```
200               ORG
                  REM            6-PLACE SINE
                  ILF            a4000,CC+1
          T6      FAD            HALFPI,U→T6
          T6      FDV            HALFPI,U→T6
                  IF(POS)TRA     aCC+1
          -U      ILN            a4000,U→T6
          T6      FAD+60         EXP06
                  DML            a1,R→T7
                  IF(ZER)TRA     aSINE
          -U      IDV            a4,R→B5
          T7      BEU            C2,U→T6
          -U      NOP            aCC+B5+3,I→CC
          -U      FSB            d1,0
                  STO            T6,CC+1
                  FAD            d1,0,U→T6
SINE      T6      FMP            T6,U→T7
                  FMP            C4
                  FAD            C3
                  FMP            T7
                  FAD            C2
                  FMP            T7
                  FAD+40         C1
                  FMP            T6,U→T6
                  IF(NMO)TRA     aPF
          -U      TRA            aPF,U→T6
HALFPI            DEC            1.570796326794
C1                DEC            1.5707948520
C2                DEC            -0.6459209780
C3                DEC            0.0794876630
C4                DEC            -0.0043624760
EXP06             OCT            0600000000000000
                  END
```

1301	HALFPI		0	31	0	36000000000000	0
1302	EXP06		0	36	0	50000000000000	0
1303	SINE		0	17	0	23000000000000	0
1304	C2		0	33	0	42000000000000	0
1305		0	0	37	0	52000000000000	0
1306	C4		0	35	0	46000000000000	0
1307	C3		0	34	0	44000000000000	0
1310	C1		0	32	0	40000000000000	0

6-PLACE SINE

5		1	01	42005	20	4000	04000		
6		2	06	10400	06	0001	00026	HALFPI	
7		3	06	10700	06	0001	00025	HALFPI	
10		4	01	01110	00	4001	00001		
11		5	11	42001	06	4000	04000		
12		6	06	10460	00	0001	00027	EXP06	
13		7	01	44010	17	4000	00001		
14		10	01	01010	00	4001	00006	SINE	
15		11	11	13300	55	4000	00004		
16		12	07	21000	06	0001	00020	C2	
17		13	11	30000	70	4041	00003		
20		14	11	10500	00	0001	00022		0
21		15	01	20001	20	4000	00006		
22		16	01	10400	06	0001	00020		0
23	SINE	17	06	10600	07	0000	00006		
24		20	01	10600	00	0001	00014	C4	
25		21	01	10400	00	0001	00012	C3	
26		22	01	10600	00	0000	00007		
27		23	01	10400	00	0001	00007	C2	
30		24	01	10600	00	0000	00007		
31		25	01	10440	00	0001	00004	C1	
32		26	01	10600	06	0000	00006		
33		27	01	01600	00	4200	00000		
34		30	11	01000	06	4200	00000		
36	HALFPI	31	01	00144	41	7665	21040		
40	C1	32	01	00144	41	7634	41410		
42	C2	33	77	53251	16	6073	54106		
44	C3	34	77	02425	24	6661	01236		
46	C4	35	77	77670	41	4714	20015		
50	EXP06	36	06	00000	00	0000	00000		
52		37	01	00100	00	0000	00000		

```
201          ORG
             REM                6-PLACE COSINE
     -Z      IF(NSN,MOV)TRA     *200,CC+1
             END
```

PROGRAM 201 6/08/64 15:03

6-PLACE COSINE

5 1 10 01700 20 4400 00200

```
                                                                    1
203                 ORG                                             2
                    REM             6 PLACE EXP, ROUTINE            3
                T6  IF(NNZ)TRA      aCC+1                           4
                    ILF             a4000,CC+1                      5
                -U  ILN             a4000,U→T6                      6
                    FMP             C5                              7
                    FAD             C4                              10
                    FMP             T6                              11
                    FAD             C3                              12
                    FMP             T6                              13
                    FAD             C2                              14
                    FMP             T6                              15
                    FAD             C1                              16
                    FMP             T6                              17
                    FAD             d1,0                            20
                    FMP             U                               21
                    FMP             U                               22
                    IF(NMO)TRA      aPF,U→T6                        23
                    VDF             d1,0                            24
                    TSR             aPF,U→T6                        25
C1                  DEC             0.250010936                     26
C2                  DEC             0.031198056                     27
C3                  DEC             0.002673255                     30
C4                  DEC             0.000127992                     31
C5                  DEC             0.000014876                     32
                    END                                             33
                                                                    34
```

1301	C5		0	27	0	41000000000000	0
1302	C4		0	26	0	37000000000000	0
1303	C3		0	25	0	35000000000000	0
1304	C2		0	24	0	33000000000000	0
1305	C1		0	23	0	31000000000000	0
1306		0	0	30	0	43000000000000	0

6 PLACE EXP. ROUTINE

6		1	06	05550	00	4001	00001		
7		2	01	42005	20	4000	04000		
10		3	11	42001	06	4000	04000		
11		4	01	10600	00	0001	00022	C5	
12		5	01	10400	00	0001	00020	C4	
13		6	01	10600	00	0000	00006		
14		7	01	10400	00	0001	00015	C3	
15		10	01	10600	00	0000	00006		
16		11	01	10400	00	0001	00012	C2	
17		12	01	10600	00	0000	00006		
20		13	01	10400	00	0001	00007	C1	
21		14	01	10600	00	0000	00006		
22		15	01	10400	00	0001	00012		0
23		16	01	10600	00	0000	00001		
24		17	01	10600	00	0000	00001		
25		20	01	01600	06	4200	00000		
26		21	01	16700	00	0001	00006		0
27		22	01	40000	06	4200	00000		
31	C1	23	77	10000	13	3571	60624		
33	C2	24	77	00777	11	4206	16000		
35	C3	25	76	25714	34	3314	40522		
37	C4	26	76	01030	65	4564	20623		
41	C5	27	75	37144	76	7371	43033		
43		30	01	00100	00	0000	00000		

```
                                                                    1
204                 ORG                                             2
                    REM             5.5 PLACE LN ROUTINE.           3
            T6      IF(NEG)TRA      @PF                             4
                    CRL             @15,P+B5                        5
            B5      DMR             @9,U+R                          6
                    DML             @3,U+B5                         7
                    ILF             @4000                           10
            T6      BEU             @Z,CC+1                         11
                    IF(MOV)SKP      -U,B5-1                         12
                    ACC,ERM         @X                              13
            -S      BEU             C3,U+T6                         14
                    FAD             C1,U+T7                         15
            T6      FSB             C1                              16
                    FDV+            T7                              17
                    FMP             U                               20
                    FMP             C3                              21
                    FAD             C2                              22
                    FMP             T7                              23
                    FAD             C4,U+T6                         24
            -B5     CPL             @Z                              25
                    FMP             C5                              26
                    FAD+            T6                              27
                    TSR             @PF                             30
C1                  OCT             772650117146376357              31
C2                  OCT             0100177774253514O4              32
C3                  OCT             772564135444436641              33
C4                  OCT             771305620577466551              34
C5                  OCT             061305620577466551              35
                    END                                             36
                                                                    37
```

311	C3	0	20	0	400000000000000	0
312	C1	0	26	0	340000000000000	0
313	C2	0	27	0	360000000000000	0
314	C4	0	31	0	420000000000000	0
315	C5	0	32	0	440000000000000	0

5.5 PLACE LN ROUTINE.

	1	06	01510	00	4200	00000	
	2	01	45066	55	4000	00017	
	3	45	44000	02	4000	00011	
	4	01	44010	45	4000	00003	
	5	01	42005	00	4000	04000	
	6	06	21000	20	4000	00000	
	7	01	02200	65	1000	00001	
	10	01	41020	00	4000	77775	
	11	13	21000	06	0001	00016	C3
	12	01	10400	07	0001	00013	C1
	13	06	10500	00	0001	00012	C1
	14	01	10701	00	0000	00007	
	15	01	10600	00	0000	00001	
	16	01	10600	00	0001	00011	C3
	17	01	10400	00	0001	00007	C2
	20	01	10600	00	0000	00007	
	21	01	10400	06	0001	00007	C4
	22	55	50100	00	4000	00000	
	23	01	10600	00	0001	00006	C5
	24	01	10401	00	0000	00006	
	25	01	40000	00	4200	00000	
C1	26	77	26501	17	1463	76357	
C2	27	01	00177	77	4253	51404	
C3	30	77	25641	35	4444	36641	
C4	31	77	13054	20	5774	66551	
C5	32	06	13056	20	5774	66551	

```
                                                                    1
205                 ORG                                             2
                    REM             6 PLACE ARCTANGENT              3
                T6  IF(NNZ)TRA      aCC+1                           4
                    ILF             a4000,CC+1                      5
                -U  ILN             a4000,U→T6                      6
                    FAD             d1,0,U→T7                       7
                T6  FSB             d1,0                            10
                    FDV             T7,U→T6                         11
                    FMP             U,U→T7                          12
                    FMP             C6                              13
                    FAD             C5                              14
                    FMP             T7                              15
                    FAD             C4                              16
                    FMP             T7                              17
                    FAD             C3                              20
                    FMP             T7                              21
                    FAD             C2                              22
                    FMP             T7                              23
                    FAD             C1                              24
                    FMP             T6                              25
                    FAD             FRTHPI                          26
                    IF(NMO)TRA      aPF,U→T6                        27
                -U  TSR             aPF,U→T6                        30
FRTHPI              DEC             0.785398163397                  31
C1                  DEC             0.999977260                     32
C2                  DEC             -0.332623470                    33
C3                  DEC             0.193543460                     34
C4                  DEC             -0.116432870                    35
C5                  DEC             0.052653320                     36
C6                  DEC             -0.011721200                    37
                    END                                             40
                                                                    41
```

1301		0	0	35	0	51000000000000	0
1302	C6		0	34	0	47000000000000	0
1303	C5		0	33	0	45000000000000	0
1304	C4		0	32	0	43000000000000	0
1305	C3		0	31	0	41000000000000	0
1306	C2		0	30	0	37000000000000	0
1307	C1		0	27	0	35000000000000	0
1310	FRTHPI		0	26	0	33000000000000	0

6 PLACE ARCTANGENT

5		1	06	05550	00	4001	00001		
6		2	01	42005	20	4000	04000		
7		3	11	42001	06	4000	04000		
10		4	01	10400	07	0001	00030		0
11		5	06	10500	00	0001	00027		0
12		6	01	10700	06	0000	00007		
13		7	01	10600	07	0000	00001		
14		10	01	10600	00	0001	00023	C6	
15		11	01	10400	00	0001	00021	C5	
16		12	01	10600	00	0000	00007		
17		13	01	10400	00	0001	00016	C4	
20		14	01	10600	00	0000	00007		
21		15	01	10400	00	0001	00013	C3	
22		16	01	10600	00	0000	00007		
23		17	01	10400	00	0001	00010	C2	
24		20	01	10600	00	0000	00007		
25		21	01	10400	00	0001	00005	C1	
26		22	01	10600	00	0000	00006		
27		23	01	10400	00	0001	00002	FRTHPI	
30		24	01	01600	06	4200	00000		
31		25	11	40000	06	4200	00000		
33	FRTHPI	26	77	31103	75	5242	10165		
35	C1	27	77	37777	50	1174	34312		
37	C2	30	77	65266	23	0062	35746		
41	C3	31	77	06143	01	0157	03377		
43	C4	32	77	74214	27	2227	12725		
45	C5	33	77	01536	53	0037	33201		
47	C6	34	77	77477	75	3345	25101		
51		35	01	00100	00	0000	00000		

```
                                                                    1
236             ORG                                                 2
                REM     INTEGRAL ERF, FROM 0 TO X                   3
        T6      IF(PNZ)TRA  aCC+1                                   4
        Z       TSR     aPF,U+T6                                    5
                FMP     C7,U+T6                                     6
                FMP     C6                                          7
                FAD     C5                                          10
                FMP     T6                                          11
                FAD     C4                                          12
                FMP     T6                                          13
                FAD     C3                                          14
                FMP     T6                                          15
                FAD     C2                                          16
                FMP     T6                                          17
                FAD     C1                                          20
                FMP     T6                                          21
                FAD     d1,0                                        22
                SB5,ERM a4                                          23
                FMP     U,B5-1                                      24
                VDF     d0,5                                        25
        -U      FAD     d0,5,U+T6                                   26
                TSR     aPF                                         27
C1              DEC     0,07052307840                               30
C2              DEC     0,04228201230                               31
C3              DEC     0,00927052720                               32
C4              DEC     0,00015201430                               33
C5              DEC     0,00027656720                               34
C6              DEC     0,00004306380                               35
C7              OCT     772650117146376357 = 1/√2.                  36
                END                                                 37
                                                                    40
```

301	C7		0	33	0	470000000000000	0
302	C6		0	32	0	450000000000000	0
303	C5		0	31	0	430000000000000	0
304	C4		0	30	0	410000000000000	0
305	C3		0	27	0	370000000000000	0
306	C2		0	26	0	350000000000000	0
307	C1		0	25	0	330000000000000	0
310		0	0	34	0	510000000000000	0
311		0	0	35	0	520000000000000	0

INTEGRAL ERF. FROM 0 TO X

6		1	06	05150	00	4001	00001		
7		2	00	40000	06	4200	00000		
10		3	01	10600	06	0001	00027	C7	
11		4	01	10600	00	0001	00025	C6	
12		5	01	10400	00	0001	00023	C5	
13		6	01	10600	00	0000	00006		
14		7	01	10400	00	0001	00020	C4	
15		10	01	10600	00	0000	00006		
16		11	01	10400	00	0001	00015	C3	
17		12	01	10600	00	0000	00006		
20		13	01	10400	00	0001	00012	C2	
21		14	01	10600	00	0000	00006		
22		15	01	10400	00	0001	00007	C1	
23		16	01	10600	00	0000	00006		
24		17	01	10400	00	0001	00014		0
25		20	01	40025	00	4000	00004		
26		21	01	10600	65	0000	00001		
27		22	01	16700	00	0001	00012		0
30		23	11	10400	06	0001	00011		0
31		24	01	40000	00	4200	00000		
33	C1	25	77	02203	34	6353	25655		
35	C2	26	77	01264	57	7164	02317		
37	C3	27	77	00227	70	6643	11001		
41	C4	30	76	01175	46	0162	34027		
43	C5	31	76	02210	00	3424	20567		
45	C6	32	76	00264	47	6634	65411		
47	C7	33	77	26501	17	1463	76357		
51		34	01	00100	00	0000	00000		
52		35	77	20000	00	0000	00000		

ST							
77531	172	0	10732	1	9-10-68	122	0
77532	173	0	10733	1		123	0
77533	ACOSH	400	10734	1		3177730000011540	0
77534	ASIN	400	10735	1		7477740000011571	0
77535	ASINH	400	10736	1		2277740000011666	0
77536	ATAKE	400	10737	1		12377740000011711	0
77537	ATAN	400	10740	1		6000010000012031	0
77540	ATANH	400	10741	1		3177740000012116	0
77541	CACSH	400	10742	1		6777500001214 7	0
77542	CADD	400	10743	1		1077760000121 55	0
77543	CARTN	400	10744	1		1777730000121 71	0
77544	CASN	400	10745	1		2177730000122 11	0
77545	CASNH	400	10746	1		4277700000122 36	0
77546	CATAK	400	10747	1		6777500001227 4	0
77547	CATN	400	10750	1		1077740000123 04	0
77550	CATNH	400	10751	1		4377710000123 20	0
77551	CCEXP	400	10752	1		4277720000123 63	0
77552	CCOL	400	10753	1		6777500001242 3	0
77553	CCONT	400	10754	1		1177770000124 30	0
77554	CCOS	400	10755	1		2177720000124 47	0
77555	CCOT	400	10756	1		4077700000124 73	0
77556	CCSH	400	10757	1		2177720000125 32	0
77557	CDET	400	10760	1		6777500001255 1	0
77560	CDIV	400	10761	1		2277760000125 57	0
77561	CEXP	400	10762	1		2077720000126 06	0
77562	CFEXP	400	10763	1		4577710000126 30	0
77563	CHISQ	400	10764	1		4377750000126 72	0
77564	CINV	400	10765	1		2447764000012747	0
77565	CLENG	400	10766	1		6777500001320 3	0
77566	CLOG	400	10767	1		3177710000132 16	0
77567	CMADD	400	10770	1		5177720000132 47	0
77570	CMCON	400	10771	1		6577720000133 21	0
77571	CMCPY	400	10772	1		2377730000134 06	0
77572	CMMPY	400	10773	1		1257767000013436	0
77573	CMPLX	0	10774	1		0	0
77574	*****	0	10775	1		0	0
77575	CMPY	400	10776	1		1577760000135 55	0
77576	CMSPA	400	10777	1		1277750000135 74	0
77577	CMSUB	400	11000	1		6777500001360 7	0
77600	CMTAK	400	11001	1		3177740000136 17	0
77601	COL	400	11002	1		1777750000136 50	0
77602	CONJ	400	11003	1		5777600001366 7	0
77603	CONTR	400	11004	1		1200010000136 73	0
77604	CONVL	400	11005	1		1017774000013712	0
77605	COS	400	11006	1		6777500001401 3	0
77606	COSH	400	11007	1		6777500001402 2	0
77607	COT	400	11010	1		7777500001403 1	0
77610	CRCOR	400	11011	1		1637775000014041	0
77611	CROW	400	11012	1		5777500001422 5	0
77612	CSIN	400	11013	1		2177720000142 36	0
77613	CSMDV	400	11014	1		4277700000142 62	0
77614	CSMMP	400	11015	1		5777730000143 22	0
77615	CSNH	400	11016	1		2177720000144 03	0
77616	CSOLN	400	11017	1		2177740000144 23	0
77617	CSQR	400	11020	1		2577710000144 50	0
77620	CSTAR	0	11021	1		0	0
77621	*****	0	11022	1		0	0
77622	CSUB	400	11023	1		1077760000144 71	0
77623	CTAN	400	11024	1		4077700000145 10	0
77624	CTNH	400	11025	1		1077740000145 45	0
77625	CTRAN	400	11026	1		3677720000145 60	0
77626	CVSPA	400	11027	1		1277750000146 14	0
77627	CXEXP	400	11030	1		3477720000146 32	0
77630	DET	400	11031	1		1477740000146 65	0
77631	DIAG	400	11032	1		4277770000146 77	0

