

Renesas **R-Car**

H3 Starter Kit

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General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

- The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

The state of the product is undefined at the moment when power is supplied.

- The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.

In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.

In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

Access to reserved addresses is prohibited.

- The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

- When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

- The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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1. About this manual

Purpose and Target Readers

This manual is designed to provide the user with an understanding of the functions and operating specifications of the H3 Starter Kit board. A basic knowledge of electrical circuits, logical circuits, and microcomputers (SOC) is necessary in order to use this manual.

This manual comprises an overview of the H3 Starter Kit board; its function, and operating specifications.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.
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The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.
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2. Overview

2.1 Introduction

The H3 Starter Kit board is designed for evaluating the features and performance of the R-CAR H3 device from Renesas Electronics and it is also used for developing and evaluating application software for these R-CAR H3

The H3 Starter Kit, based on the R-CAR H3 SIP, comes with LPDDR4@4GB in 2 channels, each 64-bit wide+ Hyperflash @64MB, CSI2 interfaces and several communication interfaces like USB, Ethernet, HDMI and can work standalone or can be adapted to other boards, via a 440pin connector on bottom side.

It is possible to order 2 different types of H3 Starter Kit Boards, one with Ethernet connection onboard and one with Ethernet connection on ComExpress.

This will be realized by a specific resistor configuration, and signed onboard with a label.

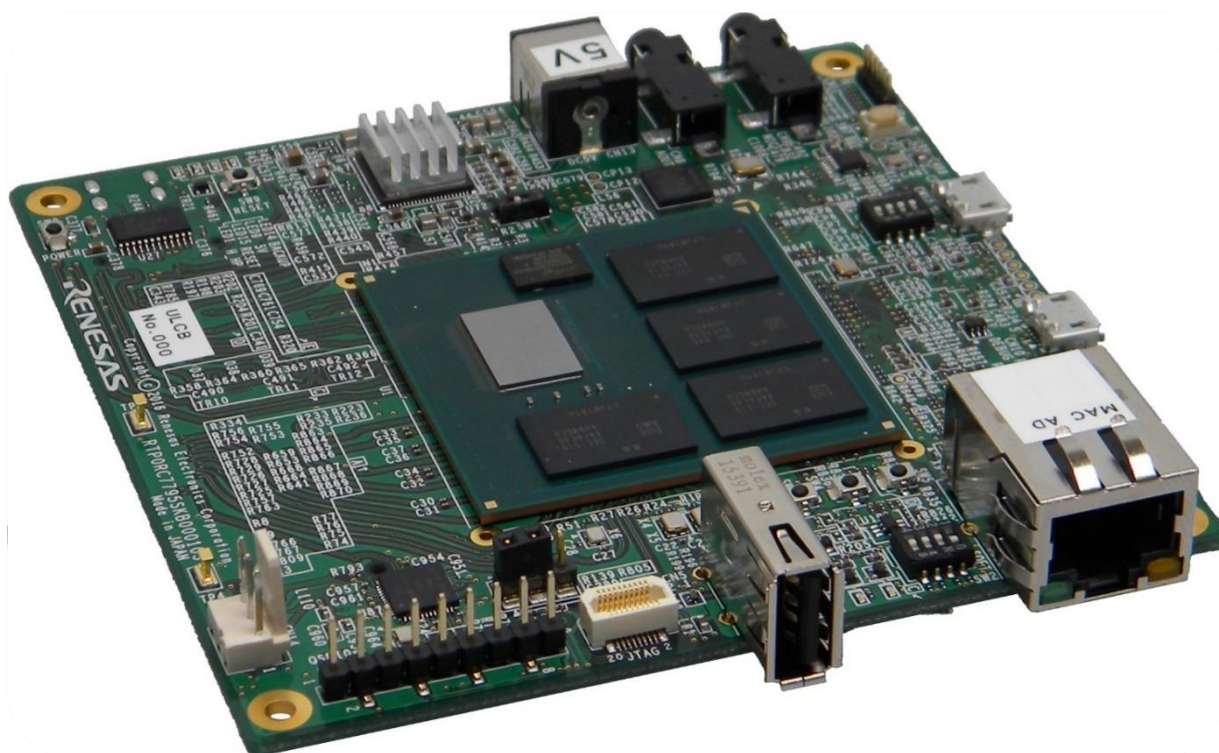


FIGURE 1 H3 STARTER KIT BOARD

2.2 H3 Starter Kit Board Major Configuration

The figure shows an example of a system configuration using the H3 Starter Kit Board.



