

# Three Magnetic Drum Memory Artifacts

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## Introduction

The VIP Club has access to three drum memory units made by ERA/Univac, probably in the mid to late 1950s. This article makes comments based on observations and measurements made on those three drums. It compares that data with published specifications for the maximum capabilities of the families for these drums. The three drums are as follows:

- Model 1119A1, Serial number 106 – Available to the club but currently belonging to Don E. Anderson. The drum was made by ERA Division of Remington Rand, 1902 W. Minnehaha, St. Paul, Minnesota – as identified on the attached nameplate. Based on the nameplate’s company name, it is believed this drum was made between 1952 and 1955.
- Model 1124A1, Serial number 7 – Available to the club but currently belonging to Don E. Anderson. The drum was made by ERA Division, Remington Rand Division, of Sperry Rand, 1902 W. Minnehaha, St. Paul, Minnesota. Based on this company name, it is believed this drum was made about 1955.
- Model 1124G1, Serial number 4UTA8 – Donated to the VIP Club by the estate of Harry Wise. The drum was made by Remington Rand Univac, New York. Based on this company name, it is believed this drum was made in the late 1950s.

Shown here are several drum memory models in an early 50’s snapshot. The engineers/managers in the photo are identified in section 2.1 of <http://vipclubmn.org/engmemory.aspx>. The drum in the front right resembles the 1119 model. The drum in the front center resembles the 1124 models described hereunder. Each of our three drums is discussed separately on the following pages.



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**Model 1119A1, Serial number 106**

This drum is probably the oldest of the three. See Appendix A for some of the observed characteristics of this drum compared to the claimed capabilities of the 1119 family. This drum is in fair condition. It is mounted via three round shock absorbing feet. Two are installed under the motor end and one under the opposite bearing support end. There are fan blades attached to the ends of the shafts under the end covers presumably to aid in bearing cooling.

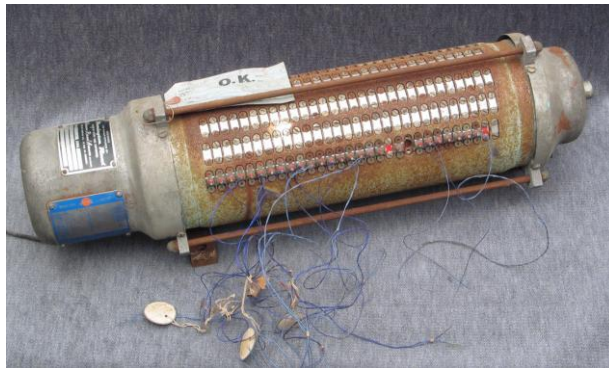
This particular drum is very unusual in that it has only six rows with milled cavities capable of holding heads and is therefore not fully populated. Each row has nine cavities. In its current configuration, four rows are open with no heads installed. The machine milled cavities in these four rows are all the same. The machine milled cavities in the other two rows are a little different and, as was initially seen, both rows contained permanent magnet heads rather than electrical read or write heads. The view above shows three rows between the bars. The back side has three rows similarly arranged. Measurements of the head locations show that although there are spaces for 54 heads, there are only 18 tracks on a 0.35 inch spacing (2.7 tracks per inch). If we number the tracks 1 thru 18 beginning at the left (motor) end, we notice the rows are staggered. The row just behind the top bar and the middle row in front are slightly left of the other two. The left shifted rows are on the odd numbered tracks, the right shifted rows are on the even numbered tracks. So, the rows alternate between odd and even numbered tracks. Including the two other rows, which are not visible in the photo, three rows of heads share a common set of tracks. The other three also share a common set on an alternating basis with the first set. The bottom row in back also has a set of magnet heads like the bottom row on the front. From this, it appears that each track has two read/write heads and one permanent magnet head. Perhaps one head would write, the second would read, and the permanent magnet would erase, all in one revolution. Looking at the drum from the motor end and assuming 0 degrees is at the top bar, the rows for track 1 are spaced at 70, 260 and 335 clockwise degrees and the track 2 rows at 25, 100, and 290 degrees. The magnets are placed in the 100 and 260 degree rows. Thus the spacing between the two read/write head rows is 95 degrees for both the odd and even numbered tracks. Based on the spacing of the rows and rpm of the motor, a read would occur 1.50 msec after the write. The timing of the erase depends on whether it is an odd or even track number but apparently this time does not matter. The numbers are the same regardless of the direction of rotation of the drum. Only about half of the drum area is used for head mounting. There are no heads in the bottom third of the case. There are two more rows of two head mounting spaces at the support end of the drum. These are at the far end of the 290 and 335 degree rows. One row of these can

be seen in the photo at the right end behind the top bar. The other row is just behind this one. Presumably these locations were used for timing or marking tracks.

