ZMD31015

RBic$_{dLite}$™ Low-Cost Sensor Signal Conditioner with Diagnostics

Development Kit Documentation

ZMD31015 RBic$_{dLite}$™ Sensor Signal Conditioner

Development Kit Documentation

Restrictions:

The ZMD AG RBic$_{Lite}$™ Development Kit hardware and software are designed for RBic$_{Lite}$™ evaluation, laboratory setup and module development only.

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1 Kit Contents

a) CD ROM of the RBic$_{dLite}$™ (Tester/Calibration) Software
b) RBic$_{Lite}$™ Development Board (Translator Board)
c) RBic$_{Lite}$™ Remote Board
d) USB Cable
e) 7ft RJ-11 (4-conductor phone line) cable

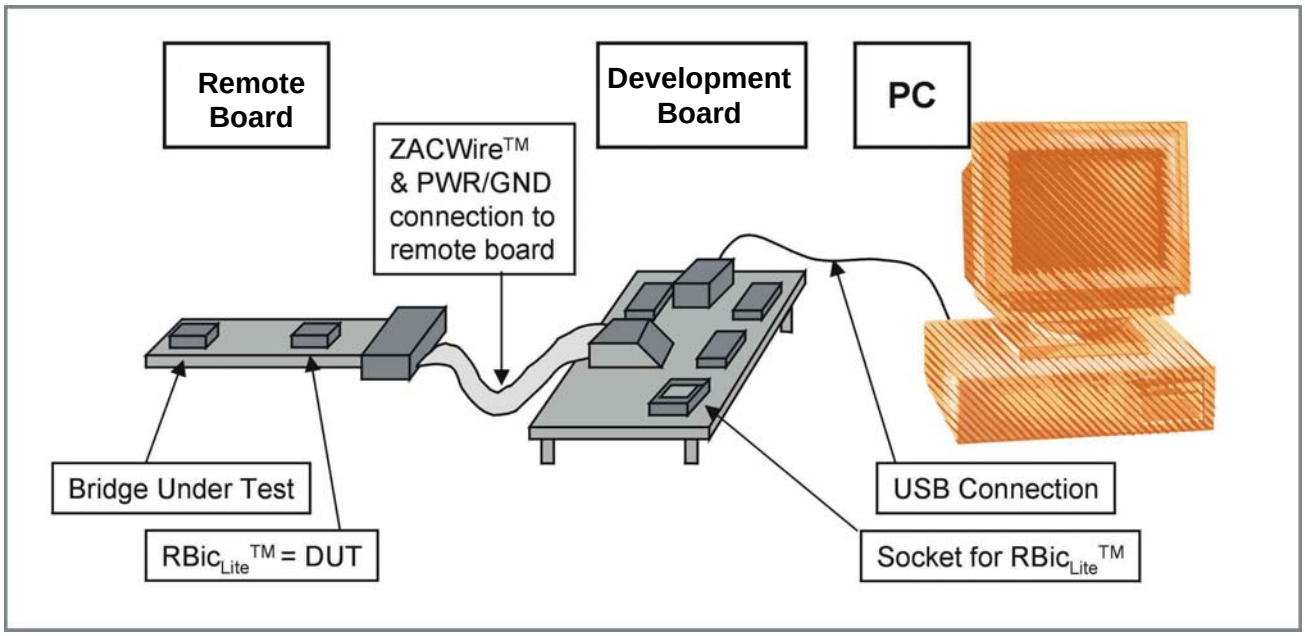

Figure 1.1 – RBic$_{Lite}$™ Development Kit

The RBic$_{dLite}$™ Development Kit contains the software and hardware needed for communication and calibration of an RBic$_{dLite}$™ sensor signal conditioning IC. A PC can communicate with the Development Board (also referred to as the "Translator Board") via a USB connection. The software should run on any Windows 98/ME/XP/NT system after the installation of an USB driver.

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2 USB Driver Installation

System Requirements

- 5x86-compatible PC
- 32 MB RAM
- Hard drive with 20MB free space
- USB port
- Microsoft W98/ME/2000/XP

The USB version of the ZMD31015 RBic$_{dLite}$™ Development Kit requires installation of two drivers. All the required driver files are in the “USB_Driver” folder on the Development Kit CD-ROM.

These two drivers will make your USB port appear as a virtual com port (typically COM3 or COM4 on most computers). The software provided with the Development Kit accesses the Development Board as if it were a COM (RS232) port. These drivers will in no way affect the operation of any other USB peripherals.

Driver installation is very similar for Windows XP or Windows 2000 installations; however, there are slight differences in the appearance of the dialog boxes. The steps for the Windows 2000 installation (given in the Appendix A in this document) are similar to the following XP installation.

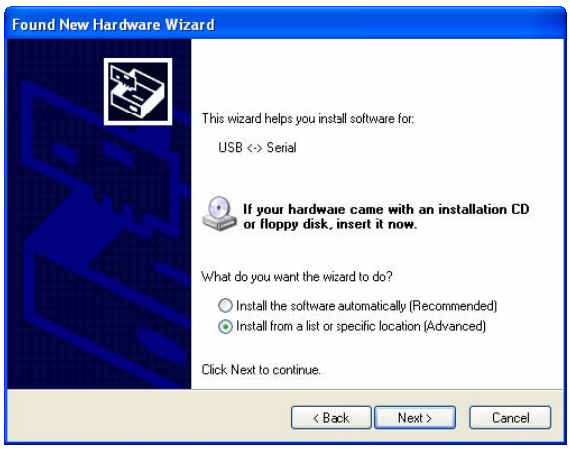
Installation for Windows XP Pro or XP Home Operating Systems

Installing the Basic USB Driver

Important: System administrator rights are required to install the USB driver on your PC.

Use the USB cable to connect the Development Board to an available USB port on your PC. The “Found New Hardware” wizard launches and brings up the following dialog box. Complete the following steps.

Step 1: Select “No, not this time,” and click “Next.”



Step 2: Select “Install from a list or specific location (Advanced).” Click “Next.”

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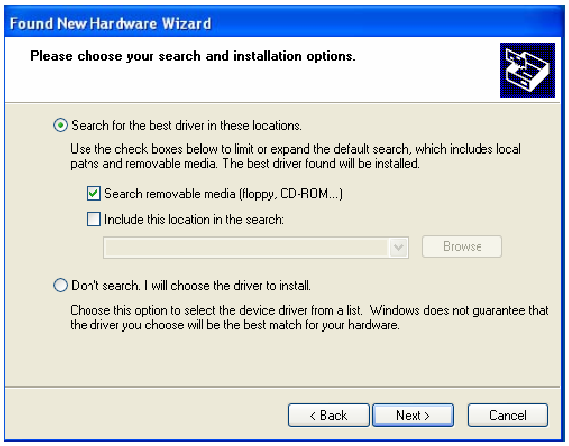
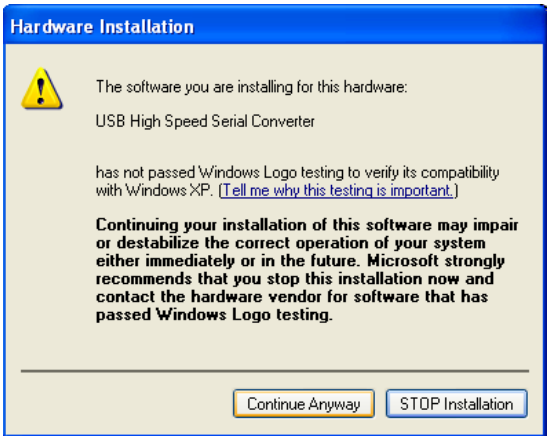
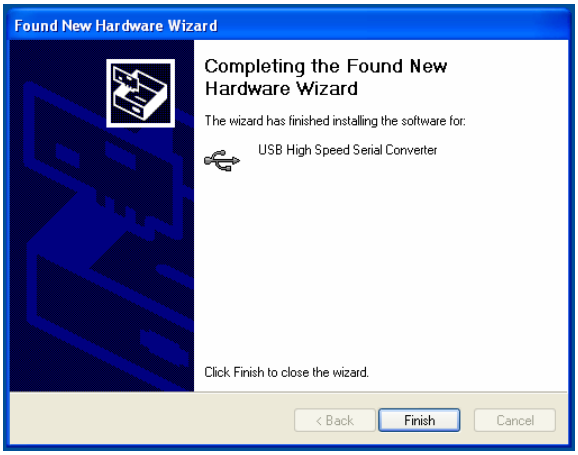


Step 3: Select “Search removable media (floppy, CD-ROM),” and click “Next.”



Step 4: When the warning about failing logo testing appears, click “Continue Anyway” because this concern is not applicable.



Step 5: Finish the driver installation by clicking “Finish.”

Installing the Virtual Com Port USB Driver

The second required USB driver causes the USB device to appear to the system as a virtual COM port.

Follow the same steps as outlined under *Installing the Basic USB Driver* above to complete this second driver installation.

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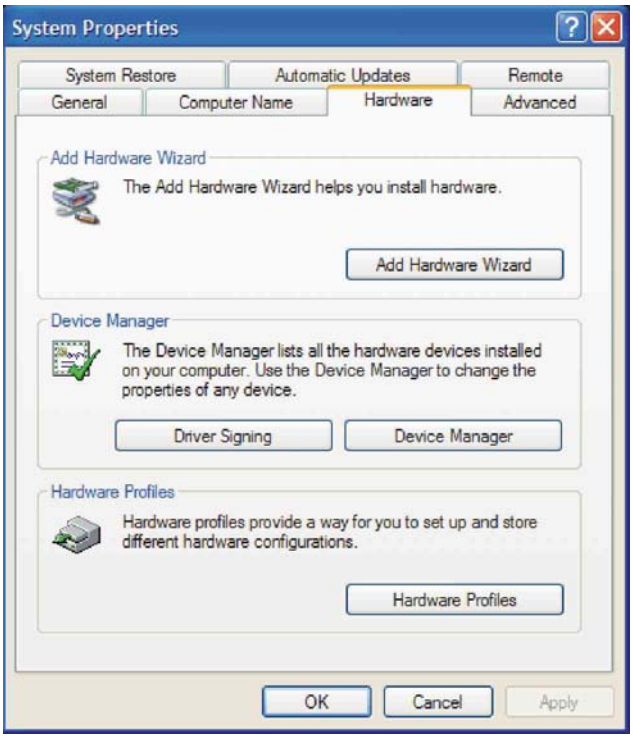
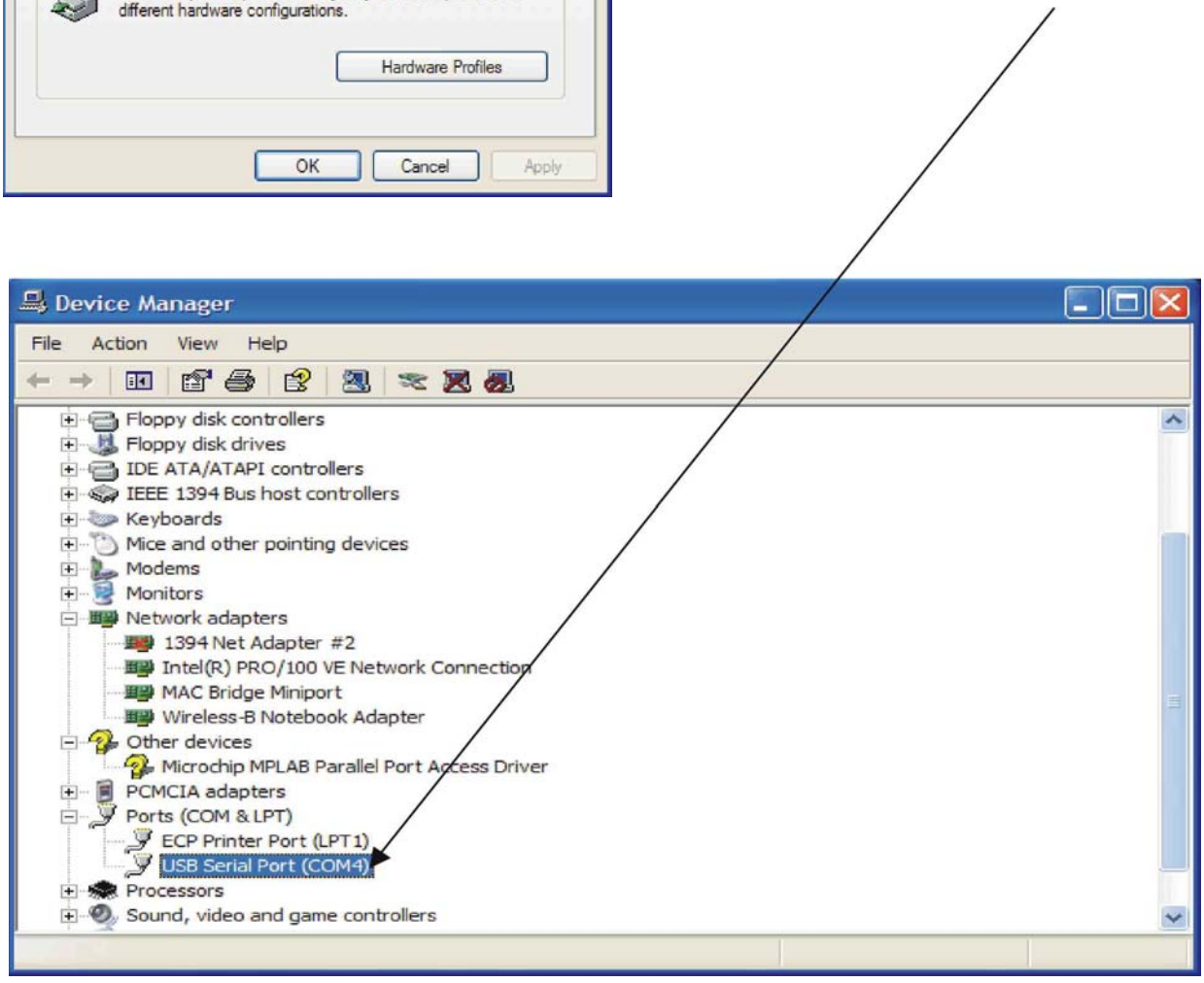


