# AN3824K

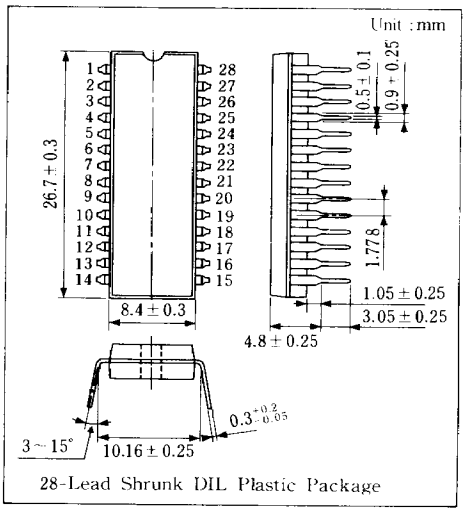
## VCR Capstan Direct Motor Drive Circuit

### ■ Outline

The AN3824K is an integrated circuit designed to drive a VCR capstan DD motor.

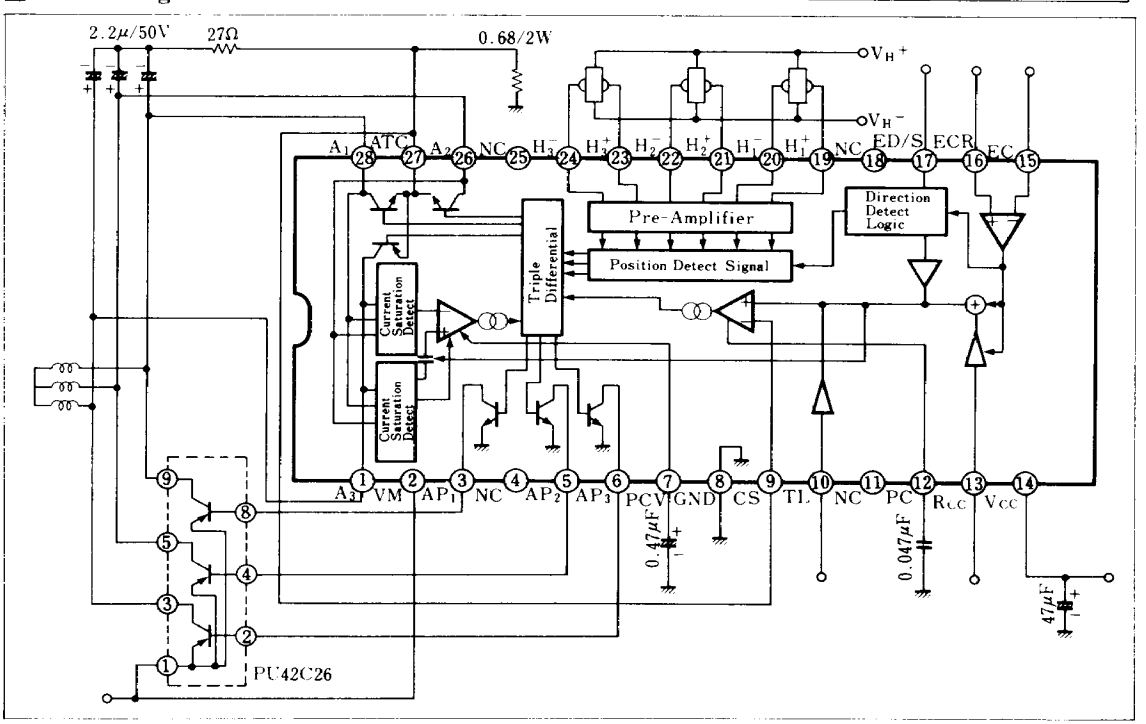
### ■ Features

- Three-phase full-wave operation.
- Torque ripple canceller built-in.
- Operation voltage of motor ($V_M$) = 24V (max.)
- Max. output current. (Io max.) = 1A
- Supply voltage : 5V




