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MICROCONTROLLER TECHNOLOGIES

Volume programming solutions for COP8 OTP families

10/30/98 - Dave Katra, email: dave.katra@nsc.com

Selecting the "correct" volume OTP 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, serviceablility of the equipment, and the costs involved.

There is not a single "best" solution, and each customer will have to evaluate their 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 COP8, and makes some recommendations for each COP8 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: Single-site, hand insertion; Single site, automatic handling; Gang, hand insertion; Gang, automatic insertion; Concurrent multi-site, hand insertion; Concurrent multi-site, automatic insertion.

The COP87Lxx and COP8ACC7 devices are slow programming devices (7-52 seconds for 4k-32k memory size) which makes gang or multi-site programming more advantageous.
Single socket volume programming of 87L2x/4x, 87L84, 8ACC7, and 87L88G devices may be cost effective for some customers. Single socket volume programming of 87LxxR (32k) devices is NOT practical.

The COP8SAx7 devices are fast programming devices (1-4 seconds for 1k-4k memory size) which makes gang programming less advantageous. Single socket volume programming of the SAA (1k) and SAB (2k) devices may be more practical than gang, especially with SOIC/PLCC packages because of handling.

The COP8SGR7 (32k) devices are slower programming because of the larger array size (17-27 seconds). Gang or Multi-site programming is recommended. The COP8SGE7 (8k) is faster programming (5-7 seconds) and gang programming is less advantageous. Single socket programming may be cost effective for some customers.

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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, and PLCC with either gravity feed, or pick-n-place.

For QFP and other fine-pitch, or tiny packages requiring trays or special handling, an automated pick-n-place system is recommended for ANY device type. 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 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, and/or ESD fallout. 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. Some inking systems also require a UV or hi-temp station for curing the ink. Laser systems may have an environmental impact. Label systems create ESD and dust. Handling the tubes 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 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/marking system.

HOW MANY DEVICES WILL YOU BE PROGRAMMING?

Your actual volumes programmed will affect how much money you invest in programming solutions. The more 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.

More than a thousand OTPs per month requires the customer to do some calculations. You need to calculate programming time (making sure you are using the actual time for your chosen

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programmer), 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 OTPs programmed outside your company.

Many thousands 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.

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, or ask about National Factory Programming.

Or, 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 gives flexibility. You have to inventory OTPs accurately though, to prevent shortages and sudden increased demands.

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 are guaranteed by using only programmers approved by National, properly maintained in an ESD safe environment, while following quality processing procedures.

Our "Approved Programmers" list indicates 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.

Every APPROVED programmer will produce a reliably programmed OTP, 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.

If the customer chooses to program OTPs in-house, 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 expected percentages). As volumes increase, it becomes even more

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important to invest in the proper equipment, environmental controls, and quality procedures.

When OTPs are purchased pre-programmed from a qualified distributor, or from National's Factory Programming, the customer is guaranteed virtually 100% programming yield with near zero ppm failure rates. The customer recieves 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.

PROGRAMMING SOLUTION OPTIONS:

A) PARALLEL GANG PROGRAMMERS

Cost effective volume production support for all device types. Hand insertion only. Other options may be better for 8SAx7. Throughput advantage increases for slower programming devices: 87L2x/4x; 87L84; 87L88; 8ACx7; 8SGE7. Best throughput for COP87LxxR and COP8SGR7. Some are limited to only 4x for QFP. Marking is limited to stick-on labels.

*** Hi-Lo/Tribal ALL-08 gang 8 programmer - 87Lxx; 8ACx7; 8SAx7; 8SGx7;**
Table-top unit with 8x40DIP 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: Supports all newer 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; Easily adapted to new COP8s;

Disadvantage: Not stand-alone (Requires a PC); Limited socket isolation (Takes extra time to isolate some problems); Requires additional-cost heads for 87Lxx devices.

*** ICE Technology GLV-COP gang 8 programmer - 87Lxx; 8ACx7; 8SAx7; 8SGx7;**
Table-top unit with 8x40DIP "universal" sockets for about $2k. Most DIP supported directly (8ACx7 requires custom adapters); 28SOIC, 44PLCC adapters available at extra cost (+$600-700 for 8 sockets); 44QFP supported for gang 4 only with third-party adapters ($600).