Checking USB Port Operation

Verify that the new hardware is operating properly before continuing. Access the control panel by clicking Start ➔ Settings ➔ Control Panel. Double click the "System" icon. The adjacent dialog box appears.

Click on the "Hardware" tab, and then on "Device Manager." This brings up the dialog box shown below:

If the USB is operating properly, "USB Serial Port (COMx)" appears under "Ports (COM & LPT). Typically, the "x" is 3 or 4. Remember this virtual COM port number. It is the COM port to select when using the software provided with the Development Kit.



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3 Development Board

Overview

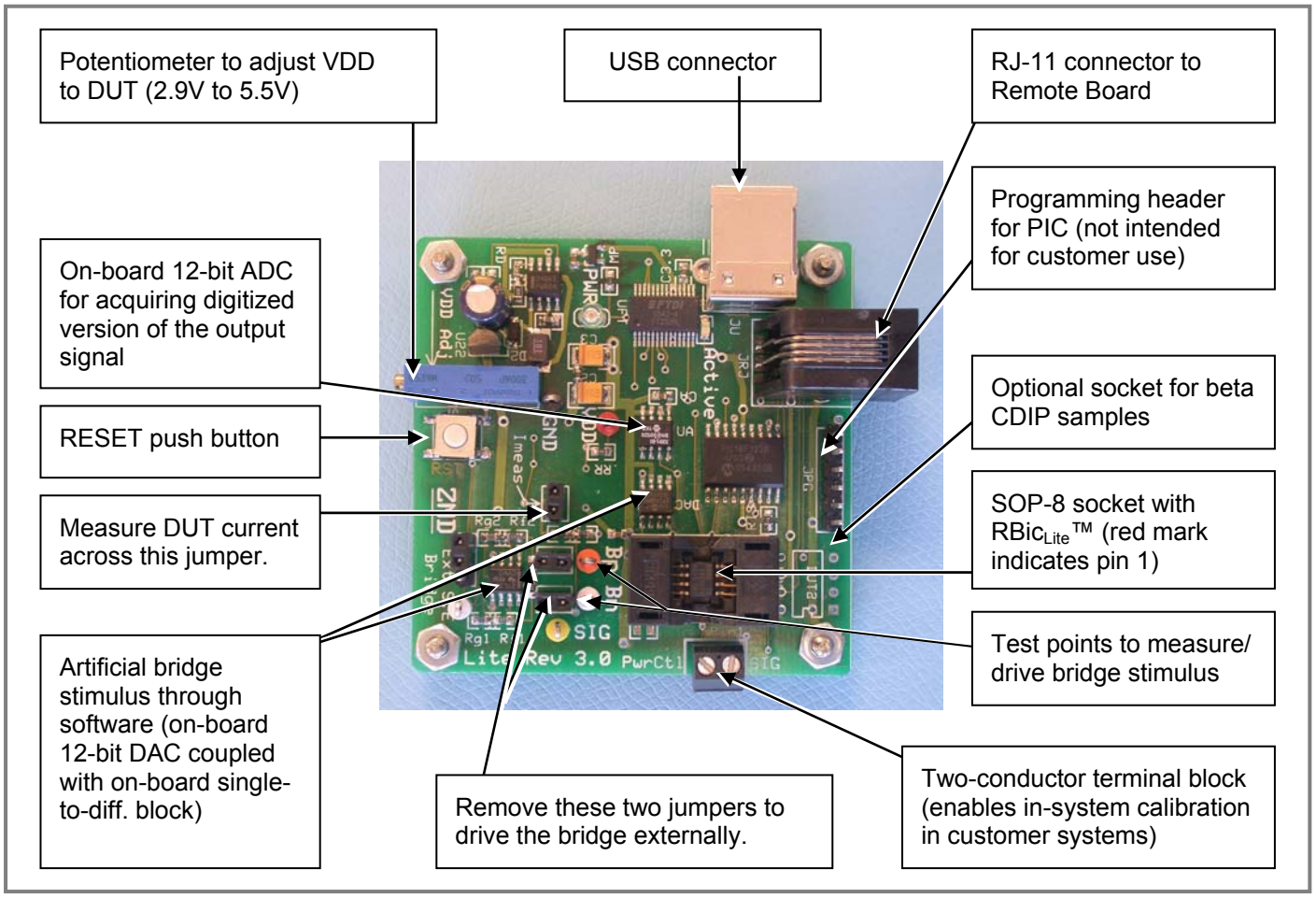

Figure 3.1– Development Board Overview

The main purpose of the Development Board is to perform communication between the PC and the RBic$_{dLite}$™ chip. The PC sends commands and data via the USB (virtual COM port). The µController on the Development Board interprets these commands and relays them to the RBic$_{dLite}$™ chip in the ZACwire™ format. The µController will also forward any data bytes from the RBic$_{dLite}$™ chip back to the PC via the USB connection as RS232 packets. These bytes can be bridge and temperature readings to be displayed by the PC software or raw ADC readings used during calibration or EEPROM content bytes.

3.1 Installing the Communications and Calibration Software

Install the RBic$_{dLite}$™ Development Kit CD-ROM in the PC hard drive. Locate the *setup.exe* file in the root directory of the CD-ROM, and double click on it. The software completes the installation.

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Connections to RBic$_{dLite}$™

The Development Board has two socket locations for inserting the RBic$_{dLite}$™. One is an SOP-8 socket and the other is an optional socket location for a ceramic dip sample (only used for beta samples; might be removed on future boards).

The RJ-11 connector can be used to connect to a remote board using the 4-conductor phone line provided with the kit. This remote board can contain the bridge to be calibrated and an RBic$_{dLite}$™ IC. The remote board can then be placed in a chamber that controls the parameter (e.g., pressure) that the bridge measures.

A third connection option is provided by the 2-wire terminal block. The two signals provided here are a power control signal and the ZACwire™ signal. These can be used for in-circuit programming of the RBic$_{dLite}$™ IC in the user's calibration fixture. The user must provide some hooks in their calibration fixture to enable this. Please see *ZMD31010 RBic$_{Lite}$™ Application Notes – In-Circuit Programming* for further information.

NOTE: Only one connection option can be used at a time. For instance, do not install an RBic$_{dLite}$™ in the SOP socket on the Development Board while another RBic$_{dLite}$™ is installed on a remote board connected through the RJ-11 connection. They will conflict with each other and cause unpredictable behavior.

Power Supply to the Board

The USB cable provides the power supply to the board. The board contains a DC/DC switcher followed by an adjustable regulator to condition the supply. The large blue 15-turn potentiometer can be used to adjust the supply voltage in the 2.9V to 5.5V range. VDD can be measured referenced to ground via the two mini-test points provided on the board (red test point labeled VDD and black test point labeled GND). All components on the board are supplied with this VDD supply. All functions of the board are operative down to lowest adjustable voltage. The board has a green LED labeled PWR which lights if the board has power.

3.2 Reset Switch

The µController contains an on-chip power-on reset circuit that resets the state of the controller during power up of the board. The manual reset switch is not normally needed; however, if your board is unresponsive and seems to have lost communication with the PC, a manual reset can sometimes be the solution. When reset, the µController sends a "50% value" to the digital-to-analog converter (DAC) used for artificial bridge input generation. This could make your artificial bridge input control out of synch with the actual value. Push the reset button again to ensure the artificial bridge value driven matches the software control.

On-Board Analog-to-Digital Converter (ADC)

The board contains a 12-bit analog-to-digital converter (ADC, A2D) that can convert the analog value on the SIG™ (ZACwire™) pin if the RBic$_{dLite}$™ is configured in an analog output mode. The software contains a "Get Analog" button that sends a command to the board requesting a conversion of the SIG™ pin. The result of the conversion will be displayed both as a voltage and as a percent of VDD. The ADC used is ratiometric, so the voltage readout is only accurate if the VDD of the board is set to exactly 5.00V when measured between the mini-test points labeled VDD (red) and GND black).

Artificial Bridge Stimulus

The board contains a 12-bit DAC and a fully differential op amp circuit used to attenuate the DAC output and convert it to differential. This DAC can be written to via the software. The full range is approximately –10mV/V to +10mV/V. If the board VDD is at 5V, the artificial bridge stimulus can range from approximately –50mV to about +50mV over the full code range (0x000 to 0xFFF) of the DAC.

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This feature can be useful for dry run calibrations and testing purposes. The differential artificial bridge stimulus can only be applied to the RBic$_{dLite}$™ if the chip is socketed on the Development Board. It does not work with a remotely connected RBic$_{dLite}$™.

The differential stimulus is driven through the two jumpers inline with the Bn/Bp test points (Bn=white=bridge negative, Bp=orange=bridge positive). These jumpers must be in place if using the DAC generated artificial bridge stimulus. When using an external bridge stimulus, remove these jumpers and apply the external stimulus directly to the Bn/Bp mini-test points.

What are the Jumpers For?

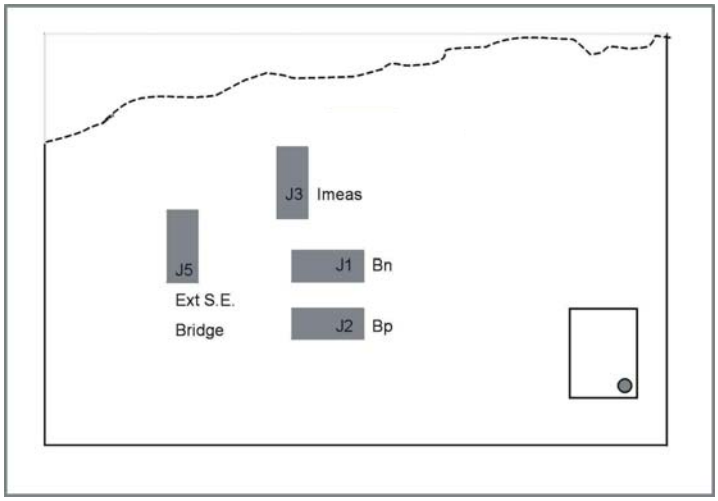

Figure 3.2– Jumpers on the Development Board

J1 Bn / J2 Bp

(See the "Artificial Bridge Stimulus" section.) Jumpers are required when using DAC as bridge stimulus.