77632	EDIT	400	11033	1	216777500001533	1 0
77633	EVEN	400	11034	1	3000100001554	5 0
77634	EXP	400	11035	1	737775000015554	0
77635	FFT	400	11036	1	71577740000156	51 0
77636	FFTC	400	11037	1	22677650000165	76 0
77637	FIX	400	11040	1	33777500001701	5 0
77640	FLEXP	400	11041	1	41777400001705	2 0
77641	FLOAT	400	11042	1	400010000171	10 0
77642	FTRAN	400	11043	1	122777100001712	4 0
77643	FXEXP	400	11044	1	54777600001724	2 0
77644	GAMMA	400	11045	1	73777300001732	2 0
77645	IM	400	11046	1	200010000174	11 0
77646	INPUT	400	11047	1	0	0
77647	INV	400	11050	1	200777400001742	0 0
77650	ITIME	400	11051	1	5777600001761	7 0
77651	ITRAN	400	11052	1	130777300001763	0 0
77652	LENGT	400	11053	1	13777500001775	7 0
77653	LGAMM	400	11054	1	35777300001777	5 0
77654	LINCT	0	11055	1	0	0
77655	LOG10	400	11056	1	11777500002003	1 0
77656	LOG	400	11057	1	64777500002004	3 0
77657	MADD	400	11060	1	125777500002013	0 0
77660	MAX	400	11061	1	33777500002025	6 0
77661	MCART	400	11062	1	51776700002032	0 0
77662	MCMPL	400	11063	1	52777200002036	7 0
77663	MCONJ	400	11064	1	14777500002043	7 0
77664	MCOPY	400	11065	1	67777100002046	0 0
77665	MEAN	400	11066	1	27777500002054	4 0
77666	MFLT	400	11067	1	36777400002057	5 0
77667	MIM	400	11070	1	14777500002063	3 0
77670	MIN	400	11071	1	6777500002065	0 0
77671	MINDE	400	11072	1	106777500002065	7 0
77672	MINSE	400	11073	1	120000100002076	3 0
77673	MITIM	400	11074	1	20777300002111	1 0
77674	MMPY	400	11075	1	12377750000211	30 0
77675	MOD	400	11076	1	3177740000212	55 0
77676	MODUL	400	11077	1	3000100002130	3 0
77677	MPATC	400	11100	1	64000100002130	7 0
77700	MPOLA	400	11101	1	6777500002137	7 0
77701	MPOWE	400	11102	1	151777300002141	0 0
77702	MRE	400	11103	1	14777500002156	0 0
77703	MSPAC	400	11104	1	35777600002157	4 0
77704	MSUB	400	11105	1	7777500002163	3 0
77705	MTAKE	400	11106	1	26077750000216	43 0
77706	ODD	400	11107	1	3000100002212	1 0
77707	ORTHO	400	11110	1	11077730000221	32 0
77710	OUTPU	400	11111	1	0	0
77711	PAGCT	0	11112	1	0	0
77712	PLOT	400	11113	1	27077740000222	42 0
77713	POLAR	400	11114	1	2777720000225	35 0
77714	PRESC	400	11115	1	10777750000225	62 0
77715	QCONF	400	11116	1	140777200002267	5 0
77716	RANDM	400	11117	1	10000100002303	0 0
77717	RE	400	11120	1	2000100002304	1 0
77720	ROW	400	11121	1	577500002304	7 0
77721	RTRAN	400	11122	1	13777730000230	57 0
77722	SCRIB	400	11123	1	61677770000232	13 0
77723	SIN	400	11124	1	10477750000240	34 0
77724	SINH	400	11125	1	4177740000241	42 0
77725	SMDIV	400	11126	1	167775000024203	0
77726	SMMPY	400	11127	1	55777500002422	2 0
77727	SQLN	400	11130	1	6777740000243	01 0
77730	SQR	400	11131	1	45777500002437	0 0
77731	STNDV	400	11132	1	4077740000244	37 0
77732	TAN	400	11133	1	747775000024477	0
77733	TANH	400	11134	1	227777000024573	0

77734	TRAN	400	11135	1	6277750000246 17	0
77735	TTAKE	400	11136	1	41777600002470 1	0
77736	VREV	400	11137	1	2777750000247 44	0
77737	VSPAC	400	11140	1	427776000024773	0
77740	←BASE	0	11141	1	239	0
77741	←CDUP	400	11142	1	11777600002503 6	0
77742	←CODE	400	11143	1	0	0
77743	←COL	0	11144	1	0	0
77744	←COMP	400	11145	1	2700010000250 46	0
77745	←CSAV	400	11146	1	21777600002510 0	0
77746	←CSWP	400	11147	1	32777600002512 2	0
77747	←CT	400	11150	1	2000010002251 52	0
77750	←DUMY	400	11151	1	0	0
77751	←←←←←	400	11152	1	0	0
77752	←ELOC	0	11153	1	0	0
77753	←ENTR	400	11154	1	47777000025175	0
77754	←ERPR	400	11155	1	1177777000025202	0
77755	←EXEC	400	11156	1	3677766000025333	0
77756	←FETC	400	11157	1	2700010000257 11	0
77757	←FTPH	400	11160	1	3500010000257 41	0
77760	←GET	400	11161	1	337771000026006	0
77761	←IFE	400	11162	1	17677700000312 12	0
77762	←INOU	400	11163	1	634777600002603 5	0
77763	←LASC	400	11164	1	2 1177720000266 76	0
77764	←LOCN	0	11165	1	0	0
77765	←LOOK	400	11166	1	7077770000271 03	0
77766	←MODE	0	11167	1	0	0
77767	←RDUP	400	11170	1	50001000027173	0
77770	←RSAV	400	11171	1	11000100002720 1	0
77771	←RSWP	400	11172	1	15000100002721 3	0
77772	←SAVE	400	11173	1	1047774000031405	0
77773	←SCAN	400	11174	1	1202776600002724 3	0
77774	←SPEN	400	11175	1	5307765000030447	0
77775	←TEMP	0	11176	1	4954	0
77776	←TEXT	400	11177	1	0	0
77777	←TYPE	400	11200	1	1400010000311 65	0

GS Coding Conventions - For Error Output

7/1/66

DRAFT

The error convention in Genie Spirel has been changed in order to have the error message include the name and order of the user's program that last transferred to Genie Spirel and also the name of that GS program first called by the user, regardless of any supporting GS subroutine in which the error may have actually been found.

In order to accomplish this objective, a new location, ←ELOC, has been added to the ST-VT. This location is "set" each time a user's program calls a supporting subroutine. The contents of this location are the name of the called program in the left five hexads and the contents of PF upon entry in the right five triads. A setting for ←ELOC must be provided for in ~~all~~ each GS programs without ← in its name.

In most cases, the above requirements can be met by having the user's program come into a GS program at the first instruction, which then sets ←ELOC, and having other GS programs come into the second instruction, avoiding this setting.

Example:

			FXEXP	
	FXEXP	—	ORG	—
	ELOC	—	REF	←ELOC
	(other REF'S ....)			
from USER→	—	PF	21600	NAME,CC+1
from GS→	—	—	TRA	CC+1
	—	—	STO	*ELOC
	(rest of program ....)			
	NAME	—	BCD	FXEXP0000
	(0000 are four zeroes)			
	—	—	END	—

An important exception is the case where, in the past, one GS program has come into another GS program at the second instruction, e.g., COS into SIN. Under the present convention,

PROG ORG
OT USE ENTRY: ENTRY REF *←ENTRY — last REF
REF *PROG
TRA *ENTRY — first instr.. uses U&R

COS will come into SIN at the third instruction, while all other GS programs will come into SIN at the second instruction.

Example:

COS,SIN

```
COS          —          ORG          —
ELOC         —          REF          ←ELOC
(other REF'S ....)
  —          PF         21600        NAME,CC+1
  —          —          TRA          CC+1
  —          —          STO          *ELOC
(....)
  —          —          STX          2
  —          —          TRA          *SIN,CC+X
(....)
NAME         —          BCD          COS ␣␣ 0000
(Note: ␣␣ = spaces)
  —          —          END          —


SIN          —          ORG          —
ELOC         —          REF          ←ELOC
(....)
USER →       —          —            TRA          CC+2
GS≠COS →     —          —            TRA          CC+3
COS →        —          —            TRA          CC+3
             —          PF           21600        NAME
             —          —            STO          *ELOC
             (....)
             NAME       —            BCD          SIN ␣␣ 0000
               —        —            END          —
```

Another exception to the general format as indicated in the FXEXP example is the case where a GS program uses U. In this case U must be stored before PF is brought to U in the setting of ←ELOC.

In line with the above convention, the transfer to←ERPR has been changed, the principal modification being that the program name no longer is mentioned in the error message or below the transfer to ←ERPR.

If a GS composed error message (numbered from 01 to 05) is desired, the code is only one line, e.g.,

```
—           03          TRA         *ERPR
```

If some other message is desired, the code is as follows, e.g.,

```
—           00          TRA         *ERPR
—           —           NOP         MESS
(....)
MESS        —           BCD         ARGUMENT
                                    TOO LARGE/
```

Real scalar

SQR

```
                                                                    1
SQR             ORG                                                 2
                                                                    3
ERPR            REF     *-ERPR                                      4
ENTRY           REF     *-ENTRY                                     5
                REF     *SQR                                        6
                                                                    7
                REM     GENIE SQR(T7) → U,T7                        10
                                                                    11
                TRA     *ENTRY                                      12
                T7      IF(ZER)TRA      BYE                         13
                T7      IF(NNZ)TRA      ERR                         14
                        CLA+2           TL,B6+1                     15
                B5      RWT             EXIT                        16
                        TLF             @10                         17
                T6      LT6+2           Z,B6+1                      20
                Z       ILF             4000,U→B5                   21
                T7      BEU             @Z,CC+1                     22
                        IF(MOV)SKP      -1,B5+1                     23
                        ACC,ERM         @Z-2,U→T6                   24
                B5      LUR             @1,U→B5                     25
                T6      DML             @B5,U→T6                    26
                T7      CRL             @H15,R→B5                   27
                B5      DMR             @H9,U→R                     30
                        DML             @2                          31
                        IDV+20          @10,U→B5                    32
                Z       CRR             @6                          33
                        ADD+20          @1,0                        34
                        DML             @B5,U→R                     35
                -T6     CPL             @5,I→B5                     36
                        FMP             R,U→T6                      37
NEWTLP          T7      FDV             T6                          40
                        FSB             T6                          41
                        DMR             @1,B5-1                     42
                        FAD             T6,U→T6                     43
                B5      IF(PNZ)TRA      @NEWTLP                     44
EXIT                    SB5             @Z,B6-1                     45
                T6      LT6             B6,B6-1                     46
                        TLN             @*36                        47
                        TRA             @PF,U→T7                    50
                                                                    51
ERR             01      TRA             *ERPR                       52
BYE             Z       TRA             PF,U→T7                     53
                                                                    54
                END                                                 55
                                                                    56
```

```
ERPR    77775   75 44615 76 1400 00000
ENTRY   77776   75 44556 26 1400 00000
        77777   62 60612 52 5400 00000
            1   01 01000 00 4401 77774     ENTRY
            2   07 01010 00 4001 00036     BYE
            3   07 05550 00 4001 00034     ERR
            4   01 21702 26 0000 77773
            5   45 21641 00 0001 00026     EXIT
            6   01 42007 00 4000 00010
            7   06 50462 26 0000 00000
           10   00 42005 45 4000 04000
           11   07 21000 20 4000 00000
           12   01 02200 25 1000 00001
           13   01 41060 06 4000 77775
           14   45 45010 45 4000 00001
           15   06 44010 06 4040 00000
           16   07 45066 55 4000 00017
           17   45 44000 02 4000 00011
           20   01 44010 00 4000 00002
           21   01 13220 45 4000 00010
           22   00 45005 00 4000 00006
           23   01 10020 00 0001 00016     +0000A
           24   01 44010 02 4040 00000
           25   16 50100 75 4000 00005
           26   01 10600 06 0000 00002
NEWTLP     27   07 10700 00 0000 00006
           30   01 10500 00 0000 00006
           31   01 44000 65 4000 00001
           32   01 10400 06 0000 00006
           33   45 05150 00 4001 77772     NEWTLP
EXIT       34   01 40005 66 4000 00000
           35   06 50460 66 0100 00000
           36   01 42003 00 4500 00000
           37   01 01000 07 4200 00000
ERR        40   01 01000 00 4401 77734     ERPR
BYE        41   00 01000 07 4200 00000
*********
+0000A     42   01 00100 00 0000 00000
```

316	ERPR	0	77775	1	200000000000000	0
317	ENTRY	0	77776	1	300000000000000	0
320	BYE	0	41	1	510000000000000	0
321	ERR	0	40	1	500000000000000	0
322	EXIT	0	34	1	440000000000000	0
323	+0000A	0	42	1	530000000000000	0
324	NEWTLP	0	27	1	370000000000000	0

EXP

```
                                                                    1
EXP             ORG                                                 2
                                                                    3
ERPR            REF             *←ERPR                              4
ENTRY           REF             *←ENTRY                             5
                REF             *EXP                                6
                                                                    7
                REM             GENIE EXP(T7) → U,T7                10
                                                                    11
                TRA             *ENTRY                              12
          T5    20002           aZ,B6+1                             13
          T6    20002           aZ,B6+1                             14
          B5    RWT             EXIT                                15
          I     RWT             LAST,U→B5                           16
          T7    IF(NZE)TRA      FINE                                17
                CLA             d1.0,U→T7                           20
                TRA             EXIT                                21
FINE      |T7|  IF(PNZ)SKP      d170.0,R→Z                          22
                TRA             aSTART                              23
          T7    IF(NSN)TRA      aLAST,R→T7                          24
          02    TRA             *ERPR                               25
                LT7             d170.0                              26
START     T7    FDV             C9,U→T7                             27
          -T7   IF(NNZ)TRA      CC+1,U→R                            30
          Z     RWT             LAST,R→T7                           31
          T7    FAD+60          EXP06,B5-1                          32
                DML             a1,U→T5                             33
                IF(ZER)TRA      aCC+1                               34
          R     BEU             C9,U→T7                             35
          T7    IF(NNZ)SKP      d0.5                                36
                STO             T7,B5-1                             37
          T7    FSB             d0.25,U→T7                          40
                VDF             C8,U→T6                             41
                FAD             T7                                  42
                VDF             C7                                  43
                FAD             T6                                  44
                FSB             C6,U→T6                             45
          T7    FMP             C5                                  46
                FAD             T6                                  47
                VDF             C3+B5                               50
                FAD             C1+B5,U→T6                          51
          T5    IDV+20          a10,U→B5                            52
          Z     CRR             a6                                  53
                ADD+20          d1.0                                54
                DML             aB5                                 55
                FMP             T6,U→T7                             56
LAST            ACC             (Z)                                 57
          T7    VDF             d1.0,U→T7                           60
EXIT            SB5             Z,B6-1                              61
          PF    SUR,LT6         B6,B6-1                             62
          T7    LT5             B6,R→CC                             63
                                                                    64
EXP06           OCT             06000 0000 0000 00000               65
C9              OCT             77261 3441 3767 64364               66
C8              OCT             01127 3256 0430 57346               67
C7              OCT             01326 1304 0426 15661               70
C6              OCT             01036 2276 6664 62216               71
C5              OCT             01001 0314 6314 63146               72
C4              OCT             01145 7173 5342 70212               73
```

```
C3                  OCT     01110 0354 7620 76734          74
C2                  OCT     01001 5350 4771 45327          75
C1                  OCT     01001 1406 7740 50616          76
                                                           77
                    END                                    100
                                                           101
```

```
        ERPR    77775     75 44615 76 1400 00000
        ENTRY   77776     75 44556 36 1400 00000
                77777     44 67572 52 5400 00000
                    1     01 01000 00 4401 77774      ENTRY
                    2     05 20002 26 4000 00000
                    3     06 20002 26 4000 00000
                    4     45 21641 00 0001 00043      EXIT
                    5     20 21641 45 0001 00040      LAST
                    6     07 01050 00 4001 00002      FINE
                    7     01 21700 07 0001 00055      *0000A
                   10     01 01000 00 4001 00037      EXIT
        FINE       11     27 06150 10 0001 00054      *0000B
                   12     01 01000 00 4001 00003      START
                   13     07 01500 17 4001 00032      LAST
                   14     02 01000 00 4401 77760      ERPR
                   15     01 50470 00 0001 00050      *0000B
        START      16     07 10700 07 0001 00035      C9
                   17     17 05550 02 4001 00001
                   20     00 21641 17 0001 00025      LAST
                   21     07 10460 65 0001 00031      EXP06
                   22     01 44010 05 4000 00001
                   23     01 01010 00 4001 00001
                   24     02 21000 07 0001 00027      C9
                   25     07 06550 00 0001 00041      *0000C
                   26     01 20001 65 4000 00007
                   27     07 10500 07 0001 00040      *0000D
                   30     01 16700 06 0001 00024      C8
                   31     01 10400 00 0000 00007
                   32     01 16700 00 0001 00023      C7
                   33     01 10400 00 0000 00006
                   34     01 10500 06 0001 00022      C6
                   35     07 10600 00 0001 00022      C5
                   36     01 10400 00 0000 00006
                   37     01 16700 00 0041 00022      C3
                   40     01 10400 06 0041 00023      C1
                   41     05 13320 45 4000 00010
                   42     00 45055 00 4000 00006
                   43     01 10020 00 0001 00021      *0000A
                   44     01 44010 00 4040 00000
                   45     01 10600 07 0000 00006
        LAST       46     01 41000 00 4000 00000
                   47     07 16700 07 0001 00015      *0000A
        EXIT       50     01 40005 66 4000 00000
                   51     47 53460 66 0100 00000
                   52     07 50450 50 0100 00000
        EXP06      53     06 00000 00 0000 00000
        C9         54     77 26134 41 3767 64364
        C8         55     01 12732 56 0430 57346
        C7         56     01 32613 04 0426 15661
        C6         57     01 03622 76 6664 62216
        C5         60     01 00103 14 6314 63146
        C4         61     01 14571 73 5342 70212
        C3         62     01 11003 54 7620 76734
        C2         63     01 00153 50 4771 45327
        C1         64     01 00114 06 7740 50616
*********
        *0000A     65     01 00100 00 0000 00000
        *0000B     66     01 25200 00 0000 00000
        *0000C     67     77 20000 00 0000 00000
        *0000D     70     77 10000 00 0000 00000
```

