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# 1 Introduction

This document is intended to give a description of how to calculate the power dissipation of the chip if an external regulator transistor is connected to pin VDD5V or if the internal regulator transistor is used.

# 2 Schematics of example Applications

All following schematics are sample schematics, which need to be adjusted depending on the application.

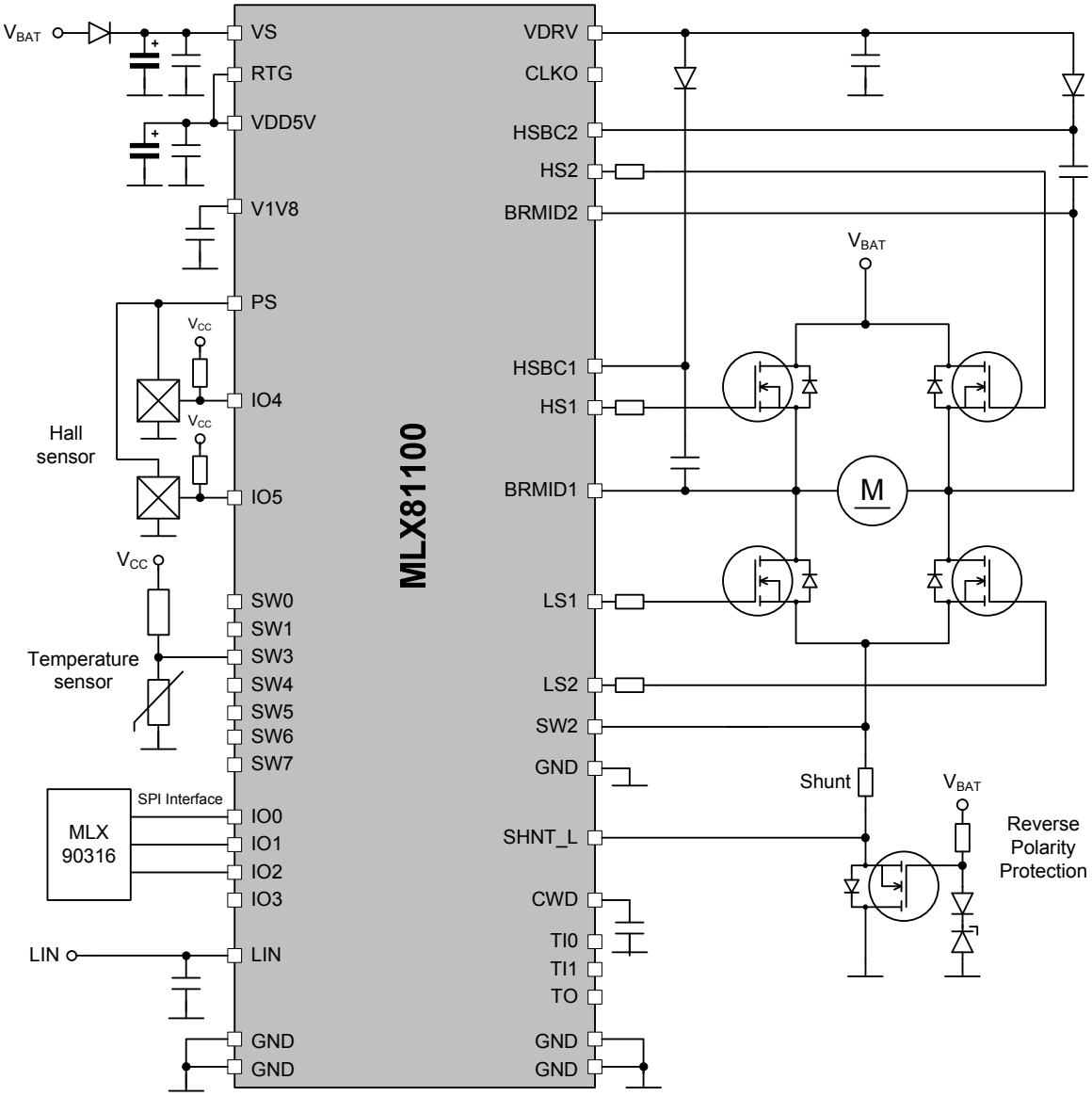


Fig. 1 Sample application circuitry for DC-motor control using internal VDD5V voltage regulator

