


## COM-1500 FPGA + DDR2 SODIMM socket + ARM + USB2 DEVELOPMENT PLATFORM

### Key Features

- Powerful digital signal processing platform comprising:
  - Large Xilinx Spartan-6 FPGA for [parallel](#) computing:  
XC6SLX45 (-A option)  
XC6SLX150 (-B option)
  - ARM 32-bit co-processor @120MHz (LPC1759) for complementary [sequential](#) computing<sup>1</sup>
  - 200-pin SODIMM socket for an optional (1 or 4 GB typ.) DDR2 memory module. 10+ Gbps throughput.
  - 1Gbit NAND for non-volatile storage of numerous FPGA configurations and user data.
  - DAC: 12-bit precision, 1 MSamples/s for gain control
- High-speed connectivity:
  - Two USB 2.0 connections:
    - High-speed (480 Mbps) connection through FPGA
    - Full-speed (12-Mbps) connection through ARM processor
  - Differential LVDS connections  
82 pairs (-A option)  
92 pairs (-B option)
  - Optional 1 or 4 port Gigabit Ethernet and HDMI connectivity (see [COM-5102](#), [COM-5401](#))
  - Input for an external, higher-stability 10 MHz frequency reference.

-  [ComScope](#) –enabled: key internal signals can be captured in real-time and displayed on host computer.



DDR2 SODIMM socket is underneath.

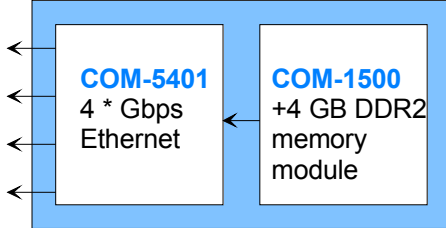
<sup>1</sup> Use of the ARM processor is at the user's discretion. The ARM processor is pre-programmed with all basic functions.

## Typical Applications

The COM-1500 is [interface-compatible](#) with numerous other ComBlock modules (RF, Analog, Network, modem, error correction). A few examples are illustrated below:

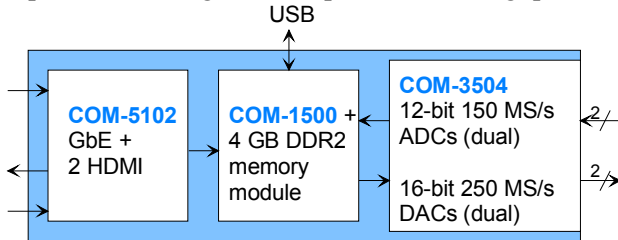
### High-throughput IP data server:

Up to 4 GB storage, 4 Gbps throughput.



### Analog signal processing

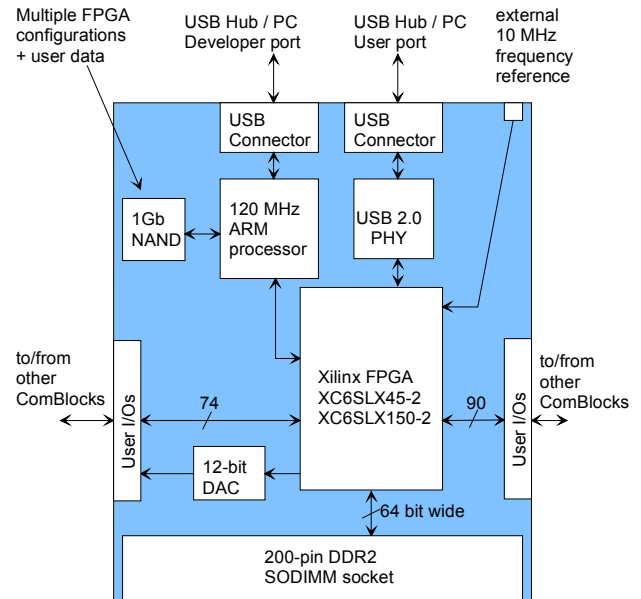
Up to 4GB storage, 10+Gbps DDR2 throughput.



For the latest data sheet, please refer to the **ComBlock** web site: [comblock.com/com1500.html](http://comblock.com/com1500.html).

These specifications are subject to change without notice.

For an up-to-date list of **ComBlock** modules, please refer [comblock.com/product\\_list.html](http://comblock.com/product_list.html).



