AN-1053
APPLICATION NOTE

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AD5933 Evaluation Board Example Measurement

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INTRODUCTION

This application note details how to set up the AD5933 evaluation board, and how to make a measurement of the impedance of the on-chip 15 pF capacitor. The AD5933 data sheet provides additional information and should be consulted when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

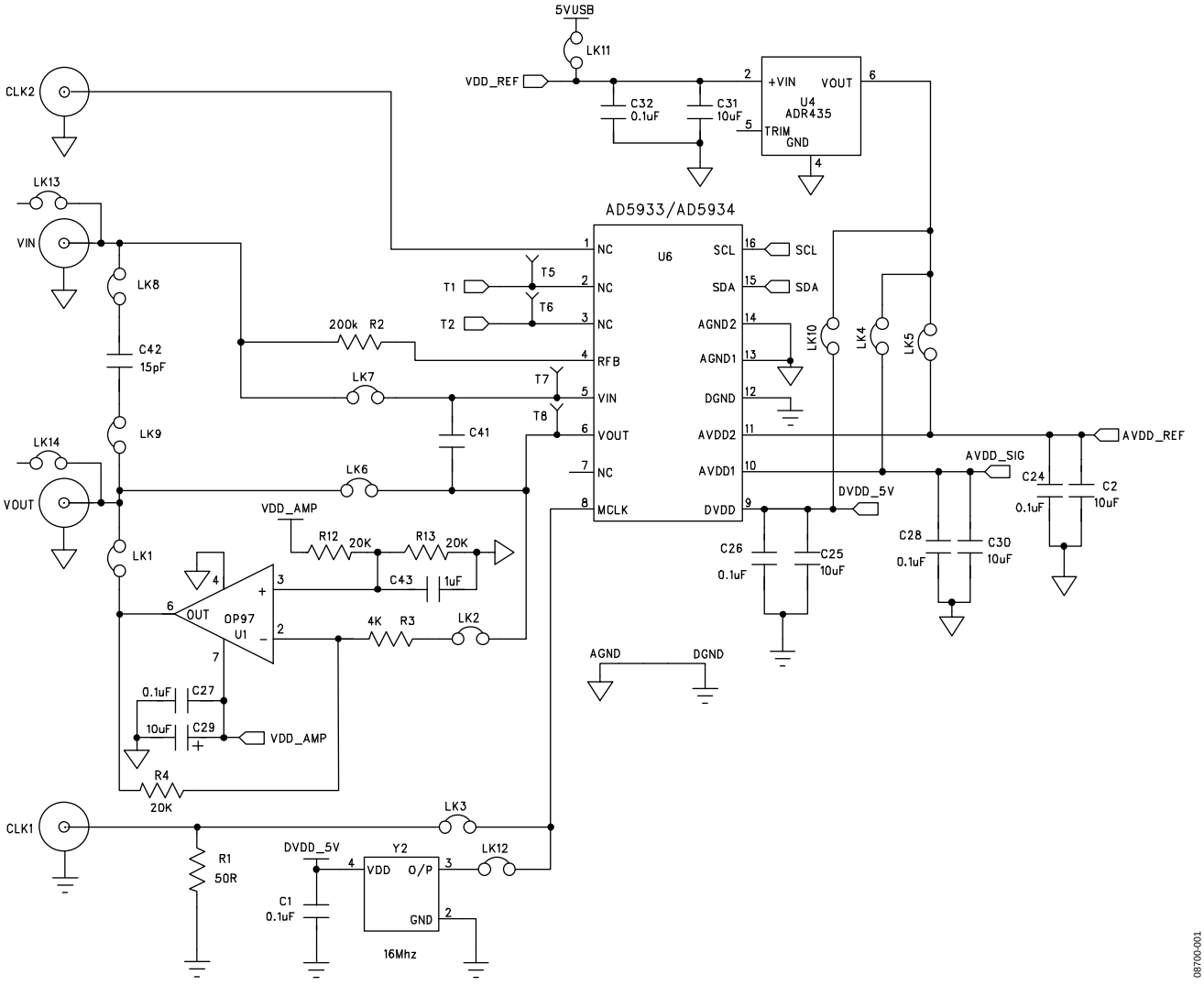

Figure 1.