28-Lead Shrunk DIL Plastic Package

### ■ Block Diagram



## ■ Pin

| Pin No. | Pin Name | Pin No. | Pin Name |
|---|---|---|---|
| 1 | NPN Output 3 on Ground Side | 15 | Torque. Command Input |
| 2 | Power Supply Terminal for Motor | 16 | Torque Command Reference Input |
| 3 | PNP Pre-drive Output 1 on $V_{CC}$ Side | 17 | Command Input for Rotational Direction |
| 4 | NC | 18 | NC |
| 5 | PNP Pre-drive Output 2 on $V_{CC}$ Side | 19 | Hall Element Input |
| 6 | PNP Pre-drive Output 3 on $V_{CC}$ Side | 20 | Hall Element Input |
| 7 | Phase Compensation for Voltage Feedback Circuit | 21 | Hall Element Input |
| 8 | GND | 22 | Hall Element Input |
| 9 | Current Detect Terminal | 23 | Hall Element Input |
| 10 | Torque Limit | 24 | Hall Element Input |
| 11 | NC | 25 | NC |
| 12 | Phase Compensation for Current Feedback Circuit | 26 | NPN Output 2 on Ground Side |
| 13 | Torque Ripple Rectification | 27 | Total Current Output |
| 14 | Voltage Supply Terminal | 28 | NPN Output 1 on Ground Side |

## ■ Absolute Maximum Ratings (Ta=25℃)

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 6 | V |
| Motor Supply Voltage | $V_{M(24)}$ | 24 | V |
| Motor Drive Current | $I_1$, $I_{26}$, $I_{28}$ | ±1.5 | A |
| Output Pin Voltage | $V_1$, $V_{26}$, $V_{28}$ | 24 | V |
| Power Dissipation | $P_D$ | 1790 | mW |
| Operating Ambient Temperature | $T_{opr}$ | −20～+70 | ℃ |
| Storage Terperature | $T_{stg}$ | −55～+150 | ℃ |

## ■ Electrical Characteristics (Ta=25℃)

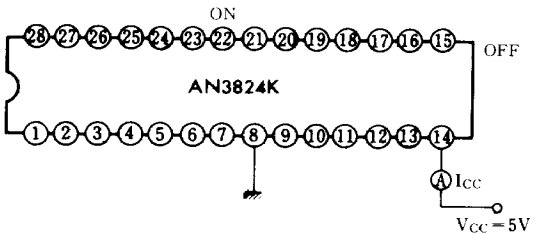
| Item | Symbol | Test Circuit | Condition | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| Supply Voltage | $I_{CC}$ | 1 | $V_{CC}$=5V | | | 1.5 | mA |
| Torque Reference Voltage | ECR | 2 | $V_{CC}$=5V | 2.3 | | 3 | V |
| Torque Command Voltage | EC | 2 | $V_{CC}$=5V, ECR=2.5V | 1 | | 4 | V |
| Torque Command Voltage offset | $EC_{offset}$ | 2 | $V_{CC}$=5V, ECR=2.5V | −150 | | +150 | mV |
| Torque Command Dead Zone | $EC_{dead}$ | 2 | $V_{CC}$=5V, ECR=2.5V | 60 | | 150 | mV |
| Output Idle Voltage | $EC_{idle}$ | 2 | $V_{CC}$=5V, ECR=2.5V | | | 4 | mV |
| Input/Output Gain | $G_{io}$ | 2 | $V_{CC}$=5V, ECR=2.5V | 0.56 | | 0.7 | times |
| Forward Motor Drive Command Voltage | $E_{D-F}$ | 3 | $V_{CC}$=5V, ECR=2.5V | | | 0.9 | V |
| STOP Command Voltage | $E_{D-S}$ | 3 | $V_{CC}$=5V, ECR=2.5V | 1.3 | | 3 | V |
| Reverse Motor Drive Command Voltage | $E_{D-R}$ | 3 | $V_{CC}$=5V, ECR=2.5V | 3.5 | | | V |
| Hall Element Input Allowable Voltage | $V_{H-ALLOW}$ | 4 | $V_{CC}$=5V, ECR=2.5V | 1.2 | | 2.35 | V |