J3 Imeas

This jumper can be removed and a current meter installed in its place to measure the current consumption of the RBic$_{dLite}$™ IC. When using a remote board with a bridge, the measurement is the current consumption of the bridge and the RBic$_{dLite}$™. Note: The RBic$_{dLite}$™ has very low current consumption at lower update rates (sub 200µA) average; however, the current consumption comes in bursts, so a standard DMM could give inaccurate readings.

J5 Ext S. E. Bridge

The factory-default position for the Ext S.E. Bridge jumper connects the single-ended-to-differential artificial bridge stimulus circuit to the DAC. If this jumper is moved to the next position, the single-ended-to-differential attenuator circuit is instead connected to the mini-test point. This allows connecting a function generator to this test pin to drive in arbitrary waveforms. These waveforms are then attenuated 50:1 and converted to a differential waveform to be driven into the bridge inputs. For example, if the user moves the jumper to this position and drives a 20Hz 5V$_{PP}$ waveform on the "Ext S.E. Bridge" test point, then a 20Hz 100mV$_{PP}$ differential waveform is driven to the bridge inputs (Bn/Bp).

Remote Board

The RBic$_{Lite}$ Remote Board allows the user to calibrate/test a bridge/IC pair in a controlled environment. The Remote Board with an RBic$_{dLite}$™ and a bridge can be placed in a control chamber set to a given condition (pressure/temperature for instance). This allows calibration of the device without placing the entire Development Board in a chamber, which is not recommended.

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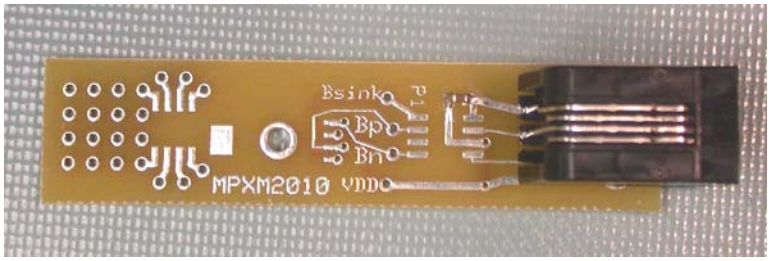

Figure 3.3 – The RBic$_{Lite}$ Remote Board

Figure 3.3 shows the RBic$_{Lite}$ Remote Board, which has a footprint for an RBic$_{dLite}$™ in an SOP-8 package. At the left, there is also a SOP-8 footprint that only breaks out to vias, which can be used for a user's sensor in an SOP-8 package. To use this footprint, wire the Bridge Supply, Bridge Sink, Brdg+, and Brdg- to VDD, Bsink, Bp, and Bn respectively. There is also a footprint (MPAK) available for a MPXM2010 gauge pressure sensor. There is also a 0.1 grid field to connect other types of bridge sensors.

The remote board can connect to the Development Board via the 4-conductor phone style modular cable. One cable is provided with the Development Kit.

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4 RBic$_{dLite}$™ Tester Software

Overview

The software ZMD provides with this Development Kit is intended for demonstration purposes and calibration of single units. ZMD can provide the user with algorithms and assistance in developing their full production calibration software. The Appendix B gives information about the protocol in detail.

COM1/COM2/COM3/COM4 Radio Button and Status Windows

Select the COM port to use for the PC ⇔ Development Board communication via USB. If the correct setting is unknown, a “trial and error method” can be used. If the COM port setting is incorrect, the Status window shows an error message.

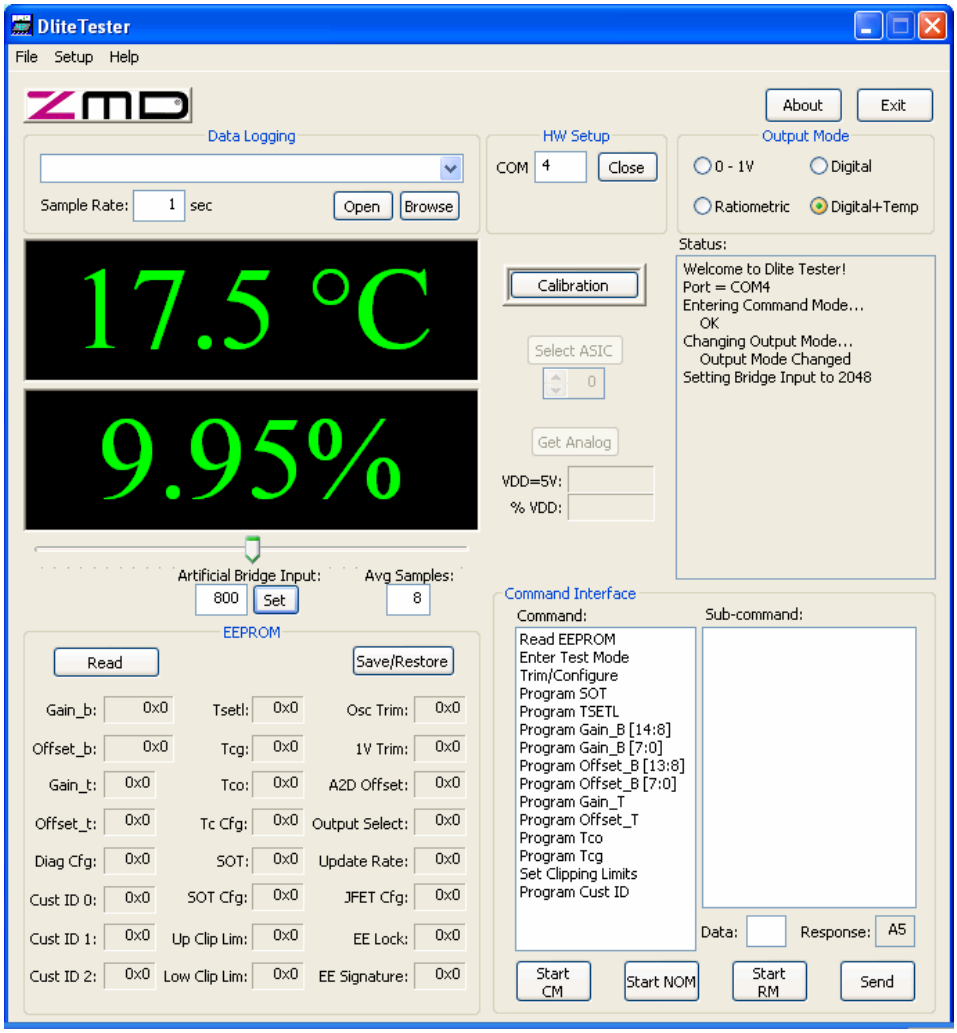

Figure 4.1 – Bridge and Temperature Display and Data Logging

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Bridge and Temperature Display

The software displays two large readout windows for temperature and bridge values. The temperature reading is the RBic$_{dLite}$™ temperature in °C. The bridge reading is in %. Calibration determines the relationship of the % reading to the value the bridge is measuring. The RBic$_{dLite}$™ is designed to be a generic resistive bridge conditioner, but for the following calibration example, assume it is connected to a pressure bridge. If the unit is calibrated to read pressure with 50kPa reading as 100% and 10kPa reading as 0%, then the span of pressure readings would be 40kPa. Half that span (20kPa) plus the set zero point (10kPa) should be the 50% point. After calibration, if the chamber is set to 30kPa, the RBic$_{dLite}$™ should give a 50% reading.

These readout windows only display temperature and bridge readings if the RBic$_{dLite}$™ is programmed in digital output configuration. There are two digital output configurations:

- Transmission of bridge readings and temperature
- Transmission of only bridge readings (no temperature)

Temperature is not displayed unless the RBic$_{dLite}$™ is configured to transmit both bridge and temperature in Digital Mode.

Data Logging Section

Bridge and temperature readings can be logged to a PC file. This feature is in the “Data Logging” section. Use the “Browse” button to select the directory where the file is stored. Then click “Open.” The “Sample Rate” field sets how often the data is collected. If the sample rate is 0sec, then an entry is written for each transmission from the RBic$_{dLite}$™. The resulting file is a space-delimited ASCII file and can be imported into Microsoft Excel®.

ZACwire™ Baud Rate

The default nominal baud rate for ZACwire™ transmissions from the Development Board to the RBic$_{dLite}$™ is 22kHz. The RBic$_{Lite}$™ oscillator is trimmed at the factory and has a nominal baud rate of 32kHz. See *ZMD31010* RBic$_{dLite}$™ *Application Notes – In-Circuit Programming Boards* for more information.

EEPROM Section

The “EEPROM” section contains all of the fields of the RBic$_{dLite}$™ EEPROM (non-volatile memory). The value of each individual field is displayed in this section when “Read” is clicked.

Command Interface Section

This section allows issuing commands to the RBic$_{dLite}$™ including any valid RBic$_{dLite}$™ command. Click the “START CM” command button (Start Command Mode) before sending any commands to the RBic$_{dLite}$™. This puts the RBic$_{dLite}$™ into Command Mode, and the output values in black display fields do not update.

Response Field

If the RBic$_{dLite}$™ successfully enters Command Mode, it sends a 0xA5 response, which is displayed in the “Response” field.

Command/Subcommand/Data Fields

To send a command to the RBic$_{dLite}$™, click on its text description in the “Command” section. If the command has a sub-command component, then also click the selected sub-command in the “Sub-Command” section. Some commands also require one or more hex digits of data. Enter these in the “Data” field.

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Send Button

After the desired command and any applicable sub-command are selected and any applicable data has been entered, click “Send.”

Start NOM Button

To exit Command Mode and return the RBic$_{dLite}$™ to Normal Operation Mode (reading, conditioning and transmitting bridge data), click “START NOM” (Start Normal Operation Mode).

Start RM Button

When in Raw Mode, the block display fields show the raw values (uncorrected ADC results) for bridge and temperature input signals if the bridge gain (Gain_B) is programmed to unity (0x800) and the temperature gain (Gain_T) is programmed to unity (0x80). The “Start RM” button is provided only as an option for control and analysis; it is not typically needed during a standard calibration run.

The Raw Mode can only be entered after entering the Command Mode.

The calibration section of the software will automatically put the RBic$_{dLite}$™ in Raw Mode and collect all the raw data needed for a given calibration point.

Get Analog Function

The board contains a 12-bit ratiometric ADC. The input to this ADC is connected to the SIG™ pin of the RBic$_{dLite}$™. When “Get Analog” is clicked, the software issues a request for analog conversion to the board. When the board responds, the result is displayed as a voltage (this is only accurate if the VDD of the board is set to exactly 5.00V between the VDD and GND mini-test points) and also as a % of VDD.

This feature is only useful if the RBic$_{dLite}$™ is programmed in analog output configuration.

Artificial Bridge Input Control

The controls for the DAC on the Development Board are directly below the bridge readout display. These controls determine what value is written to the 12-bit DAC on the Development Board. The output of the DAC is routed to a differential amp that attenuates the signal, converts it into differential, and drives it into the bridge inputs of the RBic$_{dLite}$™. This creates an artificial bridge input. The value to be written can be specified in hex and can range from 0x000 to 0xFFF. A value of 0x000 produces an approximately -50mV bridge signal. A value of 0xFFF produces an approximately +50mV bridge signal. There is always some inherent offset in the components used on the board, so these values are all approximate. This provides a convenient method for producing bridge inputs for dry runs for calibration and testing.

