

## Introduction

A common problem among board designs is that they require a means to configure hardware options, such as driving signals to a fixed high or low state, or controlling the routing of signals between two or more points. Although a DIP switch can solve these problems, it has the drawback that someone must physically set the switches, introducing the possibility of user error, mechanical damage, and the need for customer support to resolve these problems. The ispGDS family is a cost effective solution to these problems, since they can duplicate the functionality of a DIP switch without requiring manual switch setting. You also gain additional functionality through in-system programmability and nonvolatile E<sup>2</sup>CMOS<sup>®</sup> storage of the switch configuration. By using the four-pin TTL interface for in-system programmability, you can configure the device under software control, allowing a user to change the hardware setup without physically removing a card or manipulating a DIP switch. By simplifying the task the user faces in configuring the hardware, you improve system reliability and ease of use while reducing your customer support requirements.

## Significant Gains in Reliability and Cost

You can significantly improve system reliability using the ispGDS family. Since the ispGDS family can provide the same functionality with fewer pins than a DIP switch, and since ispGDS devices don't require pull-up resistors, your design will require fewer solder joints and external parts, improving mechanical reliability and lowering assembly cost. The ispGDS family also provides additional capability for system test. Since you can set each I/O pin

of an ispGDS device to either Vcc or Ground (GND), your system software can control the ispGDS device to provide test signals to other parts of the circuit, reducing test complexity and time.

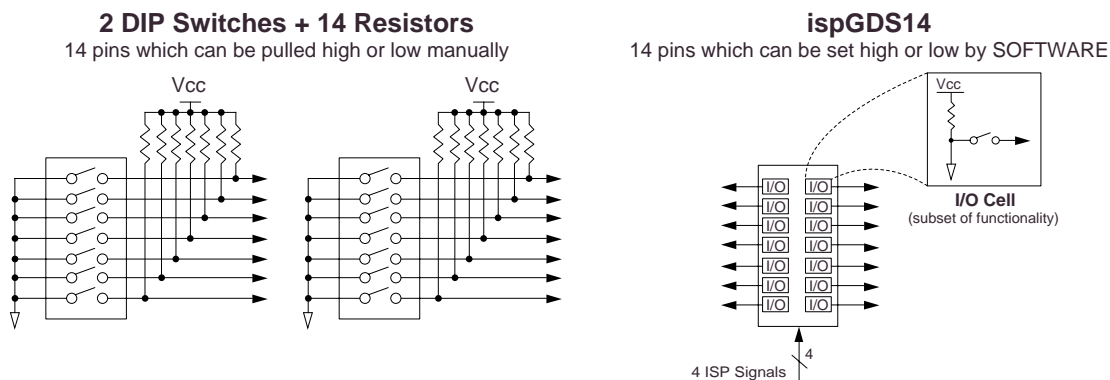
## Efficient Use of Board Space

In many applications, a DIP switch is configured with one side of the switch tied to GND, and the other side connected to pull-up resistors, as shown in the diagram below. The ispGDS family eliminates the need for these connections to GND and pullups, freeing package pins that would have been tied to GND to do something useful. For instance, an ispGDS14 has 14 pins available that can be internally tied to either Vcc or GND. This is accomplished in a 20-pin package. The equivalent DIP switch solution would require *two* seven-position DIP switches (which means two 14-pin packages) and pull-up resistors for each of the 14-switch outputs (see Figure 1).

## Digital Crosspoint Switch

Simple DIP switch replacement is not the only use for ispGDS devices. Since ispGDS devices are configured as two banks of I/O pins, with any pin in one bank able to make a connection to any pin in the other bank, an ispGDS device can also function as a digital crosspoint switch. This crosspoint switch capability provides the designer with the ability to change the routing and distribution of signals under software control. For example, the ispGDS could select one of several interrupt lines from a bus and route to a single net on the board. Another example would be swapping MSB and LSB bytes from a databus.

**Figure 1. ispGDS Devices Offer a Software-Controlled Alternative to DIP Switches.**



# Using ispGDS Devices

## A Variety of Matrix Sizes

Lattice Semiconductor offers the ispGDS in three switch matrix sizes:

Device Name	Matrix Size	I/O Pins
ispGDS22	11 X 11	22
ispGDS18	9 X 9	18
ispGDS14	7 X 7	14

As noted above, the ispGDS22 provides an 11 x 11 crosspoint matrix, the ispGDS18 provides a 9 x 9 matrix, and the ispGDS14 provides a 7 x 7 matrix. The size of the matrix indicates the size of the banks — for example, the ispGDS22 has two banks that are 11 pins wide. In this case, you can route any one of the 11 pins on one bank to any one, several or all of the 11 pins on the other bank.

## Free ispGDS Programming Software

To assist you in designing software to program ispGDS devices, Lattice provides a library of ANSI-standard C language routines that implement the ispGDS programming algorithms. These routines allow you to program and read the devices simply by making a function call to the appropriate library function. Sample applications are provided which use the PC parallel port for programming,

allowing you to program the ispGDS through a PC parallel port without modifying or compiling any code.

If you want to program ispGDS devices through another custom interface, you can modify the ispGDS source code. The hardware-dependent portion of the code is isolated in a few functions, allowing you to easily and quickly change this interface to accommodate your custom hardware needs. The diagram below shows a top level block diagram of a typical system using an ispGDS.

## Summary

ispGDS devices offer DIP switch functionality and in-system programmability at a price that is competitive with traditional DIP switch approaches. You can also use an ispGDS device to emulate a digital crosspoint switch, where any input on one bank can be driven to one or more outputs on any other bank. Through in-system programmability, ispGDS devices can also provide software controlled test capability, by driving signals either high or low, or rerouting signals for test. Software-controlled board configuration is now a reality.

## Technical Support Assistance

Hotline: 1-800-LATTICE (Domestic)  
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Figure 2. Typical System Using an ispGDS device and ispGDS Download Software

