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 – 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 – 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 – 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
  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  {Second Solution}
  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  {End of Program}
INTERSECTION PROGRAM – LL

\textbf{XEQ \textit{L} (XEQ y^x \ \textbf{ENTER})}

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

\textbf{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

\textbf{XEQ \textit{M} (XEQ 1/x \ \textbf{ENTER})}

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

\textbf{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}