CDB5467U

CDB5467U Engineering Board and GUI Software

Features

- ❑ Voltage and Current Interface
- ❑ USB Communication with PC
- ❑ On-board C8051F320 Microcontroller
- ❑ On-board Voltage Reference
- ❑ LabWindows®/CVI® GUI Software
  - – Register Setup & Chip Control
  - – FFT Analysis
  - – Time Domain Analysis
  - – Noise Histogram Analysis
- ❑ "Auto-boot" Demo with Serial EEPROM

General Description

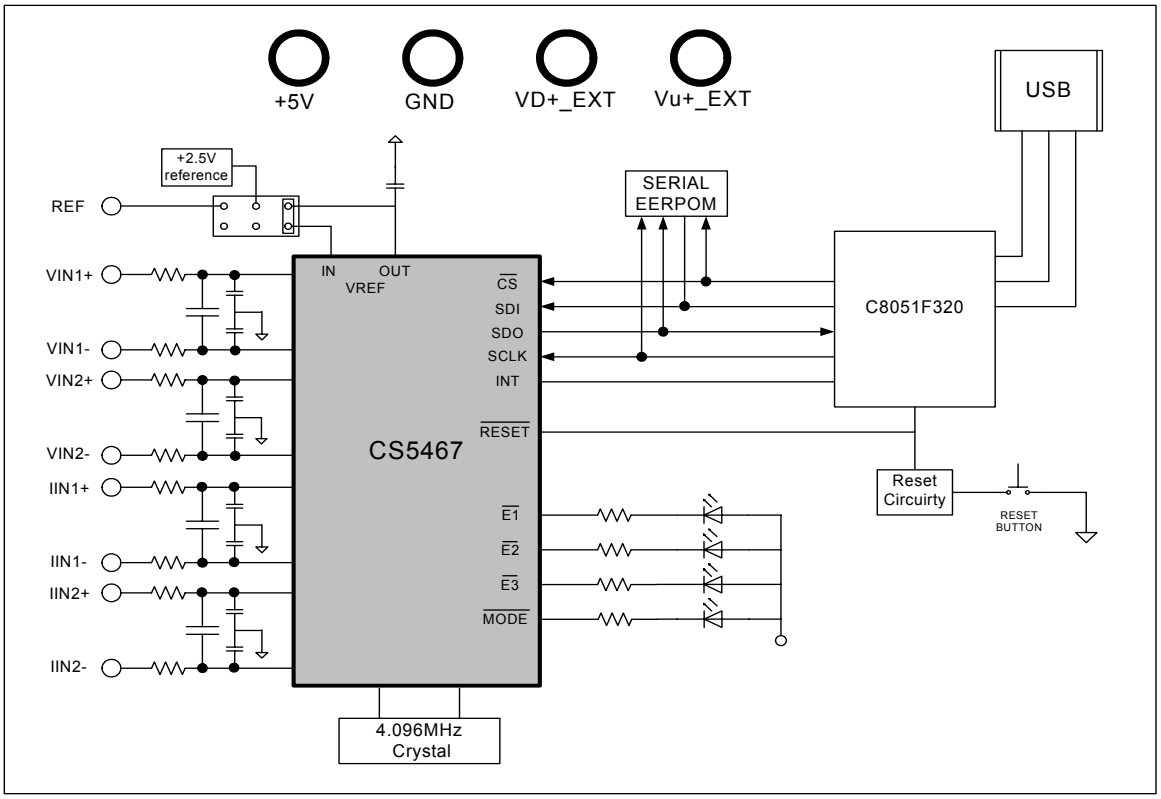
The CDB5467U is an inexpensive tool designed to evaluate the functionality and performance of the CS5467 analog-to-digital converter (ADC). The evaluation board includes an LT1019 voltage reference, a C8051F320 microcontroller with a USB interface, and firmware. The microcontroller controls the serial communication between the evaluation board and the PC via the firmware, enabling quick and easy access to all of theCS5467's registers and functions.

The CDB5467U includes software for data capture, time domain analysis, histogram analysis, and frequency domain analysis.

Schematics in PADS™ PowerLogic™ format are available for download at www.cirrus.com/IndustrialSoftware.

ORDERING INFORMATION

CDB5467U	Evaluation Board



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1. HARDWARE

1.1 Introduction

The CDB5467U evaluation board provides a convenient means of evaluating the CS5467 power measurement IC. The CDB5467U evaluation board operates from a single +5V power supply. The evaluation board interfaces the CS5467 to a PC via a USB cable. To accomplish this, the board comes equipped with a C8051F320 microcontroller and a USB interface. Additionally, the CDB5467U GUI software provides easy access to the internal registers of the CS5467. The software also provides a means to display the performance in the time domain or frequency domain.

1.2 Evaluation Board Overview

The board is partitioned into two main sections: analog and digital. The analog section consists of the CS5467 and a precision voltage reference. The digital section consists of the C8051F320 microcontroller, EEPROM, the hardware test switches, the reset circuitry, and the USB interface. The board also has a user friendly power supply connection.

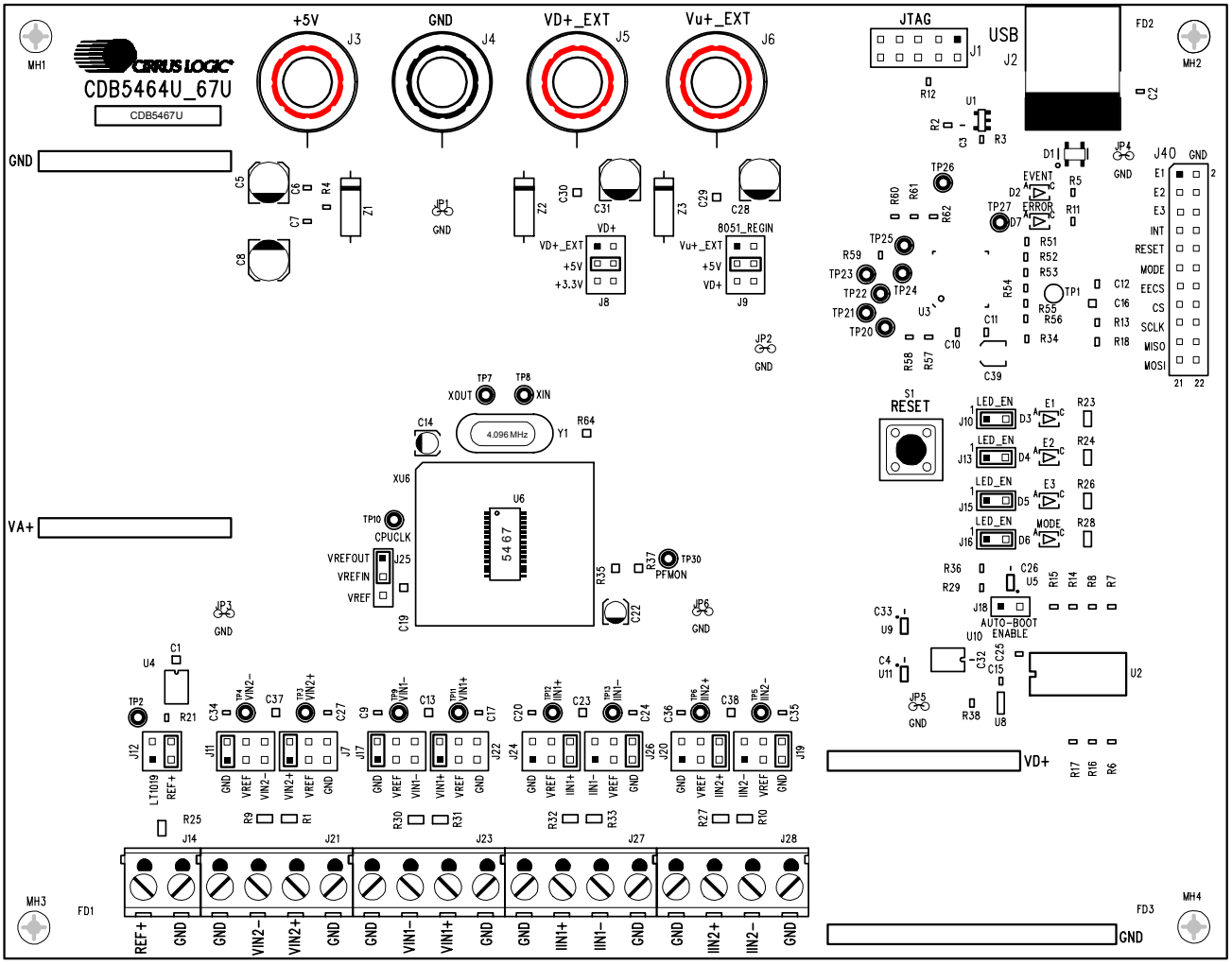


Figure 1. CDB5467U Assembly Drawing

1.3 Analog Section

The CDB5467U evaluation board provides screw-type terminals (J21, J23, J27, & J28) to connect input signals to the voltage and current channels. The screw terminals are labels as VIN2-, VIN2+, VIN1-, VIN1+, IIN1+, IIN1-, and IIN2+, IIN2-. An R-C network at each channel input provides a simple anti-alias filter.

The evaluation board provides three voltage reference options for VREFIN to the CS5467. The three voltage reference options include: VREFOUT from CS5467, the on-board +2.5V reference, and external REF+ (screw terminal J14). Table 1 and Table 2 illustrate the options available for VREFIN. With a jumper on J25 in the position labeled VREFOUT, the reference is supplied by the on-chip voltage reference. With a jumper on J25 in the position labeled VREF, the reference is supplied by an off-chip voltage reference.

Reference	Description	J25
VREFOUT	Selects On-chip Reference (25 ppm/°C)	
VREF	Selects External or LT1019 Reference(J12)	

Table 1. Internal Voltage Reference Selection for VREF

Table 2 illustrates the options available for VREF. With a jumper on J12 in position *LT1019*, the LT1019 provides a +2.5V reference (the LT1019 was chosen for its low drift - typically 5 ppm/°C). By setting the jumper on J12 to position *REF+*, an external voltage reference is supplied via screw terminal J14's *REF+* input.

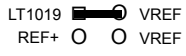
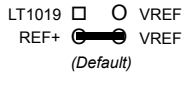
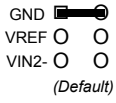
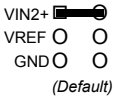
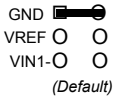
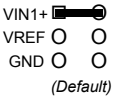
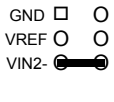
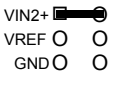
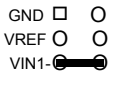
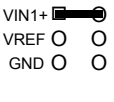
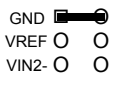
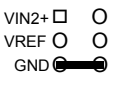
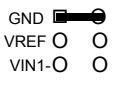
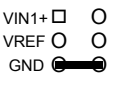
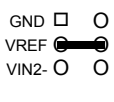
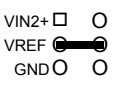
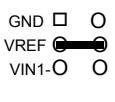
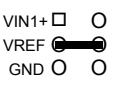
Reference	Description	J12
LT1019	Selects On-board LT1019 Reference (5 ppm/°C)	
REF+	Selects External Reference Source (J14)	

Table 2. External Voltage Reference Selection for VREF

The three input signal options for the voltage (VIN1±, VIN2±) and current (IIN1±, IIN2±) channels input include: an external signal (screw terminals J21, J23, J27, and J28), GND, or VREF. Table3 illustrates the options available. By installing jumpers on J11 to position *VIN2-*, J7 to position *VIN2+*, J17 to position *VIN1-*, J22 to position *VIN1+*, J24 to position *IIN1+*, J26 to position *IIN1-*, J20 to position *IIN2+*, and J19 to position *IIN2-*, the input voltage signal is supplied from the screw terminals J21, J23, J27, and J28. With a jumper on J11, J7, J17, J22, J24, J26, J20 and J19 in the *GND* position, the inputs are connected to

analog ground (AGND). With a jumper on J11, J7, J17, J22, J24, J26, J20 and J19 in position *VREF*, the inputs are connected to the reference voltage selected on J12.

INPUT	Description	J11	J7	J17	J22
VIN2± or VIN1±	Selects External Signal	 *(Default)*	 *(Default)*	 *(Default)*	 *(Default)*
VIN2± or VIN1±	Selects External Signal				
GND	Selects Grounding the Input				
VREFIN	Selects Reference Source				

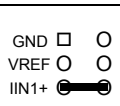
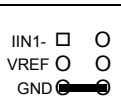
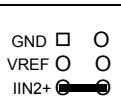
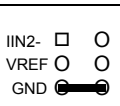
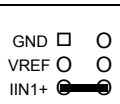
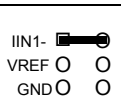
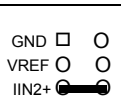
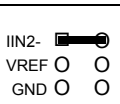
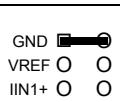
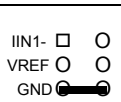
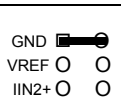
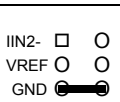
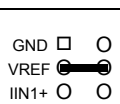
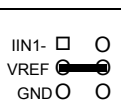
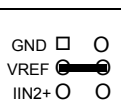
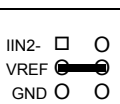
INPUT	Description	J24	J26	J20	J19
IIN1± or IIN2±	Selects External Signal	 *(Default)*	 *(Default)*	 *(Default)*	 *(Default)*
IIN1± or IIN2±	Selects External Signal				
GND	Selects Grounding the Input				
VREFIN	Selects Reference Source				

Table 3. Voltage and Current Channel Input Signal Selection

1.4 Digital Section

The digital section contains the microcontroller, USB interface, JTAG header, reset circuitry, and an external interface header (J40). The microcontroller interfaces the SPI of CS5467 with the USB connection to the PC, enabling the GUI software to access all the CS5467 registers and functions. Interface header, J40, is provided to allow the CDB5467U to be connected to an external energy registration device or an external microcontroller. To connect the CS5467 to an external microcontroller, R57, R58, R59, R60, R61, and R62 must be removed from the board. The energy output pins E1, E2, and E3 are routed to LEDs which provide a simple visual check of the energy output pulses. The MODE pin is also routed to a LED to indicate whether the CS5467 is operating in auto-boot mode. Jumpers J10, J13, J15, and J16 are equipped at the factory with jumpers to enable the LEDs.

