CODYCLOSE VERSION 4

FOR THE HEWLETT PACKARD

HP49G+ AND THE HP50G SERIES CALCULATOR

NOVEMBER 2007

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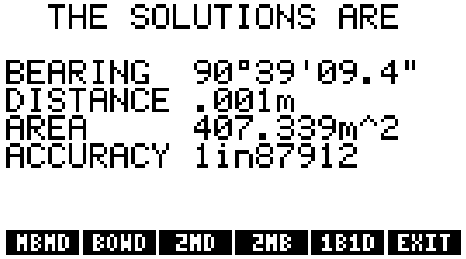
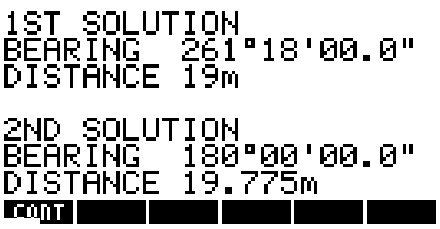
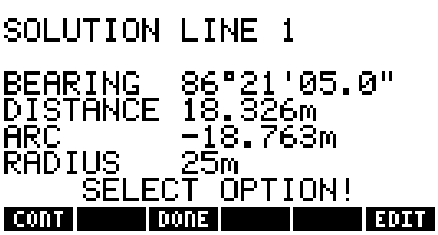
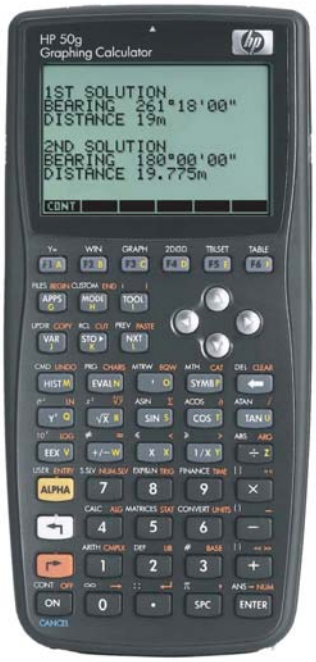
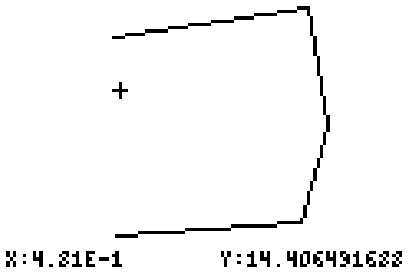










The author does not guarantee the program to be free from defects and may not be held responsible for loss caused by such.

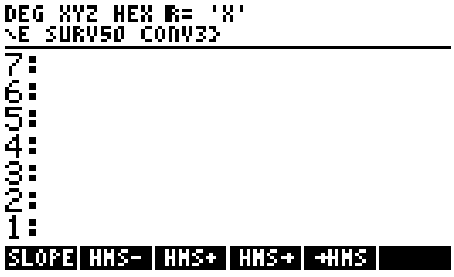
Your use of this program constitutes your acceptance of these terms.

PROGRAM - CONVERSION

1.0 Introduction

This is a program which enables quick and easy conversion of empirical units to metric units and visa-versa. To begin the program go to the directory labelled **CONV3** and initiate the **START** routine. You will then see a whole suite of subroutines which are outlined below.

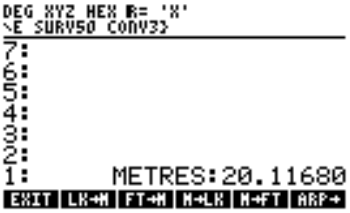
Menu Key	A	EXIT	Exits back to the previous menu.
Menu Key	B	LK→M	Converts Links to Metres.
Menu Key	C	FT→M	Converts Feet to Metres.
Menu Key	D	M→LK	Converts Metres to Links.
Menu Key	E	M→FT	Converts Metres to Feet.
Menu Key	F	ARP→	Converts Acres, Roods, Perches to m2.
Next Page → Menu Key	L		



Menu Key	A	SLOPE	Converts slope distance into Hz. & Vt..
Menu Key	B	HMS-	Subtracts two angles.
Menu Key	C	HMS+	Sums two angles.
Menu Key	D	HMS→	Converts ddd.mmsss to decimal.
Menu Key	E	→HMS	Converts decimal to ddd.mmss.

1.1 Routine LK→M

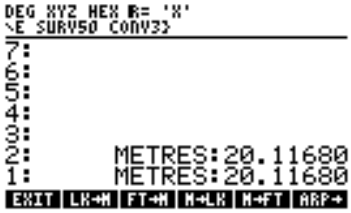
For this example convert 100 links to metres.
Simply type **100** and then initiate **LK→M** by pressing Menu Key B.
The solution is displayed on line 1 of the stack as:



1.2 Routine FT→M

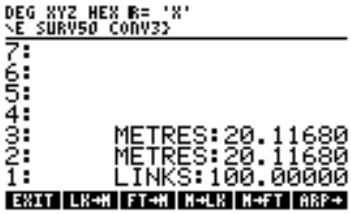
To convert 66 feet to metres.
Type **66** and then initiate **FT→M** (Menu Key C).
The solution is displayed as:

Note: 66 feet 9 inches type **66.09**
66 feet 10⅜ inches type **66.10375**
66 feet ⅜ inches type **66.00375**



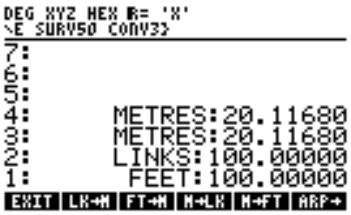
1.3 Routine M→LK

To convert 20.1168 metres to links.
Type 20.1168 and then initiate **M→LK** (Menu Key D).
The solution is displayed as:



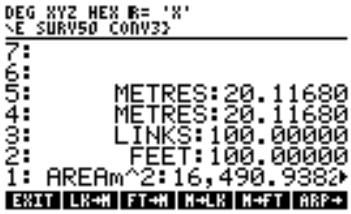
1.4 Routine M→FT

To convert 30.48 metres to feet.
Type **30.48** and then initiate **M→FT**
(Menu Key E).
The solution is displayed as:



1.5 Routine ARP→

Now convert 1 Acre 12 Roods and 12 Perches
to an area in metres². Type 1.1212 and then initiate
the **ARP→** routine (Menu Key F).
The solution is displayed as:



Note: 0 Acres 2 Roods 2 Perches type **0.0202**
1 Acres 5.6 Perches type **1.00056**

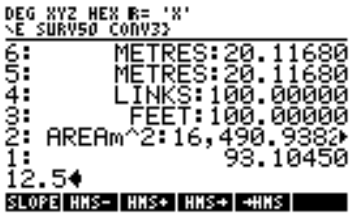
1.6 Tip

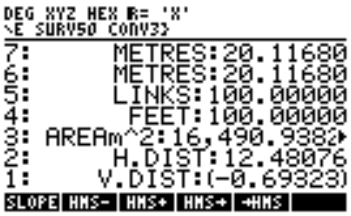
Line 1 in the calculators stack is simply a value which can be acted upon by another routine. For example type **100** then initiate the routine **FT→M** then **M→FT** you will see the figure change from **100** to **30.48** then back to **100** and so on.

1.7 Routine SLOPE

To reduce a slope distance of 12.5m having a vertical angle of 93°10'45" enter into the stack the vertical angle then the slope distance as shown in the diagram.

Then initiate the **SLOPE** routine
(Menu Key L first then Menu Key A).





1.8 Function HMS-

Input two angles into the stack and initiate the **HMS-** function (Menu Key B) to subtract those angles.

1.9 Function HMS+

Input two angles into the stack and initiate the **HMS+** function (Menu Key C) to add the those angles.

1.10 Function HMS→

Input a bearing (ddd.mmss) into the stack and initiate the **HMS→** function (Menu Key D) to convert it to decimal degrees.

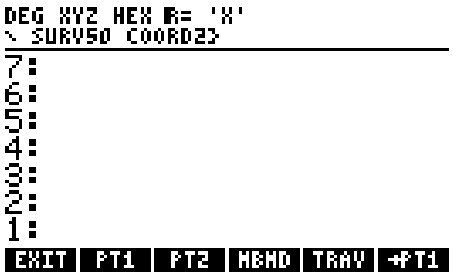
1.11 Function →HMS

Input a bearing in decimal degrees into the stack and initiate the **→HMS** function (Menu Key E) to convert it to a bearing (ddd.mmss).

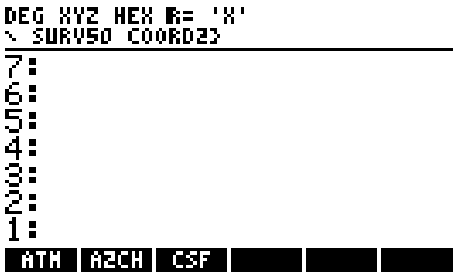
PROGRAM - COORDINATE

2.0 Introduction

This program enables coordinate manipulation. To start the program go to the directory labelled **COORD2** and initiate the **START** routine. You will see a whole suite of subroutines which are outlined below.

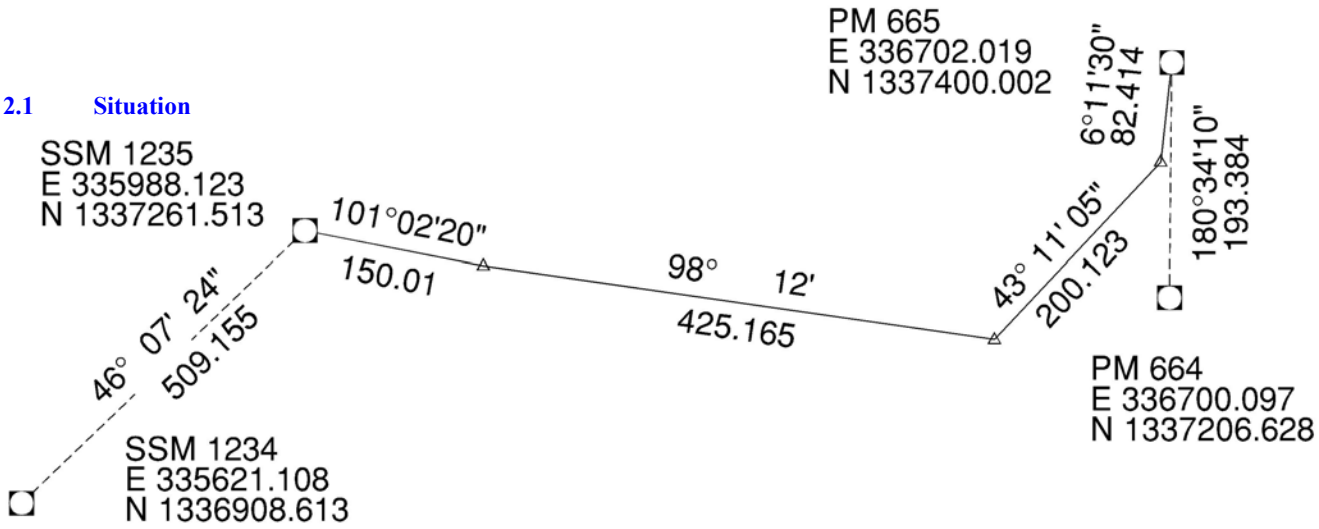


Menu Key	A	EXIT	Exits back to the previous menu.
Menu Key	B	PT1	Enters coordinates for point 1 (PT1).
Menu Key	C	PT2	Enters coordinates for point 2 (PT2).
Menu Key	D	HBHD	Calcs. bearing & distance PT1→PT2.
Menu Key	E	TRAV	Calcs. Coords. by bear & dist.
Menu Key	F	→PT1	Assigns the coordinates to PT1.



Menu Key	A	ATM	Atmospheric correction.
Menu Key	B	A2CH	Arc to Chord correction.
Menu Key	C	CSF	Combined Scale & Sea Level.

2.1 Situation



You have set your instrument on SSM1235 and can see directly to SSM1234 however PM665 and PM664 are not intervisible so you have to traverse in order to locate them as shown.

2.2 Routine PT1

To input the coordinates for SSM1235 initiate the **PT1** routine then follow the steps as shown below:

Easting for PT 1 ?	**335988.123**	→ TYPE VALUE
	CONT	→ MENU KEY A
Northing for PT 1 ?	**1337261.513**	→ TYPE VALUE
	CONT	→ MENU KEY A

This routine has now completed.

2.3 Routine PT2

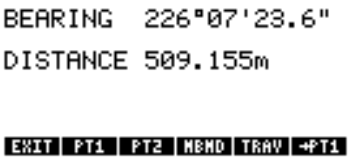
To input the coordinates for SSM1234 initiate the **PT2** routine then follow the steps as shown below:

Easting for PT 2 ?	**335621.108**	→ TYPE VALUE
	CONT	→ MENU KEY A
Northing for PT 2 ?	**1336908.613**	→ TYPE VALUE
	CONT	→ MENU KEY A

This routine has now completed.

2.4 Routine MBMD

Now two sets of coordinates are in the calculators memory using variables E1, N1, E2 and N2. Later we will see how to extract these coordinates from the memory but first we wish to calculate the bearing and distance between them. To do this simply initiate the **MBMD** routine. After this has been initiated then the solution will be displayed in the following manner always from point 1 to point 2 :

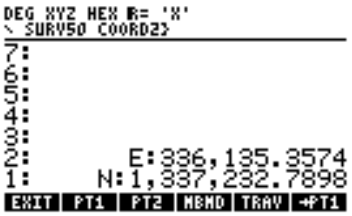


Note: This routine may be repeated many times by substituting either new coordinates for point 1 or point 2.

2.5 Routine TRAV

Once our backsight is known we then traverse to our first station being 101°02'20"~150.01m away. Initiate the **TRAV** routine and follow the steps below:

Bearing from PT 1 ?	**101.022**	→ TYPE VALUE
	CONT	→ MENU KEY A
Distance from PT 1 ?	**150.01**	→ TYPE VALUE
	CONT	→ MENU KEY A



The solution is then displayed on the screen as a coordinate relative to point 1.
Note: **This operation cannot be done using the coordinates of point 2.**

2.6 Routine →PT1

As the coordinates are still displayed on the screen they can be stored as the new coordinates of point by initiating the **→PT1** routine. This is so as to continue the traverse from point 1.

Repeating section 2.5 to the next station 98°12'00"~425.165m away the solutions will be East:336556.1756 and North:1337172.149. Initiate the **→PT1** routine.

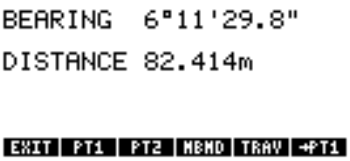
Once again repeating section 2.5 to the next station 43°11'05"~200.123m away the solutions will be East:336693.1304 and North:1337318.0689. Initiate the **→PT1** routine.

2.7 Additional

Not knowing the location of PM665 we can compute it by entering its coordinates using the **PT2** routine as shown:

Easting for PT 2 ?	**336702.019**	→ TYPE VALUE
	CONT	→ MENU KEY A
Northing for PT 2 ?	**1337400.002**	→ TYPE VALUE
	CONT	→ MENU KEY A

To compute the bearing and distance between them initiate the **MBMD** routine.



The solution will be displayed as:

We are now at PM665 and are now looking for PM664. Initiate the **PT1** routine as shown below:

Easting for PT 1 ?	**336700.097**	→ TYPE VALUE
	CONT	→ MENU KEY A
Northing for PT 1 ?	**1337206.628**	→ TYPE VALUE
	CONT	→ MENU KEY A

```
BEARING  0°34'10.1"
DISTANCE 193.384m
```

EXIT | PT1 | PT2 | MBMD | TRAV | ←PT1

Once again compute the bearing and distance between them by initiating the **MBMD** routine. The solution will be displayed as:

Note:
This solution is from point 1 to point 2 so remember to add 180°.

