Manufacturing takes spotlight

Tiny IC's play large role in Tek products

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Early in the history of Tektronix, we found it necessary to begin developing our own components to satisfy the special electrical requirements of advancingly complex Tek oscilloscopes.

The importance of component manufacturing has grown

area rep employees report

over the years until we now have about as many people making various kinds of components as there are assembling instruments.

There are three major component manufacturing groups: Metals and Plastics, CRT and Electrical Components Manufacturing, the group I manage. There are about 1000 people in Electrical Components Manufacturing. ECM is composed of three manufacturing groups: Ceramics, Specialized Electrical Componets and IC Manufacturing.

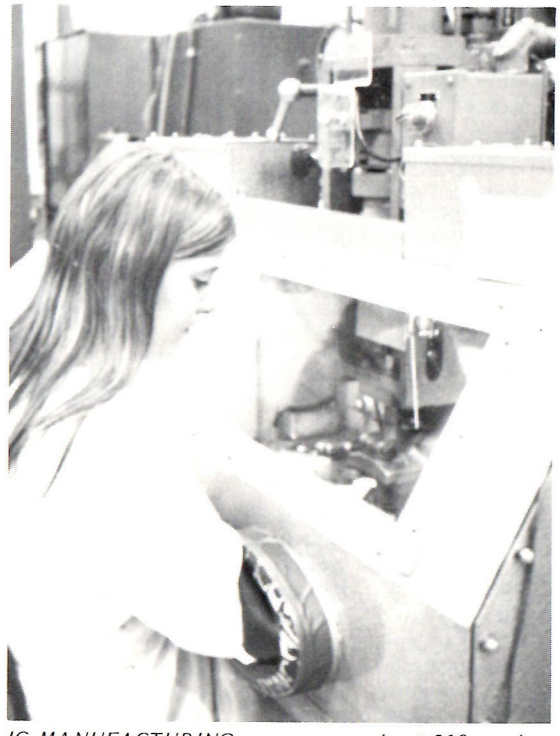
IC Manufacturing is made up of about 210 people. The jobs span the typical Tek ranges including operators, engineers, managers and support functions. The group is located on the first and second floors of Electron Devices building (48), with CRT personnel for neighbors. Although IC's represent somewhat less than 10 per cent of the group of people making Tek components, we certainly feel that they are one of the very important components.

IC stands for integrated circuits. We usually divide integrated circuits into two major categories, monolithic IC's and hybrid IC's. Monolithic means that it is all made on a single piece—in the case of IC's the single piece is a chip of the element silicon. Hybrid means the combining of two or more varieties and in the case of IC's means combining very small components, which may include monolithic IC's, into a small package. We make both categories. The larger portion of our effort currently goes into monolithic IC's.

The monolithic IC is made up of many transistors, resistors, interconnections, and some capacitors. Each IC has a dual-in-line plastic package about an inch long. The package is there to protect the IC, let us handle it and to allow us to insert it into a printed circuit board. The real guts of the IC is a much smaller piece of silicon die inside.

The silicon die is less than one tenth of an inch on a side and less than one hundredth of an inch thick. Even at this relatively small size, nine-tenths of the thickness of the wafer is available just so we can handle it in earlier processing. All of the active electrical part is in the top tenth of the die.

Some integrated circuits have more than 100 transistors. Pieces of aluminum metal evaporated onto the surface provide interconnections very much as we would wire things together with insulated copper wire or lines on a printed circuit board. The metal must line up with holes through the insulating layer on top of the silicon die. Operators must get this metal to line up in



IC MANUFACTURING encompasses about 210 employees, including Diana Benham, shown at left welding IC's, and Cheryl Bothum, operating the IC cutter. IC operations are located in the Electron Devices building (48).

Earl sees 'difficult times' ahead for Tek

In his appearance at the Area Rep Conference Monday, President Earl Wantland commented briefly on the state of the economy and its affect on Tektronix. Here is a synopsis of his remarks:

I'd like to take this opportunity to discuss some concerns I have about economic signs in the world, which are getting more worrisome every day.

