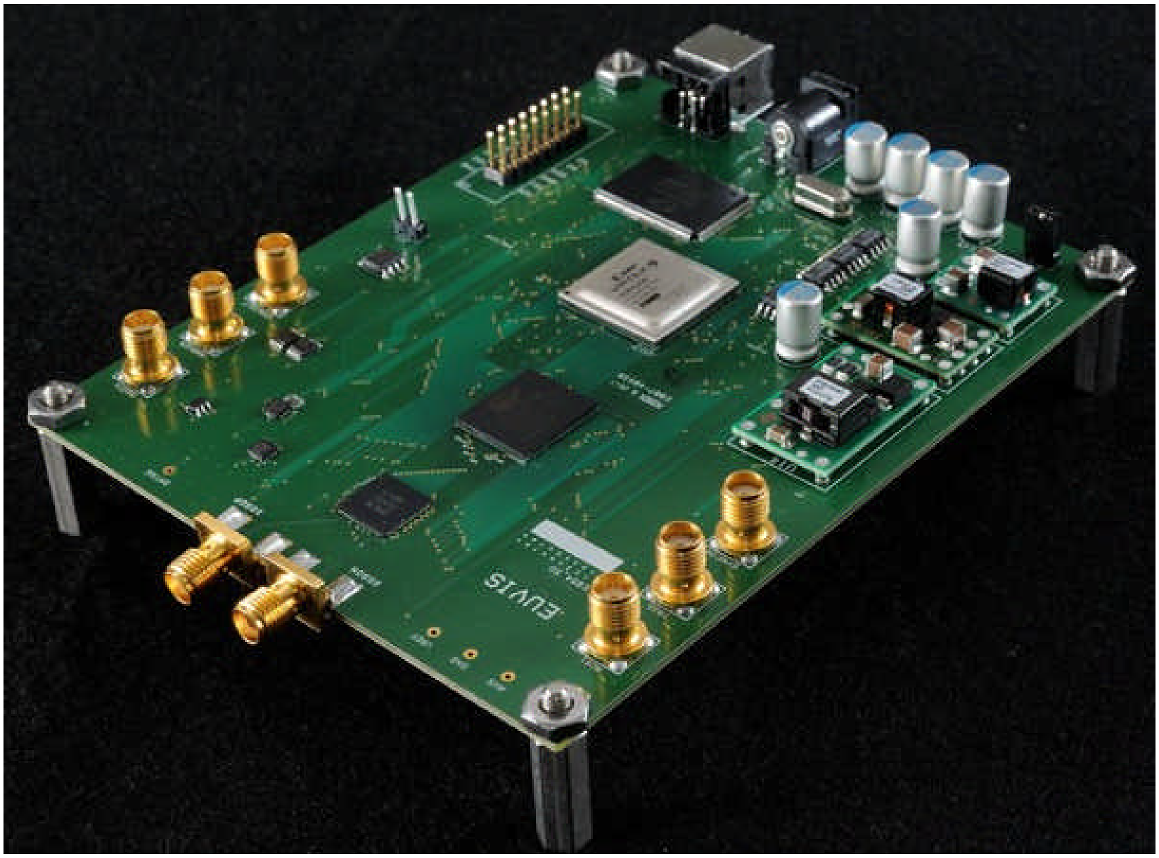
DSM303-V4 – 3.0 GHz Arbitrary Frequency Chirping Module

PRODUCT DESCRIPTION

The **DSM303-V4** module generates arbitrary frequency chirping CW with frequency update rates up to 312.5 updates/microsecond (1/8 of the clock rate). At 2.5 GSPS, the module can generate frequency chirping in a bandwidth from DC to 1.25 GHz. The chirping profile can be linear or arbitrarily programmed. The **DSM303-V4** can be controlled by a PC via GUI or by user application programs via API, or can work alone with pre-stored chirping waveform. The chirping waveform generations can be in continuous, triggered continuous, and triggered burst modes. Up to 127 waveforms can be stored in user pages and users can select which user page to be played on the fly.



KEY FEATURES:

- 3 GSPS DDS with 11-bit amplitude and 13-bit phase resolution
- Maximum clock rate: 3.0 GHz for CW and 2.5 GHz for chirping
- Chirping standard sampling rate at 2.5 GSPS (2.5 GHz clock)
- Chirping optional sampling rate range from 1 to 2.5 GSPS (1 to 2.5 GHz clock)
- 520K x 32-bit memory depth with maximum 127 waveforms
- Waveforms can be switched dynamically by selecting user pages on the fly
- Minimum waveform length of 256 ns in Burst Mode
- Maximum 1.6 millisecond chirping waveform length at 2.5 GHz clock rate and 2.1 millisecond chirping waveform length at 2.0 GHz
- Programmable phase reset for precise phase repetition
- Accepts external triggers and generates marker signals (programmable)
- 9 W power consumption with a +12V DC wall-mount power supply (included)
- USB 2.0 compliant interface (other interfaces available upon request)
- Companion API and software drivers for easy system development
- GUI with various built-in chirping waveforms

APPLICATIONS

- Linear Frequency Modulation (LFM) and chirping
- Frequency Modulation Continuous-Wave (FMCW) radar
- Agile LO frequency synthesis
- Electronic warfare
- RF signal source generation
- Fast frequency hopping
- VSAT satellite communications
- Test and measurement equipment

