HiKey960 Development Board Hardware User Manual

Version 1.0

Table of Contents

Introduction

The HiKey960 Development Board is a 96Boards compliant community board based on Hisilicon Kirin960 SoC. The following table lists its key features:

|	
Processor	Kirin 960 SoC 4x Cortex-A73 @ 2.4GHz 4x Cortex-A53 @ 1.8GHz ARM Mali-G71 MP8 900MHz
Memory/ Storage	32GB UFS flash storage MicroSD card slot PCIE Gen2 on M.2 Key connector
Wireless	WiFi (2.4- and 5-GHz dual band with two antennas)(DFS band not support) Bluetooh not support
USB	2 x USB 3.0 type A (host mode only) 1 x USB 2.0 type C OTG
Display	1 x HDMI 1.4 (Type A - full) 1 x 4L-MIPI DSI HDMI output up to FHD 1080P
Video	Inside Encoder:H.265/H.264 3840*2400@30fps 4 * 1080p @ 30 fps Inside Decoder: H.265,HEVC MP/High Tier, Main 10/High Tier,H.264BP/MP/HP, MPEG1/2/4, VC-1, VP6/8
Audio	HDMI output
Camera	1 x 4-lane MIPI CSI 1 x 2-lane MIPI CSI
Expansion Interface	40 pin low speed expansion connector: +1.8V, +5V, DC power,GND,2UART, 2I2C, SPI, I2S, 12*GPIO60 pin high speed expansion connector: 4L-MIPI DSI, I2C x2, SPI (48M),USB 2.0, 2L+4LMIPI CSI
LED	1 x WiFi activity LED（Yellow） 1 x Activity LED (Blue) 4 x User LEDs (Green)
Button	Power Button ：Button Power on/off & Reset the system
Power Source	Recommend a 12V@2A adapter with a DC plug which has a 4.75mm outerb diameter and 1.7mm center pin with standard center-positive (EIAJ-3Compliant)
OS Support	AOSP/LINUX
Appearance characteristic	85mm x 55mm

What's in the Box

The box contains one HiKey960 Development Board and a quick start guide.

Board Overview
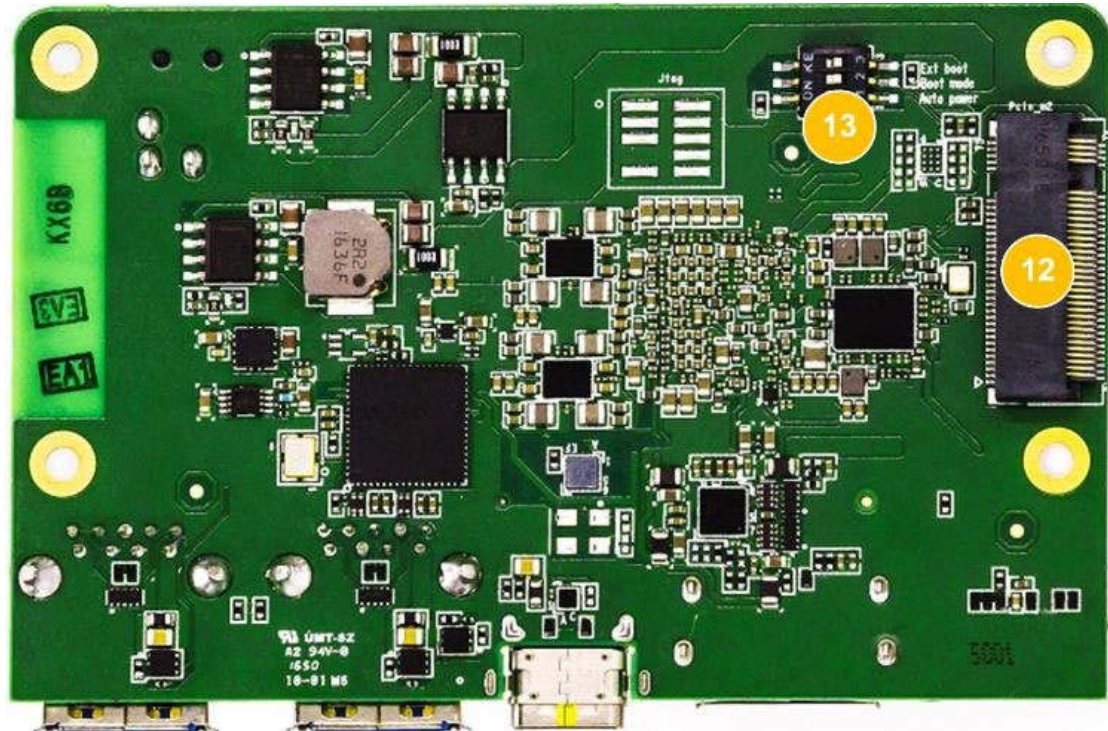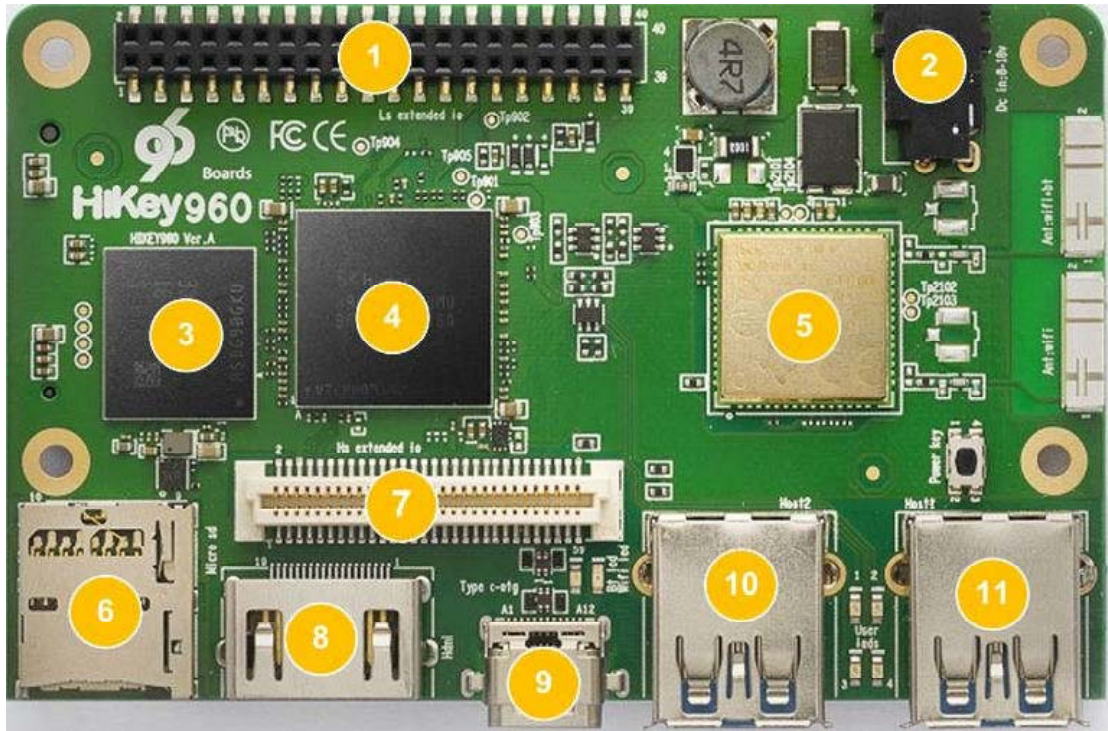
Key Components

