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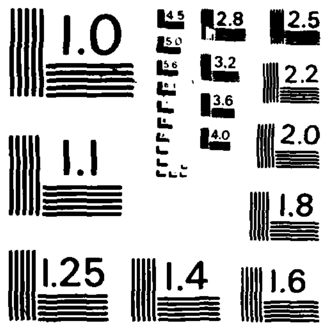
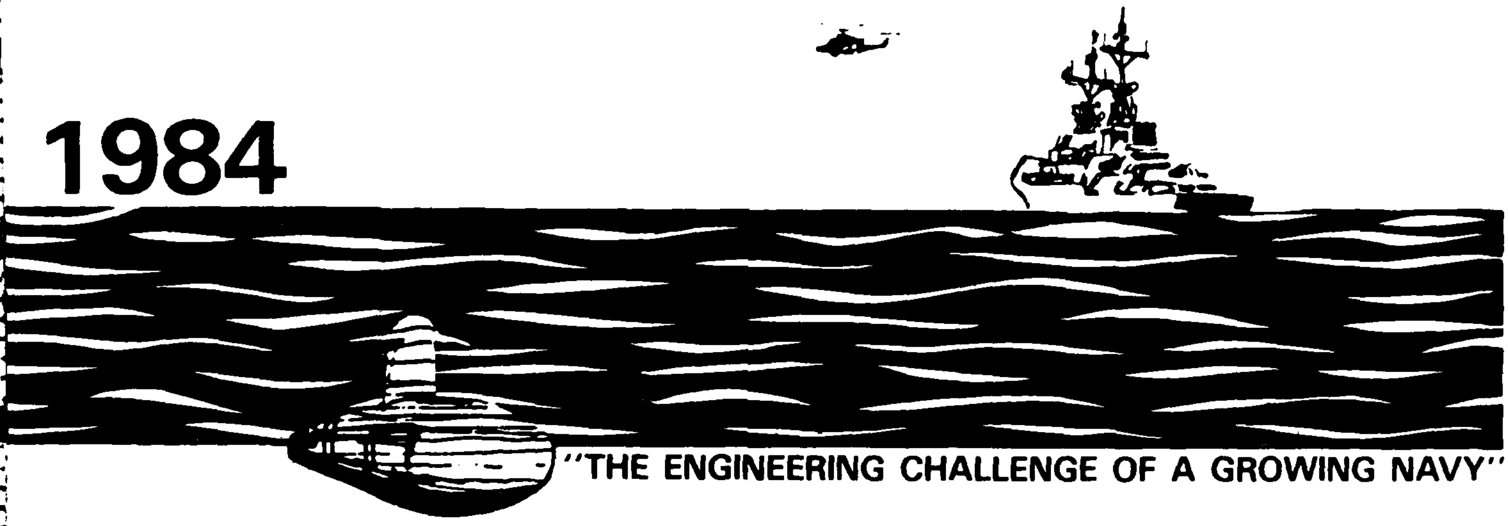


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

21ST ANNUAL TECHNICAL SYMPOSIUM

1984



"THE ENGINEERING CHALLENGE OF A GROWING NAVY"

IMPROVING SYSTEM AFFORDABILITY

Nyle N. Riegle

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IMPROVING SYSTEM AFFORDABILITY

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IMPROVING SYSTEM AFFORDABILITY

We are now in the second American Revolution. This war is not being fought with swords and guns but rather with reliability, maintainability and standardization. Strangely enough, our adversaries or major problems are not so much technical in nature, but the ability to afford the life cycle ownership of our new electronic systems. Unless we can win this war of affordability, we cannot hope to continue in our technological advancement. This paper is an announcement of the expansion of the Navy's Standard Electronic Module Program (SEM) into a larger more comprehensive program to be known as SHARP for Standard Harware Acquisition & Reliability Program. The paper is intended to discuss the factors which impact cost in all phases of the program's life; a common sense look at what major cost drivers are, and what can be done to control them. The paper will analyze standardization, quality, reliability, testability, and repairability with a look at their impacts on Navy life cycle costs. Special emphasis will be placed on the ability to standardization programs to adopt new technologies. In this day of increased costs and restriction of funds, it is imperative that weapons systems developers recognize the full impact of their efforts on overall life cycle costs and not concentrate solely on the development phase.

As expensive as new systems are to develop, the majority of the costs are incurred during the operation and support phases and not the procurement phase upon which so much emphasis is placed. Typical system operation and support costs regularly exceed initial development by a factor of 10 to 1. In many new state-of-the-art systems, the electronics portion constitutes the major cost driver for the system. It follows, then, that if we can control the cost of the electronics, we will have gone a major step towards controlling the cost of the system.

