

# KA9259D(KA9259HD)

## 5-Channel Motor Drive IC

### Features

- 4-CH Balanced Transformerless(BTL) Driver
- 1-CH (Forward/Reverse) DC Motor Driver With Speed Control Circuit
- Built-in TSD (Thermal Shutdown) Circuit
- Built-in 5V Regulator (With an External PNP Transistor)
- Built-in Mute Circuit
- Wide Operating Supply Voltage Range: 6V~13.2V

### Description

The KA9259D is a monolithic integrated circuit, and suitable for 5-CH motor driver which drives focus actuator, tracking actuator, sled motor, spindle motor and loading motor of compact disk player system.

28-SSOPH-375



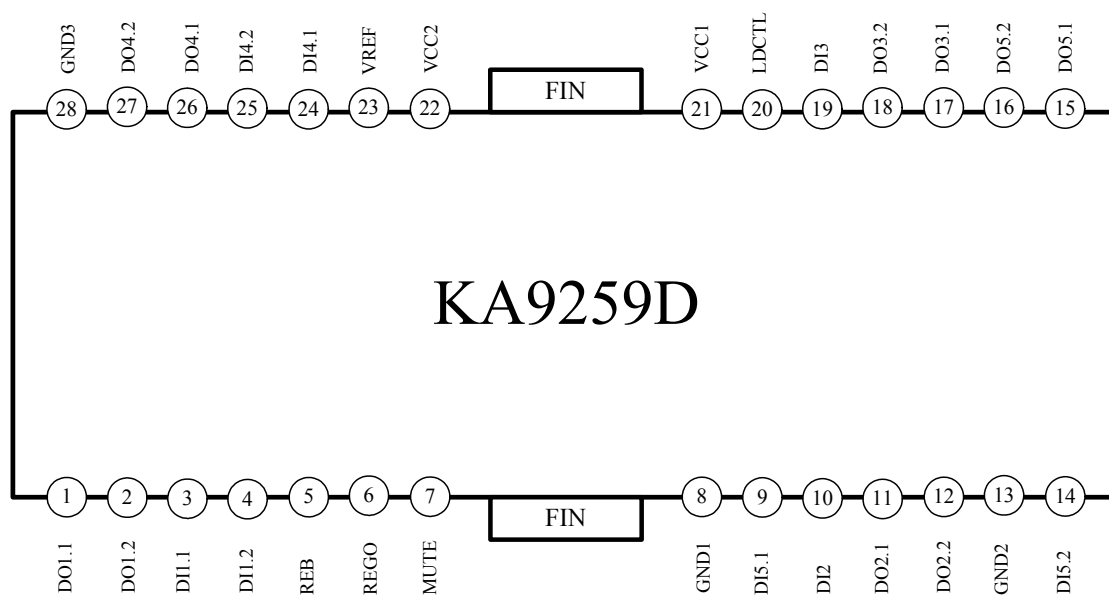
### Typical Applications

- Compact Disk Player (CDP)
- Video Compact Disk Player (VCD)
- Automotive Compact Disk Player (CDP)
- Other Compact Disk Media

### Ordering Information

| Device     | Package      | Operating Temp. |
|------------|--------------|-----------------|
| KA9259HD   | 28-SSOPH-375 | -25°C ~ +75°C   |
| KA9259HDTF | 28-SSOPH-375 | -25°C ~ +75°C   |

