5007 Dual Synthesizer Configuration Manager User's Guide
(admin Version)

Version 1.6.1

Valon Technology, LLC

valontechnology.com

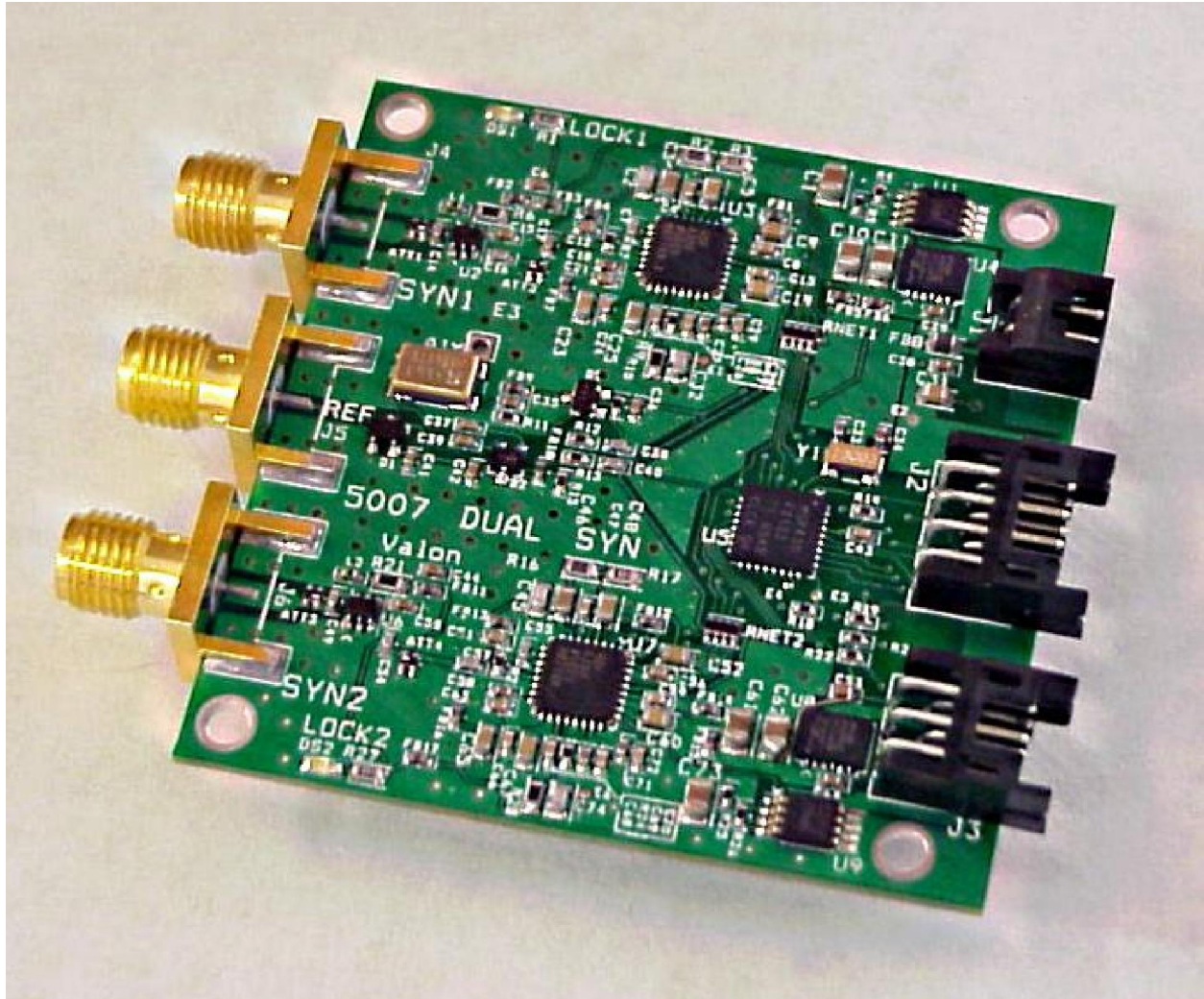**5007 Dual Synthesizer Module**

Table of Contents

1. Overview

The **Configuration Manager Program** is an easy to use software tool that enables the user to set the registers in the **Valon Technology 5007 Dual Frequency Synthesizer Board** in order to produce the desired output signals.

The **Configuration Manager Program** works in conjunction with the microcontroller on the **5007 Dual Frequency Synthesizer Board** to read and write the contents of the control, N-counter and R-counter registers in the two integrated synthesizer devices on the dual synthesizer board. Once the user is satisfied with the register settings and output signals, the **Configuration Manager Program** is used to send a command to the synthesizer board to copy the register settings to the non-volatile flash memory in the microcontroller.

In addition to the synthesizer register data, the **Configuration Manager Program** will read and write labels, frequency offsets, and reference oscillator frequency data. Like the synthesizer register data, this information can be copied to the non-volatile flash memory in the microcontroller.

The **Configuration Manager Program** will validate all of the frequency values entered by the user according to the specifications for the synthesizer device being used.

A user defined set of synthesizer parameter values and related data may be saved in a disk file and retrieved at a later time.

When exiting (using **File/Exit**) the **Configuration Manager Program**, the current set of set of synthesizer parameter values and related data will be saved automatically. The next time that the **Configuration Manager Program** is run, the values and data will be restored automatically.

1.1 Platform

The **Configuration Manager Program** will run on any Windows / Intel hardware platform and is compatible with the Windows 2000, Windows XP, Windows Vista, and Widows 7 operating systems. (we're working on linux).

1.2 Communications

The **Configuration Manager Program** communicates with the **5007 Dual Frequency Synthesizer Board** via either an RS-232 serial data communications adapter or a USB adapter. All data transfers include a checksum byte to prevent transmission errors from going undetected.

Valon Technology serial communications port adapters:
122006 RS-232 9-pin adapter.
122008 Mini-USB adapter.
Either are available from Valon Technology.

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2. Getting Started

2.1 Connect The Hardware

Before installing and/or running the **Configuration Manager Program**, it is necessary to connect one of the serial data communications ports on the computer where the **Configuration Manager Program** will be run (the host computer) to the serial data communications port on the **5007 Dual Frequency Synthesizer Board**. **To do this you will need one of the serial adapters mentioned above.**

2.2 Power Up The Board

Apply 5 VDC to the **5007 Dual Frequency Synthesizer Board**. See 5007 data sheet for voltage range.

