

# VTR-4000C

Evaluation and Product Development Platform

## User Guide



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# Preface

## About This User Guide

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This User Guide describes the features and operations of the SOC VTR-4000C Evaluation and Product Development Platform. Details on the I/O interfaces and the corresponding components are provided.

## Related Documents

### Data Sheets of IP Cores

- [Datasheet - H.265 Encoder IP Cores](#)
- [Datasheet - H.265 Decoder IP Cores](#)
- [Datasheet - H.264 Encoder IP Cores](#)
- [Datasheet - H.264 Decoder IP Cores](#)
- [Datasheet – MPEG-2 Encoder IP Cores](#)
- [Datasheet – MPEG-2 Decoder IP Cores](#)
- [Datasheet – H.264-to-H.265 Transcoder IP Cores](#)
- [Datasheet – H.265-to-H.264 Transcoder IP Cores](#)
- [Datasheet - MPEG2-to-H.264 Transcoder IP Cores](#)
- [Datasheet - H.264-to-MPEG2 Transcoder IP Cores](#)

### Integration Sheets of IP Cores

- [Integration Sheet - H.265 Encoder IP Cores](#)
- [Integration Sheet - H.265 Decoder IP Cores](#)
- [Integration Sheet - H.264 Encoder IP Cores](#)
- [Integration Sheet - H.264 Decoder IP Cores](#)
- [Integration Sheet - H.265 4k Encoder IP Cores](#)
- [Integration Sheet - H.265 4k Decoder IP Cores](#)
- [Integration Sheet - H.264 4k Encoder IP Cores](#)
- [Integration Sheet - H.264 4k Decoder IP Cores](#)
- [Integration Sheet - MPEG-2 Encoder IP Cores](#)
- [Integration Sheet - MPEG-2 Decoder IP Cores](#)
- [Integration Sheet - H.264-to-MPEG2 Transcode IP Cores](#)
- [Integration Sheet - MPEG2-to-H264 Transcoder IP Cores](#)

### Data Sheets of Codec Modules

- [Datasheet - H.264 Encoder Modules](#)
- [Datasheet - H.264 Decoder Modules](#)

### Data Sheets of Codec Chipsets

- [Datasheet - H.264 Encoder Chipsets](#)
- [Datasheet - H.264 Decoder Chipsets](#)

## ***VTR-4000C Evaluation and Product Development Platform***

### **1. Overview**

The SOC VTR-4000C Evaluation and FPGA Development Platform is an upgraded version of the VTR-4000 board. The difference of between VTR-4000 and VTR-4000C is that the VTR-4000 is mainly for HD and 4k@30 and the VTR-4000C can reach 4k@60 applications. Both the VTR-4000 and VTR-4000C are designed for four major functions:

1. As an evaluation board for the SOC MPEG codec IP Cores, modules, and chipsets of 4k and HD resolutions (encoders, decoders, and transcoders).
2. As a product development platform for systems that use the SOC MPEG codec modules, chipsets, and IP cores, especially 4k@60 (using VTR-4000C) resolutions.
3. As a development board for product development based on the SOC Generic System-on-Module (G-SoM) Modules.
4. As an OEM product of H.265/H.264/MPEG2 video/audio over IP or via WiFi transponder, especially for 4k resolutions.

A unique feature of the VTR-4000C is that it has a DDR3 SODIMM connector that are used to connect to the SOC MPEG codec modules of 4k@60 resolution. Users can use the VTR-4000C to evaluate the SOC 4k@60 MPEG codec modules, chipsets, and IP cores, and then use the same board for product development, especially for 4k@60 resolutions.

The VTR-4000C has its own FPGA chip, the Xilinx Artix-7 XC7A200T (the VTR-4000 uses the Spartan-6 LX45T), which controls the I/Os and can be combined with the FPGA on the G-SoM module. This allows for the product development of multiple FPGA based systems.

