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EMPFIT: A COMPUTER CODE FOR FITTING EMP WAVEFORMS THAT FACILITA--ETC(U)

SEP 78 J M CLODFELTER

MIPR-6-531

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HDL-TR-1801-S

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>This report is a supplement to the original report (HDL-TR-1801) on the computer code EMPFIT and reflects the changeover from a CDC 6600 computer to an IBM 370/168 computer. Also, some additional modifications have been added to increase the usefulness and versatility of the code. EMPFIT is a code that is useful in fitting an electromagnetic pulse, as well as other data, with a simple function that is easily differentiated and Fourier |                       |   |  |

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transformed. This report deals only with the aspects necessary to the conversion to the IBM system and also with the new modifications. Material not mentioned in this supplement remains unaffected.

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## 1. INTRODUCTION

The computer code EMPFIT provides a method for fitting an electromagnetic pulse (EMP), as well as other traces, with a simple function that is easily differentiated and Fourier transformed. This report is a supplement to the original report on EMPFIT and reflects the changeover from a Control Data Corp. (CDC) 6600 computer at the Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, to the IBM 370/168 computer at the Harry Diamond Laboratories (HDL), Adelphi, MD. Along with this conversion effort, several modifications have been added, making EMPFIT more useful and versatile.

In the following sections, a description of the time derivative calculations and options detailing read and write selections on a disk file of EMPFIT will be given. Next, a section on increasing the accuracy of the code using the AUTODBL option of the IBM 370/168 is explained. Also, a time cutoff modification will be detailed and a full listing of all of the output options is included. A brief description of the new subroutines added to EMPFIT is discussed and an up-to-date section on preparing input cards to run the code is also presented. Finally, a section on the job control language (JCL) necessary to run EMPFIT at the Woodbridge Research Facility (WRF) is given. In appendices A and B, a listing and sample run of EMPFIT along with examples of input data appear.

## 2. DERIVATIVE OF FITTING FUNCTION

Following the theory of EMPFIT,<sup>1</sup> we fit the data points  $(t_i, f_i)$  for  $1 \leq i \leq N$  using the function

$$f(t) = \begin{cases} A_1 e^{at} + A_3 e^{2at}, & \text{for } t \leq t_1, \quad (1) \\ \frac{f_{i+1}(t - t_i) + f_i(t_{i+1} - t)}{t_{i+1} - t_i} + \frac{1}{2}(B_i + B_{i+1})(t - t_i)(t - t_{i+1}) \\ + C_i(t - t_i)(t_{i+1} - t)^3 + D_{i+1}(t_{i+1} - t)(t - t_i)^3, & \text{for } t_i \leq t \leq t_{i+1}, \quad (2) \\ A_2 e^{-\beta t} + A_4 e^{-2\beta t}, & \text{for } t \geq t_N. \quad (3) \end{cases}$$

<sup>1</sup>Thomas V. Noon, *User's Manual for the Modular Analysis-Package Libraries ANAPAC and TRANL*, Harry Diamond Laboratories TR-1782-S (September 1977).

The derivative is then easily calculated as

$$\begin{aligned}
 & \alpha [f(t) + A_3 e^{2\alpha t}] , & \text{for } t \leq t_1 , & \quad (4) \\
 f(t) = & \left\{ \begin{aligned} & \frac{f_{i+1} - f_i}{t_{i+1} - t_i} + \frac{1}{2} (B_i + B_{i+1}) [(t - t_{i+1}) + (t - t_i)] \\ & + C_i [(t_{i+1} - t)^3 - 3(t - t_i)(t_{i+1} - t)^2] \\ & + D_{i+1} [-(t - t_i)^3 + 3(t_{i+1} - t)(t - t_i)^2] , \\ & \text{for } t_i \leq t \leq t_{i+1} , \\ & -\beta [f(t) + A_4 e^{-2\beta t}] , & \text{for } t \geq t_N . & \quad (6) \end{aligned} \right. & \quad (5)
 \end{aligned}$$

Examples of plots of  $f(t)$  and its derivative can be seen in figures 1 and 2.

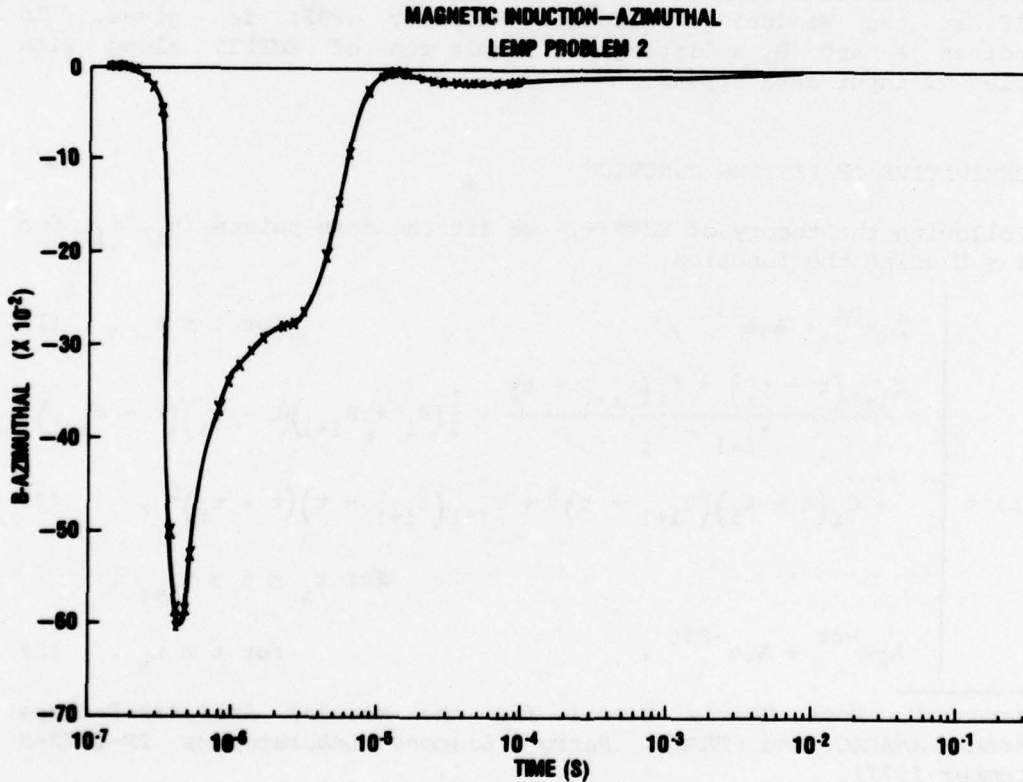


Figure 1. Curve fit,  $f(t)$ .

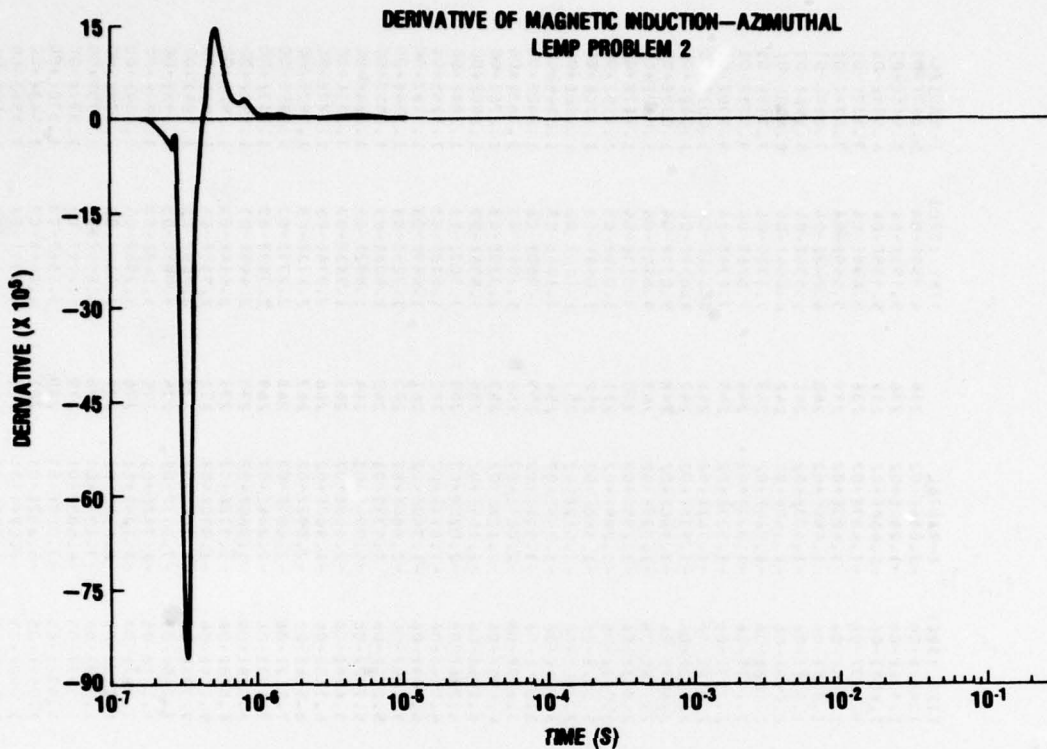


Figure 2. Derivative of curve fit,  $f'(t)$ .

### 3. READ AND WRITE DISK FILE OPTIONS

Since there was an apparent need to be able to use data not in card format, the necessary modifications were made to utilize data that exist on a permanent disk file. With these new changes, input data to EMPFIT can now be entered through a disk file and it is also possible to add or delete specified data pairs from this disk file data. When the "read from a disk file" option is chosen, a numbered printout of the data from the disk file is produced (see fig. 3) and any deletions or additions are made in reference to this listing. Deletions are accomplished by selecting the integer number of the time-amplitude point to be scratched and entering this value as described in section 8. An example of the input cards necessary to delete data points appears in appendix B. Additions to the disk file data are entered by the time-amplitude value and are automatically placed in the proper location. The use of this option is also detailed in section 8, while an example of the input cards required to add data points can be found in appendix B.

Figure 3. Example of disk file printout.

ELECTRIC FIELD STRENGTH-RADIAL  
 NEMP PROBLEM A OBSERVER 1

|    | TIME (SEC) | E-RADIAL  | TIME (SEC) | E-RADIAL   | TIME (SEC) | E-RADIAL  |           |
|----|------------|-----------|------------|------------|------------|-----------|-----------|
| 1  | 1.000E-08  | 0.0       | 1.461E-06  | -1.094E+02 | 235        | 4.959E-04 | 5.087E-01 |
| 2  | 1.000E-08  | 2.154E-12 | 1.526E-06  | -1.292E+02 | 236        | 5.193E-04 | 5.945E-01 |
| 3  | 1.038E-08  | 1.055E+00 | 1.608E-06  | -1.438E+02 | 237        | 5.435E-04 | 6.559E-01 |
| 4  | 1.269E-08  | 9.021E+00 | 1.673E-06  | -1.487E+02 | 238        | 5.698E-04 | 7.137E-01 |
| 5  | 1.481E-08  | 2.977E+01 | 1.756E-06  | -1.485E+02 | 239        | 5.959E-04 | 7.679E-01 |
| 6  | 1.705E-08  | 6.791E+01 | 1.838E-06  | -1.450E+02 | 240        | 6.242E-04 | 7.689E-01 |
| 7  | 1.948E-08  | 1.255E+02 | 1.921E-06  | -1.403E+02 | 241        | 6.536E-04 | 8.196E-01 |
| 8  | 2.191E-08  | 1.911E+02 | 2.020E-06  | -1.348E+02 | 242        | 6.855E-04 | 8.680E-01 |
| 9  | 2.406E-08  | 2.479E+02 | 2.102E-06  | -1.324E+02 | 243        | 7.172E-04 | 9.139E-01 |
| 10 | 2.656E-08  | 3.032E+02 | 2.201E-06  | -1.322E+02 | 244        | 7.516E-04 | 9.571E-01 |
| 11 | 2.843E-08  | 3.393E+02 | 2.317E-06  | -1.337E+02 | 245        | 7.874E-04 | 9.592E-01 |
| 12 | 3.043E-08  | 3.796E+02 | 2.418E-06  | -1.361E+02 | 246        | 8.246E-04 | 1.001E+00 |
| 13 | 3.133E-08  | 4.011E+02 | 2.531E-06  | -1.378E+02 | 247        | 8.634E-04 | 1.041E+00 |
| 14 | 3.214E-08  | 4.239E+02 | 2.647E-06  | -1.366E+02 | 248        | 9.037E-04 | 1.077E+00 |
| 15 | 3.287E-08  | 4.476E+02 | 2.779E-06  | -1.331E+02 | 249        | 9.475E-04 | 1.082E+00 |
| 16 | 3.353E-08  | 4.723E+02 | 2.911E-06  | -1.295E+02 | 250        | 9.913E-04 | 1.117E+00 |
| 17 | 3.412E-08  | 4.976E+02 | 3.043E-06  | -1.289E+02 | 251        | 1.039E-03 | 1.150E+00 |
| 18 | 3.465E-08  | 5.238E+02 | 3.192E-06  | -1.360E+02 | 252        | 1.088E-03 | 1.180E+00 |
| 19 | 3.513E-08  | 5.499E+02 | 3.340E-06  | -1.512E+02 | 253        | 1.140E-03 | 1.216E+00 |
| 20 | 3.556E-08  | 5.755E+02 | 3.489E-06  | -1.708E+02 | 254        | 1.194E-03 | 1.214E+00 |
| 21 | 3.595E-08  | 6.004E+02 | 3.654E-06  | -1.916E+02 | 255        | 1.250E-03 | 1.240E+00 |
| 22 | 3.630E-08  | 6.242E+02 | 3.819E-06  | -2.059E+02 | 256        | 1.309E-03 | 1.263E+00 |
| 23 | 3.661E-08  | 6.465E+02 | 4.000E-06  | -2.118E+02 | 257        | 1.370E-03 | 1.270E+00 |
| 24 | 3.689E-08  | 6.673E+02 | 4.198E-06  | -2.104E+02 | 258        | 1.436E-03 | 1.290E+00 |
| 25 | 3.715E-08  | 6.863E+02 | 4.396E-06  | -2.025E+02 | 259        | 1.502E-03 | 1.308E+00 |
| 26 | 3.737E-08  | 7.037E+02 | 4.594E-06  | -1.811E+02 | 260        | 1.573E-03 | 1.324E+00 |
| 27 | 3.758E-08  | 7.196E+02 | 4.809E-06  | -1.340E+02 | 261        | 1.649E-03 | 1.338E+00 |
| 28 | 3.778E-08  | 7.350E+02 | 5.040E-06  | -5.880E+01 | 262        | 1.725E-03 | 1.344E+00 |
| 29 | 3.818E-08  | 7.656E+02 | 5.271E-06  | 1.477E+01  | 263        | 1.808E-03 | 1.355E+00 |
| 30 | 3.858E-08  | 7.957E+02 | 5.527E-06  | -5.934E+01 | 264        | 1.892E-03 | 1.364E+00 |
| 31 | 3.898E-08  | 8.249E+02 | 5.698E-06  | -2.008E+02 | 265        | 1.983E-03 | 1.371E+00 |
| 32 | 3.938E-08  | 8.533E+02 | 6.115E-06  | -1.968E+02 | 266        | 2.074E-03 | 1.377E+00 |
| 33 | 3.998E-08  | 8.946E+02 | 6.566E-06  | -2.892E+02 | 267        | 2.173E-03 | 1.382E+00 |
| 34 | 4.039E-08  | 9.216E+02 | 7.052E-06  | -2.407E+02 | 268        | 2.277E-03 | 1.385E+00 |
| 35 | 4.189E-08  | 1.010E+03 | 7.537E-06  | -2.294E+02 | 269        | 2.383E-03 | 1.387E+00 |
| 36 | 4.316E-08  | 1.067E+03 | 8.058E-06  | -1.866E+02 | 270        | 2.495E-03 | 1.392E+00 |
| 37 | 4.515E-08  | 1.134E+03 | 8.578E-06  | -1.372E+02 | 271        | 2.614E-03 | 1.392E+00 |
| 38 | 4.659E-08  | 1.176E+03 | 9.134E-06  | -1.070E+02 | 272        | 2.735E-03 | 1.391E+00 |
| 39 | 4.827E-08  | 1.219E+03 | 9.723E-06  | -8.248E+01 | 273        | 2.864E-03 | 1.388E+00 |
| 40 | 5.020E-08  | 1.261E+03 | 1.035E-05  | -7.351E+01 | 274        | 3.001E-03 | 1.393E+00 |
| 41 | 5.245E-08  | 1.301E+03 | 1.101E-05  | -8.732E+01 | 275        | 3.143E-03 | 1.389E+00 |
| 42 | 5.413E-08  | 1.329E+03 | 1.167E-05  | -8.124E+01 | 276        | 3.290E-03 | 1.384E+00 |
| 43 | 5.599E-08  | 1.374E+03 | 1.240E-05  | -6.684E+01 | 277        | 3.445E-03 | 1.379E+00 |
| 44 | 5.804E-08  | 1.413E+03 | 1.312E-05  | -7.133E+01 | 278        | 3.609E-03 | 1.373E+00 |
| 45 | 6.031E-08  | 1.561E+03 | 1.392E-05  | -6.603E+01 | 279        | 3.779E-03 | 1.377E+00 |
| 46 | 6.280E-08  | 1.474E+03 | 1.472E-05  | -7.080E+01 | 280        | 3.956E-03 | 1.370E+00 |
| 47 | 6.555E-08  | 1.689E+03 | 1.559E-05  | -6.802E+01 | 281        | 4.144E-03 | 1.363E+00 |
| 48 | 6.858E-08  | 1.839E+03 | 1.648E-05  | -6.029E+01 | 282        | 4.339E-03 | 1.356E+00 |
| 49 | 7.192E-08  | 1.927E+03 | 1.739E-05  | -5.069E+01 | 283        | 4.544E-03 | 1.359E+00 |
| 50 | 7.372E-08  | 2.008E+03 | 1.840E-05  | -4.333E+01 | 284        | 4.757E-03 | 1.352E+00 |

Figure 3. Example of disk file printout (cont'd).

|     |           |           |     |           |            |     |           |           |
|-----|-----------|-----------|-----|-----------|------------|-----|-----------|-----------|
| 51  | 7.759E-08 | 2.153E+03 | 168 | 1.540E-05 | -4.064E+01 | 285 | 4.982E-03 | 1.344E+00 |
| 52  | 7.967E-08 | 2.205E+03 | 169 | 2.048E-05 | -3.962E+01 | 286 | 5.215E-03 | 1.337E+00 |
| 53  | 8.414E-08 | 2.359E+03 | 170 | 2.159E-05 | -3.966E+01 | 287 | 5.461E-03 | 1.340E+00 |
| 54  | 8.644E-08 | 2.406E+03 | 171 | 2.277E-05 | -3.859E+01 | 288 | 5.720E-03 | 1.332E+00 |
| 55  | 9.104E-08 | 2.395E+03 | 172 | 2.402E-05 | -3.551E+01 | 289 | 5.989E-03 | 1.325E+00 |
| 56  | 9.334E-08 | 2.458E+03 | 173 | 2.530E-05 | -3.206E+01 | 290 | 6.273E-03 | 1.317E+00 |
| 57  | 9.794E-08 | 2.623E+03 | 174 | 2.666E-05 | -2.865E+01 | 291 | 6.566E-03 | 1.319E+00 |
| 58  | 1.023E-07 | 2.604E+03 | 175 | 2.808E-05 | -2.700E+01 | 292 | 6.876E-03 | 1.312E+00 |
| 59  | 1.071E-07 | 2.653E+03 | 176 | 2.954E-05 | -2.417E+01 | 293 | 7.202E-03 | 1.304E+00 |
| 60  | 1.117E-07 | 2.704E+03 | 177 | 3.110E-05 | -2.067E+01 | 294 | 7.541E-03 | 1.297E+00 |
| 61  | 1.163E-07 | 2.702E+03 | 178 | 3.273E-05 | -2.067E+01 | 295 | 7.895E-03 | 1.298E+00 |
| 62  | 1.212E-07 | 2.732E+03 | 179 | 3.443E-05 | -2.281E+01 | 296 | 8.270E-03 | 1.291E+00 |
| 63  | 1.263E-07 | 2.773E+03 | 180 | 3.620E-05 | -2.101E+01 | 297 | 8.656E-03 | 1.284E+00 |
| 64  | 1.315E-07 | 2.785E+03 | 181 | 3.807E-05 | -1.727E+01 | 298 | 9.065E-03 | 1.278E+00 |
| 65  | 1.372E-07 | 2.751E+03 | 182 | 4.002E-05 | -1.507E+01 | 299 | 9.495E-03 | 1.272E+00 |
| 66  | 1.430E-07 | 2.749E+03 | 183 | 4.206E-05 | -1.427E+01 | 300 | 9.941E-03 | 1.273E+00 |
| 67  | 1.491E-07 | 2.759E+03 | 184 | 4.422E-05 | -1.333E+01 | 301 | 1.041E-02 | 1.267E+00 |
| 68  | 1.555E-07 | 2.748E+03 | 185 | 4.647E-05 | -1.414E+01 | 302 | 1.090E-02 | 1.262E+00 |
| 69  | 1.622E-07 | 2.724E+03 | 186 | 4.880E-05 | -1.196E+01 | 303 | 1.141E-02 | 1.257E+00 |
| 70  | 1.692E-07 | 2.690E+03 | 187 | 5.126E-05 | -0.675E+00 | 304 | 1.196E-02 | 1.257E+00 |
| 71  | 1.766E-07 | 2.655E+03 | 188 | 5.383E-05 | -1.071E+01 | 305 | 1.252E-02 | 1.252E+00 |
| 72  | 1.843E-07 | 2.620E+03 | 189 | 5.653E-05 | -1.012E+01 | 306 | 1.310E-02 | 1.248E+00 |
| 73  | 1.924E-07 | 2.583E+03 | 190 | 5.938E-05 | -9.779E+00 | 307 | 1.373E-02 | 1.244E+00 |
| 74  | 2.005E-07 | 2.518E+03 | 191 | 6.233E-05 | -7.894E+00 | 308 | 1.437E-02 | 1.244E+00 |
| 75  | 2.088E-07 | 2.468E+03 | 192 | 6.542E-05 | -6.788E+00 | 309 | 1.505E-02 | 1.240E+00 |
| 76  | 2.173E-07 | 2.416E+03 | 193 | 6.865E-05 | -7.764E+00 | 310 | 1.576E-02 | 1.237E+00 |
| 77  | 2.236E-07 | 2.360E+03 | 194 | 7.205E-05 | -7.100E+00 | 311 | 1.650E-02 | 1.233E+00 |
| 78  | 2.431E-07 | 2.303E+03 | 195 | 7.562E-05 | -6.539E+00 | 312 | 1.728E-02 | 1.233E+00 |
| 79  | 2.538E-07 | 2.245E+03 | 196 | 7.933E-05 | -6.533E+00 | 313 | 1.809E-02 | 1.230E+00 |
| 80  | 2.651E-07 | 2.186E+03 | 197 | 8.322E-05 | -6.613E+00 | 314 | 1.894E-02 | 1.227E+00 |
| 81  | 2.769E-07 | 2.126E+03 | 198 | 8.731E-05 | -5.519E+00 | 315 | 1.984E-02 | 1.225E+00 |
| 82  | 2.891E-07 | 2.067E+03 | 199 | 9.158E-05 | -5.141E+00 | 316 | 2.078E-02 | 1.222E+00 |
| 83  | 3.022E-07 | 2.006E+03 | 200 | 9.606E-05 | -6.949E+00 | 317 | 2.175E-02 | 1.222E+00 |
| 84  | 3.156E-07 | 1.947E+03 | 201 | 1.007E-04 | -6.508E+00 | 318 | 2.278E-02 | 1.220E+00 |
| 85  | 3.298E-07 | 1.888E+03 | 202 | 1.057E-04 | -6.094E+00 | 319 | 2.385E-02 | 1.218E+00 |
| 86  | 3.442E-07 | 1.831E+03 | 203 | 1.108E-04 | -6.479E+00 | 320 | 2.497E-02 | 1.216E+00 |
| 87  | 3.595E-07 | 1.774E+03 | 204 | 1.162E-04 | -9.442E+01 | 321 | 2.616E-02 | 1.216E+00 |
| 88  | 3.745E-07 | 1.720E+03 | 205 | 1.218E-04 | -3.623E+00 | 322 | 2.739E-02 | 1.214E+00 |
| 89  | 3.987E-07 | 1.640E+03 | 206 | 1.277E-04 | -3.594E+00 | 323 | 2.867E-02 | 1.212E+00 |
| 90  | 4.150E-07 | 1.590E+03 | 207 | 1.339E-04 | -3.071E+00 | 324 | 3.003E-02 | 1.211E+00 |
| 91  | 4.316E-07 | 1.541E+03 | 208 | 1.403E-04 | -2.922E+00 | 325 | 3.144E-02 | 1.211E+00 |
| 92  | 4.491E-07 | 1.491E+03 | 209 | 1.472E-04 | -2.587E+00 | 326 | 3.293E-02 | 1.209E+00 |
| 93  | 4.752E-07 | 1.426E+03 | 210 | 1.542E-04 | -2.265E+00 | 327 | 3.446E-02 | 1.208E+00 |
| 94  | 4.926E-07 | 1.373E+03 | 211 | 1.616E-04 | -2.116E+00 | 328 | 3.610E-02 | 1.207E+00 |
| 95  | 5.205E-07 | 1.304E+03 | 212 | 1.695E-04 | -1.884E+00 | 329 | 3.781E-02 | 1.207E+00 |
| 96  | 5.392E-07 | 1.258E+03 | 213 | 1.776E-04 | -1.672E+00 | 330 | 3.959E-02 | 1.205E+00 |
| 97  | 5.677E-07 | 1.190E+03 | 214 | 1.861E-04 | -1.452E+00 | 331 | 4.145E-02 | 1.204E+00 |
| 98  | 5.877E-07 | 1.143E+03 | 215 | 1.950E-04 | -1.357E+00 | 332 | 4.341E-02 | 1.203E+00 |
| 99  | 6.178E-07 | 1.074E+03 | 216 | 2.044E-04 | -1.182E+00 | 333 | 4.545E-02 | 1.203E+00 |
| 100 | 6.484E-07 | 1.005E+03 | 217 | 2.141E-04 | -1.018E+00 | 334 | 4.759E-02 | 1.203E+00 |
| 101 | 6.807E-07 | 9.343E+02 | 218 | 2.244E-04 | -0.523E-01 | 335 | 4.985E-02 | 1.202E+00 |
| 102 | 7.129E-07 | 8.653E+02 | 219 | 2.351E-04 | -7.839E-01 | 336 | 5.219E-02 | 1.201E+00 |
| 103 | 7.453E-07 | 7.970E+02 | 220 | 2.464E-04 | -6.434E-01 | 337 | 5.466E-02 | 1.200E+00 |
| 104 | 7.803E-07 | 7.268E+02 | 221 | 2.581E-04 | -5.092E-01 | 338 | 5.723E-02 | 1.200E+00 |
| 105 | 8.149E-07 | 6.586E+02 | 222 | 2.705E-04 | -3.832E-01 | 339 | 5.992E-02 | 1.200E+00 |
| 106 | 8.501E-07 | 5.917E+02 | 223 | 2.834E-04 | -2.671E-01 | 340 | 6.276E-02 | 1.199E+00 |
| 107 | 8.872E-07 | 5.233E+02 | 224 | 2.969E-04 | -2.313E-01 | 341 | 6.571E-02 | 1.199E+00 |
| 108 | 9.244E-07 | 4.576E+02 | 225 | 3.111E-04 | -1.254E-01 | 342 | 6.879E-02 | 1.199E+00 |
| 109 | 9.745E-07 | 3.738E+02 | 226 | 3.259E-04 | -2.603E-02 | 343 | 7.205E-02 | 1.198E+00 |
| 110 | 1.014E-06 | 3.111E+02 | 227 | 3.414E-04 | 6.736E-02  | 344 | 7.544E-02 | 1.198E+00 |

Figure 3. Example of disk file printout (cont'd).

|     |           |            |     |           |           |     |           |           |
|-----|-----------|------------|-----|-----------|-----------|-----|-----------|-----------|
| 111 | 1.067E-06 | 2.333E+02  | 228 | 3.577E-04 | 8.558E-02 | 345 | 7.898E-02 | 1.197E+00 |
| 112 | 1.121E-06 | 1.621E+02  | 229 | 3.746E-04 | 1.715E-01 | 346 | 8.273E-02 | 1.197E+00 |
| 113 | 1.164E-06 | 1.110E+02  | 230 | 3.925E-04 | 2.533E-01 | 347 | 6.661E-02 | 1.197E+00 |
| 114 | 1.221E-06 | 5.035E+01  | 231 | 4.116E-04 | 3.450E-01 | 348 | 9.068E-02 | 1.197E+00 |
| 115 | 1.278E-06 | -1.371E+00 | 232 | 4.308E-04 | 3.680E-01 | 349 | 9.498E-02 | 1.196E+00 |
| 116 | 1.339E-06 | -4.635E+01 | 233 | 4.517E-04 | 4.485E-01 | 350 | 9.944E-02 | 1.196E+00 |
| 117 | 1.400E-06 | -8.244E+01 | 234 | 4.734E-04 | 5.214E-01 | 351 | 1.000E-01 | 1.196E+00 |

In addition to being able to read input data from a permanent file, it is now possible to write specific output to a permanent disk file so that other computer codes may use EMPFIT's calculations. Thus, EMPFIT is now set up to write the calculations of the derivative,  $f'(t)$ , on a disk file at either the input data points or the curve fit data pairs. Also, the calculations for the curve fit,  $f(t)$ , may be written on a permanent file. The utilization of these permanent file disk writes, which are performed on separate devices, is fully described in section 8.

