

5030 Frequency Synthesizer Module Operations Manual

Version 1.1

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Valon Technology, LLC Redwood City, CA USA



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1 Introduction

This manual includes the specifications and operations of the 5030 RF frequency synthesizers.

1.1 Overview

The Valon Technology 5030 Frequency Synthesizer Module is a versatile, PLL-synthesized, RF signal source programmable from 16 GHz to 34GHz with calibrated output power control from -15dBm to over +15dBm. The synthesizer includes an internal VCTCXO reference or can be locked to an external frequency reference. The module is fully shielded by a machined aluminum, RF-tight, multi-cavity housing which not only provides enhanced noise immunity to external sources but also minimizes internal signal leakage.

The 5030 can be controlled using simple commands either through the micro-USB port or the direct TTL-User port. Alternatively, the 5030 can be configured using the V5030CM.exe MS-Windows based graphical user interface or the internal web server. The 5030 settings can all be saved to non-volatile flash memory for automatic recall on power-up.

1.2 Detailed Description

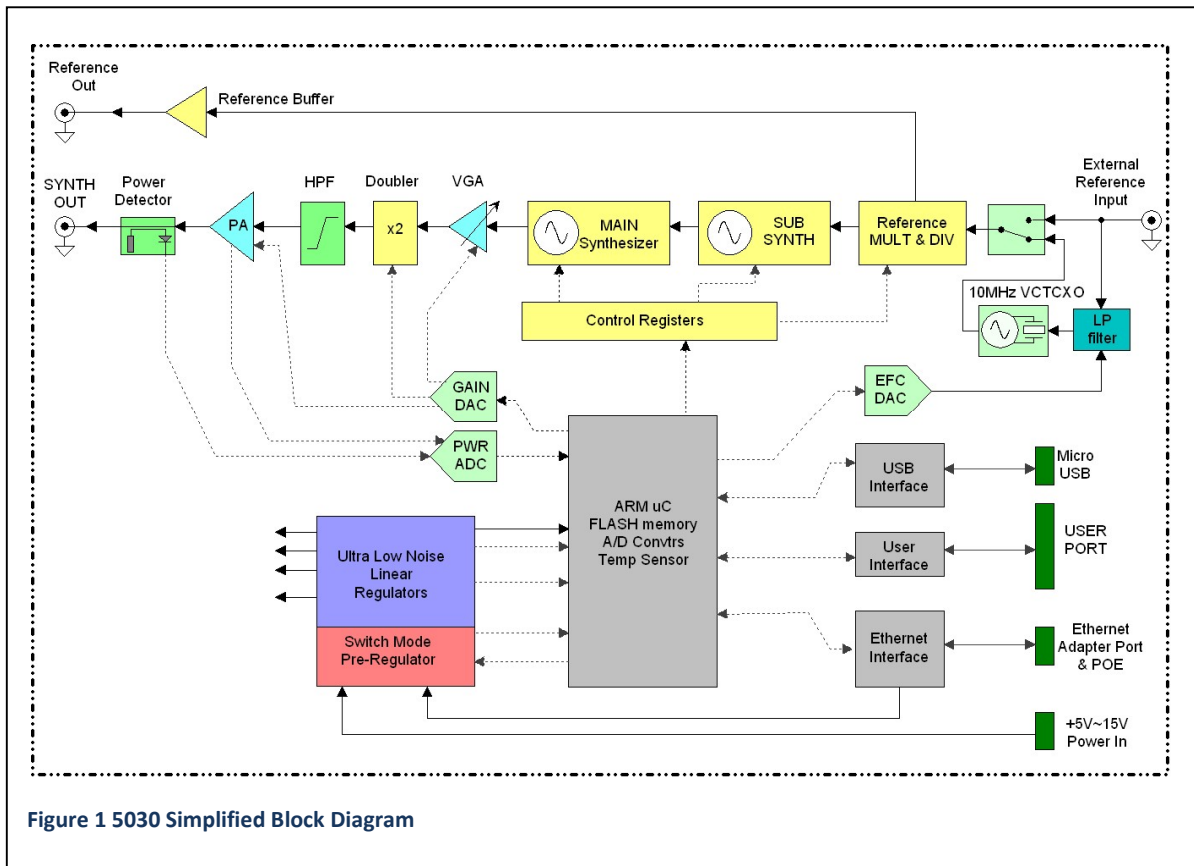


Figure-1 above shows a simplified block diagram of the 5030 system topology.

Control can be through either the micro-USB serial port, the 3.3V TTL USER port, or through the Ethernet port using the external ETH-1 adapter.

The ARM processor is the master controller (uC) for the synthesizer. It monitors all the synthesizer internal functions, maintains the non-volatile memory, performs tuning algorithms, and supervises the communications interfaces. When uC receives a command, it calculates the internal register values required for setting the main and sub-synthesizers, sets the power control, and all other necessary hardware to complete the command. The ARM processor can make these calculations very quickly which allows for fast sweep operation by simply setting the start and stop frequencies.

The synthesizer topology is designed to provide power stabilized, low phase noise, low spurious microwave output. The MAIN synthesizer consists of multiple VCOs in the 8GHz to 15GHz range which are multiplied by 2 to produce the 16GHz to 30GHz output. The MAIN synthesizer 2nd harmonic at 16GHz to 17GHz when enabled can drive the doubler to produce a quadrupled output in the 32GHz to 34GHz range.

The output of doubler is high-pass filtered and amplified by gain controlled amplifiers. The output of the amplifier is sampled by a directional coupler and a wideband RF detector. The detector output is A-D converted where it becomes the input to a digital power control servo loop maintained by the uC. The power control servo uses two DACs to control the doubler driver VGA and the PA. This power control loop provides very stable and well calibrated RF output power to the SMK 2.92mm RF connector.

The Main Synthesizer PLL is phase locked to a sub-synthesizer operating in the 100MHz range. The sub-synthesizer consists of multiple VCOs that are phase locked to either the internal 10MHz VCTCXO or an external reference in the 5MHz to 120MHz range.

The internal frequency reference is a 10MHz precision analog compensated VCTCXO. The initial accuracy is better than 2ppm and the stability over temperature and time is better than 2ppm. Typical initial frequency error is less than 1ppm while the stability over the -30deg. C. to +70deg. C is less than 0.5ppm. The user is able to correct any frequency error of internal reference to within 0.01 ppm using a reference trim function. The internal VCTCXO reference can also be electronically frequency controlled (EFC) by applying a dc tune voltage to the external reference input. This allows the 5030 to act as a precise voltage-controlled oscillator which is useful for certain system applications. For even better stability, the user can select an external reference in the range of 5MHz to 120MHz.

The 5030 uses multiple, low-noise, low dropout voltage regulators. Separate regulators provide the necessary isolation between the main synthesizer and the sub-synthesizers which improves close-in phase noise performance and minimizes spurious output signals due to cross-coupling. Ultra-low noise LDOs are used to power main and sub-synthesizers PLL/VCOs while separate low-noise LDOs regulate power for the output power amplifier. The ARM processor, Ethernet, and USB interfaces have a separate logic level LDOs which further isolate digital processor noise

from the synthesizers. The VCTCXO and associated tuning and buffers have a separate ultra-low noise regulator.

The synthesizer uses an efficient switching power pre-regulator so that a wide range of input voltages can be applied. The pre-regulator provides an internal voltage with adequate headroom to power multiple ultra-low noise linear regulators. No special power supply is required and most switching power supplies will work without degrading the noise performance of the synthesizers. The synthesizer can accept a command that will place the synthesizer in a low power standby mode when desired. The power input is reverse voltage protected. **The 5030 cannot be USB powered.**

When using the synthesizer at any input voltage it will be necessary to provide some minimal heat sinking or cooling depending upon the operating environment temperature. In most laboratory conditions, it is only necessary to rest or attach the synthesizer to a metal substrate and avoid covering the module with anything that will prevent circulating air to flow.

Raising the input voltage above the Hardware Reset Threshold for more than 10sec will reset all of the synthesizer stored settings to the factory default values. This is similar to the software RST command, but provides a means to "cleanse" the synthesizer user programmed setting without having to use a host computer.

Communications can be established with the 5030 using the USB port, or the Ethernet port (with adapter). A direct 3.3V TTL serial communications port is also available on the USER PORT for convenient machine to machine interfacing. The USER PORT is also used for the LIST mode to allow remote switches to select preset frequencies. In SWEEP mode the USER PORT has sweep trigger and sweep enable signals preset.



1.3 Electrical Specifications

Note: The 5030 is **NOT** USB powered. See Valon **PS6V-1** power supply kit.

