User's Manual

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YRL78IOLINKMAX

IO-Link Starter Kit User's Manual: Hardware

RENESAS MCU

RL78 Family/ G1x Series

Renesas Electronics
www.renesas.com

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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.

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.

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.

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.

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.

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

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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

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.		

Notation of Numbers and Symbols

Register Notation

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
IODD	IO-Link Device Description file

Table of Contents

1.Overview

The *YRL78IOLINKMAX* is an evaluation platform for small scale IO-Link sensor system based on the Renesas RL78/G1A microcontroller, and the Maxim Integrated MAX41821 IO-Link Device transceiver.

The hardware provides a platform to the user, to develop and evaluate miniature IO-Link sensors via a standard industrial sensor M12 interface to IO-Link Masters. It contains all the elements to easily start and demonstrate IO-link sensor applications.

The hardware environment and the applications are described in this manual.

A sample Demo illustrating an IO-Link sensor implementation is provided.

1.1 Features of YRL78IOLINKMAX

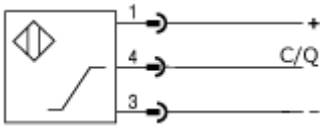
- Renesas Electronics RL78/G1A low power consumption 16-bit microcontroller.
- Maxim Integrated IO-Link Device PHY.
- Maxim Integrated 6 in 1 sensor.
- Power Supply via M12 cable.
- On-chip debugging capability

The *YRL78IOLINKMAX* board supports an On-chip debug function by using the IAR C-SPY debugger with the use of an additional E1 debugger hardware, not included in the kit. It allows FLASH downloading and standard debug functions like code execution, single stepping, breakpoints, memory manipulation etc.

- The IAR Embedded Workbench for RL78 and the IAR C-SPY debugger / simulator are included. These packages are restricted in such that maximum program code size is limited to 16 Kbyte.
- Full documentation is included for the Renesas RL78/G1A microcontroller, Renesas, IAR Systems Embedded Workbench and IAR Systems C-SPY debugger / simulator.
- IO-Link communication

  The *YRL78IOLINKMAX* board provides an IO-Link communication channel.

Current type:	-	DC
Wiring:	-	3-Wire
Output signal:	-	IO-Link
Rated operational voltage: V	24DC	



Supply voltage: V	-	18…30 DC
Short circuit protection:	-	yes
Protected against polarity rev:	-	yes

- IO-Link Data

Physical Layer:		PHY2-3W
Data Transfer Rate:	-	COM1 (4.8kBaud), COM2 (38.4kBaud), COM3 (230.4kBaud)

- Pin2 of the M12 connector configured as digital output (default) or input
- Board size: 25mm x 6mm
- Analog to digital signal conversion
- LED indicators
- Two or three wires serial I/O interfaces
- On-chip debug interface

Note

The *YRL78IOLINKMAX* is intended for evaluation purposes in a lab environment. Renesas does not allow and does not support in any way any attempt to use the *YRL78IOLINKMAX* in a commercial or technical product.

1.2 System Requirements

Host PC	**A PC supporting Windows 7 is required for the IAR Systems Embedded Workbench demo-version.** **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.** **500 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.**

Note

Updates of the IAR Embedded Workbench for RL78, documentation and/or utilities for *YRL78IOLINKMAX*, if available, may be downloaded from the Renesas Starter kit WEB page(s) at: http://www.renesas.eu/io-link

1.2.1 Optional System Requirements

User may choose to purchase the following additional equipment for the development of IO-Link applications:

- TMG USB IO-Link Master
- PC software- TMG IO-Link Device Tool for configuration and analysis.
- Please contact TMG directly for details on the TMG IO-Link Master and TMG IO-Link device Tool
- Internet: www.tmg-karlshrue.de
- Double Ended 4 pins M12 cable.

1.3 Package Contents

- YRL78IOLINKMAX board
- YRL78IOLINKMAX programming adapter
- Not included in the package but downloadable from the Renesas web page, a Starter Kit Installer containing the products documentation, including datasheets, quick start guide for the TMG Stack library, Renesas IO-Link products flyers, sample software IAR project, Renesas flash Programmer software and IODD device

description files “IO-Link user Interface" to support the sample demo in the TMG IO-Link Device tool, the IAR Embedded Workbench for RL78 and the IAR C-SPY debugger / simulator.

Please verify that you have received all parts listed in the package contents list. If any part is missing or seems to be damaged, please contact the dealer from whom you received your YRL78IOLINKMAX.

Note

The Technologie Management Gruppe, TMG (Technologie und Engineering GmbH) stack is for evaluation purposes only. For mass production end products, a full license must be purchased from TMG.

The TMG IO-Link Master and TMG IO-Link device Tool are referenced in this manual. However, they are not included in the package.

Please contact TMG directly for details on obtaining the full license, the TMG IO-Link Master and TMG IO-Link device Tool.

Technologie Management Gruppe-Karlshrue ((Technologie und Engineering GmbH).

Internet: www.tmg-karlshrue.de

Please also note that the M12 cable shown in this manual is not included in the package.

1.4 Trademarks

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Microsoft and Windows are registered trademarks of Microsoft Corporation.

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2.System Configuration

The *YRL78IOLINKMAX* is an IO-Link slave or Device. For IO-Link communication, an IO-Link Master not included in the kit is necessary to use this kit. In this manual, a TMG USB to IO-Link Master is used to explain the operation of the *YRL78IOLINKMAX*.

An IODD (IO-Link Device Description) is provided for importation and integration of the *YRL78IOLINKMAX* into the IO-Link Device tool.

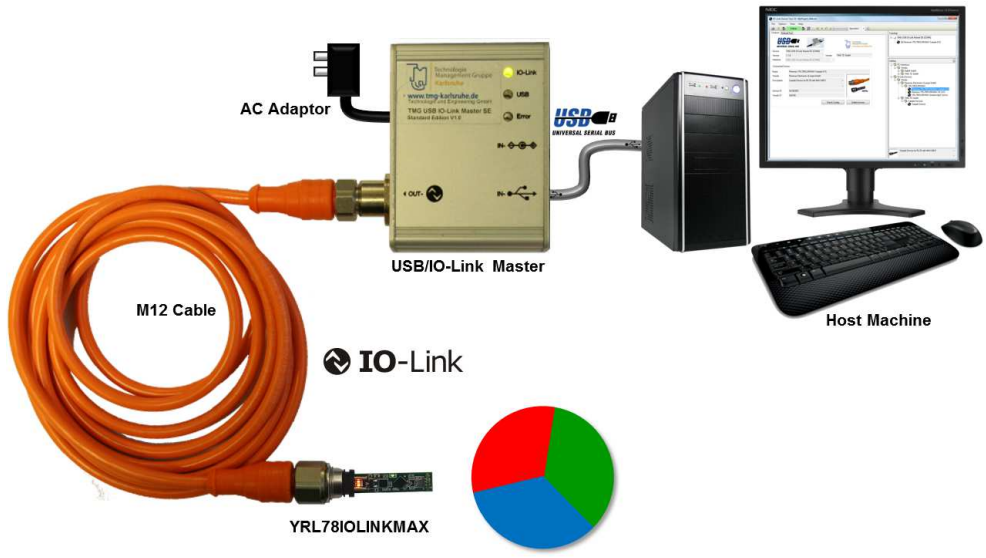

Figure 2-1 *YRL78IOLINKMAX system* configuration

2.1 YRL78IOLINKMAX Board

The *YRL78IOLINKMAX* board is a demonstration kit for the RL78/G1A 16-bit microcontroller of the RL78 family. The IO-link board can be used in two modes: IO-Link Mode (default mode), and Standalone mode.

2.1.1 IO-Link Mode

When used in IO-Link Mode, the *YRL78IOLINKMAX* board is connected to a host system via an IO-Link Master. Figure 2-1 shows the board being connected to a host computer using the TMG USB IO-Link Master (not included: see section **1.2.1.** for more details).

The Master powers and connects to the demonstrator board via the M12 connector using a M12 cable (not included). The board is working as an IO-link sensor demonstrating the application stored in the Microcontroller's memory.

2.1.2 Standalone Mode

When used in Standalone mode, the *YRL78IOLINKMAX* board is connected to a host system via a programming adapter and an E1 debugger.

The user can then perform software development or debugging on the microcontroller. The E1 debugger must be set in this case, to power the target microcontroller.

3.*YRL78IOLINKMAX* Description

The YRL78IOLINKMAX board is equipped with a range of features and components allowing a user to develop sensor applications. These components include: a microcontroller with enhanced analog features, 2 or 3-wires serial interfaces, indicator LEDs, Power LED, a 6 in 1 sensor component. A header for connection to host computers, FLASH programmer or any external target hardware.

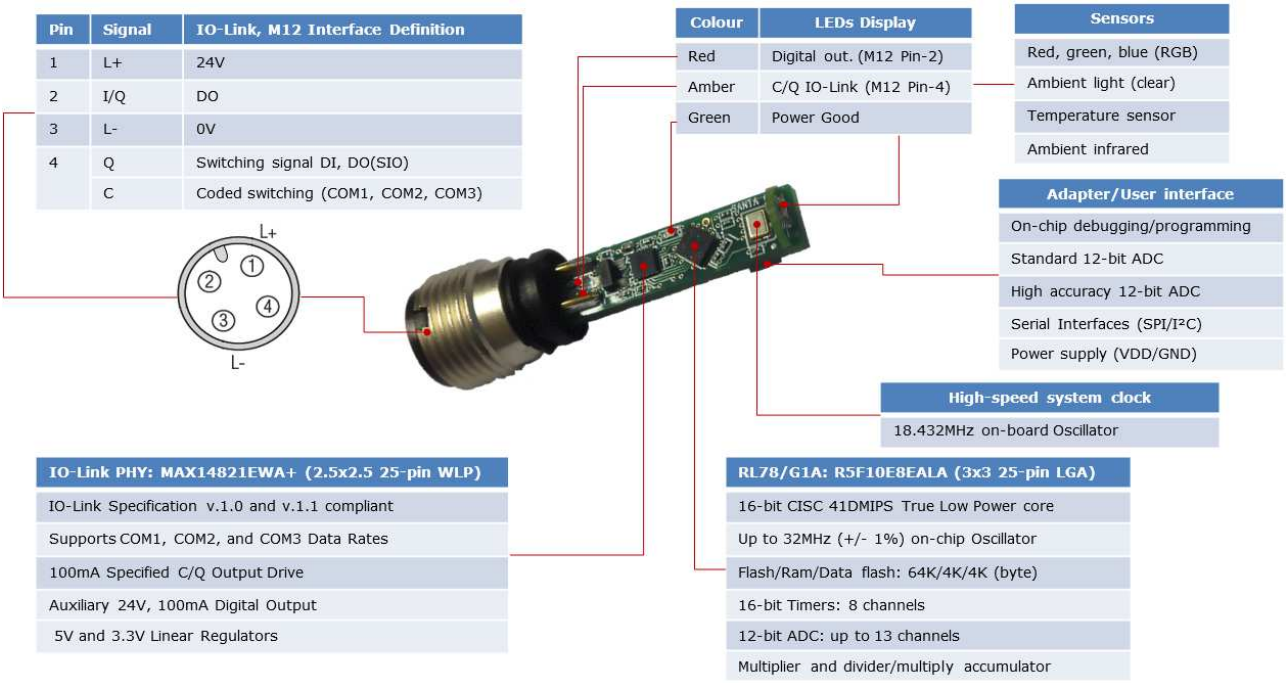

Figure 3-1 *YRL78IOLINKMAX* board Components

3.1 Internal Connections

The diagram below shows the *YRL78IOLINKMAX* board components and their connectivity to the MCU.

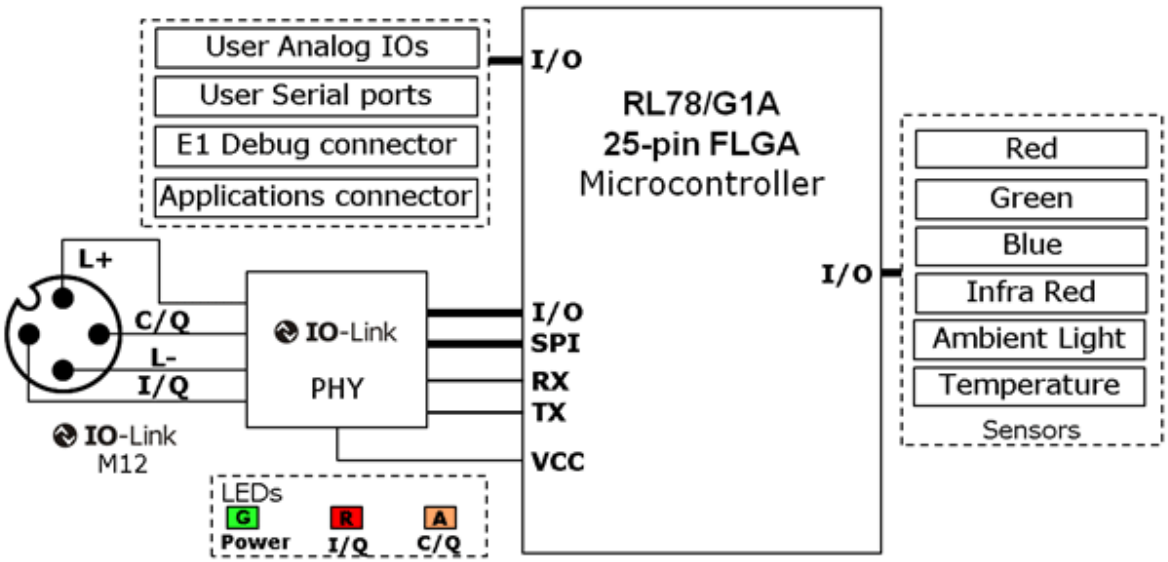

Figure 3-2 *YRL78IOLINKMAX* Internal block Diagram

3.2 Components Placement

Figure 3-3 below shows the components layout of the board.

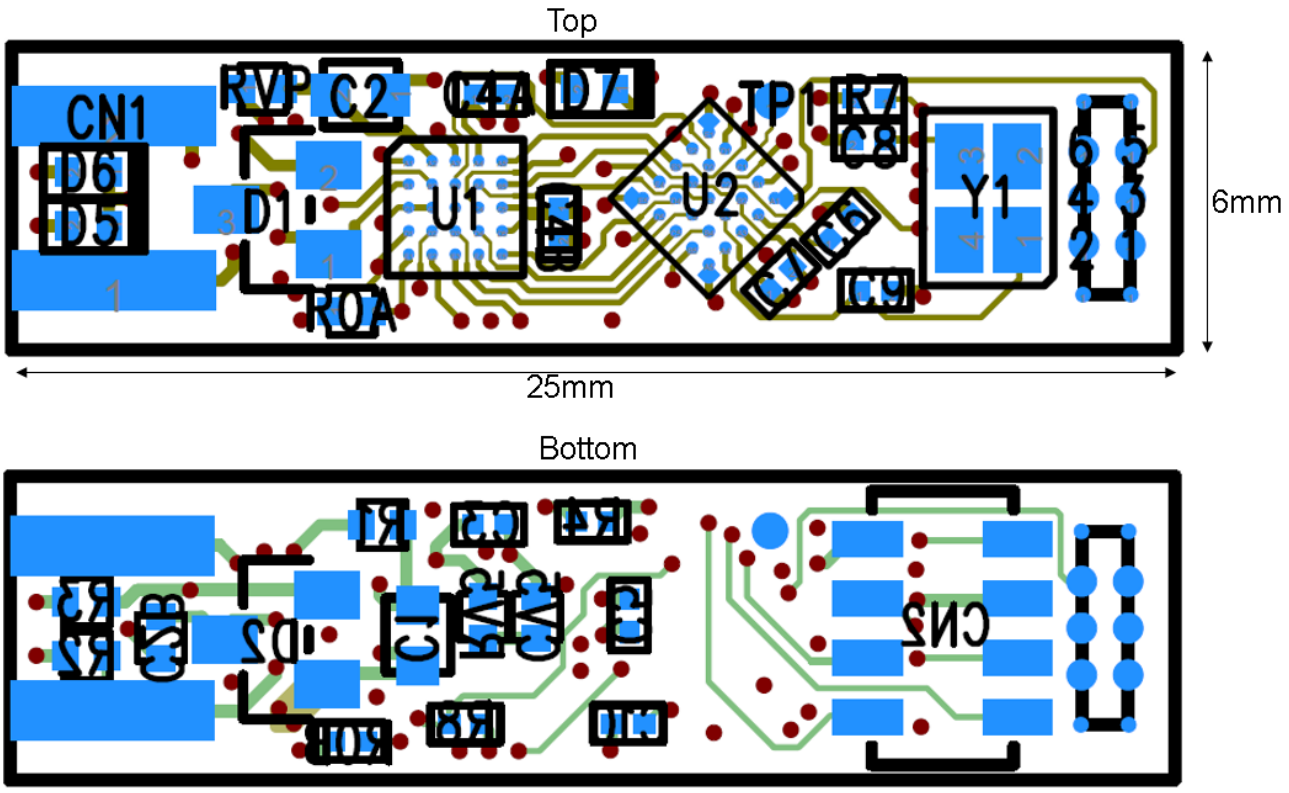

Figure 3-3 *YRL78IOLINKMAX* Top and bottom-side Component Placement

3.3 M12 Connector, CN1

The M12 connector allows the board interfacing with an industrial type Master device. **Figure 3-4** gives the wiring scheme for the plug. Pin 2 is configurable as a digital input or output. Pin4 is the IO-Link communication channel.