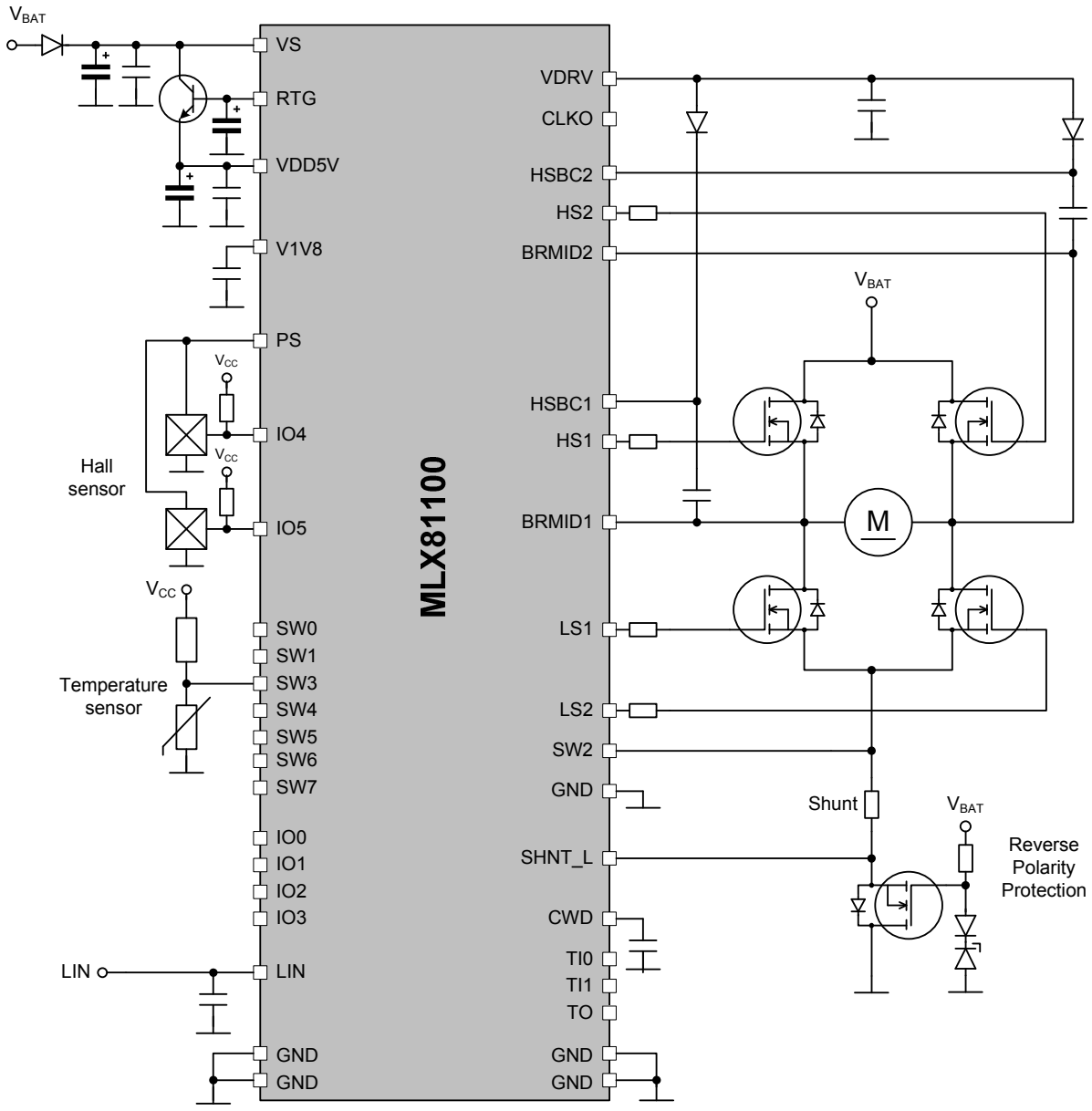


Fig. 2 Sample application circuitry for higher VCC loads and higher ambient temperatures

## 3 Calculation

The real power dissipation has to be calculated by the user depending on the user's application.

