User's Manual

Renesas Synergy™

Development Kit DK-S3A7 v2.0

User's Manual

Synergy S3A7 MCU

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Precautions

This Renesas Synergy™ Development Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:

- Ensure attached cables do not lie across the equipment.
- Reorient the receiving antenna.
- Increase the distance between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that which the receiver is connected.
- Power down the equipment when not in use.
- Consult the dealer or an experienced radio/TV technician for help.

NOTE: It is recommended that wherever possible shielded interface cables are used.

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:

- The user is advised that mobile phones should not be used within 10m of the product when in use.
- The user is advised to take ESD precautions when handling the equipment.

The Renesas Synergy™ Development Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

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Chapter 1 Overview

1.1 Purpose

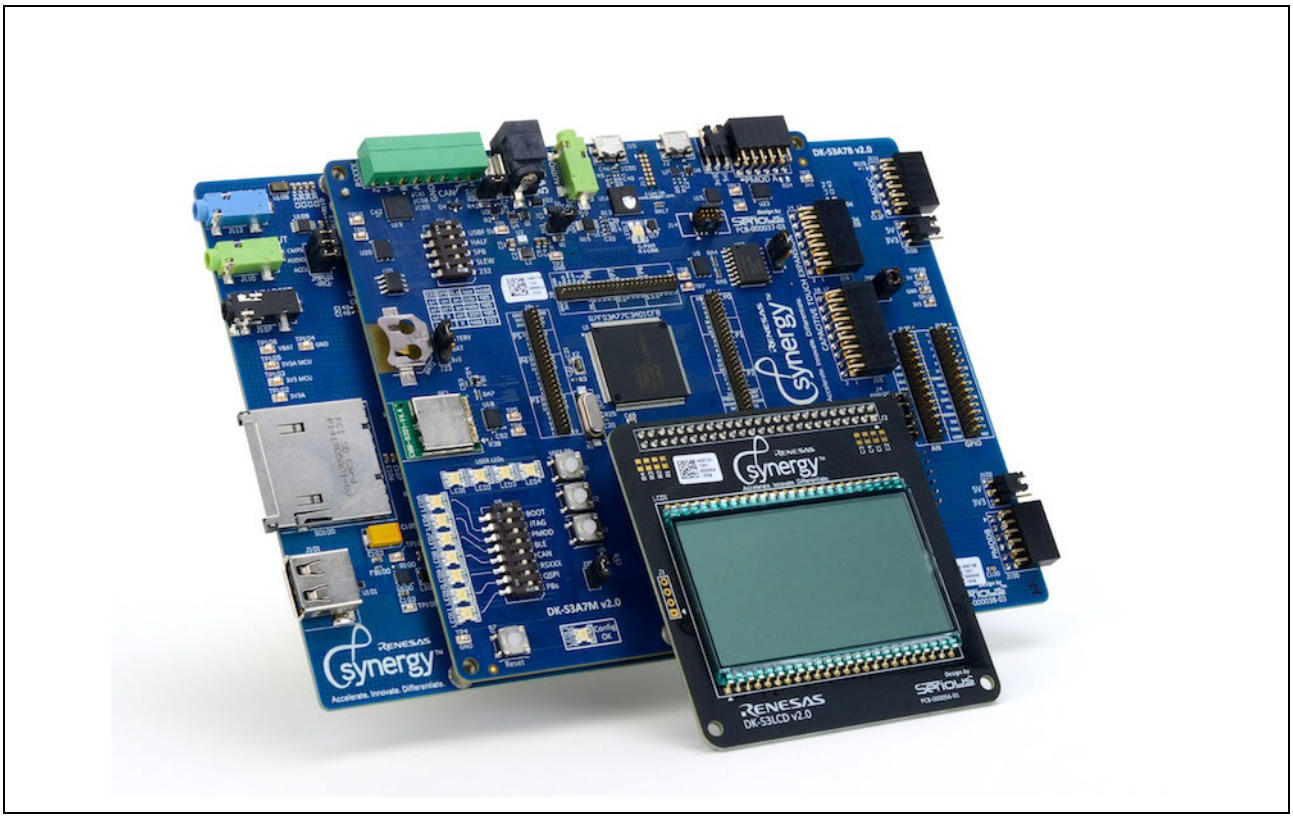
The DK-S3A7 is a development kit for the Renesas Synergy™ S3A7 microcontroller in a LQFP144 package. It contains two boards: the Main Board and the Breakout Board. The boards together provide easy-to-access interfaces and connectors for all peripherals of the S3A7 microcontroller for application development. The Main Board can be used without the Breakout Board as a compact, stand-alone development board.

The Main Board of the DK-S3A7 includes connectors for an LCD panel and capacitive-touch expansion and three connectors for direct access to the S3A7 microcontroller I/O pins. A row of DIP configuration switches allows easy selection of different board configurations and ensures that the signal lines are always properly connected.

The DK-S3A7 Main Board connects to a Breakout Board that contains additional peripherals, including USB Host, serial memory, and sensors.

The DK-S3A7 is supported by the e^2 studio Integrated Solution Development Environment (ISDE) from Renesas.

Figure 1: DK-S3A7



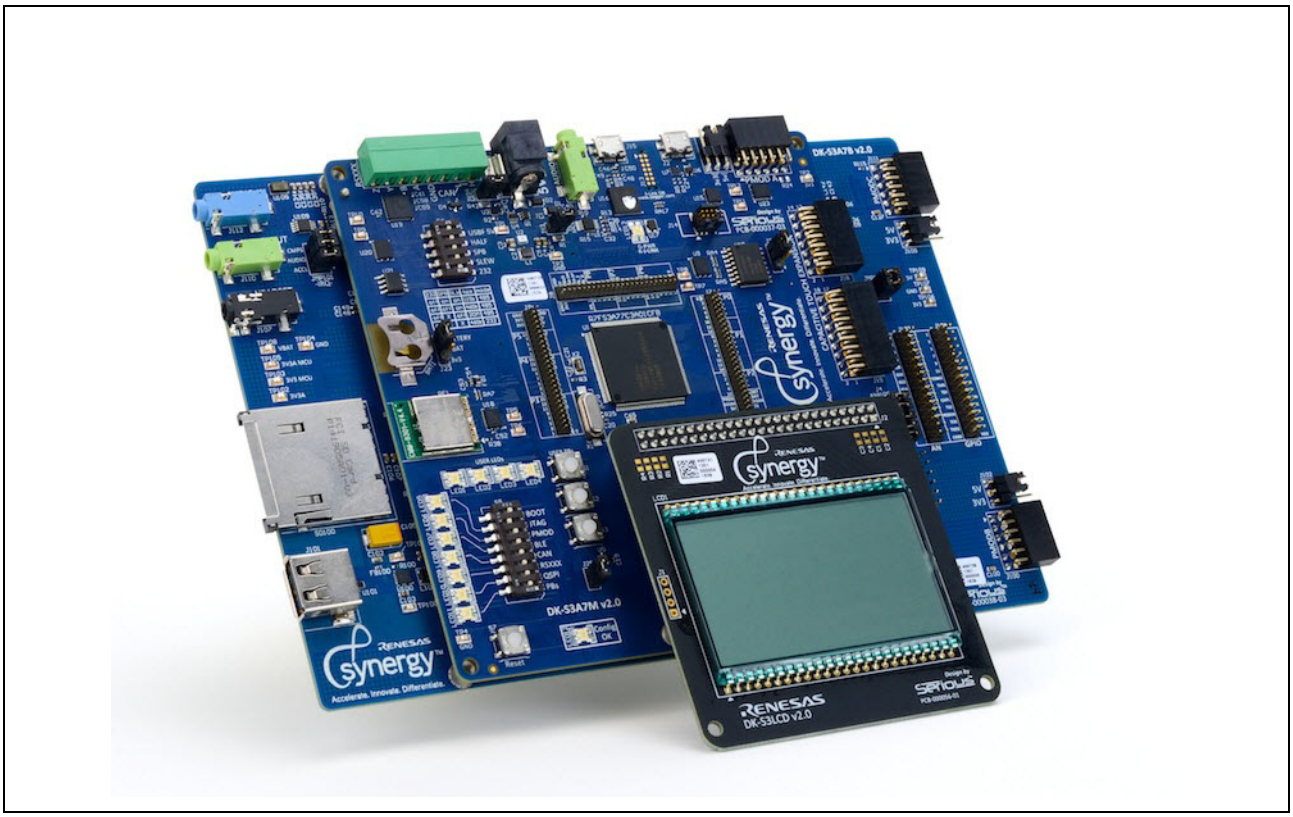
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1.2 In the box

