

# AN3840NSR

## VTR Capstan-Drive IC

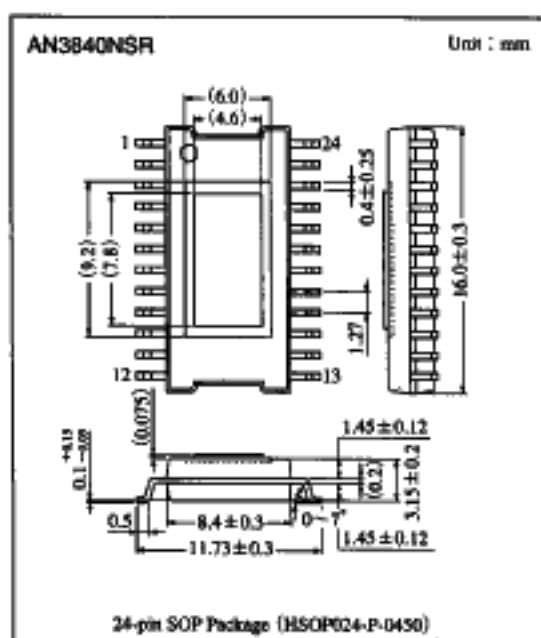
### Overview

The AN3840NSR is an IC for driving the VTR capstan motor.

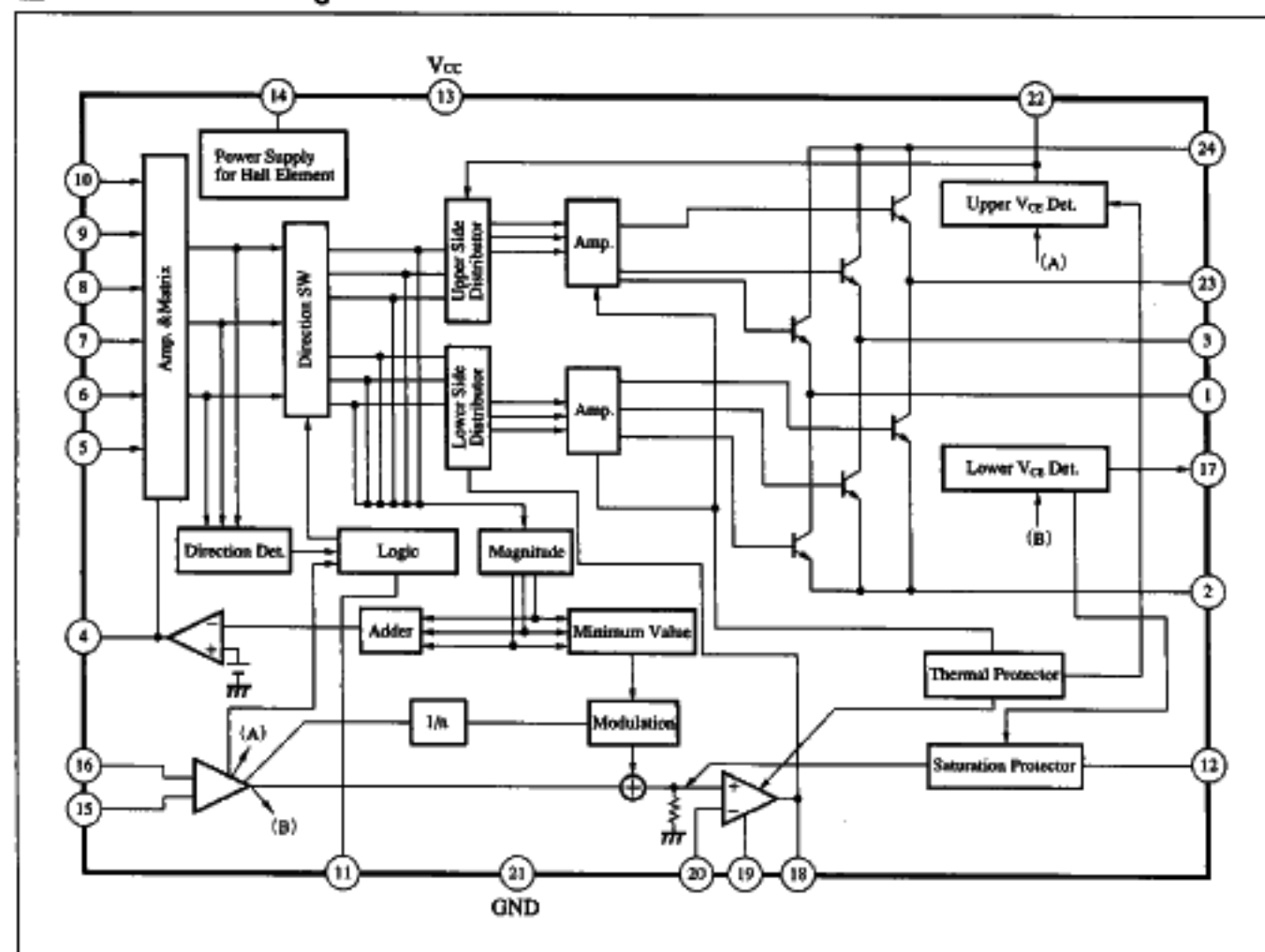
The reduction of acoustic noise, vibration and torque ripple of motor can be realized.