FIGURE 1 STANDART CONFIGURATION

2.3 H3 Starter Kit Board Major Specification

CPU R-CAR H3	<ul style="list-style-type: none"> • ARM CA57 (ARMv8) 1.5 GHz quad core, with NEON/VFPv4, L1\$ I/D 48K/32K, L2\$ 2MB • ARM CA53 (ARMv8) 1.2 GHz quad core, with NEON/VFPv4, L1\$ I/D 32K/32K, L2\$ 512K • Memory controller for LPDDR4-3200 4GB in 2 channels, each 64-bit wide • Two- and three-dimensional graphics engines, • Video processing units, • 3 channels Display Output, • 6 channels Video Input, • SD card host interface, • USB3.0 and USB2.0 interfaces, • CAN interfaces • Ethernet AVB • PCI Express Interfaces
Memories	<ul style="list-style-type: none"> • INTERNAL 384KBYTES SYSTEM RAM • DDR 4 GBYTES LPDDR4 • HYPERFLASH 64 MBYTES HYPER FLASH (512 MBITS, 160 MHz, 320 MBYTES/s) • QSPI FLASH 16MBYTES QSPI (128 MBITS, 80 MHz, 80 MBYTES/s) 1 HEADER QSPI MODULE • EMMC 32 GBYTES EMMC (HS400 240 MBYTES/s) • MICROSD-CARD SLOT (SDR104 100 MBYTES/s)
Connectors	<ul style="list-style-type: none"> • CN1 COM Express type connector 440pin • CN2 QSPI Flash module • CN3 DEBUG JTAG • CN4 HDMI • CN5 USB 2.0 • CN6 Push-Pull microSD Card Socket • CN7 Ethernet, Connector, RJ45 • CN8 LINE Out • CN9 MIC Input • CN10 DEBUG SERIAL • CN11 CPLD Programming JTAG • CN12 DEBUG SERIAL • CN13 Main Power Supply input (5VDC) • CN14 CPU Fan
Switches	<ul style="list-style-type: none"> • SW1 Hyper Flash • SW2 Software Readable DIPSWITCHES (4x) • SW3 Software Readable Push button • SW4 Software Readable Push button • SW5 Software Readable Push button • SW6 Mode Settings • SW7 Reset • SW8 Power • SW9 Reset
Board specifications	<ul style="list-style-type: none"> • Dimensions: 95mm × 95mm • Board thickness: 1.6mm • External power supply 5V / 6A max, Ripple & Noise (Vp-p) Full load 200mV • T_{opr} Operating ambient temperature 0°C to 40°C Do not expose to condensation • Vcc 5V system power supply voltage (range 5V +- 5%) • I_{board} Maximum current consumption 6A , 40W

TABLE 1 BOARD SPECIFICATIONS

Note: Power supply – connecting the 5V external power supply will be indicated by the LED9. The fan is always on.

Note: Do not remove or disconnect the fan. In addition observe the max ambient temperature.

Caution – hot!!! In case these will not observed.

For safety reason the internal temperature measurement feature of the device should be used to switch off the board in case of any unexpected heat up.

The above Power consumption specification does not cover the max power consumption Automotive Spec of the R-CAR H3 device!

