An SMBus-Controlled 10-Bit, Current Output, 50μA Full-Scale DAC

by Ricky Chow

The LTC1427-50 is a 10-bit, current-output DAC with an SMBus interface. This device provides precision, full-scale current of 50μA±1.5% at room temperature (±2.5% over temperature), wide output voltage DC compliance (from –15V to (V_{CC} – 1.3V)) and guaranteed monotonicity over a wide supply-voltage range. It is an ideal part for applications in contrast/brightness control or voltage adjustment in feedback loops.

Description

The LTC1427-50 communicates with external circuitry using the standard 2-wire I^{2}C or SMBus interface. The operating sequence (Figure 1) shows the signals on the SMBus. The two bus lines, SDA and SCL, must be high when the bus is not in use. External pull-up resistors are required on these lines. The LTC1427-50 is a receive-only (slave) device; the system master must apply the Write Byte protocol (Figure 1) to communicate with the LTC1427-50.

The master places the LTC1427-50 in a START condition and transmits a 7-bit address. The write bit is then made 0. The LTC1427-50 acknowledges and the master transmits the command byte. The LTC1427 again acknowledges and latches the active bits of the command byte into register A (see the block diagram in Figure 2) at the falling edge of the acknowledge pulse. The master then sends the data byte; the LTC1427-50 acknowledges receipt of the data byte; and, finally, the 8-bit data byte and the last two output bits (the two MSBs of the 10-bit input data) from register A are latched into the register C at the falling edge of the final acknowledge and the DAC current output assumes the new 10-bit value. A stop condition is optional.

The LTC1427-50 can respond to one of four 7-bit addresses. The first five bits have been factory pro-grammed and are always 01011. The last two LSB address bits are programmed by the user via AD1 and AD0 (Table 1). When AD1 and AD0 are both connected to V_{CC}, upon power up, the 10-bit internal register C is reset to 1000000000B and the DAC output is set to midrange. If either AD1 or AD0 is connected to ground, at power-up, register C resets to 0000000000B and the DAC output is set to zero. For the LTC1427-50, the source current output (I_{OUT}) can be biased from –15V to (V_{CC} – 1.3V); precision full-scale current is trimmed to ±1.5% at room temperature and ±2.5% over the commercial temperature range.

There are two ways to shut down the LTC1427 (see Figure 2). A logic low at the SHDN pin or a logic high at bit 7 of the command byte sent through the SMBus interface will put the LTC1427 into shutdown mode. In shutdown mode, the digital data is retained internally and the supply current drops to only 12μA typically.
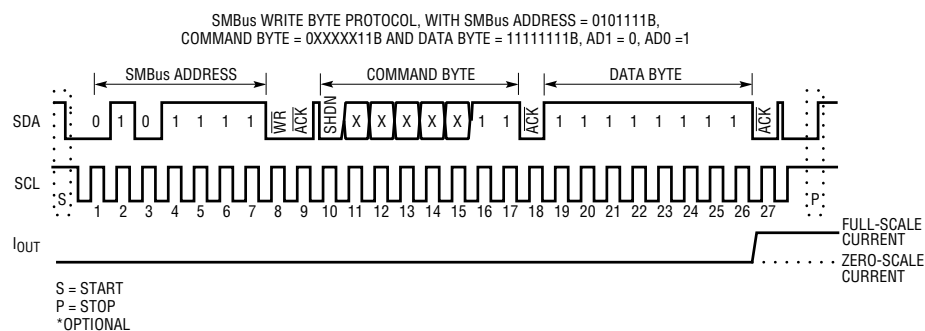

SMBus WRITE BYTE PROTOCOL, WITH SMBus ADDRESS = 0101111B, COMMAND BYTE = 0XXXXX11B AND DATA BYTE = 11111111B, AD1 = 0, AD0 =1