ELECTRICAL SPECIFICATIONS

PARAMETER	Symbol	Min	Typical	Max	Unit
Operating Temperature	T_o		25		°C
Clock Frequency	f_{CK}	1	2.5	3	GHz
Clock Input Power	P_{CK}	0	3	10	dBm
Output Level	V_{out}	-635		0	mV
Output Power[1]	P_{out}	-4		0	dBm
Output Residue Phase Noise[2]	N_f			-145	dBC/Hz
Clock Port Return Loss	RL_{CK}		13		dB
Output Port Return Loss	RL_{RF}		15		dB

[1]Due to the zero-order-hold DAC response, sinc function
[2]10 KHz offset

TERMINAL DESCRIPTION

Name	Function	I/O	Signal
GND	Ground		DC
+12V	Power, +12 V		DC
DDSOP	Waveform Output Positive	O	RF
DDSON	Waveform Output Negative	O	RF
DDSCK	Input Clock Source +	I	RF
TRIG	Trigger	I	
SYNCIN	Synchronize Input	I	
SYNCOUT	Synchronize Output	O	
MARKER	Marker	O	
AUX1	Auxiliary Output	O	

DETAILED SPECIFICATIONS

General	
DDS Frequency Resolution	32 bits
Amplitude / Phase Resolution	11 bits / 13 bits
Frequency Update Rate	1/8 of input clock
Running Modes	Continuous Triggered Continuous Triggered Burst / Pulse
User Interface	Windows Graphical User Interface, USB
Input Clock	
Type	Single-ended, 50-Ω terminated
Connector Type	SMA
Frequency Range Static	1 to 3 GHz
Frequency Range Chirping	Standard: 2.5 GHz Optional: 1 GHz to 2.5 GHz
Power Level	0 dBm to 10 dBm
Return Loss	13 dB
Output	
Type	Differential, 50-Ω terminated
Connector Type	SMA
Output Sampling Rate Range	1 GSPS to 2.5 GSPS
Output Maximum Frequency	Half of Sampling Rate
Output Level	-635 mV to 0 V
Output Power	-4 dBm to 0 dBm
Output Phase Noise	Max. –145 dBc/Hz at 10 KHz from carrier
Output Return Loss	15 dB
Trigger	
Connector	SMA
Source	External or Software
Recommended External Trigger	Low Voltage CMOS 3.3V (LVCMOS33)
Minimum Trigger Period	1 us

DETAILED SPECIFICATIONS, (CONTINUED)

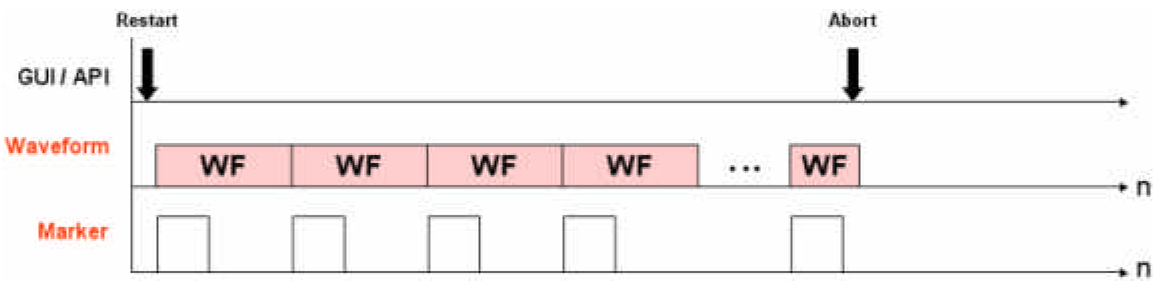
Waveform	
Max Waveform Length	523,264 words in Continuous Modes 519,176 words in Burst Mode
Minimum Waveform Length	32 words in Continuous Modes 256 ns waveform length in Burst Mode
User-Defined Waveform	User defined frequencies and markers
User Pages	
Max User Pages	128 in Continuous Modes 127 words in Burst Mode
Maximum Word per User Page	4,088 words
Waveform Length Restriction	Waveform length must be divisible by 4
Marker	
Number of Markers	1
Marker Length	User defined
Marker Output Levels	LVCMOS 3.3 V (LVCMOS33)
API	
CLR (Common Language Runtime) support languages targeting the runtime, such as C++/CLI, C#, Visual Basic, Jscript, and J#. Compatible with Matlab 2009a (with .NET framework support)	
GUI	
Available for Windows XP, Windows Vista and Windows 7	
Options	
Variable Clock Frequency Range from 1 GHz to 2.5 GHz	

WAVEFORM GENERATION MODES

The module can be operated in three waveform generation modes: *Continuous* mode, *Triggered Continuous* mode and *Triggered Burst* mode.

