AND9736/D

The Best Practices for the EMC Susceptibility

NCV7693 LED Controller

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APPLICATION NOTE

INTRODUCTION AND DOCUMENT SCOPE

The goal of this document is to provide guidelines for the use of external components on the IOx line of the NCV7693 driver chip to achieve the best EMC performance.

The NCV7693 can be used in different applications with different possible configurations.

Based on used configuration the results and subsequently the proposed solution to increase robustness differs.

The EMC susceptibility was evaluated by use of DPI (Direct Power Injection) method according to IEC62132 part 4.

OBSERVATION

A long IOx wiring behaves like an antenna. The following guidelines describe how to limit the coupled EMC power and avoid possible system malfunction.

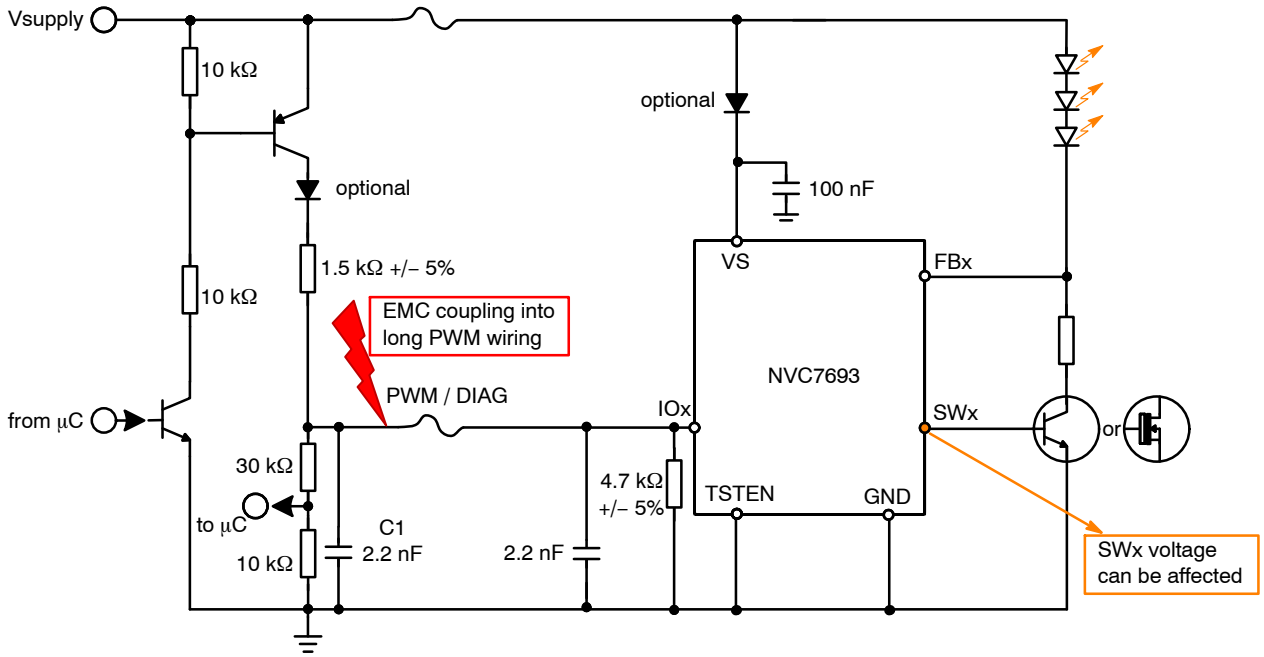

Figure 1. Application Diagram without R−C Filter

The EMC sensitivity on the IOx pins can be observed. As indicated in Figure 2, the SWx voltage can be increased during EMC exposure in frequency band 400 - 1000 MHz

