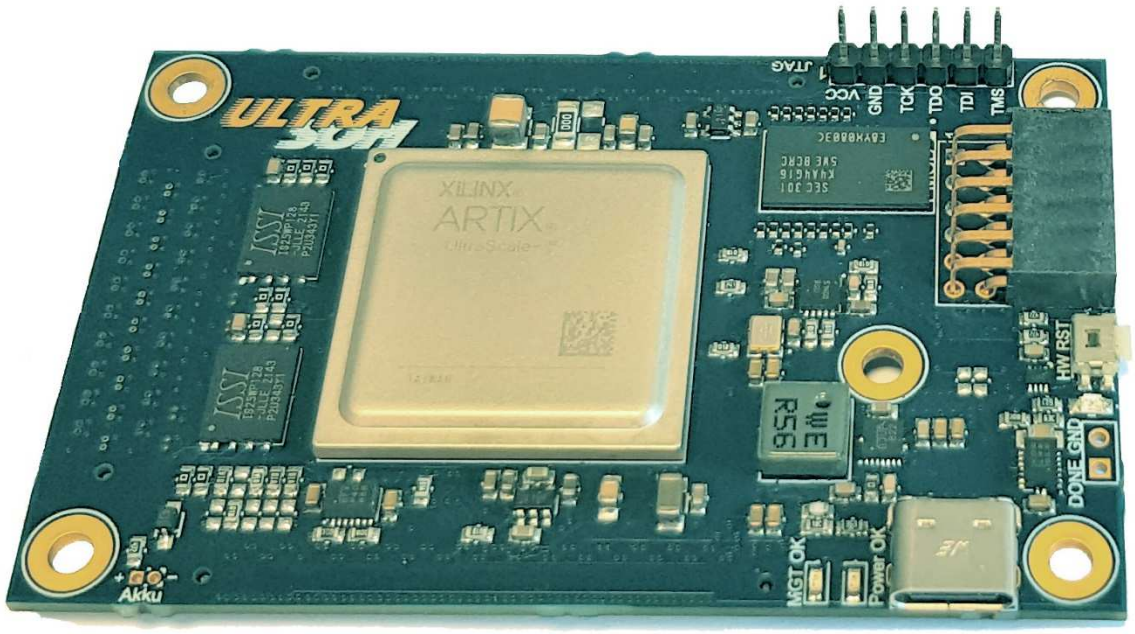
AVT ILMENAU

# Example programs for UltraSOM-Boards

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## List of abbreviations

| | |
|---|---|
| ADC | Analog to Digital Converter |
| BSP | Board Support Package |
| CPU | Central Processing Unit |
| DDR4 SDRAM | Double Data Rate fourth-generation |
| FPGA | Field Programmable Gate Array |
| GB | Giga Byte |
| Gbps | Gigabits per sec |
| GHz | Giga Hertz |
| GPIO | General Purpose Input Output |
| I2C | Inter-Intergrated Circuit |
| IC | Intergrated Circuit |
| JTAG | Joint Test Action Group |
| Kbps | Kilobits per second |
| LVDS | Low Voltage Differential Signalling |
| MAC | Media Access Controller |
| MB | Mega Byte |
| Mbps | Megabits per sec |
| MHz | Mega Hertz |
| PCB | Printed Circuit Board |
| PMIC | Power Management Integrated Circuit |
| SDRAM | Synchronous Dynamic Random Access Memory |
| SRAM | Static Random Access Memory |
| PL | Programmable Logic |
| PS | Processing System |
| RGMII | Reduced Gigabit Media Independent Interface |
| RTC | Real Time Clock |
| TPM | Trusted Platform Module |

## Introduction

With the AVT UltraSOM-Board, you have acquired a variable, easy-to-connect development kit and series product with small dimensions. This document is the example design guide based on the UltraSOM Boards of companies senTec GmbH und AVT GmbH. The used FPGA-Types on UltraSOM boards can be Artix UltraScale+ 10, Artix UltraScale+ 15, Artix UltraScale+ 20 or Artix UltraScale+ 25 as well as Kintex UltraScale+ 3 or Kintex UltraScale+ 5. Each description of the example design starts with necessary hardware arrangement.