Position	Reference	Description
1	J2002	Low Speed Expansion Connector
2	P401	DC Input 8-18V
3	U1601	UFS 32GB
4	U501	Kirin960 & 3GB LPDDR4
5	U2101	WLAN
6	P2301	Micro SD Card Socket
7	J2001	High Speed Connector
8	J1901	HDMI Type A Port
9	J1701	USB Type C Connector
10	J1801	USB3.0 Host2 Connector
11	J1702	USB3.0 Host1 Connector
12	J2501	PCI-E
13	SW2201	Auto Power Boot SEL

System Block Diagram
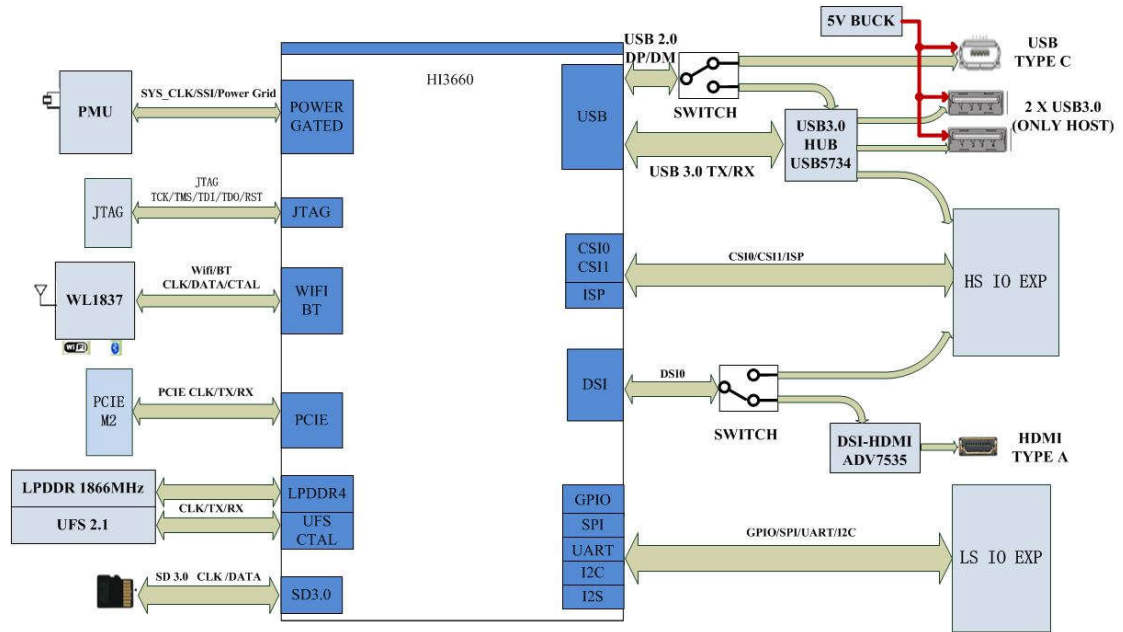
Getting Started

Prerequisites

Before you power up your HiKey960 Development Board for the first time you will need the following:

- ✓HiKey960 Development Board.
- ✓A 96Boards compliant power supply (sold separately).
- ✓A HDMI or DVI LCD Monitor that supports a resolution of 1080P/60Hz.
- ✓HDMI-HDMI cable or HDMI-DVI cable to connect the board to the Monitor.
- ✓A computer keyboard with USB interface.
- ✓A computer mouse with USB interface.

Starting the board for the first time

To start the board, follow these simple steps:

step1. Connect the HiKey960 to your display with the HDMI cable. It is important to do this first becausethe monitor will not detect the board if it is connected after starting. Ensure that the source for the displayis switched to the HDMI port you are using.

step2. Connect the Express-UartBoard.

step3. Ensure Auto Power is ON.

Component Details

Processor

4 ARM Cortex-A73 MPCore(Big Core 4 2.4G Hz) 4 A53 MPCore(Little Core 1.8G)
ARM Mali G71 MP8 3DGPU

PMIC

There are a master PMIC and two slave PMIC for Kirin960 platform.

Master PMIC is a power management system chip.

One of the slave PMIC is a 4-phase high efficiency buck converter which applied to offer the power of CPU-B, and the other one is used for GPU&CPU-L.

Memory (DRAM)

The Hikey960 Development Board provides 3GB LPDDR4-SDRAM which is a 4-channel and 64bit width bus implementation interfacing directly to the Kirin960 build-in LPDDR controller. The maximum DDR clock is 1866MHz. It is mounted over the Kirin960 using pop technology.

Storage

The Hikey960 Development Board provides an 32GB UFS which is compliant with UFS2.0.

Micro SDHC

The Hikey960 Development Board SD slot signals are routed directly to the Kirin960 SDC interface. It meets the SD3.0 standard.

Boot ROM

The Hikey960 Development Board boots up from the UFS.

Networking

WiFi

- Dual-band (2.4/5GHz) single stream 802.11 a/b/g/n RF.
- 20- and 40-MHz SISO and 20-MHz 2×2 MIMO at 2.4 GHz for High Throughput: 80 Mbps(TCP),
- 100 Mbps (UDP).
- 2.4-GHz MRC Support for Extended Range and 5-GHz Diversity Capable.

Display Interface

HDMI

The 96Boards specification calls for an HDMI port to be present on the board. The Kirin960 doesn't

include a built-in HDMI interface.

The Hikey960 Development Board deploys the built-in DSI interface as the source for the HDMI output. A peripheral Bridge IC (U1901, ADV7535) performs this task and it supports 1080p at 30Hz.

MIPI-DSI

The 96Boards specification calls for a MIPI-DSI implementation via the High Speed Expansion Connector.

The Hikey960 Development Board implements a 4-lane MIPIDSI interface meeting this requirement. It can support up to 2560*1600@60fps. The Hikey960 Development Board routes the MIPIDSI interface signals to the DSI-0 interface of the Kirin960.

Camera Interface

The 96Boards specification calls for two camera interfaces.

The Hikey960 Development Board supports two camera interfaces, one with a 4-lane MIPICSI interface and one with 2-lane MIPICSI interface, meeting this requirement. The 4-lane MIPICSI interface can support 26M camera and the 2-lane MIPICSI can support 8M camera.

USB Ports

The Hikey960 Development Board supports a USB OTG port and three USB host ports via a USB MUX. The input channel(D+/D-) of USB MUX is connected to the usb port of the SOC, and the two output channels(1D+/1D-,2D+/2D-) are connected to type C USB port and USB hub respectively. The three USB host ports are connected to the downstream ports of the USB hub. The control of MUX is done via a software controlled GPIO. When this signal is logic low, '0', the USB data lines are routed to the type C USB connector. When 'USBSWSEL' is logic level high, '1', the USB data lines are routed to USB HUB.
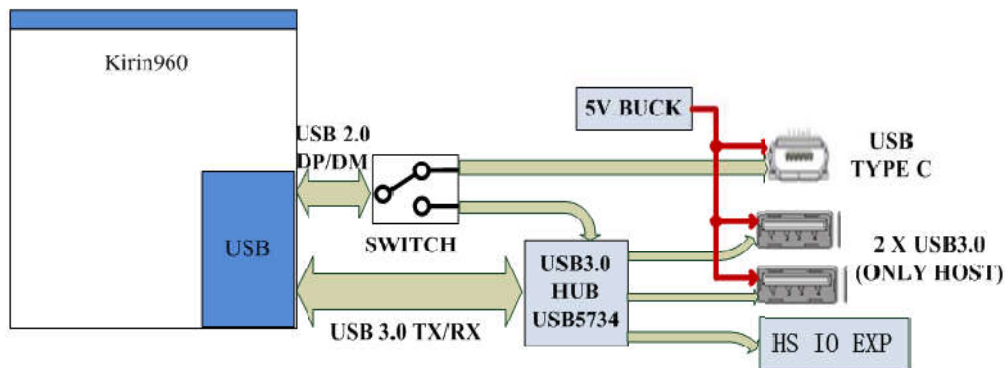
USB Host ports

The Hikey960 Development Board supports three USB host port via a USB hub (U1803 USB5734). Its upstream signal is connected to USB interface of Kirin960.

