

TEKTRONIX CRT HISTORY

Part 3. The Classics: 1955-59

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Part 1 described the situation leading to the decision in 1951-52 for Tektronix to begin design of cathode-ray tubes for its own use. Part 2 discussed the development of the first Tektronix CRT, the T51, in two different versions. Several similar CRTs with 2-digit type numbers (T52 through T56, and T64-T65) 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. These tubes differed primarily in deflection sensitivity, bandwidth, scanning area at the screen, acceleration voltages, shields used for geometry and astigmatism mounted in the deflection region, overall length, and naturally lots of different numbers. Most base connections (excluding the dual-beam and dual-gun tubes) are the same except for pins 11 and 12. These

were used in some tubes for the geometry and astigmatism control connections. Others had both pins unused. It is sometimes possible to substitute one tube in the series for another, in a pinch, if attention is paid to what is connected to those pins. Sensitivity and bandwidth specifications will not be met in many, if not all, cases. Other early Tektronix CRTs from the classic period included dual-beam*, dual-gun*, monoaccelerator, and even 3-inch tubes. See Table 1 for a listing of type number evolution and important specs for these CRTs. The following describes this series of CRTs in approximately chronological order spanning the years 1955 to 1959.

THE T54

The T54 was the next in the series and was used in the 30 MHz 541 and 545 oscilloscopes introduced in 1955. The 545 and later 545A have always been considered the "most classic of the classics" in the Tektronix scope line. The wider bandwidth vertical

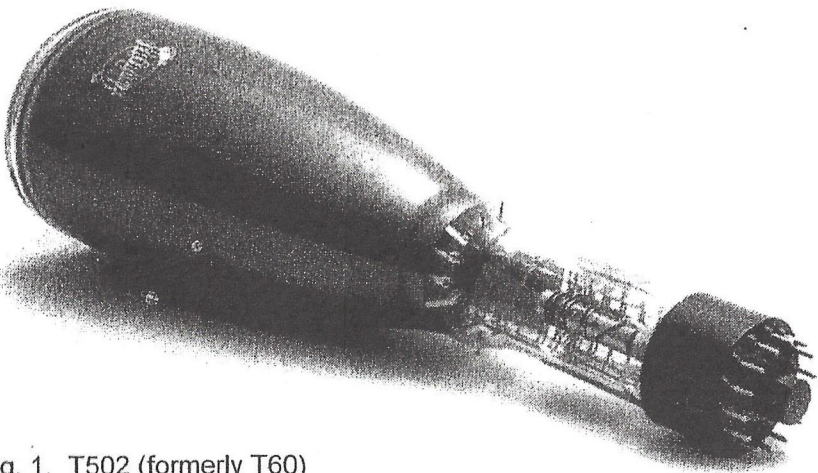


Fig. 1. T502 (formerly T60)

deflection system limited the usable scan area to 4 cm x 10 cm. The meaning of the type number follows that of the T51 except that the 4 likely refers to the 540 series scopes. P2 was the standard phosphor and the T54P2 had the part number 054-098. As with the T51, many phosphors were available, with a corresponding proliferation of part numbers. See Table 2. The T54- was registered as the 5BHP- with RETMA in 1957, about the same time that they became the Electronic Industries Association (EIA). The Tektronix designation became T0540 in 1965 with their revised part-numbering system.

A high-voltage version of the T54 was variously nomenclatured T54PH, T517PH, and T0541. It was employed in the 517A oscilloscope beginning in 1955. An acceleration potential of 24 kV was used for viewing and recording very fast single-shot events.

THE T52

The 570 vacuum-tube curve tracer, announced in late 1955, used the T52P1. In 1957, the 575 curve tracer, also using the T52P1, was introduced to meet the needs of engineers just beginning to explore the use of semiconductors. The T52 was also used in the model 532, a lower-performance version of the 531 as well as the 525 television waveform monitor introduced in 1955. The T52 was an unaluminized CRT operating at 4 kV acceleration potential. See the T55 description below for the rationale behind this. The T52- was registered with EIA as the 5CAP- in 1958. The Tektronix designation became T0520 in 1965 with their revised tube numbering system.

