



SANYO Semiconductors

DATA SHEET

LV8051PL — Bi-CMOS IC For Digital Still Cameras 6-channel 1-chip Motor Driver IC

Overview

The LV8051PL is a digital still camera motor driver that integrates six channels on a single-chip.

Features

- Five PWM drive forward/reverse motor driver channels
- One constant current forward/reverse motor driver channel
- The states of all drivers can be set up over 8-bit serial data transfer
- Ability to set the constant current reference voltage via serial data

Examples of Actuator Applications

| | Shutter | Iris | Focus | Zoom |
|---------------|----------------------|---------------|---------------|---------------|
| Application 1 | Constant current/VCM | Saturated/VCM | Saturated/STM | Saturated/STM |
| Application 2 | Constant current/VCM | Saturated/VCM | Saturated/STM | Saturated/DCM |

Specifications

Absolute Maximum Ratings at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|-------------------------------|---------|--|-------------|------|
| Supply voltage 1 | VM max | | 6 | V |
| Supply voltage 2 | VCC max | | 6 | V |
| Output peak current | IO peak | 1ch/2ch/3ch/4ch/5ch/6ch Pulse width<10ms, Duty ≤20% | 600 | mA |
| Output continuous current | IO max | 1ch/2ch/3ch/4ch/5ch/6ch | 400 | mA |
| Allowable power dissipation 1 | Pd max1 | Independent IC | 0.2 | W |
| Allowable power dissipation 2 | Pd max2 | Mounted on a circuit board* | 1.0 | W |
| Operating temperature | Topr | | -20 to +85 | °C |
| Storage temperature | Tstg | | -55 to +150 | °C |

* Mounted on a specified board: 40mm×50mm×0.8mm, glass epoxy four-layer board.

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Allowable Operating Ranges at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|------------------------|-----------------|------------------------------|---------------------------|------|
| Supply voltage range 1 | VM | | 2.7 to 5.5 | V |
| Supply voltage range 2 | V _{CC} | | 2.7 to 5.5 | V |
| Logic input voltage | V _{IN} | | 0 to V _{CC} +0.3 | V |
| PWM frequency | fPWM | PWM1, PWM2, PWM3, PWM4, PWM5 | Up to 100 | kHz |

Electrical Characteristics at Ta = 25°C, VM = 5V, V_{CC} = 3.3V

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--|-------------------------------|--|---------|-------|-------|------|
| | | | min | typ | max | |
| Standby mode current drain | I _{stn} | ST = low level | | | 1.0 | μA |
| Current drain 1 | I _M | ST= High level, PWM forward drive IN62= High level, No load | | 50 | 100 | μA |
| Current drain 2 | I _{CC} | ST= High level, PWM forward drive IN62= High level, No load | | 1.5 | 2.5 | mA |
| V _{CC} low-voltage cut voltage | V _{thV_{CC}} | | 2.1 | 2.35 | 2.6 | V |
| Low-voltage hysteresis voltage | V _{thHIS} | | 100 | 150 | 200 | mV |
| Thermal shutdown temperature | TSD | Design guarantee* | 150 | 170 | 190 | °C |
| Thermal hysteresis width | ΔTSD | Design guarantee* | 30 | 40 | 50 | °C |
| PWM forward/reverse motor drivers (Channels 1, 2, 3, 4 and 5) | | | | | | |
| Output on-resistance | R _{ou1} | I _O =400mA, upper side on-resistance | | 0.7 | 0.75 | Ω |
| | R _{od1} | I _O =400mA, lower side on-resistance | | 0.5 | 0.6 | Ω |
| Output leakage current | I _{Oleak1} | | | | 1.0 | μA |
| Diode forward voltage | V _{D1} | I _D = -400mA | 0.8 | 1.0 | 1.2 | V |
| Logic pin input current | I _{INL1} | V _{IN} =0V (ST, PWM1, PWM2, PWM3, PWM4, PWM5) | | | 1.0 | μA |
| | I _{INH1} | V _{IN} =3.3V (ST, PWM1, PWM2, PWM3, PWM4, PWM5) | 20 | 33 | 50 | μA |
| Logic input high-level voltage | V _{INH1} | ST, PWM1, PWM2, PWM3, PWM4, PWM5 | 2.5 | | | V |
| Logic input low-level voltage | V _{INL1} | ST, PWM1, PWM2, PWM3, PWM4, PWM5 | | | 1.0 | V |
| Constant current forward/reverse motor driver (channel 6) | | | | | | |
| Output on-resistance | R _{ou2} | I _O =400mA, upper side on-resistance | | 0.7 | 0.75 | Ω |
| | R _{od2} | I _O =400mA, lower side on-resistance | | 0.5 | 0.6 | Ω |
| Output leakage current | I _{Oleak2} | | | | 1.0 | μA |
| Diode forward voltage | V _{D2} | I _D = -400mA | 0.8 | 1.0 | 1.2 | V |
| Logic pin input current | I _{INL2} | V _{IN} =0V(IN61, IN62) | | | 1.0 | μA |
| | I _{INH2} | V _{IN} =3.3V(IN61, IN62) | 20 | 33 | 50 | μA |
| Logic input high-level voltage | V _{INH2} | IN61, IN62 | 2.5 | | | V |
| Logic input low-level voltage | V _{INL2} | IN61, IN62 | | | 1.0 | V |
| Current selection reference voltage | VREF1 | (D6,D5,D4,D3,D2)=(0,0,0,0,0) | 0.190 | 0.200 | 0.210 | V |
| | VREF2 | (D6,D5,D4,D3,D2)=(0,0,0,0,1) | 0.185 | 0.195 | 0.205 | V |
| | VREF3 | (D6,D5,D4,D3,D2)=(0,0,0,1,0) | 0.181 | 0.190 | 0.200 | V |
| | VREF4 | (D6,D5,D4,D3,D2)=(0,0,0,1,1) | 0.176 | 0.185 | 0.194 | V |
| | VREF5 | (D6,D5,D4,D3,D2)=(0,0,1,0,0) | 0.171 | 0.180 | 0.189 | V |
| | VREF6 | (D6,D5,D4,D3,D2)=(0,0,1,0,1) | 0.166 | 0.175 | 0.184 | V |
| | VREF7 | (D6,D5,D4,D3,D2)=(0,0,1,1,0) | 0.162 | 0.170 | 0.179 | V |
| | VREF8 | (D6,D5,D4,D3,D2)=(0,0,1,1,1) | 0.157 | 0.165 | 0.173 | V |
| | VREF9 | (D6,D5,D4,D3,D2)=(0,1,0,0,0) | 0.152 | 0.160 | 0.168 | V |
| | VREF10 | (D6,D5,D4,D3,D2)=(0,1,0,0,1) | 0.147 | 0.155 | 0.163 | V |
| | VREF11 | (D6,D5,D4,D3,D2)=(0,1,0,1,0) | 0.143 | 0.150 | 0.158 | V |
| | VREF12 | (D6,D5,D4,D3,D2)=(0,1,0,1,1) | 0.138 | 0.145 | 0.152 | V |
| | VREF13 | (D6,D5,D4,D3,D2)=(0,1,1,0,0) | 0.133 | 0.140 | 0.147 | V |
| | VREF14 | (D6,D5,D4,D3,D2)=(0,1,1,0,1) | 0.128 | 0.135 | 0.142 | V |
| | VREF15 | (D6,D5,D4,D3,D2)=(0,1,1,1,0) | 0.124 | 0.130 | 0.137 | V |