It should be noted that it is possible in EMPFIT to read and write data from or to a disk file in any particular format. The subroutines READPF and WRITPF are used by EMPFIT to perform the disk file read and write operations, respectively, and may be changed to fit the user's need. Figures 4 and 5 show the listings of READPF and WRITPF and the starred (\*) cards reflect cards that may be changed according to a particular user's requirements. To employ these user modifications requires the user's version of READPF and WRITPF to be placed behind the //FORT.SYSIN DD \* card seen in section 9.

```

SUBROUTINE READPF(NT,NSETS,X,Y,JPTS)
DIMENSION X(JPTS),Y(JPTS)
DO 10 J=1,NSETS
READ (NT) N1,N2,JPTS,(X(I),A,I=1,JPTS),(Y(I),B,I=1,JPTS)  *
10 CONTINUE
RETURN
END

```

Figure 4. Listing of subroutine READPF.

```

SUBROUTINE WRITPF(NT,X,Y,NPTS,ATITLE)
DIMENSION X(NPTS),Y(NPTS),ATITLE(10)
WRITE(NT) ATITLE  *
WRITE(NT) NPTS  *
WRITE(NT) X,Y  *
RETURN
END

```

Figure 5. Listing of subroutine WRITPF.

#### 4. DOUBLE PRECISION AND EXPONENTIAL CALCULATIONS

The IBM version of EMPFIT has been written in such a manner that the AUTODBL option of the HDL IBM 370/168 can be used and not affect the plotting software. This variation is seen in the subroutine ANOTAT which has been constructed differently from the CDC version to accommodate the AUTODBL option, which automatically converts all single and double precision variables to double and extended precision quantities, respectively. This conversion allows greater accuracy in the computations and is easy to employ. Only minor changes are required in EMPFIT, specifically dealing with the plotting software of ANAPAC.<sup>1</sup> In particular, the only modifications occur in calling the double precision versions of subroutine DRAW4, which appear in EMPFIT's plotting routine PLOTT. If the AUTODBL option is chosen, EMPFIT should be compiled with the following changes in subroutine PLOTT:

- (1) The DRAW4 calls

```
CALL DRAW4(1,3,3,3,8,20, XTITLE, YTITLE, ATITLE, TITLE)
CALL DRAW4(2,3,ILNLOG, IPTS, -2,10,T,F,0.,0.)
CALL DRAW4(2,3,ILNLOG, MAXPTS, 0,10,TT,FF,0.,0.)
CALL DRAW4(3,3,0,0,0, MAXPTS, TT,FF,2.,0.)
```

should be changed to

```
CALL DRAW41(3,3,3,8,20, XTITLE, YTITLE, ATITLE, TITLE)
CALL DRAW42(3,ILNLOG, IPTS, -2,10,T,F,0.,0.)
CALL DRAW42(3, ILNLOG, MAXPTS, 0,10,TT,FF,0.,0.)
CALL DRAW43(3,0,0,0, MAXPTS, TT,FF,2.,0.)
```

- (2) The DRAW4 calls

```
CALL DRAW4(1,3,3,3,8,20, XTITLE, YTITLE, ATITLE, TITLE)
CALL DRAW4(2,3, ILNLOG, MAXPTS, 0,10,TT,FF,0.,0.)
CALL DRAW4(3,3,0,0,0, MAXPTS, TT,FF,2.,0.)
```

should be changed to

```
CALL DRAW41(3,3,3,8,20, XTITLE, YTITLE, ATITLE, TITLE)
CALL DRAW42(3, ILNLOG, MAXPTS, 0,10,TT,FF,0.,0.)
CALL DRAW43(3,0,0,0, MAXPTS, TT,FF,2.,0.)
```

---

<sup>1</sup>Thomas V. Noon, *User's Manual for the Modular Analysis-Package Libraries ANAPAC and TRANL*, Harry Diamond Laboratories TR-1782-S (September 1977).

(3) The DRAW4 calls

```
CALL DRAW4(1,3,4,5,14,20,XTITLE,YTITLE,FTITLE,TITLE)
CALL DRAW4(2,3,2,OPTS,0,10,OMEGA,ZABS,0.,0.)
CALL DRAW4(3,3,0,0,0,OPTS,OMEGA,ZABS,2.,0.)
```

should be changed to

```
CALL DRAW41(3,4,5,14,20,XTITLE,YTITLE,FTITLE,TITLE)
CALL DRAW42(3,2,OPTS,0,10,OMEGA,ZABS,0.,0.)
CALL DRAW43(3,0,0,0,OPTS,OMEGA,ZABS,2.,0.)
```

(4) The DRAW4 calls

```
CALL DRAW4(1,3,3,3,12,20,XTITLE,YTITLE,FTITLE,TITLE)
CALL DRAW4(2,3,ILNLOG,MAXPTS,0,10,TT,DFP,0.,0.)
CALL DRAW4(3,3,0,0,0,MAXPTS,TT,DFP,2.,0.)
```

should be changed to

```
CALL DRAW41(3,3,3,12,20,XTITLE,YTITLE,FTITLE,TITLE)
CALL DRAW42(3,ILNLOG,MAXPTS,0,10,TT,DFP,0.,0.)
CALL DRAW43(3,0,0,0,MAXPTS,TT,DFP,2.,0.)
```

It should also be noted that a convention involving the exponential function calculations has been employed. This is due to the word size difference between the CDC 6600 computer, which has 60 bits per word, and the IBM 370/168 computer, which has only 32 bits per word. Since the CDC version of EMPFIT allows exponential arguments to be taken up to approximately 720, while the IBM exponential argument size is limited to approximately 174, a simple change was added. This change was mainly influenced by the fact that EMPFIT fits data primarily in the time frame of 1 to 5000 shakes (1 shake =  $10^{-8}$  s) and exponential values sometimes need to be calculated which exceed the IBM limit of 174. Thus, it was decided that the easiest solution was to limit the size of exponential values to 174 rather than to make extensive software changes to EMPFIT. This limitation is only used when fitting the exponential functions (eq 1 and 3) to the front and rear of the fitting function where the values for  $\alpha$  and  $\beta$  in equations 1 and 3 are minimized so that the argument size does not exceed 174. When this convention is automatically employed, EMPFIT prints out the largest values that can be used for  $\alpha$  and  $\beta$  and the message that this variation has been utilized.

##### 5. TIME CUTOFF OPTION

Since it is sometimes necessary to deal with data with amplitudes very nearly zero (with respect to the peak amplitude) at the tail of a

waveform, an addition has been employed which allows the user to chop off the trace after a prescribed time value. This option allows one to ignore meaningless information at the end of a waveform which exists on a permanent disk file and cannot be deleted easily. An example of this option can be seen in figures 6 and 7. The use of this modification is detailed in section 8.

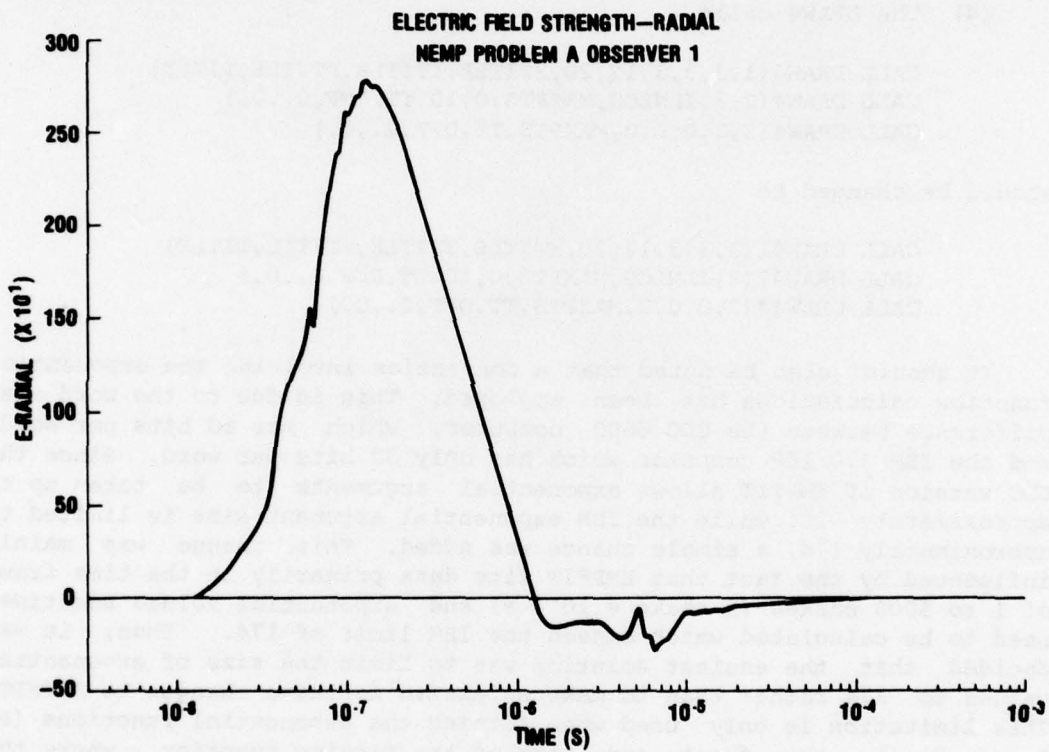


Figure 6. Example of curve with long, nearly zero tail.

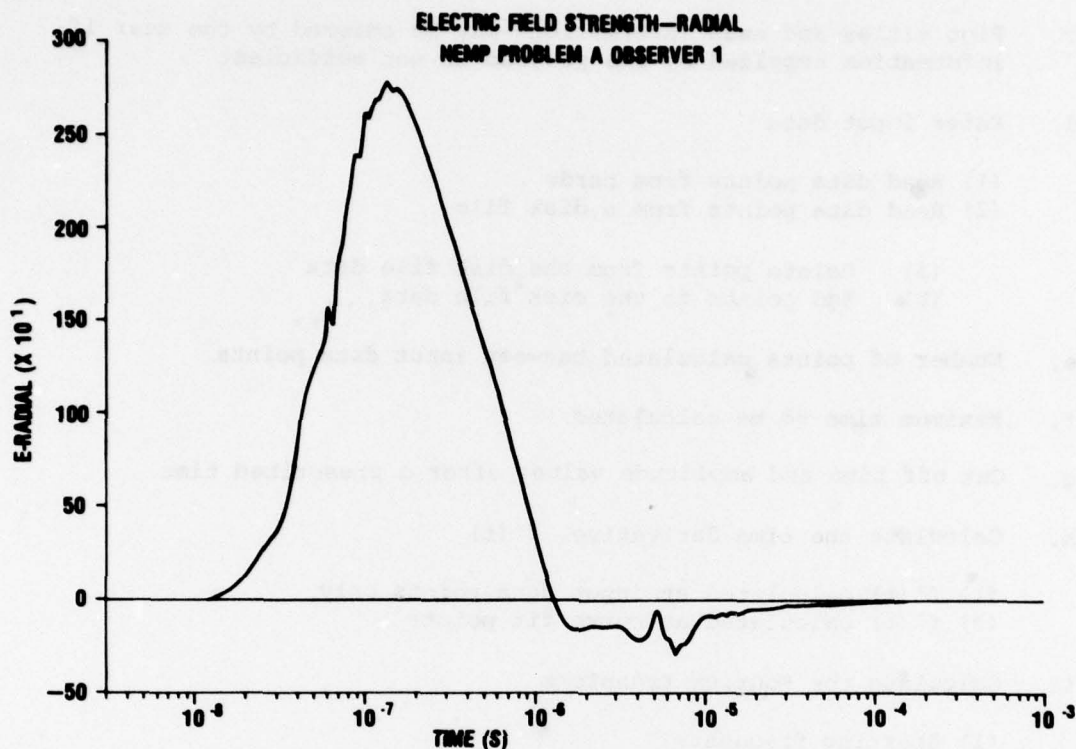


Figure 7. Example of time cutoff option applied to waveform with long, nearly zero tail.

#### 6. OUTPUT OPTIONS

With the aforementioned modifications EMPFIT now consists of numerous output options. Thus a total compilation of these selections will now be listed. The use of these options is fully detailed in section 8.

- a. Multiple runs
- b. Plot titles and axes information supplied in program
  - (1) T vs  $E_R$ --time versus electric field strength--radial
  - (2) T vs  $E_V$ --time versus electric field strength--vertical
  - (3) T vs  $B_\phi$ --time versus magnetic induction--azimuthal
  - (4) T vs  $J_R$ --time versus current density--radial
  - (5) T vs  $J_V$ --time versus current density--vertical
  - (6) T vs  $\sigma$ --time versus air conductivity

- c. Plot titles and axes information--may be entered by the user if information supplied by the program is not sufficient
- d. Enter input data
  - (1) Read data points from cards
  - (2) Read data points from a disk file
    - (a) Delete points from the disk file data
    - (b) Add points to the disk file data
- e. Number of points calculated between input data points
- f. Maximum time to be calculated
- g. Cut off time and amplitude values after a prescribed time
- h. Calculate the time derivative,  $f'(t)$ 
  - (1)  $f'(t)$  calculated at input data points only
  - (2)  $f'(t)$  calculated at curve fit points
- i. Calculate the Fourier transform
  - (1) Starting frequency
  - (2) Maximum frequency to be calculated
- j. Plots
  - (1) Linear
  - (2) Log-log
  - (3) Semilog
 

|   |  |
|---|--|
| <ul style="list-style-type: none"> <li>(a) Abscissa (log)</li> <li>(b) Ordinate (linear)</li> </ul> | Available on curve fit and derivative plots only; Fourier transform plots are always log-log |
|---|--|
  - (4) Minimum value of ordinate to be plotted (does not plot data points below this value)--useful when plotting linear or semilog and the range of values is very large
  - (5) Curve fit plots--three plots may be obtained:
    - (a) Data points (plotted with X's) and curve through data points
    - (b) Curve only
    - (c) Both (a) and (b)

(6) Derivative plot

(7) Fourier transform plot

k. Write data on a disk file

(1) Write the curve fit,  $f(t)$ , on a disk file

(2) Write the time derivative,  $f'(t)$ , on a disk file

## 7. DESCRIPTION OF NEW SUBROUTINES OF EMPFIT

The modified version of EMPFIT contains the following new subroutines.

PERFIL Subroutine: reads the data from the disk file and writes the data points on output; deletes or adds any specified data points to the disk file data.

CUTOFF Subroutine: cuts off the time and amplitude values after a prescribed time value.

DERIV Subroutine: calculates the time derivative at either the input points or the curve fit points.

RITDAT Subroutine: writes either or both the time derivative data and the curve fit data on a disk file.

READPF Subroutine: reads input data from a disk file.

WRITPF Subroutine: performs the actual writing of the data onto the disk file as specified by RITDAT.

## 8. DATA INPUT PREPARATION FOR EMPFIT (REVISION)

Input data cards for EMPFIT are prepared in the following manner. Examples of input card decks appear in appendix B.

| <u>Column</u>             | <u>Variable</u> | <u>Format</u> | <u>Explanation</u> |
|---------------------------|-----------------|---------------|--------------------|
| Card 1: Multiple Run Card |                 |               |                    |
| 8-10                      | NRUN            | I3            | Number of runs     |

| <u>Column</u>                                     | <u>Variable</u> | <u>Format</u> | <u>Explanation</u>  |
|---|-----------------|---------------|---|
| Card 2: Plot Parameter Card                       |                 |               |   |
| 10  | IDENT           | I1            | Identifies data to be read in<br>IDENT = 1 T vs E <sub>R</sub><br>= 2 T vs E <sub>V</sub><br>= 3 T vs B <sub>φ</sub><br>= 4 T vs J <sub>φ</sub><br>= 5 T vs J <sub>R</sub><br>= 6 T vs σ <sub>V</sub>               |
| 20  | IFFT            | I1            | Fourier transform?<br><br>IFFT = 0 Yes<br>= 1 No  |
| 30  | IPLLOT          | I1            | Plots?<br><br>IPLLOT = 0 Yes<br>= 1 No  |
| 40  | ILNLOG          | I1            | Plots in linear, log-log,<br>or semilog?<br><br>ILNLOG = 1 Linear<br>= 2 Log-log<br>= 3 Semilog<br>Abscissa (log)<br>Ordinate (linear)  |
| Note: Fourier transform plots are always log-log. |                 |               |   |
| 41-50   | ORDMIN          | E10.3         | Minimum value of ordinate to<br>be plotted (all points below this<br>value are not plotted on linear<br>or semilog plots)   |
| 60  | ICURV           | I1            | Curve fit plots<br><br>ICURV = 0 One plot of data<br>points and curve fit<br><br>= 1 One plot of curve<br>fit only<br><br>= 2 Two plots--one plot<br>of data points and<br>curve fit, one plot of<br>curve fit only |

| <u>Column</u> | <u>Variable</u> | <u>Format</u> | <u>Explanation</u>  |
|---------------|-----------------|---------------|---|
| 70            | IOT             | I1            | Enter own plot and axes labels?<br><br>IOT = 0 Use plot and axes labels supplied in program<br><br>= 1 Enter own labels on cards 6, 7, 8  |
| 80            | IREAD           | I1            | Read data points from permanent file?<br><br>IREAD = 0 No<br>= 1 Yes<br><br>Calculate time derivative?<br><br>IREAD = 0 No<br>= 2 Yes<br><br>Do both of above?<br><br>IREAD = 0 No<br>= 3 Yes |

Card 3: Title Card

|      |       |      |                   |
|------|-------|------|-------------------|
| 1-80 | TITLE | 8A10 | Title or subtitle |
|------|-------|------|-------------------|

Card 4: Fitting Parameter Card

|       |       |       |  |
|-------|-------|-------|--|
| 8-10  | IPTS  | I3    | Number of data points read in  |
| 18-20 | MPTS  | I3    | Number of points calculated between input data points  |
| 21-30 | TMAX  | E10.3 | Maximum time to be calculated in curve fit calculations  |
| 31-40 | ALPHA | E10.3 | Used to fit $f(t) = A_1 e^{\alpha t} + A_3 e^{2\alpha t}$ to front of waveform (good starting value: $\alpha = 1.2E+8$ ) |

| <u>Column</u> | <u>Variable</u> | <u>Format</u> | <u>Explanation</u>  |
|---------------|-----------------|---------------|---|
| 41-50         | BETA            | E10.3         | Used to fit $f(t) = A_2 e^{-\beta t} + A_4 e^{-2\beta t}$ to end of waveform (good starting value: $\beta = 5.0E+4$ ) |
| 51-60         | OSTART          | E10.3         | Frequency to start Fourier transform calculations   |
| 61-70         | OMAX            | E10.3         | Maximum frequency to be calculated  |
| 80            | ICUT            | I1            | Time cutoff?  |

ICUT = 0 No time cutoff  
= 1 Cutoff time points at prescribed time shown on card 5

Note: If IREAD = 0 Skip to card 13  
= 1 Skip to card 10  
= 2 Go to card 9  
= 3 Go to card 9

If IOT = 1 Go to cards 6,7  
8; then go to IREAD prescribed cards

If ICUT = 1 Go to card 5; then go to IREAD and IOT prescribed cards

Card 5: Time Cutoff Card

|      |      |       |                              |
|------|------|-------|------------------------------|
| 1-10 | TCUT | E10.3 | Prescribed cutoff time value |
|------|------|-------|------------------------------|

Card 6: Abscissa Label Card

|      |        |     |                            |
|------|--------|-----|----------------------------|
| 1-10 | XTITLE | A10 | X label; start in column 1 |
|------|--------|-----|----------------------------|

| <u>Column</u>                | <u>Variable</u> | <u>Format</u> | <u>Explanation</u>  |
|------------------------------|-----------------|---------------|---|
| Card 7: Ordinate Label Card  |                 |               |   |
| 1-20                         | YTITLE          | 2A10          | Y label; start in column 1;<br>on output, ordinate label is<br>only in A10, A2 format instead<br>of 2A10  |
| Card 8: Plot Label Card      |                 |               |   |
| 1-40                         | ATITLE          | 4A10          | Plot label; start in column 1   |
| Card 9: Time Derivative Card |                 |               |   |
| 10                           | IFPRIM          | I1            | IFPRIM = 1 f'(t) calculated at<br>input data points<br>only<br><br>= 2 f'(t) calculated at<br>input and calculated<br>points  |
| 20                           | IPERM           | I1            | Write f'(t) on permanent file?<br><br>IPERM = 0 No<br>= 1 Yes (as specified by<br>IFPRIM)<br><br>Write f(t) on permanent file?<br><br>IPERM = 0 No<br>= 2 Yes<br><br>Do both of above?<br><br>IPERM = 0 No<br>= 3 Yes |
| 30                           | IFPPLT          | I1            | Plot of f'(t)?<br><br>IFPPLT = 0 No<br>= 1 Yes<br><br>Note: If IREAD = 2 Skip to<br>card 13<br>= 3 Go to<br>card 10   |

| <u>Column</u> | <u>Variable</u> | <u>Format</u> | <u>Explanation</u> |
|---------------|-----------------|---------------|--------------------|
|---------------|-----------------|---------------|--------------------|

Card 10: Permanent File Card

|       |        |    |  |
|-------|--------|----|--|
| 8-10  | NSETS  | I3 | Number of particular data set to be read from disk file            |
| 8-20  | IDELET | I3 | Delete points from disk file data?<br><br>IDELET = 0 No<br>= 1 Yes |
| 28-30 | IADD   | I3 | Add points to disk file data?<br><br>IADD = 0 No<br>= 1 Yes        |

Note: If IDELET = 1 Go to card 11  
 If IADD = 1 Go to card 12  
 If IDELET & IADD = 1 Go to card 11, then 12  
 If IDELET & IADD = 0 Input for this data run is complete

Card 11: Deletion Card

|       |     |    |   |
|-------|-----|----|---|
| 8-10  | NUM | I3 | Number of data point on disk file that is to be deleted from disk file data |
| 18-20 | NUM | I3 |   |
| 28-30 | NUM | I3 |   |
| 38-40 | NUM | I3 |   |
| 48-50 | NUM | I3 |   |
| 58-60 | NUM | I3 |   |
| 68-70 | NUM | I3 |   |
| 78-80 | NUM | I3 |   |

Note: At present only eight data pairs can be deleted.

| <u>Column</u>          | <u>Variable</u> | <u>Format</u> | <u>Explanation</u>                                 |
|------------------------|-----------------|---------------|--|
| Card 12: Addition Card |                 |               |  |
| 8-10                   | NIADD           | I3            | Number of data pairs to be added to disk file data |
| 11-20                  | TX              | E10.3         | Time value of point 1 to be added                  |
| 21-30                  | FY              | E10.3         | Amplitude value of point 1 to be added             |
| 31-40                  | TX              | E10.3         | Time value of point 2 to be added                  |
| 41-50                  | FY              | E10.3         | Amplitude value of point 2 to be added             |
| 51-60                  | TX              | E10.3         | Time value of point 3 to be added                  |
| 61-70                  | FY              | E10.3         | Amplitude value of point 3 to be added             |

Note: Additional cards may be entered starting in column 11. Data input is complete.

Card 13: Data Card

|       |   |       |                           |
|-------|---|-------|---------------------------|
| 1-10  | T | E10.3 | Time value of first point |
| 11-20 | F | E10.3 | Amplitude of first point  |

Card 14: Data Card

|       |   |       |                            |
|-------|---|-------|----------------------------|
| 1-10  | T | E10.3 | Time value of second point |
| 11-20 | F | E10.3 | Amplitude of second point  |

Note: Card 13, card 14, . . . are repeated with respect to the number of input points indicated on card 4, IPTS.

Note: Card 2 to card 13, card 14, . . . are repeated according to the number of times identified on card 1, NRUN.

## 9. JOB CONTROL LANGUAGE FOR EMPFIT

The following JCL is necessary to execute EMPFIT on the HDL IBM 370/168 computer. The procedure ANAFORT is used to supply the plotting software while the object version of EMPFIT exists on permanent file.

```
//Job Card
/*JOBPARM CARDS=20000
//ST EXEC ANAFORT,PFELIB='HK3002.EMPFIT',OUT=X,F3=
//FORT.SYSIN DD *
//LKED.SYSIN DD *
  INCLUDE SYSLIB(EMPFIT)
  ENTRY MAIN
{ //GO.FT10F001 DD DISP=(NEW,CATLG),VOL=SER=USER02,
  // UNIT=SYSDA,SPACE=(TRK,(2,2)),DSN=permanent file
  name for curve fit output data,DCB=(RECFM=VS)
{ //GO.FT11F001 DD DISP=(NEW,CATLG),VOL=SER=USER02,
  // UNIT=SYSDA,SPACE=(TRK,(2,2)),DSN=permanent file
  name for derivative output data,DCB=(RECFM=VS)
{ //GO.FT12F001 DD DSN=permanent file name of disk
  file input data,DISP=SHR
//GO.SYSIN DD *
```

Input Data

//

The control cards in braces should only be used if the respective read or write option of EMPFIT is employed.

APPENDIX A.--SAMPLE RUN AND LISTING OF EMPFIT

APPENDIX A

This appendix shows a sample run of EMPFIT and lists its main program and subroutines. Figures A-1 to A-3 show sample plots from EMPFIT.

