

# ***GC5016 Daughterboard EVM and GUI Software Guide***

*User's Guide*

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DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
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## GC5016 Daughterboard Description

The GC5016 Daughterboard and GC101 EVM comprise a two-part daughterboard and motherboard used for demonstrating the digital-up-convert (DDC) and Digital-Down-Convert (DUC) operations of the GC5016. The GC5016 Daughterboard hardware is a plug-in board to the GC101 EVM.

The Daughterboard has the A and B input ports of the GC5016 connected to the Memory In Bus of the GC101 EVM. The four output ports are selected in pairs to be output to the Memory Out Bus. One of the four low speed clocks and one of the four frame strobe signals are also sent to the GC101 EVM.

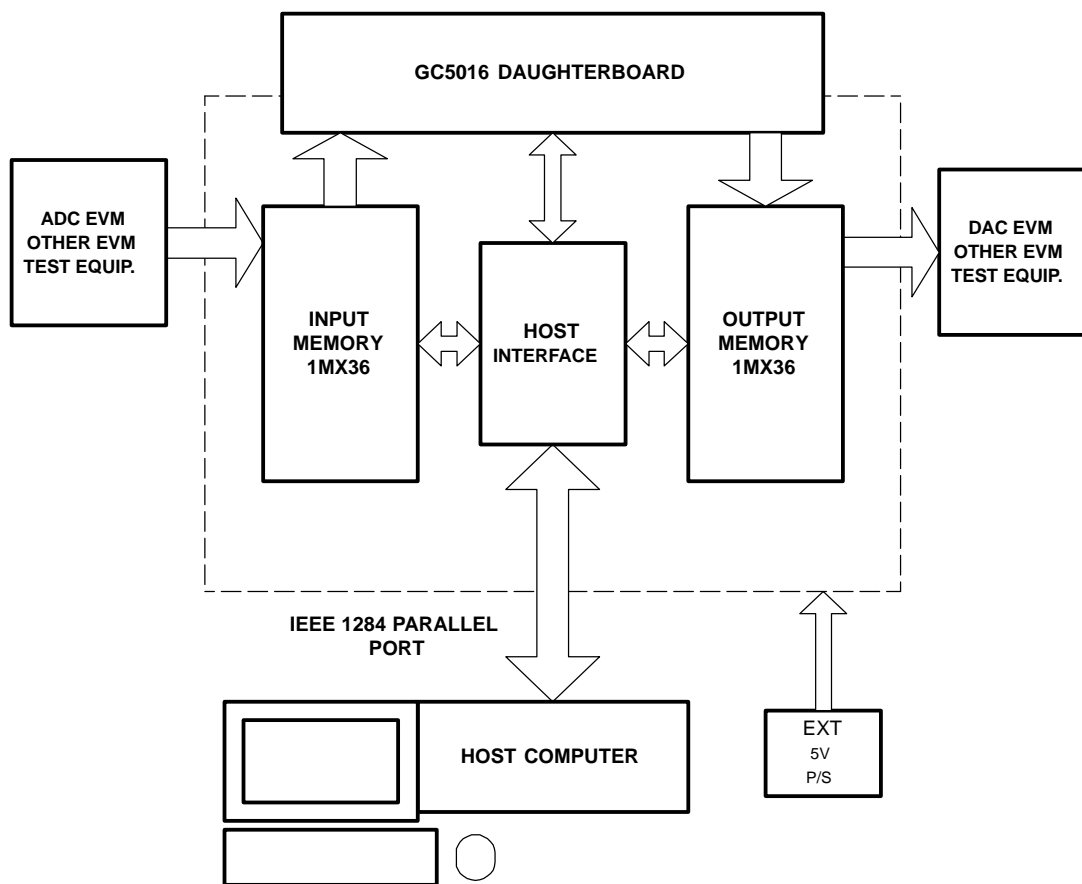
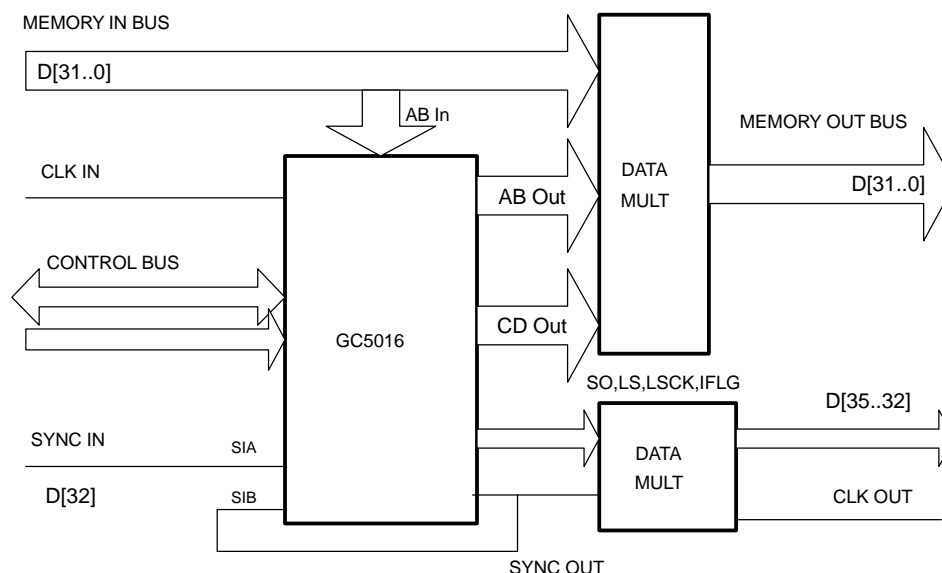


Figure 1-1. GC101 EVM and GC5016 Daughterboard



**Figure 1-2. GC5016 Daughterboard Block Diagram**

## 1.1 GC5016 Daughterboard to GC101 EVM I/O Description

The GC5016 Daughterboard has a PC-133 form-factor that utilizes the 168 pin DIMM memory connector. The 168 pin interface signals are divided into several groups:

- CLK\_IN – Input Clock for GC5016
- Memory Input Bus – 36 data Inputs used to stimulate the GC5016 inputs
  - D15..0 – Memory Input Bus A
  - D31..D16 – Memory Input Bus B
  - D32 - Sync Input. Used to synchronize the GC5016
  - D[35..33] - SP1, SP2, SP3. Spare inputs
- Memory Output Bus – 36 data Outputs from selected GC5016 outputs, sent back to the GC101 EVM for recording and/or output
  - D15..0 – Memory Output Bus A
  - D31..D16 – Memory Output Bus B
  - D32 - Sync Output. Used to output synchronization signal from GC5016
- Control Bus – Bus to program the internal registers
  - 16 Bidirectional data
  - 11 Address
  - Controls  $\overline{CE}$ ,  $\overline{RD}$ ,  $\overline{WR}$ , and  $\overline{RST}$
- JTAG – 5 pin JTAG Test Port for GC5016
  - $\overline{TRST}$ , TCK, TMS, TDI, TDO
- Power – Input power to Daughterboard
  - VDUT1 – 3.3 VDC power from GC101 EVM
  - GND – 3.3 VDC return from GC101 EVM

See the GC101 EVM Manual for the 168-pin DIMM connector pin description. The pins used for the GC5016 Daughterboard are shown in the schematic at the end of this document.

## 1.2 Configuration Switches

Switches are provided on the GC5016 Daughterboard to select specific modes. [Table 1-1](#) lists the specific modes controlled by switch S1. [Table 1-2](#) lists the modes controlled by jumper W2.



**Table 1-1. S1 Switch Settings**

SWITCH		FUNCTION	DDC DEFAULT	DUC DEFAULT
SO	S1		SO = On S1 = On	SO = Off S1 = Off
Off	Off	Routes GC5016 ACK to CLKOUT and GC5016 AFS to SP5		
On	Off	Routes GC5016 BCK to CLKOUT and GC5016 BFS to SP5		
Off	On	Routes GC5016 CCK to CLKOUT and GC5016 CFS to SP5		
On	On	Routes GC5016 DCK to CLKOUT and GC5016 DFS to SP5		
Buffer0	Buffer1		Buffer0 = Off Buffer1 = On	Buffer0 = On Buffer1 = Off
Off	Off	Places board into bypass mode. TSIGIN inputs routed to TSIGOUT outputs		
On	Off	Routes GC5016 output channels A and B to output connector		
Off	On	Routes GC5016 output channels C and D to output connector		
On	On	Routes GC5016 output channels A and B to output connector and TSIGIN inputs to Channel C and D Output		
TRST	Off On	Sets TRST to a logic 1 Sets TRST to a logic 0	On	On
WLCH	Off On	Sets WLCH to a logic 1 Sets WLCH to a logic 0	On	On
PSEN	Off On	Disables on-board +1.8V regulator U6 Enables on-board +1.8V regulator U6	On	On

**Table 1-2. W2 Jumper Settings**

JUMPER	FUNCTION	LOCATION: PINS 1-2	LOCATION: PINS 2-3	DEFAULT
W2	Selects +1.8V source for GC5016 core power	Provides +1.8V from connector J2	Provides +1.8V from regulator U6	2-3

### 1.3 GC5016 Daughterboard Memory Input and Output

The Memory InBus and Special InBus connect through the GC101 36-bit Memory Input Bus. These busses are mapped to the GC5016 and Multiplexer data selectors. The GC101 EVM data input formats are based on input files from the PC-supplied software.

Since the GC5016 can be both a DDC and a DUC, the GC101 EVM input memory data is specific to the type of software configuration that is being tested.

Memory Input Bus:

- D[15..0] -> maps to A[15..0],
- D[31..16] -> maps to B[15..0]
- D[32] -> maps to Sync In A (SIAB)
- D[35..33] -> unused

The GC5016 input ports must be 2's complement format.

The Memory Output Bus, and Special Output Bus pins are used to monitor data from the GC5016 Daughterboard.

Memory Output Bus:

D[15..0] -> maps to Data Selector  
 GC5016 Data AOut[15..0]  
 GC5016 Data COut[15..0]  
 Memory Input Bus D[15..0]  
 D[31..16] -> maps to Data Selector  
 GC5016 Data BOut[15..0]  
 GC5016 Data DOut[15..0]  
 Memory Input Bus D[31..16]

The Special Output Bus has several additional signals:

D[32] - SyncOut  
 D[33] - SP5. Selected 1 of 4 Frame Strobes  
 D[34] - SP6. IFlag  
 D[35] - SP7. Not used

## 1.4 Input Clock

The GC5016 Daughterboard operates with a single-ended CMOS input clock. The clock enters the daughter board on pin 34, and has pullup and pulldown termination resistors located near the GC5016. The clock source is provided by an adjustable skew clock buffer device on the GC101. This clock can be adjusted both in frequency and phase with software.

## 1.5 Input Sync

The GC5016 has two input sync pins, SIAB and SIBB. The GC5016 Daughterboard sync signal from pin 37 is routed to the SIAB pin of the GC5016. This signal has a test point to allow for monitoring. The Sync Out (SOB) of the GC5016 is routed to the SIAB pin. The GC5016 can be synchronized by several methods on the daughterboard. The DDC mode can be synchronized internally (One Shot), Sync Output to Sync Input B (SIBB), or from the GC101 EVM through Sync Input A (SIAB). The DUC mode can be synchronized only through SIAB due to timing constraints of the Frame Strobe in the GC5016 and the GC101 EVM Input Memory.

## 1.6 Output Clock

The GC5016 Daughterboard routes the four GC5016 output clocks (ACK, BCK, CCK, DCK) to a 4:1 mux. Only one clock can be sent to the CLKOUT pin at a time. The S0 and S1 switches on the dipswitch determine which clock is used for the output clock.

## 1.7 Output Sync

The GC5016 Daughterboard routes the Sync Out (SOB) to both the GC5016 Sync Input B (SIBB) and to the SYNCOUT pin of the board. This signal has a test point to allow for monitoring.

## 1.8 Output Frame Strobe

The GC5016 Daughterboard routes the four GC5016 output Frame Strobes (AFS, BFS, CFS, DFS) to a 4:1 mux. Only one Frame Strobe can be sent to the SP5 pin at a time. The S0 and S1 switches on the dipswitch determine which Frame Strobe is used.

## 1.9 Control Bus

The GC5016 has a 16-bit data Microprocessor port. The  $\overline{CE}$ ,  $\overline{RD}$ ,  $\overline{WR}$ , and  $\overline{RST}$  are active low and map directly from the GC101 EVM. The Address Bus A[4..0] is static when the control signals are asserted.

The Bidirectional Control Data C[15..0] provides the data path between the GC101 EVM and the GC5016 Daughterboard.

The  $\overline{CE}$ ,  $\overline{RD}$ , and  $\overline{WR}$  have test points. The Control Bus is tested with the diagnostic test.

### **1.10 JTAG Bus**

The JTAG Bus is connected through the GC101 EVM connector. The serial chain resistors are on the GC101 EVM. The JTAG is not currently used.

### **1.11 Power Supplies**

The 3.3-V input power is supplied from the GC101 EVM power supplies. The 1.8-V core power for the GC5016 is supplied from a regulator on the daughterboard. An on-board jumper (W2) allows the user to bypass this regulator and use an external power source, if desired.



## ***GC5016 Daughterboard Operational Procedure***

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This chapter describes the operation of the GC5016 Daughterboard with the GC101 EVM. The following sections are overviews of the hardware and software specifications for the GC101 EVM and GC5016 Daughterboard. For more information, the user is encouraged to read the GC101 User's Guide, SLWU018, which is included with this software package.

### **2.1 GC101 EVM Hardware Features**

The GC101 EVM provides the following features:

- A complete digital data path which allows the loading, processing, and analysis of a stream of digital data. The loading and analysis is performed through 1Meg Input and Output memory banks.
- Signal processing is performed through a 168-pin expansion slot which is designed to accommodate the GC5016 Daughterboard.
- Digitally controlled internal clocks and output clocks capable of synchronizing the daughterboard, the EVM capture memories, and external test and measurement equipment.
- The EVM communicates to input memory, output memory, and the GC5016 Daughterboard over an IEEE 1284 EPP or ECP parallel port. The GC5016 internal registers are programmed through this interface.