The VTR-4000C with an encoder or decoder module is a fully functional H.264/265 (or MPEG-2) video/audio over the Internet (IP) transmitter or receiver that can be packaged into an enclosure box for end-user uses. It provides HDMI input, HDMI output, four bidirectional 3G/HD SDI ports (which are used for 4k@30/60 video input or 4k@30/60 output), and an Ethernet port with the UDP/RTP/IP compatibilities. The VTR-4000C also has a WiFi port that

can connect to a WiFi module for wireless video transmission. Contact SOC [sales@soctechnologies.com](mailto:sales@soctechnologies.com) for details.

The VTR-4000C Evaluation Board and FPGA Development Platform is shown in Figure 1 (top view) and Figure 2 (bottom view) with the SOC Codec module connector shown - the DDR3 SODIMM connector. A block diagram of the system is provided in Figure 3.

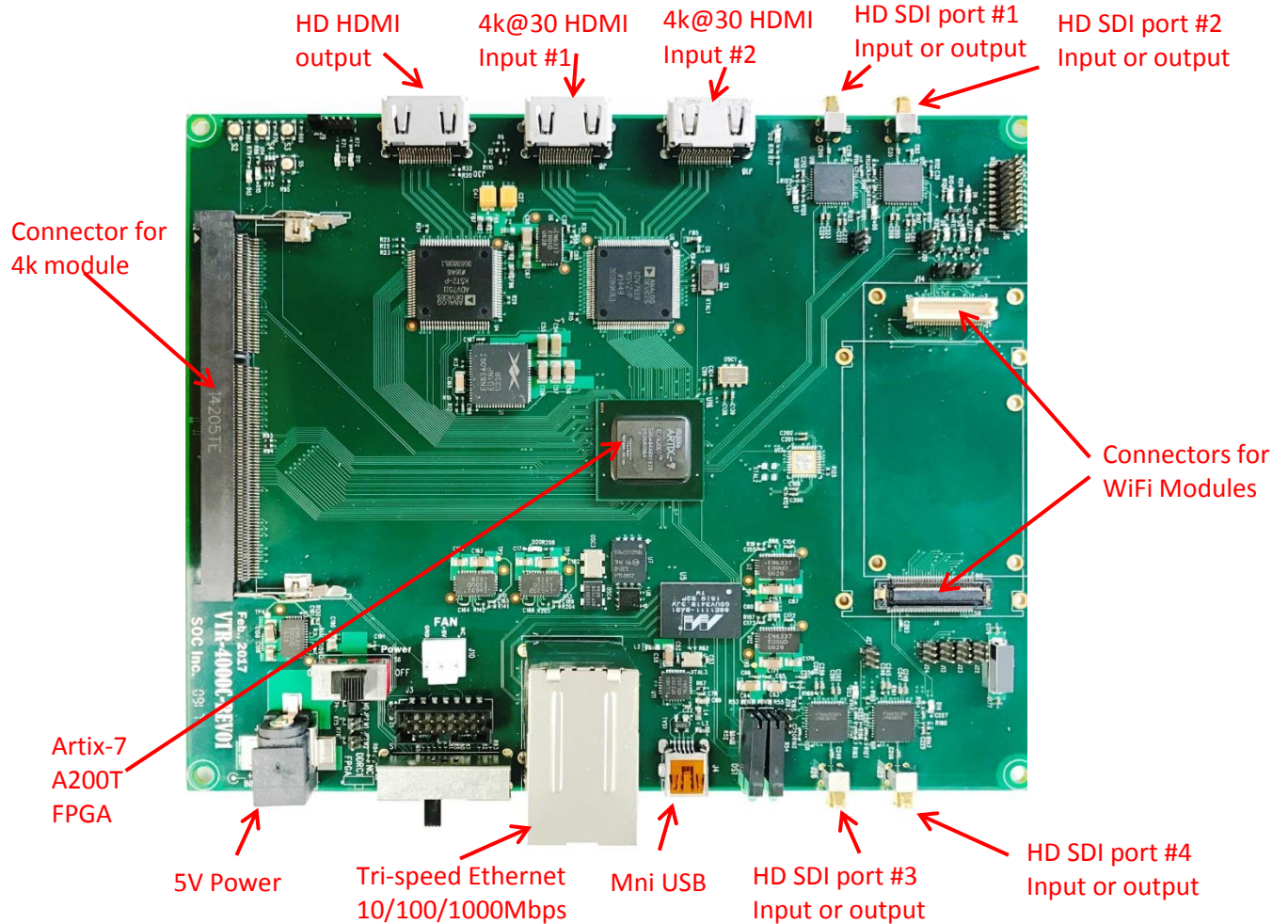


Fig.1 VTR-4000C Top View



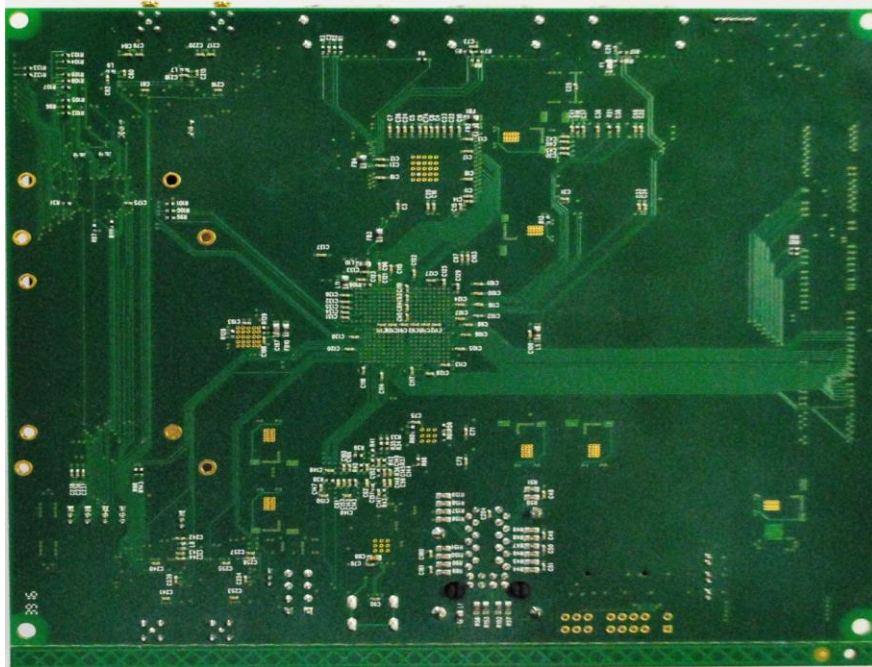


Fig. 2 VTR-4000C bottom View

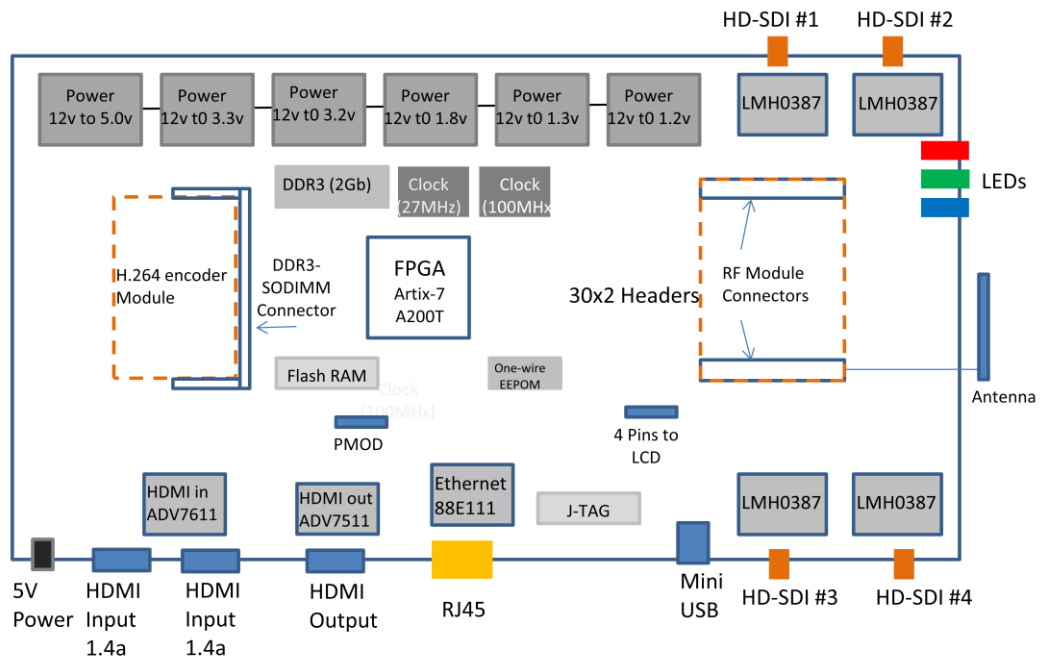


Fig.3 VTR-4000C Block Diagram

## **Key Features**

- Xilinx Artix-7 XC7A200T FPGA
- One DDR3 SODIMM connector for SOC MPEG Codec Modules or SOC SOM-1000 modules
- Two 1.4a HDMI inputs (up to 4k@30)
