MicroEJ Platform

Developer's Guide

MICROEJ®

GRPEACH 1.5.1

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Confidentiality & Intellectual Property

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Missing documentation.		
Revision 1.5.0	October 26th 2017	
Migrated to Architecture 6.17.2. Use pack UI 9.3.1 instead of 9.0.2.		
Revision 1.4.3	July 5th 2017	
Use pack Net 6.1.5 instead of 6.1.4		
Revision 1.4.2	July 5th 2017	
Soft DNS resolver doesn't retry on timeout and doesn't try other servers on errors		
Revision 1.4.1	June 8th 2017	
Increase SSL memory pool		
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Upgrade platform architecture		
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Upgrade platform architecture		
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Add HAL module low level interface implementation BugFix : Error on SSL certificate check.		
Revision 1.1.1	March 15th 2017	
BugFix : Initialization of serial handler should be done before enable IRQ.		
Revision 1.1.0	March 8th 2017	
Fixed space in MicroEJ repository path causing link errors, Change address MAC customization in flash memory by UID customization, Change output trace baudrate to 115200.		
Revision 1.0.0	January 10th 2017	
Initial version		

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Chapter 1. Introduction

1.1. Intended Audience

The intended audience for this document are developers who wish to develop their first MicroEJ standalone application with MicroEJ SDK. Notes:

- This document is for the Renesas GRPEACH board.
- Please visit the website https://developer.microej.com for more information about GRPEACH products (platforms, videos, examples, application notes, etc.).

1.2. Scope

This document describes, step by step, how to start your development with MicroEJ SDK

- Run a MicroEJ standalone application on the MicroEJ simulator.
- Run a MicroEJ standalone application on the MicroEJ platform and deploy it on the GRPEACH board.

1.3. Prerequisites

- PC with Windows 7 or later.
- The MicroEJ SDK environment must be installed.
- GRPEACH board.

Chapter 2. Develop and Run Your First MicroEJ Standalone Application

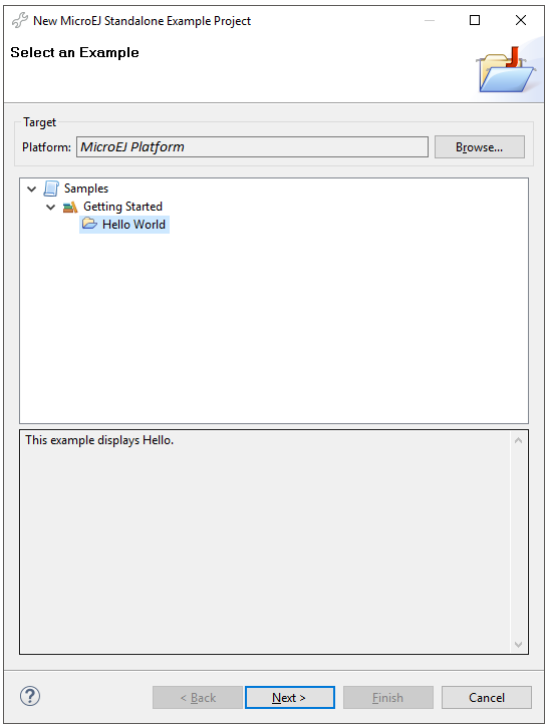
2.1. Run an Example on the MicroEJ Simulator

The aim of this chapter is to create a MicroEJ standalone application from a built-in example. Initially, this example will run on the MicroEJ simulator. Then, in the next section, this application will be compiled and deployed on the GRPEACH board using the MicroEJ platform.

2.1.1. Create Example

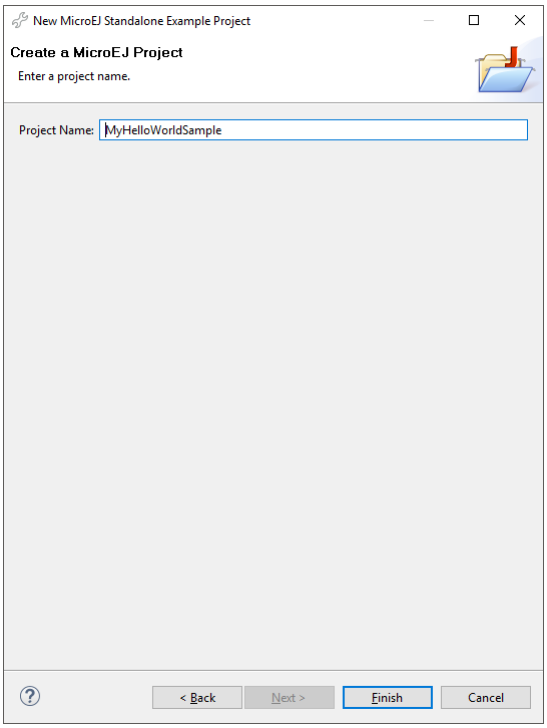
- Open MicroEJ SDK.
- Open the `File > New > MicroEJ Standalone Example Project` menu.
- Select the MicroEJ platform GRPEACH-EWCPC from the combo box.
- Select the example `Samples > Getting Started > Hello World`.