2.8 Routine ATM

This routine is used so as to compute the Atmospheric correction needed to be applied to all observations. Using a temperature of 32°C and a pressure of 1025mb initiate the **ATM** routine:

Enter Temperature ?	**32**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Pressure ?	**1025**	→ TYPE VALUE
	CONT	→ MENU KEY A

```
ATMOSPHERIC CORRECTION
      16 ppm
```

ATM | A2CH | CSF

The solution is displayed as:

2.9 Routine A2CH

This routine is used to compute Arc to Chord corrections based on a set of coordinates. To do this initiate the **PT1** Routine to input the first set of coordinates and **PT2** for the second (shown in sections 2.2 & 2.3). The **A2CH** routine can now be initiated as shown below:

```
SELECT SYSTEM
MGA
ISG
AMG
```

CANCL | OK

East1: 787420.487
North1: 6782165.201
Reference system

East2: 841341.166
North2: 6800667.210
AMG **[SELECT]**
Using up & down arrows

The results show the direct bearing and distance, the ellipsoidal distance with the scale correction added and the bearings as you would observed from point 1 and point 2.

Also works in ISG and MGA coordinate systems.

```
ARC 2 CHORD CORRECTION

BEAR     71°03'40.2"
DIST     57006.701m
E DIST   56959.833m
G BEAR1  71°03'54.6"
G BEAR2  251°03'25.0"
```

ATM | A2CH | CSF

2.10 Routine CSF

Now that we have connected to all the available Permanent Marks we can apply a Combined Scale & Sea Level Correction to the results. To do this initiate the **CSF** routine using the following information:

```
SELECT SYSTEM
MGA
ISG
AMG
```

CANCL | OK

SSM1234
(in I.S.G.)

East: 335621.108
North: 1336908.613
Level: 20.125

Enter Easting ?	**335621.108**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing ?	**1336908.613**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter mean Height ?	**20.125**	→ TYPE VALUE
	CONT	→ MENU KEY A
	SELECT ISG	→ UP/DOWN KEYS

```
COMBINED SCALE FACTOR
(ISG COORD. SYSTEM)
      0.9999525
```

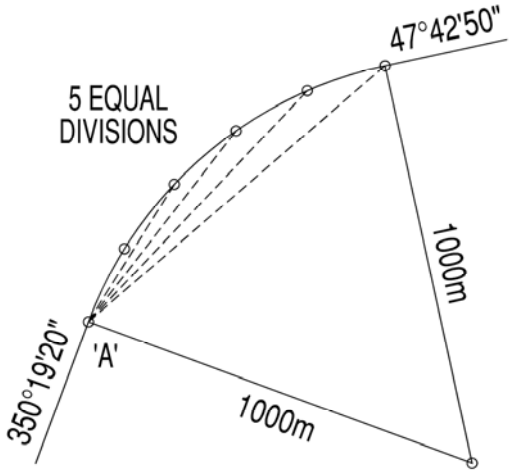
CONT

Also works in AMG and MGA coordinate systems.

PROGRAM - HORIZONTAL CURVE

3.0 Introduction

This program is a horizontal curve setout program. To start the program go to the directory labelled **CURVE4** then initiate the **START** routine. The program will show 3 separate types of division of the same curve.



3.1 Equal Division

You have set your instrument at the position labelled 'A'. Follow the steps as outlined below:

Enter Bearing in ?	**350.192**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**47.425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Eccentric Station ?	**NO**	→ MENU KEY F

At this stage the basic curve data has been entered into the calculators memory after which you are asked to choose the type of operation you wish to perform as shown below:

Menu Key	A	EQL	Divide into equal portions.
Menu Key	B	STEP	Divide using constant arcs.
Menu Key	C	CHAIN	Compute radiation to entered chainages.
Menu Key	D	SETO	CH: & Offset from entered radiation.
Menu Key	E	CSET	Compute radiation from CH: & Oset.
Menu Key	F	EXIT	Exits back to the previous menu.

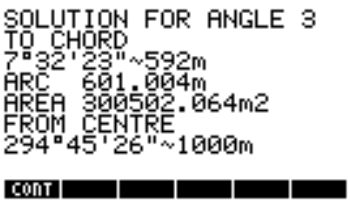
Next Page → Menu Key

Menu Key	A	PON	Turn printer ON.
Menu Key	B	POFF	Turn printer OFF. (Default is off)

Initialise the **EQL** routine and follow the steps as outlined below to divide the curve into equal segments:

Enter number of divisions ?	**5**	→ TYPE VALUE
	CONT	→ MENU KEY A

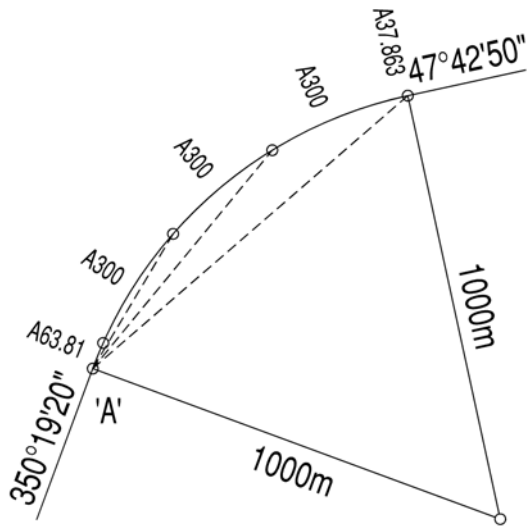
The solutions will then be displayed as shown:



Etc.....

Keep initiating the **CONT** routine to display the next solution.

After the last solution has been displayed you will be returned to the **CURVE4** directory.



3.2 Division using Arc Lengths

Again initiate the **START** routine.

Using the diagram as shown on the left for this example you will divide the horizontal curve into segments using arc lengths.

Again you have set your instrument at position labelled 'A'. Follow the steps as outlined below:

Enter Bearing in ?	**350.192**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**47.425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Eccentric Station ?	**NO**	→ MENU KEY F

Again the basic curve data has been entered into the calculators memory after which initiate the **STEP** routine and follow the steps as shown:

Enter 1st arc length ?	**63.81**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter other arc lengths ?	**300**	→ TYPE VALUE
	CONT	→ MENU KEY A

The solutions will then be displayed as shown:

```
SOLUTION FOR ANGLE 1
TO CHORD
352°09'01"~63.799m
ARC   63.81m
AREA 31905.m2
FROM CENTRE
263°58'42"~1000m
CONT
```

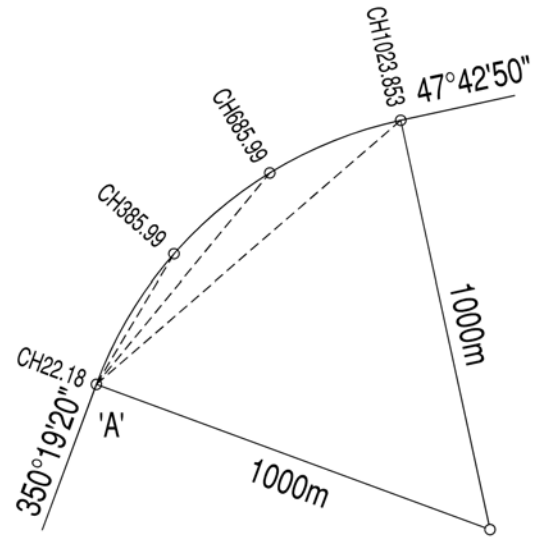
```
SOLUTION FOR ANGLE 2
TO CHORD
0°44'41"~361.807m
ARC   363.81m
AREA 181905.m2
FROM CENTRE
281°10'01"~1000m
CONT
```

```
SOLUTION FOR ANGLE 3
TO CHORD
9°20'20"~651.689m
ARC   663.81m
AREA 331905.m2
FROM CENTRE
298°21'21"~1000m
CONT
```

Etc.....

Keep initiating the **CONT** routine to display the next solution.

After the last solution has been displayed you will be returned to the **CURVE4** directory.



3.3 Division using chainages

Once again initiate the **START** routine.

Using the diagram as shown on the left for this example you will divide the horizontal curve into segments using chainages.

Once again you have set your instrument at position labelled 'A'. Follow the steps as outlined below:

Enter Bearing in ?	**350.192**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**47.425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Eccentric Station ?	**NO**	→ MENU KEY F

Once again the basic curve data has been entered into the calculators memory after which initiate the **CHAIN** routine and follow the steps as shown over:

Enter start chainage ? **22.18** → TYPE VALUE
CONT → MENU KEY A

```
ENTER REQUIRED
CHAINAGE ?
7:
6:
5:
4:
3:
2:
1:
CONT                    EXIT
```

The screen is displayed as shown left:

At this stage you have the option to exit the program using the **EXIT** routine which takes you back to the main **CURVE4** directory or the option to enter another chainage to be solved. This will continually repeat until the **EXIT** routine is initiated.

Required chainage ? **385.99** → TYPE VALUE
CONT → MENU KEY A

```
SOLUTION FOR ANGLE IS
TO CHORD
0°44'41"~361.807m
ARC  363.81m
AREA 181905.m2
FROM CENTRE
281°10'01"~1000m
CONT
```

```
SOLUTION FOR ANGLE IS
TO CHORD
9°20'20"~651.689m
ARC  663.81m
AREA 331905.m2
FROM CENTRE
298°21'21"~1000m
CONT
```

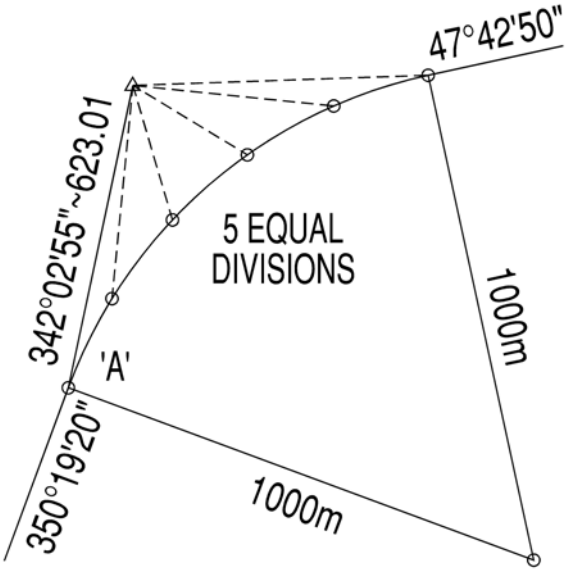
Required chainage ? **685.99** → TYPE VALUE
CONT → MENU KEY A

Required chainage ? **1023.853** → TYPE VALUE
CONT → MENU KEY A

```
SOLUTION FOR ANGLE IS
TO CHORD
19°01'05"~960.319m
ARC  1001.673m
AREA 500836.5m2
FROM CENTRE
317°42'50"~1000m
CONT
```

After you have entered the last chainage to be solved initiate the **EXIT** routine to return to the **CURVE4** directory.

3.4 Using a Eccentric Station



Again initiate the **START** routine and input the following parameters:

Enter Bearing in ?	**350.192**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**47.425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Eccentric Station ?	**YES**	→ MENU KEY A
Bearing from Tangent ?	**342.0255**	→ TYPE VALUE
	CONT	→ MENU KEY A
Distance from Tangent ?	**623.01**	→ TYPE VALUE
	CONT	→ MENU KEY A

The rest of the program is exactly the same as shown in the previous examples. Notice the similarities between the data if we were to divide the arc into 5 equal divisions as shown previously.

Initialise the **EQL** routine and follow the steps as outlined below:

Enter number of divisions ? **5** → TYPE VALUE
CONT → MENU KEY A

The solutions will then be displayed as shown:

```
SOLUTION FOR ANGLE 1
TO CHORD AT ECC. STN.
155°36'27"~431.687m
ARC   200.335m
AREA 100167.355m2
FROM CENTRE
271°48'02"~1000m
CONT
```

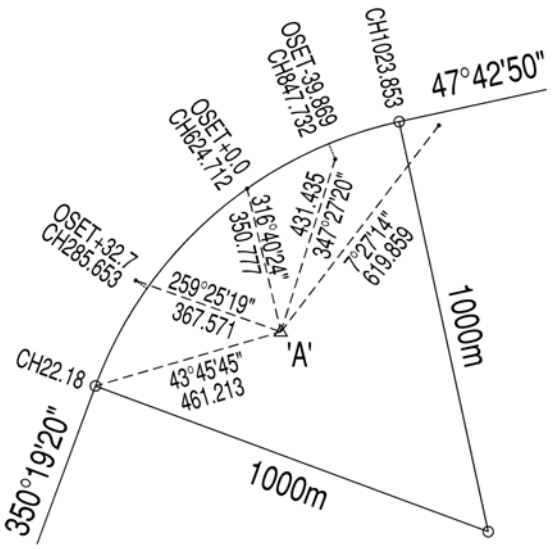
```
SOLUTION FOR ANGLE 2
TO CHORD AT ECC. STN.
133°37'02"~282.505m
ARC   400.669m
AREA 200334.709m2
FROM CENTRE
283°16'44"~1000m
CONT
```

```
SOLUTION FOR ANGLE 3
TO CHORD AT ECC. STN.
91°13'55"~269.759m
ARC   601.004m
AREA 300502.064m2
FROM CENTRE
294°45'26"~1000m
CONT
```

Etc.....

Keep initiating the **CONT** routine to display the next solution.

3.5 Routine Setout by Observations



Once again initiate the **START** routine.

Using the diagram as shown on the left for this example you will compute chainage and offset of any observed point with relation to the design curve.

Once again you have set your instrument at position labelled 'A'. Follow the steps as outlined below:

Enter Bearing in ?	**350.192**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**47.425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Eccentric Station ?	**YES**	→ MENU KEY A
Bearing from Tangent ?	**43.4545**	→ TYPE VALUE
	CONT	→ MENU KEY A
Distance from Tangent ?	**461.213**	→ TYPE VALUE
	CONT	→ MENU KEY A

Again the basic data has been entered into the calculators memory after which initiate the **SETO** routine and follow the steps as shown below:

Enter start chainage ?	**22.18**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter observed Bearing ?	**347.272**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter observed Distance ?	**431.435**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CONT	→ MENU KEY A
Enter observed Bearing ?	**259.2519**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter observed Distance ?	**367.571**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CONT	→ MENU KEY A
Enter Observed Bearing ?	**7.2714**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Observed Distance ?	**619.859**	→ TYPE VALUE
	CONT	→ MENU KEY A
	OK	→ MENU KEY F
	CONT	→ MENU KEY A
Enter Observed Bearing ?	**EXIT**	→ MENU KEY F

```
REQUIRED SOLUTION

CHAINAGE 847.732m
OFFSET   -39.869m
```

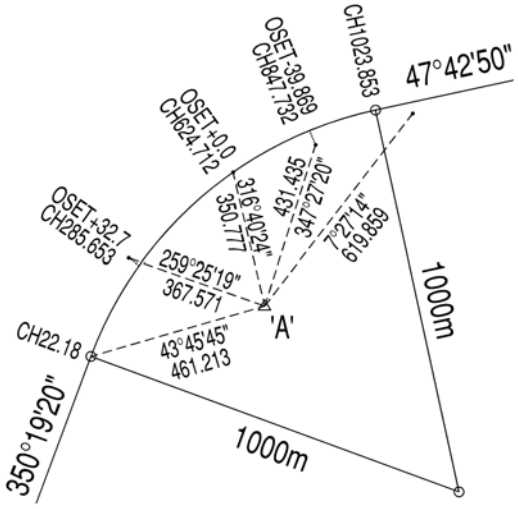
```
CONT
REQUIRED SOLUTION

CHAINAGE 285.653m
OFFSET   32.7m
```

```
CONT
CALCd. CHAINAGE
 IS OUTSIDE OF
THE ARC LENGTH.
```

```
OK
FROM RADIATION TO
START OF CURVE
BEARING  202°51'12"
DISTANCE 1028.446m
END OF CURVE
BEARING  245°16'51"
DISTANCE 95.209m
CONT
```

As shown when the observation is outside the confines of the design curve as shown in the above diagram then another set of displays will be shown to help you navigate your way back to either the start or end tangents.

3.6 Routine Setout by Chainage and Offset



Using the diagram as shown on the left for this example you will compute setout bearings and distances by entering the known chainage and offset.

