

# ***ADS1298R ECG FE-PDK Test Procedure***

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*Test Plan : 6522881– Rev B*

*HPA - Data Acquisition Products  
Applications*

*March 2011*

### IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

All test equipment used for production testing of the ADS1298R ECG FE Board shall be current calibrated equipment.

Revision	Description	Initials	Date
B	Initial Release		18MAR11

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# ADS1298R ECG FE-PDK Test Procedure

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## SUMMARY

This test plan outlines the necessary tests and adjustments that must be performed by the manufacturer to confirm that the ADS1298R ECG FE-PDK is functioning properly. Tests are to be completed in consecutive order, and performed on a pass / fail basis.

Rework of failed assemblies due to improper soldering, failed parts, or incorrectly installed parts is to be performed in accordance with all applicable industry standards. Assembly failures due to manufacturing defects in the raw PCB are to be reported to Texas Instruments and the PCB manufacturer immediately. No rework is to be performed on this type of failure.

It is assumed that the manufacturer, and their employees, are familiar with standard static discharge control procedures, and will handle all assemblies accordingly. Failures due to static damage will be responsibility of the manufacturer.

# Test Equipment Required

Table 1 lists the test equipment required to test the ADS1298R ECG FE-PDK. Equipment other than the recommended model may be used if it satisfies the specification listed in Table 1. Table 2 is a list of reference materials.

**Table 1 – Required Equipment**

Equipment Required	Specifications	Recommended Model
Power supply	6V @300mA	Agilent 3631A
Function Generator		HP 33120A
Multi-meter		HP 34401A
Optical Inspection Tools	7x Power or better	No Recommendations
ADS1298R ECG FE-PDK Software	Test software	<a href="ftp://ftp.ti.com/pub/data_acquisition/ECG_FE/ADS1298R/">ftp://ftp.ti.com/pub/data_acquisition/ECG_FE/ADS1298R/</a> latest version
EEPROM Programmer Plugin	Test software	<a href="ftp://ftp.ti.com/pub/data_acquisition/ADCPro/Plugins/">ftp://ftp.ti.com/pub/data_acquisition/ADCPro/Plugins/</a> latest version
Power cable	Wire to DC plug in	TI provided
Signal cable	DB15 cable to connect to function generator	TI provided
MSP430G2121 Programming Software	None	<a href="http://www.elprotronic.com/download.html">http://www.elprotronic.com/download.html</a> - FET-Pro430 Lite
MSP430G2121 Programming Hardware	eZ430-F2013 USB Stick Development Tool	<a href="http://focus.ti.com/docs/toolsw/folders/print/ez430-f2013.html">http://focus.ti.com/docs/toolsw/folders/print/ez430-f2013.html</a>
Standard USB cable	USB-A to USB-B	No Recommendations

**Table 2 - Reference Materials**

- ❑ ADS1298R ECG FE-PDK Schematic – PDF files located under EDGE # 6522881
- ❑ ADS1298R – TI Website, Lit. No. SBAS459
- ❑ TPS60403 – TI Website, Lit. No. SLVS324
- ❑ TPS73230 – TI Website, Lit. No. SBVS037
- ❑ TPS72301 – TI Website, Lit. No. SLVS346
- ❑ TPS73201 – TI Website, Lit. No. SBVS037

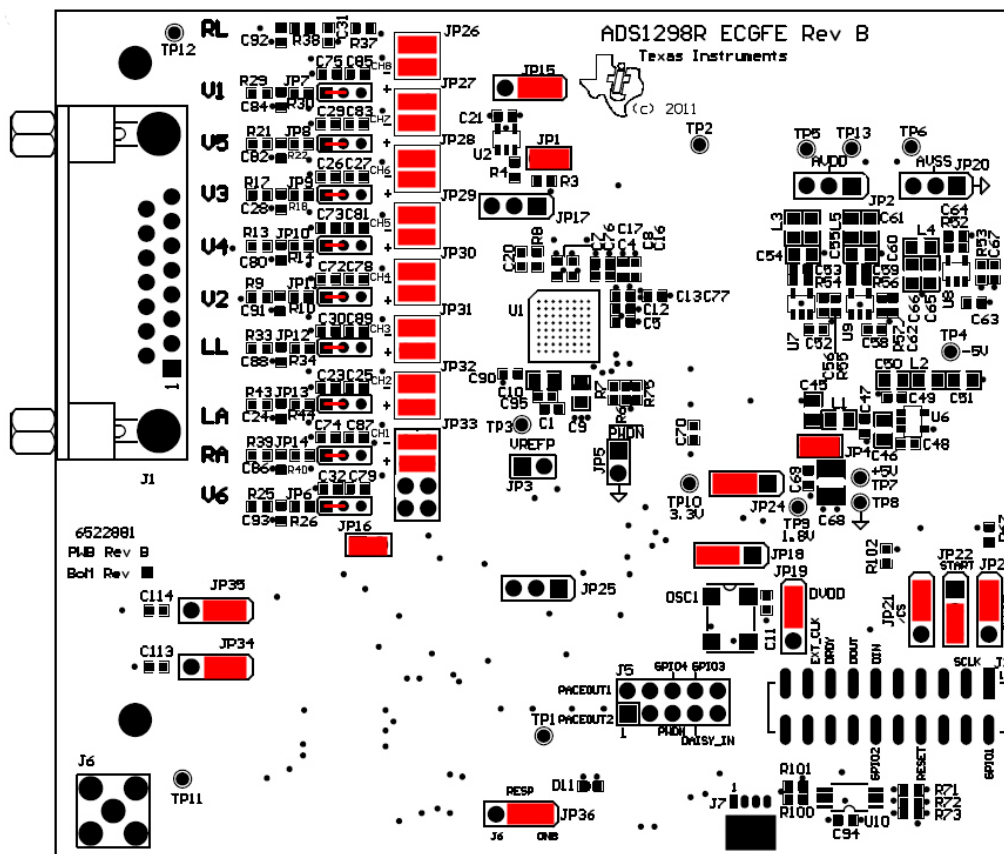
# ADS1298R ECG FE-PDK Functional Test

## 1. Pre Test Set-Up

1.1. Verify all jumper settings against Tables 3 and 4.

**Table 3 – MMB0 Jumper Test Positions**

Jumpers (MMB0 Rev D)	Position	Description
J12	Installed (closed)	Power from wall supply used for board
J13A 1-2	Installed (closed)	+5V tied to +VA
J13B 1-2	Installed (closed)	+5V tied to +5VA