Figure 2.1. MicroEJ Standalone Application Selection



- Click on Next. The next page suggests a name for the new project.

Figure 2.2. MicroEJ Standalone Application Naming

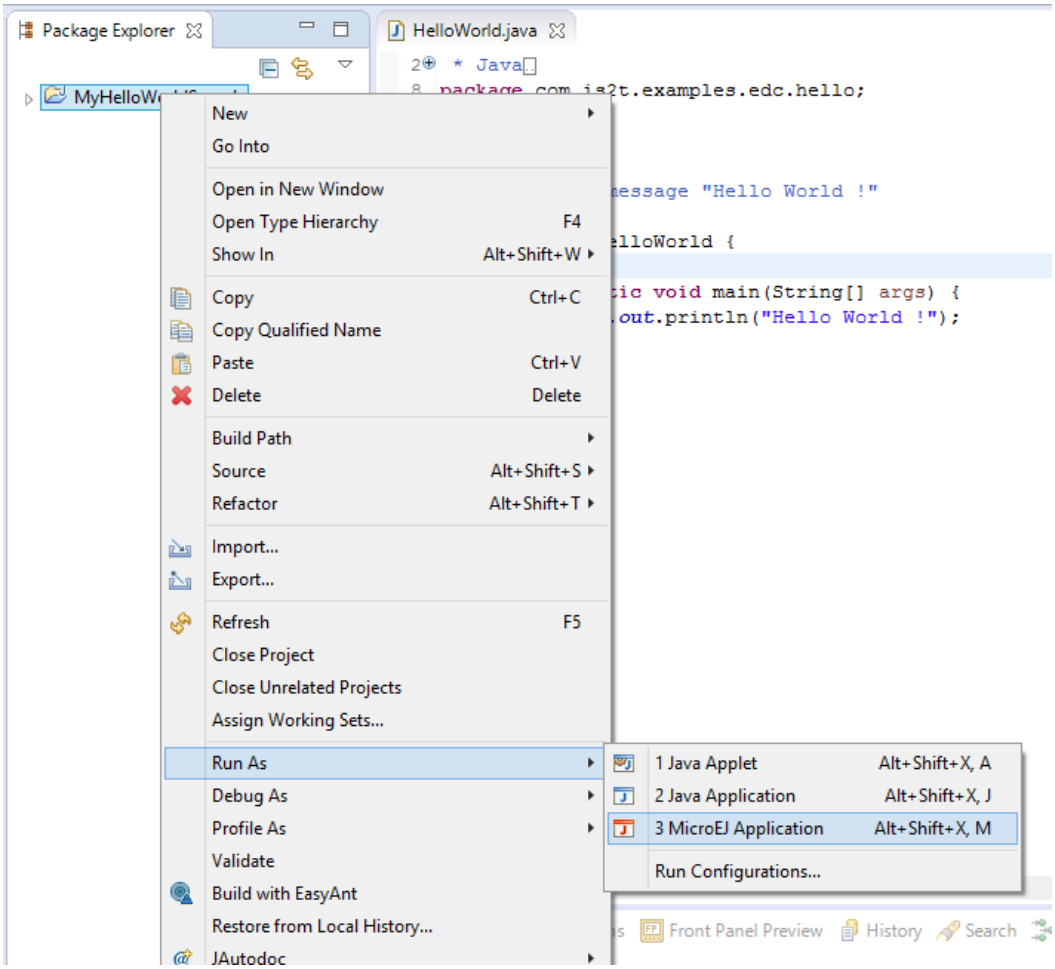


- Click on Finish. The selected example is imported into a project with the given name. The main class (the class which contains the `main()` method) is automatically opened.

2.1.2. Run Example

- Select the project in the Package Explorer tree
- Right-click on this project and select `Run As > MicroEJ Application`

Figure 2.3. MicroEJ Standalone Application Running



The application starts. It is executed on the MicroEJ simulator of the selected MicroEJ platform (GRPEACH-EWCPC). The result of the test is printed in the console:

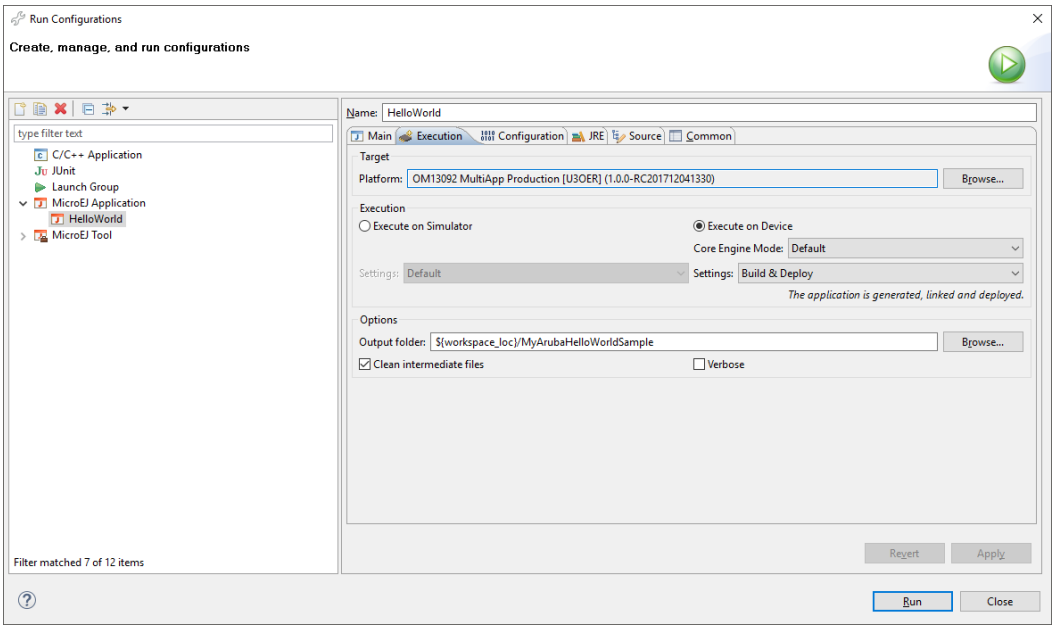
```
Hello World !
```

2.2. Run the Example on the GRPEACH Board

2.2.1. Compile MicroEJ Standalone Application

- Open the run dialog (`Run > Run configurations...`).
- Select the MicroEJ Application launcher `HelloWorld`.
- Open `Execution` tab.
- Select `Execute on Device`.

Figure 2.4. Execution on Device



- In the JRE tab, pass the following VM argument: `-Dtoolchain.dir` and set its value to the path to the toolchain directory of IAR (typically `C:\Program Files (x86)\IAR Systems\Embedded Workbench 7.80\arm\bin`).
- Click Run: the application is compiled, and the compilation result (an ELF file) is copied into a well-known location in the example project. The Open SDA tool has to be used to load the program on the board.

2.2.2. OpenSDA Programming Tool

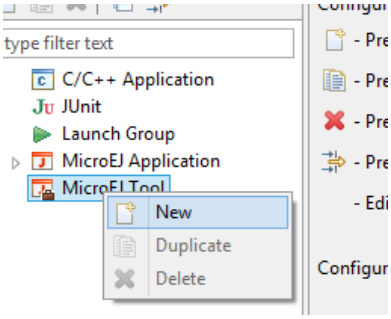
The aim of this section is to program a binary on the GRPEACH board.

Prerequisites

Download Open SDA software and documentation pack from `http://www.pemicro.com/opensda/` and install it on your machine.

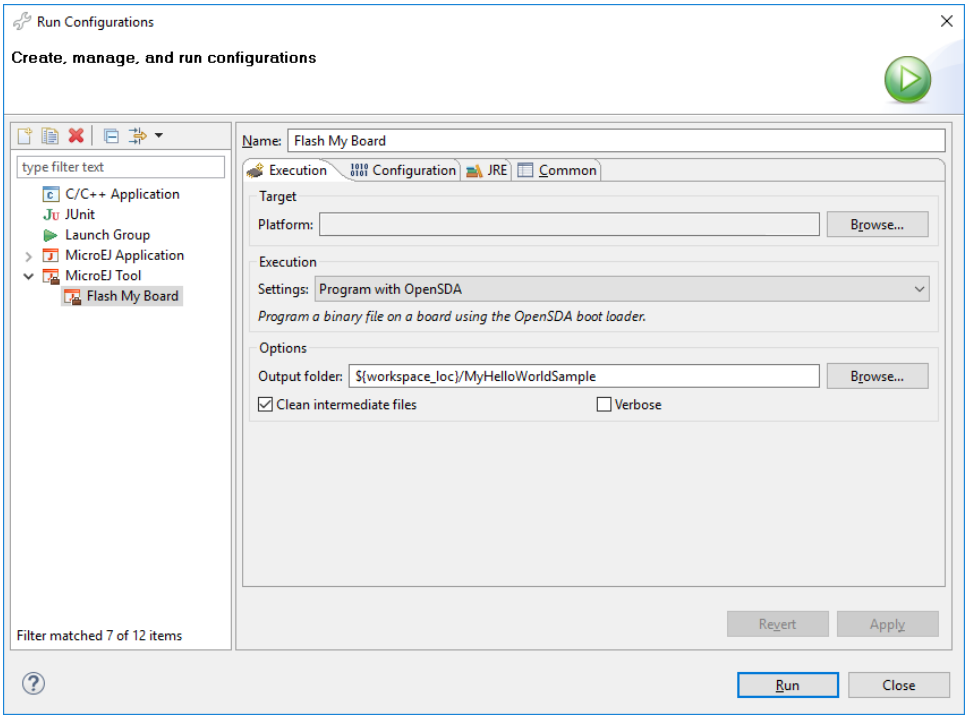
- Click on `Run > Run Configurations...`. Then right click on sub menu of `MicroEJ Tool` and select `New` to create a new MicroEJ Tool launcher:

