

## 4-CH MOTOR DRIVER

The KA3010D is a monolithic integrated circuit, and suitable for 4-CH motor driver which drives tracking actuator, focus actuator, sled motor and loading motor of CD/CD-ROM/DVD system, and can also drive spindle motor of CD system.

## FEATURES

- 1-phase, full-wave, linear DC motor driver
- Wide dynamic range:
  - $V_{CC}=5V$ ,  $R_L=8\Omega \rightarrow V_{OM}=3.0V$
  - $V_{CC}=12V$ ,  $R_L=24\Omega \rightarrow V_{OM}=9.5V$
- Output gain adjustable
- Built in op-amp
- Built in mute function
- Built in level shift circuit
- Built in thermal shutdown function

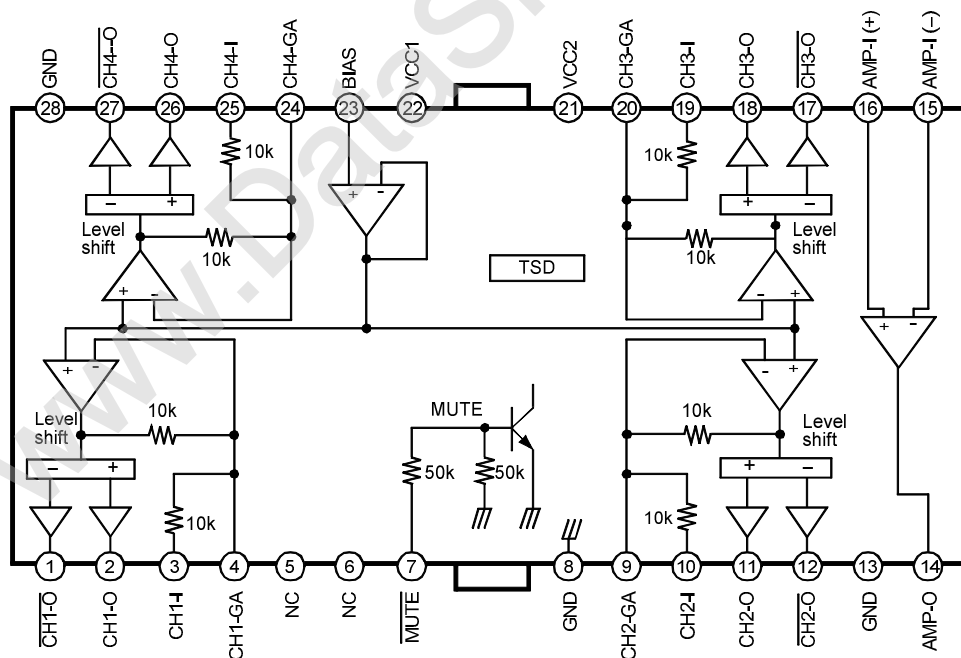
28-SSOPH-375



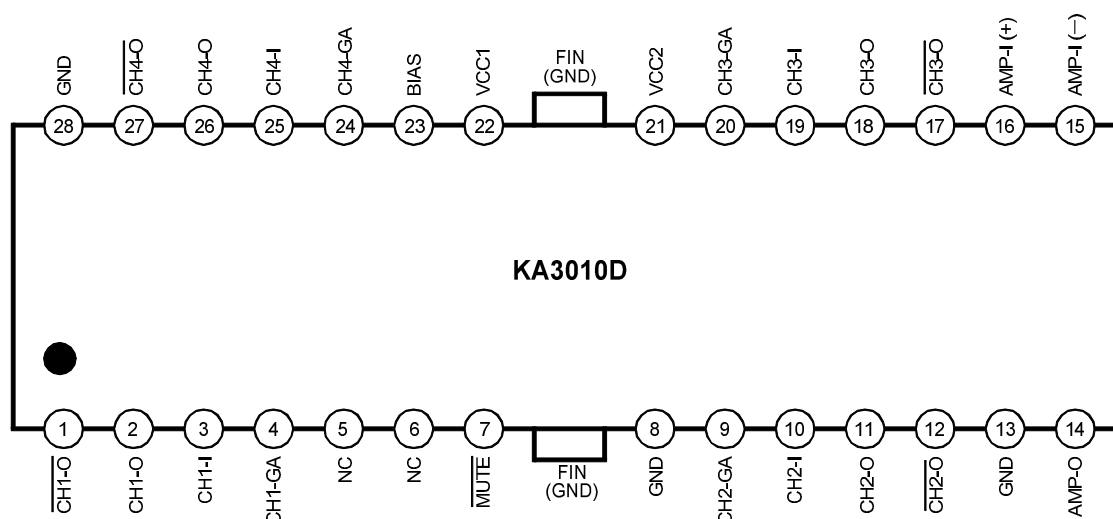
## ORDERING INFORMATION

| Device  | Package      | Operating Temperature |
|---------|--------------|-----------------------|
| KA3010D | 28-SSOPH-375 | -20°C ~ +75°C         |