A USB-C connection or a UltraSOM-Base board can be used for connection of power. USB-C voltage must be 5V. The power connection on the base board is made with 12 V.

Figure 1 shows the connection of JTAG to program example designs as bitfile or flash program and a possible UART-module.

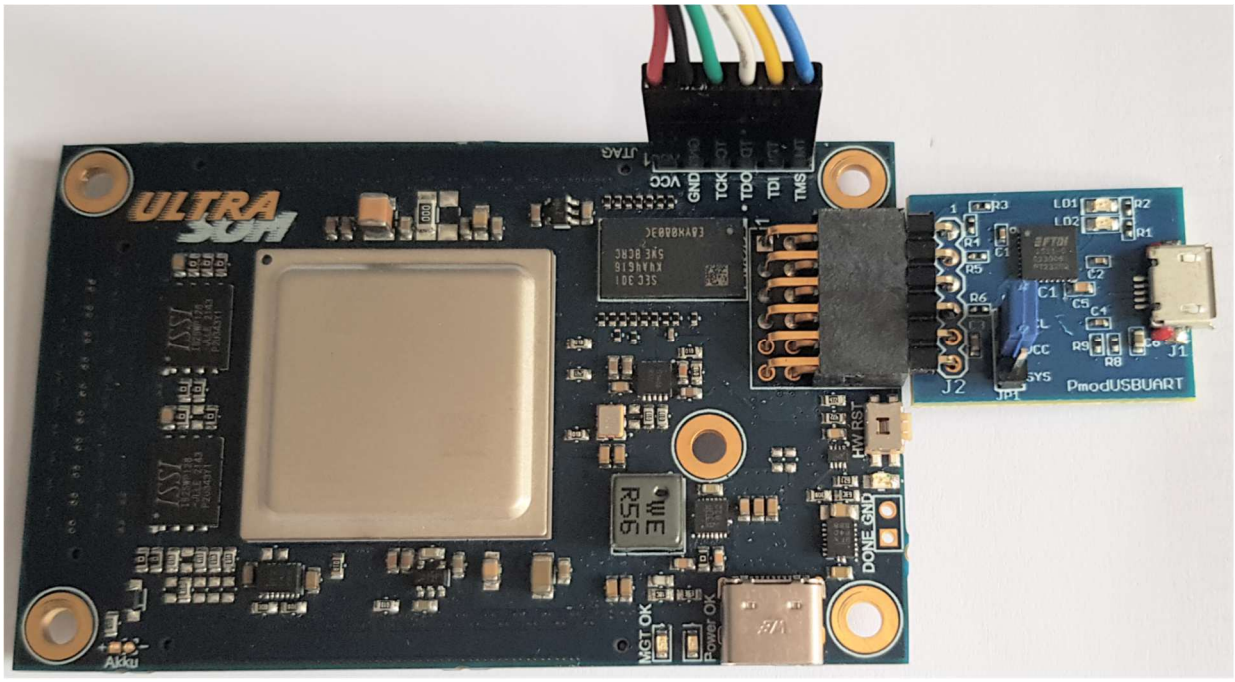


Figure 1: Connection of JTAG and a possible UART-module on base board 1

tbc

## 1. Operating Conditions and Safety Instructions

The UltraSOM-Board is designed for indoor applications only. The permissible ambient temperature and humidity must be observed. The UltraSOM-Board must never be exposed to excessive temperatures! A separate cooler is available.

The voltage rating must be observed for connecting the board.

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# 2. Example programs

## 2.1 Example program 1

The program shows basic functions like LED on baseboard, video test images on VGA adapter and UART connection to PC on UART to USB module.