1.5 Power Supply Section

Table 4 illustrates the power supply connections to the evaluation board. The *+5V* binding post (J3) supplies the positive analog (VA+) for the CS5467 and the +2.5V reference. The *VD+_EXT* binding post (J5) supplies the digital section of the CS5467 (VD+) and level shifters. Jumper J8 allows the VD+ supply to be sourced from the *VD+_EXT* binding post (J5), the *+5V* binding post (J3), or the regulated 3.3V supply derived from the microcontroller. The *Vu+_EXT* (J6) binding post supplies the positive supply for the 8051 microcontroller (*8051_REGIN*). Jumper J9 allows the *8051_REGIN* supply to be sourced from either the *Vu+_EXT* binding post (J6), *+5V* binding post (J3) or *VD+_EXT* binding post (J5).

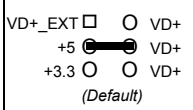
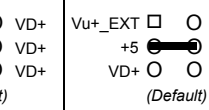
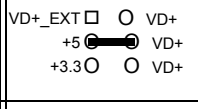
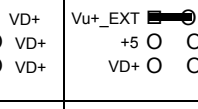
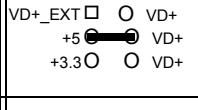
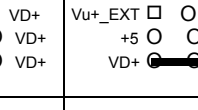
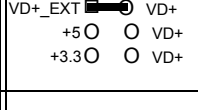
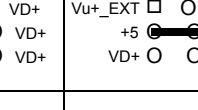
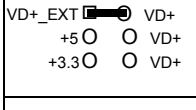
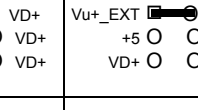
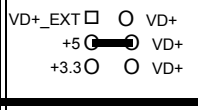
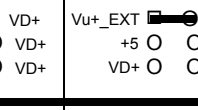
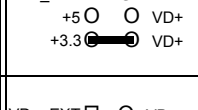
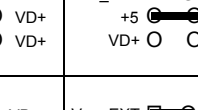
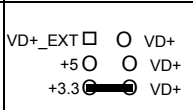
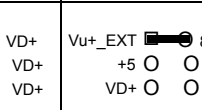
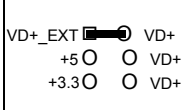
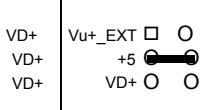
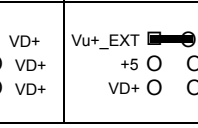
Power Supplies			Power Post Connections				VD+	8051-REGIN
Analog (VA+)	Digital (VD+)	8051 (Vu+)	+5V	GND	VD+EXT	VU+EXT	J8	J9
+5	+5	+5	+5	0	NC	NC	 *(Default)*	 *(Default)*
						+5		
						NC		
					+5	NC		
						+5		
						NC		
+5	+3.3	+5	+5	0	NC	NC		
						+5		
					+3.3	NC		
						+5		

Table 4. Power Supply Connections

1.6 Auto-boot Mode

With a jumper connection on J18 (*AUTO-BOOT ENABLE*), the CS5467 operates in auto-boot mode and the CDB5467U board operates as a stand-alone system without attaching it up to a PC. When in auto-boot mode, a hardware reset (press on S1) will cause the CS5467 to boot up using the serial data from the serial EEPROM on the board (U10). When the CS5467 is in auto-boot mode, the SPI connections between the microcontroller and the CS5467 are removed and the GUI software can not access the CS5467 registers and functions.

The EEPROM must be programmed prior to the auto-boot sequence. When the CDB5467U Evaluation Board is sent from the factory, the EEPROM is programmed with the following CS5467 command/data sequence:

1. Move to EEPROM page 1:
   0x7E 0x00 0x00 0x01
2. Write Modes register, turn high-pass filters on:
   0x60 0x00 0x01 0xE0
3. Move to EEPROM page 0:
   0x7E 0x00 0x00 0x00
4. Set bit 2 (LSD) in the Mask register:
   0x74 0x00 0x00 0x04
5. Start continuous conversion:
   0xE8
6. Write STOP bit in Control register, to terminate auto-boot sequence:
   0x78 0x00 0x01 0x00

This sequence programs the CS5467 for continuous conversion mode. If voltage and current signals are applied to the inputs, the CS5467 will issue pulses on the $\overline{E1}$ pin. See the CS5467 data sheet for more details on auto-boot.

2. SOFTWARE

The evaluation board comes with software and an USB cable to link the evaluation board to the PC. The evaluation software was developed with LabWindows®/CVI®, a software development package from national Instruments. The evaluation software is available for download on the Cirrus Logic web site at http://www.cirrus.com/industrialsoftware and was designed to run under Windows® 2000 or Windows XP®.

2.1 Installation

To install the software, go to the Cirrus Logic web site at http://www.cirrus.com/industrialsoftware and refer to application note AN278.

2.2 Using the Software

Before launching the software, check all jumper settings on the CDB5467U evaluation board as described in Section 1, and connect the board to an open USB port on the PC using the provided cable. Once the board is powered on, the software program can be launched.

2.3 Start-up Window

When the software is launched, the start-up window will appear. This window contains information concerning the software's title, revision number, copyright date, etc. See Figure 2.

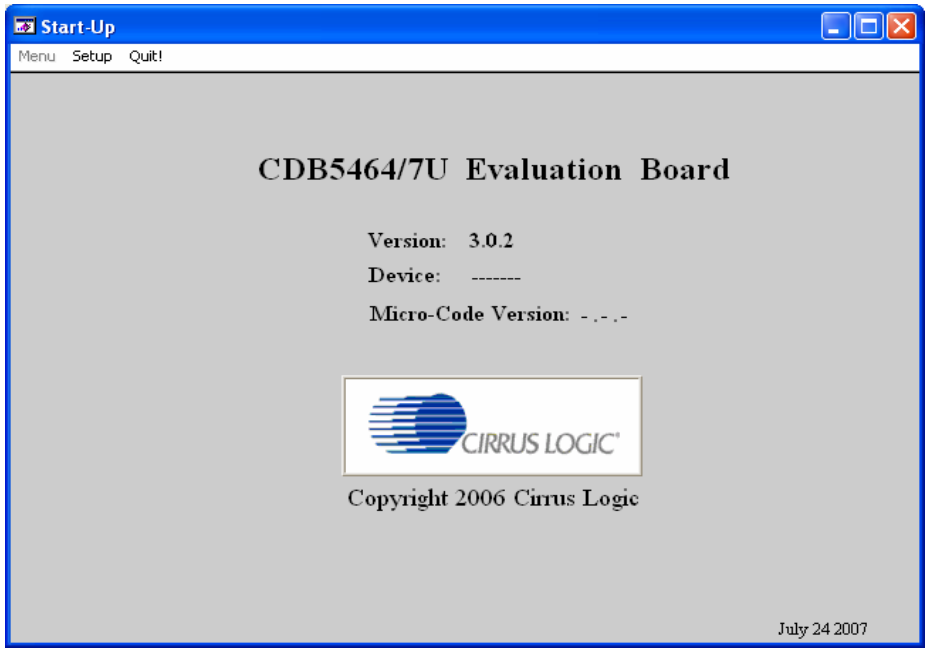


Figure 2. GUI Start-up Window

At the top of the screen is a menu bar which displays user options. The menu bar has three items: *Menu*, *Setup*, and *Quit*. Initially *Menu* is disabled. After establishing a link to a data source, the *Menu* item will become available.

2.3.1 *Setup Menu*

Setup allows user to establish a USB communication connection with CDB5467U board or select a previously saved data file for further analysis.

If the *USB* item in the *Setup* menu is selected, the evaluation software will poll the CDB5467U, verifying the serial communication link is ready. At this point, the *USB* menu item is checked indicating that the PC has successfully communicated with CDB5467U evaluation board, and device and micro-code version information are read from the board and displayed on the screen. See Figure 3. Due to improvements to the software or new features being added, the version displayed may be different than the image shown here.

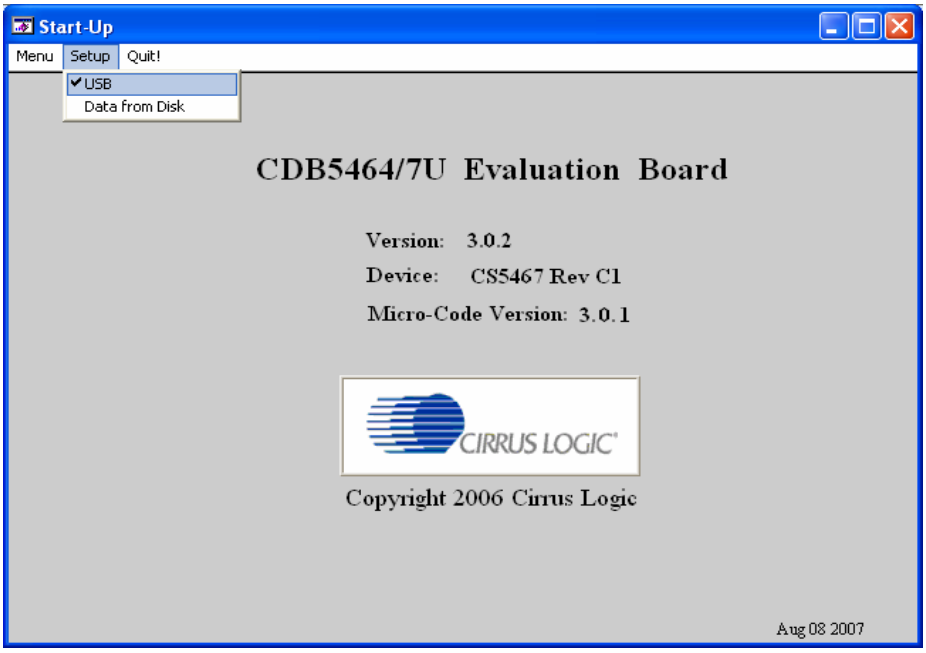


Figure 3. *Setup* Menu Showing Successful USB Connection

If the evaluation software is unable to establish a communication link with the CDB5467U board, a message will appear, indicating that the initial communication has failed. See Figure 4.

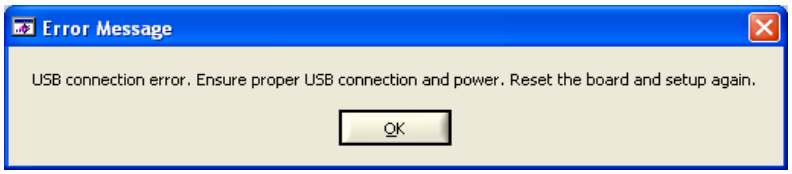


Figure 4. USB Error Message

Check to verify that the USB cable is connected properly and the power supply is on and connected properly to the CDB5467U. Reset the board (press the *RESET* button on the board) and try to setup the USB connection again.

If the *Data from Disk* item in the *Setup* menu is selected, a file selection window will appear as shown in Figure 5. User can select a pre-saved data file for further analysis using time domain, FFT, and histogram plots in Data Collection Window of the software.

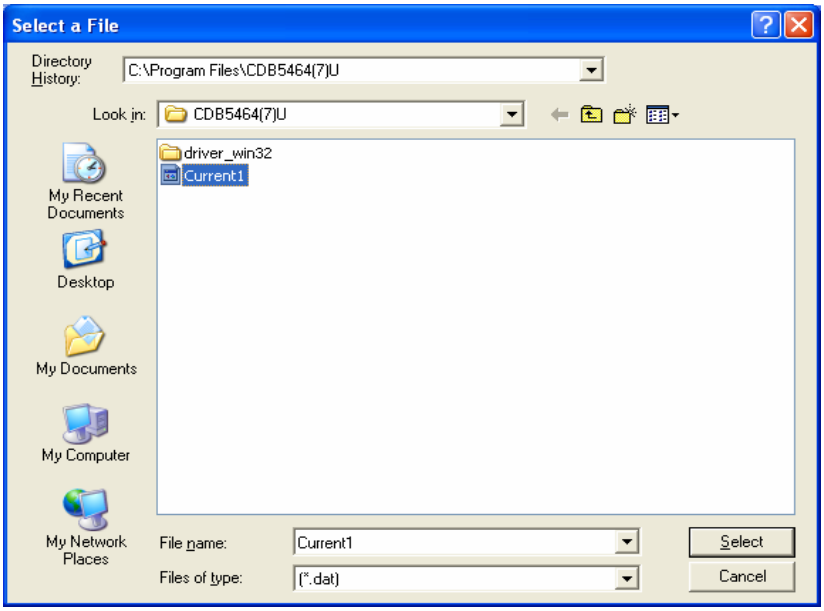


Figure 5. *Data from Disc* File Selection Window

2.3.2 *Menu Menu*

Excluding the *Start-Up* window, the *Menu* menu provides 7 options: *Setup Window*, *Calibration Window*, *Conversion Window*, *Pulse Rate Window*, *Data Collection Window*, *EEPROM Window*, and *Debug Window*. Each window provides a means to evaluate the different functions and performance of the CS5467. Each option has an associated function key (<F1>, <F2>, etc.). See Figure 6.

