



SANYO Semiconductors

# DATA SHEET

## LA6502 — Monolithic Linear IC 5ch driver for CD and DVD Spindle driver : 3-phase linear sensor-less drive BTL 4ch

### Overview

This LA6502 is a 5ch driver for CD and DVD Spindle driver : 3-phase linear sensor-less drive BTL 4ch.

### Features

- Spindle driver block
  - 1) 3-phase sensor-less motor driver
  - 2) Soft switching drive
  - 3) Analog input V type control
  - 4) Current limiter incorporated
  - 5) Counter electromotive FG output
  - 6) Reverse prevention circuit incorporated
- Threading, focusing, tracking, and loading blocks
  - 1) BTL-AMP type
- Common block
  - 1) Thermal shutdown circuit incorporated (design guarantee)
  - 2) MUTE function incorporated (pin 3)
  - 3) OP-AMP (1ch) incorporated (open collector output)

### Specifications

#### Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Motor Supply Voltage 1	V <sub>CC1</sub>	SPINDLE, SLED, LOADING power supply	14.5	V
Motor Supply Voltage 2	V <sub>CC2</sub>	FOCUS, TRACKING power supply	14.5	V
Allowable power dissipation	Pd max1	Independent IC	0.8	W
	Pd max2	Mounted on a specified board. *	1.7	W

\* Mounted on a board : 114.3×76.1×1.6mm<sup>3</sup>, glass epoxy board.

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Parameter	Symbol	Conditions	Ratings	Unit
Maximum input voltage	$V_{IN\ max}$		-0.3 to $V_{CC}+0.3$	V
Maximum output current 1	$I_O\ max1$	SPINDLE output	1.0	A
Maximum output current 2	$I_O\ max2$	SLED output	0.6	A
Maximum output current 3	$I_O\ max3$	FOCUS, TRACKING output	0.85	A
Maximum output current 4	$I_O\ max4$	LOADING output	0.6	A
Operating temperature	$T_{opr}$		-20 to +75	°C
Storage temperature	$T_{stg}$		-55 to +150	°C

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

Parameter	Symbol	Conditions	Ratings	Unit
Motor Supply Voltage 1	$V_{CC1}$	SPINDLE, SLED, LOADING power supply	4.5 to 13.8	V
Motor Supply Voltage 2	$V_{CC2}$	FOCUS, TRACKING power supply	4.5 to 13.8	V