## ■ Electrical Characteristics (Ta=25℃) (Cont'd)

| Item | Symbol | Test Circuit | Condition | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| Hall Element Input Conversion Offset | $V_{H-OFFSET}$ | 5 | $V_{CC}$=5V, ECR=2.5V | −5 | | 5 | mV |
| Saturation Voltage On Ground Side | $V_{N(sat)}$ | 6 | $V_{CC}$=5V, $I_a$=700mA | | | 1.8 | V |
| Torque Limit Current Sense Offset | $T_L$-$C_{S(offset)}$ | 7 | $V_{CC}$=5V, $V_{TL}$=700mW | 34 | | 70 | mV |
| Ripple Cancel Output | $V_{RCC}$ | 8 | $V_{CC}$=5V, $V_{TL}$=700mW | 50 | | | mV |
| Ripple Cancel OFF Voltage | $V_{RCC-ON}$ | 8 | $V_{CC}$=5V, $V_{TL}$=700mW | | | 2.3 | V |
| Ripple Cancel ON Voltage | $V_{RCC-OFF}$ | 8 | $V_{CC}$=5V, $V_{TL}$=700mW | 2.7 | | | V |

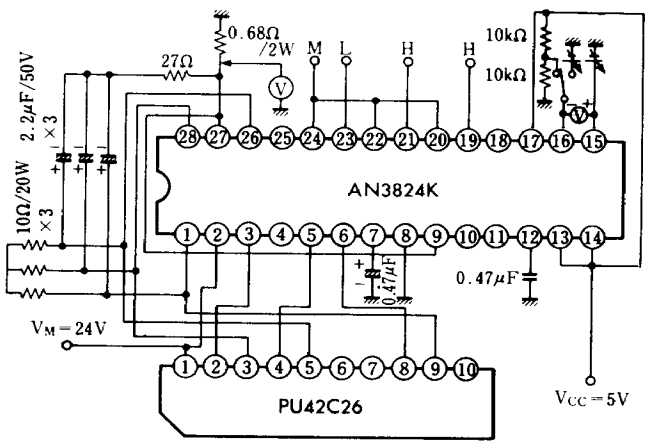
Note) Operating Supply Voltage Range : $V_{CC(OPR)}$=4.5~5.5V

**Test Circuit 1** ($I_{CC}$)




1. Measure an inflow current to $V_{CC}$ (Pin⑭) when $V_{CC}$ (Pin⑭) and GND (Pin⑧) is set at 5V and 0V respectively.

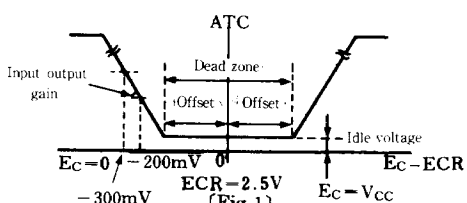
**Test Circuit 2** (ECR, EC, $EC_{offset}$, $EC_{dead}$, $EC_{idle}$, $G_{io}$)



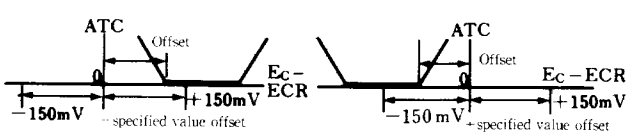

1. Input conditions are as follows
   Provided, H: 1.9V
   M: 1.7V
   L: 1.5V

| $H_1$⑲ | $H_2$㉑ | $H_3$㉓ | $H_C$⑳㉒㉔ |
|---|---|---|---|
| H | H | L | M |

2. Check V characteristics when ECR is set at 2.3~3V (ECR, EC). That is, measure AC (Pin㉗) voltage after ECR (Pin⑯) is set and EC (Pin⑮) is made variable. (See Fig.-1.)
3. Make ECR=2.5V, make EC variable from 0 to $V_{CC}$ and measure ATC (ECoffset, ECdead, Edidle, Gio). (See Fig.-1.)



