BUF20800/20820EVM User Guide and Software Tutorial

This user's guide describes the characteristics, operation, and use of the BUF20800/20820EVM evaluation board. It discusses how to set up and configure the software and hardware, and reviews various aspects of the program operation. Throughout this document, the terms *evaluation board*, *evaluation module*, and *EVM* are synonymous with the BUF20800/20820EVM. This document also includes information regarding operating procedures and input/output connections, an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the EVM.

Contents

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1 Overview

The BUF20800 and BUF2082 are programmable gamma-voltage generators and V_{COM} calibrators. The BUF20800 offers two banks of 18 programmable gamma channels and two programmable V_{COM} channels, making it ideal for 10-bit source TFT-LCD reference drivers. The BUF20820 also features programmable OTP memory that allows the user to store the gamma voltages on-chip, which eliminates the need for an external EEPROM. The BUF20800/20820EVM is a platform for evaluating the performance of either the BUF20800 or BUF20820 under various signal, reference, and supply conditions. This document gives a general overview of the BUF20800/20820EVM, and provides a general description of the features and functions to be considered while using this evaluation module. Unless otherwise noted, all references to the device under test (DUT) apply to both the BUF20800 and the BUF20820.

1.1 BUF20800/20820EVM Kit Contents

Table 1 summarizes the contents of the BUF20800/20820EVM kit. Figure 1 shows all of the included hardware. Contact the Texas Instruments Product Information Center nearest you if any component is missing. It is highly recommended that you also check the BUF20800 product folder or the BUF20820 product folder on the TI web site at www.ti.com to verify that you have the latest versions of the related software.

Table 1. BUF20800/20820EVM Kit Contents

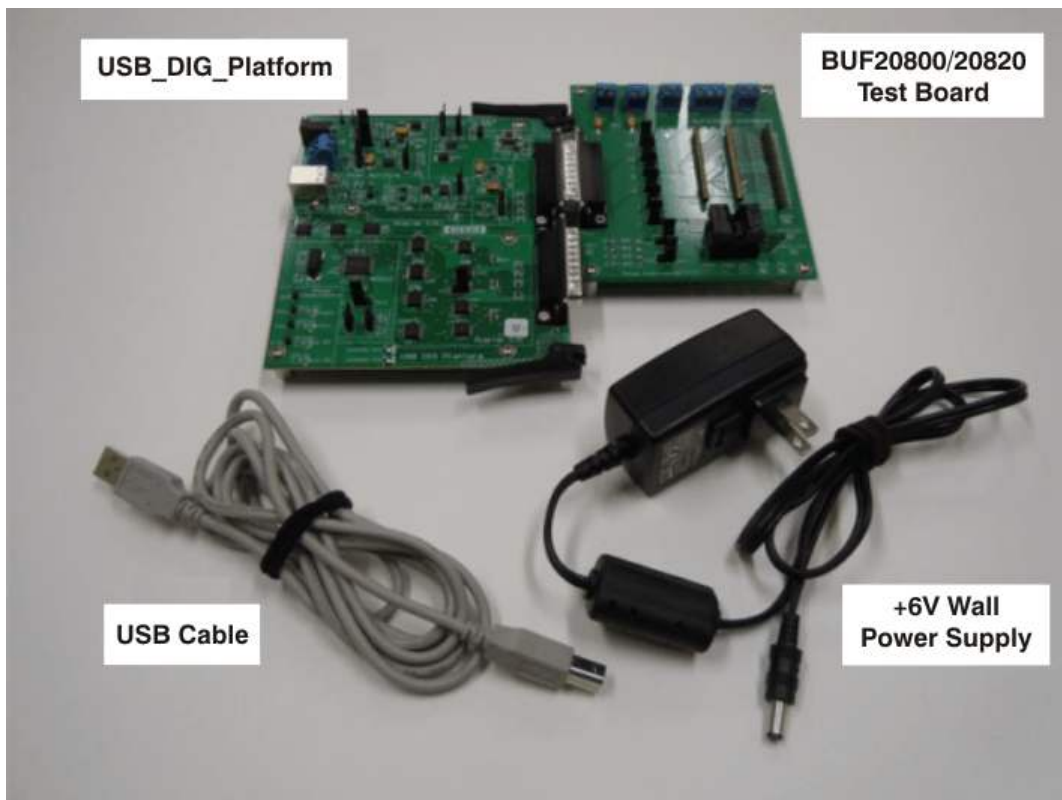| Item	Quantity
BUF20800/20820 PCB Test Board	1
USB_DIG_Platform PCB	1
USB Cable	1
+6V Power Supply	1
User's Guide CD-ROM	1

Figure 1. Hardware Included with BUF20800/20820EVM Kit

1.2 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instruments' integrated circuits used in the assembly of the BUF20800/20820EVM. This user's guide is available from the TI web site under literature number **SBOU100**. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI web site, or call the Texas Instruments' Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Related Documentation

Document	Literature Number
BUF20800/20820 Product Data Sheet	SBOS329
USB_DIG_Platform User Guide	SBOU058

2 BUF20800/20820EVM Hardware Setup

Figure 2 shows the system setup for the BUF20800/20820EVM. The PC runs software that communicates with the USB_DIG_Platform. The USB_DIG_Platform generates the analog and digital signals used to communicate with the BUF20800/20820 board. Connectors on the BUF20800/20820 allow the user to connect to the system under test conditions where the power, current, and voltage are monitored.
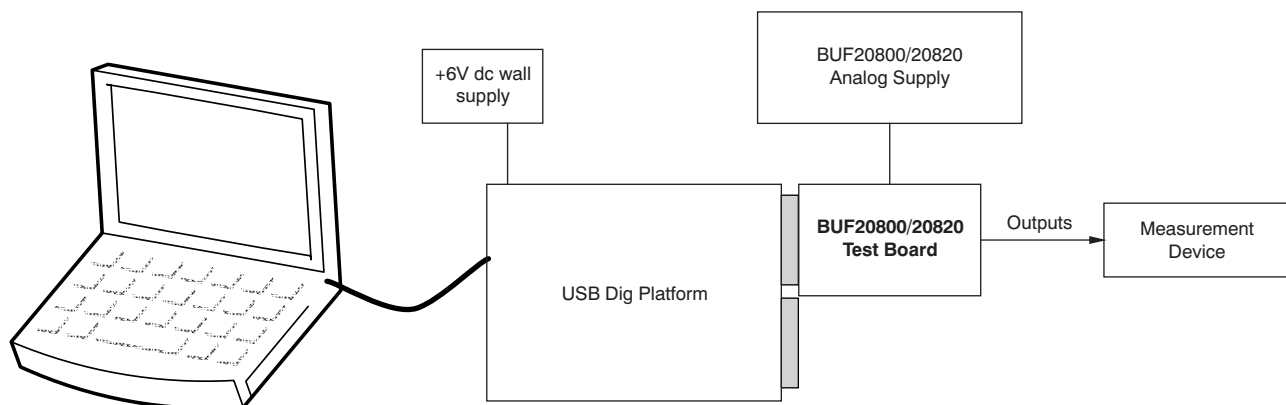
Figure 2. BUF20800/20820EVM Hardware Setup

2.1 Theory of Operation for BUF20800/20820 Hardware

A block diagram of the BUF20800/20820 test board hardware setup is shown in Figure 3. The functionality of the PCB is such that it provides connections to the I²C™ interface and general-purpose inputs/outputs (GPIOs) on the USB_DIG_Platform board. It also provides connection points for external connections of the shunt voltage, bus voltage, and ground.

Figure 3. BUF20800/20820EVM Board Block Diagram

2.2 Signal Definitions of J1 (25-Pin Male DSUB)

Table 2 lists the different signals connected to J1 on the BUF20800/20820EVM test board.

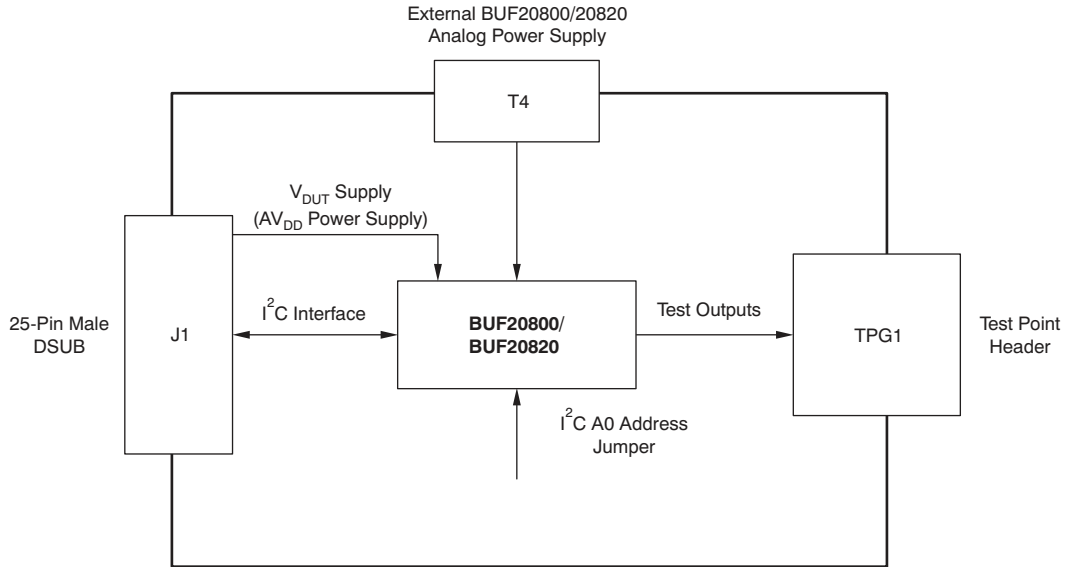**Table 2. Signal Definition of J1 (25-Pin Male DSUB) on BUF20800/20820EVM Board**

Pin on J1	Signal	BUF20800/20820 Pin
1	N/C	No connection
2	N/C	No connection
3	N/C	No connection
4	N/C	No connection
5	N/C	No connection
6	N/C	No connection
7	N/C	No connection
8	N/C	No connection
9	I2C_SCK	No connection
10	I2C_SDA2	No connection
11	N/C	No connection
12	I2C_SCK_ISO	I^2C clock signal (SCL) channel 1; can be disconnected using a switch
13	I2C_SDA_ISO	I^2C data signal (SDA) channel 1; can be disconnected using a switch
14	N/C	No connection
15	N/C	No connection
16	N/C	No connection
17	V_{DUT}	Switched 3V/5V power. Note that when power is switched off, digital I/O is also switched off.
18	V_{CC}	No connection
19	N/C	No connection
20	N/C	No connection
21	GND	Common ground connection
22	SPI_SCK	No connection
23	SPI_CS1	No connection
24	SPI_DOUT1	No connection
25	SPI_DIN1	No connection