There are a number of drivers, that impact the cost of electronics; the first of which, is lack of standardization. The need and value of standardization is intuitively obvious but regretably often ignored. Our lives are made easier and less expensive each day by wide usage of standardization in the private sector. For instance, imagine not having standard light bulb sockets. Each manufacturer, in order to insure his market share, could change the threads or the size of the socket. The additional expense incurred by the homeowner, or in our case the program manager, to try and adapt to the different sockets would be prohibitive. What would happen that you would set your house up to fit one particular socket size and then you would be forced to buy your light bulbs for the life of your home from one manufacturer, with the distinct possibility that the cost of light bulbs might go up dramatically. A simple example, but that's exactly what's happening to the Navy Program Manager. Figure 1 shows an array of circuit cards randomly pulled from non SEM Navy systems. It can be seen that there is a complete lack of standardization--no standardization in the connectors, the frames, the size of the card, mechanical holding, etc. Certainly no economies would be expected in the sparing, testing, repair, or the training of the sailors that are expected to maintain these systems, nor is it likely that competition would be possible. The second cost driver is inadequate and inconsistent quality assurance. The government has instituted a variety of standardization programs in the past, having QLPs but, with the exception of the SEM program, allowed the manufacturers to "grade their own card". Since the manufacturer's cost motive is understandably rather high in his mind, it is rare indeed that a manufacturer will remove himself from the QLP because of inadequate quality. Without a capable independent testing facility who regularly samples and assures the quality of the product line, the QLP is of no value. The third cost driver is the rapid advancement of technology. While this has always been a problem, the pace has increased dramatically in the last few years, many times obsoleting a system before it gets out of the design phase. In a recent survey, I questioned the major integrated circuits manufacturers in this country and asked how long they would guarantee the support of a newly developed integrated circuit. The typical answer was not to exceed three years. Now if you take three years and compare that to the time it requires to design, develop, produce, and deploy a system, you will find out that, by the time deployment takes place, we could find ourselves in the position of not being able to support the circuitry in the unit, to say nothing of the 20-year life of the system! The fourth point is inadequate documentation for competition. All too often, because of cost constraints during the development cycle of a program, adequate documentation to allow competition for later procurements is not purchase, thus, forcing the government into a sole source situation throughout the life of the system. The fifth and final point is inadequate design emphasis on maintenance. This causes inability to failure isolate to the piece part level and also added difficulty of repair and test. Maintainability must be a design requirement, not an afterthought.

The Navy has long recognized these problems & attacked them at the module level thru a highly successful standardization & reliability program known as SEM.

The SEM program accomplishments upon which the SHARP program is founded and plans to expand are reviewed below. Figure 2 shows an array of formats A & B SEM modules.

1. SEM has achieved exceptional reliability in a comparison with the expected values. Actual field data results have shown that the typical SEM module achieves a 10 times better than expected field reliability.

2. SEM modules have achieved multi-system commonality with over 50 percent of the standards being used in eight or more systems.

3. A significant cost savings has been achieved with a return on investment of eight or more.

4. There is a large industrial base with an excess of 15 vendors producing SEM modules.

5. There are in-place Navy facilities.

6. There is extensive Navy usage with over 250 systems and over 7 million modules committed or in use.

The concept of the SEM Program is based on the principle of limiting redundant design through the use of standard functions, thus achieving cost benefits through consequent large production volumes and a broad competitive base. As the program continues to gain further acceptance, the cost and performance benefits become even more significant.

The basic objectives of the SEM Program are:

- Partitioning electronic functions so they can be common to a majority of equipment applications.

- Documenting modules with functional specifications (to preclude dependence upon specific vendor design of technology) enabling long-term availability and cost savings through better innovations and competition.

- Achieving high reliability through stringent quality assurance and design requirements.

- Discarding modules upon failure, made possible due to high reliabilitv and low cost

- Providing flexible modular packages which accept various circuit and packaging technologies and adapt to various equipment mechanical configurations.

- Easing the logistics-support burden on the congested supply system by extensive intersystem commonality of limited number of module types.

- Providing an independent Quality Assurance Program to sample and test the vendors' modules and establish a believable QPL.

- Reducing life cycle costs as a result of all of the above.

The new SHARP program objectives are to continue to provide for standardization, rapid advancements in technology, rigorous quality disciplines, sufficient documentation for competition, and places design emphasis on maintainability. Figure 3 is a block diagram which depicts the scope of the SHARP program. Instead of replacing SEM, the SHARP Program includes it and expands the standardization effort to include Power Supplies, System Unique Models and the associated hardware required to build a system.

The SHARP Program incorporates four basic concepts to achieve these program objectives. The first one will be <u>flexible design requirements</u>, which will allow the program to be adaptable to new technologies, to be both forward and backward compatible with existing systems and to have multi-system compatibility. The second concept is a <u>disciplined quality program</u>. Independent Government labs will sample and test production units to evaluate their suitability for inclusion in a QPL. The quality program will be based on the existing in-place government laboratories currently being used to support the SEM program. The <u>specification approach</u> is the third concept. It will allow competition in multi-system modules, system unique modules, power supplies and the associated hardware. Finally, <u>standardization</u> will be maximized to insure use across multi-systems, thus increasing the life cycle cost savings realized.

Cost savings can be realized through the use of the SHARP Program in all three phases of the life cycle. Many of these costs we have already spoken to, but there are some cost savings which are intuitive but yet inderterminate, or rather hard to attach an actual number to, but a cost savings nevertheless. Such things are:

1. Short lead time procurement, because through standardization, vendors already exist, the parts are already available.

2. The enhancement of maintenance through built-in test points and common fixtures for testers, standard drawings.

3. Improved quality via standard assembly work instructions and processes.

Standardization is a matter of fact in any industry and its time has come for the Government as well--we cannot afford to do otherwise.

Through the use of standards across many systems we will experience a decreased provisioning cost through multi-system, multi-ship use, a single test program for in-house and Fleet use per type, and improved Fleet availability. A standard unit is a multi-system spare. A single qualification test of design qualifies for all systems and improves reliability and quality through common test procedures and fixtures and standard assembly and inspection techniques. Figure 4 depicts two new packaging formats for modules identified for the SHARP Program. The one on the left would be the airborne standard and is designed to be utilized with the half ATR cabinet. The card on the right would be used with surface, sub-surface, and shore applications. Both cards are compatible with existing SEM formats. Figure 5 shows how an existing system, the Enhanced Modular Signal Processor, or EMSP, could be upgraded from the current design of Format B SEM modules to new SHARP modules, and further that it could be done a portion at a time, which is the way oftentimes a system is updated. The examples show where a whole cabinet populated with Format B cards might be replaced by one drawer populated with a VHSIC technology SHARP card.

In summary, the SHARP Program provides a vital response to the major DOD initiatives of VHSIC, RM&A, and cost through a disciplined approach to standardization, quality assurance, and competition, based upon and expanding the current SEM program.

