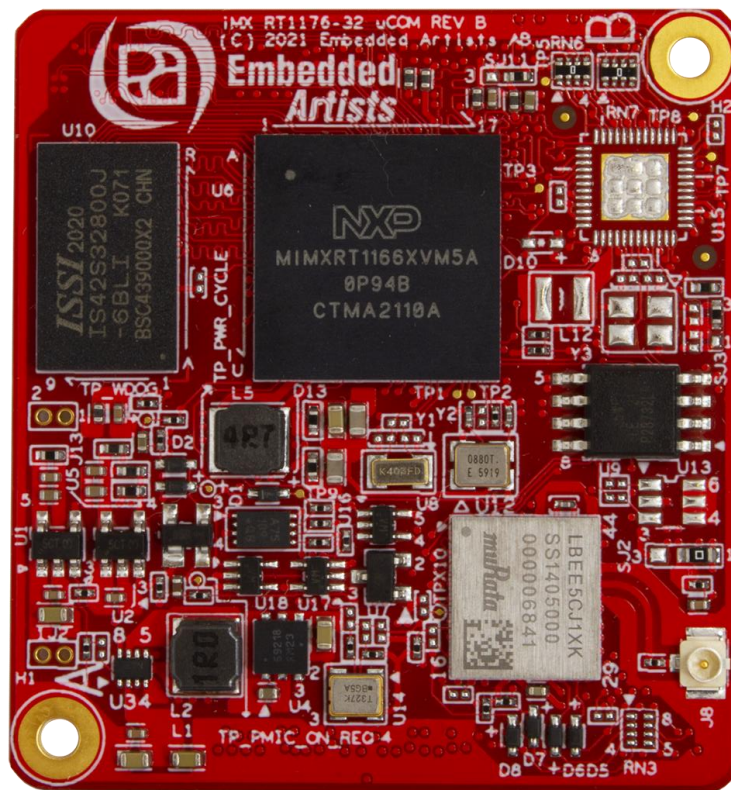


iMX RT1166-32 uCOM Board Datasheet



*Get Up-and-Running Quickly and
Start Developing Your Application On Day 1!*

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1 Document Revision History

<i>Revision</i>	<i>Date</i>	<i>Description</i>
PA1	2021-12-16	First version.
PA2	2022-11-15	Corrected JB pinning (pin 1, 3, 9, 11, 13, 15).
PA3	2023-04-21	Updated information about boot control.
PA4	2023-06-15	Added information about on-board I2C-E2PROM and powering architecture.
PA5	2023-12-22	Updated names on power supply inputs. Added information about pull-up resistor requirement on JB, pin 70. Corrected pin information for JA pin 98 (GPIO_EMC_B2_18). Corrected signaling voltage for JA pin 88 (1.8V).

2 Introduction

This document is a datasheet that specifies and describes the *iMX RT1166-32 uCOM Board* mainly from a hardware point of view. Some basic software related issues are also addressed, like booting and functional verification, but there are separate software development manuals that should also be consulted.

2.1 Hardware

The *iMX RT1166-32 uCOM Board* is a Computer-on-Module (COM) based on NXP's ARM dual-core Cortex-M7 / M4 i.MX RT1166 Crossover microcontroller. The board provides a quick and easy solution for implementing a high-performance ARM Cortex-M7 / M4 based design. The Cortex-M7 core runs at up to 600 MHz (500 MHz for industrial temperature version) and the Cortex-M4 core at 240 MHz (same for both temperature versions).

The *iMX RT1166-32 uCOM Board* has a small form factor and shields the user from a lot of complexity of designing a high performance system. It is a robust and proven design that allows the user to focus the product development, shorten time to market and minimize the development risk.

The *iMX RT1166-32 uCOM Board* targets a wide range of applications, such as:

- Industrial Computing Designs
 - PLCs
 - Factory automation
 - Test and measurement
 - M2M
 - assembly line robotics
- Home and Building Automation
 - HVAC climate control
 - Security
 - Lighting control panels
 - IoT gateways
- Motor Control and Power Conversion
- HMI/GUI solutions
- Connected vending machines
- Access control panels
- Audio Subsystem
- 3D printers, thermal printers, unmanned autonomous vehicles
- Audio
- Smart appliances
- Home energy management systems
- Smart Grid and Smart Metering
- Smart Toll Systems
- Data acquisition
- Communication gateway solutions
- Connected real-time systems
- ...and much more

The picture below illustrates the block diagram of the *iMX RT1166-32 uCOM Board*.

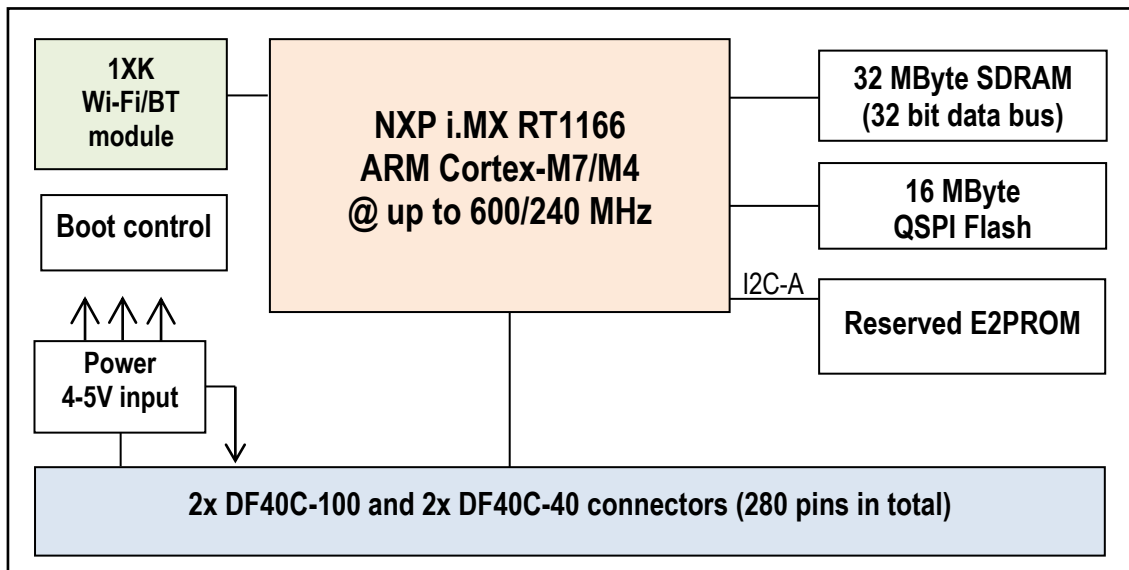


Figure 1 – iMX RT1166-32 uCOM Board Block Diagram

The *iMX RT1166-32 uCOM Board* pin assignment focus on direct connection to (carrier board) interface connectors and minimize trace and layer crossing. This is important for high speed, serial interfaces with impedance controlled differential pairs. As a result, carrier boards can be designed with few routing layers. In many cases, a four layer pcb is enough to implement advanced and compact carrier boards. The pin assignment is common for the *iMX RT/6/7/8/9 uCOM Boards* from Embedded Artists and the general, so called, EAuCOM specification is found in separate document.

2.2 Software

The *iMX RT1166 uCOM Developer's Kit* has a Board Support Package (BSP) that supports bare metal as well as FreeRTOS based architectures. It is based on NXP's SDK framework for the i.MX RT1160 family with patches from Embedded Artists to support the specifics of the uCOM board.

This document has a hardware focus and does not cover software development. See the document *iMX RT Developer's Kit Program Development Guide* for more information about software development.

2.3 Features and Functionality

The i.MX RT1166 is a powerful crossover microcontroller. The full specification can be found in NXP's *i.MX RT1160 Crossover Processor Datasheet* and *i.MX RT1160 Processor Reference Manual*. The table below lists the main features and functions of the *iMX RT1166-32 uCOM board*, which represents Embedded Artists' integration of the i.MX RT1166 Crossover microcontroller. Due to pin configuration some functions and interfaces of the i.MX RT1166 many not be available at the same time. See the *i.MX RT1160 Crossover Processor Datasheet* and reference manual for details. Also see pin multiplexing Excel sheet for details.