**Figure 1 – Initial Jumper Positions**

**Table 4 – ADS1298R ECG FE Jumper Test Positions**

<b>Shunt Jumpers</b>	<b>Position</b>	<b>Description</b>
JP1	Installed	
JP2 **	OPEN	Unipolar/bipolar operation
JP4	Installed	
JP5	Open	
JP15	Installed 2-3	
JP16	Installed	
JP18	Installed 2-3	
JP19	Installed 1-2	
JP20 **	OPEN	Unipolar/bipolar operation
JP21	Installed 1-2	
JP22	Installed 2-3	
JP23	Installed 1-2	
JP24	Installed 2-3	
JP26	Installed 1-2 (top) Installed 3-4 (bottom)	Input connections
JP27	Installed 1-2 (top) Installed 3-4 (bottom)	Input connections
JP28	Installed 1-2 (top) Installed 3-4 (bottom)	Input connections
JP29	Installed 1-2 (top) Installed 3-4 (bottom)	Input connections
JP30	Installed 1-2 (top) Installed 3-4 (bottom)	Input connections
JP31	Installed 1-2 (top) Installed 3-4 (bottom)	Input connections
JP32	Installed 1-2 (top) Installed 3-4 (bottom)	Input connections
JP33	Installed 1-2 Installed 3-4 OPEN 5-6 OPEN 7-8	Input connections Input connections Respiratory test signal Respiratory test signal
JP34	Installed 1-2	
JP35	Installed 1-2	
JP36	Installed 1-2	
JP3, JP6 – JP14, JP17, JP25	Header not installed	

†

- 1.2. Visually inspect the board for solder shorts and bent connector pins.
- 1.3. Verify the latest ADS1298R ECG FE-PDK software is installed; code is available from the ADS1298R Tool folder:  
<http://focus.ti.com/docs/toolsw/folders/print/ads1298recgfe-pdk.html>
- 1.4. Plug the ADS1298R ECG FE onto the MMB0 motherboard aligning J2, J3 and J4 on the ECG FE with J7, J4 and J5 (respectively) on the ADS1298R ECG FE.
- 1.5. Verify software is installed for programming the MSP430G2121. If not already installed, FET-PRO430 is recommended. This is free software, and can be found via the following link:

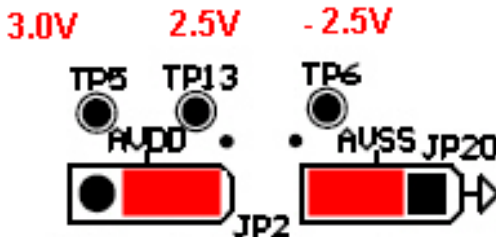
<http://www.elprotronic.com/download.html>

***Scroll down the page until you see “Flash Programmers for TI’s MSP430 MCU uses TI’s FET Adapter”. Follow the appropriate installation process, in accordance with the documentation provided with FET-Pro430 Lite.***

## 2. ADS1298R ECG FE Power Testing

In this section, the power connectivity of the ADS1298R ECG FE will be verified using LEDs located on the ADS1298R ECG FE and the MMB0.

- 2.1. Connect the MMB0 to the power supply using the power cable assembly with a 2.5mm barrel connector.
- 2.2. Ensure that JP2 and JP20 shunt jumpers on the ADS1298R ECG FE board are removed.
- 2.3. Set the power supply:
  - Voltage = 6.0V
  - Current Limit = 300mA
- 2.4. Turn on supply connected to J2 of the MMB0 and verify that no more than 150mA or current is being drawn by the MMB0 and ADS1298R hardware combination.
- 2.5. Verify the following voltages, within +/- .05VDC:
  - JP2 pin 3 – 3.0V; or TP5 referenced to TP2
  - JP2 pin 1 – 2.5V; or TP13 referenced to TP2
  - JP20 pin 3 – -2.5V; or TP6 referenced to TP2
- 2.6. After successfully completing the above test, **turn off DC power** and configure the board for Bipolar operation by installing jumpers on the following:
  - JP2, position 1 & 2
  - JP20, position 2 & 3





### 3. Testing the ADS1298R ECG FE board

Once the power testing has been successfully completed, the connectivity of the ADS1298R ECG FE-PDK can be tested.

#### 3.1. Connecting to the Hardware

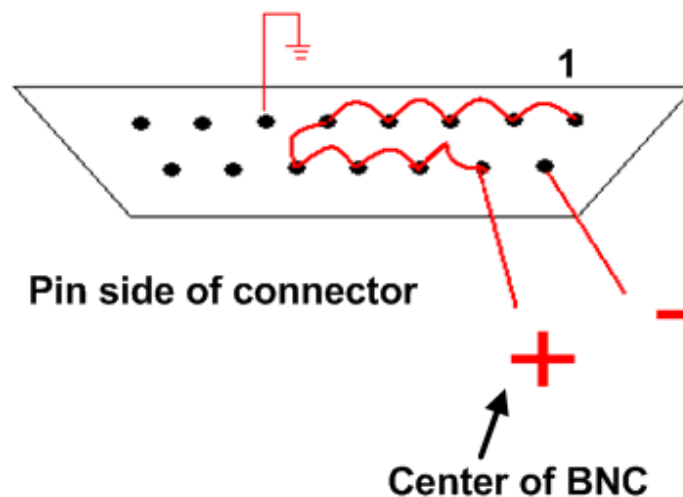
- 3.1.1. Connect the USB cable to the ADS1298R ECG FE-PDK and the PC on which the software is installed.

Note: The first time this test is performed on the PC, after connecting the ECG FE-PDK, you may be prompted to install the NI-VISA drivers required for connection.