### **2.2 GC101 EVM Software Features**

The software interface for the EVM is based on a Graphics User Interface (GUI), text interface, control dynamic link library (DLL) software, parallel port device driver, file conversion utilities, script programming files, and experiment data files.

**Graphic User Interface**— Provides for pushbutton control of the EVM. Windows-file-browsing is used to select text scripts from the software package to load the input memory, control the EVM, program the GC5016 internal registers, and collect the test output data. Analysis is provided through dual graphic displays of the input and/or output data in the time or frequency domain.

**Text Interface**— Provides manual scripted control of the EVM. This interface is recommended for power-users that require greater hardware register control for debugging and design.

**Control DLL Software**— Provides a library of software functions for device control, parser script processing, device driver communication, and user interface communication. Normally, the EVMs are controlled through running scripts, which are short command files to perform a specific function.

**Parallel Port Device Driver**— Communicates with the parallel port in ECP mode, as selected in the BIOS. The parallel port device driver uses the Warp 9 software kernel mode.

**File Conversion Utilities**— Device-specific routines for the input and output memory for each GC5016 Daughterboard. These are accessed through the GUI, or the batch processing files for the text user interface.

**Note:**

For special conversions, there are software interface controls that can be changed, located at the bottom of the GUI screen.

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**Script Programming Files** - Provide a routine that performs GC101 EVM setup, GC5016 Daughterboard register initialization, and load/capture memory bank data. Each script is specific to an experiment or demonstration of the GC5016. The DLL control software reads the script file, checks if the program line matches an existing command, and performs the command.

**Data Files** - The input and output memory files for the GC101 EVM are read and written by the DLL control software. The files are in a two column hexadecimal format containing memory data and special data, respectively.

## 2.3 Installation Guide

The following section describes hardware requirements, basic software installation procedure, and additional software libraries for application specific testing.

### 2.3.1 Hardware Requirements

Required Elements before Installation:

- GC101 EVM, external 5V power supply, high-speed parallel port cable, and GC101\_5016 Software CDROM.
- GC5016 Daughterboard
- Computer with:
  - Administrator privileges
  - Supported OS of Win98 Rel.2, WinME, Win2000 SP1, WinXP, or WinXP Prof.
  - Parallel port operating in ECP for LPT1 (BIOS)

### 2.3.2 Software Installation

1. Open the GC101\_GC5016 CDROM. From the directory called Install\_DiskImage, select and click on "SETUP.EXE".
2. At the welcome screen, click Next.

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**Note:**

If the GC101\_5016 Software has already been installed on the computer, it must be removed before installing an updated version.

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3. After reading the Software License Agreement Form select "I accept the terms" and click Next.
4. Enter the customer information, user name and organization, then click Next.
5. At the Install Labview Runtime menu, if Labview Runtime or Labview is currently installed on this computer, unselect the Install Labview Runtime check box, and click Next.

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**Note:**

Labview Runtime re-installation can cause a setup error.

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6. At the 'Choose LPT Port Number' menu, select the port connected to the GC101 (typically LPT1), then click Next.

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**Note:**

The user should verify the name of the LPT port through the Windows device manager.

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7. At the Custom Setup selection, there are two general selections; the default location of 'C:\GC101\_5016', and the sections to be installed. The default values are pre-selected. Click Next. Another window will open. Click Install to start the software installation.
8. During the installation, several additional status menus are displayed.
9. When the PicoZip Self Extraction utility opens, change the Extract Path to "C:\". Click on "Extract". This will unzip two test cases under the main directory "C:\GC101\_5016". After the unzip is completed, click on the "Exit" button.
10. The InstallShield Wizard has completed the installation. Click on "Finish".

The previous steps install two scripted test cases to the 'C:\GC101\_5016' directory along with all necessary drivers and software to demonstrate board functionality. SaveGUI\_testcase1.txt is with the GC5016 operating in 'receive mode' or as a Digital Down-Converter (DDC) using a UMTS test signal. SaveGUI\_testcase2.txt is with the GC5016 operating in 'transmit mode' or as a Digital Up-Converter (DUC) using a UMTS test signal. Detailed instructions demonstrating how to run an experiment are shown in subsequent sections of this chapter. The script test case files are described in [Table 2-1](#).

**Table 2-1. Script GC5016 Test Cases**

FILENAME	SIGNAL TYPE and MODE
saveGUI_testcase1.txt	UMTS, DDC, 16x input data, out 2x, CHA at 8 MHz, CHB at 13 MHz, CHC at 18 MHz, CHD at 23 MHz, CHA fixed gain, CHB, C, D - AGC, TDMIQ mode
saveGUI_testcase2.txt	UMTS- Real output, 1x input data, output 16x, CHA at 7 MHz, CHB at 12 MHz, CHC at 17 MHz, and CHD at 22 MHz

The two testcases are used to illustrate the GC5016 as a 4 channel DDC and DUC in a UMTS configuration. The input rate is 16x and the output rate is 2x, which sets the channel decimation to 8 (CICD4, PFIRD2). The channels have different down conversion frequencies and main gain values. [Figure 2-1](#) and [Figure 2-2](#) shows the inputs (top plot) and outputs (bottom plot) of the GC5016 when running the two test cases with GC5016 GUI software. When running these testcases and any other experiments, the dip switch settings on the GC5016 must match those called out by the experiment. This information is shown in the "Experiment Title" textbox of the GUI. If the DIMM SW settings are not called out, the default settings should be used. For DDC experiments, switches 1, 2, 4, 5, 6, and 7 should be "ON". For DUC experiments, switches 3, 5, 6, and 7 should be "ON".

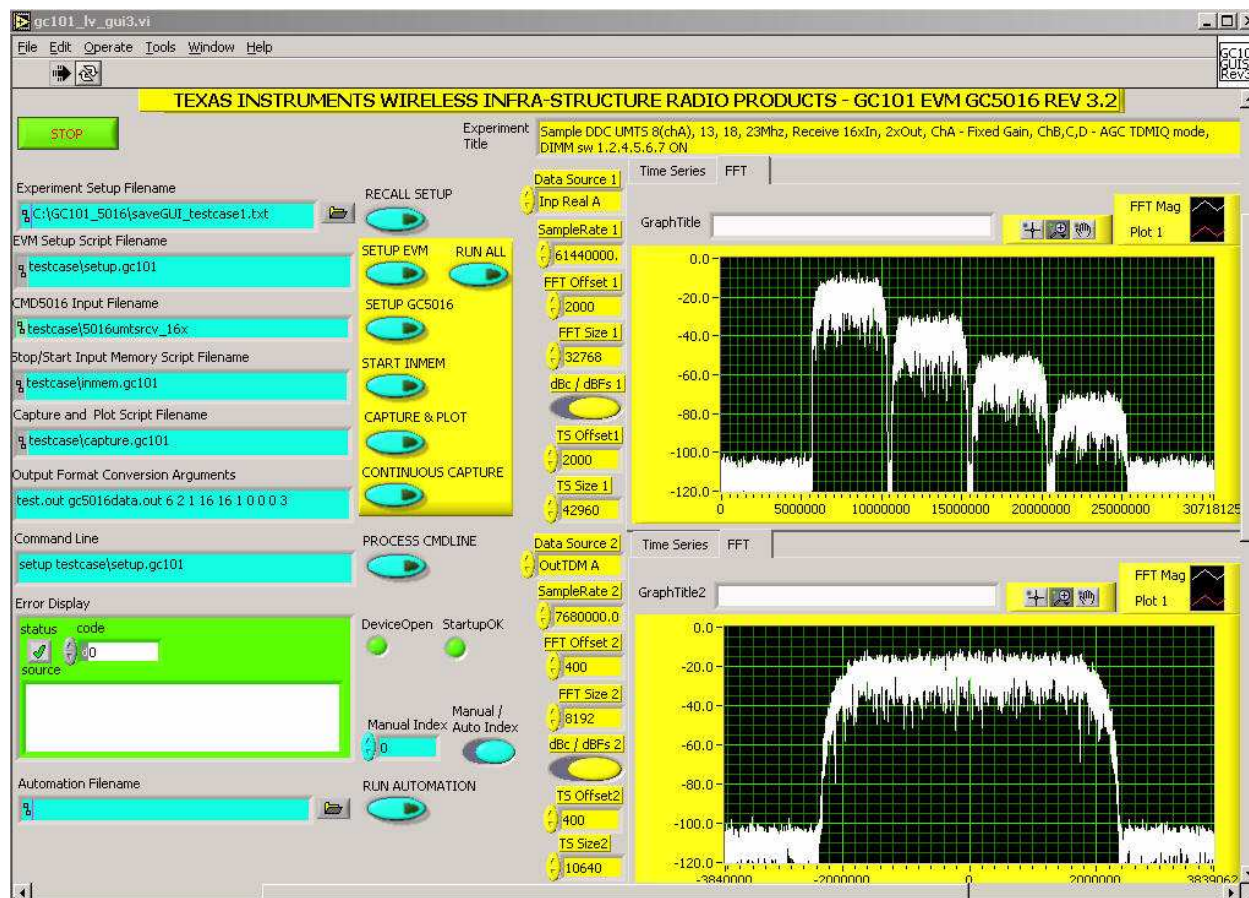


Figure 2-1. Input and Output Response of Test File saveGUI\_testcase1.txt



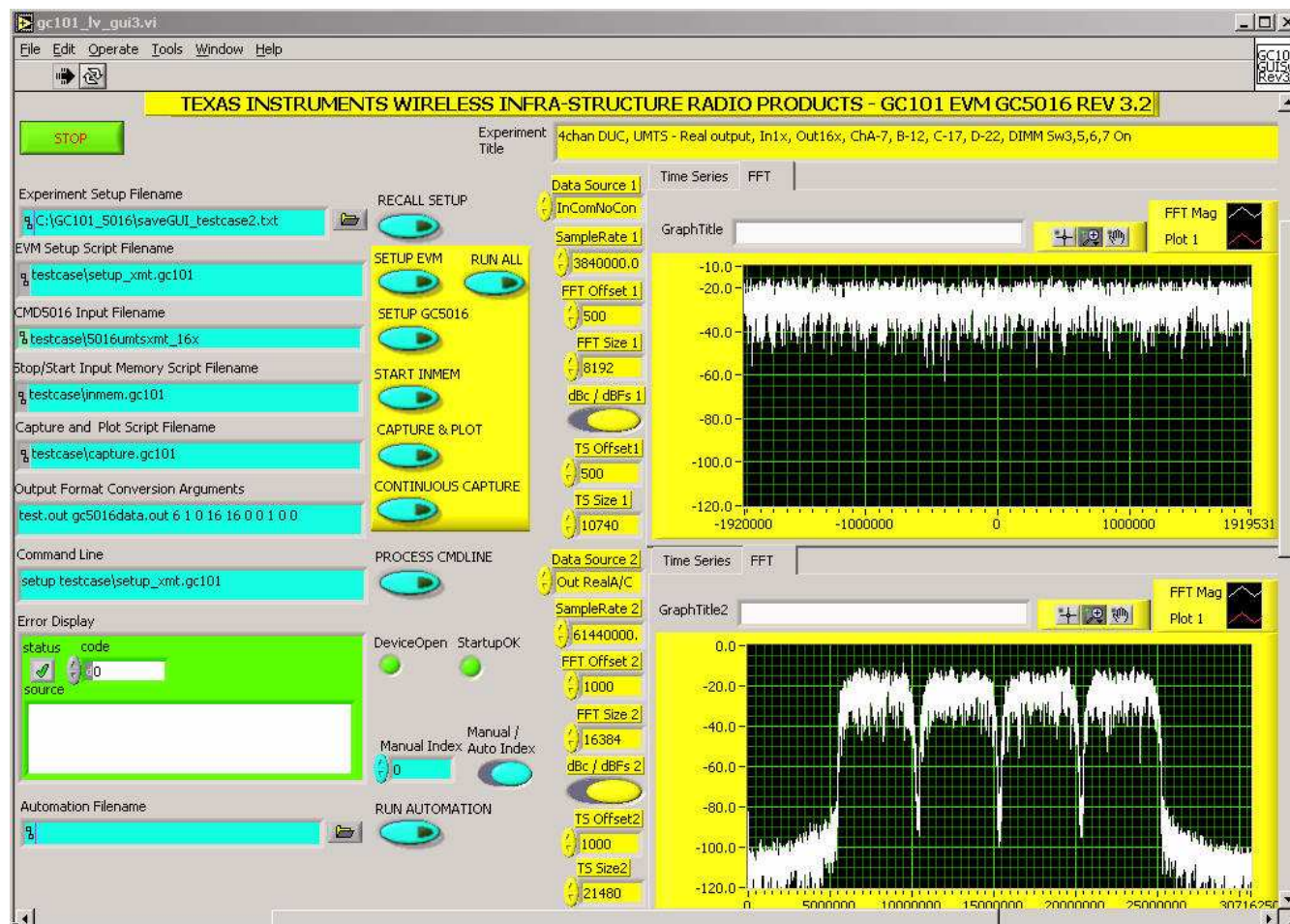


Figure 2-2. Input and Output Response of Test File saveGUI\_testcase2.txt

### 2.3.3 Additional Software Libraries

Additional documentation is provided on the CDROM to assist the user with operating the GC5016 System Evaluation Kit. Experiments for wireless standards are included on the CD under the "EXPERIMENTS" directory. These are useful in demonstrating specific operation modes of the GC5016 (DDC and DUC). The directory contains a file called GC101\_5016ExpList.xls, which is a spreadsheet that provides a brief description of each experiment along with the required dipswitch setting for the GC5016 Daughterboard. To use these experiments, go to the directory on the CD labeled "Experiments". The experiments are zipped into directories as shown in Table 2-2.

