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Design Note – DN05112/D

AR0143 Image Sensor with Power & Clocking Reference Design

Device	Application	Output Voltage	Output Current	Dropout Voltage	Package
NCV8163	Image Sensor	2.8 V	250 mA	80 mV	WLCSP

Other Specifications

- Fully integrated image sensor module with power and clocking solution
- Image sensor performance impervious to system design
- 9.5mmx9.5mm image sensor section
- Automotive AEC−Q100 Qualification

Introduction

Complementary metal-oxide semiconductor (CMOS) imaging sensors are the most commonly used type of image sensors actually. One of the great advantages of CMOS sensors over charged coupled devices (CCDs) is the very high level of product integration, such as the possibility to include the timing logic, image digitalization and processing plus capture control on a miniature single chip. This reduces system power, cost, and size without much compromise in performance.

On the other side, CMOS imaging sensors are sensitive to noise, which can be electromagnetic interference (EMI), substrate noise coupling, thermal noise and power supply ripple. First three effects can be significantly reduced by proper circuit and PCB design. We will focus on power supply ripple only in this design note.

Voltage ripple present on digital supply rails usually does not cause any significant impact to image quality, while ripple is inside required and specified limits. On the other side, ripple present on analog supply rail is directly proportional to image quality and can cause several types of image distortion, including image noise, banding, etc.

In this design note we want to focus on AR0143 image sensor, which use three voltage supply rails: 2.8V for analog circuits, 1.8V for digital I/O circuits and 1.2 V for digital core and image processing. The sensor is used in ON Semiconductor MARS reference design which is described below.