To change the value written to the DAC, enter the hex value in the “Bridge Input” field and click “Set,” or use the slider bar above it.

Avg samples (Average Samples)

This feature allows averaging the measured values by choosing the number of samples to average before displaying the result. The range is up to 255 (FFH) and must be entered as a hexadecimal value.

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Output Mode Section

Select the output mode before starting calibration. Additional selections are possible in the Calibration/Set ASIC Configuration window. This selection determines the value range of the output signals as shown in the following table:

Input Values Chamber Readings	Output Values Depending on Output Selection		
Measure example	Digital With/Without Temperature	Ratiometric Analog VDD=5V	0-1V
%	%(Digital)	V	V
10%	10% (204)	0.5	0.1
50%	50% (1024)	2.5	0.5
90%	90% (1834)	4.5	0.9

Table 4.1 – Output Mode Options

Adjustment of the Analog Pre-Amp Gain and the Analog ADC Offset Modes

The offset parameter is calculated automatically during the calibration procedure, and the result is stored in the EEPROM.

There are 4 programmable offset modes for the RBic$_{Lite}$.

a.) [-1/2,1/2)
b.) [-1/4,3/4]
c.) [-1/8,7/8]
d.) [-1/16,15/16]

During the calibration process (“Add New Point”), the software will "acquire" data four different times, acquiring data for all 4 different offset modes. The best offset mode to use is calculated automatically by the software, and the result is stored in the EEPROM.

If the user has a good understanding of the bridge and its performance, the user can choose to disable data acquisition in certain offset modes. This will expedite the calibration process because then data acquisition will not be needed in all 4 modes.

These analog offset modes help compensate for bridges that have a large inherent offset (default pre-gain = 24).

The [-1/2, 1/2] mode is best for a balanced bridge [-50mV, 50mV] @VDD=5V

The [-1/16, 15/16] mode is best for positive-skewed bridges [-10mV, 90mV] @VDD=5V.

The gain term stored in EEPROM used to compensate for span is a digital gain term (a digital number multiplied by the result of the ADC to compensate sensor span). Prior to ADC conversion, however, there is an amplifier (pre-amp). This amplifier amplifies the bridge signal to produce the differential signal converted by the ADC conversion. This amplifier can be programmed to one of four different settings.

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The programmable pre-amp gain can have the following values:

a.) A=6

b.) A=24 (default setting)

c.) A=48

d.) A=96

Any bridge input signal greater than 40mV/V in differential will saturate the pre-amp if the gain is set to 24 (default). In this case, the pre-amp gain must be set to the lower value 6.

For very small differential input signals, the higher analog gain (48 or 96) can improve the output resolution given in section 6.4 in the datasheet, but the sensor offset has always be considered as well as sensor span. Both the offset and span of the sensor are amplified by the pre-amp. With a high analog gain (48) the total offset plus span cannot exceed 20mV/V differential. With the higher analog gain (96) the total offset plus span cannot exceed 6mV/V differential. Otherwise the input to the ADC will be saturated.

Calibration Button

To initiate a calibration run, click the “Calibration” button. This results in the calibration screen and dialog box shown below.

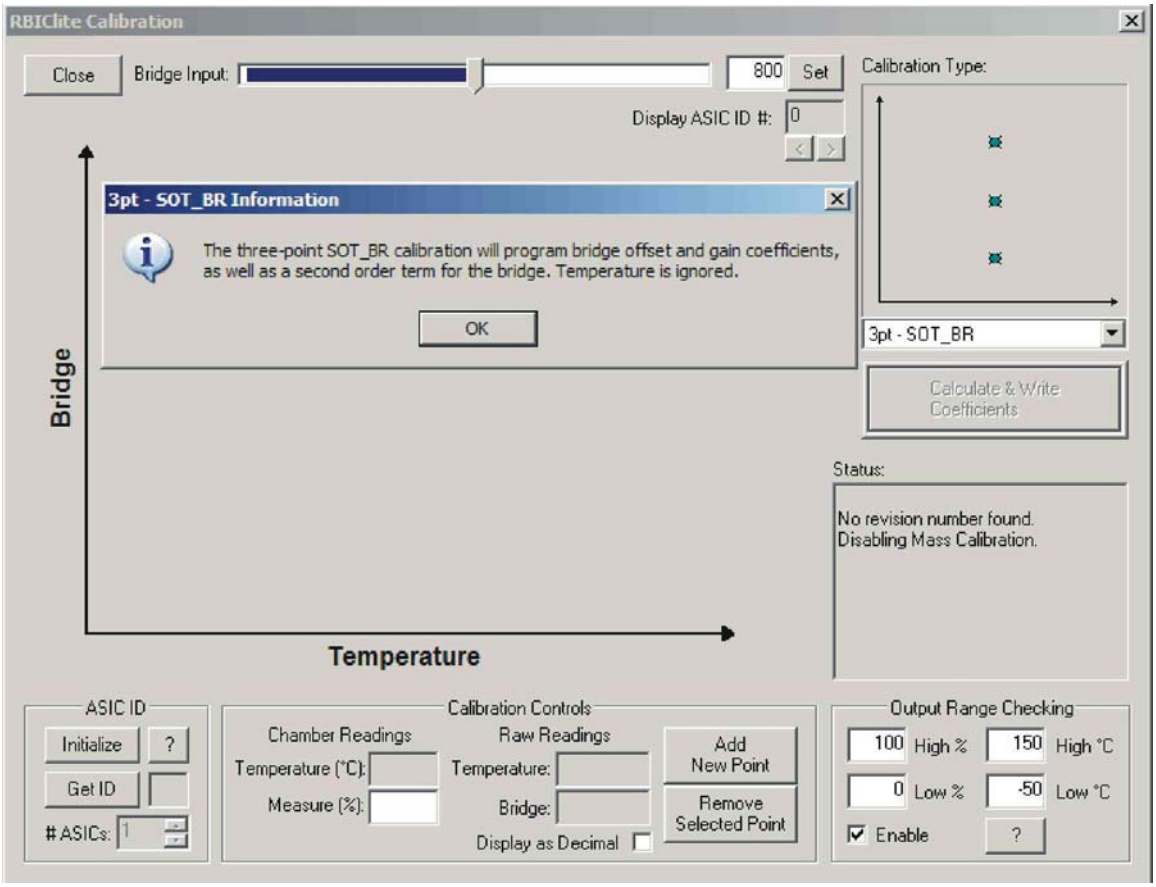

Figure 4.2 – Calibration Window

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Calibration Sequence

Although the RBic$_{dLite}$™ can function with many different types of resistive bridges, assume it is connected to a pressure bridge for the following calibration example. In this case, calibration essentially involves collecting raw bridge and temperature data from the RBic$_{dLite}$™ for different known pressures and temperatures. This raw data can then be processed by the calibration master (the PC), and the calculated coefficients can then be written to the EEPROM of the RBic$_{dLite}$™.

The software ZMD provides with this Development Kit is intended for demonstration purposes and calibration of single units. ZMD can provide customers with algorithms and assistance in developing their full production calibration software.

There are three main steps to calibration:

1. Assigning a unique identification to the RBic$_{dLite}$™. This identification is programmed in EEPROM and can be used as an index into the database stored on the calibration PC. This database will contain all the raw values of bridge readings and temperature readings for that part, as well as the known pressure (for this application example) and temperature to which the bridge was exposed.
2. Collecting data. Data collection involves getting raw data from the bridge at different known pressures and temperatures. This data is then stored on the calibration PC using the unique identification of the RBic$_{dLite}$™ as the index into the database.
3. Calculating and writing coefficients to EEPROM. After enough data points have been collected to calculate all the desired coefficients, the coefficients can be calculated by the calibrating PC and written to the EEPROM of the RBic$_{dLite}$™.

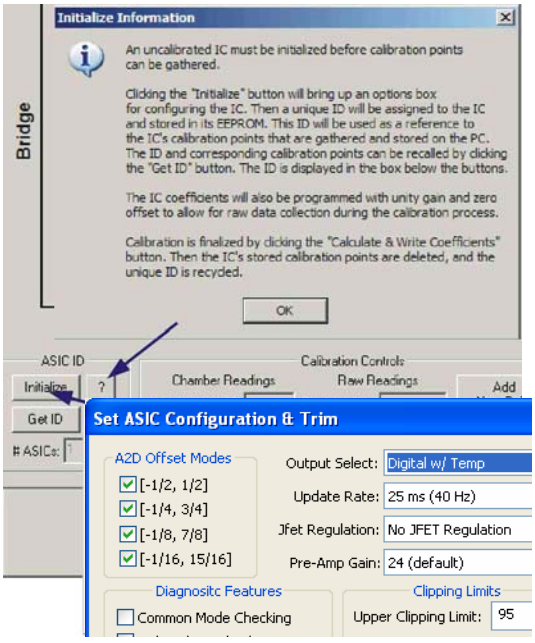

Figure 4.3 – ASIC ID Section for Initialization, Identification and Adjustment

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Step 1 – Assigning a Unique Identification (ASIC ID Section)

In the “ASIC ID” section in the bottom left corner of the calibration screen, click on “Initialize.” A dialog box (see **Error! Reference source not found.**) results for selecting the part configuration:

- Complete the fields for Output Select, Update Rate, JFET Regulation, Pre-Amp Gain, Gain Polarity and Flip Bridge Input.
- Select the diagnostic features to be enabled.
- Select External Temp if using the external temperature measurement.
- Enter the Upper and Lower Clipping Limits in hex code or % (in this case, also click “As %.”).
- Click OK.

The part is assigned a unique ID, which is used as an index in the database. This unique ID is also programmed into registers in the EEPROM.

Do not disable an ADC Offset mode unless you are certain the mode will not be needed for the bridge being calibrated. If uncertain, leave all four modes checked. Disabling offset modes only saves time during calibration. For initial evaluations of the RBic$_{Lite}$, it is best to leave all four modes checked and let the calibration software decide which modes to use (see “Adjustment...“ on page 15).

Pre-Amp gain of 24 is the default and sufficient for most bridges. Bridges that produce a large signal (>40mV/V differential (max-min)) must use the lower gain setting of 6. For bridges that have a small output signal (<2mV/V), using a higher gain setting of 48 or 96 will increase output resolution (see “Adjustment...“ on page 15).

The “?” next to “Initialize” is a help button that explains ASIC identification.

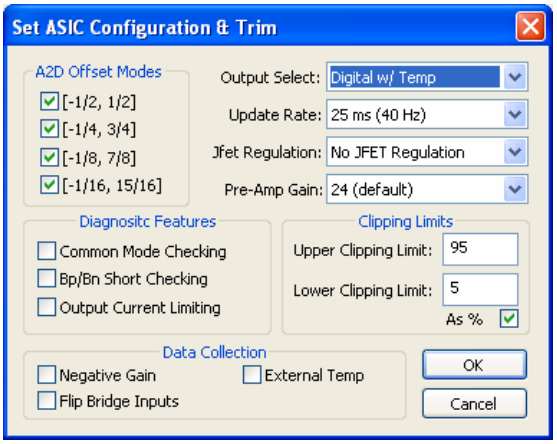

Figure 4.4 – ASIC ID Section for Initialization, Identification and Adjustment

Step 2 – Data Collection

Calibration Type Section with the Small Bridge-Temperature-Graph

The number of unique points (for this example, pressure and temperature points) at which calibration must be performed depends on the user’s requirements. The minimum is a 2-point calibration, and the maximum is a 5-point calibration. The next step is selecting the type of calibration.

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Under “Calibration Type” in the upper right section of the calibration screen (Figure 4.2), there is a smaller graph (X-axis = Temperature, Y-axis = Bridge (pressure for this example)). This graph outlines the recommended spread of points (pressure and temperature) to be used for calibration.