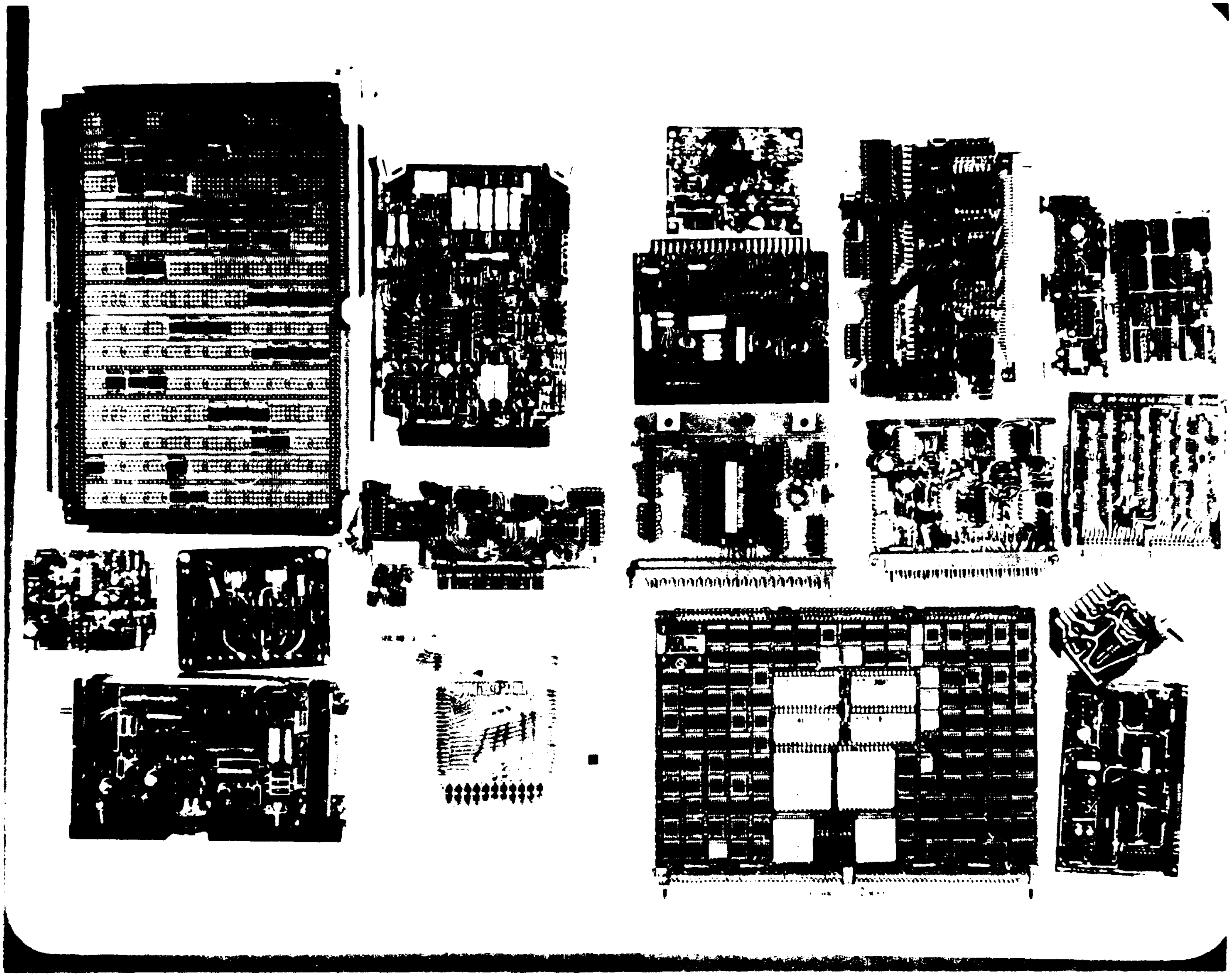
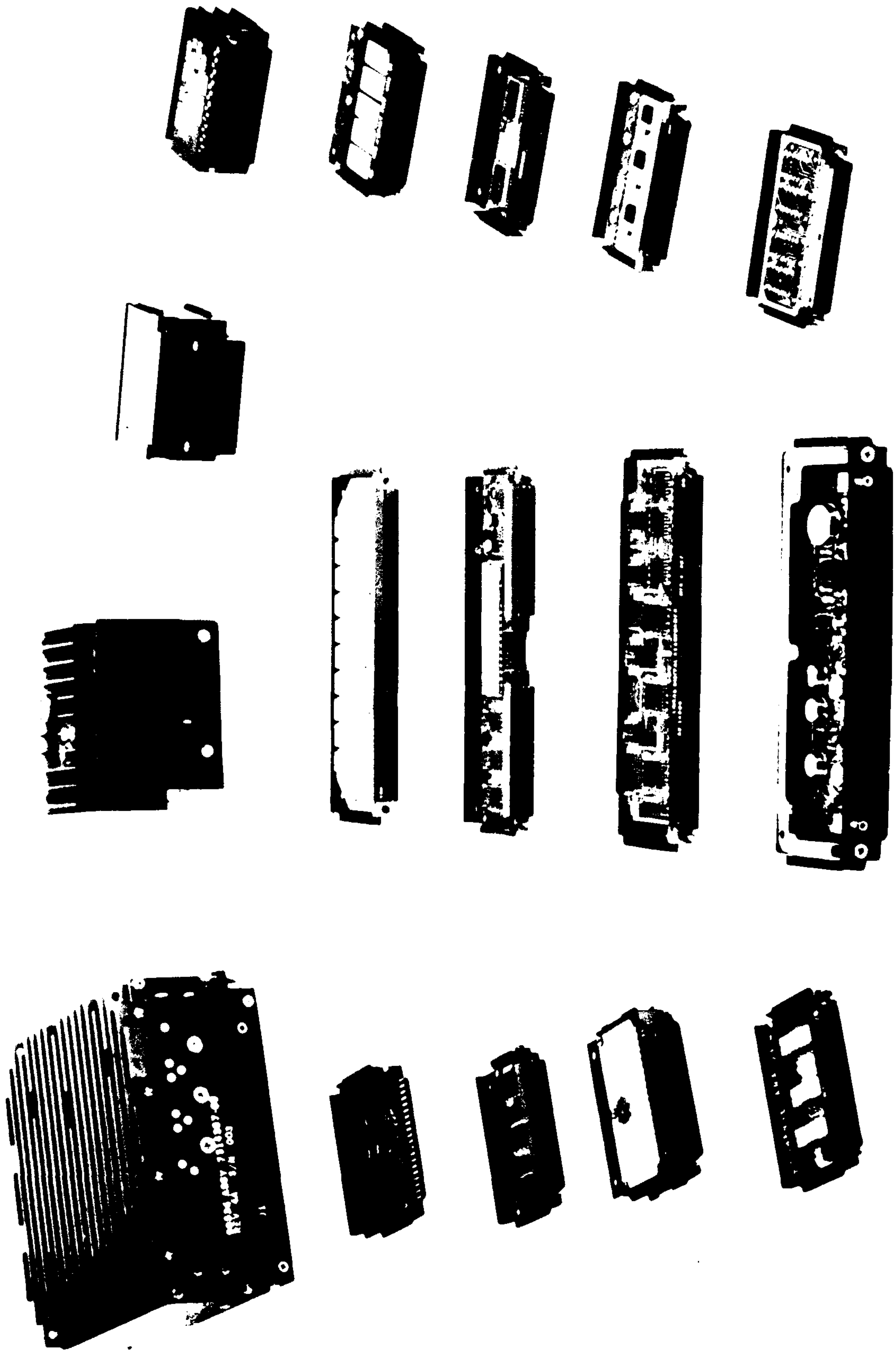
