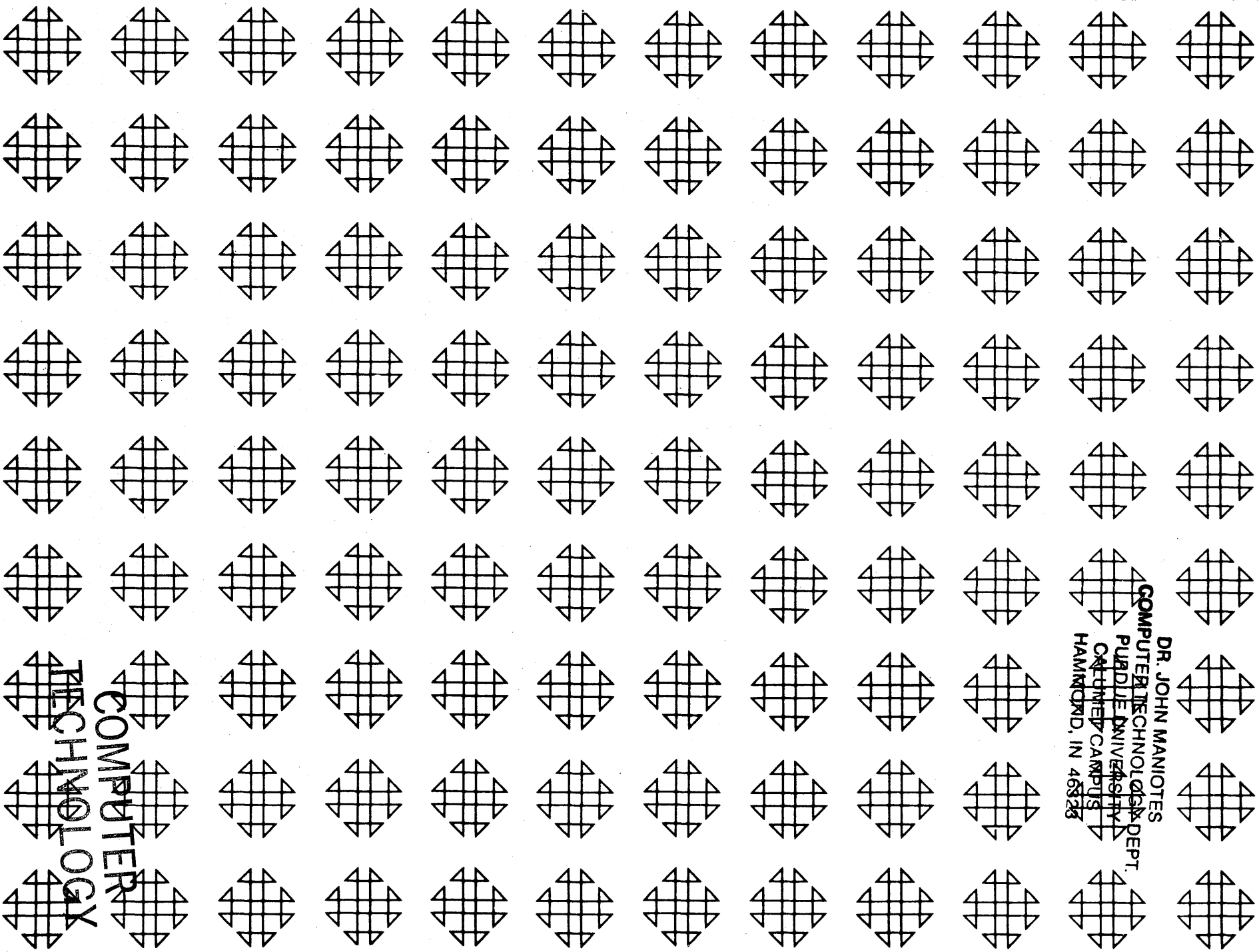


CONTRIBUTED PROGRAM LIBRARY

Inverse Geodetic Position Computation
1620-9.2.021



Inverse Geodetic Position Computation
1620-9.2.021

DR. JOHN MANIOTES
COMPUTER TECHNOLOGY DEPT.
PURDUE UNIVERSITY
CALUMET CAMPUS
HAMMOND, IN 46323

TECHNOLOGY
COMPUTER

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COMMON USERS GROUP PROGRAM REVIEW AND EVALUATION

(fill out in typewriter, ink or pencil)

Program No. _____

Date _____

Program Name: _____

1. Does the abstract adequately describe what the program is and what it does? Yes ___ No ___
Comment _____
2. Does the program do what the abstract says? Yes ___ No ___
Comment _____
3. Is the description clear, understandable, and adequate? Yes ___ No ___
Comment _____
4. Are the Operating Instructions understandable and in sufficient detail? Yes ___ No ___
Comment _____
Are the Sense Switch options adequately described (if applicable)? Yes ___ No ___
Are the mnemonic labels identified or sufficiently understandable? Yes ___ No ___
Comment _____
5. Does the source program compile satisfactorily (if applicable)? Yes ___ No ___
Comment _____
6. Does the object program run satisfactorily? Yes ___ No ___
Comment _____
7. Number of test cases run _____. Are any restrictions as to data, size, range, etc. covered adequately in description? Yes ___ No ___
Comment _____
8. Does the Program meet the minimal standards of COMMON? Yes ___ No ___
Comment _____
9. Were all necessary parts of the program received? Yes ___ No ___
Comment _____
10. Please list on the back any suggestions to improve the usefulness of the program. These will be passed onto the author for his consideration.

Please return to:

IBM Corporation
Program Information Department
40 Saw Mill River Road
Hawthorne, New York 10532

Attn: PREP FORM COORDINATOR

Your Name _____

Company _____

Address _____

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2/2/67



Los Angeles County
Department of County Engineer
Library Program No. 11-5

INVERSE GEODETIC POSITION COMPUTATION
for the
IBM 1620 DATA PROCESSING SYSTEM

May 1962

John F. McMillan
Survey Division
Geodetic Section

Modifications or revisions to this program, as they occur, will be announced in the appropriate Catalog of Programs for IBM Data Processing Systems. When such an announcement occurs, users should order a complete new program from the Program Information Department.