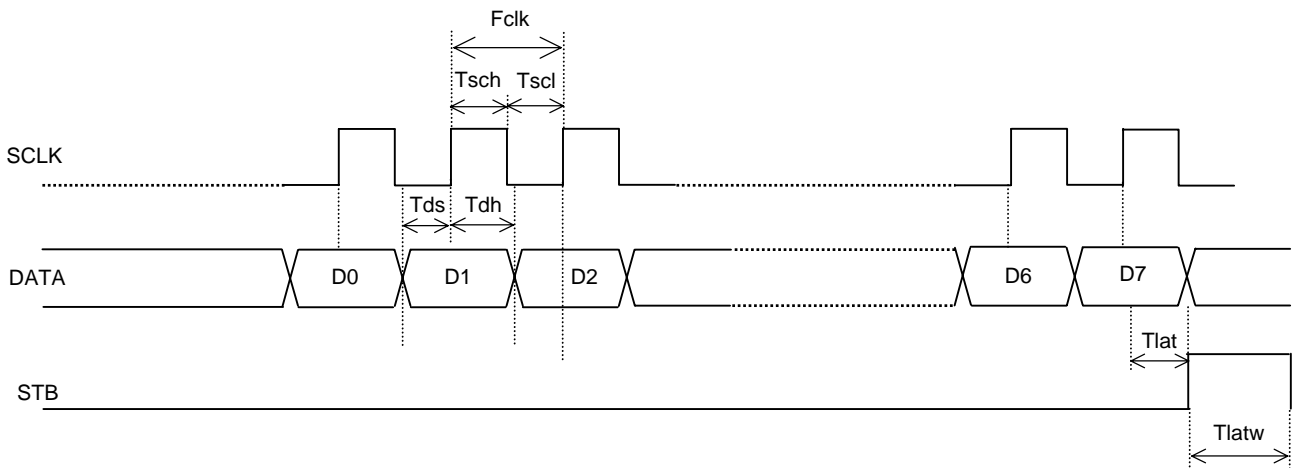
*Design target value. No measurement made.

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| Parameter | Symbol | Conditions | Ratings | | | Unit |
|-------------------------------------|------------------------------|--|---------|-------|-------|------|
| | | | min | typ | max | |
| Current selection reference voltage | VREF16 | (D6,D5,D4,D3,D2)=(0,1,1,1,1) | 0.119 | 0.125 | 0.131 | V |
| | VREF17 | (D6,D5,D4,D3,D2)=(1,0,0,0,0) | 0.114 | 0.120 | 0.126 | V |
| | VREF18 | (D6,D5,D4,D3,D2)=(1,0,0,0,1) | 0.109 | 0.115 | 0.121 | V |
| | VREF19 | (D6,D5,D4,D3,D2)=(1,0,0,1,0) | 0.105 | 0.110 | 0.116 | V |
| | VREF20 | (D6,D5,D4,D3,D2)=(1,0,0,1,1) | 0.100 | 0.105 | 0.110 | V |
| | VREF21 | (D6,D5,D4,D3,D2)=(1,0,1,0,0) | 0.094 | 0.100 | 0.106 | V |
| | VREF22 | (D6,D5,D4,D3,D2)=(1,0,1,0,1) | 0.089 | 0.095 | 0.101 | V |
| | VREF23 | (D6,D5,D4,D3,D2)=(1,0,1,1,0) | 0.084 | 0.090 | 0.096 | V |
| | VREF24 | (D6,D5,D4,D3,D2)=(1,0,1,1,1) | 0.079 | 0.085 | 0.091 | V |
| | VREF25 | (D6,D5,D4,D3,D2)=(1,1,0,0,0) | 0.074 | 0.080 | 0.086 | V |
| | VREF26 | (D6,D5,D4,D3,D2)=(1,1,0,0,1) | 0.069 | 0.075 | 0.081 | V |
| | VREF27 | (D6,D5,D4,D3,D2)=(1,1,0,1,0) | 0.064 | 0.070 | 0.076 | V |
| | VREF28 | (D6,D5,D4,D3,D2)=(1,1,0,1,1) | 0.059 | 0.065 | 0.071 | V |
| | VREF29 | (D6,D5,D4,D3,D2)=(1,1,1,0,0) | 0.054 | 0.060 | 0.066 | V |
| | VREF30 | (D6,D5,D4,D3,D2)=(1,1,1,0,1) | 0.049 | 0.055 | 0.061 | V |
| | VREF31 | (D6,D5,D4,D3,D2)=(1,1,1,1,0) | 0.044 | 0.050 | 0.056 | V |
| VREF32 | (D6,D5,D4,D3,D2)=(1,1,1,1,1) | 0.039 | 0.045 | 0.051 | V | |
| Output constant current | I _{OUT} | R _{load} =3Ω, R _F =0.5Ω, Internal VREF = 0.2V | 380 | 400 | 420 | mA |
| FC6 rapid charge current | I _{rafc6} | | 350 | 500 | 650 | μA |
| FC6 steady-state charge current | I _{chfc6} | | 5 | 10 | 15 | μA |
| FC6 steady-state discharge current | I _{disfc6} | | 5 | 10 | 15 | μA |
| Serial data transfer pins | | | | | | |
| Logic pin input current | I _{INL3} | V _{IN} =0V(SCLK, DATA, STB) | | | 1.0 | μA |
| | I _{INH3} | V _{IN} =3.3V(SCLK, DATA, STB) | 20 | 33 | 50 | μA |
| Logic input high-level voltage | V _{INH3} | SCLK, DATA, STB | 2.5 | | | V |
| Logic input low-level voltage | V _{INL3} | SCLK, DATA, STB | | | 1.0 | V |
| Minimum SCLK high-level pulse width | T _{sch} | | 0.125 | | | μs |
| Minimum SCLK low-level pulse width | T _{scl} | | 0.125 | | | μs |
| STB specified time | T _{lat} | | 0.125 | | | μs |
| Minimum STB pulse width | T _{latw} | | 0.125 | | | μs |
| Data setup time | T _{ds} | | 0.125 | | | μs |
| Data hold time | T _{dh} | | 0.125 | | | μs |
| Maximum SCLK frequency | F _{clk} | | | | 4 | MHz |

