AN214828

Power Consumption Measurements

Associated Part Family: CYW43907

This document describes procedures for measuring the current consumption of the Cypress CYW43907 WICED™ IEEE 802.11 b/g/n SoC with Embedded Applications Processor. It is intended for engineers who are designing products that include the CYW43907.

Contents

1 About this Document

1.1 Cypress Part Numbering Scheme

Cypress is converting the acquired IoT part numbers from Broadcom to the Cypress part numbering scheme. Due to this conversion, there is no change in form, fit, or function as a result of offering the device with Cypress part number marking. The table provides Cypress ordering part number that matches an existing IoT part number.

Table 1. Mapping Table for Part Number between Broadcom and Cypress

Broadcom Part Number	Cypress Part Number
BCM43907	CYW43907
BCM43909	CYW43909
BCM943907WCD2_2	CYW943907WCD2_2
BCM943909WCDEVAL_2	CYW943909WCDEVAL_2
BCM943909WCD1	CYW943909WCD1

1.2 Acronyms and Abbreviations

In most cases, acronyms and abbreviations are defined on first use. For a comprehensive list of acronyms and other terms used in Cypress documents, go to:
http://www.cypress.com/glossary

1.3 References

The references in this section may be used in conjunction with this document.

Note: Cypress provides customer access to technical documentation and software through its Cypress Developer Community and Downloads and Support site (see IoT Resources).

For Cypress documents, replace the “xx” in the document number with the largest number available in the repository to ensure that you have the most current version of the document.

	Document (or Item) Name	Broadcom Document Number	Cypress Document Number	Source
[1]	WICED™ IEEE 802.11 b/g/n SoC with Embedded Applications Processor	43907-DS1xx-R	002-14829	Cypress Developer Community
[2]	CYW43909 Programmer’s Guide	43909-PG1xx-R	002-15381	Cypress Developer Community
[3]	WICED™ SDK	Version 3.5.x	-	Cypress Developer Community

2 IoT Resources

Cypress provides a wealth of data at http://www.cypress.com/internet-things-iot to help you to select the right IoT device for your design, and quickly and effectively integrate the device into your design. Cypress provides customer access to a wide range of information, including technical documentation, schematic diagrams, product bill of materials, PCB layout information, and software updates. Customers can acquire technical documentation and software from the Cypress Support Community website (http://community.cypress.com/).

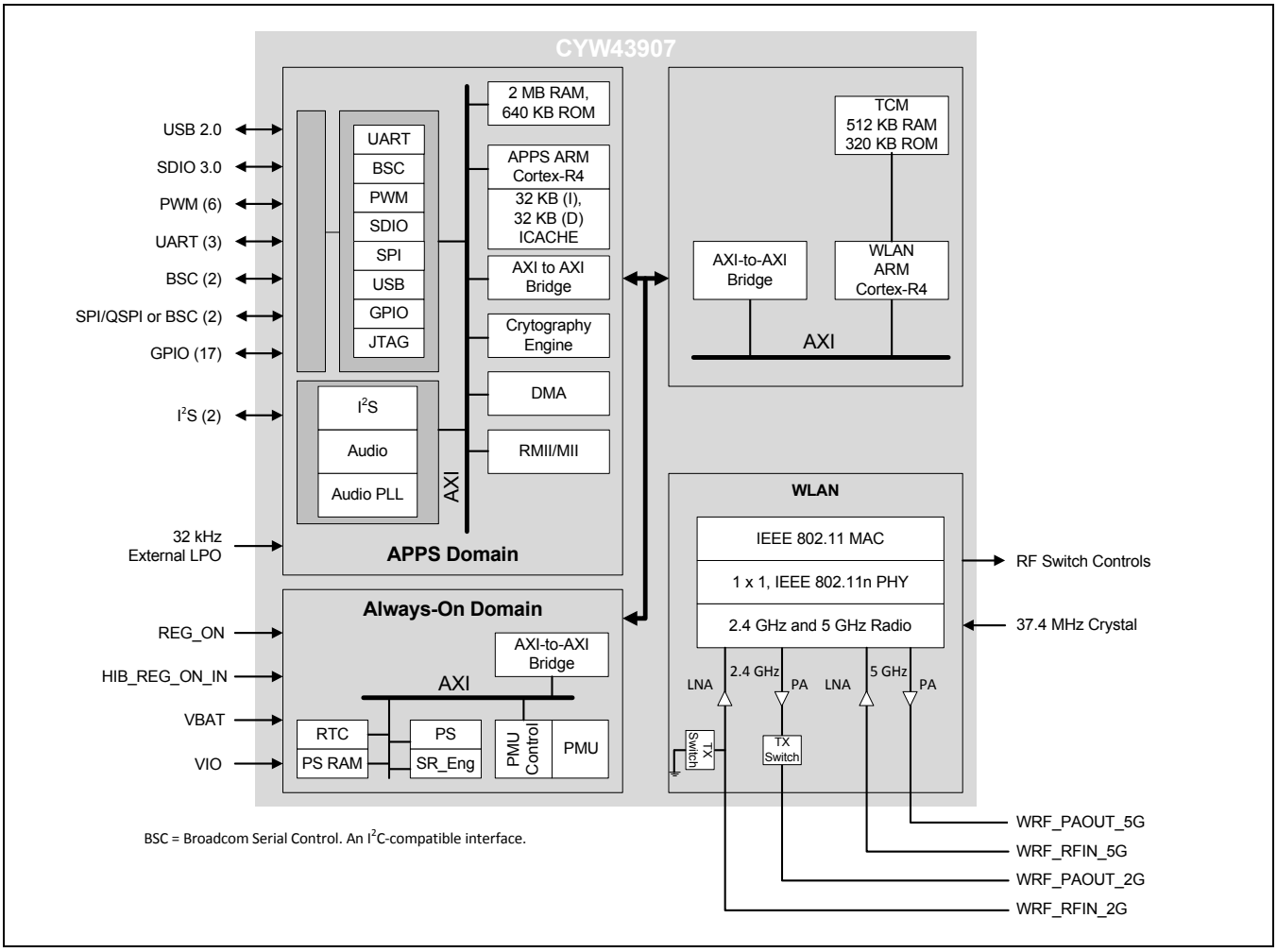
3 Introduction

3.1 CYW43907 Overview

The CYW43907 embedded wireless SoC supports all rates specified in the IEEE 802.11 b/g/n specifications and includes an ARM Cortex-based applications processor, a single-stream IEEE 802.11n MAC/baseband/radio, a dual-band (2.4 GHz/5 GHz) transmit power amplifier (PA), and a receive Low Noise Amplifier (LNA).

Figure 1 shows the interconnections of all the major physical blocks in the CYW43907 and their associated external interfaces.

Figure 1. CYW43907 Functional Block Diagram



The data sheet for the CYW43907 (see Reference [1]) contains detailed information on individual parts inside the chip. In this application note, the following blocks are referenced specifically:

- APPS: Application subsystem
- ACPU: Applications Processor (ARM Cortex-R4)
- WCPU: WLAN CPU (ARM Cortex-R4)
- WLAN PHY: Wireless LAN physical layer
- WLAN (WCPU + WLAN PHY)
- Backplane

3.2 Hardware and Software Requirements

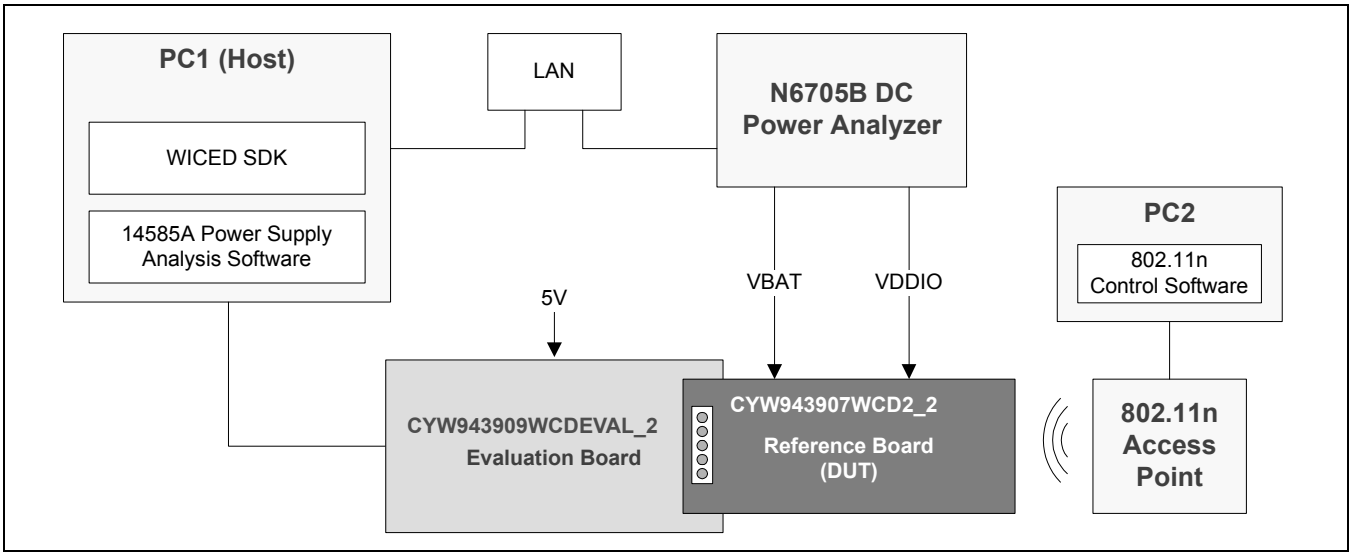
The following items are required to run the current measurement procedures described in this document:

- KeySight (formerly Agilent) N6705B DC Power Analyzer
  - 14585A Control and Analysis Software for the N6705B
- Host PC: Standard Windows PC running Windows 7
- CYW943907WCD2_2 (rev. P214). In the context of this application note, this is the Device Under Test (DUT).
- CYW943909WCDEVAL_2 (rev. P202) evaluation board with power supply and USB cables
- A commercial 802.11n Access Point connected to a PC. The PC is used to configure the Access Point to send UDP packets to the DUT.
- WICED SDK that supports current measurement software (version 3.5.1 and above; consult your Broadcom technical representative for details).
- 5 V power supply
- USB cable

Note: The reference board must be reworked to facilitate current measurements. See Appendix E: “Reference Board Rework,” on page 31 for details.

A block diagram of the hardware setup is shown in Figure 2. The reference board is plugged into the evaluation board and is powered by the N6705B through the VBAT input. The host PC (PC1) runs the WICED SDK and the power supply analysis software that controls N6705B through the LAN connection. The USB cable is used to transfer data between the evaluation board and the host PC. PC2 controls the 802.11n Access Point.

Figure 2. Current Measurement System Block Diagram



3.3 Clocks

The CYW43907 has three base clocks.

