Ordering number : EN5791

Monolithic Linear IC

LA6503

CD-ROM Drive Spindle Motor Driver + Sled Motor Driver + Sled Motion/Position Detector IC

Overview

The LA6503 was developed for CAV control CD-ROM drives, and provides spindle motor driver, sled motor driver, and sled motion/position detection circuits.

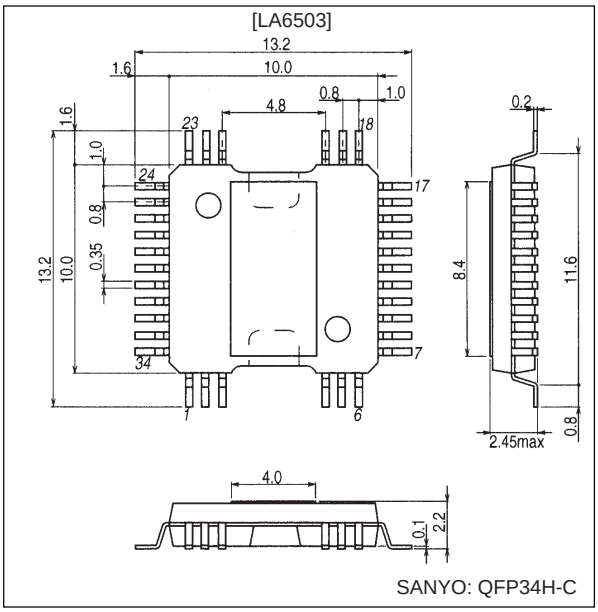
Functions and Features

- CAV control spindle motor driver
  - — Three-phase brushless motor driver
  - — $I_O$max = 1 A
  - — Built-in FG output circuit (single Hall detection output)
  - — Reverse braking circuit
  - — Built-in start/stop circuit
  - — Upper side current detection for minimal loss in the current detection resistor. Also, the voltage drop in this resistor reduces the IC internal power dissipation.
  - — Built-in thermal shutdown circuit
- Sled motor driver
  - — One built-in BTL driver channel
  - — $I_O$max = 1 A
  - — Wide dynamic range
  - — Built-in level shifting circuit
  - — Muting (output on/off) circuit
  - — Built-in thermal shutdown circuit
- Sled motion/position detection circuit
  - — Circuit that provides a pulse output corresponding to sled motion and position
  - — This circuit emits 96 pulses for each rotation from a 24-pole magnet and 90° phase difference Hall element motors, and thus detects the distance moved. It also provides two 48-pulse outputs with differing phases such that the motion direction can be detected from the phase difference between those signals.
- Hall bias power supply
  - — Generates the Hall element 3-V bias voltage.
  - — $I_O$max = 30 mA, typical

Package Dimensions

unit: mm

3219-QFP34H-C



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Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC} max		7	V
Supply voltage	V_M max		14	V
Input voltage	V_C max		V_{CC}	V
Output current	I_O max	Spindle output, sled output	1	A
Allowable power dissipation	Pd max	Independent IC	0.77	W
Operating temperature	Topr		–20 to +75	°C
Storage temperature	Tstg		–55 to +150	°C

Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Operating supply voltage range	V_{CC}		4.6 to 6.0	V
	V_M		4.6 to 13.0	V

Operating Characteristics at Ta = 25°C, V_{CC} = 5 V, V_M = 12 V (unless otherwise specified)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power Supply Current]						
Current drain 1 (V_{CC})	$I_{CC}1$	START/STOP = MUTE = 5 V		10	20	mA
Current drain 2 (V_M)	I_M1	START/STOP = MUTE = 5 V		25	50	mA
Quiescent current 1 (V_{CC})	$I_{CC}2$	START/STOP = MUTE = 0 V		5	10	mA
Quiescent current 2 (V_M)	I_M2	START/STOP = MUTE = 0 V		1	5	mA
[Spindle Motor Block]						
[Output]						
Upper side saturation voltage 1	V_{source}	I_O = –0.5 A		1.0	1.5	V
Lower side saturation voltage 1	V_{sink}	I_O = +0.5 A		0.33	0.80	V
Current limiter voltage setting	V_{CL}	R_{RE} = 0.43 Ω		0.32		V
[Hall Amplifier]						
Common-mode input voltage range	V_{HCOM}		1.2		V_{CC} – 1.0	V
Input bias current	V_{HIB}			1		µA
Minimum Hall input level	V_{HIN}		60			mVp-p
[S/S Pin]						
High-level voltage	VS/SH		2.0		V_{CC}	V
Low-level voltage	VS/SL				0.7	V
Input current	IS/SI	VS/S = 5 V			200	µA
Leakage current	IS/SL	VS/S = 0 V	–30			µA
[Control]						
VC pin input current	I_{VC}	V_C = V_{CREF} = 2.5 V		1	5	µA
VCREF pin input current	I_{VCREF}	V_C = V_{CREF} = 2.5 V		1	5	µA
Voltage gain	G_{VCO}	$\Delta V_{RF}/\Delta V_C$		0.25		Times
Rising edge threshold voltage	V_{CTH}	V_{CREF} = 2.5 V	2.35		2.65	V
Rising edge threshold voltage difference	ΔV_{CTH}	V_{CREF} = 2.5 V	50		150	mV
[Hall Comparator]						
Input offset voltage	$V_{HCIOFFSET}$				10	mV
Input hysteresis	V_{HCIHYS}			8		mV
Output on voltage	V_{OU}				0.3	V
Output off voltage	V_{OD}	*	4.7			V
Output current (sink)	I_{sink}		3			mA

