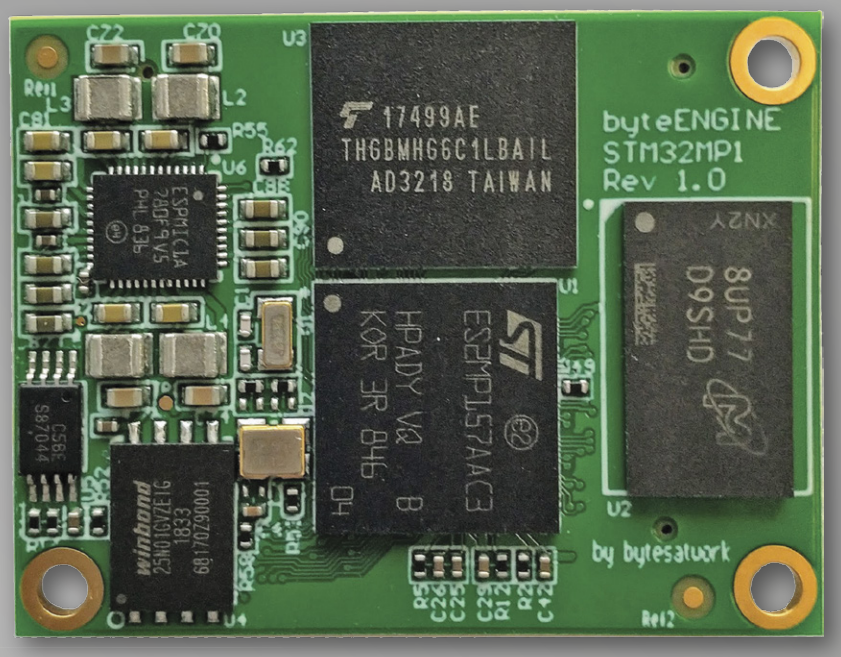
DataSheet

industrial computing module
byteENGINE STM32MP1x

Ver. 0.2 – 19. 03 2020



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Imprint

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Symbols and typographic conventions

These symbols represent important details or aspects for working with bytes at work AG-products.

NOTICE
Follow instructions. Acting against the procedure described can lead to malfunction.

LINK
Hyper- or Chapter-Link.

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1. Hardware Revisions

Hardware Revision	Marking on PCB	Release Date
1.2	byteENGINE STM32MP1x Rev 1.0	2019

2. Revisions history

2.1 Hardware revision 1.2

> 1.2 is the first version available for sales.

3. Overview

3.1 General Information

The byteENGINE STM32MP1x is a high performance industrial oriented computing module. It allows you a short time-to-market, reducing development costs and substantial design risks.

The system on module (SOM) uses the STM32MP15xxAC devices which are based on the high-performance dual-core ARM® Cortex®-A7 32-bit RISC core operating at up to 650 MHz/800 MHz. The STM32MP15xxAC devices also embed a Cortex®-M4 32-bit RISC core operating at up to 200 MHz frequency. The Cortex®-M4 core features a floating point unit (FPU) single precision which supports ARM® single-precision data-processing instructions and data types.

Furthermore, the STM32MP15xxAC devices embed a 3D graphic processing unit (Vivante® - OpenGL® ES 2.0) running at up to 533 MHz, with performances up to 26 Mtriangle/s, 133 Mpixel/s.

Scalable platform

> The STM32 family of 32-bit Flash micro-controllers based on the ARM® Cortex®-M processor are on the cutting edge of their industry thanks to the combination of functional integration, performance and extremely low current consumption.

> The combination of Cortex®-A7 and Cortex®-M4 with full access to the peripherals is one-of-a-kind and makes a versatile range of designs possible. Depending on the application, you can use a PIN in Cortex®-M4 for your real-time application or a PIN in embedded Linux on Cortex®-A7.

> The module byteENGINE STM32MP1x is the perfect basis for innovative developments.

Expandable design

> The module provides a matching Linux-Kernel. As a result, the byteENGINE offers flexibility for almost any requirement.

> The usage of familiar tools like CubeMX and Cube Library for the Cortex®-M4 is possible. Bytes at work offers the convenient Linux BSP tool with Yocto layer for the Cortex®-A7.

> The free available open-source code allows reliable functionality and maximum extensibility.

> The boot procedure can be secured so that only your software will run on the devices.

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3.2 Technical Data

Feature		Details
CPU	Architecture	Single or Dual Core ARM® Cortex™ -A7
	CPU	STM32MP15xxAC - See LINK for further Information: „3.4 Additional information" - See ST Homepage for further Information: „www.st.com/en/microcontrollers-microprocessors/stm32mp1-series.html"
	Frequency (max)	650 MHz / 800 MHz
	Floating Point	YES (NEON™)
	Co Processor	32-bit ARM® Cortex®-M4 with FPU/MPU up to 200 Mhz
	Security*	Secure boot, TrustZone® peripherals, active tamper
Memory	SDRAM	128 - 1024 MB DDR3
	FLASH	up to 64 GB eMMC or 128 MB serial NAND
	EEPROM	32 kB (containing HW Configuration)
	SPI Nor Flash	16 MB (can be used as boot device)
Ethernet	Speed	10/100/1000 (Mbit/s)
Multimedia	Video	Parallel RGB 24 bit up to 1366x768@60 FPS
	MIPI	2 DSI Lanes up to 1 GHz: only STM32MP157
	2D/3D Graphics*	Vivante® - OpenGL® ES 2.0 Up to 26 Mtriangle/s, 133 Mpixel/s (only STM32MP157)
	HDMI-CEC	1
	Camera Parallel	8- to 14-bit camera interface up to 140 Mbyte/s
Expansion	SD/MMC/SDIO	3
Serial	I^2S, PDM, S/PDIF	4
	SPI	6
	I^2C	6
	UART	4
	USART	4
	CAN	2
USB	2.0 HS	1 Host + 1 OTG
Miscellaneous	Watchdog Timers	3
	FSMC	Yes
	JTAG	Yes
	GPIO	176 GPIOS
	PWM / ECAP / QEP	4
	Motor Ctrl Timers	2
	Boot Mode	Selectable with Strapping Pins on Baseboard
	RTC	With sub-second accuracy and hardware calendar and backup battery input
	ADC	2x 16 Bit
	DAC	2x 12 Bit
	Temp	1
Hardware Acceleration	AES	128, 192, 256, TDES
	HASH	MD5, SHA-1, SHA224, SHA256, HMAC
	TRNG	2
	CRC	2
Mechanical Information	Input Voltage	3,3 - 5 V
	Power Consumption	~2 W
	Dimensions	30 x 40 x 5 mm
	Operational Temperature	-40 to +85° C
	Connector	2x 100 pin
Operating System	Linux (yocto)	Yes meta-bytesatwork available on github: follow LINK