Group	Feature	iMX RT1166 uCOM Board
CPU's	NXP MCU commercial temp. range industrial temp. range	MIMXRT1166DVM6A (0 - 70° C) MIMXRT1166CVM5A (-40 - 85° C) or MIMXRT1166XVM5A (-40 - 85° C)
	CPU Cores	1x Cortex-M7 with FPU (single and double precision)

		1x Cortex-M4 with FPU (single precision)
	Maximum M7 core frequency	600 MHz (0 - 70° C) 500 MHz (-40 - 85° C)
	Maximum M4 core frequency	240 MHz (0 - 70° C) 240 MHz (-40 - 85° C)
	L1 Instruction cache	32 KByte on the Cortex-M7 16 KByte on the Cortex-M4
	L1 Data cache	32 KByte on the Cortex-M7 16 KByte on the Cortex-M4
	I-TCM, D-TCM for Cortex-M7	Configurable, up to 512 KByte
	TCM for Cortex-M4	Up to 256 KByte
	On-chip SRAM (TCM for Cortex-M7)	1024 MByte, of with up to 512 KByte M7 TCM, 256 KByte M4 TCM and 256 KByte OCRAM
Security Functions	High Assurance Boot	✓
	Cryptographic Acceleration and Assurance Module (CAAM)	✓
	Inline Encryption Engine (IEE)	✓
	On-the-Fly AES Decryption (OTFAD)	✓
	Secure Non-Volatile Storage	✓
	Secure always-on RAM (4 KB)	✓
	Secure key management and protection	✓
	Secure and trusted access control	✓
Memory	SDRAM RAM Size	32 MByte, default. Other on request.
	SDRAM Clock Speed	148 MHz
	SDRAM Memory Width	32 bit
	QSPI Flash	16MByte, default. Other on request.
Graphical Processing	2D Vector Graphics Processing Unit (GPU)	OpenVG1.1 support
	PiXel Processing Pipeline (PXP)	✓
Graphical Output	MIPI-DSI, 2 lanes	✓ up to 1.5 GHz bit rate In practice, suitable for resolutions up to up WXGA resolution (1280x800px)@60fps
	Parallel RGB	Support 8/16/24-bit interface with up WXGA resolution (1280x800px)@60fps
Graphical Input	MIPI-CSI, 2 lanes	✓
	Parallel Camera Sensor Interface	✓
Connectivity	2x USB2.0 OTG port with Phy	✓

Interfaces (all functions are not available at the same time)	1000/100/10 Mbps Gigabit Ethernet controller with support for Audio Video Bridging (AVB)	Note that Ethernet phy is needed on carrier board. The parallel RGB interface will no longer be available.
	1000/100/10 Mbps Gigabit Ethernet controller with support for Time Sensitive Networking (TSN)	Note that Ethernet phy is needed on carrier board. The parallel RGB interface will no longer be available.
	100/10 Mbps Ethernet controller with support for IEEE1588	Note that Ethernet phy is needed on carrier board. The parallel RGB interface will no longer be available.
	QuadSPI with support for XIP	✓
	4x I2S/SAI, MQS, SPDIF, 4-ch PDM, ASRC	✓
	1x SD3.0/MMC 5.0	✓ (the second SDIO interface is used by the on-board 1XK Wi-Fi/BT module)
	6x SPI, 12x UART, 6x I ² C, 3x FlexCAN	✓
Other	PWMs, WDOG	✓
	Full PMIC integration, including on-chip DCDC and LDOs	✓
	On-board RTC via i.MX RT1166	✓
	On-board watchdog functionality	✓
	64 Kbit I2C-E2PROM	✓ connected to I2C-A, 7-bit address 0x55, 8-bit address 0xAA/0xAB

2.4 Reference Documents

The following documents are important reference documents and should be consulted when integrating the *iMX RT1166-32 uCOM board*:

- EAuCOM Board Specification

The following NXP documents are also important reference documents and should be consulted for functional details:

- IMXRT1160CEC, i.MX RT1160 Crossover Processors Data Sheet for Consumer Products, latest revision
- IMXRT1160IEC, i.MX RT1160 Crossover Processors Data Sheet for Industrial Products, latest revision
- IMXRT1160RM, i.MX RT1160 Processor Reference Manual, latest revision
- IMXRT1160SRM, Security Reference Manual for i.MX RT1160, latest revision
- IMXRT1160CE, Chip Errata for the i.MX RT1160, latest revision

Note: It is the user's responsibility to make sure all errata published by the manufacturer are taken note of. The manufacturer's advice should be followed.

The following documents are external industry standard reference documents and should also be consulted when applicable:

- GbE MDI (Gigabit Ethernet Medium Dependent Interface) defined by IEEE 802.3. The 1000Base-T operation over copper twisted pair cabling is defined by IEEE 802.3ab (www.ieee.org)
- The I2C Specification, Version 2.1, January 2000, Philips Semiconductor (now NXP) (www.nxp.com)
- I2S Bus Specification, Feb. 1986 and Revised June 5, 1996, Philips Semiconductor (now NXP) (www.nxp.com)
- JTAG (Joint Test Action Group) defined by IEEE 1149.1-2001 - IEEE Standard Test Access Port and Boundary Scan Architecture (www.ieee.org)
- SD Specifications Part 1 Physical Layer Simplified Specification, Version 3.01, May 18, 2010, © 2010 SD Group and SD Card Association (Secure Digital) (www.sdcard.org)
- SPI Bus – “Serial Peripheral Interface” – de-facto serial interface standard defined by Motorola. A good description may be found on Wikipedia (http://en.wikipedia.org/wiki/Serial_Peripheral_Interface_Bus)
- DSI (Display Serial Interface) The DSI standard is owned and maintained by the MIPI Alliance (“Mobile Industry Processor Alliance”) (www.mipi.org)
- CSI-2 (Camera Serial Interface version 2) The CSI-2 standard is owned and maintained by the MIPI Alliance (“Mobile Industry Processor Alliance”) (www.mipi.org)
- USB Specifications (www.usb.org)

3 Board Pinning

Embedded Artists has defined the EAuCOM board standard with 42 x 45 mm boards that use Hirose DF40C connectors. Note that this is not the same as the EACOM board standard with module size 82 x 50 mm. See the *EAuCOM Board specification* document for details and background information. Hereafter this standard will be referred to as **EAuCOM**.

There are four Hirose DF40C expansion connectors; two 100 pos and two 40 pos connectors. The 0.4mm pitch connectors have a board-to-board stacking height of only 1.5mm. There are also versions of the receptacle connectors that gives 3.0mm stacking height.

3.1 Pin Numbering

The figure below illustrates the location of the four expansion connectors and their respective pin numbering on the bottom side of the *iMX RT1166-32 uCOM Board*.

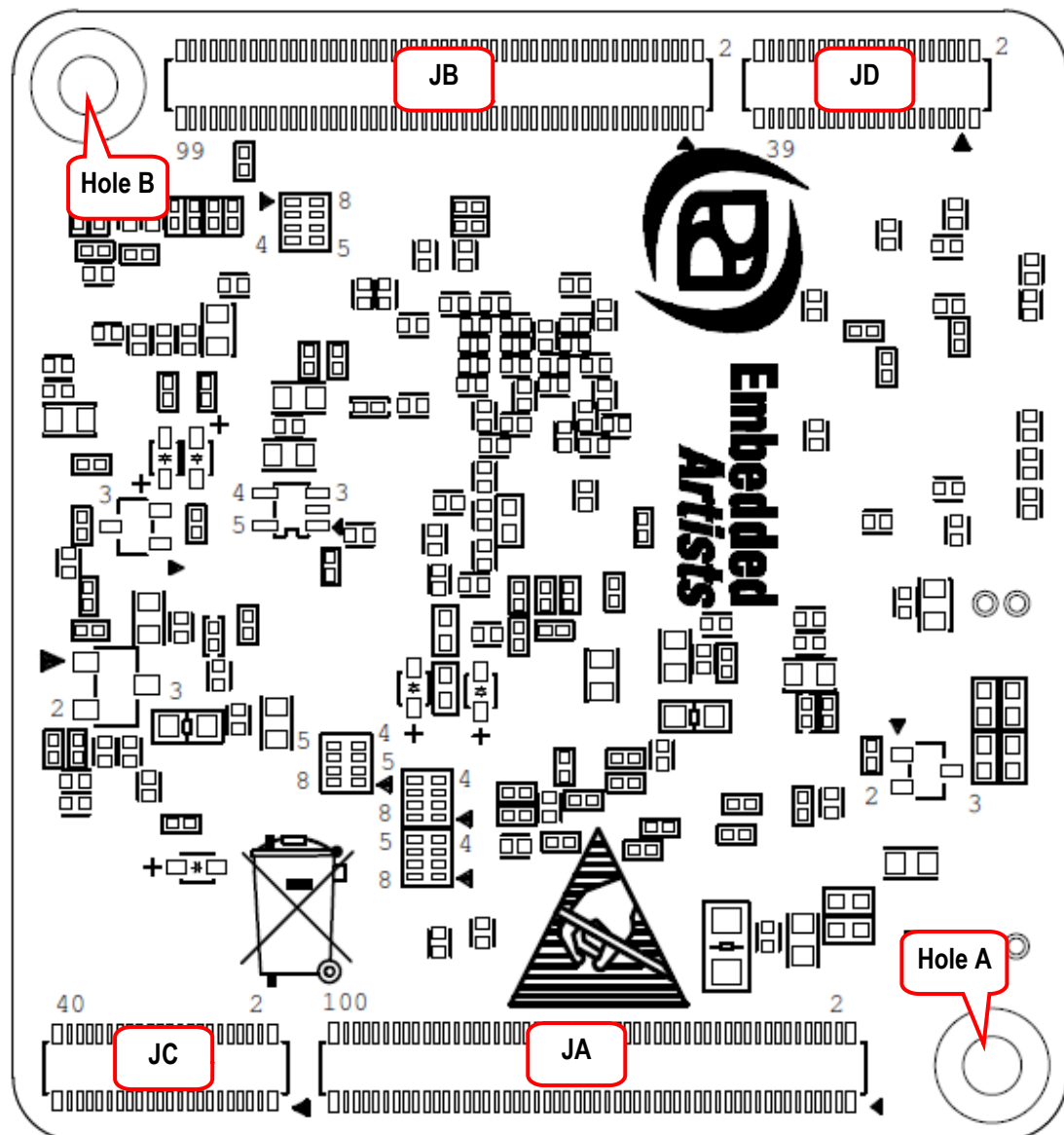


Figure 2 – iMX RT1166-32 uCOM (EAuCOM standard) Board Pin Numbering, Bottom Side

3.2 Pin Assignment

This section describes the pin assignment of the board, with the following columns:

