



# LV8012T

Bi-CMOS LSI

## Forward/Reverse Motor Driver

ON Semiconductor®

<http://onsemi.com>

### Overview

LV8012T is a 2ch forward/reverse motor driver IC using D-MOS FET for output stage. As MOS circuit is used, it supports the PWM input. Its features are that the on resistance ( $0.75\Omega$  typ) and current dissipation are low. It also provides protection functions such as heat protection circuit and reduced voltage detection and is optimal for the motors that need high-current.

### Functions

- 2ch forward/reverse motor driver
- Low power consumption
- Built-in charge pump circuit
- Compact TSSOP-24 package
- Possible to respond to 3V control voltage and 6V motor voltage device
- Low ON resistance  $1.2\Omega$
- Built-in low voltage reset and thermal shutdown circuit
- Four mode function forward/reverse, brake, stop.

### Specifications

**Absolute Maximum Ratings** at  $T_a = 25^\circ\text{C}$ ,  $\text{SGND} = \text{PGND} = 0\text{V}$

| Parameter                    | Symbol       | Conditions               | Ratings              | Unit             |
|------------------------------|--------------|--------------------------|----------------------|------------------|
| Supply voltage (For load)    | $V_M$ max    |                          | -0.5 to 7.5          | V                |
| Supply voltage (For control) | $V_{CC}$ max |                          | -0.5 to 6.0          | V                |
| Output current               | $I_O$ max    | $t \leq 100\text{ms}$    | 1.4                  | A                |
| Input voltage                | $V_{IN}$ max |                          | -0.5 to $V_{CC}+0.5$ | V                |
| Allowable power dissipation  | $P_d$        | * Mounted on a substrate | 800                  | mW               |
| Operating temperature        | $T_{opr}$    |                          | -20 to +75           | $^\circ\text{C}$ |
| Storage temperature          | $T_{stg}$    |                          | -55 to +150          | $^\circ\text{C}$ |

\* : Mounted on a substrate :  $30 \times 50 \times 1.6\text{mm}^3$ , glass epoxy board

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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## Allowable Operating Ratings at $T_a = 25^\circ\text{C}$ , $\text{SGND} = \text{PGND} = 0\text{V}$

| Parameter                      | Symbol     | Conditions | Ratings       | Unit          |
|--------------------------------|------------|------------|---------------|---------------|
| Supply voltage (VM Pin)        | VM         |            | 2.0 to 7.0    | V             |
| Supply voltage ( $V_{CC}$ Pin) | $V_{CC}$   |            | 2.7 to 5.5    |               |
| Input signal voltage           | $V_{IN}$   |            | 0 to $V_{CC}$ | V             |
| Input signal frequenc          | f max      |            | 100           | kHz           |
| Capacitor for charge pump      | C1, C2, C3 |            | 0.001 to 0.1  | $\mu\text{F}$ |

## Electrical Characteristics at $T_a = 25^\circ\text{C}$ , $V_{CC} = \text{VM} = 5.0\text{V}$ , $\text{SGND} = \text{PGND} = 0\text{V}$ , unless especially specified.

| Parameter                                      | Symbol        | Conditions                                 | Remarks | Ratings             |      |                     | Unit             |
|--|---------------|--|---------|---------------------|------|---------------------|------------------|
|  |               |  |         | min                 | typ  | max                 |                  |
| Supply current for load at standby             | IMO           | EN = 0V                                    | 1       |                     |      | 1.0                 | $\mu\text{A}$    |
| Supply current for control at standby          | ICO           | EN = 0V,<br>IN1 = IN2 = IN3 = IN4 = 0V     | 2       |                     |      | 1.0                 | $\mu\text{A}$    |
| Current drain during operation                 | IC1           | EN = 5V, VG at no load                     | 3       |                     | 0.7  | 1.2                 | mA               |
| H-level input voltage                          | $V_{IH}$      | $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ |         | $0.6 \times V_{CC}$ |      | $V_{CC}$            | V                |
| L-level input voltage                          | $V_{IL}$      | $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ |         | 0                   |      | $0.2 \times V_{CC}$ | V                |
| H-level input current (IN1, IN2, IN3, IN4)     | $I_{IH}$      |  | 4       |                     |      | 1.0                 | $\mu\text{A}$    |
| L-level input current (IN1, IN2, IN3, IN4)     | $I_{IL}$      |  | 4       | -1.0                |      |                     | $\mu\text{A}$    |
| Pull-down resistance (EN1, 2)                  | RUP           |  |         | 100                 | 200  | 400                 | $\text{k}\Omega$ |
| Output ON resistance                           | RON           | Sum of ON resistances at top and bottom    | 5       |                     | 0.75 | 1.2                 | $\Omega$         |
| Charge pump voltage                            | VG            |  | 6       | 8.5                 |      | 10.5                | V                |
| Low-voltage detection operation voltage        | VCS           |  | 7       | 2.15                | 2.30 | 2.45                | V                |
| Thermal shutdown operation temperature         | $T_{TSD}$     |  | 8       |                     | 180  |                     | $^\circ\text{C}$ |
| Charge pump capacity (IG = 500 $\mu\text{A}$ ) | VGLOAD        |  | 9       | 8                   | 9    |                     | V                |
| IG current dissipation (Fin = 20kHz)           | IG            |  | 10      |                     |      | 350                 | $\mu\text{A}$    |
| Charge pump start time                         | TVG           | CVG = 0.1 $\mu\text{F}$                    | 11      |                     |      | 1.0                 | ms               |
| Output block                                   | Turn on time  | TPLH                                       | 12      |                     | 0.2  | 0.4                 | $\mu\text{s}$    |
|  | Turn off time | TPHL                                       | 12      |                     | 0.2  | 0.4                 | $\mu\text{s}$    |