2.4 H3 Starter Kit Board Block Diagram

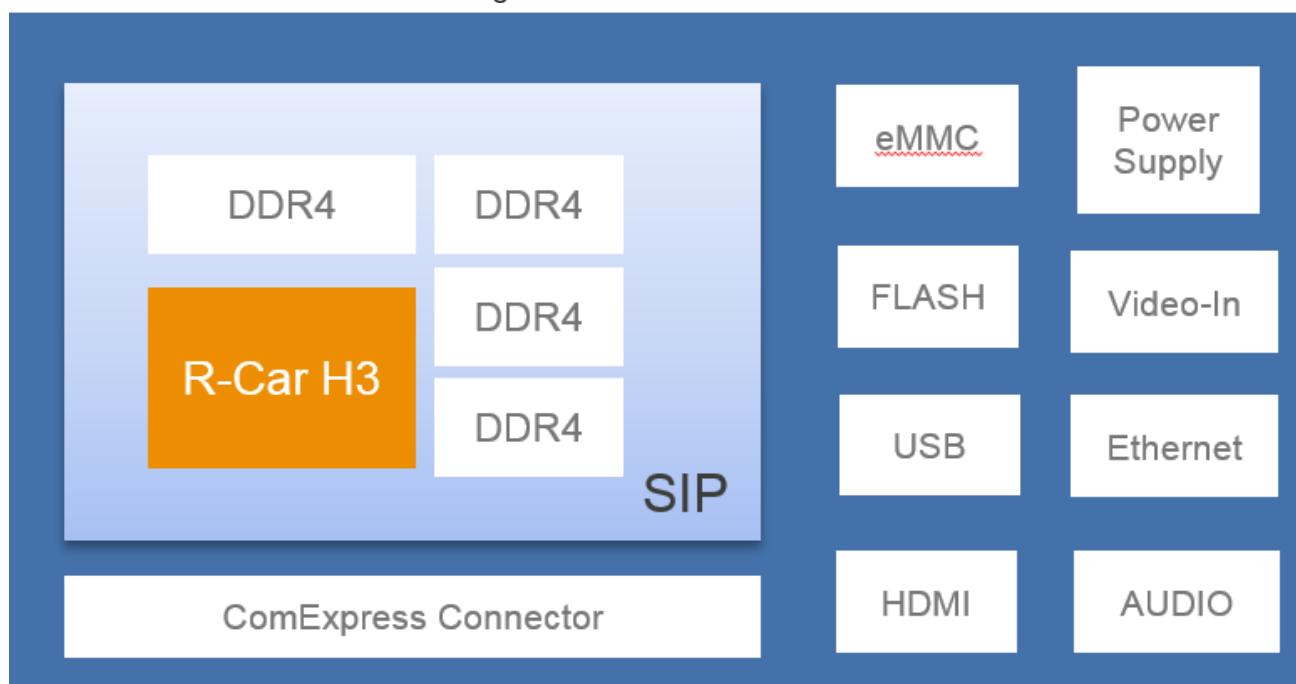


FIGURE 3FIGURE 2 3 H3 STARTER KIT BOARD BLOCK DIAGRAM

2.5 H3 Starter Kit Board Functions Supported

This table describes the functions available on the H3 Starter Kit board. Observe due to the pin-sharing some functions are shared and can't be used in parallel. It's important to check this carefully.

Function	H3 Starter Kit board
DEBUG Serial	Micro-USB available @ CN12 with Pin-Sharing on ComExpress
DEBUG Serial	Micro-USB available @ CN10 with Pin-Sharing on ComExpress
JTAG DEBUG	SICA 20pin available @CN3 with Pin-Sharing on ComExpress
QSPI FLASH	Pins available @ CN2 with Pin-Sharing on ComExpress
Ethernet 10/100	PHY and RJ45 available @CN7 with Pin-Sharing on ComExpress
SDHI-0	SD card slot available @CN6
USB2.0	USB available @ CN5
HDMI	Micro-HDMI available @CN4
AUDIO IN	3.5mm Jack @CN9
AUDIO OUT	3.5mm Jack @CN8
FAN CONNECTOR	Pins available @ CN14
CPLD JTAG	Pins available @ CN11