The following components are included in the DK-S3A7:

- DK-S3A7 Main Board
- DK-S3A7 Breakout Board
- DK-S3A7 LCD panel
- One USB Type A to USB Micro-B cable
- 5-V/2.4-A, wall-mounted power supply
- Quick Start Guide

Figure 2: DK-S3A7

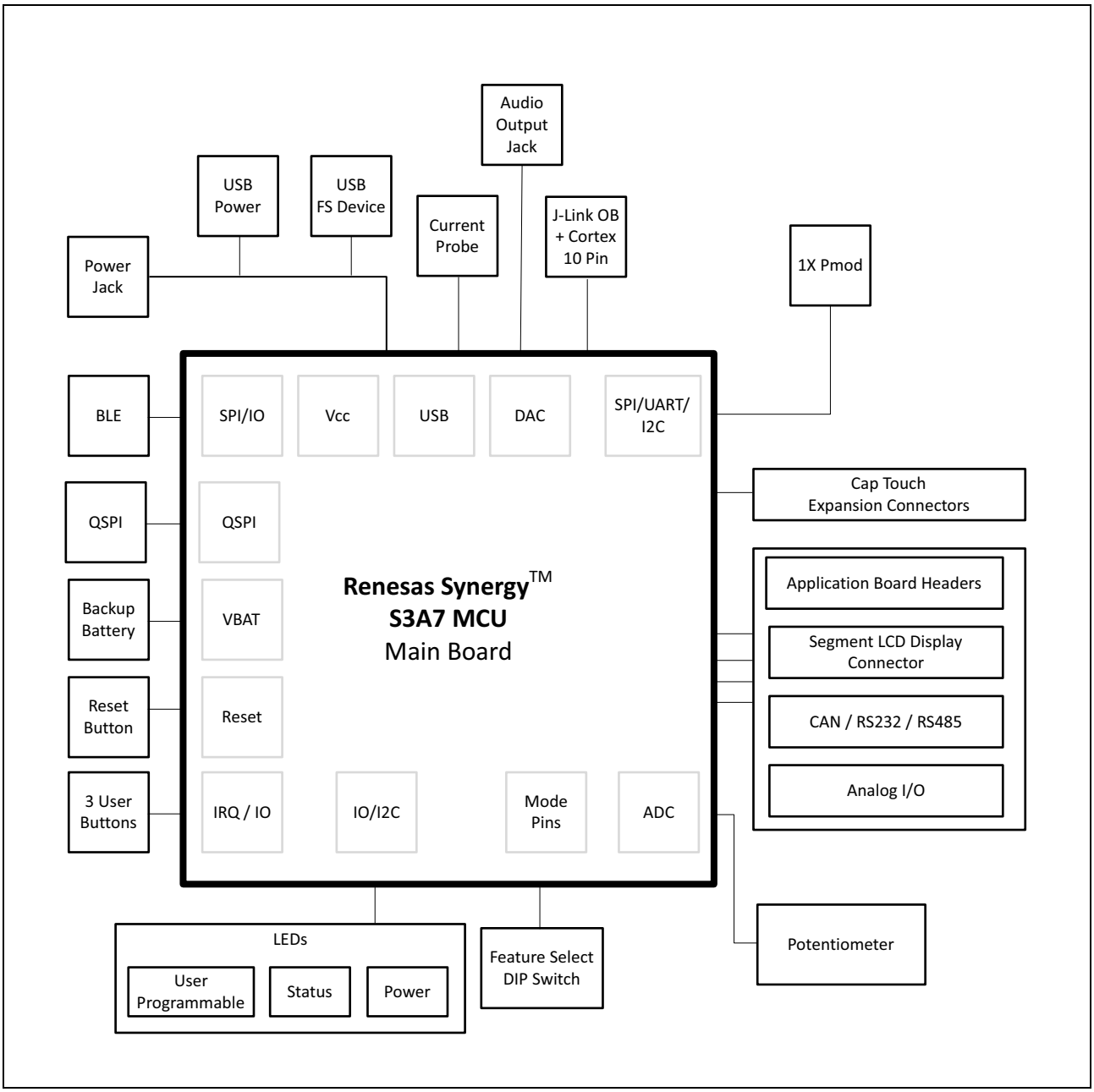


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1.3 Block diagram

1.3.1 Main Board

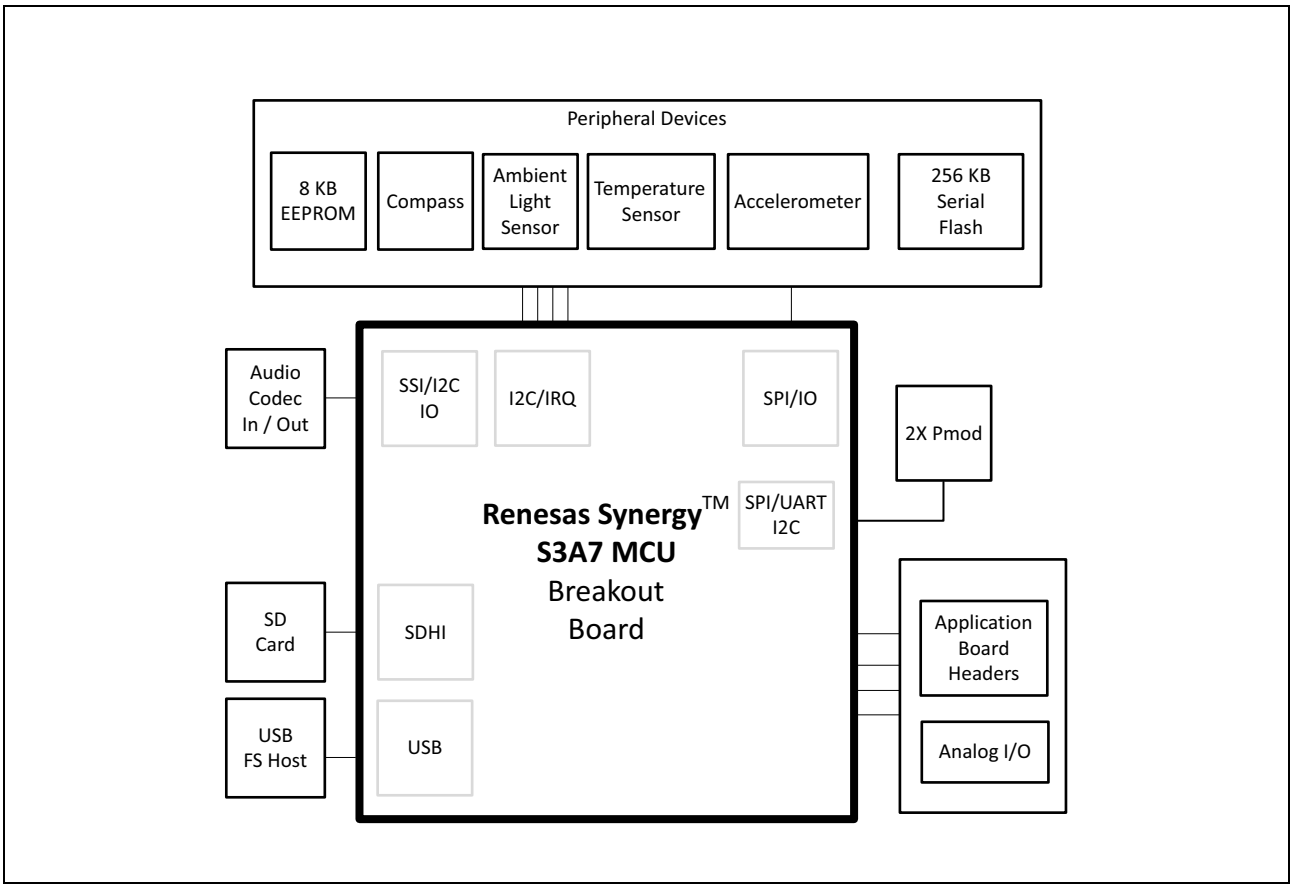
Figure 3: Block diagram: Main Board



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1.3.2 Breakout Board

Figure 4: Block diagram: Breakout Board



1.4 Hardware features

The DK-S3A7 uses the Renesas Synergy S3A7 48-MHz ARM® Cortex®-M4 microcontroller with 1 MB of code flash and 192 KB of SRAM.

For a list of S3A7 peripherals and hardware details, see the S3 Series User's Manual: Microcontrollers.