- One HDMI output (HD up to 60 frames per Second)
- Four bidirectional 3G/HD-SDI ports (each can be configured to input or output independently)
- Tri-speed Ethernet (10/100/1000/Mbps)
- Two WiFi connectors for WiFi modules
- Mini USB port
- Two Pmod Connectors
- Push buttons
- LEDs
- Power rails for SOC MPEG Codec Modules or SOC SOM-1000 modules
- 5V power.

## **2. Functions of the VTR-4000C**

### **2.1 For Evaluating the SOC 4k@30/60 Codec Modules, IP cores, and Chipsets**

The VTR-4000C is preloaded with firmware for evaluating the SOC 4k@30/60 MPEG codec modules. It is a plug-and-play system that allows the user to insert the desired module (encoder, decoder, or transcoder), and connect the I/O devices to start the evaluation.

When evaluating the SOC IP cores, the IP cores to be evaluated will be pre-loaded into the modules shipped with the evaluation kit. Since the SOC codec chipsets use SOC IP cores, chipsets are evaluated based on IP cores.

For encoder evaluation, the 4k@30/60 input video source is sent to the VTR-4000C via the four SDI ports (configured to input); the encoded stream is sent to the computer through the Ethernet port. Users can decode the encoded streams by using standard software decoders.



For decoder evaluation, the compressed streams are sent to the VTR-4000C through the Ethernet. The software for sending the streams is provided as part of the VTR-4000C package. The decoded 4k video and audio streams are sent to display via the four SDI ports.

For simultaneous evaluation of the 4k encoder and 4k decoder, two VTR-4000C kits are required – one for encoding and the second for decoding. The input 4k video stream is sent to the VTR-4000C via the SDI input ports (the four bidirectional SDI ports are configured into a 4k SDI input). The input video stream is encoded by the encoder, and then sent to the decoder for decoding via the Ethernet ports. The decoded 4k video stream is sent to the SDI output ports (the four bidirectional SDI ports are configured into a 4k SDI output), for display. The end-to-end latency of encoding, the network, and decoding can be measured by observing the time difference of the input video stream versus the output video stream.

Two VTR-4000C boards can be used to test the video transmission over WiFi, with one VTR-4000C acting as transmitter and the second acting as receiver.

For transcoder evaluation, both the input stream and transcoded stream are sent through the Ethernet port.