Once again you have set your instrument at position labelled 'A'. Follow the steps as outlined below:

Enter Bearing in ?	**350.192**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**47.425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Eccentric Station ?	**YES**	→ MENU KEY A
Bearing from Tangent ?	**43.4545**	→ TYPE VALUE
	CONT	→ MENU KEY A
Distance from Tangent ?	**461.213**	→ TYPE VALUE
	CONT	→ MENU KEY A

Again the basic data has been entered into the calculators memory after which initiate the **CSET** routine and follow the steps as shown below:

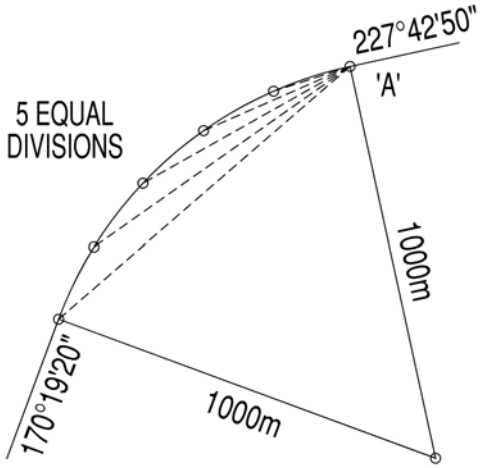
Enter start chainage ?	**22.18**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter required Chainage ?	**285.653**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter required Offset ?	**32.7**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CONT	→ MENU KEY A
Enter required Chainage ?	**624.712**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter required Offset ?	**0**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CONT	→ MENU KEY A
Enter required Chainage ?	**EXIT**	→ MENU KEY F

```
THE REQUIRED SOLUTION
AT CH: 285.653 AND
AT OSET: 32.7 IS

BEARING  259°25'19"
DISTANCE 367.571m

CONT

THE REQUIRED SOLUTION
AT CH: 624.712 AND
AT OSET: 0. IS

BEARING  316°40'24"
DISTANCE 350.777m

CONT
```

3.7 Anticlockwise rotation

If as shown in this case the curve has a anticlockwise rotation the angle should be subtracted and not added as shown in the previous examples. To handle this situation simply input the radius as a negative value as shown below.

Again initiate the **START** routine and input the following parameters:



Enter Bearing in ?	**227.425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**170.192**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**-1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Eccentric Station ?	**NO**	→ MENU KEY F

Initialise the **EQL** routine and follow the steps as outlined below:

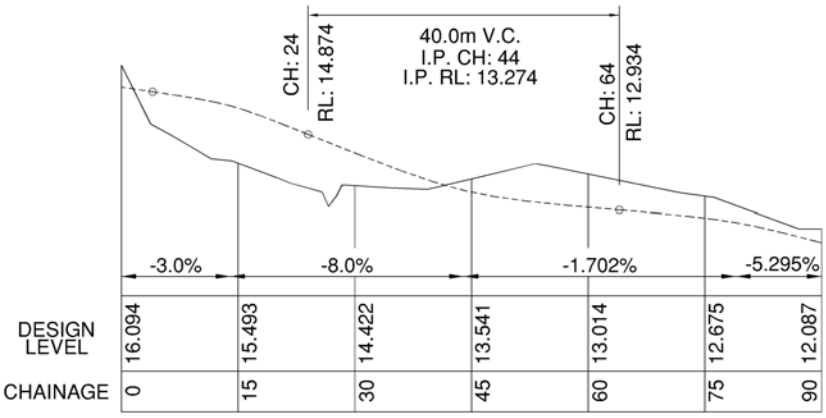
Enter number of divisions ?	**5**	→ TYPE VALUE
	CONT	→ MENU KEY A

Results →

221°58'29" ~ 200.0m
216°14'08" ~ 397.995m
210°29'47" ~ 592.0m
204°45'26" ~ 780.07m
199°01'05" ~ 960.319m

PROGRAM - VERTICAL CURVE

4.0 Introduction.

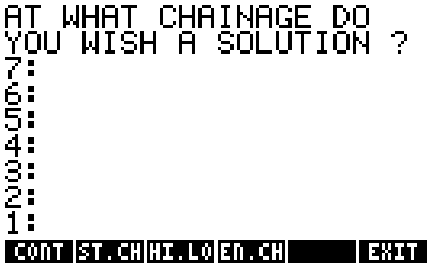


This program is a vertical curve setout program.

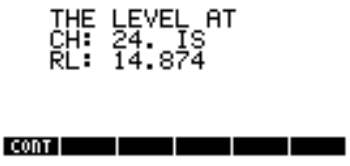
To start the program go to the directory labelled **VCURVE3** and initiate the **START** routine.

Use the diagram as shown on the left of the page for the following example.

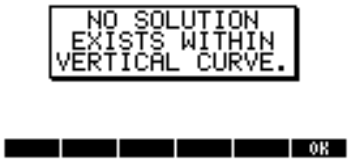
Grade in % ?	**-8**	→ TYPE VALUE
	CONT	→ MENU KEY A
Grade out % ?	**-1.702**	→ TYPE VALUE
	CONT	→ MENU KEY A
I.P. chainage ?	**44**	→ TYPE VALUE
	CONT	→ MENU KEY A
I.P. level ?	**13.274**	→ TYPE VALUE
	CONT	→ MENU KEY A
V.C. Length ?	**40**	→ TYPE VALUE
	CONT	→ MENU KEY A



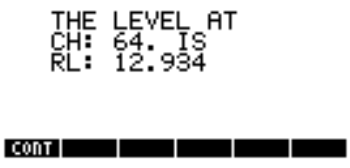
Menu Key	A	CONT	Computes entered chainage.
Menu Key	B	ST.CH	Computes start solution.
Menu Key	C	HI.LO	Computes High/Low point if any.
Menu Key	D	EN.CH	Computes end solution.
Menu Key	E		No Action.
Menu Key	F	EXIT	Exits back to the previous menu.



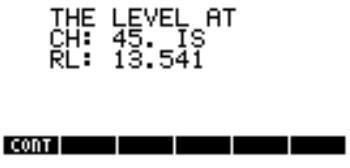
Initiating ST.CH



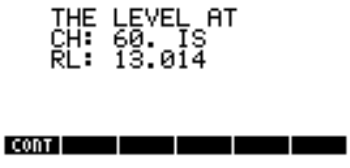
Initiating HI.LO
(There is no solution)



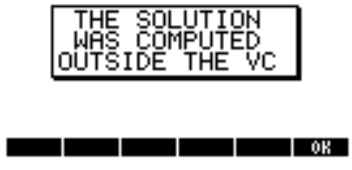
Initiating EN.CH



Enter 30 then initiate CONT

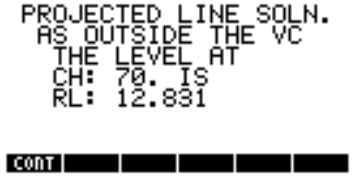


Enter 60 then initiate CONT



Enter 70 then initiate CONT

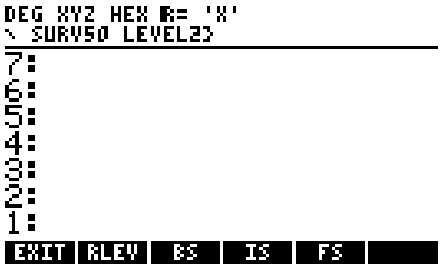
When the solution is outside the vertical curve the incoming or outgoing grades are projected to provide a straight line solution from the corresponding tangent point.



PROGRAM - LEVEL

5.0 Introduction.

This program enables quick and easy reductions of level runs as you go. To begin the program go to the directory labelled **LEVEL2** and initiate the **START** routine. You will then see a whole suite of subroutines as outlined below:-



Menu Key	A	EXIT	Exits back to the previous menu.
Menu Key	B	RLEV	Input level.
Menu Key	C	BS	Input backsight.
Menu Key	D	IS	Input intermediate sight.
Menu Key	E	FS	Input foresight.

5.1 The Program

Example of a small level run.

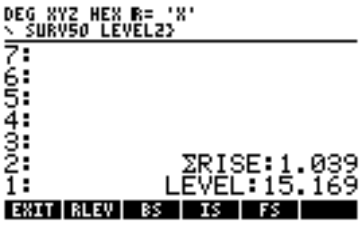
BS	IS	FS	RISE	FALL	LEVEL
1.849					14.130
	0.810		1.039		15.169
0.182		-0.631	1.441		16.610
2.378		0.673		0.491	16.119
	1.256		1.122		17.241
	1.310			0.054	17.187
-0.837		0.000	1.310		18.497
		3.533		4.370	14.127

				MISCLOSE	0.003

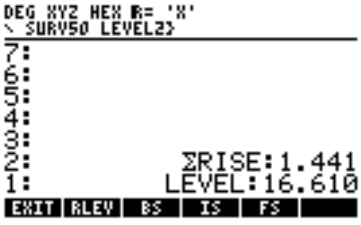
Step 1. Type **14.13** then initiate **RLEV**

Step 2. Type **1.849** then initiate **BS**

Step 3. Type **0.81** then initiate **IS** the screen will appear as shown

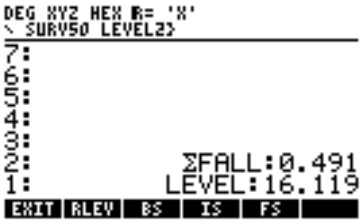


Step 4. Type **-0.631** then initiate **FS** the screen will appear as shown



Step 5. Type **0.182** then initiate **BS**

Step 6. Type **0.673** then initiate **FS** the screen will appear as shown



Step 7. Type **2.378** then initiate **BS**

Step 8. Type **1.256** then initiate **IS**

Step 9. Type **1.31** then initiate **IS**

Step 10. Type **0** then initiate **FS**

Step 11. Type **-0.837** then initiate **BS**

Step 12. Type **3.533** then initiate **FS**

Note: To initiate a new level run all you have to do is type the starting level then initiate **RLEV**.

PROGRAM - CLOSE

6.0 Introduction

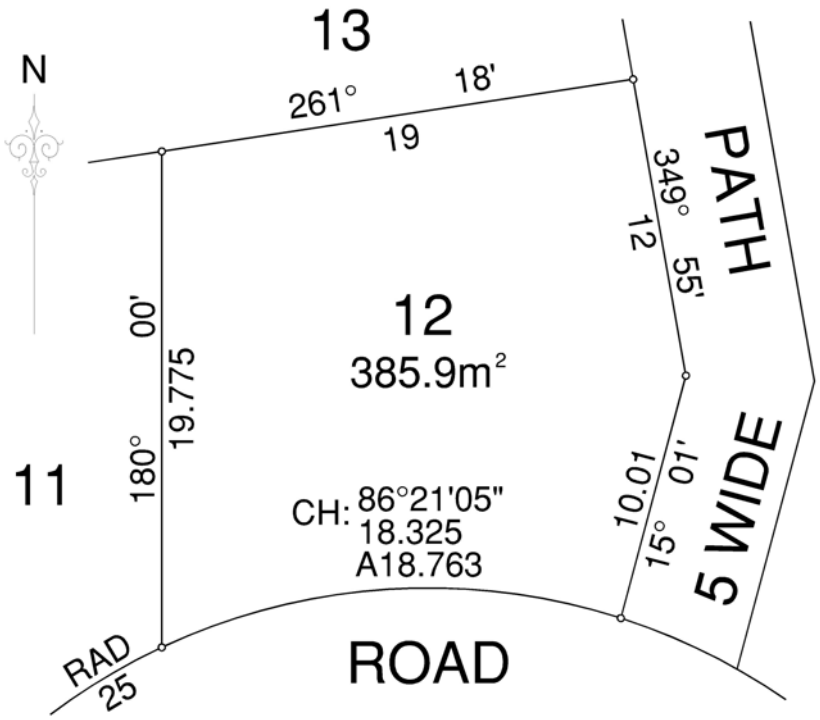
This program will be the most useful program for day to day survey problems. To start the program go to the directory labelled **CLOSE4** and initiate the **START** routine. You will then see the data entry screen which is outlined below:

```
DATA ENTRY MENU
ENTER BEARING 1 ?
7:
6:
5:
4:
3:
2:
1:
CONT CURVE CALCS      NEW EXIT
```

Menu Key	A	CONT	Continue routine to enter data.
Menu Key	B	CURVE	Enter curve boundary information.
Menu Key	C	CALCS	Display the calculations menu.
Menu Key	D		No action.
Menu Key	E	NEW	Start new close (at any time).
Menu Key	F	EXIT	Exits back to the previous menu.
Next Page → Menu Key	L		

```
DATA ENTRY MENU
ENTER BEARING 1 ?
7:
6:
5:
4:
3:
2:
1:
CONT 1/2∠ SEC. HMS+ HMS- REINI
```

Menu Key	A	CONT	Continue routine to enter data.
Menu Key	B	1/2∠	Half angle computation.
Menu Key	C	SEC.	Secant calc. (different offsets).
Menu Key	D	HMS+	Sums two bearings.
Menu Key	E	HMS-	Subtracts two bearings.
Menu Key	F	REINI	Reinstates the custom menu.



6.1 Situation

All the examples we will relate to this diagram in some way or another. This diagram with the inclusion of a curved boundary encompasses the majority of problems faced with day to day survey calculations.

6.2 Data Entry Menu

86°21'05" ~ 18.325
15°01'00 ~ 10.01
349°55'00" ~ 12.0
261°18'00" ~ 19.0
180°00'00" ~ 19.775

The first step we need to do is to input all the information necessary to perform the calculation.

As shown by the previous figure the program is now at a stage where it is ready to input the bearing of the first line. Follow the steps below to enter the close information:-

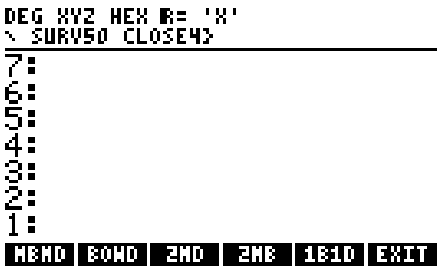
BEARING 1 ?	**86.2105**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 1 ?	**18.325**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 2 ?	**15.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 2 ?	**10.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 3 ?	**349.55**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 3 ?	**12**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 4 ?	**261.18**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 4 ?	**19**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 5 ?	**180**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 5 ?	**19.775**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 6 ?	**CALCS**	→ MENU KEY C

Note: At any stage in the data entry program if you wish to start again for example a bearing was input wrongly you are able to restart the program by initialising the **NEW** routine. If however you wish to go to another program and not continue the close then initiate the **EXIT** routine. For both these operations all information previously input is deleted. If on the other hand you wish to edit the entered data later, this can be done as shown in section 6.9.

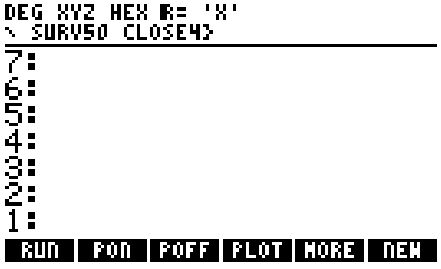
Now that all the close information is entered into the calculators memory we can perform specific computations with the data by initialising the **CALCS** routine.

6.3 Calculations

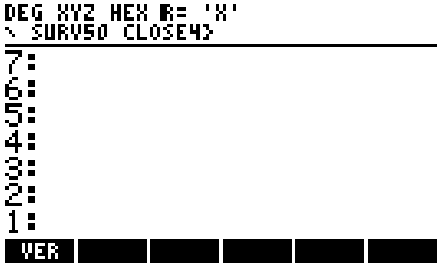
Once the **CALCS** routine has been initiated then a whole new submenu appears as illustrated below:



Menu Key A **MBMD** Computes the misclose.
Menu Key B **BOWD** Bowditch correction & area adjustment.
Menu Key C **2MD** 2 missing distance computation.
Menu Key D **2MB** 2 missing bearing computation.
Menu Key E **1B1D** Missing bearing & distance (sep. lines).
Menu Key F **EXIT** Exits back to the previous menu.



Menu Key A **RUN** Display and edit entered close.
Menu Key B **PON** Turn printer ON.
Menu Key C **POFF** Turn printer OFF.
Menu Key D **PLOT** Displays the close graphically.
Menu Key E **MORE** Continue entering data to end of close.
Menu Key F **NEW** Start a new close.