Title: Inverse Geodetic Position Computation
Department of County Engineer Library Program
No. 11-5

Description: A program for accurately determining the forward azimuth, back azimuth, delta alpha and geodetic distance (in Meters and Feet) between two survey control stations, knowing the latitude and longitude of each station.

Equipment: IBM 1620 Data Processing System with 20 K storage and the following special attachments:

- a. Automatic Divide
- b. Transfer Numerical Strip
- c. Transfer Numerical Fill
- d. Move Flag

Abstract: This program was prepared using the IBM 1620 SPS Variable Length Processor and Subroutines dated January 1, 1962. This was accomplished using a 15 digit mantissa and a 2 digit characteristic. When several geodetic inverses are to be calculated out of one station, only one input card is necessary for the "home" station. The processing of data out of this "home" station is terminated by a "999" input card.

The development of this program was accomplished using the theory and formulas listed on Pages 9 thru 11 of Special Publication No. 200 entitled "Formulas and Tables for the Computation of Geodetic Positions on the International Ellipsoid" as published by the U. S. Coast and Geodetic Survey. Considering the accuracy capabilities of the IBM 1620, using the variable length sub-routines, the program was written using the actual radian arc measure of the small angles involved. This modification has resulted in the elimination of all arc sine corrections.

The program has a length limitation of about 75 miles. There is no limitation regarding latitudes and longitudes acceptable to the program.

The time required to calculate and type one (1) inverse is 35.3 seconds. With slight modification the program can be prepared for card output. It is felt that the time consumed in typing the output is so slight compared to the actual calculation time that card output to save time is not warranted.

Acknowledgement is given to Mr. I. H. Alexander and Mr. C. R. Goss of the Survey Division for their technical advice and assistance in the preparation of this program.

Author:

John F. McMillan
 Los Angeles County
 Department of County Engineer
 108 West Second Street
 Los Angeles 12, California

-2-

GEODETTIC INVERSE

GAUSS MID LATITUDE METHOD
 WRITTEN BY JOHN F. MCMILLAN
 MAY 1962

GO RCTY
 SPY
 WATYDES610
 RCTY
 START RACDINPUT
 SF INPUT-1
 TF HOME1,INPUT678
 START1RACDINPUT1
 SF INPUT1-1
 TF DIST1,INPUT1678
 C DIST1-7A,TEST
 BE START
 SF HOME1-43
 SF DIST1-43
 SF HOME-21
 SF DIST-21
 CF HOME-10
 CF DIST-10
 TNS HOME1,HOME
 TNS DIST1,DIST
 SF HOME-10
 SF DIST-10
 BT RADIANT,HOME
 TFLSHOMEW,ANS
 TFLSWEST,HOMEW
 TF ANS,BLANK
 BT RADIANT,HOME-11
 TFLSHOMEN,ANS
 TFLSNORTH,HOMEN
 TF ANS,BLANK
 BT RADIANT,DIST
 TFLSDISTW,ANS
 TF ANS,BLANK
 BT RADIANT,DIST-11
 TFLSDISTN,ANS
 TF HERE634,INPUT634
 TF THERE634,INPUT1634
 FS DISTN,NORTH
 TFLSABK,DISTN
 TFLSABK2,ABK
 FM DISTN,HALF
 TFLSPH12,DISTN
 FA NORTH,PH12
 FCOSABE,NORTH
 TFLSABEF,ABE
 FSINABB,NORTH
 CF PH12-2
 FSINABC,PH12
 FCOSABD,PH12
 FS DISTW,WEST
 TFLSDLONG,DISTW
 FM DISTW,HALF

731

2

TFLSLAM2,DISTW
 CF LAM2-2
 FCOSABH,LAM2
 FSINABG,LAM2
 TFLSPHO,NORTH
 TFLSMAT,ONED
 ES MAT,FINO
 TF 79,ZEROS
 TFLSABM,AT
 FM ABM,MAT
 TFLSUP,ABM
 FSINMAN,PHO
 TFLSMANT,MAN
 FM ABB,ABB
 FM ABB,ETWO
 TFLSTIP,ONED
 FS JIP,ABB
 TFLSABB,TIP
 FM ABB,ABB
 FM ABB,TIP
 FSQRCA,ABB
 FD UP,CAT
 TFLSDOWN,UP
 TFLSPHI,NORTH
 FSINRAT,PHI
 FM RAT,RAT
 FM RAT,E2
 TFLSTAT,ONE
 ES IAT,RAT
 FSORRAT,TAT
 TFLSABN,AT
 FD ABN,RAT
 TFLSHAT,A
 FD UP,ABN
 TFLSABT,UP
 CF ABK-2
 FM ABT,ABK
 TFLSDPIHF,ABT
 TFLSABZ,DPIHF
 FM ABZ,HALF
 FSINSDPF2,ABZ
 FM SDPF2,ABH
 TFLSSPCL,SDPF2
 FM ABE,ABG
 TFLSCPSL,ABE
 TFLSAPP,CPSL
 TFLSAPO,SPCL
 CF APP-2
 CF APO-2
 FS APO,APP
 BNF #6174,APO-2
 FD SPCL,CPSL
 FATNSPAT,SPCL
 TFLSNINT,NINTY
 ES NINT,SPAT
 TFLSANGLE,NINT
 B #672