THE T55

In 1956, Tektronix introduced the 515 general-purpose oscilloscope with 15 MHz bandwidth, using the

T55P2. The 515 differed from the 530/540 series instruments in that it had a self-contained vertical amplifier instead of a plug-in amplifier. The T55 was of a design similar overall to the T51 with one notable exception. It was designed to operate at only 4 kV and therefore was unaluminized. At only 4 kV, beam penetration of an aluminum layer is poor unless the layer is quite thin. The result is little, if any, gain in brightness and poor brightness uniformity due to slight variations in aluminum thickness across the screen. The 516, a dual-trace* version of the 515, was introduced in 1960. It used the same T55P2 CRT. The T55- was registered with EIA as the 5CBP- in 1958. The Tektronix designation became T0550 in 1965 with the revised part numbering system.

THE T31

In 1957, a 3-inch portable oscilloscope, the type 316, was introduced. The 316 had many of the features of its larger Tektronix counterparts. The 10 MHz bandwidth specification necessitated a CRT with lower deflection-plate capacitance than that provided by the purchased 3WP- CRTs used in the earlier 310 and 315 models. The solution was a tube similar to the 3WP- but having the deflection plate connections brought out directly through neck pins instead of the base. P2 was the standard phosphor. For reasons unknown, the T31 was replaced by the T32 about 1959.

THE T56

Another 1957 introduction was the 536 X-Y oscilloscope using the T56P2 CRT. The 536 was unusual in its use of the 530/540 series plug-in amplifiers for both vertical and horizontal deflection. Deflection sensitivity specifications of the vertical and horizontal CRT deflection plates are identical. The T56 also operated at 4 kV and was unaluminized. The T56 was not regis-

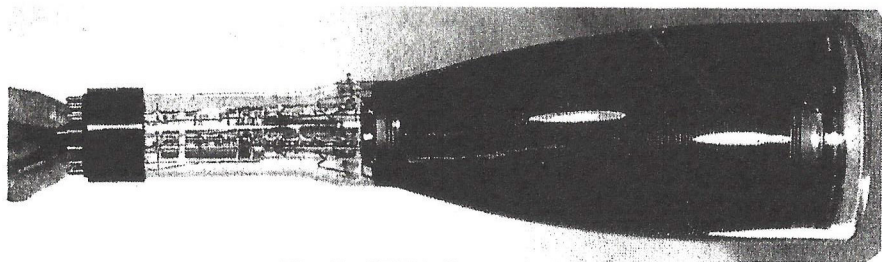


Fig. 2. T551 (formerly T57)

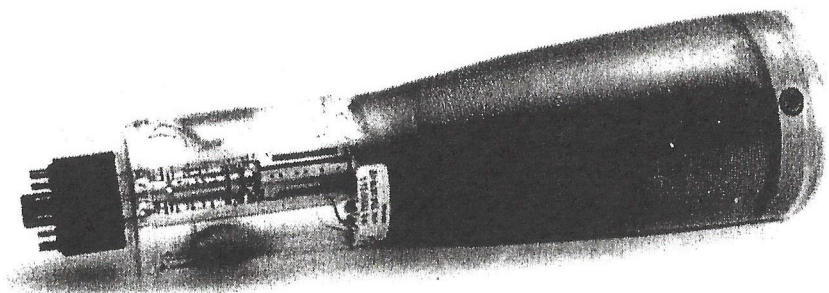


Fig. 3. T5550 (formerly T59, T555)

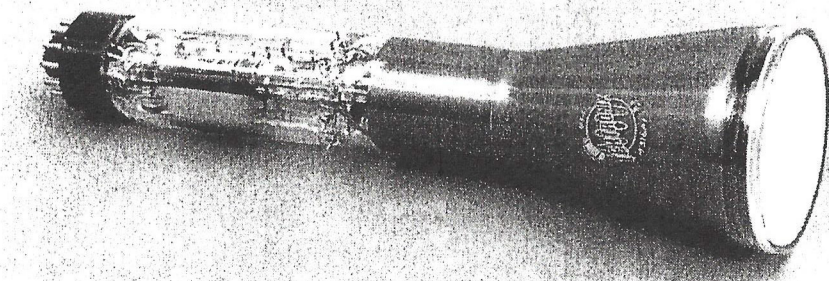


Fig. 4. T316 (formerly T32)