Main points where power dissipation can be saved are:

1 using an external regulator transistor -> $P_{reg} = 0$

2 consider DC-load at pins carefully.

$$P = U * I$$

$$P = P_{VS_I} + P_{chip} + P_{reg} + P_{LS_X}$$

$$P = (V_{S_I} * I_{VS_I}) + (I_{VDD5V} * VDD5V) + (I_{VDD5V}(V_{S_I} - VDD5V)) + (I_{PU}{}^2 * R_{DSon})$$

If an external regulator transistor is used $P_{reg} = I_{VDD5V}(V_{S_I} - VDD5V) = 0$.

$P = (V_{S_I} * I_{VS_I}) + (I_{VDD5V} * VDD5V) + (I_{VDD5V}(V_{S_I} - VDD5V))$ is the basic power dissipation in all applications when no DC-load is present at any of the pins and internal regulator transistor is used.

Case 1:

- internal voltage regulator transistor is used
- no DC-load at pins
- $I_{VS_I} = 0$
- $I_{PU} = 0$

$$P = (V_{S_I} * I_{VS_I}) + (I_{VDD5V} * VDD5V) + (I_{VDD5V}(V_{S_I} - VDD5V)) + (I_{PU}{}^2 * R_{DSon})$$

$$P = (I_{VDD5V} * VDD5V) + (I_{VDD5V}(V_{S_I} - VDD5V))$$

$$P = (30mA * 5V) + (30mA(18V - 5V))$$

$$\underline{\underline{P = 540mW}}$$

$$\Delta\vartheta = R_{th} * P$$

$$\Delta\vartheta = 40\frac{K}{W} * 0{,}54W$$

$$\underline{\underline{\Delta\vartheta = 21{,}6K}}$$

Case 2:

- external voltage regulator transistor is used
- no DC-load at pins
- $I_{VS_I} = 0$
- $I_{PU} = 0$

$$P = (V_{S_I} * I_{VS_I}) + (I_{VDD5V} * VDD5V) + (I_{VDD5V}(V_{S_I} - VDD5V)) + (I_{PU}{}^2 * R_{DSon})$$
$$P = (I_{VDD5V} * VDD5V) + (I_{VDD5V}(V_{S_I} - VDD5V))$$
$$P = (30mA * 5V) + 0$$
$$\underline{\underline{P = 150mW}}$$

$$\Delta\vartheta = R_{th} * P$$
$$\Delta\vartheta = 40\frac{K}{W} * 0{,}15W$$
$$\underline{\underline{\Delta\vartheta = 6K}}$$

Any additional DC-load at pins will be added to $P$ the power dissipation of the chip, e.g. pull-up resistors etc. depending on their internal used voltage they cause load to VDD5V or VS.

$$I_{VS} = I_{VDD5V} + I_{VS_I} + I_{PU}$$
$$I_{VS_I} = I_{PS} + I_{VDRV} + I_{SW} + I_{PSclamp}$$

Explanation of the symbols and indexes:

| | |
|---|---|
| $I_{VS} =$ | current flowing through reverse polarity diode, the sum of all currents flowing through the chip and through possible external regulator transistor. |
| $I_{VS_I} =$ | current flowing inside the chip at pin VS. |
| $I_{VDD5V} =$ | current flowing into pin VDD5V. |
| $I_{PS} =$ | current flowing through devices connected to pin PS. |
| $I_{VDRV} =$ | current flowing while driving bridge drivers with PWM, mainly the current needed for charge/discharge of the gate capacities. |
| $I_{SW} =$ | current flowing through the pull-up/-down current sources connected to the SW-pins ( max value 4mA). |
| $I_{PU} =$ | current flowing through low side drivers when a pull-up resistor is connected to these pins. |
| $I_{PSclamp} =$ | current flowing through chip-internal clamping diode when $V_S > V_{PSclamp}$ . |

All terms using the index $VS_I$ are related to chip internal voltage VS.

| | |
|---|---|
| $V_{S_I} =$ | chip internal voltage VS. |
| $VDD5V =$ | 5V supply system voltage. |
| $VS =$ | supply voltage. |
| $PS =$ | switchable supply voltage. |
| $PS_{clamp} =$ | clamped switchable supply voltage. |
| $P =$ | power dissipation caused by the chip. |
| $P_{VS_I} =$ | power dissipation caused by any load attached to chip internal power line VS. |
| $P_{chip} =$ | power dissipation caused by the MelexCM chip and any circuit connected to VDD5V. |
| $P_{reg} =$ | power dissipation caused by VDD5V voltage regulator. |
| $P_{LS_X} =$ | power dissipation caused by low side drivers when a pull-up resistor is connected to these pins and the drivers force current down to GND. |

The following schematic is a sample schematic, which needs to be adjusted depending on the application.