Next Page Menu Key L

Menu Key A **VER** Displays the version of the program.

6.4 Routine Missing Bearing Missing Distance

To compute the missing bearing and missing distance of the input data previously entered initiate the **MBMD** routine the solutions will be displayed as:

```
THE SOLUTIONS ARE

BEARING  90°39'09.4"
DISTANCE .001m
AREA     407.339m^2
ACCURACY 1in87912

MBMD BOWD 2MD 2MB 1810 EXIT
```

6.5 Routine Bowditch

If you now initiate the **BOWD** routine a Bowditch computation is performed and a new area is computed.

```
40% COMPLETED.

MBMD BOWD 2MD 2MB 1810 EXIT
```

Then the solution will be displayed as:

Initiate the **CONT** routine which will to take you back to the **CALCS** menu. Hit the menu key **L** labelled **NXT** and then initiate the routine **NEW** to start the next example.

Note: Radius and arc length are not altered hence the area of the arc is not affected.

```
ADJUSTED AREA
407.329m^2
NO AMENDMENT TO ARC
AREA HAS BEEN ADDED
CONT
```

6.6 Routine 2 Missing Distances

86°21'05" ~ A-18.763
R 25
15°01'00 ~ 10.01
349°55'00" ~ 12.0
261°18'00" ~ (?)
180°00'00" ~ (?)

To do this example input a new close as shown in diagram 6.1. This time we will use the curve option of the program. When the program asks for the arc length +/- all it is asking for is if the curve has a negative or a positive affect on the area. In our case it's a negative affect.

Initiate the **CURVE** routine when the bearing input is shown at the prompt and follow the steps below to enter the close information:-

BEARING 1 ?	**CURVE**	→ MENU KEY B
BEARING 1 ?	**86.2105**	→ TYPE VALUE
	CONT	→ MENU KEY A
ARC +/- 1 ?	**18.763**	→ TYPE VALUE
	+/-	→ MENU KEY Y
	CONT	→ MENU KEY A
RADIUS 1 ?	**25**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 2 ?	**15.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 2 ?	**10.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 3 ?	**349.55**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 3 ?	**12**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CALCS	→ MENU KEY C
	2MD	→ MENU KEY C
1ST BEARING ?	**261.18**	→ TYPE VALUE
	CONT	→ MENU KEY A
2ND BEARING ?	**180**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CONT	→ MENU KEY A

The solutions will be displayed as:

```
1ST SOLUTION
BEARING  261°18'00.0"
DISTANCE 19m

2ND SOLUTION
BEARING  180°00'00.0"
DISTANCE 19.775m
CONT
```

Initiate the **CONT** routine to take you back to the previous menu. Initiate the **MBMD** routine to display the computed area. The solutions will be displayed as:

```
  THE SOLUTIONS ARE

BEARING  180°00'00.0"
DISTANCE 19.775m
AREA     385.929m^2
ACCURACY 1in3

MBMD BOWD 2MD 2MB 1810 EXIT
```

Hit the menu key **L** labelled **NXT** and then initiate the **NEW** routine to start the next example.

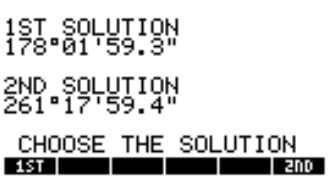
6.7 Routine 2 Missing Bearings

86°21'05" ~ A-18.763
R 25
15°01'00 ~ 10.01
349°55'00" ~ 12.0
(?) ~ 19.0
(?) ~ 19.775

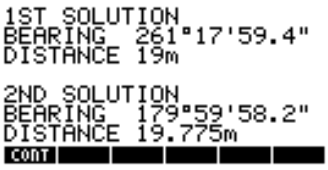
To do this example we need to input a new close exactly the same way as shown in the previous example 6.6. However when you go to the **CALCS** menu you now initiate the **2MB** routine and follow the steps over the page.

BEARING 1 ?	**CURVE**	→ MENU KEY B
BEARING 1 ?	**86.2105**	→ TYPE VALUE
	CONT	→ MENU KEY A
ARC 1 +/- ?	**18.763**	→ TYPE VALUE
	+/-	→ MENU KEY Y
	CONT	→ MENU KEY A
RADIUS 1 ?	**25**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 2 ?	**15.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 2 ?	**10.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 3 ?	**349.55**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 3 ?	**12**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CALCS	→ MENU KEY C
	2MB	→ MENU KEY D
1ST DISTANCE ?	**19**	→ TYPE VALUE
	CONT	→ MENU KEY A
2ND DISTANCE ?	**19.775**	→ TYPE VALUE
	CONT	→ MENU KEY A
	2ND	→ MENU KEY F

The solutions will be displayed as:



There is 2 options to choose from as there is 2 unique solutions at the intersections of the circles. As we know the orientation of the desired solution in this case the second being correct. Initiate the **2ND** routine to continue the computations.



Initiate the **CONT** routine to take you back to the previous menu. Initiate the **MBMD** routine to display the computed area. The solutions will be displayed as:

As the answer shows it is not exactly the same as the diagram illustrates which is only brought about by rounding errors and the relatively small close i.e. 2" in 19.775m makes 0.2mm in deviation.

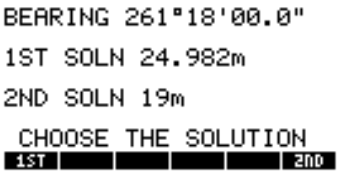
Hit the menu key **L** labelled **NXT** and then initiate the **NEW** routine to start the next example.

6.8 Routine Missing Bearing Missing Distance (Separate Lines)

86°21'05" ~ A-18.763
R 25
15°01'00 ~ 10.01
349°55'00" ~ 12.0
261°18'00" ~ (?)
(?) ~ 19.775

To do this example input a new close exactly the same way as shown in the previous examples. However this time when you go to the **CALCS** menu you now initiate the **1B1D** routine and follow the steps below.

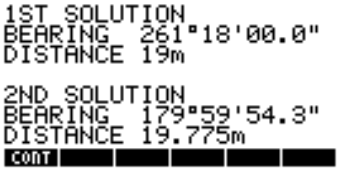
	CALCS	→ MENU KEY C
	1B1D	→ MENU KEY E
BEARING ?	**261.18**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE ?	**19.775**	→ TYPE VALUE
	CONT	→ MENU KEY A
	2ND	→ MENU KEY F



As you can see once again there is 2 options to choose from as there is 2 unique solutions at the intersection of the circles. In this case the second solution will be correct so initiate the **2ND** routine to continue the computations. This operation may need to duplicated if the desired solution is not known hence trying both options.

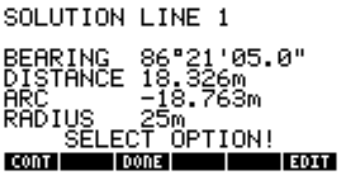
Initiate **CONT** to take you back to the previous menu. Initiate the **MBMD** routine to display the computed area of 385.934m^2.

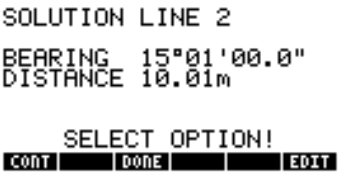
As is seen again rounding errors have occurred due to the relatively small close as 6" in 19.775m makes 0.6mm in deviation. Initiate the **EXIT** routine to end the program.

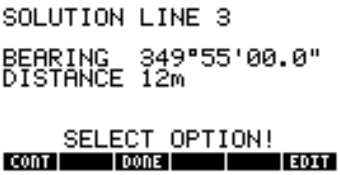


6.9 Routine Run Entered Close

To do this example as we are already in the **CALCS** menu hit the menu key **L** labelled **NXT** and then initiate the **RUN** routine. This routine will display all the entered traverse legs from start to finish, and as we have performed a calculation prior it will also display the first computed leg:



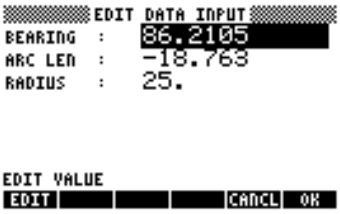




Etc.....

As shown in this example the first display is different from the rest as a curved boundary was entered at the data entry menu.

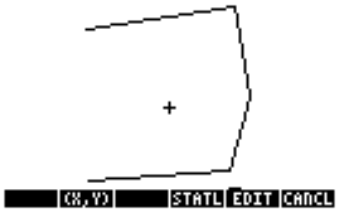
If for example the first screen flags a typing error you can then initiate the edit routine to adjust the data. Simply adjust the figures so as to be correct then hit the Enter key or Menu Key F **OK**.



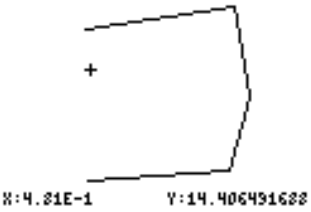
Once completed new solutions are computed including the area.

6.10 Routine Plot Close

Once again using the information previously entered initiate the **PLOT** routine. This routine will display all the entered traverse legs from start to finish, and the computed leg as shown:



Hitting the menu key **B** labelled **(X,Y)** displays the coordinates system within the entered close (Start is 0,0). The cursor can then be moved around the screen. Initiate menu key **F** labelled **CANCL** or the **ON** button to exit to the previous menu.



Note: The plot does not display the arc information of the entered curve data, however a straight line is plotted in its place from the end points of the arc.

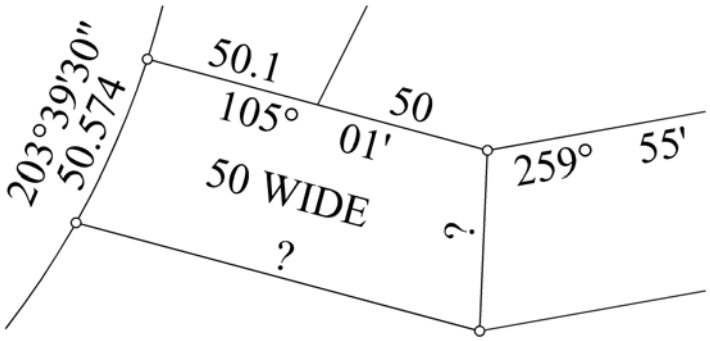
6.11 Routine Printer On

Initiate the **PON** routine to turn the printer commands on. This will then enable the calculator to send to the printer via infrared the solutions of the entered closes. All of the diagrams as shown in the previous examples will be sent to the printer and no longer displayed on the screen of the calculator. The HP49 calculator is not equipped with infrared so the commands are not added to that version.

6.12 Routine Printer Off

Initiate the **POFF** routine to turn the print commands off (which is the default).

6.13 Routine ½ Angle



As can be seen in this example there is not enough information to solve the unknowns straight away without first working out the ½ angle solution.

Once again initialise the **START** routine and follow the steps below

Note: addition, subtraction and multiplication can be used at any time.

BEARING 1 ?	**203.393**	→ TYPE VALUE
	ENTER	→ ENTER KEY
	180	→ TYPE VALUE
	-	→ MINUS KEY
	CONT	→ MENU KEY A
DISTANCE 1 ?	**50.574**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 2 ?	**105.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 2 ?	**50.1**	→ TYPE VALUE
	ENTER	→ ENTER KEY
	50	→ TYPE VALUE
	+	→ PLUS KEY
	CONT	→ MENU KEY A
		→ MENU KEY L
	½<	+ MENU KEY B
BEARING IN ?	**105.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING OUT ?	**259.55**	→ TYPE VALUE
	ENTER	→ ENTER KEY
	180	→ TYPE VALUE
	-	→ SUBTRACT
	CONT	KEY
WIDTH ?	**50**	→ MENU KEY A
	CONT	→ TYPE VALUE
		→ MENU KEY A

The half angle solution will be displayed as:

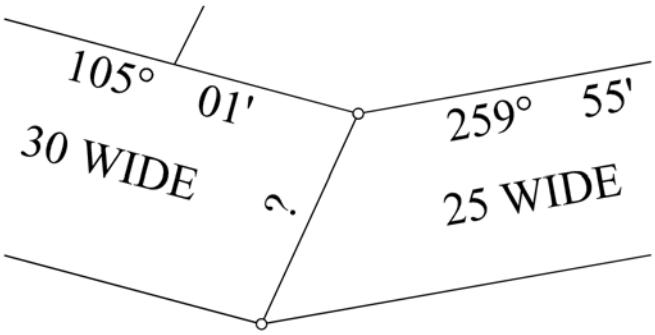
```
½ ANGLE COMPUTATION
BEARING  182°28'00.0"
DISTANCE 51.224m

CONT
```

The solution is not entered into memory enabling it to be repeated if necessary. Now you can enter this bearing and distance go to **CALCS** and find the misclose using **MBMD** or you can use **2MD** by initiating **CALCS** straight away. If you enter the information and use **MBMD** to find the misclose. The solution will be displayed as:

```
  THE SOLUTIONS ARE

BEARING  285°01'00.4"
DISTANCE 118.83m
AREA     5473.234m^2
ACCURACY 1in1

MBMD BOWD 2MD 2MB 1B1D EXIT
```

Initiate the **EXIT** routine to end the program.

6.14 Routine Secant



The Secant routine computes the join between two sets of parallel lines with two different offset distances.

The secant routine will also work for equal widths i.e. it is another way in which to solve the ½ angle solution as shown in the previous example.

Once again initialise the **START** routine and follow the steps over the page

BEARING IN ?	**105.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
OFFSET IN ?	**30**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING OUT ?	**79.55**	→ TYPE VALUE
	CONT	→ MENU KEY A
OFFSET OUT ?	**25**	→ TYPE VALUE
	CONT	→ MENU KEY A

The solution will be displayed as:

```
SECANT COMPUTATION
SOLUTION

BEARING  204°40'50.4"
DISTANCE 30.432m

CONT
```

Note: The bearing may be 180 degrees out depending on the side you wish to offset

6.15 Continuation

Try this scenario:

86°21'05" ~ A-18.763
R 25
15°01'00 ~ 10.01
(?) ~ (?)
349°55'00" ~ 12.0
261°18'00" ~ (?)
180°00'00" ~ (?)

You are running a close and midway through you wish to solve for the missing bearing and distance before continuing
on. The way this can be done is by using the **MORE** routine in the **CALCS** menu. As entered data is only deleted when starting the program afresh using the **MORE** routine you are able to go from one menu to another without loss of data.

Once again initialise the **START** routine and follow the steps over the page by initiating the **CURVE** routine first.

BEARING 1 ?	**CURVE**	→ MENU KEY B
BEARING 1 ?	**86.2105**	→ TYPE VALUE
	CONT	→ MENU KEY A
ARC 1 +/-?	**18.763**	→ TYPE VALUE
	+/-	→ MENU KEY
	CONT	→ MENU KEY A
RADIUS 1 ?	**25**	→ TYPE VALUE
	CONT	→ MENU KEY A
BEARING 2 ?	**15.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 2 ?	**10.01**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CALCS	→ MENU KEY C
	MBMD	→ MENU KEY A
	MORE	→ MENU KEY L
		+ MENU KEY E
BEARING 3 ?	**349.55**	→ TYPE VALUE
	CONT	→ MENU KEY A
DISTANCE 3 ?	**12**	→ TYPE VALUE
	CONT	→ MENU KEY A
	CALCS	→ MENU KEY C
	2MD	→ MENU KEY B
1ST BEARING ?	**261.18**	→ TYPE VALUE
	CONT	→ MENU KEY A
2ND BEARING ?	**180**	→ TYPE VALUE
	CONT	→ MENU KEY A

The solution will be displayed as:

```
  THE SOLUTIONS ARE

BEARING  242°34'41.6"
DISTANCE 23.525m
AREA     65.49m^2
ACCURACY 1in1

MBMD BOMD 2MD 2MB 1810 EXIT
```

There is 2 options to choose from as there is 2 unique solutions at the intersections of the circles. As we know the orientation of the desired solution in this case the second being correct. Initiate the **2ND** routine to continue the computations.

```
1ST SOLUTION
BEARING  261°18'00.0"
DISTANCE 19m

2ND SOLUTION
BEARING  180°00'00.0"
DISTANCE 19.775m
CONT
```

Initiate the **CONT** routine to take you back to the previous menu. Initiate the **MBMD** routine to display the computed area.

