A HAYDEN PUBLICATION

INTERNATIONAL

# ectronicDesign

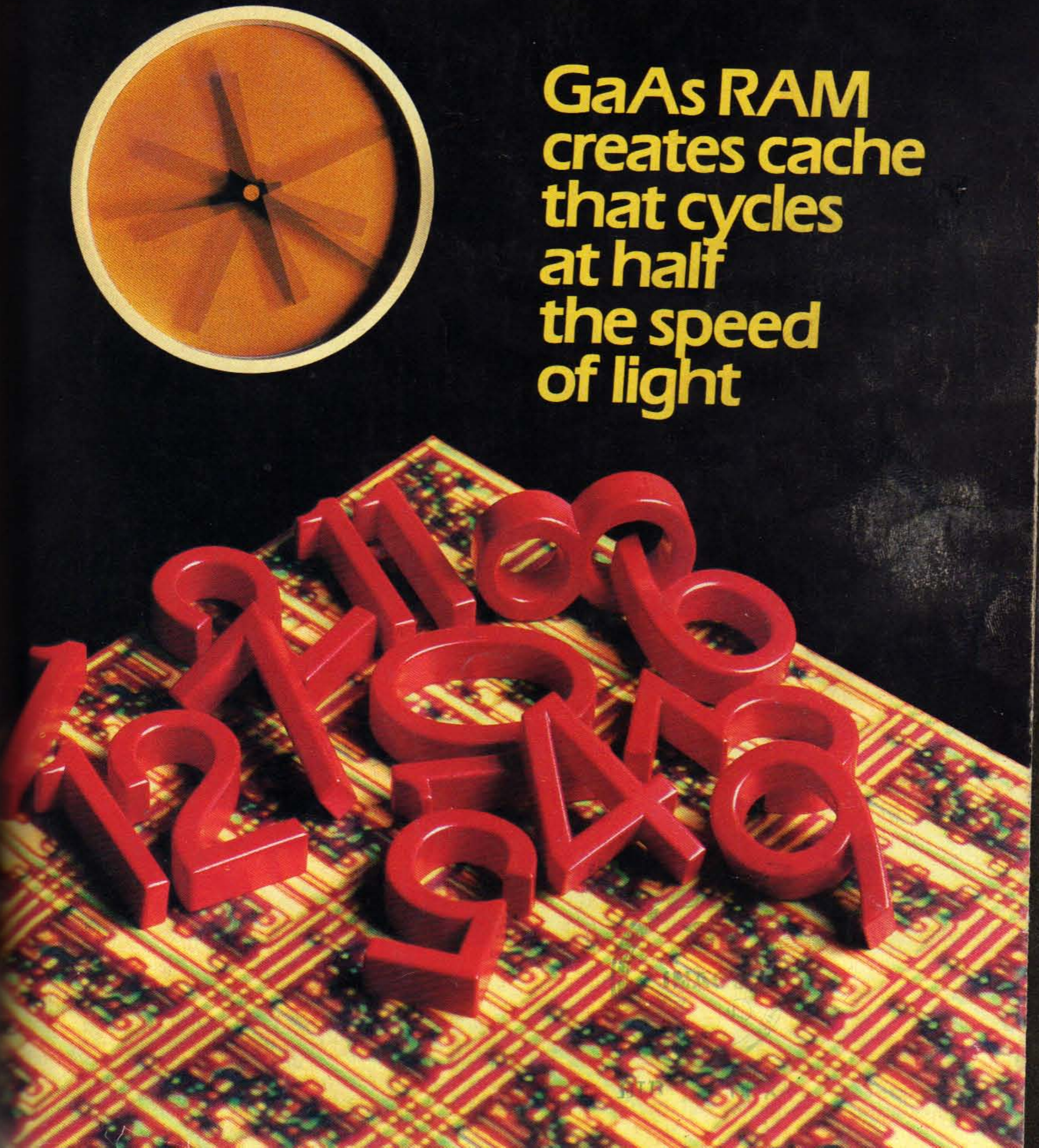
RS AND ENGINEERING MANAGERS — WORLDWIDE

DECEMBER 27, 1984

er's Reference: Software standards remain elusive for CAE, networks

al Computer Survey: Users look for a wide variety of improvements

cs workstation sculpts 3D models with high resolution, brilliant color



## GaAs RAM creates cache that cycles at half the speed of light

ElectronicDesig
December 27, 1984 • Vol. 32 No. 26

## DEPARTMENTS

## DESIGNER'S REFERENCE

**85 Introduction**

**87 Network standards**
Local and global networks are inciting the industry to
standard software protocols, albeit slowly.