2.3 Install The Software

The **Configuration Manager Program** can be downloaded from http://valontechnology.com/5007/5007.htm. To install the program on the host computer, follow the instructions below.

a. Download and save the Setup.exe program.
b. Click on the "**setup.exe**" file. The installation program will start by displaying the **Installation Options Window** as shown in Figure 2-1 below.
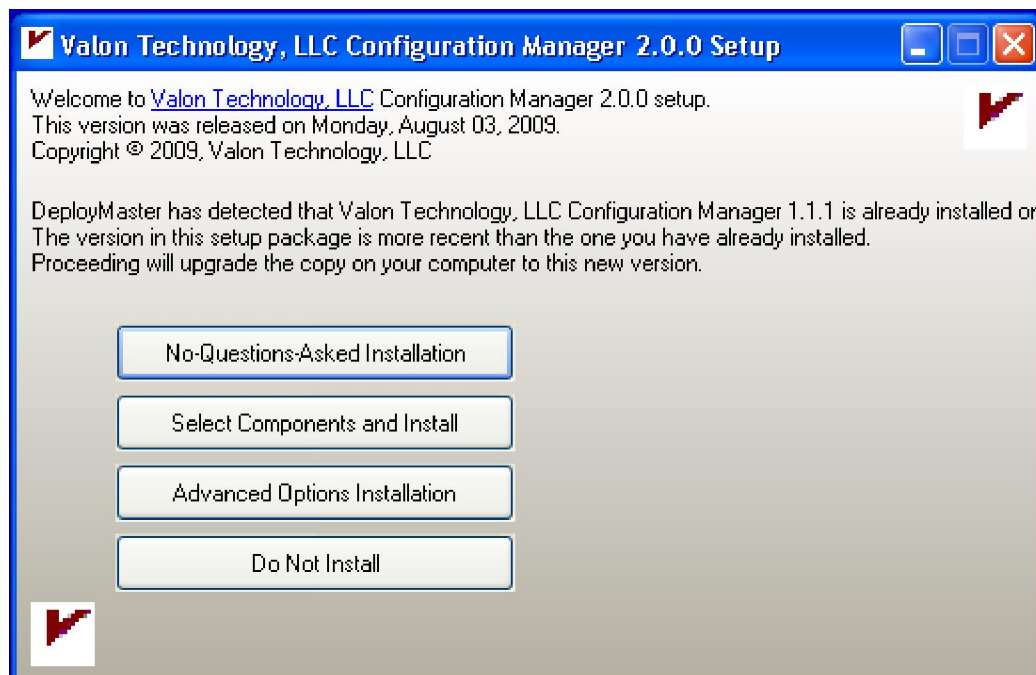
Figure 2-1 Installation Options Window (the revison shown may be and probably is different than the current

c. If you want to install the **Configuration Manager Program** in the C:\Program Files folder on your computer, click on the **No-Questions-Asked Installation** button in the installation window.

d. If you want to install the **Configuration Manager Program** in some other folder on your computer, click on the **Advanced Options Installation** button in the installation window. Enter the names of the folders where you want the **Configuration Manager Program** installed.

e. Once you have selected the installation option, **Installation License Window,** as shown in Figure 2-2 below, will be displayed.
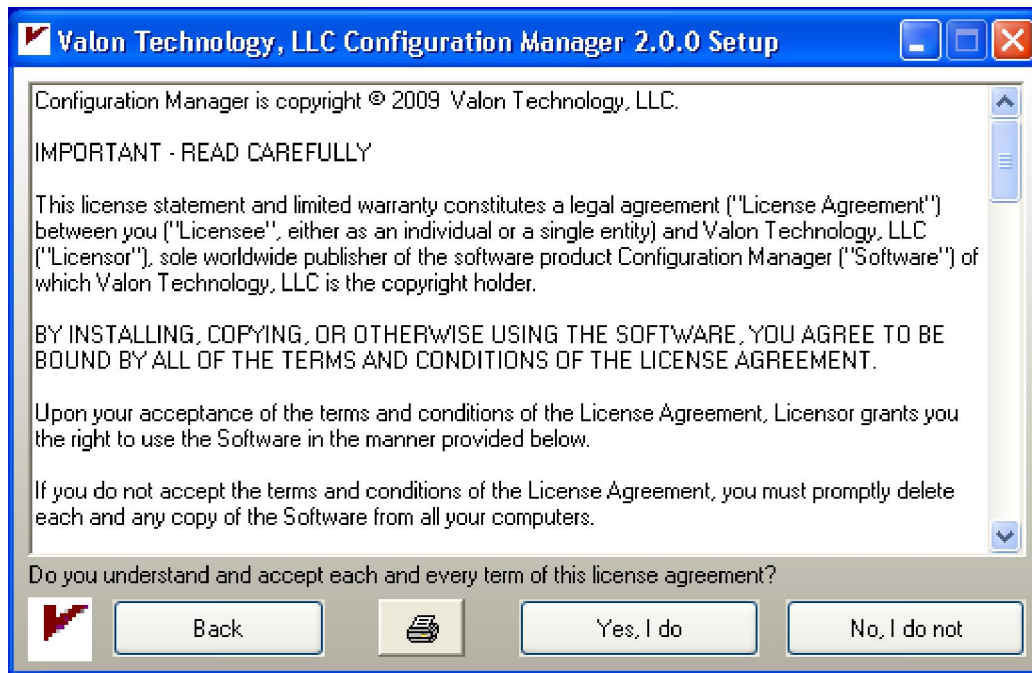
Figure 2-2 Installation License Window

f. Read the license agreement and click on the **Yes, I Do** button.

g. The **Installation Identity Window,** as shown in Figure 2-3 on the following page, will be displayed.

h. Enter your name and the name of your company in the appropriate fields. Click on the **Proceed** button.