3.3 STM32MP15xxAC block diagram

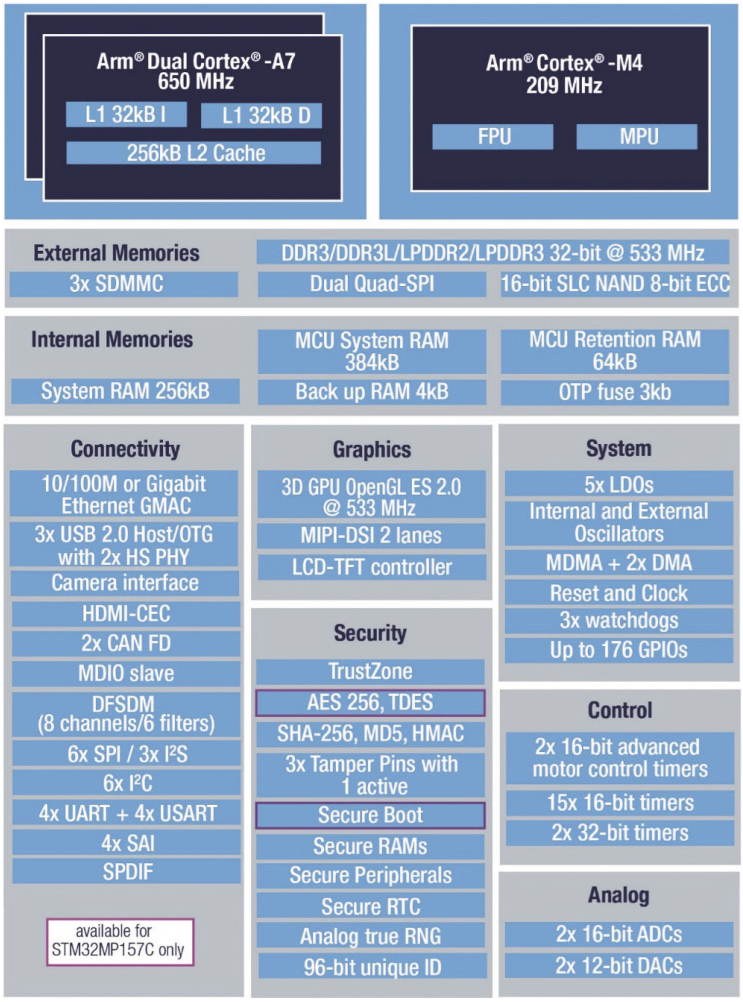
The ARM® Cortex®-A processor series is designed for devices undertaking complex compute tasks, such as hosting a rich operating system platform and supporting multiple software applications. Cortex®-A7, a power-efficient processor, is designed for use in a wide range of devices with differing requirements that demand a balance between power and performance.

The ARM® Cortex®-M processor series is designed to enable developers to create cost-sensitive and power-constrained solutions for a broad range of devices. Cortex®-M4 is a high-performance embedded processor developed to address digital signal control markets that demand an efficient, easy-to-use blend of control and signal processing capabilities.

The STM32MP15xxAC microprocessor contains the subsystems shown in the Functional Block Diagram:

Key Features of ST32MP15xxAC

- Single or Dual ARM® Cortex®-A7 processor @650/800MHz.
- 32-Bit ARM® Cortex®-M4 processor @ up to 200MHz.
- 3D GPU OpenGL ES2.0 graphics @522MHz.
- Robust hardware enablement for differentiated peripherals: LCD, UART, USART, Gbit Ethernet, 2x USB, touch screen control, integrated industrial protocols.
- 2000 MIPS and a power consumption of less than 2 Watt is Green IT by definition.
- The scalable memory (128MB up to 1GB) can be operated from -40˚ up to +85˚ Celsius.



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3.4 Additional information

For further information regarding the STM32MP15xxAC CPU, please visit the homepage of STMicroelectronics:

LINK:
STMicroelectronics

Features	STM32MP151	STM32MP153	STM32MP157
Cortex-A7	Single	Dual	Dual
Cortex-M4	Yes	Yes	Yes
GPU	No	No	Yes
Display	TFT	TFT	TFT/DSI
CAN	No	Yes	Yes

SECURITY

STM32MP15xAAC	Basic
STM32MP15xCAC	Secure boot + cryptography (CRYP)

3.5 Decision guidance byteENGINE STM32MP1x

The following three steps help identifying the suitable ARM® Cortex® Processor for the specific customer application.

> Step 1: The choice of needed CPU-Speed.

  > **Single or Dual Core ARM® Cortex®-A7 @650MHz**
  for details see „3.2 Technical Data“

> Step 2: The choice of needed flash memory type and capacity.

  > **eMMC: 4 up to 64 GB**

  > **serial NAND: 128 MB**

> Step 3: The choice of needed RAM capacity.

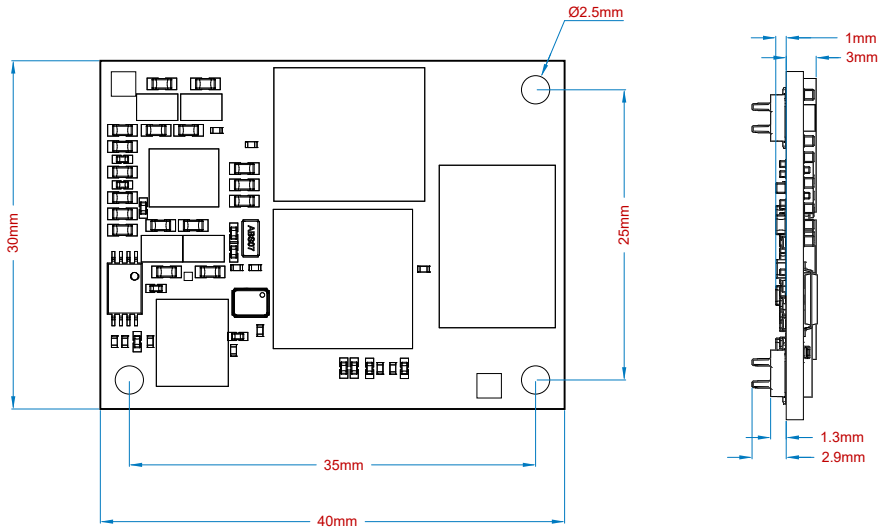
  > **Min: 256 MB (SDRAM)**

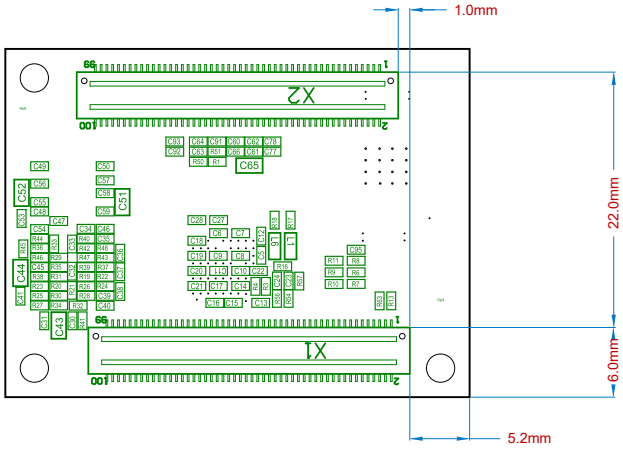
  > **Max: 1.024 MB (SDRAM)**

3.6 Dimensions of STM32MP1x

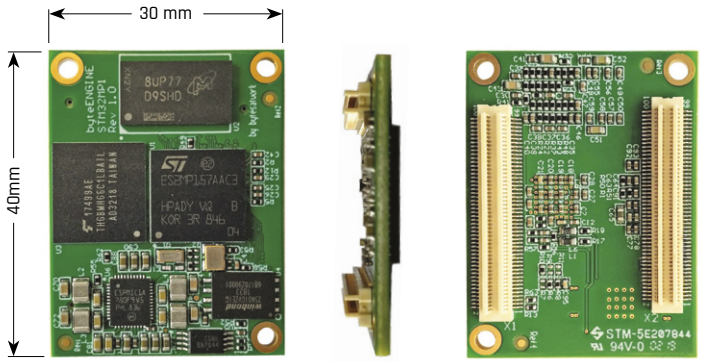
The following illustration shows all important dimensions for mounting and installation of the industrial computing module byteENGINE STM32MP1x.

> All dimensions are indicated in Millimetres (mm).