**99 CAE standards**
Language and data formats vie as potential standards
design loop.

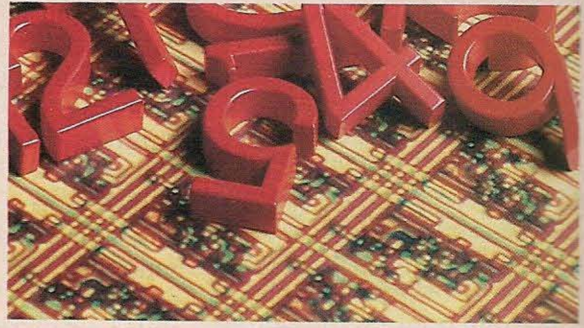
**119 Operating system standards**
Although the four main schools of Unix remain apart,
standardization within them has begun.

## PERSONAL COMPUTER SERIES

**135 Reader survey**
As personal computers become more powerful—and
commonplace—user demands grow. With engineers
shortcomings all the time, technology will have to keep

## DESIGN ENTRIES

**157 Cover: Pipelined static RAM endows cache memories with 1-ns speeds**
Synchronizing its inputs and outputs on chip, a GaAs
its 1-ns cycle time to an array with no loss in perfor



## TECHNOLOGY NEWS

Technology Forecast: What's in store for testing, packaging, telecommunications, artificial intelligence, and computer architectures . . . The view from the top: 10 eminent scientists predict the future . . . A systolic array chip as data-base manager.

Cover photograph by David Wagner
145,929 copies of this issue printed

ELECTRONIC DESIGN (USPS 172-080; ISSN 0013-4872) is published biweekly with one additional issue in February, May, October and December and two additional issues in August by Hayden Publishing Company, Inc., 10 Mulholland Dr., Hasbrouck Heights, N.J. 07604. Subscription rates are $45 per year U.S. (foreign rates available upon request). James S. Mulholland Jr., President. Printed at Brown Printing Co., Waseca, Minn., Somerset Publishing Co., Somerset, N.J., and Wisconsin Cuneo Press, Milwaukee, Wis. Second-class postage paid at Hackensack, N.J. 07602 and at additional mailing offices.

POSTMASTER: Please send change of address to ELECTRONIC DESIGN, PO BOX 1418, Riverton, N.J. 08077.

## W PRODUCTS

stable condition in the Z80's daisy-chained interrupt priority structure, the circuit has been designed so that an interrupt status signal cannot change when the Machine Cycle 1 line, $\overline{M}_1$, is low.)

An active-low interrupt request signal ($\overline{INT}$) from the support chip is sent to the CPU system through $IC_5$, an inverter, to indicate the start of the cycle. The interrupt acknowledge line (INTA) from the 8086 or 8088 system is connected to the clock inputs of dual flip-flops $IC_{1A}$ and $IC_{1B}$, as well as to an OR gate, $IC_3$. Therefore, when the first INTA pulse ends, $\overline{M}_1$ goes low. At the start of the second pulse, the Request line ($\overline{IORQ}$) also goes low. The requ ing device with the highest priority is all to place its interrupt vector on the data bus set an internal latch that indicates the in rupt is under service.

At the end of the second pulse, the $Q_2$ ou from flip-flop $IC_{1B}$ goes low, resetting IC well as $\overline{M}_1$ and $\overline{IORQ}$. A third flip-flop, IC samples the $Q_2$ output from $IC_{1B}$ and resets latter device at the end of the cycle. The len of the reset pulse is determined by the quency of the clock used by $IC_{2A}$.

---

# TI-59 program finds elliptic transfer function for low-pass filters

**David Báez-López**
Chairman
Department of Electronics
Instituto Nacional de Astrofísica,
Optica y Electronica, Apdo. Postal 51,
72000 Puebla, Puebla, Mexico

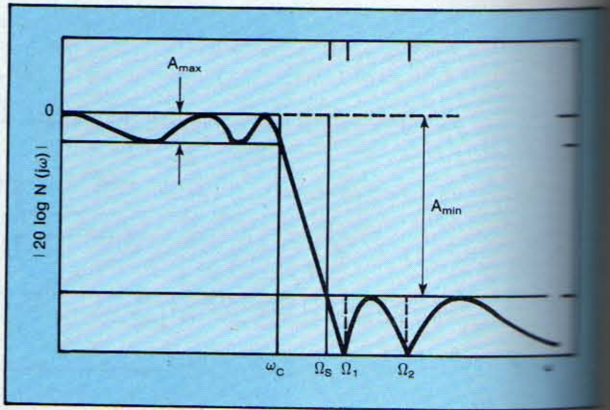
**J. Manual Ramírez-Cortés**
Department of Electronics
Universidad de las Americas
Cholula, Puebla, Mexico