The large amounts of money going to the oil-producing countries is a real puzzle for world leaders in business and finance. We have to learn to deal with problems differently than we have in the past.

In addition, there are great pressures on industrial commodities and food to meet needs throughout the world. All in all, the economic signs are not good.

I believe President Ford's program of asking cooperation of all segments of the American economy is a good one. It is a very complex problem, and the solutions will be a long time in coming.

Tektronix faces difficult times, there's no question about it. We are fortunate to have employees who are very productive and have a great concern for the company, and I'm proud of each one of you.

Frankly, I look for a fairly difficult period in the months ahead. This means stricter budgets, and likely there will be some transfers to keep all areas at full production. I am confident that Tek employees will make every effort to maintain top performance in their jobs.

We have no control over the economy, but we'll manage the best way we know how.

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KEN SPOONER
Conference Speaker

the hole with a tolerance of a fraction of a thousandth of an inch. We use sophisticated equipment so operators with normal vision and dexterity can achieve the necessary accuracy.

We currently make about 80 different monolithic IC's and 20 different hybrid IC's. There are two categories of monolithic IC's. The ones we currently make for Tek products are bipolar IC's. Bipolar means both negative and positive currents flow in the device.

It won't be long before we are making another kind of monolithic IC, the MOS IC. The initials stand for Metal-Oxide-Semiconductor. It's a monolithic IC that has fewer processing steps than the usual bipolar IC we build. It uses lower power than the bipolar IC so we can put more transistors on one chip. It doesn't process the signals as fast, but does allow us to process digital information in a very complex way on one chip. From the operator's standpoint, the main difference between the regular bipolar IC and MOS IC is that the latter has fewer processing steps but requires greater efforts to insure cleanliness in the processing.

Where do we use IC's? One of the uses is in saving space. Obviously, if we can put over 100 components in one package it takes up much less space than if we have to put them all in separately.

Another use is when we want to save cost. Just inserting and connecting hundreds of parts, without considering the individual cost of the separate components, can be more expensive than the IC containing the components already hooked together. In addition, sometimes our ability to put the components very close together gives us an electrical performance advantage resulting in a better oscilloscope than discrete components could make.

Approximately 35 per cent of the dollar volume of instruments sold by Tek contain one or more of our own IC's. We make about 15,000 integrated circuits per week and buy about 98,500 per week.

How do our people make these IC's? We start with people like yourselves, provide them training, process specifications, well maintained equipment, technical support, and managerial support. They perform high temperature processing in furnaces, photographic processing of the very small images on silicon wafers, chemical etching processes, assembly processes of microscopic parts and electrical testing processes.

In addition, many of our people work in support of those who work directly on manufacturing sequences. They concern themselves with the processes, the equipment, the reliability, the documentation, the scheduling, and interface of our parts with the instrument.

What does the future hold for IC's?

Forecasting is a difficult thing, but there are some things that we can say about the future of IC's. We do expect to see the quantity of people in ICM grow at the rate of about 15 per cent per year over the next five years. As is forecast in the rest of the industry, we don't expect much of that growth in 1975, however.

The biggest need for extra people will probably be for hybrid circuit assembly rather than for monolithic integrated circuits. Because of the greater variety of hybrid packages, the assembly and testing is not apt to become as highly automated.

We will begin putting Tek-built MOS IC's in Tek products soon. These will grow to represent quite a number of parts out, but not a lot of people because the labor content in each package will be low. They do require a lot of electrical testing time on expensive automatic testing equipment.

GOLD BONDING of IC's is a very exacting task, requiring the use of high powered microscopes. Nancy Anderson is the operator.

It is not possible to forecast if or when a major technological breakthrough might affect the ICM operation. If such a breakthrough occurs, we would expect a smooth transition as our people are trained in the new technology while the regular products continue to be manufactured for existing instrument lines.

Questions for Guest Speaker

Will we continue to build only the IC's we can't purchase outside or start to produce some of the commercially available types?

Make or buy decisions can be complex. Our guideline for IC products has been, "If we can buy it for a realistic price, don't build it. Put our efforts on components we need and cannot buy."

