



SANYO Semiconductors

DATA SHEET

LA6502

Monolithic Linear IC

— 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

- Any and all SANYO products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO representative nearest you before using any SANYO products described or contained herein in such applications.
 - SANYO assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO products described or contained herein.

SANYO Electric Co.,Ltd. Semiconductor Company

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage 1	V _{CC1}	Spindle, sled, and loading block power supply	14.5	V
Motor supply voltage 2	V _{CC2}	Focus and tracking block power supply	14.5	V
Allowable power dissipation	P _{dmax1}	Independent IC	0.8	W
	P _{dmax2}	Mounted on the specified PCB *	1.7	W
Maximum input voltage	V _{INmax}		−0.3 to V _{CC} +0.3	V
Maximum output current1	I _{Omax1}	Spindle output	1.0	A
Maximum output current2	I _{Omax2}	Sled output	0.6	A
Maximum output current3	I _{Omax3}	Focus and tracking output	0.85	A
Maximum output current4	I _{Omax4}	Loading output	0.6	A
Operating temperature	T _{opr}		−20 to +75	°C
Storage temperature	T _{stg}		−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 _{CC1}	Spindle, sled, and loading block power supply	4.5 to 13.8	V
Motor supply voltage 2	V _{CC2}	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_{CC1} = 8 V, V_{CC2} = 8 V, V_{REF} = 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 = V _{REF}		30	40	mA
Standby current	ICCQ	MUTE1, 2, 3: L		0.3	0.5	mA
V _{REF} pin input voltage range	V _{REF}		1.0		3.3	V
V _{REF} pin input current	I _{VCREF}	VC = V _{REF} = 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	$I_O = 0.5\text{ A}$, Source + Sink		1.8	2.4	V
CTL pin input voltage range	VCTL_SP		0		5	V
CTL pin input current	IVCTL_SP	$V_C = V_{REF} = 1.65\text{ V}$		-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	$V_{COIN} = 3\text{ V}$			1	μA
VCO minimum frequency	FVCOMIN_SP	$C_X = 0.01\text{ }\mu\text{F}$, $V_{COIN} = \text{OPEN}$	0.35	0.45	0.55	kHz
VCO maximum frequency	FVCOMAX_SP	$C_X = 0.01\text{ }\mu\text{F}$, $V_{COIN} = 5\text{ V}$	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: $20\text{ k}\Omega$, pulled up to 5 V	4.8			V
FGO pin low-level voltage	FGOL_SP	FGO resistor: $20\text{ k}\Omega$, pulled up to 5 V		0.15	0.4	V
FR pin input voltage range	VFR		0		5	V
FR pin input current	IFR	$VFR = 3\text{ V}$		54	100	μA

Sled Driver (AMP3)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output saturation voltage	VOSAT_3	$I_O = 0.3\text{ A}$, Source + Sink		1.5	1.8	V
Input voltage range	VIN_3		0		5	V
CTL pin input current	IIN_3	$V_{IN} = V_{REF} = 1.65\text{ V}$	-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	$I_O = 0.6\text{ A}$, Source + Sink		1.8	2.2	V
Input voltage range	VIN_1		0		5	V
CTL pin input current	IIN_1	$V_{IN} = V_{REF} = 1.65\text{ V}$	-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	$I_O = 0.2\text{ A}$, Source + Sink		1.3	1.6	V
Input voltage range	VIN_4		0		5	V
CTL pin input current	IIN_4	$V_{IN} = V_{REF} = 1.65\text{ V}$	-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	$I_O = 1\text{ mA}$, 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.