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REVISION HISTORY

11/09—Revision 0: Initial Version

EVALUATION BOARD SOFTWARE

The four steps for measuring an impedance with the evaluation board include the following:

1. System setup
2. Calibration routine
3. Measure unknown impedance
4. Download data

SYSTEM SETUP

To set up the evaluation board system, do the following:

1. Load the AD5933 evaluation board software, which is supplied with the evaluation board or is alternatively available on the AD5933 product page.
2. When the software is loaded on the PC, connect the evaluation board using a USB cable.
3. Place the following jumpers: LK4, LK5, LK6, LK7, LK10, LK11, and LK12.
4. Place a 200 kΩ through-hole resistor in the C41 position on the evaluation board; this is the calibration impedance.
5. Place a 200 kΩ through-hole resistor in the R2 position; this is the feedback resistor.

CALIBRATION ROUTINE

Set up the system as shown in Figure 2; fill out the columns from left to right. For a 2 V p-p range, the output impedance is ~200 Ω (this varies from part to part); therefore, the 200 kΩ calibration resistor is actually 200.2 kΩ.

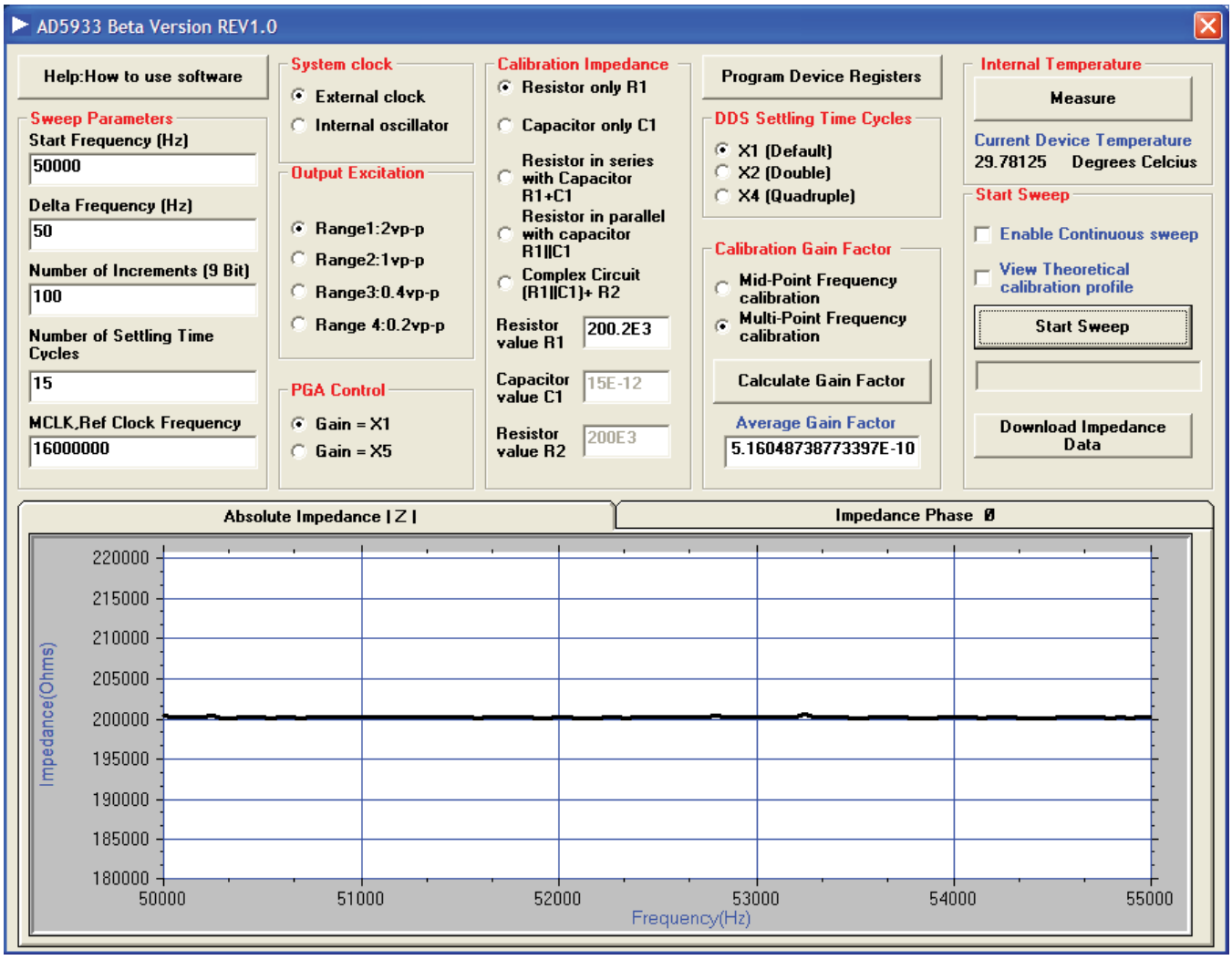


Figure 2. Calibration Routine

MEASURE UNKNOWN IMPEDANCE

Remove the 200 kΩ resistor from C41 and insert the LK9 and LK8 jumpers to connect a 15 pF (C42 on-board) capacitor to the board. Click **Start Sweep** to see the plot shown in Figure 3. Note that the impedance of the capacitor reduces with frequency according to the following equation:

$$Z = \frac{1}{2\pi fC}$$

where f is the Start Frequency + (Delta Frequency × Number of Increments).

