AN INTRODUCTORY GUIDE TO THE HEWLETT-PACKARD COMPANY MICROWAVE INSTRUMENTS AND PRACTICES

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TABLE OF CONTENTS

WHAT EVERY HP STAFF ENGINEER SHOULD KNOW ABOUT HP

INTRODUCTION

This material is intended as a briefing overview for new-hire engineers who will serve in factory marketing assignments or in field staff jobs for their early training period. During that period, they will be expected to learn at an impossible rate across a wide diversity of product information and HP organizational knowledge, and be expected to deal with a confusing array of HP information retrieval schemes.

While some of this material will be duplicated in other briefings, I felt that there would be some unique data here especially in the microwave and RF sector. Some is quite mundane, and might even be called trivial, but bear with me, since I think you will find some useful gems among the pages.

So, congratulations on your choice of HP as a place to work. And take heart that even the most successful of the top HP VP's went through the same Neophyte Seminars and paid their dues on learning the vast array of material that forms the lore and backdrop of the HP culture and tradition.

GETTING YOURSELF ON THE RIGHT MAILING LIST

The key to the HP literature and documentation is retrievability. This simply means that whenever we have something to write, we try to fit the document into one of the supported systems of titles. For example, the Application Note is a well-known and maintained system with AN numbers controlled by the corporate Marcom office. We would try not to write and print a document called an Application Brief since it would have no clear parentage and could not be referenced on the important AN Index in the annual HP T&M CATALOG.

Information letters and memos which go to the field are discouraged for the same reason. It's because once you receive a letter with product or technical info, you usually don't know where to file it, or retrieve it, if you only keep a chronological file. So we encourage factory people to use the in-place communication publication systems of retrievable documents.

In that respect, INSTRUMENT NEWS has assumed an important place in communicating to the field sales force. In earlier years, for example, we would reprint all our magazine advertisements and mail them separately to each field engineer. This function now is handled by I/N, described below. It also takes the place of multiple informational memos to the field which came in flurries like the snow.

The first mailing list to get your name on is the ROSTER list which is managed out of the corporate offices in Palo Alto. ROSTER is set up to recognize your job position and give the various divisions and other mailing entities in the company profiled lists of names for when they make their choice on mailing out literature to the field and factories. An older system, now defunct, called MAILS II allowed the RECEIVER to choose the exact types of literature and which particular division's products they wished to receive. MAILS satisfied the receiver well, but was difficult to administer. ROSTER is tied into HP's personnel tracking system.

Since mail is administered out of factories, you lose some control of what you receive, and some folks complain that they get too much across their desk. If you receive useless stuff, it sometimes helps to let the mailing division know so they make better choices the next time. But, since your manager controls your name on ROSTER, it isn't likely you can get off entirely.

You can make some choices on areas of interest. For example, SPD usually chooses to mail to lists of people who have checked the MW interest catagory in both field and factory. ROSTER contains names of factory marketing folks, but does not extend further down into the lab or production. We often mail to all SRs (field engineers), including general purpose interest as well as MW interest folks.

In late 1991, domestic literature distribution is being modified to improve distribution, avoid waste which has been pretty bad, and to provide local retrieval of items. Bulk distribution is being organized into 11 "hub" locations with full-time "librarians" who manage a number of "spoke" locations which are local offices. Spoke sites will determine stocking status on new lit items and respond to the Hub requests.

In addition, LITROM, a new lookup technology based on CDROM technology will be rolled out in early 1992. These local computer/CDROM discs will retreive more than 500 data sheets, which can be scanned on screen, or printed out locally with print quality between FAX and lithograph. ASCII files are also available in case the FE wants to capture some of the literature text for specific written quotations.

HP is also introducing a phone/FAX service whereby Field Engineers can phone in to a special number, and order a data sheet FAXed to a customer, for example.

There are several other regular publications you will want to get. You can also choose some of these with a special selection on your ROSTER request sheet. Some of these are delivered to the divisions in bulk quantities and the field offices may get theirs that way too. Your local literature clerk will usually know the ins and the outs of many of these lists.

PUBLICATIONS AND REFERENCES

1. HEWLETT-PACKARD JOURNAL is a learned monthly publication which goes to about 200K customers worldwide, and generally serves to document the entire anatomy of a given product at the time it is introduced to the market. A file of these Journals is quite invaluable, but you won't be able to get back issues. Therefore you need to get friendly with a senior FE who will likely have copies going back to the creation of the universe (actually, Vol 1, No. 1 is dated Sept 1949). The indexes should be with their file and will give you entry into the series by product number or by volume. You may wish to make a copy of the ten or so indexes so you'll know which issue to use to look up design information on a particular product.

2. TEST AND MEASUREMENT NEWS is the bi-monthly newspaper with all the recent announcements about new products and applications literature. This goes to about 250K customers in the world in about 4 or 5 languages, and keeps customers up to date. Delivery of T&M NEWS probably comes to your office in bulk form and is distributed by your dept secretary. You certainly should try to get your customers on the T&M NEWS mailing list. T&M NEWS is now being published by the T&M Sector office and is quarterly.

There is a computer version of customer news called COMPUTER ADVANCES, and a component customer newsletter called ONE VOICE/ONE TEAM. If you have a need to deal with those types of customers, you may wish to find where to send your name to stay informed on those particular product sectors.