Of all filtering functions, the elliptic transfer function is among the most useful because of its steep fall-off at the band edges (see the figure). A program designed for the TI-59 calculator can help evaluate the function by finding the odd-order poles and zeros of a low-pass filter (see the program). The algorithm calculates several things:

- The transmission zeros—$\Omega K$, where $K = 1, 2, \ldots, (N-1)/2$;
- The minimum attenuation at the stop band with respect to the maximum value at the pass band $A_{min}$ expressed in dB;
- The real poles ($P_0$);
- The complex-conjugate poles ($P_K$)

The conjugate poles are equal to $\alpha_K$ + where $\alpha_K$ is the real part and $\beta_K$ is the imag part of the $K^{th}$ pole.

Data supplied by the user (Table 1) incl the order of the filter (that is, the numb poles, or N); the cut-off frequency ($\omega_C$), expre



**A calculator program determines the poles and zeros of an elliptic transfer-function filter, one characterized by its steep fall-off at the band edges.**

ed in radians/s; the stop-band frequency ($\Omega_S$), expressed in radians/s; and either the reflection coefficient ($\rho$), shown as a percentage, or the maximum attenuation of the pass-band ripple in dB ($A_{max}$).

The last two of those parameters are related to each other by the formula:

$$A_{max} = -10 \log\left[1 + \left(\frac{\rho}{100}\right)^2\right]$$

Once the poles and the zeros have been found, the transfer function, $H_{(S)}$, is found with the help of the formula:

$$H_{(S)} = \frac{(S^2+\Omega_1^2)(S^2+\Omega_1^2)\ldots(S^2+\Omega^2_{(N-1)/2})}{(S+P_0)(S+P_1)(S+P_1^*)\ldots(S+P_{(N-1)/2})\left(S+P^{*}_{(N-}\right.}$$

The results obtained with the calculator program for a normalized low-pass filter—that is one with a $\omega_C$ of 1—compare favorably with those found in other filter tables (Table 2). Values other than unity can be used. The program, which can be recorded on a magnetic card, can evaluate the elliptic transfer filtering function up to the 21st order.

---

*S. Darlington, "Simple Algorithms for Elliptic Filters and Generalizations Thereof," *IEEE Transactions on Circuits and Systems*, Vol. CAS-25, No. 12, pp. 975-980, 1978.

### Table 1. User instructions for low-pass elliptic transfer function

| Step | Procedure | Enter | Press | | | Display |
|---|---|---|---|---|---|---|
| 1 | Filter order | n | A | | | n |
| 2 | Pass-band cut-off frequency (rad/s) | $\omega_c$ | B | | | $\omega_c$ |
| 3 | Stop-band frequency (rad/s) | $\Omega_s$ | C | | | $\Omega_s$ |
| 4a | Either reflection coefficient (%) | $\rho$ | D | | | 0 |
| | or | | | | | |
| 4b | passband ripple (dB) | $A_{max}$ | E | | | 0 |
| 5 | Compute transmission zeros, $\Omega_k$ $k = 1,2,\ldots,(n-1)/2$ | | R/S | | | $\Omega_k$ |
| | Repeat step 5 for each value of k until 0 appears in the display. | | | | | |
| 6 | Compute stop-band attenuation, $A_{min}$ | | 2nd | C′ | | $A_{min}$ |
| 7 | Compute real pole, $P_o$ | 0 | 2nd | D′ | | $P_o$ |
| 8a | Compute $k^{th}$ pole, real part | k | 2nd | D′ | | Re ($P_k$) |
| 8b | Compute $k^{th}$ pole, imaginary part | | 2nd | E′ | | Im ($P_k$) |
| | Repeat steps 8a and 8b for each value of k | | | | | |
| | $k = 1,\ldots,(n-1)/2$ | | | | | |

### Table 2. Results of calculation for a low-pass filter

| Input | Output | |
|---|---|---|
| | Zeros | Real and complex poles |
| $n = 5$<br>$\omega_c = 1$<br>$\Omega_s = 1.414213562$<br>$\rho = 50\%$ | $\Omega_1 = 1.465436966$<br>$\Omega_2 = 1.656220908$<br>$\Omega_3 = 2.165997414$<br>$\Omega_4 = 3.944466518$<br>$A_{min} = 51.4064495$ dB | $P_o = -0.3186089933$<br>$P_1 = -0.2095320012 + J\ 0.68755$<br>$P_2 = -0.0582836518 + J\ 0.99136$ |

