Ordering number : ENN7816

SANYO Semiconductors
DATA SHEET

Monolithic Linear IC

LA6502 — Three-Phase Sensorless Spindle Motor Driver for CD and DVD players

Overview

The LA6502 is a 5-channel motor driver IC that provides both a three-phase brushless motor driver and four BTL amplifier channels. It is particularly appropriate for use as the motor driver system in CD and DVD players.

Functions

- Five-channel motor driver for CD and DVD players
- Spindle driver: Three-phase linear sensorless drive
- Other driver channels: Four BTL amplifier circuits

Features

- Spindle driver block
  - — Three-phase sensorless motor driver
  - — Soft switching drive
  - — Analog input voltage control
  - — Built-in current limiter circuit
  - — Back EMF based FG output
  - — Built-in reverse rotation prevention circuit
- Sled, focus, tracking, and loading blocks
  - — BTL amplifier circuits
- Common blocks
  - — Thermal shutdown circuit (design guarantee)
  - — Muting function (3 pins)
  - — One built-in operational amplifier with open-collector output

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Specifications

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage 1	$V_{CC}1$	Spindle, sled, and loading block power supply	14.5	V
Motor supply voltage 2	$V_{CC}2$	Focus and tracking block power supply	14.5	V
Allowable power dissipation	Pdmax1	Independent IC	0.8	W
	Pdmax2	Mounted on the specified PCB *	1.7	W
Maximum input voltage	V_{IN}max		–0.3 to V_{CC} +0.3	V
Maximum output current1	$I_O$max1	Spindle output	1.0	A
Maximum output current2	$I_O$max2	Sled output	0.6	A
Maximum output current3	$I_O$max3	Focus and tracking output	0.85	A
Maximum output current4	$I_O$max4	Loading output	0.6	A
Operating temperature	Topr		–20 to +75	°C
Storage temperature	Tstg		–55 to +150	°C

Note *: Specified PCB: 114.3 × 76.1 × 1.6 mm glass epoxy PCB

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage 1	$V_{CC}1$	Spindle, sled, and loading block power supply	4.5 to 13.8	V
Motor supply voltage 2	$V_{CC}2$	Focus and tracking block power supply	4.5 to 13.8	V

The characteristics listed below are subject to change once samples have been produced.

Electrical Characteristics

(Unless specified otherwise, the conditions are $V_{CC}1$ = 8 V, $V_{CC}2$ = 8 V, VREF = 1.65 V, and Ta = 25°C.)

Common Circuits

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	ICC	MUTE1, 2, 3: H, VC = VREF		30	40	mA
Standby current	ICCQ	MUTE1, 2, 3: L		0.3	0.5	mA
VREF pin input voltage range	VREF		1.0		3.3	V
VREF pin input current	IVCREF	VC = VREF = 1.65 V	–0.2	–0.1		µA
MUTE1, 2, and 3 low-level voltage	VMUTE-L				0.5	V
MUTE1, 2, and 3 high-level voltage	VMUTE-H		2.8		4.5	V
MUTE1, 2, and 3 input current	IMUTE	VMUTE = 3 V		60	100	µA
Thermal shutdown circuit operating temperature	TSD	Design target value*	150	180	210	°C
Thermal shutdown circuit hysteresis	ΔTSD	Design target value*		40		°C

Note *: The design target values are not tested.

Spindle Driver

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output saturation voltage	VOSAT_SP	I_O = 0.5 A, Source + Sink		1.8	2.4	V
CTL pin input voltage range	VCTL_SP		0		5	V
CTL pin input current	IVCTL_SP	VC = VREF = 1.65 V		–0.2	–0.5	µA
Control gain	GVCO_SP		0.29	0.34	0.39	V/V
Control dead zone width 1	VCDZ1_SP	Forward		90	150	mV
Control dead zone width 2	VCDZ2_SP	Reverse	–150	–90		mV
Current limiter voltage	VLIM_SP		0.36	0.4	0.44	V
VCOIN input current	IVCOIN_SP	VCOIN = 3 V			1	µA
VCO minimum frequency	FVCOMIN_SP	CX = 0.01 µF, VCOIN = OPEN	0.35	0.45	0.55	kHz
VCO maximum frequency	FVCOMAX_SP	CX = 0.01 µF, VCOIN = 5 V	36	40	44	kHz
C1, C2 source current ratio	RSOURCE_SP	1 – (IC1SOURCE/IC2SOURCE)	–10		+10	%
C1, C2 sink current ratio	RSINK_SP	1 – (IC1SINK/IC2SINK)	–10		+10	%
C1 source/sink current ratio	RC1_SP	IC1SOURCE/IC1SINK	40		60	%
C2 source/sink current ratio	RC2_SP	IC2SOURCE/IC2SINK	40		60	%
FGO pin high-level voltage	FGOH_SP	FGO resistor: 20 kΩ, pulled up to 5 V	4.8			V
FGO pin low-level voltage	FGOL_SP	FGO resistor: 20 kΩ, pulled up to 5 V		0.15	0.4	V
FR pin input voltage range	VFR		0		5	V
FR pin input current	IFR	VFR = 3 V		54	100	µA