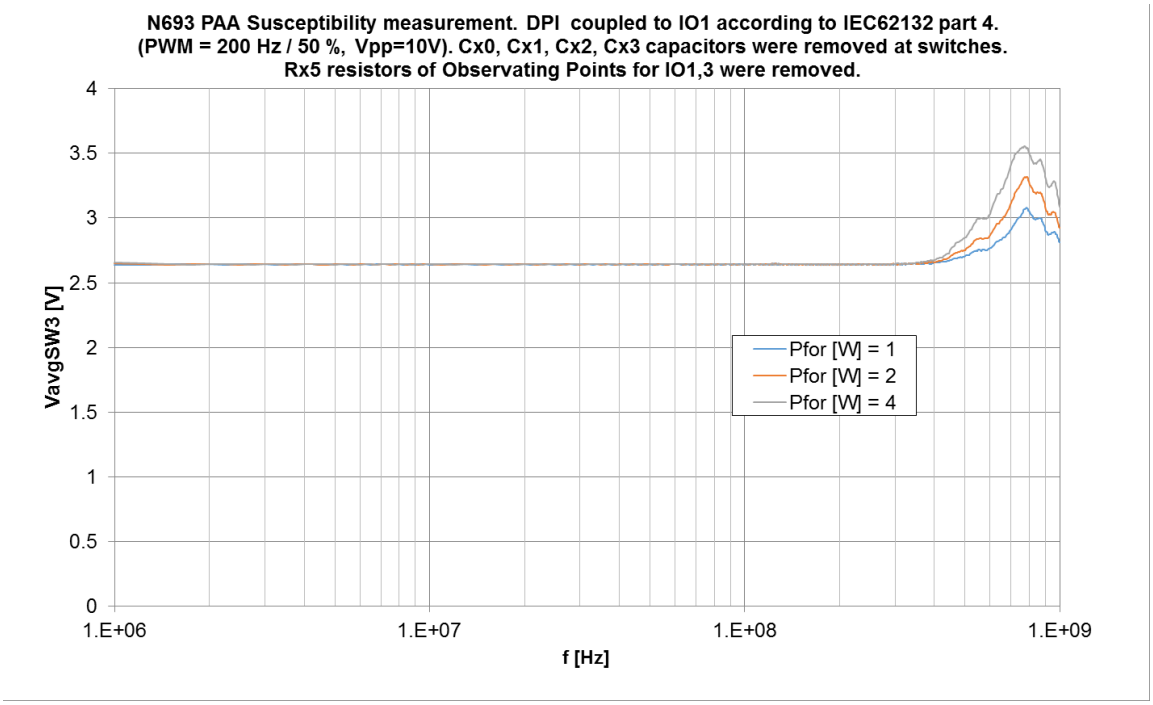

Figure 2. Increase of the SWx Signal under 1/2/4 W EMC Power [50% duty cycle; VS = 14 V]

To reduce this effect of SWx voltage increase it is highly recommended to use an external RC filter on the IOx pins as it is described in Figure 3. With this filter the output LED current is under control.