**COM-1500 Hardware Block Diagram**

## Nominal Operation

|                |                    |
|----------------|--------------------|
| Supply voltage | +4.75 to +5.25 VDC |
|----------------|--------------------|

## Absolute Maximum Ratings

|                         |                      |
|-------------------------|----------------------|
| Supply voltage          | -16V min, +16V max   |
| 98-pin connector inputs | -0.5V min, +3.6V max |

## Simple Development Setup

The COM-1500 is designed to simplify the development setup and yet allow unrestricted access to all hardware features.

- Connect the supplied USB cable between the COM-1500 USB development port and a PC.
- Connect +5VDC power to the green terminal block.
- Install the ComBlock Control Center software on a PC for monitoring, control and programming.
- Install the industry-standard tools for FPGA and optional ARM development on a PC.
- Download the FPGA source code templates from <http://comblock.com/download.html - Latest FPGA firmware>
- If needed, download the ARM processor source code template from [http://comblock.com/download.html#Latest\\_ARM firmware](http://comblock.com/download.html#Latest_ARM_firmware)

The COM-1500 is compatible with a comprehensive development environment of industry-standard tools:

- Xilinx ISE WebPACK for development from VHDL or Verilog source code to FPGA binary. [free –A option only]
- Eclipse IDE + GNU ARM toolchain from C/C++ source code to ARM binary. [free]
- ComBlock flashloader to program the FPGA and ARM binaries into the board non-volatile flash memory over USB. [included]
- **Optional** JTAG USB pod (for ARM in-circuit debugging)

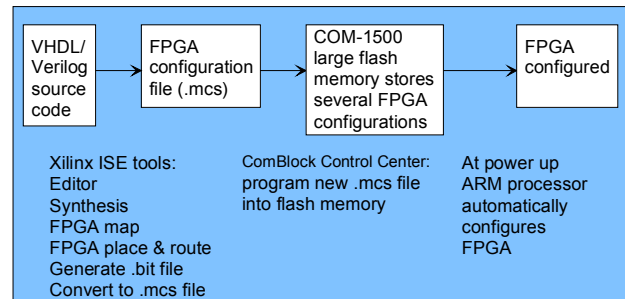
## Getting Started with FPGA Development

Developing a custom FPGA-based application requires six key steps:

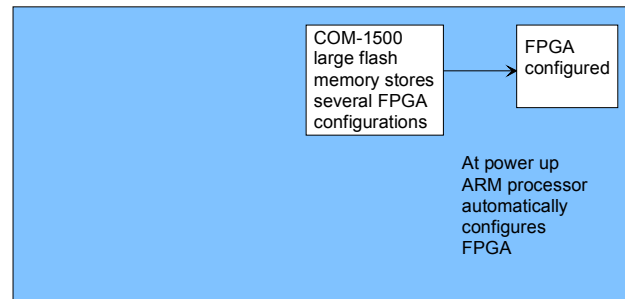
- 1) The user writes VHDL or Verilog source code.
- 2) The Xilinx synthesis tool (XST), part of the Xilinx Integrated Software Environment (ISE) design suite, converts the source code into hardware primitives (.ngc file).
- 3) The constituent .ngc files are then mapped into the target FPGA and net routing takes place, again under the supervision of the Xilinx ISE. The output is a binary .bit file.
- 4) The Xilinx iMPACT tool reformats the .bit file into a .mcs PROM file.
- 5) The ComBlock Control Center programs the .mcs file into the board non-volatile (flash) memory.
- 6) At power-up, the ARM processor configures the FPGA using the designated .mcs configuration file stored on the flash memory.

See also

[http://comblock.com/howtoFPGA\\_VHDL.html](http://comblock.com/howtoFPGA_VHDL.html)



**Development environment**



**Run-time environment**

## Getting Started with ARM Development

Writing code for the ARM co-processor is *optional*. The ARM processor is factory programmed with the full set of functions described in this document. In many application cases, the processor could be left as is.

However, since the processor resources are significantly underutilized after the initial configuration, it is made available for developers to implement additional digital signal processing algorithms or customize the power profile.

The ARM co-processor code template is available for download at

[www.comblock.com/download.html#Latest\\_ARM\\_firmware](http://www.comblock.com/download.html#Latest_ARM_firmware)