## BLOCK DIAGRAM



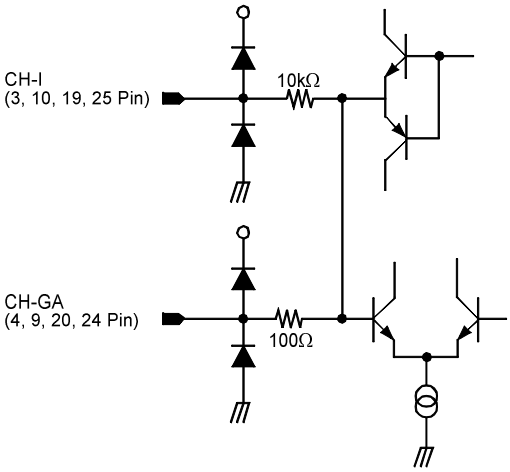
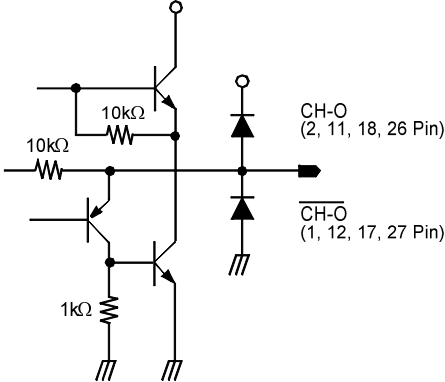
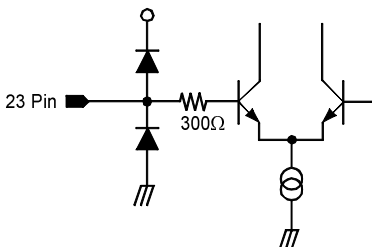
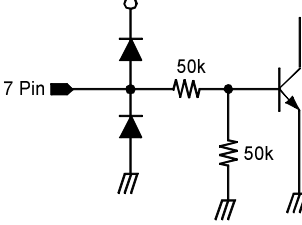
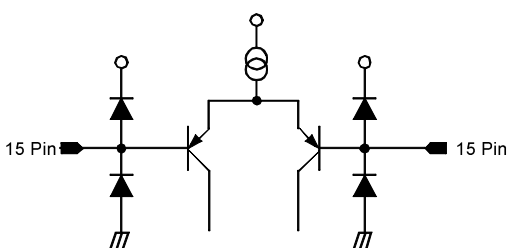
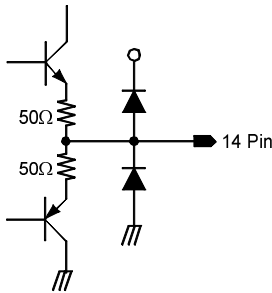
## PIN CONFIGURATION



## PIN DESCRIPTION

| Pin No. | Symbol | I/O | Description                   | Pin No. | Symbol    | I/O | Description                   |
|---------|--------|-----|-------------------------------|---------|-----------|-----|-------------------------------|
| 1       | CH1-O  | O   | Drive CH 1 output (-)         | 15      | AMP-1 (-) | I   | Op-amp input (-)              |
| 2       | CH1-O  | O   | Drive CH 1 output (+)         | 16      | AMP-I (+) | I   | Op-amp input (+)              |
| 3       | CH1-I  | I   | Drive CH 1 input              | 17      | CH3-O     | O   | Drive CH 3 output (-)         |
| 4       | CH1-GA | I   | Drive CH1 input (Adjustable)  | 18      | CH3-O     | O   | Drive CH 3 output (+)         |
| 5       | NC     | -   | No connection                 | 19      | CH3-I     | I   | Drive CH 3 input              |
| 6       | NC     | -   | No connection                 | 20      | CH3-GA    | I   | Drive CH 3 input (Adjustable) |
| 7       | MUTE   | I   | Mute                          | 21      | VCC2      | -   | Supply voltage 2              |
| 8       | GND    | -   | Signal ground                 | 22      | VCC1      | -   | Supply voltage 1              |
| 9       | CH2-GA | I   | Drive CH 2 input (Adjustable) | 23      | BIAS      | I   | 2.5V bias                     |
| 10      | CH2-I  | I   | Drive CH 2 input              | 24      | CH4-GA    | I   | Drive CH 4 input (Adjustable) |
| 11      | CH2-O  | O   | Drive CH 2 output (+)         | 25      | CH4-I     | I   | Drive CH 4 input              |
| 12      | CH2-O  | O   | Drive CH 2 output (-)         | 26      | CH4-O     | O   | Drive CH 4 output (+)         |
| 13      | GND    | -   | Power ground                  | 27      | CH4-O     | O   | Drive CH 4 output (-)         |
| 14      | AMP-O  | O   | Op-amp output                 | 28      | GND       | -   | Power ground                  |