TABLE 2 SHARED FUNCTIONS

2.6 Major Components

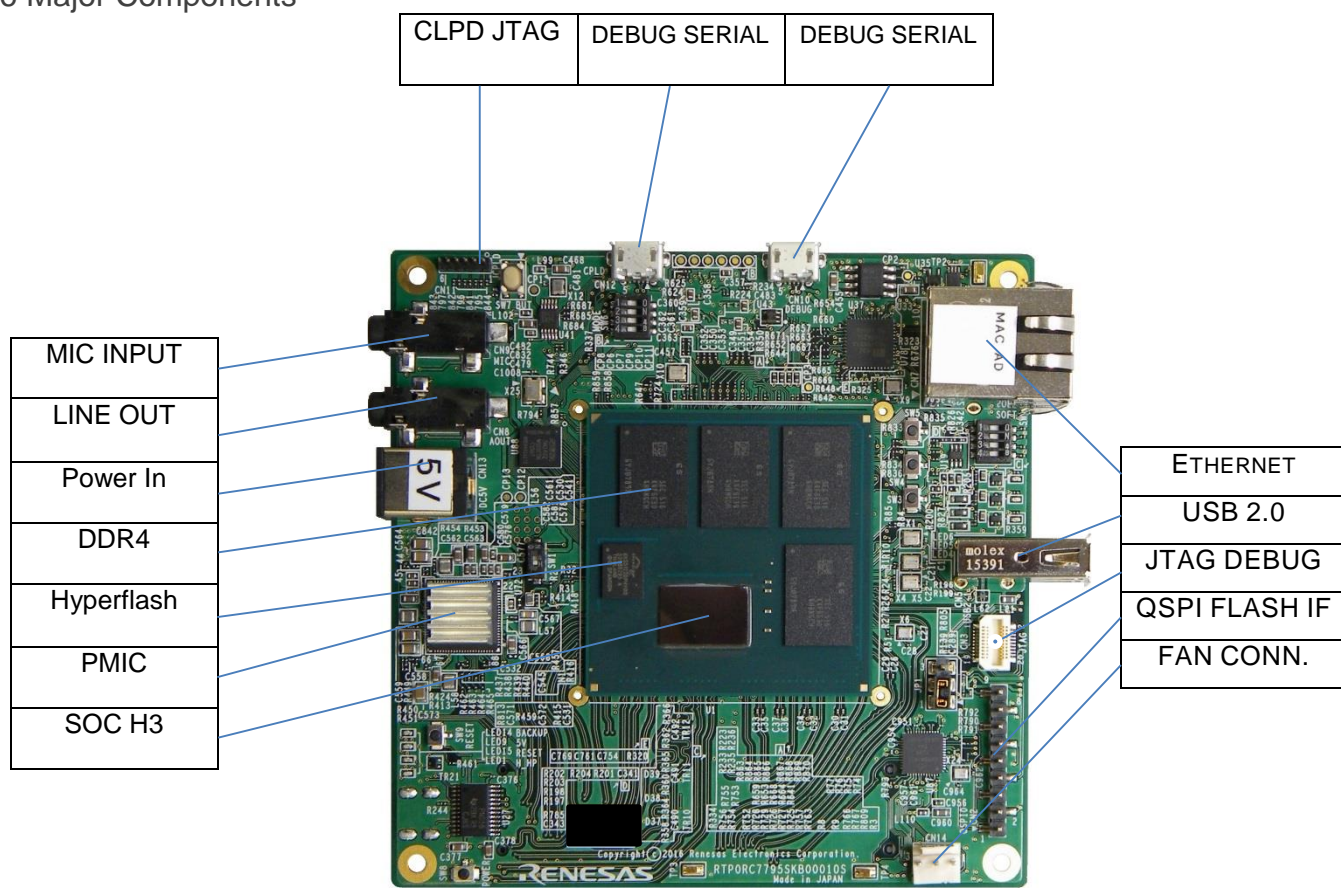


FIGURE 4 H3 STARTER KIT BOARD LAYOUT (TOP VIEW /COMPONENT SIDE)

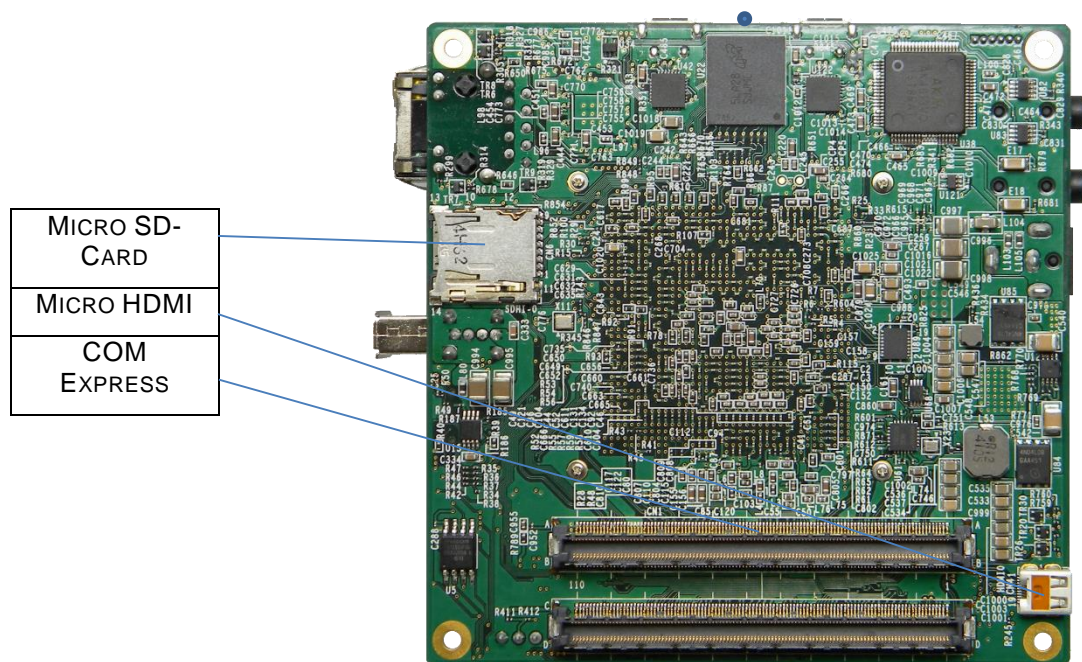


FIGURE 5 H3 STARTER KIT BOARD LAYOUT (BOTTOM VIEW /COMPONENT SIDE)