## Operations

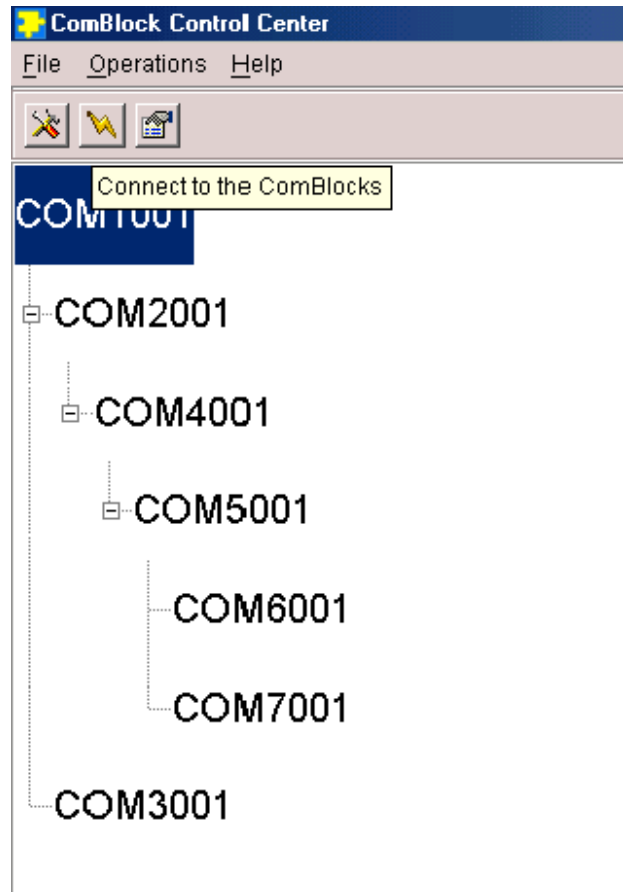
### Graphical User Interface

A user-friendly graphical user interface (hereafter named ComBlock Control Center) is supplied with the COM-1500. The ComBlock Control Center runs on any Windows PC (running XP or above). It allows the user to communicate with the COM-1500 over the USB 2.0 interface and when other ComBlocks are connected, via serial link, LAN or PCMCIA/Cardbus.

The primary use of the ComBlock Control Center is to:

- (a) Download new FPGA firmware (into non-volatile Flash memory)
- (b) Set control registers
- (c) Monitor status registers
- (d) Capture and display internal signals (ComScope).

When activated, the ComBlock Control Center enumerates the ComBlock modules within the assembly. The modules are identified by their name in a tree-like structure. Each module can be configured and monitored remotely.




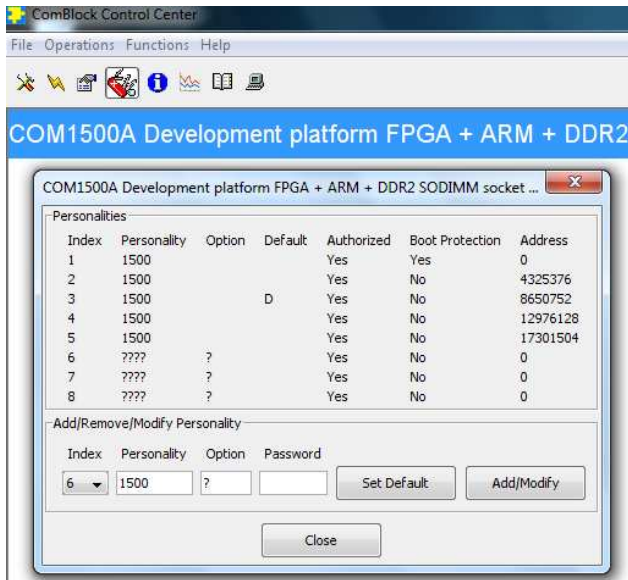
The ComBlock Control Center software is provided with all ComBlock modules. The user's manual can be found at

[www.comblock.com/download/ccchelp.pdf](http://www.comblock.com/download/ccchelp.pdf).

### Flash Memory

The FPGA configurations are stored in the COM-1500 non-volatile (Flash) memory. The ComBlock Control Center includes the utility to (re)write the FPGA .mcs PROM file into the flash

memory over USB. Upon clicking on the  button the following panel will pop-up:



From this panel, one can select the default personality index and program the FPGA .mcs configuration file into the board flash memory.

Instructions on how to generate a .mcs formatted file from a Xilinx .bit file are available [here](#):

The COM-1500 Supports [multiple personalities and dynamic reconfiguration](#):

- Up to 8 FPGA configurations can be stored in non-volatile flash memory.
- The selected configuration is automatically reloaded at power up or upon software command within 1.2 seconds (-A) or 4 seconds (-B).

## USB

The COM-1500 comprises two USB ports labeled USB HI SPEED and DEV. The development port (DEV) is the recommended port for flash programming, as it does not depend on the FPGA being properly configured. The USB high-speed data port (HI-SPEED) could be inaccessible in the case of an invalid FPGA configuration.