## EQUIVALENT CIRCUITS

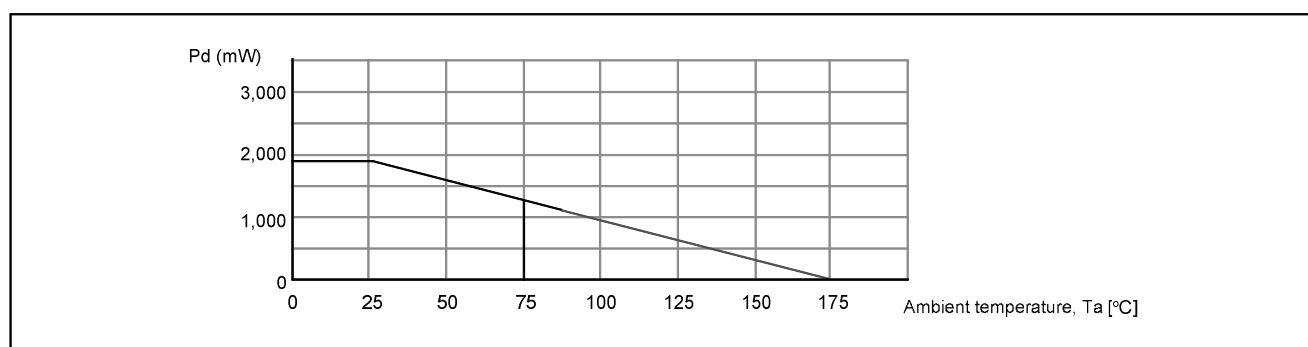
| Driver input                                                                                                                                                              | Driver output                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>CH-I (3, 10, 19, 25 Pin)</p> <p>CH-GA (4, 9, 20, 24 Pin)</p> <p>10kΩ</p> <p>100Ω</p> |  <p>CH-O (2, 11, 18, 26 Pin)</p> <p>CH-O (1, 12, 17, 27 Pin)</p> <p>10kΩ</p> <p>10kΩ</p> <p>1kΩ</p> |
| Bias                                                                                                                                                                      | Mute                                                                                                                                                                                  |
|  <p>23 Pin</p> <p>300Ω</p>                                                              |  <p>7 Pin</p> <p>50k</p> <p>50k</p>                                                               |
| Opamp input                                                                                                                                                               | Op-amp output                                                                                                                                                                         |
|  <p>15 Pin</p> <p>15 Pin</p>                                                           |  <p>50Ω</p> <p>50Ω</p> <p>14 Pin</p>                                                              |

**ABSOLUTE MAXIMUM RATING (Ta=25°C)**

| Characteristics        | Symbol             | Value               | Unit |
|------------------------|--------------------|---------------------|------|
| Maximum supply voltage | $V_{CC1}, V_{CC2}$ | 15                  | V    |
| Power dissipation      | $P_D$              | 1.7 <sup>note</sup> | W    |
| Operating temperature  | $T_{OPR}$          | -20 ~ +75           | °C   |
| Storage temperature    | $T_{STG}$          | -55 ~ +150          | °C   |

**NOTE:**

1. When mounted on 50mm × 50mm × 1mm PCB (Phenolic resin material).
2. Power dissipation reduces 13.6mW / °C for using above Ta=25°C.
3. Do not exceed Pd and SOA.

**RECOMMENDED OPERATING CONDITION (Ta=25°C)**

| Characteristics       | Symbol             | Min. | Typ. | Max. | Unit |
|-----------------------|--------------------|------|------|------|------|
| Supply voltage        | $V_{CC1}, V_{CC2}$ | 4.5  | –    | 13   | V    |
| Operating temperature | $T_{OPR}$          | -25  | –    | +75  | °C   |

## ELECTRICAL CHARACTERISTICS

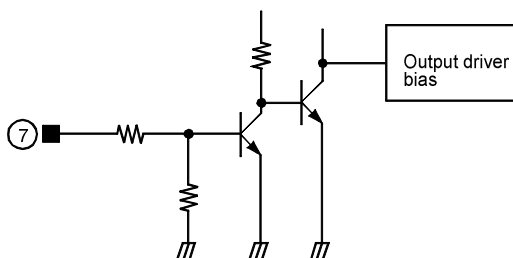
(Ta=25°C, V<sub>CC1</sub>=V<sub>CC2</sub>=5V, R<sub>L</sub>=8Ω)