316	ERPR	0	77775	1	200000000000000	0
317	ENTRY	0	77776	1	300000000000000	0
320	EXIT	0	50	1	600000000000000	0
321	LAST	0	46	1	560000000000000	0
322	FINE	0	11	1	210000000000000	0
323	←0000A	0	65	1	1100000000000000	0
324	←0000B	0	66	1	1110000000000000	0
325	START	0	16	1	260000000000000	0
326	C9	0	54	1	660000000000000	0
327	EXP06	0	53	1	640000000000000	0
330	←0000C	0	67	1	1120000000000000	0
331	←0000D	0	70	1	1130000000000000	0
332	C8	0	55	1	700000000000000	0
333	C7	0	56	1	720000000000000	0
334	C6	0	57	1	740000000000000	0
335	C5	0	60	1	760000000000000	0
336	C3	0	62	1	1020000000000000	0
337	C1	0	64	1	1060000000000000	0
340	C4	0	61	3	1000000000000000	0
341	C2	0	63	3	1040000000000000	0

LOG

```
                                                                    1
LOG             ORG                                                 2
                                                                    3
ERPR            REF             *←ERPR                              4
ENTRY           REF             *←ENTRY                             5
                REF             *LOG                                6
                                                                    7
                REM             GENIE LOG(T7) → U,T7                10
                                                                    11
                TRA             *ENTRY                              12
          T7    IF(NEG)TRA      ERR                                 13
          B5    21602           Z,B6+1                              14
          Z     20102           TL,B6+1                             15
                TLF             ā10                                 16
                SUR,LT6+2       T6,B6+1                             17
                ILF             4000                                20
          T7    IF(NZE)SKP      d1.0                                21
          Z     TRA             EXIT,U→T7                           22
          T7    CRL             d15,R→B5                            23
          B5    DMR             ad9,U→R                             24
                DML             a3,U→B5                             25
          T7    BEU             aZ,CC+1                             26
                IF(MOV)SKP      -U,B5-1                             27
                ACC,ERM         aZ-2                                30
         -S     BEU             C7,U→T7                             31
                FAD             S,U→T6                              32
          T7    FSB             C7,B5+1                             33
                FDV             T6,U→T6                             34
                FMP             U,U→T7                              35
                FMP             C6                                  36
                FAD             C5                                  37
                FMP             T7                                  40
                FAD             C4                                  41
                FMP             T7                                  42
                FAD             C3                                  43
                FMP             T7                                  44
                FAD             C2                                  45
                FMP             T6                                  46
                FSB             d0.5,U→T6                           47
          B5    BEU             C2,U→R                              50
                DML             a47                                 51
                FAD             T6                                  52
                FMP             C1,U→T7                             53
EXIT            LT6             B6-1,B6-1                           54
                TLN             a*B6-1,B6-1                         55
                SB5             a*B6-1,B6-1                         56
          T7    TRA             aPF                                 57
                                                                    60
C7              OCT             77265 0117 1463 76357               61
C6              OCT             77127 6042 0233 45572               62
C5              OCT             77151 2645 7065 01504               63
C4              OCT             77223 5677 1357 62423               64
C3              OCT             77366 1604 7036 47613               65
C2              OCT             01002 7052 4354 51335               66
C1              OCT             77261 3441 3767 64347               67
                                                                    70
ERR       01    TRA             *ERPR                               71
          Z     TRA             PF,U→T7                             72
                END                                                 73
```

```
ERPR    77775     75 44615 76 1400 00000
ENTRY   77776     75 44556 36 1400 00000
        77777     53 56462 52 5400 00000
            1     01 01000 00 4401 77774      ENTRY
            2     07 01510 00 4001 00053      ERR
            3     45 21602 26 0000 00000
            4     00 20102 26 0000 77773
            5     01 42007 00 4000 00010
            6     01 53462 26 0000 00006
            7     01 42005 00 4000 04000
           10     07 02050 00 0001 00047      *0000A
           11     00 01000 07 4001 00031      EXIT
           12     07 45066 55 4000 00017
           13     45 44000 02 4000 00011
           14     01 44010 45 4000 00003
           15     07 21000 20 4000 00000
           16     01 02200 65 1000 00001
           17     01 41020 00 4000 77775
           20     13 21000 07 0001 00026      C7
           21     01 10400 06 0000 00003
           22     07 10500 25 0001 00024      C7
           23     01 10700 06 0000 00006
           24     01 10600 07 0000 00001
           25     01 10600 00 0001 00022      C6
           26     01 10400 00 0001 00022      C5
           27     01 10600 00 0000 00007
           30     01 10400 00 0001 00021      C4
           31     01 10600 00 0000 00007
           32     01 10400 00 0001 00020      C3
           33     01 10600 00 0000 00007
           34     01 10400 00 0001 00017      C2
           35     01 10600 00 0000 00006
           36     01 10500 06 0001 00022      *0000B
           37     45 21000 02 0001 00014      C2
           40     01 44010 00 4000 00047
           41     01 10400 00 0000 00006
           42     01 10600 07 0001 00012      C1
EXIT       43     01 50460 66 0100 77776
           44     01 42003 66 4500 77776
           45     01 40005 66 4500 77776
           46     07 01000 00 4200 00000
C7         47     77 26501 17 1463 76357
C6         50     77 12760 42 0233 45572
C5         51     77 15126 45 7065 01504
C4         52     77 22356 77 1357 62423
C3         53     77 36616 04 7036 47613
C2         54     01 00270 52 4354 51335
C1         55     77 26134 41 3767 64347
ERR        56     01 01000 00 4401 77716      ERPR
           57     00 01000 07 4200 00000
*********
*0000A     60     01 00100 00 0000 00000
*0000B     61     77 20000 00 0000 00000
```

316	ERPR	0	77775	1	200000000000000	0
317	ENTRY	0	77776	1	300000000000000	0
320	ERR	0	56	1	7500000000000000	0
321	=0000A	0	60	1	10000000000000000	0
322	EXIT	0	43	1	5300000000000000	0
323	C7	0	47	1	6000000000000000	0
324	C6	0	50	1	6200000000000000	0
325	C5	0	51	1	6400000000000000	0
326	C4	0	52	1	6600000000000000	0
327	C3	0	53	1	7000000000000000	0
330	C2	0	54	1	7200000000000000	0
331	=0000B	0	61	1	10100000000000000	0
332	C1	0	55	1	7400000000000000	0

LOG10

```
                                                                    1
LOG10           ORG                                                 2
                                                                    3
LOG             REF             *LOG                                4
ENTRY           REF             *+ENTRY                             5
                REF             *LOG10                              6
                                                                    7
                REM             GENIE COMMON LOG (T7) → U,T7
                                                                   11
                TRA             *ENTRY                             12
          PF    RWT             EXIT                               13
                TSR             *LOG,CC+1                          14
          T7    FMP             CON,U→T7                           15
EXIT            TRA             (Z)                                16
                                                                   17
CON             OCT             77 1571 3366 1244 6710             20
                                                                   21
                END                                                22
                                                                   23
```

PROGRAM LOG10 3/01/67 13.08

```
      LOG    77775     53 56462 52 5400 00000
      ENTRY  77776     75 44556 36 1400 00000
             77777     53 56460 10 0400 00000
                 1     01 01000 00 4401 77774     ENTRY
                 2     47 21641 00 0001 00002     EXIT
                 3     01 40000 20 4401 77771     LOG
                 4     07 10600 07 0001 00001     CON
      EXIT       5     01 01000 00 4000 00000
      CON        6     77 15713 36 6124 46710
*********
```

```
316       LOG       0 77775    1          200000000000000    0
317       ENTRY     0 77776    1          300000000000000    0
320       EXIT      0     5    1          160000000000000    0
321       CON       0     6    1          200000000000000    0
```

SIN

```
                                                                    1
SIN             ORG                                                 2
                                                                    3
                REM             SIN(T7) → U,T7                      4
                REM             COS(T7) → R                         5
                                                                    6
ENTRY           REF             *←ENTRY                             7
ERPR            REF             *←ERPR                              10
                REF             *SIN                                11
                                                                    12
                TRA             a*ENTRY                             13
                CLA             a3,CC+1                             14
                CLA             a4                                  15
                RPA             EXIT                                16
                T5      20002   a7,B6+1                             17
                T6      20002   a7,B6+1                             20
                B5      20002   a7,B6+1                             21
                T7      IF(ZER)TRA      SPEC                        22
                T7      FMP     C7,U→T7                             23
                        IF(NN7)SKP      TWO47                       24
                        TRA     aERR                                25
                T7      FAD+60  EXP06                               26
                        DML     a1,R→T5                             27
                        IF(ZER)TRA      a JUMP,U→B5                 30
                        IDV     a4,R→B5                             31
                T5      BEU     C7,U→T7                             32
JUMP            T7      FMP     U,U→T6                              33
                T7      FMP     C7,U→T7                             34
                T6      FMP     C6                                  35
                        FAD     C5                                  36
                        FMP     T6                                  37
                        FAD     C4                                  40
                        FMP     T6                                  41
                        FAD     C3                                  42
                        FMP     T6                                  43
                        FAD     C2                                  44
                        FMP     T6                                  45
                        FAD     C1,U→T5                             46
                -T6     FAD     a4.0                                47
                        VDF     a4.0                                50
                        FAD     T5                                  51
                        FMP     T7,U→T6                             52
                        FMP     U,U→T7                              53
                        FAD     a1.0,U→T5                           54
                T6      FAD     U                                   55
                        FDV     T5,U→T6                             56
                -T7     FAD     a1.0                                57
                        FDV→    T5,U→T7                             60
                T6      TRA     aEXIT+B5                            61
                -T5     LT5     T6,U→T6                             62
                -T6     LT7     -T5,CC+1                            63
                -T5     LT7     T6                                  64
EXIT            TRA             aCC+(7),U→T6                        65
                TRA             aEXIT-3                             66
                TRA             aEXIT-2                             67
                TRA             aEXIT-1                             70
FIX             LT6→            T7                                  71
                SB5             a*B6-1,B6-1                         72
                T6      XUR,LT6 B6-1,B6-1                           73
```

```
                      LT5         B6-1,B6-1
              T7      TRA         @PF
ERR           02      TRA         @*ERPR
SPEC          7       LT7         @1.0
                      TRA         EXIT

TWO47                 OCT         0620000000000000
EXP06                 OCT         0600000000000000
C7                    OCT         7724276301556234442
C6                    OCT         7700000000001046444
C5                    OCT         7700000000043507235
C4                    OCT         7700000024256283264
C3                    OCT         7700001366536455112
C2                    OCT         7700074076040833710
C1                    OCT         7707364746233710052

                      END
```

```
ENTRY   77775   75 44556 36 1400 00000
ERPR    77776   75 44615 76 1400 00000
        77777   62 50552 52 5400 00000
            1   01 01000 00 4401 77773     ENTRY
            2   01 21700 20 4000 00003
            3   01 21700 00 4000 00004
            4   01 21601 00 0001 00046     EXIT
            5   05 20002 36 4000 00000
            6   06 20002 36 4000 00000
            7   45 20002 26 4000 00000
           10   07 01010 00 4001 00054     SPEC
           11   07 10600 07 0001 00057     C7
           12   01 06550 00 0001 00054     TW047
           13   01 01000 00 4001 00050     ERR
           14   07 10460 00 0001 00053     EXP06
           15   01 44010 15 4000 00001
           16   01 01010 45 4001 00002     JUMP
           17   01 13300 55 4000 00004
           20   05 21000 07 0001 00050     C7
JUMP       21   07 10600 06 0000 00001
           22   07 10600 07 0001 00046     C7
           23   06 10600 00 0001 00046     C6
           24   01 10400 00 0001 00046     C5
           25   01 10600 00 0000 00006
           26   01 10400 00 0001 00045     C4
           27   01 10600 00 0000 00006
           30   01 10400 00 0001 00044     C3
           31   01 10600 00 0000 00006
           32   01 10400 00 0001 00043     C2
           33   01 10600 00 0000 00006
           34   01 10400 05 0001 00042     C1
           35   16 10400 00 0001 00042     -0000A
           36   01 16700 00 0001 00041     -0000A
           37   01 10400 00 0000 00005
           40   01 10600 06 0000 00007
           41   01 10600 07 0000 00001
           42   01 10400 05 0001 00036     -00008
           43   06 10400 00 0000 00001
           44   01 10750 06 0000 00005
           45   17 10400 00 0001 00033     -00008
           46   01 10701 07 0000 00005
           47   06 01000 00 4041 00003     EXIT
           50   15 50450 06 0000 00006
           51   16 50470 20 1000 00005
           52   15 50470 00 0000 00006
EXIT       53   01 01000 06 4001 00000
           54   01 01000 00 4001 77772     EXIT    -3
           55   01 01000 00 4001 77772     EXIT    -2
           56   01 01000 00 4001 77772     EXIT    -1
FIX        57   01 50461 00 0000 00007
           60   01 40005 66 4500 77776
           61   06 54460 66 0100 77776
           62   01 50450 66 0100 77776
           63   07 01000 00 4200 00000
ERR        64   02 01000 00 4401 77711     ERPR
SPEC       65   00 50470 00 0001 00013     -00008
           66   01 01000 00 4001 77763     EXIT
TW047      67   06 20000 00 0000 00000
EXP06      70   06 00000 00 0000 00000
C7         71   77 24276 20 1556 23442
C6         72   77 00000 00 0010 46444
C5         73   77 00000 00 0435 07235
C4         74   77 00000 02 4356 23264
C3         75   77 00001 36 6536 45112
```

	C2	76	77	00074	07	6040	33710
	C1	77	77	07364	74	6233	71052
*********							
	*0000A	100	01	00400	00	0000	00000
	*0000B	101	01	00100	00	0000	00000

316	ENTRY	0	77775	1	1000000000000000	0
317	ERPR	0	77776	1	1100000000000000	0
320	EXIT	0	58	1	6500000000000000	0
321	SPEC	0	65	1	7700000000000000	0
322	C7	0	71	1	1060000000000000	0
323	TW047	0	67	1	1020000000000000	0
324	ERR	0	64	1	7600000000000000	0
325	EXP06	0	70	1	1040000000000000	0
326	JUMP	0	21	1	3300000000000000	0
327	C6	0	72	1	1100000000000000	0
330	C5	0	73	1	1120000000000000	0
331	C4	0	74	1	1140000000000000	0
332	C3	0	75	1	1160000000000000	0
333	C2	0	76	1	1200000000000000	0
334	C1	0	77	1	1220000000000000	0
335	*0000A	0	100	1	1240000000000000	0
336	*0000B	0	101	1	1250000000000000	0
337	FIX	0	57	3	7100000000000000	0

COS

```
COS          ORG

SIN          REF          *SIN

ENTRY        REF          *+ENTRY
             REF          *COS

             TRA          @*ENTRY
             STX          2
             TRA          *SIN,LC+X

             END
```

```
PROGRAM      COS                                  02/06/68 14.05

      SIN     77775   62 50552 52 5400 00000
      ENTRY   77776   75 44556 36 1400 00000
              77777   42 56622 52 5400 00000
                  1   01 01000 00 4401 77774     ENTRY
                  2   01 43005 00 4000 00002
                  3   01 01000 30 4401 77771     SIN
*********

   316       SIN       0 77775    1            20000000000000    0
   317       ENTRY     0 77776    1            30000000000000    0
```