## TI-59 program for filter transfer function

```
000  76 LBL
001  11  A
002  42 STO
003  10  10
004  04  4
005  42 STO
006  02  02
007  01  1
008  02  2
009  42 STO
010  59  59
011  43 RCL
012  10  10
013  91 R/S
014  76 LBL
015  12  B
016  42 STO
017  07  07
018  91 R/S
019  76 LBL
020  13  C
021  42 STO
022  08  08
023  55  ÷
024  43 RCL
025  07  07
026  95  =
027  34 √X
028  42 STO
029  11  11
030  43 RCL
031  08  08
032  65  ×
033  43 RCL
034  07  07
035  95  =
036  34 √X
037  42 STO
038  09  09
039  43 RCL
040  11  11
041  76 LBL
042  85  +
043  33 X²
044  42 STO
045  58  58
046  33 X²
047  75  -
048  01  1
049  95  =
050  34 √X
051  85  +
052  43 RCL
053  58  58
054  95  =
055  72 ST*
056  59  59
057  32 X:T
058  01  1
059  44 SUM
060  59  59
061  32 X:T
062  97 DSZ
063  02  02
064  85  +
065  43 RCL
066  08  08
067  91 R/S
068  76 LBL
069  14  D
070  55  ÷
071  01  1
072  00  0
073  00  0
074  95  =
075  33 X²
076  94 +/-
077  85  +
078  01  1
079  95  =
080  28 LOG
081  65  ×
082  01  1
083  00  0
084  95  =
085  94 +/-
086  76 LBL
087  15  E
088  55  ÷
089  01  1
090  00  0
091  95  =
092  22 INV
093  28 LOG
094  75  -
095  01  1
096  95  =
097  34 √X
098  42 STO
099  01  01
100  00  0
101  70 RAD
102  01  1
103  06  6
104  42 STO
105  56  56
106  00  0
107  42 STO
108  57  57
109  76 LBL
110  35 1/X
111  04  4
112  42 STO
113  02  02
114  01  1
115  04  4
116  42 STO
117  48  48
118  43 RCL
119  57  57
120  65  ×
121  89  π
122  95  =
123  55  ÷
124  53  (
125  02  2
126  65  ×
127  43 RCL
128  10  10
129  54  )
130  95  =
131  39 COS
132  55  ÷
133  43 RCL
134  15  15
135  95  =
136  35 1/X
137  76 LBL
138  34 √X
139  71 SBR
140  61 GTO
141  97 DSZ
142  02  02
143  34 √X
144  72 ST*
145  56  56
146  35 1/X
147  65  ×
148  43 RCL
149  09  09
150  95  =
151  01  1
152  44 SUM
153  57  57
154  01  1
155  44 SUM
156  56  56
157  43 RCL
158  57  57
159  32 X:T
160  43 RCL
161  10  10
162  22 INV
163  67  EQ
164  35 1/X
165  00  0
166  91 R/S
167  76 LBL
168  17 B'
169  43 RCL
170  10  10
171  42 STO
172  03  03
173  01  1
174  07  7
175  42 STO
176  56  56
177  76 LBL
178  45 Yˣ
179  73 RC*
180  56  56
181  65  ×
182  43 RCL
183  09  09
184  95  =
185  91 R/S
186  02  2
187  44 SUM
188  56  56
189  97 DSZ
190  03  03
191  45 Yˣ
192  91 R/S
193  76 LBL
194  18 C'
195  04  4
196  04  4
197  42 STO
198  54  54
199  04  4
200  42 STO
201  02  02
202  02  2
203  45 Yˣ
204  53  (
205  43 RCL
206  10  10
207  75  -
208  01  1
209  54  )
210  65  ×
211  43 RCL
212  15  15
213  45 Yˣ
214  43 RCL
215  10  10
216  95  =
217  42 STO
218  43  43
219  76 LBL
220  22 INV
221  71 SBR
222  75  -
223  72 ST*
224  54  54
225  32 X:T
226  01  1
227  44 SUM
228  54  54
229  32 X:T
230  97 DSZ
231  02  02
232  22 INV
233  43 RCL
234  01  01
235  33 X²
236  65  ×
237  43 RCL
238  47  47
239  45 Yˣ
240  04  4
241  95  =
242  85  +
243  01  1
244  95  =
245  35 1/X
246  28 LOG
247  65  ×
248  01  1
249  00  0
250  95  =
251  94 +/-
252  42 STO
253  06  06
254  43 RCL
255  01  01
256  33 X²
257  35 1/X
258  85  +
259  01  1
260  95  =
261  34 √X
262  85  +
263  43 RCL
264  01  01
265  35 1/X
266  95  =
267  65  ×
268  43 RCL
269  46  46
270  95  =
271  71 SBR
272  24 CE
273  65  ×
274  43 RCL
275  45  45
276  95  =
277  71 SBR
278  24 CE
279  65  ×
280  43 RCL
281  44  44
282  65  ×
283  02  2
284  95  =
285  55  ÷
286  43 RCL
287  43  43
288  95  =
289  35 1/X
290  71 SBR
291  24 CE
292  45 Yˣ
293  43 RCL
294  10  10
295  35 1/X
296  95  =
297  42 STO
298  53  53
299  43 RCL
300  06  06
301  91 R/S
302  76 LBL
303  19 D'
304  65  ×
305  89  π
306  95  =
307  55  ÷
308  43 RCL
309  10  10
310  95  =
311  42 STO
312  02  02
313  00  0
314  42 STO
315  01  01
316  36 PGM
317  05  05
318  17 B'
319  65  ×
320  43 RCL
321  53  53
322  95  =
323  42 STO
324  50  50
```