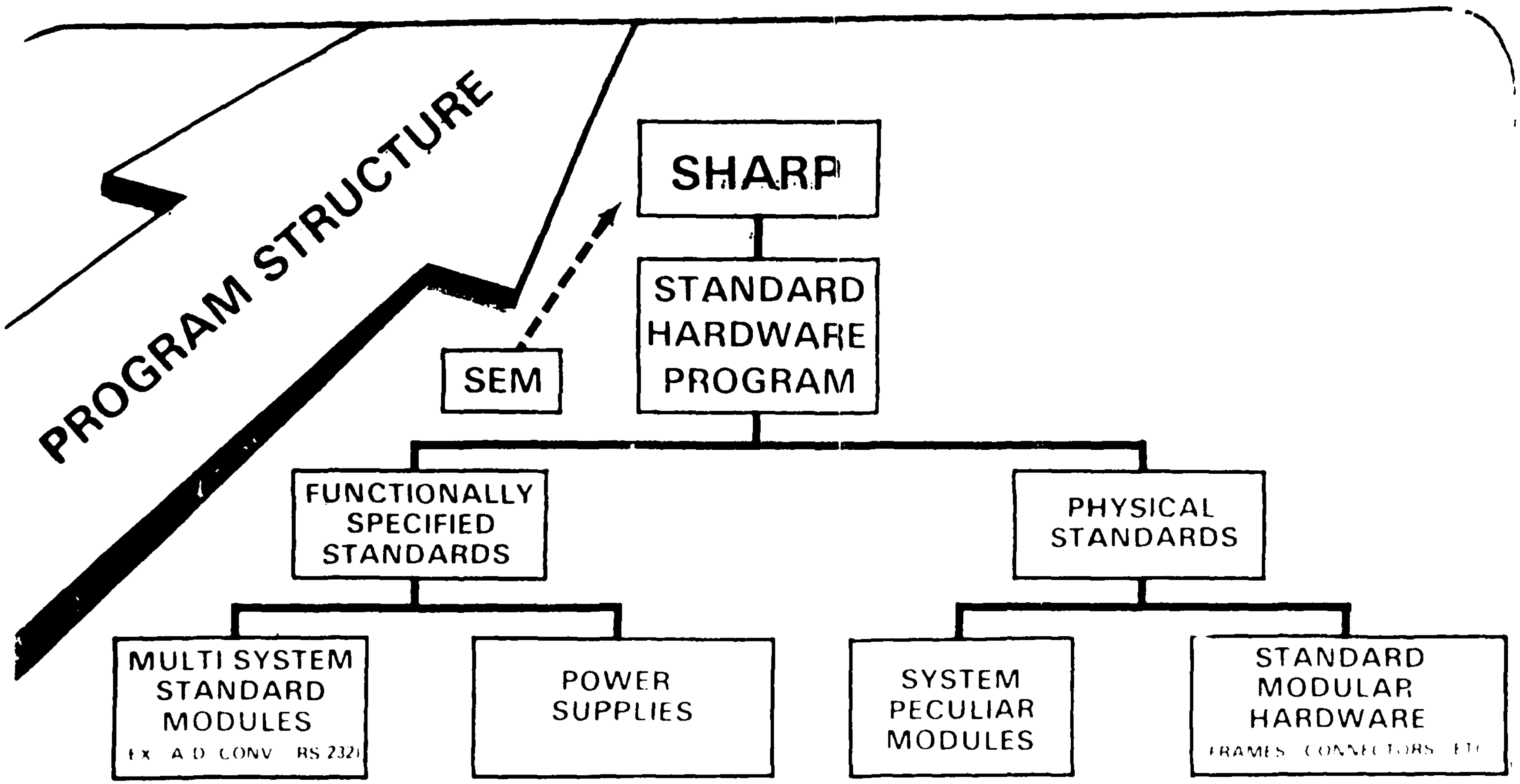