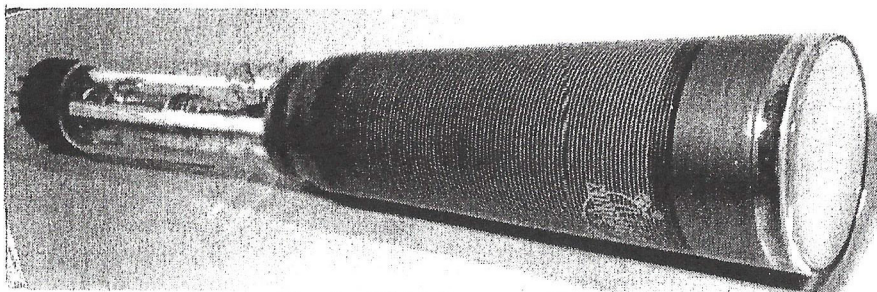


Fig. 5. T317 (formerly T33)

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tered with EIA. The Tektronix designation first became T536 in 1959, and later, T5360 in 1965 with the revised part-numbering system.

THE T65

The T65 designation was used for only about one year. In 1958, the 543 oscilloscope was introduced, with a slightly modified version of the T54P2 which was the T65P2. The 543 was similar to the 541 except for having high horizontal scan magnification and improvements in the horizontal-sweep configuration that were to become a part of all improved 540-series scopes. The T65 became the T543 in 1959 and the T5430 in 1965. It was also registered with EIA in 1964 as the 5ELP-.

THE T60

One of two Tektronix dual-beam* oscilloscopes, the 502, was announced in 1958. It was a rather specialized instrument having an extremely high vertical sensitivity of 200 microvolts/centimeter with only 100 kHz bandwidth, increasing to 1 MHz at 0.2 V/cm. The T60P2 (Figure 1) had two electron guns with a common pair of horizontal deflection plates. This allowed two time-related signals to be displayed simultaneously. The T60 was a monoaccelerator CRT operating at only 3 kV. It became the T502 in the 1959 renumbering and T5020 in 1965. 502 scopes above serial number 1720 and 502-A's used a slightly modified T5020 designated the T5021. It differed in the base pin connections which provided additional connections and a raster-alignment electrode in the anode system to permit registration adjustment of the two beams. An external shorting strap between pins 3, 6, and 8 allowed the T5021 to be used in older 502s.

THE T57

Also in 1958, another Tektronix dual-beam* CRT was employed in the 551 oscilloscope. Bandwidth was intermediate between that of the 530 and 540 series instruments. The T57P2 CRT (Figure 2) operated at a full 10 kV and was constructed similarly to the other 530/540 series scopes except for a bulge in the neck diameter to accommodate two electron guns. The T57 soon became the T551 in 1959 and the T5511 in about 1965. The later change must have coincided with some slight and unknown design change since the type number would have logically been expected to become T5510.

THE T64

The 1959 introduction of the T64 for the 530-series instruments paralleled that of the T65 for the 540-series. It was merely an improved version of the original T51 and was initially employed in the new 533 oscilloscope and the subsequent 531A and 535A. The standard phosphor was P2. It quickly became the T533 and in 1965, the T5330. For some reason, no EIA registration was ever applied for despite its wide spread usage and being from the same time period as the T65.

THE T59

The first true dual-gun* CRT, the T59P2 (Figure 3), was used in the 555 oscilloscope introduced in 1959. It was essentially two complete T54 electron guns in a single bulb. By not sharing a common set of horizontal deflection plates as in the T57 and T60, two completely unrelated signals could be viewed together. The T59 immediately became the T555 and eventually the T5550 in 1965.

THE T32

The T32 (Figure 4) replaced the earlier T31 in the type 316 portable oscilloscope at about the time of the 1959 changes to three-digit type numbers.

