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SERVICES TO DEVELOP POCKET COMPUTERS TO PERFORM PF CALCULATING --ETC(U)
JAN 78 S W CRAWLEY DCPA01-76-C-0325

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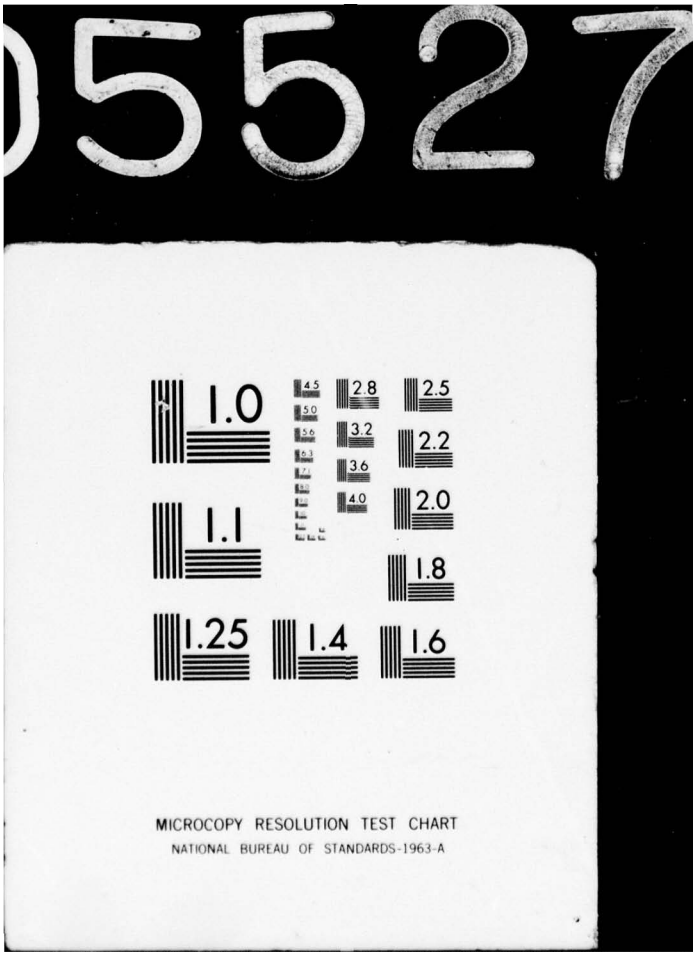
05527
1.0
1.1
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1.4
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3.2
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4.0
4.5
5.0
5.6
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7.1
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

FOR FURTHER TRAN

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SERVICES TO DEVELOP POCKET COMPUTERS
TO PERFORM PF CALCULATING BY DCPA
STANDARD METHOD AND TO PROVIDE
TRAINING FOR USE

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Detailed programs for utilizing the Hewlett-Packard (HP) 67 and 97 and Texas Instruments SR-52 programmable pocket calculators for calculating the shielding capability of buildings by the DCPA "Standard" method.

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FINAL REPORT

SERVICES TO DEVELOP POCKET COMPUTERS TO PERFORM PF CALCULATING BY DCPA STANDARD METHOD AND TO PROVIDE TRAINING FOR USE

Contract Number: DCPA 01-76-6-0325

Contracting Officers
Technical Representative: George Goforth

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Reporting Agency: Graduate School of Architecture
University of Utah
Salt Lake City, Utah 84112

Stanley W. Crawley
Professor of Architecture

Date: January 16, 1978

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A. Equations for All Charts

B. Program Listing for All Charts

C. Program Listing for All Chips

HP Process

TI Process

Jack LeDoux's Process

D. User's Manual

INTRODUCTION

Although the "Standard Method" of calculating the protection factor of a shelter is well understood by qualified FSAs, it is seldom used in practice. Reasons for this are both numerous and controversial, but the fact remains that it is seldom used in practice.

The availability of programmable pocket type calculators in 1974-75 presented a new situation. It seemed, at that time, that the pocket computer might work in calculating the PF by the "Standard Method." Consequently, a feasibility study was undertaken to decide this issue.

The feasibility study was completed in December 1976 and a favorable report written and its recommendations were used as a basis for establishing the objectives of this project. In abbreviated form these objectives are:

1) Develop programs using "Standard Method" and broad enough to be used on either the Hewlett-Packard calculator or the Texas Instrument calculator.

2) Outline steps in the chips that are programmed.

3) Prepare a User's Manual.

4) Provide training to DCPA Regional personnel.

It was decided to prepare the initial programs on the Hewlett-Packard Model 97 (desk top model). These identical programs could also be used on the HP Model 67 (pocket type). These programs had to undergo significant changes before they would work on the Texas Instruments calculator. These changes were made for the TI Model SR52. About 30% more cards are required for the TI model than is necessary for the HP models. It is interesting to note at this writing that TI has produced a new Model 59 that will significantly reduce the necessary number of cards. Perhaps only one or two would be required.

The overall approach was to develop a single methodology that could be applied to either the TI or the HP calculators. The individual operation of the calculator would be different as is required by the uniqueness of the calculators. The "Standard Method's" functional equations were to be used, giving this aspect 100% accuracy. The "Standard Method" requires the use of charts and these charts had to be converted to equations that were workable on the programmed chip. It is in these equations that some accuracy is lost.

CHART EQUATIONS

There are a limited number of steps and locations for data in each card to be programmed for use on the calculators. Consequently, it was necessary to convert into equation form all information that is contained on the charts used in the Standard Method. In a few cases this was easily achieved where there was a theoretical or derived basis for the chart. In many cases it was extremely difficult to convert the chart information into equation form.

It was decided that the accuracy should be to a ± 5% for the full range of the charts. In many cases this was unrealistic for a single equation. Therefore, where necessary, more than one equation was used. A special computer program was prepared to check the accuracy of these equations. This process was explained in detail in the Second Quarterly Report dated January 5, 1977.

Appendix A lists all chart equations used in this project.

CARD PROGRAMS FOR EQUATIONS

It was apparent from the feasibility study that a major consideration in the final developed project would be the number of programmed cards required for any PF calculation. The more cards used, the larger and more cumbersome the process. Therefore efforts were focused upon programming cards that would solve the equations for all the charts. At the time this effort was put forth, only the HP calculators were available. When all the equations were programmed successfully on separate HP cards, it was felt that to repeat this task for the TI cards would be an unnecessary duplication. The programs finalized in this phase of the study could now be used as sub-routines of the master program that solves for the PF.

Appendix B contains listings for all chart equations programmed on HP cards.

METHODOLOGY

The "Standard Method" as described in TR-20 Vol. 1 is very fundamental and presents an understanding of the principles of radiation shielding as well as a process in which the protection factor can be calculated. It is a lengthy and detailed procedure which is seldom used in practice other than in conjunction with the SAND program. However, the so-called "freight train" function equations do lend themselves to an analytical process that

can easily be accomplished on a computer. All that is necessary is a basic breakdown into parts that can be added together by the operator of the calculator.

The basic approach is to reference a complete set of calculations and procedures to a single location of the detector. If there is need for the PF to be referenced to any other location, the process or a similar process must be repeated. The initial breakdown is in two parts: overhead contribution and ground contribution.

The overhead contribution process must be prepared so as to permit calculations for any general configuration as well as for any variety of mass thicknesses. This general case for overhead contribution is accomplished by use of two chips for the HP calculators. They are labled O-1a and O-2. The TI calculator requires the use of three chips to accomplish the same thing, using basically the same methodology. These chips are labeled O-1a1, O-1a2 and O-2.

Ground contribution calculations require the use of separate chips. The six HP chips are labeled GM-1, 2, 3, 4, 5 and 6 and will calculate the ground contribution for any configuration and any assembly of wall and floor material. In some cases not all six chips need to be used. The counterpart of these for the TI calculator is eight in number and labeled GM-1, 2, 3, 4, 5, 6, 7 and BR. Their use is similar to the HP chips in that not all are needed all the time.

The use of the above chips is still a lengthy process, even with the calculator making all the calculations. Therefore other "sets" of chips were prepared for special conditions that are frequently met. These special sets are called "express" chips and are fewer in number, thereby speeding up the process considerably.

The methodology and detailed use of these chips are thoroughly explained in the USER'S MANUAL, which is included in Appendix D of this report. Detailed examples are included in this manual for explanation of the process as well as in checking the validity of the chips. Whereas the basic methodology remains the same for both the HP and TI calculators, the detailed use of each calculator must be unique for each. This calls for different step-by-step explanation for each calculator and is described in this manner in the manual.

PROGRAMS FOR THE METHODOLOGY

The development of the programs to be placed in the chips was the major task of the project. The reasons for the finalized version of the programs are manyfold. A major objective was to require as few chips as possible. Not only was the total number of chips kept to a minimum but the sequential use of the chips was organized in such a way that with certain, frequently encountered conditions, some of the chips would be by-passed.

With but two conditions, all input data is placed when the first card program is in operation for either overhead or ground contribution. The two exceptions are for special barriers for ground or overhead contribution, and that data is input while the last card is in operation. When other cards are necessary to complete the calculations they are called for by the display and simply fed into the calculator and put into operation by pressing a continue key.

Some data that is input goes directly to a storage location while other data entries start a calculation sequence, the results of which are put into a storage location. In some chips the first input sets up an internal counter in order to display the sequence of additional input data. These are only some of the reasons and considerations that played a part in developing the programs. The programs for use on HP chips were prepared first. These were used as a basis for preparing the TI chips. Changes were required in the programs because the make-up and operation of the calculators are different. These changes were kept to a minimum.

Appendix C contains the listings for all the programmed cards. In the case of the HP chips the listing was made from the printer on the HP 97 model. To make these listings more readable they have been annotated. Since the TI did not have the same capabilities, the listing for its programs are simply shown on the SR 52 coding form.

Jack LeDoux was engaged as a consultant to this project. He proceeded to prepare a new program for calculating the contribution to a detector on a wall-to-wall basis. This program was considered as a back-up for the main program in case serious obstacles were encountered. His approach was unique in that he used a chip to load numerical data into the registers before the programs for calculating PF were loaded. This is a good program but is dependent upon the user being a master of the Standard Method. It would require considerably more work before it would become a recommended program.

TRAINING OF DCPA PERSONNEL

This last phase of the project was scheduled and coordinated with DCPA and regional personnel by George Goforth, the COTR. There were four one-day training sessions. Each one-day session was attended by personnel from two regions. Each region was given a set of HP cards, a set of TI cards and a USER'S MANUAL.

The schedule and personnel attending is given as follows:

October 14, 1977 at Battle Creek, Michigan

Region 1	Morris Budnick
	Robert J. Cerasulo
Region 4	Louis H. Richie
	Bruce R. Newhard
	Franklin Egland
	James A. Colyer
	Ralph A. Myers
	Donald L. Harris

October 27, 1977 at Denver, Colorado

Region 6	Chuck Powell
	Jean LePage
	Jim McClanahan
	Monte Mingus
	Don Belew
	David Prothero
	Lyle E. Hebb
	Willard D. Froseth
Region 5	Ronald W. Morrison
	Charles V. Dansby
	Andrew J. Sidor
	Ray E. Burk

November 15, 1977 at Olny, Maryland

Region 2	R. E. Held
	Michel S. Pawlowski
	C. E. Faltot
	K. E. Edwards
	Jonathan P. Deason
	Joe Tonkin
Region 3	Roy Wilham
	Mike DeLorenzo
	Mel Schnieder
	John Griffen
Region 1	W. A. Haynes
Visitors	Tom Carroll
	Nick DiTullo
	John A. Hain
	Chuck House

November 22, 1977 at Bothell, Washington

Region 8	Barry Roenfeldt
	Bob Schleter
	Ron Runiverstrom
	Joe Dulet
	C. B. Corativo
	Herb McElvaine
	John Lindberg
Region 7	Tom Murdock
	Ed Kaufman

The reactions from the people attending these training sessions was mixed but generally favorable. Some who attended were not at all familiar with the calculator they brought to the training session. Consequently most of their effort was spent on working the calculator and not on understanding the new method. Their opinions were not of much value.

Many who attended had forgotten a great deal of the principles of the "Standard Method." This was understandable since most had taken the FSA Course many years ago and have never used it since they became FSA qualified. These people were used to working with the SAND or the EASY method.

Everyone seemed pleased with the accuracy of the new method. Everyone liked the idea of not having to look up values on charts. Nearly everyone appeared relieved at the almost eliminated mathematical error. The new method was readily understandable and no one seriously challenged the new methodology.

There was a general consensus that too many chips had to be loaded and this took too much time. Objectionable as this was, most indicated that they would use the new method.

CONCLUSIONS AND RECOMMENDATIONS

FSA by pocket computers is now a reality. The method is easy to understand and easy to use and it produces an accurate PF value. The program cards and USER'S MANUAL should be made available for anyone involved in shelter calculations.

The method should be taught near the end of the regular FSA Course and it should be included in the correspondence course.

Every effort should be made to keep current with the development of late model calculators. Many of the newer calculators have much larger memories and more program capabilities. It is probable that in the near future only one or two chips would have to be used, even for the most complex building. The methodology and programs used in this, now finished, project should be easily adapted to these newer models.

APPENDIX A

to

FINAL REPORT

EQUATIONS FOR ALL CHARTS

SERVICES TO DEVELOP POCKET CALCULATORS TO PERFORM PF CALCULATIONS
BY DCPA STANDARD METHOD AND TO PROVIDE TRAINING FOR USE

Contract Number DCPA01-76-C-0325

EQUATION USED FOR CHARTS FROM THE "STANDARD METHOD"

CHART 1A; SOLID ANGLE FRACTION (Derived)

$$\omega = \frac{2}{\pi} \operatorname{Tan}^{-1} \left[\frac{e}{2a\sqrt{4a^2+e^2+1}} \right]$$

where $e = \frac{W}{L}$

$$a = \frac{Z}{L}$$

CHART 1B; LIMITED FIELD SOLID ANGLE FRACTION (Derived)

$$2\omega_s = \operatorname{Tan}^{-1} \left[\frac{W_c}{H} \right]$$

CHART 2: GEOMETRY FACTORS, SCATTER AND SKY SHINE (Gregory)

When $\omega \leq 0.7$

$$G_a = 0.102\ (1-\omega)^{.465}$$

When $0.7 < \omega < 0.85$

$$G_a = 0.148\ (1-\omega)^{.779}$$

When $0.85 \leq \omega$

$$G_a = 0.222\ (1-\omega)^{.988}$$

In all cases

$$G_s = 5\ G_a$$

CHART 3A & 3B; GEOMETRY FACTOR, Direct (Gregory)

Compute $G_d = 0.923392H^{-.019273} + 0.158403H^{.230341} \text{ Log}(1-\omega)$

if $G_d \leq 0.25$

Compute $G_d = 0.014035H^{.322605} - 8.630295H^{(-.472326)} \text{Log } \omega$

if $G_d < .04$ and $H \geq 20$

Compute $G_d = -0.093885H^{-.459686} - 12.771735H^{-.694395} \text{Log } \omega$

CHART 4: SHAPE FACTOR (Derived)

$$E = \frac{1 + e}{\sqrt{1 + e^2}} \quad \text{Where} \quad e = \frac{W}{L}$$

CHART 5; SCATTER FRACTION, (Gregory)

When $X < 13$

$$S_w = \frac{X}{X + 37}$$

When $13 \leq X \leq 35$

$$S_w = \frac{X}{X = 34}$$

When $X > 35$

$$S_w = \frac{X}{X + 30}$$

CHART 6; EXTERIOR WALL BARRIER FACTOR (LeDoux)

$$Be = \left[0.3e^{-.0408X} + 0.7e^{-.0209X}\right] \left[(0.28-0.00054X)e^{-.00228H} + 0.3e^{-.009H} = (0.232+0.00066X)e^{-.03H} + 4e^{-.2H}\right]$$

Where e = 2.718282

CHART 7; INTERIOR PARTITION ATTENUATION FACTORS (Gregory)

When $X \leq 20$

$$B_i' = 0.9885e^{-.037X}$$

When $20 < X \leq 90$

$$B_i' = 0.8001e^{-.02723X}$$

When $X > 90$

$$B_i' = 0.53852e^{-.02303X}$$

When $X \leq 110$

$$B_i = 1.00316e^{-.0239X}$$

When $X > 110$

$$B_i = 0.7405e^{-.02108X}$$

Where e = 2.718282

CHART 8A; CEILING ATTENUATION FACTOR (Derived)

$$B_c = (1-3.5e^{-.23\omega})\ (e^{-.1X}) + (3.5e^{-2.3\omega})\ (e^{-.04X})$$

Where e = 2.718282

CHART 8B; FLOOR ATTENUATION FACTOR (Gregory)

When $2.5 \leq X \leq 10$

$$B_f = 0.8287X^{-.3999}$$

When $X < 2.5$

$$B_f = e^{-.2248X}$$

When $X > 10$

$$B_f = (10^{-.00938X})\ X^{-.38}$$

Where e = 2.718282

CHART 9; OVERHEAD CONTRIBUTION (LeDoux)

$$C_o = 0.322e^{-.02239\ (X_o + \Delta X_o)}\ \omega^{1.03-.00046X_o}$$

When $\omega < .1$

$$\Delta X_o = 0$$

When $\omega \geq .1$

$$\Delta X_o = (1.3-1.6e^{-.01674X_o})\ (30.3\omega^{1.1}-.234\omega^{-.7345})$$

if $X_o = 0$

and if C_o as calculated above is

$$0.0011 < C_o < 0.17$$

then use

$$C_o = (C_o)\ (0.9)$$

in all cases e = 2.718282

CHART 10A; LIMITED FIELD BARRIER FACTOR

When $X = 0$

$$B_s = 0.2323(2\omega_s)^{1.05}$$

When $X > 0$

$$B_s = (0.279e^{-.0223X})(2\omega_s)^{.9764X^{.2157}}$$

If B_s as calculated above < 0.002

and $20 \leq X \leq 75$ Than use

$$B_s = 1.2B_s$$

CHART 10B; LIMITED FIELD HEIGHT FACTOR

$$F_s = (0.22+\frac{H-3}{H+120})^{5-10(\frac{2\omega_s}{2})}$$

If $2\omega_s = 1$, Use as calculated above

If $H = 3$ and $2\omega_s > 0.84$

Use $F_s = 0.9F_s$

If $H \geq 40$ and $0.84 \leq 2 \leq 0.96$

Use $F_s = 1.1F_s$

in all other cases

Use $F_s = 1.05F_s$

CHART 11; PASSAGEWAYS AND SHAFTS (Gregory)

Passageways

$$C = 5\omega^{.608}$$

Shafts

When $\omega > 0.9$

$$C = 0.86906\omega^{5.98015}$$

When $0.75 \leq \omega \leq 0.9$

$$C = 0.6233\omega^{2.70493}$$

When $0.345 < \omega < 0.75$

$$C = 0.41357\omega^{1.35544}$$

When $\omega \leq 0.345$

$$C = 2.872\omega^{1.0177}$$

APPENDIX B

to

FINAL REPORT

CARD PROGRAMS FOR EQUATIONS

(HP cards only)

SERVICES TO DEVELOP POCKET CALCULATORS TO PERFORM PF CALCULATIONS
BY DCPA STANDARD METHOD AND TO PROVIDE TRAINING FOR USE

Contract Number DCPA01-76-C-0325

CHART 1A SOLID ANGLE FRACTION

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11					
002	STO 1	35 01					
003	RTN	24					
004	*LBL B	21 12					
005	STO 2	35 02					
006	RTN	24					
007	*LBL C	21 13					
008	STO 3	35 03					
009	RTN	24					
010	*LBL D	21 14					
011	RCL 1	36 01					
012	RCL 2	36 02					
013	÷	-24					
014	STO 4	35 04					
015	RCL 3	36 03					
016	RCL 2	36 02					
017	÷	-24					
018	STO 5	35 05					
019	RCL 4	36 04					
020	RCL 5	36 05					
021	X^2	53					
022	4	04					
023	×	-35					
024	RCL 4	36 04					
025	X^2	53					
026	+	-55					
027	1	01					
028	+	-55					
029	$\sqrt{X}$	54					
030	2	02					
031	×	-35					
032	RCL 5	36 05					
033	×	-35					
034	÷	-24					
035	RAD	16-22					
036	TAN^{-1}	16 43					
037	2	02					
038	×	-35					
039	π	16-24					
040	÷	-24					
041	RTN	24					
042	R/S	51					

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CHART 1B LIMITED FIELD SOLID ANGLE FRACTION

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11					
002	STO 1	35 01					
003	RTN	24					
004	*LBL B	21 12					
005	STO 2	35 02					
006	RTN	24					
007	*LBL C	21 13					
008	RCL 1	36 01					
009	RCL 2	36 02					
010	÷	-24					
011	RAD	16-22					
012	TAN⁻	16 43					
013	2	02					
014	×	-35					
015	Pi	16-24					
016	÷	-24					
017	RTN	24					
018	R/S	51					

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☐	DEG ☐	FIX ☐
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n____

CHART 2 GEOMETRY FACTORS, SCATTER & SKYSHINE

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	
002	STO1	35 01	
003	RTN	24	
004	*LBLB	21 12	
005	.	-62	
006	7	07	
007	RCL1	36 01	
008	X≤Y?	16-35	
009	GTO1	22 01	
010	.	-62	
011	8	08	
012	5	05	
013	X>Y?	16-34	
014	GTO2	22 02	
015	.	-62	
016	2	02	
017	2	02	
018	2	02	
019	ENT↑	-21	
020	.	-62	
021	9	09	
022	8	08	
023	6	08	
024	*LBL3	21 03	
025	STO2	35 02	
026	R↓	-31	
027	1	01	
028	RCL1	36 01	
029	-	-45	
030	RCL2	36 02	
031	Y^x	31	
032	x	-35	
033	RTN	24	
034	*LBL1	21 01	
035	.	-62	
036	1	01	
037	0	00	
038	2	02	
039	ENT↑	-21	
040	.	-62	
041	4	04	
042	6	06	
043	5	05	
044	GTO3	22 03	
045	*LBL2	21 02	
046	.	-62	
047	1	01	
048	4	04	
049	8	08	
050	ENT↑	-21	
051	.	-62	
052	7	07	
053	7	07	
054	9	09	
055	GTO3	22 03	
056	*LBLC	21 13	
057	GSB8	23 12	
058	5	05	
059	x	-35	
060	RTN	24	
061	E	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS
070			
080			
090			
100			
110			

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CHART 3A & 3B GEOMETRY FACTOR, DIRECT

