User Manual

16

RL78/G13 Stick

(YRPBRL78G13)

16-bit Microcontroller

RL78/G13 R5F100LEAFB

Renesas Electronics
www.renesas.com

R01UH0243ED0000, Rev. 1.0
March 25, 2011

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics.

8. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti- crime systems; safety equipment; and medical equipment not specifically designed for life support.

   “Specific”: Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems;medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.

9. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.

10. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.

11. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.

12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.

13. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

    (Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority- owned subsidiaries.

    (Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.

   The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.
2. Processing at Power-on
   The state of the product is undefined at the moment when power is supplied.

   The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.

   The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products
   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.

   The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

Regional Information

Some information contained in this document may vary from country to country. Before using any Renesas Electronics product in your application, please contact the Renesas Electronics office in your country to obtain a list of authorized representatives and distributors. They will verify:

- • Device availability
- • Ordering information
- • Product release schedule
- • Availability of related technical literature
- • Development environment specifications (for example, specifications for third-party tools and components, host computers, power plugs, AC supply voltages, and so forth)
- • Network requirements

In addition, trademarks, registered trademarks, export restrictions, and other legal issues may also vary from country to country.

Visit

http://www.renesas.com

to get in contact with your regional representatives and distributors.

Preface

Readers This manual is intended for users who want to understand the functions of the concerned microcontrollers.

Purpose This manual presents the hardware manual for the concerned microcontrollers.

Organisation This system specification describes the following sections:

- Pin function
- CPU function
- Internal peripheral function

Module instances These microcontrollers may contain several instances of a dedicated module. In general the different instances of such modules are identified by the index “n”, where “n” counts from 0 to the number of instances minus one.

Legend Symbols and notation are used as follows:

• Weight in data notation:	Left is high order column, right is low order column
• Active low notation:	xxx (pin or signal name is over-scored) or /xxx (slash before signal name) or _xxx
• Memory map address:	High order at high stage and low order at low stage

Note Additional remark or tip

Caution Item deserving extra attention

Numeric notation

Binary:	xxxx or xxxB
Decimal:	xxxx
Hexadecimal	xxxxH or 0x xxxx

Numeric prefixes representing powers of 2 (address space, memory capacity):

K (kilo):	2^{10} = 1024
M (mega):	2^{20} = 1024^2 = 1,048,576
G (giga):	2^{30} = 1024^3 = 1,073,741,824

Register contents X, x = don’t care

Diagrams Block diagrams do not necessarily show the exact wiring in hardware but the functional structure. Timing diagrams are for functional explanation purposes only, without any relevance to the real hardware implementation.

How to Use This Manual

(1) Purpose and Target Readers

This manual is designed to provide the user with an understanding of the hardware functions and electrical characteristics of the MCU. It is intended for users designing application systems incorporating the MCU. A basic knowledge of electric circuits, logical circuits, and MCUs is necessary in order to use this manual. The manual comprises an overview of the product; descriptions of the CPU, system control functions, peripheral functions, and electrical characteristics; and usage notes.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the xxx/xx Group. Make sure to refer to the latest versions of these documents. The newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
Data Sheet	Hardware overview and electrical characteristics	xxx/xx Group Datasheet	R01DSxxxxEJxxxx
User's manual for Hardware	Hardware specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and operation description. Note: Refer to the application notes for details on using peripheral functions.	xxx/xx User's manual for Hardware	This User's manual
User's manual for Software	Description of CPU instruction set	xxx/xx Series User's manual for Software	R01USxxxxEJxxxx
Application Note	Information on using peripheral functions and application examples. Sample programs. Information on writing programs in assembly language and C.	Available from Renesas Electronics Web site.	
Renesas Technical Update	Product specifications, updates on documents, etc.		

(2) Notation of Numbers and Symbols

Not applicable.

(3) Register Notation

Not applicable.

(4) List of Abbreviations and Acronyms

Abbreviation	Full Form
ACIA	Asynchronous Communication Interface Adapter
bps	bits per second
CRC	Cyclic Redundancy Check
DMA	Direct Memory Access
DMAC	Direct Memory Access Controller
GSM	Global System for Mobile Communications
Hi-Z	High Impedance
IEBus	Inter Equipment Bus
I/O	Input/Output
IrDA	Infrared Data Association
LSB	Least Significant Bit
MSB	Most Significant Bit
NC	Non-Connect
PLL	Phase Locked Loop
PWM	Pulse Width Modulation
SFR	Special Function Register
SIM	Subscriber Identity Module
UART	Universal Asynchronous Receiver/Transmitter
VCO	Voltage Controlled Oscillator

Table of Contents

Chapter 1 Introduction

The *YRPBRL78G13* is a promotion board for the new Renesas RL78 microcontroller family. It supports On-Board debugging, flash programming, and is pre-programmed to work with the GUI provided on the DVD to demonstrate the low power capabilities of the Renesas RL78 MCU.

1.1.1 Main features of *YRPBRL78G13*

- Easy to use device demonstration capabilities
  YRPBRL78G13 contains elements to easily demonstrate simple I/O-functions (i.e. LED output, I/O lines, UART serial interface) together with the key functions such as Real Time Clock (RTC), ADC, Timers, safety functions and on-chip data flash.

- Power supply via USB interface
  YRPBRL78G13 is powered via USB interface. No separate power supply is needed although a connector is provided to supply an external power supply if needed.

- On-Board debug function
  The *YRPBRL78G13* supports an On-Board debug function by using the IAR C-SPY debugger, without the need of additional debug hardware. It allows Flash programming and supports standard debug functions such as code execution, single stepping, software breakpoints, memory manipulation etc.

- WriteEZ5, Flash programming software
  Windows based Flash programming software allows the user to select and download application programs to the *YRPBRL78G13* board for evaluation purposes.

- Applilet3, Device driver code generator
  Software tool used to generate device driver code to initialize and use on-chip peripherals.

Caution Please note that the WriteEZ5 and Applilet3 software versions provided are only preliminary versions and therefore should only be used with the *YRPBRL78G13* board. We recommend not to upgrade these software tools in order to guarantee operation with the stick. Please also note that documentation is not supplied for these pre release versions but will be available to download from the Renesas website once final versions are released.

- Various input / output signals available, such as

  ◦ All I/O ports prepared to be connected to user hardware
  ◦ Virtual UART interface, via the µPD78F0730 78K0 8-bit microcontroller with on-board USB interface
  ◦ 1 LED connected to a RL78/G13 port for visualization.

- The IAR Embedded Workbench for RL78 and the IAR C-SPY debugger are included. These packages are restricted in such that maximum program code size is limited to 16 Kbytes.

Caution Please note that only the IAR Embedded Workbench for RL78 1.10 version provided on the DVD should be used with the *YRPBRL78G13* stick and will be supported.

- Full documentation is included for the Renesas software tools and the RL78/G13 device.

***YRPBRL78G13* is not intended for code development. Renesas does not allow and does not support in any way any attempt to use *YRPBRL78G13* in a commercial or technical product.**

1.1.2 System requirements

HOST PC A PC supporting Windows XP, Windows Vista or 7 is required for the GUI and development tools installation. A Pentium processor with at least 1 GHz CPU performance, with at least 256 Mbytes of RAM, allowing you to fully utilize and take advantage of the product features.
350 Mbytes of free disk space and an additional 10 Mbytes of free disk space on the Windows system drive.

A web browser and Adobe Acrobat Reader to be able to access all the product documentation.

Host interface USB interface that enables communication based on USB (Ver1.1 or later)

1.1.3 Package contents

- *YRPBRL78G13*
- USB Type A / Mini-B cable
- Screwdriver to adjust the potentiometer voltage
- DVD containing all the software, tools and documentation needed to quickly start evaluating the product.

If any part is missing or seems to be damaged, please contact the dealer from whom you received your *YRPBRL78G13* starter kit.

1.1.4 Trademarks

IAR Embedded Workbench, VisualSTATE, IAR MakeApp and C-SPY are registered trademarks of IAR Systems AB. Microsoft and Windows are registered trademarks of Microsoft Corporation. Adobe and Acrobat Reader are registered trademarks of Adobe Systems Incorporated.

All other product names are trademarks or registered trademarks of their respective owners.

Chapter 2 YRPBRL78G13 System Configuration

The *YRPBRL78G13* system configuration is given in the diagram below:

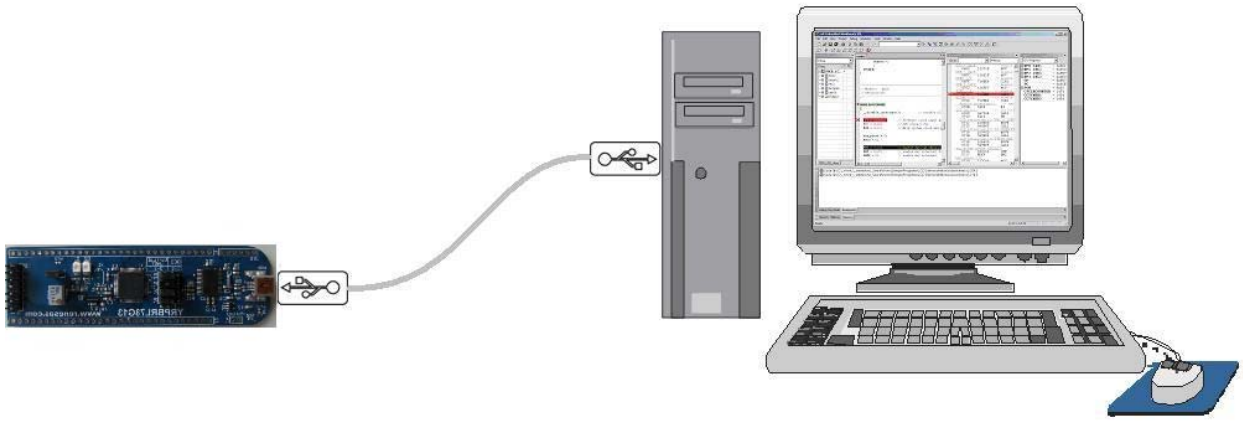

Figure 1: *YRPBRL78G13* System Configuration

2.1 YRPBRL78G13

YRPBRL78G13 is a promotion board for evaluating the new Renesas RL78/G13 family of devices. The device used is the RL78/G13 (R5F100LEAFB) the first microcontroller from the G Series. The board can be directly connected to the host system via a USB port. The host system may be used for On-Board debugging or Flash programming and to allow execution of the Demonstration program on the RL78/G13 device in combination with the supplied demonstration GUI.

As default, the RL78/G13 is using the 32 MHz internal high-speed oscillator, but the *YRPBRL78G13* board is provided with a connection for an external 20 MHz oscillator (not fitted) if the user wishes to use a different clock frequency than that provided by the internal high speed oscillator. An external Seiko Instruments low power 32.768 KHz resonator is provided for the sub-clock.

2.2 Host Computer

The USB host interface enables communication to the *YRPBRL78G13* board. The µPD78F0730 78K0 8-bit microcontroller with on-chip USB interface and the Renesas Electronics virtual UART driver allows application software to access the USB device in the same way as it would access a standard RS232 interface. The Renesas Electronics virtual UART driver appears to the windows system as an extra Com Port, in addition to any existing hardware Com Ports.

2.3 Power Supply via USB interface

YRPBRL78G13 is powered by USB interface therefore no separate power supply is required.

Chapter 3 YRPBRL78G13 Board Components

The *YRPBRL78G13* board is equipped with a USB connector and with several connectors in order to be connected to host computers, Minicube2, E1 emulator or any external target hardware.

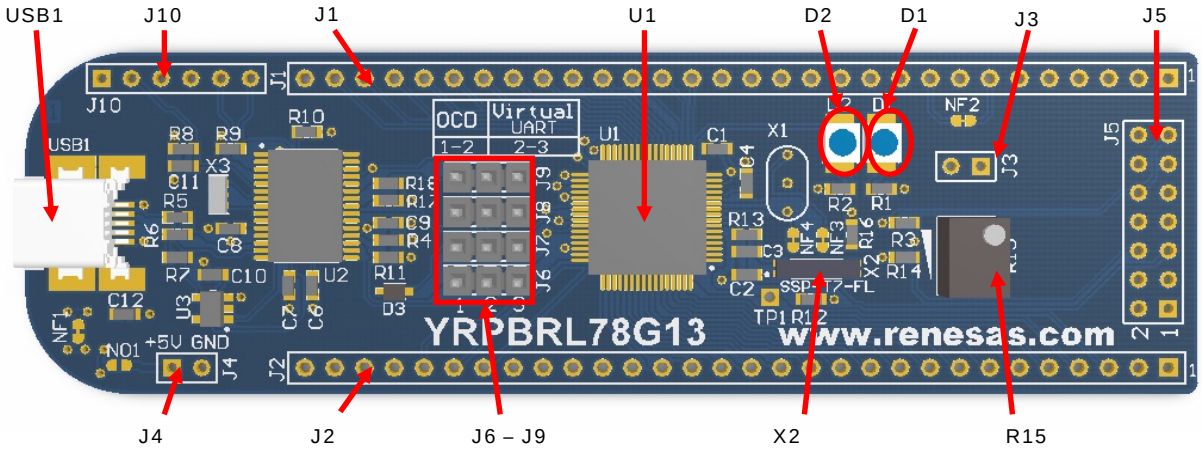

Figure 2: YRPBRL78G13 Board Components

Some of the *YRPBRL78G13* components are free for user application hardware and software. Please read the user's manual of the RL78/G13 device carefully to get information about the electrical specification of the available I/O ports before you connect any external signal to the *YRPBRL78G13* board.

3.1.1 Configuration Jumpers J6, J7, J8, J9

The jumpers J6 to J9 control the different operating modes of the *YRPBRL78G13* board.

3.1.1.1 GUI Demonstration Mode / Virtual UART Mode

The default operation of the board is set for use with the GUI using the virtual UART. Jumpers J6 to J9 should be set as shown in the table below

Jumpers	Configuration
J6	2-3
J7	2-3
J8	2-3
J9	2-3

Table 1: J6 to J9, GUI Demonstration Mode

3.1.1.2 On-Board Debug (OCD) Mode / Flash Programming Mode

The *YRPBRL78G13* starter kit supports on-board debug mode achieved by a dedicated monitor running on the RL78/G13 device. By using the IAR C-SPY debugger, flash programming and standard debug functions i.e. code execution, single stepping, software breakpoints, memory manipulation etc. are supported.

Additionally the built-in Flash memory of the RL78/G13 device can be re-programmed by using the WriteEZ5 Flash programming GUI.
Configure jumpers J6 to J9 as following to use the on-board debug or Flash programming mode:

Jumpers	Configuration
J6	1-2
J7	1-2
J8	1-2
J9	1-2

Table 2: J6 to J9, On-Board Debug / Flash Programming Mode

For more details please refer to **Chapter 8 - On-Board Debugging (OCD)** of this document.

3.1.2 User's LED D1

D1 is the Power LED. D1 is activated if power is supplied to the *YRPBRL78G13* board.

3.1.3 Power LED D2

D2 is connected to the port pin "P77" of the RL78/G13. It can be used by the user for any purpose.

3.1.4 External Power Supply J4

External power can be supplied by connecting a regulated 5V DC to the connector J4 (not assembled).

The operation of the stick is as follows:
- USB power only
Or
- External supply only (Board can only be operated as stand alone only, no USB power connection).

When external power supply (Vext) is used, make sure that you follow these guidelines:
- Solder bridge NO1 is closed (Default is open)
- Solder bridge NF1 is closed to power the 78K0/USB circuitry (Default is closed)
- Vext can only be used if the stick is not connected to the PC
- USB connection is not permitted (if both USB and external power supplies are used, then it can damage the board).

Please refer to the schematic and the assembly drawing of the board to locate the above components.

J4	Function
1	Vext (+)
2	GND (-)

Table 3: External Power Supply, Connector J4

Note: Pin number 1 is marked with a square on the assembly drawing

3.1.5 Current Measurement J3

Jumper J3 connects the 5V power supply to the V_{DD} pin of the RL78/G13 microcontroller. The jumper can be replaced by the two leads of a Multi-meter to measure the current consumed by the RL78 device. To use this function please make sure that the Multi-meter is connected before supplying power to the starter kit. The current can be measured for all the different low power modes by using the demonstration GUI supplied to enter all different power and standby modes.

3.1.6 E1 Emulator Connector J5

Jumper J5 (not fitted) is provided to allow debugging and programming of the RL78/G13 microcontroller using the E1 OCD emulator. This function allows the user to be able to debug an application and make use of the UART2 that can use the Renesas Virtual UART to interface to the PC. For this function a 14-way (2 x 7) standard pitch connector needs to be mounted and connected as shown below.

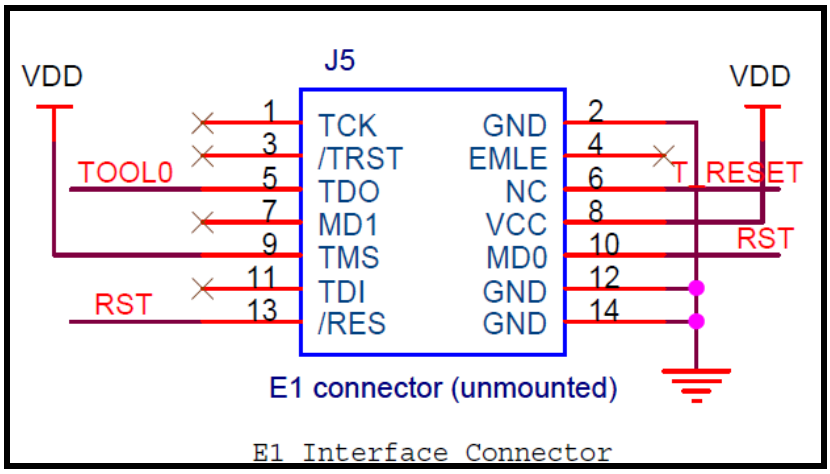

Figure 3: E1 Emulator Connection

3.1.7 Programming Connector J10

J10 is provided for production programming of the µPD78F0730 78K0 8-bit microcontroller during manufacturing. The 78K0/USB device should not be reprogrammed in order to ensure the USB interface working correctly with the GUI.

3.1.8 Mini-B USB Interface Connector USB1

The mini-B USB connector allows connecting the IAR C-SPY debugger or the WriteEZ5 Flash programming software to the *YRPBRL78G13* board in order to debug or program application software to the RL78/G13 device. The board power supply is also provided by this connector.

Additionally connector USB1 connects UART2 of the RL78/G13 device to the host system.

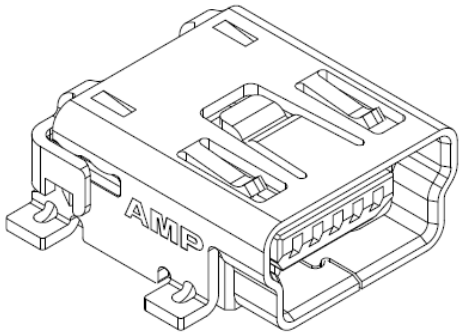

Figure 4: Connector USB1, Mini USB B Type Connector Pin Configuration

USB Connector USB1	Signal Name
1	V_{BUS}
2	D-
3	D+
4	NC
5	GND

Table 4: Pin Configuration of mini-B USB Connector USB1

For connection with the host machine, *YRPBRL78G13* can be plugged directly into an available USB port.

3.1.9 External Connectors J1 and J2

J1 to J2 are connectors for external user hardware. A standard 0.1’ pitch, 30-way single row, straight headers can be mounted to bring all I/Os for usage. Please read the user’s manual of the RL78/G13 device carefully to get information about the electrical specification of the available I/O ports.

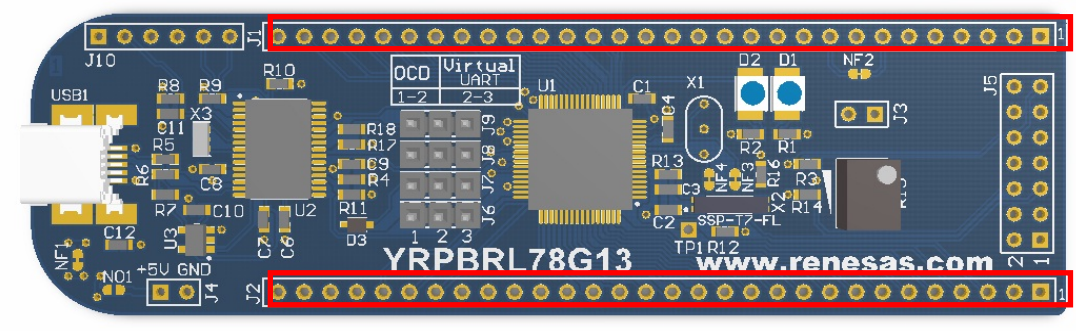

Figure 5: External Connectors J1 and J2

J1	Signal Name	RL78/G13 Pin Name	Comment
1	GND	VSS / EVSS	
2	VDD	VDD / EVDD	
3	P10	P10/SCK00/SCL00	
4	P11	P11/SI00/RxD0/TOOLRxD/SDA00	
5	P12	P12/SO00/TxD0/TOOLTxD	
6	TXD	P13/TxD2/SO20	
7	RXD	P14/RxD2/SI20/SDA20	
8	P15	P15/SCK20/SCL20	
9	P16	P16/TI01/TO01/INTP5	
10	P17	P17/TI02/TO02	
11	P55	P55	
12	P54	P54	
13	P53	P53	
14	P52	P52	
15	P51	P51/INTP2/SO11	
16	P50	P50/INTP1/SI11/SDA11	
17	P60	P60/SCLA0	
18	P61	P61/SDAA0	
19	P62	P62	
20	P63	P63	
21	P31	P31/TI03/TO03/INTP4	
22	P77	P77/KR7/INTP11	
23	P76	P76/KR6/INTP10	
24	P75	P75/KR5/INTP9/SCK01/SCL01	
25	P74	P74/KR4/INTP8/SI01/SDA01	
26	P73	P73/KR3/SO01	
27	P72	P72/KR2/SO21	
28	P71	P71/KR1/SI21/SDA21	
29	P70	P70/KR0/SCK21/SCL21	
30	NC		Not connected

Table 5: Connector J1

J2	Signal name	RL78/G13 Pin Name	Comment
1	GND	VSS / EVSS	
2	VDD	VDD / EVDD	
3	P140	P140/PCLBUZ0/INTP6	
4	P141	P141/PCLBUZ1/INTP7	
5	P00	P00/TI00	
6	P01	P01/TO00	
7	P02	P02/ANI17/SO10/TxD1	
8	P03	P03/ANI16/SI10/RxD1/SDA10	
9	P04	P04/SCK10/SCL10	
10	P130	P130	
11	AVrefp	P20/ANI0/AVREFP	
12	AVrefm	P21/ANI1/AVREFM	
13	P22	P22/ANI2	
14	P23	P23/ANI3	
15	P24	P24/ANI4	
16	P25	P25/ANI5	
17	P26	P26/ANI6	
18	P27	P27/ANI7	
19	T_RESET		Reset input Connected to 1.5 kΩ pull-up resistor
20	P120	P120/ANI19	
21	P43	P43	
22	P42	P42/TI04/TO04	
23	P41	P41/TI07/TO07	
24	P137	P137/INTP0	
25	P146	P146	
26	P147	P147/ANI18	
27	P06	P06/TI06/TO06	
28	P05	P05/TI05/TO05	
29	P30	P30/INTP3/RTC1HZ/SCK11/SCL11	
30	NC		Not connected

Table 6: Connector J2

3.1.10 Solder Bridges

Some operating functions can be customized by opening or closing the corresponding solder bridge accordingly. For more details please refer to the board schematics, Chapter 11 of this document.