Table 2-2. Archived GC5016 Experiments

FILENAMES FOR ARCHIVED EXPERIMENTS	SIGNAL TYPE AND MODE
gc5016_ddc_cdma2000.exe	CDMA2000-DDC
gc5016_duc_cdma2000.exe	CDMA2000-DUC
gc5016_ddc.exe	DDC tests
gc5016_duc.exe	DUC tests
gc5016_ddc_umtsbcdma.exe	UMTS-DDC
gc5016_duc_umtsbcdma.exe	UMTS-DUC
gc5016_ddc_ofdm.exe	OFDM-DDC

**Table 2-2. Archived GC5016 Experiments (continued)**

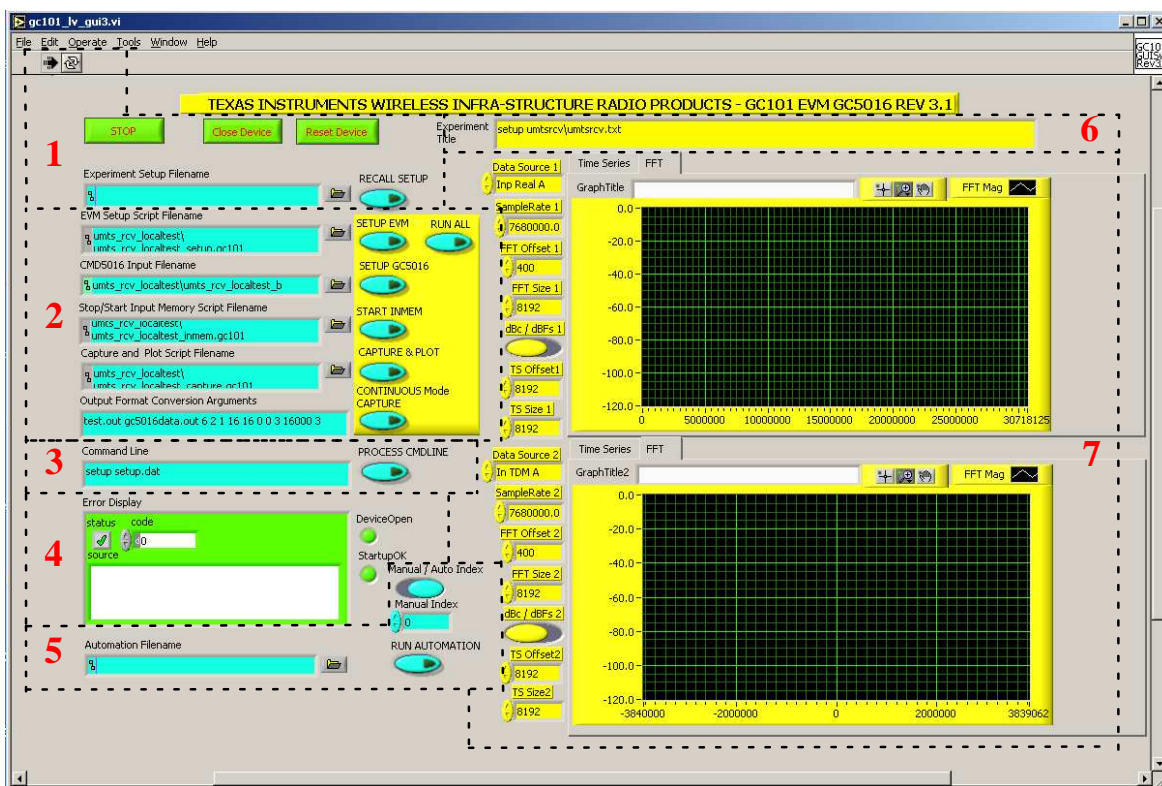
FILENAMES FOR ARCHIVED EXPERIMENTS	SIGNAL TYPE AND MODE
gc5016_duc_ofdm.exe	OFDM-DUC
gc5016_ddc_tdscdma.exe	TDSCDMA-DDC
gc5016_duc_tdscdma.exe	TDSCDMA-DUC
gc5016_duc_cablemodem.exe	Cable Modem-DUC
gc5016_duc_ums.exe	UMTS-DUC
gc5016_chksumtests.exe	Checksum tests
gc5016_testcase.exe	One DDC UMTS test case and one DUC UMTS test case
gc5016_ducdac.exe	Three experiments to be used with an external DAC EVM
gc5016_ddcadac.exe	Five experiments to be used with an external ADC EVM

To test these experiments, use the left mouse button and double click on the executable of the experiment to be tested. Click on the Unzip button and the software will automatically extract the folder selected and place it under the C:\GC101\_5016 main directory. Click on "OK" after the unzip has completed, then click on "Close". Follow the steps in the sections below to run the individual experiments.

JPEG files of the results of all of the experiments are available on the CD in directories under "DOCUMENTS\gc101\_5016\_gui\". The JPEG files show the expected results of the GUI graphical analysis windows. The experiments involving external DAC EVM's also contain JPEGs of the DAC spectral output and the settings to be entered with the DAC GUI.

## 2.4 Using the GC5016 GUI Software

The GC5016 GUI allows the user to select the desired experiment, and assign specific parameters for data collection. The user is provided with dual visualization windows to analyze the source and collected data in the time or frequency domain. To start the GUI, go to the C:\GC101\_5016 directory and double click the executable file called **gc101gui\_5016.exe**. The GUI screen will open and look as shown in [Figure 2-3](#).



**Figure 2-3. GC101 GUI for GC5016 EVM**

The interface can be divided into several sub-sections described as follows:

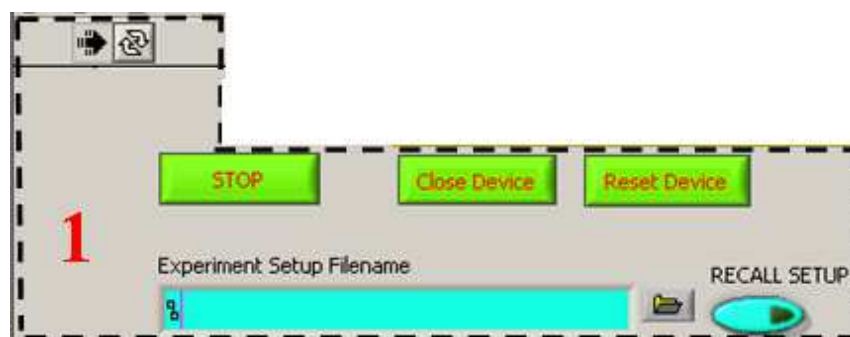
1. General GC101 and Experiment Controls
2. Process Controls and Script Filenames
3. GUI Command Line Interface
4. Error Display and Status Indicators
5. Automation Controls
6. Experiment Name and Configuration
7. Graphical Data Analysis Windows

### 2.4.1 GC5016 GUI Software Controls

The GUI Controls are based on standard Labview programming components. The GUI display has multiple pages. This software release focuses on the top page shown in [Figure 2-3](#), which is automatically displayed when starting the software. This section describes the functionality of the individual controls.

## 2.4.2 General GC101 and Experiment Controls

The first sub-section includes general GC101 device controls and indicators, an "Experiment Setup Filename" text interface window with file location pushbutton, and a "Recall Setup" pushbutton as shown in [Figure 2-4](#).



**Figure 2-4. General GC101 and Experiment Controls**

GREEN "STOP" button – This button is used to stop the experiment. This is the normal EXIT method. The "STOP" button must be depressed a second time if the software is to be restarted.

**Note:**

Closing the GUI without stopping the experiment will cause the PC parallel port to lock up. To prevent this from happening, always stop the program using the "STOP" button before closing the GUI.

GREEN "Close Device" button – This button is used for debugging. If the GUI software has stopped with an error message in the lower left error box, and the RUN arrow Indicator is not 'filled-in', the Close Device button can be used in debugging.

GREEN "Reset Device" button – This button is used for debugging. It is used after the "Close Device" to restart the GUI.

Right-facing "Arrow" button- This button is located in the upper left corner of [Figure 2-3](#) and [Figure 2-4](#). It is normally filled in, indicating that the GUI software is running. If there is an operation error, the arrow appears outlined. The error is reported by the "Error Display" in the GC101 status indicator sub-section. This feature is explained in section 2.4.5. Clicking on the arrow will cause the GUI to restart.

"Run Continuously" button- This button, located next to the right-facing "Arrow" button, is used only for debugging purposes and need not be considered for this application.

The "Experiment Setup Filename" textbox is used to load an experiment from those provided with the software. The basic installation includes the experiments named "saveGUI\_testcase1.txt" and "saveGUI\_testcase2.txt". The user can select one of these experiments or another located under the "Experiments" directory on the CD. The user may select the experiment configuration by typing the name of the desired experiment into the textbox or by clicking the appropriate filename using the windows file browser button to the right of the textbox.

"RECALL SETUP" button- This is used to load the scripts and settings from the experiment defined in the "Experiment Setup Filename" textbox. When this button is clicked, the color momentarily changes to green while the script filenames are loaded. The color returns to black once all values and registers are loaded. This button must be clicked on every time a new experiment is entered in the experiment setup filename textbox.



## 2.4.3 Process Controls and Script Filenames

The second sub-section includes all the command controls required to run experiments along with text windows that indicate the designated scripts that are running for each step in the process, as illustrated in Figure 2-5.

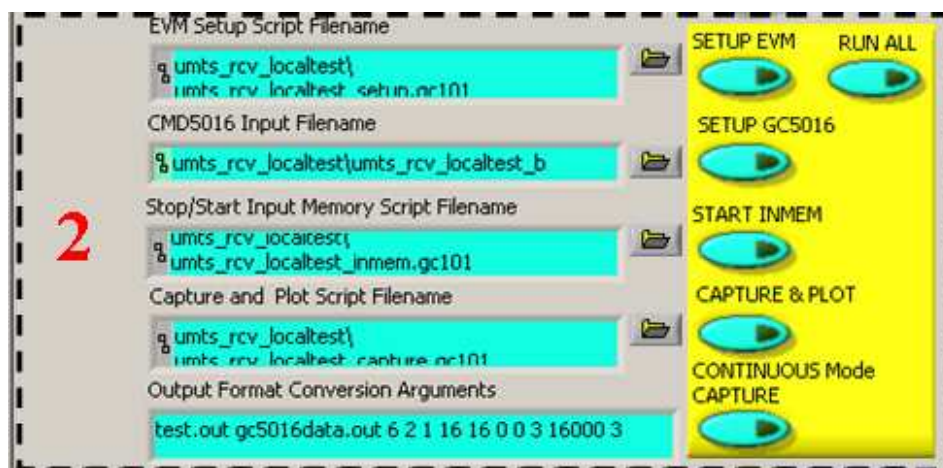


Figure 2-5. Process Controls and Script Filenames

“Setup EVM”– This command button is used to execute the EVM setup script file in the text box to the left of the command button. The “EVM Setup Script Filename” text box is normally NOT browsed or entered by hand. The setup script path and filename are typically defined when the user clicks the “Recall Setup” button defined in Section 2.4.2. When this button is clicked, the EVM is configured according to the script (approx. 10 -20 seconds, depending on the input memory file size).

“Setup GC5016”– This command button is used to execute a file conversion utility that modifies the file specified in the “CMD5016 Input Filename” textbox to the output file format required by the GC101 EVM (\*.gc101 extension). The program then runs the input file (.gc101) as a script to program the GC5016. The process time of this function takes <3 secs.

“Start InMem”– This command button stops the input memory, runs the script specified in the “Stop/Start Input Memory Script Filename” textbox, and starts the input memory. The script loads the memory start address, and number of memory transfers per cycle. After the button is clicked, the LED (D2) to the left of the U12 FPGA should be green (ON). See Figure 2-6.

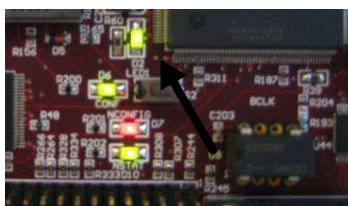


Figure 2-6. Start InMem indicator LED

“Capture & Plot”– This command button executes the capture script file in the “Capture and Plot Script Filename” textbox. The data is captured and stored to an output file in the appropriate format on the PC. The output filename and analysis parameters are shown in the “Output Format Conversion Arguments” textbox located in the bottom left corner of the current subsection.

“Continuous Mode Capture”– When selected, this command button continually performs the capture and plot function. This button should be clicked and un-clicked when activating or deactivating this operation. When this mode of operation is selected, the “Capture & Plot” button MUST be clicked to begin the continuous process. To end the continuous process, click on either the “Capture & Plot” button or the “Continuous Mode Capture” button.

**Note:**

Graphic output parameters may be changed while operating in continuous mode.

“Run All” - This command button sequentially executes ALL of the command buttons specified in sub-section two. It is useful in running experiments that are error-free such as those provided with the software package. The advanced user will troubleshoot a new experiment manually with the individual command buttons. See Appendix A of the GC101 EVM User's Guide for more details about the script files that are executed from these command buttons.

#### 2.4.4 GUI Command Line Interface (Advanced Users)

The third sub-section includes the GUI command line interface, shown in Figure 2-7. This interface allows the advanced user to run scripts, file conversion utilities, and give complete command line control over the GC101 EVM and the GC5016 Daughterboard. After an instruction is entered into the textbox, click on the “Process Cmdline” button to execute.

**Note:**

Only advanced users should use this feature.

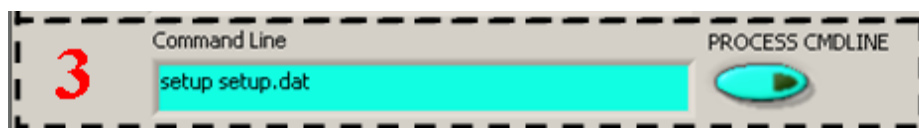


Figure 2-7. GUI Command Line Interface

#### 2.4.5 Error Display and Status Indicators

The fourth sub-section describes the GC101 EVM error display and status indicators, as illustrated in Figure 2-8. In the “Error Display”, the status source check box should be a GREEN “check mark” (✓) indicating all is functioning properly. When an error occurs, the status source check box becomes a RED “X” (✗). Anytime the red X is displayed, the GUI software must be stopped, and restarted.



Figure 2-8. Error Display and Status Indicators

The “DeviceOpen” and “StartupOK” indicators are also used to indicate the status of the GC101 EVM and GC5016 Daughterboard. The “DeviceOpen” indicator is normally GREEN. The GUI software must be stopped and restarted if it turns GREY. If the lower level gc101control.dll software is functioning properly, the “StartupOK” indicator is also normally GREEN.