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	
002	STO1	35 01	
003	RTN	24	
004	*LBLE	21 12	
005	STO2	35 02	
006	RTN	24	
007	*LBLC	21 13	
008	1	01	
009	RCL1	36 01	
010	-	-45	
011	X=0?	16-43	
012	RTN	24	
013	RCL2	36 02	
014	.	-62	
015	0	00	
016	1	01	
017	9	09	
018	3	03	
019	CHS	-22	
020	Y^x	31	
021	.	-62	
022	9	09	
023	2	02	
024	3	03	
025	4	04	
026	x	-35	
027	RCL2	36 02	
028	.	-62	
029	2	02	
030	3	03	
031	0	00	
032	3	03	
033	Y^x	31	
034	.	-62	
035	1	01	
036	5	05	
037	8	08	
038	4	04	
039	x	-35	
040	1	01	
041	RCL1	36 01	
042	-	-45	
043	LN	32	
044	x	-35	
045	+	-55	
046	RCL2	36 02	
047	3	03	
048	X≠Y?	16-32	
049	GTO2	22 02	
050	R↓	-31	
051	R↓	-31	
052	X<0?	16-45	
053	0	00	
054	RTN	24	
055	*LBL2	21 02	
056	R↓	-31	
057	R↓	-31	
058	.	-62	
059	2	02	
060	5	05	
061	X≠Y	-41	
062	X>Y?	16-34	
063	RTN	24	
064	RCL2	36 02	
065	.	-62	
066	3	03	
067	2	02	
068	2	02	
069	6	06	
070	Y^x	31	
071	.	-62	
072	0	00	
073	1	01	
074	4	04	
075	0	00	
076	4	04	
077	CHS	-22	
078	x	-35	
079	RCL2	36 02	
080	.	-62	
081	4	04	
082	7	07	
083	2	02	
084	3	03	
085	CHS	-22	
086	Y^x	31	
087	8	08	
088	.	-62	
089	6	06	
090	3	03	
091	CHS	-22	
092	x	-35	
093	RCL1	36 01	
094	LN	32	
095	x	-35	
096	+	-55	
097	.	-62	
098	0	00	
099	4	04	
100	X≠Y	-41	
101	X>Y?	16-34	
102	RTN	24	
103	RCL2	36 02	
104	2	02	
105	0	00	
106	X≤Y?	16-35	
107	GTO1	22 01	
108	R↓	-31	
109	R↓	-31	
110	RTN	24	
111	*LBL1	21 01	
112	RCL2	36 02	

LABELS

A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

FLAGS

SET STATUS

FLAGS	ON	OFF
0	☐	☐
1	☐	☐
2	☐	☐
3	☐	☐

TRIG	
DEG	☐
GRAD	☐
RAD	☐

DISP	
FIX	☐
SCI	☐
ENG	☐
n	____

CHART 3A & 3B (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	.	-62					
114	4	04					
115	5	05					
116	9	09					
117	7	07					
118	CHS	-22					
119	Y^x	31					
120	.	-62					
121	0	00					
122	9	09					
123	3	03					
124	6	06					
125	9	09					
126	CHS	-22					
127	x	-35					
128	RCL2	36 02					
129	.	-62					
130	6	06					
131	9	09					
132	4	04					
133	4	04					
134	CHS	-22					
135	Y^x	31					
136	1	01					
137	2	02					
138	.	-62					
139	7	07					
140	7	07					
141	CHS	-22					
142	x	-35					
143	RCL1	36 01					
144	LN	32					
145	x	-35					
146	+	-55					
147	.	-62					
148	0	00					
149	0	00					
150	6	06					
151	X>Y?	16-34					
152	GTO3	22 03					
153	R↓	-31					
154	RTN	24					
155	*LBL3	21 03					
156	1	01					
157	RCL1	36 01					
158	-	-45					
159	.	-62					
160	3	03					
161	x	-35					
162	RTN	24					
163	R/S	51					

LABELS					FLAGS
	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS				
FLAGS		TRIG	DISP	
	ON OFF			
0	☐ ☐	DEG ☐	FIX ☐	
1	☐ ☐	GRAD ☐	SCI ☐	
2	☐ ☐	RAD ☐	ENG ☐	
3	☐ ☐		n___	

CHART 4 SHAPE FACTOR

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	
002	STO1	35 01	
003	RTN	24	
004	*LBLB	21 12	
005	STO2	35 02	
006	RTN	24	
007	*LBLC	21 13	
008	RCL1	36 01	
009	RCL2	36 02	
010	÷	-24	
011	ENT↑	-21	
012	ENT↑	-21	
013	1	01	
014	+	-55	
015	X<>Y	-41	
016	X^2	53	
017	1	01	
018	+	-55	
019	√X	54	
020	÷	-24	
021	RTN	24	
022	R/S	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

CHART 5 SCATTER FRACTION

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11					
002	STO1	35 01					
003	RTN	24					
004	*LBLB	21 12					
005	3	03					
006	0	00					
007	STO2	35 02					
008	3	03					
009	5	05					
010	RCL1	36 01					
011	X>Y?	16-34					
012	GTO1	22 01					
013	4	04					
014	ST+2	35-55 02					
015	RCL1	36 01					
016	1	01					
017	3	03					
018	X≠Y?	16-35					
019	GTO1	22 01					
020	3	03					
021	ST+2	35-55 02					
022	*LBL1	21 01					
023	RCL1	36 01					
024	RCL1	36 01					
025	RCL2	36 02					
026	+	-55					
027	=	-24					
028	RTN	24					
029	R/S	51					

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☐	DEG ☐	FIX ☐
1	☐	☐	GRAD ☐	SCI ☐
2	☐	☐	RAD ☐	ENG ☐
3	☐	☐		n____

CHART 6. EXTERIOR WALL BARRIER FACTOR

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	STO 1	35 01	
003	RTN	24	
004	*LBL B	21 12	
005	STO 2	35 02	
006	RTN	24	
007	*LBL C	21 13	
008	.	-62	
009	2	02	
010	CHS	-22	
011	RCL 2	36 02	
012	x	-35	
013	e^x	33	
014	.	-62	
015	4	04	
016	x	-35	
017	.	-62	
018	0	00	
019	3	03	
020	CHS	-22	
021	RCL 2	36 02	
022	x	-35	
023	e^x	33	
024	.	-62	
025	0	00	
026	0	00	
027	8	08	
028	6	06	
029	6	06	
030	RCL 1	36 01	
031	x	-35	
032	.	-62	
033	2	02	
034	3	03	
035	2	02	
036	+	-55	
037	x	-35	
038	+	-55	
039	.	-62	
040	0	00	
041	0	00	
042	9	09	
043	CHS	-22	
044	RCL 2	36 02	
045	x	-35	
046	e^x	33	
047	.	-62	
048	3	03	
049	x	-35	
050	+	-55	
051	.	-62	
052	0	00	
053	0	00	
054	2	02	
055	2	02	
056	8	08	
057	CHS	-22	
058	RCL 2	36 02	
059	x	-35	
060	e^x	33	
061	.	-62	
062	0	00	
063	0	00	
064	0	00	
065	5	05	
066	4	04	
067	CHS	-22	
068	RCL 1	36 01	
069	x	-35	
070	.	-62	
071	2	02	
072	8	08	
073	+	-55	
074	x	-35	
075	+	-55	
076	.	-62	
077	0	00	
078	2	02	
079	8	08	
080	9	09	
081	CHS	-22	
082	RCL 1	36 01	
083	x	-35	
084	e^x	33	
085	.	-62	
086	7	07	
087	x	-35	
088	.	-62	
089	0	00	
090	4	04	
091	0	00	
092	8	08	
093	CHS	-22	
094	RCL 1	36 01	
095	x	-35	
096	e^x	33	
097	.	-62	
098	3	03	
099	x	-35	
100	+	-55	
101	x	-35	
102	1	01	
103	X≠Y	-41	
104	X>Y?	16-34	
105	1	01	
106	RTN	24	
107	R/S	51	
110			

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CHART 7 INTERIOR PARTITION ATTENUATION FACTOR

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	STO 1	35 01	
003	RTN	24	
004	*LBL B	21 12	
005	1	01	
006	1	01	
007	0	00	
008	RCL 1	36 01	
009	X>Y?	16-34	
010	GTO 1	22 01	
011	.	-62	
012	6	06	
013	2	02	
014	3	03	
015	9	09	
016	CHS	-22	
017	x	-35	
018	e^x	33	
019	1	01	
020	.	-62	
021	0	00	
022	0	00	
023	3	03	
024	1	01	
025	6	06	
026	x	-35	
027	1	01	
028	X≷Y	-41	
029	X>Y?	16-34	
030	1	01	
031	RTN	24	
032	*LBL 1	21 01	
033	.	-62	
034	0	00	
035	2	02	
036	1	01	
037	0	00	
038	6	06	
039	CHS	-22	
040	RCL 1	36 01	
041	x	-35	
042	e^x	33	
043	.	-62	
044	7	07	
045	4	04	
046	0	00	
047	5	05	
048	x	-35	
049	RTN	24	
050	*LBL C	21 13	
051	2	02	
052	0	00	
053	RCL 1	36 01	
054	X>Y?	16-34	
055	GTO 2	22 02	
056	.	-62	
057	0	00	
058	3	03	
059	7	07	
060	CHS	-22	
061	x	-35	
062	e^x	33	
063	.	-62	
064	9	09	
065	8	08	
066	8	08	
067	5	05	
068	x	-35	
069	RTN	24	
070	*LBL 2	21 02	
071	9	09	
072	8	00	
073	RCL 1	36 01	
074	X>Y?	16-34	
075	GTO 3	22 03	
076	-	-62	
077	8	00	
078	2	02	
079	7	07	
080	2	02	
081	3	03	
082	CHS	-22	
083	x	-35	
084	e^x	33	
085	.	-62	
086	5	05	
087	0	00	
088	0	00	
089	1	01	
090	x	-35	
091	RTN	24	
092	*LBL 3	21 03	
093	RCL 1	36 01	
094	-	-62	
095	8	00	
096	2	02	
097	3	03	
098	0	00	
099	3	03	
100	CHS	-22	
101	x	-35	
102	e^x	33	
103	.	-62	
104	5	05	
105	3	03	
106	8	08	
107	5	05	
108	2	02	
109	x	-35	
110	RTN	24	
111	R/S	51	

LABELS					FLAGS	SET STATUS		
A	B	C	D	E	0	FLAGS	TRIG	DISP
a	b	c	d	e	1	ON OFF 0 ☐ ☐ 1 ☐ ☐	DEG ☐	FIX ☐
0	1	2	3	4	2	2 ☐ ☐ 3 ☐ ☐	GRAD ☐ RAD ☐	SCI ☐ ENG ☐
5	6	7	8	9	3			n_____

CHART 8A & 8B CEILING & FLOOR ATTENUATION FACTORS

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	STO 5	35 05	
003	RTN	24	
004	*LBL B	21 12	
005	STO 1	35 01	
006	RTN	24	
007	*LBL C	21 13	
008	1	01	
009	ENT↑	-21	
010	3	03	
011	.	-62	
012	5	05	
013	ENT↑	-21	
014	2	02	
015	.	-62	
016	3	03	
017	RCL 1	36 01	
018	x	-35	
019	CHS	-22	
020	e^x	33	
021	x	-35	
022	-	-45	
023	.	-62	
024	1	01	
025	CHS	-22	
026	RCL 5	36 05	
027	x	-35	
028	e^x	33	
029	x	-35	
030	3	03	
031	.	-62	
032	5	05	
033	ENT↑	-21	
034	2	02	
035	.	-62	
036	3	03	
037	RCL 1	36 01	
038	x	-35	
039	CHS	-22	
040	e^x	33	
041	x	-35	
042	.	-62	
043	0	00	
044	4	04	
045	CHS	-22	
046	RCL 5	36 05	
047	x	-35	
048	e^x	33	
049	x	-35	
050	+	-55	
051	1	01	
052	X≠Y	-41	
053	X>Y?	16-34	
054	1	01	
055	RTN	24	
056	*LBL D	21 14	
057	STO 2	35 02	
058	RTN	24	
059	*LBL E	21 15	
060	RCL 2	36 02	
061	2	02	
062	.	-62	
063	5	05	
064	X≤Y?	16-35	
065	GTO 3	22 03	
066	R↓	-31	
067	.	-62	
068	2	02	
069	2	02	
070	4	04	
071	8	08	
072	CHS	-22	
073	x	-35	
074	e^x	33	
075	RTN	24	
076	*LBL 3	21 03	
077	R↓	-31	
078	1	01	
079	0	00	
080	X≠Y	-41	
081	X≤Y?	16-35	
082	GTO 4	22 04	
083	ENT↑	-21	
084	ENT↑	-21	
085	.	-62	
086	3	03	
087	8	08	
088	CHS	-22	
089	Y^x	31	
090	X≠Y	-41	
091	.	-62	
092	0	00	
093	0	00	
094	9	09	
095	3	03	
096	8	08	
097	CHS	-22	
098	x	-35	
099	10^x	16 33	
100	x	-35	
101	RTN	24	
102	*LBL 4	21 04	
103	.	-62	
104	3	03	
105	9	09	
106	9	09	
107	9	09	
108	CHS	-22	
109	Y^x	31	
110	.	-62	
111	8	08	
112	2	02	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

CHART 8A & 8B (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	6	06					
114	7	07					
115	x	-35					
116	RTN	24					
117	R/S	51					

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CHART 9 OVERHEAD CONTRIBUTION

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	
002	STO1	35 01	
003	RTN	24	
004	*LBLB	21 12	
005	STO2	35 02	
006	RTN	24	
007	*LBLC	21 13	
008	RCL2	36 02	
009	.	-62	
010	1	01	
011	X≠Y?	16-35	
012	GTO1	22 01	
013	0	00	
014	GTO2	22 02	
015	*LBL1	21 01	
016	1	01	
017	.	-62	
018	3	03	
019	ENT↑	-21	
020	.	-62	
021	0	00	
022	1	01	
023	6	06	
024	7	07	
025	4	04	
026	CHS	-22	
027	RCL1	36 01	
028	x	-35	
029	e^x	33	
030	1	01	
031	.	-62	
032	6	06	
033	x	-35	
034	-	-45	
035	RCL2	36 02	
036	1	01	
037	.	-62	
038	1	01	
039	Y^x	31	
040	3	03	
041	0	00	
042	.	-62	
043	3	03	
044	x	-35	
045	RCL2	36 02	
046	.	-62	
047	7	07	
048	3	03	
049	4	04	
050	5	05	
051	CHS	-22	
052	Y^x	31	
053	.	-62	
054	2	02	
055	3	03	
056	4	04	
057	x	-35	
058	-	-45	
059	x	-35	
060	*LBL2	21 02	
061	RCL1	36 01	
062	+	-55	
063	.	-62	
064	0	00	
065	2	02	
066	2	02	
067	3	03	
068	9	09	
069	CHS	-22	
070	x	-35	
071	e^x	33	
072	.	-62	
073	3	03	
074	2	02	
075	2	02	
076	x	-35	
077	RCL2	36 02	
078	RCL1	36 01	
079	.	-62	
080	0	00	
081	0	00	
082	0	00	
083	4	04	
084	6	06	
085	CHS	-22	
086	x	-35	
087	1	01	
088	.	-62	
089	0	00	
090	3	03	
091	+	-55	
092	Y^x	31	
093	x	-35	
094	RCL1	36 01	
095	X≠0?	16-42	
096	GTO3	22 03	
097	X≷Y	-41	
098	.	-62	
099	1	01	
100	7	07	
101	X≠Y?	16-35	
102	GTO3	22 03	
103	X≷Y	-41	
104	.	-62	
105	0	00	
106	0	00	
107	1	01	
108	1	01	
109	X>Y?	16-34	
110	GTO3	22 03	
111	X≷Y	-41	
112	.	-62	

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☐	DEG ☐	FIX ☐
1	☐	☐	GRAD ☐	SCI ☐
2	☐	☐	RAD ☐	ENG ☐
3	☐	☐		n____

CHART 9 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	9	09					
114	×	-35					
115	RTN	24					
116	*LBL 3	21 03					
117	R↓	-31					
118	RTN	24					
119	R/S	51					

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CHART 10A LIMITED FIELD BARRIER FACTOR

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	STO 1	35 01	
003	RTN	24	
004	*LBL B	21 12	
005	STO 2	35 02	
006	RTN	24	
007	*LBL C	21 13	
008	RCL 2	36 02	
009	RCL 1	36 01	
010	X=0?	16-43	
011	GTO 1	22 01	
012	.	-62	
013	2	02	
014	1	01	
015	5	05	
016	7	07	
017	Y^x	31	
018	.	-62	
019	9	09	
020	7	07	
021	6	06	
022	4	04	
023	x	-35	
024	Y^x	31	
025	.	-62	
026	2	02	
027	7	07	
028	9	09	
029	x	-35	
030	RCL 1	36 01	
031	.	-62	
032	0	00	
033	2	02	
034	2	02	
035	3	03	
036	4	04	
037	2	02	
038	CHS	-22	
039	x	-35	
040	e^x	33	
041	x	-35	
042	GTO 2	22 02	
043	*LBL 1	21 01	
044	RCL 2	36 02	
045	1	01	
046	.	-62	
047	0	00	
048	5	05	
049	Y^x	31	
050	.	-62	
051	2	02	
052	3	03	
053	2	02	
054	3	03	
055	x	-35	
056	*LBL 2	21 02	
057	STO 3	35 03	
058	.	-62	
059	0	00	
060	0	00	
061	2	02	
062	X≠Y?	16-34	
063	GTO 3	22 03	
064	*LBL 4	21 04	
065	RCL 3	36 03	
066	RTN	24	
067	*LBL 3	21 03	
068	7	07	
069	5	05	
070	RCL 1	36 01	
071	X≤Y?	16-35	
072	GTO 5	22 05	
073	GTO 4	22 04	
074	*LBL 5	21 05	
075	2	02	
076	0	00	
077	X≤Y?	16-35	
078	GTO 6	22 06	
079	GTO 4	22 04	
080	*LBL 6	21 06	
081	RCL 3	36 03	
082	1	01	
083	.	-62	
084	2	02	
085	x	-35	
086	RTN	24	
087	RTN	24	
088	R/S	51	

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☐	DEG ☐	FIX ☐
1	☐	☐	GRAD ☐	SCI ☐
2	☐	☐	RAD ☐	ENG ☐
3	☐	☐		n____

CHART 10B LIMITED FIELD HEIGHT FACTOR

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	STO 2	35 02	
003	RTN	24	
004	*LBL B	21 12	
005	STO 1	35 01	
006	RTN	24	
007	*LBL C	21 13	
008	RCL 2	36 02	
009	3	03	
010	-	-45	
011	RCL 2	36 02	
012	1	01	
013	2	02	
014	0	00	
015	+	-55	
016	÷	-24	
017	.	-62	
018	2	02	
019	2	02	
020	→	-55	
021	1	01	
022	RCL 1	36 01	
023	-	-45	
024	5	05	
025	x	-35	
026	Y^x	31	
027	STO 3	35 03	
028	1	01	
029	RCL 1	36 01	
030	X=Y?	16-33	
031	GTO 1	22 01	
032	.	-62	
033	8	08	
034	4	04	
035	x≷y	-41	
036	X≤Y?	16-35	
037	GTO 3	22 03	
038	3	03	
039	RCL 2	36 02	
040	X≠Y?	16-32	
041	GTO 3	22 03	
042	.	-62	
043	9	09	
044	ST×3	35-35 03	
045	GTO 1	22 01	
046	*LBL 3	21 03	
047	RCL 2	36 02	
048	2	02	
049	0	00	
050	X>Y?	16-34	
051	GTO 1	22 01	
052	RCL 2	36 02	
053	4	04	
054	0	00	
055	X>Y?	16-34	
056	GTO 2	22 02	
057	.	-62	
058	9	09	
059	6	06	
060	RCL 1	36 01	
061	X>Y?	16-34	
062	GTO 2	22 02	
063	.	-62	
064	8	08	
065	4	04	
066	X>Y?	16-34	
067	GTO 2	22 02	
068	1	01	
069	.	-62	
070	1	01	
071	ST×3	35-35 03	
072	GTO 1	22 01	
073	*LBL 2	21 02	
074	1	01	
075	.	-62	
076	0	00	
077	5	05	
078	ST×3	35-35 03	
079	*LBL 1	21 01	
080	RCL 3	36 03	
081	RTN	24	
082	R/S	51	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CHART 11 PASSAGEWAYS & SHAFTS

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL6	21 11	
002	STO1	35 01	
003	RTN	24	
004	*LBLB	21 12	
005	RCL1	36 01	
006	.	-62	
007	6	06	
008	8	08	
009	8	08	
010	Y^x	31	
011	.	-62	
012	5	05	
013	x	-35	
014	RTN	24	
015	*LBLC	21 13	
016	.	-62	
017	3	03	
018	4	04	
019	5	05	
020	RCL1	36 01	
021	X≠Y?	16-35	
022	GTO1	22 01	
023	.	-62	
024	7	07	
025	5	05	
026	X>Y?	16-34	
027	GTO2	22 02	
028	R↓	-31	
029	.	-62	
030	9	09	
031	X≠Y	-41	
032	X≠Y?	16-35	
033	GTO3	22 03	
034	5	05	
035	.	-62	
036	9	09	
037	8	08	
038	0	00	
039	1	01	
040	5	05	
041	Y^x	31	
042	.	-62	
043	8	08	
044	6	06	
045	9	09	
046	0	00	
047	6	06	
048	x	-35	
049	RTN	24	
050	*LBL3	21 03	
051	2	02	
052	.	-62	
053	7	07	
054	0	00	
055	4	04	
056	9	09	
057	3	03	
058	Y^x	31	
059	.	-62	
060	6	06	
061	2	02	
062	3	03	
063	3	03	
064	x	-35	
065	RTN	24	
066	*LBL2	21 02	
067	X≠Y	-41	
068	1	01	
069	.	-62	
070	3	03	
071	5	05	
072	5	05	
073	4	04	
074	4	04	
075	Y^x	31	
076	.	-62	
077	4	04	
078	1	01	
079	3	03	
080	5	05	
081	7	07	
082	x	-35	
083	RTN	24	
084	*LBL1	21 01	
085	1	01	
086	.	-62	
087	0	00	
088	1	01	
089	7	07	
090	7	07	
091	Y^x	31	
092	.	-62	
093	2	02	
094	8	08	
095	7	07	
096	2	02	
097	x	-35	
098	RTN	24	
099	R/S	51	
220			

LABELS

A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

FLAGS

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☐	DEG ☐	FIX ☐
1	☐	☐	GRAD ☐	SCI ☐
2	☐	☐	RAD ☐	ENG ☐
3	☐	☐		n_____

APPENDIX C

to

FINAL REPORT

PROGRAM LISTING FOR ALL CHIPS

SERVICES TO DEVELOP POCKET CALCULATORS TO PERFORM PF CALCULATIONS
BY DCPA STANDARD METHOD AND TO PROVIDE TRAINING FOR USE

