

# KA3022D/KA3022D3

## 4-Channel Motor Driver

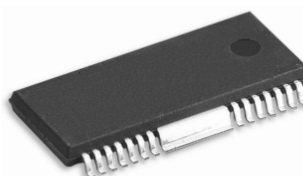
### Features

- 3-Channel Balanced TransformerLess(BTL) driver
- 1-Channel forward-Reverse control DC motor driver
- Built-in thermal shutdown circuit
- Built-in mute circuit
- Operating supply voltage: 4.5~13.2V
- Corresponds to 3.3V or 5V DSP

### Description

The KA3022D/KA3022D3 is a monolithic IC, suitable for a 1-ch (forward.reverse) control DC motor driver and a 3-ch motor driver which drives the focus actuator,tracking actuator, and sled motor of a CD-media system.

28-SSOPH-375



28-SSOPH-375SG2



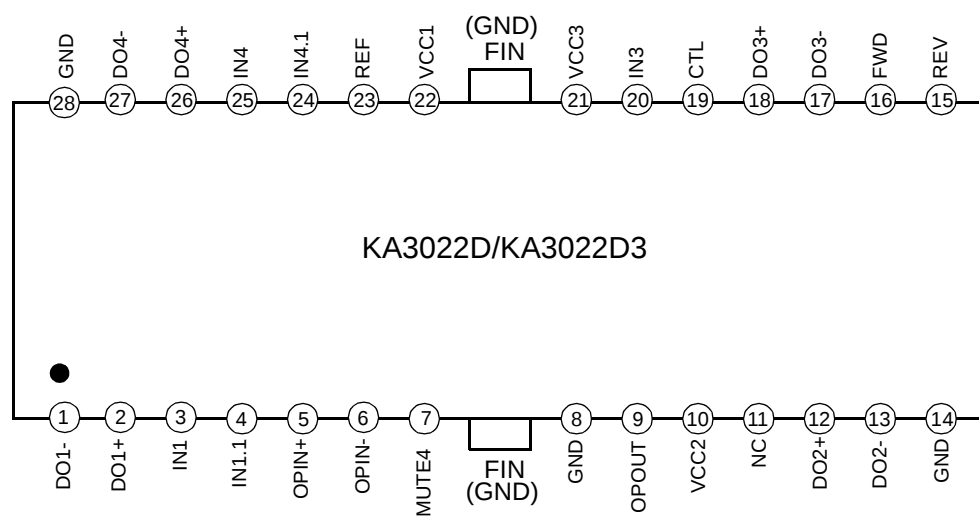
### Typical Applications

- Compact disk ROM (CD-ROM)
- Compact disk RW (CD-RW)
- Digital video disk ROM (DVD-ROM)
- Digital video disk RAM (DVD-RAM)
- Digital video disk Player (DVDP)
- Other compact disk media

### Ordering Information

| Device     | Package         | Operating Temp. |
|------------|-----------------|-----------------|
| KA3022D    | 28-SSOPH-375    | -35 °C ~ 85 °C  |
| KA3022DTF  | 28-SSOPH-375    | -35 °C ~ 85 °C  |
| KA3022D3   | 28-SSOPH-375SG2 | -35 °C ~ 85 °C  |
| KA3022D3TF | 28-SSOPH-375SG2 | -35 °C ~ 85 °C  |