2.2.1 Theory of Operation for USB_DIG_Platform

Figure 4 shows the block diagram for the USB_DIG_Platform. This platform is a general-purpose data acquisition system that is used on several different Texas Instruments evaluation modules. The details of its operation are included in a separate document, SBOU058 (available for download at www.ti.com). The block diagram shown in Figure 4 gives a brief overview of the platform. The primary control device on the USB_DIG_Platform is the TUSB3210.
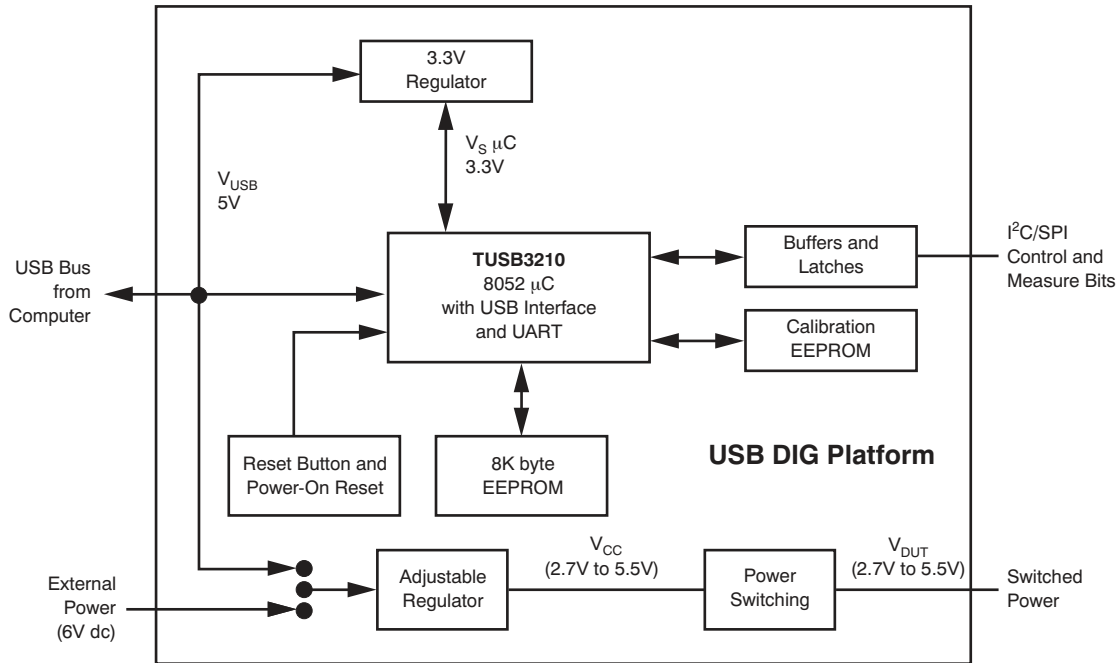

Figure 4. USB_DIG_Platform Block Diagram

3 BUF20800/20820EVM Hardware Overview

The BUF20800/20820EVM hardware overview involves connecting the two PCBs of the EVM together, applying power, connecting the USB cable, and setting the jumpers. This section presents the details of this procedure.

3.1 *Electrostatic Discharge Warning*

CAUTION

Many of the components on the BUF20800/20820EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

3.2 Typical Hardware Connections

To set up the BUF20800/20820EVM hardware, connect the two PCBs of the EVM together, and apply a power source to the BUF20800/20820EVM test board. The external connections may be the real-world system that the BUF20800 or BUF20820 will be incorporated into. Figure 5 illustrates the typical hardware connections.
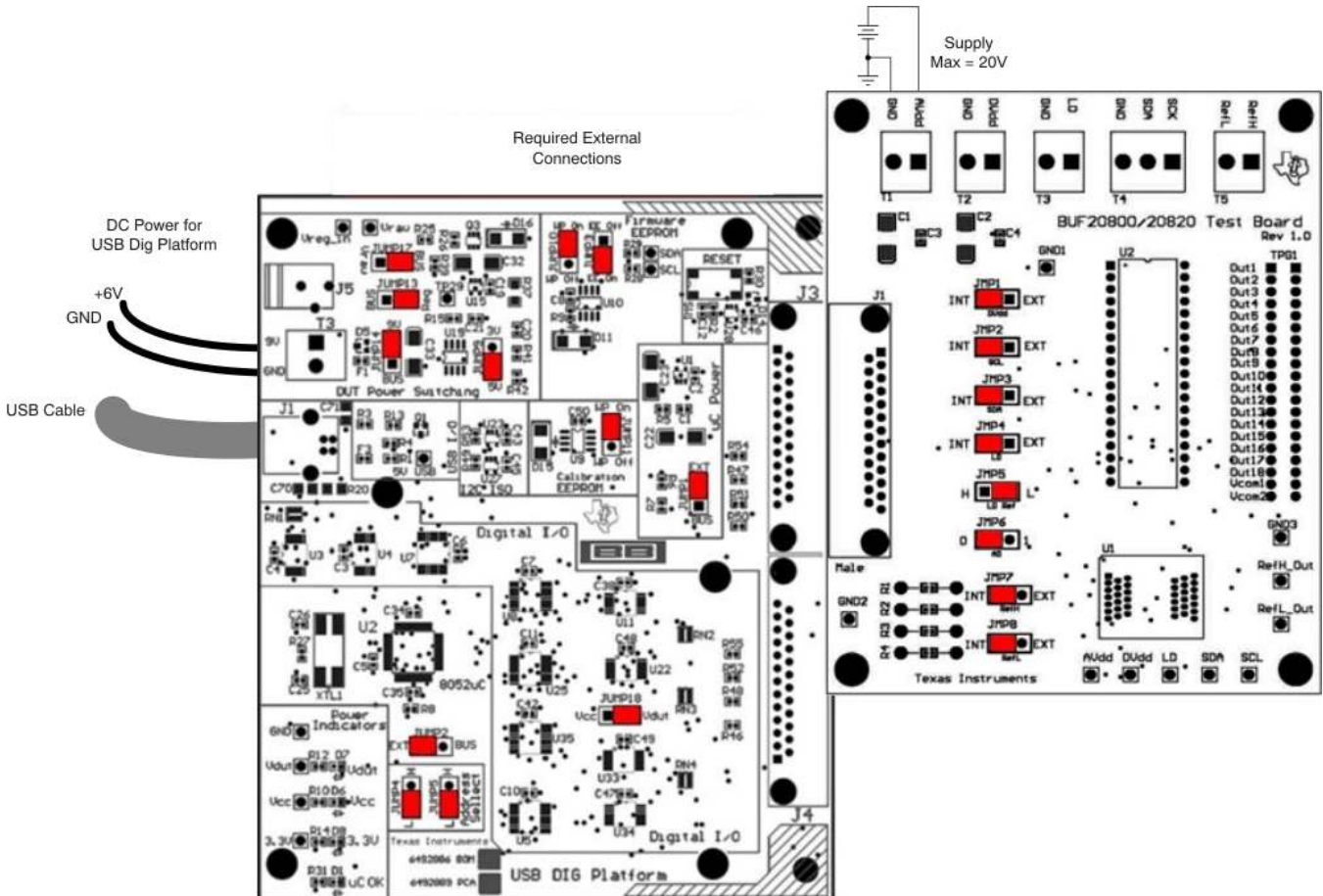

Figure 5. Typical Hardware Connections for BUF20800/20820EVM

3.3 Connecting the Hardware

To connect the two PCBs of the BUF20800/20820EVM together, gently push on both sides of the DSUB connectors (as shown in Figure 6). Note that the USB_DIG_Platform board has two DSUB connectors; either may be used. Make sure that the two connectors are completely pushed together; loose connections may cause intermittent operation.

3.4 Connecting Power

After the two parts of the BUF20800/20820EVM are conjoined, connect a +6V wall supply to the USB_DIG_Platform board, as Figure 6 shows. Always connect power before connecting the USB cable. If you connect the USB cable before connecting the power, the computer will attempt to communicate with an unpowered device that will not be able to respond.

In addition, the BUF20800/20820EVM also requires an external power source. This source is not included with the kit. Its voltage may differ depending on your testing needs, and it will be connected to the terminal T1.
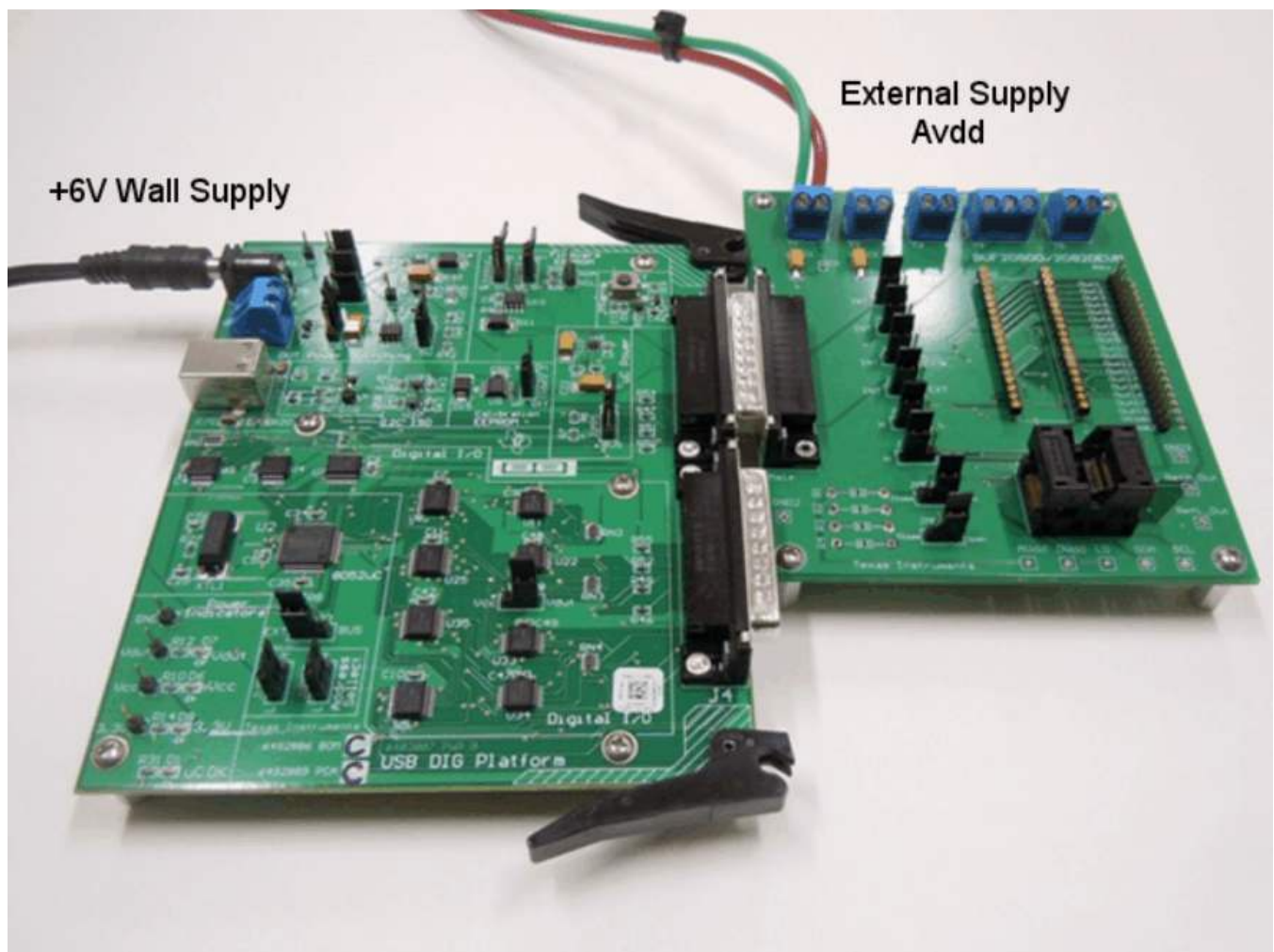