- **Idle Low Power (ILP)**: Generated by either a low-power oscillator (LPO) or by dividing the ALP clock frequency by a programmable value. Use of this clock maximizes power savings during idle states.
- **Active Low Power (ALP)**: Supplied by an internal or external oscillator. This clock is requested by cores when accessing backplane registers in other cores or when performing minor computations. When an external crystal is used to provide reference clock, ALP clock frequency is determined by the frequency of the external oscillator. A 37.4 MHz reference clock is recommended.
- **High Throughput (HT)**: Supplied by an on-chip PLL. This clock is requested by cores when they transfer blocks of data to or from memory, perform computation-intensive operations, or need to meet the requirements of external devices. Cores that cannot tolerate operations at less than the HT clock frequency, such as the memory controller, may assert the HT clock request continuously.

The HT clock frequencies for ARM CPU and the backplane can be configured to one of five options as defined in Table 2. ARM CPU current consumption rises in tandem with the operating frequency.

Table 2. ACPU and Backplane HT Clock Frequencies

High Throughput Setting	ARM CPU Frequency (MHz)	Backplane Frequency (MHz)
1	320	160
2	160	160
3	120	120
4	80	80
5	60	60

3.4 Power Profiles

The power profiles defined in this subsection reflect CYW43907 power modes in conjunction with real-world operating parameters.

3.4.1 Sleep Mode, No Association to an Access Point

In this profile the CYW43907 APPS block is in a Power Down mode, the WLAN block is in Deep Sleep mode, the AON block is on, and no association has been established between the CYW43907 and an Access Point.

3.4.2 IEEE Power Save Mode Under DTIM 1

In IEEE Power Save mode under Delivery Traffic Indication Map 1 (DTIM 1), the CYW43907 is associated with an Access Point before the CYW43907 APPS block goes into Power Down mode and the WLAN block goes into Deep Sleep mode. Before going into Deep Sleep mode, the WLAN block saves its state in memory (save-and-restore, or S/R) so that it can resume this state when it returns to Active mode (this feature is supported in the B1 and later versions of the CYW43907; see Appendix F: “Chip Revision Information,” on page 33 for details).

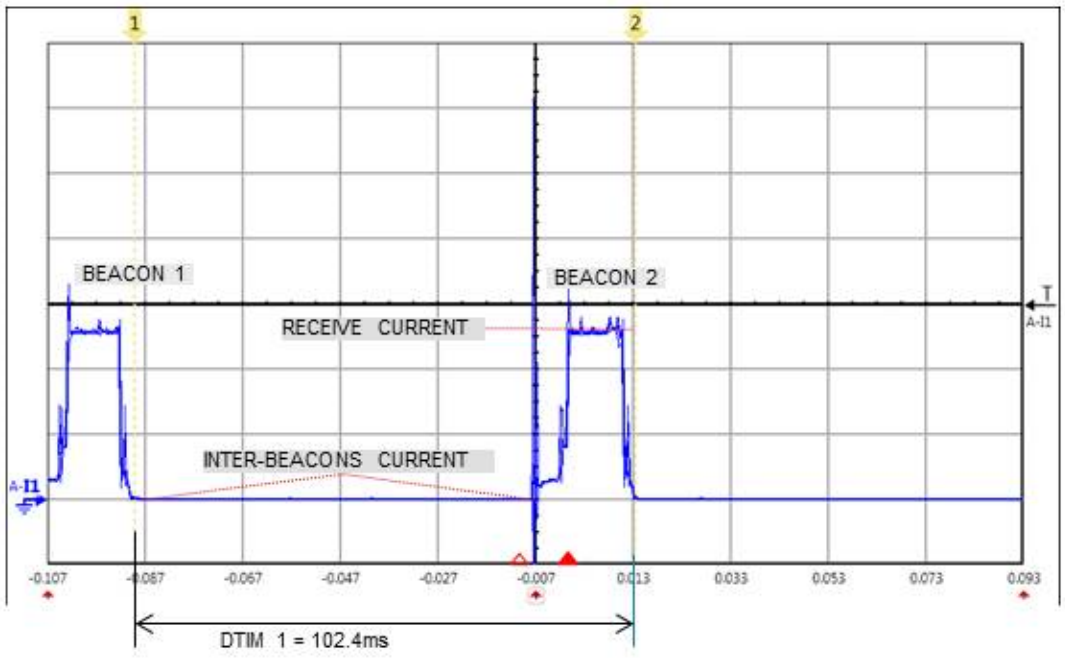
The S/R operation enables the WLAN block to wake up periodically to receive beacon packets from the Access Point. No data is transmitted, and the WLAN block returns to Deep Sleep mode after it receives a beacon packet.

In this operating scenario, the DTIM 1 duration is 102.4 ms (or 100 TU where 1 TU = 1.024 ms; see Figure 3). Three CYW43907 current measurements are taken:

- An average of the current consumed across the entire DTIM 1 interval.
- Current consumed between beacon packets, when the CYW43907 APPS block is in Power Down mode and the WLAN block is in Deep Sleep mode.
- Current consumed when the CYW43907 is receiving a beacon packet.

Note: The amount of time required to receive a beacon packet determines how long the WLAN block has to be active, which affects DTIM 1 current consumption. However, the Access Point can be programmed to shorten the beacon packet reception duration. See Appendix B: “Access Point Configuration,” on page 26 for details

Figure 3. DTIM 1 Current Consumption



3.4.3 IEEE Power Save Mode Under DTIM 3

This is identical to IEEE Power Save mode under DTIM 1 on page 5, except the Access Point is programmed to transmit beacon packets once every 307.2 ms (300 TU) instead of every 102.4 ms (100 TU).

3.4.4 Use Case 1: Waiting for Packets, IEEE Power Save Enabled, WLAN in Deep Sleep

In this scenario, IEEE Power Save mode is enabled, and the WLAN block is in Deep Sleep mode. In this mode the APPS block is in a Wait For Instruction (WFI) state: it does not request any clock signals and there is no clock running on the backplane, but received packets will wake the APPS block and the ARM Cortex-R4. The WLAN block will enter Active mode and request a clock signal from the APPS backplane. The M2M DMA, running autonomously, requests a clock on the APPS backplane.

3.4.5 Use Case 2: Active Waiting for Packets, IEEE Power Save Enabled, WLAN in Deep Sleep

This scenario is identical to Use Case 1, except the APPS block is in Active Low Power mode and the ALP clock is running.

3.4.6 Use Case 3: Low Bit Rate Data Reception

The WLAN block is in Active mode, the APPS block is in Active Low Power mode, and the Access Point is sending UDP packets at up to 2 Mbps.

3.4.7 Ping

The WLAN block is in Active mode, the APPS is in Active Low Power mode, and the WLAN block is sending a ping packets to the associated Access Point at 1-second intervals.

4 Measurement Procedures

4.1 Measurement Overview

This section contains measurement procedures for each power profile discussed in the previous section. The measurements are made on the CYW943907WCD2_2 reference board, which is the Device Under Test (DUT) in this application note. Table 3 contains a summary of the measurement results. Further details on each test are provided in the following subsections.

Table 3. Summary of Current Measurements

Profile	Measurement	I_VBAT (VBAT = 3.6V)	I_VDDIO (VDDIO = 3.3V)
Sleep mode, no association to an Access Point	–	5.6 µA	116 µA
IEEE Power Save mode under DTIM 1 (2.4 GHz)	Current consumed across the DTIM 1 duration	1.4 mA	80 µA
	Current consumed between beacon packet reception events	5.6 µA	113 µA
	Current consumed while receiving a beacon packet	49 mA	49 µA
IEEE Power Save mode under DTIM 3 (2.4 GHz)	Current consumed across the DTIM 3 duration	0.59 mA	104 µA
IEEE Power Save mode under DTIM 1 (5 GHz)	Current consumed across the DTIM 1 duration	1.2 mA	79 µA
	Current consumed between beacon packet reception events	5.6 µA	113 µA
	Current consumed while receiving a beacon packet	59 mA	49 µA
IEEE Power Save mode under DTIM 3 (5 GHz)	Current consumed across the DTIM 3 duration	0.42 mA	125 µA
Use Case 1: Waiting for Packets, IEEE Power Save Mode Enabled, WLAN Block in Deep Sleep	–	5.7 µA	894 µA
Use Case 2: Active Waiting for Packets, IEEE Power Save Enabled, WLAN in Deep Sleep	–	6.6 mA	50 µA
Use Case 3: Low bit rate data reception	–	69 mA	111 µA
Ping	Current consumed during a ping transmission	282 mA	324 µA

4.2 Configuration Prerequisites

The measurement procedures assume that the following have already been done:

- The BCM943909WCD1 PCB has been reworked as described in Appendix E: “Reference Board Rework”
- The hardware setup with the CYW943909WCDEVAL_2 evaluation board has been done as described in Appendix D: “PCB Hardware Setup”.
- The N6705B DC Power Analyzer has been configured as described in Appendix A: “N6705B Configuration”.
- The WICED application for the CYW943907WCD2_2 (the DUT) that corresponds to the test being run has been built and loaded. See Appendix C: “WICED SDK Requirements” for details.

4.3 Sleep Mode, No Association to an Access Point

Note: This procedure requires the WICED DUT application to be built with Test Flag 1 enabled. See Appendix C: “WICED SDK Requirements” for details

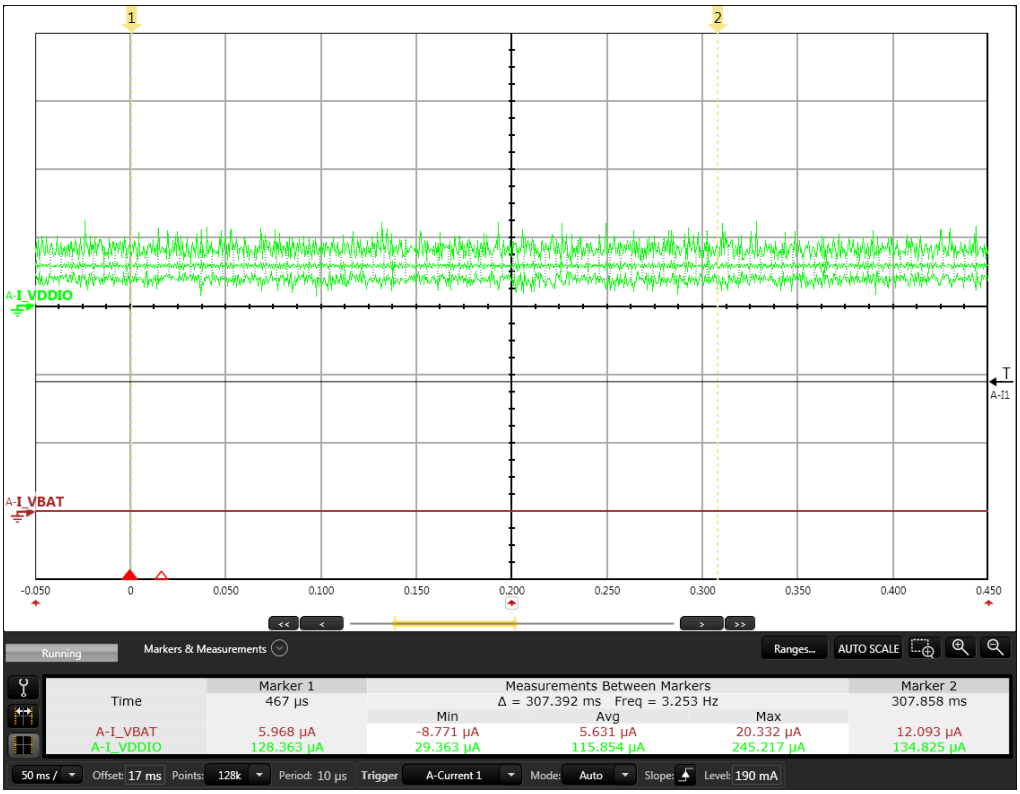
1. Set the Access point for DTIM 1.
2. Disable JTAG by configuring the SW1 switch as follows:
   a. S1 OFF
   b. S2 OFF
   c. S3 **ON**
   d. S4 OFF

   Note: JTAG must be re-enabled each time a new application is downloaded to the CYW43907. To enable JTAG, configure the SW1 switch on the CYW943907WCD2_2 board as shown below:

   - S1 and S2 = ON
   - S3 and S4 = OFF

3. Cycle power on the CYW943907WCD2_2 (this can be done from the N6705B).
4. Cycle power on the CYW943909WCDEVAL_2 by removing and reconnecting the 5V supply and the USB cables.
5. Measure the current from the VBAT and VDDIO power supplies. I_VBAT should be 5.6 µA and I_VDDIO should be 116 µA (see Figure 4).

