



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.

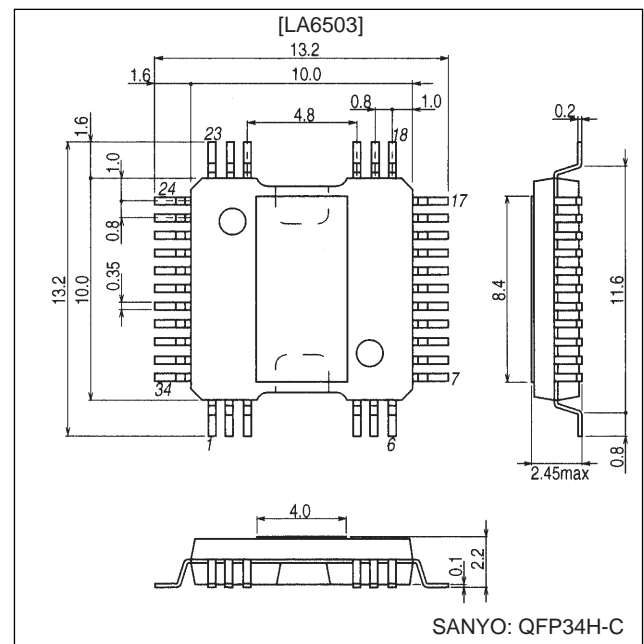
Functions and Features

- CAV control spindle motor driver
 - Three-phase brushless motor driver
 - $I_{Omax} = 1\text{ A}$
 - 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
 - $I_{Omax} = 1\text{ A}$
 - 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.
 - $I_{Omax} = 30\text{ mA}$, typical

Package Dimensions

unit: mm

3219-QFP34H-C



Specifications

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

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	P_d max	Independent IC	0.77	W
Operating temperature	T_{opr}		-20 to +75	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

Operating Conditions at $T_a = 25^\circ\text{C}$

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 $T_a = 25^\circ\text{C}$, $V_{CC} = 5\text{ V}$, $V_M = 12\text{ V}$ (unless otherwise specified)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power Supply Current]						
Current drain 1 (V_{CC})	I_{CC1}	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_{CC2}	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}	$I_O = -0.5\text{ A}$		1.0	1.5	V
Lower side saturation voltage 1	V_{sink}	$I_O = +0.5\text{ A}$		0.33	0.80	V
Current limiter voltage setting	V_{CL}	$R_{RE} = 0.43\ \Omega$		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}	$V_C = V_{CREF} = 2.5\text{ V}$		1	5	μA
VCREF pin input current	I_{VCREF}	$V_C = V_{CREF} = 2.5\text{ V}$		1	5	μA
Voltage gain	G_{VCO}	$\Delta V_{RF}/\Delta V_C$		0.25		Times
Rising edge threshold voltage	V_{CTH}	$V_{CREF} = 2.5\text{ V}$	2.35		2.65	V
Rising edge threshold voltage difference	ΔV_{CTH}	$V_{CREF} = 2.5\text{ V}$	50		150	mV
[Hall Comparator]						
Input offset voltage	$V_{HCIOFFSET}$				10	mV
Input hysteresis	V_{HCHYS}			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}	$R_L = 8 \Omega$	9.5	10.1		V
Sink output voltage	V_{O2}	$R_L = 8 \Omega$		1.8	2.4	V
Closed-circuit voltage gain	VG	Bridge Amp		12		dB
Slew rate	S_R			0.15		V/ μ s
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-OUT}	$I_{OUT} = 30 \text{ mA}$	2.5	3.0	3.5	V
Line regulation	V_{HB-LIN}	$V_{CC} = 4.6 \text{ to } 6 \text{ V}$, $I_{OUT} = 30 \text{ mA}$	-50		+50	mV
Load regulation	$V_{HB-LOAD}$	$I_{OUT} = 5 \text{ to } 30 \text{ mA}$, $V_{CC} = 5 \text{ V}$	-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 VC
		U	V	W	
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.