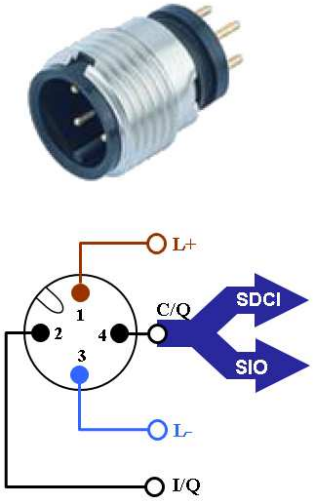

Figure 3-4 M12 Connector wiring description

Table 3-1 M12 Connector wiring description

PIN	Signal	Description	
1	L+	24V	
2	I/Q	PHY Pin	MCU pin
	Digital Input	E1	P31
	Digital Output	D1	P23
3	L-	0V	
4	C	“Coded switching” (SDCI)	
	Q	“Switching signal” DI, DO (SIO)	

3.4 Programming/Debugging Adapter Header, CN2

Via the CN2 header, the user can perform software debugging/development on the RL78/G1A microcontroller using the E1 Debugger. For more details on performing debugging operation, please refer to chapter 6 and chapter 8.

CN2 also provides the user a serial interface, AD converter access, and power connection to the prototyping area available on the programming adapter. Additionally, the SPI port (SCK00/SI00/SO00) is also used as configuration interface for the IO-Link Transceiver.

Table 3-2 Header CN2 connections

CN2	Description		MCU Function	MCU Pin	PHY pin
CN2-1	Power supply Ground		VSS/AVSS	B2/E5	C1/C2
CN2-2	Reset On-chip debugging/ flash programming		RESET	B5	
CN2-3	IO port		P40	A5	-
	On-chip debugging/ flash programming interface for tool		Tool0		
CN2-4	Power supply VDD(3.3V)		VDD	B3	A4
	IO-Link Mode	3.3V from IO-Link PHY, to prototyping area			
	Standalone Mode	3.3V from E1 Debugger			
CN2-5	IO port		P10	E3	A5
	Analog input		ANI18		
	Serial clock input/output		SCK00		
	Serial clock output		SCL00		
	Key return		(KR0)		
CN2-6	IO port		P11	D3	B5
	Analog input		ANI20		
	Serial data input		SI00		
	Serial data input/output		SDA00		
	UART Receive data		RxD0		
	Data input/output for external device		TOOLRxD		
	Key return		(KR1)		
CN2-7	IO port		P20	E1	
	Analog input		ANI0		
	A/D converter reference potential (+ side) input		AVREFP		
CN2-8	IO port		P12	D1	C4
	Analog input		ANI21		
	Serial data output		SO00		
	UART Transmit data		TxD0		
	Data input/output for external device		TOOLTxD		
	Key return		(KR2)		

3.5 LED Indicators, D5, D6

LEDs D5, D6, are indicating the communication status on the M12 Pin4 and Pin2 respectively.

Table 3-3 LED indications

LED	Colour	Function	PHY	
			connection	Pin
D5	Amber	M12 Pin4 IO-Link Channel communication signalling	C/Q	B1
D6	Red	M12 Pin2 Digital Input/output communication signalling	DI/DO	E1/D1

3.6 External Main Oscillator, Y1

The RL78/G1A can run at up to 32 MHz operating speed, with the on-chip high speed oscillator. A clock circuit fitted to the board, connects between pins X1 and X2 of the microcontroller, to generate the required clock signal to drive the MCU, and associated peripherals during IO-Link operations.

Table 3-4 Oscillator

Crystal	Function	Frequency	Default Placement
Y1	Main MCU Oscillator	18.432MHz	Fitted

3.7 Half Moon Bay Sensor Module

The Sensor transducer fitted to the main PCB board using the half-moon PCB, is the MAX4408. It integrates six sensors: red, green, blue (RGB) sensors; an ambient light (clear) sensor; a temperature sensor; and an ambient infrared sensor with an I2C interface to the RL78/G1A.

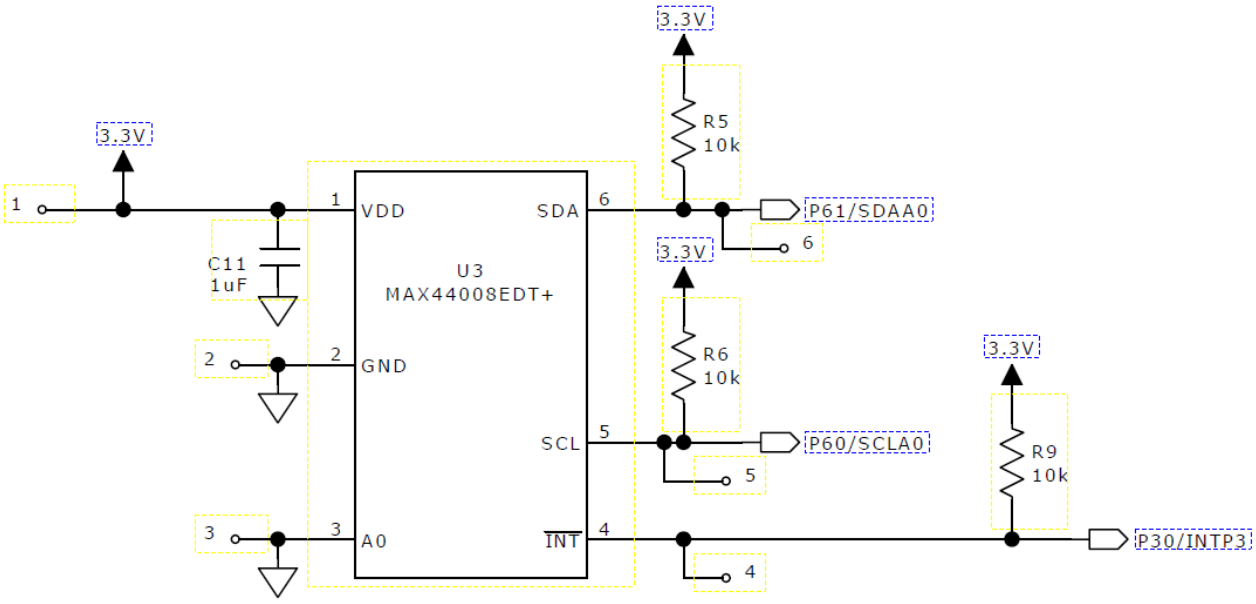

Figure 3-5 MAX4408 Connections

The following table shows the connection between the MAX4408 sensor and the RL78 microcontroller

Table 3-5 MAX44008 Connections

MAX44008		Function	RL78G1A	
Pin	Name		Name	Pin
4	INT	Interrupt	P30/INTP3	C2
5	SCL	I²C Clock	P60/SCLA0	A1
6	SDA	I²C Data	P61/SDAA0	B1

3.8 IO-Link Transceiver, U1

The IO-Link PHY used on the sensor board is the MAX14821. Connections with the RL78/G1A is made with a SPI port for configuration, and a UART port for IO-Link data communication exchange. Other IO signals are also used to ensure the correct function interfacing between the transceiver and the microcontroller.

The table below summarizes the connections between the microcontroller and the transceiver.

Table 3-6 MAX14821 Connections

MAX14821		Description	RL78/G1A	
Name	Pin		Name	Pin
UV	D2	Undervoltage Indicator Output.	P50/INTP1	E2
CS	B4	SPI Chip-Select Input	P21	C3
SDI	C4	SPI Serial-Data Input	P12/SO00	D1
SD0	B5	Serial-Data Output	P11/SI00	D3
SCLK	A5	SPI Clock Input	P10/SCK00	E3
IRQ	B3	Interrupt Request Output.	P51/INTP2	D2
RX	E4	Receiver Output	P03/RXD1	C5
WU	D3	Wake-Up Output.	P137/INTP0	B4
TXC	D4	Transmit Communication Input	P02/TXD1	C4
TXEN	E5	Transmitter Enable	P22	D4
LI	E2	Logic Output of the 24V DI Logic Input	P31	C1
LO	E3	Logic Input of the DO Output.	P23	D5

3.9 Flash Programming/On-chip Debugging Adapter

The adapter board provided in the package enables an easy connection mean for the sensor board to the E1 debugger. Additionally it provides the user with a prototyping area and further access to the RL78G1A peripherals.

The following figure shows the adapter circuit with the accessible microcontroller pins.

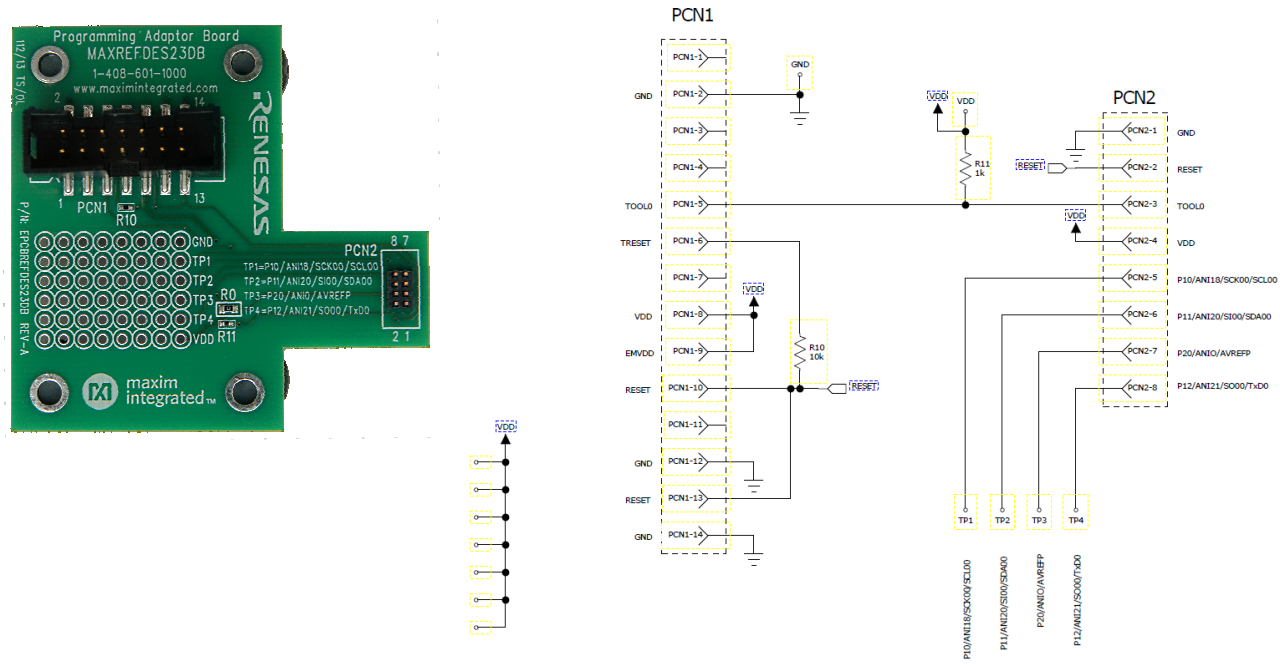

Figure 3-6 Programming/debugging adapter description

The table below shows the adapter's connectors description.

Table 3-7 Programming/debugging adapter ports description

Name	**Description**		**Name**	
PCN1	**E1 Programming/Debugging interface**		**PCN2**	
	Name	Pin	**Pin**	
	VDD	PCN1-8, PCN1-9	PCN2-3	
	GND	PCN1-2, PCN1-12, PCN1-14	PCN2-3	
	RESET	PCN1-6, PCN1-10, PCN1-13	PCN2-3	
	Tool0	PCN1-5	PCN2-	
PCN2	**Sensor board connector.**		**RL78/G1A**	
Pin	**Name**	**Description**	**Name**	**Pin**
PCN2-1	GND	E1 debugger Ground	VSS	B2
PCN2-2	RESET	Reset port	RESET	B5
PCN2-3	Tool0	Programming/Debugging Input port	P40/Tool0	A5
PCN2-4	VDD	E1 debugger power supply	VDD	B3
PCN2-5	TP1	User test point 1.	P10/ANI18/SCK00/SCL00	E3
PCN2-6	TP2	User test point 2	P11/ANI20/SI00/SDA00	D3
PCN2-7	TP3	User test point 3	P20/ANIO/AVREFP	E1
PCN2-8	TP4	User test point 4	P12/ANI21/SO00/TxD0	D1

4.Installation and operation

4.1 Getting Started

The *YRL78IOLINKMAX* board comes already flash programmed with a demonstration of an IO-Link sensors applications sample program.

The Quick Start Guide supplied on the downloadable Starter Kit Installer as a PDF file, takes the user through the software installation procedure.

The Installer creates a “Renesas Electronics Tools” repository for the YRL78IOLINKMAX in the Host PC’s “All Programs” startup folder.

From this location, the user is able to find and open all documentations, and sample Program workspace provided with the kit.

The IAR Embedded Workbench including the C-SPY debugger allows building and downloading application programs to the *YRL78IOLINKMAX* board.

Additionally, the Renesas FLASH programming software can be used for simple FLASH programming of the RL78/G1A’s internal FLASH memory.

4.2 Installed Contents

The downloadable Starter Kit Installer shows the following directory structure:

Table 4-1.*YRL78IOLINKMAX* Downloadable Starter Kit Installer contents

YRL78IOLINKMAX	Description
acroread	Acrobat Reader for Windows OS
Demo Sample Device	Demo Firmware and IODD files
Doc	Datasheets, Manuals, Stack License, board Schematics
IAR	IAR Embedded Workbench for RL78
Quick Start Guide	*YRL78IOLINKMAX* quick start guide
Renesas Flash Programmer	Flash Programmer for RL78/G1A
SampleProgram	Sample project for IAR and IODD for the Starter Kit • IO-Link Ambient light sensor demonstration Project

4.3 IODD Device Description Files Installation

Two IODD files are provided:

- The IODD repository for the Demo sample Device is located in the folder of the same name.
- The IODD repository for the IAR sample project is located in the Sample Program folder.

To install the IODD Device Description file for the *YRL78IOLINKMAX* board, import the corresponding XML file in your IO-Link device tool.