TAN

```
                                                                    1
TAN             ORG                                                 2
                                                                    3
                REM             GENIE TAN(T7) → U,T7                4
                                                                    5
ENTRY           REF             *←ENTRY                             6
ERPR            REF             *←ERPR                              7
                REF             *TAN                                10
                                                                    11
                TRA             d*ENTRY                             12
                T6      20002   dZ,B6+1                             13
                T5      20002   dZ                                  14
                T7      IF(NZE)TRA  CC+1                            15
                Z       TRA     EXIT,U→T7                           16
                T7      FMP     C10,U→T7                            17
                        IF(NNZ)SKP  TW047                           20
                Z       TRA     dERR1,U→T7                          21
                T7      FAD+60  EXP06                               22
                        DML     d1,U→T5                             23
                        IF(ZER)TRA  dJUMP                           24
                P       BEU     C10,U→T7                            25
                |T5|    IF(EVN)TRA  dJUMP                          26
                T7      IF(PNZ)TRA  dCC+1                           27
                        FAD     d1.0,CC+1                           30
                        FSB     d1.0                                31
                        STO     T7                                  32
JUMP            T7      FMP     C0,U→T6                             33
                T7      FMP     C9,U→T7                             34
                T6      FMP     C8                                  35
                        FAD     C7                                  36
                        FMP     T6                                  37
                        FAD     C6                                  40
                        FMP     T6                                  41
                        FAD     C5                                  42
                        FMP     T6                                  43
                        FAD     C4                                  44
                        FMP     T6                                  45
                        FAD     C3                                  46
                        FMP     T6                                  47
                        FAD     C2                                  50
                        FMP     T6                                  51
                        FAD     C1,U→T5                             52
                -T6     IF(NZE)SKP  -H1.0                           53
                Z       TRA     dERR2,U→T7                          54
                        VDF     d1.0                                55
                        FAD     T5                                  56
EXIT                    FMP→    T7,B6-1                             57
                PF      LT5     B6+1,U→R                            60
                T7      LT6     B6,R→CC                             61
                                                                    62
ERR1            02      TRA     d*ERPR                              63
                        TRA     dEXIT+1,B6-1                        64
ERR2            10      TRA     d*ERPR                              65
                        TRA     dEXIT+1,B6-1                        66
                                                                    67
TW047                   OCT     062000000000000000                  70
EXP06                   OCT     060000000000000000                  71
C10                     OCT     772427630155623440                  72
C9                      OCT     010012137140667116                  73
```

```
C8          OCT     770000000023667721          74
C7          OCT     770000000143165105          75
C6          OCT     770000002000027431          76
C5          OCT     770000021667336027          77
C4          OCT     770000242560431620          100
C3          OCT     770002755275130424          101
C2          OCT     770036037020161730          102
C1          OCT     770736474623371034          103
                                                104
            END                                 105
                                                106
```

```
ENTRY   77775    75 44556 36 1400 00000
ERPR    77776    75 44615 76 1400 00000
        77777    63 40552 52 5400 00000
             1   01 01000 00 4401 77773      ENTRY
             2   06 20002 26 4000 00000
             3   05 20002 00 4000 00000
             4   07 01050 00 4001 00001
             5   00 01000 07 4001 00040      EXIT
             6   07 10600 07 0001 00050      C10
             7   01 06550 00 0001 00045      TW047
            10   00 01000 07 4001 00040      ERR1
            11   07 10460 00 0001 00044      EXP06
            12   01 44010 05 4000 00001
            13   01 01010 00 4001 00006      JUMP
            14   02 21000 07 0001 00042      C10
            15   25 01020 00 4001 00004      JUMP
            16   07 05150 00 4001 00001
            17   01 10400 20 0001 00051      +0000A
            20   01 10500 00 0001 00050      +0000A
            21   01 20001 00 4000 00007
JUMP        22   07 10600 06 0000 00001
            23   07 10600 07 0001 00034      C9
            24   06 10600 00 0001 00034      C8
            25   01 10400 00 0001 00034      C7
            26   01 10600 00 0000 00006
            27   01 10400 00 0001 00033      C6
            30   01 10600 00 0000 00006
            31   01 10400 00 0001 00032      C5
            32   01 10600 00 0000 00006
            33   01 10400 00 0001 00031      C4
            34   01 10600 00 0000 00006
            35   01 10400 00 0001 00030      C3
            36   01 10600 00 0000 00006
            37   01 10400 00 0001 00027      C2
            40   01 10600 00 0000 00006
            41   01 10400 05 0001 00026      C1
            42   16 02010 00 1001 00026      +0000A
            43   00 01000 07 4001 00007      ERR2
            44   01 16710 00 0001 00024      +0000A
            45   01 10400 00 0000 00005
EXIT        46   01 10601 66 0000 00007
            47   47 50450 02 0100 00001
            50   07 50460 50 0100 00000
ERR1        51   02 01000 00 4401 77724      ERPR
            52   01 01000 66 4001 77773      EXIT    +1
ERR2        53   10 01000 00 4401 77722      ERPR
            54   01 01000 66 4001 77771      EXIT    +1
TW047       55   06 20000 00 0000 00000
EXP06       56   06 00000 00 0000 00000
C10         57   77 24276 30 1356 23440
C9          60   01 00121 37 1406 67116
C8          61   77 00000 00 0236 67721
C7          62   77 00000 00 1431 65105
C6          63   77 00000 02 0000 27431
C5          64   77 00000 21 6673 36027
C4          65   77 00002 42 5604 31620
C3          66   77 00027 55 2751 30424
C2          67   77 00260 27 0201 61730
C1          70   77 07364 74 6233 71034
********
+0000A      71   01 00100 00 0000 00000
```

316	ENTRY	0	77775	1	600000000000000	0
317	ERPR	0	77776	1	700000000000000	0
320	EXIT	0	46	1	560000000000000	0
321	C10	0	57	1	720000000000000	0
322	TWO47	0	55	1	660000000000000	0
323	ERR1	0	51	1	610000000000000	0
324	EXP06	0	56	1	700000000000000	0
325	JUMP	0	22	1	220000000000000	0
326	+0000A	0	71	1	116000000000000	0
327	C9	0	60	1	740000000000000	0
330	C8	0	61	1	760000000000000	0
331	C7	0	62	1	100000000000000	0
332	C6	0	63	1	102000000000000	0
333	C5	0	64	1	104000000000000	0
334	C4	0	65	1	106000000000000	0
335	C3	0	66	1	110000000000000	0
336	C2	0	67	1	112000000000000	0
337	C1	0	70	1	114000000000000	0
340	ERR2	0	53	1	630000000000000	0

COT

```
COT                    ORG

TAN                    REF          *TAN
ENTRY                  REF          *-ENTRY
                       REF          *COT

                       TRA          @*ENTRY
                -T7    FAD          HFPI,U+T7
                       TRA          *TAN,CC+1

HFPI                   OCT          010014441766521041

                       END
```

```
PROGRAM        COT                                          02/06/68 14.53

        TAN     77775    63 40552 52 5400 00000
        ENTRY   77776    75 44566 36 1400 00000
                77777    42 56632 52 5400 00000
                    1    01 01000 00 4401 77774     ENTRY
                    2    17 10400 07 0001 00001     HFPI
                    3    01 01000 20 4401 77771     TAN
        HFPI        4    01 00144 41 7665 21041
********

   316       TAN        0 77775     1          20000000000000     0
   317       ENTRY      0 77776     1          30000000000000     0
   320       HFPI       0     4     1         110000000000000     0
```

ASIN

```
ASIN            ORG                                                    1
                                                                       2
                                                                       3
SQRT            REF             *SQR                                   4
ERPR            REF             *←ERPR                                 5
ENTRY           REF             *←ENTRY                                6
                REF             *ASIN                                  7
                                                                       10
                REM             GENIE ASIN(T7) → U,T7                  11
                                                                       12
                TRA             *ENTRY                                 13
        T7      IF(ZER)TRA      OUT                                    14
        |T7|    IF(NEG)SKP      d1.0                                   15
                TRA             ERR                                    16
                SUR,LT6+2       T6,B6+1                                17
        PF      RWT             EXIT                                   20
        I       RPA             SIGN                                   21
        -T7     IF(NNZ)TRA      CC+1,U→R                               22
        Z       RPA             SIGN,R→T7                              23
        -T7     FAD             d1.0,U→T6                              24
        T7      FAD             d1.0                                   25
                VDF             T6,U→T7                                26
                TSR             *SQRT,CC+1                             27
        T7      FMP             C10                                    30
                FAD             d1.0,U→T6                              31
        T7      FSB             C10                                    32
                FDV             T6,U→T6                                33
                FMP             U,U→T7                                 34
                FMP             C8                                     35
                FAD             C7                                     36
                FMP             T7                                     37
                FAD             C6                                     40
                FMP             T7                                     41
                FAD             C5                                     42
                FMP             T7                                     43
                FAD             C4                                     44
                FMP             T7                                     45
                FAD             C3                                     46
                FMP             T7                                     47
                FAD             C2                                     50
                FMP             T7                                     51
                FAD             C1                                     52
                FMP             T6                                     53
                FAD             U                                      54
        -U      FAD             C9,U→T7                                55
SIGN            ACC             (Z)                                    56
        -U      STO             aT7                                    57
                LT6             B6-1,B6-1                              60
EXIT            TRA             a(Z)                                   61
                                                                       62
C10             OCT             771520236314774737                     63
C9              OCT             773110375524210263                     64
C8              OCT             777662624603017304                     65
C7              OCT             770216706207700704                     66
C6              OCT             777507643356253564                     67
C5              OCT             770343314770002120                     70
C4              OCT             777333336642076512                     71
C3              OCT             770631463101644737                     72
C2              OCT             776525252525501604                     73
```

```
C1              OCT     7737777777777777631                     74
                                                                75
ERR         Z   TRA     *ERPR                                   76
                NOP     MESS                                    77
OUT         Z   TRA     PF,U*T7                                 100
MESS            BCD     ARGUMENT LARGER THAN 1.0/               101
                END                                             102
                                                                103
```

```
        SQRT    77774       62 60612 52 5400 00000
        ERPR    77775       75 44615 76 1400 00000
        ENTRY   77776       75 44556 36 1400 00000
                77777       40 62505 52 5400 00000
                    1       01 01000 00 4401 77774      ENTRY
                    2       07 01010 00 4001 00061      OUT
                    3       27 02510 00 0001 00064      *0000A
                    4       01 01000 00 4001 00055      ERR
                    5       01 53462 26 0000 00006
                    6       47 21641 00 0001 00040      EXIT
                    7       20 21601 00 0001 00034      SIGN
                   10       17 05550 02 4001 00001
                   11       00 21601 17 0001 00032      SIGN
                   12       17 10400 06 0001 00055      *0000A
                   13       07 10400 00 0001 00054      *0000A
                   14       01 16700 07 0000 00006
                   15       01 40000 20 4401 77756      SQRT
                   16       07 10600 00 0001 00031      C10
                   17       01 10400 06 0001 00050      *0000A
                   20       07 10500 00 0001 00027      C10
                   21       01 10700 06 0000 00006
                   22       01 10600 07 0000 00001
                   23       01 10600 00 0001 00026      C8
                   24       01 10400 00 0001 00026      C7
                   25       01 10600 00 0000 00007
                   26       01 10400 00 0001 00025      C6
                   27       01 10600 00 0000 00007
                   30       01 10400 00 0001 00024      C5
                   31       01 10600 00 0000 00007
                   32       01 10400 00 0001 00023      C4
                   33       01 10600 00 0000 00007
                   34       01 10400 00 0001 00022      C3
                   35       01 10600 00 0000 00007
                   36       01 10400 00 0001 00021      C2
                   37       01 10600 00 0000 00007
                   40       01 10400 00 0001 00020      C1
                   41       01 10600 00 0000 00006
                   42       01 10400 00 0000 00001
                   43       11 10400 07 0001 00005      C9
        SIGN       44       01 41000 00 4000 00000
                   45       11 20001 00 4000 00007
                   46       01 50460 66 0100 77776
        EXIT       47       01 01000 00 4000 00000
        C10        50       77 15202 36 3147 74737
        C9         51       77 31103 75 5242 10263
        C8         52       77 76626 24 6030 17304
        C7         53       77 02167 06 2077 00704
        C6         54       77 75076 43 3562 53564
        C5         55       77 03433 14 7700 02120
        C4         56       77 73333 36 6420 76512
        C3         57       77 06314 63 1016 44737
        C2         60       77 65252 52 5255 01604
        C1         61       77 37777 77 7777 77631
        ERR        62       00 01000 00 4401 77712      ERPR
                   63       01 30000 00 0001 00001      MESS
        OUT        64       00 01000 07 4200 00000
        MESS       65       40 61466 45 4445 56325
                   66       53 40614 64 4612 56347
                   67       40 55250 12 3002 22525
********
        *0000A     70       01 00100 00 0000 00000
```

316	SQRT	0	77774	1	200000000000000	0
317	ERPR	0	77775	1	300000000000000	0
320	ENTRY	0	77776	1	400000000000000	0
321	OUT	0	64	1	1070000000000000	0
322	+0000A	0	70	1	1150000000000000	0
323	ERR	0	62	1	1050000000000000	0
324	EXIT	0	47	1	600000000000000	0
325	SIGN	0	44	1	550000000000000	0
326	C10	0	50	1	620000000000000	0
327	C8	0	52	1	660000000000000	0
330	C7	0	53	1	700000000000000	0
331	C6	0	54	1	720000000000000	0
332	C5	0	55	1	740000000000000	0
333	C4	0	56	1	760000000000000	0
334	C3	0	57	1	1000000000000000	0
335	C2	0	60	1	1020000000000000	0
336	C1	0	61	1	1040000000000000	0
337	C9	0	51	1	640000000000000	0
340	MESS	0	65	1	1110000000000000	0

ATAN

```
                                                                    1
ATAN            ORG                                                 2
                                                                    3
                REM             GENIE ATAN(T7) → U,T7               4
                                                                    5
        T7      IF(ZER)TRA      BYE                                 6
        T6      20002           aZ,B6+1                             7
        T5      20002           aZ,B6+1                            10
        B5      20002           aZ,B6-1                            11
        |T7|    FMP             C11,U→T6                           12
        |T7|    IF(NEG)SKP       B1,0                              13
        -1      TRA             aJUMP,U→B5                         14
        T6      FAD             d1,0,U→T5                          15
        |T7|    FSB             C11,R→Z                            16
                TRA             aCOMP,R→B5                         17
JUMP    |T7|    FAD             C11,U→T5                           20
        T6      FSB             d1,0,R→Z                           21
COMP            FDV             T5,U→T5                            22
                FMP             U,U→T6                             23
                FMP             C8                                 24
                FAD             C7                                 25
                FMP             T6                                 26
                FAD             C6                                 27
                FMP             T6                                 30
                FAD             C5                                 31
                FMP             T6                                 32
                FAD             C4                                 33
                FMP             T6                                 34
                FAD             C3                                 35
                FMP             T6                                 36
                FAD             C2                                 37
                FMP             T6                                 40
                FAD             C1                                 41
                FMP             T5                                 42
                FAD             C9+B5,U→T6                         43
        T7      IF(POS)TRA      aEXIT,B6=1                         44
                LT6             -T6                                45
EXIT    T6      SB5             a*B6+2,U→T7                        46
        PF      LT5             B6+1,U→R                           47
        T7      LT6             B6,R→CC                            50
BYE     7       TRA             PF,U→T7                            51
                                                                   52
C11             OCT             771520236314774737                 53
C10             OCT             010011331370774631                 54
C9              OCT             771444176652104132                 55
C8              OCT             777662624603017304                 56
C7              OCT             770216706207700704                 57
C6              OCT             777507643356253564                 60
C5              OCT             770343314770002120                 61
C4              OCT             777333366420765128                 62
C3              OCT             770631463101644737                 63
C2              OCT             776525252525501604                 64
C1              OCT             773777777777777631                 65
                                                                   66
                END                                                67
                                                                   70
```

```
                    1   07 01010 00 4001 00042      BYE
                    2   06 20002 26 4000 00000
                    3   05 20002 26 4000 00000
                    4   45 20002 66 4000 00000
                    5   27 10600 06 0001 00037      C11
                    6   27 02510 00 0001 00051      +0000A
                    7   30 01000 45 4001 00003      JUMP
                   10   06 10400 05 0001 00047      +0000A
                   11   27 10500 10 0001 00033      C11
                   12   01 01000 55 4001 00002      COMP
JUMP               13   27 10400 05 0001 00031      C11
                   14   06 10500 10 0001 00043      +0000A
COMP               15   01 10700 05 0000 00005
                   16   01 10600 06 0000 00001
                   17   01 10600 00 0001 00030      C8
                   20   01 10400 00 0001 00030      C7
                   21   01 10600 00 0000 00006
                   22   01 10400 00 0001 00027      C6
                   23   01 10600 00 0000 00006
                   24   01 10400 00 0001 00026      C5
                   25   01 10600 00 0000 00006
                   26   01 10400 00 0001 00025      C4
                   27   01 10600 00 0000 00006
                   30   01 10400 00 0001 00024      C3
                   31   01 10600 00 0000 00006
                   32   01 10400 00 0001 00023      C2
                   33   01 10600 00 0000 00006
                   34   01 10400 00 0001 00022      C1
                   35   01 10600 00 0000 00005
                   36   01 10400 06 0041 00010      C9
                   37   07 01110 66 4001 00001      EXIT
                   40   01 50460 00 1000 00006
EXIT               41   06 40005 07 4500 00002
                   42   47 50450 02 0100 00001
                   43   07 50460 50 0100 00000
BYE                44   00 01000 07 4200 00000
C11                45   77 15202 26 3147 74737
C10                46   01 00113 31 3707 74631
C9                 47   77 14441 76 6521 04132
C8                 50   77 76626 24 6030 17304
C7                 51   77 02167 06 2077 00704
C6                 52   77 75076 43 3562 53564
C5                 53   77 03433 14 7700 02120
C4                 54   77 73333 36 6420 76512
C3                 55   77 06314 63 1016 44737
C2                 56   77 65252 52 5255 01604
C1                 57   77 37777 77 7777 77631
*********
+0000A             60   01 00100 00 0000 00000
```