TYPE	YEAR	USED IN	EIA	1959	1965	A2	SCAN	LENGTH	NOTES
T31	1957	316	---	---	---	1.85 kV	8x10 div	11-1/2"?	Replaced by T32
T32	1958	316	---	T316	T3160	1.85 kV	8x10 div	11-1/2"	Monoaccelerator
T33	1959	317	---	T317	T3170	9 kV	8x10 div	13-5/8"	
T51	1954	531, 535	5BCP-	---	T0510	10 kV	6x10 cm	17-1/2"	
T52	1955	525, 532, 570, 575	5CAP-	---	T0520	4 kV	8x10 cm	17-1/2"	
T53	1959	507	---	T507	T5070	24 kV	6x10 cm	17-1/2"	
T54	1955	541, 545	5BHP-	---	T0540	10 kV	4x10 cm	18-1/8"	
T55	1956	515, 516	5CBP-	---	T0550	4 kV	6x10 cm	18-1/4"	
T56	1957	536	---	T536	T5360	4 kV	8x8 cm	17-1/8"	Identical V and H sens.
T57	1958	561	---	T551	T5511	10 kV	4x10 cm*	18-1/2"	Dual-beam
T59	1959	566	---	T555	T5550	10 kV	4x10 cm*	18-3/4"	Dual-gun
T60	1958	502	---	T502	T5020	3 kV	8x10 cm	18-3/16"	Monoaccel., dual beam
T64	1959	531A, 533, 535A	---	T533	T5330	10 kV	6x10 cm	17-1/2"	
T65	1958	541A, 543, 545A	5ELP-	T543	T5430	10 kV	4x10 cm	18-1/8"	
T66	1959	526	---	T526	T5260	4 kV	Full	16-15/16"	Monoaccelerator

* Each beam has 2 cm overlap for 6x10 cm total active screen area

Table 1. Classic Tektronix CRTs

The 1959 instrument catalog states that the "(T316) T32 . . .replaces the T31 with minor circuit changes." In 1965, it became the T3160. P2 was the standard phosphor for the 316.

THE T33

The T33 (Figure 5) was an especially interesting tube that was also announced in 1959. It was a 3-inch diameter CRT with the now-familiar spiral accelerator, operating at 9 kV for a very bright trace. It was also about 2-inches longer than other 3-inch CRTs, which aided deflection sensitivity. The T33P2 was used in the model 317 portable oscilloscope having 10 MHz bandwidth. The T33 designation immediately became the T317, and in 1965, the T3170.

THE T53

The T53P11 was used in 1959 in the 507 oscilloscope for high-voltage surge testing. The T53 designation was very brief and is listed as a T507P11 in the 1959 catalog. The T53 number may have lasted only through the engineering phases. It became the T5070P11 in the 1965 renumbering scheme. The acceleration voltage was 24 kV and the scan area 4x8 cm.

OPTIONS AND PART NUMBERS

As with the T51, many phosphor options were available, each with an individual Tektronix part number. These are listed in Table 2. Standard JEDEC phosphors available for most Tektronix oscilloscopes were P1, P2, P7, P11, and later, P31. For detailed information on the differences between the phosphor type numbers refer to JEDEC Publication 16 listed in the Reference section at the end of this article. As you can see, the number of CRT part numbers was beginning to get out of hand. Note that all tube and part numbers changed in the 1965 renumbering of tube types and part numbers. The part numbers

were expanded from the 3x3 format to a 3x4x2 format. For example, the 154-216 became the 154-0216-00. Also, evolutionary changes were made to the CRTs which resulted in totally different part numbers being set up for later versions of the tubes. A prime example was the change to internal gratitudes in the mid-1960s. It is beyond the scope of these articles (and the author's tolerance to mental fatigue!) to include them.

*Important distinctions:

Dual-trace - Two different waveforms with a common time-relationship may be displayed simultaneously on a single gun CRT by either displaying them on alternate sweeps or by rapid electronic switching (chopping) between the two signals.

Dual-beam - Two electron guns within a single CRT envelope but sharing a common pair of horizontal deflection plates, time-base, and amplifier. As with a dual-trace scope, the two vertical signals applied to the CRT must be time-related.

Dual-gun - Two completely independent electron guns within a common CRT envelope. Since two sets of horizontal deflection plates are used, two signals differing in both timing and amplitude may be viewed simultaneously.

