

# ID7T0610AD

## 3-phase Gate Driver integrated with LDO



### General Description

The ID7T0610AD is a gate driver IC designed for three phase brushless DC motor driver applications. It is capable of driving three half bridges consisting of 6 N-channel power MOSFETs. The ID7T0610AD integrates a LDO to generate local power for microcontrollers or other circuitry. Internal protection features include dead-time for over-shoot prevention, and under voltage lockout. The ID7T0610AD is available in wafer level.

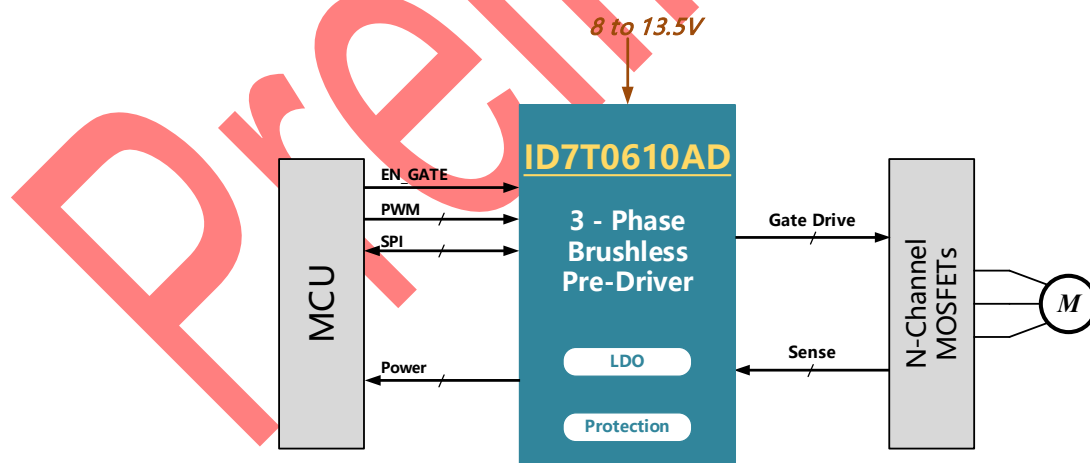
### Features

- ❑ Input voltage range from 8V to 13.5V
- ❑ 5V Low-drop regulator supply
- ❑ UVLO protection
- ❑ Built in 100ns dead-time to prevent cross-conduction
- ❑ Built in bootstrap diode for gate driver circuit
- ❑ 1A/1A sink/source three-phase gate drivers

### Applications

- ❑ 3-phase, brushless DC motors and permanent magnet synchronous motors
- ❑ Power drills
- ❑ E-bikes

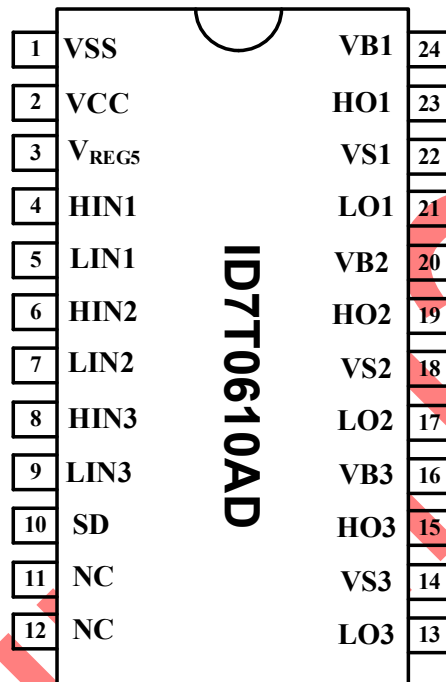
### Typical Application



## Order Information

| Part Number | Order Code | Package | Type |
|-------------|------------|---------|------|
| ID7T0610AD  | ID7T0610AD | QSOP24  | ---  |