DC Input

Input Voltage Range Absolute Max Operational Max Operational Min Very low voltage operation Hardware Reset Threshold	+16V to -16V (reverse protected) +15v +4.5V (minimum voltage at the module power connector) +3.5V (synthesizer remains locked and serial port ok) 16.0V for >10sec resets the synthesizer to factory default settings
Input Power	8 Watts normal operation 800mW Standby (power down)
DC Input Connector	Hirose DF3A-2P-2DS Mates with Hirose DF3-2S-2C plug and pre-crimped wire H2BXT-10112-R4 (red) and H2BXT-10112-B4 (black). 20" dc cable is supplied with synthesizer, additional cables available for purchase.

RF Synthesizer Specifications

Frequency Range	18GHz to 32GHz. Tunable 16GHz to 34GHz with reduced power and spectral performance.						
Frequency Lock Time	<400uS Lock time is from the time the frequency command is sent, or a frequency step in sweep mode, or input from User Port in List mode to a stable Lock Detector output.						
Phase Noise	Typical phase noise						
Offset	100Hz	1kHz	10kHz	100kHz	1MHz	10MHz	dBc/Hz
20GHz	-68	-90	-101	-104	-112	-133	
30GHz	-65	-88	-99	-101	-110	-130	
Harmonics	2f harmonics are typically <-20dBc, 3f and higher order harmonics are tbd.						
Sub Harmonics	Sub harmonics (f/2, 3f/2 and f/4) are typically <-20dBc for 20GHz to 30GHz operation.						
Spurious	Non-harmonic spurious typically <-60dBc including fraction-N spurs and boundary spurs. See selectable spur reduction modes. See section 6.10.4.						
Output Return loss 20GHz ~30GHz	Typical 6dB						
RF Connectors Reference Input /Output RF Output	SMA Female SMK 2.92mm Female (mates with 2.92, 3.5mm and SMA male)						

Maximum Output Power	Min dBm	Typical dBm	Max dBm
18GHz ~ 30GHz	+16	+18	+20
30GHz ~ 34GHz	+10	+13	+15
16GHz ~ 18GHz	+13	+15	+16
Minimum Output Power			-15



RF Output Power Accuracy	18GHz ~ 30GHz 16GHz ~18GHz, 30GHz to 34GHz	±1.2dB, +15dBm~-15dBm ±2.0dB, +10dBm~-15dBm
RF Output Power Resolution		0.01dB

Reference Frequency

Internal Reference	Frequency Initial Accuracy Temperature Stability Reference Trim Range Reference Trim Resolution	10.000MHz ± 2ppm (23°C) ±0.5ppm -20°C to +70°C (case temp) ± 10ppm 0.01ppm
External Reference Input	Frequency Range Input power range	50Ω nominal impedance 5MHz to 100MHz, typical max 120MHz -10dBm min. +13dBm max. SMA Female 50Ω nominal impedance Note: Ext input is ac coupled to synthesizer but dc coupled to internal VCTCXO control circuit. See section 2 for details.
Reference Output		10MHz buffered internal reference +9dBm ± 1dB SMA Female 50Ω nominal impedance ac coupled 5MHz to 120 MHz +9dBm buffered external reference when external reference is selected
EFC Electronic frequency Control at external reference input		Pulling range >±10ppm Voltage ±3V Input resistance 20kΩ Frequency response 0Hz~>5kHz

Interface

USB	Micro-B socket FTDI virtual com port 9600, 8, N,1,N default, see selectable baud rates below See FTDI for drivers for your computer. Note: The Configuration Manager GUI will automatically configure the USB port and switch to 115200 baud rate.
USER PORT	3.3V TTL TXD & RXD 115200,8,N,1,N default Lock detect External Sweep Trigger Input: 3.3V TTL Hi-Z input LMS-2 LIST Mode switch and cable accessory is also available. (see section 5) (see section 8 for connector mating information)
Selectable Baud Rates	USB, serial TTL: 9600, 19200, 38400, 57600,115200, 230400, 460800, 921600

Environmental

Operational full specifications:	-0°C~+60°C (case temperature, heat sink required)
No damage functional:	-20°C~+70°C (case temperature)
Humidity:	5%~95% minimal condensation allowed
IP rating:	50 No water protection.

2 Connections

2.1 Power Connections

Power connections are made to the dc power supply using the provided Hirose 2-pin plug and 20" pig-tail cable assembly. The input voltage for full performance is 5 Volts to 15 Volts and will require typically 8 Watts (Amps = Watts/V). When using a power supply at or near 5V, the input current will be over 1.0A. Therefore, it is very important to keep the total power supply leads as short as possible. The red wire is the positive input and correct polarity is required. The 5030 is reverse polarity protected and no damage will occur if reverse connected to dc power supplies of less than 15V. There is no provision for power to be supplied by USB.

2.2 RF Output

The 2.92mm RF Output port provides the synthesizer output signal. This signal can be programmed to be in the range from 16GHz to 34GHz. The output level is programmable from less than -15dBm to over +15dBm in 0.01dB steps. The nominal output impedance is 50 ohms.

This port is directly connected to the internal broadband microwave power amplifier and is static sensitive. Care should be taken to only use this port as an output. **Do not apply any signal to this port.** Be especially careful in connecting long, un-terminated, coaxial cables that might contain a static charge as this can easily damage the amplifier.

2.3 External Reference Input

The external reference input can be used to provide a more stable reference frequency for the synthesizer. The quality of the external reference will have little effect on the synthesizer phase noise at offsets frequencies greater than ~ 50 Hz. The phase noise at offsets below 50 Hz may be improved by 15dB or more if a low phase noise (< -85 dBc/Hz @10Hz for 10MHz external reference) external reference is used. The reference frequency should be in the range of 5MHz to 120MHz. The optimum input level is approximately 0dBm to +10dBm (50 ohms).

The external reference input also serves as an Electronic Frequency Control (EFC) input. The EFC can be used to adjust the synthesizer frequency ± 10 ppm with an analog voltage in the 0V \sim ± 3.3 V range. This is a convenient control for phase locking or frequency locking the synthesizer to an external system when a suitable external reference frequency is not applicable. The REFERENCE DAC can be used to center the EFC range using the "reft" command.

The external reference signal can be either ac or dc coupled. The external reference input on the synthesizer is ac coupled for the RF reference signal but dc coupled for the EFC control.

Figure-2. Any non-ac coupled source or load connected to the external reference input will pull the internal reference frequency slightly.

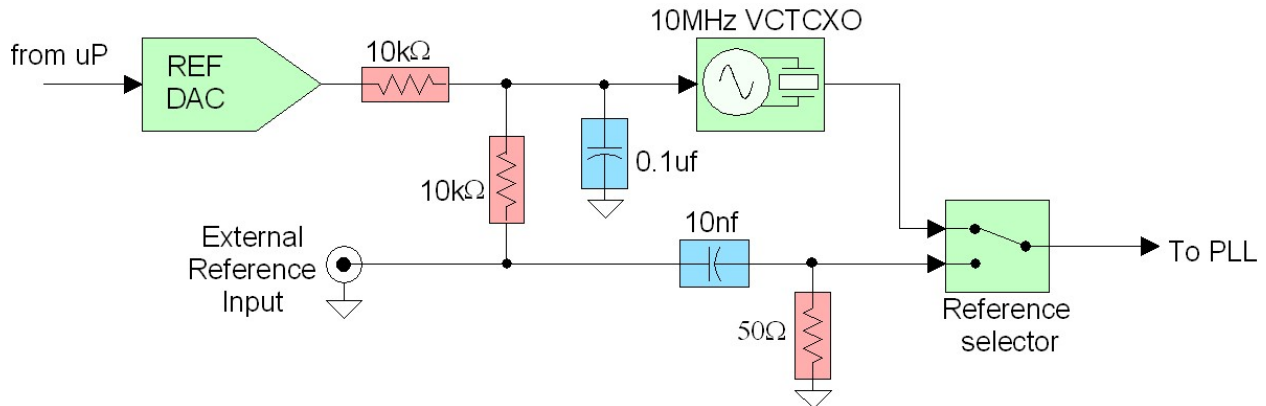


Figure-2: Block diagram of the internal / external reference input circuit.

2.4 Reference Output

The reference output is a buffered replica of either the internal or external reference depending on which is selected. Reference output frequency will be the same as the internal (10MHz) reference or the external reference frequency if present and selected. The reference output is phase coherent with internal or external reference and lags either by approximately 10ns. The reference output impedance is nominally 50 ohms, ac coupled, with a typical level of +9dBm.

