# AN-1096
# Multiplexing Two Power Rails using Renesas' GreenFET Load Switch

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*Date: May 11, 2017*

## Introduction

Many recent consumer-electronic devices use multiple power sources for operation. For example, tablet PCs can work from an internal Li-chemistry battery and an external 5V power supply (such as a USB port) during battery charging. In these devices, it is very important to switch between two power rails without a disruptive output voltage drop and at the same time prevent reverse current flowing from the higher voltage rail to the lower voltage rail. Renesas' dual-channel SLG59M1639V or a pair of single-channel, WLCSP SLG59M1748Cs are excellent choices for these types of applications.

## Multiplexing Two Power Rails Circuit Design and Analysis

Fig 1 shows circuit examples of multiplexing two power rails to one common output using a dual-channel load switch (Fig 1a) or a pair of single channel load switches (Fig 1b). The SLG59M1639V is a dual-channel, 45-mΩ PMOS load switch designed to switch 1.5V to 5V power rails up to 2A in each channel, while the SLG59M1748C is a single-channel, 35-mΩ PMOS load switch designed to switch 1.6V to 5V power rails up to 2.2A. Both load switches' feature true reverse current blocking and fast reverse-current detection response time. If $V_{OUT}>V_{IN}$ by 50mV, the switch is automatically turned off.

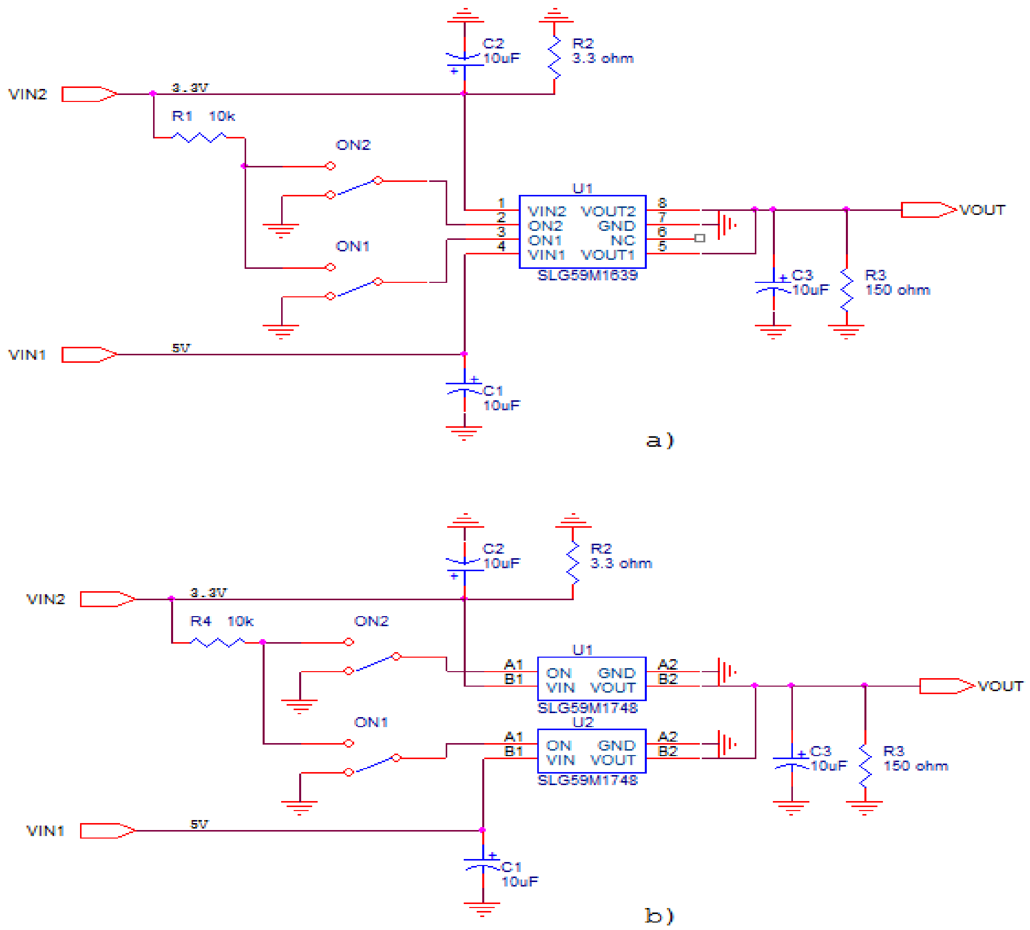


**Figure 1. Multiplexing Two Power Rails using GreenFET Load Switch**

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Since the $RDS_{ON}$ of either load switch is very small, the power sources must be tolerant to 1-1.1A reverse-current levels during switch over, as voltage drop in those cases can be less than the 50mV the reverse-current detect threshold.