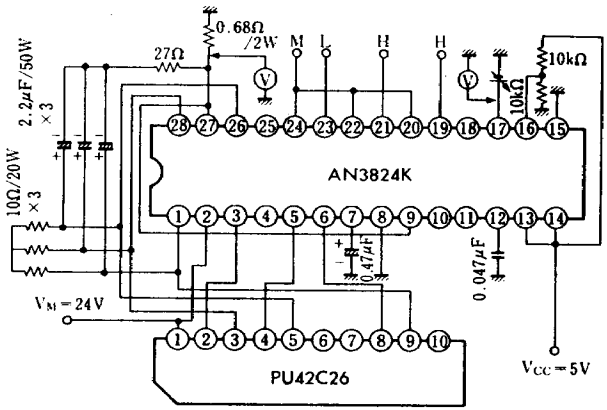

〔Fig-1〕



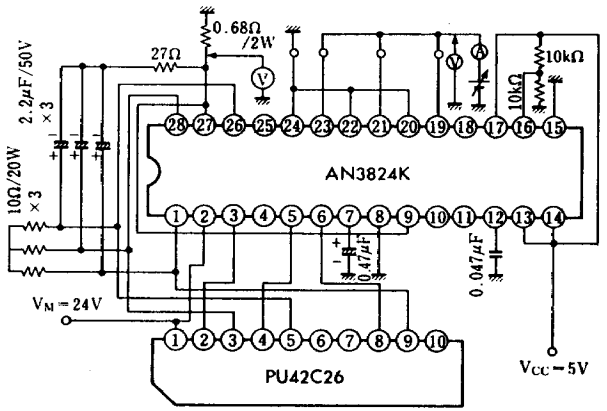

〔Fig-2〕

Note)
- Idle voltage denotes ATC voltage at the dead zone.
- Torque command voltage is the characteristics in Fig.-2.

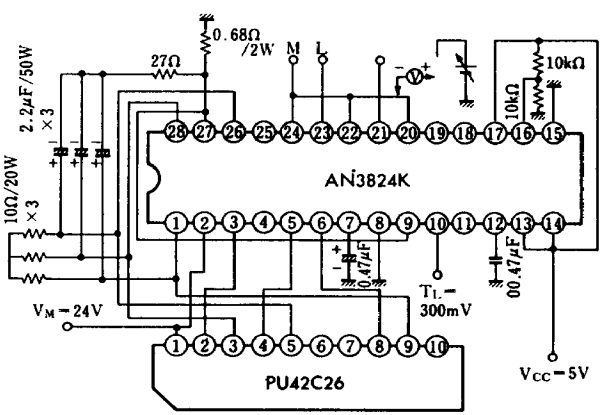
**Test Circuit 3** ($E_{D-F}$, $E_{D-S}$, $E_{D-R}$)




**Test Circuit 4** ($V_{H-ALLOW}$)




**Test Circuit 5** ($V_{H-OFFSET}$)

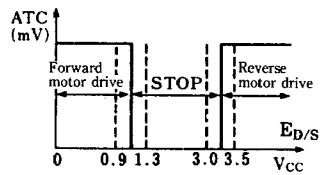



Input setting has three types as shown in Table3. Test circuit above is the case of setting1. In this case. the measuring method is as follows. The same sequence will be taken in input settings 3 and 5.

1. Set the input conditions as shown in Table 2 and ED/S (Pin⑰) at 0V.
2. Gradually increasing the voltage of ED/S, measure the threshold voltage of characteristics diagram. (See Fig.-3)

Table2

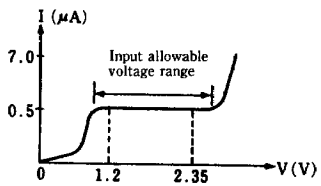
| EC⑮ | $H_1^+$⑲ | $H_2^+$㉑ | $H_3^+$㉓ | $H_C$⑳㉒㉔ |
|---|---|---|---|---|
| 0V | H | H | L | M |




[Fig-3]

1. Connecting $H_1^+$ (Pin⑲), $H_2^+$ (Pin㉑) and $H_3^+$ (Pin㉓), apply voltage and measure the range where flowing current does not change at 0.5~7.0μA.

Note) Change of current when the voltage is applied from 0V will be as shown in Fig.-4.