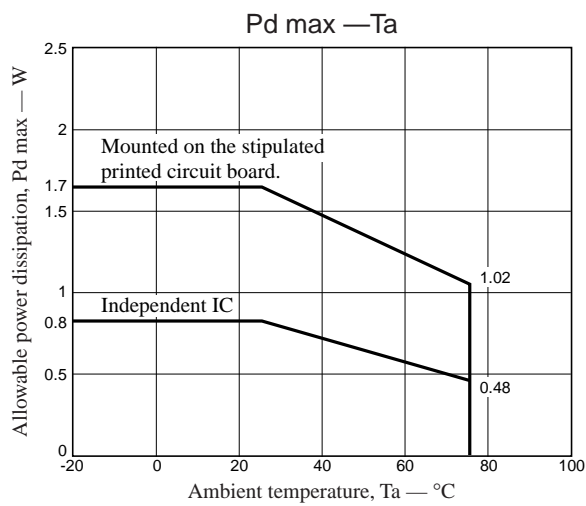
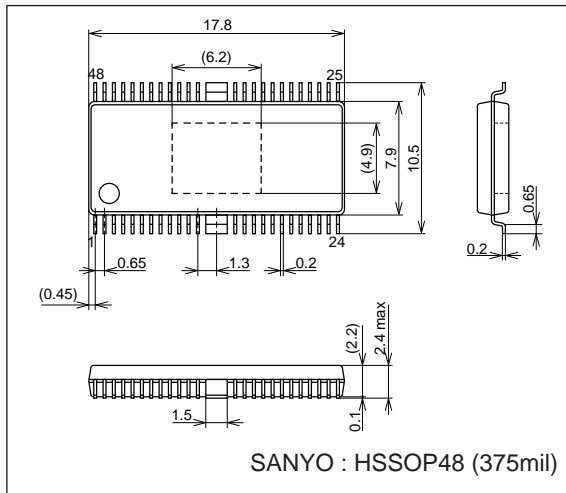
Mute Function