If an error occurs, the “Error Display” will indicate an error code and message in the text display. The error codes, for the most part, are self explanatory. If the error can not be resolved, contact your local FAE with the error code number and message.

Custom experiment errors are often due to the location of files and script inaccuracies. The individual command buttons should be used to determine if the scripts function properly and for general troubleshooting. Installation of software requires administrator group privileges and is often the source of errors. In this case the software may need to be re-installed.

If the error persists, record the experiment error code and message, and contact your local Texas Instruments FAE.

**Note:**

If it is a custom experiment, you may have to send the experiment files and configuration information to Texas Instruments for troubleshooting.

## 2.4.6 Automation Controls

Subsection five describes the automation controls for the GC101 EVM. These controls are typically used for demonstration purposes and have little flexibility. The text interface shown in Figure 2-9 is used to select an automation input file which lists a set of experiments to run. The list of experiments is repeated until the “Run Automation” button is released. The “Automation Filename” is a database of two columns separated by commas. It contains the “saveGUI\*.txt” filename and the number of seconds to display the results between the test cases. An example of an automation file that will run two experiments in the gc5016\_duc\_umts directory continuously would look as follows:

```
gc5016_duc_umts\saveGUI_umtsxmt_16_IntlQ_3car.txt, 3,
gc5016_duc_umts\saveGUI_umtsxmt_16_ParlQ.txt, 3,
```



Figure 2-9. Automation Controls

**Manual / Auto Index**– This selection control determines if the user is attempting to index a specific test case from the automation script (Manual Mode) or all test cases defined in the automation script (Automatic Mode).

**Manual Index**– When the “Manual/Auto Index” selection control is in manual mode (LEFT), the manual index defines which line is to be executed from the specified automation script.

**Run Automation**– This button executes the experiments defined by the file entered in the Automation Filename textbox. Clicking the button again stops the automation.

## 2.4.7 Experiment Name and Configuration

The sixth sub-section of the GC101 GUI includes the “Experiment Title” textbox shown in Figure 2-10. The experimental title is automatically loaded with the configuration information from the first line in the Experiment Setup File (usually a saveGUI\*.txt file) when the “Recall Setup” button is clicked. This value can be redefined by the user.



Figure 2-10. Experiment Name and Configuration

## 2.4.8 Graphical Data Analysis Windows

The seventh sub-section describes the graphical data analysis windows shown in [Figure 2-11](#). The two graphical analysis windows are identified as “Data Source 1” and “Data Source 2”. They allow the users to specify all visualization and data analysis preferences. Some controls must be selected before data capture (Pre-Capture Controls), while others may be modified after the data capture (Post-Capture Controls). The options are described below for both windows:

### 2.4.8.1 Pre-Capture Controls

**Data Source** – This textbox defines the input or output file format that is used. Selecting the text in the box provides a drop-down box from which the user can select the desired display.

---

**Note:**

The standard experiments will pre-select the most useful viewing options for both DDC and DUC operating modes.

---

**Sample Rate** – This value is the sample rate for the upper FFT.

**FFT Offset** – This value is the sample offset, used for starting the FFT.

**FFT Size** – This value is the number of FFT bins, used for the FFT.

**dBc / dBFs** – This applies a scale factor to the maximum amplitude for the FFT Y scale. dBc scales all of the values to 0.

**TS Offset** – This is the X minimum value for the time series.

**TS Size** – This is the X maximum value for the time series.

### 2.4.8.2 Post-Capture Controls

**Time Series, FFT Tab** – This selection, located at the top of either graphical analysis window, allows the user to specify the desired data visualization format in either the time or frequency domain.

**Graph Title** – This user-defined text box can be used for plotting and documentation.

**“Magnifying Glass” zoom box** – After the capture and plot have been performed, the zoom box control is useful for detailed analysis of the captured data.

**Graph X and Y axis limits** – After the capture and plot have been performed, the X min, X max, Ymin, and Ymax values can be changed by selecting and typing over the graph limits.





Figure 2-11. Graphical Data Analysis Windows

## 2.5 Example Operation

The following section describes a step-by-step sample experiment which allows the user to get started quickly. Once all the necessary software is installed, follow the instruction set to ensure your GC101 EVM and GC5016 Daughterboard are operating according to specifications.

### 2.5.1 STEP 1 – GC5016 Daughterboard Switch Settings

It is CRITICAL that the GC5016 Daughterboard dip switches are properly set before starting any experiment. For most DUC experiments, set the switches as follows:

Switches 3 (BUFEN0), 5 (TRST), 6 (WLCH), and 7 (PFEN) "ON"

Switches 1 (S0), 2 (S1), 4 (BUFEN1), 8 (N/A) "OFF"

For most DDC experiments, set the switches as follows:

Switches 1, 2, 4, 5, 6, 7 "ON"

Switches 3, 8 "OFF"

For this example experiment, set the switches to DDC Mode as mentioned previously.

### 2.5.2 STEP 2 – Connections

With the power OFF, insert the GC5016 Daughterboard into the expansion slot of the GC101. The slot will "lock" the card into place when properly inserted. Plug the provided high-speed parallel port cable (DB-25) into both the GC101 EVM and the computer. Using the provided 5V supply, power-up the EVM. When power is applied to the EVM, the D6, D7, and D10 LED's should immediately turn ON as shown in [Figure 2-12](#). If the LED's do not power up, verify your connections. If the problem persists contact your local Texas Instruments FAE.



Figure 2-12. LED's at Power ON

### 2.5.3 Software and Experiment Initialization

Go to the C:\GC101\_5016 directory on the PC. To start the GUI software, click on the executable file called "gc101gui\_5016.exe".

Using the browse box to the right of the "Experiment Setup Filename" textbox, select the "saveGUI\_testcase1.txt" experiment file (see Figure 2-13). The file should be located in the default path "C:\GC101\_5016" (see Figure 2-14). Click the "Recall Setup" button to load the default parameters for the experiment (see Figure 2-15).



Figure 2-13. Experiment Setup Filename

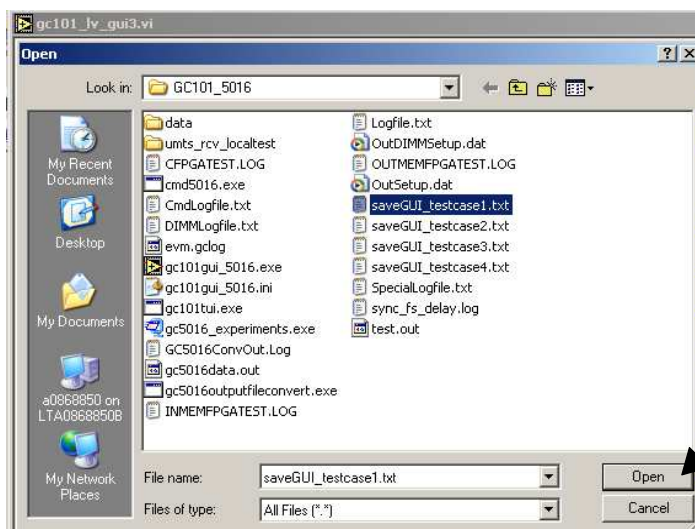
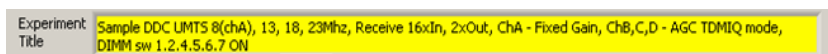


Figure 2-14. Select Experiment



**Figure 2-15. Load Experiment**

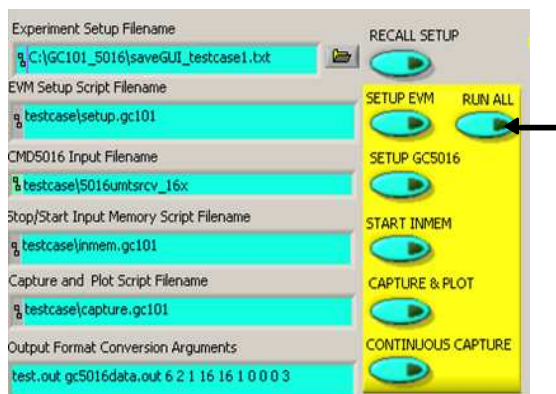
If the experiment was loaded correctly, the “Experiment Title” should look identical to that shown in [Figure 2-16](#).



**Figure 2-16. Experiment Title**

## 2.5.4 STEP 4 – Running the Simulation

To start the experiment, simply click on the “Run All” button from the “Process Controls and Script Filenames” window, as illustrated in [Figure 2-17](#).



**Figure 2-17. Starting the Experiment**

After approximately 30 seconds, depending on the computer speed, check that the displayed results look identical to those shown in [Figure 2-18](#) for the “saveGUI\_testcase1.txt” experiment.

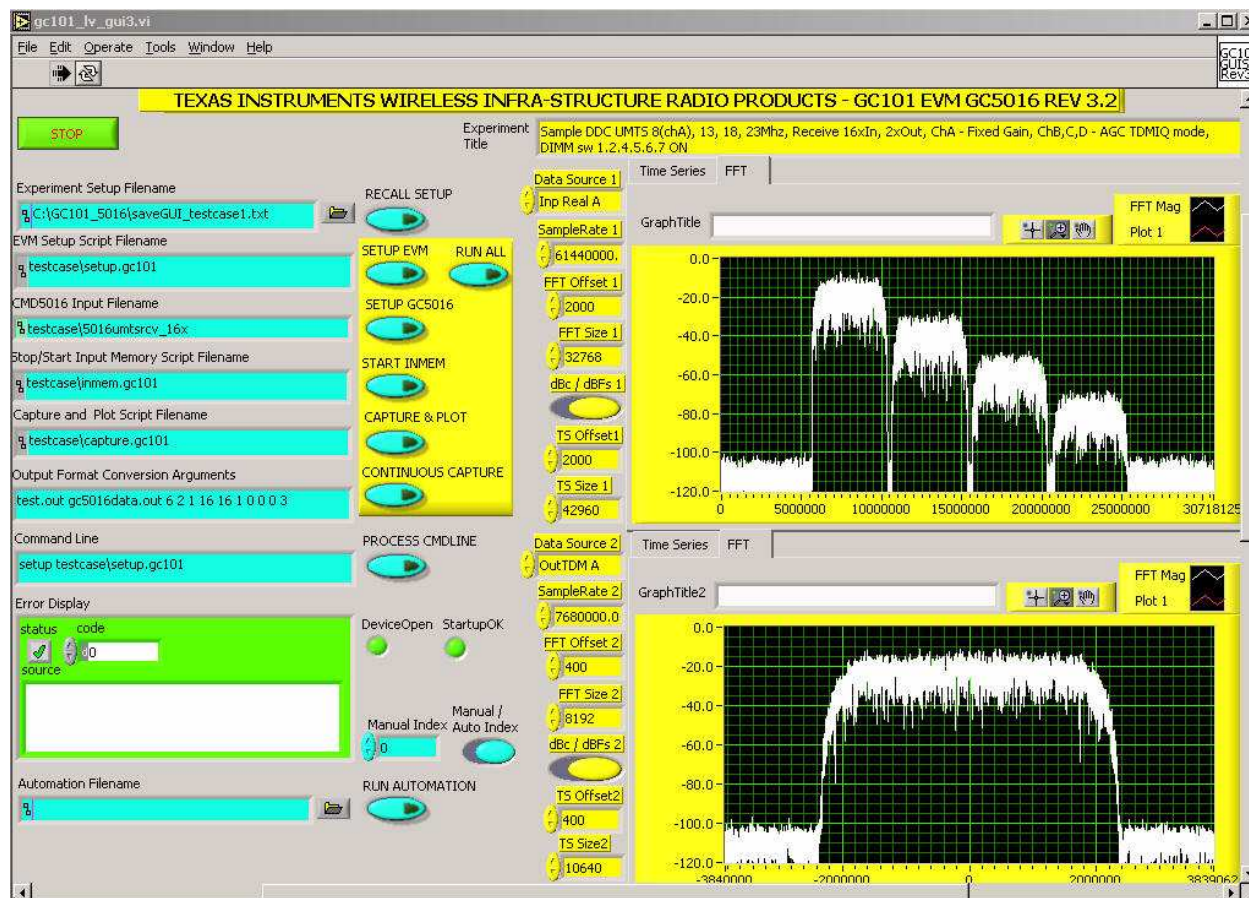


Figure 2-18. GUI Output for Default Configuration of “saveGUI\_testcase1.txt” Experiment

## 2.6 GC5016 Built-In Self-Test

The following section describes step-by-step how to perform the built-in self tests of the GC5016 to verify the operation of the GC5016 and the interface with the GC101 EVM. The self-test provides the GC5016 with input data using an internal pattern generator, an internal sync using the general timer in the chip, and analyzes the output using a checksum generator. Four different configurations (two transmit, one receive, and one transceiver) are provided to check the different functions of the GC5016.

### 2.6.1 Running the Self-Test Software

To run the built-in self-test software, extract the checksum test files by double clicking on the following executable on the CD:

**Experiments\gc5016\_chksumtests.exe**

Unzip the folder to the default location by clicking on the "Unzip" button. When the extraction is completed, click on "OK" then the "Close" button. The software has now just created a directory called "gc5016\_checksumtest" within C:\GC101\_5016. Inside this directory will be the software files to perform the checksum test as well as the results of the tests after the checksum test has been executed. To run the checksum test, go to the C:\GC101\_5016 directory and double click on the following batch file:

**gc5016\_checksumtests.bat.**

The software will open a MSDOS window and perform four configuration tests. After the tests are complete, the results are placed in the C:\GC101\_5016\GC5016\_checksumtest\ directory. Each results file will have the checksum value at the end of the file as shown in Figure 2-19.





**Figure 2-19. Checksum File Showing the Generated Checksum Result (0x61ef) from Configuration File gc5016\_diagtest2.dat**

The name of the configuration file, the generated checksum file with the results, and the expected checksums are shown in [Table 2-3](#).