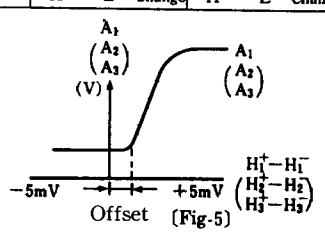



[Fig-4]

1. Select the input setting 1.
2. Observe an electric potential change of $A_1$ (Pin㉘) when ($H_1^+ - H_1^-$) is changed at 1mV STEP. (See Fig.-5.)
3. Differential voltage of input ($H_1^+ - H_1^-$) when $A_1$ is to be changed from L to H is within ± 5mV.

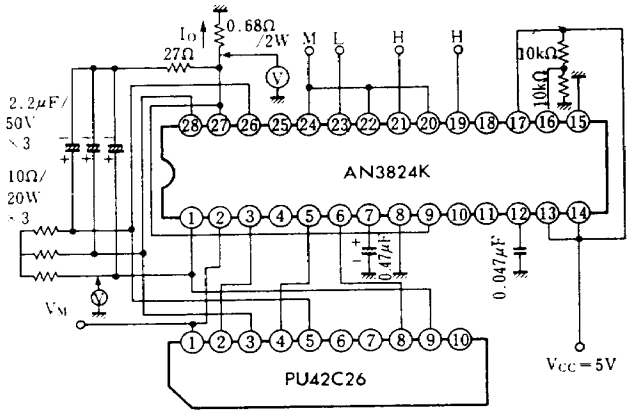
Table3

| Input setting | Input | | | Output | | |
|---|---|---|---|---|---|---|
| | $H_1^+$ | $H_2^+$ | $H_3^+$ | $A_1$ | $A_2$ | $A_3$ |
| 1 | Change | H | L | Change | H | L |
| 3 | L | Change | H | L | Change | H |
| 5 | H | L | Change | H | L | Change |

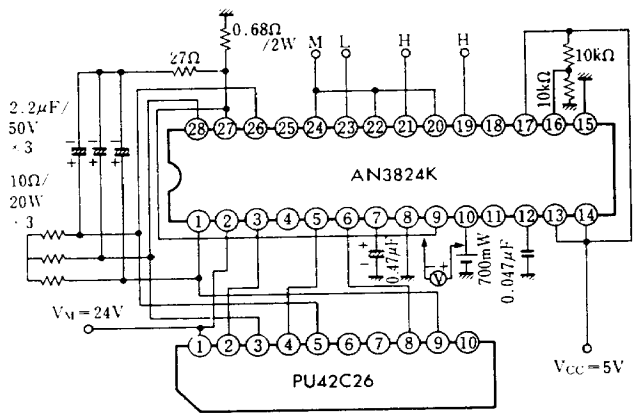



[Fig-5]

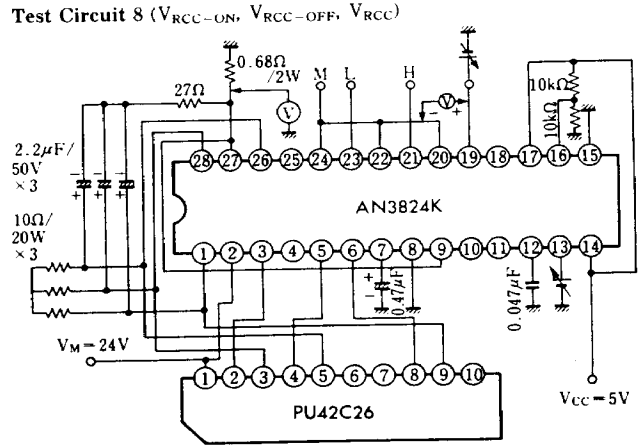
**Test Circuit 6** ($V_{N(sat)}$)




**Test Circuit 7** ($T_L$-$C_{S(offset)}$)




**Test Circuit 8** ($V_{RCC-ON}$, $V_{RCC-OFF}$, $V_{RCC}$)




1. $R_{CC}$ (Pin⑬) = $V_{CC}$
2. Adjust $H_1^+$ (Pin⑲) voltage to be $H_1^+ + H_1^- = 50mV$ and measure ATC (Pin㉗) voltage $V_1$.

