AN3824K

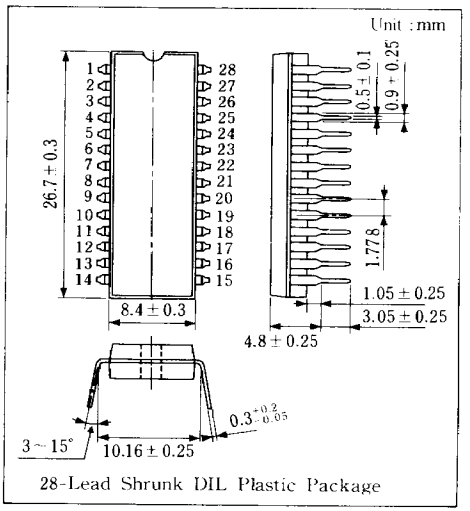
VCR Capstan Direct Motor Drive Circuit

■ Outline

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

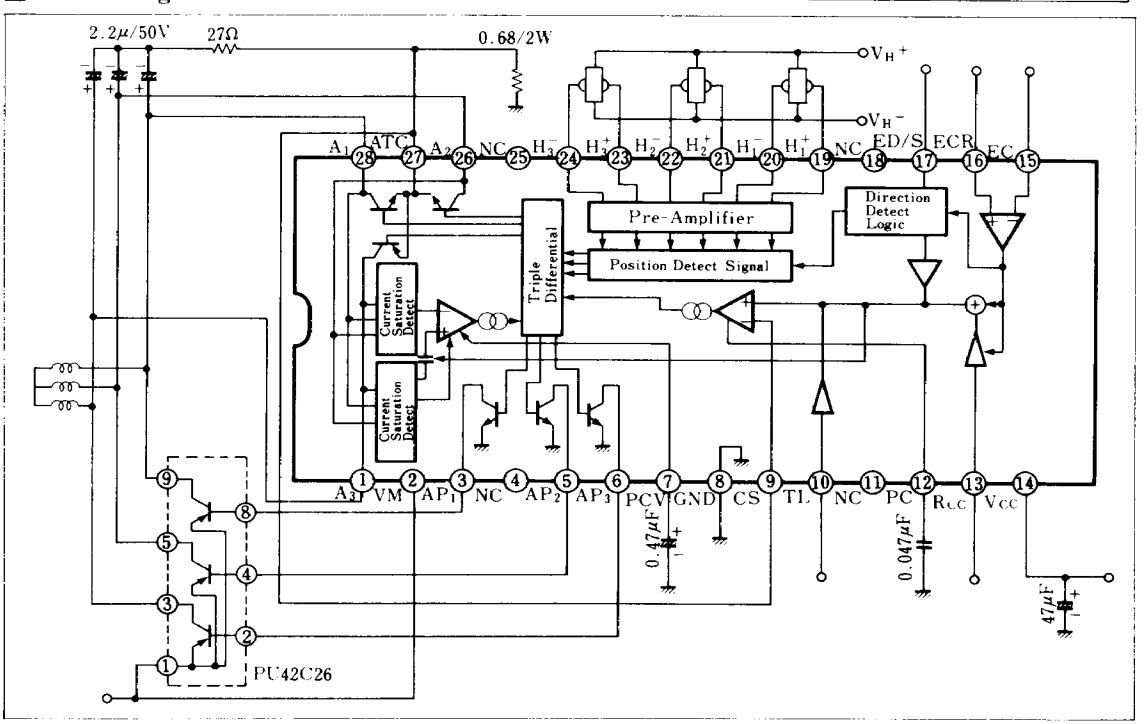
■ Features

- 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



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■ 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

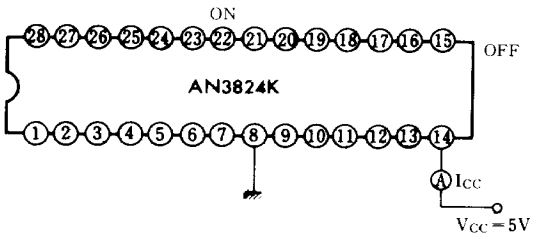
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■ Electrical Characteristics (Ta=25℃) (Cont'd)

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

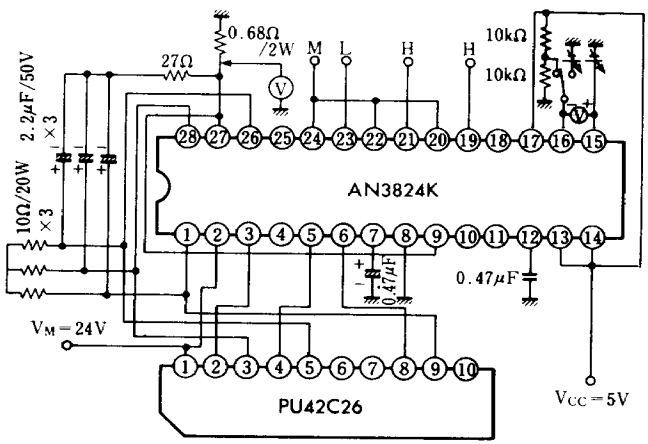
Note) Operating Supply Voltage Range : $V_{CC(OPR)}$=4.5~5.5V

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.

