The design guidelines for power sequencing when using PI5C680X

By Paul Li

Introduction

The PI5C6800 and PI5C6801 (Figure 1.) are 10-bit bus switches with low on-state resistance, ultra low quiescent power (0.2uA typical) and are hot swappable.

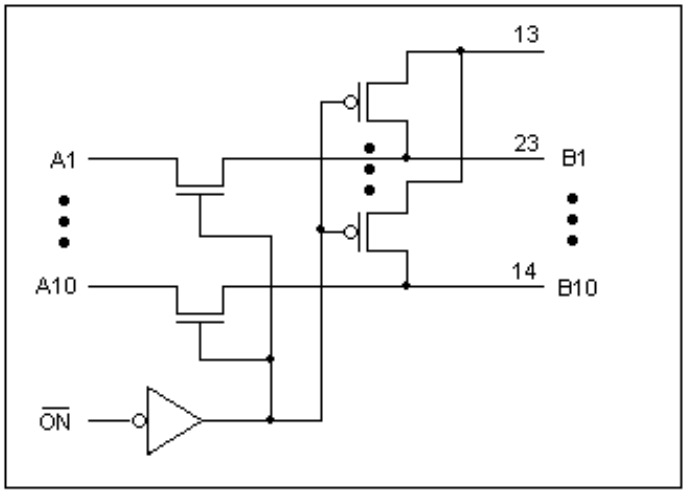

Figure 1. The logic diagram of PI5C6800 and PI5C6801

TheTwo Power Sequencing Conditions

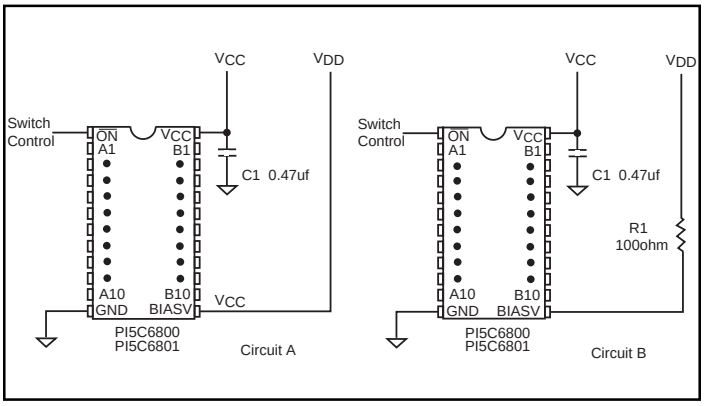

Figure 2. The Power Sequencing Protection Circuit using Resistor

1. The PI5C680X chip has two pins connected to power, the V_{CC} and BIASV pins. The V_{CC} pin will power up the chip. The BIASV pin will provide the bias voltage for the internal pull-up resistor on the BX side (see Figure 2.). In normal conditions, on power up, the V_{CC} and V-bias should reach the PI5C680X at the same time. If the V_{DD} reaches the BIASV pin earlier than the power reaches the V_{CC} pin (see the circuit A, Figure 2), the V_{DD} at pin BIASV will shorten to ground through the V_{CC} pin and will damage the internal circuit at the pin BIASV. Adding a 100ohm resistor connected between V_{DD} and pin BIASV will limit the current and prevent this potential problem (see circuit B, Figure 2).

2. If the logic signals on BX come earlier than the V_{CC} power on PI5C680X, the signals on BX will shorten to ground through the V_{CC} pin, and could damage the internal circuit at BX. If the BX pins are connected to a pull-up bus (PCI bus for example), the situation discussed above will affect the logic status of that bus. Adding a diode on the V_{CC} pin in Figure 3. will prevent this potential problem.

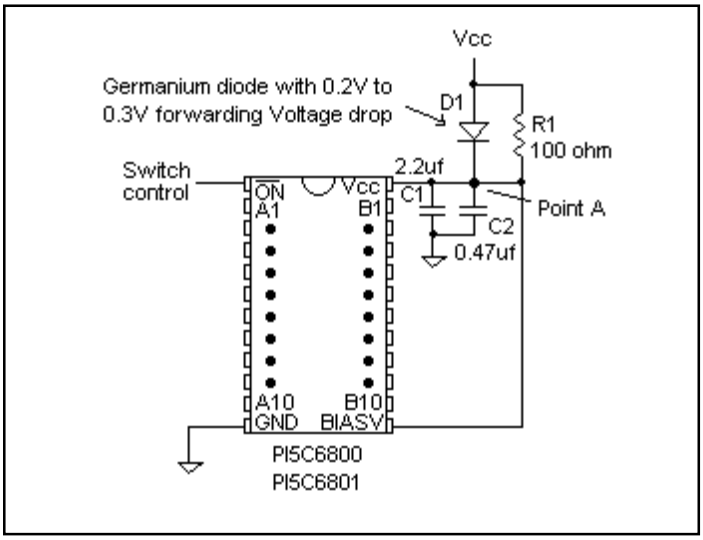

Figure 3. The Power sequencing protection circuit using Germanium diode for PI5C6800 and PI5C6801

The circuit in Figure 3. will protect both of the power sequencing problems above. Therefore, the circuit in Figure 2. is not needed if using the circuit in Figure 3.

