logic IO
The M2M Enabler

Modular 1-Wire Concept Technical Manual

Revision 1.02

Introduction

This technical manual introduce how to install and use the modular 1-Wire network for X32 based RTCU units. The network protocol is the well known 1-Wire®[1] from Maxim/Dallas Semiconductors. Information on the possibilities and limitations using the 1-Wire on RTCU units will be explained also information on the tool free installation.

Currently the supported 1-wire products are the iButton®[1] identification key, with and without on-board memory and a temperature sensor. Other products may be supported in future please consult Logic IO for more information. All the supported 1-Wire products are available directly from Logic IO.

The iButton is a unique, factory-lasered and tested 64-bit registration number that assures absolute traceability because not two parts are alike. It comes in a small metal MicroCan that is very robust even in harsh environments. In order to read the iButton a special reader must be used. The reader is attached to the 1-wire bus and connects the iButton to the 1-wire bus. A small key-ring (iButton Fob) adapter is available so the iButton is easier to carry and place in the reader.

The temperature sensor is a small wide-range (–55°C to +125°C) temperature sensor, which requires no external power (it derives its power directly from the 1-wire bus, called parasitic power). This makes remote temperature sensing in various places very easy.

Supported RTCU units
MX2i pro+
MX2i pro
MX2i eco+
DX4 pro
DX4 flex
DX4 eco
AX9 pro
AX9 pro-x
AX9 eco
AX9 eco-x
CX1i pro
CX1i flex

[1] 1-Wire® and iButton® are registered trademarks of Maxim/Dallas Semiconductors.

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Ordering Information

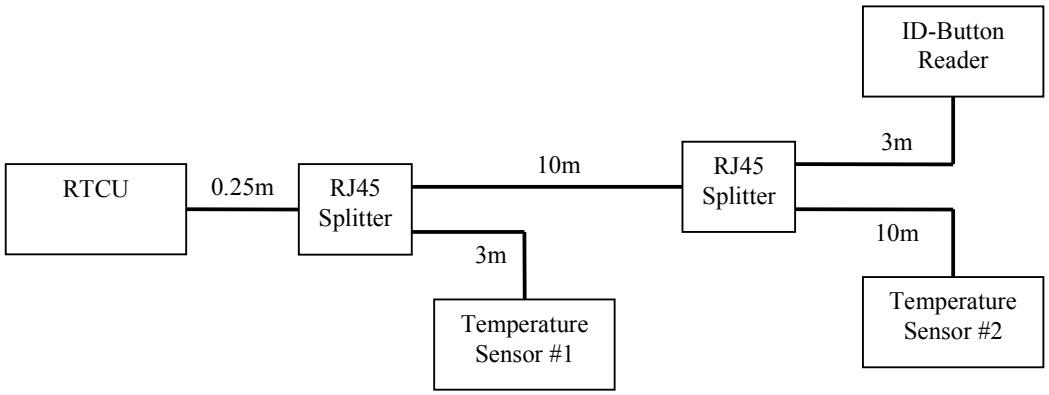
Order-code	Description
RT-O-1WM-IF1	Interface cable for the DX4, AX9 Series
RT-O-1WM-IF2	Interface cable for the MX2i unit
RT-O-1WM-IF3	Interface cable for the CX1i Series
RT-O-1WM-TEMP3	Temperature sensor cable, 3m
RT-O-1WM-TEMP10	Temperature sensor cable, 10m
RT-O-1WM-IDRD3	ID-Button Reader cable, 3m
RT-O-1WM-IDRD10	ID-Button Reader cable, 10m
RT-O-1W-ID1	iButton – Unique identification ID button
RT-O-1W-ID2	iButton – Unique identification ID button with 116 bytes of memory
RT-O-1W-FOB1	ID-Button Holder
RJ45-CMB	RJ45 Combiner for modular 1-Wire network
RJ45-SPL2	RJ45 1:2 Splitter for modular 1-Wire network
RJ45-UTP-02MB	2m UTP cable, black
RJ45-UTP-03MB	3m UTP cable, black
RJ45-UTP-05MB	5m UTP cable, black
RJ45-UTP-07MB	7m UTP cable, black
RJ45-UTP-10MB	10m UTP cable, black
RJ45-UTP-15MB	15m UTP cable, black

Installation

Installation of the modular 1-wire network can be done without the use of any tools, using standard of the shelf RJ-45 cables, splitters and/or combiners allowing multi device network installation.