✓Port 1 of the USB HUB is routed to J1702, a Type 'A' USB Host connector. A current controller (U1704) sets the Power Current limit to 1A.

✓Port 2 of the USB HUB is routed to J1801, a Type 'A' USB Host connector. A current limited controller (U1806) sets the Power Current limit to 1A.

✓Port 3 of the USB HUB is routed to the High Speed Expansion connector. No current limited controller is implemented on the board for this channel.

USB OTG ports

The Hikey960 Development Board implements a OTG port. The port is located at J1701, a type C USB.

Note: the board can work in one mode at a time, Host mode or Device mode, not both.

Audio

The Hikey960 Development Board has two audio ports: HDMI and I2S.

DC Power

The Hikey960 Development Board can be powered as follow:

8V to 18V supply from a dedicated DC jack(P401)

Power Measurement

The Hikey960 Development Board has three current sense resistors R401/R413/R408.

Reference	Net	Description
R401	DCIN	To measure the current of total base board power
R413	SYS5V	To measure the current of SYS_5V power
R408	VCC4V2	To measure the current of VDD4V2 power

External Fan Connection

The 96Boards specification calls for support for an external fan. That can be achieved by using the 5V orthe SYS_DCIN (12V), both present on the Low Speed Expansion connector.

UART

The Hikey960 Development Board has two UART ports (UART6 / UART3), both present on the Low Speed Expansion connector. They are routed to the UART6 (UART1TxD, UART1RxD) and UART3 (UART3TxD, UART3RxD, UART3CTS, UART3RTS) interface of Kirin960 separately. The UART6 isused for the serial console output.

Buttons

The Hikey960 Development Board presents one button. It is Power key which also can be used as Resetkey. The power ON/OFF and RESET signals are also routed to the Low Speed Expansion connector.

Power Button

The push-button S2201 serves as the power-on/sleep button. Upon applying power to the board, press thepower button the board will boot up. Once the board is running you can turn power-off by pressing thepower button for more than 3 seconds. If the board is in a sleep mode, pressing the power bottom willwake up the board. Oppositely, if the board is in an active mode, pressing the power bottom will changethe board into sleep mode.

Reset Button

The push-button S2201 also serves as the hardware reset button. press the button for more than 10 seconds,the system will be rebooted.

LED Indicators

The MediaTek X20 Professional Board has six LEDs.

Two activity LEDs:

- WiFi activity LED –The Hikey960 Development Board drives this Yellow LED via GPIO205 fromKirin960.
- Activity LED –The Hikey960 Development Board drives this Blue LED via GPIO207 fromKirin960.

Four User LEDs:

The four user LEDs are surface mount Green in 0603 size located next to the USB type A connector. TheHikey960 Development Board drives the four LEDs from the soc GPIO: GPIO150, GPIO151，GPIO189and GPIO190.

Additional Functionality

The Hikey960 Development Board also has a additional interface for user debugging. It includes JTAG interface. The position is reserved, but the component is not mounted in the mass production.

Expansion Connectors

Low Speed Expansion Connector

The following tables show the Low Speed Expansion Connector pin out:

HiKey960 Signals	96Boards Signals	PIN	PIN	96Boards Signals	HiKey960 Signals
GND	GND	1	2	GND	GND
UART3CTSN	UART0CTS	3	4	PWRBTNN	PWRONN
UART3TXD	UART0TxD	5	6	RSTBTNN	EXPRSTOUTN
UART3RXD	UART0RxD	7	8	SPI0SCLK	SPI1CLK
UART3RTSN	UART0RTS	9	10	SPI0DIN	SPI1DI
UART5TXD	UART1TxD	11	12	SPI0CS	SPI1CSN
UART5RXD	UART1RxD	13	14	SPI0DOUT	SPI1DO
I2C0SCL	I2C0SCL	15	16	PCMFS	CODECSSIDATA
I2C0SDA	I2C0SDA	17	18	PCMCLK	SLIMBUSCLK
I2C7SCL	I2C1SCL	19	20	PCMDO	SLIMBUSDATA
I2C7SDA	I2C1SDA	21	22	PCMDI	GPIO045CODECRST
GPIO215	GPIO-A	23	24	GPIO-B	GPIO216
GPIO217	GPIO-C	25	26	GPIO-D	GPIO218
GPIO220	GPIO-E	27	28	GPIO-F	LCDBLPWM
LCDTE0	GPIO-G	29	30	GPIO-H	GPIO040LCDRSTN
GPIO052CAM0RSTN	GPIO-I	31	32	GPIO-J	CAMPDN0
GPIO075CAM1RSTN	GPIO-K	33	34	GPIO-L	CAMPDN1
VOUT111V8/2V95	+1V8	35	36	SYSDCIN	SYSDCIN
SYS_5V	+5V	37	38	SYCDCIN	SYSDCIN
GND	GND	39	40	GND	GND