Detailed instructions for evaluating the SOC encoders and decoders using the VTR-4000C are provided in “Instruction Sheet of Using the VTR-4000C to Evaluate SOC Codec Modules and IP cores”.

## 2.2 For Product Development

The VTR-4000C is a versatile platform for product development, based on the SOC MPEG codec modules (or IP cores).

SOC provides (under licensing agreement) a “netlist” IP cores for all the I/O ports, including the network stack for the VTR-4000C, so that the users can drop them into their own designs without having to implement the I/O modules.

Design templates of the I/O drivers and the network stack IP cores are available for licensing. These can greatly speed up the development process.

The PDF schematics design of the VTR-4000C is available under licensing programs, which provides the details information for using the board for product development. Users can also purchase the design files (e.g. Gerber file) from SOC, which can be used as a reference for the user PCB once the product is developed. Contact SOC sales ([sales@soctechnologies.com](mailto:sales@soctechnologies.com)) for details.

### 2.3 For Product Development based on the SOC G-SoM

The SOC SoM modules can also be used as generic System on Module (SoM) platform for user designs. The modules are equipped with one FPGA with two ARM processors, and with the required memory blocks. This allows users to download their own firmware/software to configure the module according to their specific design. Once configured, the module can be used as SoM module for user applications. This accelerates product development and saves costs. Refer to the datasheet of the G-SoM-4000 for further details.

### 2.4 As an H.264/265 (or MPEG-2) Video over Internet/WiFi OEM Product

The VTR-4000C, with a H.264 or H.265 (or MPEG-2) encoder or a decoder module, is a ready to use H.264 (or H.265 or MPEG-2) video/audio over wired (Internet) or wireless (WiFi) 4k@30/60 transmitter or receiver which is offered as an OEM product by SOC. Contact SCO [sales@soctechnologies.com](mailto:sales@soctechnologies.com) for information.

## 3. Hardware Descriptions

Table-1 lists the components on the VTR-4000C that are important to the users. Refer to the schematics of the VTR-4000C for the circuit design and the auxiliary components.

The following Sections describe the components listed in Table-1. Refer to the datasheets of the components for further details.

**Table-1 Major components on the VTR-4000C**

| Item | Reference in Schematics | Part Name              | Description                                                               | Manufacturer        |
|------|-------------------------|------------------------|---------------------------------------------------------------------------|---------------------|
| 1    | U6                      | XC7A200T-2SBG484C      | FPGA, Artix-7, A200T                                                      | Xilinx              |
| 2    | U4                      | ADV7511KSTZ-P          | HDMI Transmitter                                                          | Analog Devices Inc  |
| 3    | U1                      | ADV7619KSVZ-P          | HDMI receiver (up to 4k@30 resolution)                                    | Analog Devices Inc  |
| 4    | U19                     | LMH0387SLE/NOPB        | 3 Gbps HD/SD SDI Configurable I/O Adaptive Cable Equalizer / Cable Driver | TI                  |
| 5    | U5                      | 88E1111_BAB1C000       | Gigabit Ethernet Transceiver, 10/100/1000                                 | Marvell             |
| 6    | U16                     | CP2103                 | SINGLE-CHIP USB TO UART BRIDGE                                            | Silicon Labs        |
| 7    | U8                      | N25Q128A13EF740F       | 128Mb, Serial Flash Memory                                                | MICRON              |
| 8    | Y3                      | ASFL1-27.000MHZ-L-T    | OSCILLATOR 27.000 MHZ 3.3V                                                | ABRACON             |
| 9    | Y4                      | ASFLMB-100.000MHZ-XY-T | OSCILLATOR MEMS 100.000 MHZ                                               | ABRACON             |
| 10   | Y1                      | ABM3-28.6363MHZ-B2-T   | CRYSTAL 28.6363MHZ 18PF                                                   | Abracon Corporation |
| 11   | Y2                      | ABM8-25.000MHZ-B2-T    | CRYSTAL 25.000MHZ 18PF                                                    | Abracon Corporation |
| 12   | J2                      | MM80-204B1             | CONN 204POS DDR3 SDRAM SODIMM                                             | JAE Electronics     |
| 13   | U7                      | DS28E01P-100+          | 1Kb PROTECTED 1-WIRE EEPROM                                               | MAXIM               |