Figure 6. Connecting External Power to the EVM

3.5 Connecting the USB Cable to the BUF20800/20820EVM

Once power is connected, the USB cable must be connected to the USB_DIG_Platform, as shown in Figure 7. Note that the BUF20800/20820EVM test board and the USB_DIG_Platform board must each be powered on before connecting the USB cable. Typically, the computer will respond with a *Found New Hardware, USB Device* pop-up dialog. The pop-up window typically changes to *Found New Hardware, USB Human Interface Device*. This pop-up indicates that the device is ready to be used. The USB_DIG_Platform uses the human interface device drivers that are part of the Microsoft® Windows® operating system.
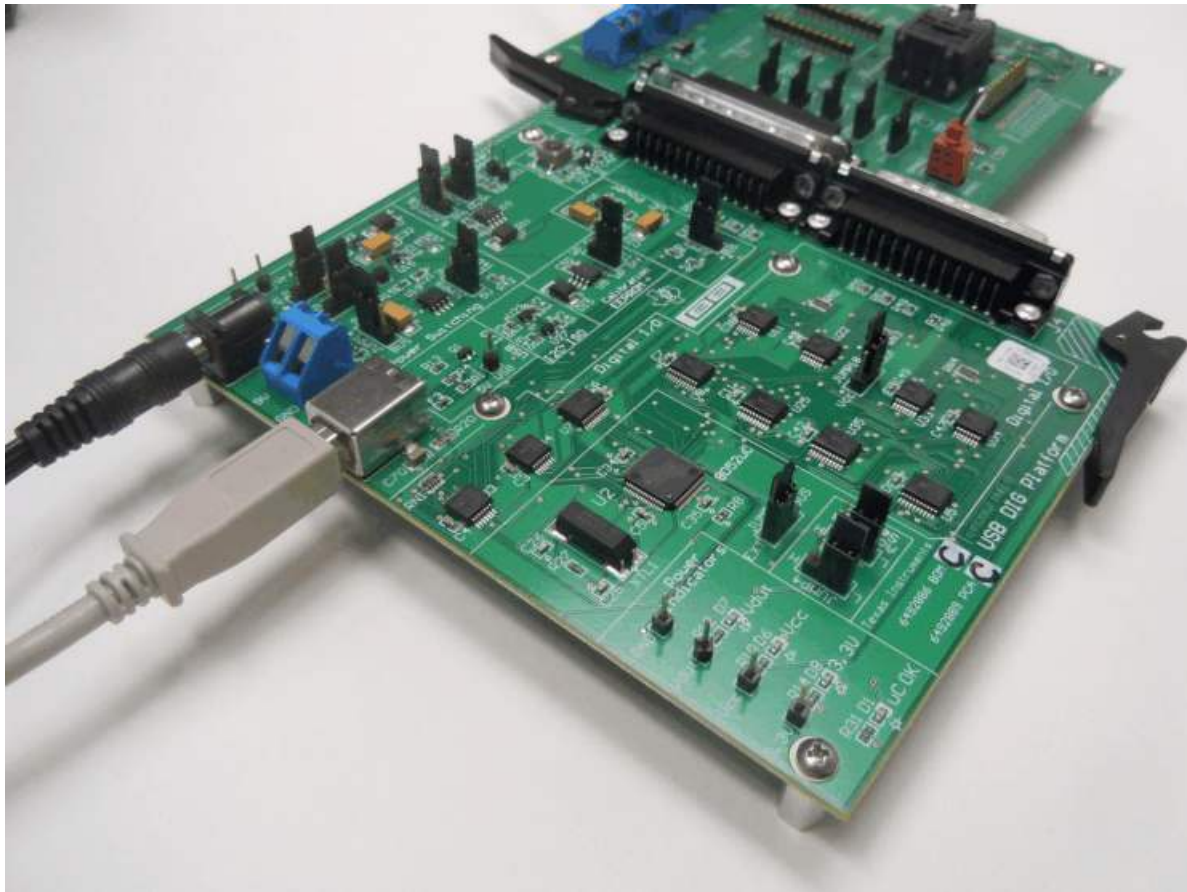

Figure 7. Connecting the USB Cable to the USB_DIG_Platform

In some cases, the Windows *Add Hardware Wizard* may pop up. If this prompt appears, allow the system device manager to install the human interface drivers by clicking **Yes** when requested to install drivers. Windows will confirm installation of the drivers with the message shown in Figure 8.

Figure 8. Confirmation of USB_DIG_Platform Driver Installation

3.6 BUF20800/20820EVM Default Jumper Settings

Figure 9 shows the default jumpers configuration for the BUF20800/20820EVM. In general, the jumper settings of the USB_DIG_Platform will not need to be changed. You may want to change some of the jumpers on the BUF20800/20820EVM board to match your specific configuration. For instance, you may wish to set a specific I²C address on the DUT.
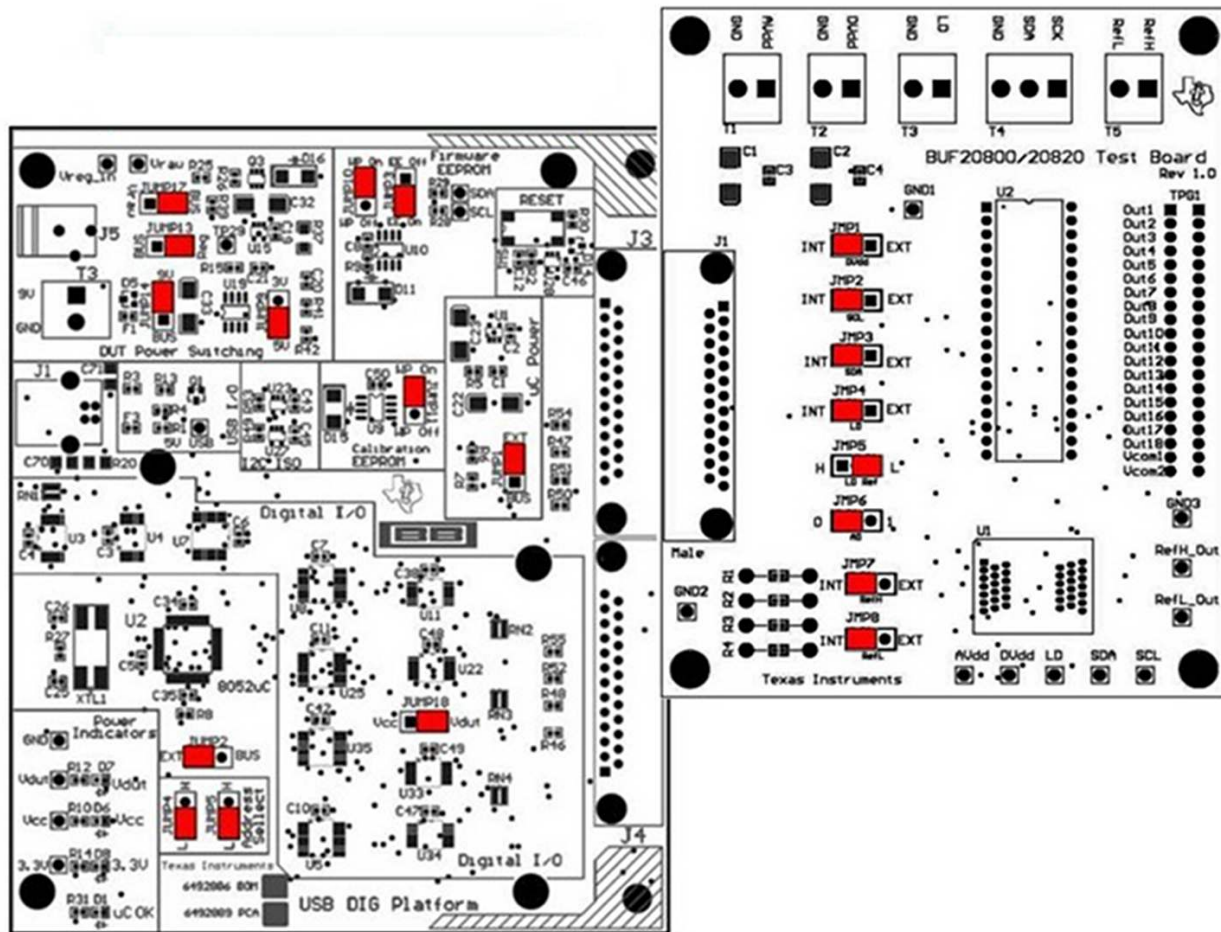

Figure 9. BUF20800/20820EVM Default Jumper Settings

Jumpers 1 through 4 on the BUF20800/20820EVM are all typically set to the same position. When set to the INT position, the signals from the digital supply (JMP1) and the digital communication lines (JMP2-JMP4) are generated and controlled from the USB_DIG_Platform or by the onboard bank select switch. When these jumpers are set the EXT position, the signals from JMP1-JPM4 connect to the terminal strips T2, T3, and T4. Jumper 6 controls the I²C address pin for the BUF20800/20820; this jumper can set the address for A0 to either high or low. Jumper 5 can be set to low or high to hard set the LD signal to the BUF20800/20820 as long as JMP4 is configured correctly.