### Features

- Output transistor built-in
- Torque ripple cancellation circuit built-in
- Overlap drive
- Output terminal electrolytic capacitor not required
- Thermal protection circuit built-in
- Output maximum current of 1.5 A
- Copper block with good heat radiation built-in



### Function Block Diagram



### ■ Absolute Maximum Rating ( $T_a=25^{\circ}\text{C}$ )

| Parameter                                      | Symbol    | Rating      | Unit               |
|------------------------------------------------|-----------|-------------|--------------------|
| Supply voltage                                 | $V_{CC}$  | 6           | V                  |
| Motor supply voltage                           | $V_M$     | 20          | V                  |
| Motor supply current <small>Note 1)</small>    | $I_M$     | $\pm 1.5$   | A                  |
| Output terminal voltage <small>Note 1)</small> | $V_o$     | 20          | V                  |
| Terminal voltage <small>Note 2)</small>        | $V_{in}$  | $V_{CC}$    | V                  |
| Terminal I4 current                            | $I_{I4}$  | -100        | mA                 |
| Power dissipation                              | $P_D$     | 1400        | mW                 |
| Operating ambient temperature                  | $T_{op}$  | -20 to +70  | $^{\circ}\text{C}$ |
| Storage temperature                            | $T_{stg}$ | -55 to +150 | $^{\circ}\text{C}$ |

Note 1) Pin No. = 1, 3, 23    Note 2) Pin No. = 5, 6, 7, 8, 9, 10, 11, 15, 16, 19

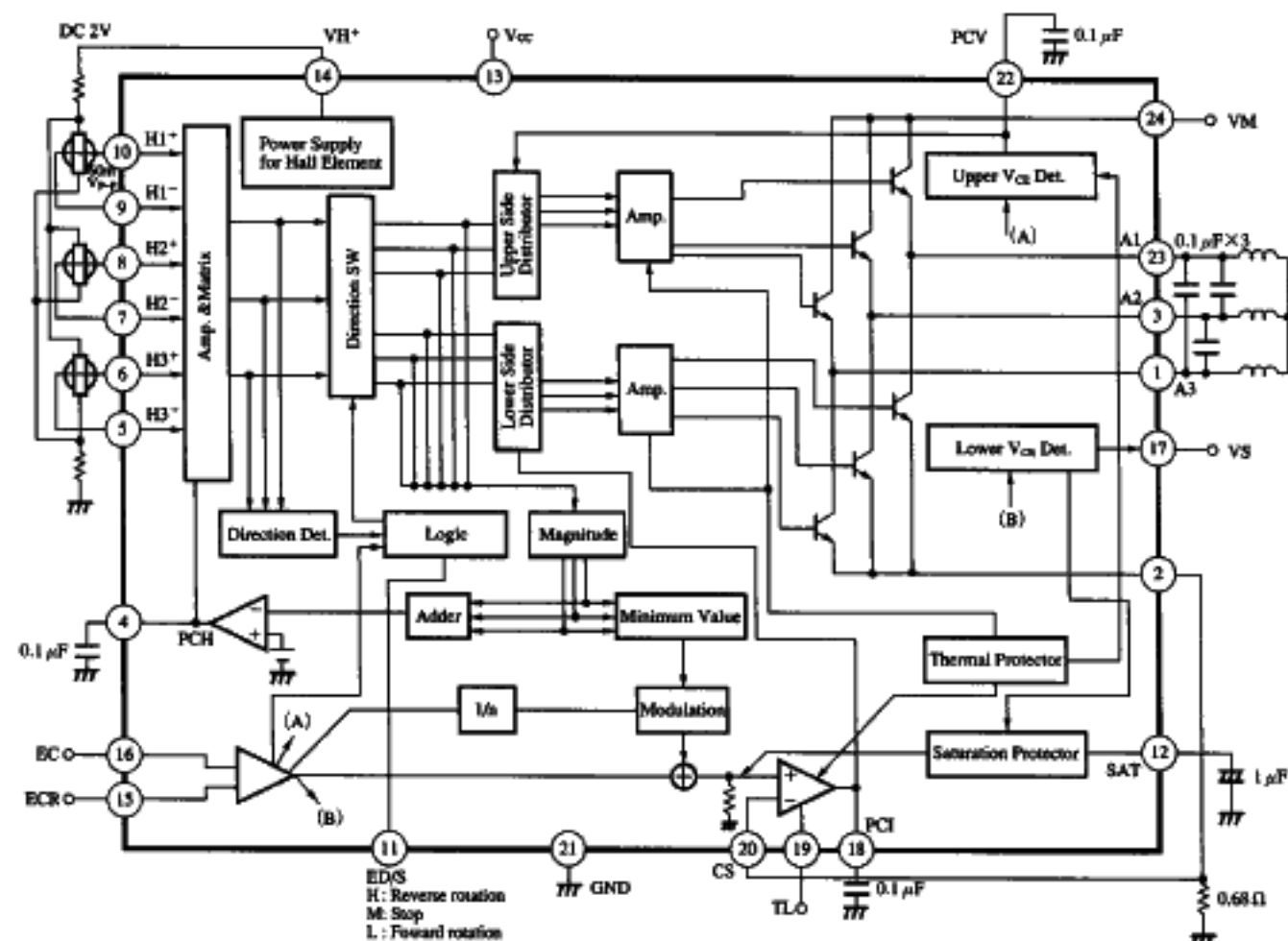
### ■ Recommended Operating Range ( $T_a=25^{\circ}\text{C}$ )