Note: If testing requires the installation of the TMS320D5507 driver, make sure to select the driver that contains “NI-VISA” in the name/description.

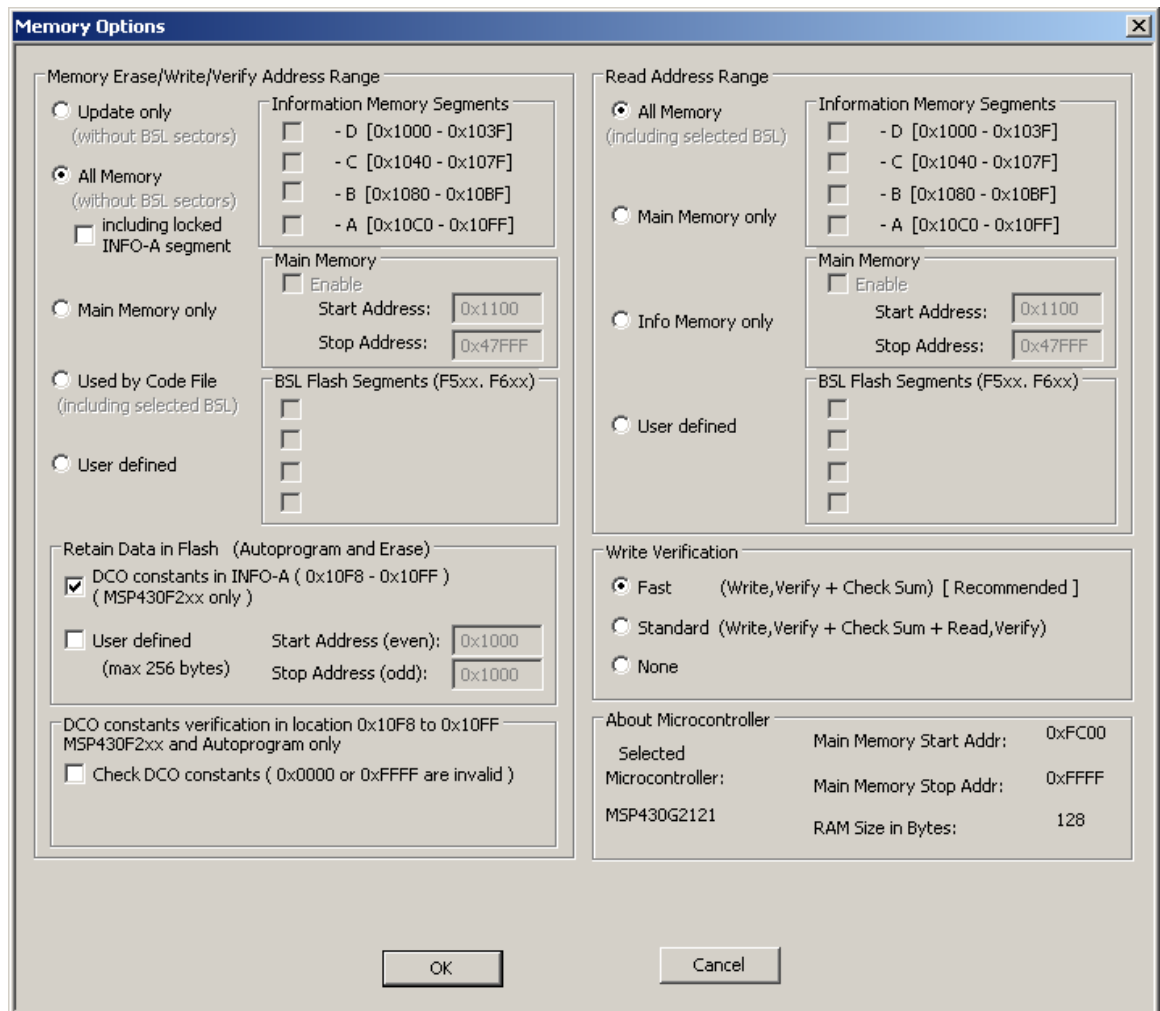
- 3.1.2. Connect test cable BNC connector to a function generator on one end and to the ECG FE-PDK under test on the other (DB15 connector-Refer to Figure 1 for further details).
- 3.1.3. Connect the ground wire (connected to pin 6 of the DB15 connector) of the cable to JP5-2 (ground).
- 3.1.4. Set the function generator to output a 10Hz sine wave @ 50mVpp.
- 3.1.5. Enable the 6V power supply.

**Figure 1: DB15 Connector**



### 3.2. Programming the MSP430

- 3.2.1. From the Start Menu, launch the All Programs > Elptronic – Flash Programmers > (MSP430) FET-Pro430 > Lite FETPro430 tool.
- 3.2.2. Following the instructions from the Lite FETPro430 tool, load the 6522881.d43 file that was provided to you.
- 3.2.3. Press the 'Auto Program' button. Assuming the default setup of the programmer tool was used along with the following memory option settings, the Lite FETPro430 tools should report a 'PASS' comment in the status window.