1.4.1 Main Board

- One Full-Speed Micro-B USB Device connector
- Micro-B USB connector and SEGGER J-Link On-Board (J-Link OB) for debug access
- One 12-pin Type A Pmod™ Compatible connector for SPI, IIC, and UART

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- One CAN interface with CAN transceiver (1 Mbit/s)
- RS-232/485 interface with on-board transceiver
- Capacitive-touch expansion connectors compatible with the Renesas RX113 Capacitive-Touch Kit for touch buttons and sliders
- One LCD panel connector
- Configuration through DIP switches to select boot source and enable/disable board devices including Bluetooth Low Energy, QSPI flash, push buttons, J-Link OB, and Pmod Compatible connector
- Push buttons: Three user-configurable and one reset
- 10-kΩ potentiometer to ADC
- Eight user-programmable LEDs, one power indicator LED, and one J-Link operation LED
- Backup battery for the Realtime Clock (RTC)
- Bluetooth™ Low Energy (BLE) module
- Current sense resistors and power measurement test points for microcontroller current measurement
- Three connectors to provide direct access to the I/O pins of the S3A7 microcontroller

1.4.2 Breakout Board

- On-board peripherals: EEPROM, compass, accelerometer, ambient light and proximity sensor, temperature sensor, and a serial flash device
- One Full-Speed USB Host connector
- Two 12-pin Type 2A Pmod Compatible connectors
- Two additional extension connectors which include General Purpose I/O (GPIO), serial I/O, and analog I/O
- Full-size SD card socket
- Audio input and output through a codec device

1.4.3 LCD Panel

- 176-segment T6022A-1PRP0 LCD panel

1.4.4 On-board external memory

- 8-KB serial EEPROM
- 256-KB serial flash with advanced write protection

1.4.5 Power

The DK-S3A7 can be powered through a USB device connection or a 5-V, 2.1-mm center-positive barrel connector. An on-board, removable CR2020 battery provides backup power to the microcontroller's RTC.

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1.5 Resources

The following related documents are related to S3A7 and DK-S3A7 hardware:

- DK-S3A7 Quick Start Guide
- DK-S3A7 Schematics
- DK-S3A7 Data Short
- S3A7 User's Manual: Hardware
- S3A7 Data sheet

For programming the DK-S3A7, refer to the SSP User's Manual: Hardware.

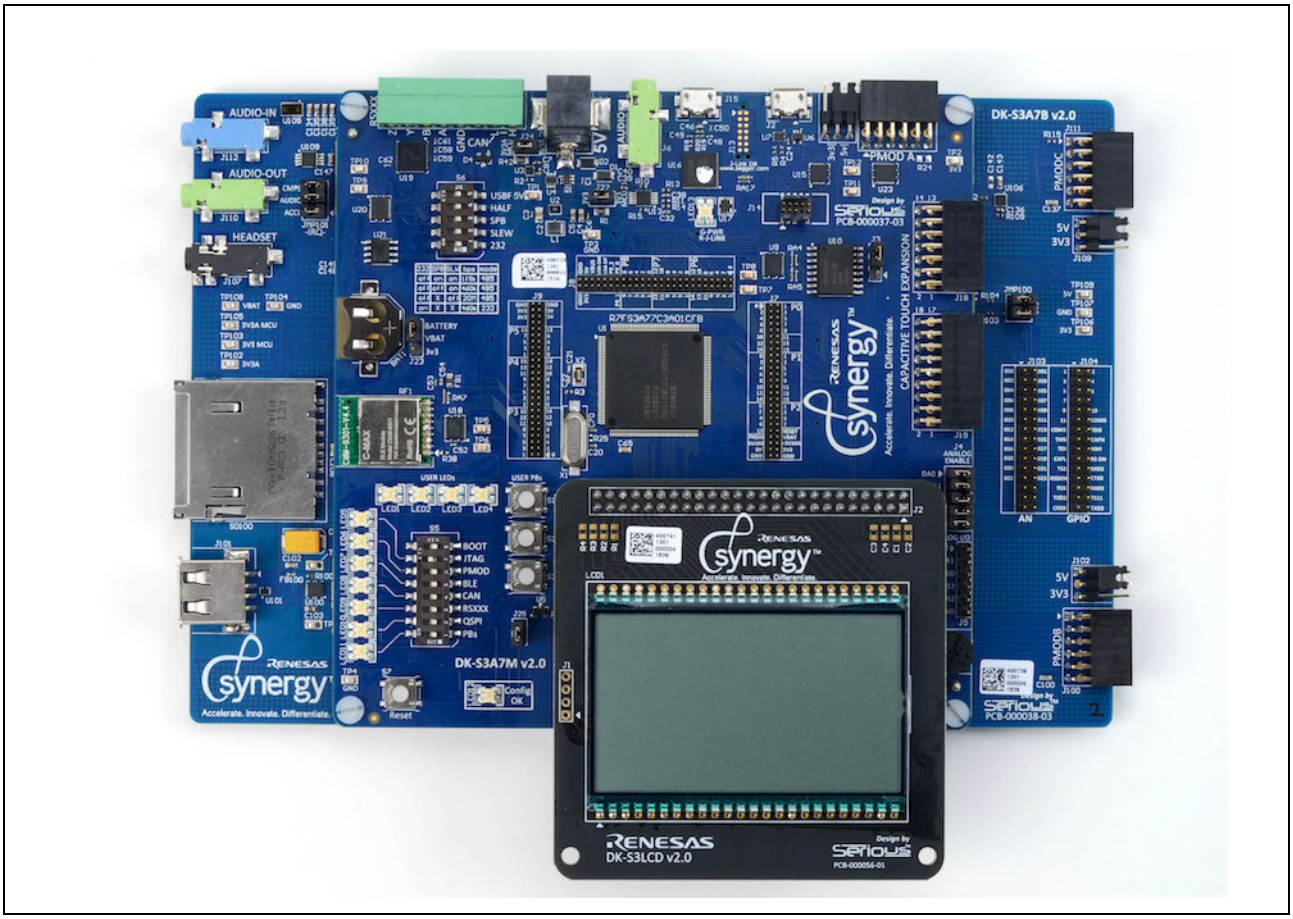
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Chapter 2 Getting Started

The DK-S3A7 includes the Main Board mounted on the Breakout Board together with the LCD panel.

To start working with the DK-S3A7, see the Quick Start Guide included in the DK-S3A7 Kit.

Figure 5: DK-S3A7



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Chapter 3 Power Supplies

3.1 Power supply

Power is supplied to the DK-S3A7 through a barrel connector on the Main Board using a 5-V/2.5-A, wall-mounted power supply. When +5 V is applied to J1, a green LED (LED3) illuminates on the main board.

The DK-S3A7 Main Board includes a backup battery for powering the Realtime Clock (RTC) when no external power is supplied.

NOTE: Do not use the J-Link on-board connector (J14) to supply power to the DK-S3A7 Main Board.

3.2 Power-up behavior

The DK-S3A7 is provided without preloaded applications or demonstration programs. LED3 on the Main Board lights green when power is connected.

3.3 Battery supply

In the out-of-the-box board configuration, coin cell battery BAT1 supplies voltage to the VBAT pin for backup power. The VBAT voltage powers the Realtime Clock power domain of the S3A7 microcontroller, which remains powered even when the main power is removed.

The source of the VBAT power supply is controlled through connector J23. By default, no jumper is set on J23. In this configuration, the battery (BAT1) is the VBAT supply. If you want to remove BAT1, connect VBAT to the main power supply by setting a jumper across pins 1 and 2 of J23.

Connector J23 can also be used to measure the battery current as described in Battery current.

IMPORTANT: For normal operation of the S3A7 microcontroller, VBAT must be powered at all times.

3.4 Microcontroller current

You can monitor the power supply current for the following two power supply inputs of the S3A7 microcontroller by measuring the voltage drop across the precision 50-mΩ 1% resistors R1 and R42:

- To monitor MCU current, use connector J22 on the Main Board to measure the voltage drop across resistor R1.
- To monitor analog current, use connector J24 on the Main Board to measure the voltage drop across resistor R42.

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3.5 Battery current

You can monitor the VBAT current by measuring the voltage drop across the 1-kΩ resistor R41 using pins 2 and 3 of connector J23. In this setting, the voltage drop indicates the current consumption of the S3A7 microcontroller when the microcontroller is powered by the on-board coin cell battery.

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Chapter 4 Components

4.1 LCD Panel (LCD1)

The DK-S3A7 a Renesas 176-segment T6022A-1PRP0 LCD panel featuring:

- Large 3-digit numerical display with decimal point
- 5-digit numerical display with decimal point and clock colon
- 6-digit alphanumeric display
- 4-bar battery gauge and 6-bar graph
- Day of the week indicators
- 17 assorted symbols

The LCD display is connected to the Segment LCD Controller SLCDC on the S3A7 microcontroller.