Circuit Description

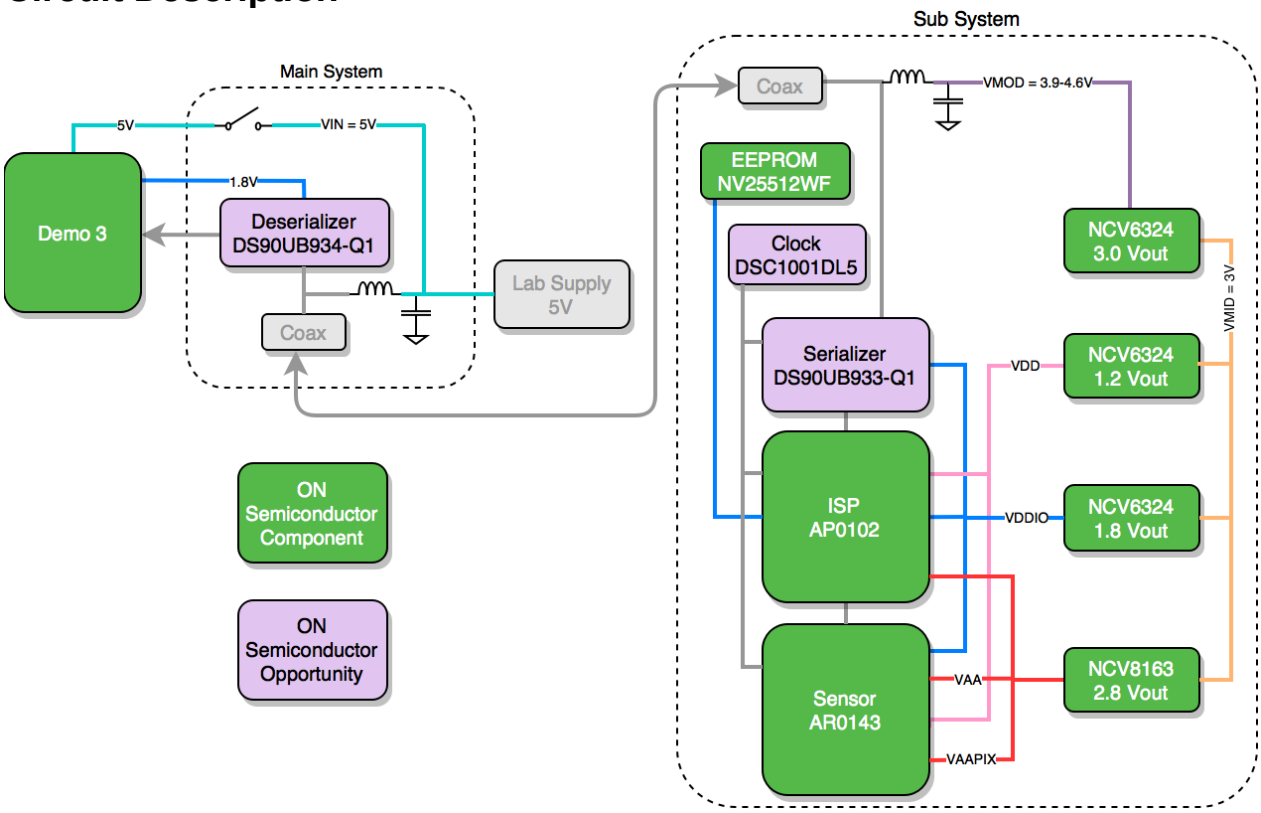

Figure 1: AR0143 Camera module high level block diagram

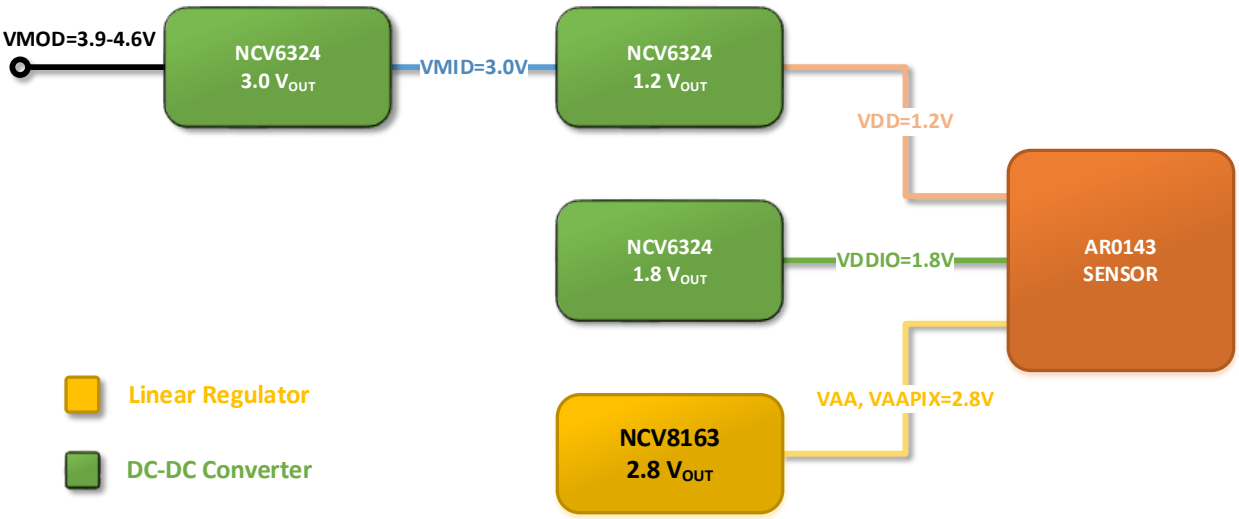

Figure 2: AR0143 Sensor power supply block diagram

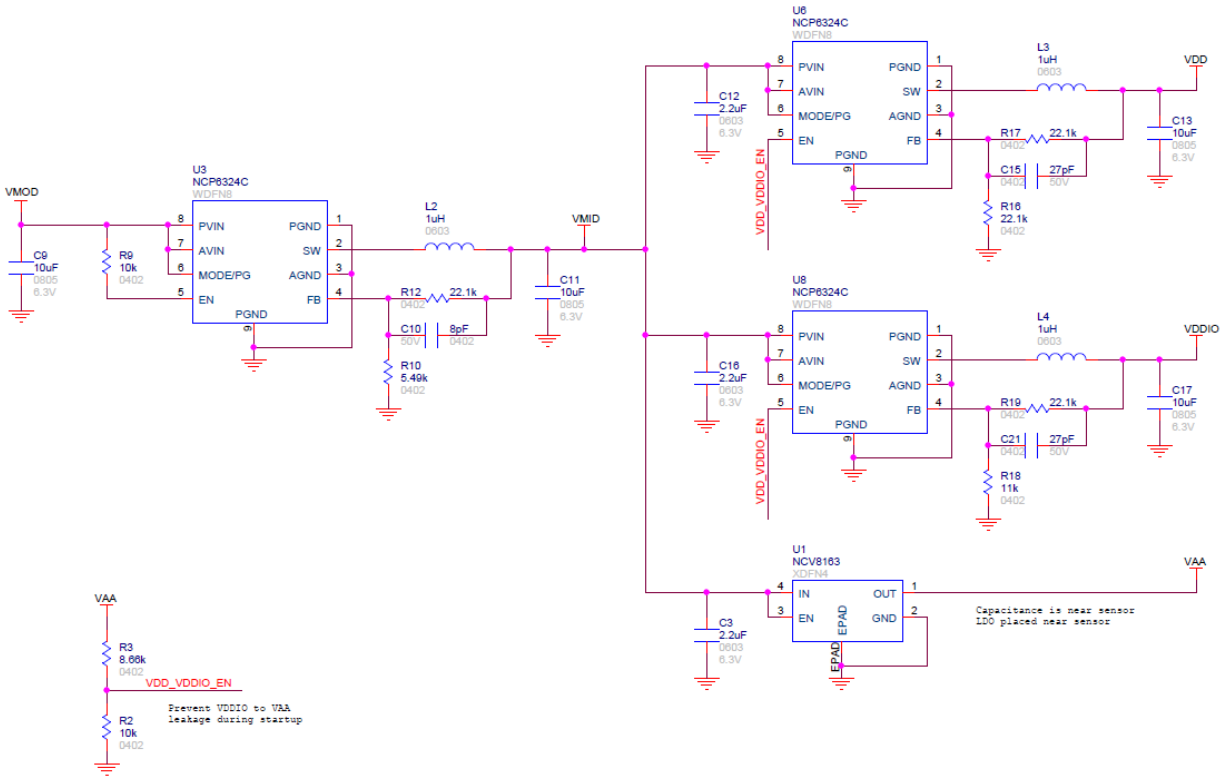