→ **Choose the desired calibration type from the drop-down list box below the smaller graph.**

The “?” next to the drop-down box is a help button which explains the selected calibration type.

Place the bridge/ RBic$_{dLite}$™ pair to be calibrated in a controlled environment (pressure/temperature chamber), and stabilize the environment at the first desired calibration point.

Calibration Controls Section

→ **Enter the temperature of the chamber, as well as the desired read out (in %) of the RBic$_{dLite}$™ at this pressure**.

→ **Click on “Add New Point.”** The raw data is obtained from the part, and the temperature and the point is displayed on the large graph. It is graphed on the X-axis according to the raw temperature reading from the part, and on the Y-axis according to the % value entered in the previous step.

→ **Change the pressure/temperature of the bridge/ RBic$_{dLite}$™ pair being calibrated and take as many more points as needed.**

Hints:

For good calibration results, choose the temperature and read out (%) values as close as possible to the desired working range.

The raw readings of temperature should be in the range of the measured chamber temperature for a valid calibration; if there is a problem, change the temperature about +/-5°C.

Step 3 Calculate & Write Coefficients

After enough data points have been collected to calculate the calibration coefficients, the **“Calculate and Write Coefficients”** button becomes active. Click this button. The software calculates all the coefficients, writes them to EEPROM, and frees up that index for future use. The bridge/IC pair is now calibrated.

Save/Restore Button

To save or restore EEPROM settings to and from a file, click the “Save/Restore” button. All settings are saved in a tab-separated file *SavedSettings.txt* located in C:\program files\ZMD America\RBIClite Tester.

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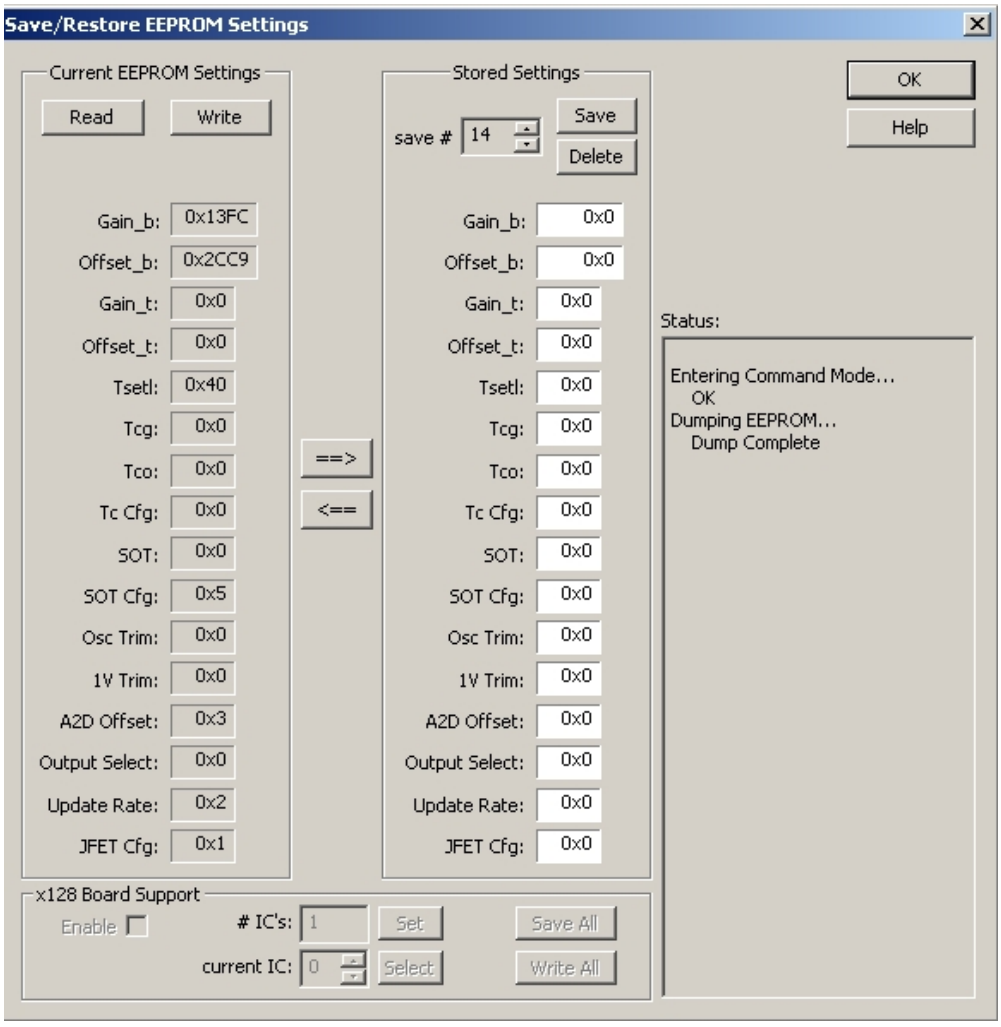

Figure 4.4 Dialog Window Save/Restore EEPROM Settings

When the Save/Restore dialog window opens, the EEPROM contents of the currently selected IC are read and displayed in the text boxes under “Current EEPROM Settings.”

==> Button

Clicking the ==> button transfers the values under “Current EEPROM Settings” to the dialog boxes under “Stored Settings” and writes these values to the *SavedSettings.txt* file under the index selected in the Save # dialog box.

<== Button

Clicking the <== button transfers the values currently displayed under “Stored Settings” to “Current EEPROM Settings” and writes these values to the EEPROM of the currently selected IC. To manually change the EEPROM settings in the currently selected IC, change the values under “Stored Settings” and click the <== button. Note: These changes are not stored to the *SavedSettings.txt* file until the Save button is clicked.

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Current EEPROM Settings Section

Read Button

To read and display the EEPROM settings stored in the currently selected IC, click the Read button. This is done automatically upon opening the Save/Restore dialog window; however the Read button can be used to verify a valid write operation. In addition, this button must be used to perform a single chip read in x64 mode.

Write Button

This button writes all the values under “Current EEPROM Settings” to the EEPROM of the currently selected IC. This is done automatically when the restore (<==) button is clicked; however the Write button is available in case of a write failure.

Stored Settings Section

EEPROM Fields

The values in the EEPROM dialog boxes under “Stored Settings” can be changed by saving from EEPROM (==> button), restoring from the *SavedSettings.txt* file (automatically retrieved when the Save # index is changed), or by changing values manually. If values are changed manually, the changes are not saved in the *SavedSettings.txt* file until the Save button is pressed.

Save # Field

The Save # value represents the index in the *SavedSettings.txt* file on disk which is referenced when saving or retrieving EEPROM values. The first column of data in *SavedSettings.txt* lists the indices. The last available index will always contain all zeros in the EEPROM fields.

Save Button

The Save button writes the values in the dialog boxes under “Stored Settings” to the *SavedSettings.txt* file on disk. This is done automatically on a transfer (==> button); however the Save button must be used to save any manual changes in the dialog box values to the *SavedSettings.txt* file.

Delete Button

The Delete button deletes the current index and shifts all indices after the deleted index down by one position.

X128 Board Support Section

This section allows interfacing with up to 128 ICs at a time. This section is not available when using the single RBic$_{dLite}$ Development Board; it only activates if the RBic$_{dLite}$™ Mass Calibration Board has been detected.

 # ICs Field and Set Button

This section is not available when using the single RBic$_{dLite}$ Development Board. If the x128 Board Support section has been enabled, type the number of ICs to be enabled in the # ICs dialog box and press the Set button. The software then validates that it can communicate with all of the ICs.

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Current IC Field and Select Button

This section is not available when using the single RBic$_{dLite}$ Development Board. After the IC number has been set, the enabled ICs can be scrolled through using the Current IC dialog box. After entering an IC number, press the Select button. All single chip operations can now be performed as described above (READ, WRITE, ==>, <==). Writing different values to each of the enabled ICs must be performed one chip at a time; there is no automated mass restore feature.

Save All Button

This section is not available when using the single RBic$_{dLite}$ Development Board. The Save All button cycles through all of the enabled ICs (0 → (# ICs-1)), reads each IC's EEPROM, and writes its settings to the end of the *SavedSettings.txt* file. Note: It is not possible to automatically restore these values to multiple ICs.

Write All Button

This section is not available when using the single RBic$_{dLite}$ Development Board. The Write All button writes the values currently displayed under "Current EEPROM Settings" to all enabled ICs. Upon completion, all enabled ICs will have identical EEPROM settings.

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5 Dry Run Calibration

The following directions perform an example of a simple 2-point linear calibration using the artificial bridge inputs generated by the on board DAC and single-to-differential attenuator feature.

Steps to the Dry Run Calibration

1.) Place the RBic$_{dLite}$™ in the SOP-8 socket on the Development Board. Pin 1 on rev 3.3 and later Development Boards is labeled “Pin1.”

2.) Connect a USB cable from the USB connector on the Development Board to an available USB port. Verify that the green PWR LED is lit.

3.) Start the “RBic$_{dlite}$™ Tester” software.

4.) Select the proper COM port using the radio buttons at the top of the screen (Figure 4.1) as determined during USB driver installation (see page 7).

5.) Click on “START CM.” If the setup is correct, A5 is displayed in the “Response” field at the bottom right.

6.) Click on “Calibration.” The calibration window appears (Figure 4.2).

7.) In the upper right section of the calibration window, under “Calibration Type,” choose “2-Pt Gain_B & Offset_B” calibration from the drop-down list box. The smaller graph above the list box indicates the recommended pattern of two bridge readings at the same temperature.

8.) Click on “Initialize” in the ASIC ID section (lower left corner). A dialog box results. Choose “Digital no Temp” as the output select; 25ms as the update rate; “No JFET Regulation”; “Pre-Amp Gain” 24 (default) and “normal bridge inputs” (not flipped). A unique identifier is assigned to this RBic$_{dLite}$™ and is written to its EEPROM.

9.) The next step is to start data collection. Normally this would be done with a real bridge attached to the RBic$_{dLite}$™ on a remote board in a controlled chamber. Instead, this dry run calibration uses the artificial bridge inputs controlled by the on-board DAC. The DAC controls are available at the top of the calibration window (Figure 4.2).

   a. Set the DAC control to 400hex.
   b. Enter 25% in the “Measure %” box in the “Calibration Controls” section.
   c. Click on “Add New Point.” The software obtains a raw reading from the part and graphs the new data point.
   d. Change the DAC setting to C00 Hex.
   e. Enter 75% in the “Measure %” box.
   f. Click on “Add New Point” again. The software obtains a new raw reading from the part and graph the new data point.

10.) Because this is a 2-point calibration, the software has all the necessary data for calculating and writing the coefficients. Click on “Calculate and Write Coefficients,” which should now be active.

11.) Close the calibration window. The temp reading is not valid because not enough data points were collected for temp calibration.

12.) Adjust the DAC controls and check that the values that make sense. For example, 800hex should read 50% and A00hex should read 62.5%.

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6 EEPROM Bits

See the *ZMD RBic$_{dLite}$ Datasheet* for full details.