*(continued* on p.

*(continued from p. 238)*

## TI-59 program for filter transfer function

```
325  32 X:T    353  76 LBL    381  85  +     409  42 STD    437  22 INV
326  65  ×     354  10 E'     382  01  1     410  04  04    438  44 SUM
327  43 RCL    355  43 RCL    383  95  =     411  36 PGM    439  52  52
328  53  53    356  51  51    384  34 √X     412  04  04    440  92 RTN
329  95  =     357  65  ×     385  85  +     413  10 E'     441  76 LBL
330  42 STD    358  43 RCL    386  43 RCL    414  36 PGM    442  61 GTD
331  51  51    359  11  11    387  05  05    415  04  04    443  42 STD
332  05  5     360  95  =     388  95  =     416  17 B'     444  49  49
333  42 STD    361  91 R/S    389  92 RTN    417  73 RC*    445  35 1/X
334  00  00    362  76 LBL    390  76 LBL    418  52  52    446  85  +
335  01  1     363  75  -     391  54  )     419  65  ×     447  43 RCL
336  05  5     364  42 STD    392  43 RCL    420  02  2     448  49  49
337  42 STD    365  55  55    393  50  50    421  95  =     449  95  =
338  52  52    366  35 1/X    394  42 STD    422  35 1/X    450  55  ÷
339  76 LBL    367  85  +     395  01  01    423  42 STD    451  02  2
340  53  (     368  43 RCL    396  43 RCL    424  03  03    452  95  =
341  71 SBR    369  55  55    397  51  51    425  00  0     453  55  ÷
342  54  )     370  95  =     398  42 STD    426  42 STD    454  73 RC*
343  97 DSZ    371  55  ÷     399  02  02    427  04  04    455  48  48
344  00  00    372  02  2     400  36 PGM    428  36 PGM    456  95  =
345  53  (     373  95  =     401  05  05    429  04  04    457  32 X:T
346  43 RCL    374  34 √X     402  15  E     430  13  C     458  01  1
347  50  50    375  92 RTN    403  43 RCL    431  42 STD    459  22 INV
348  65  ×     376  76 LBL    404  50  50    432  50  50    460  44 SUM
349  43 RCL    377  24 CE     405  42 STD    433  32 X:T    461  48  48
350  11  11    378  42 STD    406  03  03    434  42 STD    462  32 X:T
351  95  =     379  05  05    407  43 RCL    435  51  51    463  92 RTN
352  91 R/S    380  33 X²     408  51  51    436  01  1
```

# Five-transistor amplifier boosts fast pulses into 50-Ω coaxial cable

**M.U. Khan**
Manager of Research and Development
Systronics
89-02, Naroda Industrial Area, Naroda-382 330,
Ahmedabad District, India

A simple five-transistor pulse amplifier delivers 5-V pulses into a 50-Ω load, with rise times of just 2.6 ns and fall times of 3.5 ns, matching the performance of more costly circuits containing more parts. Simply by varying the supply voltage over a range of 6 to 14 V and adjusting the circuit's off-board attenuator, the pulse amplitude can be reduced to as little as 100 mV.

The circuit (see the figure) works from dc to 50 MHz and will deliver pulses as short as 10 ns. It is driven by a TTL signal through a 74S00 quad Schottky NAND gate, $IC_A$ through $IC_D$. If, however, only an ECL-level signal is available, a level translator, such as the MC10125, can be substituted for the 74S00.

Transistor $Q_1$, wired as a common-emitter