Sled Driver (AMP3)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output saturation voltage	VOSAT_3	I_O = 0.3 A, Source + Sink		1.5	1.8	V
Input voltage range	VIN_3		0		5	V
CTL pin input current	IIN_3	V_{IN} = VREF = 1.65 V	–0.5	–0.1		µA
Control gain	GVCO_3		17.8	18.7	19.6	dB
Output offset voltage	VOOFF_3	*	–50	0	+50	mV

Focus and Tracking Drivers (AMP1, AMP2)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output saturation voltage	VOSAT_1	I_O = 0.6 A, Source + Sink		1.8	2.2	V
Input voltage range	VIN_1		0		5	V
CTL pin input current	IIN_1	V_{IN} = VREF = 1.65 V	–0.5	–0.1		µA
Control gain	GVCO_1		11.6	12.7	13.8	dB
Output offset voltage	VOOFF_1	*	–50	0	+50	mV

Loading Driver (AMP4)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output saturation voltage	VOSAT_4	I_O = 0.2 A, Source + Sink		1.3	1.6	V
Input voltage range	VIN_4		0		5	V
CTL pin input current	IIN_4	V_{IN} = VREF = 1.65 V	–0.5	–0.2		µA
Control gain	GVCO_4		17.8	18.7	19.6	dB
Output offset voltage	VOOFF_4	*	–50	0	+50	mV

Operational Amplifier

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Low-level output voltage	VOL_5	I_O = 1 mA, Sink		0.2	0.4	V
Input voltage range	VIN_5		0		5	V
Input offset voltage	VIOFF_5		–5	0	+5	mV

Note *: The pre-operational amplifier in the previous stage is used as a buffer.

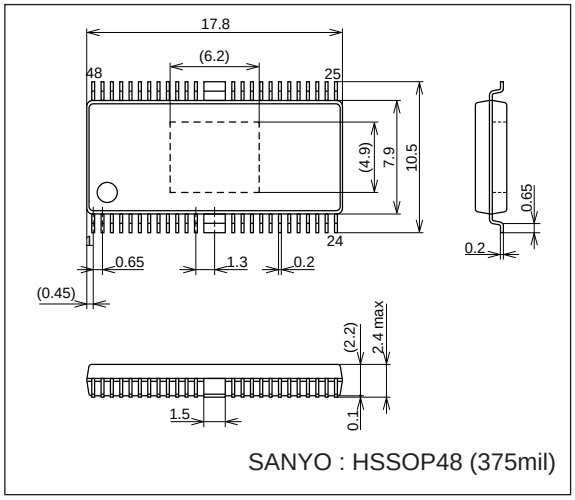
Mute Function

	Mode
MUTE1:H	Spindle: on
MUTE2:H	Focus, tracking and sled: on
MUTE3:H	Loadeng: on

