

Keywords: 1-wire, 1wire, interface, ibutton, overview, memory, security, control, single contact

#### **APPLICATION NOTE 3989**

# Add Control, Memory, Security, and Mixed-Signal Functions with a Single Contact

Abstract: This application note provides a high-level overview of the 1-Wire® interface. It discusses power and data delivery along with data-bit-level communication, device selection, and the unalterable, unique ID in each device. As its name implies, the single-contact 1-Wire interface is an unmatched solution that provides key functions to systems where interconnect must be minimized.

#### **Overview**

The Dallas Semiconductor 1-Wire bus is a simple signaling scheme that performs half-duplex bidirectional communications between a host/master controller and one or more slaves sharing a common data line (**Figure 1**). Both power and data communication for slave devices are transmitted over this single 1-Wire line. For power delivery, slaves capture charge on an internal capacitor when the line is in a high state and then use this charge for device operation when the line is low during data transmission. A typical 1-Wire master consists of an opendrain I/O port pin with a resistor pullup to a 3V to 5V supply. More sophisticated masters, including dedicated line-driver solutions, are available from Dallas Semiconductor. This clever communication scheme also allows you to add memory, authentication, and mixed-signal functions at any time, easily and efficiently.



Figure 1. In a 1-Wire master/slave configuration, all devices share a common data line.

### **64-Bit Serial Numbers**

There is an important, fundamental feature in every 1-Wire system: each slave device has a unique, unalterable (ROM), 64-bit, factory-lasered serial number (ID) that will never be repeated in another device. Besides providing a unique electronic ID to the end product, this 64-bit ID value allows the master device to select a slave device among the many that can be connected to the same bus wire. Part of the 64-bit ID is also an 8-bit family code that identifies the device type and functionality supported.

## **Data-Bit-Level Communication**

The bus master initiates and controls all 1-Wire communication. As illustrated in **Figure 2**, the 1-Wire communication waveform is similar to pulse-width modulation, because data is transmitted by wide (logic 0) and narrow (logic 1) pulse widths during data-bit time periods or time slots. A communication sequence starts when the bus master drives a defined length "Reset" pulse that synchronizes the entire bus. Every slave responds to the Reset pulse with a logic-low "Presence" pulse. To write data, the master first initiates a time slot by driving the 1-Wire line low, and then either holds the line low (wide pulse) to transmit a logic 0 or releases the line (short pulse) to allow the bus to return to the logic 1 state. To read data, the master again initiates a time slot by driving the line with a narrow low pulse. A slave can then either return a logic 0 by turning on its open-drain output and holding the line low to extend the pulse, or a logic 1 by leaving its open-drain output off to allow the line to recover. Most 1-Wire devices support two data rates: Standard speed of about 15kbps, and Overdrive speed of about 111kbps. The protocol is self-clocking and tolerates long inter-bit delays, which ensures smooth operation in interrupted software environments.



Figure 2. This waveform example shows master-initiated write/read of data bits with slave and master sampling points.

## **Device Selection**

The first action in a 1-Wire communication is selecting a slave device for subsequent communications. In a single slave-device environment, the selection sequence is minimal. In a multidevice environment, however, slave selection is done either by selecting all slaves or a specific slave targeted by its 64-bit ID. A binary search algorithm (described as ROM-level commands in 1-Wire data sheets) enables the bus master to "learn" and subsequently select the respective 64-bit ID of any slave device on the line. Once a specific slave is selected, the master issues device-specific commands and sends data to it, or reads data from it. Meanwhile, all the other slave devices ignore communications until the next reset pulse is issued.

## Summary

Layered on these 1-Wire fundamentals are a variety of memory, digital, analog, and mixed-signal functions. This variety results in a product portfolio optimized for applications where the single-contact 1-Wire interface can solve an interconnect-constrained problem and/or add value with unique product-line features. The 1-Wire products are available in standard IC packaging and the Company's rugged, stainless steel <u>i</u>Button package. Products, packaging, and extensive software support are detailed at <u>1-Wire Devices</u>.

#### More Information

For technical questions and support: <u>http://www.maxim-ic.com/support</u> For samples: <u>http://www.maxim-ic.com/samples</u> Other questions and comments: <u>http://www.maxim-ic.com/contact</u>

#### **Related Parts**

DS2401:	QuickView Full (PDF) Data Sheet Free Samples
DS2405:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2406:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2408:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2411:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2413:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2417:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2431:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2432:	QuickView Abridged Data Sheet
DS2433:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2450:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2480B:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2482-100:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2502:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS2505:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS28E01-100:	QuickView Abridged Data Sheet
DS28E04-100:	<u>QuickView</u> <u>Full (PDF) Data Sheet</u> <u>Free Samples</u>
DS28EA00:	QuickView Full (PDF) Data Sheet Free Samples

AN3989, AN 3989, APP3989, Appnote3989, Appnote 3989 Copyright © by Maxim Integrated Products Additional legal notices: <u>http://www.maxim-ic.com/legal</u>