### 3.3. Starting the Software

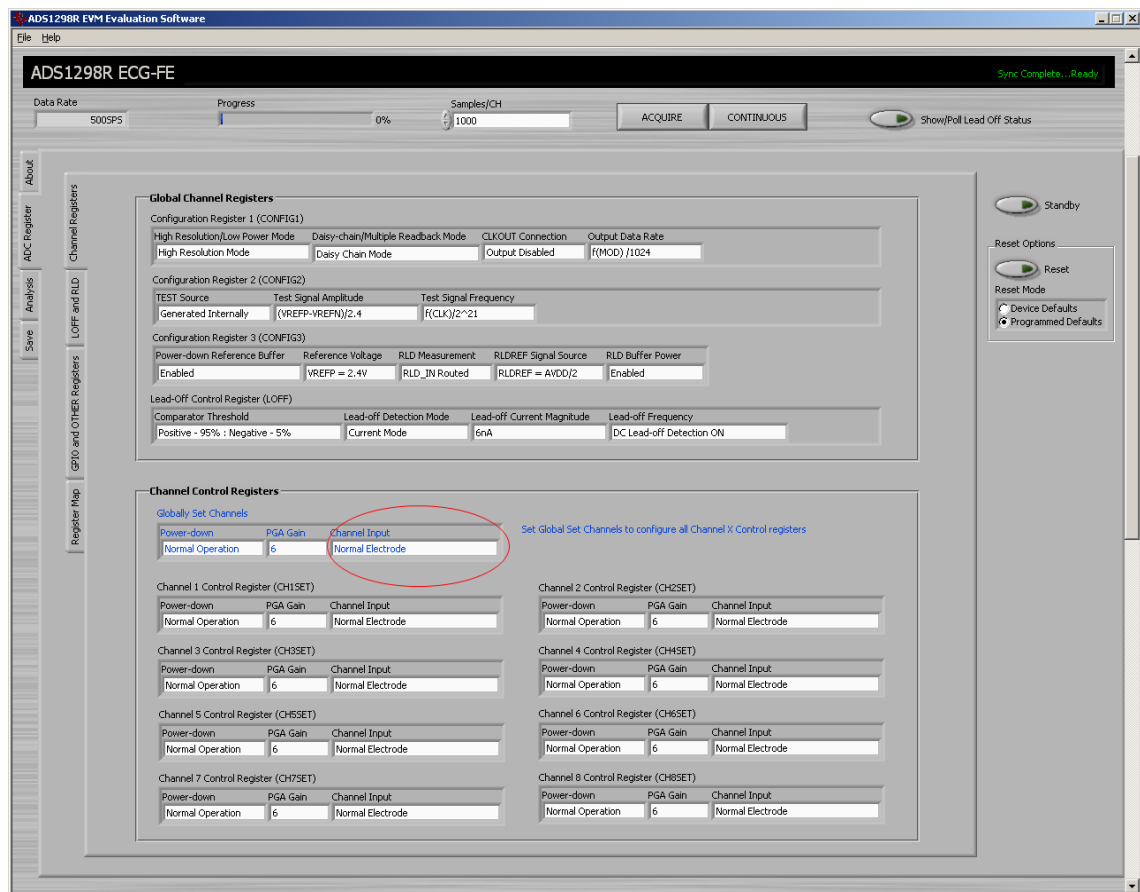
- 3.3.1. Cycle power to the MMB0
- 3.3.2. Start the evaluation software from the shortcut or Start menu (Start > ADS1x98ECG > ADS1298R ECG FE).
- 3.3.3. Wait for the firmware to download and be started by noting the status window at the top of the screen (**Sync Complete...Ready**).

Note: The first time this test is performed on the PC, after starting the software, you will be prompted to install the USBStyx drivers required for connection.

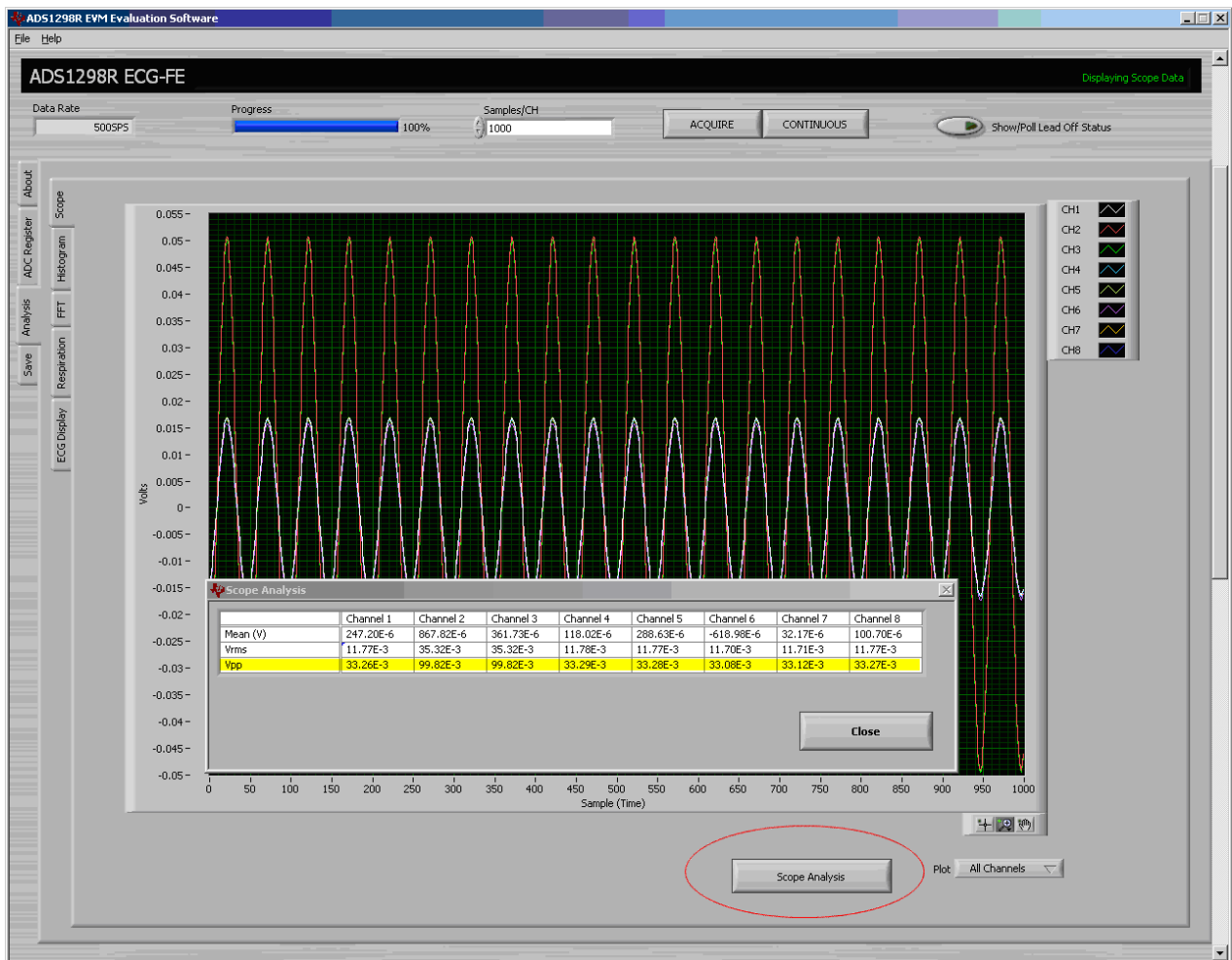
- 3.3.4. Verify that LED D11 on the ADS1298R ECG FE is blinking green at an approximate 0.3Hz rate (on/off for about 1.5 seconds).