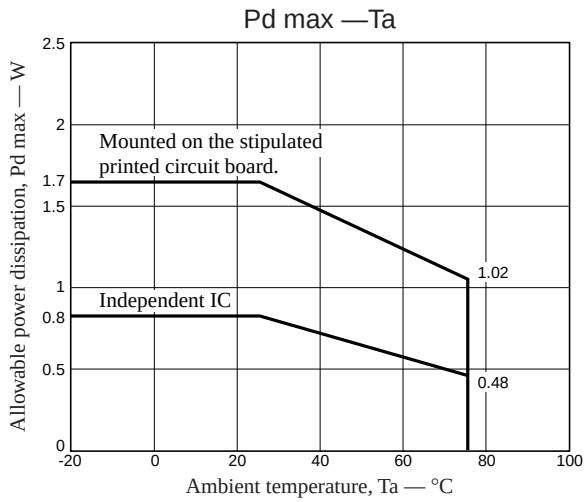
Package Dimensions

unit : mm

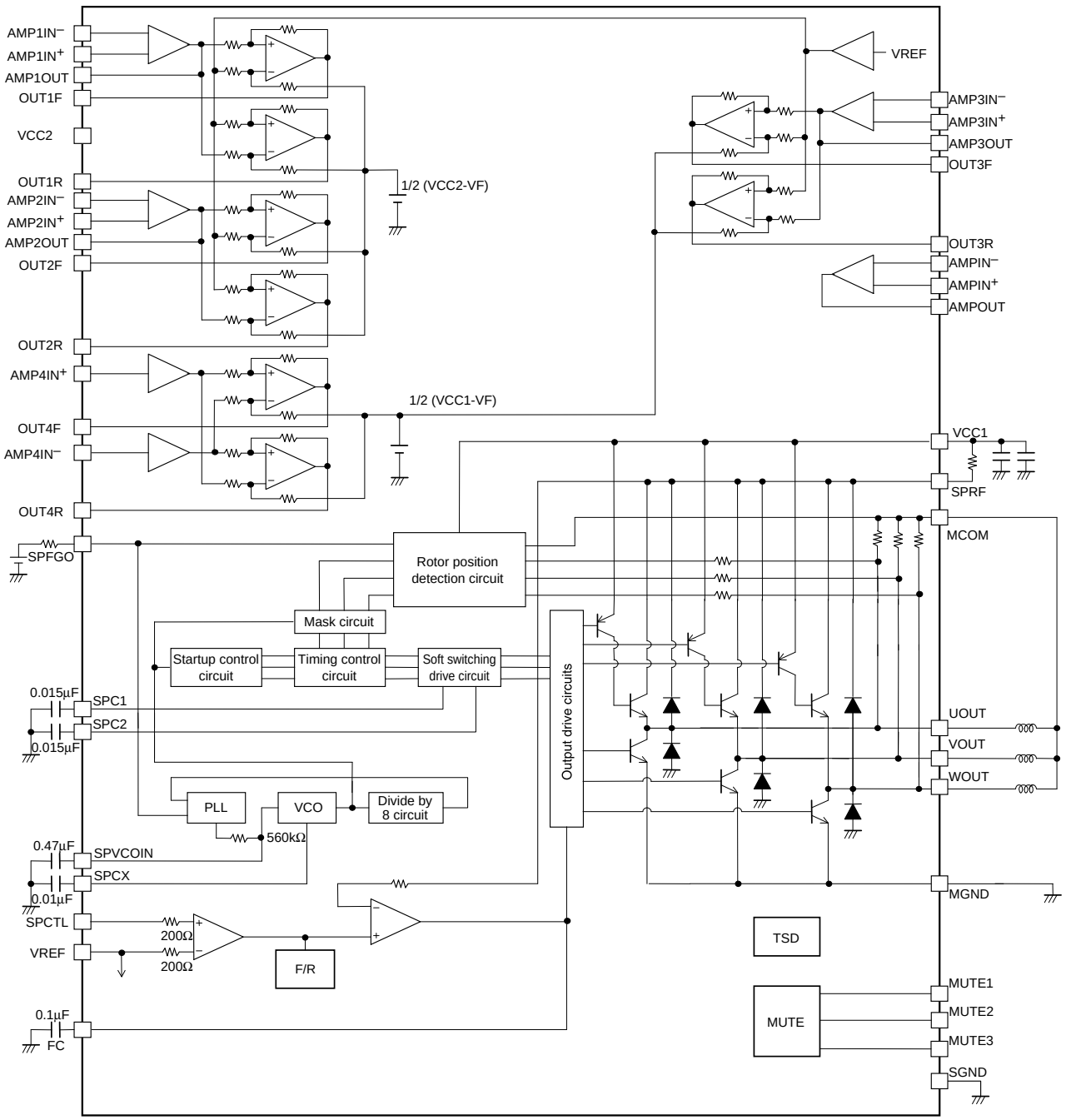
3278



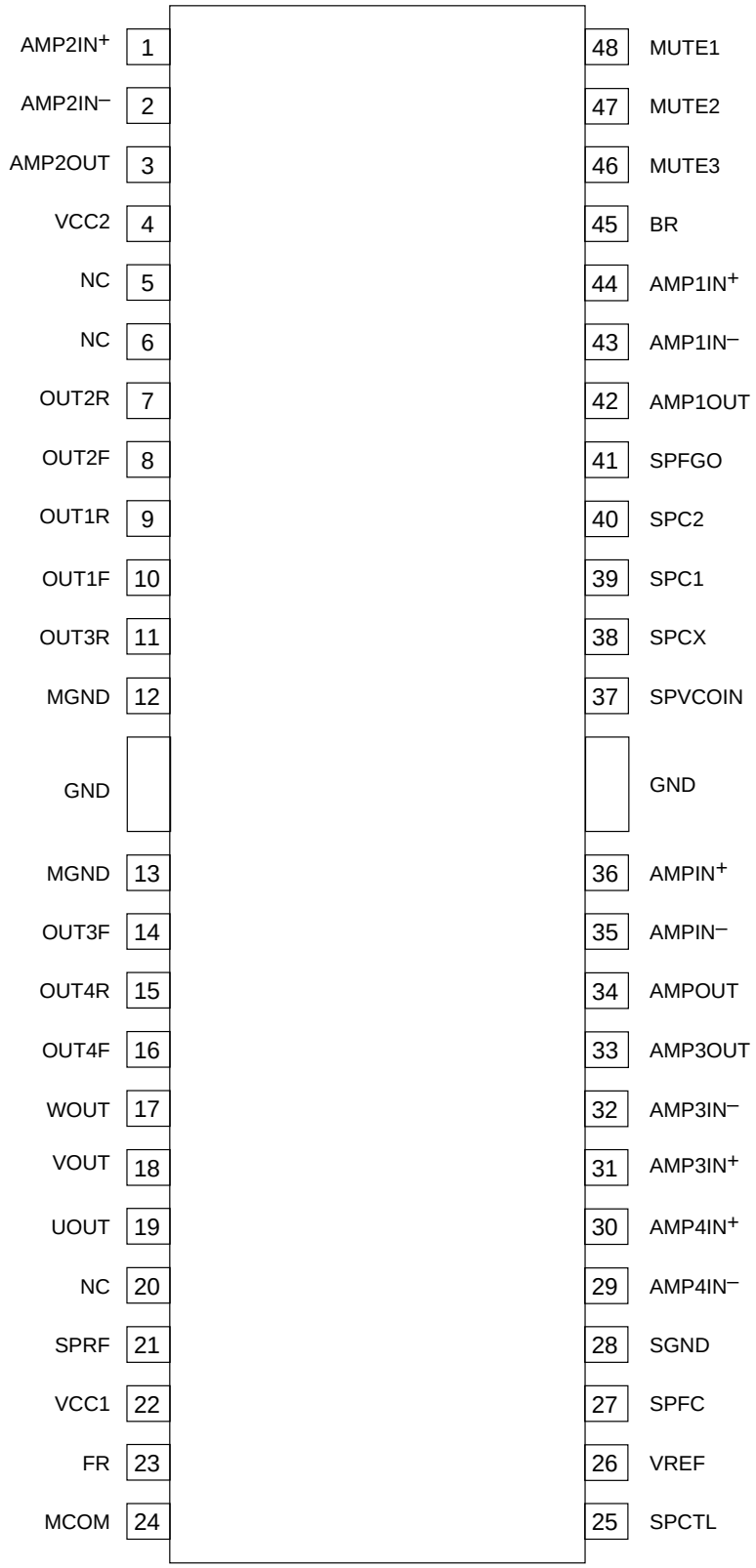
SANYO : HSSOP48 (375mil)