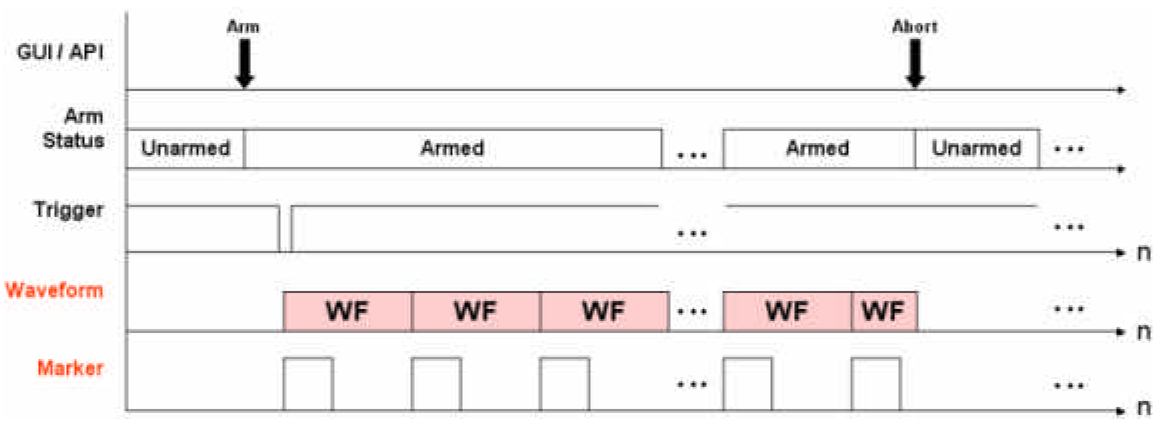
Continuous Mode

In *Continuous* mode, the module starts waveform generation by a *Restart* command from the GUI or API-based application. Once the waveform starts, the module repeats the waveform continuously. There is no latency between two consecutive waveforms. The following waveform starts right after the end of the preceding waveform. The waveform generation can be aborted by an *Abort* command from the GUI or API-based application.



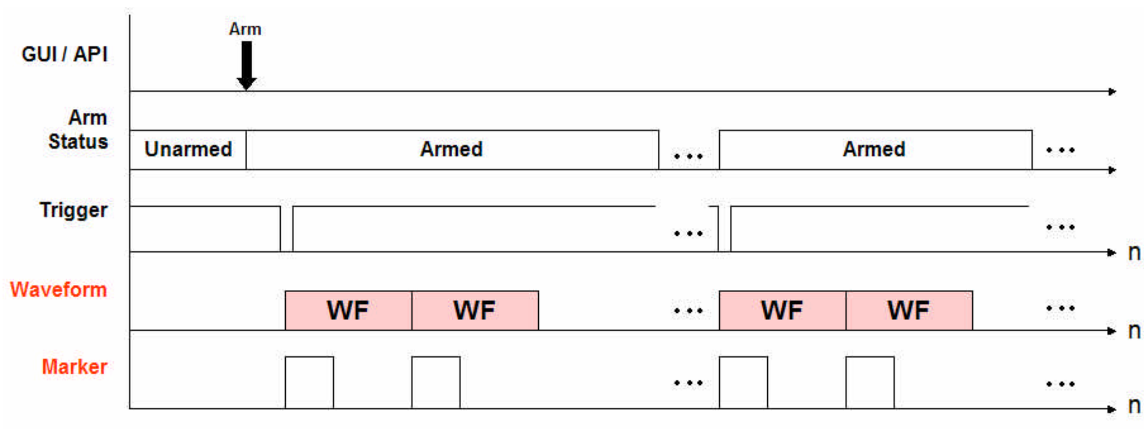
Triggered Continuous Mode

In *Triggered Continuous* mode, the operation manner is similar to that in *Continuous* mode except for the start of waveform. The waveform generation is initiated by a trigger signal. In order to accept the upcoming trigger signals, the module has to be *armed* prior to the instance of the trigger signal. Trigger signals happening before the module is armed will be ignored. An *Arm* command from the GUI or API-based applications can be used to arm the module. Once the module is armed, it waits for the trigger signal. The waveform generation starts after the falling edge of the trigger signal. The trigger signal can be applied via the TRIGGER SMA connector or provided by a command *Trigger* via the GUI or API-based application.