### 3.4. Testing

- 3.4.1. Click **ADC Register** tab >> **Channel Registers** tab >> Channel Control Registers.
- 3.4.2. Select Normal Electrode from the pull-down menu of Channel Input control in the Globally Set Channels grouping. Note: All of the Channel Input controls should change to Normal Electrode.



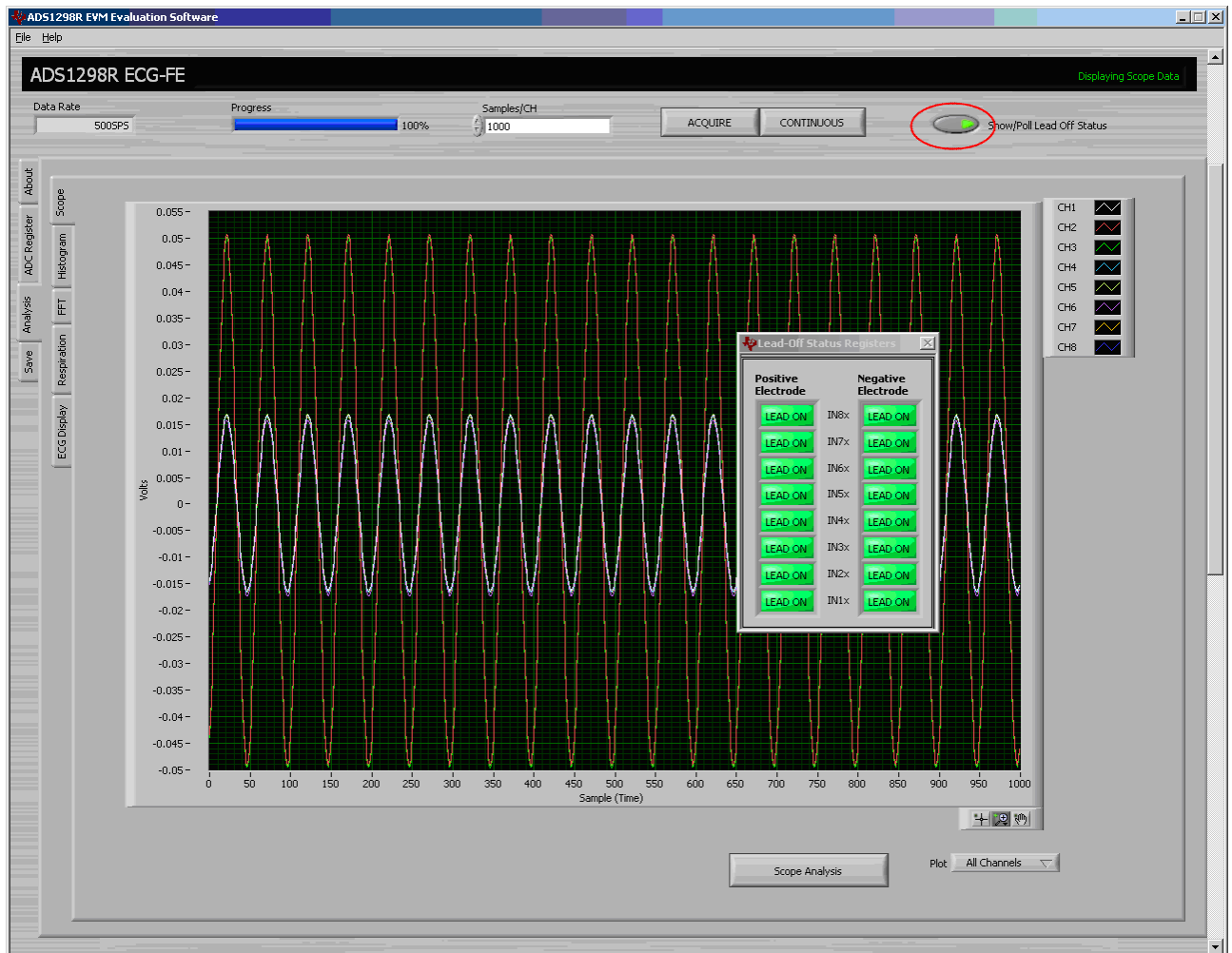
- 3.4.3. Enable the output of the function generator.
- 3.4.4. Click **Acquire**. The software will acquire the default (1000) requested number of samples.
- 3.4.5. After acquisition is completed, click **Analysis** tab and ensure you are viewing the **Scope** tab. Click the 'Scope Analysis' button.
- 3.4.6. Compare the response against the figure below to verify performance. Individual channels can be verified to have amplitude of +/-50mV to +/-35mV by selecting them from the pull down menu, labeled **Plot** at the bottom right corner of the screen.