An IODD file version 1.1 is provided as well as a version 1.0.1 for older IO-Link Master systems. Please use the appropriate IODD for your system.

5.Renesas Flash Programmer Usage

The following section describes how to set up and use the Renesas Flash Programmer interface (RFP) with the *YRL78IOLINKMAX* kit.

5.1 Hardware Setup

Before connecting the board to the E1 debugger, please connect the debugger to the host PC. It will be automatically detected and the appropriate drivers will be installed.

Once the E1 debugger is installed, connect the board as pre figure below.

Figure 5-1 *YRL78IOLINKMAX* Flash Programming setup

5.2 Software Setup

The Renesas Flash Programmer (RFP) is deployed during the software installation process, or they can be found on the Downloadable Starter kit Installer.

The RFP has been installed in the default location.

- Start Menu =>
- All programs =>
- Renesas Electronics Utilities =>
- Programming Tools =>
- Renesas Flash Programmer V2.04 =>
- Renesas Flash Programmer V2.04.exe
- Double click on the file name to open the application. (Note that Windows Vista and 7 users may have to use “Run as administrator”) and the opening screen should open as in Figure 5-2 below.

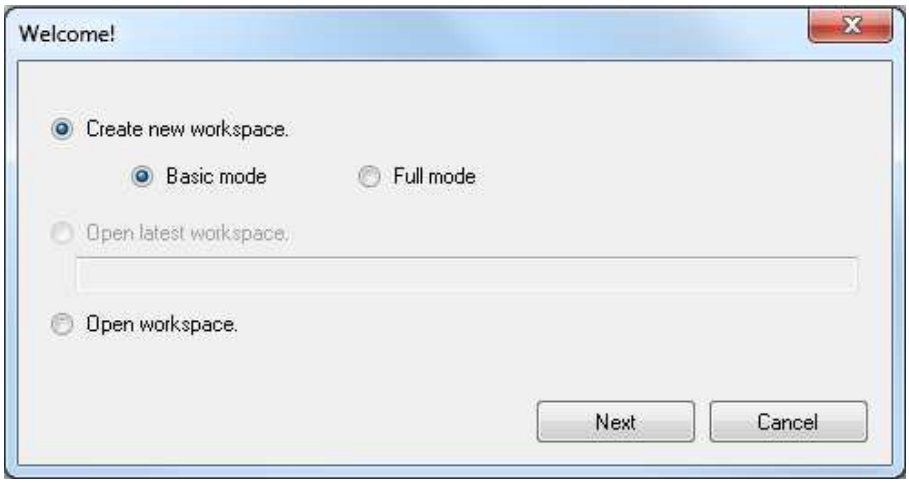

Figure 5-2.RFP start-up screen

- Click the "Next" button to start the set-up process.

5.3 Workspace Creation

- Press the Microcontroller drop down tab on the new screen displayed, and select the RL78 option. This should now show all the RL78 devices.

The kit supports the RL78/G1A.

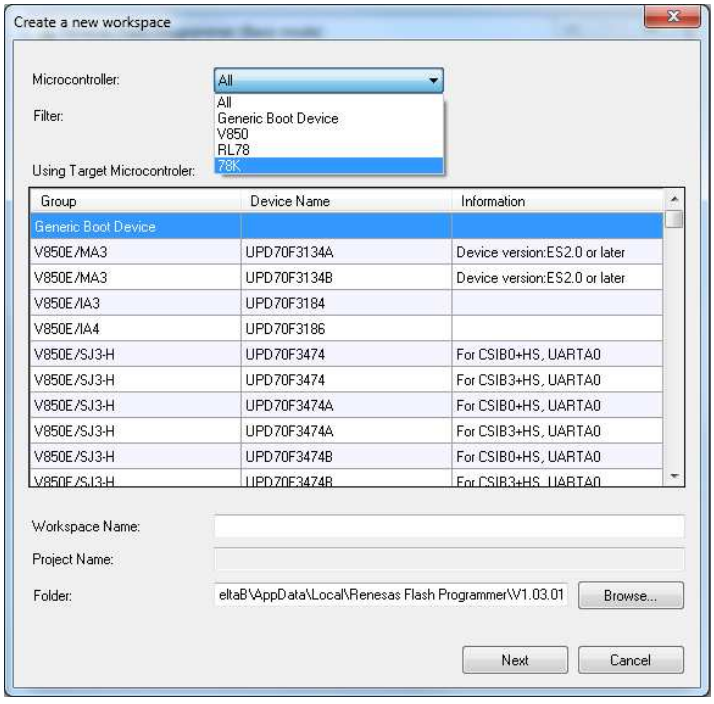

Figure 5-3.Workspace creation

Select the following settings:

- Use the filter to find and select RL78/G1A as Target Microcontroller, or enter the part number R5F10E8E in the filter section.
- Enter the RFP workspace name.

- Select a location to save the RFP workspace files (use the browse button).
- Press the OK button.

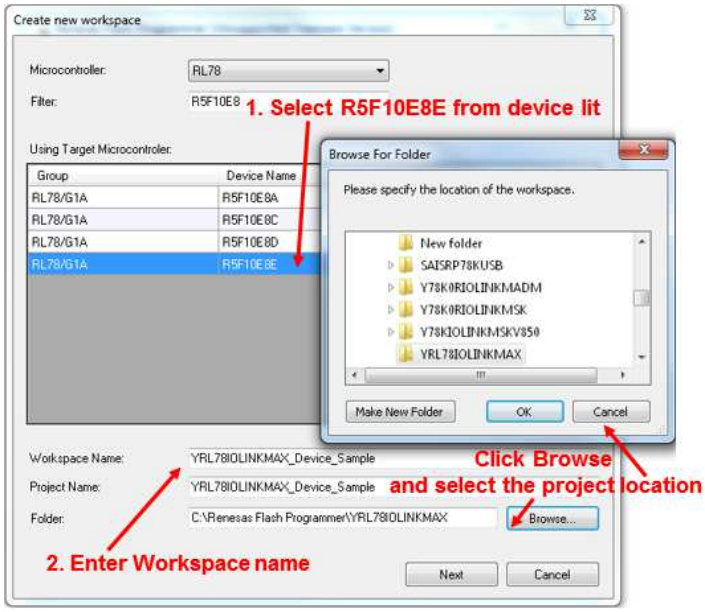

Figure 5-4.Project setup

- Press the "Next" button to select the communications interface.

5.4 Communication Interface Setup

- Make sure E1 is selected in the "Select Tool" drop down menu and press "Next".
- Keep the Target Device connection to default setting and press "Next".

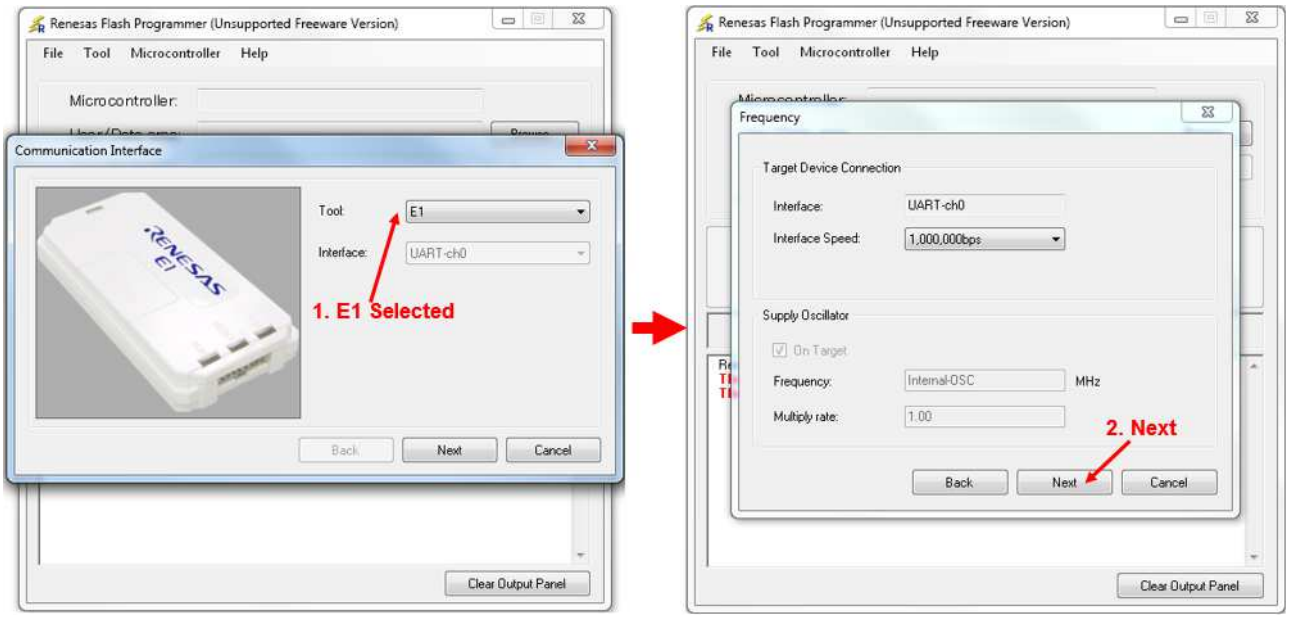

Figure 5-5.Communication interface setup

5.5 Target Power Supply Setup

- Tick the box to enable the Power supply from the emulator (3.3V).
- Press the "Next" button to complete the set-up.

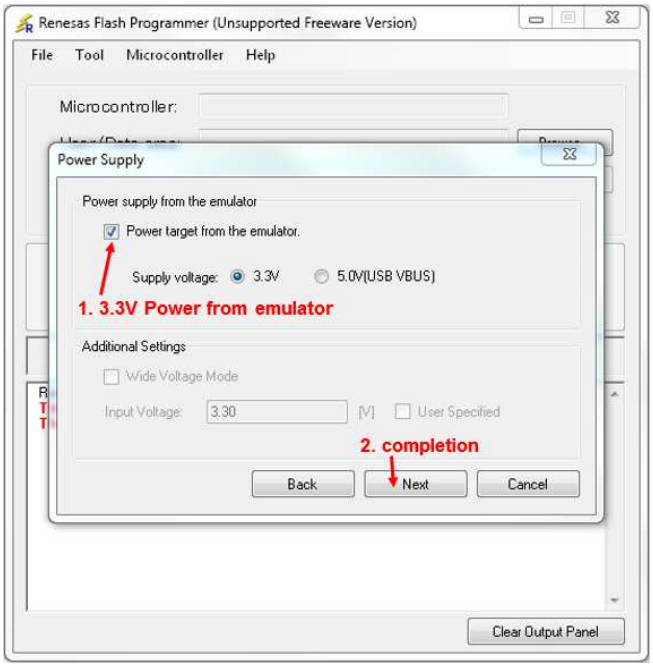

Figure 5-6.Target Power Supply setup

A status screen opens as shown below.

- Press the "Complete" button to finish the setup procedure.

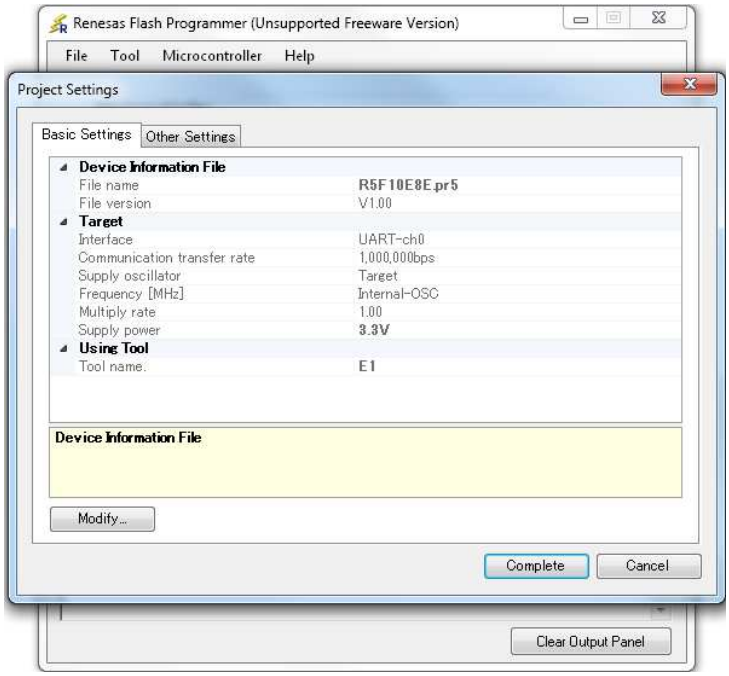

Figure 5-7.Information setting display

5.6 Firmware Selection and Command Setting

The data file to be programmed needs to be selected.

- Press the "Browse" button and locate the ".a87" file to be programmed into the RL78/G1A.
- Follow the instructions to select the file. The file name should appear in the User/Data area as shown below.

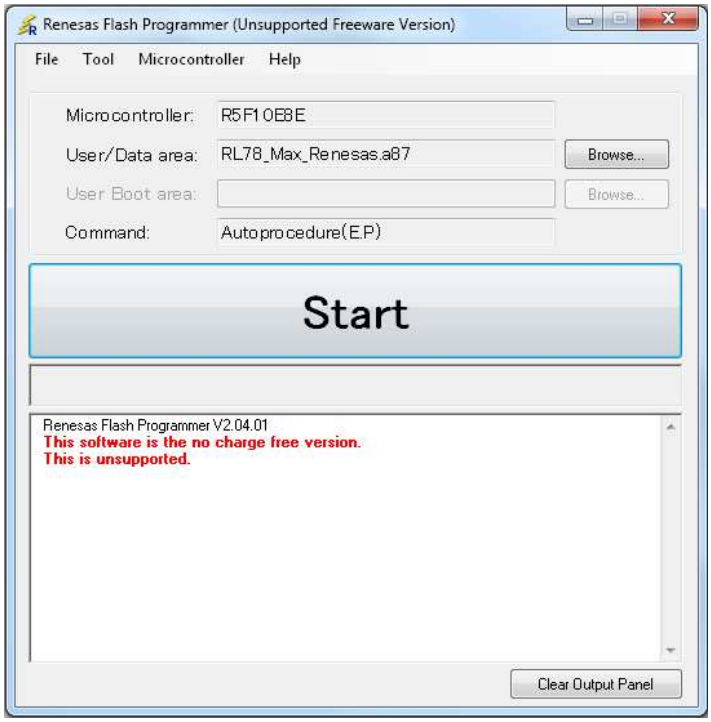

Figure 5-8.*YRL78IOLINKMAX* firmware selected

Next the command needs to be set.

5.6.1 Autoprocedure Command Setting

- Press the "Microcontroller" menu button and select the "Autoprocedure (E.P)" option.

The following sequence is executed when the "START" button is pressed.

- Blank Check the Device =>
- Erase the device if not blank =>
- Program the device with the Data file selected.

5.6.2 Blank Check" or "Signature Read" Command Setting

If the user is unsure of the use of the RFP process then a different command such as "Blank Check" or "Signature Read" can be performed. This confirms that the communication interface is working and that the RFP can connect to the RL78/G1A on the board without corrupting or damaging the device.

- Press the "Microcontroller" menu button and select the "Blank Check" or "Signature Read" option.
- Press the large "START" button to execute the command

The green LED turns ON as the emulator powers the board.