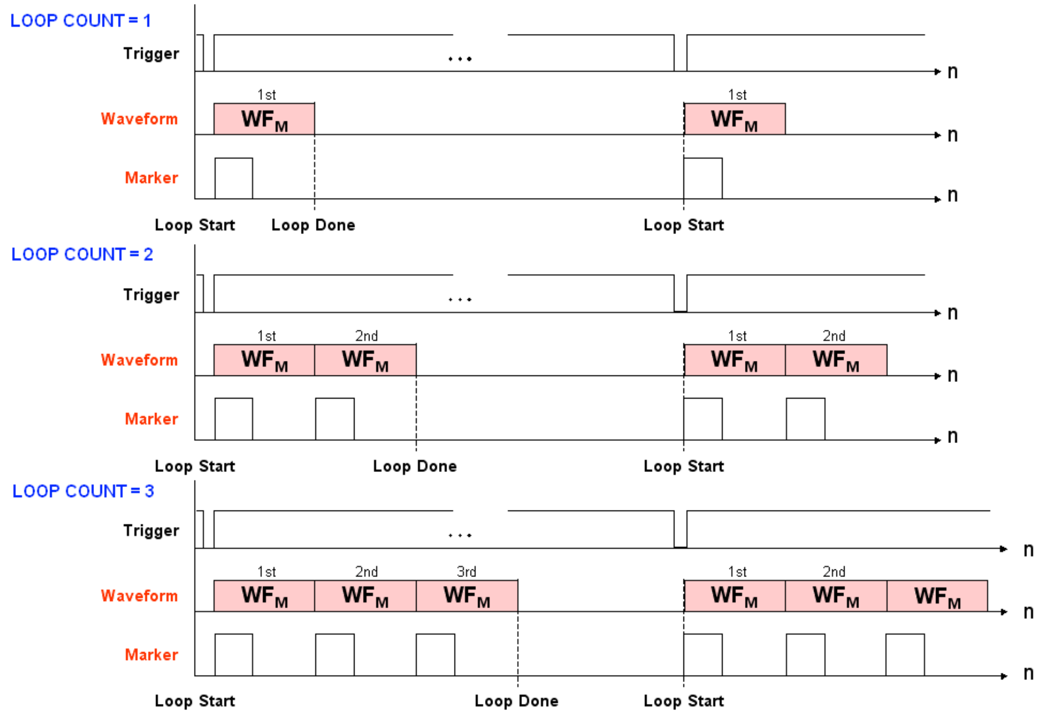


Triggered Burst Mode

In *Triggered Burst* mode, the module starts waveform generation when it is armed and receives the trigger signal as in the *Triggered Continuous* mode. Instead of repeating continuously, the waveform starts, repeats, and stops after finite repetitions. The number of the repetitions can be specified by a property *Loop Count* via the GUI or the API-based applications. The *Loop Count* can be set from 1 to 255. Trigger signals occurring before the module is armed will be ignored. Similarly, trigger signals will be ignored if the module is in the middle of a waveform. Once the waveform stops, the module will arm itself automatically and wait for the next trigger signal. The diagram below shows the waveform output when *Loop Count* is set to 2.



The following figure shows waveform generation for different *Loop Counts:* 1, 2, and 3.



WAVEFORM DETAILS

The DSM module includes a 523,776 32-bit word memory so the maximum length of one waveform is 523,776 frequencies in Continuous Modes. In Burst Mode, the maximum waveform length is 519,684.

The minimum waveform length depends on the mode of the DSM. In Continuous or Triggered Continuous Mode, the waveform length can be as short as 32 data points. Each data point represents one frequency word and lasts 8 input clock periods so at 2.0 GHz, each data point lasts for 4 ns (1 / 2GHz * 8). The minimum waveform length in Burst Mode can be as short as 256 ns. Note that the minimum waveform length is defined as an absolute time in Burst Mode whereas the minimum waveform length in Continuous Modes is defined in number of data points. This means that the minimum number of data points that can be chirped in Burst Mode will depend on your input clock. At 2.0 GHz, 256 ns translates to about 64 data points (256ns / 4ns); at 2.5 GHz, the minimum number of data points is about 80; and at 1.5 GHz, the minimum number of data points is about 48.

The oscilloscope photos below demonstrate some of the capabilities of the DSM. All three waveforms in the photos are chirping from 1/256 of the input clock frequency to 1/16 of the input clock frequency in steps of 1/256 of the input clock frequency. The three example waveforms differ in how many times they repeat this chirping segment. As you can see in Chart 1, each segment will take the waveform through 4.25 phase cycles.

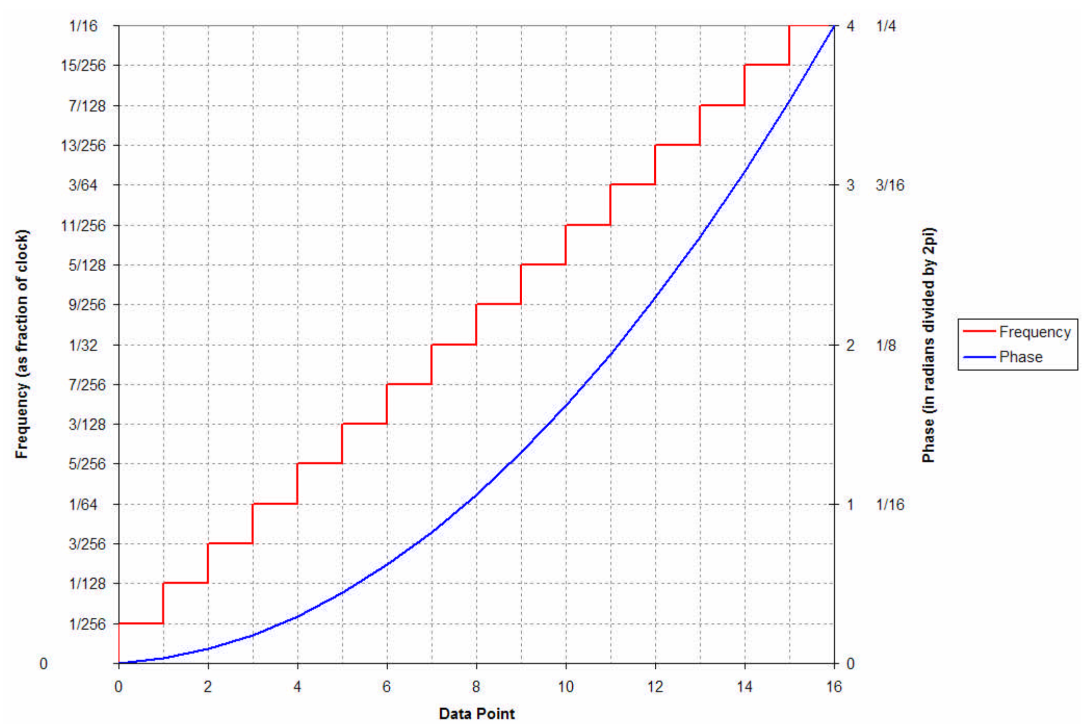


Chart 1

The input clock in the waveforms are all 2.0 GHz, so for each segment of the waveform, the DSM is chirping from 7.8125 MHz (2000MHz / 256) all the way up to 125 MHz (2000MHz / 16) in 7.8125 MHz steps for a total of 16 data points. There are 8 data points at the beginning of each waveform that is used for reset and where the phase and frequency is 0.