Figure 3: Detailed power supply block diagram, 3x NCP6324 DC-DC and 1x NCV8163 LDO used.

PCB Details

(Shown with and without lens)

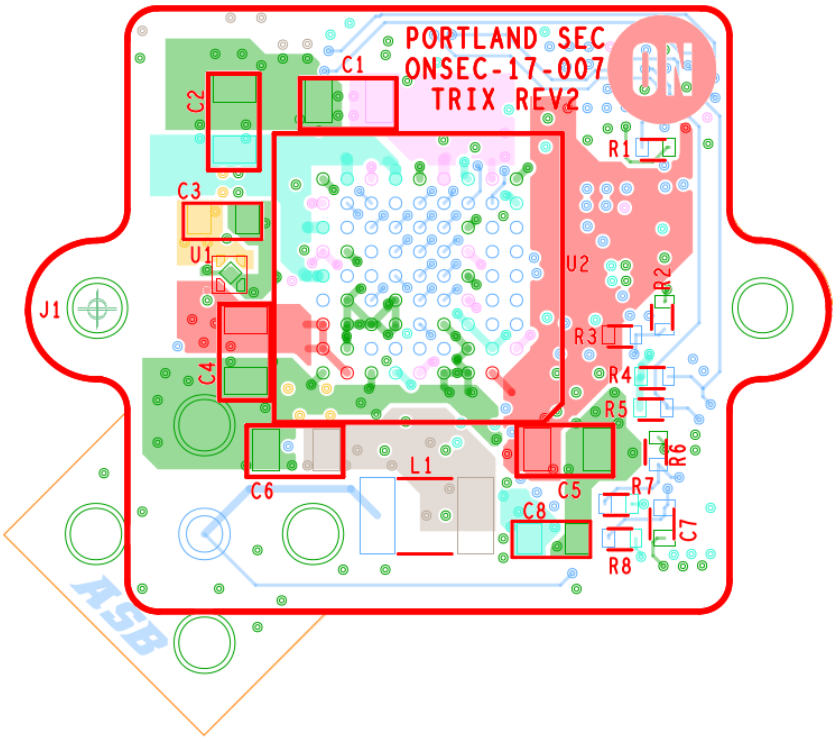

Figure 4: Top side of demo board with main components layout (not in scale).