In some applications, there are a number of components at the VIN2 terminal where the total current at that node will be approximate to or higher than 1A. In this case, it may not be necessary to use R2. In the case where VIN1 (the higher power rail) is already turned ON and it needs to switch to VIN2 (lower power rail) and toggling ON2 High, it is obligatory to toggle ON1 Low, otherwise VOUT will still be closed to the VIN1 rail. An example of such an operation is illustrated in the waveform of Figure 5. To minimize 5V → 3.3V → 5V switchover transients, ON1 can be toggled Low or High while ON2 is always high. Examples of such operation is illustrated in the waveforms shown in Figures 3 and 4. To reduce voltage drop during a 5V to 3.3V switchover, it is possible to use a larger $C_{LOAD}$ (C3) or a larger $R_{LOAD}$ (R3). An example of such improvement is illustrated in the waveform shown in Figure7.

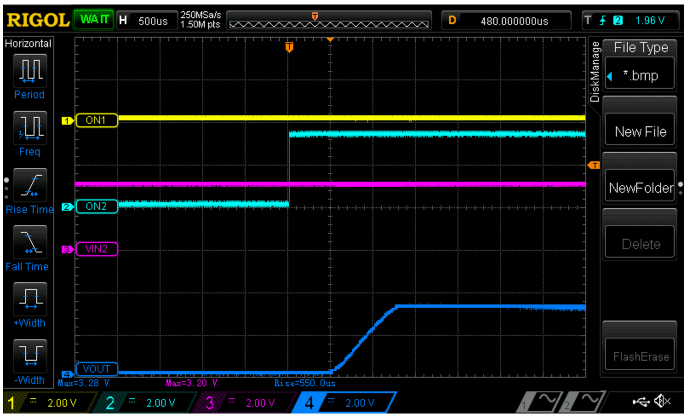


**Figure 2. Waveform 1: 3.3V Power-up Operation**

## Operation waveforms

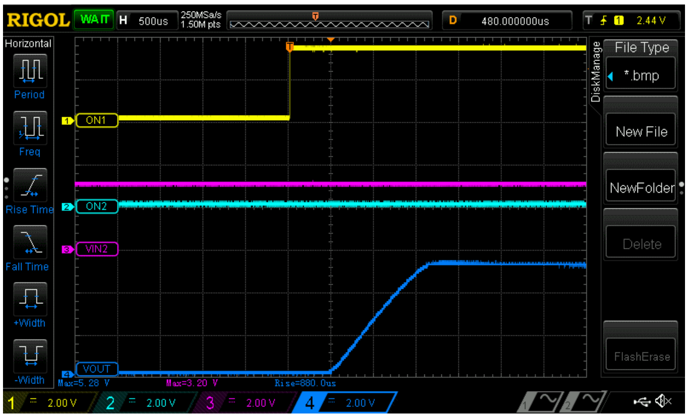


**Figure 3. Waveform 2: 5V Power-up Operation**

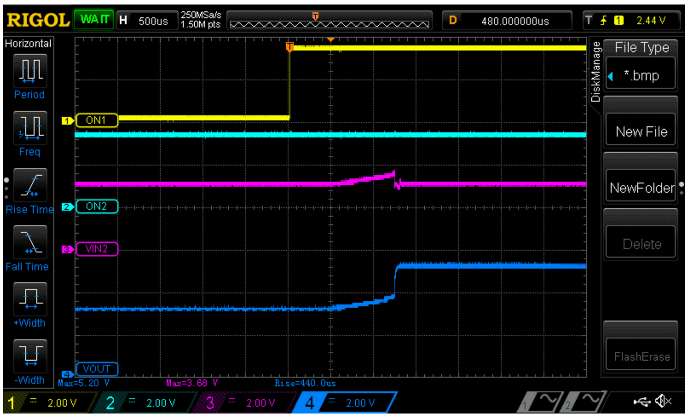


