User's Manual

for

CG6000

2 Channel
25 MHz to 6.0 GHz
Clock Synthesizer

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1   GENERAL INFORMATION

1.1   Introduction

The CG6000 is a 2 Channel Clock Synthesizer that can fit into a PCI, PCIe, no-slot, or an external USB enclosure and can produce an AC coupled square wave between 25.0 MHz and 6.0 GHz with a programmable amplitude from -4 dBm to +5 dBm in 3 dBm steps. By default it is locked to an internal 50 MHz reference clock with 1 PPM stability but can also accept an external 10 MHz reference clock.

The CG6000 board has the following standard features:

- 2 independent AC coupled square wave output channels from 25.0 MHz to 6.0 GHz [SMA]
- Programmable amplitudes from -4 dBm to +5 dBm in 3 dBm steps [SMA]
- 1 PPM 50 MHz on-board clock.
- External selectable 10 MHz reference clock (square wave). [SMA]
- Card fits into PCI, PCIe, No-Slot, and external USB box (optional)
- All functions controlled through USB Mini-B connector
  accessible through bracket to outside of PC or directly to optional USB box.

1.2   References

See USB 2.0 specifications.

1.3   Deliverables

1.3.1   Software

The CG6000 comes with USB drivers, GUI, and programmers API software for **Windows XP (32-bit) and Windows 7 (32/64-bit)**. All software can be downloaded from "www.wavepond.com". Check with WavePond for the latest information on drivers for other operating system platforms or check the web site for the latest updates.

For maximum compatibility the programming interface for the CG6000 uses the "cg6000.exe" and command line parameters to execute all functions. Most (if not all) existing software languages can initiate an external process and pass parameter strings. This may seem like an inconvenience but this completely eliminates compatibility issues between compilers, operating systems, and processors. Instruction lists can also be stored in a script file (e.g. batch) for convenience.

See section on software drivers for description of each function along with an example.

1.3.2   Hardware

The CG6000 hardware consists of a single PCB module, PCI/PCIe bracket, and a 3ft USB cable (A Male to USB 5-Pin Mini B Male) which is used for power and control.

1.3.3   Checklist

Item #	Qty	Part Number	Description
1	1	CG6000	25.0 MHz – 6.0 GHz Clock Synthesizer Card
2	1	USB Cable	3ft USB cable (A Male to USB 5-Pin Mini B Male).
3	1	USB Enclosure	Optional USB enclosure for tethering to PC, Tablet, Mac, etc.

1.4   Product Specification

(all specifications are at 25C unless otherwise specified)

I/O SPECIFICATIONS

Square Wave Outputs (SMA)	
Output Voltage	-4 dBm to +5 dBm Square Wave, programmable in 3 dBm steps (typical).
Frequency Range	25.0 MHz to 6.0 GHz
Frequency Calculation (Integer)	$F = (10e6*N)/(2^D)$ where N: $300 <= N <= 600$, D: $0 <= D <= 7$
Frequency Calculation (Fract.)	TBD (contact factory)
Frequency Step Response	300 usec Typical to 1 Hz error @ 1.0 GHz clock output
Phase Noise	< -100dBc/Hz @ 100 Hz Offset (Typical @ Fc = 1.0 GHz)
Jitter	< 5 psec typical @ 1.0 GHz clock output
External Reference Clock (SMA)	
Frequency (default)	10.00 MHz square wave (contact factory for custom configurations)
Amplitude range	200 mVpp <= Ampl. <= 3 Vpp into 50 ohms.

GENERAL

Operating Temperature	0 to 70 degrees C standard
Operating Humidity	5 to 95% non-condensing
Size	2" Long x 4.25" Tall x 0.5" Thick (fits into PCI, PCIe, no-slot, USB box.
Data Bus	USB 2.0

1.5   Technical Support / Software Updates

For technical support:

Email	Use form on web site below for first contact. A personal email address will be given at that time.
Mail	WavePond
P.O. Box 1487
Langley, WA 98260
Web	http://www.wavepond.com

For software updates check web site:

Web	http://www.wavepond.com

1.6   Warranty

WavePond warrants to the original purchaser that its CG6000, and the component parts thereof, will be free from defects in workmanship and materials for a period of ONE YEAR from the data of purchase.