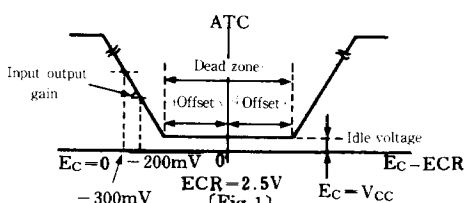
Test Circuit 2 (ECR, EC, EC_{offset}, EC_{dead}, EC_{idle}, G_{io})



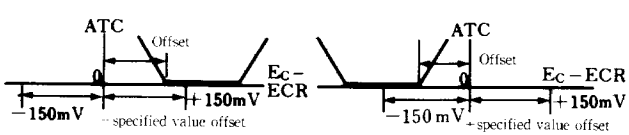
1. Input conditions are as follows
   Provided, H: 1.9V
   M: 1.7V
   L: 1.5V

H_1⑲	H_2㉑	H_3㉓	H_C⑳㉒㉔
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〕

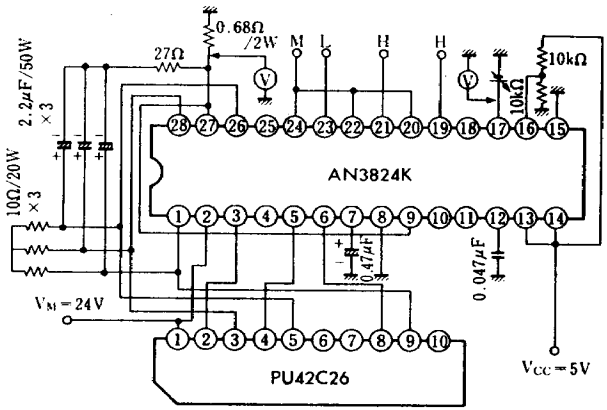


〔Fig-2〕

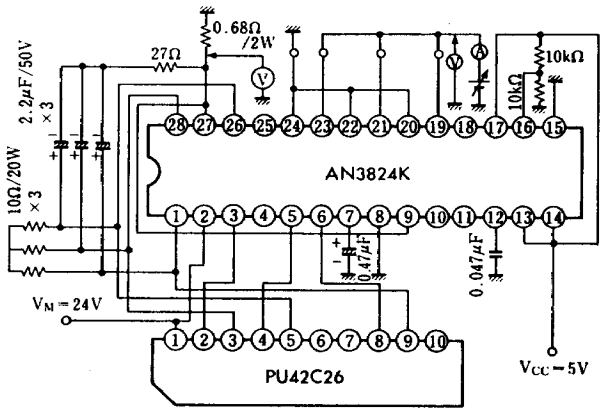
Note)
- Idle voltage denotes ATC voltage at the dead zone.
- Torque command voltage is the characteristics in Fig.-2.

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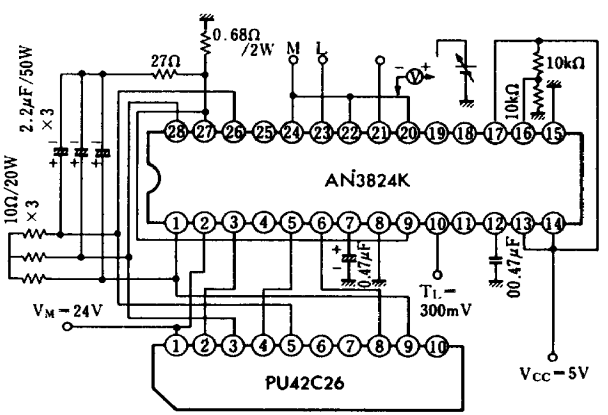
Test Circuit 3 (E_{D-F}, E_{D-S}, E_{D-R})



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



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

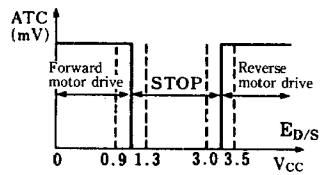


Input setting has three types as shown in Table3. Test circuit above is the case of setting1. In this case. the measuring method is as follows. The same sequence will be taken in input settings 3 and 5.