**Table 2-3. Expected Checksum Results**

CONFIGURATION FILE	CHECKSUM FILE	EXPECTED RESULTS
gc5016_diagtest1.dat	TCK100R0_cksum.txt	0x121d
gc5016_diagtest2.dat	TCK100R0_cksum.txt	0x61ef
gc5016_diagtest3.dat	RCK100R0_cksumr1.txt	0x64cf
	RCK100R0_cksumr2.txt	0x4747
	RCK100R0_cksumr3.txt	0x7bd9
	RCK100R0_cksumr4.txt	0x4747
gc5016_diagtest4.dat	TRCK100R0_cksum.txt	0x15c8
	TRCK100R0_cksumr3.txt	0x7bd9
	TRCK100R0_cksumr4.txt	0xe1cb

See the GC5016 data sheet for more information on these tests.

## 2.7 Interfacing to External EVM's

The user can test the GC5016 with external analog-to-digital (ADC) converter EVM's and digital-to-analog (DAC) converter EVM's using the GC101 I/O connectors and the provided software. Several experiments are available on the CD to run the GC5016 in either DDC or DUC mode with existing Texas Instruments ADC and DAC EVM's.

### 2.7.1 DUC Experiments using DAC5686 and DAC5687 EVM's

To setup for a test with an external DAC EVM, extract the DAC experiments by double clicking on the following executable on the CD:

**\\Experiments\\gc5016\_ducdac.exe**

Unzip the folder to the default location by clicking on the "Unzip" button. When the extraction is completed, click on "OK" then the "Close" button. The software has just created a directory called "gc5016\_ducdac" within C:\\GC101\_5016. Inside this directory will be experiments that allow the user to test several different standards with the GC5016 DUC and a DAC5686 or DAC5687 DAC EVM.

### 2.7.1.1 Hardware Setup

With the power off, connect the inputs of a DAC5686 or DAC5687 EVM to the GC101 output connectors either with a harness or an interface board that can be provided by Texas Instruments. Since the "A" data coming out of the GC101 does not line up with the "A" data connector on the DAC EVM's, the interface board was designed to swap the busses to correct for this.

Set the GC5016 Daughterboard dip switches 3, 5, 6, and 7 to "ON".

Provide an external clock source for the DAC EVM.

Connect the PLLLOCK (J2) output of the DAC EVM to the EXT Clock In SMA (J1) of the GC101 EVM. This allows the test data from the DUC to be synchronized with the DAC clock. The setup should look as shown in Figure 2-20.

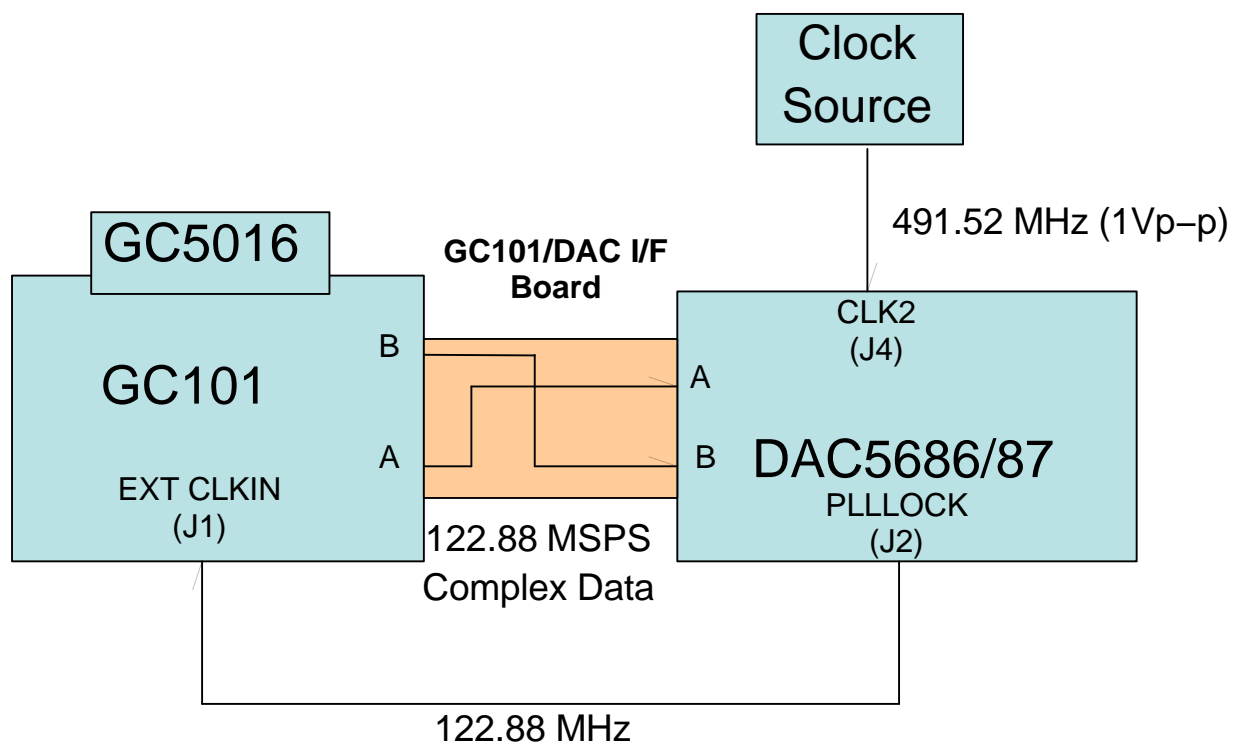


Figure 2-20. GC101/GC5016 Interface to DAC5686/87 EVM

### 2.7.1.2 Running the Experiment

Provide power to the DAC EVM and GC101. Using the DAC5687 SPI Control Software, setup the DAC5687 internal registers per the requirements of the experiment to be tested. A JPEG of the settings to be used by the DAC5687 is available for each experiment inside the four test directories under the following directory on the CD:

**Documents\gc101\_5016\_gui\gc5016\_ducdac**

Start the GC5016 GUI software.

Using the browse box to the right of the "Experiment Setup Filename" textbox, go the "**GC101\_5016\gc5016\_ducdac**" directory.

Select one of the "**saveGUI\_XXXX.txt**" experiment files.

Click the "Recall Setup" button to load the default parameters for the experiment.

Click on the "Run All" button from the "Process Controls and Script Filenames" window to start the experiment. The output spectrum shown in the GUI graphical analysis window (Data Source 2) and the output of the DAC5687 should look per the corresponding JPEGs inside the four directories under "Documents\gc101\_5016\_gui\gc5016\_ducdac" directory.

### 2.7.1.3 DAC5687 Input Data Timing

For proper operation, the data setup and hold times for the DAC5687 must meet the device specifications. If not, the end results of the experiment will be a degraded or an invalid output.

When using the DAC5687, there is an option that allows the user to clock the data into the device with either the rising or falling edge of PLLLOCK. This is controlled by the **Inv. PLL Lock** switch on the DAC5687 SPI Control Software, as shown in Figure 2-21.

If the output spectrum does not appear to be correct, changing the setting of this switch usually corrects the problem. Figure 2-22 shows an example of proper DAC timing with the **Inv. PLL Lock** turned off.

If this does not fix the problem, to provide the proper timing, the user must use either the proper cable length between J2 of the DAC5687 EVM and J1 of the GC101, or use a setup that has a dual clock source that can adjust the skew between the clocks. Figure 2-23 shows a setup using two clock sources that allows clock skew adjustment.

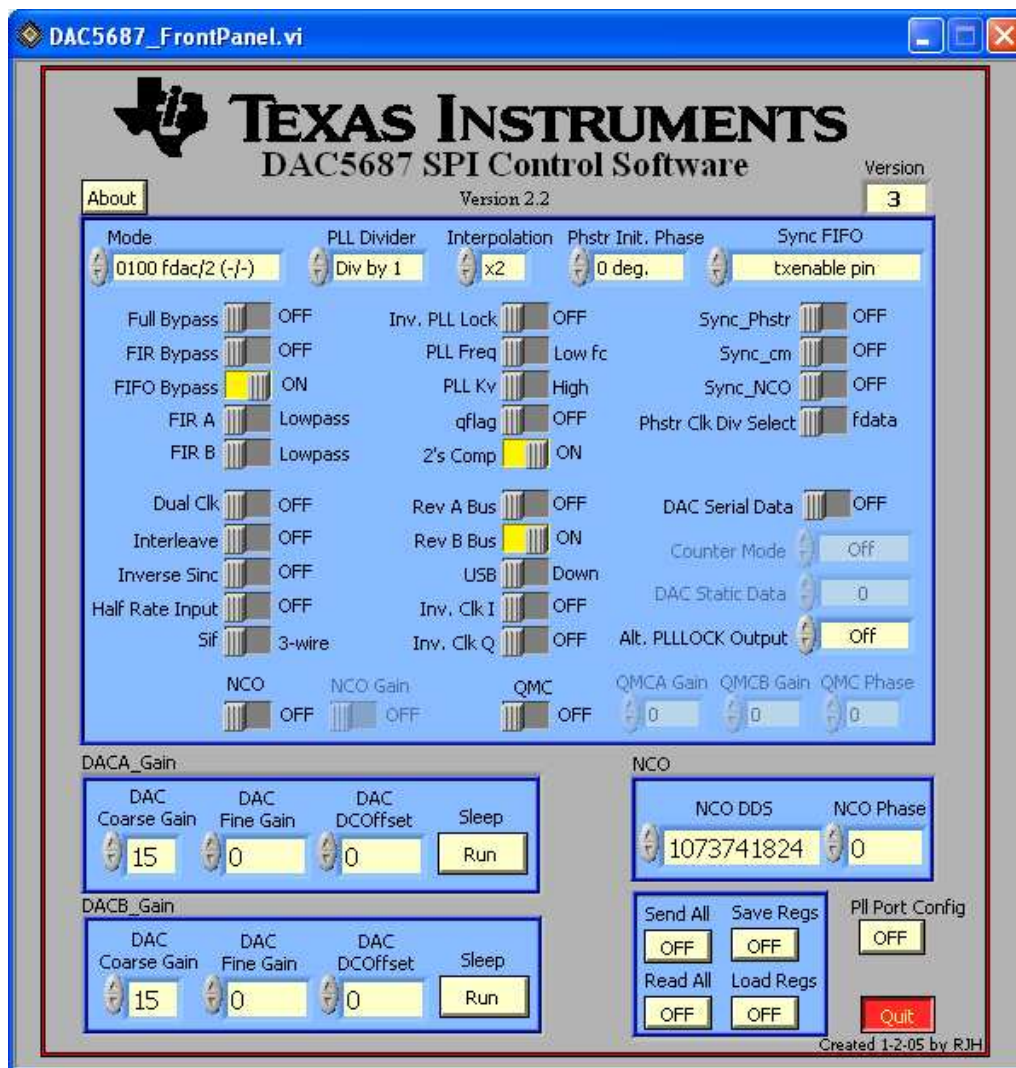
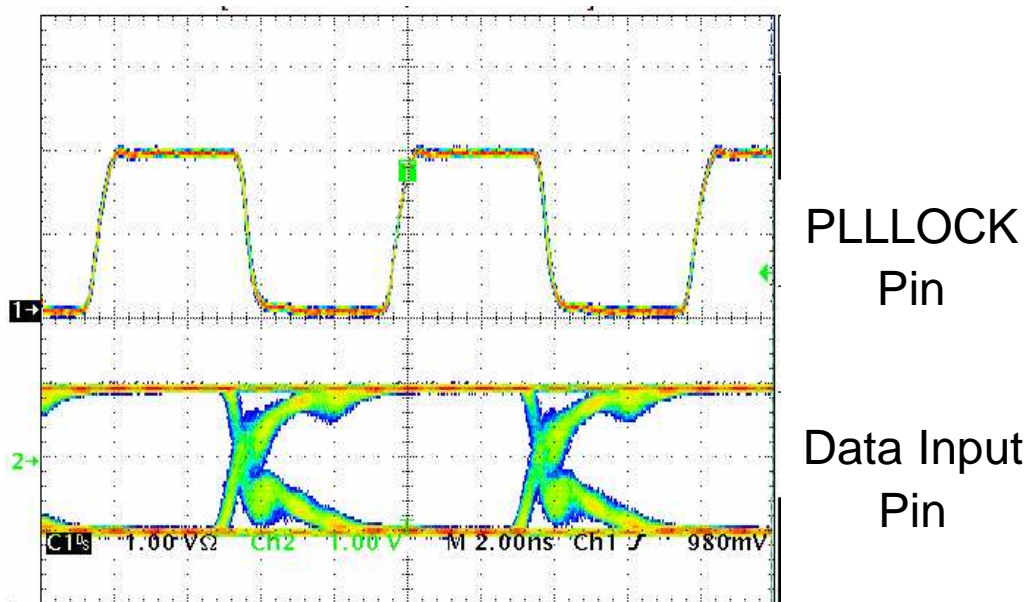


Figure 2-21. Setting the DAC5687 to Clock Data with the Rising Edge of PLLLOCK



## Latch on Rising Edge

Figure 2-22. PLLLOCK and Input Data of DAC5687 (Inv. PLL Lock Should Be "OFF" for This Case)

### 2.7.1.4 DAC5686 Input Data Timing

For proper operation, the data setup and hold times for the DAC5686 must meet the device specifications. If not, the end results of the experiment will be a degraded or an invalid output.

Unlike the DAC5687, the DAC5686 does not have an option to clock the data into the device with either the rising or falling edge of PLLLOCK. To provide the proper timing, the user must use either the proper cable length between J2 of the DAC5686 EVM and J1 of the GC101, or use a setup that has a dual clock source that the skew can be adjusted (See Figure 2-23).