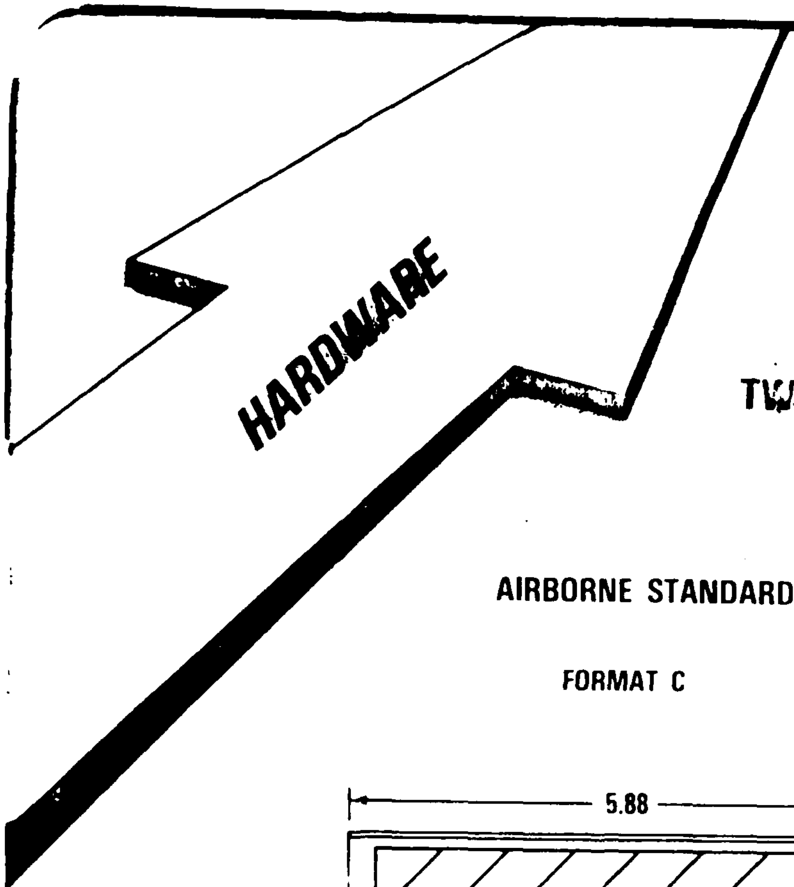
FIGURE 2





- CONTROLLED DESIGN & FUNCTION BY SPECIFICATION
- STD MODULES UTILIZE MODULAR HARDWARE STANDARDS
- CONTROLLED PHYSICAL CHARACTERISTICS
- STANDARD MODULAR HARDWARE DESIGN CONTROLLED BY SPECIFICATION