3. BENCH BRIEFS is a service-oriented publication which goes to customer's repair and metrology departments. It also is intended for our own service personnel. The editor is Jim Bechtold at the Product Support Division in Mountain View. You should keep this publication in mind for your customers who have service and parts ordering functions, such as the Calibration and Metrology Lab.

5. The HP T&M CATALOG is the industry "wish book" and prints every year to the tune of over 350K copies. It costs HP many millions, but there is no better single piece of selling literature. Even a year-old copy is treasured by customers since it gives them the reference book they need when configuring test systems. Only about 10 percent of the information changes each year or is added to by new instruments. So old copies remain useful for quite a while. These come in bulk to field offices and divisions.

6. APPLICATION NOTE INDEX. There are countless (over 500) application notes and product-oriented notes available which are indexed for yourself and customers. The previously-published AN index which gave short abstracts and ordering information has been superceded by a long index in the rear of the T&M CATALOG.

For your information, each sales document from HP carries a literature number of the form 5952-6722. This number which appears on the bottom/back page of each document is in addition to the title of the document, and the family number (AN 281-1). The Lit numbers are assigned in series so there is no code to decipher. The publishing division assigns a Lit Number whenever the document is to move through the Lit Center or will have a long life or will need retrievability.

APPLICATION NOTES are generic measurement techniques which give overview-type descriptions involving families of products and are not product-specific. PRODUCT NOTES are very similar to AN's in technical depth but have extensive descriptions of a particular product or series of products. PN's often show extensions of performance outside normal limits or show lab environment performance versus the specified performance which includes the specification budget to allow for 0 to 55°C operation, time drift, and age considerations. When the authors envision a series of smaller notes to make up a total theme, they can assign a base number plus dash sequence to either the AN or PN. (AN150-12).

PROGRAMMING NOTES are written for HP-IB products to serve as pre- and post-sale documents for getting a customer up and running quickly on an automated setup. They include demonstration software to do simple but useful steps to learn the various programming functions of a particular product. If the division chooses to program against several different desktop computers, there will be a separate programming note for each computer. The numbering system uses the form 436A/9836A-1.

7. INSTRUMENT NEWS and COMPUTER NEWS. These internal publications are intended for HP personnel only. They carry a security designation FOR INTERNAL USE ONLY. Incidently, there are several other levels of company security that most of us never see, and have little use for since it usually involves product or business strategies. The next highest is COMPANY CONFIDENTIAL and the highest security is COMPANY PRIVATE.

INSTRUMENT NEWS gets its circulation list from ROSTER. The basic objective for INSTRUMENT NEWS is to serve as a single newsletter from the T&M Sector of divisions which need to speak with a particular sales force, eg. T&M field force. The information includes a wide variety of useful and current material on product news, sales aids, competitive information, division personnel changes, advertising reprints and strategies, etc.

8. DATA SHEETS, BROCHURES, CONFIGURATION GUIDES, TRAINING MANUALS, COMPETITIVE SALES AMPLIFIERS, PRODUCT SELECTION GUIDES, are all mailed out to ROSTER names at the selection of the division.

9. Service personnel have a wholly separate set of documents they can order, SERVICE NOTES, SERVICE MEMOS, and so forth. Those are mostly keyed to particular product numbers.

10. SALES LITERATURE INDEX. Most divisions provide a complete index of all of their currently available literature which includes most of the above-mentioned stuff, and other special material. In the case of Microwave Test Accessories (Microwave Technology Division), for example, we index the MICROWAVE ACCESSORIES CATALOG, the bible for all the 350 little microwave components which "glue" our measuring setups together. These SALES LIT INDEXES are usually stocked in your literature bins too. They are produced about every 6 months. The Corporate Literature Center also provides literature reference and information retrieval scheme.

11. GSA SCHEDULES. If you're doing any amount of work with government purchasing offices or in some cases with large aerospace contractors, you may need to know that certain of our products are sold to the government under special purchasing agreements. Periodically, the General Services Administration of the government goes out to large vendors and negotiates a blanket order agreement with certain trade discounts or whatever, and publishes this information to all their various departments and agencies.

Once an instrument appears on a "GSA Schedule", then the whole purchasing process gets easier because any particular buyer or purchasing agent does not have the usual long sequence of publishing the bidding or getting multiple bids from many vendors. If you have such customers in your area, you should get yourself briefed by your local HP contracts personnel or call on the contracts group in any of the large division's marketing department.

12. INSTRUCTION MANUALS, OPERATING NOTES, PRODUCT SUPPORT LITERATURE. There is a wealth of information on each specific product (except for some small accessories) contained in the service manual. This includes theory, sometimes simple applications, and complete repair and service procedures. Detailed schematics and replacement parts lists along with calibration procedures are offered for most of the traditional instrument products. There is some changing of service strategy going on now with certain products being set up for no field repair, or for servicing only by HP. That strategy is growing out of the usual business practice for computers and associated equipment and we will likely see more of it in the future.

13. PRODUCT SUPPORT GUIDES. The product support groups of some divisions publish an annual compendium of service-related information of all the products of their division, including histories of SERVICE NOTES, publication numbers of the documentation, service kits and discontinued products.

