Lattice Semiconductor Corporation

User Electronic Signature

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Introduction

In the course of system development and production, the proliferation of PLD architectures and patterns can be significant. To further complicate the record-keeping process, design changes often occur, especially in the early stages of product development. The task of maintaining "which pattern goes into what device for which socket" becomes exceedingly difficult. What's more, once a manufacturing flow has been set, it becomes important to "label" each PLD with pertinent manufacturing information which can be quite beneficial in the event of a customer problem or return – traceability aided by a manufacturing history can help to quickly reconstruct details of a defective product and thereby effect a speedy solution.

Lattice's ispLSI®, ispMACH™, GAL®, ispGAL®, ispGDX®, ispGDS® and ispPAC® families can ease the problems associated with document control and traceability, thanks to a feature called User Electronic Signature (UES). This application note describes the concept behind the UES, how it is used, and the advantages associated with manufacturing flow control, documentation and traceability.

The UES is essentially a user's "notepad" provided in electrically erasable (E^2) cells on each Lattice device. Essentially an extra row appended to the array and allocated for data storage, the physical size of the UES varies by device type. Table 1 lists the various sizes of the UES. All of the Lattice ispJTAG™ devices (ispLSI 1000EA, 2000E, 2000VE, 2000VL, 2000V, 5000V, ispMACH and ispGDXV) have a 32-bit USERCODE as defined by the IEEE 1149.1 boundary scan specification. The ispGDX and ispLSI 8000 families have both a 32-bit USERCODE and UES.

Lattice incorporated the UES to store such design and manufacturing data as the manufacturer's ID, programming date, programmer make, pattern code, checksum, PCB location, revision number and product flow. The intent was to assist users with the complex chore of record maintenance and product flow control. In practice, the UES can be used for any of a number of ID functions.

Within the various number of bits available for UES data storage, users may find it helpful to define specific fields to make better use of information storage. A field may use only one bit (or all bits), and may contain a variety of topics. Some fields should probably be reserved for future expansion. The possibilities for fields are endless, and completely up to the user. As an example for the GAL16V8, the UES could be divided into five fields: manufacturer's ID (two bytes or 16 bits), device program data code (two bytes), programmer ID code (one byte), pattern ID code (two bytes) and a reserved section (one byte).

Even with the device's security feature enabled, the UES can still be read. If a pattern code is stored in the UES, the user can identify which pattern has been used in a given device. In this way, a device pattern can be confidentially retrieved. As a second safety feature, when a device is erased and repatterned, the UES row is automatically erased. This prevents a situation in which an old UES might be associated with a new pattern (no information is better than wrong information). It is the user's responsibility to update the UES when reprogramming. It should be noted that UES information will be included in the checksum reading. Therefore, when the UES is modified, the checksum will also change.

The UES may be accessed several ways (read or write) for all devices listed in Table 1. First, most third-party programmers support the UES option through the programer's user interface, so programming or verifying the UES is as simple as programming or verifying any other array. Second, the UES may be installed within the JEDEC file by selecting the proper fuse locations in the fuse map. Consult specific device data sheets or the Lattice CD-ROM or web site at www.latticesemi.com. Third, the UES and USERCODE can be edited within ispLEVER™. See the ispDesignEXPERT online help for information on the specific software feature to access the UES. Fourth, the ispVM™ System software supports editing the UES in the JEDEC file or displaying the UES directly. The UES edit feature supports both HEX and ASCII modes for editing the UES information. Refer to the ispVM software online help.

Though provided to assist designers and manufacturers who use Lattice products, making use of the UES is not essential to realizing the many benefits of Lattice devices. For those willing to invest in it, however, the reduction of hidden costs associated with PLDs can be significant. The following outlines some of the opportunities presented.

Table 1. UES Sizes by Device

Device/Family	UES Size
All ispJTAG Devices	32 bits*
ispLSI 1016/E	80 bits
ispLSI 1024/E	120 bits
ispLSI 1032/E	160 bits
ispLSI 1048/C/E	240 bits
ispLSI 2032	40 bits
ispLSI 2064	80 bits
ispLSI 2096	120 bits
ispLSI 2128	160 bits
ispLSI 2032A	80 bits
ispLSI 2064A	160 bits
ispLSI 2096A	240 bits
ispLSI 2128A	320 bits
ispGDX Family	160 bits
ispGDS Family	32 bits
ispGAL22V10	64 bits
ispGAL22LV10	64 bits
GAL16V8/20V8	64 bits
GAL16VP8/20VP8	64 bits
GAL16V8Z/20V8Z	64 bits
GAL16V8ZD/20V8ZD	64 bits
GAL16LV8	64 bits
GAL16LV8ZD	64 bits
GAL18V10	64 bits
GAL20LV8	64 bits
GAL20LV8ZD	64 bits
GAL22V10	64 bits
GAL26CLV12	64 bits
GAL26CV12	64 bits
GAL20XV10	40 bits
GAL20RA10	64 bits
GAL22LV10	64 bits
GAL22LV10Z/ZD	64 bits
GAL6001/6002	72 bits
ispPAC10	8 bits
ispPAC20	7 bits
ispPAC80	21 bits

*IEEE 1149.1 USERCODE

Benefits

Eliminating Labels

By automatically storing the appropriate identification information into device UES locations while the programming hardware is patterning the device, the need for a costly additional handling step to apply messy gummed labels or ink is eliminated. And throughput and quality of the patterned devices are greatly increased.

Document Control

The job of document control becomes more manageable when using the device UES, since a pattern code in the UES can specify each pattern and its application. This proves an absolute boon in military programs, where accurate documentation is essential. If a change occurs, it is easily handled with a new pattern code. With a pattern code in each device, a readout can actually be conducted during board assembly. Code verification ensures the use of properly patterned devices and serves as a quality-monitor step. And validation is simplified when checking against a lot or board-traveler, since master devices are not required.

Software Revisions

With the UES, a software ID code can be stored and referenced in Document Control to a current pattern version. When a revision occurs, a new pattern code is simultaneously stored in the UES. Pattern codes can be monitored to verify that incorrect versions of software are not inadvertently being used. Since Lattice devices are reprogrammable, any material flagged with an improper pattern code can simply be sent back and reprogrammed to the current pattern revision. When security is enabled, a UES-resident pattern ID code is the only certain means of documenting which pattern resides within a device.

Manufacturing Information

As described earlier, manufacturing information stored in the UES can help track down problems (e.g., products needing to be serviced in the field or returned). A field technician can easily read checksum and pattern revision information to facilitate rapid debug assuming these fields were stored in the UES. Additionally, if each board-assembly location is coded into the devices used at a particular assembly site, customer board returns can be linked to a common source.

Manufacturing Flow

With the UES, devices can be preprogrammed at one location and given a destination code. Upon shipment and receipt, sample readouts of destination codes can be performed to ensure that the proper devices were received.

As systems become more complex, production and document control costs can become dominant. UES is one of the many valuable ease-of-use features offered in the Lattice device families that can reduce these costs.

Technical Support Assistance

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