

# YRL78IOLINKMAX

**IO-Link Starter Kit: Tutorial Manual** 

RENESAS MCU RL78 Family/ G1x Series

User's Manual

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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.

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• Network requirements

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## 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 r	notation:	Left is high order column, right is low order column
	Active low notation	on:	xxx (pin or signal name is over- scored) or /xxx (slash before signal name) or _xxx
	Memory map add	dress:	High order at high stage and low order at low stage
Note	Additional remark or tip		
Caution	Item deserving extra atte	ention	
Numeric notation	Binary:	xxxx	or xxxB
	Decimal:	xxxx	
	Hexadecimal	xxxxH or 0	x xxxx
Numeric prefixes	representing powers of 2	2 (address	space, memory capacity):
	K (kilo): 2 <sup>10</sup> = 1024		
	M (mega):	2 <sup>20</sup> = 1024 <sup>2</sup>	<sup>2</sup> = 1,048,576
	G (giga):	2 <sup>30</sup> = 1024 <sup>3</sup>	<sup>3</sup> = 1,073,741,824
Register contents	X, x = don't care		
Diagrams	Block diagrams do not n functional structure. Tim only, without any relevar	ecessarily ing diagrar nce to the r	show the exact wiring in hardware but the ns are for functional explanation purposes eal 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 Renes site.	as Electronics Web
Renesas Technical Update	Product specifications, updat	tes 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

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## 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.

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*.

This manual provides information on how to use the *YRL78IOLINKMAX* with the Demo Sample Device preprogrammed in the microcontroller at shipment

This demo exhibits all the sensor features available on the platform.

IODDs (IO-Link Device Description) are provided for importation and integration of the *YRL78IOLINKMAX* into the 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.



Figure 1-1 YRL78IOLINKMAX board Components

### 1.1 LED Indicators, D5, D6

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

Table 1-1 LED indications

	Colour	Eurotion	PHY	
	Colour	Function	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



## 2.Installation

#### 2.1 Getting Started

The downloadable Starter kit Installer shows the following directory structure:

Table 2-1. 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	<ul><li>Sample project for IAR and IODD for the Starter Kit</li><li>IO-Link Ambient light sensor demonstration Project</li></ul>

#### 2.2 IODD Device Description Files Installation

The IODD repository for the Demo sample Device is located in the folder of the same name.

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

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

For further details please refer to section 4.2.2

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.

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

#### 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.



## 3.Hardware setup

• 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 3-1.

Note

There is no lighting for the sensor element and no lens focuses to the object. Therefore the measurement is not optimal and should be tested under easy conditions. E.g. colour bars on a screen are good for demonstration.



Figure 3-1.YRL78IOLINKMAX Ambient light sensor demo setup



## 4.Demo Sample Device

#### 4.1 Demo Features

The Renesas Demo Sample Device demonstrates a small size design for an IO-Link sensor based on components of Renesas, Maxim and software of TMG TE. As powerful features the sensor offers RGBC Colours, Ambient light compensation, Infra-red and ambient temperature measurements, transmitted via the IO-Link process data.

For more details on the Maxim sensor MAX4008 capabilities, please refer to the component datasheet installed on the host PC.

#### 4.1.1 Commands

Using the parameterization feature in the IO-Link Device tool, the user can set intensity values, which can be used to detect the presence of an object, a given ambient light condition, or colours.

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

The demo provides the user with the following executable commands:

- Teaching: four colours, Clear limit, Ambient Light limit, IR limit.
- MAX4008 ADC parameter settings.
- Reset temperature values (min, max, avr).
- Reset to factory settings.

For further details on how to teach the sensor please refer to section 4.4.

#### 4.1.2 Sample Device characteristics

The following tables displays the sample demo's characteristics.