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

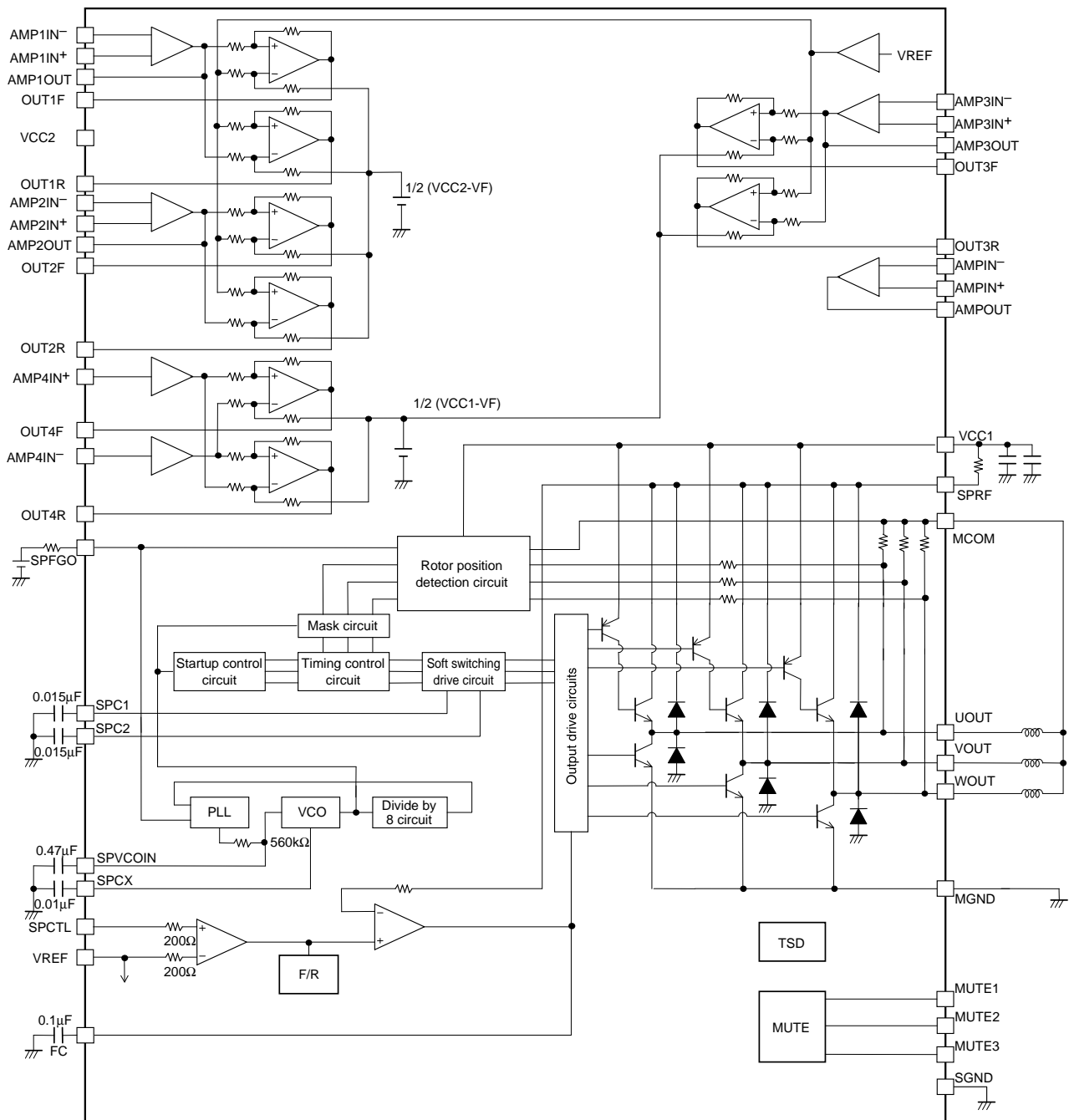
Package Dimensions

unit : mm

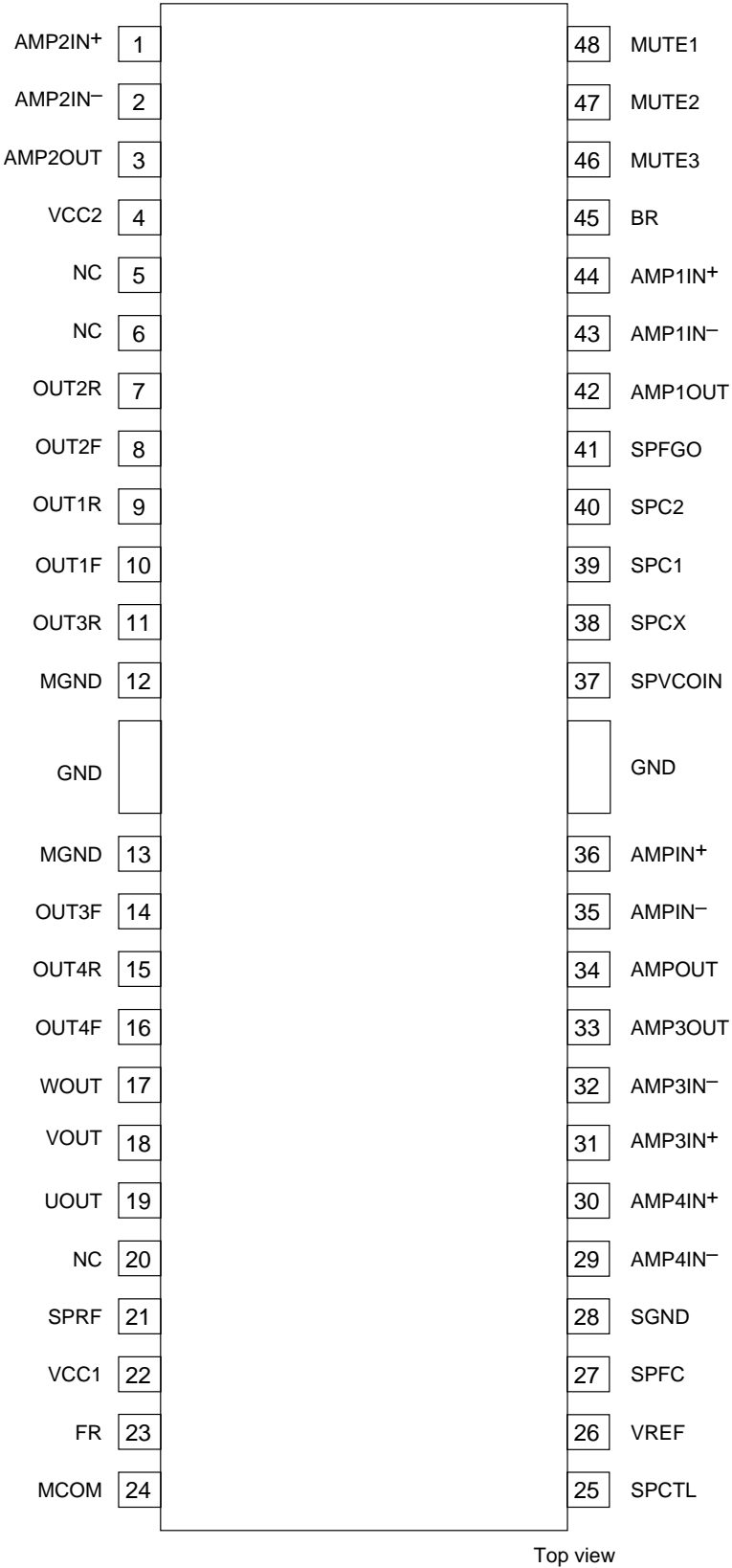
3278



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



Pin Assignment



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	

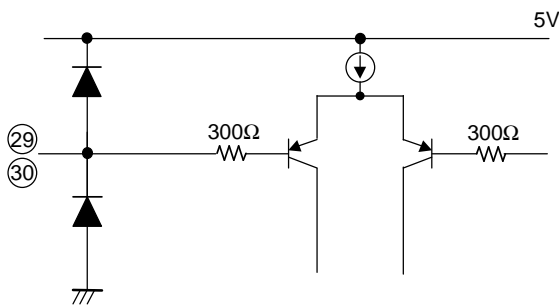
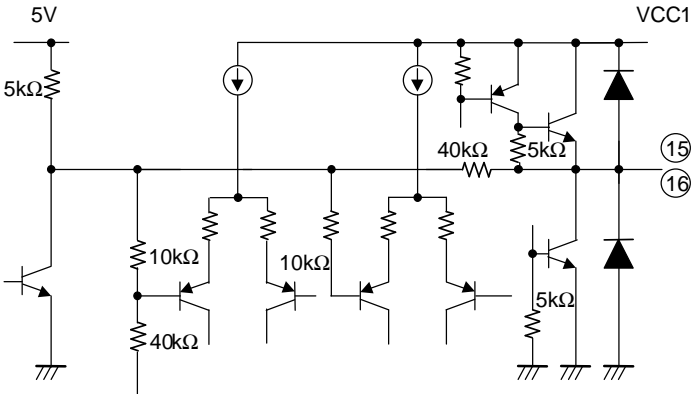
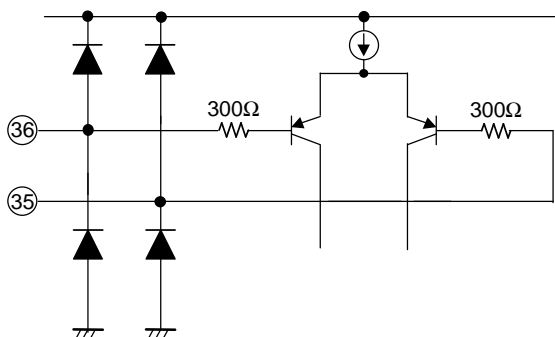
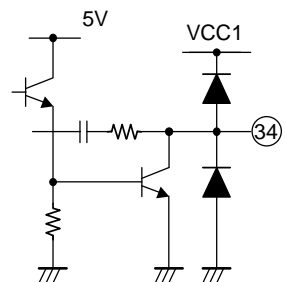
Continued on next page.

Continued from preceding page.

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	

Continued on next page.

Continued from preceding page.

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	

Continued on next page.

Continued from preceding page.

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.	

Continued on next page.

Continued from preceding page.