| Parameter                | Symbol   | Range        |
|--------------------------|----------|--------------|
| Operating supply voltage | $V_{CC}$ | 4.5V to 5.5V |
| Motor supply current     | $V_M$    | 6V to 18V    |

### ■ Electrical Characteristics ( $T_a=25^{\circ}\text{C}$ )

| Parameter                            | Symbol        | Condition                                     | min  | typ  | max  | Unit     |
|--------------------------------------|---------------|-----------------------------------------------|------|------|------|----------|
| Supply current                       | $I_{CC}$      | Current of hall element power supply excluded | —    | —    | 15   | mA       |
| Torque command reference voltage     | ECR           |                                               | 2    | —    | 3.5  | V        |
| Torque command voltage               | EC            |                                               | 0.5  | —    | 4    | V        |
| Torque command input offset voltage  | $EC_{offset}$ |                                               | -150 | —    | 150  | mV       |
| Torque command dead zone             | $EC_{DZ}$     |                                               | 50   | —    | 150  | mV       |
| Output idle voltage                  | $ATC_{idle}$  |                                               | —    | —    | 4    | mV       |
| Input/Output gain                    | $G_{io}$      |                                               | 0.61 | 0.68 | 0.75 | multiple |
| Output maximum voltage               | $ATC_{max}$   |                                               | 0.75 | —    | —    | V        |
| Normal rotation command voltage      | $ED_F$        |                                               | —    | —    | 0.9  | V        |
| Stop command voltage                 | $ED_S$        |                                               | 1.3  | —    | 3    | V        |
| Reverse rotation command voltage     | $ED_R$        |                                               | 3.5  | —    | —    | V        |
| Hall element input offset voltage    | $H_{offset}$  |                                               | -8   | —    | 8    | mV       |
| Lower-side output voltage (1)        | $V_{N(1)}$    | $ATC=68\text{mV}$                             | 0.44 | —    | 0.88 | V        |
| Lower-side output voltage (2)        | $V_{N(2)}$    | $E_{CR}=2.5\text{V}$<br>$E_C=0.5\text{V}$     | 2    | —    | 3.5  | V        |
| TL-CS offset voltage                 | $\Delta TL$   | $TL=600\text{mV}$                             | 5    | —    | 40   | mV       |
| Ripple cancellation ratio            | $\alpha$      | $ATC=68\text{mV}$<br>$ATC=47\text{mV}$        | 4    | —    | 18   | %        |
| Hall element supply voltage          | $VH^+$        | $I_{VH^+} = -20\text{mA}$                     | 2.6  | 2.85 | 3.2  | V        |
| Hall element input allowable voltage | $H_{in}$      |                                               | 1.2  | —    | 3.5  | V        |
| Switching supply control output      | $V_S$         | $EC=ECR, V_M-A1=1.3\text{V}$                  | 2.1  | 2.5  | 2.9  | V        |
| Switching supply control output gain | $G_{VS}$      |                                               | -3.4 | —    | -2.3 | multiple |

