

Product Preview

Single Low Side Driver with  
Integrated Freewheeling Diode  
and Output dv/dt & di/dt Control

The Short-circuit Protected Low Side Driver will be used for PWM switchmode current control of an inductive load.

If one or both of the two inputs (Reset or PWM) switch at the low level input voltage, the output transistor will be turned off. Only if both inputs are at the high level input voltage, the output will be turned on. Reset and PWM inputs have Schmitt-Trigger input characteristics.

To protect the device and a possible external shunt for current measurements against short-circuit to positive battery voltage, the on-state output current is limited to a maximum value of 7 A.

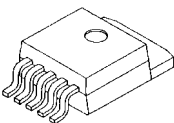
The output driver will be switched off if the junction temperature exceeds its maximum value. This thermal shutdown is monitored by an hysteresis. In order to reduce RFI, the output voltage and supply current rise and fall times are limited.

At a Vs voltage lower than approximately 6V, the driver will be switched off by the undervoltage shutdown circuit. Down to this voltage the driver will work correctly.

MC33185

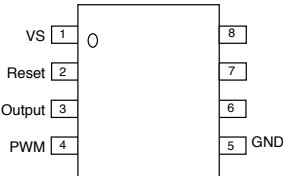
SINGLE LOW SIDE  
DRIVER

SILICON MONOLITHIC  
INTEGRATED CIRCUIT



D<sup>2</sup>PAK

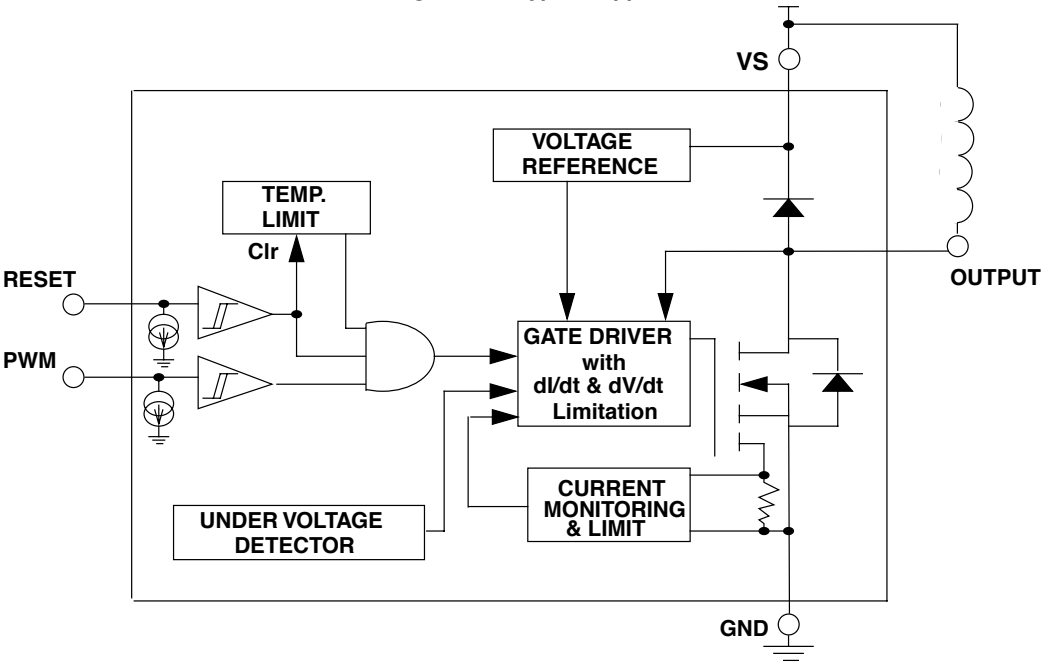
PIN ASSIGNMENT



ORDERING INFORMATION

| Device     | Temperature Range | Package            |
|------------|-------------------|--------------------|
| MC33185D2T | - 40°C to +125°C  | D <sup>2</sup> PAK |

Block Diagram and Typical Application



**MAXIMUM RATINGS** T<sub>c</sub> = - 40 to 125°C unless otherwise noted.

| Ratings | Symbol | Value | Unit |
|---------|--------|-------|------|
|---------|--------|-------|------|