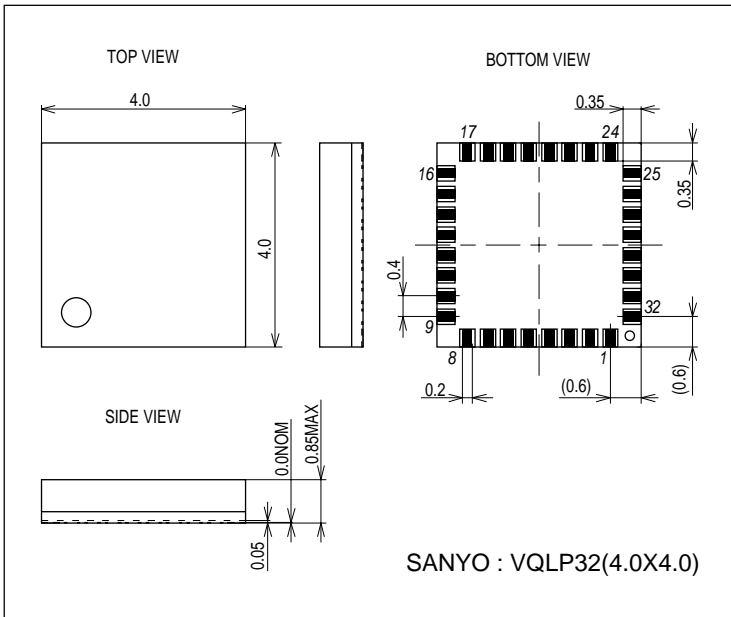


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Package Dimensions

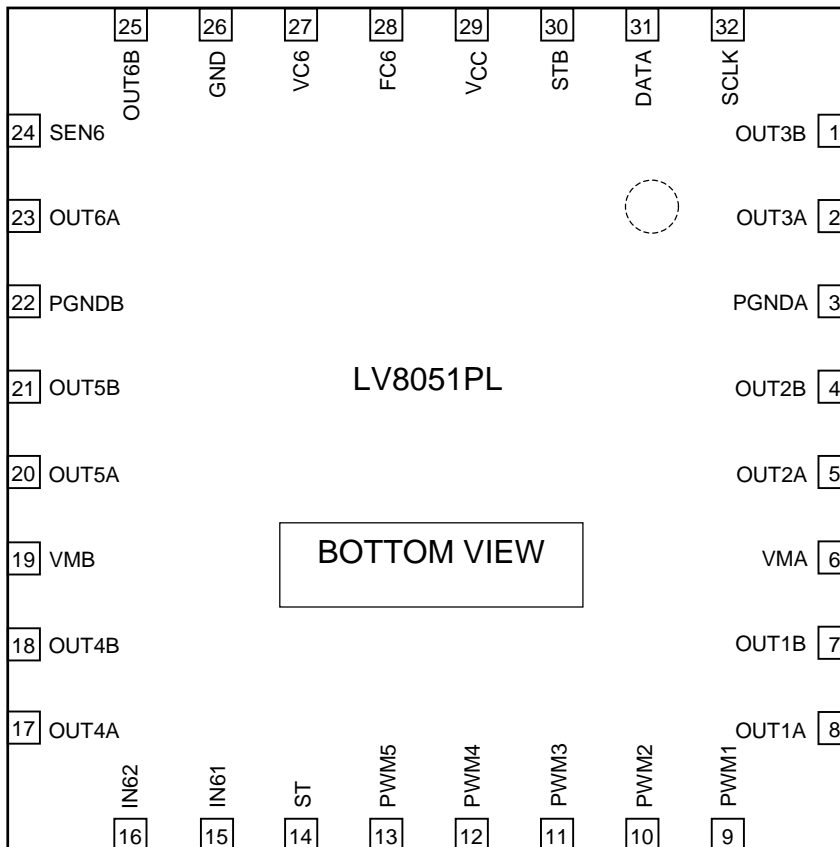
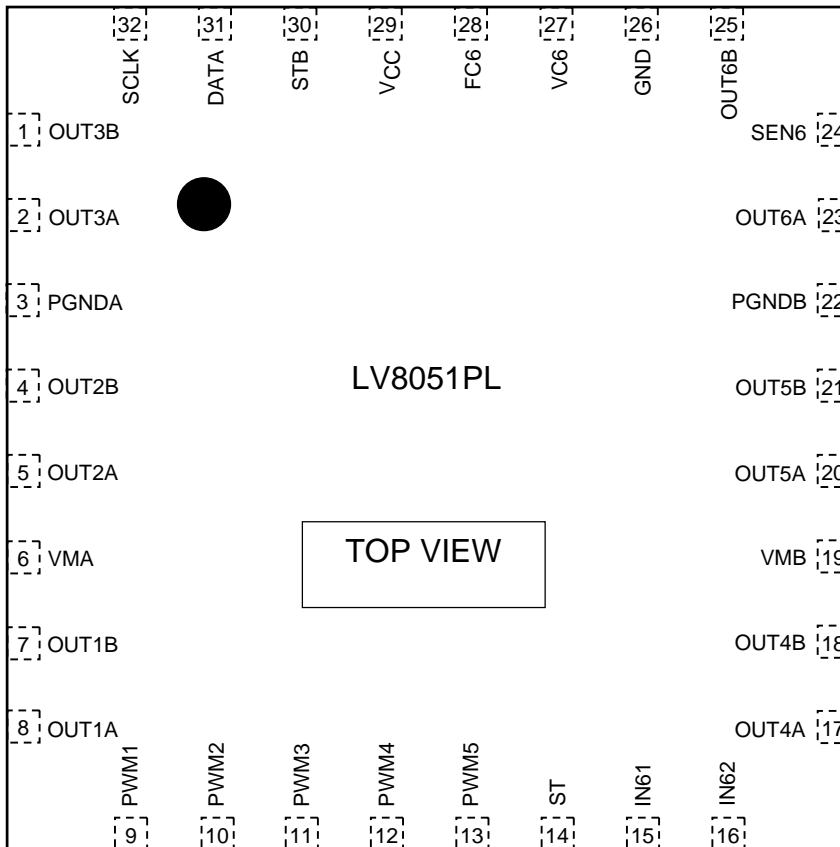
unit : mm (typ)