WavePond will, without charge, repair or replace at its option, defective or component parts upon delivery to WavePond's service department within the warranty period accompanied by proof of purchase date in the form of a sales receipt.

<u>**EXCLUSIONS:**</u> This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

WavePond shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation or incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights. You may also have other rights that vary from state to state.

WavePond warrants products "directly" sold anywhere in the world. If a WavePond product is purchased through an authorized distributor then warranty details are resolved through them.

<u>**NOTICE**</u>: WavePond reserves the right to make changes and/or improvements in the product(s) described in this manual at any time without notice.

2   HARDWARE DESCRIPTION

2.1   Introduction

The CG6000 hardware module consists of the following major functions:

- Low Jitter Frequency Synthesizer
- 1 PPM Reference Clock
- 2 Square Wave Output Drivers
- 10 MHz External Clock Reference Input
- USB Peripheral Controller

2.2   Hardware Installation

The CG6000 can be installed in any PCI, PCIe, or empty slot as long as there is location to attach the bracket. Since the card is completely powered by the USB connection there is no need for any power supply connections. This applies to the optional external USB box as well.

2.3   Block Diagram

Figure 1 – Block Diagram (TBD)
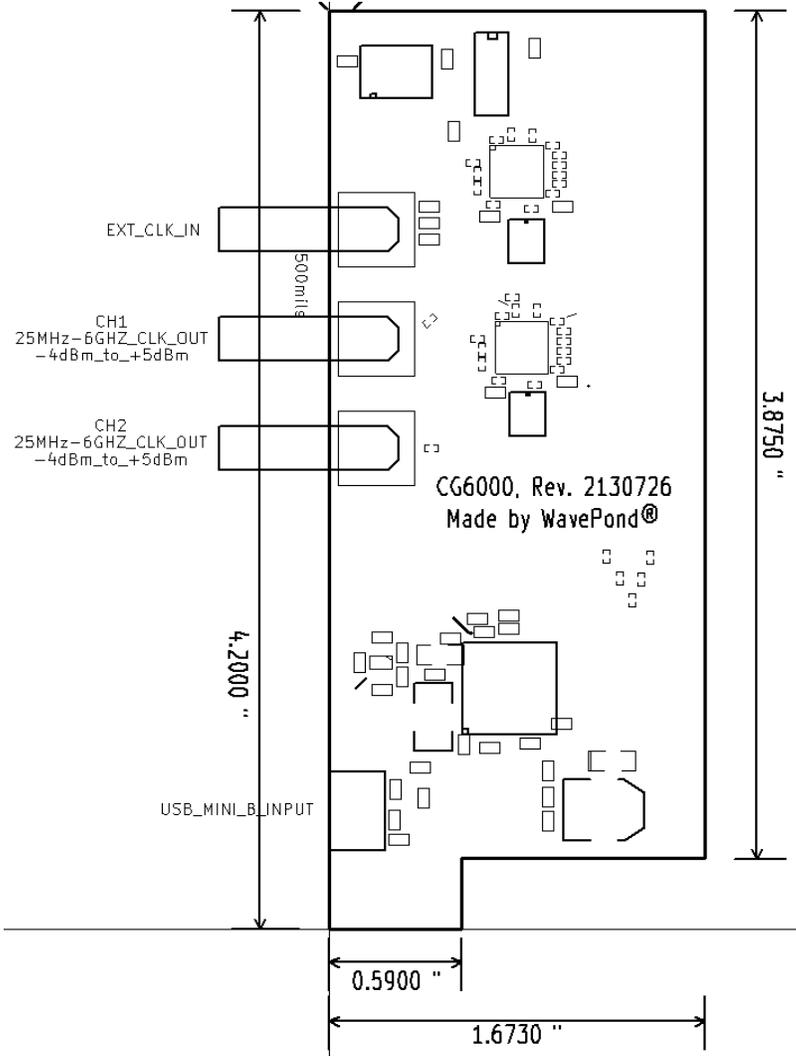
2.4   Board Drawing

Figure 2 – Board Layout for CG6000

3   THEORY OF OPERATION

3.1   Introduction

The CG6000 consists of 2 Frequency Synthesizers, a 50 MHz 1 PPM internal reference clock, software drivers / GUI, and USB interface. Between 3.0 GHz and 6.0 GHz the outputs are phase locked to the onboard/offboard clock (and to each other). For output frequencies below 3.0 GHz the outputs are frequency locked only (phase relationships are different each time board is programmed).