**ELECTRICAL RATINGS**

|  |                                       |                              |   |
|--|---------------------------------------|------------------------------|---|
| Supply Voltage   | V <sub>s-Gnd</sub>                    |                              | V |
| DC Voltage   |                                       | 40                           | V |
| Transient Voltage (400ms, no repetitive, no operation) | Note1                                 | - 2 to 40                    | V |
| Output Voltage   | Q-Gnd                                 |                              | V |
| DC Voltage   |                                       | - 0,5 to V <sub>s</sub> +1,5 | V |
| Transient (Schaffner Pulses). Note 1b                  |                                       |                              | V |
| Output Current (internally protected)                  |                                       |                              |   |
| Freewheeling Diode Reverse Voltage (Q = GND)           | V <sub>S-Q</sub>                      |                              | V |
| DC Voltage   |                                       | 40                           | V |
| Transient (Schaffner Pulses). Note 1a, 1b              |                                       |                              |   |
| Freewheeling Diode Forward Current                     |                                       |                              |   |
| DC Current   | V <sub>ffw</sub>                      | 1,7                          | A |
| Transient (200ms)                                      | V <sub>ffwtr</sub>                    | 3,3                          | A |
| Peak (10μs)  | V <sub>ffwpk</sub>                    | 10                           | A |
| MOS Body Diode Forward Current                         |                                       |                              | A |
| DC Current   | I <sub>bd</sub>                       | 1,7                          | A |
| Peak (10μs)  | I <sub>bdpk</sub>                     | 10                           | A |
| Input Voltages (Reset & PWM pins)                      | V <sub>reset</sub> & V <sub>pwm</sub> | - 0,3 to 6                   | V |
| ESD Voltage Capability. Note 2                         | V <sub>esd</sub>                      | 2000                         | V |

**THERMAL RATINGS**

|   |                   |             |      |
|---|-------------------|-------------|------|
| Storage Temperature   | T <sub>stg</sub>  | - 55 to 175 | °C   |
| Operating Junction Temperature                                | T <sub>j</sub>    | - 40 to 150 | °C   |
| Power Dissipation @T <sub>c</sub> = 110°C                     | P <sub>d</sub>    | 13          | W    |
| Thermal Resistance Junction to Case                           | R <sub>thJC</sub> | 3           | °C/W |
| Thermal Resistance Junction to Ambient                        | R <sub>thJA</sub> | 65          | °C/W |
| Maximum Lead Temperature for Soldering 1/8" from case for 5s. | T <sub>L</sub>    | 275         | °C   |

**ELECTRICAL CHARACTERISTICS.** 7V ≤ Vs ≤ 24V, -40°C ≤ Tj ≤ 150°C unless otherwise specified.

| Parameters | Symbol | Min | Typ | Max | Unit |
|------------|--------|-----|-----|-----|------|
|------------|--------|-----|-----|-----|------|

**VS PIN 1**

|   |      |     |  |         |        |
|---|------|-----|--|---------|--------|
| Supply Voltage<br>Operating Maximum. Note 3<br>Turn On Threshold (fully functional) | Vs   |     |  | 24<br>7 | V<br>V |
| Quiescent Vs Supply Current (Vs = Q = 12V, IN1 & IN2 = L)                           | Isby | 1   |  | 5       | mA     |
| Undervoltage Detection. Note 7  |      | 5,5 |  | 6,9     | V      |

**RESET PIN 2**

|  |                   |                     |  |                |                |
|--|-------------------|---------------------|--|----------------|----------------|
| Input Current<br>High level (7,0V ≤ Vs ≤ 40,0V)<br>High level (- 2V ≤ Vs ≤ 40,0V)<br>Low level (- 2V ≤ Vs ≤ 40,0V) | lih<br>lih<br>lil | 5,0<br>- 10<br>- 10 |  | 10<br>10<br>10 | μA<br>μA<br>μA |
|--|-------------------|---------------------|--|----------------|----------------|

