# AN3890FBS

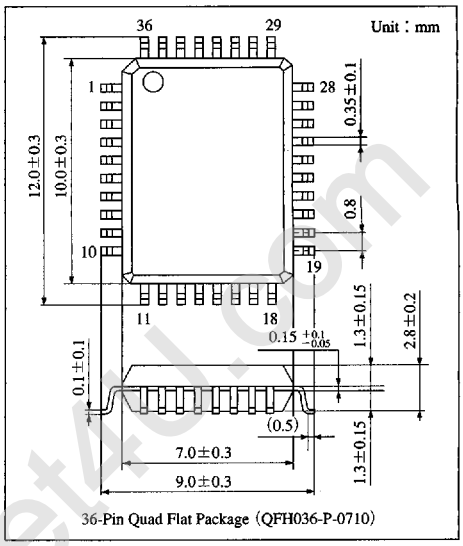
## Capstan Motor Drive IC for VCR

### ■ Overview

The AN3890FBS is an IC designed as a VCR capstan motor drive. It is particularly optimum for camera combined VCR.

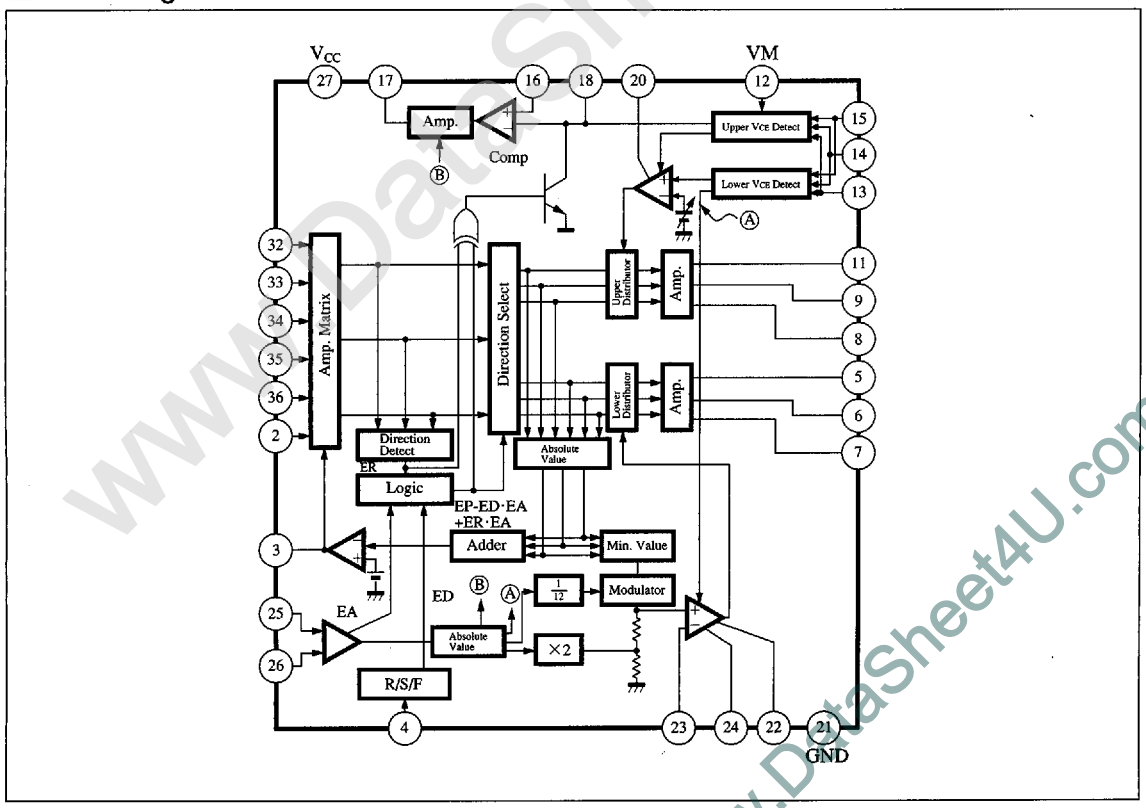
### ■ Features

- Controls the output transistors (external) at low $V_{CE}$.
- Built-in torque ripple cancellation circuit.
- Overlap drive.
- Provided with predrive output for switching regulator control.
- Output pin electrolytic capacitor unrequired.




