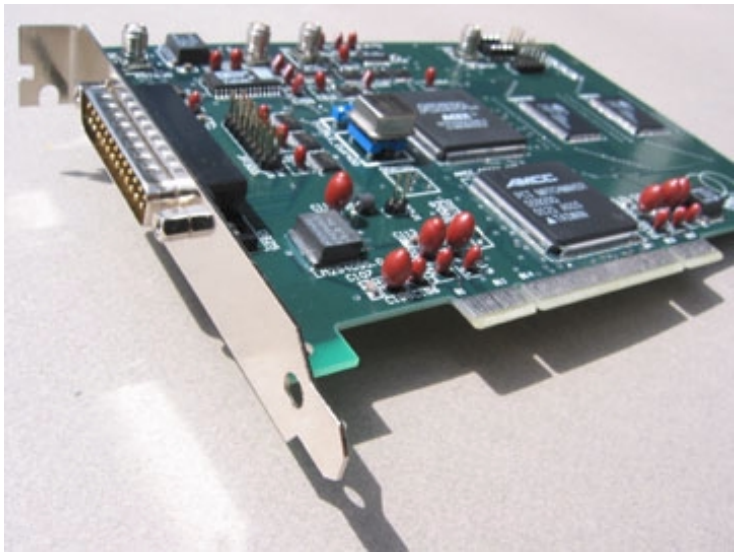
Owner's Manual for the

ClockMaster™

Models:
CM2-100-PCI



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Congratulations and THANK YOU for choosing a system from SpinCore Technologies, Inc. We appreciate your business. At SpinCore we try to fully support the needs of our customers, so if you ever need assistance please contact us and we will strive to provide the necessary help.

SpinCore Technologies, Inc. makes every effort to verify the correct operation of the equipment. This equipment should NOT, however, be used in system where the failure of a SpinCore device will cause serious damage to other equipment or harm to a person.

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Section I: Introduction

1. Quick Product Overview

The ClockMaster™ is a variable frequency digital clock generator implemented on a single PCI board (1/2 size). The output voltage range of the digital signal is 0V to 2.5V. It is controlled by a simple PCI interface. The system runs off of a 100 MHz reference clock and has 31 bits of frequency data, which provides for a frequency resolution of 47 mHz. Its valid frequency operating range is from 0 Hz to 70 MHz. When the frequency selected is zero Hz, the output of the system will remain at ground.

2. System Architecture

Block diagram

Figure 1 presents the general architecture of the ClockMaster™.

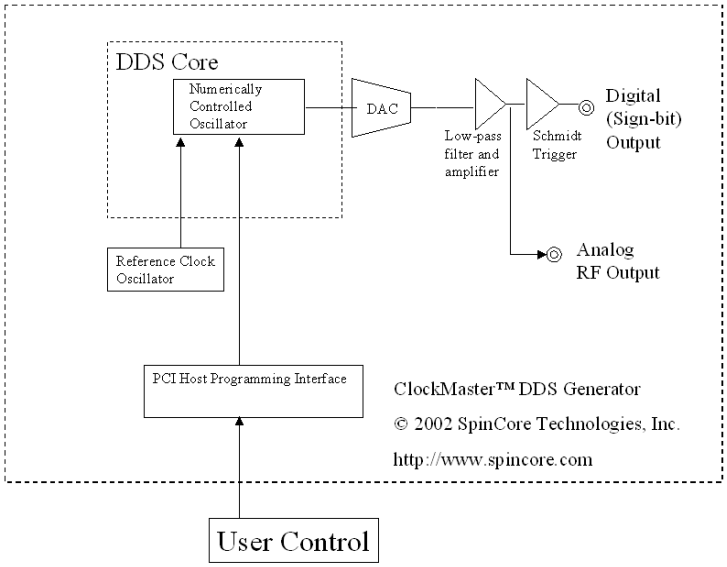


Fig. 1. ClockMaster™ system architecture.

ClockMaster™, Fig. 1, contains a high performance Direct Digital Synthesis (DDS) system equipped with additional circuitry for frequency control and output interface. At the core of the ClockMaster™ board is a numerically controlled oscillator (NCU) with an internal sine lookup table. Digital output values of the DDS core are converted to sinusoidal waveforms via the Digital-to-Analog (DAC) converter. The DAC's output is then filtered, amplified, and routed to the SMA output connector.