**Table 4-1 Sample Program Characteristics** 

Characteristics	Description
Vendor ID	0x018C
Device ID	0x18C003
IODD V1.1	Renesas-YRL78IOLINKMAX-V2-20140612-IODD1.1.xml
IODD V1.0.1	Renesas-YRL78IOLINKMAX-V2-20140612-IODD1.0.1.xml
IO-Link Version	V1.1, compatible to V1.0
Software	TE GmbH
SIO Mode supported	Yes
Pin 2	Can be configured (V_Pin2Mode) to show the Ambient Light switch point or be controlled from the IO-Link master (e.g. controlled by the PLC). If V_Pin2Mode is set to "Digital Output", Pin 2 bit from the process output bits will control state of Pin2. Pin2 function is available in SIO Mode and IO-Link Mode.
Pin 4	In SIO Mode Pin4 will show the IR switch point



Table 4-2 IO-Link Mode – Process Data

Characteristics		Descriptio	n
	Process Data:		
		Red	16Bit Value (14 significant)
		Green	16Bit Value (14 significant)
		Blue	16Bit Value (14 significant)
IO-Link Mode	Inputs (56 Bits)	Switch Points : Booleans (packed in 8 Bit)	Color 1 detected Color 2 detected Color 3 detected Color 4 detected Ambient Light above limit IR above limit Temperature above limit PDout Bit (Pin 2) Mirror of the output bit
		can be set by the t with the teach com	ool or PLC function block or taught mand
	Outputs (8 Bits)	Pin2	Only active if Pin2Mode = "digital output"

Table 4-3 Device specific parameters

Characteristics	Parameter Type	Description
V_AMBPGA	Read/Write (rw)	parameter for gain of the MAX4008 ADC
V_AMBTIM	(rw)	parameter for integration time of the MAX4008 ADC
V_Temperature, V_TemperatureAVR, V_TemperatureMIN, V_TemperatureMAX	Read Only (ro)	temperature measurement
V_Temperature_Limit	(rw)	switch point setting
V_AMB_Clear, V_AMB_Red, V_AMB_Green, V_AMB_Blue, V_AMB_IR, V_AMB_IRComp	(ro)	measurement values
V_Clear_Limit, V_IR_Limit	(rw)	can be set by the tool or PLC function block or taught with the teach command
V_AMB_Red_Hysteresis, V_AMB_Green_Hysteresis, V_AMB_Blue_Hysteresis	(rw)	gives the +/- tolerance of detecting the taught colours
V_AMB_Red/Green/Blue_Value1,2,3,4	(rw)	teach values for colour switch points 1,2,3,4
V_Pin2Mode	(rw)	configures Pin2 behaviour Controlled by process data output bit or By Ambient Light switch point



#### 4.2 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.

#### 4.2.1 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 below.

IO-Link Device Tool V3	
File Options View Help	st 🔹 🛈
Exit online connection Online status	Topology
	Catalog © PC Interfaces © Vendor © Vendor © Uother E GambH © Vendor © Sample Devices © Sample Devices
Common field	

#### Figure 4-1.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.



#### 4.2.2 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".

ile	Options View Help		
а.	Change Language	Specialist - 🛈	
	Change Login Status User Management	Topology	
	Import Device Description		
		Catalog	
		Control Contro Control Control Control Control Control Control Control Control Co	