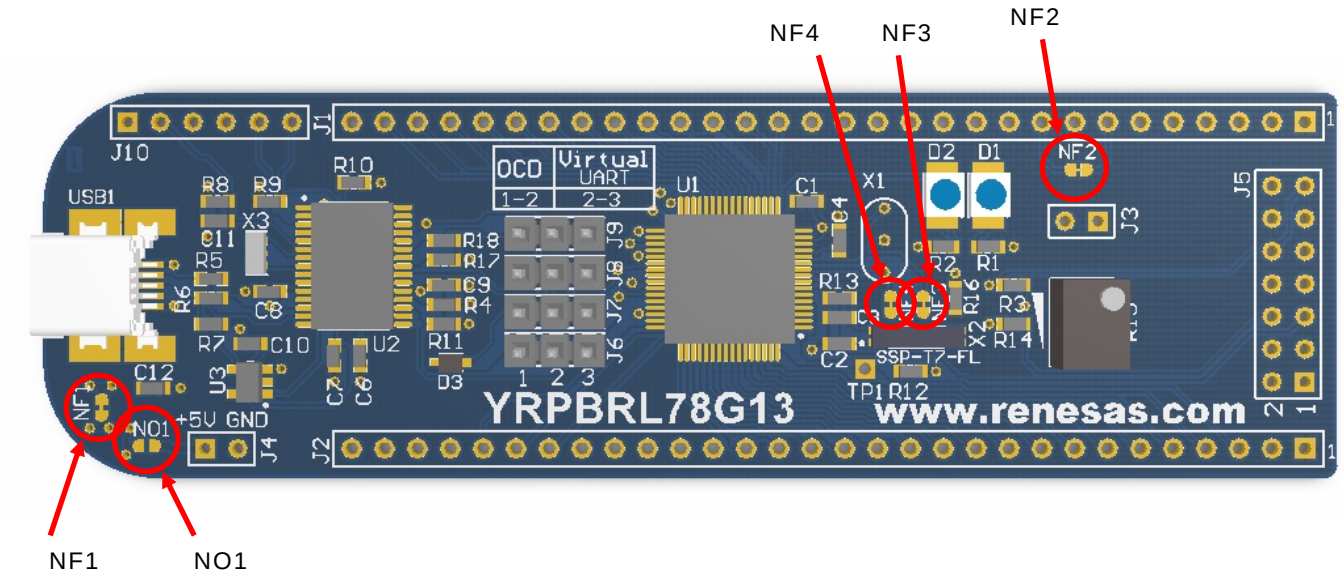

Figure 6: Location of Solder Bridges

Solder Bridge Name	Default Setting	Comment
NF1	Closed	Power is supplied from the USB interface
NF2	Closed	Connects RxD2 pin to INTP5 pin (for waking up the device from STOP mode upon data reception)
NF3	Closed	Connects X1 pin to a 10K pull-down resistor (when 20MHz resonator not fitted)
NF4	Closed	Connects X2 pin to a 10K pull-down resistor (when 20MHz resonator not fitted)
NO1	Open	By closing the solder bridge, power is supplied externally

Table 7: Solder Bridges

3.1.11 Seiko Instruments Inc. Low Power 32 KHz Resonator

The *YRPBRL78G13* board is fitted with an external 32 KHz resonator (X2) characterized specifically for the RL78/G13 device supplied by Seiko Instruments Inc.

This is a specially designed low power resonator designed to support the very low power consumption of the RL78/G13 family.

For more technical details on this device and contact details for Seiko Instruments, please refer to chapter 13.

3.1.12 RL78/G13 Memory Map

The RL78/G13 memory layout is shown in the table below.

Address area	0xFFFFF 0xFFF00	SFR Area 256 bytes	Free for user application software
	0xFFEFF 0xFEF00	Internal RAM 4KB	
	0xFEEFF 0xF2000	Mirror 51.75 KB	
	0xF1FFF 0xF1000	Data flash memory 4 KB	
	0x0F0FFF 0xF0800	Access prohibited area	
	0x0F07FF 0xF0000	2nd SFR 2 KB	Free for user application software
	0xEFFFF 0x10000	Access prohibited area	
	0x0FFFF 0x00000	64 KB code flash memory	Free for user application software

Table 8: RL78/G13 Memory Map

.

Chapter 4 Getting Started

The default setting of the *YRPBRL78G13* board is set for demonstration use with the GUI. The DVD included and quick start guide will take the user through the installation procedure

Initially the user will be required to select between the two installation options that are available to the user:

1. Quick Start Installation
   This will just install the GUI, drivers and associated documentation.

2. Complete Installation
   This will install the GUI full documentation and all of the development tools.

The Quick Start Guide will automatically open after the installation process to guide the user through the initial set-up and connection to the PC and GUI.

Please note as the communication interface between the host computer and the *YRPBRL78G13* board is the USB port interface, the hardware and software must be installed properly.

4.1 Installed Contents

The installer will copy and install the contents of the DVD on the host PC.

The contents copied and installed from the DVD will appear on the "Start → All Programs" menu under the main "Renesas Electronics Tools → YRPBRL78G13" and main "IAR Systems" folders with the following directory structure:

YRPBRL78G13	DESCRIPTION
Manual Navigator	- Documentation
YRPBRL78G13-Demo	- GUI software
Applilet3 for RL78G13	- Device driver code generator
WriteEZ5	- Flash programming software
IAR Systems	**DESCRIPTION**
IAR Embedded Workbench for Renesas RL78 1.10 Kickstart	- IAR Embedded Workbench for RL78

Table 9: Contents Installed on Start → All Programs

Chapter 5 Hardware Installation

After unpacking the *YRPBRL78G13* promotion board, connect the USB cable supplied to the board. The connection of the board to the Host PC should be done in conjunction with **Chapter 6.5 - USB Driver Installation**.
This driver must be installed before the user can use the GUI or debugger.

Chapter 6 Software Installation

The *YRPBRL78G13* package comes with several software demonstration packages:

- IAR Systems Embedded Workbench for RL78, including C compiler, assembler, linker, librarian and IAR C-SPY debugger
- A project built for use with the IAR debugger is included
- WriteEZ5 Flash programming GUI software to allow Flash programming of the RL78/G13 internal Flash memory
- GUI to be run with the main demonstration programs
- Source code for the demonstration and debugger programs

The IAR Systems Embedded Workbench environment and the WriteEZ5 Flash programming GUI must be installed on your PC. For detailed installation hints, refer to the following chapters and to the corresponding documentation of the IAR Embedded Workbench for RL78 and WriteEZ5.

6.1 IAR Systems Embedded Workbench for RL78 Installation

This program will be installed automatically by the installer on the DVD when the full installation is selected. If the quick install (GUI) was previously selected, please insert the DVD again and select the full installation.

6.2 WriteEZ5 Flash Programming GUI Installation

This program will be installed automatically by the installer on the DVD when the full installation is selected. If the quick install (GUI) was selected, please insert the DVD again and select the full installation.

6.3 GUI Installation

This program will be installed automatically by the installer on the DVD for both quick start and full installation.

6.4 Sample Programs Installation

The DVD installer will automatically install the sample debugger programs and the demonstration source code when the full installation is selected. If the quick start installation was previously selected, then please insert the DVD again and select the full installation.

The programs will be located in the following directories on the host PC:

C:\Workspace\RPB\RL78G13\IAR Sample Projects\Debugging Project\

C:\Workspace\RPB\RL78G13\IAR Sample Projects\GUI Demo Source Code\

6.5 USB driver installation

In order to use the *YRPBRL78G13* board in combination with IAR C-SPY debugger or the WriteEZ5 Flash programming GUI software, “Renesas Electronics Starter Kit Virtual UART” USB driver must be installed on the host machine.

Please follow according to version of Windows OS. Please check your Windows version, and follow the instructions:

Installation on Windows XP → Chapter 6.5.1

Installation on Windows Vista → Chapter 6.5.2

Installation on Windows 7 → Chapter 6.5.3

Note *Please insert the YRPBRL78G13* DVD *in your* DVD *drive in order to proceed with the USB driver installation.*

After the installation, please go to **Chapter 6.5.4 – Confirmation of USB Driver Installation**.

6.5.1 Installation on Windows XP

<1> When the *YRPBRL78G13* board is connected to the host machine, the board is recognized by “Plug and Play”, and the wizard for finding new hardware is started.

Select “No, not this time” and click Next >.

Figure 7: Found New Hardware Wizard (Windows XP)

Select “Install from a list or a specific location (Advanced)” and click Next >.

Figure 8: Install from a Specific Location (Windows XP)

<2> Mark “Include this location in the search” and then browse the computer to select the following directory:

C:\Program Files\Renesas\RPB\RL78G13\USB Drivers\Win2k\

Click Next >.

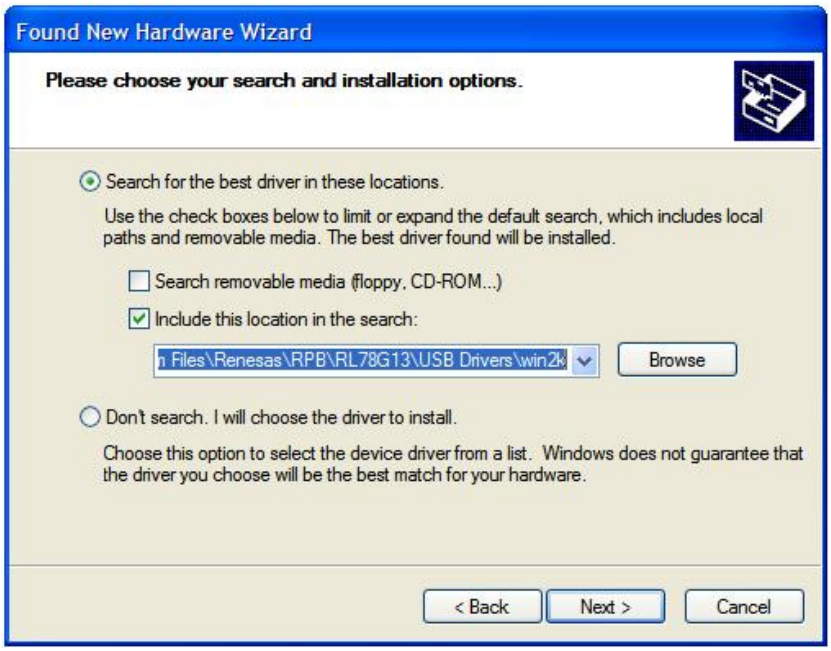

Figure 9: Search Location Specification (Windows XP)

<3> Click Continue Anyway to continue the installation.

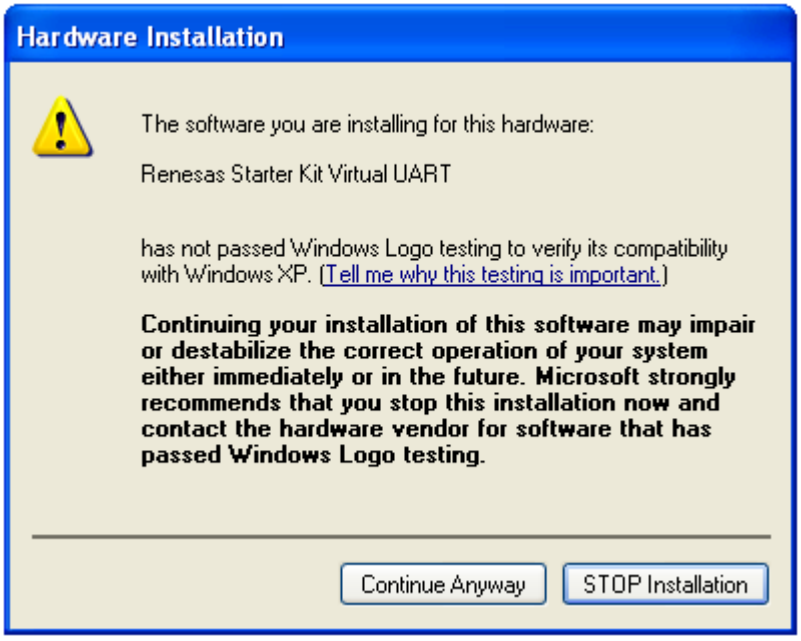

Figure 10: Installation Confirmation (Windows XP)

<4> Click Finish to close the installation wizard.

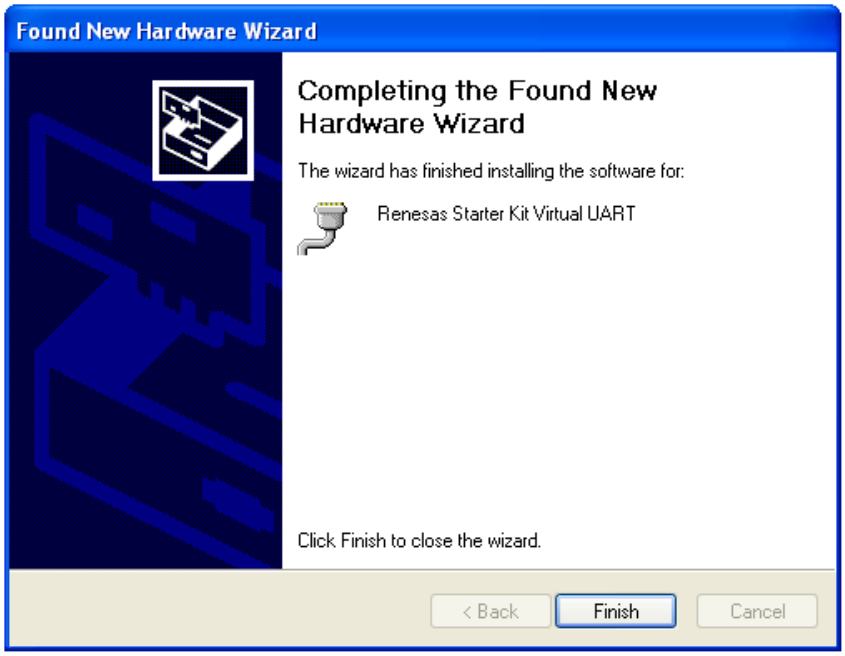

Figure 11: USB Driver Installation Completion (Windows XP)

6.5.2 Installation on Windows Vista

<1> When the *YRPBRL78G13* board is connected to the host machine for the first time, the board is recognized by “Plug and Play” and the “Found New Hardware” window will pop up.

Select “Locate and install driver software (recommended)”.

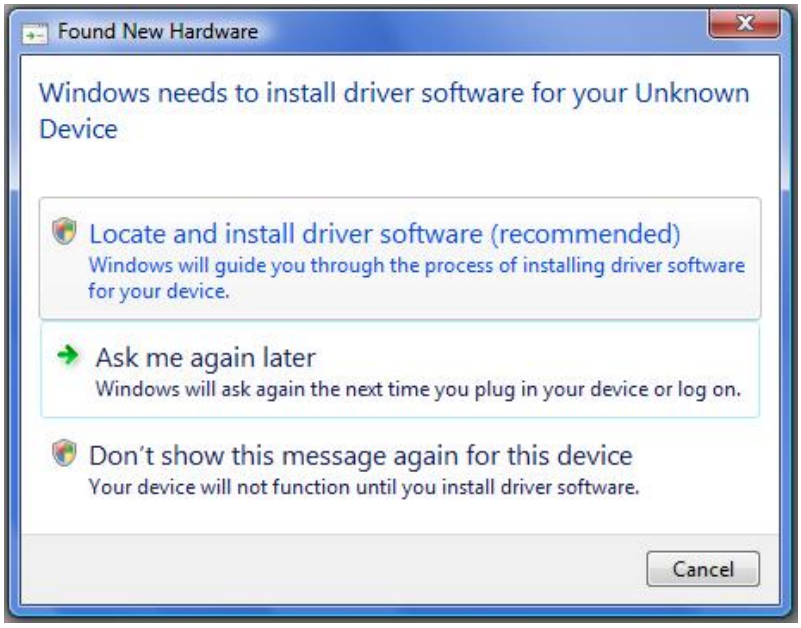

Figure 12: Found New Hardware Wizard (Windows Vista)

Then select “Browse my computer for driver software (advanced)” on the next window.

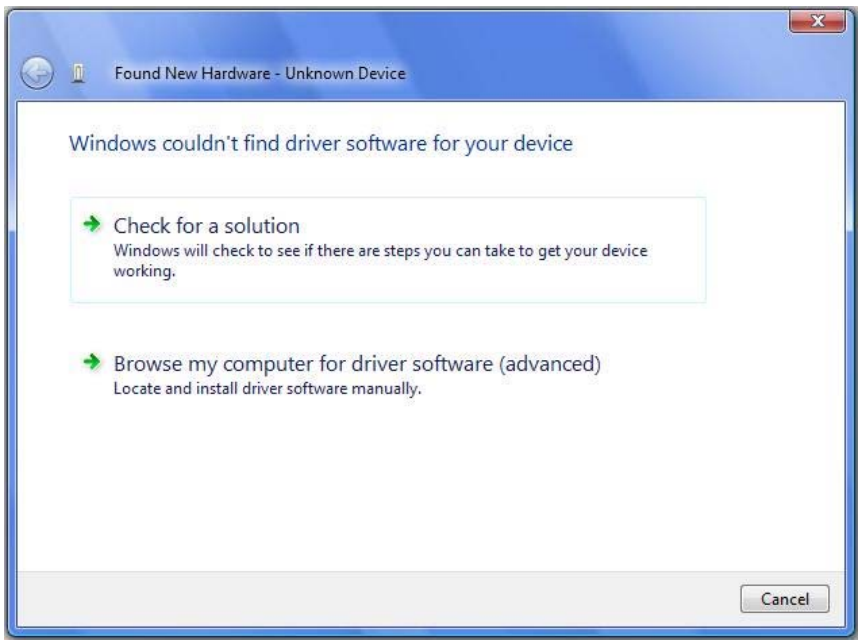

Figure 13: Install from a Specific Location (Windows Vista)

<2> Select the folder where the installer has copied the USB drivers from the DVD.

For 32-bit Operating Systems, select the following location:

C:\Program Files\Renesas\RPB\RL78G13\USB Drivers\Win2k\

For 64-bit Operating Systems, select this location:

C:\Program Files\Renesas\RPB\RL78G13\USB Drivers\wlh_amd64\

Click Next >.

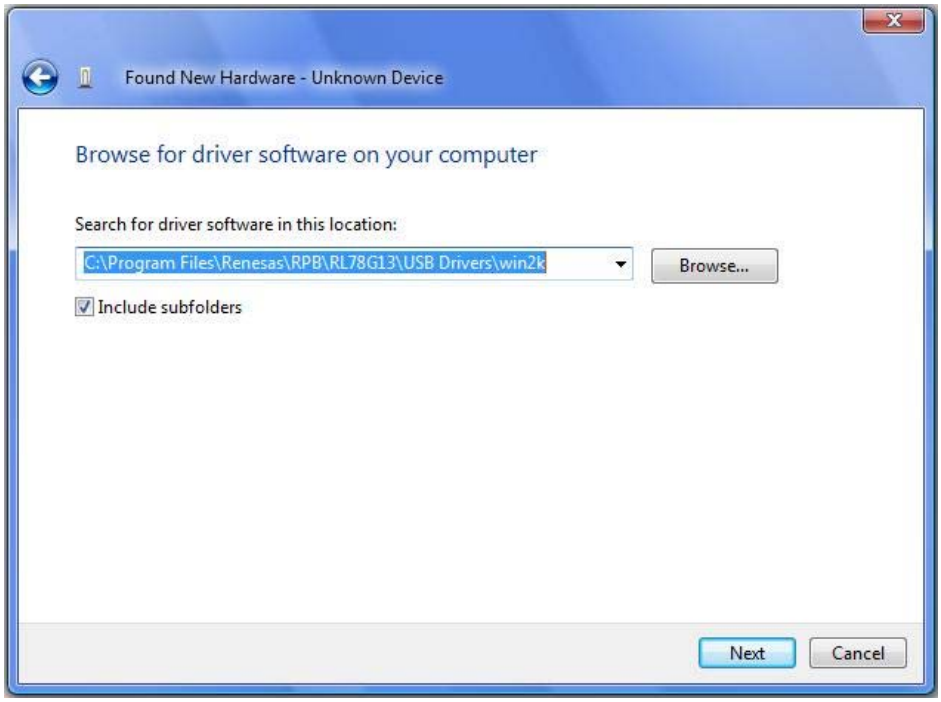

Figure 14: Search Location Specification (Windows Vista)

<3> Click Install when the driver has been found..

Figure 15: Installation Confirmation (Windows Vista)

<4> Click Close to close the installation wizard.

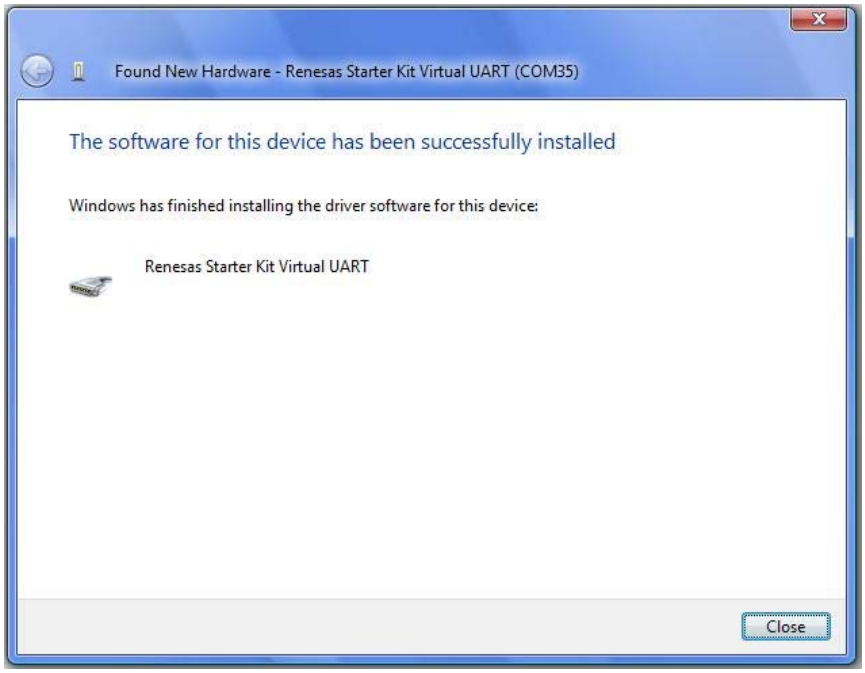

Figure 16: USB Driver Installation Completion (Windows Vista)

6.5.3 Installation on Windows 7

<1> When the *YRPBRL78G13* board is connected to the host machine, the board is recognized as an “Unknown Device” in the Device Manager. Right click on the “Unknown Device” and select “Update Driver Software…” within the Device Manager window.

Select “Browse my computer for driver software”.