Figure 2.5. MicroEJ Tool Launcher Creation



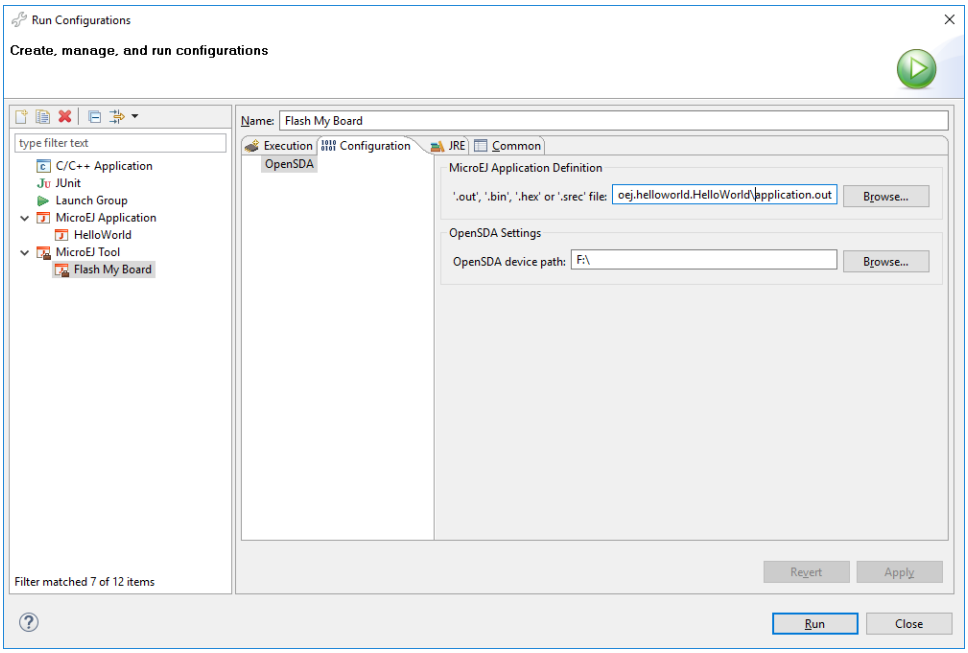
- A new window appears. Give a name to the launcher and set the `MicroEJ platform` field to `GRPEACH-EWCPC` and the `Settings` field to `Program with OpenSDA`

Figure 2.6. OpenSDA MicroEJ SDK Tool Window



- Click on `Configuration` tab select the `application.out` file available in the MicroEJ project.

Figure 2.7. OpenSDA MicroEJ SDK Tool Configuration Window



- Click on Run to program the binary.

  At the end of the execution the following message appears:

```
Flash programming complete successfully.
```

The application starts. The result of the execution is output on printf COM port. (See “Mandatory Connectors” to use the right connectors). Congratulations, you have deployed a MicroEJ standalone application on a MicroEJ platform.

Chapter 3. Specification

3.1. Overview

MicroEJ platform on GRPEACH includes LEDS and BUTTON user interface, a TCP/IP network connection, a SSL client stack and a file system on SD card.

3.2. MicroEJ Platform Configuration

MicroEJ platform is based on MicroEJ architecture for ARM Cortex-A9.

Table 3.1. MCU Technical Specifications

MCU architecture	Cortex-A9 (Renesas R7S721001)
MCU Clock speed	400 MHz
Internal RAM	10 MB
External Flash	8 MB (NOR type on SPI bus)

MicroEJ platform uses several architecture extensions. The following table illustrates the MicroEJ architecture and extensions versions.

Table 3.2. MicroEJ Configuration

Name	Version
MicroEJ architecture	6.17.2
UI	9.3.1
Network	6.1.5
File System	3.0.0
HAL	1.0.4

3.3. Platform Output stream

MicroEJ platform uses USB Virtual COM port as output print stream. The virtual COM port is available on USB connector for power and probe and is connected to the MCU USART 2.

The COM port uses the following parameters:

- Baudrate: 115200
- Data bits bits: 8
- Parity bits: None
- Stop bits: 1
- Flow control: None

3.4. Memories

MicroEJ Plaform uses several internal and external memories. The following table illustrates the MCU and board memory layouts and sizes fixed by the MicroEJ platform.