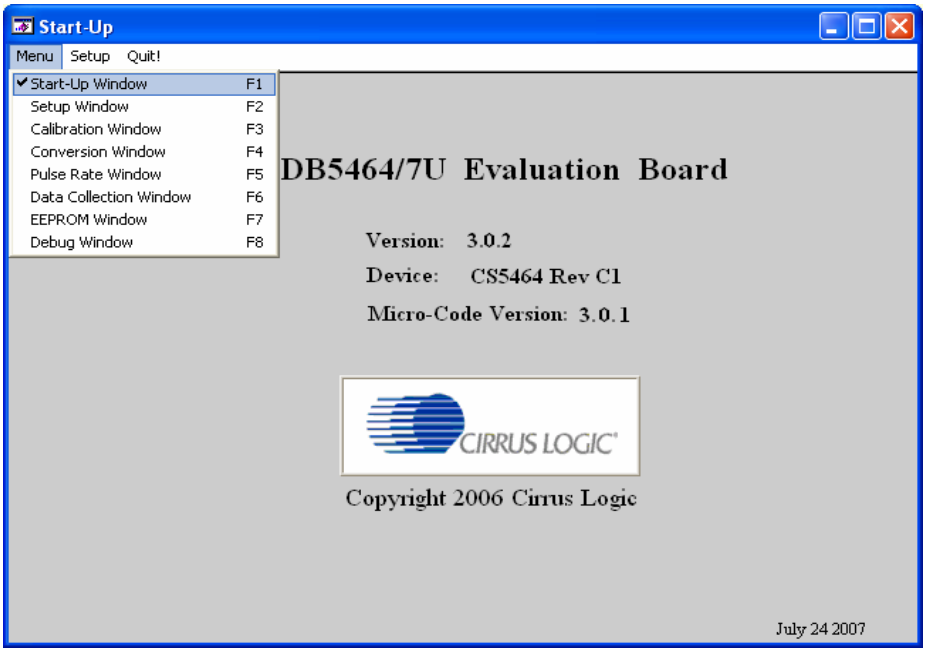


Figure 6. *Menu* Pull-down Options

2.3.3 *Quit Menu*

The *Quit* menu allows the user to exit the evaluation software. Upon selecting *Quit*, a message window appears and queries if exiting the evaluation software is desired. See Figure 7.

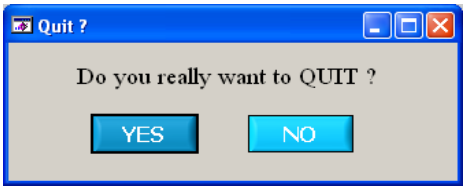


Figure 7. *Quit* Dialog

2.4 *Setup* Window

The evaluation software provides access to the CS5467's internal registers through the *Setup* window. See Figure 8. The user can enter the *Setup* window by pulling down the *Menu* menu and selecting *Setup Window*, or by pressing <F2> on the keyboard.

In the *Setup* window, all of the CS5467's registers are displayed in hexadecimal notation and are decoded to provide easier readability. Refer to the CS5467 data sheet for information on register functionality and definitions. See Figure 8.

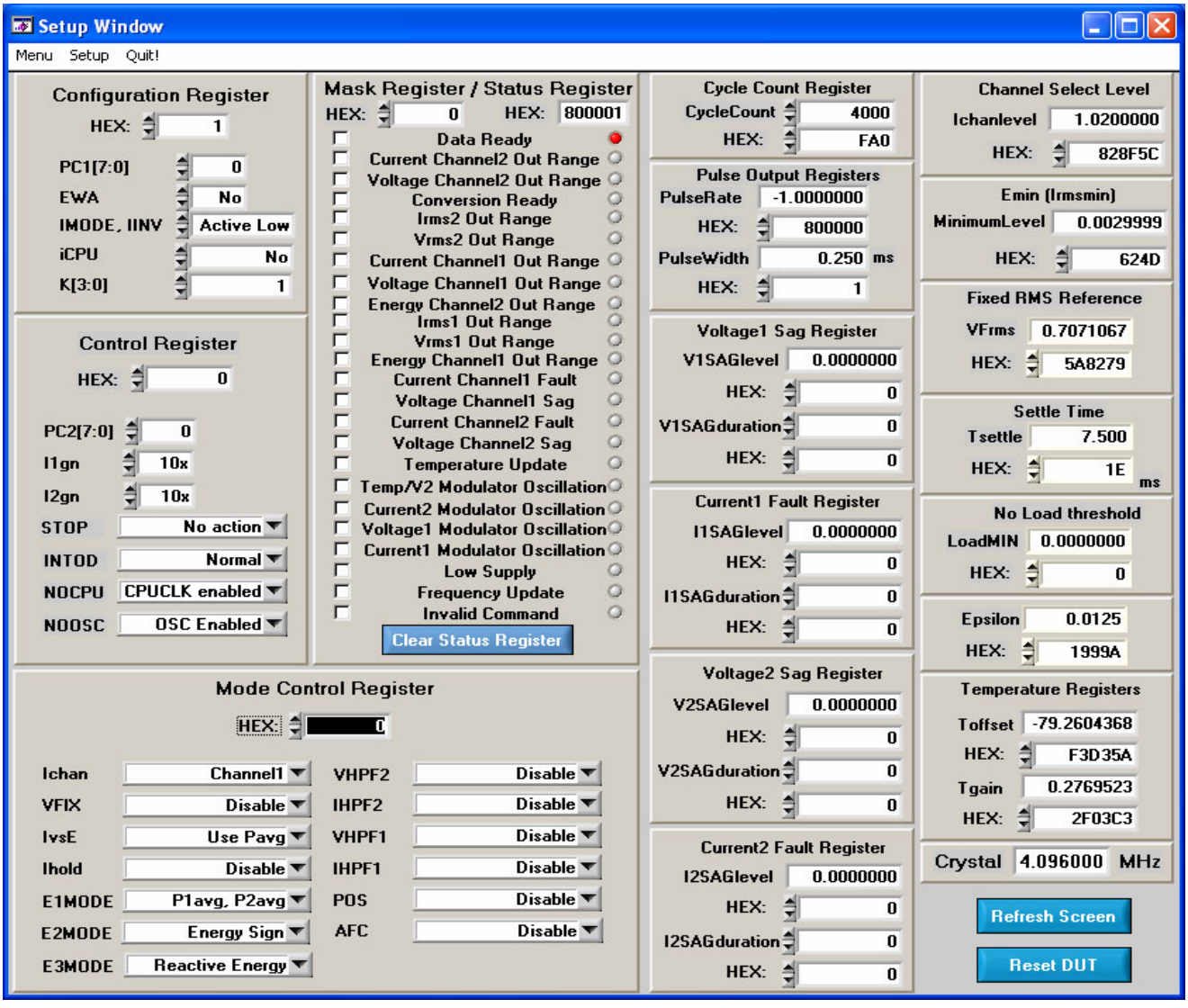


Figure 8. *Setup* Window

2.4.1 Refresh Screen Button

The *Refresh Screen* button will update the contents of the screen by reading all the register values from the CS5467. It is a good idea to press the *Refresh Screen* button when entering the *Setup* window, or after modifying any registers, to reflect the current status of the CS5467.

2.4.2 Reset DUT Button

The *Reset DUT* button will hardware reset the CS5467. The CS5467 will perform a reset as discussed in the CS5467 data sheet. After the hardware reset to the CS5467 device, the screen contents will be automatically refreshed with the updated status of the CS5467.

2.4.3 CS5467 Crystal Frequency

The CS5467 accepts a wide range of crystal input frequencies, and can therefore run at many different sample rates. The crystal frequency being used on the CS5467 should be entered in this box to provide accurate frequency calculation in the *FFT* window. This will also help the software decide which functions the evaluation system can perform reliably.

2.4.4 Configuration Register

In the *Configuration Register* box, the contents of the Config register can be modified by typing a hexadecimal value in the *HEX:* field, or by changing any of the values below the *HEX:* field to the desired settings. Although the CDB5467U software allows the user to modify any of the bits in the Config register, changing certain bits may cause the software and board to behave erratically. For the evaluation system to function properly, the *IMODE, IINV* field should be set to the default *Active Low*. This applies only to the CDB5467U evaluation system, and not to the CS5467 chip itself.

2.4.5 Control Register

The *Control Register* section is used to make changes to and display the contents of the Ctrl register. The Ctrl register contains various bits used to activate or terminate various features of the CS5467. Refer to the CS5467 data sheet for descriptions of the bits. The user is able to turn each bit on or off individually. The value of the Ctrl register is displayed in Hexadecimal format. Most of the Ctrl register bits are reserved or unused. Only the usable bits are displayed in the Setup Window.

2.4.6 Mask Register / Status Register

The *Mask Register / Status Register* box displays the values for these registers in hexadecimal and decodes them to indicate each bit's function. The Mask register can be modified by typing a value in the *HEX:* field, or by checking the appropriate check boxes for the bits that are to be masked. The Status register cannot be directly modified. It can only be reset by pressing the *Clear Status Register* button. The *HEX:* field for this register and the lamps are indicators only. A lamp which is on means that the corresponding bit in the Status register is set (except the Invalid Command bit, which is inverted). The value present in the Mask register may be changed by the software during certain operations to provide correct functionality of the CDB5467U board.

2.4.7 Temperature, Voltage SAG, Current Fault Registers

These boxes display the values of the corresponding registers in both hexadecimal and decimal format. Each register can be modified by typing a value in the corresponding offset, level, duration, or gain value field (decimal) or *HEX:* field (hexadecimal).

2.4.8 *Cycle Count / Pulse Output Registers*

These fields display the values of corresponding register in both hexadecimal and decimal format. Each register can be modified by typing a value in the corresponding *Decimal Value* or *HEX:* field.

2.4.9 *Voltage Sag / Current Fault / Ichanlevel / Emin (Irmsmin) / VFrms / Tsettle / LoadMIN / Epsilon / Temperature Rigisters*

These boxes display the values of the corresponding register in both hexadecimal and decimal format. Each register can be modified by typing a value in the corresponding *Decimal Value* or *HEX:* field.

2.5 Calibration Windows

The *Calibration* window is used to display and write to the CS5467 offset and gain calibration registers. The user is also able to initiate the CS5467's calibration sequences that are used to set the calibration values. Both AC and DC calibrations can be run for offset and gain, for either the voltage channel or the current channel, or both simultaneously. The user should refer to the CS5467 data sheet for more details on calibration.

The *Refresh Screen* button will update the contents of the screen by reading all the register values from the part. It is a good idea to press the *Refresh Screen* button when entering the *Calibration* window, or after modifying any registers to reflect the current status of the CS5467.

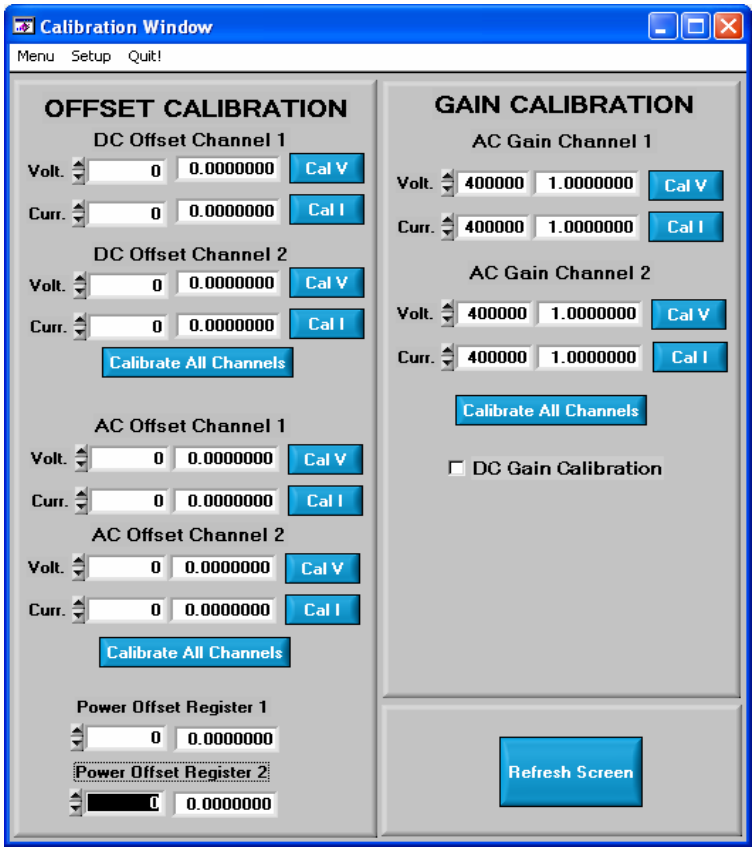


Figure 9. *Calibration* Window

2.5.1 Offset / Gain Register

In the offset and gain register boxes, the offset and gain registers for all channels are displayed in hexadecimal and decimal. These registers can be modified directly by typing the desired value in the hexadecimal display boxes. There are three types of offset registers: DC offset, AC offset and power offset. The AC offset registers only affect the RMS register values. The power offset registers only affect the active power register values. The DC/AC/power offset register is a two's complement number whose value ranges from -1 to +1. The gain register value ranges from 0 to 4.

2.5.2 Performing Calibrations

AC/DC offset and gain calibrations can be performed on both the voltage and current channels of the CS5467. It is generally a good idea to software-reset the CS5467 before running calibrations, because the initial values in the calibration registers will affect the results of the calibration. A software reset will reset these registers back to the default values of zero offset and unity gain. AC/DC offset calibration should be performed before gain calibration to ensure accurate results.

2.5.2.1 Offset Calibrations

1. Ground the channel(s) you want to calibrate directly at the channel header(s), J11 and J7 for voltage channel 2, J17 and J22 for voltage channel 1, J24 and J26 for current channel 1, and J20 and J19 for current channel 2. The channel(s) could also be grounded directly at the screw-type terminals.
2. Press the corresponding AC or DC offset calibrate button (*Cal V*, *Cal I*, or *Calibrate All Channels*) beside or below the offset register boxes.
3. The offset register value(s) will automatically update when the calibration is completed.

2.5.2.2 Gain Calibrations

1. Attach an AC or DC calibration signal to the screw-type terminals, and make sure the corresponding channel headers (J11, J7, J17, J22, J24, J26, J20 and J19) are set to the input position.
2. Press the corresponding AC or DC gain calibrate button (*Cal V*, *Cal I*, or *Calibrate All Channels*) beside or below the gain register boxes.
3. The gain register value(s) will automatically update when the calibration is completed.

The *Calibration* window also contains the *Power Offset Register1 / 2* display and adjustment. The user can read and write the values in the power offset registers (P1off / P2off).

2.6 Conversion Window

The *Conversion Window* allows the user to see the results of single and continuous conversions, perform data averaging, and utilize the power-saving modes of the CS5467. See Figure 10. The Conversion Window can be accessed from the *Menu* pull-down and selecting *Conversion Window*, or by pressing <F4>.

