Legal Statements

Important legal notice before reading this documentation.

PROPRIETARY NOTICE

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Preface

About this guide and technical support information.

About this document

This document mainly provides the users with the general information and feature description for StarFive next generation SoC platform - JH7110.

Revision History

Table 0-1 Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Released</th>
<th>Revision</th>
</tr>
</thead>
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<tr>
<td>1.3</td>
<td>2022/12/8</td>
<td>Added GMAC limitations</td>
</tr>
<tr>
<td>1.2</td>
<td>2022/10/20</td>
<td>Refined block diagram and refined MIPI output specs.</td>
</tr>
<tr>
<td>1.1</td>
<td>2022/09/15</td>
<td>Updated block diagram in sync with datasheet.</td>
</tr>
<tr>
<td>1.0</td>
<td>2022/08/23</td>
<td>1st official release of the document.</td>
</tr>
</tbody>
</table>

Notes and notices

The following notes and notices might appear in this guide:

- **Tip:**
  Suggests how to apply the information in a topic or step.

- **Note:**
  Explains a special case or expands on an important point.

- **Important:**
  Points out critical information concerning a topic or step.

- **CAUTION:**
  Indicates that an action or step can cause loss of data, security problems, or performance issues.

- **Warning:**
  Indicates that an action or step can result in physical harm or cause damage to hardware.
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1. Introduction

JH7110 is a high-performance RISC-V SoC featuring high-performance, low-power-consumption, rich interface options, and powerful image and video processing capabilities.

JH7110 is equipped with a 64-bit high-performance quad-core RISC-V processor core sharing 2 MB of cache coherency, whose working frequency is 1.5 GHz. JH7110 has a rich high-speed native interface, supports the Linux operating system, and has powerful image and video processing system. The StarFive ISP is compatible with mainstream camera sensors, built-in image/video processing subsystem supports H.264/H.265/JPEG codec. The integrated GPU makes its image processing capabilities stronger, such as 3D rendering. With high-performance, OpenCL/OpenGL ES/Vulkan support, JH7110 can further enhance intelligence and efficiency. JH7110 can complete a variety of complex image/video processing and intelligent visual calculations. Also, it meets multiple visual real-time processing requirements at the edge.
2. Block Diagram

The following figure shows the block diagram of JH7110.

**Figure 2-1 Block Diagram**

- **RISC-V 64-bit Quad-core CPU U74**
  - L1$ 32 KB/32 KB
- **RISC-V 64-bit S7**
  - L1$ 16 KB
  - 8 KB DTIM
- **L2Cache (2 MB)**
- **NOC/AXI BUS**
- **Audio DSP**
- **SGDMA**
- **Mailbox**
- **RISC-V 32-bit CPU E24**
- **MIPI-CSI**
- **ISP-RGB**
- **12-bit DVP**
- **GPU**
- **BootROM (32 KB)**
- **LPDDR4/DDR4/LPDDR3/DDR3 32-bit, 2,800 Mbps**
- **QSPI Flash Controller**
- **SMTPC/=`=
x2**
- **USB 2.0 Host/Device**
- **TRNG**
- **Security HW Engine AES/DES/IDEA/SHA/PKA**
- **IP**
- **SPI x7**
- **UART x6**
- **PWM x8**
- **WDT**
- **GPIO x64**
- **Timex4**
- **eMMC5.0 BootROM (32 KB)**
- **SDIO3.0**
- **CAN2.0B x2**
- **Ethernet MAC 10/100/1000 Mbps x2**
- **JTAG**
- **PLL x3**
- **Temp Sensor**
- **RISC-V 64-bit Quad-core CPU U74**
  - L1$ 32 KB/32 KB
- **RISC-V 64-bit S7**
  - L1$ 16 KB
  - 8 KB DTIM

**Note:**

- JH7110 supports one USB port. One of the PCIe2.0 lanes can be shared by USB3.0.
- JH7110 supports one port for SDIO and one port for eMMC, or both ports for SDIO.
3. Application

An introduction to the application scenarios.

JH7110 applies to the following scenarios.