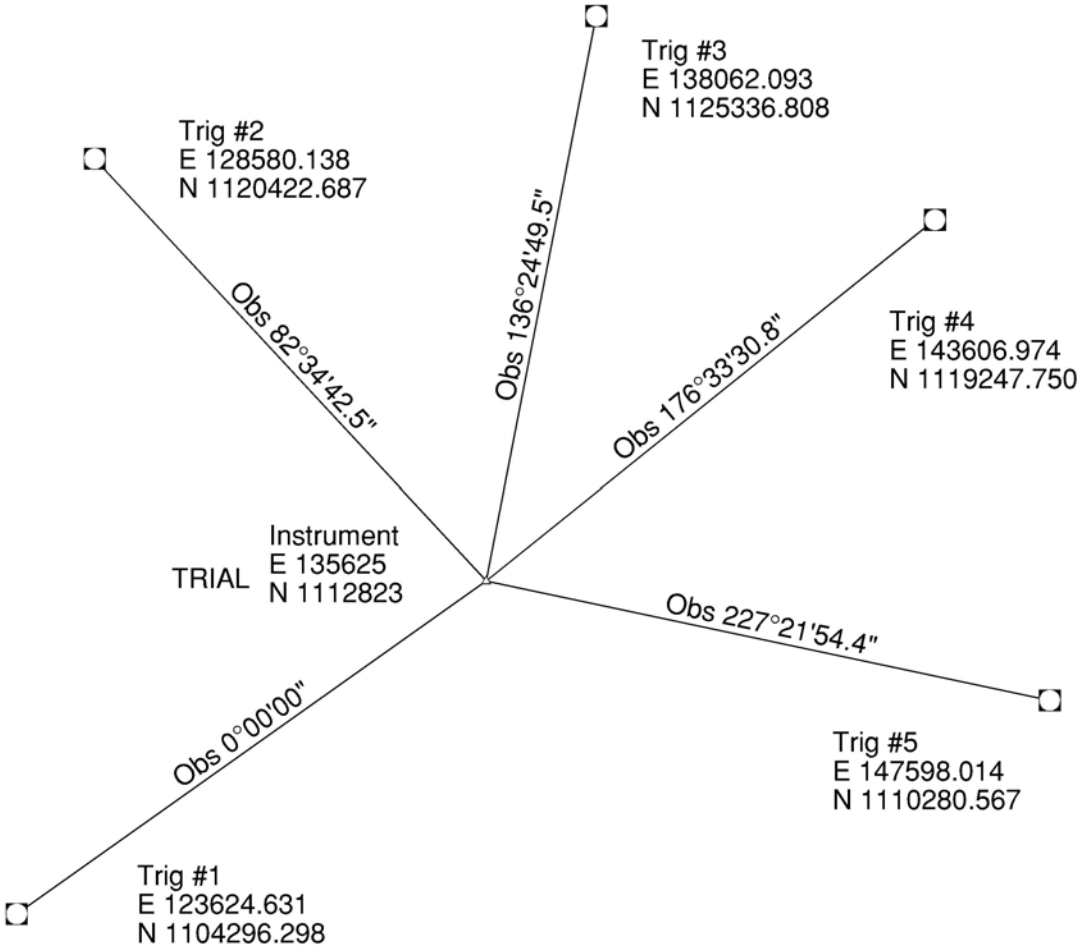
Note: As shown in chapter 1of this manual using the program **CONVERSION** it enables you to convert quick and easily from Feet or Links to Metres, using the same logic when in the data entry menu and the input distance is prompt you again have the option to perform the conversion before continuing.

But remember 66 feet 9 inches is typed as **66.09**
66 feet 10⅜ inches is typed as **66.10375**
66 feet ⅜ inches is typed as **66.00375**

PROGRAM - RESECTION

7.0 Introduction.

This is a resection program using the Croute-Cholesky method. The number of observations and proportionally the size of the matrices is only limited by the calculator memory. For this example you will perform a 5 ray resection problem using the diagram as illustrated below:



To start the program go to the directory labelled **RESN2** then initiate the **START** routine. At this stage you have the options to display all the computations by initiating the **YES** routine or alternatively you have the option to display the final answer only by initiating the **NO** routine. Your screen will look like this:

You also have the option to exit the program returning you to the **RESN2** menu by initiating the **EXIT** routine.

This example will be based on the option to display all computations. So initiate the **YES** routine and follow the steps below:

Number of Observations ?	**5**	→ TYPE VALUE
	CONT	→ MENU KEY A
Standard Deviation ?	**5**	→ TYPE VALUE
	CONT	→ MENU KEY A
Precision ?	**0.001**	→ TYPE VALUE
	CONT	→ MENU KEY A

The next operation is to input the coordinate information which repeats by the number observations, 5 in this case.

Enter Easting for STN 1 ?	**123624.631**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing for STN 1 ?	**1104296.298**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Easting for STN 2 ?	**128580.138**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing for STN 2 ?	**1120422.687**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Easting for STN 3 ?	**138062.093**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing for STN 3 ?	**1125336.808**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Easting for STN 4 ?	**143606.974**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing for STN 4 ?	**1119247.75**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Easting for STN 5 ?	**147598.014**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing for STN 5 ?	**1110280.567**	→ TYPE VALUE
	CONT	→ MENU KEY A

Followed by the observation information which also repeats by the number of observations (5).

Enter Observation to STN 1 ?	**0**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Observation to STN 2 ?	**82.34425**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Observation to STN 3 ?	**136.24495**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Observation to STN 4 ?	**176.33308**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Observation to STN 5 ?	**227.21544**	→ TYPE VALUE
	CONT	→ MENU KEY A

The program then prompts the user for the coordinates of the instrument which is only a rough guess.

Enter trial easting of station ?	**135625**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter trial northing of station ?	**1112823**	→ TYPE VALUE
	CONT	→ MENU KEY A

```
SELECT THE VARIABLE
   TO REVIEW AND
  EDIT FROM BELOW
```

Menu Key A **CORDS** Display and edit the entered coordinates.

Menu Key B **OBS** Display and edit the entered observations.

Menu Key C **REST** Display and edit remaining data.

Menu Key D **PON** Turn printer ON.

Menu Key E **POFF** Turn printer OFF.

Menu Key F **CALC** Start the calculation.

Next Page →Menu Key L

Menu Key F **EXIT** Exits back to the previous menu.

Basically what the message details is that the first stage of the program has finished allowing you to view all the information you have input into the calculators memory before proceeding. If you are happy with the correctness of the all the variables then initiate the **CALC** routine or reinitiate the **START** routine to input the information again. See the over the page for variable listing:

Variable **CORDS -** A nx2 matrix of all the entered coordinates.
Variable **OBS -** A nx1 matrix of all the entered observations.
Rest [Var **TE -** Trial easting Var **TN -** Trial northing
Var **PREC-** Precision Var **STDV -** 1 / (standard deviation)^2

Once the **CALC** routine is initiated the screen will display the iteration number and the percentage completed of the computation. Once 100% complete and as you selected to view all computations the following screens will be displayed as:
Note: After each screen initiate the **CONT** routine to display the next screen.

```
COMPUTED SOLUTIONS
FROM THE INSTRUMENT
TO STATION 1

BEARING  234°36'17.3"
DISTANCE 14721.192m
```

```
COMPUTED SOLUTIONS
FROM THE INSTRUMENT
TO STATION 2

BEARING  317°10'10.8"
DISTANCE 10362.689m
```

```
COMPUTED SOLUTIONS
FROM THE INSTRUMENT
TO STATION 3

BEARING  11°01'13.9"
DISTANCE 12748.914m
```

CONT CONT CONT Etc....

```
CONSTRUCTION OF
THE A MATRIX IS

ROW1
COL1 -11.421779
COL2 8.115593
COL3 1
```

```
CONSTRUCTION OF
THE A MATRIX IS

ROW2
COL1 -13.53171
COL2 -14.597414
COL3 1
```

```
CONSTRUCTION OF
THE A MATRIX IS

ROW3
COL1 3.092793
COL2 -15.880648
COL3 1
```

CONT CONT CONT Etc....

```
CONSTRUCTION OF
THE L MATRIX IS

ROW1
COL1 0.
```

```
CONSTRUCTION OF
THE L MATRIX IS

ROW2
COL1 -48.98282
```

```
CONSTRUCTION OF
THE L MATRIX IS

ROW3
COL1 7.11333
```

CONT CONT CONT Etc....

```
CORRECTIONS TO COORDS

CORn E    -2.612
EASTING   135622.388
CORn N    -3.231
NORTHING  1112819.769
```

CONT

These displays are repeated for each iteration until a solution has been reached to the required precision. In this case 3 times.

The Croute-Cholesky method of computation in which the formulae used are as follows and hence the logic of the previous displays:

V=Ax+L

Where **A** is a matrix the magnitude of the n x 3
X is a 3 x 1 matrix containing the solution.
L is a matrix the magnitude of the n x 1

The A matrix
Column 1 [206265 . sin(bearing)] / distance
Column 2 -[206265 . cos(bearing)] / distance
Column 3 Is set to 1.0

The L matrix
Column 1 (The computed bearing)
- (The computed bearing to the first station)
- (The observation) in seconds

As we are able to substitute values for both the A matrix and the L matrix using simultaneous equations the solutions can be computed. Once the desired precision as stated is achieved the final answer will be displayed as such:

```
THE FINAL COORDINATES
AFTER 3 ITERATIONS

  EAST   135623.193

  NORTH 1112820.492
```

CONT

```
DISPLAY ALL FINAL
BEARING & DISTANCES ?
7:
6:
5:
4:
3:
2:
1:
```

YES NO

You are then prompted to display the final adjusted bearing and distances from the instrument to each station. If the **YES** routine is selected then the following screens will be displayed as shown below.

```
COMPUTED SOLUTIONS
FROM THE INSTRUMENT
TO STATION 1

BEARING  234°36'31.3"
DISTANCE 14718.266m
```

```
COMPUTED SOLUTIONS
FROM THE INSTRUMENT
TO STATION 2

BEARING  317°11'11.2"
DISTANCE 10363.301m
```

```
COMPUTED SOLUTIONS
FROM THE INSTRUMENT
TO STATION 3

BEARING  11°01'34.9"
DISTANCE 12751.722m
```

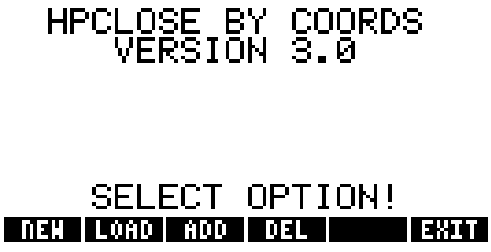
CONT CONT CONT Etc....

PROGRAM - POINTS

8.0 Introduction

This is a coordinated based program utilising the upload/download capabilities of the HP48 calculator.

To start the program go to the directory labelled **PNTS3** then initiate the **START** routine. You will then see the startup menu as outlined below:



Menu Key	A	NEW	Starts a new file.
Menu Key	B	LOAD	Load a previously stored file.
Menu Key	C	ADD	Add information to the current file.
Menu Key	D	DEL	Delete a stored file from memory.
Menu Key	E		No Action.
Menu Key	F	EXIT	Exits back to the previous menu.

8.1 Routine Load

If a job has previously been stored within the calculators memory it can be retrieved and added through the use of the **LOAD** routine. Initiating **LOAD** will also asks you to save the previous working file to the Jobs directory as shown in the previous example. Once completed a list will appear of the available files to open.

Use the up and down arrows (Menu keys K & Q) to position the marker bar over the selected file you wish to load and then press **OK** (Menu key F). Menu key E (**CNCL**) will terminate the operation returning you to the Start menu.

Note: This routine may also be initiated from within the body of the main program at any stage.

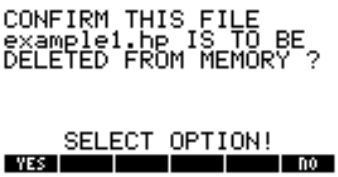
8.2 Routine Add

If a job has already been initiated but not previously stored within the calculators permanent memory it can be accessed by using the **ADD** routine. Basically all that this routine accomplishes is to initiate the main menu without altering any of the programs running parameters. Once initiated you at the same position prior to exiting the program.

8.3 Routine DEL

Routine **DEL** is used to delete unwanted stored jobs from the calculators memory. Once again a easy pick list will appear of the available files to delete.

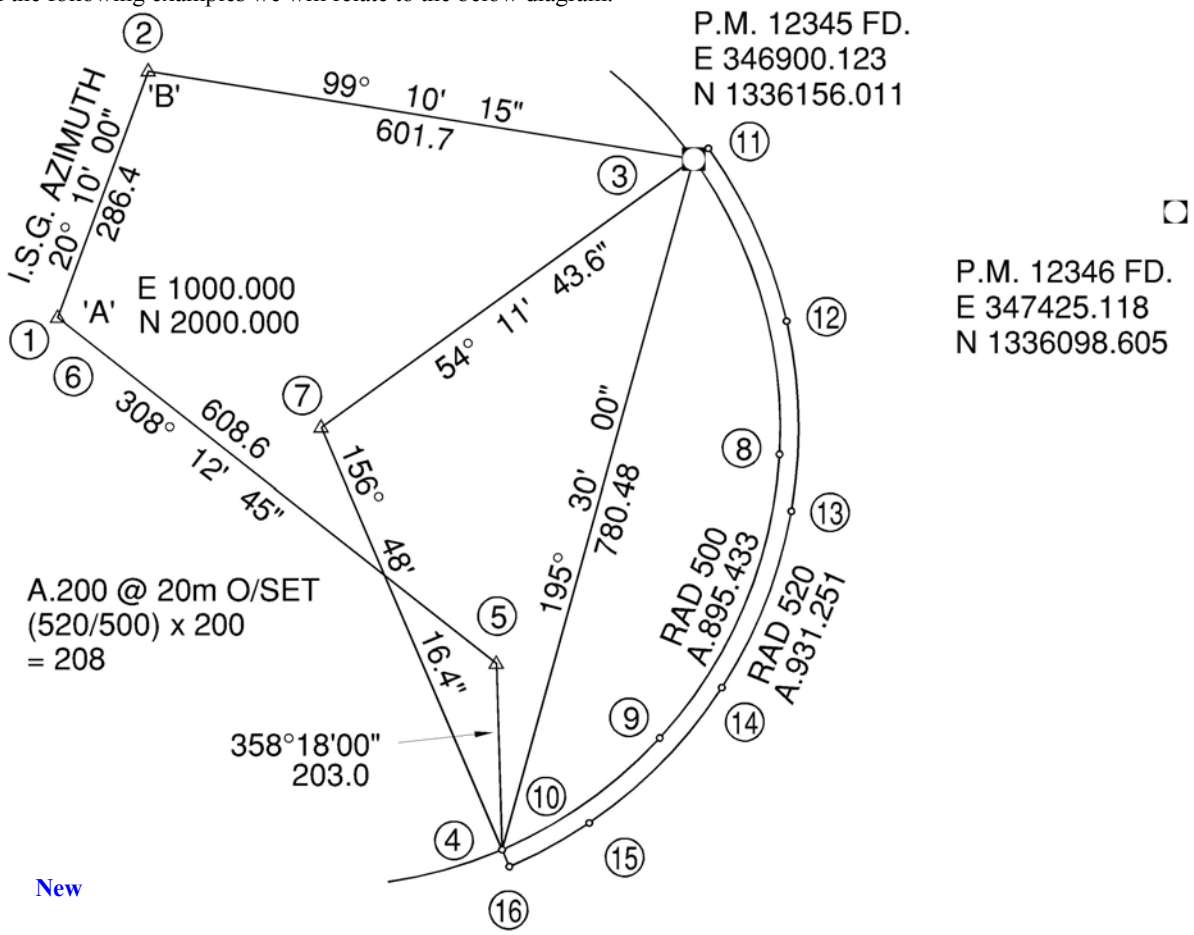
Again position using the up / down Menu keys and then press **OK** (Menu key F). Menu key E the **CNCL** command and terminate the operation returning you to the Start menu.