### 3.1 FPGA Selection

The FPGA on the VTR-4000C is Xilinx Artix-7 XC7A200T-2SBG484C. Refer to the schematics of the VTR-4000C and Data Sheet of the FPGAs for further details.

### 3.2 HDMI Receiver

The HDMI Receiver interface chip is the ADV7619KSVZ-P by Analog Devices. Refer to the Datasheet of ADV7619KSVZ-P for details.

The ADV7619KSVZ-P supports two channels of HD or 4k@30 video inputs. SOC provides the configuration file for ADV7619KSVZ-P which is a part of the I/O driver package. For evaluations, the ADV7619KSVZ-P is preconfigured for plug-and-play.

### 3.3 HDMI Transmitter

The HDMI transmitter interface chip is the ADV7511KSTZ-P by Analog Devices. Refer to the Datasheet of ADV7511KSTZ-P for details.

SOC provides the configuration file for ADV7511KSTZ-P which is a part of the I/O driver package. For evaluations, the ADV7511KSTZ-P is preconfigured for plug-and-play.

### 3.4 Bidirectional SDI Transmitter/ Receiver

The SOC VTR-4000C has four SDI ports, each is connected to a 3 Gbps HD/SD SDI Configurable I/O Adaptive Cable Equalizer/Cable Driver (LMH0387). These two SDI ports can be configured into both inputs, or both outputs, or one input and one output. Refer to the LMH0387 data sheet for details.

SOC provides the configuration file for LMH0387 which is a part of the I/O driver package. For evaluations, the LMH0387 is preconfigured for plug-and-play.

### 3.5 Gigabit Ethernet

The Ethernet PHY is the 88E1111\_BAB1C000 by Marvel. It can be used for 10Mbps/100Mbps/1000Mbps. The configuration file is included in the I/O package. An Ethernet MAC core is a part of the Ethernet/UDP/IP network stack which can be licensed. For evaluations, the networks stack is preloaded to allow a plug-and-play system.

### 3.6 Mini USB

The VTR-4000C has a mini USB port which is used as UART port. The CP2103, single-chip USB to UART bridge, is used as the interface chip.

### 3.7 Serial Flash Memory

The serial flash memory, N25Q128A13EF740F, is used to store the firmware of the FPGA. For evaluation, the I/O drivers and the Ethernet/UDP/IP network stack are pre-stored in the N25Q128A13EF740F. When the VTR-4000C is booted, the firmware stored in the N25Q128A13EF740F will configure the FPGA and make the board a plug-and-play device to facilitate the evaluations of the SOC MPEG codec modules.

After the evaluation, users can store their own firmware into the N25Q128A13EF740F for product development. For product development purposes, the I/O driver and the Ethernet/UDP/IP network stack IP core in “netlist” format are available for licensing. The method of downloading the firmware into the N25Q128A13EF740F is detailed in Evaluation Instruction Manual.

## 4. Ordering Information

The VTR-2000 can be ordered from SOC directly or through the distributors of SOC. Refer to the SOC web site, [www.soctechnologies.com](http://www.soctechnologies.com), for distributor locations and contact information.

#### **SOC contacts:**

E-mail: [sale@soctechnologies.com](mailto:sale@soctechnologies.com)

Telephone: 1-519-880-8609

## **Revision History**

The following table shows the revision history for this document.

| Date       | Version             | Revision |
|------------|---------------------|----------|
| 15/11/2016 | SOC initial Release |          |
|            |                     |          |
|            |                     |          |