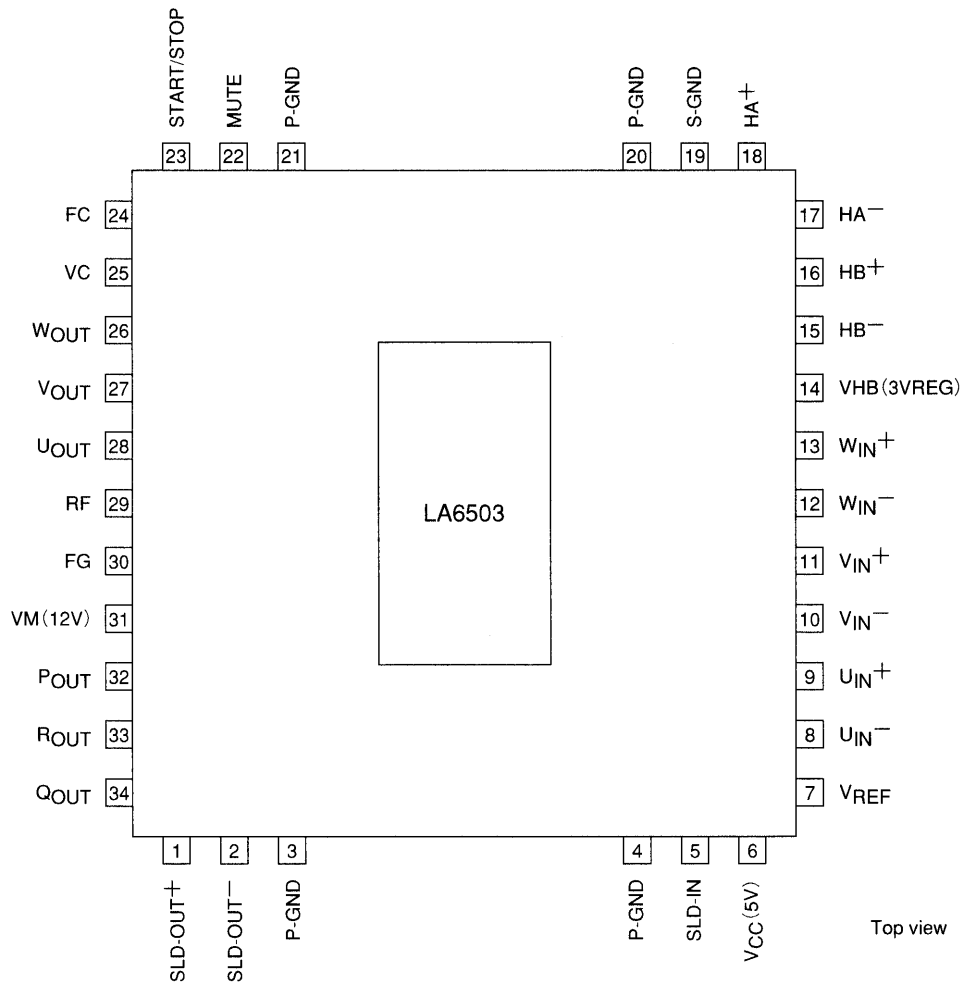
(Sled Motor Block)

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.