#### Figure 4-2.Catalog update

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

Import Device Description   Organize  New folder   IO-Link library   IODD   Name   Date modified   Renesas-YRL78IOLINKMAX-Sample-V2-20140612-IODD 1.0.1xml   06/08/2014 05:55   Vendor TMETE Gaces Vendor Wendor TMETE Gaces Vendor Sample Devices Sample Devices Sample Device Sample Devi	. 0		l													10	-	-	-	-	-	-	-	-		-		-	-	-	53.0	51/2	10	10	0				6				0	0				10	10	10	10	0	10	10																								 	3.7							3.7	3.7																Į						10	10				10	10																				
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Organize ▼ New folder       IE ▼ I ♥         IO-Link library IODD       Arrange by: Folder ▼         Name       Date modified		_						_							۲			]	]	1	1				]								T.										ł	ł										T.				]			>	>	,	)						)	>	)	)	)	)				T.		Ĩ.	]	]	T.	T.		T.	1		1	T.					i.	i.	1		]	]	]						1																											
IO-Link library       Arrange by: Folder ▼         Name       Date modified         Image: Renesas-YRL78tOLINKMAX-Sample-V2-20140612-10DD.1.1xml       06/08/2014 06:02         Image: Renesas-YRL78tOLINKMAX-Sample-V2-20140612-10DD.1.1xml       06/08/2014 05:05         Image: Renesas-YRL78tOLINKMAX-Sample-V2-20140612-10DD.1.1xml       06/08/2014 05:05         Image: Renesas-YRL78tOLINKMAX-Sample Time: Renesas-YRL78tOLINKMAX-Sample Ti				-								_			Ľ																				I	ľ	Ì	Ì	I	l	Ī	l	İ	İ	I	İ	I					I			]																-																																																																
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				1	< (V2)	X SK (	mbH <max< th=""><th>pe Gml DLINKM</th><th>Europ 4X L78IO ce</th><th>onics   NKMA is YRL vices Devic</th><th>esas bH Devi ple [</th><th>is Eler 17810 Rene 3 Gml nple D Samp</th><th>vices YRL7 Q F G TE Samp Q S</th><th>k-Dev endor Ren Mo TM TM</th><th>·Link Ver</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>1000</th><th>1000</th><th>1000</th><th></th><th></th><th></th><th></th><th></th><th></th><th>3</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>3</th><th>3</th><th>3</th><th>3</th><th>20</th><th></th><th></th><th></th><th></th><th>辞</th><th></th><th></th><th></th><th>•</th><th>•</th><th>*</th><th></th><th></th><th></th><th></th><th></th><th></th><th>•</th><th>•</th><th>P</th><th>•</th><th>•</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>11000</th><th>11000</th><th>(421)</th><th>11423</th><th></th><th></th><th>(C)</th><th>(C)</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></max<>	pe Gml DLINKM	Europ 4X L78IO ce	onics   NKMA is YRL vices Devic	esas bH Devi ple [	is Eler 17810 Rene 3 Gml nple D Samp	vices YRL7 Q F G TE Samp Q S	k-Dev endor Ren Mo TM TM	·Link Ver											1000	1000	1000							3													3	3	3	3	20					辞				•	•	*							•	•	P	•	•																										11000	11000	(421)	11423			(C)	(C)																												
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Figure 4-3.Import Device Description

• Press the open button.



#### 4.2.3 Catalog Update Confirmation

A successful update shows the Renesas Electronics Europe GmbH vendor and the *YRL78IOLINKMAX* Sample (V2), 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 4-4. YRL78IOLINKMAX in Device catalog

#### 4.2.4 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).

1 2 9	🌢 Offline 😫 🔢 . 🕂 🕇	#? +	Specialist - 🛈	
Common M.	anual Test			Topology
	SDCI SAL SERIAL BUS		Technologie Managemient Gruppe Technologie und Engineering	TMG USB IO-Link Master DE (COM6)
Device	TMG USB IO-Link Master DE (COM6)	1		Catalog
Version	1.1.8	Vendor	TMG TE GmbH	
Interface	TMG USB IO-Link Master DE (COM6)	•	Search for interfaces	- W Vendor
Connected I Name Vendor Description	Device			In The Gubban Control of the Gubban Con
Device ID				THE Renesas YRL78IDLINKMAX Sample (v2)     THE Renesas YRL78IDLINKMAX SK (v2)     THE TE GmbH     THE TE GmbH     Sample Devices     Sample Device

Figure 4-5.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.

	🎒 Online 🔮 🔡 🖉 🕂 🕂	+? + Specialist ▼ ①	
ommon M	a pal Test		Topology
	etup Online Connection	Technologie Management Gruppe	TMG USB 10-Link Master DE (COM6)
Device	TME USB IO-Link Master DE (COM6)		Catalon
Version	1.1.4	Vendor TMG TE GmbH	EContractor
Interface	TMG SB ID-Link Master DE (COM6)	~	🖉 🙆 Vendor
Connected	Setup Online c	onnection	TMG TE GmbH     TMG USB IO-Link Master     Molecular     Molecular     Molecular
Citie			Wendor     Seresas Electronics Europe GmbH
Vendor			W YRL78IOLINKMAX
Vendor		~	Person VPL 2010 LINK MAX Sample (V.
/endor Description			TMG TE GmbH
/endor Description Device ID			TMG TE GmbH

Figure 4-6.Online status, Check Config

• Click on the "Check Config" button.

