



SANYO Semiconductors

DATA SHEET

LV8212T — Bi-CMOS IC For CD and DVD-ROM System Motor Driver

Overview

The LV8212T is a system motor driver IC that implements all the motor driver circuits required by CD and DVD players in just a single IC. Since the LV8212T includes both a spindle motor driver and sled, tilt, focus and tracking drivers (as two-phase stepper method), it can contribute to thinner form factors and miniaturization in end products.

Furthermore, the spindle motor driver uses a direct PWM sensor-less drive method that minimizes the number of external components and provides highly efficient motor drive.

Function

- PWM H-bridge motor driver (5channels) + direct PWM sensor-less motor driver

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V_{CC} max		6	V
Output block supply voltage	V_S max		6	V
Predriver voltage (gate voltage)	V_G max		10	V
Spindle output current	I_O max1		1.3	A
Channel 1 and 2 output current	I_O max2		0.8	A
Channel 3 output current	I_O max3		0.6	A
Channel 4 and 5 output current	I_O max4		0.8	A
Allowable power dissipation	P_d max	Independent IC	0.45	W
Operating temperature	T_{opr}		-30 to +85	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

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Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V _{CC}		3.3 to 5.5	V
Output block supply voltage	V _S		0 to V _{CC}	V
Predriver voltage (gate voltage)	V _G		V _S +3.5 to 9.8	V

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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain 1	I _{CC1}	S/S pin : High		5	9	mA
Current drain 2	I _{CC2}	S/S pin : Low (standby mode)			20	μA
Charge pump output						
Output voltage	V _{CP}			9.5	9.8	V
Control reference voltage						
Control reference voltage range	SREF		1.25		2	V
Internal oscillator circuit						
Internal oscillation frequency	OSC1		2.6	3.2	4.0	MHz
Thermal protection circuit						
Thermal protection circuit operating temperature	TSD	Design target value	150	180		°C
Temperature hysteresis width	ΔTSD	Design target value		25		°C
S/S pin						
High level input voltage range	V _{SSH}	Start	2.7		V _{CC}	V
Low level input voltage range	V _{SSL}	Stop	0		0.6	V
MUTE pin						
High level input voltage range	V _{MUH}	OUT3F pin and OUT3R pin of channel 3 are OPEN	2.7		V _{CC}	V
Low level input voltage range	V _{MUL}		0		0.6	V

Actuator block : (channel 1, 2, and 3) at Ta=25°C and V_{CC} = 5V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Control						
Output offset voltage	VOFS	AREF = IN1, 2, 3 = 1.65V	-60		+60	mV
Actuator input pin						
Input voltage range	V _{IN}	AREF = 1.65V	0		3.3	V
Current feedback output pin						
Source	ISO		30	40	50	μA
Sink	ISI		30	40	50	μA
Output block						
Channel 1, 2 output ON resistance	R _{on1, 2}	I _O = 0.5A, sum of the low and high side outputs		1.1	1.5	Ω
Channel 3 output ON resistance	R _{on3}	I _O = 0.5A, sum of the low and high side outputs		1.5	1.8	Ω
Internal oscillator circuit (triangular wave)						
Oscillation frequency	OSC2	AREF = 1.65V	170	200	230	kHz

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Actuator block : (channel 4 and 5) at Ta=25°C and V_{CC} = 5V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Actuator input pin						
Input voltage range	V _{IN}	AREF = 1.65V	0		3.3	V
Output block						
Channel 4 and 5 output ON resistance	R _{on4, 5}	I _O = 0.5A, sum of the low and high side outputs		1.3	1.6	Ω
Current control circuit						
Forward drive gain	GDF ⁺	(RF = 0.2Ω)	0.15 (0.75)	0.17 (0.85)	0.185 (0.925)	V/V (A/V)
Reverse drive gain	GDF ⁻	(RF = 0.2Ω)	0.15 (0.75)	0.17 (0.85)	0.185 (0.925)	V/V (A/V)
Dead band width	VDZ	AREF = 1.65V	±25	±75	±95	mV
Limiter voltage	VR _f		0.17	0.20	0.23	V