Table 3 summarizes the function of the BUF20800/20820EVM board jumpers. For most application, Jumpers 2 through 5 are all set to the default positions.

Table 3. BUF20800/20820EVM Test Board Jumper Functions

Jumper	Default	Purpose
JMP1	INT	This jumper selects whether the DV_{DD} digital supply pin on the BUF20800 or BUF20820 is connected to the V_{DUT} signal generated from the USB_DIG_Platform or whether DV_{DD} is connected to terminal T2 to allow for an external supply to power the digital circuitry. The default INT position connects the DV_{DD} pin to the V_{DUT} control signal
JMP2	INT	This jumper selects whether the SCL pin on the BU20800 or BUF20820 is connected to the I2C_SCK_ISO signal generated from the USB_DIG_Platform or whether the SCL pin is connected to terminal T4 to allow for an external source to control the I^2C clock line. The default INT position connects the SCL pin to the I2C_SCK_ISO control signal.
JMP3	INT	This jumper selects whether the SDA pin on the BUF20800 or BUF20820 is connected to the I2C_SDA_ISO signal generated from the USB_DIG_Platform or whether the SDA pin is connected to terminal T4 to allow for an external source to control the I^2C data line. The default INT position connects the SDA pin to the I2C_SDA_ISO control signal.
JMP4	INT	This jumper selects whether the LD pin on the BUF20800 or BUF20820 is connected to jumper JMP5 or whether the LD pin is connected to terminal T3 to allow for an external source to control the latch pin. The default INT position connects the LD pin to jumper JMP5.
JMP5	L	This jumper selection depends on the configuration of JMP4. In the event that JMP4 is set to INT, JMP5 is used to select whether or not the LD pin on the BUF20800 or BUF20820 is connected to the DV_{DD} digital supply or whether the LD pin is connected to ground. The default LOW position connects the LD pin to ground. If JMP4 is set to the EXT position, JMP4 is not used.
JMP6	0	This jumper selects the I^2C A0 address selection. Two separate I^2C addresses can be selected depending on whether JMP6 is set high or low.
JMP7	INT	This jumper selects whether or not the RefH pin on the BUF20800 is connected or BUF20820 to the AV_{DD} signal generated by the external analog power-supply input at terminal T1, or whether the RefH pin is connected to a user-designated reference, which is set using an external input at terminal T5 as well as resistors R1 and R2. The default INT position connects the RefH pin to the external power-supply input at terminal T1.
JMP8	INT	This jumper selects whether or not the RefL pin on the BUF20800 is connected to ground or whether the RefL pin is connected to a user-designated reference, which is set using an external input at terminal T5 as well as resistors R3 and R4. The default INT position connects the RefL pin to ground.

Table 4 summarizes the function of the USB_DIG_Platform jumpers. For most applications, the default jumper position should be used. A separate document (SBOU058) gives details regarding the operation and design of the USB_DIG_Platform.

Table 4. USB_DIG_Platform Jumper Functions

Jumper	Default	Purpose
JUMP1	EXT	This jumper selects external power or bus power. External power is applied on J5 or T3 (9V dc). Bus power is 5V from the USB bus. External power is typically used because the USB Bus power is noisy.
JUMP2	EXT	Same as JUMP1.
JUMP3	EE ON	This jumper determines where the TUSB3210 will load the USB_DIG_Platform firmware upon power-up or reset. The *EE Off* position is used for development for development or firmware update.
JUMP4, JUMP5	L, L	This jumper sets the address for the USB board. The only reason to change from the default setting is if multiple boards are being used.
JUMP9	5V	This jumper selects the voltage of the device under test supply (V_{DUT} = 5V or 3V). This jumper is typically the only jumper that is changed for most applications.
JUMP10	WP ON	This write protects the firmware EEPROM.
JUMP11	WP ON	This write protects the calibration EEPROM.
JUMP13	REG	Uses the regulator output to generate the V_{DUT} supply. The USB bus can be used as the V_{DUT} supply.
JUMP14	9V	Uses the external power (9V as opposed to the bus).
JUMP17	BUS	While in the BUS position V_{DUT} operation is normal. While in the V_{RAW} position the V_{DUT} supply is connected to an external source. This configuration allows for any value of V_{DUT} between 3V and 5V.[1]
JUMP18	V_{DUT}	Connects the pull-up on GPIO to the V_{DUT} supply or the V_{CC} supply.

[1] **CAUTION:** Adjusting outside of this range will damage the EVM.

3.7 BUF20800/20820EVM Features

This section describes some of the hardware features present on the BUF20800/20820 test board.

3.7.1 JMP1: DV_DD Control Setting

Jumper JMP1 selects where the BUF20800 or BUF20820 digital supply pin is connected. If JMP1 is set to the INT position, the DV_{DD} pin is connected to the switchable V_{DUT} signal generated from the USB_DIG_Platform. This voltage can be set to either +3.3V or +5V depending on how JMP9 on the USB_DIG_Platform is set. While JMP1 is set to the INT position, the **DV_DD Power** button in the BUF20800/20820 software is able to control whether the V_{DUT} supply voltage is turned on or off.

When JMP1 is set in the EXT position, an external supply connected to terminal T1 can be used to provide the digital supply voltage for the BUF20800 or BUF20820.

3.7.2 JMP2: I²C SCL Control Setting

Jumper JMP2 selects where the BUF20800 or BUF20820 I²C SCL pin is connected. If JMP2 is set to the INT position, the I²C clock signal is generated from the I2C_SCK_ISO signal from the USB_DIG_Platform.

When JMP2 is set to the EXT position, an external source connected to SCL pin of terminal T4 can be used to provide the I²C SCK signal for the BUF20800 or BUF20820.

3.7.3 JMP3: I²C SDA Control Setting

Jumper JMP3 selects where the BUF20800 or BUF20820 I²C SDA pin is connected. If JMP4 is set in the INT position, the I²C data signal is generated from the I2C_SDA_ISO signal from the USB_DIG_Platform.

When JMP3 is set in the EXT position, an external source connected to SDA pin of terminal T4 can be used to provide the I²C SDA signal for the BUF20800 or BUF20820.

3.7.4 JMP4: LD Control Setting

Jumper JMP4 selects which input the LD latch pin of the BUF20800 or BUF20820 is connected to. If JMP4 is set in the INT position, it is routed through the JMP5 jumper where the reference voltage can be set high or low (see Section 3.7.5).

When JMP4 is set to the EXT position, an external source connected to the LD pin of terminal T3 can be used to provide a reference voltage for the latch pin, which dictates the method by which the DAC output voltage is updated.

3.7.5 JMP5: LD Reference Setting

Jumper JMP5 is used to select the reference voltage that is connected to the LD latch pin. It is used only when jumper JMP4 is set to INT. If JMP5 is set to *H*, the latch pin is connected to the DV_{DD} supply voltage, which allows all DAC output voltages to retain the respective values during data transfer until LD sees a low reference (such as when JMP5 is set to the *L* position).

When JMP5 is set to the *L* position, the LD latch pin is connected to ground, which then updates each DAC output voltage whenever its corresponding register is updated.

3.7.6 JMP6: I²C Address Hardware Setting

Jumper JMP6 is used to set the hardware setting for the A0 I²C address pin on the BUF20800 or BUF20820. Using JMP6, the A0 address can be set to either logic '1' or logic '0' to allow for two unique I²C addresses. See Section 5.2.1 on how to configure the BUF20800/20820EVM software to match the JMP6 hardware setting.

3.7.7 JMP7: RefH Control Setting

Jumper JMP7 selects where the BUF20800 or BUF20820 high reference supply pin RefH is connected. If JMP7 is set to the INT position, RefH is connected to AVDD, the external analog supply input at terminal T1.

When JMP7 is set to the EXT position, the reference voltage is then designated by using the RefH pin of terminal T5 along with resistors R1 and R2. An external power supply is connected to the RefH pin of terminal T5, and R1 and R2 act as a voltage-divider circuit; the user sets the values of R1 and R2 to achieve the desired reference voltage using Equation 1:

$$RefH = V_{SUP\_H}\left(\frac{R2}{R1 + R2}\right)$$

(1)

Where V_{SUP_H} is the input supply voltage seen at the RefH pin of terminal T5.

3.7.8 JMP8: RefL Control Setting

Jumper JMP8 selects where the BUF20800 or BUF20820 low reference supply pin RefL is connected. If JMP8 is set to the INT position, RefL is connected to ground.

When JMP8 is set to the EXT position, the reference voltage is then designated by using the RefL pin of terminal T5 along with resistors R3 and R4. An external power supply is connected to the RefH pin of terminal T5, and R3 and R4 act as a voltage-divider circuit; the user sets the values of R3 and R4 to achieve the desired reference voltage using Equation 2:

$$\text{RefL} = V_{SUP\_L} \left(\frac{R4}{R3 + R4} \right)$$

(2)

Where V_{SUP_L} is the input supply voltage seen at the RefL pin of terminal T5.

3.7.9 BUF20800/20820 Device Placement

The BUF20800/20820EVM offers the user two separate locations on the PCB where the BUF20800 of BUF20820 test device can be installed. The U1 location on the BUF20800/20820EVM test board is a 38-pin, QFN/MLF test socket that allows the user to evaluate and program many devices very quickly. One drawback to this socket is that there is no connection to the PowerPAD™ of the BUF20800 or BUF20820 DUT. Because of this limitation, while in this socket, the BUF20800/20820 device cannot operate at its full output capability as a result of thermal dissipation restrictions.

The U2 location allows for a BUF20800 or BUF20820 device that is soldered down on a DIP adapter board to be installed on the BUF20800/20820EVM test board. The output capability of the BUF20800 or BUF20820 device that is soldered on this adapter board can be fully evaluated. The PowerPAD of this soldered BUF20800/20820 unit is connected correctly, allowing the device to dissipate the necessary power while being evaluated.

CAUTION

Only one location should be populated at a time. The use of both locations simultaneously will damage one or both of the devices being tested.

3.7.10 Terminal Strip TPG1

Terminal strip TPG1 provides the individual output signals on a single row of headers as well as a row of vias. This footprint provides the user with multiple options regarding how to interface the output signals of the BUF20800 or BUF20820 with the available display panel. Users can develop a custom cable to connect the headers to their respective panels directly, or to solder directly to the individual vias.

4 BUF20800/20820EVM Software

4.1 Hardware Requirements

The BUF20800/20820EVM software has been tested on Microsoft® Windows® XP, Vista, and Windows 7 operating systems (OS) with United States and European regional settings.