Figure 4. Current—Sleep Mode, No association to an Access Point



4.4 IEEE Power Save mode Under DTIM 1 (2.4 GHz)

Note: This procedure requires the WICED DUT application to be built with Test Flag 2 enabled. See Appendix C: “WICED SDK Requirements” for details

1. Set the Access Point for DTIM 1.
2. Disable JTAG by configuring the SW1 switch as follows:
   a. S1 OFF
   b. S2 OFF
   c. S3 **ON**
   d. S4 OFF

   Note: JTAG must be re-enabled each time a new application is downloaded to the CYW43907. To enable JTAG, configure the SW1 switch on the CYW943907WCD2_2 board as shown below:

   - S1 and S2 = ON
   - S3 and S4 = OFF

3. Cycle power on the CYW943907WCD2_2 (this can be done from the N6705B).
4. Cycle power on the CYW943909WCDEVAL_2 by removing and reconnecting the 5 V supply and the USB cables.
5. Measure current consumed during the DTIM 1 duration, current consumed between beacon packets, and current consumed while a beacon packet is being received. The results are shown Table 4 and in Figure 5, Figure 6, and Figure 7.

Table 4. Current—DTIM 1, Between Beacons, and While Receiving Beacons (2.4 GHz)

Measurement	I_VBAT (Average)	I_VDDIO (Average)
Current consumed across the DTIM 1 duration	1.4 mA	80 µA
Current consumed between beacon packet reception events	5.6 µA	113 µA
Current consumed while receiving a beacon packet	49 mA	49 µA

Figure 5. Current Consumed Across the DTIM 1 Duration @ 2.4 GHz

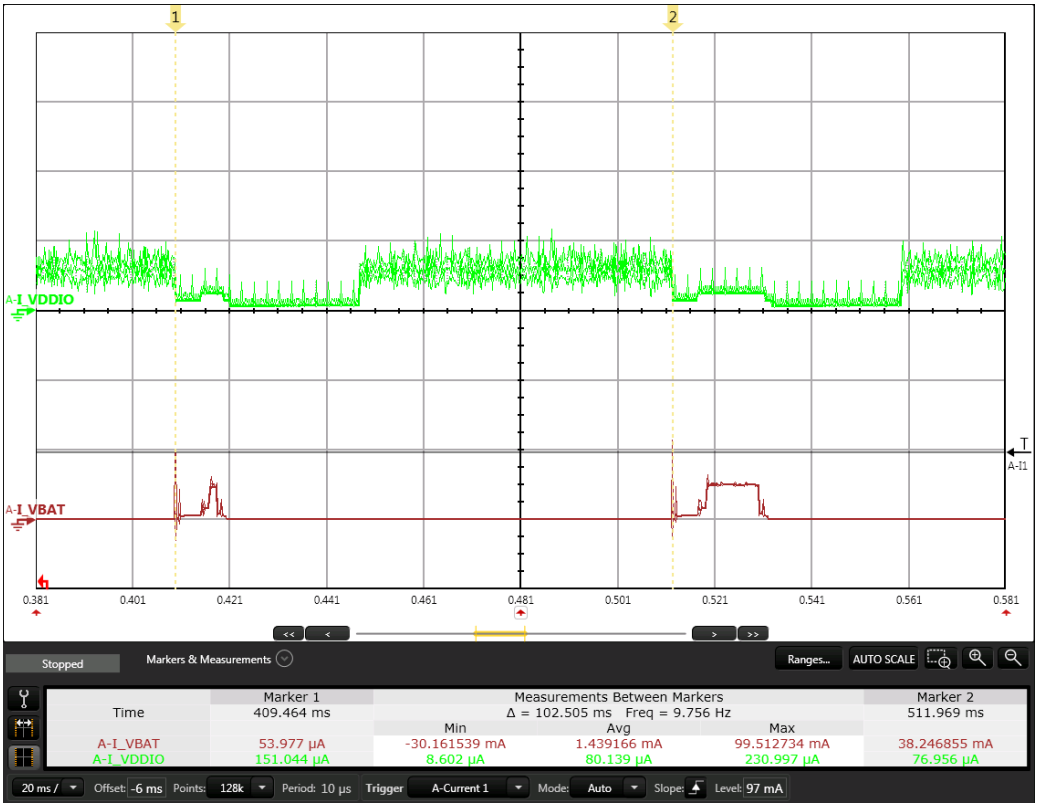


Figure 6. Current Consumed Between Beacon Packets, DTIM 1 @ 2.4 GHz

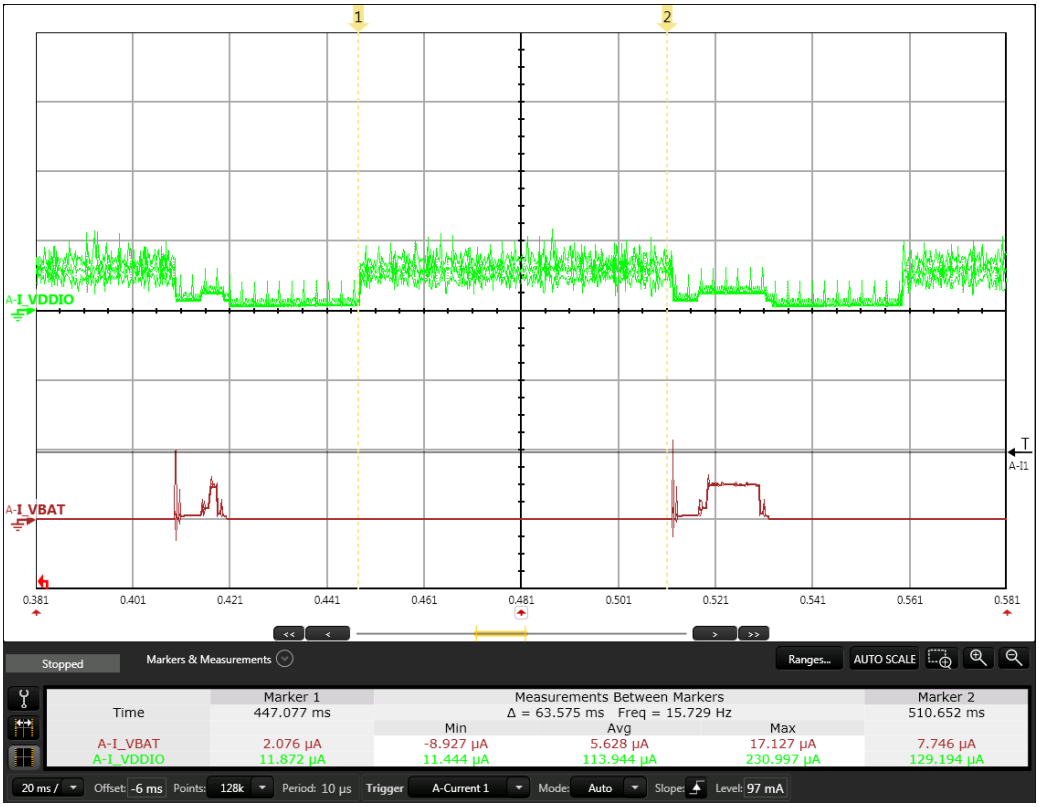
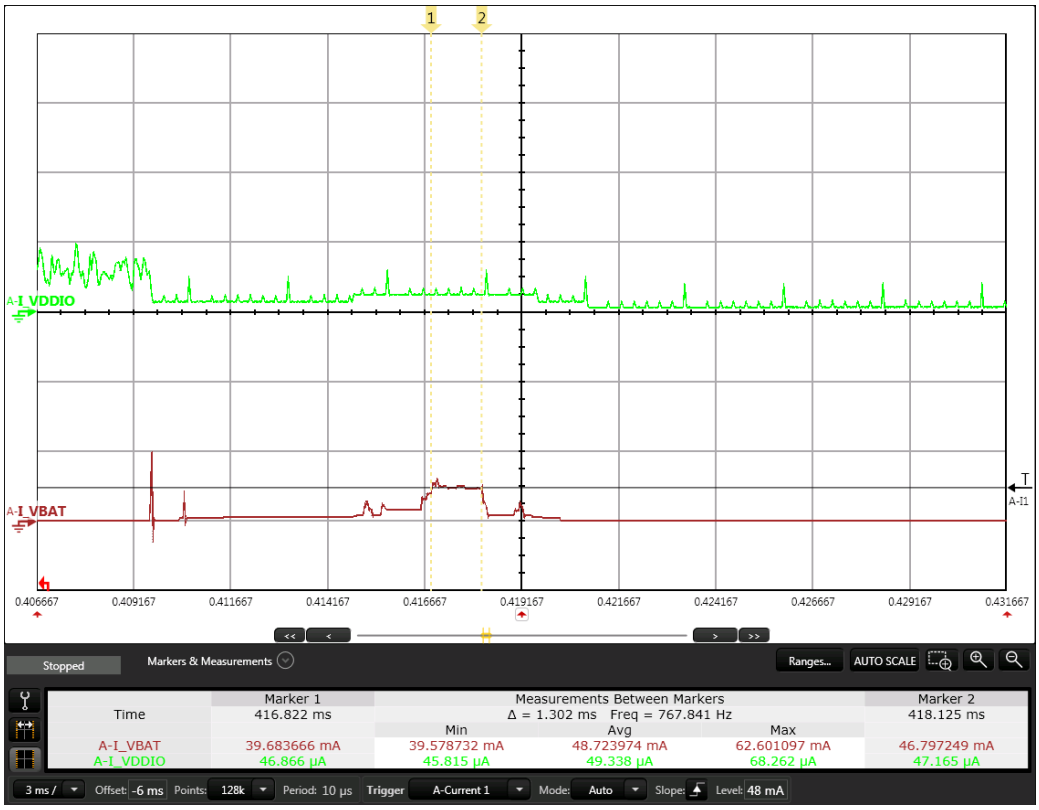


Figure 7. Current While Receiving Beacon Packets, DTIM 1 @ 2.4 GHz



4.5 IEEE Power Save Mode Under DTIM 3 (2.4 GHz)

Note: This procedure requires the WICED DUT application to be built with Test Flag 2 enabled. See Appendix C: “WICED SDK Requirements” for details

1. Set the Access Point for DTIM 3.
2. Disable JTAG by configuring the SW1 switch as follows:
   a. S1 OFF
   b. S2 OFF
   c. S3 **ON**
   d. S4 OFF
3. Cycle power on the CYW943907WCD2_2 (this can be done from the N6705B).
4. Measure the current from the VBAT and VDDIO power supplies. I_VBAT should be 0.59 mA and I_VDDIO should be 104 µA (see Figure 8).