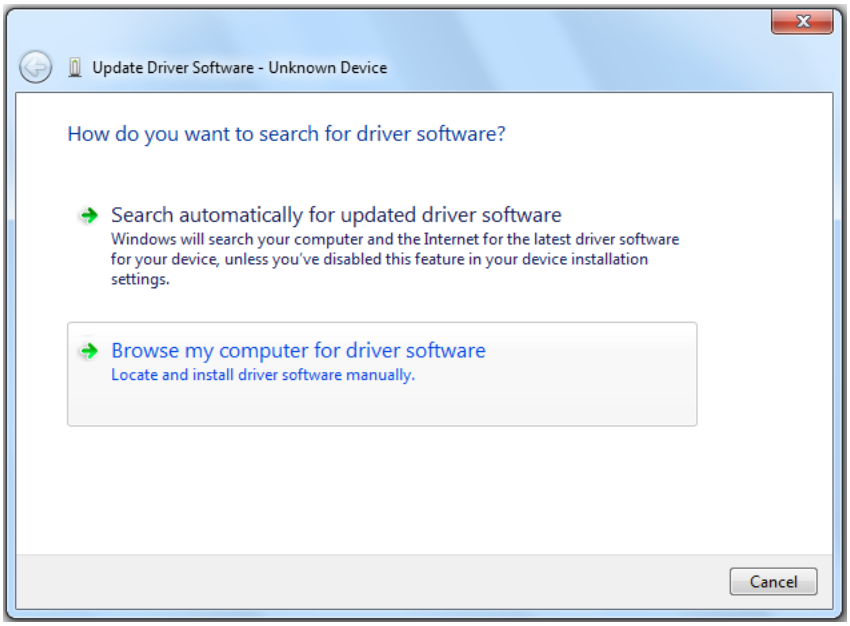

Figure 17: Update Driver Software (Windows 7)

<2> Select the folder where the installer has copied the USB drivers from the DVD.
For 32-bit Operating Systems, select the following location:

C:\Program Files\Renesas\RPB\RL78G13\USB Drivers\Win2k\

For 64-bit Operating Systems, select this location:

C:\Program Files\Renesas\RPB\RL78G13\USB Drivers\wlh_amd64\

Click Next >.

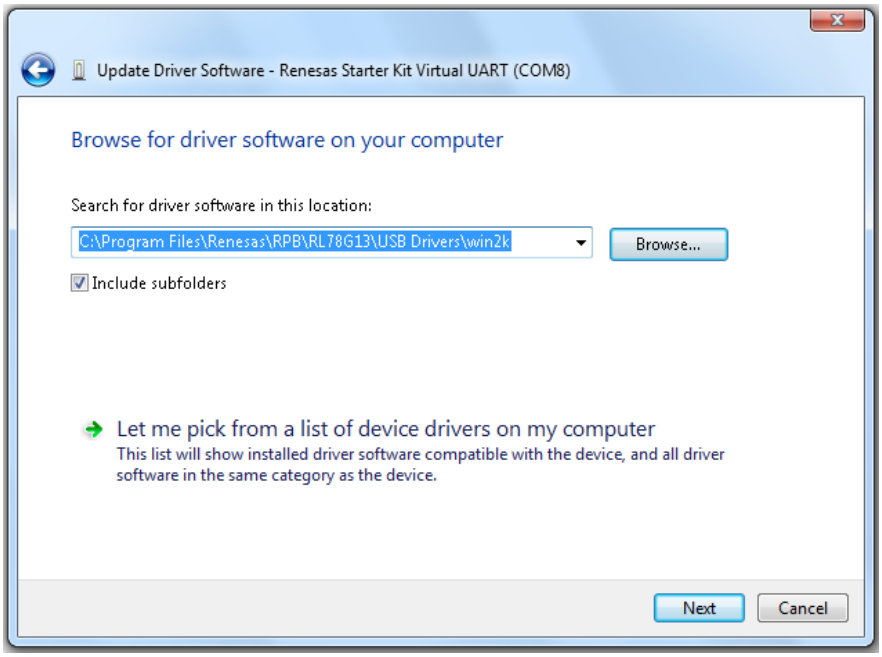

Figure 18: Search Location Specification (Windows 7)

<3> Click Install when the driver has been found..

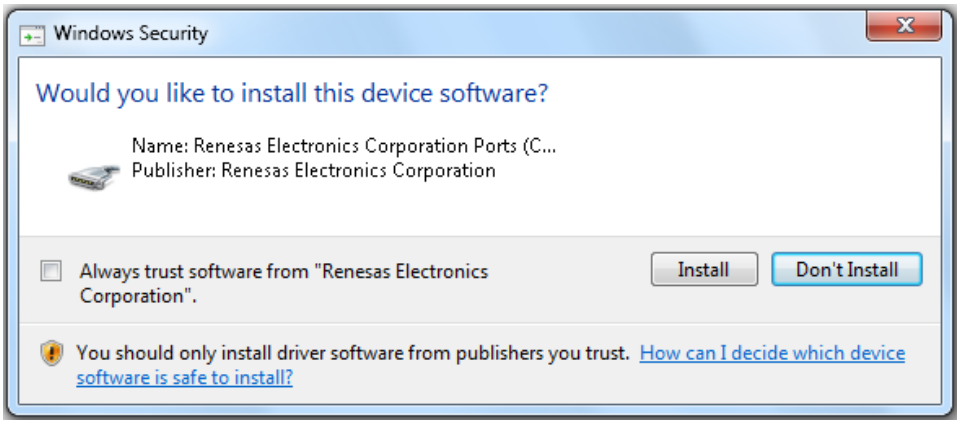

Figure 19: Installation Confirmation (Windows 7)

<4> Click Close to close the installation wizard.

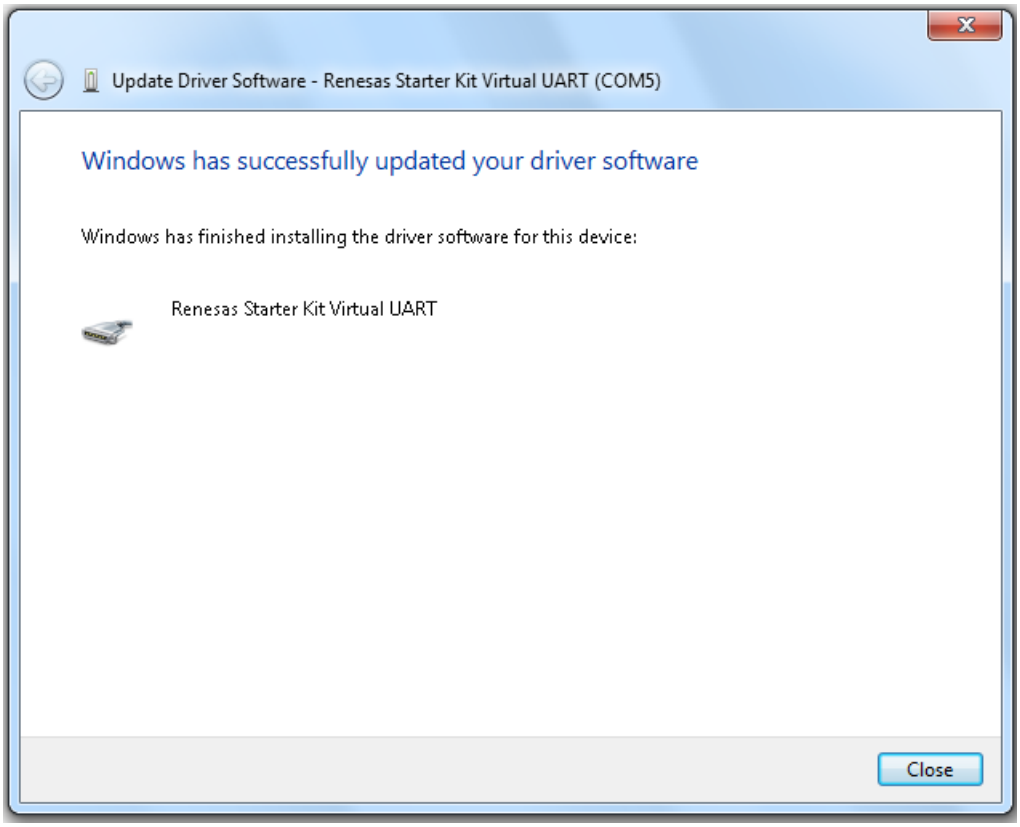

Figure 20: USB Driver Installation Completion (Windows 7)

6.5.4 Confirmation of USB Driver Installation

After installing the USB driver, check that the driver has been installed correctly, according to the procedure below.

Open "Device Manager" by entering:

[Start] → [Settings] → [Control Panel] → [System] → tab [Hardware]

When the *YRPBRL78G13* board is connected to the host PC, the "Renesas Electronics Starter Kit Virtual UART" (without "?" mark) should be present under the section "Ports (COM & LPT)".

The screen above shows that the COM port number is "COM23".

When you change the USB port connection, the COM port number will be changed as well.

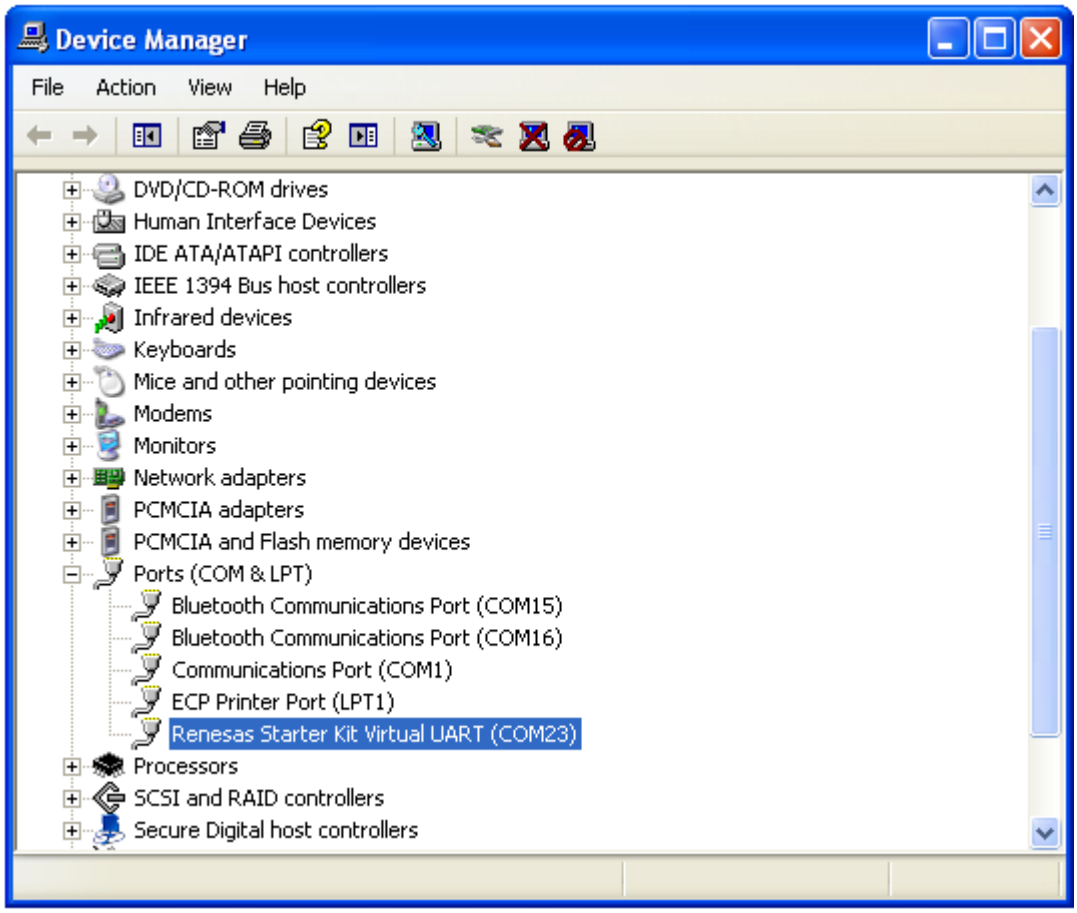

Figure 21: Device Manager

Caution Do not do “Hardware Modification Scan” when you communicate with the target device.

Chapter 7 How to Use WriteEZ5 Flash Programming Software

This chapter explains the basic operations of the WriteEZ5 GUI for programming the *YRPBRL78G13* board. This chapter covers how to start the system, execute the EPV command (Erase, Program, Verify), and program the target RL78/G13 device.

The conditions of the series of operations described in this chapter are as follows:

Hardware Configuration of YRPBRL78G13

Board	:	YRPBRL78G13
CPU	:	RL78/G13
Target Device	:	R5F100LE
Voltage level	:	5V

Software Configuration of WriteEZ5 GUI

Parameter file	:	R5F100LE.pr5
Clock setting	:	Internal-OSC
Port	:	UART-ch0 (1Mbps)
Operation mode	:	Chip
Write HEX file	:	YRPBRL78G13_Stick_Demo_SW.hex or YRPBRL78G13_IAR_OCD_Project.hex
Option Setting	:	Blank check before Erase

The YRPBRL78G13_Stick_Demo_SW.hex file is the main demonstration software for use with the GUI.

The YRPBRL78G13_IAR_OCD_Project.hex file is the sample project for use with the IAR Embedded Workbench debugger.

<1> Installing the WriteEZ5 GUI

Install the WriteEZ5 GUI software on the host machine you are using, by referring to **Chapter 6 – Software Installation** (if the software has not been installed yet).

<2> Installing the driver

Install the USB driver on the host machine you are using, by referring to **Chapter 6 – Software Installation** (if the driver has not been installed yet).

<3> Installing the parameter file

The parameter file for the RL78/G13 device is installed automatically during installation of WriteEZ5 GUI in the folder:

C:\Program Files\Renesas\RPB\RL78G13\WriteEZ5 for RL78G13\PR5-RL78G13_V100

Nevertheless the parameter files for the family RL78/G13 can also be found in the folder /WriteEZ5 for RL78G13/PR5-RL78G13_V100/ of the DVD.

<4> Setting and connecting Set the *YRPBRL78G13* board by configuring J6 to J9 as following:

Jumpers	Configuration
J6	1-2
J7	1-2
J8	1-2
J9	1-2

Table 10: J6 to J9 Configuration for Flash Programming Mode

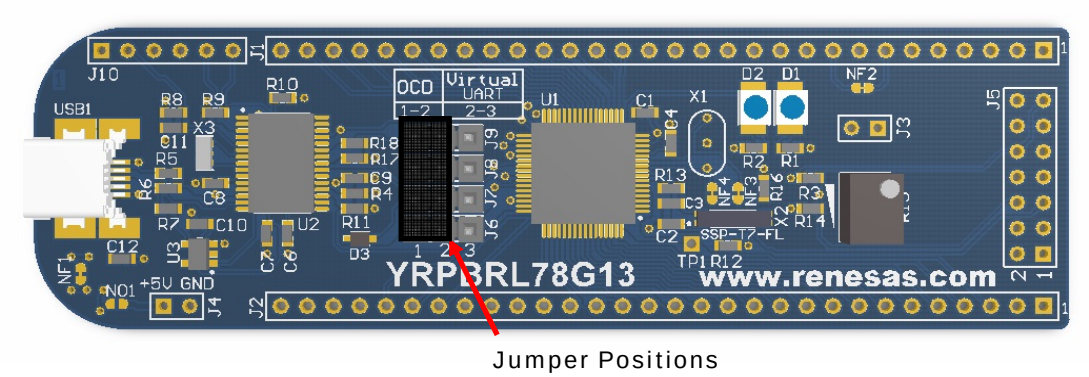

Figure 22: Stick in Flash Programming Configuration

Connect the *YRPBRL78G13* board with the host machine.

<5> Starting Start the WriteEZ5 GUI from the start menu:

[Start] → [All Programs] → [Renesas Electronics Tools] → [WriteEZ5]

Or use the shortcut icon on your Desktop.

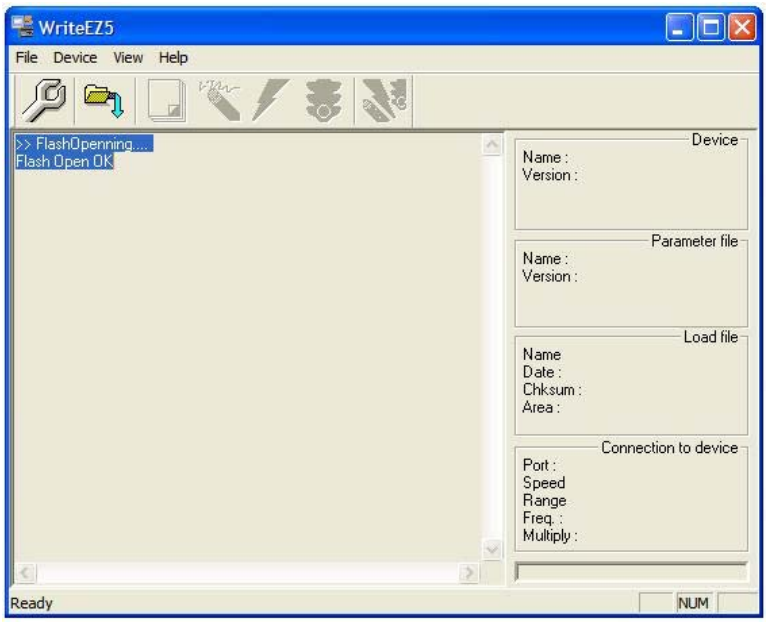

Figure 23: WriteEZ5 Start-up Screen

<6> Setting the programming environment

(6.1) Select [Device] → [Setup] from the menu bar or click on the [Setup] icon.
The “Standard” tab of the “Device Setup” dialog box is opened:

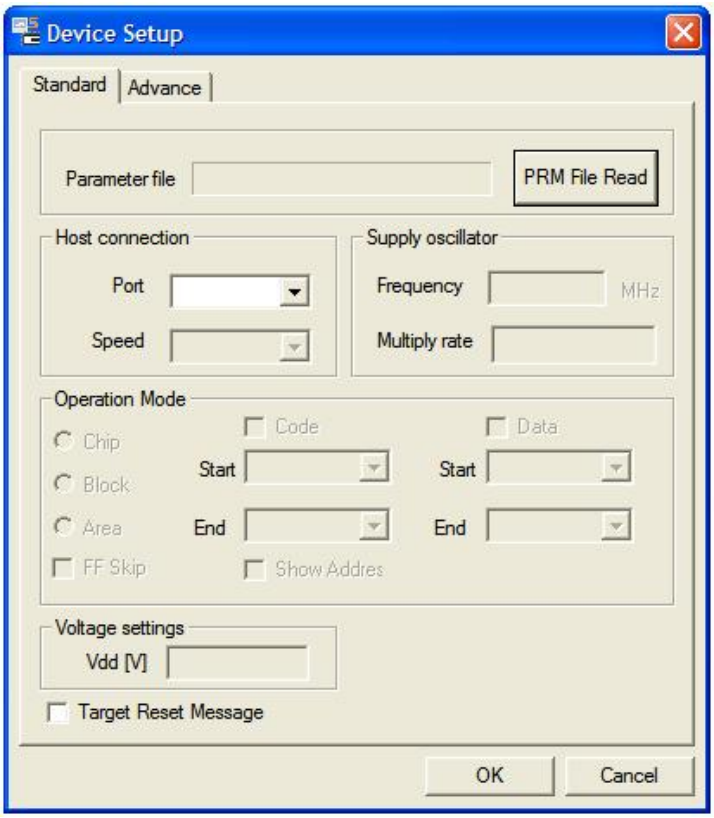

Figure 24: « Standard Device Setup » Dialog Box

(6.2) Click on PRM File Read to open the parameter file selection window.

C:\Program Files\Renesas\RPB\RL78G13\WriteEZ5 for RL78G13\PR5-RL78G13_V100

Select the parameter file “R5F100LE.pr5” then click on Open.

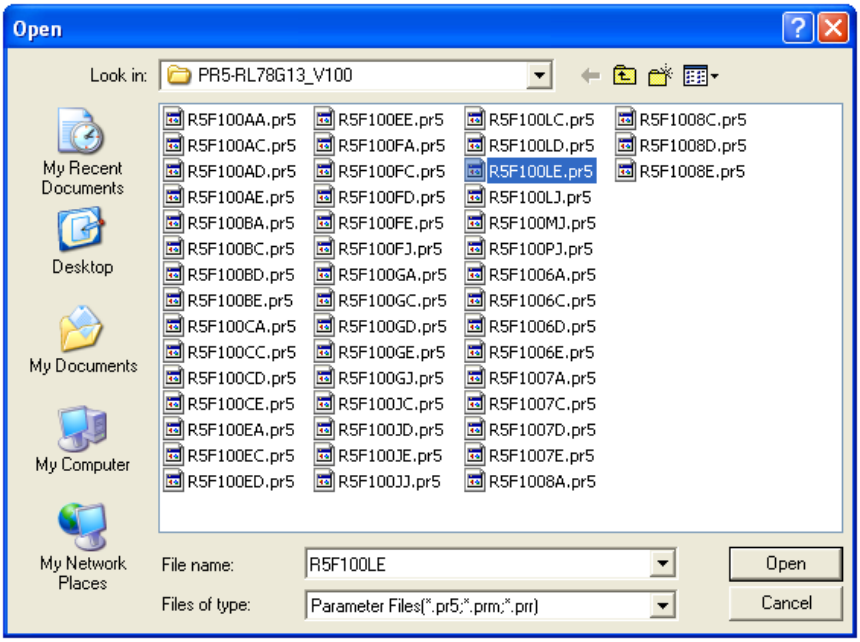

Figure 25: Parameter File Selection

(6.3) From the “Port” list box, select the communication port that matches the host machine being used. Select the communication speed of the host connection.

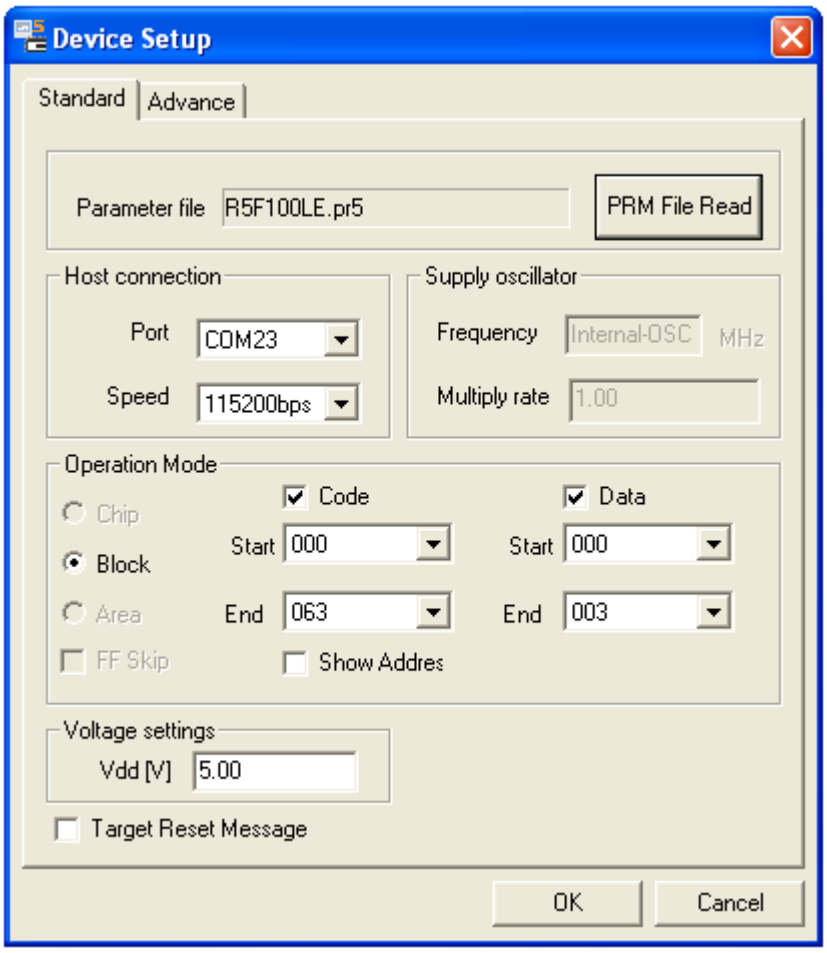

Figure 26: Port Selection

Remark Selectable ports can be checked using Device Manager. For details, refer to **Chapter 6.5.4 - Confirmation of USB Driver Installation**.

(6.5) Switch to the “Advance” dialog box:

In “Command Options”, check “Blank check before Erase”.