4.2 RS-232/485 transceiver (U19)

The Main Board includes an Intersil ISL41387 dual-protocol RS-232/485 transceiver with loop-back mode and shutdown functions. The shutdown mode disables the receive and transmit outputs of the transceiver, disables the charge pump in RS-232 mode, and places the transceiver in low-current (35 µA) mode.

In RS-232 mode, the on-board charge pump generates RS-232 compliant +/- 5 V Tx output levels. The transceiver supports Rx input levels of +/- 25 V and Tx output levels of +/- 12 V with data rates of up to 460 kbps.

In RS-485 mode, the charge pump is disabled to save power and minimize noise. The RS-485 receiver supports full fail-safe operation that keeps the Rx output in a high states if the inputs are opened or shorted together. The RS-485 transmitter supports three data rates up to 20 Mbps, 460 kbps, and 115 kbps. Data rates of 460 kbps and 115 kbps in RS-485 mode are slew-rate limited for problem-free communication.

For configuring the transceiver, see RS-232/485 transceiver configuration. The transceiver is connected to the Serial Communication Interface SCI channel 2 on the S3A7 microcontroller.

4.3 Audio codec

The Breakout Board includes a Maxim MAX98089 Audio Stereo Codec Amplifier with line in, line out, headphone and microphone connectors. The audio codec is connected to channel 0 of the Serial Sound Interface on the S3A7 microcontroller. IIC channel 2 is used to control the codec.

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4.4 Peripheral devices

- EEPROM (U108)
  - Device: OnSemi CAT24C64
  - 8-KB CMOS serial EEPROM device, internally organized as 8192 words of 8 bits each. The EEPROM device features a 32−byte page write buffer and supports the Standard (100 kHz), Fast (400 kHz) and Fast−Plus (1 MHz) IIC protocol.
  - Communication: IIC using IIC channel 2 on the S3A7 microcontroller
- Compass (U107)
  - Device: Honeywell HMC5883L
  - Magneto-resistive sensors with ASIC containing amplification, automatic degaussing strap drivers, offset cancellation, and a 12-bit ADC that enables 1° to 2° compass heading accuracy.
  - Communication: IIC using IIC channel 2 on the S3A7 microcontroller
- Ambient light and proximity sensor (U105)
  - Device: Osram SFH 7776
  - The device combines a digital ambient light sensor and a proximity sensor (emitter + detector). The sensor provides an IIC bus interface and an interrupt pin.
  - Communication: IIC using IIC channel 2 on the S3A7 microcontroller
- Temperature sensor (U109)
  - Device: OnSemi NCT75
  - The device is a two-wire (IIC) serially programmable temperature sensor with an over-temperature/interrupt output pin to signal out of limit conditions.
  - The output pin is an open-drain pin and can operate in either comparator or interrupt mode.
  - Temperature measurements are converted into digital form using a high resolution (12 bit), sigma-delta, analog-to-digital converter (ADC).
  - The device operates over the –55°C to +125°C temperature range.
  - Communication: IIC using IIC channel 2 on the S3A7 microcontroller
- Accelerometer sensor (U106)
  - Device: Kionix KX022
  - The device is a robust, low-power, IIC/SPI, 3-axis accelerometer with integrated FIFO/FILO buffer that features a wide range of embedded functionality, including tap detection, orientation, activity, and wake-up algorithms.
  - Communication: SPI using SPI channel 0 on the S3A7 microcontroller
- Serial flash (U102)
  - Device: Micron M25P20

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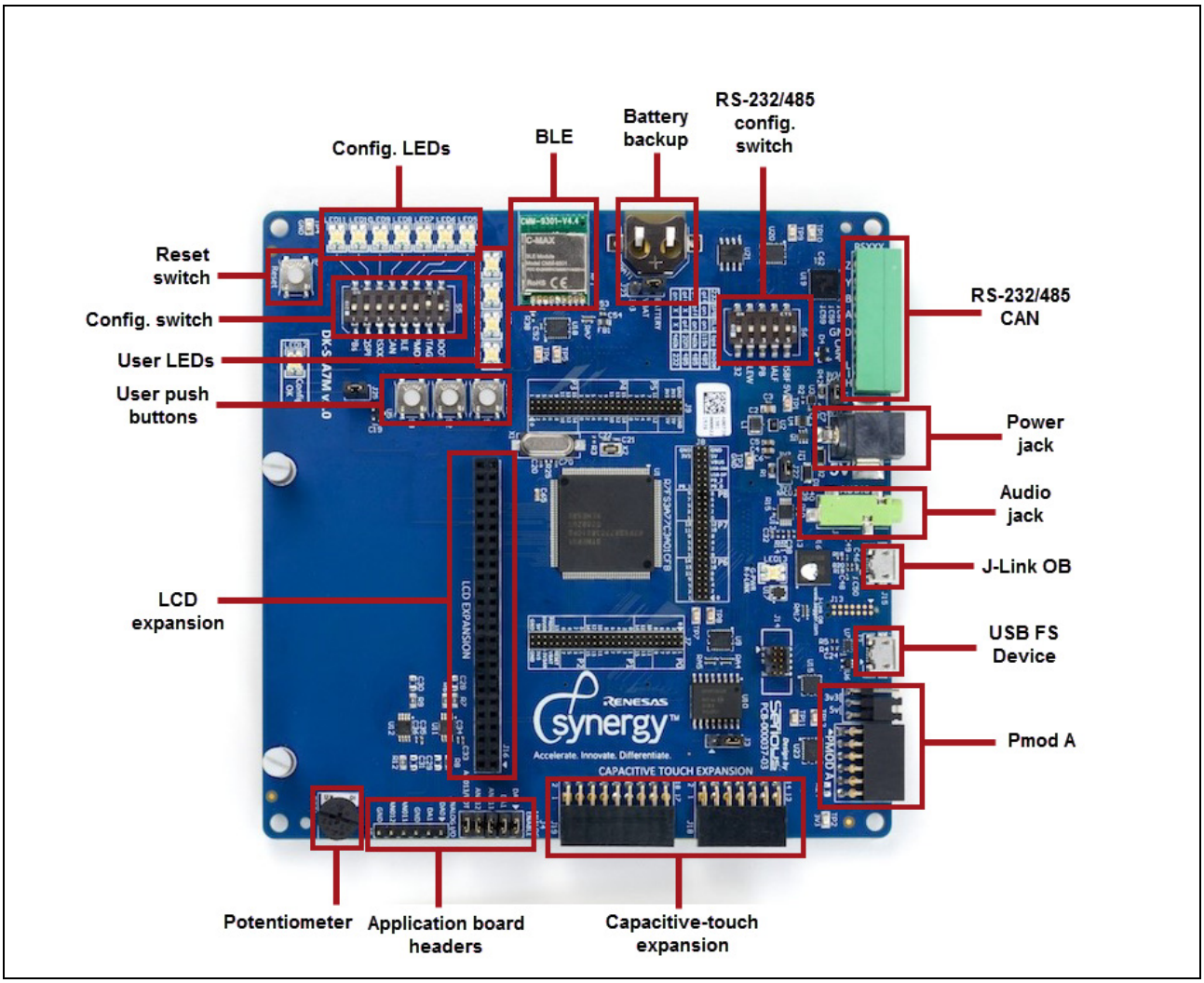
  - The M25P20 is a 2-Mb (256 K x 8) serial flash memory device with advanced write protection mechanisms accessed by a high speed SPI-compatible bus.
  - The device supports high-performance commands for clock frequencies of up to 75 MHz.
  - Communication: SPI using SPI channel 0 on the S3A7 microcontroller
- Bluetooth Low Energy (BLE) module (RF1)
  - Device: C_Max CMM-9301-V4.4
  - The module is based on EM Microelectronic's low-power, fully-integrated, single-chip Bluetooth Low Energy (BLE) Controller EM9301 and includes a folded dipole antenna.
  - Communication: SCI channel 1 (SPI mode) on the S3A7 microcontroller