Figure 8. Current Consumed Across the DTIM 3 Duration @ 2.4 GHz

4.6 IEEE Power Save Mode Under DTIM 1 (5 GHz)

Note: This procedure requires the WICED DUT application to be built with Test Flag 2 enabled. See Appendix C: “WICED SDK Requirements” for details

1. Set the Access Point for DTIM 1.
2. Disable JTAG by configuring the SW1 switch as follows:
   a. S1 OFF
   b. S2 OFF
   c. S3 **ON**
   d. S4 OFF
3. Cycle power on the CYW943909WCD1 (this can be done from the N6705B).
4. Measure current consumed during the DTIM 1 duration, current consumed between beacon packets, and current consumed while a beacon packet is being received. The results are shown Table 5 and in Figure 9, Figure 10, and Figure 11.

Table 5. Current—DTIM 1, Between Beacons, and While Receiving Beacons (5 GHz)

Measurement	I_VBAT (Average)	I_VDDIO (Average)
Current consumed across the DTIM 1 duration	1.2 mA	79 µA
Current consumed between beacon packets	5.6 µA	113 µA
Current consumed while receiving a beacon packet	59 mA	49 µA

Figure 9. Current Consumed Across the DTIM 1 Duration @ 5 GHz

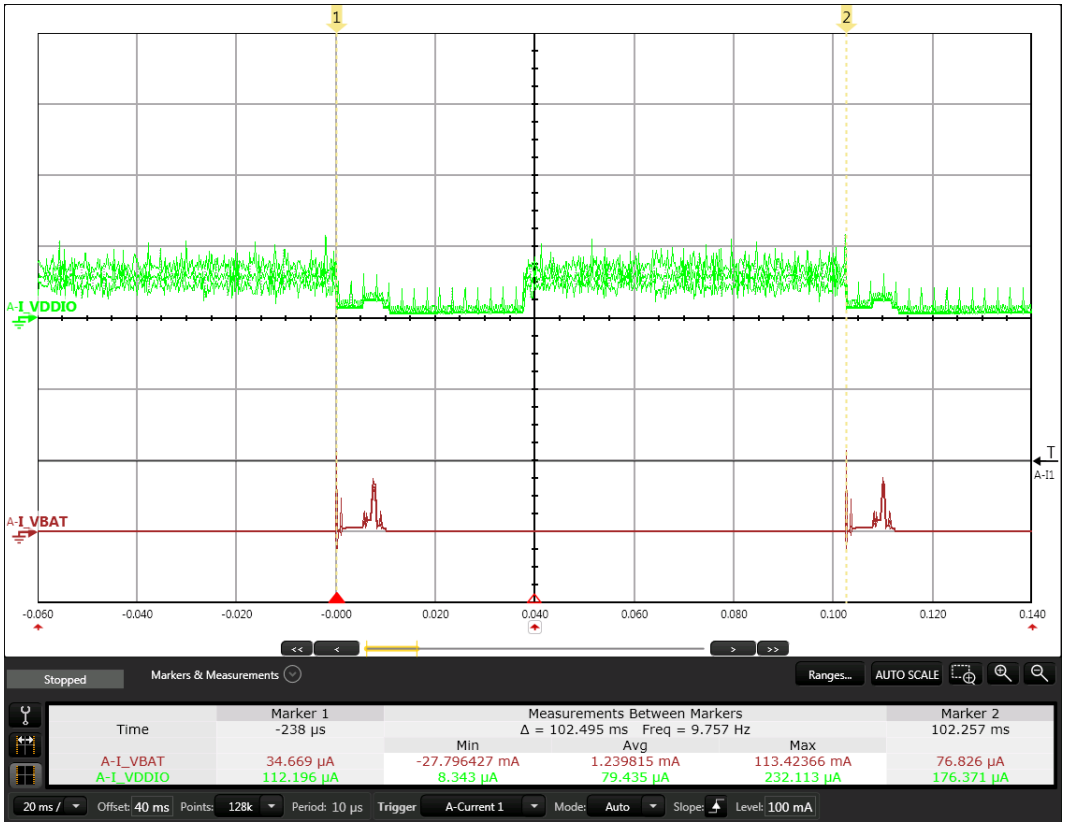


Figure 10. Current Consumed Between Beacon Packets, DTIM 1 @ 5 GHz

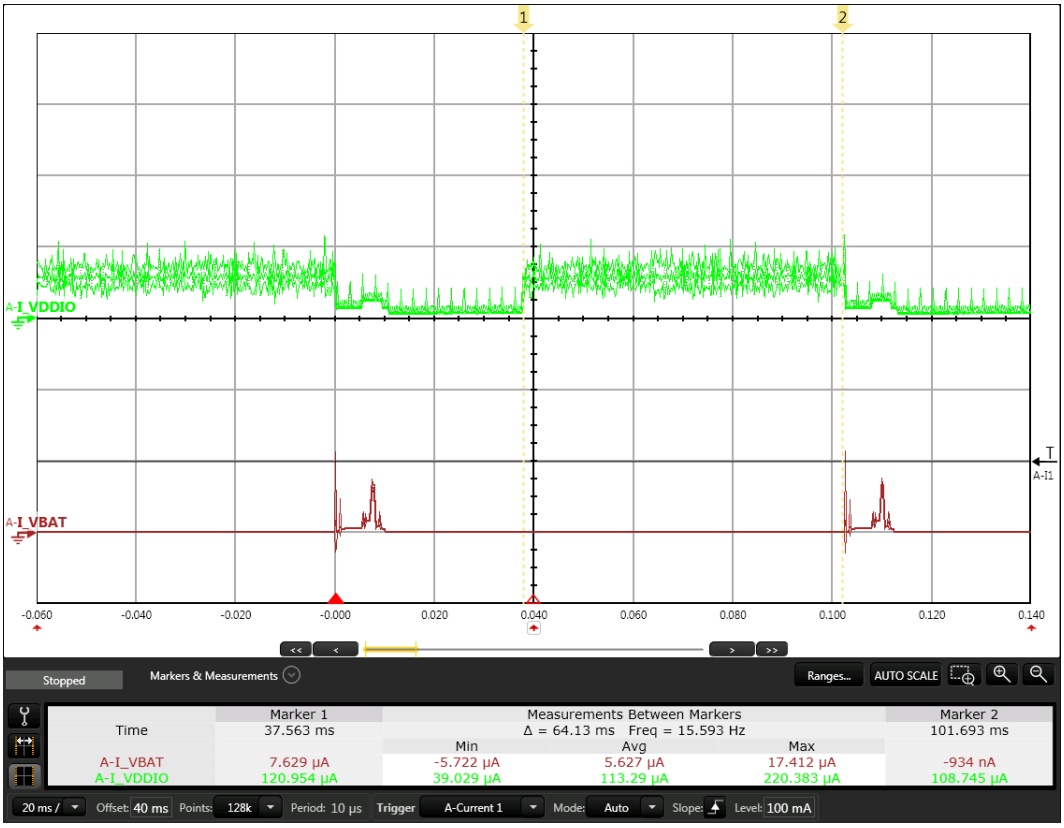
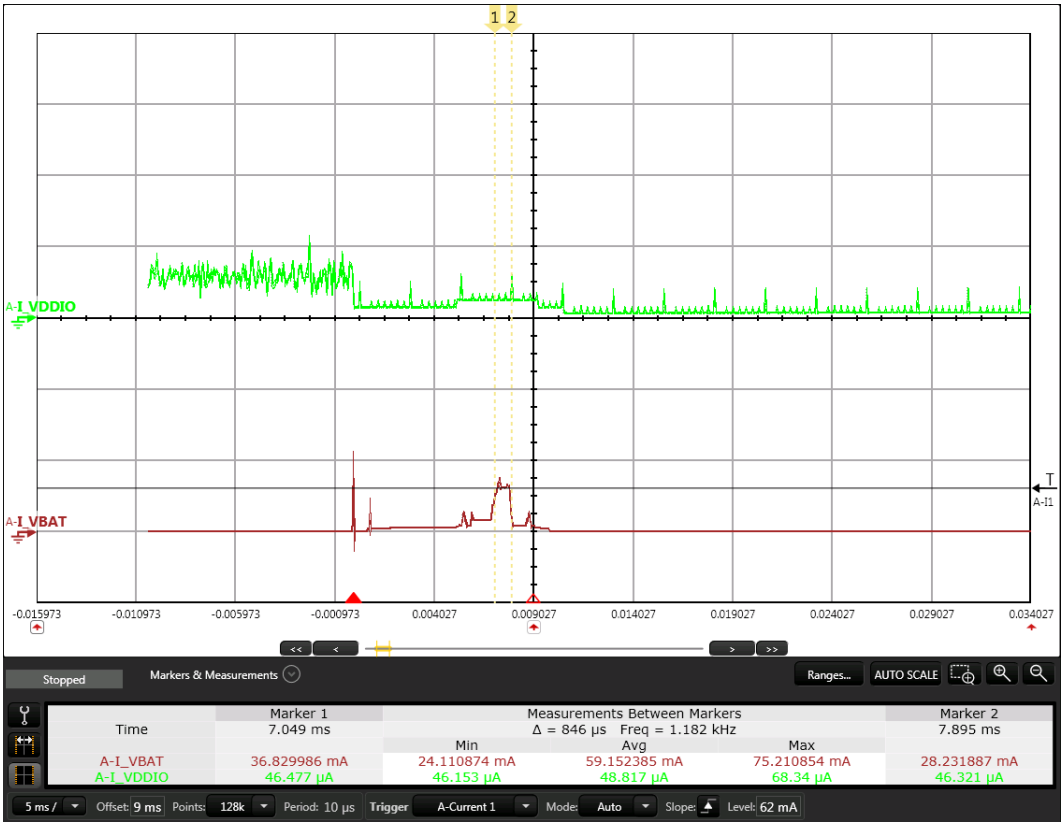


