ZL70251 Application Development Kit (ADK) User's Guide

Microsemi

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1 Introduction

The ZL70251 Application Development Kit (ADK) is intended to support customer design and evaluation activities related to developing products that are based on Microsemi's ZL70251 Ultra-Low-Power RF Transceiver. The kit provides customers with an example system-level platform of an application, including a base station and a remote device. In addition to being a working system to evaluate performance of the ZL70251 device, the kit provides hardware and software design examples to aid in the development of products.

This document applies to ZL70251 ADK version 1.1.X.

2 Installation and Setup

2.1 Hardware List

The ZL70251 ADK includes the following hardware:

1. Base Station (BASE251 mated with ADP100A) — Qty 1
2. Remote Device (REMOTE251 mated with ADP100A) — Qty 1
3. Antennas — Qty 2 each:
   - US ISM band: Antenna Factor 916 MHz, Dipole Antenna, P/N ANT-916-CW-HWR-SMA, identified with two yellow stripes at top of antenna.
   - European SRD band: Antenna Factor 868 MHz, Dipole Antenna, P/N ANT-868-CW-HWR-SMA, identified with two gray stripes at top of antenna.
4. MSP430 Programming Adapter (PCA100) — Qty 1
5. Installation CD — Qty 1
6. USB Cable, Mini-B to A — Qty 2

2.2 System Hardware Components

This paragraph provides a brief description of the main hardware components of the ZL70251 ADK, as shown in Figure 1 and Figure 2 on page 6.

Base Station: The base station is comprised of a BASE251 board mated to an ADP100A board. The base station that is included with the ADK looks similar to the example remote device shown in Figure 1. The kit also includes a dipole helical antenna for operation in the US ISM band and a dipole helical antenna for operation in the European SRD band.

Remote Device: The remote device is comprised of a REMOTE251 board mated to an ADP100A board. Figure 1 shows an example remote device that is similar to the remote device included with the ADK. The kit also includes a dipole helical antenna for operation in the US ISM band and a dipole helical antenna for operation in the European SRD band.

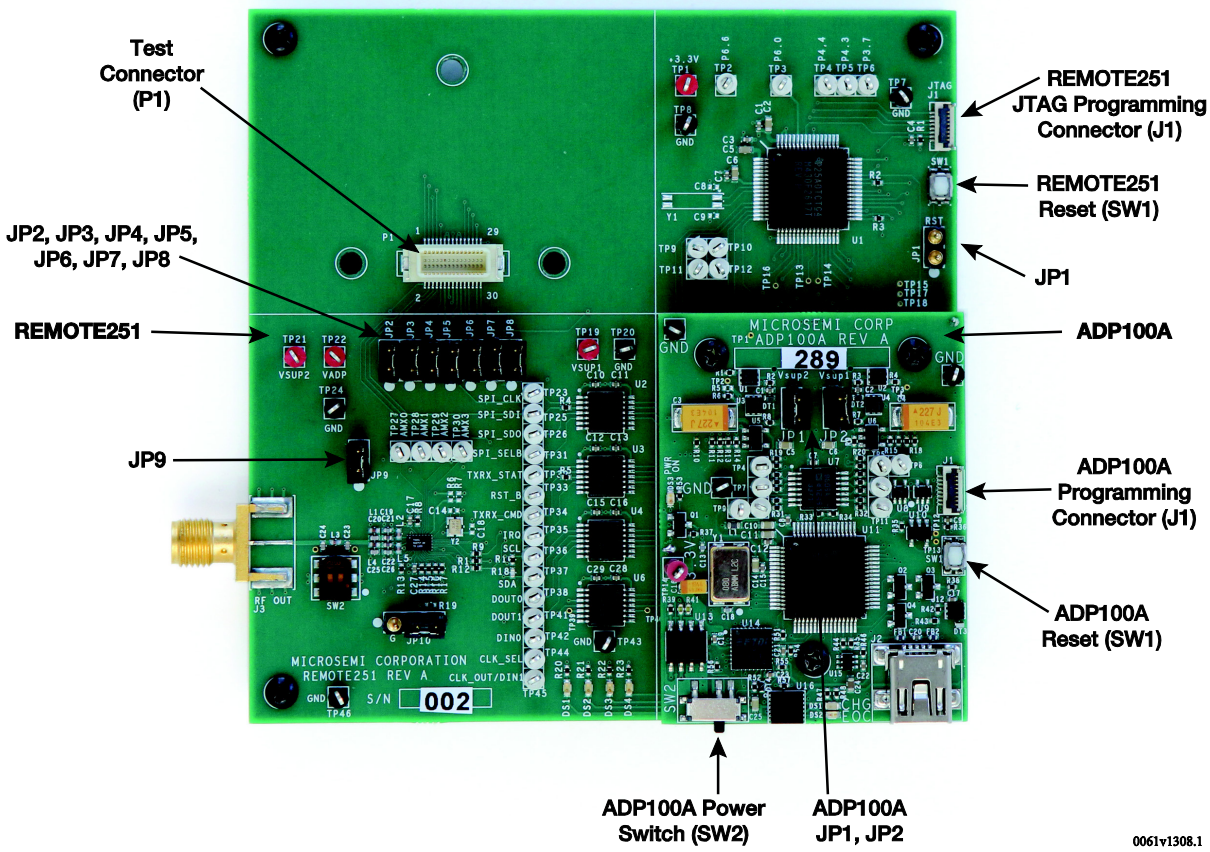


Figure 1 – Example Remote Device

Programmer Cable Adapter: The Programmer Cable Adapter (PCA100) connects between the MSP430 microcontroller on the BASE251, REMOTE251, or ADP100A and the optional Texas Instruments MSP430 USB Debugging Interface ten-pin ribbon cable (MSP-FET430UIF - refer to "A – Performing Firmware Updates" on page 34 for ordering information). The PCA100 allows users to download code and run the debugger to implement and test new features on the BASE251, REMOTE251, and ADP100A.

Figure 2 – Programmer Cable Adapter (PCA100)

2.3 Jumper Configuration

Table 1 provides a description and the default setting for each jumper on each board.

Table 1 – Jumper Configuration

	Jumper Description	Default Setting
ADP100A		
JP1	When installed, provides power to BASE251 or REMOTE251 board on Vsup 2. Also allows the user to measure the current on Vsup 2 supply by removing the jumper and placing a current meter across jumper.	On
JP2	When installed, provides power to BASE251 or REMOTE251 board on Vsup 1. Also allows the user to measure the current on Vsup 1 supply by removing the jumper and placing a current meter across jumper.	On
BASE251 and REMOTE251		
JP1	When installed, holds MSP430 processor in reset. This allows another processor to be used from the test connector P1.	Off
JP2	When removed, breaks connection between ZL70251's DOUT0 signal and MSP430 processor. To prevent contention, jumper should be removed when another ZL70251 device is being used via the test connector P1.	On
JP3	When removed, breaks connection between ZL70251's DOUT1 signal and MSP430 processor. To prevent contention, jumper should be removed when another ZL70251 device is being used via the test connector P1.	On
JP4	When removed, breaks connection between ZL70251's TXRX_STAT signal and MSP430 processor. To prevent contention, jumper should be removed when another ZL70251 device is being used via the test connector P1.	On
JP5	When removed, breaks connection between ZL70251's SPI_CLK signal and MSP430 processor. To prevent contention, jumper should be removed when another ZL70251 device is being used via the test connector P1.	On
JP6	When removed, breaks connection between ZL70251's SPI_DATA_OUT signal and MSP430 processor. To prevent contention, jumper should be removed when another ZL70251 device is being used via the test connector P1.	On
JP7	When removed, breaks connection between ZL70251's SPI_SEL_B signal and MSP430 processor. To prevent contention, jumper should be removed when another ZL70251 device is being used via the test connector P1.	On
JP8	When removed, breaks connection between ZL70251's IRQ signal and MSP430 processor. To prevent contention, jumper should be removed when another ZL70251 device is being used via the test connector P1.	On
JP9	When installed, provides power to ZL70251 device. Allows the user to measure the current to the ZL70251 device by removing the jumper and placing a current meter across jumper.	On
BASE251 Rev E and later, and REMOTE251		
JP10	Allows user to hold the ZL70251 device in reset. This is necessary when connecting an external ZL70251 device via connector P1, which may be done for testing purposes.	Jumper on pin 2 and 3

Table 1 – Jumper Configuration

	Jumper Description	Default Setting
BASE251 Rev B only		
JP10	When installed, provides +3.3 V to the external LNA. When removed, allows the user to supply an external voltage to the external LNA via pin 2.	On
JP11	Allows user to hold the ZL70251 device on the BASE251 Rev B in reset. This is necessary when connecting an external ZL70251 device via connector P1, which may be done for testing purposes.	Jumper on pin 2 and 3

2.4 Switch Configuration

Table 2 provides a description and the default setting (if applicable) for each switch on each board.

Table 2 – Switch Configuration

	Switch Description	Default Setting
ADP100A		
SW1	Push-button switch. When pressed, resets the processor (i.e., the MSP430 microcontroller) on the ADP100A and the processor on the BASE251 or REMOTE251 attached to the ADP100A.	NA
SW2	Slide switch. Provides power to the ADP100A and the BASE251 or REMOTE251 attached to the ADP100A. To apply power, slide the switch to the left side (away from the Mini-B USB connector).	Right (Note 1)
BASE251 and REMOTE251		
SW1	Push-button switch. When pressed, resets the processor on the BASE251 or REMOTE251.	NA
REMOTE251		
SW2	Dip switch that allows for a low-pass filter network to be switched in to attenuate out-of-band emissions.	Both switches in top position

Note:

1. *Direction is given assuming the user is reading the board name upright.*

2.5 Hardware and Software Installation

Note: The ADK is supported under Windows XP and Windows 7.

The base station and remote device come preassembled with ADP100A boards. The following steps are required before operation of the ZL70251 ADK can begin.

1. Screw the desired frequency band helical antenna on the SMA connector located on the edge of both the BASE251 and REMOTE251.
2. Install the supplied CD (or run *setup.exe* extracted from the ZIP file) and follow the on-screen instructions. Note that multiple versions of the ADK can be installed on a PC without conflict, so there is no need to remove previous versions (although you may if you no longer need them).
3. Connect one of the supplied USB cables from the base station's Mini-B connector (located on the ADP100A board) to a PC. The PC then detects a new USB device and either prompts to search for the device driver, or starts searching automatically (if it starts searching automatically, cancel the search so you can install the driver manually). At that point, take the steps necessary to install the driver located in the following folder (in this path, replace [Version] with the ADK version number, such as 1.1.0):

   C:\Program Files\Microsemi\ZL70251 ADK [Version]\ADP Board USB Driver

   If you need guidance, the driver folder contains files with installation instructions, for example FTDI USB drivers (*FTDI Drivers Installation Guide for Windows XP.pdf* and *FTDI Drivers Installation Guide for Windows 7.pdf*). In these examples substitute the driver folder above for the driver folder in the example, and substitute *ADP Board* for the device named in the example. Also, ignore instructions pertaining to the COM port driver because the ADP board driver does not use that.
4. Connect the second supplied USB cable from the remote device's Mini-B connector (located on the ADP100A board) to the PC, then repeat the instructions from the previous step to install the device driver for the remote device (each ADP100A board has a unique serial number that requires its own separate driver installation).
5. Power on the base station. Note that the power switch is located on the ADP100A (refer to SW2 in Figure 1 on page 6 and Table 2 on page 8). Sliding this switch to the left (away from the Mini-B USB connector) turns on power to the whole unit.
6. Power on the remote device (refer to the note in the previous step).