Do you primarily build only experimental types of IC's?

The IC's built in manufacturing are not experimental in the sense of being built to generate information but rather are built to work in specific applications in Tek equipment. They are, however, specialized and many would not find broad use in other applications. We do prototyping for new instrument applications.

Are our IC's interchangeable with those built by other manufacturers?

No, we have not built any IC's to the identical specifications of commercially available units.

Would we sell IC's to other instrument manufacturers if we produced more than our own need?

This has not tended to be attractive. Other oscilloscope manufacturers, for example, would probably want to buy them to reduce the competitive edge which our developmental efforts give us.

Are we still considering a new building for IC Manufacturing?

We have adequate capacity to meet current production requirements in our present facility. Both Manufacturing and Engineering will review changing space and facility quality levels as part of our regular planning process.

Is there anything to the rumor that Texas Instruments, or some other company, has developed a process that will change the whole IC market? (What I heard was they can build IC's that now sell for around $3 to sell for around 48 cents.)

We do not know of any processes applicable to our volumes and specifications which would lead to the dramatic cost reduction which you heard rumored.

If some other company comes up with a revolutionary new process for building IC's, how would it affect us?

If it is to our economic or technical advantage, we give it serious consideration.

What's the present volume of production in IC's at Tek now?

About 15,000 IC's per week average.

How will it affect Tek when Intel starts up in Aloha?

As was reported in the newspapers, Intel has postponed their Aloha facility. Tek and Intel have always had a cordial relationship. We expect no major impact when they do start up.

About three years ago, we put in a new machine to automatically solder the legs on IC's. Did it work out well, and did we buy more?

I think you mean the automatic bonder which attaches leads from the IC die to the lead frame. It worked well and we now have two.

We're always making something that other IC manufacturers haven't

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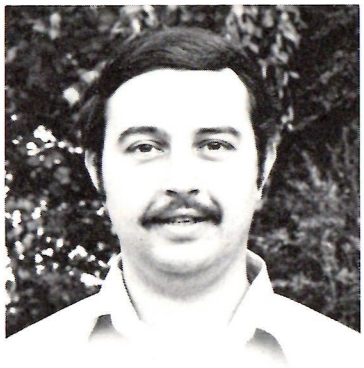

MIKE TRODOUX
Conference Chairman

tackled yet. When others do start up commercial production of those types, do we then stop producing them and buy outside?

Most of our circuits would not have the high volume markets which would attract the usual IC manufacturers to produce them for outside sale. If an outside manufacturer does make a circuit we could use, we would give it serious make-or-buy consideration. We have always purchased more IC's than we make.

What's the most difficult IC we make right now?

Vertical amplifiers for CRT's in the 475, 485 and 7700 Series. There are many others that are difficult as well.

Do we buy our own Tek made test systems to use in IC Manufacturing, and will we be able to do it with an austerity program likely to come up?

These systems are a large investment and get a close look before buying either inside or outside whether or not we are in an austere period. Tek systems have been a good buy when we needed systems in the past.

What is the connection between Ceramics and IC's?

They are both part of Electrical Components Manufacturing. Ceramics supplies subparts to ICM. Ceramics makes some hybrids with passive components.

Are you having problems with material shortages in your area?

Supply problems have eased in the past months and few critical ones remain.

Why are reclaimed wafers sometimes better than new ones?

There are some small companies now which reclaim wafers for a user. Certain types of impurities and imperfections can be removed to better than original quality. It doesn't work for all wafers. We are evaluating some of these services now for used and new wafers.

Is our biggest problem with IC's getting high-speed performance characteristics?

High-speed is one of many significant parameters.

Of about 1000 employees in your area, how many are engineers, especially in IC's?

Electrical Components Manufacturing has 38 engineers of various disciplines plus the technical personnel who support them. Of that number, 16 are in ICM.

In IC's are most jobs, even in assembly areas, more technical than the average at Tek? Do they need more training?

Averages are always hard to talk about. ICM has a broad range of jobs from range 4 on up. We provide considerable training, but there are many technical jobs in other areas of Tek.