## Electrical Characteristics at $T_a = 25^\circ\text{C}$ , $V_{CC1} = 8\text{V}$ , $V_{CC2} = 8\text{V}$ , $V_{REF} = 1.65\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
<b>Common</b>						
Current drain	$I_{CC}$	MUTE1, 2, 3 : H, $V_C = V_{REF}$		30	40	mA
Standby current	$I_{CCQ}$	MUTE1, 2, 3 : L		0.3	0.5	mA
VREF pin input voltage range	$V_{REF}$		1.0		3.3	V
VREF pin input current	$I_{VREF}$	$V_C = V_{REF} = 1.65\text{V}$	-0.2	-0.1		$\mu\text{A}$
MUTE1, 2, 3 L voltage	$V_{MUTE-L}$				0.5	V
MUTE1, 2, 3 H voltage	$V_{MUTE-H}$		2.8		4.5	V
MUTE1, 2, 3 input current	$I_{MUTE}$	$V_{MUTE} = 3\text{V}$		60	100	$\mu\text{A}$
Thermal shutdown operation temperature	TSD	Designed target value	150	180	210	°C
Thermal shutdown hysteresis width	$\Delta\text{TSD}$	Designed target value		40		°C
Note) Design guarantee values, not measured.						
<b>Spindle Driver</b>						
Output saturation voltage	$V_{OSAT\_SP}$	$I_O = 0.5\text{A}$ , Source+Sink		1.8	2.4	V
CTL pin input voltage range	$V_{CTL\_SP}$		0		5	V
CTL pin input current	$I_{VCTL\_SP}$	$V_C = V_{REF} = 1.65\text{V}$		-0.2	-0.5	$\mu\text{A}$
Control gain	$G_{VCO\_SP}$		0.29	0.34	0.39	V/V
Control dead zone width 1	$V_{CDZ1\_SP}$	Forward		+90	150	mV
Control dead zone width 2	$V_{CDZ2\_SP}$	Revers	-150	-90		mV
Current limiter voltage	$V_{LIM\_SP}$		0.36	0.4	0.44	V
VCOIN input current	$I_{VCOIN\_SP}$	$V_{COIN} = 3\text{V}$			1	$\mu\text{A}$
VCO min frequency	$F_{VCOMIN\_SP}$	$CX = 0.01\mu\text{F}$ , $V_{COIN} = \text{OPEN}$	0.35	0.45	0.55	kHz
VCO max frequency	$F_{VCOMAX\_SP}$	$CX = 0.01\mu\text{F}$ , $V_{COIN} = 5\text{V}$	36	40	44	kHz
C1,C2 source current ratio	$R_{SOURCE\_SP}$	$1-(I_{C1\ SOURCE}/I_{C2\ SOURCE})$	-10		10	%
C1,C2 sink current ratio	$R_{SINK\_SP}$	$1-(I_{C1\ SINK}/I_{C2\ SINK})$	-10		10	%
C1 source, sink current ratio	$R_{C1\_SP}$	$I_{C1\ SOURCE}/I_{C1\ SINK}$	40		60	%
C2 source, sink current ratio	$R_{C2\_SP}$	$I_{C2\ SOURCE}/I_{C2\ SINK}$	40		60	%
FGO pin H voltage	$V_{FGOH\_SP}$	FGO resistance $20\text{k}\Omega$ , 5V pull-up	4.8			V
FGO pin L voltage	$V_{FGOL\_SP}$	FGO resistance $20\text{k}\Omega$ , 5V pull-up		0.15	0.4	V
FR pin input voltage range	$V_{FR}$		0		5	V
FR pin input current	$I_{FR}$	$V_{FR} = 3\text{V}$		54	100	$\mu\text{A}$
<b>Thread driver (AMP3)</b>						
Output saturation voltage	$V_{OSAT\_3}$	$I_O = 0.3\text{A}$ , Source+Sink		1.5	1.8	V
Input voltage range	$V_{IN\_3}$		0		5	V
CTL pin input current	$I_{IN\_3}$	$V_{IN} = V_{REF} = 1.65\text{V}$	-0.5	-0.1		$\mu\text{A}$
Current gain	$G_{VCO\_3}$		17.8	18.7	19.6	dB
Output offset voltage	$V_{OFF\_3}$	Note)	-50	0	50	mV

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
<b>Focusing and tracking drivers (AMP1, 2)</b>						
Output saturation voltage	$V_{OSAT\_1}$	$I_O = 0.6A$ , Source+Sink		1.8	2.2	V
Input voltage range	$V_{IN\_1}$		0		5	V
CTL pin input current	$I_{IN\_1}$	$V_{IN} = V_{REF} = 1.65V$	-0.5	-0.1		$\mu A$
Control gain	GVC0_1		11.6	12.7	13.8	dB
Output offset voltage	$V_{OFF\_1}$	Note)	-50	0	50	mV
<b>Loading driver (AMP4)</b>						
Output saturation voltage	$V_{OSAT\_4}$	$I_O = 0.2A$ , Source+Sink		1.3	1.6	V
Input voltage range	$V_{IN\_4}$		0		5	V
CTL pin input current	$I_{IN\_4}$	$V_{IN} = V_{REF} = 1.65V$	-0.5	-0.2		$\mu A$
Control gain	GVC0_4		17.8	18.7	19.6	dB
Output offset voltage	$V_{OFF\_4}$	Note)	-50	0	50	mV
<b>OP-AMP</b>						
Output L voltage	$V_{OL\_5}$	$I_O = 1mA$ , Sink		0.2	0.4	V
Input voltage range	$V_{IN\_5}$		0		5	V
Input offset voltage	$V_{IOFF\_5}$		-5	0	5	mV