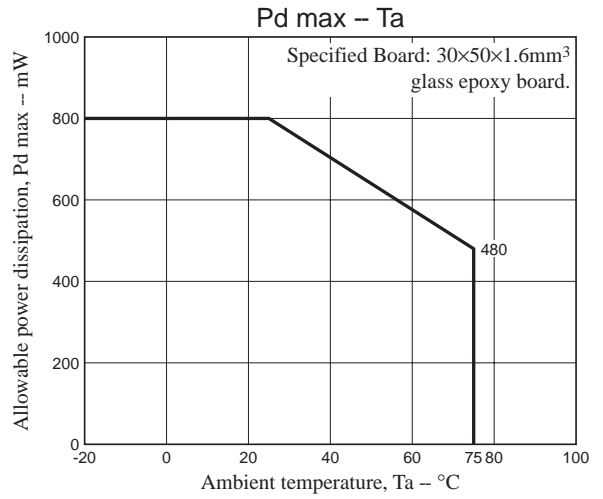
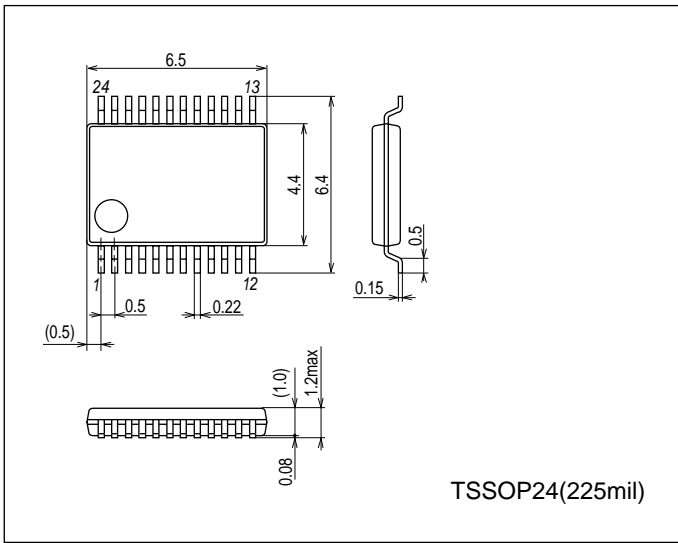
### Remarks

1. It shows current dissipation of VM pin in output OFF state.
2. It shows current dissipation of  $V_{CC}$  pin in stand-by state.  
(The standard current depends on EN pin pull-down resistance.)
3. It shows current dissipation of  $V_{CC}$  pin in state of EN = 5V (stand-by), including current dissipation of VG pin.
4. For IN1, IN2, IN3 and IN4 pins, no pull-down and pull-up resistance is needed. (High impedance pin)
5. It shows sum of upper and lower saturation voltages of OUT pin.
6. It controls charge-pump oscillation and makes specified voltage.
7. When low voltage is detected, the lower output is turned OFF.
8. When thermal protection circuit is activated, the lower output is turned OFF.  
When the heat temperature is fallen, it is turned ON again.
9. IG (VG pin load current) = 500 $\mu\text{A}$
10. It shows VG pin current dissipation in state of PWM input for IN pin.
11. It specifies start-up time from 10% to 90% when VG is in non-load state  
(when setting the capacitor between VG and GND to 0.1 $\mu\text{F}$  and  $V_{CC}$  is 5V).
12. It specifies 10% to 90% for start-up and 90% to 10% for shut-down.