The delivered interface cable for the selected RTCU ends in a RJ45 plug, from this point use cable splitters or combiners to attach 1-Wire devices onto the network.

Example of a modular 1-Wire network with two temperature sensors and one ID-Button Reader:



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Modular 1-Wire

Unit interface cables that connects the RTCU unit to a splitter or combiner, that again connects to branches with more splitters and combiners and at the end-points of this arbitrary topology various lengths of 1-Wire devices such temperature sensors or ID-button readers can be connected. As the backbone is based on standard RJ45 UTP cable technology expanding a network can easily be achieved.

Modular Temperature Sensor (RT-O-1WM-TEMP3 / RT-O-1WM-TEMP10)

The modular 1-wire Temperature Sensor features an easy to install and easy to use digital thermometer. The sensor offers an accuracy of typical +/- 0.5ºC and ranges from –55ºC to +125ºC.

RJ45 Connections:

Signal	RJ-45 connections (based on T568B Plug)
1-Wire Data	Pin 6 (green)
Ground	Pin 4 (blue)

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Modular ID-Button reader (RT-O-1WM-IDRD3 / RT-O-1WM-IDRD10)

The modular 1-wire ID-Button reader features an easy to install and easy to use modular 1-Wire ID-Button reader with controllable LED indicator. The ID-Button reader offers a way to uniquely identify persons or items equipped with ID-Buttons.

RJ45 Connections:

Signal	RJ-45 connections (based on T568B Plug)
1-Wire Data	Pin 6 (green)
1-Wire LED	Pin 2 (orange)
Ground	Pin 4 (blue) + Pin 5 (blue/white)

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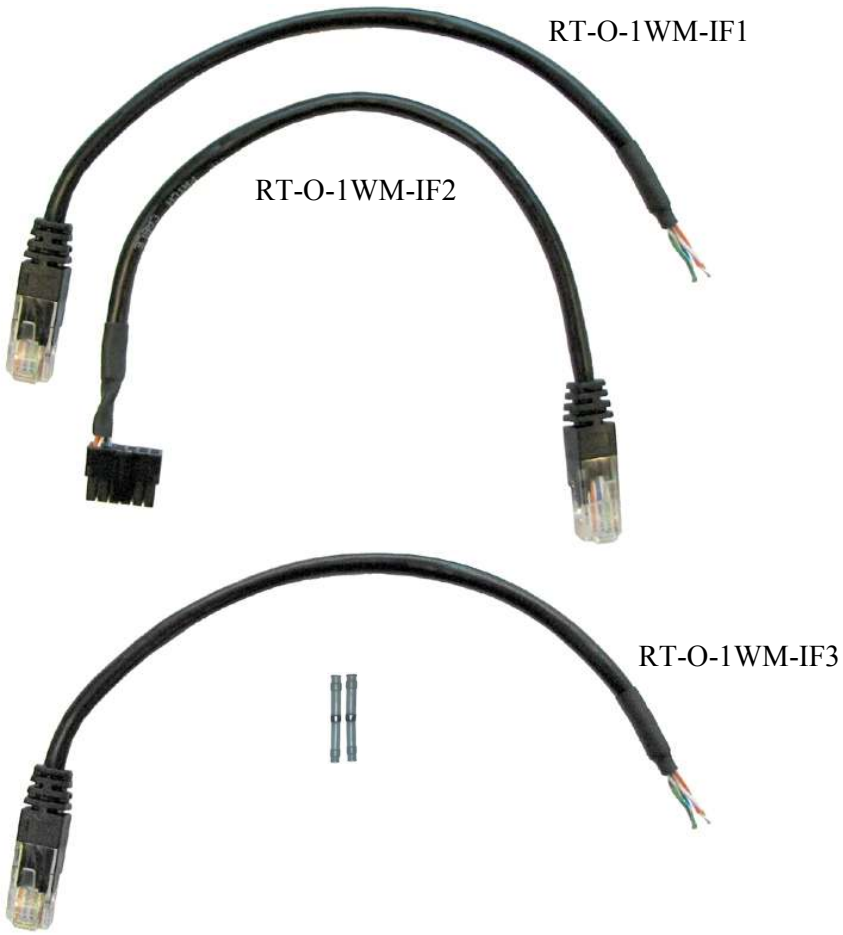
Modular 1-Wire interface cables (RT-O-1WM-IF1 / RT-O-1WM-IF2 / RT-O-1WM-IF3)

The modular 1-wire interface cable makes the physical bridge to the modular 1-Wire network. The Modular 1-Wire interface cable is available in two versions: For the MX2i series (RT-O-1WM-IF2), for the DX4/AX9 series (RT-O-1WM-IF2) and for the CX1i series (RT-O-1WM-IF3). In the package of RT-O-1WM-IF3 heat shrink solder tube are included for easy connection to the RTCU CX1i series interface cable.



