OUTPUT DEVICES AND COMPUTERS

	Alpha CRS	APS-5	Comp. 8600	Epson MX-80	Facit 4542	Fla. Data OSP	HP2680	Imagen Imprint 10	Laser-grafix	Linotron 202	Perq/ Canon	Symbolics LGP-1	Varian	Versatec	Xerox Dover	Xerox XGP	Xerox 9700
Amdahl(MTS)																	*Michigan
Amdahl (MVS)			Wash. St. U														
Apollo								*OCLC						*OCLC			
Ethernet							Stanford								Stanford		
DEC10								Vanderbilt						Vanderbilt			
DEC10 *														*G A Technology			*Univ. Del.
DEC20	AMS					Math Reviews		*SRI		Adapt, Inc.			AMS		*CMU		
DG MV8000									*Texas A&M								
HP1000				*JDJ Wordware													
IBM(MVS)																	*CIT
IBM(VM)														*SLAC			
IBM370		Info. Handling															
Onyx C8002								TYX Corp.									
Prime														*Livermore			
Sail																Stanford	
Siemens BS2000											*GMD Bonn						
Sun *		*Textset				*Textset				*Textset							
Univac 1100			Univ. Wis.														
VAX (Unix)												UC Santa Cruz		Cal. Tech.			
VAX (Unix) *								*UC Irvine						*Univ. Wash.	*Stanford		
VAX (VMS)					*INFN CNAF			Argonne	Texas A&M			Calma	Sci. Appl.	Sandia			

*(running TEX82)

Index to Sample Output from Various Devices

As with previous issues of TUGboat, several articles have been submitted for publication in the form of camera copy. The following items were prepared on the devices indicated, and can be taken as representative of the output produced by those devices. With each item is given a percentage, which is the size of the copy as received; items received as copy larger than 100% were reduced photographically using the PMT process. The bulk of this issue, as usual, has been prepared on the DEC 2060 and Alphatype CRS at AMS.

- Epson MX-80; 100%: L. J. Bunner and J. D. Johnson, *TEX on the HP-1000*, p. 16; HP-1000.
- Florida Data OSP 130; 130%: p. 13; DEC 2060.
- HP 2680A; 145%: L. Carnes, *"Small" TEX*, p. 24; HP-3000.
- Imagen Imprint-10; 100%: G.M.K. Tobin, *Computer Calligraphy*, p. 26; Apollo.
- Versatec; 130%: R. Furuta and P. MacKay, *Unix TEX Site Report* and the two articles which follow, p. 17; VAX/UNIX.

LOW-COST DOWNLOADABLE FONT DEVICES

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A fundamental problem with typesetting is that output devices capable of displaying material as it would appear in typeset form are expensive and slow. Electrostatic printer plotters have resolutions of 100 to 400 dots per inch and can produce up to 20 pages/minute, but cost from $10K to $100K and require special paper. Laser printers offering resolutions of 240 to 300 dots per inch can produce up to 12 pages/minute on normal paper and cost around $20K to $25K. High-quality phototypesetters start around $20K, but are generally quite slow, requiring as much as 10 minutes/page, often on expensive photographic paper.

It seems worthwhile therefore to investigate what low-cost output devices capable of accepting downloaded fonts are available on the market today. The goal is to find output devices which can display a typeset page about as rapidly as normal text can be displayed. This survey sets an upper limit of about $5K ($10K for color terminals) and includes both dot-matrix printers and display terminals. The cost limit excludes workstations like the Xerox Star and the Apple Lisa which are designed from the beginning to support multiple fonts. Multi-font devices whose fonts are pre-recorded in ROM storage by the manufacturer are excluded because of their general lack of usefulness for scientific typesetting.

Since the number of manufacturers of printers and terminals has become very large, I will no doubt have missed several. If reader response is sufficient, I would be willing to update this column in later issues of TUGboat. At present, all but two of these devices have severely limited maximum character matrix sizes, and most cannot properly handle proportional spaced fonts. The maximum matrix size is noted as "$n \times n$", and the number of downloaded characters or amount of memory for font storage, where available, is also given. For terminals, the screen resolution (H × V) is also given, since this is a limiting factor on the display quality. Entries are tabulated alphabetically by manufacturer name.

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Printers

Model(s): CI-300, CI-600
Character Grid: 17 × 17
Manufacturer: C-Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066, USA
Telephone: (213) 306-6700.

Model(s): Florida Data OSP 120 and 130
Character Grid: matrix variable depending on character configuration; maximum dot density - obtainable 360H × 192V (graphics option available)
Manufacturer: Florida Data, 600-D John Rodes Blvd., Melbourne, FL 32935, USA
Telephone: (305) 259-4700.
Remarks: Up to 18K RAM font storage. Sample output of the earlier Florida Data BNY model may be found in TUGboat Vol. 2, No. 1 (February 1981), pp. 130-131; sample output of the current OSP 130 appears on p. 12 of this issue.