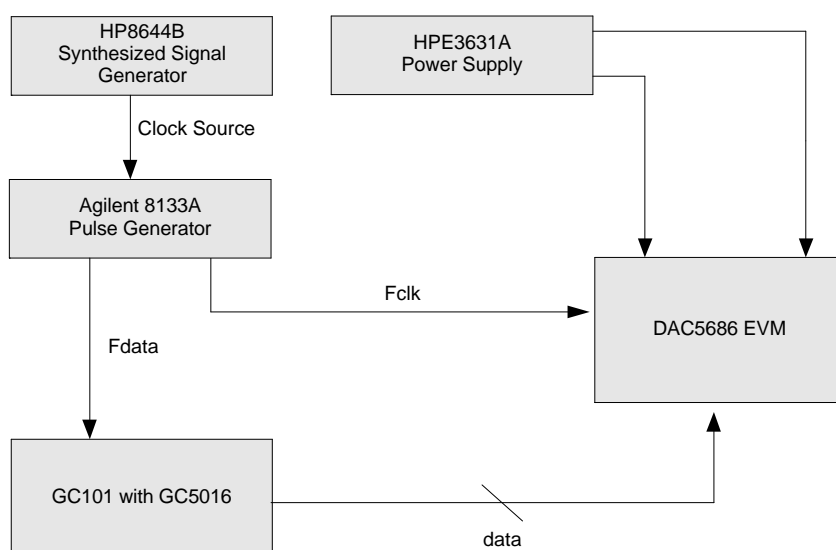


Figure 2-23. DAC5686 Interface With Adjustable Clock Skew



## 2.7.2 DDC Experiments using an ADS5500 EVM

To setup for a test with an external ADC EVM, extract the files from the following executable on the CD:

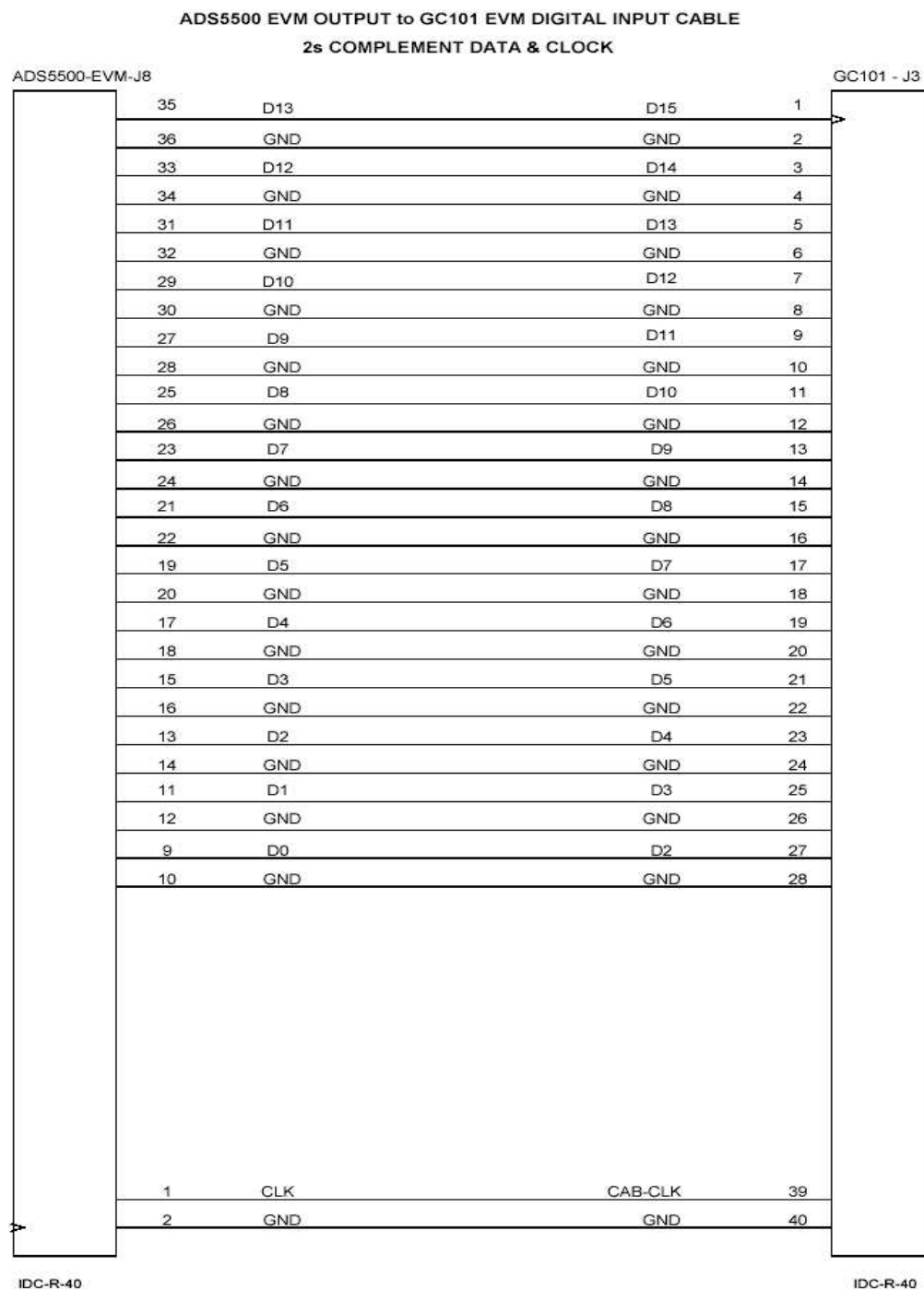
**\\Experiments\\gc5016\_ddcadc.exe**

The software will automatically create a directory called "**gc5016\_ddc\_adc**" inside the C:\\GC101\_5016 main directory. Inside this directory will be experiments that allow the user to test several different standards with the GC5016 DDC and an ADS5500 14-bit A-to-D converter.

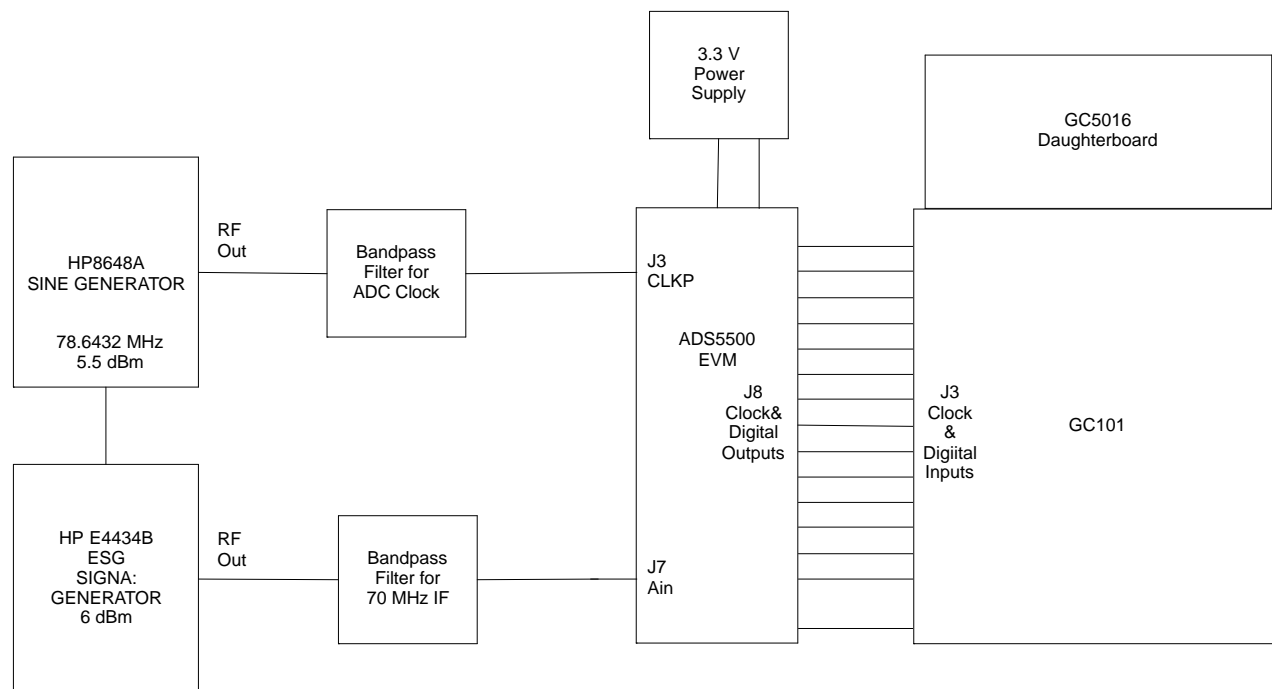
### 2.7.2.1 Hardware Setup

With the power off, connect the data and clock outputs from the IDC connector of an ADS5500 EVM to the GC101 input IDC connector J3 using high performance interface cables per [Figure 2-25](#). One option is to use IDC interface cables manufactured by Joy Signal Inc. (<http://www.joysignal.com/ssi.htm>, part # S71-S71-017-06). These are RG-178, 50  $\Omega$  coax cables, that plug directly into standard 0.100" IDC headers.

Provide the appropriate external clock frequency and analog test input per the experiment to be tested for the ADS5500 EVM. An example of an ADS5500 EVM interface to a GC101 is shown in [Figure 2-24](#).



**Figure 2-24. ADS5500 EVM Interface to GC101/GC5016**



**Figure 2-25. ADS5500 EVM to a GC101 Interface Connection Diagram**

### 2.7.2.2 Running the Experiment

Provide power to the ADS5500 EVM and GC101.

Start the GC5016 GUI software.

Using the browse box to the right of the "Experiment Setup Filename" textbox, go to the **"GC101\_5016\gc5016\_ddc\_adc"** directory.

Select one of the **"saveGUI\_xxxx.txt"** experiment files.

Click the "Recall Setup" button to load the default parameters for the experiment. Set the GC5016 Daughterboard dip switches per the description inside the "Experiment Title" textbox of the GUI. This setting may be different for other experiments. If no setting is specified, use the DDC default setting of 1, 2, 4, 5, 6, and 7 to "ON".

Click on the "Run All" button from the "Process Controls and Script Filenames" window to start the experiment. The output spectrum shown in the GUI graphical analysis window should look per the corresponding JPEGs inside the **"Documents\gc101\_5016\_gui\gc5016\_ddcadc"** directory. The graph in the Data Source 1 widow represents the output of the ADC, and the graph in the Data Source 2 widow represents the output of the DDC.

### 2.7.2.3 GC101 Input Data Timing

For proper operation, the data setup and hold times for the output data from the ADC EVM must meet the GC101 EVM input register timing specifications. If not, the end results of the experiment will be a degraded or an invalid output.



## Physical Description

This chapter describes the physical characteristics and PCB layout of the EVM and lists the components used on the module.

### 3.1 PCB Layout

The EVM is constructed on a 6-layer, 2.6-inch x 5.25-inch, 0.05-inch thick PCB using FR-4 material. Figure 3-1 through Figure 3-6 show the PCB layout for the EVM.

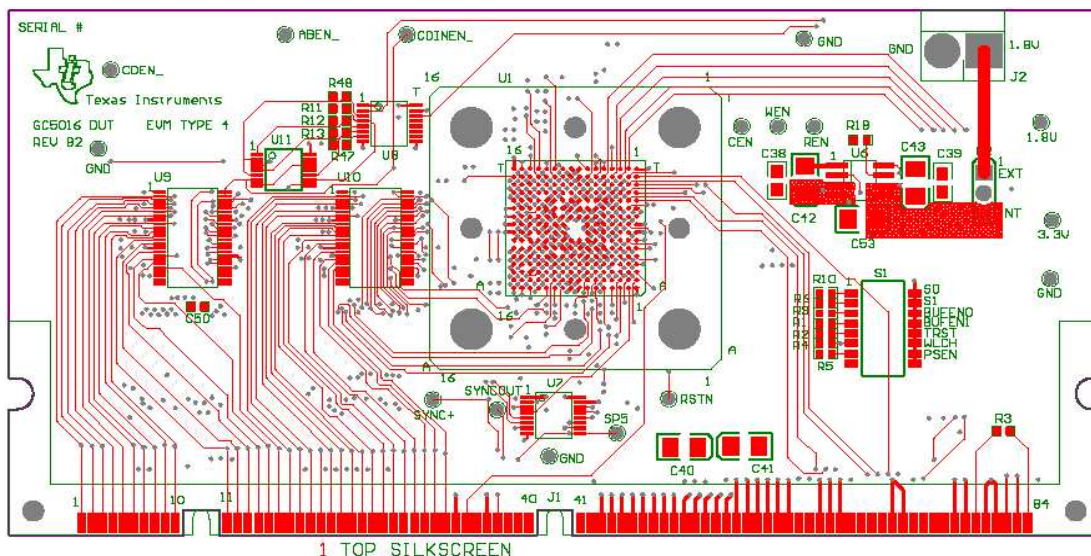
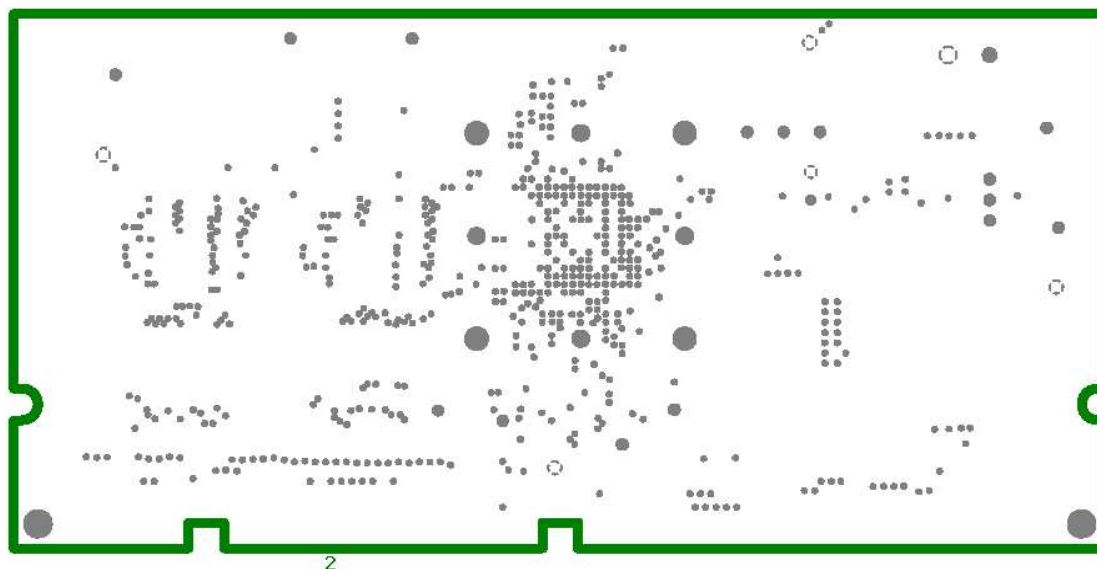
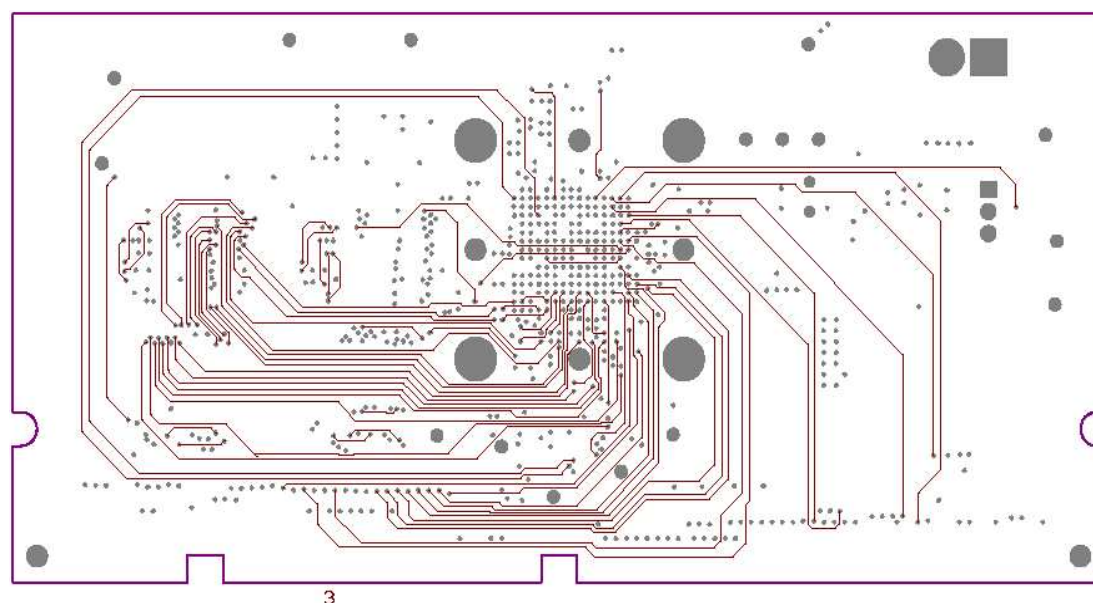


