TEKTRONIX CRT HISTORY

Part 2. The First Tek CRTs

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Part 1 described the situation leading to the decision in 1951-52 for Tektronix to be-gin design of CRTs for its own use. Another factor of concern in purchasing tubes from a competitor was the inability to request new designs, as it would tip them off as to new product plans. Designing a device as complex as a precision cathode-ray tube involves many technical disciplines. Vacuum technology, glass working, electron-optics, metallurgy, chemistry, materials science, coatings, screening, and electronics are all critical to developing a manufacturable CRT. Many of these apply to convention-al vacuum tubes but the problems in CRT design are multiplied by the high accelerating voltages, volume of the large evacuated bulbs, bulb surface area, life requirements, cost, and the critical alignment required to have a finely focused high-voltage beam of invisible electrons arrive at the center of the screen. A two axis deflection system of prescribed bandwidth, sensitivity and minimum pattern distortion anywhere within the active display area adds to the challenge. All of this was done in the days before the existence of advanced computer programs for electron-optical design. In the early days of Tektronix history, it is especially noteworthy that almost all employees were home-grown. Most of the individuals employed in designing the new CRT were engineers and physicists from Northwest Oregon who had never been involved with CRTs previously. This probably both hindered and helped the task at hand. There was certainly a lot of reinventing of the wheel but conversely, they were not bound by old methods. There was a lot of free-thinking going on and some major improvements to the CRT resulted. When the author joined the CRT Engineering department in 1963 there were still hardly any "outsiders" in the group. At that time Tek had internal cabinet and metal shops that made workbenches, shelves, rolling carts, and even book-ends for company use.

THE T51 AND THE T51

Yes, you read that right. Read on. The Du Mont 5XP- (Figure 1) appears to be the starting point in the design process for the first Tektronix CRT. Figure 2 shows a prototype CRT that must have been about mid-way in the development process. Note that it uses the same bulb as the Du Mont 5XP-, has the Tektronix spiral accelerator, and has an electron gun that looks very much like that of the RCA 5CP-. This would indicate that the coating, sealing, pumping, and finishing processes were fairly well developed at that point but that electron guns were not yet being assembled at Tektronix.

After three years of concentrated effort solving the design and manufacturing problems, production finally began in 1954 of Tektronix's first CRT, the T51P2 (Figure 3). By now the tube design is beginning to look uniquely Tektronix. The T51 was used in the new 10-MHz models 531 and 535 that were a mainstay in the prestigious 530 / 540 oscilloscope series with plug-in vertical amplifiers for which Tektronix became famous. These were the work-horse oscilloscopes found in almost every lab during the late 1950s and the 1960s. Rack-mount versions were available as the RM-31 and RM-35

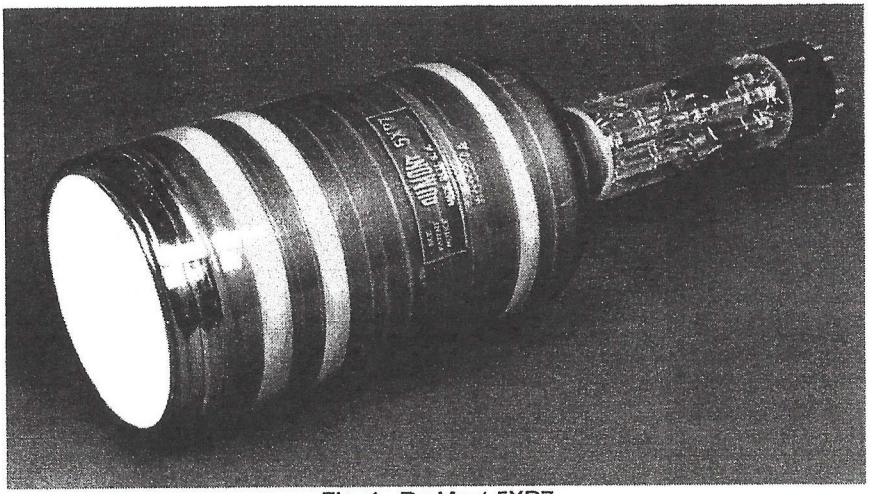

Fig. 1. Du Mont 5XP7

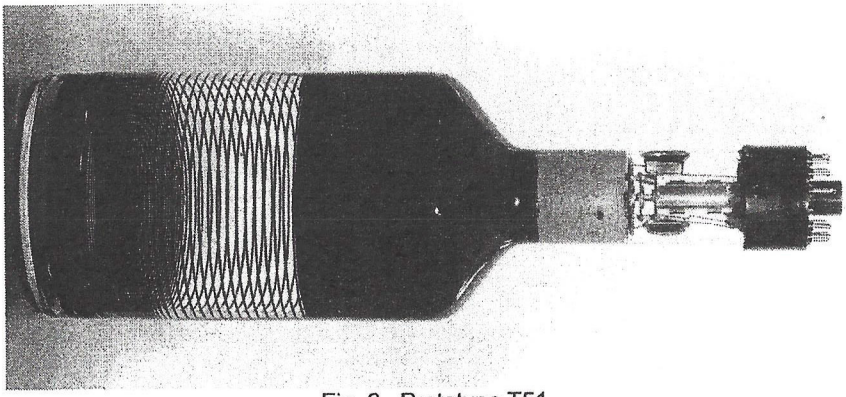

Fig. 2. Prototype T51

Fig. 3. Early production T51

respectively. The T51 also replaced the 5XP- in the model 513 after serial number 1887.