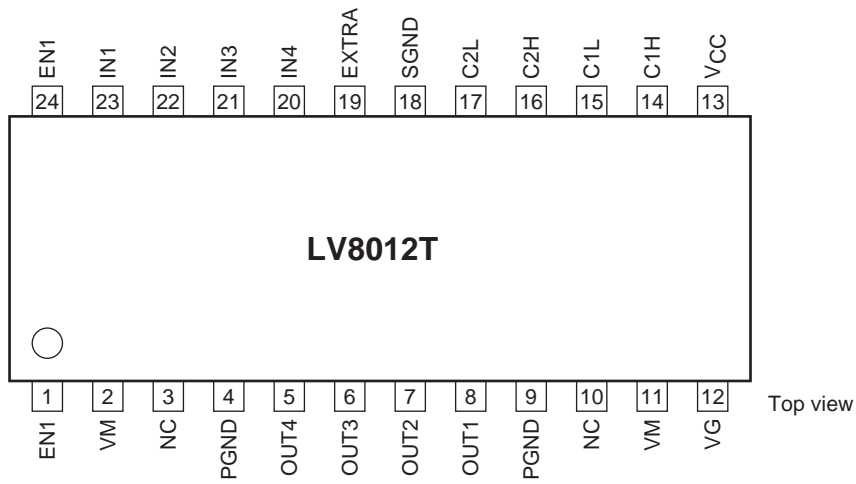
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## Package Dimensions

unit : mm (typ)  
3260A

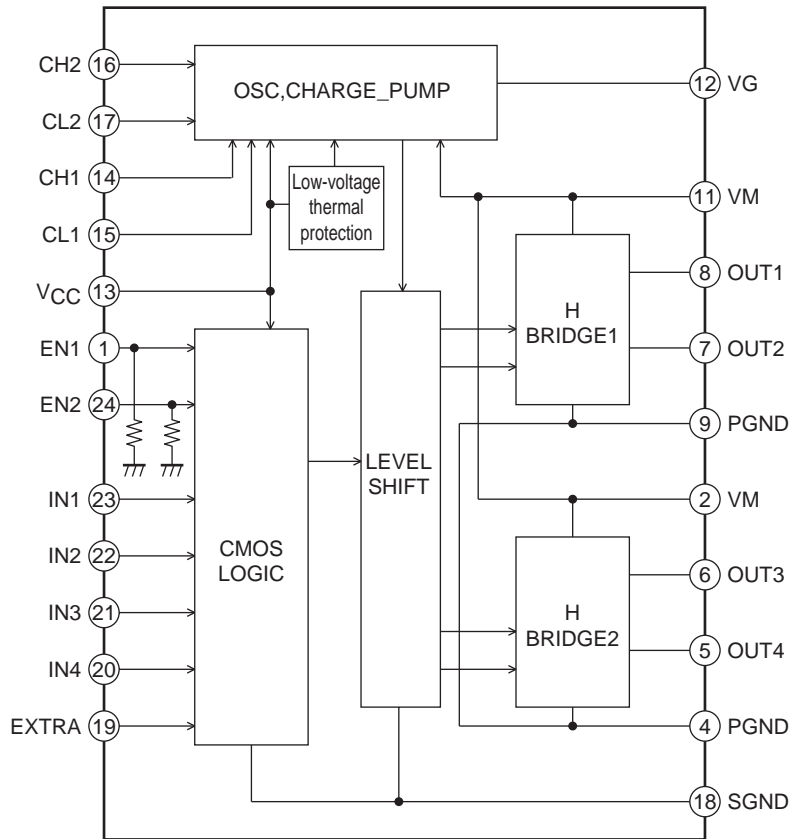


## Pin Assignment



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## Block Diagram



## Truth table

| EXTRA | EN1 (EN2) | IN1 (IN3) | IN2 (IN4) | OUT1 (OUT3) | OUT2 (OUT4) | Circuit of Charge Pump | Mode    |
|-------|-----------|-----------|-----------|-------------|-------------|------------------------|---------|
| L     | H         | H         | H         | Z           | Z           | ON                     | Standby |
|       |           | H         | L         | L           | H           |                        | Reverse |
|       |           | L         | H         | H           | L           |                        | Forward |
|       |           | L         | L         | L           | L           |                        | Brake   |
| H     | H         | H         | -         | L           | H           | ON                     | Reverse |
|       |           | L         | -         | H           | L           |                        | Forward |
|       |           | L         | -         | L           | L           |                        | Brake   |
| L     | L         | -         | -         | L           | L           | OFF                    | Standby |
|       |           | -         | -         | L           | L           |                        | Standby |

- : Don't care Z : High-Impedance

\* Current drain becomes zero in the standby mode.