Connector and Pin number	The pin numbers are listed in consecutive order. Odd pin numbers are on one row and even numbers on the other row.
Non-i.MX RT1166 signals	Lists signals that are not directly connected to the i.MX RT1166 MCU. These signals are typically related to powering and connected to the on-board Power Management.
i.MX RT1166 Ball Name	The name of the ball of the i.MX RT1166 MCU that is connected to this pin.
Alternative Pin Function	Information if the signal is a dedicated interface or a general pin that can multiples different signals. See separate Excel sheet for details about available multiplexing alternatives.
Notes	When relevant, the preferred pin function is listed.

Note that some pins are EAuCOM board *type specific*, meaning that these pins might not be compatible with other EAuCOM boards. Using these may result in lost compatibility between EAuCOM boards, but not always. Check details between EAuCOM boards of interest.

The table below lists the pins on expansion connector JA (100-pos connector).

JA Pin Number	EAuCOM Board Signal	i.MX RT1166 Ball Name	Alternative Pin Function?	Notes
1-8	VSYS_IN			System supply voltage input, see chapter for more details.
9-16	GND			
17	VDD_SNVS	VDD_SNVS_ANA		Internal 1.8V power supply rail. Do not connect to except a possible 100Kohm pullup of J1 pin 88 (WAKEUP pin).
18	VDD_RTC_IN	VDD_SNVS_IN		Power supply input for on-chip RTC. See chapter for more details.
19, 21, 23, 25, 27, 29	VDD_1V8			1.8V voltage rail output, see chapter for more details.
20, 22, 24, 26, 28, 30	VDD_3V3			3.3V voltage rail output, see chapter for more details.
31-32	GND			
33	Board specific	GPIO_DISP_B1_00	Yes	
34, 36, 38, 40, 42	VDD_RF			3.3V input supply voltage for on-board Wi-Fi/BT module, see chapter for more details.
35	Board specific	GPIO_DISP_B1_02	Yes	
37	Board specific	GPIO_DISP_B1_03	Yes	
39	Board specific	GPIO_DISP_B1_01	Yes	
41	GND			
43	Board specific	GPIO_DISP_B1_04	Yes	
44	GND			
45	Board specific	GPIO_DISP_B1_05	Yes	
46	GND			
47	Board specific	GPIO_DISP_B1_06	Yes	
48	VBAT_TEMP	-		Not connected
49	Board specific	GPIO_DISP_B1_07	Yes	

50	VBAT_CURRP	-	Not connected
51	GND		
52	VBAT_CURRN	-	Not connected
53	Board specific	GPIO_DISP_B1_08	Yes
54, 56, 58, 60	PSU_5V	-	Not connected
55	Board specific	GPIO_DISP_B1_09	Yes
57	Board specific	GPIO_DISP_B1_10	Yes
59	Board specific	GPIO_DISP_B1_11	Yes
61	GND		
62, 64, 66, 68	VBUS_USB	-	Not connected
63	Board specific	GPIO_DISP_B2_00	Yes
65	Board specific	GPIO_DISP_B2_01	Yes
67	Board specific	GPIO_DISP_B2_02	Yes
69	Board specific	GPIO_DISP_B2_03	Yes
70-71	GND		
72	Board specific	GPIO_SNVS_00	Yes
73	Board specific	GPIO_DISP_B2_04	Yes
74	Board specific	GPIO_LPSR_00	Yes
75	Board specific	GPIO_DISP_B2_05	Yes
76	Board specific	GPIO_LPSR_01	Yes
77	Board specific	GPIO_DISP_B2_06	Yes
78	Board specific	GPIO_AD_I6	Yes
79	Board specific	GPIO_DISP_B2_07	Yes
80	Board specific	GPIO_AD_I5	Yes
81-82	GND		
83	Board specific	GPIO_DISP_B2_08	Yes
84	Board specific	GPIO_AD_I4	Yes
85	Board specific	GPIO_DISP_B2_09	Yes
86	Board specific	GPIO_SNVS_09	Yes
87	Board specific	GPIO_DISP_B2_10	Yes
88	Board specific	WAKE_INP	Yes
Note that this is a 1.8V signal. The internal power supply is VDD_SNVS_ANA (available on JA pin 17), which is an internal power supply.			
89	Board specific	GPIO_DISP_B2_11	Yes
90	Board specific	GPIO_LPSR_08	Yes
91-92	GND		
93	Board specific	GPIO_DISP_B2_12	Yes
94	Board specific	GPIO_LPSR_09	Yes
95	Board specific	GPIO_DISP_B2_13	Yes
96	Board specific	-	Not connected
97	Board specific	GPIO_DISP_B2_14	Yes
98	Board specific	GPIO_EMC_B2_18	Yes
99	Board specific	GPIO_DISP_B2_15	Yes

100	Board specific	BT_CFG1	Do not connect to.
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The table below lists the pins on expansion connector JB (100-pos connector).

JB Pin Number	EAuCOM Board Signal	i.MX RT1166 Ball Name	Alternative Pin Function?	Notes
1	UART-C_RXD	GPIO_AD_01	Yes	
2	GPIO-A	GPIO_AD_05	Yes	
3	UART-C_TXD	GPIO_AD_00	Yes	
4	GPIO-B	GPIO_AD_12	Yes	
5	UART-A_RXD	GPIO_AD_25	Yes	
6	GPIO-C	GPIO_AD_26	Yes	
7	UART-A_TXD	GPIO_AD_24	Yes	
8	GPIO-D	GPIO_AD_27	Yes	
9	UART-C_CTS	GPIO_AD_03	Yes	
10	GPIO-E	GPIO_AD_35	Yes	
11	UART-C_RTS	GPIO_AD_02	Yes	
12	GPIO-F	-		Not connected
13	UART-B_RXD	GPIO_EMC_B1_41	Yes	
14	GPIO-G	PMIC_ON_REQ	No	Do not connect to this signal.
15	UART-B_TXD	GPIO_EMC_B1_40	Yes	
16	GPIO-H	PMIC_STBY_REQ	No	Do not connect to this signal.
17	GND			
18	GPIO-J	DAC_OUT	No	
19	SD-A_VDD	-		Not connected
20	GPIO-K	GPIO_AD_04	No	Internal watchdog signal (pin function: WDOG_B). Do not connect to this signal.
21	GND			
22	GPIO-L	GPIO_AD_34	No	Internal signal connected to SD1_VSEL, controlling voltage level on SD1 interface. Do not connect to this signal.
23	SD-A_CLK	-		Not connected
24	GPIO-M	GPIO_AD_13	Yes	
25	SD-A_CMD	-		Not connected
26	GND			
27	SD-A_DATA0	-		Not connected
28	SPI-A_SCLK	GPIO_AD_28	Yes	
29	SD-A_DATA1	-		Not connected
30	SPI-A_MISO	GPIO_AD_31	Yes	
31	SD-A_DATA2	-		Not connected
32	SPI-A_MOSI	GPIO_AD_30	Yes	
33	SD-A_DATA3	-		Not connected
34	SPI-A_SS0	GPIO_AD_29	Yes	
35	GND			
36	GND			

