HP-35s CALCULATOR PROGRAMS
MnDOT Office of Land Management
Surveys Research & Support Unit

General Instructions for Running the Programs

The programs prompt for coordinate input and output as X and Y pairs, which correspond to E and N. All angle input and output is north-based AZIMUTH in the form D.MMSSss. Use the XEQ key, a letter label, and the ENTER key (or XEQ *label* 001) to run a program.

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Non-MnDOT users can expect only limited support. Please report program or listing errors.

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Warning: The user releases the Minnesota Department of Transportation from all liability resulting from inaccuracies in these application listings.

INVERSE TRAVERSE PROGRAM

XEQ I (XEQ COS ENTER)

↗	Enter X-Coord. of Beginning Point	R/S
↑	Enter Y-Coord. of Beginning Point	R/S
↑	Enter X-Coord. of Ending Point	R/S
↑	Enter Y-Coord. of Ending Point	R/S
↑	Read Inverse Distance	R/S
↑	Read Inverse Azimuth (D.MMSSss)	R/S
↖	(Next Beginning Point = This Ending Point}	

AZIMUTH TRAVERSE PROGRAM

XEQ T (XEQ 9 ENTER)

↗	Enter X-Coord. of Beginning Point	R/S
↑	Enter Y-Coord. of Beginning Point	R/S
↑	Enter Azimuth to New Point (D.MMSS)	R/S
↑	Enter Distance to New Point	R/S
↑	Read X-Coord. of New Point	R/S
↑	Read Y-Coord. of New Point	R/S
↖	(Next Beginning Point = This New Point}	

RADIAL INVERSE PROGRAM

XEQ R (XEQ 7 ENTER)

	Enter X-Coord. of Fixed Point	R/S
	Enter Y-Coord. of Fixed Point	R/S
↗	Enter X-Coord. of Next Point	R/S
↑	Enter Y-Coord. of Next Point	R/S
↑	Read Inverse Distance	R/S
↑	Read Inverse Azimuth (D.MMSSss)	R/S
↖	(Enter Next Radial Point}	

RADIAL STUB PROGRAM

XEQ S (XEQ 8 ENTER)

	Enter X-Coord. of Fixed Point	R/S
	Enter Y-Coord. of Fixed Point	R/S
↗	Enter Azimuth to New Point (D.MMSS)	R/S
↑	Enter Distance to New Point	R/S
↑	Read X-Coord. of New Point	R/S
↑	Read Y-Coord. of New Point	R/S
↖	(Enter Next Radial Stub}	

TRIANGLE PROGRAM – SSS

XEQ C (XEQ XEQ ENTER)

Enter Length of First Side	R/S
Enter Length of Second Side	R/S
Enter Length of Third Side	R/S
Read Angle Opposite & First Side	R/S
Read Angle Opposite & Second Side	R/S
Read Angle Opposite & Third Side	R/S
Read Triangle Area	R/S

TRIANGLE PROGRAM – SAA

XEQ E (XEQ R↓ ENTER)

Enter Length of First Side	R/S
Enter Angle After (DMS)	R/S
Enter Next Angle (DMS)	R/S
Read Angle Opposite & First Side	R/S
Read Angle Opposite & Second Side	R/S
Read Angle Opposite & Third Side	R/S
Read Triangle Area	R/S

TRIANGLE PROGRAM – SAS

XEQ D (XEQ MODE ENTER)

Enter Length of First Side	R/S
Enter Angle Between (DMS)	R/S
Enter Length of Second Side	R/S
Read Angle Opposite & First Side	R/S
Read Angle Opposite & Second Side	R/S
Read Angle Opposite & Third Side	R/S
Read Triangle Area	R/S

TRIANGLE PROGRAM – ASA

XEQ F (XEQ x◀ ▶y ENTER)

Enter Angle Before (DMS)	R/S
Enter Length of First Side	R/S
Enter Angle After (DMS)	R/S
Read Angle Opposite & First Side	R/S
Read Angle Opposite & Second Side	R/S
Read Angle Opposite & Third Side	R/S
Read Triangle Area	R/S

TRIANGLE PROGRAM – SSA

XEQ G (XEQ i ENTER)

Enter Length of First Side	R/S	
Enter Length of Second Side	R/S	
Enter Angle Opposite First Side (DMS)	R/S	
Prompt "SOLUTION 1"	R/S	{Skip Prompt if Single Solution}
Read Angle Opposite & First Side	R/S	{First or Single Solution}
Read Angle Opposite & Second Side	R/S	
Read Angle Opposite & Third Side	R/S	
Read Triangle Area	R/S	{End of Program if Single Solution}
Prompt "SOLUTION 2"	R/S	
Read Angle Opposite & First Side	R/S	{Second Solution}
Read Angle Opposite & Second Side	R/S	
Read Angle Opposite & Third Side	R/S	
Read Triangle Area	R/S	{End of Program}

INTERSECTION PROGRAM – LL

XEQ L (XEQ y^x ENTER)