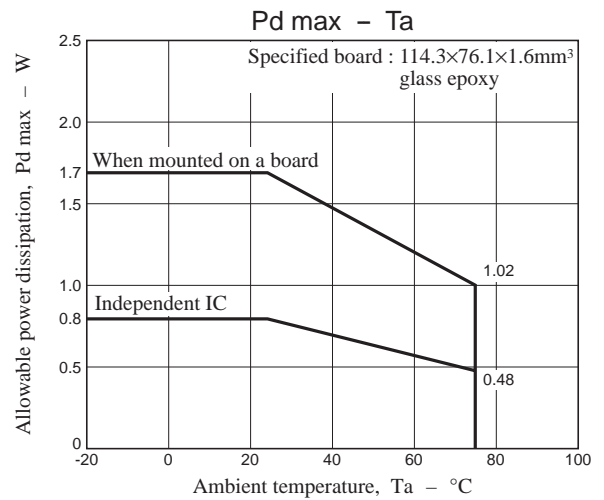
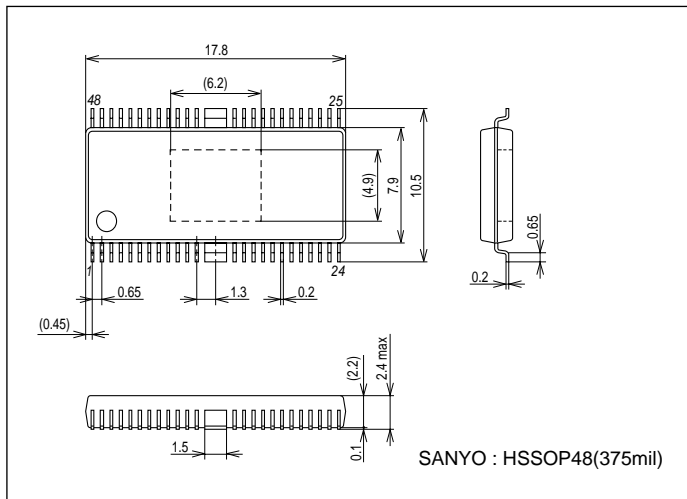
Note) The pre-OPAMP in the previous stage is used as buffer.

MUTE function	Mode
MUTE1 : H	SPINDLE : ON
MUTE2 : H	FOCUS, TRACKING, SLED : ON
MUTE3 : H	LOADENG : ON

## Package Dimensions

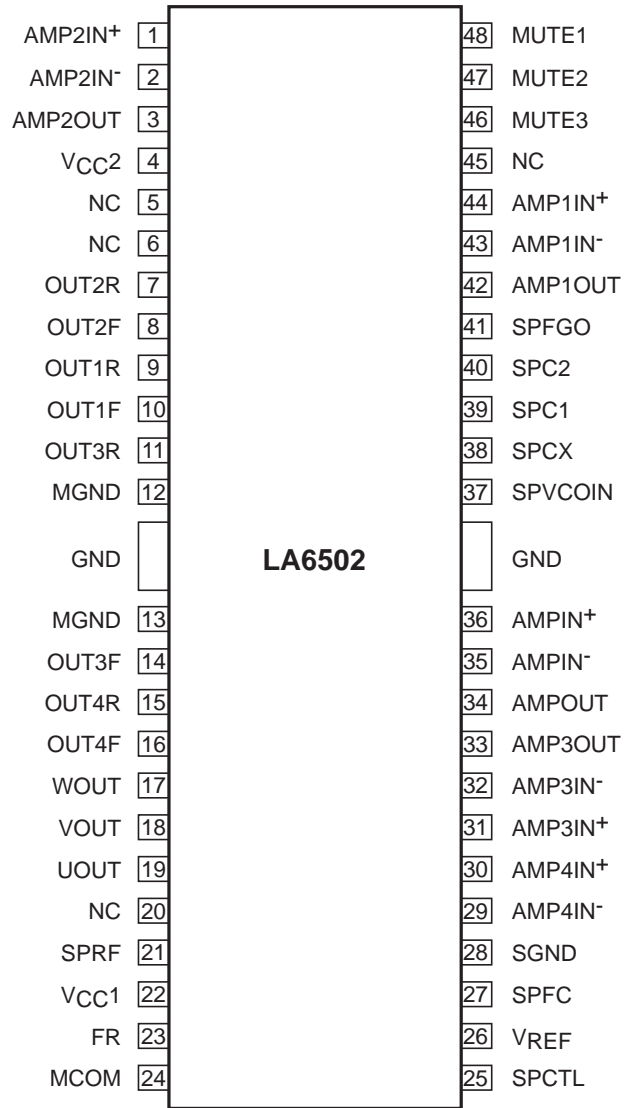
unit : mm (typ)