316	BYE	0	44	1	5100000000000000	0
317	C11	0	45	1	5300000000000000	0
320	+0000A	0	60	1	1010000000000000	0
321	JUMP	0	13	1	2000000000000000	0
322	COMP	0	15	1	2200000000000000	0
323	C8	0	50	1	6100000000000000	0
324	C7	0	51	1	6300000000000000	0
325	C6	0	52	1	6500000000000000	0
326	C5	0	53	1	6700000000000000	0
327	C4	0	54	1	7100000000000000	0
330	C3	0	55	1	7300000000000000	0

331	C2	0	56	1	7500000000000000	0
332	C1	0	57	1	7700000000000000	0
333	C9	0	47	1	5700000000000000	0
334	EXIT	0	41	1	4600000000000000	0
335	C10	0	46	3	5500000000000000	0

SINH

```
                                                                    1
SINH            ORG                                                 2
                                                                    3
EXP             REF             *EXP                                4
ERPR            REF             *-ERPR                              5
ENTRY           REF             *-ENTRY                             6
                REF             *SINH                               7
                                                                    10
                REM             GENIE SINH(T7) -> U,T7              11
                                                                    12
                TRA             *ENTRY                              13
                Z       RWT     WHICH,CC+1                          14
                I       RWT     WHICH                               15
                FF      RWT     EXIT                                16
                T7      IF(NZE)TRA  FINE                            17
                Z       STO     B6                                  20
                        CLA     =1.0                                21
                        TRA     WHICH                               22
FINE            |T7|    IF(NEG)SKP  =170.0                         23
                        TRA     ERR                                 24
                        TSR     *EXP,CC+1                           25
                T7      VDF     =1.0                                26
                        BSF     T7                                  27
                        FMP+2   =0.5                                30
                        BSF     T7                                  31
WHICH                   ACC     Z,U->R                              32
                        CLA     B6,CC+1                             33
                R       LDR     B6                                  34
EXIT                    TRA     Z,U->T7                             35
                                                                    36
ERR             =2      TRA     *ERPR                               37
                T7      LDR     CON,R->T7                           40
                        IF(PNZ)TRA  PF,R->U                         41
                        ACC     *WHICH                              42
                -R      TRA     PF,U->T7                            43
                -R      XUR     =PF,I->CC                           44
                                                                    45
CON                     OCT     37 0231 0516 1340 2663              46
                                                                    47
                END                                                 50
                                                                    51
```

```
          EXP     77774   44 67572 52 5400 00000
          ERPR    77775   75 44615 76 1400 00000
          ENTRY   77776   75 44556 36 1400 00000
                  77777   62 50554 72 5400 00000
                      1   01 01000 00 4401 77774     ENTRY
                      2   00 21641 20 0001 00015     WHICH
                      3   20 21641 00 0001 00014     WHICH
                      4   47 21641 00 0001 00016     EXIT
                      5   07 01050 00 4001 00003     FINE
                      6   00 20001 00 4100 00000
                      7   01 21700 00 0001 00023     +0000A
                     10   01 01000 00 4001 00007     WHICH
          FINE       11   27 02510 00 0001 00022     +0000B
                     12   01 01000 00 4001 00011     ERR
                     13   01 40000 20 4401 77760     EXP
                     14   07 16700 00 0001 00016     +0000A
                     15   01 14500 00 0000 00007
                     16   01 10602 00 0001 00016     +0000C
                     17   01 14500 00 0000 00007
          WHICH      20   01 41000 02 4000 00000
                     21   01 21700 20 0100 00000
                     22   02 50400 00 0100 00000
          EXIT       23   01 01000 07 4000 00000
          ERR        24   02 01000 00 4401 77750     ERPR
                     25   07 50400 17 0001 00004     CON
                     26   01 05150 11 4200 00000
                     27   01 41000 00 4401 77767     WHICH
                     30   12 01000 07 4200 00000
                     31   12 54000 70 4200 00000
          CON        32   37 02310 51 6134 02663
*********
          +0000A     33   01 00100 00 0000 00000
          +0000B     34   01 25250 00 0000 00000
          +0000C     35   77 20000 00 0000 00000
```

```
316      EXP      0 77774    1       20000000000000    0
317      ERPR     0 77775    1       30000000000000    0
320      ENTRY    0 77776    1       40000000000000    0
321      WHICH    0    20    1       31000000000000    0
322      EXIT     0    23    1       34000000000000    0
323      FINE     0    11    1       22000000000000    0
324      +0000A   0    33    1       46000000000000    0
325      +0000B   0    34    1       47000000000000    0
326      ERR      0    24    1       35000000000000    0
327      +0000C   0    35    1       50000000000000    0
330      CON      0    32    1       44000000000000    0
```

COSH

```
3/01/67 12.11                                            PAGE    1

COSH            ORG

SINH            REF        *SINH
ENTRY           REF        *-ENTRY
                REF        *COSH

                TRA        *ENTRY
                STX        2
                TRA        *SINH,CC+X

                END
```

```
PROGRAM     COSH                                    3/01/67 12.20

      SINH   77775      62 50554 72 5400 00000
      ENTRY  77776      75 44556 36 1400 00000
             77777      42 56624 72 5400 00000
                 1      01 01000 00 4401 77774     ENTRY
                 2      01 43005 00 4000 00002
                 3      01 01000 30 4401 77771     SINH
*********

 316       SINH       0 77775      1              20000000000000     0
 317       ENTRY      0 77776      1              30000000000000     0
```

TANH

```
                                                                          1
TANH            ORG                                                       2
                                                                          3
EXP             REF             *EXP                                      4
                                                                          5
                REM             GENIE TANH (T7) → U,T7                    6
                                                                          7
                NOP             Z                                        10
          T7    IF(NZE)TRA      CC+1                                     11
          Z     TRA             PF,U→T7                                  12
          |T7|  IF(NNZ)SKP      d170.0                                   13
                TRA             BIG                                      14
          PF    RWT             EXIT                                     15
                TSR             *EXP,CC+1                                16
          T7    VDF+2           d1.0,B6+1                                17
                FAD+2           T7                                       20
          T7    FSB             B6-1                                     21
                FDV             B6,B6-1                                  22
EXIT            TRA             (Z),U→T7                                 23
                                                                         24
BIG       T7    IF(NEG)TRA      CC+1                                     25
          PF    SUR,LT7         d1.0,R→CC                                26
          PF    SUR,LT7         -d1.0,R→CC                               27
                                                                         30
                END                                                      31
                                                                         32
```

PROGRAM TANH 3/01/67 12.20

```
      EXP   77777    44 67572 52 5400 00000
               1     01 30000 00 0000 00000
               2     07 01050 00 4001 00001
               3     00 01000 07 4200 00000
               4     27 06550 00 0001 00013      →0000A
               5     01 01000 00 4001 00007      BIG
               6     47 21641 00 0001 00005      EXIT
               7     01 40000 20 4401 77767      EXP
              10     07 16702 26 0001 00010      →0000B
              11     01 10402 00 0000 00007
              12     07 10500 00 0100 77776
              13     01 10700 66 0100 00000
      EXIT    14     01 01000 07 4000 00000
      BIG     15     07 01510 00 4001 00001
              16     47 53470 50 0001 00002      →0000B
              17     47 53470 50 1001 00001      →0000B
*********
      →0000A  20     01 25200 00 0000 00000
      →0000B  21     01 00100 00 0000 00000
```

316	EXP	0	77777	1	20000000000000	0
317	→0000A	0	20	1	270000000000000	0
320	BIG	0	15	1	230000000000000	0
321	EXIT	0	14	1	220000000000000	0
322	→0000B	0	21	1	300000000000000	0

ASINH

```
ASINH             ORG

SQR               REF          *SQR
LOG               REF          *LOG
ENTRY             REF          *+ENTRY
                  REF          *ASINH

                  REM          GENIE ASINH(T7)+U,T7

                  TRA          *ENTRY
           PF     RWT          EXIT
           T7     IF(NZE)TRA   CC+1
           Z      TRA          EXIT,U+T7
           T7     STO          B6,B6+1
           T7     FMP          T7
                  FAD          d1.0,U+T7
                  TSR          *SQR,CC+1
           T7     FAD          (B6-1),U+T7
                  TSR          *LOG,CC+1
           Z      IF(POS)SKP   -B6=1,B6-1
           -T7    NOP          aZ,U+T7
EXIT       T7     TRA          Z

                  END
```

```
PROGRAM     ASINH                                       3/01/67 12.20

      SQR     77774     62 60612 52 5400 00000
      LOG     77775     53 56462 52 5400 00000
      ENTRY   77776     75 44556 36 1400 00000
              77777     40 62505 54 7400 00000
                  1     01 01000 00 4401 77774      ENTRY
                  2     47 21641 00 0001 00012      EXIT
                  3     07 01050 00 4001 00001
                  4     00 01000 07 4001 00010      EXIT
                  5     07 20001 26 4100 00000
                  6     07 10600 00 0000 00007
                  7     01 10400 07 0001 00006      +0000A
                 10     01 40000 20 4401 77763      SQR
                 11     07 10400 07 2100 77776
                 12     01 40000 20 4401 77762      LOG
                 13     00 02110 66 1100 77776
                 14     17 30000 07 4000 00000
      EXIT       15     07 01000 00 4000 00000
********
      +0000A     16     01 00100 00 0000 00000

   316      SQR        0 77774     1         20000000000000    0
   317      LOG        0 77775     1         30000000000000    0
   320      ENTRY      0 77776     1         40000000000000    0
   321      EXIT       0    15     1        260000000000000    0
   322      +0000A     0    16     1        300000000000000    0
```

ACOSH

```
                                                                    1
ACOSH           ORG                                                 2
                                                                    3
SQR             REF             *SQR                                4
LOG             REF             *LOG                                5
ERPR            REF             *-ERPR                              6
ENTRY           REF             *-ENTRY                             7
                REF             *ACOSH                              10
                                                                    11
                REM             GENIE ACOSH(T7)->U,T7               12
                                                                    13
                TRA             *ENTRY                              14
          PF    RWT             EXIT                                15
          T7    IF(NZE)SKP      d1.0                                16
                TRA             BYE                                 17
          T7    IF(POS)SKP      d1.0                                20
                TRA             ERR                                 21
          T7    STO             B6,B6+1                             22
          T7    FMP             T7                                  23
                FAD             -d1.0,U->T7                         24
                TSR             *SQR,CC+1                           25
          T7    FAD             |B6-1|,B6-1                         26
EXIT            SPF             Z,U->T7                             27
                TRA             *LOG,CC+1                           30
                                                                    31
ERR       Z     TRA             *ERPR                               32
                NOP             MESS                                33
BYE       Z     TRA             PF,U->T7                            34
MESS            BCD             ARGUMENT LESS THAN 1.0/             35
                                                                    36
                END                                                 37
                                                                    40
```

```
        SQR     77773     62 60612 52 5400 00000
        LOG     77774     53 56462 52 5400 00000
        ERPR    77775     75 44615 76 1400 00000
        ENTRY   77776     75 44556 36 1400 00000
                77777     40 42566 24 7400 00000
                    1     01 01000 00 4401 77774     ENTRY
                    2     47 21641 00 0001 00011     EXIT
                    3     07 02050 00 0001 00020     *0000A
                    4     01 01000 00 4001 00013     BYE
                    5     07 02110 00 0001 00016     *0000A
                    6     01 01000 00 4001 00007     ERR
                    7     07 20001 26 4100 00000
                   10     07 10600 00 0000 00007
                   11     01 10400 07 1001 00012     *0000A
                   12     01 40000 20 4401 77760     SQR
                   13     07 10400 66 2100 77776
        EXIT       14     01 40007 07 4000 00000
                   15     01 01000 20 4401 77756     LOG
        ERR        16     00 01000 00 4401 77756     ERPR
                   17     01 30000 00 0001 00001     MESS
        BYE        20     00 01000 07 4200 00000
        MESS       21     40 61466 45 4445 56325
                   22     53 44626 22 5634 74055
                   23     25 01230 02 2252 52525
*********
        *0000A     24     01 00100 00 0000 00000
```

```
316     SQR     0 77773     1     200000000000000     0
317     LOG     0 77774     1     300000000000000     0
320     ERPR    0 77775     1     400000000000000     0
321     ENTRY   0 77776     1     500000000000000     0
322     EXIT    0    14     1    2600000000000000     0
323     *0000A  0    24     1    4000000000000000     0
324     BYE     0    20     1    3200000000000000     0
325     ERR     0    16     1    3000000000000000     0
326     MESS    0    21     1    3400000000000000     0
```

ATANH

```
ATANH           ORG                                                    1
                                                                       2
                                                                       3
LOG             REF         *LOG                                       4
ERPR            REF         *-ERPR                                     5
ENTRY           REF         *-ENTRY                                    6
                REF         *ATANH                                     7
                                                                       10
                REM         GENIE ATANH(T7)→U,T7                       11
                                                                       12
                TRA         *ENTRY                                     13
          T7    IF(ZER)TRA  EXIT                                       14
          |T7|  IF(NNZ)SKP  d1.0                                       15
                TRA         ERR                                        16
          T6    STO         B6,B6+1                                    17
          T7    FAD         d1.0,U→T6                                  20
          -T7   FAD         d1.0                                       21
                VDF         T6,U→T7                                    22
          PF    NOP         Z,U→T6                                     23
                TSR         *LOG,CC+1                                  24
          T6    LT6         B6-1,U→PF                                  25
          T7    FMP         d0.5,U→T7                                  26
                TRA         PF,B6-1                                    27
                                                                       30
ERR       Z     TRA         *ERPR                                      31
                NOP         MESS                                       32
EXIT      Z     TRA         PF,U→T7                                    33
MESS            BCD         ARGUMENT LARGER THAN 1.0/                  34
                                                                       35
                END                                                    36
                                                                       37
```

```
        LOG     77774    53 56462 52 5400 00000
        ERPR    77775    75 44615 76 1400 00000
        ENTRY   77776    75 44556 36 1400 00000
                77777    40 63405 54 7400 00000
                    1    01 01000 00 4401 77774    ENTRY
                    2    07 01010 00 4001 00015    EXIT
                    3    27 06550 00 0001 00020    +0000A
                    4    01 01000 00 4001 00011    ERR
                    5    06 20001 26 4100 00000
                    6    07 10400 06 0001 00015    +0000A
                    7    17 10400 00 0001 00014    +0000A
                   10    01 16700 07 0000 00006
                   11    47 30000 06 0000 00000
                   12    01 40000 20 4401 77761    LOG
                   13    06 50460 47 0100 77776
                   14    07 10600 07 0001 00010    +0000B
                   15    01 01000 66 4200 00000
        ERR        16    00 01000 00 4401 77756    ERPR
                   17    01 30000 00 0001 00001    MESS
        EXIT       20    00 01000 07 4200 00000
        MESS       21    40 61466 45 4445 56325
                   22    53 40614 64 4612 56347
                   23    40 55250 12 3002 22525
*********
        +0000A     24    01 00100 00 0000 00000
        +0000B     25    77 20000 00 0000 00000
```

```
 316    LOG       0 77774   1    20000000000000   0
 317    ERPR      0 77775   1    30000000000000   0
 320    ENTRY     0 77776   1    40000000000000   0
 321    EXIT      0    20   1   310000000000000   0
 322    +0000A    0    24   1   370000000000000   0
 323    ERR       0    16   1   270000000000000   0
 324    +0000B    0    25   1   400000000000000   0
 325    MESS      0    21   1   330000000000000   0
```

GAMMA

```
GAMMA               ORG
ENTRY               REF           *+ENTRY
LOG                 REF           *LOG
EXP                 REF           *EXP
ERPR                REF           *+ERPR
                    REF           *GAMMA
                    TRA           *ENTRY
          -Z        TRA           *SAVE,U→R
                    SB3           1,CC+1
                    SB3           0
          PF        SB1           1,U→R
                    RWT,DBL       OUT1
          T7        IF(POS)SKP    d27.
                    FAD           d27.,B1-1
                    FAD           d27.,U→T7
                    LT6           T7,R→Z
                    VDF           d1.,U→T5
                    FMP           T5,U→T4
                    FMP           CON+4
                    SB2           3,U→R
L1        R         BSF           CON+B2,B2-1
                    FMP           T4,U→R
          B2        IF(PNZ)TRA    L1
          R         BSF           CON
                    FMP           T5
                    FAD           LP2
                    FSB           T7,U→T5
          T7        FSB           d0.5,U→T4
                    TSR           *LOG,CC+1
          T7        FMP           T4
                    FAD           T5,U→T7
          B3        IF(ZER)TRA    OUT1
                    TSR           *EXP,CC+1
          B1        IF(PNZ)TRA    OUT
                    SB1           d24
          T6        FSB           d1.0,U→T6
                    LT4           T6
LOOP      T6        FSB           d1.0,U→T6
                    FMP           T4,U→T4
          B1        IF(POS)TRA    LOOP,B1-1
          T7        FDV           T4,U→T7
                    IF(ZER)TRA    ERR
OUT                 TRA           *UNSAVE
          T7        TRA           PF
ERR       00        TRA           *ERPR
                    NOP           aMESS
                    TRA           OUT
OUT1      B1        IF(ZER)TRA    Z
                    TRA           Z,CC+1
MESS                BCD           NEGATIVE INTEGER/
LP2                 OCT           773531770710311623
CON                 OCT           770252525252525252
                    OCT           762660266026602660
                    OCT           760640064006400640
                    OCT           760470047004700470
                    OCT           760700070007000700
SAVE                EQU           136
UNSAVE              EQU           137
```