4

3

FD CPSL,SPCL
 FATNANGLE,CPSL
 TFLSTWOPW,TWOPY
 TFLSPIE2,PIE
 TFLSPIE3,PIE
 CRA BNF CBB,ABK2-2
 CRC BNF CBD,DLONG-2
 CRE FS TWOPW,ANGLE
 TFLSAZWOC,TWOPW
 B #6198
 CBB BNF CBH,DLONG-2
 CBF FA PIE2,ANGLE
 TFLSAZWOC,PIE2
 B #6114
 CBD TFLSAZWOC,ANGLE
 B #672
 CBH FS PIE3,ANGLE
 TFLSAZWOC,PIE3
 FA ABN,ABN
 TFLSTWON,ABN
 BNF #6114,APO-2
 FSINNOW,ANGLE
 FD APP,NOW
 TFLSDATA,APP
 B #6102
 FCOSHOW,ANGLE
 FD SDPF2,HOW
 TFLSDATA,SDPF2
 TFLSDATA1,DATA
 FM DATA,DATA
 TFLSONEN,ONEM
 FS ONEN,DATA
 FSORONEN,ONEN
 FD DATA1,ONEP
 FATNPQ3,DATA1
 FM PQ3,TWON
 TFLSS,PQ3
 TFLSS1,S
 FM S1,FEET
 TFLSDLO,DLONG
 CF DLO-2
 FM MAN,DLO
 TFLSAOR,ABD
 CF AOR-2
 FD MAN,AOR
 TFLSTWETH2,TWETH
 FM MANT,TWETH2
 FM ABEF,ABEF
 FM ABEF,MANT
 TFLSSEC2,SECOND
 FM SEC2,SEC2
 FM SEC2,ABEF
 TFLSE2,SEC2
 TFLSDLOT,DLO
 FD DLOT,SECOND
 TFLSDLONE,DLOT
 FM DLONE,DLONE
 FM DLONE,DLOT

5

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 1100 N. ZEEB RD.
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 (800) 541-1111

FM F2,DLONE
FM F2,SECOND
TFLSF,F2
FA E,MAN
BNF #624,DLONG-2
R #642

FM F,MINUS1
TFLSDALPHA,F
FM DALPHA,HALF
FS AZWOC,DALPHA
TFLSAZ1,AZWOC
TFLSAZ3,AZ1

FS AZ3,TWOPY
BNF #684,AZ3-2
TFLSALPHA1,AZ1
TFLSALP11,ALPHA1
B #672

TFLSALPHA1,AZ3
TFLSALP11,ALPHA1
FA ALP11,PIF
FA ALP11,F
TFLSAZ2,ALP11
FS AZ2,TWOPY

BNF #658,AZ2-2
TFLSALPHA2,ALP11
R #642
TFLSALPHA2,AZ2
RCTY

TD ALPHA161,400
TD ALPHA261,400
TD F61,400
TD S61,400
TD S161,400

WATYHERE
SPTY
SPTY

WATYTO
SPTY
SPTY
SPTY

WATYTHERE
RCTY
SPTY

TFM OUT66,A1
BTFSRADDEG,ALPHA1
TNF DEGOT64,FIXDEG
TNF MINIT62,FIXMIN
TNF SEK62,FIXSEC
TNF DES66,DECSEC-2
WATYDEGOT

SPTY
SPTY
TFM OUT66,A2
BTFSRADDEG,ALPHA2

A2 TNF DEGOT64,FIXDEG
TNF MINIT62,FIXMIN
TNF SEK62,FIXSEC

TNF DES66,DECSEC-2
WATYDEGOT
SPTY
SPTY
TFLSFM,F
CF F-2

TFM OUT66,A3
BTFSRADDEG,F
A3 TNF DEGOT64,FIXDEG
TNF MINIT62,FIXMIN
TNF SEK62,FIXSEC
TNF DES66,DECSEC-2

BNF B7,FM-2
WATYMINUS
B7 WATYMINIT
SPTY

SPTY
BTFSEDIT,S
SF NUML-5
TNF NUM1610,NUML
TNF NUM268,NUML65
WATYNUM1

SPTY
SPTY
BTFSEDIT,S1
SF NUML-5
TNF NUM1610,NUML
TNF NUM268,NUML65
WATYNUM1
B START1

INPUT DAS 80
INPUT1DAS 80
HOME1 DS 80
DIST1 DS 80

TEST DC 6,797979
HOME DS 22
DIST DS 22
HOMEW DS 17
WEST DS 17
HOMEN DS 17
NORTH DS 17
DISTW DS 17
DISTN DS 17

DC 15,5000000000000000
HALF DC 2,00
BLANK DC 17,0000000000000000
ZERO DC 2,00
ANS DS 17
MAN DS 17
UP DS 17

DC 15,1000000000000000
ONET DC 2,01
TIP DS 17
FM DS 17
CAT DS 17
PHI DS 17
RAT DS 17

729

DC 15,676865799729100
 DC 1,0
 E2 DC 1,2
 DC 15,1000000000000000
 ONE DC 2,01
 IAT DS 17
 DC 15,637820640000000
 A DC 2,07
 HAT DS 17
 ABT DS 17
 ARK DS 17
 DC 15,785398163382000
 FFIVE DC 2,00
 ANGLE DS 17
 DC 15,157079632676400
 NINTY DC 2,01
 APP DS 17
 APO DS 17
 DPIMF DS 17
 ASZ DS 17
 SDPF2 DS 17
 SPCL DS 17
 CPSL DS 17
 DOWN DS 17
 DLONG DS 17
 QNES DC 2,01
 ZEROS DC 20,0000000000000000 00
 PHI2 DS 17
 ASE DS 17
 DS 17
 RADDEGFD *-1,RD
 BTSEEDIT,RADDEG-1
 SF NUML-2
 TF FIXDEG,NUML
 TF NORMAL-3,NUML615
 BTM NORMAL,00,10
 FM FLTNUM,SIXTY
 BTSEEDIT,FLTNUM
 SF NUML-1
 TF FIXMIN,NUML
 TF NORMAL-3,NUML615
 BTM NORMAL,00,10
 FM FLTNUM,SIXTY
 BTSEEDIT,FLTNUM
 SF NUML-1
 TF FIXSEC,NUML
 TF DECSEC,NUML66
 CF DECSEC-5
 AM DECSEC,01,10
 CM FIXSEC,60,10
 BNE R1
 TFM FIXSEC,00,10
 AM FIXMIN,01,10
 CM FIXMIN,60,10
 BNE R1
 TFM FIXMIN,00,10
 AM FIXDEG,01,10
 R1 SF DECSEC-5
 OUT B