Block Diagram (A snubber circuit is required on the spindle motor coil output in certain applications.)

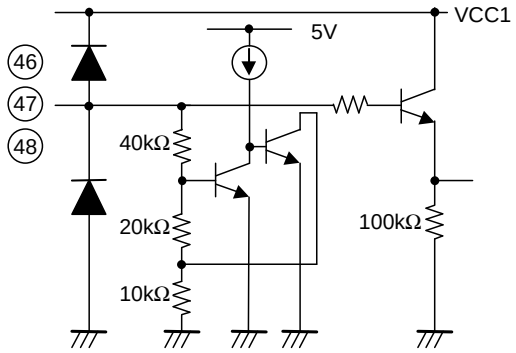
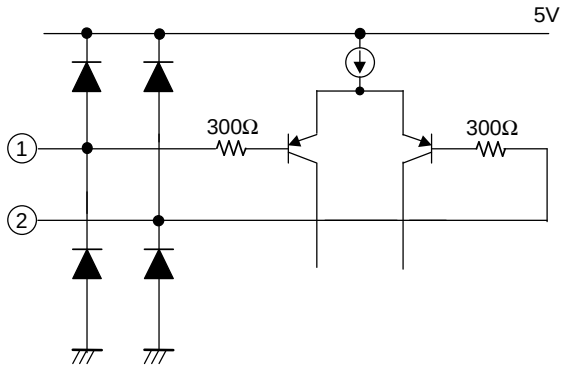
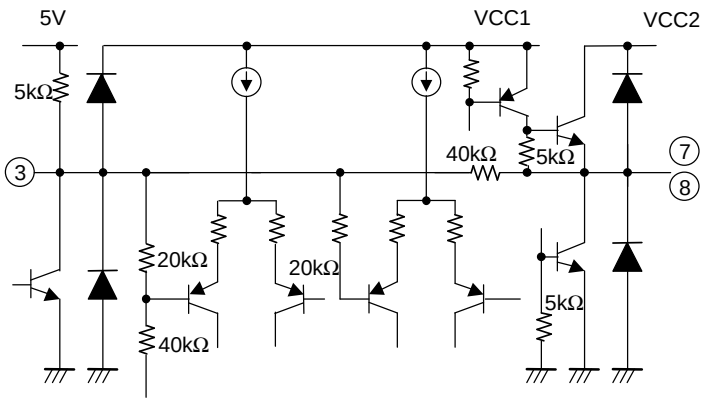