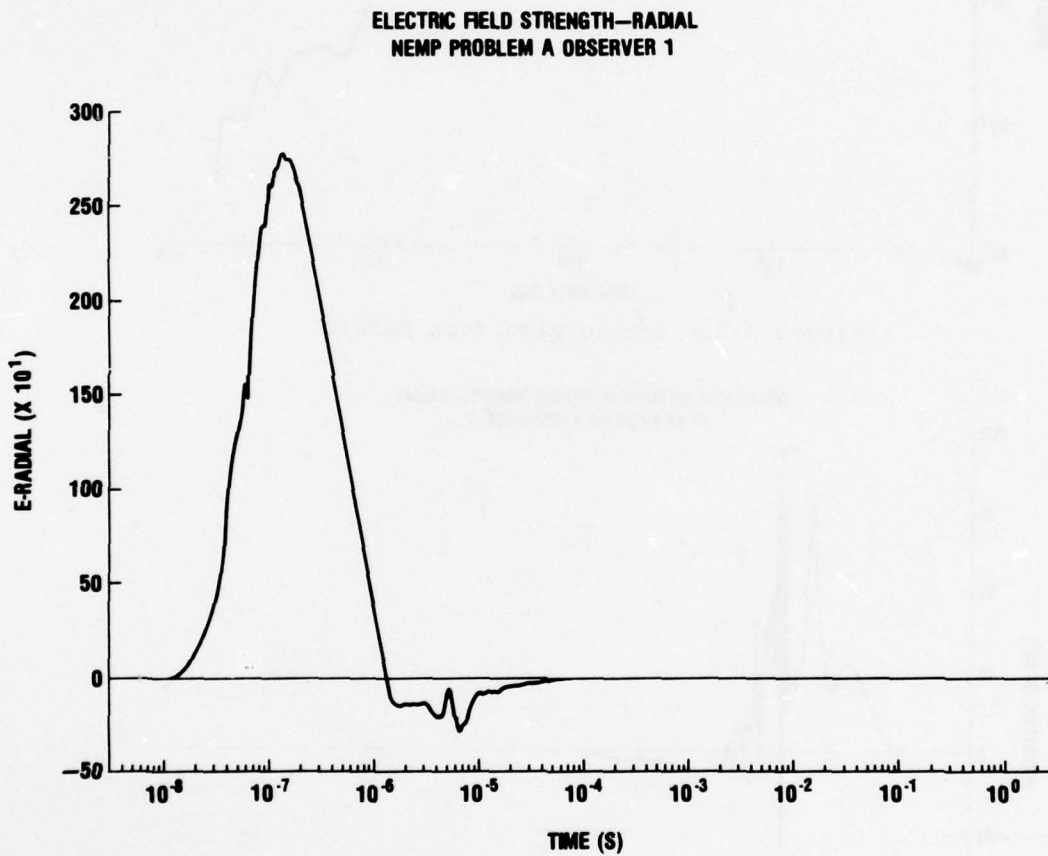


Figure A-1. Sample plot from EMPFIT.

APPENDIX A

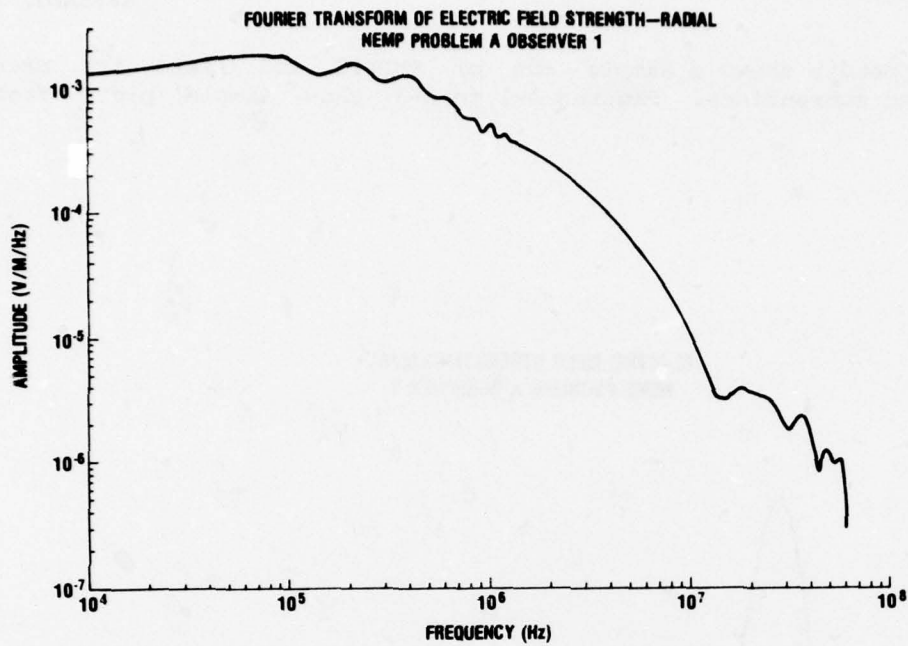


Figure A-2. Sample plot from EMPFIT.

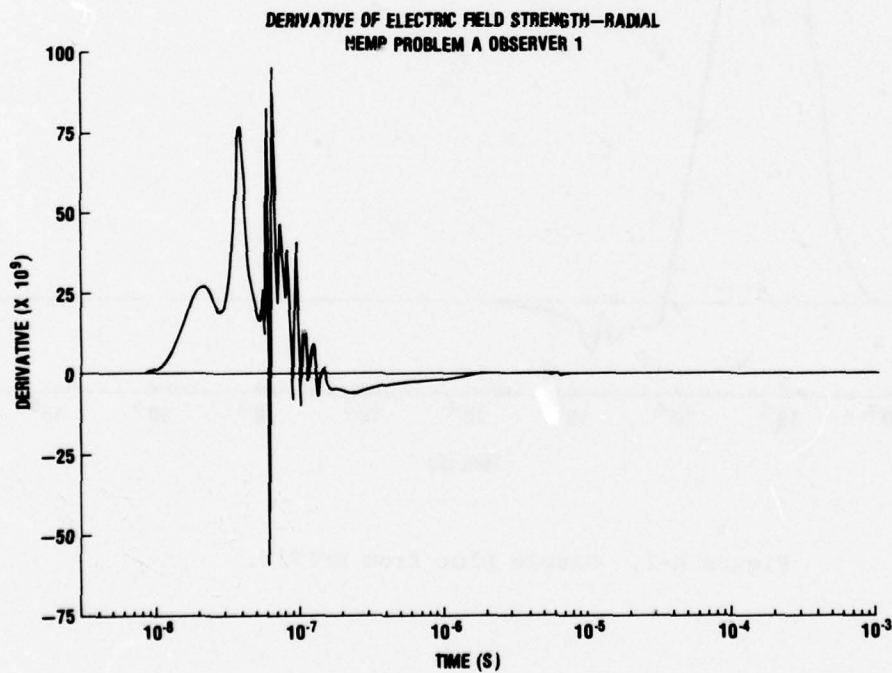


Figure A-3. Sample plot from EMPFIT.

REQUESTED OPTIONS: SOURCE, NMAP, NOXREF, OPT(10)  
 OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODOBLINDONE!  
 SOURCE EBCDIC NDLIST NODCK OBJECT NMAP NOFORMAT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NONE

```

1SN 0002 C PROGRAM EMPFIT(INPUT,OUTPUT,TAPES=INPUT,TAPE6=OUTPUT,TAPES,
1SN 0003 C TAPE10,TAPE11,TAPE12)
1SN 0004 C INTEGER TITLE
1SN 0005 C COMMON/COMMON/ DRDMIN,IDENT,IFFT,TITLE(20),IPLCT,ILMLDC
1SN 0006 C COMMON/H/ TOT,IFPRM,IFPRM,IFPPLT
1SN 0007 C READ(5,10) NRUN
1SN 0008 C DO 50 L=1,NRUN
1SN 0009 C FORMAT(7X,13)
1SN 0010 C DO 50 L=1,NRUN
1SN 0011 C READ IN INPUT DATA
1SN 0012 C CALL INPUTT
1SN 0013 C CALCULATE CURVE FIT
1SN 0014 C CALL CURFIT
1SN 0015 C CALCULATE FOURIER TRANSFORM
1SN 0016 C IF(1FFT.EQ.1) GO TO 20
1SN 0017 C CALL FORT
1SN 0018 C WRITE OUTPUT
1SN 0019 C 20 CALL OTPUT
1SN 0020 C PLOT DATA
1SN 0021 C IF(1PLOT.EQ.1) GO TO 30
1SN 0022 C CALL PLOTT
1SN 0023 C 30 CONTINUE
1SN 0024 C WRITE DATA ON PERMANENT FILE
1SN 0025 C IF(1PERM.EQ.0) GO TO 40
1SN 0026 C CALL RTTCAT
1SN 0027 C 40 CONTINUE
1SN 0028 C 50 CONTINUE
1SN 0029 C STOP
1SN 0030 C END
  
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODOBLINDONE!  
 \*OPTIONS IN EFFECT\*SOURCE EBCDIC NDLIST NODCK OBJECT NMAP NOFORMAT NOXREF NOALC NOANSF NOTERM FLAG(1)  
 \*OPTIONS IN EFFECT\* FUNCTIONS IN LINE ARE: NONE

\*STATISTICS\* SOURCE STATEMENTS = 23, PROGRAM SIZE = 424, SUBPROGRAM NAME = MAIN

LEVEL 2.2 (SEPT 76)

REQUESTED OPTIONS: SOURCE,NOMAP,NOXREF,OPT(0)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(160) SIZE(05000) AUTOCBL(MONE)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOCALC MEANSF MOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

15M 0002 SUBROUTINE INPUT
15M 0003 COMPLEX FT
15M 0004 INTEGER XTITLE,YTITLE,ATITLE,TITLE
15M 0005 COMMON/A/ ORDMIN,IDENT,JEFT,TITLE(20),IPLOT,ILNLOG
15M 0006 COMMON/B/ T(500),F(500),ALPHA,BETA,T(5000),FF(5000),
    DF(500),OFF(5000)
15M 0007 COMMON/C/ TMAX,TCUT,MPTS,MPTS,IPTS,MAXPTS,DPTS,ICUT
15M 0008 COMMON/D/ DELF,OSTART,OMAX,OMEGA(5000),FT(5000)
15M 0009 COMMON/G/ ICURV
15M 0010 COMMON/H/ IDT,IFPRIM,IPERM,IFPPLT
15M 0011 COMMON/K/ TX(100),FY(100),IREAD,IDELET,IADD,MIADD,MSETS,NUM(8)
15M 0012 DIMENSION XTITLE(10),YTITLE(10),ATITLE(10)
15M 0013 READ(5,10) IDENT,JEFT,IPLOT,ILNLOG,ORDMIN,ICURV,ICT,IREAD
15M 0014 FORMAT(4(9X,11),E10.3,3(9X,11))
15M 0015 READ(5,20) (TITLE(I),I=1,20)
15M 0016 READ(5,30) IPTS,MPTS,TMAX,ALPHA,BETA,OSTART,OMAX,ICUT
15M 0017 FORMAT(7X,13,7X,13,5E10.3,9X,11)
15M 0018 IF(1CUT.EQ.1) READ(5,33) TCUT
15M 0019
15M 0021
15M 0022 MPTS=IPTS*1
15M 0023 IF(1DT.EQ.0) GO TO 35
15M 0025 CALL ENTTL(1,XTITLE,YTITLE,ATITLE)
15M 0026
35 CONTINUE
C READ TIME DERIVATIVE INFORMATION
C
C IF(IREAD.EQ.2-OR-IREAD.EQ.3) READ(5,36) IFPRIM,IPERM,IFPPLT
C READ PERMANENT FILE DATA
C
IF(IREAD.EQ.1-OR-IREAD.EQ.3) READ(5,36) MSETS,IDELET,IADD
FORMAT(3(9X,11))
IF(IDELET.EQ.1) READ(5,37) (NUM(I),I=1,8)
FORMAT(8(7X,13))
IF(IADD.EQ.1) READ(5,38) MIADD,(TX(I),FY(I)),I=1,MIADD)
FORMAT(7X,13,6E10.3)
IF(IREAD.EQ.1-OR-IREAD.EQ.3) CALL PERFIL
IF(IREAD.EQ.1-OR-IREAD.EQ.3) GO TO 60
C READ DATA POINTS
C
DO 50 I=2,MPTS
READ(5,40) T(I),F(I)
FORMAT(2E10.3)
50 CONTINUE
60 IF(1CUT.EQ.1) CALL CUTOFF
RETURN
END
15M 0042
15M 0043
15M 0044
15M 0045
15M 0046
15M 0048
15M 0049
    
```

QUESTED OPTIONS: SOURCE,NOMAP,NDXREF,OPT(0)  
 TTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(MONE)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT ADMAP NOFORMAT NOGDSMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE NONE

```

15M 0002 SUBROUTINE CURFIT
15M 0003 INTEGER CPTS
15M 0004 COMMON/B/ T(500),F(500),ALPHA,BETA,T(5000),FF(5000),
      * DF(500),DEF(5000)
15M 0005 COMMON/C/ TMAX,TCUT,MPTS,MPTS,MPTS,MPTS,MPTS,MPTS,MPTS,ICUT
15M 0006 COMMON/E/ A1,A2,A3,A4,C1,CMM1,C2,DNN
15M 0007 COMMON/H/ IDT,JFPRM,JPERM,JFPLT
15M 0008 COMMON/K/ TX(100),FY(100),IREAD,IDELET,IADD,MIADD,MSETS,NUR(8)
15M 0009 I=2
15M 0010 J=2
15M 0011 T(I)=.8*T(I)
15M 0012 F(I)=0.
15M 0013 T(I)=T(I)
15M 0014 FF(I)=0.
15M 0015 T(MPTS+1)=TMAX
15M 0016 CALL A2A3(A1,A3,C1)
15M 0017 CALL A2A4(A2,A4,DNN)
15M 0018 H=T(I)-T(J-1)
15M 0019 DEL=H/(MPTS+1)
15M 0020 T(I)=T(I)-DEL
15M 0021 IF(T(I).LT.(T(J)-DEL/100.)) GO TO 30
15M 0022 IF(T(I).GT.(MPTS)) GO TO 50
15M 0023 T(I)=T(J)
15M 0024 FF(I)=F(J)
15M 0025 I=I+1
15M 0026 J=J+1
15M 0027 GO TO 10
15M 0028 30 CONTINUE
15M 0029 IF(T(I).GT.T(I)) GO TO 50
15M 0030 ARG1=ALPHA*T(I)
15M 0031 ARG2=2.*ARG1
15M 0032 FF(I)=A1*EXP(ARG1)+A3*EXP(ARG2)
15M 0033 I=I+1
15M 0034 GO TO 20
15M 0035 50 IF(T(I).LT.(MPTS)) GO TO 60
15M 0036 ARG3=-BETA*T(I)
15M 0037 ARG4=2.*ARG3
15M 0038 FF(I)=A2*EXP(ARG3)+A4*EXP(ARG4)
15M 0039 I=I+1
15M 0040 GO TO 20
15M 0041 60 CONTINUE
15M 0042 DT=T(I)-T(J-1)
15M 0043 DTM=T(I)-T(I)
15M 0044 DTM=T(I)-T(J-1)
15M 0045 DTPI=T(I)-T(J)
15M 0046 IF(IJ.NE.MPTS) GO TO 70
15M 0047 CALL A2A4(U,V,D)
15M 0048 GO TO 80
15M 0049 70 D=DN(J)
15M 0050
15M 0051
15M 0052
15M 0053
15M 0054
15M 0055
15M 0056

```

LEVEL 2.2 (SEPT 76) CURFIT

```

15N 0057      90 P1=(F(J)*DT*(J-1)+DTM1)/DTM
15N 0058      P2=-5*(BN(J-1)+BN(J))*DT*DTPI
15N 0059      P3=CM(J-1)*DT*(DTM**3)
15N 0060      P4=D*DTM*(DT**3)
15N 0061      PF(I)=P1+P2+P3+P4
15N 0062      I=I+1
15N 0063      GO TO 20
15N 0064      90 CONTINUE
15N 0065      MAXPTS=1
15N 0066      OPTS=MAXPTS
    
```

C CALCULATE TIME DERIVATIVE  
C

```

15N 0067      IF(IREAD.EQ.2.OR.IREAD.EC.3) CALL DERIV
15N 0069      L=0
15N 0070      DO 100 I=2,MAXPTS
15N 0071      L=L+1
15N 0072      T(L)=T(I)
15N 0073      F(L)=F(I)
15N 0074      100 CONTINUE
15N 0075      RETURN
15N 0076      END
    
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(INORE)

\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NOCHECK OBJECT NDMAP NOFCRMT NOGOSTRT NOHREF NOALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT\* FUNCTIONS INLINE ARE: NONE

\*OPTIONS IN EFFECT\*

\*STATISTICS\* SOURCE STATEMENTS = 75, PROGRAM SIZE = 1994, SUBPROGRAM NAME =CURFIT

\*STATISTICS\* NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

200K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)  
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LEVEL 2.2 (SEPT 76)  
 REQUESTED OPTIONS: SOURCE,NOMAP,NOMXREF,OPT(0)  
 OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(MONEY)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NGALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

1SN 0002 SUBROUTINE FORT
1SN 0003 REAL IPFT
1SN 0004 INTEGER OPTS
1SN 0005 COMPLEX FT
1SN 0006 COMMON/B/ T(5000),F(5000),ALPHA,BETA,TI(5000),FF(5000),
        DF(5000),DFF(5000)
1SN 0007 COMMON/C/ TMAX,TCUT,MPTS,MPTS,MPTS,MPTS,MPTS,ICUT
1SN 0008 COMMON/D/ DELF,OSTART,DMAX,CMEGA(5000),FT(5000)
1SN 0009 COMMON/E/ A1,A2,A3,A4,C1,CNM1,02,DM
1SN 0010 COMMON/F/ RPFT(1000),IPFT(1000),ZABS(1000)
1SN 0011 DATA TOPI/6-2831853/
1SN 0012 OMEGA(I)=OSTART
1SN 0013 DELF=(DMAX/OSTART)**(1./IDPTS-1)
1SN 0014 DD 10 J=1,OPTS
1SN 0015 CALL FLINE(FT(J),OMEGA(J)*TOPI,TT,FF,OPTS)
1SN 0016 OMEGA(J+1)=OMEGA(J)*DELF
1SN 0017 10 CONTINUE
1SN 0018 DD 20 J=1,OPTS
1SN 0019 RPFT(J)=REAL(FT(J))
1SN 0020 IPFT(J)=AIMAG(FT(J))
1SN 0021 ARG=RPFT(J)**2+IPFT(J)**2
1SN 0022 ZABS(J)=SQRT(ARG)
1SN 0023 20 CONTINUE
1SN 0024 RETURN
1SN 0025 END
    
```

\*OPTIONS IN EFFECT=NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(MONEY)  
 \*OPTIONS IN EFFECT=SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NGALC NOANSF NOTERM FLAG(1)  
 \*OPTIONS IN EFFECT= FUNCTIONS INLINE ARE: NONE  
 \*OPTIONS IN EFFECT= SOURCE STATEMENTS = 24, PROGRAM SIZE = 786, SUBPROGRAM NAME = FORT  
 \*STATISTICS= NC DIAGNOSTICS GENERATED  
 \*\*\*\*\* END OF COMPILATION \*\*\*\*\*

208K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

REQUESTED OPTIONS: SOURCE, NOMAP, NOXREF, OPT40

OPTIONS IN EFFECT: NADPTIMIZE LINECOUNT(60) SIZE(5000) AUTOBLINDONE

SOURCE EBCDIC NOLIST MODECK OBJECT NOMAP NOFORMAT NUGOSTINT NCBREF NCALC NCBANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NOME

```

15M 0002 SUBROUTINE OUPUT
15M 0003 COMPLEX FT
15M 0004 INTEGER DPTS,FTITLE,TITLE,XTITLE,YTITLE,ATITLE
15M 0005 COMMON/A/ DROMIN,IDENT,IEFT,TITLE(20),IPLOT,ILMLGC
15M 0006 COMMON/B/ T(500),F(500),ALPHA,BETA,TT(5000),FF(5000),
      * DF(500),DFE(500)
15M 0007 COMMON/C/ TMAX,TCUT,MPTS,IPTS,MAXPTS,DPTS,ICUT
15M 0008 COMMON/D/ DELF,DSTART,DMAX,DMEGA(5000),FT(5000)
15M 0009 COMMON/H/ TOT,IFPRIM,IPERM,IFPPLT
15M 0010 COMMON/J/ALFA,BET,AL,BE,LAL,LAL2
15M 0011 COMMON/K/ TX(100),FY(100),IREAD,IDELET,IADD,NIADD,MSETS,MUM(8)
15M 0012 DIMENSION ATITLE(10),XTITLE(10),YTITLE(10)
15M 0013 DATA ATITLE/10*4H /,XTITLE/10*4H /,YTITLE/10*4H
15M 0014 IF(1CT.EQ.1) GO TO 5
15M 0015 CALL ANDTAT(XTITLE,YTITLE,ATITLE,0)
15M 0016 GO TO 7
15M 0017
15M 0018 5 CALL ENTITL(0,XTITLE,YTITLE,ATITLE)
15M 0019 7 WRITE(6,10)
15M 0020 10 FORMAT(1H1)
15M 0021 WRITE(6,20) (TITLE(I),I=1,20)
15M 0022 20 FORMAT(2X,20A4)
15M 0023 WRITE(6,30) (ATITLE(I),I=1,10)
15M 0024 30 FORMAT(/,6X,13HINPUT DATA -,10A4)
15M 0025 WRITE(6,40) AL,BE,TMAX,IPTS,MPTS
15M 0026 40 FORMAT(/,9X,7HALPHA=,1PE11.3,5X,6HBETA=,1PE11.3,5X,
      * 13)HMAXIMUM TIME TO BE CALCULATED=,1PE11.3,/,9X,
      * 22)HNUMBER OF INPUT DATA POINTS=,13,5X,
      * 35)HNUMBER OF POINTS CALCULATED BETWEEN INPUT DATA POINTS=,13)
15M 0027 IF(1CT.EQ.1) WRITE(6,41) TCUT
15M 0028 41 FORMAT(9X,22HCUTOFF TIME EMPLOYED=,1PE11.3)
15M 0029 IF(LAL.EQ.1) WRITE(6,43) ALFA
15M 0030 43 FORMAT(9X,30HMAXIMUM VALUE FER ALPHA USED=,1PE11.3)
15M 0031 IF(LAL2.EQ.1) WRITE(6,45) BET
15M 0032 45 FORMAT(9X,29HMAXIMUM VALUE FER BETA USED=,1PE11.3)
15M 0033 45 WRITE(6,50) (XTITLE(I),I=1,3),(YTITLE(I),I=1,3),(XTITLE(I),
      * I=1,3),(YTITLE(I),I=1,3),(XTITLE(I),I=1,3),(YTITLE(I),I=1,3)
15M 0034 50 FORMAT(/,13X,2A4,A2,4X,3A4,2(10X,2A4,A2,4X,3A4))
15M 0035 60 WRITE(6,60)
15M 0036 60 FORMAT(3(2X,25(1H-)))
15M 0037 CALL COLMNS(3,IPTS,T,F)
15M 0038 WRITE(6,80) IPTS
15M 0039 80 FORMAT(/,15X,19)HNUMBER OF POINTS =,13)
15M 0040 WRITE(6,90)
15M 0041 90 FORMAT(/,7,6X,22HCURVE FIT CALCULATIONS)
15M 0042 WRITE(6,95) DROMIN
15M 0043 95 FORMAT(/,9X,43)HMINIMUM VALUE OF ORDINATE TO BE PLOTTED=,
      * 1PE11.3)
15M 0044 WRITE(6,50) (XTITLE(I),I=1,3),(YTITLE(I),I=1,3),(XTITLE(I),I=1,3),
      * (XTITLE(I),I=1,3),(YTITLE(I),I=1,3)
15M 0045
15M 0046
15M 0047
15M 0048

```

```

15M 0049 WRITE(6,60)
15M 0050 CALL COLMNS(3,MAXPTS,TT,FF)
15M 0051 WRITE(6,80) MAXPTS
15M 0052 IF(IFFT.EQ.1) GO TO 140
15M 0054 CALL ANDAT(XTITLE,YTITLE,ATITLE,1)
15M 0055 WRITE(6,10)
15M 0056 WRITE(6,100)
15M 0057 100 FORMAT(/,6X,30HFQUIER TRANSFORM CALCULATIONS)
15M 0058 110 WRITE(6,110) DSTART,DELTA,OMAX
15M 0059 117HDELTA FREQUENCY= ,1PE11.3/,9X,
15M 0060 236HMAXIMUM FREQUENCY TC BE CALCULATED= ,1PE11.3)
15M 0061 *J=1,4),(YTITLE(1),1=1,4),(YTITLE(1),1=1,5),(XTITLE(1),
15M 0062 *9HIMAGINARY,1X))
15M 0063 WRITE(6,130)
15M 0064 130 FORMAT(2(1)X,30(1)H-1))
15M 0065 CALL COLMNS(1,OPTS,OMEGA,FT)
15M 0066 WRITE(6,80) OPTS
15M 0067 140 CONTINUE
15M 0068 IF(IREAD.EQ.0,OR,IREAD.EQ.1) GO TO 200
15M 0069 IF(ICT.EQ.1) GO TO 150
15M 0071 CALL ANDAT(XTITLE,YTITLE,ATITLE,0)
15M 0072 GO TO 160
15M 0073 150 CALL FNTTL(0,XTITLE,YTITLE,ATITLE)
15M 0074 160 WRITE(6,10)
15M 0075 WRITE(6,170)
15M 0076 170 FORMAT(/,6X,28HTIME DERIVATIVE CALCULATIONS)
15M 0077 WRITE(6,180)
15M 0078 180 FORMAT(/,27X,13HDERIVATIVE OF,2(2)X,13HDERIVATIVE OF))
15M 0079 *I=1,3),(YTITLE(1),1=1,3),(YTITLE(1),1=1,3),(XTITLE(1),
15M 0080 *1=1,3),(YTITLE(1),1=1,3),(XTITLE(1),1=1,3),(YTITLE(1),1=1,3)
15M 0081 190 FORMAT(13X,2A4,AZ,4X,3A4,2(1)CX,2A4,AZ,4X,3A4))
15M 0082 WRITE(6,60)
15M 0083 CALL COLMNS(3,MAXPTS,TT,DF)
15M 0084 WRITE(6,80) MAXPTS
15M 0085 200 RETURN
END

```

```

*OPTIONS IN EFFECT*NAME(MAIN) MODOPTIMIZE LINECOUNT(60) SIZE(40500K) AUTOOBLINDONE)
*OPTIONS IN EFFECT*SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGDSINT NOXREF NCALC NCANSF NCTERM FLAG(1)
*OPTIONS IN EFFECT* FUNCTIONS INLINE AREA MORE
*OPTIONS IN EFFECT*
*STATISTICS* SOURCE STATEMENTS = 84, PROGRAM SIZE = 2852, SUBPROGRAM NAME = CTPUT
*STATISTICS* NC DIAGNOSTICS GENERATED
***** END OF COMPILATION *****
192K BYTES OF CORE NOT USED

```

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

DATE 77.325/14.19.15

LEVEL 2.2 (SEPT 76)

REQUESTED OPTIONS: SOURCE, NOMAP, NOXREF, OPT(0)

OPTIONS IN EFFECT: NAME(I,N) MDOPTIMIZE L INECOUNT(60) SIZE(10500K) AUTODBL(ROME)  
 SOURCE EBCDIC MOLLIST MDOCK OBJECT NOMAP MFORMAT MNOGOSTMT MNOXREF MNOALC MNOANSF MNOTERM FLAG(1)