Once you have chosen the file to delete you are then asked to confirm the deletion of that file. Upon completion you are returned to the Start menu.

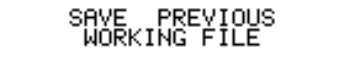
8.4 The Situation

All of the following examples we will relate to the below diagram.

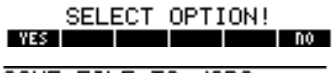


8.5 New

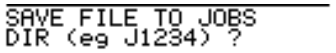
At the start of every job this routine must be initiated so as to clear all stored variables out of the calculators memory and setup a new working file. After initiating the **NEW** routine you are then asked if you wish to backup the previous working file to the Jobs directory. If **YES** is initiated then you are asked to enter a name which ***must consist of at least have 1 character prior to any number*** for the file to be stored properly.



The calculator is already in alpha mode and lowercase, so type the name in this case **bak** and hit the enter key when finished. The program will automatically use the previous filename or you can change it.

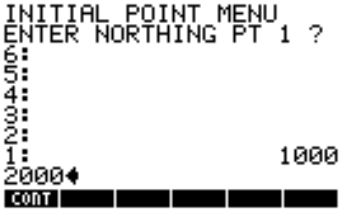


Type the filename **"example1"** to be stored into memory and hit the enter key when finished.



To cancel simply enter no name i.e. null character at either of the text prompts.

The program is now at a stage where it is ready to go and is waiting for you to input the coordinates of the initial station to be stored as point number 1. Input the Easting and Northing coordinates as shown below:-



Easting for PT 1 ?	**1000**	→ TYPE VALUE
	CONT	→ MENU KEY A
Northing for PT 1 ?	**2000**	→ TYPE VALUE
	CONT	→ MENU KEY A

8.6 The Main Program

Once the main program has been initiated the main menu appears as outlined below:-

Menu Key A **TRAV** Coordinate traverse routine.

Menu Key B **MBMD** Missing Bearing & Distance.

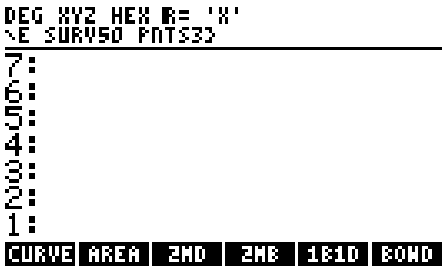
Menu Key C **CLOSE** Continual Bearing and Distance from 1 point.

Menu Key D **RUN** Run a loop of Bearing and Distances.

Menu Key E **CORDS** Displays and edits coordinate information.

Menu Key F **E.PT** Coordinate entry routine.

Next Page →Menu Key L



Menu Key A **CURVE** Input curve details and divide.

Menu Key B **AREA** Area by coordinates computation.

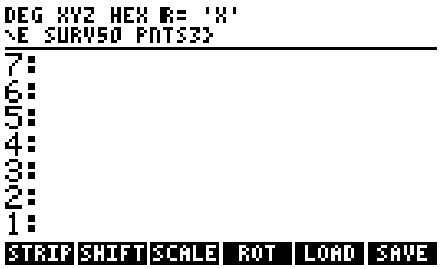
Menu Key C **2MD** 2 Mising Distance computation.

Menu Key D **2MB** 2 Mising Bearing computation.

Menu Key E **1B1D** Missing Bearing & Distance sep. lines.

Menu Key F **BOWD** Bowditch correction.

Next Page →Menu Key L



Menu Key A **STRIP** Delete points from memory.

Menu Key B **SHIFT** Shift a group of points.

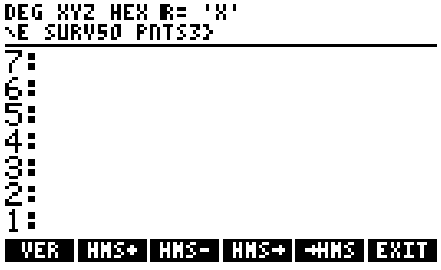
Menu Key C **SCALE** Scale a group of points.

Menu Key D **ROT** Rotate a group of points.

Menu Key E **LOAD** Load a previously saved file from memory.

Menu Key F **SAVE** Save the working file to permanent memory.

Next Page →Menu Key L



Menu Key A **VER** Displays the current program version.

Menu Key B **HMS+** Sums two angles.

Menu Key C **HMS-** Subtracts two angles.

Menu Key D **→HMS** Decimal degrees to degrees minutes seconds.

Menu Key E **HMS+** Degrees minutes seconds to decimal degrees.

Menu Key F **EXIT** Exits back to the main menu.

8.7 Routine TRAV

This routine provides for a close to be input into the calculators working memory and stored as coordinates. Adhering to the diagram as shown in section 8.4 initiate the **TRAV** routine and follow the instructions below:-

Traverse from pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter bearing to pt 2 ?	**20.1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter distance to pt 2 ?	**286.4**	→ TYPE VALUE
	CONT	→ MENU KEY A

```
DATA ACCEPTED AS
 POINT NUMBER 2


CONT          FEET LNKS
```

Note: The next available point number is displayed within the prompt area and once the routine is completed the stored point number is displayed briefly.

Now enter the remaining traverse by following the instructions below :-

Enter bearing to pt 3 ?	**99.1015**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter distance to pt 3 ?	**601.7**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter bearing to pt 4 ?	**195.3**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter distance to pt 4 ?	**780.48**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter bearing to pt 5 ?	**358.18**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter distance to pt 5 ?	**203**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter bearing to pt 6 ?	**308.1245**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter distance to pt 6 ?	**608.6**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter bearing to pt 7 ?	**DONE**	→ MENU KEY F

```
COORDINATE TRAVERSE
BEARING TO PT 7 ?
7:
6:
5:
4:
3:
2:
1:
CONT                DONE
```

At this stage we have finished data input and need to stop the routine.

8.8 Routine RUN

Now that we have entered all the data within the close it is a good time to check its correctness. To do this we need to review the data as input into the calculator. Initiate the **RUN** routine and follow the instructions below:-

Close from pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Close to pt number ?	**6**	→ TYPE VALUE
	CONT	→ MENU KEY A

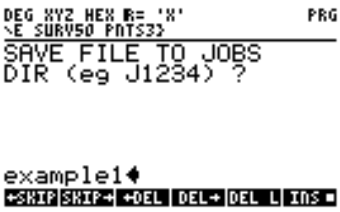
```
THE SOLUTION BETWEEN
PT 1 AND PT 2 IS

BEARING  20°10'00.0"

DISTANCE 286.4m


CONT
```

The first screen will appear as shown. Initiate **CONT** to display the next screen and so on. If continued the sequence will appear like this:-

PT 1 → PT 2	BEARING	20°10'00"	DISTANCE	286.4m
PT 2 → PT 3	BEARING	99°10'15"	DISTANCE	601.7m
PT 3 → PT 4	BEARING	195°30'00"	DISTANCE	780.48m
PT 4 → PT 5	BEARING	358°18'00"	DISTANCE	203m
PT 5 → PT 6	BEARING	308°12'45"	DISTANCE	608.6m

At the end of the routine you are returned to the main menu. If the data is found to be incorrect then either start a new file or use the **STRIP** routine as will be explained in section 8.23 starting at last correct line.

8.9 Routine SAVE



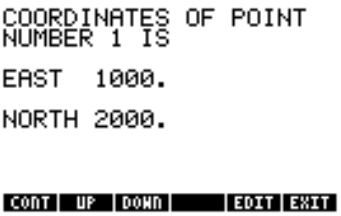
Before any other operations are performed it is advisable to store the data to a permanent file by initiating the **SAVE** routine.

The screen will be displayed as shown. Remember it is important to save the file as a string which has a ***character first followed by a numerical sequence if required*** due to the calculators storage system. For this exercise we will save the file as "example1" being the initial job name as recalled by the calculator. Initiate **SAVE** "example1" is already displayed so simply hit the **ENTER** key. At the end of the routine you are returned to the previous menu.

Note: Once again to cancel the routine input a null string.

8.10 Routine CORDS

This routine will display coordinate information relating to one individual point at a time. Initiate the **CORDS** routine and follow the instructions below:-



View coordinate pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
	UP	→ MENU KEY B
	UP	→ MENU KEY B
	etc....	

The screen will be displayed as shown. To continue this routine initiate **CONT** to repeat the procedure for a non sequential point or **UP** to retrieve the next point number or **DOWN** for the previous. The **EXIT** routine returns you back to the main menu. The sequence is:-

PT 1	EASTING	1000	NORTHING	2000
PT 2	EASTING	1098.737	NORTHING	2268.8419
PT 3	EASTING	1692.7458	NORTHING	2172.9437
PT 4	EASTING	1484.1716	NORTHING	1420.8495
PT 5	EASTING	1478.1493	NORTHING	1623.7601
PT 6	EASTING	999.959	NORTHING	2000.2278

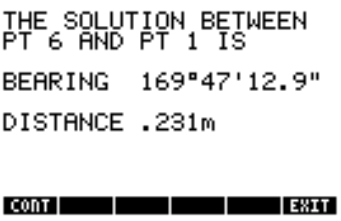
To edit the coordinate of a point initiate the **EDIT** routine Menu Key E at the desired point. If for example the easting of coordinate point 1 should be 2000 then follow the instructions below:

	EDIT	→ MENU KEY E
Alter Easting for Point 1 ?	**2000**	→ TYPE VALUE
	ENTER	→ ENTER KEY
Alter Northing for Point 1 ?	**ENTER**	→ ENTER KEY

Once completed the coordinates are displayed once again for confirmation.
Now change the coordinate back before continuing.

8.11 Routine MBMD

As shown by the coordinates of point number 6 there is a misclose within the loop to the magnitude of 0.041 in Easting and 0.2278 in Northing. This routine equates this relationship to a bearing and distance for any two points of coordinates. Initiate the **MBMD** routine and follow the instructions below:-



Misclose from pt number ?	**6**	→ TYPE VALUE
	CONT	→ MENU KEY A
Misclose to pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
	EXIT	→ MENU KEY F

The screen will be displayed as shown. Initiating **CONT** repeats the procedure and **EXIT** returns you to the main menu.

8.12 Routine CLOSE

This routine is basically the same as the **MBMD** routine with a added feature. It enables you to perform joins to numerous points from one initial data point. As also shown in the **COORD** routine you have the ability to go up and down to consecutive points. Initiate **CLOSE** and follow the instructions below:-

Misclose from pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Misclose to pt number ?	**2**	→ TYPE VALUE
	CONT	→ MENU KEY A
	UP	→ MENU KEY B
	5	→ TYPE VALUE
	CONT	→ MENU KEY A
	DOWN	→ MENU KEY C
	EXIT	→ MENU KEY F

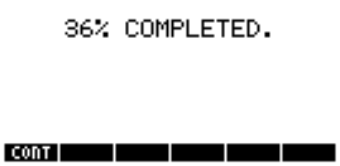
For example let's say we wish to performs a string of calculations all from point number 1 to point numbers 2, 3, 5 and 4 in that order.

The **UP** and the **DOWN** routines can be initiated continually.

8.13 Routine BOWD

A Bowditch adjustment can be performed on the data by the use of this routine. Before adjusting the data the routine firstly computes the accuracy of the loop and then provides you with the option to go ahead and adjust the data or to leave unadjusted. Initiate **BOWD** and follow the instructions below:-

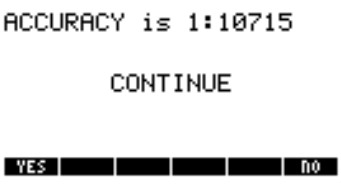
Bowditch start pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Bowditch finish pt number ?	**6**	→ TYPE VALUE
	CONT	→ MENU KEY A
Continue ?	**YES**	→ MENU KEY A



The routine starts computing and as shown above right you have a percentage completed indicator for timing. Once the first stage is complete the accuracy is displayed leaving you with a option to adjust (**YES**) or to leave the data as is (**NO**).

In this case we wish adjust the data set by initiating **YES**. Utilise the **RUN** routine as explained in section 8.8 to see the adjusted data. The sequence will appear like this:-

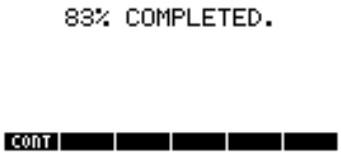
LINE 1	BEARING 20°10'09.7"	DISTANCE 286.377m	
LINE 2	BEARING 99°10'33.2"	DISTANCE 601.719m	
LINE 3	BEARING 195°29'51.6"	DISTANCE 780.546m	
LINE 4	BEARING 358°18'02.8"	DISTANCE 202.981m	
LINE 5	BEARING 308°12'32.2"	DISTANCE 608.558m	



8.14 Routine ROT

As shown by the Bowditch adjustment the data has been altered and now shows that the initial azimuth line has swung from 20°10'00" to 20°10'09.7". The **ROT** routine will swing the data set back to that of the original as shown in the following example. Initiate **ROT** and follow the instructions below:-

Rotate points by (dddmmsss) ?	**-0.00097**	→ TYPE VALUE
	CONT	→ MENU KEY A
Rotate about pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Start pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Finish pt number ?	**6**	→ TYPE VALUE
	CONT	→ MENU KEY A



The routine starts computing and as shown you again have a percentage completed indicator for timing.

Again utilise the **RUN** routine to review the sequence as shown over:-

PT 1 → PT 2	BEARING 20°10'00"	DISTANCE 286.377m	
PT 2 → PT 3	BEARING 99°10'23.5"	DISTANCE 601.719m	
PT 3 → PT 4	BEARING 195°29'41.9"	DISTANCE 780.546m	
PT 4 → PT 5	BEARING 358°17'53.1"	DISTANCE 202.981m	
PT 5 → PT 6	BEARING 308°12'22.5"	DISTANCE 608.558m	

8.15 Routine SCALE

If after the survey has been completed and it is found that a scale factor is needed to be applied to the observations then the **SCALE** routine can be used to adjust the points. For this example let's assume that a scale factor of 0.996 is needed to be applied to the observations to bring them to a true reading. Initiate **SCALE** and follow the instructions below:-

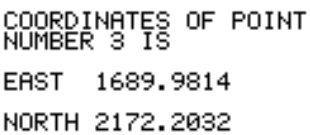
Scale points by factor ?	**0.996**	→ TYPE VALUE
	CONT	→ MENU KEY A
Scale about pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Start pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Finish pt number ?	**6**	→ TYPE VALUE
	CONT	→ MENU KEY A

Once again utilise the **RUN** routine to review the adjusted data. The sequence will appear like this:-

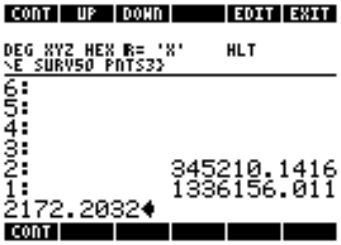
PT 1 → PT 2	BEARING	20°10'00"	DISTANCE	286.231m
PT 2 → PT 3	BEARING	99°10'23.5"	DISTANCE	599.312m
PT 3 → PT 4	BEARING	195°29'41.9"	DISTANCE	777.423m
PT 4 → PT 5	BEARING	358°17'53.1"	DISTANCE	202.169m
PT 5 → PT 6	BEARING	308°12'22.5"	DISTANCE	606.123m

8.16 Routine SHIFT

We now know that our traverse loop has been corrected to represent their true positions as best possible. As shown in the initial diagram located at point number 3 is PM12345 having ISG coordinates of magnitude in Easting of 346900.123 and Northing of 1336156.011. Knowing this and the coordinates of point number 3 as stored in the calculators memory the data set can be adjusted. Using the **CORDS** routine the coordinates of point number 3 are Easting 1689.9814 and Northing 2172.2032. Initiate the **SHIFT** routine and follow the instructions below:-



Shift points by Easting ?	**346900.123**	→ TYPE VALUE
		HIT ENTER KEY
	1689.9814	→ TYPE VALUE
	-	→ SUBTRACT
	CONT	→ MENU KEY A
Shift points by Northing ?	**1336156.011**	→ TYPE VALUE
		HIT ENTER KEY
	2172.2032	→ TYPE VALUE
	-	→ SUBTRACT
Start pt number ?	**CONT**	→ MENU KEY A
	1	→ TYPE VALUE
Finish pt number ?	**CONT**	→ MENU KEY A
	6	→ TYPE VALUE
	CONT	→ MENU KEY A



Utilise the **CORDS** routine to display the altered coordinates as shown in Section 8.10.

