5008 Dual 137.5-4400MHz Frequency Synthesizer Module

Valon Technology, LLC

The 5008 Dual Synthesizer module provides two independent frequency sources suitable for high quality clock, carrier, or local oscillator frequency generation applications. The unique feature of our synthesizers is our microprocessor controller with FLASH memory that lets you retain your frequency setting after power down. This makes these synthesizers ideal for portable equipment or in any application where user programmable and non-volatile frequency settings are desirable.

The USB serial interface and our intuitive user configuration software allows the user to program the desired operating frequency of each synthesizer and save to the on-board FLASH memory. The synthesizer will then power up using the FLASH memory to reload the last saved frequencies.

Either output can be independently set to any frequency in the 137.5-4400MHz range. The synthesizer can be used with the on-board TCXO or an external reference.

Note: Specifications apply to both synthesizers

Parameter			Min	Typical	Max	Units	Notes
RF outputs							
RF output frequency range			137.5	-	4400	MHz	Basic range is 2200-4400MHz, Output divide-by-1,2,4,8, & 16 automatic range selection
Frequency increment (2200-4400MHz)			2.5		10000	kHz	
Output Impedance 50 ohm nominal		137-1500 MHz		-24	<-20	dB	Output return loss
		1500-4400MHz		-15	<-12		
Output RF power		Level 7	7	8	9	dBm	RF output power level can be set to one of 4 output power levels.
		Level 4	5	6	7		
		Level 1	2	3	4		
		Level -2	-1	0	1		
RF Output Disabled		<2200MHz		-30	-20		Disabling the output buffer allows the synthesizer to run with some output leakage power present.
		>2200MHz		-45	-40		
Output power flatness				1	2.5	dB	Output power variation over the 140MHz to 3.1GHz range. Output roll-off at 4.4GHz <4dB
Harmonics levels		2nd		-22	-15	dBc	Relative to carrier power. Outputs are digitally derived and high harmonic content is present.
		3rd		-9	-7		
		4th		-22	-20		
Synthesizer Isolation				-62	<-60	dB	Relative amount of synthesizer signal from one synthesizer appearing in the output of the other
Phase Noise							
Frequency	3GHz	10kHz offset		-90	<-85	dBc/Hz	Using low noise mode. Internal 10MHz TCXO, Phase Detector Frequency =10MHz, Frequency Increment = 1000KHz, CP Current Setting: 5.00mA, (Note; 10kHz typical and max. values below -106dBc are projected estimates, 100kHz typical and max values are projected estimates below -116dBc)
		100kHz offset		-102	<-100		
	1.5GHz	10kHz offset		-96	<-91		
		100kHz offset		-108	<-105		
	750MHz	10kHz offset		-102	<-97		
		100kHz offset		-114	<-110		
	375MHz	10kHz offset		-108	<-103		
		100kHz offset		-120	<-115		
	187MHz	10kHz offset		-114	<-109		
		100kHz offset		-126	<-120		
Non-harmonic spurious output							
PFD Reference spurs				<-90	<-75	dBc	In low noise mode, lower in low-spur mode (10MHz to 200MHz at output)
Ext or TCXO reference spurs				-105	<-90	dBc	
Internal Reference 10MHz							
Calibration				2	<+/-2.5	ppm	
Temp. stability (0-70deg. C.)				2	<+/-2.5	ppm	
Reference Input		Input frequency range	5	10	150	MHz	External reference frequency must be integer divisible to 10MHz, 5MHz input uses internal doubler. Disconnect any exteranl reference when using internal reference
		Input amplitude	-10	-	10	dBm	
		Input amplitude	0.2	0.6	2	Vpk-pk	
		Input 50 ohm return loss		-10	<-6	dB	
Reference Output		Output amplitude	2	2.2	2.4	Vpk-pk	Square wave, Open circuit
		Output amplitude	0.8	1	1.1	Vpk-pk	Into 50 ohms
reference output 50 ohm return loss				-20	<-15	dBm	1-150MHz
Power Requirements			5.5	6.0	6.5	Vdc	Recommended operating range
			-20		20	Vdc	Brief over voltage without damage
			3.5		5.0	Vdc	Reduced output power (increased 2nd harmonic)
		Max current			340	mA	Both synthesizers operating
					170	mA	One synthesizer operating
Connectors							
RF Outputs and External Reference			SMA Female				
dc power input			2-pin Hirose DF3A-2P-2DS				Supplied with mating 12" pig-tail plug cable
Control Interface			Mini-USB type B				Supplied with 6' Mini-USB to USB type A cable
Dimensions		Length	2.665			Inches	Dimensions refer to module housing size but does not include RF connector protrusions. See mechanical drawing below.
		Width	3.61				
		Height	0.52				

5008 Description

The synthesizer module consists of two separate fractional/integer-N synthesizers chips. The RF output of the synthesizer chips are each buffered by a wide-band MMIC RF amplifier followed by an output attenuator.