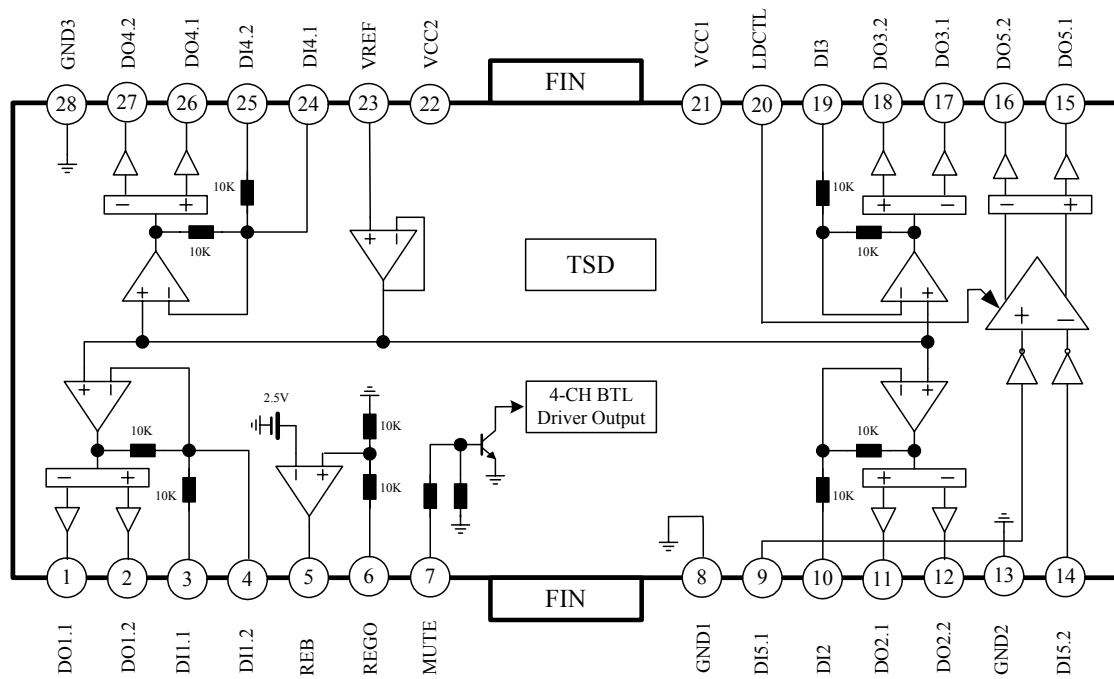
## Pin Assignments



## Pin Definitions

| Pin Number | Pin Name | I/O | Pin Function Description                      |
|------------|----------|-----|-----------------------------------------------|
| 1          | DO1.1    | O   | Channel 1 output 1                            |
| 2          | DO1.2    | O   | Channel 1 output 2                            |
| 3          | DI1.1    | I   | Channel 1 input 1                             |
| 4          | DI1.2    | I   | Channel 1 input 2 (Adjustable)                |
| 5          | REB      | O   | External transistor base drive output         |
| 6          | REO      | O   | Regulator output                              |
| 7          | MUTE     | I   | Mute signal input                             |
| 8          | GND1     | -   | Ground 1                                      |
| 9          | DI5.1    | I   | Channel 5 input 1 (Loading Motor)             |
| 10         | DI2      | I   | Channel 2 input                               |
| 11         | DO2.1    | O   | Channel 2 output 1                            |
| 12         | DO2.2    | O   | Channel 2 output 2                            |
| 13         | GND2     | -   | Ground 2                                      |
| 14         | DI5.2    | I   | Channel 5 input 2 (Loading Motor)             |
| 15         | DO5.1    | O   | Channel 5 output 1 (Loading Motor)            |
| 16         | DO5.2    | O   | Channel 5 output 2 (Loading Motor)            |
| 17         | DO3.1    | O   | Channel 3 output 1                            |
| 18         | DO3.2    | O   | Channel 3 output 2                            |
| 19         | DI3      | I   | Channel 3 input                               |
| 20         | LD CTL   | I   | Channel 5 (Loading Motor) speed control input |
| 21         | VCC1     | -   | Power supply voltage 1                        |
| 22         | VCC2     | -   | Power supply voltage 2                        |
| 23         | VREF     | I   | Bias voltage input                            |
| 24         | DI4.1    | I   | Channel 4 input 1 (Adjustable)                |
| 25         | DI4.2    | I   | Channel 4 input 2                             |
| 26         | DO4.1    | O   | Channel 3 output 1                            |
| 27         | DO4.2    | O   | Channel 3 output 2                            |
| 28         | GND3     | -   | Ground 3                                      |

## Internal Block Diagram



Equivalent Circuits

| Driver Input (Except For Loading Motor Driver) | Driver Output                     |
|------------------------------------------------|-----------------------------------|
|                                                |                                   |
| Loading Motor Driver Input                     | Loading Motor Speed Control Input |
|                                                |                                   |
| Mute Input                                     | Bias Input                        |
|                                                |                                   |

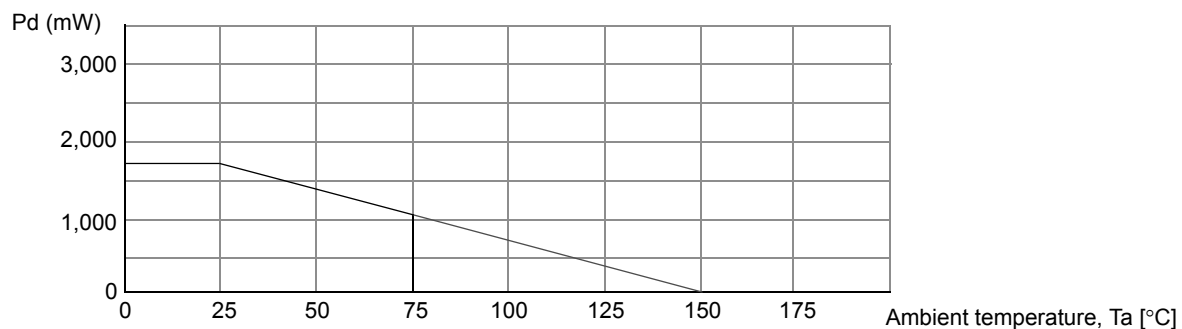
## Absolute Maximum Ratings (Ta = 25°C)

| Parameter              | Symbol             | Value               | Unit |
|------------------------|--------------------|---------------------|------|
| Maximum Supply Voltage | V <sub>CCMAX</sub> | 15                  | V    |
| Power Dissipation      | P <sub>D</sub>     | 1.7 <sup>note</sup> | W    |
| Operating Temperature  | T <sub>OPR</sub>   | -25 ~ +75           | °C   |
| Storage Temperature    | T <sub>STG</sub>   | -55 ~ +150          | °C   |
| Maximum Current Output | I <sub>OMAX</sub>  | 1                   | A    |

### Note:

1. When mounted on 76mm × 114mm × 1.57mm PCB (Phenolic resin material).
2. Power dissipation reduces 13.6mW / °C for using above Ta=25°C
3. Do not exceed Pd and SOA.