The sequence will be displayed as shown.

PT 1	EASTING	346210.1416	NORTHING	1335983.8078
PT 2	EASTING	346308.4758	NORTHING	1336251.5528
PT 3	EASTING	346900.123	NORTHING	1336156.011
PT 4	EASTING	346692.4311	NORTHING	1335406.8439
PT 5	EASTING	346686.4268	NORTHING	1335608.9241
PT 6	EASTING	346210.1416	NORTHING	1335983.8078

8.17 Routine E.PT

Now knowing that we are on ISG azimuth and coordinates we are able to input the coordinates relating to PM12346. The mark has a Easting of 347425.118 and a Northing of 1336098.605 as shown in the initial diagram. To input the coordinates initiate the **E.PT** routine and follow the instructions below:-

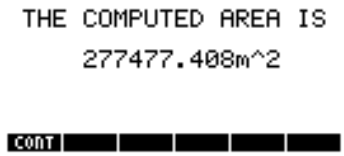
Easting for pt number 7 ?	**347425.118**	→ TYPE VALUE
	CONT	→ MENU KEY A
Northing for pt number 7 ?	**1336098.605**	→ TYPE VALUE
	CONT	→ MENU KEY A

As shown by the data entry screen the coordinates have been allocated to point number 7 within the calculators memory. Once completed the **MBMD** routine can be used to review the join between PM12345 and PM12346 (i.e. Pt3 and Pt7). The solution will be displayed as Bearing 96°14'24.9" and Distance 528.124m.

8.18 Routine AREA

This routine computes area by coordinates within a continuous string of points. Let's say we need a area of the traverse loop from point number 1 to 6. As we have adjusted the data set the coordinates of point number 6 are exactly the same as point number 1 therefore it is redundant to the computation. Initiate the **AREA** routine and follow the instructions below:-

Area start pt number ?	**1**	→ TYPE VALUE
	CONT	→ MENU KEY A
Area finish pt number ?	**5**	→ TYPE VALUE
	CONT	→ MENU KEY A



8.19 Routine LOAD

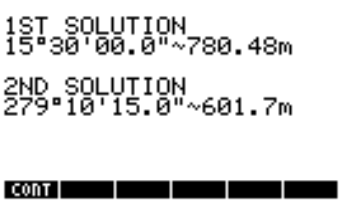
This routine is exactly the same as shown in section 8.1 just duplicated in this menu for convenience. Load from memory "example1" to continue with the examples.

8.20 Routine 2MD

155°33'25.1" ~ 931.48
15°30'00" ~ (?)
279°10'15" ~ (?)

This routine performs a two (2) missing distance computation between two data points. First we have computed the bearing and distance from point 2 to point 4 as 155°33'25.1"~931.478m using the **MBMD** routine as outlined in section 8.11. Start the routine by initiating **2MD** and follow the instructions below:-

Calculation from pt number ?		**2**	→ TYPE VALUE
		CONT	→ MENU KEY A
Calculation to pt number ?		**4**	→ TYPE VALUE
		CONT	→ MENU KEY A
Enter 1st Bearing ?	(to pt 3)	**15.3**	→ TYPE VALUE
		CONT	→ MENU KEY A
Enter 2nd Bearing ?	(to pt 2)	**279.1015**	→ TYPE VALUE
		CONT	→ MENU KEY A



Note: It is also important to note that when performing the 2 missing distance computation the output solution is direction sensitive. So if the program flags to the user that the bearings don't intersect it could be that one direction has been entered 180 degrees out. This is the only reason you need to firstly find the close between the points to ascertain the directions.

8.21 Routine 2MB

155°33'25.1" ~ 931.48
(?) ~ 780.48
(?) ~ 601.7

This routine performs a two (2) missing bearing computation between two data points. Start the routine by initiating **2MD** and follow the instructions below:-

Calculation from pt number ?	**2**	→ TYPE VALUE
	CONT	→ MENU KEY A
Calculation to pt number ?	**4**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter 1st Distance ? (to pt 3)	**780.48**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter 2nd Distance ? (to pt 2)	**601.7**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Solution	**2ND**	→ MENU KEY F

There is 2 options to choose from as there is 2 unique solutions at the intersections of the circles. As we know the orientation of the desired solution in this case the second being correct. Initiate the **2ND** routine to continue the computations.

```
SELECT THE
DESIRED SOLUTION
1ST SOLN 295°36'50.2"
2ND SOLN 15°30'00.0"
```

```
1ST SOLUTION
15°30'00.0"~780.48m
2ND SOLUTION
279°10'15.0"~601.7m
```

1ST 2ND CONT

8.22 Routine 1B1D

155°33'25.1" ~ 931.48
15°30'00" ~ (?)
(?) ~ 601.7

This routine performs a missing bearing and missing distance computation on separate lines between two data points. Start the routine by initiating **1B1D** and follow the instructions below:-

Calculation from pt number ?	**2**	→ TYPE VALUE
	CONT	→ MENU KEY A
Calculation to pt number ?	**4**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter known Bearing ? (to pt 3)	**15.3**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter known Distance ? (to pt 2)	**601.7**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Solution	**1ST**	→ MENU KEY A

As you can see once again there is 2 options to choose from as there is 2 unique solutions at the intersection of the circles. In this case the first solution will be correct so initiate the **1ST** routine to continue the computations. This operation may need to duplicated if the desired solution is not known hence trying both options.

```
BEARING 15°30'00.0"
1ST SOLN 780.48m
2ND SOLN 647.817m
 CHOOSE THE SOLUTION
```

```
1ST SOLUTION
15°30'00.0"~780.48m
2ND SOLUTION
279°10'15.0"~601.7m
```

1ST 2ND CONT

8.23 Routine STRIP

The strip routine enables the deletion of points from the calculators memory. It is limited in the fact that when you initiate the routine you can only delete a string of points from a certain point number to the end of the point file (i.e. you cannot delete a set of points from the middle of the file).

For example if you wish to delete all coordinate information for point number 5 and above then initiate **STRIP** and follow the steps below:-

Purge points after number ?	**4**	→ TYPE VALUE
	CONT	→ MENU KEY A

8.24 Routine CURVE

This routine divides curves into smaller segments. Before starting load "example1" into memory. If you wish to put the centre of the circle into memory simply use the traverse command from point 3 or 4 which will be allocated point number 7 (the centre of the circle is not needed for the computation). Initiate **CURVE** and follow the steps as outlined below:

Enter T.P. point number ?	**3**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing in ?	**144.11436**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**246.48164**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**500**	→ TYPE VALUE
	CONT	→ MENU KEY A

At this stage the basic data has been entered into the calculators memory after which you are asked to choose the type of operation you wish to perform as shown below:

Menu Key A **EQL** Divide curve into equal portions.

Menu Key B **STEP** Divide curve using arc lengths.

Menu Key C **CHAIN** Divide curve by entering a chainage.

Menu Key D No action.

Menu Key E No action.

Menu Key F **EXIT** Exits back to the main menu.

If you wish to divide the arc into 3 equal segments then use the **EQL** routine and follow the steps as outlined below:

Enter number of divisions ?	**3**	→ TYPE VALUE	Points 8,9 and 10 are allocated into memory. Point 10 should be the same as point number 4.
	CONT	→ MENU KEY A	

Or if you wish to divide the arc using arc lengths then use the **STEP** routine and follow the steps as outlined below:

Enter first arc length ?	**298.478**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter the other arc lengths ?	**298.478**	→ TYPE VALUE
	CONT	→ MENU KEY A

Or if you wish to divide the arc using chainages then use the **CHAIN** routine and follow the steps as outlined below:

Enter start chainage ?	**0**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter chainage required ?	**298.478**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter chainage required ?	**596.955**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter chainage required ?	**895.433**	→ TYPE VALUE
	CONT	→ MENU KEY A
etc.....	**EXIT**	→ MENU KEY F

If you do not wish to mark the centerline but for example an offset of 20m at every 200m interval from the tangent point then follow the steps over the page:-

Initiate the **TRAV** routine to offset the tangent point 20m.

Traverse from pt number ?	**3**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter bearing to pt 11 ?	**54.11436**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter distance to pt 11 ?	**20**	→ TYPE VALUE
	CONT	→ MENU KEY A
	DONE	→ MENU KEY F

Initiate **CURVE** and follow the steps as outlined below:

Enter T.P. point number ?	**11**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing in ?	**144.11436**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**246.48164**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**520**	→ TYPE VALUE
	CONT	→ MENU KEY A

Now we wish to divide the arc using arc lengths by using the **STEP** routine, follow the steps as outlined below:

Enter first arc length ?	**520**	→ TYPE VALUE	
	ENTER	→ ENTER KEY	
	500	→ TYPE VALUE	
	/	→ DIVISION KEY	
	200	→ TYPE VALUE	Points 12, 13, 14, 15 and 16 are
	*****	→ MULTIPLY KEY	allocated into memory.
	CONT	→ MENU KEY A	
Enter the other arc lengths ?	**ENTER**	→ ENTER KEY	
	CONT	→ MENU KEY A	

Utilise the **CORDS** routine to display the coordinates as shown in Section 8.10.

The screen will be displayed as shown.

PT 8	EASTING	1787.0418	NORTHING	1894.4067
PT 9	EASTING	1708.4562	NORTHING	1611.0361
PT 10	EASTING	1484.1716	NORTHING	1420.8493
PT 11	EASTING	1708.9661	NORTHING	2184.6442
PT 12	EASTING	1794.1408	NORTHING	1996.401
PT 13	EASTING	1799.2866	NORTHING	1789.849
PT 14	EASTING	1723.591	NORTHING	1597.5982
PT 15	EASTING	1579.0047	NORTHING	1450.0007
PT 16	EASTING	1492.0489	NORTHING	1402.466

8.25 ANTICLOCKWISE ROTATION

If the curve division has a anticlockwise rotation the angle should be subtracted and not added as shown in the previous examples. To handle this situation simply input the radius as a negative value (i.e. -500).

Initiate **CURVE** and follow the steps as outlined below to input data:

Enter T.P. point number ?	**4**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing in ?	**66.48164**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Bearing out ?	**324.11436**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Radius ?	**500**	→ TYPE VALUE
	+/-	→ MENU KEY Y
	CONT	→ MENU KEY A

8.26 AutoCAD Lisp Routine HP48.lsp

For the users of AutoCAD a lisp routine has been incorporated into the package which enables the extraction of coordinates from within a AutoCAD drawing file which then writes the information to the screen and also to a file which will be placed in the ***C:\HP48*** directory on your computer. Firstly copy the HP48.lsp file to the AutoCAD support directory. To attach the routine to your menu add this line to the ACAD.mnu file:

[HP48]^c^c^p^(if (not c:HP48) (load "HP48")):^pHP48

To initialise the lisp routine from the command prompt you will need to type the following as shown over:

Command: **(load"hp48")**
Command: **hp48**

At this stage the routine is ready. You will then see the following prompts:

Enter Output Filename ? — i.e. the filename you wish to send the coordinates to in the C:\HP48\ directory. For example let's say **JOB1**. Simple type job1 and hit enter.
Note: No file extension should be used.

Select origin of points list on screen — As the program not only writes data to a file but also to the screen the routine needs to know where you would like the start of the table to be generated on the screen. Pick a point using your cursor.

At this stage the Osnap Settings dialogue box is initiated enabling you to set the endpoint snap mode on for picking the location of corners or maybe the centre snap mode for picking the centre of circles and so on.

Select the Point needed — Simply select all the points you wish to know values for. When you have finished use the right button on your mouse to exit the routine or the ESC button on your keyboard.

The output file will look something like this:

```
%%HP: T(3)A(D)F(.);
[ [ 1000.000   2000.000 ]
[ 1098.737   2268.842 ]
[ 1692.746   2172.944 ]
[ 1484.172   1420.849 ]
[ 1478.149   1623.760 ]
[  999.959   2000.228 ]
```

File is ready to upload to the calculator.

8.27 Executable File HP48.exe

This routine converts a TXT or a CSV file to a HP48 file so as to upload into the calculators memory. All the text file needs is a set of easting and northing coordinates separated by a space or a comma. Note: The file you wish to reduce and the executable file must be in the same directory on your computer to work. Execute the routine and follow the prompts.

ENTER DATA FILE TO REDUCE (e.g. J123.CSV):

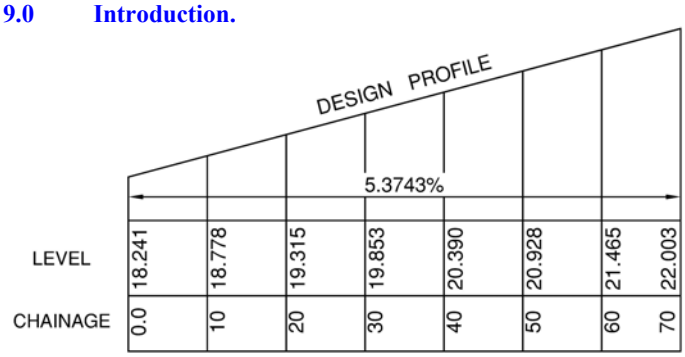
ENTER DATA FILE TO WRITE TO (e.g. J123):

Note: The output file has no file extension.
The output file will be similar to that shown in section 8.26 above.

These files can be mailed to you on request, be it either by floppy disc and through snail mail or via your e-mail.

PROGRAM - GRADE

9.0 Introduction.



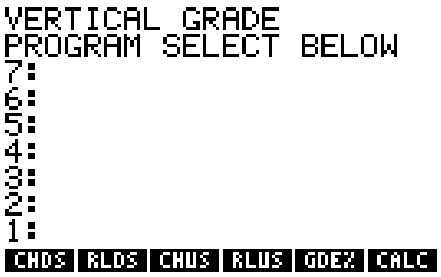
This program deals with linear vertical alignments. To start the program go to the directory labelled **GRADE** and initiate the **START** routine.

Use the diagram as shown on the left of the page to follow the example.

This operation can be done two ways

Option1: Input the Downstream and Upstream information and let the program compute the grade.

Option2: Input the Downstream information and the known grade.



Menu Key	A	CHDS	Input downstream chainage.
Menu Key	B	RLDS	Input downstream level
Menu Key	C	CHUS	Input upstream chainage.
Menu Key	D	RLUS	Input upstream level.
Menu Key	E	GDE%	Input grade.
Menu Key	F	CALC	Start the computations.

9.1 Entering Data.

Once this routine has been initiated and the basic data has been entered the program will allow any chainage to be computed. Follow the examples below:-

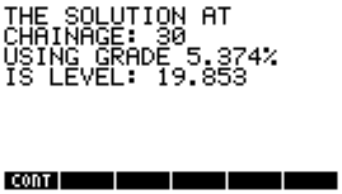
OPTION1

Input D/S Chainage	**0**	**→ TYPE VALUE**
		→ MENU KEY A
Input D/S Level	**18.241**	**→ TYPE VALUE**
		→ MENU KEY B
Input U/S Chainage	**70**	**→ TYPE VALUE**
		→ MENU KEY C
Input U/S Level	**22.003**	**→ TYPE VALUE**
		→ MENU KEY D
	CALC	**→ MENU KEY F**

OPTION2

Input U/S Chainage	**70**	**→ TYPE VALUE**
		→ MENU KEY A
Input U/S Level	**22.003**	**→ TYPE VALUE**
		→ MENU KEY B
Input grade	**5.3743**	**→ TYPE VALUE**
		→ MENU KEY E
	CALC	**→ MENU KEY F**
D/S works as well		

Enter CH30.0	**30**	**→ TYPE VALUE**
	CONT	**→ MENU KEY A**
	CONT	**→ MENU KEY A**
Enter CH ?.?	**etc....**	



The routine will continue until the **EXIT** routine is initiated (Menu Key F).