The signal at the bottom of each photo is the Marker and goes high at the beginning of the waveform and stays high for the first 8 data points before going back low again.

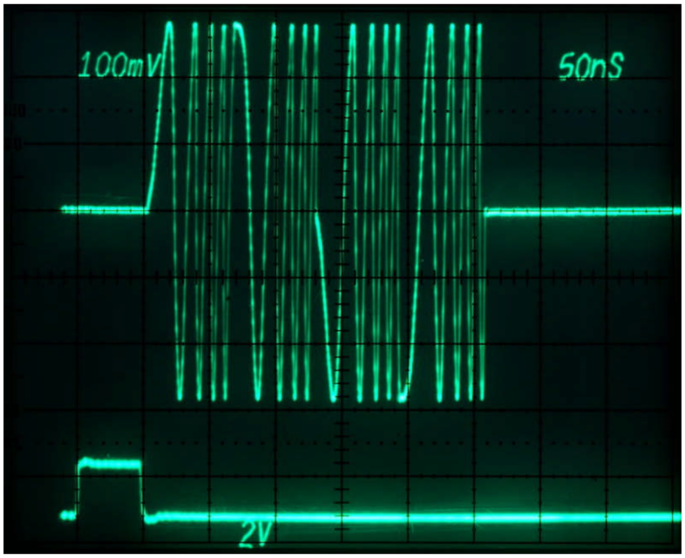


Photo 1

In Photo 1, the DSM is chirping 4 segments back to back for one complete waveform. The loop count is set to 1 so the DSM runs the complete waveform one time when it senses a trigger. At the end of the waveform, the module stops output and waits for the next trigger. The total waveform length is 72 data points (8 reset frequencies + 4 * (16 data points per segment) = 72), which translates to about 288 ns. Figure 1 shows the ideal waveform of Photo 1.

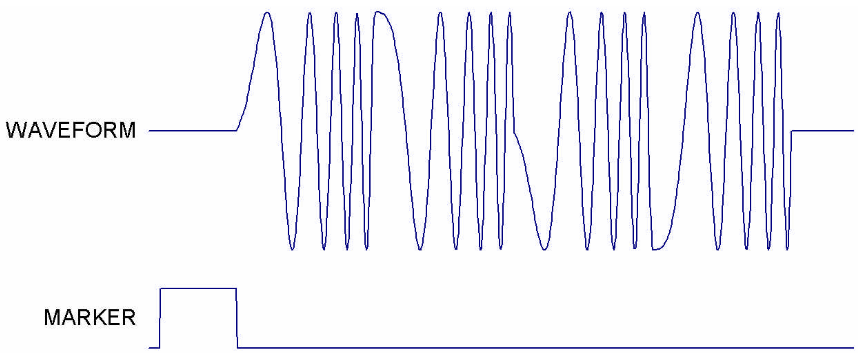


Figure 1

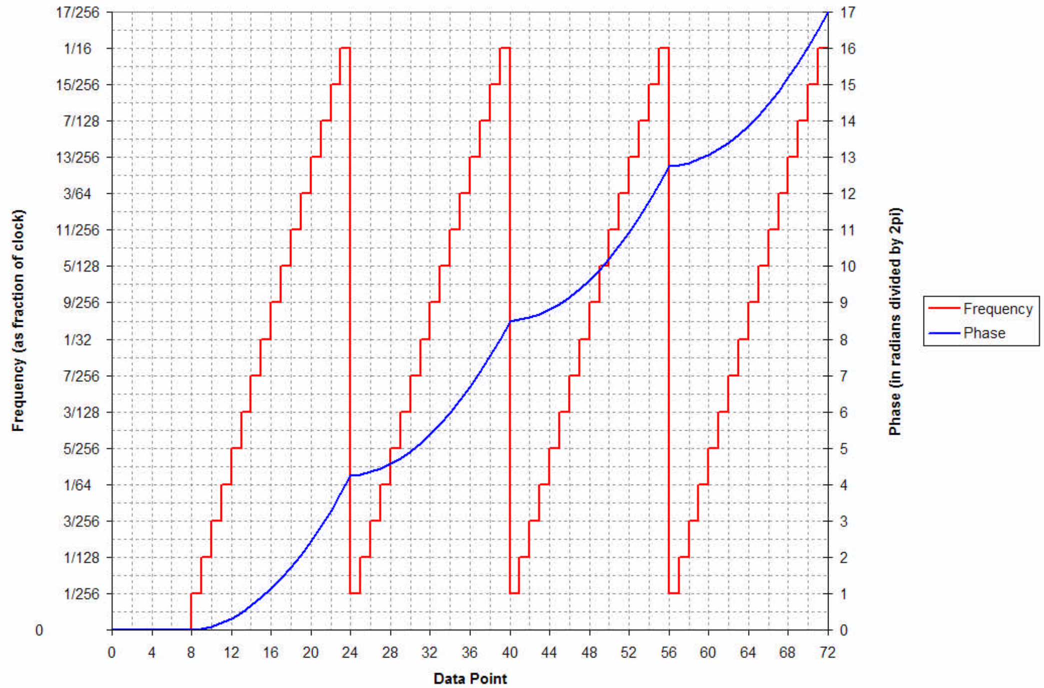


Chart 2

Each frequency "triangle" shown in red in Chart 2 represents one of the four chirping segments of the waveform in Photo 1. The phase is shown in blue. Recall that each segment will take the waveform through 4.25 phase cycles. After the first segment, the waveform has completed 4.25 phase cycles. After the second segment, the waveform has completed 8.5 phase cycles. After the third segment, the waveform has completed 12.75 phase cycles. Finally, after the fourth segment, the waveform has completed 17 phase cycles and is back at the original starting point. Figure 1 shows where the segments on the waveform are.