| Characteristic              | Symbol              | Test conditions                                              | Min. | Typ. | Max. | Unit   |
|-----------------------------|---------------------|--------------------------------------------------------------|------|------|------|--------|
| <b>DRIVE PART</b>           |                     |                                                              |      |      |      |        |
| Quiescent current           | I <sub>CC</sub>     | –                                                            | –    | 9    | 12   | mA     |
| Output offset voltage       | V <sub>OO</sub>     | –                                                            | –50  | 0    | 50   | mV     |
| Maximum output voltage      | V <sub>OM</sub>     | –                                                            | 2.0  | 3.0  | –    | V      |
|                             |                     | V <sub>CC1</sub> =V <sub>CC2</sub> =12V, R <sub>L</sub> =24Ω | 6.5  | 9.5  | –    | V      |
| Voltage gain                | G <sub>VC</sub>     | V <sub>IN</sub> =0.1V <sub>RMS</sub> , 1kHz                  | 10.5 | 12.0 | 13.5 | dB     |
| Ripple rejection ratio      | RR                  | V <sub>IN</sub> =0.1V <sub>RMS</sub> , 120Hz                 | –    | 50   | –    | dB     |
| Slew rate                   | SR                  | 120Hz, 2V <sub>P-P</sub>                                     | –    | 0.8  | –    | V / μs |
|                             |                     | V <sub>CC1</sub> & 2=12V, 120Hz, 4V <sub>p-p</sub>           | –    | 1.0  | –    | V / μs |
| Mute off voltage            | V <sub>MOFF</sub>   | –                                                            | 2.0  | –    | –    | V      |
| Mute on voltage             | V <sub>MON</sub>    | –                                                            | –    | –    | 0.5  | V      |
| <b>OP-AMP PART</b>          |                     |                                                              |      |      |      |        |
| Input offset voltage        | V <sub>OFOP</sub>   | –                                                            | –10  | 0    | 10   | mV     |
| Input bias current          | I <sub>BOP</sub>    | –                                                            | –    | –    | 300  | nA     |
| High level output voltage   | V <sub>OHOP</sub>   | –                                                            | 3    | 3.9  | –    | V      |
|                             |                     | V <sub>CC1</sub> =V <sub>CC2</sub> =12V                      | 10   | 10.9 | –    | V      |
| Low level output voltage    | V <sub>OLOP</sub>   | –                                                            | –    | 1.1  | 1.8  | V      |
| Output sink current         | I <sub>SINK</sub>   | R <sub>L</sub> =50Ω                                          | 10   | 30   | –    | mA     |
|                             |                     | V <sub>CC1</sub> =V <sub>CC2</sub> =12V, R <sub>L</sub> =50Ω | 10   | 95   | –    | mA     |
| Output source current       | I <sub>SOURCE</sub> | R <sub>L</sub> =50Ω                                          | 10   | 30   | –    | mA     |
|                             |                     | V <sub>CC1</sub> =V <sub>CC2</sub> =12V, R <sub>L</sub> =50Ω | 10   | 50   | –    | mA     |
| Voltage gain                | G <sub>VO</sub>     | V <sub>IN</sub> = –75dB, 1kHz                                | –    | 78   | –    | dB     |
| Slew rate                   | SR <sub>OP</sub>    | 100Hz, 2V <sub>p-p</sub>                                     | –    | 2    | –    | V / μs |
| Ripple rejection ratio      | RR <sub>OP</sub>    | V <sub>IN</sub> = –20dB, 120kHz                              | –    | 65   | –    | dB     |
| Common-mode rejection ratio | CMRR                | V <sub>IN</sub> = –20dB, 1kHz                                | –    | 84   | –    | dB     |

## APPLICATION INFORMATION

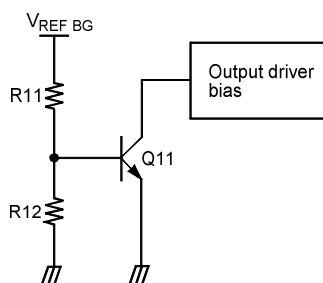
## 1. MUTEM

| Pin #7 | Mute circuit |
|--------|--------------|
| High   | Turn-off     |
| Low    | Turn-on      |
| Open   | Turn-on      |



- When the mute pin #7 is open or the voltage of the mute pin #7 is below 0.5V, the mute circuit is activated so that the output circuit will be muted.
- When the voltage of the mute pin is above 2V, the mute circuit is stopped and the output circuit is operated normally.
- If the chip temperature rises above 175°C, then the TSD (Thermal shutdown) circuit is activated and the output circuit is muted.

## 2. TSD (THERMAL SHUTDOWN)

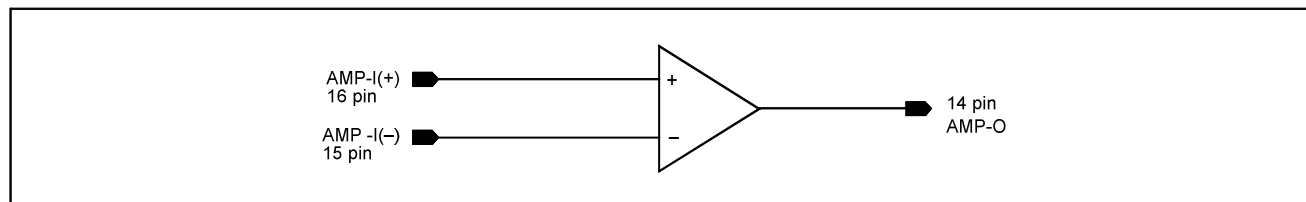


- The  $V_{REF\ BG}$  is the output voltage of the band-gap-referenced bias in circuit and acts as the input voltage of the TSD circuit.
- The base-emitter voltage of the TR, Q11 is designed to turn-on at below voltage.  