For the purpose of generating low-jitter digital output signals, the ClockMaster™ is also equipped with a fast Schmidt trigger that extracts the sign bit information of the generated analog waveforms. The sign bit is the digital output signal of the system. By generating analog waveforms, low-pass filtering them, and then extracting the sign bit, the resulting digital output signals are of improved quality and reduced jitter, compared to the standard approach where only the Most Significant Bit (MSB) of the DDS's sine lookup table is used.

The on-board Schmidt trigger is supplied off of a 2.5 V power supply line and generates a maximum of 2.5 V voltage swing at the output pin.

Section II: Installation

1. Quick Installation Guide

1. Go to http://www.pulseblaster.com/CD/ClockMaster/ and download the zip file from the correct directory for your operating system.

2. Unzip the files to their own directory.

3. Turn off your computer.

4. Insert the ClockMaster™ board into an empty PCI slot.

5. Turn on your computer. The board will automatically be outputting a 25 MHz signal.

6. A dialog box will appear that says “New Hardware Found.” Click “Next”

7. Place a check by the box that says “Specify Location” and uncheck all others. Click “Next”

8. A window will pop up asking for the driver directory. Click “Browse”

9. Browse to the newly created folder containing the drivers.

10. Click “Open” and then “Next”

11. The next dialog box should say that an appropriate driver was found – “ClockMaster PM02PC01-100”

12. Click “Next” and “Finish” until installation is complete.

13. Open an MS-DOS window in the directory of the unzipped files.

14. Run install.bat. The following messages should appear:
    Creating driver entry… OK.
    Starting driver entry… OK.
    * If you receive a message that this process fails, please proceed to the troubleshooting section.

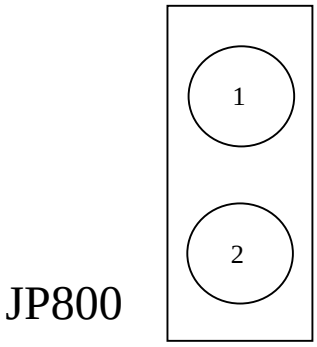
15. Run cmster.exe. You will see:
    Usage: cmster <freq (kHz)>
    * If you receive a indicating that the board could not be found, please proceed to the troubleshooting section.

    The board is now ready for use. As an example, cmster 1000 will cause the ClockMaster™ board to generate a 1Mhz signal.

Section III: Physical Description

1. Connector Information

Just to the right of the top of the PC bracket, there is a two pin header named JP800. This is where the output signal of the system is generated. An illustration of this header and the use of its pins are described below.



Pin 1 – This pin contains the output signal. The output signal is a square wave with a low voltage of 0V and a high voltage of 2.5V. The frequency of the signal is set through the PCI interface.

Pin 2 – Ground

On the cable provided by SpinCore Technologies, Inc., one of the two lines has stranded silver cable exposed. This is the ground pin and should be connected to pin 2 of the header.

Section IV: Programming Information

Programming Notes for ClockMaster™:

1. Using the PM02PC01 DLL

In order to change the output frequency of the ClockMaster™, we have packaged a DLL (pm02pc01.dll) and a library file (pm02pc01.lib) that provide a function with this capability. Use of this function is demonstrated below.

Provided Functions

int cm_set_freq(double frequency);

This function accepts desired output frequency as its input and returns a 0 if the call was successful.

double frequency – value of desired output frequency (in kHz).

2. Ordered Byte Output Description

All data transfers to the ClockMaster™ are sent to the base address of the I/O space defined for the card plus an offset of 0x0C. Data transfers involve the sending of 8 bytes of data. The data transfer must take place in the following manner. The top four bits of each output word must start at 0xF and toggle between 0xF and 0x0 for each byte output. The lower four bits of each output word are the bits of the desired output word, starting with the most significant 4 bits.

Example Output:

The following is an example of the output sequence to program the ClockMaster™. Explanations are included in brackets in the middle of the code. Use this method only if you are writing directly to the output port by using an _outp or similar function and not using the provided functions and drivers.

First, you must find the new data value to transfer based on the desired frequency. The formula for finding the desire frequency is

Output Word = Desired Frequency (in MHz)* 2^32 / Clock Frequency (in MHz)

For example, if you wanted an output frequency of 19.6415 MHz on a 50 MHz system

Output Word = 19.6415 * 2^32 / 50 = 1687192002.88768 ≈ 1687192003
= 0x649081C3

With this example, the output of the program would be

```
Output "0xF6" to port base + 0x0C
Output "0x04" to port base + 0x0C
Output “0xF9” to port base + 0x0C
Output “0x00” to port base + 0x0C
Output “0xF8” to port base + 0x0C
Output “0x01” to port base + 0x0C
Output “0xFC” to port base + 0x0C
Output “0x03” to port base + 0x0C
```

Section V: Troubleshooting

Note - This troubleshooting guide is only for Microsoft Operating systems.