4.2 Software Installation

The BUF20800/20820EVM software is included on the CD that is shipped with the EVM kit. It is also available through the BUF20800/20820EVM product folder on the TI web site. To install the software to a computer, insert the disc into an available CD-ROM drive. Navigate to the drive contents and open the BUF20800/20820EVM software folder. Locate the compressed file (*BUF20800/20820EVM.zip*) and open it using WinZIP® or a similar file compression program; extract the BUF20800/20820EVM files into a specific BUF20800/20820EVM folder (for example, *C:\BUF20800/20820EVM*) on your hard drive.

Once the files are extracted, navigate to the BUF20800/20820EVM folder you created on the hard drive. Locate the *setup.exe* file and execute it to start the installation, as shown in Figure 10.
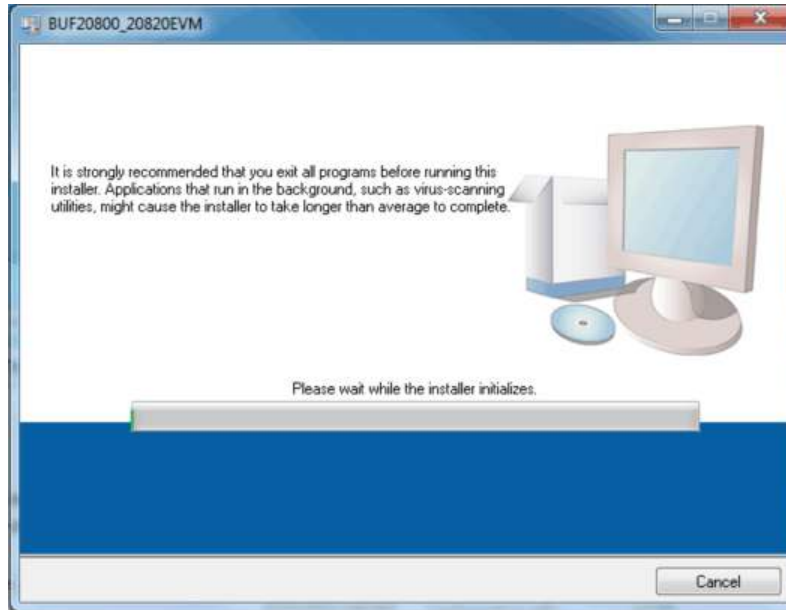

Figure 10. BUF20800/20820EVM Software Installation

After the installation process initializes, the user is given the choice of selecting the directory in which to install the program; the default location is *C:\Program Files\BUF208xx* and *C:\Program Files\National Instruments*. Following this option, two license agreements are presented that must be accepted, as shown in Figure 11. After accepting the Texas Instruments and National Instruments license agreements, the progress bar opens and shows the installation of the software, as Figure 12 illustrates. Once the installation process is completed, click **Finish**.
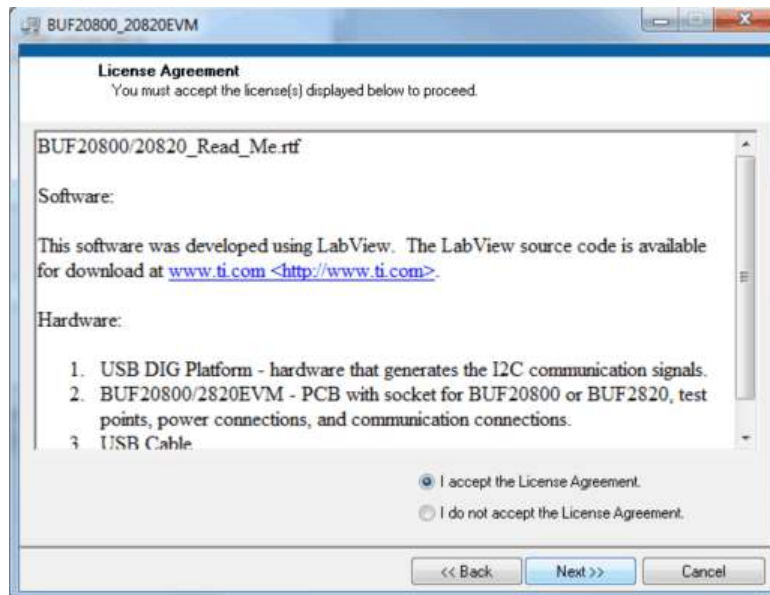
Figure 11. BUF20800/20820EVM License Agreements
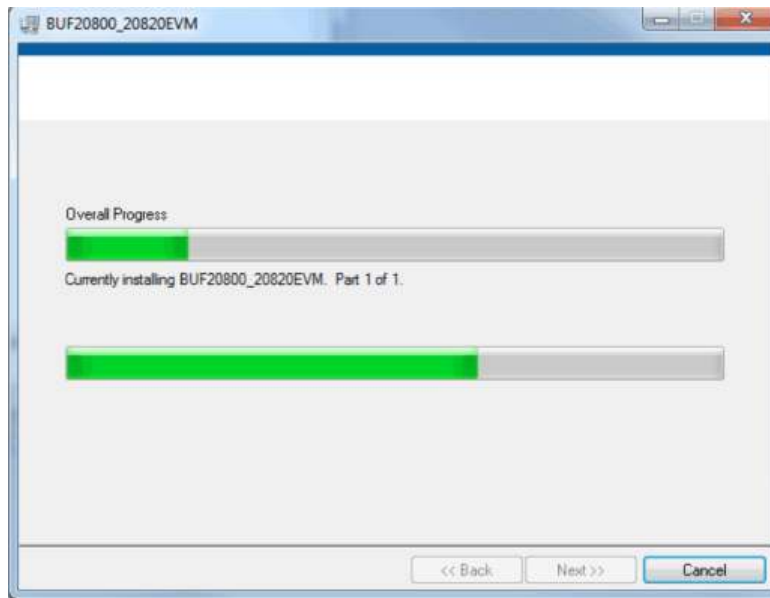
Figure 12. BUF20800/20820EVM Software Installation Progress

4.3   Software Description and Set-Up

The BUF20800/20820EVM software allows the user to read and write to all registers in the BUF20800/20820 gamma correction buffer. Furthermore, it allows programming of the OTP register on the BUF20820. The software also permits the user to select either I^{2}C address. Press the **About** button, as shown in Figure 13, to verify that you have the latest version of the software.
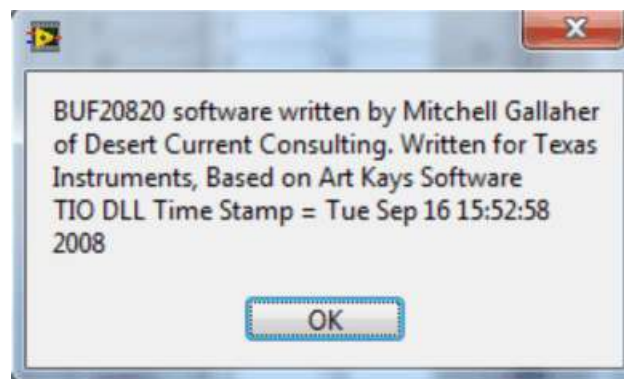
Figure 13. BUF20800/20820EVM Software *About* **Button**

5   BUF20800/20820EVM Software Overview

This section discusses how to use the BUF20800/20820EVM software.

5.1 Starting the BUF20800/20820EVM Software

The BUF20800/20820 software can be operated through the Windows *Start* menu. From Start, select *All Programs*; then select the *BUF20800/20820EVM* program. Figure 14 illustrates how the software should appear if the BUF20800/20820EVM is functioning properly.
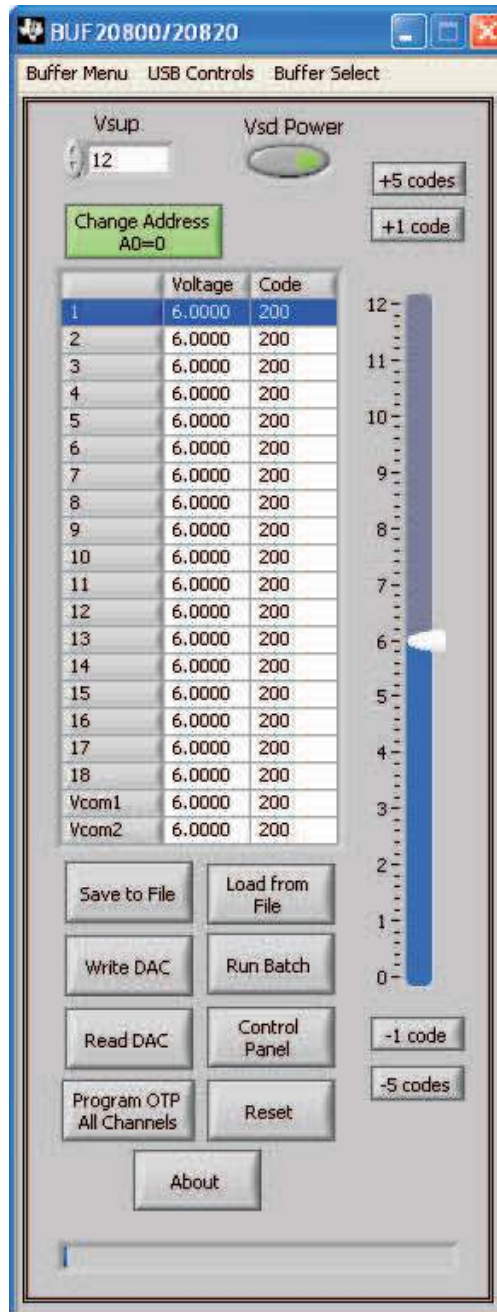
Figure 14. BUF20800/20820EVM Software Interface

Figure 15 shows an error that pops up if the computer cannot communicate with the EVM. If you receive this error, first check to see that the USB cable is properly connected on both ends. This error can also occur if you connect the USB cable before the USB_DIG_Platform power source. Another possible source for this error is a problem with your PC USB Human Interface Device driver. Make sure that the device is recognized when the USB cable is plugged in; recognition is indicated by a Windows-generated confirmation sound.
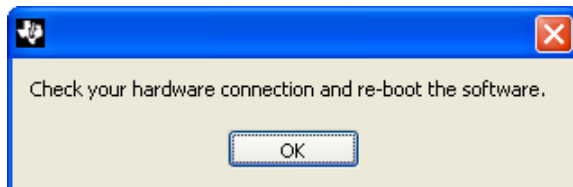
Figure 15. BUF20800/20820EVM Software: Communication Error with the USB_DIG_Platform

5.2 Using the BUF20800/20820 Software

5.2.1 I²C Address Selection

As mentioned previously in the *BUF20800/20820EVM Features* section (see Section 3.7), jumper JMP6 is used to set the I²C address pin of the BUF20800/20820 . Figure 16 shows how the hardware and software must both be set to allow for communication between the BUF20800/20820EVM and the software. Without jumper JMP6 and the software address button configured correctly, the software will not be able to communicate with the BUF20800/20820 device.