**Necessary hardware:**

- UltraSOM A15-01-xx
- UltraSOM baseboard 1
- Pmod USBUART (Digilent)
- Pmod VGA (Digilent)
- Power supply 12V
- Display with VGA-input
- VGA cable
- PC for programming and UART terminal

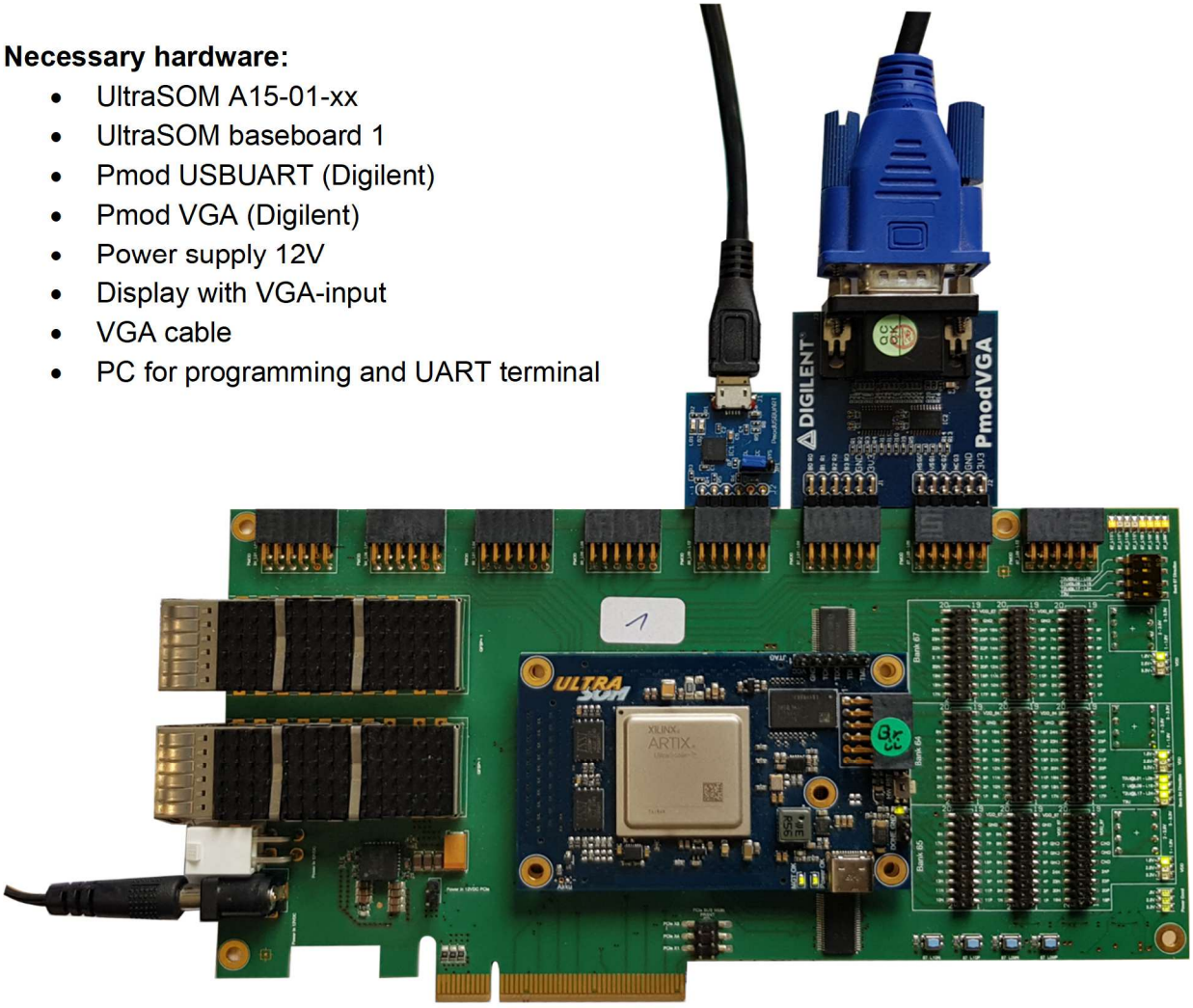


Figure 2.1: Connection of hardware components on UltraSOM boards

The example hardware program consists of some basic elements and AVT made parts in Vivado Block Design environment (figure 2.2). These program components are (The colors of the text correspond to the markings in the program.):

- clocking wizard creating 100 MHz (system) and 148,4 MHz (video out) from 200 MHz input
- MicroBlaze CPU with environment (reset, irq, memory for data and instructions, debug)
- AXI interconnection for periphery between CPU and controlled components
- LED hardware driver with CPU influence
- UART interface (115,2 kbit/s)
- Test video generator for FullHD resolution (1920 x 1080 Pixel)

In CPU a software is running to realize the UART communication und to influence the LED outputs (find in description of functions).

