Application Note 212
Autoconfiguration of 1-Wire Modular Systems

INTRODUCTION

As computerization continues to expand, it is a common occurrence for a system or net to require association of location or function at a particular node. Examples include rack and modular systems, building security systems where doors and windows are monitored, stocking, bin storage, or similar warehousing where a specific location requires physical node identification. The preferred method is one that allows automatic association of the node with the location or function of the installed device. This Application Note discusses autoconfiguration methods on 1-Wire® nets.

ASSOCIATING NODE AND LOCATION—BACKGROUND

In the simplest method, a preassigned association between a number and a location such as a door or window is defined. Afterward, the numbered node device is attached to the net at the assigned location. Alternatively, the bus master could locate and associate each device as it is installed eliminating the possibility of mislabeling a node. An interesting illustration of preassigning association of location and function is a key cabinet, that is, the traditional locked box containing a column and row array of keys hanging on hooks. For example, suppose one wanted the key to the supply cabinet. In the precomputer era, each key possessed a hand-written label and a designated location in the cabinet. The desired key was found by reading the tags, or knowing the proper location in the cabinet where the key was stored. Upon its return, the key would be restored to its original location. If the key became misplaced in the cabinet, it was necessary to examine each key's tag until the one in question was located and returned to its proper place. Maintaining the cabinet could be a time consuming and costly endeavor.

Although the key cabinet is used as a familiar example, the basic concepts are broadly applicable to rack and modular systems, battery packs and ink cartridges, stocking, bin storage, or similar warehousing where a specific location requires node identification. The concept extends equally to halls and corridors of a building in which case the doors and entryways are the "keys" of our example. From these we see that the general case is a two-dimensional array of columns and rows that can represent various specifics, but have in common the need to associate location and or function of both the node and the node-labeling device. As described above, the two techniques available to identify the nodes are the use of preassigned association between a number and a location, and master location in which the numbered node device is attached at the required location and the bus master finds and notes the proper association.

TAGGING ELECTRONICALLY

In a modern system, the hand-written label is replaced with an electronic one allowing a computer or µP bus master to keep track of a key regardless of where it is placed in the array. Both preassigning and master-location methods can be implemented using 1-Wire devices such as the DS2401 silicon serial number or improved upon by taking advantage of the availability of 1-Wire devices with on-board memory. This allows information concerning the location or function of either the device or the position to be stored within the node identification device (referred to as tagging), to minimize the probability of error in handling. Nonvolatile (NV) memory devices such as the DS2430A and DS2433 that can be written many times are available for this purpose, as well as one-time programmable (OTP) devices such as the DS250x series. A review of some available 1-Wire products for tagging follows.

DIGITAL SERIAL NUMBER

Since every 1-Wire device produced by Dallas Semiconductor is created with its own guaranteed unique 64-bit address, it is possible to use any one of them as an electronic address for association with a node. For example, in the key cabinet illustration given previously each key could have a computer-readable Dallas Semiconductor 1-Wire chip permanently attached or embedded. This important electronic feature allows the key to be returned to the cabinet and placed in any arbitrary position as the bus master can locate it by reading its unique ID. While the DS2401 is the lowest-cost 1-Wire device available, other 1-Wire devices containing memory could be used where it is advantageous for the product to be able to provide information concerning its source, installation date, use, or current status electronically.