2.5 User interface USB and TTL User Port

The simplest way to set frequencies and configure the 5030 synthesizer module is to use the USB port with the Valon Technology downloadable V5030CM.exe Configuration Manager (GUI). The Configuration Manager is an MS Windows compatible graphic user interface. No programming knowledge is required. The V5030CM will automatically detect a connected 5030 synthesizer and configure the USB port. Multiple 5030 synthesizers can be supported simultaneously with multiple instances of the V5030CM GUI.

Alternatively, the user can also use our 5000term.exe terminal program, **Figure-3**, to control and configure the synthesizer using simple text commands. 5000term.exe will support multiple 5030 synthesizers. If you have more than one 5030 connected, you can simply start a new instance of 5000term which will connect to the next 5030 synthesizer found. Alternatively, you can type: 5000term -S <serial_num> where <serial_num> is the serial number of the 5030. You can find the serial number of the 5030 by using the ID or STATus command. (Note: use upper case S and the exact case for the serial number).

The Configuration Manager and 5000term.exe can be found on the Valonrf.com web site in the 5030 DOWNLOADS section.

Any other terminal emulator program should also work well, however 5000term.exe will automatically detect the 5030 and configure the virtual serial port. A list of available commands appears in section 4.

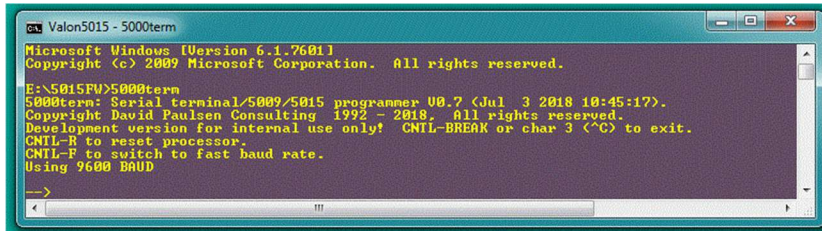


Figure 3: The Valon 5000term.exe terminal program provides a simple command line user interface for controlling the synthesizer. Type “help” for a list of commands.

Links to our GUI and terminal program are shown below in the [Quick-Start section 4.0](#).

Also available is a direct 3.3V-TTL serial interface at the USER PORT. This allows the same command set to be sent directly to the synthesizer processor from a host processor without requiring any USB connection.

The default baud rates are 9600 for the USB port and 115200 for the USER PORT. Either port can be set to 9600, 19200, 38400, 57600, 115200, 230400, 460800, or 921600.

2.6 Setting the Baud Rate

The USB baud rate can be changed using the baud command as in "baud 230400" which would change the baud rate from the default value of 9600 to 230400. However, once the baud rate has been changed, it will be necessary to exit out using ^C since communication will no longer be possible. To reestablish communication, restart the terminal program with the corresponding baud rate. With 5000term the starting command then in this example is: 5000term -r230400. The baud rate command applies only to the port that the command is issued from.

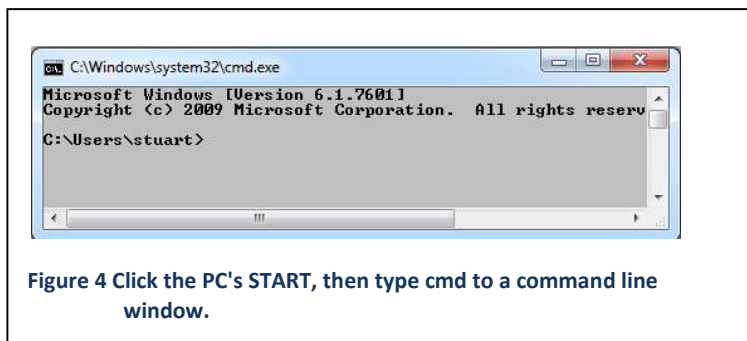
2.7 Using the Ethernet port with Telnet

The Valon Ethernet Adapter **ETH-1** is required if network connectivity is desired. The ETH-1 is available from Valon Technology as an optional accessory. You may use a standard Telnet session for a command line terminal interface similar to using the USB port with a terminal emulator application as shown in **Figure-4**. Note it may be necessary to install or turn on the Telnet Client in your particular computer.

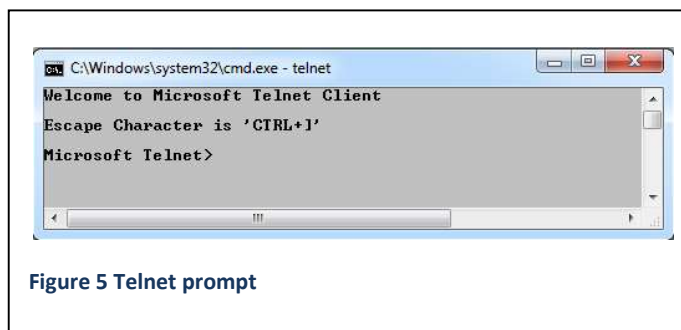
The default Ethernet address is typically **10.0.0.15** or **10.1.10.15**. To change the IP address, set the IP address using the **USB port** connection with a terminal program or the GUI. Use the command: **eth set_ip** followed the desired IP address. Then be sure to use the SAVE command in order to keep the IP address. To discover which IP addresses may be available on the local network, type: **arp -a** in dos command widow.

You can make a Telnet connection using a Command-line interface. In MS Windows:

1. Click **Start**
2. In the Search or Run line, type **cmd** (for command), press Enter. A command line window will be displayed as shown in **Figure-4**.



3. At the prompt, type "telnet" (and Enter). A Telnet prompt will appear as shown in **Figure-5**.



4. At the Telenet prompt, type “o” for open and then the synthesizer IP address as shown in **Figure-6**.

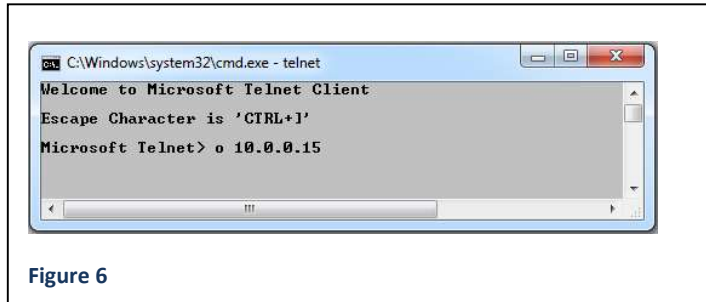


Figure 6

A successful connection will respond with synthesizer status displayed as shown in **Figure-7**.

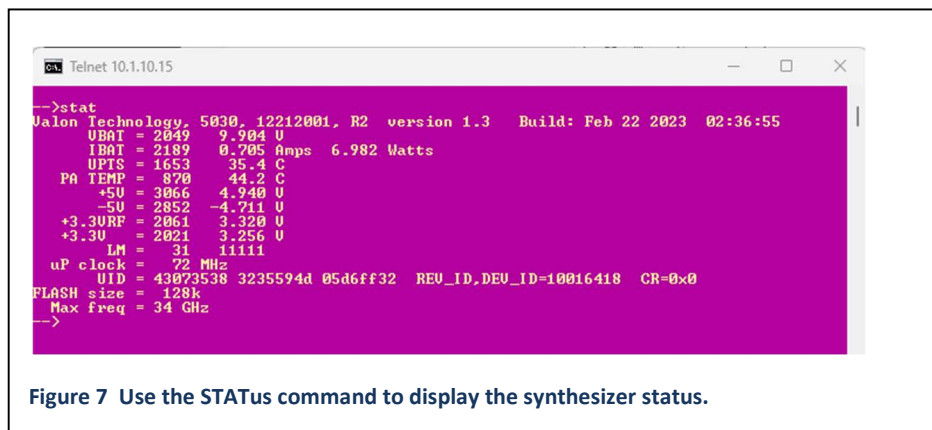


Figure 7 Use the STATUS command to display the synthesizer status.

Once connected, it will be necessary to suppress (turn off) the local echo by using the command: “ETH echo off”.

2.8 Using the Ethernet Port with the Built-in Web Server

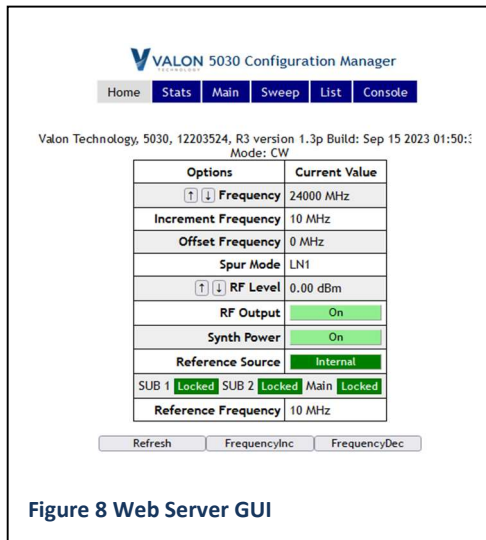


Figure 8 Web Server GUI

The 5030 synthesizers have a built-in web server that provides a GUI that will run on any computer platform that has a web browser.

