TEKTRONIX MODIFICATION NUMBERING SYSTEM

1. History.

Originally, modifications to Tektronix instruments which went beyond the level of complexity of a simple order-processing option were identified by an S-number suffix to the basic type number of the instrument, as 535-S1, 315-S2, etc. The S-numbers were a part of the regular panel marking, and each special had its own panel filmwork. The numbers were assigned consecutively by instrument, so that S1 in one instrument might be a timing change, in another instrument a DC fan motor, and in another instrument the same designation might mean an added single-sweep lockout circuit. The special versions of instruments were mostly listed in the catalog.

Because of the confusion arising from the use of the same suffix to mean different modifications in different instruments, the system was expanded to three digits, with each mod number taking on a particular meaning: 101 meant "400 cycle mod", 104 meant "single sweep mod" and so forth. However, it quickly became evident that this system would not be adequate to identify the various versions of the indicated modifications that would become available: "single sweep" is a pretty simple concept when you're thinking in terms of a 532 or RM15, with a switch, a pushbutton and a neon bulb on the front panel. It gets more complicated when remote reset, remote ready-lights, reset from closure, reset from release of closure, reset from positive pulse, reset from negative pulse and gang-reset requirements come into the picture: three or four "single sweep" mods may have to be available for a single instrument. A letter suffix was added to the mod number to indicate which version of the indicated modification was installed. The mod number was at about the same time eliminated from the panel marking and changed to an interchangeable slug, which allowed the same basic panel to be used for a number of mods which used the same basic panel marking.

2. Two- and Three (Four)-Digit Mods.

At present, we have two classes of modifications: those which are performed by description and do not alter the instrument nomenclature, and those which are quoted and ordered by mod number, and are made a permanent part of the instrument nomenclature.

For in-house use, the former are assigned two-digit modification numbers, but the numbers only indicate the class of work to be done, not the actual modification. For instance, Mod 08 indicates a change to an optional phosphor, but (except for the 564) does not indicate which of several dozen possibilities is to be included. Mod 13 indicates a painted panel, but the color, gloss, letter-fill colors, etc. must be specified in addition. There is nothing in the two-digit modification number that automatically keys any inventory control, cost or delivery data or customer billing; the two digits at most identify work-areas that will be involved in handling of the order (CRT, Electrochem, Finals) to incorporate the options. Two-digit modifications are those which (a) have little or no effect on the electrical and mechanical performance characteristics of the instrument and (b) are relatively simple to install. Something else that characterizes the two-digit mod: it is usually a fairly simple procedure for the customer to return the instrument to "standard" configuration and thus "eliminate" the mod. Some two-digit mods such as 26 (two instruments calibrated and shipped together) and 24 (test data furnished) are entirely ephemeral,

and the instrument after being shipped is indistinguishable from the standard.

Three-digit (four-digit) mods are more complex, have more effect on the instrument's performance characteristics, are less easily removed by the customer, and require more complete records-keeping in Portland in order to support the instrument in spare parts and service information. Because these instruments require special operating and maintenance techniques, contain parts not normally stocked by Tek, or do not meet standard performance requirements, the mod identification is made a permanent part of the instrument nomenclature. When "Mod XXXX" is added to the front panel of an instrument, all standard instrument performance capabilities, compatibilities etc. are in question until the specific manual for that modified instrument is consulted.

Unless otherwise stated in the drawing for the modified instrument, any three-digit mod is compatible generally with all two-digit options. However, no three-digit mods are considered to be mutually compatible. If it happens that two three-digit mods <u>are</u> compatible, and some customer wants both in one instrument, a NEW mod number is assigned (usually a 400-series number) for that particular combination. The philosophy behind this is as follows: if both of the modifications are individually important enough to warrant a change of instrument nomenclature, then both should be included in the instrument nomenclature when they are both installed. The only practical means of handling this is by a third number.

3. <u>Confusion</u>.

In the two- and three-digit mod system, we have a convenient key for order-handling procedures: if it's a two-digit mod, we simply do it and ship it. If it's a sufficiently complex operation to warrant changing the instrument nomenclature, the precise changes we propose to make in the instrument, together with information on any consequential effects on instrument performance characteristics, are communicated to the customer by means of a Tektronix drawing for the specific modified instrument, as a part of the price and delivery quotation, and the customer may place an order only against that quotation. The manual contains an addendum covering operation, parts and maintenance procedure changes, and records are maintained in CME on the specific circuitry and parts used to aid in field support of the instrument and further reproduction of it. This support must be keyed to the specific modification identified permanently on the front panel of the instrument, the "three digit" or "four digit" mod.