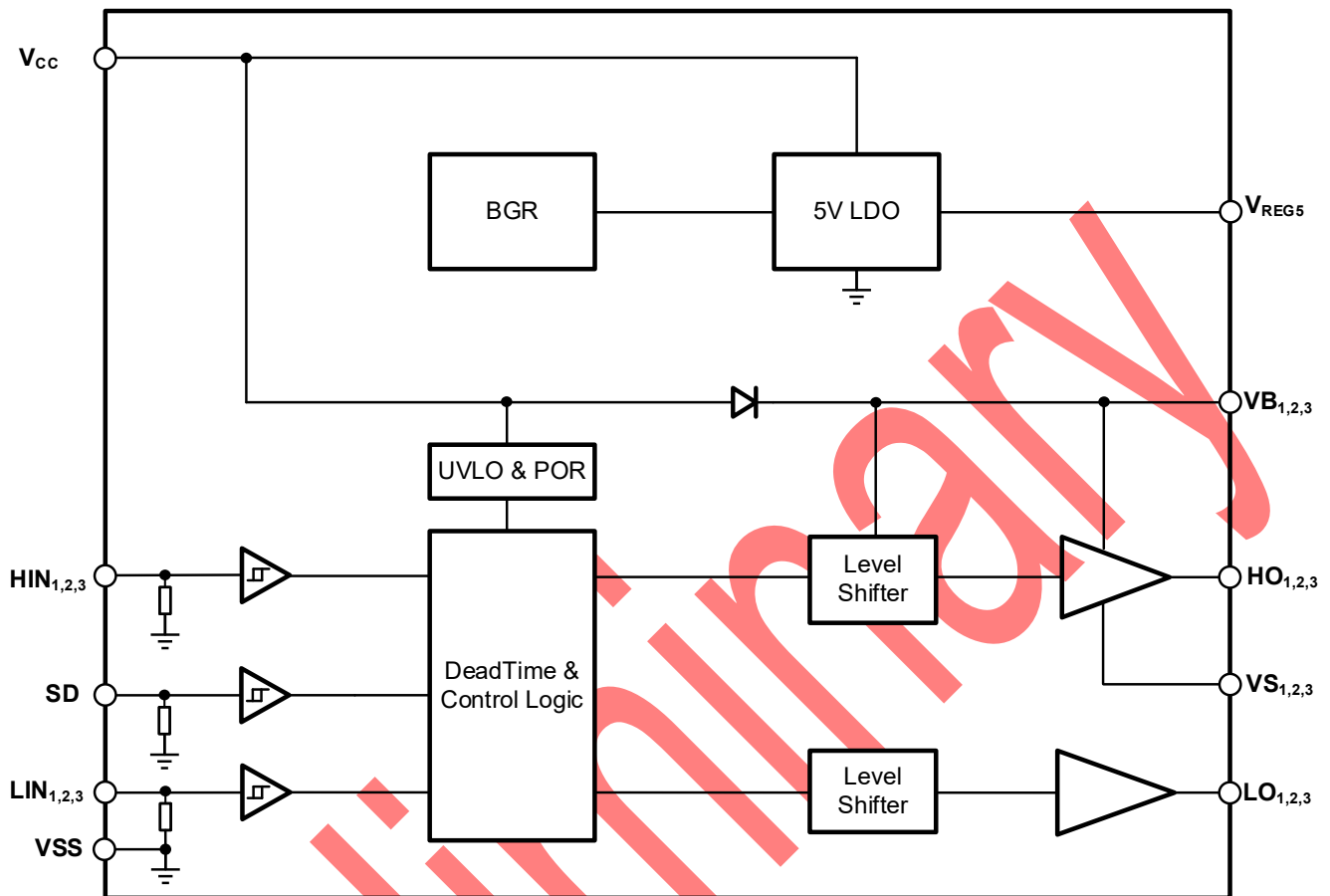
## PAD Information



## PAD Definitions

| PIN NAME             | PIN FUNCTION                                   |
|----------------------|------------------------------------------------|
| V <sub>CC</sub>      | The supply voltage of LDO and gate driver      |
| V <sub>REG5</sub>    | 5V Liner regulator output                      |
| VSS                  | Ground                                         |
| SD                   | Shutdown logic HVIC                            |
| HIN <sub>1,2,3</sub> | Logic inputs for high-side gate driver outputs |
| LIN <sub>1,2,3</sub> | Logic inputs for low-side gate driver outputs  |
| LO <sub>1,2,3</sub>  | Low-side driver outputs                        |
| VB <sub>1,2,3</sub>  | High-side gate drive floating supply           |
| HO <sub>1,2,3</sub>  | High-side driver outputs                       |
| VS <sub>1,2,3</sub>  | High voltage floating supply return            |

## Functional Block Diagram



## Absolute Maximum Ratings

Exceeding these ratings may damage the device.