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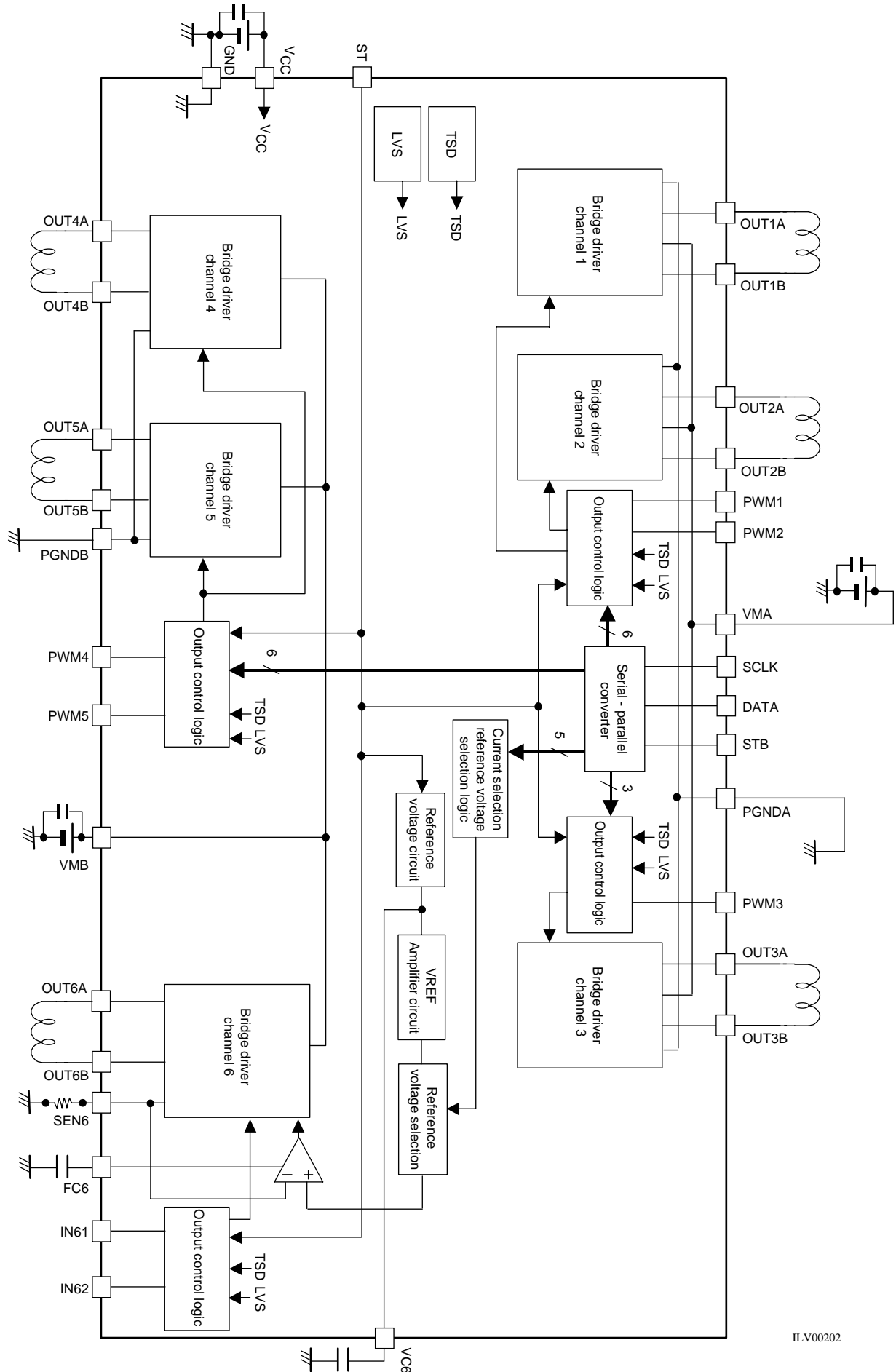