HOW WE NUMBER PRODUCTS AND THINGS

Product numbers range from HP-1 which was a digital wristwatch for all of you new folks, to HP 99999A. The numbers are controlled by Corporate Manufacturing Specifications which has allocated blocks of numbers to the various divisions. The suffixes can range from A to Z to represent either different models in the same family or different vintages. A double suffix is allowed for coding-in certain ordering information, and has been used most recently for TEMPEST-qualified products which meet certain government security requirements. (The TEMPEST product line was recently sold to Hughes Aircraft Co.)

When we retire an old model A we might renumber the new one B. We are sensitive to the customer identification problem on service and repair. For example, if there is substantial internal mechanical or electrical change, we might give the modified instrument a new suffix to be sure that customers realize that it has significant changes inside.

There is a brand new numbering system which will begin to appear shortly due to the problem of running out of old numbers. It will permit the use of "merchandising" numbers such as the HP 150A

Computer which used other 5-digit product numbers to back it up and for ordering purposes. The new system will use the format of ANNNNA. For example, the new VXI power meter is numbered E1416A Power Meter. The alpha prefix and four-digit format will permit 260,000 numbers so we won't run out for a while.

There is no particular code on model numbers, although divisions sometimes try to place some mnemonic aids by numbering products in sequence or in contiguous families. Or sometimes plug-ins are numbered with the mainframe number times 10 (HP 8350A and 83522A). But that only works well if the division owns those decade relationships on model numbers. It also causes reservation of too many blocks of model number assignments and with 72 divisions, you can understand numbers are a scarce resource.

Waveguide products are designated for frequency band with an alpha prefix. For example the HP X382A Rotary-Vane Attenuator operates in X-band which is 8.2 to 12.4 GHz. A double-prefix is allowed for a waveguide-to-waveguide transition, eg. HP MX292A.

Each division can assign regular product OPTIONS to any product if they determine that such flexibility will help customers order what they need. Options numbers range from 001 to 999. Certain numbers are pre-empted to specify rack handles or rack mount ears or a spare manual (Opt 907-910). Options can "add" performance and a price increment or can be used to delete performance and subtract a quoted price decrement.

Divisions are usually anxious to increase sales by offering to perform modifications to standard instruments to meet special customer needs. This practice extends beyond the option offerings. Typical "SPECIAL HANDLING" offerings would perhaps be a special color paint for system use. Or input terminals for an instrument might be desired on the rear panel for wiring into system racks without front panel clutter. Sometimes instruments can be selected for improved performance or for operation slightly outside normal specified limits of frequency or power.

"Specials" get identified by a number assigned by each division. The number is of the form alpha-number-number (A02). For example, the HP C04 33311B is a mechanical modification to a basic HP 33311B Coaxial Switch.

There is some consistancy in assigning special numbers but don't count on it to be always true. A and B prefixes have meant special paint. C and D have meant mechanical modifications. H and J specials usually mean electrical modifications. E specials usually mean combinations of instruments with the major instrument of the cluster taking the number.

For example an HP E01-8672A includes the synthesizer along with an HP 11720A Pulser. K specials are for "kits" or related clusters of accessories that go with some instrument with enough tie-in importance that it should carry that instrument's number relationship. For example a K05-435A is a special calibrator reference oscillator that would be used mostly with the HP 435A Power Meter, but not important enough to create a standard instrument for our production line or to carry its own number.

Incidentally, there is an important legal reason to always protect the Hewlett-Packard name and trademarks. You will note that we now always preface a model number with HP, for example, HP 436A. Also, we are very careful about HP-IB or HP Interface Bus, or HP-IL. The placement of the hyphen turns out to be crucial from a legal standpoint. Usually, if you follow the lead of the printed literature, you will be OK.

Most HP products carry a serial number on each item. Most small accessories don't carry a serial number. The criteria we use is to consider whether a customer will want to identify that particular item individually. They would want to do that if the product came back for regular yearly calibrations.

Therefore, we do serialize certain coaxial and waveguide items like attenuators if we feel that the customers will calibrate them and need to control their movement.

Serial numbers take the form 1234A-00154. The first four numbers show the date code which represents the date of the last significant production change. In that way, we control the vintage of our service manuals and change sheets which reflect the parts lists and photos inside a product. The alpha character shows the country of manufacture. That's important for many custom considerations. The last five numbers are the actual serial number. There is some consideration being given to begin using serial numbers that are scrambled to prevent a competitor from gaining market information from them.

Some of your customer calls will deal with identifying parts. HP uses two forms of part numbers. There is an 8 digit number of the form 1234-5678 which is used for all purchased parts from vendors. The first four digits have significance, for example, 1250 is the catagory for rf connectors.

The other catagory we use is fabricated parts. These are mostly related to a particular instrument such as sheet metal and printed circuit boards, etc. These 10-digit numbers are of the form 00436-67000. As you can see, that one would be used in an HP 436A Power Meter. (Notice how I used the HP in front of the number 436A but not in front of the part numbers or publication numbers?) This is no place to recount the significant catagories of either purchased parts or fab parts. If you need that, you can get that information from a division service group.