Figure 11. Current Consumed While Receiving Beacon Packets, DTIM 1 @ 5 GHz

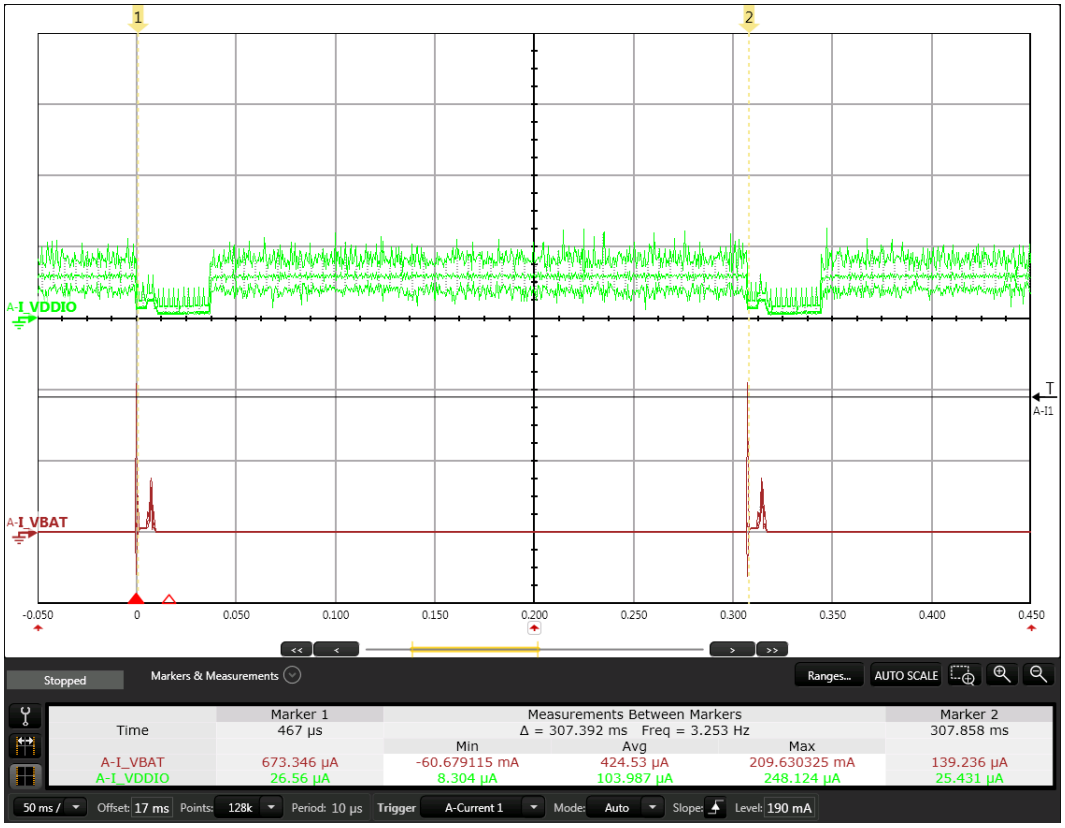


4.7 IEEE Power Save Mode Under DTIM 3 (5 GHz)

Note: This procedure requires the WICED DUT application to be built with Test Flag 2 enabled. See Appendix C: “WICED SDK Requirements” for details

1. Set the Access Point for DTIM 3.
2. Disable JTAG by configuring the SW1 switch as follows:
   a. S1 OFF
   b. S2 OFF
   c. S3 **ON**
   d. S4 OFF
3. Cycle power on the CYW943909WCD1 (this can be done from the N6705B).
4. Measure the current from the VBAT and VDDIO power supplies. I_VBAT should be 0.42 mA and I_VDDIO should be 104 µA (see Figure 12).

Figure 12. Current Consumed Across the DTIM 3 Duration @ 5 GHz



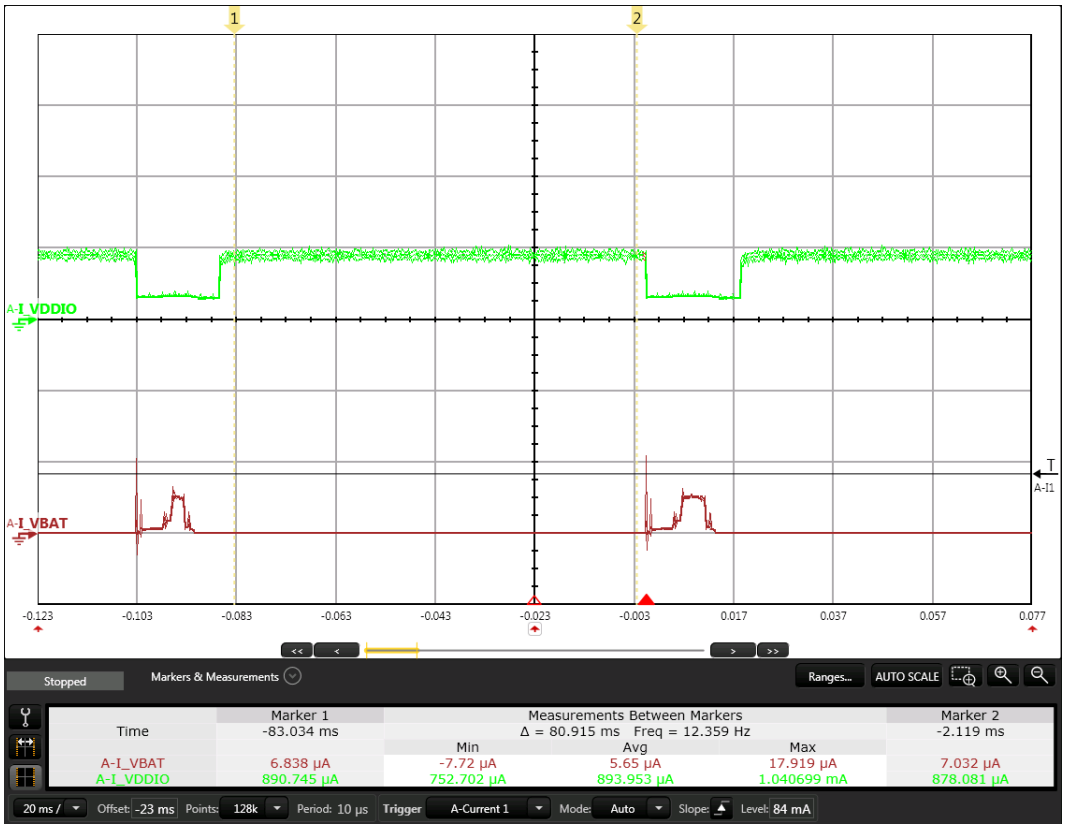
4.8 Use Case 1: Waiting for Packets, IEEE Power Save Enabled, WLAN in Deep Sleep

Note: IEEE Power Save mode is enabled for this procedure.

Note: This procedure requires the WICED DUT application to be built with Test Flag 3 enabled. See Appendix C: “WICED SDK Requirements” for details.

1. Cycle power on the CYW943907WCD2_2 (this can be done from the N6705B).
2. Measure the current from the VBAT and VDDIO power supplies when no packets are being received. I_VBAT should be 5.7 µA and I_VDDIO should be 894 µA (see Figure 13).

Figure 13. Current—Waiting for Packets (IEEE Power Save Mode Enabled, WLAN = Deep Sleep)



4.9 Use Case 2: Active Waiting for Packets, IEEE Power Save Enabled, WLAN in Deep Sleep

Note: IEEE Power Save mode is enabled for this procedure.

Note: This procedure requires the WICED DUT application to be built with Test Flag 4 enabled. See Appendix C: “WICED SDK Requirements” for details.

1. Cycle power on the BCM943909WCD1 (this can be done from the N6705B).
2. Measure the current from the VBAT and VDDIO power supplies when no packets are being received. I_VBAT should be 6.6 µA and I_VDDIO should be 50 µA (see Figure 14).

Figure 14. Current—Active Waiting for Packets (IEEE Power Save Mode Enabled, WLAN = Deep Sleep)

4.10 Use Case 3: Low Bit Rate Data Reception

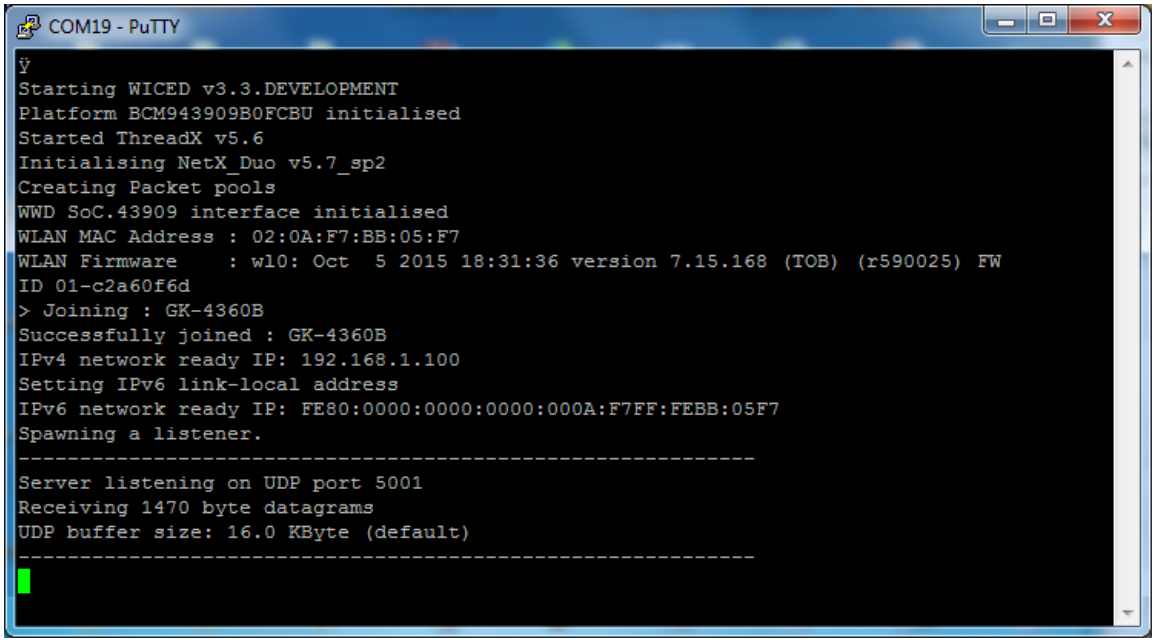
The bit rate is controlled by the Access Point. Broadcom engineers recommend a bit rate of 0.5 Mbps for this test. This can be done through the *Iperf* test utility by defining the `-b BITRATE` option in the command line. In the example below, 1 Mbps is selected:

```
iperf -c serveraddress -u -b 500k
```

See Appendix B: “Access Point Configuration” for more details on Access Point Configuration.

