pump pulse output pin. A capacitor must be connected between this pin and CPC2 (pin 5).	
3	CPC1	Pin for charge pump. A capacitor must be connected between this pin and CP1 (pin 2).	
5	CPC2	Pin for charge pump. A capacitor must be connected between this pin and CP2 (pin 4).	
6	VG	Pin for charge pump. A capacitor must be connected between this pin and GND	
7	VCC	Power supply pin to supply to the small signal system circuit A capacitor must be connected between this pin and GND	

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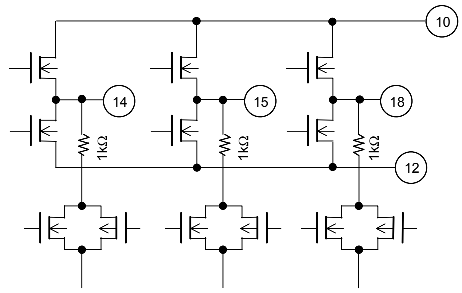
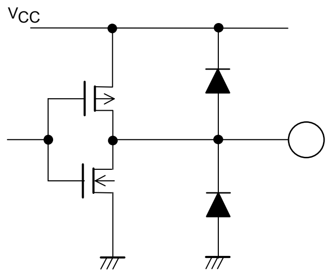
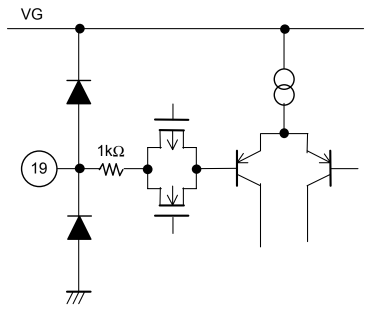
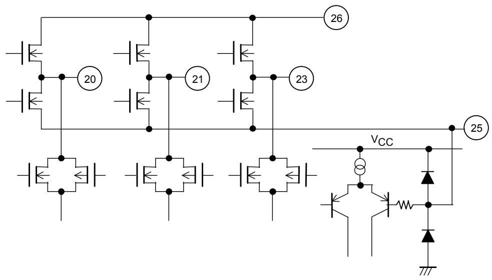
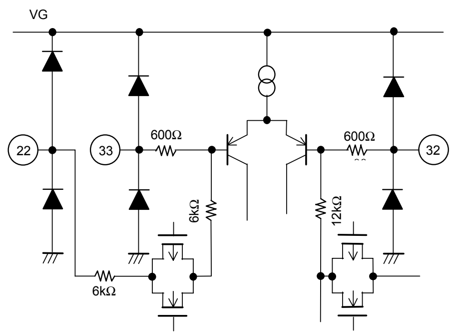
Pin No.	Pin Name	Pin description	Equivalent circuit
10	VS3	Power supply pin for sled motor driver. A capacitor must be connected between this pin and GND.	
14 15 18	SUO SVO SWO	Sled driver outputs. Connect these pins to the sled motor coils.	
12	PGND3	Sled output block ground	
13 17 18	SUCO SVCO SWCO	Sled driver block position detection comparator outputs	
24	FG	FG pulse output pin. The pulse of three hall sensor is outputted.	
19	SCOM	Three-phase sled motor common point connection	
26	VS	Power spply for spindle motor driver. A capacitor must be connected between this pin and GND.	
23 21 20	UOUT VOUT WOUT	Output pin. Connect the spindle motor coil.	
25	RF	Output current detection pin. Drive current is detected when a resistor with a small value is connected between this pin and GND.	
22	COM	Spindle motor common point connection connect to COM	
32	FIL	Waveform synthesis signal filter pin. A capacitor is connected between this pin and COMIN (pin 33).	
33	COMIN	Differential input pin of Position detection comparator. A capacitor must be connected between this pin and FIL (pin 32).	