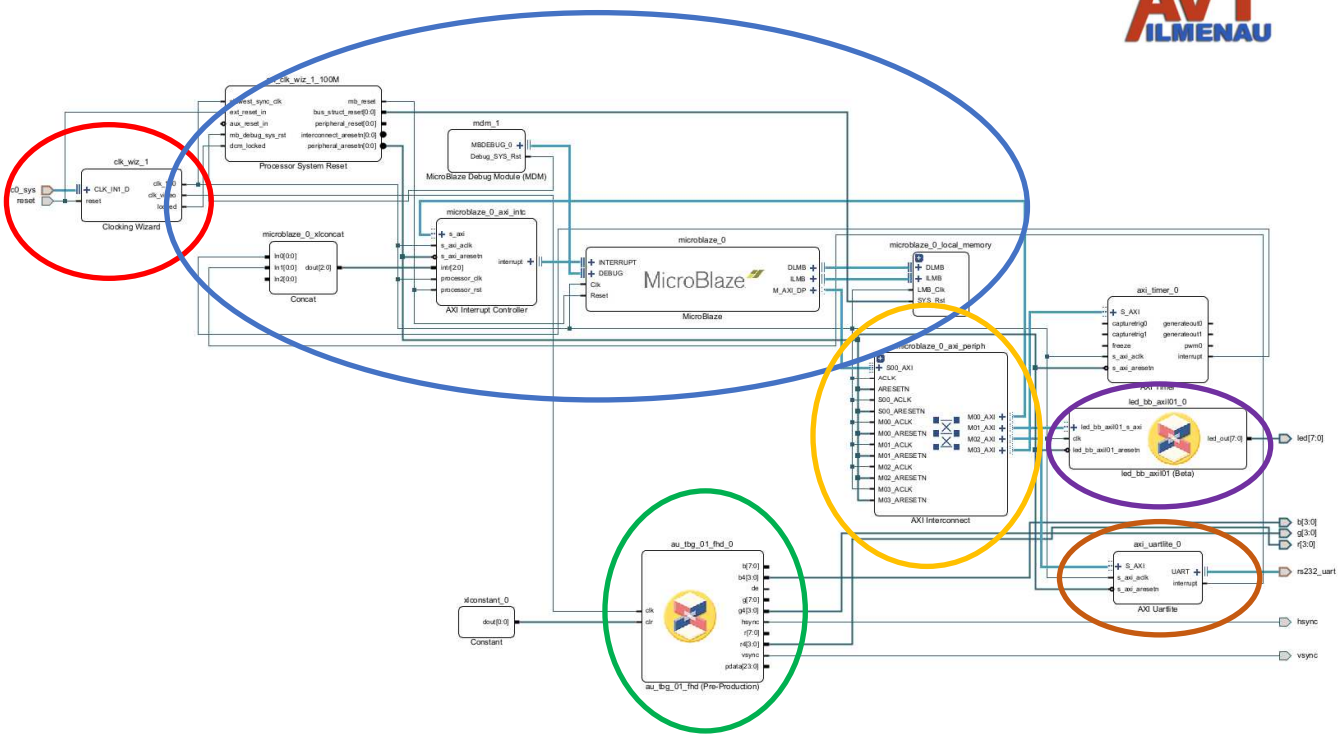


Figure 2.2: Components of example program 1 for UltraSOM A boards

**Descriptions of function**

1. The hardware LED binary counter shows each LED as one bit of the counter (figure 2.3). Every 10 s the CPU switch the LED output to software controlled output for 1 s. It is showed by a fast blinking of all LEDs with switch on and off by CPU.