When the synthesizer is connected to a local network using the ETH-1 adapter all that is necessary is to enter the synthesizer's IP address into the address bar on the browser.

Figure-8 shows an example of the 5030 connected at 10.1.10.15 using the built-in web server. The web server Configuration Manager is very similar in operation to the Valon Configuration Manager GUI that runs on an MS Windows platform. See Section 5 for operation and settings.

2.9 Lock and Status LEDs -- Trouble Shooting

Normal operation is indicated by both the Lock and Status LEDs being on continuously. If the Status LED is on but the Lock LED is not then one or more of the internal sub-synthesizers is not locked. Generally, this will occur if the External Reference is selected but no valid external reference signal is present. Check to see that Reference Select mode is set for the desired mode and that the Reference Frequency matches the selected reference frequency. The internal reference frequency is 10MHz. The external reference must be within ± 10 ppm of the nominal frequency.

If the Lock LED is out and the Status LED is blinking then the usual cause is incorrect input dc power supply voltage. If the input voltage at the input to synthesizer is below 4.5V but above 3.5V, the synthesizer will revert to a low power state which disables the RF output. The synthesizer can still maintain communication but will not provide and output signal. In this condition Status LED will flash for 1/8th of second every two seconds.

A common problem can occur when using 5.0V power supplies. With a power supply set to 5.00V, the synthesizer will draw over 1.0Amp of current. With long power supply leads it is not uncommon to drop 0.5V in the power supply leads. This can cause the power synthesizer to power down due to under voltage. When the synthesizer powers down the voltage drop on the power supply leads is decreased which allows the dc input voltage at the synthesizer to rise to a normal 5.0V condition. This condition is usually noted by both LEDs flashing at about a 2 second

rate. Also, make sure the power supply current limit is not set too low. Usually, a current limit setting should be higher than about 1.5Amps.

If the Lock LED is out and the Status LED is blinking about twice per second then off for two seconds, check the power supply input voltage. If the input voltage is above 16V for longer than 10 seconds the synthesizer will power down and reset the any changed parameters to the factory default values.

3 General Information

3.1 Safety

The 5030 Frequency Synthesizer operates on an external, user provided, low-voltage power supply. The user is responsible for ensuring the safety of the power source and any components or equipment connected to it including this one. The 5030 can be connected to any number of external components and care should be taken to fully understand the safety issues with these connections. Valon Technology is not responsible for any damage this equipment causes to any other equipment connected to or used with it in any way.

3.2 RoHS (Restriction of the use of certain Hazardous Substances)

The 5030 module is manufactured using all RoHS compliant components and RoHS compliant printed circuit board processing. The case is manufactured using only aluminum with steel fasteners.

Valon Technology, LLC certifies that the 5030 is RoHS compliant and conforms with the requirements of EC directive 2002/95/EC (RoHS) by having no intentional addition of Lead (Pb), Cadmium (Cd), Mercury (Hg), Hexavalent Chromium (Cr), Polybrominated Biphenyls (PBB), Polybrominated Diphenyl Ethers (PBDE), and any trace impurities of these substances are below the threshold limits as specified by the RoHS directive, specifically Cr+6, Hg, Pb, PBB, PBDE do not exceed 1000 ppm (0.1%) and Cd does not exceed 100 ppm (0.01%).

3.3 FCC Part 15

The 5030 is considered an industrial component and is intended to be incorporated into customer supplied equipment and is therefore exempt from FCC Part 15.

3.4 Default Settings

Default settings are 24GHz at 0dBm, CW mode, internal reference.

3.5 Cleans (Sanitize)

The Cleans function completely erases all stored user entries including frequency settings, LIST settings, and Sweep Start and Stop settings and restores the default frequencies. The Cleans function can be set by selecting Cleans from the Configuration Manager drop down **Synthesizer** menu tab, or in the case where no serial interface is available, the input voltage can be raised to just above 16V until the blue LED flash rapidly for 10 seconds. After 10 seconds the blue LED will flash four times per second for 1 second and then remain off for 1 second and then repeat. This indicates the Cleans function was successful.

Note: Do not exceed 16V and limit 16V cleans time to less than 30 seconds.

3.6 Place of Manufacture

The Valon 5030 synthesizer modules are designed, assembled, and tested in Northern California. All components are sourced from U.S.A. vendors and distributors. Final assembly and test is performed at Valon Technology.

4 Quick-Start Instructions

The 5030 Frequency Synthesizer module has been pre-programmed to 24000MHz at an output of power of +0dBm. Apply 5Vdc ~15Vdc (requires ~8W) using the supplied power cable (red +, black -). Within 2 seconds, the two blue LED STATUS and LOCK lights should be illuminated (see note at end). The 5030 requires some heat sinking or airflow; a quick solution is to simply place the module on a heat conduction surface.

In order to control the synthesizer, you may use any terminal emulator program or the Valon **Configuration Manager GUI**. The Valon V5030CM (GUI) and 5000term terminal programs are available as a download at:

<https://valontechnology.com/5030users/5030.htm>

Note: If you don't want to use the GUI and would prefer to use a terminal program to send commands directly, see Section 6.

The download website above will also have a link to our **5000term.exe** terminal emulator program. This terminal emulator program can be as a standard terminal emulator for controlling the 5030 and is also necessary for reprogramming the 5030 with any updated firmware.

1. From the website link, click the V5030CM.exe and save the program to your desktop or any other folder.
2. Connect the micro-USB cable to your PC and the synthesizer module. Your computer should automatically start to detect the new USB device. If it does not you may need to install the FTDI driver. <https://www.ftdichip.com/Drivers/VCP.htm>.

3. Launch the V5030CM GUI program by double-clicking the icon. At the start of the launch process a Windows dialog box will appear that verifies that a Valon 5030 synthesizer is connected. The serial number will be displayed as shown in **Figure-9**. More than one 5030 synthesizer may be connected. The dialog box allows the selection of the desired synthesizer. To control another synthesizer, start another instance of the configuration manager.



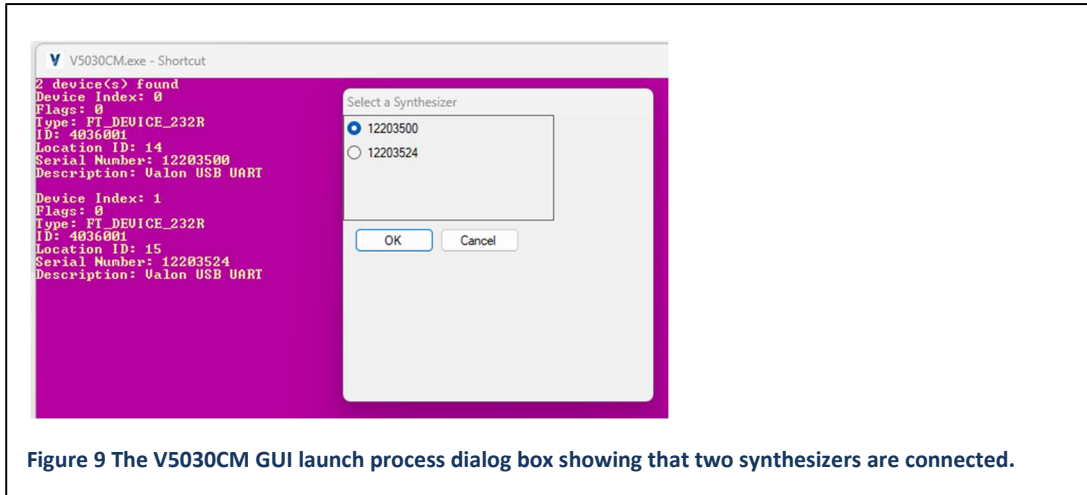


Figure 9 The V5030CM GUI launch process dialog box showing that two synthesizers are connected.

4. Once the connection to the synthesizer is established, it is recommended that you select **Synthesizer/Read Registers** command before you perform any other operation. That will update the Configuration Manager with all the initial register values that were programmed into your synthesizer as it was shipped. Make a note of the serial number for future reference. You may want to save these original setting by using the **File/Save Config** command. This will save your synthesizer's register setting to a disk file.
5. Now you are ready to change your frequency settings using the CM. Once you are satisfied with your settings use the **Synthesizer/ Save to Flash** command to store your settings in non-volatile flash memory.
6. Your 5030 is initialized to use the internal 10MHz reference. You can easily change to an external reference by clicking the **External** button in the **Reference Source** section of the Configuration Manager. When an external reference has been connected and selected, it may be necessary to update the synthesizer with a **File/Write Registers** command.