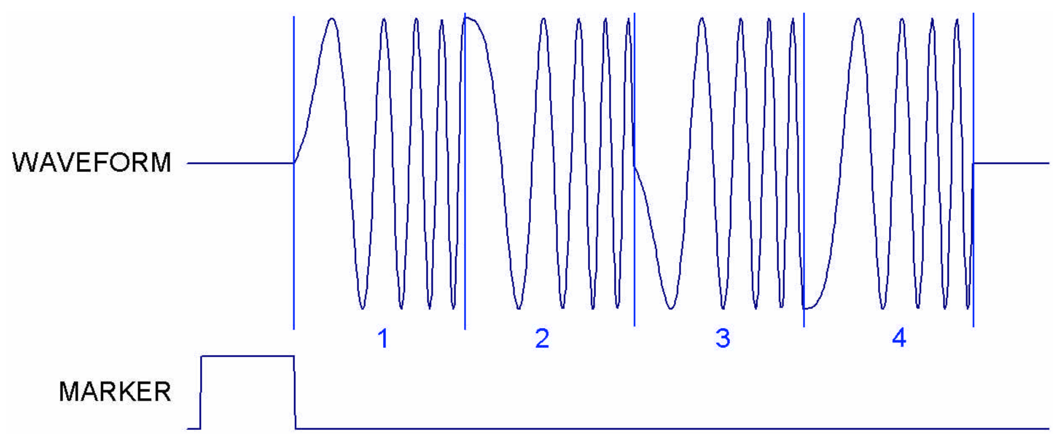


Figure 2

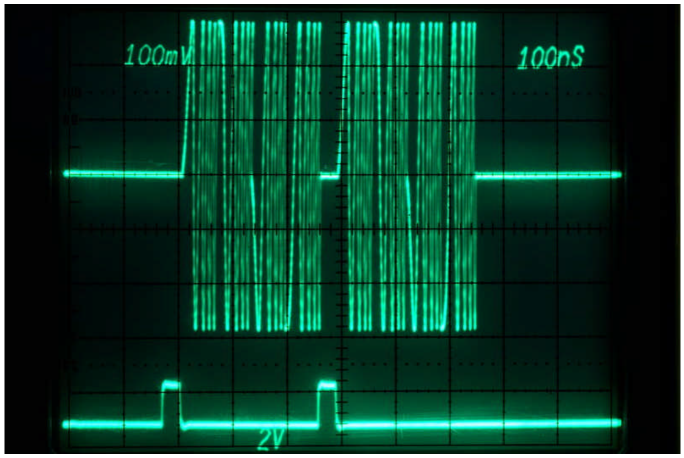


Photo 2

In Photo 2, the DSM is chirping the same complete waveform as in Photo 1 but this time the loop count is set to 2. When the module senses a trigger, it will run the complete waveform two times in succession and at the end of the second complete waveform, the DSM will stop output and wait for the next trigger. The total waveform length is about 544 ns at 2.0 GHz. Figure 3 shows ideal waveform of Photo 2.

