Application Report
SLAA209–August 2004

Interfacing the MSOP8EVM to MSP430 Processors

Tom Hendrick *Data Acquisition Products*

ABSTRACT

This application note presents a method for interfacing the modular MSOP8EVM - an EVM for single-channel, low-power, 8- to 16-bit serial analog-to-digital converters - to the MSP430 series microcontrollers. The hardware used for this example includes the HPA449 from SoftBaugh, Inc. (www.softbaugh.com), featuring the MSP430F449. The software developed provides compile options to choose the proper data formatting for the ADS7816, ADS7817, ADS7818, ADS7822, ADS7826, ADS7827, ADS7829, ADS7835, ADS7835, ADS8320, ADS8321, ADS8324 and ADS8325.To reduce development time, the source code for this application note can be found on the Texas Instruments Web site at http://www.ti.com. Search for document number SLAA209 from the home page, and follow the links to this application note.

Contents

List of Figures

1 Introduction

The modular MSOP8EVM was designed to allow any one of 13 different high-speed, micropower analog-to-digital converters to be placed on a single PCB fabrication. This family of converters is able to gluelessly interface to the serial peripheral interface (SPI port) of most MSP430 series microcontrollers. For the development of this application note, the HPA449 Evaluation System along with the modular MSOP8 evaluation module and Embedded Workbench™ from IAR Systems were used.

2 Hardware

The combination of the HPA449 and the modular format of the MSOP8 board is a convenient way of experimenting with the MSP430 series microcontroller and the variety of data converters available on the MSOP8 evaluation module. The MSOP8 EVM plugs onto the HPA449 Evaluation System which provides a custom LCD screen to display the conversion results.

2.1 MSP430F449

While written specifically for the MSP430F449, the methods used in this application report can be adapted to most MSP430 family devices which contain at least one SPI port. Because the MSP430F449 device contains two SPI ports, it is possible to combine two MSOP8 evaluation boards onto the HPA449 Evaluation System in order to realize simultaneous sampling applications using an SPI master/slave relationship.

3 MSOP8 EVM

The modular MSOP8 EVM provides a platform to demonstrate the functionality of the ADS7816, ADS7817, ADS7818, ADS7822, ADS7826, ADS7827, ADS7829, ADS7835, ADS7835, ADS8320, ADS8321, ADS8324, and ADS8325 analog-to-digital converters. The EVM interfaces with various Texas Instruments DSPs and microcontrollers, while allowing easy access to all analog and digital signals for customized end-user applications. For more information on the EVM, search for document number SLAU115 from the main page of the Texas Instruments Web site at http://www.ti.com.

3.1 Hardware Interface

The hardware interface is seamless between the HPA449 and the MSOP8 EVM. The HPA449 Evaluation System provides buffered access to the STE, SCLK, SIMO, and SOMI pins of ports three and four on the MSP430F449. The buffers are provided for protection of the MSP430 device and would not be required in an embedded system.

The hardware connections via the HPA449 Evaluation System are shown in Figure 1. The DCLOCK, /CS, and SDO pins from the data converter are connected to SCLK, GPIO, and SOMI pins of port 3. For the purpose of this application note, it is assumed JMP2 has a shunt jumper loaded at position 2-3 (use P3.7 as the chip-select signal).

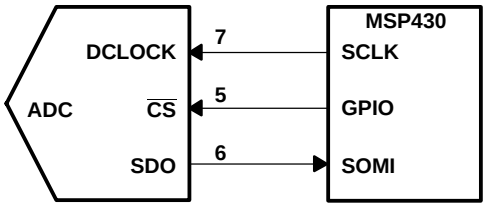

Figure 1. MSP430 Hardware Connections

4 Software Interface

The code archive associated with this application note (SLAA209.ZIP) contains one workspace folder and an IAR Embedded Workbench project. Extract the archive to any folder of your IAR Tool installation, and locate the MSOP8 workspace.

All the software was written and compiled using the evaluation version of Embedded Workbench for the MSP430 (a free download from TI) version 3.20. The most involved portion of writing the code for this simple interface is programming the serial port and formatting the received data. The *C*-style programming examples provided in the code archive can be easily adapted for most any processor or software development environment. For greater efficiency, consider converting the code to assembly language for the specific target processor.

4.1 Board Support Libraries

The archive for this software example contains all the necessary header files to enable the display function calls in the code.

4.2 SPI Port Settings

The serial port was set up using a 32-kHz watch crystal found on the HPA449 (X1). The frequency lock loop (FLL) functions of the MSP430F449 then generate a 2-MHz SPI clock to be used as the serial clock to the data converter. In the software provided for this example, the SPI port is set to a 3-wire master mode.

If a second ADC were added to the system, the SPI function of port 4 could be enabled in master mode to provide two independent ADC channels. It could also be set in slave mode, using external wiring to feed the chip select and clock from the first device to the second. As a slave device, a shunt jumper needs to be placed on J2 pins 11–13 (on the EVM) in order to transfer the returned data stream to the SIMO input. Chip select would then be wired to J2.9 (the STE input) via R10 on the EVM.

4.3 Software Flow

The software presented in this application report reads 200 samples at approximately 3 kHz continuously. Three variables (byte 0, byte 1, and byte 2) are used to store the received SPI data, which is then formatted according to the device being tested and stored in a array called adc_data. Once the array is filled, the index is reset and the process starts over again. Each stored sample is displayed on the LCD screen of the HPA449 as a decimal representation of the binary code received.

The software associated with this application note expects the MSOP8 EVM to be loaded on the *SERIAL_A* portion of the HPA449 board. This corresponds to connectors J9, J12, and J7 for the analog input, power, and digital I/O, respectively

4.4 Software Compile Options

As mentioned previously, the Embedded Workbench project associated with this application note provide conditional compile statements which allow the proper data formatting function to be called. The function called is based on the resolution of the converter being tested.

```
/******** IMPORTANT!!! Please Follow these notes!!! **********/
// Change the following entries according to the group the board under test falls in.
// Only 1 entry can be set to "1", the other three must be set to "0" (zero).
#define ADS7826 (0) //10-Bit, 4th rising, CKPL = 0
#define ADS7827 (0) // 8-Bit, 4th rising, CKPL = 0
#define ADS7816_17_22_29 (0) // 12-Bit, 5th rising, CKPL = 0
#define ADS7818_34_35 (0) // 12-Bit, 4th rising, CKPL = 0
#define ADS8320_21_25 (1) // 16-Bit, 7th rising, CKPL = 0
#define ADS8324 (0) // 14-Bit, 7th rising, CKPL = 0
/*********************************************************/
```

The preceding code can be found in the main.c file found under the MSOP8.c tab in the Embedded Workbench project manager window. Proper formatting of the data received from the data converter, as well as display of the converter type, is achieved by simply setting #define statement to 1 (true). Only one statement should be set to true – the others should remain 0 (not true).

For additional information on these and other Data Acquisition Products from Texas Instruments, visit the TI Web site at www.ti.com.

5 References

1. *MSP430x1xx Family User's Guide* (SLAU049)
2. *MSOP8 EVM Users Guide* (SLAU115)
3. *Designing Modular EVMs for Data Acquisition Products* (SLAA185)
4. HPA449 User's Manual (www.softbaugh.com)

Associated Product Data Sheets:

ADS7816	SBAS110
ADS7817	SBAS230
ADS7818	SBAS078
ADS7822	SBAS062
ADS7826/27/29	SLAS388
ADS7834	SBAS098
ADS7835	SBAS102
ADS8320	SBAS108
ADS8321	SBAS123
ADS8324	SBAS172
ADS8325	SBAS226

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265