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LV8401V

Bi-CMOS IC Forward/Reverse Motor Driver

Overview

The LV8401V is a 1-channel motor driver IC using D-MOS FET for output stage and operates in one of the four modes under program control: forward, reverse, brake, and standby.

As the P/N-channel structure is used in the H-bridge output stage, the LV8401V features minimal number of external component and low on-resistance (0.33Ω typical). This IC is optimal for driving motors that need large-current.

Functions

- 1-channel forward/reverse motor driver
- Low power consumption
- Low output ON resistance 0.33Ω
- Built-in constant current output circuit
- Built-in low voltage reset and thermal shutdown circuit
- Four mode function forward/reverse, brake, standby.

Specifications

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

| Parameter | Symbol | Conditions | Ratings | Unit |
|------------------------------------|---------------|--|----------------------|------------------|
| Power supply voltage (for load) | V_M max | | -0.5 to 16.0 | V |
| Power supply voltage (for control) | V_{CC} max | | -0.5 to 6.0 | V |
| Output current | I_O max | DC | 1.2 | A |
| | I_O peak1 | $t \leq 100\text{ms}$, $f = 5\text{Hz}$ | 2.0 | A |
| | I_O peak2 | $t \leq 10\text{ms}$, $f = 5\text{Hz}$ | 3.8 | A |
| | I_{OUT} max | DC | 30 | mA |
| Input voltage | V_{IN} max | | -0.5 to $V_{CC}+0.5$ | V |
| Allowable power dissipation | P_d max | Mounted on a specified board * | 800 | mW |
| Operating temperature | T_{opr} | | -20 to +75 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -55 to +150 | $^\circ\text{C}$ |

* Specified board : $30\text{mm} \times 50\text{mm} \times 1.6\text{mm}$, glass epoxy board.

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 Conditions at $T_a = 25^\circ\text{C}$, $\text{SGND} = \text{PGND} = 0\text{V}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|------------------------------------|-----------------|------------|----------------------|------|
| Power supply voltage (for load) | VM | | 4.0 to 15.0 | V |
| Power supply voltage (for control) | V _{CC} | | 2.7 to 5.5 | V |
| Input signal voltage | V _{IN} | | 0 to V _{CC} | V |
| Input signal frequency | f max | Duty = 50% | 200 | kHz |

Electrical Characteristics $T_a = 25^\circ\text{C}$, $V_{CC} = 5.0\text{V}$, $V_M = 12.0\text{V}$, $\text{SGND} = \text{PGND} = 0\text{V}$, unless otherwise specified.

| Parameter | Symbol | Conditions | Remarks | Ratings | | | Unit |
|--|--------------------------------|---|---------|---------------------|------|---------------------|------|
| | | | | min | typ | max | |
| Standby load current drain 1 | IMO1 | EN = 0V | 1 | | | 1.0 | μA |
| Standby load current drain 2 | IMO2 | EN = 0V, V _{CC} = 0V, Each input pin = 0V | 1 | | | 1.0 | μA |
| Standby control current drain | ICO | EN = 0V, IN1 = IN2 = 0V | 2 | 12.5 | 25 | 50 | μA |
| Operating load current drain 1 | IM1 | V _{CC} = 3.3V, EN = 3.3V | 3 | | 0.35 | 0.70 | mA |
| Operating load current drain 2 | IM2 | V _{CC} = 5.0V, EN = 5.0V | 3 | | 0.35 | 0.70 | mA |
| Operating current consumption 1 | IC1 | V _{CC} = 3.3V, EN = 3.3V | 4 | | 0.6 | 1.2 | mA |
| Operating current consumption 2 | IC2 | V _{CC} = 5.0V, EN = 5.0V | 4 | | 0.8 | 1.6 | mA |
| High-level input voltage | V _{IH} | $2.7 \leq V_{CC} \leq 5.5\text{V}$ | | $0.6 \times V_{CC}$ | | V _{CC} | V |
| Low-level input voltage | V _{IL} | $2.7 \leq V_{CC} \leq 5.5\text{V}$ | | 0 | | $0.2 \times V_{CC}$ | V |
| High-level input current (IN1, IN2, ICTRL) | I _{IH} | V _{IN} = 5.0V | 5 | 12.5 | 25 | 50 | μA |
| Low-level input current (IN1, IN2, ICTRL) | I _{IL} | V _{IN} = 0V | 5 | -1.0 | | | μA |
| Pull-up resistance value (EN) | R _{UP} | | | 100 | 200 | 400 | kΩ |
| Pull-down resistance value (IN1, IN2, ICTRL) | R _{DN} | | | 100 | 200 | 400 | kΩ |
| Output ON resistance | R _{ON} | Sum of top and bottom sides ON resistance. $2.7\text{V} \leq V_{CC} \leq 5.5\text{V}$ | 6 | | 0.33 | 0.5 | Ω |
| Constant current output leakage current | I _O LEAK | EN = 0V | 7 | | | 1.0 | μA |
| Output constant current | I _{OUT} | RSET = 40Ω, Internal reference = 0.2V | 8 | 4.65 | 5.00 | 5.35 | mA |
| ISET pin voltage | V _{ISET} | RSET = 40Ω | 9 | 0.186 | 0.20 | 0.214 | V |
| Constant current output ON resistance | R _{ON} I _O | RSET = 0Ω, I _O = 5mA | 10 | | 20 | 30 | Ω |
| Low-voltage detection voltage | VCS | V _{CC} voltage | 11 | 2.10 | 2.25 | 2.40 | V |
| Thermal shutdown temperature | T _{th} | Design guarantee * | 12 | 150 | 180 | 210 | °C |
| Output block | Turn-on time | TPLH | 13 | | 0.5 | 1.0 | μs |
| | Turn-off time | TPHL | 13 | | 0.5 | 1.0 | μs |