**OUTPUT PIN 3**

|  |              |     |      |                         |                   |
|--|--------------|-----|------|-------------------------|-------------------|
| Drain to Source On Resistance. Note 4<br>(with IN1 & IN2 = H, Active High)<br>Iout = 1,5A & Vs ≥ 10,0V<br>Iout = 1,5A & 7,0V ≤ Vbat < 10,0V<br>Tj = 25°C, Iout = 1,5A & Vbat = 12V | Rdson        |     |      | 0,450<br>0,500<br>0,250 | Ohm<br>Ohm<br>Ohm |
| Off State MOS Output Leakage Current<br>Vs = Q = 40V, IN1 & IN2 = L  | Voutlk       |     |      | 1                       | mA                |
| Forward Voltage of MOS Body Diode<br>VF @ If = 1,7A. Note 5  | Vfbd         |     |      | 2                       | V                 |
| Switchmode Output Current<br>Continuous<br>Transient (200ms, Tc = 125°C)   | Isw<br>Iswpk |     |      | 1,7<br>3,3              | A<br>A            |
| Short-Circuit Current Limit. Note 6  | Isc          | 3,5 | 5,25 | 7                       | A                 |
| Overtemperature Shutdown<br>Overtemperature Hysteresis. Note 8   | Tlim<br>Thys | 155 | 20   |                         | °C<br>°C          |

**PWM PIN 4**

|  |                        |                     |   |                |                |
|--|------------------------|---------------------|---|----------------|----------------|
| Input (CMOS Compatible)<br>Output On Threshold<br>Output Off Threshold<br>Input Hysteresis Voltage                 | Vion<br>Vioff<br>Vihys | 2.0<br>1.0          | 1 | 3.0<br>2.0     | V<br>V<br>V    |
| Input Current<br>High level (7,0V ≤ Vs ≤ 40,0V)<br>High level (- 2V ≤ Vs ≤ 40,0V)<br>Low level (- 2V ≤ Vs ≤ 40,0V) | lih<br>lih<br>lil      | 5,0<br>- 10<br>- 10 |   | 10<br>10<br>10 | μA<br>μA<br>μA |

**FREEWHEELING DIODE CHARACTERISTICS** 7V ≤ Vs ≤ 24V, -40°C ≤ Tj ≤ 150°C unless otherwise noted

|  |       |  |  |            |        |
|--|-------|--|--|------------|--------|
| Forward Voltage<br>Tj = 25°C, If = 1,7A<br>Tj = 125°C, If = 1,7A               |       |  |  | 1,5<br>1,3 | V<br>V |
| Reverse Leakage Current<br>(Vs = Vq = 40V)                                     | Ifwlk |  |  | 500        | μA     |
| Leakage Current from Vs-GND Vs = 40V<br>during Freewheeling. Note 9, If = 1,7A |       |  |  | 22         | μA     |

# MC33185

**ELECTRICAL CHARACTERISTICS.** 7V ≤ Vs ≤ 24V, -40°C ≤ Tj ≤ 150°C unless otherwise specified.

| Parameters | Symbol | Min | Typ | Max | Unit |
|------------|--------|-----|-----|-----|------|
|------------|--------|-----|-----|-----|------|

**TIMING CHARACTERISTICS** 7V ≤ Vs ≤ 24V, -40°C ≤ Tj ≤ 150°C unless otherwise specified.

|  |                            |           |  |           |               |
|--|----------------------------|-----------|--|-----------|---------------|
| Turn On Delay  | tdl on                     |           |  | 10        | μs            |
| Turn Off Delay   | tdl off                    |           |  | 10        | μs            |
| Rise Time. Note 10<br>Output Voltage Slope<br>Output Current Slope | (dVout/dt)r<br>(dIout/dt)r | 2,5<br>50 |  | 10<br>100 | V/μs<br>mA/μs |
| Fall Time. Note 10<br>Output Voltage Slope<br>Output Current Slope | (dVout/dt)f<br>(dIout/dt)f | 2,5<br>50 |  | 10<br>100 | V/μs<br>V/μs  |

NOTES 1a : Schaffner test, see figure 3, Pulses 1, 2, 3a, 3b, 5, 6.

NOTES 1b : Schaffner test, see figure 4, Pulses 1, 2, 3a, 3b, 5, 6.

NOTES 2 : Equivalent human body model R = 1,5KΩ ; C = 200pF.