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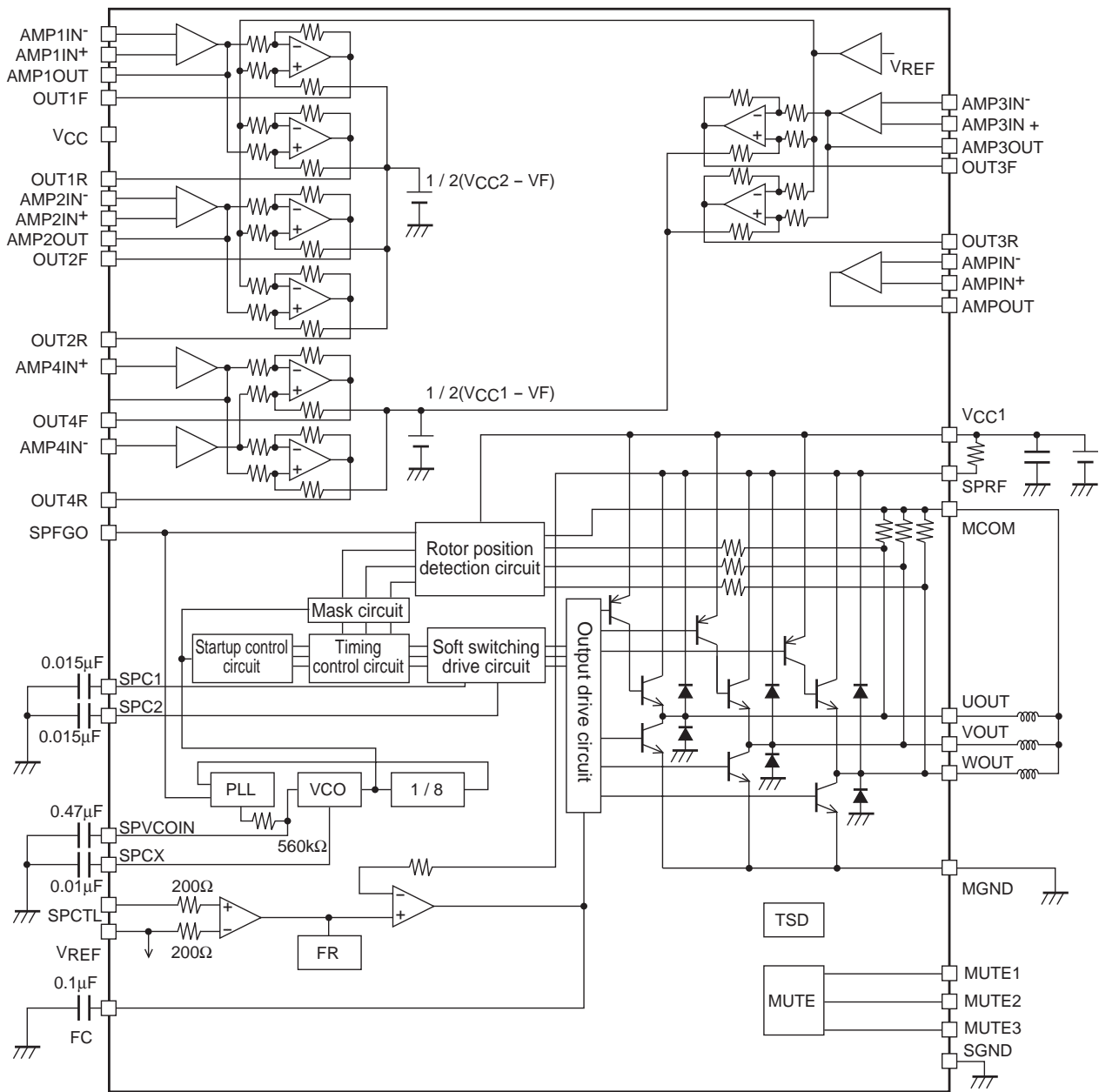
## Pin Assignment



