IMPROVING, OPTIMIZING AND ACCELERATING YOUR EMBEDDED SOFTWARE DEVELOPMENT PROCESS FOR POWER EFFICIENCY WITH RENESAS RL78 WEB SIMULATOR TOOL:

The increase in energy consumption cost and power supply cost, the government regulations (e.g.: EU’s electricity directive) and the need to manage the power dissipation of increasingly powerful processors have stimulated the investigation of new innovative techniques for the energy consumption reduction in the entire electronics industry. In particular, for the hand-held devices which require battery power to be able to guarantee a certain minimum usage time between recharging (e.g.: wearables, hearables, IoT, etc...) but also devices like wireless sensing, wireless base station, measurement, medical and test equipment that are very sensitive to power, energy efficiency has become an absolute top priority.

The customers and especially the consumers are increasingly asking for smaller footprints along with a high demand to increase battery life, to switch to smaller and cheaper battery type in order to lower the overall cost. This trend does not correspond only to specific applications areas, but the entire microcontroller and embedded systems market is underpinned by the fundamental need for better power management resulting in energy friendly embedded software development.

Hence, developers and engineers designing embedded systems are facing stringent power requirements for energy friendly software. This means, they should manage to make the right choice of the Microcontroller running their application to guarantee that the fulfillment of the low-power expectations is covered by low-power features available in the Microcontroller. On the other side, they should get the right power consumption profiling tools that assist them in measuring energy consumption of the different sections of the Microcontroller accurately in order to identify the energy-hungry sections and optimize the code for power efficiency.

Essentially, we often see that the expectation for better energy efficiency has turned out to be a major concern of the engineers designing embedded systems unfortunately, posing them challenges, putting a lot of pressure on them and making it seems like this responsibility falls only on their shoulders alone. Some of the challenges associated with energy friendly embedded software development are listed here:

- Using the “ampere meter” to measure the power consumption of increasingly complex embedded software application is not enough anymore:
  - Precise power consumption measurement in an embedded application Software, where there is continuous change between low-power and active modes is difficult.
  - In Energy harvesting devices, the use of standard power measurement tools is impractical.
Extensive experience, expertise and know-how is required:

- It is important for developers to have clear understanding of what the analysis tools are and what the hardware and software target platform requirements are.
- System design & implementation at all levels is required
- Hardware-Sofware co-design expertise is required in order to cope with hardware debugging, software functionality debugging and software energy debugging which have become 3 essential steps in the embedded software development process.
- More analysis should be done to evaluate power consumption carefully rather in the beginning and not in the final stage of the development instead in order to avoid mistakes
- Software portion should be optimized to run on the hardware

Fortunately, Renesas has clearly understood the fact that, the Microcontroller’s vendors have the potential and the ability to provide a large contribution to energy efficiency, so the engineers can easily manage the pressure to shorten project time, increase battery life and bring costs down.

Hence, to address this fundamental need for better power efficiency and empower engineers to face the challenges associated with energy friendly embedded software development in an optimum fashion, Renesas provides a web-based development tool called **RL78 Web Simulator tool**, comprising a **current consumption calculator** and a **current consumption simulator**. These tools help engineers designing embedded solutions to hit against schedules, to set and keep power requirements of their embedded system designs while taking advantage of all power saving features of RL78 Microcontrollers.

### Choosing the right MCU for your embedded ultra-low Power application is essential:

The growing trend towards hand-held devices, patient healthcare and all type of small wireless sensing devices including devices for the Internet of Things (IoT) have seen the emergence of increasingly number of Microcontrollers families from different IC vendors making claims about being ultra-low power. This upwards trend opens up a countless variety of different options and in turn make it difficult for developers, engineers and makers to select the right Microcontroller for their low-power applications. However, it is important to understand the fundamental concept of a good power management consideration which is based on the right choice of the Microcontroller used for your embedded ultra-low power system.

The bottom line is that the Microcontroller should incorporates advanced power-saving features which allows the user to utilize different sleep modes and optimize individual application needs and frequency speeds to save power. Also, the microcontroller RUN time must be minimized to enable lowest power.

Renesas's industry leading RL78 family of 16-Bit Microcontrollers have been designed to answer to these needs and requirements, and will assist the developers in optimum fashion by eliminating unnecessary power consumption in active but especially in sleep modes. In addition, the RL78 family of Microcontrollers incorporates smart peripherals which are implemented in a way to help
developers, engineers and makers to reduce RUN mode operation time in their low-power applications.

The figure 1 below shows the different operation modes of RL78 Microcontrollers.

