

# AN8290NS

## Spindle Motor PWN Driver

### Overview

The AN8290NS is a brushless motor drive IC with the PWM (Pulse Width Modulation) method employed. It is suitable for driving the spindle motors of the compact disc players, and so on.

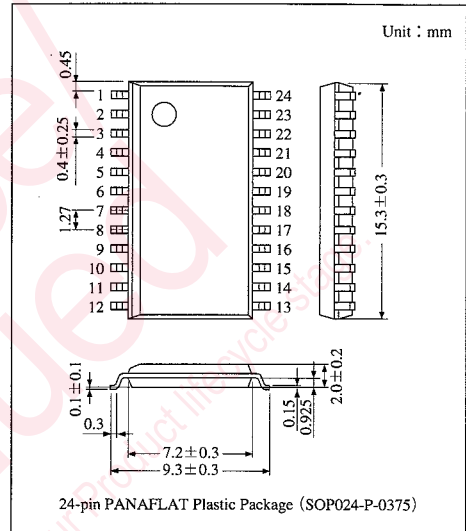
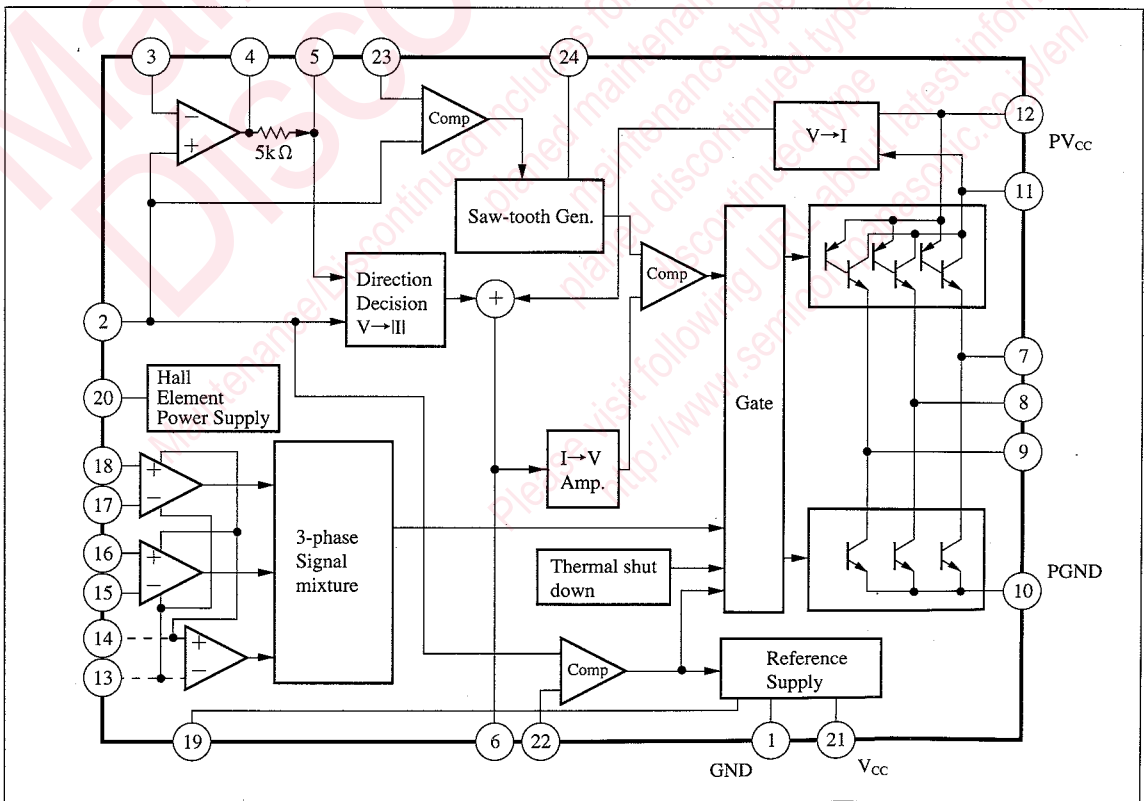
### Features