## Power Dissipation Curve



## Recommended Operating Condition (Ta = 25°C)

| Parameter                | Symbol          | Value    | Unit |
|--------------------------|-----------------|----------|------|
| Operating Supply Voltage | V <sub>CC</sub> | 6 ~ 13.2 | V    |

## Electrical Characteristics

(Ta = 25°C, VCC = 8V, RL = 8Ω, f = 1kHz, unless otherwise specified)

| Parameter                                                                  | Symbol   | Conditions                                 | Min. | Typ. | Max. | Unit |
|----------------------------------------------------------------------------|----------|--------------------------------------------|------|------|------|------|
| Quiescent Circuit Current                                                  | ICCQ     | Under no-load                              | 2.5  | 6    | 10   | mA   |
| Mute-on Current                                                            | IMUTE    | Pin 7=GND                                  | -    | 2.5  | 5    | mA   |
| Mute-on Voltage                                                            | VMON     | -                                          | -    | -    | 0.5  | V    |
| Mute-off Voltage                                                           | VMOFF    | -                                          | 2    | -    | -    | V    |
| <b>REGULATOR PART</b>                                                      |          |                                            |      |      |      |      |
| Output Voltage                                                             | VREG     | IL=100mA                                   | 4.7  | 5.0  | 5.3  | V    |
| Load Regulation                                                            | ΔVRL3    | IL=0→200mA                                 | -50  | 0    | 50   | mV   |
| Line Regulation                                                            | ΔVCC     | VCC=6→13V, IL=100mA                        | -20  | 0    | 80   | mV   |
| <b>BTL DRIVER PART (CH1, CH2, CH3 and CH4)</b>                             |          |                                            |      |      |      |      |
| Input Offset Voltage                                                       | VIO      | -                                          | -15  | -    | 15   | mV   |
| Output Offset Voltage 1                                                    | VOO1     | -                                          | -40  | -    | 40   | mV   |
| Maximum Source Current 1                                                   | ISOURCE1 | RL=8Ω→VCC                                  | 0.25 | 0.4  | -    | A    |
| Maximum Sink Current 1                                                     | ISINK1   | RL=8Ω→GND                                  | 0.25 | 0.4  | -    | A    |
| Maximum Output Voltage 3                                                   | VOM3     | VIN=0.7V, VCC=13V                          | 2.5  | 3.3  | 4.6  | V    |
| Maximum Output Voltage 4                                                   | VOM4     | VIN=7V, VCC=13V, VIN=8V                    | -    | -5.8 | -5.0 | V    |
| Closed-Loop Voltage Gain                                                   | AVF      | VIN=8V, VCC=13V                            | 5    | 6.5  | 8    | dB   |
| Ripple Rejection Ratio (Note1)                                             | RR       | VIN=0.1VRMS, f=120Hz                       | 40   | 60   | -    | dB   |
| Slew Rate (Note1)                                                          | SR       | 120Hz, VIN=1VRMS, Square wave              | 1    | 2    | -    | V/μs |
| <b>LOADING MOTOR DRIVER PART (UNLESS OTHERWISE SPECIFIED, VCTL=OPENED)</b> |          |                                            |      |      |      |      |
| Output Voltage 1                                                           | VO1      | VPIN9=5V, VPIN14=0V, RL=45Ω                | 2.5  | 3.1  | 3.8  | V    |
| Output Voltage 2                                                           | VO2      | VPIN9=0V, VPIN14=5V, RL=45Ω                | 2.5  | 3.1  | 3.8  | V    |
| Output Voltage Regulation 1 (CTL)                                          | VOCTL1   | VCTL=3.5→4.5V, VPIN9=5V, VPIN14=0V, RL=45Ω | 0.5  | 1.0  | 1.5  | V    |
| Output Voltage Regulation 2 (CTL)                                          | VOCTL2   | VCTL=3.5→4.5V, VPIN9=0V, VPIN14=5V, RL=45Ω | 0.5  | 1.0  | 1.5  | V    |
| Load Regulation 1                                                          | ΔVRL1    | IL=100→400mA, VPIN9=5V, VPIN14=0V          | -    | 300  | 700  | mV   |
| Load Regulation 2                                                          | ΔVRL2    | IL=100→400mA, VPIN9=0V, VPIN14=5V          | -    | 300  | 700  | mV   |
| Output Offset Voltage 2                                                    | VOO2     | VPIN9=5V, VPIN14=5V                        | -40  | -    | 40   | mV   |
| Output Offset Voltage 3                                                    | VOO3     | VPIN9=0V, VPIN14=0V                        | -40  | -    | 40   | mV   |

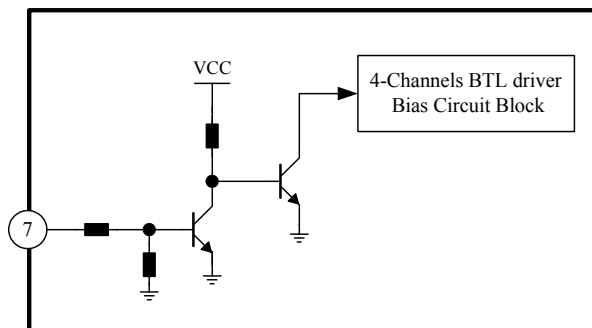
### Note :

1. Guaranteed design value

## Application Information

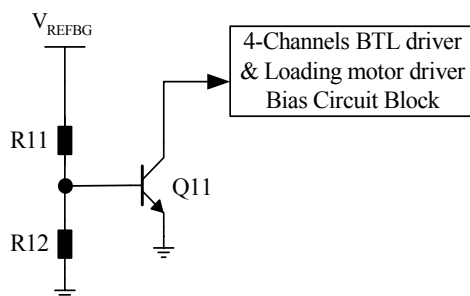
### 1. Mute Function

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



- When the mute (pin 7) is high level, the bias circuit of BTL driver is activated. On the other hand, when the mute (pin7) is open or low level, the bias circuit of BTL driver is disabled. So that the 4-channels BTL driver output circuit will be muted.

