Communicating With the UCD9081; Unpowered, in System

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ABSTRACT
Communication with the UCD9081 in an un-powered user system may be necessary to upload a new configuration or read the flash error log contents. Of course in order to communicate, power must be furnished to the UCD9081. The following application report details a simple circuit that provides isolation between the external communication equipment and system power sources to facilitate communication in the absence of system provided power.

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1 Introduction
The UCD9081 can be configured over the I2C bus as described in the UCD9081EVM User’s Guide (SLVU249). In some cases users will have already populated devices loaded with the factory null configuration onto their application circuits, and will require a way to update this configuration in system without powering the system. Referencing the UCD9081EVM User’s Guide schematic, configuration can occur through the I2C connector (J3), or alternatively reprogramming can occur using standard programming equipment over the EVM update connector (J2).

In each case, the UCD9081 requires 3.0-3.6V to be configured (or reprogrammed). This power can be furnished by the external configuration (EVM USB-I2C adapter) or programming (EVM Update Connector) equipment, or by the user system. The following report describes a circuit which allows the external equipment to provide this voltage without back feeding the customer application circuitry. The example shown uses the USB-I2C adapter (connected to PC) furnished 3.3V (3P3V_USB) to power the UCD9081 for communication.
2 Power Insertion

Figure 1 illustrates the circuitry required to isolate the UCD9081 and communication interface from the system input voltage. J3 is the USB-I2C connector to which the USB-I2C adapter is connected.

Q1 (P-channel MOSFET) blocks the UCD9081 VCC (UCD_VCC) from the system furnished VCC (SYS_3.3V) during configuration. This is desirable so that the configuration source voltage does not have to power all of the associated customer circuitry that is present on the SYS_3.3V node. When the USB-I2C adapter is connected and furnishes the required voltage at 3P3V_USB, Q1 is turned off through D1 (both upper and lower conduct and keep Q1 Vgs < Vgs-th). 3P3V_USB also provides the voltage to power the UCD9081 through the lower half D1. D1 is a dual, common anode schottky diode with a small forward voltage drop at the low operating currents of the UCD9081 device. Since the gate (pin 1) and source (pin 2) of Q1 are at approximately the same voltage when 3P3V_USB is present, Q1 will remain off and block UCD_VCC from SYS_3.3V.

For normal operation, 3P3V_USB must not be present. R14 will pull 3P3V_USB to 0V as system source voltage is applied. SYS_3.3V and UCD_VCC will rise as current flows through the Q1 body diode. R15 will pull Q1-1 to 0V and when UCD_VCC rises above the Q1 Vgs-th, Q1 will saturate.

Since UCD_VCC can be chosen as the A/D converter reference voltage during normal operation, the selection of Q1 should consider UCD_VCC operating current and the Q1 on state characteristics. The Fairchild FDN340P has a typical RDSon of 70mΩ. Worst case UCD9081 active current will be less than 4mA and typical pullup resister loading will keep the current through Q1 to less than 5mA. The voltage drop across Q1 will be much less than 1mV which is negligible.

In similar fashion, the update connector could furnish the UCD9081 voltage if device reprogramming is required. Standard programmers furnish 3.3V via pin 2 of the update connector (J2 as shown in Figure 2).
Figure 1. I2C Configuration Power Schematic
3 Test Results

Figure 2 illustrates the UCD9081EVM schematic modified with the circuitry described above. The USB-I2C adapter that is furnished with the UCD9081EVM was used to power the UCD9081 via J3-5. Jumper JP30 was used to select the external voltage source.

The circuitry worked as designed. Communication voltage applied through the USB-I2C connector powered the UCD9081 and not the system 3.3V (C3.3V). Reliable communication between the USB-I2C adapter and UCD9081 was established and flash error log contents could be read. For normal system operation, measurement of the voltage drop across the Q3 MOSFET was below a millivolt (actual Vds was < 300µV) and the device operated normally. The following table documents node voltages for several conditions.

<table>
<thead>
<tr>
<th>TEST CONDITION</th>
<th>3P3V_USB at JP30-1</th>
<th>C3.3V at TP11</th>
<th>B3.3V at Q3-2</th>
<th>Vgate at Q3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB-I2C adapter power on, system power (TP11) off</td>
<td>3.342 V</td>
<td>0 V</td>
<td>3.093 V</td>
<td>3.178 V</td>
</tr>
<tr>
<td>USB-I2C adapter power on, system power (TP11) on</td>
<td>3.341 V</td>
<td>3.293 V</td>
<td>3.096 V</td>
<td>3.180 V</td>
</tr>
<tr>
<td>USB-I2C adapter power off, system power (TP11) on</td>
<td>0.011 V</td>
<td>3.292 V</td>
<td>3.292 V</td>
<td>0.011 V</td>
</tr>
</tbody>
</table>

4 Application Notes

- A voltage present at 3P3V_USB may degrade ADC reporting accuracy. For normal operation, voltage at 3P3V_USB should be kept well below SYS_3.3V (TP11 on EVM) to ensure Q1 (Q3 on EVM) is fully on.
- Real world application should add some filtering and gate protection for Q1 (for hot plug transients that may occur) at the 3P3V_USB node. An RC filter of 10Ω and 0.1µF with a 3.6V zener diode should be more than adequate.
Figure 2. Modified UCD9081EVM Schematic
5 Conclusion

With the addition of four inexpensive components the UCD9081 can be easily set up for in system configuration, programming, or flash log access in the absence of system power.

6 References

1. UCD9081 Datasheet (SLVS813A)
2. UCD9081EVM User's Guide (SLVU249)
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