HOW TO FIND THINGS

Many of your first calls will involve finding which factory might be responsible for some product. The Ordering system and a good system of field office microfiche is a good place to start. Each division and sales office has an entity number. Look for that in the TELNET directory or the WORLDWIDE SALES, SERVICE, AND MANUFACTURING DIRECTORY. The Corporate Price List carries all the currently available products with complete lists of options and prices, listed both by product number in a numerical sequence and another by division sequence. The same information is available on a microfiche both sequenced by model number or a separate list sequenced by division.

This might be a good time to introduce the type of sorting system that HP uses to list products, and parts, and most everything. It is an alpha-numeric computer-type sort that keys on the first digit, picks up the next number in sequence without regard to the total number of digits. Then the next digit and so forth. Thus these following numbers would be arranged as shown.

So these numbers:	are arranged in this sequence:
1220-6789	X382A
11344A	00436-67890
X382A	11344A
67B	1220-6789
00436-67890	67B

One of the most useful lists is the INSTRUMENT HISTORY MICROFICHE. This will list every product by number that HP has ever offered, and give you the divisional responsibility. This list is most useful to trace back through the history of products that have moved from division to division when they changed cities and locations from time to time. It also gives a history of price changes. One advance warning. Sometimes when you call a division that was the last known resting place for a product, those people may disavow any knowledge. That may be because the phone answerer is too new to the division, or the product just arrived at that location in time to be obsoleted. And the real product knowledge resides at the old division. Feel free to call them.

There are often questions about the vendor part numbers of the purchased parts we use. We normally recommend that customers purchase the HP part number involved even though it may be fully equivalent to a vendor number. The reason is that our materials engineering people have fully qualified all parts for reliability and performance to meet stringent temperature and environmental conditions of the instruments. Occasionally the BENCH BRIEFS will publish a long list of HP part numbers of transistors, diodes, and integrated circuits with the closest equivalent of vendor and industry part types and numbers. These are made available as a convenience to customers who have no choice but to get parts fast and are willing to take a calculated risk in using such parts. The HP parts delivery system is a marvel of speed and efficiency to many places on the globe, so we still suggest that you encourage customers to use the HP supply system.

An important file when you're chasing information on parts and small accessories is the PARTS PRICING MICROFICHE. It contains an amazing variety of parts from instrument parts to the transit cases that are described in the T&M CATALOG or the cabinet handles and rack-mount ears necessary to rack up various gear. They also stock quite a few of the 5-digit accessories to allow for fast delivery. Most connector adapters and other cabinet parts on those pages in the T&M CATALOG are included. Try it; you'll like it.

There is another whole catagory of designations for hardware used by the US Federal Supply System and the US Department of Defense. These are the well-known MIL-NOMENCLATURE system. Everything carries a number if the military procures it. An airborne radar might be an AN/APS-67 and a communication system might be the AN/TRC-44 and so forth. Test instrumentation is procured the same way. Your HP bible for those customers is the HP LOGISTICS DATA BOOK, published about every two years.

This comprehensive listing of HP products and their equivalent military numbers is invaluable when dealing with the services themselves or with prime contractors who are often contractually obligated to buy support equipment from the federal supply system. Even if the service doesn't create an AN nomenclature, we are often required to get NATIONAL STOCK NUMBERS for a product purchased by a prime contractor. So the LOGISTICS DATA BOOK gives several cross-references on all HP products as well as those items where HP may have something to offer that is reasonably equivalent.

Most divisions that do a lot of government business also have indexes within their contracts group which can locate nomenclature and National Stock Numbers for other kinds of products that are not HP. Incidently, the general code for MIL-NOMENCLATURE is listed in the ITT REFERENCE DATA FOR RADIO ENGINEERS. For example, APS stands for Airborne, Radar, Detecting. Similarly, USM stands for general Utility, Special-type, Maintainence and test assemblies. Much of our HP testing equipment falls under the USM category.

PEOPLE HELP

At the risk of increasing their phone-load, there is a group of people in the Corporate Parts Center in Roseville who are literally worth their weight in gold. These are the unsung heros in the PARTS IDENTIFICATION OFFICE at the Corporate Parts Center, who depend on a wall-full of documents, an enormous memory, old service and parts manuals, changes, and any other kind of material lists they could scrounge from earlier production. You can call these folks with off-the-wall questions, and they will try their hearts out to help you. Get to know them, and send them a box of candy once in a while if they help you with a particularly difficult one.

Quite a bit of material is also available in your own local service shop which supports the local customers with up-to-date documentation. Get to know your Service Manager who can give you some

leads when you're trying hard to help a customer. They have some master microfiches of many things.

SPECIFICATIONS, SUPPLEMENTAL CHARACTERISTICS, AND SPEC BUDGETS.

About 8 years ago, HP set out on a program to reduce our customers' calibration costs. As many of you know, in the military and aerospace as well as other well-run industries, our customers have carefully established programs to recall all important instruments in their inventory for an annual calibration cycle. It isn't unusual for some of these procedures to run to 3 or 4 hours per year per instrument, and some installations have 60,000 calibration actions per year. Our HP programs recognized that not all performance parameters for every instrument need to have hard, warranted specs.