In “Security flag settings”, all the different options should remain unchecked.

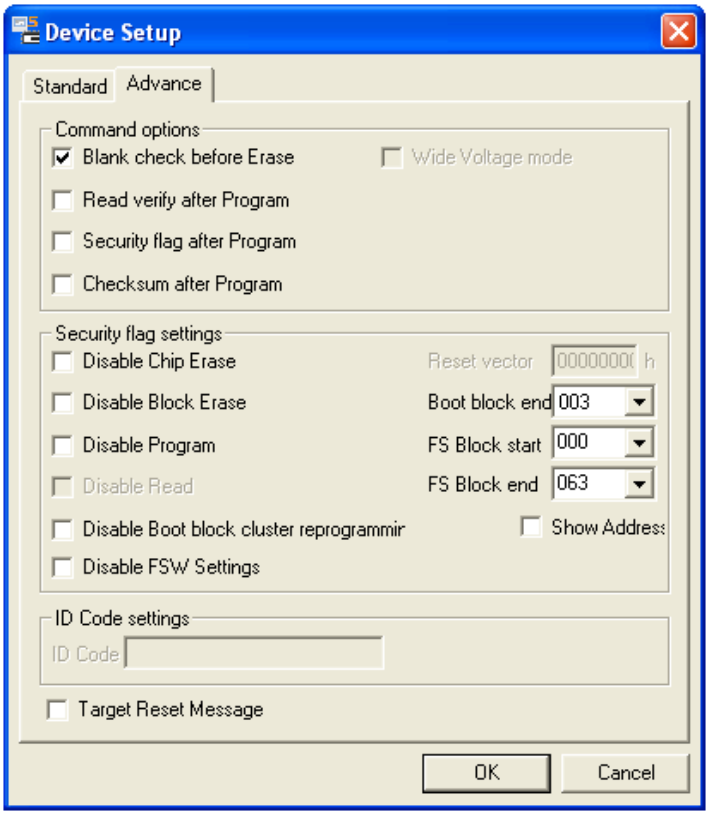

Figure 27: « Advance Device Setup » Dialog Box

(6.6) Click on the button OK. The GUI software sets the parameters.

When the settings have bee completed, the following screen is displayed:

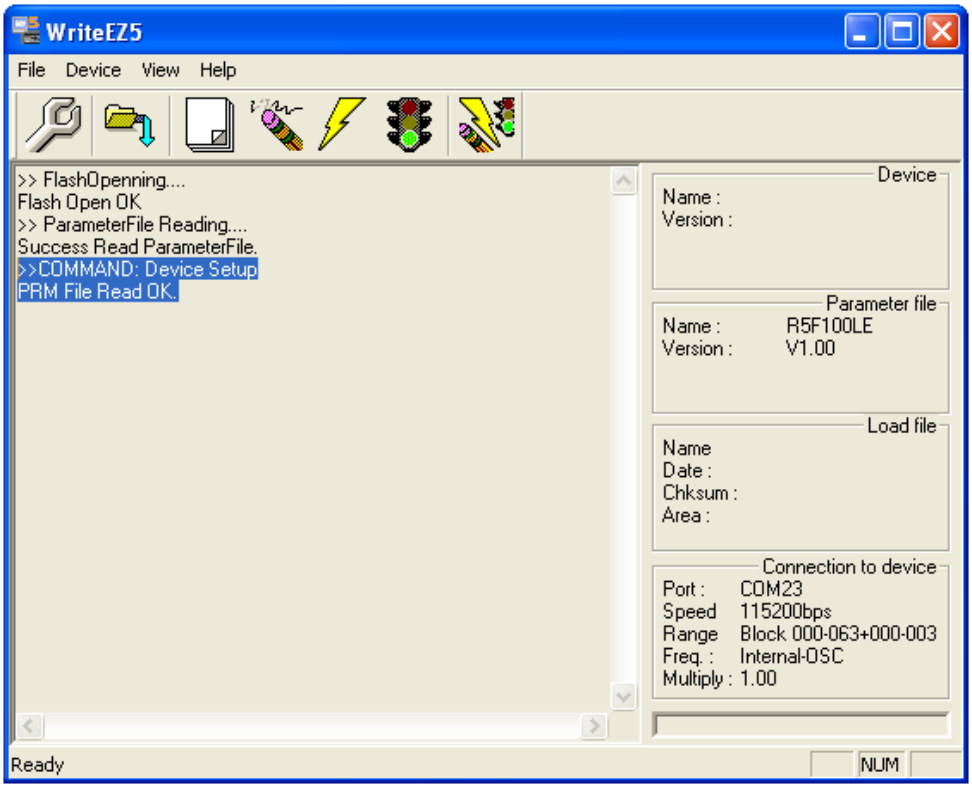

Figure 28: Completion of Parameter Settings

<7> Selecting a user program

(7.1) Select [File] → [Load] from the menu bar or click on the [Load] icon.

(7.2) Select a program file to be written to the target device, then click on the button Open.

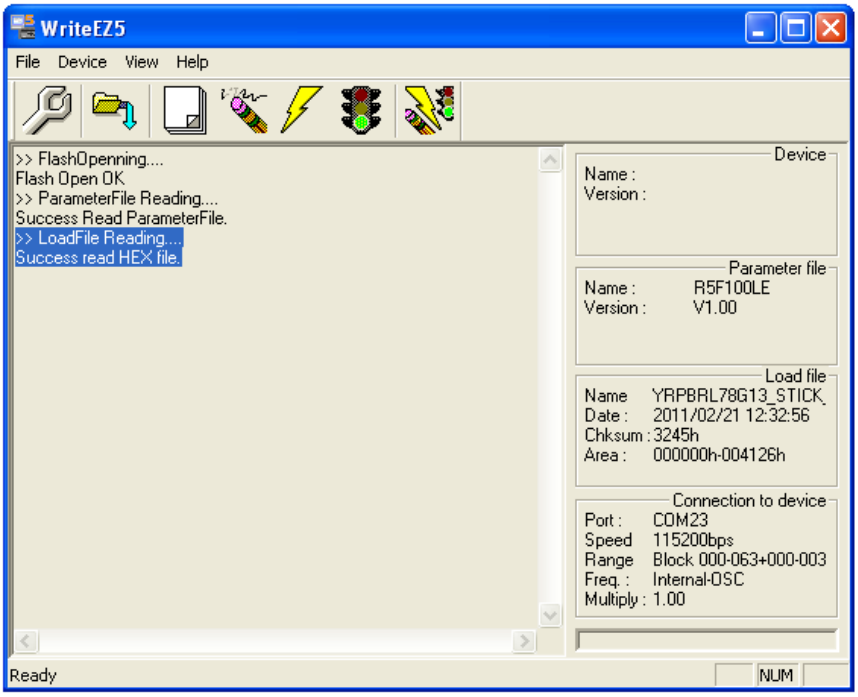

Figure 29: Completion of HEX File Download

<8> Auto procedure (EPV) command execution

Select [Device] → [Autoprocedure(EPV)] form the menu bar or click on the [Autoprocedure] icon.

When the [Autoprocedure(EPV)] command is executed, Blank Check → Erase → Program and Flash Internal Verify are executed sequentially for the RL78/G13 device.

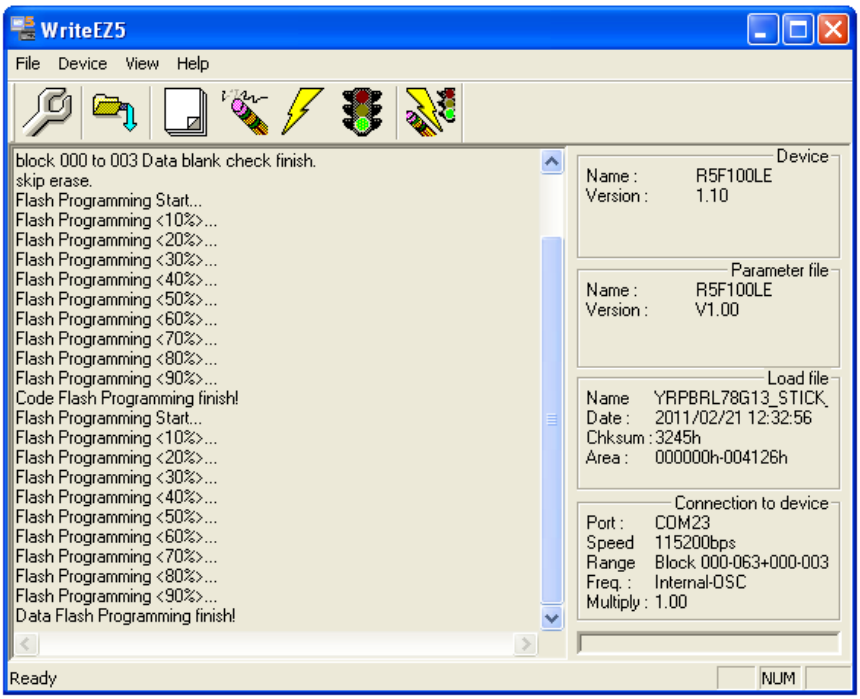

Figure 30: Completion of EPV Command

<9> Terminating the GUI Select [File] → [Quit] to terminate the GUI software. All settings executed so are saved, so that those settings can be reused when the WriteEZ5 GUI is restarted.

<10> Execute application Set the *YRPBRL78G13* board to the normal operation mode by applying the following settings.

Jumpers	Configuration
J6	2-3
J7	2-3
J8	2-3
J9	2-3

Table 11: J6 to J9 Configuration for Normal Operation Mode

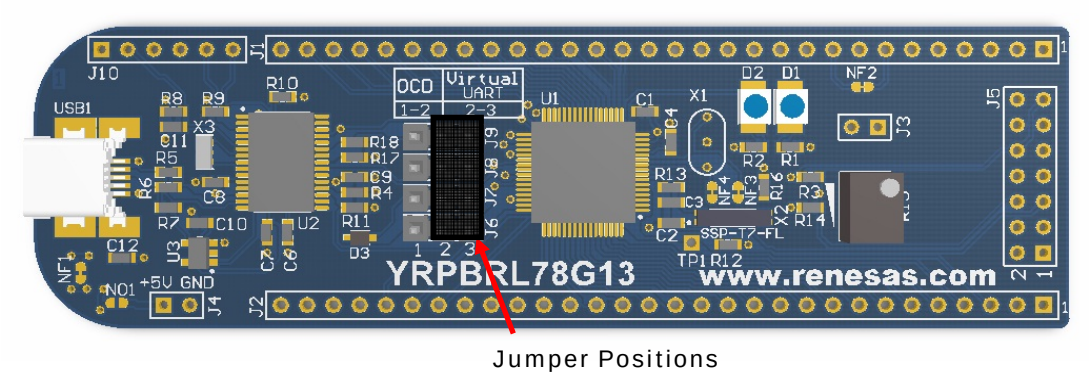

Figure 31: Stick in Normal Operation Configuration

<11> Restarting the GUI When the WriteEZ5 GUI is restarted, the latest settings should be applied.

Chapter 8 On-Board Debugging (OCD)

Before using the On-Board debug function of the *YRPBRL78G13* board together with the IAR C-SPY debugger please ensure that the Virtual UART USB driver has been installed. Please refer to section 6.5 for the installation of the USB driver.

To set the *YRPBRL78G13* starter kit to the on-board debug mode configure jumpers J6 to J9 as following:

Jumpers	Configuration
J6	1-2
J7	1-2
J8	1-2
J9	1-2

Table 12: J6 to J9 Configuration

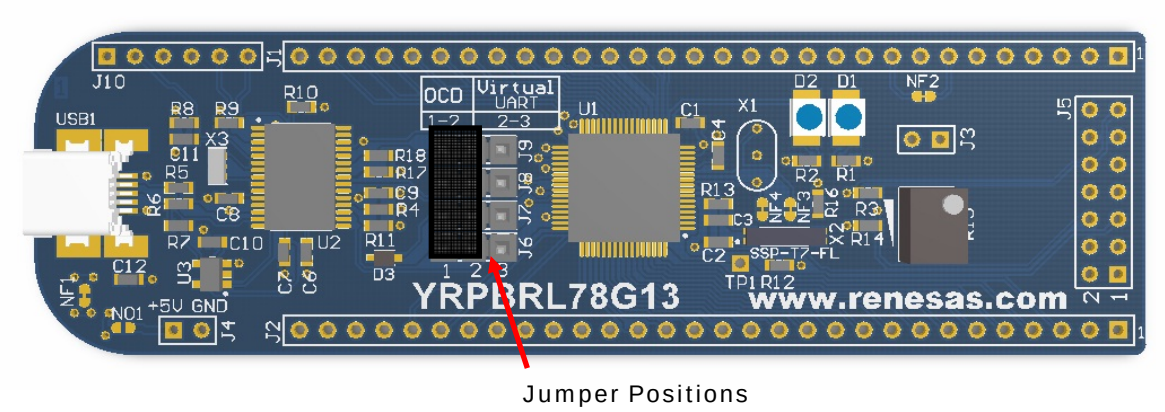

Figure 32: Stick in On-Board Debug Configuration

8.1 Monitor Resources

The debugging feature of the *YRPBRL78G13* starter kit has been realized by a monitor program that is running on the RL78/G13 device. Therefore, the following resources are reserved by the monitor and can not be used by the user program.

8.1.1 TOOL0

The RL78/G13 uses the V_{DD}, RESET, TOOL0, and V_{SS} pins to communicate with the host machine via the Virtual UART using the 78K0/USB or the E1 on-chip debugging emulator.

Serial communication is performed by using a single-line UART that uses the TOOL0 pin, which is shared with P40 and therefore cannot be used for another purpose during debugging.

8.1.2 Memory Area

Four different areas (24 bytes in total) are reserved for placing the debug monitor program in the flash memory of the RL78/G13 device, so user programs or data cannot be allocated in these spaces. When using the on-chip debug function, these spaces must be secured so as not to be used by the user program. Moreover, this area must not be rewritten by the user program.

The monitor reserves 6 bytes of the global stack area by halting the user program, caused by a forcible break (debugger stop command) or a software breakpoint.

8.2 IAR Sample Program Description

8.2.1 General Introduction

The sample program is located in a single directory, which will be called main-directory of the sample. This main directory contains the complete project including all output files of the development tool. The workspace file "**YRPBRL78G13_IAR_OCD_Project**" is located on top of the sample program directories.
The project has been created using the Applilet software tool to generate the different source and header files. Any changes that the user wishes to make to the project's peripheral initializations should ideally be done by changing the settings in the Applilet tool.

YRPBRL78G13_IAR_OCD_Project	RL78/G13 project and output files
Debug	Debug output files for IAR C-SPY debugger
applilet3_src	C source files, header files and Linker control file
Release	Release output files, i.e. Intel HEX file
settings	Configuration files, IAR Embedded Workbench
user_src	Empty directory available for new user source files
YRPBRL78G13_IAR_OCD_Project.dep	Dependency information file, IAR Embedded Workbench
YRPBRL78G13_IAR_OCD_Project.ewd	Project setting file, IAR C-SPY debugger
YRPBRL78G13_IAR_OCD_Project.ewp	Project file, IAR Embedded Workbench
YRPBRL78G13_IAR_OCD_Project.eww	Workspace file, IAR Embedded Workbench RL78

Table 13: Example Directory Structure

The main directory contains only the project files for the IAR Embedded Workbench. All source files, header files and linker control file are located in the /applilet3_src. The sample project uses two targets. One target is the "Debug" (directory /Debug) that holds all information for debugging purpose and the other one is the "Release" target (directory /Release) contains the programmable file, i.e. the Intel HEX file, for programming the RL78/G13 internal Flash memory by using the WriteEZ5 software.

All output files of the development tools for the corresponding target are generated in the directories /Debug and /Release.

For details of using the IAR Embedded Workbench and the IAR C-SPY debugger please refer to the IAR Embedded Workbench IDE User Guide.

8.2.2 Functionality

The sample project shows a simple demonstration of Interval Timer usage, ADC usage and interrupts handling. Interval Timer is setup to generate an interrupt every 200 milliseconds which toggles the LED on P77. When turning the potentiometer to increase the ADC input voltage, the timer interrupt interval is reduced which results in toggling the LED faster.

8.2.3 Required Resources

The sample program uses the following peripheral resources of the R5F100LE device:

- Interval Timer
- ADC (Potentiometer input)
- Port 7 Pin 7 (P77)

8.2.4 Project Structure

The project consists of the following software modules:

8.2.4.1 System Initialization

All the system initialization including Clock, ADC, Interval Timer, Port, and On-board OCD resources are within this module. The files generated for this module are:

- CG_ad.c
- CG_it.c
- CG_port.c
- CG_system.c
- CG_systeminit.c

8.2.4.2 Main Loop

This module includes the main loop and additional system initialization such as Security ID for OCD and Option Byes settings
The file generated for this module is:

- CG_main.c

8.2.4.3 Interrupt Handling

This module includes the interrupt handling of ADC and interval interrupt of the Interval Timer. The files generated for this module are:

- CG_ad_user.c
- CG_it_user.c

8.3 IAR Sample Debugging Session

When everything is set up correctly the IAR Embedded Workbench for RL78 can be started. To do so, start the IAR Embedded Workbench from Windows “Start” menu > “All Programs” > folder “IAR Systems” > “IAR Embedded Workbench for Renesas RL78 1.10 Kickstart”. The following screen appears:

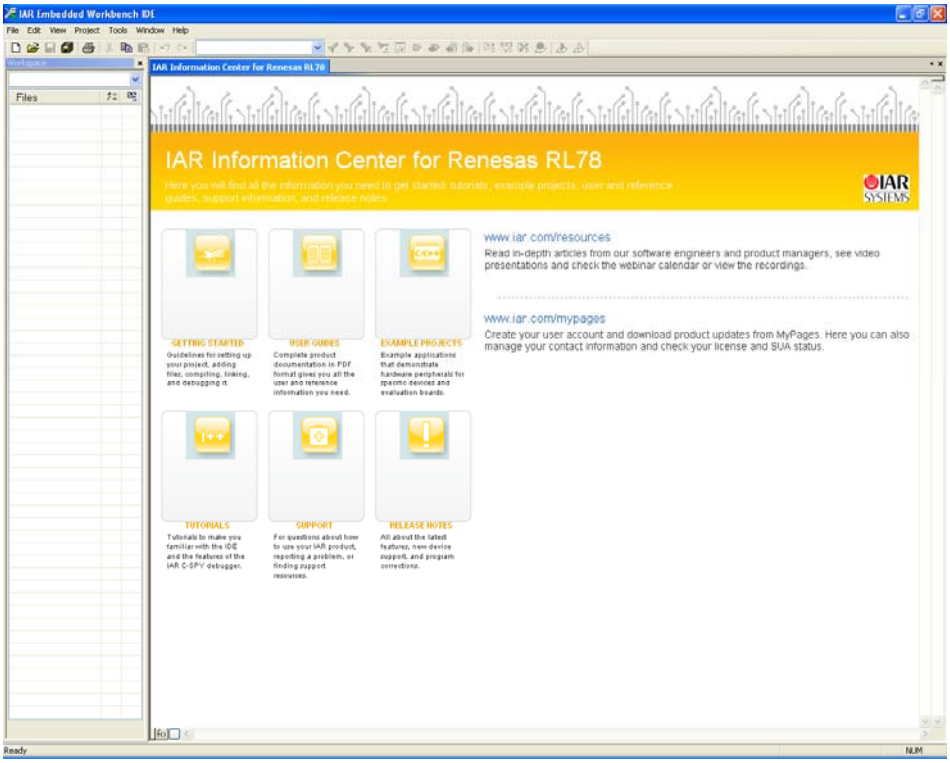

Figure 33: IAR Embedded Workbench for RL78

Now from the “File” menu select “Open” and select the option “Workspace”. Open the file “YRPBRL78G13_IAR_OCD_Project.eww” located in:

C:\Workspace\RPB\RL78G13\IAR Sample Projects\Debugging Project\.

This is the workspace file that contains general information about the sample project and settings.

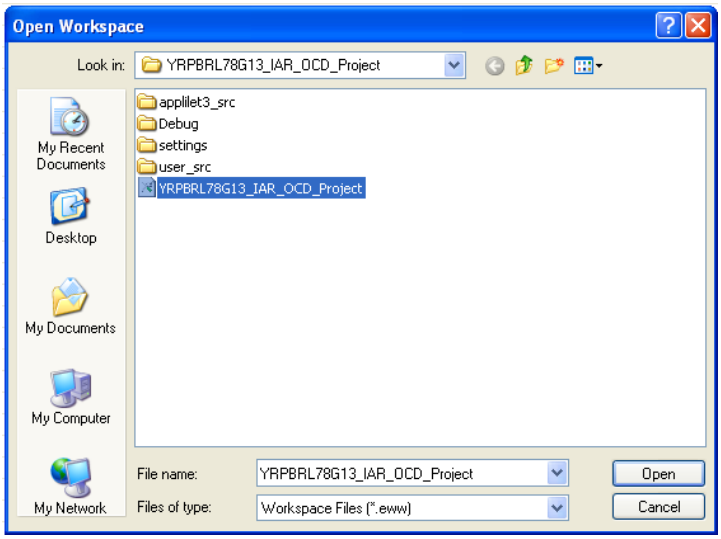

Figure 34: IAR Sample Project Location

After the demo workspace has been opened the project contained in the workspace is displayed. Now click on the "+" sign next to the "**YRPBRL78G13_IAR_OCD_Project**" project to show files that are part of the project. The screen should now look similar to this:

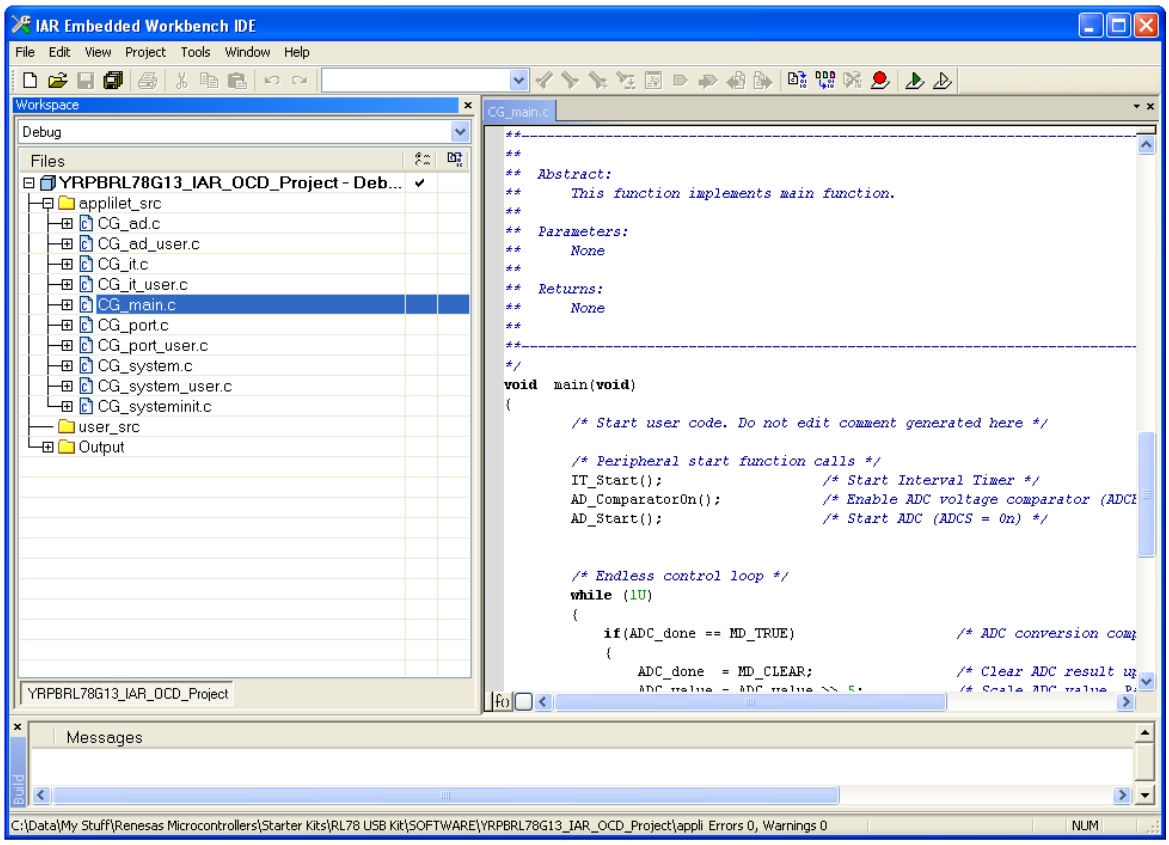

Figure 35: IAR Project Workspace

The next step is to check the settings of the IAR Embedded Workbench that have to be made for correct operation and usage of the on-board debug function of the *YRPBRL78G13* board. First highlight the upper folder called "**YRPBRL78G13_IAR_OCD_Project**" in the workspace window. Then select "Project" > "Options" from the pull-down menus. Next select the category "Debugger". Make sure that the driver is set to "TK" in order to use the on-board debug function of the *YRPBRL78G13* board.