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RT-O-1WM-IF2 Tyco connection:

Signal	Tyco connector
1-Wire Data	Pin 1
1-Wire LED	Pin 7
Ground	Pin 2

RT-O-1WM-IF1 flying leads connection:

Signal	Flying leads
1-Wire Data	green + green/white
1-Wire LED	orange + orange/white
Ground	blue + blue/white

RT-O-1WM-IF3 flying leads connection:

Signal	Flying leads
1-Wire Data	green + green/white
Ground	blue + blue/white

RJ45 connection:

Signal	RJ-45 connections (based on T568B Plug)
1-Wire Data	Pin 6 + 3 (green + green/white)
1-Wire LED	Pin 2 + 1 (orange + orange/white)
Ground	Pin 4 + 5 (blue + blue/white)

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Modular 1-Wire network accessories:

UTP network cable and the cable combiner and splitter below make almost any 1-Wire network configuration possible.

RJ45-CMB

RJ45-SPL2

RJ45-UTP-02MB
RJ45-UTP-03MB
RJ45-UTP-05MB
RJ45-UTP-07MB
RJ45-UTP-10MB
RJ45-UTP-15MB

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1-Wire bus

It's important to understand that the 1-Wire bus is a very complex thing, even though it only consists of only two wires; the communication form and the communication speed will set a high demand for correct cabling and load of the bus. Every 1-Wire network behaves differently due to the variation in cable length, the amount of devices (load) on the bus and the surrounding environment.

Topology

When configuring 1-Wire hardware and transmission lines (the 1-Wire bus) certain terminologies are used; these terms are circuit topology, radius and weight.

Circuit topology is the way to describe how the circuit is coupled. There are three topologies Linear, stubbed and star.

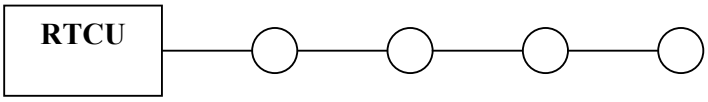

Figure 1 - Linear topology network

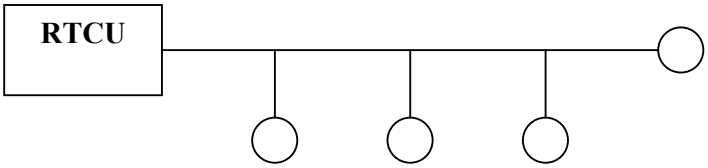

Figure 2 - Stubbed topology network

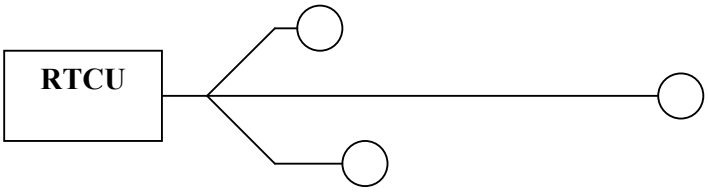

Figure 3 - Star topology network

The three topologies will behave differently due to signal reflections etc. The most reliable topology is the linear topology but sometimes it's not possible to obtain this topology. When the three topologies are mixed the circuit becomes even more complex and it's very hard to predict how reliable the network will be.

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Radius and Weight

Other terms like radius and weight are used to describe the length and load of the 1-wire bus. The radius describes the total length of the bus. The 1-wire protocol has a radius limitation of 750-meters due to timing, but the RTCU units only support a total radius of approximately 65-metes.
If a linear topology is used and four devices are attached each with 1-meter space in-between the total radius of the network is the length to the furthest device i.e. 4-meter.

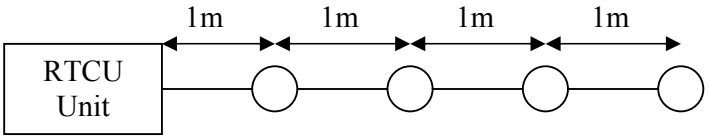

Figure 4 - Weight and radius of the network

The weight of the network consists of two things; the total amount of cable and the number of devices. Every time a 1-wire device is attached to the network it adds some weight due to its capacitance. An iButton add a weight of 1-meter and a temperature sensor adds 0.5 meter. In the linear topology case the weight of the cable would be 4-meter and with four temperature sensors attached the total weight will be 6-meters.