Click the **Impedance Phase 0** tab to check that the phase is approximately −90°.

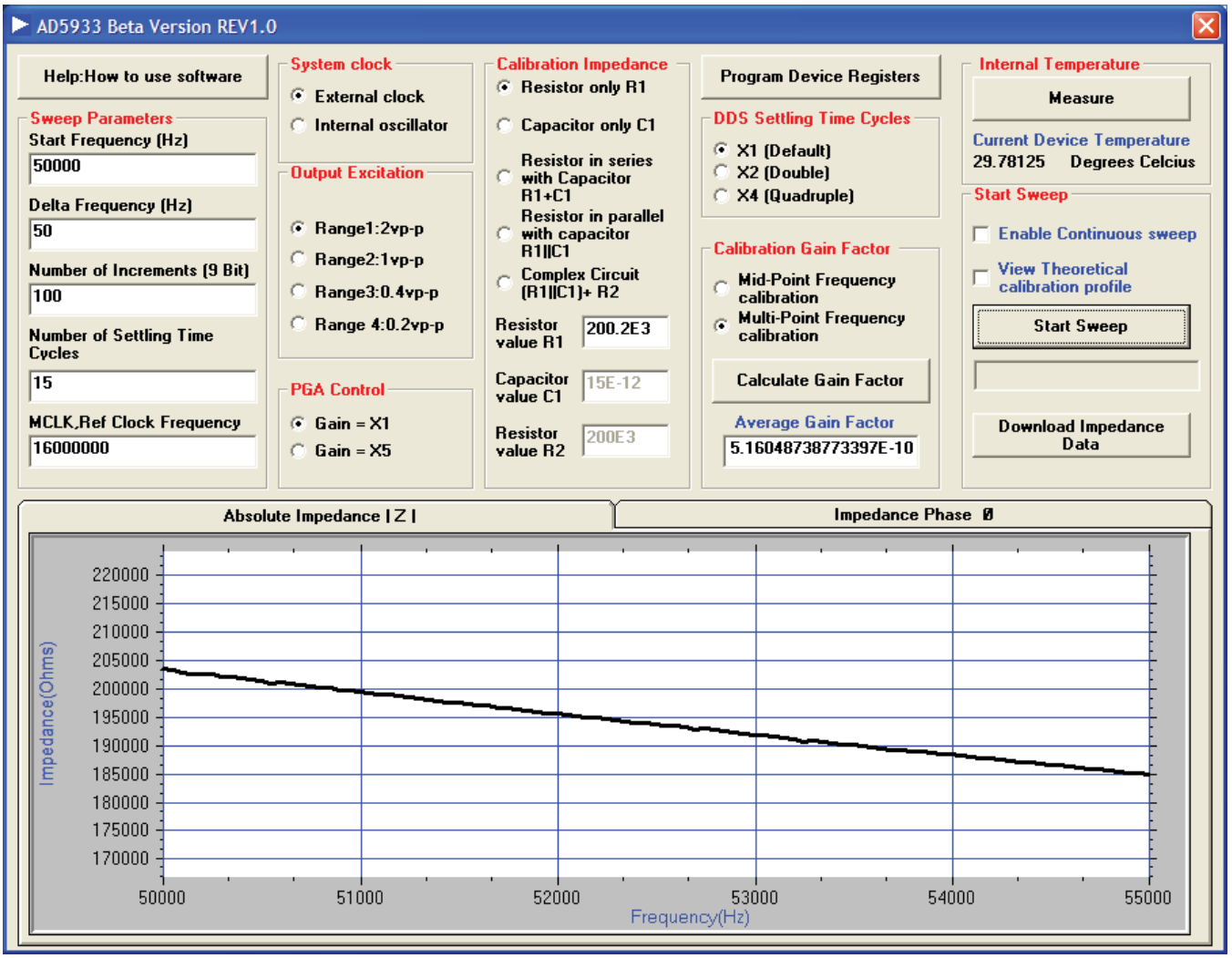


Figure 3. Measuring the Impedance of Capacitor

DOWNLOAD DATA

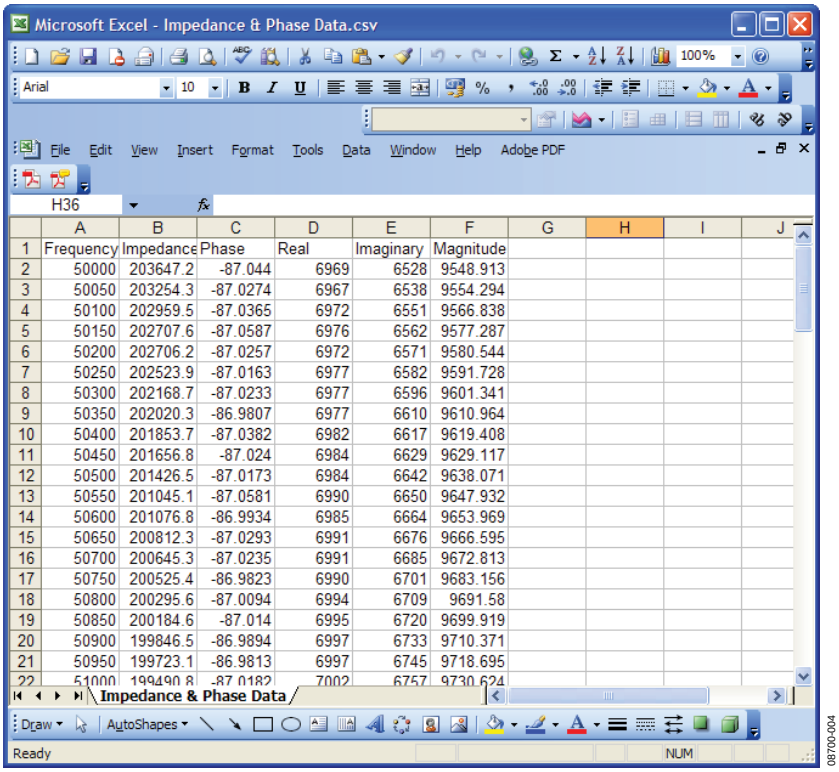
Click **Download Impedance Data** to save the measured impedance data in an excel file.

The following data is downloaded to the excel file:

- Frequency column, excitation frequency (Column A).
- Real data register contents, R (Column D).
- Imaginary data register contents, I (Column E).
- $Magnitude = \sqrt{R^2 + I^2}$ (Column F)
- $Impedance = \frac{1}{Gain\ Factor \times Magnitude}$ (Column B), where *Gain Factor* is calculated in Step 1
- *Phase* (rads) = $A\tan\frac{I}{R}$ or

  Phase (degrees) = *Phase* (rads) $\times \frac{180}{\pi}$ (Column C)

It does not give the phase in this column because the phase in this column is actually equal to (X in degrees) − (calibration phase [or system phase] in degrees). The system phase is calculated when the gain factor is calculated using, for example, the midpoint calibration. The calibration sets up the system phase, and then to determine the phase of the sensor, the system phase is deducted.