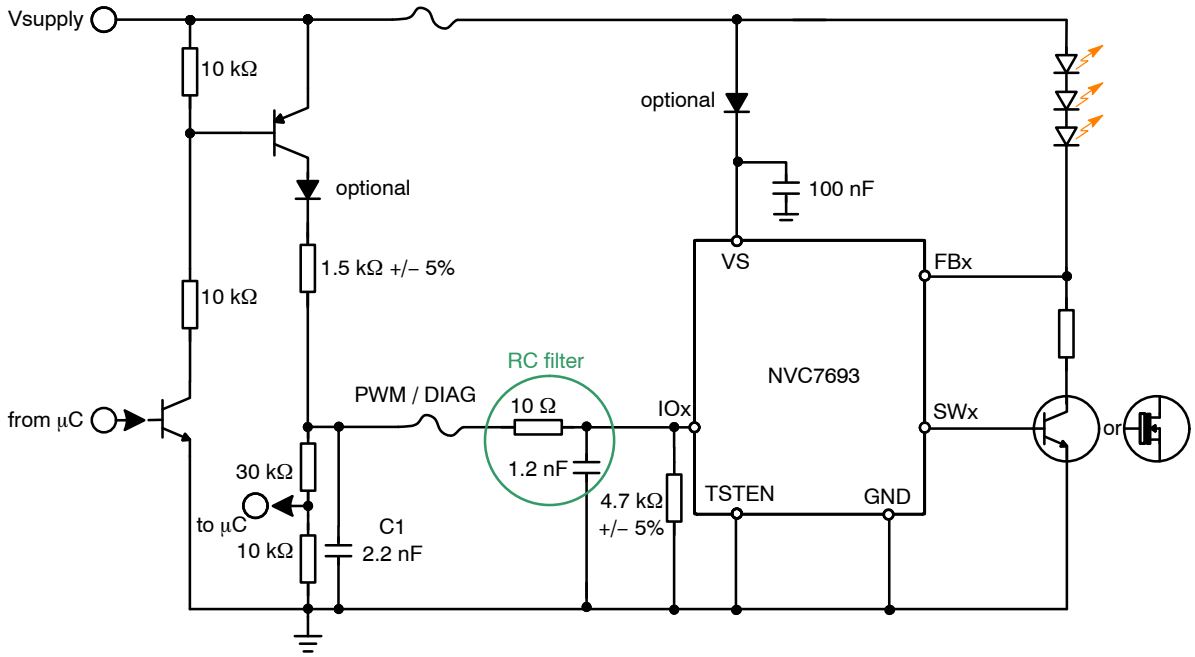

Figure 3. Application Diagram without RC Filter

TEST RESULTS

In chapters Configuration with External Bipolar Transistors and Configuration with External MOS Transistors are EMC results with proper placing of the external filters. (Should be placed as close as possible to the IOx pins, more info in chapter PCB Design Improvements) The RC filter values are 10 Ω and 1.2 nF.

Two search loops were applied to find out the maximum forward EMC power which can be applied to the IOx pins while the parameters will remain in the following tolerances:

- Pfor for Consumption Test
- Pfor for Mask test result

The maximum allowed tolerance for the consumption test is ±10% from the nominal current.

The Mask Test method observes the waveforms of the SWx signals on the oscilloscope and passes the result if the deviation from the typical waveform is less than ±10% (less than ±0.52 V and ±167 μs).

Configuration with External Bipolar Transistors

The SWx voltage and the I_{LED} current are passing EMC testing with no weakness observed (See Figure 4).