> Module design in scale 1:1:



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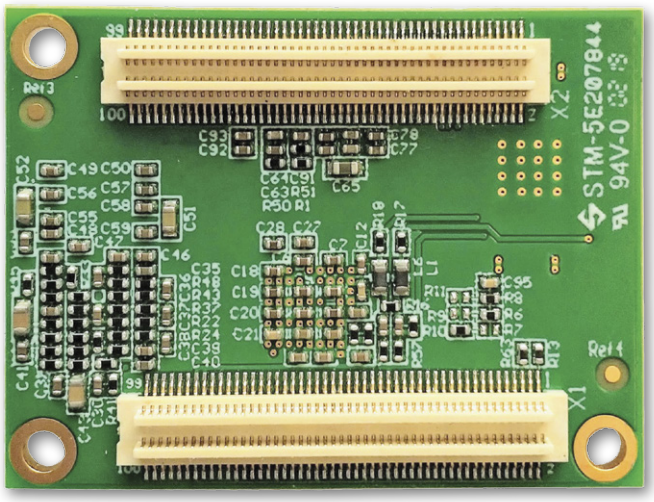
3.7 STM32MP1x connectors layout

The STM32MP1x is connected to the carrier board with 200 pins on two module connectors.
The following picture shows the location of the connectors on the bottom side of the SOM byteENGINE.



CONNECTORS

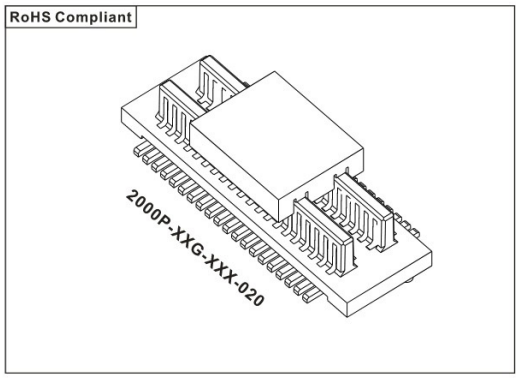
X1	USB, Ethernet, SPI, UART, I2C, SDMMC, AUDIO, ADC
X2	POWER, LCD, Flexible Memory Controller (FMC)

LINK:
Schematic of the connectors X1 and X2

NOTICE
The module is held in the connectors with a considerable retention force. To avoid damaging the modules' connectors as well as the carrier board connectors while removing the module the use of an extraction tool is strongly recommended.

3.8 Connectors - Neltron 2001S-100G-270-020

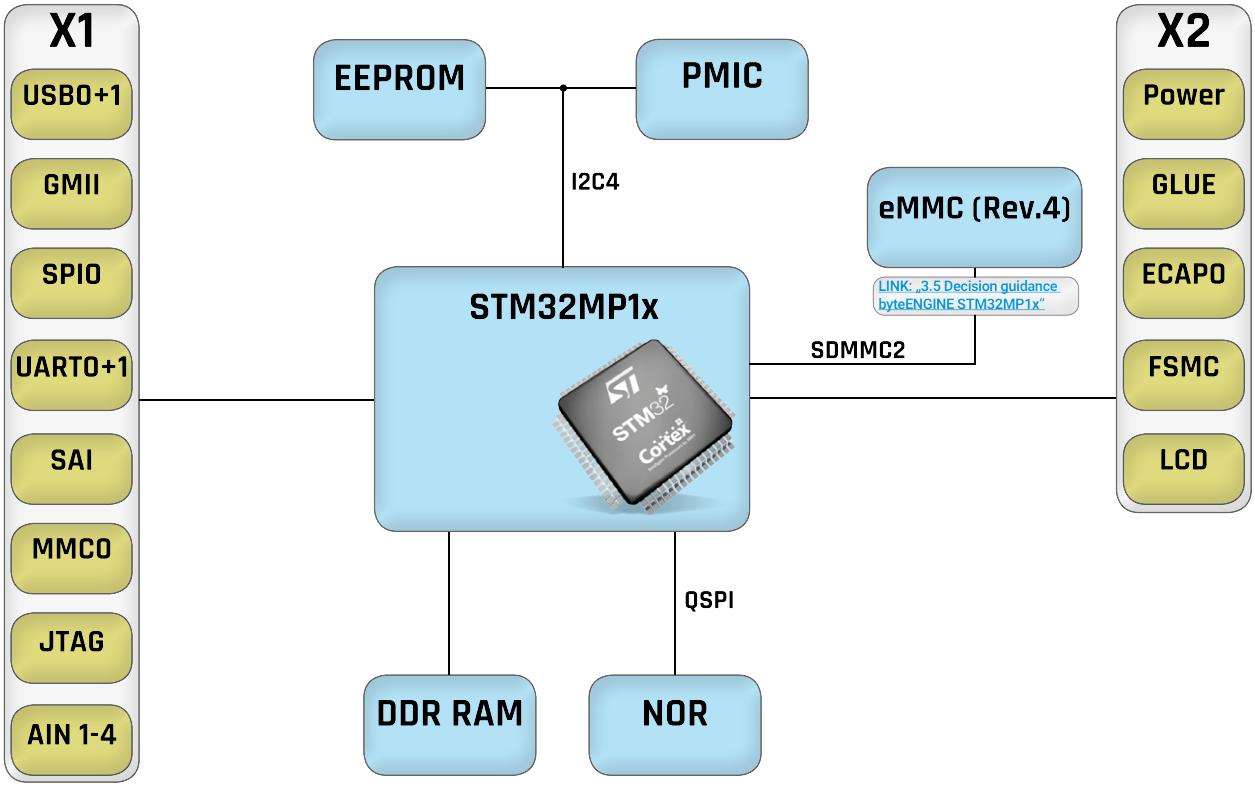
The byteENGINE uses two Neltron 0,5mm Board to Board Plug connectors.
For more specific information about the connectors used, please visit:



LINK:
Datasheet of Neltron 0,5mm Connectors

3.9 byteENGINE STM32MP1x Connectors Overview

The following illustration shows the „Default-Configuration" of the byteENGINE STM32MP1x. The function of the components shown in blue squares cannot be changed. The yellow squares show the module connectors X1 and X2. The functions of X1 and X2 can be adapted and each connector module serves multiple functions. The detailed pinout-functions are shown in chapter „4. Pinouts"



3.10 STM32CubeMX Tool - configuring the STM32MP15xxAC CPU

STM32CubeMX is a graphical tool that allows a very easy configuration of STM32 microcontrollers and microprocessors, as well as the generation of the corresponding initialization C code for the ARM® Cortex®-M core or a partial Linux® Device Tree for ARM® Cortex®-A core), through a step-by-step process.

The first step consists in selecting the STMicroelectronics STM32 microcontroller or microprocessor that matches the required set of peripherals.

For microprocessors, the second step allows to configure the GPIOs and the clock setup for the whole system, and to interactively assign peripherals either to the ARM Cortex®-M or to the Cortex®-A world. Specific utilities, such as DDR configuration and tuning, make it easy to get started with STM32 microprocessors. For Cortex®-M core, the configuration includes additional steps that are exactly similar to those described for microcontrollers.

For microcontrollers and microprocessor ARM® Cortex®-M, the second step consists in configuring each required embedded software thanks to a pinout-conflict solver, a clock-tree setting helper, a power-consumption calculator, and an utility that configures the peripherals (such as GPIO or USART) and the middleware stacks (such as USB or TCP/IP).

Eventually the user launches the generation that matches the selected configuration choices. This step provides the initialization C code for the ARM® Cortex®-M, ready to be used within several development environments, or a partial Linux® device tree for the ARM® Cortex®-A.

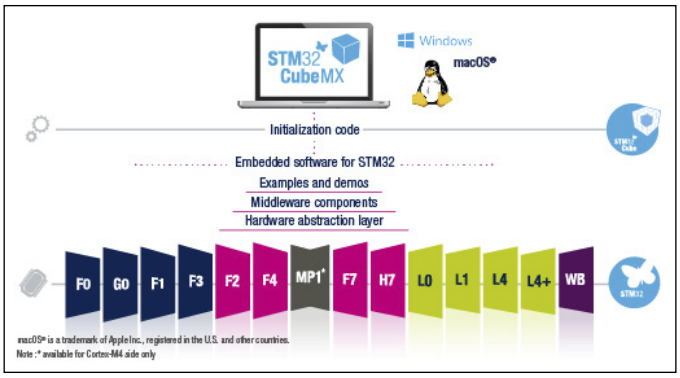
The Link on the right side delivers a prepared project from bytes at work.