* Design guarantee value and no measurement is performed.

Remarks

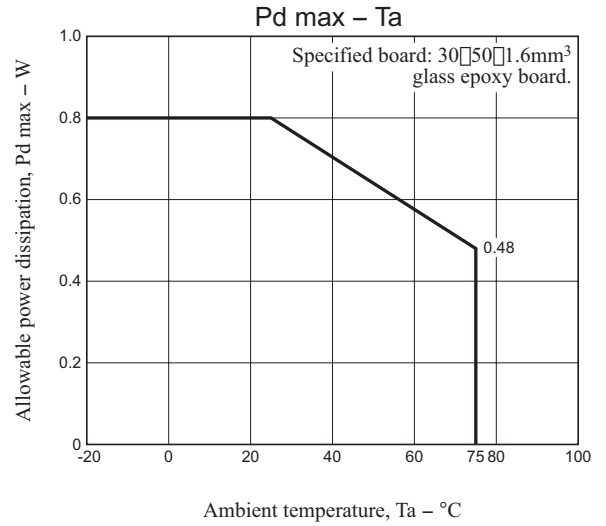
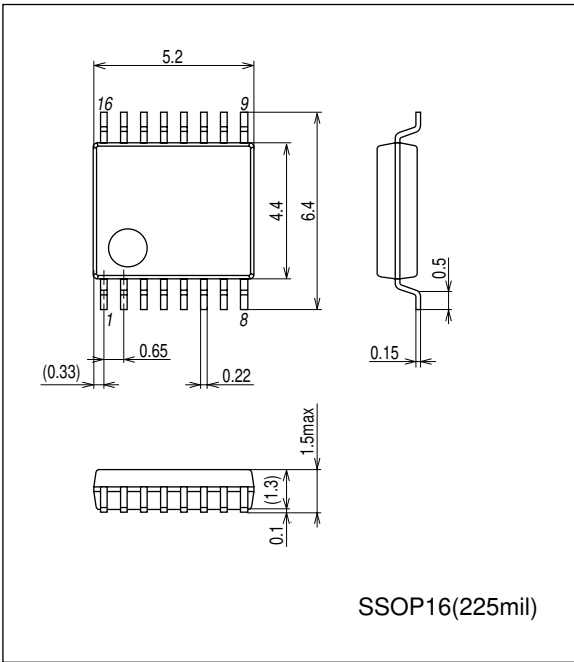
- Current consumption when output at the VM pin is off.
- Current consumption at the V_{CC} pin when in all function stop mode.
- Current consumption at the VM pin when EN is high.
- Current consumption at the V_{CC} pin when EN is high.
- These input pins (IN1, IN2, and ICTRL) have an internal pull-down resistor and the EN pin an internal pull-up resistor.
- Sum of the top and bottom side output on resistance.
- Leakage current when the constant current output is off.
- Current value that is determined by dividing the internal reference voltage (0.2V) by RSET.
- ISET pin voltage when the constant current output block is active.
- ON resistance value of the constant current output block.
- All output transistors are turned off if a low-voltage is detected.
- All output transistors are turned off if the thermal protection circuit is activated. They are turned on again as the temperature goes down.
- Rising time from 10 to 90% and falling time from 90 to 10% are specified.