Pin Assignment



Top view

Pin Functions

Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
22	VCC1	4.5 to 13.8	Power supply for all circuits other than the BTL-AMP1 and BTL-AMP2 output transistors	
4	VCC2	4.5 to 13.8	Power supply for the BTL-AMP1 and BTL-AMP2 output transistors	
28	SGND		Ground for all circuits other than the outputs	
12 13	MGND		Ground for outputs other than the spindle output	
46	MUTE3	0 V to 4 V	Mute function control MUTE: High → Motor drive MUTE: Low → Drive off High level: Over 2.8 V Low level: Under 0.5 V MUTE1: SP MUTE2: BTL1, 2, 3 MUTE3: BTL4	
47	MUTE2			
48	MUTE1			
1	AMP2IN+	0 V to 5 V	Operational amplifier noninverting input	
2	AMP2IN−		Operational amplifier inverting input	
3	AMP2OUT		Operational amplifier output	
8	OUT2F		BTL amplifier forward output	
7	OUT2R		BTL amplifier reverse output	

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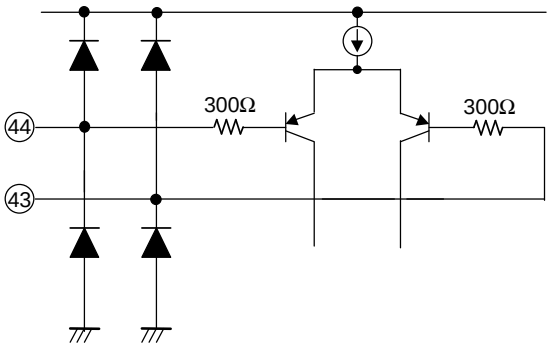
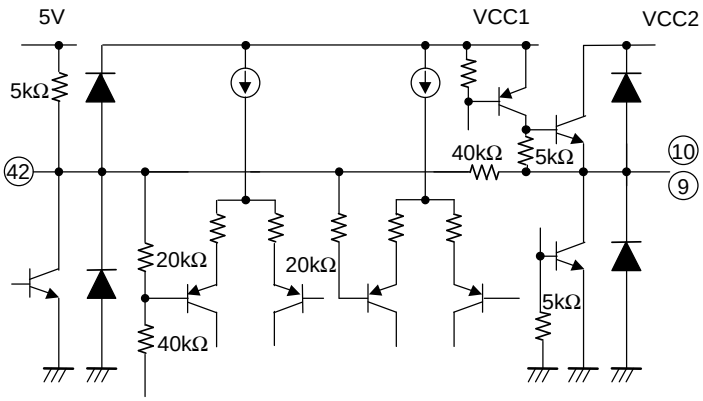
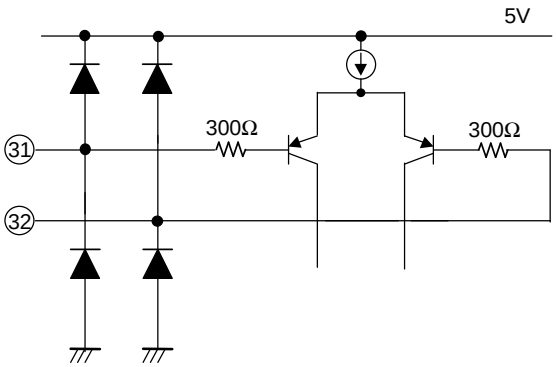
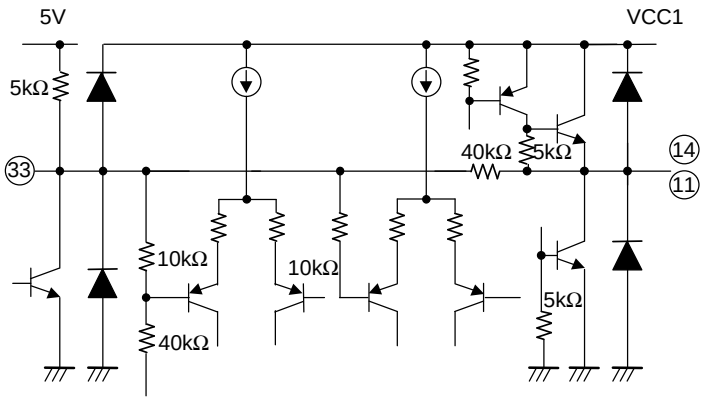
Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
44	AMP1IN+	0 V to 5 V	Operational amplifier noninverting input	
43	AMP1IN−		Operational amplifier inverting input	
42	AMP1OUT		Operational amplifier output	
10	OUT1F		BTL amplifier forward output	
9	OUT1R		BTL amplifier reverse output	
31	AMP3IN+	0 V to 5 V	Operational amplifier noninverting input	
32	AMP3IN−		Operational amplifier inverting input	
33	AMP3OUT		Previous stage operational amplifier output	
14	OUT3F		BTL amplifier forward output	
11	OUT3R		BTL amplifier reverse output	