NOTICE
Follow the Link to STM32CubeMX Tool. You need to install the Tool. Then choose the Processor.

LINK:
STM32CubeMX Tool

LINK:
byteENGINE STM32MP1x prepared CubeMX Project

LINK:
Step Model



4. Pinouts

The multiple pin configurations must be taken note when using processor signals.
The pins of the module connectors are described in detail in the following tables.

4.1 Restrictions

These peripherals are internally connected and should not be utilized in the customer design if the components are populated and in use.

Restricted peripherals

I2C4	PMIC and EEPROM
SDMMC2	eMMC
QUADSPI	SPI NOR Flash

4.2 Carrier board connectors X1

Con	Pin	Signal Name	Available Modes on Pin																		Note
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
X1	1	BOOT2																			
X1	2	GND																			
X1	3	n.c.																			
X1	4	PA15	ADC1_ EXTI15	ADC2_ EXTI15	CEC, I2S1_WS	I2S3_WS, SAI4_D2	SAI4_ FS_A	SD-MMC1_ CDIR	SD-MMC1_ D5	SD-MMC2_ CDIR	SDMMC2_ D5	SPI1_ NSS	SPI3_ NSS	SPI6_ NSS	SYS_DB-TRGI	TIM2_ CH1	TIM2_ ETR	UART4_ DE	UART4_ RTS	UART7_ TX, GPIO	
X1	5	NRST																			
X1	6	GND																			
X1	7	PB13	DFSDM1_ CKIN1	DFSDM1_ CKOUT	ETH1_ TXD1	I2S2_CK	LPTIM2_ OUT	SPI2_SCK	TIM1_ CH1N	UART5_ TX	USART3_ CTS	USART3_ NSS	GPIO								
X1	8	PB11	ADC1_ EXTI11	ADC2_ EXTI11	DFSDM1_ CKIN7	DSI HOST_TE	ETH1_ TX_CTL	ETH1_ TX_EN	I2C2_ SDA	LPTIM2_ ETR	LTDC_G5	TIM2_ CH4	USART3_ RX	GPIO							
X1	9	USB_DM1	USBH_ HS1_DM	USBH_ HS1_DM																	
X1	10	USB_DM2	USB_ OTG_HS_ DM	USBH_ HS2_DM	USB_OTG_ HS_DM																
X1	11	USB_DP1	USBH_ HS1_DP	USBH_ HS1_DP																	
X1	12	USB_DP2	USB_ OTG_HS_ DP	USBH_ HS2_DP	USB_OTG_ HS_DP																
X1	13	n.c.																			
X1	14	OTG_VBUS	USB_ OTG_ FS_ VBUS	USB_ OTG_ HS_ VBUS	USB_ OTG_FS_ VBUS																
X1	15	PB5		DCMI_ D10	ETH1_ CLK	ETH1_ PPS_ OUT	I2C1_ SMBA														
X1	16	PA10	USB_ OTG_ HS_ID	DC-MI_D1	I2S3_WS	LTDC_ B1	SAI4_ FS_B	SPI3_ NSS	TIM1_ CH3	US-ART1_ RX	USB_ OTG_ HS_ID	USB_ OTG_ FS_ID	MDIOS_ MDIO	GPIO							
X1	17	GND																			
X1	18	GND																			
X1	19	PC1	ETH1_ MDC	ADC1_ INN10	ADC1_ INP11	ADC2_ INN10	ADC2_ INP11	DFS-DM1_ CKIN4	DFS-DM1_ DATIN0	ETH1_ MDC	I2S2_ SDO	SAI1_D1	SAI1_ SD_A	SD-MMC2_ CK	SPI2_ MOSI	SYS_ TRA-CED0	SYS_ WKUP6	MDIOS_ MDC	TAMP_ IN3	GPIO	
X1	20	PA2	ETH1_ MDIO	ADC1_ INP14	ETH1_ MDIO	LP-TIM4_ OUT	LTDC_ R1	SAI2_ SCK_B	SD-MMC2_ D0DIR	SYS_ WKUP2	TIM15_ CH1	TIM2_ CH3	TIM5_ CH3	US-ART2_ TX	MDIOS_ MDIO	GPIO					
X1	21	GND																			
X1	22	GND																			