Contract Number DCPA01-76-C-0325

CARD 0-1a Co, OFF CENTER DETECTOR

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	STO 5	35 05	
003	R↓	-31	input
004	STO 4	35 04	
005	R↓	-31	$X_1\ X_2\ Y_1\ Y_2$
006	STO 3	35 03	
007	R↓	-31	
008	STO 2	35 02	
009	RTN	24	
010	*LBL B	21 12	
011	STO 6	35 12	input Z
012	RTN	24	
013	*LBL C	21 13	
014	STO C	35 13	input X_o
015	RTN	24	
016	*LBL e	21 16 15	start subroutine for ω_i
017	SF 1	16 21 01	set Flag 1
018	STO 0	35 00	
019	ABS	16 31	save X-Y in R_0
020	X≷Y	-41	and keep |X| and
021	ST×0	35-35 00	|Y| on stack
022	ABS	16 31	
023	X>Y?	16-34	smallest dimension
024	X≷Y	-41	in R_X
025	X=0?	16-43	if a dimension is 0
026	RTN	24	return $\omega_i = 0$
027	X≷Y	-41	largest dimension in R_X
028	RCL 0	36 00	
029	X<0?	16-45	if X-Y < 0
030	CF 1	16 22 01	clear Flag 1
031	R↓	-31	
032	STO E	35 15	compute ω_i as follows
033	÷	-24	
034	STO D	35 14	
035	RCL B	36 12	
036	RCL E	36 15	
037	÷	-24	
038	ENT↑	-21	
039	X²	33	
040	RCL D	36 14	
041	X²	33	
042	+	-55	
043	1	01	
044	+	-55	
045	√X	34	
046	×	-35	
047	RCL D	36 14	
048	X≷Y	-41	
049	÷	-24	
050	RAD	16-22	
051	TAN⁻¹	16-43	
052	2	02	
053	×	-35	
054	PI	16-24	
055	÷	-24	
056	F1?	16 23 01	if Flag 1 is set

$$\omega_i = \frac{e}{\left(2d\sqrt{4d^2+e^2+1}\right)} - \tan^{-1}\left(\frac{e}{\sqrt{4d^2+e^2+1}}\right)$$

where $e = \frac{W}{L}$, $d = \frac{Z}{L}$

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	RTN	24	then return, else
058	CHS	-22	change sign of ω_i
059	RTN	24	and then return
060	*LBL D	21 14	start subroutine for C_o
061	RCL 2	36 02	
062	RCL 4	36 04	compute ω_3
063	GSB e	23 16 15	
064	STO 6	35 06	
065	RCL 2	36 02	
066	RCL 5	36 05	compute ω_2
067	GSB e	23 16 15	
068	STO 7	35 07	
069	RCL 3	36 03	
070	RCL 4	36 04	compute ω_4
071	GSB e	23 16 15	
072	STO 9	35 09	
073	RCL 3	36 03	
074	RCL 5	36 05	compute ω_5
075	GSB e	23 16 15	
076	STO 8	35 08	
077	0	00	zero R_0
078	STO 0	35 00	
079	RCL C	36 13	if $X_o \leq .2$
080	.	-62	
081	2	02	$X_o \leftarrow .2$
082	X≤Y?	16-35	
083	GTO 1	22 01	
084	STO C	35 13	
085	*LBL 1	21 01	
086	9	09	set up index for R_I
087	STO I	35 46	
088	*LBL 2	21 02	
089	RCL i	36 45	get next ω
090	SF 1	16 21 01	set Flag 1
091	X>0?	16-44	if $\omega > 0$ go to
092	GTO 6	22 06	compute C_o
093	X=0?	16-43	if $\omega = 0$ go to
094	GTO 5	22 05	finished
095	CF 1	16 22 01	if $\omega < 0$ clear Flag 1
096	ABS	16 31	$\|\omega\|$ on stack
097	STO i	35 45	$\|\omega\|$ in memory
098	*LBL 6	21 06	start computation for C_o
099	.	-62	
100	1	01	if $\omega < .1$
101	X≤Y?	16-35	
102	GTO 4	22 04	$\Delta X_o = 0$
103	0	00	
104	GTO 8	22 08	
105	*LBL 4	21 04	else
106	1	01	
107	.	-62	
108	3	03	compute ΔX_o
109	ENT↑	-21	as follows
110	.	-62	
111	0	00	
112	1	01	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD 0-1a (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	6	06	
114	7	07	
115	CHS	-22	
116	RCLC	36 13	
117	x	-35	
118	e^x	33	
119	1	01	
120	.	-62	
121	6	06	
122	x	-35	
123	-	-45	
124	RCLi	36 45	
125	1	01	
126	.	-62	
127	1	01	
128	Y^x	31	
129	3	03	
130	0	00	
131	.	-62	
132	3	03	
133	x	-35	
134	RCLi	36 45	
135	.	-62	
136	7	07	
137	3	03	
138	5	05	
139	CHS	-22	
140	Y^x	31	
141	.	-62	
142	2	02	
143	3	03	
144	4	04	
145	x	-35	
146	-	-45	
147	x	-35	
148	*LBL8	21 08	compute C_o as follows
149	RCLC	36 13	
150	4	-55	
151	.	-62	
152	0	00	
153	2	02	
154	2	02	
155	4	04	
156	CHS	-22	
157	x	-35	
158	e^x	-33	
159	.	-62	
160	3	03	
161	2	02	
162	2	02	
163	x	-35	
164	RCLi	36 45	
165	RCLC	36 13	
166	4	04	
167	6	06	
168	EEX	-23	

$\Delta X_o = (1.3 - 1.6\,e^{-.01674 X_o})(30.3\,\omega^{1.1} - .234\,\omega^{-.7345})$

$C_o = .322\,e^{-.02239(X_o+\Delta X_o)}\,\omega^{(1.03-.00046 X_o)}$

STEP	KEY ENTRY	KEY CODE	COMMENTS
169	5	05	
170	CHS	-22	
171	x	-35	
172	CHS	-22	
173	1	01	
174	.	-62	
175	0	00	
176	3	03	
177	+	-55	
178	Y^x	31	
179	x	-35	
180	RCLC	36 13	special condition to modify C_o if $X_o = 0$ and $.0011 < C_o < .17$ then $C_o \leftarrow .9 C_o$
181	X≠0?	16-42	
182	GTO3	22 03	
183	R↓	-31	
184	.	-62	
185	1	01	
186	7	07	
187	X≤Y?	16-35	
188	GTO3	22 03	
189	R↓	-31	
190	.	-62	
191	0	00	
192	0	00	
193	1	01	
194	1	01	
195	X>Y?	16-34	
196	GTO3	22 03	
197	R↓	-31	
198	.	-62	
199	9	09	
200	x	-35	
201	GTO5	22 05	get C_o that is in R_x
202	*LBL3	21 03	
203	R↓	-31	
204	*LBL5	21 05	
205	F1?	16 23 01	if Flag 1 is cleared change sign of C_o
206	GTO7	22 07	
207	CHS	-22	
208	*LBL7	21 07	
209	ST+0	35-55 00	add to total C_o
210	5	05	
211	RCLI	36 45	decrement counter in R_I
212	1	01	
213	-	-45	
214	STOI	35 45	
215	X≠Y?	16-32	if not done go to LBL2
216	GTO2	22 02	
217	4	04	divide total by 4
218	ST÷0	35-24 00	
219	SPC	16-11	
220	1	01	print code 1 and C_o
221	PRTX	-14	
222	RCL0	36 00	
223	PRTX	-14	
224	RTN	24	

LABELS					FLAGS	SET STATUS		
A	B	C	D	E	0	FLAGS	TRIG	DISP
a	b	c	d	e	1	ON OFF		
0	1	2	3	4	2	0 ☐ ☐	DEG ☐	FIX ☐
5	6	7	8	9	3	1 ☐ ☐	GRAD ☐	SCI ☐
						2 ☐ ☐	RAD ☐	ENG ☐
						3 ☐ ☐		

CARD 0-1b Co, CENTER DETECTOR

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	input W
002	STO3	35 03	
003	RTN	24	
004	*LBLB	21 12	input L
005	STO4	35 04	
006	RTN	24	
007	*LBLC	21 13	input Z
008	STO5	35 05	
009	RTN	24	
010	*LBLD	21 14	input X_o
011	STO1	35 01	
012	RTN	24	
013	*LBLE	21 15	start computation for Co
014	RCL3	36 03	$e = \frac{W}{L}$
015	RCL4	36 04	
016	÷	-24	$a = \frac{Z}{L}$
017	STO6	35 06	
018	RCL5	36 05	
019	RCL4	36 04	
020	÷	-24	$\beta = \tan^{-1}\left(\frac{e}{2a\sqrt{4a^2+e^2+1}}\right)$
021	2	02	
022	x	-35	
023	ENT↑	-21	
024	X²	53	
025	RCL6	36 06	
026	X²	53	
027	+	-55	
028	1	01	
029	+	-55	
030	√X	54	
031	x	-35	
032	RCL6	36 06	
033	X≷Y	-41	
034	÷	-24	α/β
035	RAD	16-22	
036	TAN⁻¹	16 43	
037	2	02	
038	x	-35	
039	Pi	16-24	
040	÷	-24	
041	STO2	35 02	save ω in R_2
042	.	-62	
043	1	01	if $\omega < .1$
044	X≤Y?	16-35	
045	GTO1	22 01	$\Delta X_o = 0$
046	0	00	
047	GTO2	22 02	else
048	*LBL1	21 01	compute ΔX_o
049	1	01	as follows
050	.	-62	
051	3	03	
052	ENT↑	-21	
053	.	-62	
054	0	00	
055	1	01	
056	6	06	
057	7	07	
058	4	04	
059	CHS	-22	
060	RCL1	36 01	
061	x	-35	
062	e^x	33	
063	1	01	
064	.	-62	
065	6	06	
066	x	-35	
067	-	-45	
068	RCL2	36 02	
069	1	01	
070	.	-62	
071	1	01	
072	Y^x	31	
073	3	03	
074	0	00	
075	.	-62	
076	3	03	
077	x	-35	
078	RCL2	36 02	
079	.	-62	
080	7	07	
081	3	03	
082	4	04	
083	5	05	
084	CHS	-22	
085	Y^x	31	
086	.	-62	
087	2	02	
088	3	03	
089	4	04	
090	x	-35	
091	-	-45	
092	x	-35	
093	*LBL2	21 02	compute Co from
094	RCL1	36 01	
095	+	-55	
096	.	-62	
097	0	00	
098	2	02	
099	2	02	
100	3	03	
101	9	09	
102	CHS	-22	
103	x	-35	
104	e^x	33	
105	.	-62	
106	3	03	
107	2	02	
108	2	02	
109	x	-35	
110	RCL2	36 02	
111	RCL1	36 01	
112	.	-62	

$$\Delta X_o = \left(1.3 - 1.6\, e^{-.0167 X_o}\right)\left(30.3\,\omega^{1.1} - .2340\,\omega^{.7345}\right)$$

$$Co = .322\, e^{-.0223(X_o + \Delta X_o)}\, \omega^{(.005 - .0004 X_o)}$$

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD 0-1b (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	0	00	
114	0	00	
115	0	00	
116	4	04	
117	6	06	
118	CHS	-22	
119	×	-35	
120	1	01	
121	.	-62	
122	0	00	
123	3	03	
124	+	-55	
125	Y^x	31	
126	×	-35	
127	RCL1	36 01	special condition for modifying C_0
128	X≠0?	16-42	
129	GTO3	22 03	if $X_0 = 0$
130	X≷Y	-41	and
131	.	-62	$.0011 < C_0 < .17$
132	1	01	than
133	7	07	$C_0 \leftarrow .9C_0$
134	X≤Y?	16-35	
135	GTO3	22 03	
136	X≷Y	-41	
137	.	-62	
138	0	00	
139	0	00	
140	1	01	
141	1	01	
142	X>Y?	16-34	
143	GTO3	22 03	
144	X≷Y	-41	
145	.	-62	
146	9	09	
147	×	-35	
148	GTO4	22 04	
149	*LBL3	21 03	
150	RI	-31	get C_0 in R_X
151	*LBL4	21 04	
152	STO0	35 00	save C_0 in R_0
153	SPC	16-11	
154	1	01	print code 1
155	PRTX	-14	and C_0
156	RCL0	36 00	
157	PRTX	-14	
158	RTN	24	
159	R/S	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS

LABELS

A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

FLAGS

SET STATUS

FLAGS	ON	OFF
0	☐	☐
1	☐	☐
2	☐	☐
3	☐	☐

TRIG: DEG ☐ GRAD ☐ RAD ☐

DISP: FIX ☐ SCI ☐ ENG ☐ n____

CARD 0-2 Co, WITH INTERIOR PARTITIONS

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	input C_o
002	STO 0	35 00	
003	RTN	24	
004	*LBL E	21 15	input X_i
005	STO E	35 15	
006	RTN	24	
007	*LBL C	21 13	start computing $B_i' \cdot C_o$
008	RCL E	36 15	
009	2	02	if $X_i \leq 20$
010	0	00	compute
011	RCL E	36 15	
012	X>Y?	16-34	
013	GTO 2	22 02	
014	.	-62	$B_i' = .9885\, e^{-.0370 X_i}$
015	0	00	
016	3	03	
017	7	07	
018	CHS	-22	
019	X	-35	
020	e^x	33	
021	.	-62	
022	9	09	
023	8	08	
024	8	08	
025	5	05	
026	X	-35	
027	GTO 1	22 01	
028	*LBL 2	21 02	if $20 < X_i \leq 90$
029	9	09	compute
030	0	00	
031	RCL E	36 15	
032	X>Y?	16-34	
033	GTO 3	22 03	
034	.	-62	$B_i' = .800\, e^{-.0272 X_i}$
035	8	08	
036	2	02	
037	7	07	
038	2	02	
039	3	03	
040	CHS	-22	
041	X	-35	
042	e^x	33	
043	.	-62	
044	8	08	
045	0	00	
046	0	00	
047	1	01	
048	X	-35	
049	GTO 1	22 01	
050	*LBL 3	21 03	if $X_i > 90$
051	RCL E	36 15	compute
052	.	-62	
053	0	00	
054	2	02	
055	3	03	
056	6	00	

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	3	03	$B_i' = .53852\, e^{-.0230 X_i}$
058	CHS	-22	
059	X	-35	
060	e^x	33	
061	.	-62	
062	5	05	
063	3	03	
064	8	08	
065	5	05	
066	2	02	
067	X	-35	
068	*LBL 1	21 01	store B_i' in R_D
069	STO D	35 14	compute $B_i' \cdot C_o$
070	RCL 0	36 00	
071	X	-35	print code 1 and $B_i' \cdot C_o$
072	SPC	16-11	
073	1	01	
074	PRTX	-14	
075	R↓	-31	
076	PRTX	-14	
077	RTN	24	
078	0	00	Blank steps to require all cards to be read on both sides
079	0	00	
080	0	00	
081	0	00	
082	0	00	
083	0	00	
084	0	00	
085	0	00	
086	0	00	
087	0	00	
088	0	00	
089	0	00	
090	0	00	
091	0	00	
092	0	00	
093	0	00	
094	0	00	
095	0	00	
096	0	00	
097	0	00	
098	0	00	
099	0	00	
100	0	00	
101	0	00	
102	0	00	
103	0	00	
104	0	00	
105	0	00	
106	0	00	
107	0	00	
108	0	00	
109	0	00	
110	0	00	
111	0	00	
112	0	00	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD 0-2 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	0	00					
114	0	00					
115	0	00					
116	0	00					
117	0	00					
118	0	00					
119	0	00					
120	0	00					
121	0	00					
122	R/S	51					

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☐	DEG ☐	FIX ☐
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n____

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL a	21 16 11	input X_i W L
002	STOB	35 12	
003	÷	-24	save $e = \frac{W}{L}$
004	STOA	35 11	
005	R↓	-31	
006	*LBL a	21 16 14	compute B_i
007	1	01	
008	1	01	if $X_i > 110$
009	0	00	
010	X≠Y	-41	go to LBL 1
011	X>Y?	16-34	
012	GTO 1	22 01	
013	.	-62	if $X_i \leq 110$ compute
014	0	00	
015	2	02	$B_i = 1.003e^{-.0239X_i}$
016	3	03	
017	9	09	
018	CHS	-22	
019	x	-35	
020	e^x	33	
021	1	01	
022	.	-62	
023	0	00	
024	0	00	
025	3	03	
026	x	-35	
027	1	01	if $B_i > 1$
028	X≠Y	-41	than
029	X>Y?	16-34	$B_i \leftarrow 1$
030	1	01	
031	GTO 2	22 02	
032	*LBL 1	21 01	if $X_i > 110$ compute
033	.	-62	
034	0	00	$B_i = .7405e^{-.0211X_i}$
035	2	02	
036	1	01	
037	1	01	
038	CHS	-22	
039	x	-35	
040	e^x	33	
041	.	-62	
042	7	07	
043	4	04	
044	0	00	
045	5	05	
046	x	-35	
047	*LBL 2	21 02	save B_i in R_2
048	STO 2	35 02	
049	RTN	24	
050	*LBL A	21 11	input X_i x y w
051	P≠S	16-51	get secondary register
052	STO 7	35 07	
053	R↓	-31	save w
054	STO 9	35 09	
055	R↓	-31	save y
056	STO 8	35 08	save x

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	R↓	-31	
058	P≠S	16-51	get primary register
059	GSB a	23 16 14	compute $B_i[X_i]$
060	P≠S	16-51	get secondary register
061	2	02	
062	ST÷7	35-24 07	$R_{S7} \leftarrow w/2$
063	RCL7	36 07	
064	RCL8	36 08	compute A_z
065	+	-55	
066	RCL9	36 09	
067	÷	-24	$A_z = \tan^{-1}\left(\frac{x+w/2}{y}\right) - \tan^{-1}\left(\frac{x-w/2}{y}\right)$
068	DEG	16-21	
069	TAN⁻¹	16 42	
070	RCL8	36 08	
071	RCL7	36 07	
072	-	-45	
073	RCL9	36 09	
074	÷	-24	
075	TAN⁻¹	16 42	
076	-	-45	
077	3	03	
078	6	06	
079	0	00	
080	÷	-24	
081	P≠S	16-51	get primary register
082	STX2	35-35 02	$R_2 \leftarrow B_i \cdot A_z$
083	P≠S	16-51	get secondary register
084	RCL9	36 09	if
085	RCL8	36 08	$x + w/2 \leq y$
086	RCL7	36 07	
087	+	-55	go to LBL 3
088	X≠Y?	16-35	
089	GTO 3	22 03	
090	2	02	else, if $x + w/2 > y$
091	x	-35	
092	STOB	35 12	$L = 2(x + w/2)$
093	X≠Y	-41	
094	2	02	$W = 2y$
095	x	-35	
096	X≠Y	-41	$e = \frac{W}{L}$
097	÷	-24	
098	GTO 4	22 04	if $x + w/2 \leq y$
099	*LBL 3	21 03	
100	RCL8	36 08	$L = 2\sqrt{x^2+y^2}$
101	X²	53	
102	RCL9	36 09	
103	X²	53	
104	+	-55	
105	√X	54	
106	2	02	
107	x	-35	
108	STOB	35 12	$e = 1$
109	1	01	
110	*LBL 4	21 04	
111	STOA	35 11	$e \rightarrow R_4$
112	P≠S	16-51	get primary register

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	RTN	24	return
114	*LBL E	21 12	input H z_1 z_2 z_3
115	STO 5	35 05	save z_3
116	R↓	-31	
117	STO 6	35 06	save z_2
118	R↓	-31	
119	STO 7	35 07	save z_1
120	R↓	-31	
121	STO E	35 15	
122	9	09	set indirect register
123	STO I	35 46	counter to R_9
124	RCL 6	36 06	$R_{50} \leftarrow \bar{\omega}(z_2)$
125	GSB e	23 16 15	($\bar{\omega}_{u1}$ OR $\bar{\omega}_{L2}$)
126	RCL 7	36 07	($\bar{\omega}_{u2}$ OR $\bar{\omega}_{L1}$)
127	GSB e	23 16 15	$R_{51} \leftarrow \bar{\omega}(z_1)$
128	RCL 9	36 09	$R_{52} \leftarrow \bar{\omega}(z_3 - z_2)$
129	RCL 6	36 06	($\bar{\omega}_{02}$)
130	-	-45	
131	GSB e	23 16 15	$R_{53} \leftarrow \bar{\omega}(z_3 - z_1)$
132	RCL 9	36 09	($\bar{\omega}_{01}$)
133	RCL 7	36 07	
134	-	-45	
135	GSB e	23 16 15	
136	RCL 9	36 09	$R_{54} \leftarrow \bar{\omega}(z_3)$
137	GSB e	23 16 15	($\bar{\omega}_{u3}$)
138	P≠S	16-51	get secondary register
139	1	01	initialize
140	STO 5	35 05	$R_{55} \leftarrow 1(\bar{\omega}_L)$
141	STO 6	35 06	$R_{56} \leftarrow 1\omega_{oc}$
142	P≠S	16-51	get primary register
143	RTN	24	return
144	*LBL e	21 16 15	compute $\bar{\omega}$ [z]
145	ISZI	16 26 46	increment I register
146	CF 1	16 22 01	clear Flag 1
147	X<0?	16-45	if $Z < 0$
148	SF 1	16 21 01	set Flag 1
149	ABS	16 31	$R_X \leftarrow \lvert Z \rvert$
150	X≠0?	16-42	if $Z \neq 0$
151	GTO 5	22 05	go to LBL 5
152	1	01	if $Z = 0$, $\bar{\omega} = 1$
153	GTO 6	22 06	go to LBL 6
154	*LBL 5	21 05	compute $\bar{\omega}$
155	RCL B	36 12	
156	÷	-24	
157	2	02	
158	x	-35	
159	ENT↑	-21	
160	X²	53	
161	RCL A	36 11	
162	X²	53	
163	+	-55	
164	1	01	
165	+	-55	
166	√X	54	
167	X	-35	
168	RCL A	36 11	

$\bar{\omega} = \frac{2}{\pi}\tan^{-1}\left(\frac{e}{2\sqrt{4z^2e^{2x}+1}}\right)$

STEP	KEY ENTRY	KEY CODE	COMMENTS
169	X≠Y	-41	
170	÷	-24	where
171	RAD	16-22	$e = W/L$
172	TAN⁻¹	16 43	$a = Z/L$
173	2	02	
174	x	-35	
175	Pi	16-24	
176	÷	-24	
177	*LBL 6	21 06	if Flag 1 set
178	F1?	16 23 01	$\bar{\omega}$ is negative
179	CHS	-22	
180	STO i	35 45	save $\bar{\omega}$
181	RTN	24	return
182	*LBL D	21 14	input P_a or A_p
183	STO 5	35 05	in R_5
184	RTN	24	
185	*LBL C	21 13	input Xe X_a
186	STO D	35 14	$R_D \leftarrow X_a$
187	R↓	-31	
188	STO C	35 13	$R_C \leftarrow X_e$
189	RTN	24	
190	*LBL E	21 15	input W_c
191	STO 1	35 01	save W_c
192	2	02	$R_X \leftarrow 2W_c$
193	x	-35	$R_Y \leftarrow 2W_c$
194	ENT↑	-21	$R_Z \leftarrow 2W_c$
195	ENT↑	-21	
196	RCL A	36 11	save e in R_4
197	STO 4	35 04	
198	RCL B	36 12	$R_B \leftarrow 2W_c + L$
199	x	-35	
200	+	-55	
201	X≠Y	-41	$R_A \leftarrow \frac{2W_c + W}{2W_c + L}$
202	RCL B	36 12	
203	+	-55	
204	STO B	35 12	$R_B \leftarrow L'$
205	÷	-24	$R_A \leftarrow a'$
206	STO A	35 11	
207	RCL E	36 15	$R_{55} \leftarrow \bar{\omega}(H)$
208	GSB e	23 16 15	$R_{56} \leftarrow \bar{\omega}(H + z_3)$
209	RCL E	36 15	$\bar{\omega}_{03}$
210	RCL 9	36 09	
211	+	-55	
212	GSB e	23 16 15	restore R_A
213	RCL 4	36 04	with e
214	STO A	35 11	
215	SPC	16-11	display
216	2	02	program 2
217	PRTX	14	request
218	RTN	24	
219	R/S	51	