Spindle motor driver block : at Ta=25°C and V_{CC} = 5V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output block						
Source 1	R _{on} (H)	I _O = 0.5A, VS = 5V, VG = 9.5V		0.25	0.40	Ω
Sink	R _{on} (L)	I _O = 0.5A, VS = 5V, VG = 9.5V		0.25	0.40	Ω
Source+Sink	R _{on} (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 value V _{CC} = 5.0V, VCOM = 2.5V	-5		5	mV
Control						
VCTL input voltage range	VCTL	SREF = 1.65V	0		3.3	V
GSW pin (gain change)						
High level input voltage range	V _{GSWH}	Change to 1/2 gain (gain 2)	2.7		V _{CC}	V
Low level input voltage range	V _{GSWL}	Normally control GAIN (gain 1)	0		0.6	V
Current control circuit						
Forward drive gain 1	GDF ⁺¹	GSW = L (RF = 0.2Ω)	0.30 (1.50)	0.34 (1.70)	0.37 (1.85)	V/V (A/V)
Forward drive gain 2	GDF ⁺²	GSW = H (RF = 0.2Ω)	0.15 (0.75)	0.17 (0.85)	0.185 (0.925)	V/V (A/V)
Reverse drive gain 1	GDF ⁻¹	GSW = L (RF = 0.2Ω)	0.30 (1.50)	0.34 (1.70)	0.37 (1.85)	V/V (A/V)
Reverse drive gain 2	GDF ⁻²	GSW = H (RF = 0.2Ω)	0.15 (0.75)	0.17 (0.85)	0.185 (0.925)	V/V (A/V)
Dead band width 1	V _{DZ1}	GSW = L SREF = 1.65V	±15	±45	±75	mV
Dead band width 2	V _{DZ2}	GSW = H SREF = 1.65V	±20	±55	±85	mV
Limiter voltage	VR _f		0.17	0.20	0.23	V
OSC pin						
High level input voltage range	OSCH		0.9	1.0	1.2	V
Low level input voltage range	OSCL		0.4	0.6	0.8	V
BRK SEL pin						
High level input voltage range	V _{BRH}	Short brake	2.7		V _{CC}	V
Low level input voltage range	V _{BRL}	Reverse torque brake	0		0.6	V
FG1 output and FG3 output pin						
Low level output voltage	V _{FGL}	I _O = 0.5mA	0		0.5	V

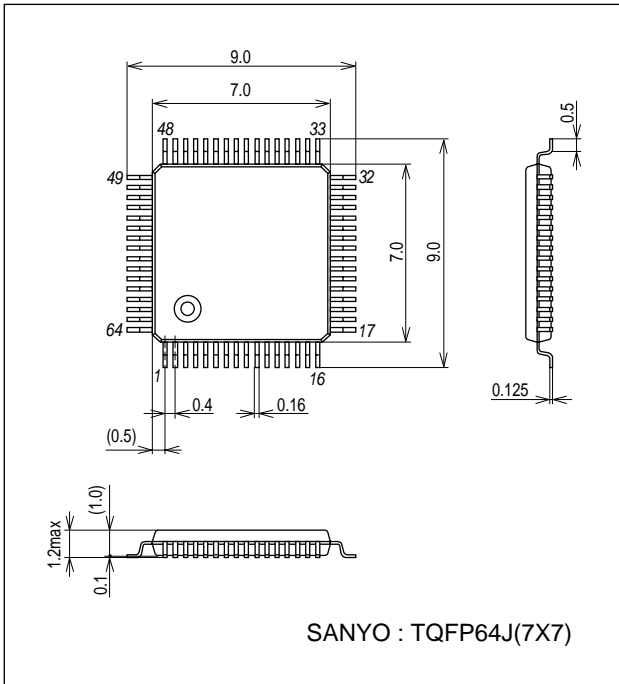
*Design target value : Item specified to be a design target in the conditions column are not measured.