![Figure 1: Different operation modes of RL78 Microcontrollers.](attachment:image1)

The really interesting thing that crystallizes what Renesas have achieved with RL78 MCUs is for a good part the enhanced peripherals with the possibility to reduce system energy by smart CPU management, combined with the unique low power features built-in that adds years to the battery life for applications that spend the majority of their time in sleep modes. This fantastic features make the Renesas RL78 MCUs the right choice for low-power and battery-operated applications.

**Having the right power profiling tools that fit into your target and low-power application requirements makes the difference:**

In the face of rising competitive pressure, short innovation cycles and continually growing need for energy efficient applications, developers, engineers and makers are constantly looking for development tools:

- that support them effectively in their decision-making of the optimum MCU selection,
- that help them to cope successfully with the challenges associated with energy friendly embedded software development,
- that assist them in achieving their critical design factors and meet time to market schedules.

I think the whole engineering community can easily agree on one point: Having the right hardware and software development tools play a major active role in the reduction of the energy requirements of an Embedded System.

Energy harvesting applications is a typical area where there is an urgent need of very accurate power estimation and a very careful optimization. The ability to measure energy consumption accurately and
to optimize it for various conditions can potentially increase the adoption of energy harvesting products and applications that contribute in a greener and smarter world.

Luckily, thanks to Renesas, software and hardware engineers designing embedded systems will not have any more to go through the painful process of estimating the power requirement of their application using the old-fashion, or to get confused by the MCU documentation, or to run through a miscalculation of the power estimation due to mistakes, or even to rely on their intuition when trying to optimize their embedded software for energy consumption. The figure 2 below shows the old-fashion (manual entry) of estimating energy in the left side, and the modern way of energy estimation by Renesas tools in the right-end side.

More details about the Renesas RL78 Web simulator tool and some other useful links and further information can be found at:


Figure 2: Possible methods of estimating current consumption.

As part of the Renesas RL78 Web simulator tool, both the current consumption calculator and the current consumption simulator are energy measurement tools that enable the engineers not only to understand the effect of the different improvements and Enhancements to the MCU's and application’s activity profile, but also, these tools support their development and debug efforts while helping them to achieve the targets based on the energy demand. These tools are available free of charge and can be found at the “Renesas Engineer School” landing web page as shown in the figure 3 below:
Basically, the premises of the Renesas RL78 Web simulator tools are to be able to give Developers, Engineers and Makers a real head start when they start developing a Low-power application. They can simulate consumption current of RL78 MCUs without the need to purchase a development tool. There is no need to check the detailed characteristics in the hardware manual or to write a program code to do this job. By so doing, they can focus on optimizing their application code for energy efficiency instead of trying to figure out how the power consumption of the core, of the peripherals and the whole application can be measured accurately.

In that sense, Renesas has done a great job that makes your life easier as you now have a tool that assist you in pinpointing energy-hungry sections in your code and debug/remove them.

So, users and developers can immediately see great benefits in the performance of the tool. To be honest, I was myself, thrilled about the powerful capabilities of this tool, and I am strongly confident, that it will make your day-to-day job dealing with embedded Software for power efficiency with Renesas RL78 MCU a lot easier to perform.

Engineers can now rely on the RL78 Web simulator tool that allows them to see energy consumption during hardware and software development.

All they have to do is to simply set up the MCU operating conditions, start up the tool, log in to “my Renesas” to access their account, and they are ready to go. If they are not registered yet to access “my Renesas” account, just hit “Don’t have an account yet? Register here”. When they are done with all settings, just hit “calculate current consumption” button and the simulator calculates the current consumption current of the CPU including the peripherals.
Figure 4 below shows the screenshot of the RL78 current simulator where the amount of energy consumed by each peripheral is shown.

![Screenshot of Current simulator for RL78](image)

**Figure 4: Screenshot of Current simulator for RL78.**

We more often see that the project development tools from the competition offering are not including a power profiler to see the way how the code is accessing the MCU and identify the energy-hungry portion of the code. This is exactly the point where RL78 Web simulator tool stands out from its competition.

To conclude, the beauty of the where RL78 Web simulator tool is to bring a total experience for you with an IDE with intelligent Editor, Debugger, Compiler, project examples, Power profiling tools, all in one roof umbrella.

**Website and Support**

RL78 – Renesas Engineering School:
https://www.renesas.com/en-eu/support/technical-resources/engineer-school.html

Renesas RL78 Web Simulator:

RL78 – Renesas Current consumption Simulator:

RL78 low power MCU family:

Website:
http://www.renesas.com