Table 3.3. Internal RAM: 10 MB

Section Name	Size
MicroEJ standalone application heaps	1 MB [a]
MicroEJ standalone application stack blocks	512 * *n* bytes [b]
MicroEJ platform internal heap	*n* bytes [c]
SSL buffers	128 KB

[a] Maximum size of the addition of MicroEJ heap size and MicroEJ immortal heap size. These sizes are defined in MicroEJ Application launcher options.
[b] *n* is the number of stack blocks defined in MicroEJ Application launcher options.
[c] *n* depends on memory configuration set in MicroEJ Application launcher options.

Table 3.4. External flash: Program Flash (8 MB)

Section Name	Size
Any RO	*n* bytes [a]

[a] *n* depends on MicroEJ application, MicroEJ libraries, Board support package, RTOS, drivers, etc.

3.5. Multi Applications

This MicroEJ platform includes the Multi applications mode. Multi applications mode allows to build a firmware that can manage MicroEJ sandboxed applications. Multi applications mode requires a specific memory area to load MicroEJ sandboxed applications. This memory area is located in Internal RAM and its default size is 3 MB.

3.6. Graphical User Interface

This MicroEJ plaform features a reduced user interface. It includes a three-color LEDs (handled as 3 different LED), a user LED and a user buttons.

3.6.1. LEDs

The number of available LEDs on the platform is 4 (Value returned by Leds.getNumberOfLeds()). The LED ID values passed as parameters for LED functions are :

- 0 : User LED
- 1 : 3 colors LED Red
- 2 : 3 colors LED Green

- 3 : 3 colors LED Blue

User LED: The user LED output can be modified using Leds.setLedOn or Leds.setLedOff. The function Leds.setLedIntensity as no effect on this LED.

3 color LED: Each LED output can be modified using Leds.setLedIntensity to set the color intensity. (Leds.setLedOn is similar to Leds.setLedIntensity with intensity to 0 and Leds.setLedOff is similar to Leds.setLedIntensity with maximum intensity.)

3.6.2. Inputs

User buttons: The user buttons state are transmitted to Java application as button events (pressed and released).

3.7. Network

MicroEJ plaform features a network interface. Sockets are limited to 10. A DHCP client can be activated to retrieve an IP address.

3.7.1. MAC address customization

The MAC address used is by priority:

- The MAC address provided in the MicroEJ application launcher
- The device MAC address stored at the end of the Flash
- The default MAC address provided in mbed BSP

If no MAC address is supplied by the user in the MicroEJ application launcher, the platform uses a unique ID to generate a MAC address. In order to provide a unique default MAC address for each device, the platform is able to retrieve a custom MAC address using the UID customization written to the serial Flash memory.

The GRPEACH hardware does not provide a unique ID mechanism that can be used to generate a unique ID for each device. The last 20 bytes of the serial Flash are used to store a board defined UID with a summing checksum. If no UID is written to flash memory or if the checksum check fail, the platform automatically generate a new UID in flash memory using analogic reading on pins A0 to A3.

This UID could be defined and written manually to the Flash address 0x187FFFEC.

- Addresses 0x187FFFEC to 0x187FFFFD : 18 bytes of the UID (MSB to LSB)
- Addresses 0x187FFFFE to 0x187FFFFF : 2 bytes checksum (addition off all UID bytes)

UID programming can be done with a JLink probe by modifying and running the batch script on windows `GRPEACH-MyPlatform-GNUv48_cortexa9hf_launchpad_arm-none-eabi-configuration/tools/JLinkWriteUID/Windows`

3.8. SSL

MicroEJ plaform features a network secure interface. Available secured protocols are SSL 3.0, TLS 1.0, TLS 1.1, TLS 1.2. Keys and certificates supported formats are PEM and DER. The SSL memory pool allows up to 10 secure socket opened at the same time.

3.9. File System

MicroEJ plaform features a file system interface. A SD card is used for the storage (previously formatted to a FAT32 file system). Up to 2 files can be opened simultaneously.

3.10. Serial Communications

3.10.1. UART Connector

MicroEJ platform provides one serial connection (ECOM COMM) on UART0 port. UART0 pins are (RTS/CTS mode is not used):

- TX: P2_14; available on connector CN14 D1
- RX: P2_15; available on connector CN14 D0

3.11. HAL

MicroEJ platform provides several GPIOs programmable via the HAL foundation library. All GPIOs are available on ARDUINO connectors (CN9, CN10, CN14 and CN15). Digital pins are implemented by a GPIO access.

Analog input pins (ADC) are driven by ADC channels.