Switches and LED's description are on chapter 3.13-3.14

3. Functions & Interfaces

3.1 Power In

On Board:

5V/8A input
PMIC for all required voltages; SEEPROM-configured
Power button

On ComExpress:

Power-up/down by edge or level
Power-good status

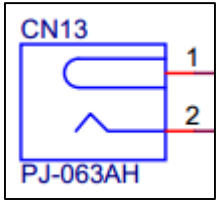


FIGURE 6 POWER CN13

CN13	
1	D5.0V
2	GND
PJ-063AH	

TABLE 3 POWER CN13

3.2 Fan Connector

On Board:

CPU 3-Pin Fan Connector



FIGURE 7 FAN CONNECTOR

CN14	
1	D5.0V
2	GND
3	x
22-04-1031	

TABLE 4 FAN CONN. CN14

3.3 Debug Serial (via USB)

On Board:

Standard micro USB connector

The SCIF2 interface of the R-Card Device is provided over the Converter FT232RQ
By default available on-board

On ComExpress:

Available after reassembling

Note: This is not a USB Port of the SOC

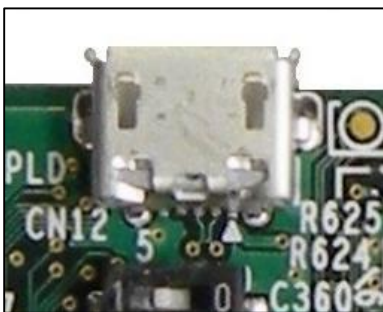


FIGURE 8 DEBUG SERIAL

3.4 Debug Serial (via USB)

On Board:

Standard micro USB connector

The SCIF1 interface of the R-Card Device is provided over the Converter CP2102
Available after reassembling

On ComExpress:

By default available ComExpress

Note: This is not a USB Port of the SOC



FIGURE 9 DEBUG SERIAL

3.5 QSPI Flash

On Board:

16MBytes QSPI (128 Mbits, 80 MHz, 80 MBytes/s)

1 header for QSPI module VIO=1.8V,VCC=3.3V

SW1 to Switch between the Modes Hyper Flash | On: Hyperflash / Off: QSPI

On ComExpress:

QSPI flash memory: 1ch QSPI

(Max. 80 MHz, 80 MBytes/s)

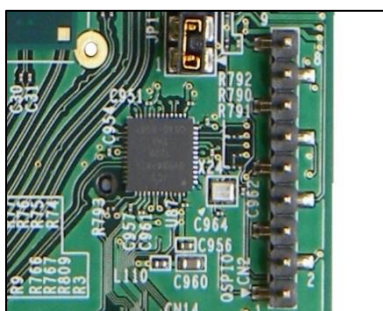


FIGURE 10 QSPI FLASH

SW 1	SW 6.3	JP1	QSPI Source	CN2	
ON	ON	*	Hyperflash	1	Reset#/NC
OFF	OFF	1-2	INT.QSPI	2	I03
OFF	OFF	2-3	EXT.QSPI	3	I02
OFF	OFF	OPEN	QSPI @ComEx.	4	CS#
				5	I00
				6	I01
				7	CK
				8	GND
				9	VCC
				PSM410336-09	
				SMT PinHeader	

TABLE 5 QSPI FLASH CN2

3.6 Micro HDMI

On Board:

HDMI0 / HDMI connector (micro type D, 19 pins)

HDMI 1.4b, up to 1080p60 / 4Kp30, 297MHz, with audio

On ComExpress:

HDMI1 / 1 additional HDMI channel 1.4b, up to 1080p60 / 4Kp30, 297MHz with audio

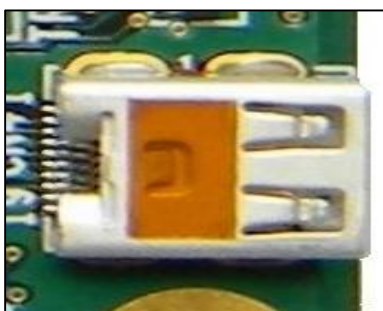


FIGURE 11 MICRO HDMI

3.7 Micro SD-Card

On Board:

SDHI0 / MicroSD-Card slot (SDR104 100 MBytes/s)