Figure 16. Software Setting for JMP6 Low

When JMP6 is set high and the software is set as shown in Figure 17, the second I²C address can be configured.

Figure 17. Software Setting for JMP6 High

5.2.2 Measuring the Power Supply

You must measure the power supply (V_S) with respect to the GND on the BUF20800/20820EVM board and enter it in the V_{SUP} field located in the top section of the software interface, as shown in Figure 18.
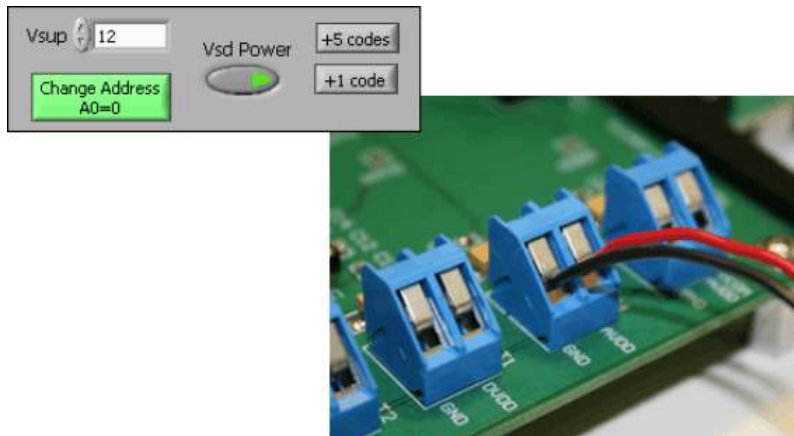
Figure 18. Measuring and Entering Power-Supply Voltage

The voltage out of each DAC is calculated according to the V_{REFH} and the V_{REFL} scaled values entered. These values exist as a *window* for maximum and minimum levels that the voltage can achieve. These maximum and minimum levels are then multiplied by the decimal code to determine the DAC voltage. The calculation is performed according to Equation 3.

$$V_{OUT} = \left[\frac{V_{REFH} - V_{REFL}}{1024} \times \text{Decimal Value of Code} \right] + V_{REFL}$$

(3)

For example, changing the value in the channel 6 cell, with V_{REFH} and V_{REFL} connected internally, immediately changes the output of channel 6 to 0.996V.

Example: Channel 6: Code 44 (hexadecimal) = 68 (decimal)

$$V_{OUT} = \left[\frac{15 - 0}{1024} \times 68 \right] + 0 = \frac{1020}{1024} = 0.996$$

5.2.3 Read DAC Button

By pressing the **Read DAC** button in the BUF20800/20820EVM software, all of the BUF20800/20820 DAC/V_{COM} registers are read to obtain the respective current register contents. Once the read procedure is complete, all of the corresponding text boxes are updated to show the current values present in the DAC/V_{COM} registers.

5.2.4 Write DAC Button

The method used to write the values in the DAC/V_{COM} registers is based on whether or not the Auto Write feature is enabled. The BUF20800/20820 has two methods of writing information into the DAC/V_{COM} registers. The first method allows for the output voltage to change immediately after the writing to the DAC register. In the BUF20800/20820EVM software, this mode is configured by enabling the Auto Write feature found in the Buffer Menu dropdown menu. In this mode, as an individual channel is written to, the output voltage changes as soon as the user moves to a different text box in the software. The second method of writing to the DAC/V_{COM} registers allows for the user to write multiple channels and then have all of the output voltages change at the same time, rather than each channel voltage changing as soon as it is written to.

Disabling the Auto Write feature in the software allows the user to enter all of the values desired for all of the channels and then press the **Write DAC** button to change all of the output voltage of all of the channels at one time. When the Auto Write feature is enabled, no change occurs to the output voltages when the **Write DAC** button is pressed. No change occurs because after the text box for a given channel has been updated, as soon as another item in the software is clicked, the Auto Write feature automatically performs a write command to the updated channel that then updates the output voltage. When in the Auto Write enabled mode, the **Write DAC** button cannot be pressed with different data in the corresponding channel text boxes than the values already stored in the DAC/V_{COM} register; thus, no change occurs. Figure 19 shows the location in the Buffer Menu showing the Auto Write feature enabled. Clicking on the Auto Write feature again enables/disables the feature, depending on its current state.
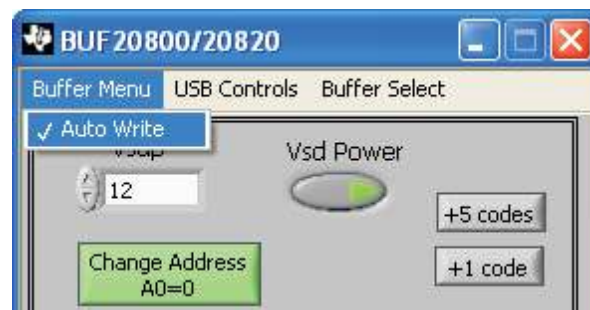
Figure 19. Auto Write Feature Enabled

5.2.5 Reset Button

Pressing the **Reset** button in the BUF20800/20820EVM software performs two functions. The first function is to call a General-Call Reset for the BUF20800 or BUF20820. The status of the DAC/V_{COM} registers after this General-Call Reset has been used depends on the DUT on the EVM.

If the BUF20800 is in the test board, the channel registers default to *1000000000*, or mid-supply.

If the BUF20820 is in the test board, the status of the DAC/V_{COM} registers after this General-Call Reset depends on whether or not the OTP has been programmed. If the OTP has been programmed, the channel registers are loaded with the last values programmed into the OTP memory. If the OTP memory has not been programmed, the channel registers will default to *1000000000*, or mid-supply.

The second function performed after the reset button is pressed is that a Read DAC call is made to update the corresponding channel text boxes to the current value for each channel. This function is valid for both the BUF20800 and the BUF20820 device.

5.2.6 Save to File Button

The register configurations of the BUF20800/20820 DACs are displayed in both analog voltage and in hexadecimal. The DAC codes (that is, gamma voltages) can be saved into a text file using the **Save to File** button.

Pressing the **Save to File** button opens a file-save dialog box similar to that shown in Figure 20. Pressing the folder icon creates a new folder on your PC. It is a good idea to create a directory exclusively for BUF20800/20820 DAC code (that is, gamma voltage) files. Enter a unique file name in the *File name* field to store your BUF20800/20820 register information. Press the **OK** button to save the file.
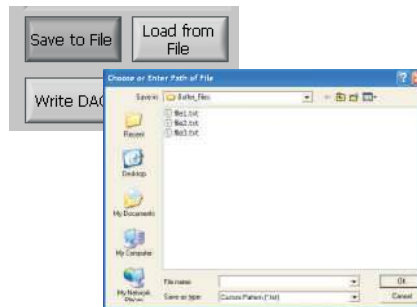
Figure 20. Save to File Dialog Box Button and Window

Saved BUF20800/20820 DAC codes (gamma voltages) exist in a text file that can be opened in a text editor, as Figure 21 illustrates.
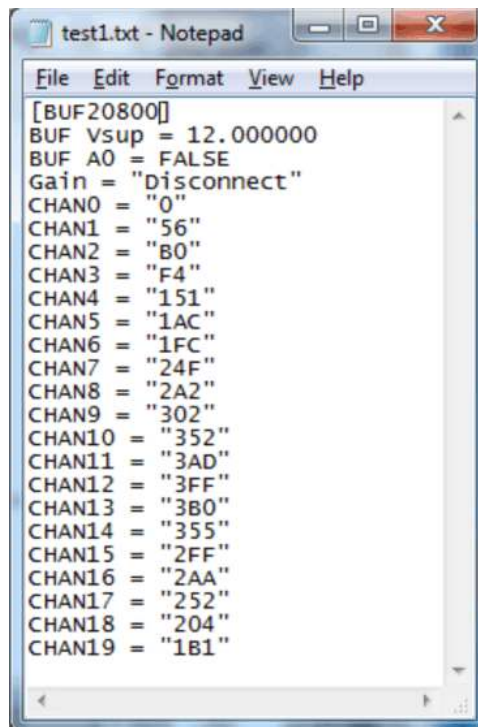
Figure 21. File Format of Saved Data

5.2.7 Load From File Button

The BUF20800/20820EVM software is also able to load data saved from previous evaluations. A saved register configuration can be loaded into the BUF20800/20820 using the **Load From File** button, as shown in Figure 22. The program remembers where you saved the last register configuration. Simply select the desired configuration and press *Open*.
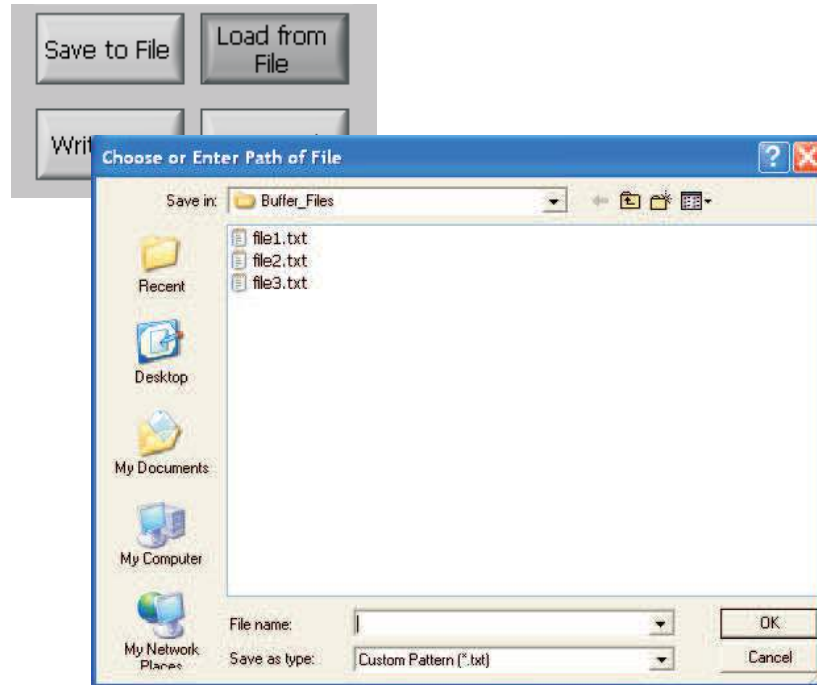
Figure 22. Load From File Button and Window

5.2.8 Changing the DAC/V_{COM} Analog Voltage

The voltage of any of the DAC or V_{COM} channels can be adjusted in several ways. First, you can change the voltage by entering the desired voltage directly in the voltage text box. In order to be able to manually type the voltage into the text box, you must first click on the cell to be edited. Click a second time and the cell turns from blue to black, and allows the user to type the updated voltage in the cell. The hexadecimal DAC codes can be entered in the *Code* column in the same manner.