NOTES 3 : The normal operating voltage range is 7V ≤ Vs ≤ 24V. Between 24V and 40V the output stage will follow the state defined by the inputs, but the electrical characteristics are not totally specified.

NOTES 4 : Pulse tested, tp ≤ 300μs, D ≤ 2%.

NOTES 5 : The inherent body diode (source to drain) of the output FET will conduct current if the output pin is pulled below ground.

NOTES 6 : Linear short-circuit current regulation. When the overcurrent lasts enough time to raise the junction temperature, thermal shutdown will react as described in note 8.

NOTES 7 : The driver works correctly down to the shutdown voltage. Below the shutdown voltage, the driver is off.

NOTES 8 : The output driver will be switched off if the junction temperature exceeds its maximum value. This thermal shutdown works with an hysteresis, with a self reset.

NOTES 9 : This is the current measured on GND when the device is in freewheeling. It consists in the supply current for the logic (5mA max) plus the leakage current flowing from Vs to GND. The leakage current is specified to be less than 1% of the nominal freewheeling forward current.

NOTES10 : In order to reduce RFI, the output voltage and supply current rise and fall times are limited.

| Pin | Name   | Description   |
|-----|--------|---|
| 1   | Vs     | The Vs pin supplies operational power to the MC33185.   |
| 2   | Reset  | This pin controls the turn OFF of output.   |
| 3   | Output | This pin is internally connected to the DMOS output transistor which source current into the corresponding load. The output incorporates dynamic clamping to accommodate inductive load. In order to reduce RFI, the output voltage and supply current rise and fall times are limited (see figure below). In addition, the output has an overcurrent detection and current limiting. |
| 4   | PWM    | This pin controls the turn ON and turn OFF of output when reset pin is at high level. It is a CMOS input.   |
| 5   | GND    | This pin is the circuit ground.   |

Figure 1. Timing Diagram

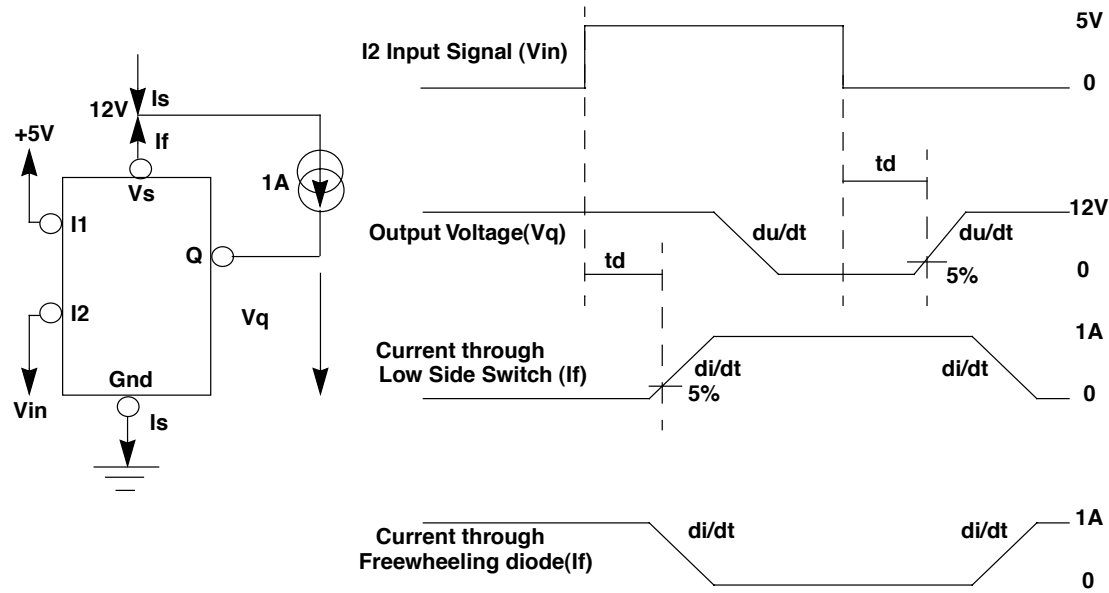



Figure 1: The minimum value is due to the fact that the product should not dissipate too much during transition.

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