### 2. TSD (Thermal Shutdown) Function

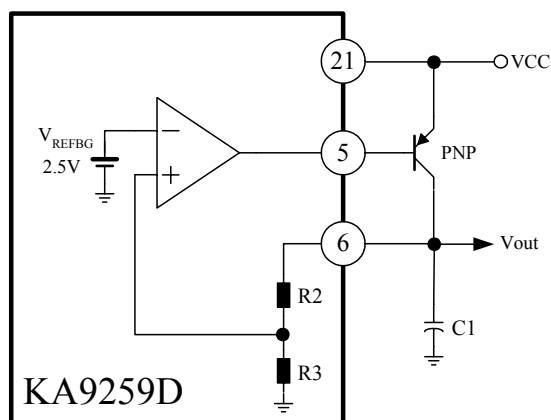


- The VREFBG is the output voltage of the band-gap-referenced biasing circuit and acts as the input voltage of the TSD circuit.
- The base-emitter voltage of the transistor, Q11 is designed to turn-on at below voltage.

$$V_{BE} = \frac{V_{REFBG} \times R12}{R11 + R12} = 400[mV]$$

- If the chip temperature rises above 175°C, then the TSD circuit is activated and the output circuit is muted. The TSD circuit has the hysteresis temperature of 25°C.

### 3. Voltage Regulator



- The  $V_{REFBG}$  is the output voltage of the band-gap-referenced biasing circuit and is the reference voltage of the regulator.
- The external circuit is composed of the transistor(PNP), KSB772 and a capacitor(C1),  $100\mu F$ , and the capacitor is used as a ripple eliminator and should have a good temperature characteristics.
- The output voltage,  $V_{OUT}$  is decided as follows.

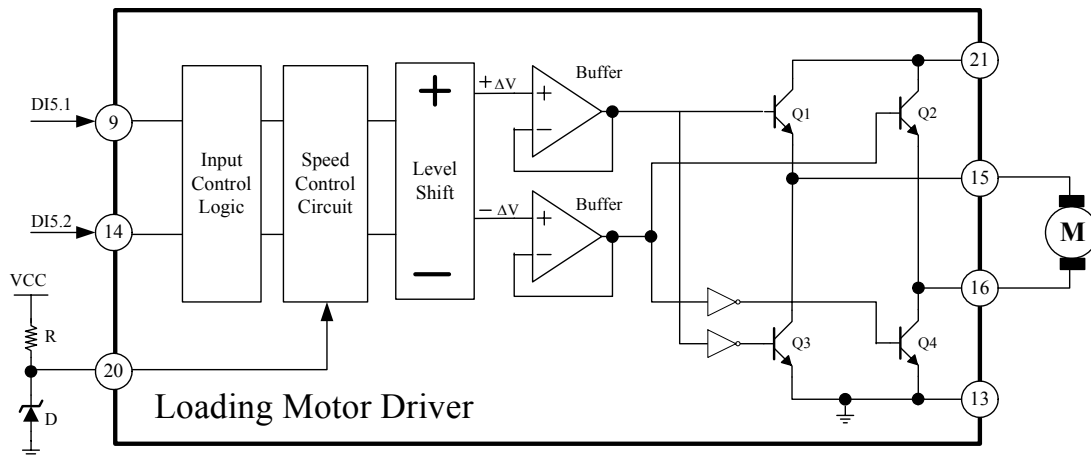
$$V_{OUT} = (1 + \frac{R2}{R3})V_{REFBG} = 2 \times 2.5 = 5[V]$$

Where,  $R2 = R3$

## 4. Loading Motor Driver

### 4.1 Truth table and Operation

| INPUT       |              | OUTPUT       |               |         |
|-------------|--------------|--------------|---------------|---------|
| PIN9(DI5.1) | PIN14(DI5.2) | PIN15(DO5.1) | PIN16 (DO5.2) | State   |
| L           | L            | L            | L             | Brake   |
| H           | L            | H            | L             | Forward |
| L           | H            | L            | H             | Reverse |
| H           | H            | L            | L             | Brake   |