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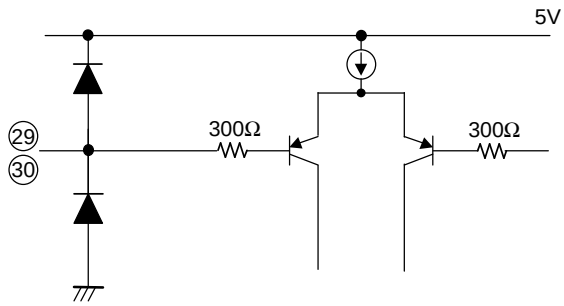
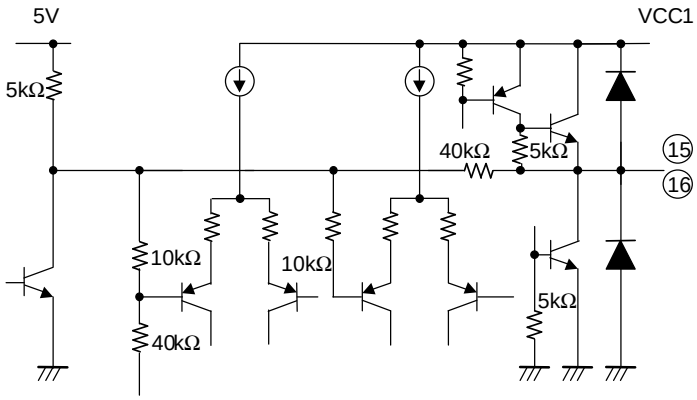
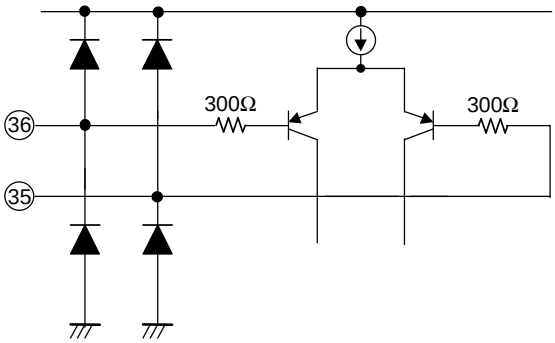
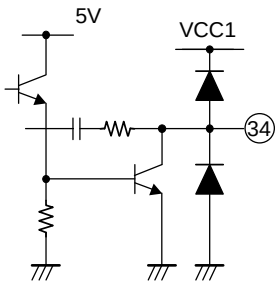
Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
30	AMP4IN+	0 V to 5 V	Operational amplifier noninverting input	
29	AMP4IN–		Reference voltage for the four BTL channels	
16	OUT4F		BTL amplifier forward output	
15	OUT4R		BTL amplifier reverse output	
36	AMPIN+	0 V to 5 V	Operational amplifier noninverting input	
35	AMPIN–		Operational amplifier inverting input	
34	AMPOUT		Operational amplifier output	