36-Pin Quad Flat Package (QFH036-P-0710)

### ■ Block Diagram



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

| Parameter | Symbol | Rating | Unit | Note |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | 6 | V | |
| Power dissipation | $P_D$ | 500 | mW | |
| Operating ambient temperature | $T_{opr}$ | −20 to +70 | ℃ | |
| Storage temperature | $T_{stg}$ | −55 to +125 | ℃ | |
| Motor supply voltage | $V_{12}$ | 20 | V | |
| Output pin voltage | $V_1$ | 20 | V | $V_l$=13,14,15 |
| Pin voltage | $V_m$ | −0.3 to $V_{CC}$ | V | m=2,4,16,24, 25,26,32, 33,34,35,36 |

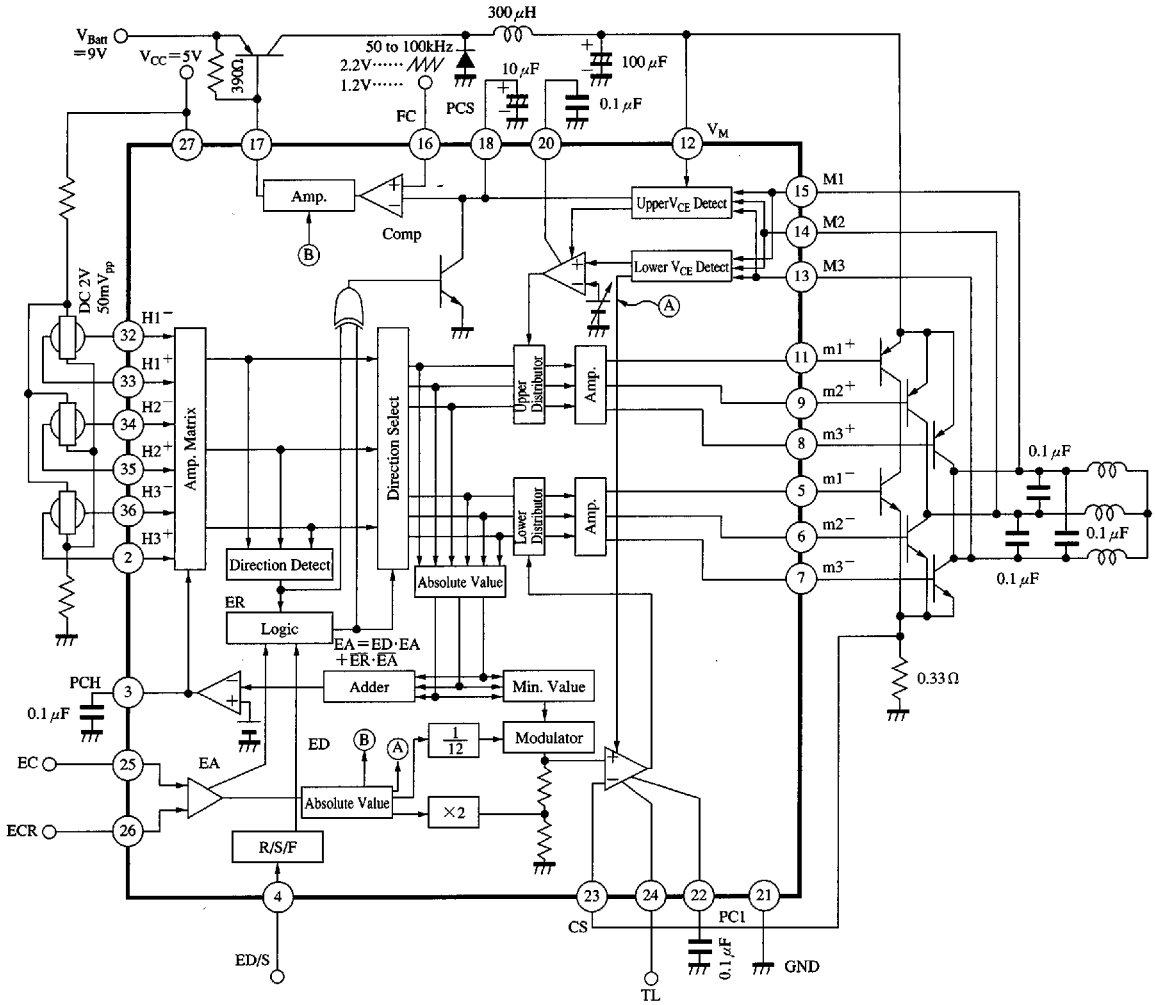
## ■ Recommended Operating Range (Ta=25℃)

| Parameter | Symbol | Range |
|---|---|---|
| Operating supply voltage range | $V_{CC}$ | 4.5V to 5.5V |