FIGURE #3



TWO NEW PACKAGING FORMATS IDENTIFIED

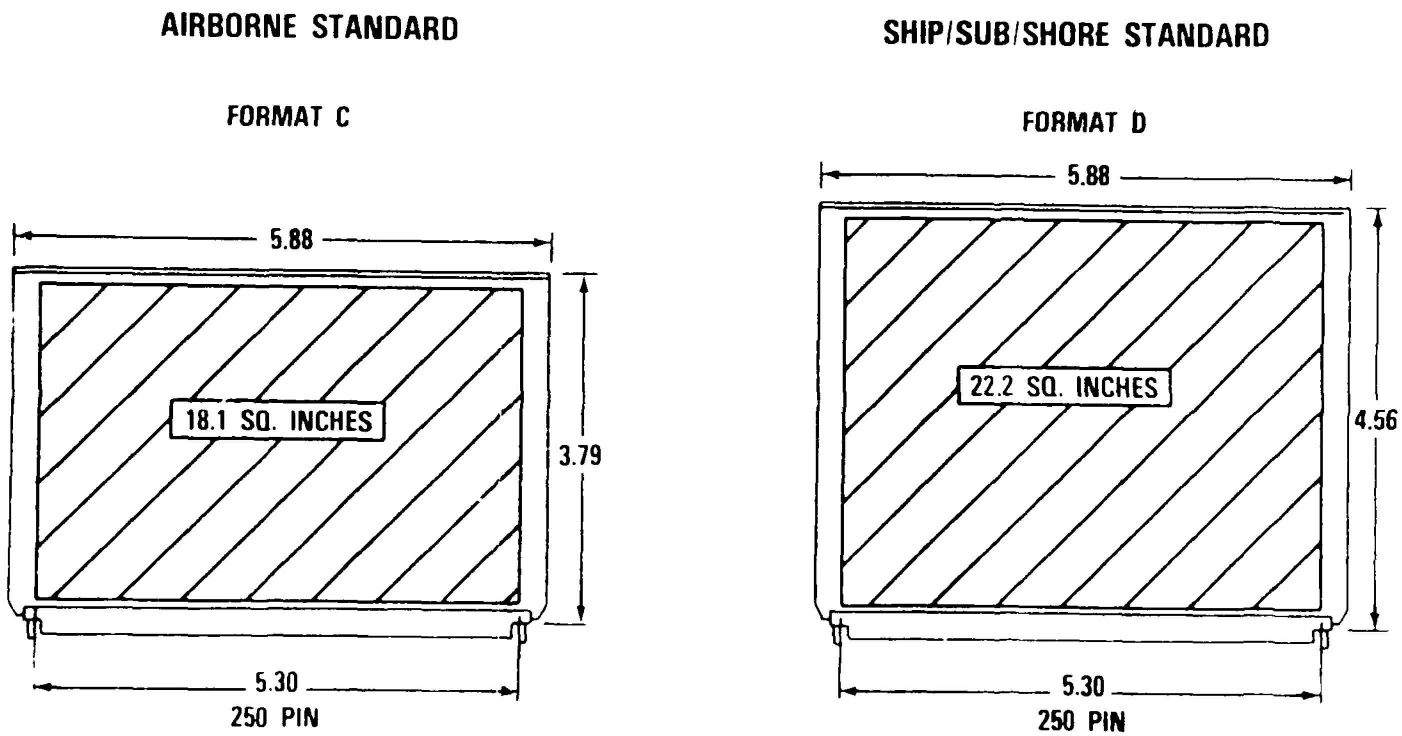


FIGURE 4

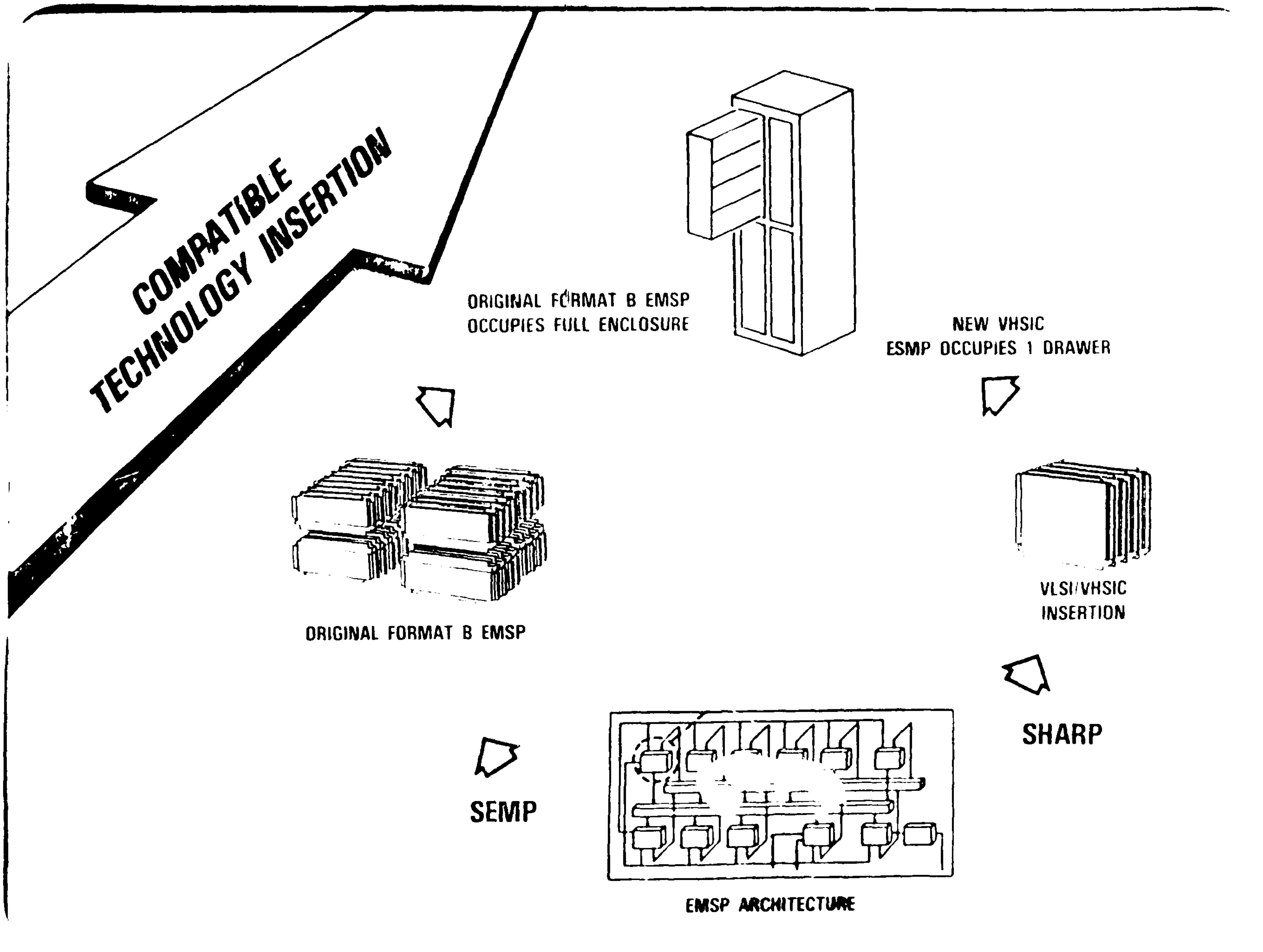
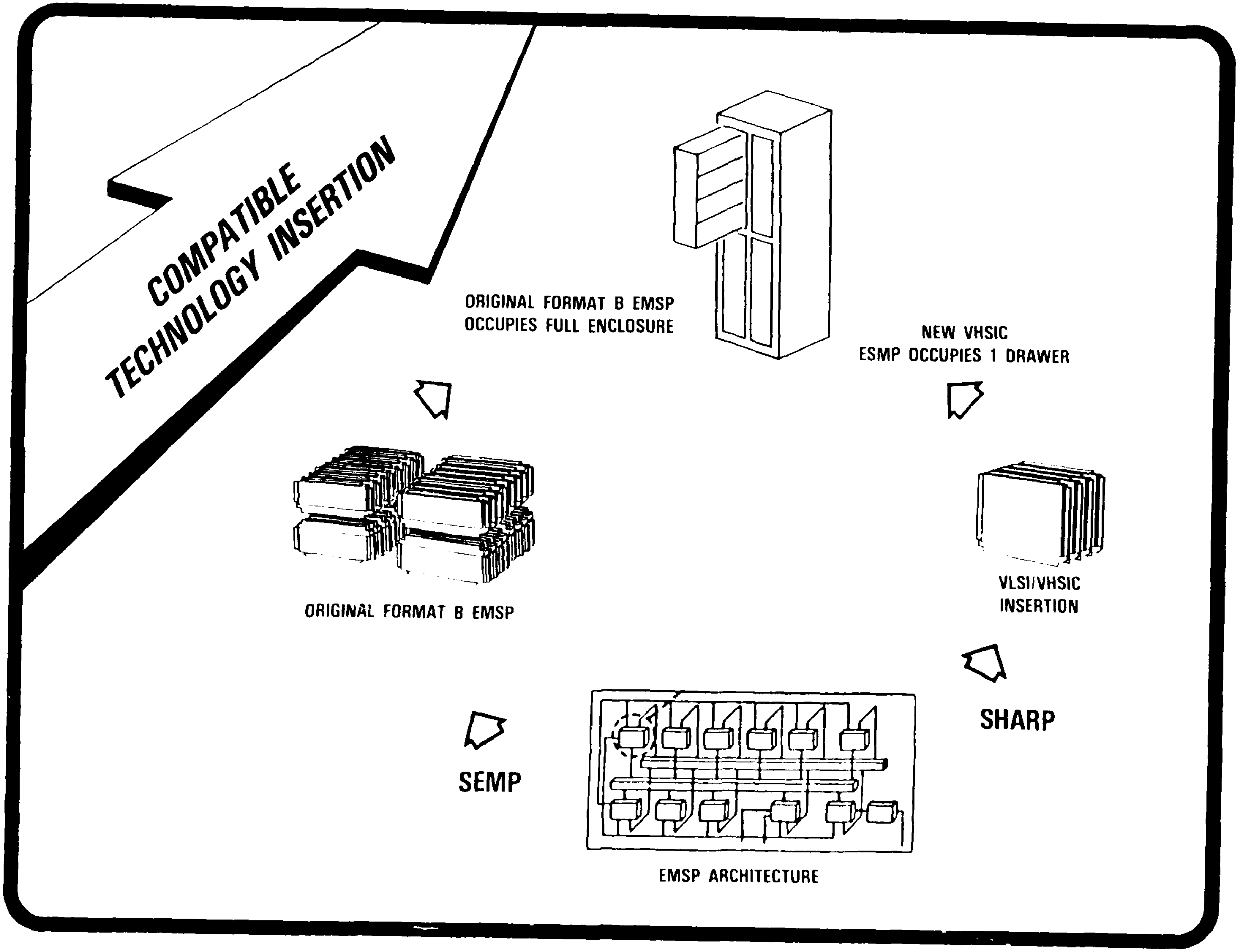