Each synthesizer chip has its own 3.3V low-noise, LDO voltage regulator. A separate 5V LDO is used to power the output buffer amplifier. The recommended input voltage is 5.0V in order to ensure the LDOs are in regulation.

Both synthesizers are referenced to a common 10MHz temperature stabilized crystal oscillator (TCXO). A software controlled switch also lets the user select an external reference. When the internal reference is selected, a sample of the reference signal is available at the reference connector. External reference input should be ac coupled and between -10 and 10dBm. The external reference frequency should be an integer multiple of 10MHz, such as 10, 20, 50, 100, or 150MHz. A 5MHz external reference frequency can be used by enabling the reference doubler function with the Configuration Manager software.

Both synthesizers will operate either in the fractional-N or integer-N mode depending on the user selected frequency. Since the internal phase-frequency detectors and loop filters are set operate at 10MHz, the synthesizers will be operating in the factional-N mode whenever a channel frequency is selected that is not an integer multiple of 10MHz. The Configuration Manager allows the user to set the frequency increment to channel spacing as small as 5kHz in the divide-by-1 range with the reference doubler on. The frequency increment will be smaller by the divide-by factor on lower frequencies. In order to minimize phase noise and spurs its best to use the largest possible frequency increment setting that will provide the desired output frequency.

The Configuration Manager software allows the user to set the desired output frequency and channel spacing directly through the USB interface. The Configuration Manager can also store any offset frequency and sign. This allows direct entry of the desired frequency if the synthesizer is used as a local oscillator in a heterodyne system. For example, if the synthesizer is used as the first LO in a high-side receiver with a 160MHz IF and 1045MHz is the desired tuned frequency, then the user would simply set the desired frequency to 1045MHz and the offset to 160MHz. The Configuration Manager calculates the correct LO output frequency.

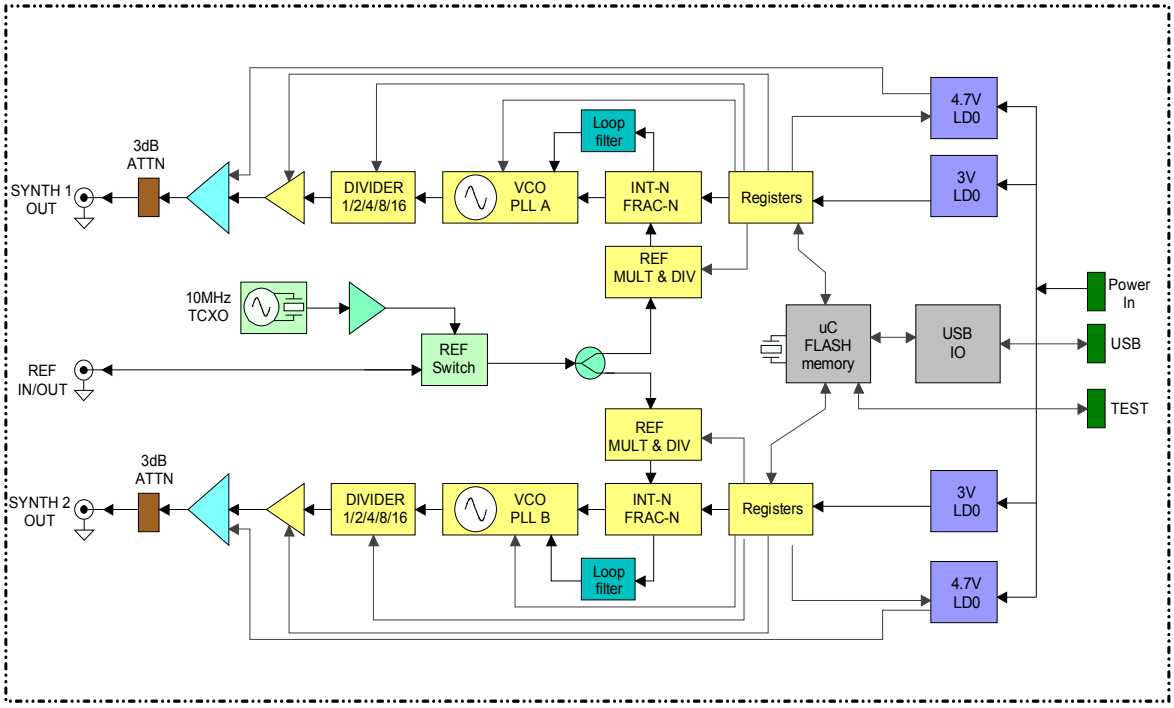
The low-power on-board microcontroller (uC) is used to load the multiple control and frequency registers of each synthesizer with the data stored in either its RAM or FLASH memory. The uC is also used to manage bi-directional communications over the serial interface.