COMING NEXT

The CRTs discussed in this article were based almost entirely on innovations developed for the original T51 and existing monoaccelerator CRT technology. The next article in this series will discuss the CRTs with the additional power, deflection sensitivity, and beam-expansion innovations required for the first Tektronix transistorized and hybrid oscilloscopes beginning in 1960. Also to be discussed will be other CRTs used to round out

Corrected Table 2 for Peter Keller's "Tektronix CRT History, Part 3. The Classics: 1955-59"

Table 2. Tektronix Part Numbers

TYPE	P1	P2	P4	P5	P7	P11	P12	P13	P14
T31	154-138	154-131			154-142	154-148			
T32/T316	154-154	154-155			154-156	154-157	154-201		
T33/T317	154-216	154-196		154-412	154-217	154-218			
T51/5BGP	154-080	154-081	154-197	154-123	154-082	154-083			154-117
T52/5CAP	154-093	154-097		154-129	154-102	154-103			
T53/T507	154-331				154-239	154-137			
T54/5BHP	154-106	154-098	154-198	154-111	154-104	154-099	154-141	154-166	154-110
T55/5CBP	154-125	154-120		154-369	154-126	154-127	154-192		
T56/T536	154-140	154-133	154-214	154-242	154-135	154-136	154-193		
T57/T551	154-186	154-160		154-210	154-189	154-143			
T59/T555	154-218	154-198		154-328	154-220	154-211			
T60/T502	154-172	154-144		154-236	154-170	154-173	154-211		
T64/T533	154-178	154-165		154-241	154-179	154-180			
T65/T543/5ELP	154-181	154-175	154-312	154-262	154-182	154-183			154-334
T66/T526	154-231	154-225							

TYPE	P15	P16	P19	P20	P24	P25	P27	P31	P32
T31					154-145				
T32/T316		154-158			154-159			154-345	154-383
T33/T317	154-329	154-325						154-346	154-384
T51/5BGP	154-096	154-092	154-121	154-203	154-124	154-150		154-342	154-379
T52/5CAP	154-330	154-162	154-176					154-343	154-380
T53/T507								154-415	
T54/5BHP	154-122	154-118	154-153		154-152	154-164		154-409	
T55/5CBP	154-151	154-161	154-139		154-177			154-344	154-381
T56/T536	154-184	154-169	154-190					154-351	154-381
T57/T551					154-237				
T59/T555			154-333						
T60/T502		154-256					154-213		
T64/T533	154-235	154-194	154-222						
T65/T543/5ELP	154-243	154-227	154-234		154-263				
T66/T526									

the product line to cover diverse customer requirements.

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ADDENDUM TO PART 1

In further researching part numbers for this article, a Tektronix part number was found to have been assigned to the 3KP1 early in the part numbering system. Vacuum-tube part numbers from 154-001 to 154-056 were all receiving and special purpose tubes, in order of tube registration number, starting at 0A2 and continuing to type 6080. The first CRT (154-057) listed is the 3KP1, although no known Tektronix instrument employed it. Other purchased CRTs follow it, again in order by type and phosphor, ending at 154-074 (5ADP11). Apparently, all of these part numbers were assigned as

a group around the time that the T51P2 (154-076) was introduced. At part number 154-075, the listings changed to chronological order. It is conceivable that the curved-face 3KP1 was initially used in the engineering phase of the 315 oscilloscope and was assigned a part number in anticipation of using production quantities. As far as existing records show, the 315 was manufactured only with the flat-face 3WP- type. It is hard to envision any other explanation unless it was intended for another early instrument that never made it into production.

The 5ADP- type, also found in the same part-number list, may be easier to explain. The Du Mont 5ADP- series was essentially the same as the RCA 5ABP- series CRT used in several early Tektronix oscilloscopes. It may have been simply a case of second-sourcing. It must not have been used often since it is rarely, if ever, found in Tektronix instruments. The logical explanation for that may be that it likely was higher priced than the RCA 5ABP- series, as was often the case with Du Mont CRTs, and the fact that Du Mont was the principal competitor of Tektronix. Part numbers for the 5ADP- series included 154-071 for the 5ADP1, 154-072 for the 5ADP2, 154-073 for the 5ADP7, and previously mentioned 154-074 for the 5ADP11.



RCA's "meatball" logo, Arabic version