37	SD-A_WP	-		Not connected
38	SPI-B_SCLK	GPIO_SD_B2_00	Yes	Not connected when on-board Wi-Fi/BT module mounted.
39	SD-A_NCD	-		Not connected
40	SPI-B_MISO	GPIO_SD_B2_03	Yes	Not connected when on-board Wi-Fi/BT module mounted.
41	SD-A_NRST	-		Not connected
42	SPI-B_MOSI	GPIO_SD_B2_02	Yes	Not connected when on-board Wi-Fi/BT module mounted.
43	USB-A_OC	GPIO_AD_11	Yes	
44	SPI-B_SS0	GPIO_SD_B2_01	Yes	Not connected when on-board Wi-Fi/BT module mounted.
45	USB-A_PWR	GPIO_AD_10	Yes	
46	GND			
47	USB-A_VBUS	VBUS_OTG1	No	
48	I2C-A_SCL	GPIO_LPSR_05	No	Note: Do not change pin function. Must be an I2C channel since the interface is used on-board. Note: This pin has a 4.7 Kohm pull-up resistor to 3.3V.
49	USB-A_DN	OTG1_DN	No	
50	I2C-A_SDA	GPIO_LPSR_04	No	Note: Do not change pin function. Must be an I2C channel since the interface is used on-board. Note: This pin has a 4.7 Kohm pull-up resistor to 3.3V.
51	USB-A_DP	OTG1_DP	No	
52	I2C-B_SCL	GPIO_LPSR_07	Yes	Note: This pin has a 4.7 Kohm pull-up resistor to 3.3V.
53	USB-A_ID	GPIO_AD_09	No	
54	I2C-B_SDA	GPIO_LPSR_06	Yes	Note: This pin has a 4.7 Kohm pull-up resistor to 3.3V.
55	GND			
56	I2C-C_SCL	GPIO_AD_32	Yes	Note: This pin has a 4.7 Kohm pull-up resistor to 3.3V.
57	USB-B_OC	GPIO_AD_06		
58	I2C-C_SDA	GPIO_AD_33	Yes	Note: This pin has a 4.7 Kohm pull-up resistor to 3.3V.
59	USB-B_PWR	GPIO_AD_07		
60	I2C-D_SCL	-		Not connected
61	USB-B_VBUS	VBUS_OTG2	No	
62	I2C-D_SDA	-		Not connected
63	USB-B_DN	OTG2_DN	No	
64	GND			
65	USB-B_DP	OTG2_DP	No	
66	GND			
67	USB-B_ID	GPIO_AD_08	Yes	
68	PERI_PWR_EN		No	Power enable signal for external peripherals. No external must drive any signal to the i.MX RT1166 MCU before this signal is active. The signal is active high and is connected to the on-board generated 3.3V supply rail. If all external circuits that can drive a signal to the i.MX1166 MCU are powered from the uCOM-generated 3.3V and 1.8V supplies, this gating signal can be ignored.
69	GND			
70	POR_B	POR_B		3.3V translated signal of the i.MX RT1166 MCU's POR_B. Signal shall normally only be used to connect to debug interface connector. Use signals PWR_CYCLE_IN (JB pin 74)

				to power cycle reset of the board. Note: a 50K-100K ohm pull-up resistor must be connected to this signal and to JA pin 20, 22, 24, 26, 28, 30 in the other end (the internally generated 3.3V supply). Do not leave this pin floating!
71	ETH_LED_10/100	-		Not connected
72	ONOFF	ONOFF		Connected to ONOFF on the i.MX RT1166 MCU
73	ETH_LED_1000	-		Not connected
74	PWR_CYCLE_IN			A low pulse on this input cause a power cycle reset of the board.
75	ETH_LED_ACT	-		Not connected
76	BOOT_MODE0	GPIO_LPSR_02	No	This signal shall be left unconnected under normal operation. The Boot Mode is controlled by signals ISP_ENABLE (JB pin 100) and BOOT_CTRL (JB pin 98). Note. This signal is 1.8V logic level.
77	GND			
78	BOOT_MODE1	GPIO_LPSR_03	No	This signal shall be left unconnected under normal operation. The Boot Mode is controlled by signals ISP_ENABLE (JB pin 100) and BOOT_CTRL (JB pin 98). Note. This signal is 1.8V logic level.
79	ETH_TRXP1	-		Not connected
80	TEST_MODE	-		Not connected
81	ETH_TRXN1	-		Not connected
82	JTAG_VCC			The supply voltage of the JTAG debug interface, 3.3V
83	GND			
84	GND			
85	ETH_TRXP0	-		Not connected
86	JTAG_TCK	GPIO_LPSR_14	Yes	
87	ETH_TRXN0	-		Not connected
88	JTAG_TMS	GPIO_LPSR_15	Yes	
89	GND			
90	JTAG_TDI	GPIO_LPSR_12	Yes	
91	ETH_TRXN3	-		Not connected
92	JTAG_TDO	GPIO_LPSR_11	Yes	
93	ETH_TRXP3	-		Not connected
94	JTAG_TRST	GPIO_LPSR_10	Yes	Leave this signal unconnected.
95	GND			
96	JTAG_MOD	GPIO_LPSR_13	Yes	
97	ETH_TRXN2	-		Not connected
98	BOOT_CTRL			See section 8.5 for details about boot control and options. Leave pin floating, which means that the i.MX RT1166 MCU boots from on-chip OTP fuses (programmed to boot from on-board QSPI flash) but connect this pin to the ground via a zero-ohm resistor that is not mounted . This would make it easy to ground the pin, if ever needed in the future.
99	ETH_TRXP2	-		Not connected
100	ISP_ENABLE			Leave floating/open for normal boot. Pull low to ground to place i.MX RT1166 MCU in USB OTG

boot mode (during next power cycle).

The table below lists the pins on expansion connector JC (40-pos connector).

JC Pin Number	EAuCOM Board Signal	i.MX RT1166 Ball Name	Alternative Pin Function?	Notes
1	SD-B_VCC	NVCC_SD1		Internal SD1 interface supply voltage output. Do not connect to this supply voltage when on-board Wi-Fi/BT module is mounted.
2	GND			
3	SD-B_CLK	SD1_CLK	Yes	Not connected when on-board Wi-Fi/BT module mounted.
4	Board specific	GPIO_EMC_B2_19	Yes	
5	SD-B_CMD	SD1_CMD	Yes	Not connected when on-board Wi-Fi/BT module mounted.
6	Board specific	GPIO_EMC_B2_20	Yes	
7	SD-B_DATA0	SD1_DATA0	Yes	Not connected when on-board Wi-Fi/BT module mounted.
8	Board specific	GPIO_SNVS_02		Not connected when on-board Wi-Fi/BT module mounted.
9	SD-B_DATA1	SD1_DATA1	Yes	Not connected when on-board Wi-Fi/BT module mounted.
10	Board specific	GPIO_SNVS_03		Not connected when on-board Wi-Fi/BT module mounted.
11	SD-B_DATA2	SD1_DATA2	Yes	Not connected when on-board Wi-Fi/BT module mounted.
12	GND			
13	SD-B_DATA3	SD1_DATA3	Yes	Not connected when on-board Wi-Fi/BT module mounted.
14	Board specific	GPIO_SNVS_04		Not connected when on-board Wi-Fi/BT module mounted.
15	Board specific	GPIO_SNVS_01	Yes	Note. This signal is 1.8V logic level.
16	Board specific	GPIO_SNVS_05		Not connected when on-board Wi-Fi/BT module mounted.
17	Board specific	GPIO_SNVS_02	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
18	Board specific	GPIO_SNVS_06		Note. This signal is 1.8V logic level.
19	Board specific	GPIO_SNVS_03	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
20	Board specific	GPIO_SNVS_07	Yes	Note. This signal is 1.8V logic level.
21	Board specific	GPIO_SD_B2_04	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
22	GND			
23	Board specific	GPIO_SNVS_04	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
24	Board specific	GPIO_SNVS_08	Yes	Note. This signal is 1.8V logic level.
25	Board specific	GPIO_SNVS_05	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
26	Board specific	-		Not connected
27	SAI_TXFS	GPIO_AD_23	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
28	Board specific			
29	SAI_TXD	GPIO_AD_21	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
30	Board specific			
31	SAI_TXC	GPIO_AD_22	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
32	GND			
33	SAI_RXD	GPIO_AD_20	Yes	Not connected if on-board Wi-Fi/BT module is mounted.
34	Board specific			
35	Board specific	GPIO_AD_18	Yes	

36	Board specific		
37	Board specific	GPIO_AD_19	Yes
38	Board specific		
39	Board specific	GPIO_AD_17	Yes
40	Board specific		

The table below lists the pins on expansion connector JD (40-pos connector).

JD Pin Number	EAuCOM Board Signal	i.MX RT1166 Ball Name	Alternative Pin Function?	Notes
1	DSI_DN3	-		Not connected
2	CSI_CKN	CSI_CKN	No	
3	DSI_DP3	-		Not connected
4	CSI_CKP	CSI_CKP	No	
5	GND			
6	GND			
7	DSI_DN0	DSI_DN0	No	
8	CSI_DN0	CSI_DN0	No	
9	DSI_DP0	DSI_DP0	No	
10	CSI_DP0	CSI_DP0	No	
11	GND			
12	GND			
13	DSI_DN2	-		Not connected
14	CSI_DN1	CSI_DN1	No	
15	DSI_DP2	-		Not connected
16	CSI_DP1	CSI_DP1	No	
17	GND			
18	GND			
19	DSI_DN1	DSI_DN1	No	
20	CSI_DN2	-		Not connected
21	DSI_DP1	DSI_DP1	No	
22	CSI_DP2	-		Not connected
23	GND			
24	GND			
25	DSI_CKN	DSI_CKN	No	
26	CSI_DN3	-		Not connected
27	DSI_CKP	DSI_CKP	No	
28	CSI_DP3	-		Not connected
29	GND			
30	GND			
31	Board specific	-		Not connected
32	PCIE_RXN	-		Not connected
33	PCIE_CLKREQ_B	-		Not connected

34	PCIE_RXP	-	Not connected
35	GND		
36	GND		
37	PCIE_CLKN	-	Not connected
38	PCIE_TXN	-	Not connected
39	PCIE_CLKP	-	Not connected
40	PCIE_TXP	-	Not connected

4 Murata 1XK Wi-Fi/BT Module

The default mounting option for the *iMX RT1166-32 uCOM* board is to mount the high-performance, power-efficient 1XK Wi-Fi/BT module from Murata. Other Wi-Fi/BT modules can also be mounted. Contact Embedded Artists for a discussion. The u.fl. antenna connector is located in the lower left corner.