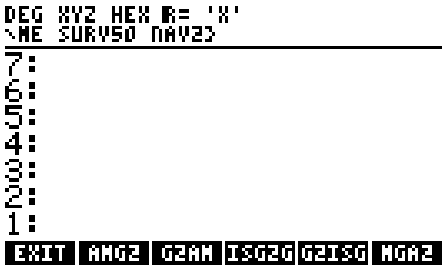
As can be seen by Option 2 if you only have a grade and a start level the computation is the same just entered differently.

The program will also work when negative chainages and levels are entered.

PROGRAM - NAV

10.0 Introduction.

This is a program which enables conversion from a grid based reference system of Easting and Northing to a geographical based system of Longitude and Latitude and visa-versa. To begin the go to the directory labelled **NAV2** and initiate **START**. You will then see a whole suite of subroutines which are outlined below.



Menu Key A **EXIT** Exits back to the main menu.

Menu Key B **AMG2** Convert AMG East & North to Lat. & long.

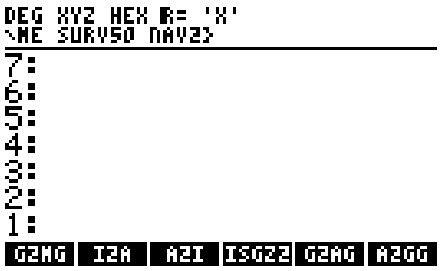
Menu Key C **G2AM** Convert AMG Lat & Long to East & North.

Menu Key D **ISG2G** Convert ISG East & North to Lat. & long.

Menu Key E **G2ISG** Convert ISG Lat & Long to East & North.

Menu Key F **MGA2** Convert MGA East & North to Lat. & long.

Next Page →Menu Key L



Menu Key A **G2MG** Convert MGA Lat & Long to East & North.

Menu Key B **I2A** Convert ISG E,N to AMG E, N.

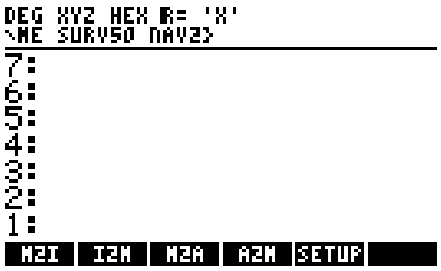
Menu Key C **A2I** Convert AMG E,N to ISG E, N.

Menu Key D **ISG22** Convert ISG zone to zone.

Menu Key E **G2AG** Convert from MGA to AGD(66/84) Lat/Long

Menu Key F **A2GG** Convert from AGD(66/84) to MGA Lat/Long

Next Page →Menu Key L



Menu Key A **M2I** Convert from MGA E,N to ISG E,N.

Menu Key B **I2M** Convert from ISG E,N to MGA E,N.

Menu Key C **M2A** Convert from MGA E,N to AMG E,N.

Menu Key D **A2M** Convert from AMG E,N to MGA E,N.

Menu Key E **SETUP** Setup local parameters.

Notations: ISG - Integrated Survey Grid AMG - Australian Map Grid
MGA - Map Grid of Australia G - Geographical

10.1 Where we Stand

Before we can start any computation it is important to know which zone the coordinates lie within. MGA and AMG both have the same 6 degree zones where ISG has 2 degree zones. For example zone 55 in AMG or MGA is broken up into 3 ISG zones of 55/1, 55/2 and 55/3. The zone should either be supplied with the coordinates or found on the reference map you are using.

Use the setup program as shown in section 10.3 to input the local running parameters and zone information.

10.2 Accuracy

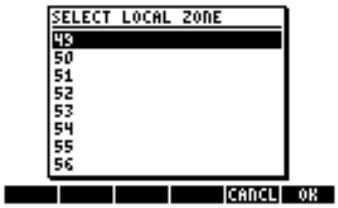
For every nearest 0.001 metres in grid coordinates the geographical Latitude and Longitude will change by 0.0001" of arc.

10.3 Routine SETUP

This program will initialise the running constraints for most of the conversion utilities. Initiate the **SETUP** routine by pressing menu key L twice then menu key E and assuming we are within zone 56 in NSW then input the information below at the prompts.

Select Local Zone ?	**56**	→ Up / Down MENU KEYS
	CONT	→ MENU KEY A
Select Area ?	**NSW66**	→ Up / Down MENU KEYS
	CONT	→ MENU KEY A

Note: 'AGD84' incorporates the national similarity parameters. If you wish to enter your own local area values then select "other" at the select area prompt to enter the values.



10.4 Routine AMG2G

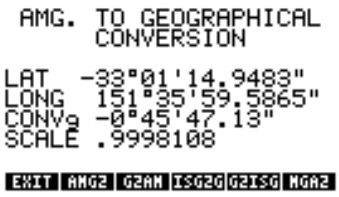
This program will convert from AMG grid Easting and Northing to AMG geographical Latitude and Longitude.

Initiate the **AMG2** routine by pressing menu key L then menu key B and input the information below at the prompts.

Enter Easting ?	**369232.026**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing ?	**6345521.591**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Zone ?	**56**	→ Up / Down MENU KEYS
	OK	→ MENU KEY F

Note: Latitude is -ve as in the southern hemisphere

RESULT



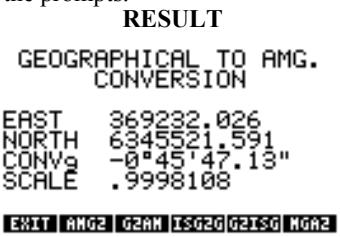
10.5 Routine G2AMG

This program will convert from AMG geographical Latitude and Longitude to AMG grid Easting and Northing.

Initiate the **G2AM** routine by pressing menu key C and input the information below at the prompts.

Enter Latitude ?	**33.011494828**	→ TYPE VALUE -ve or +ve value
	CONT	→ MENU KEY A
Enter Longitude ?	**151.355958644**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Zone ?	**56**	→ Up / Down MENU KEYS
	OK	→ MENU KEY F

RESULT



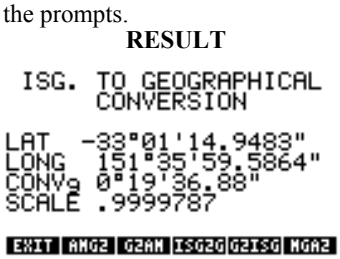
10.6 Routine ISG2G

This program will convert from ISG grid Easting and Northing to ISG geographical Latitude and Longitude.

Initiate the **ISG2G** routine by pressing menu key D and input the information below at the prompts.

Enter Easting ?	**356045.283**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing ?	**1344989.776**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Zone ?	**56/1**	→ Up / Down MENU KEYS
	OK	→ MENU KEY F

RESULT



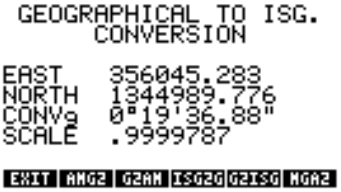
10.7 Routine G2ISG

This program will convert from ISG geographical Latitude and Longitude to ISG grid Easting and Northing.

Initiate the **G2ISG** routine by pressing menu key E and input the information below at the prompts.

Enter Latitude ?	**-33.011494828**	→ TYPE VALUE -ve or +ve value
	CONT	→ MENU KEY A
Enter Longitude ?	**151.355958644**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Zone ?	**56/1**	→ Up / Down MENU KEYS
	OK	→ MENU KEY F

RESULT



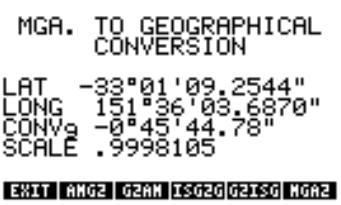
10.8 Routine MGA2G

This program will convert from MGA grid Easting and Northing to MGA geographical Latitude and Longitude.

Initiate the **MGA2** routine by pressing menu key F and input the information below at the prompts.

Enter Easting ?	**369336.559**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter Northing ?	**6345711.045**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Zone ?	**56**	→ Up / Down MENU KEYS
	OK	→ MENU KEY F

RESULT



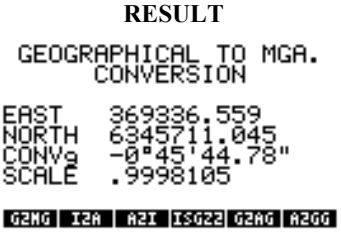
10.9 Routine G2MGA

This program will convert from MGA geographical Latitude and Longitude to MGA grid Easting and Northing.

Initiate the **G2MG** routine by pressing menu key L then menu key A and input the information below at the prompts.

Enter Latitude ?	**-33.01092544**	→ TYPE VALUE -ve or +ve value
	CONT	→ MENU KEY A
Enter Longitude ?	**151.360368699**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Zone ?	**56**	→ Up / Down MENU KEYS
	OK	→ MENU KEY F

RESULT



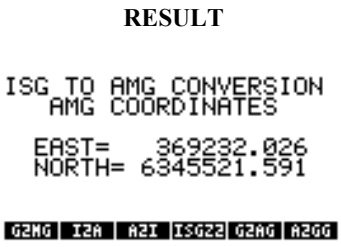
10.10 Routine I2A

This program will convert from ISG grid Easting and Northing to AMG grid Easting and Northing.

Initiate the **I2A** routine by pressing menu key B and input the information below at the prompts.

Enter ISG Easting ?	**356045.283**	→ TYPE VALUE
	CONT	→ MENU KEY A
Enter ISG Northing ?	**1344989.776**	→ TYPE VALUE
	CONT	→ MENU KEY A
Select Zone ?	**56/1**	→ Up / Down MENU KEYS
	OK	→ MENU KEY F

RESULT



10.11 Routine A2I

This program will convert from AMG grid Easting and Northing to ISG grid Easting and Northing.

Initiate the **A2I** routine by pressing menu key C and input the information below at the prompts.

			RESULT
Enter AMG Easting ?	**369232.026**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Enter AMG Northing ?	**6345521.591**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Select Zone ?	**56**	→ Up / Down MENU KEYS	
	OK	→ MENU KEY F	
Select Zone ?	**56/1**	→ Up / Down MENU KEYS	
	OK	→ MENU KEY F	

```
AMG TO ISG CONVERSION
   ISG COORDINATES

  EAST=   356045.283
  NORTH= 1344989.776

G2MG I2A A2I ISG22 G2AG A2GG
```

10.12 Routine ISGZ2Z

This program will convert a ISG grid Easting and Northing from one zone to another.

Initiate the **ISGZ2** routine by pressing menu key D and input the information below at the prompts.

			RESULT
Enter ISG Easting ?	**356045.283**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Enter ISG Northing ?	**1344989.776**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Select Zone ?	**56/1**	→ Up / Down MENU KEYS	
	CONT	→ MENU KEY A	
Select Zone ?	**55/3**	→ Up / Down MENU KEYS	
	CONT	→ MENU KEY A	

```
ISG ZONE-ZONE
  CONVERSION.

EAST    542930.967
NORTH  1342144.853

G2MG I2A A2I ISG22 G2AG A2GG
```

10.13 Routine G2AG

This program will convert from MGA geographical Latitude and Longitude to AGD geographical Latitude and Longitude. Remember it is essential to first run the setup routine as discussed in section 10.3 so as to use the right parameters.

Initiate the **G2AG** routine by pressing menu key E and input the information below at the prompts.

			RESULT
Enter MGA Latitude ?	**-33.01092544**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Enter MGA Longitude ?	**151.360368699**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Enter Ellipsoidal Height ?	**0**	→ TYPE VALUE	
	CONT	→ MENU KEY A	

```
GEOG. MGA TO AGD
    CONVERSION

LAT   :-33°01'14.9460"
LONG  :151°35'59.5815"
HEIGHT:11.637m
    ACCURACY 1m.

G2MG I2A A2I ISG22 G2AG A2GG
```

10.14 Routine A2GG

This program will convert from AGD geographical Latitude and Longitude to MGA geographical Latitude and Longitude. Once again first run the setup routine as discussed in section 10.3 so as to use the right parameters.

Initiate the **A2GG** routine by pressing menu key F and input the information below at the prompts.

			RESULT
Enter AGD Latitude ?	**33.011494828**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Enter AGD Longitude ?	**151.355958644**	→ TYPE VALUE	
	CONT	→ MENU KEY A	
Enter Ellipsoidal Height ?	**0**	→ TYPE VALUE	
	CONT	→ MENU KEY A	

```
GEOG. AGD TO MGA
    CONVERSION

LAT   :-33°01'09.2567"
LONG  :151°36'03.6919"
HEIGHT:11.637m
    ACCURACY 1m.

G2MG I2A A2I ISG22 G2AG A2GG
```

10.15 Routine M2I

This program will convert from MGA grid Easting and Northing to ISG grid Easting and Northing.

Initiate the **M2I** routine by pressing menu key L then menu key A and input the information below at the prompts.

			RESULT
Enter MGA Easting ?	**369336.559**	→ TYPE VALUE	MGA TO ISG CONVERSION
	CONT	→ MENU KEY A	
Enter MGA Northing ?	**6345711.045**	→ TYPE VALUE	EAST 356045.164 NORTH 1344989.862
	CONT	→ MENU KEY A	
Select Zone ?	**56/1**	→ Up / Down MENU KEYS	ACCURACY 1 m.
	OK	→ MENU KEY F	M2I I2M M2A A2M SETUP

10.16 Routine I2M

This program will convert from ISG grid Easting and Northing to MGA grid Easting and Northing.

Initiate the **I2M** routine by pressing then menu key B and input the information below at the prompts.

			RESULT
Enter ISG Easting ?	**356045.283**	→ TYPE VALUE	ISG TO MGA CONVERSION
	CONT	→ MENU KEY A	
Enter ISG Northing ?	**1344989.776**	→ TYPE VALUE	EAST 369336.679 NORTH 6345710.962
	CONT	→ MENU KEY A	
Select Zone ?	**56/1**	→ Up / Down MENU KEYS	ACCURACY 1m.
	OK	→ MENU KEY F	M2I I2M M2A A2M SETUP

10.17 Routine M2A

This program will convert from MGA grid Easting and Northing to AMG grid Easting and Northing.

Initiate the **M2A** routine by pressing menu key C and input the information below at the prompts.

			RESULT
Enter MGA Easting ?	**369336.559**	→ TYPE VALUE	MGA TO AMG CONVERSION
	CONT	→ MENU KEY A	
Enter MGA Northing ?	**6345711.045**	→ TYPE VALUE	EAST 369231.905 NORTH 6345521.675
	CONT	→ MENU KEY A	
Select Zone ?	**56**	→ Up / Down MENU KEYS	ACCURACY 1 m.
	OK	→ MENU KEY F	M2I I2M M2A A2M SETUP

10.16 Routine A2M

This program will convert from AMG grid Easting and Northing to MGA grid Easting and Northing.

Initiate the **A2M** routine by pressing then menu key D and input the information below at the prompts.

			RESULT
Enter AMG Easting ?	**369232.026**	→ TYPE VALUE	AMG TO MGA CONVERSION
	CONT	→ MENU KEY A	
Enter AMG Northing ?	**6345521.591**	→ TYPE VALUE	EAST 369336.68 NORTH 6345710.961
	CONT	→ MENU KEY A	
Select Zone ?	**56**	→ Up / Down MENU KEYS	ACCURACY 1m.
	OK	→ MENU KEY F	M2I I2M M2A A2M SETUP

Registration

To be kept informed of software updates and other program information please take the time to fill in the registration form below and send to :

Mr. Martin Burns
5 Michael Street
CARDIFF NSW 2285.
Fax: 0249 504 483
Email martin@pearson.net.au

Given Name: ..... Surname: .....

Company Name: .....

Address: .....

Postcode: ..... Telephone: (.....).....

Email Address: .....

Date of Purchase: .....

Dealer Name: .....

Calculator Model: ..... Calculator Serial # .....

How did you learn about this product ? .....

Any Suggestions or Comments .....

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Entire Manual is also available in PDF format.