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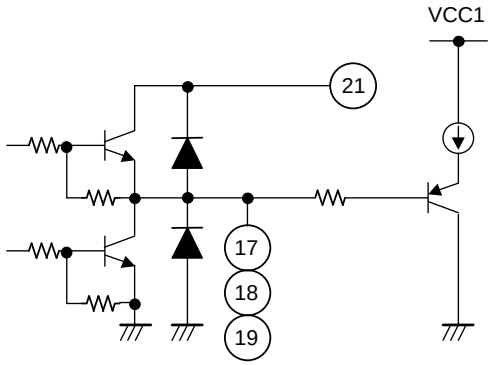
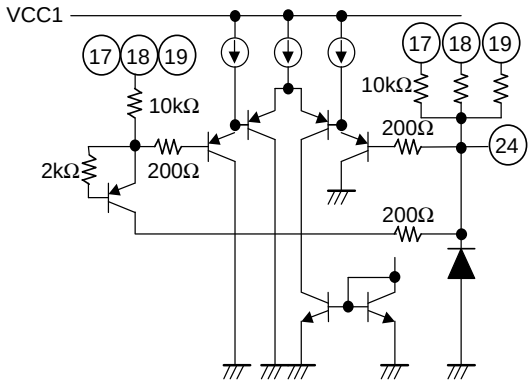
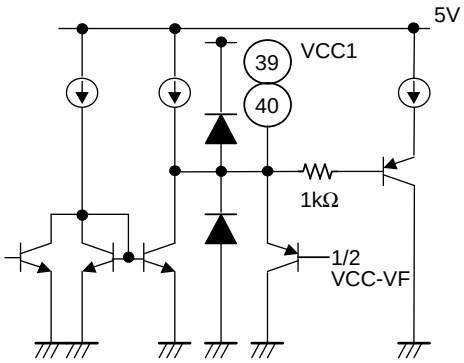
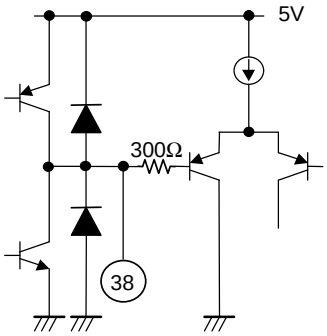
Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
19	SPUOUT		Spindle motor driver output	
18	SPVOUT			
17	SPWOUT			
21	SPRF		Spindle motor driver output transistor power supply. Constant-current control is implemented by detecting this voltage. The current limiter circuit also operates by detecting this voltage.	
24	MCOM		Spindle motor coil center point input. The coil voltage waveform is detected using this voltage as the reference.	
39	SPC1		Spindle triangular wave signal generation capacitor connection This triangular wave signal is used for soft switching of the coil output waveform.	
40	SPC2			
38	SPCX		The value of the capacitor connected between this pin and ground determines the operating frequency range and the minimum operating frequency for the spindle VCO circuit.	

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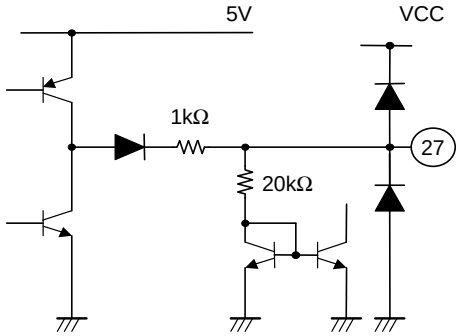
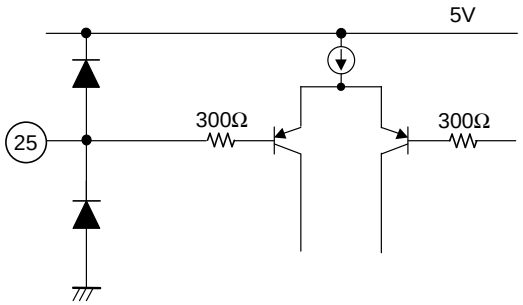
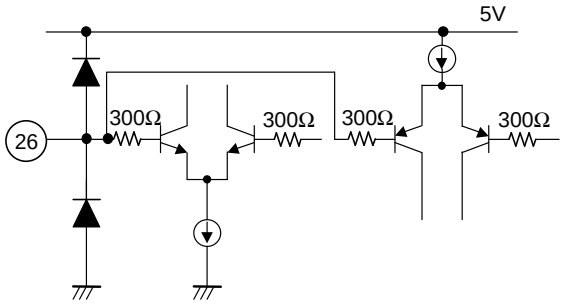
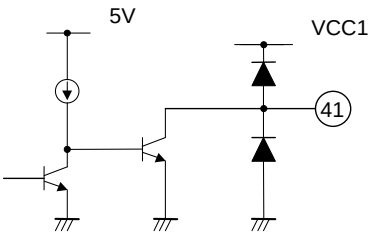
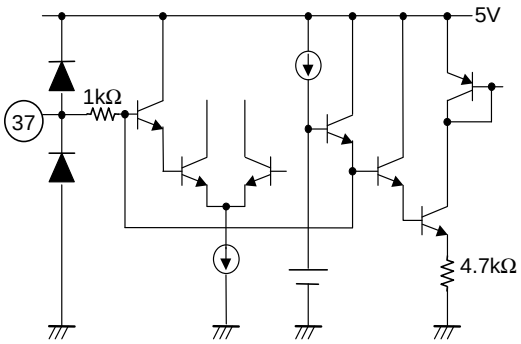
Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
27	SPFC		Frequency characteristics correction. Closed loop oscillator in the current control system can be prevented by inserting a capacitor between this pin and ground.	
25	SPCTL	0 V to 5 V	Spindle speed control. Control is implemented as constant current control based on current feedback from the SPRF pin.	
26	VREF	1 V to 3.3 V	Spindle speed control reference. BTL amplifier internal VREF buffer input	
41	SPFGO		Spindle motor back EMF detection FG output (three-phase synthesized output)	
37	SPVCOIN		Drum block VCO circuit voltage input. Input the PCOUT pin voltage filtered by an CR circuit to this pin.	