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Sled Motor Block]						
Output offset voltage	V_{OFF}	Voltage difference between outputs	–50		+50	mV
Buffer input voltage range	V_{BIN}		1.5		V_{CC} – 1.5	V
Input voltage range	V_{IN}		1.0		V_{CC} – 1.5	V
Source output voltage	V_O1	R_L = 8 Ω	9.5	10.1		V
Sink output voltage	V_O2	R_L = 8 Ω		1.8	2.4	V
Closed-circuit voltage gain	VG	Bridge Amp		12		dB
Slew rate	S_R			0.15		V/µs
Muting on voltage	V_{MUTE}	The amplifier output is on when at the high level.	0.7	1.2	2.0	V
[Hall Bias (3-V Output Power Supply)]						
Output voltage	$V_{HB\text{-}OUT}$	I_{OUT} = 30 mA	2.5	3.0	3.5	V
Line regulation	$V_{HB\text{-}LIN}$	V_{CC} = 4.6 to 6 V, I_{OUT} = 30 mA	–50		+50	mV
Load regulation	$V_{HB\text{-}LOAD}$	I_{OUT} = 5 to 30 mA, V_{CC} = 5 V	–200		+200	mV

Note: For items marked with an asterisk (*), the Hall comparator goes to the high level when the S/S pin is off (standby mode).

Truth Table

(Spindle Motor Block)

	Source → Sink	Input			Control
		U	V	W	VC
1	W → V	H	H	L	H
	V → W				L
2	W → U	H	L	L	H
	U → W				L
3	V → W	L	L	H	H
	W → V				L
4	U → V	L	H	L	H
	V → U				L
5	V → U	H	L	H	H
	U → V				L
6	U → W	L	H	H	H
	W → U				L

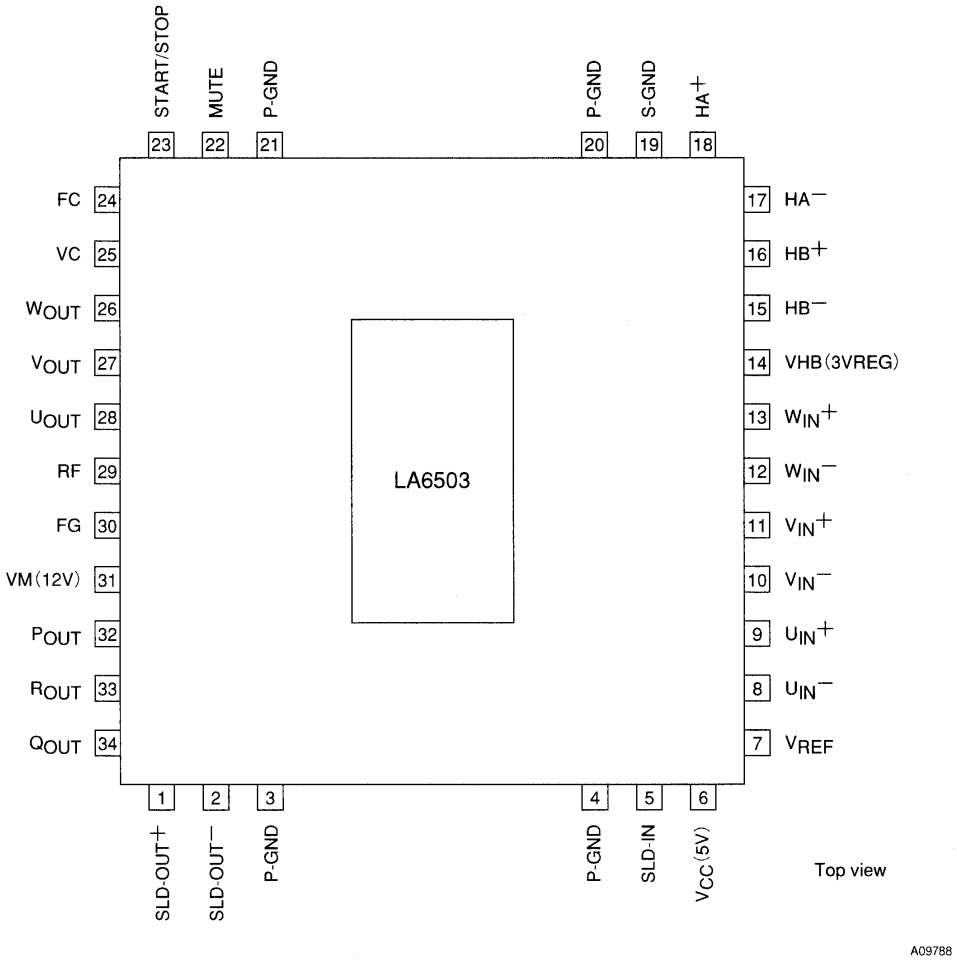
Inputs: The “H” state is when the + input of the corresponding phase is 0.2 V or more higher than the – input.
The “L” state is when the + input of the corresponding phase is 0.2 V or more lower than the – input.