Top view

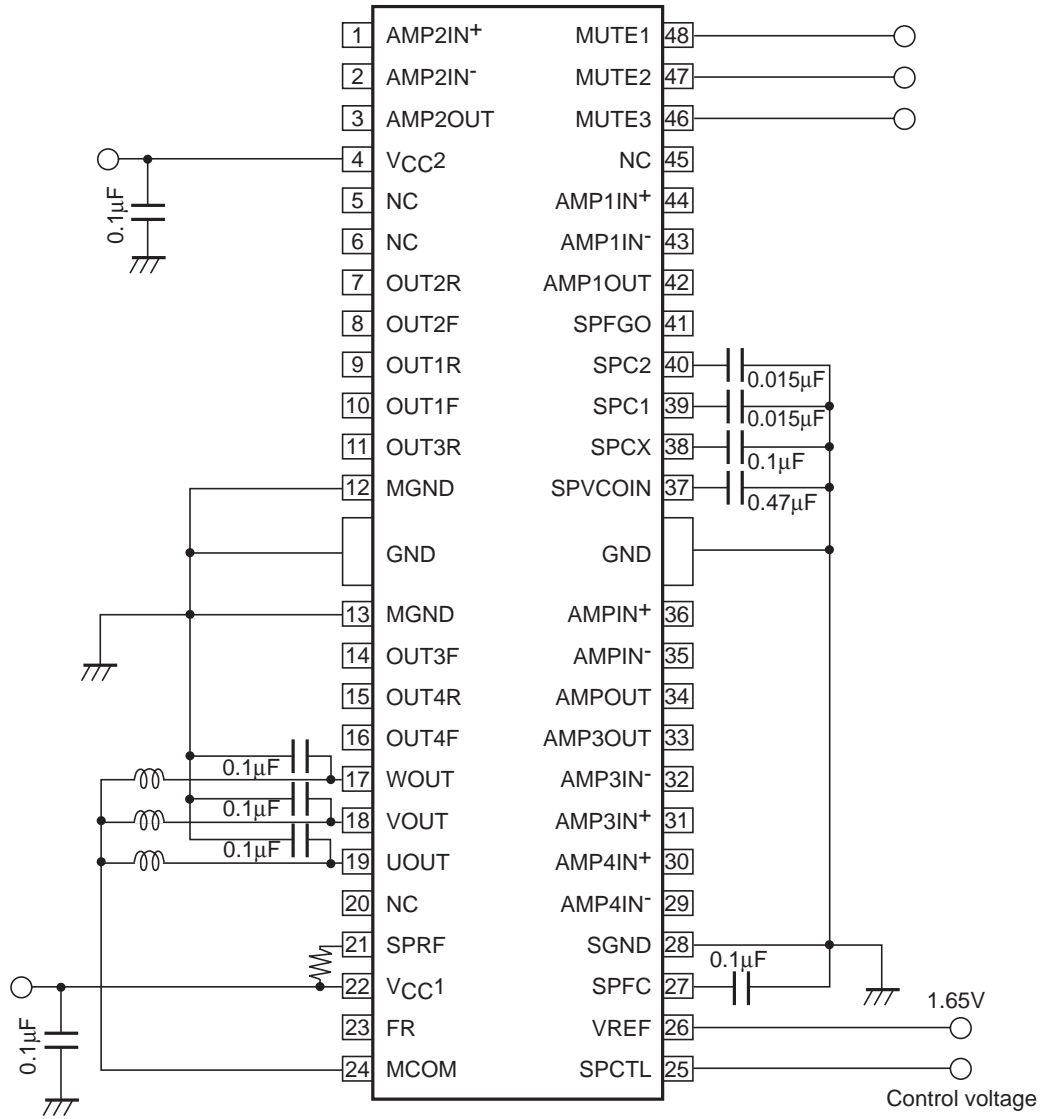
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**Block Diagram** (In certain applications, snubber may be added to the spindle motor coil output.)



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## Sample Application Circuit (Spindle Block)



Note) The external constant is for reference only and the optimum constant may differ from one motor to another.