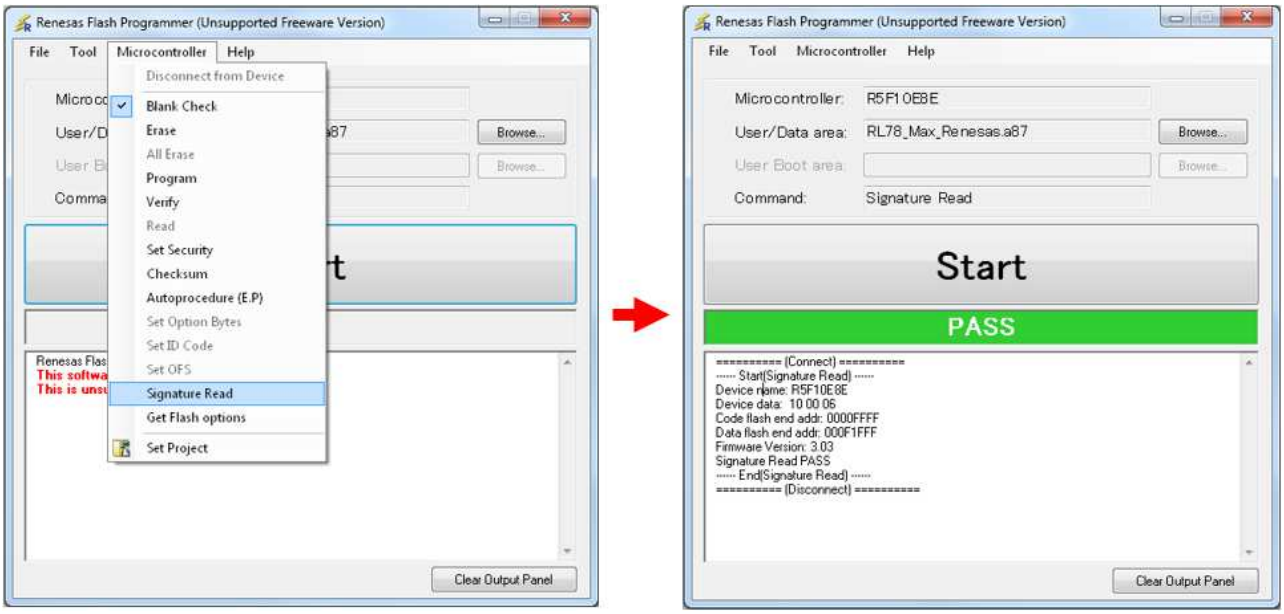

Figure 5-9 "Signature reading command execution

The RFP opens a progress bar and connect to the board and device. The results of reading from the device should be as shown below.

========== (Connect) ==========

------ Start(Signature Read) ------

Device name: R5F10E8E

Device data: 10 00 06

Code flash end addr: 0000FFFF

Data flash end addr: 000F1FFF

Firmware Version: 3.03

Signature Read PASS

------ End(Signature Read) ------

========== (Disconnect) ==========

If the execution is correct, the command can be changed to "Autoprocedure (E.P)" and the device can be programmed with the selected Data file.

5.7 *YRL78IOLINKMAX* Flash Programming

To download the Data file to the microcontroller:

- Select the "Autoprocedure (E.P)" option from the Microcontroller menu Press the "START" button.

The green LED turns ON as the emulator powers the board and the results should be as shown in Figure 5-10 below.

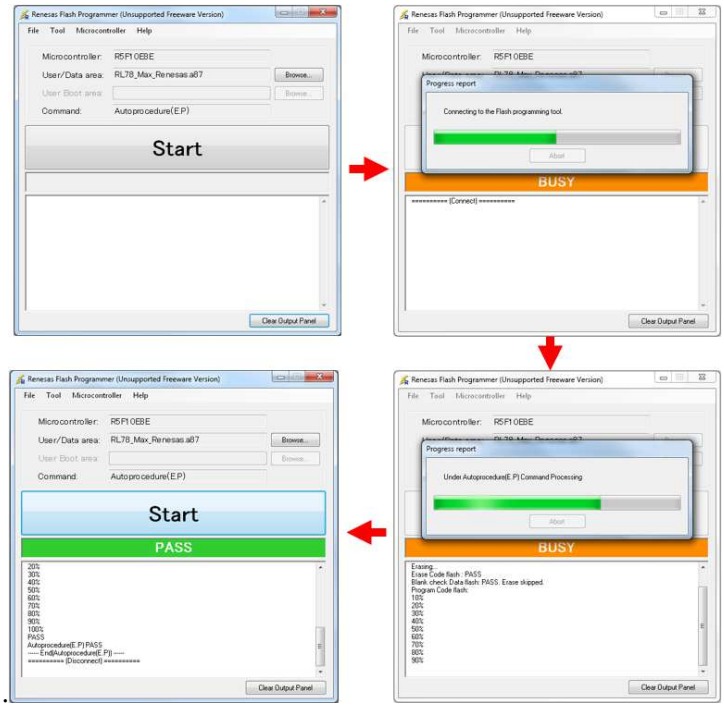

Figure 5-10.Autoprocedure execution

The full list of the progress and status is shown below.

```
========== (Connect) ==========
------ Start(Autoprocedure(E.P)) ------
Blank check Code flash: Not blank, Erase need.
Erasing...
Erase Code flash : PASS
Blank check Data flash: PASS. Erase skipped.
Program Code flash:
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
PASS
Autoprocedure(E.P) PASS
------ End(Autoprocedure(E.P)) ------
========== (Disconnect) ==========
```

6.On-Chip Debugging

The microcontroller on the *YRL78IOLINKMAX* board can be debugged using an E1 debugger connected to the sensor board via the programming/debugging adapter.

Figure 6-1shows the system configuration for debugging.

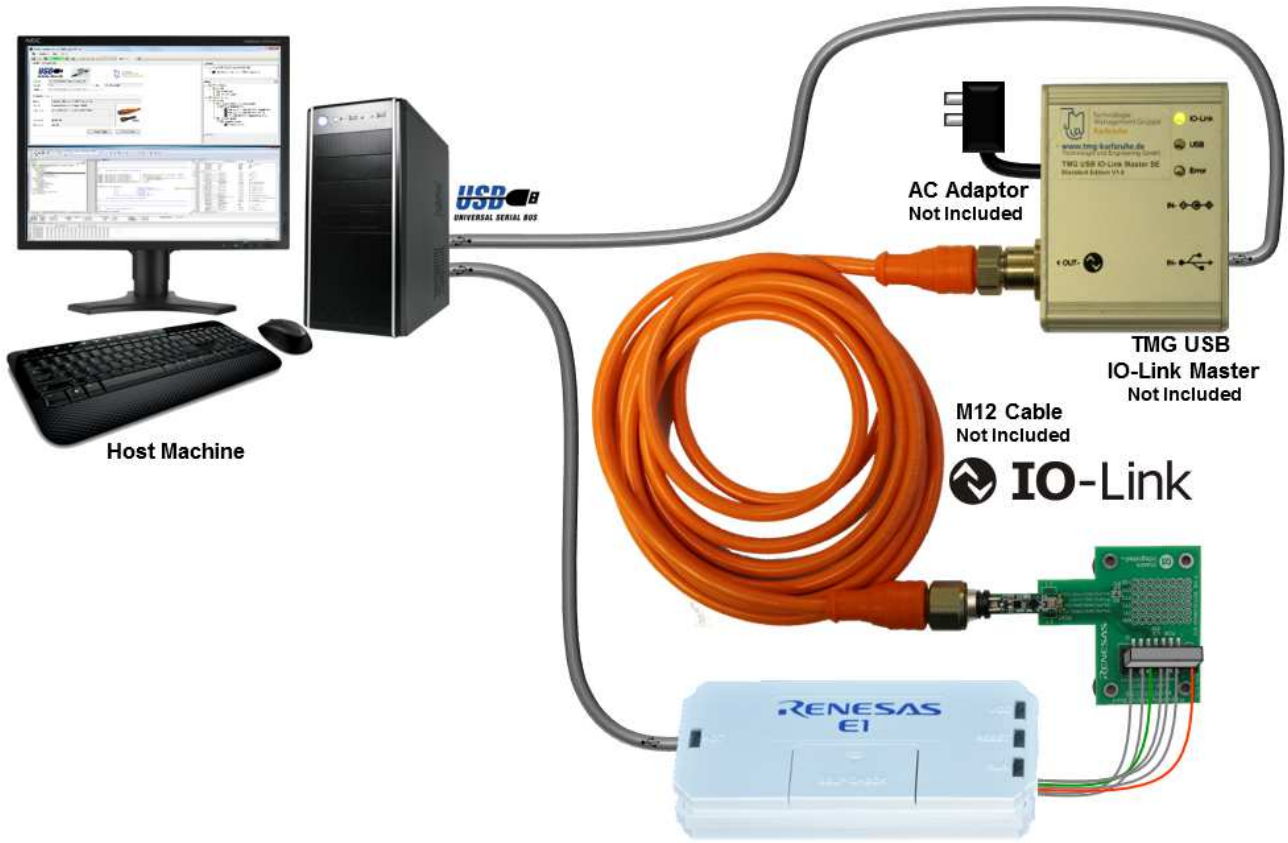

Figure 6-1.On-chip debugging system configuration

Note:

Before starting a debug session and powering the system, please ensure that the target power supply source is set properly in the debugger's hardware setup option.

If the microcontroller is powered via the M12 cable, the power supply setting in the debugger's hardware setup option must be set to "Target".

For more details on how to change this setting, please refer to section 8.1.4.

7.*YRL78IOLINKMAX* Sample Project

The IAR Embedded Workbench IDE is a very powerful Integrated Development Environment that allows you to develop and manage a complete embedded application project.

The project described in this section can be found on the *YRL78IOLINKMAX* downloadable Starter Kit Installer.

To run/debug the project with the IAR C-SPY debugger, it is necessary to follow the steps described below in this chapter.

Note:

The *YRL78IOLINKMAX* is shipped with the demo firmware programmed to the RL78/G1A's internal memory. Make sure the Flash memory is erased properly before the first project download to the target device. Please refer to chapter 5.for more details on how to proceed.

7.1 IAR Sample Project

Once installation is completed, the workspace file "RL78_Max_IAR_Ambient_SK.eww" can be located in the sample program directory on the host PC: C:\Renesas\Workspace\YRL78IOLINKMAX\SampleProgram.

The table below shows directory structure:

Table 7-1 Directory structure example

Ambient light_Demo	***YRL78IOLINKMAX* project and output files**
Firmware	C header and source files
Stack	IO-Link device stack and header files
Debug	debug output files for IAR C-SPY debugger
Release	release output files, i.e. Intel HEX file
settings	configuration files, IAR Embedded Workbench
RL78_Max_IAR_Ambient_SK.dep	dependency information file, IAR Embedded Workbench
RL78_Max_IAR_Ambient_SK.ewd	project setting file, IAR C-SPY debugger
RL78_Max_IAR_Ambient_SK.ewp	project file, IAR Embedded Workbench
RL78_Max_IAR_Ambient_SK.eww	workspace file, IAR Embedded Workbench RL78

All source files are located in the `\Firmware` directory. The `\Stack` directory contains the IO-Link stack library and the board support package files.

The sample project uses two targets:

- One target is the "Debug" (directory `\Debug`), which holds all information for debugging purpose.

- The other target is the “Release” target (directory \Release), which contains the programmable file, i.e. the Intel “.a87” file, for programming the RL78/G1A internal FLASH memory via the E1 Debugger.

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

7.2 Ambient Light Sample Project

The *YRL78IOLINKMAX* sample project for IAR demonstrates the TMG IO-Link stack on RL78. The stack library provided included all 7 layers functionalities of the IO-Link specification. Functionality such as data storage or block parameterization is part of the application. However for simplicity, the sample code provided does not support these features.

For further details on the IO-Link stack and how to setup the library parameters, please refer to the “QuickStartGuide IO-Link DeviceStack Library v1.1.pdf” and “UserManual Device Software.pdf” documentations.

The sample code project implements an ambient light sensor. The user can teach the ambient light intensity limit to the sensor using the parameterization feature in the IO-Link Device tool.

For further details on how to teach the sensor please refer to section 9.4.

The table below displays the sample program’s characteristics.

Table 7-2 Sample Program Characteristics

Characteristics	Description		
Vendor ID	0x018C		
Device ID	0x18C004		
IODD V1.1	Renesas-YRL78IOLINKMAX-V2-SK-20140612-IODD1.1.xml		
IODD V1.0.1	Renesas-YRL78IOLINKMAX-V2-SK-20140612-IODD1.0.1.xml		
IO-Link Version	V1.1, compatible to V1.0		
Software	TE GmbH		
SIO Mode supported	Yes		
PIN 2	as digital out (2nd channel) Controlled from the IO-Link master via the process output bit		
Pin 4	In SIO Mode Pin4 will show the ambient light switch point		
IO-Link Mode	Process Data:		
	Inputs (16 Bits)	Ambient light	14Bit Value (bit offset = 2)
		Switch Points	Booleans (packed)
		Ambient Light above limit	
		PD out bit	mirror of the output bit
	Outputs (8 Bits)	PD out bit	Boolean
		only active, if Pin2Mode = “digital output”	
Device specific parameters	V_AMB_Clear (ro)	measurement value	
	V_Clear_Limit (rw)	can be set by the tool or PLC function block or taught with the teach command	
Commands	Reset to factory settings		
	Teach Ambient Light Limit (V_Clear_Limit)		

8.IAR Embedded Workbench

8.1 *YRL78IOLINKMAX* Sample Project Setup

- Start the Embedded Workbench from Windows: “Start” menu > “Programs” > folder “IAR Systems” > “IAR Embedded Workbench for Renesas RL78”.

The following screen appears:

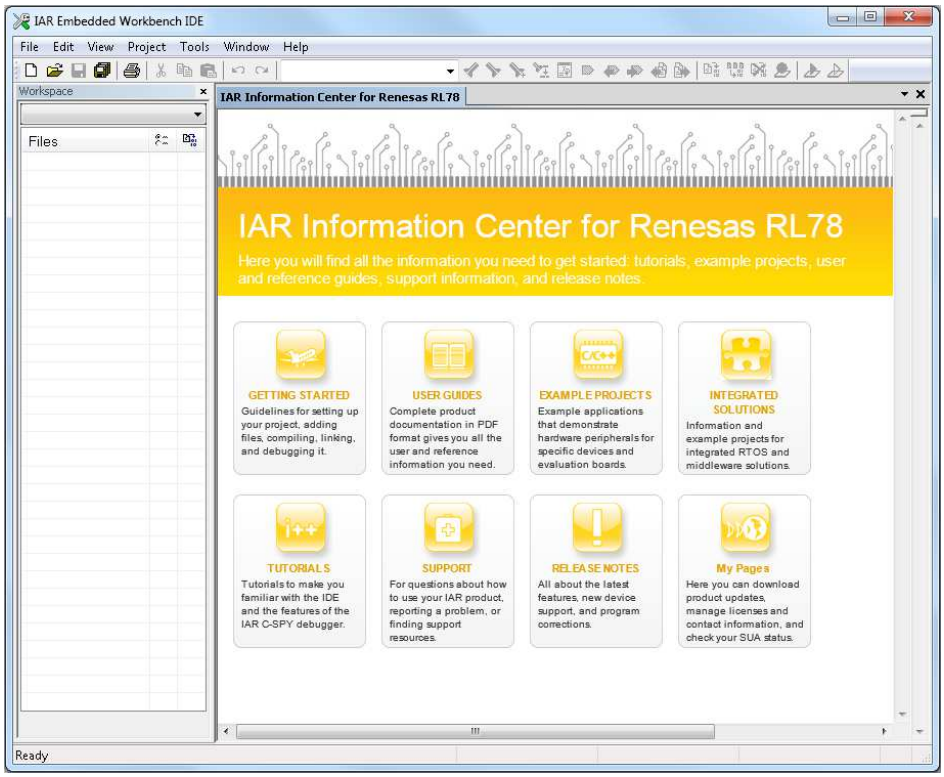

Figure 8-1.IAR Embedded Workbench Startup window

8.1.1 Project Loading

In this window you are able to choose the Open existing workspace button.

- Now select the option “Open exiting workspace” from the “File” menu and locate the sample project. Open the RL78_Max_IAR_Ambient_SK.eww workspace file. This workspace file contains general information about the demonstration projects and settings.

