

The Use of the Charactron with ERA 1103

BEN FERBER

THE Charactron^{1,2} 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.

A 6-bit code is used to select the proper alphanumeric 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 alphanumeric 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

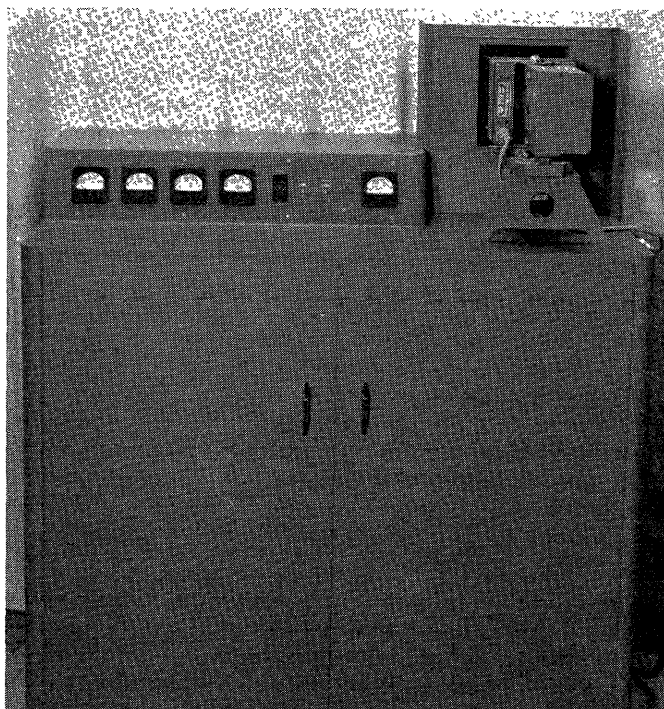
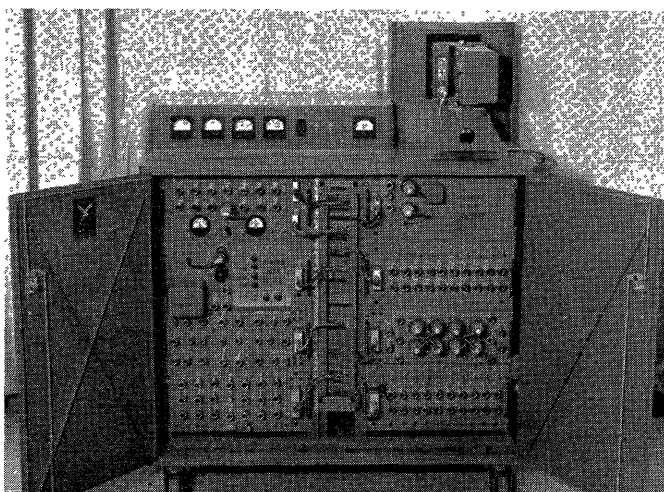


Fig. 2



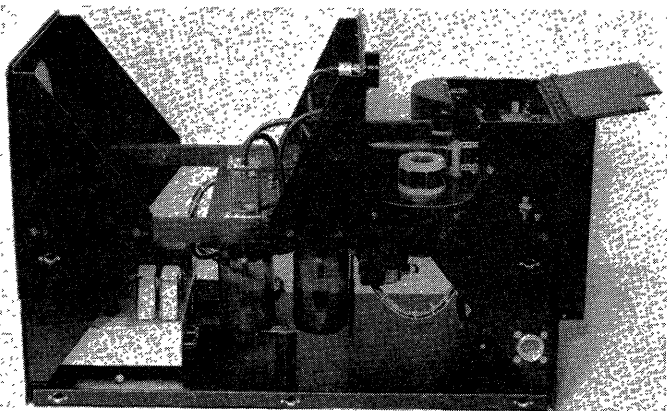
BEN FERBER is with Convair, a division of General Dynamics, San Diego, Calif.



Fig. 3

000000	45	000000	001500
000001	45	000000	016200
000002	45	000000	767801
000003	00	000000	000000
000004	55	000000	000000
000005	77	777777	774700
000006	00	000000	002000
000007	00	000000	000000
000010	00	000000	000700
000011	77	777777	776000
000012	11	000011	740011
000013	00	000500	00202
000014	32	00473	000000
000015	32	00473	000000
000016	45	000000	00356
000017	00	000000	77734
000020	73	00073	00005
000021	11	20000	00112
000022	36	00121	00006
000023	41	00005	00110
000024	21	00100	00073
000025	45	000000	00100
000026	16	00112	00116
000027	11	00040	00007
000030	21	00007	00000
000031	55	20000	00033
000032	51	00075	10000
000033	71	10000	00006
000034	00	000000	00000
000035	00	000000	00000
000036	00	000000	00000
000037	00	000000	00000