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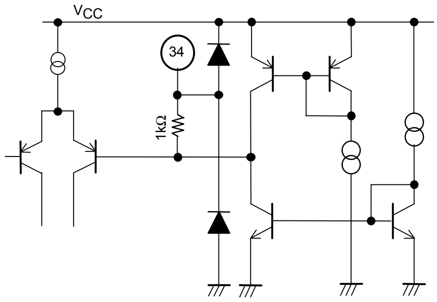
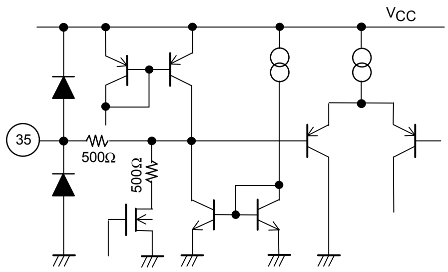
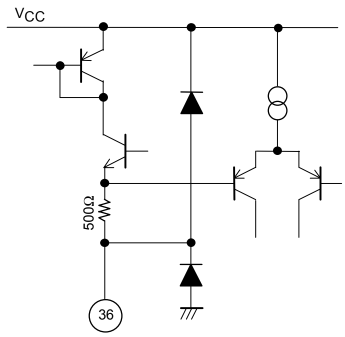
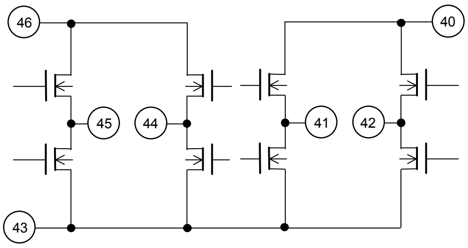
Pin No.	Pin Name	Pin description	Equivalent circuit
31	GND	GND pin of small signal system	
34	VCOIN	Pin to control the voltage of VCO pin. A capacitor must be connected between this pin and GND.	
35	VCO	Oscillation frequency of VCO pin. A capacitor must be connected between this pin and GND. The VCO oscillation frequency changes in correspondence to the spindle motor rotation speed.	
36	RMAX	Sets the maximum frequency of VCO pin. With the resistance of a resistor connected to GND reduced, the higher frequency can be set.	
46, 40 45, 44 41, 42 43	VS1/VS2 OUT1F/R OUT2F/R PGND1	H bridge block outputs Insert capacitors between VS1 (pin 46) and ground and between VS2 (pin 40) and ground.	

Functional Description and External Components

The LV8206T is a system motor driver IC that implements all the motor driver circuits required by CD and MD players in just a single IC. Since the LV8206T includes sled, focus, and tracking drivers (as H-bridge driver), it can contribute to thinner form factors in end products. Furthermore, the spindle motor driver uses a direct PWM sensorless drive method that minimizes the number of external components and provides highly efficient motor drive.

This document presents information necessary to design systems with the best possible characteristics and should be read before designing driver circuits using the LV8206T.

- Output Drive Circuits and Speed Control Methods

  The LV8206T 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-resistances: 0.8 Ω (typical))

  The spindle driver speed control system uses two signals supplied from an external DSP: the PWM and BRK signals. The PWM signal is created by the sink side transistor, and speed is controlled by switching proportional to the duty of the signal input to the PWM pin (pin 30). (The sink side transistor is on when the PWM input is high, and off when the PWM input is low.)

  This IC performs variable-duty soft switching for quieter motor operation.

- Current Limiter Circuit

  The current limiter circuit limit current is determined according to I = VRF/Rf. (VRF = 0.20 V, typical) The current limiter is activated by the peak current at the RF pin (pin 25), and turns the sink transistor off. Applications that do not use the current limiter should connect the RF pin to the power system ground.

- Notes on VCO Circuit Constant Determination

  The LV8206T spindle block adopts a sensorless drive method. In sensorless drive, the IC detects the back EMF signal generated by the motor and uses that to determine the timing with which it applies power to the motor. For this reason, it uses a VCO signal to control the timing and other aspects. We recommend the following procedure to determine the VCO circuit external component values.

  — Build a test system using components with temporary values.
  Connect a 2.2 μF capacitor and a 4.7 MΩ resister in parallel between the VCOIN pin (pin 34) and ground, a 68KΩ resistor between the RMAX pin (pin 36) and ground, and a 3300 pF capacitor between the VCO pin (pin 35) and ground.

  — Determine the optimal capacitance of the VCO pin (pin 35) capacitor.
  Select a value that gives the shortest startup time (the time until the target speed is reached) and furthermore gives the minimum variation in the startup time. If the capacitance is too large, the variation in the startup time will be excessive, and the value too small, idling may occur. Since the optimal value of the VCO pin capacitor will vary with the motor characteristics and startup current, the value of this capacitor must be verified if the type of motor used is changed or if the specifications change.