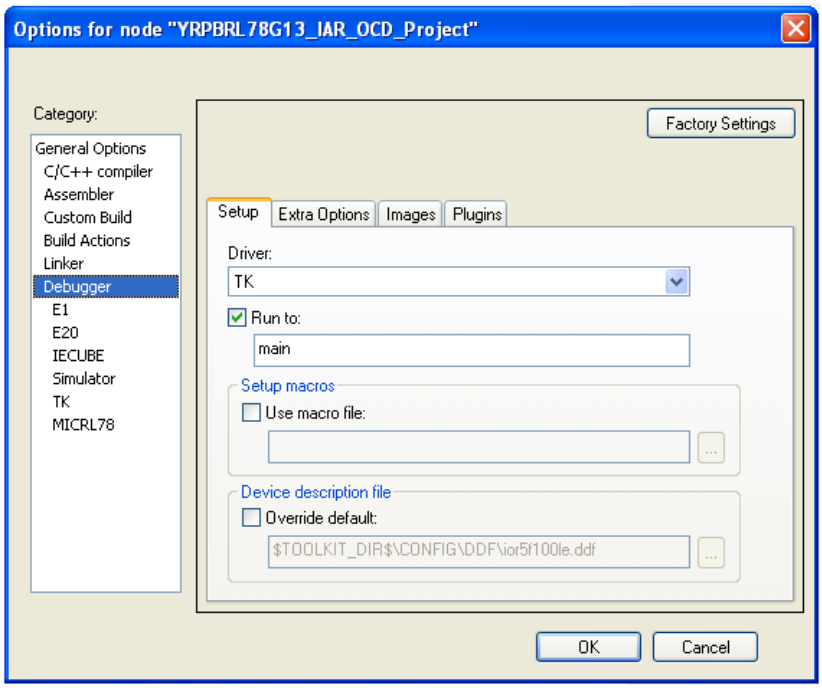

Figure 36: IAR Debugger Options

Next the correct linker settings of the demo project will be checked. This can be done in the “Linker” category as shown below. Select the “Config” tab and check that the linker command file “md_lnkr5f100le.xcl” is selected. This file is used by the linker and contains information on where to place the different sections of code and data that may be used within the demo project:

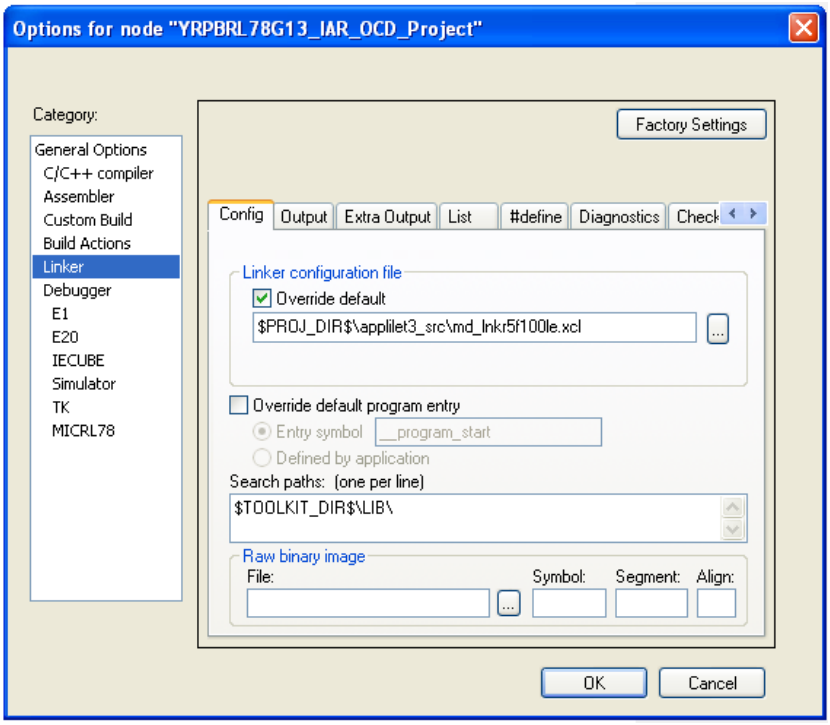

Figure 37: IAR Linker Options

Now after everything has been setup correctly it's time to build (compile + link) the demonstration project. Close the Options menu and select "Rebuild All" from the "Project" menu. If the project is compiled and linked without errors or warnings it can now be downloaded to the *YRPBRL78G13* board and debugged.

To start the IAR C-SPY debugger select the option "Debug" from the "Project" menu or press the "Debugger" button  .

In the next step the TK hardware setup has to be configured before downloading a new application. Press the OK button to enter the hardware setup menu. Set the configuration as show in the figure below and start the download by pressing the OK button.

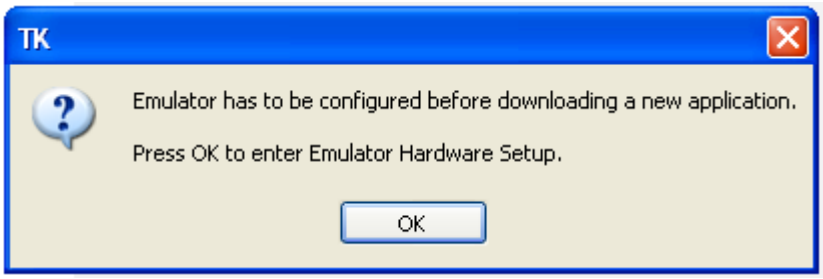

Figure 38: TK Hardware Setup Menu 1/2

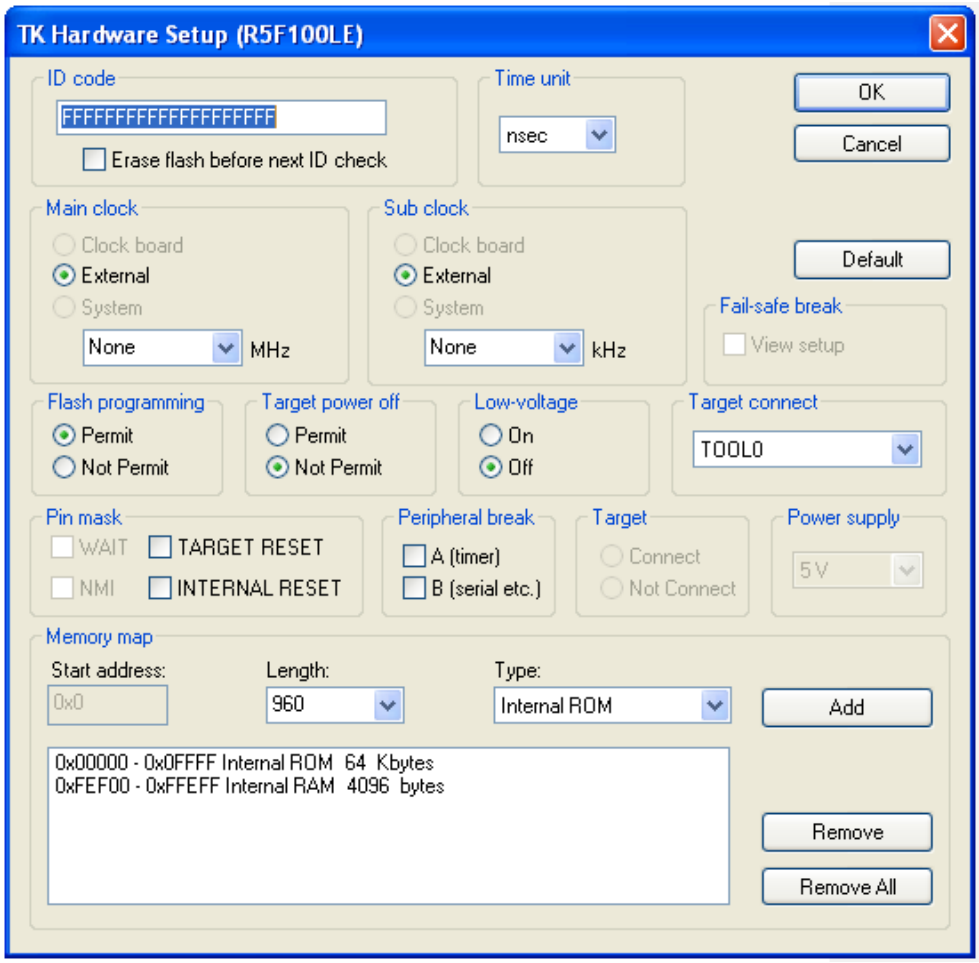

Figure 39: TK Hardware Setup Menu 2/2

Now the debugger is started and the demo project is downloaded to the *YRPBRL78G13* board. In other words, the Flash memory of the RL78/G13 device is reprogrammed with the user application.

After the download is completed all debug features of IAR C-SPY debugger are available, i.e. Single Stepping (Step Over/-In/-Out), Go, Stop, Breakpoints, Register / Memory view etc.

To get more details on the debugger configuration and capabilities please refer to the RL78 IAR Embedded Workbench IDE User Guide of the IAR installation.

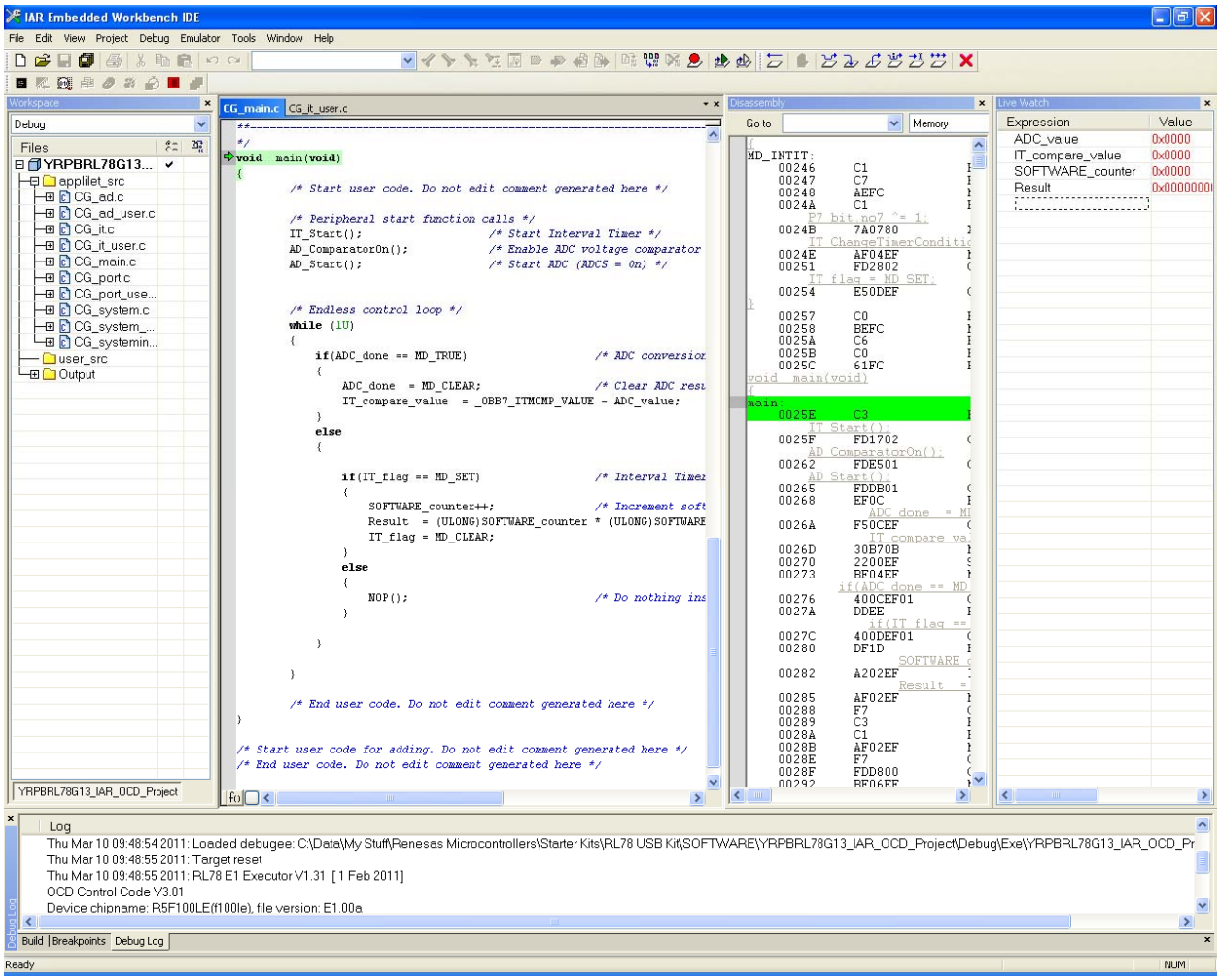

Figure 40: IAR C-SPY Debugger

As can be seen from the debugger window, the user can now set Software breakpoints in the code or assembler windows. This can be done simply double clicking on the C-Source code line or the in the assembler window (Other methods of setting software breakpoints by “right clicking” the mouse button or using the pull down menus are available).

One hardware (Event) breakpoint is available so that a break can be made on a data event (for example a write of a specific value from the ADC (Potentiometer)). The event can be set up as shown below, by clicking on the “Edit Events…” feature on the “Emulator” pull down menu.

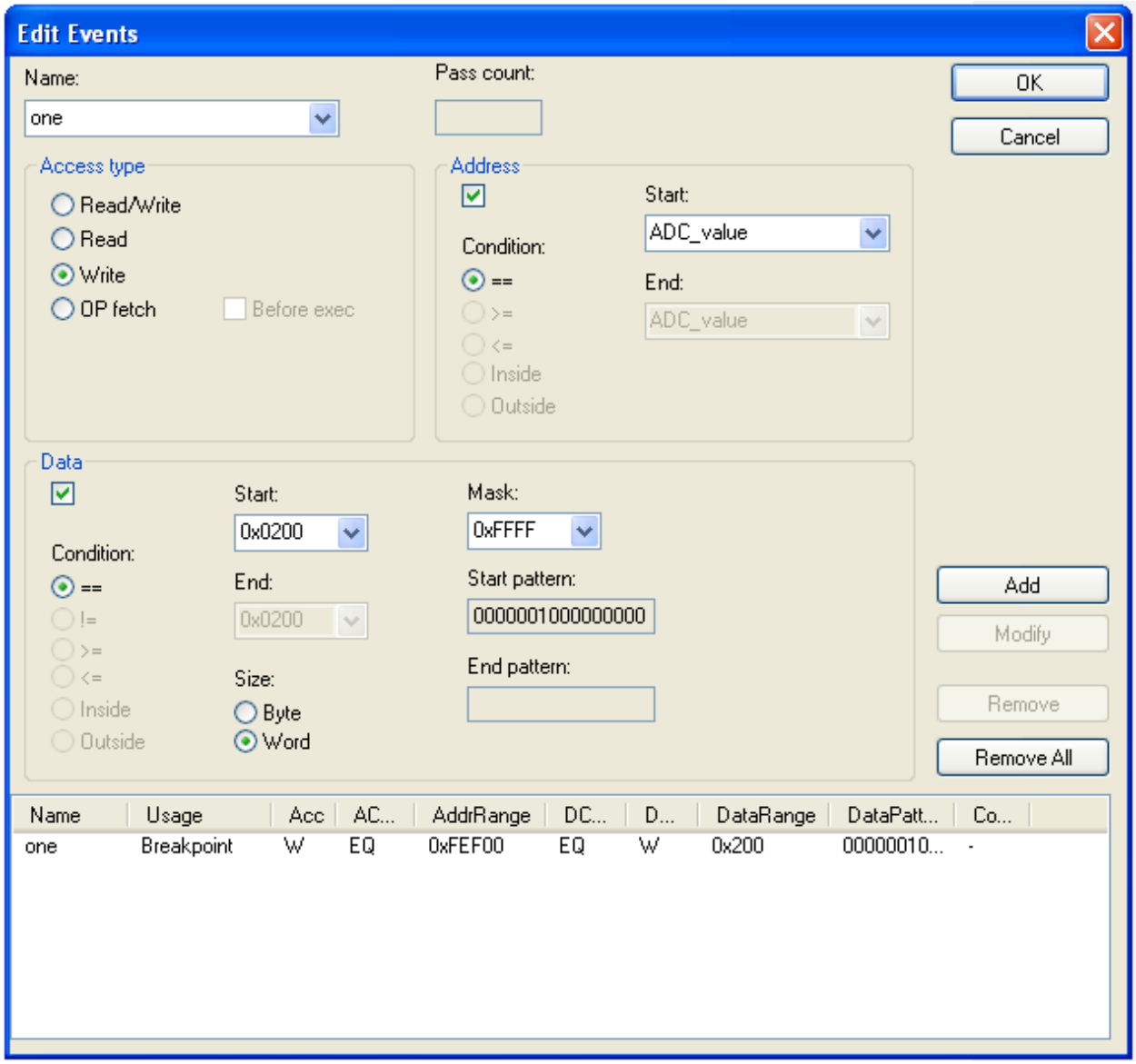

Figure 41: Edit Event Window

Then this event can be assigned to a breakpoint:

- In the view window select breakpoints, a breakpoint Tab will be added
- Click the breakpoint Tab and in the breakpoint window select “New Breakpoint” and select “Event”
- Then select the event as shown below and click “OK”

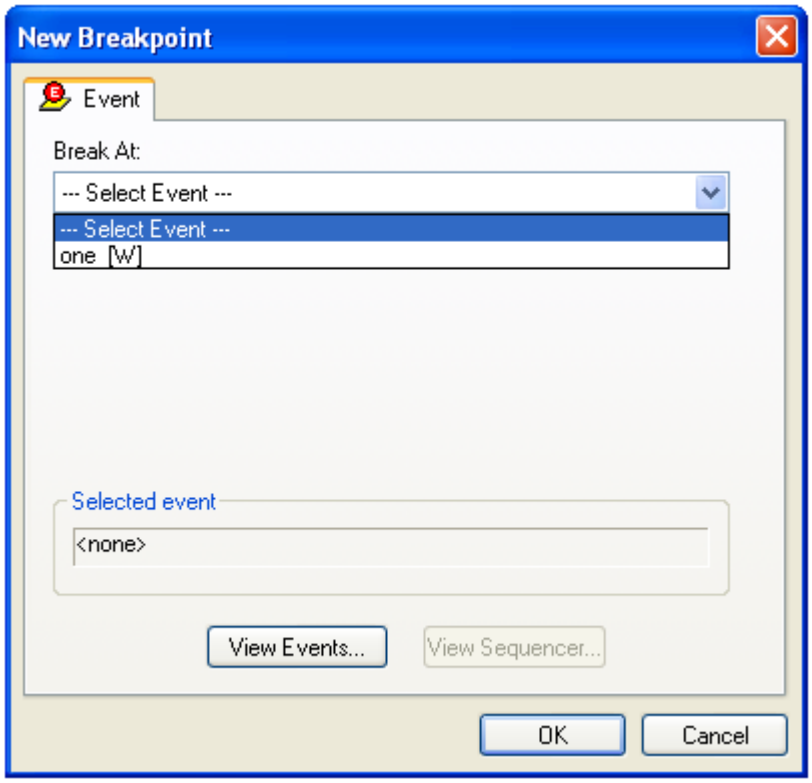

Figure 42: New Breakpoint Window

The debugger will now break when the “ADC_value” variable is written with a value of 0x200.

The use of the “Live Watch” feature can be used to show the periodic update of the selected variables. This can be used for example to see the ADC conversion variable for potentiometer. Live updates can also be used to view the memory window in the “Live Memory” window. The “Live Memory” window can be opened from the “Emulator” pull down menu.

8.4 Debugging using E1 Emulator in IAR

If the UART2 is required in the user application, the user can use the TOOL0 interface of the RL78/G13 available using P40. Please consult Figure 3 for the schematic and the E1 emulator user manual for proper connections. To use this interface for debugging proceed as explained above, but make sure to change the driver to “E1” in the “Debugger” section, and set the E1 hardware setup as shown below.

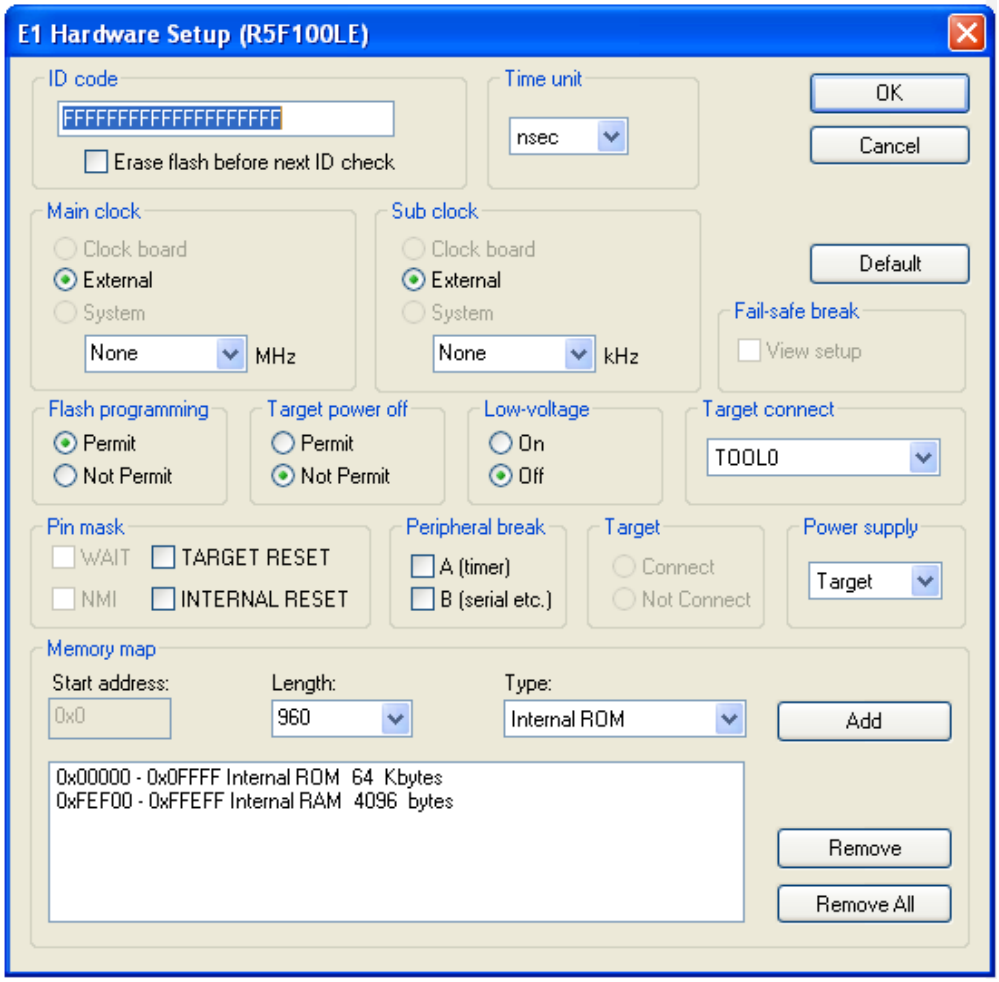

Figure 43: E1 Emulator Hardware Setup for TOOL0 Interface

It is important to note that any use of the E1 emulator must be set to “Target” in the Power supply box. Thus, it is the USB interface which is used to power all circuits function (V_{USB} and V_{DD}).