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Pin Assignment / VQLP32



Block Diagram



ILV00202

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Pin Function

| Pin No. | Pin name | Pin function |
|---------|----------|--|
| 6 | VMA | PWM: Channels 1, 2 and 3 motor power supply connection |
| 8 | OUT1A | PWM: Channel 1 OUTA output |
| 7 | OUT1B | PWM: Channel 1 OUTB output |
| 9 | PWM1 | PWM: Channel 1 PWM signal input |
| 5 | OUT2A | PWM: Channel 2 OUTA output |
| 4 | OUT2B | PWM: Channel 2 OUTB output |
| 10 | PWM2 | PWM: Channel 2 PWM signal input |
| 2 | OUT3A | PWM: Channel 3 OUTA output |
| 1 | OUT3B | PWM: Channel 3 OUTB output |
| 11 | PWM3 | PWM: Channel 3 PWM signal input |
| 3 | PGNDA | PWM: Channels 1, 2 and 3 power ground |
| 19 | VMB | PWM: Channels 4, 5 constant current, Channel 6 motor power supply connection |
| 17 | OUT4A | PWM: Channel 4 OUTA output |
| 18 | OUT4B | PWM: Channel 4 OUTB output |
| 12 | PWM4 | PWM: Channel 4 PWM signal input |
| 20 | OUT5A | PWM: Channel 5 OUTA output |
| 21 | OUT5B | PWM: Channel 5 OUTB output |
| 13 | PWM5 | PWM: Channel 5 PWM signal input |
| 22 | PGNDB | PWM: Channels 4, 5 power ground |
| 23 | OUT6A | Constant current drive: Channel 6 OUTA output |
| 25 | OUT6B | Constant current drive: Channel 6 OUTB output |
| 24 | SEN6 | Constant current drive: Channel 6 current sensing resistor connection |
| 15 | IN61 | Constant current drive: Channel 6 logic input pin 1 |
| 16 | IN62 | Constant current drive: Channel 6 logic input pin 2 |
| 28 | FC6 | Constant current drive: Channel 6 phase compensation capacitor connection |
| 27 | VC6 | Constant current drive: Channel 6 start-up correction capacitor connection |
| 32 | SCLK | Serial data transfer clock input |
| 31 | DATA | Serial data input |
| 30 | STB | Serial data latch pulse input |
| 14 | ST | Chip enable |
| 29 | VCC | Logic system power connection |
| 26 | GND | Signal system ground |

Serial Data Input Specifications

Register (D1, D0): Data transfer Address register selections

| D1 | D0 | Mode |
|----|----|--|
| 0 | 0 | PWM Channel 1 and 2 settings |
| 0 | 1 | PWM Channels 3 and 4 settings |
| 1 | 0 | PWM Channel 5 settings |
| 1 | 1 | Constant current channel 6 reference voltage/ PWM mode switch settings |

Select the register for setting the state of each motor driver by setting the serial data (D1, D0) as shown above.

PWM Channel 1 and 2 settings

| Register No. | Data | Symbol | Functions |
|--------------|--------|-------------|--------------------------------|
| D0 | 0 | REG_SELECT1 | Register selection 1 |
| D1 | 0 | REG_SELECT2 | Register selection 2 |
| D2 | 0 or 1 | MODE1 | Channel 1 input mode selection |
| D3 | 0 or 1 | MODE2 | Channel 2 input mode selection |
| D4 | 0 or 1 | IN1A | Channel 1 input a |
| D5 | 0 or 1 | IN1B | Channel 1 input b |
| D6 | 0 or 1 | IN2A | Channel 2 input a |
| D7 | 0 or 1 | IN2B | Channel 2 input b |

PWM Channel 3 and 4 settings

| Register No. | Data | Symbol | Functions |
|--------------|--------|-------------|--------------------------------|
| D0 | 1 | REG_SELECT1 | Register selection 1 |
| D1 | 0 | REG_SELECT2 | Register selection 2 |
| D2 | 0 or 1 | MODE3 | Channel 3 input mode selection |
| D3 | 0 or 1 | MODE4 | Channel 4 input mode selection |
| D4 | 0 or 1 | IN3A | Channel 3 input a |
| D5 | 0 or 1 | IN3B | Channel 3 input b |
| D6 | 0 or 1 | IN4A | Channel 4 input a |
| D7 | 0 or 1 | IN4B | Channel 4 input b |

PWM Channel 5 settings

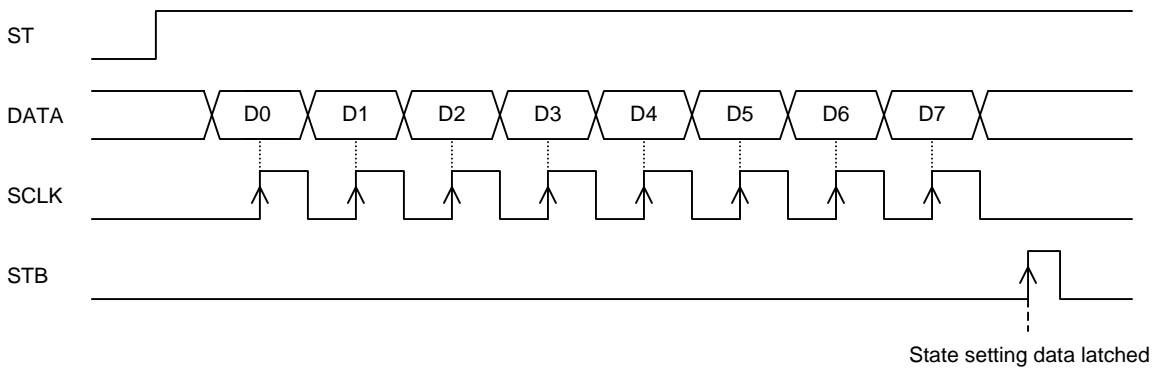
| Register No. | Data | Symbol | Functions |
|--------------|--------|-------------|--------------------------------|
| D0 | 0 | REG_SELECT1 | Register selection 1 |
| D1 | 1 | REG_SELECT2 | Register selection 2 |
| D2 | 0 or 1 | MODE5 | Channel 5 input mode selection |
| D3 | 0 or 1 | (DUMMY) | (Dummy data) |
| D4 | 0 or 1 | IN5A | Channel 5 input a |
| D5 | 0 or 1 | IN5B | Channel 5 input b |
| D6 | 0 or 1 | (DUMMY) | (Dummy data) |
| D7 | 0 or 1 | (DUMMY) | (Dummy data) |