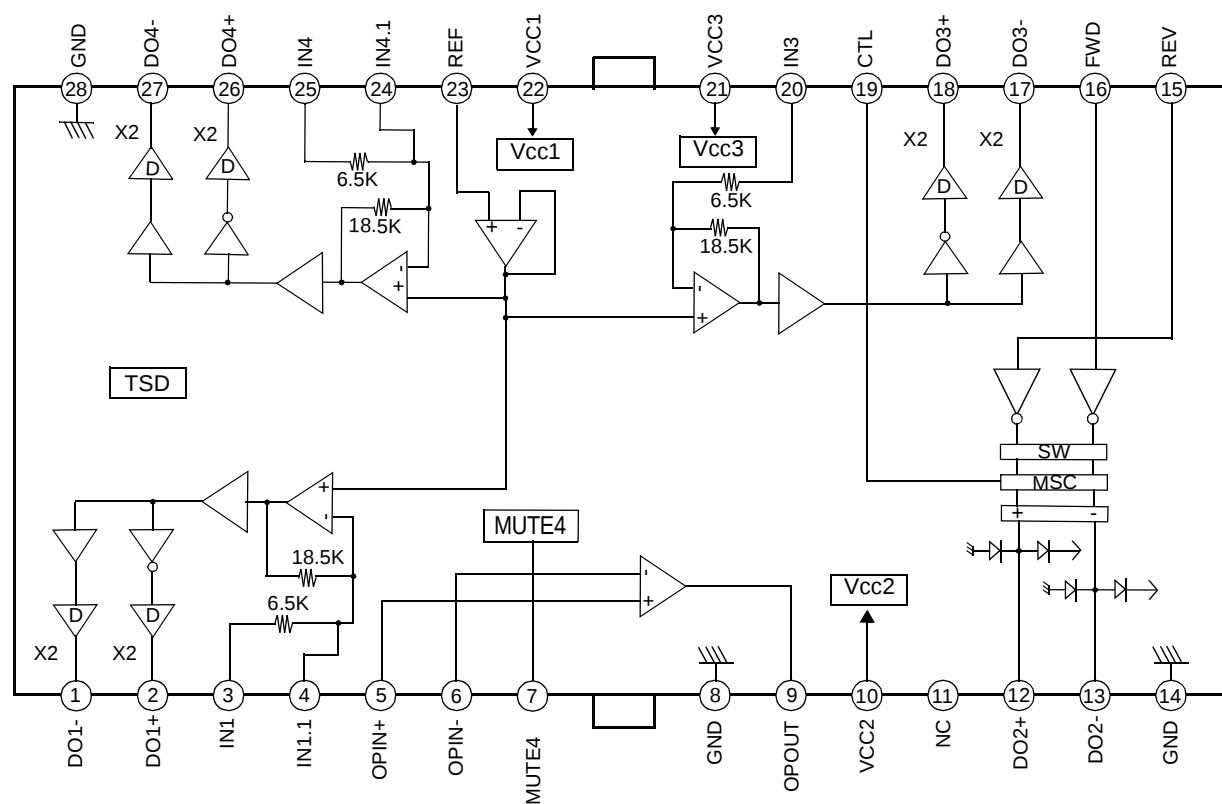
## Pin Assignments



## Pin Definitions

| Pin Number | Pin Name | I/O | Pin Function Description            |
|------------|----------|-----|-------------------------------------|
| 1          | DO1-     | O   | Drive1 Output (-)                   |
| 2          | DO1+     | O   | Drive1 Output (+)                   |
| 3          | IN1      | I   | Drive1 Input                        |
| 4          | IN1.1    | I   | Drive1 Input, gain adjust.          |
| 5          | OPIN+    | I   | OP-AMP Input (+)                    |
| 6          | OPIN-    | I   | OP-AMP Input (-)                    |
| 7          | MUTE4    | I   | CH4 Mute                            |
| 8          | GND      | -   | Ground                              |
| 9          | OPOUT    | O   | OP-Amp Output                       |
| 10         | VCC2     | I   | Power Supply for CH2 and pre driver |
| 11         | NC       | -   | No Connection                       |
| 12         | DO2+     | O   | Drive2 Output (+)                   |
| 13         | DO2-     | O   | Drive2 Output (-)                   |
| 14         | GND      | -   | Ground                              |
| 15         | REV      | I   | CH2 Reverse                         |
| 16         | FWD      | I   | CH2 Forward                         |
| 17         | DO3-     | O   | Drive3 Output (-)                   |
| 18         | DO3+     | O   | Drive3 Output (+)                   |
| 19         | CTL      | I   | CH2 Motor Speed Control             |
| 20         | IN3      | I   | CH3 Input                           |
| 21         | VCC3     | I   | Power Supply for CH3                |
| 22         | VCC1     | I   | Power Supply for CH1,4              |
| 23         | REF      | I   | Bias Voltage Input                  |
| 24         | IN4.1    | I   | Drive4 Input, gain adjust.          |
| 25         | IN4      | I   | Drive4 Input                        |
| 26         | DO4+     | O   | Drive4 Output (+)                   |
| 27         | DO4-     | O   | Drive4 Output (-)                   |
| 28         | GND      | -   | Ground                              |