The LEDs on the Master will 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.

ommon M	anual Test		-	Technologie Management Gruppe Technologie und England	Topology	D-Link Master DE (COM6)
Device Version Interface	TMG USB IO-L 1.1.8 TMG USB IO-L	ink Master DE (COM6) ink Master DE (COM6)	Vendor TMG	i TE GmbH	Catalog - 🍄 PC-Interface - 🍄 Vendor - 🍄 TMI	ss 3 TE GmbH ————————————————————————————————————
Name Vendor Description	Compar Port	e online with engine Engineering	ering	Online Renesas YRL78101	LINKMAX Sample (V2)	Electronics Europe GmbH BIOLINKMAX DUNKMAX
Device ID Vendor ID	Take ove	close er type of c	levice(s) i	Take over type of device(s) in <b>nto engineeri</b>	nto engineering	Sample Device

Figure 4-7.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 4-8.

ile Opti	ons View	Help					
1	🎒 Önline		1 + + +? +	Specia	list 🔹 🕕		
Common M	anual Test					Topology	
	SDC E		F	Tech Man	nologie agement Gruppe nalogie und Engionering	- TMG USB IO-Link Master	DE (COM6)
Device	TMG USB IO-	Link Maste	r DE (COM6)			Catalog	
Version	1.1.8	Compar	e online with engineeri	ng			3
nterface	TMG USB IO-	Port	Engineering		Online		
Connected	Device	0					hk Master
Name			Close				
/endor	1	Ľ					Europe GmbH
Description				*		Renesas Renesas TMG TE GmbH	YRL78IOLINKMAX Sample (V YRL78IOLINKMAX SK (V2)
Device ID				10		Sample Devi	Des Device
/endor ID						- Sample L	

Figure 4-8. 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.

	) Online 😭 🔠 🕂 🕇	T( +	Specialist 👻 🕕	1 • • • • • • • •
ommon Mar	nual Test			Topology
UNIVERS	AL SERIAL BUS	F	Technologie Management Gruppe Technologie und Engineering	TMG USB 10-Link Master DE (COM5)     GO Renesas YRL78IOLINKMAX Sample (V2)
Device	TMG USB IO-Link Master DE (COM6)			
Version	1.1.8	Vendor	TMG TE GmbH	Catalog
Interface	TMG USB IO-Link Master DE (COM6)			e-S Vendor
Connected D	evice			TMG TE GmbH TMG USB IO-Link Master
Name	Renesas YRL78IOLINKMAX Sample	(V2)		e- Vendor
Vendor	Renesas Electronics Europe GmbH			🖨 🦃 Renesas Electronics Europe GmbH
Description	Sample Device for RL78 with MAX14	821		YHL/3IULINKMAX     Renesas YRL73I0LINKMAX Sample (V.     Senesas YRL73I0LINKMAX Sample (V.     Senesas YRL73I0LINKMAX SK (V2)
Device ID	0x18C003		(ac.70	Sample Devices
Vendor ID	0x018C			Sample Device

Figure 4-9.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 Sample (V2); Device ID: 0x18C003; Vendor name: Renesas Electronics Europe GmbH; Vendor ID: 0x018C; Picture of the Io-Link device connected to the Master.



#### 4.3 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.

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Common Process E	ata   Parameter   O:	cilloscope	E		Topology
<b>@ 10</b> -Li	nk Vendor Vendor ID	Renesas Electroni 0x018C	cs Europe Gm	RENESAS	
Device	Renesas YRL7810	LINKMAX Sample (V	2)		
Description	Sample Device for	RL78 with MAX1482	1 ^		
Device ID	0x18C003	10-Link Version	1.1		
Hardware Revision	1	Firmware Revision		MININ LIGUE AND	
Bitrate	COM3	MinCycleTime	2000 µs	RL78	
SIO Mode	yes				
ODD	Renesas-YRL7810	LINKMAX-Sample-V2	-20140612-IOD	D1.1.xml	
Document Version	V2.0	Date of Creation	6/12/2014 1:		

Figure 4-10. YRL78IOLINKMAX Sample (V2) in device tool

#### 4.3.1 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.

#### 4.3.2 Process Data Tab

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

TMG IO-Link Device Tool V3			
File Options View Help			
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Common Process Data Parameter Oscilloscope			Topology
Name	Processdata	Unit	
[·] Process Data Inputs			[0] Renesas YRL78IOLINKMAX Sample (V2)
Red Intensity	2351		
Green Intensity	3674		
Blue Intensity	610		
Color 1 detected	false		
Color 2 detected	false		
Color 3 detected	false		
Color 4 detected	false		
Ambient Light above limit	true		
IR above limit	false		
Temperature above limit	true		
PDout Bit (Pin 2)	false		
[·] Process Data Outputs			
Pin 2	false		
<u></u>			

Figure 4-11. YRL78IOLINKMAX Sample (V2) Process data



The user can find information such as the colour intensity, a range of flags on switch point such as detected colours, Ambient light, infra-Red, and temperature limits. Out of the box, all the detected colours are false and the limit switch points are reflecting to the factory settings.