**Figure 4. Waveform 3: 3.3V to 5V VOUT Switchover Transient Behavior**

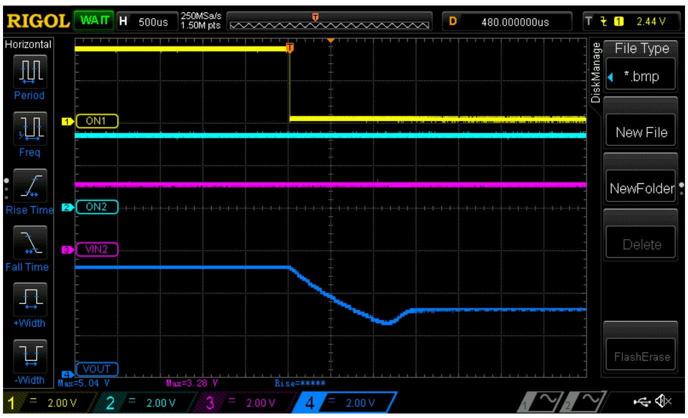


**Figure 5. Waveform 4: 5V to 3.3V VOUT Switchover Transient Behavior**

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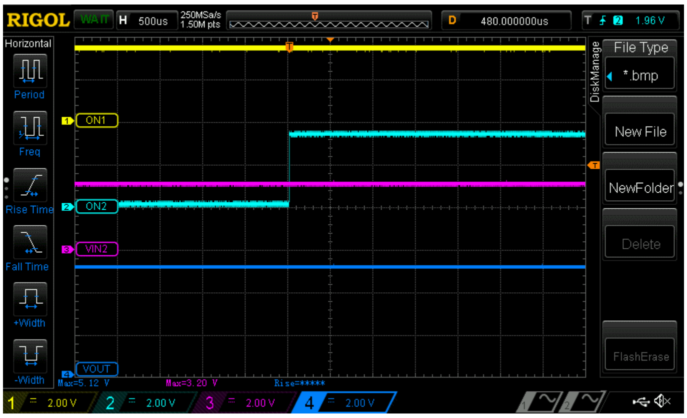


**Figure 6. Waveform 5: Not switching to VIN2 if VIN1 turned on**

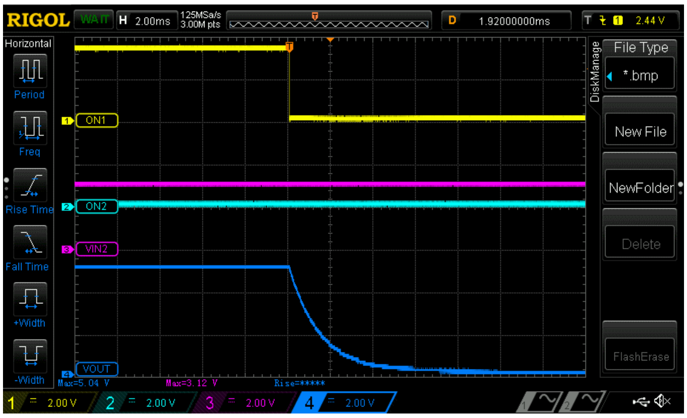


**Figure 7. Waveform 6: 5V VOUT Power-down Behavior**

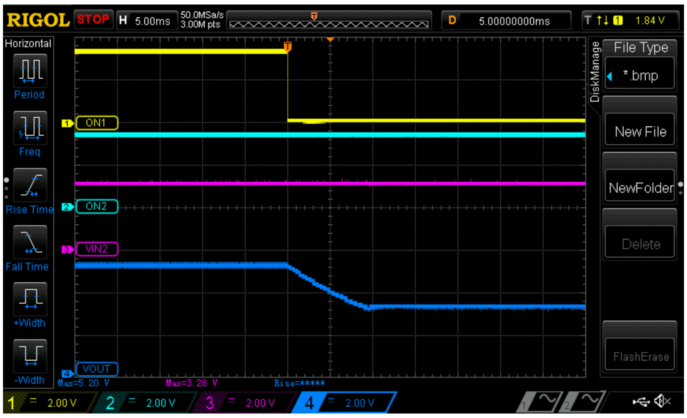


**Figure 8. Waveform 7: 5V to 3.3V VOUT Switchover Transient Behavior with C3 = 100µF, R3 = 150Ω**

## Conclusion

Using Renesas' dual-channel SLG59M1639V or a pair of single-channel SLG59M1748C devices makes it easy to multiplex two power rails to one common output. This application is very often used for switching between external and internal power sources in tablet PCs, smartphones, and other consumer electronic products. Also, it is possible to implement a similar solution using Renesas' SLG59M1641V with active LOW ON-OFF control and faster turn on/off times instead of the SLG59M1639V.

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