Smart Card Interfaces Made Easy

by Steven Martin

Introduction

Smart Card interfaces must comply with extensive, and often difficult, software and hardware standards to produce robust card reading systems. The LTC4556 makes it easy to comply with Smart Card interface requirements by integrating all required power management, control, ESD and fault protection circuitry into a single device, precluding the need for a complicated array of discrete components.

The LTC4556 employs a voltage doubling charge pump and a low dropout linear regulator to generate an output voltage of 5V, 3V or 1.8V from a 2.7V to 5.5V input. It supports custom Smart Card systems—in addition to the EMV (Europay, MasterCard, Visa) and ISO7816 standards—by providing control for the C4 and C8 pins and a bidirectional clock mode for clock stretching in I²C™- or SMBus-like Smart Cards. A microcontroller compatible serial interface controls the entire device. Above all, a complete solution takes little space. The LTC4556 is available in a small 4mm × 4mm × 0.75mm leadless package and requires a minimum of external components.

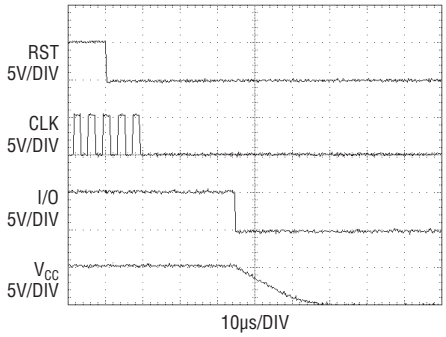

Figure 1. Smart Card deactivation sequence

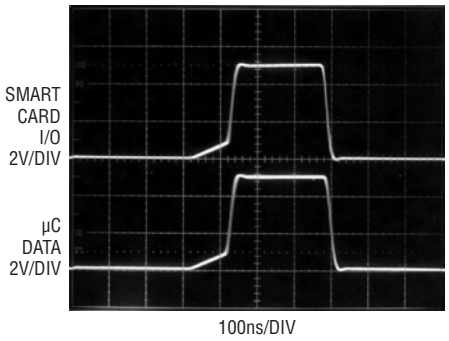

Figure 2. Bidirectional pin waveforms

Features

The LTC4556 includes a considerable number of features and yet remains

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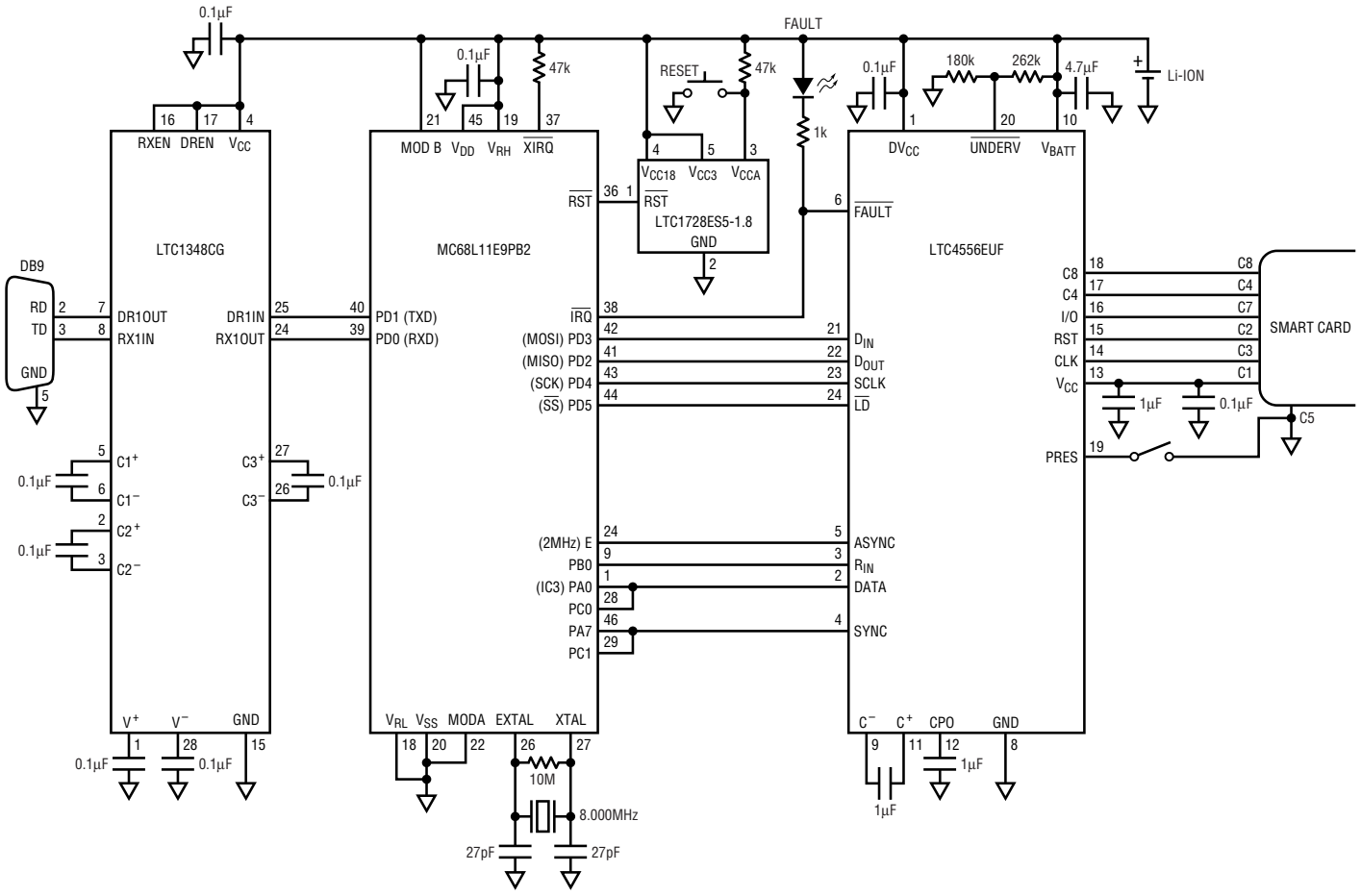