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Chapter 5 Board Layout

5.1 Main Board components:

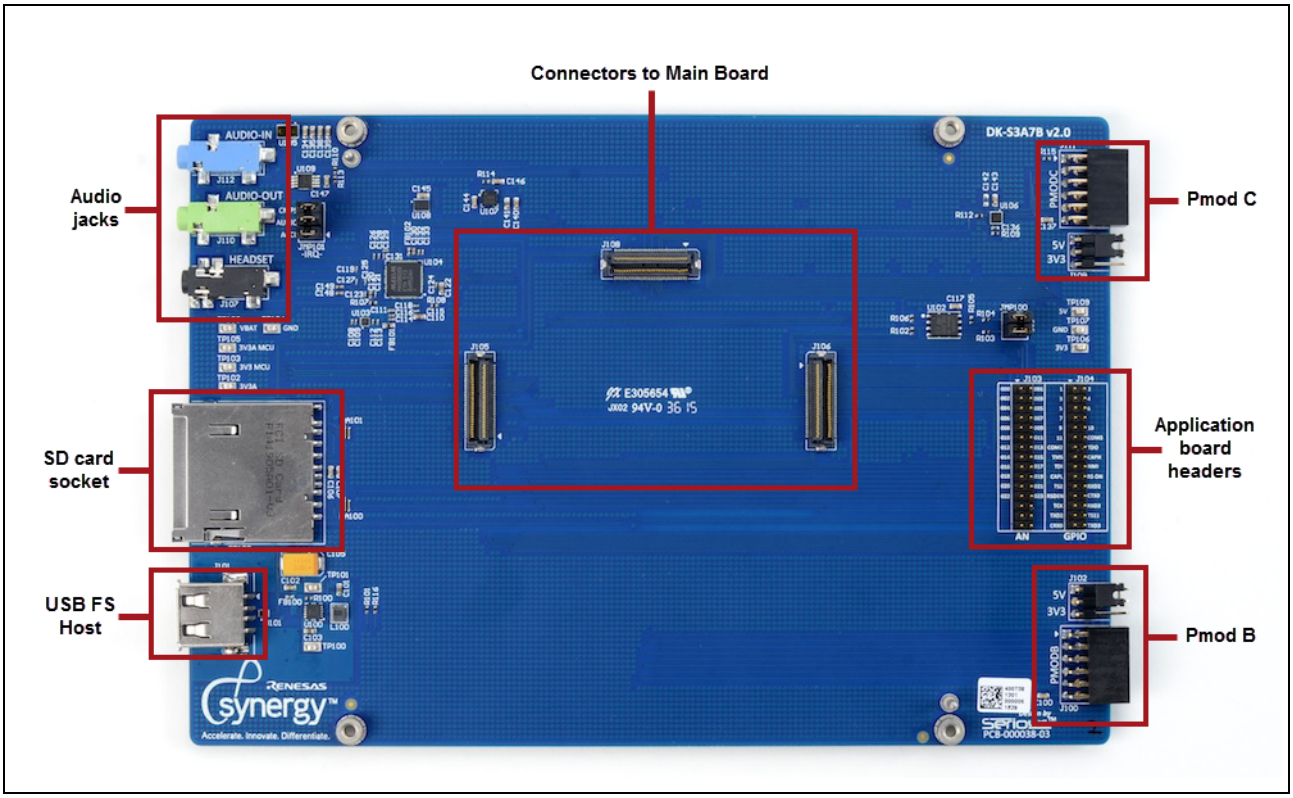
Figure 6: Components: Main Board



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5.2 Breakout Board components

Figure 7: Components: Breakout Board



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Chapter 6 Configuration

The DK-S3A7 has the following configuration options:

- DIP switch S5 for board function select
- J4 analog enable for analog application header
- Switch S6 for configuring the RS-232/485 transceiver for the serial connector J7
- USB connector selection
- Boot configuration

6.1 Function select DIP switches

Most pins on the Synergy S3A7 microcontroller support multiple functions and can therefore be connected to more than one device or connector on the DK-S3A7. To make it easy and safe to connect some of the important functions of the DK-S3A7, the kit provides a set of DIP switches mounted on the Main Board.

Each DIP switch controls a high-speed buffer which, when the switch is in the ON position, connects the signal lines between the microcontroller and the on-board device or connector. When the switch is in the OFF position, the microcontroller pins are isolated from the connector or device controlled by the switch and can be used for another board function. All microcontroller pins are accessible on the breakout pin connectors J7 to J9, regardless of the switch setting.

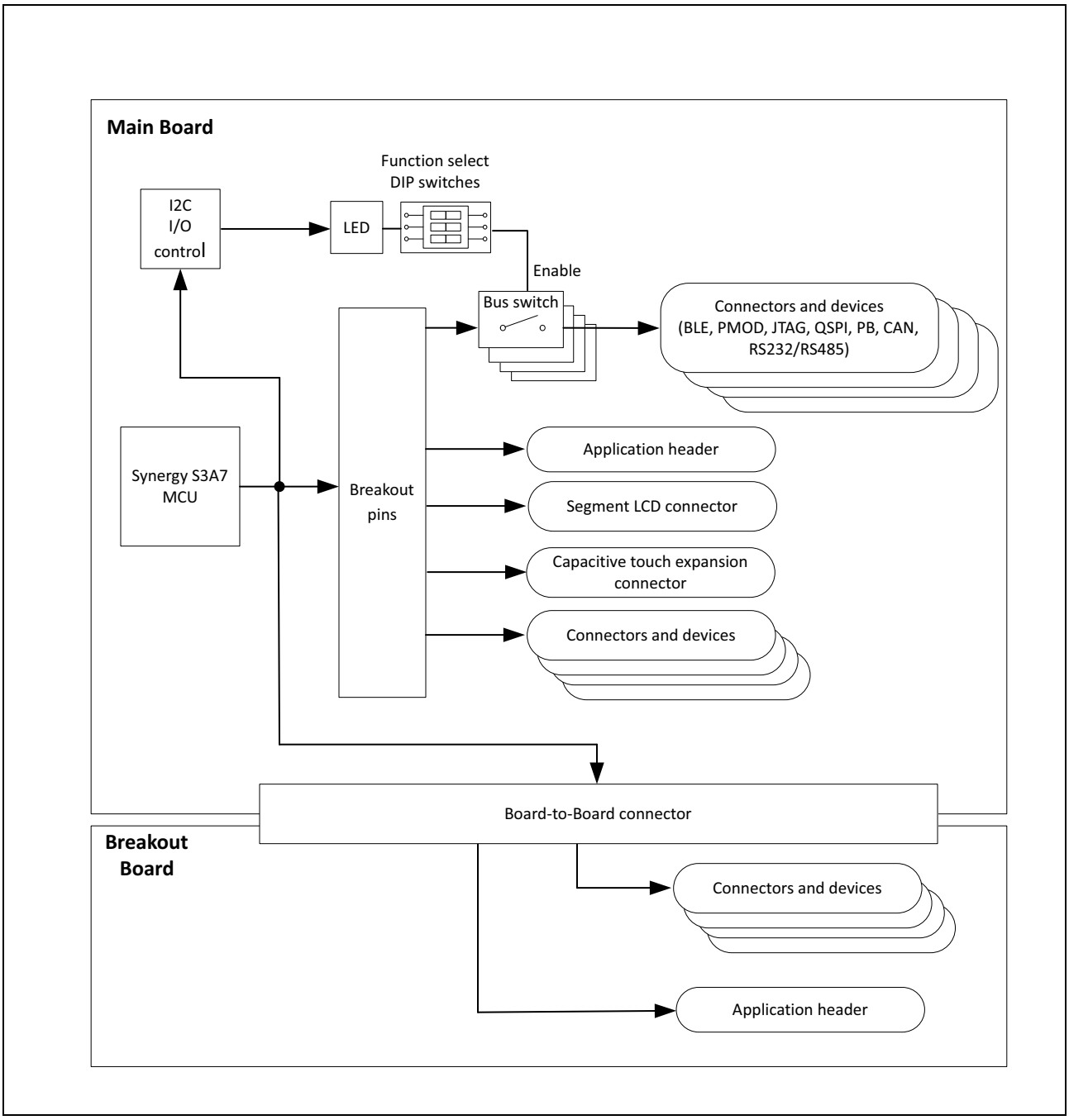
When a DIP switch is in the OFF position, software can dynamically enable the desired peripherals at system initialization through an I/O expander. The I/O expander is controlled through software through an IIC port connected to SCI channel 2 on the S3A7 microcontroller and performs the following functions:

- Sense the position of the DIP switch.
- Generate the enable signal for the buffer.
- Control an LED.

Through the I/O expander's IIC port, software can read the position of the DIP switch and, if the DIP switch is open, enable the buffers to connect the device to the microcontroller pins. The LEDs next to the DIP switch on the Main Board indicate when the respective device is connected under software control.