i. The Configuration Manager Program will be installed on your system and the **Installation Completed Window,** as shown in Figure 2-4 on the following page, will be displayed.
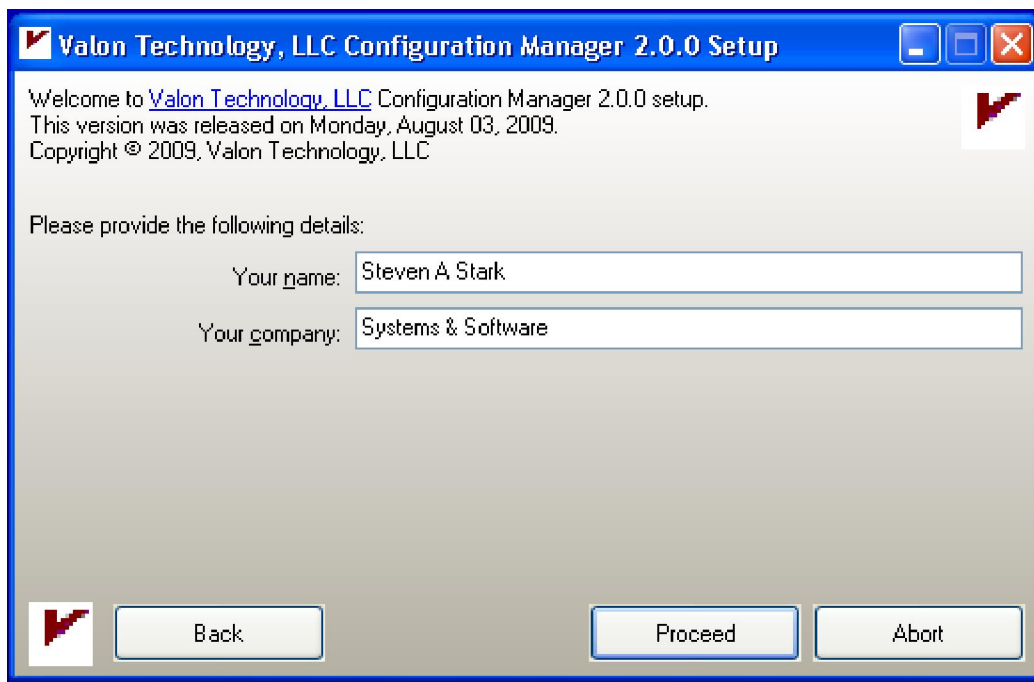
Figure 2-3 Installation Identity Window
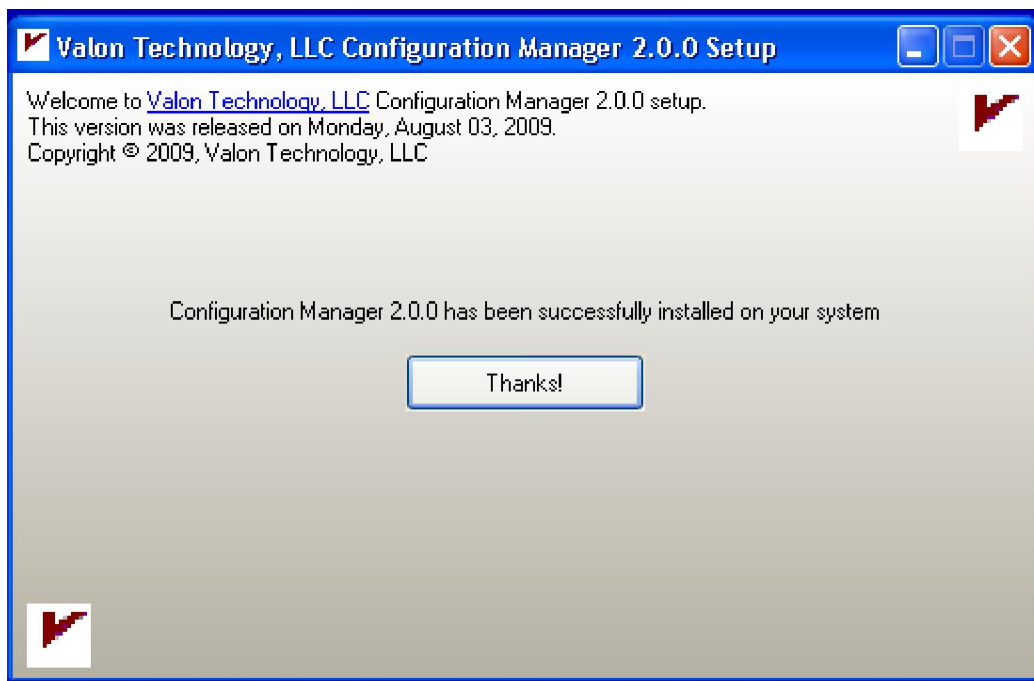
Figure 2-4 Installation Completed Window

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3. Main Window

The **Main Window**, as shown in Figure 3-1 below, is displayed when the **Configuration Manager Program** is started. The buttons and the list selection boxes in the window are used to set and/or modify many of the synthesizer operating parameters. Get started by using *File/Read Registers* to see your synthesizer's pre-loaded default settings.