Enter X-Coord. of Point on Line 1	R/S	
Enter Y-Coord. of Point on Line 1	R/S	
Enter Azimuth of Line 1 (D.MMSSss)	R/S	{-999 to compute using a second POT}
Enter X-Coord. of Point on Line 2	R/S	
Enter Y-Coord. of Point on Line 2	R/S	
Enter Azimuth of Line 2 (D.MMSSss)	R/S	{-999 to compute using a second POT}
Read X-Coord. of Intersection	R/S	
Read Y-Coord. of Intersection	R/S	
Read Distance Point 1 to Intersection	R/S	
Read Distance Point 2 to Intersection	R/S	{End of Program}

NOTES :

This calculation is also known as a Bearing-Bearing Intersection.
Register X contains the X-Coord. of the Intersection Point
Register Y contains the Y-Coord. of the Intersection Point
Register D contains the Distance from Point 2 to the Intersection Point

INTERSECTION PROGRAM – LC

XEQ M (XEQ 1/x ENTER)

Enter X-Coord. of Point on Line	R/S	{POT}
Enter Y-Coord. of Point on Line	R/S	{POT}
Enter Azimuth of Line (D.MMSSss)	R/S	{-999 to compute using a second POT}
Enter X-Coord. of Radius Point	R/S	
Enter Y-Coord. of Radius Point	R/S	
Enter Radius of Circle	R/S	
Prompt "SOLUTION 1"	R/S	{First or Single Solution}
Read X-Coord. of Intersection 1	R/S	
Read Y-Coord. of Intersection 1	R/S	
Read Azimuth, Rad. Pt. to Intersection 1	R/S	
Read Distance, POT to Intersection 1	R/S	{End of Program if Single Solution}
Prompt "SOLUTION 2"	R/S	{Second Solution}
Read X-Coord. of Intersection 2	R/S	
Read Y-Coord. of Intersection 2	R/S	
Read Azimuth, Rad. Pt. to Intersection 2	R/S	
Read Distance, POT to Intersection 2	R/S	{End of Program}

NOTES :

This calculation is also known as a Bearing-Distance Intersection.
Register U contains the X-Coord. of Intersection Point 1
Register V contains the Y-Coord. of Intersection Point 1
Register W contains the Azimuth from the Radius Point to Intersection Point 1
Register X contains the X-Coord. of Intersection Point 2
Register Y contains the Y-Coord. of Intersection Point 2
Register Z contains the Azimuth from the Radius Point to Intersection Point 2

INTERSECTION PROGRAM – CC

XEQ N (XEQ +/– ENTER)

Enter X-Coord. of Radius Point 1	R/S	
Enter Y-Coord. of Radius Point 2	R/S	
Enter Radius of Circle 1	R/S	
Enter X-Coord. of Radius Point 2	R/S	
Enter Y-Coord. of Radius Point 2	R/S	
Enter Radius of Circle 2	R/S	
Prompt "SOLUTION 1"	R/S	{First or Single Solution}
Read X-Coord. of Intersection 1	R/S	
Read Y-Coord. of Intersection 1	R/S	
Read Azimuth, Rad. Pt. 1 to Intersection 1	R/S	
Read Azimuth, Rad. Pt. 2 to Intersection 1	R/S	{End of Program if Single Solution}
Prompt "SOLUTION 2"	R/S	{Second Solution}
Read X-Coord. of Intersection 2	R/S	
Read Y-Coord. of Intersection 2	R/S	
Read Azimuth, Rad. Pt. 1 to Intersection 2	R/S	
Read Azimuth, Rad. Pt. 2 to Intersection 2	R/S	{End of Program}

NOTES :

This calculation is also known as a Distance-Distance Intersection.
Register U contains the X-Coord. of Intersection Point 1
Register V contains the Y-Coord. of Intersection Point 1
Register J contains the Azimuth from Radius Point 1 to Intersection Point 1
Register K contains the Azimuth from Radius Point 2 to Intersection Point 1
Register X contains the X-Coord. of Intersection Point 2
Register Y contains the Y-Coord. of Intersection Point 2
Register L contains the Azimuth from Radius Point 1 to Intersection Point 2
Register M contains the Azimuth from Radius Point 2 to Intersection Point 2

RATIO PROGRAM

XEQ O (XEQ E ENTER)

Enter X-Value of Beginning Point	R/S	{Typically the first station}
Enter Y-Value at Beginning Point	R/S	{Value at start of taper, super transition, etc.}
Enter X-Value of Ending Point	R/S	{Typically the last station}
Enter Y-Value at Ending Point	R/S	{Value at end of taper, super transition, etc.}
Displays Ratio X:Y	R/S	{Goes directly into Y-Value computation}
Y-Value computation -- key XEQ E 0 1 5 to run		
Enter an increment for the X-Value	R/S	{Facilitates computation at regular intervals}
↗ X-Value at which to compute Y-Value	R/S	{Accept incremented value or enter another}
↖ Read X-Value and computed Y-Value	R/S	{X-Value above and Y-Value below}
X-Value computation -- key XEQ E 0 2 4 to run		
↗ Y-Value for which to compute X-Value	R/S	
↖ Read computed X-Value and Y-Value	R/S	{X-Value above and Y-Value below}