FUNCTIONS INLINE ARE: NCNE

```

15M 0002 SUBROUTINE COLMNS(L,KPTS,X,Y)
15M 0003 COMPLEX FT
15M 0004 DIMENSION X(1),Y(1)
15M 0005 COMMON/D/ DELF, DSTART, OMAX, OMEGA(5000), FT(5000)
15M 0006 IF(L.EQ.2) GO TO 40
15M 0007 IF(L.EQ.3) GO TO 40
15M 0008 INC=KPTS/2
15M 0009 IK=MOD(KPTS,2)
15M 0010 ICOL=INC+1
15M 0011 IF(IK.EQ.0) GO TO 10
15M 0012 IF(IK.EQ.1) GO TO 30
15M 0013
15M 0014
15M 0015
15M 0016
15M 0017 10 WRITE(6,20) (OMEGA(I), FT(I), (MEGA(I+INC), FT(I+INC), I=1, INC)
15M 0018 20 FORMAT(2(11X,1PE11.3,3X,1PE11.3,2X,1PE11.3))
15M 0019 RETURN
15M 0020 30 WRITE(6,20) (OMEGA(I), FT(I), OMEGA(I+ICOL), FT(I+ICOL), I=1, INC)
15M 0021 WRITE(6,20) OMEGA(ICOL), FT(ICOL)
15M 0022 RETURN
15M 0023 INC=KPTS/3
15M 0024 IK=MOD(KPTS,3)
15M 0025 ICOL=INC+1
15M 0026 IF(L.EQ.2) GO TO 90
15M 0027 IF(IK.EQ.0) GO TO 50
15M 0028 IF(IK.EQ.1) GO TO 70
15M 0029 IF(IK.EQ.2) GO TO 80
15M 0030
15M 0031
15M 0032 50 WRITE(6,60) (X(I), Y(I), X(I+INC), Y(I+INC), X(I+2*INC), Y(I+2*INC),
15M 0033 I=1, INC)
15M 0034 60 FORMAT(3(11X,1PE11.3,3X,1PE11.3))
15M 0035 RETURN
15M 0036
15M 0037 70 WRITE(6,60) (X(I), Y(I), X(I+ICOL), Y(I+ICOL), X(I+2*ICOL-1),
15M 0038 Y(I+2*ICOL-1), I=1, INC)
15M 0039 WRITE(6,60) X(ICOL), Y(ICOL)
15M 0040 RETURN
15M 0041 80 WRITE(6,60) (X(I), Y(I), X(I+ICOL), Y(I+ICOL), X(I+2*ICOL),
15M 0042 Y(I+2*ICOL), I=1, INC)
15M 0043 RETURN
15M 0044 90 CONTINUE
15M 0045 IF(IK.EQ.0) GO TO 100
15M 0046 IF(IK.EQ.1) GO TO 130
15M 0047 IF(IK.EQ.2) GO TO 150
15M 0048
15M 0049
15M 0050 100 DO 110 I=1, INC
15M 0051 IINC=I+INC
15M 0052 I2INC=I+2*INC
15M 0053 WRITE(6,120) I, X(I), Y(I), IINC, X(IINC), Y(IINC), I2INC, X(I2INC),
15M 0054 Y(I2INC)
15M 0055 110 CONTINUE
15M 0056 120 FORMAT(3(4X,13,4X,1PE11.3,3X,1PE11.3))
15M 0057 RETURN
15M 0058 130 DO 140 I=1, INC
15M 0059 I1COL=I+ICOL
    
```

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)  
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```

LEVEL 2.2 (SEPT 76) COLUMNS
15M 0059      12ICOL=1+2*ICOL-1
15M 0060      WRITE(6,120) I,X(I),Y(I),IICCL,X(IICOL),Y(IICOL),I2ICOL,X(I2ICOL),
              Y(I2ICOL)
15M 0061      140 CONTINUE
15M 0062      WRITE(6,120) ICOL,X(IICOL),Y(IICOL)
15M 0063      RETURN
15M 0064      150 DO 160 I=1,IMC
15M 0065      IICOL=I+ICOL
15M 0066      12ICOL=1+2*ICOL
15M 0067      WRITE(6,120) I,X(I),Y(I),IICCL,X(IICOL),Y(IICOL),I2ICOL,X(I2ICOL),
              Y(I2ICOL)
15M 0068      160 CONTINUE
15M 0069      12COL=2*ICOL
15M 0070      WRITE(6,120) ICOL,X(IICOL),Y(IICOL),I2COL,X(I2COL),Y(I2COL)
15M 0071      RETURN
15M 0072      END
    
```

```

*OPTIONS IN EFFECT*(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(10500K) AUTOBLINDME)
*OPTIONS IN EFFECT*SOURCE EBCDIC NOLIST NODECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NCANSF NOTERM FLAG(1)
*OPTIONS IN EFFECT* FUNCTIONS INLINE AREA= NONE
*OPTIONS IN EFFECT*
*STATISTICS* SOURCE STATEMENTS = 71, PROGRAM SIZE = 2894, SUBPROGRAM NAME *COLUMNS
*STATISTICS* NO DIAGNOSTICS GENERATED
***** END OF COMPILATION *****
    
```

196K BYTES OF CORE NOT USED

LEVEL 2.2 (SEPT 76)      REQUESTED OPTIONS: SOURCE, NCMAP, NOXREF, OPT(10)      DATE 77.325/14.19.17      PAGE 1

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(160) SIZE(10500K) AUTODBL(MONE)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT NCMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

```

FUNCTIONS IN LINE ARE:  NCFE

ISN 0002 SUBROUTINE PLOTT
ISN 0003 REAL IPFT
ISN 0004 COMPLEX FT
ISN 0005 INTEGER OPTS, FTITLE
ISN 0006 INTEGER XTITLE, YTITLE, ATITLE, TITLE
ISN 0007 COMMON/A/ DRDMIN, IDENT, IFFT, TITLE(20), IPLOT, ILMLOG
ISN 0008 COMMON/B/ T(500), F(500), ALPHA, BETA, TT(5000), FF(5000),
* DF(500), DFF(500)
ISN 0009 COMMON/C/ TMAX, TCUT, NPTS, IPTS, MAXPTS, OPTS, ICUT
ISN 0010 COMMON/D/ DELF, DSTART, DMAX, DPEGA(5000), FT(5000)
ISN 0011 COMMON/E/ A1, A2, A3, A4, C1, CMM1, D2, DMN
ISN 0012 COMMON/F/ RPFT(1000), IPFT(1000), ZABS(1000)
ISN 0013 COMMON/G/ ICURY
ISN 0014 COMMON/H/ IOT, IFRIM, IPRM, IFRPLT
ISN 0015 DIMENSION FTITLE(14), ATITLE(10), XTITLE(10), YTITLE(10)
ISN 0016 DATA FTITLE/10*4H /, ATITLE/10*4H /, XTITLE/10*4H /,
YTITLE/10*4H /
IF(ILNLOG.EQ.2) GO TO 2
L=0
DO J 1=1, MAXPTS
JF(FFT) = LT.ORDMIN) GO TO 1
L=L+1
TT(L) = TT(1)
FF(L) = FF(1)
CONTINUE
1 MAXPTS=L
GO TO 4
2 CONTINUE
DO J 1=1, MAXPTS
JF(FFT) = LT.ORDMIN) TT(J)=0.
3 CONTINUE
4 IF(IOT.EG.1) GO TO 5
CALL ANOTAT(XTITLE, YTITLE, ATITLE, 0)
GO TO 7
5 CALL ENTITL(0, XTITLE, YTITLE, ATITLE)
IF(ICURY.EQ.1) GO TO 8
CALL DRAW4(1, 3, 3, 8, 20, XTITLE, YTITLE, ATITLE, TITLE)
CALL DRAW4(2, 3, 1, ILMLOG, IPTS, -2, 10, 1, 0, 0.)
CALL DRAW4(2, 3, 1, ILMLOG, MAXPTS, 0, 10, 1, 0, 0.)
CALL DRAW4(3, 0, 0, 0, MAXPTS, 11, FF, 2, 0.)
IF(ICURY.EQ.0) GO TO 9
CONTINUE
8 CALL DRAW4(1, 3, 3, 8, 20, XTITLE, YTITLE, ATITLE, TITLE)
CALL DRAW4(2, 3, 1, ILMLOG, MAXPTS, 0, 10, 1, 0, 0.)
CALL DRAW4(3, 0, 0, 0, MAXPTS, 11, FF, 2, 0.)
9 CONTINUE
IF(IFFT.EQ.1) GO TO 20
CALL ANOTAT(XTITLE, YTITLE, ATITLE, 1)
DO IO J=7, 14
    
```

```

ISW 0057      K=J-6
ISW 0058      FTITLE(J)=ATITLE(K)
ISW 0059      CONTINUE
ISW 0060      10  CALL DRAW4(1,3,4,5,14,20,XTITLE,VTITLE,FTITLE,TITLE)
ISW 0061      CALL DRAW4(2,3,2,OPTS,0,10,OMEGA,ZABS,0,0)
ISW 0062      CALL DRAW4(3,0,0,0,0,OPTS,OMEGA,ZABS,2,0)
ISW 0063      20  CONTINUE
ISW 0064      IF(IFFPPLT.EQ.0) GO TO 6C
ISW 0065      IF(IOT.EQ.1) GO TO 30
ISW 0066      CALL ANOTAT(XTITLE,VTITLE,ATITLE,0)
ISW 0067      GO TO 40
ISW 0068      30  CALL ENTITLEC,XTITLE,VTITLE,ATITLE)
ISW 0069      40  CONTINUE
ISW 0070      CALL ANOTAT(XTITLE,VTITLE,FTITLE,2)
ISW 0071      DO 50 J=5,12
ISW 0072      K=J-4
ISW 0073      FTITLE(J)=ATITLE(K)
ISW 0074      CONTINUE
ISW 0075      50  CALL DRAW4(1,3,3,3,12,20,XTITLE,VTITLE,FTITLE,TITLE)
ISW 0076      CALL DRAW4(2,3,1,LOG,MAXPTS,0,10,TT,OFF,0,0)
ISW 0077      CALL DRAW4(3,0,0,0,MAXPTS,TT,OFF,2,0)
ISW 0078      60  RETURN
ISW 0079      END
ISW 0080
ISW 0081

```

```

*OPTIONS IN EFFECT*NAME(MAIN) NDOPTIMIZE LINECOUNT(60) SIZE(OSCOK) AUTOOBL(NONE)
*OPTIONS IN EFFECT*SOURCE EBCDIC NOLIST NODECK OBJECT ADMAP NOFCRMT NCGDSTRT NDRREF NOALC NDANSF NOTERM FLAG(1)
*OPTIONS IN EFFECT* FUNCTIONS INLINE AREA: NONE
*OPTIONS IN EFFECT*
*STATISTICS* SOURCE STATEMENTS = 80, PROGRAM SIZE = 1804, SUBPROGRAM NAME = PLOTT
*STATISTICS* NO DIAGNOSTICS GENERATED
***** END OF COMPILATION *****

```

196K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

DATE 77-325/14-19-20

05/360 FORTRAN M EXTENDED PLUS

LEVEL 2-2 (SEPT 76)

REQUESTED OPTIONS: SOURCE, NOMAP, NOXREF, DPT(6)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(10500K) AUTODBL(NONE)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTRT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

1SN 0002 SUBROUTINE ANDAT(XTITLE, YTITLE, ATITLE, IZ)
1SN 0003 INTEGER TIME, ERAD, YERAD, EVER, YEVER, BAZ, YBAZ, YJRAD, YJVER, SIG
1SN 0004 INTEGER YSIG, FOUR, YFOUR, YDER, YDRIV, YFOR
1SN 0005 INTEGER XTITLE, YTITLE, ATITLE, TITLE
1SN 0006 COMMON/A/ DRDMIN, IDENT, JFFT, TITLE(20), IPLDT, ILMLOG
1SN 0007 COMMON/H/ IOT, IPRIM, IPRM, IPRPLT
1SN 0008 DIMENSION ATITLE(8), XTITLE(4), YTITLE(5)
1SN 0009 . . . YBAZ(5), YJRAD(8), YJVER(5), YJVER(8), YJVER(5), YJVER(8),
. . . YSIG(5), YFOUR(8), YFOUR(4), YFOUR(5), YDER(5), YDRIV(8),
. . . YFOR(5)
1SN 0010 DATA TIME/4HTIME, 4H (SE,4HC) , 4H /
. . . ERAD/4HELEC, 4HTRIC, 4H FIE, 4HLD S, 4HTREN, 4HGTH-, 4HRADI, 4HAL /
. . . YERAD/4HE-RA, 4HDIAL, 3*4H /
. . . EVER/4HELEC, 4FTRIC, 4H FIE, 4FLD S, 4HTREN, 4HGTH-, 4HVERT, 4HICAL /
. . . YEVER/4HE-VE, 4HTRIC, 4HAL , 2*4H /
. . . BAZ/4HMAGN, 4HETIC, 4H IND, 4HUCTI, 4HON-A, 4HZIMU, 4HTHAL, 4H /
. . . YBAZ/4HB-AZ, 4HMUT, 4HHAL , 2*4H /
. . . YJRAD/4HCURR, 4HEHT , 4HDEK S, 4FITV-, 4HRADI, 4HAL , 2*4H /
. . . YJVER/4HJ-RA, 4HCIAL, 3*4H /
. . . YJVER/4HCURR, 4HEHT , 4HDEK S, 4FITV-, 4HRADI, 4HAL , 2*4H /
. . . YJVER/4HJ-VE, 4HTRIC, 4HAL , 2*4H /
. . . SIG/4HAIR , 4HCOND, 4HUCTI, 4HVITY, 4*4H /
. . . YSIG/4HSIGN, 4HA , 3*4H /
. . . FOUR/4H F, 4HOURI, 4HER T, 4HRANS, 4HFORM, 4H OF , 2*4H /
. . . YFOUR/4HFREQ, 4HUENC, 4HY (HZ, 4H) /
. . . YFOR/4HAMPL, 4HITUD, 4HE (V, 4HM/HZ, 4H) /
. . . YDER/4HAMPL, 4HITUD, 4HE , 2*4H /
. . . YDR/4HDERI, 4HVATI, 4HVE , 2*4H /
. . . DRIV/4H DE, 4HRIVA, 4RTIVE, 4F OF , 4*4H /
IF(IZ-.EQ.1) GO TO 200
DO 10 I=1,4
XTITLE(I)=TIME(I)
10 CONTINUE
IF(IZ-.EQ.2) GO TO 240
GO TO (20,50,80,110,140,170), IDENT
DO 30 I=1,8
ATITLE(I)=ERAD(I)
30 CONTINUE
DO 40 I=1,5
YTITLE(I)=YERAD(I)
40 CONTINUE
RETURN
DO 60 I=1,8
ATITLE(I)=EVER(I)
60 CONTINUE
DO 70 I=1,5
YTITLE(I)=YEVER(I)
70 CONTINUE
RETURN
    
```

```

180 DD 90 I=1,8
    ATITLE(I)=BAZ(I)
190 CONTINUE
    DD 100 I=1,5
    YTITLE(I)=YBAZ(I)
100 CONTINUE
    RETURN
110 DD 120 I=1,8
    ATITLE(I)=JRAD(I)
120 CONTINUE
    DD 130 I=1,5
    YTITLE(I)=YJRAD(I)
130 CONTINUE
    RETURN
140 DD 150 I=1,8
    ATITLE(I)=JVER(I)
150 CONTINUE
    DD 160 I=1,5
    YTITLE(I)=YJVER(I)
160 CONTINUE
    RETURN
170 DD 180 I=1,8
    ATITLE(I)=SIG(I)
180 CONTINUE
    DD 190 I=1,5
    YTITLE(I)=YSIG(I)
190 CONTINUE
    RETURN
200 CONTINUE
    DD 210 I=1,8
    ATITLE(I)=FOUR(I)
210 CONTINUE
    DD 220 I=1,4
    XTITLE(I)=XFOUR(I)
220 CONTINUE
    IF (IDENT.EQ.1.OR.IDENT.EQ.2) GO TO 235
    DD 237 I=1,5
    YTITLE(I)=YFQR(I)
237 CONTINUE
    RETURN
235 CONTINUE
    DD 230 I=1,5
    YTITLE(I)=YFQR(I)
230 CONTINUE
    RETURN
240 CONTINUE
    DD 250 I=1,5
    YTITLE(I)=YDER(I)
250 CONTINUE
    DD 260 I=1,8
    ATITLE(I)=DRIV(I)
260 CONTINUE
    RETURN
    END

```

\*OPTIONS IN EFFECT=NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODOBLINDNE)

\*OPTIONS IN EFFECT=SOURCE EBCDIC NDLIST NOCHECK OBJECT NDMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

LISTING OF EHPPFIT AND SAMPLE RUN (cont'd)

REQUESTED OPTIONS: SOURCE, NCMAP, NOXREF, OPT(10)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(NONE)  
SOURCE EBCDIC NDLIST NDLIST NOCHECK OBJECT NDMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NCNE

```

1SN 0002 SUBROUTINE FLINE(SUM,W,T,Y,MT)
1SN 0003 DIMENSION T(1),Y(1)
1SN 0004 COMPLEX AA,AB,AC,F3,F4,SUM
1SN 0005 SUM=(0.0,C.0)
1SN 0006 IF(M.EQ.0.0) GO TO 101
1SN 0007 AA=1.0
1SN 0008 IF(ABS(W*T(1)).GE.8.231E+5) GO TO 10
1SN 0009 AA=CMPLX(COS(W*T(1)),-SIN(W*T(1)))
1SN 0010 CONTINUE
10 DO 100 I=2,MT
1SN 0011 DT=T(I)-T(I-1)
1SN 0012 AB=1.0
1SN 0013 IF(ABS(W*T(I)).GE.8.231E+5) GO TO 20
1SN 0014 AB=CMPLX(COS(W*T(I)),-SIN(W*T(I)))
20 CONTINUE
1SN 0015 WDT=W*DT
1SN 0016 C THE BREAKPOINT BETWEEN LARGE- AND SMALL-ARGUMENTS SHOULD BE 1.0E-N,
1SN 0017 C WHERE N=(D-4)/8, WHERE D = NUMBER OF DIGITS CARRIED BY THE COMPUTER.
1SN 0018 C THE AMPLITUDE ACCURACY OF THE LARGE ARGUMENT PROCEDURE IS D-2N DIGITS
1SN 0019 C AND OF THE SMALL-ARGUMENT PROCEDURE IS 6W+4 DIGITS.
1SN 0020 IF(ABS(WDT).GT.5.0E-2) GO TO 50
1SN 0021 G=WDT**2
1SN 0022 AC= G * (CMPLX(0.5,-(1.0/3.0)*WDT)+C*(CMPLX(-0.125,(1.0/30.0)*WDT
1SN 0023 *-1)*G*CMPLX(1.0/144.0),-(1.0/840.0)*WDT))
1SN 0024 F3=CONJG(AC)*AB
1SN 0025 F4=AC*AA
1SN 0026 GO TO 60
1SN 0027 AC=CMPLX(1.0,WDT)
1SN 0028 F4=AC*AB-AA
1SN 0029 F3=CONJG(AC)*AA-AB
1SN 0030 SUM=SUM+(F3*Y(I-1)+F4*Y(I))/(WDT*W)
1SN 0031 AA=AB
1SN 0032 RETURN
1SN 0033 DO 102 J=2,MT
1SN 0034 SUM=SUM+0.5*(Y(J-1)+Y(J))*T(J)-T(J-1))
1SN 0035 RETURN
1SN 0036 END
1SN 0037

```

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(NONE)

OPTIONS IN EFFECT: SOURCE EBCDIC NDLIST NDLIST NOCHECK OBJECT NDMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NCNE

OPTIONS IN EFFECT:

STATISTICS: SOURCE STATEMENTS = 36, PROGRAM SIZE = 1876, SUBPROGRAM NAME = FLINE

STATISTICS: NO DIAGNOSTICS GENERATED

REQUESTED OPTIONS: SOURCE=NCMAP,NXREF,OPT(0)  
 OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LIMECOUNT(60) SIZE(10500K) AUTOBLINDNE)  
 SOURCE EBCDIC NCLIST NOCHECK OBJECT NMAP NCFORMAT NOGOSTMT NOXREF NCALC NOANSF MOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

15M 0002 SUBROUTINE AIA3(A1,A3,C1)
15M 0003 REAL K1,K2
15M 0004 COMMON/8/ T(500),F(500),ALPHA,BETA,TT(5000),FF(5000),
15M 0005 COMMON/J/ALFA,BE,AL,BE,LA1,LA2
15M 0006 DF2=F(3)-F(2)
15M 0007 DT2=T(3)-T(2)
15M 0008 DT1=T(2)-T(1)
15M 0009 K1=DF2/DT2+.5*(BN(2)+BN(3))*CT1-ALPHA*F(2)
15M 0010 K2=BN(2)+BN(3)-(ALPHA**2)*F(2)
15M 0011 ARG1=2.*ALPHA*T(2)
15M 0012 AL=ALPHA
15M 0013 IF(ABS(ARG1))-LT.174.) GO TO 10
15M 0014 ALFA=174./12.*T(2)
15M 0015 LA1=1
15M 0016 ALPHA=ALFA
15M 0017 ARG1=2.*ALPHA*T(2)
15M 0018 ARG2=-ALPHA*T(2)
15M 0019 EXA2=EXP(ARG1)
15M 0020 EXA=EXP(ARG2)
15M 0021 A3=(K1+K2*DT2/6.)/((ALPHA**2)*DT2/2.+ALPHA)*EXA2)
15M 0022 A1=(F(2)-A3*EXA2)*EXA
15M 0023 RMUM=K1+K2*DT2/6.
15M 0024 RDENOM=((ALPHA**2)*DT2/2.+ALPHA
15M 0025 C1=(K2-3.*(ALPHA**2)*(BNLM/RDENOM))/6.*(DT2**2))
15M 0026 RETURN
15M 0027 END
15M 0028

```

\*OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LIMECOUNT(60) SIZE(10500K) AUTOBLINDNE)  
 \*OPTIONS IN EFFECT: SOURCE EBCDIC NCLIST NOCHECK OBJECT NMAP NCFORMAT NOGOSTMT NOXREF NCALC NOANSF MOTERM FLAG(1)  
 \*OPTIONS IN EFFECT: FUNCTIONS INLINE ARE: NONE  
 \*OPTIONS IN EFFECT:  
 \*STATISTICS: SOURCE STATEMENTS = 27, PROGRAM SIZE = 992, SUBPROGRAM NAME = AIA3  
 \*STATISTICS: NO DIAGNOSTICS GENERATED  
 \*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED

LEVEL 2.2 (SEPT 76)

DS/360 FORTRAN H EXTENDED PLUS

REQUESTED OPTIONS: SOURCE,NOMAP,NOXREF,OPT(10)

OPTIONS IN EFFECT: NAME(MAIN) NDOPTIMIZE LINECOUNT(160) SIZE(10500K) AUTODBL(NONE)  
 SOURCE EBCDIC MOLLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(11)

FUNCTIONS INLINE ARE: NONE

```

1SN 0002 SUBROUTINE A2A4(A2,A4,DNN)
1SN 0003 REAL K3,K4
1SN 0004 COMMON/B/ T(1500),F(1500),ALPHA,BETA,T(15000),FF(15000),
, DF(1500),DEF(1500)
COMMON/C/ THAX,TCUT,NPTS,MPTS,IPTS,MAXPTS,OPTS,ICUT
COMMON/J/ALFA,BET,AL,BE,LA1,LA2
DFM=F(NPTS)-F(MPTS-1)
DTN=T(NPTS)-T(MPTS-1)
K3=-DFM/DTN-.5*(DM(NPTS)+DM(MPTS-1))*DTN-BETA*(F(NPTS)
K4=(BETA**2)*F(NPTS)-(DM(NPTS)+DM(MPTS-1))
BE=BETA
ARG1=-2.*BETA*(NPTS)
IF(ABS(ARG1).LT.174.) GO TO 10
LA2=1
BET=174./(-2.*T(NPTS))
BETA=BET
10 ARG1=-2.*BETA*(NPTS)
ARG2=BETA*(NPTS)
EXB2=EXP(ARG1)
EXB=EXP(ARG2)
A4=(K3-K4*DTN/6.)/(BETA*(BETA**2)*DTN/2.)*EXB2
A2=(F(NPTS)-A4*EXB2)*EXB
RNUM=K3-K4*DTN/6.
RDENOM=BETA*(BETA**2)*DTN/2.
DNN=(K4**3.*(BETA**2)*(RNUM/RDENOM))/16.*(DTN**2))
RETURN
END
    
```

OPTIONS IN EFFECT: NAME(MAIN) NDOPTIMIZE LINECOUNT(160) SIZE(10500K) AUTODBL(NONE)

OPTIONS IN EFFECT: SOURCE EBCDIC MOLLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(11)

OPTIONS IN EFFECT: FUNCTIONS INLINE ARE: NONE

OPTIONS IN EFFECT:

STATISTICS: SOURCE STATEMENTS = 27, PROGRAM SIZE = 1182, SUBPROGRAM NAME = A2A4

STATISTICS: NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED

LEVEL 2.2 (SEPT 76) CS/360 FORTRAN H EXTENDED PLUS DATE 77.325/14.19.28 PAGE 1

REQUESTED OPTIONS: SOURCE, NMAP, NOXREF, OPT(0)  
 OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(MONE)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT NMAP NOFORMAT NOCGSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NCNE

```

15N 0002 FUNCTION BM(1)
15N 0003 COMMON/B/ T(500),F(500),ALPHA,BETA,TT(5000),FF(5000),
      , DF(500),DFF(5000)
15N 0004 JF(1),NE(2) GO TO 10
15N 0005 DF2=F(3)-F(2)
15N 0006 DT2=T(3)-T(2)
15N 0007 D1=DFF2/DT2
15N 0008 BN=(D1-ALPHA*F(2))/(1./DT2)
15N 0009 RETURN
15N 0010
15N 0011 10 IF(1-NE,MPTS) GO TO 20
15N 0012 DFN=F(MPTS)-F(MPTS-1)
15N 0013 DTM=T(MPTS)-T(MPTS-1)
15N 0014 D2=DFN/DTM
15N 0015 BN=(D2-BETA*F(MPTS)-D2)/(1./DTM)
15N 0016 RETURN
15N 0017
15N 0018 20 DFP=F(1+1)-F(1)
15N 0019 FD=F(1)-F(1-1)
15N 0020 DTP=T(1+1)-T(1)
15N 0021 DT=T(1)-T(1-1)
15N 0022 BN=(DFP/DTP-FD/DT)/(1./((T(1+1)-T(1-1))))
15N 0023 RETURN
15N 0024 END
15N 0025

```

\*OPTIONS IN EFFECT:NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(MONE)  
 \*OPTIONS IN EFFECT:SOURCE EBCDIC NOLIST NOCHECK OBJECT NMAP NOFORMAT NOCGSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)  
 \*OPTIONS IN EFFECT: FUNCTIONS IN LINE ARE: NONE  
 \*OPTIONS IN EFFECT:  
 \*STATISTICS: SOURCE STATEMENTS = 24, PROGRAM SIZE = 834, SUBPROGRAM NAME = BN  
 \*STATISTICS: MC DIAGNOSTICS GENERATED  
 \*\*\*\*\* END OF COMPILATION \*\*\*\*\*  
 212K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

LEVEL 2-2 (SEPT 76)

DATE 77.325/14.19.30

REQUESTED OPTIONS: SOURCE, NMAP, NOXREF, OPT(0)

OPTIONS IN EFFECT: MARE(MAIN) NCOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(MONE)  
 SOURCE EBCDIC NOLIST NDECK OBJECT NMAP NDFORMAT NDCSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NONE