After the demo workspace has been opened, the project contained in the workspace is displayed.

- Click on the little “+” sign next to the “RL78_Max_IAR_Ambient_SK” project to show files part of the project.

The IDE should look similar to the following Figure 8-2.

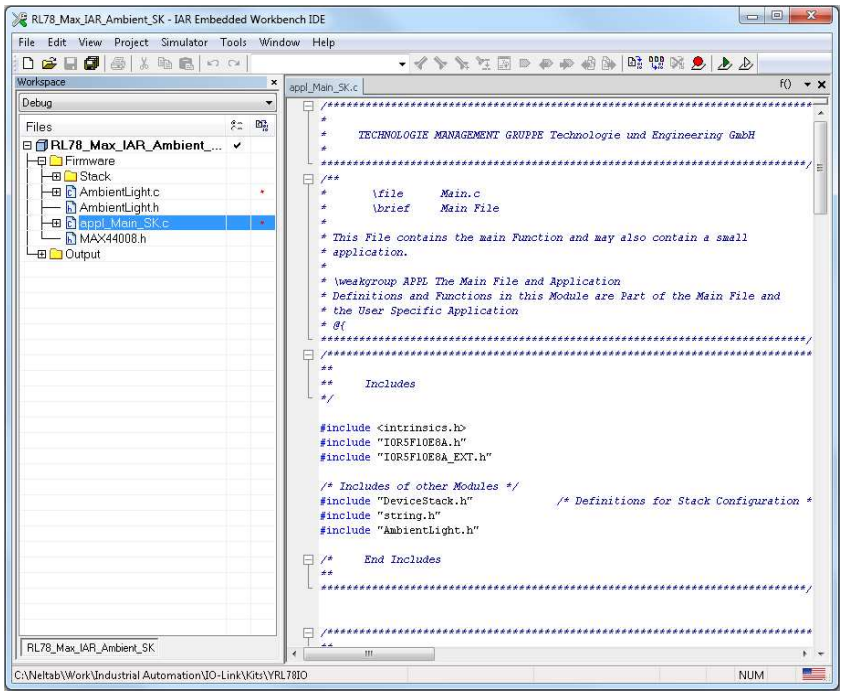

Figure 8-2.IAR Embedded Workbench Main IDE window

8.1.2 Debugger Interface Option Checking

- To verify that the right debugging interface is selected, please open the project options window by clicking **Project →Options** and then open the tab **Debugger**.
- Then from the drop down menu select the “E1” interface driver as shown below.

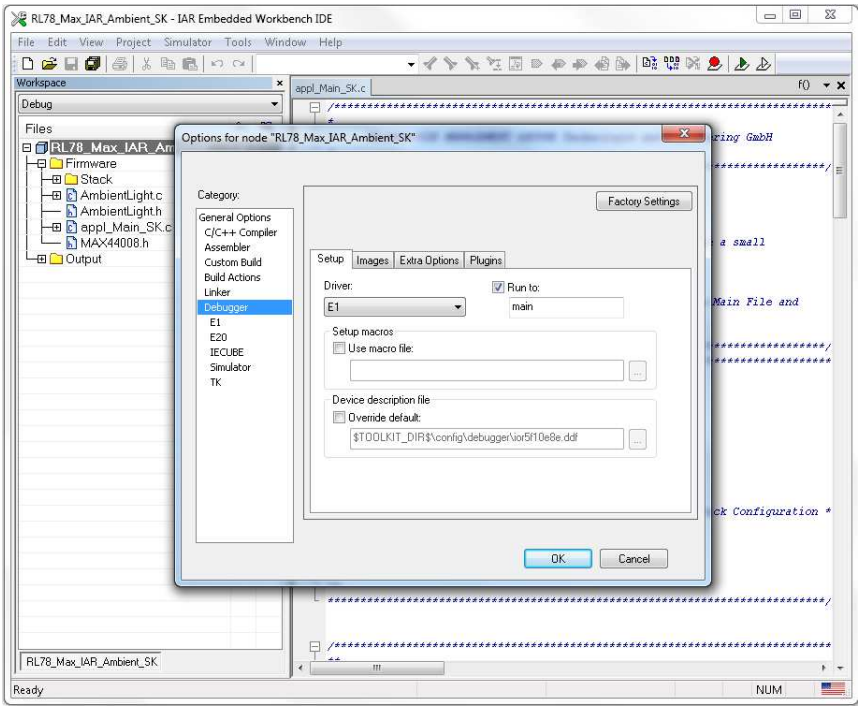

Figure 8-3.IAR Embedded Workbench Debugger Options

- Press the “OK” button.

8.1.3 Project Compilation

Once the setup is completed, it's time to build and link the demonstration project.

The necessary settings have been set in the IDE, so that it is not necessary to configure or make changes to any of the build options. These can obviously be viewed for reference, just select the "Options" menu as described above.

Caution:

It is recommended that no changes are made to any of the build settings as the resulting build results could not be guaranteed.

The project can be built from the build ICON in the workspace Ribbon or from the "Rebuild All" option in the "Project" drop down menu.

The project should build without errors. Some warnings (Warning [w15]) regarding predefined sizes in library may be displayed. These warnings can be ignored. Thereafter, the program can be downloaded to the *YRL78IOLINKMAX* board and debugged.

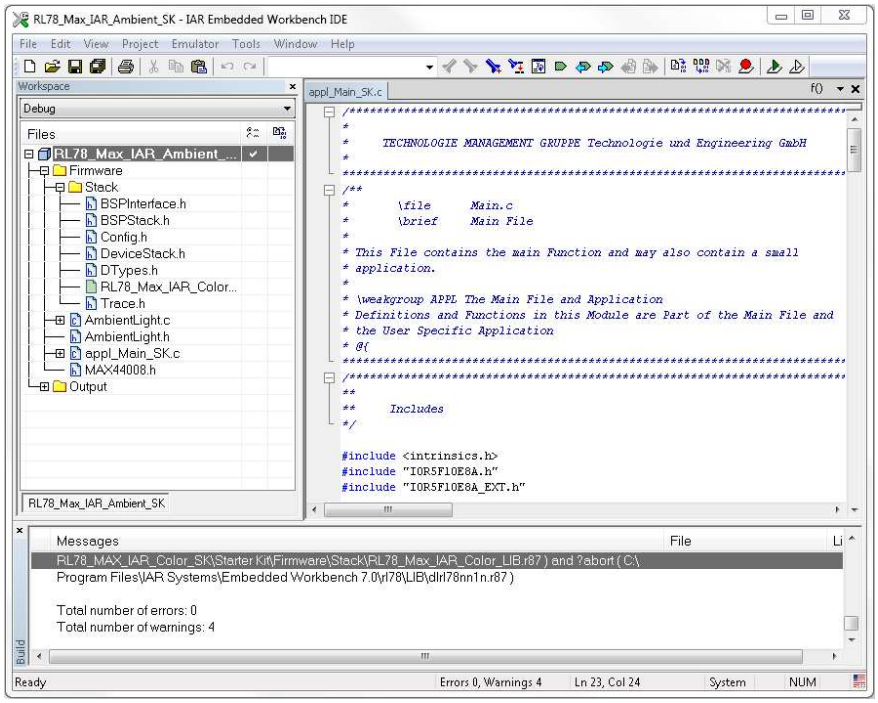

Figure 8-4.Project build successful

8.1.4 Debugging Session Start

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

When starting the debugger connection for the first time after building the project, it is necessary to set up the right connection settings. Please take care that the following settings are chosen:

ID code = FFFFFFFFFFFFFFFFFFFF

Main clock = External 18.432 MHz

Sub clock = None

Target connect = TOOL0

Power Supply = 3V

The E1 Hardware setup should look similar to the Figure 8-5 below.

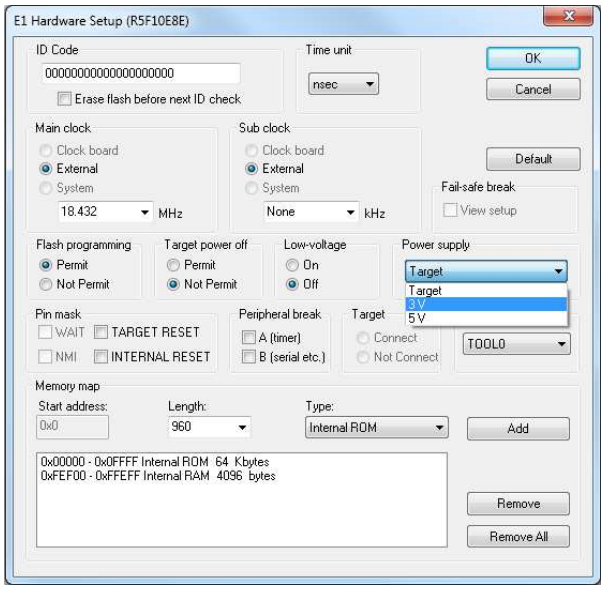

Figure 8-5.IAR Embedded Workbench debugging interface settings

Note

If the microcontroller is powered via the M12 cable, the “Power supply” setting in the debugger’s hardware setup option must be set to “Target”.

- Press the “OK” button.

Once the “OK” button is pressed, communication is established with the board and the demo project is downloaded to the *YRL78IOLINKMAX* board. The progress of downloading displayed on screen. Please note that downloading of larger executable may take some time.

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

Please note that the debugger window may contain different settings. The user can configure the debugging environment by closing unwanted debugging function windows and opening new windows via the “View” drop down menu.

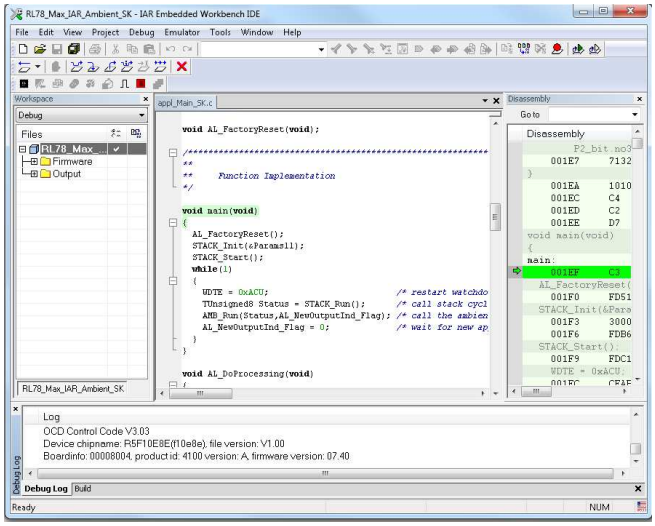

Figure 8-6.IAR C-SPY debugger

Other debugging windows can be opened to “watch variables, monitor registers, view the Stack, memory etc.

These can be selected by using the “View” menu tab at the top of the workbench and then selecting the required debugging function.

Please note that there are some other debugging function such as “Events” that are located under the “Emulator” tab.

Data is held for all debugging options whether displayed or not, so that windows can be opened or closed as required to make the management of the workspace and the data viewed clearer.

Software breakpoints can be set in the C source or assembler windows by simply double clicking on the source code line or the in the appropriate window. (Other methods of setting software breakpoints by “right clicking” the mouse button or using the pull down menus are available).

The main debugging control functions are shown below. Other debugging functions are disabled in this mode

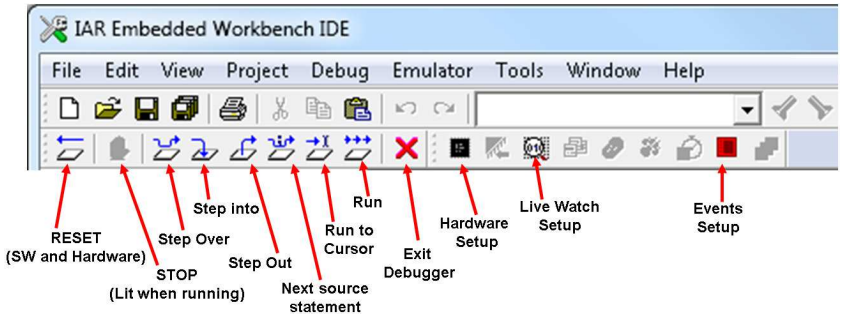

Figure 8-7.IAR C-SPY main debugging control functions

For a full explanation of all debugging options, please use the full documentation included in the IAR installation. These can be accessed via the help menu button in the embedded workbench IDE.

8.1.5 Modifying E1 Emulator Hardware Setup Setting

The user is requested to check the “Hardware Setup” only once: before the first debugging session.

Subsequent debugging sessions are launched automatically with the same settings, once the project build up is done, and download is completed.

To change the Hardware setup settings before a debugging session, follow the steps below before clicking on the “Download and Debug “button.

- From the menu bar, expand the “Emulator” Tab.
- Left click to select “Hardware Setup…”.

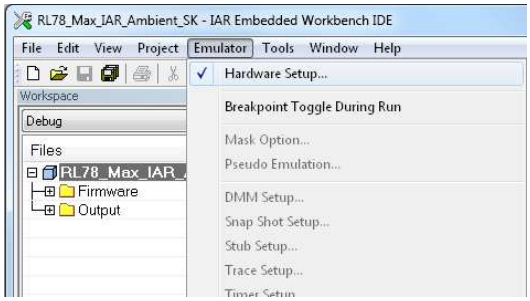

Figure 8-8.Emulator Hardware Setup

The next time when the “Download and Debug “button is pressed, the “E1 Hardware setup” window will open.

9.IO-Link Ambient Sensor Demo Sample

The *YRL78IOLINKMAX board* is shipped with a demo pre-programmed to the microcontroller. This demo exhibits all the sensor features available on the platform. To play with the demo, another tutorial manual is provided explaining how to use the board with the demo.

The present chapter addresses only the use of the YRL78IOLKMAX board with regards to the ambient light sensor project.

For the purpose of this demo the TMG USB IO-Link Master has been used. The screenshots in the following sections are those of the TMG device tool software, operating with the TMG Master device.

If you have the TMG Master device, an IODD device description file for the *YRL78IOLINKMAX* board demo is installed on the host PC by the downloadable Starter kit Installer.

The IODD can be found in the starter kit workspace, under The “IODD” folder of the SampleProgram repository.

- IODD file name: Renesas-YRL78IOLINKMAX-V2-SK-20140612-IODD1.1.xml

Once the Device tools software has been updated, the *YRL78IOLINKMAX* board can be controlled from the software GUI.

For further details please refer to **section 9.2 Using *YRL78IOLINKMAX* Board Demo with TMG IO-Link Device Tool.**

- Connect the IO-Link Master to the host computer. The *YRL78IOLINKMAX* board should be now connected to the Master via the M12 cable see Figure 9-1.

Remark

If you do not have the TMG USB IO-Link Master, and your equipment does not support the IODD description file, please refer to the “QuickStart Guide IO-Link Device Stack library” installed by the Starter kit Installer for a list of indexes referring to the application’s process-data and parameters accessible through IO-Link.