The GUI program doubles as the "programmers" interface (i.e. API) and does this by accepting parameters on the command line. No GUI is displayed when parameters are present. Since all software programming languages have the ability to execute an external process, compatibility problems are virtually eliminated.

Please note that how you plan to use the card will determine whether your program waits for the external process to complete or not.

4   SOFTWARE GUI APPLICATION

4.1   Introduction

Simply run "cg6000.exe" or "cg6000_64.exe" to display the CG6000 exerciser program. The on-screen controls are self explanatory. However, USB drivers must also be installed first (see below).

5   SOFTWARE DRIVERS

5.1   Introduction

The WavePond CG6000 card uses the command line approach for the user's application programming interface (i.e. API). The API interface uses the same executable file as the GUI software itself. If the GUI detects ANY parameters were passed it suppresses the display and processes the parameters, otherwise the GUI is displayed and operates stand-alone.

The details on installing the USB drivers are listed in 5.2.xx. The listing of the command line parameters are listed in section 5.4.xx and the programming examples in section 5.5.x will show you how to include them into your programs.

The drivers are designed to work under Windows 32/64-bit systems [check for availability on Mac OS X, Linux, and Android].

5.2   USB Driver Installation

Windows 7 (32/64-bit) should install drivers automatically when card is plugged in "if" auto-update is enabled. If not, see USB driver installation guide for the appropriate operating system instructions.

5.3   API Installation

There is No installation necessary for the programmers API. Just include the following two files into the same directory as your application software:

"cg6000_64.exe", "ftd2xx64.dll"   (for 64-bit)
"cg6000.exe", "ftd2xx.dll"   (for 32-bit)

When you execute the EXE without any command line parameters then the GUI program will display. When parameters are added on the command line then the command is executed without the GUI and returns after completion.

5.4   Command Line Parameters

5.4.1   Single Call

Command line call (simple text)

Example: "cg6000.exe 1 200e6 100e6 1 1 0 0 0"
{cg6000.exe CardNum Freq1 Freq2 En1 En2 Amp1 Amp2 ExtClk}

CardNum: 1 <= CardNum <= 4
Freq1:   25e6 <= Freq1 <= 6.0e9
Freq2:   25e6 <= Freq1 <= 6.0e9
En1:   0 = Off; 1 = On
En2:   0 = Off; 1 = On
Amp1:   0 = 5dBm; 1 = 2dBm; 2 = -1dBm; 3 = -4dBm
Amp2:   0 = 5dBm; 1 = 2dBm; 2 = -1dBm; 3 = -4dBm
ExtClk: 0 = Internal 50 MHz 1ppm Clock; 1 = External 10 MHz clock

5.5   Calling External Processes (notes)

Again, since almost every software tool in existence has the capability to call an executable and pass parameters the following are just a few example references only, not a comprehensive coverage of every language. Python, C/C++, Pascal, C#, Java, etc., all have their own nuances.

Caution: Be sure the process finishes before asking it to do something again.

Lazarus/FreePascal:

SysUtils.ExecuteProcess(Full_Path, parameters, []); // waits until done

Full_Path includes "cg6000.exe".
Parameters includes function name + parameters separated by spaces.

C++:

The following are just a few functions that could be used in C++:

system(string.c_string)
CreateProcess(...)
ShellExecuteEx()

Windows Batch File ==> (self explanatory)

6   MISCELLANEOUS

6.1   Calibration

The CG6000 has no user feature to perform calibration. However, future versions may incorporate method to upload firmware to fix bugs or add features to the FPGA.

6.2   Maintenance

No maintenance is required. Call factory for maintenance and/or extended warranty information.

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