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

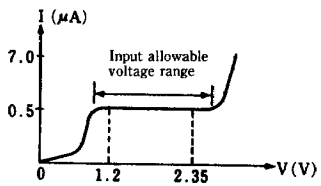
EC⑮	H_1^+⑲	H_2^+㉑	H_3^+㉓	H_C⑳㉒㉔
0V	H	H	L	M



[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.

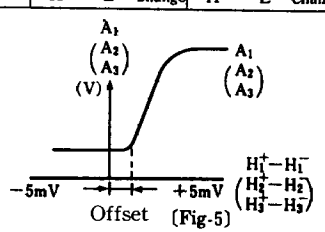


[Fig-4]

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

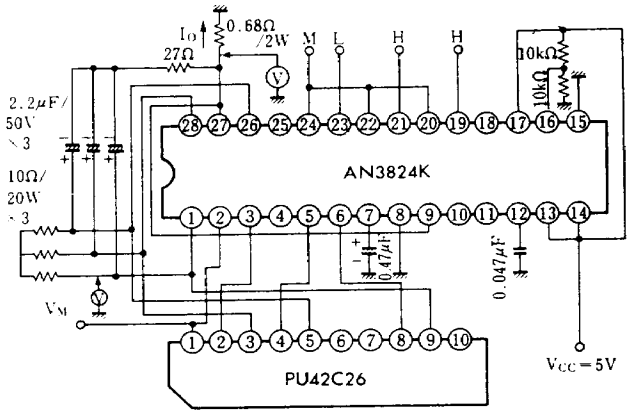
Input setting	Input			Output		
	H_1^+	H_2^+	H_3^+	A_1	A_2	A_3
1	Change	H	L	Change	H	L
3	L	Change	H	L	Change	H
5	H	L	Change	H	L	Change



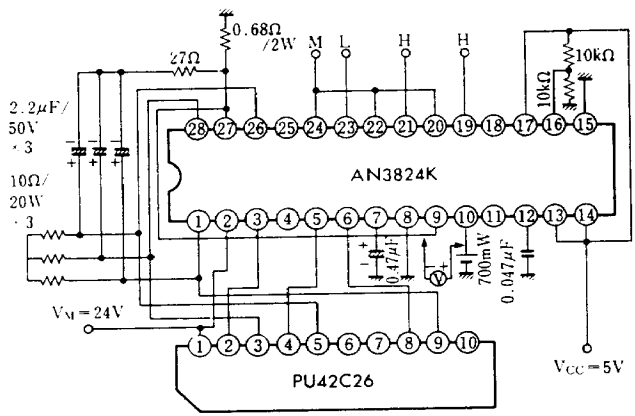
[Fig-5]

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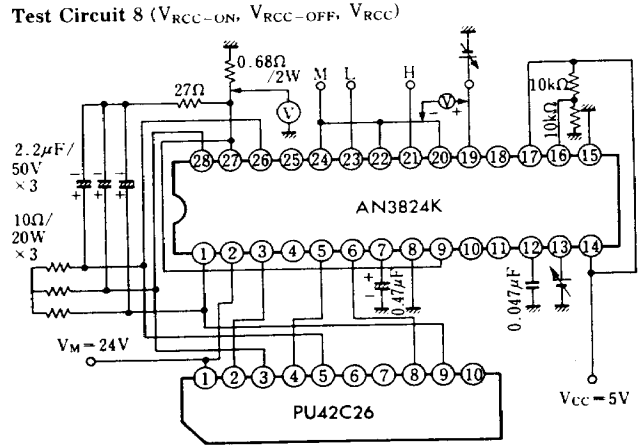
Test Circuit 6 ($V_{N(sat)}$)



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.

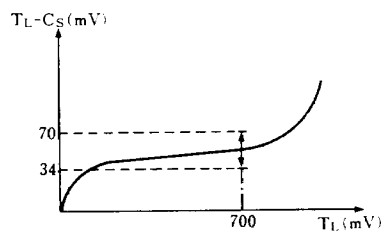
1. Select the input setting1.
2. Adjust VM voltage so that ATC (Pin27) voltage will be 480mV (Ia = 700mA) and measure A_3 (Pin①).

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〕

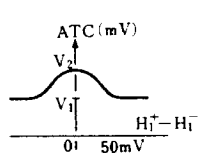
3. Measure ATC (Pin㉗) voltage for $H_1^+ - H_1^- = 0mV$. Ripple cancel output voltage is set at $V_2 - V_1$.