(Sled Motor Block)

Input (V_{IN})	Mute	Output	
		SLD-OUT+	SLD-OUT–
H	H	H	L
	L	—	—
L	H	L	H
	L	—	—

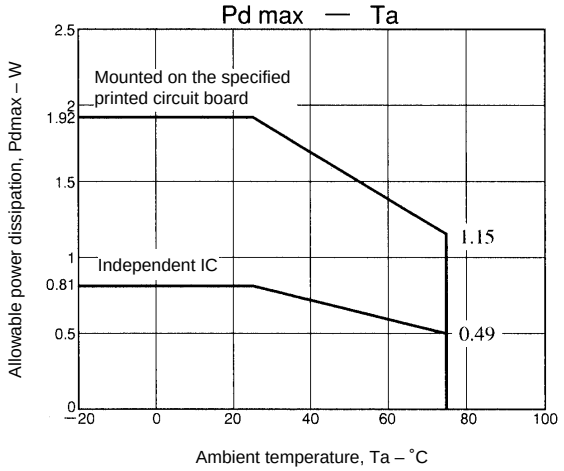
Note: “—” indicates that the amplifier output is off.

Pin Assignment

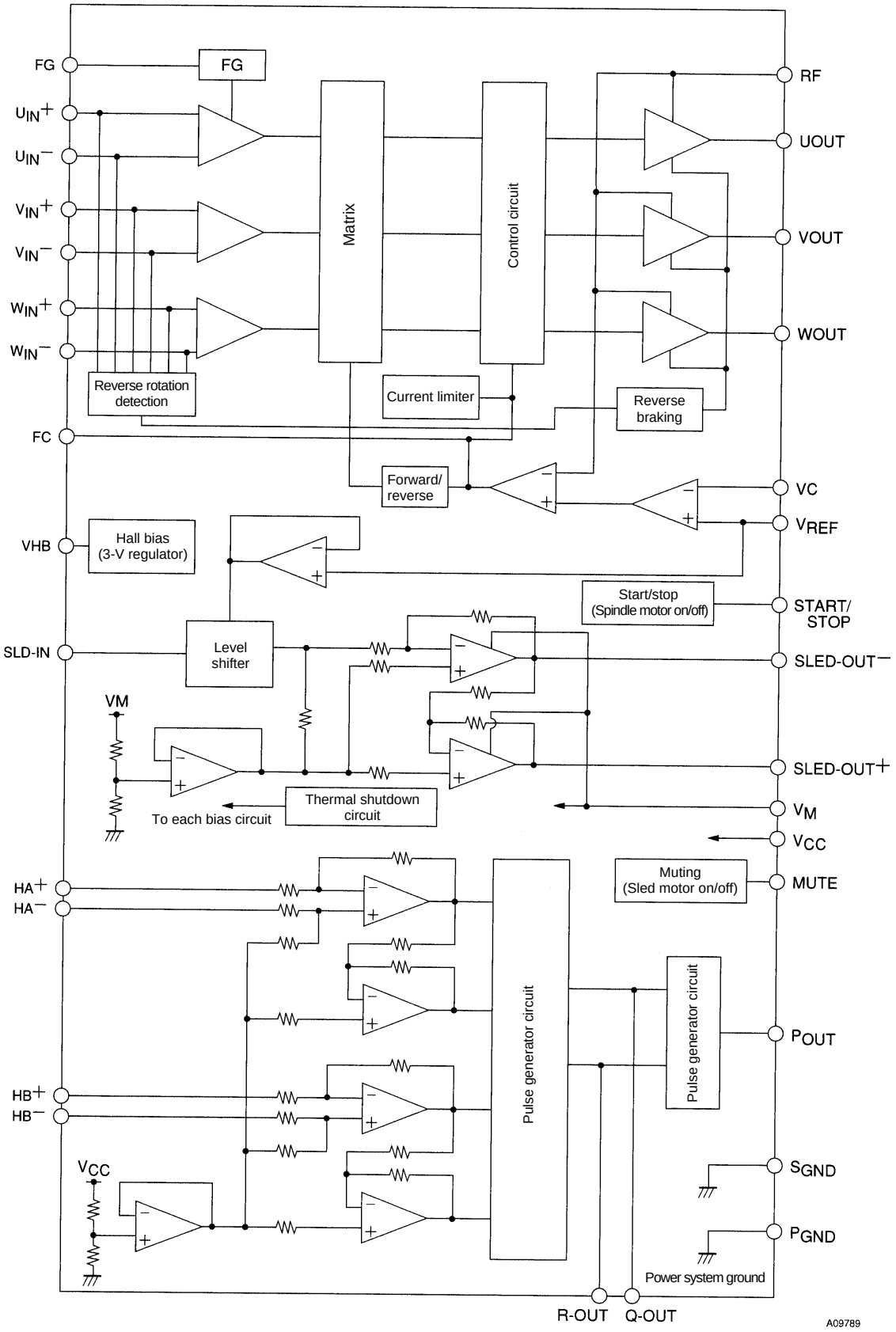


Pin Functions

Pin No.	Symbol	Function
1	SLED OUT^+	Sled motor noninverted output
2	SLED OUT^-	Sled motor inverted output
3	P-GND	Power system ground
4	P-GND	Power system ground
5	SLED-IN	Sled motor signal input (The gain is set with a resistor.)
6	V_{CC} (5 V)	Signal system power supply (5 V)
7	V_{REF}	Reference voltage input
8	U_{IN}^-	Three-phase spindle motor hall signal input pin (U phase –)
9	U_{IN}^+	Three-phase spindle motor hall signal input pin (U phase +)
10	V_{IN}^-	Three-phase spindle motor hall signal input pin (V phase –)
11	V_{IN}^+	Three-phase spindle motor hall signal input pin (V phase +)
12	W_{IN}^-	Three-phase spindle motor hall signal input pin (W phase –)
13	W_{IN}^+	Three-phase spindle motor hall signal input pin (W phase +)
14	VHB (3Vreg)	Hall bias output pin (3-V power supply output)
15	HB^-	Sled motion distance detection hall element input (HB –)