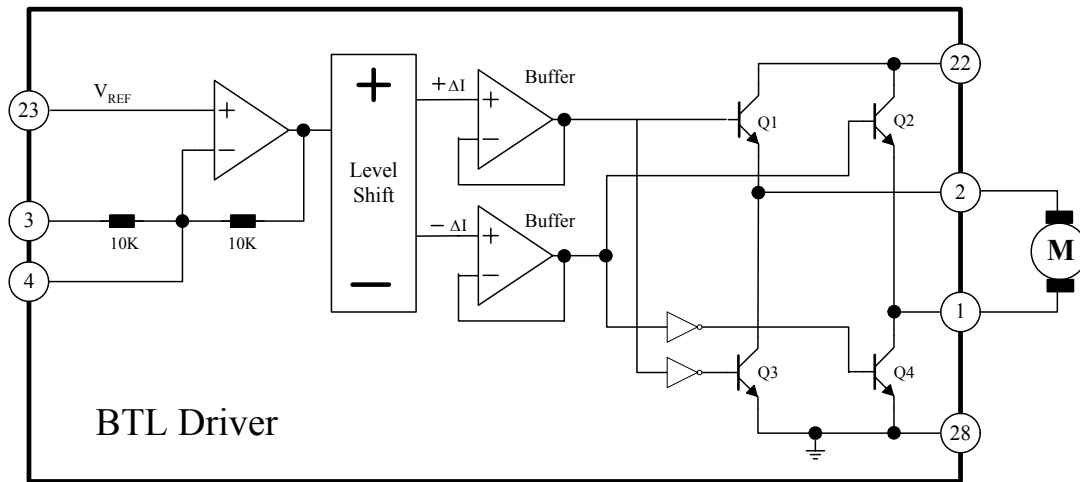


- The input voltages of (5V and 0V) or (0V and 5V) pairs are applied to the input pin #9 and #14 respectively.
- When the input voltages are applied to the input pin #9 and #14, then the output of the comparator is decided depends on the input voltage status.
- As shown in the above diagram, the difference voltage,  $\Delta V$ , is applied to the both terminals of the motor. The direction of the motor is decided by the voltage difference,  $+\Delta V$  and  $-\Delta V$ .
- The output characteristics is as follows,
  - If pin # 9=5V and #14=0V, then pin # 15=  $+\Delta V$  and #16=  $-\Delta V$ , hence the motor turn in forward direction.
  - If pin # 9=0V and #14=5V, then pin # 15=  $-\Delta V$  and #16=  $+\Delta V$ , hence the motor turn in reverse direction.
  - If pin # 9=5V and #14=5V, then  $\Delta V=0V$ , hence the motor stop.
  - If pin # 9=0V and #14=0V, then  $\Delta V=0V$ , hence the motor stop.

### 4.2 Loading Motor Speed Control

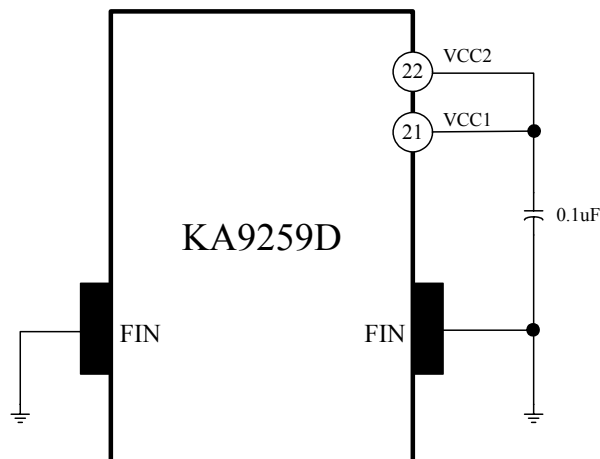
- If the torque of the loading motor is too low when it is used with the pin #20 open, then it should used as the above diagram.
- The desired torque could be obtained by selecting the appropriate resistor R as shown in the left diagram.
- If it is necessary, the zener diode can be used as in the right diagram.
- The maximum torque is obtained when the applied voltage at pin #20 is about 6.8V (at  $V_{CC}=8V$ ).

## 6. BTL Driver (CH1, CH2, CH3 and CH4)



- 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 Transistor 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 transistor Q1 and Q4. On the other hand, if transistor Q2 and 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.
- When the bias voltage of the pin #23 is below 1.4V, then the output circuit is muted.  
Hence for the normal operation, the bias voltage should be used in 1.6V~6.5V.