MOORE BUSINESS FORMS INC. FORM 6140 FORM 6113 FORM 6114

ZEROS2DC 50,0
 NUML DS 115
 NUML1 DS 1
 NUM DS 14
 NUMR DS 100
 DS 17
 EDIT TF NUMR,ZEROS2
 TF NUMR-49,ZEROS2
 TF NUMR-98,ZEROS2
 TF NUMR-147,ZEROS2
 TF ZEROS2650,ZEROS2
 SF *626
 S *618,EDIT-1
 TF NUM,EDIT-3
 TFM *-6,NUM
 MF NUMR,EDIT-3
 SF *631
 S *623,EDIT-1
 ME NUML,NUM
 TFM *-1,NUM
 SF *631
 S *623,EDIT-1
 ME NUML1,NUML1
 TFM *-1,NUML1
 SF NUML1
 RR
 CHK1 DC 3,0
 ZEROS1DC 17,0
 FLTNUMDS 17
 DS 17
 NORMAL TF FLTNUM,ZEROS1
 TF FLTNUM-2,NORMAL-3
 TF FLTNUM,NORMAL-1
 SF FLTNUM-16
 BD NN1,FLTNUM-16
 TDM NORMAL-3,0
 ME FLTNUM-15,FLTNUM-16
 TF NORMAL-4,FLTNUM-2
 ME NORMAL-3,NORMAL-4
 TF FLTNUM-2,NORMAL-3
 SM FLTNUM,01,10
 AM CHK1,01,10
 CM CHK1,16
 BNE NORMAL636
 TFM FLTNUM,-99,10
 NN1 TFM CHK1,00,10
 BB
 FIXDEGDS 4
 FIXMINDS 2
 FIXSECDS 2
 DECSECDS 6
 DEGRADCF *-6
 TF NORMAL-3,FIXDEG
 BTM NORMAL,15,10
 TFLSRADDEG-1,FLTNUM
 TF NORMAL-3,FIXMIN
 BTM NORMAL,15,10
 FD FLTNUM,SIXTY

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FA RADDEG-1,FLTNUM
 TF NORMAL-3,DEGRAD-1
 BTM NORMAL,09,10
 FD FLTNUM,SIXTY
 FD FLTNUM,SIXTY
 FA RADDEG-1,FLTNUM
 FM RADDEG-1,RD
 BR
 DEG DS 14
 RAD DS 18
 DC 15,600000000000000
 SIXTY DC 2,02
 DC 15,174532925199433
 RD DC 2,-01
 HERE DAS 18
 DAC 1,0
 THERE DAS 18
 DAC 1,0
 DC 15,320083333333333
 FEET DC 2,01
 S1 DS 17
 DS 1
 MINUS DAC 1,0
 DAC 1,0
 DEGOT DAS 3
 DAC 1,0
 MINIT DAS 2
 DAC 1,0
 SEK DAS 2
 DAC 1,0
 DES DAS 4
 DAC 1,0
 DAC 43, FORW-D AZIMUTH BACK AZIMUTH DELTA ALPHA
 DAC 27, DIST*METERS' DIST*FEET'
 DAC 1,0
 ABB DS 17
 ABC DS 17
 ABD DS 17
 LAM2 DS 17
 ABH DS 17
 ABG DS 17
 PHO DS 17
 MAT DS 17
 DC 15,100000000000000
 ONED DC 2,01
 DC 15,676865799729100
 DC 1,0
 ETWO DC 1,2
 DC 15,637820660000000
 AT DC 2,07
 AZWOC DS 17
 DC 15,628318530717959
 TWOPY DC 2,01
 DC 15,314159265358979
 PIE DC 2,01
 TWOPW DS 17
 PIE2 DS 17

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PIE3 DS 17
 NINT DS 17
 ABN DS 17
 ABM DS 17
 SPAT DS 17
 ASK2 DS 17
 TWON DS 17
 NOW DS 17
 NOW DS 17
 S DS 17
 DS 1
 TO DAC 2,10
 DAC 1,0
 DLO DS 17
 DLONE DS 17
 AOR DS 17
 F DS 17
 DS 1
 DC 14,100000000000000
 DC 1,0
 MINUS1DC 2,01
 DALPHADS 17
 AZ1 DS 17
 AZ2 DS 17
 AZ3 DS 17
 ALPHA1DS 27
 DS 1
 ALP11 DS 17
 ALPHA2DS 17
 DS 1
 DC 15,833333333333333
 DC 1,0
 TWETH DC 1,1
 MANT DS 17
 TWETH2DS 17
 ABEF DS 17
 DC 15,484813681110000
 DC 1,0
 SECONDDC 1,5
 SEC2 DS 17
 DATA DS 17
 DC 15,100000000000000
 ONEM DC 2,01
 ONEN DS 17
 ONEP DS 17
 DATA1 DS 17
 DATUM DS 17
 DC 15,157079632679490
 PO2 DC 2,01
 PO3 DS 17
 F2 DS 17
 DLOT DS 17
 NUM1 DAS 6
 DAC 1,0
 NUM2 DAS 5
 DAC 1,0
 DS 25
 RDIANSE RDIAN=6
 SF RDIAN=8

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 BIRDSONG
 ROOM 8113
 WASHINGTON, D.C.