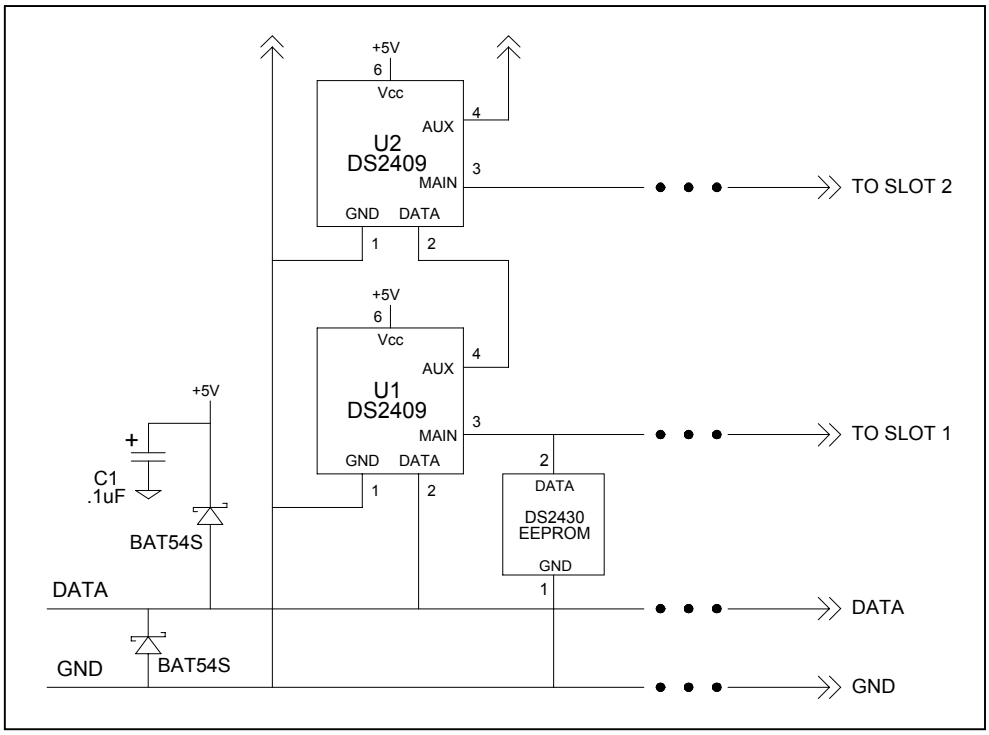
ONE-TIME PROGRAMMABLE (OTP) DEVICES

Dallas Semiconductor offers the DS250x series of parts with up to 64kb of OTP memory, which provide an economical means of labeling rack and modular systems and the plug-in cards that go with them. By providing not only a unique registration number but also including information describing the product to which it is attached, a DS250x can streamline assembly while reducing handling errors. For example, by storing card specifications on board using a DS250x combined with a 1-Wire net on the back plane, a modular system can be electronically configured. When the card is inserted into a card-cage slot, the 1-Wire master is able to determine the slot in which it was placed and read its specifications from its DS250x. The same example applies for other products such as battery packs and ink cartridges as well as stocking, bin storage, or similar warehousing.

CHAIN SEQUENCING

While the master can quickly find the 1-Wire devices on the net using a search algorithm, it has no means of knowing the sequence in which they are connected. Although it is possible to use the two techniques described earlier to predetermine sequence, use of DS2409s wired in a daisy chain makes it possible to electronically determine sequence. Rather than connecting the DS2409 in parallel along the main trunk to form branches, they can be used to break the main bus into series connected sections as shown in Figure 1. The net is then constructed of the required number of these sections linked together in a ladder- or chain-type architecture. While the first DS2409 is always connected to the bus master, others will only become available when the pass gates of those preceding them are turned on. This has the advantage that the on-resistance of the pass gate in the DS2409s helps to filter out the noise and spurious signal response of an unterminated transmission line. The down side of the pass gate on-resistance is that it limits the maximum length of the bus to that value which causes problems with the logic-low level. This would be about 100Ω, or ten DS2409s, which provides a 300m net if each section were 30m. The method accommodates faults or addition and removal of sections of the bus by isolating the affected portion beyond the last DS2409 prior to the adverse activity. Figure 1 shows two sections used to monitor slots in a back plane. This arrangement allows for automatic configuration of modular systems such as a back plane by the master. Referring to the figure, notice that U1 is the only device located on the net at power-up or reset. U2 is found on the net only after the AUX port of U1 is turned on, thus determining the sequence of DS2409s on the net. Additional DS2409s connected in the same manner are sequenced in the same way with the pass gates of all DS2409s being left on during normal operation. Once determined, saving this sequence data at the host or on a memory chip such as the DS2430A EEPROM shown connected to U1 eliminates the need to re-scan on each power-up. Notice that the AUX output of the DS2409 forms the net trunk and the 1-Wire slaves are connected to the MAIN output. This allows activity on the branch to flag the bus. Therefore, if a card were to be inserted into Slot 1, U1 would set a flag that would notify the master to interrogate the arrival and determine its capabilities. Information on constructing an X-Y matrix using a combination of DS2409s and DS2406s can be found in section four of *Tech Brief 1*. [1]

Figure 1. Net architecture using DS2409s in a series-connected daisy chain.



SUMMARY

Dallas Semiconductor/Maxim has developed mature solutions for association of location and/or function at a particular node on a 1-Wire net. These include simple devices that only provide an electronic address, devices that also possess OTP or EEPROM memory on-board, and circuit arrangements that permit automatic association of the node with the location or function of the installed device. Use of these solutions to provide a unique electronic address for portable products such as plug-in cards, battery packs, and inks cartridges simplifies association and minimizes the probability of human error. Selection of 1-Wire devices with memory enhances products by providing electronic access to data concerning the function, specifications, or other pertinent information useful to configure or evaluate them.

References:

1. Tech Brief 1 is available at: http://www.maxim-ic.com/appnotes.cfm/appnote_number/570.