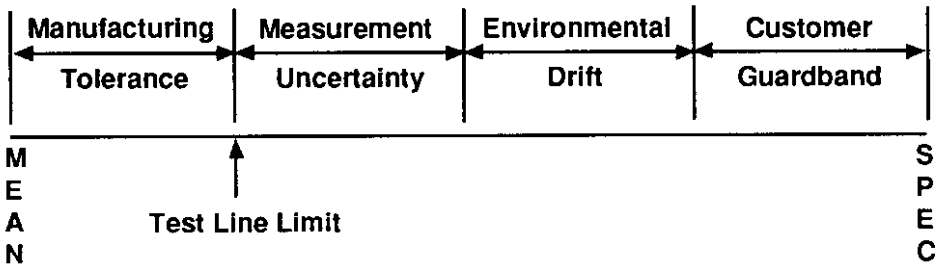
We therefore established the two-tier or "hard spec-soft spec" system that is defined on most instrument data sheets just above the list of the product specs.

SPECIFICATIONS, the "hard-specs", describe the instrument's warranted performance over the entire 0 to 55°C range of operating temperature.

SUPPLEMENTAL CHARACTERISTICS, the "soft-specs", are intended to provide information useful in applying the instrument, by giving typical, but non-warranted performance parameters. Supplemental characteristics are denoted as typical, nominal, or approximate, and are often shown in italics.

This strategy has a number of important benefits. Our own test times go down and yields go up because we have fewer specs to test to. Our customers find fewer places to reject products. They also reduce expenses each year because the calibration time is reduced. Yet, the supplemental data still gives the customer good, useful operating information. Incidentally, the numbers used for a supplemental parameter are determined by measurements on a group of products and are set so that 90% of the units will meet that nominal or typical value.

This leads to the concept of the specification budget. Over the years, HP has built a considerable reputation by specing our products very conservatively. You can think of any given spec as in the following diagram.



As you can see, we use data generated typically from a pilot run's worth group of instruments. Then we add a band for the drift with time and temperature; another band for measurement uncertainty of the test equipment and the hierarchy of traceable links to the US National Institute for Standards and Technology (NIST) which was formerly the National Bureau of Standards. Finally, we add a customer guardband just for the heck of it. That makes for a pretty conservative spec and gives us the reputation we like. The downside of this practice is that competition sometimes specs much closer to the quoted specs and may take some sales from us from time to time. About all I can say about that is that the policy of conservatism is a judgement call and when you're hurting competitively, let us know. I will say that there are a number of examples where we have speced too close to the line and regretted it

later. You usually get into a horsepower race with a competitor and no-one wins because the product gets rejected and returned or they churn around on the production line.

This following example of the accuracy specification for our HP 8970A Noise Figure Meter is taken from the Symposium Paper, TREATMENT OF UNCERTAINTY STATEMENTS IN SETTING INSTRUMENT SPECIFICATIONS, by Bill Carmichael, available from SPD.

As the plot shows, we measured the actual performance for 640 units and plotted them for a nominal value of 0.03 dB to meet a spec of 0.1 dB. While it looks like we could quote a 0.05 DB value to meet the AilTech competitor, we choose not to do that.

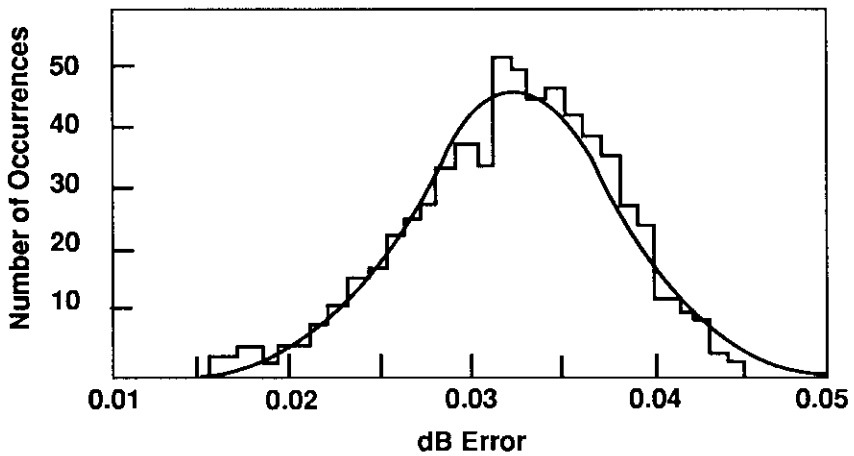
RELIABILITY AND MTBF

With some of our major instruments like synthesizers now containing 6000 active parts, reliability is crucial. While it might seem logical to us to argue that more components should lead to poorer reliability, if fact when a customer must pay 45 to 60K dollars for an instrument, they obviously expect HIGHER reliability. Some years ago we began a sophisticated program aimed at the best reliability, and with the authority of our highest management levels. It consists mostly of substantial derating of parts, and a totally intolerant attitude to temperature rise. The decade of the 1980s in fact achieved a factor of 10 reduction in warranty failures.

For a more detailed description of the SPD program, ask for the RF/MW Symposium paper, WHAT EVERY CIRCUIT DESIGN ENGINEER SHOULD KNOW ABOUT DESIGNING RELIABLE CIRCUITS, by Julius Trager. It shows how each circuit must be analyzed part by part for heat rise. Various failure rates are applied according to their part type, and careful knowledge of their vulnerable characteristics. For example, relays are among the least reliable of parts and are used as little as possible. Since all new products must endure a complete series of environmental tests including 95% humidity, careful attention is given to leakage paths and similar design practices.