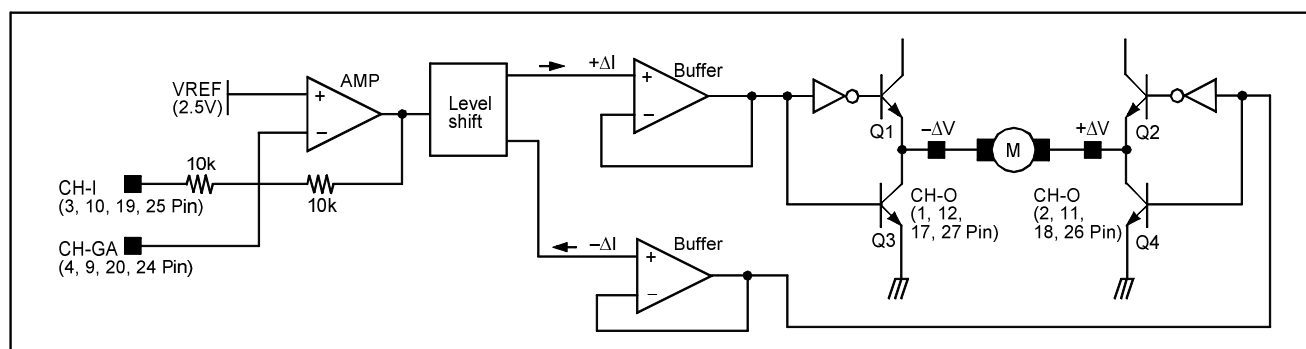
$$V_{BE} = V_{REF\ BG} \times R12 / (R11 + R12) = 460mV$$
- When the chip temperature rises up to 175°C, then the turn-on voltage of the Q11 would drop down to 460mV. (Hysteresis: 25°C) Hence, the Q11 would turn on so the output circuit will be muted.

### 3. OP-AMP

Op-amp is integrated in the IC for user's convenience.



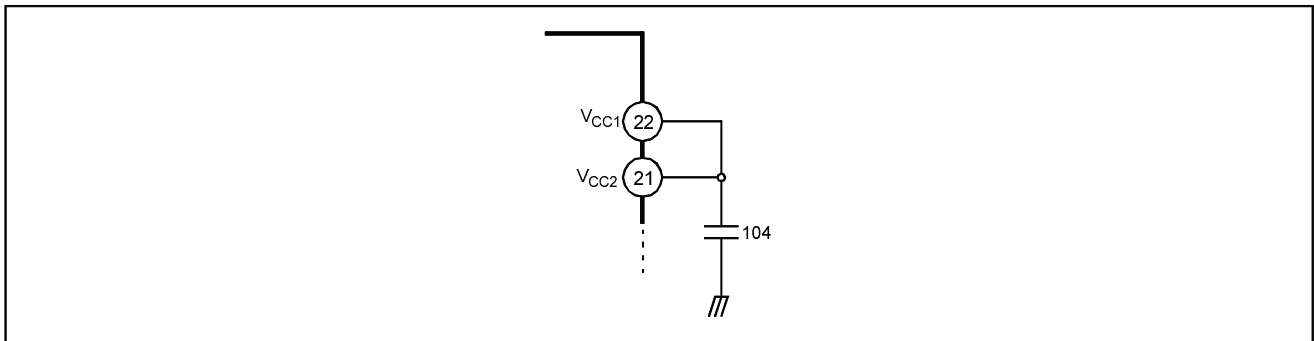
### 4. DRIVER



- The voltage,  $V_{REF}$ , is the reference voltage given by the bias voltage of the pin #23.
- The input signal through the pin #3 is amplified by 10k/10k times and then fed to the level shift.
- The level shift produces the current due to the difference between the input signal and the arbitrary reference signal. The current produced as  $+\Delta I$  and  $-\Delta I$  is fed into the driver buffer.
- Driver buffer operates the power TR of the output stage according to the state of the input signal.
- The output stage is the BTL driver and the motor is rotating in forward direction by operating TR Q1 and TR Q4. On the other hand, if TR Q2 and TR Q3 is operating, the motor is rotating in reverse direction.
- When the input voltage through the pin #3 is below the  $V_{REF}$ , then the direction of the motor in forward direction.
- When the input voltage through the pin #3 is above the  $V_{REF}$ , then the direction of the motor in reverse direction.
- If it is desired to change the gain, then the pin #4 can be used.
- The gain ( $A_V$ ) of the drive circuit is as follows.