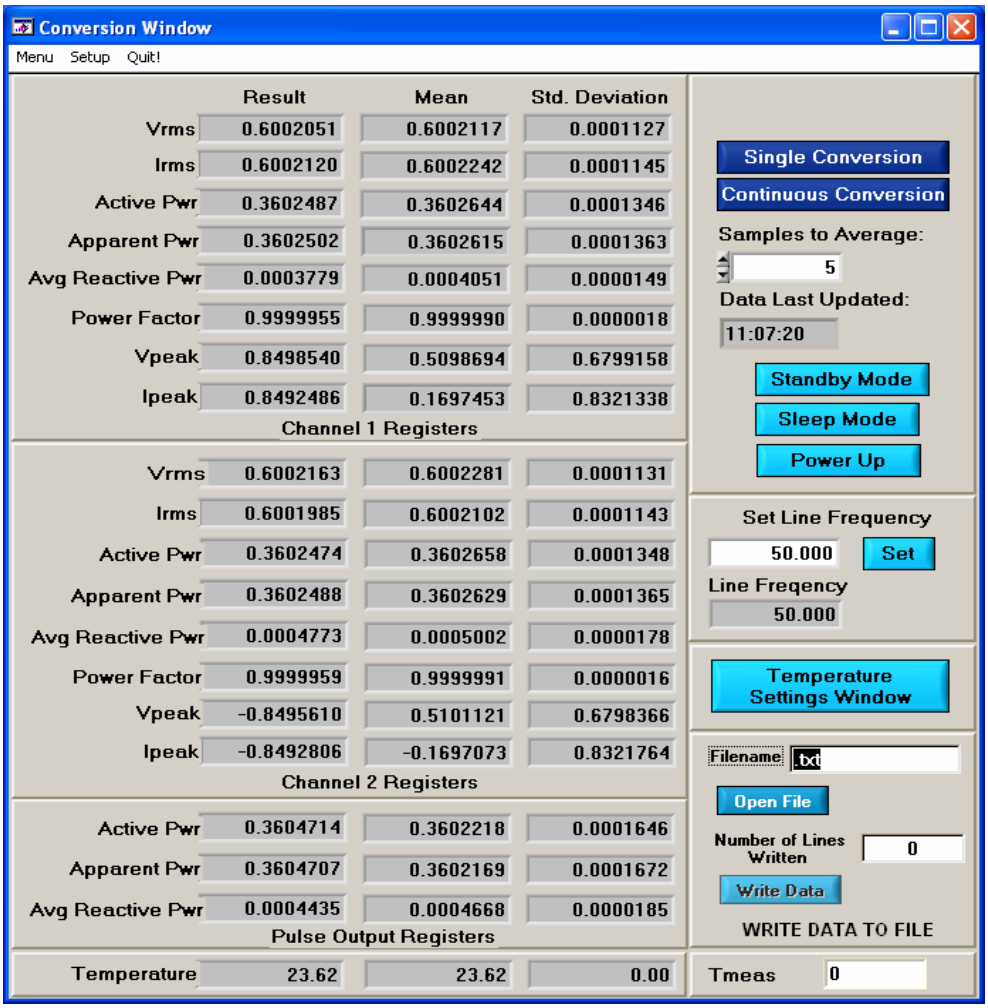


Figure 10. *Conversion Window*

2.6.1 Single Conversion Button

Pressing this button will cause a single conversion to be performed. After a single conversion is complete, the *Result* column will be updated with the values present in each data register.

2.6.2 Continuous Conversion Button

Pressing this button will cause continuous conversions to be performed until the user presses the *Stop* button. After each conversion is complete, the *Result* column will be updated with the values present in each data register. The *Mean* and *Standard Deviation* columns will be updated every N cycles, where N is the number in the *Samples to Average* field. If the *Samples to Average* is set to a large number, it may take many collection cycles after pressing the *Stop* button before the data actually stops being collected.

2.6.3 Standby / Sleep Mode Buttons

When these buttons are pressed, the CS5467 will enter either standby or sleep power saving modes. To return to normal mode, press the *Power Up* button.

2.6.4 Power Up Button

This button is used to send the *Power Up/Halt* command to the CS5467. The part will return to normal operating mode and halt any conversions that are being done at this time.

2.6.5 Set Line Frequency

If the AFC bit in the Mode register is set, the Epsilon register will be calculated automatically by the CS5467 and the *Line Frequency* display field will be updated automatically in continuous conversion mode. If the AFC bit in the Mode register is not set and the line frequency is other than the default value (50Hz), to ensure the accuracy of the quadrature power (Q1, Q2) and the reactive power (Q1avg, and Q2avg), the line frequency must be set manually here to make Epsilon be the ratio of line frequency to the output word rate (OWR). Refer to the CS5467 datasheet for more details.

2.6.6 Temperature Settings Window

The *Temperature Settings Window* is used to adjust the temperature offset register (Toffset) and temperature gain register (Tgain) to convert the temperature register (T) from a Celsius scale (°C) to a Fahrenheit scale (°F) or vice versa and to improve temperature measurement accuracy. Refer to the CS5467 data sheet for the details of the on-chip temperature sensor.

2.6.7 Write Data to File Window

This window provides a means to write the conversion result data to a .txt text file for later analysis or print out. The file path and name will be shown in *Filename* field. The *Open File* button is used to open a new or existing .txt text file for data writing. Each time the *Write Data* button is pressed, the result data is written into the file and the *Number of Lines Written* field value will be increased by 1.

2.6.8 Temperature Measurement

In the CS5467, voltage 2 and temperature are multiplexed on one ADC channel. To initiate a temperature measurement, write 1 to the Tmeas register while in continuous conversion mode. When the Tmeas register returns to 0, the Temperature field should be updated with the data in the T (Temperature) register.

2.7 Pulse Rate Window

The CS5467 features a pulse-rate energy output. The CDB5467U has the capability to demonstrate the functionality of this output in the *Pulse Rate Output Window.* See Figure 11. The *Pulse Rate Output Window* can be accessed by pressing <F5>, or by pulling down the *Menu* menu, and selecting the *Pulse Rate Window* item.

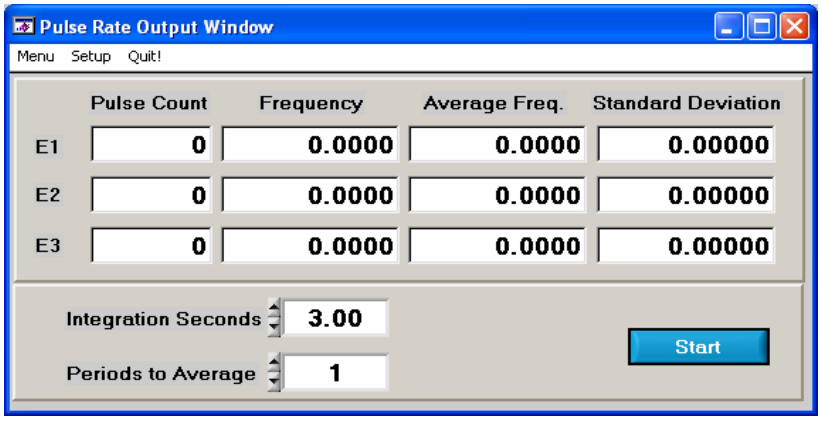


Figure 11. Pulse Rate Output Window

2.7.1 Integration Seconds

This field allows the user to select the length of time over which pulses will be collected after the *Start* button is pressed. Because there is a time delay (2x N / OWR) from start conversion to pulse output, the *Integration Seconds* field is normally set to a delay longer than the actual pulsing period.

2.7.2 Periods To Average

This field allows the user to average a number of integration periods.

2.7.3 Start Button

When the *Start* button is pressed, the CDB5467U will capture pulse rate data according to the values in the *Integration Seconds* and *Periods to Average* fields. After each integration period, the *Pulse Count*, *Frequency*, *Average Freq.,* and *Standard Deviation* columns will be updated. The *Average Frequency* and *Standard Deviation* columns will only be updated after all the integrations have been collected. The software stops collecting data when the user presses the *Stop* button, or when the data collection is finished. Due to speed limitations of the on-board microcontroller, some higher pulse rates cannot be accurately collected.

2.8 Data Collection Window

The *Data Collection Window* (Figure 12) allows the user to collect sample sets of data from the CS5467 and analyze them using time domain, FFT, and histogram plots. The *Data collection Window* can be accessed by pulling down the *Menu* menu, and selecting the *Data Collection Window* item, or by pressing <F6>.

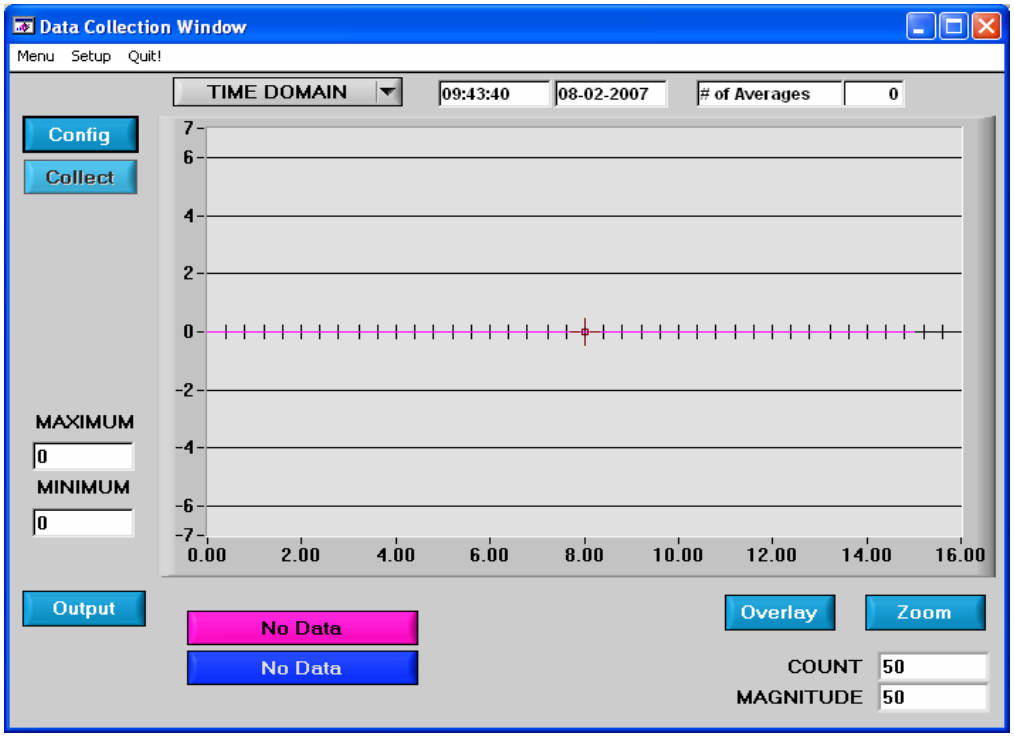


Figure 12. Data Collection Window

2.8.1 Time Domain / FFT/ Histogram Selector

This menu selects the type of data processing to perform on the collected data and display in the plot area. Refer to the Analyzing Data section for more information.

2.8.2 Config Button

This button will bring up the *Configuration* window, in which the user can modify the data collection specifications. Refer to the Configuration Window section in this document for more information.

2.8.3 Collect Button

This button will collect data from the part, to be analyzed in the plot area. See the Collecting Data Sets section for more information.

2.8.4 Output Button

This button will bring up a window in which the user can output the data to a file for later use, print out a plot, or print out the entire screen. When saving data, only the data channel being displayed on the plot will be saved to a file.

2.8.5 Zoom Button

This button allows the user to zoom in on the plot by selecting two points in the plot area. Press the *Restore* button to return to the normal data plot, or press the *Zoom* button again to zoom in even further.

2.8.6 Channel Select Button

After data collection, the two buttons labeled as “No Data” will be replaced with *Current* and *Voltage* buttons, allowing the user to choose the appropriate channel for display. In the time domain mode, an additional *Overlay* button will be present which allows the user to display all the channels on the same plot.

2.8.7 Configuration Window

The *Configuration* window allows the user to set up the data collection and analysis parameters.

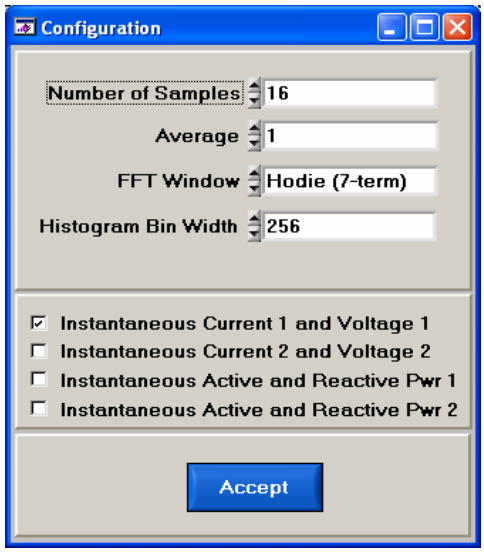


***Figure 13. Configuration* Window**

2.8.7.1 Number of Samples

This field allows the user to select the number of samples to collect, between 16 and 32768.

2.8.7.2 Average

When performing FFT analyses, this field determines the number of FFTs to average. FFTs will be collected and averaged when the *Collect* button is pressed.

2.8.7.3 FFT Window

This box allows the user to select the type of windowing algorithm for FFT processing. Windowing algorithms include the *Blackman*, *Blackman-Harris*, *Hanning*, *5-term Hodie*, and *7-term Hodie*. The 5-term Hodie and 7-term Hodie are windowing algorithms developed at Crystal Semiconductor.

2.8.7.4 Histogram Bin Width

This field determines the "bin width" when plotting histograms of the collected data. Each vertical bar in the histogram plot will contain the number of output codes entered in this field. Increasing this number may allow the user to view histograms with larger input ranges.

2.8.7.5 Data to Collect

These two check boxes allow the user to select the data types that will be collected and returned to the PC for processing.

2.8.7.6 Cycle Count

The value in the *Cycle Count* field will be written to the Cycle Count register in the CS5467. The Cycle Count register determines the length of one computation cycle. The Cycle Count value should be selected appropriately according to the *Data to Collect* setting. For example, if the *Data to Collect* is instantaneous current, voltage, or power it is better to set *Cycle Count* to 1.

2.8.7.7 Accept Button

When this button is pressed, the current settings will be saved, and the user will return to the *Data Collection Window*.