## Internal Block Diagram



## Equivalent Circuits

| MUTE INPUT             | POWER OUTPUT          |
|------------------------|-----------------------|
|                        |                       |
| SIGNAL REFERENCE INPUT | LOADING CONTROL INPUT |
|                        |                       |
| LOADING LOGIC INPUT    |                       |
|                        |                       |

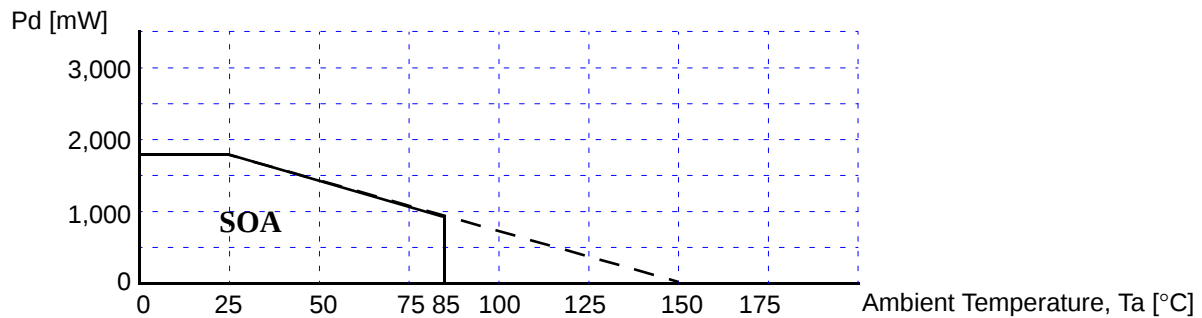
## Absolute Maximum Ratings (Ta = 25°C)

| Parameter                   | Symbol      | Value                | Unit |
|-----------------------------|-------------|----------------------|------|
| Maximum supply voltage      | $V_{CCmax}$ | 15                   | V    |
| Power dissipation(KA3022D)  | $P_D$       | 1.7 <sup>note1</sup> | W    |
| Power dissipation(KA3022D3) | $P_D$       | 2.5 <sup>note2</sup> | W    |
| Operating temperature range | $T_{OPR}$   | -35 ~ +85            | °C   |
| Storage temperature range   | $T_{STG}$   | -55 ~ +150           | °C   |

### NOTE1:

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

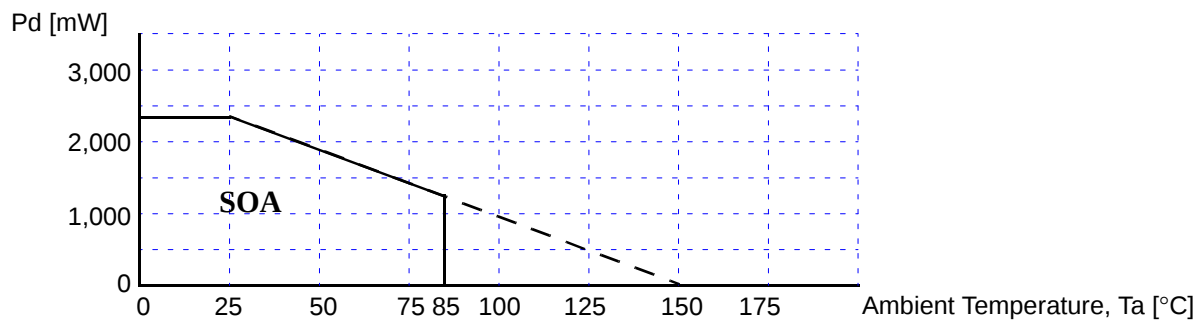
## Power Dissipation Curve1



### NOTE2:

1. When mounted on a 76.2mm × 114.3mm × 1.6mm PCB (Phenolic resin material).
2. Power dissipation reduces 16.6mW/°C for using above Ta = 25°C & Tjmax =150°C
3. Do not exceed  $P_D$  and SOA(Safe operating area).