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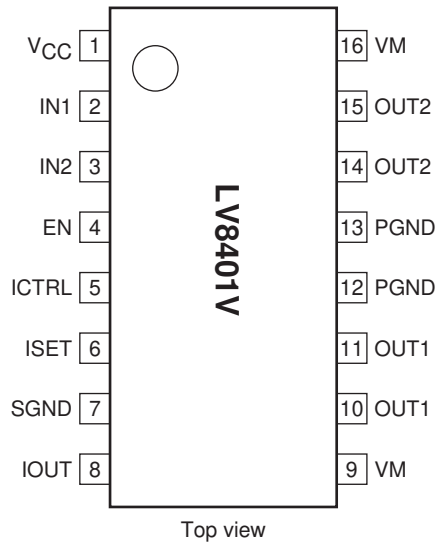
Package Dimensions

unit : mm (typ)

3178B

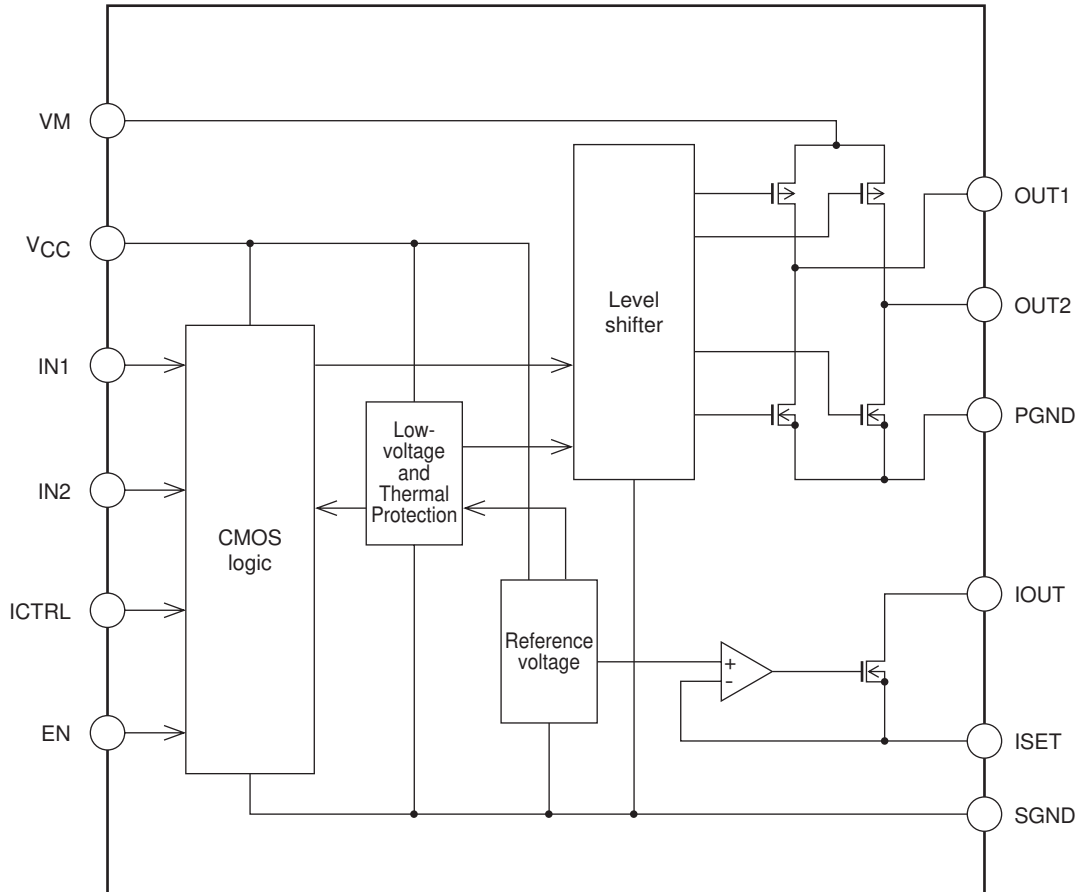


Pin Assignment



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Block Diagram



Truth Table

| EN | IN1 | IN2 | OUT1 | OUT2 | Mode |
|----|-----|-----|------|------|-------------------|
| H | H | H | L | L | Brake |
| | H | L | H | L | Forward |
| | L | H | L | H | Reverse |
| | L | L | Z | Z | Standby |
| L | - | - | Z | Z | All function stop |

| EN | ICTRL | IOUT | Mode |
|----|-------|------|----------------------|
| H | H | ON | Constant current ON |
| | L | Z | Constant current OFF |
| L | - | Z | All function stop |