Model(s): Infoscribe 1000
Character Grid: 7 × 9
Manufacturer: Infoscribe, 2720 S. Croddy Way, Santa Ana, CA 92704, USA
Telephone: (714) 741-8595.
Remarks: 96 characters font storage

Model(s): Okidata Microline 92 and 93
Character Grid: 9 × 9
Manufacturer: Okidata Corp., 111 Gaither Drive, Mount Laurel, NJ 08054, USA
Telephone: (800) 654-3282.
Remarks: 96 characters font storage

Model(s): Printek 900 series
Character Grid: 9 × 9 and 18 × 18
Manufacturer: Printek, 1517 Townline Road, Benton Harbor, MI 49022, USA
Telephone: (616) 925-3200.

Terminals

Model(s): BBN BitGraph
Screen: 768 × 1024 monochrome
Character Grid: unlimited; proportional fonts supported.
Manufacturer: Bolt Beranek and Newman, Inc., 10 Moulton Street, Cambridge, MA 02174, USA
Telephone: (617) 497-3178.
Remarks: With the default 12×16 font, the BitGraph displays 64 lines of 85 characters. With a 5 × 8 terminal font, the smallest that has lowercase letters with descenders, it shows 113 lines of 128 characters, and is still quite readable.

Model(s): CIT-427
Screen: 640 × 480 color
Character Grid: 8 × 14
Manufacturer: C-Itoh Electronics, Inc., 5301 Beethoven Street, Los Angeles, CA 90066, USA
Telephone: (213) 306-6700.
Remarks: font storage 7 96-character sets

Model(s):	Datacopy
Screen:	1728 × 2200 monochrome
Character Grid:	
Manufacturer:	Datacopy, 1070 East Meadow Circle. Palo Alto, CA 94303. USA
Telephone:	(415) 493-3420.
Remarks:	Datacopy does not yet make this display available as a terminal, but I am including it here as something to be watched closely. The screen is sharp enough to display readable 4-point type on a full page of text, or the engraving lines in a page image of a dollar bill. The January 1983 issue of *Computer Graphics World* (p. 65) contains a photograph of a sample image.

Model(s):	Direct 828. 831. 1000. 1025
Screen:	640 × 480 monochrome
Character Grid:	10 × 12
Manufacturer:	Direct Inc., 4201 Burton Drive, Santa Clara, CA 95054 USA
Telephone:	(800) 538-8404.
Remarks:	2 128-character user-definable fonts; downloading must be in blocks of 16 characters.

Model(s):	Quadram Omega Data X7
Screen:	960 × 528 monochrome
Character Grid:	5 × 7 ASCII or 6 × 8 symbol
Manufacturer:	Quadram Corp., 4357 Park Drive, Norcross, GA 30093, USA
Telephone:	(404) 923-6664.
Remarks:	66 lines of 160 characters, or two split screens with 66 lines of 80 characters. Up to 2048 downloaded characters.

Model(s):	Ramtek 6211
Screen:	640 × 480 color
Character Grid:	8 × 12, proportional spacing
Manufacturer:	Ramtek Corp., 2211 Lawson Lane, Santa Clara, CA 95050, USA
Telephone:	(408) 988-2211.

Model(s):	Tektronix 4027, 4112, 4113 (raster), 4114, 4116 (storage tube)
Screen:	640 × 480 color (4027, 4113), 640 × 480 monochrome (4112), 4096 × 4096 monochrome (4114, 4116)
Character Grid:	8 × 14 on raster, vector fonts on storage tubes
Manufacturer:	Tektronix, Inc., Instruments Division, P.O. Box 500, Beaverton, OR 97077, USA
Telephone:	(503) 627-2256.
Remarks:	font storage 31 96-character sets (tube), and 4116 support user-defined vector fonts.

Model(s):	Terak 8510a, 8600
Screen:	640 × 480 monochrome (8510a) and color (8600)
Character Grid:	8 × 10 and 16 × 10 in monochrome, unlimited in color
Manufacturer:	Terak Corp., 14151 N. 76 St., Scottsdale, AZ 85260, USA
Telephone:	(602) 998-4800.
Remarks:	LSI-11 based workstation with DEC RT11 or UCSD Pascal operating systems.

Model(s):	Vectrix VX128 and VX384
Screen:	672 × 480 color
Character Grid:	8 × 8
Manufacturer:	Vectrix Corp., 700 Battleground Ave., Greensboro, NC 27401, USA
Telephone:	(800) 334-8181.
Remarks:	Low-cost frame buffer; no cursor commands; font magnification factors 1..16 plus slants in 45 degree increments; 96 downloadable characters.