UART {3/6}

The 96Boards specifications calls for a 4-wire UART implementation, UART0 and an optimal second 2-wire UART, UART1 on the Low Speed Expansion Connector.The HiKey960 Development Board implements UART3 as a 4-wire UART that connects directly to theMT6797 SoC. These signals are driven at 1.8V.The HiKey960 Development Board implements UART6 as a 2-wire UART that connects directly to theMT6797 SoC. These signals are driven at 1.8V.

I2C {0/1}

The 96Boards specification calls for two I2C interfaces to be implemented on the Low Speed Expansion Connector.
The HiKey960 Development Board implements both interfaces named I2C0 and I2C7. They connect directly to the Kirin960 SoC. Each of the I2C lines is pulled up to VIO18_PMU via 1K resistor.

GPIO {A-L}

The 96Boards specification calls for 12 GPIO lines to be implemented on the Low Speed Expansion Connector. Some of these GPIOs may support alternate functions for DSI/CSI controlThe HiKey960 Board implements this requirement. All GPIOs are routed to the Kirin960 SoC. Take LowSpeed Expansion Connector for reference.

SPI 0

The 96Boards specification calls for one SPI bus master to be provided on the Low Speed Expansion Connector.

The HiKey960 Development Board implements a full SPI master with 4 wires, CLK, CS, MOSI and MISO. The signals are connected directly to the Kirin960 SoC and driven at 1.8V.

I2S

The 96Boards specification calls for one PCM/I2S bus to be provided on the Low Speed Expansion Connector. The CLK, FS and DO signals are required while the DI is optional.

The HiKey960 Development Board implements a I2S interface with 4 wires, CLK, FS, DO and DI. The signals are connected directly to the Kirin960 SoC and driven at 1.8V.

Power and Reset

The 96Boards specification calls for a signal on the Low Speed Expansion Connector that can power on/off the board and a signal that serves as a board reset signal.

The HiKey960 Development Board routes the PWR*BTN*N (named PWRKEY on schematic) signal to thePWRKEY pin of the PMIC. This signal is driven by s2201 as well, the on-board power on push-buttonswitch. A mezzanine implementation of this signals should not drive it with any voltage, the only allowedoperation is to force it to GND to start the board from a sleep mode.

The HiKey960 Development Board routes the RST*BTN*N (named exp_rstout*n on schematic) signal to the HRESET*N pin of the PMIC Hi6421.

Power Supplies

The 96Boards specification calls for three power rails to be present on the Low Speed Expansion Connector:

- ✓ +1.8V Max of 100mA
- ✓ +5V Provide a minimum of 5W of power (1A).
- ✓ SYS_DCIN 8-18V input with enough current to support all the board functions or the output DCIN from on-board DC Connector able to provide a minimum of 7W of power.

The HiKey960 Development Board supports these requirements as follows:

- ✓ +1.8V Driven by PMIC up to 150mA.
- ✓ +5V Driven by a 5A DC-DC buck converter (U403). It also provides the VBUS power to the twoUSB host connectors (J1702, J1801) and the HDMI 5V power to the HDMI connector (J1901).Theremaining capacity provides a total of 7W which meets the 96Boards requirements.

High Speed Expansion Connector

There is a 60-pin High Speed Expansion Connector on board. As shown in the table below.

