SEMICONDUCTORS

DN88
The ZXCT1030 current monitor used as a GPS antenna switch with short circuit protection

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Introduction

High side current monitors such as the Zetex ZXCT1030 were developed to enable the measurement of current on the supply side of a circuit versus the ground return path. They are often used in the output of a power supply or motor drive to determine if excess current is flowing and to take evasive action such as shutting down the supply or motor drive circuit. Another type of application for the current monitor is described in this design note where the current in a signal path is used to detect an active GPS antenna and automatically switch the RF path

Application

Most GPS navigation systems are equipped with an internal GPS antenna but sometimes it is desirable to use an external active antenna for improved performance or to place the antenna at a distance from the equipment such as on the roof of a car. In this case the user of the system would plug an active GPS antenna into an external jack on the navigation system and place the antenna in the desired location. In the past the user then had to cause the circuit to switch over to the external antenna via a switch or software selection. In addition short circuit protection is needed on the external antenna jack in case the user applies a short or a faulty antenna. This has historically been accomplished using discrete components to detect an over current condition on the active antenna power line.

Description

This design note shows a method of accomplishing both RF path switching and short circuit protection with the ZXCT1030 current monitor. Refer to Figure 1 for this description of circuit details and operation. U1 is the current monitor, U2 is a typical RF switch and U3 is an optional comparator added for an OCP (over-current protection) error flag. A sense resistor R5 is inserted in the active antenna power supply path and the current monitor U1 senses the voltage across R5. The ZXCT1030 has an open collector comparator and voltage reference integrated in the package. In this application the comparator output is used to switch the RF path between antennas.

Antenna switching

The comparator output ‘VCOUT’ is brought out on pin 8 and its inverting input ‘VCOMP’ is available on pin 5. The ZXCT1030 has an internal 1.24V reference ‘VREF’ that is brought out on pin 6. A voltage divider is formed by R3 and R4 to provide a 100mV reference level at ‘VCOMP’, which represents 10mA of current flow to the external antenna. The 10mA level was chosen to be below the range of current draw of active antennas, typically 20mA to 35mA. The comparator has an open collector active low output that is asserted when Vsense x Gain > Vcomp, where Gain = 10. When the current passes 10mA, Vsense x10 > 100mV and the output on pin 8 is asserted low. The comparator output is pulled up to the 3.3V rail via R1 and R8 and the output switches from 3.3V to 0V when asserted. This output is connected to the CNTL input of the UPG2012 RF switch at U2 and causes the connection to be made between the external antenna and the receiver as shown. When no external antenna is connected, the CNTL input is high and the connection is made between the internal antenna and the receiver.

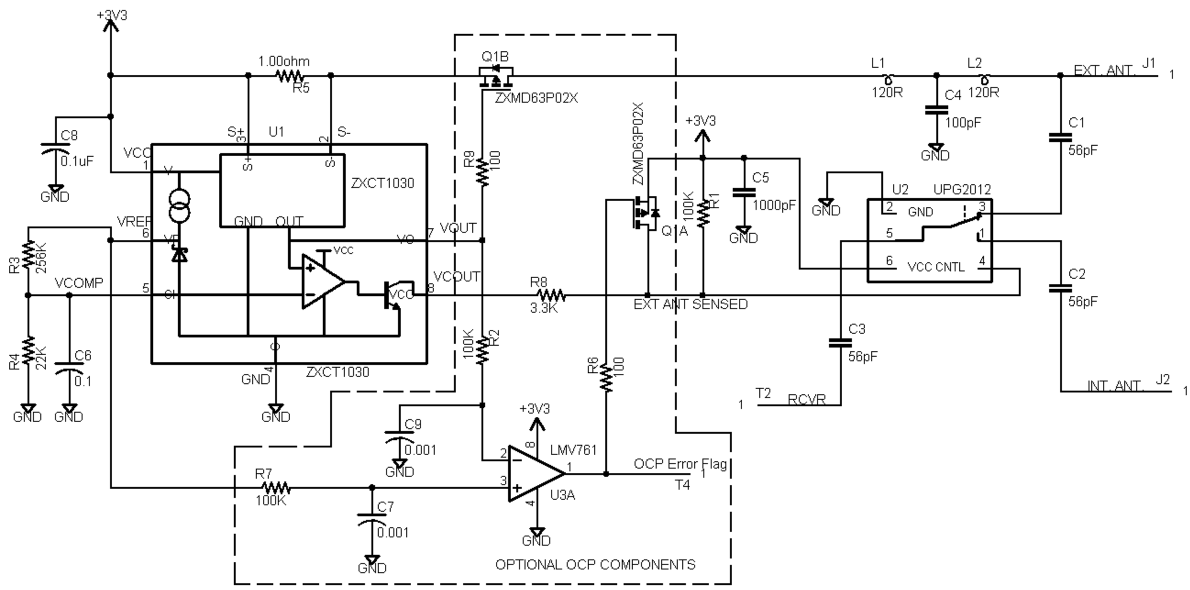

Figure 1 - ZXCT1030 RF path switching with optional over-current protection

Optional over-current protection

An analog voltage 'VOUT' that is proportional to the current flow through sense resistor R5 is available from the ZXCT1030 on pin 7. This output is used for short circuit protection in this design. Another comparator U3 has been added to create an error flag for a processor and to automatically switch back to the internal antenna when there is a short on the external jack. VOUT is applied to U3's inverting input via R2 and the 1.24V reference level from VREF is applied to its non-inverting input via R7. When the current through Rsense exceeds 124mA, VOUT will exceed 1.24V and the U3 output will assert low. In addition to acting as an error flag, this output is connected to the gate of Q1A via R6. Q1 is a dual P channel MOSFET package ZXMD63P02X. Q1A will apply a low resistance across the R1 pull up resistor causing U2's CNTL input to return high and the internal antenna to be reconnected. U3, Q1A and associated passive components are optional and only needed if it is desired to have uninterrupted operation when a shorted antenna is applied to the external antenna jack.

The second P channel MOSFET Q1B is located in the 3.3V rail and its gate is connected to VOUT via resistor R9. As the current increases due to an over current condition in the external antenna connection, VOUT reduces the gate to source voltage causing the Q1B channel resistance to increase. Short circuit current is limited below 200mA from the 3.3V source into a shorted external antenna by this method.

Conclusion

The flexibility of the ZXCT1030 current monitor was demonstrated in this application. It was used to perform two functions in this example. This design note showed how a current monitor can be used to detect a circuit configuration change, in this case an external antenna being plugged into a GPS navigation system, and make an automatic circuit change. In addition the second function of over current protection was added with minimal additional parts reducing the discrete component count.

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