I. Problem: 'Failed' Message Received on Running Install

Solution:

1. Driver may already be installed. Run Uninstall.bat and re-run Install.bat. If the problem persists, and cmster.exe returns an error, proceed to step 2.

2. Please be sure you are running the latest ClockMaster™ drivers from www.pulseblaster.com.

II. Problem: 'No cards found.' message received upon running cmster.exe or your own developed application

Solution:

1. Check to make sure that the card is properly inserted into the PCI slot and reboot your computer.

2. Open Device Manger. Under Multifunction adapters there should be an entry for ClockMaster™ PM02PC01. If you see the ClockMaster™ card, please proceed to step 3. If there is no entry for the ClockMaster™ PM02PC01 device, look for 'PCI Card' with an exclamation mark on it. Select 'Properties' for the PCI Card, and reinstall the driver using SpinCore's drivers. Reboot your computer.

3. Double click on this device to make sure it is working properly. If it is not working properly, you should see one of the following messages:

   Error message 1: Device is not present, or is not working properly

   Check to make sure that the card is properly inserted into the PCI slot and reboot your computer. If this does not fix the problem, try inserting the card into another PCI slot. If neither of these steps work, please follow the solution to Error message 2.

   Error message 2: Windows cannot load the driver for this device

   Download another copy of the drivers from www.pulseblaster.com for your particular operating system. Extract the installation files from the zip file.

   Under the device manager properties for the ClockMaster™, click on the "Reinstall Driver" button and follow the steps listed in the Quick Installation Guide.

4. If the device is not listed in Device Manager, repeat the steps listed under Error message 1 above.

III. 'Card does not have all items expected for PMSTER02_PCI' message received upon running cmster.exe or your own developed application

Solution:

1. See Solution to II.

IV. 'Failed opening WinDriver device' message received upon running cmster.exe or your own developed application

Solution:

1. Check to make sure that the card is properly inserted into the PCI slot and reboot your computer.

2. Re-run Install.bat. If the problem persists, please be sure you are running the latest ClockMaster™ drivers from www.pulseblaster.com.

Appendix I: Example C Program

```
// This sample application uses the PM02PC01 DLL to control the
// ClockMaster-100 board through the cm_set_freq DLL function call.
//
// SpinCore Technologies, Inc.
// August 2002
// http://www.spincore.com
//
// Notes: Remember to include PM02PC01.lib in your Project settings when
//    using the PM02PC01 DLL
//

#include <stdio.h>
#include <math.h>

#define KILO         1000
#define MEGA         1000000
#define FREQ_BITS    32
#define CLOCK_RATE      100*MEGA

// Imported Function from PM02PC01
extern "C" __declspec(dllimport) int cm_set_freq(double Freq_to_Output,
double Clock_Rate);


int main(int argc, char* argv[])
{
   double   Freq, TempFreq;

   Freq = 125.500;   // Freq to output in kHz

   // The Output to ClockMaster
   int cm_ret = cm_set_freq(Freq, CLOCK_RATE);

   // Check Function Return for Success
   if (cm_ret == -1) return -1;

   // For Display Purposes Only, Convert to Hex and Back to get the Rounded
True Value Output
   TempFreq = Freq * pow(2, FREQ_BITS - 1) * KILO / (CLOCK_RATE / 2);
   TempFreq = (unsigned int) TempFreq;
   TempFreq = (float) TempFreq / pow(2, FREQ_BITS - 1) * (CLOCK_RATE / 2) /
KILO;
   printf("Now Outputting --\nFrequency: %.4f kHz\n", TempFreq);
   return 0;
}
```

Appendix II: Available Custom Options

The ClockMaster™ can be customized to fit some specific needs. Below is a sample list of available options.

1. RS-232 serial interface.
2. Stand alone ClockMaster™ system housed in a shielded plastic enclosure with internal power supply.
3. Input for external hardware gating control.
4. Frequency modulation, frequency hopping.
5. Internal timing engine for pre-programmed execution of arbitrary sequences of output pulses of arbitrary duration with complex program-flow control statements, including nested loops, subroutines, etc.

For more information and/or to request a quotation, please contact sales@spincore.com.