Note: This procedure requires the WICED DUT application to be built with Test Flag 5 enabled. See Appendix C: “WICED SDK Requirements” for details.

1. Cycle power on the BCM943909WCD1 (this can be done from the N6705B).
2. Open the appropriate COM port on the host PC.



3. The DUT should now be ready to receive data packets from the Access Point.
4. Enter the following command to send UDP packets from the Access Point to the DUT using the IP address (192.168.1.100):

   ```
   iperf -c 192.168.1.100 -u -i1 -b500k
   ```

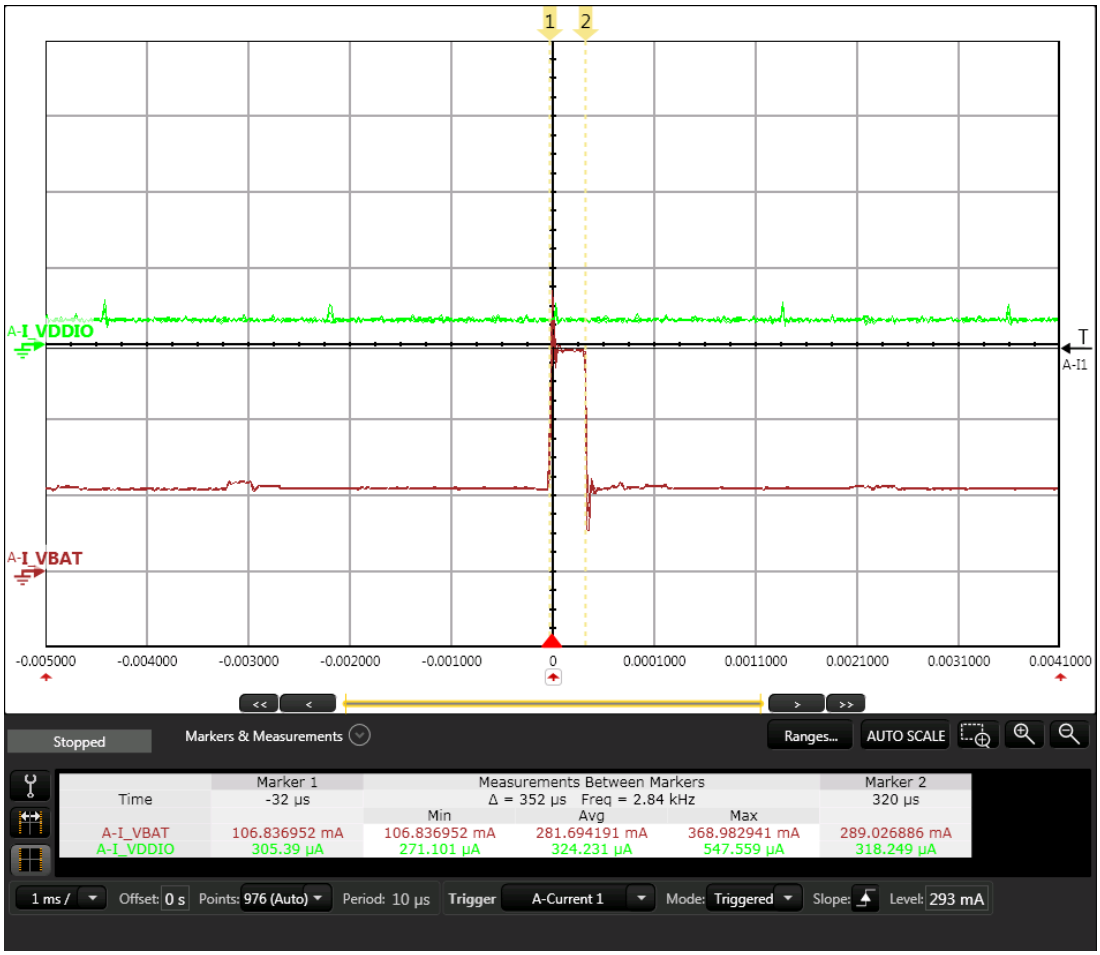
5. Measure the current from the VBAT and VDDIO power supplies. I_VBAT should be 69 mA and I_VDDIO should be 111 µA.

4.11 Ping

This test measures current consumption when the DUT is sending a ping packet to the associated Access Point.

1. Build and download the snip.ping_powersave-BCM943909WCD1_3 download run application (see Appendix C: “WICED SDK Requirements”).
2. Open the appropriate COM port on the host PC.
3. Cycle power on the DUT, then check the COM port terminal window on the host PC to confirm that the DUT is sending ping messages to the Access Point.
4. Measure current during the packet transmission as shown below. I_VBAT should be 282 mA and I_VDDIO should be 324 µA (see Figure 15).

Figure 15. Current Consumed While Sending Ping Packets



Appendix A: N6705B Configuration

A.1. N6705B Overview

The N6705B DC power analyzer is used to measure current consumption. It has two embedded DC supply modules. In the context of this application note, Module 1 (N6782A) is connected to the VBAT input on the DUT (that is, the CYW943907WCD2_2), and Module 2 (N6784A) is connected to the VDDIO input on the DUT.

Figure 16. N6705B DC Power Analyzer

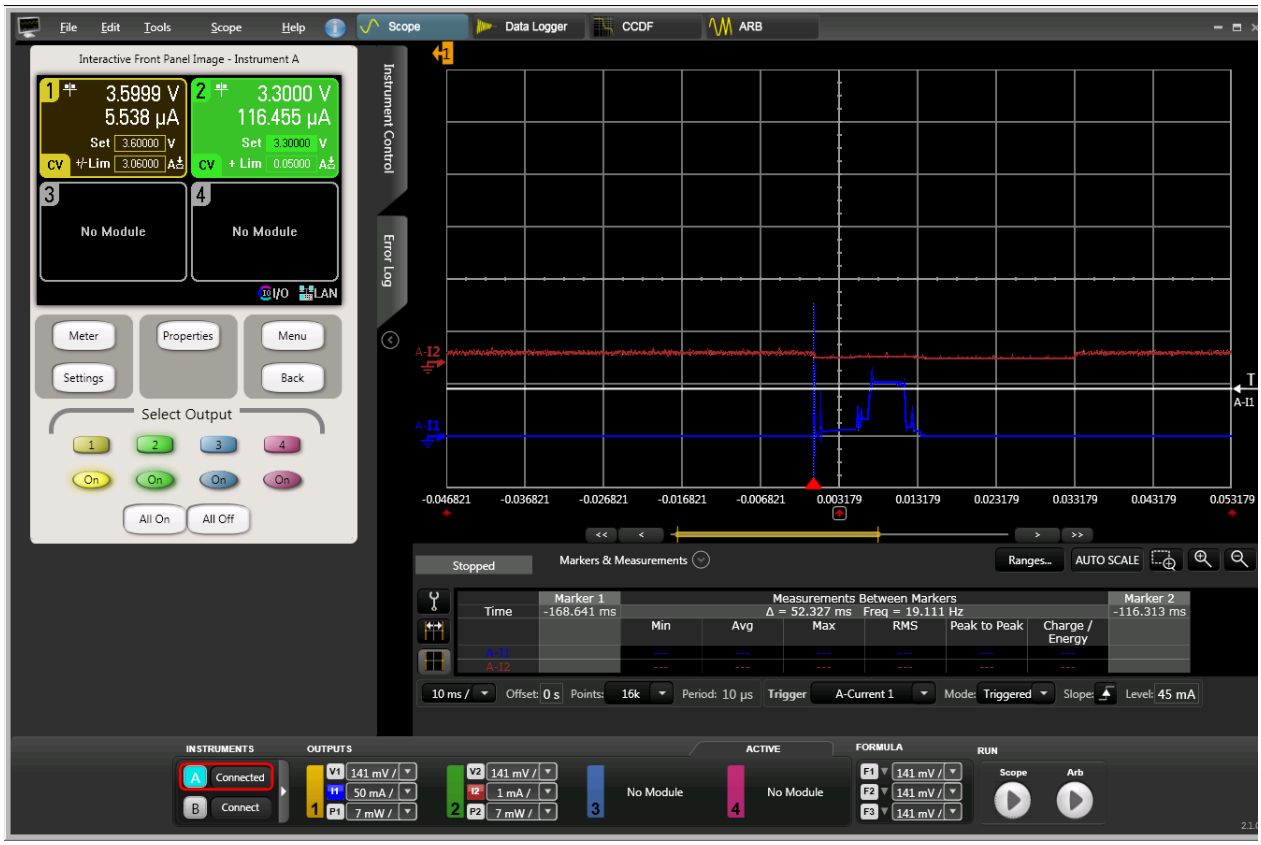
A.2. 14585A Control and Analysis Software

The N6705B is controlled through the 14585A control and analysis software running on the PC. The user interface is shown in Figure 17. 14585A software is used to set plotting parameters and to configure of the embedded power supply modules in the N6705B.

Measurement accuracy is function of current range settings. To configure the current range, open the **Scope** menu, select **Measurement Ranges**, and set the following current range parameters:

- 3A range = 0.03% + 250 µA
- 100 mA range = 0.025% + 10 µA
- 1 mA range = 0.025% + 100 nA
- 10 µA range = 0.025% + 8 nA

Figure 17. 14585A Control and Analysis Software



Note: Cypress engineers recommend that N6705B accuracy be verified by measuring a known voltage across a known resistance value (for example 3.3 V across a 470 kΩ resistor).

A.3. Configuring the Power Supply Modules

Broadcom engineers recommend that the auto-ranging feature on the N6705B be enabled for the two power supplies used in the hardware setup. This feature is mandatory for the module connected to the VBAT supply on the CYW943907WCD2_2 (Module 1 in the context of this application note) because it varies over a large range, from hundreds of milliamps down to a few microamps.

Note: Auto-ranging should also be enabled for Module 2 (VDDIO) if it is available. If auto-ranging is not available for Module 2, manually change the settings to the lowest possible range for a given measurement.

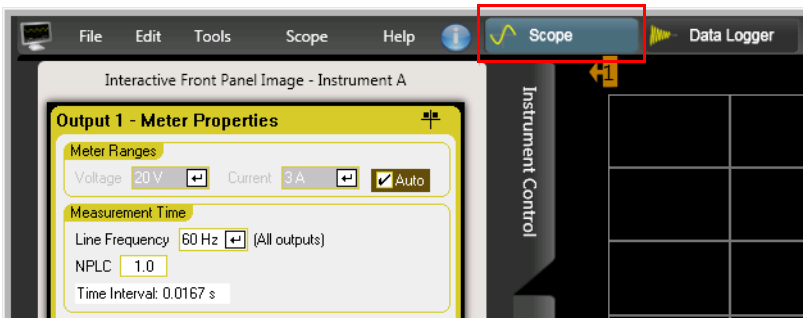
Follow the steps below to enable auto-ranging on Module 1.

1. In the **Interactive Front Panel Image - Instrument A** control panel, click **1** (Module 1), then click the **Properties** button. The **Output 1 - Meter Properties** control panel will open.