  — Determine the optimal resistance of the RMAX pin (pin 36) resistor.
  With the motor running at the maximum operating speed, select a resistance that brings the VCOIN pin voltage to about VCC - 1.0 (V) (or lower). If the resistance is too large, the VCOIN pin voltage may rise.

  — Determine the optimal capacitance of the VCOIN pin (pin 34) capacitor.
  With the motor running at the minimum operating speed, increase the value of the VCOIN capacitor if the FG output (pin 24) pulse signal is unstable.

  — Determine the value of the resistor inserted between VCOIN (pin 34) and ground.
  The LV8206T generates a VCO control voltage, which is proportional to the spindle motor speed at the VCOIN pin. In an application that implements intermittent drive using the S/S pin (and/or the MUTE pin) to save power, the VCOIN pin potential will be retained in the power saving states due to the charge stored on the capacitor. This means that a voltage discharge resistor with a large value (a few MΩ) is required for the VCOIN pin. Choose a time constant that makes the discharge time longer than the motor free-running deceleration time. Note that when determining this time constant, the discharge characteristics may be changed by an oscilloscope probe connected to the VCOIN pin, and that this may cause problems when testing prototypes. (We recommend using an FET probe.) This discharge capacitor is not required if intermittent drive (free-running deceleration) is not used.

• S/S and Mute Circuits

The S/S pin (pin 47) is the spindle driver start/stop pin; a high level selects the start state. The MUTE pin (pin 39) applies to the driver circuits other than the spindle block; a low level selects the muted state. In the muted state, the corresponding drivers (the H-bridge and 3-phase sled drivers) all go to the high-impedance state, regardless of the input logic. Since the S/S pin and the MUTE pin operate independently, both the S/S pin and the MUTE pin must be set to the low level to put the IC in full standby state (power saving mode).

• BRK Circuit

The BRK pin (pin 11) functions to reverse the direction of the spindle driver torque; a low level selects reverse torque breaking. When the motor speed becomes adequately slow by reverse torque breaking, the IC switches to the short-circuit braking state and stops the motor. (Note: The IC must not be in the power saving state at this point.)

When using the BRK pin function to stop the motor, if the timing of the switch to short-circuit braking is too early, excessive motor rotation remains, and problems occur, the value of the RMAX pin (pin 36) resistor must be reduced. Also, if motor oscillation continues when the motor is nearly stopped, and the IC does not switch to short braking mode, 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.)

• The CLK and PWM Signals

The LV8206T CLK pin (pin 8) signal is used as the sensorless logic reference clock, for voltage step-up pulses, and for other purposes. Therefore, it must be provided at all times the IC is in the start state. The CLK input signal must be either 32 or 64 times the frequency of the PWM input signal. The MODE pin (pin 9) selects the relationship between the CLK and PWM pin frequencies; a low level on the MODE pin (pin 9) selects 64× input, a high level on the MODE pin (pin 9) selects 32× input. We recommend that the CLK input frequency be less than 6 MHz.

• FG Output Circuit

The FG pin (pin 24) is the spindle block FG output pin. It provides a pulse signal equivalent to that provided by systems that use three Hall-effect sensors. This output has a MOS circuit structure.

• Spindle Block Position Sensor Comparator Circuit

The spindle block position sensor comparator circuit uses the back EMF 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 4700 pF) between the COMIN pin (pin 33) and the FIL pin (pin 32). Note that if the value of this capacitor is too large, the output current application timing may be delayed at higher motor speeds and efficiency may be degraded.

• Charge Pump Circuit

Since the LV8206T has a DMOS (n-channel) output structure, it includes a charge pump based voltage step-up circuit. A voltage multiplied by a factor of three (or a voltage of about 6.0 V) can be acquired by connecting capacitors between the CP1 and CPC1 pins and between the CP2 and CPC2 pins. 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 ≥ 3.0 V. Note that the IC is designed so that the stepped up voltage (VG) is clamped at about 6.0 VDC. If the stepped-up voltage (VG) exceeds 6.5 V (VGmax) due to ripple or other cause, the value of the VG pin capacitor must be increased.

Observe the following points if the VG voltage is supplied externally.