Another method of changing the voltage of a DAC or V_{COM} channel is through the use of the slider on the main software window. There is only a single slider that is used for all channels. In order to use the slider to adjust the voltage of a particular channel, that channel must first be selected. To select a channel, click on either the channel number, voltage, or code of a particular channel. The entire channel row highlights in blue to show the user that the channel is selected. Adjusting the slider bar then only updates the highlighted channel.

The final method to change DAC/V_{COM} voltages is through the **±1 Code** and **±5 Code** buttons on the main software window. These buttons allow for fine and coarse adjustments, respectively, to the highlighted channel, giving the user the ability to quickly step the channel output up or down as needed without having to manually enter the changes in the *Code* column.

5.2.9 Run Batch Button

The **Run Batch** button (as highlighted in Figure 23) enables the user to configure the BUF20800 of BUF20820 to cycle through different register configurations in a continuous loop. When connected to the end application, this feature can be used to cycle through different gamma settings to determine what the optimal settings must be for a given application.

When the **Run Batch** button is pressed, a new dialog box displays as Figure 23 shows. The delay time is the amount of time allowed between loading new configurations into the BUF20800/20820 DUT.

Use the **Single Step Up** and **Single Step Down** buttons to step through the selected files manually. The currently-selected file name is displayed in the lower left corner area of the dialog box. Double-click on the file names to select them. Once a series of filenames have been selected, the check box turns dark. Double-click on a filename again to unselect it from the batch run.
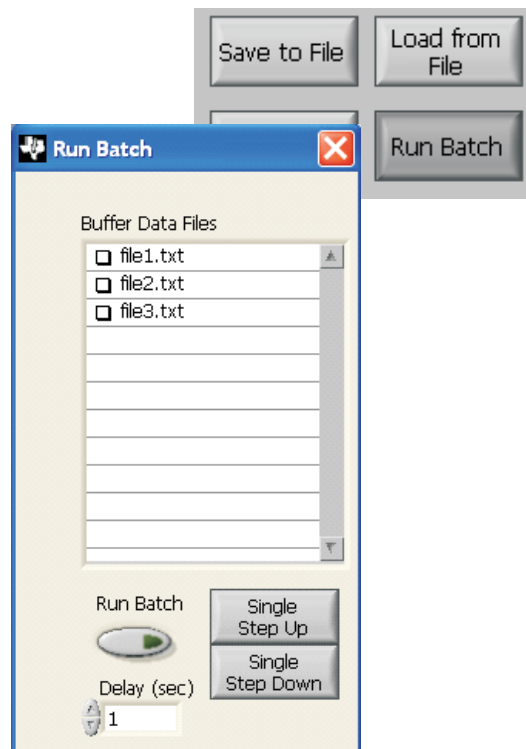
Figure 23. Run Batch Dialog Button and Window

5.2.10 Control Panel Button

Pressing the **Control Panel** button brings up a display panel that allows you to adjust each channel using a set of graphical sliders, as shown in Figure 24. Simply drag the slider to adjust the desired channel output. The DAC code and corresponding output value of each channel change automatically. This function is similar to the slider present on the primary BUF20800/20820EVM software window that changes based on the channel that highlighted (as discussed in the above section).
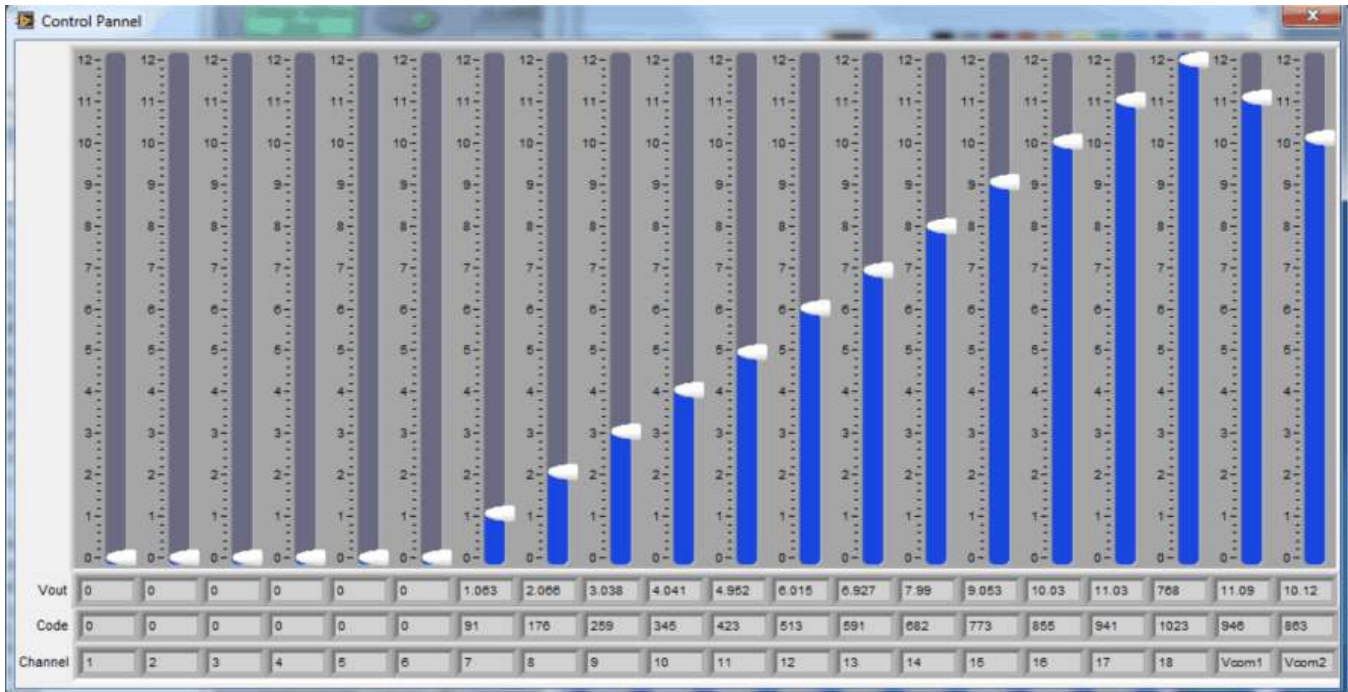
Figure 24. Control Panel Button and Window

5.2.11 Program OTP All Channels Button (BUF20820 DUT Only)

To configure the BUF20820 Program OTP function, make sure the device inserted into the BUF20800/20820 test board is the BUF20820. Also, be sure the BUF20820 is selected from the *Buffer Model* menu. As Figure 25 shows, pressing the **Program OTP All Channels** button allows you to program a gamma curve into the nonvolatile memory of the BUF20820. All 18 channels (including the V_{COM} channels) are then programmed simultaneously. The values are stored in the memory bank.
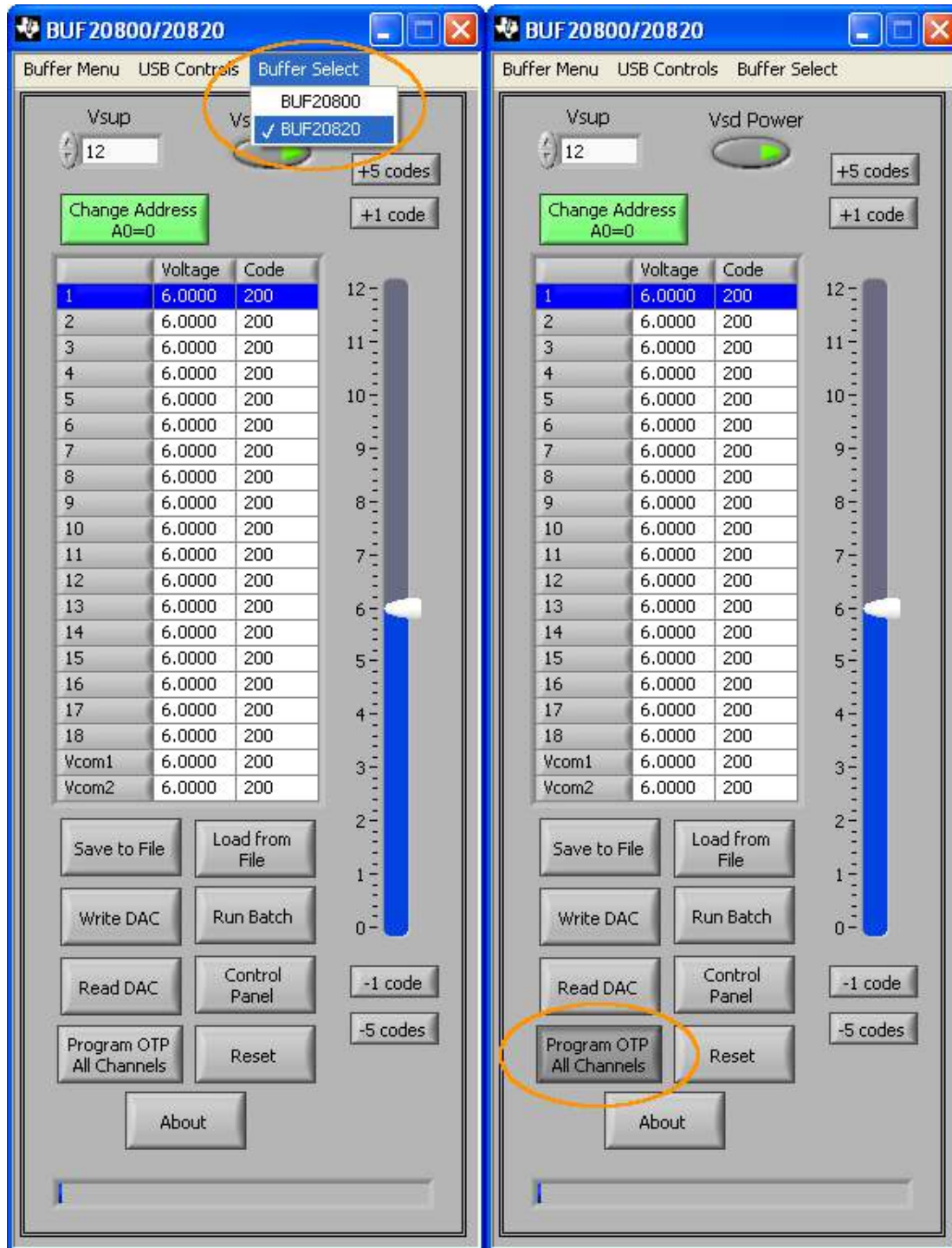
Figure 25. Program OTP All Channels (BUF20820 DUT Only)

6 BUF20800/20820EVM Documentation

This section contains the complete bill of materials and schematic diagram for the BUF20800/20820EVM. Documentation information for the USB_DIG_Platform can be found in the USB_DIG_Platform User's Guide, SBOU058, available at the TI web site at http://www.ti.com.