#### 4.3.3 Parameter Tab

The Parameter tab displays the sensor's identification settings, as well as enabling the user to read data from the sensor, or teach the sensor by writing new values to the board.

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).

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Name	R/W	Value		Unit	I opology B. J. MG USB IO-Link Master DE (COM6)
Identification					🛛 🚷 [0] Renesas YRL78IOLINKMAX Sample (V
Parameter					
Observation					

Figure 4-12. YRL78IOLINKMAX Sample (V2) Parameter page

#### 4.3.3.1 Identification settings

Provides the default settings allowing to identify the sensor connected to the Master. By default the factory information recorded in the IODD are displayed.

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

• Left click in the "Value" column, to read the information stored in the sensor and find out whether the sensor connected is of the same hardware and firmware revision as that of the released version.

File Options View Help				
J 및 S Donline 📑 뫒 . ┥	+ +?	+ Specialist + 🤇	)	
Common Process Data Parameter Oscilloscope				Topology
Name	R/W	Value	l	Jnit TMG USB IO-Link Master DE (COM6)
[·] Identification				0] Renesas YRL78IOLINKMAX Sample (V2)
Vendor Name	10	Renesas Electronics Europe GmbH	i	
Vendor Text	oı	http://www.renesas.eu/io-link	i	
Product Name	01	Renesas YRL78IOLINKMAX Sample (V2)		
Hardware Version	01	1.0	d	
Firmware Version	10	2.0	d	
Application Specific Tag	ſW	USE IO-Link	d	
[·] Parameter				
[-] Observation				
Left cli	ck to	read data from Sensor		
* [				•

Figure 4-13. YRL78IOLINKMAX Sample (V2) Identification settings



#### 4.3.3.2 Parameter settings

Provides the user access to the parameters to teach the sensor.

Two types of teaching methods are available to send parameters to the sensor:

- Automatic teaching (Standard Commands): identifiable by the write only (wo) type. The user can only execute these parameters.
- Manual teaching: identifiable by the read/write (rw) type. The user can manually enter a value to be transmitted to the sensor.
  - A sub parameter section referred to as "Teach Values", provides the set of parameters to manually teach the various colour intensity, ambient light and infra-red limits.

file Options View Help						
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Common Process Data Parameter Oscilloscope						Topology
Name	R/W	Value	-	Unit	^	B∽_ TMG USB IO-Link Master DE (COM6)
[·] Parameter					1	[0] Renesas YRL78IOLINKMAX Sample (V2)
Gain	RW	1 x	i			Sec. 42.0
Integration Time	rw	100	i			
Temperature Limit	rw	14200	i			
Red Hysteresis	rw	600	i			
Green Hysteresis	rw	300	i		-	
Blue Hysteresis	rw	150	i			
Pin2 Mode	rw	Ambient Light Switch	d			
Standard Command < Teach IR Limit>	wo					
Standard Command < Teach Clear Limit>	wo				- 15	
Standard Command <restore factory="" settings=""></restore>	wo					
Standard Command <reset temperature="" values=""></reset>	wo					
Standard Command <teach 2="" color=""></teach>	wo					
Standard Command <teach 1="" color=""></teach>	wo					
Standard Command < Teach Color 4>	wo					
Standard Command < Teach Color 3>	wo					
Device Access Locks Parameter (write) Access Lock	ΓW	false	d			
[-] Teach values						

Figure 4-14. YRL78IOLINKMAX Sample (V2) Parameter settings

The table below summarises the parameters offered in the demo and their capabilities.