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Constant Current Channel 6 Reference Voltage/ PWM Mode Switch Settings

| Register No. | Data | Symbol | Functions |
|--------------|--------|-------------|---|
| D0 | 1 | REG_SELECT1 | Register selection 1 |
| D1 | 1 | REG_SELECT2 | Register selection 2 |
| D2 | 0 or 1 | VSEN1 | Current control reference voltage selection 1 |
| D3 | 0 or 1 | VSEN2 | Current control reference voltage selection 2 |
| D4 | 0 or 1 | VSEN3 | Current control reference voltage selection 3 |
| D5 | 0 or 1 | VSEN4 | Current control reference voltage selection 4 |
| D6 | 0 or 1 | VSEN5 | Current control reference voltage selection 5 |
| D7 | 0 or 1 | PWMOFF | PWM control mode switch control |

Serial Data Input Settings



Data is input in order from data bit 0 to data bit 7. Data is transferred on the rising edge of the clock signal and after all the data has been transferred, it is latched on the rising edge of the STB signal. The data is reflected in the output simultaneously with the STB signal.

Note: When ST is low level and at the V_{CC} low-voltage cut voltage, all serial data is reset to 0.
(At initialization all register data is set to 0.)

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PWM Drive Forward/Reverse Drivers (Channels 1, 2, 3, 4 and 5)

PWM Control I/O Logic Truth Table

MODE_x= "0", PWMOFF= "0"

| Input | | | Output | | Operating Mode |
|-------|------|------|--------|-------|----------------------------|
| INxA | INxB | PWMx | OUTxA | OUTxB | |
| 0 | 0 | * | OFF | OFF | Standby |
| 0 | 1 | L | L | H | Counterclockwise (reverse) |
| 0 | 1 | H | L | L | Short-circuit braking |
| 1 | 0 | L | H | L | Clockwise (forward) |
| 1 | 0 | H | L | L | Short-circuit braking |
| 1 | 1 | * | L | L | Short-circuit braking |

MODE_x= "0", PWMOFF= "1"

| Input | | | Output | | Operating Mode |
|-------|------|------|--------|-------|----------------------------|
| InxA | InxB | PWMx | OUTxA | OUTxB | |
| 0 | 0 | * | OFF | OFF | Standby |
| 0 | 1 | L | L | H | Counterclockwise (reverse) |
| 0 | 1 | H | OFF | OFF | Standby |
| 1 | 0 | L | H | L | Clockwise (forward) |
| 1 | 0 | H | OFF | OFF | Standby |
| 1 | 1 | * | L | L | Short-circuit braking |

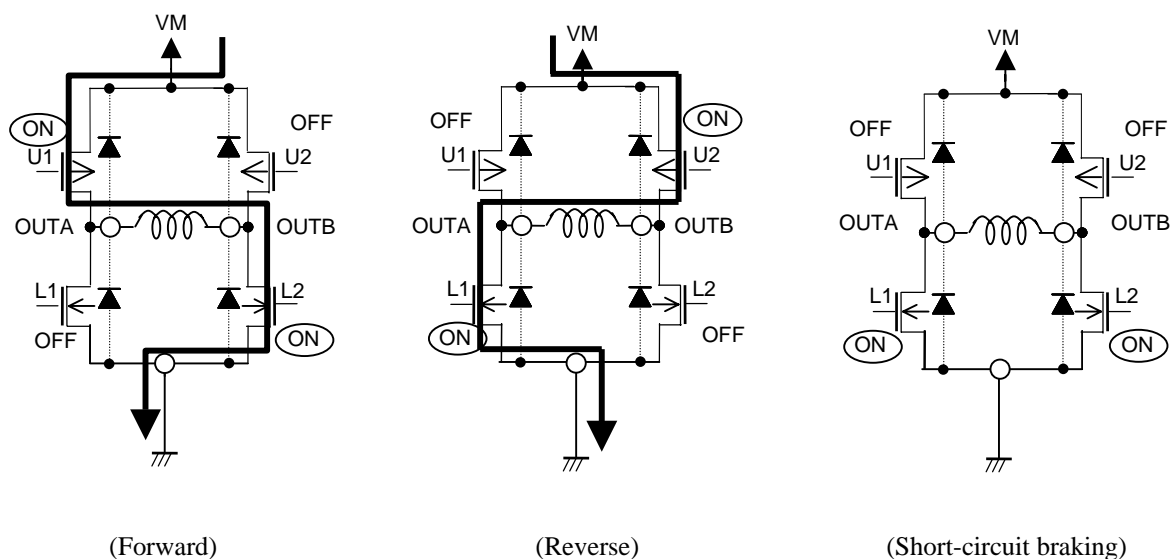
PWMOFF(D7): When in PWM control mode, it is possible to switch among Forward (Reverse) – Braking and Forward (Reverse) – Standby. However, it switches channels 1 through 5 at the same time.