3 Operation

This chapter describes in detail the operation of the main components of the ZL70251 ADK for both the base station and the remote device.

3.1 ADK Main Form

The main form for the ADK (refer to Figure 3) controls the launch of the ADK application and its components. It displays the ADK software version and allows the user to control system-level timing intervals for various functions.

Figure 3 – ADK Main Form

The ADK main form includes the following buttons and fields:

- ***Base Station (BASE251)***: This button launches the main form for the base station (refer to "3.2 Base Station and Remote Device Main Form" on page 12 for details).
- ***Remote Device (REMOTE251)***: This button launches the main form for the remote device (refer to "3.2 Base Station and Remote Device Main Form" on page 12 for details).

- ***System Settings***: When the ADK application is first launched, click the *System Settings* button to see the expanded view that includes the *System Settings* section and its fields (as shown in Figure 3 on page 10). The fields control the interval of timers used for various operations of the system. The range of these settings is from 0.5 Hz to 10 Hz. If both the base station and the remote device are connected to the same PC, then these settings affect both the base station and the remote device. If the base station and the remote device are connected to separate PCs, then these settings apply only to the connected device. (The settings on each PC are completely independent and do not need to match.) The fields are:
  - ***Status Poll Rate (Hz)***: This drop-down box controls the update rate for the status polling operation.
  - ***RSSI Rate (Hz)***: This drop-down box controls the update rate for the Clear Channel Assessment (CCA) and RSSI polling operation.

To exit the ADK application, click on the Close button (the red ×) on the title bar of the ADK main form.

3.2 Base Station and Remote Device Main Forms

The main forms for the base station and remote device are divided into two major sections (refer to Figure 4 below and Figure 5 on page 13). The upper section contains tabs allowing access to the different configuration settings of the ZL70251, as well as providing for control of operational modes of the device (for example, test functions). The lower section is a static display that allows for basic system status and control for the main operational features of the ZL70251 (for example, link status). Paragraphs 3.2.1 through 3.2.4 provide detailed descriptions of the various control and status functions on the base station and remote device main forms, which are the same except where noted.

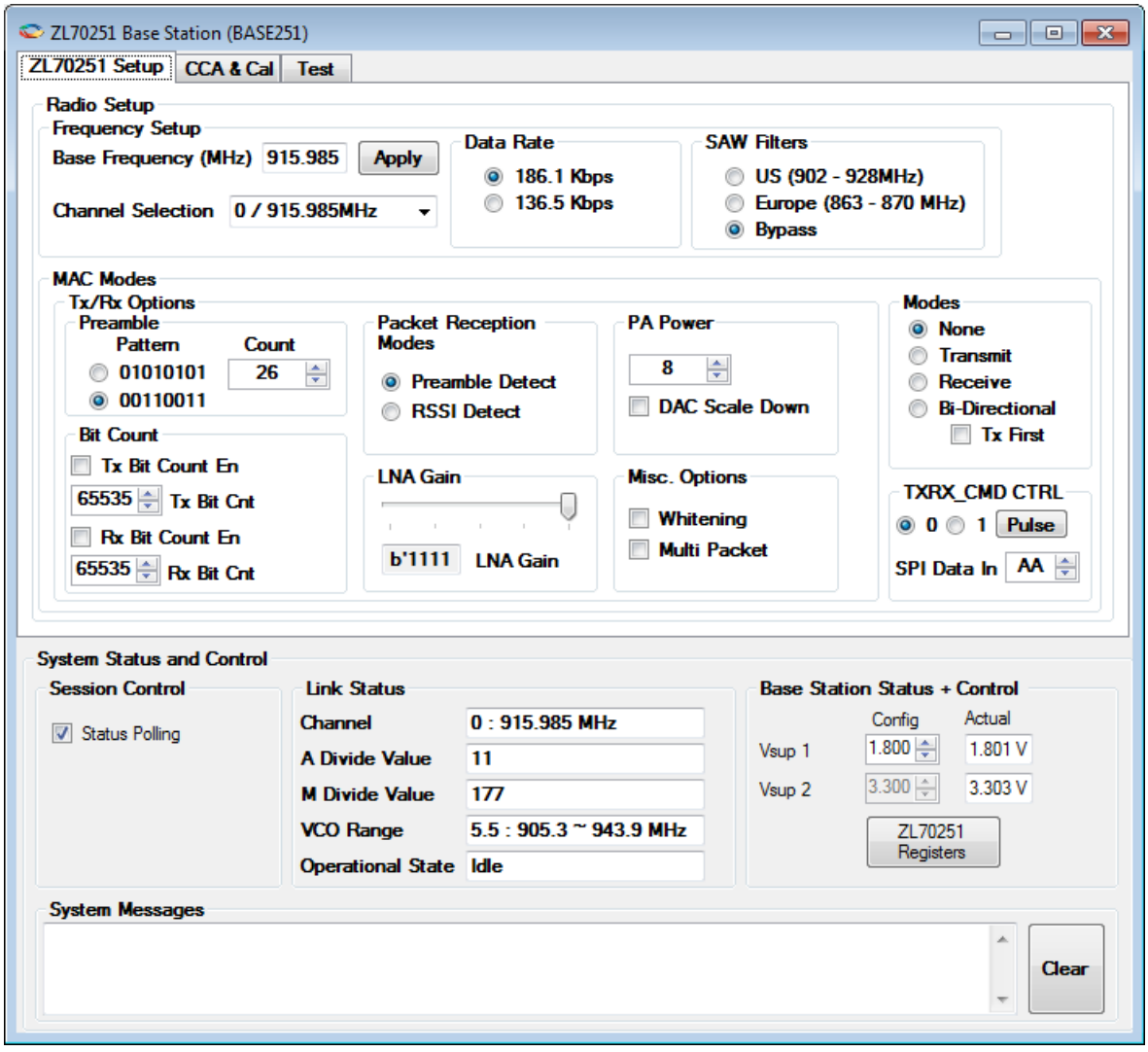


Figure 4 – Base Station Main Form

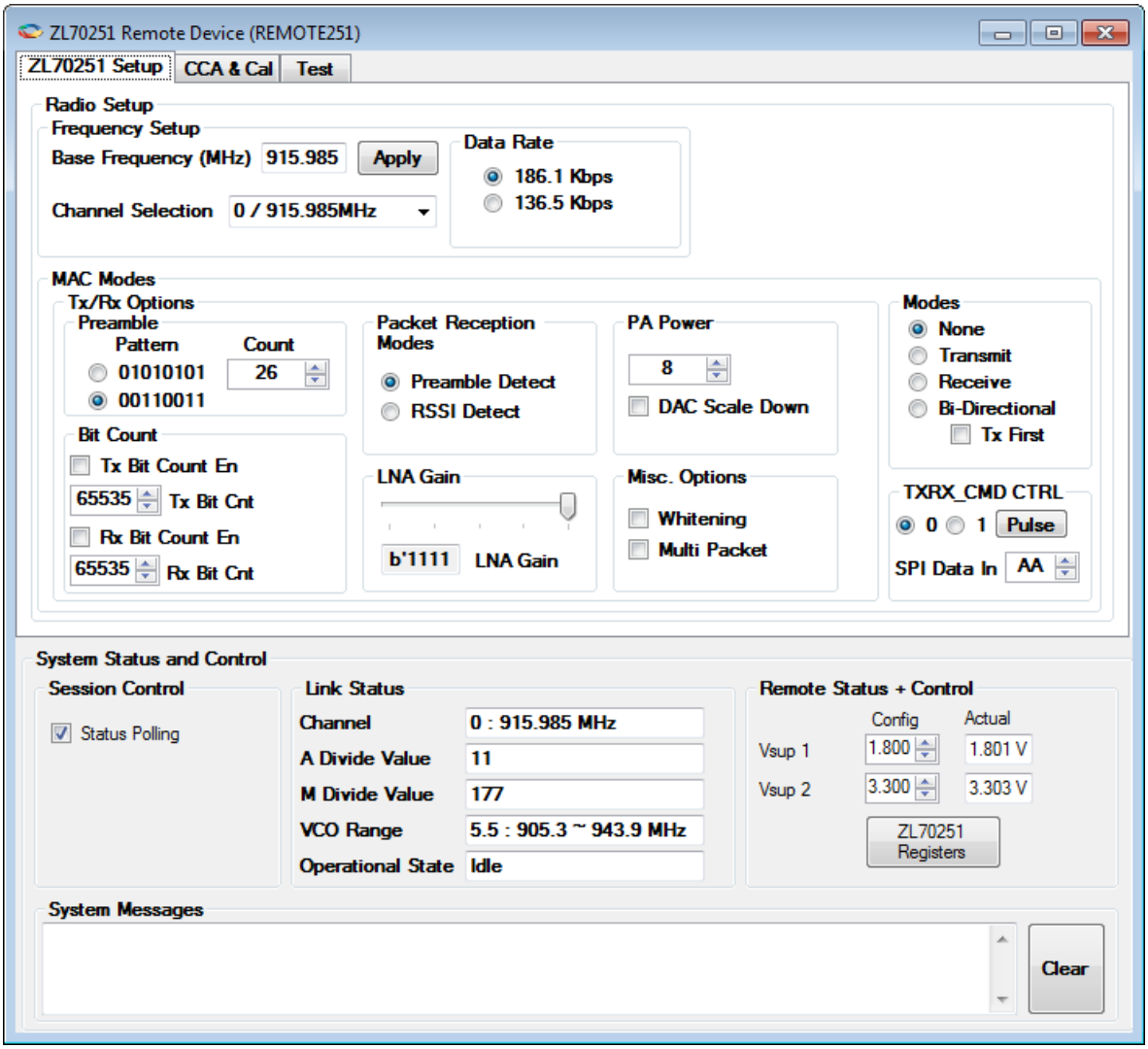


Figure 5 – Remote Device Main Form

3.2.1 *System Status and Control*

The *System Status and Control* section of the main form (refer to Figure 4 on page 12 and Figure 5 above) provides for control of the main functions of the system as well as status information for the key operational settings of the link. This section is always visible when the main form is displayed. The four subsections of the *System Status and Control* section are *Session Control*, *Link Status*, either *Base Station Status + Control* or *Remote Status + Control*, and *System Messages*.