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Con	Pin	Signal Name	Available Modes on Pin																		Note
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
X1	23	PB12	ETH1_TXD0	DFSDM1_DATIN1	ETH1_TXD0	I2C2_SMBA	I2C6_SMBA	I2S2_WS	SPI2_NSS	TIM1_BKIN	UART5_RX	USART3_CK	USART3_RX	FDCAN2_RX	GPIO						
X1	24	PC4	ETH1_RXD0	ADC1_INP4	ADC2_INP4	DFSDM1_CKIN2	ETH1_RXD0	I2S1_MCK	SPDIFRX_IN2	GPIO											
X1	25	PG14	ETH1_TXD1	ETH1_TXD1	LPTIM1_ETR	LTDC_B0	QUADSPI_BK2_IO3	SAI4_D1	SAI4_SD_A	SPI6_MOSI	SYS_TRACED1	USART6_TX	FMC_A25	GPIO							
X1	26	PC5	ETH1_RXD1	ADC1_INN4	ADC1_INP8	ADC2_INN4	ADC2_INP8	DFSDM1_DATIN2	ETH1_RXD1	SAI1_D3	SAI1_D4	SAI4_D3	SAI4_D4	SPDIFRX_IN3	GPIO						
X1	27	PC2	ETH1_TXD2	ADC1_INN11	ADC1_INP12	DFSDM1_CKIN1	DFSDM1_CKOUT	ETH1_TXD2	I2S2_SDI	SPI2_MISO	GPIO										
X1	28	PH6	ETH1_RXD2	DCMI_D8	ETH1_RXD2	I2C2_SMBA	SPI5_SCK	TIM12_CH1	MDIOS_MDIO	GPIO											
X1	29	PE2	ETH1_TXD3	ETH1_TXD3	I2C4_SCL	QUADSPI_BK1_IO2	SAI1_CK1	SAI1_MCLK_A	SPI4_SCK	SYS_TRACECLK	FMC_A23	GPIO									
X1	30	PH7	ETH1_RXD3	DCMI_D9	ETH1_RXD3	I2C3_SCL	SPI5_MISO	MDIOS_MDC	GPIO												
X1	31	PG4	ETH1_GTX_CLK	ETH1_GTX_CLK	TIM1_BKIN2	FMC_A14	GPIO														
X1	32	PA1	ETH1_RX_CLK	ADC1_INN16	ADC1_INP17	ETH1_CLK	ETH1_REF_CLK	ETH1_RX_CLK	LPTIM3_OUT	LTDC_R2	QUADSPI_BK1_IO3	SAI2_MCLK_B	TIM15_CH1N	TIM2_CH2	TIM5_CH2	UART4_RX	USART2_DE	USART2_RTS	GPIO		
X1	33	PG11	ETH1_TX_EN	ADC1_EXTI11	ADC2_EXTI11	DCMI_D3	ETH1_TX_CTL	ETH1_TX_EN	LTDC_B3	SPDIFRX_IN0	SYS_TRACED11	UART4_TX	USART1_TX	GPIO							
X1	34	PB10	ETH1_RX_ER	DFSDM1_DATIN7	ETH1_RX_ER	I2C2_SCL	I2S2_CK	LPTIM2_IN1	LTDC_G4	QUADSPI_BK1_NCS	SPI2_SCK	TIM2_CH3	USART3_TX	GPIO							
X1	35	PA3	ETH1_COL	ADC1_INP15	ETH1_COL	LPTIM5_OUT	LTDC_B2	LTDC_B5	SYS_PVD_IN	TIM15_CH2	TIM2_CH4	TIM5_CH4	USART2_RX	GPIO							
X1	36	PA7	ETH1_RX_DV	ADC1_INN3	ADC1_INP7	ADC2_INN3	ADC2_INP7	ETH1_CRS_DV	ETH1_RX_CTL	ETH1_RX_DV	I2S1_SDO	QUADSPI_CLK	SAI4_D1	SAI4_SD_A	SPI1_MOSI	SPI6_MOSI	TIM14_CH1	TIM1_CH1N	TIM3_CH2	TIM8_CH1N	
X1	37	PH2	ETH1_CRS	ETH1_CRS	LPTIM1_IN2	LTDC_R0	QUADSPI_BK2_IO0	SAI2_SCK_B	GPIO												
X1	38	PA13	DBTRGO	DBTRGI	MCO1	UART4_TX	EVENTOUT														
X1	39	GND																			
X1	40	GND																			
X1	41	PZ3	SPI1_NSS	I2C2_SDA	I2C4_SDA	I2C5_SDA	I2C6_SDA	I2S1_WS	SPI1_NSS	SPI6_NSS	USART1_CTS	USART1_NSS	GPIO								
X1	42	PZ1	SPI1_MISO	I2C2_SDA	I2C4_SDA	I2C5_SDA	I2C6_SDA	I2S1_SDI	SPI1_MISO	SPI6_MISO	USART1_RX	GPIO									
X1	43	PE1	FMC_NBL1	DCMI_D3	I2S2_MCK	LPTIM1_IN2	SAI3_SD_B	UART8_TX	FMC_NBL1	GPIO											
X1	44	PZ2	SPI1_MOSI	I2C2_SCL	I2C4_SMBA	I2C5_SMBA	I2C6_SCL	I2S1_SDO	SPI1_MOSI	SPI6_MOSI	USART1_TX	GPIO									
X1	45	PZ0	SPI1_SCK	I2C2_SCL	I2C6_SCL	I2S1_CK	SPI1_SCK	SPI6_SCK	USART1_CK	GPIO											
X1	46	GND																			
X1	47	GND																			
X1	48	PC3	TRACECLK	DFSDM1_DATIN1	SPI2_MOSI	I2S2_SDO	ETH1_GMII_TX_CLK	ETH1_MII_TX_CLK	EVENTOUT	ADC1_INP13	ADC1_INN12										
X1	49	PH13	UART4_TX	FDCAN1_TX	LTDC_G2	TIM8_CH1N	UART4_TX	GPIO													
X1	50	PA9	USART1_TX	DAC1_EXTI9	DCMI_D0	I2C3_SMBA	I2S2_CK	LTDC_R5	SDMMC2_CDIR	SDMMC2_D5	SPI2_SCK	TIM1_CH2	USART1_TX	GPIO							
X1	51	PH14	UART4_RX	DCMI_D4	FDCAN1_RX	LTDC_G3	TIM8_CH2N	UART4_RX	GPIO												
X1	52	PB7	USART1_RX	DCMI_VSYNC	DFSDM1_CKIN5	I2C1_SDA	I2C4_SDA	SDMMC2_D1	TIM17_CH1N	TIM4_CH2	USART1_RX	FMC_NL	GPIO								
X1	53	PH5	I2C2_SDA	I2C2_SDA	SAI4_SD_B	SPI5_NSS	GPIO														
X1	54	PA11	USART1_CTS	ADC1_EXTI11	ADC2_EXTI11	FDCAN1_RX	I2C5_SCL	I2C6_SCL	I2S2_WS	LTDC_R4	SPI2_NSS	TIM1_CH4	UART4_RX	USART1_CTS	USART1_NSS	USB_OTG_FS_DM	GPIO				
X1	55	PH4	I2C2_SCL	I2C2_SCL	LTDC_G4	LTDC_G5	GPIO														
X1	56	PA12	USART1_RTS	FDCAN1_TX	I2C5_SDA	I2C6_SDA	LTDC_R5	SAI2_FS_B	TIM1_ETR	UART4_TX	USART1_DE	USART1_RTS	USB_OTG_FS_DP	GPIO							
X1	57	PG15		ADC1_EXTI15	ADC2_EXTI15	DCMI_D13	I2C2_SDA														
X1	58	GND																			
X1	59	PE0	SAI2_MCLK_A	DCMI_D2	I2S3_CK	LPTIM1_ETR	LPTIM2_ETR	SAI2_MCLK_A	SAI4_MCLK_B	SPI3_SCK	TIM4_ETR	UART8_RX	FMC_NBL0	GPIO							
X1	60	PI7	SAI2_FS_A	DCMI_D7	LTDC_B7	SAI2_FS_A	TIM8_CH3	GPIO													
X1	61	PD13	SAI2_SCK_A	DSIHOST_TE	I2C1_SDA	I2C4_SDA	I2S3_MCK	LPTIM1_OUT	QUADSPI_BK1_IO3	SAI2_SCK_A	TIM4_CH2	FMC_A18	GPIO								
X1	62	PE6	SAI2_MCLK_B	DCMI_D7	LTDC_G1	SAI1_D1	SAI1_SD_A	SAI2_MCLK_B	SDMMC1_D2	SDMMC2_D0	SPI4_MOSI	SYS_TRACED2	TIM15_CH2	TIM1_BKIN2	FMC_A22	GPIO					
X1	63	PB2	TRACED4	RTC_OUT2	SAI1_D1	DFSDM1_CKIN1	USART1_RX	I2S_CKIN	SAI1_SD_A	SPI3_MOSI	I2S3_SDO	UART4_RX	QUADSPI_CLK	EVENTOUT							

