



SANYO Semiconductors

## DATA SHEET

An ON Semiconductor Company

# LV8406T — Bi-CMOS IC 2ch Forward/Reverse Motor Driver

## Overview

LV8406T is a 2-channel 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

- 2-channel forward/reverse motor driver.
- Low power consumption.
- Low-ON resistance  $0.75\Omega$ .
- Built-in low voltage reset and thermal shutdown circuit.
- Four mode function forward/reverse, brake, stop.
- Built-in charge pump.

## Specifications

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

| Parameter                          | Symbol              | Conditions                    | Ratings                      | Unit |
|------------------------------------|---------------------|-------------------------------|------------------------------|------|
| Power supply voltage (for load)    | VM max              | VM1, VM2                      | -0.5 to 16.0                 | V    |
| Power supply voltage (for control) | V <sub>CC</sub> max |                               | -0.5 to 6.0                  | V    |
| Output current                     | I <sub>O</sub> max  |                               | 1.4                          | A    |
| Output peak current                | I <sub>O</sub> peak | $t \leq 10\text{ms}$          | 2.5                          | A    |
| Input voltage                      | V <sub>IN</sub> max |                               | -0.5 to V <sub>CC</sub> +0.5 | V    |
| Allowable power dissipation        | Pd max              | Mounted on a specified board* | 3.1                          | W    |
| Operating temperature              | T <sub>opr</sub>    |                               | -30 to +85                   | °C   |
| Storage temperature                | T <sub>stg</sub>    |                               | -55 to +150                  | °C   |

\* Specified board : 90mm × 90mm × 1.6mm, glass epoxy 2-layer board (2S0P).

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.

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# LV8406T

## Allowable Operating Conditions at Ta = 25°C, SGND = PGND = 0V

| Parameter                      | Symbol | Conditions | Ratings     | Unit |
|--------------------------------|--------|------------|-------------|------|
| Power supply voltage (VM pin)  | VM     |            | 1.5 to 15.0 | V    |
| Power supply voltage (VCC pin) | VCC    |            | 2.8 to 5.5  | V    |
| Input signal voltage           | VIN    |            | 0 to VCC    | V    |
| Input signal frequency         | f max  |            | 200         | kHz  |

## Electrical Characteristics Ta = 25°C, VCC = 3.0V, VM = VS = 6.0V, SGND = PGND = 0V, unless otherwise specified.

| Parameter                                                  | Symbol        | Conditions                                            | Remarks | Ratings             |      |                     | Unit |
|------------------------------------------------------------|---------------|-------------------------------------------------------|---------|---------------------|------|---------------------|------|
|                                                            |               |                                                       |         | min                 | typ  | max                 |      |
| Standby load current drain                                 | IMO           | EN = 0V                                               | 1       |                     |      | 1.0                 | μA   |
| Standby control current drain                              | ICO           | EN = IN1 = IN2 = IN3 = IN4 = 0V                       | 2       |                     |      | 1.0                 | μA   |
| Standby load current drain2                                | IMO2          | VCC = 0V, VM = VS = 6V                                |         |                     |      | 1.0                 | μA   |
| Operating control current drain                            | IC1           | EN = 3V, with no load                                 | 3       |                     | 0.85 | 1.2                 | mA   |
| High-level input voltage                                   | VIH           | $2.7 \leq V_{CC} \leq 5.5V$                           |         | $0.6 \times V_{CC}$ |      | VCC                 | V    |
| Low-level input voltage                                    | VIL           | $2.7 \leq V_{CC} \leq 5.5V$                           |         | 0                   |      | $0.2 \times V_{CC}$ | V    |
| High-level input current<br>(EN1, EN2, IN1, IN2, IN3, IN4) | IIH1          | VIN = 3V                                              | 4       |                     | 15   | 25                  | μA   |
| Low-level input current<br>(EN1, EN2, IN1, IN2, IN3, IN4)  | IIL1          | VIN = 0V                                              | 4       | -1.0                |      |                     | μA   |
| Pull-down resistance value                                 | RDN           | EN1, EN2, IN1, IN2, IN3, IN4                          |         | 100                 | 200  | 400                 | kΩ   |
| Charge pump voltage                                        | VG            | VCC + VS                                              |         | 8.5                 | 9.0  | 9.5                 | V    |
| Output ON resistance 1                                     | RON1          | Sum of top and bottom sides ON resistance.            | 5       |                     | 0.75 | 1.2                 | Ω    |
| Output ON resistance 2                                     | RON2          | Sum of top and bottom sides ON resistance. VCC = 2.8V | 5       |                     | 1.0  | 1.5                 | Ω    |
| Low-voltage detection voltage                              | VCS           | VCC pin voltage is monitored                          | 6       | 2.15                | 2.30 | 2.45                | V    |
| Thermal shutdown temperature                               | Tth           | Design guarantee value *                              | 7       | 150                 | 180  | 210                 | °C   |
| Output block                                               | Turn-on time  | TPLH                                                  | 8       |                     | 0.2  | 0.4                 | μS   |
|                                                            | Turn-off time | TPHL                                                  | 8       |                     | 0.2  | 0.4                 | μS   |