This affects price of mod.

Unfortunately, this distinction between two-digit order-processing options which do not materially affect the operation and performance of instruments and three (four) digit mods, which do have significant effects on the use and maintenance of the instruments, is breaking down. There are repeated requests for use of three-digit mod numbers for what are essentially order-processing modifications (change accessories, or ship with extra accessories), primarily for price-cutting purposes (costs increase by making it a 3-digit mod, but it enables Marketing to give selected customers a discount on accessories as a means of avoiding the "no discount on accessories" and "no price-cutting" rules) and for setting up catalog listing of options by number rather than by description. Some of these options as set up in Manufacturing involve an instrument nomenclature change; others (even using the same 3-digit mod number) do not. Some are covered by the standard instrument manual; others are not.

There is also some demand now to use three-digit mod numbers as the basic nomenclature of what are essentially new instruments, in order to conserve instrument type-numbers (primarily a result of previous rulings that "A" and "B" models of an instrument will not be offered simultaneously by Tektronix) -- but without actually marking the front-panel of the instrument with the "mod" number, though this number appears in the manuals. This leads to some confusion in the customer's mind as to whether he actually has the correct manual for his instrument or not. The Type 520 (NTSC/PAL) Vectorscopes are an example (compounded in this case by a catalog listing of the same manual part number for both instruments) arising from assignment of three- or four-digit mod numbers for order-processing use only, without the same nomenclature appearing on the instrument.

In the cases where three-digit mods are set up in advance of customer needs and via channels other than CME, there is occasionally conflict in procedures as to what nomenclature is to be provided on the finished instrument where a "standard option" using a three-digit mod number is exercised on an instrument containing a more complex custom modification. If the "option" changes the instrument nomenclature via the mod slot, it may be left to the finaler to decide which three-digit mod is "more important" and is put into the mod slot. The alternative is to treat these three-digit "options" the same as any other custom modifications -- that is, refuse to make them available as options exercisable independently of custom modifications actually quoted. (Example: If a customer receives a quotation on a Type 602 Mod 165Q, we will accept his order for a Type 602 Mod 165Q Mod 08 (P7) Mod 13 (Painted Panel) Mod 06 (Customer Inspection) Mod 15 (Extra Manuals), but we might not accept his order for Type 602 Mod 165Q Mod 146B (less cabinet). In the case of the less-cabinet version, we might "invent" a new instrument called Type 602 Mod 299X or Type 602 Mod 441A, and make up a new specification drawing for that number and requote to the customer. After he issued a new purchase order for the new mod number, we could then accept his order.)

4. Future.

From an engineering point of view, front-panel identification of an exercised option or custom modification is usually needed only if the customer (at the operating level, as distinguished from management, purchasing, bookkeeping, etc.) must refer to something other than a standard instrument instruction manual to obtain applicable instrument operating and maintenance information. Particularly in large installations having many similar instruments, it may be impossible to keep manuals with specific serial numbers with their corresponding instruments at all times. The user needs a means of identifying a manual which is at least approximately correct for the instrument he is using. The panel identification also aids the customer with a number of similar instruments in selecting or identifying those which are suitable or unsuitable for a given application (without taking them all apart).

At the customer's end of the purchasing operation, it is primarily important that the identification on the instrument received be the same as that for which the purchase order was issued. This applies whether the customer is a private party making his first purchase, or a hidebound, drawing-oriented government contractor.

From the customer's order-writing point of view, numerical identification of a modification is desirable wherever an unambiguous description can't be handled in a few words. However, from a communications point of view, simple options are better handled by the redundant description process, particularly in Tektronix' order-handling processes in which the customer's original purchase order is retyped in the field-office and sometimes again in Portland before being actually entered into the order-filling machinery. In a zero-redundancy system, the slip of a digit in these various transcribing processes can generate a major snafu that's undetectable until the customer actually receives something he doesn't want -- or doesn't receive anything at all because the order is hung up waiting for the customer's paint or the customer's inspector (Mod 03 or Mod 06) which were numerically keyed into the order processing machinery by the simple hitting of a wrong key somewhere.

Within the order-processing loop (MPA to shipping dock), a low-redundancy code is relatively safe, if the product on the shipping dock can be compared with the original description before it's sent on to the customer (and some means is provided for going back to the original description in the event of the non-arrival of the product at the shipping dock). Outside of the loop, reliance on non-redundant digital inputs becomes more and more dangerous as intermediate feedback loops are eliminated to reduce response time.