A driver must be installed prior to using USB to communicate with ComBlocks for the first time. In summary, connect the ComBlock to power and a Windows OS PC via USB, then go to the Control Panel | Device Manager and add the driver by pointing to the driver located in the CD-ROM /Windows Drivers/USB 2.0/Windows Driver folder.

Detailed instructions are available in the USB user manual [www.comblock.com/download/USB20\\_UserManual.pdf](http://www.comblock.com/download/USB20_UserManual.pdf)

## Accidental FPGA file corruption

The COM-1500 is protected against corruption by an invalid FPGA configuration file. To recover from such occurrence, connect a jumper in JP1 position 2-3 prior and during power-up. This prevents the FPGA configuration. Once this is done, the user can safely re-load a valid FPGA configuration file into flash memory using the ComBlock Control Center GUI.

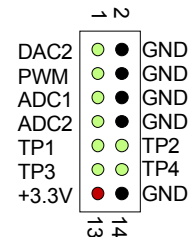
## Analog I/Os

The COM-1500 includes multiple ADCs and DACs as listed below:

| Function | Precision | Speed   | Under control by |
|----------|-----------|---------|------------------|
| DAC1     | 12-bit    | 1 MS/s  | FPGA             |
| DAC2     | 10-bit    | TBD     | ARM              |
| PWM      | 10-bit    | TBD     | ARM              |
| ADC1     | 12-bit    | 100KS/s | ARM              |
| ADC2     | 12-bit    | 100KS/s | ARM              |

## ARM Co-processor Test Points

A 14-pin header (J4) is provided for easy access to several key analog I/Os, digital I/Os and interrupt.



## Power Control

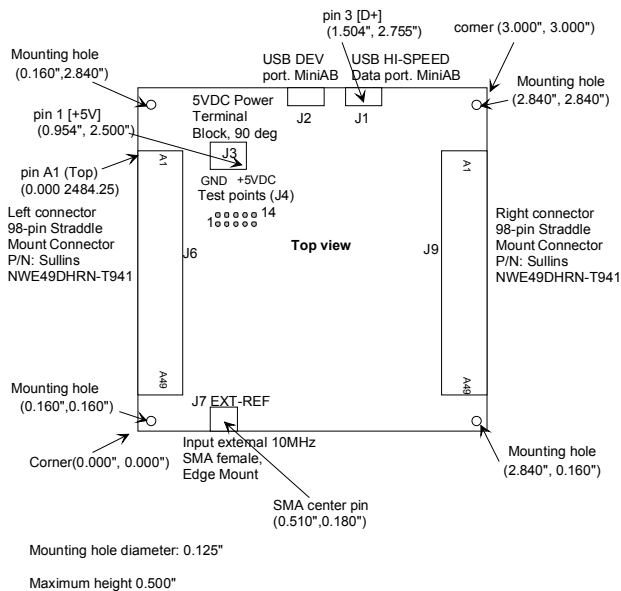
The COM-1500 hardware is designed to operate in several low-power modes:

- **Sleep mode 1:**
  - The ARM processor is the only powered circuit. It can be woken up by an external wake-up signal or a USB input pin transition (USB development port).
  - FPGA is off. It will need to be reconfigured upon wake-up.
  - DAC/DDR2 SDRAM/NAND are off.

- **Sleep mode 2:**
  - o ARM processor is active and able to communicate through USB.
  - o FPGA is in suspend mode, i.e. keeps state and configuration.
  - o DAC/DDR2 SDRAM/NAND are off.
- **Operating:**
  - o Individual controls for powering the DAC, DDR2 SDRAM and NAND are accessible through the ARM processor.

Power control requires custom programming of the ARM processor.

## Mechanical Interface



## Schematics

The board schematics are available on-line at [http://comblock.com/download/com\\_1500schematics.pdf](http://comblock.com/download/com_1500schematics.pdf)

## VHDL code template

A VHDL template project is available on the ComBlock CD or on-line at <http://comblock.com/download.html#COM1500template>  
The template project includes:

- The VHDL source code (.vhd)
- The constraint file (.ucf) listing all pin assignments
- The Xilinx ISE project with the synthesis and implementation settings

- The resulting bit file (.mcs) is ready to be loaded into flash memory.

The sample code describes how the application interfaces with the ComBlock Control Center graphical user interface through control and monitoring registers. Monitoring and control messages and syntax are described in [www.comblock.com/download/m&c\\_reference.pdf](http://www.comblock.com/download/m&c_reference.pdf).