\* : Design guarantee value and no measurement is preformed.

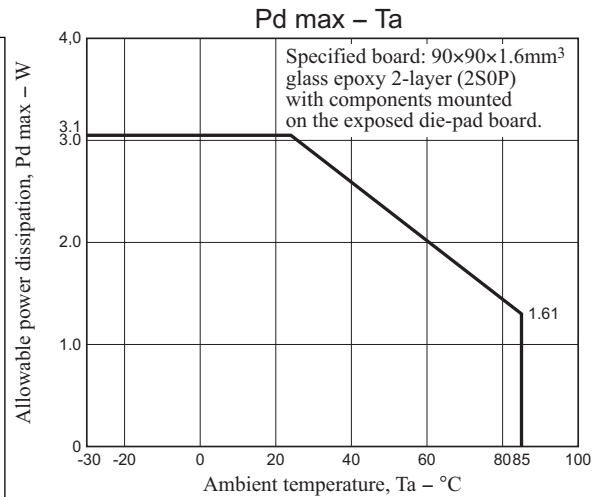
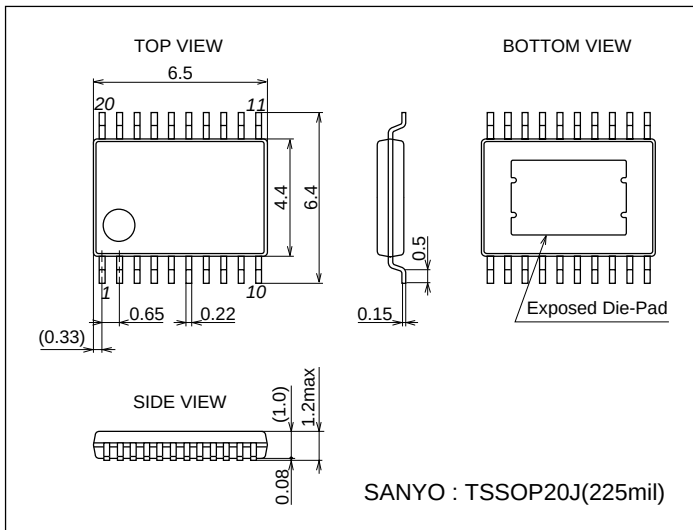
### Remarks

1. Current consumption when output at the VM pin is off.
2. Current consumption when the VCC pin when in standby mode.
3. Current consumption at the VCC pin when EN is 3V (standby mode).
4. Pins EN1, 2, IN1, 2, 3, and 4 are all pulled down.
5. Sum of upper and lower saturation voltages of OUT pin divided by the current.
6. All power transistors are turned off if a low VCC condition is detected.
7. All output transistors are turned off if the thermal protection circuit is activated. They are turned on again as the temperature goes down.
8. Rising time from 10 to 90% and falling time from 90 to 10% are specified.

## Package Dimensions

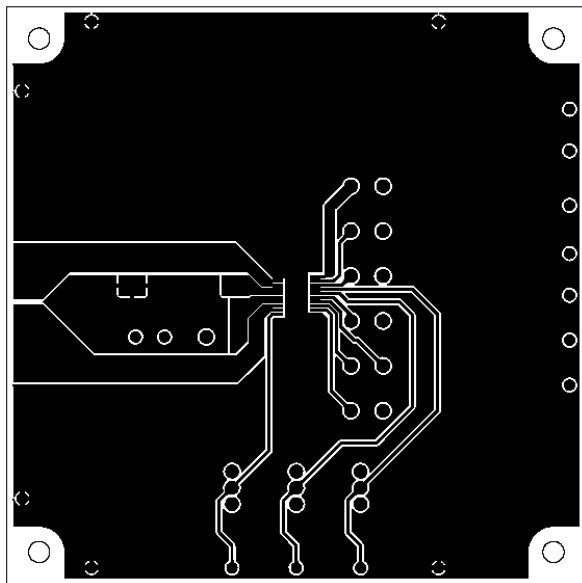
unit : mm (typ)