EEPROM Range	Description	Note
2:0	Osc_Trim	See the table in the "Trimming the Oscillator" section in the *ZMD RBic$_{dLite}$ Datasheet* for complete data. 100 => Fastest 101 => 3 clicks faster than nominal 110 => 2 clicks faster than nominal 111 => 1 click faster than nominal 000 => Nominal 001 => 1 click slower than nominal 010 => 2 clicks slower than nominal 011 => Slowest
6:3	1V_Trim/JFET_Trim	See the table under "Voltage Reference Block," section 1.4.3 in the *ZMD RBic$_{dLite}$ Datasheet*.
10:7	A2D_Offset	The upper two bits are flip polarity and invert bridge input (negative gain) respectively. If both are used in conjunction, negative offset modes can be achieved. 00 => normal polarity, positive gain 01 => normal polarity, negative gain 10 => flip polarity, positive gain 11 => flip polarity, negative gain The lower two bits form the ADC offset selection. Offset selection: 11 => [-1/2,1/2] mode bridge inputs 10 => [-1/4,3/4] mode bridge inputs 01 => [-1/8,7/8] mode bridge inputs 00 => [-1/16,15/16] mode bridge inputs
12:11	Output_Select	00 => Digital (3 bytes with parity) Bridge High {00,[5:0]} Bridge Low [7:0] Temp [7:0] 01 => 0-1V Analog 10 => Rail-to-Rail Ratiometric 11 => Digital (2 bytes with parity) (No Temp) Bridge High {00,[5:0]} Bridge Low [7:0]

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EEPROM Range	Description	Note
14:13	Update_Rate	00 => 1 msec (1kHz) 01 => 5 msec (200Hz) 10 => 25 msec (40Hz) 11 => 125 msec (8 Hz)
16:15	JFET_cfg	00 => No JFET regulation (lower power) 01 => No JFET regulation (lower power) 10 => JFET regulation centered around 5.0V 11 => JFET regulation centered around 5.5V (i.e. over-voltage protection).
31:17	Gain_B	Bridge Gain (also see bits 10:7): Gain_B[14] => multiply x 8 Gain_B[13:0] => 14-bit unsigned number representing a number in the range [0,8)
45:32	Offset_B	Unsigned 14-bit offset for bridge correction
53:46	Gain_T	Temperature gain coefficient used to correct PTAT or ExtTemp reading
61:54	Offset_T	Temperature offset coefficient used to correct PTAT or ExtTemp reading
68:62	T_{SETL}	Stores Raw PTAT or ExtTemp reading at temperature in which low calibration points were taken
76:69	Tcg	Coefficient for temperature correction of bridge gain term: Tcg = 8-bit magnitude of Tcg term. Sign is determined by Tc_cfg (bits 87:85).
84:77	Tco	Coefficient for temperature correction of bridge offset term. Tco = 8-bit magnitude of Tco term. Sign and scaling are determined by Tc_cfg (bits 87:85)
87:85	Tc_cfg	This 3-bit term determines options for temperature compensation of the bridge. Tc_cfg[2] => If set, Tcg is negative Tc_cfg[1] => Scale magnitude of Tco term by 8, and if SOT applies to Tco, scale SOT by 8 Tc_cfg[0] => If set, Tco is negative

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EEPROM Range	Description	Note
95:88	SOT	2nd Order Term. This term is a 7-bit magnitude with sign. SOT[7] = 1 ➔ negative SOT[7] = 0 ➔ positive SOT[6:0] = magnitude [0-127] This term can apply to a 2nd order Tcg, Tco or bridge correction. (See Tc_cfg above.)
99:96	{SOT_cfg, Pamp_Gain}	Bits [99:98] = SOT_cfg 00 = SOT applies to Bridge 01 = SOT applies to Tcg 10 = SOT applies to Tco 11 = Prohibited Bits [97:96] = Pre-Amp Gain 00 => 6 01 => 24 (default setting) 10 => 48 11 => 96
102:100	Diag_cfg	This 3-bit term applies to diagnostic features Diag_cfg[2] → enable output short circuit protection. Diag _cfg[1] → enable sensor short checking. Diag_cfg[0] → enables sensor connection checking.
105:103	Lock_ExtTemp	EEPROM lock 011 or 110 => locked All other => unlocked When EEPROM is locked, the internal charge pump is disabled and the EEPROM can never be programmed again. Bit 105 (the MSB of this field) is also used for selecting external temperature measurement. 0XX => Internal PTAT used for temp 1XX => External diode used for temp
112:106	Up_Clip_Lim	7-bit value used to select an upper clipping limit for the output. It affects both analog and digital output. The 14-bit upper clipping limit value is comprised of {11,Up_Clip_Lim[6:0],11111}. 127 different clipping levels are selectable between 75.19% and 100% of VDD.
119:113	Low_Clip_Lim	7-bit value used to select a lower clipping limit for the output. It affects both analog and digital output. The 14-bit lower clipping limit value is comprised of {00,Low_Clip_Lim[6:0],00000}. 127 different clipping levels are selectable between 0% and 24.8% of VDD.

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EEPROM Range	Description	Note
127:120	Cust_ID0	Customer ID byte 0
135:128	Cust_ID1	Customer ID byte 1
143:136	Cust_ID2	Customer ID byte 2
151:144	Signature	8-bit EEPROM signature. Generated through a LFSR[1]. This signature is checked on power-on to ensure integrity of EEPROM contents.

[1] Linear feedback shift register

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7 Frequently Asked Questions and Known Development Kit Problems

1. How does the guaranteed output resolution vary with sensor sensitivity, and how does the output quantization step size vary with this resolution?

For smaller input spans, the minimum guaranteed resolution results in higher quantization steps. For the higher ranges of input span (blue cells in the following table), the output quantization steps are limited by the 11-bit output DAC.

Input Span	Min. Guaranteed Resolution	Analog Output Quantization Step ≤			Output Quantization As %
mV/V(min)	Bits	mV/VDD	mV(VDD=3V)	mV(VDD=5V)	≤ %
0.8	8	3.9	11	18	0.391
1.6	9	2.0	5	9	0.195
3.2	10	1.0	3	4	0.098
6.4	11	0.5	1.3	2.2	0.049
12.8	12	0.5	1.3	2.2	0.049
16.0	12.6	0.5	1.3	2.2	0.049

Table 7.1 – Output Quantization Steps

2. Can the Development Board be used to determine the output noise performance of the ASIC?

The Development Board is intended to provide a calibration and communication interface from the PC to the RBic$_{dLite}$™. An in-depth evaluation of the RBic$_{dLite}$™ for noise should not be performed with the Development Kit because the noise floor of the Development Board is higher than the noise of the RBic$_{dLite}$™ itself. If an in-depth evaluation of noise is required, use a circuit representative of the final application.

Output noise propagated by the RBic$_{dLite}$™ will appear as quantization noise at the update rate. For example, if the part is programmed for ratiometric output with a 1 kHz update rate, then output noise propagated through the part will appear as a 1 kHz dither ≤2mV.

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8 Related Documents

- ZMD31015 RBic$_{dLite}$™ *Datasheet*
- ZMD31015 RBic$_{dLite}$™ *SSC Kits Feature Sheet* (includes ordering codes and price information)
- ZMD31015 RBic$_{dLite}$™ *Errata Sheet – B2*
- ZMD31010 RBic$_{dLite}$™ *Application Notes – In-Circuit Programming Boards*
- ZMD31015 RBic$_{dLite}$™ *Die Dimensions and Pad Coordinates*
- ZMD31015 RBic$_{dLite}$™ *Mass Calibration Kit Documentation*

For the current revisions of this document and of the related documents, please go to www.zmd.biz or contact the ZMD sales team (see addresses on last page).

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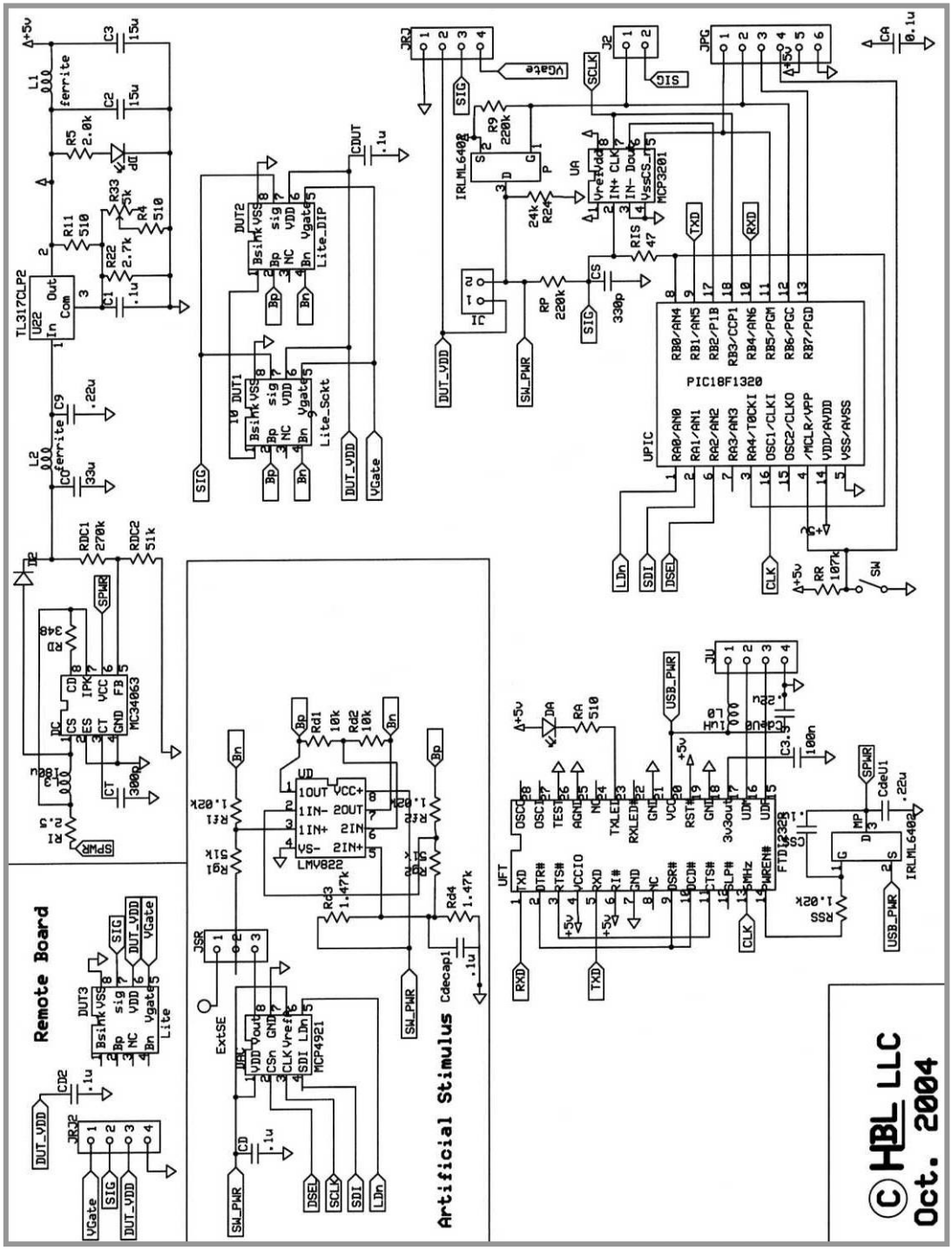
Appendix A: Schematic RBic$_{Lite}$™ Development Board /Remote Board



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Appendix B: RBic$_{dLite}$™ Tester Protocol

The following chapter includes also commands and descriptions, which are only available with the RBic$_{dLite}$™ Lite Mass calibration board (**LCB**) and **ZMD31010DK rev. 3.1 or higher**. These parts are marked **bold and with blue font color.**

1 Protocol

The RBIC Tester™ software communicates with the Development Kit (DK) and the Lite Mass Calibration Board (LCB) via a virtualized COM port (virtualized over a USB physical connection). Because the software sees the connection as a COM port, it uses the RS232 communication protocol. The software opens the selected COM port at 57600 baud with 8-bit data and no parity. USB virtualized COM ports typically appear in the computer's device manager as COM 3, 4, 5 or 6.

The higher-level protocol between the software and hardware implements command/data streams. The software can issue commands to the board. The board responds by executing the command and then returning some form of data or acknowledgement. Many of the commands issued to the board are actually commands intended for the RBic$_{dLite}$™ to execute. These commands are forwarded by the board to the RBic$_{dLite}$™. The RBic$_{dLite}$™ also responds to most commands with some form of data or acknowledgement. The response from the RBic$_{dLite}$™ is in turn sent back to the PC by the board. To keep all this data straight, some form of higher-level protocol is needed. This system uses a concept of "lead bytes" and "prepended bytes."