```

15N 0002 FUNCTION CM(J)
15N 0003 COMMON/B/ T(500),F(500),ALPHA,BETA,TT(5000),FF(5000),
      * DF(500),CFF(5000),
15N 0004 COMMON/C/ TMAX,TCUT,NPTS,MPIS,IPTS,MAXPTS,OPTS,ICUT
15N 0005 COMMON/E/ A1,A2,A3,A4,C1,CMR1,D2,DNN
15N 0006 IF(J.EQ.2) GO TO 10
15N 0007 DTN=T(J)-T(J-1)
15N 0008 DTP1=T(J+1)-T(J)
15N 0009 DTP2=T(J+1)-T(J-1)
15N 0010 CN=(-DELFI(J)+DELF2(J)*DTN/6.)/((DTP1**2)+DTP2)
15N 0011 IF(J.NE.NPTS-1) RETURN
15N 0012 CM(J)=CN
15N 0013 RETURN
15N 0014 CM(J)=CN
15N 0015 RETURN
15N 0016 CN=C1
15N 0017 RETURN
15N 0018 END
    
```

\*OPTIONS IN EFFECT: MARE(MAIN) NCOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(MONE)  
 \*OPTIONS IN EFFECT: SOURCE EBCDIC NOLIST NDECK OBJECT NMAP NDFORMAT NDCSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NONE

\*STATISTICS: SOURCE STATEMENTS = 17, PROGRAM SIZE = 562, SUBPROGRAM NAME = CN

\*STATISTICS: NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

REQUESTED OPTIONS: SOURCE, NDMAP, NOXREF, OPT(0)  
OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(NONE)  
SOURCE EBCDIC MOLIST AGDECK OBJECT NDMAP MOPFRMAT MCGOSTMT NOXREF NOALC NMANSE NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

1SM 0002      FUNCTION DM(LJ)
1SM 0003      COMMON/B/ T(1500),F(500),ALPHA,BETA,TT(5000),FF(5000),
              DF(500),OFF(5000)
1SM 0004      COMMON/E/ A1,A2,A3,A4,A5,CI,CM11,D2,DNN
1SM 0005      DTM=T(J)-T(J-1)
1SM 0006      DTP2=T(J+1)-T(J-1)
1SM 0007      DN=(-DELFI(J)-DELFI(J+1))/((IDIM**2)*DTP2)
1SM 0008      IF(J.NE.3) RETURN
1SM 0009      D2=DN
1SM 0010      RETURN
1SM 0011      END
1SM 0012

```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(NONE)  
\*OPTIONS IN EFFECT\*SOURCE EBCDIC MOLIST AGDECK OBJECT NDMAP MOPFRMAT MCGOSTMT NOXREF NOALC NMANSE NOTERM FLAG(1)  
\*OPTIONS IN EFFECT\* FUNCTIONS INLINE ARE: NONE  
\*OPTIONS IN EFFECT\*  
\*STATISTICS\* SOURCE STATEMENTS = 11, PROGRAM SIZE = 466, SUBPROGRAM NAME = DN  
\*STATISTICS\* MC DIAGNOSTICS GENERATED  
\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

DATE 77-325/14,19,33

LEVEL 2.2 (SEPT 76)

CS/360 FORTRAN H EXTENDED PLUS

REQUESTED OPTIONS: SOURCE,NCHAP,NDXREF,OPT(10)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(10500K) AUTOCBL(INCH)  
 SOURCE EBCDIC NOLIST NODECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

1SN 0002 FUNCTION DELF1(J)
1SN 0003 ,COMMON/8/ T(500),F(500),ALPHA,BETA,T(15000),FF(5000),
          DF(500),DFF(5000)
1SN 0004 DFPI=F(IJ*1)-F(IJ)
1SN 0005 DFN=F(IJ)-F(IJ-1)
1SN 0006 DFP1=T(IJ*1)-T(IJ)
1SN 0007 DTN=T(IJ)-T(IJ-1)
1SN 0008 R1=.5*(BN(IJ)+BN(J+1))*DTPI
1SN 0009 R2=.5*(BN(IJ)+BN(J-1))*DTM
1SN 0010 DELF1=DFPI/DTPI-DFN/DTN-R1-R2
1SN 0011 RETURN
1SN 0012 END
    
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(10500K) AUTOCBL(NONE)

\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NODECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT\* FUNCTIONS INLINE ARE: NONE

\*OPTIONS IN EFFECT\*

\*STATISTICS\* SOURCE STATEMENTS = 11, PROGRAM SIZE = 584, SUBPROGRAM NAME = DELF1

\*STATISTICS\* NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)  
 CS/360 FORTRAN M EXTENDED PLUS DATE 77.325/14.19.35 PAGE 1

LEVEL 2.2 (SEPT 76)

REQUESTED OPTIONS: SOURCE\*NO\*MAP\*NOXREF\*OPT(0)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LIMECCOUNT(60) SIZE(0500K) AUTODBL(NONE)  
 SOURCE EBCDIC NOLIST NNODECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NCME

```

15M 0002 FUNCTION DELF2(J)
15M 0003   DELF2=0M(J*1)-BNEJ-1)
15M 0004   RETURN
15M 0005   END
    
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LIMECCOUNT(60) SIZE(0500K) AUTODBL(NONE)

\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NNODECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT\* FUNCTIONS INLINE ARE: NCME

\*OPTIONS IN EFFECT\*

\*STATISTICS\* SOURCE STATEMENTS = 4, PROGRAM SIZE = 306, SUBPROGRAM NAME = DELF2

\*STATISTICS\* NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

222K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

REQUESTED OPTIONS: SOURCE,NOMAP,NORREF,OPT(0)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(NONE)

SOURCE EBCDIC NOLIST NODECK OBJECT NOMAP NOFORMAT NOGOSTMT NORREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

ISM 0002 SUBROUTINE ENTTL(I2,XLAB,YLAB,PLAB)
ISM 0003 INTEGER XTITLE,YTITLE,ATITLE
ISM 0004 INTEGER XLAB,YLAB,PLAB
ISM 0005 COMMON/I/ XTITLE(I0),YTITLE(I10),ATITLE(I10)
ISM 0006 DIMENSION XLAB(I0),YLAB(I0),PLAB(I0)
ISM 0007 IF(I2-EQ-0) GO TO 40
ISM 0008 READ(5,10) (XTITLE(I),I=1,3)
ISM 0009 FORMAT(3A4)
ISM 0010 READ(5,20) (YTITLE(I),I=1,5)
ISM 0011 FORMAT(5A4)
ISM 0012 READ(5,30) (ATITLE(I),I=1,10)
ISM 0013 FORMAT(10A4)
ISM 0014 RETURN
ISM 0015 40 CONTINUE
ISM 0016 DO 50 I=1,3
ISM 0017 XLAB(I)=XTITLE(I)
ISM 0018 DO 60 J=1,5
ISM 0019 YLAB(J)=YTITLE(I)
ISM 0020 DO 70 K=1,10
ISM 0021 PLAB(K)=ATITLE(I)
ISM 0022 RETURN
ISM 0023 END
ISM 0024
    
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(NONE)

\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NODECK OBJECT NOMAP NOFORMAT NOGOSTMT NORREF NOALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT\* FUNCTIONS INLINE ARE: NONE

\*OPTIONS IN EFFECT\*

\*STATISTICS\* SOURCE STATEMENTS = 23, PROGRAM SIZE = 724, SUBPROGRAM NAME =ENTTL

\*STATISTICS\* NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED



LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

```

15N 0044      60 IF(IJ.EQ.JPTS.AND.T(IJ).EQ.BLANK) K=K+1
15N 0046      70 CONTINUE
15N 0047      JPTS=K-1
C
C ADD SPECIFIED POINTS
C
15N 0048      80 IF(IADD.EQ.0) GO TO 130
15N 0050      DO 120 I=1,NIADD
15N 0051      K=1
15N 0052      DO 110 J=1,JPTS
15N 0053      T(K)=T(IJ)
15N 0054      F(K)=F(IJ)
15N 0055      IF(T(IJ).GE.T(IJ).AND.TX(IJ).LE.T(IJ+1)) GO TO 90
15N 0057      IF(J.EQ.JPTS.AND.TX(IJ).GE.T(IJ+1)) GO TO 90
15N 0059      GO TO 100
15N 0060      90 K=K+1
15N 0061      T(K)=T(IJ)
15N 0062      F(K)=F(IJ)
15N 0063      100 K=K+1
15N 0064      110 CONTINUE
15N 0065      JPTS=K-1
15N 0066      120 CONTINUE
C
C DELETE FIRST POINT IF TIME OR AMPLITUDE EQUAL TO ZERO
C
15N 0067      130 IF(T(1).NE.0..AND.F(1).NE.0.) GO TO 150
15N 0069      DO 140 I=2,JPTS
15N 0070      T(I-1)=T(I)
15N 0071      F(I-1)=F(I)
15N 0072      140 CONTINUE
15N 0073      JPTS=JPTS-1
15N 0074      150 CONTINUE
15N 0075      DO 200 I=1,JPTS
15N 0076      K=JPTS+2-I
15N 0077      T(K)=T(K-1)
15N 0078      F(K)=F(K-1)
15N 0079      200 CONTINUE
15N 0080      IPTS=JPTS
15N 0081      NPIS=JPTS+1
15N 0082      RETURN
15N 0083      END

```

```

*OPTIONS IN EFFECT*NAME(MAIN) NDOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBLINDNEI
*OPTIONS IN EFFECT*SOURCE EBCDIC NOLIST NDECK NMAP NDFORMAT NUGOSTMT NOXREF NOALC MUANSF NOTERM FLAG(1)
*OPTIONS IN EFFECT* FUNCTIONS INLINE ARE: NONE
*OPTIONS IN EFFECT*
*STATISTICS* SOURCE STATEMENTS = 82, PROGRAM SIZE = 2070, SUBPROGRAM NAME =PERFIL
*STATISTICS* NO DIAGNOSTICS GENERATED
***** END OF COMPILATION *****

```

196K BYTES OF CORE NOT USED

REQUESTED OPTIONS: SOURCE, NOMAP, NOXREF, OPT(0)  
 OPTIONS IN EFFECT: NAME(MAIN) NDOPTIMIZE LINE(COUNT(60) SIZE(10500K) AUT(CBLINONE)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NDALC NOANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NONE

```

1SN 0002 SUBROUTINE DERIV
1SN 0003 COMMON/B/ T(500),F(500),ALPHA,BETA,T(15000),FF(5000),
    , DF(500),DEF(500)
1SN 0004 COMMON/C/ TMAX,ICUT,APTS,MPTS,IPTS,MAXPTS,OPTS,ICUT
1SN 0005 COMMON/E/ A1,A2,A3,A4,C1,CNH1,D2,DNN
1SN 0006 COMMON/H/ IOT,IFPRIM,IPERM,IFPPLT
1SN 0007 COMMON/K/ TX(100),FY(100),IREAD,IOELET,IADD,NIADD,NSETS,NUM(8)
1SN 0008 DF(1)=0.
1SN 0009 DF(1)=0.
1SN 0010 IF(IFPRIM.EQ.2) GO TO 40
1SN 0011 DO 30 I=2,MPTS
1SN 0012 IF(T(I).NE.T(I2)) GO TO 10
1SN 0013 DF(I)=ALPHA*(F(I)+A3*EXP(2.*ALPHA*T(I)))
1SN 0014 GO TO 30
1SN 0015
1SN 0016
1SN 0017
1SN 0018
1SN 0019
1SN 0020
1SN 0021
1SN 0022
1SN 0023
1SN 0024
1SN 0025
1SN 0026
1SN 0027
1SN 0028
1SN 0029
1SN 0030
1SN 0031
1SN 0032
1SN 0033
1SN 0034
1SN 0035
1SN 0036
1SN 0037
1SN 0038
1SN 0039
1SN 0040
1SN 0041
1SN 0042
1SN 0043
1SN 0044
1SN 0045
1SN 0046
1SN 0047
1SN 0048
1SN 0049
1SN 0050
1SN 0051
1SN 0052
1SN 0053
1SN 0054
1SN 0055
1SN 0056
1SN 0057
1SN 0058
10 IF(T(I).NE.T(MPTS)) GO TO 20
    DF(I)=-BETA*(F(I)+A4*EXP(-2.*BETA*T(I)))
    GO TO 30
20 FT=(F(I)-F(I-1))/(T(I)-T(I-1))
    BT=(T(I)-T(I-1))
    DT=-((T(I)-T(I-1)))**3
    DF(I)=FT+.5*(BN(I-1)+BN(I))*BT*DN(I)*DT
    RETURN
30 CONTINUE
40 CONTINUE
    I=2
    J=2
50 CONTINUE
    IF(T(I).GT.T(J)) J=J+1
    IF(T(I).GT.T(2)) GO TO 60
    DF(I)=ALPHA*(FF(I)+A3*EXP(2.*ALPHA*T(I)))
    I=I+1
    GO TO 50
60 IF(T(I).LT.T(MPTS)) GO TO 70
    DF(I)=-BETA*(FF(I)+A4*EXP(-2.*BETA*T(I)))
    IF(T(I).GE.TMAX) GO TO 100
    I=I+1
    GO TO 50
70 FT=(F(I)-F(J))/(T(I)-T(J)-1)
    BT=(T(I)-T(J)+T(I)-T(J)-1)
    CT=(T(I)-T(J))**3-3.*T(I)*T(J)-T(I)-T(J))**2
    DT=-((T(I)-T(J)-1))**3+3.*T(I)*T(J)-T(I)-T(J)-1)**2
    IF(J.NE.MPTS) GO TO 80
    CALL A2A4(4U,V,D)
    GO TO 90
80 D=DN(J)
90 DF(I)=FT+.5*(BN(J-1)+BN(J))*BT*CN(J-1)*CT*D*DT
    I=I+1
    GO TO 50
100 RETURN
    END
    
```

REQUESTED OPTIONS: SOURCE,NOMAP,NOMREF,OPT(0)
OPTIONS IN EFFECT: NAME(MAIN) NDOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(INONE)
SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

```
FUNCTIONS INLINE ARE: NONE
SUBROUTINE RITDAT
INTEGER TITLE
COMMON/ A / URDMIN,IDENT,IFFT,TITLE(20),IPLDT,ILMLDG
COMMON/ B / T(500),F(500),ALPHA,BETA,T(15000),FF(5000),
, DF(500),DFF(5000)
COMMON/ C / TMAX,TCUT,MPTS,MPTS,IPTS,MAXPTS,GPTS,ICUT
COMMON/ H / IOT,JFPRIM,IPERM,IPPLT
DIMENSION XTITLE(10),YTITLE(10),ATITLE(10)
DATA XTITLE/10*4H /,YTITLE/10*4H /,ATITLE/10*4H /
GO TO (10,60,10),IPERM
10 CONTINUE
IF(IOT.EQ.1) GO TO 20
CALL ANDTAT(XTITLE,YTITLE,ATITLE,2)
GO TO 30
20 CALL ENTITL(0,XTITLE,YTITLE,ATITLE)
30 IF(IFPRIM.EQ.2) GO TO 40
CALL WRITPF(11,T,DF,IPTS,ATITLE)
GO TO 50
40 CALL WRITPF(11,TT,DF,MAXPTS,ATITLE)
50 IF(IPERM.NE.3) RETURN
60 CONTINUE
IF(IOT.EQ.1) GO TO 70
CALL ANDTAT(XTITLE,YTITLE,ATITLE,0)
GO TO 80
70 CALL ENTITL(0,XTITLE,YTITLE,ATITLE)
80 CALL WRITPF(10,TT,FF,MAXPTS,ATITLE)
RETURN
END
15N 0002
15N 0003
15N 0004
15N 0005
15N 0006
15N 0007
15N 0008
15N 0009
15N 0010
15N 0011
15N 0012
15N 0014
15N 0015
15N 0016
15N 0017
15N 0019
15N 0020
15N 0021
15N 0022
15N 0024
15N 0025
15N 0027
15N 0028
15N 0029
15N 0030
15N 0031
15N 0032
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NDOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(INONE)
\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NOCHECK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)
\*OPTIONS IN EFFECT\* FUNCTIONS INLINE ARE: NONE
\*STATISTICS\* SOURCE STATEMENTS = 31, PROGRAM SIZE = 710, SUBPROGRAM NAME =RITDAT
\*STATISTICS\* NL DIAGNOSTICS GENERATED
\*\*\*\*\* END OF COMPILATION \*\*\*\*\*
208K BYTES OF CORE NOT USED

LEVEL 2.2 (SEPT 76) DS/360 FURTRAN H EXTENDED PLUS

REQUESTED OPTIONS: SOURCE, NEMAP, NOXREF, OPT10)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(10500K) AUTOOBL(NONE)  
 SOURCE EBCDIC NOLIST NOCHECK OBJECT ACMAP NOFCRMAP NOGOSTMT NOXREF NDALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NONE

```

1SN 0002 SUBROUTINE READPF(NT,NSETS,X,Y,JPTS)
1SN 0003 DIMENSION XL(JPTS),YL(JPTS)
1SN 0004 DO 10 J=1,NSETS
1SN 0005 READ (NT) NI,NZ,JPTS,(X(I),A,I=1,JPTS),(Y(I),B,I=1,JPTS)
1SN 0006 10 CONTINUE
1SN 0007 RETURN
1SN 0008 END

```

\*OPTIONS IN EFFECT=NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(10500K) AUTOOBL(NONE)

\*OPTIONS IN EFFECT=SOURCE EBCDIC NOLIST NOCHECK OBJECT ACMAP NOFCRMAP NOGOSTMT NOXREF NDALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT= FUNCTIONS INLINE ARE: NONE

\*OPTJMS IN EFFECT=

\*STATISTICS= SOURCE STATEMENTS = 7, PROGRAM SIZE = 540, SUBPROGRAM NAME =READPF

\*STATISTICS= NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

DATE 77.325/14.19.47

CS/360 FORTRAN H EXTENDED PLUS

LEVEL 2.2 (SEPT 76)

REQUESTED OPTIONS: SOURCE, NDMAP, NOXREF, OPT(0)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODOBL(MDNE)  
SOURCE EBCDIC NOLIST NODECK OBJECT NDMAP NOFORNAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NONE

```

1SM 0002 SUBROUTINE WRITPF(INT,X,Y,MPTS,ATITLE)
1SM 0003 DIMENSION X(NPTS),Y(NPTS),ATITLE(10)
1SM 0004 WRITE(INT) ATITLE
1SM 0005 WRITE(INT) NPTS
1SM 0006 WRITE(INT) X,Y
1SM 0007 RETURN
1SM 0008 END

```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODOBL(MDNE)

\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NODECK OBJECT NDMAP NOFORNAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT\* FUNCTIONS IN LINE ARE: NONE

\*OPTIONS IN EFFECT\*

\*STATISTICS\* SOURCE STATEMENTS = 7, PROGRAM SIZE = 446, SUBPROGRAM NAME =WRITPF

\*STATISTICS\* NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)  
 LEVEL 2-2 (SEPT 76) CS/360 FORTRAN H EXTENDED PLUS DATE 77.325/14.19.49 PAGE 3

REQUESTED OPTIONS: SOURCE,NOMAP,NOXREF,OPT(0)  
 OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(NONE)  
 SOURCE EBCDIC NOLIST NODCK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS IN LINE ARE: NLME

```

1SN 0002 SUBROUTINE CUTOFF
1SN 0003 COMMON/B/ T(500),F(500),ALPHA,BETA,TT(5000),FF(5000),
* DF(500),DFF(5000)
1SN 0004 COMMON/C/ TMAX,TCUT,NPTS,MPTS,IPTS,MAXPTS,DPTS,ICUT
1SN 0005 DO 10 I=2,MPTS
1SN 0006 IF(T(I)-GE-TCUT) GO TO 20
1SN 0007 10 CONTINUE
1SN 0008 20 MPTS=I
1SN 0009 IPTS=NPTS-1
1SN 0010 RETURN
1SN 0011 END
1SN 0012
    
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTOOBL(NONE)

\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NODCK OBJECT NOMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT\* FUNCTIONS IN LINE ARE: NLME

\*OPTIONS IN EFFECT\*

\*STATISTICS\* SOURCE STATEMENTS = 11, PROGRAM SIZE = 284, SUBPROGRAM NAME =CUTOFF

\*STATISTICS\* NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

212K BYTES OF CORE NOT USED

APPENDIX A

LEVEL 2-2 (SEPT 76)

05/360 FORTRAN H EXTENDED PLUS

DATE 77.325/14.19.51

PAGE 1

REQUESTED OPTIONS: SOURCE, NMAP, NOXREF, OPT(0)

OPTIONS IN EFFECT: NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(NONE)  
 SOURCE EBCDIC NOLIST NODECK OBJECT NMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

FUNCTIONS INLINE ARE: NCNE

```

1SN 0002      BLOCK DATA
1SN 0003      INTEGER TITLE
1SN 0004      COMMON/A/IDENT,IFFT,TITLE(20),IPLDT,ILMLOG,ORDMIN
1SN 0005      COMMON/J/ALFA,BET,AL,BE,LAI,LA2
1SN 0006      DATA TITLE/20*1H /,LAI/0/,LA2/0/
1SN 0007      END
    