— The externally applied VG voltage must not exceed VGmax in the Absolute Maximum Ratings.
— The capacitor between the CP1 and CPC1 pins (pins 2 and 3), and the capacitor between the CP2 and CPC2 pins (pins 4 and 5) are not required.
— The sequence in which the VG voltage is applied requires care. The VG voltage must be applied after VCC, and must be removed before VCC is cut off.
— Since there is an internal diode between the VCC and VG pins in the IC, a voltage such that VCC > VG must never be applied to the VG pin.

- Three-Phase Sled Driver

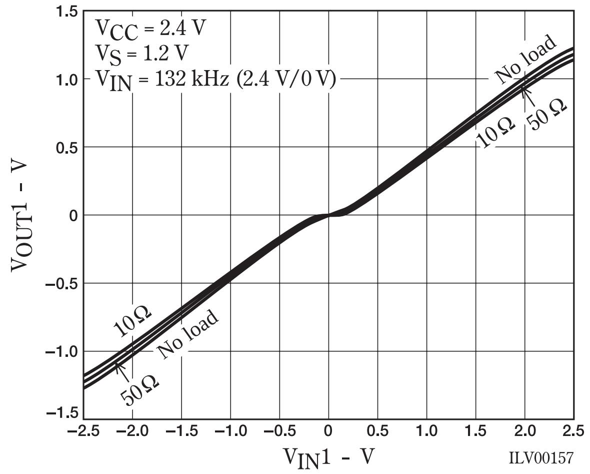
  This driver is designed for sled motor drive. The SUC0 to SWC0 pins (pins 13, 16, and 17) are the sled driver position detection comparator output pins, and are MOS outputs. These pins are used to feed back the sled motor speed information (position information) to the DSP or microcontroller. The S1 to S3 pins (pins 29, 28, and 27, respectively) are the sled driver logic inputs, and are connected to the DSP. These pins have built-in pull-up resistors.

- Actuator Block

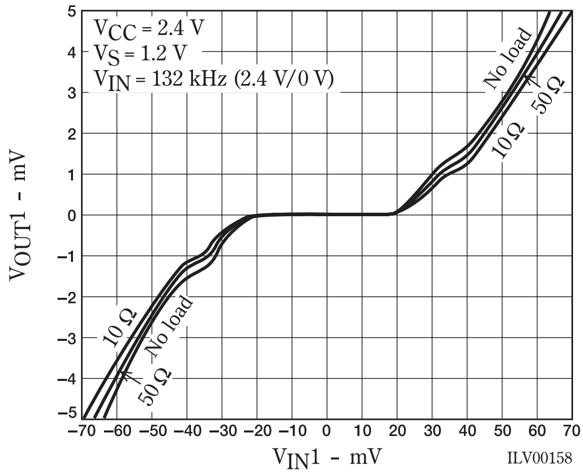
  The LV8206T provides two H-bridge driver channels as actuator drivers for the focus and tracking systems. The logic input pins have built-in pull-down resistors. PWM is used for actuator control, and synchronous commutation is supported.

  The figures below present reference data related to the dead band during control.

Actuator Infinitesimal Signal I/O Characteristics



Actuator Extremely Small Signal I/O Characteristics



- Notes on PCB Pattern Design

  The LV8206T is a system driver IC fabricated in a BI-DCMOS process, and includes bipolar circuits, MOS logic circuits, and MOS driver circuits on a single chip. This means that ground leading and sneak currents must be considered during application circuit design.