3279

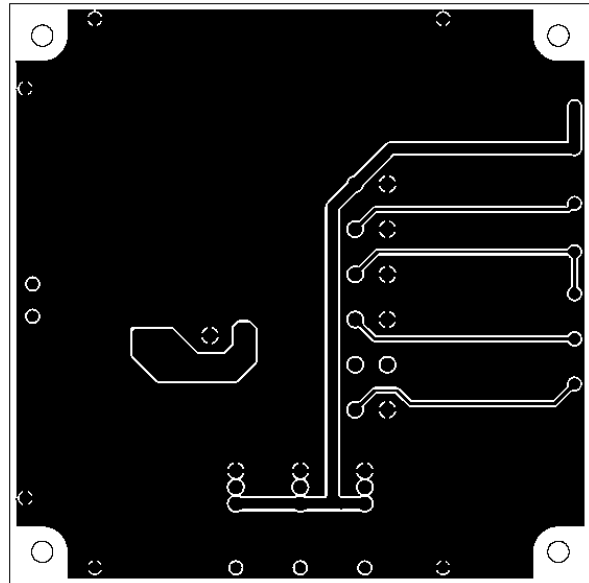


## Substrate Specifications

Size : 90mm × 90mm × 1.6mm (2-layer substrate [2S0P])  
 Material : Glass epoxy  
 Copper wiring density : L1 = 95% / L2 = 95%



