DESIGN SHOWCASE

Dissecting the versatile Dallas 1-Wire network

The Dallas 1-Wire bus is a simple signaling scheme that performs two-way communications with peripheral devices over a single electrical connection. In any 1-Wire system, there is a single master and one or more slaves sharing a common data line. On this single data line are multiplexed address, control, and data information. Most of the devices operate entirely from power robbed from the data bus, although some opt to use local power if it is available. Charge is stored internally during periods when the data line is high, and the device operates using this charge during periods when the data line is low. An array of devices can be attached to a microprocessor on a single port pin. 1-Wire devices are available that store data (NV RAM, EPROM, and EEPROM), read and log temperatures and voltages, adjust resistance, count, control and sense, interface to other systems, and perform time keeping and cryptographic functions.

The most basic feature that all 1-Wire bus devices share is that each device has a factory-lasered address (like a serial number) that will never be repeated in any other device. That is to say every device is unique. This allows any single device to be individually selected from among many that may be connected to the same bus wire. Because one, two, or even dozens of 1-Wire devices can share a single wire for communications, a binary searching algorithm is used to find each device in turn. Once each device address is known, any device can be uniquely selected for communication using that address.

Electrically, the 1-Wire bus is a wired-OR configuration. A typical master consists of an open-drain pull- down and a resistor pull-up to 3 to 5 volts. Slaves have an open drain output and are only able to pull the bus down.

The 1-Wire data waveform is similar to pulse-width modulation. The bus master issues a reset (the longest low period) that synchronizes the entire bus. The master then initiates each bit time period, or time slot, and writes zero or one bits using wide or narrow pulse widths. To read data, the master initiates time slots using narrow pulses, and the slaves return a logical 0 bit by holding the line low and thereby extending the pulse, or a logical 1 bit by leaving the pulse unchanged.

Most 1-Wire devices support two data rates. The lower (standard) data rate is about 14kbps and the higher data rate is about 140kbps. An even higher data rate, 1Mbps, is in development. The protocol is self-clocking and tolerant of long inter-bit delays, making for easy operation in interrupted software environments.

The first pan of any communication involves the selection of a slave device for subsequent communications. This can be done by selecting all slaves, selecting a specific slave (using the serial number of the device), or discovering the next slave on the bus using a binary search algorithm. Once a specific device has been selected, all other devices drop out and ignore subsequent communications until the next reset is issued.

Once a device has been isolated for bus communication, the master can issue device-specific commands to it, send data to it, or read data from it.

An integral part of the unique ID number in each slave is an 8-bit family code. This code is specific to the device type. Because each device type performs different functions, this code is used to select the protocol that will be used to control or interrogate it. Because each device type performs a different function and serves a different purpose, each has a unique protocol once it has been selected.

Because slave devices may have timed processes or monitor real-world (asynchronous) data sources, they sometimes need to be able to gain the attention of the master quickly. A poll of several dozen connected slaves, addressing each by unique ID number and then reading its internal registers, is somewhat slow and can be CPU-intensive. A special type of device search, called a conditional search, is also supported for this purpose. Slave devices will appear in this special search only if they are in a condition, or have had an event, that matches preset criteria. The master performs this conditional search at regular intervals, and any device that is found is a device in need of service.

Most 1-Wire devices are available in durable, stainless steel containers about the size of four stacked dimes called iButtons. Some iButtons contain tiny lithium cells that power internal real-time clocks or data loggers and maintain NV SRAM data or configuration information for well over 10 years. Some have EEPROM technology that requires no backup power.

These stainless steel iButtons also have their unique serial number laser-etched into the lid so humans can identify them. Many 1-Wire devices are also available in standard 50 TSOC, or TO packages for PC board mounting. Chip-scale packaging (flip chip) forms are also available for some devices.

1-Wire peripherals include various serial- and parallel- port adaptors for PCs, probes, fob and holders, and a wide array of iButton attachments.

Extensive 1-Wire software examples and APIs are available that implement standards for file communications, structure, and error control at www.ibutton.com.

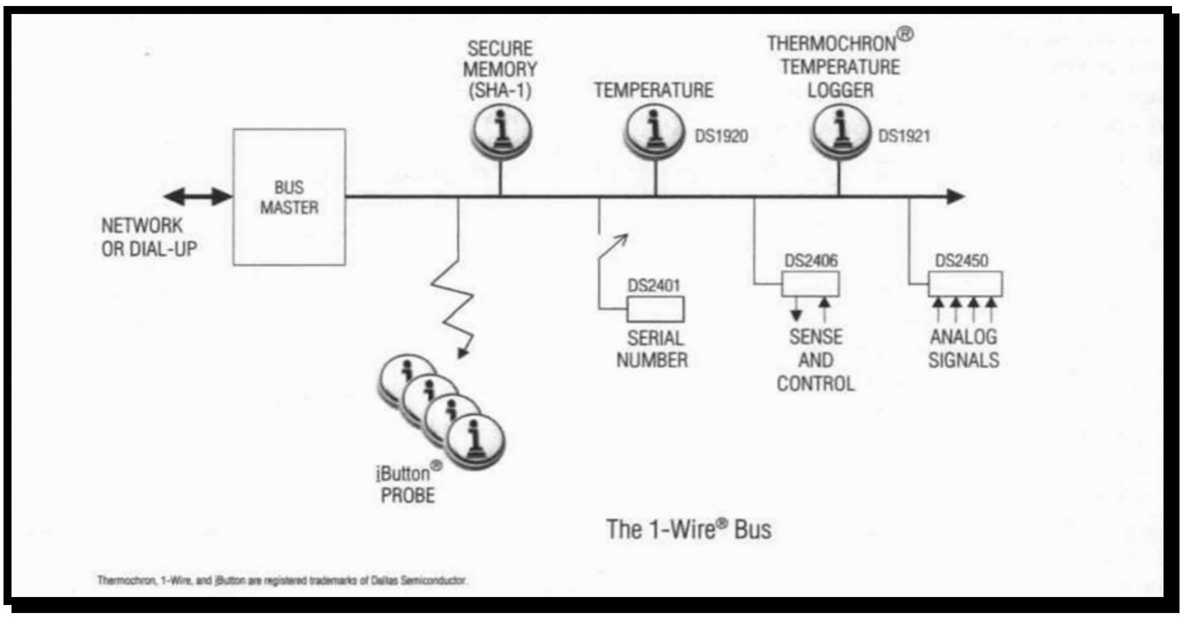

Figure 1. Various 1-Wire devices store data (NV RAM, EPROM, and EEPROM read and log temperature and voltage, adjust resistance, count, control and sense, interface other systems, and perform timekeeping and cryptographic functions.