6.1 Schematic

Figure 26 shows the schematic for the BUF20800/20820EVM.
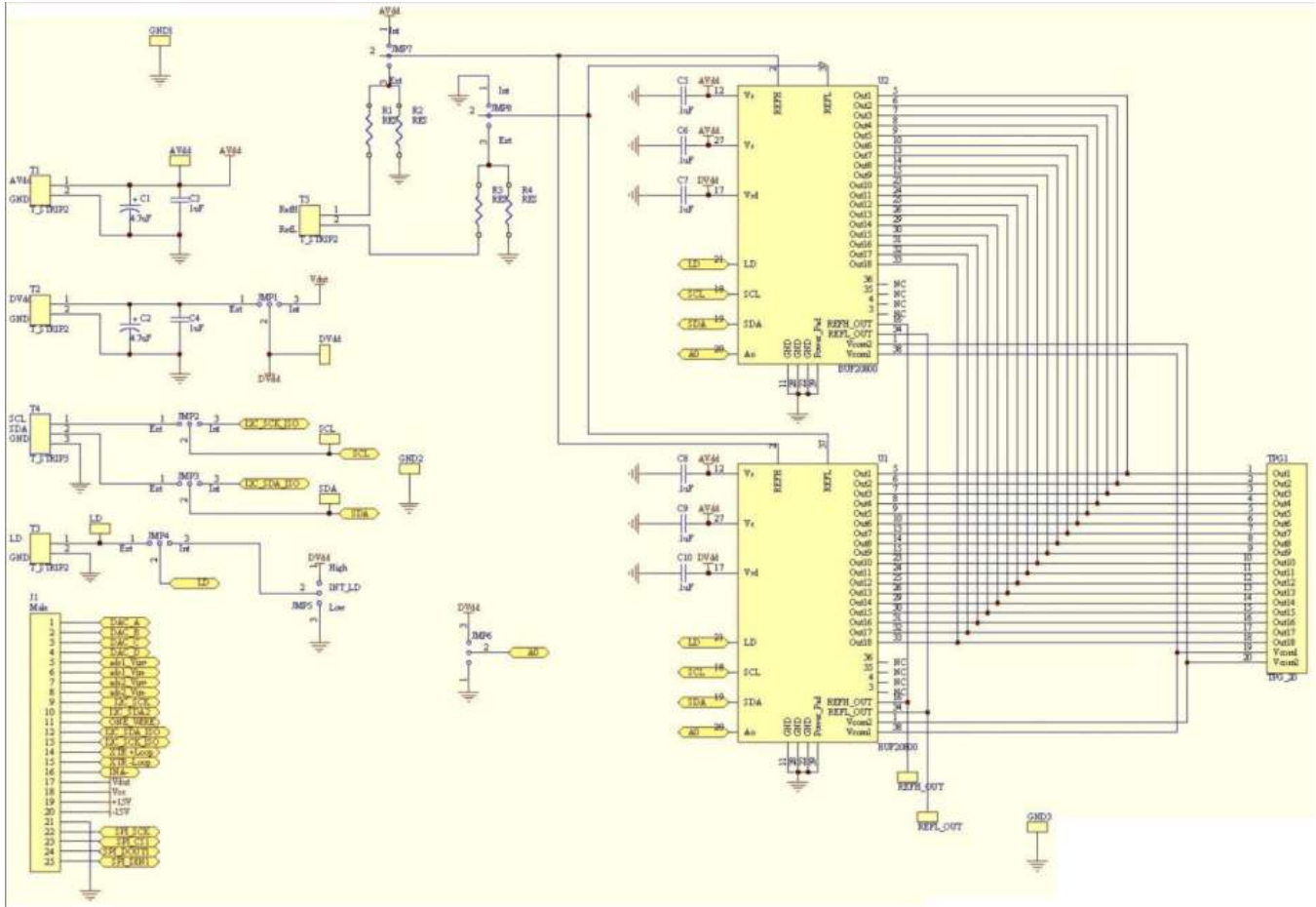
Figure 26. BUF20800/20820EVM Schematic

6.2 PCB Layouts

Figure 27 shows the PCB component layout of the BUF20800/20820EVM.
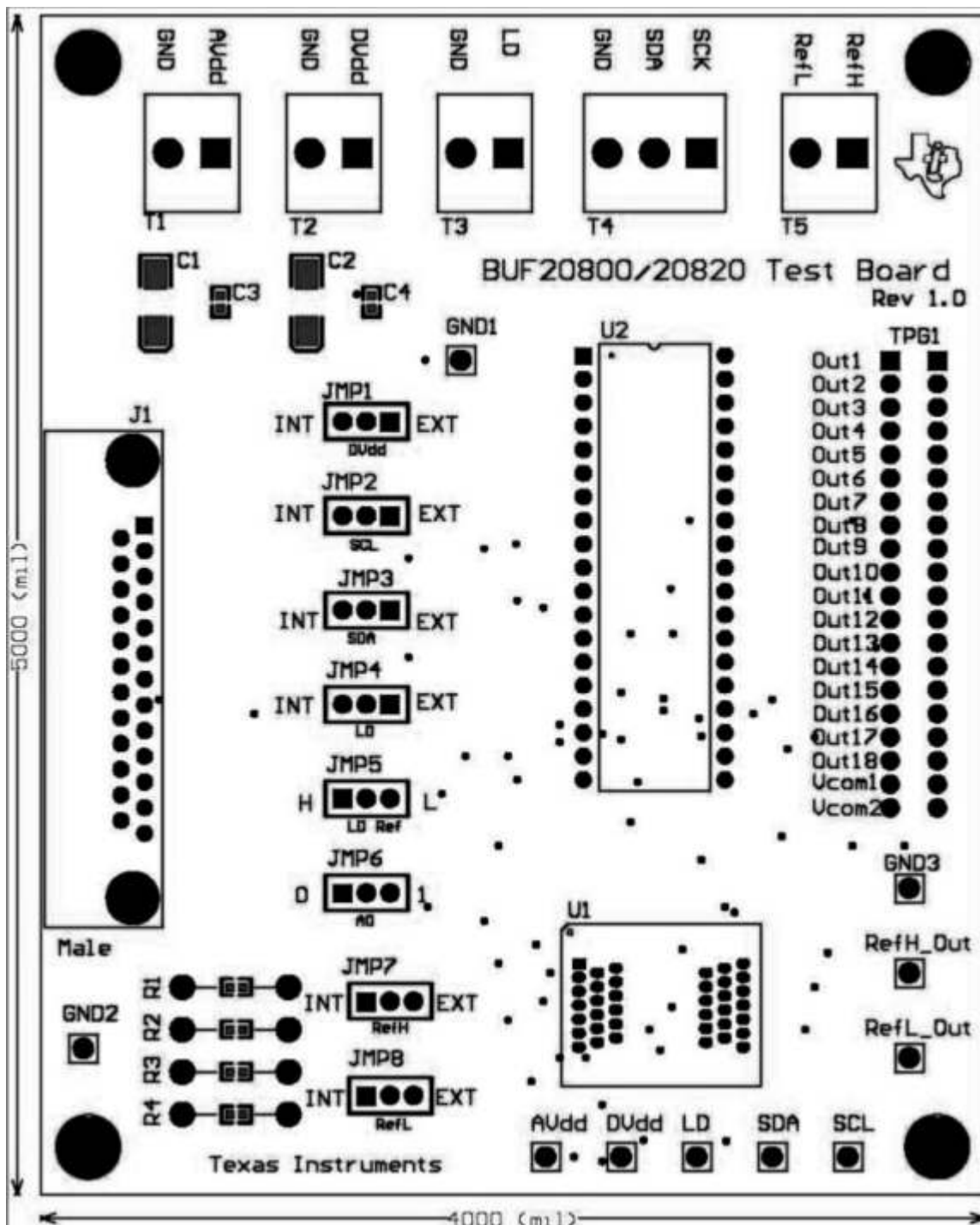
Figure 27. BUF20800/20820EVM PCB Top Layer (Component Side)

6.3   Bill of Materials

Table 5 lists the bill of materials for this EVM.

Table 5. Bill of Materials

Item No	Count	Value	RefDes	Description	Part Number	Mfr
1	4		R1-R4	Resistor, 1/16W .5% 0603 SMD	Varies	Susumu Co Ltd
2	2	4.7µF	C1, C2	Capacitor, Tantalum 4.7µF 35V 10% SMD	293D475X9035C2TE3	Vishay/Sprague
3	2	1µF	C3, C4	Capacitor, Ceramic 1µF 25V Y5V 0603	GRM188F51E105ZA12D	Murata Electronics North America
4	6	0.1µF	C5-C10	Capacitor, .10µF 25V Ceramic Y5V 0603	C0603C104Z3VACTU	Kemet
5	1		U1	Socket, TSSOP 38-Pin ZIF	OTS-38(28)-0.65-01	ENPLAS
6	2		U2	Connector, Rcpt .100" 19-Position Gold T/H	SS-119-G-2	Samtec
7	1	DSUB25M	J1	Connector, D-SUB plug R/A 25-Position 30 Gold (with threaded inserts and board locks)	5747842-4	AMP/Tyco Electronics
8	4		T1, T2, T3, T5	Terminal Block 5MM 2-Position	ED300/2	On-Shore Technology Inc
9	1		T4	Terminal Block 5MM 3-Position	ED300/3	On-Shore Technology Inc
10	1	Strip cut to size	TPG1	Connector, Header 20-Position .100" SGL Gold	TSW-120-07-G-S	Samtec
11	10	TP cut to size	Test Points, All	Connector, Header 1-Position .100" SGL Gold	TSW-101-07-G-S	Samtec
12	4	Standoff	None	Standoffs, Hex , 4-40 Threaded, 0.500" length, 0.250" OD, Aluminum Iridite Finish	2203	Keystone
13	4	Screw	None	Screw Machine Phillips 4-40 × 1/4 SS	PMSSS 440 0025 PH	B & F Fastener Supply
14	8	Strip cut to size	JMP1- JMP8	Connector, Header 3-Position .100" SGL Gold	TSW-103-07-G-S	Samtec
15	8	Jumper	JMP1- JMP8	LP W/Handle 2-Position	881545-2	AMP/Tyco Electronics

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 7V (min) to 18V (max) and the output voltage range of 7V (min) to 18V (max).

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than +25°C. The EVM is designed to operate properly with certain components above +25°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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