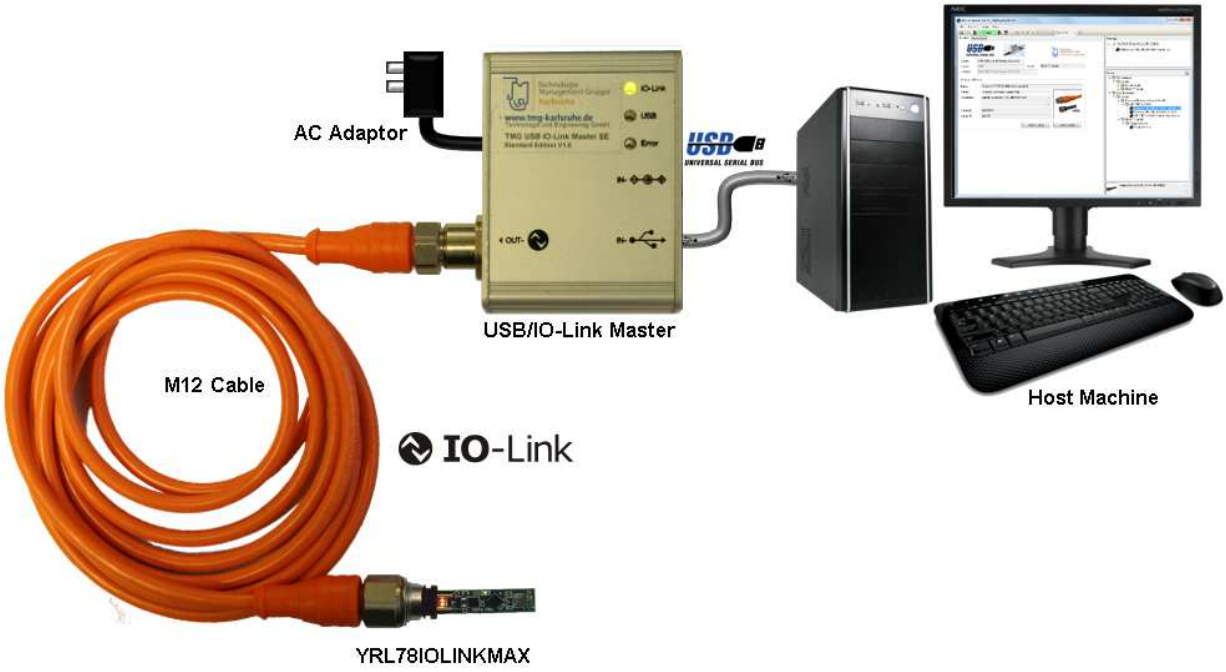

Figure 9-1.YRL78IOLINKMAX Ambient light sensor demo setup

9.1 Demo Features

The sensor continuously measure the ambient light and transmits the information via the IO-Link process data.

The user can set an intensity limit, which can be used to detect the presence of an object or a given ambient light condition.

When the measured ambient light is over the limit set by the user, the Red LED on the board turns ON as a visual indication.

9.2 Using *YRL78IOLINKMAX* Board Demo with TMG IO-Link Device Tool.

The IO-Link device tool can be used for the configuration of IO-Link Masters, setting and steering parameters as well as the diagnosis of IO-Link devices.

The IO-Link Master initiates the communication, and channels information from the board to the host machine. The operator is able to see the information on the host machine via the installed IO-Link Device Tool.

9.2.1 Getting Started with the TMG Master:

- Launch the IO-Link device Tool.

Once the tool is up and running, two panes can be seen in the GUI (Topology at the top left, and Catalog on the right) see Figure 9-2 below.

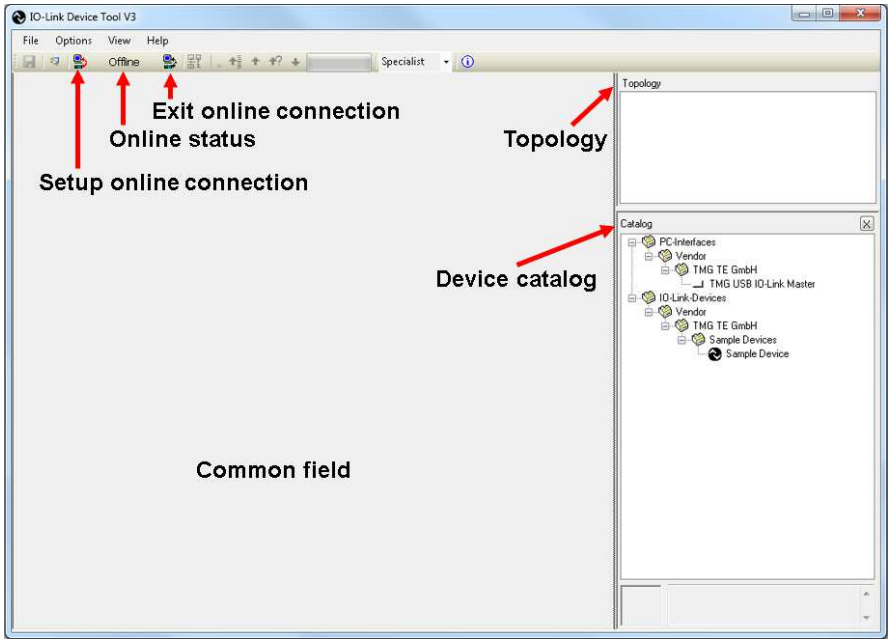

Figure 9-2.IO-Link Device Tool GUI

The topology pane shows the topology from the PC interfaces to the IO-Link Devices.

The Catalog pane shows all the Devices installed with the tool.

On the symbol bar, two icons (setup/exit online connection) allow to set the IO-Link line status.

When the line is Online, the “Online status” symbol will blink green with the symbol “online”.

The common field is currently blank but it will display the description of the devices present in the Topology view.

9.2.2 Updating the IO-Link Device Catalog

Before the *YRL78IOLINKMAX* can be displayed in the device tool, the IO-Link devices catalog must be updated

- In the menu bar select “Options” then “Import Device Description“.

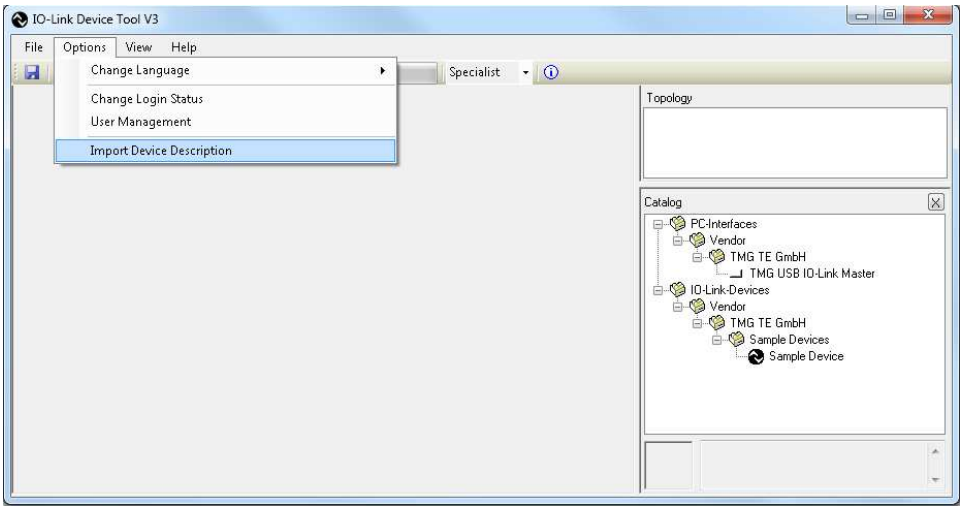

Figure 9-3.Catalog update

A new window opens, in which you can browse your PC to find the Renesas-YRL78IOLINKMAX-V2-SK IODD file.

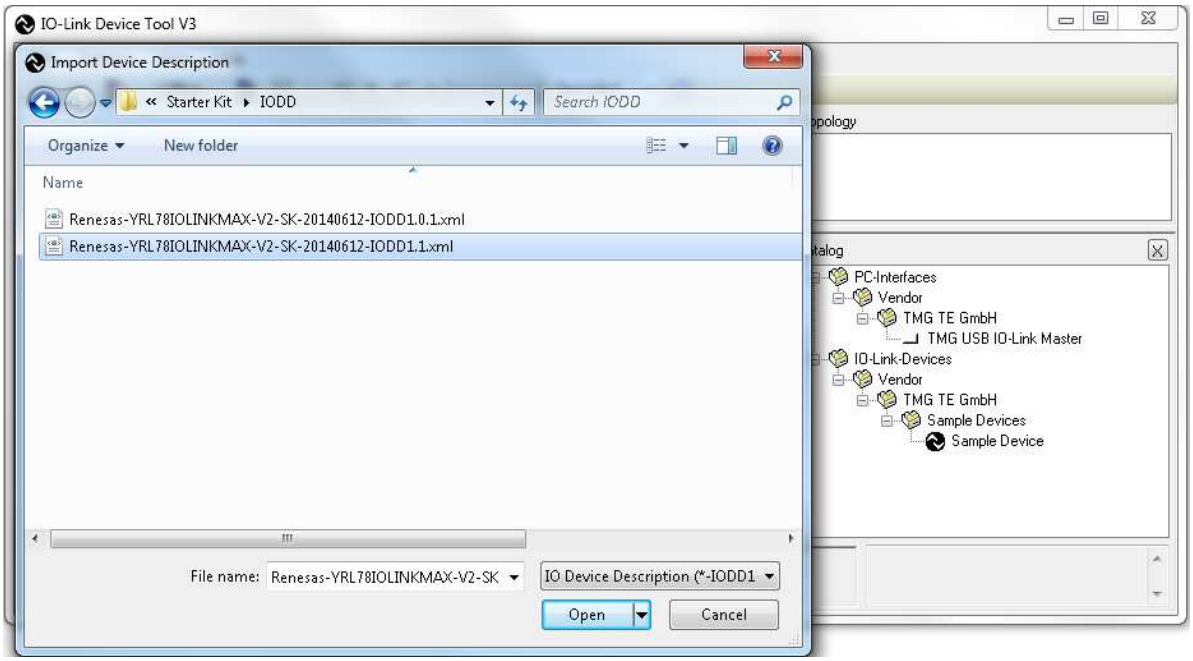

Figure 9-4.Import Device Description

- Press the open button.

9.2.3 Catalog Update Confirmation

A successful update shows the Renesas Electronics Europe GmbH vendor and the *YRL78IOLINKMAX* SK, in the IO-Link Devices section of the catalog.

The TMG USB IO-Link Master can also be seen under PC Interfaces section of the catalog.

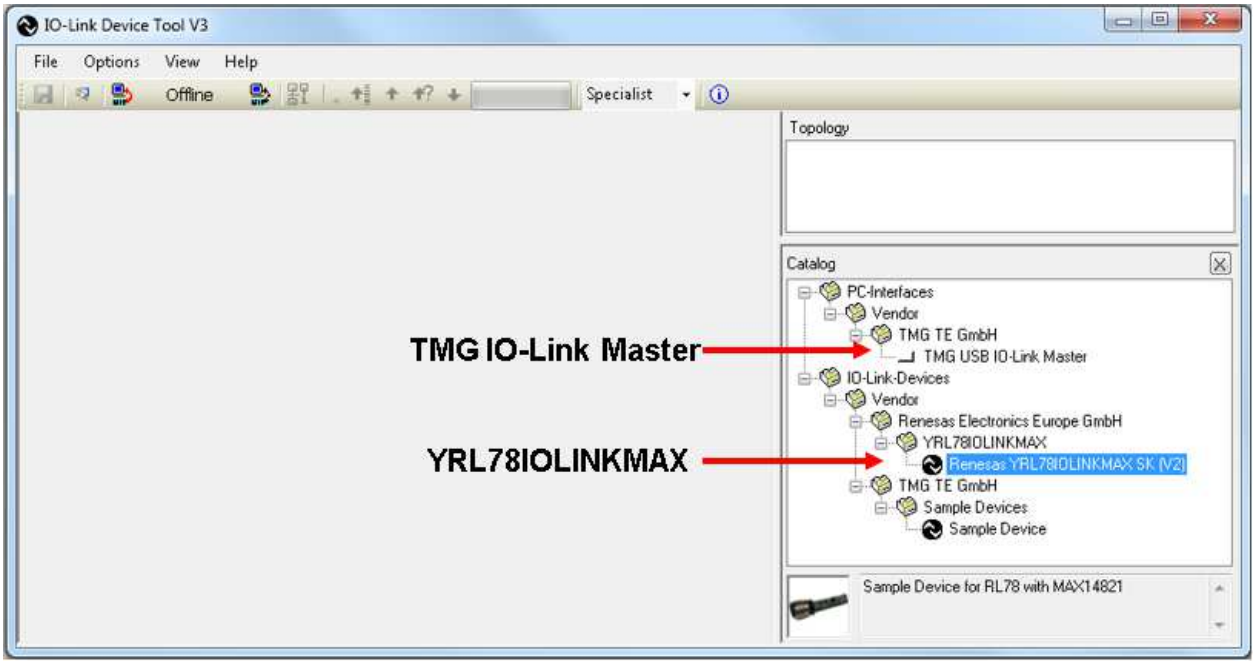

Figure 9-5.*YRL78IOLINKMAX* in Device catalog

9.2.4 IO-Link Communication Set-up

- From the Catalog pane, drag and drop the TMG USB IO-Link Master into the Topology pane.
- Left click on TMG USB IO-Link Master DE in the Topology pane, and the IO-Link Master's details can be seen in the Common pane (left section of the GUI).

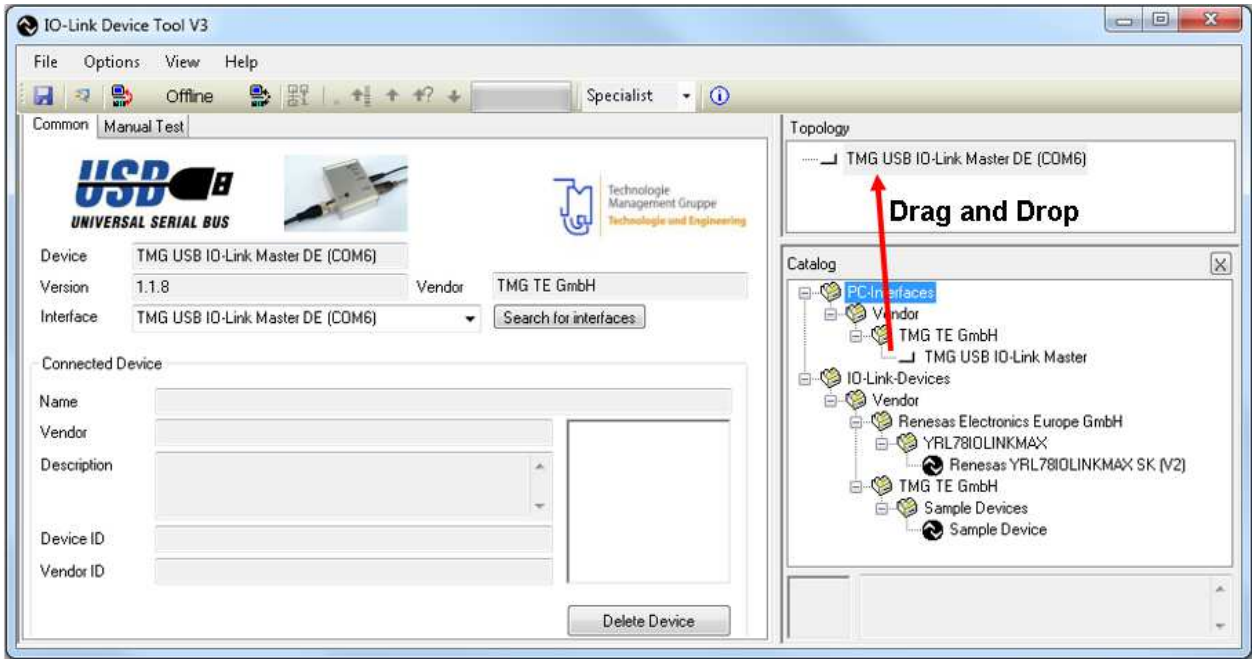

Figure 9-6.TMG USB IO-Link Master

- Left click on the "Setup online connection" icon in the Device Tool GUI, shows the "Check Config" button within the "Connected Device" area, of the Common section.