COMPATIBLE TECHNOLOGY INSERTION
ORIGINAL FORMAT B EMSP OCCUPIES FULL ENCLOSURE
NEW VHSIC ESMP OCCUPIES 1 DRAWER
ORIGINAL FORMAT B EMSP
VLSI/VHSIC INSERTION
SHARP
SEMP
EMSP ARCHITECTURE

FIGURE 5


COMPATIBLE
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OCCUPIES FULL ENCLOSURE
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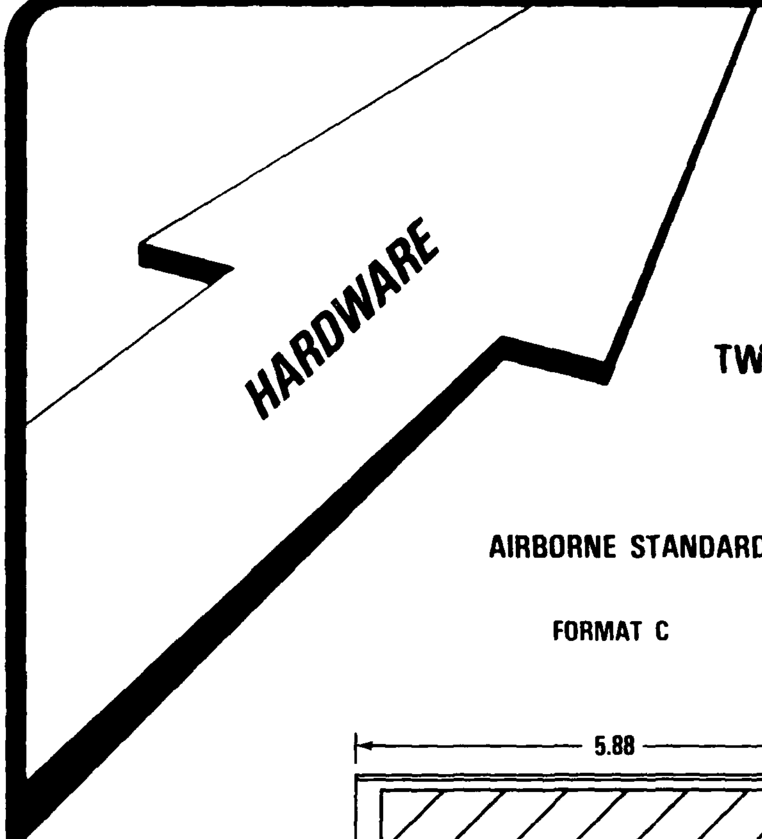
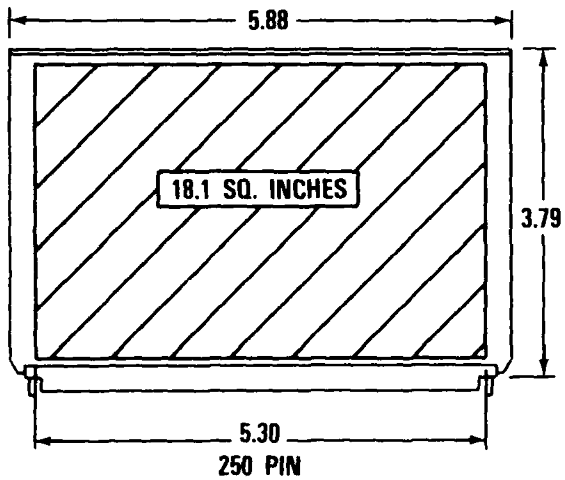