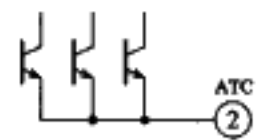
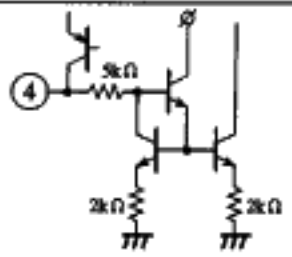
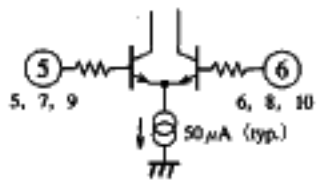
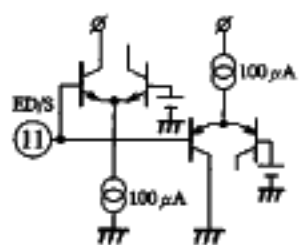
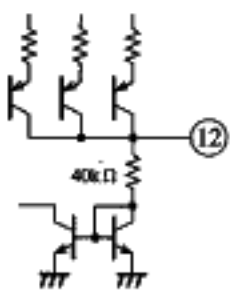
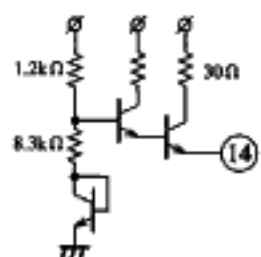
## ■ Application Diagram



## ■ Pin Descriptions

| Pin No.      | Pin name                                                       | Standard waveform | Description          | Equivalent circuit |
|--------------|----------------------------------------------------------------|-------------------|----------------------|--------------------|
| 1<br>3<br>23 | A3: Drive output 3<br>A2: Drive output 2<br>A1: Drive output 1 |                   | Motor coil connected |                    |