Incidentally, HP instruments have traditionally been designed to what we designate "Class B" environmental specifications. Generally, this represents first rate industrial equipment with the capability to withstand rough treatment and conditions. Briefly, the instruments are "type-tested" to meet performance specifications for an operating temperature range of 0 to 55°C, non-operating from –20 to 65°C. They get some humidity cycles up to 95%, operating altitude to 15,000 feet, and non-operating to 50,000 feet. They get certain vibration and shock testing. You understand that these do not mean we warrant all instruments to perform to those limits. What we warrant is given on the data sheets, and they often contain temperature specifications. The testing is done to assure good design. It is repeated periodically on important products.

A second environmental specification for us is the "Class A". This requires operation to 65 or 75°C, and is intended for components like microwave detectors that will end up being designed into other folk's systems and must endure more severe conditions. Occasionally, we have designed certain instruments for full military rattle and roll, and they have required Class A specs. Incidentally, these conditions are quite similar to MIL-T-28800 which the government often uses to procure reliable electronic



equipment. They designate four classes from highly-rugged flight-line gear to the benign use in a temperature-controlled Cal Lab.

Many new products are achieving excellent results. For example, we knew from the start that our HP 438A Power Meter would find heavy use in automatic test systems, so the design target from the start was a Mean-Time-Before-Failure (MTBF) of 25,000 hours. We're pretty sure that most customers act like we do in the production areas and let their systems run continuously. That is 2000 hours for an 8-hr. shift year, but 8600 hours for a continuous year.

You'll also notice that we are beginning to get a little tougher on specifying MTBF, just to be less ambiguous to our customers, many of whom are pretty sophisticated. Here are the catagories.

CALCULATED OR PREDICTED MTBF. This value results from essentially working from the material list and assigning a particular reliability number for types of parts like resistors, capacitors, etc. Those numbers by type part come from stress tests and handbooks such as practiced by the USAF Rome AFB people who are experts on this subject. HP, of course, being a gigantic user of parts and components, has extensive data banks which give us the starting reliability numbers. The final result, however, is still pretty much a "dry-lab" prediction number.

DEMONSTRATED MTBF. This number results from tests on products that have no field warranty information because they are too new. A group of perhaps 5 to 10 new units undergo an accelerated stress test series to accumulate life data. The acceleration factor caused from the extra high temperature of the stress has been carefully researched and has good confidence. We will typically footnote such an MTBF number with the statement, "Based on accelerated stress tests providing a 90% confidence level."

WARRANTY MTBF. HP has a worldwide statistics gathering system that yields much data. While we recognize that not all failures get reflected into the data bank, that factor, (perhaps 50%) is figured into the calculations too. When we use warranty data to quote MTBF, we will use a statement like, "Based on one year of warranty reports using a 5-month moving average."

Sometimes a customer will want to know MTBF for a given instrument. If the product was invented recently, you can ask the Service Engineer for the product. While we don't warrant the MTBF number, it still serves as a good guide for purchasing and applying an instrument.

Incidentally, some customers want to find out what our estimates are for RECALL PERIOD and CALIBRATION TIME for a given instrument. They use this in their own Cal Lab to set the first recall interval before they gather enough of their own data to set their own intervals. Some customers with thousands of instruments in inventory, have highly-sophisticated data systems that allow them to

set intervals by product family type or even by particular serial number for products giving them trouble.

In this case, you can ask the Instrument Support Division for a copy of their Service Cost List which basically gives our price quote forselling a customer a service contract for a given model number. We quote a price for annual cost and you simply divide that number by our current labor rate at CSC. There is also a column for our recommended recall interval which customers can use.

THE GENERIC HP DIVISION MARKETING DEPARTMENT

Hewlett-Packard Divisions are the basic organizational unit here. They operate on a fairly decentralized basis to offer the best of management by objectives and stay in group sizes of 1500 to 2000 people, but still maintain all the strengths of the big HP organization with its purchasing power, technology power, sales power, and so forth.

The factory marketing departments are deliberately organized to look very similar to each other. There is a good reason for this, and that is to make dealing with divisions quite similar from group to group. This makes most divisions look like small companies, with a Product Development Dept., Marketing, Quality Assurance, Manufacturing, Personnel, and Finance. There are exceptions to this strategy, especially in the computer areas where common interests call for much more group level coordination in areas as diverse as the product strategy all the way through advertising.

In any event, the generic marketing department usually has the following functions: Sales Development, Order Processing, Product Marketing, Marcom, Product Support, and sometimes, other functions like shipping, etc.

Here is the way the various functions interact with the field sales people. We try to have this relationship established with the usual HP style, personal contacts on the working level so that we get the job done without a lot of written policies and procedures. Here would be your typical interactions with the factory marketing.

1. SALES DEVELOPMENT. This is the primary point of contact between field and factory. Regional Sales Engineers usually are assigned to service a given field region. They are responsible for technical questions, competitive problems, quoting special handling products, both price and delivery, travelling to the regional offices to train on New Product Training, quoting on large deals, and in general answering all questions a new or senior FE might have. The RSE is the main face of a division to the field.