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

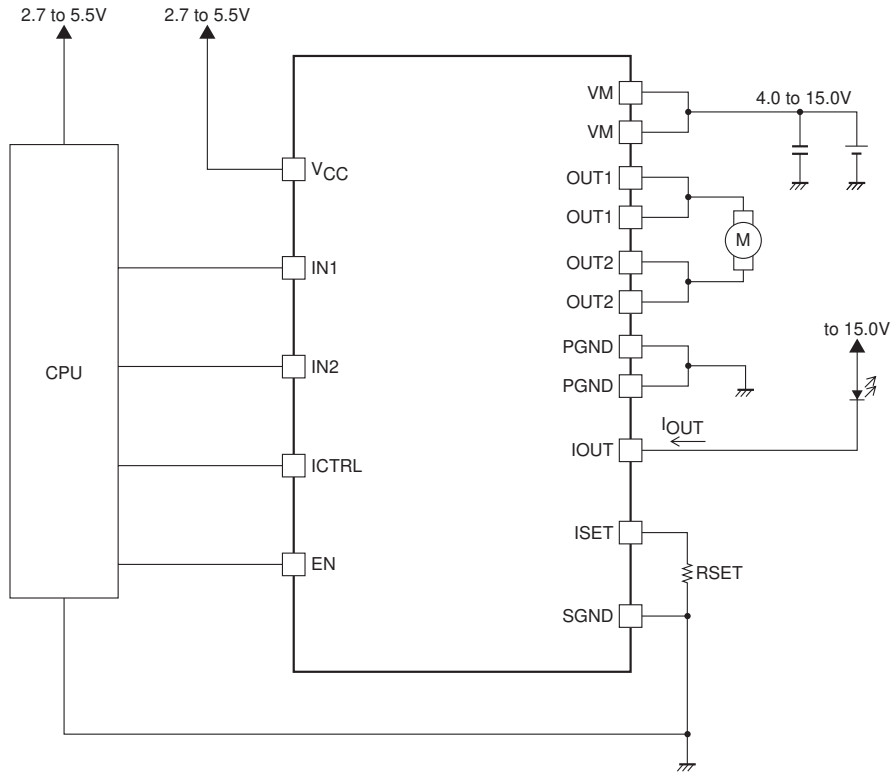
- Current drain is zero in all function stop mode. (excluding the current that flows out of the EN pin)
- * All power transistors turn off and the motor stops driving when the IC is detected in low voltage or thermal protection mode.

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Pin Functions

| Pin No. | Pin name | Description | Equivalent circuit |
|----------------------|---------------------|---|--------------------|
| 9 16 | VM | Motor block power supply. (Both pins must be connected) | |
| 1 | V _{CC} | Logic block power supply. | |
| 4 | EN | Logic enable pin. (Pull-up resistor incorporated) | |
| 2 3 5 | IN1 IN2 ICTRL | Driver output switching. (Pull-down resistor incorporated) | |
| 10 11 14 15 | OUT1 OUT2 | Driver output. | |
| 6 8 | ISET IOUT | Constant current output. | |
| 7 | SGND | Logic block ground. | |
| 12 13 | PGND | Driver block ground. (Both pins must be connected) | |

Sample Application Circuit



- *1 : Connect a kickback absorbing capacitor as close as possible to the IC. Characteristics deterioration of the IC or damage may result if an instantaneous voltage surge exceeding the maximum rated value is applied to the VM line due to coil kickback or other causes.
- *2 : The output constant current (I_{OUT}) is determined by the internal reference voltage and the sense resistor between the ISET and SGND pins.
 $I_{OUT} = \text{Internal reference voltage (0.2V)} \div \text{Sense resistor (RSET)}$

From the formula above, $I_{OUT} = 5\text{mA}$ when a sense resistor of 40Ω is connected between the ISET and SGND.

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