LABELS					FLAGS	SET STATUS		
A	B	C	D	E	0	FLAGS	TRIG	DISP
a	b	c	d	e	1	ON OFF		
0	1	2	3	4	2	0 ☐ ☐	DEG ☐	FIX ☐
5	6	7	8	9	3	1 ☐ ☐	GRAD ☐	SCI ☐
						2 ☐ ☐	RAD ☐	ENG ☐
						3 ☐ ☐		n___

CARD GM-2 $\mathcal{L}_g$, DETAIL WALL PORTION

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	continue
002	RCL C	36 13	compute $S_{WR}(X_E)$
003	GSB d	23 16 14	
004	STO 3	35 03	save in R_3
005	RCL D	36 14	compute $S_{WR}(X_A)$
006	GSB d	23 16 14	
007	STO 4	35 04	save in R_4
008	RCL A	36 11	compute $E(\varepsilon)$
009	ENT↑	-21	
010	ENT↑	-21	
011	1	01	
012	+	-55	
013	X≷Y	-41	
014	X^2	53	
015	1	01	
016	+	-55	
017	$\sqrt{X}$	54	
018	÷	-24	
019	STO 1	35 46	store in R_1
020	P≷S	16-51	get secondary register
021	RCL 2	36 02	if $\omega_{03} > \omega_{02}$
022	RCL 6	36 06	go to LBL 3
023	X>Y?	16-34	no M.S. effect
024	GTO 3	22 03	$\omega_{02} \leftarrow \omega_{03}$
025	STO 2	35 02	if $\omega_{02} > \omega_{01}$
026	RCL 3	36 03	go to LBL 3
027	X≷Y	-41	ok
028	X>Y?	16-34	$\omega_{01} \leftarrow \omega_{03}$
029	GTO 3	22 03	initialize
030	STO 3	35 03	Air, scatter
031	*LBL 3	21 03	and direct
032	0	00	
033	STO 7	35 07	get primary register
034	STO 8	35 08	if $X_A \neq 0$
035	STO 9	35 09	no aperture
036	P≷S	16-51	
037	RCL D	36 14	if $3+Z_3 < 0$
038	X≠0?	16-42	story below
039	GTO e	22 16 15	go to LBL e
040	3	03	
041	RCL 7	36 07	if $Z_3 - Z_2 < 0$
042	→	-55	story above
043	X<0?	16-45	go to LBL e
044	GTO e	22 16 15	
045	RCL 9	36 09	$G_c \neq 0$ go to LBL c
046	RCL 8	36 08	$G_c = 0$
047	→	45	
048	X<0?	16-45	get secondary register
049	GTO e	22 16 15	. $R_{53} \leftarrow 0$ (G_c)
050	GTO c	22 16 13	
051	*LBL e	21 16 15	compute G_q
052	0	00	
053	P≷S	16-51	
054	STO 3	35 03	
055	GTO 4	22 04	
056	*LBL c	21 16 13	

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	P≷S	16-51	get secondary register
058	RCL 3	36 03	compute G_c
059	GSB b	23 16 12	$G_c = S[G_c(\omega_{01}) - G_c(\omega_{02})] \times [1 - G_c(\omega_{12})]$
060	STO 3	35 03	
061	RCL 2	36 02	
062	GSB b	23 16 12	
063	ST- 3	35-45 03	
064	RCL 4	36 04	
065	GSB a	23 16 11	
066	.	-62	
067	1	01	
068	X≷Y	-41	
069	-	-45	
070	STx 3	35-35 03	$R_{53} \leftarrow G_c$
071	*LBL 4	21 04	if $R_{50} < 0$
072	RCL 0	36 00	then case 3
073	X<0?	16-45	ω_{L3}
074	GTO 1	22 01	go to LBL 1
075	GSB b	23 16 12	else case 1 or 2
076	ST+ 8	35-55 08	add $G_s(\omega_{01})$ to R_{58}
077	5	05	add $G_a(\omega_{01})$
078	÷	-24	to R_{57} (air)
079	ST+ 7	35-55 07	if $R_{51} < 0$
080	RCL 1	36 01	then case 2 or 3
081	X<0?	16-45	go to LBL 2
082	GTO 2	22 02	else case 1, subtract
083	GSB b	23 16 12	$G_s(\omega_{02})$ from R_{58}
084	ST- 8	35-45 08	subtract
085	5	05	$G_a(\omega_{02})$
086	÷	-24	from R_{57}
087	ST- 7	35-45 07	
088	GTO 9	22 09	case 2 or 3
089	*LBL 2	21 02	$\lvert\omega_{L1}\rvert$
090	CHS	-22	add $G_s(\omega_{L1})$
091	GSB b	23 16 12	to R_{58}
092	ST+ 8	35-55 08	
093	GTO 8	22 08	case 3
094	*LBL 1	21 01	add $G_s(\omega_{L3})$
095	RCL 1	36 01	to R_{58}
096	CHS	-22	
097	GSB b	23 16 12	subtract
098	ST+ 8	35-55 08	$G_s(\omega_{L2})$
099	RCL 0	36 00	from R_{58}
100	CHS	-22	
101	GSB b	23 16 12	case 1 end
102	ST- 8	35-45 08	get primary register
103	GTO 8	22 08	display
104	*LBL 9	21 09	program 4 request
105	P≷S	16-51	no direct
106	SPC	16-11	
107	4	04	case 1 and 2 end
108	PRTX	14	get primary register
109	RTN	24	
110	*LBL 8	21 08	
111	P≷S	16-51	
112	SPC	16-11	

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☐	DEG ☐	FIX ☐
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n____

CARD GM-2 (Continuted)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	3	03	display program 3 request needs direct
114	PRTX	-14	compute G_a
115	RTN	24	save ω
116	*LBL a	21 16 11	if $\omega \leq .7$
117	STO6	35 06	
118	.	-62	go to LBL 5
119	7	07	
120	RCL6	36 06	
121	X≤Y?	16-35	
122	GTO5	22 05	
123	.	-62	if
124	8	08	$.7 < \omega < .85$
125	5	05	
126	X>Y?	16-34	go to LBL 6
127	GTO6	22 06	
128	.	-62	for $.85 \geq \omega$
129	2	02	compute G_a
130	2	02	
131	2	02	
132	ENT↑	-21	$G_a = .222(1-\omega).968$
133	.	-62	
134	9	09	
135	8	08	
136	8	08	
137	*LBL7	21 07	
138	ENT↑	-21	
139	1	01	
140	RCL6	36 06	
141	-	-45	
142	X⇄Y	-41	
143	Y^x	31	
144	x	-35	
145	RTN	24	
146	*LBL5	21 05	for $\omega \leq .7$
147	.	-62	compute G_a
148	1	01	
149	0	00	
150	2	02	
151	ENT↑	-21	$G_a = .102(1-\omega).965$
152	.	-62	
153	4	04	
154	6	06	
155	5	05	
156	GTO7	22 07	
157	*LBL6	21 06	for $.7 < \omega < .85$
158	.	-62	compute
159	1	01	
160	4	04	
161	8	08	$G_a = .148(1-\omega)^{.714}$
162	ENT↑	-21	
163	.	-62	
164	7	07	
165	7	07	
166	9	09	
167	GTO7	22 07	
168	*LBL6	21 16 12	

STEP	KEY ENTRY	KEY CODE	COMMENTS
169	GSB a	23 16 11	get G_a
170	5	05	
171	x	-35	$G_s = 5 G_a$
172	RTN	24	
173	*LBL d	21 16 14	compute Sur
174	STO I	35 4E	save X
175	3	03	
176	0	00	$R_0 \leftarrow 30$
177	STO 0	35 00	
178	3	03	if $X > 35$
179	5	05	
180	RCL I	36 4E	go to LBL 0
181	X>Y?	16-34	use 30
182	GTO 0	22 00	
183	4	04	
184	ST+0	35-55 00	else
185	RCL I	36 46	$R_0 \leftarrow 34$
186	1	01	
187	3	03	if $X \geq 13$
188	X≤Y?	16-35	
189	GTO 0	22 00	go to LBL 0
190	3	03	use 34
191	ST+0	35-55 00	
192	*LBL 0	21 00	$R_0 \leftarrow 37$
193	RCL I	36 46	use 37
194	RCL I	36 46	
195	RCL 0	36 00	$Sur = \frac{X}{(X+R_0)}$
196	+	-55	
197	÷	-24	
198	RTN	24	
199	R/S	51	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD GM-3 Cg, DETAIL WALL PORTION

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	P≠S	16-51	get secondary register
003	RCL1	36 01	if $\omega_{L1} > 0$
004	X>0?	16-44	no direct
005	GTO6	22 06	go to LBL 6
006	CHS	-22	$\lvert\omega_{L1}\rvert$
007	STO1	35 01	save in R_{S1}
008	RCL5	36 05	if $\omega_c \leq \omega_{L1}$
009	X≠Y?	16-35	complete MS of direct
010	GTO6	22 06	go to LBL 6
011	RCL0	36 00	if $\omega_{L2} < 0$
012	X<0?	16-45	
013	GTO4	22 04	go to LBL 4
014	RCL5	36 05	else use
015	STO0	35 00	ω_c as ω_{L2}
016	GTO5	22 05	$\omega_{L2} \leftarrow \omega_c$
017	*LBL4	21 04	$-\lvert\omega_{L2}\rvert$
018	CHS	-22	
019	STO0	35 00	save in R_{S0}
020	RCL5	36 05	if $\omega_c > \omega_{L2}$
021	X>Y?	16-34	go to LBL 5
022	GTO5	22 05	else use
023	STO0	35 00	ω_c for ω_{L2}
024	*LBL5	21 05	add $G_d(\omega_L)$
025	RCL1	36 01	
026	GSBe	23 16 15	to R_{S9}
027	ST+9	35-55 09	
028	RCL0	36 00	subtract
029	GSBe	23 16 15	$G_d(\omega_{L2})$
030	ST-9	35-45 09	from R_{S9}
031	*LBL6	21 06	finished
032	P≠S	16-51	get primary registers
033	SPC	16-11	
034	4	04	display
035	PRTX	-14	program 4
036	RTN	24	request
037	*LBLe	21 16 15	
038	STO6	35 06	compute G_d
039	1	01	save ω
040	-	-45	if $\omega = 1$
041	X=0?	16-43	
042	RTN	24	$G_d = 0$
043	RCLE	36 15	
044	.	-62	
045	0	00	compute
046	1	01	as
047	9	09	follows
048	3	03	
049	CHS	-22	
050	Y^x	31	
051	.	-62	
052	9	09	
053	2	02	
054	3	03	
055	4	04	
056	x	-35	
057	RCLE	36 15	
058	.	-62	
059	2	02	
060	3	03	
061	0	00	
062	3	03	
063	Y^x	31	
064	.	-62	
065	1	01	
066	5	05	
067	8	08	
068	4	04	
069	x	-35	
070	1	01	
071	RCL6	36 06	
072	-	-45	
073	LN	32	
074	x	-35	
075	+	-55	
076	RCLE	36 15	
077	3	03	
078	X≠Y?	16-32	
079	GTO2	22 02	
080	R↓	-31	
081	R↓	-31	
082	X<0?	16-45	
083	0	00	
084	RTN	24	
085	*LBL2	21 02	
086	R↓	-31	
087	R↓	-31	
088	.	-62	
089	2	02	
090	5	05	
091	X≠Y	-41	
092	X>Y?	16-34	
093	RTN	24	
094	RCLE	36 15	
095	.	-62	
096	3	03	
097	2	02	
098	2	02	
099	6	06	
100	Y^x	31	
101	.	-62	
102	0	00	
103	1	01	
104	4	04	
105	0	00	
106	4	04	
107	CHS	-22	
108	x	-35	
109	RCLE	36 15	
110	.	-62	
111	4	04	
112	7	07	

$G_d = .9234H - .0193 \times .1584 \cdot 2303 \log(1-\omega)$

if $H \neq 3$

go to LBL 2

else if $H = 3$

get back G_d

if $G_d < 0$

$G_d = 0$

return G_d

for $H \neq 3$

get back G_d calc.

if $G_d > .25$

return G_d

else compute

$G_d = -.01404H \cdot .3226 \times 8.63H \cdot .4723 \log \omega$

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

CARD GM-3 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	2	02	
114	3	03	
115	CHS	-22	
116	Y^x	31	
117	8	08	
118	.	-62	
119	6	06	
120	3	03	
121	CHS	-22	
122	x	-35	
123	RCL6	36 06	
124	LN	32	
125	x	-35	
126	+	-55	
127	.	-62	
128	0	00	
129	4	04	
130	X≷Y	-41	
131	X>Y?	16-34	
132	RTN	24	
133	RCLE	36 15	
134	2	02	
135	0	00	
136	X≤Y?	16-35	
137	GTO1	22 01	
138	R↓	-31	
139	R↓	-31	
140	RTN	24	
141	*LBL1	21 01	
142	RCLE	36 15	
143	.	-62	
144	4	04	
145	5	05	
146	9	09	
147	7	07	
148	CHS	-22	
149	Y^x	31	
150	.	-62	
151	0	00	
152	9	09	
153	3	03	
154	8	08	
155	9	09	
156	CHS	-22	
157	x	-35	
158	RCLE	36 15	
159	.	-62	
160	6	06	
161	9	09	
162	4	04	
163	4	04	
164	CHS	-22	
165	Y^x	31	
166	1	01	
167	2	02	
168	.	-62	

Calculating G_d

if $G_d > .04$

Ok Return

else

if $20 \leq H$

go to LBL 1

else return

G_d calculated

Compute

$G_d = .09389H^{-.4597} - 12.77H^{-.6944\log H}$

STEP	KEY ENTRY	KEY CODE	COMMENTS
169	7	07	
170	7	07	
171	CHS	-22	
172	x	-35	
173	RCL6	36 06	
174	LN	32	
175	x	-35	
176	+	-55	
177	.	-62	
178	0	00	
179	0	00	
180	6	06	
181	X>Y?	16-34	
182	GTO3	22 03	
183	R↓	-31	
184	RTN	24	
185	*LBL3	21 03	
186	1	01	
187	RCL6	36 06	
188	-	-45	
189	.	-62	
190	3	03	
191	x	-35	
192	RTN	24	
193	R/S	51	

else

return

G_d

compute

$G_d = (1-G_d)\cdot .3$

LABELS					FLAGS	SET STATUS		
A	B	C	D	E	0	FLAGS	TRIG	DISP
a	b	c	d	e	1	ON OFF 0 ☐ ☐ 1 ☐ ☐ 2 ☐ ☐ 3 ☐ ☐	DEG ☐ GRAD ☐ RAD ☐	FIX ☐ SCI ☐ ENG ☐ n_____
0	1	2	3	4	2			
5	6	7	8	9	3			

CARD GM-4 Cg, DETAIL WALL PORTION

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	$R_0 \leftarrow 0$ initialize
002	0	00	
003	STO 8	35 08	
004	1	01	$R_6 \leftarrow 1 - P_a$
005	RCL 5	36 05	
006	-	-45	
007	STO 6	35 06	get secondary registers
008	P≠S	16-51	
009	RCL 1	36 01	save ω_{uz} in R_{54}
010	STO 4	35 04	
011	RCL C	36 13	$R_{50} \leftarrow Be(X_e)$
012	GSB c	23 16 13	
013	STO 8	35 08	
014	RCL D	36 14	$R_{51} \leftarrow Be(X_a)$
015	GSB c	23 16 13	
016	STO 1	35 01	
017	RCL 7	36 07	$Air \cdot Be(X_a)$
018	RCL 1	36 01	
019	x	-35	
020	RCL 7	36 07	$Air \cdot Be(X_e)$
021	RCL 8	36 08	
022	x	-35	
023	P≠S	16-51	get primary registers
024	1	01	add
025	RCL 3	36 03	$(1 - Sw(X_e))$
026	-	-45	$\times (Air \cdot Be(X_e))$
027	x	-35	$\times (1 - P_a)$ to R_0
028	RCL 6	36 06	
029	x	-35	add
030	ST+ 8	35-55 08	$(1 - Sw(X_a))$
031	R↓	-31	$\times (Air \cdot Be(X_a))$
032	1	01	$\times (P_a)$ to R_1
033	RCL 4	36 04	
034	-	-45	get secondary registers
035	x	-35	
036	RCL 5	36 05	$Direct \cdot Be(X_a)$
037	x	-35	
038	ST+ 8	35-55 08	$Direct \cdot Be(X_e)$
039	P≠S	16-51	
040	RCL 9	36 09	get primary register
041	RCL 1	36 01	add
042	x	-35	$(1 - Sw(X_e))$
043	RCL 9	36 09	$\times (Direct \cdot Be(X_e)$
044	RCL 8	36 08	$\times (1 - P_a)$ to R_0
045	x	-35	
046	P≠S	16-51	add
047	1	01	
048	RCL 3	36 03	
049	-	-45	
050	x	-35	
051	RCL 6	36 06	
052	x	-35	
053	ST+ 8	35-55 08	
054	R↓	-31	
055	1	01	
056	RCL 4	36 04	

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	-	-45	$(1 - Sw(X_a))$
058	x	-35	$\times (Direct \cdot Be(X_a)$
059	RCL 5	36 05	$\times (P_a)$ to R_1
060	x	-35	
061	ST+ 6	35-55 06	get secondary register
062	P≠S	16-51	
063	RCL 3	36 03	$G_c \cdot Be(X_a)$
064	RCL 1	36 01	
065	x	-35	get primary register
066	P≠S	16-51	add
067	RCL 5	36 05	$G_c \cdot Be(X_a) \cdot P_a$ to R_0
068	x	-35	
069	ST+ 8	35-55 08	get secondary register
070	P≠S	16-51	
071	1	01	on stack $\{^{1}_{\omega_c}\}$
072	RCL 5	36 05	
073	P≠S	16-51	get primary register
074	X=Y?	16-33	if $\omega_c = 1$ no M.S.
075	GTO 3	22 03	go to LBL 3
076	RCL 2	36 02	multiply
077	STx 8	35-35 08	R_0 by $Bi \cdot Az$
078	SPC	16-11	display
079	5	05	program 5 request
080	PRTX	-14	need M.S.
081	RTN	24	
082	*LBL 3	21 03	no MS
083	P≠S	16-51	get secondary register
084	RCL 8	36 08	
085	RCL 1	36 01	$Scat. \cdot Be(X_a)$
086	x	-35	
087	RCL 8	36 08	$Scat. \cdot Be(X_e)$
088	RCL 8	36 08	
089	x	-35	get primary register
090	P≠S	16-51	add
091	RCL I	36 46	$(Scat. \cdot Be(X_e)$
092	x	-35	$\times (E \cdot Sw(X_e))$
093	RCL 3	36 03	$\times (1 - P_a)$ to R_0
094	x	-35	
095	RCL 6	36 06	add
096	x	-35	$(Scat. \cdot Be(X_a)$
097	ST+ 8	35-55 08	$\times (E \cdot Sw(X_a))$
098	R↓	-31	$\times (P_a)$ to R_0
099	RCL I	36 46	
100	x	-35	multiply
101	RCL 4	36 04	R_0 by $Bi \cdot Az$
102	x	-35	
103	RCL 5	36 05	display
104	x	-35	code 2
105	ST+ 8	35-55 08	and $Cg(R_0)$
106	RCL 2	36 02	
107	STx 8	35-35 08	
108	SPC	16-11	
109	2	02	
110	PRTX	-14	
111	RCL 8	36 08	
112	PRTX	-14	

LABELS

A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

FLAGS

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☐	DEG ☐	FIX ☐
1	☐	☐	GRAD ☐	SCI ☐
2	☐	☐	RAD ☐	ENG ☐
3	☐	☐		n____

CARD GM-4 (Continued)

STEP	KEY ENTRY	KEY CODE
113	RTN	24
114	*LBL c	21 16 13
115	STO 6	35 06
116	.	-62
117	2	02
118	CHS	-22
119	RCL E	36 15
120	x	-35
121	e^x	33
122	.	-62
123	4	04
124	x	-35
125	.	-62
126	0	00
127	3	03
128	CHS	-22
129	RCL E	36 15
130	x	-35
131	e^x	33
132	.	-62
133	0	00
134	0	00
135	0	00
136	6	06
137	6	06
138	RCL 6	36 06
139	x	-35
140	.	-62
141	2	02
142	3	03
143	2	02
144	+	-55
145	x	-35
146	+	-55
147	.	-62
148	0	00
149	0	00
150	9	09
151	CHS	-22
152	RCL E	36 15
153	x	-35
154	e^x	33
155	.	-62
156	3	03
157	x	-35
158	+	-55
159	.	-62
160	0	00
161	0	00
162	2	02
163	2	02
164	8	08
165	CHS	-22
166	RCL E	36 15
167	x	-35
168	e^x	33

$$B_e = [.3e^{-.0408\chi_e} + .17e^{-.0209\chi_e}][(.28 - .00054\chi_e)e^{-.0022BH} + .3e^{-.009H} + (.232 + .000c\chi_e)e^{-.03H} + .4e^{-.2H}]$$

STEP	KEY ENTRY	KEY CODE
169	.	-62
170	0	00
171	0	00
172	0	00
173	5	05
174	4	04
175	CHS	-22
176	RCL 6	36 06
177	x	-35
178	.	-62
179	2	02
180	8	08
181	+	-55
182	x	-35
183	+	-55
184	.	-62
185	0	00
186	2	02
187	0	00
188	9	09
189	CHS	-22
190	RCL 6	36 06
191	x	-35
192	e^x	33
193	.	-62
194	7	07
195	x	-35
196	.	-62
197	0	00
198	4	04
199	0	00
200	8	08
201	CHS	-22
202	RCL 6	36 06
203	x	-35
204	e^x	33
205	.	-62
206	3	03
207	x	-35
208	+	-55
209	x	-35
210	1	01
211	X≠Y	-41
212	X>Y?	16-34
213	1	01
214	RTN	24
215	0	00
216	0	00
217	R/S	51

computing B_e

if $B_e > 1$
then
$B_e = 1$

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD GM-5 Cg, DETAIL WALL PORTION