The presumed “erase” heads (See Appendix B) are made from a permanent magnet. They are roughly in the form of a cylinder about 0.25 inch in diameter. The magnetic end is also shaped so there is a small gap and the head is about 0.025 inch wide, same as the read/write head. But they appear to be positioned about 0.1 inch off of the drum surface.

The function/purpose of this drum is unknown but proposed applications include a register, delay line, or data transfer/sharing between two computers.

### **Model 1124A1, Serial number 7**



See Appendix A for characteristics of this drum and advertised capabilities of the 1124 family. This drum is in the worst condition of the three in that the chrome (?) plating on the casing has eroded or has mostly fallen off and the surface has a coating of rust. The shaft does turn but it will not coast. This drum is also mounted via three round shock absorbing feet. Two are installed under the motor end but the one under the bearing support end is missing. The drum has a blue OK tag attached. The date on the tag is 2/25/58. Comments written on the back of this tag are as follows: “Head C19 had rubbed depositing loose oxide inside of shroud. This was removed as much as possible. If further difficulty is experienced it will be necessary to overhaul this drum completely.”

This drum has six rows of thirty milled head locations. All rows are in the top half of the case. It is not known how the rows are identified but there is only one row of the six with heads installed. This drum, when initially seen, had 27 heads installed in one row. In the view above, row C is presumed to be the row with heads installed. The two rows above are presumed to be rows A and B. On the back side, under and to the rear of the blue OK tag, are three more rows spaced like the A thru C rows. Tracks for row C are supposedly numbered 1 thru 30 beginning at the left end nearest the motor. The 19<sup>th</sup> head location in row C has a missing head and the space is covered with a cover plate having a red ‘X’ marked on it. By removing the cover plate, a visual inspection of this track shows a deep groove has been worn in the magnetic coating. So, this is presumed to be the C19 head mentioned on the blue tag. There are also cover plates over the holes for what would be heads C29 and C30 and the C29 cover also has a red ‘X’ marked on it. The other five rows have cover plates over all the head holes. Measurements show that, if heads were installed in all the locations, each head would be on its own track and tracks are on a 16

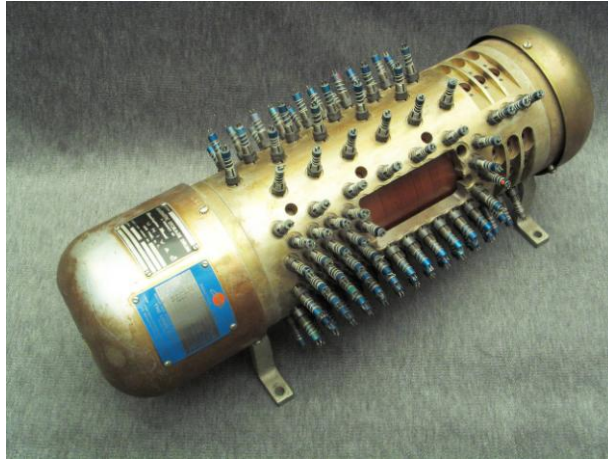
track per inch spacing. There are small round tags attached to the electrical lead wires from heads in locations C4, C6, and C8. Markings on those tags are as follows (line breaks as shown on the tag):

C4	C6	C8
Mark Track 1 pulse in phase with TT	Word marks 10 pulses every 84 cells 1 <sup>st</sup> ½ cell from Ref. Mk.	Char. Marks 120 pulses 7 cells apart 1 <sup>st</sup> pulse 1 cell delayed from Ref. Mk.

There are no separate locations to mount timing or marking heads so apparently this function was done within the six by thirty array of heads if all were installed (possibly the tagged C4, C6, and C8 tracks).

The heads on this drum (See Appendix B) are apparently of a newer shorter design although they are very delicate. Each head has a twisted pair of about 28 gauge insulated stranded wire emerging from the top end. Due to handling, all wires are sharply bent at the point of egress from the head and, if they have not already broken off, the remainder soon will also be broken. The wires are 18 inches long and have a taper pin crimped to the end. The heads themselves are round cylinders about ¼-inch in diameter and 0.7 inch long. The head shell appears to be copper or brass. The head is slid into a split and tapered brass holder. The top end is threaded which allows adjustment of the distance of the head gap from the drum. A nut is tightened to hold it in place in its holder once set and there is a red thread-lock material on each. The heads and their holder are clamped in place by two flat head screws which hold the holder mounting surface against the milled case surface. Crude measurements show the current setting for head to drum spacing is probably 1 to 3 thousandths of an inch (published data says this should be 2 thousandths). The magnetic gap end of the head shows the head material is probably a ferrite material about 0.025 inch wide. There is a gap in the ferrite of about 0.002 inch and it is filled with a metal shim. At one end of the ferrite head is the end of a copper bar which is electrically connected to the case (possibly to bleed off static charges). The electrical resistance of the head coil is about 2.5 ohms. The 18 inches of twisted pair wire adds about an ohm to this value. The mounting for these heads appears identical to the milled holes in the model 1119A1 drum discussed previously so it is assumed these same heads were used in that drum.