Please note that the E1 emulator is a separate tool from Renesas Electronics and is not included with this starter kit. The E1 emulator can be purchased separately.

Chapter 9 GUI Description

The RL78/G13 demonstration GUI is Windows software application that can be used to demonstrate the key operation of the 16-bit microcontroller RL78/G13 mounted on the *YRPBRL78G13* board. The demonstrations allow the user to check the on-board RTC, the memory contents (both data flash and RAM), switch between the different standby modes and to check associated power consumptions, and to use the self-test functions implemented in the RL78/G13 device. The user can measure the current in each power mode using a multi-meter connected to the J3 jumper provided on the board as shown.

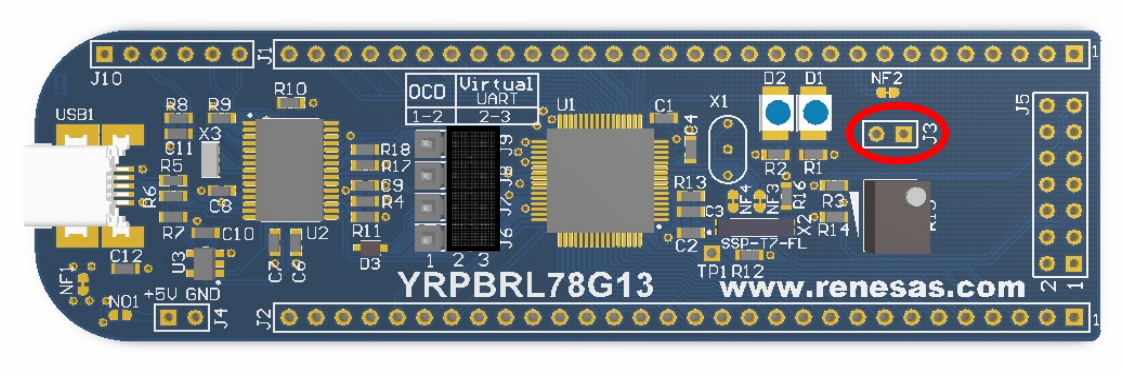

Figure 44: Current Measurement Connector

Please note that the *YRPBRL78G13* needs to be running the program supplied "**YRPBRL78G13_Stick_Demo_SW.hex**" within the "GUI Demo Source Code" directory copied to the host PC during installation (This is programmed as default in manufacture).

Before connecting the *YRPBRL78G13* board, check the jumpers J6 to J9 are configured correctly as stated in Table 1 (GUI Demonstration Mode).

After plugging the board to a free USB port make a note of the COM port assigned to the device from the device manager.

9.1 Running the RL78/G13 Demo

From the menu "All Programs" locate the folder "Renesas Electronics Tools → YRPBRL78G13" within that folder select "YRPBRL78G13-Demo" to run the RL78/G13 demo as shown below. It is also possible to run the demo by double clicking on the GUI demo shortcut icon on the desktop.

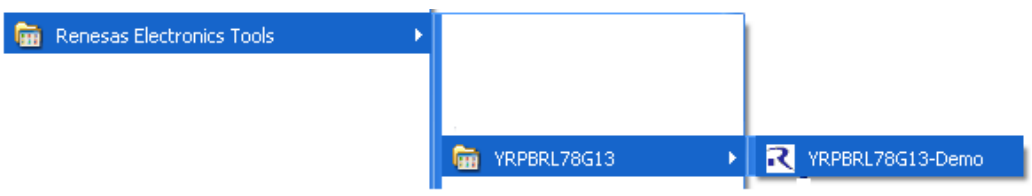

Figure 45: Running the Demo

When the Demo GUI is started, the COM port to which the *YRPBRL78G13* board is connected should be automatically detected and selected in the “RL78/G13” tab. The GUI software should also connect to the *YRPBRL78G13* board and start automatically.

If for any reason this does not happen, please select the appropriate port number from the drop down list, and then press the “Connect” button on the GUI start window.

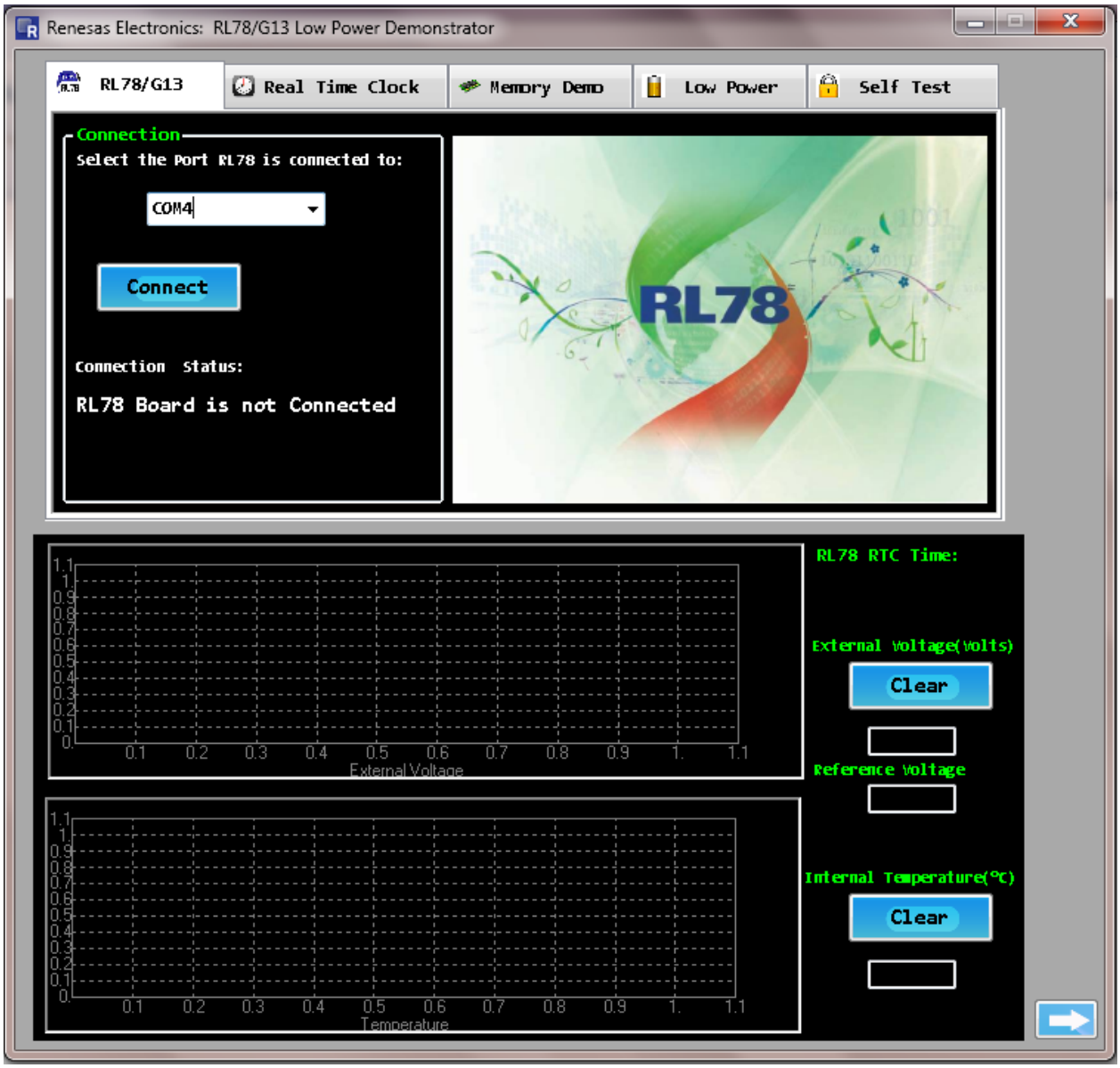

Figure 46: COM Setup

9.2 GUI Demo Sections

The following screenshot shows the GUI demo followed by the names and short explanations of the different sections. Please note that the lower part of the GUI (graphs and values are displayed in all of the demonstration Tabs.

Figure 47: Demo GUI Screenshot

<1> ADC – External Voltage & Temperature Graphs

This section displays the external voltage (measured from the potentiometer on the board) and the temperature reported by the internal temperature sensor of the RL78/G13. The measurements are performed by the 10-bit ADC of the RL78/G13. The graphs can be reinitialized by clicking the "Clear" buttons on the right hand side of the window. Note that the graphs are re-scaled automatically when the "Clear" buttons are pressed, so a more detailed look of the reported values can be made.

<2> Real Time Clock

This section displays the date and time reported by the on-board RTC. The RL78/G13 RTC registers can be synchronized with the PC system date and time by clicking the "Sync" button. The user can also set and enable the interval interrupt and the alarm functions.

<3> Memory – Data Flash & RAM Content

When the "Enable" button is pressed, the RL78 writes 4 bytes of data to the internal data flash memory for every ADC measurement (~ 5 sec). The data saved are the converted ADC values for the external voltage (Potentiometer) and internal temperature sensor. The GUI window shows the current 64 bytes window of the current data flash block that is being written into. Data flash contents are retained even when the power is removed from the device.

This section also displays the data RAM content read from the RL78/G13 RAM variable memory and an 8 byte user area which can written and read by the user. RAM content is not lost even when the RL78/G13 enters the lowest power mode (STOP mode) providing power is not removed from the board.

<4> Low Power – Low Power Mode Selection:

Three different standby modes are implemented in the RL78/G13 device, HALT mode, STOP mode and the new SNOOZE mode.

Buttons are used to switch the operational mode of the RL78/G13 to the standby mode selected. The button clicked will set the RL78 into the selected low power mode and change caption to "Release". The RL78 will remain in the selected low power mode until button is clicked again to release the RL78/G13 to the active mode, except for the Snooze mode which requires the user to adjust the external potentiometer to exit.

Detailed explanations about each of the low power modes are provided in the section 9.6 Low Power Demo, please refer to it.

<5> Self-Test Function:

This section demonstrates the different self-test functions provided within the RL78/G13. The self-test functions are CRC check, RAM & SFR write protection and system clock measurement.

It is important to note that tooltips are present on every buttons to guide the user through the experience of the RL78/G13 GUI Demo, and provide him with useful information for a good and quick understanding of the different features and peripherals demonstrated.

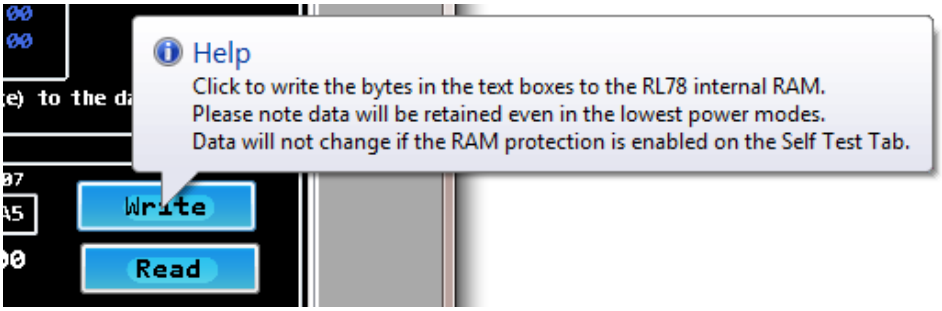

Figure 48: Tooltip Example

9.3 ADC Demonstration

This section of the GUI makes use of the ADC to measure and display the external voltage and the temperature using the RL78/G13 internal temperature sensor. The sensor is internal to the RL78/G13 device therefore the measured temperature might not reflect the room temperature. The internal reference voltage (TYP: 1.44 V) is also displayed on the right hand side of the GUI window.

For all ADC data requests by the GUI (every 5 sec.), the internal reference voltage is measured and then used as a calculation scaling point for the external voltage (Potentiometer) and internal temperature calculations as shown in the example below:

Ext. Voltage (V) = Ext. Voltage ADC result x (1.44V / Int. Ref. Voltage ADC result)

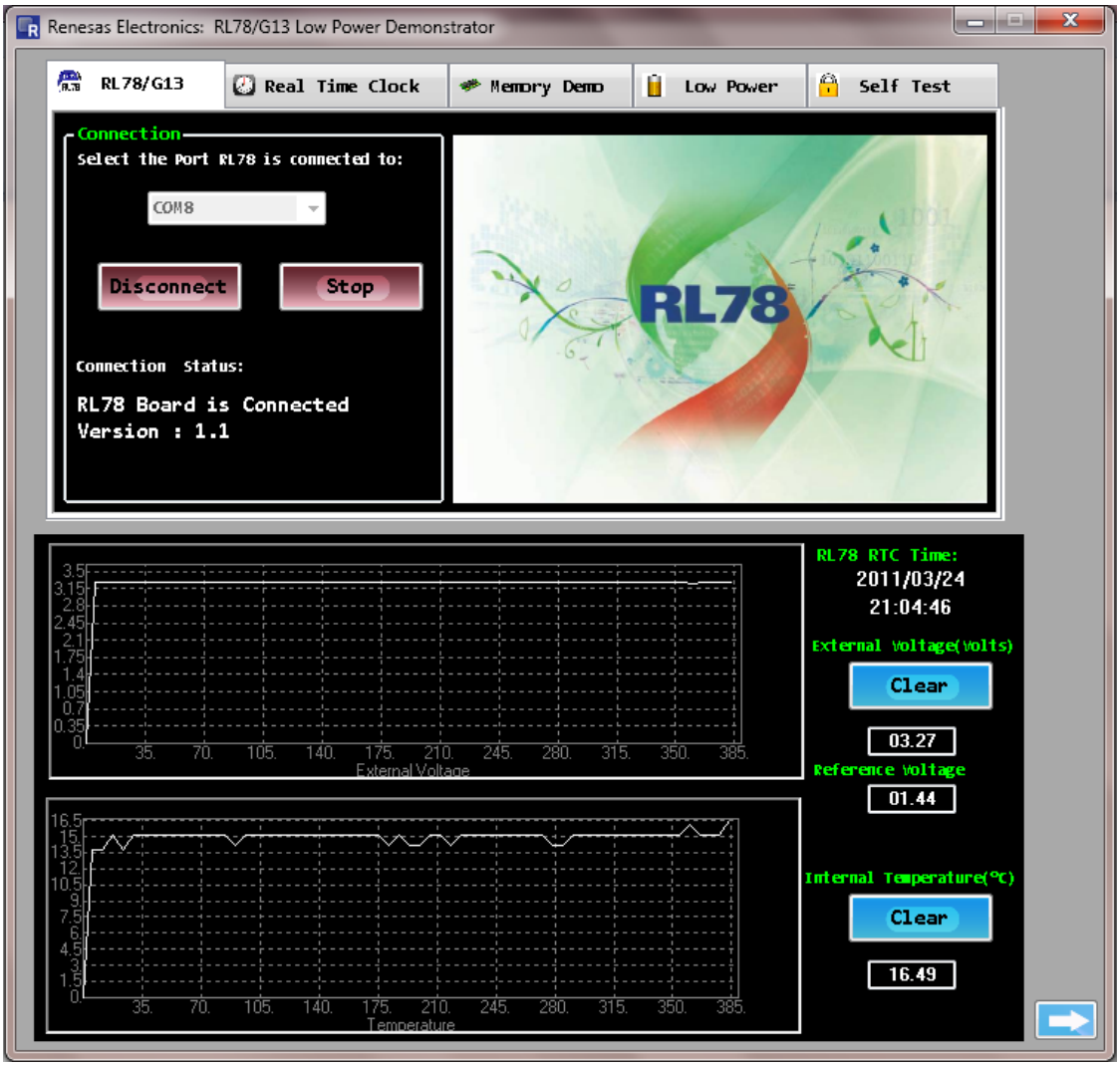

Figure 49: External Voltage & Temperature Measurements

The graphs keep a history of all the reported values from the RL78/G13. In order to clear the history and get clear readings please click the "Clear" buttons. The graphs then automatically re-scale to the displayed data values. To see the external voltage changes turn the potentiometer using the screwdriver. To increase the voltage, turn the potentiometer in a clockwise direction, to decrease the value turn the potentiometer anticlockwise. The temperature can be changed by simply touching the MCU with a finger or blowing air over the RL78 device.

9.4 Real Time Clock Demonstration

This section of the GUI demonstrates the capability of the RL78/G13 to implement full calendar function using the internal separate registers for seconds, minutes, hours, days, days of the week, months and years. For full explanation of the on-board RTC please consult the user manual of the device.

The RL78 stick sends the value of the RTC registers to the GUI every second and the values are displayed on the GUI on the right hand side of the lower window. When the board is first connected and powered, the RTC will start with a default value. The user can synchronize the on-board RTC with the time and date of the PC system by clicking the "Sync" button. To verify the operation Windows Date and Time applet can be launched to check that the values displayed by the GUI demonstration are synchronized with the PC system date and time.

Two other features of the RTC can be used, the interval interrupt and alarm function.
The interval interrupt allows the user to generate periodic interrupts that have been selected in the drop-down menu. Click the "Enable" button and you will see the LED D2 on the board toggling according to the selected period.
The alarm function lets the user select the time (Days of the week, hours and minutes) for which you want the alarm to go off. When pressing the "Set Alarm" button the LED D2 will stop blinking and will turn on when the alarm has gone off. The GUI will also show a notification that the alarm has gone off.
When the RTC tab is selected in the GUI, the alarm values will be automatically set to the current time and date plus one minute, so that the user only has to click the "Set Alarm" button to set the alarm. Otherwise please check that alarm has a time and date in advance of the current settings. This can be done using the Days, Hours and Minutes buttons in the GUI.

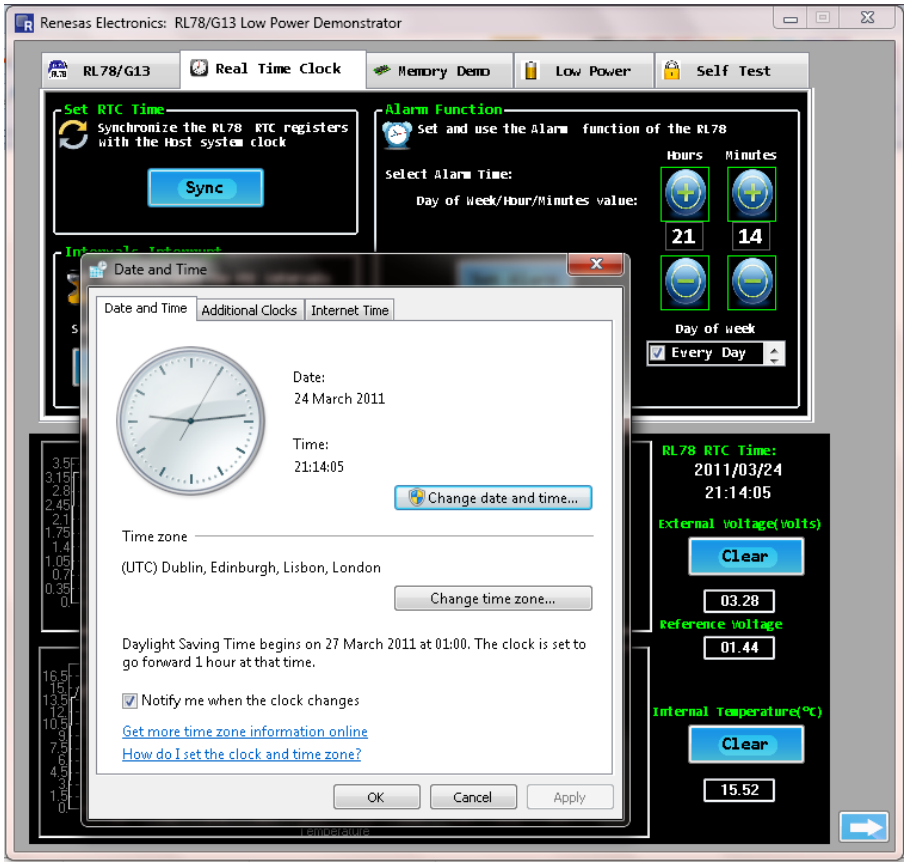

Figure 50: On-Board RTC Operation

9.5 Memory Demonstration

This section of the GUI demonstrates the internal data flash operation and the RAM data retention in the lowest power mode. Note the RAM window can also be used for the RAM write protection function in the “Self Test” tab as this is part of the user write protection RAM area.

In the “Data Flash Content” box, when the “Enable” button is pressed, the RL78/G13 starts writing 4 bytes of data into the internal data flash memory for every ADC measurement (Occurring every 5 seconds).
The 4 bytes of data written are:

- The temperature value - 2 bytes (The first byte represents the integer part and the second byte the fractional part of the value)
- The external voltage - 2 bytes.

The active window shows the current 64 bytes of the data flash memory block being written into. The current 4 bytes written in the data flash memory appear in red colour. Data flash content is retained even when the power is removed from the device, so that if you stop the GUI demonstration, unplug the *YRPBRL78G13* board and then plug it back and restart the GUI, the data flash content is still available, and the window shows the current 64 bytes data written.
The use of the data flash is based on a simple E^2 Emulation technique where two data flash blocks are used to save the data being written. One block is used until it is full and the writing is switched to the next erased block. The previous block is then erased.

User data can be written to the internal RAM of the RL78/G13 device by entering or changing the values in the write window and clicking the “Write” button. The data is then written to a specific location within the internal RAM of the RL78/G13. To read the data back click the “Read” button and the same internal RAM location is read by the RL78/G13 and sent back to the GUI.
The upper text field in white colour can be modified to enter random values to be written to the internal RAM. The lower text field displays the actual contents reported by the RL78/G13.