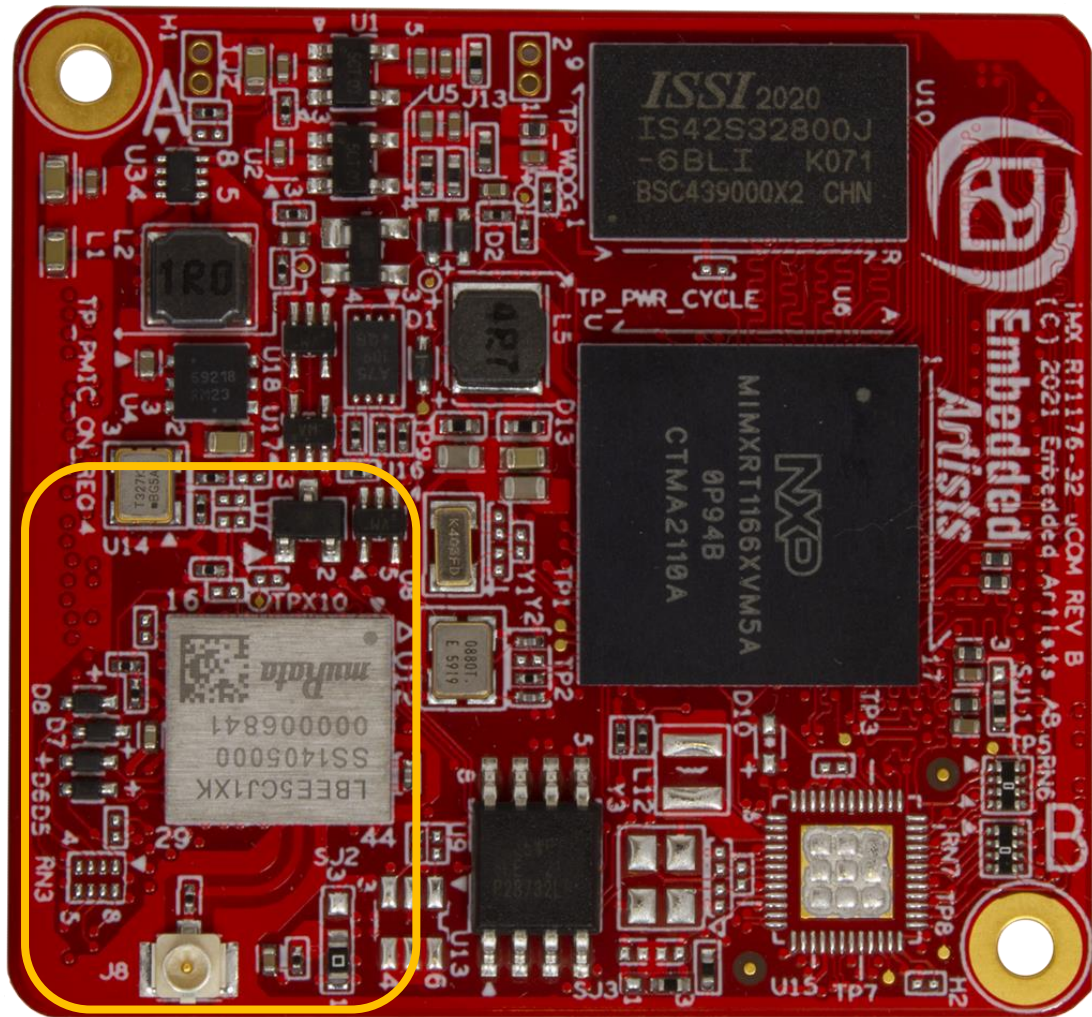


Figure 3 – Wi-Fi/BT Module Mounted on iMX RT1166 uCOM Board

The Wi-Fi/BT module is powered by default from an external 3.3V source. Design this supply to be able to handle 1A current peaks.

5 Powering and Integration

The i.MX RT1166 uCOM board has several internal voltage regulators. Some of these are also available for the carrier board design, reducing integration cost. Designs with moderate power consumption may not need any external power supply at all on the carrier board. Everything can be handled by the on-board generated voltage supplies.

5.1 Available Power Supply Rails

The table below presents the available power rails that can be used on the carrier board that the *iMX RT1166 uCOM Board* is integrated on.

Power Rail Output	Description	Voltage Range	Max Current
NVCC_3V3 on JA pins 20/22/24/26/28/30	3.3V for external use on carrier board.	3.3V	400mA
NVCC_1V8 on JA pins 19/21/23/25/27/29	1.8V for external use on carrier board.	1.8V	150mA

Note that each pin on the Hirose DF40C expansion connectors can carry 300mA maximum. Connect to all pins on the expansion connectors that carry a specific power rail. High current power rails have more than one pin.

Note that external load variations can affect the internal voltage regulators operation and potentially disturb the i.MX RT1166 MCU operation. Make sure that the carrier board electronics does not have abrupt consumption variations and does not generate noise on the power rails. Also **calculate the heat dissipation** of the voltage converters in case the carrier board has high current consumption.

The 5 to 3.3V voltage regulator is a buck dc/dc voltage regulator with 85% efficiency and the 1.8V voltage regulator is an LDO, supplied from the 3.3V internal power supply.

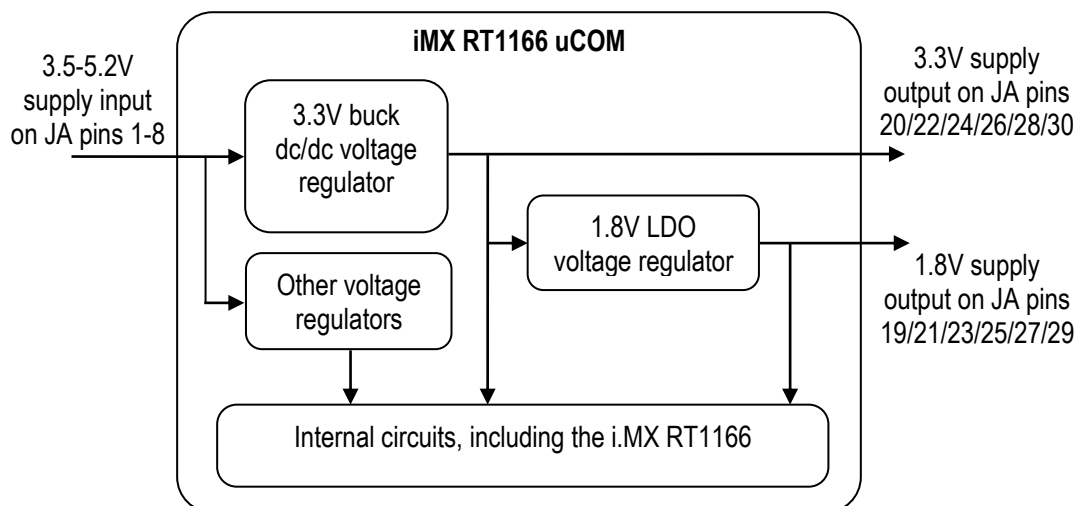


Figure 4 – iMX RT1166 uCOM Board Powering Architecture

5.2 Integration

This integration is very simple. An external 3.5-5.2V supply is basically all that is needed. The internal RTC can optionally be powered from a separate RTC supply input.

- Supply the 3.5-5.2V input voltage to **VSYS_IN** (connect to all eight pins on connector JA)

- Optionally supply a 3.5-5.2V input voltage to **VBAT_RTC_IN** to power the real-time clock (RTC) and keep it running. If no supply is connected to VBAT_RTC_IN, the RTC is powered from VSYS_4V2 supply input if this is valid.
- Leave signals BAT_TEMP, BAT_CURRP and BAT_CURRN unconnected.
- Leave supply inputs PSU_5V on JA pin 54/56/58/60 and VBUS_USB on JA pin 62/64/66/68 unconnected.

6 Technical Specification

6.1 Absolute Maximum Ratings

All voltages are with respect to ground, unless otherwise noted. Stress above these limits may cause malfunction or permanent damage to the board.