The auto-update feature of the **Configuration Manager Program** will automatically update the registers in the synthesizers on the **5007 Dual Frequency Synthesizer Board** whenever a setting is changed. Thus, the registers on the board will always be in sync with the parameters displayed in the **Main Window**.
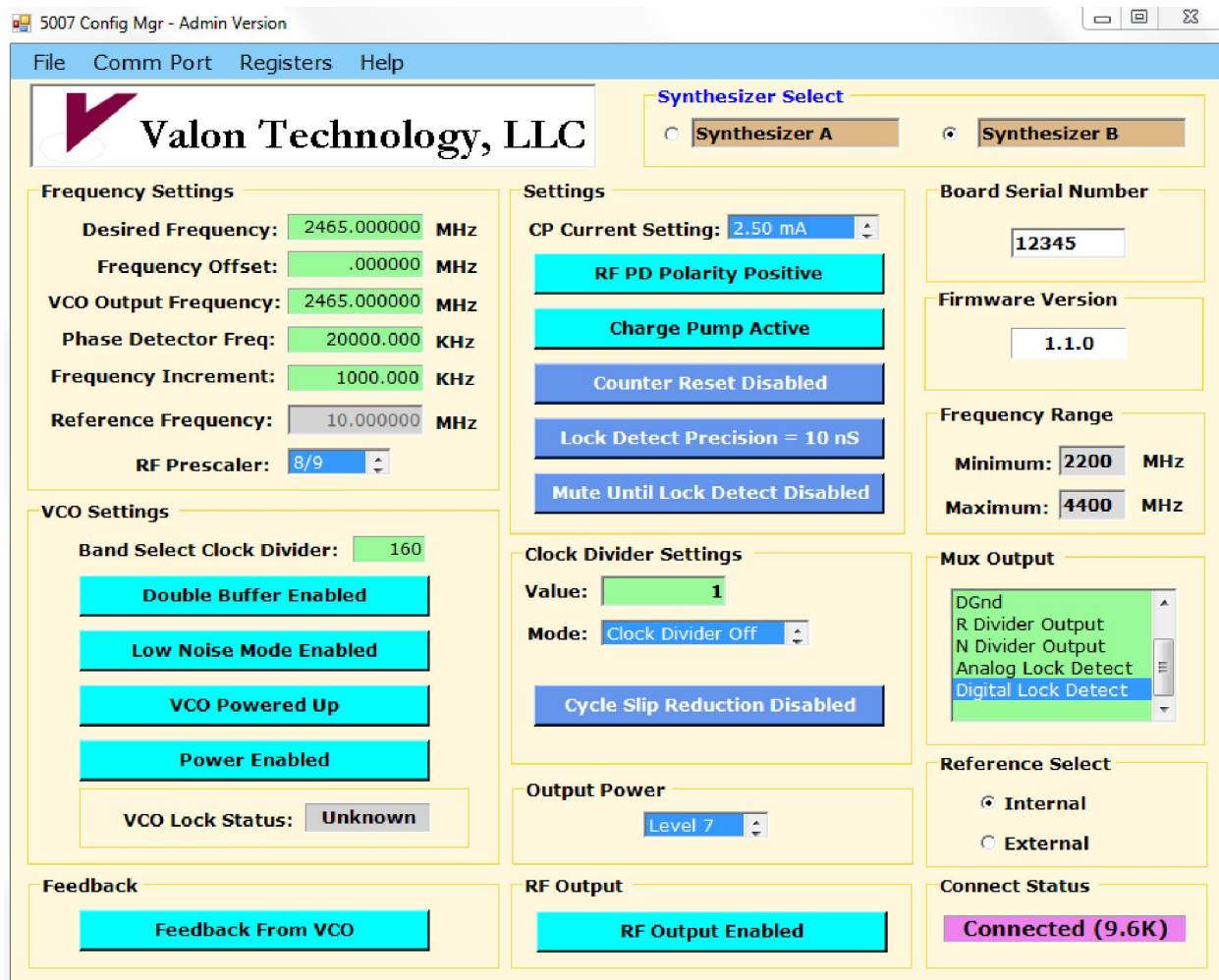
Figure 3-1 Main Window

3.1 Synthesizer Select

Being a Dual synthesizer module, you can chose which synthesizer is active by clicking on these buttons. You can arbitrarily label each synthesizer to suit your application if desired.

The **Synthesizer Name** field is a text field containing the name of the synthesizer. The default names are "Synthesizer A" and "Synthesizer B". The default names

may be overwritten by the user. The maximum length of the name is 16 characters. When changing the name, it may be necessary to first delete the existing characters before entering the new characters of the name.

3.2 Board Serial Number.

The **Board Serial Number** field is a field showing the serial number of the synthesizer board. This is a write field and you are free to insert a different serial number if you choose.

3.3 Firm Version

The **Firm Version** field is a read-only field showing the version of the firmware that is installed in the synthesizer board.

3.4 Frequency Settings

There are two groups of fields, titled "Frequency Settings", showing the various frequencies for the two synthesizer devices . The following text is applicable to both groups of fields unless otherwise noted. Use Synthesizer Select to switch between the two groups.

3.4.1 Desired Frequency:

The **Desired Frequency** is a read-only field that shows the desired output frequency of the corresponding synthesizer. The **Desired Frequency** should not be confused with the **VCO Output Frequency**. Clicking on this field will cause the **Set Frequencies** dialog box to be displayed enabling the user to set and/or modify the **Desired Frequency.**

3.4.2 Frequency Offset:

The **Frequency Offset** is a read-only field that shows the frequency offset of the corresponding synthesizer. The **Frequency Offset** is added (if a positive value) or subtracted (if a negative value) from the **Desired Frequency** in order to calculate the required **VCO Output Frequency**. Clicking on this field will cause the **Set Frequencies** dialog box to be displayed enabling the user to set and/or modify the **Frequency Offset**.

Frequency offset is a useful when using the synthesizer as a local oscillator in a heterodyning system.

3.4.3 VCO Output Frequency: Informational Only

The **VCO Output Frequency** is a read-only field that shows the output frequency of the VCO of the corresponding synthesizer. The value of this field is calculated as shown below:

VCO Output Freq = (Desired Freq + Freq Offset) x 1/Divide By Factor

Where the *Divide By Factor* is the VCO output divide-by factor which is equal to 1,2,4,8, or 16. For example, if the **Desired Frequency** is set to 300.000 MHz, the

Frequency Offset set to +25 MHz then the **Div By Factor** will be 8, and the resulting VCO Output Frequency will be:

VCO Output Freq = (300.000 + 25) x 8 = 2485 MHz

Note that the VCO Output is an internal signal is not available as an output. This field is informational only and will always be within the limits of the **Frequency Range**.

3.4.4 Phase Detector Frequency:

The **Phase Detector Frequ**ency is a read-only field that shows the input frequency of the phase frequency detector of the corresponding synthesizer. Clicking on this field will cause the **Set Frequencies** dialog box to be displayed enabling the user to set and/or modify the **Phase Detector Frequency.** (see section 4 below).

3.4.5 Frequency Increment

The **Frequency Increment** is a read-only field that shows the frequency increment size of the corresponding synthesizer. The **Frequency Increment** is added (**Up** button) or subtracted (**Down** button) from the **Desired Frequency.** Clicking on this field will cause the **Set Frequencies** dialog box to be displayed enabling the user to set and/or modify the **Frequency Increment**. (see section 4 below).

3.4.6 Reference Frequency

The **Reference Frequency** is a write-able field that shows the input frequency of the reference oscillator. Clicking on this field will enable the user to set and/or modify the **Reference Frequency.** Because the reference oscillator is common to both synthesizers, there is only one field for this parameter and it is included in the Synthesizer A settings group.

There are few restrictions on what the Reference Frequency value can be so long as it is greater than 5MHz and less than the maximum frequency shown in the data sheet (typically the maximum is 150MHz although we've operated units as high at 200MHz.