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Figure 8: Function configuration



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Table 1: Configuration Switch S5

DIP Switch	Connector/ device	Reference
1	PBs	Push buttons
2	QSPI	QSPI flash
3	RSXXX	RS-232/485
4	CAN	CAN
5	BLE	BLE/Pmod B
6	PMOD	Pmod A
7	JTAG	JTAG
8	BOOT	Boot configuration

6.2 Analog enable jumper

Analog signals on the Main Board analog I/O connector (J5) can be disabled individually through the configuration of jumper J4. See Analog I/O.

6.3 RS-232/485 transceiver configuration

The Main Board includes a dual-protocol (RS-232/485) transceiver that can be configured for either RS-232 or RS-485 and various data rates using switches 1 to 3 of DIP switch S6.

Supported data rates are up to 460 kbps in RS-232 mode. Three different data rates can be selected in RS-485 mode: up to 20 Mbps, 460 kbps, and 115 kbps. Data rates of 460 kbps and 115 kbps in RS-485 mode are slew-rate limited for robust communication.

In addition to the transceiver mode, DIP switch 4 (HALF) on S6 can be used to disable the receiver output and use the UART in half-duplex mode by controlling the direction through a GPIO pin.

Table 2: RS-232/485 (S6) configuration

232	SLEW	SPB	Data rate	Mode
OFF	ON	ON	115 kbps	485

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Table 2: RS-232/485 (S6) configuration (Continued)

232	SLEW	SPB	Data rate	Mode
OFF	ON	OFF	460 kbps	485
OFF	OFF	X	20 Mbps	485
ON	X	X	460 kbps	232

6.4 USB configuration

DIP switch 5 (USBF) on S6 disables the USB Device connector (J2) on the Main Board.

6.5 Boot configuration

By default, the S3A7 microcontroller boots from internal flash. To enable an external boot source, set the BOOT switch 8 on S5 to ON. You can find details on the boot configuration and boot process in the S3A7 User's Manual: Hardware.

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Chapter 7 Connectivity

7.1 Pmod A

To enable 12-pin Pmod Compatible connector Pmod A on the DK-S3A7 Main Board, use either of the following methods:

- Set DIP switch 6 (PMOD) on S5 to ON.
- If DIP switch 6 on S5 is in the OFF position, Pmod A can be enabled under software control through the IIC-controlled I/O Expander U14.

The Pmod A connector provides access to channel 3 of the Serial Communications Interface (SCI) peripheral on the S3A7 microcontroller, which can be configured through software as SPI, UART, or IIC-bus interface (IIC Fast mode and Standard mode only).

NOTE: The SCI3 signals can also be observed on the breakout pin connector J9 on the Main Board. The SCI3 receive and transmit signals can be observed on application header J104 on the Breakout Board.

Table 3: Pmod A connector (J20)

PMODA connector (Main Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
1	SCI CTS	P411 (P4_11)	CTS3
2	SCI transmit	P409 (P4_9)	TXD3
3	SCI receive	P408 (P4_8)	RXD3
4	SCI serial clock	P410 (P4_10)	SCK3
5, 11	GND	-	-
6, 12	+3V3 or +5V depending on setting of J21	-	-
7	PMODA_7	P700 (P7_0)	GPIO
8	PMODA_8	P705 (P7_5)	GPIO
9	PMODA_9	P712 (P7_12)	GPIO

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Table 3: Pmod A connector (J20) (Continued)

PMODA connector (Main Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
10	PMODA_10	P713 (P7_13)	GPIO

RELATED LINKS:

Configuration

7.2 Pmod C

Twelve-pin Pmod Compatible connector Pmod C provides access to the SPI0 peripheral or to SCI channel 0 on the S3A7 microcontroller.

Table 4: Pmod C connector (J111)

PMODC connector (Breakout Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
1	PMODC_CS#	P105 (P1_5)	SSLA1_A
2	MOSI0	P101 (P1_1)	MOSIA_A
3	MISO0	P100 (P1_0)	MISOA_A
4	SCI serial clock RSPCK0	P102 (P1_2)	RSPCKA_A
5, 11	GND	-	-
6, 12	+3V3 or +5V depending on setting of J102	-	-
7	PMODC_7	P603 (P6_3)	GPIO
8	PMODC_8	P602 (P6_2)	GPIO
9	PMODC_9	P601 (P6_1)	GPIO
10	PMODC_10	P600 (P6_0)	GPIO

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7.3 BLE/Pmod B

The Bluetooth Low Energy (BLE) device and Pmod Compatible connector Pmod B both use the Serial Communication Interface (SCI) channel 1 of the S3A7 microcontroller. To use the Pmod B connector, disconnect the BLE device from the S3A7 microcontroller by setting switch 5 of DIP switch S5 to OFF.

RELATED LINKS:

Bluetooth

Pmod B

7.3.1 Bluetooth

To enable the BLE device on the DK-S3A7 Main Board, use either of the following methods:

- Set DIP switch 5 (BLE) on S5 to ON.
- If DIP switch 5 on S5 is in the OFF position, the BLE device can be enabled under software control through the IIC-controlled I/O Expander U14.

The BLE device is connected to channel 1 of the Serial Communications Interface (SCI) peripheral on the S3A7 microcontroller, which must be configured through software as an SPI interface.

NOTE: The BLE signals can also be observed on the breakout pin connectors on the Main Board.

NOTE: SCI channel 1 used for BLE is also routed to the Pmod B connector on the Breakout Board. If you are using the Pmod B connector, disable the BLE device.

Table 5: BLE device (RF1)

BLE device (Main Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
BLE_CS#		P711 (P7_11)	CTS1
BLE_MISO		P708 (P7_8)	RXD1
BLE_MOSI		P709 (P7_9)	TXD1
BLE_SCK		P710 (P7_10)	SCK1
BLE_IRQ#		P000 (P0_0)	-
BLE_RESET#		P001 (P0_1)	-

RELATED LINKS:

Pmod B

Configuration

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7.3.2 Pmod B

Twelve-pin Pmod Compatible connector Pmod B provides access to channel 1 of the Serial Communications Interface (SCI) peripheral on the S3A7 microcontroller, which can be configured through software as SPI, UART, or IIC-bus interface (IIC Fast mode and Standard mode only).

To use the Pmod B connector, disable the BLE device on the Main Board by setting DIP switch 5 on S5 to OFF.

Table 6: Pmod B connector (J100)

PMODB connector (Breakout Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
1	SCI CTS	P711 (P7_11)	CTS1
2	SCI transmit	P709 (P7_9)	TXD1
3	SCI receive	P708 (P7_8)	RXD1
4	SCI serial clock	P710 (P7_10)	SCK1
5, 11	GND	-	-
6, 12	+3V3 or +5V depending on setting of J102	-	-
7	PMODB_7	P800 (P8_0)	GPIO
8	PMODB_8	P801 (P8_1)	GPIO
9	PMODB_9	P804 (P8_4)	GPIO
10	PMODB_10	P805 (P8_5)	GPIO

RELATED LINKS:

Configuration

7.4 RS-232/485

To enable the RS-232/485 transceiver on the DK-S3A7 Main Board, use either of the following methods:

- Set DIP switch 3 (RSXXX) on S5 to ON.
- If DIP switch 3 on S5 is in the OFF position, the RS-232/485 transceiver can be enabled under software control through the IIC-controlled I/O Expander U14.

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The RS-232/485 signals are controlled by the RS-232/485 transceiver (U19) on Main Board. The transceiver uses channel 2 of the Serial Communication Interface (SCI) on the S3A7 microcontroller, which must be configured through software as a UART interface.

For configuring the modes of the RS-232/485 transceiver, see RS-232/485 transceiver configuration.

NOTE: The RS-232/485 transceiver signals can also be observed on the breakout pin connectors on the Main Board and on application header J104 on the Breakout Board.

Table 7: RS-232/485 transceiver (U19)

RS-232/485 transceiver (Main Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
RS_RX	UART Receive	P301 (P3_1)	RXD2
RS_DEN	UART Driver Enable	P802 (P8_2)	GPIO
RS_TX	UART Transmit	P302 (P3_2)	TXD2
RS_ON	UART On	P803 (P8_3)	GPIO

RELATED LINKS:

Configuration

Pin mapping

7.5 CAN

To enable the CAN transceiver on the DK-S3A7 Main Board, use either of the following methods:

- Set DIP switch 5 (CAN) on S5 to ON.
- If DIP switch 5 on S5 is in the OFF position, the CAN transceiver can be enabled under software control through the IIC-controlled I/O Expander U14.