Symbol	Description	Min	Max	Unit
VSYS_IN	Main input supply voltage	-0.3	5.5	V
VDD_RF	RF module input supply voltage	-0.3	3.6	V
VDD_RTC_IN	RTC supply voltage	-0.3	3.7	V
VIO	Vin/Vout (I/O VDD + 0.3): 3.3V IO	0	3.6	V
	Vin/Vout (I/O VDD + 0.3): 1.8V IO	0	1.98	V
USB_xx_VBUS	USB VBUS signals	-0.3	5.25	V
USB_xx_DP/DN	USB data signal pairs	-0.3	3.63	V

6.2 Recommended Operating Conditions

All voltages are with respect to ground, unless otherwise noted.

Symbol	Description	Min	Typical	Max	Unit
VSYS_IN^[1]	Main input supply voltage	4.2		5.0	V
	Ripple with frequency content < 10 MHz			50	mV
	Ripple with frequency content ≥ 10 MHz			10	mV
VDD_RF	RF module input supply voltage	3.1		3.4	V
	Ripple with frequency content < 10 MHz			50	mV
	Ripple with frequency content ≥ 10 MHz			10	mV
VDD_RTC_IN^[1]	RTC supply voltage	3.0		3.5	V
	Note: This voltage must remain valid at all times for correct operation of the board (including, but not limited to the RTC).				
USB_xx_VBUS	USB VBUS signals		5	5.25	V

^[1] Either VSYS_IN or VDD_RTC_IN must be present (and within valid range) for correct operation of the board (including, but not limited, the ONOFF functionality and the RTC).

6.3 Power Ramp-Up Time Requirements

Input supply voltages (VSYS_IN and VDD_RTC_IN) shall have smooth and continuous ramp from 10% to 90% of final set-point. Input supply voltages shall reach recommended operating range in 1-20 ms.

6.4 Electrical Characteristics

For DC electrical characteristics of specific pins, see NXP's *i.MX RT1160 Crossover Processor Datasheet*. The internal VDD operating point for GPIOs is 3.3V or 1.8V for all signals.

6.4.1 Reset Input

The reset input is triggered by pulling the reset input low (0.2 V max). The internal power on sequence will start immediately on the negative edge of the reset input.

6.5 Power Consumption

There are several factors that determine power consumption of the *iMX RT1166-32 uCOM Board*, like input voltage, operating temperature, SDRAM/QSPI/Wi-Fi activity, operating frequencies for the different cores, body biasing and the software executed.

The values presented are typical values and should be regarded as an estimate. Always measure current consumption in the real system to get a more accurate estimate.

Symbol	Description (VIN = 5.0V, Toperating = 25°C)	Typical	Max Observed	Unit
I _{VSYS_IN_MAX}	Maximum CPU load, 500/240 MHz ARM Cortex-M7/M4 frequency	TBD	TBD	mA
I _{VSYS_IN_SDRAM}	Additional current for SDRAM	TBD	TBD	mA
I _{VDD_RF}	Current to 1XK Wi-Fi/BT module Note: power supply must be able to handle peak current		600	mA
I _{VSYS_IN_SYSIDLE}	System idle state	TBD	TBD	mA
I _{VSYS_IN_LPIDLE}	Low power idle state	TBD	TBD	mA
I _{VSYS_IN_SUSPEND}	Suspend state	TBD	TBD	uA
I _{VBAT_RTC_IN_RTC}	Current consumption to keep internal RTC running	TBD	TBD	uA

6.6 Mechanical Dimensions

The table below presents the mechanical dimensions of the module.

Dimension	Value (±0.1 mm)	Unit
Module width	42	mm
Module height	45	mm
Module top side height	2.0	mm
Module bottom side height	1.4	mm
PCB thickness	1.4	mm
Mounting hole diameter	2.3	mm
Module weight	2 ±0.5 gram	gram

The picture below show the mechanical details of the *iMX RT1166-32 uCOM Board*. The outer measurement is 42 x 45 mm. Note that the picture is seen from the bottom side.

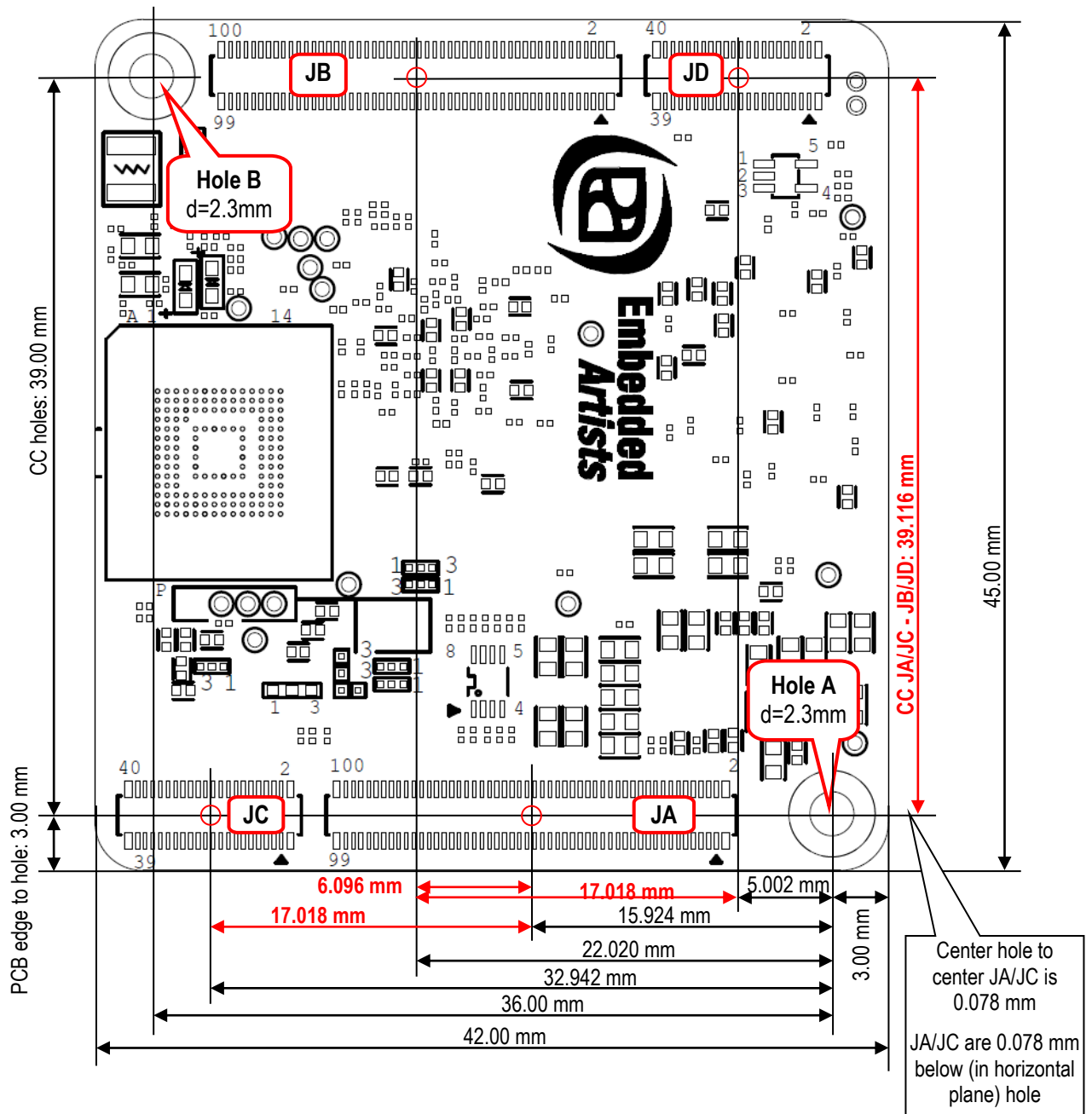


Figure 5 – iMX RT1166-32 uCOM Board Mechanical Outline, View from Bottom Side

Note that placement of the connectors on the carrier board is very important. They must be parallel and have a placement tolerance of ± 0.1 mm (non-accumulative). Make sure the relative measures between the connectors (marked with red in the picture above) are correct.

Note that the mounting hole location shall be measured relative to the three connectors, not relative to the pcb edge.

Since the stacking height is only 1.5mm in normal case, make sure no components other than the three connectors are within the dotted red line. When using 3mm stacking height it is possible to have low-profile components under the *iMX RT1166-32 uCOM Board*. The picture below illustrates the principal dimensions.

