

# KA3021D

## 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: 4.5V ~ 13.2V
- Corresponds to 3.3V or 5V DSP

### Description

The KA3021D 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.



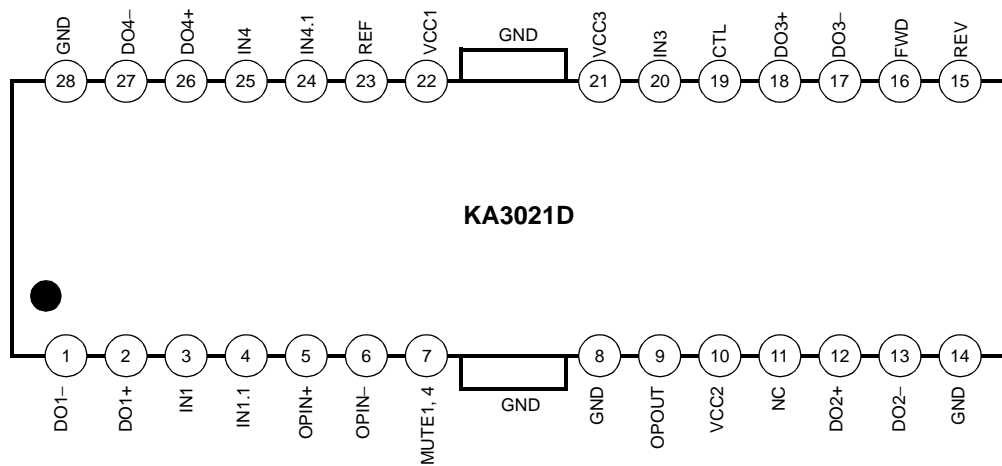
### Typical Applications

- 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. |
|-----------|--------------|-----------------|
| KA3021D   | 28-SSOPH-375 | -35°C ~ +85°C   |
| KA3021DTF | 28-SSOPH-375 | -35°C ~ +85°C   |