- Operating supply voltage range :  $V_{CC}=4.5$  to  $20V$
- Low power consumption due to 3-phase full-wave PWM drive
- Position detection enabled by the two Hall elements
- Stable control loop by the current feedback circuit
- Stable circuit operation against supply voltage change and temperature change due to the built-in stabilized power supply
- Built-in thermal protective circuit

### Applications

Driving the brushless motors such as compact disc player spindle motors, and so on

### Block Diagram



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### ■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	21	V
Supply current	I <sub>CC</sub>	20	mA
Power dissipation	P <sub>D</sub>	560	mW
Operating ambient temperature	T <sub>opr</sub>	-20 to +75	°C
Storage temperature	T <sub>stg</sub>	-55 to +125	°C

### ■ Recommended Operating Range (Ta=25°C)

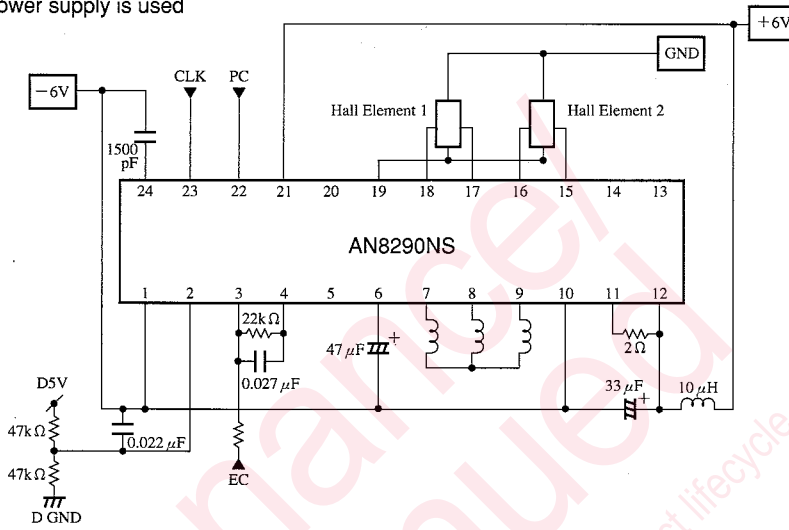
Parameter	Symbol	Range
Operating supply voltage range	V <sub>CC</sub>	4.5V to 20V

### ■ Electrical Characteristics (Ta=25°C)

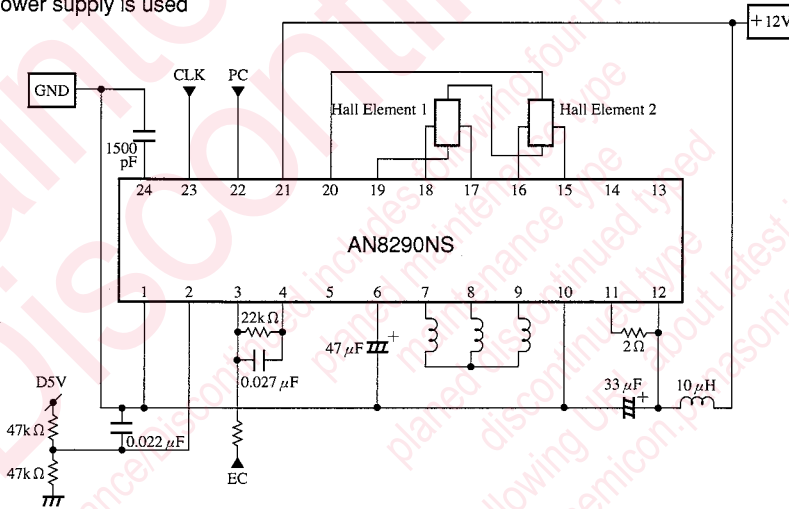
Parameter	Symbol	Condition	min	typ	max	Unit
No-load total current	I <sub>total</sub>	V <sub>CC</sub> =12V	7	9	11	mA
Power down mode total current	I <sub>PD</sub>	V <sub>CC</sub> =12V	—	—	1	mA
Output amplitude (1)	V <sub>out1</sub>	V <sub>CC</sub> =12V	8.5	—	—	V
Output amplitude (2)	V <sub>out2</sub>	V <sub>CC</sub> =12V	-0.05	0.001	0.05	V
Limit voltage (1)	V <sub>LF</sub>	V <sub>CC</sub> =12V	0.5	0.55	0.7	V
Limit voltage (2)	V <sub>LR</sub>	V <sub>CC</sub> =12V	0.5	0.53	0.7	V
Idle voltage	V <sub>I</sub>	V <sub>CC</sub> =12V	—	1	20	mV
Driver offset voltage (1)	V <sub>OF</sub>	V <sub>CC</sub> =12V	—	—	100	mV
Driver offset voltage (2)	V <sub>OR</sub>	V <sub>CC</sub> =12V	—	—	100	mV
PWM output (1)	T <sub>P(1-2)</sub>	V <sub>CC</sub> =12V, V <sub>FA1</sub> =9.9V, V <sub>FA1</sub> =9.7V	140	200	260	mV
PWM output (2)	T <sub>P(2-2)</sub>	V <sub>CC</sub> =12V, V <sub>FA1</sub> =9.1V, V <sub>FA1</sub> =9.3V	140	200	260	mV
Saw-tooth wave amplitude value	V <sub>KA</sub>	V <sub>CC</sub> =12V	0.7	0.9	1.1	V
Saw-tooth wave offset voltage	V <sub>KO</sub>	V <sub>CC</sub> =12V	1.8	1.95	2.1	V
Hall bias voltage	V <sub>HB</sub>	V <sub>CC</sub> =12V, I <sub>HA</sub> =0mA	1.7	2.2	2.5	V
Hall switch saturation voltage	V <sub>HS</sub>	V <sub>CC</sub> =12V, I <sub>HIS</sub> =10mA	—	—	1.2	V
Switching offset	V <sub>OF</sub>	V <sub>CC</sub> =12V	—	—	25	mV