On ComExpress:

SDHI3 / 1 additional SD host interface available (SDR104 104 MBytes/s)



FIGURE 12 MICRO SD-CARD

3.8 JTAG Coresight Debug

On Board:

20-pin SICA2P20S connector (via adapter SICA20I2P)

On ComExpress:

Available



FIGURE 13 JTAG DEBUG

		CN3		
D1.8V	-----	1	2	D1.8V
TRSTn18	-----	3	4	GND
TDI_18	-----	5	6	GND
TMS_18	-----	7	8	GND
TCK_18	-----	9	10	GND
x	-----	11	12	GND
TDO_18	-----	13	14	GND
Presetn_18	-----	15	16	GND
ASEBRK_18	-----	17	18	GND
GND	-----	19	20	GND
		SICA2P20S05		

TABLE 6 JTAG DEBUG CN3

3.9 Ethernet

On Board:

PHY + RJ45 connector (100/1000)

On ComExpress:

Alternatively to on-board PHY: RGMII V1.3 interface (2.5V)

Note: For this Interface are 2 different Order codes available.

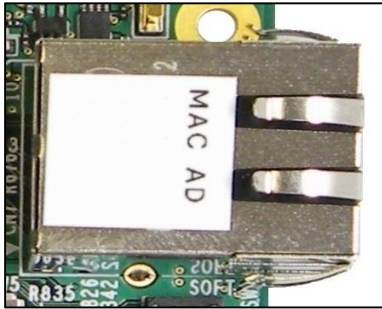


FIGURE 14 ETHERNET

3.10 USB 2.0 host

On Board:

USB 2.0 host, USB-A connector

On ComExpress:

2 additional USB 2.0 host channels (EHCI/OHCI); PHYs integrated
2 additional channels available on USB 3.0 interfaces

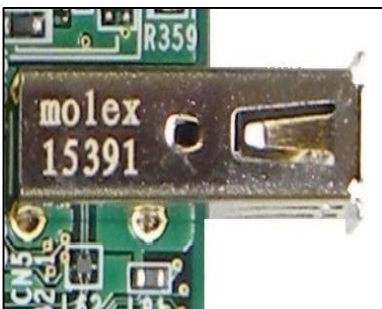


FIGURE 15 USB 2.0

3.11 Line Out / MIC Input

On Board:

Stereo microphone input (AK4613 codec)
Stereo line out (AK4613 codec)

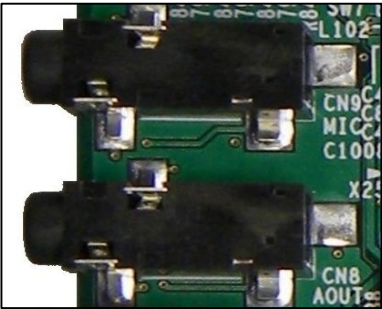


FIGURE 16 LINE OUT / MIC INPUT

3.12 CPLD JTAG

On Board:

Interface for programming the CPLD
6-Pin 1.27 Pin Header



FIGURE 17 CPLD JTAG

	CN11
BS1_TDO	1
BS1_TMS	2
BS1_TCK	3
BS1_TDI	4
D3.3V	5
GND	6

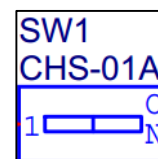
PSS-710153-06

TABLE 7 CPLD JTAG CN11

3.13 Buttons and Switches

SW 1

Hyper Flash | On: Hyperflash / Off: QSPI



SW 2

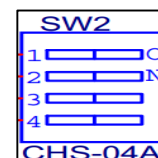
4x DIPSW Software Readable

SW2.1 at GP5_17

SW2.2 at GP5_20

SW2.3 at GP5_22

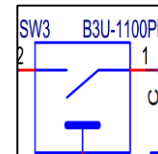
SW2.4 at GP5_23



SW 3

Software Readable Push button

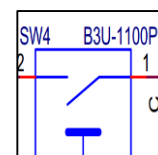
SW3 at GP6_11



SW 4

Software Readable Push button

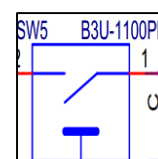
SW4 at GP6_12



SW 5

Software Readable Push button

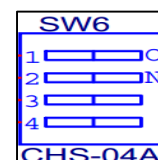
SW5 at GP6_13



SW 6

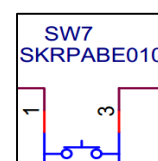
4x Mode Settings via CPLD

SW6.2/1	DDR Speed	ON / ON:DDR3200
SW6.2/1	DDR Speed	OFF / ON:DDR2133
SW6.2/1	DDR Speed	OFF / OFF:DDR1600
SW6.3	Boot flash	ON:HypFlash 80Mhz / OFF: QSPI
SW6.4	EXTAL input freq.	ON:16.66MHz(1/1) / OFF:33.33MHz(1/2)