- Lead Byte
  A lead byte is the first (lead) byte of a command/data packet from the PC to the board. The lead byte is a command that informs the board of the packet type; e.g., a command/data pair to be forwarded to the RBic$_{dLite}$™. For more details, see the table in section 1.
- Prepended Byte
  After the board has executed the command, it typically responds to the PC in the form of requested data or an acknowledgement that the command was executed. The first byte of the packet it sends back is called a "prepended" byte. This byte is prepended on the packet to indicate the packet type. For example, a prepended byte might inform the PC that the following data is the result of a requested analog to digital conversion.

2 Summary Table of Commands (Lead Bytes) to the LCB/ZMD31010DK (firmware rev.3.1 or higher)

Lead Byte	Additional Bytes	Comment:
0x01	CMD_Byte Data_Byte	A lead byte of 0x01 instructs the LCB to forward the next two bytes (CMD_Byte & Data_Byte) to the RBic$_{dLite}$™ IC.
0x02	0x0H 0x0L	Used to write to the DAC on the single-unit RBic$_{dLite}$™ Development Board. Not applicable for the Mass Calibration Board.
0x03	None	Get Analog. A lead byte of 0x03 instructs the LCB to perform a 12-bit ratiometric conversion on the current Sig™ pin of the RBic$_{dLite}$™ IC and send the results to the PC. The MCB response to the PC has a 0x04 prepended, indicating analog data.
0x07	CMD_Byte Data_Byte	Only applicable to the RBic$_{dLite}$™ IC A lead byte of 0x07 instructs the board to forward the next two bytes (CMD_Byte & Data_Byte) to the RBic$_{dLite}$™.

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Lead Byte	Additional Bytes	Comment:
0x08	ASIC_Number	Switch ASIC lead byte. A 0x08 lead byte directs the LCB to switch to the ASIC specified by the following byte (ASIC_Number). The LCB responds by echoing a 0x08 followed by the ASIC number it selected. The firmware will immediately put the newly selected part into Command Mode.
0x09	None	Get Board ID. The board sends back a byte indicating its type and revision. The composition of the returned byte is as follows: [7:6] = Board Type: 00 => Single-Unit RBic$_{Lite}$™ Development Board 01 => 64X Multi-Unit Calibrator Board 10 => LCB 11 => Reserved [5:3] = Major revision # [2:0] = Minor revision #
0x0B	**None**	**Get RAW_DATA. This command to the LCB is used to obtain raw A2D readings of the bridge and temperature signals. It performs a series of steps including averaging raw samples, and combining temperature samples. It returns a 5-byte packet. See section 3 for a detailed description.**
0x0D	**EEP_FIELD (dLite)**	**Get EEP_FIELD_dLite. This command to the LCB instructs the board to perform and EEPROM dump of the RBic$_{dLite}$™, and parse out the requested field. Then only the contents of this field are returned. The pre-pended byte on the returned packet will be a 0x09. See section 2.**
0x23 (only supported on LCB1)	**None**	**Get current consumption. A lead byte of 0x23 instructs the LCB to perform a 12-bit conversion on the current signal. This signal on the board is proportional to the current the module is consuming (only valid if the internal board supply is used to power the modules). The LCB will return three bytes in total. A 0x04 prepended byte followed by a 0x0H and a 0xLL (where 0x0H represents the upper 4 bits of a 12-bit value and 0xLL represents the lower 8 bits of a 12-bit value)**

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3 Summary Table of Prepended Bytes From LCB/ ZMD31010DK (firmware rev.3.1 or higher) to Host PC

Pre-Pended Byte	Additional Data	Comment:
0x00	<Data Byte from ASIC>	A prepended byte of 0x00 from the LCB means the following byte came from the IC while it was in Command Mode.
0x01	0xBH	A prepended byte of 0x01 from the board means the following byte is the bridge high data.
0x02	0xBL	A prepended byte of 0x02 from the board means the following byte is the bridge low data
0x03	0xTT	A prepended byte of 0x03 from the board means the following byte is temperature data.
0x04	0x0H 0xLL	A prepended byte of 0x04 from the board means the following two bytes represent the result of an A2D conversion.
0x05	None	Indicates parity error received from ZACwire™ transmission.
0x06	**EEP_FIELD**	**A prepended byte of 0x06 from the board means the following byte is the requested field from the RBic$_{dLite}$™ EEPROM memory**
0x07	**0xBH** **0xBL** **0xTH** **0xTL**	**A prepended byte of 0x07 from the board means the following 4-bytes are raw bridge and temperature data. A 14-bit bridge value is returned as {0xBH,0xBL} and is the average of 16 samples. An 11-bit temperature value is returned as {0xTH,0xTL}.**
0x08	**TSETL** **TCO** **TCG**	**A prepended byte of 0x08 means the next 3-bytes coming back are the unique identifier. Programmed into (TSETL,TCO,TCG) on a Lite (31010) or into (Cust_ID2,Cust_ID1,Cust_ID0) on a RBic$_{dLite}$™ (31015)**

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4 Details of EEP_FIELD (RBicdLiteTM (ZMD 31015) not RBicLiteTM (ZMD 31010)) command:

The RBic$_{dLite}^{TM}$ ASIC when it dumps EEPROM does so as one long string of bytes. This data string needs to be parsed to obtain the desired fields. This command instructs the LCB to perform the dump and parse out a desired 1-byte field. This field is then returned with a pre-pended byte of 0x09.

A two byte command is sent the the LCB by the host. The first byte (0x0D) is the EEP_FIELD_dLite command, the second byte indicates which field of the EEPROM the user desires to read. The following table specifies the EEPROM field designations.

A EEP_FIELD identifier of 0x00 is a special case that will return a 4-byte (pre-pended, plus 3-bytes of data) Packet. This is useful to read the unique identifier (Cust_ID2,Cust_ID1,Cust_ID0) used as an index into the database. The pre-pended byte returned in this case is 0x08.

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2nd Byte Specifies Desired Field	EEPROM Field Returned
0x00	Special case, returns 3 bytes instead of 1. Returns (Cust_ID2,Cust_ID1,Cust_ID0) which is the unique identifier field.
0x01	{0000,1V_TRIM[3:0]}
0x02	{000000,A2D_Offset[1:0]}
0x03	{000000,Output_Select[1:0]}
0x04	{000000,Update_Rate[1:0]}
0x05	{000000,JFET_Cfg[1:0]}
0x06	{0,Gain_B[14:8]}
0x07	{Gain_B[7:0]}
0x08	{00,Offset_B[13:8]}
0x09	{Offset_B[7:0]}
0x0A	{Gain_T[7:0]}
0x0B	{Offset_T[7:0]}
0x0C	T_{SETL}[7:0]
0x0D	{Tcg[7:0]}
0x0E	{Tco[7:0]}
0x0F	{0000,Tc_cfg[3:0]}
0x10	{SOT[7:0]}
0x11	{0000,SOT_cfg[1:0],Pamp_Gain[1:0]}
0x12	{00000,diag_cfg[2:0]}
0x13	{00000,lock[2:0]}
0x14	{0,Up_Clip_Lim}
0x15	{0,Low_Clip_Lim}
0x16	{Cust_ID0}
0x17	{Cust_ID1}
0x18	{Cust_ID2}

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5 Details of GET_RAW command:

This command is used to obtain raw readings from the RBic$_{dLite}$™ when performing calibration. Once the part is at a given calibration set point and temperature this command can be issued to obtain raw A2D readings for the bridge and temperature signals. It performs the following functions.

1. **Enter command mode.**
2. **Program Gain_T to unity (0x80)**
3. **Program Offset_T to zero (0x00)**
4. **Program Gain_B to unity (0x800)**
5. **Set output mode to digital with temperature**
6. **Set update mode to 2nd fastest (5ms)**
7. **Enter RAW mode**
8. **Collect and average 16 bridge readings. Read temperature low bits**
9. **Enter command mode**
10. **Enter normal operation and read temperature high bits**
11. **Enter command mode**
12. **Combine temperature bytes to form an 11-bit temperature reading**
13. **Transmit raw data packet back to host PC.**

A 5-byte packet is returned, a pre-pended byte (0x07) and four bytes of data:

0x07 {00,0xBH} {0xBL} {00000,0xTH} {0xTL}

where:

0xBH = high 6-bits of raw bridge data (average of 16 samples)

0xBL = low 8-bits of raw bridge data (average of 16 samples)

0xTH = high 3-bits of raw temp data

0xTL = low 8-bits of raw temp data

NOTE: It is important to realize that this command will leave the RBic$_{dLite}$™ configured in digital output mode and at an update rate of 5ms. If these are not the desired settings for the final calibrated device then the user must program these options after the last use of this command.

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Appendix C: Calibrating the On Board A2D

The ZMD 31010 Development Board (ZMD 31010DK for RBic$_{Lite}$™ and RBic$_{dLite}$™) and the LCB1(128 channel mass calibration board) have a 12-bit ratiometric A2D converter. The input of this A2D is connected to the Sig™ pin (multiplexed Sig™ pin in case of LCB1) of the RBic$_{Lite}$™/RBic$_{dLite}$™. This allows analog to digital conversion of the RBic$_{Lite}$™/RBic$_{dLite}$™ output if the part is configured in analog mode. Thus software can get a reading of the analog output value of the signal conditioner.

1 A2D Specifications:

The A2D in use is the MCP320x. This A2D comes in a B grade and a C grade classification. The B grade devices have slightly better INL specifications. Early 31010DK's were built with the C grade devices. Later kits moved to the B grade devices.

Device:	Non-Linearity (INL)	Gain Error	Quantization Noise
MCP3201C	2 LSB's	1 LSB	0.5LSB's
MCP3201B	1 LSB	1 LSB	0.5 LSB's

Table 2 A2D Specifications

The A2D also has an offset error, but this document describes the procedure for calibrating that error out. Thus the worst case error for a class B device is 2.5 LSB's. Put in voltage terms that is:

$Error = VDD \bullet \frac{2.5}{2^{14}}$ with VDD=5.00V $Error \approx 3mV$ worst case.

2 Hardware/Firmware Requirements

For many revisions of the boards firmware (both 31010DK and LCB1) the firmware did not hold the sampling window of the A2D open for long enough for full settling time within the MCP3201 sample and hold circuit. This affected the quality of the A2D conversion and added another 7 to 10 LSB's of error worst case. To achieve maximum performance from the A2D the firmware revisions must have upgraded according to the following table.

Hardware Description:	Required Firmware Revision
31010DK boards rev 1.0 to 2.2. (yellow boards without green solder mask and without white silkscreen lettering.	**Not Applicable**. These boards did not contain a boot loader. Their firmware cannot be upgraded. A2D performance cannot be improved.
31010DK boards rev 3.0 to 3.1 populated with a PIC18F1220.	2.4 or higher
31010DK boards rev 3.1 and greater populated with a PIC18F1320	3.3 or higher
LCB1's version 0.x These boards have a socketed PIC16F62x μController. Firmware cannot be field upgraded. Firmware upgrades made by replacing PIC μController with a newly programmed PIC	1.3 or higher

Table 3 Required Firmware Revision

If the firmware of your board can be upgraded it is recommended you upgrade to the latest available firmware.

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3 Steps To Calibrate The 31010DK A2D.

It is assumed you are calibrating the A2D versus an accurate reference like a calibrated Keithly or Fluke multimeter that displays down 0.1mV granularity when on a 5V scale.

1. Adjust the board VDD supply.
   Measuring the VDD supply of the board, adjust the blue potentiometer until the VDD supply is within 1mV of 5.000V.