Reference Frequencies that are not integer divisible will result in a Phase Detector Frequency that is not 10MHz. For example, if you entered 30.72MHz as the Reference Frequency, the configuration manager will pick the nearest integer, R= 3, which will result in a Phase Detector Frequency of 10240kHz. This is okay and will not cause any problems, however, the Frequency Increment will also be off by the same relative error.

3.4.7 RF Prescaler (*Admin version only*)

The **Prescaler** fields selects either the 8/9 or 4/5 dual-modulus prescaler for the selected synthesizer's N register. For best performance the prescaler should be set

to 8/9 whenever the VCO frequency is greater than 3000MHz. For most cases the prescaler can be left at 8/9.

3.5 VCO Settings

3.5.1 Band Select Clock Divider (*Admin version only*) informational

Diagnostic.

3.5.2 Double Buffer Enabled (*Admin version only*)

Diagnostic.

3.5.3 Low Noise Mode Enabled

Low noise mode affects the operation of the fractional synthesizer. Clicking this button will enable the Low Spur Mode.

Low noise mode will produce the lowest phase noise but there may be some spurious output signals.

Low spur mode will reduce spurious output response but the overall phase noise will be higher.

3.5.4 VCO Powered Up (*Admin version only*)

Diagnostic. Leave this button in the VCO Powered Up setting.

3.5.5 Power Enabled

Clicking Power Enable will power down the selected synthesizer. Use this button when its desirable to completely shut down one of the synthesizers and its output buffer amplifier. When the VCO is powered down, the VCO Lock Status will be Unlocked, the on-board blue LED will be extinguished and power supply current will be reduced by half.

3.5.6 VCO Lock Status

The **VCO Lock Status** field is a read-only field showing the lock status of the selected synthesizer.

The Mux Output must be in the Digital Lock Detect mode for this field to be display the correct status. Setting the Mux Output to DGnd will force the VCO Lock Status to Unlocked. Setting the Mux Output to DVdd will force the VCO Lock Status to Locked. This may be useful for testing the function of an external lock detector status logic connected to J3 pin 6.

3.5.7 Feedback From VCO (Feedback from Divider)

Feedback from VCO is the normal mode of operation. Clicking this button will select **Feedback from Output Divider**. Only use feedback from output divider when its desirable adjust the relative output phase.

3.6 Settings   (*Admin version only*)

Most of the fields and buttons under **Settings** are primarily for diagnostic and or information purposes only and are not used or needed by the user. Leave the buttons and fields in their default settings.

3.6.1 CP (Charge Pump) Current Setting:

The **CP Current Setting** field set the values of the selected synthesizer charge pump. Normally this will be set 5.0mA for lowest phase noise performance.

Note that when scrolling through the available CP field using the ↑↓ arrows, the selected value only takes effect when the field is clicked on and the background color changes.

3.6.2 RF PD Polarity Positive (Negative) (*Admin version only*)

Diagnostic. This button changes the polarity of the selected synthesizer phase detector output. Normal setting is Positive.

3.6.3 Charge Pump Active (*Admin version only*)

Diagnostic. This button turns the charge pump on and off. The normal setting is Charge Pump Active. The clicking this button will tri-state the charge pump.

3.6.4 Counter Reset Disabled (*Admin version only*)

Diagnostic. Clicking this button will hold the selected synthesizer's N and R counters in the reset mode. The normal operating mode for this useless button is Counter Reset Disabled.

3.6.5 Lock Detect Precision = 10ns (*Admin version only*)

Diagnostic. Clicking this button changes the digital lock detector precision.   This button can be in either 10nS or 6nS setting.

3.6.6 Mute Until Lock Detect Enabled

When enabled, the synthesizer will output will be complete off if synthesizer is unlocked. When disabled, the synthesizer output can be analyzed should an unlocked condition be observed so that the VCO output can be analyzed. This button should be set to the Mute Until Lock Detect Enabled for normal operation.

3.7 Clock Divider Setting   *Admin version only*

All of the fields and buttons under **Clock Divider Settings** are diagnostic and or information purposes only and are not used or needed by the user. Leave the buttons and fields in their default settings.

3.8 Output Power

This field allows the user to select one of the four output power levels; 7, 4, 1, -2. These levels correspond approximately to the output power in dBm. Typically, the actual output power will 1dB higher which allows for some cable loss and roll-off above 3GHz.

Note that when scrolling through the available Output Power Level field using the ↑↓ arrows, the selected value only takes effect when the field is clicked on and the background color changes.

3.9 RF Output Enabled

RF Output Enabled button enables the selected synthesizer's internal buffer amplifier. When disabled, the synthesizer will continue to be locked and functional. The output power will be substantially reduced by 30-60dB depending on frequency. Disabled mode does not completely removed all output power. To completely turn off all output power the **Power Enabled** button must be set to the Power Disabled position (see VCO settings above).

3.10 Frequency Range (*Admin version only*)

The **VCO Frequency Range** fields set the minimum and maximum frequency range of the selected synthesizer VCO. The **VCO Frequency Range** information is used to limit and check the resulting VCO output frequency entered in the **Set Frequencies** dialog box.

3.10.1 Minimum (*Admin version only*)

The minimum frequency is the lowest VCO output frequency (in MHz) that may be set. Set to 2200MHz.

3.10.2 Maximum (*Admin version only*)

The maximum frequency is the highest VCO output frequency (in MHz) that may be set. Set to 4400MHz.

3.11 Mux Output (*Admin version only*)

The **Mux Output** is a selectable field that shows the status of the multiplexer of the corresponding synthesizer. The multiplexer is used for diagnostic testing and is only available on a board test point.

In normal operation, each synthesizer Mux Output should be set to Digital Lock Detect.

3.11.1 Digital Lock Detect (*Admin version only*)

Output of the synthesizer internal digital lock detector circuit. In normal operation, each synthesizer Mux Output should be set to Digital Lock Detect.

3.11.2 Analog Lock Detect (*Admin version only*)

Raw, unfiltered lock detect signal from phase-frequency detector output.

3.11.3 N Divider Output (*Admin version only*)

N Divider output, one of the two inputs to the phase-frequency detector.

3.11.4 R Divider Output (*Admin version only)*

R Divider output, one of the two inputs to the phase-frequency detector.

3.11.5 Dgnd (*Admin version only)*

Sets the MUX output to a LOW logic state. Can be used to test internal and external lock detect circuits.