HiKey960 Signals	96Boards Signals	PIN	PIN	HiKey960 Signals	96Boards Signals

GPIO148SPI3DO	SDDAT0/SPI1DOUT	1	2	CSI0C+	CSI0CLKP
UART0IRDARXD	SDDAT1	3	4	CSI0C-	CSI0CLKN
UART0IRDATXD	SDDAT2	5	6	GND	GND
GPIO149SPI3CS0N	SDDAT3/SPI1CS	7	8	CSI0D0+	CSI0DATA0P
GPIO146SPI3CLK	SDSCLK/SPI1SCLK	9	10	CSI0D0-	CSI0DATA0N
GPIO147SPI3DI	SDCMD/SPI1DIN	11	12	GND	GND
GND	GND	13	14	CSI0D1+	CSI0DATA1P
ISPCCLK0MCAM	CLK0/CSI0MCLK	15	16	CCSI0D1-	CSI0DATA1N
ISPCCLK1SCAM	CLK1/CSI1MCLK	17	18	GND	GND
GND	GND	19	20	CSI0D2+	CSI0DATA2P
DSI2CLKP	DSICLK+	21	22	CSI0D2-	CSI0DATA2N
DSI2CLKN	DSICLK-	23	24	GND	GND
GND	GND	25	26	CSI0D3+	CSI0DATA3P
DSI2DATA0P	DSID0+	27	28	CSI0D3-	CSI0DATA3N
DSI2DATA0N	DSID0-	29	30	GND	GND
GND	GND	31	32	I2C2SCL	ISPSCL0
DSI2DATA1P	DSID1+	33	34	I2C2SCL	ISPSDA0
DSI2DATA1N	DSID1-	35	36	I2C3SDA	ISPSCL1
GND	GND	37	38	I2C3SDA	ISPSDA1
DSI2DATA2P	DSID2+	39	40	GND	GND
DSI2DATA2N	DSID2-	41	42	CSI1D0+	CSI1DATA0P
GND	GND	43	44	CSI1D0-	CSI1DATA0N
DSI2DATA3P	DSID3+	45	46	GND	GND
DSI2DATA3N	DSID3-	47	48	CSI1D1+	CSI1DATA1P
GND	GND	49	50	CSI1D1-	CSI1DATA1N
USB2DNDP4CON	USBD+	51	52	GND	GND
USB2DNDM4CON	USBD-	53	54	CSI1C+	CSI1CLKP
GND	GND	55	56	CSI1C-	CSI1CLKN
NC	HSICSTR	57	58	GND	GND
NC	HSICDATA	59	60	RESERVED	Pull-up vout21v8

MIPI DSI {0}

The 96Boards specification calls for a MIPI-DSI to be present on the High Speed Expansion Connector. A minimum of one lane is required and up to four lanes can be accommodated on the connector. The Hikey960 Development Board implementation supports a full four lane (1.2Gbps/lane) MIPI-DSI interface that is routed to the High Speed Expansion Connector. The MIPI-DSI signals are directly connected to DSI-0 of Kirin960.

MIPI CSI {0/1}

The 96Boards specification calls for two MIPI-CSI interfaces to be present on the High Speed ExpansionConnector. Both interfaces are optional. CSI0 interface can be up to four lanes while CSI1 is up to twolanes.

The Hikey960 Development Board implementation supports a full four lane MIPI-CSI interface on CSI0 and two lanes of MIPI-CSI on CSI1. All MIPI-CSI signals are routed directly to/from the Kirin960 SoC. CSI0 can support up to 26M@30fps and CSI1 can support up to 8M@30fps. The max data rate of each lane is 2.5Gbps.

I2C {2/3}

The 96Boards specification calls for two I2C interfaces to be present on the High Speed Expansion Connector. Both interfaces are optional unless a MIPI-CSI interface has been implemented. Then an I2C interface shall be implemented.

The Hikey960 Development Board implementation supports two MIPI-CSI interfaces and therefore mustsupport two I2C interfaces,they are ISPI2C0 and ISPI2C1. Each of the I2C lines is pulled up to VIO18_PMU via 1K resistor.

SD/SPI

The 96Boards specification calls for an SD interface or a SPI port to be part of the High Speed ExpansionConnector.

The Hikey960 Development Board implements a full SPI master with 4 wires (96Boards SPI Configuration), CLK, CS, MOSI and MISO. All the signals are connected directly to the Kirin960 SoC. These signals are driven at 1.8V.

Clocks

The 96Boards specification calls for one or two programmable clock interfaces to be provided on the High Speed Expansion Connector. These clocks may have a secondary function of being CSI0MCLK andCSI1MCLK. If these clocks can't be supported by the SoC than an alternative GPIO or No-Connect isallowed by the specifications.

The Hikey960 Development Board implements two CSI clocks which are connected directly to the Kirin960 SoC. These signals are driven at 1.8V.

USB

The 96Boards specification calls for a USB Data line interface to be present on the High Speed ExpansionConnector.

The Hikey960 Development Board implements this requirement by routing USB channel 4 from the USBHUB to the High Speed Expansion Connector.

HSIC

The 96Boards specification calls for an optional MIPI-HSIC interface to be present on the High Speed Expansion Connector.

The Hikey960 Development Board implementation doesn't support this optional requirement.
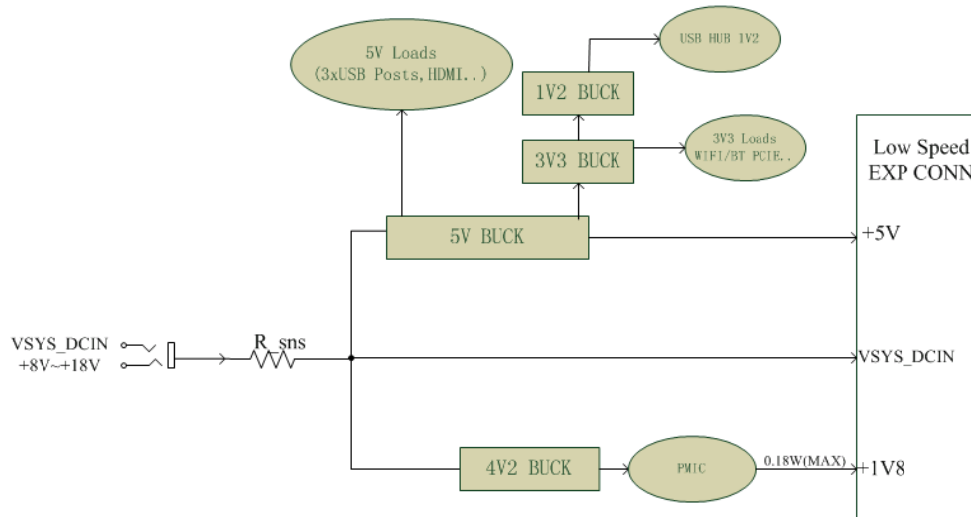
Reserved