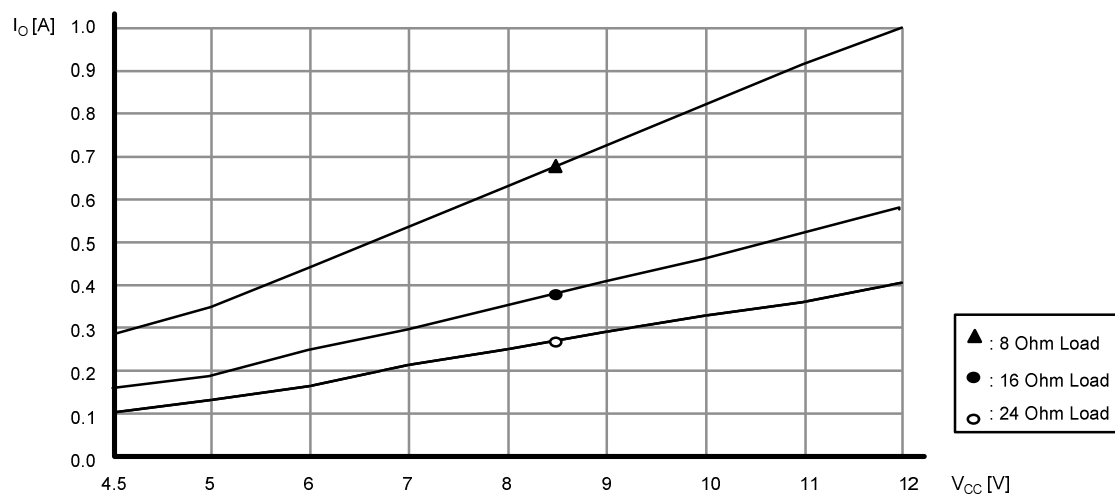
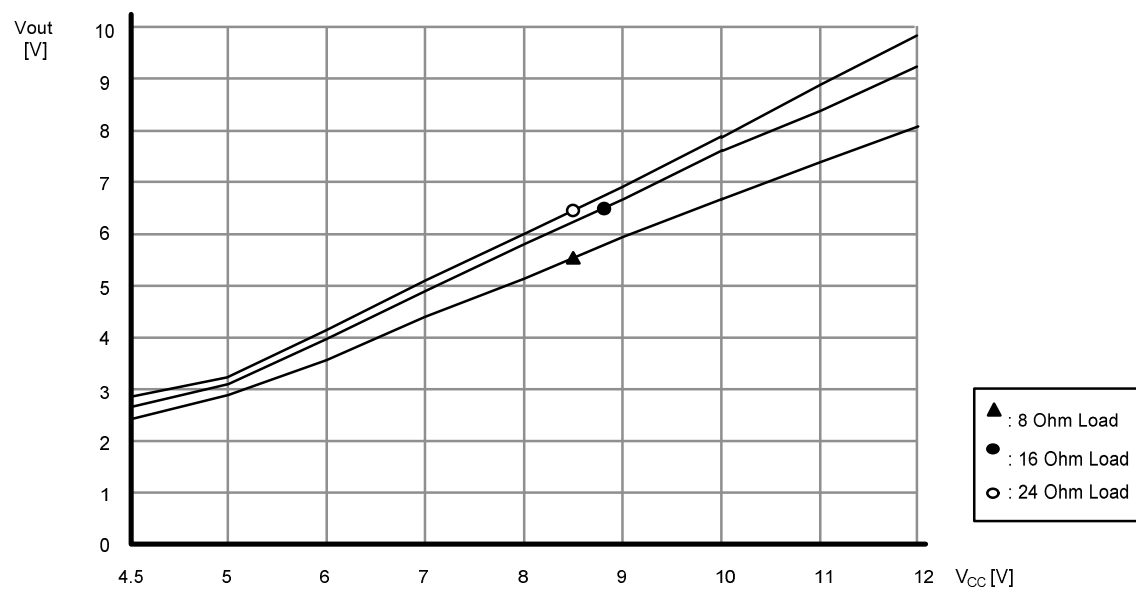
$$A_V = 20 \log \left[ \frac{4V_{IN}}{V_{IN}} \right] = 12(dB)$$