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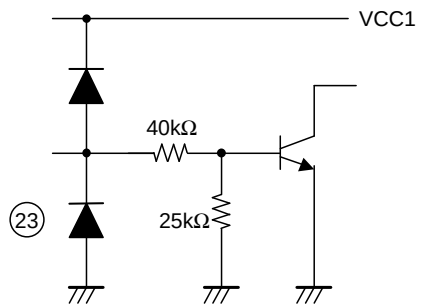
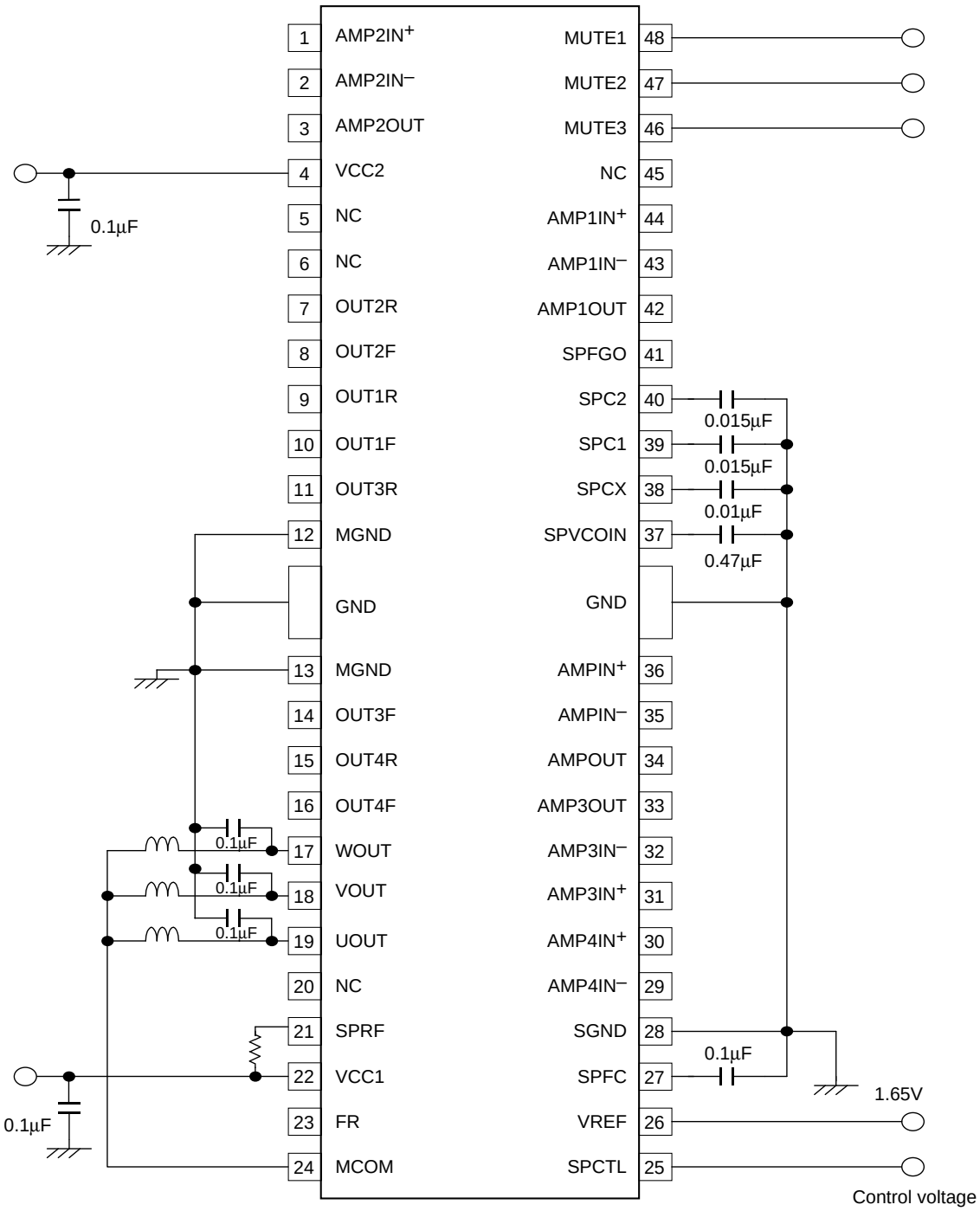
Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
23	FR	0 V to $V_{CC}1$	Spindle block voltage control switching. FR: High → VREF > SPCTL drive FR: Low → VREF < SPCTL drive High level: Over 2.8 V Low level: Under 0.5 V	

Sample Application Circuit (Spindle Block)



Note: The values of external components shown here are provided for reference purposes and differ from the optimal values, which depend on the motors actually used, in any particular application.