It also describes how to capture key internal signals in real-time and display on a host computer using the ComScope feature of the ComBlock Control Center. The ComScope user manual is available at [www.comblock.com/download/comscope.pdf](http://www.comblock.com/download/comscope.pdf)

Finally, the code template includes the following binary (.ngc) drivers:

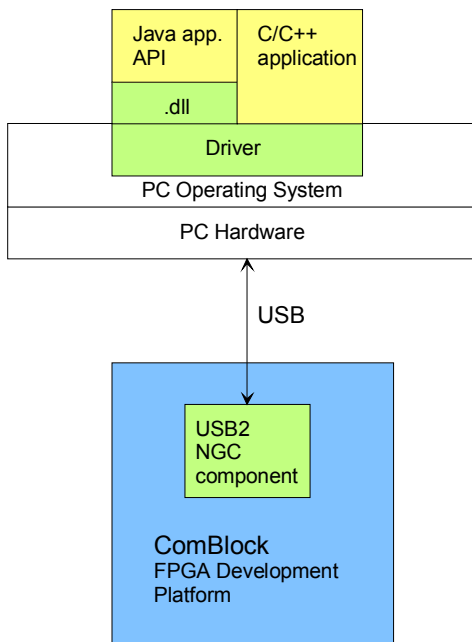
- DDR2 driver
- 12-bit auxiliary DAC driver
- USB 2.0 driver
- Tri-mode 10/100/1000 Mbps Ethernet MAC

## USB 2.0 Driver

Software to help developers create USB high-speed communications between the COM-1500 platform and a host PC is provided. The **USB 2.0 software package** includes the following:

- USB20 NGC component for integration within the VHDL code.
- VHDL top-level code template
- Windows device driver (.sys, .inf files)
- Java API, .dll and application sample code
- C/C++ application sample code

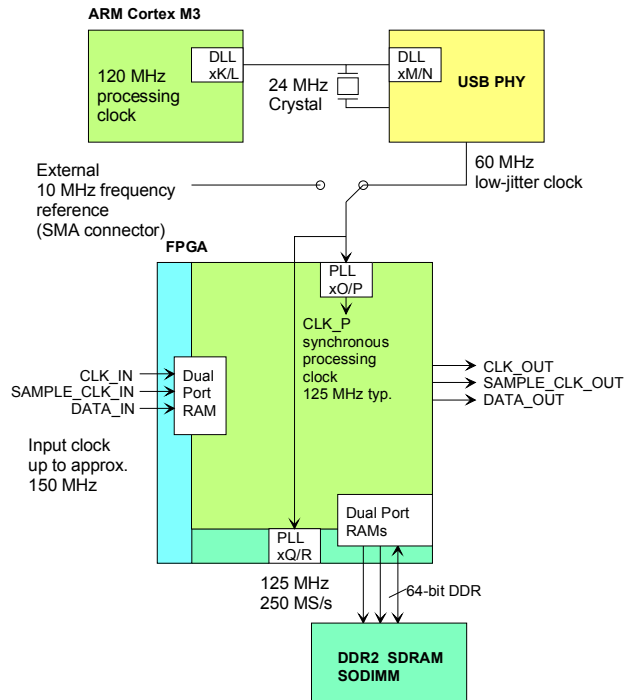
The **USB 2.0 software package** is available on the ComBlock CD and can also be downloaded from [www.comblock.com/download/usb20.zip](http://www.comblock.com/download/usb20.zip).  
The user manual is available at [www.comblock.com/download/USB20\\_UserManual.pdf](http://www.comblock.com/download/USB20_UserManual.pdf)



**Blue:** supplied hardware  
**Green:** supplied ready-to-use software  
**Yellow:** source code examples

## Clock Architecture

The clock distribution scheme embodied in the COM-1500 is illustrated below.



Most of the COM-1500 internal frequencies are locked onto a single 24 MHz crystal oscillator. This oscillator (part of the USB PHY) serves as reference for the 120 MHz ARM coprocessor clock, the 60 MHz USB PHY interface clock, and the 125 MHz FPGA clocks.

The VHDL code template generates the following FPGA clocks:

- 125 MHz processing clock
- 125 MHz DDR2 interface clock

The internal reference clock frequency stability is typically in the range [-100, 0] ppm.

Other clock architectures and frequencies are possible by changing the FPGA source code. For example, in applications requiring a higher frequency accuracy, the FPGA code can be written to select a user-supplied ultra-stable 10 MHz frequency signal as its frequency reference.

## I/O Standards

The digital signals on connectors J6 and J9 are LVTTTL (0 – 3.3V) single-ended signals by default. However, the I/O types can be easily changed by