Figure 3. Battery powered RS232 to Smart Card interface

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plifier. The current in a photodiode is converted to a voltage at the output. The low input bias current and input noise current, combined with low voltage offset, provide a precision signal monitor. A high degree of input sensitivity is provided to the circuit by the large dynamic range, characterized by low input offset and high DC gain of the LTC2054. In addition, the LTC2054HV allows ±5V supply operation, further increasing dynamic range.

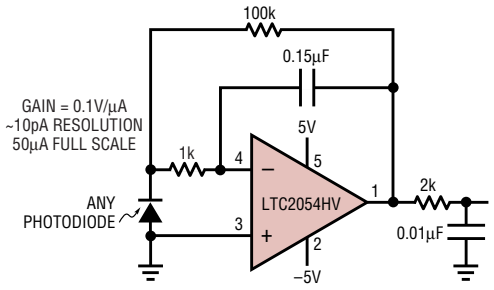

Figure 5. Ultra-precision, wide dynamic range 10Hz bandwidth photodiode amplifier

Conclusion

The LTC2054 and LTC2055 low drift operational amplifiers couple low power consumption with high precision DC specifications. They require little board area, available in small footprint packages including SOT-23-5 for the LTC2054 and the industry-leading 3mm × 3mm DD package for the LTC2055. A wide input common-mode range and a wide supply range that allows operation between 2.7V and ±5V provide flexibility.

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easy to use. Its simple 8-wire serial port provides maximum control with a minimum number of wires.

A detection circuit indicates the presence or absence of the Smart Card. Card insertion is debounced with a 40ms delay to ensure that the contacts are well seated before the card is activated. If the card is removed from its socket during a transaction, the LTC4556 cleanly deactivates it before its pads leave the connector's contact pins. Figure 1 shows the sequencing of the Smart Card pads during an automatic deactivation. RST is brought low first. On the next available edge, CLK is brought low. After CLK goes low, I/O goes low, followed by V_{CC}.

When providing power to 5V cards from a lower voltage supply, the charge pump operates in constant frequency mode under heavy load, and features Burst Mode operation for power savings when lightly loaded. The constant frequency operation allows the use of small capacitors. The charge pump is powerful enough to supply the Smart Card at rated current requirements for all 3 V_{CC} voltages.

A low dropout linear regulator controls the voltage of the Smart Card. The LTC4556 supports all three Smart Card classes (1.8V, 3V and 5V). The Smart Card signals are level shifted to the appropriate microcontroller supply voltage (which can range from 1.7V to 5.5V).

The data communication pins (I/O and DATA) are bidirectional and full duplex. This feature allows true *acknowledge* data to be returned to the microcontroller interface. These bidirectional pins also have special accelerating pull-up sources to ensure fast rise times. These sources are faster than a resistor, and don't suffer the power dissipation of a resistor when the pin is held low. They sense the edge rate on the pin and compare it to a preset limit. If the limit is exceeded, an additional current source is applied to the pin, thereby accelerating it. Once the pin reaches its local supply level, the acceleration current is disabled. Figure 2 shows an example of the data waveforms on a Smart Card pin and a microcontroller pin.

For further information on any of the devices mentioned in this issue of *Linear Technology*, use the reader service card or call the LTC literature service number:

1-800-4-LINEAR

Ask for the pertinent data sheets and Application Notes.

For the Smart Card clock pins, special clock divider and synchronization circuitry allows easy interfacing to a microcontroller. Separate clock input pins are available to support either asynchronous Smart Cards or synchronous memory cards. A true bidirectional mode is available to allow clock stretching for custom Smart Card applications. In this mode, the clock channel is identical to the data channel with its bus accelerators.

Ease of Use

Figure 3 shows an example of the LTC4556 used in a Smart Card to RS232 application powered by only a single Li-Ion battery. A simple 4-wire command and status interface plus a 4-wire Smart Card communications interface are all that is required. The command/status serial port can be easily daisy-chained, and the Smart Card communications port paralleled, to expand this application to virtually any number of Smart Cards while maintaining the same number of wires to the microcontroller.

Conclusion

The LTC4556 provides a compact, simple and cost effective solution to the difficult problems facing Smart Card system designers.