- ***Session Control***: This subsection contains a control for status polling:
  - ***Status Polling***: This checkbox controls the status polling operation. When this box is checked, status polling is enabled and the polling interval is based on the setting in the *Status Poll Rate (Hz)* field under *System Settings* on the main form (refer to "3.1 ADK Main Form" on page 10). This can be unchecked to reduce the

amount of digital disturbance when making sensitive measurements in a lab environment (e.g., RX sensitivity tests).

- ***Link Status***: This subsection displays the real-time setup and operational status of the unit. All fields in this subsection are read-only.
  - ***Channel***: This field displays the current channel number and the associated center frequency for that channel. Channel 0 is equivalent to the base frequency, and channels 1 through 7 are contiguous channels. Channel separation is typically 303.407 kHz.
  - ***A Divide Value***: This field is used in conjunction with the *M Divide Value* field to set the synthesizer to the desired frequency. Refer to the *ZL70251 Programmer User's Guide* for synthesizer frequency calculations.
  - ***M Divide Value***: This field is used in conjunction with the *A Divide Value* field to set the synthesizer to the desired frequency. Refer to the *ZL70251 Programmer User's Guide* for synthesizer frequency calculations.
  - ***VCO Range***: Since the ZL70251 VCO can be used over a wide range of frequencies, it is split into eight bands of operation. There is also a *half_band* bit that can be used (in conjunction with the *vco_frq[13:11]* bits) to increase or decrease the VCO frequency tuning by half of a band. The *VCO Range* field displays a combination of the VCO band (*vco_frq[13:11]*) and the *half_band* bit. For example, if the *VCO Range* value is 5.5, this indicates that the VCO band is 5 and the *half_band* bit is set.
  - ***Operational State***: This field displays the current operational status of the unit—Idle, BER Transmitting, or BER Receiving:
    - Idle: No operation is currently being performed.
    - BER Transmitting: The unit is acting as a transmitter during a Bit Error Rate (BER) test.
    - BER Receiving: The unit is acting as a receiver during a BER test.
- ***Base Station Status + Control* or *Remote Status + Control***: This subsection displays the real-time setup and operational status of the unit.
  - ***ZL70251 Registers***: This button brings up a separate display for accessing the registers of the unit (refer to "3.3 Registers Main Form" on page 26).
  - ***Vsup 1***:

    Config: The *Vsup 1 Config* field allows the user to define the supply voltage for the ZL70251 transceiver. The range is 1.1 V to 1.9 V.

    Actual: The *Vsup 1 Actual* field is a read-only display of the voltage of the power supply for the ZL70251 transceiver as measured by the ADC within the MSP430 microcontroller. The accuracy of this voltage is ±5%.
  - ***Vsup 2***:

    Config: For the remote device, the *Vsup 2 Config* field allows the user to define the supply voltage for the MSP430 microcontroller. The range is 1.8 V to 3.5 V.

    Actual: The *Vsup 2 Actual* field is a read-only display of the voltage of the power supply for the MSP430 microcontroller as measured by the ADC within the MSP430 microcontroller. The accuracy of this voltage is ±5%.

- ***System Messages***: The text box in the *System Messages* subsection at the bottom of the form displays critical system messages. Typically, these are error messages returning from an operation to help users understand operational problems. The *Clear* button clears any messages that are currently displayed in the text box.

3.2.2 *ZL70251 Setup* Display Tab

The *ZL70251 Setup* tab (refer to Figure 6) contains link setup information for the transceiver. During operation, the *System Status and Control* section typically reflects these settings (refer to "3.2.1 System Status and Control" on page 13). However, when certain test or control functions (for example, TX carrier test) temporarily override these settings, the overrides are reflected in the *System Status and Control* section.

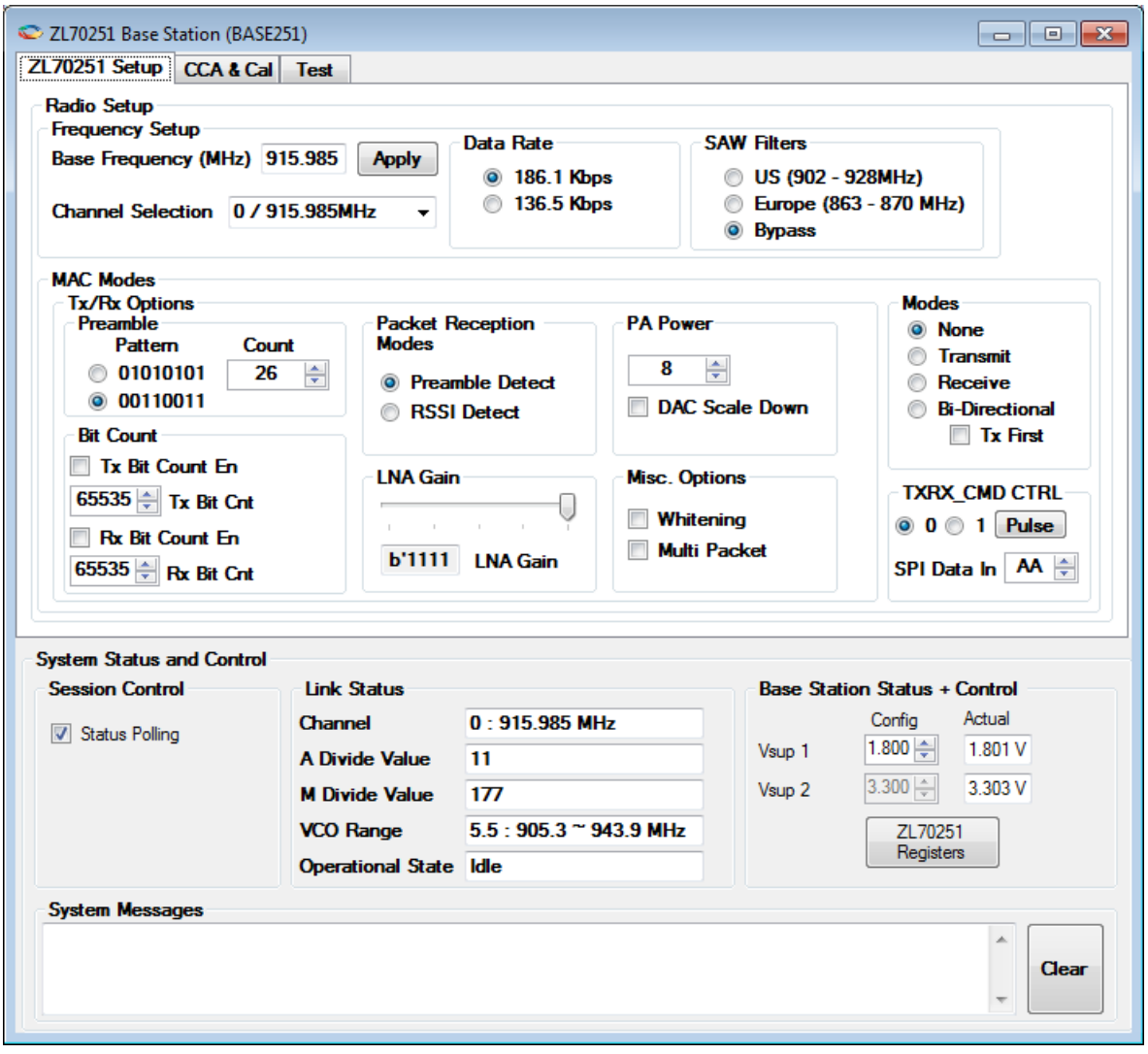


Figure 6 – *ZL70251 Setup* Display Tab

The *ZL70251 Setup* tab contains two subsections under the *Radio Setup* section, which are *Frequency Setup* and *MAC Modes*:

- ***Frequency Setup***:
  - ***Base Frequency (MHz)***: This field allows the user to define the base frequency in megahertz for which the chip can be programmed. Once the frequency is entered and the *Apply* button is pressed, the corresponding A, M, and *vco_frq[13:11]* values are calculated for the eight channels starting at the base frequency. If the base frequency is changed, a complete trim procedure is done on the transceiver. If just the channel number is changed, then only the VCO trims are performed.
  - ***Channel Selection***: This drop-down box selects the channel to be used. The channel selection can be from 0 to 7. Channel 0 is equivalent to the base frequency; each channel is typically separated by 303.407 kHz for a crystal frequency of 24.576 MHz. When a new channel is selected, the user **should not** click the *Apply* button. The software configures the ZL70251 device to the selected channel and initiates the VCO calibrations for that channel.
  - ***Data Rate***: These radio buttons allow the user to select a data rate of either 186.1 kbit/s or 136.5 kbit/s.
  - ***SAW Filters*** (base station only): This group of radio buttons allows the user to switch in an appropriate SAW filter for the band of operation in which the user is working. For example, if the user is testing in the US ISM band, they may want to select the SAW filter for this band to attenuate out-of-band emissions. The three options are:
    - *US (902 - 928 MHz)*
    - *Europe (863 - 870 MHz)*
    - *Bypass*
- ***MAC Modes:***
  - ***Tx/Rx Options:***
    - ***Preamble:***
      - ***Pattern***: The user can select a preamble pattern of *01010101* or *00110011*.
      - ***Count***: This field determines how many bytes of preamble to send in transmit mode (in decimal format). This amount of preamble is sent after TXRX_CMD is set high.
    - ***Bit Count:***
      - ***Tx Bit Count En***: When checked, the device is in bit-count mode when transmitting. This means the radio sends the number of bits defined in the *Tx Bit Cnt* field only and sets the *tx_done_irq* at the end of the bit count.
      - ***Tx Bit Cnt***: Determines the number of bits to send when the radio is in bit-count mode.

  - o ***Rx Bit Count En***: When checked, the device is in bit count mode when transmitting. This means the radio only receives the number of bits defined in the *Rx Bit Cnt* field and sets the *rx_done_irq* at the end of the bit count.
  - o ***Rx Bit Cnt***: Determines the number of bits to receive when the radio is in bit-count mode.
- ***Packet Reception Modes:***
  - o ***RSSI Detect***: Enables use of the RSSI to determine if a wanted packet is available for reception. This mode is used in conjunction with the RX RSSI threshold. If in autoreceive mode and a signal is above the RX RSSI threshold, the receiver begins looking for the sync pattern. Care must be taken when setting the threshold and using the RSSI detect mode. The threshold must be set a minimum of four counts above the RSSI noise floor so that the receiver does not trigger on noise.
  - o ***Preamble Detect***: Enables the preamble detection mode when in receive mode. When selected, the RSSI threshold is set to 0 and bypassed for packet detection. Selecting preamble detection mode is desirable when a high noise environment is present, which results in a high RSSI reading when no wanted signal is present.
- ***LNA_GAIN***: Moving the slider sets the gain for the internal LNA. Each tick is approximately 4 dB of gain, with a setting of 0 equal to a gain of 16 dB. The *LNA Gain* text box is a read-only field that dynamically displays the register value in binary format.
- ***PA Power***: Gives the user the ability to set the power amplifier (PA) power setting. The chip default is a value of 8, which corresponds to approximately −10 dBm out of the PA.
  - o ***DAC Scale Down***: When checked, the PA output power is attenuated by approximately 3 dB.
- ***Misc. Options:***
  - o ***Whitening***: When checked, the SPI data being transmitted is whitened. The setting should be the same for both the transmitter and receiver when sending data.
  - o ***Multi Packet***: Places the receiver or transmitter in multipacket mode.

