AN8290NS

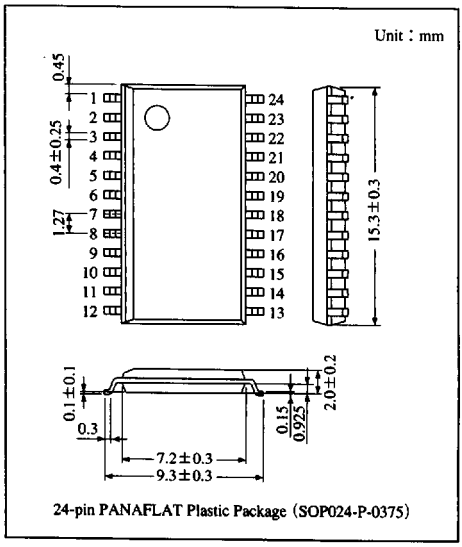
Spindle Motor PWN Driver

■ 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 termal protective circuit

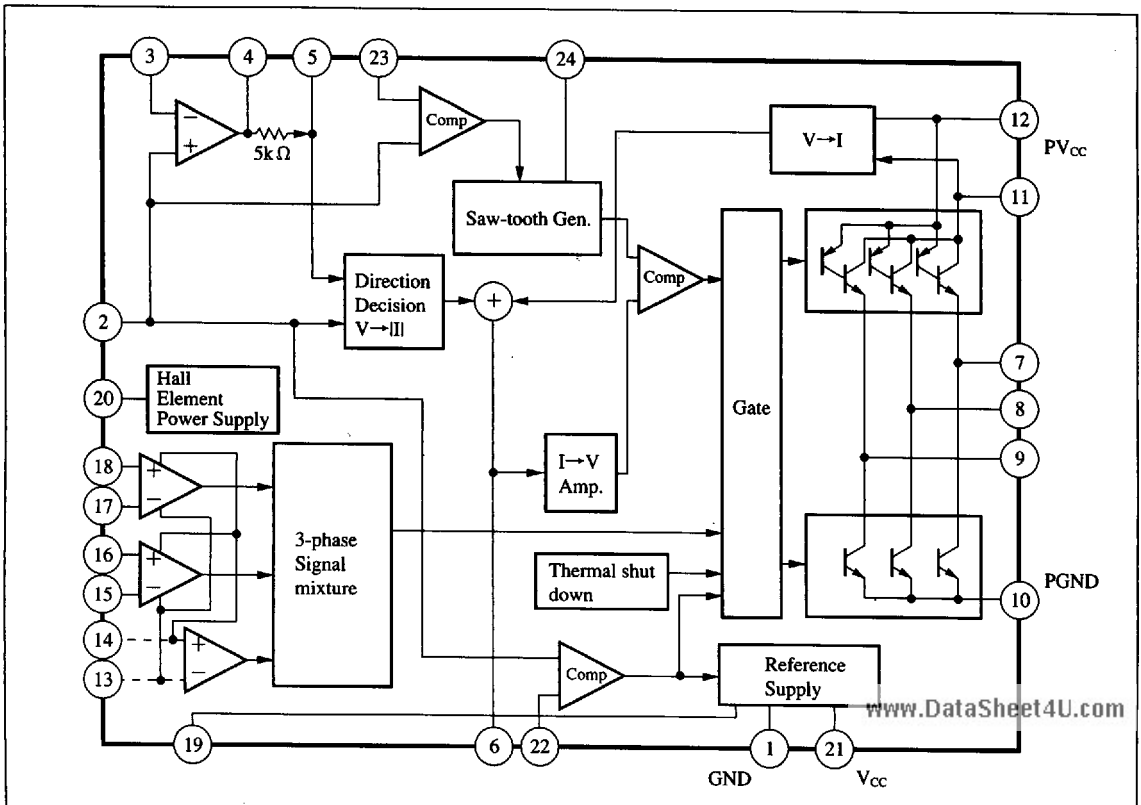


24-pin PANAFLAT Plastic Package (SOP024-P-0375)