Parameter	Teaching Method	Factory Setting	Value range	Description	
Gain	Gain Manual 1x 1x, 1/4		1x, 1/4x, 1/16x, 1/256x	MAX4008's ADC gain parameter	
Integration Time	ntegration Time Manual 100 1.5625, 6.25, 25,		1.5625, 6.25, 25, 100, 400	MAX4008's ADC integration time	
Temperature Limit	Manual	14200	UInteger16	Temperature measurement switch point	
Red Hysteresis	Manual	600	1001000		
Green Hysteresis	Manual	300 501000		+/- tolerance detection of taught colours	
Blue Hysteresis	Manual	150	501000		
Pin2 Mode	Manual	ABS	Ambient Light Switch (ABS), Digital Output	Pin 2 behaviour control	
Standard Command	Automatic	NA	Executable	Colours, lights, factory reset teaching	
Device Access Locks	Manual	false	false, true	Parameterisation lock capability	
Teach Values	Manual	0	Process Data in values (UInteger16)	Colours intensity, Ambient light limit, Infra-red Limit	



#### 4.3.3.3 Observation settings

Provides a snapshot of the "Process Data In" and "Process Data Out" values (Read Only) recorded by the sensor.

The values displayed in this section can be used to manually teach the sensor with the "Teach values" parameters.

Please refer to section 4.4 for information on how to read data and write data to the sensor.

File Options View Help							
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Common Process Data Parameter Oscilloscope						_	Topology
Name	R/W Y	/alue		-	Unit	^	B-→ TMG USB IO-Link Master DE (COM6)
[·] Identification							0] Renesas YRL78IOLINKMAX Sample (V2)
[·] Parameter							
[] Observation							
[·] Process Data In							
Red Intensity	ro			e			
Green Intensity	o			e		E	
Blue Intensity	ro			e			
Color 1 detected	ro			e			
Color 2 detected	ro			е			
Color 3 detected	ro			e			
Color 4 detected	ro			e			
Ambient Light above limit	ro			e			
IR above limit	ro			e	1		
Temperature above limit	ro			e	1		
PDout Bit (Pin 2)	ro			e			
[·] Process Data Out							
Pin 2	o			e			
Ambient Light Intensity	ro			e			

Figure 4-15. YRL78IOLINKMAX Sample (V2) Observation settings

#### 4.3.4 Oscilloscope Tab

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

The following section describes the scope window and its features.

mon Process Data	Parameter Oscillosco	pe			Topology
	Stop Bu Pause Butt Play Button	e Time titton Configur	Ana e Button Analog 2 trac	65535 65535 e Scaling 52428	TMG USB IO-Link Master DE (COM6)
Analog 2214	i trace Scaling	Analog 1 Red In2 Analog 2 Rote Hed In2 Digital 1 Bize In1 Digital 2 Roter Color	ensty nensty ensty delected detected		
lor 2	Digital 1 Digital 2	Color 3 Color 4 Ambien IR abox Temper PDout Pin 2 Scope Window	detected detected Utipht above finit re linit ature above finit Sit (Pin 2)	Bar	
<		m		•	

Figure 4-16. YRL78IOLINKMAX Sample (V2) Oscilloscope window



#### **4.3.4.1** Configure Button

- Left click on the configure button to select the process data variables to be display in the scope window.
  - Set Analog 1 and Analog 2 to display the colour intensity measurements.
  - o Set Digital 1 and Digital 2 to display the switch points available in the demo.

#### **4.3.4.2** Analog trace Scaling.

The user can set the range of values to be displayed in the scope window for Analog1 and Analog 2 traces. Therefore enabling a zoom function on the trace.

- To set the maxim range value for a trace, right click the box indicating the max value, and enter a new value.
  - Press Enter on your keyboard to confirm.
- To set the minimum range value for a trace, right click the box indicating the min value, and enter a new value.
  - Press Enter on your keyboard to confirm.

#### 4.3.4.3 Play Button (Data Display)

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

#### 4.3.4.4 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.

#### 4.3.4.5 Stop Button

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

The latest information measured remains 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.

#### 4.3.4.6 Cycle Time

• Left click on the cycle time button to set the cycle time (10 samples per cycle are displayed).

#### 4.4 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 4-13 for details.

#### 4.4.1 Read Parameter from the *YRL78IOLINKMAX* Board Sensor

To read or refresh the display with the current or most recent information recorded by the sensor:

• 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, lets the user know that the read command was successful.

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

In Figure 4-17 below, the Ambient light intensity limit set in the device is being checked.