L1 : Copper wiring pattern diagram

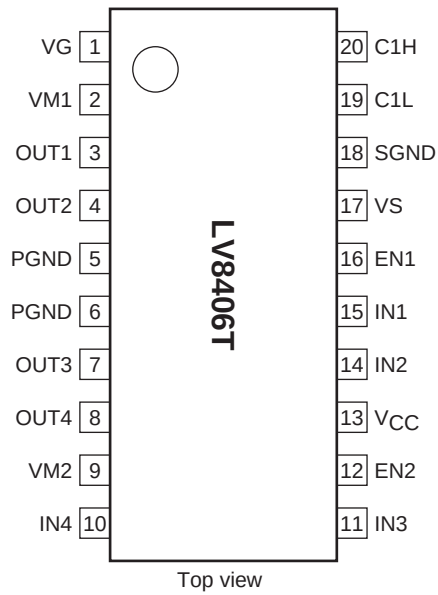


L2 : Copper wiring pattern diagram

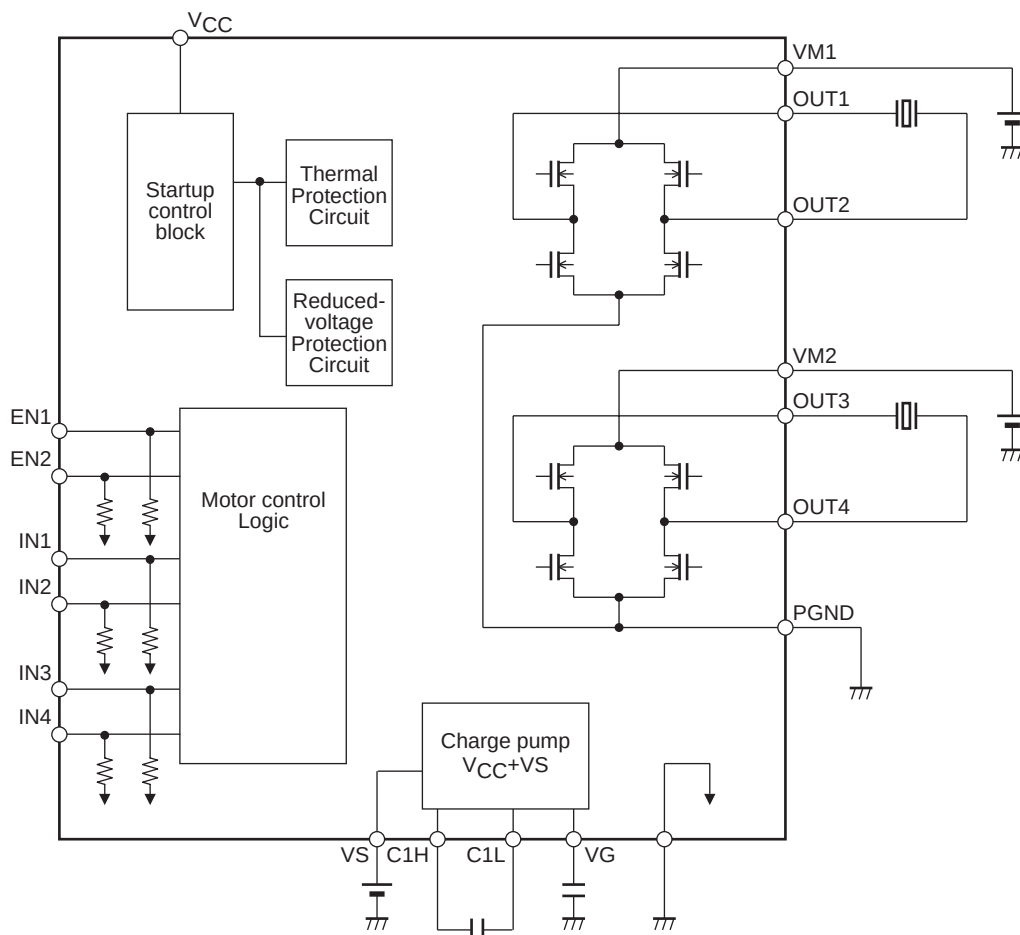
## Cautions

- 1) The data for the case with the Exposed Die-Pad substrate mounted shows the values when 90% or more of the Exposed Die-Pad is wet.
- 2) For the set design, employ the derating design with sufficient margin.  
 Stresses to be derated include the voltage, current, junction temperature, power loss, and mechanical stresses such as vibration, impact, and tension. Accordingly, the design must ensure these stresses to be as low or small as possible.  
 The guideline for ordinary derating is shown below :  
 (1)Maximum value 80% or less for the voltage rating  
 (2)Maximum value 80% or less for the current rating  
 (3)Maximum value 80% or less for the temperature rating
- 3) After the set design, be sure to verify the design with the actual product.  
 Confirm the solder joint state and verify also the reliability of solder joint for the Exposed Die-Pad, etc.  
 Any void or deterioration, if observed in the solder joint of these parts, causes deteriorated thermal conduction, possibly resulting in thermal destruction of IC.

## Pin Assignment



## Block Diagram



\* Connect a kickback absorption capacitor as near as possible to the IC. Coil kickback may cause increase in VM line voltage, and a voltage exceeding the maximum rating may be applied momentarily to the IC, which results in deterioration or damage of the IC

\* The pin VS is a terminal that supplies a source power supply of the charge pump circuit. The charge pump voltage,  $V_G = V_S + V_{CC}$  is generated.  
Apply the high voltage of VM1 or VM2.

## Truth Table

| EN1<br>(EN2) | IN1<br>(IN3) | IN2<br>(IN4) | OUT1<br>(OUT3) | OUT2<br>(OUT4) | Charge pump | Mode              |
|--------------|--------------|--------------|----------------|----------------|-------------|-------------------|
| H            | H            | H            | L              | L              | ON          | Brake             |
|              | H            | L            | H              | L              |             | Forward           |
|              | L            | H            | L              | H              |             | Reverse           |
|              | L            | L            | Z              | Z              |             | Standby           |
| L            | -            | -            | Z              | Z              | OFF         | All function stop |

- : denotes a don't care value. Z : High-impedance

- In standby mode, consumption current serves as zero..

\* All power transistors turn off and the motor stops driving when the IC is detected in low voltage or thermal protection mode.

## Pin Functions

| Pin No.                          | Pin name                               | Description                                                                        | Equivalent circuit |
|----------------------------------|----------------------------------------|------------------------------------------------------------------------------------|--------------------|
| 20<br>1<br>17                    | C1H<br>VG<br>VS                        | Step-up capacitor connection pin.<br><br>Charge pump source voltage supply pin.    |                    |
| 19                               | C1L                                    | Step-up capacitor connection pin.                                                  |                    |
| 16<br>12<br>15<br>14<br>11<br>10 | EN1<br>EN2<br>IN1<br>IN2<br>IN3<br>IN4 | Logic enable pin.<br>(Pull-down resistor incorporated)<br>Driver output switching. |                    |
| 3<br>4<br>7<br>8                 | OUT1<br>OUT2<br>OUT3<br>OUT4           | Driver output.                                                                     |                    |
| 2<br>9                           | VM1<br>VM2                             | Motor block power supply.                                                          |                    |
| 13                               | VCC                                    | Logic block power supply.                                                          |                    |
| 18                               | SGND                                   | Control block ground.                                                              |                    |
| 5<br>6                           | PGND<br>PGND                           | Driver block ground.                                                               |                    |

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