Circuit Analysis for Figure 3.

- A germanium diode with low forwarding voltage drop (0.2V 0.3V) is suggested to minimize the V_{CC} voltage drop. A Schottky diode with 0.3V to 0.4V forwarding voltage drop could be an alternative.
- R1 in Figure 3. is to reduce the V_{CC} drop on D1. It will reduce the V_{CC} drop to 0.005V when quiescent mode. The voltage drop on D1 is 0.2V when the switching frequency at pin "/on" is lower than 10mhz.
- C1 and C2 in Figure 3. must be as close to the V_{CC} and GND pins of PI5C6801 as possible to minimize the V_{CC} ripple and ground bounce.
- Figure 4. and table-1 are the curves and the data to explain the relation between the V_{CC} drop on D1/R1 versus the switching frequency at pin "/on".

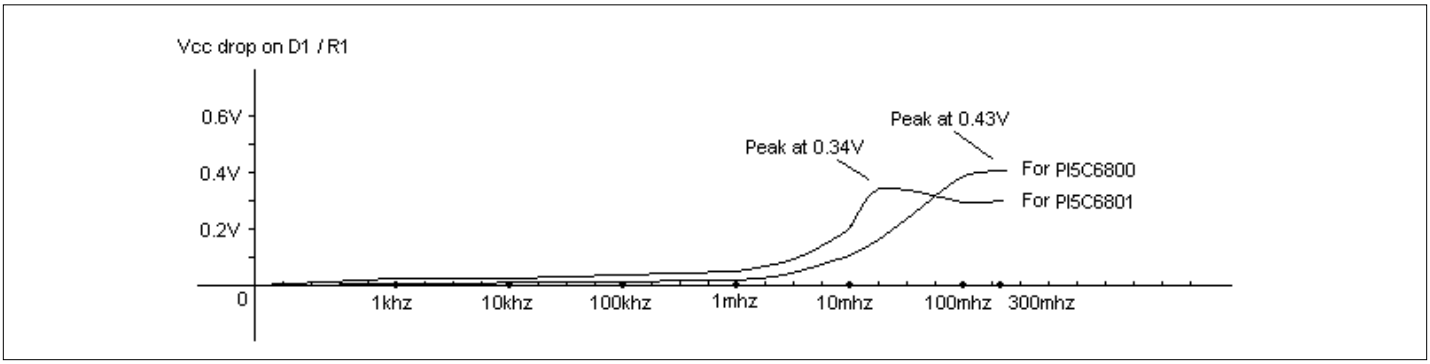

Figure 4. The Voltage Drop on D1 / R1 versus Frequency

Switching frequency at /ON	PI5C6800		PI5C6801	
	ICC Power Current (mA)	V-drop on D1/R1 (Volt)	ICC Power Current (mA)	V-drop on D1/R1 (Volt)
DC	0.052	0.004	0.059	0.005
1khz	0.128	0.012	0.32	0.031
100Khz	0.141	0.013	0.405	0.039
1Mhz	0.242	0.023	0.62	0.061
10Mhz	1.188	0.115	2.28	0.201
32Mhz	3.135	0.250	5.89	0.340
70Mhz	6.84	0.33	4.1	0.28
100Mhz	10.39	0.38	4.2	0.29
150Mhz	15.6	0.42	4.39	0.29
200Mhz	18.7	0.43	4.53	0.29
300Mhz	13.3	0.404	4.77	0.299
400Mhz	6.9	0.33	5.02	0.305

Table 1. The Comparison of PI5C6800 and PI5C6801: the PI5C6801 has less I_{CC} current and voltage drop on D1 / R1 at higher frequency range.

Conclusion

If the V_{DD} voltage at pin BIASV comes earlier than the V_{CC} voltage at the V_{CC} pin; or if the signals at BX come earlier than the V_{CC} voltage at V_{CC} pin, a diode as in Figure 3. is needed to prevent the shorten current through V_{CCD} pin to ground.