```

\*OPTIONS IN EFFECT\*NAME(MAIN) NOOPTIMIZE LINECOUNT(60) SIZE(0500K) AUTODBL(NONE)

\*OPTIONS IN EFFECT\*SOURCE EBCDIC NOLIST NODECK OBJECT NMAP NOFORMAT NOGOSTMT NOXREF NOALC NOANSF NOTERM FLAG(1)

\*OPTIONS IN EFFECT\* FUNCTIONS INLINE ARE: NCNE

\*OPTIONS IN EFFECT\*

\*STATISTICS\* SOURCE STATEMENTS = 6, PROGRAM SIZE = 0, SUBPROGRAM NAME = A

\*STATISTICS\* NO DIAGNOSTICS GENERATED

\*\*\*\*\* END OF COMPILATION \*\*\*\*\*

\*STATISTICS\* NU DIAGNOSTICS THIS STEP

212K BYTES OF CORE NOT USED

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

NEMP PROBLEM A OBSERVER 1

INPUT DATA - ELECTRIC FIELD STRENGTH--RADIAL

ALPHA= 1.200E+08 BETA= 5.000E+04 MAXIMUM TIME TO BE CALCULATED= 5.000E-04  
 NUMBER OF INPUT DATA POINTS= 221 NUMBER OF POINTS CALCULATED BETWEEN INPUT DATA POINTS= 1  
 CUTOFF TIME EMPLOYED= 3.000E-04

| TIME (SEC) | E-RADIAL  | TIME (SEC) | E-RADIAL    | TIME (SEC) | E-RADIAL   |
|------------|-----------|------------|-------------|------------|------------|
| 1.038E-08  | 1.055E+00 | 2.300E-07  | 2.360E+03   | 7.537E-06  | -2.294E+02 |
| 1.269E-08  | 9.021E+00 | 2.431E-07  | 2.303E+03   | 8.058E-06  | -1.866E+02 |
| 1.481E-08  | 2.977E+01 | 2.538E-07  | 2.245E+03   | 8.578E-06  | -1.372E+02 |
| 1.705E-08  | 6.791E+01 | 2.651E-07  | 2.186E+03   | 9.134E-06  | -1.070E+02 |
| 1.948E-08  | 1.255E+02 | 2.769E-07  | 2.128E+03   | 9.723E-06  | -8.248E+01 |
| 2.191E-08  | 1.911E+02 | 2.891E-07  | 2.067E+03   | 1.035E-05  | -7.351E+01 |
| 2.406E-08  | 2.479E+02 | 3.022E-07  | 2.006E+03   | 1.101E-05  | -6.732E+01 |
| 2.656E-08  | 3.032E+02 | 3.156E-07  | 1.947E+03   | 1.167E-05  | -6.124E+01 |
| 2.843E-08  | 3.393E+02 | 3.298E-07  | 1.888E+03   | 1.240E-05  | -6.684E+01 |
| 3.043E-08  | 3.798E+02 | 3.442E-07  | 1.831E+03   | 1.312E-05  | -7.133E+01 |
| 3.133E-08  | 4.011E+02 | 3.594E-07  | 1.774E+03   | 1.392E-05  | -6.603E+01 |
| 3.214E-08  | 4.239E+02 | 3.745E-07  | 1.720E+03   | 1.472E-05  | -7.080E+01 |
| 3.287E-08  | 4.476E+02 | 3.987E-07  | 1.640E+03   | 1.559E-05  | -6.802E+01 |
| 3.353E-08  | 4.723E+02 | 4.150E-07  | 1.590E+03   | 1.646E-05  | -6.029E+01 |
| 3.412E-08  | 4.978E+02 | 4.316E-07  | 1.541E+03   | 1.739E-05  | -5.089E+01 |
| 3.465E-08  | 5.238E+02 | 4.491E-07  | 1.491E+03   | 1.840E-05  | -4.333E+01 |
| 3.513E-08  | 5.499E+02 | 4.752E-07  | 1.420E+03   | 1.940E-05  | -4.064E+01 |
| 3.556E-08  | 5.755E+02 | 4.926E-07  | 1.375E+03   | 2.048E-05  | -3.942E+01 |
| 3.595E-08  | 6.004E+02 | 5.205E-07  | 1.304E+03   | 2.159E-05  | -3.986E+01 |
| 3.630E-08  | 6.242E+02 | 5.392E-07  | 1.258E+03   | 2.277E-05  | -3.859E+01 |
| 3.661E-08  | 6.465E+02 | 5.677E-07  | 1.190E+03   | 2.402E-05  | -3.551E+01 |
| 3.689E-08  | 6.673E+02 | 5.877E-07  | 1.143E+03   | 2.530E-05  | -3.206E+01 |
| 3.715E-08  | 6.863E+02 | 6.178E-07  | 1.074E+03   | 2.666E-05  | -2.865E+01 |
| 3.737E-08  | 7.037E+02 | 6.484E-07  | 1.005E+03   | 2.808E-05  | -2.700E+01 |
| 3.758E-08  | 7.196E+02 | 6.807E-07  | 9.343E+02   | 2.954E-05  | -2.417E+01 |
| 3.778E-08  | 7.350E+02 | 7.129E-07  | 8.653E+02   | 3.110E-05  | -2.087E+01 |
| 3.818E-08  | 7.658E+02 | 7.457E-07  | 7.970E+02   | 3.273E-05  | -2.067E+01 |
| 3.858E-08  | 7.957E+02 | 7.803E-07  | 7.268E+02   | 3.443E-05  | -2.281E+01 |
| 3.898E-08  | 8.249E+02 | 8.149E-07  | 6.586E+02   | 3.620E-05  | -2.101E+01 |
| 3.938E-08  | 8.533E+02 | 8.501E-07  | 5.917E+02   | 3.807E-05  | -1.727E+01 |
| 3.998E-08  | 8.946E+02 | 8.872E-07  | 5.233E+02   | 4.002E-05  | -1.507E+01 |
| 4.039E-08  | 9.216E+02 | 9.244E-07  | 4.576E+02   | 4.206E-05  | -1.427E+01 |
| 4.189E-08  | 1.010E+03 | 9.745E-07  | 3.738E+02   | 4.422E-05  | -1.333E+01 |
| 4.316E-08  | 1.067E+03 | 1.016E-06  | 3.111E+02   | 4.647E-05  | -1.414E+01 |
| 4.513E-08  | 1.134E+03 | 1.067E-06  | 2.333E+02   | 4.880E-05  | -1.196E+01 |
| 4.659E-08  | 1.176E+03 | 1.121E-06  | 1.621E+02   | 5.126E-05  | -9.675E+00 |
| 4.827E-08  | 1.219E+03 | 1.164E-06  | 1.110E+02   | 5.383E-05  | -1.071E+01 |
| 5.020E-08  | 1.261E+03 | 1.221E-06  | 5.035E+01   | 5.653E-05  | -1.012E+01 |
| 5.245E-08  | 1.301E+03 | 1.278E-06  | -1.371E+00  | 5.938E-05  | -9.779E+00 |
| 5.413E-08  | 1.329E+03 | 1.339E-06  | -6.635E+01  | 6.233E-05  | -7.894E+00 |
| 5.599E-08  | 1.374E+03 | 1.400E-06  | -8.244E+01  | 6.542E-05  | -6.788E+00 |
| 5.804E-08  | 1.413E+03 | 1.461E-06  | -1.096E+02  | 6.865E-05  | -7.744E+00 |
| 6.031E-08  | 1.561E+03 | 1.526E-06  | -1.1292E+02 | 7.205E-05  | -7.100E+00 |
| 6.280E-08  | 1.474E+03 | 1.608E-06  | -1.438E+02  | 7.562E-05  | -6.539E+00 |
| 6.555E-08  | 1.689E+03 | 1.673E-06  | -1.487E+02  | 7.933E-05  | -6.533E+00 |
| 6.850E-08  | 1.839E+03 | 1.756E-06  | -1.485E+02  | 8.322E-05  | -5.613E+00 |

APPENDIX A

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |           |           |            |           |            |
|-----------|-----------|-----------|------------|-----------|------------|
| 7-192E-08 | 1-927E+03 | 1-838E-06 | -1-450E+02 | 8-731E-05 | -5-519E+00 |
| 7-372E-08 | 2-006E+03 | 1-921E-06 | -1-403E+02 | 9-158E-05 | -5-141E+00 |
| 7-759E-08 | 2-153E+03 | 2-202E-06 | -1-348E+02 | 9-606E-05 | -4-949E+00 |
| 7-967E-08 | 2-205E+03 | 2-102E-06 | -1-324E+02 | 1-007E-04 | -4-508E+00 |
| 8-414E-08 | 2-359E+03 | 2-201E-06 | -1-322E+02 | 1-057E-04 | -4-094E+00 |
| 8-644E-08 | 2-400E+03 | 2-317E-06 | -1-337E+02 | 1-108E-04 | -4-479E+00 |
| 9-104E-08 | 2-395E+03 | 2-416E-06 | -1-361E+02 | 1-218E-04 | -3-623E+00 |
| 9-334E-08 | 2-458E+03 | 2-531E-06 | -1-378E+02 | 1-277E-04 | -3-594E+00 |
| 9-794E-08 | 2-623E+03 | 2-647E-06 | -1-366E+02 | 1-339E-04 | -3-071E+00 |
| 1-025E-07 | 2-604E+03 | 2-779E-06 | -1-331E+02 | 1-403E-04 | -2-922E+00 |
| 1-071E-07 | 2-653E+03 | 2-911E-06 | -1-295E+02 | 1-472E-04 | -2-587E+00 |
| 1-117E-07 | 2-704E+03 | 3-043E-06 | -1-289E+02 | 1-542E-04 | -2-265E+00 |
| 1-163E-07 | 2-702E+03 | 3-192E-06 | -1-360E+02 | 1-616E-04 | -2-116E+00 |
| 1-212E-07 | 2-732E+03 | 3-340E-06 | -1-512E+02 | 1-695E-04 | -1-884E+00 |
| 1-263E-07 | 2-775E+03 | 3-489E-06 | -1-706E+02 | 1-776E-04 | -1-672E+00 |
| 1-315E-07 | 2-785E+03 | 3-654E-06 | -1-916E+02 | 1-861E-04 | -1-452E+00 |
| 1-372E-07 | 2-751E+03 | 3-819E-06 | -2-059E+02 | 1-950E-04 | -1-357E+00 |
| 1-430E-07 | 2-749E+03 | 4-000E-06 | -2-116E+02 | 2-044E-04 | -1-182E+00 |
| 1-491E-07 | 2-759E+03 | 4-198E-06 | -2-104E+02 | 2-141E-04 | -1-018E+00 |
| 1-555E-07 | 2-748E+03 | 4-396E-06 | -2-025E+02 | 2-244E-04 | -8-523E-01 |
| 1-622E-07 | 2-724E+03 | 4-594E-06 | -1-811E+02 | 2-351E-04 | -7-839E-01 |
| 1-692E-07 | 2-690E+03 | 4-809E-06 | -1-340E+02 | 2-464E-04 | -6-434E-01 |
| 1-766E-07 | 2-655E+03 | 5-040E-06 | -5-880E+01 | 2-581E-04 | -5-092E-01 |
| 1-843E-07 | 2-620E+03 | 5-272E-06 | -5-934E+01 | 2-705E-04 | -3-832E-01 |
| 1-924E-07 | 2-583E+03 | 5-698E-06 | -2-008E+02 | 2-834E-04 | -2-671E-01 |
| 2-050E-07 | 2-518E+03 | 6-115E-06 | -1-968E+02 | 2-969E-04 | -2-313E-01 |
| 2-138E-07 | 2-468E+03 | 6-566E-06 | -2-892E+02 | 3-111E-04 | -1-254E-01 |
| 2-231E-07 | 2-416E+03 | 7-052E-06 | -2-407E+02 |           |            |

NUMBER OF POINTS = 221

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

CURVE FIT CALCULATIONS

MINIMUM VALUE OF ORDINATE TO BE PLOTTED= -5.000E+05

| TIME (SEC) | E-RADIAL  | TIME (SEC) | E-RADIAL  | TIME (SEC) | E-RADIAL   |
|------------|-----------|------------|-----------|------------|------------|
| 8.304E-09  | 0.0       | 2.280E-07  | 2.388E+03 | 7.294E-06  | -2.336E+02 |
| 9.342E-09  | 8.872E-02 | 2.330E-07  | 2.360E+03 | 7.537E-06  | -2.294E+02 |
| 1.038E-08  | 1.055E+00 | 2.380E-07  | 2.331E+03 | 7.798E-06  | -2.109E+02 |
| 1.153E-08  | 3.282E+00 | 2.431E-07  | 2.303E+03 | 8.058E-06  | -1.866E+02 |
| 1.269E-08  | 9.021E+00 | 2.485E-07  | 2.274E+03 | 8.318E-06  | -1.608E+02 |
| 1.375E-08  | 1.763E+01 | 2.538E-07  | 2.245E+03 | 8.578E-06  | -1.372E+02 |
| 1.481E-08  | 2.977E+01 | 2.595E-07  | 2.215E+03 | 8.856E-06  | -1.201E+02 |
| 1.593E-08  | 4.686E+01 | 2.651E-07  | 2.186E+03 | 9.134E-06  | -1.070E+02 |
| 1.705E-08  | 6.791E+01 | 2.710E-07  | 2.156E+03 | 9.429E-06  | -9.338E+01 |
| 1.827E-08  | 9.509E+01 | 2.769E-07  | 2.126E+03 | 9.723E-06  | -8.248E+01 |
| 1.948E-08  | 1.255E+02 | 2.830E-07  | 2.096E+03 | 1.004E-05  | -7.530E+01 |
| 2.070E-08  | 1.579E+02 | 2.891E-07  | 2.067E+03 | 1.033E-05  | -7.351E+01 |
| 2.191E-08  | 1.911E+02 | 2.956E-07  | 2.036E+03 | 1.068E-05  | -8.020E+01 |
| 2.298E-08  | 2.201E+02 | 3.022E-07  | 2.006E+03 | 1.101E-05  | -8.732E+01 |
| 2.406E-08  | 2.479E+02 | 3.089E-07  | 1.976E+03 | 1.134E-05  | -8.630E+01 |
| 2.531E-08  | 2.768E+02 | 3.156E-07  | 1.947E+03 | 1.167E-05  | -8.124E+01 |
| 2.656E-08  | 3.032E+02 | 3.227E-07  | 1.917E+03 | 1.203E-05  | -7.315E+01 |
| 2.750E-08  | 3.215E+02 | 3.298E-07  | 1.888E+03 | 1.240E-05  | -6.684E+01 |
| 2.843E-08  | 3.393E+02 | 3.370E-07  | 1.859E+03 | 1.276E-05  | -6.841E+01 |
| 2.943E-08  | 3.586E+02 | 3.442E-07  | 1.831E+03 | 1.312E-05  | -7.133E+01 |
| 3.043E-08  | 3.796E+02 | 3.518E-07  | 1.802E+03 | 1.352E-05  | -6.880E+01 |
| 3.088E-08  | 3.899E+02 | 3.594E-07  | 1.774E+03 | 1.392E-05  | -6.603E+01 |
| 3.133E-08  | 4.011E+02 | 3.670E-07  | 1.747E+03 | 1.432E-05  | -6.812E+01 |
| 3.174E-08  | 3.745E+02 | 3.745E-07  | 1.720E+03 | 1.472E-05  | -7.080E+01 |
| 3.214E-08  | 4.239E+02 | 3.866E-07  | 1.680E+03 | 1.515E-05  | -7.036E+01 |
| 3.251E-08  | 4.353E+02 | 3.987E-07  | 1.640E+03 | 1.559E-05  | -6.802E+01 |
| 3.287E-08  | 4.476E+02 | 4.069E-07  | 1.615E+03 | 1.602E-05  | -6.454E+01 |
| 3.320E-08  | 4.595E+02 | 4.150E-07  | 1.590E+03 | 1.646E-05  | -6.029E+01 |
| 3.353E-08  | 4.723E+02 | 4.233E-07  | 1.565E+03 | 1.692E-05  | -5.539E+01 |
| 3.382E-08  | 4.846E+02 | 4.316E-07  | 1.541E+03 | 1.739E-05  | -5.069E+01 |
| 3.412E-08  | 4.978E+02 | 4.404E-07  | 1.516E+03 | 1.790E-05  | -4.649E+01 |
| 3.439E-08  | 5.104E+02 | 4.491E-07  | 1.491E+03 | 1.840E-05  | -4.333E+01 |
| 3.465E-08  | 5.238E+02 | 4.621E-07  | 1.455E+03 | 1.890E-05  | -4.157E+01 |
| 3.489E-08  | 5.365E+02 | 4.752E-07  | 1.420E+03 | 1.940E-05  | -4.064E+01 |
| 3.513E-08  | 5.499E+02 | 4.839E-07  | 1.397E+03 | 1.994E-05  | -3.995E+01 |
| 3.534E-08  | 5.625E+02 | 4.926E-07  | 1.375E+03 | 2.048E-05  | -3.962E+01 |
| 3.556E-08  | 5.755E+02 | 5.066E-07  | 1.339E+03 | 2.104E-05  | -3.963E+01 |
| 3.575E-08  | 5.878E+02 | 5.205E-07  | 1.304E+03 | 2.159E-05  | -3.966E+01 |
| 3.595E-08  | 6.004E+02 | 5.298E-07  | 1.281E+03 | 2.218E-05  | -3.933E+01 |
| 3.612E-08  | 6.121E+02 | 5.392E-07  | 1.258E+03 | 2.277E-05  | -3.859E+01 |
| 3.630E-08  | 6.242E+02 | 5.534E-07  | 1.224E+03 | 2.340E-05  | -3.720E+01 |
| 3.645E-08  | 6.353E+02 | 5.677E-07  | 1.190E+03 | 2.402E-05  | -3.551E+01 |
| 3.661E-08  | 6.465E+02 | 5.777E-07  | 1.166E+03 | 2.466E-05  | -3.379E+01 |
| 3.675E-08  | 6.568E+02 | 5.877E-07  | 1.143E+03 | 2.530E-05  | -3.206E+01 |
| 3.689E-08  | 6.673E+02 | 6.028E-07  | 1.108E+03 | 2.598E-05  | -3.021E+01 |
| 3.702E-08  | 6.768E+02 | 6.178E-07  | 1.074E+03 | 2.668E-05  | -2.865E+01 |
| 3.715E-08  | 6.863E+02 | 6.331E-07  | 1.039E+03 | 2.737E-05  | -2.777E+01 |
| 3.726E-08  | 6.950E+02 | 6.484E-07  | 1.005E+03 | 2.808E-05  | -2.700E+01 |
| 3.737E-08  | 7.037E+02 | 6.645E-07  | 9.695E+02 | 2.881E-05  | -2.571E+01 |

APPENDIX A

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |           |           |            |           |            |
|-----------|-----------|-----------|------------|-----------|------------|
| 3.748E-08 | 7.116E+02 | 6.807E-07 | 9.343E+02  | 2.954E-05 | -2.417E+01 |
| 3.758E-08 | 7.196E+02 | 6.968E-07 | 8.995E+02  | 3.032E-05 | -2.234E+01 |
| 3.768E-08 | 7.273E+02 | 7.129E-07 | 8.653E+02  | 3.110E-05 | -2.087E+01 |
| 3.778E-08 | 7.350E+02 | 7.293E-07 | 8.309E+02  | 3.191E-05 | -2.037E+01 |
| 3.798E-08 | 7.504E+02 | 7.457E-07 | 7.970E+02  | 3.273E-05 | -2.067E+01 |
| 3.818E-08 | 7.656E+02 | 7.630E-07 | 7.617E+02  | 3.356E-05 | -2.184E+01 |
| 3.838E-08 | 7.807E+02 | 7.803E-07 | 7.268E+02  | 3.443E-05 | -2.281E+01 |
| 3.858E-08 | 7.957E+02 | 7.976E-07 | 6.925E+02  | 3.532E-05 | -2.233E+01 |
| 3.878E-08 | 8.104E+02 | 8.149E-07 | 6.586E+02  | 3.620E-05 | -2.101E+01 |
| 3.898E-08 | 8.249E+02 | 8.325E-07 | 6.249E+02  | 3.714E-05 | -1.915E+01 |
| 3.918E-08 | 8.392E+02 | 8.501E-07 | 5.917E+02  | 3.807E-05 | -1.727E+01 |
| 3.938E-08 | 8.533E+02 | 8.687E-07 | 5.572E+02  | 3.905E-05 | -1.595E+01 |
| 3.968E-08 | 8.742E+02 | 8.872E-07 | 5.233E+02  | 4.002E-05 | -1.507E+01 |
| 3.998E-08 | 8.946E+02 | 9.058E-07 | 4.901E+02  | 4.104E-05 | -1.459E+01 |
| 4.019E-08 | 9.082E+02 | 9.244E-07 | 4.576E+02  | 4.206E-05 | -1.427E+01 |
| 4.039E-08 | 9.216E+02 | 9.430E-07 | 4.250E+02  | 4.314E-05 | -1.369E+01 |
| 4.114E-08 | 9.683E+02 | 9.745E-07 | 3.738E+02  | 4.422E-05 | -1.333E+01 |
| 4.189E-08 | 1.010E+03 | 9.544E-07 | 3.420E+02  | 4.534E-05 | -1.381E+01 |
| 4.253E-08 | 1.041E+03 | 1.014E-06 | 3.111E+02  | 4.647E-05 | -1.414E+01 |
| 4.316E-08 | 1.067E+03 | 1.041E-06 | 2.713E+02  | 4.763E-05 | -1.328E+01 |
| 4.416E-08 | 1.103E+03 | 1.067E-06 | 2.333E+02  | 4.880E-05 | -1.196E+01 |
| 4.515E-08 | 1.134E+03 | 1.094E-06 | 1.967E+02  | 5.003E-05 | -1.057E+01 |
| 4.587E-08 | 1.155E+03 | 1.121E-06 | 1.621E+02  | 5.126E-05 | -9.675E+00 |
| 4.659E-08 | 1.176E+03 | 1.142E-06 | 1.360E+02  | 5.254E-05 | -1.006E+01 |
| 4.743E-08 | 1.198E+03 | 1.164E-06 | 1.110E+02  | 5.383E-05 | -1.071E+01 |
| 4.827E-08 | 1.219E+03 | 1.192E-06 | 7.961E+01  | 5.516E-05 | -1.053E+01 |
| 4.924E-08 | 1.241E+03 | 1.221E-06 | 5.035E+01  | 5.653E-05 | -1.012E+01 |
| 5.020E-08 | 1.261E+03 | 1.249E-06 | 2.334E+01  | 5.796E-05 | -1.003E+01 |
| 5.132E-08 | 1.282E+03 | 1.278E-06 | -1.371E+00 | 5.938E-05 | -9.779E+00 |
| 5.245E-08 | 1.301E+03 | 1.308E-06 | -2.509E+01 | 6.085E-05 | -8.754E+00 |
| 5.329E-08 | 1.315E+03 | 1.339E-06 | -4.635E+01 | 6.233E-05 | -7.894E+00 |
| 5.413E-08 | 1.329E+03 | 1.369E-06 | -6.552E+01 | 6.387E-05 | -8.255E+00 |
| 5.506E-08 | 1.352E+03 | 1.400E-06 | -8.244E+01 | 6.542E-05 | -8.788E+00 |
| 5.599E-08 | 1.374E+03 | 1.430E-06 | -9.711E+01 | 6.703E-05 | -8.403E+00 |
| 5.702E-08 | 1.387E+03 | 1.461E-06 | -1.098E+02 | 6.865E-05 | -7.764E+00 |
| 5.804E-08 | 1.413E+03 | 1.493E-06 | -1.204E+02 | 7.035E-05 | -7.386E+00 |
| 5.918E-08 | 1.496E+03 | 1.526E-06 | -1.292E+02 | 7.205E-05 | -7.100E+00 |
| 6.031E-08 | 1.561E+03 | 1.567E-06 | -1.378E+02 | 7.383E-05 | -6.771E+00 |
| 6.155E-08 | 1.518E+03 | 1.608E-06 | -1.438E+02 | 7.562E-05 | -6.539E+00 |
| 6.280E-08 | 1.474E+03 | 1.641E-06 | -1.469E+02 | 7.748E-05 | -6.558E+00 |
| 6.417E-08 | 1.562E+03 | 1.673E-06 | -1.487E+02 | 7.933E-05 | -6.533E+00 |
| 6.555E-08 | 1.689E+03 | 1.715E-06 | -1.493E+02 | 8.128E-05 | -6.084E+00 |
| 6.706E-08 | 1.777E+03 | 1.756E-06 | -1.485E+02 | 8.322E-05 | -5.613E+00 |
| 6.858E-08 | 1.839E+03 | 1.797E-06 | -1.470E+02 | 8.527E-05 | -5.519E+00 |
| 7.025E-08 | 1.882E+03 | 1.838E-06 | -1.450E+02 | 8.731E-05 | -5.519E+00 |
| 7.192E-08 | 1.927E+03 | 1.880E-06 | -1.427E+02 | 8.945E-05 | -5.341E+00 |
| 7.282E-08 | 1.966E+03 | 1.921E-06 | -1.403E+02 | 9.156E-05 | -5.141E+00 |
| 7.372E-08 | 2.008E+03 | 1.970E-06 | -1.373E+02 | 9.382E-05 | -5.045E+00 |
| 7.565E-08 | 2.087E+03 | 2.020E-06 | -1.348E+02 | 9.606E-05 | -4.949E+00 |
| 7.759E-08 | 2.153E+03 | 2.061E-06 | -1.333E+02 | 9.840E-05 | -4.748E+00 |
| 7.863E-08 | 2.179E+03 | 2.102E-06 | -1.324E+02 | 1.007E-04 | -4.508E+00 |
| 7.967E-08 | 2.205E+03 | 2.152E-06 | -1.320E+02 | 1.032E-04 | -4.242E+00 |
| 8.190E-08 | 2.284E+03 | 2.201E-06 | -1.322E+02 | 1.057E-04 | -4.094E+00 |
| 8.414E-08 | 2.359E+03 | 2.259E-06 | -1.328E+02 | 1.082E-04 | -4.263E+00 |
| 8.529E-08 | 2.384E+03 | 2.317E-06 | -1.337E+02 | 1.108E-04 | -4.479E+00 |
| 8.644E-08 | 2.400E+03 | 2.366E-06 | -1.349E+02 | 1.163E-04 | -4.139E+00 |
| 8.874E-08 | 2.393E+03 | 2.416E-06 | -1.361E+02 | 1.218E-04 | -3.623E+00 |
| 9.104E-08 | 2.395E+03 | 2.474E-06 | -1.372E+02 | 1.247E-04 | -3.617E+00 |
| 9.219E-08 | 2.422E+03 | 2.531E-06 | -1.378E+02 | 1.277E-04 | -3.594E+00 |
| 9.334E-08 | 2.458E+03 | 2.589E-06 | -1.375E+02 | 1.308E-04 | -3.343E+00 |

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |           |           |            |           |            |
|-----------|-----------|-----------|------------|-----------|------------|
| 9.564E-08 | 2.550E+03 | 2.647E-06 | -1.366E+02 | 1.339E-04 | -3.071E+00 |
| 9.794E-08 | 2.623E+03 | 2.713E-06 | -1.350E+02 | 1.371E-04 | -2.977E+00 |
| 1.002E-07 | 2.622E+03 | 2.779E-06 | -1.331E+02 | 1.403E-04 | -2.922E+00 |
| 1.025E-07 | 2.604E+03 | 2.845E-06 | -1.312E+02 | 1.437E-04 | -2.768E+00 |
| 1.048E-07 | 2.623E+03 | 2.511E-06 | -1.295E+02 | 1.472E-04 | -2.587E+00 |
| 1.071E-07 | 2.653E+03 | 2.577E-06 | -1.286E+02 | 1.507E-04 | -2.411E+00 |
| 1.094E-07 | 2.682E+03 | 3.043E-06 | -1.289E+02 | 1.542E-04 | -2.265E+00 |
| 1.117E-07 | 2.704E+03 | 3.117E-06 | -1.314E+02 | 1.579E-04 | -2.182E+00 |
| 1.140E-07 | 2.705E+03 | 3.192E-06 | -1.360E+02 | 1.616E-04 | -2.116E+00 |
| 1.163E-07 | 2.702E+03 | 3.266E-06 | -1.428E+02 | 1.655E-04 | -2.004E+00 |
| 1.188E-07 | 2.713E+03 | 3.340E-06 | -1.512E+02 | 1.693E-04 | -1.884E+00 |
| 1.212E-07 | 2.732E+03 | 3.414E-06 | -1.606E+02 | 1.735E-04 | -1.776E+00 |
| 1.237E-07 | 2.755E+03 | 3.489E-06 | -1.708E+02 | 1.776E-04 | -1.672E+00 |
| 1.263E-07 | 2.775E+03 | 3.571E-06 | -1.816E+02 | 1.818E-04 | -1.554E+00 |
| 1.289E-07 | 2.786E+03 | 3.654E-06 | -1.916E+02 | 1.861E-04 | -1.452E+00 |
| 1.315E-07 | 2.765E+03 | 3.736E-06 | -1.998E+02 | 1.906E-04 | -1.400E+00 |
| 1.344E-07 | 2.769E+03 | 3.819E-06 | -2.059E+02 | 1.950E-04 | -1.357E+00 |
| 1.372E-07 | 2.751E+03 | 3.509E-06 | -2.099E+02 | 1.997E-04 | -1.274E+00 |
| 1.401E-07 | 2.747E+03 | 4.000E-06 | -2.116E+02 | 2.044E-04 | -1.182E+00 |
| 1.430E-07 | 2.749E+03 | 4.099E-06 | -2.118E+02 | 2.093E-04 | -1.098E+00 |
| 1.460E-07 | 2.754E+03 | 4.198E-06 | -2.104E+02 | 2.141E-04 | -1.016E+00 |
| 1.491E-07 | 2.759E+03 | 4.297E-06 | -2.077E+02 | 2.193E-04 | -9.277E-01 |
| 1.523E-07 | 2.756E+03 | 4.396E-06 | -2.025E+02 | 2.244E-04 | -8.523E-01 |
| 1.555E-07 | 2.748E+03 | 4.495E-06 | -1.940E+02 | 2.298E-04 | -8.154E-01 |
| 1.589E-07 | 2.737E+03 | 4.594E-06 | -1.811E+02 | 2.351E-04 | -7.839E-01 |
| 1.622E-07 | 2.724E+03 | 4.702E-06 | -1.610E+02 | 2.408E-04 | -7.183E-01 |
| 1.657E-07 | 2.707E+03 | 4.809E-06 | -1.340E+02 | 2.464E-04 | -6.434E-01 |
| 1.692E-07 | 2.690E+03 | 4.924E-06 | -9.314E+01 | 2.523E-04 | -5.742E-01 |
| 1.729E-07 | 2.672E+03 | 5.040E-06 | -5.880E+01 | 2.561E-04 | -5.092E-01 |
| 1.766E-07 | 2.655E+03 | 5.154E-06 | -4.953E+01 | 2.643E-04 | -4.446E-01 |
| 1.805E-07 | 2.638E+03 | 5.272E-06 | -5.934E+01 | 2.705E-04 | -3.832E-01 |
| 1.843E-07 | 2.620E+03 | 5.485E-06 | -1.289E+02 | 2.770E-04 | -3.184E-01 |
| 1.884E-07 | 2.602E+03 | 5.698E-06 | -2.008E+02 | 2.834E-04 | -2.671E-01 |
| 1.924E-07 | 2.583E+03 | 5.906E-06 | -2.028E+02 | 2.902E-04 | -2.478E-01 |
| 1.987E-07 | 2.552E+03 | 6.115E-06 | -1.968E+02 | 2.969E-04 | -2.313E-01 |
| 2.050E-07 | 2.518E+03 | 6.340E-06 | -2.445E+02 | 3.040E-04 | -1.836E-01 |
| 2.094E-07 | 2.493E+03 | 6.566E-06 | -2.892E+02 | 3.111E-04 | -1.254E-01 |
| 2.138E-07 | 2.468E+03 | 6.809E-06 | -2.733E+02 | 4.055E-04 | -9.985E-04 |
| 2.185E-07 | 2.442E+03 | 7.052E-06 | -2.407E+02 | 5.000E-04 | -8.864E-06 |
| 2.231E-07 | 2.416E+03 |           |            |           |            |

NUMBER OF POINTS = 445

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

FOURIER TRANSFORM CALCULATIONS

STARTING FREQUENCY(HERTZ)= 1.000E+04 DELTA FREQUENCY= 1.020E+00  
 MAXIMUM FREQUENCY TO BE CALCULATED= 6.000E+07

| FREQUENCY(HZ) | AMPLITUDE(V/M/Hz) |           | FREQUENCY(HZ) | AMPLITUDE(V/M/Hz) |            |
|---------------|-------------------|-----------|---------------|-------------------|------------|
|               | REAL              | IMAGINARY |               | REAL              | IMAGINARY  |
| 1.000E+04     | -2.061E-05        | 1.323E-03 | 7.898E+05     | 2.799E-05         | -5.743E-04 |
| 1.020E+04     | 1.234E-06         | 1.324E-03 | 8.054E+05     | 2.480E-05         | -5.786E-04 |
| 1.040E+04     | 2.299E-05         | 1.325E-03 | 8.213E+05     | 1.145E-05         | -5.810E-04 |
| 1.061E+04     | 4.469E-05         | 1.326E-03 | 8.376E+05     | -8.696E-06        | -5.764E-04 |
| 1.082E+04     | 6.638E-05         | 1.327E-03 | 8.541E+05     | -3.056E-05        | -5.619E-04 |
| 1.103E+04     | 8.811E-05         | 1.327E-03 | 8.710E+05     | -4.874E-05        | -5.373E-04 |
| 1.125E+04     | 1.099E-04         | 1.327E-03 | 8.883E+05     | -5.676E-05        | -5.047E-04 |
| 1.147E+04     | 1.317E-04         | 1.327E-03 | 9.058E+05     | -4.939E-05        | -4.716E-04 |
| 1.170E+04     | 1.535E-04         | 1.327E-03 | 9.238E+05     | -2.741E-05        | -4.492E-04 |
| 1.193E+04     | 1.753E-04         | 1.326E-03 | 9.420E+05     | -7.294E-07        | -4.457E-04 |
| 1.216E+04     | 1.970E-04         | 1.325E-03 | 9.607E+05     | 1.639E-05         | -4.608E-04 |
| 1.241E+04     | 2.185E-04         | 1.324E-03 | 9.797E+05     | 1.465E-05         | -4.842E-04 |
| 1.265E+04     | 2.398E-04         | 1.323E-03 | 9.991E+05     | -6.733E-06        | -5.010E-04 |
| 1.290E+04     | 2.610E-04         | 1.321E-03 | 1.019E+06     | -3.898E-05        | -5.013E-04 |
| 1.316E+04     | 2.821E-04         | 1.320E-03 | 1.039E+06     | -6.861E-05        | -4.827E-04 |
| 1.342E+04     | 3.031E-04         | 1.319E-03 | 1.060E+06     | -8.449E-05        | -4.510E-04 |
| 1.368E+04     | 3.242E-04         | 1.317E-03 | 1.081E+06     | -8.157E-05        | -4.186E-04 |
| 1.395E+04     | 3.454E-04         | 1.316E-03 | 1.102E+06     | -6.402E-05        | -3.993E-04 |
| 1.422E+04     | 3.667E-04         | 1.314E-03 | 1.124E+06     | -4.558E-05        | -3.991E-04 |
| 1.451E+04     | 3.880E-04         | 1.312E-03 | 1.146E+06     | -4.152E-05        | -4.119E-04 |
| 1.480E+04     | 4.093E-04         | 1.311E-03 | 1.169E+06     | -5.484E-05        | -4.226E-04 |
| 1.509E+04     | 4.308E-04         | 1.309E-03 | 1.192E+06     | -7.688E-05        | -4.192E-04 |
| 1.539E+04     | 4.523E-04         | 1.307E-03 | 1.215E+06     | -9.416E-05        | -4.017E-04 |
| 1.569E+04     | 4.740E-04         | 1.306E-03 | 1.239E+06     | -9.874E-05        | -3.796E-04 |
| 1.600E+04     | 4.962E-04         | 1.304E-03 | 1.264E+06     | -9.305E-05        | -3.639E-04 |
| 1.632E+04     | 5.186E-04         | 1.302E-03 | 1.289E+06     | -8.653E-05        | -3.585E-04 |
| 1.664E+04     | 5.420E-04         | 1.300E-03 | 1.314E+06     | -8.673E-05        | -3.588E-04 |
| 1.697E+04     | 5.656E-04         | 1.297E-03 | 1.340E+06     | -9.413E-05        | -3.572E-04 |
| 1.731E+04     | 5.896E-04         | 1.294E-03 | 1.367E+06     | -1.034E-04        | -3.499E-04 |
| 1.765E+04     | 6.137E-04         | 1.290E-03 | 1.394E+06     | -1.095E-04        | -3.386E-04 |
| 1.800E+04     | 6.379E-04         | 1.285E-03 | 1.422E+06     | -1.114E-04        | -3.278E-04 |
| 1.836E+04     | 6.619E-04         | 1.280E-03 | 1.450E+06     | -1.122E-04        | -3.199E-04 |
| 1.872E+04     | 6.856E-04         | 1.273E-03 | 1.478E+06     | -1.142E-04        | -3.137E-04 |
| 1.909E+04     | 7.089E-04         | 1.267E-03 | 1.508E+06     | -1.178E-04        | -3.070E-04 |
| 1.947E+04     | 7.319E-04         | 1.260E-03 | 1.537E+06     | -1.215E-04        | -2.981E-04 |
| 1.985E+04     | 7.546E-04         | 1.253E-03 | 1.568E+06     | -1.239E-04        | -2.907E-04 |
| 2.023E+04     | 7.774E-04         | 1.246E-03 | 1.599E+06     | -1.257E-04        | -2.834E-04 |
| 2.063E+04     | 8.002E-04         | 1.238E-03 | 1.631E+06     | -1.281E-04        | -2.768E-04 |
| 2.105E+04     | 8.229E-04         | 1.230E-03 | 1.663E+06     | -1.315E-04        | -2.699E-04 |
| 2.147E+04     | 8.455E-04         | 1.221E-03 | 1.696E+06     | -1.348E-04        | -2.613E-04 |
| 2.190E+04     | 8.673E-04         | 1.211E-03 | 1.729E+06     | -1.363E-04        | -2.523E-04 |
| 2.233E+04     | 8.882E-04         | 1.202E-03 | 1.763E+06     | -1.365E-04        | -2.446E-04 |
| 2.277E+04     | 9.082E-04         | 1.192E-03 | 1.798E+06     | -1.375E-04        | -2.393E-04 |
| 2.322E+04     | 9.278E-04         | 1.183E-03 | 1.834E+06     | -1.409E-04        | -2.327E-04 |
| 2.368E+04     | 9.475E-04         | 1.175E-03 | 1.870E+06     | -1.438E-04        | -2.250E-04 |
| 2.415E+04     | 9.676E-04         | 1.167E-03 | 1.907E+06     | -1.456E-04        | -2.151E-04 |
| 2.463E+04     | 9.883E-04         | 1.158E-03 | 1.945E+06     | -1.440E-04        | -2.075E-04 |

## LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |           |            |           |            |            |
|-----------|-----------|------------|-----------|------------|------------|
| 2-511E+04 | 1-009E-03 | 1-150E-03  | 1-983E+06 | -1-451E-04 | -2-018E-04 |
| 2-561E+04 | 1-036E-03 | 1-141E-03  | 2-023E+06 | -1-464E-04 | -1-963E-04 |
| 2-612E+04 | 1-051E-03 | 1-132E-03  | 2-063E+06 | -1-496E-04 | -1-879E-04 |
| 2-663E+04 | 1-073E-03 | 1-122E-03  | 2-103E+06 | -1-496E-04 | -1-792E-04 |
| 2-716E+04 | 1-094E-03 | 1-112E-03  | 2-145E+06 | -1-485E-04 | -1-717E-04 |
| 2-770E+04 | 1-115E-03 | 1-101E-03  | 2-188E+06 | -1-484E-04 | -1-662E-04 |
| 2-825E+04 | 1-136E-03 | 1-090E-03  | 2-231E+06 | -1-495E-04 | -1-606E-04 |
| 2-881E+04 | 1-156E-03 | 1-079E-03  | 2-275E+06 | -1-509E-04 | -1-520E-04 |
| 2-938E+04 | 1-176E-03 | 1-068E-03  | 2-320E+06 | -1-494E-04 | -1-439E-04 |
| 2-996E+04 | 1-197E-03 | 1-057E-03  | 2-366E+06 | -1-486E-04 | -1-383E-04 |
| 3-055E+04 | 1-218E-03 | 1-045E-03  | 2-413E+06 | -1-483E-04 | -1-322E-04 |
| 3-115E+04 | 1-239E-03 | 1-033E-03  | 2-460E+06 | -1-490E-04 | -1-248E-04 |
| 3-177E+04 | 1-261E-03 | 1-020E-03  | 2-509E+06 | -1-177E-04 | -1-177E-04 |
| 3-240E+04 | 1-282E-03 | 1-006E-03  | 2-559E+06 | -1-458E-04 | -1-119E-04 |
| 3-304E+04 | 1-303E-03 | 9-925E-04  | 2-609E+06 | -1-454E-04 | -1-062E-04 |
| 3-369E+04 | 1-319E-03 | 9-800E-04  | 2-661E+06 | -1-437E-04 | -9-883E-05 |
| 3-436E+04 | 1-340E-03 | 9-673E-04  | 2-714E+06 | -1-424E-04 | -9-392E-05 |
| 3-504E+04 | 1-361E-03 | 9-536E-04  | 2-767E+06 | -1-413E-04 | -8-688E-05 |
| 3-573E+04 | 1-383E-03 | 9-389E-04  | 2-822E+06 | -1-387E-04 | -8-163E-05 |
| 3-644E+04 | 1-404E-03 | 9-232E-04  | 2-878E+06 | -1-375E-04 | -7-634E-05 |
| 3-716E+04 | 1-426E-03 | 9-065E-04  | 2-935E+06 | -1-354E-04 | -6-989E-05 |
| 3-790E+04 | 1-447E-03 | 8-884E-04  | 2-993E+06 | -1-330E-04 | -6-569E-05 |
| 3-865E+04 | 1-467E-03 | 8-687E-04  | 3-052E+06 | -1-317E-04 | -5-928E-05 |
| 3-941E+04 | 1-486E-03 | 8-483E-04  | 3-113E+06 | -1-278E-04 | -5-537E-05 |
| 4-019E+04 | 1-503E-03 | 8-281E-04  | 3-174E+06 | -1-281E-04 | -5-050E-05 |
| 4-099E+04 | 1-519E-03 | 8-088E-04  | 3-237E+06 | -1-226E-04 | -4-364E-05 |
| 4-180E+04 | 1-535E-03 | 7-897E-04  | 3-301E+06 | -1-212E-04 | -4-325E-05 |
| 4-262E+04 | 1-551E-03 | 7-708E-04  | 3-366E+06 | -1-200E-04 | -3-398E-05 |
| 4-347E+04 | 1-567E-03 | 7-521E-04  | 3-433E+06 | -1-141E-04 | -3-325E-05 |
| 4-433E+04 | 1-584E-03 | 7-328E-04  | 3-501E+06 | -1-152E-04 | -2-901E-05 |
| 4-521E+04 | 1-601E-03 | 7-125E-04  | 3-570E+06 | -1-092E-04 | -2-278E-05 |
| 4-610E+04 | 1-617E-03 | 6-917E-04  | 3-641E+06 | -1-079E-04 | -2-234E-05 |
| 4-701E+04 | 1-633E-03 | 6-703E-04  | 3-713E+06 | -1-052E-04 | -1-588E-05 |
| 4-794E+04 | 1-648E-03 | 6-488E-04  | 3-786E+06 | -1-008E-04 | -1-451E-05 |
| 4-889E+04 | 1-663E-03 | 6-247E-04  | 3-861E+06 | -9-940E-05 | -1-045E-05 |
| 4-986E+04 | 1-676E-03 | 6-015E-04  | 3-938E+06 | -9-520E-05 | -7-496E-06 |
| 5-084E+04 | 1-688E-03 | 5-791E-04  | 4-015E+06 | -9-307E-05 | -4-920E-06 |
| 5-185E+04 | 1-701E-03 | 5-570E-04  | 4-095E+06 | -8-985E-05 | -1-931E-06 |
| 5-288E+04 | 1-713E-03 | 5-351E-04  | 4-176E+06 | -8-660E-05 | 3-074E-07  |
| 5-392E+04 | 1-726E-03 | 5-130E-04  | 4-259E+06 | -8-409E-05 | 3-212E-06  |
| 5-499E+04 | 1-740E-03 | 4-904E-04  | 4-343E+06 | -8-049E-05 | 4-828E-06  |
| 5-608E+04 | 1-755E-03 | 4-663E-04  | 4-429E+06 | -7-789E-05 | 7-553E-06  |