The absolute maximum ratings are stress ratings only at  $T_A=25^{\circ}\text{C}$ , unless otherwise specified.

| Symbol        | Definition                                                | MIN.      | MAX.         | Units                       |
|---------------|-----------------------------------------------------------|-----------|--------------|-----------------------------|
| $V_{CC}$      | Supply voltage of LDO and gate driver                     | -0.3      | 15           | V                           |
| $V_{REG5}$    | 5V Liner regulator output                                 | -0.3      | 6            |                             |
| $HIN_{1,2,3}$ | Logic inputs for high-side gate driver outputs            | -0.3      | $V_{CC}+0.3$ |                             |
| $LIN_{1,2,3}$ | Logic inputs for low-side gate driver outputs             | -0.3      | $V_{CC}+0.3$ |                             |
| $VB_{1,2,3}$  | High-side gate drive floating supply                      | -0.3      | $V_M+0.3$    |                             |
| $VS_{1,2,3}$  | High voltage floating supply return                       | $V_B-15$  | $V_B+0.3$    |                             |
| $HO_{1,2,3}$  | High-side driver outputs                                  | $V_S-0.3$ | $V_B+0.3$    |                             |
| $LO_{1,2,3}$  | Low-side driver outputs                                   | -0.3      | $V_{CC}+0.3$ |                             |
| $P_D$         | Package Power Dissipation @ $T_A \leq 25^{\circ}\text{C}$ | —         | 0.625        | W                           |
| $R_{thJA}$    | Thermal Resistance, Junction to Ambient                   | —         | 200          | $^{\circ}\text{C}/\text{W}$ |
| $T_J$         | Junction Temperature                                      | —         | 150          | $^{\circ}\text{C}$          |
| $T_S$         | Storage Temperature                                       | -55       | 150          |                             |
| $T_L$         | Lead Temperature (Soldering, 10 seconds)                  | —         | 300          |                             |

## Recommended Operating Conditions

| Symbol               | Definition                                     | MIN.              | MAX.                 | Units |
|----------------------|------------------------------------------------|-------------------|----------------------|-------|
| V <sub>CC</sub>      | Supply voltage of LDO and gate driver          | 8                 | 13.5                 |       |
| V <sub>REG5</sub>    | 5V Liner regulator output                      | 4.5               | 5.5                  |       |
| HIN <sub>1,2,3</sub> | Logic inputs for high-side gate driver outputs | V <sub>S</sub>    | V <sub>B</sub>       |       |
| LIN <sub>1,2,3</sub> | Logic inputs for low-side gate driver outputs  | 0                 | V <sub>CC</sub>      |       |
| VB <sub>1,2,3</sub>  | High-side gate drive floating supply           | V <sub>S</sub> +5 | V <sub>S</sub> +13.5 |       |
| VS <sub>1,2,3</sub>  | High voltage floating supply return            | -5                | 45                   |       |
| HO <sub>1,2,3</sub>  | High-side driver outputs                       | V <sub>S</sub>    | V <sub>B</sub>       |       |
| LO <sub>1,2,3</sub>  | Low-side driver outputs                        | 0                 | V <sub>CC</sub>      |       |
| T <sub>A</sub>       | Ambient temperature                            | -40               | 125                  | °C    |

Note 1: Operational for transient negative V<sub>S</sub> of V<sub>SS</sub> - 50 V with a 50 ns pulse width. Guaranteed by design.

Note 2: In case of input pulse width at LIN<sub>1,2,3</sub> and HIN<sub>1,2,3</sub> below 1 $\mu$ s the input pulse cannot be transmitted properly.

## Electrical Characteristics

$V_{CC}=V_B=12V$ ,  $C_L=1nF$ ,  $T_A=25^{\circ}C$ , unless otherwise specified

### 5V LDO

| Symbol           | Parameter                                                                  | Min  | Typ. | Max  | unit |
|------------------|----------------------------------------------------------------------------|------|------|------|------|
| $V_{REG5}$       | Liner regulator output and gate driver supply ( $I_O=40\text{ mA}$ )       | 4.85 | 5    | 5.15 | V    |
| $I_{REG5,lim}$   | Linear regulator current limit                                             | -    | 40   | -    | mA   |
| $V_{REG5,drop1}$ | Drop voltage 1 ( $1\text{ mA} \leq I_O \leq 40\text{ mA}$ , $V_{CC}=12V$ ) | -    | 100  | 200  | mV   |
| $V_{REG5,drop2}$ | Drop voltage 2 ( $10V \leq V_{CC} \leq 15V$ , $I_O=40\text{ mA}$ )         | -    | 200  | 400  | mV   |