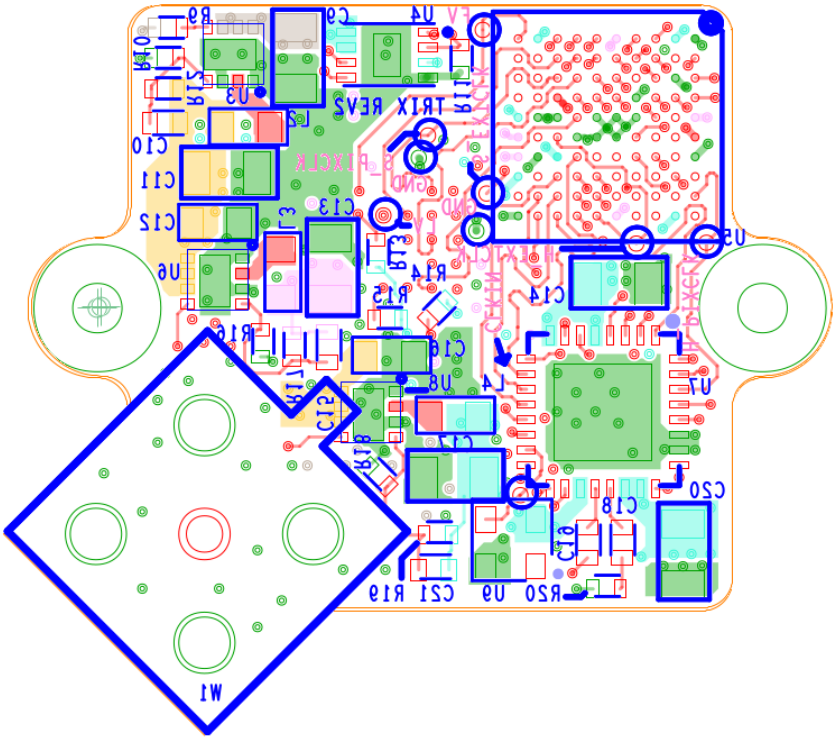

Figure 5: Bottom side of demo board with main components layout (not in scale)