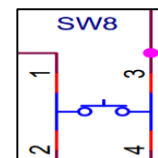
SW 7

Reset (same as SW 9)



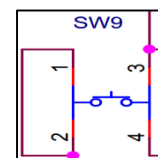
SW 8

Power



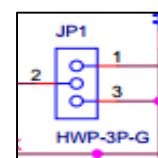
SW 9

Reset (same as SW 7)



JP1

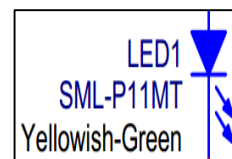
QSPI Selector



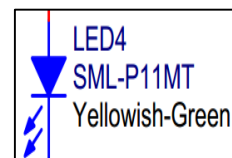
3.14 On Board LED's

LED1

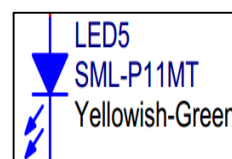
HDMI / Hot Plug Sync Detect

**LED4**

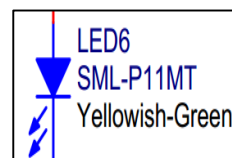
Software Controllable LED

**LED5**

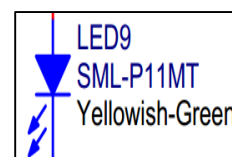
Software Controllable LED

**LED6**

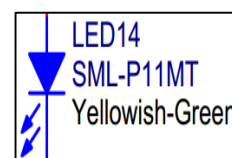
Software Controllable LED

**LED 9**

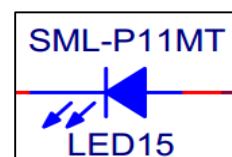
5V Main Supply

**LED14**

Backup LED

**LED15**

System Reset



3.14 Booting

The on-board QSPI flash and Hyperflash are pre-loaded with a bootloader and U-boot.

It is possible to boot a Linux from Ethernet (TFTP), from a microSD card or from a USB stick.

A console is available at the USB/UART CN12. The default parameters are 115200BD, 8N1

Note: Caution - if all flashes are deleted, the system is rendered unbootable. A recovery must be performed.

Booting is possible from external QSPI flash or via the JTAG debugger interface.

3.15 JTAG SICA Debug Interface

The JTAG debug connector for R-CAR H3 is a SICA2P0S05 20pin Port, which is to use with a SICA-Small Interface Cable Adapter.

Debug interface can be directly connected to a debugger.

D1.8V	1	2	D1.8V
TRST	3	4	GND
TDI	5	6	GND
TMS	7	8	GNDI
TCK	9	10	GND
n.u.	11	12	GND
TDO	13	14	GND
PRESET	15	16	GND
ASEBRK	17	18	GND
GND	19	20	GND

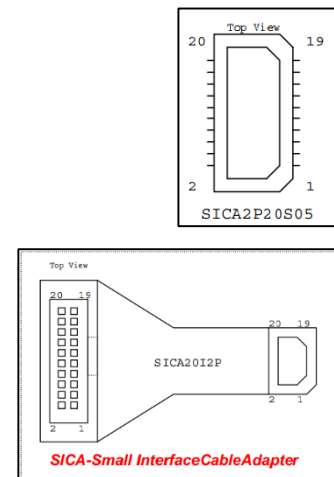


FIGURE 18 SICA ADAPTER

3.16 Board to Board Connector (COM Express 440pin)

The board to board connector on the bottom side is according the COM Express definition. The pin mapping is not identical to this standard, it's only similar. Refer to the attached table for the H3 Starter Kit pin mapping. For the mechanical dimension please refer to the attached drawing.