4.2 Carrier board connectors X1

Con	Pin	Signal Name	Available Modes on Pin																		Note
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
X1	64	PE12	SAI2_SCK_B	DFSDM1_DATIN5	FMC_D9	LTDC_B4	SAI2_SCK_B	SDMMC1_D0DIR	SPI4_SCK	TIM1_CH3N	GPIO										
X1	65	PI6	SAI2_SD_A	DCMI_D6	LTDC_B6	SAI2_SD_A	TIM8_CH2	GPIO													
X1	66	PA0	SAI2_SD_B	ADC1_INP16	ETH1_CRS	SAI2_SD_B	SDMMC2_CMD	SYS_WKUP1	TIM15_BKIN	TIM2_CH1	TIM2_ETR	TIM5_CH1	TIM8_ETR	UART4_TX	USART2_CTS	USART2_NSS	GPIO				
X1	67	GND																			
X1	68	GND																			
X1	69	PC8	SDMMC1_D0	DCMI_D2	SDMMC1_D0	SYS_TRACED0	TIM3_CH3	TIM8_CH3	UART4_TX	UART5_DE	UART5_RTS	USART6_CK	GPIO								
X1	70	PD2	SDMMC1_CMD	DCMI_D11	I2C5_SMBA	SDMMC1_CMD	TIM3_ETR	UART4_RX	UART5_RX	GPIO											
X1	71	PC9	SDMMC1_D1	DAC1_EXTI9	DCMI_D3	I2C3_SDA	I2S_CKIN	LTDC_B2	QUADSPI_BK1_IO0	SDMMC1_D1	SYS_TRACED1	TIM3_CH4	TIM8_CH4	UART5_CTS	GPIO						
X1	72	PC12	SDMMC1_CK	DCMI_D9	I2S3_SDO	RCC_MCO_2	SAI4_D3	SAI4_SD_B	SDMMC1_CK	SPI3_MOSI	SYS_TRACECLK	UART5_TX	USART3_CK	GPIO							
X1	73	PC10	SDMMC1_D2	DCMI_D8	DFSDM1_CKIN5	I2S3_CK	LTDC_R2	QUADSPI_BK1_IO1	SAI4_MCLK_B	SDMMC1_D2	SPI3_SCK	SYS_TRACED2	UART4_TX	USART3_TX	GPIO						
X1	74	VMMC (3V3)																			
X1	75	PC11	SDMMC1_D3	ADC1_EXTI11	ADC2_EXTI11	DCMI_D4	DFSDM1_DATIN5	I2S3_SDI	QUADSPI_BK2_NCS	SAI4_SCK_B	SDMMC1_D3	SPI3_MISO	SYS_TRACED3	UART4_RX	USART3_RX	GPIO					
X1	76	VMMC (3V3)																			
X1	77	GND																			
X1	78	GND																			
X1	79	NJTRST	SYS_JTRST	SYS_JTRST																	
X1	80	JTDO-TRACESWO	SYS_JTDO-SWO	SYS_JTDO-SWO																	
X1	81	JTCK-SW-CLK	SYS_JTCK-SWCLK	SYS_JTCK-SWCLK																	
X1	82	JTDI	SYS_JTDI	SYS_JTDI																	
X1	83	JTMS-SW-DIO	SYS_JTMS-SWDIO	SYS_JTMS-SWDIO																	
X1	84	PI8	TAMP_IN2	RTC_LSCO	SYS_WKUP4	RTC_OUT2	TAMP_IN2	TAMP_OUT3	GPIO												
X1	85	AGND																			
X1	86	PC13	TAMP_OUT2	RTC_LSCO	RTC_OUT_ALARM1	RTC_OUT_CALIB1	RTC_TS	SYS_WKUP3	TAMP_IN1	TAMP_OUT2	TAMP_OUT3	GPIO									
X1	87	AGND																			
X1	88	GND																			
X1	89	ANA0	ADC1_INP0	ADC1_INN1	ADC1_INP0	ADC2_INN1	ADC2_INP0														
X1	90	ANA1	ADC1_INP1	ADC1_INP1	ADC2_INP1																
X1	91	PF11	ADC1_INP2	ADC1_EXTI11	ADC1_INP2	ADC2_EXTI11	DCMI_D12	LTDC_G5	SAI2_SD_B	SPI5_MOSI	GPIO										
X1	92	n.c.	ADC1_INP9																		
X1	93	PB1	ADC1_INP5	ADC1_INP5	ADC2_INP5	DFSDM1_DATIN1	ETH1_RXD3	LTDC_G0	LTDC_R6	TIM1_CH3N	TIM3_CH4	TIM8_CH3N	MDIOS_MDC	GPIO							
X1	94	PC0	ADC1_INP10	ADC1_INP10	ADC2_INP10	DFSDM1_CKIN0	DFSDM1_DATIN4	LPTIM2_IN2	LTDC_R5	QUADSPI_BK2_NCS	SAI2_FS_B	GPIO									
X1	95	PA4	ADC1_INP18	ADC1_INP18	ADC2_INP18	DAC1_OUT1	DCMI_HSYNC	I2S1_WS	I2S3_WS	LTDC_VSYNC	SAI4_D2	SAI4_FS_A	SPI1_NSS	SPI3_NSS	SPI6_NSS	SYS_HDP0	TIM5_ETR	USART2_CK	GPIO		
X1	96	PA5	ADC1_INP19	ADC1_INN18	ADC1_INP19	ADC2_INN18	ADC2_INP19	DAC1_OUT2	I2S1_CK	LTDC_R4	SAI4_CK1	SAI4_MCLK_A	SPI1_SCK	SPI6_SCK	TIM2_CH1	TIM2_ETR	TIM8_CH1N	GPIO			
X1	97	GND																			
X1	98	GND																			
X1	99	GND																			
X1	100	GND																			

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4.3 Carrier board connectors X2

Con	Pin	Signal Name	Available Modes on Pin																		Note
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
X2	1	VIN																			
X2	2	VIN																			
X2	3	VIN																			
X2	4	VIN																			
X2	5	VIN																			
X2	6	VIN																			
X2	7	VIN																			
X2	8	VIN																			
X2	9	VIN																			
X2	10	VIN																			
X2	11	GND																			
X2	12	GND																			
X2	13	GND																			
X2	14	GND																			
X2	15	GND																			
X2	16	GND																			
X2	17	PWR_BUT-TON																			
X2	18	PG8	TIM2_CH1	ETH1_CLK	ETH1_PPS_OUT	LTDC_G7	SAI4_D2	SAI4_FS_A	SPDIF-RX_IN2	SPI6_NSS	SYS_TRA-CED15	TIM2_CH1	TIM2_ETR	TIM8_ETR	US-ART3_DE	US-ART3_RTS	US-ART6_DE	US-ART6_RTS	GPIO		
X2	19	PWR_ON																			
X2	20	EXT_WAKEUP																			
X2	21	VBAT																			
X2	22	PI3		DCMI_D10	I2S2_SDO	SPI2_MOSI	TIM8_ETR	GPIO													
X2	23	DSIHOST_CK_P	DSI HOST_CK_P	DSI HOST_CK_P																	
X2	24	GND																			
X2	25	DSIHOST_CK_N	DSI HOST_CK_N	DSI HOST_CK_N																	
X2	26	GND																			
X2	27	DSIHOST_D1_P	DSI HOST_D1_P	DSI HOST_D1_P																	
X2	28	GND																			
X2	29	DSIHOST_D1_N	DSI HOST_D1_N	DSI HOST_D1_N																	
X2	30	VREFP	VREFP																		
X2	31	DSIHOST_D0_P	DSI-HOST_D0_P	DSI-HOST_D0_P																	
X2	32	VSSA	VSSA																		
X2	33	DSIHOST_D0_N	DSI-HOST_D0_N	DSI-HOST_D0_N																	
X2	34	GND																			
X2	35	PD6	FMC_NWAIT	DCMI_D10	DFSDM1_CKIN4	DFS-DM1_DATIN1	FMC_NWAIT	I2S3_SDO	LTDC_B2	SAI1_D1	SAI1_SD_A	SPI3_MOSI	TIM16_CH1N	US-ART2_RX	GPIO						
X2	36	PG2	FMC_A12	ETH1_TXD6	RCC_MCO_2	SYS_TRA-CED2	TIM8_BKIN	FMC_A12	GPIO												
X2	37	PG3	FMC_A13	DFS-DM1_CKIN1	ETH1_TXD7	SYS_TRA-CED3	TIM8_BKIN2	FMC_A13	GPIO												
X2	38	PD11	FMC_CLE	ADC1_EXTI11	ADC2_EX-TI11	FMC_CLE	I2C1_SMBA	I2C4_SMBA	LP-TIM2_IN2	QUA-DSPI_BK1_IO0	SAI2_SD_A	US-ART3_CTS	US-ART3_NSS	FMC_A16	GPIO						
X2	39	PD12	FMC_ALE	FMC_ALE	I2C1_SCL	I2C4_SCL	LP-TIM1_IN1	LPTIM2_IN1	QUA-DSPI_BK1_IO1	SAI2_FS_A	TIM4_CH1	US-ART3_DE	US-ART3_RTS	FMC_A17	GPIO						
X2	40	PG5	FMC_A15	ETH1_CLK125	TIM1_ETR	FMC_A15	GPIO														
X2	41	PD4	FMC_NOE	DFS-DM1_CKIN0	FMC_NOE	SAI3_FS_A	SD-MMC3_D1	USART2_DE	US-ART2_RTS	GPIO											