- Commercial Electronics
  - Personal Single Board Computer (SBC)
  - Home NAS
  - Router (Soft routing)
  - Notebook computer
- Smart Home
  - Sweeping robot
  - Intelligent home appliances
  - Video surveillance
- Industrial Intelligence
  - Industrial robot
  - Unmanned store
4. Highlighted Feature

JH7110 has the following highlighted features.

- RISC-V U74 quad-core and S7 monitor core with 2 MB L2 cache
- Support Linux OS with kernel versions 5.10 and 5.15
- CPU work frequency up to 1.5 GHz
- GPU IMG BXE-4-32
- 32-bit LPDDR4/DDR4/LPDDR3/DDR3, up to 2,800 Mbps
- Video decoder supports up to 4K@60fps and multi-stream for H.264/H.265
- Video encoder supports up to 1080p@30fps and multi-stream for H.265
- Provide JPEG encoder/decoder
- Support up to 1080p@30fps full-functional ISP
- Support video input: 1 × DVP and 1 × MIPI-CSI with 4D2C up to 4K@30fps
- Support video output: MIPI display output with 4D1C up to 1080p@60fps
- Support 1 × HDMI2.0 port display up to 4K@30fps
- Support 24-bit RGB parallel interface up to 1080p@30fps
- Support 2 × PCIe2.0, 1 lane
- Support USB3.0 Host/Device (By reusing 1 of the PCIe2.0 lanes)
- Support 2 × Ethernet MAC 1000 Mbps, 2 × CAN2.0B
- Support IEEE 1588-2002 and IEEE 1588-2008 standards
- Support TRNG and support OTP, DMA, QSPI, and other peripherals
- Audio DSP supports floating-point instructions
- Dedicated audio processing and sub-system
5. Feature

CPU Subsystem
- 64-bit high-performance RISC-V CPU quad-core
  - Support RV64GC RISC-V ISA
  - L1-cache: I$32 KB/D$32 KB
  - Cache coherence for quad-core
- RV64IMAC monitor core
  - 16 KB L1 I-Cache with ECC
  - 8 KB DTIM with ECC
  - 8 region physical memory protection
- 32-bit RISC-V CPU core
  - Support RV32IMFC RISC-V ISA
  - 16 KB I-cache only
- L2-cache up to 2 MB cache size
- Dual DMA controllers support up to 16+4 channels

Memory and Storage
- BUS RAM up to 256 KB
- DDR controller support 1 channel of x32
  - DDR4/3 and LPDDR4/3 for 2800 Mbps
  - Support 2 pieces of x16 or 1pcs of x32 devices
  - Support DDR memory density up to 8 GB
- QSPI controller support external flash memory
  - Support XIP mode and Page mode
  - Separate 1/2/4 data width
  - Support SPI Nor Flash size up to 16 MB
  - Support SPI Nand Flash size up to 2 GB

GPU Subsystem
- Support OpenCL 3.0
- Support OpenGL ES 3.2
- Support Vulkan 1.2

Video Processing Subsystem
- Camera MIPI Interface
  - MIPI CSI-2 RX DPHY
  - Up to 6 lanes of 1.5 Gbps
- Support 4D1C × 1 MIPI sensors
- Support 2D1C × 2 MIPI sensors
• ISP (Image Signal Process)
  ◦ Support 1 × MIPI CSI channel and 1 × DVP input channel
  ◦ Support up to 1080p@30fps CMOS RGB image sensor
  ◦ ISP core support
• Defective pixel correction
• R/G/B LUT, AE/AWB/AF
• Histogram analysis
• Lens Shading/Color Shading
• Sensor spatial crosstalk cancellation
• Global tone mapping/Spatial noise reduction
• Seamless digital scale down from 1/4x to 1x
• Video Encoder
  ◦ H.265 Encoder, 1080p@30fps
  ◦ Support I/P type slice
  ◦ High-performance CABAC encoding
  ◦ Support Region of Interest (ROI)
• Video Decoder
  ◦ 4K@60fps or 1080p@30fps
  ◦ Compatible with the ITU-T Recommendation H.264
  ◦ Compatible with ISO/IEC 23008-2 H.265
  ◦ Support Format 420, 8-bit/10-bit
  ◦ Support I/P type slice
  ◦ H.265 Main/Main10, L5.1
  ◦ H.264 High/High10, L5.2
• JPEG
  ◦ Up to 290 MPixel/Sec for YUV420, 210 MPixel/Sec for YUV422, 140 MPixel/Sec for YUV444
  ◦ Bit rate 480 Mbps (MJPG 8M@30fps 422 1:8)
  ◦ Compliant with Baseline/Extended sequential ISO/IEC 10918-1 JPEG
  ◦ Compliant with Motion JPEG
  ◦ Support from 16x16 pixels to 32 K × 32 K (32,768 × 32,768)