On power-up, the uC reads the previously saved frequency and control setting for each synthesizer out of FLASH memory. The uC then loads this data using the internal serial bus to each of the synthesizers. The synthesizer will then lock and pass the lock detect signal back to the uC.

After power-up, the Configuration Manager software can communicate with the synthesizer module and control all the synthesizer frequency and control settings. The Write Registers command can be used at any time to update the register settings. The Read Registers command can be used to see what the frequency and control settings are. The Write FLASH command is used to store the setting into the non-volatile FLASH memory. The Configuration Manager can also Save and Get synthesizer's setting to and from a local disk.

Note that the output from the PLL is fed into a digital divider. The digital divider will produce an output waveform with high harmonic content. Typically, the worst harmonic is the 3rd and typically -10dBc. Normally this is not a problem in most applications. If lower harmonic output is required then a coaxial low-pass filter is recommended.

5008 Block Diagram



Interface Connectors

dc Power In

J1-1	dc power input positive	5.0 to 6.5V dc input
J1-2	dc power input ground	

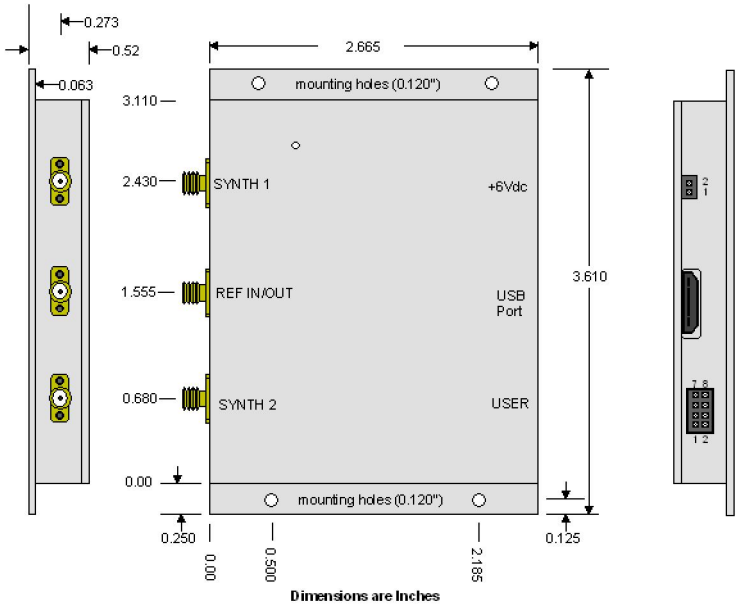
Mini-USB type B

USB-1	VCC
USB-2	USB DM
USB-3	USB DP
USB-4	NC
USB-5	Ground

JTAG

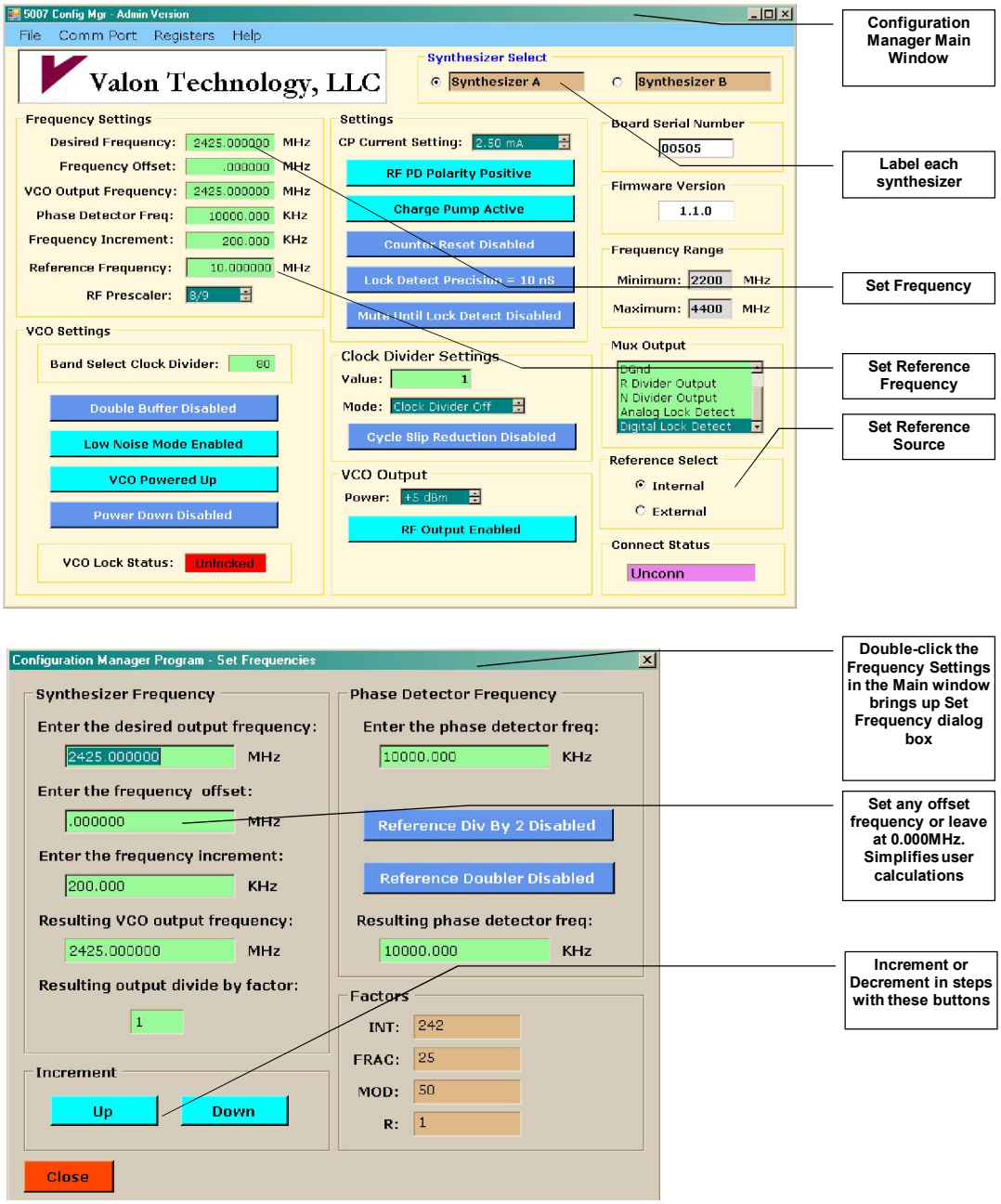
J2-1	TDO	JTAG Programming port (no user functions)
J2-2	Lock detector output	
J2-3	TDI	
J2-4	Reset, active low	
J2-5	TMS	
J2-6	TEST MODE SELECT	
J2-7	TCK	