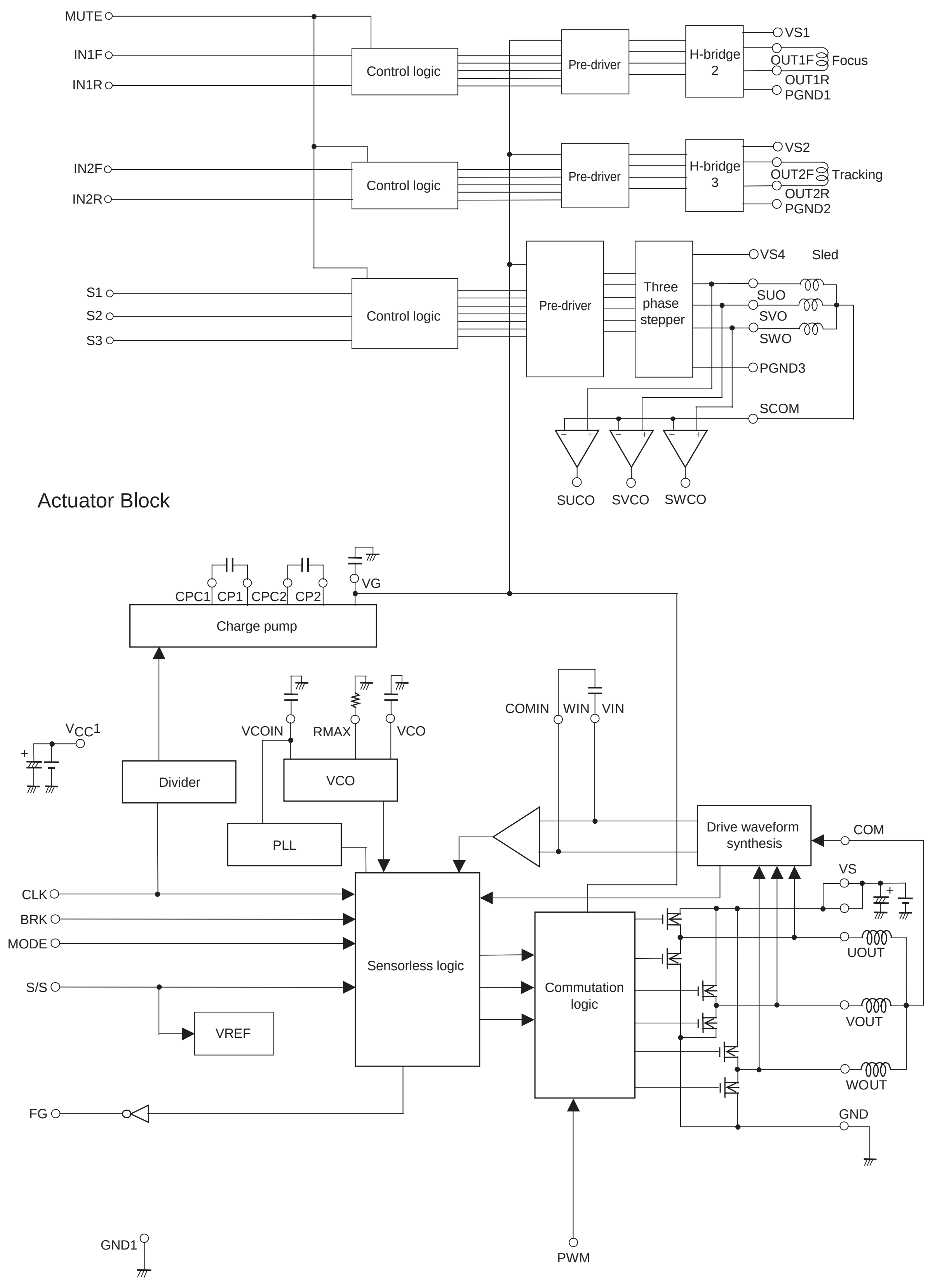
  — Ground and VCC/VS lines

  The LV8206T ground and power supply pins are classified as follows.
  Small-signal system ground pins → GND (pin 31)
  Large-signal system ground pins → PGND1 (pin 43), PGND3 (pin 12)
  Small-signal system power supply pins → VCC (pin 7)
  Large-signal system power supply pins → VS (pin 26), VS1 (pin 46), VS2 (pin 40), and VS3 (pin 10)
  Capacitors must be inserted between the small-signal system power supply pin (pin 7) and ground pin (pins 31). Locate these capacitors as close to the IC as possible.
  The large-signal system ground (PGND) pins must be connected with the shortest distances possible, and furthermore must not have any shared impedances with the small-signal system ground lines. The large-signal system power supply (VS) pins must also be connected with the shortest distances possible, and capacitors must be inserted between these pins and the corresponding large-signal system ground pin. Locate these capacitors as close to the IC as possible.

  — Location of small-signal system external components

  Of the small-signal system external components, those that are connected to ground must be connected to the small-signal system ground with the shortest possible lines.

Block Diagram



Spindle Motor Driver Block