5. Connect a by-pass capacitor,  $0.1\mu\text{F}$  between the supply voltage source.

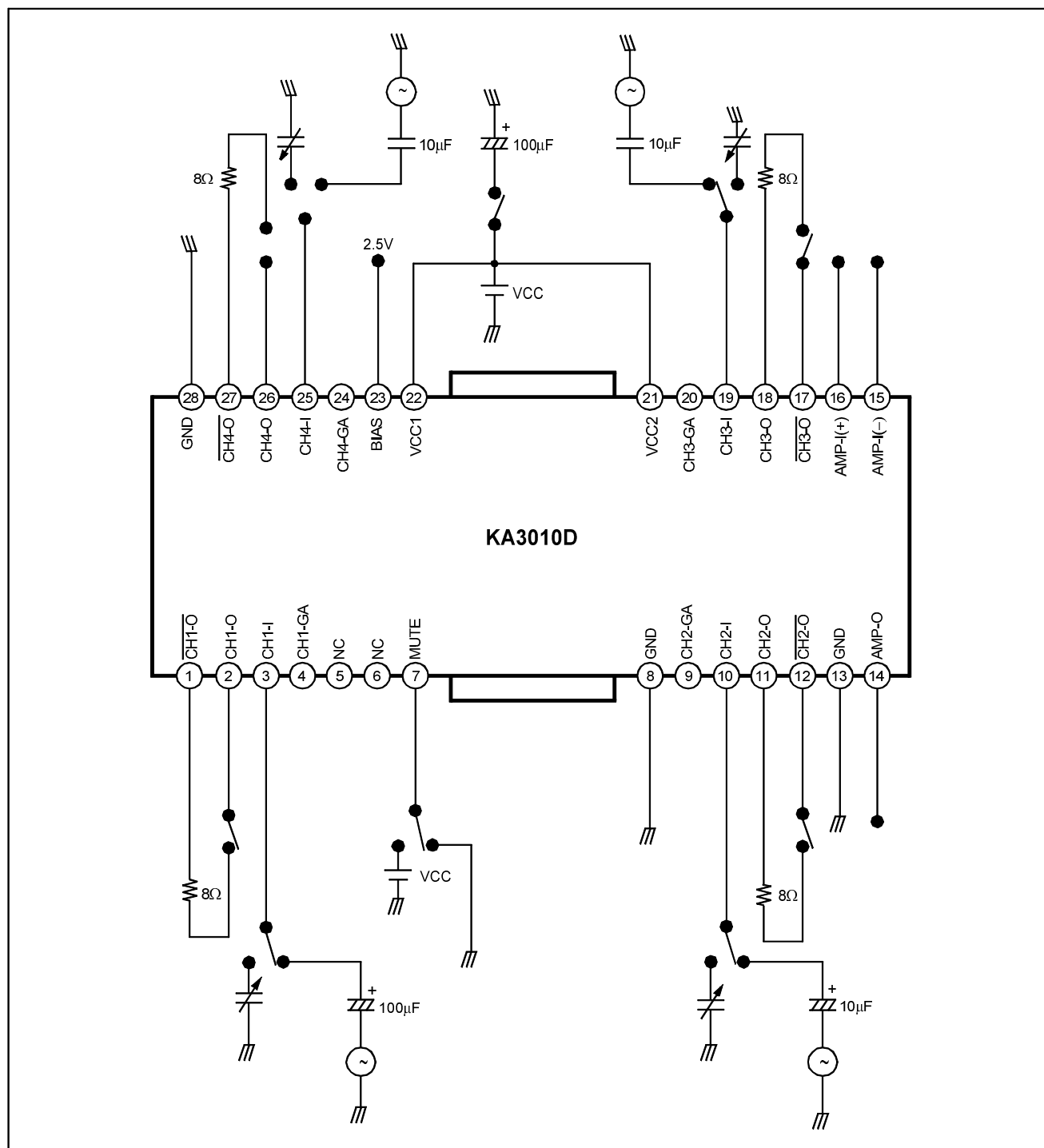


6. Radiation fin is connecting to the internal GND of the package.  
Connect the fin to the external GND.

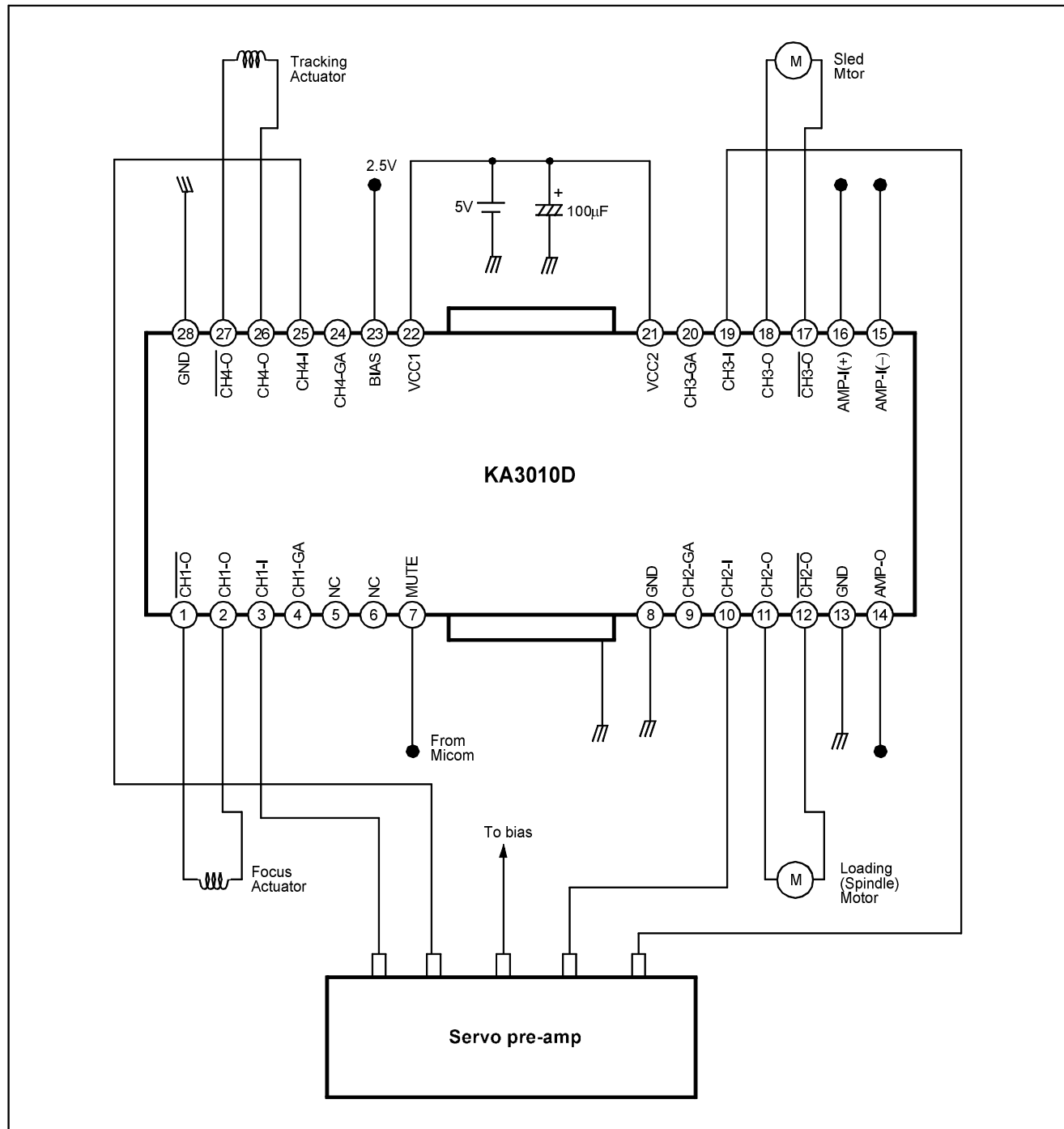