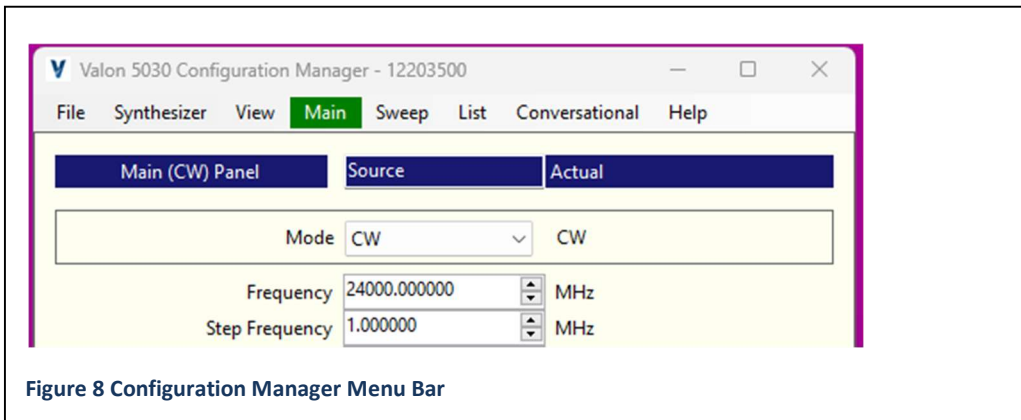
Note: Supply Voltage and Current at 6.0V and typically 800mA. You may experience startup and lock problems if you are using additional clip leads to connect the supplied power cable to a power supply. The supplied leads should be connected directly to a low impedance dc power supply.

5 Configuration Manager (CM) graphical user interface (GUI)

The **Configuration Manager** can be used to quickly and easily set the 5030 synthesizer frequencies and mode of operation. The Configuration Manager is available as a free download from the Valon Technology Products web site. Install the V5030CM.exe in any directory or on the desktop.

5.1 Configuration Manager Menu Bar

The CM menu bar, **Figure 10**, provides quick access to the 5030's various operational modes.



File: The File drop-down menu item provides.

File/Load Config: Loads all the previously saved CM configuration parameters from a .VR0 file to the active CM.

File/Save: Saves the all the current CM configuration parameters to a file.

File/Toggle LogFile: Creates a log5030.txt log file in the directory that the CM is in and captures all CM commands and responses. Note that the recorded data is only available after the CM is closed.

File/Exit: Closes the CM.



Synthesizer:

Synthesizer/Read Registers: Read registers will fill the CM with the all the parameter data of the connected synthesizer model. Do this when first connecting to a synthesizer model.

Synthesizer/Write Registers: Write registers will transfer all CM data to the synthesizer module. Do this if you just loaded a configuration from a file and want to update the synthesizer with the new parameters.

Synthesizer/Reset: Resets the synthesizer to the factory presets.

Synthesizer/Save to Flash: Saves all synthesizer setting to non-volatile flash memory. Next power up will restore these settings.

Synthesizer/Recall from Flash: Recalls synthesizer settings from flash memory.

Synthesizer/Cleanse: Completely clears all edited synthesizer setting and information including synthesizer names. Does not clear internal calibration data.

View:

View /Small Font: Smaller screen size and fonts.

View /Large Font: Larger screen size and fonts.

5.2 Configuration Manager Main Page

Clicking **Main** button on the Configuration Manger, **figure 11**, allows the user to enter the desired operating frequencies and output power attenuation levels.

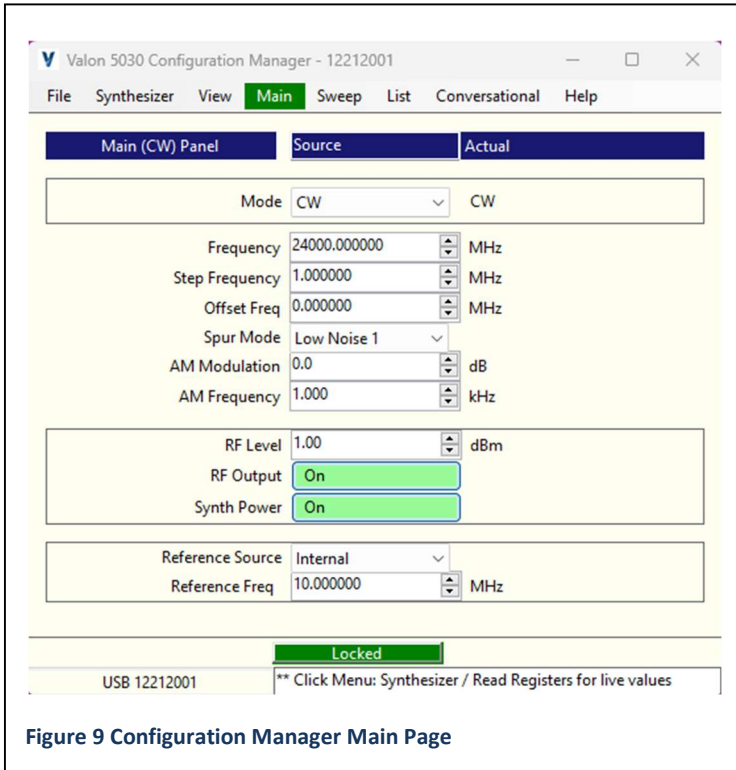


Figure 9 Configuration Manager Main Page

The Main page also has a number of useful secondary functions.

Main/Frequency: Enter the desired operating frequency here. The up and down arrows in the Frequency window will increment or decrement the displayed frequency by the Step Frequency amount.

Main/Step Frequency: Amount the Frequency will change with the Frequency up and down arrows.

Main/Offset/ Frequency: This can be either a positive or negative number and is useful added to the Frequency value. Use an offset frequency when it is desired to automatically account for an IF frequency in a super heterodyne system. For example, if the Offset frequency is 10.7MHz (a standard FM broadcast receiver IF) and the desired 88.5MHz (KQED), the actually synthesizer frequency will be 99.2MHz (LO).

Main/Spur Mode: The default spur reduction mode is LN1. LN1 is the lowest phase noise mode. LN2 is a low phase noise mode with lower spurs. LS1 is a low-spur mode with high phase noise. LS2 is the lowest spur mode but with higher phase noise. (see SDN command elsewhere in this document).

Main/RF Level: Sets the output power level in dBm.

Main/RF Output: Enables the main RF power amplifier. Setting to off will decrease the output RF power to the lowest possible level while the synthesizer is powered on. RF Output off or on does not significantly change the input dc power required.

Main/Synth Power: Off completely disables the synthesizer RF signal and no output will appear at the output connector. When Off, the unlocked notification will appear. The synthesizer will continue to maintain communications on the USB, Serial, and Ethernet connections.

Reference Source: Internal selects the internal 10MHz VCTCXO. External selects the external reference frequency.

Main/Reference Frequency: Set to actual external reference frequency. Setting this to a frequency other than the actual external reference frequency will cause unpredictable results. The internal reference frequency cannot be changed. This setting only takes effect when the Reference Source is set to external.

Main/Reference Trim: Provides $>\pm 10$ ppm trimming range to the internal VCTCXO with 12-bit resolution. Reference Trim is useful when it's desirable to "spot" 5030 frequency to an external frequency when an external reference source is not available. Reference trim can also be used to provide a fine frequency control. For example, with an output frequency of setting of 20GHz, the 12-bit reference trim range would be $>\pm 100$ kHz in 50Hz steps.

Main/Lock: Lock indicator is shown at the bottom of the main page. Normally, the Lock indicator will be green if the synthesizer is functioning correctly. If the Lock indicator is red, then the synthesizer is malfunctioning. If an unlocked condition is detected (red Lock indicator), check for the following conditions:

1. **Synth Power** is **On**.
2. **Reference Source** is set to **Internal**.
3. If Reference source is set to **External**, then check to see that external reference is connected and available.
4. **Reference Freq** setting matches actual internal or external reference frequency in use. The reference frequency must be within 10ppm of the nominal reference frequency in order to establish a lock condition.

5.3 Configuration Manager Sweep Page

Controls for operating sweep mode are found on this page shown in **Figure 12**.