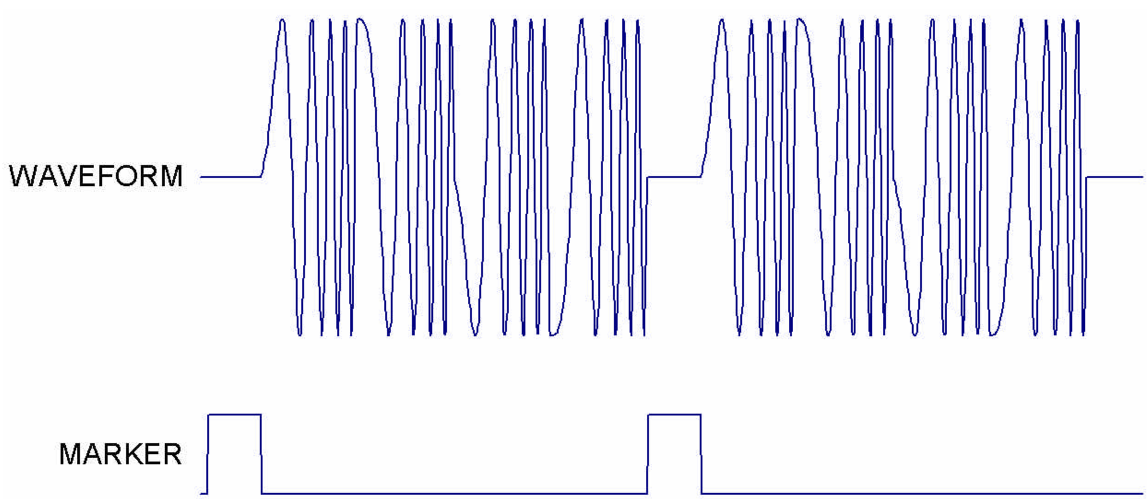


Figure 3

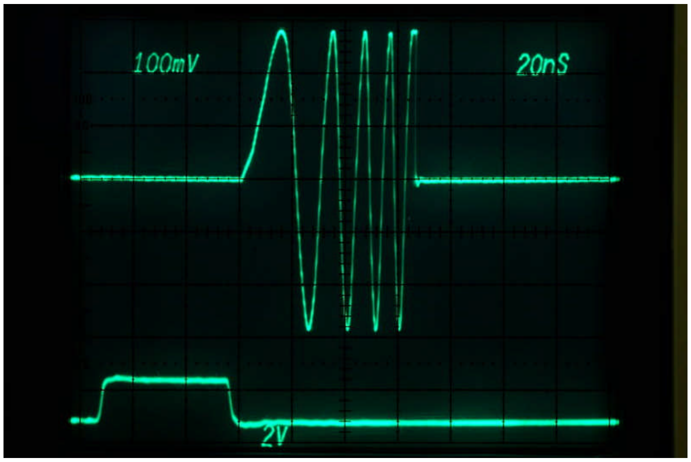


Photo 3

Photo 3 demonstrates how short a waveform can be. This time, only one segment (1/256 of clock to 1/16 of clock in 1/256 of clock steps) is output as opposed to the 4 cycles in Photos 1 and 2. The first 8 data points consist of resets while the next 16 data points is the chirping segment. The total length is therefore 24 frequencies, which is only about 96 ns at 2.0 GHz. Figure 4 shows the ideal waveform of Photo 3.