■ Application Circuit

i) When  $\pm$ power supply is used



ii) When +power supply is used



■ Pin Descriptions

Pin No.	Symbol	Description	I/O	DC Voltage V <sub>CC</sub> /12V	Equivalent Circuit
1	GND	GND pin	I	0V	—
2	DCR	Input pin for reference voltage and to compare the PC (Pin②) and CLK (Pin⑬) (typ. 2.5V)	I	2.5V	
3	FAI	Torque command filter/amp. input pin. Forward rotation specified when FAI < DCR	I	2.5V	
4	FAO	Filter/amp. output pin	O	2.5V	
5	DI	Absolute value circuit input pin	I	2.5V	
6	LPF	Current feedback loop phase compensating capacitor connection pin	I	1.4V	

**Pin Descriptions (Cont.)**

Pin No.	Symbol	Description	I/O	DC Voltage V <sub>cc</sub> /12V	Equivalent Circuit
7	A <sub>1</sub>	Drive output pin	O	—	
8	A <sub>2</sub>	Drive output pin	O	—	
9	A <sub>3</sub>	Drive output pin	O	—	
11	CS	Drive current detecting resistor connection pin	I	11.8V	
12	PV <sub>cc</sub>	Power pin for large current circuit	I	12V	
10	PGND	GND pin for large current circuit	I	0V	
13	H3 <sup>-</sup>	Hall voltage input pin (reverse) when 3 Hall elements are used (reverse). Open when 2 Hall elements are used	I	—	
14	H3 <sup>+</sup>	Hall voltage input pin (forward) when 3 Hall elements are used (reverse). Open when 2 Hall elements are used	I	—	
15	H2 <sup>-</sup>	Hall voltage input (reverse) pin	I	—	
16	H2 <sup>+</sup>	Hall voltage input (forward) pin	I	—	
17	H1 <sup>-</sup>	Hall voltage input (reverse) pin	I	—	
18	H1 <sup>+</sup>	Hall voltage input (forward) pin	I	—	
19	HSW	Hall element bias switch. OFF when PC > DCR	I	0V	
20	HB	Hall element bias voltage output	O	2V	

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**Supplementary Explanation**

(1) Motor setting conditions

(A) Relationship between drive output and Hall element

● Fig.1 shows the relationship between the drive output voltage and Hall element output when forward rotation is specified.