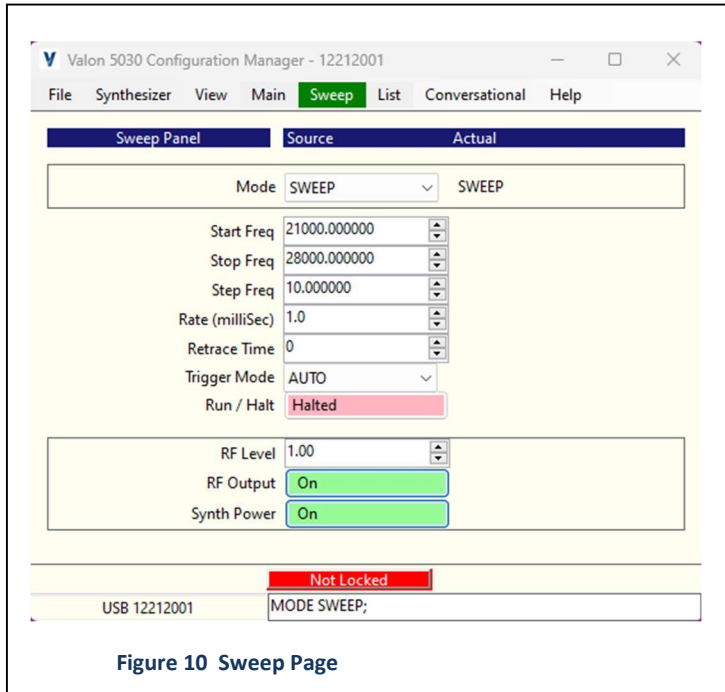


Figure 10 Sweep Page

Sweep is implemented by stepping from the Start Frequency to the Stop Frequency by an incremental Step Frequency at the sweep step Rate. The Mode has to be set to Sweep for sweep setting to take effect.

Sweep/Mode: CW, Sweep, or List modes are selected and displayed. This bar is a global element of the CM and will be shown on the Main and List pages as well.

Sweep/Start Freq: Set sweep start frequency.

Sweep/Stop Freq: Set sweep stop frequency.

Sweep/Step Freq: Set sweep step size.

Sweep/Rate: Set sweep step rate (milliseconds). **Sweep/ Frac / Int;** Set sweep mode to Fractional or Integer mode.

Sweep/Trigger Mode: Start sweep trigger modes are Auto (continuous sweep), Manual Trigger, External Trigger, and External Step (See USER PORT).

5.4 Configuration Manager LIST page

Selecting **List** in the CM menu bar, **figure 14**, presents the frequency list tables for both sources.

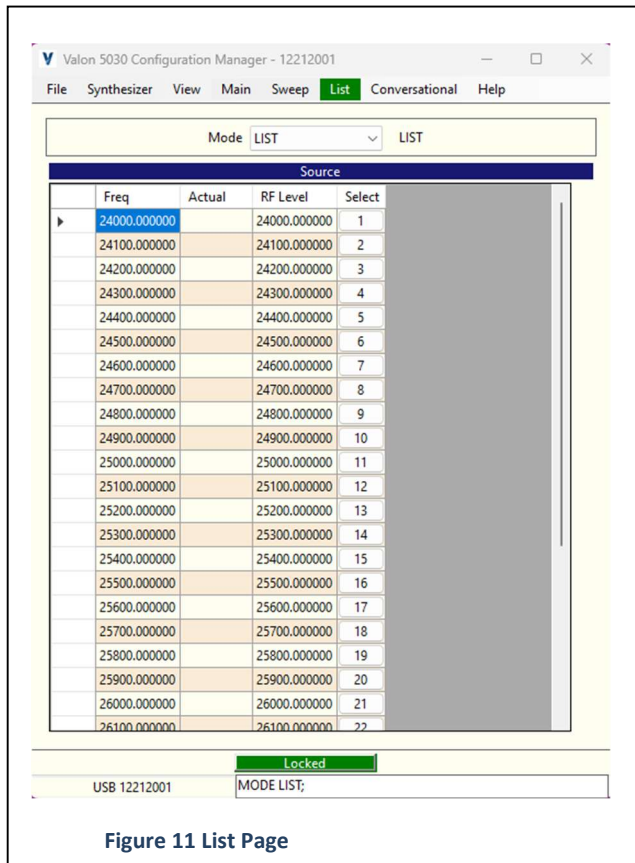


Figure 11 List Page

To edit the table, click on the table entry and enter the desired frequency and power level. The Mode has to be set to LIST for sweep setting to take effect.

The List page provides a convenient method for quickly selecting preset frequency and attenuation setting. While in CW mode, clicking on any of the "radio" buttons in the Select column, will program the synthesizer to the preset frequency and attenuation. When the Mode is set to List, the synthesizer presets will be selected by the state of the USER PORT input (see USER PORT for more details).

5.5 Conversational Page

The Conversational page allows the user to communicate with the synthesizers using commands. This may be more convenient in certain situation such as requesting status using the STATus command. The Conversational method is also handy for debugging user applications to see how the synthesizer responds to the text commands.

5.6 Help Page

The Help page provides access to the Operations Manual if the .chm file is also available in the same directory as the Configuration Manager application.

6 Programming With a Terminal Program

In some instances, the user will not want to use the MS-Windows based V5030CM GUI and will prefer to communicate directly with the synthesizer using a terminal program to send and simple commands. The following section describes the available commands.

6.1 Introduction to Commands

The synthesizer can be programmed using a set of simple commands accessed by the micro-USB serial interface or TTL USER Port and either a terminal emulator program such as Putty, TeraTerm or the recommended 5000term.exe. The 5000term.exe is a download available on the valonrf.com website. A direct digital TTL interface is also available at the 14-pin User Port.

Once connection to the serial port has been established, type "help" in the terminal program for a list of the latest available commands.

6.2 Syntax notes:

[] means optional entry may be used. f ;[CW];25000 MHz.

< > String value to be entered: Frequency;CW <25000> <MHz>.

Upper-case lettering indicates that the upper-case portion of the command is the minimum required for the command. For example, F is the minimum required for the Frequency command. Note: The minimum required character does not have to be sent as upper case.

Lower-case lettering indicates that the lower-case portion of the command is optional; it can either be included with the minimum required upper-case portion of the command or omitted.

Commands must be separated by a semi-colon (;) and no action is taken until a carriage return is sent. If only a single command is being sent then the semicolon is not required.

Spaces between command entries are not required and are ignored.

Units: When entering frequency numbers, the units <U> entry is optional. You can specify M for MHz, G for Gigahertz or K for kilohertz. You can also specify H for Hertz. If you do not specify the units, the synthesizer will make logical assumptions. For example, if you entered 24500 with no units, the synthesizer would know you meant MHz since it can't produce 24500Hz, or 24500kHz, or 24500GHz.

Parameters: Certain command inputs are binary in nature. In most cases a binary input parameter such as Enable can also be a "1" and Disable a "0". Also references to External can be a "1" while Internal is a "0".

6.3 Query syntax

Query syntax is used to check the state or parameter of a command function. If a command has a query mode, and most do, enter the command with no parameters or with a "?" .

6.4 General Commands

6.4.1 Baud

Note: Baud has a query, the command "baud or baud?" followed by a RETURN will display //Available rates = 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600.

You may send the command "baud" followed by any of the allowable baud rates, 9600, 19200, 38400,57600, 115200, 230400, 460800, and 921600. Once the baud rate has been changed the terminal program will no longer be able to communicate. Close the terminal program, change the terminal program baud rate to match the synthesizer's baud rate previously changed, and then reconnect at the new baud rate.

6.4.2 STATus

Returns the Manufacturer's name, model, serial number, firmware version, firmware build date and time, uP clock rate, power supply voltage (VBAT), internal temperature, LM, and UID.

6.4.3 Lock

Returns the status of the PLL lock condition from Main and Sub PLLS.

6.4.4 ID <n>

This query returns an identifying string. The response will show the following information: Valon Technology, 5030, serial number, firmware revision. Adding a number to the ID command will flash the STATus LED in short burst of 1 second for the number of times entered for n. The STATus LED is located just above the USB connector and visible through the label. Use the ID with the flash LED number in order to physically identify a particular synthesizer when many are simultaneously connected.

6.4.5 Help

Help, or just h, List all the commands available for the 5030. Note: Help with commands is not available from the UI.

6.4.6 RCL

Recalls the synthesizer state from flash memory. All setting stored in flash memory will be loaded into the synthesizers. This function is useful when it is desirable to restore previously stored flash settings. The RCL command performs the same function as power-up.

Recall is also under the File menu drop-down box in the UI.

6.4.7 RST

This command resets both synthesizers to default factory settings. RST does not change the Reference trim value.

6.4.8 SAV

The SAV command writes the current synthesizer state to flash memory. This is the state the synthesizer will be in on the next power-up.

6.4.9 CLEans

This command cleanses all user saved data in flash (non-volatile) memory. Use this command to "sanitize" the synthesizer. Same as RST except also removes any user synthesizer names.