■ Applications

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

■ Block Diagram



■ Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	21	V
Supply current	I_{CC}	20	mA
Power dissipation	P_D	560	mW
Operating ambient temperature	T_{opr}	−20 to +75	℃
Storage temperature	T_{stg}	−55 to +125	℃

■ Recommended Operating Range (Ta=25℃)

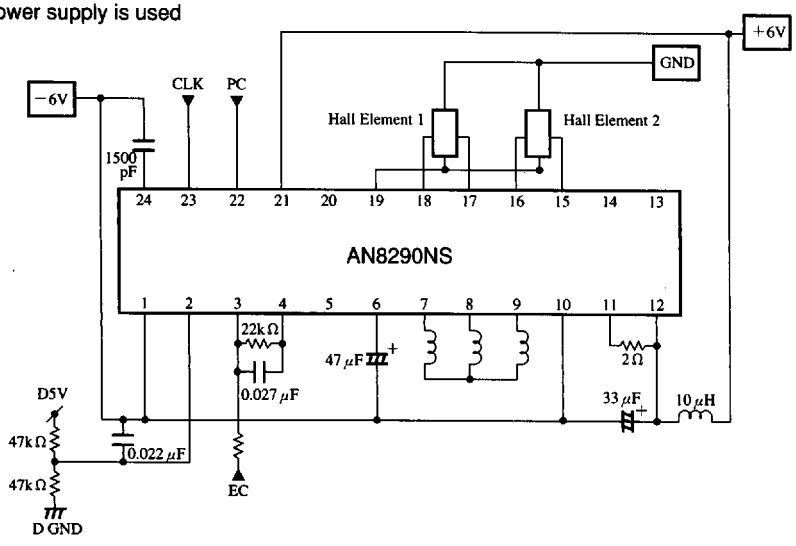
Parameter	Symbol	Range
Operating supply voltage range	V_{CC}	4.5V to 20V

■ Electrical Characteristics (Ta=25℃)

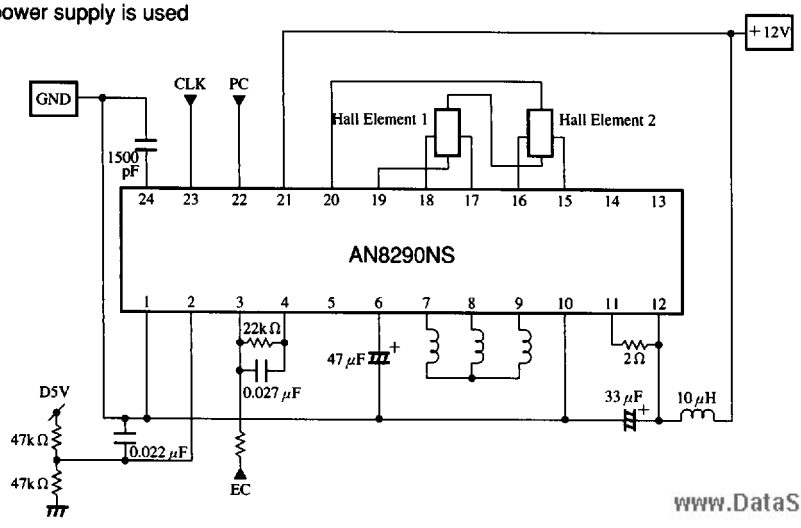
Parameter	Symbol	Condition	min	typ	max	Unit
No-load total current	I_{total}	V_{CC}=12V	7	9	11	mA
Power down mode total current	I_{PD}	V_{CC}=12V	—	—	1	mA
Output amplitude (1)	V_{out1}	V_{CC}=12V	8.5	—	—	V
Output amplitude (2)	V_{out2}	V_{CC}=12V	−0.05	0.001	0.05	V
Limit voltage (1)	V_{LF}	V_{CC}=12V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