- ***Modes:***
  - ***None***: When selected, the MAC is disabled.
  - ***Transmit***: When selected, the MAC is placed into transmit mode. Groups within the *MAC Modes* subsection that are not appropriate for transmit mode are disabled. The radio should be configured with the other settings within the *MAC Modes* subsection before this is enabled.
  - ***Receive***: When selected, the MAC is placed into receive mode. Groups within the *MAC Modes* subsection that are not appropriate for receive mode are disabled. The radio should be configured with the other settings within the *MAC Modes* subsection before this is enabled.
  - ***Bi-Directional***: When selected, the MAC is placed into bidirectional mode. Groups within the *MAC Modes* subsection that are not appropriate for bidirectional mode are disabled. The radio should be configured with the other settings within the *MAC Modes* subsection before this is enabled. When bidirectional mode is selected, multipacket mode is automatically selected since it is required for bidirectional mode.
    - ***Tx First***: Determines whether the radio is first in transmit or receive mode when in bidirectional mode. If this box is checked the radio is in transmit mode first.
- ***TXRX_CMD CTRL:***
  - ***0, 1, Pulse***: These fields control the state of the TXRX_CMD output from the ZL70251 device. When *Pulse* is pressed, TXRX_CMD is pulsed for 2 µs depending on its current state. For example, if TXRX_CMD is low, when the *Pulse* button is pressed, TXRX_CMD goes high for 2 µs and then back low.
  - ***SPI Data In***: Determines what data is placed on SPI_DATA_IN when transmitting. This value is repeated if more than one byte of data is being sent. The value is expressed in hexadecimal format.

3.2.3 *CCA & Cal* Display Tab

The *CCA & Cal* tab (refer to Figure 7) allows the user to configure and perform a CCA and various calibrations.

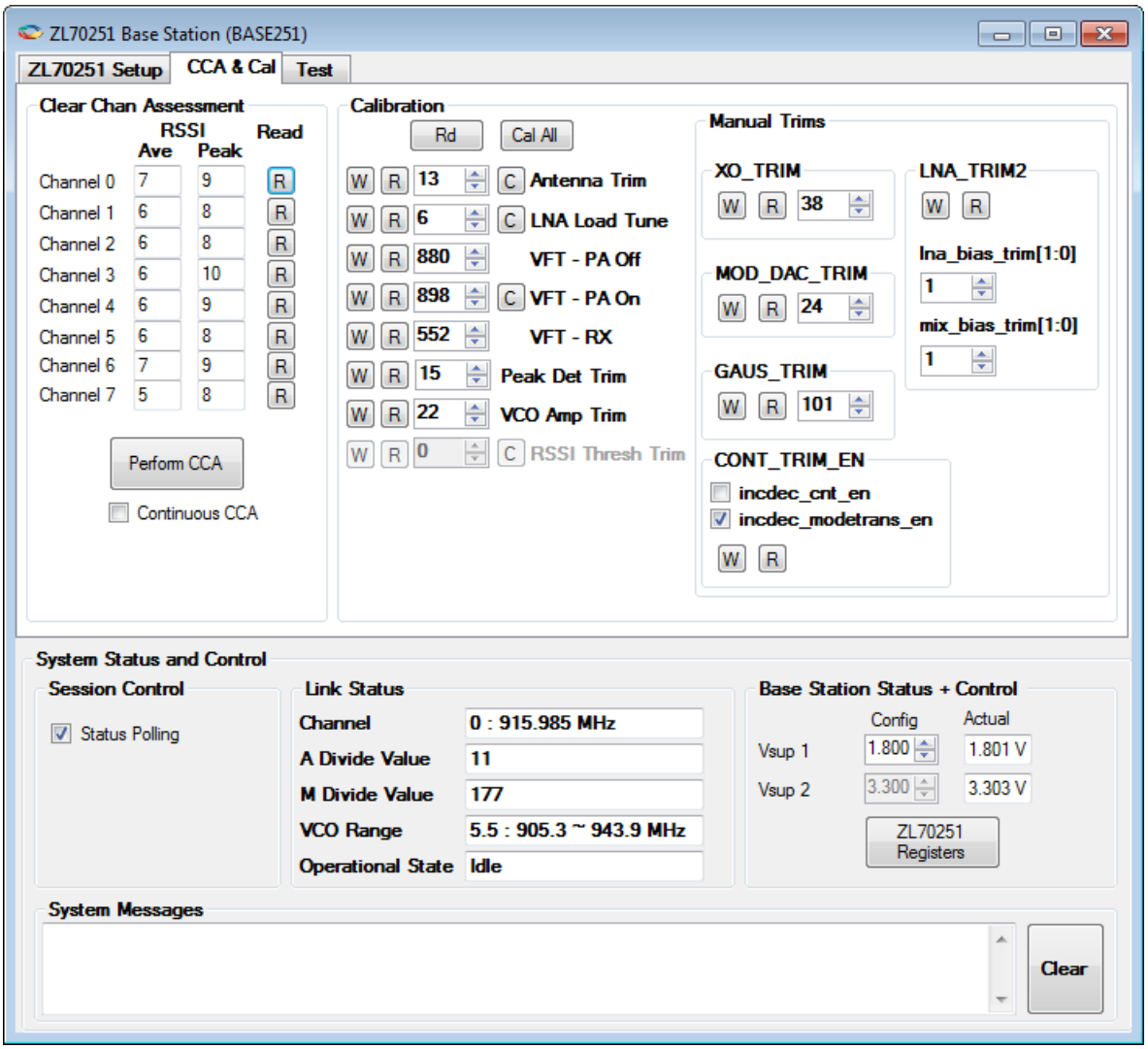


Figure 7 – *CCA & Cal* Display Tab

The *CCA & Cal* tab has three subsections, for clear channel assessment, calibration, and manual trims.

- ***Clear Chan Assessment***:
  - ***Perform CCA* or *Stop CCA***: When the *Perform CCA* button is pressed, a CCA is performed on all eight channels. Eight samples are taken for each channel and the *RSSI* results — both the average (*Ave*) and the *Peak* values — are displayed. The channel with the lowest value is the one most suitable for use for operation. If the user desires to do a CCA only on a particular channel, press the *R* button for the appropriate channel and only the results for that channel are displayed.

    Note: The following calibrations are performed for each channel before the RSSI reading is taken; these are trims that need to be done for a change in frequency: VCO calibrations (PAOFF, PAON, RX, and amplitude), peak detector trim, LNA load tune, and antenna tune. These calibrations are done for each channel when performing a CCA for all channels or just one channel.

    Press the *Stop CCA* button to terminate a continuous CCA function. This option is available only if the *Continuous CCA* box is checked (see below) and the *Perform CCA* button has been pressed.
  - ***Continuous CCA***: If this box is checked when the *Perform CCA* button is pressed, a CCA is performed at the interval that is defined by the setting on the *ZL70251 Application Development Kit (ADK)* main form under *System Settings* > *RSSI Rate (Hz)* (for more details, refer to "3.1 ADK Main Form" on page 10).
- ***Calibration***: Various calibrations can be performed on demand, or the current register settings may be read for all calibrations. Pressing the *Rd* (read) button allows the user to view the current register settings for all automatically calibrated registers (i.e., those calibrations that are listed underneath the *Rd* and *Cal All* buttons) and for the manual trims. Pressing the *Cal All* button performs all automatic calibration functions (i.e., those calibrations that are listed underneath the *Rd* and *Cal All* buttons) and displays the results of their respective registers. Alternatively, the *C* button next to a calibration can be used to initiate that specific calibration function by itself.

  The user can also manipulate the trim registers by entering a value in the appropriate field and then pressing the *W* button. The user can read the value for a trim register by pressing the *R* button for the trim register of interest. Values are in decimal format. Refer to the *ZL70251 Programmer User's Guide* for a description of the calibrations in this subsection: antenna trim, LNA load tune, VCO frequency TXPAOFF, VCO frequency TXPAON, VCO frequency RX, peak detector offset, VCO amplitude, and RSSI threshold trim.
  - ***Manual Trims***: *Manual Trims* are registers that can be set manually and for which there is no automatic calibration function in the GUI. The *W* or *R* buttons in the *Manual Trims* group can be used, respectively, to manually manipulate or to read the registers XO_TRIM, MOD_DAC_TRIM, GAUS_TRIM, CONT_TRIM_EN, and LNA_TRIM2. For a description of these registers and associated trims, please refer to the *ZL70251 Programmer User's Guide*.

3.2.4 *Test* Display Tab

The *Test* display tab (refer to Figure 8) allows users to perform certain test functions with the ZL70251, such as transmitting a carrier wave or performing a BER test.