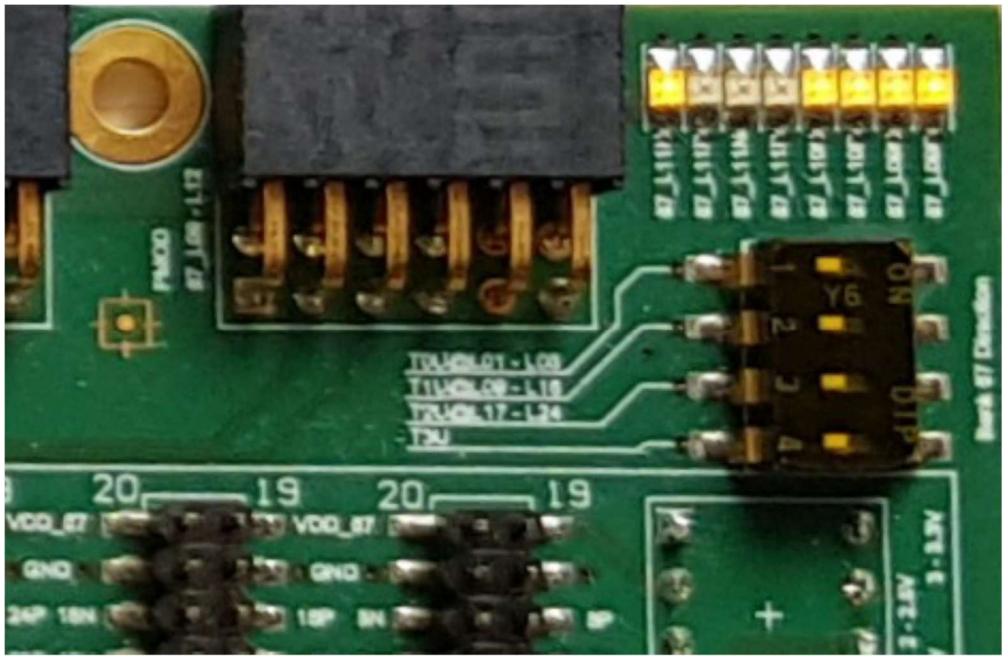

Figure 2.3: Blinking LEDs on the upper right corner of base board

2. In a terminal program on a PC connected to a USB UART, a counter is output every 1 s with each new count value (figure 2.4). Every 10 s, “Hello UltraSOM” is also output in parallel with the rapidly flashing LEDs.