4.3 Carrier board connectors X2

Con	Pin	Signal_Name	Available Modes on Pin																		Note
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
X2	42	PD9	FMC_D14	DAC1_EXTI9	DFSDM1_DATIN3	FMC_D14	LTDC_B0	SAI3_SD_B	US-ART3_RX	GPIO											
X2	43	PD5	FMC_NWE	FMC_NWE	SD-MMC3_D2	US-ART2_TX	GPIO														
X2	44	PD7	FMC_NE1	DFS-DM1_CKIN1	DFSDM1_DATIN4	I2C2_SCL	SD-MMC3_D3	SPDIF-RX_IN0	SYS_TRA-CED6	US-ART2_CK	FMC_NE1	GPIO									
X2	45	PD3	FMC_CLK	DC-MI_D5	DFSDM1_CKOUT	DFS-DM1_DATIN0	I2S2_CK	LTDC_G7	SD-MMC1_D123 DIR	SD-MMC1_D7	SD-MMC2_D123 DIR	SD-MMC2_D7	SPI2_SCK	SYS_HDP5	US-ART2_CTS	US-ART2_NSS	FMC_CLK	GPIO			
X2	46	PG9	FMC_NCE	DAC1_EXTI9	DCMI_VSYNC	FMC_NCE	QUA-DSPI_BK2_IO2	SAI2_FS_B	SPDIF-RX_IN3	SYS_DB-TRGO	USART6_RX	FMC_NE2	GPIO								
X2	47	PG10	LTDC_B2	DC-MI_D2	LTDC_B2	LTDC_G3	QUA-DSPI_BK2_IO2	SAI2_SD_B	SYS_TRA-CED10	UART8_CTS	FMC_NE3	GPIO									
X2	48	PH8	LTDC_R2	DCMI_HSYNC	I2C3_SDA	LTDC_R2	TIM5_ETR	GPIO													
X2	49	PB0	LTDC_G1	ADC1_INN5	ADC1_INP9	ADC2_INN5	ADC2_INP9	DFS-DM1_CKOUT	ETH1_RXD2	LTDC_G1	LTDC_R3	TIM1_CH2N	TIM3_CH3	TIM8_CH2N	UART4_CTS	MDIOS_MDIO	GPIO				
X2	50	PH3	LTDC_R1	DFS-DM1_CKIN4	ETH1_COL	LTDC_R1	QUA-DSPI_BK2_IO1	SAI2_MCLK_B	GPIO												
X2	51	PG13	LTDC_R0	ETH1_TXD0	LPTIM1_OUT	LTDC_R0	SAI1_CK2	SAI1_SCK_A	SAI4_CK1	SAI4_MCLK_A	SPI6_SCK	SYS_TRA-CED0	US-ART6_CTS	US-ART6_NSS	FMC_A24	GPIO					
X2	52	PG12	LTDC_B1	ETH1_PHY_IN-TN	LPTIM1_IN1	LTDC_B1	LTDC_B4	SAI4_CK2	SAI4_SCK_A	SPDIF-RX_IN1	SPI6_MI-SO	US-ART6_DE	US-ART6_RTS	FMC_NE4	GPIO						
X2	53	PE4	LTDC_B0	DC-MI_D4	DFSDM1_DATIN3	LTDC_B0	SAI1_D2	SAI1_FS_A	SD-MMC1_CKIN	SD-MMC1_D4	SD-MMC2_CKIN	SD-MMC2_D4	SPI4_NSS	SYS_TRA-CED1	TIM15_CH1N	FMC_A20	GPIO				
X2	54	PE14	LTDC_G0	FMC_D11	LTDC_CLK	LTDC_G0	SAI2_MC LK_B	SD-MMC1_D123 DIR	SPI4_MOSI	TIM1_CH4	UART8_DE	UART8_RTS	GPIO								
X2	55	PE9	FMC_D6	DAC1_EXTI9	DFSDM1_CKOUT	FMC_D6	QUA-DSPI_BK2_IO2	TIM1_CH1	UART7_DE	UART7_RTS	GPIO										
X2	56	PE10	FMC_D7	DFS-DM1_DATIN4	FMC_D7	QUA-DSPI_BK2_IO3	TIM1_CH2N	UART7_CTS	GPIO												
X2	57	PE7	FMC_D4	DFS-DM1_DATIN2	FMC_D4	QUA-DSPI_BK2_IO0	TIM1_ETR	TIM3_ETR	UART7_RX	GPIO											
X2	58	PE8	FMC_D5	DFS-DM1_CKIN2	FMC_D5	QUA-DSPI_BK2_IO1	TIM1_CH1N	UART7_TX	GPIO												
X2	59	PD0	FMC_D2	DFS-DM1_CKIN6	DFSDM1_DATIN7	FD-CAN1_RX	FMC_D2	I2C5_SDA	I2C6_SDA	SAI3_SCK_A	SD-MMC3_CMD	UART4_RX	GPIO								
X2	60	PD1	FMC_D3	DFS-DM1_CKIN7	DFSDM1_DATIN6	FD-CAN1_TX	FMC_D3	I2C5_SCL	I2C6_SCL	SAI3_SD_A	SD-MMC3_D0	UART4_TX	GPIO								
X2	61	PD14	FMC_D0	FMC_D0	SAI3_MCLK_B	TIM4_CH3	UART8_CTS	GPIO													
X2	62	PD15	FMC_D1	ADC1_EXTI15	ADC2_EX-TI15	FMC_D1	SAI3_MC LK_A	TIM4_CH4	UART8_CTS	GPIO											
X2	63	PG0	FMC_A10	DFS-DM1_DATIN0	ETH1_TXD4	SYS_TRA-CED0	FMC_A10	GPIO													
X2	64	PG1	FMC_A11	ETH1_TXD5	SYS_TRA-CED1	FMC_A11	GPIO														
X2	65	PF14	FMC_A8	ADC2_INN2	ADC2_INP6	DFS-DM1_CKIN6	ETH1_RXD6	I2C1_SCL	I2C4_SCL	SYS_TRA-CED6	FMC_A8	GPIO									
X2	66	PF15	FMC_A9	ADC1_EXTI15	ADC2_EX-TI15	ETH1_RXD7	I2C1_SDA	I2C4_SDA	SYS_TRA-CED7	FMC_A9	GPIO										
X2	67	PF12	FMC_A6	ADC1_INN2	ADC1_INP6	ETH1_RXD4	SYS_TRA-CED4	FMC_A6	GPIO												
X2	68	PF13	FMC_A7	ADC2_INP2	DFSDM1_DATIN3	DFS-DM1_DATIN6	ETH1_RXD5	I2C1_SMBA	I2C4_SMBA	SYS_TRA-CED5	FMC_A7	GPIO									
X2	69	PF4	FMC_A4	SD-MMC3_D1	SD-MMC3_D123 DIR	US-ART2_RX	FMC_A4	GPIO													
X2	70	PF5	FMC_A5	SD-MMC3_D2	USART2_TX	FMC_A5	GPIO														
X2	71	PF2	FMC_A2	I2C2_SMBA	SD-MMC1_D0DIR	SD-MMC2_D0DIR	SD-MMC3_D0DIR	FMC_A2	GPIO												
X2	72	PF3	FMC_A3	ETH1_TX_ER	FMC_A3	GPIO															
X2	73	PF0	FMC_A0	I2C2_SDA	SD-MMC3_CKIN	SD-MMC3_D0	FMC_A0	GPIO													
X2	74	PF1	FMC_A1	I2C2_SCL	SD-MMC3_CDIR	SD-MMC3_CMD	FMC_A1	GPIO													

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4.3 Carrier board connectors X2