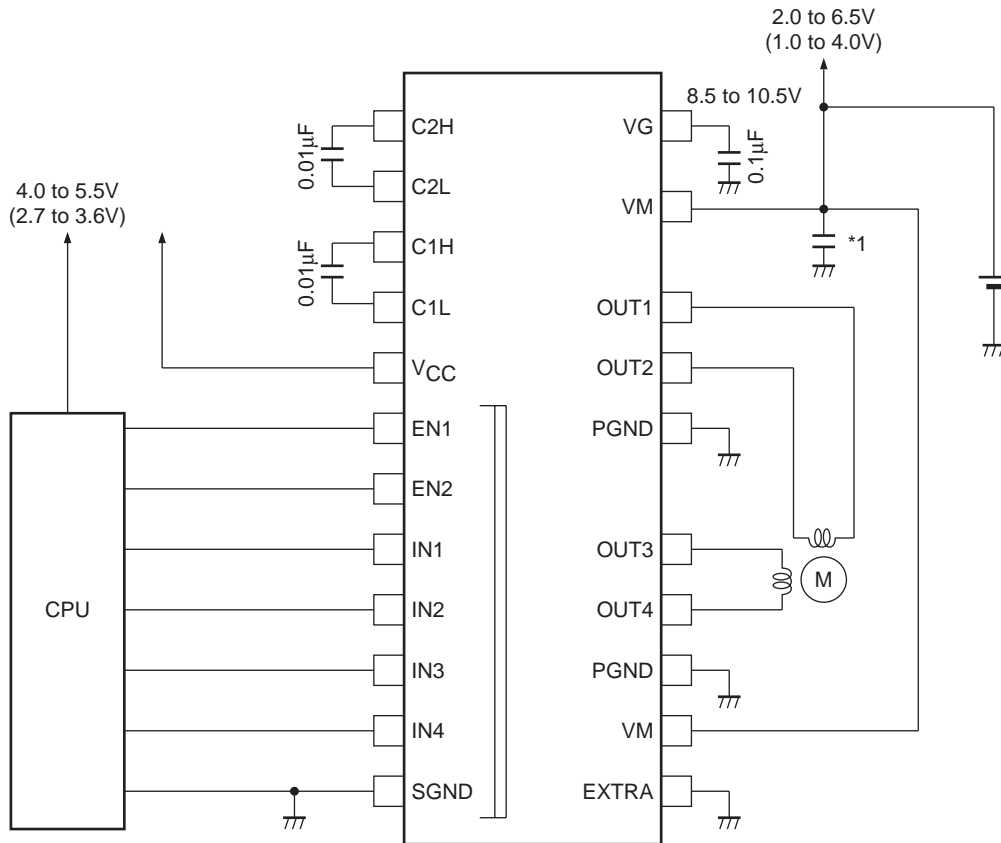
\* The output side becomes OFF, with motor drive stopped, during voltage reduction and thermal protection.

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## Pin Functions

| Pin No.                    | Pin name                             | Function  | Equivalent Circuit |
|----------------------------|--------------------------------------|---|--------------------|
| 15<br>17                   | C1L<br>C2L                           | Voltage raising capacitor connection pin  |                    |
| 14<br>16                   | C1H<br>C2H                           | Voltage raising capacitor connection pin  |                    |
| 23<br>22<br>21<br>20<br>19 | IN1<br>IN2<br>IN3<br>IN4<br>EXTRA    | Driver output changeover  |                    |
| 1<br>24                    | EN1<br>EN2                           | Logic enable pin<br>TOOUT output control pin<br>(Pull-down resistor incorporated) |                    |
| 8<br>7<br>6<br>5           | OUT1<br>OUT2<br>OUT3<br>OUT4<br>PGND | Driver output pin   |                    |
| 2<br>11                    | VM<br>VM                             | Motor power supply<br>(both terminals to be connected)                            |                    |
| 13                         | VCC                                  | Logic power supply  |                    |
| 12                         | VG                                   | Driver drive circuit power supply   |                    |
| 18                         | SGND                                 | Logic GND   |                    |
| 9<br>4                     | PGND<br>PGND                         | Driver GND<br>(both terminals to be connected)                                    |                    |

Sample Application Circuit



\*1 : Connect a kickback absorption capacitor directly near IC. Coil kickback may cause rise of the voltage of VM line, and the voltage exceeding the maximum rating may be applied momentarily, resulting in deterioration or damage of IC.

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