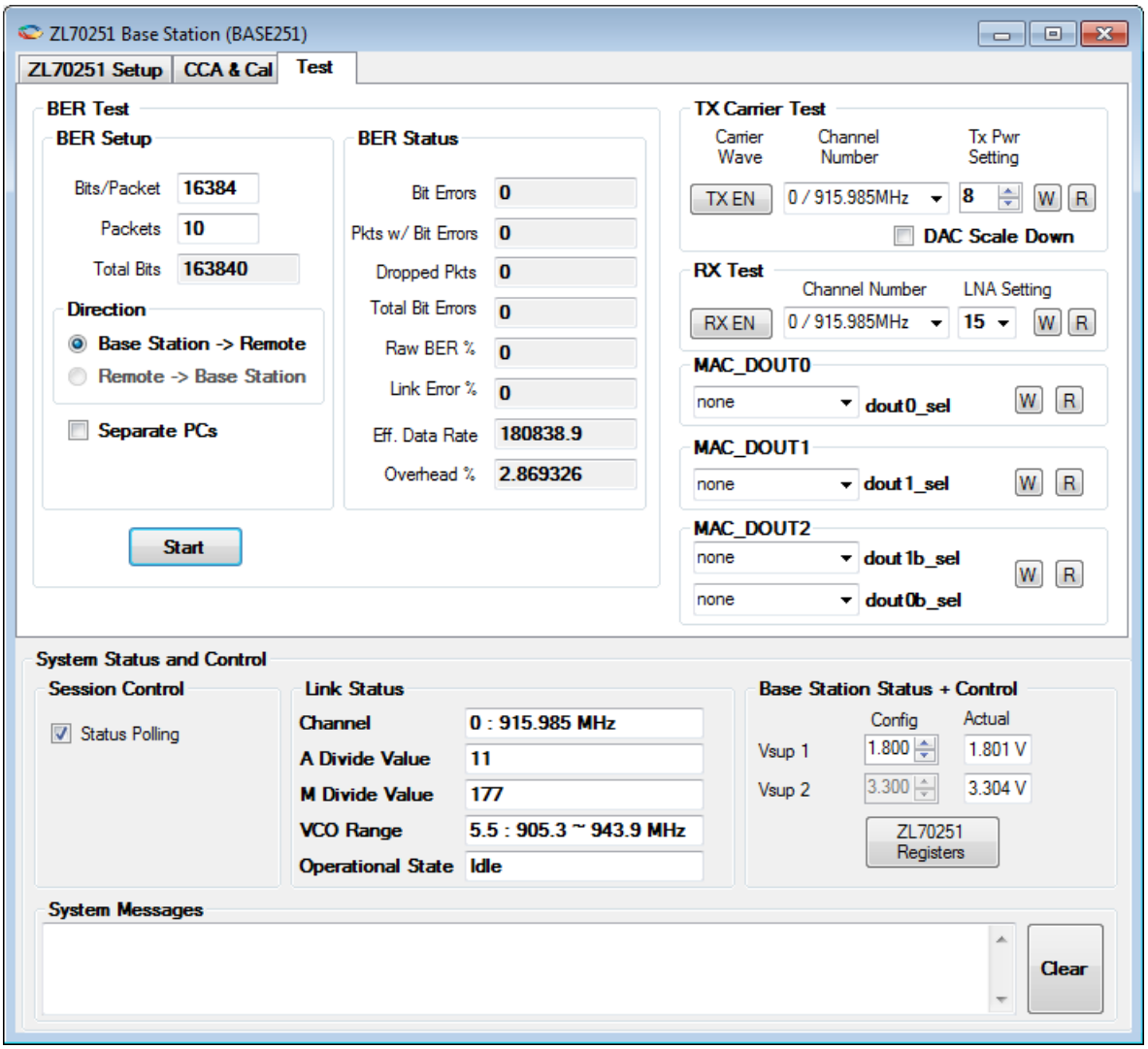


Figure 8 – *Test* Display Tab

The *Test* display tab contains six subsections, one for BER testing, one for Tx carrier wave testing, one for Rx testing, and three for outputting test signals onto the DOUT0 and DOUT1 pins via the MAC_DOUT0, MAC_DOUT1, and MAC_DOUT2 registers.

- ***TX Carrier Test***: The fields in this subsection allow the user to observe a carrier wave of the selected frequency from the ZL70251 TX RF output. The functions are:
  - ***Channel Number***: This drop-down box selects channel to be output. The channel is the selected channel +303 kHz from the base frequency. Channel 0 is equal to the base frequency.
  - ***Carrier Wave***: The *TX EN* button or *TX DIS* button enables or disables, respectively, the TX carrier test function for the ZL70251 output.

- ***TX Pwr Setting***: This field provides the register setting in decimal for the TX output power of the ZL70251. It may be read from or written to by pressing the *R* (read) or *W* (write) button, respectively.
- ***DAC Scale Down***: Checking this box reduces the PA output power by approximately 4 dB.

- ***RX Test***: The fields in this subsection allow the user to enable the receiver and manually adjust the gain. The functions are:
  - ***Channel Number***: This drop-down box selects channel to be output. The channel is the selected channel +303 kHz from the base frequency. Channel 0 is equal to the base frequency. The *RX EN* button or *RX DIS* button enables or disables, respectively, the RX test function for the ZL70251.
  - ***LNA Setting***: This drop-down box allows the user to manually adjust the LNA gain setting for the ZL70251. The user should select the desired gain setting (in decimal format) and then press the *W* button to write the value to the LNA_GAIN register. The user can also read the current setting of the LNA_GAIN register by pressing the *R* button.
- ***BER Test***: The fields in this subsection allow the user to set up, initiate, and review results from a BER test between a base station and a remote device.

  Note: Be sure to set the LNA gain and the RSSI threshold on the receiving board via the *ZL70251 Setup* tab to the desired setting and set the PA power on the transmitting board via the *Test* tab before running a BER test. These three parameters can greatly affect the results of the BER test. The BER test does not set these parameters when the test is run, as it assumes that the user wants to adjust these numbers for their application.

  The functions for the BER test are:
  - ***BER Setup*:** The fields in the *BER Setup* group allow the user to set up the BER test.
    - ***Bits/Packet***: This field selects the bit count for each transmitted packet.
    - ***Packets***: This field defines how many packets are being sent for the BER test. This field changes to *Expected Pkts* when the test is performed on separate PCs and the unit is used as a receiver.
    - ***Total Bits***: This read-only field represents the total number of bits that are sent between the two units. It is bits-per-packet multiplied by the number of packets, or:

      $$Bits/Packet \times Packets.$$

    - ***Direction***: The *Direction* subgroup is used in combination with the *Separate PCs* checkbox to define how the test is going to be run. The options are:
      - ***Base Station -> Remote* (if same PC)**: For this test to work, both the base station and the remote device have to be connected to the same PC and the *Separate PCs* checkbox must be unchecked. The test is started from the base station acting as the transmitter. The GUI for the remote device that is acting as the receiver does not have to be launched for this test to work; however, it is recommended to launch the GUI so that, if problems do arise, the REMOTE251 can easily be retrimmed or adjusted to improve test results. After the test is started, the base station main form displays "BER Transmitting" in the *Operational*

State field (in the *System Status and Control* section at the bottom of the window) and the remote device main form displays "BER Receiving" in the *Operational State* field. Once all the packets are sent, the base station returns to the "Idle" state, gets the results of the test, and displays the results in the *BER Status* group on the GUI for the base station (no results are displayed on the GUI for the remote device).

- ***Remote −> Base Station* (if same PC)**: For this test to work, both the base station and the remote device have to be connected to the same PC and the *Separate PCs* checkbox must be unchecked. The test is started from the remote device acting as the transmitter. The GUI for the base station that is acting as the receiver does not have to be launched for this test to work; however, it is recommended to launch the GUI so that, if problems do arise, the BASE251 can easily be retrimmed or adjusted to improve test results. After the test is started, the remote device displays "BER Transmitting" in the *Operational State* field (in the *System Status and Control* section at the bottom of the window) and the base station displays "BER Receiving" in the *Operational State* field. Once all the packets are sent, the remote device returns to the "Idle" state, gets the results of the test, and displays the results in the *BER Status* group on the GUI for the remote device (no results are displayed on the GUI for the base station).
- ***Base Station −> Remote* (if separate PCs)**: This test is used when the base station and the remote device are connected to separate PCs. The GUIs for both the base station and the remote device must be launched and must have the same configuration, with the *Base Station −> Remote* radio button selected and the *Separate PCs* checkbox checked. The remote device (receiver) for the BER test should be started first, then the base station (transmitter) may be started. After the test is started, the base station main form displays "BER Transmitting" in the *Operational State* field (in the *System Status and Control* section at the bottom of the window) and the remote device main form displays "BER Receiving" in the *Operational State* field. After the test is done, the base station returns to the "Idle" state and the GUIs display the test results in the *BER Status* group. Since the base station is done transmitting data, the remote device should be stopped (manually). Note that the GUI for the base station displays only the effective data rate and the overhead percentage, since it has no knowledge of the receiver performance. The GUI for the remote device displays only bit error information, since it has no knowledge of the transmitter performance.
- ***Remote −> Base Station* (if separate PCs)**: This test is used when the base station and the remote device are connected to separate PCs. The GUIs for both the base station and the remote device must be launched and must have the same configuration, with the *Remote −> Base Station* radio button selected and the *Separate PCs* checkbox checked. The base station (receiver) for the BER test should be started first, then the remote device (transmitter) may be started. After the test is started, the base station main form displays "BER Receiving" in the *Operational State* field (in the *System Status and Control* section at the bottom of the window) and the remote device main form displays "BER Transmitting" in

the *Operational State* field. After the test is done, the remote device returns to the "Idle" state and the GUIs display the test results in the *BER Status* group. Since the remote device is done transmitting data, the base station should be stopped (manually). Note that the GUI for the remote device displays only the effective data rate and the overhead percentage, since it has no knowledge of the receiver performance. The GUI for the base station displays only bit error information, since it has no knowledge of the transmitter performance.

- ***Separate PCs***: This checkbox is used in combination with the radio buttons in the *Direction* subgroup, as described above.

– ***Start* or *Stop***: Press the *Start* button to start BER testing using the setup in the *BER Test* subsection, Press the *Stop* button to terminate the test manually. The *Stop* button is displayed only while test data and packets are being sent, and therefore may be available only if the user is sending a lot of data and packets. If the amount of data and packets being sent is small, the test may finish before there is an opportunity to stop it.

  The *Start* button changes to a *Stop* button until the test is done and then automatically changes back to a *Start* button.

  If the *Separate PCs* checkbox is checked, the user needs to manually stop the BER test on the receiving board. The button automatically changes back to a *Start* button on the transmitting board when it is done sending all the data.

– ***BER Status***: This group displays the results from the BER test. The read-only result fields are:

  - ***Bit Errors***: This field displays the total number of bit errors that were received during the whole BER test. If the base station and remote device are connected to separate PCs, then this field is displayed only on the GUI for the receiving unit.
  - ***Pkts w/ Bit Errors***: This field displays how many packets have a bit error during the BER test. There may be many bit errors during the BER test, but they may not be in all packets; there could be a burst of errors in one packet but no bit errors in all of the other packets. This statistic can give an idea of how many packet retransmissions may be necessary in a communication link.
  - ***Dropped Pkts***: When the base station and the remote device are connected to the same PC, this field displays the number of dropped packets from the receiver.

    When the units are connected to separate PCs, this field is displayed only on the GUI for the receiving unit, and it displays the difference between the number of packets received and the value in the *Expected Pkts* field. For example, if the receiver is expecting 10 packets (because *Expected Pkts* is 10) and it receives only 9 packets, then the field displays 1 dropped packet.

- ***Total Bit Errors***: This field displays the number of dropped packets times the number of bits-per-packet plus the number of bit errors counted by the receiver, or:

  (*Dropped Pkts* × *Bits/Packet*) + *Bit Errors*.

  This is saying that if a packet is dropped, each bit that should have been in that packet is counted as a bit error. If the base station and the remote device are connected to separate PCs, then this field is displayed only on the GUI for the receiving unit.
- ***Raw BER %***: This field displays the raw BER percentage, which does not take into account the dropped packets. It is the number of bit errors divided by the product of the number of packets received and the number of bits per packet, or:

  Bit Errors / ((*Packets* – *Dropped Pkts*) × *Bits/Packet*).

  If the base station and the remote device are connected to separate PCs, this field is displayed only on the GUI for the receiving unit.
- ***Link Error %***: The link error percentage takes into account the dropped packets. It is the total number of bit errors divided by the total number of bits, or:

  Total Bit Errors / *Total Bits*.