If a terminal program or Valon Configuration Manager GUI is not available then use the following procedure to cleanse the non-volatile memory: Connect the synthesizer to a variable power supply, then increase the input voltage to 16 .5V for >10 seconds. The blue LED LOCK indicators will flash off and then back on indicating that the cleansing operation was successful.

6.5 MODE

Three mode types are available. The three MODE(s) are: CW, SWEep, and LIST. MODE can be sent as a single command or combined with other commands. Typically, the synthesizer will be set to a specific mode and then subsequent commands will be interpreted for that mode.

6.5.1 MODE <CW >

Sets the synthesizer to the normal default CW, or single tone, mode. All subsequent commands will be assumed to be single frequency commands. See Frequency Setting Commands for more information.

6.5.2 MODE SWEep

Sets the synthesizer to sweep mode. A START frequency, STOP frequency, STEP frequency, sweep RATE will also have to be set.

6.5.3 MODE LIST

Sets the synthesizer to the list mode. When set to list, the synthesizer frequency is set to preset values much like radio push-buttons. The specific list value from the list is selected by the hardware bit selected by the user port.

6.6 Frequency Setting Commands (CW)

The frequency setting commands are listed below.

6.6.1 Frequency <F> <U>

Frequency is the method for setting the single tone frequency. The range of <F> is 18GHz to 32GHz. You may enter frequencies outside these limits but with reduced performance. You may specify Units (GHz, MHz, kHz, Hz) but there is no frequency ambiguity in the 5030 frequency range and therefore the Units are unnecessary. For example: F 20, F 20000, F 20000000 can only be 20GHz.

6.6.2 OFFset <F> <U>

An offset frequency value can be added or subtracted to the Frequency. This command is useful for heterodyned frequency conversion systems, i.e. systems that employ an RF mixer. For example, if the frequency is set to 24GHz and the offset set to -1GHz, the actual frequency from the synthesizer would be 23GHz.

Note: UI may accept offsets that result in an out of range frequency. However, firmware will check and report an error condition. The maximum offset is limited to approximately 4295MHz to -4295MHz with 1Hz resolution.

6.6.3 FrequencyStep <F> <U>

Sets the frequency step size in CW mode. Used with INCRement and DECRement command.

6.6.4 FrequencyINCRement

Increases the CW frequency by the amount set by the STEP command.

6.6.5 FrequencyDECRement

Decreases the CW frequency by the amount set by the STEP command.

6.7 Sweep Mode

6.7.1 SWEep

Sweep from a Start frequency to Stop frequency by setting the mode to SWEep. Example:

```
MODE SWEep
```

6.7.2 START <F> <U>

Sweep Start frequency. Example:

```
START 20000M
```

6.7.3 STOP <F> <U>

Sweep Stop frequency. Example:

```
STOP 24000M
```

6.7.4 STEP <F> <U>

Frequency step size <Frequency> <Units>. Example STEP 10 M will sweep in 10MHz steps at the step RATE.

6.7.5 RATE<ms>

Sweep step rate in milliseconds. Step rates of 10ms to 200ms are typically optimum.

6.7.6 RTIME <ms>

Sweep retrace time. Use for blanking external display devices.

6.7.7 Run

Sweeping begins with a Run command. The state of the Run command can be saved so that the synthesizer will power up in Sweep Run mode.

6.7.8 Halt

Sweeping stops with the Halt command.

6.7.9 TMODE <AUTO|MANual|EXTRernal|EXTStep>

Three sweep trigger mode (TMOD) options are available. Auto trigger is a continuous, free-running mode where the trigger is supplied by the internal controller. Manual trigger is a single-sweep mode occurring once with every TRG command. External trigger is provided by a positive edge on pin-6 of the USER PORT connector. EXTERNAL trigger will trigger one sweep for every trigger input. EXTStep increments the frequency by the value of the STEP.

Setting the MODE to CW or LIST will disable the SWEEP mode.

6.7.10 TRGR

This command must be sent to start the sweep in Manual mode. One sweep will occur each time the command is sent.

6.7.11 RetraceTIME ; <ms>

Retrace time or RTIME allows the user to set a dwell interval of 0ms to over 100 seconds before the start of a new sweep.

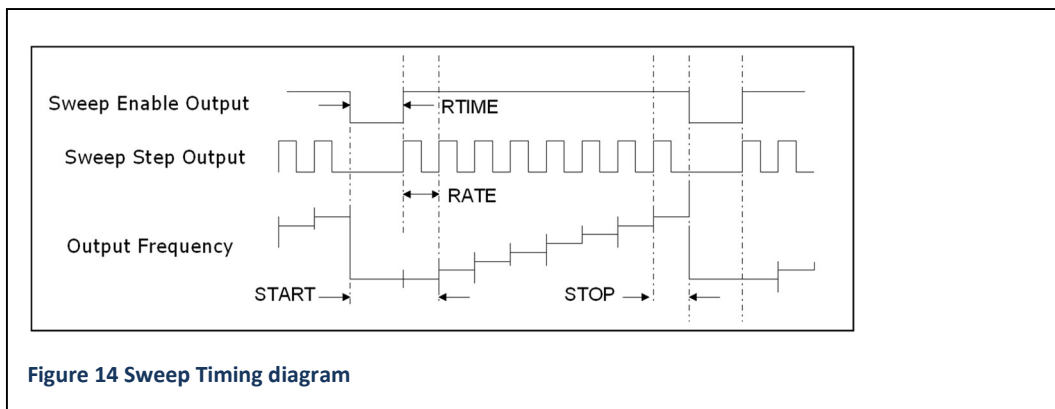


Figure 14 Sweep Timing diagram

6.8 List Mode

The List mode is useful in production or automatic test environments where it is desirable to switch between a number of preset frequencies or "markers" under hardware control. Once in list mode, a terminal or host computer is no longer required to set the output frequencies.

The List Mode allows the setting of the 32 preset frequencies. When the list mode is set using the MODE LIST command, the source output frequency is set by the list frequency settings and the 5-bit logic state of the USER PORT. Not all 32 preset entries have to be set. Unless user modified, the default list frequency settings for all 32 settings is 2441MHz to 2472MHz.

6.8.1 List entry

List <N > <Fn> [<U>] [<PWR>];

This mode sets synthesizer frequency to the values set in the list table. The list table can have up to 32 entries. N is the list number.

An example of the list command: list 5 21550m would set LIST frequency number 5 to 21550MHz.

List?, List will return the 32 list entries.

LIST <N> will return only the frequency of the **nth** entry in the units specified.

After setting the list frequencies, remember to use the SAVE command to store the list frequencies to flash memory.

Power entries may also be set with the list frequency. The method below shows how to set a power value for a specific LIST entry. If the power value is not specified after the LIST command, then the power value set globally by the POWER command will be retained.

6.8.2 List Hardware Control

See Section USER Port for information on hardware control of the List selection. The List selection can either be done with a switch closure to ground or by TTL logic level.

6.9 Power Level and Amplitude Modulation

6.9.1 PoWeR<PWR>

Sets the power level in dBm. PoWeR or PoWeR? returns the value PoWeR in dBm.

6.9.2 OEN <0|1| or OFF|ON>

Enables or disables the RF output buffer amplifiers while leaving the synthesizer PLL locked. This command does not completely extinguish the RF output signal level but reduces the level by approximately 50dB. This command can be used with the POWER command to reduce the output level by 80dB. ON turns the buffer amplifiers on.

6.9.3 PDN <0|1 or OFF|ON>

PDN places the synthesizer in a low power mode by disabling most of the synthesizer internal circuits while keeping the control interface and microcontroller alive.

6.9.4 AMD<dB>

Enables AM modulation. The default modulation rate is 1 kHz square wave. The AM modulator uses the PoWeR function modulate the CW power setting to AM is enabled when the AM is set to any value other than 0(dB). For example to turn on 20dB modulation the command would be AMD 20.

6.9.5 AMF<f>

AMF sets the AM frequency from 1Hz to 2.0 kHz with 1Hz resolution.

6.10 Configuration Commands

Configuration commands are used to control settings that are secondary to the operation of the synthesizers or affect operation of both synthesizers together.

6.10.1 REFerence; <F> <U>

REF sets the expected value of the external reference frequency. The reference frequency is the used by the PLL circuitry in the sub synthesizers and is the fundamental clock that determines the accuracy, stability, phase noise, and overall quality of the output signals. The default internal reference frequency is 10MHz. If an external reference is being used, that is not 10MHz then the reference, **REF** must be set to correspond to that frequency. Setting **REF** to something other than the actual internal or external frequency will result in indeterminate or unstable performance.

The query form is **REF?** [U]

This query returns the value of the expected external reference frequency.

