Application Report
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Interfacing the DAC8554EVM to TMS320C6x Processors

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ABSTRACT

The DAC8554 is a quad-channel, low-power, 16-bit, serial digital-to-analog converter. This application report presents a method for interfacing the DAC8554 to the TMS320C6x-series DSKs using McBSP1 and the 5-6K interface board. The software developed for this application creates a 256-point sine table, then continuously writes values from the sine table to the DAC8554. To reduce development time, the source code for this application report is posted on the Texas Instruments web site at http://www.ti.com. Search for the appropriate device data sheet from the home page and follow the links to this application report. Project collateral discussed in this application report can be downloaded from the following URL: www.ti.com/lit/zip/SLAA300.

Contents

1 Introduction 1
2 Hardware 1
3 Software Interface 2
4 References 4

List of Figures

1 Basic Hardware Interface Schematic 2
2 Software Flow Chart 4

List of Tables

1 Introduction

The DAC8554 is a quad-channel, 16-bit digital-to-analog converter (DAC), offering low-power operation and a flexible 3-wire serial interface with triple buffering. This DAC is 16-bit monotonic and has good linearity, typically at 4 LSB with very low glitch energy. The converter directly interfaces to the TMS320C6x digital signal processors and is capable of operating with input data clock frequencies of up to 50 MHz for IOV_{DD} of 5 V. For development of this application report, the TMS320C6711, TMS320C6414, and TMS320C6713 DSP starter kits (DSK) along with the DAC8554EVM were used in conjunction with the 5-6K interface board.

2 Hardware

The combination of the TMS320C6x DSK and the 5-6K interface board is a convenient tool for evaluation and development with the TMS320C6x series DSPs and the DAC8554. The DAC8554EVM plugs onto the 5-6K interface board, which then plugs directly into the DSK through mating connectors compatible with the TMS320 cross-platform daughtercard interface connectors (described in document number SPRA711) on the DSK platform.

2.1 TMS320C6x DSKs

The TMS320C6x DSP starter kits (DSKs) provide an introduction to C6000 DSP platform technology and are powerful enough to use for rapid development of networking, communications, imaging, and other applications like data acquisition. See the TI web site for more information on the TMS320C6x series DSKs .

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2.2 DAC8554EVM

The DAC8554 is one of many resistor-string architecture serial DACs available from Texas Instruments. The DAC8554EVM provides a platform to demonstrate the functionality of the DAC8554 device 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 SBAU121 from the home page of the Texas Instruments web site.

2.3 Hardware Interface

The DAC8554EVM interfaces seamlessly to the C6x DSKs. The 5-6K interface board provides direct access to the C6711- and C6713-DSK McBSP ports zero and one and to the C6416-DSK McBSP ports zero and two.

For the C6416 DSK, the McBSP2 is mapped to the peripheral connector at the same locations as the McBSP1 on the C6711 and C6713 DSKs. The information in subsequent sections describes the McBSP2 port signals of the C6416 DSK.

The hardware connections via the 5-6K interface board are shown in Figure 1. The SCLK, SYNC, and D_{IN} pins from the DAC8554 are connected to the CLKX, FSX, and DX pins of McBSP1, respectively (CLKX2, FSX2, and DX2 for the C6416). The EN, LDAC, A0, and A1 pins are grounded via jumpers on the DAC8554EVM. The LDAC input is grounded to configure the DAC-update function for software control.