3.11.6 DVdd (*Admin version only)*

Sets the MUX output to a HI logic state. Can be used to test internal and external lock detect circuits.

3.11.7 Three-State Output *(Should be tri-state output)* (*Admin version only)*

Sets the MUX output to tri-state. This mode is not used and we have no idea why we included it at this time.

3.12 Reference Select

The **Reference Select** button allow the user to select either the on-board internal 10.00MHz reference or an external reference. An external reference can be 5MHz to 150MHz at approximately 0dBm.

The default mode selects the internal 10.00MHz TCXO. To use an external reference, first select the external reference and then connect the external reference to the Reference SMA connector. Since the Reference connector is an output when using the internal reference, its important to select External reference <u>before</u> connecting any external reference source.

3.13 Connect Status

The **Status** field is a read-only field showing the status of the connection between the host computer and synthesizer board. If the status is ***Connect***, the host computer is able to communicate with the synthesizer board to read and write register data. If the status is ***Unconn***, the host computer is not able to communicate with the synthesizer board to read and write register data.

4. Set Frequencies dialog box

The **Set Frequencies dialog box**, as shown in Figure 4-1 below, is displayed when the user clicks in the **Desired Frequency, Frequency Offset, Phase Detector Freq, or, Frequency Increment**. The numeric fields and buttons in the dialog box are used to set and/or modify the frequencies in the synthesizers. The Set Frequencies dialog box is common to both synthesizers and can be updated when either is selected.

The auto-update feature of the **Configuration Manager Program** will automatically update the registers in the synthesizers on the **5007 Dual Frequency Synthesizer Board** whenever a setting is changed. Thus, the registers on the board will always be in sync with the parameters displayed in the **Set Frequencies Dialog Box**.

Figure 4-1 Set Frequencies Dialog Box

4.1 Synthesizer Frequency

4.1.1 Enter the desired output frequency

The **Desired Output Frequency** field is used to specify the desired output frequency. Pressing the *Enter* key or the *Tab* key after changing the **Desired Output Frequency** will cause the registers in the synthesizer to be updated and the new frequency generated. The resulting **VCO Output Frequency** must be within the range specified in the **Frequency Range** fields (see section 3.9).

4.1.2 Frequency Offset

The **Frequency Offset** field is used to specify the desired frequency offset. Pressing the *Enter* key or the *Tab* key after changing the **Frequency Offset** will cause the registers in the synthesizer to be updated and the new output frequency generated. The resulting **VCO Output Frequency** must be within the range specified in the **Frequency Range** fields (see section 3.9).

4.1.3 Frequency Increment

The **Frequency Increment** field is used to specify the desired frequency step size. Pressing the *Enter* key or the *Tab* key after changing the **Frequency Increment** will set value of the step size.

Typically the F**requency Increment** should be set to the highest increment value that will allow setting the **Desired Frequency** to the required precision. For example, if the desired frequency is 1500.000MHz, then setting the Frequency increment to 1,000kHz or 10,000kHz would be appropriate. Setting the Frequency Increment to the highest value that will provide the desired frequency will result in the lowest phase noise and minimize spurious output signals.

There is no advantage to setting the Frequency Increment to a value that is larger than 10,000kHz other than the convenience of a larger step size.

4.1.4 Resulting VCO output frequency

The **Resulting VCO output frequency** is a read-only field that shows the output frequency of the VCO of the corresponding synthesizer.

4.1.5 Resulting output divide by factor

The **Resulting output divide by factor** is a read-only field that shows the output frequency of the VCO of the corresponding synthesizer. The value of this field is calculated as shown below:

VCO Output Freq = (Desired Freq + Freq Offset) x Divide By Factor

Where the *Divide By Factor* is the VCO output divide-by factor which is equal to 1,2,4,8, or 16.

4.2 Frequency Increment

The **Increment UP and Down** buttons are used to increase or decrease the **desired output frequency** by the **frequency increment** value. Pressing the **UP** button or **Down** button will cause the registers in the synthesizer to be updated.

4.3 Phase Detector Frequency

4.3.1 Enter the phase detector frequency

The **Phase Detector Frequency** field is used to set the phase detector frequency. This frequency should be set to 10,000kHz (10MHz). The synthesizer loop filters have been optimized to work at a phase detector frequency of 10MHz and should not be changed.

Reference Frequencies that are not integer divisible will result in a Phase Detector Frequency that is not 10MHz. For example, if you entered 30.72MHz as the Reference Frequency, the configuration manager will pick the nearest integer, R= 3, which will result in a Phase Detector Frequency of 10240kHz. This is okay and will not cause any problems, however, the Frequency Increment will also be off by the same relative error.

Pressing the *Enter* key or the *Tab* key after changing the phase detector frequency will cause the registers in the synthesizer to be updated.

4.3.2 Reference Divide By 2 Disabled (*Admin version only*)

The **Reference divide by 2** button is used to enable a divide by 2 function after the internal reference divider. When enabled, the input to phase-frequency detector will have a 50% duty cycle which will allow for faster lock up time. In order to use this mode a 20,000kHz (20MHz) external reference would have to be available. Fast lock up times are not of any relevance when using the Configuration Manager to set the desired frequency. For normal operation set the Reference Div By 2 to Disabled.

4.3.3 Reference Doubler Disabled.

The **Reference Doubler** button is used to enable a multiply by 2 function before the internal reference divider.   Enable the doubler when using a 5MHz external reference frequency. When using the internal 10MHz reference the doubler should be disabled.

4.4.4 Resulting phase detector frequency

The Resulting phase detector freq is a read only field that indicates the result of the divide by 2 and doubler buttons. The value in this field is also replicated in the main window.

4.4 Factors

The Factors are read only fields that show the results of the Configuration Manager calculations. The fields are used to set the registers of the synthesizers to the desired frequency according to:

*Output Freq = (PDF * (INt +(FRAC/MOD) x 1/Divide By Factor) + Frequency Offset*

4.4. 1 INT

Integer divisor. Must be 23≤ for Prescaler = 4/5 and 75≤ for Prescaler = 8/9.

4.4. 2 FRAC

Fractional divisor

4.4. 3 MOD

Factional modulus

4.4. 3 R

Reference divider.

4.5 Phase

The phase mode allows adjustment of the phase of each synthesizer relative to the reference. The phase mode takes advantage of the sigma-delta modulator and so is only available in the factional mode of operation. In order to adjust the phase the **Feedback from Output Divider** must be enabled and the **FRAC** value cannot be zero.