Fig. 6



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	7786632	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	1734627	00
01410	1401	5431	5431	4484115	-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	6524900	-23
01406	1421	1415	0037	6524900	-23
01407	1422	5444	0037	2524954	-01
01410	1401	5431	5431	7491932	00
01411	1451	1400	5424	5737521	24
01405	1421	1415	0037	5737521	24
01407	1422	5444	0037	1865924	-01
01410	1401	5431	5431	5885707	04
01411	1451	1400	5424	2267092	-32
01406	1402	0044	1407	2267092	-32
01352	1402	5431	1416	4055602	01
01353	1451	1400	5438	2748183	-19
01352	1440	0044	1387	2748183	-19
01352	1402	5431	1416	4487167	-01
01353	1451	1400	5438	7110195	28

Fig. 4

Fig. 7

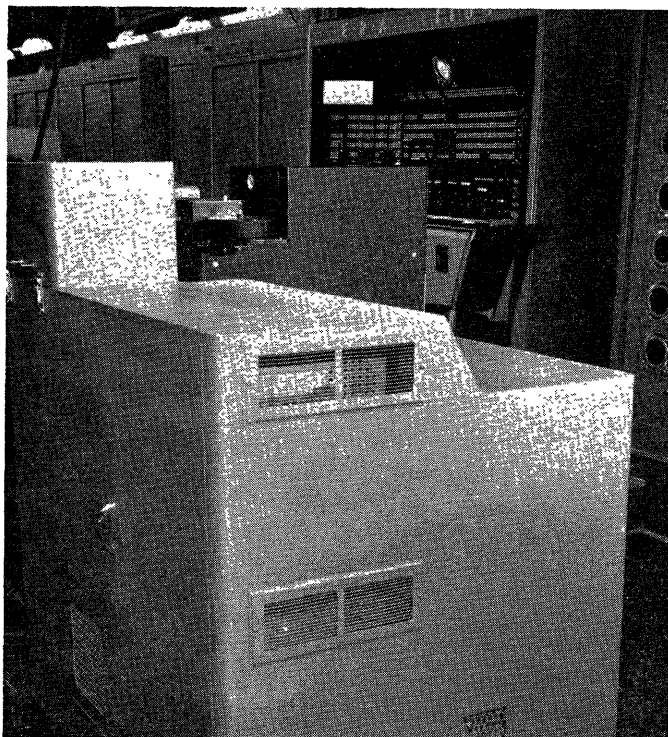


Fig. 5

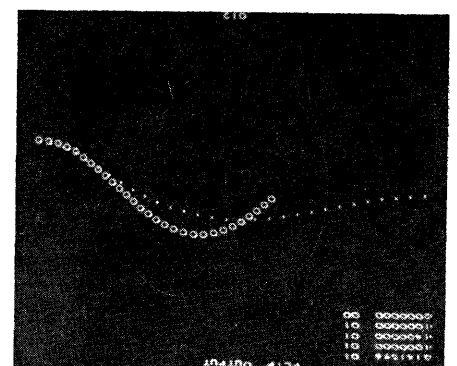


Fig. 8

		FLIP		OUTPUT			
0000000	00						
0141596	01	-3338035	-05	0000000	00	0000000	00
0283254	01	-1411876	00	0799058	00	-4291887	-02
0426343	01	-2809178	00	0592540	00	-2508857	-01
0572366	01	-4175735	00	0375276	00	-3590257	-01
0722958	01	-5491652	00	0114297	01	-9819071	-01
0879926	01	-6730564	00	0389279	01	-1506881	00
1200000	01						
0045208	01	-7855690	00	0862401	01	-2125196	00
0220587	01	-4814832	00	0933882	01	-2810397	00
0406894	01	-9536984	00	0204292	01	-3536900	00
0602512	01	-9939696	00	0474552	01	-4268964	00
0802172	01	-9959722	00	0745788	01	-4963790	00
0998498	01	-9593493	00	0018990	01	-5576206	00
2400000	01						
0185875	01	-8899839	00	0294660	01	-4044973	00
0362347	01	-7861092	00	0572644	01	-4396534	00
0528574	01	-6850054	00	0852192	01	-4545395	00
0688293	01	-5620746	00	0132078	01	-4493299	00
0837444	01	-4311270	00	0410754	01	-4228719	00
0983851	01	-2948841	00	0686502	01	-5746872	00
3600000	01						
0127167	01	-1553864	00	0957615	01	-5049946	00
0268903	01	-1628162	-01	0222593	01	-4147196	00
0410496	01	-1249672	00	0480336	01	-3054887	00
0553374	01	-2469137	00	0730333	01	-1794878	00
0699029	01	-039623	00	0972794	01	-3948679	-01
0849080	01	-5361716	00	0208764	01	-1112078	00

Fig. 9

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

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.

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:

ROBERT BRUMBAUGH is with the Ampex Corporation, Redwood City, Calif.