## Power Dissipation Curve2



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

| Parameter      | Symbol   | Min | Typ | Max  | Unit |
|----------------|----------|-----|-----|------|------|
| Supply Voltage | $V_{CC}$ | 4.5 | -   | 13.2 | V    |

## Electrical Characteristics

(Unless otherwise specified,  $T_a = 25\text{ }^{\circ}\text{C}$ ,  $V_{CC1} = V_{CC2} = V_{CC3} = 5\text{V}$ )

| Parameter                                                                                | Symbol          | Conditions                                                  | Min. | Typ. | Max. | Units |
|------------------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|------|------|------|-------|
| Quiescent Current                                                                        | $I_{CC}$        | $V_{IN} = 0\text{V}$                                        | -    | 9.3  | 15   | mA    |
| Mute On Current                                                                          | $I_{MUTE}$      | Mute Pin = $V_{CC}$                                         | -    | 7.9  | 9.5  | mA    |
| Mute On Voltage                                                                          | $V_{Mon}$       | -                                                           | 2.0  | -    | -    | V     |
| Mute Off Voltage                                                                         | $V_{Moff}$      | -                                                           | -    | -    | 0.5  | V     |
| <b>DRIVE CIRCUIT</b>                                                                     |                 |                                                             |      |      |      |       |
| Output Offset Voltage                                                                    | $V_{OO}$        | $V_{IN} = 2.5\text{V}$                                      | -50  | -    | +50  | mV    |
| Maximum Output Voltage1                                                                  | $V_{OM1}$       | $V_{CC} = 8\text{V}$ , $R_L = 8\Omega$                      | 5.4  | 6.0  | -    | V     |
| Closed Loop Voltage Gain                                                                 | $G_{VC}$        | $f = 1\text{kHz}$ , $V_{IN} = 0.1\text{V}_{RMS}$ (CH1,3, 4) | 19.5 | 21.0 | 22.5 | dB    |
| Ripple Rejection Ratio                                                                   | RR              | $V_{IN} = 0.1\text{V}_{RMS}$ , $f = 120\text{Hz}$           | -    | 60   | -    | dB    |
| Slew Rate                                                                                | SR              | $V_O = 2\text{V}_{p-p}$ , $f = 120\text{kHz}$               | -    | 0.8  | -    | V/us  |
| <b>TRAY DRIVE CIRCUIT(<math>V_{CC2} = 8\text{V}</math>, <math>R_L = 45\Omega</math>)</b> |                 |                                                             |      |      |      |       |
| Input High Level Voltage                                                                 | $V_{IH}$        | -                                                           | 2    | -    | -    | V     |
| Input Low Level Voltage                                                                  | $V_{IL}$        | -                                                           | -    | -    | 0.5  | V     |
| Output Voltage1                                                                          | $V_{O1}$        | $V_{CC} = 8\text{V}$ , $V_{CTL} = 4.0\text{V}$              | 5.2  | 6    | 6.8  | V     |
| Output Voltage2                                                                          | $V_{O2}$        | $V_{CC} = 13\text{V}$ , $V_{CTL} = 5.7\text{V}$             | 7.5  | 8.5  | 9.5  | V     |
| Output Load Regulation                                                                   | $\Delta V_{RL}$ | $V_{CC} = 8\text{V}$ , $V_{CTL} = 3.0\text{V}$              | -    | 300  | 700  | mV    |
| Output Offset Voltage1                                                                   | $V_{OO1}$       | $V_{IN} = 5\text{V}$ , $5\text{V}$                          | -10  | -    | +10  | mV    |
| Output Offset Voltage1                                                                   | $V_{OO2}$       | $V_{IN} = 0\text{V}$ , $0\text{V}$                          | -10  | -    | +10  | mV    |
| <b>GENERAL Op-Amp</b>                                                                    |                 |                                                             |      |      |      |       |
| Input Offset Voltage                                                                     | $V_{OFOP}$      | -                                                           | -15  | -    | +15  | mV    |
| Input Bias Current                                                                       | $I_{BOP}$       | -                                                           | -    | -    | 300  | nA    |
| High Level Output Voltage                                                                | $V_{OHOP}$      | $V_{CC} = 5\text{V}$ , $R_L = 1\text{K}\Omega$              | 3    | 4    | -    | V     |
| Low Level Output Voltage                                                                 | $V_{OLOP}$      | $V_{CC} = 5\text{V}$ , $R_L = 1\text{K}\Omega$              | 0.7  | 1    | 1.3  | V     |
| Output Sink Current                                                                      | $I_{SINK}$      | $V_{CC} = 5\text{V}$ , $R_L = 30\Omega$                     | 10   | 20   | -    | mA    |
| Output Source Current                                                                    | $I_{SOURCE}$    | $V_{CC} = 5\text{V}$ , $R_L = 30\Omega$                     | 10   | 20   | -    | mA    |
| Open Loop Voltage Gain                                                                   | $G_{VO}$        | $V_{IN} = -75\text{dB}$ , $f = 1\text{KHz}$                 | -    | 75   | -    | dB    |
| Ripple Rejection Ratio                                                                   | $RR_{OP}$       | $V_{IN} = -20\text{dB}$ , $f = 120\text{Hz}$                | -    | 65   | -    | dB    |
| Slew Rate                                                                                | $SR_{OP}$       | $f = 120\text{KHz}$ , $2\text{V}_{p-p}$                     | -    | 1    | -    | V/us  |
| Common Mode Rejection Ratio                                                              | $CMRR$          | $V_{IN} = -20\text{dB}$ , $f = 1\text{KHz}$                 | -    | 80   | -    | dB    |
| Common Mode Input Range                                                                  | $V_{ICM}$       | $V_{CC} = 8\text{V}$                                        | -0.3 | -    | 6.8  | V     |