■ Application Circuit

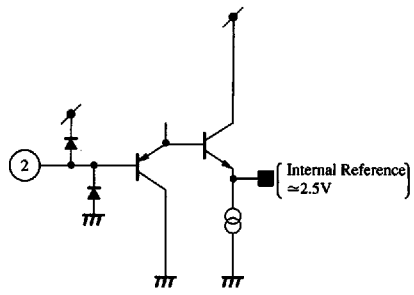
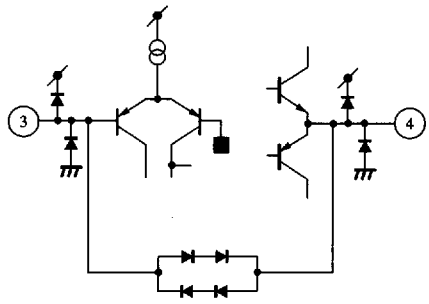
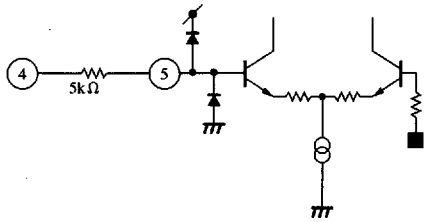
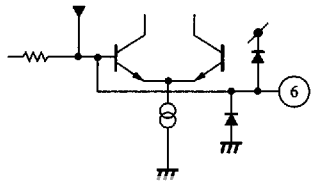
i) When ±power supply is used



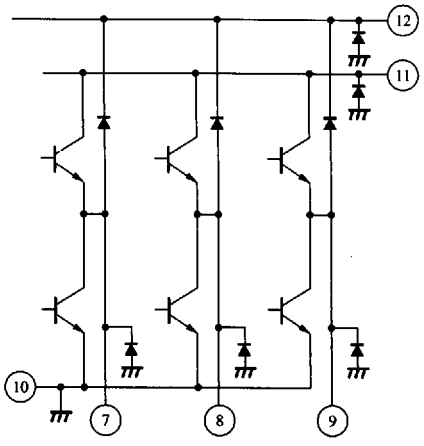
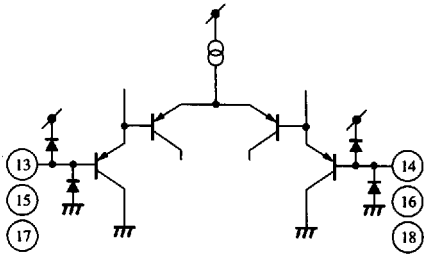
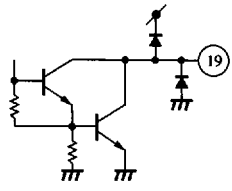
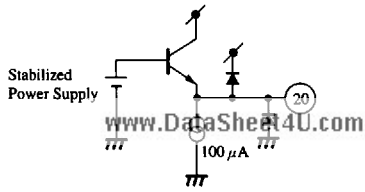
ii) When +power supply is used



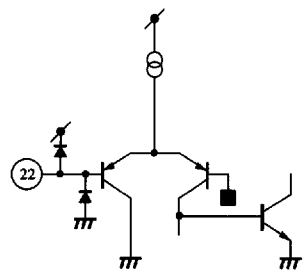
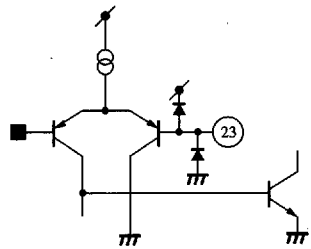
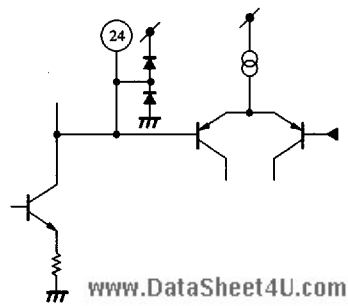
■ Pin Descriptions