The CAN signals are controlled by the CAN transceiver (U21) on Main Board. The transceiver uses channel 0 of the CAN Controller on the S3A7 microcontroller. The transceiver signals are routed to connector J17 on the Main Board.

NOTE: The CAN signals can also be observed on the breakout pin connectors on the Main Board and application header J104 on the Breakout Board.

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Table 8: CAN transceiver (U21)

CAN transceiver (Main Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
CAN_TX	CAN Transmit	P401 (P4_1)	CTX0
CAN_RX	CAN Receive	P402 (P4_2)	CRX0

RELATED LINKS:

Configuration

Pin mapping

7.6 User LEDs

The Main Board features two LEDs that can be controlled by the application through the GPIO pins of the S3A7 microcontroller. Each LED supports two colors, red and green, which can be individually turned on or off through the corresponding GPIO pins.

Table 9: LED1 and LED2

User LED (Main Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
LED1	Green	P701 (P7_1)	GPIO
LED1	Red	P702 (P7_2)	GPIO
LED2	Green	P703 (P7_3)	GPIO
LED2	Red	P704 (P7_4)	GPIO

7.7 Push buttons

To enable the push buttons on the DK-S3A7 Main Board, use either of the following methods:

- Set DIP switch 1 (PB) on S5 to ON.
- If DIP switch 1 on S5 is in the OFF position, the push buttons can be enabled under software control through the IIC-controlled I/O Expander U14.

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The Main Board features three push buttons, which are connected to the external interrupt inputs of the S3A7 microcontroller.

Table 10: Push buttons

Push buttons (Main Board)		S3A7 microcontroller	
Pin	Description	Pin	Function name
S1	IRQ8	P305 (P3_5)	IRQ8
S2	IRQ9	P304 (P3_4	IRQ9
S3	IRQ3	P202 (P2_2)	IRQ3

RELATED LINKS:

Pin mapping

Configuration

7.8 JTAG

To enable JTAG debug on the DK-S3A7 Main Board for all JTAG connectors, use either of the following methods:

- Set DIP switch 7 (JTAG) on S5 to ON.
- If DIP switch 7 on S5 is in the OFF position, JTAG can be enabled under software control through the IIC-controlled I/O Expander U14.

The JTAG signals can be used through the J-Link OB USB port (J15), directly through the JTAG connector (J14), or through the SEGGER J-Link OB connector (J13). The SEGGER J-Link OB connector and the J-Link OB USB port are connected to the RX621 microcontroller (U16).

Table 11: JTAG

JTAG (Main Board)		S3A7 microcontroller	
Pin	Description	Pin	Function name
TMS/SWDIO	Test Mode Select	P108 (P1_8)	TMS/SWDIO
TCK/SWCLK	Test Clock	P300 (P3_0)	TCK/SWCLK
TDO	Test Data Out	P109 (P1_9)	TDO
TDI	Test Data In	P110 (P1_10)	TDI

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Table 11: JTAG (Continued)

JTAG (Main Board)		S3A7 microcontroller	
Pin	Description	Pin	Function name
RESET#	Reset	RESET#	RESET#

RELATED LINKS:

Pin mapping

Configuration

7.9 Capacitive touch expansion

The Main Board includes a capacitive-touch expansion port, which is compatible with the RX113 Capacitive-Touch Kit. The expansion port consists of two connectors, J18 and J19. The pins of connector J18 are routed directly to the S3A7 microcontroller pins. Connector J19 is connected to the I/O Expansion Controller U22, which is controlled by channel 2 of the IIC peripheral on the microcontroller.

Table 12: Capacitive touch expansion connector (J18)

Capacitive touch connector (Main Board)		S3A7 microcontroller	
Pin	Description	Pin	Function name
1	TS0	P204 (P2_4?)	TS0
2	TS1	P206 (P2_6)	TS1
3	TS2	P008 (P0_8)	TS2
4	TS3	P412 (P4_12)	TS8
5	TS4	P4_13 (P4_13)	TS9
6	TS5	P414 (P4_14)	TS10
7	TS6	P415 (P4_15)	TS11
8	TS7	P406 (P406)	TS14
9	TS8	P405 (P4_5)	TS15
10	TS9	P404 (P4_4)	TS16

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Table 12: Capacitive touch expansion connector (J18) (Continued)

Capacitive touch connector (Main Board)		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
11	TS10	P403 (P4_3)	TS17
12	TS11	P400 (P4_0)	TS20
13	TS ID	P010 (P010)	

Table 13: I/O Expansion Controller (U22) for capacitive touch expansion connector (J19)

I/O Expansion Controller		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
SCL		P512 (P5_12)	SCL2
SDA		P511 (P5_11)	SDA2

Table 14: Capacitive coupling

I/O Expansion Controller		S3A7 microcontroller	
Pin	**Description**	**Pin**	**Function name**
TSCAP_B		P203 (P2_3)	-

RELATED LINKS:

Pin mapping

7.10 QSPI flash

To enable the QSPI flash on the DK-S3A7 Main Board, use either of the following methods:

- Set DIP switch 2 (QSPI) on S5 to ON.
- If DIP switch 2 on S5 is in the OFF position, the QSPI flash can be enabled under software control through the IIC-controlled I/O Expander U14.

The microcontroller pins for the QSPI flash are also connected to application header J103 on the Breakout Board as inputs to the ADC.

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Table 15: QSPI flash (U10)

QSPI flash (Main Board)		S3A7 microcontroller	
Pin	Description	Pin	Function name
QSPI CS#		P501 (P5_1)	QSSL
QSPI CLK		P500 (P5_0)	QSPCLK
QSPI DQ0		P502 (P5_2)	QIO0
QSPI DQ1		P503 (P5_3)	QIO1
QSPI DQ2		P504 (P5_4)	QIO2
QSPI DQ3		P505 (P5_5)	QIO3

RELATED LINKS:

Pin mapping

7.11 Analog I/O

A limited number of analog signals (ADC and DAC) are available on the DK-S3A7 Main Board through connector J5.

Table 16: Analog I/O header (J5)

Analog I/O header (Main Board)		S3A7 microcontroller	
Pin	Description	Pin	Function name
1	DA0	P014 (P0_14)	DA0
2	DA1	P015 (P0_15)	DA1
4	AN011	P011 (P0_11)	AN011
5	AN012	P012 (P0_12)	AN012
6	AN013	P013 (P0_13)	AN013

RELATED LINKS:

Pin mapping

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Chapter 8 Appendix

8.1 Pin mapping

The following table shows the routing of the microcontroller pins between the Main Board and the Breakout Board. All microcontroller pins are accessible on the breakout pin connectors J7 to J9 on the Main Board. The microcontroller pins are also routed to the Breakout Board through board-to-board connectors as needed for the Breakout Board functions. Many microcontroller pins are routed to more than one function and are used for functions on both boards. For some functions, the entire connector or device can be switched on or off under software control or using the Main Board DIP switches. See Function select DIP switches.

Table 17: Main Board to Breakout Board pin mapping

S3A7 microcontroller	Main Board		Breakout Board	
Port pin	Breakout pins	Other connectors or devices	Application header pins	Other connectors or devices
P000 (P0_0)	J7/1	Bluetooth	J103/1	-
P001 (P0_1)	J7/2	Bluetooth	J103/2	-
P002 (P0_2)	J7/3	-	J103/3	-
P003 (P0_3)	J7/4	-	J103/4	-
P004 (P0_4)	J7/5	-	J103/5	-
P005 (P0_5)	J7/6	-	J103/6	-
P006 (P0_6)	J7/7	-	J103/7	-
P007 (P0_7)	J7/8	-	J103/8	-
P008 (P0_8)	J7/9	Capacitive touch expansion	J103/9	-
P009 (P0_9)	J7/10	-	J103/10	
P010 (P010)	J7/11	Capacitive touch expansion	J103/11	-
P011 (P0_11)	J7/12	Analog I/O	J103/12	-

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Table 17: Main Board to Breakout Board pin mapping (Continued)