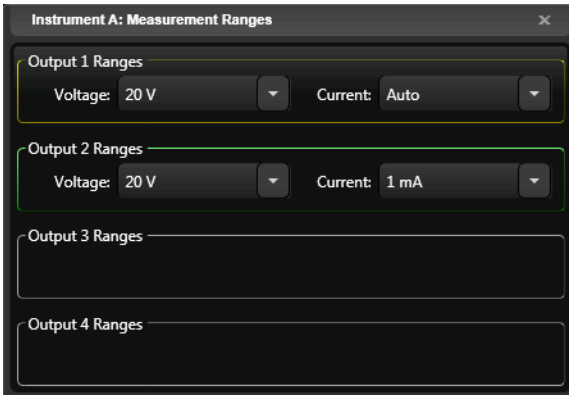
2. In the **Output 1 - Meter Properties** control panel:
   a. Set the voltage as required for the test being run.
   b. Set the current as required for the test being run.
   c. Select the **Auto** option to enable auto-ranging.
   d. Click the **Close** button.

3. Repeat Step 1 and Step 2 for Module 2. If auto-ranging is not available, select the lowest possible setting for the given test to get the best accuracy (for example, a limit of 1 mA should be set for DTIM tests).

4. The Module 1 and Module 2 settings must be duplicated in the 14584A “Soft Scope” in order for the current consumption calculations to be done correctly.
   a. Click the **Scope** button, then select **Measurement Ranges**. The **Measurement Ranges** window will open.



   b. In the **Measurement Ranges** window, duplicate the settings chosen for Module 1 and Module 2. An example is shown below



Appendix B: Access Point Configuration

B.1. Access Point Overview

Any commercially available Access Point may be used for doing the current measurements. The following subsections define information that is relevant for the tests described in this application note.

B.1.1. DTIM Period

The Delivery Traffic Indication Map (DTIM) period is a parameter associated with an infrastructure network, and is advertised in an Access Point beacon frame. All beacon frames include a Traffic Indication Map (TIM) which indicates to the infrastructure stations (STAs) that buffered frames are available. Unicast frames buffered for individual stations are delivered in response to a query from the station. However, this polled approach is not suitable for multicast and broadcast frames because it takes too much capacity to transmit multicast and broadcast frames multiple times. Instead of the polled approach, broadcast and multicast frames are delivered after every DTIM interval.

Increasing the DTIM duration allows stations to conserve power, but at the cost of buffer space in the Access Point and delays in reception of multicast and broadcast frames by all stations, including stations in active mode.

The default DTIM beacon interval for most Access Points is either DTIM = 1 or DTIM = 3. In the case of DTIM = 3, the station need only wake from low power mode to receive every third beacon and any ensuing queued broadcast or multicast traffic.

B.1.2. Beacon Packet Size

The access beacon size must be ≤101 bytes to get low current consumption numbers. This may be achieved by:

- Disabling WMM
- Disabling Wi-Fi Protected Setup (WPS)
- Reducing the country information. A beacon packet contains 6 bytes of information on the country in which the given Access Point is operating (this option may not be supported in some Access Points).
- Changing to 802.11b mode only (that is, rate 1) when operating at 2.4 GHz. For 5 GHz operation, the data rate can be 6 Mbps.

B.1.3. Band Setting

When testing 2.4 GHz or 5 GHz, ensure that the Access Point is set to the appropriate band.

Appendix C: WICED SDK Requirements

C.1. WLAN Firmware

WLAN firmware that supports the “save-and-restore” feature is required. Version 3.5.1 of the WICED SDK is the first release that supports this feature. The firmware is located in the following directory:

resources/firmware/43909B0.bin

This file must be named *43909B0.bin* in order for the DUT application to function correctly.

C.2. NVRAM

The WLAN NVRAM file is located in the following directory:

platforms\BCM943909WCD1_3\B1\wifi_nvram_image.h

This file must be named *wifi_nvram_image.h* in order for the DUT application to function correctly. In addition, this file must be edited to disable antenna diversity. Leaving antenna diversity enabled affects the accuracy of the CYW43907 current measurements.

To disable antenna diversity, change `swdiv_en=1` to `swdiv_en=0`.

C.3. Updating Access Point information

Go to apps/test/powersave.c directory and enter the following line to update the Access Point Service Set Identifier (SSID):

```
* #define POWERSAVE_JOIN_COMMAND    "join test123 open PASSWORD 192.168.1.100
192.168.1.255 192.168.1.1"
 *
```

C.4. Test Flags in powersave.c

The test flags in apps/test/powersave.c are defined in Table 6. Only one test flag is set to 1 at any time; all others are cleared. Different tests require different test flags to be enabled.

Table 6. List of Test Flags in apps/test/powersave.c

Test Flag No.	Test Flag Name	Value
1	`#define POWERSAVE_STANDALONE_TEST_DEEPSLEEP_NO_ASSOC`	0 or 1
2	`#define POWERSAVE_STANDALONE_TEST_DEEPSLEEP_ASSOC`	0 or 1
3	`#define POWERSAVE_STANDALONE_TEST_WAIT_FOR_WLAN`	0 or 1
4	`#define POWERSAVE_STANDALONE_TEST_ACTIVE_WAIT_FOR_WLAN`	0 or 1
5	`#define POWERSAVE_STANDALONE_TEST_LOW_POWER_NETWORKING`	0 or 1
6	`#define POWERSAVE_STANDALONE_TEST_WAKEUP_FROM_DEEP_SLEEP_PROFILE`	0 or 1

A separate instance of the DUT application must be created for each test flag being used. For example, when building an application to support a power profile in which the CYW943907WCD2_2 is in a deep sleep state and is not associated with an Access point, the following test flag configuration would be used:

```
#define POWERSAVE_STANDALONE_TEST_DEEPSLEEP_NO_ASSOC              1
#define POWERSAVE_STANDALONE_TEST_DEEPSLEEP_ASSOC                 0
#define POWERSAVE_STANDALONE_TEST_WAIT_FOR_WLAN                   0
#define POWERSAVE_STANDALONE_TEST_ACTIVE_WAIT_FOR_WLAN            0
#define POWERSAVE_STANDALONE_TEST_LOW_POWER_NETWORKING            0
#define POWERSAVE_STANDALONE_TEST_WAKEUP_FROM_DEEP_SLEEP_PROFILE  0
```

C.5. Building and Downloading an Application

After updating the test flags in powersave.c, build the application as shown in Figure 18 using the following make target:

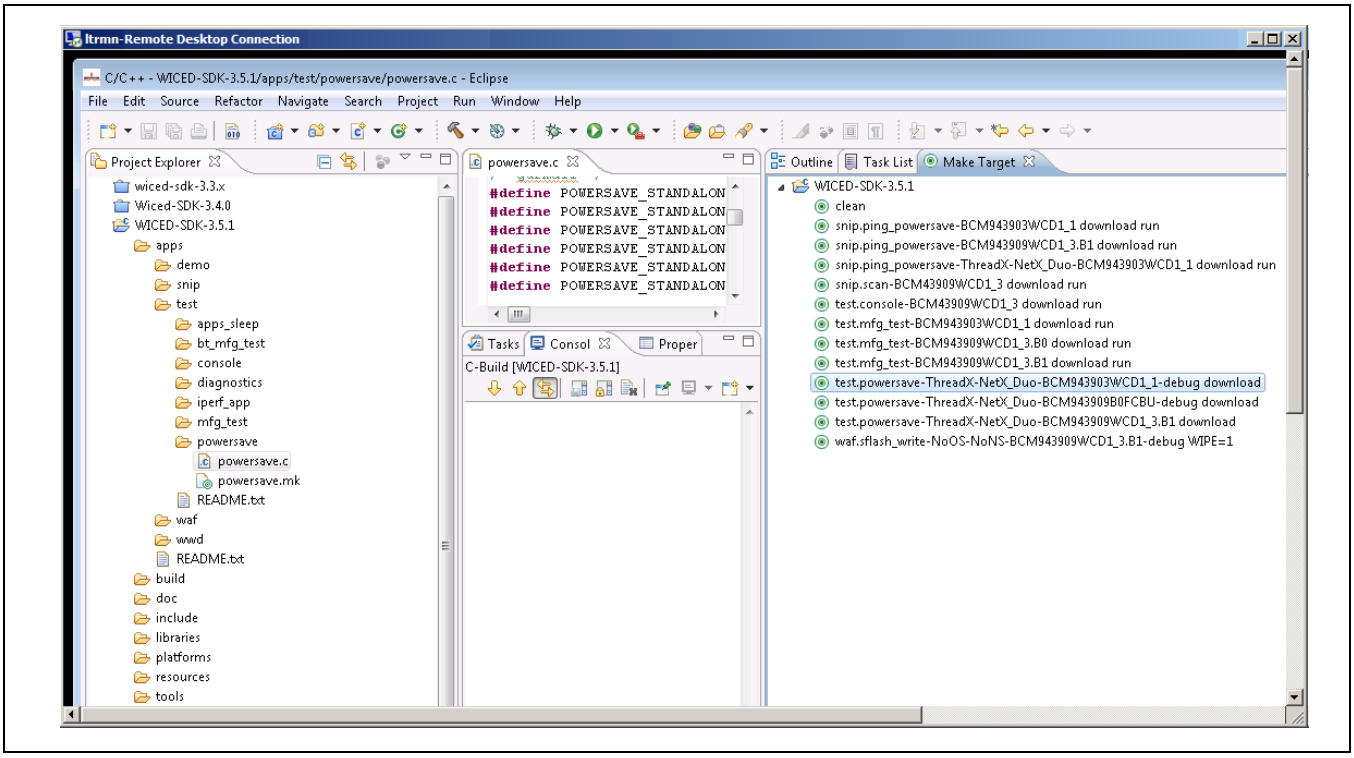
test.powersave-ThreadX-NetX_Duo-BCM943909WCD1_3.B1 download

JTAG must be enabled in order to download the application. To enable JTAG, configure the SW1 switch as follows:

- S1 = ON
- S2 = ON
- S3 = OFF
- S4 = OFF

Cycle power on the CYW943907WCD2_2 after downloading the application.