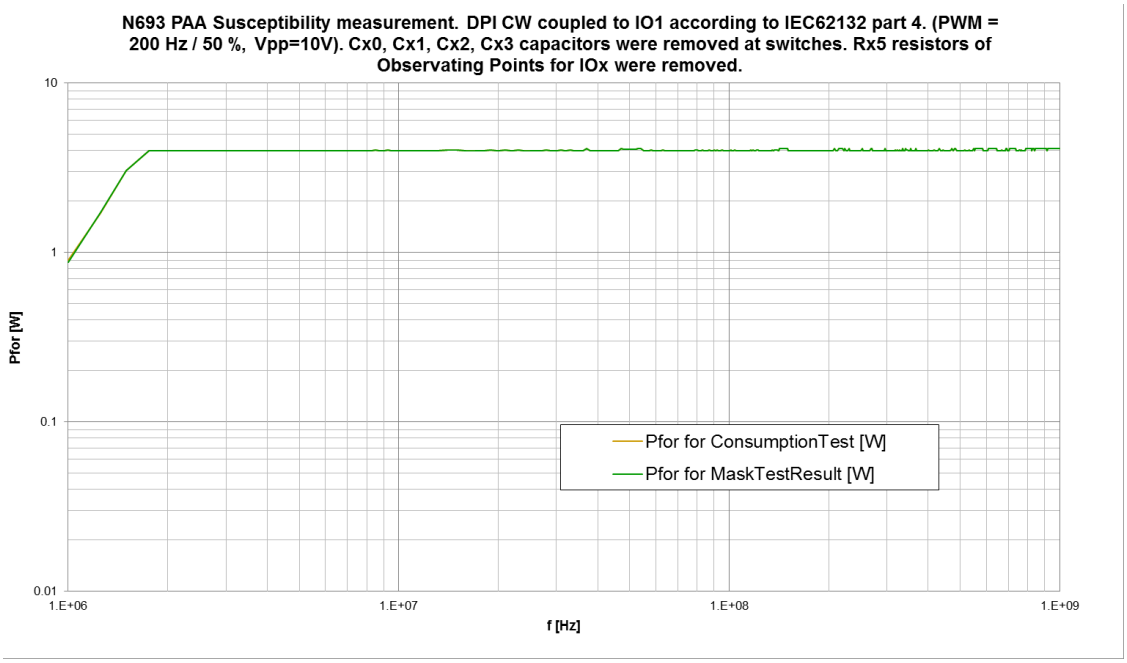

Figure 4. Bipolar Susceptibility Result Test on the IOx Pins

Configuration with External MOS Transistors

The difference between Bipolar and Mosfet drive is that the SWx outputs are not resistively loaded for the MOSFET configuration.

The results are shown in Figure 5. **The LED current is stable.** The SWx voltages are slightly increasing approx. up to 10%. Due to the chip layout, there are differences in the EMC susceptibility between the IOx channels. The best performance in terms of the SWx voltage rise is visible for channel three.