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	compute $2\tan^{-1}(W_c/H)/\pi$
002	RCL1	36 01	
003	RCLE	36 15	
004	÷	-24	
005	RAD	16-22	
006	TAN⁻¹	16 43	
007	2	02	
008	×	-35	
009	PI	16-24	
010	÷	-24	
011	.	-62	
012	8	08	on stack $\{.8, 2\omega_s\}$
013	X≷Y	-41	
014	P≷S	16-51	get secondary registers
015	STO6	35 06	$R_{s6} \leftarrow 2\omega_s$
016	X>Y?	16-34	if $2\omega_s > .8$
017	GTO9	22 09	go to LBL9
018	RCLC	36 13	save X_e
019	STO5	35 05	in R_{s5}
020	GSBa	23 16 11	
021	STO0	35 00	$R_{s0} \leftarrow B_s$
022	RCLD	36 14	save X_a
023	STO5	35 05	in R_{s5}
024	GSBa	23 16 11	
025	STO1	35 01	$R_{s1} \leftarrow B_s$
026	GTO0	22 00	go to LBL0
027	*LBL9	21 09	compute F_s
028	GSBb	23 16 12	
029	STx0	35-35 00	$R_0 \leftarrow B_e(X_a) \cdot F_s$
030	STx1	35-35 01	$R_1 \leftarrow B_e(X_e) \cdot F_s$
031	*LBL0	21 00	
032	RCL	36 08	(scat-E)
033	RCLI	36 46	
034	×	-35	
035	RCL1	36 01	$\times (B_s(X_a))$
036	×	-35	
037	RCL8	36 08	(scat-E)
038	RCLI	36 46	
039	×	-35	$\times [B_s(X_e)]$
040	RCL0	36 00	
041	×	-35	
042	P≷S	16-51	get primary registers
043	RCL3	36 03	(scat-E)
044	×	-35	$\times (B_s(X_a))$
045	RCL6	36 06	
046	×	-35	$\times (S_{wi}(X_a) \cdot [(-P_a)]$
047	X≷Y	-41	(scat-E)
048	RCL4	36 04	
049	×	-35	$\times (B_s(X_a))$
050	RCL5	36 05	
051	×	-35	$(S_{wi}(X_a) \cdot (P_a))$
052	+	-55	total
053	RCL2	36 02	scat-$B_i \cdot A_2$ added
054	×	-35	
055	ST+0	35-55 00	to total in R_0
056	SPC	16-11	
057	2	02	display code 2 and C_g
058	PRTX	-14	
059	RCL0	36 00	
060	PRTX	-14	
061	RTN	24	
062	*LBLa	21 16 11	compute B_s
063	RCL6	36 06	$2\omega_s$
064	RCL5	36 05	if $X_e = 0$
065	X=0?	16-43	
066	GTO1	22 01	go to LBL 1
067	.	-62	for $X_e > 0$
068	2	02	compute
069	1	01	
070	5	05	
071	7	07	
072	Y^x	31	
073	.	-62	
074	9	09	
075	7	07	
076	6	06	
077	4	04	
078	×	-35	
079	Y^x	31	
080	.	-62	
081	2	02	
082	7	07	
083	9	09	
084	×	-35	
085	RCL5	36 05	
086	.	-62	
087	0	00	
088	2	02	
089	2	02	
090	3	03	
091	4	04	
092	2	02	
093	CHS	-22	
094	×	-35	
095	e^x	33	
096	×	-35	
097	GTO2	22 02	
098	*LBL1	21 01	for $X_e = 0$
099	RCL6	36 06	compute
100	1	01	
101	.	-62	
102	0	00	
103	5	05	
104	Y^x	31	
105	.	-62	
106	2	02	
107	3	03	
108	2	02	
109	3	03	
110	×	-35	
111	*LBL2	21 02	
112	STO2	35 02	save B_s in R_{s2}

$B_s = (.1279e^{-.223X_e})(2\omega_s) \cdot .9764X_e \cdot .2157$

$B_s = .2323(2\omega_s)^{.05}$

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

CARD GM-5 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	.	-62	if .002 > B_s
114	0	00	
115	0	00	
116	2	02	
117	X>Y?	16-34	
118	GTO3	22 03	go to LBL 3
119	*LBL4	21 04	
120	RCL2	36 02	return B_s
121	RTN	24	
122	*LBL3	21 03	if $X_e \leq 75$
123	7	07	
124	5	05	
125	RCL5	36 05	go to LBL 5
126	X≠Y?	16-35	
127	GTO5	22 05	
128	GTO4	22 04	else return
129	*LBL5	21 05	if $20 \leq X_e$
130	2	02	
131	0	00	
132	X≠Y?	16-35	
133	GTO6	22 06	go to LBL 6
134	GTO4	22 04	else return
135	*LBL6	21 06	return
136	RCL2	36 02	
137	1	01	$B_s \leftarrow B_s \cdot (1.2)$
138	-	-62	
139	2	02	
140	X	-35	
141	RTN	24	
142	*LBL6	21 16 12	Compute F_s
143	RCLE	36 15	
144	3	03	
145	-	-45	
146	RCLE	36 15	
147	1	01	
148	2	02	
149	0	00	
150	+	-55	
151	=	-24	
152	.	-62	
153	2	02	
154	2	02	
155	+	-55	
156	1	01	
157	RCL6	36 06	
158	-	-45	
159	5	05	
160	X	-35	
161	Y^x	31	
162	STO2	35 02	save in R_{s2}
163	1	01	
164	RCL6	36 06	if $2\omega_s = 1$ return thru LBL 7
165	X=Y?	16-33	
166	GTO7	22 07	
167	.	-62	
168	8	08	

$$F_s = .22 + \left(\frac{H-3}{H+120}\right)^{5-10\left(\frac{2\omega_s}{n}\right)}$$

$n = 44$

STEP	KEY ENTRY	KEY CODE	COMMENTS
169	4	04	if $2\omega_s \leq .84$ or $H \neq 0$ go to LBL C
170	X≠Y	-41	
171	X≠Y?	16-35	
172	GTO c	22 16 13	
173	3	03	
174	RCLE	36 15	
175	X≠Y?	16-32	
176	GTO c	22 16 13	
177	.	-62	
178	9	09	
179	ST×2	35-35 02	
180	GTO7	22 07	
181	*LBL c	21 16 13	
182	RCLE	36 15	
183	2	02	
184	0	00	
185	X>Y?	16-34	
186	GTO7	22 07	
187	RCLE	36 15	
188	4	04	
189	0	00	
190	X>Y?	16-34	
191	GTO8	22 08	
192	.	-62	
193	9	09	
194	6	06	
195	RCL6	36 07	
196	X>Y?	16-34	
197	GTO8	22 08	
198	.	-62	
199	8	08	
200	4	04	
201	X>Y?	16-34	
202	GTO8	22 08	
203	1	01	
204	.	-62	
205	1	01	
206	ST×2	35-35 02	
207	GTO7	22 07	
208	*LBL8	21 08	
209	1	01	
210	.	-62	
211	0	00	
212	5	05	
213	ST×2	35-35 02	
214	*LBL7	21 07	
215	RCL2	36 02	
216	RTN	24	
217	R/S	51	

if $2\omega_s \leq .84$ or $H \neq 0$ go to LBL C

else go to LBL 7

$F_s \leftarrow .9 F_s$

if $20 > H$ return F_s

if $H > 40$ and $2\omega_s \leq .96$ and $.84 \leq 2\omega_s$ then $F_s \leftarrow 1.1 F_s$

else $F_s \leftarrow 1.05 F_s$

return

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☐	DEG ☐	FIX ☐
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐

CARD GM-6 Cg, DETAIL WALL PORTION

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	input C_g and X_o or X_c
002	P≠S	16-51	get secondary register
003	STO 5	35 05	save X
004	P≠S	16-51	get primary registers
005	R↓	-31	
006	STO 6	35 06	save C_g
007	RTN	24	
008	*LBL B	21 12	compute $C_g \cdot B_c$
009	RCL 0	36 00	get C_g
010	P≠S	16-51	get secondary register
011	RCL 5	36 05	
012	1	01	compute
013	ENT↑	-21	
014	3	03	
015	.	-62	
016	5	05	
017	ENT↑	-21	
018	2	02	
019	.	-62	
020	3	03	
021	RCL 4	36 04	
022	x	-35	
023	CHS	-22	
024	e^x	33	
025	x	-35	
026	-	-45	
027	.	-62	
028	1	01	
029	CHS	-22	
030	RCL 5	36 05	
031	x	-35	
032	e^x	33	
033	x	-35	
034	3	03	
035	.	-62	
036	5	05	
037	ENT↑	-21	
038	2	02	
039	.	-62	
040	3	03	
041	RCL 4	36 04	
042	x	-35	
043	CHS	-22	
044	e^x	33	
045	x	-35	
046	.	-62	
047	8	08	
048	4	04	
049	CHS	-22	
050	RCL 5	36 05	
051	x	-35	
052	e^x	33	
053	x	-35	
054	+	-55	
055	1	01	
056	X≠Y	-41	

$B_c = \left(1 - 3.5e^{-2.3D}\right)\left(e^{-.1X}\right) + \left(3.5e^{-2.3D}\right)\left(e^{-.04X}\right)$

if $B_c > 1$

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	X>Y?	16-34	then $B_c \leftarrow 1$
058	1	01	
059	*LBL 2	21 02	get primary register on stack $\{ {}^{C_g}_{B_c \text{ or } B_f}$
060	P≠S	16-51	
061	RCL 6	36 06	save B_c or B_f
062	X≠Y	-41	$B_c \cdot$ (B_c or B_f)
063	STO 0	35 00	
064	x	-35	display Code 2 and $C_g \cdot B_c$ or $C_g \cdot B_f$
065	SPC	16-11	
066	2	02	
067	PRTX	-14	
068	R↓	-31	
069	PRTX	-14	
070	RTN	24	
071	*LBL C	21 13	compute $C_g \cdot B_f$
072	RCL 0	36 00	get C_g
073	P≠S	16-51	get secondary register
074	RCL 5	36 05	
075	2	02	if $2.5 \leq X$
076	.	-62	
077	5	05	go to LBL 3
078	X≤Y?	16-35	
079	GTO 3	22 03	
080	R↓	-31	if $X < 2.5$ compute
081	.	-62	
082	2	02	
083	2	02	
084	4	04	
085	8	08	
086	CHS	-22	
087	x	-35	
088	e^x	33	
089	GTO 2	22 02	
090	*LBL 3	21 03	if ≤ 10
091	R↓	-31	
092	1	01	go to LBL 4
093	0	00	
094	X≠Y	-41	
095	X≤Y?	16-35	
096	GTO 4	22 04	
097	ENT↑	-21	else if $10 < X$ compute
098	ENT↑	-21	
099	.	-62	
100	3	03	
101	8	08	
102	CHS	-22	
103	Y^x	31	
104	X≠Y	-41	
105	.	-62	
106	8	08	
107	8	08	
108	9	09	
109	3	03	
110	6	06	
111	CHS	-22	
112	x	-35	

$B_x = (10 - .00938X)^{1.8}$

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD GM-6 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	10^x	16 33	
114	x	-35	
115	GTO2	22 02	
116	*LBL4	21 04	for $2.5 \leq X \leq 10$ compute $B_f = .8287X - .3999$
117	.	-62	
118	3	03	
119	9	09	
120	9	09	
121	9	09	
122	CHS	-32	
123	Y^x	31	
124	.	-62	
125	8	08	
126	2	02	
127	8	08	
128	7	07	
129	x	-35	
130	GTO2	22 02	
131	R/S	51	

STEP	KEY ENTRY	KEY CODE	COMMENTS

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☐	DEG ☐	FIX ☐
1	☐	☐	GRAD ☐	SCI ☐
2	☐	☐	RAD ☐	ENG ☐
3	☐	☐		n____

CARD GE-1 Cg, DETECTOR STORY

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL a	21 16 11	input L
002	STO B	35 12	
003	X≷Y	-41	input w
004	STO A	35 11	e = w/L
005	X≷Y	-41	
006	÷	-24	save e
007	STO 6	35 06	
008	R↓	-31	go compute
009	GSB a	23 16 14	Bi (Xi)
010	RTN	-24	
011	*LBL d	21 16 14	compute
012	1	01	Bi
013	1	01	
014	0	00	
015	X≷Y	-41	
016	X>Y?	16-34	
017	GTO 1	22 01	if $X_i \leq 110$
018	-	-62	compute
019	0	00	
020	2	02	
021	3	03	
022	9	09	
023	CHS	-22	
024	x	-35	
025	e^x	33	$B_i = 1.00316\, e^{-.0239 X_i}$
026	1	01	
027	.	-62	
028	0	00	
029	0	00	
030	3	03	
031	1	01	
032	6	06	
033	x	-35	
034	1	01	if $B_i > 1$
035	X≷Y	-41	then
036	X>Y?	16-34	$B_i \leftarrow 1$
037	1	01	
038	GTO 2	22 02	
039	*LBL 1	21 01	if $X_i > 110$
040	.	-62	compute
041	0	00	
042	2	02	
043	1	01	$B_i = .7405\, e^{-.0108 X_i}$
044	0	00	
045	8	08	
046	CHS	-22	
047	x	-35	
048	e^x	33	
049	.	-62	
050	7	07	
051	4	04	
052	0	00	
053	5	05	
054	x	-35	
055	*LBL 2	21 02	save B_i
056	STO 2	35 02	in R_2

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	RTN	24	
058	*LBL A	21-11	input w
059	STO 3	35-03	
060	R↓	-31	input y
061	STO 5	35 05	
062	R↓	-31	input x
063	STO 4	35 04	
064	R↓	-31	go compute Bi
065	GSB d	23 16 14	
066	2	02	$R_3 \leftarrow w/2$
067	ST÷3	35-24 03	
068	RCL 3	36 03	compute A_z
069	RCL 4	36 04	
070	+	-55	$A_z = \frac{x_{dm} - \tan^{-1}\left(\frac{x+w/2}{y}\right) - \tan^{-1}\left(\frac{x-w/2}{y}\right)}{360}$
071	RCL 5	36 05	
072	÷	-24	
073	DEG	16-21	
074	TAN⁻¹	16 43	
075	RCL 4	36 04	
076	RCL 3	36 03	
077	-	-45	
078	RCL 5	36 05	
079	÷	-24	
080	TAN⁻¹	16 43	
081	-	-45	
082	3	03	
083	6	06	
084	0	00	
085	÷	-24	
086	STx2	35-35 02	$R_2 \leftarrow B_i \cdot A_z$
087	RCL 5	36 05	is
088	RCL 4	36 04	$x + \frac{w}{2} \leq y$?
089	RCL 3	36 03	
090	+	-55	
091	X≤Y?	16-35	
092	GTO 3	22 03	
093	2	02	if
094	x	-35	$x + \frac{w}{2} > y$
095	STO B	35 12	then
096	X≷Y	-41	$L = 2\left(x + \frac{w}{2}\right)$
097	2	02	$W = 2y$
098	x	-35	$e = w/L$
099	X≷Y	-41	
100	÷	-24	
101	GTO 4	22 04	
102	*LBL 3	21 03	if
103	RCL 5	36 05	$x + \frac{w}{2} \leq y$
104	X²	53	$L = 2\sqrt{x^2 + y^2}$
105	RCL 4	36 04	
106	X²	53	$W = L$
107	+	-55	
108	√X	54	$e = 1$
109	2	02	
110	x	-35	
111	STO B	35 12	
112	1	01	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD GE-1 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	*LBL4	21 04	save e
114	STO6	35 06	in R_6
115	RTN	24	
116	*LBL8	21 12	input Z_3
117	STO7	35 07	
118	R↓	-31	input Z_2
119	STO9	35 09	
120	R↓	-31	input Z_1
121	CHS	-22	
122	STO8	35 08	input H
123	R↓	-31	
124	STOE	35 15	
125	9	09	initialize counter
126	STOI	35 46	
127	3	03	$R_{S0} \leftarrow \omega_L(3)$
128	GSBe	23 16 15	
129	RCL8	36 08	$R_{S1} \leftarrow \omega_u'(Z_1)$
130	GSBe	23 16 15	
131	RCL7	36 07	$R_{S2} \leftarrow \omega_u(Z_3)$
132	GSBe	23 16 15	
133	RCL9	36 09	$R_{S3} \leftarrow \omega_u(Z_2)$
134	GSBe	23 16 15	
135	RCL7	36 07	$R_{S4} \leftarrow \omega_c'(Z_3-Z_2)$
136	RCL9	36 09	
137	-	-45	$R_{S5} \leftarrow \omega_c(Z_1-Z_3)$
138	GSBe	23 16 15	
139	RCL7	36 07	
140	RCL8	36 08	
141	+	-55	
142	GSBe	23 16 15	
143	RTN	24	
144	*LBLe	21 16 15	compute ω
145	ISZI	16 26 46	increment counter
146	X≠0?	16-42	if $Z = 0$
147	GTO5	22 05	$\omega = 1$
148	1	01	
149	GTO6	22 06	if $Z \neq 0$
150	*LBL5	21 05	compute
151	RCL8	36 12	
152	÷	-24	
153	2	02	
154	×	-35	
155	ENT↑	-21	
156	X²	53	
157	RCL6	36 06	
158	X²	53	
159	+	55	
160	√	01	

$$\omega'' = \frac{e}{\left(2a\sqrt{4k^2+e^{mx}+1}\right)} \tan^{-1}$$

STEP	KEY ENTRY	KEY CODE	COMMENTS
161	+	-55	
162	↑X	54	
163	×	-35	
164	RCL6	36 06	
165	X≷Y	-41	
166	÷	-24	
167	RAD	16-22	
168	TAN⁻¹	16 42	
169	2	02	
170	×	-35	
171	Pi	16-24	
172	÷	-24	
173	*LBL6	21 06	computing R
174	STOi	35 45	
175	RTN	24	
176	*LBLC	21 13	save ω
177	STOD	35 14	
178	R↓	-31	input X_a
179	STOC	35 13	
180	RTN	24	input X_c
181	*LBLD	21 14	
182	STO0	35 00	input P_a
183	SPC	16-11	
184	2	02	call for
185	PRTX	-14	card 2
186	RTN	24	
187	R/S	51	

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☐	DEG ☐	FIX ☐
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n____

CARD GE-2 Cg, DETECTOR STORY

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	continue
002	RCL C	36 13	compute
003	GSB c	23 16 13	B_e (Xe)
004	STO 3	35 03	compute
005	RCL D	36 14	B_e (Xa)
006	GSB c	23 16 13	compute
007	STO 4	35 04	S_W (Xe)
008	RCL C	36 13	compute
009	GSB d	23 16 14	S_W (Xa)
010	STO C	35 13	compute E
011	RCL D	36 14	
012	GSB d	23 16 14	$E'' = \frac{1+e}{\sqrt{e^{2x}+1}}$
013	STO D	35 14	
014	RCL 6	36 06	
015	ENT↑	-21	$R_1 \leftarrow E(e)$
016	ENT↑	-21	
017	1	01	call for
018	+	-55	GE 3
019	X≠Y	-41	
020	X²	52	compute S_W
021	1	01	$R_9 \leftarrow X$
022	+	-55	
023	√X	54	$R_q \leftarrow 30$
024	÷	-24	
025	STO I	35 45	if X > 35
026	SPC	16-11	go compute
027	3	03	S_W
028	PRTX	-14	
029	RTN	24	else
030	*LBL d	21 16 14	$R_q \leftarrow 34$
031	STO 8	35 08	
032	3	03	if
033	0	00	X ≥ 13
034	STO 9	35 09	
035	3	03	go compute S_W
036	5	05	
037	RCL 8	36 08	else
038	X>Y?	16-34	$R_q \leftarrow 37$
039	GTO 1	22 01	compute
040	4	04	
041	ST+9	35-55 09	$\frac{+}{x^x + R_q} = S_W$
042	RCL 8	36 08	
043	1	01	
044	3	03	
045	X≤Y?	16-35	
046	GTO 1	22 01	
047	3	03	
048	ST+9	35-55 09	
049	*LBL 1	21 01	
050	RCL 8	36 08	
051	RCL 8	36 08	
052	RCL 9	36 09	
053	+	55	
054	÷	24	
055	RTN	24	
056	*LBL c	21 16 13	compute B_e

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	STO 5	35 05	save X_i in R_5
058	.	-62	compute B_e
059	2	02	
060	CHS	-22	
061	RCL E	36 15	
062	×	-35	
063	e^x	33	
064	.	-62	
065	4	04	
066	×	-35	
067	.	-62	
068	0	00	
069	3	03	
070	CHS	-22	
071	RCL E	36 15	
072	×	-35	
073	e^x	33	
074	.	-62	
075	0	00	
076	0	00	
077	0	00	
078	6	06	
079	6	06	
080	RCL 5	36 05	
081	×	-35	
082	.	-62	
083	2	02	
084	3	03	
085	2	02	
086	+	-55	
087	×	-35	
088	+	-55	
089	.	-62	
090	0	00	
091	0	00	
092	9	09	
093	CHS	-22	
094	RCL E	36 15	
095	×	-35	
096	e^x	33	
097	.	-62	
098	3	03	
099	×	-35	
100	+	-55	
101	.	-62	
102	0	00	
103	0	00	
104	2	02	
105	2	02	
106	8	08	
107	CHS	-22	
108	RCL E	36 15	
109	×	-35	
110	e^x	33	
111	.	-62	
112	0	00	

$B_e = [.3e^{-.0405 X_e} + .7e^{-.0209 X_e}](1.2 - .00054 X_e)e^{-.0022 H_{AA}} + .3e^{-.0004 H_{CM} - .0022 H_{AA}}(1.2 - .00054 X_e)e^{-.0209 X_e} + .7e^{-.24}$

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
)	1	2	3	4	2
(	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☐	DEG ☐	FIX ☐
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n ____

CARD GE-2 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	0	00	
114	0	00	
115	5	05	
116	4	04	
117	CHS	-22	
118	RCL5	36 05	
119	x	-35	
120	.	-62	
121	2	02	
122	8	08	
123	+	-55	
124	x	-35	
125	+	-55	
126	.	-62	
127	0	00	
128	2	02	
129	0	00	
130	9	09	
131	CHS	-22	
132	RCL5	36 05	
133	x	-35	
134	e^x	33	
135	.	-62	
136	7	07	
137	x	-35	
138	.	-62	
139	0	00	
140	4	04	
141	0	00	
142	8	08	
143	CHS	-22	
144	RCL5	36 05	
145	x	-35	
146	e^x	33	
147	.	-62	
148	3	03	
149	x	-35	
150	+	-55	
151	x	-35	
152	1	01	
153	X≷Y	-41	
154	X>Y?	16-34	
155	1	01	
156	RTN	24	
157	R/S	51	