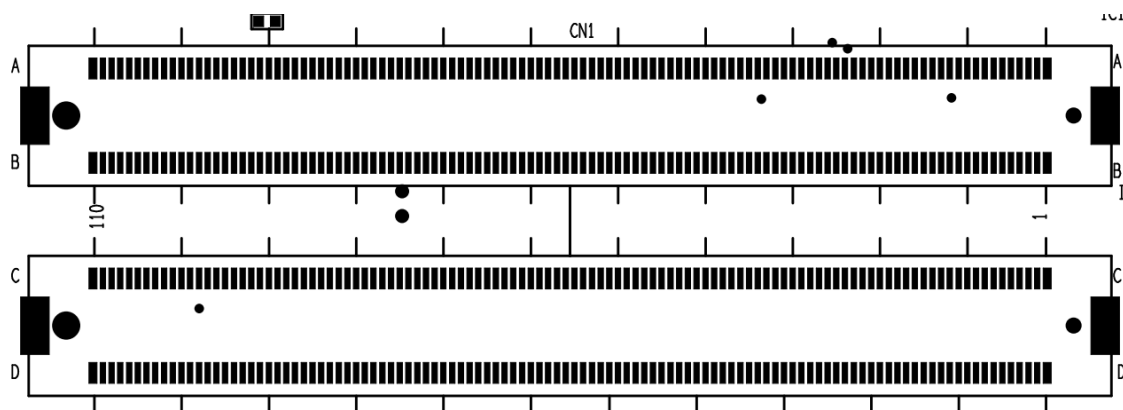


FIGURE 19 BOARD TO BOARD CONNECTOR COM EXPRESS

COM Express, a computer-on-module (COM) form factor.

H3 Start Kit type on bottom side: CN1 COM Express 440pin (TYCO ELECTRONICS 3-5353652-6)

Mating type on top side of any application boards 440pin (TYCO ELECTRONICS 3-1827231-6)

Following interfaces are available at this connector. Some signals are shared (on the board or from R-CAR H3 device), so not all can be used at the same time. Refer to the table "pin-sharing" for details.

CSI2 length matching for custom designed add-on boards

According to the MIPI Standard, the CSI2 data and clock lanes need to be length-matched, inter-lane and also inter-lane. The complete lane length from transmitter (here: add-on board) to receiver (here: H3 SoC) must be considered.

This table shows the length of the signals on the H3 Starter Kit.

If you are designing a custom add-on board, please constrain the lengths on that board, so that the sum of the lengths match the MIPI standard requirements.

Net Name	Length [mm]
----------	-------------

CSI0_CLKP	56.2201
CSI0_CLKN	56.0873
CSI0_DATAP0	46.7633
CSI0_DATAN0	46.7876
CSI0_DATAP1	54.6317
CSI0_DATAN1	54.6398
CSI0_DATAP2	69.6125
CSI0_DATAN2	69.6932
CSI0_DATAP3	75.4055
CSI0_DATAN3	75.4257

CSI1_CLKP	22.9172
CSI1_CLKN	22.9604
CSI1_DATAP0	18.5268
CSI1_DATAN0	18.5179
CSI1_DATAP1	24.9266
CSI1_DATAN1	24.9015

CSI2_CLKP	31.464
CSI2_CLKN	31.4391
CSI2_DATAP0	48.2885
CSI2_DATAN0	48.2843
CSI2_DATAP1	38.782
CSI2_DATAN1	38.7304
CSI2_DATAP2	41.1817
CSI2_DATAN2	41.1121
CSI2_DATAP3	39.5967
CSI2_DATAN3	39.5811

CSI3_CLKP	26.2212
CSI3_CLKN	26.2613
CSI3_DATAP0	27.8771
CSI3_DATAN0	27.8609

3.17 Power supply and control from add-on boards

By default, the board is supplied with 5V by the on-board connector (CN13).

By default, the board can be turned on and off by pressing the power button (SW8).

When designing a custom add-on board, it is possible to supply the board through the CoM Express connector.

It is also possible to turn the board on or off from the add-on board.

The signal PWRONZ (pin A15) is in parallel to SW8. Pulsing it low will toggle the power-state of the H3 Starter Kit (the same behavior as pushing SW8).

Alternatively, if the signal RSTMODE (pin A18) is clamped low, the signal on pin A15 will become level-sensitive. In that case holding A15 high will enable power, holding it low will turn it off.

4. Order Codes

H3 Starter Kit board Order Codes:

P/N: Y-ASK-RCAR-H3-WS1 (Ethernet on ComExpress)

P/N: Y-ASK-RCAR-H3-ETH-WS1 (Ethernet on Board)

5. Appendix

4.1 “H3 Starter Kit “board dimensions drawing

4.2 “H3 Starter Kit “board schematics

4.3 “H3 Starter Kit “board silk screen drawing

4.4 “H3 Starter Kit “board assembly drawing

4.5 “H3 Starter Kit “board COM Express H3 Starter Kit

Refer to the attachments of this Hardware Manual file.

Revision History	H3 Starter Kit Hardware Manual
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		Page	Summary
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H3 Starter Kit



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