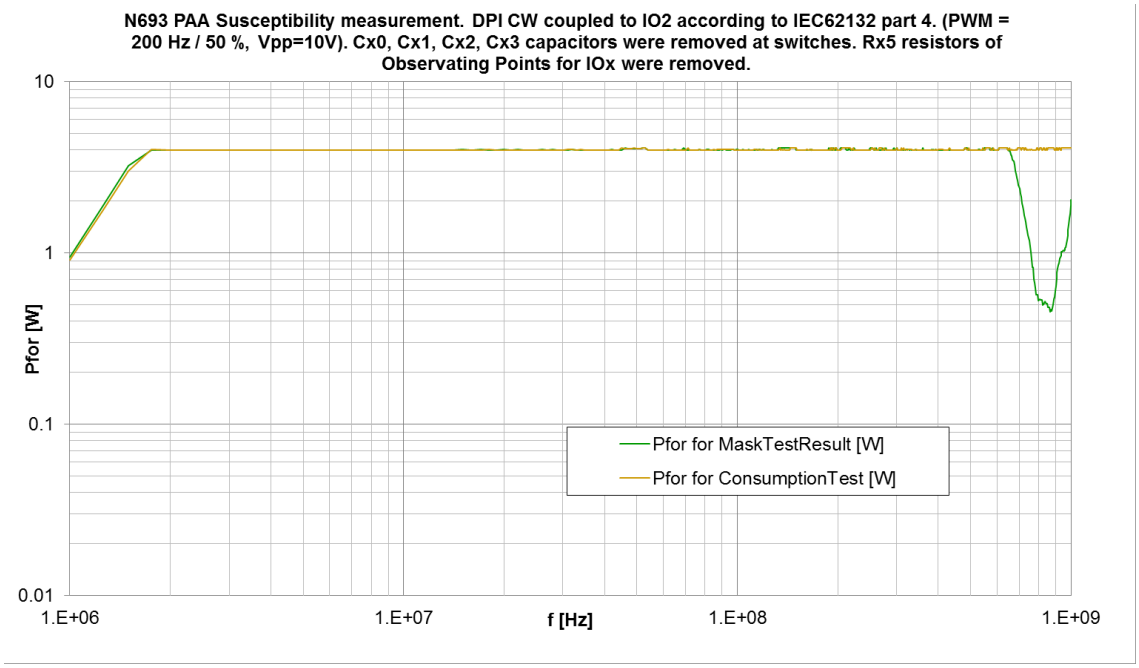

Figure 5. Mosfet Configuration for Channel 1 with the Filter

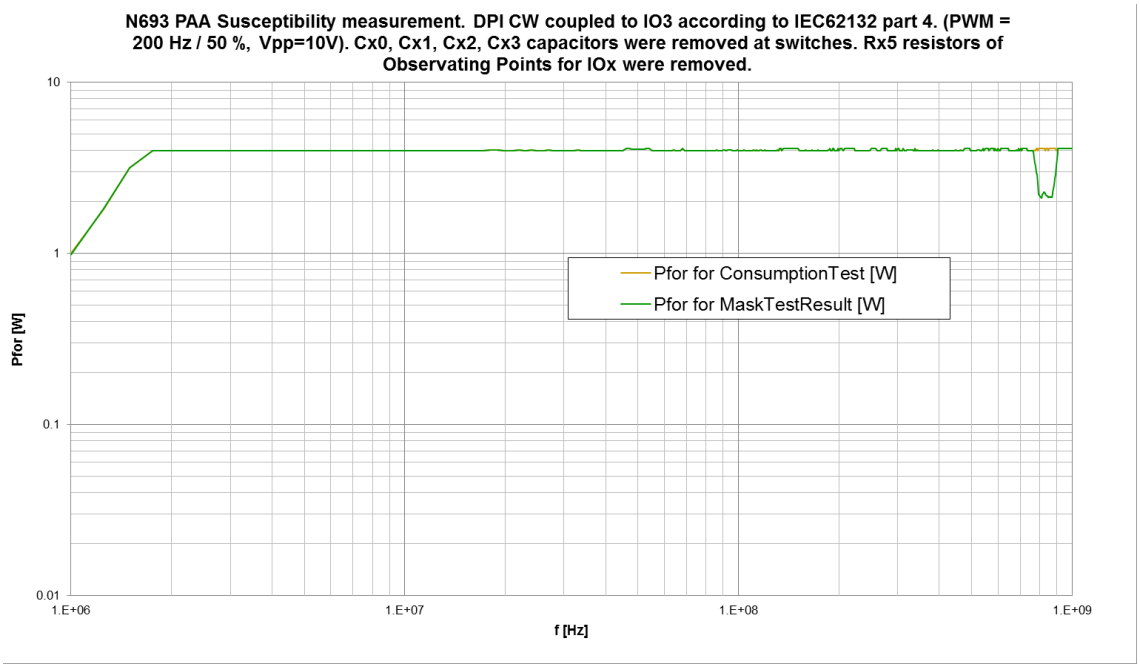

Figure 6. Mosfet Configuration for Channel 3 with the Filter

The actual value of the SWx voltage increase depends mainly on the injected power and on the supply voltage value. For the applications with DC/DC converter powered by 6.5 V supply voltage, the SWx voltage increase is practically negligible.

The applications using the Mosfet transistors having V_{GS} up to 20 V shows no deviation in I_{LED} current consumption tests.

Other Application Consideration – MCU Driven Application

Due to possible voltage increase on the SWx pins during the EMC noise (Figure 2), the impact on the other applications