

# The Use of the Charactron with ERA 1103

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THE Charactron<sup>1,2</sup> tube was invented by Joseph T. McNaney and developed by Convair since 1950. The main purpose for installing a Charactron on Convair's ERA 1103 computer was for real time simulation. However, other valuable uses for the Charactron on the 1103 have been found.

## Physical Characteristics

This Charactron, with its cathode-ray display tube, type C7A, can display alphanumeric characters at a rate of 10,000 characters per second. The equipment which includes a cathode-ray tube with 7-inch-diameter screen can be used with either one of two cameras, easily interchangeable in a matter of a few minutes. Fig. 1 shows the Charactron with a Beattie camera using 35-millimeter film in a magazine. It is possible to remove the exposed film without removing or exposing the unexposed film. Fig. 2 shows the type of construction of the main body of the equipment. Fig. 3 shows the tube mounted vertically and viewed by the camera using a mirror mounted at 45 degrees to the camera lens and to the tube screen. The screen may be viewed through a filter during operation without impairing the results. The four drawers contain the power supplies.

The second camera, the Kenyon camera shown in Fig. 4, is a camera and photo laboratory combined. All operations, exposing, developing, fixing, and projecting, are performed in parallel. While the computer is calculating and displaying one page of answers, the camera is fixing and developing the previous pages. This process takes about 2 seconds, and if the calculations take more than 2 seconds a page, then the fixing and developing does not hold up the process at all. The finished film is extruded and can immediately be viewed on a film reader such as a Recordak. Editing can be done at this point to determine which frames are to be enlarged and printed. Fig. 5 shows the Charactron, with Kenyon camera attached, connected to the ERA 1103. A test generator is also included in this unit which enables alignment adjustments to be made without the use of the computer.

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A 6-bit code is used to select the proper alphanumerical character from a matrix in the Charactron tube. These characters are in a 6-by-6-array. Three bits are used for horizontal selection and 3 for vertical. A 20-bit code is used to position the characters on the face of the tube. Ten of these are used for horizontal selection and ten for vertical. Thus, a total of 26 bits defines the alphanumerical character and its position on the face of the tube. The IOB buffer on the 1103 has a capacity of 36 bits. The characters we chose to display are the numbers 0

through 9 and the alphabet not including the letters O or I. (The numbers zero and one do double duty.) A decimal point and a minus sign complete the list of characters.

## Applications

As an aid in debugging, it can display the contents of memory, Fig. 6. Another common technique used in debugging a floating point program is a trace or auto-monitor, Fig. 7. This is an example of a concurrent trace giving the address, the command, and the result of each command. The trace operates at a rate of better than ten lines per second. The Charactron can also be used to edit input data. In this case, while the computer is calculating the results, the input data are plotted. Cases that show up with points obviously