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

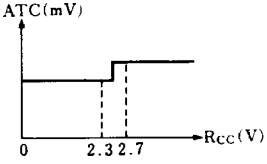
1. Select the input setting as shown in Table5.
2. Change R_{CC} (Pin⑬) to the range of 0 to V_{CC}. When ATC (Pin㉗) is changed, measure Rcc voltage. (See Fig.-8.)

Table5

H_1^+	H_2^+	H_3^+	Hc
M	H	L	M



〔Fig-7〕

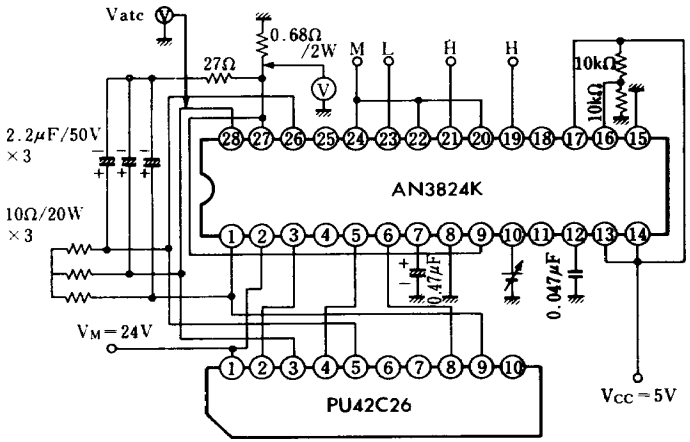


〔Fig-8〕

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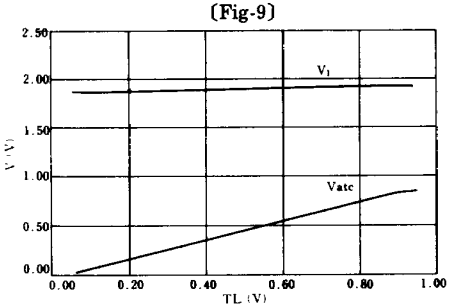
〈Saturation Detect Voltage Characteristics〉

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.

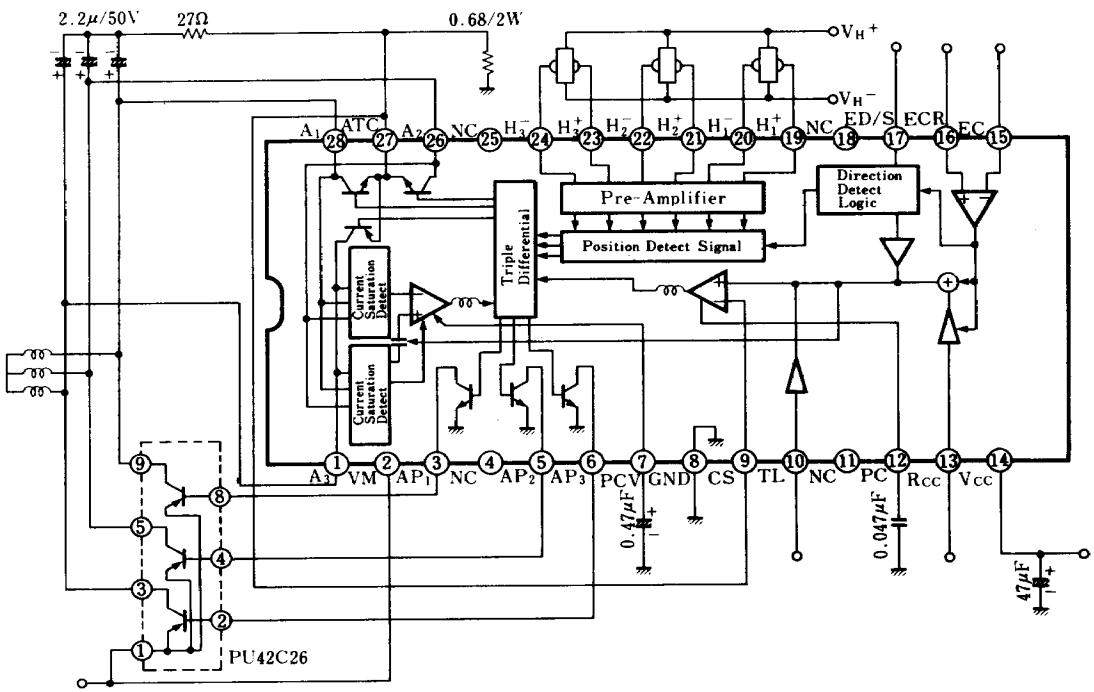


V_{CE} of Tr when a motor is actually rotated will be $V_1 - Vatc$.

〔Fig-9〕



■ Application Circuit



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