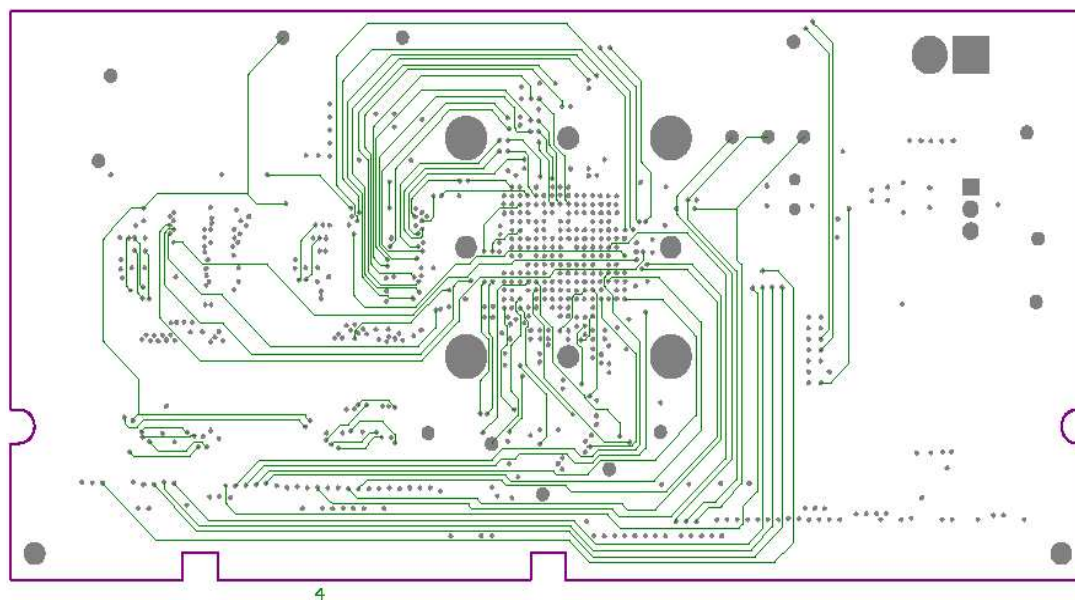
Figure 3-1. Top Layer 1



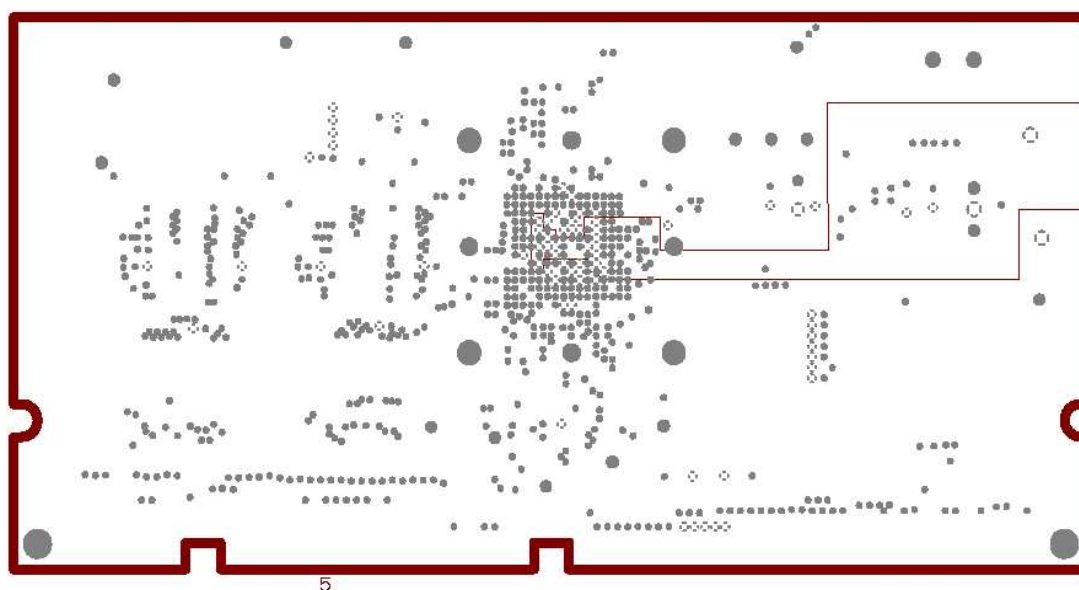
**Figure 3-2. Ground Plane Layer 2**



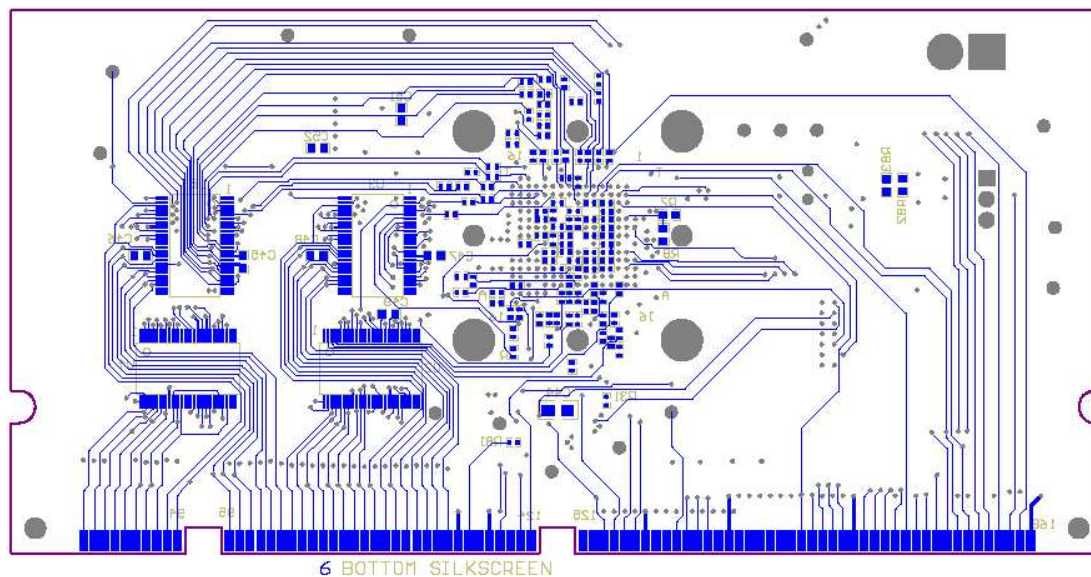
**Figure 3-3. Signal Layer 3**



**Figure 3-4. Signal Layer 4**



**Figure 3-5. Power Plane Layer 5**



**Figure 3-6. Bottom Layer 6**

## 3.2 Parts List

Table 3-1 lists the parts used in constructing the EVM.

**Table 3-1. Bill of Materials for GC5016 EVM**

VALUE	QTY	PART NUMBER	MANUFAC- TURER	REF DES	NOT INSTALLED
2.2 $\mu$ F, 20 V, 10%, Capacitor	1	ECS-T1DX225R	PANASONIC	C40	
10 $\mu$ F, 20 V, 10%, Capacitor	4	ECS-T1DX106R	PANASONIC	C41 C42 C43 C53	
0.1 $\mu$ F, 16 V, 10%, Capacitor	3	ECJ-2VB1C104K	PANASONIC	C38 C39 C44	
0.1 $\mu$ F, 16 V, 10%, Capacitor	8	ECJ-1VB1C104K	PANASONIC	C45-C52	
0.1 $\mu$ F, 16 V, 10%, Capacitor	37	ECJ-0EF1C104Z	PANASONIC	C1-C37	
100 $\Omega$ resistor, 1/16 W, 1%	1	ERJ-3EKF1000V	PANASONIC	R3	
130 $\Omega$ resistor, 1/16 W, 1%	2	ERJ-3EKF1300V	PANASONIC	R7 R8	
0 $\Omega$ Resistor, 1/16 W, 1%	1	ERJ-3GEY0R00V	PANASONIC	R47	
4.75 k $\Omega$ Resistor, 1/16 W, 1%	11	ERJ-3EKF4752V	PANASONIC	R1R2 R4 R5 R6 R9-R13 R48	
30.1 k $\Omega$ Resistor, 1/16 W, 1%	1	ERJ-3EKF3012V	PANASONIC	R18	
15.8 k $\Omega$ Resistor, 1/16 W, 1%	1	ERJ-3EKF1582V	PANASONIC	R83	
249 k $\Omega$ Resistor, 1/16 W, 1%	1	ERJ-3EKF2491V	PANASONIC	R82	
22.1 $\Omega$ resistor, 1/16 W, 1%	65	ERJ-2RKF22R1V	PANASONIC	R14-R17 R19-R46 R49-R81	
Red test point	12	5000k	KEYSTONE	TP4-TP6 TP8-TP16	
Black test point	4	5001k	KEYSTONE	TP1 TP2 TP3 TP17	



**Table 3-1. Bill of Materials for GC5016 EVM (continued)**

VALUE	QTY	PART NUMBER	MANUFAC- TURER	REF DES	NOT INSTALLED
CON_2TERM_SCREW	0	KRMZ3	LUMBERG		J2
Switch_8pos_smt	1	DHS8S	APEM	S1	
GC5016_PBGA	1	GC5016-PB	Texas Instru- ments	U1	
SN74CBTLV16210	6	SN74CBTLV16210GR	Texas Instru- ments	U2-U5 U9 U10	
SN74CBTLV3253	2	SN74CBTLV3253PWR	Texas Instru- ments	U7 U8	
SN74LVC08	1	SN74LVC08APWR	Texas Instru- ments	U11	
TPS76801Q	1	TPS76801QD	Texas Instru- ments	U6	

### 3.3 Schematics

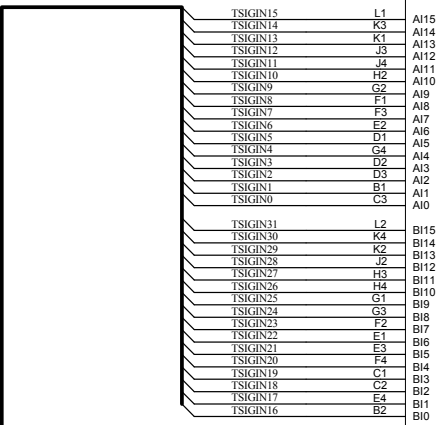
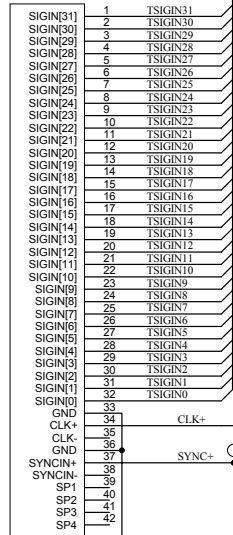
This chapters contains the schematics for the EVM.