I'm not satisfied with that answer. Would you tell us more?

It boils down to, what's technical? Training depends on the technical job, and IC's are no different in training than any other area. Obviously, some specialized jobs require more education.

Are you now building any new types of IC's for some new instrument types that will be coming out?

We are prototyping several.

In building IC's, is contamination a major problem with no permanent solution?

Yes, contamination is a major problem. We keep getting better, but future circuits can always require further efforts.

Are extreme controls during production of IC's necessary to get a reasonable yield?

Extreme might overstate it a bit, but we do have to work at it.

How do reliability figures on Tek-made IC's in the field compare with others?

They compare favorably when you consider the level of field problems and the type of applications.

Is there still as large a reject rate in IC Manufacturing as two or three years ago?

There are many steps in building IC's, each with a yield that fluctuates. Perhaps the most commonly referred to yield is the final electrical yield. This yield has improved during the last two or three years. There is, however, more effort going into yield improvement, particularly on new processes, than ever before.

Is the electron microscope used in IC Manufacturing Tek-made?

It is a Model AMR1000 made by Advanced Materials Research, Inc.

Where in the manufacturing process do most failure problems originate?

They are about equally distributed between wafer fabrication and packaging.

How many times during the production process (about 100 steps, I understand) is the IC tested?

There are three major electrical tests with many other inspections of various kinds.

What are the minimum and maximum costs to Tek of making an IC?

We have IC's which range in cost from $1.50 to $50.00.

The IC was a revolution in electronics when it came out. Is it likely to be pushed out by some other big innovation very soon?

It doesn't appear likely now, but Tek Labs will help us keep up as technology advances.

Isn't there already another process called something like micro-filming that goes beyond IC's?

I am not aware of anything that would be directly applicable to our work.

Is the slower growth in IC's now related to an austerity program?

The growth rate is keyed to output requirements and inventory levels.

Are Tek IC yields comparable to yields of other manufacturers?

Yes, our yields compare favorably when comparing like devices.

Is it true that Tek hired an IC consultant? Will he be paid according to the yield improvement in IC production?

Yes, we have retained a consultant to help in the IC operation, but his pay is a fixed figure. It does not depend on yield improvement. Incidentally, yields in recent months have improved considerably.

Does Tek own a Model 25 ESI laser for IC production?

We have a laser in Ceramics, and I believe there is one in Engineering, but we don't have one in IC manufacturing. We take work over to Ceramics when we need to use the laser. They are expensive machines and our utilization rate doesn't justify another one now.

Are all IC's made in Beaverton or are some made overseas?

They are all made here in Beaverton.

Do we chrome plate IC's with a laser?

No, we don't. We have a wafer scriber, but we don't plate IC's.

Is attaching the gold wires the biggest slowdown in the IC process?

That's hard to answer. I'd say the problems are about equal between bonding and the wafer process.

Do we buy silicon?

Yes, we buy silicon wafers. We have no plans to grow our own.

Do we reclaim silicon wafers?

We reclaim in-house wafers if there are no diffusion problems. A company in California is reclaiming finished wafers and claiming better results than with new ones.

Do packaged finished IC's break if they are dropped?

No, they aren't heavy enough to be hurt if dropped.

How much do wafers cost?

Around three dollars.

Why are parking lots so dark at night, especially the one behind Education and Training?

(Larry Frost) The E&T parking lot has always had poor lighting. The lighting will be improved soon, however, upon completion of the Distribution Center parking lot.

Are there any plans to construct a covered parking lot for bikes?

(Larry Frost) We struck out in our search for an economical cover. Consequently, we have no plans to build bicycle and motorcycle covers.

Can you estimate the expected growth in IC Manufacturing?

As the nation's economists have been finding out, forecasting the future is risky business. If the economist's forecasts and the company's forecasts prove to be accurate, over the next five years the average growth in parts out of IC Manufacturing should be about 25 per cent per year. This may correspond to a growth rate in number of employees of about 15 per cent per year. Very little extra floor space would be required during the next five years to meet this increased output.