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Pin Assignment

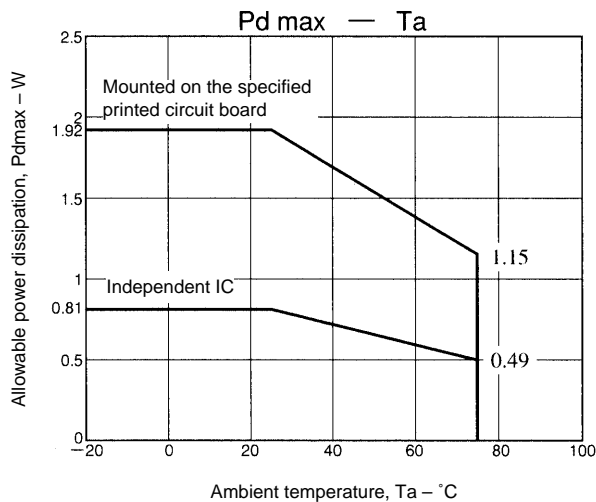


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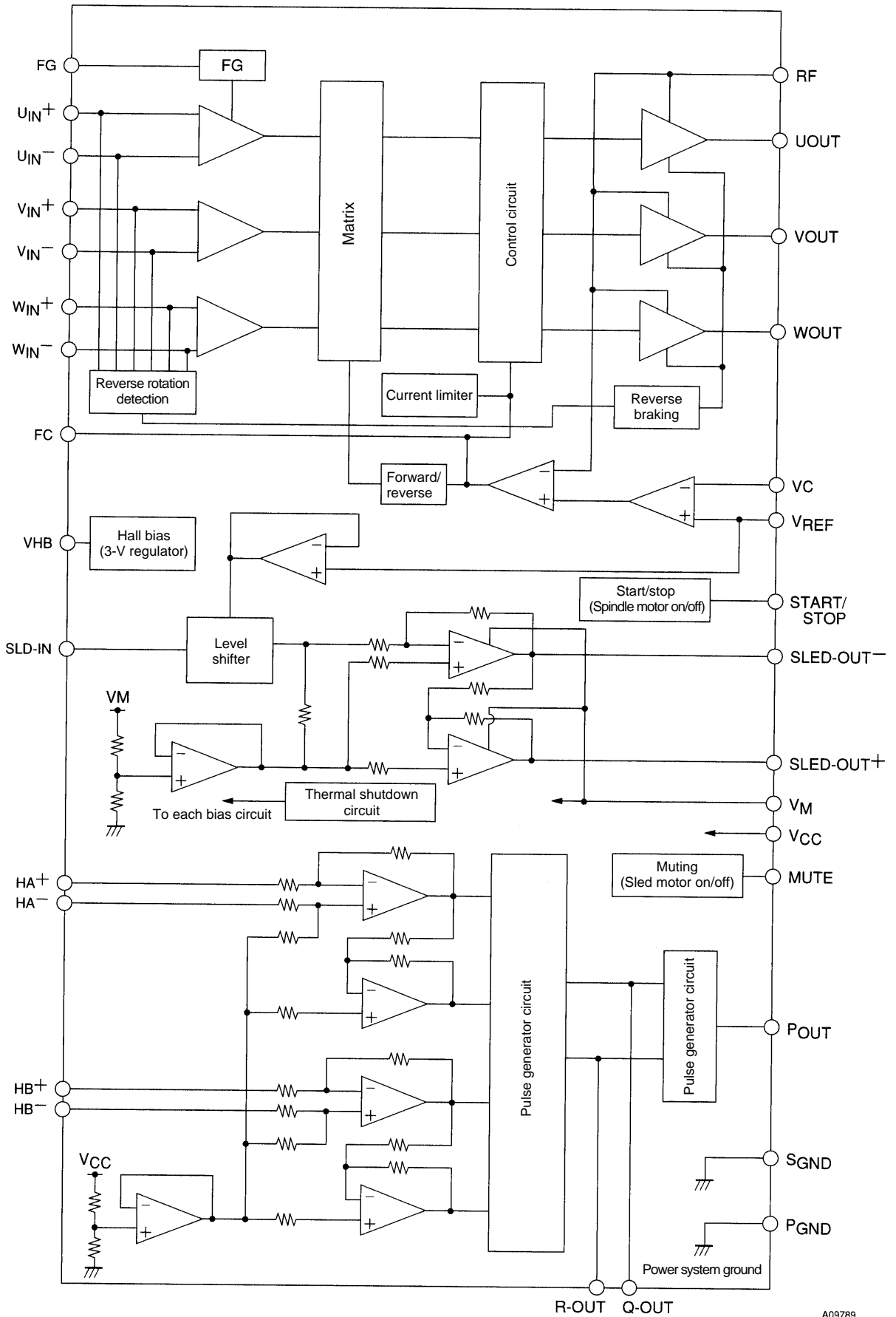
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Pin Functions

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	WO _{UT}	Three-phase spindle motor output (W phase output)
27	VO _{UT}	Three-phase spindle motor output (V phase output)
28	UO _{UT}	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	PO _{UT}	Sled motion position detection pulse output P (96 pulses)
33	RO _{UT}	Sled motion position detection pulse output R (48 pulses)
34	QO _{UT}	Sled motion position detection pulse output Q (48 pulses)



Block Diagram

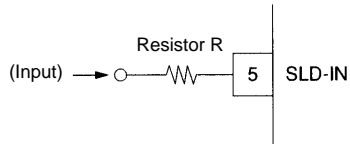


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Notes on Gain Adjustment (Sled Motor Block)