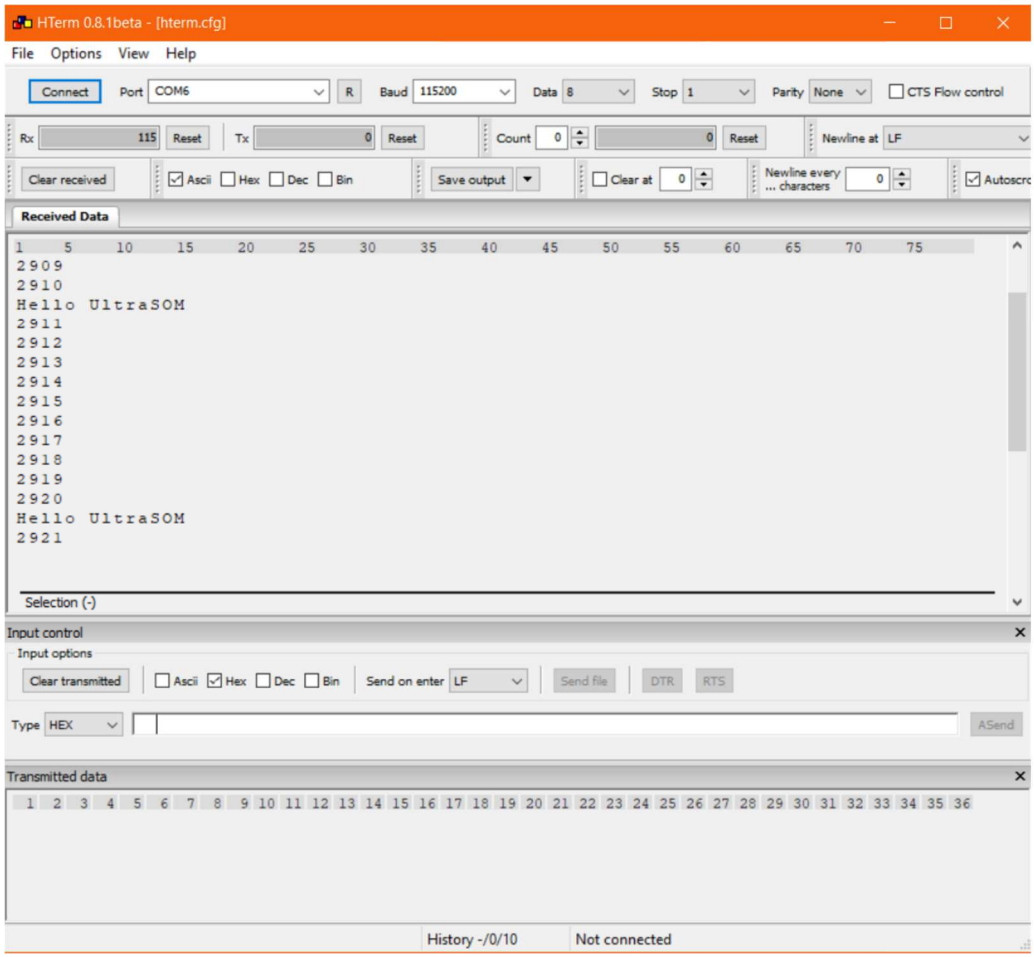


Figure 2.4: Counter and text output on a terminal program of connected PC

3. The moving test image (Figure 2.5) is displayed on the monitor connected via VGA. The squares move at different speeds on the monitor. Since the Pmod VGA output board only allows a resolution of 64 colors, the color gradients are stepped.

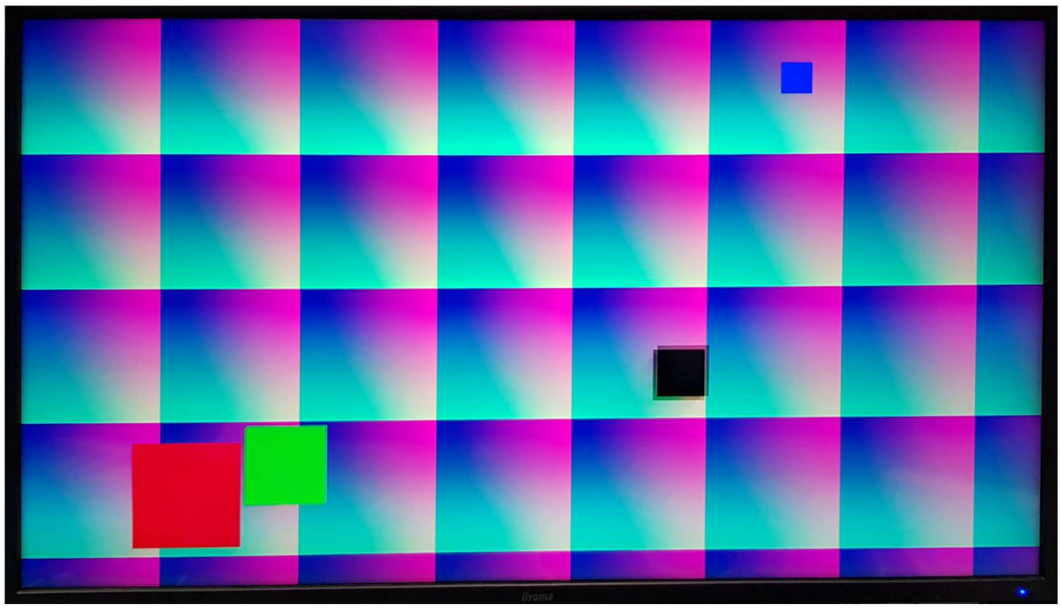

Figure 2.5: Test video output on VGA display

Further functions can be seen in a JTAG connection with the Vivado Hardware Manager (chip temperature, voltage values).

## Modification History

Version

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| 1.00 | Initial creation of the document (06.05.2023) |
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