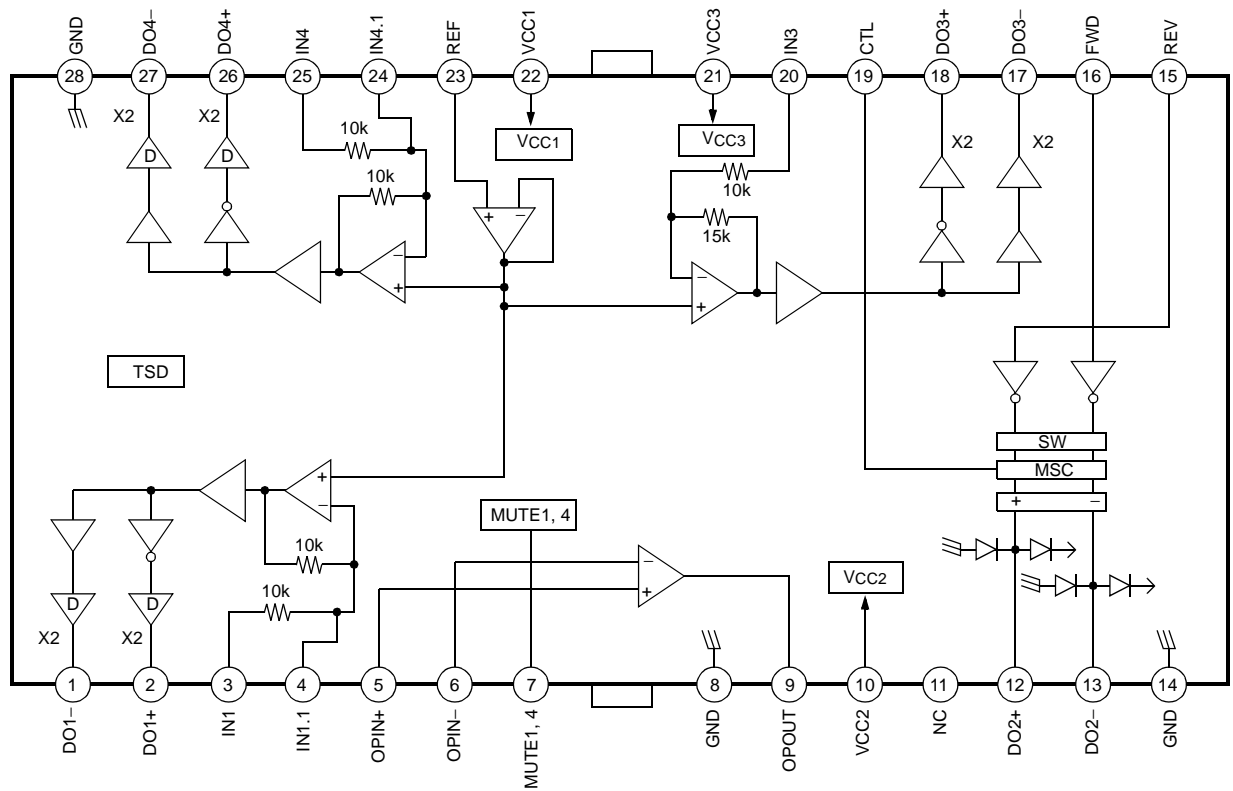
## Pin Assignments



## 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          | MUTE1, 4 | I   | CH1, 4 mute                     |
| 8          | GND      | -   | Ground                          |
| 9          | OPOUT    | O   | Op-amp output                   |
| 10         | VCC2     | I   | Power supply for CH2 and signal |
| 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    |                       |
|                        |                       |

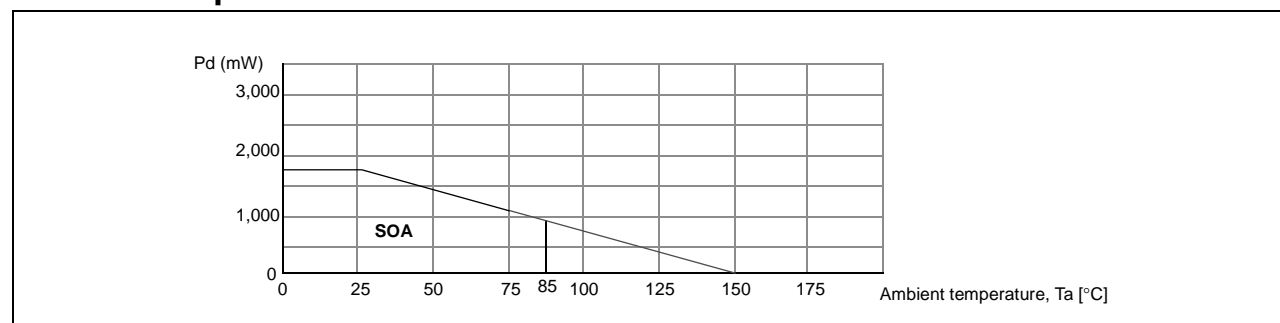
## Absolute Maximum Ratings (Ta = 25°C)

| Parameter                   | Symbol             | Value               | Unit |
|-----------------------------|--------------------|---------------------|------|
| Maximum supply voltage      | V <sub>CCmax</sub> | 18                  | V    |
| Power dissipation           | P <sub>D</sub>     | 1.7 <sup>note</sup> | W    |
| Operating temperature range | T <sub>OPR</sub>   | -35 ~ +85           | °C   |
| Storage temperature range   | T <sub>STG</sub>   | -55 ~ +150          | °C   |

### NOTE:

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<sub>D</sub> and SOA (Safe operating area).

## Power Dissipation Curve



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

| Parameter      | Symbol          | Min | Typ | Max  | Unit |
|----------------|-----------------|-----|-----|------|------|
| Supply voltage | V <sub>CC</sub> | 4.5 | -   | 13.2 | V    |

## Electrical Characteristics

(Unless otherwise specified,  $T_a=25^{\circ}\text{C}$ ,  $V_{CC1}=V_{CC3}=5\text{V}$ ,  $V_{CC2}=12\text{V}$ )