727

MM RADIANT-7,60,10
 TF DEGREE-5,99
 A DEGREE-1,RADIANT-1
 LD 93,DEGREE-1
 DM 89,3600,8
 TF DEGREE-1,95
 MF DEGREE-14,DEGREE-11
 A DEGREE-11,RADIANT-9
 TF 79,ZEROS
 M DEGREE-1,6181
 AM 91,5,10
 TF 99,90
 SF 85
 TF RADIANT-1,ZEROS-4
 TF DEGREE-1,ZEROS
 BD .XXXX,86
 TF ANS,ZERO
 SF 87
 TF ANS-4,99
 BB
 XXXXX TF ANS,ONES
 SF 86
 TF ANS-3,99
 BB
 DORG*-9
 DC 12,017453292520
 DS 20
 DEGREE TF 79,ZEROS-10
 LD 89,DEGREE-1
 D 85,*-45
 AM 87,5,10
 SF 74
 TF DEGREE-9,76
 SF 77
 TF RADIANT-1,86
 MM RADIANT-1,60,10
 TF DEGREE-7,89
 MF 90,88
 TF RADIANT-1,99
 MM RADIANT-1,60,10
 AM 94,5,10
 TF DEGREE-1,93
 CF DEGREE-6
 CE DEGREE-8
 TF 99,DEGREE-1
 B *-370
 DORG*-3
 DAC 1,0
 DENDGO

Input - General Description

The input data for a geodetic inverse consists of the latitude and longitude of the two stations under consideration.

One input card per station is used.

The station name or other designation may occupy the first eighteen (18) card columns. This information can be both alphabetic and numeric.

The latitude occupies columns 19 thru 29, inclusive. The longitude occupies columns 30 thru 40, inclusive.

For examples of input see pages 14 and 15 of this report.

ECHO ROCK 0341329533911803147297
 SAN JUAN 0335449470411744140052
 PAS EAST BASE NO. 20340714102411741162575
 999
 BLACKWOOD 0340716245911750481760
 SHAY 0340755030711748011384
 SAN JOSE 0340323125111750592044
 999
 PUENTE 0340126812911756011037
 WORKMAN HILL 0335930107011800071139
 999
 WORKMAN HILL 0335930107011800071139
 ECHO ROCK 0341329533911803147297
 999
 AZUSA D-11 0340647654911758039401
 DUARTE 0340848369011757400999
 999
 SAN JUAN 0335449470411744140052
 WORKMAN HILL 0335930107011800071139
 999

15

COUNTY OF LOS ANGELES
 DEPARTMENT OF COUNTY ENGINEER
 SURVEY DIVISION
GEODETTIC INVERSE

5-62

TAB. BY JEM 5-8-62

CHECKED BY CRG 5-8-62

FOR
 I.B.M. 1620 SOLUTION

STATION																		LATITUDE												LONGITUDE																																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40																								
ECHO ROCK																		0	3	4	1	3	2	9	5	3	3	9	1	1	8	0	3	1	4	7	2	9	7																								
SAN JUAN																		0	3	3	5	4	4	9	4	7	0	4	1	1	7	4	4	1	4	0	0	5	2																								
PAS EAST BASE NO. 20340714102411741162575																		2	0	3	4	0	7	1	4	1	0	2	4	1	1	7	4	1	1	6	2	5	7	5																							
999																																																															
BLACKWOOD																		0	3	4	0	7	1	6	2	4	5	9	1	1	7	5	0	4	8	1	7	6	0																								
SHAY																		0	3	4	0	7	5	5	0	3	0	7	1	1	7	4	8	0	1	1	3	8	4																								
SAN JOSE																		0	3	4	0	3	2	3	1	2	5	1	1	1	7	5	0	5	9	2	0	4	4																								
999																																																															
PUENTE																		0	3	4	0	1	2	6	8	1	2	9	1	1	7	5	6	0	1	1	0	3	7																								
WORKMAN HILL																		0	3	3	5	9	3	0	1	0	7	0	1	1	8	0	0	0	7	1	1	3	9																								
999																																																															
WORKMAN HILL																		0	3	3	5	9	3	0	1	0	7	0	1	1	8	0	0	0	7	1	1	3	9																								
ECHO ROCK																		0	3	4	1	3	2	9	5	3	3	9	1	1	8	0	3	1	4	7	2	9	7																								
999																																																															
AZUSA D-11																		0	3	4	0	6	4	7	6	5	4	9	1	1	7	5	8	0	3	9	4	0	1																								
DUARTE																		0	3	4	0	8	4	8	3	6	9	0	1	1	7	5	7	4	0	0	9	9	9																								
999																																																															
SAN JUAN																		0	3	3	5	4	4	9	4	7	0	4	1	1	7	4	4	1	4	0	0	5	2																								
WORKMAN HILL																		0	3	3	5	9	3	0	1	0	7	0	1	1	8	0	0	0	7	1	1	3	9																								
999																																																															

-41-

Output - General Descriptions

The following data will be typed out:

Forward Azimuth as
XXX°-XX'-XX.XXXX"

Back Azimuth as
XXX°-XX'-XX.XXXX"

Delta Alpha as
XX'-XX.XXXX"

Distance in Meters as
XXXXXX.XXXXX

Distance in Feet as
XXXXXX.XXXXX

No rounding off has been incorporated in this program. However, all output values are expressed in sufficient length to correctly interpret the data to normal requirements.