2.8.8 Collecting Data Sets

To collect a sample data set:

1. In the *Data Collection Window*, press the *Config* button to bring up the *Configuration* window and view the current settings.
2. Select the appropriate settings from the available options (see the Configuration Window section) and press the *Accept* button.
3. The *Data Collection Window* should still be visible. Press the *Collect* button to begin collecting data.
4. Once the data has been collected, it can be analyzed, printed, or saved to disk.

2.8.9 Retrieving Saved Data From a File

The CDB5467U software allows the user to save data to a file, and retrieve it later when needed. To load a previously saved file:

1. Pull down the *Setup* menu and select the *Disk* menu item. A file menu will appear.
2. Find the data file in the list and select it. Press the *Select* button to return.
3. Go to the *Data Collection Window*, and press the *Collect* button.
4. The data from the file should appear on the screen. The data will be ready for different types of analysis.
5. To select a different file, repeat the procedure.

2.8.10 Analyzing Data

The evaluation software provides three types of analysis tests: *Time Domain*, *Frequency Domain*, and *Histogram*. The time domain analysis processes acquired conversions to produce a plot of magnitude versus conversion sample number. The frequency domain analysis processes acquired conversions to produce a plot of magnitude versus frequency using the Fast-Fourier transform (results up to Fs/2 are calculated and plotted). Also statistical noise calculations are calculated and displayed. The histogram analysis processes acquired conversions to produce a histogram plot. Statistical noise calculations are also calculated and displayed.

2.8.11 Histogram Information

The following is a description of the indicators associated with histogram analysis. Histograms can be plotted in the *Data Collection Window* by setting the analysis type pull-down menu to *Histogram*.

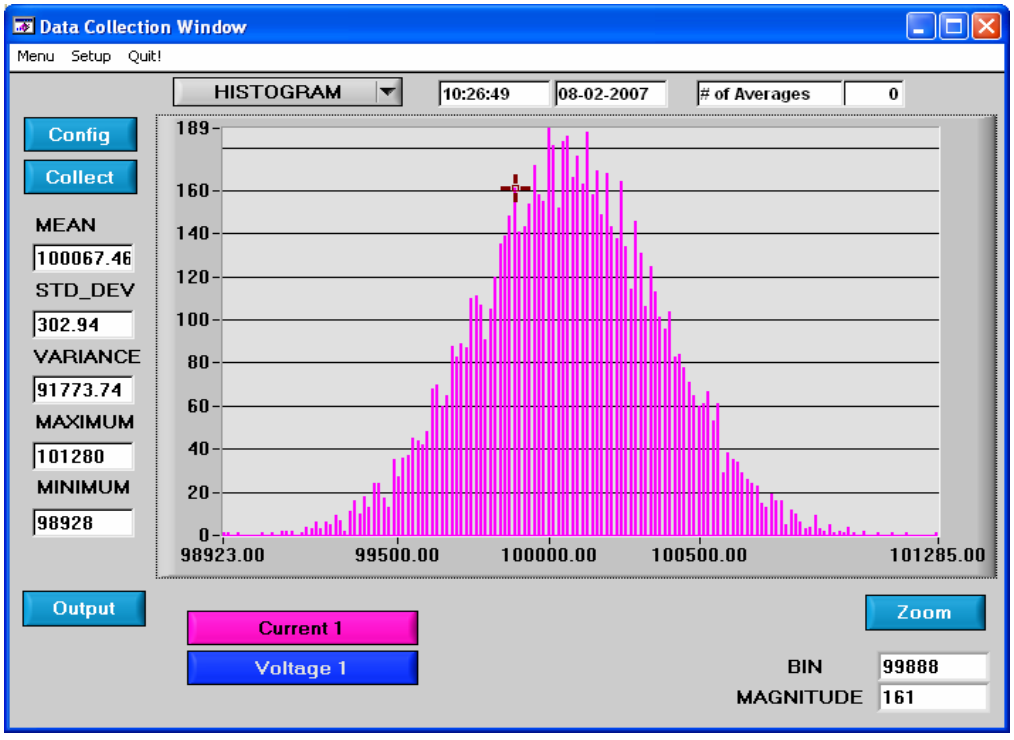


Figure 14. Histogram Analysis

2.8.11.1 BIN

Displays the x-axis value of the cursor on the histogram.

2.8.11.2 MAGNITUDE

Displays the y-axis value of the cursor on the histogram.

2.8.11.3 MEAN

Indicates the mean of the data sample set. The mean is calculated using the following formula:

$$\text{Mean} = \frac{\sum_{i=0}^{n-1} Xi}{n}$$

2.8.11.4 STD_DEV

Indicates the standard deviation of the collected data set. The standard deviation is calculated using the following formula:

$$\text{STDDEV} = \sqrt{\frac{\sum_{i=0}^{n-1} (Xi - \text{MEAN})^2}{n}}$$

2.8.11.5 VARIANCE

Indicates for the variance of the current data set. The variance is calculated using the following formula:

$$\text{VARIANCE} = \frac{\sum_{i=0}^{n-1} (Xi - \text{MEAN})^2}{n}$$

2.8.11.6 MAXIMUM

Indicates the maximum value of the collected data set.

2.8.11.7 MINIMUM

Indicates the minimum value of the collected data set.

2.8.12 Frequency Domain Information

The following describe the indicators associated with FFT (Fast Fourier Transform) analysis. FFT data can be plotted in the *Data Collection Window* by setting the analysis type selector to *FFT* (Figure 15).

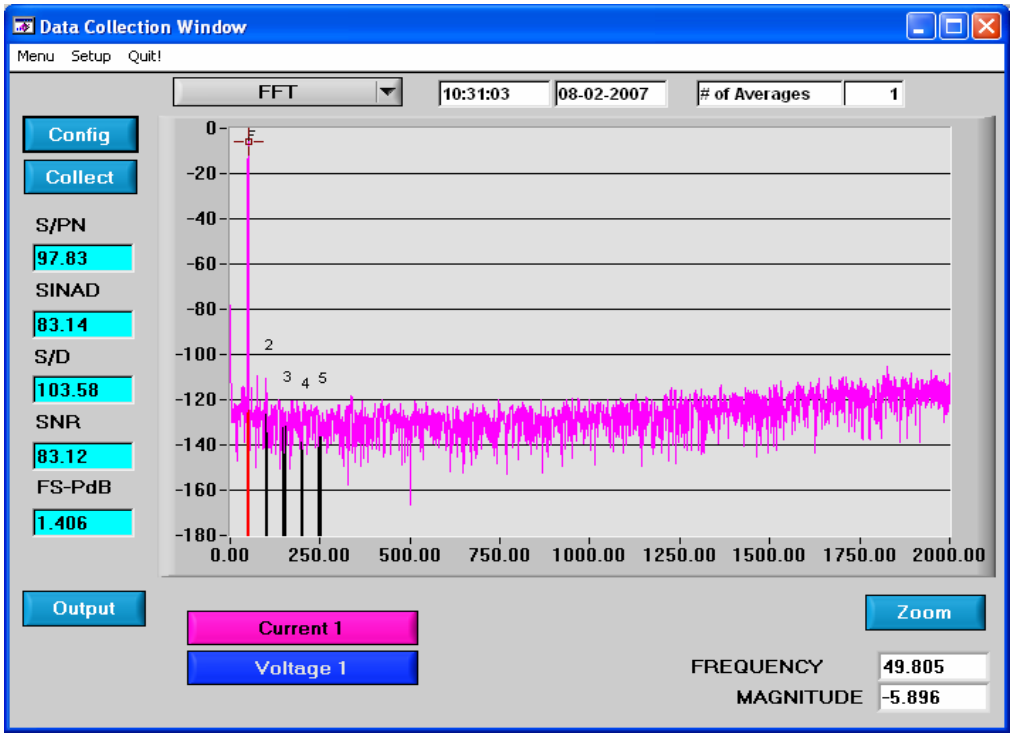


Figure 15. FFT Analysis

2.8.12.1 FREQUENCY

Displays the x-axis value of the cursor on the FFT display.

2.8.12.2 MAGNITUDE

Displays the y-axis value of the cursor on the FFT display.

2.8.12.3 S/PN

Indicates the signal-to-peak noise ratio (decibels).

2.8.12.4 SINAD

Indicates for the signal-plus-noise-plus-distortion to noise-plus-distortion ratio (decibels).

2.8.12.5 S/D

Indicates for the signal-to-distortion ratio, 4 harmonics are used in the calculations (decibels).

2.8.12.6 SNR

Indicates for the signal-to-noise ratio, first 4 harmonics are not included (decibels).

2.8.12.7 FS-Pdb

Indicates for the full-scale to signal Ratio (decibels).

2.8.12.8 Time Domain Information

The following controls and indicators are associated with time domain analysis. Time domain data can be plotted in the *Data Collection Window* by setting the analysis type selector to *Time Domain* (Figure 16).

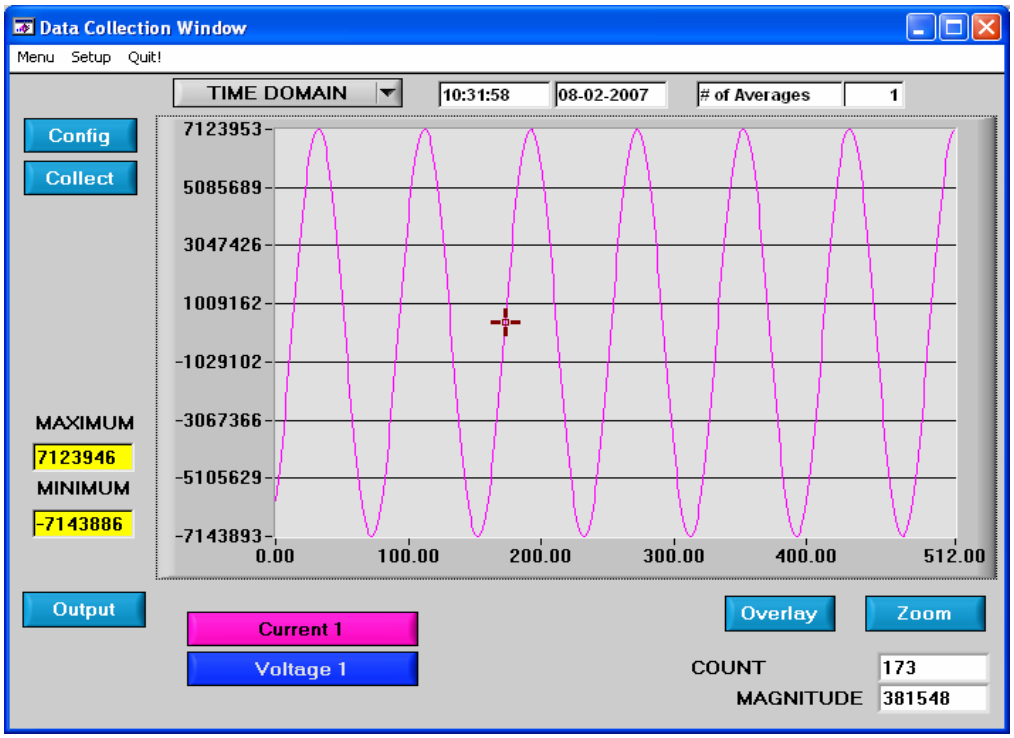


Figure 16. Time Domain Analysis

2.8.12.9 COUNT

Displays current x-position of the cursor on the time domain display.

2.8.12.10 MAGNITUDE

Displays current y-position of the cursor on the time domain display.

2.8.12.11 MAXIMUM

Indicates for the maximum value of the collected data set.

2.8.12.12 MINIMUM

Indicates for the minimum value of the collected data set.

2.9 EEPROM Window

CDB5467U has an "Auto-Boot" demo feature that uses the on-board serial EEPROM, so that the CDB5467U can operate independently without being connected to a PC. CDB5467U GUI software also provides an EEPROM Window for reading & writing the serial EEPROM (Figure 17).

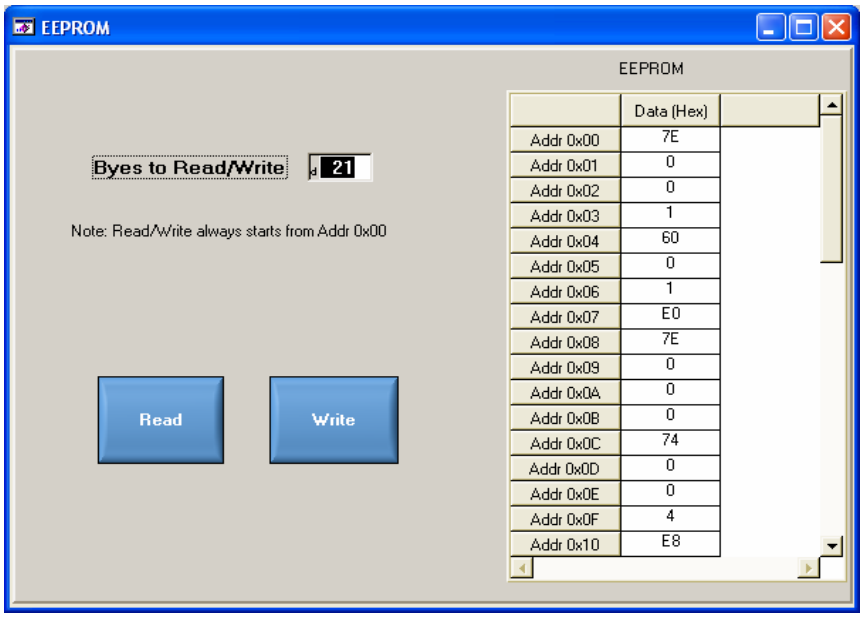


Figure 17. EEPROM Window

2.9.1 Bytes to Read/Write

The *Bytes to Read/Write* field allows the user to define the number of bytes to read or write.

2.9.2 Read EEPROM

First input the number of bytes to read in the *Bytes to Read/Write* field. After pressing the *Read* button, that number of bytes starting from the address 0x00 will be read from EEPROM and displayed in the *EEPROM* table in hexadecimal format.

2.9.3 Write EEPROM

Input the number of bytes to write in the *Bytes to Read/Write* field and input the hexadecimal byte values in the EEPROM table starting from address 0x00. After pressing the *Write* button, the bytes in the *EEPROM* table will be written to the EEPROM.