| Parameter   | Symbol          | Conditions  | Min. | Typ. | Max. | Units             |
|---|-----------------|---|------|------|------|-------------------|
| Quiescent current   | $I_{CC}$        | $V_{IN}=0\text{V}$                                      | -    | 6    | 15   | mA                |
| Mute on current   | $I_{MUTE}$      | Mute pin=GND  | -    | 4.5  | 8    | mA                |
| Mute on voltage   | $V_{Mon}$       | -   | 2.0  | -    | -    | V                 |
| Mute off voltage  | $V_{Moff}$      | -   | -    | -    | 0.5  | V                 |
| DRIVE CIRCUIT   |                 |   |      |      |      |                   |
| Output offset voltage   | $V_{OO}$        | $V_{IN}=2.5\text{V}$                                    | -40  | -    | +40  | mV                |
| Maximum output voltage1<br>(High level)                             | $V_{OM1}$       | $V_{CC}=8\text{V}$ , $R_L=8\Omega$ (CH1,3,4)            | 5    | 6.0  | -    | V                 |
| Maximum output voltage2<br>(Low level)                              | $V_{OM2}$       | $V_{CC}=8\text{V}$ , $R_L=8\Omega$ (CH1,3,4)            | -    | -6.0 | -5   | V                 |
| Closed loop voltage gain1   | $G_{VC1}$       | $f=1\text{kHz}$ , $V_{IN}=0.1\text{V}_{RMS}$<br>(CH1,4) | 9.5  | 11.5 | 13.5 | dB                |
| Closed loop voltage gain2   | $G_{VC2}$       | $f=1\text{kHz}$ , $V_{IN}=0.1\text{V}_{RMS}$<br>(CH3)   | 13.0 | 15.0 | 17.5 | 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 / $\mu\text{s}$ |
| TRAY DRIVE CIRCUIT ( $V_{CC2}=V_{CC3}=8\text{V}$ , $R_L=45\Omega$ ) |                 |   |      |      |      |                   |
| Input high level voltage  | $V_{IH}$        | -   | 2    | -    | -    | V                 |
| Input low level voltage   | $V_{IL}$        | -   | -    | -    | 0.5  | V                 |
| Output voltage1   | $V_{O1}$        | $V_{CC}=8\text{V}$ , $V_{CTL}=6.5\text{V}$              | 5.2  | 6    | 6.8  | V                 |
| Output voltage2   | $V_{O2}$        | $V_{CC}=13\text{V}$ , $V_{CTL}=4.5\text{V}$             | 7.5  | 8.5  | 9.5  | V                 |
| Output load regulation  | $\Delta V_{RL}$ | -   | -    | 300  | 700  | mV                |
| Output offset voltage1  | $V_{OO1}$       | $V_{IN}=5\text{V}$                                      | -40  | -    | +40  | mV                |
| Output offset voltage2  | $V_{OO2}$       | $V_{IN}=5\text{V}$                                      | -40  | -    | +40  | mV                |
| GENERAL OF AMP CIRCUIT  |                 |   |      |      |      |                   |
| Input offset voltage  | $V_{OFOP}$      | -   | -20  | -    | +20  | 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   | $I_{SINK}$      | $V_{CC}=5\text{V}$ , $R_L=50\Omega$                     | 10   | 20   | -    | mA                |
| Output source current   | $I_{SOURCE}$    | $V_{CC}=5\text{V}$ , $R_L=50\Omega$                     | 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   | $SR_{OP}$       | $f=120\text{kHz}$ , $2V_{p-p}$                          | -    | 1    | -    | V / $\mu\text{s}$ |
| 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                 |

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## 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 1V   | Mute function operation |
| All mute off voltage | Above 1.4V | Normal operation        |

