



## Device Connectivity Division COP8 and CP3 Controller Programming

### Volume programming solutions for COP8 OTP/Flash and CP3 Flash

Selecting the "correct" volume OTP/FLASH programming solution depends on a variety of factors, such as the programming time required for each device, the device package type, any marking or labeling, the actual volumes needed, when they will be needed, the capabilities of the customer, quality issues, PPM issues, serviceability of the equipment, and the costs involved.

There is not a single "best" solution, and each customer will have to evaluate his or her needs, capabilities, resources, and perhaps be prepared to experiment. The "best" solution for your customer may be a combination of solutions.

This document explores the issues involved in determining solutions, details the programming options available for DCD devices, and makes some recommendations for each family device.

#### DEVICE PROGRAMMING SPEED AND THROUGHPUT

The programming throughput (processing time per device) is critical in selection of a programming solution. Time is money! Unfortunately, program times for any particular device vary widely from programmer to programmer. Handling and marking times will vary widely as well.

GENERALLY, throughput **increases** in the following order: Flash ISP (can be quite slow); Single-site, hand insertion; Gang 8, hand insertion; Single site, automatic handling; Concurrent multi-site, hand insertion; Concurrent multi-site, automatic insertion (highest throughput).

The **COP8SAx7 OTP (1k/2k/4k)** devices are fast programming devices (1-4 seconds). Single-site programming, manual or automatic, is recommended. Manual gang 8 programming may be cost effective for the 4k, but not practical for the 1k /2k devices, especially with the handling time of SOIC/PLCC packages. In-Circuit programming is not supported.

The **COP8TA Flash (2k/4k)** devices are fast programming devices (2-4 seconds). In-System Programming (ISP) is recommended, especially for the LLP packages. Manual or automatic single-site programming, or a dual-site concurrent system, is a good alternative for the SOIC packages. Non-ISP LLP package programming requires National Factory Programming services. Manual 8 gang programming of the TAB9 (2k) and TAC9 (4k) devices is really not practical at.

The **COP8SGE7 OTP (8k) and COP8A/CxE9 Flash (8k)** devices are medium-speed programming devices (5-10 seconds). Gang 8, or Multi-Site programming is recommended, but automatic single socket programming may be cost effective for some customers. In System Programming (ISP) is available for Flash devices, but programming times become much longer, and production throughput slows. Non-ISP LLP package programming requires National Factory Programming services.

The **COP8SGR7 OTP (32k) and COP8C/SxR9 Flash (32k)** devices are slower programming devices (17-27 seconds). Gang 8, or Multi-site programming is almost a necessity. continued.....  
Flash ISP programming is not recommended because of significant programming times (it varies with each ISP setup). Non-ISP LLP package programming requires National Factory Programming services.

The **CP3BT and CP3UB/CN Flash (256k)** devices are slower programming devices (17-27 seconds). Multi-site programming is almost a necessity. Flash ISP programming may not be practical because of significant programming times (it varies with each ISP setup). Non-ISP CSP/LLP package programming requires National Factory Programming services.

## PACKAGE TYPES

Every programmer supports DIP packages with ZIF sockets. These are very easy to use by hand, even for larger volumes. Every programmer also supports SMD devices with package-specific vendor modules, or widely available SMD-to-DIP adapters. SOIC and PLCC hand insertion is generally easy with the right type of sockets (For SOIC use the ones with lidded test sockets. For PLCC use either lidded test, or non-lidded burn-in sockets).

Economical table-top automatic handlers, and stand-alone programming systems commonly handle DIP, SOIC, PLCC, and sometimes TSSOP with either gravity feed, or pick-n-place.

For QFP, and other fine-pitch SMD packages requiring trays or special handling, an automated pick-n-place system is required. Appropriate sockets for automatic programming of some packages may not be available (In National's case, volume programming of CSP/LLP requires Factory Programming). For flash devices, handling can be eliminated completely with ISP. Programming more than a few devices by hand is not practical.

## MARKING AND LABELING

Depending on the final application, the type of marking required (if any) will factor into your final programming solution. Choices offered include high-quality lasers, ink marking systems, and a choice of stick-on labels (depending on your quality needs).

A common solution for larger package types (DIP, PLCC, SOIC) is a simple printed label which is hand applied during the programming operation. This requires a separate procedure to produce and apply the labels, and creates additional possibility of operator error, ESD fallout, and dust. This is the only solution when using hand-insertion programmers, unless you plan to handle the parts a second time with a stand-alone marker/labeler.