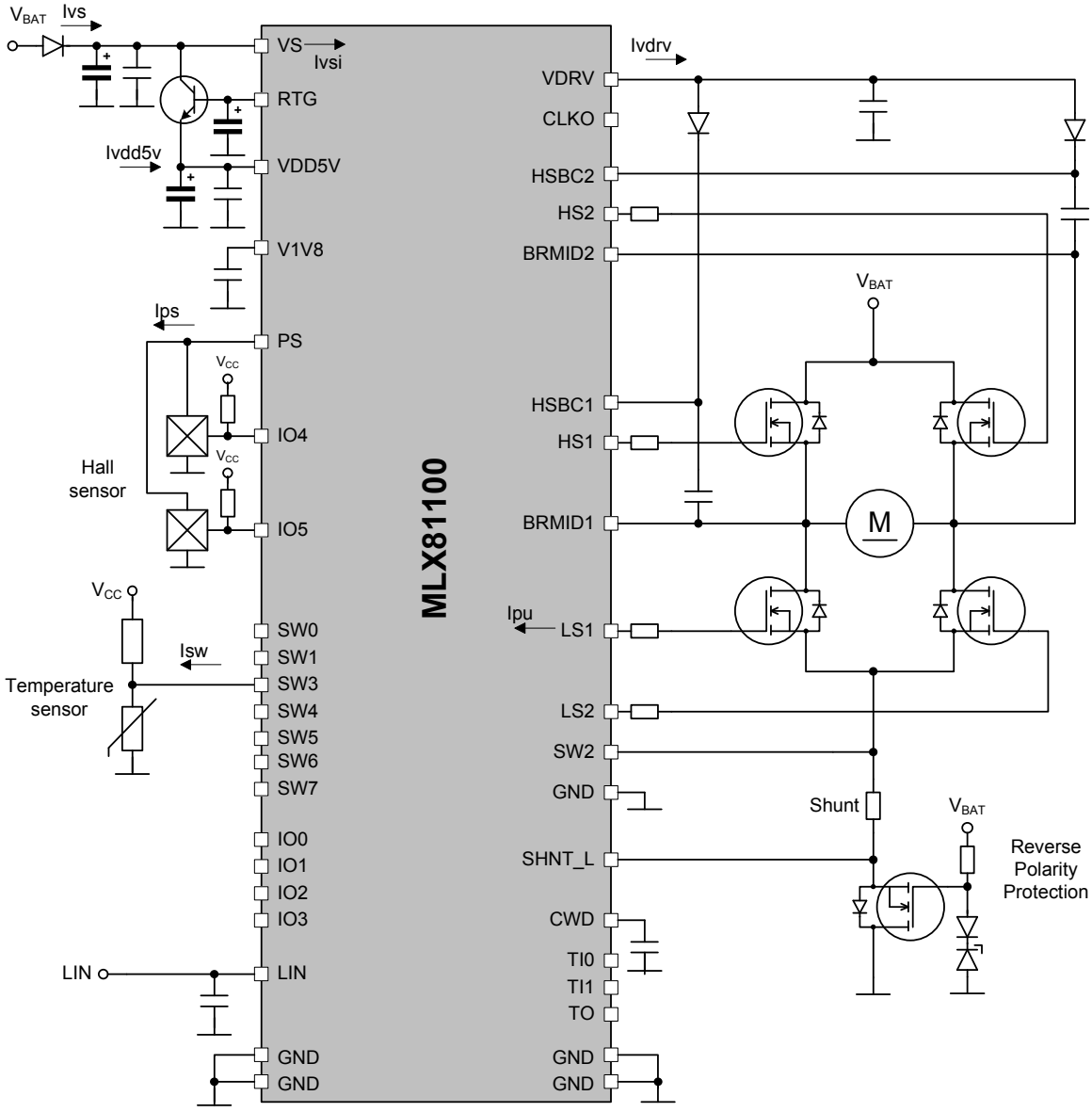


Fig. 3 Sample application circuitry including current indicators

## History record

| Rev. | No. | Change | Date |
|---|---|---|---|
| 1.0 | 1 | Creation | 16/03/07 |

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