2.10 Debug Panel

The *Debug* panel provides the user a way to access CS5467 registers and send commands to CS5467 directly (Figure 18). Refer to 5.15 in CS5467 data sheet for more details.

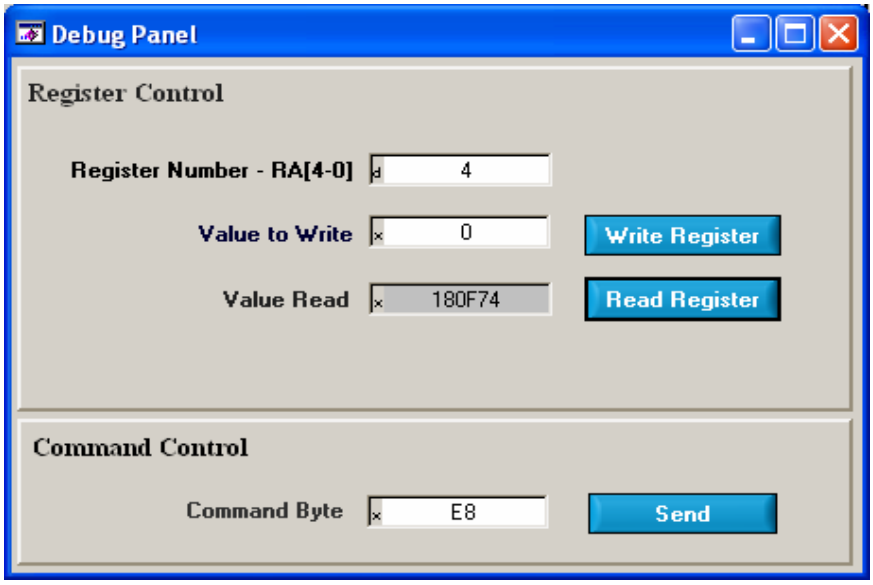


Figure 18. Debug Panel

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BILL OF MATERIAL (Page 1 of 2)

Description	Qty	Reference Designator	MFG	MFG P/N	Notes
CAP 0.1uF ±10% 50V NPb X7R 1206	6	C1 C18 C19 C21 C29 C30	KEMET	C1206C104K5RAC	
CAP 22pF ±5% 50V C0G NPb 0805	1	C2	KEMET	C0805C220J5GAC	
CAP 0.1uF ±10% 16V X7R NPb 0603	5	C3 C4 C26 C32 C33	KEMET	C0603C104K4RAC	
CAP 47uF ±20% 10V ELEC NPb CASE C	2	C5 C8	PANASONIC	EEE1AA470WR	
CAP 0.1uF ±5% 50V X7R NPb 0805	7	C6 C7 C10 C11 C12 C15 C25	KEMET	C0805C104J5RAC	
CAP 220pF ±10% 50V X7R NPb 0805	8	C9 C17 C20 C24 C27 C34 C35 C36	KEMET	C0805C221K5RAC	
CAP 0.018uF ±10% 50V X7R NPb 1206	4	C13 C23 C37 C38	KEMET	C1206C183K5RAC	
CAP 10uF ±20% 16V ELEC NPb CASE A	3	C14 C22 C39	PANASONIC	EEE1CS100SR	
CAP 1uF ±10% 25V X7R NPb 1206	1	C16	KEMET	C1206C105K3RAC	
CAP 47uF ±20% 16V NPb ELEC CASE C	2	C28 C31	PANASONIC	EEE1CA470WR	
DIODE ARRAY 5V (TVS) ESD NPb SOT143	1	D1	LITTELFUSE	SP0503BAHTG	
LED SUP RED 1.7V 1mA 1.6MCD NPb SMD	6	D2 D3 D4 D5 D6 D7	CHICAGO MINIATURE	CMD28-21SRC/TR8/T1	
HDR 5x2 ML .1"CTR S GLD NPb	1	J1	SAMTEC	TSW-105-07-G-D	
CON RA USB BLK NPb TH	1	J2	AMP	292304-1	
CON BPOST 2" SILV NYLON INS RED NPb	3	J3 J5 J6	JOHNSON COMPONENTS	111-0102-001	REQUIRES WIRE, 1.5L X 0.25T X 0.25T TYPE E 24/19 BLU SQUIRES ELEC. INC.
CON BPOST 2" SILV NYLON INS BLK NPb	1	J4	JOHNSON COMPONENTS	111-0103-001	REQUIRES WIRE, 1.5L X 0.25T X 0.25T TYPE E 24/19 BLU SQUIRES ELEC. INC.
HDR 3x2 ML .1"CTR 062 S GLD NPb	10	J7 J8 J9 J11 J17 J19 J20 J22 J24 J26	SAMTEC	TSW-103-07-G-D	
HDR 2x1 ML .1" 062BD ST GLD NPb TH	5	J10 J13 J15 J16 J18	SAMTEC	TSW-102-07-G-S	
HDR 2x2 ML .1"CTR .062BD S GLD NPb	1	J12	SAMTEC	TSW-102-07-G-D	
CON TERM BLOCK 2POS 5mm NPb BLU TH	1	J14	ON-SHORE TECHNOLOGY	ED 100/2DS	
CON TERM BLCK 4 POS 5mm NPb BLU TH	4	J21 J23 J27 J28	OST	ED 100/4DS	
HDR 3x1 ML .1" 062 ST GLD NPb TH	1	J25	SAMTEC	TSW-103-07-G-S	
HDR 2x1 ML .1" 062BD ST GLD NPb TH	0	J29 J30	SAMTEC	TSW-102-07-G-S	NO POP
HDR 11x2 ML .1"CTR 062 S GLD NPb	1	J40	SAMTEC	TSW-111-07-G-D	
WIRE JUMPER 2P 0.1" BRASS NPb TH	6	JP1 JP2 JP3 JP4 JP5 JP6	COMPONENTS CORPORATION	TP-101-10	
SPCR STANDOFF 4-40 THR .875L AL NPb	4	MH1 MH2 MH3 MH4	KEYSTONE	1809	REQUIRES 4-40- PAN HEAD SCREW
RES 470 OHM 1/3W ±1% NPb 1210 FILM	8	R1 R9 R10 R27 R30 R31 R32 R33	DALE	CRCW1210470RFKEA	
RES 2k OHM 1/8W ±1% NPb 0805 FILM	12	R2 R3 R6 R7 R8 R14 R15 R16 R17 R29 R36 R38	DALE	CRCW08052K00FKEA	
RES 10 OHM 1/8W ±1% NPb 0805 FILM	1	R4	DALE	CRCW080510R0FKEA	
RES 1k OHM 1/8W ±1% NPb 0805 FILM	5	R5 R11 R12 R13 R18	DALE	CRCW08051K00FKEA	
RES 49.9 OHM 1/8W ±1% NPb 0805 FILM	1	R21	DALE	CRCW080549R9FKEA	

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BILL OF MATERIAL (Page 2 of 2)

Description	Qty	Reference Designator	MFG	MFG P/N	Notes
RES 1k OHM 1/3W ±5% NPb 1210 FILM	4	R23 R24 R26 R28	DALE	CRCW12101K00JNEA	
RES 301 OHM 1/3W ±1% NPb 1210 FILM	1	R25	DALE	CRCW1210301RFKEA	
RES 0 OHM 1/18W ±1% NPb 0805 FILM	12	R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62	DALE	CRCW08050000Z0EA	
RES 12k OHM 1/4W ±5% NPb 1206 FILM	1	R35	DALE	CRCW120612K0JNEA	
RES 15k OHM 1/4W ±1% 1206 NPb FILM	1	R37	DALE	CRCW120615K0FKEA	
RES 0 OHM 1/4W NPb 1206 FILM	1	R64	DALE	CRCW12060000Z0EA	
SWT SPST 130G 0/1 5mm TACT ESD NPb	1	S1	C&K	PTS645TL50	INSTALL AFTER WASH PROCESS
CON TEST PT .1"CTR TIN PLAT NPb BLK	20	TP1 TP2 TP3 TP4 TP5 TP6 TP9 TP10 TP11 TP12 TP13 TP20 TP21 TP22 TP23 TP24 TP25 TP26 TP27 TP30	KEYSTONE	5001	
CON TEST PT .1"CTR TIN PLAT NPb BLK	0	TP7 TP8	KEYSTONE	5001	NO POP
IC PGM 128BIT SER EPROM NPb SOT23-5	1	U1	MICROCHIP	24LC00-I/OT	
IC DIG LOW V BUF/LDRV 5V NPb SOIC20	1	U2	FAIRCHILD SEMICONDUCTOR	74LCX760WMX	
IC PGM USB 16kB FLAS MCU NPb LQFP32	1	U3	SILICON LABORATORIES INC	C8051F320-GQ	PROGRAM AT TEST
IC LNR PREC V REF 2.5V NPb SO8	1	U4	LINEAR TECH	LT1019CS8-2.5#PBF	
IC LOG UHS TINY DUAL BUF NPb SC70-6	1	U5	FAIRCHILD SEMICONDUCTOR	NC7WZ07P6X	
IC CRUS 4 CH PWR MEASURE NPb SSOP28	1	U6	CIRRUS LOGIC	CS5467-ISZ/C1	
IC LOG INV 5P UHS TINY NPb SOT23	1	U8	FAIRCHILD SEMICONDUCTOR	NC7SZ04M5X	
IC LOG UHS TINY ANA SWT 6P NPb SC70	2	U9 U11	FAIRCHILD SEMICONDUCTOR	NC7SB3157P6X	
IC PGM EEPROM 512x8 SPI NPb SOIC8	1	U10	ATMEL	AT25040AN-10SU-2.7	
WIRE BPOST 1.5X.25 24/19 GA BLU NPb	4	XJ3 XJ4 XJ5 XJ6	SQUIRES	L-1.5X.25TX.25T_TYPE_E_	
SCREW 4-40X5/16" PH MACH SS NPb	4	XMH1 XMH2 XMH3 XMH4	BUILDING FASTENERS	PMSSS 440 0031 PH	
PINCH CONTACT SOCKET FOR SSOP28	0	XU6	ENPLAS	OTS-28(34)-0.65-01	NO POP
XTL 4.0960MHZ HC49S 50ppm 50pF NPb	1	Y1	CAL CRYSTAL	CCL-6S-4.0960C14F-R	
DIODE TR 6.8V 600W NPb AXL	3	Z1 Z2 Z3	LITTLE FUSE	P6KE6.8	
SCHEM CDB5467U-Z NPb	REF		CIRRUS LOGIC	600-00213-Z2	
PCB CDB5464U_67U	1		CIRRUS LOGIC	240-00213-Z1	
ASSY DWG PWA CDB5464U_67U	REF		CIRRUS LOGIC	603-00213-01	
LBL SUBASSY PRODUCT ID AND REV	1		CIRRUS LOGIC	422-00013-01	
TST PROC CDB5467U	REF		CIRRUS LOGIC	602-00213-02	
CON SHUNT 2P .1"CTR BLK NPb	16		MOLEX	15-29-1025	
RES 0 OHM 1/18W ±1% 0805 FILM	0	R34	DALE	NP-CRCW0805000Z	DO NOT POPULATE
LBL SUBASSY PRODUCT NUMBER	1		CIRRUS LOGIC	422-00037-01	LABEL FOR PRODUCT NUMBER
INSULATOR .312 x .145 HC49U/US NPb	1	XY1	ECS	700-9001	