## 7. Connect a by-pass capacitor, 0.1 $\mu$ F between the supply voltage source.



1. Radiation FIN is connecting to the internal GND of the package.
2. Connect the FIN to the external GND.

## Typical Performance Charateristics

- Test contrions:  $V_{REF}=2.5[V]$ , Mute : OFF

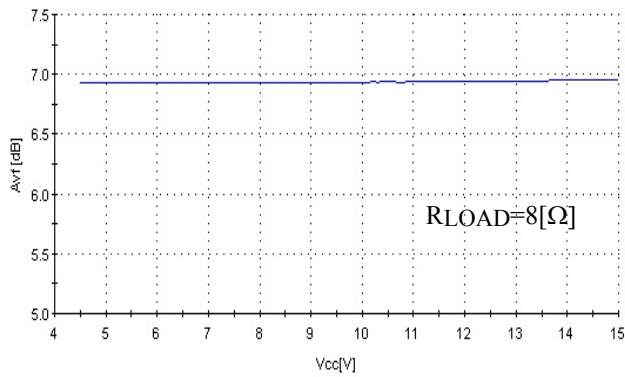


Figure 1. VCC vs. AVF

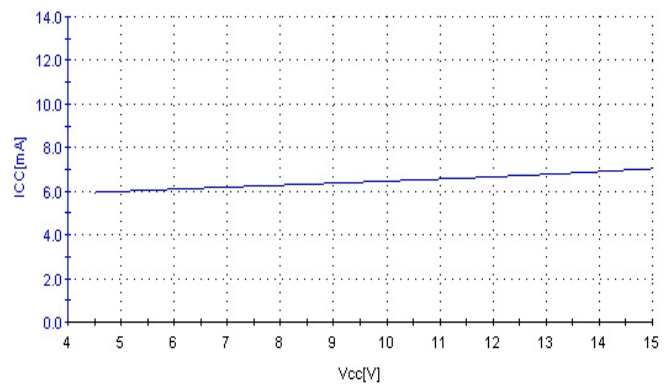