| 5-719E+04 | 1-770E-03 | 4-594E-04  | 4-516E+06 | -7-449E-05 | 9-003E-06  |
| 5-832E+04 | 1-782E-03 | 4-100E-04  | 4-606E+06 | -7-169E-05 | 1-117E-05  |
| 5-947E+04 | 1-791E-03 | 3-803E-04  | 4-697E+06 | -6-906E-05 | 1-229E-05  |
| 6-065E+04 | 1-798E-03 | 3-524E-04  | 4-790E+06 | -6-568E-05 | 1-426E-05  |
| 6-185E+04 | 1-806E-03 | 3-266E-04  | 4-885E+06 | -6-356E-05 | 1-588E-05  |
| 6-307E+04 | 1-815E-03 | 3-005E-04  | 4-981E+06 | -6-009E-05 | 1-644E-05  |
| 6-432E+04 | 1-826E-03 | 2-720E-04  | 5-080E+06 | -5-719E-05 | 1-837E-05  |
| 6-559E+04 | 1-836E-03 | 2-399E-04  | 5-180E+06 | -5-491E-05 | 1-902E-05  |
| 6-689E+04 | 1-843E-03 | 2-054E-04  | 5-283E+06 | -5-222E-05 | 1-974E-05  |
| 6-821E+04 | 1-845E-03 | 1-708E-04  | 5-387E+06 | -4-893E-05 | 2-042E-05  |
| 6-956E+04 | 1-846E-03 | 1-380E-04  | 5-494E+06 | -4-677E-05 | 2-209E-05  |
| 7-094E+04 | 1-845E-03 | 1-067E-04  | 5-603E+06 | -4-476E-05 | 2-153E-05  |
| 7-234E+04 | 1-846E-03 | 7-535E-05  | 5-713E+06 | -4-105E-05 | 2-226E-05  |
| 7-378E+04 | 1-845E-03 | 4-251E-05  | 5-826E+06 | -3-949E-05 | 2-334E-05  |
| 7-524E+04 | 1-842E-03 | 8-186E-06  | 5-942E+06 | -3-723E-05 | 2-276E-05  |
| 7-672E+04 | 1-836E-03 | -2-565E-05 | 6-059E+06 | -3-423E-05 | 2-308E-05  |
| 7-824E+04 | 1-828E-03 | -5-770E-05 | 6-179E+06 | -3-235E-05 | 2-371E-05  |
| 7-979E+04 | 1-818E-03 | -8-820E-05 | 6-301E+06 | -3-052E-05 | 2-339E-05  |

APPENDIX A

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |           |            |           |            |           |
|-----------|-----------|------------|-----------|------------|-----------|
| 8.137E+04 | 1.808E-03 | -1.181E-04 | 6.426E+06 | -2.816E-05 | 2.309E-05 |
| 8.258E+04 | 1.796E-03 | -1.468E-04 | 6.553E+06 | -2.594E-05 | 2.338E-05 |
| 8.462E+04 | 1.783E-03 | -1.729E-04 | 6.683E+06 | -2.432E-05 | 2.311E-05 |
| 8.629E+04 | 1.770E-03 | -1.955E-04 | 6.815E+06 | -2.239E-05 | 2.255E-05 |
| 8.800E+04 | 1.761E-03 | -2.166E-04 | 6.950E+06 | -2.022E-05 | 2.250E-05 |
| 8.974E+04 | 1.756E-03 | -2.391E-04 | 7.087E+06 | -1.873E-05 | 2.226E-05 |
| 9.152E+04 | 1.752E-03 | -2.657E-04 | 7.228E+06 | -1.702E-05 | 2.158E-05 |
| 9.333E+04 | 1.749E-03 | -2.962E-04 | 7.371E+06 | -1.521E-05 | 2.120E-05 |
| 9.518E+04 | 1.741E-03 | -3.313E-04 | 7.517E+06 | -1.387E-05 | 2.093E-05 |
| 9.706E+04 | 1.724E-03 | -3.805E-04 | 7.665E+06 | -1.265E-05 | 2.022E-05 |
| 9.898E+04 | 1.697E-03 | -4.214E-04 | 7.817E+06 | -1.111E-05 | 1.962E-05 |
| 1.009E+05 | 1.662E-03 | -4.553E-04 | 7.972E+06 | -9.620E-06 | 1.900E-05 |
| 1.029E+05 | 1.626E-03 | -4.819E-04 | 8.129E+06 | -8.492E-06 | 1.866E-05 |
| 1.050E+05 | 1.588E-03 | -5.026E-04 | 8.290E+06 | -7.702E-06 | 1.797E-05 |
| 1.070E+05 | 1.550E-03 | -5.180E-04 | 8.454E+06 | -6.897E-06 | 1.704E-05 |
| 1.092E+05 | 1.514E-03 | -5.283E-04 | 8.621E+06 | -5.889E-06 | 1.605E-05 |
| 1.113E+05 | 1.480E-03 | -5.336E-04 | 8.792E+06 | -4.903E-06 | 1.518E-05 |
| 1.135E+05 | 1.447E-03 | -5.416E-04 | 8.966E+06 | -4.094E-06 | 1.440E-05 |
| 1.158E+05 | 1.414E-03 | -5.452E-04 | 9.143E+06 | -3.362E-06 | 1.374E-05 |
| 1.181E+05 | 1.382E-03 | -5.455E-04 | 9.324E+06 | -2.510E-06 | 1.306E-05 |
| 1.204E+05 | 1.350E-03 | -5.424E-04 | 9.509E+06 | -1.822E-06 | 1.214E-05 |
| 1.228E+05 | 1.320E-03 | -5.357E-04 | 9.697E+06 | -1.385E-06 | 1.137E-05 |
| 1.252E+05 | 1.291E-03 | -5.244E-04 | 9.889E+06 | -9.727E-07 | 1.081E-05 |
| 1.277E+05 | 1.268E-03 | -5.099E-04 | 1.008E+07 | -5.325E-07 | 1.018E-05 |
| 1.302E+05 | 1.248E-03 | -4.949E-04 | 1.028E+07 | -2.006E-07 | 9.392E-06 |
| 1.328E+05 | 1.230E-03 | -4.788E-04 | 1.049E+07 | -1.198E-07 | 8.582E-06 |
| 1.354E+05 | 1.215E-03 | -4.584E-04 | 1.069E+07 | -1.387E-07 | 8.043E-06 |
| 1.381E+05 | 1.208E-03 | -4.353E-04 | 1.091E+07 | 1.356E-07  | 7.571E-06 |
| 1.408E+05 | 1.208E-03 | -4.145E-04 | 1.112E+07 | 2.950E-07  | 6.936E-06 |
| 1.436E+05 | 1.212E-03 | -3.971E-04 | 1.134E+07 | 4.327E-07  | 6.360E-06 |
| 1.465E+05 | 1.219E-03 | -3.814E-04 | 1.157E+07 | 2.617E-07  | 5.957E-06 |
| 1.494E+05 | 1.232E-03 | -3.677E-04 | 1.180E+07 | 4.186E-07  | 5.472E-06 |
| 1.523E+05 | 1.250E-03 | -3.592E-04 | 1.203E+07 | 2.453E-07  | 5.059E-06 |
| 1.553E+05 | 1.271E-03 | -3.600E-04 | 1.227E+07 | 3.233E-07  | 4.698E-06 |
| 1.584E+05 | 1.288E-03 | -3.707E-04 | 1.251E+07 | 2.370E-07  | 4.485E-06 |
| 1.615E+05 | 1.297E-03 | -3.837E-04 | 1.276E+07 | 2.804E-07  | 4.005E-06 |
| 1.647E+05 | 1.301E-03 | -3.915E-04 | 1.301E+07 | 3.737E-08  | 3.948E-06 |
| 1.680E+05 | 1.308E-03 | -3.945E-04 | 1.327E+07 | 5.077E-08  | 3.633E-06 |
| 1.713E+05 | 1.323E-03 | -3.984E-04 | 1.353E+07 | -1.725E-07 | 3.450E-06 |
| 1.747E+05 | 1.342E-03 | -4.093E-04 | 1.380E+07 | -1.257E-07 | 3.256E-06 |
| 1.782E+05 | 1.359E-03 | -4.219E-04 | 1.407E+07 | -2.155E-07 | 3.254E-06 |
| 1.817E+05 | 1.374E-03 | -4.502E-04 | 1.435E+07 | -3.911E-07 | 3.180E-06 |
| 1.853E+05 | 1.387E-03 | -4.747E-04 | 1.463E+07 | -4.756E-07 | 3.169E-06 |
| 1.889E+05 | 1.399E-03 | -5.035E-04 | 1.492E+07 | -5.671E-07 | 3.113E-06 |
| 1.927E+05 | 1.409E-03 | -5.378E-04 | 1.522E+07 | -5.561E-07 | 3.116E-06 |
| 1.965E+05 | 1.413E-03 | -5.757E-04 | 1.552E+07 | -4.984E-07 | 3.252E-06 |
| 2.004E+05 | 1.412E-03 | -6.143E-04 | 1.583E+07 | -5.696E-07 | 3.446E-06 |
| 2.043E+05 | 1.409E-03 | -6.554E-04 | 1.614E+07 | -4.567E-07 | 3.433E-06 |
| 2.084E+05 | 1.400E-03 | -7.002E-04 | 1.646E+07 | -2.683E-07 | 3.623E-06 |
| 2.125E+05 | 1.384E-03 | -7.470E-04 | 1.678E+07 | -1.417E-07 | 3.709E-06 |
| 2.167E+05 | 1.359E-03 | -7.928E-04 | 1.712E+07 | 1.940E-07  | 3.745E-06 |
| 2.210E+05 | 1.328E-03 | -8.385E-04 | 1.745E+07 | 4.995E-07  | 3.811E-06 |
| 2.254E+05 | 1.288E-03 | -8.770E-04 | 1.780E+07 | 7.251E-07  | 3.888E-06 |
| 2.298E+05 | 1.241E-03 | -9.109E-04 | 1.815E+07 | 1.043E-06  | 3.780E-06 |
| 2.344E+05 | 1.188E-03 | -9.359E-04 | 1.851E+07 | 1.334E-06  | 3.586E-06 |
| 2.390E+05 | 1.134E-03 | -9.509E-04 | 1.888E+07 | 1.629E-06  | 3.379E-06 |
| 2.438E+05 | 1.081E-03 | -9.568E-04 | 1.925E+07 | 1.937E-06  | 3.240E-06 |
| 2.486E+05 | 1.029E-03 | -9.557E-04 | 1.963E+07 | 2.156E-06  | 2.970E-06 |
| 2.535E+05 | 9.803E-04 | -9.462E-04 | 2.002E+07 | 2.374E-06  | 2.771E-06 |
| 2.585E+05 | 9.361E-04 | -9.289E-04 | 2.042E+07 | 2.594E-06  | 2.493E-06 |

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |           |            |           |            |            |
|-----------|-----------|------------|-----------|------------|------------|
| 2.636E+05 | 9.007E-04 | -9.055E-04 | 2.082E+07 | 2.797E-06  | 2.135E-06  |
| 2.688E+05 | 8.741E-04 | -8.808E-04 | 2.123E+07 | 2.948E-06  | 1.894E-06  |
| 2.742E+05 | 8.541E-04 | -8.563E-04 | 2.165E+07 | 3.061E-06  | 1.539E-06  |
| 2.796E+05 | 8.405E-04 | -8.320E-04 | 2.208E+07 | 3.160E-06  | 8.049E-07  |
| 2.851E+05 | 8.343E-04 | -8.098E-04 | 2.252E+07 | 3.260E-06  | 8.059E-07  |
| 2.908E+05 | 8.343E-04 | -7.926E-04 | 2.296E+07 | 3.300E-06  | 2.222E-07  |
| 2.963E+05 | 8.368E-04 | -7.809E-04 | 2.342E+07 | 3.342E-06  | 1.391E-07  |
| 3.024E+05 | 8.414E-04 | -7.733E-04 | 2.388E+07 | 3.214E-06  | 6.247E-07  |
| 3.084E+05 | 8.473E-04 | -7.706E-04 | 2.435E+07 | 3.001E-06  | -1.109E-06 |
| 3.145E+05 | 8.535E-04 | -7.730E-04 | 2.483E+07 | 2.761E-06  | -1.588E-06 |
| 3.207E+05 | 8.591E-04 | -7.790E-04 | 2.533E+07 | 2.327E-06  | -1.955E-06 |
| 3.270E+05 | 8.642E-04 | -7.895E-04 | 2.583E+07 | 1.872E-06  | -2.326E-06 |
| 3.335E+05 | 8.674E-04 | -8.048E-04 | 2.634E+07 | 1.269E-06  | -2.412E-06 |
| 3.401E+05 | 8.673E-04 | -8.237E-04 | 2.686E+07 | 6.808E-07  | -2.560E-06 |
| 3.468E+05 | 8.637E-04 | -8.445E-04 | 2.739E+07 | 1.370E-07  | -2.529E-06 |
| 3.537E+05 | 8.574E-04 | -8.673E-04 | 2.793E+07 | -2.956E-07 | -2.297E-06 |
| 3.607E+05 | 8.487E-04 | -8.927E-04 | 2.849E+07 | -6.944E-07 | -2.055E-06 |
| 3.678E+05 | 8.355E-04 | -9.207E-04 | 2.905E+07 | -9.575E-07 | -1.780E-06 |
| 3.751E+05 | 8.173E-04 | -9.509E-04 | 2.962E+07 | -1.157E-06 | -1.491E-06 |
| 3.825E+05 | 7.932E-04 | -9.815E-04 | 3.021E+07 | -1.326E-06 | -1.209E-06 |
| 3.901E+05 | 7.622E-04 | -1.012E-03 | 3.081E+07 | -1.472E-06 | -9.885E-07 |
| 3.978E+05 | 7.238E-04 | -1.041E-03 | 3.142E+07 | -1.650E-06 | -7.550E-07 |
| 4.057E+05 | 6.778E-04 | -1.065E-03 | 3.204E+07 | -1.796E-06 | -4.790E-07 |
| 4.137E+05 | 6.254E-04 | -1.083E-03 | 3.267E+07 | -1.970E-06 | -1.434E-07 |
| 4.219E+05 | 5.682E-04 | -1.092E-03 | 3.332E+07 | -2.038E-06 | 3.074E-07  |
| 4.302E+05 | 5.082E-04 | -1.089E-03 | 3.398E+07 | -2.006E-06 | 8.433E-07  |
| 4.388E+05 | 4.507E-04 | -1.075E-03 | 3.465E+07 | -1.803E-06 | 1.422E-06  |
| 4.474E+05 | 4.000E-04 | -1.050E-03 | 3.534E+07 | -1.391E-06 | 1.895E-06  |
| 4.563E+05 | 3.574E-04 | -1.019E-03 | 3.604E+07 | -8.054E-07 | 2.250E-06  |
| 4.653E+05 | 3.255E-04 | -9.846E-04 | 3.675E+07 | -1.410E-07 | 2.360E-06  |
| 4.745E+05 | 3.029E-04 | -9.514E-04 | 3.748E+07 | 5.241E-07  | 2.201E-06  |
| 4.839E+05 | 2.865E-04 | -9.230E-04 | 3.822E+07 | 1.053E-06  | 1.819E-06  |
| 4.935E+05 | 2.733E-04 | -8.979E-04 | 3.897E+07 | 1.383E-06  | 1.317E-06  |
| 5.033E+05 | 2.608E-04 | -8.752E-04 | 3.974E+07 | 1.461E-06  | 7.958E-07  |
| 5.132E+05 | 2.511E-04 | -8.526E-04 | 4.053E+07 | 1.343E-06  | 3.888E-07  |
| 5.234E+05 | 2.450E-04 | -8.301E-04 | 4.133E+07 | 1.129E-06  | 1.378E-07  |
| 5.337E+05 | 2.448E-04 | -8.118E-04 | 4.215E+07 | 8.979E-07  | 5.707E-08  |
| 5.443E+05 | 2.497E-04 | -7.998E-04 | 4.298E+07 | 7.991E-07  | 1.104E-07  |
| 5.550E+05 | 2.536E-04 | -7.986E-04 | 4.383E+07 | 8.617E-07  | 1.336E-07  |
| 5.660E+05 | 2.521E-04 | -8.065E-04 | 4.470E+07 | 9.815E-07  | 8.597E-08  |
| 5.772E+05 | 2.394E-04 | -8.186E-04 | 4.559E+07 | 8.041E-08  | -8.041E-08 |
| 5.887E+05 | 2.156E-04 | -8.284E-04 | 4.649E+07 | 1.138E-06  | 3.753E-07  |
| 6.003E+05 | 1.840E-04 | -8.298E-04 | 4.741E+07 | 1.020E-06  | -6.484E-07 |
| 6.122E+05 | 1.513E-04 | -8.216E-04 | 4.835E+07 | 8.026E-07  | -8.671E-07 |
| 6.243E+05 | 1.223E-04 | -8.062E-04 | 4.930E+07 | 5.271E-07  | -9.697E-07 |
| 6.366E+05 | 9.735E-05 | -7.878E-04 | 5.028E+07 | 3.061E-07  | -9.680E-07 |
| 6.492E+05 | 7.515E-05 | -7.680E-04 | 5.127E+07 | 1.433E-07  | -9.459E-07 |
| 6.621E+05 | 5.506E-05 | -7.465E-04 | 5.229E+07 | -1.828E-10 | -9.432E-07 |
| 6.752E+05 | 3.769E-05 | -7.220E-04 | 5.332E+07 | -1.872E-07 | -9.745E-07 |
| 6.885E+05 | 2.438E-05 | -6.967E-04 | 5.438E+07 | -4.739E-07 | -9.170E-07 |
| 7.022E+05 | 1.609E-05 | -6.716E-04 | 5.545E+07 | -7.492E-07 | -7.111E-07 |
| 7.161E+05 | 1.026E-05 | -6.479E-04 | 5.655E+07 | -8.973E-07 | -3.352E-07 |
| 7.302E+05 | 6.986E-06 | -6.254E-04 | 5.767E+07 | -8.059E-07 | 5.582E-08  |
| 7.447E+05 | 7.982E-06 | -6.038E-04 | 5.881E+07 | -5.106E-07 | 2.947E-07  |
| 7.594E+05 | 1.375E-05 | -5.855E-04 | 5.997E+07 | -1.636E-07 | 2.439E-07  |
| 7.744E+05 | 2.236E-05 | -5.755E-04 |           |            |            |

NUMBER OF POINTS = 445

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

TIME DERIVATIVE CALCULATIONS

| TIME (SEC) | DERIVATIVE OF<br>E-RADIAL | TIME (SECC) | DERIVATIVE OF<br>E-RADIAL | TIME (SECC) | DERIVATIVE OF<br>E-RADIAL | TIME (SECC) | DERIVATIVE OF<br>E-RADIAL |
|------------|---------------------------|-------------|---------------------------|-------------|---------------------------|-------------|---------------------------|
| 8.304E-09  | 0.0                       | 2.280E-07   | -5.702E+09                | 7.294E-06   | 3.006E+06                 | 1.101E-05   | -9.772E+06                |
| 9.342E-09  | 7.728E+08                 | 2.330E-07   | -5.654E+09                | 7.537E-06   | 4.385E+07                 | 1.134E-05   | 1.149E+07                 |
| 1.038E-08  | 1.104E+09                 | 2.380E-07   | -5.582E+09                | 7.798E-06   | 8.823E+07                 | 1.167E-05   | 1.915E+07                 |
| 1.153E-08  | 5.234E+09                 | 2.431E-07   | -5.516E+09                | 8.058E-06   | 9.690E+07                 | 1.203E-05   | 2.323E+07                 |
| 1.269E-08  | 6.655E+09                 | 2.481E-07   | -5.437E+09                | 8.318E-06   | 9.659E+07                 | 1.240E-05   | 6.705E+06                 |
| 1.375E-08  | 9.651E+09                 | 2.538E-07   | -5.345E+09                | 8.578E-06   | 7.745E+07                 | 1.276E-05   | -1.057E+07                |
| 1.481E-08  | 1.332E+10                 | 2.595E-07   | -5.244E+09                | 8.856E-06   | 5.073E+07                 | 1.312E-05   | -1.358E+06                |
| 1.592E-08  | 1.711E+10                 | 2.651E-07   | -5.158E+09                | 9.134E-06   | 4.674E+07                 | 1.352E-05   | 1.010E+07                 |
| 1.705E-08  | 2.066E+10                 | 2.710E-07   | -5.069E+09                | 9.429E-06   | 4.311E+07                 | 1.392E-05   | 7.144E+05                 |
| 1.827E-08  | 2.382E+10                 | 2.769E-07   | -4.968E+09                | 9.723E-06   | 3.002E+07                 | 1.432E-05   | -8.336E+06                |
| 1.948E-08  | 2.600E+10                 | 2.830E-07   | -4.860E+09                | 1.004E-05   | 1.600E+07                 | 1.472E-05   | -3.191E+06                |
| 2.070E-08  | 2.730E+10                 | 2.891E-07   | -4.751E+09                | 1.035E-05   | -7.788E+06                | 1.515E-05   | 3.891E+06                 |
| 2.191E-08  | 2.726E+10                 | 2.956E-07   | -4.636E+09                | 1.068E-05   | -2.709E+07                | 1.559E-05   | 6.743E+06                 |
| 2.298E-08  | 2.654E+10                 | 3.022E-07   | -4.528E+09                | 1.101E-05   | -9.772E+06                | 1.602E-05   | 9.107E+06                 |
| 2.406E-08  | 2.463E+10                 | 3.089E-07   | -4.418E+09                | 1.134E-05   | 1.149E+07                 | 1.646E-05   | 1.031E+07                 |
| 2.531E-08  | 2.208E+10                 | 3.156E-07   | -4.295E+09                | 1.167E-05   | 1.915E+07                 | 1.692E-05   | 1.047E+07                 |
| 2.656E-08  | 2.018E+10                 | 3.227E-07   | -4.170E+09                | 1.203E-05   | 2.323E+07                 | 1.739E-05   | 9.343E+06                 |
| 2.750E-08  | 1.911E+10                 | 3.298E-07   | -4.045E+09                | 1.240E-05   | 6.705E+06                 | 1.790E-05   | 7.412E+06                 |
| 2.843E-08  | 1.902E+10                 | 3.370E-07   | -3.961E+09                | 1.276E-05   | -1.057E+07                | 1.846E-05   | 4.876E+06                 |
| 2.943E-08  | 1.978E+10                 | 3.442E-07   | -3.848E+09                | 1.312E-05   | -1.358E+06                | 1.890E-05   | 2.415E+06                 |
| 3.043E-08  | 2.253E+10                 | 3.518E-07   | -3.734E+09                | 1.352E-05   | 1.010E+07                 | 1.940E-05   | 1.511E+06                 |
| 3.088E-08  | 2.378E+10                 | 3.594E-07   | -3.631E+09                | 1.392E-05   | 7.144E+05                 | 1.994E-05   | 9.889E+05                 |
| 3.133E-08  | 2.592E+10                 | 3.670E-07   | -3.533E+09                | 1.432E-05   | -8.336E+06                | 2.048E-05   | 2.321E+05                 |
| 3.174E-08  | 2.816E+10                 | 3.745E-07   | -3.442E+09                | 1.472E-05   | -3.191E+06                | 2.104E-05   | -1.744E+05                |
| 3.214E-08  | 3.035E+10                 | 3.866E-07   | -3.306E+09                | 1.515E-05   | 3.891E+06                 | 2.159E-05   | 2.027E+05                 |
| 3.253E-08  | 3.253E+10                 | 3.987E-07   | -3.176E+09                | 1.559E-05   | 6.743E+06                 | 2.218E-05   | 8.765E+05                 |
| 3.287E-08  | 3.505E+10                 | 4.069E-07   | -3.092E+09                | 1.602E-05   | 9.107E+06                 | 2.277E-05   | 1.734E+06                 |
| 3.320E-08  | 3.753E+10                 | 4.150E-07   | -3.027E+09                | 1.646E-05   | 1.031E+07                 | 2.340E-05   | 2.587E+06                 |
| 3.352E-08  | 4.039E+10                 | 4.233E-07   | -2.966E+09                | 1.692E-05   | 1.047E+07                 | 2.402E-05   | 2.728E+06                 |
| 3.382E-08  | 4.315E+10                 | 4.316E-07   | -2.904E+09                | 1.739E-05   | 9.343E+06                 | 2.466E-05   | 2.667E+06                 |
| 3.412E-08  | 4.614E+10                 | 4.404E-07   | -2.844E+09                | 1.790E-05   | 7.412E+06                 | 2.530E-05   | 2.737E+06                 |
| 3.439E-08  | 4.895E+10                 | 4.491E-07   | -2.786E+09                | 1.846E-05   | 4.876E+06                 | 2.598E-05   | 2.646E+06                 |
| 3.465E-08  | 5.185E+10                 | 4.591E-07   | -2.710E+09                | 1.890E-05   | 2.415E+06                 | 2.666E-05   | 2.646E+06                 |
| 3.489E-08  | 5.452E+10                 | 4.752E-07   | -2.648E+09                | 1.940E-05   | 1.511E+06                 | 2.737E-05   | 9.438E+05                 |
| 3.513E-08  | 5.716E+10                 | 4.839E-07   | -2.610E+09                | 1.994E-05   | 9.889E+05                 | 2.808E-05   | 1.414E+06                 |
| 3.534E-08  | 5.955E+10                 | 4.926E-07   | -2.577E+09                | 2.048E-05   | 2.321E+05                 | 2.881E-05   | 1.994E+06                 |
| 3.556E-08  | 6.201E+10                 | 5.066E-07   | -2.531E+09                | 2.104E-05   | -1.744E+05                | 2.954E-05   | 2.258E+06                 |
| 3.575E-08  | 6.421E+10                 | 5.205E-07   | -2.485E+09                | 2.159E-05   | 2.027E+05                 | 3.032E-05   | 2.294E+06                 |
| 3.595E-08  | 6.637E+10                 | 5.298E-07   | -2.456E+09                | 2.218E-05   | 8.765E+05                 |             |                           |
| 3.612E-08  | 6.844E+10                 | 5.392E-07   | -2.431E+09                | 2.277E-05   | 1.734E+06                 |             |                           |
| 3.630E-08  | 6.988E+10                 | 5.534E-07   | -2.397E+09                | 2.340E-05   | 2.587E+06                 |             |                           |
| 3.645E-08  | 7.125E+10                 | 5.677E-07   | -2.369E+09                | 2.402E-05   | 2.728E+06                 |             |                           |
| 3.661E-08  | 7.247E+10                 | 5.777E-07   | -2.350E+09                | 2.466E-05   | 2.667E+06                 |             |                           |
| 3.675E-08  | 7.346E+10                 | 5.877E-07   | -2.330E+09                | 2.530E-05   | 2.737E+06                 |             |                           |
| 3.689E-08  | 7.433E+10                 | 6.028E-07   | -2.300E+09                | 2.598E-05   | 2.646E+06                 |             |                           |
| 3.702E-08  | 7.502E+10                 | 6.178E-07   | -2.271E+09                | 2.666E-05   | 2.646E+06                 |             |                           |
| 3.715E-08  | 7.560E+10                 | 6.331E-07   | -2.242E+09                | 2.737E-05   | 9.438E+05                 |             |                           |
| 3.726E-08  | 7.605E+10                 | 6.484E-07   | -2.219E+09                | 2.808E-05   | 1.414E+06                 |             |                           |
| 3.737E-08  | 7.648E+10                 | 6.645E-07   | -2.195E+09                | 2.881E-05   | 1.994E+06                 |             |                           |
| 3.748E-08  | 7.679E+10                 | 6.807E-07   | -2.167E+09                | 2.954E-05   | 2.258E+06                 |             |                           |
| 3.758E-08  | 7.703E+10                 | 6.968E-07   | -2.138E+09                | 3.032E-05   | 2.294E+06                 |             |                           |

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |            |           |            |           |            |
|-----------|------------|-----------|------------|-----------|------------|
| 3.768E-08 | 7.713E+10  | 7.129E-07 | -2.110E+09 | 3.110E-05 | 1.271E+06  |
| 3.778E-08 | 7.711E+10  | 7.293E-07 | -2.081E+09 | 3.191E-05 | 9.877E+04  |
| 3.798E-08 | 7.671E+10  | 7.457E-07 | -2.055E+09 | 3.273E-05 | -9.181E+05 |
| 3.818E-08 | 7.596E+10  | 7.630E-07 | -2.027E+09 | 3.358E-05 | -1.581E+06 |
| 3.838E-08 | 7.506E+10  | 7.803E-07 | -2.001E+09 | 3.443E-05 | -3.462E+05 |
| 3.858E-08 | 7.407E+10  | 7.976E-07 | -1.973E+09 | 3.532E-05 | 1.173E+06  |
| 3.878E-08 | 7.302E+10  | 8.149E-07 | -1.937E+09 | 3.620E-05 | 1.768E+06  |
| 3.898E-08 | 7.208E+10  | 8.325E-07 | -1.901E+09 | 3.714E-05 | 2.121E+06  |
| 3.918E-08 | 7.113E+10  | 8.501E-07 | -1.872E+09 | 3.807E-05 | 1.719E+06  |
| 3.938E-08 | 7.023E+10  | 8.677E-07 | -1.842E+09 | 3.905E-05 | 1.101E+06  |
| 3.968E-08 | 6.879E+10  | 8.872E-07 | -1.807E+09 | 4.002E-05 | 6.920E+05  |
| 3.998E-08 | 6.713E+10  | 9.058E-07 | -1.771E+09 | 4.104E-05 | 3.088E+05  |
| 4.019E-08 | 6.586E+10  | 9.244E-07 | -1.730E+09 | 4.206E-05 | 4.089E+05  |
| 4.039E-08 | 6.475E+10  | 9.494E-07 | -1.672E+09 | 4.314E-05 | 5.629E+05  |
| 4.114E-08 | 5.955E+10  | 9.745E-07 | -1.618E+09 | 4.422E-05 | -5.310E+04 |
| 4.189E-08 | 5.134E+10  | 9.544E-07 | -1.574E+09 | 4.534E-05 | -5.737E+05 |
| 4.253E-08 | 4.466E+10  | 1.014E-06 | -1.530E+09 | 4.647E-05 | 2.130E+05  |
| 4.316E-08 | 3.930E+10  | 1.041E-06 | -1.468E+09 | 4.763E-05 | 1.064E+06  |
| 4.416E-08 | 3.268E+10  | 1.067E-06 | -1.397E+09 | 4.880E-05 | 1.156E+06  |
| 4.515E-08 | 3.041E+10  | 1.094E-06 | -1.323E+09 | 5.003E-05 | 1.045E+06  |
| 4.587E-08 | 2.914E+10  | 1.121E-06 | -1.252E+09 | 5.126E-05 | 2.237E+05  |
| 4.659E-08 | 2.749E+10  | 1.142E-06 | -1.196E+09 | 5.254E-05 | -6.078E+05 |
| 4.743E-08 | 2.584E+10  | 1.164E-06 | -1.141E+09 | 5.383E-05 | -2.120E+05 |
| 4.827E-08 | 2.379E+10  | 1.192E-06 | -1.067E+09 | 5.518E-05 | 3.328E+05  |
| 4.924E-08 | 2.157E+10  | 1.221E-06 | -9.881E+08 | 5.653E-05 | 1.834E+05  |
| 5.020E-08 | 1.963E+10  | 1.249E-06 | -9.089E+08 | 5.796E-05 | 2.395E+04  |
| 5.132E-08 | 1.795E+10  | 1.278E-06 | -8.253E+08 | 5.938E-05 | 4.418E+05  |
| 5.245E-08 | 1.645E+10  | 1.308E-06 | -7.381E+08 | 6.085E-05 | 8.029E+05  |
| 5.329E-08 | 1.582E+10  | 1.339E-06 | -6.634E+08 | 6.233E-05 | 1.822E+05  |
| 5.413E-08 | 2.043E+10  | 1.369E-06 | -5.913E+08 | 6.387E-05 | -4.632E+05 |
| 5.506E-08 | 2.620E+10  | 1.400E-06 | -5.165E+08 | 6.542E-05 | -6.536E+04 |
| 5.599E-08 | 1.864E+10  | 1.430E-06 | -4.443E+08 | 6.703E-05 | 4.132E+05  |
| 5.702E-08 | 1.166E+10  | 1.461E-06 | -3.709E+08 | 6.865E-05 | 3.154E+05  |
| 5.804E-08 | 4.870E+10  | 1.493E-06 | -2.986E+08 | 7.035E-05 | 1.698E+05  |
| 5.916E-08 | 8.313E+10  | 1.526E-06 | -2.408E+08 | 7.205E-05 | 1.783E+05  |
| 6.031E-08 | 1.319E+10  | 1.567E-06 | -1.775E+08 | 7.383E-05 | 1.764E+05  |
| 6.155E-08 | -5.905E+10 | 1.608E-06 | -1.179E+08 | 7.562E-05 | 5.814E+04  |
| 6.285E-08 | 1.134E+10  | 1.641E-06 | -7.317E+07 | 7.746E-05 | -4.248E+04 |
| 6.417E-08 | 9.519E+10  | 1.673E-06 | -3.476E+07 | 7.933E-05 | 1.200E+05  |
| 6.553E-08 | 7.732E+10  | 1.715E-06 | 5.704E+06  | 8.128E-05 | 2.881E+05  |
| 6.704E-08 | 4.665E+10  | 1.756E-06 | 2.633E+07  | 8.322E-05 | 1.484E+05  |
| 6.859E-08 | 3.381E+10  | 1.797E-06 | 4.273E+07  | 8.527E-05 | -1.264E+04 |
| 7.025E-08 | 2.170E+10  | 1.838E-06 | 5.334E+07  | 8.731E-05 | 3.971E+04  |
| 7.194E-08 | 3.797E+10  | 1.880E-06 | 5.803E+07  | 8.945E-05 | 1.059E+05  |
| 7.372E-08 | 4.664E+10  | 1.921E-06 | 6.049E+07  | 9.158E-05 | 6.796E+04  |
| 7.563E-08 | 4.546E+10  | 1.970E-06 | 5.725E+07  | 9.382E-05 | 3.115E+04  |
| 7.759E-08 | 3.788E+10  | 2.020E-06 | 4.290E+07  | 9.608E-05 | 6.463E+04  |
| 7.863E-08 | 2.332E+10  | 2.061E-06 | 2.903E+07  | 9.844E-05 | 9.833E+04  |
| 7.967E-08 | 2.831E+10  | 2.102E-06 | 1.580E+07  | 1.007E-04 | 1.064E+05  |
| 8.140E-08 | 3.653E+10  | 2.152E-06 | 1.180E+06  | 1.032E-04 | 1.006E+05  |
| 8.414E-08 | 2.462E+10  | 2.201E-06 | -7.058E+06 | 1.057E-04 | -2.370E+03 |
| 8.549E-08 | 1.857E+10  | 2.259E-06 | -1.358E+07 | 1.082E-04 | -1.010E+05 |
| 8.644E-08 | 7.235E+09  | 2.317E-06 | -2.067E+07 | 1.108E-04 | -4.323E+04 |
| 8.844E-08 | -6.143E+09 | 2.366E-06 | -2.409E+07 | 1.163E-04 | 1.187E+05  |
| 9.104E-08 | 1.698E+10  | 2.416E-06 | -2.234E+07 | 1.218E-04 | 3.250E+04  |
| 9.219E-08 | 2.846E+10  | 2.474E-06 | -1.614E+07 | 1.247E-04 | -1.231E+04 |
| 9.334E-08 | 3.582E+10  | 2.531E-06 | -2.619E+06 | 1.277E-04 | 4.445E+04  |
| 9.564E-08 | 4.125E+10  | 2.589E-06 | 1.147E+07  | 1.208E-04 | 1.010E+05  |
| 9.774E-08 | 1.560E+10  | 2.647E-06 | 2.020E+07  | 1.339E-04 | 5.964E+04  |
|           |            | 2.713E-06 | 2.679E+07  | 1.371E-04 | 1.223E+04  |

APPENDIX A

LISTING OF EMPFIT AND SAMPLE RUN (cont'd)

|           |            |           |            |           |           |
|-----------|------------|-----------|------------|-----------|-----------|
| 1.002E-07 | -1.001E+10 | 2.779E-06 | 2.976E+07  | 1.403E-04 | 3.051E+04 |
| 1.025E-07 | -1.725E+08 | 2.845E-06 | 2.791E+07  | 1.437E-04 | 5.299E+04 |
| 1.048E-07 | 1.257E+10  | 2.911E-06 | 1.982E+07  | 1.472E-04 | 5.771E+04 |
| 1.071E-07 | 1.305E+10  | 2.977E-06 | 6.181E+06  | 1.507E-04 | 4.745E+04 |
| 1.094E-07 | 1.229E+10  | 3.043E-06 | 1.729E+07  | 1.542E-04 | 3.211E+04 |
| 1.117E-07 | 4.859E+09  | 3.117E-06 | -4.713E+07 | 1.579E-04 | 1.652E+04 |
| 1.140E-07 | -2.331E+09 | 3.192E-06 | -7.698E+07 | 1.616E-04 | 2.281E+04 |
| 1.163E-07 | 1.455E+09  | 3.266E-06 | -1.040E+08 | 1.655E-04 | 3.162E+04 |
| 1.186E-07 | 6.640E+09  | 3.340E-06 | -1.215E+08 | 1.695E-04 | 2.875E+04 |
| 1.212E-07 | 8.509E+09  | 3.414E-06 | -1.321E+08 | 1.735E-04 | 2.515E+04 |
| 1.237E-07 | 9.353E+09  | 3.489E-06 | -1.351E+08 | 1.776E-04 | 2.681E+04 |
| 1.263E-07 | 6.182E+09  | 3.571E-06 | -1.295E+08 | 1.818E-04 | 2.754E+04 |
| 1.289E-07 | 1.935E+09  | 3.654E-06 | -1.112E+08 | 1.861E-04 | 1.776E+04 |
| 1.315E-07 | -3.037E+09 | 3.736E-06 | -8.775E+07 | 1.906E-04 | 8.286E+03 |
| 1.344E-07 | -7.179E+09 | 3.819E-06 | -5.972E+07 | 1.950E-04 | 1.343E+04 |
| 1.372E-07 | -4.159E+09 | 3.909E-06 | -2.917E+07 | 1.997E-04 | 2.003E+04 |
| 1.401E-07 | -4.563E+07 | 4.000E-06 | -1.090E+07 | 2.044E-04 | 1.854E+04 |
| 1.430E-07 | 1.311E+09  | 4.099E-06 | 6.731E+06  | 2.093E-04 | 1.632E+04 |
| 1.460E-07 | 2.073E+09  | 4.198E-06 | 2.051E+07  | 2.141E-04 | 1.707E+04 |
| 1.491E-07 | 4.227E+08  | 4.297E-06 | 3.768E+07  | 2.193E-04 | 1.715E+04 |
| 1.523E-07 | -1.857E+09 | 4.396E-06 | 6.801E+07  | 2.244E-04 | 1.076E+04 |
| 1.555E-07 | -2.819E+09 | 4.495E-06 | 1.056E+08  | 2.298E-04 | 4.738E+03 |
| 1.589E-07 | -3.652E+09 | 4.594E-06 | 1.594E+08  | 2.351E-04 | 8.602E+03 |
| 1.622E-07 | -4.385E+09 | 4.702E-06 | 2.124E+08  | 2.408E-04 | 1.346E+04 |
| 1.657E-07 | -4.884E+09 | 4.809E-06 | 3.080E+08  | 2.464E-04 | 1.262E+04 |
| 1.692E-07 | -4.874E+09 | 4.924E-06 | 3.637E+08  | 2.523E-04 | 1.126E+04 |
| 1.729E-07 | -4.691E+09 | 5.040E-06 | 1.904E+08  | 2.581E-04 | 1.082E+04 |
| 1.766E-07 | -4.804E+09 | 5.156E-06 | -4.341E+06 | 2.643E-04 | 1.010E+04 |
| 1.805E-07 | -4.512E+09 | 5.272E-06 | -1.869E+08 | 2.705E-04 | 1.001E+04 |
| 1.843E-07 | -4.510E+09 | 5.485E-06 | -4.101E+08 | 2.770E-04 | 9.617E+03 |
| 1.884E-07 | -4.575E+09 | 5.698E-06 | -1.766E+08 | 2.834E-04 | 5.377E+03 |
| 1.924E-07 | -4.806E+09 | 5.906E-06 | 8.041E+07  | 2.902E-04 | 1.473E+03 |
| 1.987E-07 | -5.224E+09 | 6.115E-06 | -8.735E+07 | 2.969E-04 | 4.639E+03 |
| 2.050E-07 | -5.456E+09 | 6.340E-06 | -2.674E+08 | 3.040E-04 | 7.729E+03 |
| 2.054E-07 | -5.597E+09 | 6.566E-06 | -7.168E+07 | 3.111E-04 | 6.925E+03 |
| 2.138E-07 | -5.639E+09 | 6.809E-06 | 1.469E+08  | 4.055E-04 | 4.998E+01 |
| 2.185E-07 | -5.641E+09 | 7.052E-06 | 8.310E+07  | 5.000E-04 | 4.443E-01 |
| 2.231E-07 | -5.683E+09 |           |            |           |           |

NUMBER OF POINTS = 445

APPENDIX B.--SAMPLE INPUT DATA

Figures B-1 to B-3 show examples of input card decks of EMPFIT.

APPENDIX B