  If the base station and the remote device are connected to separate PCs, this field is displayed only on the GUI for the receiving unit.
- ***Eff. Data Rate***: The ZL70251 transceiver has a maximum data rate of 181.81 kbit/s. When multiple packets are sent, the data rate can be greatly affected by the number of bits per packet. If the number of bits per packet is small, the data rate decreases. This field shows the effective data rate during the BER test. If the base station and the remote device are connected to separate PCs, this field is displayed only on the GUI for the transmitting unit.
- ***Overhead %***: This field displays what percentage of the data transfer was due to overhead, such as preamble, sync pattern, delay between packets, etc. If the base station and the remote device are connected to separate PCs, this field is displayed only on the GUI for the transmitting unit.

- ***MAC_DOUT0, MAC_DOUT1,* and *MAC_DOUT2***: These drop-down boxes allow the user to route internal ZL70251 test signals onto either the DOUT0 or DOUT1 pins. Refer to section 9.13 of the *ZL70251 Programmer User's Guide* for a list of internal test signals that are available. The user must press the *W* button to write to the appropriate register or can press the *R* button to get the current value of the desired register.

3.3 Registers Main Form

The registers main form for the ADK provides access to all ZL70251 registers. Similar to the main forms for the base station and remote device, the registers main form uses tabs to access the various groups of ZL70251 registers.

The registers main form is divided into two major sections (refer to Figure 9). The form for the base station is shown in Figure 9 (the form for the remote device is not shown since it is identical to the base station). The upper section of the form contains tabs that allow access to different groups of ZL70251 registers. The lower section is a static display that allows for basic register controls. Paragraphs 3.3.1 through 3.3.2 provide detailed descriptions of the various controls for the registers main form.

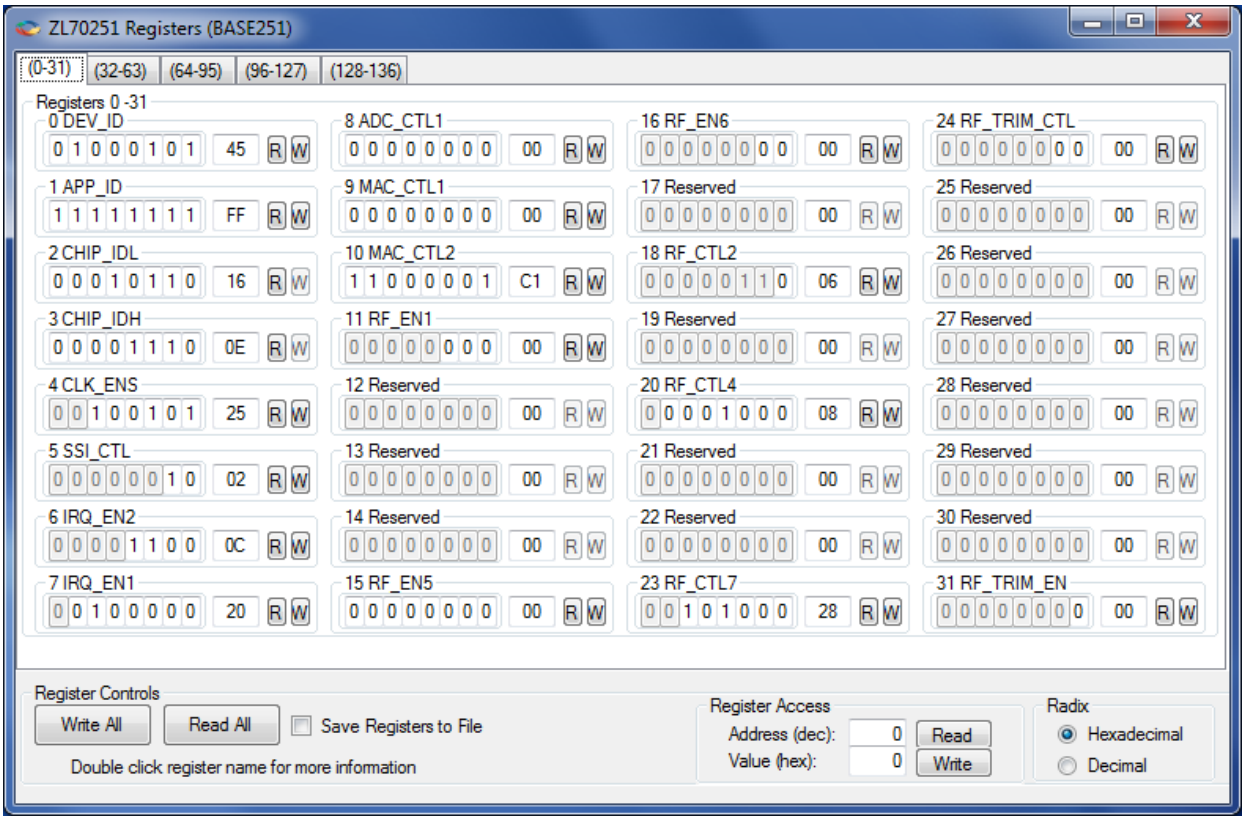


Figure 9 – Registers Main Form

3.3.1 Register Tabs

The upper section of the registers main form contains tabs that allow the user to access all registers of the ZL70251. Each tab is labeled with the decimal addresses of the registers that are found on that tab; for example, the first tab *(0-31)* enables access to the first 32 registers. Since all tabs in the registers main form (Figure 9) have the same register access subsections, only one register function is detailed in Figure 10 (on page 27) and described below.

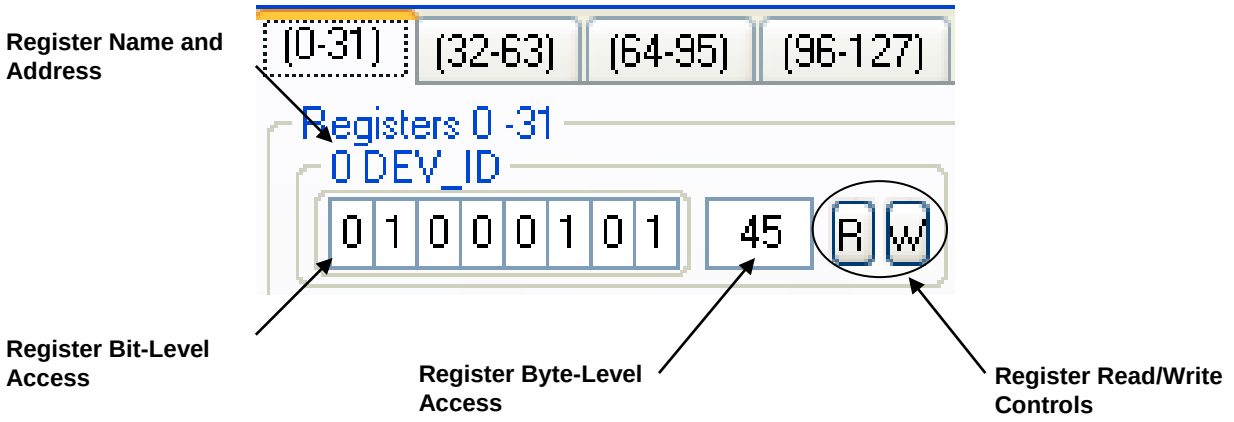


Figure 10 – Sample Register Access Subsection

The sample register access subsection in Figure 10 above includes:

- **Register name and address**: The register name and decimal address are the same as those given in the *ZL70251 Programmer User's Guide* (refer to Chapter 11). By double-clicking on the register name (near the register address), more information about the register is displayed in a pop-up window (refer to "3.3.3 *Register Description* Window" on page 29).
- **Register bit-level access**: This field allows for bit-level access to the register value. Bits that are not valid (don't cares) for a register are grayed out and cannot be modified. When clicking on a bit, the value toggles and turns red, indicating a change from the current value. After all desired bit changes are made, pressing the *W* (write) button causes the new bit values to turn back to black and the new register value is written to the ZL70251. (Refer to Note below.)
- **Register byte-level access**: This field allows for byte-level access to the register value in hexadecimal format. When clicking in this field, the current value disappears and a new value may be written in its place. The new value turns red, indicating a change from the current value. After the new value is entered, pressing the *W* (write) button causes the new value to turn black and the new value is written to the ZL70251. (Refer to Note below.) The radix used to display and enter the value is controlled by the *Radix* fields in the *Register Controls* section (located below the tabs; refer to "3.3.2 Register Controls" on page 28).
- **Register read/write controls**: The *R* and *W* buttons control the read and write functions, respectively, from and to the registers. If an *R* or *W* control is grayed out, it is an indication that its operation is not allowed for that register.
  - *R*: Pressing the *R* button causes a read from the register of the ZL70251 at the address displayed in the register name, and displays the register's value in both the byte- and bit-level access fields. All values are displayed in black.
  - *W*: If the register value is changed by the user (and is therefore red in the GUI), pressing the *W* button writes the new value to the register of the ZL70251 at the address displayed in the register name, and changes the color of the new value to black. (Refer to Note below.)

Note: If the user wants to simultaneously change multiple registers, refer to "3.3.2 Register Controls" on page 28 for a description of the *Write All* button.

3.3.2 *Register Controls* Section

The lower section of the registers main form, called *Register Controls*, provides for control over global functions of all register tabs (for example the ability to write to and read from all registers). The buttons and fields in this section are:

- ***Write All***: When this button is pressed, all outstanding register changes (shown in red on the register tabs) are written to the ZL70251. This operation takes a few seconds to complete.
- ***Read All***: When this button is pressed, all register settings are read from the ZL70251. This operation takes a few seconds to complete.
- ***Save Registers to File***: When this checkbox is checked and *Read All* is pressed, all registers settings are saved to a text file. The file is stored under **C:\Program Files\Microsemi\ZL70251 ADK [Version]\Program** where **[Version]** is the ADK version. Figure 11 is an example of the file format viewed in Notepad.

  Figure 11 shows that the address is displayed in decimal and the data is displayed in hexadecimal. This is compatible with the default format shown in the registers main form as well as the *ZL70251 Programmer User's Guide*.
- ***Register Access***: The fields in this group allow users to enter any register address for *Read* or *Write* access. The address is in decimal and the data value is in hexadecimal (in the *Address (dec)* and *Value (hex)* fields, respectively). The *Radix* radio buttons (refer to next bullet) do not apply to this function.
- ***Radix***: These radio buttons select the radix used for register values in the register byte-level access field for each register in the register tabs.

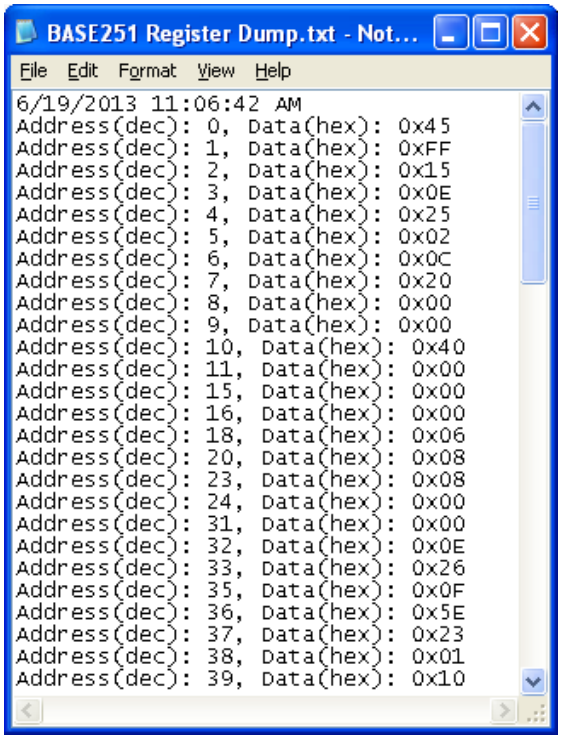


Figure 11 – Register Settings Saved to Text File

3.3.3 *Register Description* Window

The *Register Description* window is displayed when a user double-clicks on a register name (near the address) in the register tabs. Figure 12 shows an example of the *Register Description* window for the MAC_CTL1 register.