The early production T51 was another step between the Du Mont 5XP- and the final Tektronix design for the 530 / 540 series instruments. It used the cylindrical flat-face bulb of the 5XP- but instead of the multi-band stepped post-deflection accelerator with its four anode buttons, a single anode button was used near the screen and the Tektronix developed resistive-spiral accelerator provided a gradually increasing acceleration potential along the length of the bulb. This minimized deflection distortion caused by the abrupt changes in the acceleration fields that were present in the Du Mont design. Early 531 and 535 oscilloscopes using this tube are easily identified by the cylindrical mu-metal CRT shield.

Characteristics of the T51 included an acceleration voltage of 10 kV and an aluminized screen for high brightness when viewing and photographing fast single-shot events, 6 x 10 cm scan area, minimal spot and pattern distortion and thin-wire feed-through neck-pin connections to the deflection plates to reduce capacitance loading of the deflection amplifiers for wider bandwidth.

Soon, the bulb of the T51 was changed to the tapered-curve shape (Figure 4) of the common 5ABP-. Of course, painting a uniform resistive spiral accelerator on the tapering curved bulb walls was a problem even more difficult than it had been with the cylindrical bulb. It is estimated that the change of bulb shape occurred in 1955. Instruments with the later production T51 may be identified by a tapered CRT shield. The tube type number and part number remained the same as the early production tubes, hence the title of this section. At about the same time, the bandwidth specification for the model 531 and 535 instruments became 15 MHz.

Several similar CRTs based upon the second T51 design were eventually developed and manufactured for forthcoming 530 / 540 series instruments as well as the 515 oscilloscope, 570 vacuum tube curve tracer and 575 transistor curve tracer. This group of CRTs will be discussed in the next article of this series.

PART NUMBERS AND MARKINGS

Many cathode-ray tube type and part numbers have been used since the introduction of the Tektronix 511 oscilloscope in 1947. Because of evolutionary changes in CRT design as well as changes in part numbering systems, several hundred pages of cross-reference lists between instrument type number, CRT type number, and part number exist. Adding to the confusion are the many phosphor and internal graticule variations that were used.

During the early 1950s, CRT numbering was still simple – a CRT type number used mostly by the engineers who probably couldn't be trusted keep part numbers straight and one part number for the manufacturing, inventory control, accountants and field service folks who wanted a uniform numbering system for all parts. They didn't really care what the part was, just that the numbers on the box matched those on paper and that there were enough of the parts with that number on the shelf. The tube number at least told the engineers something about the tube and its use. In the case of the of the T51P2, T designated that is was a tube (duh!), 5 represented the screen size (5-inch), 1 probably was for the first of the planned series, and P2 denoted a green long-persistence phosphor. The part number, 154-081 for the T51P2, was merely the next available tube number in sequence, in this case. Simple? Yes, so far, but we forgot the customer.

Fig. 4. Later production T51

TYPE-OLD	TYPE-NEW	TYPE-EIA	P/N-OLD	P/N-NEW
T51P1	T0510-1	5BGP1	154-080	154-0080-00
T51P2	T0510-2	5BGP2	154-081	154-0081-00
T51P4	T0510-4	5BGP4		154-0197-00
T51P5	T0510-5	5BGP5		154-0123-00
T51P7	T0510-7	5BGP7	154-082	154-0082-00
T51P11	T0510-11	5BGP11	154-083	154-0083-00
T51P12		5BGP12		154-0101-00
T51P14	T0510-14	5BGP14		154-0117-00
T51P15	T0510-15	5BGP15		154-0096-00
T51P16	T0510-16	5BGP16		154-0092-00
T51P19		5BGP19		154-0121-00
T51P24	T0510-24	5BGP24		154-0124-00
T51P25		5BGP25		154-0150-00
T51P31	T0510-31	5BGP31		154-0342-00
T51P32	T0510-32	5BGP32		154-0379-00

Table 1. T51 Cross-reference list

Fig. 5. Tektronix logo

These were being ordered by engineers who often had special needs, or at least wants, of different phosphor color and persistence. Some of them discovered the JEDEC book of RTMA (formerly RMA) registered phosphors. It contained data on over 20 different phosphors. They began requesting instruments and replacement CRTs with them. The T51 was ultimately available with 15 phosphors, each with its own part number in no particular sequence other than the order that someone asked for that phosphor.