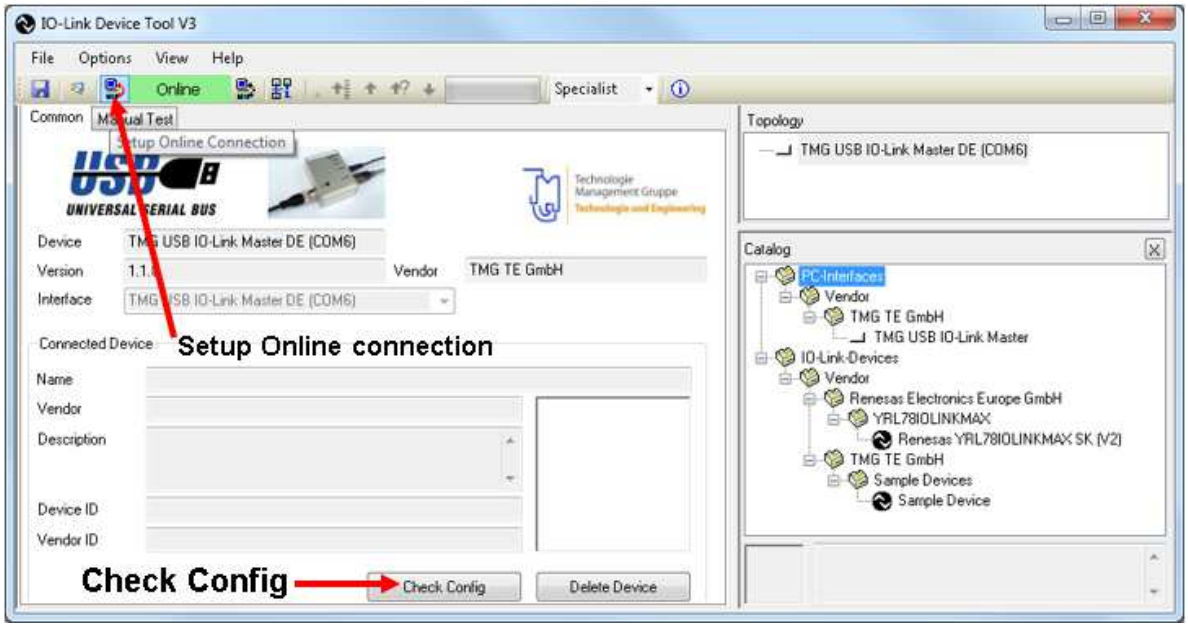

Figure 9-7.Online status, Check Config

- Click on the "Check Config" button.

The LEDs on the Master blink as the Master tries to connect to the *YRL78IOLINKMAX board.*

If the *YRL78IOLINKMAX board* is working and the Master can connect to it, a small window shows up with information on the board and a “Take over type of device(s) into engineering” button. See following Figure 9-8.

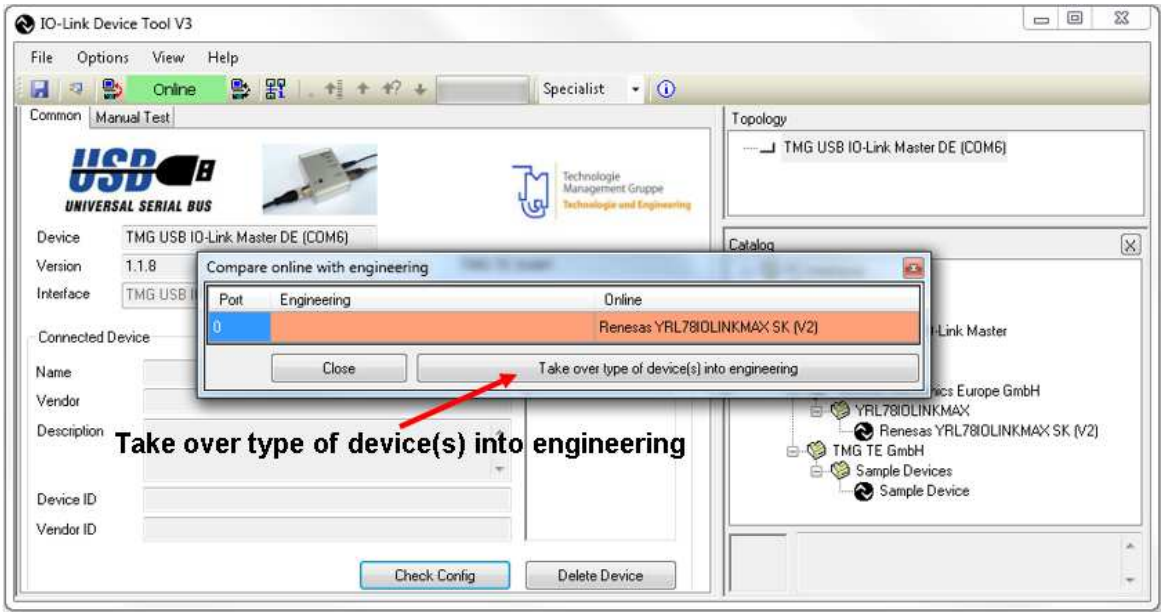

Figure 9-8.Check Config successful

If the Master cannot connect to the *YRL78IOLINKMAX* board, a window with an error message “can’t read configuration” or an empty “Compare with Engineering” window will appear. See following figure

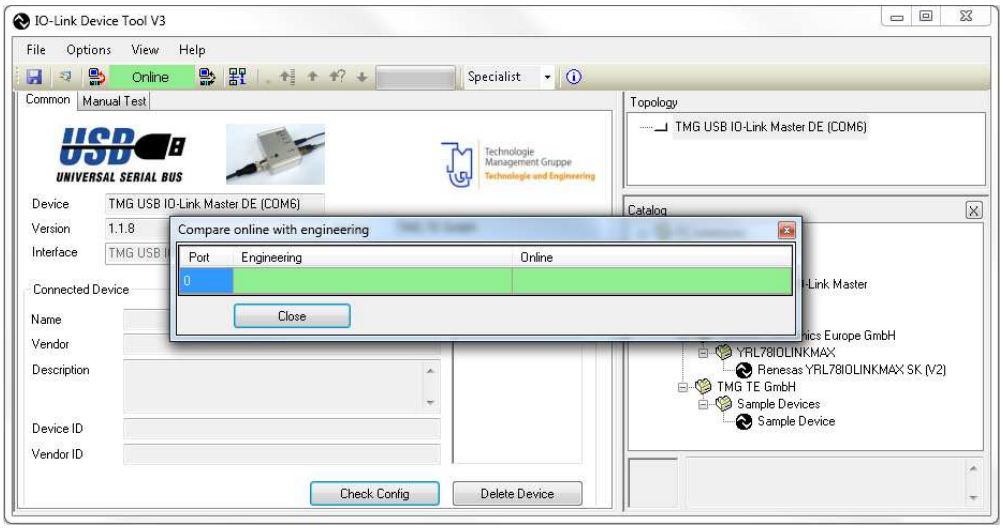

Figure 9-9.Check Config failure

Caution

It can happen that the "can't read configuration" message appears in the Device Tool when the Master is not properly initialized. Unplugging the Master from the USB port of the host machine and re-starting the Device tool solves this problem. Also please check that the *YRL78IOLINKMAX* board is properly connected and powered by the IO-Link Master. The external power supply adapter provided with the TMG USB IO-Link Master must be used for this purpose.

Other possible sources of malfunction could be a blank microcontroller, or faulty IO-Link communication channel.

- Click on the "Take over type of device into engineering" button.

The *YRL78IOLINKMAX* board now appears under the TMG USB IO-Link Master DE in the topology pane, and details on the board can be read in the Common pane.

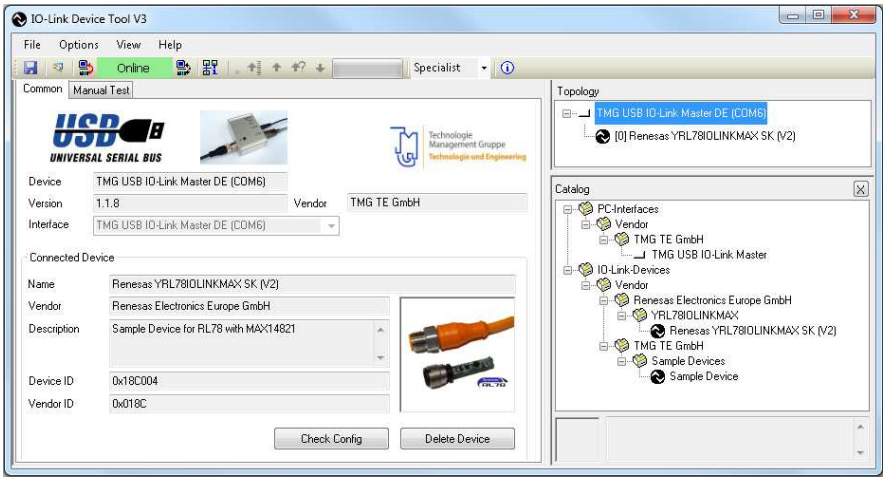

Figure 9-10.IO-Link communication active

The IO-Link communication is now active and we can have a closer look at the device and the sensor application running on the board.

The Common pane provides information on the connected device such as:

Device name: Renesas YRL78IOLINKMAX SK; Device ID: 0x18C004; Vendor name: Renesas Electronics Europe GmbH; Vendor ID: 0x018C; Picture of the Io-Link device connected to the Master.

9.3 *YRL78IOLINKMAX* Board Sensor Demo in IO-Link device tool

In this section we see how the *YRL78IOLINKMAX* board works with the IO-Link Master and how the demo's features explained earlier can be used from the IO-Link Device tool GUI.

- Left click on the *YRL78IOLINKMAX* in the topology pane to display generic information on the board in the Common pane.

Next to the Common tab, two other tabs can be seen (Process data and Parameter). See figure below

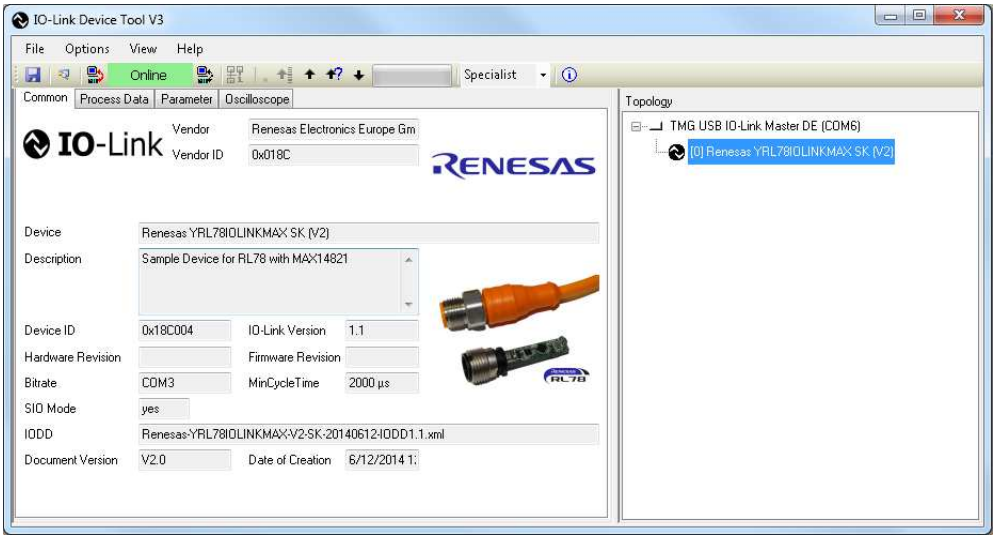

Figure 9-11. *YRL78IOLINKMAX* SK (V2) in device tool

9.3.1 Common Tab

The Common pane provides information on the device such as:

Picture of the device; Device name, Product ID, Device ID, vendor name; Hardware and firmware revision; Device description file, its version and date of creation; Device version; IO-Link version.

9.3.2 Process Data Tab

The Process data tab displays the sensor measurements (raw process data inputs from the sensor).

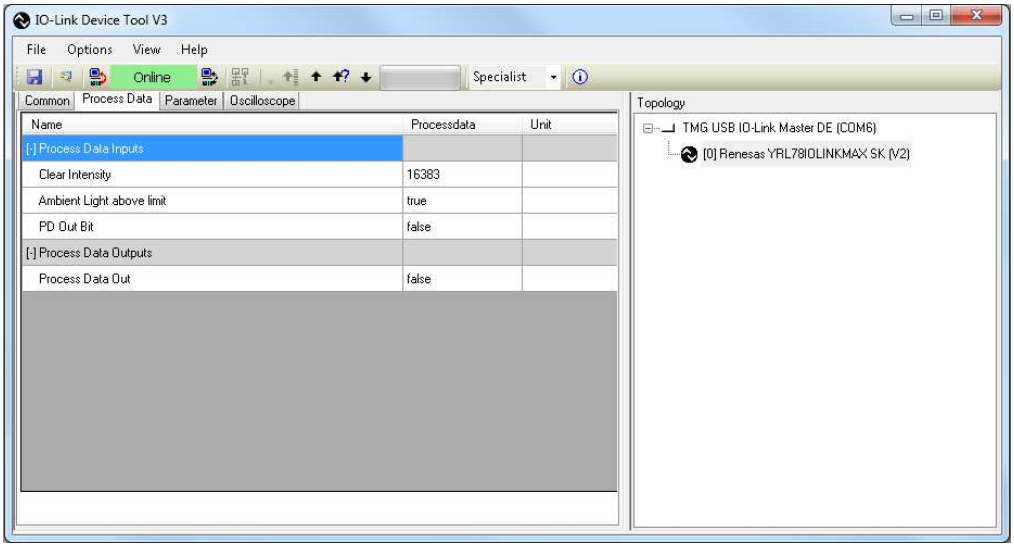

Figure 9-12. *YRL78IOLINKMAX* SK (V2) Process data

The user can find information such as the ambient light intensity measured by the sensor. Whether the intensity is above the limit set, and the process data output bit.

9.3.3 Parameter Tab

The Parameter tab displays the sensor's parameter settings, as well as enabling the user to read data from the sensor or teach the sensor by writing new values to the board. See Figure 9-13 for details.

9.3.3.1 Page organisation

Three types of information can found on this page (Identification, parameter and observation).

"Identification" and "observation" information are read only (ro) information, while parameter can be read/write (rw), write only (wo), or read only (ro) information.

- "Identification": displays the default settings allowing to identify the sensor connected to the Master.

  By default the factory information recorded in the IODD are displayed. However the user can read the information stored in the sensor, to find out whether the sensor connected is of the same hardware and firmware revision as that of the released version.

  The user can find information such as: Vendor and product names, hardware and firmware revisions.

- Observation data: provide a snapshot of the sensor's process data in and process data out variables.

- Parameter: displays the parameters the user can access to teach the sensor. In our sample application the user can restore the factory settings or teach an intensity limit to the sensor.

Please refer to the next section 9.4 for information on how to read data and write data to the sensor.