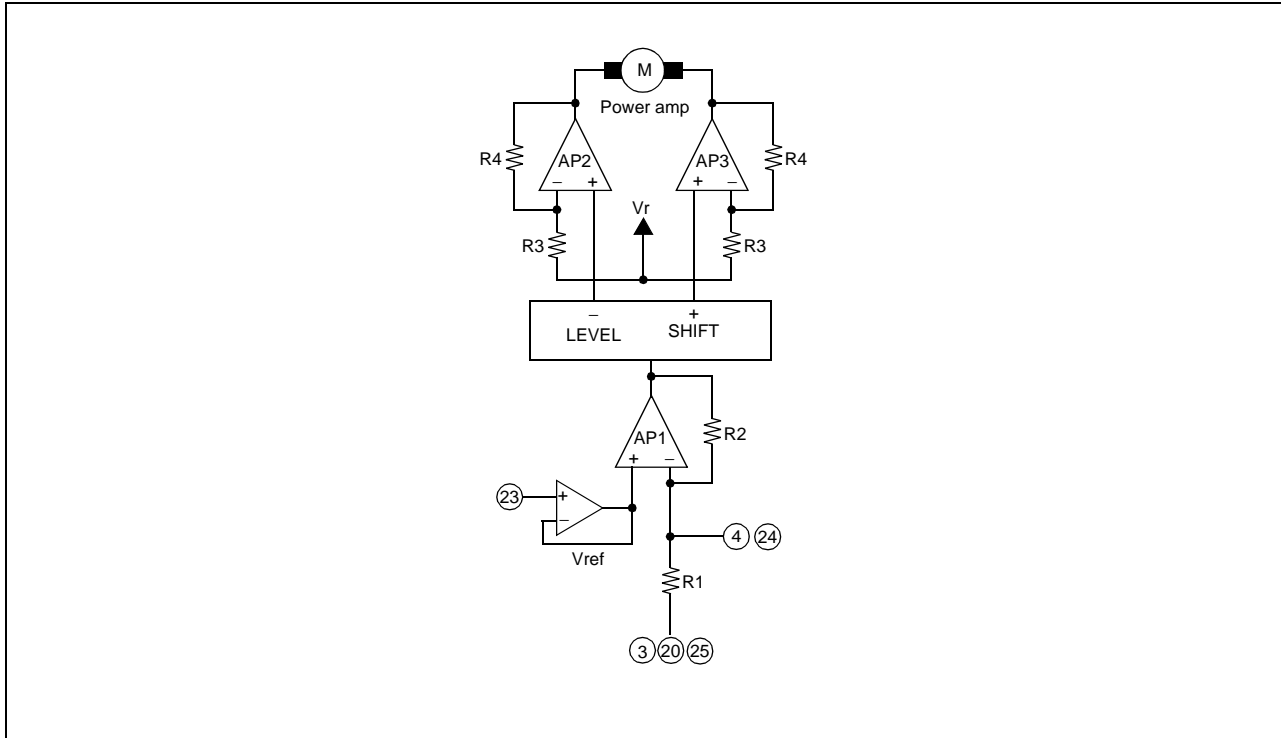
### 2. PROTECTION FUNCTION

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

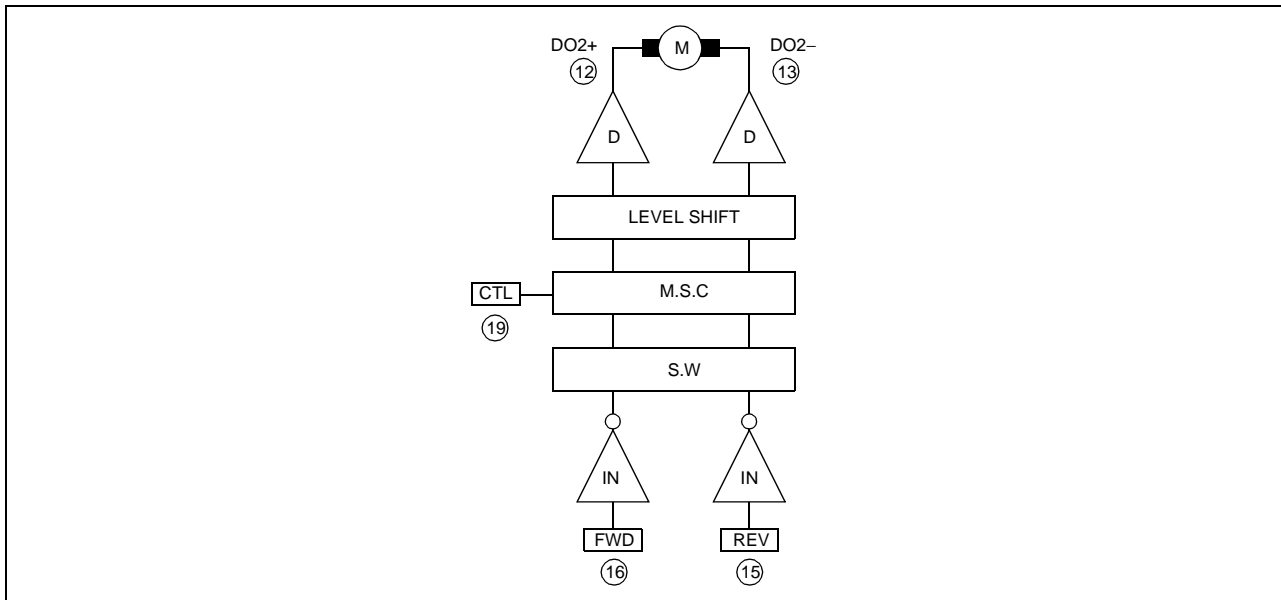


**3. FOCUS, TRACKING ACTUATOR, SLED MOTOR DRIVE PART**



- The reference voltage REF is given externally through pin 23.
- The input signal, pin 3, 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<sub>ref</sub>) is about a half of the supply voltage (V<sub>M</sub>).