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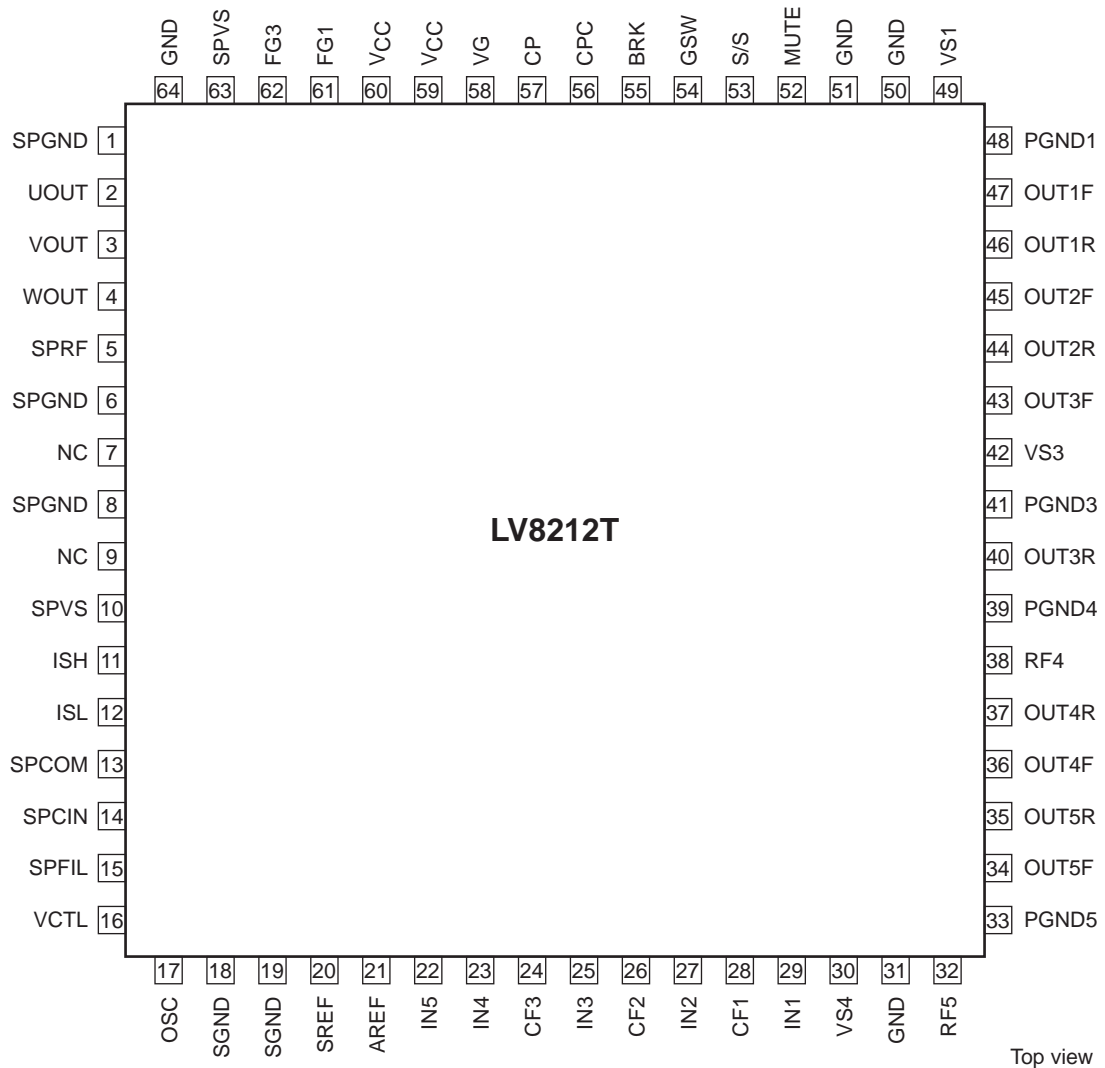
Package Dimensions

unit : mm (typ)