APPENDIX B. SCHEMATICS

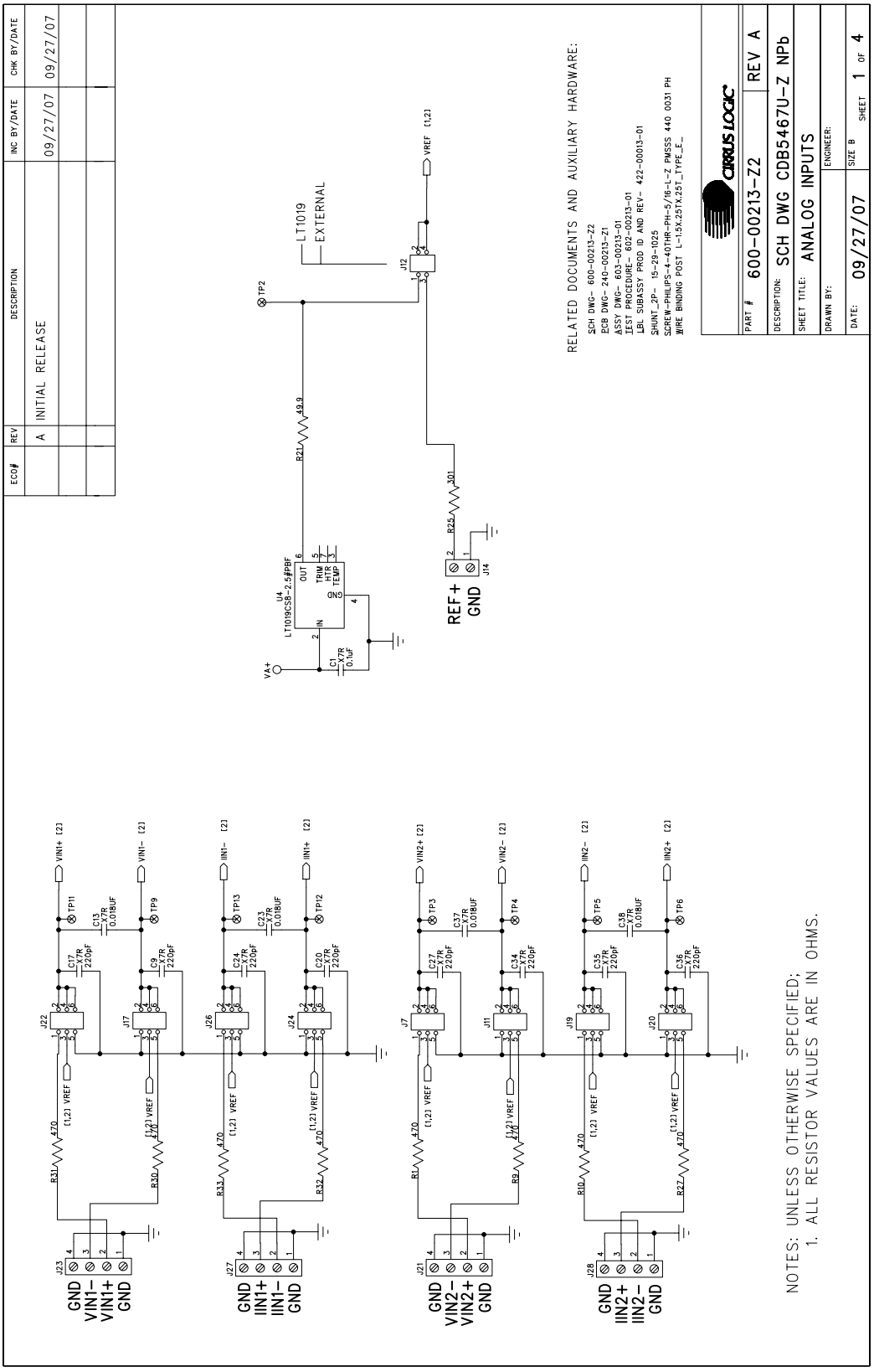


Figure 19. Schematic - Analog Inputs

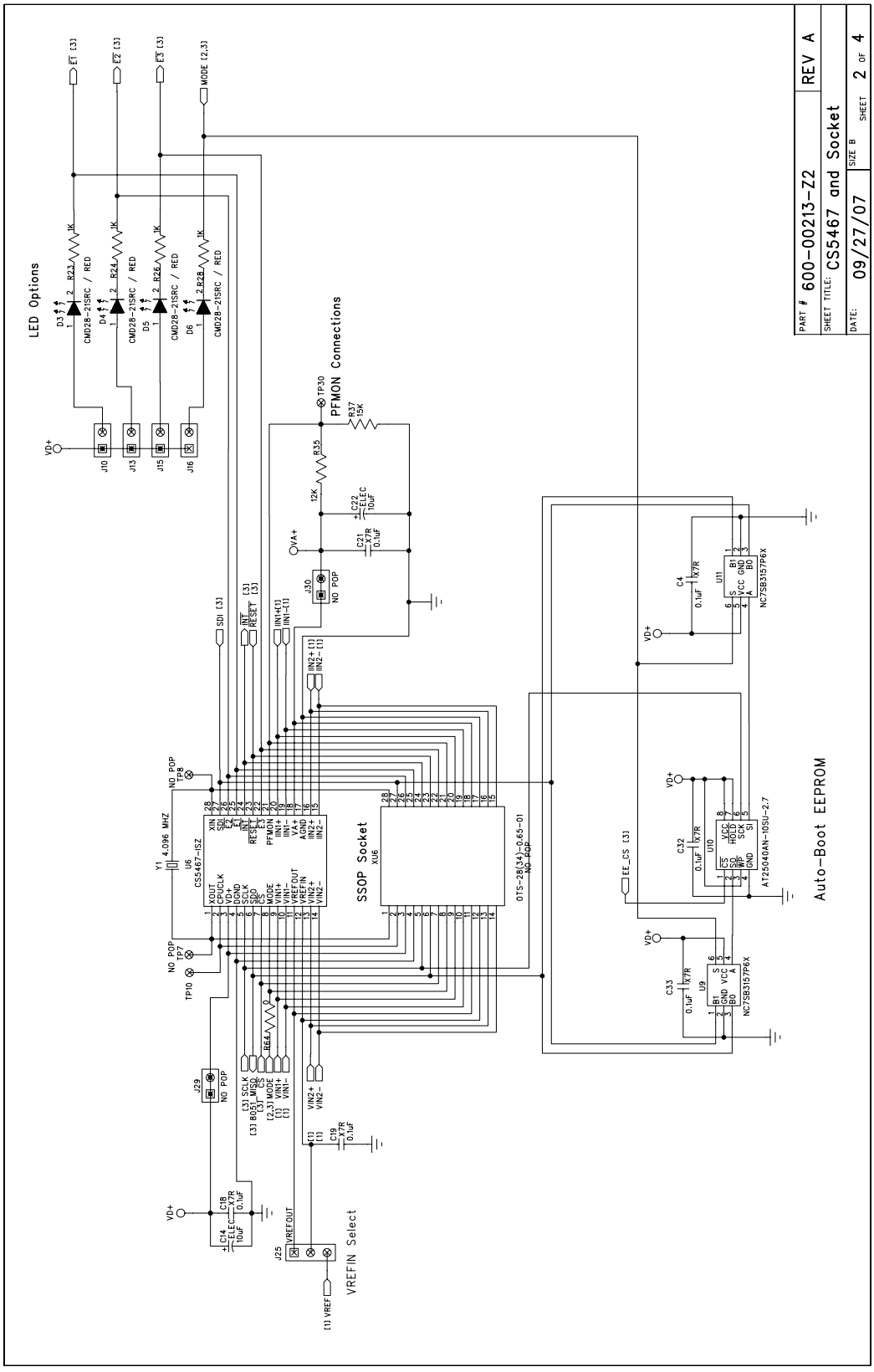


Figure 20. Schematic - CS5467 & Socket

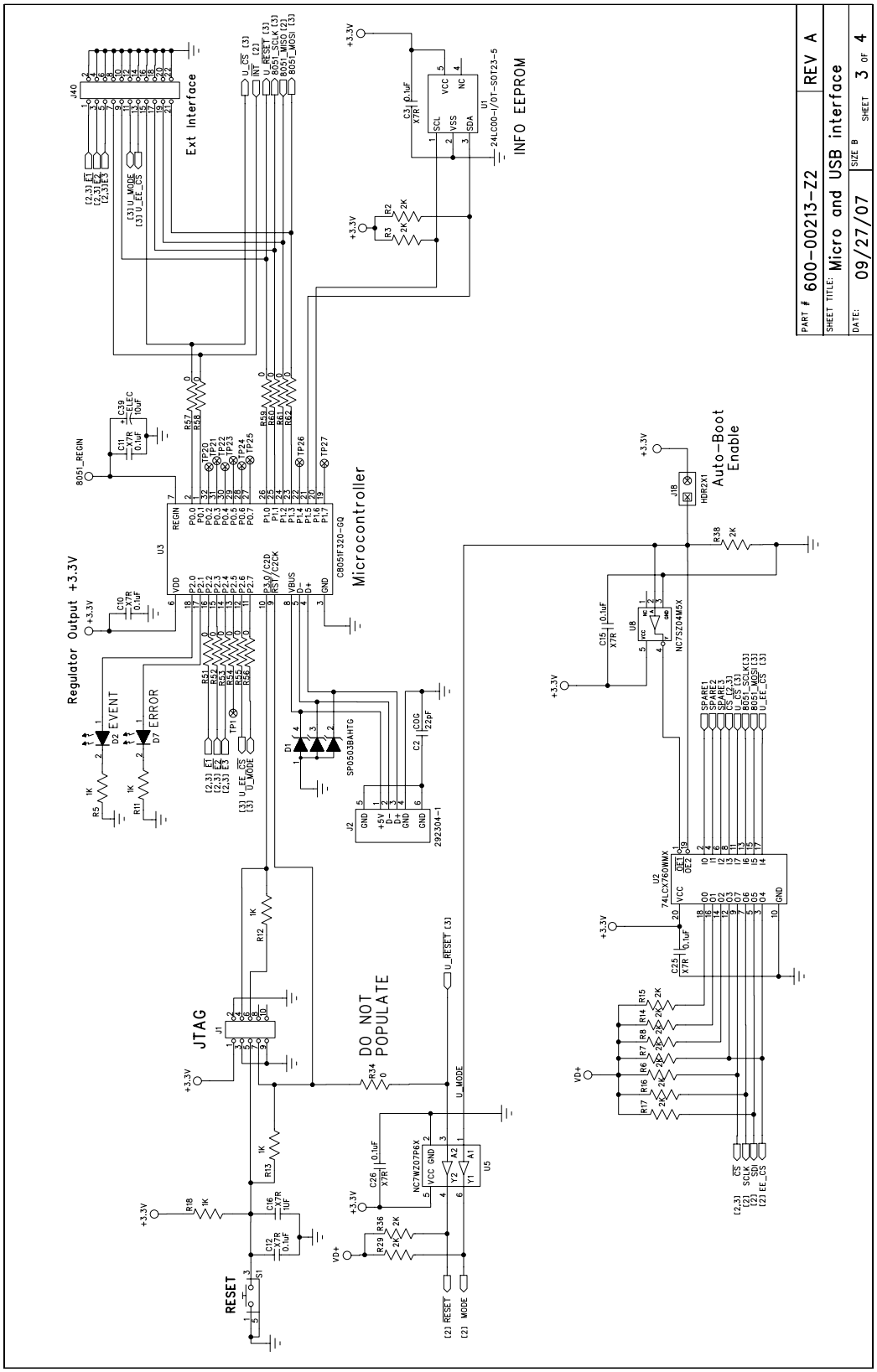


Figure 21. Schematic - Microcontroller & USB Interface

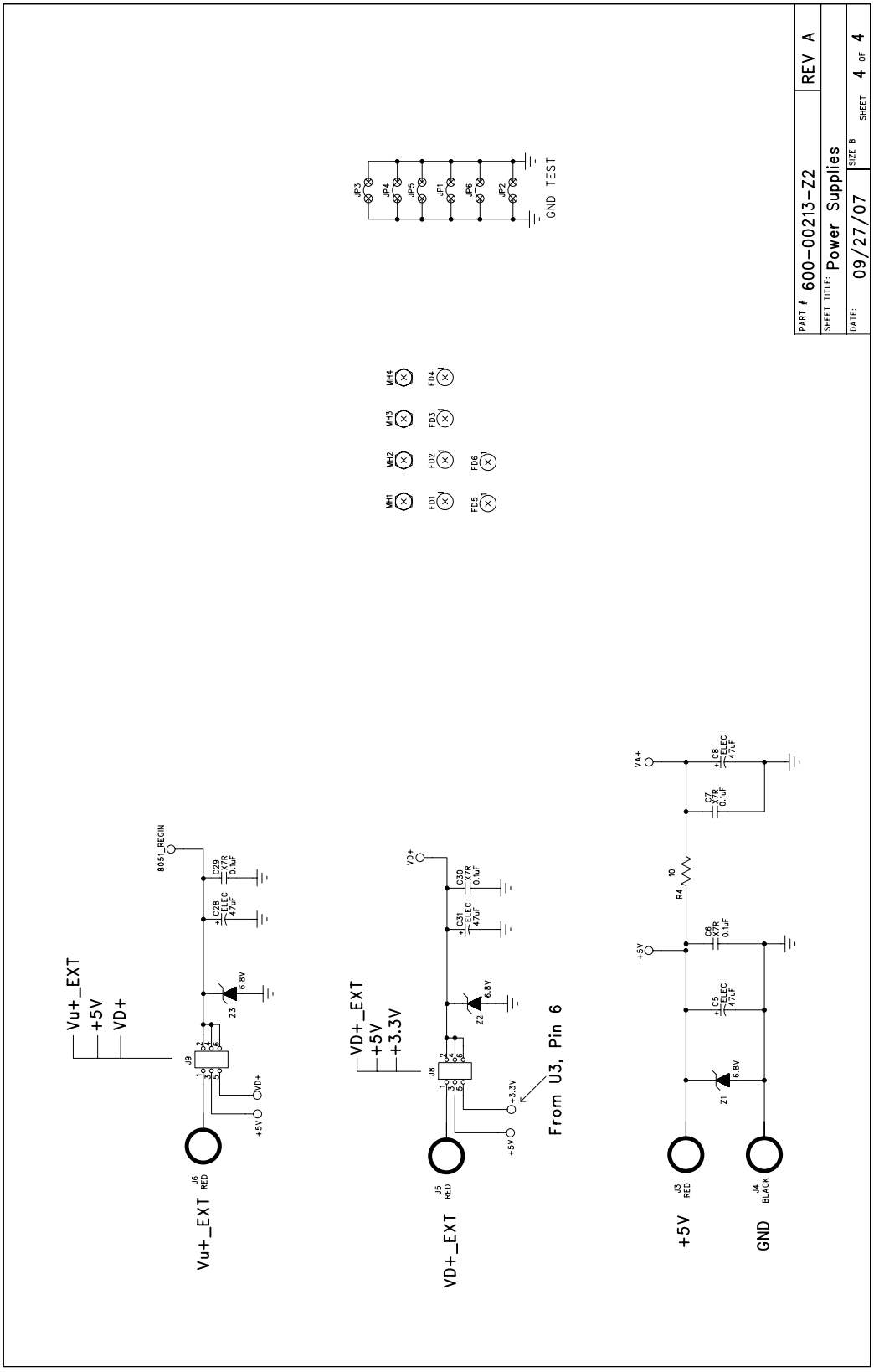


Figure 22. Schematic - Power Supplies

APPENDIX C. LAYER PLOTS

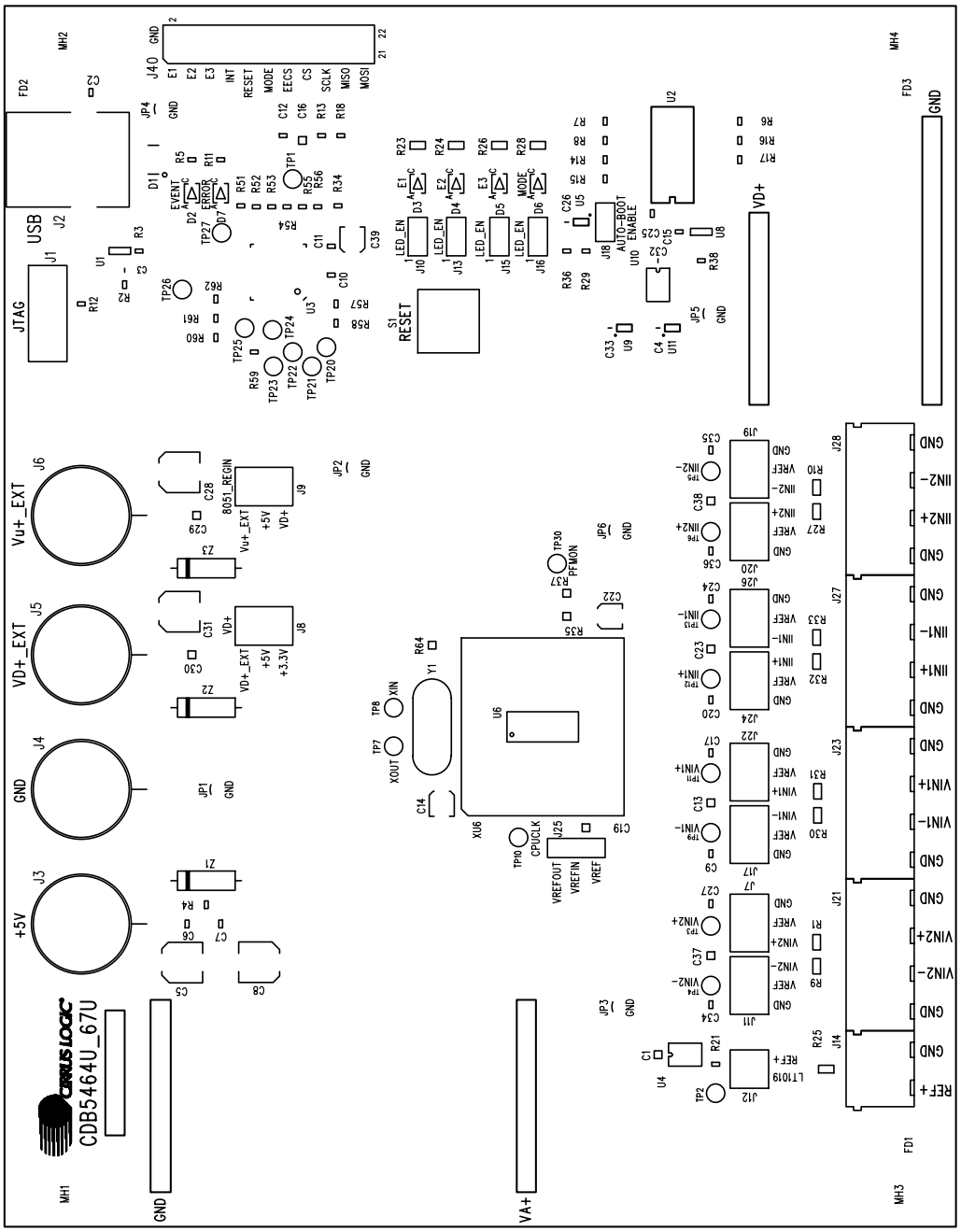


Figure 23. Top Silkscreen