**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.

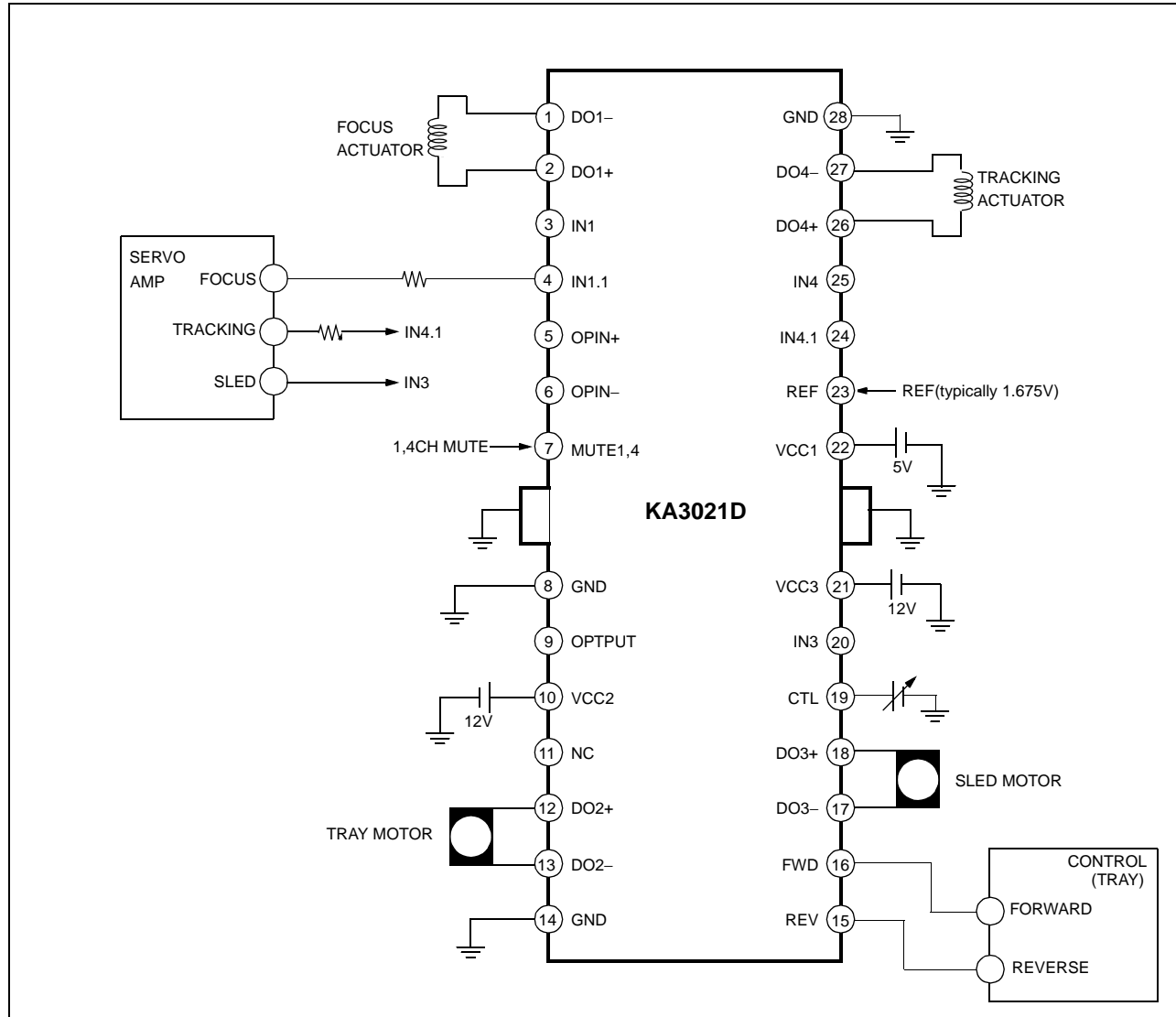
Conditions are as follows.

| 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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