For a higher quality mark, stand alone systems are available for labels, ink, or laser, but these require a separate handling operation, and introduce additional quality considerations: Labels produce dust and ESD; Some inking systems require a UV or hi-temp station for curing the ink; Laser systems may have an environmental impact. Handling the tubes and trays, and device insertion, can be manual or automatic depending on the system used. Additional ppm loss can be experienced during this operation.

Many automatic handling systems allow for an optional, integrated label or laser marking system. An integrated system will reduce handling fallout and may increase the quality of the label/mark, but there are fewer choices in integrated programming/marketing systems.

Handling and marking tiny CSP/LLP, TSSOP, and QFP packages require expensive, and sometimes customized, equipment to deal with trays and tape-n-reel. National offers custom marking as part of our Factory Programming operations.

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## **HOW MANY DEVICES WILL YOU BE PROGRAMMING?**

Your actual volumes programmed will affect how much money you invest in programming solutions. The more units you program, the more critical reliability, and programming time, becomes (even seconds per part)!

A few hundred, or even a thousand devices per month may be easily handled with a single-site, hand-insertion programmer. You may be able to get by with a lower cost solution, or just have your local distributor do the programming. Flash ISP can be a good option.

Programming more than a thousand OTP/FLASH devices per month requires some calculations. You need to calculate programming time (making sure you are using the actual time for your chosen programmer, which can vary widely), handling time per device (loading/unloading sockets AND loading/unloading the tubes), and marking/labeling time. You may want to invest in a faster solution, install multiple programming sites, or have the devices programmed outside your company. Use your local distributor, or a third-party programming house. Flash ISP is again an option, but you should make sure you understand the actual programming times per device for your specific ISP setup, and the impact it will have on your production cycles.

Programming many thousands of devices per month will require some planning, and investment in a higher quality programming solution. You probably should have several options available as insurance. Investing in faster programmers, automatic handlers and markers, multiple programmers, and a good relationship with your local distributor programming center can save you many dollars and headaches. Flash ISP may be more expensive than you think, because of programming time delays on the manufacturing line.

## **WHEN WILL YOU NEED THE PROGRAMMED DEVICES?**

How often you need programmed devices, and how well you can forecast your needs, are both part of the final solution. This is especially critical for large volume customers.

If you can schedule your requirements with some consistency and accuracy, you may be able to use an outside programming source for your needs. You invest less in resources and inventory management, but pay a bit more for the final, programmed product. This is usually the least flexible solution, but easy and fast to set up. Just call your local distributor, a programming house, or ask about National Factory Programming.

Instead, you may prefer to do all the programming in-house, with complete control over scheduling. This will require more planning and investment in resources, but provides flexibility. You have to inventory devices accurately though, to prevent shortages and to avoid over-stocking.

Many volume customers choose a combination of in-house, and out-sourced solutions depending on their manufacturing flow, and production timing.

## **QUALITY AND PPM OF THE FINAL PRODUCT**

The quality and programming yields of the finished OTP/FLASH are guaranteed by using only programmers approved by National, properly maintained in an ESD safe environment, while following quality processing procedures.

Our "Approved Programmers" lists indicate which programmers are acceptable for "engineering" and/or "production" use. Additionally, there are industry standards for ESD environments, quality procedures for manufacturing environments, and vendor's equipment maintenance recommendations. Continued.....

Every APPROVED programmer will produce a reliably programmed OTP/FLASH, but not all programmers are of sufficient electrical quality and performance to be acceptable for high volume programming. While we don't expect any programming yield issues, the lowest cost programmers are generally approved for engineering and prototype use only, because they cannot meet every electrical and performance specification that National requires for a "production grade" programmer.

If the customer chooses to program OTP/FLASH with their own custom-made equipment (including flash ISP), then they are accepting the responsibility (and cost) for any yield loss due to handling, environment, equipment failure, operator error, and programming yield loss (beyond normal expected percentages). As volumes increase, it becomes even more important to invest in the proper equipment, environmental controls, and quality procedures.

When OTP/FLASH devices are purchased pre-programmed from a qualified distributor, programming center, or from National's Factory Programming, the customer is guaranteed virtually 100% programming yield with near zero ppm failure rates. The customer receives programmed, marked, and packaged product, ready for putting into the final application PCB.

## **EQUIPMENT RELIABILITY, SERVICE, AND SUPPORT**

National works with established, major programmer vendors that have demonstrated a history of supporting their products in a variety of world-wide regions. But, our approval for programming is not a guarantee of the reliability of the equipment, nor the ability of the vendor to meet a customer's service needs.

Each customer must research these issues with the vendor of choice BEFORE purchasing. Each vendor has varying degrees of support services in the customer's region.