has to be considered. Especially where the NCV7693 driver is used as transceiver to send information from the IOx pins to the MCU a special care must be taken not to exceed the maximum operation voltage of the MCU. It is advised e.g. to limit the SWx voltage by external components (see Figure 7.) or to supply the NCV7693 from the DC/DC convertor with low VS supply voltage.

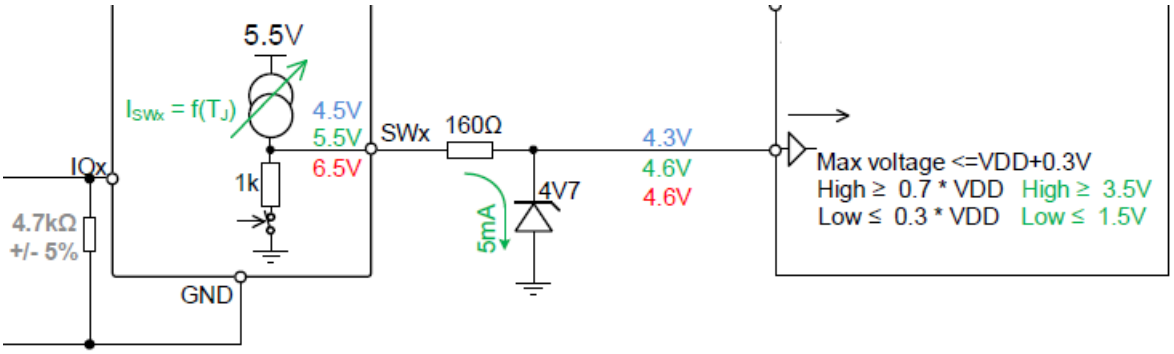

Figure 7. Block Diagram of MCU Driven Application

PCB DESIGN IMPROVEMENTS

In Figure 8, there are highlighted examples of the wrong PCB design / layout which can cause higher sensitivity to the EMC noise. The Figure 9 shows better PCB design reducing the EMC sensitivity. (The notes in the figures further comment on the recommendations)