END

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75

```
ENTRY   77773   75 44556 36 1400 00000
LOG     77774   53 56462 52 5400 00000
EXP     77775   44 67572 52 5400 00000
ERPR    77776   75 44615 76 1400 00000
        77777   46 40545 44 0400 00000
            1   01 01000 00 4401 77771   ENTRY
            2   10 01000 02 4400 00136   SAVE
            3   01 40003 20 4000 00001
            4   01 40003 00 4000 00000
            5   47 40001 02 4000 00001
            6   01 21645 00 0001 00043   OUT1
            7   07 02110 00 0001 00054   *0000A
           10   01 10400 61 0001 00053   *0000A
           11   01 10400 07 0001 00052   *0000A
           12   01 50460 10 0000 00007
           13   01 16700 05 0001 00051   *0000B
           14   01 10600 04 0000 00005
           15   01 10600 00 0001 00045   CON     +4
           16   01 40002 02 4000 00003
L1         17   02 14500 62 0005 00037   CON
           20   01 10600 02 0000 00004
           21   42 05150 00 4001 77774   L1
           22   02 14500 00 0001 00034   CON
           23   01 10600 00 0000 00005
           24   01 10400 00 0001 00031   LP2
           25   01 10500 05 0000 00007
           26   07 10500 04 0001 00037   *0000C
           27   01 40000 20 4401 77744   LOG
           30   07 10600 00 0000 00004
           31   01 10400 07 0000 00005
           32   43 01010 00 4001 00017   OUT1
           33   01 40000 20 4401 77741   EXP
           34   41 05150 00 4001 00010   OUT
           35   01 40001 00 4000 00030
           36   06 10500 06 0001 00026   *0000B
           37   01 50440 00 0000 00006
LOOP       40   06 10500 06 0001 00024   *0000B
           41   01 10600 04 0000 00004
           42   41 01110 61 4001 77774   LOOP
           43   07 10700 07 0000 00004
           44   01 01010 00 4001 00002   ERR
OUT        45   01 01000 00 4400 00137   UNSAVE
           46   07 01000 00 4200 00000
ERR        47   00 01000 00 4401 77726   ERPR
           50   01 30000 00 4001 00003   MESS
           51   01 01000 00 4001 77772   OUT
OUT1       52   41 01010 00 4000 00000
           53   01 01000 20 4000 00000
MESS       54   55 44464 06 3506 54425
           55   50 55634 44 6446 12225
LP2        56   77 35217 70 7103 11623
CON        57   77 02525 25 2525 25252
           60   76 26602 66 0266 02660
           61   76 06400 64 0064 00640
           62   76 04700 47 0047 00470
           63   76 07000 70 0070 00700
*********
*0000A     64   01 03300 00 0000 00000
*0000B     65   01 00100 00 0000 00000
*0000C     66   77 20000 00 0000 00000
```

316	ENTRY	0	77773	1	20000000000000	0
317	LOG	0	77774	1	30000000000000	0
320	EXP	0	77775	1	40000000000000	0
321	ERPR	0	77776	1	50000000000000	0
322	SAVE	0	136	0	101000000000000	0
323	OUT1	0	52	1	60000000000000	0
324	=00004	0	64	1	104000000000000	0
325	=00005	0	65	1	105000000000000	0
326	CON	0	57	1	70000000000000	0
327	L1	0	17	1	25000000000000	0
330	LP2	0	56	1	66000000000000	0
331	=00006	0	66	1	106000000000000	0
332	OUT	0	45	1	53000000000000	0
333	LOOP	0	40	1	46000000000000	0
334	ERR	0	47	1	55000000000000	0
335	UNSAVE	0	137	0	102000000000000	0
336	MESS	0	54	1	63000000000000	0

LGAMMA

```
                                                                    1
LGAMM           ORG                                                 2
LOG             REF             *LOG                                3
GAMMA           REF             *GAMMA                              4

ENTRY           REF             *←ENTRY                             5
ERPR            REF             *←ERPR                              6
                REF             *LGAMM                              7
                TRA             *ENTRY                              10
                -Z      TRA     *SAVE,U→R                           11
                Z       STX     3,U→B4                              12
                T7      IF(NEG)TRA      ERR                         13
                20002           Z,B6+1                              14
                TSR             *GAMMA,CC+X                         15
                SB4             1                                   16
                B4      IF(ZER)TRA      OUT                         17
                CLA             B6-1,B6-1                           20
                FAD             d27.,U→T6                           21
                Z       LT5     T7,U→T4                             22
                SB1             d25                                 23
LOOP            T6      FSB     d1.0,U→T6                           24
                LT7             T6                                  25
                TSR             *LOG,CC+1                           26
                FAD             T4,U→T4                             27
                B1      IF(POS)TRA      LOOP,B1-1                   30
                T5      FSB     T4,U→T7                             31
OUT             TRA             *UNSAVE                             32
                T7      TRA     PF                                  33
ERR             01      TRA     *ERPR                               34
                Z       TRA     OUT,U→T7                            35
SAVE            EQU             136                                 36
UNSAVE          EQU             137                                 37
                END                                                 40
                                                                    41
```

```
PROGRAM       LGAMM                                              06/26/67  13.41

          LOG      77773    53 56462 52 5400 00000
          GAMMA    77774    46 40545 44 0400 00000
          ENTRY    77775    75 44556 36 1400 00000
          ERPR     77776    75 44615 76 1400 00000
                   77777    53 46405 45 4400 00000
                       1    01 01000 00 4401 77773      ENTRY
                       2    10 01000 02 4400 00136      SAVE
                       3    00 43005 44 4000 00003
                       4    07 01510 00 4001 00020      ERR
                       5    01 20002 26 0000 00000
                       6    01 40000 30 4401 77765      GAMMA
                       7    01 40004 00 4000 00001
                      10    44 01010 00 4001 00012      OUT
                      11    01 21700 66 0100 77776
                      12    01 10400 06 0001 00014      •0000A
                      13    00 50450 04 0000 00007
                      14    01 40001 00 4000 00031
          LOOP        15    06 10500 06 0001 00012      •0000B
                      16    01 50470 00 0000 00006
                      17    01 40000 20 4401 77753      LOG
                      20    01 10400 04 0000 00004
                      21    41 01110 61 4001 77772      LOOP
                      22    05 10500 07 0000 00004
          OUT         23    01 01000 00 4400 00137      UNSAVE
                      24    07 01000 00 4200 00000
          ERR         25    01 01000 00 4401 77750      ERPR
                      26    00 01000 07 4001 77773      OUT
*********
          •0000A      27    01 03300 00 0000 00000
          •0000B      30    01 00100 00 0000 00000

   316       LOG        0  77773    1          20000000000000    0
   317       GAMMA      0  77774    1          30000000000000    0
   320       ENTRY      0  77775    1          40000000000000    0
   321       ERPR       0  77776    1          50000000000000    0
   322       SAVE       0    136    0         350000000000000    0
   323       ERR        0     25    1         330000000000000    0
   324       OUT        0     23    1         310000000000000    0
   325       •0000A     0     27    1         400000000000000    0
   326       LOOP       0     15    1         230000000000000    0
   327       •0000B     0     30    1         410000000000000    0
   330       UNSAVE     0    137    0         360000000000000    0
```

Complex scalar

RE

```
RE          ORG
            REM         RE(*B6=2)+U,T7
            SUR,LT7     *B6=2,B6=1
            TRA         PF,B6-1
            END
```


RE(*B6-2)+U,T7

```
1     01 53470 66 0500 77775
2     01 01000 66 4200 00000
```

****

IM

```
IM          ORG
            REM             IM(*B6=2)→U,T7
            SUR,LT7         *B6=1,B6=1
            TRA             PF,B6=1
            END
```

PROGRAM IM 6/14/66 15.11

```
IM(*B6=2)→U,T7
                1       01 53470 66 0500 77776
                2       01 01000 66 4200 00000
*********
```

CARTN

```
CARTN                 ORG

                      REM             POLAR TO CARTESIAN

SIN                   REF             *SIN
REAL                  REF             CMPLX
IMAG                  REF             *....
ENTRY                 REF             *+ENTRY
                      REF             *CARTN

                      TRA             @*ENTRY
            Z         IF(NZE)SKP      *36=2
            Z         STO             *36=2
            PF        LT7+2           *36=1,36+1
                      TSR             *SIN,CC+1
            R         FMP             *36=3,36-1
                      STO             *REAL
            T7        FMP             *36=2,36-1
                      STO             *IMAG
                      TRA             *36+1,36-1

                      END
```

```
PROGRAM      CARTN                                     02/06/68 15.36

      SIN       77773    62 50552 52 5400 00000
      REAL      77774    42 54575 26 7000 00000
      IMAG      77775    75 75757 57 5000 00000
      ENTRY     77776    75 44556 26 1400 00000
                77777    42 40616 35 5400 00000
                    1    01 01000 00 4401 77774      ENTRY
                    2    00 02050 00 0500 77775
                    3    00 20001 00 4500 77775
                    4    47 50472 26 0500 77776
                    5    01 40000 20 4401 77765      SIN
                    6    02 10600 66 0500 77774
                    7    01 20001 00 4401 77764      REAL
                   10    07 10600 66 0500 77775
                   11    01 20001 00 4401 77763      IMAG
                   12    01 01000 66 4500 00001
*********
```

```
316      SIN       0 77773     1          50000000000000     0
317      REAL      0 77774     1          60000000000000     0
320      IMAG      0 77775     1          70000000000000     0
321      ENTRY     0 77776     1         100000000000000     0
```

POLAR

```
POLAR           ORG
                REM             CARTESIAN TO POLAR

ASIN            REF             *ASIN
MOD             REF             *MOD
RHO             REF             CMPLX
THETA           REF             ←←←←
ENTRY           REF             *←ENTRY
                REF             *POLAR

                TRA             *ENTRY
          PF    RPA             EXIT
                CLA,DBL+2       B6-2,B6+1
                TSR             *MOD,CC+1
                IF(ZER)TRA      CLEAN,R→Z
          T7    STO             *RHO
                VDF             *B6-1,U→T7
                TSR             *ASIN,CC+1
          Z     IF(NEG)SKP      *B6-2,B6-1
         -T7    FAD             PI,U→T7
          T7    IF(POS)TRA      ¤CC+1
                FAD             TWOPI,U→T7
          T7    STO             *THETA,CC+1
CLEAN     Z     STO,DBL         *RHO,B6-1
EXIT            TRA             Z,B6-1

PI              DEC             3.141592653589
TWOPI           DEC             6.283185307178

                END
```

PROGRAM POLAR 3/02/67 13.40

```
        ASIN    77772     40 62505 52 5400 00000
        MOD     77773     54 56432 52 5400 00000
        RHO     77774     42 54575 36 7000 00000
        THETA   77775     75 75757 57 5000 00000
        ENTRY   77776     75 44556 36 1400 00000
                77777     57 56534 06 1400 00000
                    1     01 01000 00 4401 77774    ENTRY
                    2     47 21601 00 0001 00014    EXIT
                    3     01 21706 26 0100 77775
                    4     01 40000 20 4401 77766    MOD
                    5     01 01010 10 4001 00010    CLEAN
                    6     07 20001 00 4401 77765    RHO
                    7     01 16700 07 0500 77776
                   10     01 40000 20 4401 77761    ASIN
                   11     00 02510 66 0500 77775
                   12     17 10400 07 0001 00005    PI
                   13     07 01110 00 4001 00001
                   14     01 10400 07 0001 00004    TWOPI
                   15     07 20001 20 4401 77757    THETA
        CLEAN      16     00 20005 66 4401 77755    RHO
        EXIT       17     01 01000 66 4000 00000
        PI         20     01 00311 03 7552 42101
        TWOPI      21     01 00622 07 7325 04204
*********
```

```
316      ASIN     0 77772     1        50000000000000    0
317      MOD      0 77773     1        60000000000000    0
320      RHO      0 77774     1        70000000000000    0
321      THETA    0 77775     1       100000000000000    0
322      ENTRY    0 77776     1       110000000000000    0
323      EXIT     0    17     1       310000000000000    0
324      CLEAN    0    16     1       300000000000000    0
325      PI       0    20     1       330000000000000    0
326      TWOPI    0    21     1       350000000000000    0
```

CONJ

```
CONJ            ORG
                REM             CONJUGATE OF COMPLEX SCALAR
REAL            REF             CMPLX
IMAG            REF             ****
                CLA,DBL         -*36-2,B6-1
          -U    STO             *REAL
          PF    XUR*            *IMAG,R*CC
                END
```

PROGRAM CONJ 02/06/68 16.49

```
      REAL   77776   42 54575 36 7000 00000
      IMAG   77777   75 75757 57 5000 00000
                 1   01 21704 66 1500 77775
                 2   11 20001 00 4401 77773     REAL
                 3   47 54001 50 0401 77773     IMAG
*********
```

```
316       REAL      0 77776    1          600000000000000    0
317       IMAG      0 77777    1          700000000000000    0
```

MOD

```
                                                                    1
MOD             ORG                                                 2
                                                                    3
                REM             MODULUS OF COMPLEX SCALAR           4
SQR             REF             *SQR                                5
ENTRY           REF             *+ENTRY                             6
ERPR            REF             *+ERPR                              7
                REF             *MOD                                10
                                                                    11
                TRA             *ENTRY                              12
                7       05350   *B6-1,B6-1                          13
                S       FMP     S,U+T7                              14
                        CLA     *B6-1,B6-1                          15
                        FMP     U                                   16
                        IF(EQV)SKP  -T7,U+T7                        17
                        TRA     a*SQR,CC+1                          20
                        CLA     *B6                                 21
                        FDV     L                                   22
                        FMP     U,U+T7                              23
                        CLA     *B6+1                               24
                        FDV     L                                   25
                        FMP     U                                   26
                        FAD     T7,U+T7                             27
                PF      RWT     OUT                                 30
                        TSR     a*SQR,CC+1                          31
                        FMP     L,U+T7                              32
OUT                     IF(NEQ)TRA  a(Z),I+PF                       33
                02      TRA     a*ERPR                              34
                7       TRA     aPF,U+T7                            35
                                                                    36
L               OCT     377777777777777777                          37
                END                                                 40
                                                                    41
```

```
        SQR     77774   62 60612 52 5400 00000
        ENTRY   77775   75 44556 36 1400 00000
        ERPR    77776   75 44615 76 1400 00000
                77777   54 56432 52 5400 00000
                    1   01 01000 00 4401 77773    ENTRY
                    2   00 05250 66 0500 77776
                    3   03 10600 07 0000 00003
                    4   01 21700 66 0500 77776
                    5   01 10600 00 0000 00001
                    6   01 02300 07 1000 00007
                    7   01 01000 20 4401 77764    SQR
                   10   01 21700 00 0500 00000
                   11   01 10700 00 0001 00013    L
                   12   01 10600 07 0000 00001
                   13   01 21700 00 0500 00001
                   14   01 10700 00 0001 00010    L
                   15   01 10600 00 0000 00001
                   16   01 10400 07 0000 00007
                   17   47 21641 00 0001 00002    OUT
                   20   01 40000 20 4401 77753    SQR
                   21   01 10600 07 0001 00003    L
        OUT        22   01 01700 77 4000 00000
                   23   02 01000 00 4401 77752    ERPR
                   24   00 01000 07 4200 00000
        L          25   37 37777 77 7777 77777
*********
```

316	SQR	0	77774	1	60000000000000	0
317	ENTRY	0	77775	1	70000000000000	0
320	ERPR	0	77776	1	100000000000000	0
321	L	0	25	1	370000000000000	0
322	OUT	0	22	1	330000000000000	0

ITIMES

```
ITIMES          ORG
                REM             ITIMES(X+/Y)=-Y+/X

REAL            REF             CMPLX
IMAG            REF             ****

                CLA,DBL         -*B6-2,B6-1
          -U    STO             *IMAG,B6-1
          PF    XUR*            &*REAL,R*CC

                END
```

PROGRAM ITIME 02/06/68 16.53

```
      REAL   77776   42 54575 36 7000 00000
      IMAG   77777   75 75757 57 5000 00000
                 1   01 21704 66 1500 77775
                 2   11 20001 66 4401 77774      IMAG
                 3   47 54001 50 4401 77772      REAL
*********
```

```
316       REAL      0 77776    1          500000000000000    0
317       IMAG      0 77777    1          600000000000000    0
```

CSQR

```
                                                                    1
CSQR            ORG                                                 2
                                                                    3
                REM             CSQR(*B6-2)=CMPLX                   4
                REM             SQR(MOD)xe↑HALF(THETA)↓             5
                                                                    6
REAL            REF             CMPLX                               7
IMAG            REF             ↑↑↑↑↑                               10
SQR             REF             *SQR                                11
POLAR           REF             *POLAR                              12
CARTN           REF             *CARTN                              13
ENTRY           REF             *=ENTRY                             14
                REF             *CSQR                               15
                                                                    16
                TRA             *ENTRY                              17
          PF    RWT             EXIT                                20
                CLA,DBL+2       *B6-2,B6+1                          21
                CLA,DBL+2       aB6-2,B6+1                          22
                TSR             *POLAR,CC+1                         23
                CLA,DBL         *REAL,U=T7                          24
          R     FDV+2           d2,,B6+1                            25
                TSR             *SQR,CC+1                           26
                STO             B6-2                                27
                CLA,DBL+2       aB6=2,B6+1                          30
                TSR             *CARTN,CC+1                         31
                AB6             Z-5                                 32
EXIT            TRA             Z                                   33
                                                                    34
                END                                                 35
```

```
        REAL    77771      42 54575 36 7000 00000
        IMAG    77772      75 75757 57 5000 00000
        SQR     77773      62 60612 52 5400 00000
        POLAR   77774      57 56534 06 1400 00000
        CARTN   77775      42 40616 35 5400 00000
        ENTRY   77776      75 44556 36 1400 00000
                77777      42 62606 12 5400 00000
                    1      01 01000 00 4401 77774    ENTRY
                    2      47 21641 00 0001 00012    EXIT
                    3      01 21706 26 0500 77775
                    4      01 21706 26 4100 77775
                    5      01 40000 20 4401 77766    POLAR
                    6      01 21704 07 0401 77762    REAL
                    7      02 10702 26 0001 00006    +0000A
                   10      01 40000 20 4401 77762    SQR
                   11      01 20001 00 4100 77775
                   12      01 21706 26 4100 77775
                   13      01 40000 20 4401 77761    CARTN
                   14      01 41006 00 4000 77772
        EXIT       15      01 01000 00 4000 00000
*********
        +0000A     16      01 00200 00 0000 00000
```