J2-8	Ground	

Dimensions and Mounting locations

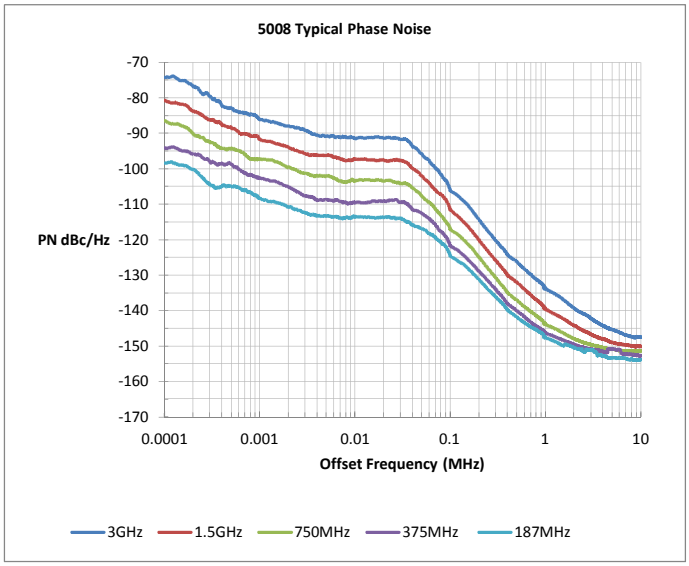


The Configuration Manager software, is an easy to use Windows application, supplied via free download from our web site. The **Configuration Manager** allows the user to control the operation of each synthesizer independently.

Set each synthesizer frequency and assign a unique label or name.
Set the frequency increment and provides a push-button Increment or Decrement function.
Check Lock condition of each synthesizer with the Read command.
Enable or disable either or both synthesizers for low power operation when only one or neither synthesizer operation is needed.
Set an offset frequency which makes direct frequency entry easier when used in a heterodyne scheme.
Set the reference source to either internal TCXO or external local standard. Set the reference frequency.
Save and recall setups to your computer files.
Write to synthesizer FLASH to save all setting in non-volatile memory.
Set the synthesizer output power.



Typical phase noise performance



Phase noise was measured using the internal 10MHz reference with the Phase Detector Frequency set to 10MHz. The Frequency Increment was set to 1000kHz. The Charge Pump Current setting was 5mA.

The phase noise data was taken at the center of the 5 frequency bands. The phase noise will be slightly higher at the top of each band and slightly lower at the bottom.

Using an external low phase noise frequency reference will also improve phase noise.

Agilent E4440A PSA used to acquire phase noise plots using the built-in phase noise measurement utility.