General advices:

1. The 2.2 nF capacitor on the IOx pins near the connector will absorb most of the EMC noise on the board entrance
2. The EMC power can be further reduced using R−C filter with value of 10 Ω and 1 nF
3. The 1.2 nF capacitor from R−C filter should be as close as possible to the NCV7693 IOx pins

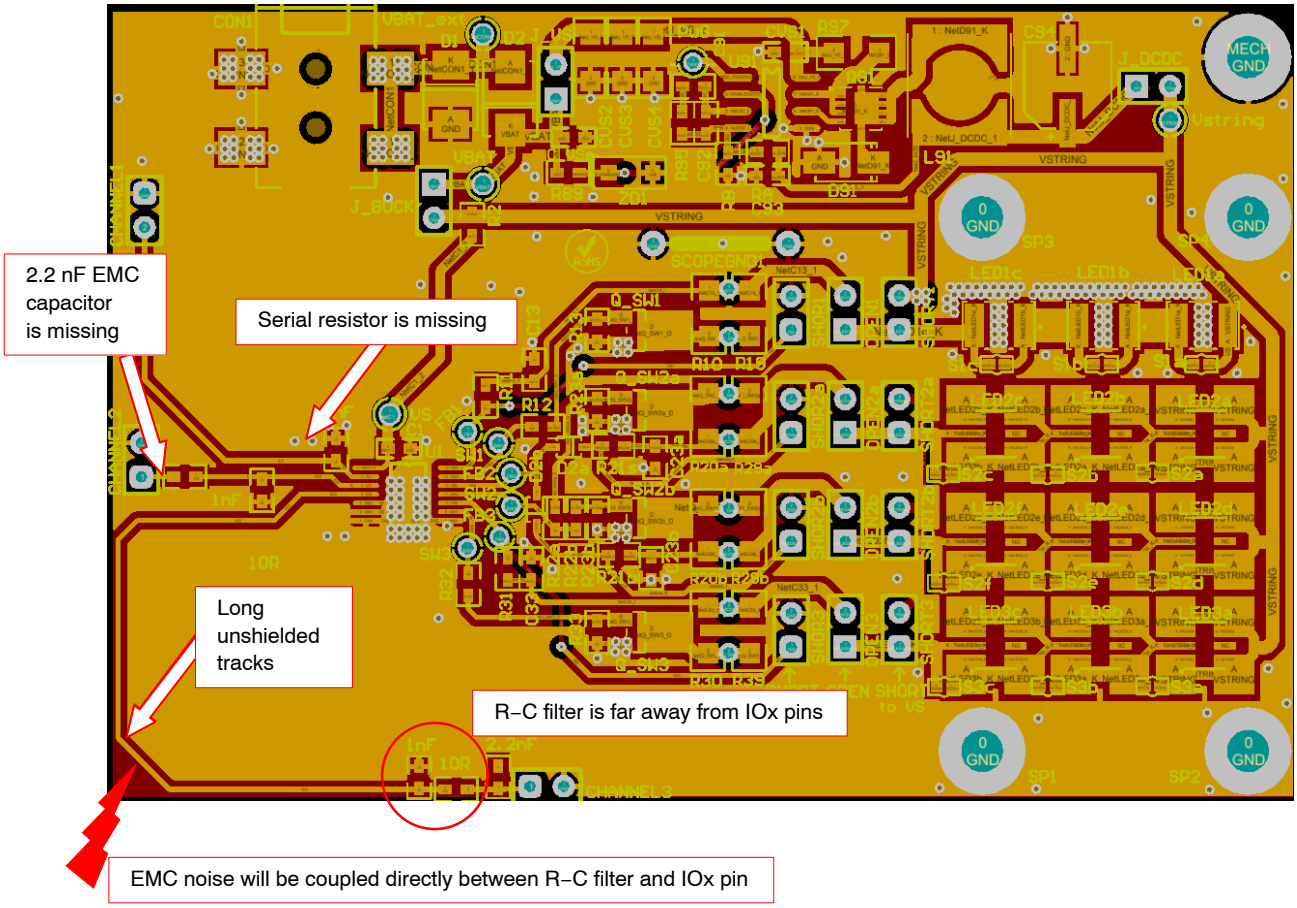

Figure 8. Example of the Wrong PCB Layout

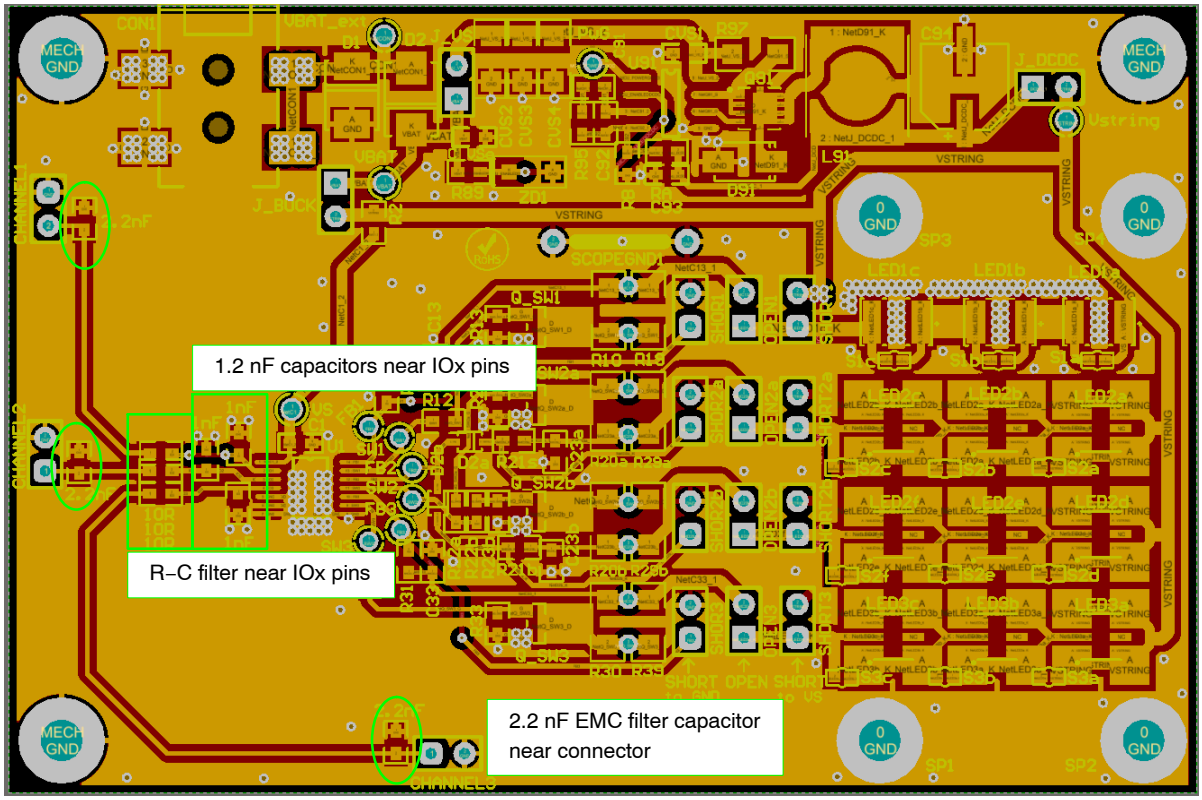

Figure 9. Example of the Correct PCB Layout

Referenced Documents

[1] NCV7693: NCV7693 datasheet, www.onsemi.com

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
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