HORIZONTAL CURVE PROGRAM

XEQ H (XEQ SIN ENTER)

Required – Enter at Least One of the Following Three Fields (R/S to Skip) :		
Enter the Delta Angle	R/S	{A? D.MMSS}
Enter the Degree of Curve	R/S	{D? D.MMSS – Valid for English Only}
Enter the Curve Radius	R/S	{R? English or Metric}
Optional – Enter One of the Following Fields if Needed :		
Enter the Tangent Length	R/S	{T?}
Enter the Curve Length	R/S	{L?}
Enter the Chord Length	R/S	{C?}
Enter the Mid-Ordinate	R/S	{M?}
Enter the External Distance	R/S	{E?}
View the Computed Values :		
Read the Delta Angle	R/S	{A= D.MMSS}
Read the Degree of Curve	R/S	{D= D.MMSS – Valid for English Only}
Read the Tangent Length	R/S	{T=}
Read the Curve Length	R/S	{L=}
Read the Curve Radius	R/S	{R=}
Read the Chord Length	R/S	{C=}
Read the Mid-Ordinate	R/S	{M=}
Read the External Distance	R/S	{E=}
Read the Sector Area	R/S	{S=}
Read the Segment Area	R/S	{G=}
Read the Fillet Area	R/S	{F=}
Enter the Station of the PI	R/S	{"PI STA"}
Read the PC and PT Stations	R/S	{End of Program}

VERTICAL CURVE (& TANGENT) PROGRAM

XEQ V (XEQ 5 ENTER)

Enter the PVI Station	R/S	{Any POT if Computing a Tangent Grade}
Enter PVI Elevation	R/S	{Any POT if Computing a Tangent Grade}
Enter the % Grade into the PVI (G1)	R/S	
Enter the % Grade out of the PVI (G2)	R/S	{= G1 if Computing a Tangent Grade}
Enter the Length of the Vertical Curve	R/S	{Zero if Computing a Tangent Grade}
Read the High or Low Point, If It Exists	R/S	{Elevation in Y- & Station in X-Registers}
Enter a Stationing Increment	R/S	{Prompt is STA INC}
↗ Enter Any Station	R/S	{Prompt is S?}
↑ Read Elevation at the Entered Station	R/S	{Display E=}
↖ Increment for Next Station		

AREA BY COORDINATES PROGRAM

XEQ A (XEQ R/S ENTER)

	Enter X-Coord. of Beginning Point	R/S
	Enter Y-Coord. of Beginning Point	R/S
↗	Enter X-Coord. of Next Point	R/S
↑	Enter Y-Coord. of Next Point	R/S
↖	Repeats Until Beginning Point Is Re-entered	
	Read Area in Square Feet (or Meters)	R/S {Coordinates are assumed to be in feet.}
	Read Area in Acres (Assuming Feet)	R/S {If units are Meters, ignore this value.}
	Read Perimeter	R/S {End of Program}

HMS+ PROGRAM

Enter the first angle in DDD.MMSSss	**ENTER**
Enter the angle to add in DDD.MMSSss	**XEQ P [XEQ ( ) ENTER]**
Read the sum of the angles in DDD.MMSSss	

HMS– PROGRAM

Enter the first angle in DDD.MMSSss	**ENTER**
Enter the angle to subtract in DDD.MMSSss	**+/– XEQ P [XEQ ( ) ENTER]**
Read the difference of the angles in DDD.MMSSss	

POLAR → RECTANGULAR (y,x →θ,r) FUNCTION

Enter the Distance	**ENTER**
Enter the Azimuth (D.MMSSss)	**XEQ J [XEQ TAN ENTER]**
Read the X-Coordinate difference	{X-Difference in the Y-Register}
Read the Y-Coordinate difference	{Y-Difference in the X-Register}

RECTANGULAR → POLAR (θ,r → y,x) FUNCTION

Enter the X-Coordinate difference	**ENTER**
Enter the Y-Coordinate difference	**XEQ K [XEQ √x ENTER]**
Read the resulting distance	{Distance in the Y-Register}
Read the resulting azimuth in DDD.MMSSss	{Azimuth in the X-Register}

BEARING → AZIMUTH PROGRAM

XEQ B (XEQ GTO ENTER)

↗	Enter the Bearing to be converted	R/S {In DMS}
↑	Enter the Quadrant code of the bearing	R/S {1 = NE, 2 = SE, 3 = SW, 4 = NW}
↖	Read the Azimuth	R/S {In DMS}

AZIMUTH → BEARING PROGRAM

XEQ Q (XEQ EQN ENTER)

↗	Enter the Azimuth to be converted	R/S {DMS}
↑	Read the Bearing	R/S {DMS}
↖	Read the Quadrant code of the bearing	R/S {1 = NE, 2 = SE, 3 = SW, 4 = NW}