3289



Pin Assignment



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Spindle and Actuator Control Truth Table

S/S	MUTE	spindle	H-bridge1	H-bridge2	H-bridge3	H-bridge4	H-bridge5
H	L	Active	Active	Active	Active	Active	Active
H	H	Mute	Mute	Mute	Mute	Active	Active
L	*	Mute	Mute	Mute	Mute	Mute	Mute

Pin Descriptions

Pin No.	Pin name	Description
1, 6, 8	SPGND	Spindle output current detection pin. The drive current is detected by connecting low resistance to GND.
2	UOUT	3-phase spindle U-phase output pin. Motor coil is connected to this pin.
3	VOUT	3-phase spindle V-phase output pin. Motor coil is connected to this pin.
4	WOUT	3-phase spindle W-phase output pin. Motor coil is connected to this pin.
5	SPRF	Detection signal input pin of spindle output current. This pin must be used shorted to the SPGND pin.
7, 9	NC	
10, 63	SPVS	Power supply pin for spindle driver. Connect a capacitor between this pin and GND.
11	ISH	
12	ISL	
13	SPCOM	Spindle motor COM point connection.
14	SPCIN	Spindle motor position detection comparator filter pin. Connect a capacitor between this pin and SPFIL pin (pin 15).
15	SPFIL	Spindle motor position detection comparator filter pin. Connect a capacitor between this pin and SPCIN pin (pin 14).
16	VCCTL	Spindle speed control pin. Positive torque control is applied when greater than VCREP.
17	OSC	Motor start-up oscillation frequency alternative pin. If this pin is connected to GND or the V _{CC} pin, start-up oscillation select the internal oscillation dividing signal. When a capacitor connect between this pin and GND pin, the start-up frequency is adjusted by charge and discharge current (2.5μA) and capacitance of capacity.
18, 19	SGND	Small signal GND pin.
20	SREF	Spindle control reference voltage input pin.
21	AREF	Control reference voltage input pin of channel 4 and 5 actuator.
22	IN5	Speed control pin of the channel 5 actuator.
23	IN4	Speed control pin of the channel 4 actuator.
24	CF3	Current feedback circuit output pin of the channel 3 actuator (H-bridge).
25	IN3	Control signal input pin of the channel 3 actuator (H-bridge).
26	CF2	Current feedback circuit output pin of the channel 2 actuator (H-bridge).
27	IN2	Control signal input pin of the channel 2 actuator (H-bridge).
28	CF1	Current feedback circuit output pin of the channel 1 actuator (H-bridge).
29	IN1	Control signal input pin of the channel 1 actuator (H-bridge).
30	VS4	Power supply pin for the channel 4 and 5 of the actuator. Connect a capacitor between this pin and GND.
31	GND	Ground
32	RF5	Output current detection signal input of the channel 5 actuator. This pin must be used shorted to the PGND5 pin. (pin 33)
33	PGND5	Output current detection pin of the channel 5 actuator. The drive current is detected by connecting low resistance to GND
34	OUT5F	H-bridge output of the channel 5 actuator.
35	OUT5R	
36	OUT4F	H-bridge output of the channel 4 actuator.
37	OUT4R	
38	RF4	Output current detection signal input pin of the channel 4 actuator. This pin must be used shorted to the PGND4 pin (pin 39).
39	PGND4	Output current detection pin of the channel 4 actuator. The drive current is detected by connecting low resistance to GND
40	OUT3R	Output pin of the channel 3 actuator.
41	PGND3	GND pin of the output block of the channel 3 actuator.
42	VS3	Power supply pin for drive of the channel 3 actuator. Connect a capacitor between this and GND.
43	OUT3F	Channel 3 actuator output pin
44	OUT2R	Channel 2 actuator output pin.
45	OUT2F	
46	OUT1R	Channel 1 actuator output pin.
47	OUT1F	