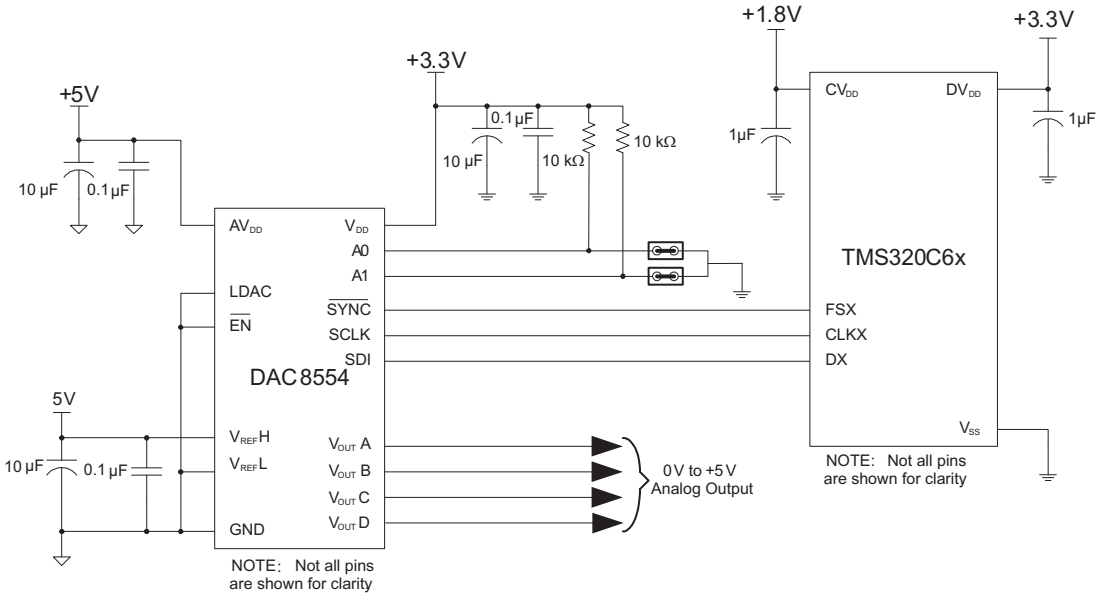

Figure 1. Basic Hardware Interface Schematic

3 Software Interface

The code archive associated with this application report (SLAA300.ZIP) contains three folders and three separate Code Composer Studio (CCS) projects. The three project folders identify the associated processor. Extract the archive to the *myprojects* folder of your CCS installation and locate the DAC8554_xxxx folder for your installed DSK (replace xxxx with 6711, 6713 or 6416).

The software was written and compiled using CCS version 2.20. The most involved portion of writing the code for this simple interface is programming the McBSP. If an earlier version of CCS is used, the DSP configuration file (DAC8554.cbd) associated with the project must be re-created.

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3.1 Board Support Libraries

The C6416 and C6713 DSKs both use board support library files (*.bsl) in order to assign the McBSP signals to the 5-6K interface board. The library files must be included in the projects in order for the code examples to work properly. Copies of the appropriate .bsl files are located in the software example archive.

3.2 McBSP Configuration

The user interface of the configuration tool makes it easy to write programs and configure the McBSP. To set up the McBSP registers, double click on the .cdb file (in the code example provided, choose DAC8554.CDB from the DSP/BIOS Config tab) from within the project window. Browse through the CDB tree to find the McBSP configuration manager under CSL. Right click on mcbspCfgx and select properties. This is where the McBSP registers are available as tabs, with individual bit-field settings provided as pulldown options. Once all options are selected, click OK, then choose Rebuild All from the Project pulldown menu. Register options can be confirmed by opening the file DAC8554cfc_c.c under the *Generated Files* branch in the project manager window. The generated code for the C6711 DSK project example used in this application is shown in the following box.

```
MCBSP_Config mcbspCfg1 = { 0x00000000, /* Serial Port Control Reg. (SPCR) */ 0x00000000, /*
Receiver Control Reg. (RCR) */ 0x00010080, /* Transmitter Control Reg. (XCR) */ 0x30180002, /*
Sample-
Rate Generator Reg. (SRGR) */ 0x00000000, /* Multichannel Control Reg. (MCR) */ 0x00000000, /*
Receiver Channel Enable(RCER) */ 0x00000000, /* Transmitter Channel Enable(XCER) */ 0x00000A00
/* Pin Control Reg. (PCR) */ };
```

McBSP1 of the C6711 DSK is programmed as a serial port in nonstop clock mode (or DSP mode). Frame sync and serial clock transmit signals are output pins. The transmitter is set for 24-bit transfers with a one bit delay. The frame sync (FSX1) is generated by the sample rate generator and is used to strobe the SYNC signal on the DAC8554 by J2-7 on the EVM.

In the C6711 DSK sample code, the DAC8554 is updated at a 1-MHz rate with a 25-MHz serial clock. The C6711 DSK clocks the C6711 DSP at 150 MHz. The sample rate generator clock source is one-half the CPU clock frequency, or 75 MHz. The 25-MHz clock on CLKX is derived by setting the CLKGDV bit field in the sample rate generator register to three. The formula for calculating the serial clock is given in the following equation.