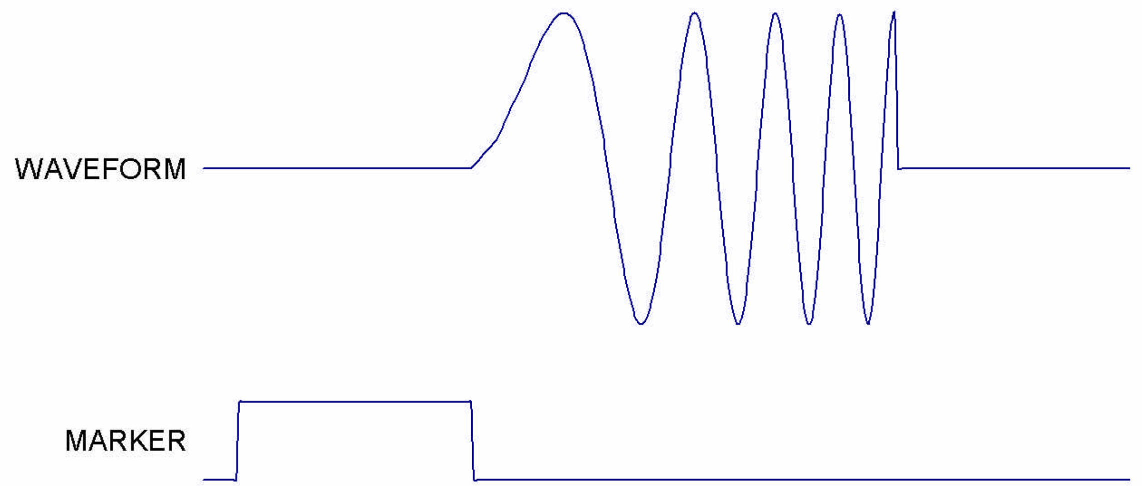


Figure 4

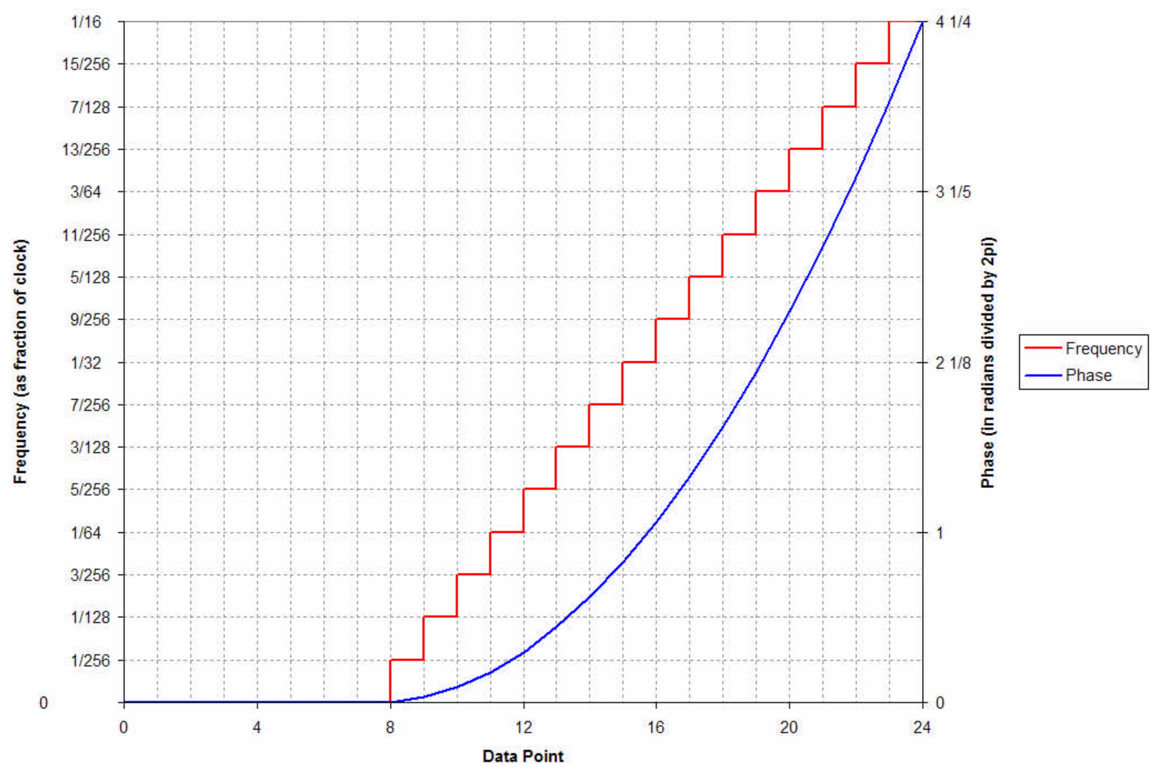
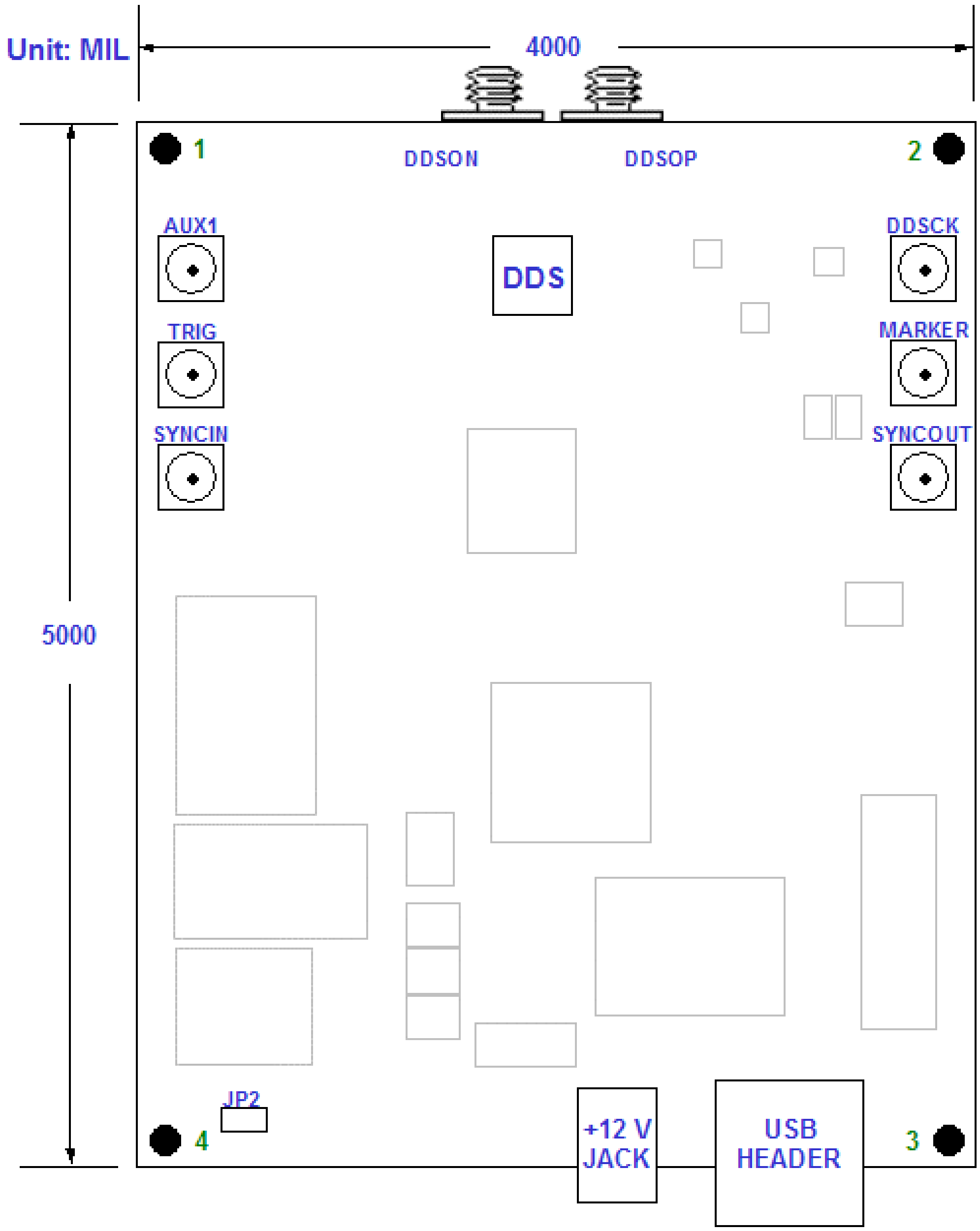


Chart 2

Chart 2 shows the frequency and phase that the waveform in Photo 3 goes through. At the end of the waveform, it will have gone through 4.25 phase cycles.

BOARD DIAGRAM



DIMENSIONS AND MOUNT HOLE LOCATIONS

Length	5.0 inches
Width	4.0 inches
Height	0.7 inches with heat sink 0.6 inches without heat sink
Weight	Less than 1 lb
4 Mount Hole Locations (mils. Origin is lower left corner)	125, 3875 3875, 4875 3875, 125 125,125

Ordering Information:

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Or fax: (805) 583-9889