In the area of custom modifications, where the instrument changes are sufficiently complex, or where a dozen different modifications may be confused under any simple description, special precautions are taken to insure that even though primary identification of the modified instrument is by the mod number, a slipped digit will have minimum chance of resulting in a wrong product being shipped to the customer. First, no orders are accepted "out of the blue". An inquiry is responded to (after the requirement is ascertained) by a quotation which includes a complete description (drawing) of the modified product we intend to ship. The quotation opens a 30-day window within which we will accept an order from a specific customer for a specific quantity of a specific instrument for a specific price. If customer, quantity, price, referenced quotation number and instrument nomenclature (including mod number) agree, the order is accepted. The instrument is compared against the original description (drawing) as a QA function before shipping, and the modification number is always made a part of the instrument nomenclature. The customer receives a manual keyed to both the new nomenclature and the serial number.

Whatever future course we take, it would appear that in the absence of any reasonable alternative, custom-modified products will require some kind of alphanumeric identification on the instruments themselves, from the customer's need to be able to order, identify and replace products having specific characteristics with minimum inconvenience.

However, there are many, sometimes conflicting, needs within Tektronix to be satisfied by whatever system is used. Basic to all these in-house needs is a desire to deliver to the customer as nearly as possible what he wants or needs, as quickly as possible, with a minimum of direct and indirect costs, but without impairing our ability to provide a desirable level of after-sale support and to provide additional instruments to essentially the same description in the future.

Each of the desiderata in the paragraph above is in conflict with one or more of the others. Our in-house conflicts are primarily between or among systems that have been individually set up to optimize one or two of these goals, and to some extent are due to unresolved differences of opinion as to what compromises will result in the greatest combination of customer satisfaction and Tektronix profit.

Instant delivery on a customer's order calls for a highly-automated order-handling system, keyed by means of a completely unambiguous language to spring specific items from finished goods inventory into the proper transportation channel with minimum human intervention. Coupled with "what the customer wants or needs", instant-delivery requires a high degree of anticipation of all possible wants and needs, with all possible combinations and permutations in stock and ready to be sprung by the proper code. This combination obviously runs into conflict with cost goals, since the external world of customers and competitors is neither stable nor consistent enough to permit detailed analysis and prediction to the point where even a majority of orders can be filled with sealed boxes off the warehouse shelf while maintaining a price commensurate with profit on the one side and utility on the other.

Competition and cost factors indicate that instant delivery should yield somewhat to flexibility, maintaining inventory in a state of completion which is proportional to the degree to which customer wants and needs are predictable, with a system for applying the unpredictable permutations and combinations of variables according to the orders as actually received. The "plug-in" oscilloscope concept is an outstanding example of how flexibility can pay off in supplying a wide variety of "what the customer wants or needs" with quick delivery but with a minimum finished goods inventory. The onus in this case is placed on the customer to order two or more separately identified products and fit them together himself. Though some customers at various times past have had difficulty understanding that two or more line items are required to have an operating assembly, the overall result of this method of supplying a wide variety of products has been immensely beneficial to Tektronix, and is so widely accepted in terms of the benefits to the customer that it is now impossible for a manufacturer to be accepted as a serious vendor of oscilloscopes unless he offers a plug-in line.

Not all variations can be handled by the plug-in idea, of course. A phosphor change is not accomplished by shipping an accessory jar of phosphor powder; a painted panel requirement is not met by "also" shipping the paint or even a painted panel. However, they are options that can be exercised via relatively quick and simple procedures without having to revise the instruction manual or undertake any extensive engineering involvement, and usually with only a small sacrifice in delivery time. The chief sacrifice is in the area of after-sale support: these simple options are not identified as such in the instrument nomenclature or instruction manual. Such changes as may affect the replacement parts list or the manner of specifying an exact duplicate instrument are not identified on the instrument itself. (By not assigning code-numbers on the instrument itself to these simple options, a dozen or two options can be handled in any combination without having to develop non-duplicating code numbers for the thousands of variations possible.)

When the customer-requested variations become too complex, however, and begin to interfere with the free exercise of the "normal" options and begin to affect the normal performance characteristics of the instrument, more and more human involvement is required in processing the initial inquiry and order and in applying the customer-requested variations to the product itself.

At this point, "instant delivery" is out of the question; likewise is reference to the modified instrument by general descriptive terms. A code number is assigned and permanently affixed to the instrument and all documents referring to the instrument, not because a short code is easily adaptable to automated order-handling, but because descriptive language is subject to too many variations in itself in referring to a given object, and to too many varied interpretations by those who are more aware of similar objects requiring differentiation than was the coiner of the description. The code is used to call up, not a prepackaged piece of goods from the warehouse, but simply a reference document containing an exhaustive description of what is to be manufactured.