6.10.2 REFTrim; <0|1|2|...255>

REFerence Trim command can be used to trim or "spot" the synthesizers' frequency when using the internal reference. Reference trim changes the voltage sent to the VCTCXO by setting the reference DAC output voltage. Reference trimming can be used to minimize the internal

reference frequency error. Reference trim can also be used when a small frequency offset is desired. The trimming range is ± 10 ppm. REFTrim accepts decimal values in $1/16^{\text{th}}$ rounded to two decimal places. For example, these are valid entries: 120.00, 120.06, 120.13, 120.19 ...etc.

Note: The EFC circuit is connected to the external reference input through a lowpass filter networks. The EFC voltage is summed with the REFTrim DAC. Any dc path such as a termination or dc coupled source on the external reference input will shunt part of the REFTrim voltage to ground. A dc coupled external reference should be disconnected when using the internal reference.

6.10.3 REFERENCESOURCE;

REFS sets the reference source to either internal or external. **REFS 0** set the reference to internal **REFS 1** set the reference source to external.

REFS? returns the state of the reference source.

6.10.4 SDN<LN1|LN2|LS1|LS2>

The 5030 synthesizer is based on fractional-N architecture. Fractional-N synthesizers will produce spurious frequency products at certain frequencies throughout frequency range. The SDN command has four spur mitigation modes. LN1=Lowest phase noise default mode, LN2=Low phase noise reduced spur, LS1=low-spur mode, LS2= Lowest spur mode with higher phase noise.

6.10.5 NAME <name>

Allows the user to specify an alias name of up to 48 characters long.

6.10.6 ETH SET_IP <IP address>

Eth set_IP is used to set the Ethernet IP address using either the USB connection or the TTL serial port. ETH SET_IP 10.1.10.15 for example sets the IP address to 10.1.10.15.

eth ip; Will display the IP address.

eth echo; Sent from telnet will turn echoing off.

eth noecho; Sent from telnet will turn echoing on.

7 User Port

The user port is a 14-pin male Hirose 2mm connector DF11-14P-2DS(52) located on the back edge of the synthesizer module. This port can be used as the List Mode hardware control input or an auxiliary 3.3V TTL serial port.

The User Port also provides sweep trigger, sweep active, and sweep step signals. All signals are TTL 3.3V compatible.

Note that all inputs are 5V tolerant. The TTL outputs are 3.3 V but 5V logic inputs should be compatible and recognize 3V at a TTL HIGH.

7.1 User Port Pin Assignments

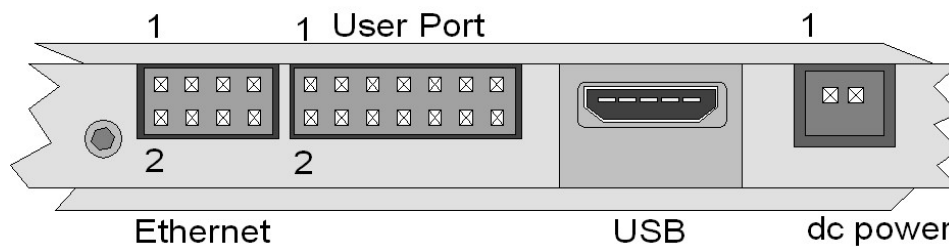


Figure 12 USER PORT PIN assignment and Location

USER PORT Pin	Name	Description
1	L0	List bit 0 Input
2	L1	List bit 1 Input
3	L2	List bit 2 Input
4	L3	List bit 3 Input
5	L4	List bit 4 Input
6	Sweep Trigger In	Input
7	Sweep Enable Out	Output, high level when sweep is active
8	Sweep Step Out	Output, pulse for each sweep step
9		Not used (factory test)
10	Serial RXD	Input, serial data input from host computer
11	Serial TXD	Output, serial data output to host computer
12	Lock Detector	Output, LOW when synthesizer is in a locked condition
13	GND	Common ground (same as chassis)
14	Not Used	

User Port Pin Assignment Table



The USER PORT mating connector is a Hirose DF11-14DS-2C with pre-terminated cables H3BBT-10112-W4. All available from Digi-Key or you can order the LMS-2 List Mode Selector switch from us.

7.2 Lock Detector/Sweep Sync/ Sweep Trigger

Sweep Trigger In: Sweep trigger input for external trigger mode.

Sweep Enable Out: Output high during active sweep cycle.

Sweep Step Out: Output pulse for each frequency change step of sweep.

Serial RXD: Input serial data from host.

Serial TXD: Output serial data to host.

Lock Detector: Low when synthesizer is operating normally.

GND: Common ground connection for User Port

8 Mechanical Dimensions

3.625"W x 2.685"L x 0.55"H

Weight: 0.2lbs, 91g

Material: AL-6061-T6

Finish: Clear Alodine (conductive)

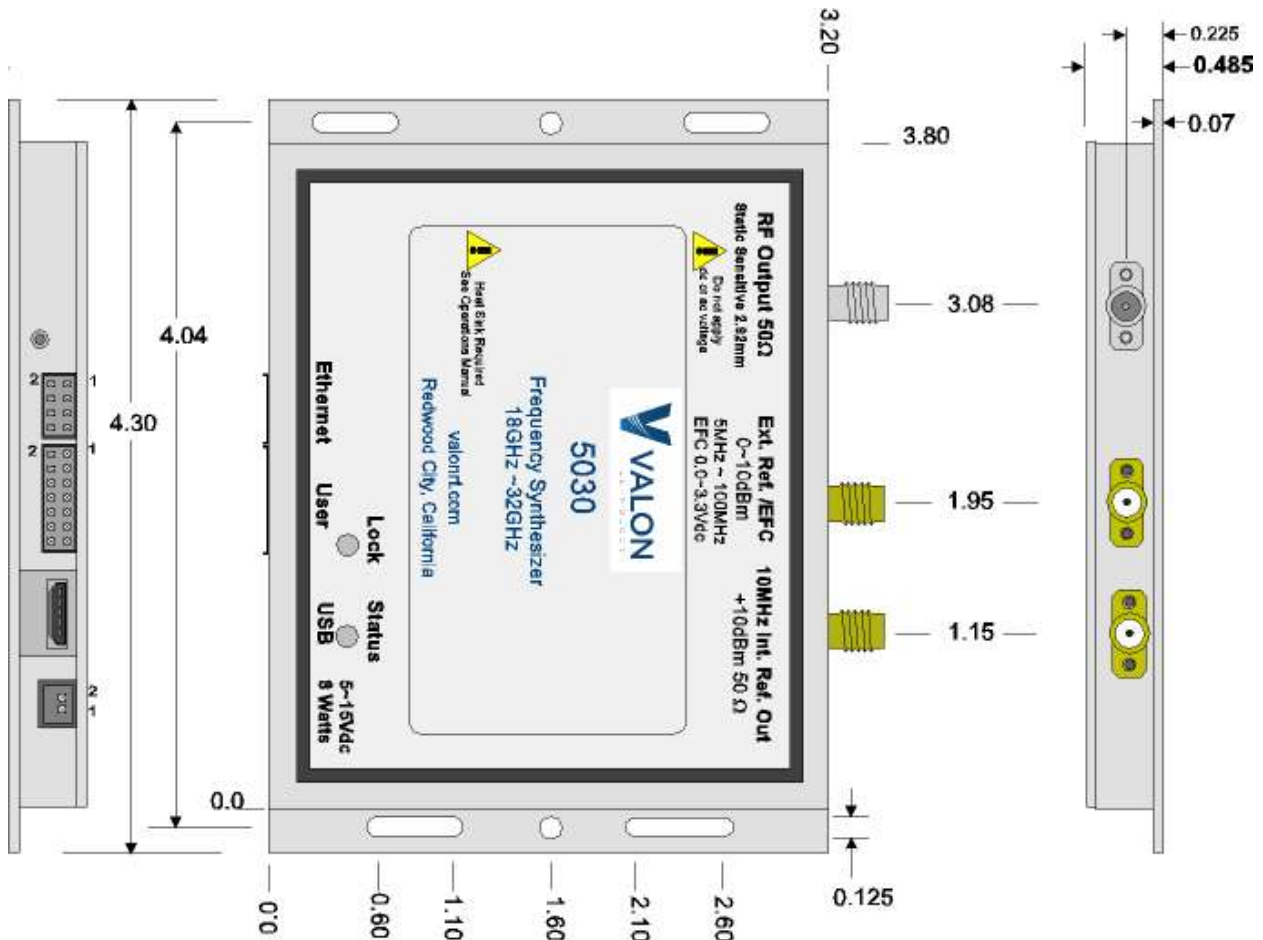


Figure 13 5030 outline dimensions (inches).



Change History

Version 1.0 First revision.

Version 1.1 Correct 7.2 Lock Detector