## ELECTRICAL CHARACTERISTICS CURVES

1.  $V_{CC}$  vs. output current2.  $V_{CC}$  vs.  $V_{out}$ 

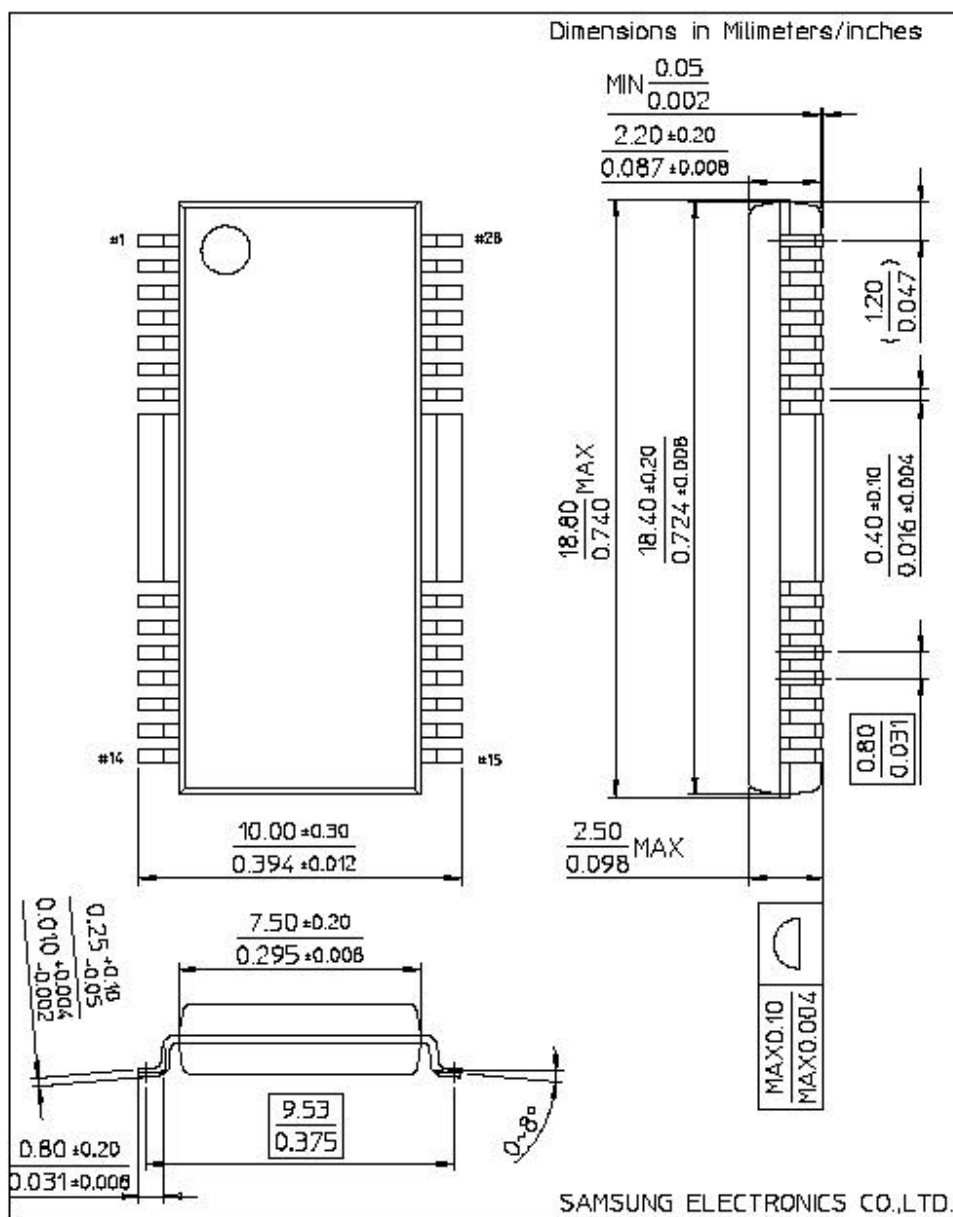
## TEST CIRCUIT



## APPLICATION CIRCUIT



## PACKAGE DIMENSION

**28-SSOPH-375**

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