Division Sales Development also handles the division's portion of training such as Field Neophyte Seminars for new sales people. These are now coordinated at the T&M Sector level and held in Bldg 54 in Santa Clara. They also do the more specialized peaking seminars held every several years for the portion of the sales force responsible for that part of the product line. They often travel to assist at national trade shows or regional road shows or open houses that are traditional in many regions. Basically you call the RSE for any question regarding a division that can't be solved anywhere else.

In divisions that have large business with the government or prime contractors, there is often a CONTRACTS GROUP. These people are specialists in dealing with the myriad of special paperwork that is expected and demanded from those customers. Typically, the customer needs special quotations for marking and packaging with special government numbers and perhaps moisture barrier bags. There is special paperwork needed when it comes time to ship the material, called a DD 250 form. Many times, your field contract people need to get assistance for contractual requests for special and unusual cost accounting procedures (DD 633). We usually turn those down and intend to sell our equipment as catalog equipment. When the government goes out to buy Coca Cola, they certainly

don't expect to be given the formula for mixing their own Coke, or to get the cost accounting data on factory cost or profit. The free market sets those values and the procurement regulations provide for that.

Incidently, the Contracts people can help with other quality assurance provisions that the govenment invokes on many prime contractors. These are well-known specifications such as MIL-Q-9858A, MIL-I-45028A, and MIL-C-45662B. While HP conformed to all those specs a few years ago, the fact that most of our divisions worked into other markets meant that they incurred extra expense since divisions like the medical products also had to meet other federal regulations such as the Good Medical Practice series.

The Contracts Group will also help you out on customer requirements for CERTIFICATES OF COMPLIANCE. Various divisions offer several types of certificates. The CERTIFICATE OF COMPLIANCE merely writes down that HP duly tested the unit and it meets our published specifications. This document has no test data.

Some customers need more and will have to have a special quote for actual test data for the unit and this might be done on the production line. The reason it costs quite a lot is that in many cases we may have to write a new test card since many tests are performed by automated testing these days, and we have to go out of our way to get data output. The professionals call these data cards VARIABLES data.

A third form of customer requirement will be to have a new instrument sent through the PRIMARY STANDARDS LAB after it goes through the usual production test to have certified test data measured with direct traceablility to NIST. Since the STANDARDS LAB is the closest to NIST in the calibration hierarchy, some customers and their government auditors think that data gives them more confidence. But it is quite expensive and usually has relatively few points of data.

All three of these data requirements can be explained to you by the friendly Contracts people in most divisions.

2. PRODUCT MARKETING. This group usually has a Product Marketing Manager in charge. The PMM will often have 2 to 4 Product Managers reporting to them, with each PM having responsibility for a given product line. Each PM in turn has a number of Product Marketing Engineers working on that product line. These groups are the real strategic strength of the company since those PME's are the ones who carry the product load. They are basically the 1st and 2nd Lieutenants of HP.

Product Marketing covers the waterfront on product strategy. They gather market intelligence for customer needs and work with the HP Triad of Lab, Marketing, and Manufacturing to devise the 5-year strategic product plan for their area of concern. They write the marketing and introduction plans, the pricing proposal, the competitive literature, and also prepare all the sales literature for the new products. In addition, they are also responsible for all of the older products in that line and work to enhance that business, or to propose obsolescence when that time-of-life arrives.

Your contact with the PM's usually comes when you have product or application or competitive intelligence for their particular product line. With that information, you can go directly to Product Marketing, but there is still some sentiment to feed such information back to the division through the RSE. As you deal with various divisions, take the lead from your specific RSE. Some wish to be in on all information flow, while others are so busy they prefer to have information more appropriate to Product Marketing to go directly to the PME.

You may hear from the PME's occasionally when they need to get out to visit one of your customers to check technical status of the industry. We try not to get in between you and your customer and you should always be informed whenever a division person wants to meet your customer. There are times

of course, when we meet your customers at national trade shows, or perhaps, when the customer will call directly to the factory to try and solve a problem. Depending on the particular problem, we may try to solve it right away, and then we'll let you know what we did in our best judgement for that situation. This is usually a tricky matter because if we are too helpful, the customer has little incentive to keep trying to get help through you. Putting ourself in the customers shoes, we can't blame the customer too much for going to whomever can help him best, and most consistantly. So if we do happen to help, we'll often try to get the information back to the customer through you. We definitely do not want to get in between you and your good customer. We'll always try to keep you informed of what we've done.

The amount of technical and application intelligence a division needs varies a lot by the type of products they produce. There has been a traditional technique coined by Bill Hewlett, called the "next bench syndrome", which simply means that for many general purpose products, a designer can merely walk down the hall and talk to their fellow engineer to do market research. It works fine for digital voltmeters and maybe network analyzers. But for divisions like Stanford Park, since we don't build radar sets or communication earth stations or EW countermeasure pods, we badly need field inputs from you and your customers to feed into our product plan. You'll hear from us a lot on our needs to get into the field.

3. PRODUCT SUPPORT. This department writes the service and operating manuals, and perhaps more importantly, works with the Lab to initiate innovative service aids into the new products while in the design stage. There is a Service Engineer assigned to each product by number. If you have feedback on anything out of line with a particular instrument or its manual, whatever, get in touch with that particular service engineer. They also make recommendations of all the spare parts and stocking levels, as well as service methods of board exchange versus component-level diagnostics.