MODE_x= "1", PWMOFF= "*"

| Input | | | Output | | Operating Mode |
|-------|------|------|--------|-------|----------------------------|
| InxA | InxB | PWMx | OUTxA | OUTxB | |
| 0 | * | * | OFF | OFF | Standby |
| 1 | 0 | L | H | L | Clockwise (forward) |
| 1 | 0 | H | L | H | Counterclockwise (reverse) |
| 1 | 1 | * | L | L | Short-circuit braking |

*: Don't care x: Xch

Output stage transistor functions



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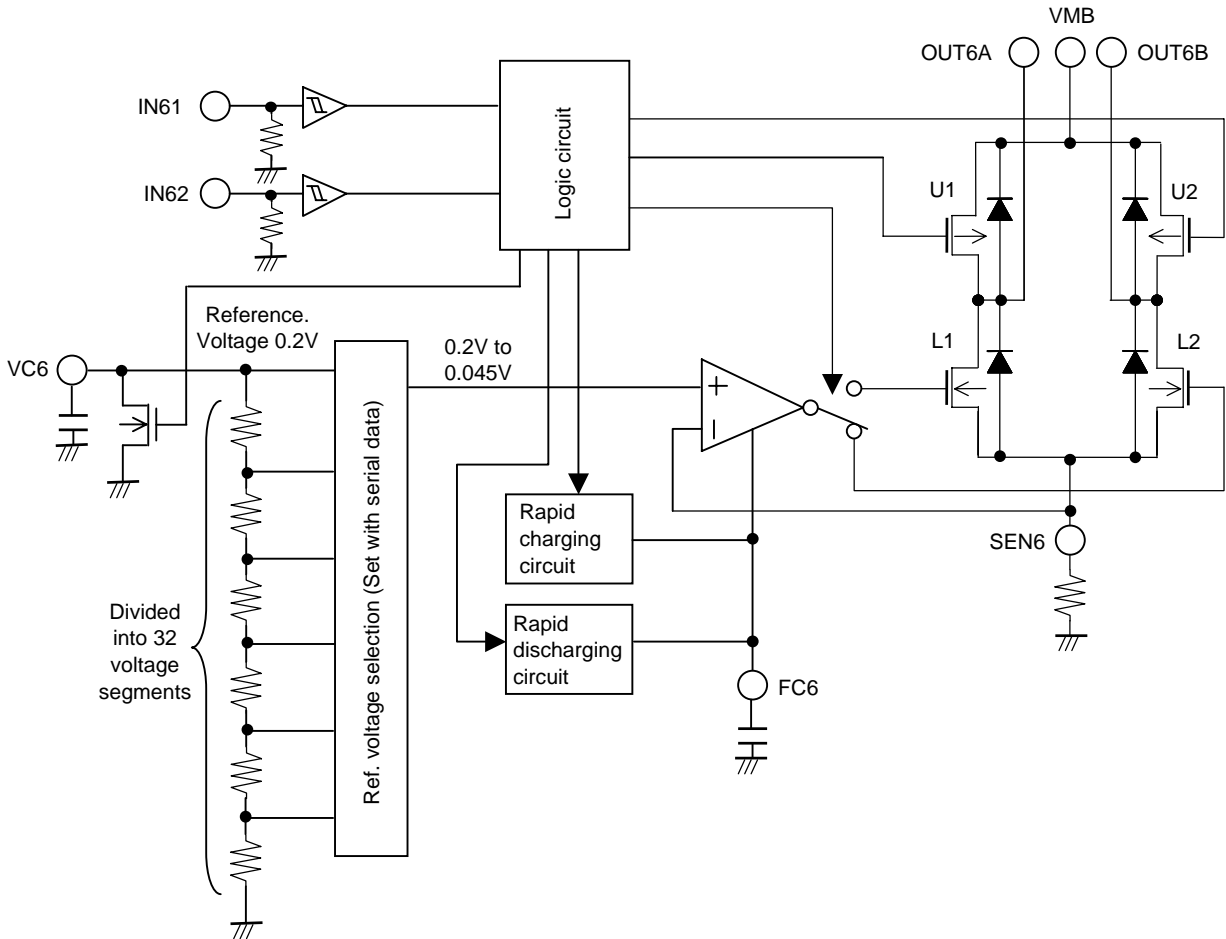
Constant Current Forward/Reverse Motor Driver (Channel 6)

Truth Table

| Input | | Output | | Mode |
|-------|------|--------|-------|----------------------------|
| IN61 | IN62 | OUT6A | OUT6B | |
| L | L | OFF | OFF | Standby |
| L | H | H | L | Clockwise (forward) |
| H | L | L | H | Counterclockwise (reverse) |
| H | H | L | L | Short-circuit braking |

Reference Voltage Settings: 5 bits (D1,D0 = 1,1)

| D6 (VSEN5) | D5 (VSEN4) | D4 (VSEN3) | D3 (VSEN2) | D2 (VSEN1) | Current setting reference voltage |
|---------------|---------------|---------------|---------------|---------------|--------------------------------------|
| 0 | 0 | 0 | 0 | 0 | 0.200V |
| 0 | 0 | 0 | 0 | 1 | 0.195V |
| 0 | 0 | 0 | 1 | 0 | 0.190V |
| 0 | 0 | 0 | 1 | 1 | 0.185V |
| 0 | 0 | 1 | 0 | 0 | 0.180V |
| 0 | 0 | 1 | 0 | 1 | 0.175V |
| 0 | 0 | 1 | 1 | 0 | 0.170V |
| 0 | 0 | 1 | 1 | 1 | 0.165V |
| 0 | 1 | 0 | 0 | 0 | 0.160V |
| 0 | 1 | 0 | 0 | 1 | 0.155V |
| 0 | 1 | 0 | 1 | 0 | 0.150V |
| 0 | 1 | 0 | 1 | 1 | 0.145V |
| 0 | 1 | 1 | 0 | 0 | 0.140V |
| 0 | 1 | 1 | 0 | 1 | 0.135V |
| 0 | 1 | 1 | 1 | 0 | 0.130V |
| 0 | 1 | 1 | 1 | 1 | 0.125V |
| 1 | 0 | 0 | 0 | 0 | 0.120V |
| 1 | 0 | 0 | 0 | 1 | 0.115V |
| 1 | 0 | 0 | 1 | 0 | 0.110V |
| 1 | 0 | 0 | 1 | 1 | 0.105V |
| 1 | 0 | 1 | 0 | 0 | 0.100V |
| 1 | 0 | 1 | 0 | 1 | 0.095V |
| 1 | 0 | 1 | 1 | 0 | 0.090V |
| 1 | 0 | 1 | 1 | 1 | 0.085V |
| 1 | 1 | 0 | 0 | 0 | 0.080V |
| 1 | 1 | 0 | 0 | 1 | 0.075V |
| 1 | 1 | 0 | 1 | 0 | 0.070V |
| 1 | 1 | 0 | 1 | 1 | 0.065V |
| 1 | 1 | 1 | 0 | 0 | 0.060V |
| 1 | 1 | 1 | 0 | 1 | 0.055V |
| 1 | 1 | 1 | 1 | 0 | 0.050V |
| 1 | 1 | 1 | 1 | 1 | 0.045V |