The late 1950s marked the end of simple part numbering at Tektronix. In 1957, the T51 received the EIA (formerly RMA, RTMA, and RETMA) registered type number 5BGP- along with several of the phosphor type numbers appended to the end. The full type number now read T51P2 / 5BGP2 with a part number of 154-081. Tubes have been observed marked T51P2, 5BGP2, and 5BGP2 / T51P2. By 1961 the T51P- was listed as "formerly designated 5BGP-". Problems were being encountered with Electronic Tube Corporation, Sylvania, and others manufacturing and selling inferior tubes under that number to the replacement market, particularly the U.S. government which put out RFQs for open bid. Naturally, they would accept the lowest bid. When the scopes didn't meet their specifications, the customers would complain to Tek. Ending use of the EIA number didn't completely end the problem – companies continued to produce replacement tubes marked with the T-number instead.

In 1963, a couple of "0"s were added to both ends of the two-digit portion of the tube type number and the "P" replaced with a "-," thus making it a T0510-2. To add to the fun, in 1965, the Tektronix part number system was hard pressed to accommodate the many parts required by the company's rapid growth. The first group of three numbers remained the same but the second group of three digits now became four and a two-digit suffix was added to denote changes in the part or variants of it. The part number for the T51P2 became 154-0081-00. This was just the beginning of type- and part-number proliferation. Both of these numbering systems remained in place until 1996 when CRT manufacturing was ended at Tektronix. More insights will be provided in following articles. See Table 1 for the various type and part numbers assigned to the basic T51s with their various phosphors. This was derived from the 1967 cross-reference list. There are a few gaps, possibly a result of the list being compiled a decade later than when the T51 was Tek's most important CRT.

And lastly, while we are on the subject of markings, the fondly remembered "Tek bug" trade mark (Figure 5) was applied in bright yellow paint at the screen end of completed CRTs before shipping up until early 1965. While "busy" by today's streamlined corporate logo standards, the well-respected Tek bug was used for many years and appeared on all products, manuals, catalogs, and even cafeteria chairs, coffee cups and Tektronix-made bookends. Many variations of additional markings may be found on Tektronix CRTs manufactured during the 1954 -64 period. These included:

- Tek-Bug region – The Tek Bug was applied near the screen with it and its associated markings reading correctly with the tube resting on its screen end. The tube type number and phosphor type were usually written just below the Tek Bug. They were marked in the same rich yellow paint. Often the phosphor type was handwritten while the tube type was printed. Early

CRTs also had "Serial XXXX" just below the type number. The serial number has also been observed between the anode button and the screen. Later CRTs had a date code consisting of the week number and the last digit of the year separated by a hyphen or a space and handwritten in yellow paint above the Tek Bug.

- Neck-pin region – Later CRTs had the date code handwritten in yellow paint just above the neck pins so as to be visible through the neck pin cutout in the mu-metal CRT shield. One to three digits of the type number and the serial number separated by a hyphen were handwritten in yellow paint just below the neck pins. An example is "1-31357". In this example, the "1" indicates a T51. As the T52 through T55 were introduced, only a single digit was required to indicate the type.

- Bulb markings – Three digit numbers (no hyphen) stamped in high-temperature metallic ink applied to the bulb in bulb-prep may indicate the processing date. Another 8-digit number is often present but its significance is unknown. It was probably used to identify batches or processing variables. The phosphor type may also be stamped in a similar manner, for instance, "P2" or "P11". These bulb markings are not found on earlier Tek CRTs.

- Focus ring – One to three digits from the CRT type number were usually handwritten in high-temperature black ink on the focus ring. They were not present on early T51 CRTs but became necessary to identify different electron gun types as additional tube types entered production.

- Anode barrel - A serial number, also handwritten in high-temperature black ink, appeared on the first-anode barrel. It was usually the same as the serial number applied to outside of the tube after final test.

- Grid cup - Numbers were usually scratched or penciled on the grid cups. They are suspected to indicate cathode batches or cathode processing dates. Due to the difficulty in reading the markings, no conclusions have been reached as to their significance.

- Crudely handwritten 1- or 2-digit numbers in black paint are sometimes found on the outside of the neck

- Just forward of the base. The purpose of them is unknown but it is hypothesized that they might indicate the test operator or test station in final test.

This is intended only to serve only as a general guide to those CRTs displaying the Tek Bug, since many variations on these markings were employed over the years. It should help identify tubes and manufacturing dates for CRTs with illegible external markings, since the internal numbers may help pin them down. Special thanks to Stan Griffiths for pulling a number of early Tek CRTs from his inventory to allow study of the many different numbering schemes employed.

COMING NEXT

The T51 spawned a whole series of related tubes used in the classic vacuum-tube Tektronix oscilloscopes of the 1950s. These will be covered in Part 3, "The Classic Years."

REFERENCES

See Part 1, TC, June 2006, p. 9.