SAMPLE OUTPUT

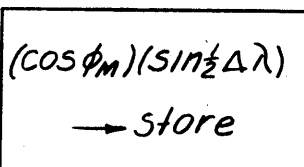
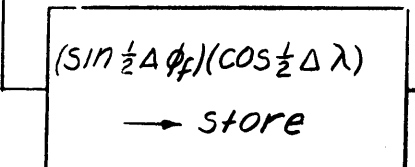
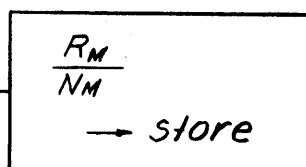
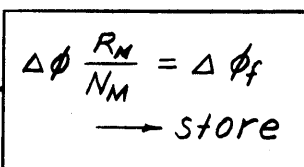
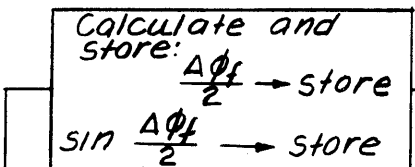
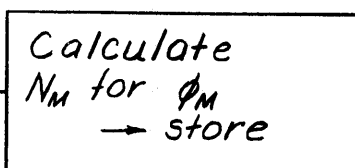
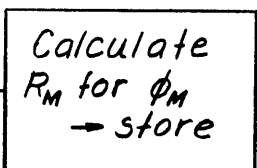
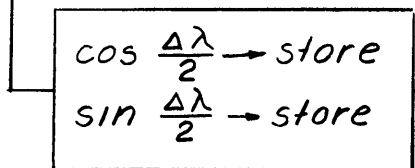
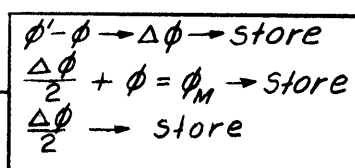
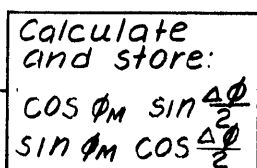
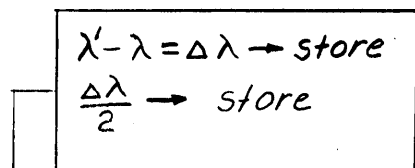
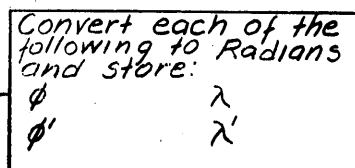
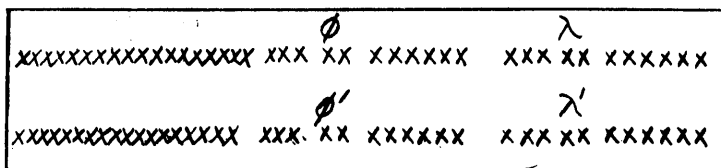
FORW-D AZIMUTH	BACK AZIMUTH	DELTA ALPHA	DIST(METERS)	DIST(FEET)
ECHO ROCK	TO SAN JUAN			
319-37-37.2155	139-48-16.2475	10-39.0319	045239.04735	148421.77454
ECHO ROCK	TO PAS EAST BASE NO.2			
288-43-25.3521	109-00-45.9263	12-20.5741	035693.74064	117105.21409
BLACKWOOD	TO SHAY			
254-23-16.2037	074-24-49.9156	01-33.7119	004444.00934	014580.05399
BLACKWOOD	TO SAN JOSE			
002-15-17.8775	182-15-11.6963	-00-06.1811	007188.32444	023583.69443
PUENTE	TO WORKMAN HILL			
060-21-10.3802	240-18-52.7849	-02-17.5953	007265.05847	023835.44600
WORKMAN HILL	TO ECHO ROCK			
169-23-56.3847	349-27-11.1773	-01-45.2074	026307.16271	086309.41632
AZUSA D-11	TO DUARTE			
189-19-30.7834	009-19-44.1595	00-13.3760	003769.21936	012366.18052
SAN JUAN	TO WORKMAN HILL			
109-31-57.5399	289-23-05.2697	-08-52.3201	025955.73160	085156.42943

Operating Instructions

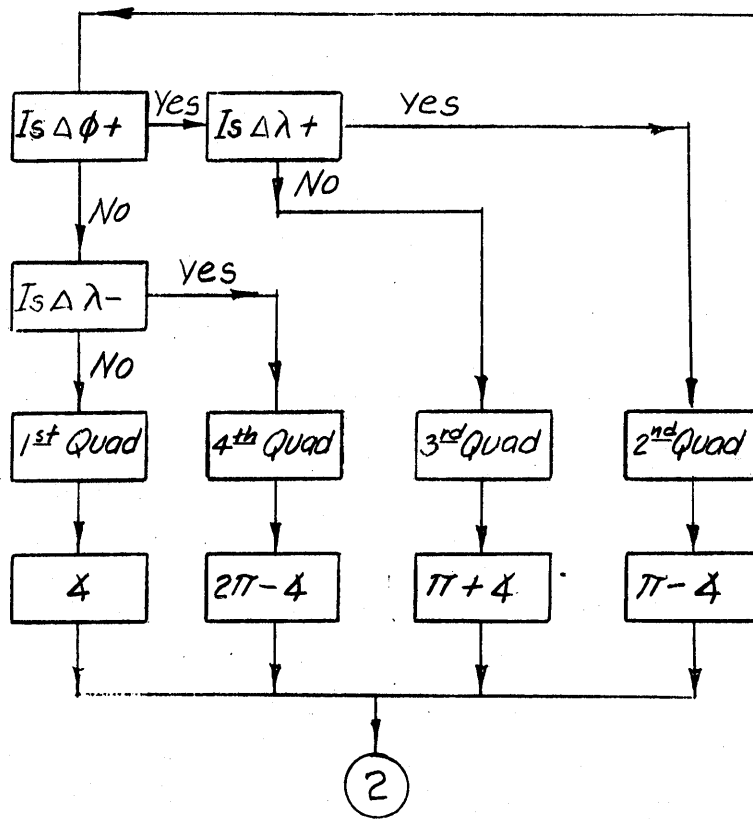
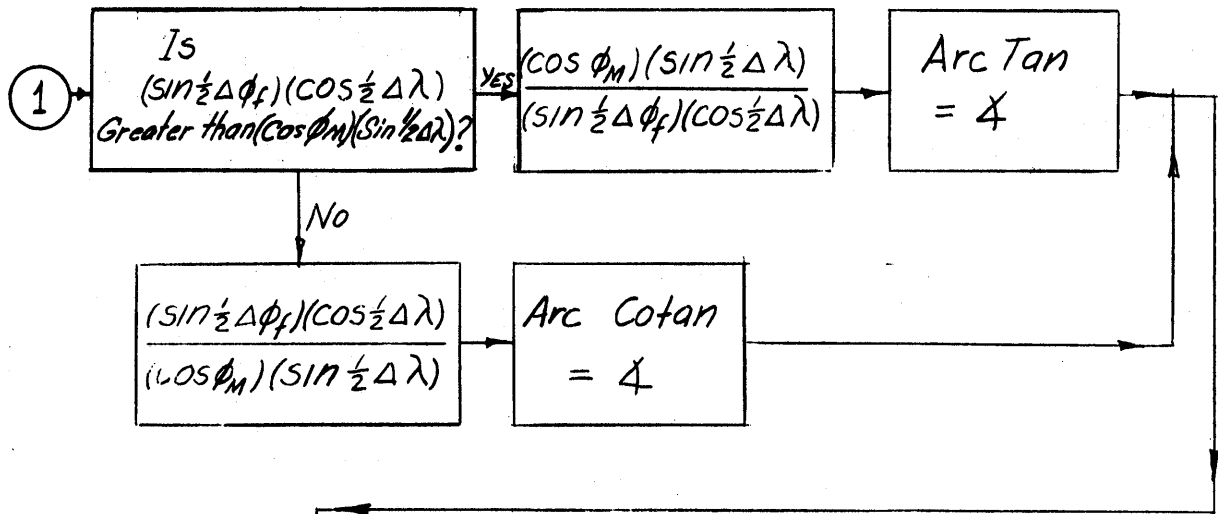
1. Load the program deck onto the 1622 Card Read-Punch Unit.
2. Clear Memory
 - a. Parity and I/O switches to Program
 - b. Reset; Insert
 - c. Type 31 00009 00008
 - d. Release; Start
 - e. Instant stop (after 1 cycle of MAR)
 - f. Reset
3. Set all switches to OFF
4. Load Program into Memory
5. Load Data
 - a. If using compressed deck, column headings will start typing out immediately after deck is loaded.
 - b. If using regular object program deck; after loading, push start on console to begin column heading type-outs.
6. All inversing out of a certain station must terminate with a 999 before a new home station will be properly placed in storage.