The pin 60 of the High Speed Expansion Connector is pulled up to VIO18_PMU via 100K resistor.

## Power Management Overview

Block Diagram

DC Power Input

- An 8V to 18V power from a dedicated DC jack J901.
- An 8V to 18V power from the SYS_DCIN pins on the Low Speed Expansion Connector CON7001.

Note: Please refer to the mechanical size of the DC plug below. The inside diameter of the plug is 1.7mm，the outer diameter of the plug is 4.75mm.The positive electrode of the DC plug is in the inside, and the negative pole is outside.
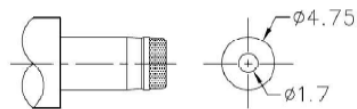
MATING PLUG
Jack Insertion Depth: 8.00 mm

Power-on Sequence
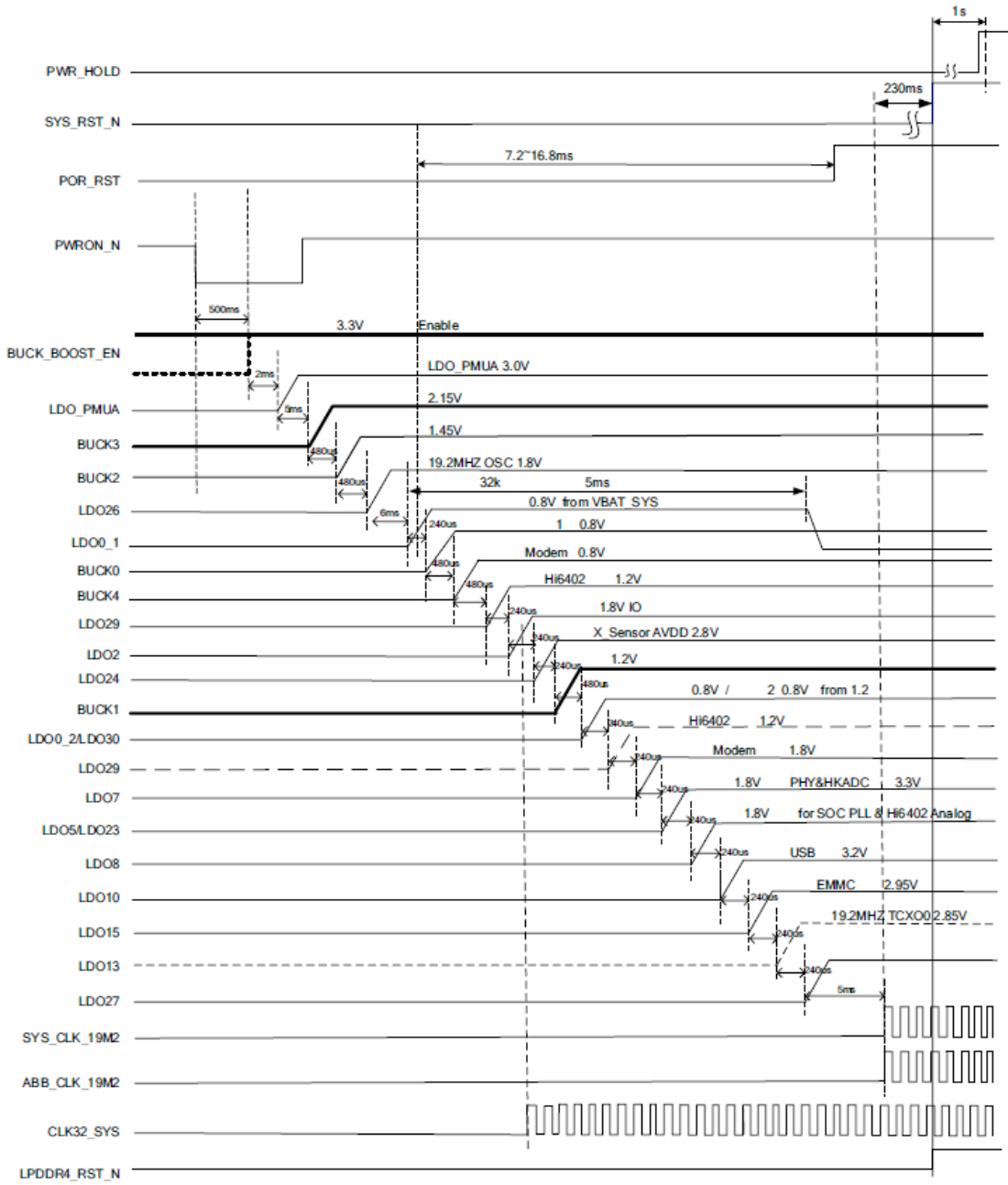
Voltage Rails

Circuit Type	Net Name	Default ON Voltage(V)	Iout Max (mA)	Expected use

BUCK	SYS5V	5	5000	system 5V
	VDD4V2	4.2	5000	system power
	VDDCPUB	0.8	16000	4Cortex A73
	VDDCPUL	1.05	30000	4Cortex A53
	VDDGPU	0.8	12000	Core power for GPU
	Vbuck00V8	0.8	2500	core power for PERI
	Vbuck11V1	1.1	3000	DRAM and LDO
	Vbuck21V45	1.45	2500	power for LDO
	Vbuck32V15	2.15	2500	power for LDO
LDO	LDO0	0.8	300	UFS,sys
	LDO1	1.29	300	HDMI V1P2
	LDO2	1.8	800	1.8V IO
	LDO3	1.85	300	HDMI
	LDO5	1.8	500	MIPI phy,DDR phy,HKADC