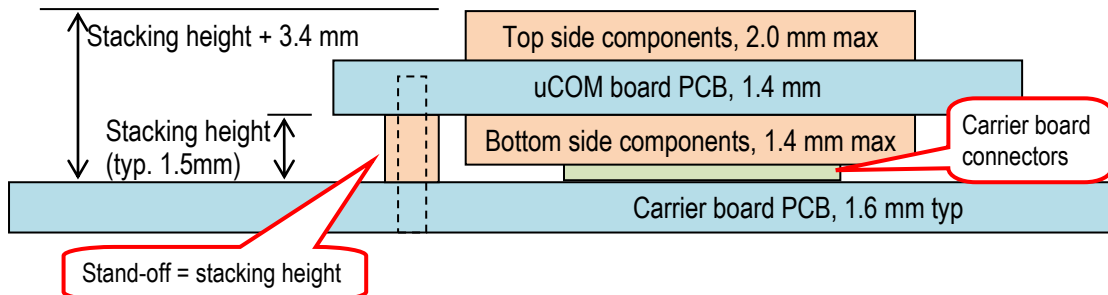


Figure 6 – uCOM Board Mounting on Carrier Board, Stacking Height

6.6.1 DF40C Socket

The headers mounted on the *iMX RT1166-32 uCOM Board* are DF40C-100DP-0.4V(51) (for JA / JB) and DF40C-40DP-0.4V(51) (for JC / JD).

The receptacles that are needed on the carrier board are, depending on stacking height:

Connector	1.5 mm stacking height (standard)	3.0 mm stacking height
100-pos (JA / JB)	DF40C-100DS-0.4V(51) HRS number: 684-4033-4 51	DF40HC(3.0)-100DS-0.4V(51) HRS number: 684-4151-0 51
40-pos (JC / JD)	DF40C-40DS-0.4V(51) HRS number: 684-4008-7 51	DF40HC(3.0)-40DS-0.4V(51) HRS number: 684-4169-6 51

If any of the connectors are not needed on the carrier board design, these do not have to be mounted. This typically applies to JC and JD.

6.6.2 Module Assembly Hardware

The *iMX RT1166-32 uCOM Board* has two 2.3 mm mounting holes for securing a good mechanical mounting. Use M2 screws and associated standoffs that have the same height as the stacking height (1.5mm or 3 mm, depending on carrier board connectors).

When mounting the *iMX RT1166-32 uCOM board*, match hole A on the carrier board with hole A on the uCOM board before the final mounting.

A suitable threaded insert is 9774015243R from Würth Elektronik. This component is used on the *uCOM Carrier Board*.

6.7 Environmental Specification

6.7.1 Operating Temperature

Ambient temperature (T_A)

Parameter	Min	Max	Unit
Operating temperature range:	0	70 ^[1]	°C
	-40	85 ^[1]	°C
Storage temperature range	-40	85	°C
Junction temperature i.MX RT1166 MCU, operating:	0	95	°C
	-40	105	°C

^[1] Depends on cooling/heat management solution.

6.7.2 Thermal Parameters

The i.MX RT1166 MCU thermal parameters are listed in the table below.

Parameter	Typical	Unit
Thermal Resistance, Junction to ambient ($R_{\theta JA}$), natural convection	31.6	°C/W
Thermal Resistance, Junction to package top ($R_{\theta JC}$)	10	°C/W

6.7.3 Relative Humidity (RH)

Parameter	Min	Max	Unit
Operating: $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, non-condensing (comm. temp. range)	10	90	%
Operating: $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, non-condensing (ind. temp. range)			
Non-operating/Storage: $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, non-condensing	5	90	%

6.7.4 Thermal Design Considerations

Heat dissipation from the i.MX RT1166 MCU depending on many operating conditions, like operating frequency, operating voltage, activity type, activity cycle duration and duty cycle. Dissipated heat can be up to 2.5 Watt but is typically much lower. Note that an active Wi-Fi module or Ethernet-Phy can have considerable heat dissipation. This must be taken into account also.

If external cooling is needed, or not, depends on dissipated heat and ambient temperature range. In most cases it is possible to operate the *iMX RT1166 uCOM Board* without external cooling, at least with ambient temperature up to +50° Celsius. Above this, care must be taken not to exceed max junction temperature of the i.MX RT1166 MCU.

Verify operating conditions in the final product. Self-heating in an application can sometimes be significant (depending on ventilation and cooling). Always measure the operating temperature on the i.MX RT1166 MCU under worst case situation (lowest temperature, no execution activity versus highest temperature, maximum execution). Verify that the case temperature is within allowed limits.

The i.MX RT1166 MCU has an integrated temperature sensor for monitoring the junction (i.e., die) temperature.

6.7.5 Humidity Design Considerations

Also make sure the relative humidity (RH) limits are met. The non-condensing requirement is important to meet. This can be a problem if temperature in the system is varying rapidly.

6.8 Product Compliance

Visit Embedded Artists' website at http://www.embeddedartists.com/product_compliance for up to date information about product compliances such as CE, RoHS2/3, Conflict Minerals, REACH, etc.

7 Functional Verification and RMA

There is a number of functional tests that can be performed on the *iMX RT1166-32 uCOM Board* to verify correct operation on the different interfaces. Note that these tests must be performed on the carrier board that is supplied with the *iMX RT1166-32 uCOM Developer's Kit* and with the latest version of an unmodified copy of the patched SDK that Embedded Artists provide.

The tests can also be done to troubleshoot a board that does not seem to operate properly. It is strongly advised to read through the list of tests and actions that can be done before contacting Embedded Artists. The different tests can help determine if there is a problem with the board, or not. For return policy, please read Embedded Artists' General Terms and Conditions document (http://www.embeddedartists.com/sites/default/files/docs/General_Terms_and_Conditions.pdf).

8 Things to Note

This chapter presents a number of issues and considerations that users must note.

8.1 Shared Pins and Multiplexing

The i.MX RT1166 Crossover microcontroller has multiple on-chip interfaces that are multiplexed on the external pins. It is not possible to use all interfaces simultaneously and some interface usage is prohibited by the *iMX RT1166-32 uCOM* on-board design. Check if the needed interfaces are available to allocation before starting a design. There is a separate Excel sheet for this, showing all the pin multiplexing options available for each signal on the DF40C expansion connectors.

8.2 On-board I2C Connected Devices

There is an I2C-E2PROM connected to the I2C-A channel, as outlined in the table below. Note that maximum clock frequency on I2C-A is 400kHz.

Board Revisions	Reserved I2C-E2PROM
Component mounted	Microchip 24LC64T-E/MNY
B	Connected to I2C-A 7-bit address 0x55 8-bit address 0xAA/0xAB

Note that the on-board I2C-E2PROM is reserved for future, internal use. The E2PROM is write-protected in normal operation.

Note that it is not possible to connect an external I2C-device to IC2-channel #A on the carrier board to the already taken addresses, see table above.

8.3 Program Content when uCOM Boards are Delivered

The *iMX RT1166 uCOM* board is delivered with a pre-programmed application that is just a forever loop of NOP operations. No pin initialization is done so the application mimics what happens if the program flash would be empty or if USB Boot loader/ISP mode is enabled.

Note that in general **it is a bad idea to assume an *iMX RT1166 uCOM* board is always empty when you first mount in on a carrier board**. The board can have been accidentally programmed with another application during the program development work.

It is strongly recommended to implement a procedure to always make sure a known application is programmed a *iMX RT1166 uCOM* board when mounted on a carrier board. Before powering a board that has just been mounted on a carrier board, place the processor in USB Boot loader/ISP mode (by pulling pin ISP_Enable low). Design the carrier board so that a processor in USB Boot loader mode/ISP will not be damaged or do anything harmful to the carrier board. Program the correct application directly after powering the carrier board (with the new *iMX RT1166 uCOM* board).

Note that when the *iMX RT1166 uCOM* board is sold as part of a *iMX RT1166 Developer's Kit*, a demo application is programmed to the board. This is one of the reasons to never assume an *iMX RT1166 uCOM* board does not have an application programmed.

8.4 Note uCOM Orientation when Mounting

It is possible to mount the uCOM board with incorrect orientation. Doing that will damage the uCOM board beyond repair and can also damage the carrier board. Make sure (production) mounting instructions are particular about the orientation and how to identify the correct orientation of the uCOM. It is recommended to add notes in the silk screen on the carrier board to make operators aware of the issue. The picture below illustrates the silk screen text found on the *uCOM Carrier Board*.

Always match the "A" and "B" marking on the uCOM with the "A" and "B" on the *Carrier Board*.