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Pin No.	Pin name	Description
48	PGND1	GND pin of the output block of the channel 1, 2 actuator.
49	VS1	Power supply pin for drive of the channel 1 and 2 actuator. Connect a capacitor between this and GND.
50, 51	GND	Small signal GND pin. Sled driver block position detection comparator output pin.
52	MUTE	MUTE pin except for channels 4 and 5. The output pin, except for channels 4 and 5, must be left open.
53	S/S	Spindle motor block start/stop control. Apply a high level for the start state.
54	GSW	Spindle motor V type control GAIN switching pin.
55	BRK	Spindle motor block braking type switching control. Low level : reverse torque braking.
56	CPC	Used for charge pump voltage step up. Connect a capacitor between this and the CP pin (pin.57).
57	CP	Charge pump voltage step up pulse output. Connect a capacitor between this pin and CPC pin (pin.56)
58	VG	Charge pump voltage step up output. Connect a capacitor between this pin and GND.
59, 60	V _{CC}	Small signal system power supply pin. Connect a capacitor between this pin and GND.
61	FG1	FG pulse output pin (MOS open drain output). Outputs a pulse signal equivalent to a one Hall sensor system pulse out put.
62	FG3	FG pulse output pin (MOS open drain output). Outputs a pulse signal equivalent to a three Hall sensor system pulse out put.
64	GND	Small signal GND pin.

Pin Functions

Pin No.	Pin name	Function	Equivalent circuit
10, 63	SPVS	Power supply pin for spindle driver. Connect a capacitor between this pin and GND	
2	UOUT	3-phase spindle output pin. Motor coil is connected to this pin.	
3	VOUT	U-phase : Pin 2 V-phase : Pin 3	
4	WOUT	U-phase : Pin 2 V-phase : Pin 3 W-phase : Pin 4	
1, 6, 8	SPGND	Spindle output current detection pin. The drive current is detected by connecting low resistance to GND.	
5	SPRF	Detection signal input pin of spindle output current. This pin must be used shorted to the SPGND pin.	
11	ISH		
12	ISL		
13	SPCOM	Spindle motor COM point connection.	
14	SPCIN	Spindle motor position detection comparator filter pin. Connect a capacitor between this pin and SPFIL pin (pin 15).	
15	SPFIL	Spindle motor position detection comparator filter pin. Connect a capacitor between this pin and SPCIN pin (pin 14).	
17	OSC	Motor start-up oscillation frequency alternative pin. If this pin is connected to GND or the V _{CC} pin, start-up oscillation select the internal oscillation dividing signal. When a capacitor connect between this pin and GND pin, the start-up frequency is adjusted by charge and discharge current (2.5μA) and capacitance of capacity.	
18, 19	SPGND	Small signal GND pin.	

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Pin No.	Pin name	Function	Equivalent circuit
16	VCTL	Spindle speed control pin. Positive torque control is applied when greater than VCREF.	
20	SREF	Spindle control reference voltage input pin.	
21	AREF	Control reference voltage input pin of channel 4 and 5 actuator.	
22	IN5	Speed control pin of the channel 5 actuator.	
23	IN4	Speed control pin of the channel 4 actuator.	
24	CF3	Current feedback circuit output pin of the channel 3 actuator (H-bridge).	
26	CF2	Current feedback circuit output pin of the channel 2 actuator (H-bridge).	
28	CF1	Current feedback circuit output pin of the channel 1 actuator (H-bridge).	
25	IN3	Control signal input pin of the channel 3 actuator (H-bridge).	
27	IN2	Control signal input pin of the channel 2 actuator (H-bridge).	
29	IN1	Control signal input pin of the channel 1 actuator (H-bridge).	
31, 50 51, 64	GND	Small signal GND pin. Sled driver block position detection comparator output pin.	
30	VS4	Power supply pin for the channel 3 and 4 of the actuator. Connect a capacitor between this pin and GND.	
32	RF5	Output current detection signal input of the channel 5 actuator. This pin must be used shorted to the PGND4 pin. (pin 33)	
33	PGND5	Output current detection pin of the channel 5 actuator. The drive current is detected by connecting low resistance to GND.	
34,35	OUT5F/R	H-bridge output of the channel 5 actuator.	
36, 37	OUT4F/R	H-bridge output of the channel 4 actuator.	
38	RF4	Output current detection signal input pin of the channel 4 actuator. This pin must be used shorted to the PGND4 pin (pin 39).	
39	PGND4	Output current detection pin of the channel 4 actuator. The drive current is detected by connecting low resistance to GND.	
42	VS3	Power supply pin for drive of the channel 3 actuator. Connect a capacitor between this and GND.	
49	VS1	Power supply pin for drive of the channel 1 and 2 actuator. Connect a capacitor between this and GND.	
40, 43	OUT3R/F	Output pin of the channel 3 actuator.	
44, 45	OUT2R/F	Output pin of the channel 2 actuator.	
46, 47	OUT1R/F	Output pin of the channel 1 actuator.	
41	PGND3	GND pin of the output block of the channel 3 actuator.	
48	PGND1	GND pin of the output block of the channel 1 and 2 actuator.	