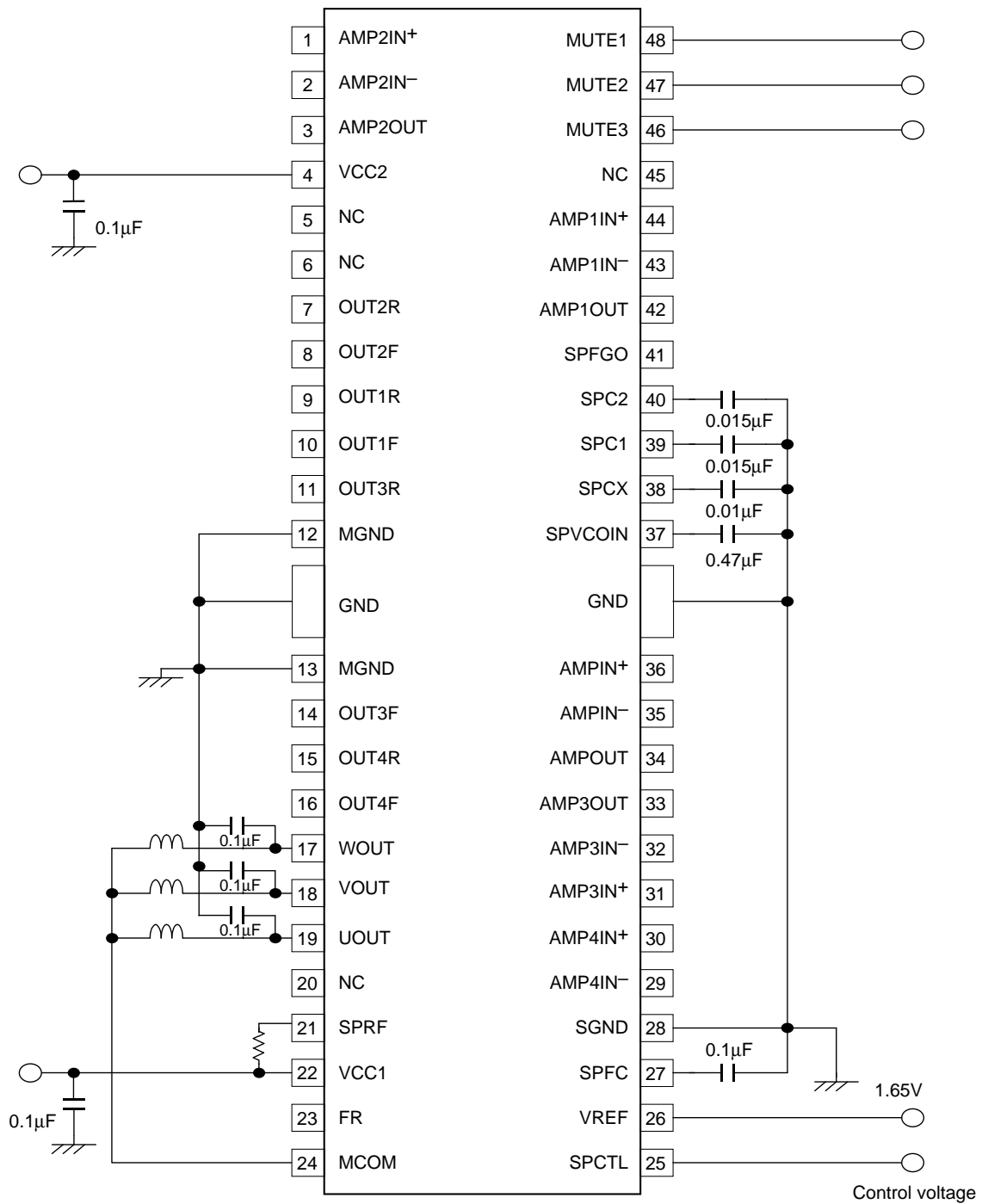
Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
27	SPFC		Frequency characteristics correction. Closed loop oscillator in the current control system can be prevented by inserting a capacitor between this pin and ground.	
25	SPCTL	0 V to 5 V	Spindle speed control. Control is implemented 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.	

Continued on next page.

Continued from preceding page.

Pin No.	Pin Name	Pin Voltage	Pin Description	Equivalent circuit
23	FR	0 V to V _{CC1}	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.

- Specifications of any and all SANYO products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- SANYO Electric Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO products(including technical data,services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of SANYO Electric Co., Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of April, 2004. Specifications and information herein are subject to change without notice.