## Model 1124G1, Serial number 4UTA8



See Appendix A for the observed characteristics of this drum and the advertised capabilities of the 1124 family. This drum is in the best condition of the three and is possibly the newest. However the head design is significantly different and, although more durable, is less space efficient. The bearings are in very good condition and the drum will coast for several minutes once set to spinning. This drum has several characteristics that put its purpose into question. The drum itself is highly magnetic, similar to the iron/steel case. Not at all similar to what should be an aluminum drum as claimed in published specs. The case is thicker than the other two drums. Although it has been drilled to accommodate 133 heads, there is a 2 inch by 4 inch cutout where 26 heads would have been. This allows a good view of the drum surface. There are also 3 unused plain 0.4 inch diameter holes, the function of which is unknown. Lastly, is the arrangement of heads - if it were not for the cutout, there would be eight rows of 12 heads, two rows of six heads, and five rows of five heads. Many of these characteristics are visible in the above photo. This drum also has a serial number format not like the other two drums.

According to measurements of head position, each would have a dedicated magnetic track. Opposite the motor end nearest the bearing support end, there are three pairs of 3-head rows (at the right end in the above photo). One pair has heads installed that are the same as other heads on this drum. Another pair is machined in a manner that is similar to those found on the other two artifact drums. In fact, heads from the 1124A1 will fit nicely in these rows. The third-pair are machined in a manner similar to the second head but the head access hole is much larger. It is not known what type of head would be installed in these two rows. All six holes are located where the timing or marker tracks would be. However, it is noted that the head at the far right end is not above a usable portion of the magnetic plating on the drum (this is at the edge of the plated area and shows a white under-plate material).

The heads installed on this drum (See Appendix B) have a magnetic end similar to the heads on the 1124A1 drum and have a ¼ inch diameter aluminum shell but are 2 inches long. Instead of leads coming out the top end, they have a pair of terminals or pins which could receive a small connector. The electrical resistance of the head coils measures about 2.5 ohms, the same as the smaller heads. The magnetic end of the head is similar to that of the short heads except the copper bar at the end of the ferrite does not appear to have any electrical connection to coil or case. The case covers more of the end of the head and possibly that alone provides any protection from static charges. The heads are slid into a

split cylinder which is press fit into the casing. There is a threaded collar which can be tightened to squeeze the head and hold it in place. A spring mounted around the head will push the head out of the drum if the collar is loosened. The heads have a raised dimple(s) on the side of the body which allows the head to be inserted into the split cylinder in only four possible orientations. This would force the head to be either in line with the track or 90 degrees out of position. As received, all heads were fully retracted away from the drum surface so it was not possible to determine a head to drum surface spacing. The method of mounting these heads takes up much more room than that used in the other two drums thus the potential head density is lower. It has been stated that the heads are this long because this was the length of the heads on the first drums, thus they took no more space. Supposedly the short style heads are a newer innovation which takes less space. But this argument is contrary to the apparent date of manufacture of the drums.

This drum weighs significantly more than the other two due to the apparent ferrous drum and thicker iron/steel casing. One theory is that this was a drum used in an airborne application and needed to be more rugged. Another theory is that it is a marketing display model (for RRU in New York) showing various options that are available for potential applications.

## **Concluding Statements**

Each drum is unique by itself and there are few redundant characteristics. So they all have merit in the archive of history. However, none are representative of the maximum advertised characteristics of the family. It has been proposed that each drum in the family was different and each serial number was tailor made to meet a specific application so maybe few were alike.

One issue has to do with the preservation of the heads on the 1124A1 drum. As stated above, the leads from the heads themselves are in a very delicate situation. Almost any movement will tend to break more wires. In fact, although there are twisted pairs coming from some of the heads, one wire of the twisted pair may already be broken. In other cases, it is believed the wire inside is broken and the only thing holding it on is a strand of insulation. Although the wires could probably be coiled and then restrained, many would break in the process. It has been proposed that the wires be clipped off close to the heads and placed in a separate package. Another proposal is that the heads be removed from the 'less than ideal' 1124A1 drum and use them to populate at least some locations on the 1119A1 drum to more accurately show how it would have actually been in use. Again, in this case, the head wires would be clipped and saved separately. We do have several digital close-up photos of the heads both on and off the drums so these details would not be totally lost.