## **VOLUME PROGRAMMING SOLUTIONS:**

### **A) PARALLEL GANG 8 PROGRAMMERS**

Cost effective volume production support for all device types. Hand insertion only. Other options may be better for COP8Tax9 and COP8SAx7. Throughput advantage increases for slower programming devices COP8SGE7 and COP8Cx9 8k Flash. Best throughput for 32k devices COP8SGR7 and COP8S/CxR9 Flash. Some are limited to only 4 sockets for QFP. Marking is limited to stick-on labels.

#### **\* Hi-Lo ALL-11 gang 8 programmer - COP8 only: 8SAx7; 8SGx7; 8S/CxR9; 8Cx9**

Table-top unit with 8x40 DIP family-specific heads for under \$2k. Devices supported directly without adapters; 28SOIC, 44PLCC, 44QFP heads available at extra cost (About \$1k for 8 heads).

Advantage: **Evaluated by National**; Supports most COP8 families; Universal base supports optional single-site and gang modules for other vendor's products; Lower cost for single-family support; Easy operation; Good interface;

Disadvantage: Not stand-alone (Requires a PC); Limited socket isolation (Takes extra time to isolate some problems); Requires additional-cost heads for CSP/LLP.

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### C) SINGLE SOCKET, HIGH-PERFORMANCE, UNIVERSAL PROGRAMMERS.

Throughput is very good for the faster programming 8SAx7, and 8Tax9 devices. Slower for the large-memory devices: 8SGR7, 8S/CxR9 Flash, and CP3. Good throughput for the others. Throughput can be very high with non-stop handler operation.

Approved for high-volume production, and attachment to an automatic device handler. May have universal socketing for most packages. CSP/LLP packages are hand-insertion only. Prices and performance are essentially the same (\$3k-\$5k) depending on configuration and socketing. Table-top automatic handler prices begin at about +\$20k for DIP; +\$30k for SOIC; Up to \$150k for stand-alone systems including programmer.

In alphabetical order (Visit our web site for up-to-date listings at [www.national.com/cop8](http://www.national.com/cop8)):

**\*BP Microsystems 1200/1400/1600** - Direct support for all packages. Supports ALL NSC micros including COP8, CR16 and CP3. Fast programming. 1600 supports low voltages; **(RECOMMENDED)**

Advantages: Very fast programming; Can attach to auto-handling equipment with marking systems; Supports most types of programmable devices; Supports special user features (such as serialization); Proven reliability in production, and auto-handler environments for many years; Used by many programming houses and distributors. Support QFP and TSSOP handlers. **NOTE: No automatic handling support for CSP/LLP packages.**

Disadvantage: Cost; Some vendors slow to support new devices.

### D) MULTI-SITE UNIVERSAL PROGRAMMING SYSTEMS.

Throughput can be very high (even with hand insertion) by optimizing the number of programming sites. Fewer sites for the faster programming COP8SAx7 and COP8Tax9 devices. More sites for the larger memory devices: COP8SG OTP, COP8S/C Flash, and CP3. Expensive, but the very highest throughput available.

Concurrent or Gang programming. Can be used stand-alone by hand, or in automatic pick-n-place handling systems (necessary for PQFP and TSSOP volume programming). Very high throughput, but much higher cost (about \$3,000-5,000 per site; 2-16 sites). Integrated auto, pick-n-place handler systems available from each vendor (about \$150k-500k including custom socketing). **NOTE: No automatic handling support for CSP/LLP packages.**

**\*BP Microsystems 2100/2200/3100/4100/5100** - Same features as 1200/1400/1600. (Concurrent; Hand insertion, or Automated Pick-n-place handlers) **RECOMMENDED**

**\*Data I/O Dual/Quad/MultiSite** - Same features as the Expert/Optima. (Gang; Hand insertion only)

Advantages: Universal device support. Very high throughputs for slower programming devices in concurrent systems. Compatible with necessary handlers for volume PQFP and TSSOP programming. Available in programming centers world-wide.

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Disadvantages: Cost; Very large handler installations; Distributor programming center location may not be convenient.

#### **E) FLASH ISP (IN-SYSTEM-PROGRAMMING) SYSTEMS.**

Throughput can be very low when using a single ISP location. Higher throughput can be obtained by using a multiple-site ISP system for concurrent programming. Can be used stand-alone by hand, or in an automated environment, and throughput will vary depending on your custom installation.

A simple, single-site ISP setup with a hand-connection can cost as little as \$100 plus a PC. A more complex, multi-site, networked system can cost as much as \$500 per site.

**\*KANDA Systems COP8ISP (COP8)** – Single site, with hand connection to 2x5 header on PCB.

**\*KANDA Systems CRISP (CP3)** – Single site, with hand connection to header on PCB.

**\*KANDA Systems MultiSite** - Similar features to the single-site tool, but in a networked and automated environment.

End.