Input setting has three types as shown in Table4. Test circuit above is the case of setting1. In this case, the measuring method is as follows. The same sequence will be taken in input settings 3 and 5.

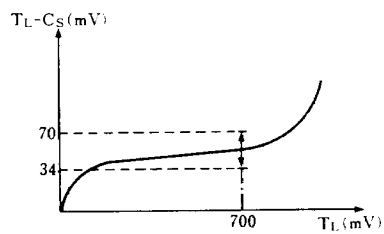
1. Select the input setting1.
2. Adjust VM voltage so that ATC (Pin27) voltage will be 480mV (Ia = 700mA) and measure $A_3$ (Pin①).

Table4

| Input setting | Input $H_1^+$ | Input $H_2^+$ | Input $H_3^+$ | Output |
|---|---|---|---|---|
| 1 | H | H | L | $A_3$ |
| 3 | L | H | H | $A_1$ |
| 5 | H | L | H | $A_2$ |

1. Measure ($T_L$-$C_S$) voltage when $T_L$ (Pin⑩).

Note) Relationship between torque limit (TL) and current sense (CS) is shown in Fig.-6.




〔Fig-6〕

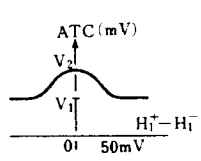
3. Measure ATC (Pin㉗) voltage for $H_1^+ - H_1^- = 0mV$. Ripple cancel output voltage is set at $V_2 - V_1$.

Note) Relationship between ($H_1^+ - H_1^-$) and ATC is shown in Fig.-7.

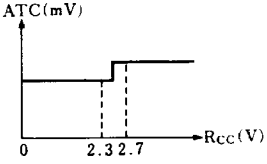
1. Select the input setting as shown in Table5.
2. Change $R_{CC}$ (Pin⑬) to the range of 0 to $V_{CC}$. When ATC (Pin㉗) is changed, measure Rcc voltage. (See Fig.-8.)

Table5

| $H_1^+$ | $H_2^+$ | $H_3^+$ | Hc |
|---|---|---|---|
| M | H | L | M |



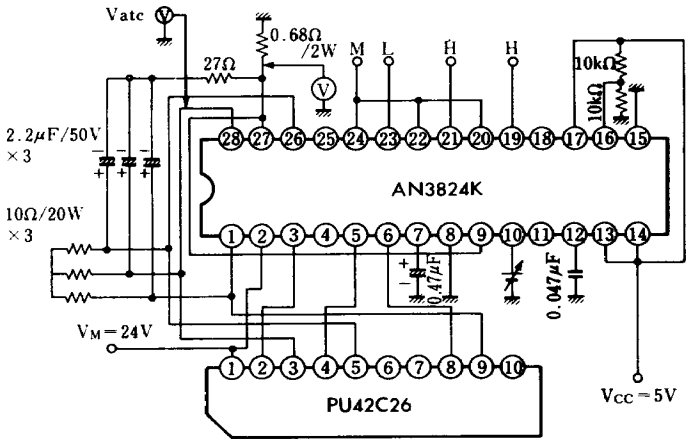

〔Fig-7〕




〔Fig-8〕

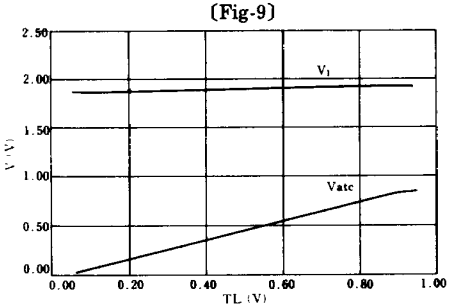
〈Saturation Detect Voltage Characteristics〉

To prevent the power Tr from being saturated, detect the collector voltage. When reaching a fixed level, decrease the base current to prevent the electric potential of collector and its decrease. The characteristics are shown in Fig.-9.




$V_{CE}$ of Tr when a motor is actually rotated will be $V_1 - Vatc$.

〔Fig-9〕




## ■ Application Circuit