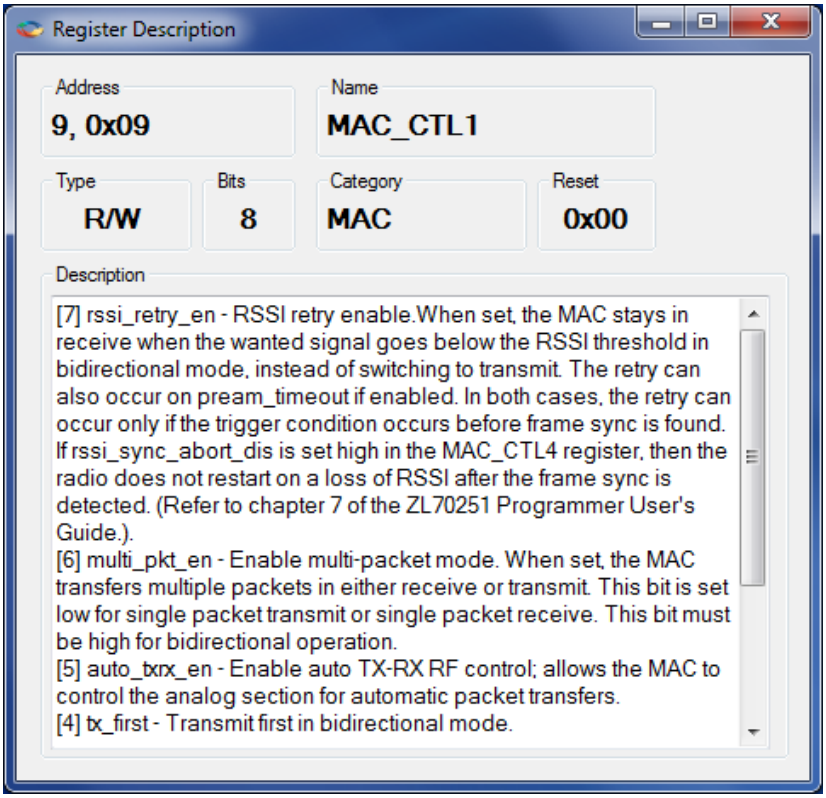


Figure 12 – Sample *Register Description* Window (MAC_CTL1 register)

The *Register Description* window is an informational dialog and therefore all fields are read-only. The fields are:

- ***Address***: The address of the register is displayed in decimal and in hexadecimal.
- ***Name***: This field gives the name of the register. This name is consistent with the name in the *ZL70251 Programmer User's Guide*.
- ***Type***: This field indicates which type of access is permissible. The options are:
  - R: Read only. A write operation is ignored.
  - W: Write only. A read value is meaningless.
  - R/W: Read or write.
- ***Bits***: This field indicates how many bits in the register are relevant. The relevant bits are right justified.
- ***Category***: This field indicates the register grouping as defined in the *ZL70251 Programmer User's Guide* in chapter "9 – System Memory Map".

- ***Reset***: This field indicates the default value, in hexadecimal format, for the register at power-on reset.
- ***Description***: This field gives a bit definition (bit word name) and a description for each bit in the register.

4 Getting Started Guide

This chapter contains examples of some of the more common operations that the ZL70251 ADK can perform. Either of these operations can run without having to change any default settings. These examples are helpful in becoming familiar with the ZL70251 ADK system components. Before attempting any of the operations in this chapter, make sure the following steps are complete:

1. Connect the supplied USB cable between the base station and the PC running the ZL70251 ADK application. Repeat this step for the remote device.
2. Make sure the associated antennas are attached to the BASE251 and REMOTE251 (refer to "2.1 Hardware List" on page 5).
3. Turn on the power to the units using the SW2 switch on the ADP100A board. To apply power, slide the switch to the left side (away from the Mini-B USB connector).
4. Launch the ZL70251 ADK application (refer to "3.1 ADK Main Form" on page 10).
5. Launch the base station main form and the remote device main form from the *ZL70251 Application Development Kit (ADK)* main form.
6. Make no error message are displayed in the GUI for either unit. (Error messages would be displayed in the *System Messages* text box at the bottom of the *System Status and Control* section on the main form.)
7. You are now ready to perform common operations such as those discussed in this chapter.

4.1 Performing a CCA While Transmitting a Carrier Wave

1. On the base station main form's *CCA & Cal* tab, check the *Continuous CCA* checkbox (in the *Clear Chan Assessment* subsection).
2. While still on the base station main form's *CCA & Cal* tab, press the *Perform CCA* button (in the *Clear Chan Assessment* subsection).
3. Observe the change in the values for the column labeled *RSSI Ave* and *Peak*.
4. On the remote device main form, go to the *Test* tab and press the *TX EN* button (in the *TX Carrier Test* subsection, under the *Carrier Wave* label). In the base station main form's *CCA & Cal* tab, observe the increase in power detected for channel 0 in the *RSSI Ave* and *Peak* columns of the *Clear Chan Assessment* subsection.
5. On the remote device main form's *Test* tab, select a different channel in the *Channel Number* drop-down in the *TX Carrier Test* subsection. In the base station main form's *CCA & Cal* tab, observe the increase in power detected for the selected channel in the *RSSI* column of the *Clear Chan Assessment* subsection.
6. On the base station main form's *CCA & Cal* tab, press the *Stop CCA* button (in the *Clear Chan Assessment* subsection). Notice that the values in the *RSSI Ave* and *Peak* columns are no longer updating.

4.2 Transmitting and Receiving a Packet in Multipacket Bit-Count Mode

For this example, the base station is the transmitter and the remote device is the receiver. This example demonstrates one possible method to send a packet of 16 bits from the base station to the remote board (refer to *ZL70251 Programmer User's Guide* for other possible methods). A logic analyzer or oscilloscope can be used to monitor the signals to verify that the packet is transmitted and received. The recommended signals to monitor on the BASE251 and REMOTE251, using external test equipment, are TXRX_CMD, SPI_SEL_B, SPI_DATA_IN, SPI_DATA_OUT, SPI_CLK, and IRQ. Note that IRQ can be used only when *tx_done_irq* or *rx_done_irq* is enabled.

1. Setup for the remote device:
   a. On the *ZL70251 Setup* tab under *Radio Setup* > *Frequency Setup*, enter the desired operating frequency of operation in the *Base Frequency (MHz)* text box and click the *Apply* button.
   b. On the *ZL70251 Setup* tab under *Radio Setup* > *MAC Modes*, perform the following setup for this example:
      i. Under *Tx/Rx Options* > *Preamble* > *Pattern,* select the *00110011* radio button.
      ii. Under *Tx/Rx Options* > *Bit Count*, check the *Rx Bit Count En* checkbox.
      iii. Enter the desired bit count in the *Rx Bit Cnt* counter. For this example, set this value to 16.
      iv. Under *Tx/Rx Options* > *Misc. Options*, check the *Multi Pkt* checkbox.
      v. Under *TXRX_CMD CTRL*, verify that the *0* radio button is checked.
      vi. Under *Tx/Rx Options* > *Rx RSSI*, set the *Threshold* to four counts above the RF noise floor. To find the RF noise floor, click on the *CCA & Cal* tab and click the *Perform CCA* button (in the *Clear Chan Assessment* subsection). Read the value of *RSSI Ave* for *Channel 0* (or for the channel on which the packet is being sent) and then set *Rx RSSI* > *Threshold* four counts above this reading.
      vii. Under *Tx/Rx Options* > *LNA_GAIN,* the *LNA Gain* can be set according to how close the boards are together. If the boards are within a couple meters of each other, use the slider to set the *LNA Gain* to b'0011 (equivalent to 0x03). If the boards are greater than 2 meters apart, use the slider to set the *LNA Gain* to b'1111 (equivalent to 0x0F).
      viii. Under *Modes,* select the *Receive* radio button.
      ix. The user can click the *R* button near the *Tx/Rx Options* > *Rx RSSI* > *Result* text box to read the value in the RX_RSSI_RESULT register, which shows the RSSI level of the incoming RF signal.
2. Setup for the base station:
   a. On the *ZL70251 Setup* tab under *Radio Setup* > *Frequency Setup*, enter the desired operating frequency of operation in the *Base Frequency (MHz)* text box and click the *Apply* button.

b. On the *ZL70251 Setup* tab under *Radio Setup* > *MAC Modes* for the base station, perform the following setup for this example:

   i. Under *Tx/Rx Options* > *Preamble* > *Pattern,* select the *00110011* radio button. Note that the preamble pattern for the base station **must** match the preamble pattern for the remote device.

   ii. Under *Tx/Rx Options* > *Preamble,* enter a value of 29 for *Count*.

   iii. Under *Tx/Rx Options* > *Bit Count*, check the *Tx Bit Count En* checkbox.

   iv. Enter the desired bit count in the *Tx Bit Cnt* counter. For this example, set this value to 16.

   v. Under *Tx/Rx Options* > *Misc. Options*, check the *Multi Pkt* checkbox.

   vi. Under *TXRX_CMD CTRL*, select the *1* radio to set TXRX_CMD high.

   vii. Enter the desired data pattern in the *SPI Data In* counter. This value is in hexadecimal format. For this example, enter 0xBD.