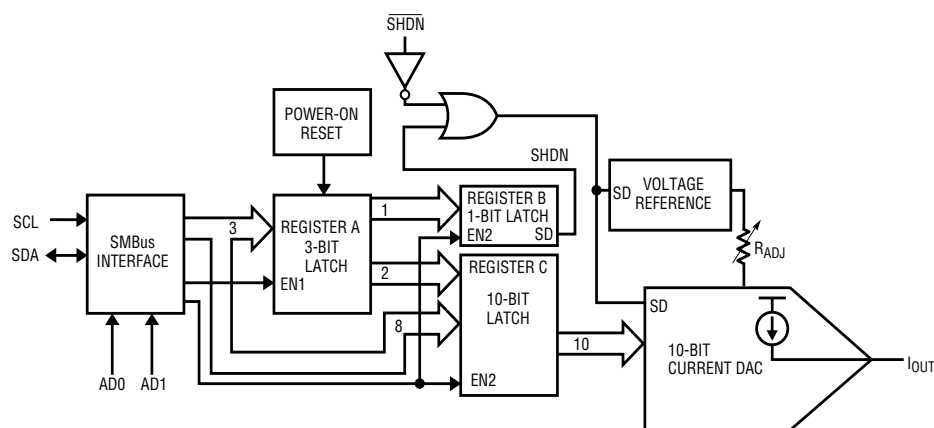Figure 1. LTC1427-50 operating sequence

Figure 2. LTC1427-50 block diagram

Table 1. LTC1427-50 function table

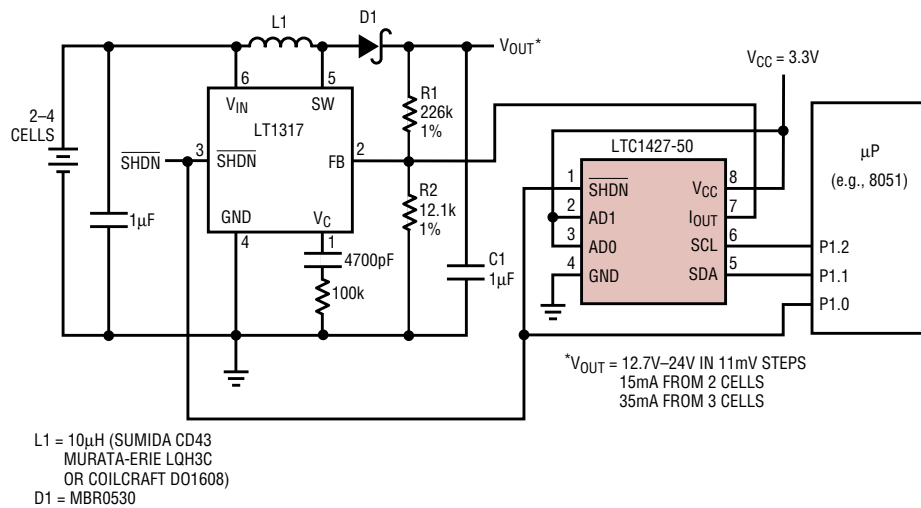| AD1	AD0	SMBus Address Location	DAC Power-Up Value	Application
L	L	0101101	Zero-scale	LCD Backlight Control
L	H	0101111	Zero-scale	General Purpose
H	L	0101110	Zero-scale	General Purpose
H	H	0101100	Mid-scale	LCD Contrast Control

Figure 3. Digitally controlled LCD bias generator

Digitally Controlled LCD Bias Generator

Figure 3 is a schematic of a digitally controlled LCD bias generator using a standard SMBus 2-wire interface. The LT1317 is configured as a boost converter, with the output voltage (V_{OUT}) determined by the values of the feedback resistors, R1 and R2. The LTC1427-50's DAC current output is connected to the feedback node of the

LT1317. The LTC1427-50's DAC current output increases or decreases according to the data sent via the SMBus. As the DAC output current varies from 0µA to 50µA, the output voltage is controlled over the range of 12.7V to 24V. A 1LSB change in the DAC output current corresponds to an 11mV change in the output voltage.

Digitally Controlled CCFL Current Using the SMBus Interface

Figure 4 is a schematic of a 90% efficient, digitally controlled floating CCFL lamp supply using the SMBus serial interface. The DAC current output is connected to the I_{CCFL} pin of LT1184F. With the DAC output current range of 0µA to 50µA, this circuit gives 0mA to 6mA lamp current for a typical display. Varying the lamp current from its minimum to maximum level adjusts the lamp intensity, and hence, the display brightness.

Conclusion

The LTC1427-50 is a precision 10-bit, 50µA full-scale DAC that communicates directly with an I^2C or SMBus interface. It operates from a wide supply range, consumes low power, has guaranteed monotonicity and is packaged in a popular SO-8. It is ideal for applications such as contrast/brightness controls, output voltage adjustment in power supplies and other potentiometer applications. ◢◤
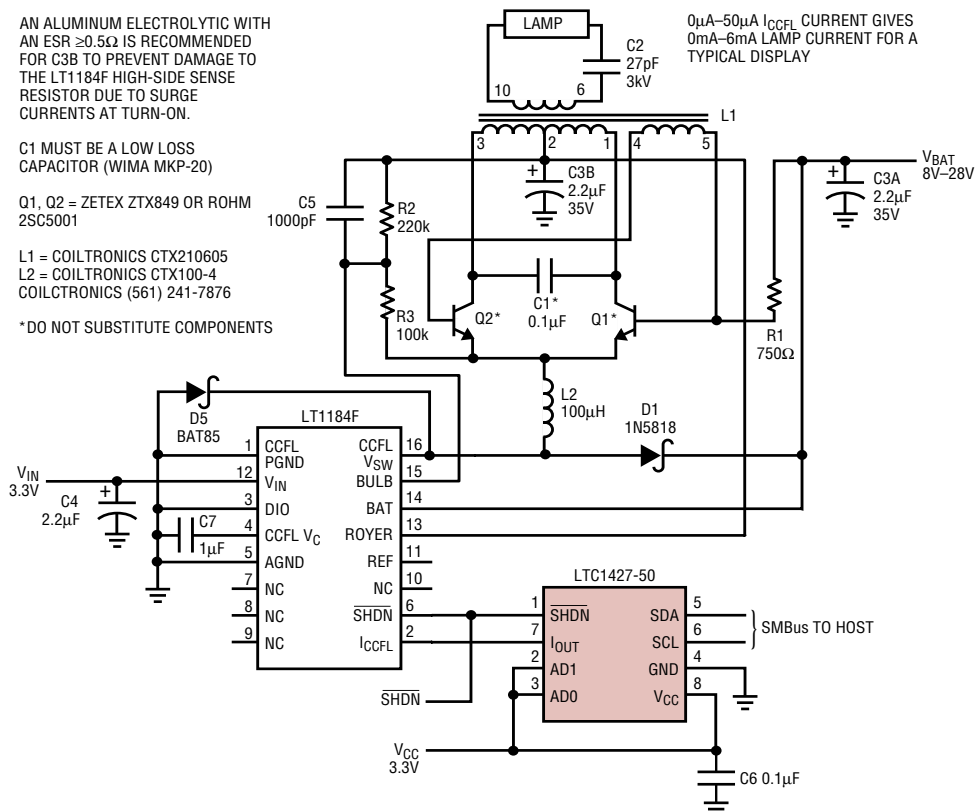

Figure 4. 90% efficient digitally controlled floating CCFL supply using the SMBus serial interface