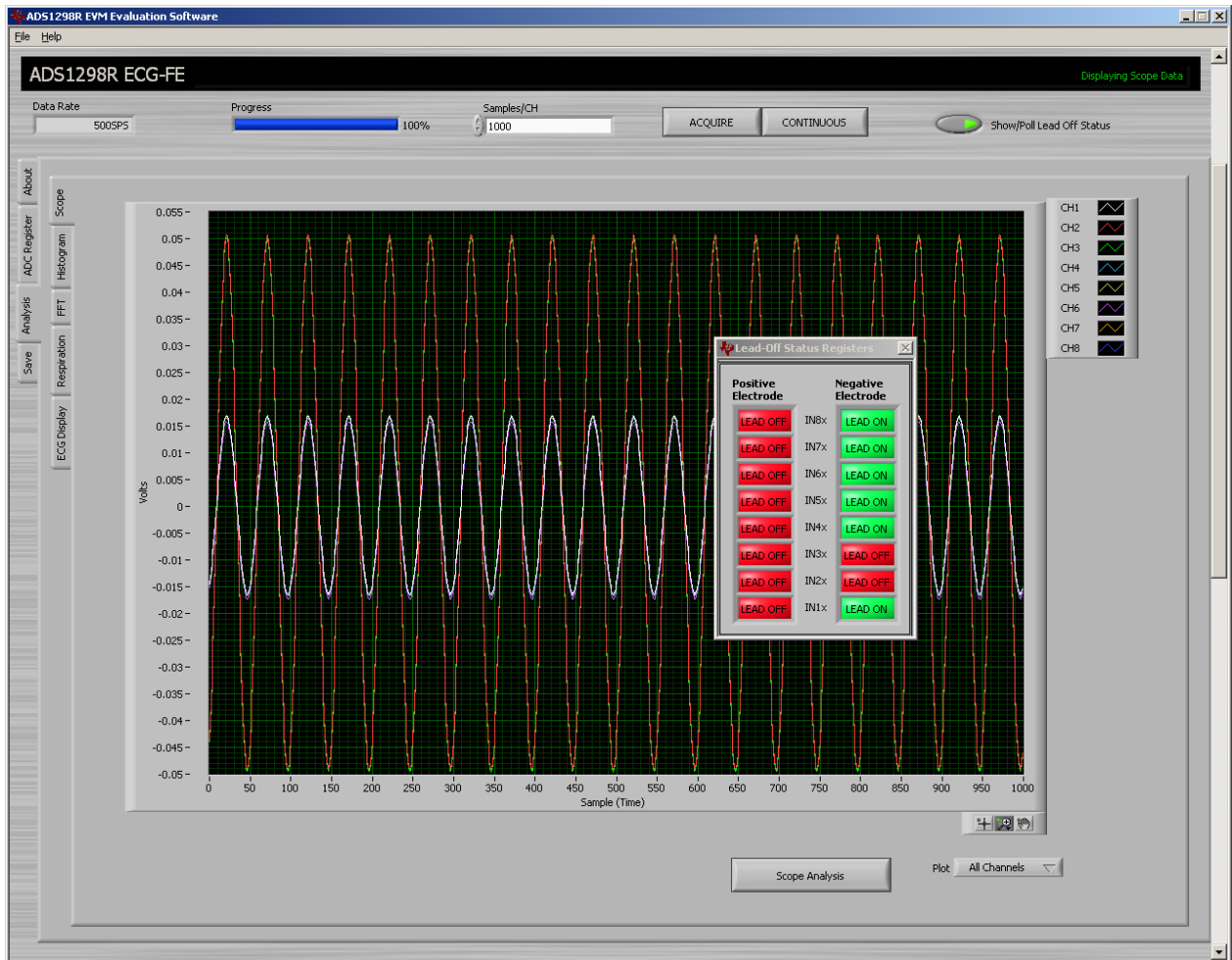
- 3.4.7. Verify Channels as followed:

- Channels 1 and 4-8 should show 34mVp/p (+/-5mVpp)
- Channels 2 and 3 should read 100mV p/p (+/-10mVpp)

- 3.4.8. Click **Show/Poll Lead Off Status** to show the indicator panel. All electrode LEAD ON indicators should be green.