Initially, some distinction was made among alphanumeric codes which would be used for catalog products (Type numbers), accessories and replacement parts (part numbers), order-processing options (2-digit mods) not made a part of product identification, and specials (custom mods) which become a part of the product identification. With the breakdown of these distinctions in recent usage, there is considerable difficulty in determining the nature or origin of any given change (or whom to contact to find out about it), and how these have been and will be handled in various combinations, or, indeed, if they can be so handled.

It would be desirable in any future system to restore the distinctions between standard products compatible with various quick-change options and modified products which may (a) be incompatible with standard options or (b) be obsolete or no longer feasible because of intervening changes in the standard instrument; between options which require no panel identification and modifications which need to be included in the product nomenclature at some point visible to the user or operator.

Because any change of system runs into difficulties with customer records and requirements data, I would suggest developing a new system along these lines:

1. OPTIONS: To be handled by description only, so far as the customer is concerned. Eliminate all use of "two digit" references in catalogs and advertising, and provide standardized descriptions for the customer to order by. This creates no expectation on the customer's part that special identification will appear on the panel. If two-digit codes are desirable for in-house use, any number of them can be added internally to order-processing paperwork, but will appear only as keyed descriptions in the customer billing.

2. CUSTOM MODIFICATIONS: Variations in instrument design and performance characteristics quoted on an inquiry basis only after examination of the customer's requirements and the present state of the instrument to be modified. These would be identified on the instrument front panel by the currently-used three-digit mod number with letter suffix. Because of data-processing program limitations, it might be necessary to handle all order processing and billing of these "outside" of the machine-billing system. No advertising or catalog listing would be permitted for these products, which would always be subject to instant obsolescence, and could only be sold with "no guarantee of future supply".

3. SPECIAL VERSIONS OF STANDARD INSTRUMENTS. Variations in instrument design and performance <u>initiated by Tektronix</u> rather than by customer inquiry, which except for the desire to conserve Type numbers would be eligible for separate Type nomenclature. These versions would be eligible for catalog listing and advertising, be compatible with most or all standard options, and would be maintained in producibility (or inventory) the same as any standard instrument.

These instruments would be panel-identified by a distinctive coding separate from the "mod-slot", but compatible with order-processing machine programs. I understand that the "big machine" can handle a 3-unit suffix consisting of a number and two letters (2AA, 9BZ, etc), which provides about 5000 possible suffixes, which are not subject to confusion with Type numbers or part numbers. These special versions would be eligible for custom modification on an inquiry basis the same as standard products; the full custom-modified special nomenclature would become "R599C 7NX Mod 101N" or whatever, and both "7NX" and "101N" would appear on the front panel.

Custom modifications which appeared headed for production volumes not conveniently handled on the slow per-inquiry basis, could be converted to "production special" (SPECIAL VERSIONS) status, but only with a change of nomenclature to the the digit-letter-letter suffix.

However -- and this is critical to the system -- the custom-modified version, instead of being absolutely obsoleted by the change to production special status, would continue to be available to those customers whose investment in the former nomenclature is so great that they are willing to go through the inquiry-quote-drawing-order process, at a price commensurate with the inherently less-efficient custom-mod process. Thus at some point in time, an EMI-rated 453 which started life with "Mod 163D" nomenclature, might, if demand justified, be put into the catalog and put onto a regular production and inventory schedule, but under the new name "Type 453 3EM", for $100 above the standard 453 price. However, a customer refusing to take delivery of an instrument carrying that nomenclature, could obtain a ("hand-made") Type 453 Mod 163D as a custom modification for $225 over catalog, or whatever the appropriate price might be for the added cost of quoting, revising and issuing custom-mod drawings, etc.

The distinctive nomenclature would provide a clear indication of what kind of documentation exists (and where it is located) on a product, what kind of parts replacement program exists for it (or should exist for it), where the responsibility lies for maintaining performance and producibility, currency of specifications, and applicability of production modifications, and what the appropriate order-processing procedure is. Assignment of this nomenclature would be in the hands of the Nomenclature committee (or Instrument Engineering), with no possibility of duplication or interference with the assignment of custom modified instrument numbers or the processing of custom-modified instrument orders and quotations. It would also free "converted" custom-modifications from hold-over limitations based on the ease of converting finished instruments, since the change of nomenclature would permit any number of changes of construction and performance characteristics achievable by "starting from scratch" rather than "starting from patch".

The chief advantage of this plan would be, I think, the minimum amount of effort and changeover, cross-referenced records and confusion of customers, if implemented in the near future. The longer we continue with the present "mixed" system, the more difficult it will be to make any change without a great deal of work.

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