Performance Information

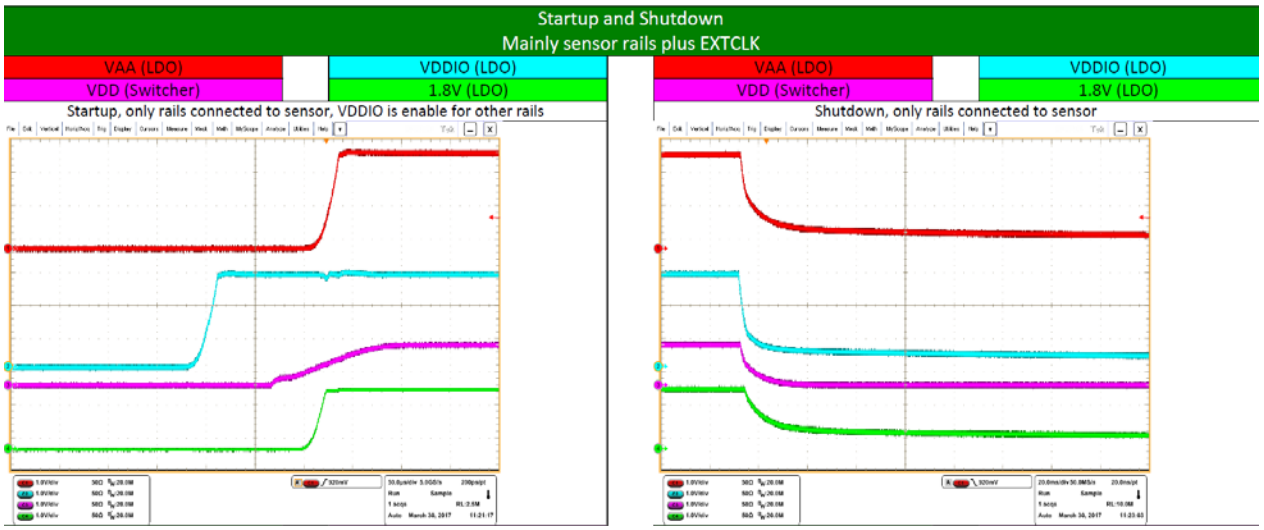

Figure 6: Detail of proper timing for all voltage rails, where red line shows VAA analog voltage 2.8V (the most important voltage for picture quality).

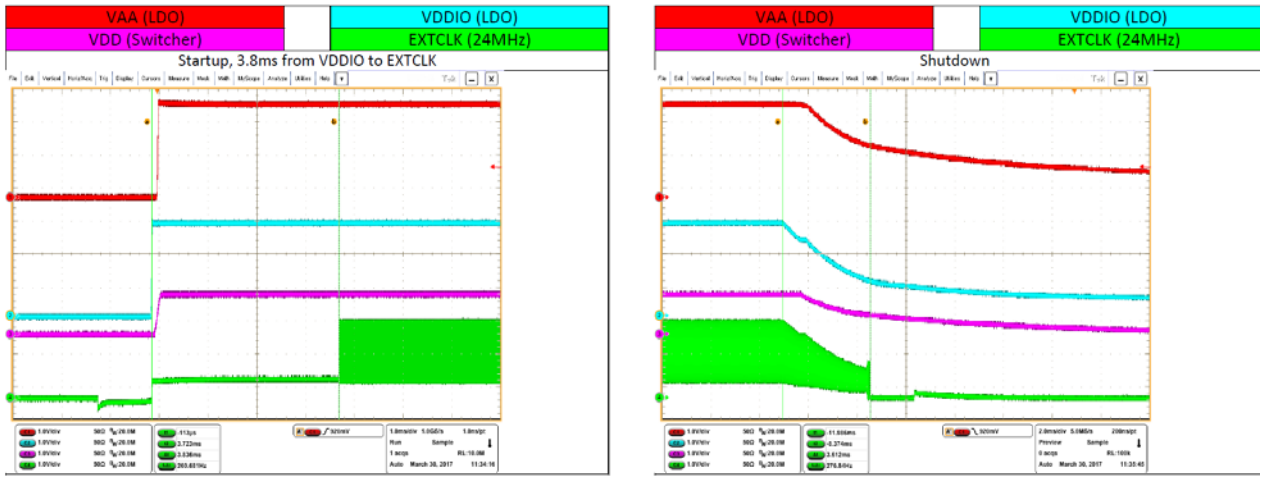

Figure 7: Detail of time delay between VDDIO digital voltage and AR0143 sensor clock signal for both startup and shutdown event.

Performance Information (continued)