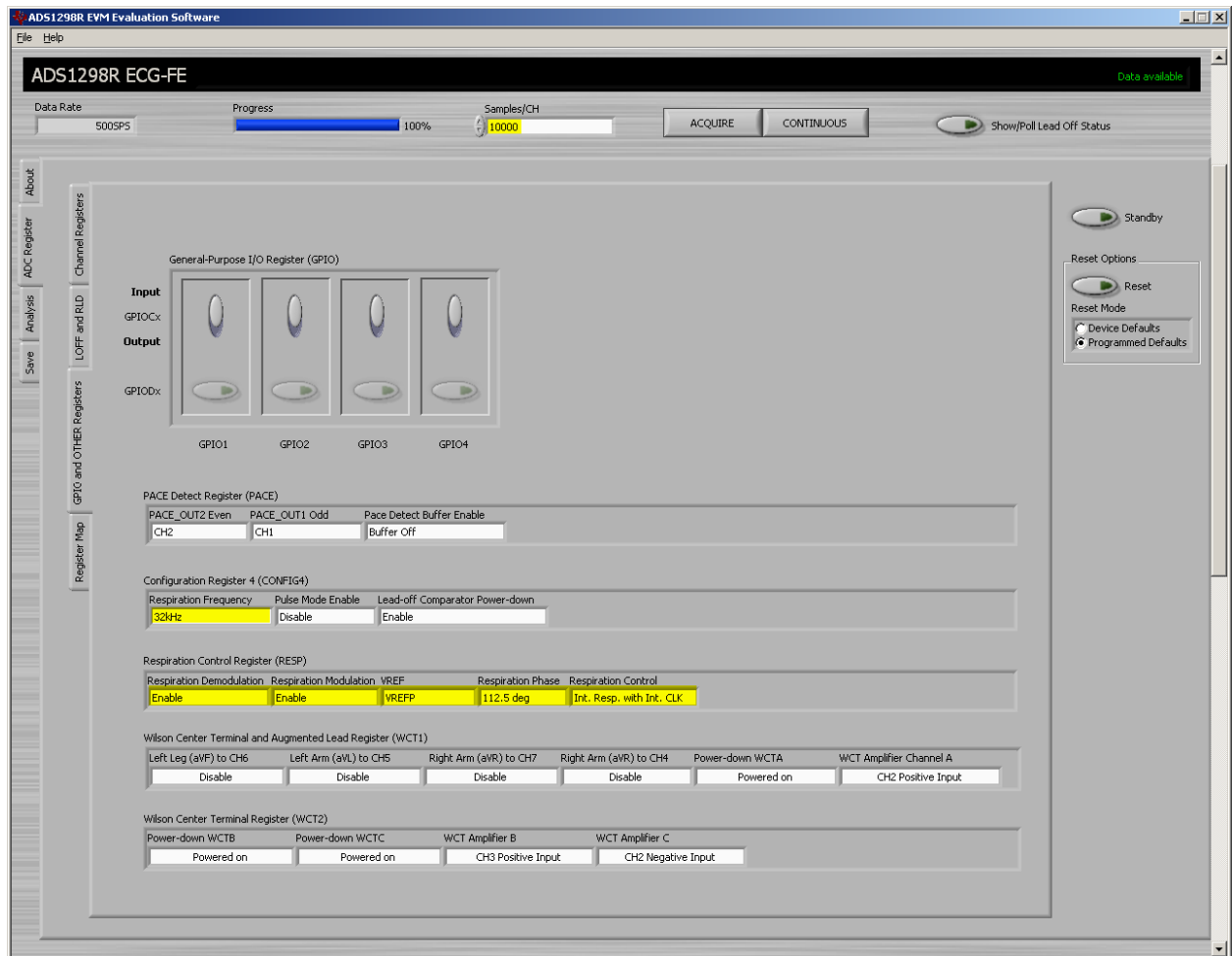


- 3.4.9. Disconnect the DB15 connector. All positive electrodes and IN2x & IN3x negative electrodes should turn red.



- 3.4.10. Click **Show/Poll Lead Off Status** again, to close the indicator panel.

- 3.4.11. Move the two shunt jumpers on JP33 jumpers to: 5-6, and 7-8 (There is no need to reset hardware/software after jumpers are switched).
- 3.4.12. Change **Samples/CH** to 10,000 as highlighted in the figure below
- 3.4.13. Under **ADC Register** tab>>**GPIO and Other Registers**>>**Respiration Control Register**→
  - **Verify:** Configuration Register 4>>Respiration Frequency>> 32KHz;
  - **Verify:** Respiration demodulation>>Enable;
  - **Verify:** Respiration Modulation>>Enable;
  - **Verify:** VREF>>VREFP;
  - **Verify:** Respiration Phase>>112.5deg;
  - **Select:** **Respiration Control**>>Int. Resp. with Int. Clk





- 3.4.14. Click **Acquire** and then move to the Analysis >>Respiration Tab, you should see a figure similar to that above.
- 3.4.15. Verify that the “Statistical Data” Window shows a Mean of 0.062V, +/-10%. The Noise reading should be between 2.7 and 4.0uVp-p.
  - Please note, the default ‘Unsettled Points to Remove’ is 2000. If there is excessive Noise, try changing that to 2500 as shown above. It may be necessary to take a second capture of data to have the noise settle to the required range, this is normal behavior of the device
- 3.4.16. Close the ADS1298R ECG FE Evaluation Software.



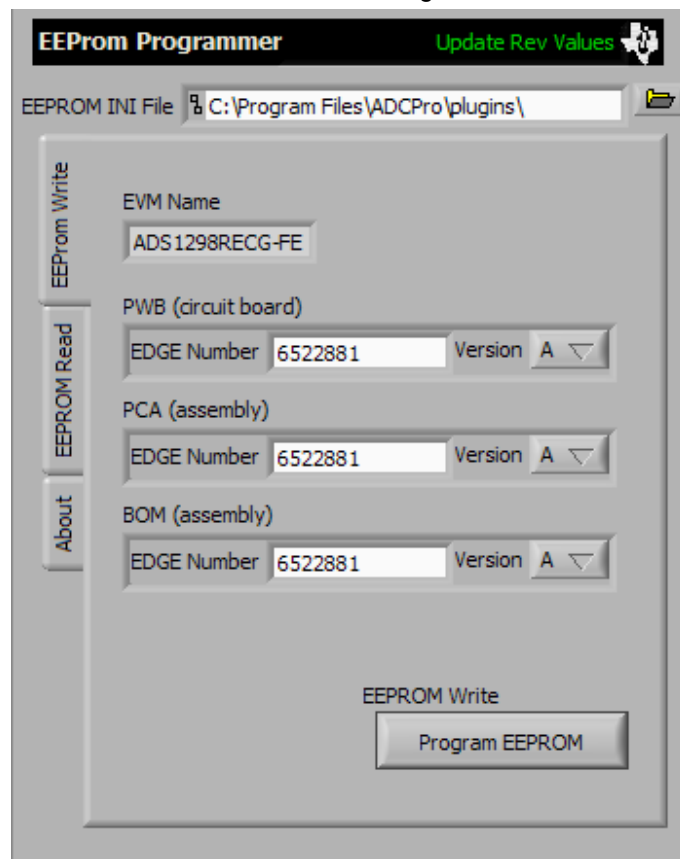
## 4. EEPROM Programming

If Sections 2 through 3 successfully completed, then the hardware under test has PASSED.

- 4.1. Install the provided ADCPro software and EEPROM Programming plugin (listed below).

\*This step may be skipped if the software was installed for previous ECG FE testing.\*

- ADCPro software – See [ADCPro Tool Folder \( ti.com/ADCpro \)](http://ti.com/ADCpro)
  - EEPROM Programming Plugin - [eeeprom-programmer-plugin](http://ftp.ti.com/pub/data_acquisition/ADCPro/Plugins/eeeprom-programmer-plugin)  
([ftp://ftp.ti.com/pub/data\\_acquisition/ADCPro/Plugins/eeeprom-programmer-plugin](http://ftp.ti.com/pub/data_acquisition/ADCPro/Plugins/eeeprom-programmer-plugin))
    - Please Note – The EEPROM tool is password protected, the password is ti\_evm
  - Copy the INI file contained with the software (ADS1298R\_EEPROM.ini) to a known location on the PC being used for testing.
- 4.2. Press the 'Reset' button on the MMB0 hardware (located in the upper right corner).
- 4.3. Start the ADCPro software from the Start Menu or the shortcut on the desktop.
- 4.4. From the ECG FE menu, select EEPROM Programmer. The EEPROM programming plug-in should load and the firmware should download to the MMB0.
- 4.5. When the firmware is finished downloading and the software is connected to the ECG FE, the software will prompt you to select the INI file to use for programming.
- 4.6. Select/Navigate to the location of the INI file that was copied in Step 1.2. The plug-in portion of the screen should look like the figure below:

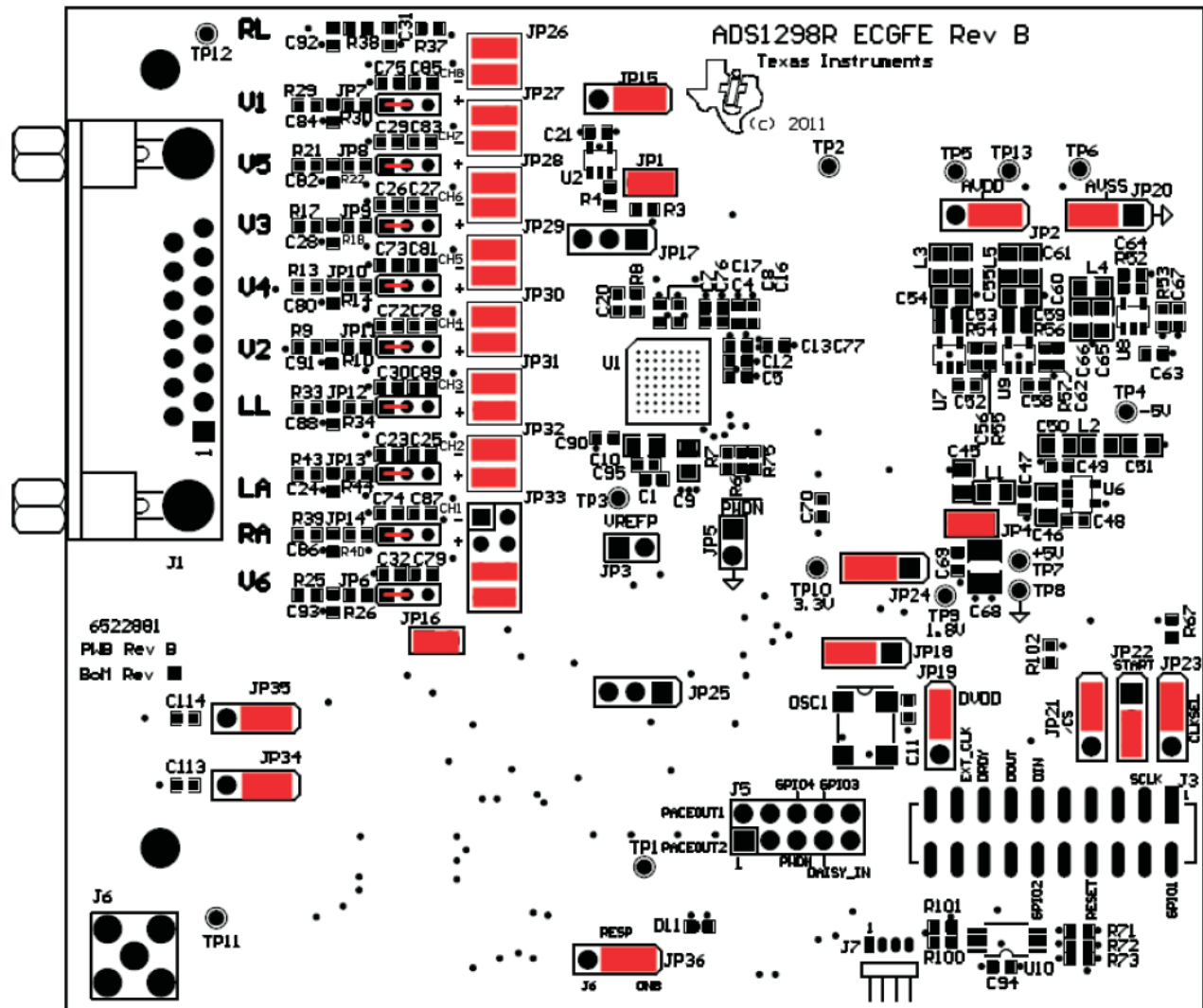


- 4.7.** At each prompt enter the correct revision number for the specified property. The revision numbers are shown in Table 5 below.

**Table 5. EEPROM Field Information**

Field	Revision
PWB	A (or current PWB rev)
PCA	A (or current PCA rev)
BOM	A (or current BOM rev)

- 4.8. Click the **Program EEPROM** button to write the EEPROM values.
- 4.9. Verify the values by clicking on the **EEPROM Read** tab and pressing the **Read EEPROM** button
- 4.10. Exit the ADCPro software
- 4.11. Turn off/disconnect the power to the ECG FE.-PDK After power down, disconnect all other cables from the ECG FE-PDK.
- 4.12. Prep boards for shipment to the distribution center as described on the next page.
- 4.13. Verify all jumpers are installed as shown below:



## Preparation for shipment

All functional tests are now complete. Before packaging board for shipment, verify the following:

1. Remove all test equipment.
2. Ensure all final jumpers are securely seated.
3. Mark the box on the board (located in the bottom left corner of the board) indicating the current BoM revision. This can be done with permanent marker or label.
4. **Do not** remove the MMB0 from the ADS1298RECGFE-PDK boards. Add the hardware listed in the table below. These will be shipped as a unit.

Board Name	MMB0	Hardware
ADS1298RECGFE-PDK	Yes	MMB0 <b>Rev D</b> $\frac{3}{4}$ " standoff (2204) 2 screws (PMSSS 440 0038 PH)

5. Ensure the standoffs are securely fastened. Mark the board as necessary showing that it has passed all functional tests.
6. Place/seal the tested board into an anti-static bag.
7. Label the bag with the appropriate ECG FE name - **ADS1298RECGFE-PDK**.