Each GPIO port / pin value is accessible using either:

- The global MCU designation: all pins of all ports are grouped under only one virtual port (port 0) and have consecutive values: P1_0 has the ID 0, P1_1, the ID 1, P1_15 the ID 15, P2_0 the ID 16 and so on. For instance pin *P5_7* is accessible by `(0, 71)`. This designation is useful to target all MCU pins using only one virtual port.
- The standard MCU designation: Port1 has the ID 1, Port2 the ID 2 etc. Each pin of each port is a value between 0 (Port*N*-0) to 15 (Port*N*-15). For instance pin *P5_7* is accessible by `(5, 7)`. This designation is useful to target a specific MCU pin.
- The virtual board connectors designation. Board has 2 virtual connectors: ARDUINO digital port and ARDUINO analog port, with respectively these IDs 30 and 31. For instance pin *P1_15* is accessible on connector ARDUINO analog, pin P1_15: `(31, 5)`. This designation is useful to target a virtual connector pin without knowing which MCU pin it is and on which physical connector pin is connected.

- The physical board connectors designation. Board has 3 connectors: CN9, CN14 and CN15 (CN10 is not connected to the MCU), with respectively these IDs: 69, 74 and 75. For instance pin *P1_15* is accessible on connector CN15, pin6: `(75, 6)`. This designation is useful to target a physical connector pin without knowing which MCU pin it is.

The following table summarizes the exhaustive list of GPIOs ports accessible from HAL library, and the ranges of pin IDs:

Table 3.5. HAL GPIOs Ports and Pins

Port name	HAL port ID	Pins range
Global MCU virtual port	0	0 to 324
MCU port 1	1	0 to 15
MCU port 2	2	0 to 15
MCU port 3	3	0 to 15
MCU port 4	4	0 to 15
MCU port 5	5	0 to 11
MCU port 7	7	0 to 15
MCU port 8	8	0 to 15
MCU port 9	9	0 to 7
MCU port 10	10	0 to 15
MCU port 11	11	0 to 15
Board virtual port "ARDUINO digital"	30	0 to 15
Board virtual port "ARDUINO analog"	31	0 to 5
Board physical port "CN9"	69	1 to 10
Board physical port "CN14"	74	1 to 8
Board physical port "CN15"	75	1 to 6

The following table shows the exhaustive list of GPIOs connected to the HAL library, their IDs according the ports IDs and pins IDs (see before):

Table 3.6. HAL GPIOs Pins Designation Mapping

Port / Pin	MCU virtual port (1)	MCU port (2)	Board virtual port (3)	Board physical port (4)
P1_2	0, 3	1, 2	31, 15	69, 1
P1_3	0, 4	1, 3	31, 14	69, 2
P1_8	0, 9	1, 8	30, 0	75, 1
P1_9	0, 10	1, 9	30, 1	75, 2

Port / Pin	MCU virtual port (1)	MCU port (2)	Board virtual port (3)	Board physical port (4)
P1_10	0, 11	1, 10	30, 2	75, 3
P1_11	0, 12	1, 11	30, 3	75, 4
P1_13	0, 14	1, 13	30, 4	75, 5
P1_14	0, 15	1, 14	30, 5	75, 6
P2_14	0, 31	2, 14	31, 1	74, 7
P2_15	0, 32	2, 15	31, 0	74, 8
P4_4	0, 53	4, 4	31, 5	74, 3
P4_5	0, 54	4, 5	31, 4	74, 4
P4_6	0, 55	4, 6	31, 3	74, 5
P4_7	0, 56	4, 7	31, 2	74, 6
P8_11	0, 119	8, 11	31, 7	74, 1
P8_13	0, 121	8, 13	31, 6	74, 2
P8_14	0, 122	8, 14	31, 9	69, 9
P8_15	0, 123	8, 15	31, 8	69, 10
P10_12	0, 144	10, 12	31, 13	69, 5
P10_13	0, 165	10, 13	31, 10	69, 8
P10_14	0, 146	10, 14	31, 11	69, 7
P10_15	0, 147	10, 15	31, 12	69, 6

The following table lists the hardware analog devices (ADC channel) used by HAL analog pins:

Table 3.7. HAL Analog IOs Pins Designation Mapping

Port / Pin	ADC channel	PWM / channel
P1_8	0	-
P1_9	1	-
P1_10	2	-
P1_11	3	-
P1_12	4	-
P1_13	5	-
P1_14	6	-
P1_15	7	-
P4_4	-	PWM2E
P4_5	-	PWM2F
P4_6	-	PWM2G
P4_7	-	PWM2H

Port / Pin	ADC channel	PWM / channel
P8_11	-	PWM1D
P8_13	-	PWM1F
P8_14	-	PWM1H
P8_15	-	PWM1G

Chapter 4. Foundation Libraries

4.1. List

This table illustrates the available foundation libraries in the MicroEJ platform, and their versions.

Table 4.1. Foundation Libraries

Name	Version
EDC	1.2
BON	1.3
ECOM	1.1
ECOM-COMM	1.1
NLS	2.0
SNI	1.2
SP	2.0
KF	1.4
MicroUI	2.2
NET	1.1
SSL	2.0
FS	2.0

Chapter 5. Board Configuration

GRPEACH provides several connectors, each connector is used by the MicroEJ Core Engine itself or by a foundation library.