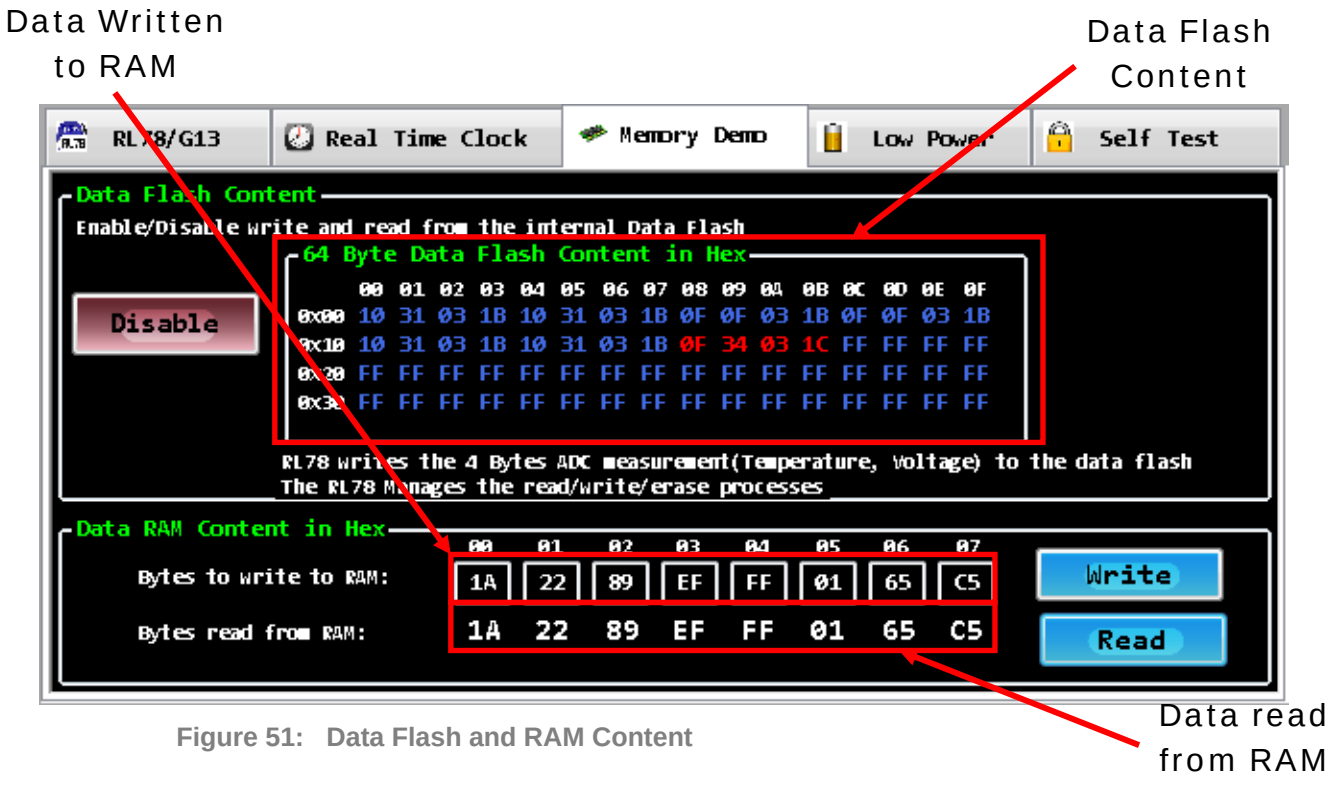

Figure 51: Data Flash and RAM Content

9.6 Low Power Demonstration

It is recommended to remove the jumper link from the connector **J3** and replace it with the two leads of a multi-meter to be able to measure the current consumption of the RL78/G13. The following figure gives an illustration on how to connect.

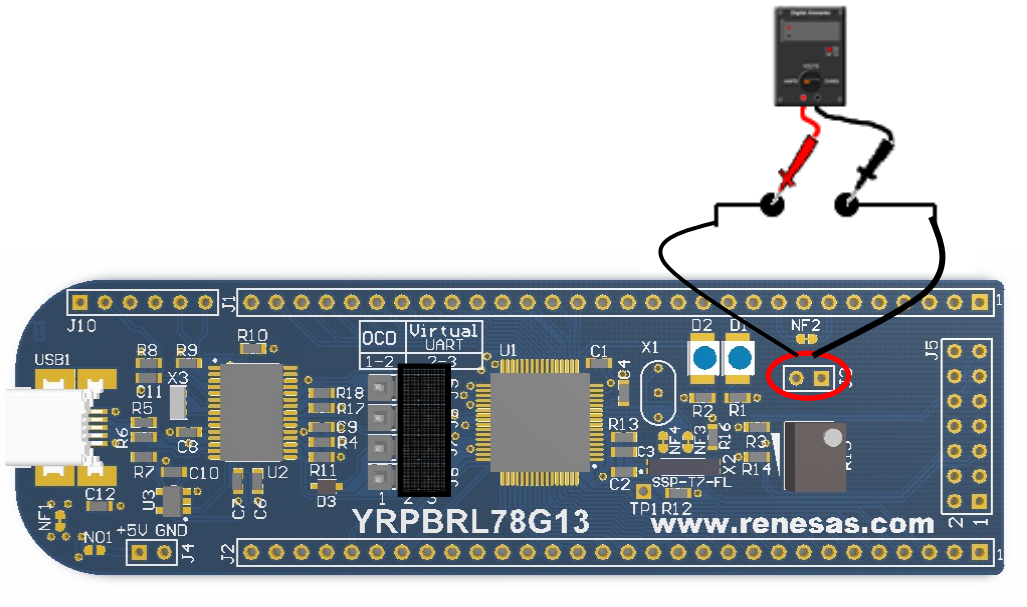

Figure 52: Multi-Meter Connection for Current Measurement

The RL78/G13 supports 3 low power modes that the GUI utilizes and demonstrates (HALT, STOP and SNOOZE). For more details on the power saving modes of the RL78/G13 please consult the device user manual.
When using the low power demonstration the user clicks the appropriate button in the GUI window. The RL78/G13 will enter the selected low power mode and will remain in that state until released by the GUI again. The different low power modes supported by this GUI demonstration are explained below.

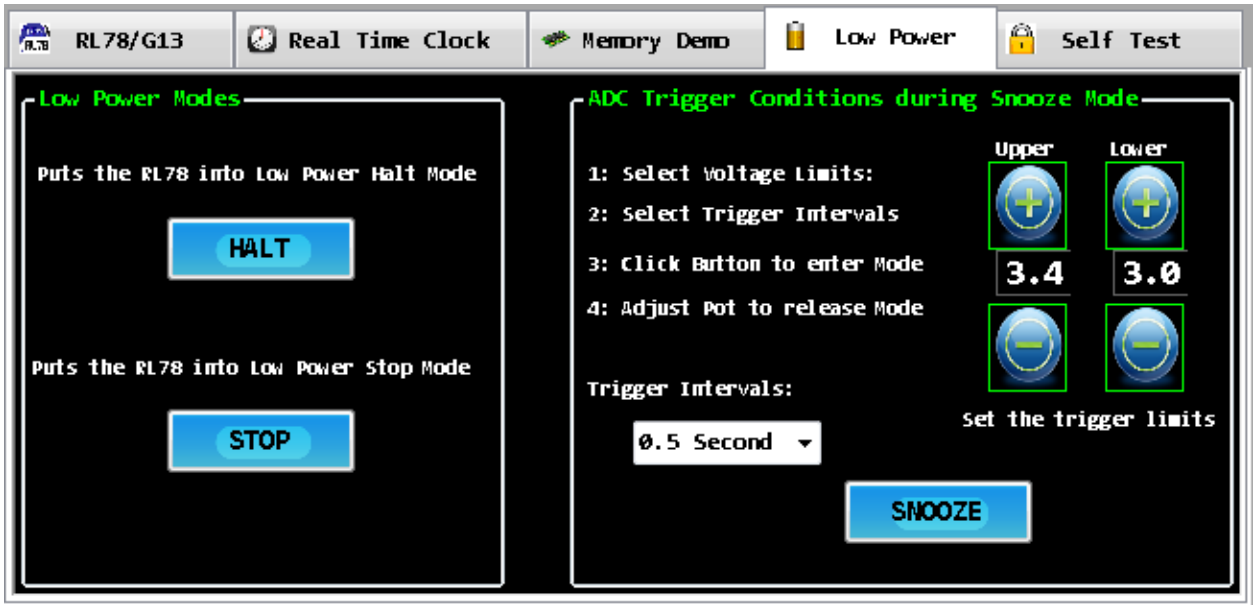

Figure 53: Low Power Mode Selection

9.6.1 HALT Mode

In this mode only the operating system clock to the CPU is stopped. The system clock can still be supplied to the peripherals. The total current consumption of the system can be reduced by using this mode in combination with the normal operation mode for intermittent operation.
Typical current consumption values for the RL78 Stick configuration in this mode is shown in table 14 below.

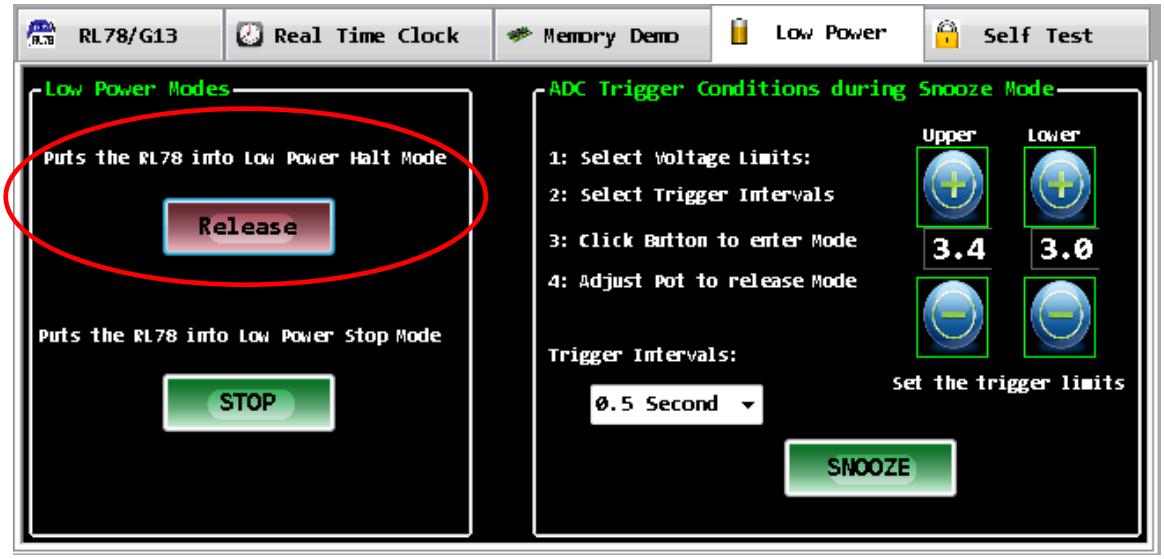

Figure 54: HALT Mode

9.6.2 STOP Mode

In this mode all the operations of the internal circuits except the sub-clock oscillator are stopped.
This mode can reduce the power consumption to a level lower than all other modes. The RL78/G13 is still operating the RTC using the 32.768 KHz sub-system clock.
Typical current consumption values for the RL78 Stick configuration in this mode is shown in table 14 below.

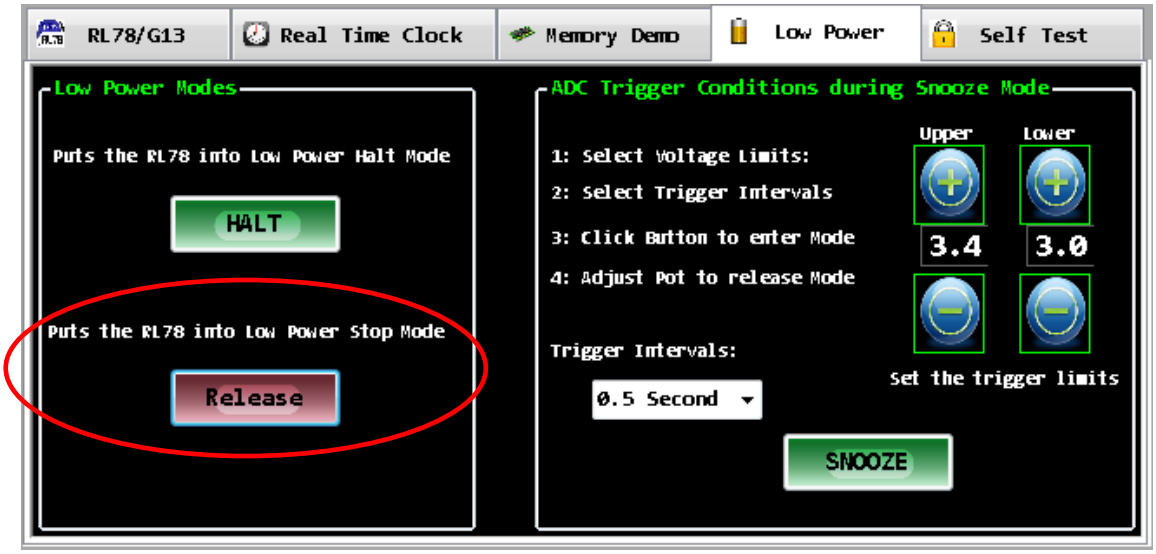

Figure 55: STOP Mode

9.6.3 SNOOZE Mode

The SNOOZE mode is a new mode which allows the RL78 to test for a valid “Wake Up” mode to occur, before waking the CPU. In this way the average power consumption can be reduced. The test is performed solely in hardware without having to wake the CPU each time until the valid event is met.

SNOOZE is technically part of STOP mode, but for the purposes of the demonstration the user only has to press the “SNOOZE” button to activate this demonstration.

Before activating SNOOZE mode, the user must specify the voltage window that the device is to wake up, as well as set the trigger interval of the ADC measurements. In this demonstration the RL78 has been set to wake on an external ADC voltage (Potentiometer value) that is “Outside” the specified voltage window.

SNOOZE mode alternates between STOP mode and SNOOZE mode where the system clock is supplied periodically to the ADC according to the RTC trigger intervals specified. An ADC measurement is automatically performed on the selected input channel (In our case, it is channel 2 where the potentiometer is connected). If the result of the AD conversion is outside the specified voltage range, the ADC issues an interrupt and the system clock is supplied to the CPU so that the RL78 device fully wakes up. If the ADC value is not outside the range, the CPU is not woken and the device returns to STOP mode until the next RTC trigger event.

For example, for an upper limit voltage sets to 2.9V and a lower limit voltage sets to 2.5V, the device will only wake up if you adjust the potentiometer voltage (using the provided mini screwdriver) to a voltage below 2.5V (between 0V and 2.5V) or above 2.9V (between 2.9V and 5V).

As this is the only way of waking the RL78 in this mode, a window will pop up to remind the user to adjust the potentiometer.

Tooltips and set-up instructions are provided in the GUI for the user to follow the instructions given in the SNOOZE mode box before clicking the “SNOOZE” button and entering this mode.

Other wake up options are available for the RL78 device, but are not included in this demonstration. Please refer to the RL78/G13 user manual for more details.

These are:

a. The wake up voltage can be set to occur inside the specified voltage range

b. CSI00 or UART0 reception

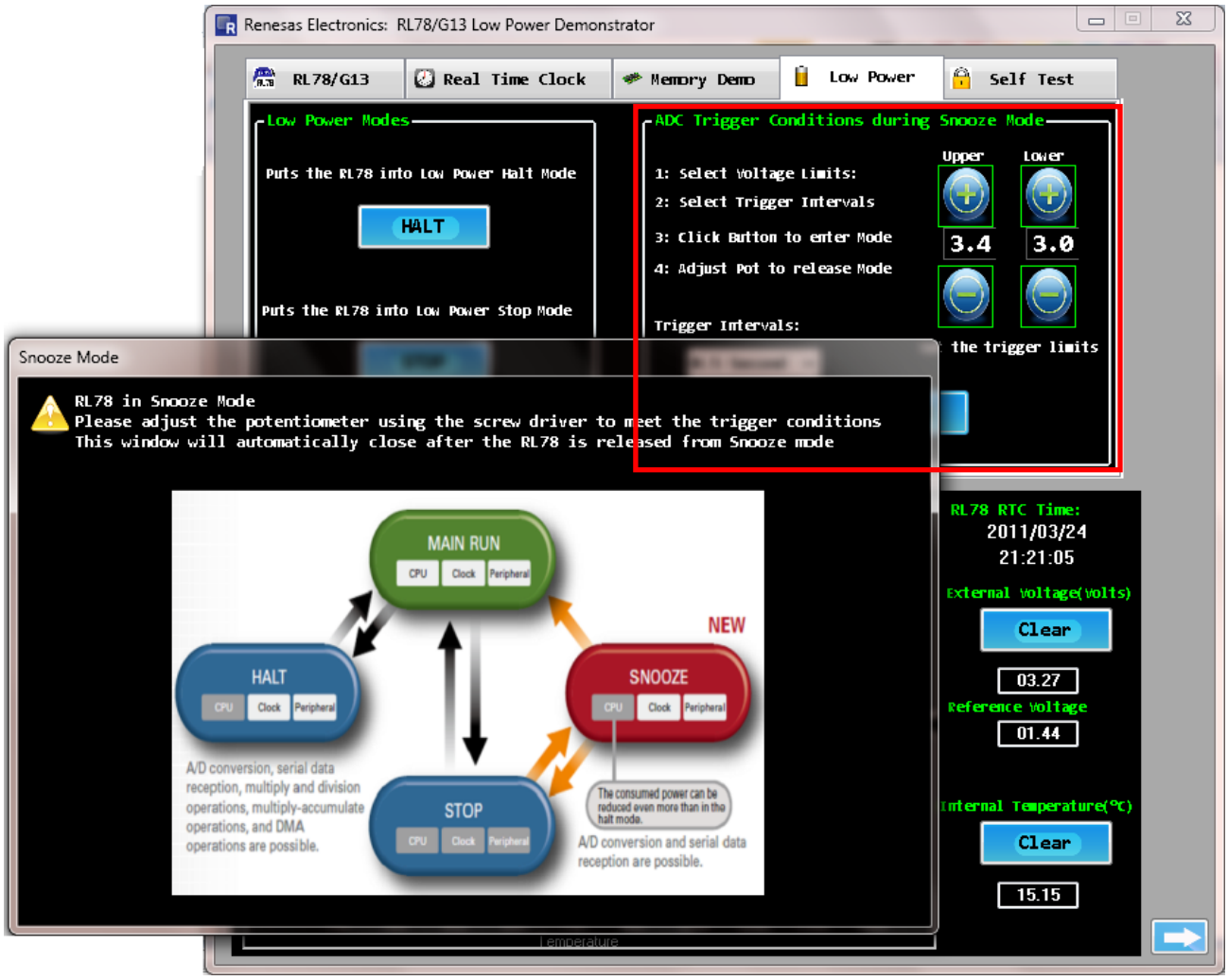

Figure 56: SNOOZE Mode

9.6.4 Typical Current Consumption Figures

The table below shows typical current consumption figures for the different operating and low power modes of the RL78, and shows the corresponding active and non-active clocks and peripherals used in the RL78 demonstration. In a real application, these settings can be adjusted to minimize the current consumption further.

Power Mode	Current Consumption										
		CPU	32 MHz	32 KHz	UART	Timer	ADC	RTC	LVD	Flash	RAM
RUN	5.1 mA	On	On	On	On	On	On	On	Off	On	On
HALT	1 mA	Off	On	On	On	On	On	On	Off	On	On
STOP	0.62 µA	Off	Off	On	Off	Off	Off	On	Off	Off	On
SNOOZE	1 µA (depends on the trigger interval time)	Off	Off	On	Off	Off	On (periodically)	On	Off	Off	On

Table 14: Current Consumption Table

9.7 Self-Test Functions Demonstration

The RL78/G13 includes several new self-test and safety hardware functions, amongst these are:

1. Hardware CRC Peripheral.
   This can be used for background CRC calculations on part or all of the code flash memory, or as a peripheral CRC unit (also called general purpose CRC) which performs a CRC check only on a desired set of data,

2. RAM and SFR Guard Protection.
   This provides a write protection function on a part of the internal SRAM and the SFR registers.

3. System Clock Measurement.
   This allows the measurement and monitoring of the internal system clock.

Each of them is demonstrated in the GUI.

1. CRC
   In the “CRC Test” box, click the “Automatic” button and the background CRC result is calculated on the first 32KB section of the code flash memory, and will be displayed under the button.

   To initiate the peripheral CRC, click on the “Enable” button. Please refer to the “Memory Demo” tab, as the CRC check is performed on the 64 bytes of the data flash displayed in this window.
   Each time a new set of 4 bytes is written in this 64 bytes data flash window, both the GUI and the RL78/G13 calculate the CRC check and should display the same results.

2. RAM and SFR Guard
   The RL78/G13 features two guard functions (write protect) which protect part of the internal SRAM and the SFR registers.
   Select one of them and then click the “Enable” button.

   When selecting the RAM guard, the first 512 bytes of the RAM memory are protected, therefore the following data reported to the GUI no longer change (The data is still sent to the GUI):
   - ADC measurements (both external voltage and internal temperature)
   - RTC registers
   - The user RAM area in this window will remain as previously set (Note the Read function is still able to read the RAM data)

   Regarding the SFR guard, the LED D2 is toggled every second by changing the mode of the corresponding port pin between output and input. The internal pull-up resistor is enabled so that when the port pin is set as an input, the state is high (1), that is D2 turned off. When the port pin switches to output, the output is specified as low (0) that is D2 turned on. When the SFR guard is enabled, the LED D2 stops flashing as the corresponding port mode register is protected.

   When the “Disable” button is pressed the RAM or SFR returns to normal, RAM data can be written and the variables in the GUI now update and the LED starts to flash as before.

3. System Clock Frequency Monitoring
   Finally, the RL78/G13 also provides the ability to measure and check the system clock frequency. Click the "Enable" button, the GUI will then display the current 32 MHz internal high-speed oscillator frequency, measured by the RL78 device. The GUI will also show the minimum and maximum frequencies measured. The user can then check that the frequency is always within the desired accuracy.
   The RL78 uses the external Seiko 32KHz resonator as the reference clock to measure the internal 32MHz high speed oscillator. This utilizes the special mode of the Timer Array Unit (Channel 5).

