



# Application Note 1-Wire Basics Ver. 1.0

This application note describes how to configure and use the Maxim/Dallas Semiconductors 1-Wire<sup>®1</sup> products with the Logic IO RTCU units. The document will explain some basic 1-wire hardware configuration. Currently the supported 1-wire products are the iButton<sup>®1</sup> identification key 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 ( $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ) temperature sensor, which needs no external power (it derives its power directly from the 1-wire bus, called parasitic power). This makes it very easy to do remote temperature sensing in various places.

## Hardware

It's important to understand that the bus is a very complex thing, even though it only consist of two wires; the communication form and the communication speed will set a high demand for correct cabling and loading 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.

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.

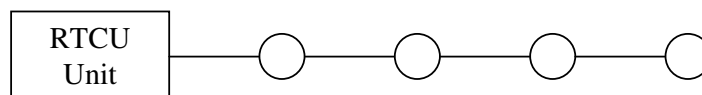


Figure 1, linear topology network

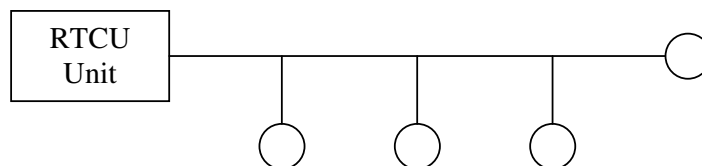


Figure 2, stubbed topology network

<sup>1</sup> 1-Wire<sup>®</sup> and iButton<sup>®</sup> are registered trademarks of Maxim/Dallas Semiconductors.

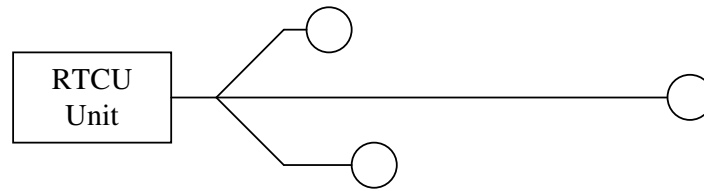


Figure 3, star topology network

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.

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-unit supports only a total radius of approximately 65-meters. 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.

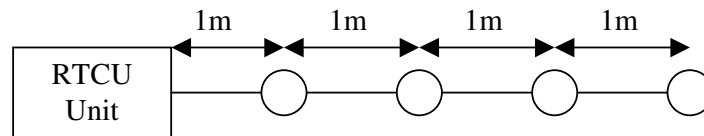


Figure 4, weight and radius of the network

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.



The cable has to be a Category 5 twisted pair copper wire. Other cables can be used but the radius and weight capabilities are highly reduced.

Please note RTCU-A9i Max units before serial number x41001000 (x can be the number 1,2 or 3) only supports:

- 6 temperature devices.
- Maximum network radius of 20 meters
- Maximum weight of 20 meters

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](http://www.maxim-ic.com).

For 1-wire software functions and examples please consult the online documentation supplied with the RTCU IDE program.

## 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.