*Preservation suggestions are welcome.*

In the meantime, drum 1124G1 is in the VIP Club artifact collection at the Lockheed Martin facility in Eagan, MN. The 1119A1 and 1124A1 drums are at Don Anderson's home in Eagan, MN. Tags will be affixed to Don's drums defining points of contact in case someone eventually decides to dispose of the drums. The eventual disposition of these drums has not been determined. It is possible the Minnesota Historical Society may be interested in one or more to add to the original drum memory which they already have.

**Appendix A – Drum Model Characteristics**

<b>Model</b>	<b>1119</b>	<b>1119 A1</b>	<b>1124</b>	<b>1124 A1</b>	<b>1124 G1</b>
<b>Serial Number</b>	n/a, spec sheet	106	n/a, spec sheet	7	4UTA8
<b>Feature</b>					
Maximum bit capacity	196,000	19,800	287,000	198,000	146,000
Number of tracks	180	18	270	180	133
Heads		36 + 4		180 + 0	133 + 6
Head arrangement		4 rows of 9 (2 heads per track) plus 2 rows of 2		6 rows of 30	8 rows of 12 2 rows of 6 5 rows of 5 plus 2 rows of 3
Magnets (erase heads?)		2 rows of 9 (1 magnet per track)		none	none
Bits per track (approx.)	1100	1100 est	1100	1100 est	1100 est
Tracks per inch (axial)	25	2.7	25	16	16
Maximum access time (msec)	5	1.50 typical	5	not measured	not measured
Normal bits per inch (peripheral)	80	80 assumed	80	80 assumed	80 assumed
Drum diameter (inches)	4-3/8	4-3/8	4-3/8	4-3/8	4-3/8
Drum circumference (inches)	13.74	13.74	13.74	13.74	13.74
Drum material	coated aluminum	unknown	coated aluminum	unknown	coated ferrous
Motor Nominal RPM	12,000	10,500	12,000	12,000	12,000
Motor Horsepower	1/5	0.3	1/5	1/5	1/5
Motor Supply Voltage		120 Volt, 3 Phase 180 Cycle		115 Volt, 3 Phase 420 Cycle	115 Volt, 3 Phase 420 Cycle
Weight (lbs. approx)	55	50	70	60	80
Dimensions (WHL inches)	6-1/2x7x18-1/2	6-1/2x7x18-1/2	7x7x22	6-1/4x7x22-1/2	8.5x8.5x22-1/4
Casing material		plated iron/steel		plated iron/steel (rusty)	plated iron/steel
Casing thickness (inches)		0.375		0.375	0.55
Casing length (inches)		8.75		12.5	12.5
Mounting		3 point shock mount		3 point shock mount	4 display feet
Manufacturer (per label)		ERA Div of Rem Rand St. Paul		Rem. Rand Div. of Sperry Rand ERA Division St. Paul	R. R. Univac New York
Donor/Owner		Don Anderson		Don Anderson	Harry Wise

## Appendix B – Drum Heads



Photo B1 – Three types of heads. From left to right: Permanent magnet head with mounting screws, short head with twisted pair wires and with holder and mounting screws, one wire with taper pin termination, long head with spring.

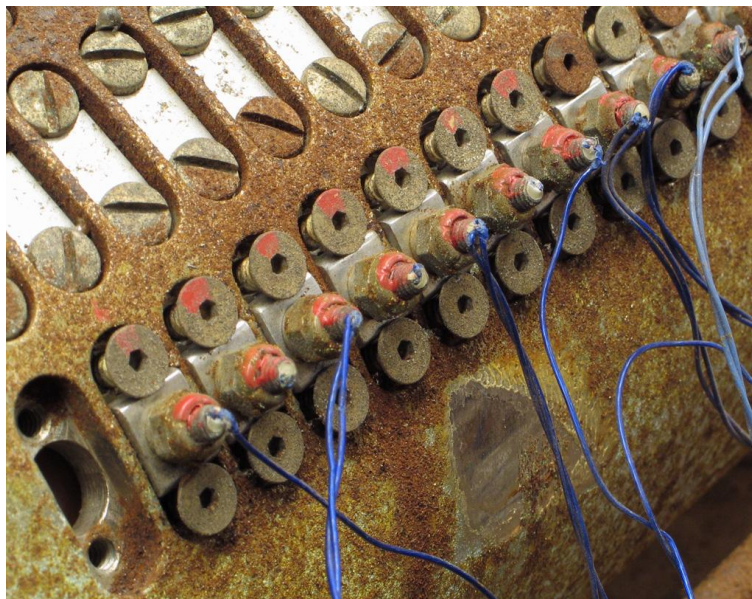


Photo B2 - Small head mounting on 1124A1 drum. Also shows cover plates on unused locations as well as an open hole with head removed at position C1.