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## Pin Function

Pin No.	Pin name	Function	Pin voltage	Equivalent circuit
22	V <sub>CC1</sub>	Power pin to provide the voltage of all other than BTL-AMP1 and 2 output transistors.	4.5 to 13.8	
4	V <sub>CC2</sub>	Power pin of the BTL-AMP1 and 2 outputs.	4.5 to 13.8	
28	SGND	GND for all other than output.		
12 13	MGND	Output GND other than spindle		
46	MUTE3	MUTE function control pin.  MUTE : H ⇒ Motor drive MUTE : L ⇒ drive OFF	0V to 4V	
47	MUTE2	"H" is for 2.8V or more. "L" is for 0.5V or less.		
48	MUTE1	MUTE1 : SP MUTE2 : BTL1, 2, 3 MUTE3 : BTL4		
1	AMP2IN <sup>+</sup>	OP-AMP non-inverted input pin.	0V to 5V	
2	AMP2IN <sup>-</sup>	OP-AMP inverted input pin.		
3	AMP2OUT	OP-AMP output pin.		
8	OUT2F	BTL-AMP Forward output pin		
7	OUT2R	BTL-AMP Reverse output pin		
44	AMP1IN <sup>+</sup>	OP-AMP non-inverted input pin.	0V to 5V	
43	AMP1IN <sup>-</sup>	OP-AMP inverted input pin.		

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Pin No.	Pin name	Function	Pin voltage	Equivalent circuit
42	AMP1OUT	OP-AMP output pin.		
10	OUT1F	BTL-AMP Forward output pin.		
9	OUT1R	BTL-AMP Reverse output pin.		
31	AMP3IN+	OP-AMP non-inverted input pin.	0V to 5V	
32	AMP3IN-	OP-AMP inverted input pin.		
33	AMP3OUT	OP-AMP output pin of previous stage.		
14	OUT3F	BTL-AMP Forward output pin.		
11	OUT3R	BTL-AMP Reverse output pin.		
30	AMP4IN+	non-inverted input pin.	0.3V to 5V	
29	AMP4IN-	BTL-4ch reference voltage pin	1V to 4V	
16	OUT4F	BTL-AMP Forward output pin.		
15	OUT4R	BTL-AMP Reverse output pin.		

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Pin No.	Pin name	Function	Pin voltage	Equivalent circuit
36	AMPIN <sup>+</sup>	OP-AMP non-inverted input pin.	0V to 5V	
35	AMPIN <sup>-</sup>	OP-AMP inverted input pin.		
34	AMPOUT	OP-AMP output pin.		
19	SPUOUT	Spindle motor driver output pin.		
18	SPVOOUT			
17	SPWOUT			
21	SPRF	Spindle motor driver output transistor power pin Detects this voltage for constant current control /The current limiter also detects this potential and is activated.		
24	MCOM	Spindle motor coil mid-point input pin Detects the coil voltage waveform with reference to this voltage.		
39	SPC1	Spindle triangular wave generating capacitor connection pin With this triangular wave, the coil output waveform is soft switched.		
40	SPC2			

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Pin No.	Pin name	Function	Pin voltage	Equivalent circuit
38	SPCX	With the value of a capacitor connected between this pin and GND in the spindle VCO circuit, the operation frequency range and minimum operation frequency are determined.		
27	SPFC	Frequency characteristics compensation pin. With a capacitor inserted between this pin and GND, oscillation of the current control system closed loop can be stopped.		
25	SPCTL	Spindle speed control pin Control is the constant current control by applying current return from DRS.	0V to 5V	
26	VREF	Spindle speed control reference pin BTLAMP internal VREF buffer input pin.	1V to 3.3V	
41	SPFGO	Spindle motor counter electromotive voltage detection FG output pin (synthesis of three phases)		
37	SPVCOIN	Drum block VCO circuit voltage input pin PCOUT pin voltage is filtered with CR for input.		

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Pin No.	Pin name	Function	Pin voltage	Equivalent circuit
23	FR	Spindle block V-type control switching pin.  FR : H $\Rightarrow$ VREF < SPCTL drive FR : L $\Rightarrow$ VREF < SPCTL drive  "H" is for 2.8V or more. "L" is for 0.5V or less.	0V to V <sub>CC1</sub>	

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