316	REAL	0	77771	1	1100000000000000	0
317	IMAG	0	77772	3	1200000000000000	0
320	SQR	0	77773	1	1300000000000000	0
321	POLAR	0	77774	1	1400000000000000	0
322	CARTN	0	77775	1	1500000000000000	0
323	ENTRY	0	77776	1	1600000000000000	0
324	EXIT	0	15	1	3400000000000000	0
325	+0000A	0	16	1	3600000000000000	0

CEXP

3/02/67 13.25 PAGE 1

```
CEXP            ORG
                REM         CEXP(*B6-2)-CMPLX
                REM         REAL=e↑X↓COS Y,   IMAG=e↑X↓SIN Y

REAL            REF         CMPLX
IMAG            REF         -----
EXP             REF         *EXP
SIN             REF         *SIN
ENTRY           REF         *-ENTRY
                REF         *CEXP

                TRA         *ENTRY
          PF    LT7+2       *B6-2,B6+1
                TSR         *EXP,CC+1
                LT7+2       *B6-2,B6+1
                TSR         *SIN,CC+1
          R     FMP         B6-1,B6-1
                STO         *REAL
          T7    FMP         B6,B6-1
                STO         *IMAG,B6-1
                TRA         *B6+1,B6-1

                END
```

```
PROGRAM     CEXP                                    3/02/67 13.42

     REAL    77772     42 54575 36 7000 00000
     IMAG    77773     75 75757 57 5000 00000
     EXP     77774     44 67572 52 5400 00000
     SIN     77775     62 50552 52 5400 00000
     ENTRY   77776     75 44556 36 1400 00000
             77777     42 44675 72 5400 00000
                 1     01 01000 00 4401 77774     ENTRY
                 2     47 50472 26 0500 77775
                 3     01 40000 20 4401 77770     EXP
                 4     01 50472 26 0500 77775
                 5     01 40000 20 4401 77767     SIN
                 6     02 10600 66 0100 77776
                 7     01 20001 00 4401 77762     REAL
                10     07 10600 66 0100 00000
                11     01 20001 66 4401 77761     IMAG
                12     01 01000 66 4500 00001
********
```

```
316     REAL     0 77772     1     12000000000000000     0
317     IMAG     0 77773     1     13000000000000000     0
320     EXP      0 77774     1     14000000000000000     0
321     SIN      0 77775     1     15000000000000000     0
322     ENTRY    0 77776     1     16000000000000000     0
```

CLOG

```
CLOG            ORG                                                    1
                                                                       2
                                                                       3
                REM             CLOG(*B6-2)=CMPLX                      4
                REM             CLOG(*B6-2)=LOG(MOD) + .ITHETA
                                                                       6
LOG             REF             *LOG                                   7
POLAR           REF             *POLAR                                 10
REAL            REF             CMPLX                                  11
IMAG            REF             ****                                   12
ERR             REF             *=ERPR                                 13
ENTRY           REF             *=ENTRY                                14
                REF             *CLOG                                  15
                                                                       16
                TRA             *ENTRY                                 17
          PF    RWT             EXIT                                   20
                CLA,DBL+2       *B6-2,R=T7                             21
                IF(NZE)SKP      Z,B6+1                                 22
          T7    IF(ZER)TRA      ERROR                                  23
                CLA,DBL+2       aB6=Z,B6+1                             24
                TSR             *POLAR,CC+1                            25
                LT7             *REAL                                  26
                TSR             *LOG,CC+1                              27
BACK            STO             *REAL                                  30
                AB6             Z-4                                    31
EXIT            TRA             Z                                      32
                                                                       33
ERROR     00    TRA             *ERR                                   34
                NOP             MESS                                   35
          Z     STO             *IMAG                                  36
          Z     TRA             BACK                                   37
MESS            BCD             ZERO ARGUMENTS/                        40
                                                                       41
                END                                                    42
                                                                       43
```

LOG	77771	53	56462	52	5400	00000	
POLAR	77772	57	56534	06	1400	00000	
REAL	77773	42	54575	36	7000	00000	
IMAG	77774	75	75757	57	5000	00000	
ERR	77775	75	44615	76	1400	00000	
ENTRY	77776	75	44556	36	1400	00000	
	77777	42	53564	62	5400	00000	
	1	01	01000	00	4401	77774	ENTRY
	2	47	21641	00	0001	00011	EXIT
	3	01	21706	17	0500	77775	
	4	01	02050	26	0000	00000	
	5	07	01010	00	4001	00007	ERROR
	6	01	21706	26	4100	77775	
	7	01	40000	20	4401	77762	POLAR
	10	01	50470	00	0401	77762	REAL
	11	01	40000	20	4401	77757	LOG
BACK	12	01	20001	00	4401	77760	REAL
	13	01	41006	00	4000	77773	
EXIT	14	01	01000	00	4000	00000	
ERROR	15	00	01000	00	4401	77757	ERR
	16	01	30000	00	0001	00002	MESS
	17	00	20001	00	4401	77754	IMAG
	20	00	01000	00	4001	77770	BACK
MESS	21	71	44615	62	5406	14664	
	22	54	44556	36	2222	52525	

****

316	LOG	0	77771	1	12000000000000	0
317	POLAR	0	77772	1	13000000000000	0
320	REAL	0	77773	1	14000000000000	0
321	IMAG	0	77774	1	15000000000000	0
322	ERR	0	77775	1	16000000000000	0
323	ENTRY	0	77776	1	17000000000000	0
324	EXIT	0	14	1	34000000000000	0
325	ERROR	0	15	1	35000000000000	0
326	BACK	0	12	1	32000000000000	0
327	MESS	0	21	1	42000000000000	0

CSIN

```
CSIN            ORG

                REM        CSIN(*B6-2)+CMPLX
                REM        SIN(R)COSH(I),COS(R)SINH(I)

COS             REF        *COS
SINH            REF        *SINH
REAL            REF        CMPLX
IMAG            REF        +++++
ENTRY           REF        *+ENTRY
                REF        *CSIN

                TRA        *ENTRY
          PF    LT7+2      *B6-1,B6+1
                TSR        *SINH,CC+1
                LT7        *B6-3
                STO,DBL    B6-3
                TSR        *COS,CC+1
          R     FMP        B6-2
                STO        *REAL
          T7    FMP        B6-3,I+B6
                STO        *IMAG
                TRA        *B6+2

                END
```

```
PROGRAM     CSIN                                      3/02/67 13.43

      COS     77772     42 56622 52 5400 00000
      SINH    77773     62 50554 72 5400 00000
      REAL    77774     42 54575 36 7000 00000
      IMAG    77775     75 75757 57 5000 00000
      ENTRY   77776     75 44556 36 1400 00000
              77777     42 62505 52 5400 00000
                  1     01 01000 00 4401 77774     ENTRY
                  2     47 50472 26 0500 77776
                  3     01 40000 20 4401 77767     SINH
                  4     01 50470 00 0500 77774
                  5     01 20005 00 4100 77774
                  6     01 40000 20 4401 77763     COS
                  7     02 10600 00 0100 77775
                 10     01 20001 00 4401 77763     REAL
                 11     07 10600 76 0100 77774
                 12     01 20001 00 4401 77762     IMAG
                 13     01 01000 00 4500 00002
********

  316     COS      0 77772    1        110000000000000    0
  317     SINH     0 77773    1        120000000000000    0
  320     REAL     0 77774    1        130000000000000    0
  321     IMAG     0 77775    1        140000000000000    0
  322     ENTRY    0 77776    1        150000000000000    0
```

CCOS

```
CCOS              ORG
                  REM          CCOS(*B6-2)←CMPLX
                  REM          COS(R)COSH(I),-SIN(R)SINH(I)

SIN               REF          *SIN
SINH              REF          *SINH
REAL              REF          CMPLX
IMAG              REF          ←←←←←
ENTRY             REF          *←ENTRY
                  REF          *CCOS

                  TRA          *ENTRY
           PF     LT7+2        *B6-1,B6+1
                  TSR          *SINH,CC+1
                  LT7          *B6-3
                  STO,DBL      B6-3
                  TSR          *SIN,CC+1
           R      FMP          B6-2
                  STO          *REAL
           T7     FMP          B6-3,I←B6
           -U     STO          *IMAG
                  TRA          *B6+2

                  END
```

```
PROGRAM        CCOS                                       3/02/67 13.44

        SIN      77772      62 50552 52 5400 00000
        SINH     77773      62 50554 72 5400 00000
        REAL     77774      42 54575 36 7000 00000
        IMAG     77775      75 75757 57 5000 00000
        ENTRY    77776      75 44556 36 1400 00000
                 77777      42 42566 22 5400 00000
                     1      01 01000 00 4401 77774     ENTRY
                     2      47 50472 26 0500 77776
                     3      01 40000 20 4401 77767     SINH
                     4      01 50470 00 0500 77774
                     5      01 20005 00 4100 77774
                     6      01 40000 20 4401 77763     SIN
                     7      02 10600 00 0100 77775
                    10      01 20001 00 4401 77763     REAL
                    11      07 10600 76 0100 77774
                    12      11 20001 00 4401 77762     IMAG
                    13      01 01000 00 4500 00002
********

  316        SIN       0 77772      1           120000000000000    0
  317        SINH      0 77773      1           130000000000000    0
  320        REAL      0 77774      1           140000000000000    0
  321        IMAG      0 77775      1           150000000000000    0
  322        ENTRY     0 77776      1           160000000000000    0
```

CTAN

```
                                                                    1
CTAN            ORG                                                 2
                                                                    3
                REM     CTAN(*B6-2)=CMPLX                           4
                REM     REAL=SIN 2X/(COSH 2Y + COS 2X)
                REM     IMAG=SINH 2Y/(COSH 2Y + COS 2X)
SINH            REF     *SINH                                       7
SIN             REF     *SIN                                       10
TAN             REF     *TAN                                       11
ERR             REF     *=ERPR                                     12
REAL            REF     CMPLX                                      13
IMAG            REF     ******                                     14
ENTRY           REF     *=ENTRY                                    15
                REF     *CTAN                                      16
                                                                   17
                TRA     *ENTRY                                     20
            PF  RWT     EXIT,B6-1                                  21
                CLA,DBL *B6=1,U=T7                                 22
            P   FAD+2   U                                          23
                IF(ZER)TRA  YZERO                                  24
            T7  FAD     T7,B6+1                                    25
                TSR     *SIN,CC+1                                  26
                DBL+2   Z,B6+1                                     27
                LT7     B6-3                                       30
                TSR     *SINH,CC+1                                 31
            R   FAD+2   B6-1                                       32
                IF(ZER)TRA  ERROR                                  33
                VDF     B6-2                                       34
                STO     *REAL,B6-1                                 35
            T7  FDV     B6+1,B6-1                                  36
                STO     *IMAG,B6-1                                 37
EXIT            TRA     Z,B6-1                                     40
                                                                   41
YZERO           TSR     *TAN,CC+1                                  42
                LDR     Z                                          43
                STO,DRL *REAL                                      44
                TRA     *EXIT,B6-1                                 45
                                                                   46
ERROR       10  TRA     *ERR,B6-1                                  47
                LT7     *B6=3,B6-1                                 50
                TRA     YZERO,B6-1                                 51
                                                                   52
                END                                                53
```

```
SINH    77770   62 50554 72 5400 00000
SIN     77771   62 50552 52 5400 00000
TAN     77772   63 40552 52 5400 00000
ERR     77773   75 44615 76 1400 00000
REAL    77774   42 54575 36 7000 00000
IMAG    77775   75 75757 57 5000 00000
ENTRY   77776   75 44556 36 1400 00000
        77777   42 63405 52 5400 00000
              1 01 01000 00 4401 77774    ENTRY
              2 47 21641 66 0001 00016    EXIT
              3 01 21704 07 0500 77776
              4 02 10402 00 0000 00001
              5 01 01010 00 4001 00014    YZERO
              6 07 10401 26 0000 00007
              7 01 40000 20 4401 77761    SIN
             10 01 20006 26 0000 00000
             11 01 50470 00 0100 77774
             12 01 40000 20 4401 77755    SINH
             13 02 10402 00 0100 77776
             14 01 01010 00 4001 00011    ERROR
             15 01 16700 00 0100 77775
             16 01 20001 66 4401 77755    REAL
             17 07 10700 66 0100 00001
             20 01 20001 66 4401 77754    IMAG
EXIT         21 01 01000 66 4000 00000
YZERO        22 01 40000 20 4401 77747    TAN
             23 01 50400 00 0000 00000
             24 01 20005 00 4401 77747    REAL
             25 01 01000 66 4401 77772    EXIT
ERROR        26 10 01000 66 4401 77744    ERR
             27 01 50470 66 0500 77774
             30 01 01000 66 4001 77770    YZERO
```

****

316	SINH	0	77770	1	170000000000000	0
317	SIN	0	77771	1	200000000000000	0
320	TAN	0	77772	1	210000000000000	0
321	ERR	0	77773	1	220000000000000	0
322	REAL	0	77774	1	230000000000000	0
323	IMAG	0	77775	1	240000000000000	0
324	ENTRY	0	77776	1	250000000000000	0
325	EXIT	0	21	1	470000000000000	0
326	YZERO	0	22	1	500000000000000	0
327	ERROR	0	26	1	540000000000000	0

CCOT

```
                                                                    1
CCOT            ORG                                                 2
                                                                    3
                REM             CCOT(*B6-2)→CMPLX                   4
                REM             REAL=SIN 2X/(COSH 2Y-COS 2X)
                REM             IMAG=SINH 2Y/(COS 2X-COSH 2Y)
                                                                    7
SINH            REF             *SINH                              10
SIN             REF             *SIN                               11
COT             REF             *COT                               12
ERR             REF             *←ERR                              13
REAL            REF             CMPLX                              14
IMAG            REF             ←←←←←                              15
ENTRY           REF             *←ENTRY                            16
                REF             *CCOT                              17
                                                                   20
                TRA             *ENTRY                             21
                PF      RWT     EXIT,B6-1                          22
                        CLA,DBL *B6-1,U→T7                         23
                R       FAD+2   U                                  24
                        IF(ZER)TRA YZERO                           25
                T7      FAD←    T7,B6+1                            26
                        TSR     *SIN,CC+1                          27
                        DBL+2   Z,B6+1                             30
                        LT7     B6-3                               31
                        TSR     *SINH,CC+1                         32
                R       FSB+2   B6-1                               33
                        IF(ZER)TRA ERROR                           34
                        VDF     B6-2                               35
                        STO     *REAL,B6-1                         36
                -T7     FDV     B6+1,B6-1                          37
                        STO     *IMAG,B6-1                         40
EXIT            TRA             Z,B6-1                             41
                                                                   42
YZERO           TSR             *COT,CC+1                          43
                LDR             Z                                  44
                STO,DRL         *REAL                              45
                TRA             *EXIT,B6-1                         46
                                                                   47
ERROR   10      TRA             *ERR,B6-1                          50
                LT7             *B6-3,B6-1                         51
                TRA             YZERO,B6-1                         52
                                                                   53
                END                                                54
```

```
SINH    77770      62 50554 72 5400 00000
SIN     77771      62 50552 52 5400 00000
COT     77772      42 56632 52 5400 00000
ERR     77773      75 44615 76 1400 00000
REAL    77774      42 54575 36 7000 00000
IMAG    77775      75 75757 57 5000 00000
ENTRY   77776      75 44556 36 1400 00000
        77777      42 42566 32 5400 00000
            1      01 01000 00 4401 77774      ENTRY
            2      47 21641 66 0001 00016      EXIT
            3      01 21704 07 0500 77776
            4      02 10402 00 0000 00001
            5      01 01010 00 4001 00014      YZERO
            6      07 10401 26 0000 00007
            7      01 40000 20 4401 77761      SIN
           10      01 20006 26 0000 00000
           11      01 50470 00 0100 77774
           12      01 40000 20 4401 77755      SINH
           13      02 10502 00 0100 77776
           14      01 01010 00 4001 00011      ERROR
           15      01 16700 00 0100 77775
           16      01 20001 66 4401 77755      REAL
           17      17 10700 66 0100 00001
           20      01 20001 66 4401 77754      IMAG
EXIT       21      01 01000 66 4000 00000
YZERO      22      01 40000 20 4401 77747      COT
           23      01 50400 00 0000 00000
           24      01 20005 00 4401 77747      REAL
           25      01 01000 66 4401 77772      EXIT
ERROR      26      10 01000 66 4401 77744      ERR
           27      01 50470 66 0500 77774
           30      01 01000 66 4001 77770      YZERO
********
```

```
316    SINH     0 77770   1    170000000000000   0
317    SIN      0 77771   1    200000000000000   0
320    COT      0 77772   1    210000000000000   0
321    ERR      0 77773   1    220000000000000   0
322    REAL     0 77774   1    230000000000000   0
323    IMAG     0 77775   1    240000000000000   0
324    ENTRY    0 77776   1    250000000000000   0
325    EXIT     0    21   1    470000000000000   0
326    YZERO    0    22   1    500000000000000   0
327    ERROR    0    26   1    540000000000000   0
```