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

The intensity values are set 0 and colours are not detected since the sensor has not been taught any colour.

ommon Process Data Parameter Oscilloscope				Topology
Name	R/w	Value	Unit *	□ TMG USB ID-Link Master DE (COM6)
Device Access Locks.Parameter (write) Access Lock	TW	false	d	[0] Renesas YRL78IOLINKMAX Sample (V2)
[·] Teach values				
Ambient Light Intensity Limit	644	2000	ď	
IR Intensity Limit	EW	2700	d	
Red Intensity Value 1	- FW	0	d	
Green Intensity Value 1	EW	0	8	
Blue Intensity Value 1	199	0		
Red Intensity Value 2	FWV	0	a Left	click to read data from Senso
Green Intensity Value 2	0.0	0	d	
Blue Intensity Value 2	TW	0	d	
Red Intensity Value 3	111	0	d	
Green Intensity Value 3	<b>EWV</b>	0	d	
Blue Intensity Value 3	F#V	0	d 🗉	
Red Intensity Value 4	EW.	0	d	
Green Intensity Value 4	ENA.	0	d	
Blue Intensity Value 4	199	0	d	
] Observation				
[-] Process Data In				
Red Intensity	ro	16383	Б	
Green Intensity	10	16383	d	
Blue Intensity	ro	4655	d	
Color 1 detected	10	false	d	
Color 2 detected		false	d	

Figure 4-17.Parameter and data reading

#### 4.4.2 Write Parameter to the YRL78IOLINKMAX Board Sensor

• When teaching parameters, please make sure the parameter "Device Access Parameter Locks" is set to "false", or any attempt to write information to the sensor will fail.

Parameters can be transmitted to the board automatically by using the "Standard commands", or manually by using the "Teach Values" parameters.

#### 4.4.2.1 Using "Teach values" parameters

The example below shows the manual teaching of "IR intensity Limit".

When manually teaching a colour, the Red, Green, and Blue intensity for that colour must be taught.

To write or teach a parameter to the board using a Teach Values parameters:

• Right click in the "Value" field corresponding to the parameter you want to teach. ("IR intensity Limit")

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

• Enter a value in the box and click "Transmit this Value" or press Enter on your Keyboard".

Figure 4-18 shows the dialog box and setting of the IR limit been set to 7000.



File Options View Help	+ <b>  + +? +</b> s	pecialist • 0 1. Right click in Field
Common Process Data Parameter Oscillosco	ре	Topology
Name	R/W Value	Unit A Ind USB IO-Link Master DE (COM6)
[-] Teach values		🕘 [0] Renesas YRL78IOLINKMAX Sample
Ambient Light Intensity Limit	rw 2000	d
IR Intensity Limit	rw 6378	7004
Red Intensity Value 1	rw 0	
Green Intensity Value 1	rw 0	Transmit this Value
Blue Intensity Value 1	rw 0	Transmit Last Edit Values
Red Intensity Value 2	rw 0	Transmit Values Immediately
Green Intensity Value 2	rw 0	d
Blue Intensity Value 2	rw 0	3. Left click Transmit
Red Intensity Value 3	rw 0	d
Green Intensity Value 3	rw 0	d
Blue Intensity Value 3	rw 0	d
Red Intensity Value 4	rw 0	a +

Figure 4-18. YRL78IOLINKMAX IR Limit teaching

Note:

The value entered must be of the correct type and in the correct range, or the teaching will fails as shown in the figure below.

TMG IO-Link Device Tool V3						
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ommon Process Data Parameter Oscilloscope			Topology			
Name	R/w	Value Unit ^	⊟ ⊒ TMG USB IO-Link Master DE (COM6)			
[·] Teach values			. [0] Renesas YRL78IOLINKMAX Sample (V2)			
Ambient Light Intensity Limit	rw	2000 d				
IR Intensity Limit	rw	7000	<u> </u>			
Red Intensity Value 1	Ciau	100000				
Green Intensity Value 1						
Blue Intensity Value 1		dues				
Red Intensity Value 2		Input is out of range or has wrong format				
Green Intensity Value 2						
Blue Intensity Value 2	1					
Red Intensity Value 3		OK				
Green Intensity Value 3	W	10				
Blue Intensity Value 3	rw	0 d				
Red Intensity Value 4	rw	0 d -				

Figure 4-19. YRL78IOLINKMAX IR limit Teach value failure

#### 4.4.2.2 Using Standard Commands

The example below shows the automatic teaching of IR Limit "Teach IR Limit".