Fig. 1

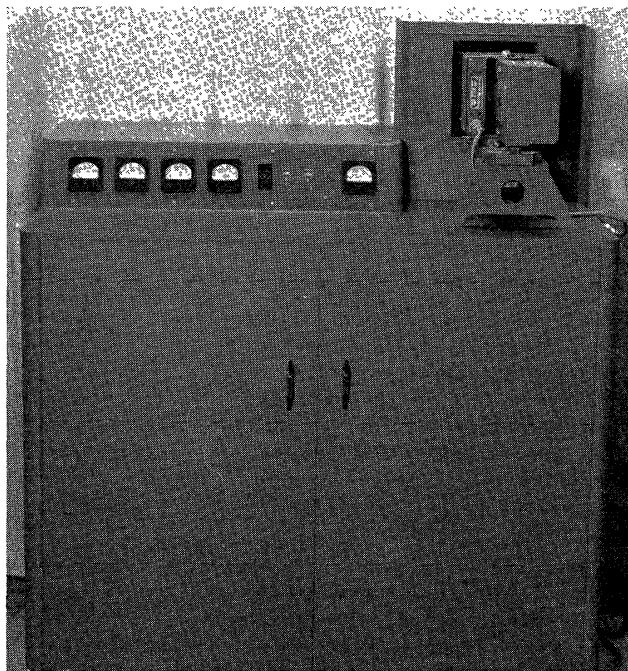


Fig. 2

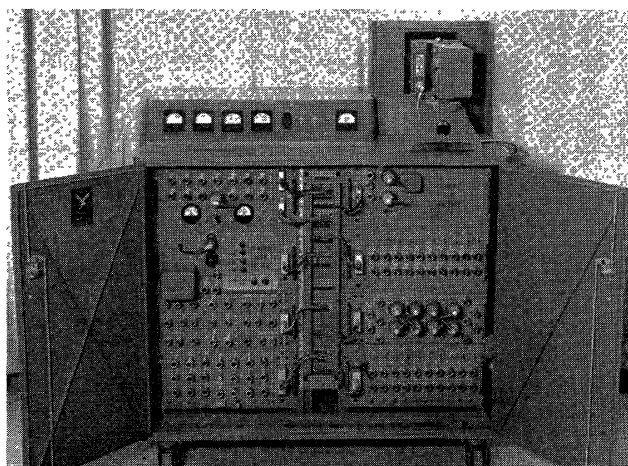




Fig. 3

00000	45	00000	00150
00001	45	00000	01824
00002	45	00000	76781
00003	00	00000	00000
00004	55	00000	00000
00005	77	77777	17670
00006	00	00000	00200
00007	00	00000	00000
00010	00	00000	00070
00011	77	77777	77600
00012	11	00001	74001
00013	00	00050	00202
00014	32	00473	00000
00015	32	00473	00000
00016	45	00000	00356
00017	00	00000	77734
00020	73	00073	00005
00021	11	20000	00112
00022	36	00121	00006
00023	41	00005	00110
00024	21	00100	00073
00025	45	00000	00100
00026	16	00112	00116
00027	11	00040	00007
00030	21	00007	00000
00031	55	20000	00033
00032	51	00075	10000
00033	71	10000	00006
00034	00	00000	00000
00035	00	00000	00000
00036	00	00000	00000
00037	00	00000	00000

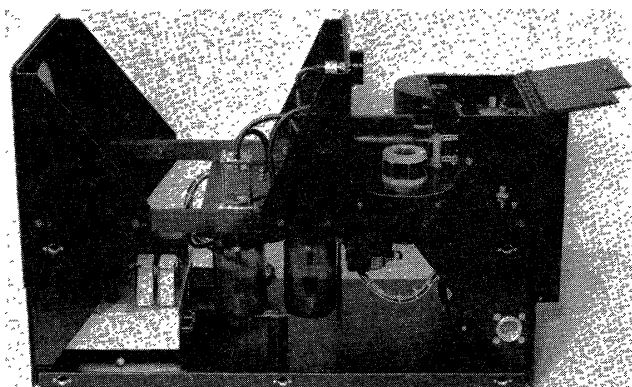


Fig. 4

FLIP TRACE				
01401	1423	5444	5444	1786701 -02
01402	1440	0044	1401	1786701 -02
01404	1422	1443	1416	7949729 -02
01405	1436	0037	1774	4449389 01
01406	1421	1415	0037	7786432 01
01407	1422	5444	0037	1074035 00
01410	1401	5431	5431	4055571 01
01411	1451	1400	5424	2748162 -19
01405	1421	1415	0037	2748162 -19
01407	1422	5444	0037	1734427 00
01410	1401	5431	5431	4488415 -01
01411	1451	1400	5424	7105355 28
01406	1421	1415	0037	7105355 28
01407	1422	5444	0037	2563338 00
01410	1401	5431	5431	2465038 00
01411	1451	1400	5424	8524900 -23
01406	1421	1415	0037	8524900 -23
01407	1422	5444	0037	2524954 -01
01410	1401	5431	5431	2491932 00
01411	1451	1400	5424	5737521 24
01406	1421	1415	0037	5737521 24
01407	1422	5444	0037	1885924 -01
01410	1401	5431	5431	5885707 04
01411	1451	1400	5424	2267092 -32
01352	1440	0044	1401	2267092 -32
01352	1402	5431	1416	4055502 01
01353	1451	1400	5436	2748183 -19
01354	1440	0044	1347	2748183 -19
01352	1402	5431	1416	4487167 -01
01353	1451	1400	5436	7110195 28