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Pin No.	Pin name	Function	Equivalent circuit
52	MUTE	MUTE pin except for channels 4 and 5. The output pin, except for channels 4 and 5, must be left open.	
53	SS	Spindle motor block start/stop control. Apply a high level for the start state.	
54	GSW	Spindle motor V type control GAIN switching pin.	
55	BRK	Spindle motor block braking type switching control. Low level : reverse torque braking	
56	CPC	Used for charge pump voltage step up. Connect a capacitor between this and the CP pin (pin 57).	
57	CP	Charge pump voltage step up pulse output. Connect a capacitor between this pin and CPC pin (pin 56)	
58	VG	Charge pump voltage step up output. Connect a capacitor between this pin and GND.	
59, 60	V _{CC}	Small signal system power supply pin. Connect a capacitor between this pin and GND.	
61	FG1	FG pulse output pin (MOS open drain output). Outputs a pulse signal equivalent to a one Hall sensor system pulse out put.	
62	FG3	FG pulse output pin (MOS open drain output). Outputs a pulse signal equivalent to a three Hall sensor system pulse out put.	

LV8212T Functional Description and External Components

This document presents information necessary to design systems with the best possible characteristics and should be read before designing driver circuits using the LV8212T.

1. Output Drive Circuits and Speed Control Methods

The LV8212T 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 devices on-resistance is 0.5Ω (typical)).

The LV8212T spindle drivers control system takes an analog input and uses a V-type control amplifier.

The gain of V-type control circuit can be selected by the following formula with the GSW pin (pin 54).

$$\text{typ} = 0.34\text{V/V (when the GSW pin is low)}$$

$$\text{and typ} = 0.17\text{V/V (when the GSW pin is high).}$$

The V-type control amplifier based speed control system controls the speed by controlling the voltage of the VCTL pin (pin 16) and SREF pin (pin 20). The circuit provides forward torque when VCTL is greater than VCREF, and allows the application to select either reverse torque braking (when the BRK pin is low) or short-circuit braking (when the BRK pin is low) when VCTL is less than VCREF. The PWM frequency is twice the frequency of the charge pump pulse rate (pin 57).

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 $I = \text{VRF}/R_f$ (here, VRF = 0.20V, typical).

Spindle block : the current limiter circuit detects the SPGND pin (pin 1, 6 and 8) peak current at the SPRF pin (pin 5) and turns the sink side transistor off.

4. OSC circuit

The OSC pin (pin 17) is an oscillation terminal for start-up current commutation of sensor-less, it has two types, the main-clock dividing mode, and the self-excited oscillation mode. The main-clock dividing mode can be set-up by connecting the OSC pin to the VCC pin or GND. The set-up frequency is divided by internal oscillation frequency (here, 3.2 MHz as typical). And, when the OSC pin is connected to the VCC pin (high level), the main-clock divided by 4096 to get ground 781Hz.