## Application Information

### 1. REFERENCE INPUT & ALL MUTE FUNCTION

Pin 23 (REF) is a reference input pin.

- Reference input  
The applied voltage at the reference input pin must be between 1.4V and 6.5V, when  $V_{CC}=8.5V$ .
- Mute input  
The following input conditions must be satisfied for the normal mute function.

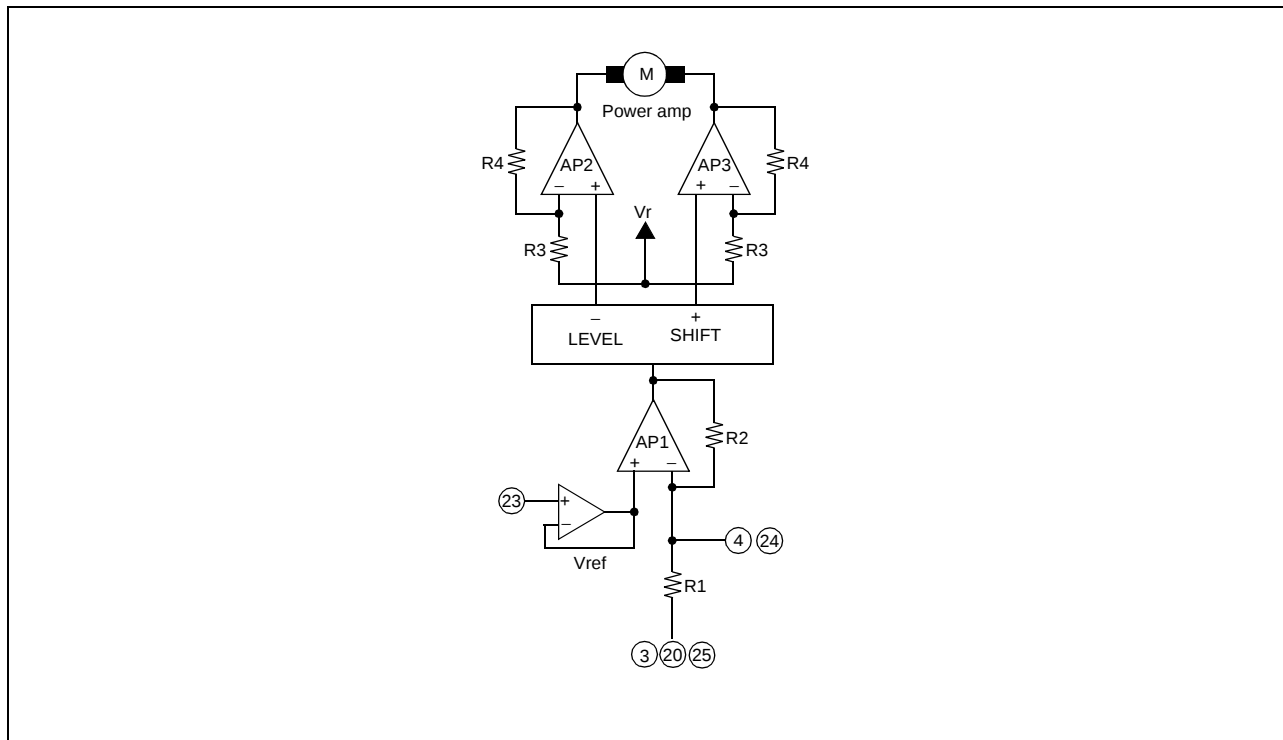
|                      |            |                         |
|----------------------|------------|-------------------------|
| All mute on voltage  | Below 1.0V | Mute function operation |
| All mute off voltage | Above 1.4V | Normal operation        |