TWO NEW PACKAGING FORMATS IDENTIFIED

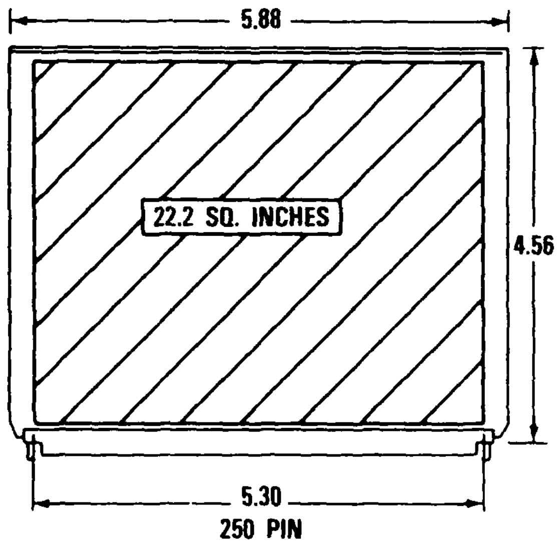
AIRBORNE STANDARD

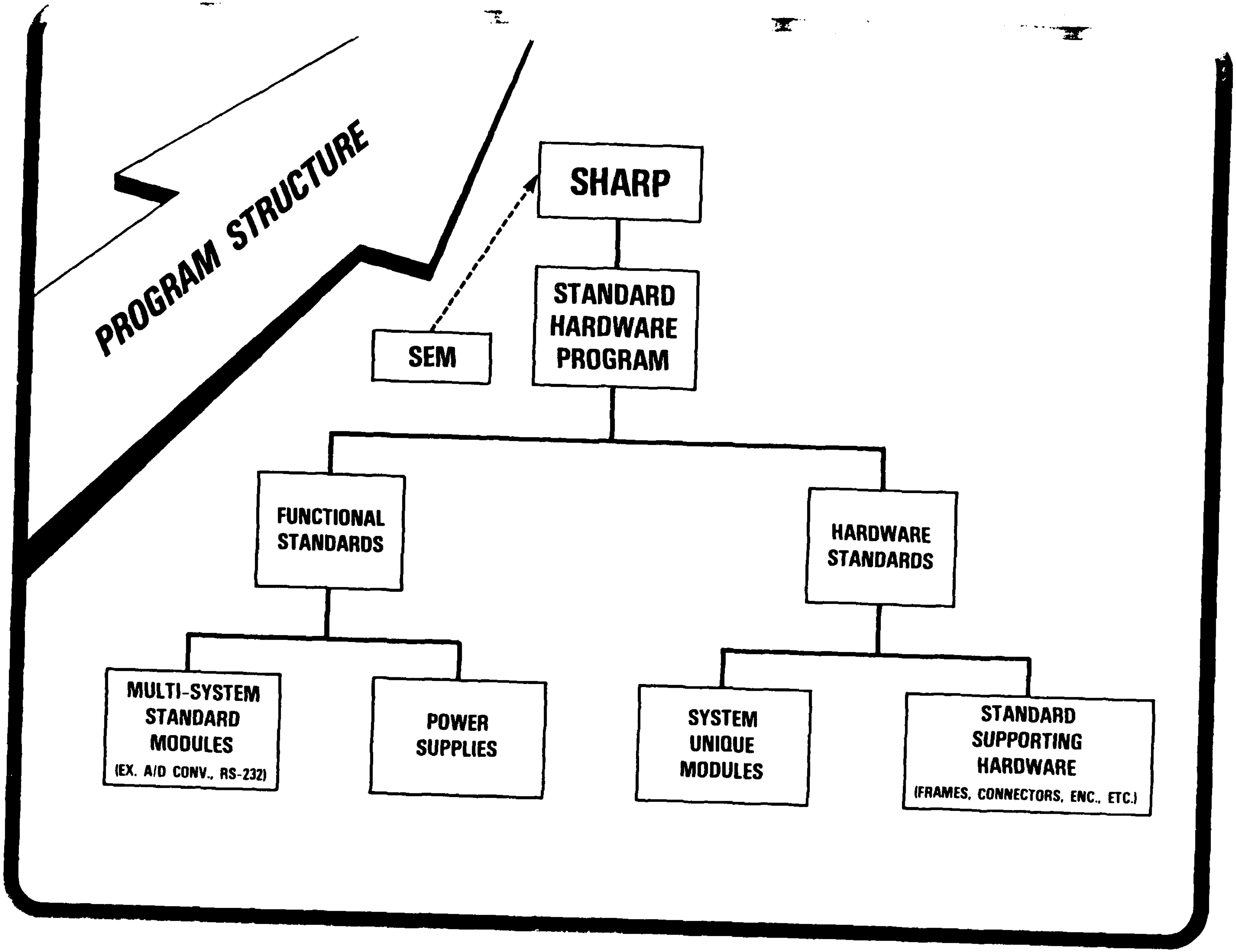
FORMAT C



SHIP/SUB/SHORE STANDARD

FORMAT D





PROGRAM STRUCTURE
SHARP
SEM
STANDARD HARDWARE PROGRAM
FUNCTIONAL STANDARDS
HARDWARE STANDARDS
MULTI-SYSTEM STANDARD MODULES (EX. A/D CONV., RS-232)
POWER SUPPLIES
SYSTEM UNIQUE MODULES
STANDARD SUPPORTING HARDWARE (FRAMES, CONNECTORS, ENC., ETC.)

END

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