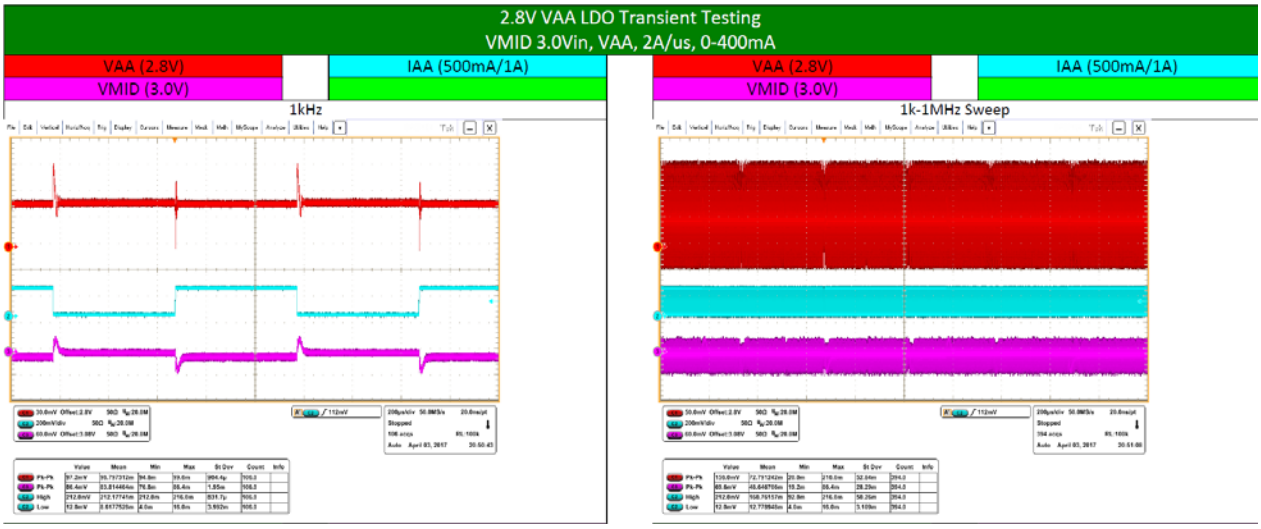

Figure 8: Transient testing waveform for VAA analog voltage 2.8V (NCV8163 used), when supplied from 3.0V VMID voltage (see power block diagram).

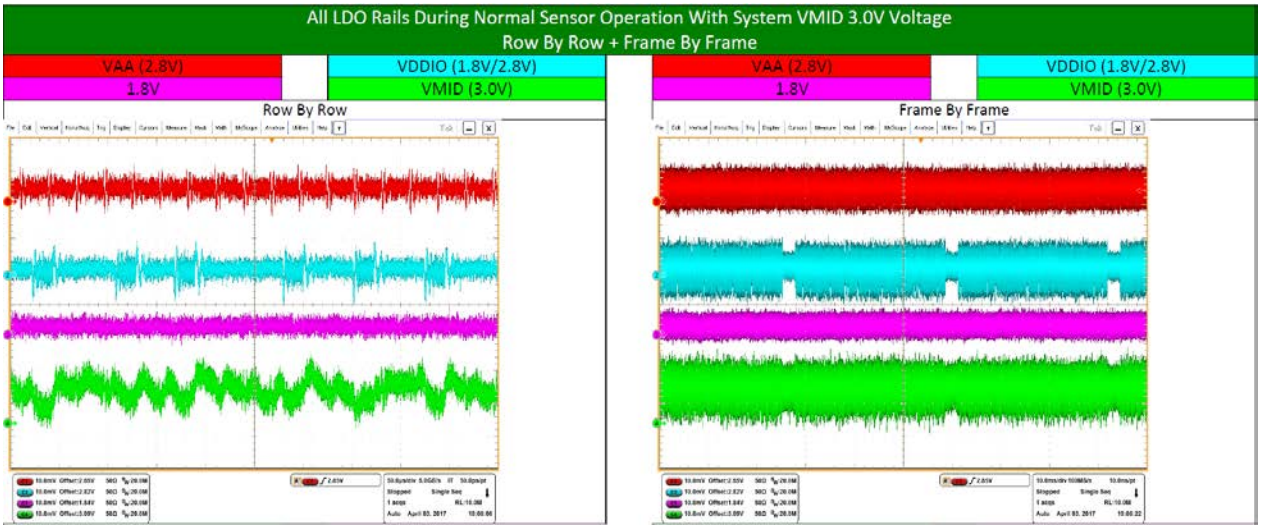

Figure 9: Waveforms for all voltage rails during normal operation of AR0143 image sensor with VMID voltage set to 3.0V. Please note low VAA analog voltage ripple, which is crucial for image quality.

Conclusion

The modern image sensor like AR0143 offers excellent image quality suitable for various automotive application. To achieve the best performance proper power supply design is crucial. The analog part of sensor is the most sensitive voltage rail and any voltage fluctuations are the most visible. The NCV8163 with its excellent transient response and high PSRR in wide frequency range is perfect device for supply such sensitive voltage rail. Very low dropout helps to reduce power dissipation and improve efficiency. The NCV8163 provides much cleaner output voltage with lower output capacitance than any DC-DC converter and improve cost efficiency of whole design.