The amount of total phase shift is 360 degrees. The phase step increment will depend on the MOD value.   For example, if the synthesizer was set to 2465MHz and the Frequency increment set to 1000kHz, then the MOD is 20. The phase increment step size is then 360deg/20 = 18degrees/step.

You can get smaller phase step increments by reducing the Frequency Increment. For example, changing the frequency increment from 1000kHz to 10kHz in this example would change the MOD from 20 to 500. Now the phase increment is 360deg/500 = 0.72deg/step.

When going to lower frequencies the Output Divider value will increase. Higher Output Divider values will restrict the range of frequencies that will allow useful phase increments. Also be aware of the minimum **INT** values when setting the frequency. You can increase the INT value at low frequencies by Disabling the Reference Doubler.

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5. Commands

5.1 File

5.1.1 Get Configuration

The **Get Configuration** command will retrieve a previously saved set of synthesizer parameters. When the **Get Configuration** command is invoked, the **Get Configuration File** dialog box, as shown in Figure 5-1 below, will be displayed. Click on the desired configuration file. The dialog box will disappear and all of the synthesizer parameters in the Configuration Manager Program will be set to the values in the file.
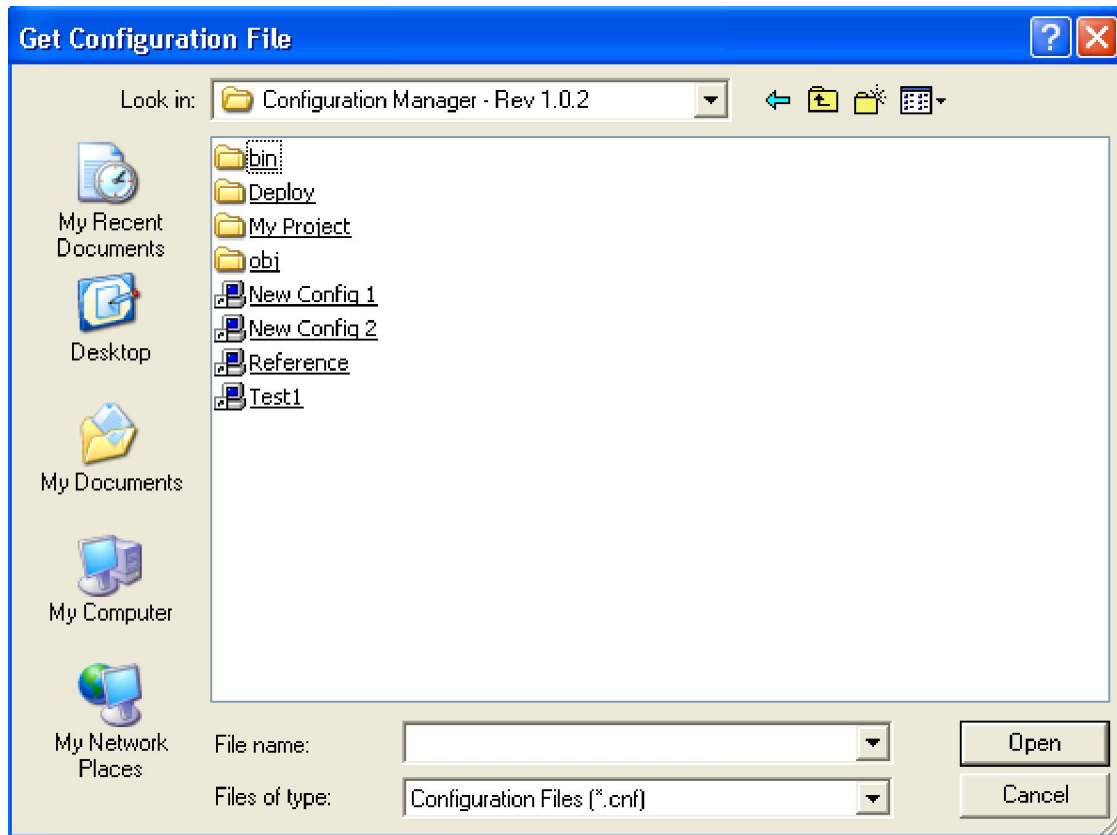

Figure 5-1 Get Configuration Dialog Box

5.1.2 Save Configuration

The **Save Configuration** command will save the current set of synthesizer parameters. When the **Save Configuration** command is invoked, the **Save Configuration File** dialog box, as shown in Figure 5-2 below, will be displayed. Enter the name of the file to be saved in the File Name: field and click on the Save button. All of the synthesizer parameters in the Configuration Manager Program will be saved in the file and the dialog box will disappear.
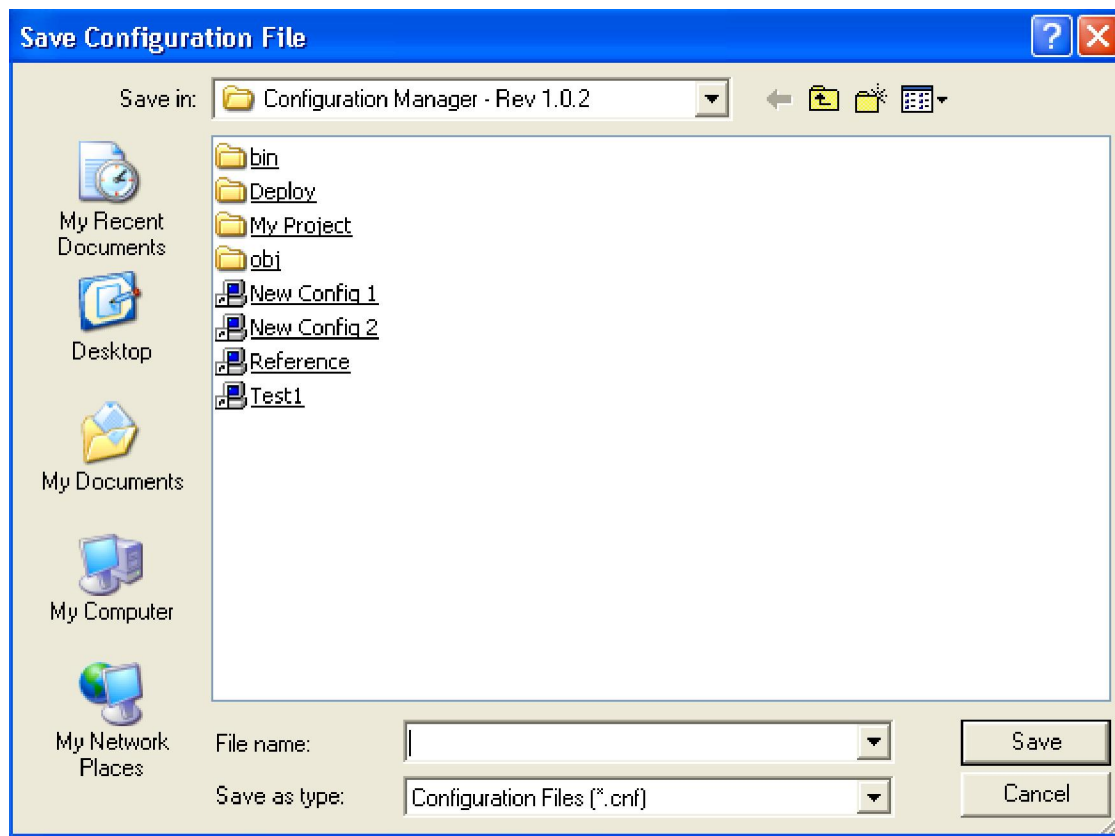
Figure 5-2 Save Configuration File Dialog Box