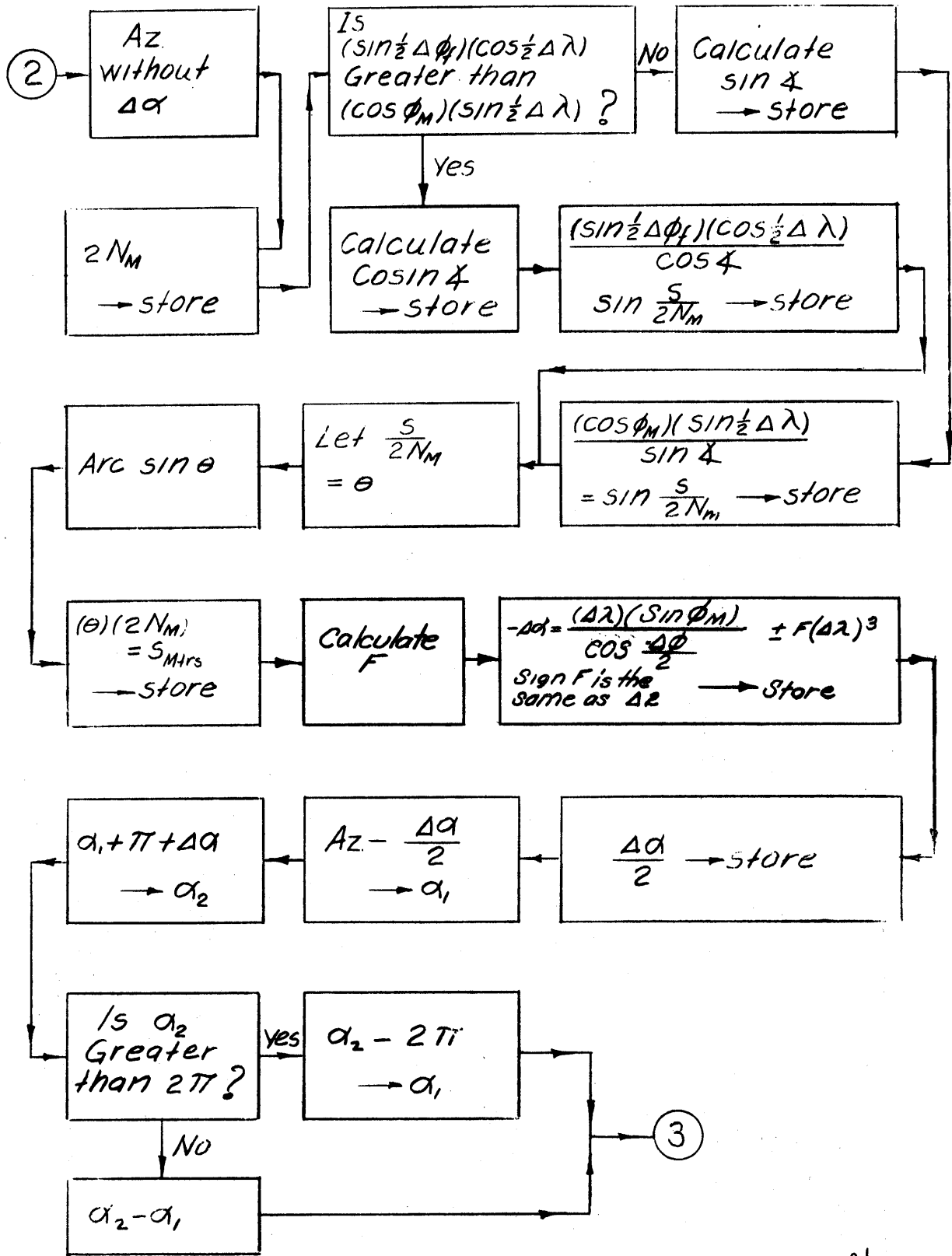
FLOW DIAGRAM GEODETTIC INVERSE

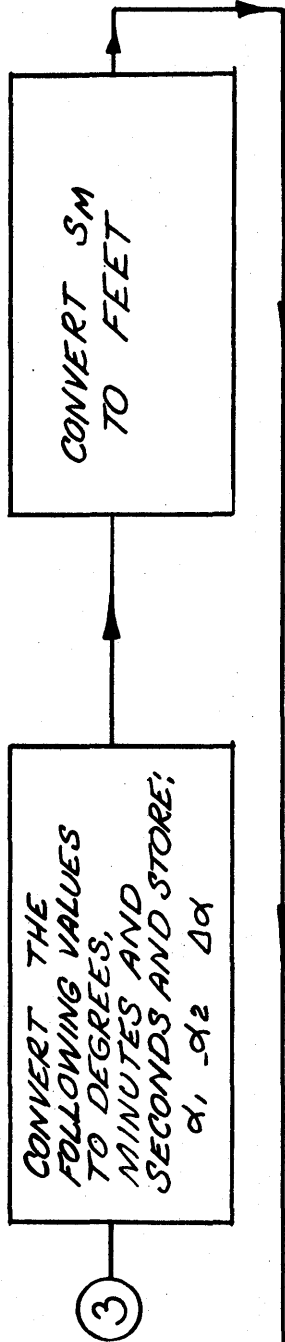
INPUT



①







OUTPUT

TYPE OUT AS FOLLOWS:

FORWARD AZIMUTH BACK AZIMUTH DELTA ALPHA DIST.(METERS) DIST.(METERS)
 (HOME STATION NAME) TO (DISTANT STATION NAME)
 XXXXX.XXX.XXX.XXX XXXXX.XXX.XXX.XXX
 XXX-XX-XX.XXXX XXX-XX-XX.XXXX XXXXX.XXXX XXXXX.XXXX

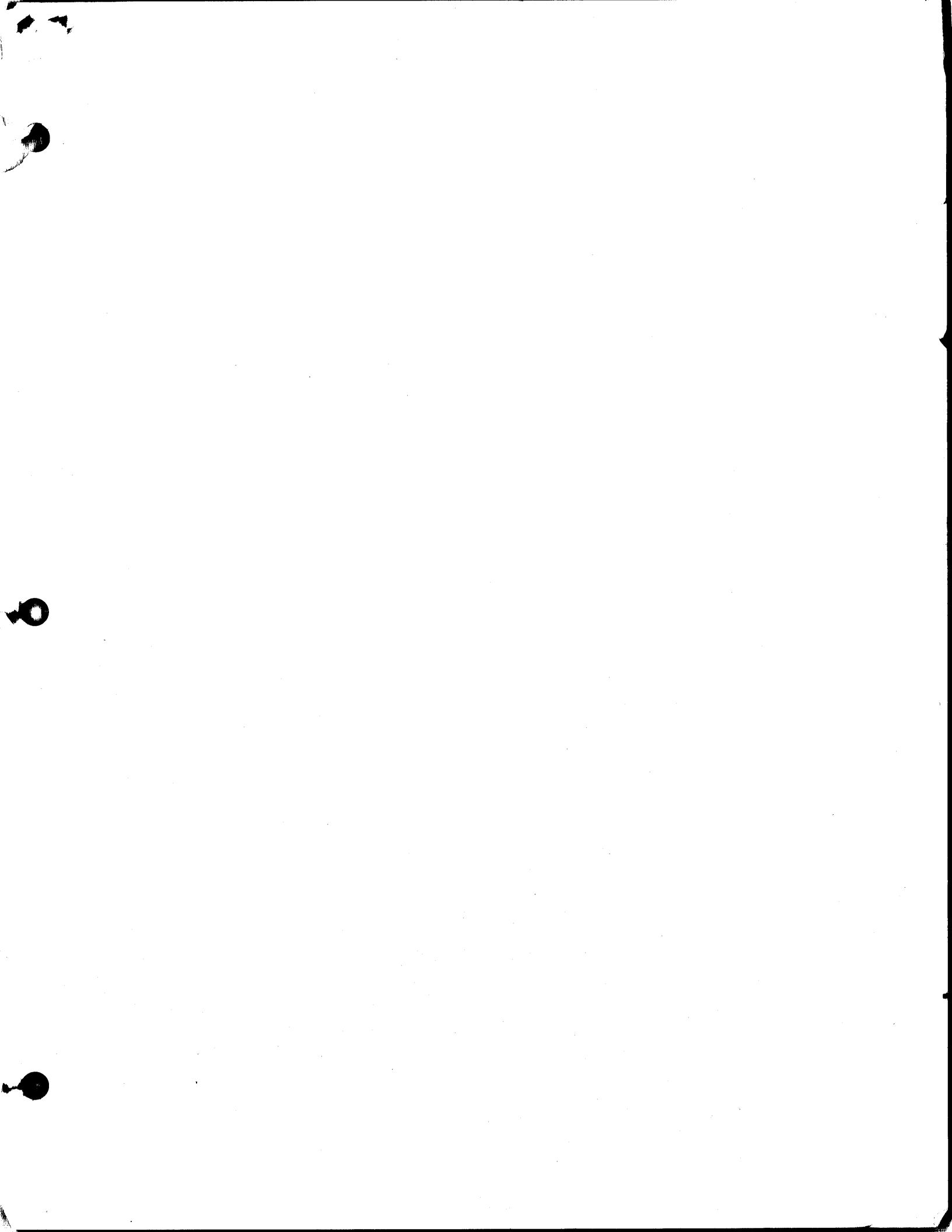
FORMULAS:

$$N = \frac{a}{(1 - e^2 \sin^2 \phi_M)^{1/2}} = R (1 + e^2 \cos^2 \phi_M)$$

$$R = \frac{a(1 - e^2)}{(1 - e^2 \sin^2 \phi_M)^{3/2}}$$

ITEMS TO BE STORED:

1. $\sin 1'' = 0.0000048481$ 36811 1 (=ARC 1")
2. $a = 6,378,206.4$ METERS
3. $e^2 = 0.00676$ 86579 97291
4. $e'^2 = 0.00681$ 47849 45915



COMPUTER TECHNOLOGY

THE COMPUTER MUSEUM HISTORY CENTER

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