### 2. PROTECTION FUNCTION

Thermal shutdown (TSD)

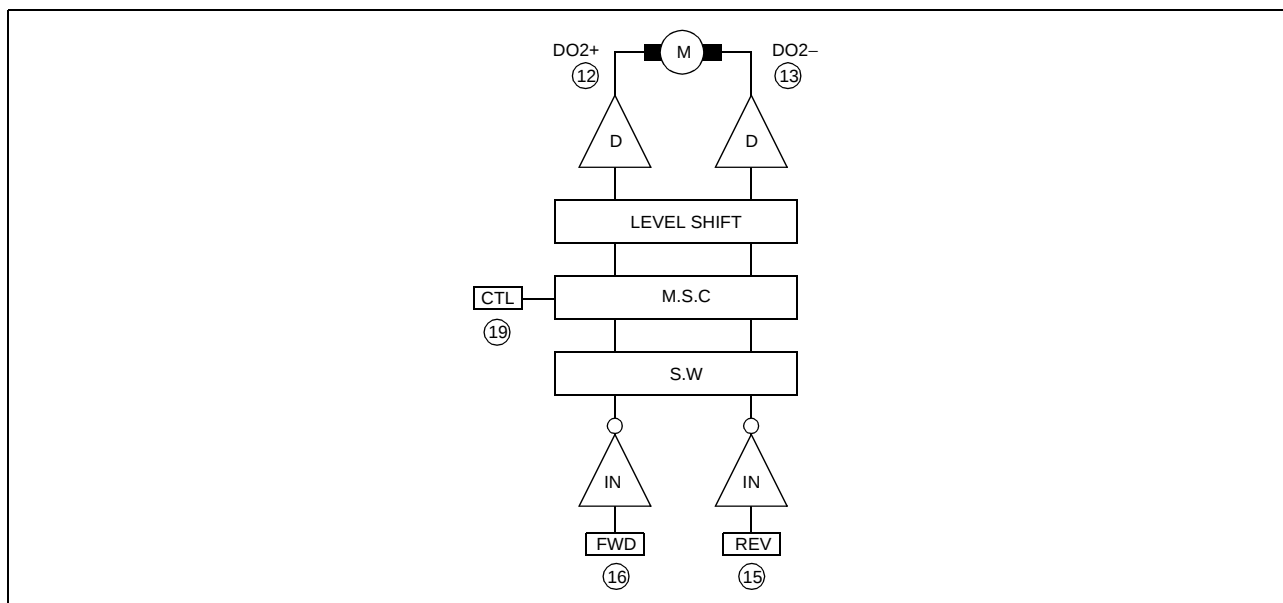
- If the chip temperature rises above 175°C, the thermal shutdown (TSD) circuit is activated and the output circuit is in the mute state, that is off state. The thermal shutdown(TSD) circuit has a temperature hysteresis of 25°C

### 3. FOCUS, TRACKING ACTUATOR, SLED MOTOR DRIVE PART



- The reference voltage REF is given externally through pin 23.
- The input signal, pin3,20,25 is amplified by  $R2 / R1$  times and then fed to the level shift circuit.
- The level shift circuit produces the differential output voltages and drives the two output power amplifiers. Since the differential gain of the output amplifiers is equal to  $2 \times (1 + R4 / R3)$ , input signal is amplified by  $(R2 / R1) \times 2 \times (1 + R4 / R3)$ .
- If the total gain is insufficient, the external resistors can be used through pin 4, 24 to increase the gain. The bias voltage ( $V_{ref}$ ) is about a half of the supply voltage ( $V_M$ ).

### 4. TRAY MOTOR DRIVE PART



- Rotational direction control

The forward and reverse rotational direction is controlled by FWD (pin 16) and REV (pin 15) inputs.  
Conditions are as follows.