	A	B	C	D	E	F
1	Frequency	Impedance	Phase	Real	Imaginary	Magnitude
2	50000	203647.2	-87.044	6969	6528	9548.913
3	50050	203254.3	-87.0274	6967	6538	9554.294
4	50100	202959.5	-87.0365	6972	6551	9566.838
5	50150	202707.6	-87.0587	6976	6562	9577.287
6	50200	202706.2	-87.0257	6972	6571	9580.544
7	50250	202523.9	-87.0163	6977	6582	9591.728
8	50300	202168.7	-87.0233	6977	6596	9601.341
9	50350	202020.3	-86.9807	6977	6610	9610.964
10	50400	201853.7	-87.0382	6982	6617	9619.408
11	50450	201656.8	-87.024	6984	6629	9629.117
12	50500	201426.5	-87.0173	6984	6642	9638.071
13	50550	201045.1	-87.0581	6990	6650	9647.932
14	50600	201076.8	-86.9934	6985	6664	9653.969
15	50650	200812.3	-87.0293	6991	6676	9666.595
16	50700	200645.3	-87.0235	6991	6685	9672.813
17	50750	200525.4	-86.9823	6990	6701	9683.156
18	50800	200295.6	-87.0094	6994	6709	9691.58
19	50850	200184.6	-87.014	6995	6720	9699.919
20	50900	199846.5	-86.9894	6997	6733	9710.371
21	50950	199723.1	-86.9813	6997	6745	9718.695
22	51000	199490.8	-87.0182	7002	6757	9730.624

Figure 4. Downloaded Data

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