Advantage: Supports all newer COP8 Families; Lower cost; Fast performance; Compact, lightweight design; Easy operation; Excellent operator interface; "Stand-alone" operation is optional (no PC required); Good value for COP8 gang programming.

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Disadvantage: Supports COP8 Micros only; Requires a PC ("Stand-alone" feature is primitive with LED interface); Limited socket isolation (Takes extra time to isolate some problems); Future devices may require custom adapters;

*** Lloyd Research L9000 Gang 8 programmer - 87Lxx; 8ACx7; 8SAx7; 8SGx7;**
Table-top unit with two 4x40DIP family-specific modules for about $3.3k. 4x28SOIC modules available; Most DIP and SOIC supported directly (8ACx7 may require adapters); PLCC and QFP modules available on request.

Advantage: Supports all newer COP8 families; Gang programs other EPROM and Micro devices from universal base with optional modules; True stand-alone operation (No PC required); Very Fast programming; Superior socket isolation; Easy operation;

Disadvantage: Higher cost; Requires additional modules for 87Lxx devices; Larger, heavier packaging; Stand-alone operator interface is very limited;

B) SINGLE SOCKET, HAND-INSERTION, UNIVERSAL PROGRAMMERS.

Throughput is good for the faster programming 8SAx7 and 87L4x/2x devices. Not recommended for the slower programming 87LxxR and 8SGR7. Varying throughput for the others.

These programmers are NOT approved for high-volume "production" programming, or automatic handler use. They are acceptable for engineering, prototype, and pre-production programming. Socketing is typically DIP with SMD adapters, although some provide direct SMD socketing options. Prices, performance, and support vary widely ($.5k-$3k).

In alphabetical order (Visit our web site for up-to-date listings at www.national.com/cop8):
*Advantech - Lab Tool 48
*BP Microsystems - 1140/48
*HI-LO - ALL-07/11
*Logical Devices - AllPro-96
*MQP - PM48
*Needhams - EMP20/30
*Tribal - Flex 700/All-11

Advantages: Price; Some are very good price/performers; May offer better regional support.

Disadvantages: Some are relatively slow programming (Especially for larger memory sizes); Some vendors are slow to support new devices; Often limited in number of programmable devices supported; May not support all COP8 devices; Some may be less reliable for production use; Programming yields may vary; Marking limited to stick-on labels.

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

Throughput is very good for the faster programming 8SAx7 and 87L4x/2x devices. Not recommended for the slower programming 87LxxR and 8SGR7. 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. Typically universal socketing for all packages (Including QFP). 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):

***BP Microsystems 1200/1400** - Direct support for all packages. Supports ALL NSC micros including CR16. Fast programming. (RECOMMENDED)
***Data I/O 2900/3900/Autosite** - Supports all COP8. Direct support for all packages. (Not recommended for 87Lxx, 8ACx7. Programming times are VERY slow).
***SMS Expert/Optima** - Supports all COP8. Direct support for all packages. Requires hardware modifications to support some pinouts; Some CR16 devices supported.
***System General TURPRO-FX** - Supports all COP8. (Not recommended because of extra adapter requirement for all packages including DIP). No CR16.

Advantages: Very fast programming; Can attach to auto-handling equipment with marking systems; Supports virtually any type of programmable device; 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.

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 8SAx7 and 87L4x/2x devices. More sites for the slower programming 87LxxR and 8SGR7. 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 volume programming). Very high throughput, but much higher cost (about $3,000-4,000 per site; 2-16 sites). Integrated auto, pick-n-place handler systems available from each vendor (about $150k-500k including custom socketing).

***BP Microsystems 2100/2200/3100/4100** - Same features as 1200. (Concurrent)
***System General Multi-Apro** - Similar features as TURPRO. (Concurrent)
***SMS MultiSite** - Same features as the Expert/Optima. (Gang)

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Advantages: Universal device support. Very high throughputs for slower programming devices in concurrent systems. Necessary for volume PQFP programming. Available in programming centers world-wide.

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