Fig. 6

Fig. 7

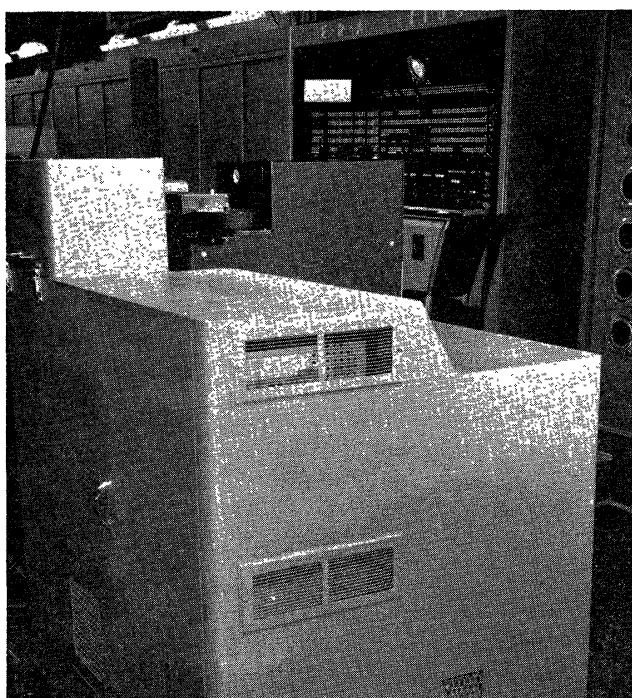


Fig. 5

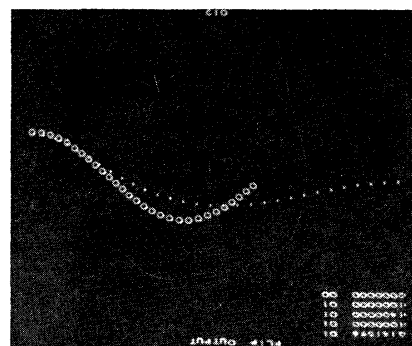


Fig. 8

FLIP		OUTPUT	
0000000	00	0000000	00
0141596	01	-0338035	-05
0283254	01	-1411876	00
0426343	01	-2809178	00
0572366	01	-4175735	00
0722958	01	-5491652	00
0879926	01	-6730564	00
1200000	01	-7855690	00
1404520	01	-8814832	00
1606894	01	-9536984	00
1802512	01	-9939696	00
1802172	01	-9959722	00
1998498	01	-9593493	00
2400000	01	-8899839	00
25185875	01	-7964092	00
26362347	01	-6850054	00
27528574	01	-5620746	00
2868293	01	-4311270	00
2983744	01	-2948841	00
3000000	01	-1553864	00
3127167	01	-1428162	-01
3248903	01	1269472	00
3410488	01	2669137	00
3553374	01	4039423	00
3699028	01	5419116	00
3849080	01	6208764	00
4000000	00	699058	00
4291887	-02	799274	00
4504657	-01	8375274	00
4590257	-01	1114297	01
4819071	-01	1389279	01
4508861	00	1662401	01
4212514	00	1933882	01
3810397	00	2204292	01
3336900	00	2474552	01
2848964	00	2745788	01
2446370	00	3018990	01
20464973	00	3294640	01
16396536	00	3572644	01
12545395	00	3852192	01
8493299	00	4132078	01
4228719	00	4410754	01
3746872	00	4686502	01
3099944	00	4957415	01
2467184	00	5222593	01
1805467	00	5480336	01
1194678	00	5730333	01
5948679	-01	5972794	01
1112078	00	6208764	01

Fig. 9

characters per second. It should be noted that the format is not limited with a Charactron. Answers can be printed in vertical columns. Each column, for example, could represent all variables at one time interval of integration.

Early this year, Convair expects to tie together a very large analogue computer with the ERA 1103. Between the two will be the conversion equipment—analogue to digital and digital to analogue. This setup is for a real time simulation problem. Of course, the output plotters on the analogue will be used, but the output of calculation from the ERA 1103 are also needed. This output must be very fast because of the real time simulation. Since the magnetic tapes have inertia start and stop times which make them too slow, and the drum may not be large enough to store all the answers before the problem is finished, it is felt that the Charactron with its extremely high speed may answer this challenge.

### References

1. THE CHARACTRON, Joseph T. McNaney, *Proceedings, Institute of Radio Engineers, New York, N. Y.* March 1952.
2. THE TYPE C19K CHARACTRON TUBE AND ITS APPLICATION TO AIR SURVEILLANCE SYSTEMS, Joseph T. McNaney. *Ibid.*, March 1955.

out of line can be corrected and rerun.

Any of the characters can be used to plot graphs. Multiple graphs can be plotted on the same frame, Fig. 8. The input parameters can also be displayed on the same frame. These graphs represent the solution to two simultaneous differential equations. A table of the values plotted could be separate, Fig. 9.

A question often asked is, "How many characters can be displayed on one horizontal line?" With this installation 50 characters can be displayed horizontally. A Charactron with a 7-inch tube has been built which can display 100 characters per line with very fine definition and sufficient intensity for photographing at a rate better than 20,000

# A New Tape Handler for Computer Applications

ROBERT BRUMBAUGH

THE rapid advances made in digital computer design within the past few years have, unfortunately, not been accompanied by a corresponding advance in the design of input-output equipment of comparable performance. The increasing scope of computer applications has further intensified the limitations imposed by available input-output equipment.

Magnetic recording tape, as a storage medium for digital information, is assuming a role of ever-increasing importance, and is now unsurpassed as an input-out-

put medium for the rapid transfer of information. In addition, magnetic tape equipment has become an important element in automatic data-reduction systems.

Many types of magnetic tape handlers have been designed in the past, the great majority to meet a more or less specific application. As a result, extensive modification has often been necessary to adapt these units for other applications. In recent years, more versatile designs have been evolved to meet the increasingly diversified requirements for digital recording equipment. Although the new equipments represent a step in the right direction, these pioneering efforts were at times

overly complex, and consequently caused a sacrifice both of reliability and economy.

For many years Ampex has concurrently pioneered in the recording of analogue signals on magnetic tape. Many of the problems in this field are very similar in nature, if not in degree, to those in the computer field. In addition to their useful analogue function, standard instrumentation recorders have many times been modified for application to computer systems; this approach is obviously not the answer to the increasingly stringent and refined requirements of the computer industry.

Believing that its extensive past experience could be applied to solve many of the increasingly difficult problems in the application of input-output equipment, Ampex Corporation initiated a program to develop a magnetic tape transport for computer use, providing versatility and reliability equal to that of the instrumentation recorder. Briefly, the most desired requirements of a tape transport for computer use are as follows:

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