Pin No.	Symbol	Description	I/O	DC Voltage V_{CC}/12V	Equivalent Circuit
1	GND	GND pin	I	0V	———
2	DCR	Input pin for reference voltage and to compare the PC (Pin㉒) 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_{CC}/12V	Equivalent Circuit
7	A_1	Drive output pin	O	—	
8	A_2	Drive output pin	O	—	
9	A_3	Drive output pin	O	—	
11	CS	Drive current detecting resistor connection pin	I	11.8V	
12	PV_{CC}	Power pin for large current circuit	I	12V	
10	PGND	GND pin for large current circuit	I	0V	
13	$H3^-$	Hall voltage input pin (reverse) when 3 Hall elements are used (reverse). Open when 2 Hall elements are used	I	—	
14	$H3^+$	Hall voltage input pin (forward) when 3 Hall elements are used (reverse). Open when 2 Hall elements are used	I	—	
15	$H2^-$	Hall voltage input (reverse) pin	I	—	
16	$H2^+$	Hall voltage input (forward) pin	I	—	
17	$H1^-$	Hall voltage input (reverse) pin	I	—	
18	$H1^+$	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	

■ Pin Descriptions (Cont.)

Pin No.	Symbol	Description	I/O	DC Voltage V_{CC}/12V	Equivalent Circuit
21	V_{CC}	Supply voltage input pin	I	12V	———
22	PC	Power control input pin. Power down mode when PC > DCR	I	0V	
23	CLK	Trianglar wave generating clock input pin. DCR reference. Operates at a rise edge.	I	2.5V	
24	TC	Saw-tooth wave oscillating capacitor connection pin	I	1.95V	

■ 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.

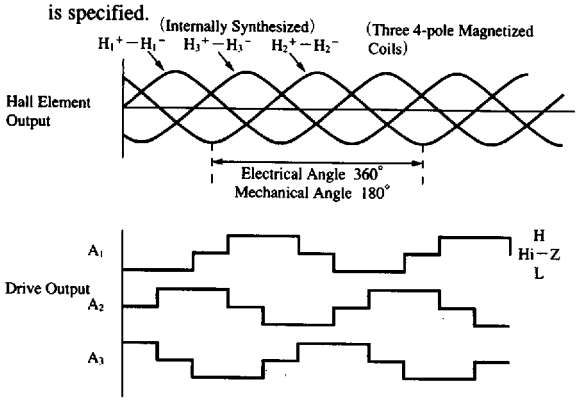


Fig.1 Output and Hall Element Output

●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.

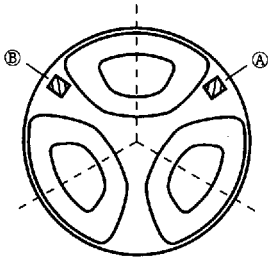


Fig.2 Hall Element Position

●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 wavefrom 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 of about 0.6V from PV_{CC} at the Pin⑪. Therefore, the limit current I_L is given by the following expression.

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

●Set the limit current to 300mA or less.

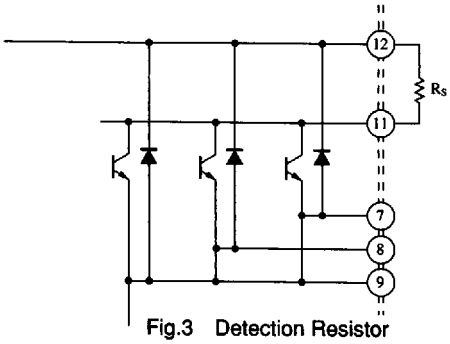


Fig.3 Detection Resistor

(3) Saw-tooth wave generator

●Fig.4 shows the relationship between the input signal to the Pin㉓ and the output waveform of the Pin㉔.