NOTE 1. PART NOT INSTALLED

U1A  
GC5016\_PBGa

Revision History		
REV	ECN Number	Approved

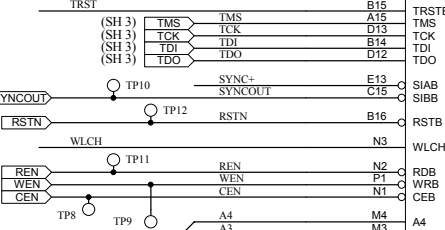
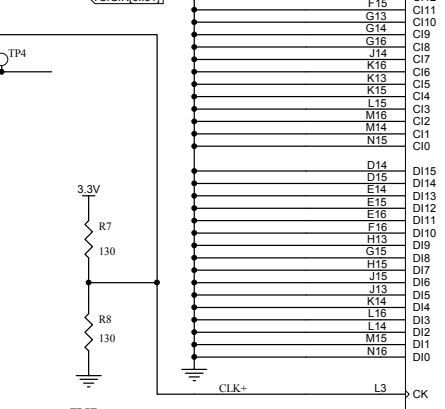
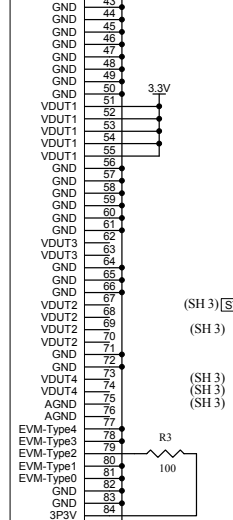
J1A  
168-CONN-AMP-RA-TH



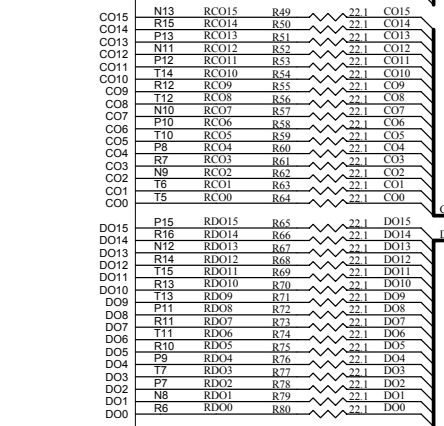
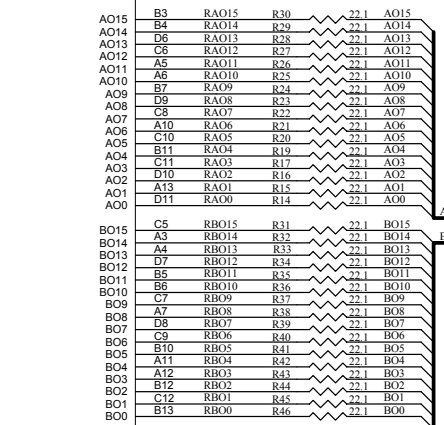
TEST IN BUS

(SH 3) [SIGIN[0..31]]

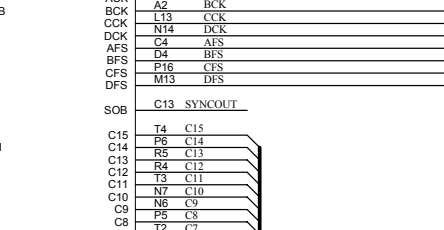
J1B



GC CONTROL BUS  
(SH 3) [A[0..4]]

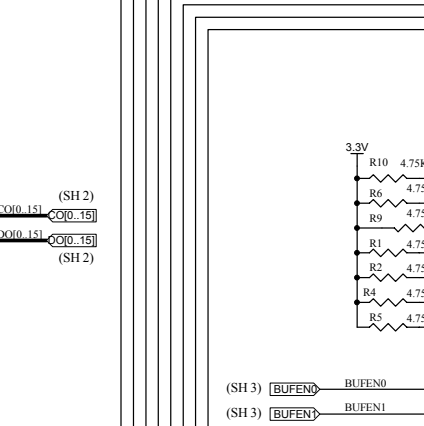
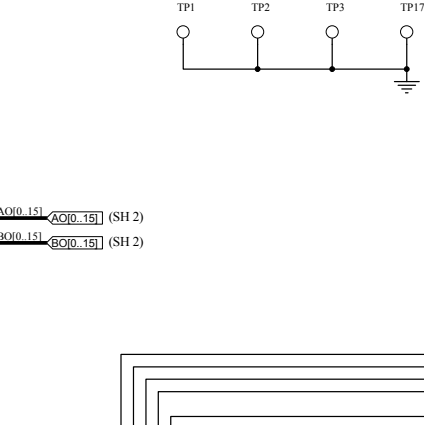


GC CONTROL BUS  
(SH 3) [A[0..4]]

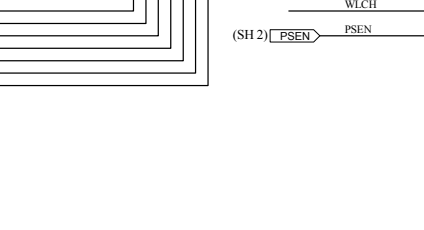


GC CONTROL BUS  
(SH 3) [A[0..4]]

GC CONTROL BUS  
(SH 3) [A[0..4]]

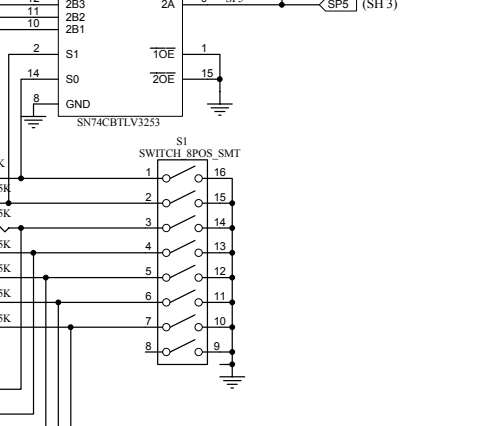
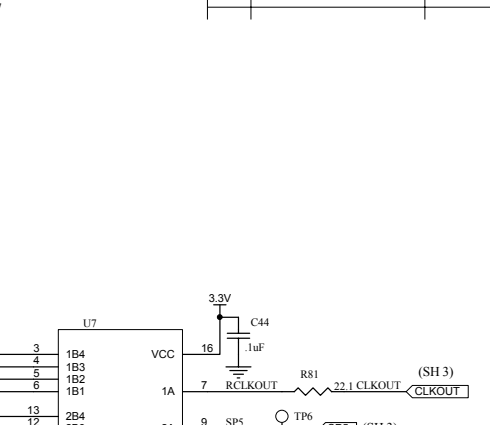


GC CONTROL BUS  
(SH 3) [A[0..4]]



GC CONTROL BUS  
(SH 3) [A[0..4]]

GC CONTROL BUS  
(SH 3) [A[0..4]]



GC CONTROL BUS  
(SH 3) [A[0..4]]



GC CONTROL BUS  
(SH 3) [A[0..4]]

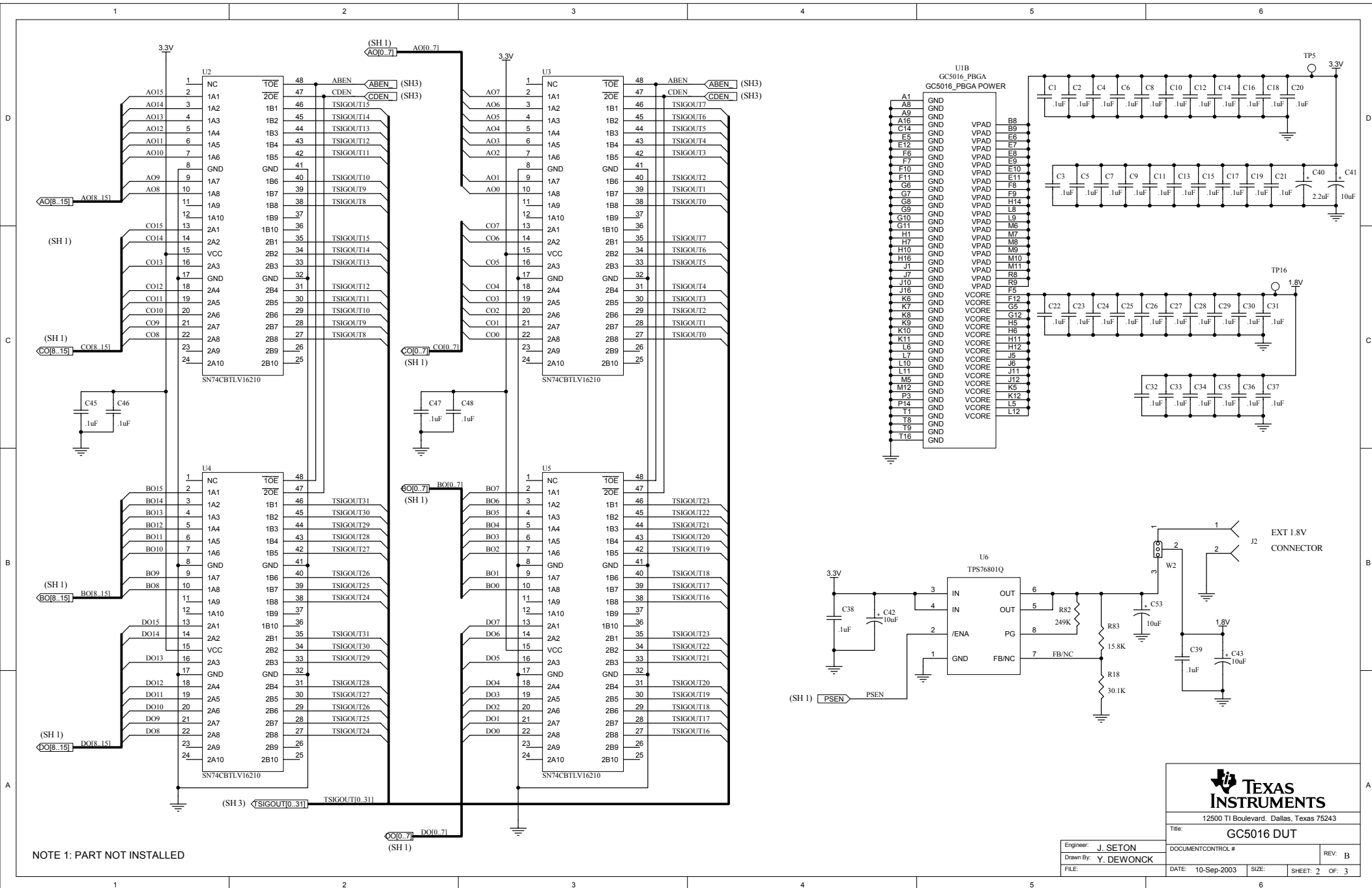
GC CONTROL BUS  
(SH 3) [A[0..4]]

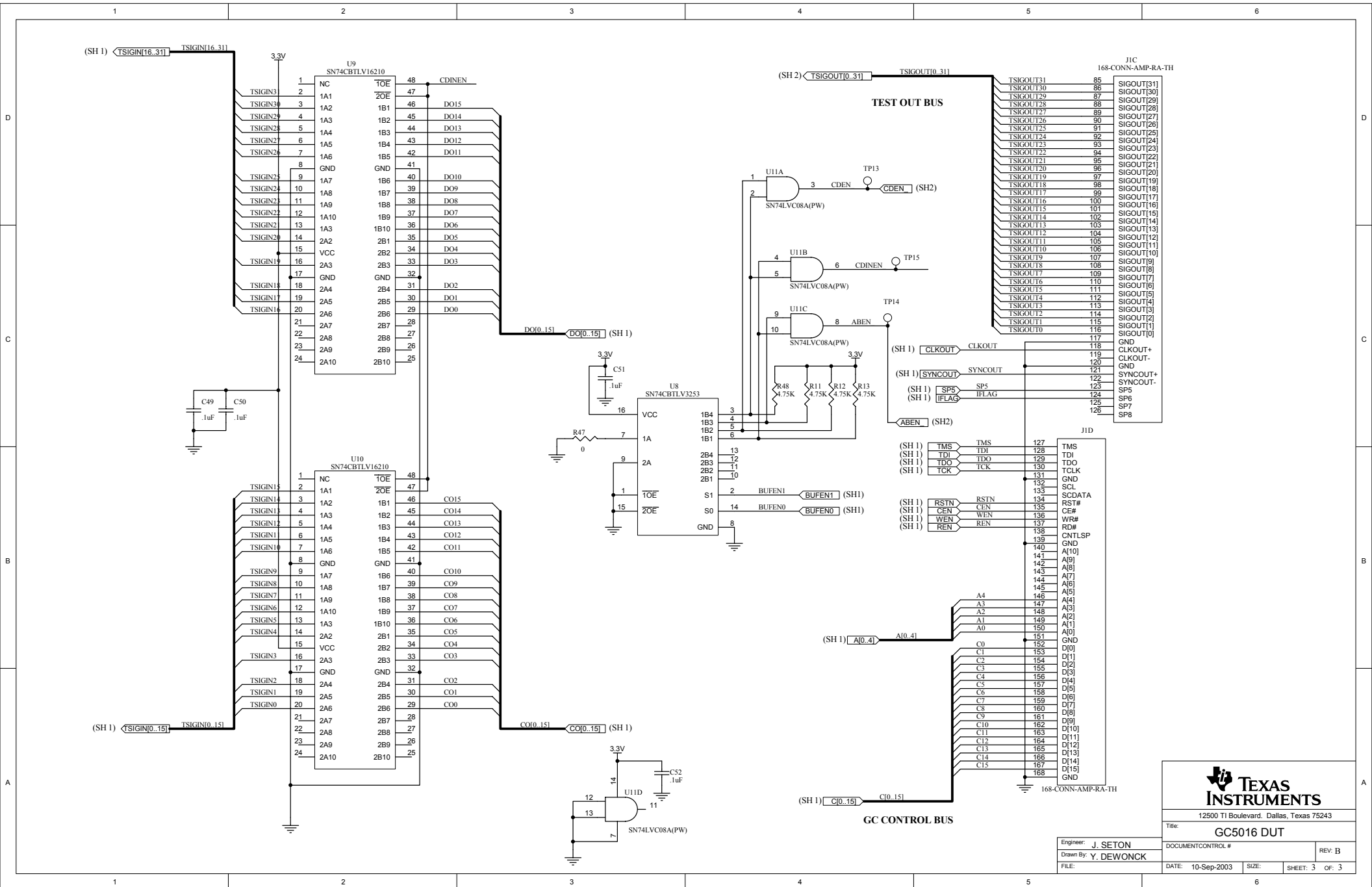


12500 TI Boulevard, Dallas, Texas 75243

GC5016 DUT

Engineer: J. SETON	DOCUMENT CONTROL #	REV: B
Drawn By: Y. DEWONCK	DATE: 10-Sep-2003	SHEET: 1 OF 3
FILE: Sheet1.Sch	SIZE:	







Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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- Поставка сложных, дефицитных, либо снятых с производства позиций;
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- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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