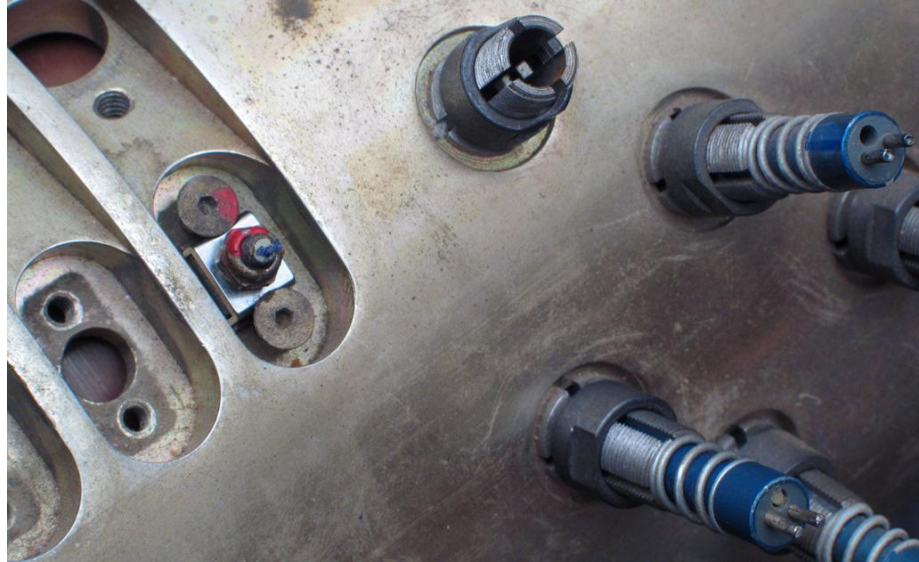


Photo B3 – Large head mounting on 1124G1 drum, one where the head has been removed. Also shows a small head from the 1124A1 drum installed into one of the auxiliary mark/timing track locations.

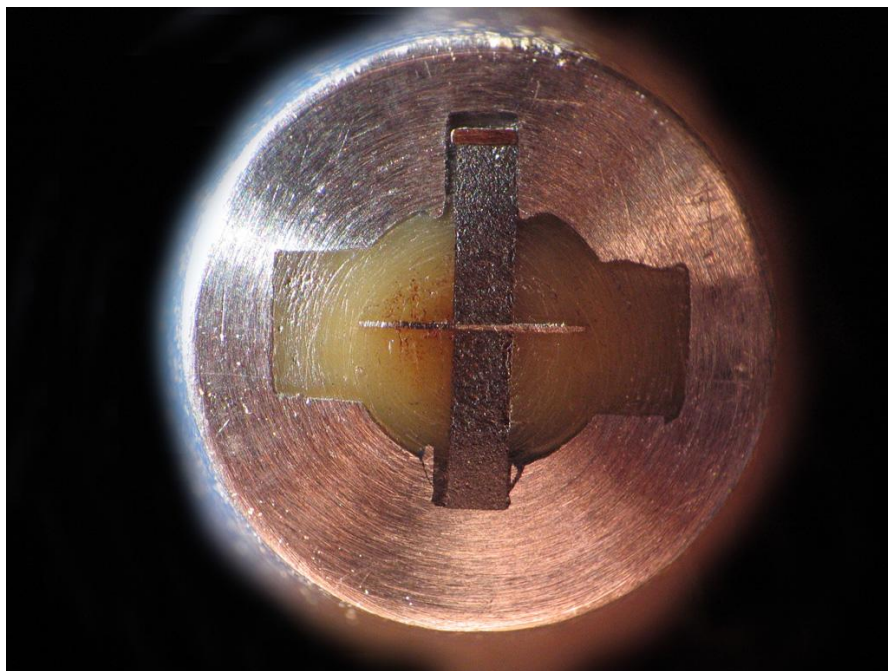


Photo B4 – Typical magnetic operating end of a long head as found in the 1124G1 drum. Note: the copper color is due to the ambient light, not the color of the metal except for the end of the copper bar at top of the ferrite. True case color is aluminum as shown at the top left of the photo. The small heads are slightly different in that the case does not cover as much of the end as is shown here.