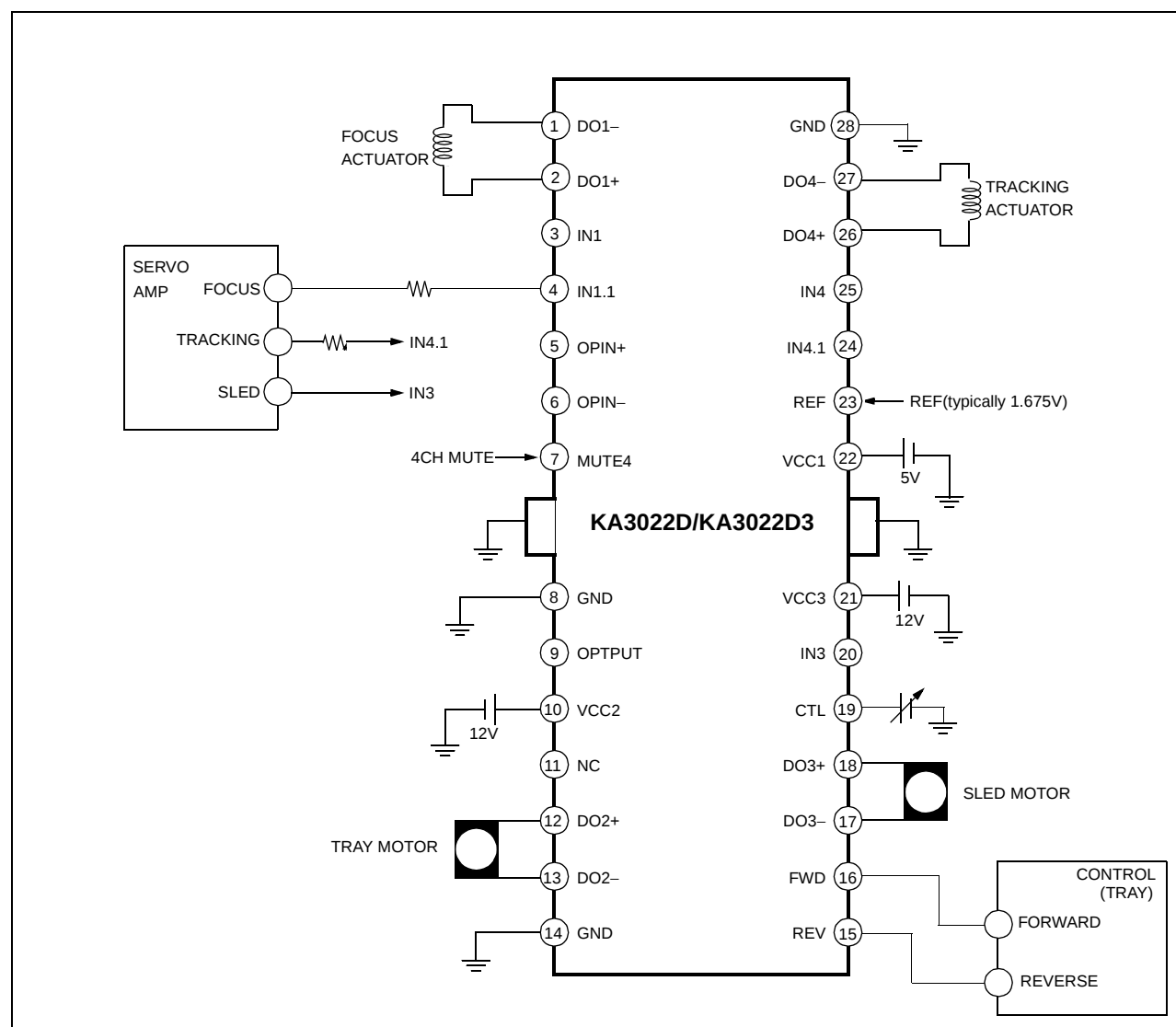
| Input |     | Output |      |         |
|-------|-----|--------|------|---------|
| FWD   | REV | DO2+   | DO2– | State   |
| H     | H   | Vr     | Vr   | Brake   |
| H     | L   | H      | L    | Forward |
| L     | H   | L      | H    | Reverse |
| L     | L   | Vr     | Vr   | Brake   |

- Motor speed control

- The motor speed is proportional to the differential voltage between the pin12 (DO2+) and the pin13 (DO2–).
- By applying the voltage to the pin19 of CTL, the motor speed can be controlled and it is linearly proportional to the applied control voltage.

Motor torque is maximum when pin 19 is open.

## Typical Application Circuits



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