Computing B_e

If $B_e > 1$

then $B_e = 1$

STEP	KEY ENTRY	KEY CODE	COMMENTS

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

CARD GE-3 Cg, DETECTOR STORY -

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	continue
002	P≠S	16-51	get secondary registers
003	RCL1	36 01	compute
004	GSBe	23 16 15	G_d (ω_u')
005	STO8	35 08	
006	RCL6	36 06	compute
007	GSBe	23 16 15	G_d (ω_L)
008	STO9	35 09	
009	P≠S	16-51	get primary registers
010	SPC	16-11	call for
011	4	04	program 4
012	PRTX	-14	
013	RTN	24	
014	*LBLe	21 16 15	Compute G_d
015	STO6	35 06	save ω
016	1	01	if $\omega = 1$
017	-	-45	
018	X=0?	16-47	$G_d = 0$
019	RTN	24	
020	RCLE	36 15	compute G_d
021	.	-62	as follows
022	0	00	
023	1	01	
024	9	09	
025	3	03	
026	CHS	-22	
027	Y^x	31	
028	.	-62	
029	9	09	
030	2	02	
031	3	03	
032	4	04	
033	x	-35	
034	RCLE	36 15	
035	.	-62	
036	2	02	
037	3	03	
038	0	00	
039	3	03	
040	Y^x	31	
041	.	-62	
042	1	01	
043	5	05	
044	8	08	
045	4	04	
046	x	-35	
047	1	01	
048	RCL6	36 06	
049	-	-45	
050	LN	32	
051	x	-35	
052	+	-55	
053	RCLE	36 15	
054	3	03	
055	X≠Y?	16-32	
056	GTO2	22 02	

$G_d = .9234 + .0193 + .1584 \cdot .383 \log(1-\omega)$

if $H \neq 3$ go to LBL 2

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	R↓	-31	else if $H = 3$
058	R↓	-31	get back G_d
059	X<0?	16-45	if $G_d < 0$
060	0	00	$G_d = 0$
061	RTN	24	return G_d
062	*LBL2	21 02	for $H \neq 3$
063	R↓	-31	get back G_d calc.
064	R↓	-31	
065	.	-62	if $G_d > .23$
066	2	02	
067	5	05	return G_d
068	X≠Y	-41	
069	X>Y?	16-34	
070	RTN	24	
071	RCLE	36 15	else compute
072	.	-62	
073	3	03	
074	2	02	
075	2	02	
076	6	06	
077	Y^x	31	
078	.	-62	
079	0	00	
080	1	01	
081	4	04	
082	0	00	
083	4	04	
084	CHS	-22	
085	x	-35	
086	RCLE	36 15	
087	.	-62	
088	4	04	
089	7	07	
090	2	02	
091	3	03	
092	CHS	-22	
093	Y^x	31	
094	8	08	
095	-	-62	
096	6	06	
097	3	03	
098	CHS	-22	
099	x	-35	
100	RCL6	36 06	
101	LN	32	
102	x	-35	
103	+	-55	
104	.	-62	
105	0	00	
106	4	04	
107	X≠Y	-41	
108	X>Y?	16-34	
109	RTN	24	
110	RCLE	36 15	
111	2	02	
112	0	00	

$G_d = 1 - .6140 + .3226 + 6.634 \cdot 1.4723 \log \omega$

if $G_d > .04$ OK return

else if $20 \leq H$

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD GE-3 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	X≠Y?	16-35	go to LBL 1
114	GTO1	22 01	
115	R↓	-31	else return
116	R↓	-31	G_d calculated
117	RTN	24	
118	*LBL1	21 01	compute
119	RCLE	36 15	
120	.	-62	
121	4	04	
122	5	05	
123	9	09	
124	7	07	
125	CHS	-22	
126	Y^x	31	
127	.	-62	
128	0	00	
129	9	09	
130	3	03	
131	8	08	
132	9	09	
133	CHS	-22	
134	x	-35	
135	RCLE	36 15	
136	.	-62	
137	6	06	
138	9	09	
139	4	04	
140	4	04	
141	CHS	-22	
142	Y^x	31	
143	1	01	
144	2	02	
145	.	-62	
146	7	07	
147	7	07	
148	CHS	-22	
149	x	-35	
150	RCL6	36 06	
151	LN	32	
152	x	-35	
153	+	-55	
154	.	-62	
155	0	00	
156	0	00	
157	6	06	
158	X≠Y?	16-34	
159	GTO3	22 03	
160	R↓	-31	
161	RTN	24	
162	*LBL3	21 03	
163	1	01	
164	RCL6	36 06	
165	-	-45	
166	.	-62	
167	3	03	
168	x	-35	

$G_d = .09389H^{-.4597} - 12.77H^{-.6944 \log B}$

else return G_d

compute $G_d = (1-G).3$

STEP	KEY ENTRY	KEY CODE	COMMENTS
169	RTN	24	
170	R/S	51	

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☐	DEG ☐	FIX ☐
1 ☐ ☐	GRAD ☐	SCI ☐
2 ☐ ☐	RAD ☐	ENG ☐
3 ☐ ☐		n____

CARD GE-4 Cg, DETECTOR STORY

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 16 11	continue
002	P≠S	16-51	get secondary registers
003	RCL5	36 05	compute
004	GSBa	23 16 11	$G_a(\omega_c) - G_a(\omega_c')$
005	STO5	35 05	
006	RCL4	36 04	Save in R_{55}
007	GSBa	23 16 11	
008	ST-5	35-45 05	
009	RCL2	36 02	compute $G_a(\omega_u)$
010	GSBa	23 16 11	
011	ST+9	35-55 09	$R_{99} \leftarrow G_d(\omega_c) + G_a(\omega_u)$
012	.	-62	
013	1	01	compute
014	X≠Y	-41	$R_{55} \times [5(.1 - G_a(\omega_u))]$
015	-	-45	
016	5	05	$= G_c$
017	x	-35	
018	ST×5	35-35 05	
019	RCL3	36 03	
020	GSBa	23 16 11	$R_B \leftarrow R_B + G_a(\omega_u)$
021	ST+8	35-55 08	
022	RCL3	36 03	
023	GSBb	23 16 12	$R_C \leftarrow G_c(\omega_a)$
024	STO6	35 06	
025	RCL1	36 01	
026	GSBb	23 16 12	$R_C \leftarrow R_C + G_s(\omega_a')$
027	ST+6	35-55 06	
028	RCL0	36 00	
029	GSBb	23 16 12	$R_7 \leftarrow G_s(\omega_c) + G_s(\omega_u)$
030	STO7	35 07	
031	RCL2	36 02	
032	GSBb	23 16 12	
033	ST+7	35-55 07	
034	RCL6	36 06	
035	RCL1	36 46	$R_A \leftarrow C_a'$
036	x	-35	$C_a' = [G_s(\omega_u) + G_s(\omega_c')$
037	RCLC	36 13	
038	x	-35	$\times [E \cdot (S_w(x_c))$
039	1	01	
040	RCLC	36 13	$+ 1 - S_w(x_c)]$
041	-	-45	
042	RCL8	36 08	$[G_d(\omega_a') + G_a(\omega_a)]$
043	x	-35	
044	+	-55	
045	STOA	35 11	$R_D \leftarrow C_a$
046	RCL6	36 06	
047	RCL1	36 46	$C_a = [G_s(\omega_a) + G_s(\omega_a')]$
048	x	-35	
049	RCLD	36 14	$\times [E \cdot S_w(x_a) + (1 - S_w)(x_a)]$
050	x	-35	
051	1	01	
052	RCLD	36 14	$\times [G_d(\omega_a') + G_g(\omega_a)]$
053	-	-45	
054	RCL5	36 05	
055	x	-35	
056	+	-55	

STEP	KEY ENTRY	KEY CODE	COMMENTS
057	STOD	35 14	
058	RCL7	36 07	$R_c \leftarrow C_g$
059	RCL1	36 46	
060	x	-35	$C_g = [G_s(\omega_u) + G_s(\omega_c)]$
061	RCLC	36 13	
062	x	-35	$\times [E \cdot S_w(x_c) + (1 - S_w)(x_c)]$
063	1	01	
064	RCLC	36 13	
065	-	-45	$\times [G_d(\omega_c) + G_a(\omega_u)]$
066	RCL9	36 09	
067	x	-35	
068	+	-55	
069	STOC	35 13	
070	RCL5	36 05	$R_B \leftarrow R_{55} = G_c$
071	STOB	35 12	
072	P≠S	16-51	get primary Registers
073	RCLC	36 13	compute
074	RCL3	36 03	
075	x	-35	$[B_c(\epsilon) - C_g$
076	RCLD	36 14	
077	RCL4	36 04	$+ (B_{ca} \cdot C_a - B_{ca} \cdot C_a$
078	x	-35	
079	RCLA	36 11	$+ B_{ca} \cdot G_c) \cdot (P_a)]$
080	CHS	-22	
081	RCL3	36 03	
082	x	-35	$\times [A_z - B_i]$
083	+	-55	
084	RCLB	36 12	
085	RCL4	36 04	
086	x	-35	
087	+	-55	
088	RCL0	36 00	
089	x	-35	
090	+	-55	
091	RCL2	36 02	
092	x	-35	
093	SPC	16-11	print code 2
094	2	02	and C_g
095	PRTX	-14	
096	R↓	-31	
097	PRTX	-14	
098	RTN	24	
099	*LBLa	21 16 11	compute G_a
100	STOE	35 15	save ω
101	.	-62	if $\omega \leq .7$
102	7	07	
103	RCLE	36 15	go to LBL 3
104	X≤Y?	16-35	
105	GTO3	22 03	if $.7 < \omega < .85$
106	.	-62	
107	8	08	go to LBL 4
108	5	05	
109	X>Y?	16-34	
110	GTO4	22 04	
111	.	-62	
112	2	02	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

CARD GE-4 (Continued)

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	2	02	for .5 ≥ D compute
114	2	02	
115	ENT↑	-21	
116	.	-62	
117	9	09	
118	6	06	
119	8	08	
120	*LBL5	21 05	
121	ENT↑	-21	
122	1	01	
123	RCLE	35 15	
124	-	-45	
125	X≷Y	-41	
126	Y^x	31	
127	x	-35	
128	RTN	24	
129	*LBL3	21 03	for D ≤ .7 compute
130	.	-62	
131	1	01	
132	0	00	
133	2	02	
134	ENT↑	-21	
135	.	-62	
136	4	04	
137	6	06	
138	5	05	
139	GTO5	22 05	
140	*LBL4	21 04	
141	.	-62	
142	1	01	
143	4	04	
144	8	08	
145	ENT↑	-21	
146	.	-62	
147	7	07	
148	7	07	
149	9	09	
150	GTO5	22 05	
151	*LBL6	21 16 12	compute G_s get G_a
152	GSBa	23 16 11	
153	5	05	
154	x	-35	
155	RTN	24	
156	R/S	51	

$G_a = .222\,(1-D)\cdot 988$

$G_a = .102\,(1-D)\cdot 465$

$G_s = 5\,G_a$

STEP	KEY ENTRY	KEY CODE	COMMENTS

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF	DEG ☐	FIX ☐
0 ☐ ☐	GRAD ☐	SCI ☐
1 ☐ ☐	RAD ☐	ENG ☐
2 ☐ ☐		n____
3 ☐ ☐		

TITLE 02

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		+/-	94		+/-	94
	A	11		X	65	075	X	65
	STO	42		RCL	43		RCL	43
	0	00	040	1	01		1	01
	0	00		1	01		1	01
005	*RTN	56		)	54		)	54
	*LBL	46		INV	22	080	INV	22
	B	12		Inx	23		Inx	23
	STO	42	045	)	54		)	54
	1	01		GTO	41		GTO	41
010	1	01		*1'	87		*1'	87
	*RTN	56		LBL	46	085	LBL	46
	*LBL	46		*2'	88		*3'	89
	C	13	050	(	53		(	53
	CLR	25		RCL	43		.	93
	(	53		1	01		5	05
	RCL	43		1	01	090	3	03
	1	01		-	75		8	08
	1	01	055	9	09		5	05
	-	75		0	00		2	02
020	2	02		)	54		X	65
	0	00		*IF POS	80	095	(	53
	)	54		*3'	89		.	93
	*IF POS	80	060	(	53		0	00
	*2'	88		.	93		2	02
025	(	53		8	08		3	03
	.	93		0	00	100	0	00
	9	09		0	00		3	03
	8	08	065	1	01		+/-	94
	8	08		X	65		X	65
030	5	05		(	53		RCL	43
	X	65		.	93	105	1	01
	(	53		0	00		1	01
	.	93	070	2	02		)	54
	0	00		7	07		INV	22
035	3	03		2	02		Inx	23
	7	07		3	03	110	)	54

TITLE 02 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
	LBL	46						
	* 1'	87						
	(	53						
	STO	42						
115	1	01						
	0	00						
	X	65						
	RCL	43'						
	0	00						
120	0	00						
	)	54						
	STO	42						
	1	01						
	2	02						
125	* RTN	56						

TITLE 01a1

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
000	*LBL	46
	A	11
	STO	42
	0	0
	6	6
005	2	2
	STO	42
	0	0
	1	1
	1	1
010	*RTN	56
	*LBL	46
	B	12
	*IND	36
	STO	42
	0	0
	1	1
	1	1
	SUM	44
	0	0
020	1	1
	RCL	43
	0	0
	1	1
	−	75
025	1	1
	=	95
	*RTN	56
	*LBL	46
	C	13
030	STO	42
	0	0
	7	7
	*RTN	56
	*LBL	46
035	D	14
	2	2

LOC.	KEY	COMMENTS
	STO	42
	1	1
	0	0
040	4	4
	STO	42
	1	1
	1	1
	E	15
045	STO	42
	0	0
	1	1
	5	5
	STO	42
050	1	1
	1	1
	E	15
	STO	42
	0	0
055	2	2
	3	3
	STO	42
	1	1
	0	0
060	4	4
	STO	42
	1	1
	1	1
	E	15
065	STO	42
	0	0
	4	4
	5	5
	STO	42
070	1	1
	1	1
	E	15
	STO	42

LOC.	KEY	COMMENTS
	0	0
075	3	3
	2	2
	*RTN	56
	*LBL	46
	E	15
080	*STFLG	50
	1	1
	(	53
	*IND	36
	RCL	43
085	1	1
	0	0
	X	65
	*IND	36
	RCL	43
090	1	1
	1	1
	)	54
	INV	22
	*IF ZRO	90
095	*5'	78
	0	0
	*RTN	56
	*LBL	46
	*5'	78
100	*IF POS	80
	*1'	87
	INV	22
	*STFLG	50
	1	1
105	*LBL	46
	*1'	87
	*IND	36
	RCL	43
	1	1
110	0	0

TITLE 01a1 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
	*IFPOS	80		*LBL	46	185	RCL	43
	* 2'	88		* 4'	77		0	0
	+/-	94	150	(	53		9	9
	*LBL	46		RCL	43		X	65
115	* 2'	88		1	1		(	53
	STO	42		2	2	190	RCL	43
	1	1		÷	55		0	0
	2	2	155	RCL	43		9	9
	*IND	36		1	1		*x^2	40
120	RCL	43		3	3		+	85
	1	1		)	54	195	RCL	43
	1	1		STO	42		0	0
	*IFPOS	80	160	0	0		8	8
	* 3'	89		8	8		*x^2	40
125	+/-	94		(	53		+	85
	*LBL	46		RCL	43	200	1	1
	* 3'	89		0	0		)	54
	(	53	165	6	6		*$\sqrt{x}$	30
	STO	42		÷	55		)	54
130	1	1		RCL	43		)	54
	3	3		1	1	205	INV	22
	-	75		3	3		tan	34
	RCL	43	170	)	54		)	54
	1	1		STO	42		*IFFLG	60
135	2	2		0	0		1	1
	)	54		9	9	210	*6'	79
	*IFPOS	80		(	53		+/-	94
	* 4'	77	175	2	2		*LBL	46
	RCL	43		÷	55		* 6'	79
140	1	1		*π	59		*RTN	56
	2	2		X	65	215		
	*EXC	48		(	53			
	1	1	180	RCL	43			
	3	3		0	0			
145	STO	42		8	8			
	1	1		÷	55			
	2	2		(	53			

SR 52

PROGRAM FORM

TITLE 01a2

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		*if zero	90		−	75
	A	11		*4'	77	075	RCL	43
	0	00		*if pos	80		0	00
	STO	42	040	*7'	67		9	09
	0	00		+/−	94		)	54
005	6	06		INV	22		*if pos	80
	4	04		*SF FLG	50	080	*8'	68
	STO	42		1	01		*if zero	90
	0	00	045	*LBL	46		*8'	68
	0	00		*7'	67		(	53
010	*LBL	46		STO	42		1	01
	*6'	79		0	00	085	.	93
	E	15		9	09		3	03
	34M	44	050	CLR	25		−	75
	0	00		(	53		1	01
	6	06		.	93		.	93
	*dsz	58		3	03	090	6	06
	*6'	79		2	02		X	65
	(	53	055	2	02		(	53
	RCL	43		X	65		.	93
020	0	00		(	53		0	00
	6	06		.	93	095	1	01
	÷	55		0	00		6	06
	4	04	060	2	02		7	07
	)	54		2	02		4	04
025	STO	42		3	03		+/−	94
	0	00		9	09	100	X	65
	0	00		+/−	94		RCL	43
	*RTN	56	065	X	65		0	00
	*LBL	46		(	53		7	07
030	E	15		RCL	43		)	54
	*ST FLG	50		0	00	105	INV	22
	1	01		7	07		Inx	23
	*IND	36	070	+	85		)	54
	RCL	43		(	53		X	65
035	0	00		.	93		(	53
	0	00		1	01	110	3	03

TITLE 01a2 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
	0	00		INV	22	185	1	01
	.	93		lnx	23		1	01
	3	03	150	X	65		−	75
	X	65		RCL	43		RCL	43
115	RCL	43		0	00		0	00
	0	00		9	09	190	8	08
	9	09		y^x	45		)	54
	y^x	45	155	(	53		*if pos	80
	1	01		1	01		*1'	87
120	.	93		.	93		(	53
	1	01		0	00	195	RCL	43
	−	75		3	03		0	00
	.	93	160	−	75		8	08
	2	02		(	53		−	75
125	3	03		.	93		.	93
	4	04		0	00	200	1	01
	X	65		0	00		7	07
	RCL	43	165	0	00		)	54
	0	00		4	04		*if pos	80
130	9	09		6	06		*1'	87
	y^x	45		X	65	205	.	93
	.	93		RCL	43		9	09
	7	07	170	0	00		*PROD	49
	3	03		7	07		0	00
135	4	04		=	95		8	08
	5	05		STO	42	210	*LBL	46
	+/−	94		0	00		*1'	87
	)	54	175	8	08		RCL	43
	GTO	41		RCL	43		0	00
140	*9'	69		0	00		8	08
	*LBL	46		7	07	215	*if flg	60
	*8'	68		*if pos	80		1	01
	0	00	180	*1'	87		*4'	77
	*LBL	46		(	53		+/−	94
145	*9'	69		.	93		*LBL	46
	)	54		0	00	220	*4'	77
	)	54		0	00		*RTN	56

C-33

TITLE 01b

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		0	00		2	02
	A	11		6	06	075	-	75
	STO	42		÷	55		.	93
	0	00	040	(	53		1	01
	3	03		RCL	43		)	54
005	*RTN	56		0	00		*IF POS	80
	*LBL	46		5	05	080	*1'	87
	B	12		÷	55		*IF ZRO	90
	STO	42	045	RCL	43		*1'	87
	0	00		0	00		0	00
010	4	04		4	04		GTO	41
	*RTN	56		X	65	085	*2'	88
	*LBL	46		2	02		LBL	46
	C	13	050	X	65		*1'	87
	STO	42		(	53		(	53
015	0	00		*x^2	40		1	01
	5	05		+	85	090	.	93
	*RTN	56		RCL	43		3	03
	*LBL	46	055	0	00		-	75
	D	14		6	06		.1	01
020	STO	42		*x^2	40		.	93
	0	00		+	85	095	6	06
	1	01		1	01		X	65
	*RTN	56	060	)	54		(	53
	*LBL	46		*$\sqrt{x}$	30		.	93
025	E	15		)	54		0	00
	CLR	25		)	54	100	1	01
	RCL	43		INV	22		6	06
	0	00	065	TAN	34		7	07
	3	03		X	65		4	04
030	+	55		2	02		+/-	94
	RCL	43		÷	55	105	X	65
	0	00		*π	59		RCL	43
	4	04	070	=	95		0	00
	=	95		(	53		1	01
035	(	53		STO	42		)	54
	STO	42		0	00	110	INV	22

TITLE 01b (CONTINUED)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
	lnX	23		(	53	185	0	00
	)	54		(	53		0	00
	X	65	150	STO	42		4	04
	(	53		+	85		6	06
115	3	03		RCL	43		X	65
	0	00		0	00	190	RCL	43
	.	93		1	01		0	00
	3	03	155	)	54		1	01
	X	65		X	65		=	95
120	RCL	43		.	93		STO	42
	0	00		0	00	195	0	00
	2	02		2	02		0	00
	y^x	45	160	2	02		*RTN	56
	1	01		3	03			
125	.	93		9	09			
	1	01		+/-	94			
	-	75		)	54			
	.	93	165	INV	22			
	2	02		lnX	23			
130	3	03		X	65			
	4	04		.	93			
	X	65		3	03			
	RCL	43	170	2	02			
	0	00		2	02			
135	2	02		X	65			
	y^x	45		RCL	43			
	.	93		0	00			
	7	07	175	2	02			
	3	03		y^x	45			
140	4	04		(	53			
	5	05		1	01			
	+/-	94		.	93			
	)	54	180	0	00			
	=	95		3	03			
145	LBL	46		-	75			
	* 2'	88		.	93			
	(	53		0	00			

TITLE GM-1

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		*RTN	56		3	03
	*E	10		*LBL	46	075	−	75
	CLR	25		*A'	16		5	05
	1	01	040	*D'	19		)	54
	9	09		(	53		*isZro	90
005	STO	42		STO	42		*2	BB
	0	00		0	00	080	RCL	43
	0	00		3	03		0	00
	0	00	045	−	75		3	03
	STO	42		4	04		*RTN	56
010	0	00		)	54		*LBL	46
	8	08		*isZro	90	085	*2	BB
	1	01		*1	01		*C'	18
	STO	42	050	RCL	43		2	02
	0	00		0	00		INV	22
	2	02		3	03		*PROD	49
	STO	42		*RTN	56	090	1	01
	0	00		*LBL	46		6	06
	1	01	055	*1	87		(	53
	*RTN	56		*C'	18		RCL	43
020	*LBL	46		0	00		1	01
	*D'	19		*D'	19	095	8	08
	*IND	36		*RTN	56		+	85
	STO	42	060	*LBL	46		RCL	43
	0	00		A	11		1	01
025	0	00		*LBL	46		6	06
	INV	22		B	12	100	)	54
	*dsz	58		*LBL	46		÷	55
	*D'	19	065	C	13		RCL	43
	(	53		*LBL	46		1	01
030	2	02		D	14		7	07
	0	00		*LBL	46	105	=	95
	−	75		E	15		INV	22
	RCL	43	070	*D'	19		TAN	34
	0	00		(	53		−	75
035	0	00		STO	42		(	53
	)	54		0	00	110	(	53