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TeX ON THE OSP130

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Mathematical Reviews is now using the Florida Data OSP130 as a TeX output device. The OSP130 prints on continuous stock (cards and paper) as well as on cut-sheet paper. Average time per dense page of TeX output is 1 min:40 sec. Current dot resolution is H120 x V128, although the machine does have the potential for producing much higher resolution. This improvement requires a modified spooler capable of handling a second set of font masks. At present the fonts used are those with a resolution of 128 x 128 pixels/inch prepared by METAFONT for the Florida Data BNY. Although the dot resolution is similar, the quality of the output is greatly improved. We are all very pleased.

Our OSP130 is driven by a Monolithic Systems MSC8004 Z80 processor which is fed and controlled through a multiplexor by the Dec2060 machine in Providence, RI. We used a parallel Centronics interface and a hardware handshake, checking Busy only [this involves using the 8255 in Mode 1], to interface the OSP with the Monolithic.

The authors wish to thank the following people for all their help in making our first attempt at such a task a SUCCESS: Frank Price and Jim Neil of Florida Data Corporation, Marty Haase and Joel Berkman of Monolithic Systems, and David Fuchs of Stanford.

Anyone desiring more information about TeX on the Florida Data OSP should contact the authors at the above address or call 1-313-763-6828.

Sample Output from Florida Data OSP 130

and obtain the factorizations

(7) $5^{5h}-1=(5^h-1)L_{5h}M_{5h},\ \ L_{5h},M_{5h}=5^{2h}+3.5^h+1\mp 5^k(5^h+1)$

(8) $6^{6h}+1=(6^{2h}+1)L_{6h}M_{6h},\ \ L_{6h},M_{6h}=6^{2h}+3.6^h+1\mp 6^k(6^h+1)$

(9) $7^{7h}+1=(7^h+1)L_{7h}M_{7h},\ \ L_{7h},M_{7h}=(7^h+1)^3\mp 7^k(7^{2h}+7^h+1)$

(10) $10^{10h}+1=(10^{2h}+1)L_{10h}M_{10h},$ where L_{10h},M_{10h}
$=10^{4h}+5.10^{3h}+7.10^{2h}+5.10^h+1\mp 10^k(10^{3h}+2.10^{2h}+2.10^h+1)$

(11) $11^{11h}+1=(11^h+1)L_{11h}M_{11h},$ where L_{11h},M_{11h}
$=11^{5h}+5.11^{4h}-11^{3h}-11^{2h}+5.11^h+1\mp 11^k(11^{4h}+11^{3h}-11^{2h}+11^h+1)$

The appropriate formulas for L and M are printed at the end of each relevant main table.

The numbers with an Aurifeuillian factorization can be completely factored more readily than other numbers b^n-1, because they break into two roughly equal pieces. For this reason, Table 2LM has been extended to 2400, twice as far as the other base 2 tables. The Aurifeuillian factorizations for the other bases (in Tables 3+, 5−, 6+, 7+, 10+, 11+ and 12+) are not given in a separate table as in base 2, but are incorporated in a special format in the tables themselves and are carried somewhat farther than the consecutively indexed entries, the extensions being listed below a line of dashes in the respective tables.

Since the factorizations produced in (4) to (11) cut across those produced in (2) and (3), it is important to analyze how the two factorizations relate to each other.

Example. Since $156=2^2.39$, we have from (3) that

$$2^{78}+1=\prod_{d|39}\Phi_{4d}(2)=\Phi_4(2)\Phi_{12}(2)\Phi_{52}(2)\Phi_{156}(2)$$
$$=(5.13.53.157.1613)\ \underline{13}^*.\underline{313}.\underline{1249}.\underline{3121}.\underline{21841}$$

and from (4) that

$$2^{78}+1=L_{78}M_{78}=(13.53.157.\underline{13}^*.\underline{313}.\underline{1249})(5.1613.\underline{3121}.\underline{21841})$$

The fact that the second factorization splits both the algebraic and primitive parts of $2^{78}+1$ suggests that in order to describe this multiplicative structure, the primitive parts of L_n and M_n should be defined and then L_n and M_n can be expressed as a product of primitive parts as in (2). To do this we denote the respective primitive parts by L_n^* and M_n^*. For base b, let $\epsilon_d=\epsilon_d(b)=[1+(b|d)]/2$, where d is odd, $(b,d)=1$, and $(b|d)$ is the Jacobi symbol. (Recall that $(b|1)=1$.) Also, let $n=2^s m$, m odd, $s\geq 0$. Then we have the formulas (which we state without proof)