1. Launch the RBic$_{Lite}$™ or RBic$_{dLite}$™ software provided by ZMD.
2. With a RBic$_{Lite}$™ or RBic$_{dLite}$™ connected (or an SOIC-8 part in the on board socket) put the device in Ratiometric output mode. (The purpose of this is to get the software to realize the device is in an analog output mode. Thus it will enable the "Get Analog" button on the main software form. Otherwise this button may be "greyed out" and not active.
3. Disconnect the RBic$_{Lite}$™ or RBic$_{dLite}$™ device (or remove the SOIC-8 from the socket).
4. Adjust a stable lab power supply to somewhere near 2.5V.
5. Connect the ground of the lab power supply to the ground of the board. Hook the positive supply of the lab power supply to the Sig™ connector of the board.
6. Using your accurate well calibrated multimeter measure the voltage value of the Sig™ connector.
7. Now hit the "Get Analog" button on the software.
8. How does the value returned from the on board A2D compare to the measured value?

- **<Alt> + <Shift>** while hitting the **>** button will cause the A2D value to read about **1.25mV higher**. If you need it to read about 3mV higher you would hit that key combination 2 to 3 times.
- **<Alt> + <Shift>** while hitting the < button will cause the A2D value to read about **1.25mV lower**.

9. This offset adjustment is stored in the EEPROM data space of the PIC μController and is always added to every conversion. Once you have the "Get Analog" readings agreeing with your measured reading within +/- 1mV you are done with the adjustment process.

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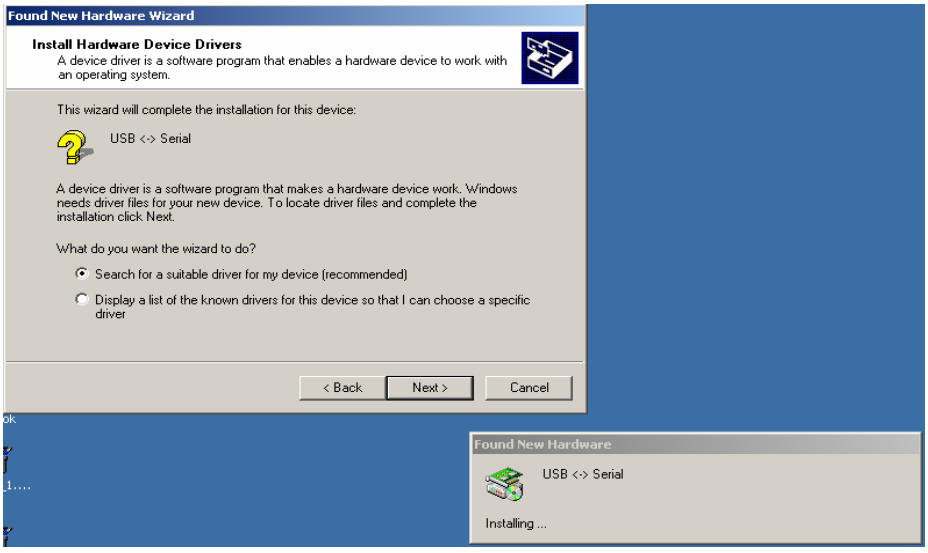
Appendix D: Driver Installation on Windows 2000 Operating Systems

Follow these steps to install the basic USB driver on Windows 2000 operating systems:

1. Connect the Development Board to a USB port with a USB cable. The “Found New Hardware” wizard automatically launches, and the following dialog box appears:

2. Click Next. The following dialog box appears. Select “Search for a suitable driver for my device (recommended)”.



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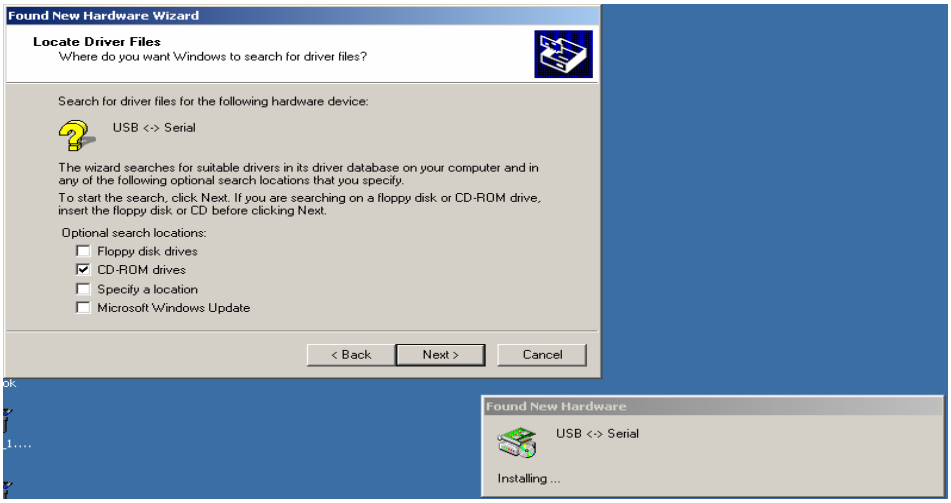
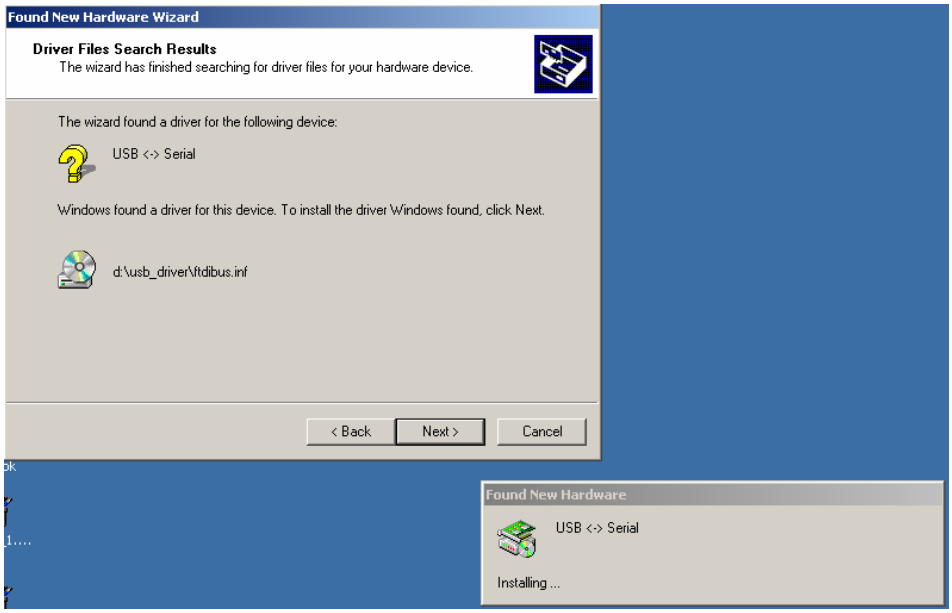
3. Click on Next. The following dialog appears. Select “CD-ROM drives.”



4. Click on Next. The following display appears confirming that the driver was found on the CD-ROM drive.



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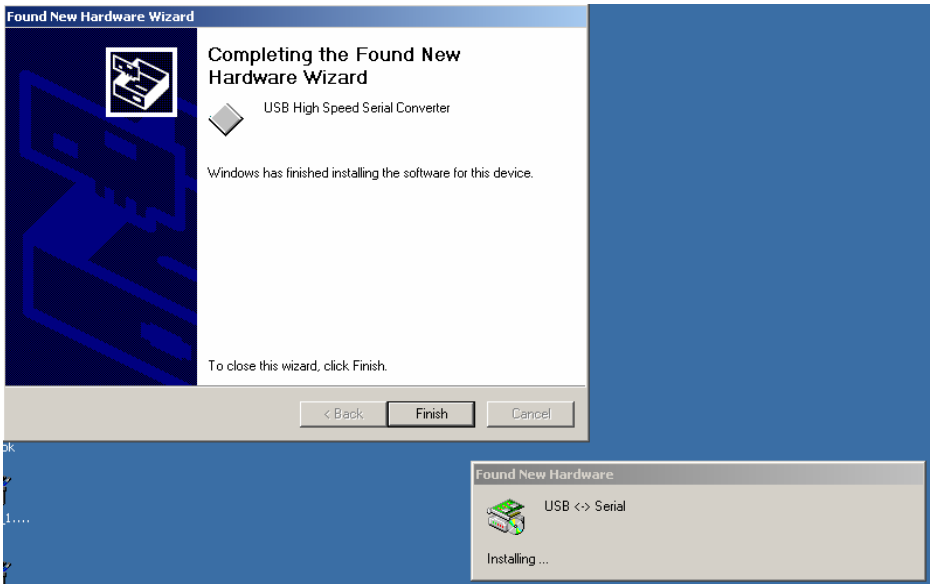
5. Click on Next. The following display confirms the installation of the basic USB driver.



6. Click on Finish. The second USB driver installation automatically starts. This second required USB driver causes the USB device to appear to the system as a virtual COM port. Follow the same steps as outlined under *Installing the Basic USB Driver* above to complete this second driver installation.

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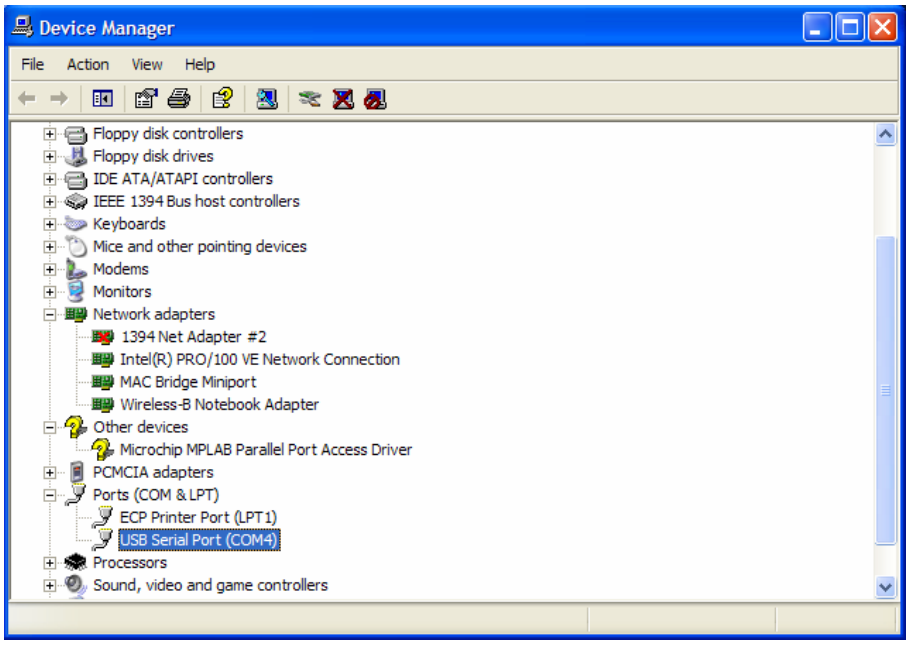
7. Verify that the new hardware is operating properly before continuing. Access the control panel by clicking Start ➔ Settings ➔ Control Panel. Double click the “System” icon. The following dialog box appears.

8. Click on the “Hardware” tab, and then on “Device Manager.” The following display appears.



If the USB is operating properly, “USB Serial Port (COMx)” appears under “Ports (COM & LPT). Typically, the “x” is 3 or 4. Remember this virtual COM port number. It is the COM port to select when using the software provided with the Development Kit.

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ZMD31015

RBic$_{dLite}$™ Low-Cost Sensor Signal Conditioner with Diagnostics

Development Kit Documentation

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For further information:

ZMD AG
Grenzstrasse 28
01109 Dresden, Germany
Phone +49 (0)351-8822-366
Fax +49 (0)351-8822-337
sales@zmd.de
www.zmd.biz

ZMD America, Inc.
201 Old Country Road, Suite 204
Melville, NY 11747, USA
Phone +01 (631) 549-2666
Fax +01 (631) 549-2882
sales@zmda.com
www.zmd.biz

ZMD Far East
1F, No.14, Lane 268
Sec. 1 Guangfu Road
HsinChu City 300
Taiwan
Phone +886.3.563.1388
Fax +886.3.563.6385
sales@zmd.de
www.zmd.biz

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