### Three-phase gate driver

| Symbol       | Parameter                                          | Min | Typ. | Max | unit |
|--------------|----------------------------------------------------|-----|------|-----|------|
| $I_{QCC}$    | Quiescent VCC supply current ( $HIN=LIN=0V$ )      | --  | 0.7  | 1.2 | mA   |
| $U_{VCC}$    | VCC under voltage rising threshold                 | 6   | 7    | 8   | V    |
| $U_{VHYS}$   | VCC threshold hysteresis                           | --  | 0.3  | --  |      |
| $V_{IH}$     | High level input threshold voltage                 | 2.4 | --   | --  |      |
| $V_{IL}$     | Low level input threshold voltage                  | --  | --   | 0.8 |      |
| $R_{INPD}$   | Input pull down resistance                         | --  | 200  | --  | kΩ   |
| $I_{IN+}$    | INPUT bias current (HO=high)                       | -25 | --   | 25  | uA   |
| $I_{IN-}$    | INPUT bias current (HO=low)                        | --  | 2    | --  |      |
| $I_{QBS}$    | Quiescent VB supply current per - 1 phase (HO low) | --  | 60   | 100 |      |
| $R_{BSD}$    | BSD on resistor (Forward bias current = 10mA)      | --  | 100  | --  | Ω    |
| $I_{sink}$   | Output sinking current                             | --  | 1    | --  | A    |
| $I_{source}$ | Output sourcing current                            | --  | 1    | --  |      |
| $t_r$        | Output rising time                                 | --  | 30   | 60  | ns   |
| $t_f$        | Output falling time                                | --  | 30   | 60  |      |
| $t_{DT}$     | Dead time                                          | --  | 45   | 65  |      |
| $t_{on}$     | Turn on propagation delay                          | --  | 40   | 60  |      |
| $t_{off}$    | Turn off propagation delay                         | --  | 40   | 60  |      |
| $t_{SD}$     | Shut down propagation delay                        | --  | 40   | 60  |      |

## Function Description

### 5V LDO Output characteristics

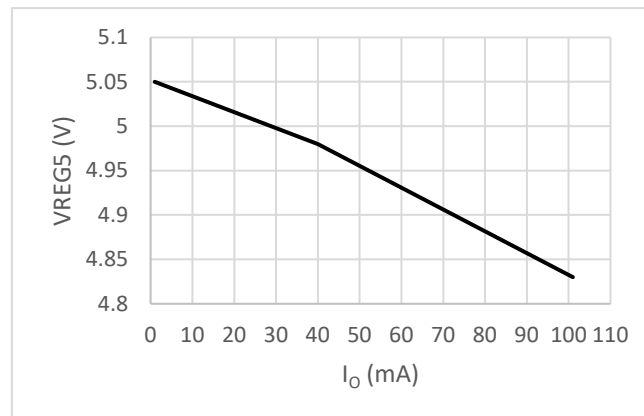


Figure 1  $V_{REG5}$  vs  $I_O$  ( $V_{CC}=12$  V)

