Authentic SPI – SPI/Microwire Virtual Peripherals for SX-28

Synchronous serial interfaces are widely used to provide economical board-level interface between different devices such as microcontrollers, DACs, ADCs and other. Although there is no single standard for the synchronous serial bus, there are industry accepted guidelines based on two most popular implementations: SPI (a trademark of Motorola Semiconductor) and Microwire (a trademark of National Semiconductor). These interfaces use master-slave model and typically have three signal lines: data input line, data output line and clock line. Chip select signals from the master are used to address different slaves on the bus. The hardware realization of such an interface is a simple shift register. The data bits are shifted in/out MSB (most significant bit) first. Often the data is shifted simultaneously out from the output pin and in to the input pin.

The primary difference between the SPI and the Microwire is that SPI supports data locking on both falling and rising edges of the clock signal while the latter is always operating on the rising edge. Many IC manufacturers produce components that are compatible with SPI and Microwire. Since both standards define only the communication lines and the clock edge, other parameters vary for different devices. Clock frequencies happen to be anywhere from 100kHz to a few MHz and word lengths are from 8 to 16 or more bits. This makes it hard to create a single virtual peripheral (VP) that would work for all of these situations. Therefore a family of SPI/Microwire VPs optimized for different operating conditions was created:

SPIM	high bit-rate (1.72 - 0.2 MHz clock frequency) master mode VP
SPIS	high bit-rate (1.1 and lower clock frequency) slave mode VP
SPIML	low bit-rate (330 – 0.7659KHz clock frequency) master mode VP
SPIG	general SPI driver, which supports all the modes

All virtual peripherals support word lengths anywhere from 1 to 16 bits. SPIM VP does not use any interrupts; SPIS uses wake-up interrupts from port B (therefore is limited to PORTB pins only); and the SPI_ML uses RTCC interrupts to generate slow clock while freeing the processor for other activities in between.

Three demo programs were created to demonstrate the operation of SPI virtual peripherals.

The SPI Demo #1 uses SPIML VP working with two serial devices: the 12-bit ADC (Linear Technology LTC1594) and the 12-bit DAC (LTC1453). Special SPI evaluation board was developed for this demo program. The program executes the cycles of analog to digital conversion followed by digital to analog conversion.

The SPI Demo #2 program is similar to the #1 with the difference that the processing of sample data is offloaded to another SX-28 microcontroller. After the sample is acquired by the master SX-28, it is then transferred via high speed SPI to the slave SX-28, processed, transferred back and then output to the DAC.

The SPI Demo #3 demonstrates operation of high-speed data transfer between SPIM and SPIS, running on different SX microcontrollers.

Extensive documentation and source files are included.