Also, when the OSC pin is connected to GND, the main-clock is divided by 3072 to get around 1042Hz.

The self-excited oscillation mode can be set up by connecting a capacitor between the OSC pin and GND.

When the self-excited oscillation mode is chosen, the OSC pin starts self-excited.

Thus, it becomes set-up frequency. Oscillation frequency can be adjusted by changing the capacity of an external capacitor. (ex, if capacity is made small, the set-up frequency will become high.)

When the OSC pin is connected to the VCC pin or GND, and if there is no problem in the start-up characteristic, the number of external components are reduced. However, if a problem occurs in it, you should choose the value of a capacitor which can obtain the best start-up characteristic after choosing self-excited mode.

5. 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. Start-up problems due to noise on the comparator inputs can be ameliorated by inserting a capacitor (1000 of 4700pF) between the SPCIN pin (pin 14) and the SPFIL pin (pin 15).

6. Actuator Block (channel 4 and 5) Output Drive Circuit and Speed Control Method

This IC adopts a synchronous commutation direct PWM drive method. Low on-resistance DMOS devices are used as the output transistors. (the upper and lower side output block devices on-resistance is 1.3Ω (typical)).

This circuit takes an analog input and uses a V-type control amplifier. The V-type control amplifier based speed control system controls the speed by controlling the voltage of the IN4 pin (pin 23 : channel 4), the IN5 pin (pin 22 : channel 5) and the AREF pin (pin 21).

7. Actuator Block (channel 4 and 5) Current Limiter Circuit

Actuator block : the current limiter circuit detects the PGND4 pin (pin 39 : channel 4) and the PGND5 pin (pin 33 : channel 5) peak current at the RF4 pin (pin 38 : channel 4) and the RF5 pin (pin 32 : channel 5) and turns the SINK side transistor off.

8. S/S and MUTE Circuit

The S/S pin (pin 53) 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 52) operates in all the driver blocks except for channels 4 and 5 ; a high-level input mutes these outputs.

In the muted state, the H-bridge drivers will shift to high-impedance state, regardless of the logic input conditions for the spindle motor driver, if mute is activated while the motor is active, the motor will slow down as set by the BRK pin (High means a short brake, Low means a reverse torque brake). After the motor stops, all the outputs will become high (short brake condition).

A low level input must be applied to the S/S pin to set the IC to the standby state (power saving mode).

9. BRK Circuit

The BRK pin (pin 55) switches between reverse torque and short-circuit braking ; a high level selects short-circuit braking and a low level selects reverse torque braking. 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.).

Set the S/S pin (pin 53) to the low level to put the IC in power saving state.

10. FG Output Circuit

The FG3 pin (pin 62) 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 61) 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 10k Ω .

11. Charge Pump Circuit

Since the LV8212T has a DMOS (n-channel) output structure, it includes a charge pump based voltage step-up circuit. When capacitors (recommended value : 0.22 μ F or higher) are connected between the CP and CPC pins, the IC generates a level that is twice the V_{CC} 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 $VG-VS \geq 3.5V$. 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 the CPC pin (pin 57 and 56) 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.

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12. Notes on PCB Pattern Design

The LV8212T is a system driver IC fabricated in a BI-DCMOS process, and includes bipolar circuits, MOS logic circuits, and MOS driver circuits on the same chip. This means that ground leading and sneak currents must be considered during application circuit design.

(1) Ground and V_{CC}/V_S lines.

The LV8212T ground and power supply pins are classified as follows.

Small-signal system ground pins → SGND (pin 18 and 19).

Large-signal system ground pins → PGND1 (pin 48), PGND3 (pin 41) and GND (pin 31 and 64).

Small-signal system power supply pins → V_{CC} (pin 59 and 60).

Large-signal system power supply pins → SPVS (pin 10 and 63), VS1 (pin 49), VS3 (pin 42) and VS4 (pin 38).

Capacitors must be connected between the small-signal system power supply pin and GND. Locate these capacitors as close to the IC as possible.