S3A7 microcontroller	Main Board		Breakout Board	
Port pin	Breakout pins	Other connectors or devices	Application header pins	Other connectors or devices
P012 (P0_12)	J7/13	Analog I/O	J103/13	-
P013 (P0_13)	J7/14	Analog I/O	J103/14	-
P014 (P0_14)	J7/15	Analog I/O, Audio out (U13)	J103/15	-
P015 (P0_15)	J7/16	Analog I/O	J103/14	-
P100 (P1_0)	J7/17	LCD	-	Pmod C, SPI Flash
P101 (P1_1)	J7/18	LCD	-	Pmod C, SPI Flash
P102 (P1_2)	J7/19	LCD	-	Pmod C, SPI Flash
P103 (P1_3)	J7/20	LCD	-	-
P104 (P1_4)	J7/21	LCD		SPI Flash
P105 (P1_5)	J7/22	LCD	-	Pmod C
P106 (P1_6)	J7/23	LCD	-	-
P107 (P1_7)	J7/24	LCD	-	-
P108 (P1_8)	J7/25	JTAG	J104/15	-
P109 (P1_9)	J7/26	JTAG	J104/14	-
P110 (P1_10)	J7/27	JTAG	J104/17	-
P111 (P1_11)	J7/28	LCD	-	-
P112 (P1_12)	J7/29	LCD	-	-
P113 (P1_13)	J7/30	-	J104/9	-
P114 (P1_14)	J7/31	-	J104/10	-
P115 (P1_15)	J7/32	-	J104/11	-
P200 (P2_0)	J7/33	-	J104/18	-

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Table 17: Main Board to Breakout Board pin mapping (Continued)

S3A7 microcontroller	Main Board		Breakout Board	
Port pin	Breakout pins	Other connectors or devices	Application header pins	Other connectors or devices
P201 (P2_1)	J7/34	Boot pin	-	-
P202 (P2_2)	J7/35	Push buttons	-	SD_CARD_DET (SD100)
P203 (P2_3)	J7/36	Capacitive touch expansion	-	-
P204 (P2_4)	J7/37	Capacitive touch expansion	-	USB Power switch (U100)
P205 (P2_5)	J7/38	-	-	SD Card (SD100)
P206 (P2_6)	J7/39	Capacitive touch expansion	-	SD Card (SD100)
P207 (P2_7)	J7/40	-	J104/21	
P213 (P2_13)	J7/41	-	-	Compass IRQ
P300 (P3_0)	J9/1	JTAG	J104/25	
P301 (P3_1)	J9/2	RS-232/485	J104/22	-
P302 (P3_2)	J9/3	RS-232/485	J104/27	-
P303 (P3_3)	J9/4	LCD	-	-
P304 (P3_4)	J9/5	Push buttons	-	Temperature Sensor TEMP SENSOR (U109)
P305 (P3_5)	J9/6	Push buttons	-	Ambient Light and Proximity Sensor ALS (U105)
P306 (P3_6)	J9/7	LCD	-	-
P307 (P3_7)	J9/8	LCD	-	-
P308 (P3_8)	J9/9	LCD	-	-
P309 (P3_9)	J9/10			
P310 (P3_10)	J9/11	LCD	-	-
P311 (P3_11)	J9/12	LCD	-	-

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Table 17: Main Board to Breakout Board pin mapping (Continued)

S3A7 microcontroller	Main Board		Breakout Board	
Port pin	Breakout pins	Other connectors or devices	Application header pins	Other connectors or devices
P312 (P3_12)	J9/13	LCD	-	-
P313 (P3_13)	J9/14	LCD	-	-
P314 (P3_14)	J9/15	LCD	-	-
P315 (P3_15)	J9/16	LCD	-	-
P400 (P4_0)	J9/17	Capacitive touch expansion	-	Audio Codec (U104)
P401 (P4_1)	J9/18	CAN	J104/24	-
P402 (P4_2)	J9/19	CAN	J104/29	-
P403 (P4_3)	J9/20	Capacitive touch expansion	-	Audio Codec (U104)
P404 (P4_4)	J9/21	Capacitive touch expansion	-	Audio Codec (U104)
P405 (P4_5)	J9/22	Capacitive touch expansion	-	Audio Codec (U104)
P406 (P4_6)	J9/23	Capacitive touch expansion	-	Audio Codec (U104)
P407 (P4_7)	J9/24	USB (U6)	-	USB (U100)
P408 (P4_8)	J9/25	Pmod A	J104/26	-
P409 (P4_9)	J9/26	Pmod A	J104/30	-
P410 (P4_10)	J9/27	Pmod A	-	SD Card (SD100)
P411 (P4_11)	J9/28	Pmod A	-	SD Card (SD100)
P412 (P4_12)	J9/29	Capacitive touch expansion	-	SD Card (SD100)
P413 (P4_13)	J9/30	Capacitive touch expansion	-	SD Card (SD100)
P414 (P4_14)	J9/31	Capacitive touch expansion	-	SD Card (SD100)
P415 (P4_15)	J9/32	Capacitive touch expansion	J104/28	-
P500 (P5_0)	J9/33	QSPI flash	J103/17	-

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Table 17: Main Board to Breakout Board pin mapping (Continued)

S3A7 microcontroller	Main Board		Breakout Board	
Port pin	Breakout pins	Other connectors or devices	Application header pins	Other connectors or devices
P501 (P5_1)	J9/34	QSPI flash	J103/18	-
P502 (P5_2)	J9/35	QSPI flash	J103/19	-
P503 (P5_3)	J9/36	QSPI flash	J103/20	-
P504 (P5_4)	J9/37	QSPI flash	J103/21	-
P505 (P5_5)	J9/38	QSPI flash	J103/22	-
P506 (P5_6)	J9/39		J103/23	
P507 (P5_7)	J9/40		J103/24	
P511 (P5_11)	J9/42	Capacitive touch expansion, I/O extensions	-	Audio Codec (U104), EEPROM (U108), all sensors
P512 (P5_12)	J9/41	Capacitive touch expansion, I/O extensions	-	Audio Codec (U104), EEPROM (U108), all sensors
P600 (P6_0)	J8/1	LCD	-	Pmod C
P601 (P6_1)	J8/2	LCD	-	Pmod C
P602 (P6_2)	J8/3	LCD	-	Pmod C
P603 (P6_3)	J8/4	LCD	-	Pmod C
P604 (P6_4)	J8/5	LCD	-	Accelerometer
P605 (P6_5)	J8/6	LCD	-	-
P606 (P6_6)	J8/7	LCD	-	-
P608 (P6_8)	J8/8	LCD	-	-
P609 (P6_9)	J8/9	LCD	-	-
P610 (P6_10)	J8/10	LCD	-	-

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Table 17: Main Board to Breakout Board pin mapping (Continued)

S3A7 microcontroller	Main Board		Breakout Board	
Port pin	Breakout pins	Other connectors or devices	Application header pins	Other connectors or devices
P611 (P6_11)	J8/11	LCD	-	-
P612 (P6_12)	J8/12	LCD	-	-
P613 (P6_13)	J8/13	LCD	-	-
P614 (P6_14)	J8/14	LCD	-	-
P700 (P7_0)	J8/15	-	-	-
P701 (P7_1)	J8/16	User LEDs	J104/1	-
P702 (P7_2)	J8/17	User LEDs	J104/2	-
P703 (P7_3)	J8/18	User LEDs	J104/3	-
P704 (P7_4)	J8/19	User LEDs	J104/4	-
P705 (P7_5)	J8/20	-	J104/5	-
P708 (P7_8)	J8/21	Bluetooth	-	Pmod B
P709 (P7_9)	J8/22	Bluetooth	-	Pmod B
P710 (P7_10)	J8/23	Bluetooth	-	Pmod B
P711 (P7_11)	J8/24	Bluetooth	-	Pmod B
P712 (P7_12)	J8/25	-	J104/6	-
P713 (P7_13)	J8/26	-	J104/7	-
P800 (P8_0)	J8/27	LCD	-	Pmod B
P801 (P8_1)	J8/28	LCD	-	Pmod B
P802 (P8_2)	J8/29	RS-232/485	J104/23	-
P803 (P8_3)	J8/30	RS-232/485	J104/20	-
P804 (P8_4)	J8/31	LCD	-	Pmod B

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Table 17: Main Board to Breakout Board pin mapping (Continued)

S3A7 microcontroller	Main Board		Breakout Board	
Port pin	Breakout pins	Other connectors or devices	Application header pins	Other connectors or devices
P805 (P8_5)	J8/32	LCD	-	Pmod B
P806 (P8_6)	J8/33	LCD	-	-
P807 (P8_7)	J8/34	LCD	-	-
P808 (P8_8)	J8/35	LCD	-	-
P809 (P8_9)	J8/36	LCD	-	-
P900 (P9_0)	J8/37	LCD	-	-
P901 (P9_1)	J8/38	LCD	-	-
P902 (P9_2)	J8/39	LCD	-	-
USB_DP	J8/41	USB (J2)	-	
USB_DM	J8/43	USB (J2)	-	USB (J101)
RESET#	J7/42	Multiple	-	Multiple

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		Page	Summary
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Renesas Synergy™ DK-S3A7

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