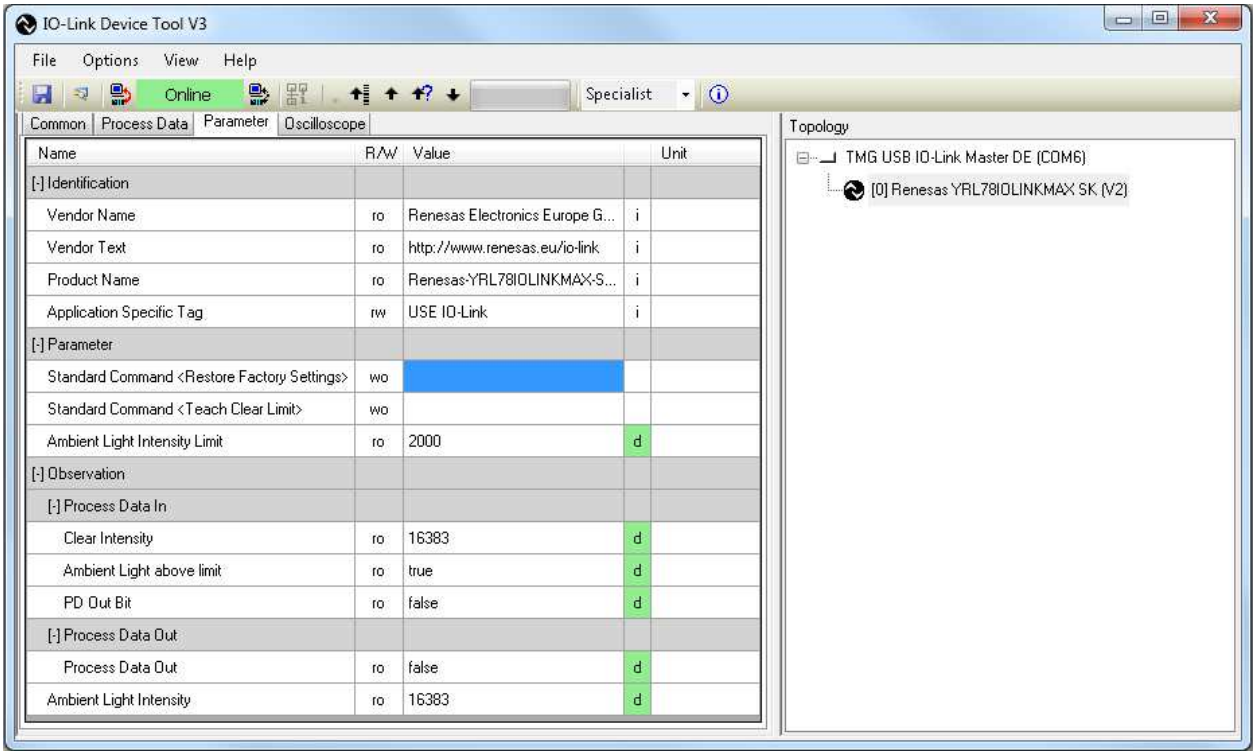

Figure 9-13.*YRL78IOLINKMAX* SK (V2) Parameter page

9.3.4 Oscilloscope Tab

The oscilloscope function enables the visualization of the process data in the scope window.

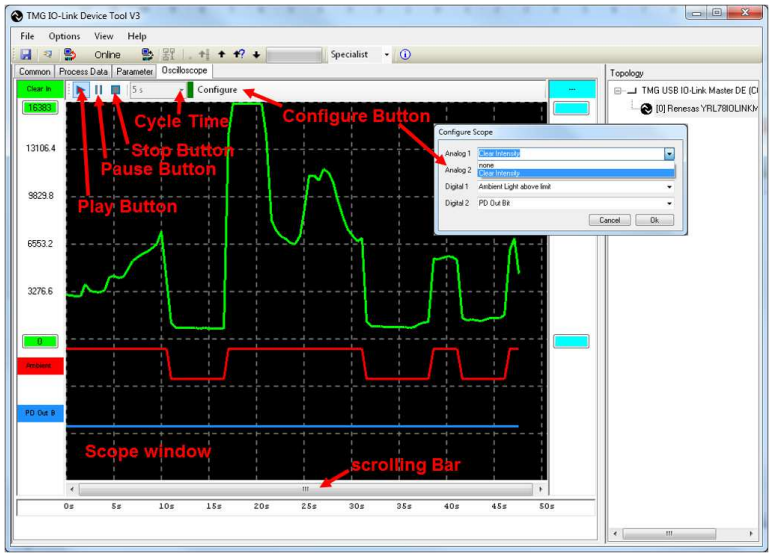

Figure 9-14. *YRL78IOLINKMAX* SK (V2) Oscilloscope window

9.3.4.1 Play Button (Data Display)

- Left click on the Play button to start the real time display of process data.

Figure 9-14 shows the 14-bit ambient light measurement (green trace) and the digital intensity Limit (red trace).

At factory setting, the intensity limit is set to 2000. By moving a light source closer of further away from the sensor, the corresponding light intensity is displayed. When the value is above 2000 the intensity limit is set to 1. Respectively the red LED on the board turns on.

9.3.4.2 Pause Button

- Left click on the Pause button freezes the display of measured information in the scope window, while the recording of process data continues in the background.
- Another click on the Pause button displays the information recorded during the paused period, followed by the real time measurement.

9.3.4.3 Stop Button

- Left click on the stop button to terminate the real time display of process data.

The latest information measured remain displayed on screen. The user can use the scroll bar to view different sections of the information recorded. However a click on the play button will reset the scope window to zero and restart the recording.

9.3.4.4 Cycle Time

- Left click on the cycle time button to set the cycle time.

10 samples per cycle are displayed

9.3.4.5 Configure Button

- Left click on the configure button to select the process data variables to display in the scope window.

9.4 *YRL78IOLINKMAX* Board Sensor Read/Teach-in

When the user opens the parameter page for the first time, the device specific parameters are set to their default values in the “Value” columns. These values are recorded in the IODD file. See Figure 9-15 for details.

9.4.1 Read Parameter from the *YRL78IOLINKMAX* Board Sensor

To read or refresh the display with the current or most recent information from the board:

- Use a left click under the “Value” column, in the cell you want to check the information.

The cell being read is highlighted in blue and the current parameter value is displayed.

A green status cell with the data type right next to the cell being read, let user know that read command was successful.

If the read command fails, the status cell will be Red.

In Figure 9-15 below, the light intensity limit set in the device is being checked.

We can also see that the Parameter and Observation data have been read as their status cell is green.

The Vendor name, on the other hand are showing the factory setting registered in the IODD file.

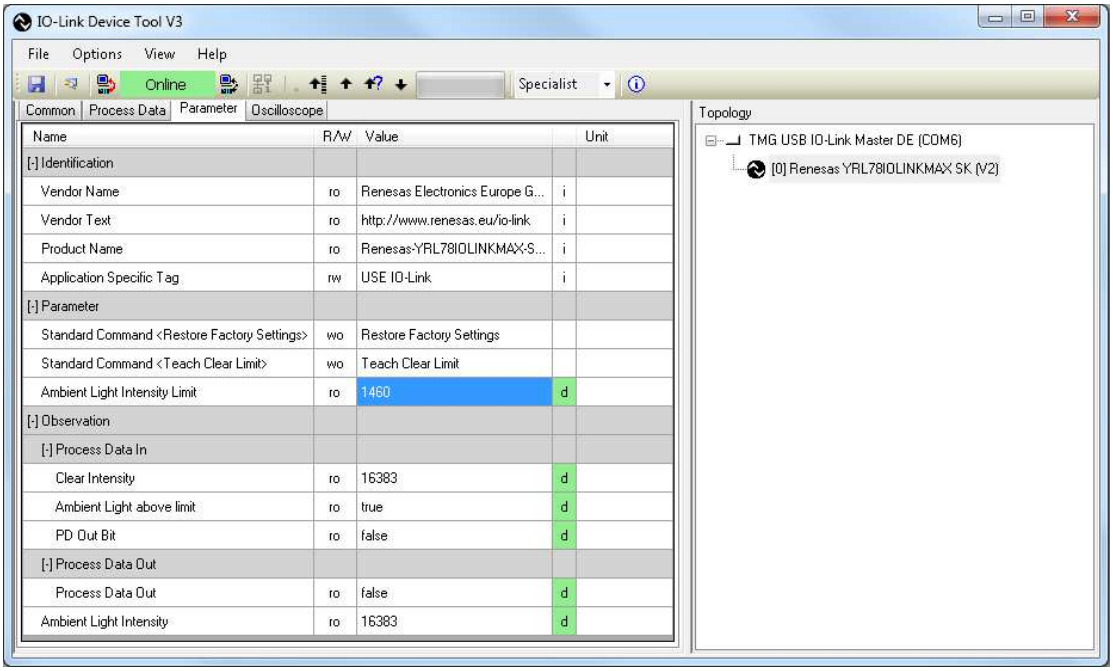

Figure 9-15.Parameter and data reading

9.4.2 Write Parameter to the *YRL78IOLINKMAX* Board Sensor

The teach-in functionality allows changing the light Intensity limit on the fly, and restore the factory settings.

9.4.2.1 Light Intensity Setting

To write or teach a parameter to the board:

- Cover the tip of the sensor board with your hand or an opaque object to block the light.
- Under the “Value” column, click Right in the cell corresponding to the parameter you want to change. (Teach Clear Limit).

The cell is highlighted in blue and a dialog box shows up.

- Left click “Execute”.

Figure 9-16 shows the dialog box and setting of the light intensity limit.

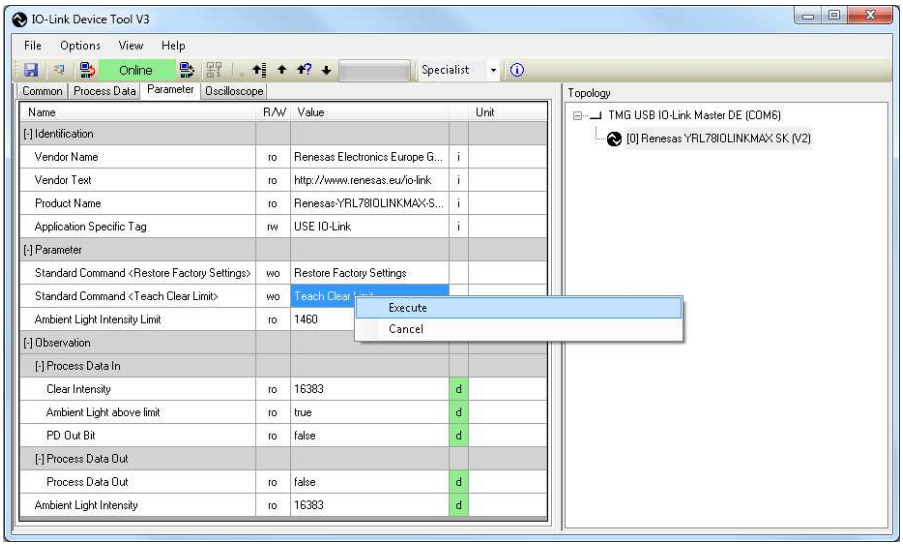

Figure 9-16.*YRL78IOLINKMAX* Ambient Light Intensity Limit setting

9.4.2.2 Factory Settings Restoration

Similarly, to restore the sensor settings to factory settings:

- Under the “Value” column, click Right in the cell corresponding to the parameter you want to change. (Restore Factory Settings).

The cell is highlighted in blue and a dialog box shows up.

- Left click “Execute”.

Figure 9-17 shows the dialog box and setting of the factory settings restoration.

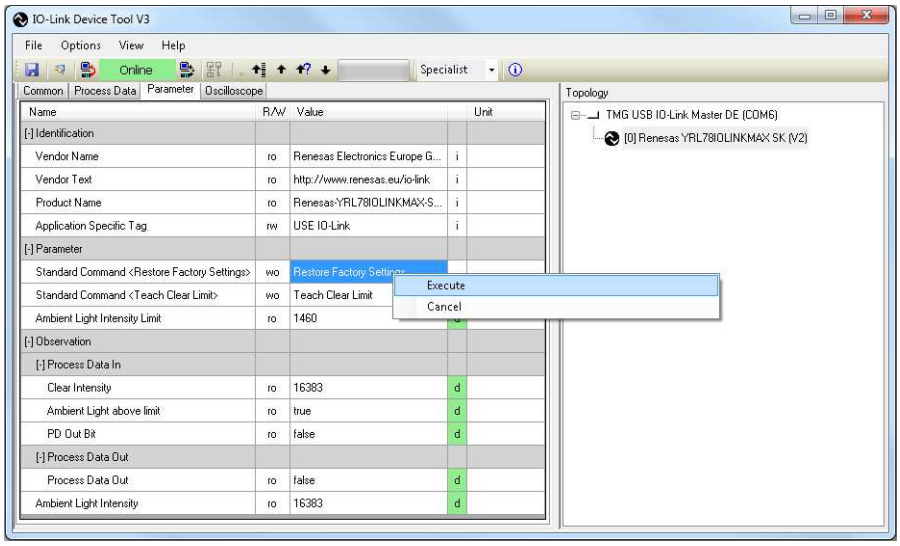

Figure 9-17.*YRL78IOLINKMAX* Factory restoration setting

10.Bill of Materials

Table 10-1 *YRL78IOLINKMAX* Bill of Materials

Item	QTY	Remarks	Component Description	Component	Manufacturer Part Number
01	2	C1, C2	CAP CER 1UF 50V 10% X7R (0603)	EC2601	Taiyo Yuden UMK107AB7105KA-T
02	5	C3,C4B,C5,C7,C10,	CAP CER 0.1UF 16V 10% X5R (0201)	EC2602	TDK C0603X5R1C104K030BC
03	2	C8,C9	CAP CER 15PF 50V 5% NP0 (0201)	EC2603	TDK C0603C0G1H150J030BA
04	2	C4A,C6	CAP CER 1UF 6.3V 20% X5R (0201)	EC2281	TDKC0603X5R0J105M030BC
05	1	CN1	M12-A 4-pin Male connector (M12_Edge)	EH1385	Binder 09-0431-212-04
06	1	CN2	8-pin Female connector (2x4x1.27)	EH1387	Samtec CLP-104-02-G-D
07	1	CV5	CAP CER 1UF 10V 10% X5R (0402)	EC2048	TDK C1005X5R1A105K
08	2	D1, D2	36V TVS Diode with 55V clamp (3 SOT23)	ED0692	Semtech SDC36C.TCT
09	1	D5	Yellow 1mA Led, (0402)	ED0912	Rohm SML-P12YTT86
10	1	D6	Red 1mA Led, (0402)	ED0913	Rohm SML-P12UTT86
11	1	D7	Green 1mA Led, (0402)	ED0914	Rohm SML-P12PTT86
12	1	R0A	0 Ohm resistor 50V (0402) 0.125W	ER1190	Vishay/Dale CRCW04020000Z0EDHP
13	1	R1	1 Ohm 1% resistor 50V (0402) 0.125W / 353mA max	ER1191	Vishay/Dale CRCW04021R00FKEDHP
14	2	R2, R3	20k Ohm 5% resistor (0402) 0.1W / 2.2mA max	ER0504022002	
15	1	R4	1.5k Ohm 5% resistor (0201) 0.05W / 5.7mA max	ER0502011501	
16	2	R7,R8	10k Ohm 5% resistor (0201) 0.05W / 2.2mA max	ER0502011002	
17	1	RV5	10 Ohm 1% resistor (0402)	ER01040210R0	
18	1	RVP	10 Ohm 1% resistor 50V (0402) 0.125W / 111mA max	ER1186	Vishay/Dale CRCW040210R0FKEDHP
19	1	U1	IO Link Device Transceiver (25 WLP)	MAX14821EWA+	Maxim MAX14821EWA+
20	1	U2	Low Power uC (25 WFLGA)	EQ1385	Renesas R5F10E8EALA#YE
21	1	Y1	18.432MHz Crystal (4 SMD)	EX0519	Mercury X22-18.432-12-30/30/4085
22	1	PCB1	Assembled PC board: Half Moon Bay (MAXREFDES26#) Ambient Light Sensor Board shaped like a half moon	MAXREFDES26#	MAXREFDES26#
23	0	C2B	Not installed. CAP CER 0.1UF 50V 10% X7R (0402)	EC2502	Taiyo Yuden UMK105B7104KV-FR
24	0	R0B	Not installed. 0 Ohm 5% resistor (0201) 0.05W	ER0502010R00	
25	0	TP1	Not installed .Test Point	N/A	

Revision History

Rev	Date	Description	
		Page	Summary
1.00	Jul ,2014	-	First edition issued

YRL78IOLINKMAX IO-Link Starter Kit

Renesas Electronics Corporation

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