Display Subsystem
• Display
  ◦ Support 1 × HDMI 2.0 up to 4 K@30fps display
  ◦ RGB656, RGB888 I/F, up to 1080p@30fps display
  ◦ Support 6 image layers shared by 2 display panels (screens)
  ◦ Support 1/64-64 times scaler (1/64 not covered)
  ◦ Support MIPI TX DPHY lane connected with panel module
• MIPI Display Interface
MIPI TX DSI Controller for single display output
- MIPI TX DPHY support up to 4D1C lanes
- Data rate support up to 2.5 Gbps

Connectivity Subsystem
- 2x PCIe2.0 controller with integrated PHY
  - X1 PCI Express Core
  - Support link rate of 5 GT/s per lane
- USB 2.0 host/device mode with high speed and full speed
- 2 × Ethernet GMAC for 10/100/1000 Mbps with RGMII
  - Ethernet GMAC supports data transfer rates of 10/100/1,000 Mbps auto-negotiation using the following PHY models
    - YT8521DH/DC
    - YT8531DH/DC
  - Ethernet GMAC supports data transfer rates of 1,000 Mbps only using all other PHY models
- 2 × SDIO 3.0/eMMC 5.0 host controllers
- 2 × CAN2.0B data rates up to 5 Mbps

Security Subsystem
- Encrypt Engines: AES; DES/3DES; HASH; PKA
- Compliant with TRNG
- Support 256-bit random number generation
- 512 × 32-bit (2 KB) of OTP for key data on-die storage

Audio DSP
- Used for traditional audio/voice data algorithm processing
- 32-bit Audio DSP, support floating-point instructions
- 96 Kbytes DTCM, 96 Kbytes ITCM
- 16 Kbytes I-cache, 32 Kbytes D-cache
- Support internal DMA
- Support On-Chip Debug (OCD)
- 32 interrupts count

Audio Interface
- 8 channel TX and RX I2S/PCM TDM
- Provide 4 sets of I2S/PCM I/F and support DMA interface
- Provide 2 sets of SPDIF and support RX mode and TX mode
- 4-channel PDM input for digital MIC application

Rich System Peripherals
- 6 × UART
- 7 × I2C
<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 7 × SPI</td>
</tr>
<tr>
<td>• 2 × SDIO</td>
</tr>
<tr>
<td>• 1 × DPI (Parallel RGB Display)</td>
</tr>
<tr>
<td>• 1 × PCM/I2S</td>
</tr>
<tr>
<td>• 7 × 32-bit timers</td>
</tr>
<tr>
<td>• 1 × temperature sensor</td>
</tr>
<tr>
<td>• 2 × INTC</td>
</tr>
<tr>
<td>• 8 × PWM outputs</td>
</tr>
<tr>
<td>• 1 × 32-bit WDT reset output</td>
</tr>
<tr>
<td>• 64 × GPIO</td>
</tr>
<tr>
<td>• 1 × DVP sensor input interface</td>
</tr>
<tr>
<td>• 3 × GPCLK outputs</td>
</tr>
</tbody>
</table>

Package

• Body Size 17 × 17 mm, 0.65 mm ball pitch, FCBGA 625 balls

Power Supply

• 0.9 V core voltage
• 3.3 V/2.5 V/1.8 V I/O voltage