3. Transmit and receive the packet:

   a. If desired, on the remote board, the user can verify using a logic analyzer or oscilloscope that a packet of 16 bits with the data defined in the *SPI Data In* field on the base station GUI (under *ZL70251 Setup* > *Radio Setup* > *MAC Modes* > *TXRX_CMD CTRL*) was received by monitoring the SPI_SEL_B, SPI_CLK, and the SPI_DATA_OUT signals (refer to the *REMOTE251SchRevA.pdf* schematic for the REMOTE251 test points).

   b. If desired, on the base station board, the user can verify using a logic analyzer or oscilloscope that a packet of 16 bits with the data defined in the *SPI Data In* field was transmitted by monitoring the SPI_SEL_B, SPI_CLK, and the SPI_DATA_IN signals (refer to the *BASE251SchRevA.pdf* schematic for the BASE251 test points).

   c. On the base station's *ZL70251 Setup* tab, select the *Transmit* radio button under *Radio Setup* > *MAC Modes* > *Modes*. The base station then sends the packet over the RF link. Since the base station transceiver is in multipacket mode, the transceiver sends the 16 bits of data then sets the *tx_done_irq* status bit (the IRQ output of the transceiver is also set if the *tx_done_irq_en* bit is set). After the initial packet is sent and *tx_done_irq* is set, the transceiver immediately begins sending preamble via the RF link for the next packet. To send a subsequent packet, simply click the *Pulse* button under *ZL70251 Setup* > *Radio Setup* > *MAC Modes* > *TXRX_CMD CTRL*. This can be repeated to continue sending packets.

   d. The remote transceiver receives the 16 bits of data then sets the *rx_done_irq* status bit (the IRQ output of the transceiver is also set if the *rx_done_irq_en* bit is set). Since the transceiver on the remote board is in multipacket mode, the transceiver immediately begins searching for the next packet after the *rx_done_irq* status bit is set.

   e. To remove the base station transceiver from transmit, select the *None* radio button under *ZL70251 Setup* > *Radio Setup* > *MAC Modes* > *Modes* on the base station GUI.

   f. To remove the remote transceiver from receive, select the *None* radio button under *ZL70251 Setup* > *Radio Setup* > *MAC Modes* > *Modes* on the remote GUI.

A Performing Firmware Updates

This appendix describes how to program the firmware on the boards included with the ZL70251 Application Development Kit. The ADK is shipped with the latest firmware installed. If customers want to either modify the software for their own needs or install firmware updates from a future release, follow the procedure outlined in this appendix.

Note: **WARNING!** The firmware included in the ZL70251 ADK is not compatible with boards that were included with the ZL70250 ADK (ERM250, REMOTE250, BASE250, and ADP100), so do not try to use the firmware on those boards. Most notably, if you try to use the firmware on an ADP100 board connected to an ERM250, it could damage the ZL70250 chip on the ERM250.

A.1 Programming Firmware Using Elprotronic's FET-Pro430

The ADK includes a TI text format file (.txt) for each board's firmware. These files can be used with Elprotronic's FET-Pro430 programming software to program the firmware on the boards. (FET-Pro430 is available free at www.elprotronic.com.) This procedure also requires an MSP-FET430UIF, which may be purchased separately from Texas Instruments (at www.ti.com).

If you installed the ADK, the firmware files can be found under *C:\Program Files\Microsemi\ZL70251 ADK [Version]\Firmware* where *[Version]* is the ADK version. (If you installed the ADK in a different location, adjust the path accordingly.) If you have not installed the ADK, the firmware files can be found under the *Firmware* directory in the ADK release (CD or ZIP file).

A.2 Procedure to Program a BASE251 or REMOTE251 Board

To program a BASE251 or REMOTE251 board:

1. Connect the MSP-FET430UIF to the PC via USB.
2. Connect a USB cable between the PC and the Mini-B USB connector on the ADP board (the ADP100A board attached to the target board). This is required to ensure the target board has sufficient power to program the firmware.
3. Connect the MSP-FET430UIF to the JTAG port on the BASE251 or REMOTE251 target board using the PCA100 adapter included with the ADK. Be careful not to break the flap on the JTAG connector. (It is possible to pop the flap back in, or replace it if it breaks, but it can be tricky.)
4. Turn on the power switch on the ADP board, or if the power switch is already on, press the reset button on the ADP board (refer to SW1 and SW2 in Figure 1 on page 6 and Table 2 on page 8). This is necessary so the MSP-FET430UIF detects the target board.
5. Start the FET-Pro430 software.
6. In *Setup* > *Connection / Device Reset*, set the *COM Port* field to *USB*.
7. Set the *Microcontroller Type* field to *MSP430F2617*.

8. In *Setup* > *Memory Options*, select the following options.

   Under *Memory Erase/Write/Verify Address Range*, select *Main Memory Only*.

   Under *Retain Data in Flash (Autoprogram and Erase)*, uncheck the field *DCO Constants in INFO-A…* to prevent FET-Pro430 from reading the DCO constants and writing them back later (i.e., it just leaves them as is).

   Note: The default settings also work, but with the above settings, the FET-Pro430 software never accesses the DCO constants in information memory, helping to ensure they are never corrupted. If the DCO constants are ever corrupted, you can restore them using FlashPro430, available for purchase at www.elprotronic.com.

9. Under *Device Action*, check *Reload Code File*.
10. Click the *Open Code File* button and browse to the desired firmware file for the target board. The firmware files can be found under *C:\Program Files\Microsemi\ZL70251 ADK [Version]\Firmware* or under the *Firmware* directory in the ADK release (CD or ZIP file). Make sure you select the correct file for the target board, as follows:

    Base251.txt for a BASE251 board.

    Remote251.txt for a REMOTE251 board.
11. Click the *AUTO PROG* button to start programming the firmware.
12. The FET-Pro30 might ask if you want to update the firmware on the MSP-FET430UIF, which you might need to do in order to continue. Note if you also use CCS with the MSP-FET430UIF, and you want to continue to do so after updating the firmware on the MSP-FET430UIF, you might need to install the latest CCS updates as well. (Information on updating CCS can be found through www.ti.com/tool/ccstudio.)
13. When FET-Pro430 finishes programming the firmware, you may disconnect the JTAG port from the PCA100 adapter.
14. To run the new firmware, toggle the power switch or press the reset button on the ADP board.

A.3 Procedure to Program the ADP Board (ADP100A)

To use FET-Pro430 to program the ADP board (ADP100A) firmware:

1. Connect the MSP-FET430UIF to the PC via USB.
2. Connect a USB cable between the PC and the Mini-B USB connector on the ADP board. This is required to ensure the ADP board has sufficient power to program the firmware.
3. Connect the MSP-FET430UIF to the JTAG port on the ADP board using the PCA100 adapter included with the ADK. Be careful not to break the flap on the JTAG connector. (It is possible to pop the flap back in, or replace it if it breaks, but it can be tricky.)
4. Turn on the power switch on the ADP board, or if the power switch is already on, press the reset button on the ADP board (refer to SW1 and SW2 in Figure 1 on page 6 and Table 2 on page 8). This is necessary so the MSP-FET430UIF detects the ADP board.
5. Start the FET-Pro430 software.
6. In *Setup* > *Connection* / *Device Reset*, set the *COM Port* field to *USB*.

7. Set the *Microcontroller Type* field to *MSP430F1611*.
8. Under *Device Action*, check *Reload Code File*.
9. Click the *Open Code File* button and browse to the firmware file for the ADP board (*Adp.txt*). The firmware files can be found under *C:\Program Files\Microsemi\ZL70251 ADK [Version]\Firmware* or under the *Firmware* directory in the ADK release (CD or ZIP file).
10. Click the *AUTO PROG* button to start programming the firmware.
11. The FET-Pro30 might ask if you want to update the firmware on the MSP-FET430UIF, which you might need to do in order to continue. Note if you also use CCS with the MSP-FET430UIF, and you want to continue to do so after updating the firmware on the MSP-FET430UIF, you might need to install the latest CCS updates as well (information on updating CCS can be found through www.ti.com/tool/ccstudio).
12. When FET-Pro430 finishes programming the firmware, you may disconnect the JTAG port from the PCA100 adapter.
13. To run the new firmware, toggle the power switch or press the reset button on the ADP board.

B References

Document	Document Title
146499	ZL70251 Programmer User's Guide
146670	ZL70251 Data Sheet
146916	ZL70251 ADK Release Notes
N/A	ZL70251 ADK Source Code Overview

C Glossary

Paragraphs "C.1 Definitions" and "C.2 Abbreviations" below contain lists of definitions and abbreviations that are used throughout the User Guide.

C.1 Definitions

Term	Definition
ADP100A	Application Development Platform board. This is the main application development overhead board that supports all application boards.
BASE251	Base station application board. This is the functional level of hardware and software for the application.
REMOTE251	Remote device application board. This is the functional level of hardware and software for the application.
ZL70251 ADK	ZL70251 Application Development Kit. A combination of hardware and software components that make up a complete test and evaluation system based on Microsemi's ZL70251 Ultra-Low-Power RF Transceiver.

C.2 Abbreviations

Term	Definition
ADC	Analog-to-digital converter
ADK	Application development kit
AGC	Automatic gain control
BER	Bit error rate
CCA	Clear channel assessment
CCS	Code Composer Studio™, an integrated development environment for Texas Instruments (TI) embedded processor families (also called CCStudio)
CD	Compact disc
GUI	Graphical user interface
ISM	Industrial Scientific Medical (various unlicensed frequency bands throughout the RF spectrum for the purposes of industrial, scientific, and medical applications)
JTAG	Joint Test Action Group (standard to test integrated circuit connections)
LED	Light-emitting diode
P/N	Part number
PA	Power amplifier
PC	Personal computer
Qty	Quantity
RF	Radio frequency
RSSI	Received strength signal indicator
RX	Receive *or* receiver

Term	Definition
SMA	Subminiature A
TI	Texas Instruments
TX	Transmit *or* transmitter
US	United States
USB	Universal serial bus
VCO	Voltage-controlled oscillator
ZIP	Zone information protocol (a protocol that allows compression of files) *or* the three-character file extension on such a compressed file

D List of Changes

The following table lists substantive changes that were made in the ZL70251 Application Development Kit (ADK) User's Guide.

Revision	Change	Page
Revision 1 (August 2013)	Initial release. Note this document revision was initially created for ZL70251 ADK version 1.0.0.	–
Revision 2 (October 2013)	Changes for ZL70251 ADK version 1.1.0, as follows: • Added preamble detection functionality. • Added support for *half_band* bit for VCO calibrations. • Added status for how many packets had bit errors during BER test. • Added RSSI threshold trim to calibration section. • Moved the "Performing Firmware Updates" section to an appendix, and added a note stating the ADK is shipped with the latest firmware installed. • Minor corrections and improvements.	–
Revision 3 (March 2014)	Changes for ZL70251 ADK version 1.1.1, as follows: • Updated the GUI snapshots to show the new default settings and ADK version. • Changed the jumper configuration table to include the jumpers on BASE251 Rev E and later. • Minor improvements.	–
Revision 4 (August 2014)	Changes for ZL70251 ADK version 1.1.2, as follows: • Updated the GUI snapshots to show the ADK version.	–

E Product Support

Microsemi CMPG backs its products with various support services, including customer service, a website, electronic mail, and worldwide sales offices. This appendix contains information about contacting Microsemi CMPG and using these support services.

E.1 Customer Service

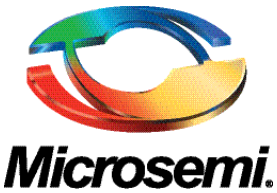
Contact Customer Service for nontechnical product support, such as product pricing, product upgrades, update information, order status, and authorization.

From North America, call 800.432.4009
From the rest of the world, call 512.228.5400

Via e-mail, write to sales.support@microsemi.com

E.2 Website

For more information, please visit www.microsemi.com, where you can browse a variety of technical and nontechnical information. Many answers available on the searchable web resource include diagrams, illustrations, and links to other resources on the website.



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