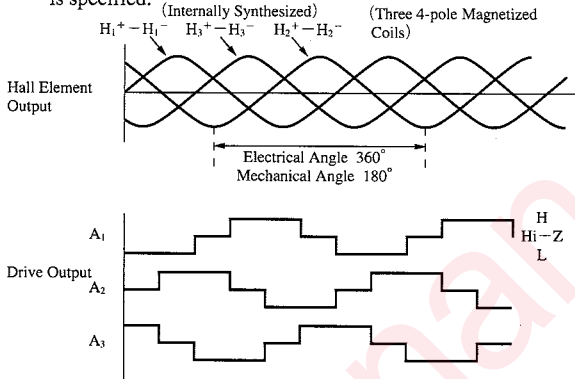


Fig.1 Output and Hall Element Output

● The output voltage is given an opposite sign when reverse rotation is specified

(B) Hall element position

● Fig.2 shows the three 4-pole magnetized coils.

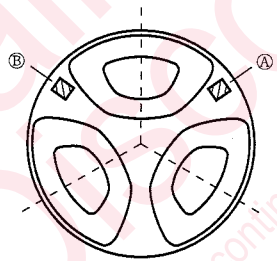


Fig.2 Hall Element Position

● Since the AN8290NS synthesizes signals corresponding to the three elements inside the IC, it can detect a position through the two Hall elements.

● When configured with the two Hall elements, make adjustment so that their output waveform will be shaped like a sine wave as much as possible.

The IC does not work with a trapezoidal wave.

Input D range 2V to  $V_{CC} - 2V_{BE} - V_{CE(sat)}$

(C) Maximum drive current

● The maximum drive current  $I_{max}$  is determined by the coil series resistor  $R_L$  and  $V_{CC}$ . Assuming that the voltage applied to the IC (saturation voltage of the built-in transistor, etc.) is about 2V, it is expressed as follows.

$$I_{max} = \frac{V_{CC} - 2V}{R_L}$$

The AN8290NS incorporates the current limiting circuit and can set a limit current. (Refer to the below)

(2) Limit Current

● The drive current is detected by the detection resistor  $R_S$  and is limited by a voltage drop of about 0.6V from  $V_{CC}$  at the Pin⑩. Therefore, the limit current  $I_L$  is given by the following expression.

$$I_L \approx \frac{0.6(V)}{R_S}$$

● Set the limit current to 300mA or less.

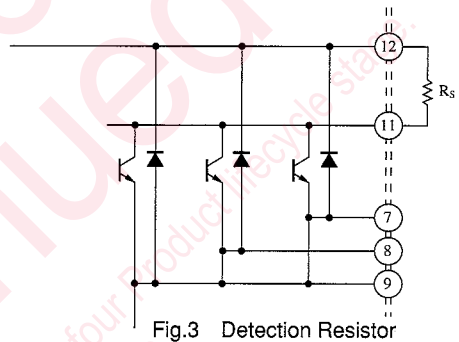


Fig.3 Detection Resistor

(3) Saw-tooth wave generator

● Fig.4 shows the relationship between the input signal to the Pin⑳ and the output waveform of the Pin㉔.

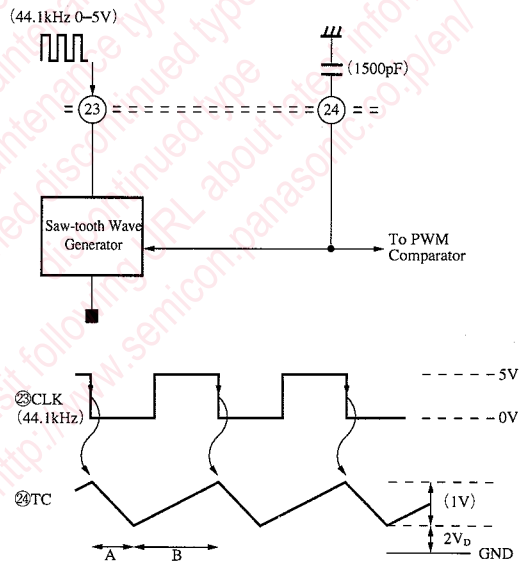


Fig.4 Saw-tooth Wave Generator

● At a fall of CLK, the voltage of the Pin㉔ is discharged by a 0.2mA sink current. When the Pin㉔ comes lower than  $2V_D$ , the internal comparator is inverted and the capacitor of the Pin㉔ is charged by a 0.1mA source current.