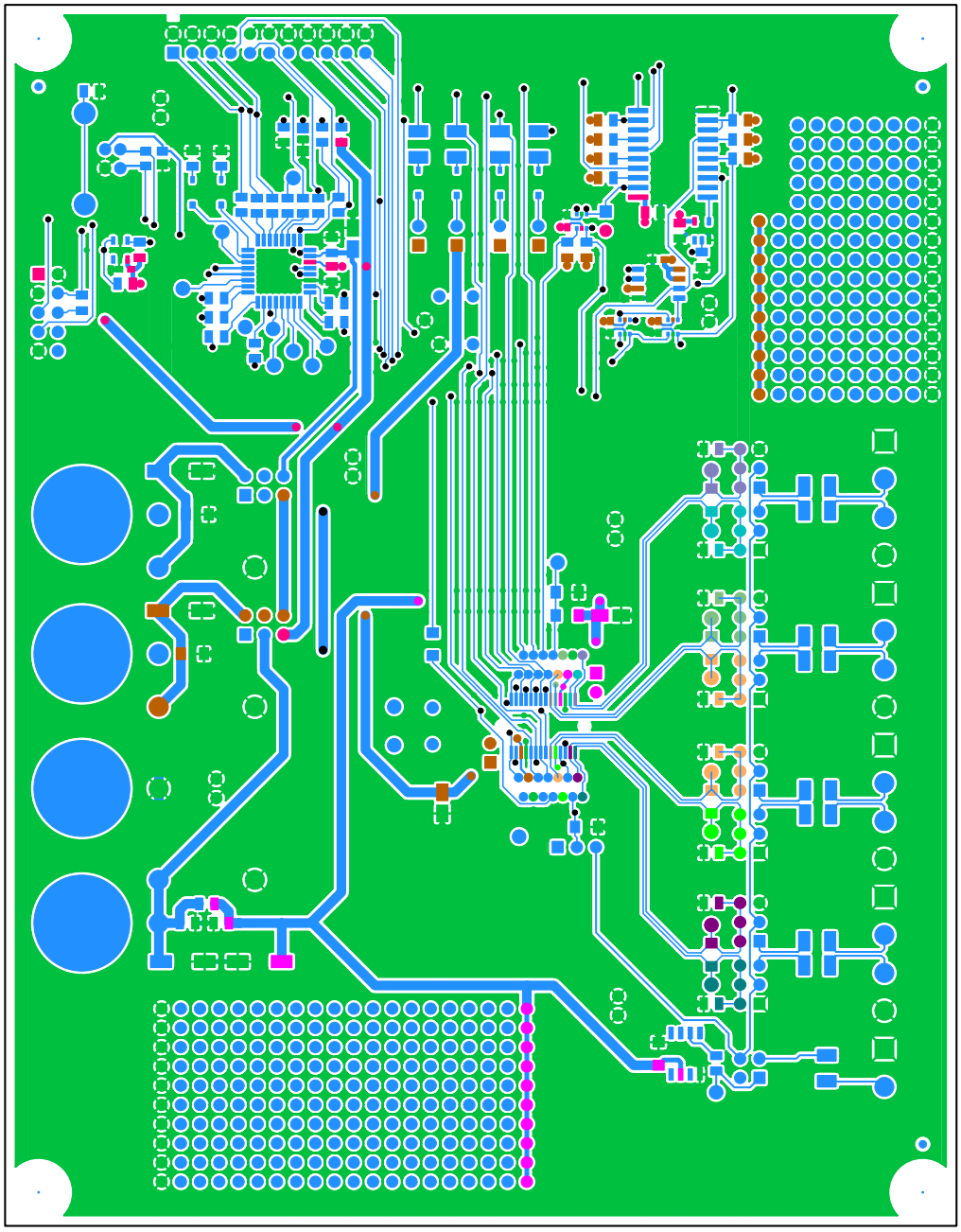


Figure 24. Top Routing

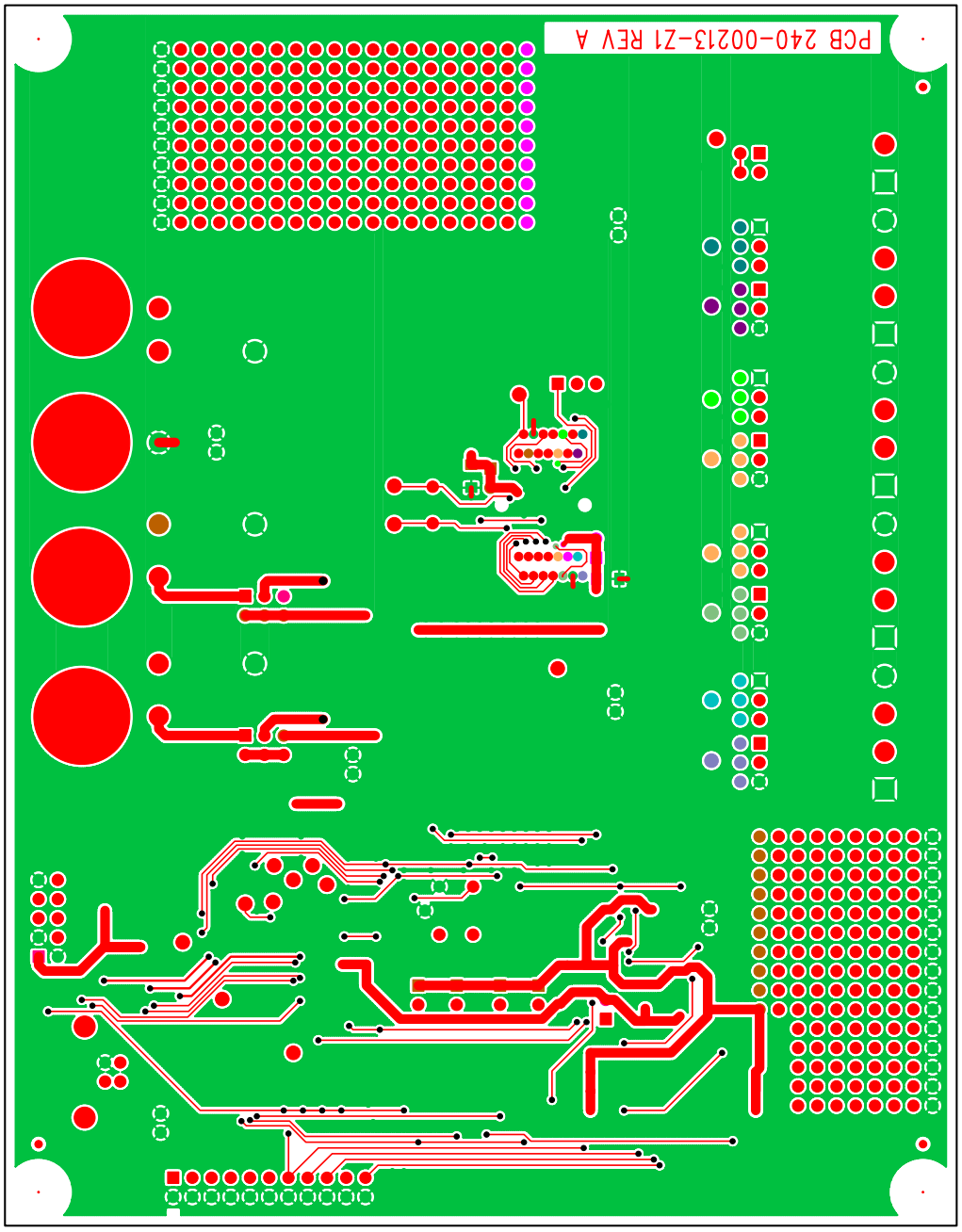


Figure 25. Bottom Routing

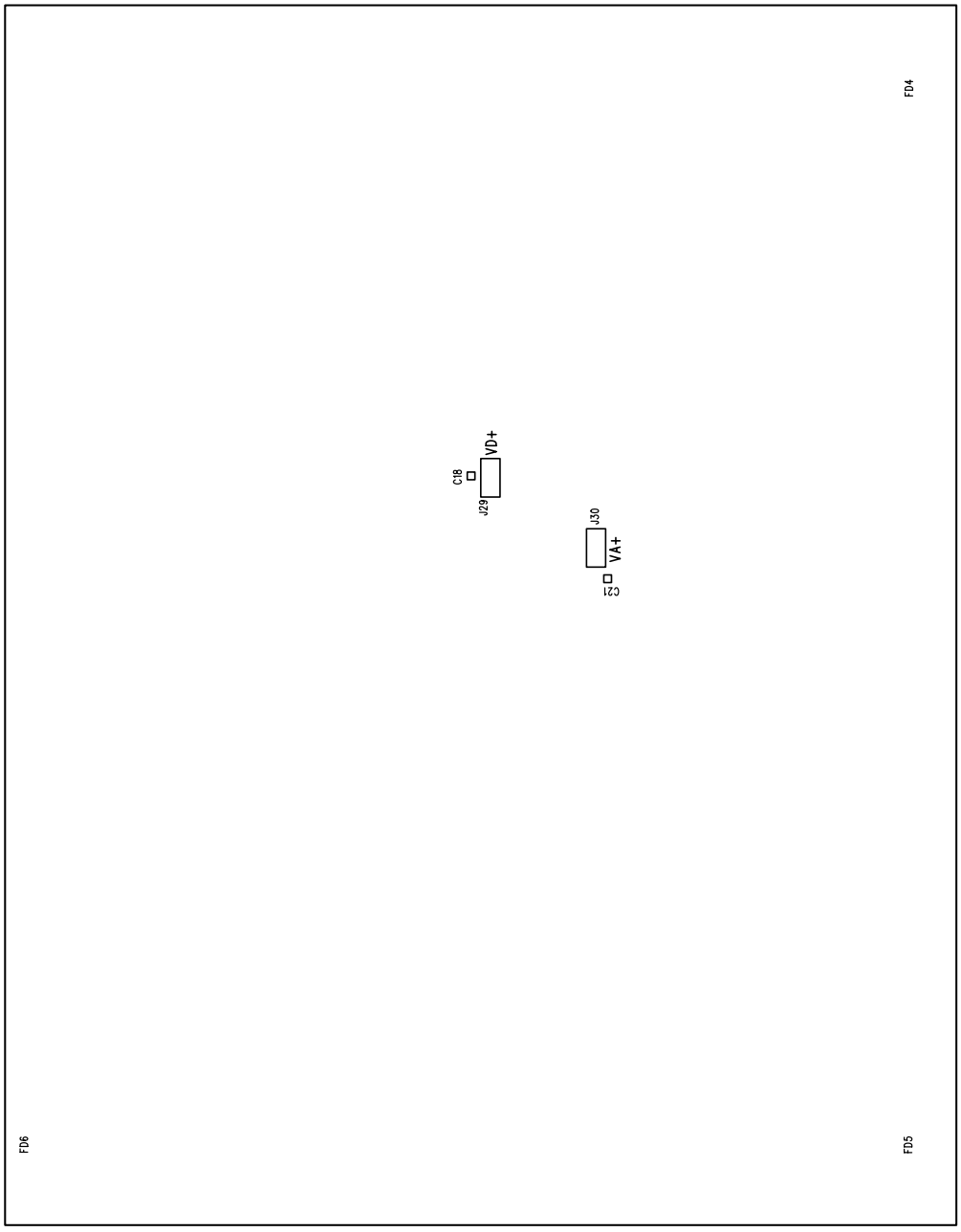


Figure 26. Bottom Silkscreen

REVISION HISTORY

Revision	Date	Changes
DB1	OCT 2007	Initial Release.

Contacting Cirrus Logic Support

For all product questions and inquiries contact a Cirrus Logic Sales Representative. To find the one nearest to you go to www.cirrus.com

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