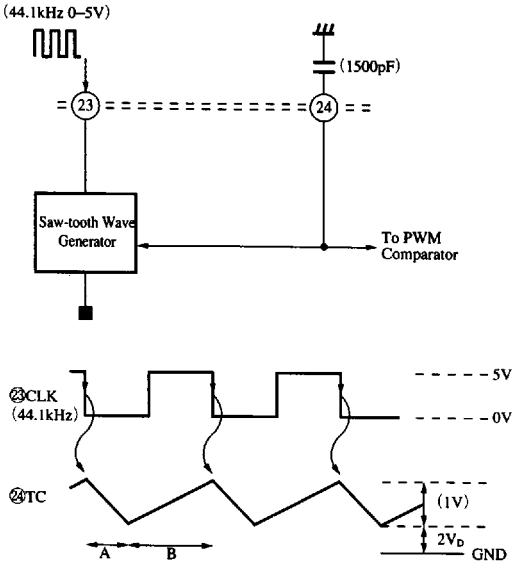


Fig.4 Saw-tooth Wave Generator

●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.

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 Pin㉔.

●Assuming that the input signal frequency to the Pin㉓ is 44.1kHz and the capacitor of the Pin㉔ 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.

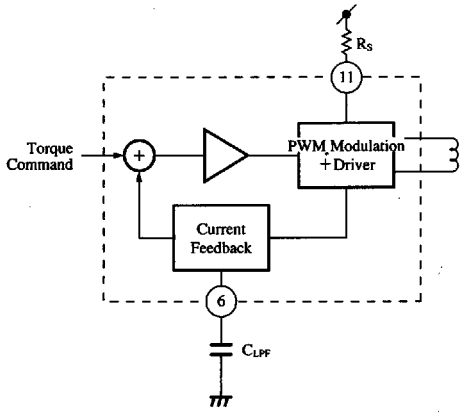


Fig.5 Current Feedback Loop

(5) DCR reference voltage

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

(6) Filter amplifier

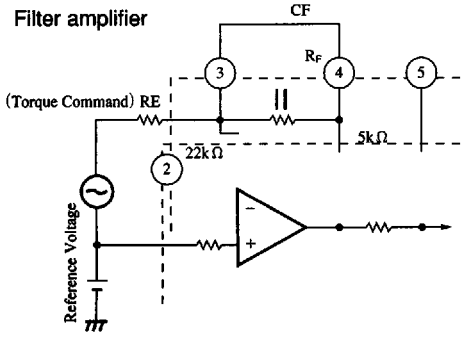


Fig.6 Ripple Filer

●This is 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 s phase compensating amplifier, etc.

(7) PV_{CC} noise elimination

●Since a large ripple current (44.1kHz) flows to PV_{CC}, it is recommended to eliminate noise with an LC filter.

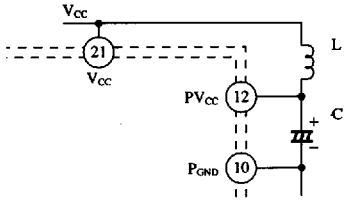


Fig.7 Noise Elimination

(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".

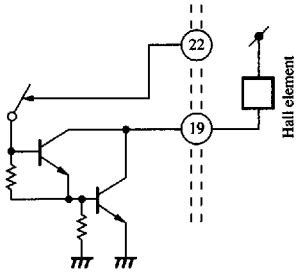


Fig.8 Hall Switch

(10) Drive gain

●The Pin⑤ is a torque command input pin (input to the absolute value circuit). If a difference voltage $V_{5\text{-}2}$ 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_{CC}, an output current can be detected as a voltage. The drive gain G is defiend by the following expression.

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

In this IC, G=1.

(11) Hall bias

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

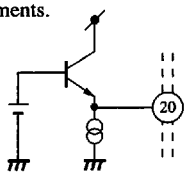


Fig.9 Hall Bias