5.1. Mandatory Connectors

GRPEACH provides three connectors used as:

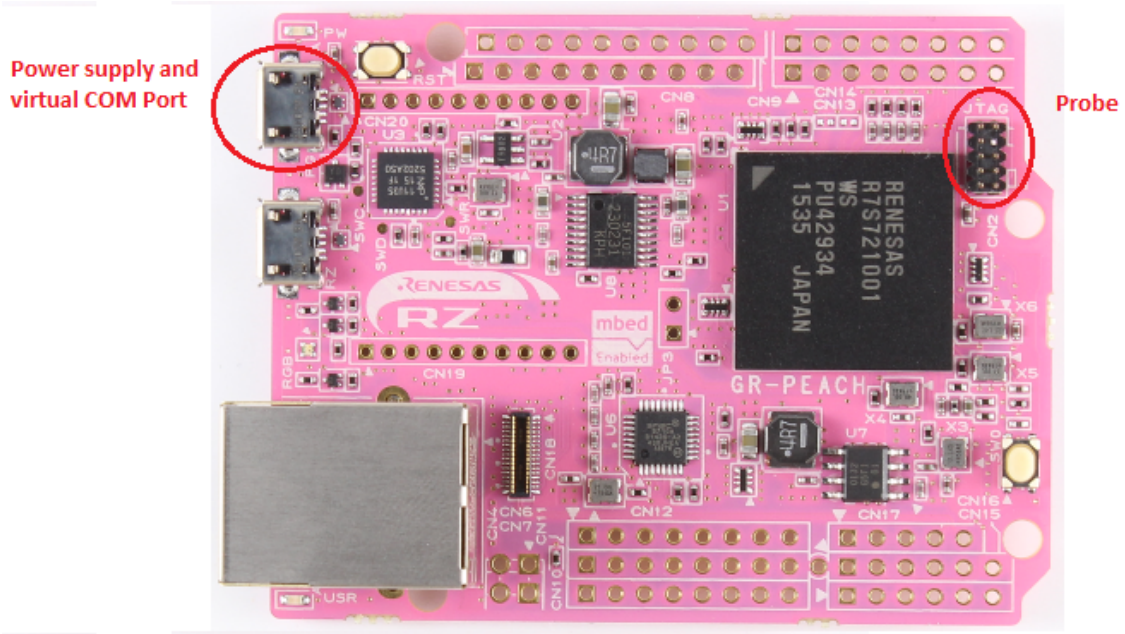
- Power supply connector and Virtual COM port
- Probe connector

Plug a micro-B USB cable to a computer to power the board and be able to see the MicroEJ standalone application `System.out.print` traces. The virtual port configuration is 115200 baud 8N1.

Prerequisites

Download mbed Windows serial port driver from `https://developper.mbed.org/handbook/Windows-serial-configuration/` and install it on your machine.