5.1.3 Write Registers

The **Write Registers** command will update the registers in the **5007 Dual Frequency Synthesizer Board** with the current set of synthesizer parameters. This command is only used when the current set of synthesizer parameters have been retrieved from a configuration file. This is because, in normal use, whenever an individual synthesizer parameter is changed, the auto-update feature of the **Configuration Manager Program** will automatically update the corresponding registers in the board.

5.1.4 Read Registers

The **Read Registers** command will read the registers in the **5007 Dual Frequency Synthesizer Board** and translate them to the current set of synthesizer parameters in the **Configuration Manager Program**.

5.1.5 Write Flash

The **Write Flash** command will copy the data in the registers in the ***5007 Dual Frequency Synthesizer Board*** to the non-volatile flash memory in the microcontroller in the board. If the board is powered down before a **Write Flash** command is issued, all of the data in the registers will be lost. The next time that the board is powered up, the registers will be set to the values in the non-volatile flash memory.

If the ***Configuration Manager Program*** detects that a setting is incorrect, an error message will be displayed identifying the incorrect setting and the command will be ignored.

5.1.6 Exit

The **Exit** command will terminate the ***Configuration Manager Program***. If any of the register data has been changed during the current session, a message box will be displayed asking you if you want to copy the data in the registers in the ***5007 Dual Frequency Synthesizer Board*** to the non-volatile flash memory in the microcontroller in the board. If you want to copy the data to the flash memory, click on **Yes**. If you want to maintain the original contents of the flash memory, click on **No**.

If the ***Configuration Manager Program*** detects that a setting is incorrect, an error message will be displayed identifying the incorrect setting and the **Exit** command will be ignored.

5.2 Comm Port

The **Comm Port** commands will set the serial data communications port on the host computer to be used to communicate with the ***5007 Dual Frequency Synthesizer Board***.

5.3 Registers

There are two **Display Registers** commands, one for each synthesizer. Selecting either command will cause the **Registers** window, as shown in Figure 5-4 below, to be displayed. Registers are used for diagnostics.
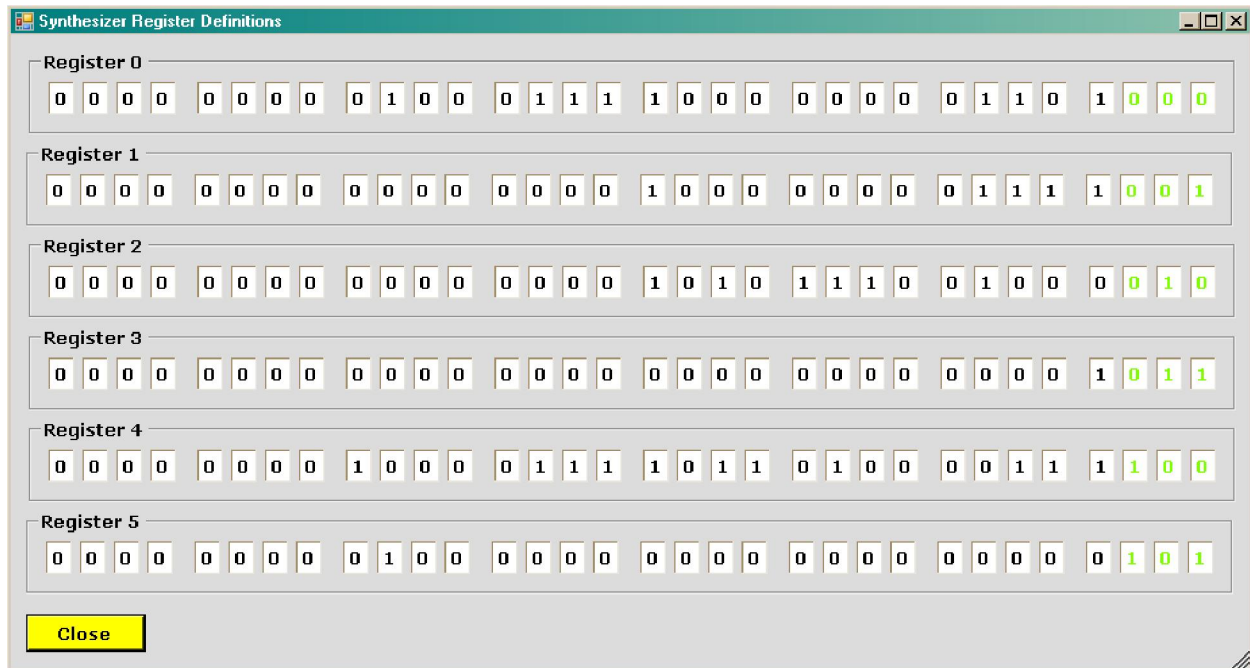

Figure 5-4 Synthesizer Register Definitions

5.4 Help

The Help command will display information about the *Configuration Manager Program*.

For even more help, Contact:

Stuart Rumley

stuart@valontechnology.com
650-369-0575