Con	Pin	Signal_Name	Available Modes on Pin																		Note
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
X2	75	PI10	ETH1_RX_ER	LTDC_HSYNC	SYS_HDP0	US-ART3_CTS	US-ART3_NSS	GPIO													
X2	76	GND																			
X2	77	PB8	LTDC_B6	DC-MI_D6	DFSDM1_CKIN7	ETH1_TXD3	FD-CAN1_RX	I2C1_SCL	I2C4_SCL	LTDC_B6	SD-MMC1_CKIN	SD-MMC1_D4	SD-MMC2_CKIN	SD-MMC2_D4	SYS_HDP6	TIM16_CH1	TIM4_CH3	UART4_RX	GPIO		
X2	78	PD8	LTDC_B7	DFS-DM1_CKIN3	FMC_D13	LTDC_B7	SAI3_SCK_B	SPDIF-RX_IN1	US-ART3_TX	GPIO											
X2	79	PI4	LTDC_B4	DC-MI_D5	LTDC_B4	SAI2_MCLK_A	TIM8_BKIN	GPIO													
X2	80	PI5	LTDC_B5	DCMI_VSYNC	LTDC_B5	SAI2_SCK_A	TIM8_CH1	GPIO													
X2	81	PI2	LTDC_G7	DC-MI_D9	I2S2_SDI	LTDC_G7	SPI2_MISO	TIM8_CH4	GPIO												
X2	82	PD10	LTDC_B3	DFS-DM1_CKOUT	FMC_D15	I2C5_SMBA	I2S3_SDI	LTDC_B3	RTC_RE-FIN	SAI3_FS_B	SPI3_MI-SO	TIM16_BKIN	US-ART3_CK	GPIO							
X2	83	PI0	LTDC_G5	DCMI_D13	I2S2_WS	LTDC_G5	SPI2_NSS	TIM5_CH4	GPIO												
X2	84	PI1	LTDC_G6	DC-MI_D8	I2S2_CK	LTDC_G6	SPI2_SCK	TIM8_BKIN2	GPIO												
X2	85	PE11	LTDC_G3	ADC1_EXTI11	ADC2_EX-TI11	DFS-DM1_CKIN4	FMC_D8	LTDC_G3	SAI2_SD_B	SPI4_NSS	TIM1_CH2	US-ART6_CK	GPIO								
X2	86	PH15	LTDC_G4	ADC1_EXTI15	ADC2_EX-TI15	DCMI_D11	LTDC_G4	TIM8_CH3N	GPIO												
X2	87	PE15	LTDC_R7	ADC1_EXTI15	ADC2_EX-TI15	FMC_D12	LTDC_R7	SYS_HDP3	TIM15_BKIN	TIM1_BKIN	UART8_CTS	US-ART2_CTS	US-ART2_NSS	GPIO							
X2	88	PA6	LTDC_G2	ADC1_INP3	ADC2_INP3	DCMI_PIXCLK	I2S1_SDI	LTDC_G2	SAI4_CK2	SAI4_SCK_A	SPI1_MI-SO	SPI6_MISO	TIM13_CH1	TIM1_BKIN	TIM3_CH1	TIM8_BKIN	MDIOS_MDC	GPIO			
X2	89	PH11	LTDC_R5	ADC1_EXTI11	ADC2_EX-TI11	DC-MI_D2	I2C1_SCL	I2C4_SCL	LTDC_R5	TIM5_CH2	GPIO										
X2	90	PH12	LTDC_R6	DC-MI_D3	I2C1_SDA	I2C4_SDA	LTDC_R6	SYS_HDP2	TIM5_CH3	GPIO											
X2	91	PH9	LTDC_R3	DAC1_EXTI9	DCMI_D0	I2C3_SMBA	LTDC_R3	TIM12_CH2	GPIO												
X2	92	PH10	LTDC_R4	DC-MI_D1	I2C1_SM-BA	I2C4_SMBA	LTDC_R4	TIM5_CH1	GPIO												
X2	93	PG7	LTDC_CLK	DCMI_D13	LTDC_CLK	QUA-DSPI_BK2_IO3	QUAD-SPI_CLK	SAI1_MCLK_A	SYS_TRA-CED5	UART8_DE	UART8_RTS	US-ART6_CK	FMC_INT	GPIO							
X2	94	PI9	LTDC_VSYNC	DAC1_EXTI9	FDCAN1_RX	LTDC_VSYNC	SYS_HDP1	UART4_RX	GPIO												
X2	95	PE13	DFS-DM1_CKIN5	FMC_D10	LTDC_DE	SAI2_FS_B	SPI4_MISO	SYS_HDP2	TIM1_CH3	GPIO											
X2	96	PC6	LTDC_HSYNC	DC-MI_D0	DFSDM1_CKIN3	DSI HOST_TE	I2S2_MCK	LTDC_HSYNC	SD-MMC1_D0DIR	SD-MMC1_D6	SD-MMC2_D0DIR	SD-MMC2_D6	SYS_HDP1	TIM3_CH1	TIM8_CH1	US-ART6_TX	GPIO				
X2	97	PZ6		I2C2_SCL	I2C4_SM-BA	I2C6_SCL	I2S1_MCK														
X2	98	PZ7		I2C2_SDA	I2C6_SDA	US-ART1_TX	GPIO														
X2	99	GND																			
X2	100	GND																			

4.4 Power Supply

> The byteENGINE can be powered with 2.8V to 5.5V.

> The recommended power supply is 5V.

LINK:
STPMIC1 power management IC

4.5 Boot Modes byteENGINE STM32MP1x

> Default boot mode: BOOT0 = 1, BOOT1 = 0, BOOT2 = 1 (SDCARD):
Follow LINK: STM32MP157c Data Sheet: "Chapter 3.7 Boot Modes"

> **BOOT2 is connected to X1:1 and can select the boot source.**
Use an open drain buffer or switch to control this pin. It is pulled up at 1 kOhm on the Module.

LINK:
STM32MP157c Data Sheet

Chart Boot Modes

BOOT2	Boot Source
hiZ	SDCARD
0	SPI Nor Flash

5. Ordering Info

The Ordering Code allows the customer to recognize easily the detailed specification of the ordered SOM. Please refer to chapter „3.4 Additional information" auf Seite 7 for further information concerning the CPU.

[SOM]-STM32MP15[x]_[SPEED]_R[xxx MB]_[E/GB,S/MB]_[C, I]		
[SOM]:	SOM type	bE: byteENGINE
STM32MP15[x]:	CPU type	1: STM32MP151, 3: STM32MP153, 7: STM32MP157
[SPEED MHz]:	Clock speed	650, 800
R[xxx MB]:	RAM size	128, 256, 512, 1024 MB
[E/GB], [S/MB]:	FLASH type/size	eMMC: 4, 8, 16, 32, 64 GB / serial NAND: 128 MB
[C, I]:	Temperature range	[C] Customer 0° to +70° Celsius, [I] Industrial -40° to +85° Celsius

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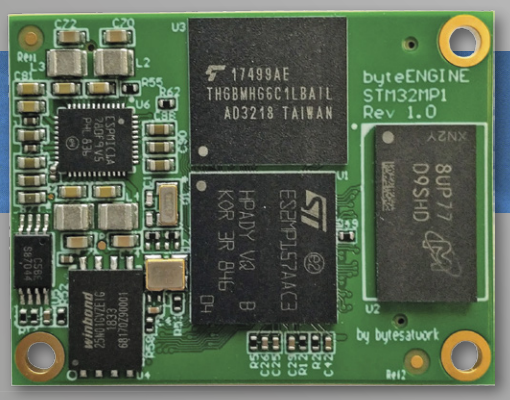
6. References

NOTICE
Files can only be downloaded with login credentials.
Please request your download credentials via
info@bytesatwork.ch or contact your sales representative.

LINKS:

>	Detailed pinout for byteENGINE STM32MP1x	Chapter: 4.2, 4.3
>	Datasheet Connectors Neltron 2001S-100G-270-020	Chapter: 3.8
>	Altium Schematic of the connectors X1 and X2	Chapter: 3.7
>	Schematic of the connectors X1 and X2	Chapter: 3.7
>	meta-bytesatwork on github	Chapter: 3.1
>	STMicroelectronics STM32MP1 microprocessor series	Chapter: 3.2, 3.4
>	STPMIC1 power management IC	Chapter: 4.4
>	Data Sheet STM32MP157C	Chapter: 4.5
>	STM32CubeMX Software Download	Chapter: 3.10
>	byteENGINE STM32MP1x prepared CubeMX Project	Chapter: 3.10
>	prepared project: Step Model	Chapter: 3.10
>	Altium Library Neltron 2001S-100G-270-020	
>	Altium Library byteENGINE STM32MP1x (X1/X2 position mask on layer 21)	

7. Contact information



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