4. ORDER PROCESSING. This marketing group takes care of all the daily routine of accepting your customer orders sent in over the big computer system in the sky called HEART. There is an order coordinator assigned for each product number. Scheduling information goes to production control from sophisticated statistical programs, but is always overseen by a human who lends judgement to the process.

The main contact you will probably have with Order Processing will be to expedite certain orders of your customers. This can happen when our production process goes sour and we have to push out delivery promised. Or occasionally, the US Government or its contractors can order products with national priorities which by law take precedence over other orders. Or your customer may just not like the delivery we have quoted. You need to understand that every division wishes to operate with as large an order backlog as possible to make production smooth. Stanford Park for example, has perhaps 350 different products and can't afford to have everything in stock. Yet the marketing department understands that competitive pressures demand that certain products be in stock, while other less-competitive products can survive quite well with 12 to 16 week delivery quotes. We feed such overall competitive considerations into the forecasting information we send to production and recognize its effect on the delivery quote.

If you try to expedite a particular order, we will usually ask for your office or region to offer to displace one of your other customers to take their unit for the requested expedite. We feel that is only fair since units can't be made to appear by use of mirrors. It's clearly not fair to bump another region's order because that would quickly get out of hand. We obviously don't like to do this often and will try other avenues like trying to help you find a demo instrument or some similar action. Generally speaking though, long-time customers know that HP treats delivery committments scrupulously honest and will not dump one customer to serve another. That is an important reputation to have and to maintain. So please be sure that your customers know how we handle the delivery times. That way, the customer will always know that orders will have to be placed in plenty of time for those instruments in demand that seem to always be at 16 to 20 weeks delivery.

5. MARCOM. This stands for Marketing Communications and often but not always exists in divisions. Generally, Marcom is responsible first off for media advertising and technical public relations. This means all the publicity releases that are sent to the technical press are written in the division and then sent through group and finally through the corporate PR department where all the releases are finally reviewed and mailed. Some Marcoms have responsibility for the graphics group that lays out the literature for the division. Some divisions that are more remote use their Marcom people to take care of local PR work with their city or region too. We plan trade shows, HP-only symposiums, write technical articles, fill-up Instrument News and T&M NEWS with creative editorial, and generally promote the product lines of our division. Some Marcom groups are also responsible for all the graphics production and printing services for all promotional and support manuals.

So there it is, the generic factory for HP. We all try to be helpful to old and new. Try us.

MICROWAVE TRIVIA— EVERYTHING YOU WANTED TO KNOW ABOUT MICROWAVE THINGS, BUT NOT SO MUCH THAT YOU'D HAVE TO GET TOO FAMILIAR WITH JAMES CLERK MAXWELL

This section will deal with a variety of microwave information that is not contained on most data sheets. It involves things like cable attenuation, power handling capability, etc.

First off, an information tidbit. One of our microwave tools that has not been completely superceded by the electronic calculator is a cardboard sliderule called the REFLECTOMETER CALCULATOR, obtainable from your HP literature shelves and with a Lit # of 5952-0948. It relates SWR to reflection coefficient to return loss and mismatch loss. It shows you mismatch losses for power measurements when you know the SWR of the source and the SWR of the power sensor. And it is a handy reminder for the numerical vs the dB ratios of voltage and power.

ATTENUATION AND VOLTAGE AND POWER RATINGS OF MICROWAVE THINGS

HP sells a variety of accessories that are basically unspecified. These are the connector adapters, cables, etc. A typical customer question might ask for the attenuation of the RG-214/U cable used in the HP 11500A Cable Assembly? The answer is to look in the REFERENCE DATA BOOK FOR RADIO ENGINEERS that many of us used at college. Publisher is ITT Howard Sams & Co of Indianapolis, IN, Library of Congress number 43-14665. Cable attenuation is plotted for all sorts of coaxial cables from the RG-59/U video cable we use with BNC connectors to large 3 1/8-inch rigid coax, which we don't sell. Incidentally, our HP 11500A which is 6-feet long would have attenuation of 2.4 dB at 10 GHz (40 dB per 100 feet).

The ITT tables on the Army-Navy list of preferred Radio-Frequency cables also shows other useful data. For example, the capacitance of RG-59/U cable is 21.5 pF per foot. This may be useful if you need to know the shunt loading capacitance of some BNC video cable which may connect a microwave detector to the input jack of your oscilloscope, if you want to use it unterminated, and look at the pulsed RF envelope.

Those same tables show that the maximum operating voltage of the RG-214/U cable is 5,000 volts rms. In a 50 Ω system, that might imply that you could put one half megawatt on the cable. But there are two things that limit that power. The Type-N connector on each end is only rated at 500 volts and if you look at one, you can see why. It uses air dielectric while the cable itself uses polyethylene dielectric. That connector rating of 500 volts of course permits about 5000 watts. But if you consider the attenuation of the cable, that will limit your CW power to much less. Consider the 2.4 dB at X-Band. That means that about 7 feet of the cable would exhibit 3 dB or a loss of half the power. I'd guess that