ICs for Motor

■ Supplementary Explanation (Cont.)

- The crest value of the saw-tooth wave is determined by an input signal frequency to the Pin②③, IC sink/source current, and capacitor of the Pin④.
- Assuming that the input signal frequency to the Pin②③ is 44.1kHz and the capacitor of the Pin④ is 1,500pF, the crest value of the saw-tooth wave crest value is about 1V.

(4) Current feedback loop

- Fig.5 shows a current feedback loop incorporated to obtain a stable CLV loop against disturbances such as supply voltage change and load change.
- The external capacitor  $C_{LPF}$  of the Pin⑥ is for phase compensation of this feedback loop.

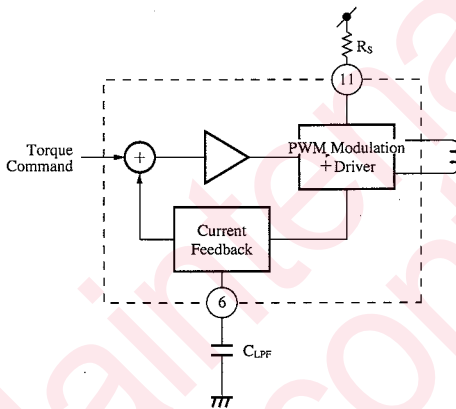


Fig.5 Current Feedback Loop

(5) DCR reference voltage

- DCR is used as a servo reference voltage, and a PC-CLK comparison voltage.

(6) Filter amplifier

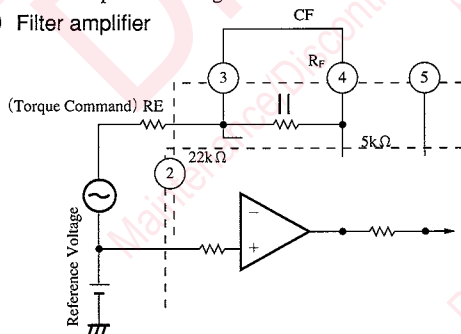


Fig.6 Ripple Filter

- This IC incorporates an operational amplifier. When a torque command is PWM input, it is used as a ripple filter. (Refer to Fig.6) In case of linear input, it is available as a phase compensating amplifier, etc.

(7) PV<sub>CC</sub> noise elimination

- Since a large ripple current (44.1kHz) flows to PV<sub>CC</sub>, it

is recommended to eliminate noise with an LC filter.

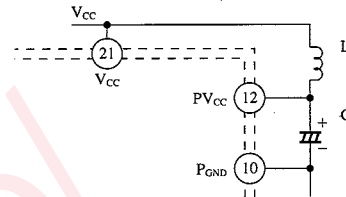


Fig.7 Noise Elimination

(8) Power down mode

- Inputting "H" to the Pin②② for DCR turns off the entire constant current inside the IC and turns off the output pins simultaneously. The then supply current  $I_{21}$  is 1mA or less. In normal operation, input "L" to the Pin②②.

(9) Hall switch

- The Pin①⑨ is an open collector pin. It is turned off when the Pin②② is at "H", and turned on when the Pin②② is at "L".

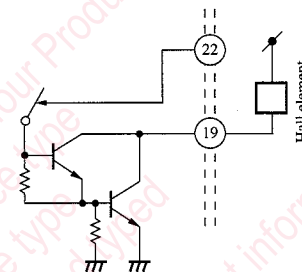


Fig.8 Hall Switch

(10) Drive gain

- The Pin⑤ is a torque command input pin (input to the absolute value circuit). If a difference voltage  $V_{5-2}$  from DCR is input from the Pin⑤, the Pins⑦, ⑧ and ⑨ function in the mode corresponding to the input of the Pins①⑤ through ①⑧, and if a detection resistor is connected to the Pin①① and PV<sub>CC</sub>, an output current can be detected as a voltage. The drive gain  $G$  is defined by the following expression.

$$G = \frac{V_{12-11}}{V_{5-2}}$$

In this IC,  $G=1$ .

(11) Hall bias

- This IC incorporates the bias power supply (up to 2V) for the Hall elements.

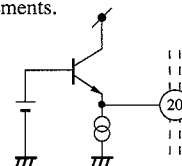


Fig.9 Hall Bias

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