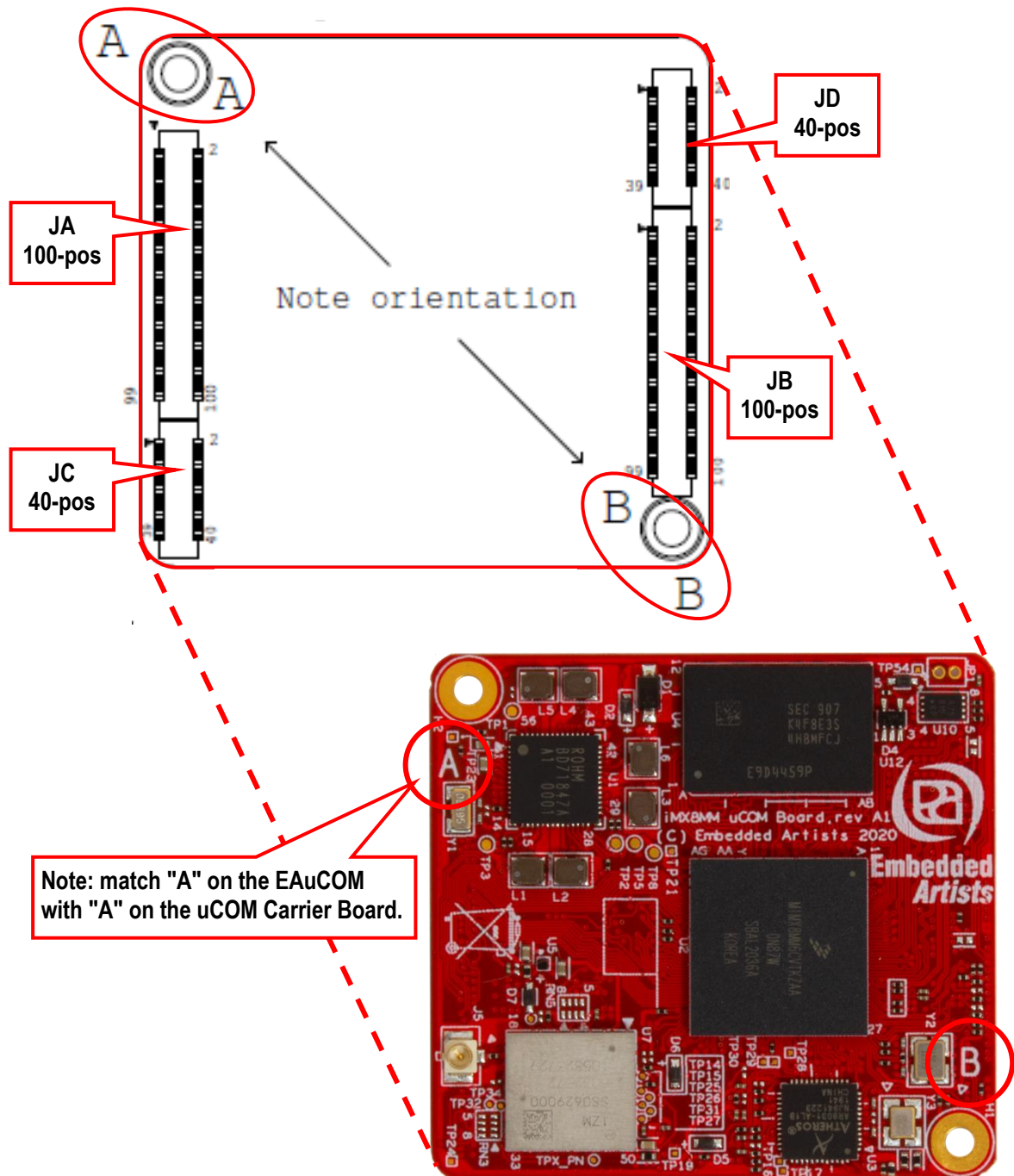


Figure 7 – Orientation of uCOM Board when Mounting on Carrier Board

8.5 OTP Fuse Programming and Boot Control

The i.MX RT1166 MCU has on-chip OTP fuses that can be programmed, see NXP documents *IMXRT1160RM*, *i.MX RT1160 Processor Reference Manual* for details. Once programmed, there is no possibility to reprogram them.

iMX RT1166 uCOM Boards are delivered with BT_FUSE_SEL = 1. No other OTP fuse has been programmed. It is completely up to the COM board user to decide if OTP fuses shall be programmed, and in that case, which ones.

Just programming BT_FUSE_SEL = 1 will set the boot device to the on-board QSPI flash. It is possible to specify another boot mode by programming the BOOT_CFG1[7:0] and BOOT_CFG2[3:0] fuses.

Note that Embedded Artists does not replace iMX RT1166 uCOM Boards because of wrong OTP programming. It's the user's responsibility to be absolutely certain before OTP programming and not to program the fuses by accident.

Note that signal BOOT_CTRL can be either high or low. It does not matter. The result is the same since BT_FUSE_SEL = 1. The board will boot according to OTP fuses. The default (when no specific fuses, except BT_FUSE_SEL, are programmed) is from external QSPI flash. Other boot sources are possible by programming OTP fuses. See NXP document *IMXRT1160RM*, *i.MX RT1160 Processor Reference Manual* for details.

8.6 Handle the uCOM Board with Great Care

Handle the *iMX RT1166 uCOM board* with great mechanical care. Only remove/unmount it from the *uCOM Carrier board* if absolutely needed. Only use small movements and small force. Do not insert a screwdriver between the uCOM board and uCOM Carrier board and bend without having first watched the Youtube video we have published about this topic:

https://www.youtube.com/watch?v=-a1UGi_rLM, title "How to mount and unmount a uCOM board"

8.7 Integration - Contact Embedded Artists

It is strongly recommended to contact Embedded Artists at an early stage in your project. A wide range of support during evaluation and the design-in phase are offered, including but not limited to:

- *iMX RT1166 uCOM Developer's Kit* to simplify evaluation
- Custom Carrier board design, including 'ready-to-go' standard carrier boards
- Display solutions
- Mechanical solutions
- Schematic review of customer carrier board designs
- Driver and application development

The *iMX RT1166-32 uCOM Board* targets a wide range of applications, such as:

- HMI/GUI solutions
- Connected vending machines
- Point-of-Sale (POS) applications
- Access control panels
- Audio
- IP phones
- Smart appliances
- Home energy management systems
- Industrial automation
- HVAC Building and Control Systems
- Smart Grid and Smart Metering
- Smart Toll Systems
- Data acquisition
- Communication gateway solutions
- Connected real-time systems
- ...and much more

For more harsh use and environments, and where fail-safe operation, redundancy or other strict reliability or safety requirements exists, always contact Embedded Artists for a discussion about suitability.

There are application areas that the *iMX RT1166-32 uCOM Board* is not designed for (and such usage is strictly prohibited), for example:

- Military equipment
- Aerospace equipment
- Control equipment for nuclear power industry
- Medical equipment related to life support, etc.
- Gasoline stations and oil refineries

If not before, **it is essential to contact Embedded Artists before production begins**. In order to ensure a reliable supply for you, as a customer, we need to know your production volume estimates and forecasts. Embedded Artists can typically provide smaller volumes of the *iMX RT1166-32 uCOM Board* directly from stock (for evaluation and prototyping), but **larger volumes need to be planned**.

The more information you can share with Embedded Artists about your plans, estimates and forecasts the higher the likelihood is that we can provide a reliable supply to you of the *iMX RT1166-32 uCOM Board*.

8.8 ESD Precaution when handling the uCOM Board

Please note that the *iMX RT1166-32 uCOM Board* come without any case/box and all components are exposed for finger touches – and therefore extra attention must be paid to ESD (electrostatic discharge) precaution, for example use of static-free workstation and grounding strap. Only qualified personnel shall handle the product.



Make it a habit always to first touch the mounting hole (which is grounded) for a few seconds with both hands before touching any other parts of the boards. That way, you will have the same potential as the board and therefore minimize the risk for ESD.

In general touch as little as possible on the boards in order to minimize the risk of ESD damage. The only reasons to touch the board are when mounting/unmounting it on a carrier board.

Note that Embedded Artists does not replace boards that have been damaged by ESD.

8.9 EMC / ESD

The *iMX RT1166-32 uCOM Board* has been developed according to the requirements of electromagnetic compatibility (EMC). Nevertheless depending on the target system, additional anti-interference measurement may still be necessary to adherence to the limits for the overall system.

The *iMX RT1166-32 uCOM Board* must be mounted on carrier board (typically an application specific board) and therefore EMC and ESD tests only makes sense on the complete solution.

No specific ESD protection has been implemented on the *iMX RT1166-32 uCOM Board*. ESD protection on board level is the same as what is specified in the i.MX RT1166 MCU datasheet. **It is strongly advised to implement protection against electrostatic discharges (ESD) on the carrier board** on all signals to and from the system. Such protection shall be arranged directly at the inputs/outputs of the system.

9 Custom Design

This document specifies the standard *iMX RT1166-32 uCOM Board* design. Embedded Artists offers many custom design services. Contact Embedded Artists for a discussion about different options.

Examples of custom design services are:

- Mounting a different Wi-Fi/BT module.
- Different memory sizes on SDRAM and QSPI Flash.
- Different I/O voltage levels on all or parts of the pins.
- Different mounting options, for example add Gigabit Ethernet interface
- Different pinning on DF40C connectors.
- Different board form factor and different expansion connectors (different board standard).
- Different input supply voltage range.
- Single Board Computer solutions, where the core design of the *iMX RT1166-32 uCOM Board* is integrated together with selected interfaces.
- Changed internal pinning to make certain pins available.

Embedded Artists also offers a range of services to shorten development time and risk, such as:

- Standard Carrier boards ready for integration
- Custom Carrier board design
- Display solutions
- Mechanical solutions

10 Disclaimers

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Embedded Artists does not accept any liability for errata on individual components. Customer is responsible to make sure all errata published by the manufacturer of each component are taken note of. The manufacturer's advice should be followed.

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