Start-up correction function (VC6)

A capacitor is connected to terminal VC6 and by controlling the rate at which the reference voltage rises, it corrects the start-up waveform of the coil. By doing this, stable shutter operation can be carried out with respect to the power supply variations.

For the start-up correction, check the coil current start-up wave for the VM reduced voltage when there is no VC6 capacitor and choose a capacitor so that the decay time constant is lower than this wave.

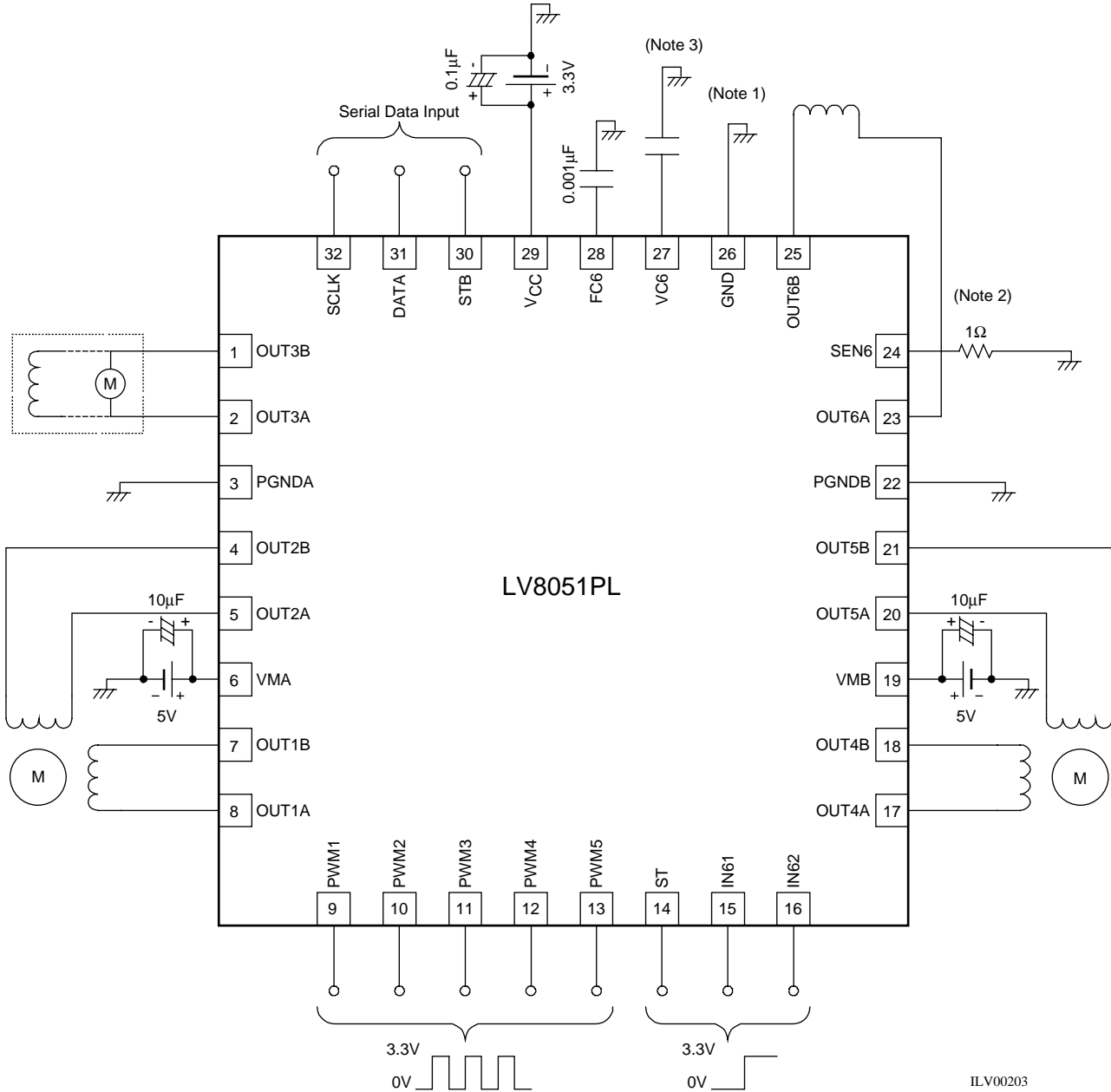
However, when power supply voltage is stable or the start-up correction function is not required, the start-up correction capacitor is not necessary.

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Recommended Application Circuit

The value at each pixel is a recommended value. Check the allowable operation range described previously for the values of each input condition.

- 1ch/2ch STM
- 3ch DCM/VCM
- 4ch/5ch STM
- 6ch VCM



Note 1: We recommend one-point grounding wherever possible.

Note 2: A 1Ω resistor is connected to the SEN6 pin. This gives an output current of 200mA when the reference voltage is set to 0.2V.

Note 3: The VC6 capacitor is optional. This pin must be held open when the capacitor is not to be used.

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