16	HB^+	Sled motion distance detection hall element input (HB +)
17	HA^-	Sled motion distance detection hall element input (HA –)
18	HA^+	Sled motion distance detection hall element input (HA +)
19	S-GND	Signal system ground
20	P-GND	Power system ground
21	P-GND	Power system ground
22	MUTE	Sled motor output muting (output on/off control)
23	START/STOP	Spindle motor output start/stop (output on/off control)
24	FC	Phase compensation capacitor connection
25	VC	Input for the spindle control signal from the ASP
26	WOUT	Three-phase spindle motor output (W phase output)
27	VOUT	Three-phase spindle motor output (V phase output)
28	UOUT	Three-phase spindle motor output (U phase output)
29	RF	Output current detection
30	FG	FG signal output
31	V_M (12 V)	Motor power supply (12 V)
32	POUT	Sled motion position detection pulse output P (96 pulses)
33	ROUT	Sled motion position detection pulse output R (48 pulses)
34	QOUT	Sled motion position detection pulse output Q (48 pulses)

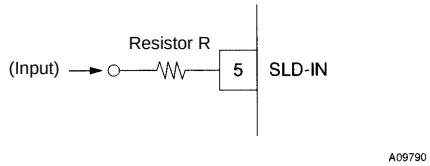


Block Diagram



Notes on Gain Adjustment (Sled Motor Block)