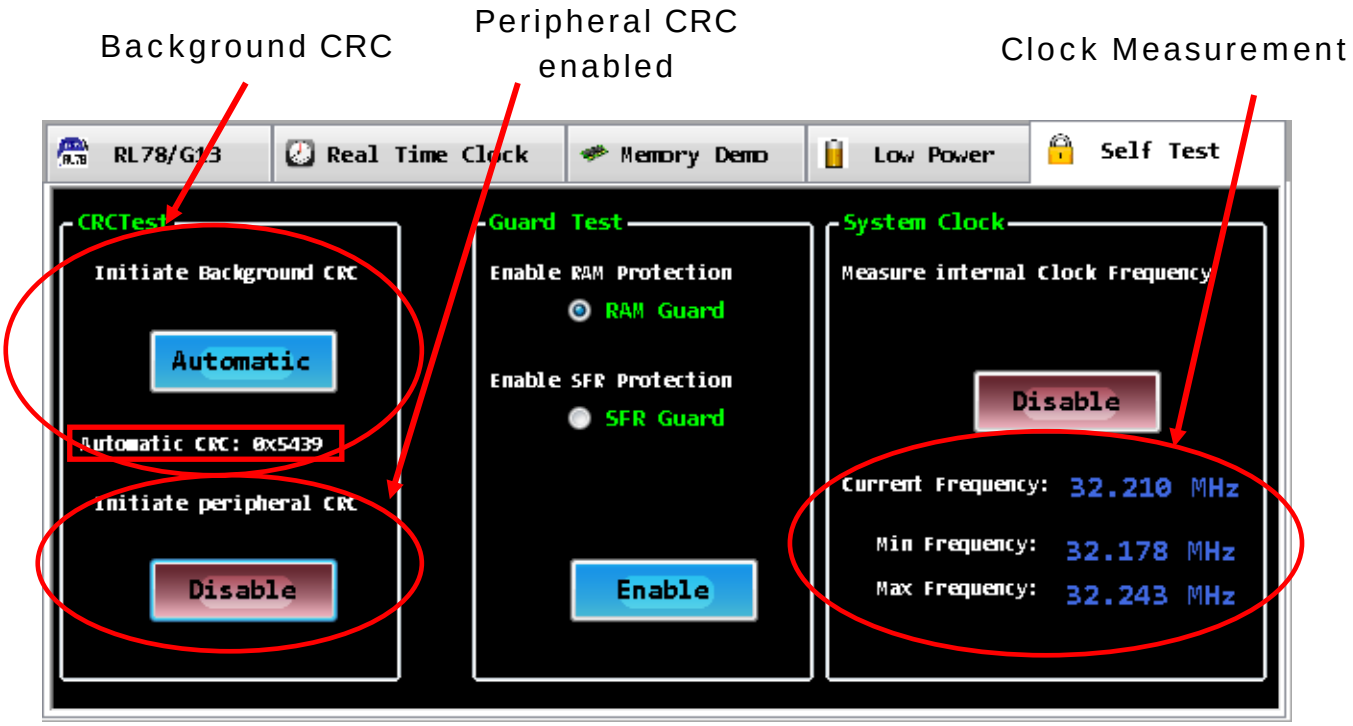

Figure 57: Self-Test Functions

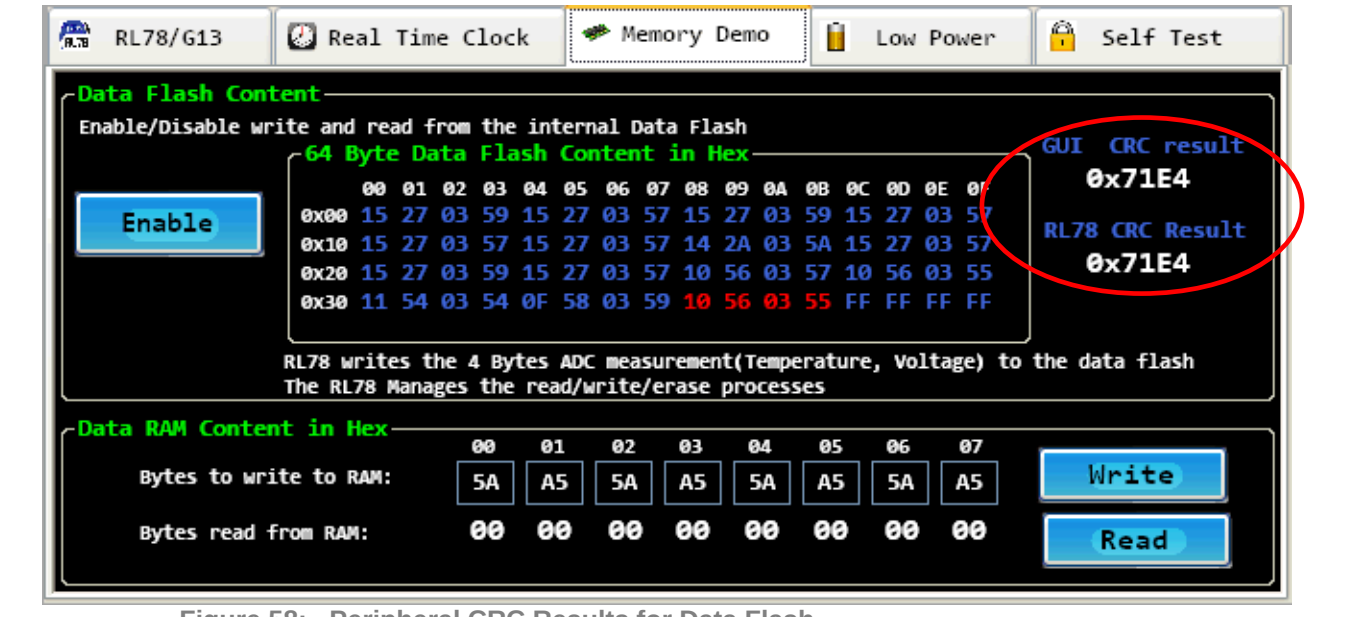

Figure 58: Peripheral CRC Results for Data Flash

Chapter 10 Troubleshooting

- **In driver installation, recognition based on Plug and Play is disabled.**

Cause:

The USB connector may not be inserted normally into the USB port of the personal computer.

Action:

Check that the USB connector is inserted fully into the USB port of the personal computer.

Alternatively, disconnect the USB connector, and then insert the USB connector again after a while.

- **The driver file cannot be found at a specific location**

Cause:

The WriteEZ5 programming software may not be installed correctly.

Action:

Install the WriteEZ5 software again by referring to **Chapter 6 - Software Installation**.

- **In checking by Device Manager, "USB Serial Port" or "USB High Speed Serial Converter" is not displayed. Alternatively, the "!" or "×" is prefixed**

Cause:

The USB connector may not be inserted normally into the USB port of the personal computer.

Action:

Check that the USB connector is inserted fully into the USB port of the personal computer.

Alternatively, disconnect the USB connector from the USB port, then insert the USB connector again after a while.

Cause:

The driver may not be installed correctly.

Action:

<1> When this product is connected to the personal computer, right-click the driver marked with "!" or "×".

Click Erase when displayed.

<2> On Device Manager, execute [Hardware Modification Scan].

<3> Install the driver again with Plug and Play.

Cause:

The device may not be recognized (in the case of connection with the USB hub).

Action:

Try the following:

- Disconnect the USB connector, then insert the USB connector again.
- Connect the USB connector to another port of the USB hub.

If the same symptom occurs, do not use the USB hub, but directly connect the connector to the USB port of the personal computer.

- **When this product is connected with a personal computer, the "Add New Hardware Wizard" screen is displayed**

Cause:

If the USB connector of this product is not inserted into the USB port used at the installation time but into another USB port, this product may be recognized as a new hardware item.

Action:

Install the driver by referring to **Chapter 6 - Software Installation**

- **Communication with the *YRPBRL78G13* is disabled**

Cause:

The driver may not be installed correctly.

Action:

Check if the USB driver is installed correctly by referring to **Chapter 6 – Software Installation**.

Cause:

The COM port selected via the “Port list box” within device setup menu of WriteEZ5 may not be set correctly.

Action:

Set the port checked using Device Manager.

Cause:

The *YRPBRL78G13* board is operating in GUI Demo / Virtual UART mode.

Action:

Set the board to the On-Board Debugging / Flash Programming mode.

Cause:

The PRM file selected in [Device Setup] may be incorrect.

Action:

Use the corresponding PRM file that matches the target device. For information about the PRM file, refer to **Chapter 7 – How to Use WriteEZ5 Flash Programming Software**.

Chapter 11 Schematics

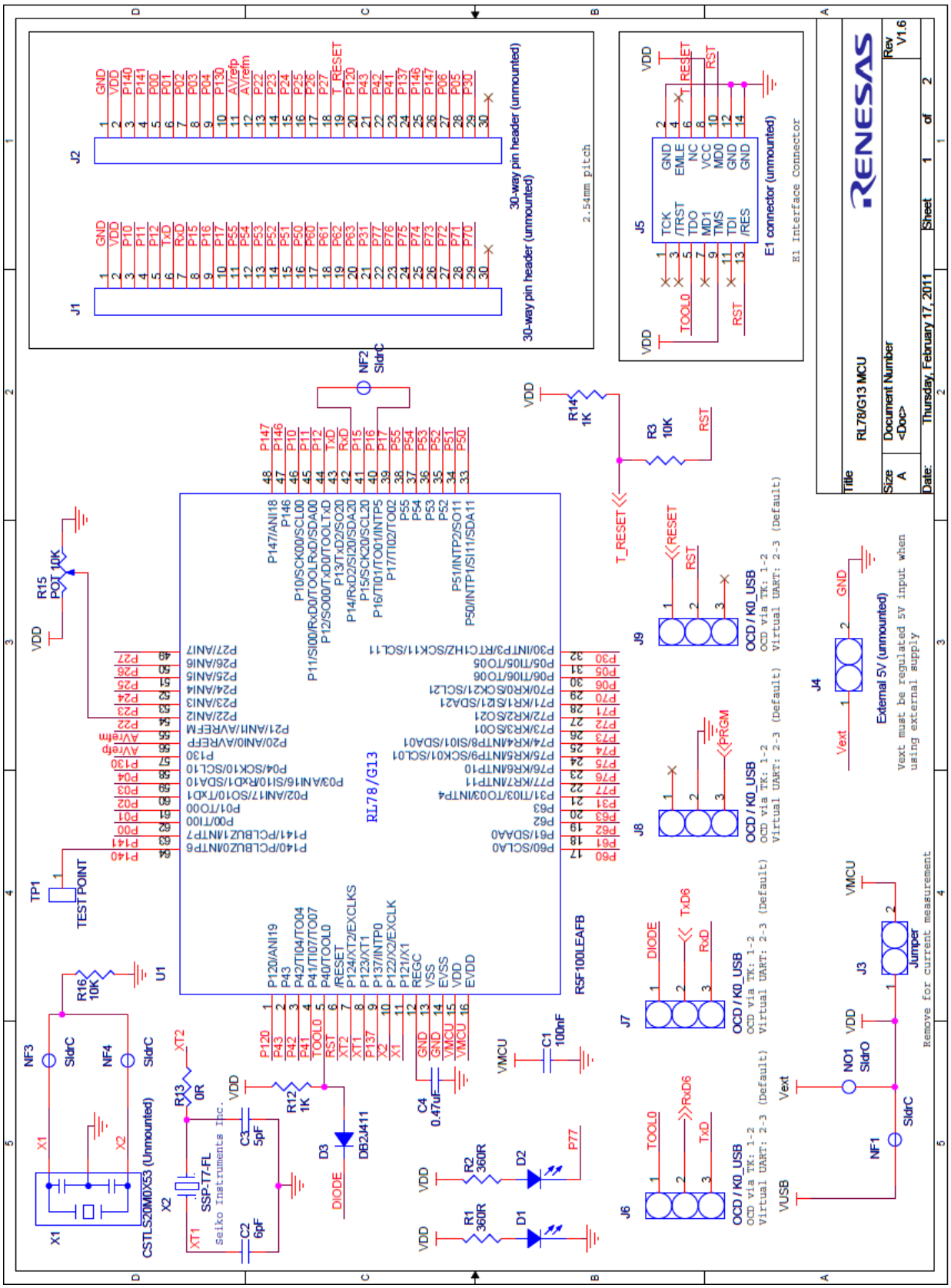

Figure 59: *YRPBRL78G13* Board Schematics 1/2

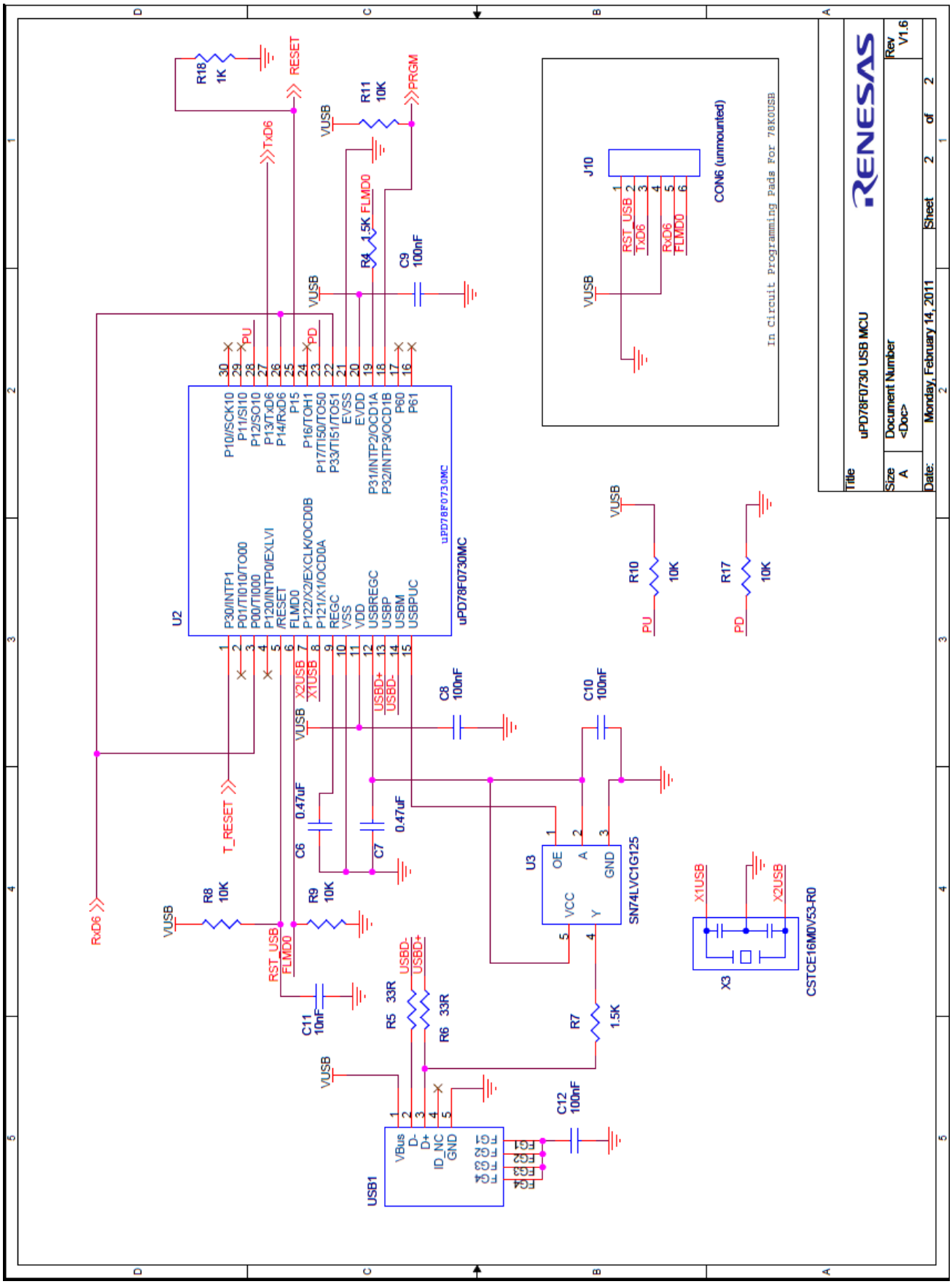

Figure 60: *YRPBRL78G13* Board Schematics 2/2

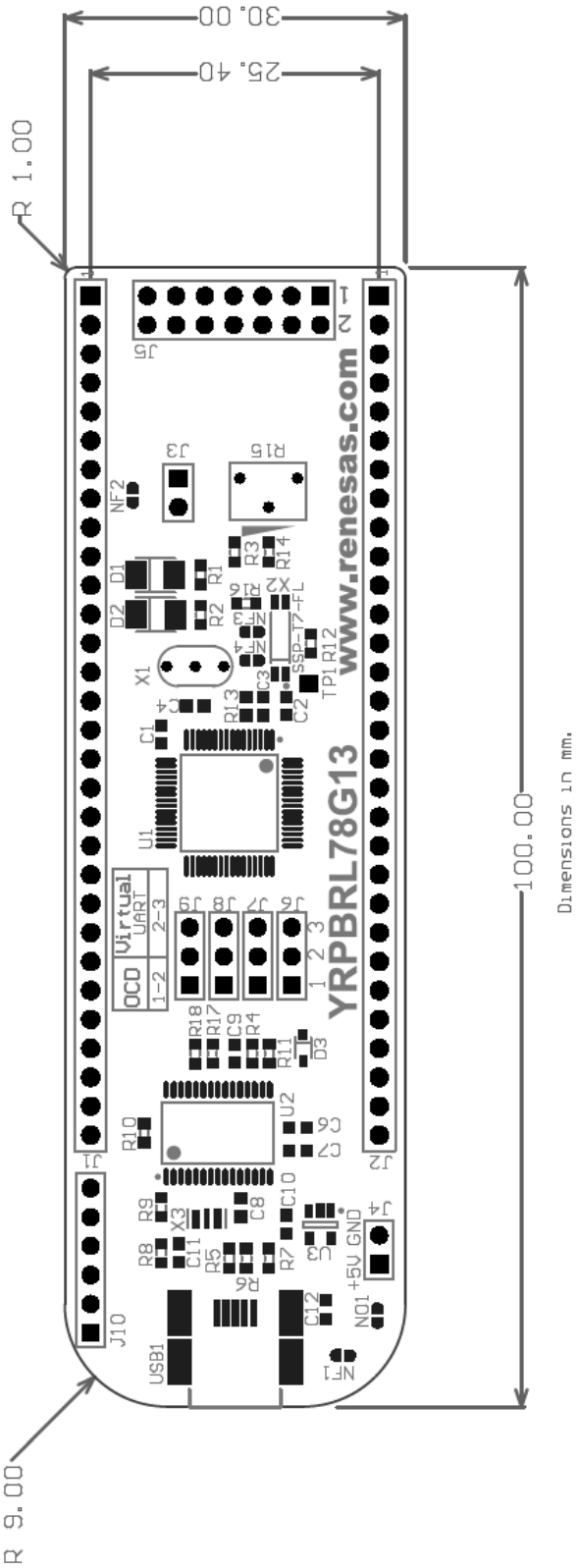

Figure 61: *YRPBRL78G13* Board Assembly Drawing

Chapter 12 Bill of Materials

Item	Qty	Reference		Comment
1	5	C1,C8,C9,C10,C12	0.1uF	YAGEO (PHYCOMP) - CAPACITOR, 0603, 100NF, 50V, X7R
2	1	C2	6pF	MULTICOMP - MLCC, 0603, NP0, 50V, 6PF
3	1	C3	5pF	MULTICOMP - MLCC, 0603, NP0, 50V, 5P
4	3	C4,C6,C7	0.47uF	KEMET - CAPACITOR, 0603, 470NF, 16V, X7R
5	1	C11	10nF	MULTICOMP - MLCC, 0603, X7R, 25V, 10NF
6	2	D1,D2	LED	LED, BLUE, SMD, OSRAM LBT676
7	2	J1,J2	CON30	On PCB Board (0.1' pitch) (Pin headers not fitted)
8	1	J3	JUMPER	2 way straight PCB pin headers (0.1' pitch) + jumper
9	1	J4	CON2	On PCB Board (0.1' pitch) (Pin headers not fitted)
10	1	J5	CON7x2	7 x 2 straight pin headers (0.1' pitch) (Pin headers not fitted)
11	4	J6,J7,J8,J9	CON3	3 way straight pin headers (0.1' pitch) + jumpers
12	1	J10	CON6	On PCB Board (0.1' pitch) (Pin headers not fitted)
13	4	NF1,NF2, NF3, NF4	SldrC	On PCB Board
14	1	NO1	SldrO	On PCB Board
15	2	R1,R2	360R	MULTICOMP - RESISTOR, 0603 360R
16	7	R3,R8,R9,R10,R11, R16, R17	10K	MULTICOMP - RESISTOR, 0603 10K,0.063W,1%
17	3	R12, R14, R18	1K	MULTICOMP- RESISTOR, 0603 1K,0.063,1%
18	2	R4,R7	1.5K	MULTICOMP - RESISTOR, 0603 1K5
19	2	R5,R6	33R	MULTICOMP - RESISTOR, 0603 33R
20	1	R13	0R	MULTICOMP - RESISTOR, 0603 0R0,0.063W
21	1	R15	POT 10K	T63YB top adj cermet pcb pot,10K 0.25W
22	1	TP1	TEST POINT	On PCB Board (Pin headers not fitted)
23	1	USB1	USB	TYCO ELECTRONICS / AMP - 1734035-1 - CONN, RECEPT. 5, USB SERIES B
24	1	U1	R5F100LEAFB	RL78/G13 MCU
25	1	U2	uPD78F0730MC	USB MCU
26	1	U3	74LVC1G125CK	Bus Buffer/Gate w/3-StSN74LVC1G125DBVR
27	1	X1	CSTLS20M0X53	Ceramic resonator THT CSTLS 20.00MHz (not fitted)
28	1	X2	SSP-T7-FL	Seiko Instruments Inc, 32.768KHz
29	1	X3	CSTCE16M0V53-R0	Murata SMT Ceramic resonator, CSTCE, 16.00MHz
30	1	D3	DB2J411	Panasonic Schottky Diode DB2J411 40V 1A SMini2-F5-B

Table 15: Bill of Materials

Chapter 13 Resonator from Seiko Instruments Inc.

13.1 Features of the 32 KHz Resonator

The SSP-T7-FL is a tuning fork 32 KHz low CL crystal resonator from Seiko Instruments Inc. designed for the new low power RL78 MCU family. Microcontrollers from the RL78 family using this 32 KHz low CL resonator achieves ultra low power oscillation circuit (0.2 µA max.) with fast start-up time (within 1 sec.), high accuracy (±10 sec. per month), and high efficiency (oscillation allowance up to 20%).

13.2 Product Name and Specifications

The different product names offered by Seiko Instruments Inc. for the RL78 microcontrollers are:

- SSP-T7-FL (SMD type low CL resonator)
- VT-200-FL (Cylinder type Low CL resonator)

The main specifications are as follows: 32.768 KHz ± 20ppm CL 4.4pF.

13.3 Web URL

Fore more information about those products, please refer to the following URL:
www.sii-components.com/quartz/renesas/

13.4 Contact Addresses

(Japan)
Contact person name: Katsuyuki Masuko
Quartz Crystal Sales, Electronic Components Business Unit
Tel. number: +81-43-211-1207
Email address: katsuyuki.masuko@sii.co.jp
Company name: Seiko Instruments Inc.
Address: 8,Nakase 1-choume,Mihama-ku,CHiba-shi,
Chiba 261-8507,Japan

(China)
Contact person name: Kensei Nozu
Tel. number: +86-775-82462680-307
Email address: kensei.nozu@sii.co.jp
Company name: Seiko Instruments (H.K.) Ltd. Shenzhen Rep. office
Address: 2212-2215 Diwang commercial building, Shunhin square
5002, Shennan Est Rd., Shenzhen, Guangdong, China

(Americas)
Contact person name: Jim Schlumpberger
Tel. number: +01-310-517-7884
Email address: jim.schlumpberger@siu-la.com
Company name: Seiko Instruments U.S.A. Inc.
Address: 2990 Lomita Blvd. Torrance, CA 90505, U.S.A.

(Europe)
Contact person name: Michael Bertsch
Tel. number: +49-6102-297-303
Email address: michael.bertsch@seiko-instruments.de
Company name: Seiko Instruments GmbH
Address: Siemensstr. 9, D-63263 Neu Isenburg, Germany

(Korea) To be informed later
Contact person name: Sungnam Chung / Choi Kyonghoan
Tel. number: +82-2-565-8006
Email address: sungnam.chung@sii.co.jp / kyonghoan.choi@sii.co.jp
Company name: Seiko Instruments Korea Inc.
Address: #507,508, Korea City Air Terminal Bldg,
159-6, Samsung-dong, Gangnam-gu, Seoul, 135-728 Korea

(Taiwan)
Contact person name: Shawn Yang
Tel. number: +886 2 2516-8518 ext: 239
Email address: shawn.yang@sii.co.jp
Company name: Seiko Instruments Taiwan Inc.
Address: 6F,No.236,Sec.2,Jianguo N.Rd.,Taipei 104,Taiwan

REVISION HISTORY	RL78/G13 Stick User's Manual: Hardware

Rev.	Date	Description	
		Page	Summary
1.00	Mar 25, 2011	—	First Edition issued

RL78/G13 Stick User's Manual: Hardware

Publication Date: Rev.1.00 Mar 25, 2011

Published by: Renesas Electronics Corporation

Renesas Electronics Corporation

SALES OFFICES http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130
Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220
Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900
Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327
Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679
Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898
Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044
Renesas Electronics Taiwan Co., Ltd.
7F, No. 363 Fu Shing North Road Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670
Renesas Electronics Singapore Pte. Ltd.
1 harbourFront Avenue, #06-10, keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6278-8001
Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510
Renesas Electronics Korea Co., Ltd.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

RL78/G13 Stick

Renesas Electronics Corporation

R01UH0243ED0000