```

*****
1          2          3          4          5          6          7          8
*****
1
1          3-5.000E+05          1          1
NEMP  PROBLEM A  OBSERVER 1
1 5.000E-04 1.200E+08 5.000E+04 1.000E+04 6.000E+07          1
3.000E-04
1          1
2          146          204

```

Figure B-1. Example of data preparation by using disk file to enter data points, using time cutoff option, deleting data points.

```

*****
1          2          3          4          5          6          7          8
*****
1
3          3-5.000E+05          2          1
NEMP  PROBLEM A  OBSERVER 1
1 2.000E+00 1.200E+08 5.000E+00 1.000E+00 1.000E+10
3          1          1
2          146
2 3.043E-07-1.289E+02 8.058E-06-1.866E+02

```

Figure B-2. Example of data preparation by using disk file to enter data points, deleting data points, adding data points.

APPENDIX B

```

*****
      1           2           3           4           5           6           7           8
*****

      1
      3
LEMP  PROBLEM 2          3-1.000E+05          2
      42          4 1.000E-01 1.200E+08 5.000E+05 1.000E+00 3.000E+09
      2
      1
1.424E-07-4.389E-05
1.563E-07-1.088E-04
1.718E-07-2.948E-04
1.886E-07-8.535E-04
2.072E-07-2.522E-03
2.498E-07-1.322E-02
2.745E-07-2.469E-02
3.021E-07-5.096E-02
3.653E-07-4.974E-01
4.003E-07-5.838E-01
4.380E-07-6.015E-01
4.793E-07-5.843E-01
5.259E-07-5.215E-01
8.368E-07-3.596E-01
9.178E-07-3.372E-01
1.104E-06-3.185E-01
1.326E-06-3.054E-01
1.595E-06-2.884E-01
2.103E-06-2.789E-01
2.529E-06-2.753E-01
3.041E-06-2.641E-01
4.399E-06-1.978E-01
5.287E-06-1.459E-01
6.358E-06-9.011E-02
8.377E-06-2.672E-02
1.007E-05-8.379E-03
1.105E-05-4.926E-03
1.211E-05-3.658E-03
1.328E-05-3.954E-03
1.456E-05-5.381E-03
1.919E-05-1.054E-02
2.307E-05-1.324E-02
2.773E-05-1.464E-02
3.334E-05-1.533E-02
3.656E-05-1.546E-02
4.009E-05-1.531E-02
4.300E-05-1.546E-02
5.284E-05-1.619E-02
6.353E-05-1.480E-02
7.638E-05-1.396E-02
8.080E-05-1.367E-02
8.374E-05-1.337E-02

```

Figure B-3. Example of data preparation by using cards to enter data points.

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