Figure 18. Building and Downloading a Test Application



C.6. Ping Mode Application

The WICED SDK includes the following application to measure current when the CYW43907 is sending a ping to the associated Access Point:

snip.ping_powersave-BCM943903WCD1_1 download run

In order for the ping application to work properly, some lines in a Wi-Fi configuration file must be edited:

Wiced-SDK/include/default_wifi_config_dct.h

The specific lines that must be edited are:

```
#define CLIENT_AP_SSID       "YOUR_AP_SSID"
#define CLIENT_AP_PASSPHRASE "YOUR_AP_PASSPHRASE"
#define CLIENT_AP_SECURITY   WICED_SECURITY_WPA2_MIXED_PSK
```

The edits are shown below in bold:

```
#define CLIENT_AP_SSID       "test123"
 #define CLIENT_AP_PASSPHRASE ""
 #define CLIENT_AP_SECURITY   WICED_SECURITY_OPEN
```

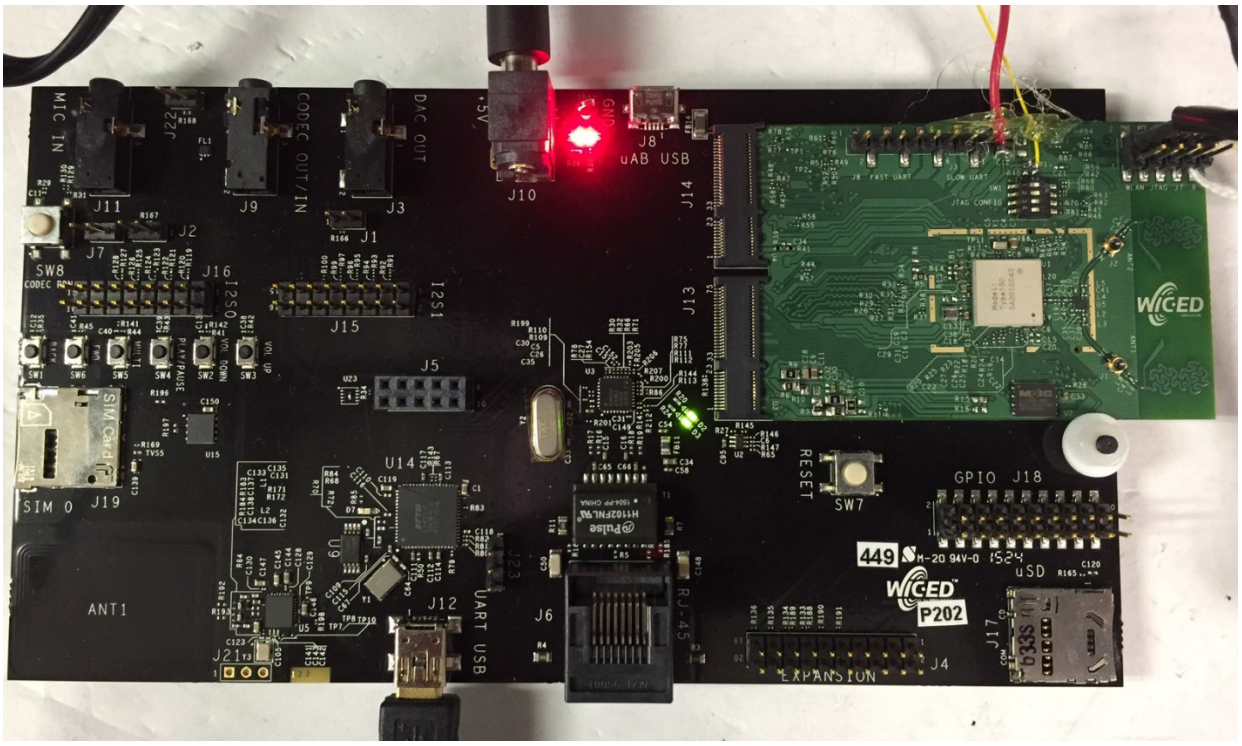
Where the Access Point password (`YOUR APP PASSPHRASE`) is deleted and `test123` represents the SSID of the Access Point being used.

Appendix D: PCB Hardware Setup

D.1. PCB Setup Overview

Figure 19 shows a picture of the PCB hardware setup, in which the CYW943907WCD2_2 reference board (green) plugged into the CYW943909WCDEVAL_2 evaluation board (black).

Figure 19. Reference Board/Evaluation Board Hardware Setup



D.2. Configuring the PCB Hardware Setup

Note: The procedures below assume that the rework described in Appendix E on page 31 has already been performed

Follow the procedure below to set up the PCB hardware for current measurements:

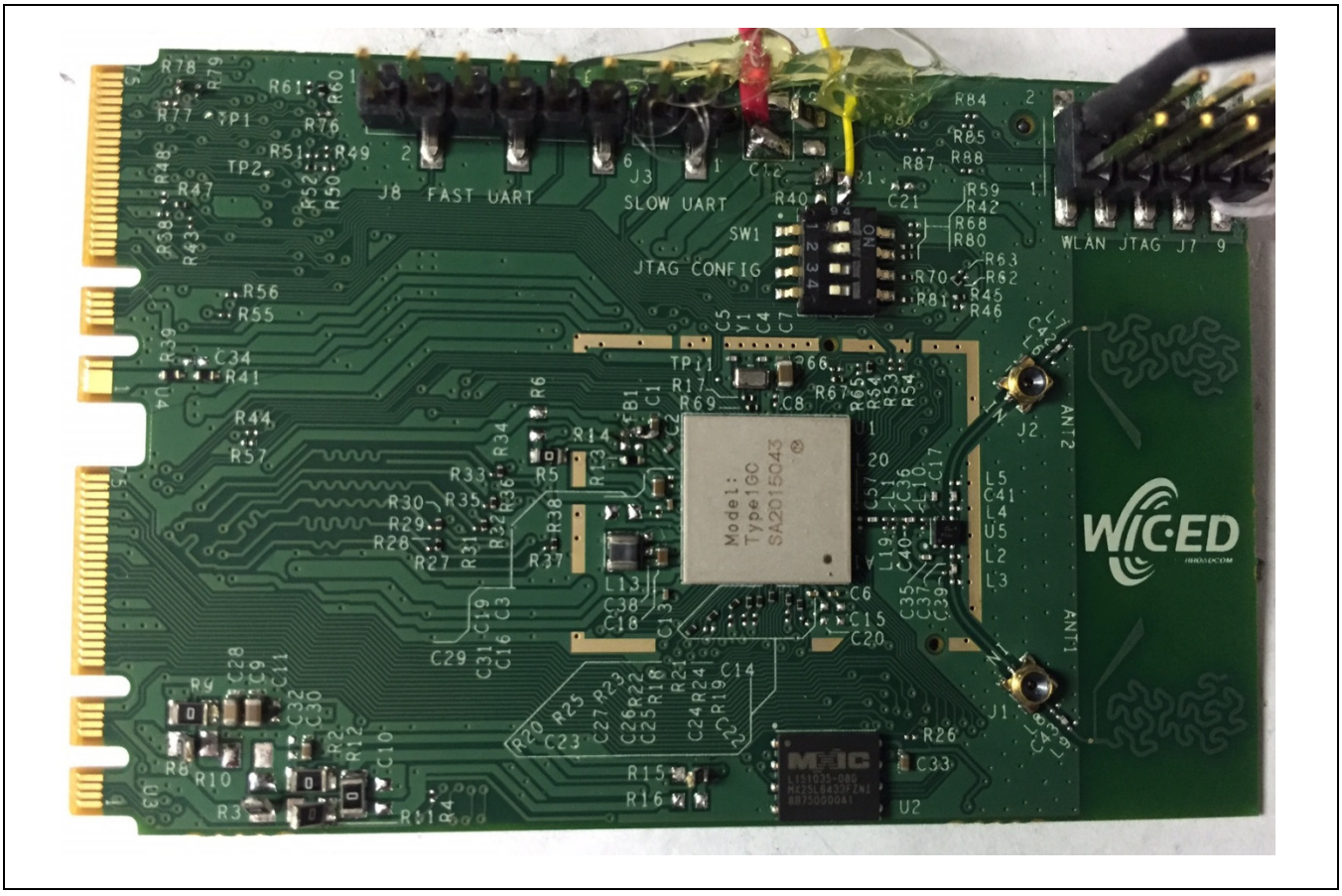
1. Plug the reference board into the evaluation board.
2. Connect a 5 V wall power adapter to the J10 input on the CYW943909WCDEVAL_2 board.
3. On the CYW943907WCD2_2:
   a. Connect VBAT 3.6V (N6705B Module 1) at J20 pin 1 and connect a GND lead to pin 2.
   b. Connect VDDIO 3.3V (N6705B Module 2) at J19 pin 1 and connect a GND lead to pin 2.
4. Connect UART/USB cable between J12 on the CYW943909WCDEVAL_2 board and the host PC running the WICED SDK.
5. On the host PC, open the Device Manager and confirm that the CYW943907WCD2_2 has been detected.
6. Load the WICED SDK DUT application into the CYW943907WCD2_2.
7. Cycle power on the CYW943907WCD2_2 by turning the embedded N6705B power supply modules off and then on.

Appendix E: Reference Board Rework

E.1. CYW943907WCD2_2 Overview

The CYW943907WCD2_2 (rev. P214) reference board is shown in Figure 20. Current consumption is measured on the reference board only. The purpose of the rework is to ensure that only the current going into the reference board (the green PCB) is measured.

Figure 20. CYW943907WCD2_2 Reference Board



The rework required to configure the CYW943907WCD2_2 to support CYW43907 current measurement is defined in Table 7.

Table 7. CYW943907WCD2_2 Rework Tasks

Task No.	Description	Comment
1	Remove R11	–
2	Remove R8	–
3	Remove R3	–
4	Remove R76, R77, R78, R79	–
5	Remove R1 and jump a 3.3V supply wire at the R1 terminal pad to feed VDDIO_EMB = VDD_3V3	–
6	Remove R7 and jump a 3.6V supply wire at the R7 terminal pad to feed VDDIO_EMBDAT_3V6 = VDD_VBAT	–
7	Remove FB1	Cuts off the supply to USB
8	Remove R15 and ensure R16 is already depopulated	Cuts off VDDIO to RMII
9	Set the SW1 configuration switch to enable JTAG: ■ S1 and S2 = ON ■ S3 and S4 = OFF. JTAG must be enabled in order to download an application to the CYW43907.	This enables the APPS JTAG port, which is required for downloading firmware.

Appendix F: Chip Revision Information

F.1. Getting the CYW43907 Chip Revision

The CYW43907 is embedded inside a System-in-Package (SiP) that is soldered onto the CYW943907WCD2_2 reference board. The chip is not exposed, so the revision code is not visible. To get around this a the manufacturing application, *test.mfg_test-BCM943909WCD1_3.B1*, can be downloaded to the reference board to allow chip revision information to be called up through the WICED SDK command line interface.

The `wl revinfo` command is used to read and report the chip revision information:

```
c:\wiced>wl43909b0.exe --serial 19 revinfo
vendorid 0x14e4
deviceid 0x43d0
radiorev 0x5a030b
chipnum 0xab85
chiprev 0x2            (0 for chip rev A0, 1 for B0, and 2 for B1.)
chippackage 0x0
corerev 0x34
boardid 0x755
boardvendor 0x14e4
boardrev P308
driverrev 0x70fa830
ucoderev 0x249a03ee
bus 0x0
phytype 0xb
phyrev 0x10
anarev 0x0
nvramrev 0
```

Document History Page

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Rev.	**ECN No.**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	–	–	12/22/2015	43907-AN100-R Initial release
*A	5466544	UTSV	10/13/2016	Updated to Cypress template. Added Cypress Part Numbering Scheme.
*B	5725313	AESATMP8	05/03/2017	Updated logo and Copyright.

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