- Gain setting

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



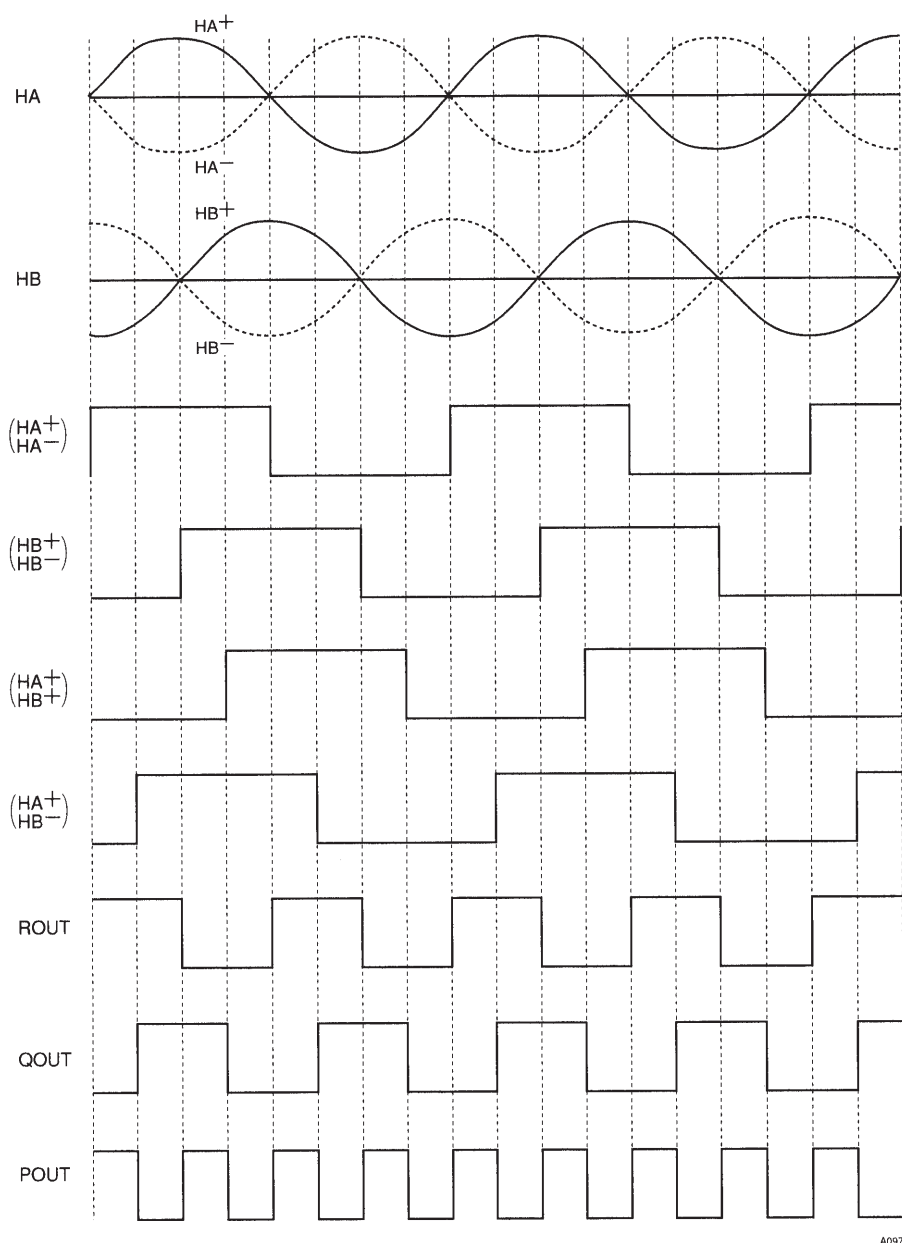
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For example, when the external resistor R is $22\text{ k}\Omega$, the gain will be 0 dB when seen as an independent output amplifier and 6 dB when seen as a BTL circuit (between outputs). Referenced to this $22\text{-k}\Omega$ resistor, the independent output amplifier gain will be $22\text{k}/R$ (as a multiple) or $20\log(22\text{k}/R)\text{ dB}$. Similarly, the BTL gain will be $2 \times 22\text{k}/R$ (as a multiple) or $20\log(22\text{k}/R)\text{ dB} + 3\text{ dB}$. 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



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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.

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