Figure 5.1. Mandatory Connectors

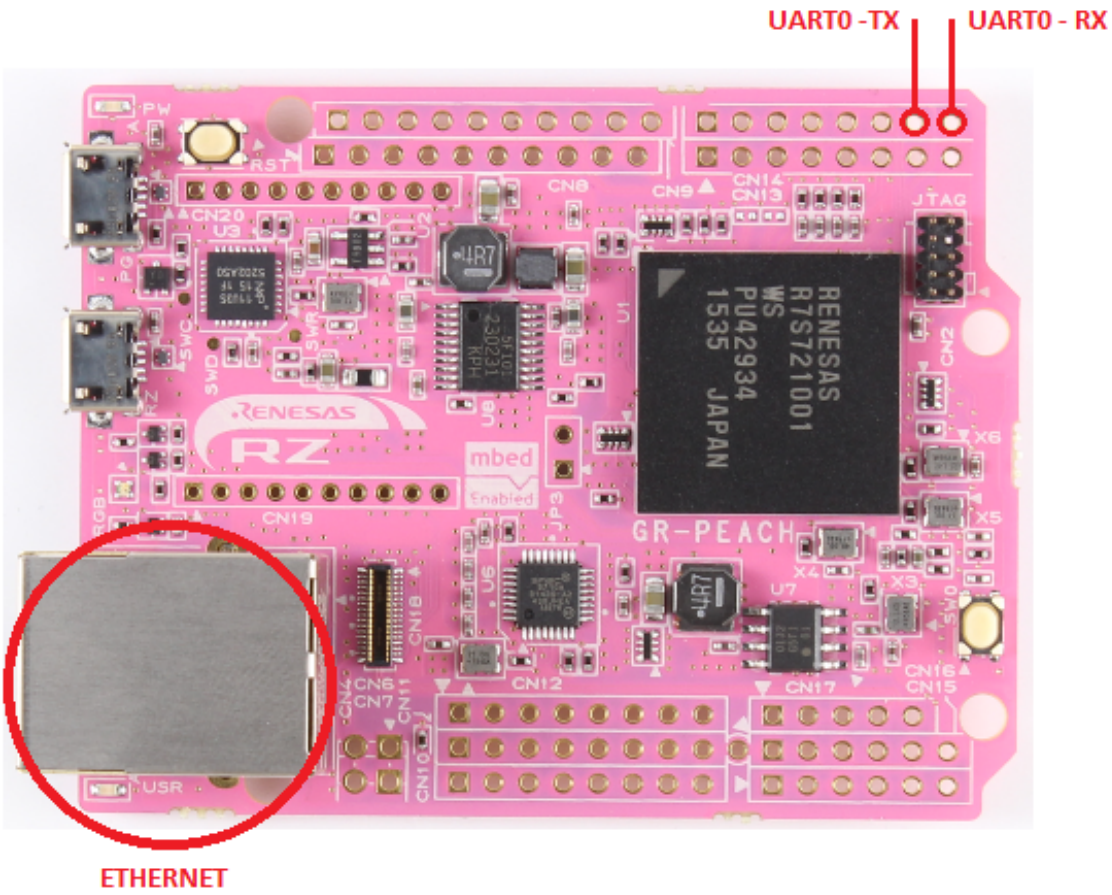


5.2. Communication Connectors

GRPEACH provides several communication ports:

- Ethernet
- Serial communication

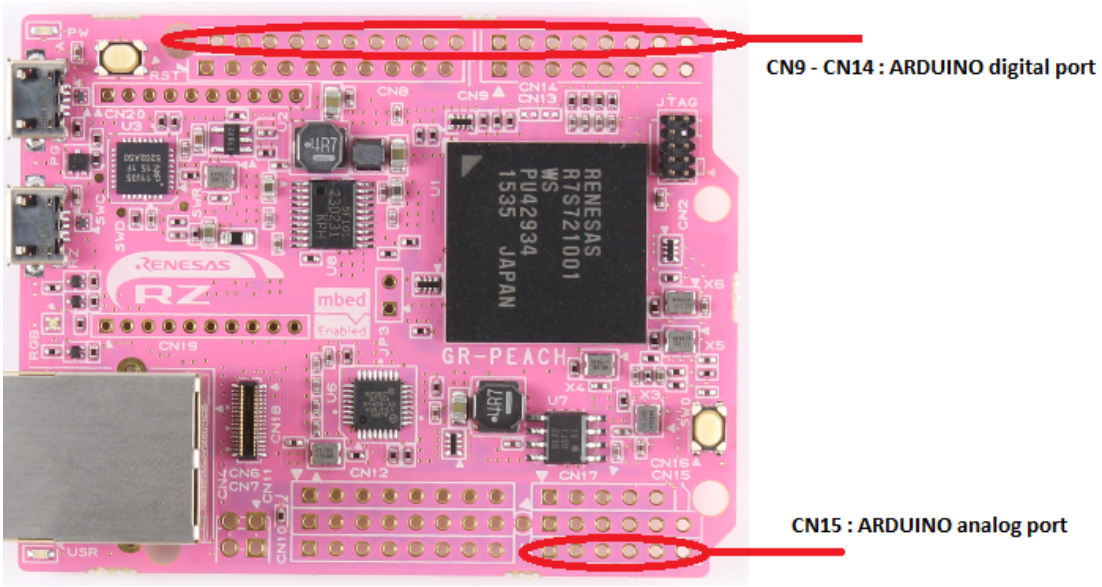
Figure 5.2. Communication Connectors



5.3. HAL Connectors

GRPEACH provides several HAL GPIOs on connector CN9, CN14 and CN15.

Figure 5.3. HAL Connectors



Chapter 6. Changelog

6.1. Version 1.5.1

- Migrated to Architecture 6.17.2.
- Use pack UI 9.3.1 instead of 9.0.2.

6.2. Version 1.4.3

- BugFix : Use pack Net 6.1.5 instead of 6.1.4

6.3. Version 1.4.2

- BugFix : Soft DNS resolver doesn't retry on timeout and doesn't try other servers on errors

6.4. Version 1.4.1

- Increase SSL memory pool

6.5. Version 1.4.0

- Upgrade platform architecture

6.6. Version 1.3.0

- Upgrade platform architecture

6.7. Version 1.2.0

- Add HAL module low level interface implementation
- BugFix : Error on SSL certificate check.

6.8. Version 1.1.1

- BugFix : Initialization of serial handler should be done before enable IRQ.

6.9. Version 1.1.0

- Fixed space in MicroEJ repository path causing link errors

- Change address MAC customization in flash memory by UID customization
- Change output trace baudrate to 115200

6.10. Version 1.0.0

Initial release of the platform.