	LDO7	1.8	300	ABB,PLL
	LDO8	1.8	300	sys PLL
	LDO9	1.8/2.95	150	SD card IO
	LDO10	3.2	100	USB phy 3.3V
	LDO11	1.8	150	40 pin connector
	LDO15	3	600	UFS
	LDO16	2.95	800	SD card
	LDO21	1.8	200	efusesys
	LDO26	1.8	50	19.2M XO
	LDO29	1.2	200	UFS 1.2V
	LDO30	0.8	300	UFS 0.8V
Other	HDMI5V	5		HDMI output voltage
	VBUSHOST1	5		USB host1 output voltage(CON6401)
	VBUSHOST2	5		USB host2 output voltage(CON6402)
	VIO18PMU	1.8		1.8V on LS connector
	SYS5V	5		5V on LS connector
	DCIN	8 ~ 18		8-18V DCIN on LS connector as output

Mechanical specification

The Hikey960 Development Board is compliant with the 96boards mechanical specification.
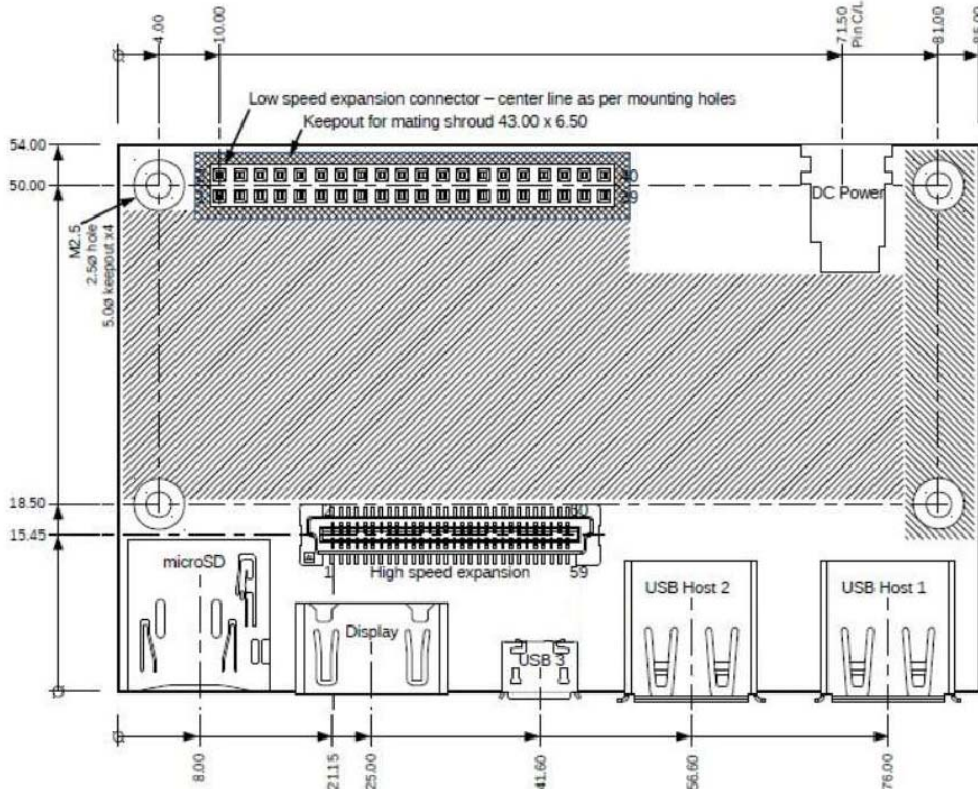
FCC Regulations:

- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

- This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause

harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/ TV technician for help.

● Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

FCC RF Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. To comply with FCC RF Exposure compliance requirements, this grant is applicable to only Mobile Configurations. The antennas used for the transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.