The RTCU unit is designed only for short and medium range networks. As mentioned earlier the RTCU-unit supports a radius of approximately 65 meters and a maximum weight of 65 meters. When a linear topology is used it is possible to have 64.5 meters cable and a single temperature sensor. See examples in the table 1 below.

Max Weight [m]	Cable [m]	Device Weight [m]	Total Weight [m]
65	64,5	0,5 = 1 temperature Device	65
65	57	8 = 16 temperature Device	65
65	49	16 = 32 temperature Device	65

Table 1 - Examples on how to determine the weight of a 1-wire network

The total weight of the network must not exceed the maximum allowed weight i.e. 65m. The bus should not be routed together with high power signals like the mains supply or other equipment that will have electrical influence on the 1-wire signal.

It's advisable to read the Maxim Application note "App Note 148: Guidelines for Reliable 1-Wire Networks" which can be downloaded from www.maxim-ic.com

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Software

Functions for the 1-Wire are implemented in the RTCU-IDE; these are:

Function	Description
owSearch	Search for 1-Wire Devices
owTempGetID	Get the ID of a specific temperature sensor
owTempGet	Get the temperature from a specific device
owiButtonGetID	Query iButton for its ID
owiButtonReadData	Read data from a iButton with on-board memory
owiButtonWriteData	Write data to an iButton with on-board memory
owiButtonEnableLED	Enable or disable the use of iButton Reader LED
owiButtonSetLed	Control the iButton LED

Please refer to RTCU IDE online-help for how to use theses functions and code examples.

iButton

The owiButtonGetID function will return a string with the iButton ROM-number in hex format. In order to use the function it's necessary to know the ROM-number of the iButton. The ROM-number can be read on the top of the iButton. Please see figure 5. All twelve digits have to be read.

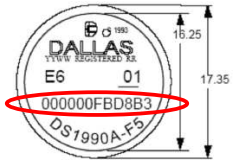

Figure 5 - iButton ROM-number

The ROM-number from figure 5 is 000000FBD8B3. When an iButton is used the ROM-number can be compared to a known one to clarify if the iButton has a valid ROM-number or not.

It cannot be determined when a user places an iButton in the reader; therefore it is important to call the owiButtonGetID function very often, so the user won't experience a delay before the iButton is read. Make sure not to have more time-consuming tasks in the main program loop than necessary.
The iButton reader is supplied with a LED that easily can be used to inform the user if the iButton placed in the reader was valid or not.

Please notice that it's only possible to have ONE iButton connected to the 1-wire bus at a time.

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Temperature sensor

Each temperature sensor has a unique ROM-number like the iButton. This number is used to point out one of up to 32 temperature devices, which is the maximum capability of the RTCU-unit.
Before any temperature measurement can be carried out the ROM-number has to be discovered. By using the 1-wire search function all temperature sensors on the 1-wire bus are discovered and all the ROM-numbers are stored in a temporary list placed inside the RTCU unit. When the unit is powered off the list is erased and a new search has to be performed on power on. The devices are sorted with the lowest ROM-number first. If a device is removed from the bus all devices with a higher ROM-number will move one number down the list when a new search is carried out. The search function returns the number of devices found.

As the search function is intended for generally 1-Wire use, the family number has to be supplied when making the function call. For 1-wire temperature devices the family number is 1.

After the 1-wire search is done the temperature from each device on the bus can be read. Use the 1-wire get temperature function to read the temperature from a device. Place the number (between 1 and the number returned by the 1-wire search function) of which temperature sensor is to be read.

The temperature sensors retrieve its power directly from the 1-wire bus this is called parasitic power and no external power is needed for remote temperature sensing. A temperature conversion takes approximately 0.8 → 1.0 seconds in this mode. This is due to the power needed for a temperature conversion when operating in parasitic mode.

Please Notice and be aware of

As mentioned earlier the 1-wire network is very complex and sensitive for interruptions. If an interrupt or any interactions interfere with the bus while a communication or a device search is performed it may result in an erroneous reading, termination of device search or devices that are not discovered and/or accessed correctly. The more often a 1-wire device search is done the more it's likely that a device is left out due to interrupts on the bus. This will for the temperature sensors result in a different organized list of ROM-numbers and the user will experience a reading of another temperature sensor than expected or an "-1" error (device not known) if it was the device with the highest ROM-number that was left out.

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