CLOCK = (CPUCLOCK / 2) / (CLKDIV + 1)

By the equation above, each clock cycle is approximately 40 ns, triggering a frame-sync pulse every 25 serial-clock cycles to yield an update rate of 1 MHz. The 25-cycle period is set in the frame-period (FPER) field in the sample-rate generator register.

3.3 DAC Commands

Header file DAC8554CMD.h is included in the project directories of the software archive associated with this application report. This header file defines the command instructions that are sent to the DAC8554. For the purposes of this application report, the DAC8554 is set to broadcast mode. All DAC outputs are updated each time the SYNC (via FSx) pin is toggled.

3.4 Software Flow

The software presented in this application report creates a 256-point sine table. The software simply initializes the sine table and then writes the value to the serial port. All register and peripheral programming is done during initialization using the options selected with the configuration tool. The DSP/BIOS pre-initializes all McBSP registers and other DSP registers before arriving in the main function. The main function simply initializes the interrupt service routine (ISR) and McBSP1, and then the DSP/BIOS and McBSP-receive ISR do all of the work. When a McBSP1 transmit interrupt occurs, McBSP1Xmt writes the values stored in the sine table along with the DAC command byte defined in DAC8554CMD.h.

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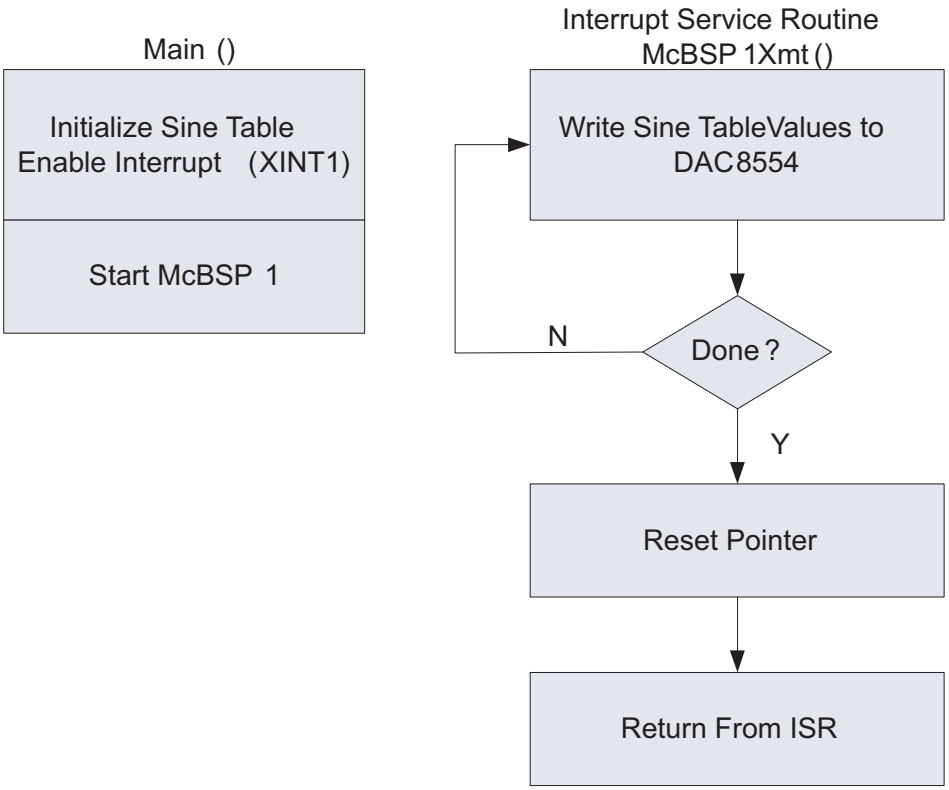

Figure 2. Software Flow Chart

4 References

1. DAC8554 data sheet (SLAS431)
2. TMS320C6X data sheet (SPRS088)
3. TMS320C6000 DSP/BIOS User's Guide (SPRU303)
4. TMS320 Cross-Platform Daughtercard Specification Revision 1.0 (SPRA711)
5. 5-6K Interface Board EVM User's Guide (SLAU104)
6. DAC8554 Evaluation Module User's Guide (SBAU121)
7. Designing Modular EVMs for Data Acquisition Products (SLAA185)

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