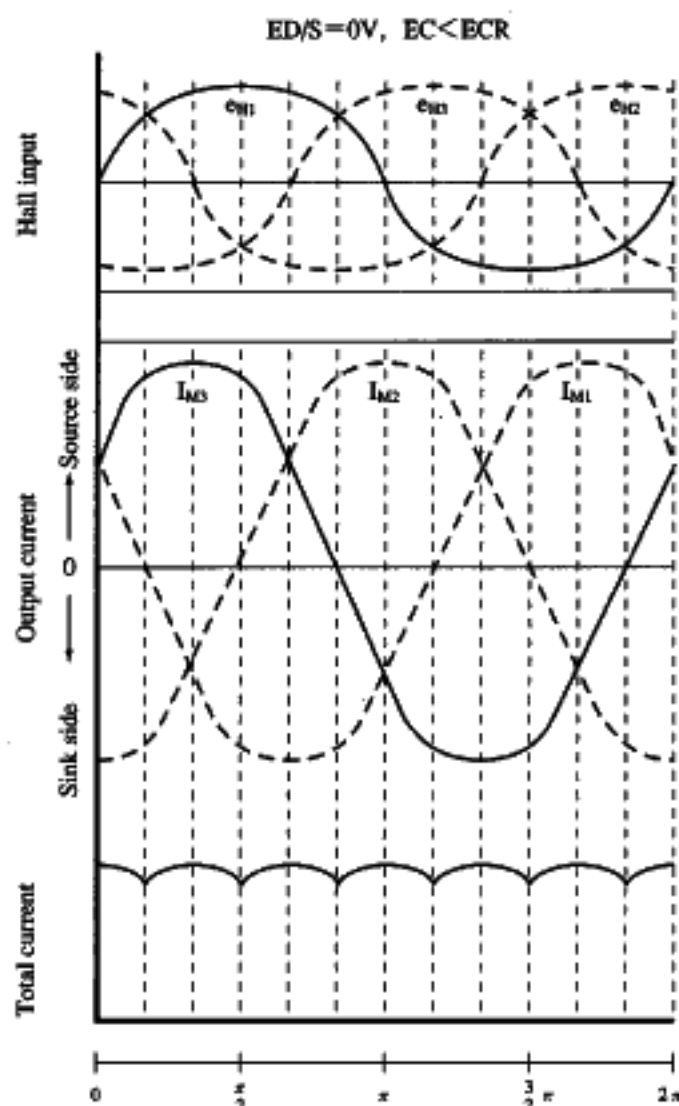
## ■ Pin Descriptions

| Pin No.                     | Pin name                                                                                                                                                                                                                                                                                                             | Standard waveform                                                                 | Description                                                                                 | Equivalent circuit                                                                    |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 2                           | ATC : Total current output                                                                                                                                                                                                                                                                                           |  | The total current of the output transistor is outputted.                                    |    |
| 4                           | PCH : Hall amp. phase compensation                                                                                                                                                                                                                                                                                   |  | Terminal for phase compensation of AGC loop of Hall amp.                                    |    |
| 5<br>6<br>7<br>8<br>9<br>10 | H <sub>5</sub> <sup>-</sup> : Hall element input<br>H <sub>5</sub> <sup>+</sup> : Hall element input<br>H <sub>7</sub> <sup>-</sup> : Hall element input<br>H <sub>7</sub> <sup>+</sup> : Hall element input<br>H <sub>9</sub> <sup>-</sup> : Hall element input<br>H <sub>9</sub> <sup>+</sup> : Hall element input |  | Hall Element output of motor is inputted.                                                   |   |
| 11                          | ED/S : Direction command input terminal                                                                                                                                                                                                                                                                              |                                                                                   | Terminal for directing the rotation direction and stop of the motor with 3-value input.     |  |
| 12                          | SAT : Saturation prevention phase compensation                                                                                                                                                                                                                                                                       |                                                                                   | Terminal for phase compensation of the loop preventing the saturation of output transistor. |  |
| 13                          | V <sub>CC</sub> : Power supply terminal                                                                                                                                                                                                                                                                              |                                                                                   | The terminal for inputting the supply voltage.                                              |                                                                                       |
| 14                          | V <sub>H</sub> <sup>+</sup> : Hall element power supply                                                                                                                                                                                                                                                              |                                                                                   | The terminal for outputting the supply voltage for Hall element.                            |  |

## ■ Pin Description (cont.)

| Pin No. | Pin name                                               | Standard waveform | Description                                                                                                                             | Equivalent circuit |
|---------|--------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| 15      | ECR : Torque command reference input terminal          |                   | Terminal for inputting the reference voltage of torque command.                                                                         |                    |
| 16      | EC : Torque command input terminal                     |                   | Terminal for inputting the torque command voltage.                                                                                      |                    |
| 17      | V <sub>S</sub> : Switching power supply control output |                   | Terminal outputting the voltage proportional to V <sub>CE</sub> of source side output transistor to control the switching power supply. |                    |
| 18      | PCI : Current feedback system phase compensation       |                   | Terminal for phase compensation of the system which controls the current of the sink side output transistor.                            |                    |
| 19      | TL : Torque limit terminal                             |                   | Terminal setting the maximum voltage of the ATC terminal.                                                                               |                    |
| 20      | CS : Current detection terminal                        |                   | Terminal connected to the ATC terminal, for inputting the value which is current-detected by the resistor.                              |                    |
| 21      | GND :                                                  |                   | Ground terminal                                                                                                                         |                    |
| 22      | PCV : Voltage feedback system phase compensation       |                   | Terminal for phase compensation of the system which controls the source side output transistor.                                         |                    |
| 24      | V <sub>M</sub> : Motor power supply terminal           |                   | Terminal inputting the motor power supply.                                                                                              |                    |

## Phase of Hall Input and Output Current



## Torque Direction Setting Logic

The direction of generated torque is determined according to the following information.

- Information from the rotation direction detection circuit :  $\overline{ER}$

High :  $H_1 \rightarrow H_3 \rightarrow H_2$

- Brake information from the torque command circuit :  $\overline{EA}$

High :  $BCR > EC$

- Rotation direction command :  $\overline{ED}$

High :  $H_1 \rightarrow H_3 \rightarrow H_2$

$\therefore ED/S = 0V$  is set for  $H_1 \rightarrow H_3 \rightarrow H_2$  (normal rotation)

- Direction of generated torque :  $\overline{EP}$

Generated torque rotating in the direction : High :  $H_1 \rightarrow H_3 \rightarrow H_2$

$\overline{EP}$  is determined by  $\overline{ER}$ ,  $\overline{EA}$  and  $\overline{ED}$  as follows :

$$\overline{EP} = \overline{ED} \cdot \overline{EA} + \overline{ER} \cdot \overline{EA}$$

|                 | $\overline{EA}$ | $\overline{EA}$ |                 | $\overline{EA}$ |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| $\overline{ED}$ | H               | H               | H               | L               |
| $\overline{ED}$ | H               | L               | L               | L               |
|                 | $\overline{ER}$ |                 | $\overline{ER}$ |                 |

Carnot map of torque direction setting logic