## ■ Electrical Characteristics ($V_{CC}$=5V, Ta=25℃)

| Parameter | Symbol | Condition | min | typ | max | Unit |
|---|---|---|---|---|---|---|
| Circuit current | $I_{CC}$ | | — | — | 15 | mA |
| Torque command ref. voltage | ECR | | 2 | — | 3 | V |
| Torque command voltage | EC | | 0.5 | — | 4 | V |
| Torque command input current | $I_{EC}$ | EC=ECR=2.5V | −1 | — | 0 | μA |
| Torque command input offset voltage | $EC_{off}$ | | −150 | — | 150 | mV |
| Torque command dead zone | $EC_{DZ}$ | | 30 | — | 150 | mV |
| Output idle voltage | $ATC_{idle}$ | | 0 | — | 4 | mV |
| I/O gain | $G_{io}$ | | 0.19 | 0.24 | 0.28 | times |
| Output max. voltage | $ATC_{max}$ | | 0.3 | — | — | V |
| Forward command voltage | $ED_F$ | | — | — | 0.9 | V |
| Stop command voltage | $ED_S$ | | 1.3 | — | 3.1 | V |
| Reverse command voltage | $ED_R$ | | 3.5 | — | — | V |
| Hall element input allowable voltage | $H_{in}$ | | 1.1 | — | 3.5 | V |
| Hall element input conversion offset | $H_{offset}$ | | −8 | — | 8 | mV |
| Lower output voltage (1) | VN (1) | ATC=66mV | 0.25 | 0.37 | 0.55 | V |
| Lower output voltage (2) | VN (2) | EC=0.5V | — | — | 1.2 | V |
| TL-CS offset | $TL_{offset}$ | TL=0.2V | 0 | 7 | 15 | mV |
| Ripple cancellation rate | α | $V_{ATC}$=66mV | 6 | 10.5 | 15 | % |
| Upper drive max. current | $I_{MP}$ | | 15 | — | — | mA |
| Lower drive max. current | $I_{MN}$ | | — | — | −15 | mA |
| Switching power supply control output operating point | PCS | PCS=1.7V at $V_M$=6V. Value of $V_M$−MI Times | 0.25 | 0.4 | 0.55 | V |
| Switching power supply control output gain | $G_{PCS}$ | $V_M$=6V | 6.5 | 9 | 11 | times |
| Output drive max. current for switching power supply | $I_{SW}$ | EC=0.5V | 8 | — | — | mA |
| Output rise time for switching power supply | $t_{on}$ | | — | — | 1 | μs |
| Output fall time for switching power supply | $t_{off}$ | | — | — | 1 | μs |
| Switching power supply comparator input offset | $\Delta V_{FC}$ | | −10 | — | 10 | mV |
| Switching power supply comparator input current | $I_{FC}$ | FC=1.7V | −10 | — | 0 | μA |

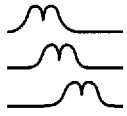
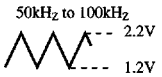
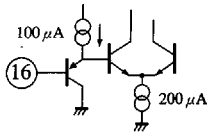
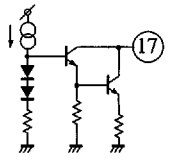
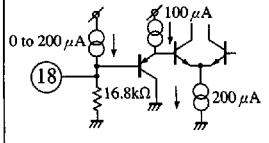
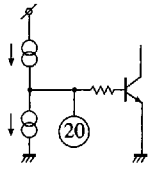
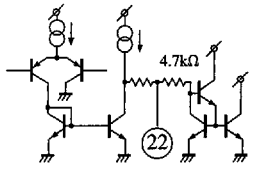
## ■ Application Circuit



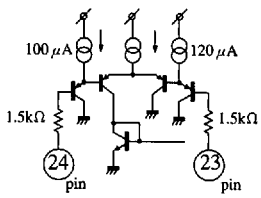
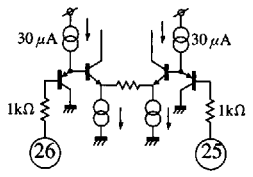
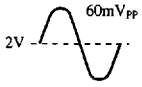
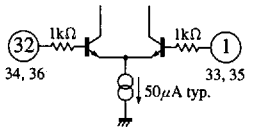
## ■ Pin Descriptions

| Pin No. | Pin name | Typ. waveform | Description | I/O impedance | Equivalent circuit |
|---|---|---|---|---|---|
| 1 | NC | ——— | ——— | — | ——— |
| 2 | $H_3^+$ Hall element input | 60mV$_{PP}$, 2V | Inputs signal for the Hall element of the motor. | — | 1kΩ, 1kΩ, 2, 36, 50μA typ. |
| 3 | PCH Hall amp. phase compensation | | AGC loop phase-compensation pin of the Hall amplifier | — | 3, 5.1kΩ, 2kΩ, 2kΩ |
| 4 | ED/S direction command input | ——— | Gives motor rotary direction or stop command with 3-valued input. | — | 4, 1kΩ, 100μA, 100μA |
| 5 | $m_2^-$lower predrive output 1 | ——— | Pre-drive output for output transistor of the sink side (lower side) | — | $V_{CC}$, 5, 6.7 |
| 6 | $m_2^-$lower predrive output 2 | | | | |
| 7 | $m_3^-$lower predrive output 3 | | | | |
| 8 | $m_3^+$upper predrive output 3 | ——— | Pre-drive output for output transistor of the source side | — | 8, 9.11 |
| 9 | $m_2^+$upper predrive output 2 | | | | |
| 11 | $m_1^+$upper predrive output 1 | | | | |
| 10 | NC | ——— | ——— | — | ——— |
| 12 | $V_M$ motor power pin | ——— | Motor power input pin | — | ——— |