Figure 2. VCC vs. ICC

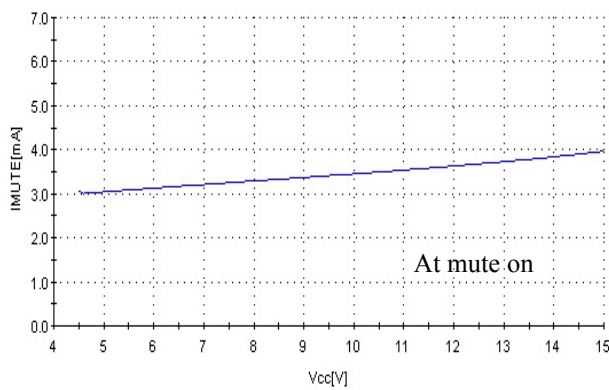


Figure 3. VCC vs.  $I_{mute}$

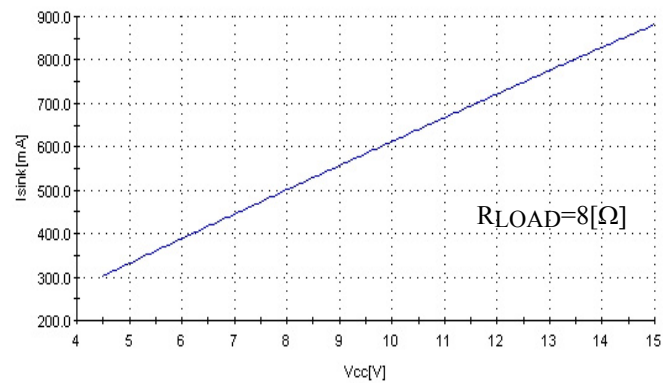


Figure 4. VCC vs.  $I_{SINK}$

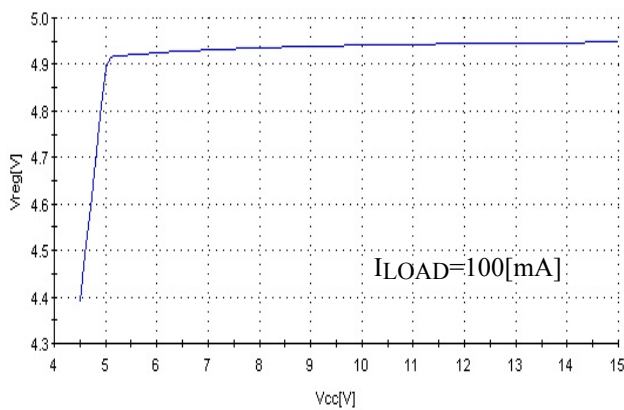


Figure 5. VCC vs.  $V_{REG}$

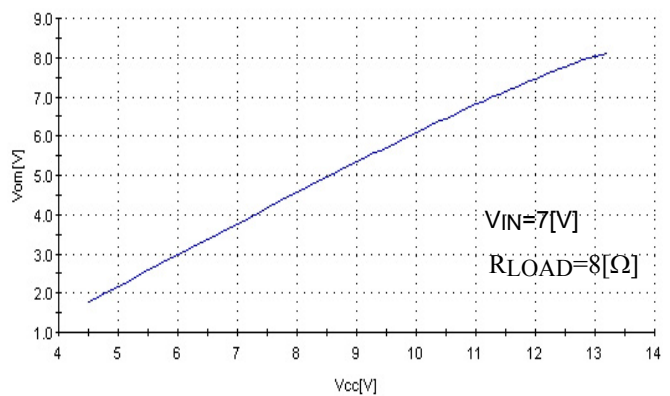
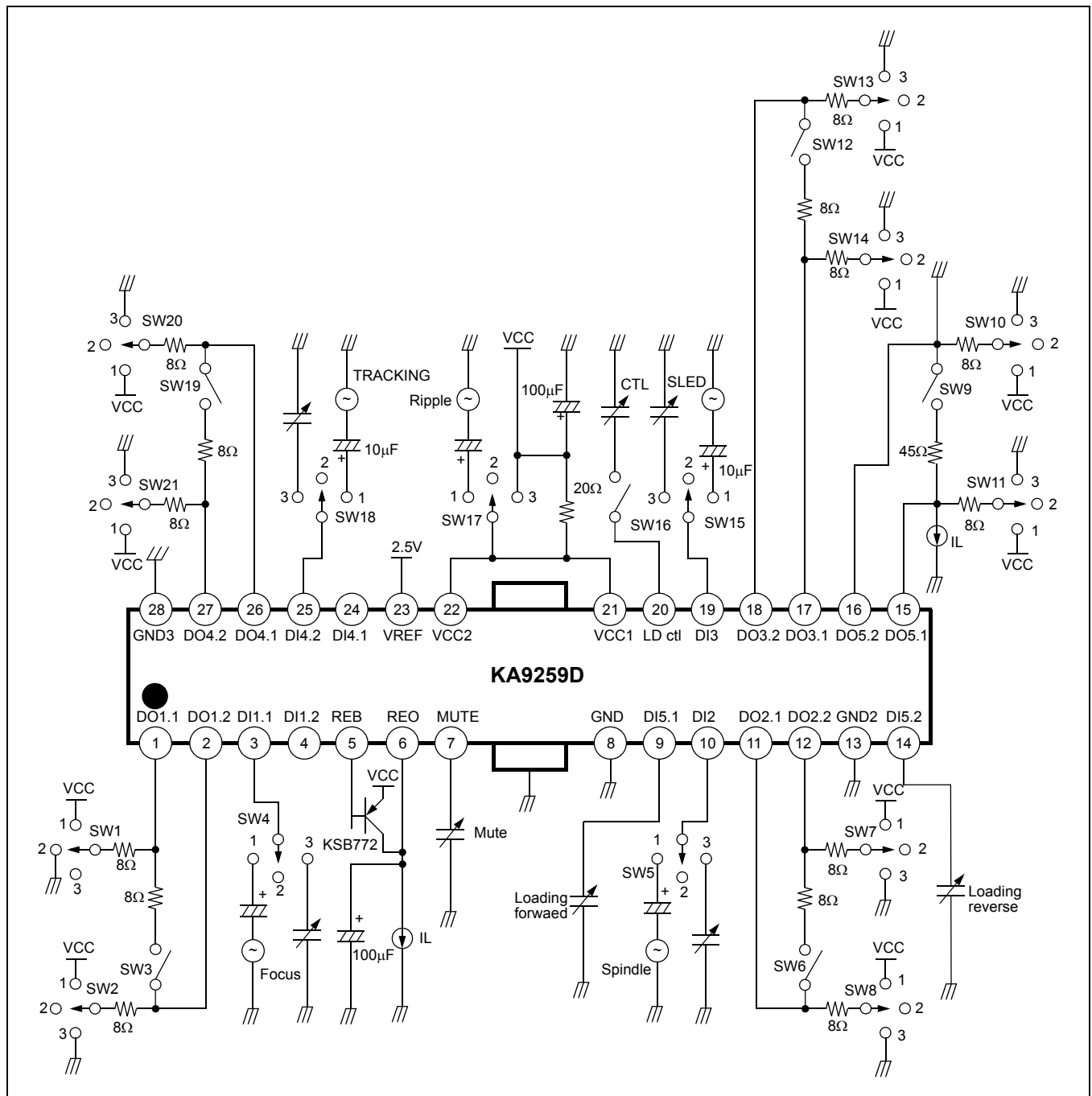
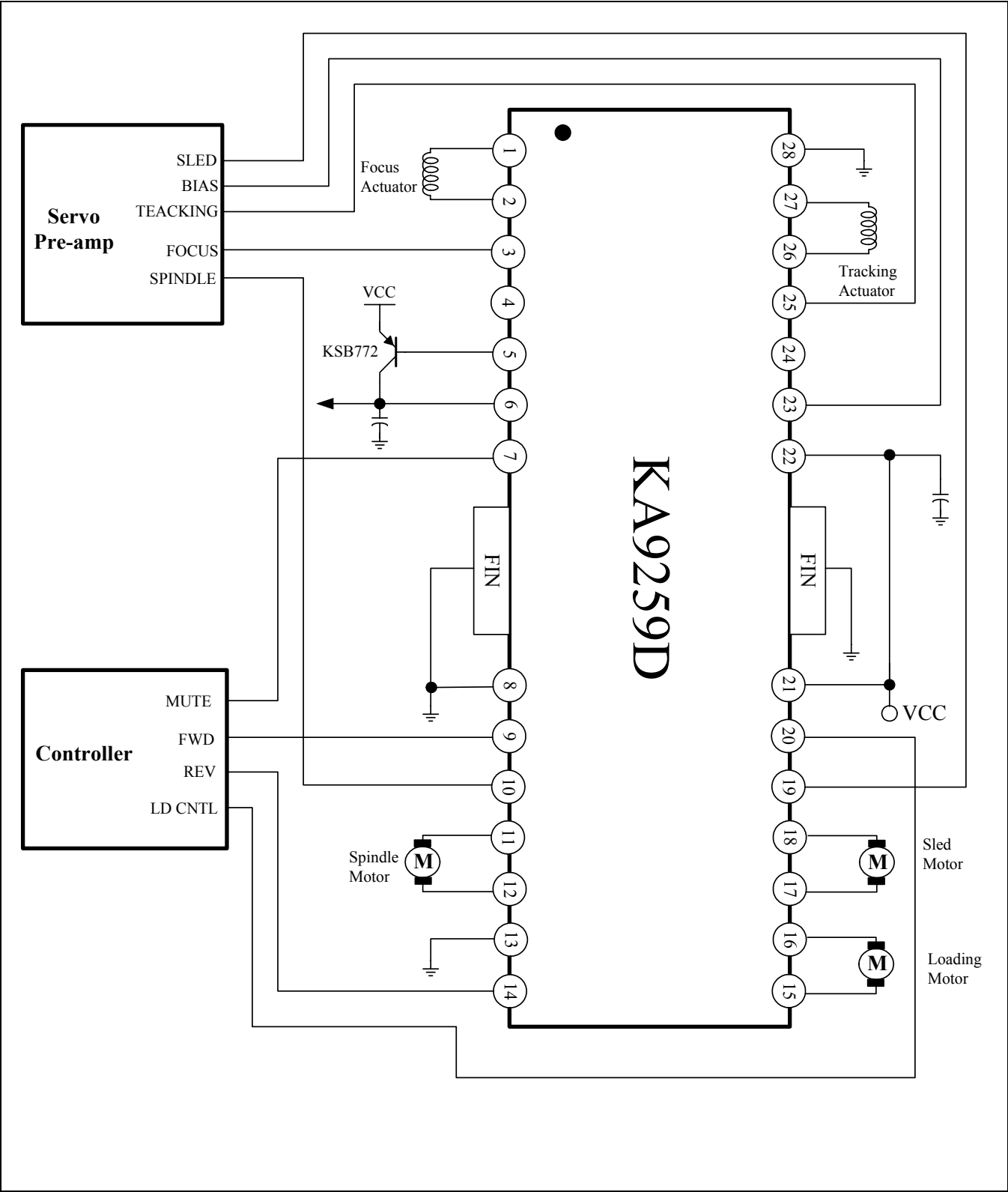