TITLE GM-1 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
	RCL	43		1	01	185	1	01
	1	01		0	00		1	01
	8	08	150	)	54		+/-	94
	−	75		*if pos	80		)	54
115	RCL	43		* 5	78		INV	22
	1	01		(	53	190	lnx	23
	6	06		RCL	43		X	65
	)	54	155	1	01		•	93
	÷	55		9	09		7	07
120	RCL	43		X	65		4	04
	1	01		•	93	195	0	00
	7	07		0	00		5	05
	)	54	160	2	02		*LBL	46
	INV	22		3	03		* 6	79
125	TAN	34		9	09		=	95
	=	95		+/-	94	200	(	53
	÷	55		)	54		STO	42
	2	02	165	INV	22		1	01
	÷	55		lnx	23		9	09
130	*π	59		X	65		−	75
	=	95		1	01	205	1	01
	*PROD	49		•	93		)	54
	1	01	170	0	00		*if pos	80
	9	09		0	00		* 7	67
135	RCL	43	.	3	03		*RTN	56
	0	00		GTO	41	210	*LBL	46
	3	03		* 6	79		* 7	67
	*RTN	56	175	*LBL	46		1	01
	*LBL	46		* 5	78		STO	42
140	* C'	18		(	53		1	01
	(	53		RCL	43	215	9	09
	(	53		1	01		* RTN	56
	RCL	43	180	9	09			
	1	01		X	65			
145	9	09		•	93			
	−	75		0	00			
	1	01		2	02			

TITLE GM-2

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		7	07		*E'	10
	A	11		STO	42	075	RCL	43
	RCL	43		1	01		1	01
	1	01	040	8	08		4	04
	6	06		GTO	41		*E'	10
005	*if zro	90		*1	87		RCL	43
	*1	87		*LBL	46	080	1	01
	RCL	43		*2	88		2	02
	1	01	045	RCL	43		-	75
	8	08		1	01		RCL	43
010	+	85		8	08		1	01
	RCL	43		+	85	085	3	03
	1	01		RCL	43		=	95
	6	06	050	1	01		*E'	10
	-	75		6	06		RCL	43
C	RCL	43		=	95		1	01
	1	01		X	65	090	2	02
	7	07		2	02		-	75
	=	95	055	=	95		RCL	43
	*if pos	80		*EXC	48		1	01
020	*2	88		1	01		4	04
	RCL	43		7	07	095	=	95
	1	01		X	65		*E'	10
	8	08	060	2	02		RCL	43
	$*x^2$	40		=	95		1	01
025	+	85		STO	42		2	02
	RCL	43		1	01	100	*E'	10
	1	01		8	08		RCL	43
	7	07	065	*LBL	46		0	00
	$*x^2$	40		*1	87		8	08
030	=	95		7	07		*if zro	90
	$*\sqrt{x}$	30		STO	42	105	*6	79
	X	65		0	00		X	65
	2	02	070	0	00		2	02
	=	95		RCL	43		=	95
035	STO	42		1	01		SUM	44
	1	01		3	03	110	1	01

TITLE GM-2 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
	7	07
	SUM	44
	1	01
	8	08
115	RCL	43
	1	01
	5	05
	*E'	10
	RCL	43
120	1	01
	5	05
	+	85
	RCL	43
	1	01
125	2	02
	=	95
	*E'	10
	RCL	43
	0	00
130	8	08
	X	65
	2	02
	=	95
	INV	22
135	SUM	44
	1	01
	7	07
	INV	22
	SUM	44
140	1	01
	8	08
	3	03
	*RTN	56
	*LBL	46
145	*E'	10
	*if zro	90
	* 7	67

LOC.	KEY	COMMENTS
	INV	22
	*if flg	50
150	1	01
	*if pos	80
	* 4	77
	*if flg	50
	1	01
155	+/-	94
	*LBL	46
	* 4	77
	STO	42
	÷	55
160	RCL	43
	1	01
	7	07
	X	65
	2	02
165	=	95
	X	65
	(	53
	*x^2	40
	+	85
170	(	53
	RCL	43
	1	01
	8	08
	÷	55
175	RCL	43
	1	01
	7	07
	)	54
	*x^2	40
180	+	85
	1	01
	)	54
	*$\sqrt{x}$	30
	=	95

LOC.	KEY	COMMENTS
185	*1/x	20
	X	65
	RCL	43
	1	01
	8	08
190	÷	55
	RCL	43
	1	01
	7	07
	=	95
195	INV	22
	TAN	34
	X	65
	2	02
	÷	55
200	*π	59
	=	95
	INV	22
	*if flg	00
	1	01
205	*5	78
	+/-	94
	*LBL	46
	*5	78
	*IND	36
210	STO	42
	0	00
	0	00
	*dsz	58
	* 6	79
215	*LBL	46
	* 6	
	3	03
	*RTN	56
	*LBL	46
220	* 7	67
	1	01
	GTO	41

223 *5 78

TITLE GM-3

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
000	*LBL	46
	A	11
	CLR	25
	RCL	43
	0	00
005	1	01
	−	75
	RCL	43
	0	00
	5	05
010	=	95
	*if pos	80
	* 3	89
	RCL	43
	0	00
	1	01
	STO	42
	0	00
	5	05
	−	75
020	RCL	43
	0	00
	4	04
	=	95
	*if pos	80
025	* 3	89
	SUM	44
	0	00
	4	04
	*LBL	46
030	* 3	89
	0	00
	STO	42
	0	00
	1	01
035	STO	42
	1	01

LOC.	KEY	COMMENTS
	6	06
	* EXC	48
	1	01
040	7	07
	INV	22
	* PROD	49
	1	01
	8	08
045	RCL	43
	1	01
	0	00
	INV	22
	*if zro	90
050	* 9	69
	RCL	43
	1	01
	4	04
	+	85
055	3	03
	=	95
	INV	22
	*if pos	80
	* 9	69
060	RCL	43
	1	01
	2	02
	−	75
	RCL	43
065	1	01
	3	03
	=	95
	INV	22
	*if pos	80
070	* 9	69
	GTO	41
	* 8	68
	*LBL	46

LOC.	KEY	COMMENTS
	* 9	69
075	0	00
	STO	42
	0	00
	4	04
	GTO	41
080	* 4	77
	*LBL	46
	* 8	68
	RCL	43
	0	00
085	4	04
	* B'	17
	STO	42
	0	00
	4	04
090	RCL	43
	0	00
	5	05
	*B'	17
	INV	22
095	SUM	44
	0	00
	4	04
	RCL	43
	0	00
100	3	03
	* A'	16
	+/-	94
	+	85
	.	93
105	1	01
	=	95
	*PROD	49
	0	00
	4	04
110	*LBL	46

TITLE GM-3 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
	* 4	77		*LBL	46	165	*A'	16
	RCL	43		* 2	88		+/-	94
	0	00	150	+/-	94		+	85
	7	07		*B'	17		1	01
115	INV	22		SUM	44		=	95
	*if pos	80		1	01	190	STO	42
	* 1	87		7	07		0	00
	*B'	17	155	GTO	41		0	00
	SUM	44		* 6	79		X	65
120	1	01		*LBL	46		.	95
	7	07		* 1	87	195	2	02
	÷	55		RCL	43		4	04
	5	05	160	0	00		−	75
	=	95		6	06		.	93
125	SUM	44		+/-	94		1	01
	1	01		*B'	17	200	4	04
	6	06		SUM	44		X	65
	RCL	43	165	1	01		RCL	43
	0	00		7	07		0	00
130	6	06		RCL	43		0	00
	INV	22		0	00	205	y^x	45
	*if pos	80		7	07		1	01
	* 2	88	170	+/-	94		.	93
	*B'	17		*B'	17		7	07
135	INV	22		INV	22		5	05
	SUM	44		SUM	44	210	=	95
	1	01		1	01		*RTN	56
	7	07	175	7	07		*LBL	46
	÷	55		*LBL	46		*B'	17
140	5	05		* 6	79		*A'	16
	=	95		4	04	215	STO	42
	INV	22		*RTN	56		X	65
	SUM	44	180	*LBL	46		5	05
	1	01		* 7	67		=	95
145	6	06		5	05		*RTN	56
	GTO	41		*RTN	56	220		
	* 7	67		*LBL	46			

TITLE GM-4

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
000	*LBL	46
	A	11
	CLR	25
	RCL	43
	0	00
005	6	06
	*if pos	80
	* 6	79
	+/-	94
	STO	42
010	0	00
	6	06
	−	75
	RCL	43
	0	00
	5	05
	2	02
	=	95
	*if pos	80
	* 6	79
	RCL	43
020	0	00
	7	07
	INV	22
	*if pos	80
	* 4	77
025	RCL	43
	0	00
	2	02
	STO	42
	0	00
030	7	07
	GTO	41
	* 5	78
	*LBL	46
	* 4	77
035	+/-	94
	STO	42

LOC.	KEY	COMMENTS
	0	00
	7	07
	−	75
040	RCL	43
	0	00
	2	02
	=	95
	INV	22
045	*if pos	80
	* 5	78
	RCL	43
	0	00
	2	02
050	STO	42
	0	00
	7	07
	*LBL	46
	* 5	78
055	RCL	43
	0	00
	6	06
	*E'	10
	SUM	44
060	0	00
	1	01
	RCL	43
	0	00
	7	07
065	*E'	10
	INV	22
	SUM	44
	0	00
	1	01
070	*LBL	46
	* 6	79
	5	05
	*RTN	56

LOC.	KEY	COMMENTS
	*LBL	46
075	*E'	10
	STO	42
	0	00
	5	05
	−	75
080	1	01
	=	95
	*if zro	90
	* 9	69
	•	93
085	9	09
	2	02
	X	65
	RCL	43
	1	01
090	5	05
	y^x	45
	•	93
	0	00
	2	02
095	+/-	94
	+	85
	•	93
	1	01
	6	06
100	X	65
	RCL	43
	1	01
	5	05
	y^x	45
105	•	93
	2	02
	3	03
	X	65
	(	53
110	1	01

TITLE GM-4 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
	−	75
	RCL	43
	0	00
	5	05
115	)	54
	lnx	23
	=	95
	STO	42
	0	00
120	0	00
	RCL	43
	1	01
	5	05
	−	75
125	3	03
	=	95
	*if zro	90
	*8	68
	*LBL	46
130	*2	88
	RCL	43
	0	00
	0	00
	−	75
135	.	93
	2	02
	5	05
	=	95
	*if pos	80
140	*8	68
	.	93
	0	00
	1	01
	4	04
145	+/−	94
	X	65
	RCL	43

LOC.	KEY	COMMENTS
	1	01
	5	05
150	y^x	45
	.	93
	3	03
	2	02
	−	75
155	8	08
	.	93
	6	06
	X	65
	RCL	43
160	1	01
	5	05
	y^x	45
	.	93
	4	04
165	7	07
	+/−	94
	X	65
	RCL	43
	0	00
170	5	05
	lnx	23
	=	95
	STO	42
	0	00
175	0	00
	−	75
	.	93
	0	00
	4	04
180	=	95
	*if pos	80
	*8	68
	.	93
	0	00

LOC.	KEY	COMMENTS
185	9	09
	4	04
	+/−	94
	X	65
	RCL	43
190	1	01
	5	05
	y^x	45
	.	93
	4	04
195	6	06
	+/−	94
	−	75
	1	01
	3	03
200	X	65
	RCL	43
	1	01
	5	05
	y^x	45
205	.	93
	6	06
	9	09
	+/−	94
	X	65
210	RCL	43
	0	00
	5	05
	lnx	23
	=	95
215	*LBL	46
	*9	69
	*RTN	56
	*LBL	46
	*8	68
220	RCL	43
	0	00
	0	00
	*RTN	56

TITLE GM-5

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
000	*LBL	46
	A	11
	CLR	25
	1	01
	+	85
005	RCL	43
	1	01
	8	08
	=	95
	÷	55
010	(	53
	RCL	43
	1	01
	8	08
	*x^2	40
	+	85
	1	01
	)	54
	*$\sqrt{x}$	30
	=	95
020	STO	42
	1	01
	8	08
	RCL	43
	1	01
025	0	00
	*D'	19
	STO	42
	1	01
	2	02
030	RCL	43
	1	01
	1	01
	*D'	19
	STO	42
035	1	01
	3	03
	1	01
	−	75
	RCL	43
040	0	00
	9	09
	=	95
	STO	42
	0	00
045	5	05
	RCL	43
	1	01
	0	00
	*C'	18
050	STO	42
	0	00
	3	03
	RCL	43
	1	01
055	1	01
	*C'	18
	STO	42
	0	00
	7	07
060	6	06
	*RTN	56
	*LBL	46
	*D'	19
	÷	55
065	(	53
	STO	42
	+	85
	3	03
	5	05
070	)	54
	=	95
	*RTN	56
	*LBL	46
	*C'	18
075	(	53
	(	53
	STO	42
	1	01
	4	04
080	X	65
	.	93
	0	01
	4	04
	1	01
085	+/-	94
	)	54
	INV	22
	lnx	23
	X	65
090	.	93
	3	03
	+	85
	.	93
	7	07
095	X	65
	(	53
	RCL	43
	1	01
	4	04
100	X	65
	.	93
	0	00
	2	02
	1	01
105	+/-	94
	)	54
	INV	22
	lnx	23
	)	54
110	X	65

TITLE GM-5 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
	(	53
	(	53
	.	93
	2	02
115	8	08
	−	75
	.	93
	0	00
	0	00
120	0	00
	5	05
	4	04
	X	65
	RCL	43
125	1	01
	4	04
	)	54
	X	65
	(	53
130	RCL	43
	1	01
	5	05
	X	65
	.	93
135	0	00
	0	00
	2	02
	3	03
	+/−	94
140	)	54
	INV	22
	Inx	23
	+	85
	.	93
145	3	03
	X	65
	(	53

LOC.	KEY	COMMENTS
	.	93
	0	00
150	0	00
	9	09
	+/−	94
	X	65
	RCL	43
155	1	01
	5	05
	)	54
	INV	22
	Inx	23
160	+	85
	(	53
	.	93
	2	02
	3	03
165	+	85
	.	93
	6	00
	0	00
	0	00
170	6	06
	6	06
	X	65
	RCL	43
	1	01
175	4	04
	)	54
	X	65
	(	53
	RCL	43
180	1	01
	5	05
	X	65
	.	93
	0	00

LOC.	KEY	COMMENTS
185	3	03
	+/−	94
	)	54
	INV	22
	Inx	23
190	+	85
	.	93
	4	04
	X	65
	(	53
195	RCL	43
	1	01
	5	05
	X	65
	.	93
200	2	02
	+/−	94
	)	54
	INV	23
	Inx	22
205	=	95
	STO	42
	1	01
	4	04
	−	75
210	1	01
	=	95
	*if neg	80
	* 1	87
	RCL	43
215	1	01
	4	04
	*RTN	56
	*LBL	46
	* 1	87
220	1	01
	*RTN	56

TITLE GM-6

SR 52

PROGRAM FORM

LOC.	KEY	CODE	COMMENTS
000	*LBL	46	
	A	11	
	CLR	25	
	(	53	
	RCL	43	
005	1	01	
	6	06	
	+	85	
	RCL	43	
	0	00	
010	1	01	
	)	54	
	X	65	
	(	53	
	(	53	
	1	01	
	−	75	
	RCL	43	
	1	01	
	3	03	
020	)	54	
	X	65	
	RCL	43	
	0	00	
	7	07	
025	X	65	
	RCL	43	
	0	00	
	5	05	
	+	85	
030	(	53	
	1	01	
	−	75	
	RCL	43	
	1	01	
035	2	02	
	)	54	
	X	65	
	RCL	43	
	0	00	
	3	03	
	X	65	
	RCL	43	
	0	00	
	4	04	
040	X	65	
	RCL	43	
	0	00	
	3	03	
	X	65	
	RCL	43	
	0	00	
	9	09	
045	)	54	
	+	85	
	RCL	43	
	0	00	
	1	01	
	4	04	
050	X	65	
	RCL	43	
	0	00	
	3	03	
	X	65	
055	RCL	43	
	0	00	
	9	09	
	=	95	
	STO	42	
060	0	00	
	0	00	
	RCL	43	
	0	00	
	2	02	
065	−	75	
	1	01	
	=	95	
	INV	22	
	*if zro	90	
070	*	39	
	RCL	43	
	1	01	
	7	07	
	X	65	
	RCL	43	
075	RCL	43	
	1	01	
	8	08	
	X	65	
	(	53	
080	RCL	43	
	0	00	
	7	07	
	X	65	
	RCL	43	
085	1	01	
	3	03	
	X	65	
	RCL	43	
	0	00	
090	5	05	
	+	85	
	RCL	43	
	0	00	
	3	03	
095	X	65	
	RCL	43	
	1	01	
	2	02	
	X	65	
100	RCL	43	
	0	00	
	9	09	
	=	95	
	SUM	44	
105	0	00	
	0	00	
	RCL	43	
	0	00	
	0	00	
110	X	65	

TITLE GM-6 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
	RCL	43
	1	01
	9	09
	=	95
115	STO	42
	0	00
	0	00
	*RTN	56
	*LBL	46
120	* 3	89
	RCL	43
	0	00
	8	08
	÷	55
125	RCL	43
	1	01
	5	05
	=	95
	INV	22
130	tan	34
	X	65
	2	02
	÷	55
	* π	59
135	=	95
	STO	42
	0	00
	8	08
	+/-	94
140	+	85
	.	93
	8	08
	=	95
	INV	22
145	*if pos	80
	* 9	69
	RCL	43

LOC.	KEY	COMMENTS
	1	01
	1	01
150	* A'	16
	STO	42
	0	00
	7	07
	RCL	43
155	1	01
	0	00
	* A'	16
	STO	42
	0	00
160	3	03
	*LBL	46
	* 9	69
	7	07
	*RTN	56
165	*LBL	46
	* A'	16
	STO	42
	1	01
	4	04
170	*if zero	90
	* 8	68
	.	93
	2	02
	8	08
175	X	65
	(	53
	RCL	43
	1	01
	4	04
180	X	65
	.	93
	0	00
	2	02
	2	02

LOC.	KEY	COMMENTS
185	+/-	94
	)	54
	INV	22
	$\ln x$	23
	X	65
190	RCL	43
	0	00
	8	08
	y^x	45
	(	53
195	.	93
	9	09
	8	08
	X	65
	RCL	43
200	1	01
	4	04
	y^x	45
	.	93
	2	02
205	2	02
	=	95
	*RTN	56
	*LBL	46
	* 8	68
210	.	93
	2	02
	3	03
	X	65
	RCL	43
215	0	00
	8	08
	y^x	45
	1	01
	.	93
20	0	00
	5	05
	=	95
	*RTN	56

TITLE GM-7

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
000	*LBL	46
	A	11
	RCL	43
	0	00
	8	08
005	+/-	94
	+	85
	.	93
	&	08
	=	95
010	INV	22
	*if pos	80
	*9	69
	RCL	43
	0	00
	1	01
	STO	42
	1	01
	4	04
	RCL	43
020	0	00
	3	03
	*A'	16
	*PROD	49
	0	00
025	3	03
	RCL	43
	1	01
	1	01
	STO	42
030	1	01
	4	04
	RCL	43
	8	08
	7	07
	GTO	41
040	*&	68
	*LBL	46
	*9	69
	.	93
	2	02
045	2	02
	+	85
	(	53
	RCL	43
	1	01
050	5	05
	-	75
	3	03
	)	54
	÷	55
055	(	53
	RCL	43
	1	01
	5	05
	+	85
060	1	01
	2	02
	0	00
	=	95
	y^x	45
065	(	53
	5	05
	-	75
	5	05
	)	54
070	RCL	43
	8	08
	8	08
	=	95
	INV	22
	*if zero	90
	*7	67
075	1	01
	4	04
	RCL	43
	0	00
	8	08
080	-	75
	1	01
	=	95
	*if zero	90
	*7	67
085	RCL	43
	1	01
	5	05
	-	75
	3	03
090	=	95
	INV	22
	*if zero	90
	*6	79
	.	93
095	9	09
	PROD	49
	1	01
	4	04
	GTO	41
100	*7	67
	*LBL	46
	*6	79
	RCL	43
	1	01
105	5	05
	-	75
	2	02
	0	00
	=	95
110	INV	22

TITLE GM-BR

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
000	*LBL	46
	A	11
	STO	42
	0	00
	5	05
005	*RTN	56
	*LBL	46
	B	12
	CLR	25
	(	53
010	1	01
	−	75
	3	03
	.	93
	5	05
C	X	65
	(	53
	RCL	43
	0	00
	6	06
020	X	65
	2	02
	.	93
	3	03
	+/−	94
025	)	54
	INV	22
	Inx	23
	)	54
	X	65
030	(	53
	RCL	43
	0	00
	5	05
	X	65
035	.	93
	1	01
	+/−	94
	)	54
	INV	22
040	Inx	23
	+	85
	3	03
	.	93
	5	05
045	X	65
	(	53
	RCL	43
	0	00
	6	06
050	X	65
	2	02
	.	93
	3	03
	+/−	94
055	)	54
	INV	22
	Inx	23
	X	65
	(	53
060	RCL	43
	0	00
	5	05
	X	65
	.	93
065	0	00
	4	04
	+/−	94
	)	54
	INV	22
070	Inx	23
	=	95
	STO	42
	1	01
	4	04
075	−	75
	1	01
	=	95
	INV	22
	*if pos	80
080	* 2	BB
	1	01
	STO	42
	1	01
	4	04
085	*LBL	46
	* 2	BB
	RCL	43
	1	01
	4	04
090	X	65
	RCL	43
	0	00
	0	00
	=	95
095	*RTN	56
	*LBL	46
	C	13
	CLR	25
	RCL	43
100	0	00
	5	05
	−	75
	2	02
	.	93
105	5	05
	=	95
	INV	22
	*if neg	80
	* 3	BC
110	1	01

TITLE GM-7 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
	*if pos	80
	* 7	07
	1	01
	.	93
115	0	00
	5	05
	*PROD	49
	1	01
	4	04
120	*LBL	46
	* 7	07
	RCL	43
	1	01
	4	04
125	*PROD	49
	0	00
	3	03
	*PROD	49
	0	00
130	7	07
	*LBL	46
	* 8	08
	RCL	43
	1	01
135	7	07
	X	65
	RCL	43
	1	01
	8	08
140	X	65
	(	53
	RCL	43
	0	00
	3	03
145	X	65
	RCL	43
	1	01

LOC.	KEY	COMMENTS
	2	02
	X	65
150	RCL	43
	0	00
	9	09
	+	85
	RCL	43
155	0	00
	7	07
	X	65
	RCL	43
	1	01
160	3	03
	X	65
	RCL	43
	0	00
	0	00
	5	05
165	=	95
	+	85
	RCL	43
	0	00
	0	00
170	=	95
	X	65
	RCL	43
	1	01
	9	09
175	=	95
	STO	42
	0	00
	0	00
	*RTN	56
180	*LBL	46
	*A'	16
	-	75
	.	93
	0	00

LOC.	KEY	COMMENTS
185	0	00
	2	02
	=	95
	*if pos	80
	* 5	78
190	2	02
	0	00
	-	75
	RCL	43
	1	01
195	4	04
	=	95
	*if pos	80
	* 5	78
	RCL	43
200	1	01
	4	04
	-	75
	7	07
	5	05
205	=	95
	*if pos	80
	* 5	78
	1	01
	.	93
210	2	02
	*RTN	56
	*LBL	46
	* 5	78
	1	01
215	*RTN	56