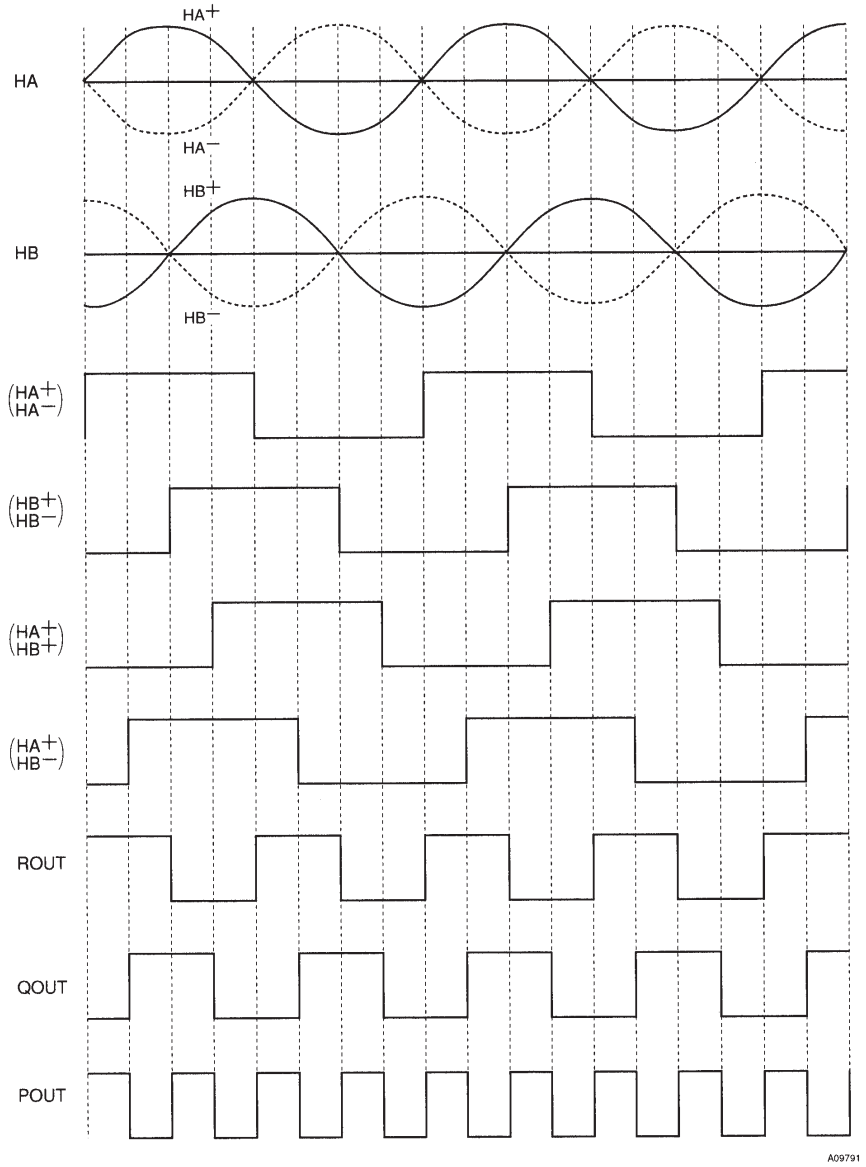
- Gain setting
  The sled motor block gain is set using an external resistor as shown below.



For example, when the external resistor R is 22 kΩ, the gain will be 0 dB when seen as an independent output amplifier and 6 dB when seen as a BTL circuit (between outputs). Referenced to this 22-kΩ resistor, the independent output amplifier gain will be 22k/R (as a multiple) or 20 log(22k/R) dB. Similarly, the BTL gain will be 2×22k/R (as a multiple) or 20 log(22k/R) dB + 3 dB. The level shifting circuits used in current models perform both current and voltage conversion, and thus have a different input type from normal operational amplifiers. The current that flows in the external resistor, that is, the potential difference, becomes the input to AMP1 and AMP2.

- Output offset voltage
  The output offset voltage is 1/2 V_M (typical). The V_O^- and V_O^+ outputs are converted to outputs that are centered on this voltage.

Sled Position Detection Pulse Waveforms



Note: When the sled motor rotation direction changes (that is, when the HA and HB phase relationship changes), the R-OUT and Q-OUT phase relationship changes and the direction can be detected from that phase. The motion distance and position are detected from P-OUT.