CASN

```
3/03/67 16.29                                                          PAGE    1

CASN                     ORG

                         REM           CASN(X+.IY)=-.ICASNH.I(X+.IY)
                         REM           CATN, CTNH ENTER AT ORDER 3

REAL                     REF           CMPLX
IMAG                     REF           *****
CASNH                    REF           *CASNH
ENTRY                    REF           *+ENTRY
                         REF           *CASN

                         TRA           *ENTRY
                         CLA           CASNH
                         RWT           TOSUBR
              PF         RWT           EXIT,B6-1
                         CLA+2         -*B6,B6+1
                         CLA+2         *B6-2,B6+1
                         CLA,DBL+2     aB6-2,B6+1
TOSUBR                   TSR           *Z,CC+1
                         CLA,DBL       *REAL,B6-1
              -U         XUR           Z,B6-1
                         STO,DBL       *REAL,B6-1
EXIT                     TRA           Z

                         END
```

```
PROGRAM        CASN                                            3/03/67 16.33

          REAL     77773       42 54575 36 7000 00000
          IMAG     77774       75 75757 57 5000 00000
          CASNH    77775       42 40625 54 7400 00000
          ENTRY    77776       75 44556 36 1400 00000
                   77777       42 40625 52 5400 00000
                       1       01 01000 00 4401 77774      ENTRY
                       2       01 21700 00 0001 77772      CASNH
                       3       01 21641 00 0001 00004      TOSUBR
                       4       47 21641 66 0001 00007      EXIT
                       5       01 21702 26 1500 00000
                       6       01 21702 26 0500 77775
                       7       01 21706 26 4100 77775
          TOSUBR      10       01 40000 20 4400 00000
                      11       01 21704 66 0401 77761      REAL
                      12       11 54000 66 0000 00000
                      13       01 20005 66 4401 77757      REAL
          EXIT        14       01 01000 00 4000 00000
********

  316        REAL        0 77773      1            120000000000000     0
  317        IMAG        0 77774      3            130000000000000     0
  320        CASNH       0 77775      1            140000000000000     0
  321        ENTRY       0 77776      1            150000000000000     0
  322        TOSUBR      0      10    1            260000000000000     0
  323        EXIT        0      14    1            320000000000000     0
```

CATN

```
CATN            ORG

                REM       CATN(*B6-2)=-.ICATNH.I(X+,IY)-CMP X
                REM       |REAL| IS BETWEEN ZERO AND PI

CATNH           REF       *CATNH
CASN            REF       *CASN
ENTRY           REF       *+ENTRY
                REF       *CATN

                TRA       *ENTRY
                STX       2
                CLA       CATNH
                TRA       *CASN,CC+X

                END
```

```
PROGRAM    CATN                                    3/03/67 16.34

     CATNH  77774     42 40635 54 7400 00000
     CASN   77775     42 40625 52 5400 00000
     ENTRY  77776     75 44556 36 1400 00000
            77777     42 40635 52 5400 00000
                1     01 01000 00 4401 77774     ENTRY
                2     01 43005 00 4000 00002
                3     01 21700 00 0001 77770     CATNH
                4     01 01000 30 4401 77770     CASN
*********
```

```
316    CATNH    0 77774    1        140000000000000    0
317    CASN     0 77775    1        150000000000000    0
320    ENTRY    0 77776    1        160000000000000    0
```

CSNH

```
CSNH            ORG

                REM         CSNH(*B6-2).CMPLX
                REM         CSNH(X+/Y)=SINH X COS Y+/COSH X SIN

REAL            REF         CMPLX
IMAG            REF         *****
SIN             REF         *SIN
SINH            REF         *SINH
ENTRY           REF         *+ENTRY
                REF         *CSNH

                TRA         *ENTRY
          PF    LT7+2       *B6-1,B6+1
                TSR         *SIN,CC+1
                LT7         *B6-3
                STO,DBL     B6-3
                TSR         *SINH,CC+1
          R     FMP         B6-3,I+B6
                STO         *IMAG
          T7    FMP         B6+1
                STO         *REAL
                TRA         *B6+2

                END
```

PROGRAM CSNH 3/02/67 13.55

```
      REAL   77772    42 54575 36 7000 00000
      IMAG   77773    75 75757 57 5000 00000
      SIN    77774    62 50552 52 5400 00000
      SINH   77775    62 50554 72 5400 00000
      ENTRY  77776    75 44556 36 1400 00000
             77777    42 62554 72 5400 00000
                 1    01 01000 00 4401 77774      ENTRY
                 2    47 50472 26 0500 77776
                 3    01 40000 20 4401 77770      SIN
                 4    01 50470 00 0500 77774
                 5    01 20005 00 4100 77774
                 6    01 40000 20 4401 77766      SINH
                 7    02 10600 76 0100 77774
                10    01 20001 00 4401 77762      IMAG
                11    07 10600 00 0100 00001
                12    01 20001 00 4401 77757      REAL
                13    01 01000 00 4500 00002
********
```

```
 316     REAL     0 77772    1          130000000000000    C
 317     IMAG     0 77773    1          140000000000000    C
 320     SIN      0 77774    1          150000000000000    C
 321     SINH     0 77775    1          160000000000000    C
 322     ENTRY    0 77776    1          170000000000000    C
```

CCSH

```
CCSH                ORG

                    REM         CCSH(*B6-2)+CMPLX
                    REM         CCSH(X+/Y)=(COSH X)COS Y+/(SINH X)SI

REAL                REF         CMPLX
IMAG                REF         *****
SIN                 REF         *SIN
SINH                REF         *SINH
ENTRY               REF         *+ENTRY
                    REF         *CCSH

                    TRA         *ENTRY
          PF        LT7+2       *B6-1,B6+1
                    TSR         *SIN,CC+1
                    LT7         *B6-3
                    STO,DBL     B6-3
                    TSR         *SINH,CC+1
          R         FMP         B6-2
                    STO         *REAL
          T7        FMP         B6-3,I+B6
                    STO         *IMAG
                    TRA         *B6+2

                    END
```

```
PROGRAM        CCSH                                      3/02/67 14.00

        REAL   77772     42 54575 36 7000 00000
        IMAG   77773     75 75757 57 5000 00000
        SIN    77774     62 50552 52 5400 00000
        SINH   77775     62 50554 72 5400 00000
        ENTRY  77776     75 44556 36 1400 00000
               77777     42 42624 72 5400 00000
                   1     01 01000 00 4401 77774     ENTRY
                   2     47 50472 26 0500 77776
                   3     01 40000 20 4401 77770     SIN
                   4     01 50470 00 0500 77774
                   5     01 20005 00 4100 77774
                   6     01 40000 20 4401 77766     SINH
                   7     02 10600 00 0100 77775
                  10     01 20001 00 4401 77761     REAL
                  11     07 10600 76 0100 77774
                  12     01 20001 00 4401 77760     IMAG
                  13     01 01000 00 4500 00002
********

 316      REAL      0 77772     1          13000000000000    C
 317      IMAG      0 77773     1          14000000000000    C
 320      SIN       0 77774     1          15000000000000    C
 321      SINH      0 77775     1          16000000000000    C
 322      ENTRY     0 77776     1          17000000000000    C
```

CTNH

```
                                                                    1
CTNH            ORG                                                 2
                                                                    3
                REM             CTNH(X+.IY)=-.ICTAN.I(X+.IY)
                                                                    5
CTAN            REF             *CTAN                               6
CASN            REF             *CASN                               7
ENTRY           REF             *-ENTRY                            10
                REF             *CTNH                              11
                                                                   12
                TRA             *ENTRY                             13
                STX             2                                  14
                CLA             CTAN                               15
                TRA             *CASN,CC+X                         16
                                                                   17
                END                                                20
```

PROGRAM CTNH 3/03/67 16.34

```
      CTAN    77774     42 63405 52 5400 00000
      CASN    77775     42 40625 52 5400 00000
      ENTRY   77776     75 44554 36 1400 00000
              77777     42 63554 72 5400 00000
                  1     01 01000 00 4401 77774     ENTRY
                  2     01 43005 00 4000 00002
                  3     01 21700 00 0001 77770     CTAN
                  4     01 01000 30 4401 77770     CASN
*********
```

```
316         CTAN        0 77774     1          600000000000000     0
317         CASN        0 77775     1          700000000000000     0
320         ENTRY       0 77776     1         1000000000000000     0
```

CASNH

```
CASNH           ORG                                                    1
                                                                       2
                                                                       3
                REM             CASNH(Z)=CLOG(Z+CSQR(Z↑2↓+1))
                REM             CACSH ENTERS AT THIRD INSTRUCTION
                                                                       6
CADD            REF             *CADD                                  7
REAL            REF             CMPLX                                 10
IMAG            REF             ←←←←←                                 11
CLOG            REF             *CLOG                                 12
CMPY            REF             *CMPY                                 13
CSQR            REF             *CSQR                                 14
ENTRY           REF             *←ENTRY                               15
                REF             *CASNH                                16
                                                                      17
                TRA             *ENTRY                                20
          U     CLA             CC-1,CC+1                             21
         -U     CLA             CC-1                                  22
                RPE,WTG         FETCH,B6-1                            23
          PF    RWT             EXIT,B6-1                             24
                CLA,DBL+2       *B6,B6+1                              25
                CLA+2           aB1,B6+1                              26
                CLA+2           aB2,B6+1                              27
                SB1             B6-4,I←B2                             30
                TRA             *CMPY                                 31
                CLA             d1.0                                  32
FETCH     U     FAD←            *REAL                                 33
                CLA,DBL+2       *REAL,B6+1                            34
                CLA,DBL+2       aB6=2,B6+1                            35
                TSR             *CSQR,CC+1                            36
                SB1             B6-6,B6-1                             37
                CLA,DBL+2       *REAL,B6+1                            40
                SB2             aB6=2                                 41
                TSR             *CADD                                 42
                CLA,DBL+2       *REAL,B6+1                            43
                CLA,DBL+2       aB6=2,B6+1                            44
                TSR             *CLOG,CC+1                            45
                AB6             Z-d9                                  46
                CLA,DBL         a*B6+2,U→B1                           47
EXIT            TRA             Z,R→B2                                50
                                                                      51
                END                                                   52
```

```
        CADD    77770     42 40434 32 5400 00000
        REAL    77771     42 54575 36 7000 00000
        IMAG    77772     75 75757 57 5000 00000
        CLOG    77773     42 53564 62 5400 00000
        CMPY    77774     42 54577 02 5400 00000
        CSQR    77775     42 62606 12 5400 00000
        ENTRY   77776     75 44556 36 1400 00000
                77777     42 40625 54 7400 00000
                    1     01 01000 00 4401 77774     ENTRY
                    2     01 21700 20 0001 77776
                    3     11 21700 00 0001 77776
                    4     01 20741 66 0001 00007     FETCH
                    5     47 21641 66 0001 00023     EXIT
                    6     01 21706 26 0500 00000
                    7     01 21702 26 4002 00000
                   10     01 21702 26 4004 00000
                   11     01 40001 72 4100 77773
                   12     01 01000 00 4401 77761     CMPY
                   13     01 21700 00 0001 00016     *0000A
        FETCH      14     01 10401 00 0401 77754     REAL
                   15     01 21706 26 0401 77753     REAL
                   16     01 21706 26 4100 77775
                   17     01 40000 20 4401 77755     CSQR
                   20     01 40001 66 4100 77771
                   21     01 21706 26 0401 77747     REAL
                   22     01 40002 00 4100 77775
                   23     01 40000 00 4401 77744     CADD
                   24     01 21706 26 0401 77744     REAL
                   25     01 21706 26 4100 77775
                   26     01 40000 20 4401 77744     CLOG
                   27     01 41006 00 4000 77766
                   30     01 21704 41 4500 00002
        EXIT       31     01 01000 52 4000 00000
*********
        *0000A     32     01 00100 00 0000 00000
```

```
316     CADD    0 77770    1    1400000000000000    0
317     REAL    0 77771    1    1500000000000000    0
320     IMAG    0 77772    3    1600000000000000    0
321     CLOG    0 77773    1    1700000000000000    0
322     CMPY    0 77774    1    2000000000000000    0
323     CSQR    0 77775    1    2100000000000000    0
324     ENTRY   0 77776    1    2200000000000000    0
325     FETCH   0    14    1    3700000000000000    0
326     EXIT    0    31    1    5400000000000000    0
327     *0000A  0    32    1    5600000000000000    0
```

CACSH

```
CACSH          ORG

               REM          CACSH(*B6-2)=CLOG(Z+CSQR(Z*2+-1))+CM

CASNH          REF          *CASNH
ENTRY          REF          *+ENTRY
               REF          *CACSH

               TRA          *ENTRY
               CLA          a*CASNH
               ADD          a2,U+CC

               END
```

```
PROGRAM      CACSH                                  3/02/67 14.03

      CASNH  77775     42 40625 54 7400 00000
      ENTRY  77776     75 44556 36 1400 00000
             77777     42 40426 24 7400 00000
                 1     01 01000 00 4401 77774     ENTRY
                 2     01 21700 00 4401 77772     CASNH
                 3     01 10000 40 4000 00002
********

 316       CASNH       0 77775      1            10000000000000      0
 317       ENTRY       0 77776      1            11000000000000      0
```

CATNH

```
                                                                        1
CATNH           ORG                                                     2
                                                                        3
                REM     CATNH(*B6-2)=1/2CLOG((1+Z)/(1-Z))-CMP           4
                                                                        5
REAL            REF     CMPLX                                           6
IMAG            REF     *****                                           7
CLOG            REF     *CLOG                                          10
CDIV            REF     *CDIV                                          11
ERPR            REF     *-ERPR                                         12
ENTRY           REF     *-ENTRY                                        13
                REF     *CATNH                                         14
                                                                       15
                TRA     *ENTRY                                         16
        PF      RWT     EXIT                                           17
                CLA,DBL+2 *B6=2,U-T7                                   20
                STO,DBL B6-3                                           21
        R       IF(NZE)TRA OKAY,B6+1                                   22
        |T7|    IF(NZE)SKP d1.0,R-Z                                    23
                TRA     ERROR,B6-1                                     24
OKAY    B1      LT7+2   d1.0,B6+1                                      25
        B2      STO     B6,B6+1                                        26
        T7      FAD-    B6-6,I-B1                                      27
        T7      FSB-    B6-4,I-B2                                      30
                CLA-    -B6=3                                          31
                TSR     *CDIV                                          32
                SB2     *B6=1,B6-1                                     33
                SB1     *B6=1,B6-1                                     34
                CLA,DBL *REAL,B6-1                                     35
                STO,DBL B6-3,B6-1                                      36
                CLA,DBL+2 aB6=2,B6+1                                   37
                TSR     *CLOG,CC+1                                     40
                LT7     d2.0,B6-1                                      41
        T7      VDF-    *REAL,B6-1                                     42
        T7      VDF-    *IMAG                                          43
EXIT            TRA     Z                                              44
                                                                       45
ERROR   Z       STO,DBL *REAL,B6-1                                     46
        10      TRA     *ERPR,B6-1                                     47
                TRA     *EXIT,B6-1                                     50
                                                                       51
                END                                                    52
```

```
REAL    77771    42 54575 36 7000 00000
IMAG    77772    75 75757 57 5000 00000
CLOG    77773    42 53564 42 5400 00000
CDIV    77774    42 43506 52 5400 00000
ERPR    77775    75 44615 76 1400 00000
ENTRY   77776    75 44556 36 1400 00000
        77777    42 40635 54 7400 00000
              1  01 01000 00 4401 77774     ENTRY
              2  47 21641 00 0001 00024     EXIT
              3  01 21706 07 0500 77775
              4  01 20005 00 4100 77774
              5  02 01050 26 4001 00002     OKAY
              6  27 02050 10 0001 00024     *0000A
              7  01 01000 66 4001 00020     ERROR
OKAY          10 41 50472 26 0001 00022     *0000A
             11  42 20001 26 4100 00000
             12  07 10401 71 0100 77771
             13  07 10501 72 0100 77773
             14  01 21701 00 1100 77774
             15  01 40000 00 4401 77756     CDIV
             16  01 40002 66 4500 77776
             17  01 40001 66 4500 77776
             20  01 21704 66 0401 77750     REAL
             21  01 20005 66 4100 77774
             22  01 21706 26 4100 77775
             23  01 40000 20 4401 77747     CLOG
             24  01 50470 66 0001 00007     *0000B
             25  07 16701 66 0401 77743     REAL
             26  07 16701 00 0401 77743     IMAG
EXIT         27  01 01000 00 4000 00000
ERROR        30  00 20005 66 4401 77740     REAL
             31  10 01000 66 4401 77743     ERPR
             32  01 01000 66 4401 77773     EXIT
*********
*0000A       33  01 00100 00 0000 00000
*0000B       34  01 00200 00 0000 00000
```

```
316  REAL    0 77771  1  1000000000000000  0
317  IMAG    0 77772  1  1100000000000000  0
320  CLOG    0 77773  1  1200000000000000  0
321  CDIV    0 77774  1  1300000000000000  0
322  ERPR    0 77775  1  1400000000000000  0
323  ENTRY   0 77776  1  1500000000000000  0
324  EXIT    0    27  1  4500000000000000  0
325  OKAY    0    10  1  2600000000000000  0
326  *0000A  0    33  1  5200000000000000  0
327  ERROR   0    30  1  4600000000000000  0
330  *0000B  0    34  1  5300000000000000  0
```