TITLE GM BR (continued)

SR 52 C-50

PROGRAM FORM

LOC.	KEY	COMMENTS
	0	00
	−	75
	RCL	43
	0	00
115	5	05
	=	95
	INV	22
	*if pos	80
	* 4	77
120	.	93
	8	08
	2	02
	8	08
	7	07
125	X	65
	RCL	43
	0	00
	5	05
	y^x	45
130	.	93
	3	03
	9	09
	9	09
	9	09
135	+/−	94
	=	95
	GTO	41
	* 5	78
	*LBL	46
140	* 3	89
	(	53
	.	93
	2	02
	2	02
145	4	04
	8	08
	+/−	94

LOC.	KEY	COMMENTS
	X	65
	RCL	43
150	0	00
	5	05
	)	54
	INV	22
	Inx	23
155	=	95
	GTO	41
	* 5	78
	*LBL	46
	* 4	77
160	1	01
	0	00
	y^x	45
	(	53
	RCL	43
165	0	00
	5	05
	X	65
	.	93
	0	00
170	0	00
	9	09
	3	03
	8	08
	+/−	94
175	)	54
	X	65
	RCL	43
	0	00
	5	05
180	y^x	45
	.	93
	3	03
	8	08
	+/−	94

LOC.	KEY	COMMENTS
185	=	95
	*LBL	46
	* 5	78
	STO	42
	1	01
190	4	04
	GTO	41
	* 2	88
195		

TITLE GE-1

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		)	54		*PROD	49
	*E'	10		*if zero	90	075	1	01
	CLR	25		*1	87		4	04
	1	01	040	RCL	43		2	02
	9	09		0	00		*RTN	56
005	STO	42		3	03		*LBL	46
	0.	00		*RTN	56	080	*2	BB
	0	00		*LBL	46		*C'	18
	1	01	045	*1	87		2	02
	*RTN	56		*C'	18		INV	22
010	*LBL	46		0	00		*PROD	49
	*D'	19		*D'	19	085	1	01
	*IND	36		*RTN	56		6	06
	STO	42	050	*LBL	46		(	53
	0	00		A	11		RCL	43
015	0	00		*LBL	46		1	01
	INV	22		B	12	090	B	08
	*dsz	5B		*LBL	46		+	85
	*D'	19	055	C	13		RCL	43
	(	53		*D'	19		1	01
020	2	02		STO	42		6	06
	0	00		0	00	095	)	54
	-	75		3	03		÷	55
	RCL	43	060	-	75		RCL	43
	0	00		5	05		1	01
025	0	00		=	95		7	07
	)	54		*if zero	90	100	=	95
	*RTN	56		*2	BB		INV	22
	*LBL	46	065	RCL	43		tan	34
	*A'	16		0	00		-	75
030	*D'	19		3	03		(	53
	(	53		*RTN	56	105	(	53
	STO	42		*LBL	46		RCL	43
	0	00	070	D	14		1	01
	3	03		*D'	19		B	08
035	-	75		1	01		-	75
	4	04		+/-	94	110	RCL	43

TITLE GE-1 (continued)

SR 52

C-52

PROGRAM FORM

LOC.	KEY	COMMENTS
	1	01
	6	06
	)	54
	÷	55
115	RCL	43
	1	01
	7.	07
	)	54
	INV	22
120	tan	34
	=	95
	÷	55
	2	02
	÷	55
125	* π	59
	=	95
	*PROD	49
	1	01
	9	09
130	RCL	43
	0	00
	3	03
	*RTN	56
	*LBL	46
135	* C'	18
	(	53
	(	53
	RCL	43
	1	01
140	9	09
	-	75
	1	01
	1	01
	0	00
145	)	54
	*ifpos	80
	*5	78

LOC.	KEY	COMMENTS
	(	53
	RCL	43
150	1	01
	9	09
	X	65
	.	93
	0	00
155	2	02
	3	03
	9	09
	+/-	94
	)	54
160	INV	22
	Inx	23
	X	65
	1	01
	.	93
165	0	00
	0	00
	3	03
	GTO	41
	*6	79
170	*LBL	46
	*5	78
	(	53
	RCL	43
"	1	01
175	9	09
	X	65
	.	93
	0	00
	2	02
180	1	01
	1	01
	+/-	94
	)	54
	INV	22

LOC.	KEY	COMMENTS
185	Inx	23
	X	65
	.	93
	7	07
	4	04
190	0	00
	5	05
	*LBL	46
	*6	79
	=	95
195	(	53
	STO	42
	1	01
	9	09
	-	75
200	1	01
	)	54
	*ifpos	80
	*7	67
	*RTN	56
205	*LBL	46
	*7	67
	1	01
	STO	42
	1	01
210	9	09
	*RTN	56

TITLE GE-2

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
000	*LBL	46
	A	11
	RCL	43
	1	01
	6	06
005	*if zero	90
	* 1	87
	RCL	43
	1	01
	8	08
010	+	85
	RCL	43
	1	01
	6	06
	−	75
	RCL	43
	1	01
	7	07
	=	95
	*if pos	80
020	* 2	88
	RCL	43
	1	01
	8	08
	*x^2	40
025	+	85
	RCL	43
	1	01
	7	07
	*x^2	40
030	=	95
	*$\sqrt{x}$	30
	X	05
	2	02
	=	95
035	STO	42
	1	01
	7	07
	STO	42
	1	01
	8	08
040	GTO	41
	* 1	87
	*LBL	46
	* 2	88
045	RCL	43
	1	01
	8	08
	+	85
	RCL	43
050	1	01
	6	06
	=	95
	X	65
	2	02
055	=	95
	*EXC	48
	1	01
	7	07
	X	65
060	2	02
	=	95
	STO	42
	1	01
	8	08
065	*LBL	46
	* 1	87
	7	07
	STO	42
	0	00
070	0	00
	3	03
	*E'	10
	RCL	43
	1	01
	1	01
075	4	04
	*E'	10
	RCL	43
	1	01
	2	02
080	*E'	10
	RCL	43
	1	01
	3	03
	*E'	10
085	RCL	43
	1	01
	2	02
	−	75
	RCL	43
090	1	01
	3	03
	=	95
	*E'	10
	RCL	43
095	1	01
	2	02
	+	85
	RCL	43
	1	01
100	4	04
	=	95
	*E'	10
	RCL	43
	1	01
105	8	08
	÷	55
	RCL	43
	1	01
	7	07
110	=	95

TITLE GE-2 (continued)

SR 52

C54

PROGRAM FORM

LOC.	KEY	COMMENTS
	+	85
	1	01
	=	95
	÷	55
115	(	53
	(	53
	RCL	43
	1	01
	8	08
120	÷	55
	RCL	43
	1	01
	7	07
	)	54
125	* x^2	40
	+	85
	1	01
	)	54
	* $\sqrt{x}$	30
130	=	95
	STO	42
	1	01
	6	06
	RCL	43
135	1	01
	0	00
	* D'	19
	STO	42
	1	01
140	7	07
	RCL	43
	1	01
	1	01
	* D'	19
145	STO	42
	1	01
	8	08

LOC.	KEY	COMMENTS
	3	03
	*RTN	56
150	*LBL	46
	* D'	19
	÷	55
	(	53
	STO	42
155	+	85
	3	03
	5	05
	=	95
	*RTN	56
160	*LBL	46
	* E'	10
	*if zero	90
	* 7	67
	STO	42
165	÷	55
	RCL	43
	1	01
	7	07
	X	65
170	2	02
	=	95
	X	65
	(	53
	* x^2	40
175	+	85
	(	53
	RCL	43
	1	01
	8	08
180	÷	55
	RCL	43
	1	01
	7	07
	)	54

LOC.	KEY	COMMENTS
185	* x^2	40
	+	85
	1	01
	)	54
	* $\sqrt{x}$	30
190	=	95
	* 1/x	20
	X	65
	RCL	43
	1	01
195	8	08
	÷	55
	RCL	43
	1	01
	7	07
200	=	95
	INV	22
	tan	34
	X	65
	2	02
205	÷	55
	* π	59
	=	95
	*LBL	46
	* 5	78
210	* IND	36
	STO	42
	0	00
	0	00
	* dsz	58
215	* 6	79
	*LBL	46
	* 6	79
	*RTN	56
	*LBL	46
220	* 7	67
	1	01
	GTO	41
	* 5	78

TITLE GE-3

SR 52

PROGRAM FORM

LOC.	KEY		COMMENTS
000	*LBL	46	
	A	11	
	CLR	25	
	RCL	43	
	1	01	
005	0	00	
	*C'	18	
	STO	42	
	1	01	
	0	00	
010	RCL	43	
	1	01	
	1	01	
	*C'	18	
	STO	42	
	1	01	
	1	01	
	4	04	
	*RTN	56	
	*LBL	46	
020	*C'	18	
	(	53	
	(	53	
	STO	42	
	0	00	
025	1	01	
	X	65	
	.	93	
	0	00	
	4	04	
030	0	00	
	8	08	
	+/-	94	
	)	54	
	INV	22	
035	lnx	23	
	X	65	

LOC.	KEY		COMMENTS
	.	93	
	3	03	
	+	85	
040	.	93	
	7	07	
	X	65	
	(	53	
	RCL	43	
045	0	00	
	1	01	
	X	65	
	.	93	
	0	00	
050	2	02	
	0	00	
	9	09	
	+/-	94	
	)	54	
055	INV	22	
	lnx	23	
	)	54	
	X	65	
	(	53	
060	(	53	
	.	93	
	2	02	
	8	08	
	−	75	
065	.	93	
	0	00	
	0	00	
	0	00	
	5	05	
070	4	04	
	X	65	
	RCL	43	
	0	00	

LOC.	KEY		COMMENTS
	1	01	
075	)	54	
	X	65	
	(	53	
	RCL	43	
	1	01	
080	5	05	
	X	65	
	.	93	
	0	00	
	0	00	
085	2	02	
	2	02	
	8	08	
	+/-	94	
	)	54	
090	INV	22	
	lnx	23	
	+	85	
	.	93	
	3	03	
095	X	65	
	(	53	
	.	93	
	0	00	
	0	00	
100	9	09	
	+/-	94	
	X	65	
	RCL	43	
	1	01	
105	5	05	
	)	54	
	INV	22	
	lnx	23	
	+	85	
110	(	53	

TITLE GE-3 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
	•	93
	2	02
	3	03
	2	02
115	+	85
	•	93
	0	00
	0	00
	0	00
120	6	06
	6	06
	X	65
	RCL	43
	0	00
125	1	01
	)	54
	X	65
	(	53
	RCL	43
130	1	01
	5	05
	X	65
	•	93
	0	00
135	3	03
	+/-	94
	)	54
	INV	22
	Inx	23
140	+	85
	•	93
	4	04
	X	65
	(	53
145	RCL	43
	1	01
	5	05

LOC.	KEY	COMMENTS
	X	65
	•	93
150	2	02
	+/-	94
	)	54
	INV	22
	Inx	23
155	=	95
	STO	42
	0	00
	1	01
	-	75
160	1	01
	=	95
	*if pos	80
	* 1	87
	RCL	43
165	0	00
	1	00
	*RTN	56
	*LBL	46
	* 1	87
170	1	01
	*RTN	56
175		
180		

LOC.	KEY	COMMENTS
185		

TITLE GE-4

SR 52

C-57

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		5	5		5	05
	A	11		y^x	45	075	−	75
	CLR	25		•	93		3	03
	RCL	43	040	0	00		=	95
	0	00		1	01		*if zero	90
005	6	06		9	09		* &	68
	*E'	10		3	03	080	*LBL	46
	STO	42		+/−	94		* 2	88
	1	01	045	+	85		RCL	43
	3	03		•	93		0	00
010	RCL	43		1	01		0	00
	0	00		5	05	085	−	75
	7	07		&	08		•	93
	*E'	10	050	4	04		2	02
	STO	42		X	65		5	05
015	1	01		RCL	43		=	95
	4	04		1	01	090	if pos	80
	5	05		5	05		* &	68
	*RTN	56	055	y^x	45		•	93
	*LBL	46		•	93		0	00
020	*E'	10		2	02		1	01
	STO	42		3	03	095	4	04
	0	00		X	65		+/−	94
	1	01	060	(	53		X	65
	−	75		1	01		RCL	43
025	1	01		−	75		1	01
	=	95		RCL	43	100	5	05
	*if zero	90		0	00		y^x	45
	*9	69	065	1	01		•	93
	•	93		)	54		3	03
030	9	09		lnx	23		2	02
	2	02		=	95	105	2	02
	3	03		STO	42		6	06
	4	04	070	0	00		−	75
	X	65		0	00		8	08
035	RCL	43		RCL	43		•	93
	1	01		1	01	110	6	06

TITLE GE-4 (continued)

SR 52

PROGRAM FORM

LOC.	KEY	COMMENTS
	3	03
	X	65
	RCL	43
	1	01
115	5	05
	y^x	45
	.	93
	4	04
	7	07
120	2	02
	3	03
	+/-	94
	X	65
	RCL	43
125	0	00
	1	01
	Inx	23
	=	95
	STO	42
130	0	00
	0	00
	−	75
	.	93
	0	00
135	4	04
	=	95
	*if pos	80
	* 8	68
	RCL	43
140	1	01
	5	05
	−	75
	2	02
	0	00
145	=	95
	*if pos	80
	* 1	87

LOC.	KEY	COMMENTS
	* 8	68
	*LBL	46
150	* 1	87
	.	93
	0	00
	9	09
	3	03
155	9	09
	+/-	94
	X	65
	RCL	43
	1	01
160	5	05
	y^x	45
	.	93
	4	04
	6	06
165	+/-	94
	−	75
	1	01
	2	02
	.	93
170	7	07
	7	07
	X	65
	RCL	43
	1	01
175	5	05
	y^x	45
	.	93
	6	06
	9	09
180	4	04
	+/-	94
	X	65
	RCL	43
	0	00

LOC.	KEY	COMMENTS
185	1	01
	Inx	23
	=	95
	STO	42
	0	00
190	0	00
	−	75
	.	93
	6	00
	0	00
195	6	06
	=	95
	*if pos	80
	* 8	68
	1	01
200	−	75
	RCL	43
	0	00
	1	01
	=	95
205	X	65
	.	93
	3	03
	=	95
	*RTN	56
210	*LBL	46
	* 9	69
	*RTN	56
	*LBL	46
	* 8	68
215	RCL	43
	0	00
	0	00
	*if pos	80
	* 5	78
220	0	00
	*LBL	46
	* 5	78
	*RTN	56

TITLE GE-5

SR 52

C-59

PROGRAM FORM

LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS	LOC.	KEY	COMMENTS
000	*LBL	46		SUM	44		+	85
	A	11		1	01	075	RCL	43
	CLR	25		3	03		1	01
	RCL	43	040	X	65		3	03
	0	00		5	05		X	65
005	2	02		=	95		(	53
	*B'	17		STO	42	080	1	01
	STO	42		1	01		−	75
	0	00	045	2	02		RCL	43
	2	02		RCL	43		1	01
010	RCL	43		0	00		&	08
	0	00		6	06	085	=	95
	3	03		*B'	17		STO	42
	*B'	17	050	SUM	44		0	00
	INV	22		1	01		4	04
015	SUM	44		2	02		RCL	43
	0	00		RCL	43	090	1	01
	2	02		0	00		2	02
	RCL	43	055	7	07		X	65
	0	00		*B'	17		RCL	43
020	5	05		STO	42		1	01
	*A'	16		0	00	095	6	06
	SUM	44		8	08		X	65
	1	01	060	RCL	43		RCL	43
	4	04		0	00		1	01
025	+/−	94		5	05		7	07
	+	85		*B'	17	100	+	85
	.	93		SUM	44		RCL	43
	1	01	065	0	00		1	01
	=	95		8	08		3	03
030	*PROD	49		RCL	43		X	65
	0	00		1	01	105	(	53
	2	02		2	02		1	01
	RCL	43	070	X	65		−	75
	0	00		RCL	43		RCL	43
035	4	04		1	01		1	01
	*A'	16		6	06	110	7	07

TITLE GE-5 (continued)

SR 52

C-60

PROGRAM FORM

LOC.	KEY	COMMENTS
	=	95
	STO	42
	0	00
	6	06
115	RCL	43
	0	00
	&	08
	X	65
	RCL	43
120	0	01
	6	06
	X	65
	RCL	43
	1	01
125	8	08
	+	85
	RCL	43
	1	01
	4	04
130	X	65
	(	53
	1	01
	−	75
	RCL	43
135	1	01
	8	08
	=	95
	X	65
	RCL	43
140	1	01
	1	01
	+	85
	(	53
	RCL	43
145	1	01
	0	00
	X	65

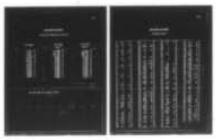
LOC.	KEY	COMMENTS
	RCL	43
	0	00
150	6	06
	−	75
	RCL	43
	1	01
	1	01
155	X	65
	RCL	43
	0	00
	4	04
	+	85
160	RCL	43
	1	01
	0	00
	X	65
	RCL	43
165	0	00
	2	02
	)	54
	X	65
	RCL	43
170	0	00
	9	09
	=	95
	X	65
	RCL	43
175	1	01
	9	09
	=	95
	STO	42
	0	00
180	0	00
	*RTN	56
	*LBL	46
	*A'	16
	+/−	94

LOC.	KEY	COMMENTS
185	+	185
	1	01
	=	95
	STO	42
	0	00
190	0	00
	X	65
	.	93
	2	02
	4	04
195	−	75
	.	93
	1	01
	4	04
	X	65
200	RCL	43
	0	00
	0	00
	y^x	45
	1	01
205	.	93
	7	07
	5	05
	=	95
	*RTN	56
210	*LBL	46
	*B'	17
	*A'	16
	STO	42
	X	65
215	5	05
	=	95
	*RTN	56

AD-A055 278 UTAH UNIV SALT LAKE CITY GRADUATE SCHOOL OF ARCHITECTURE F/G 9/2
SERVICES TO DEVELOP POCKET COMPUTERS TO PERFORM PF CALCULATING --ETC(U)
JAN 78 S W CRAWLEY DCPA01-76-C-0325

UNCLASSIFIED NL

2 OF 2
AD
A055278



END
DATE
FILMED
7 -78
DDC

OF 2

55278

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Co Process

2.0002
0.3216
-0.0224
1.0290
-0.0005
-0.0167
30.3000
1.1670
-0.2340
-0.7345
0.0000
0.0000
0.0000
0.0000
0.0000
0.0000

See ne

Jack LeDoux's Process

reload All Registers as Follows:

Cg Process Card 1		Cg Process Card 2	
-0.6666	0	-0.6666	0
300.3280	1	300.3280	1
200.1100	2	200.1100	2
46.8140	3	46.8140	3
0.0000	4	0.0000	4
0.0000	5	0.0000	5
0.0001	6	0.0001	6
5.7900	7	5.7900	7
17.4000	8	17.4000	8
-0.0239	9	-0.0239	9
0.0000	A	0.0000	A
0.0000	B	0.0000	B
0.0000	C	0.0000	C
0.0000	D	0.0000	D
0.0000	E	0.0000	E
0.0000	F	0.0000	F

for program listing.

Jack LeDoux's Process

Program Listing

21 11	051	+	-55	101	RCL5	36 05	151	+	-55
16-51	052	Y^x	31	102	×	-35	152	STOD	35 14
35 12	053	RCLE	36 15	103	e^x	33	153	RCLE	36 15
-31	054	RCL8	36 08	104	1	01	154	RCLC	36 13
-24	055	+	-55	105	.	-62	155	+	-55
35 00	056	RCL2	36 02	106	6	06	156	STOC	35 13
16-53	057	×	-35	107	×	-35	157	RTN	24
-41	058	e^x	33	108	CHS	-22	158	*LBLE	21 15
-31	059	×	-35	109	1	01	159	STOE	35 15
-24	060	RCL1	36 01	110	.	-62	160	R↓	-31
35 01	061	×	-35	111	3	03	161	STOB	35 12
53	062	F1?	16 27 01	112	+	-55	162	GTO5	22 05
04	063	GTO7	22 07	113	×	-35	163	RTN	24
-35	064	F0?	16 23 00	114	STO0	35 00	164	*LBLB	21 12
36 00	065	GTO4	22 04	115	RTN	24	165	SF0	16 21 00
53	066	STOA	35 11	116	*LBL6	21 06	166	GSBA	23 11
-55	067	STOC	35 13	117	X=0?	16-43	167	CF0	16 22 00
01	068	RTN	24	118	GTO3	22 03	168	RTN	24
-55	069	*LBL1	21 01	119	P≠S	16-51	169	*LBLC	21 13
54	070	P≠S	16-51	120	ENT↑	-21	170	SF1	16 21 01
36 01	071	RCLE	36 15	121	ENT↑	-21	171	GSBA	23 11
-35	072	RCL9	36 09	122	RCL6	36 06	172	CF1	16 22 01
02	073	Y^x	31	123	×	-35	173	RTN	24
-35	074	RCLE	36 15	124	e^x	33	174	*LBL7	21 07
53	075	RCL8	36 08	125	RCL5	36 05	175	RCLC	36 13
36 00	076	Y^x	31	126	×	-35	176	-	-45
-35	077	+	-55	127	X≠Y	-41	177	R/S	51
16 43	078	RCL7	36 07	128	RCL4	36 04	178	GSB6	23 06
09	079	×	-35	129	×	-35	179	×	-35
00	080	F1?	16 23 01	130	e^x	33	180	RCLC	36 14
-24	081	GTO7	22 07	131	+	-55	181	+	-55
35 15	082	F0?	16 23 00	132	RCL3	36 03	182	STOD	35 14
16-51	083	GTO4	22 04	133	×	-35	183	RTN	24
21 05	084	STOA	35 11	134	STOI	35 46	184	*LBLD	21 14
00	085	STOC	35 13	135	P≠S	16-51	185	RCLA	36 11
35 00	086	P≠S	16-51	136	RTN	24	186	RCLD	36 14
36 12	087	RTN	24	137	*LBL3	21 03	187	+	-55
16-43	088	*LBL2	21 02	138	1	01	188	STOB	35 12
22 01	089	RCLE	36 15	139	STOI	35 46	189	0	00
-62	090	RCL9	36 09	140	RTN	24	190	STOC	35 13
01	091	Y^x	31	141	*LBL4	21 04	191	STOD	35 14
36 15	092	RCL8	36 08	142	RCLA	36 11	192	STOA	35 11
16 51	093	×	-35	143	-	-45	193	CF0	16 22 00
16-34	094	RCLE	36 15	144	R/S	51	194	CF1	16 22 01
23 02	095	RCL7	36 07	145	X≠Y	-41	195	RCLB	36 12
36 15	096	Y^x	31	146	STOE	35 15	196	RTN	24
36 12	097	RCL6	36 06	147	X≠Y	-41	197	R/S	51
36 04	098	×	-35	148	GSB6	23 06			
-35	099	+	-55	149	×	-35			
36 03	100	RCLE	36 12	150	RCLD	36 14			