### Three-phase gate driver

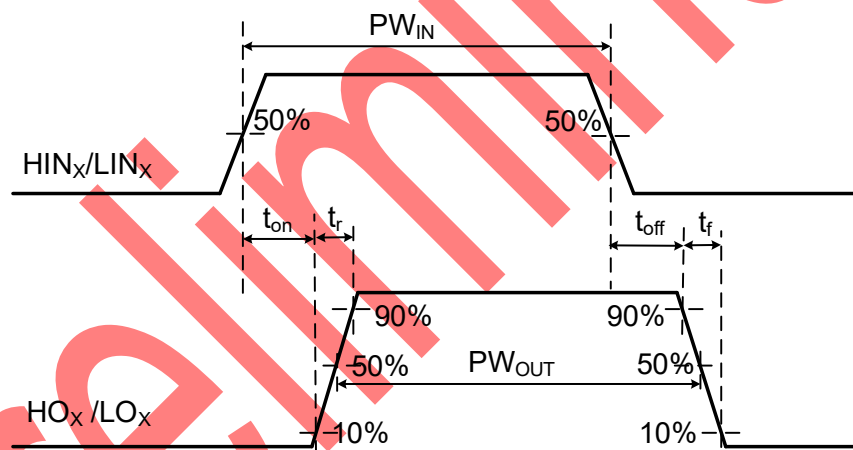


Figure.2 Switching Time Waveform Definitions

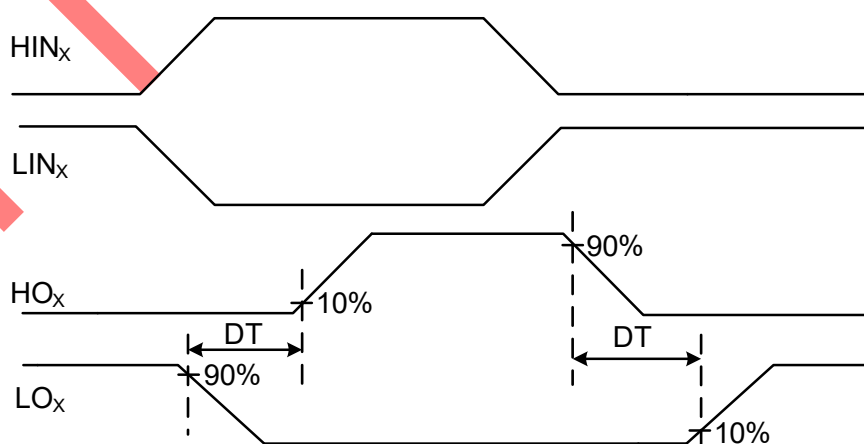


Figure.3 Dead time Waveform Definitions

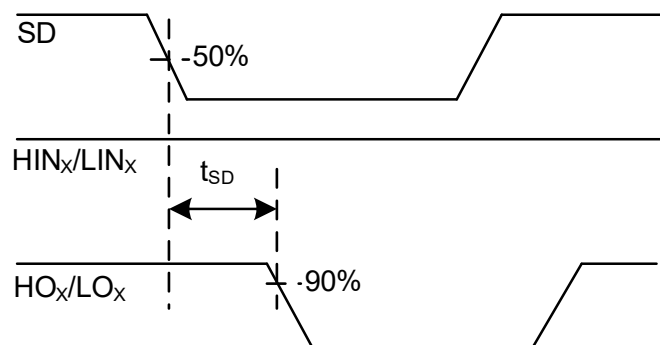
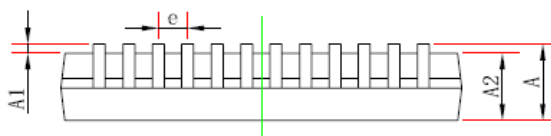
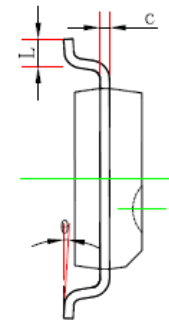
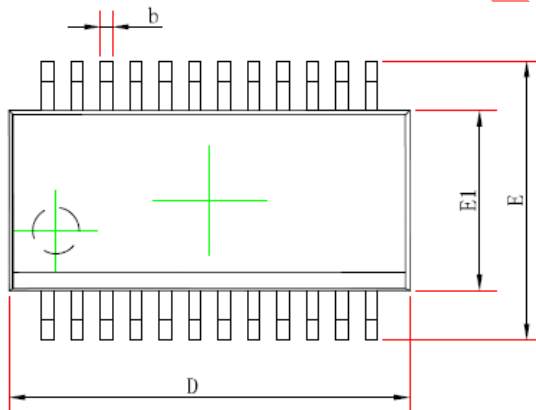


Figure.4 Shutdown time Waveform Definitions

## Package Information

## QSOP24 Package Outlines and Dimensions

| Symbol   | Dimensions In Millimeters |       |
|----------|---------------------------|-------|
|          | Min                       | Max   |
| A        | —                         | 1.750 |
| A1       | 0.04                      | 0.14  |
| A2       | 1.250                     | —     |
| b        | 0.203                     | 0.305 |
| c        | 0.102                     | 0.254 |
| D        | 8.450                     | 8.850 |
| E1       | 3.800                     | 4.000 |
| E        | 5.800                     | 6.200 |
| e        | 0.635 (BSC)               |       |
| L        | 0.400                     | 1.270 |
| $\theta$ | 0°                        | 8°    |



| Mark                | Package |
|---------------------|---------|
| ID7T0610AD<br>ABYWX | QSOP24  |

Note : AB : Product code , Y : Year code ; W : Week code ; X : Package code