## ■ Pin Descriptions (cont.)

| Pin No. | Pin name | Typ. waveform | Description | I/O impedance | Equivalent circuit |
|---|---|---|---|---|---|
| 13<br>14<br>15 | M3 motor coil pin 3<br>M2 motor coil pin 2<br>M1 motor coil pin 1 |  | Connect to the motor coil. | — | ——— |
| 16 | FC switching power triangular wave input pin |  | Inputs switching power supply control triangular wave from external. | — |  |
| 17 | SW switching power output | ——— | Power transistor pre-drive output for switching power supply | — |  |
| 18 | PCS switching power control output | ——— | Outputs a voltage proportional to $V_{CE}$ of the output on the source side.<br>It also serves as a phase compensation pin for the switching power supply loop. | 16.8kΩ |  |
| 19 | NC | ——— | NC | — | ——— |
| 20 | PCV voltage feedback system phase compensation | ——— | Phase compensation pin of the control system for the output transistor on the source side | — |  |
| 21 | GND pin | ——— | Ground pin | — | ——— |
| 22 | PCI current feedback phase compensation | ——— | Phase compensation pin of the control system for the output transistor on the sink side. | — |  |

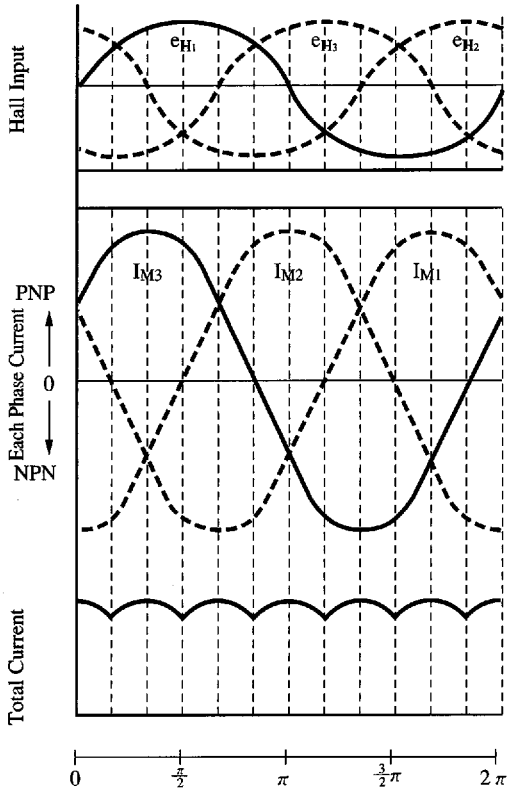
## ■ Pin Descriptions (cont.)

| Pin No. | Pin name | Typ. waveform | Description | I/O impedance | Equivalent circuit |
|---|---|---|---|---|---|
| 23 | CS current detection pin | ——— | Inputs the value detected by a current detection resistor. | — |   |
| 24 | TL torque limit pin | ——— | Inputs an output current limit value. | — | |
| 25 | EC torque command input pin | ——— | Inputs a torque command. | — |   |
| 26 | ECR torque command ref. input pin | ——— | Inputs a torque command ref. voltage. | — | |
| 27 | $V_{CC}$ power pin | ——— | Inputs the supply voltage. | — | ——— |
| 28, 29 30, 31 | NC | ——— | NC | — | ——— |
| 32 33 34 35 36 | $H_1^-$ Hall element input $H_1^+$ Hall element input $H_2^+$ Hall element input $H_2^-$ Hall element input $H_3^-$ Hall element input |   | Inputs a signal for the Hall elements of the motor. | — |   |

## ■ Supplementary Explanation

● Hall Input and Output Current Phases for AN3890FBS

ED/S=0V EC<ECR




• Torque Direction Setting Logic

The direction of generated torque is determined by the following information.

- Information from the rotary direction detection circuit : ER
  High : $H_1 \rightarrow H_3 \rightarrow H_2$
- Brake information from the torque command circuit : EA
  High : ECR>EC
- Rotary direction command : ED
  High : $H_1 \rightarrow H_3 \rightarrow H_2$
  $H_1 \rightarrow H_3 \rightarrow H_2$ (forward rotation) at ED/S=0V
- Direction of generated torque : EP
  High : Generates a torque rotaing in the direction of $H_1 \rightarrow H_3 \rightarrow H_2$

EP is determined as follows, depending on ER, EA, or ED

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

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

Torque Direction Setting Logic Carnot's Diagram