Figure 6. VCC vs.  $V_{OM}$

## Test Circuits



Application Circuits

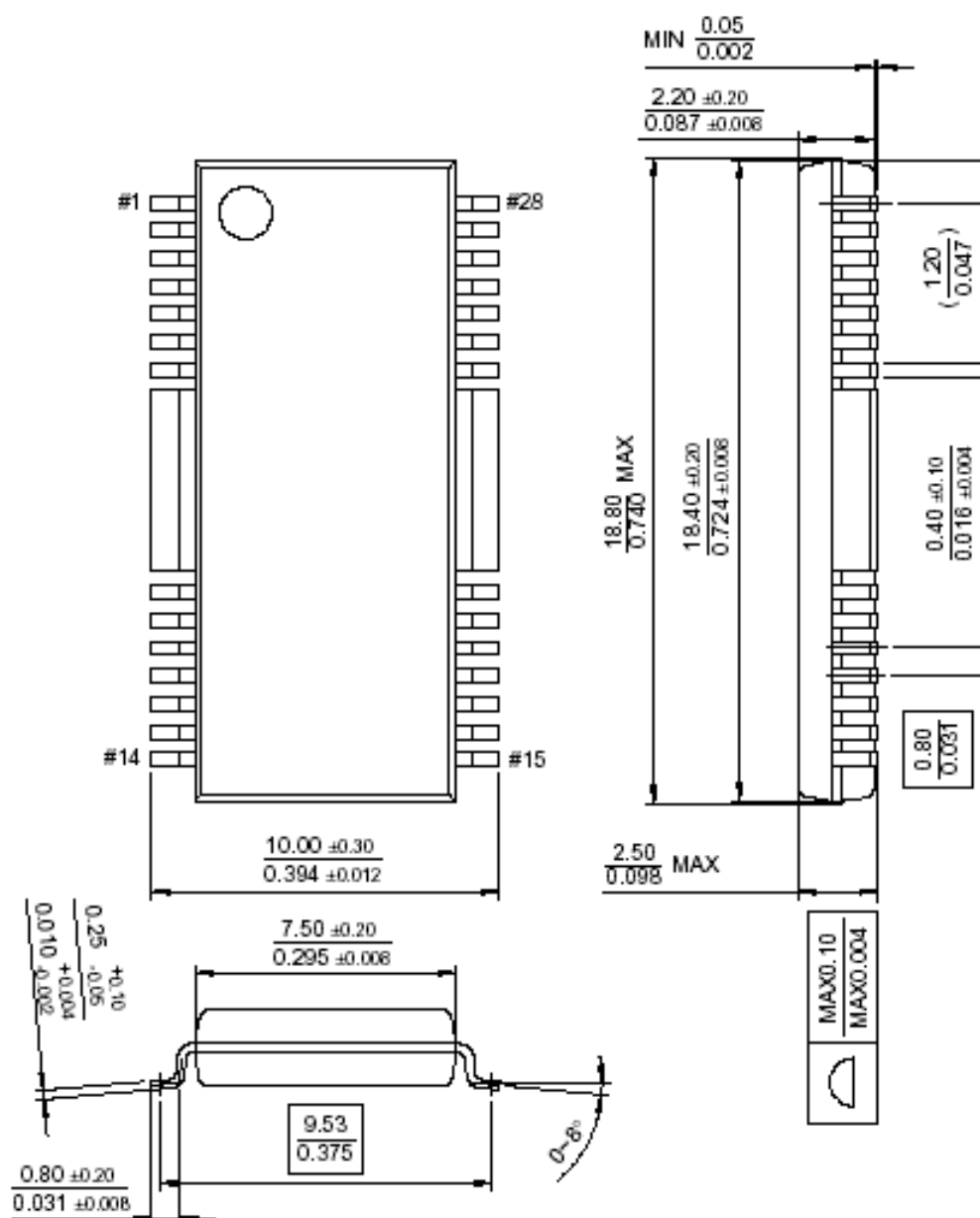


# Mechanical Dimensions

## Package

Dimensions in Millimeters

## 28-SSOPH-375





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