To write or teach a parameter to the board using a Standard command:

• Right click in the "Value" field corresponding to the parameter you want to teach.

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

• Left click "Execute".

You can verify the value taught by reading the parameter in the "Teach value" section.

Figure 4-20 shows the dialog box and setting of the IR limit.



File Options View Help	+ +? .	Specialist + ①		
Common Process Data Parameter Oscilloscope	in din			Tapology
Name	R/W	Value	Unit	TMG USB IO-Link Master DE (COM6)
Application Specific Tag	ſW	USE ID-Link	d	0] Renesas YRL78IOLINKMAX Sample (V2
[-] Parameter				
Gain	rw	1×	d	
Integration Time	IW	100	d	E
Temperature Limit	ſW	14200	d	
Red Hysteresis	ĩW	600	d	1. Right click in Field
Green Hysteresis	rw	300	d	
Blue Hysteresis	tw	150	d	
Pin2 Mode	tW	Ambient Light Switch	d	
Standard Command < Teach IR Limit>	wo	Teach IR Limit		
Standard Command < Teach Clear Limit>	wo	Teach Clear Limit Execute	-	
Standard Command < Restore Factory Settings>	wo	Restore Factory Setting		
Standard Command < Reset Temperature Values>	wo	Reset Temperature Values		2 Loft aliak
Standard Command < Teach Color 2>	WO	Teach Color 2		Z. Left click
Standard Command < Teach Color 1>	wo	Teach Color 1		
Standard Command < Teach Color 4>	wo	Teach Color 4		
Standard Command < Teach Color 3>	wo	Teach Color 3		-

Figure 4-20. YRL78IOLINKMAX IR Limit teaching

#### 4.4.2.3 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 4-21 shows the dialog box and setting of the factory settings restoration.

File Options View Help					
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Common Process Data Parameter Oscilloscope					Topology
Name	R/W	Value	Unit	^	
Application Specific Tag	ſW	USE IO-Link	в		🛛 🕘 [0] Renesas YRL78IOLINKMAX Sample (V2)
[-] Parameter					
Gain	ſW	1x	Ь		
Integration Time	ſW	100	Ь	E	
Temperature Limit		14200	в		
Red Hysteresis	rw	600	d		
Green Hysteresis	rw	300	Ь	-	
Blue Hysteresis	rw	150	в		
Pin2 Mode	rw	Ambient Light Switch	в		
Standard Command < Teach IR Limit>	wo	Teach IR Limit		-	
Standard Command < Teach Clear Limit>	wo	Teach Clear Limit			
Standard Command < Restore Factory Settings>	wo	Restore Factor			
Standard Command <reset temperature="" values=""></reset>	wo	Reset Tempera Cancel			
Standard Command < Teach Color 2>	wo	Teach Color 2			
Standard Command < Teach Color 1>	wo	Teach Color 1			
Standard Command < Teach Color 4>	wo	Teach Color 4			
Standard Command <teach 3="" color=""></teach>	WO	Teach Color 3		-	

Figure 4-21. YRL78IOLINKMAX Factory restoration setting



#### 4.4.3 Colours detection visualisation in Oscilloscope window

Figure 4-22 shows the colours detection as the RGB wheel is turned in front of the sensor.

In this instance the sensor has been taught to detect Red as colour 1 and Green as colour 2.

The table below summarises the variables used to display the traces and the switch points for the two colours.

Table 4-5	Oscilloscope	variables
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Scope window variable	Process Data	Trace colour	Description
Analog 1	Red Intensity	Green	Red intensity level in the colour detected
Analog 2	Green Intensity	Light Blue	Green intensity level in the colour detected
Digital 1	Colour 1 detected	Red	Switch point for Red colour detection
Digital 2	Colour 2 detected	Dark Blue	Switch point for Green colour detection



Figure 4-22. YRL78IOLINKMAX sample (V2) Colour Detection in Oscilloscope window



#### **Revision History**

Rev	Date		Description			
1107		Page	Summary			
1.00	Jul ,2014	-	First edition issued			



## YRL78IOLINKMAX IO-Link Starter Kit



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