The large-signal system GND (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.

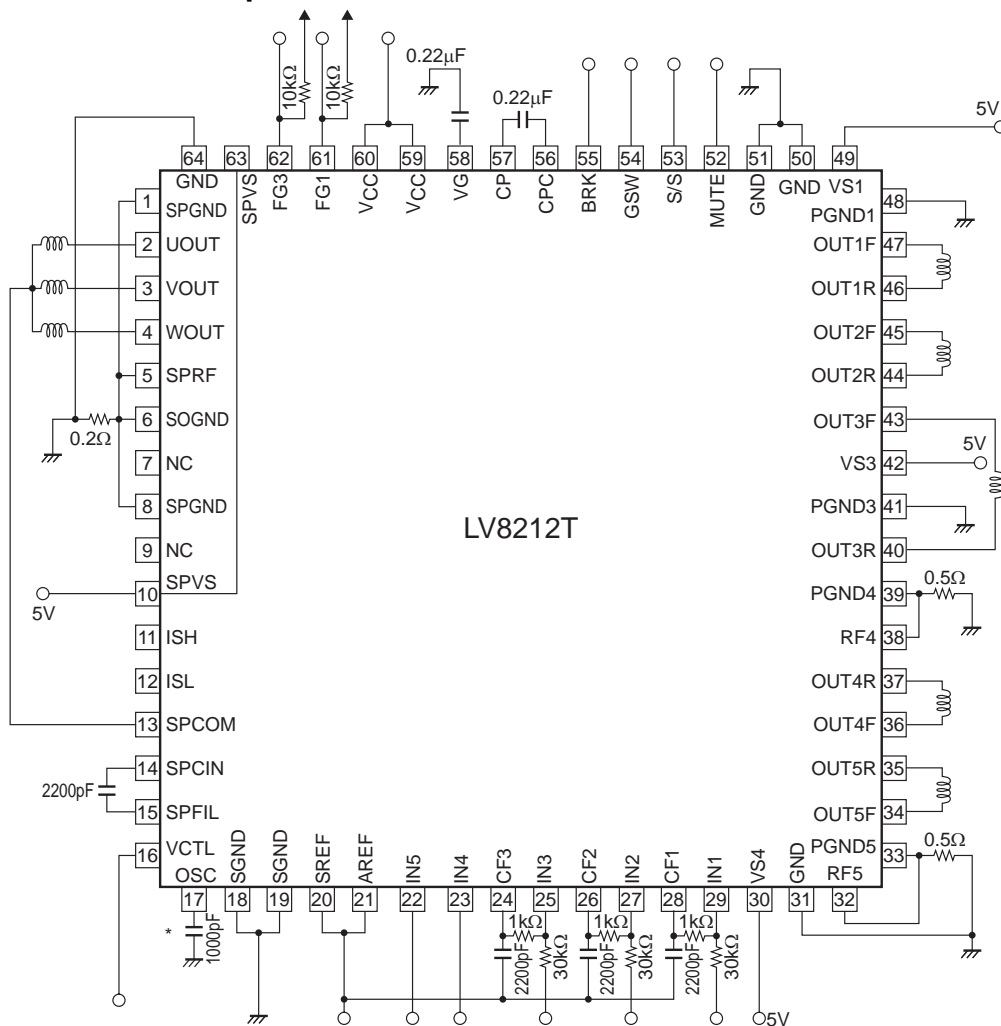
The large signal system power supply (VS) pins must also be connected with the shortest distances possible, and capacitors must be connected between these pins and the corresponding large-signal system ground pin.

Locate these capacitors as close to the IC as possible.

(2) 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.

Application Circuit Example



Remarks : Connect a capacitor the terminals SPVS and GND, the terminals V_{CC} and GND, the terminals VS1 and GND, the terminals VS3 and GND and the terminals VS4 and GND.

* When the motor start up oscillation frequency is adjusted, a capacitor is connected at the outer side of the OSC pin.

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