



HP-33s CALCULATOR PROGRAMS

Mn/DOT Office of Land Management

Surveys Research & Support Unit

General Instructions For Keyboard Entry

The listings that follow show the **KEYSTROKES** (the text on the face of the keys to press) and **DISPLAY** (what should appear on the display after each step is entered) for entering the programs. You can step forward and backward through the program to check or edit entries with the cursor key.

◀ is the green shift key.

▶ is the purple shift key.

↔ is the white arrow key to the far right of the XEQ key.

ⓐ is the “ON” key in the lower left corner of the keyboard.

The cursor key is the large silver rocker between the display and the keyboard. Press the top to scroll the display up, and press the bottom to scroll down.

The user does not have to use the ⓐ key to exit program mode after entering a program if another program is to be entered immediately. Simply enter the next program label and continue. The order in which labels are entered is irrelevant.

Verifying Correct Program Entry

After entering a program and exiting program mode, the user can verify the correct entry of the program by accessing its checksum and comparing it to the checksum in the listings.

To find the checksum for any label, key in **MEM** { ◀ x ▶ y 2 } to bring up the program catalog. Scroll to the label to be checked using the cursor key. Key in **SHOW** { ▶ ENTER } to display the label’s checksum. Hold down the ENTER key to keep the checksum visible.

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Non-Mn/DOT users can expect only limited support.

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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 RADIAL INVERSE PROGRAM

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + 8	R0001 LBL R	
1 7	R0002 17	
STO ●	R0003 STO i	{● = decimal point}
→ X 1 4	R0004 SF 4	
→ X 1 0	R0005 SF 0	
XEQ +/-	R0006 XEQ O	{Get fixed beginning point}
← GTO 7	R0007 GTO Q	
← + %	I0001 LBL I	
9	I0002 9	
STO ●	I0003 STO i	{● = decimal point}
→ X 1 4	I0004 SF 4	
→ X 1 0	I0005 SF 0	
XEQ +/-	I0006 XEQ O	{Get beginning point}
← + 7	Q0001 LBL Q	
→ X 2 0	Q0002 CF 0	
XEQ +/-	Q0003 XEQ O	{Get next point}
RCL Σ+	Q0004 RCL E	
RCL - 2	Q0005 RCL- X	
RCL x◀▶y	Q0006 RCL N	
RCL - 3	Q0007 RCL- Y	
← 4	Q0008 y,x →θ,r	
STO 1/x	Q0009 STO D	
x◀▶y	Q0010 x<>y	
1 8 0	Q0011 180	
+	Q0012 +	
→ 5	Q0013 → HMS	
STO e ^x	Q0014 STO A	
→ 0 1/x	Q0015 VIEW D	{Read inverse distance}
→ 0 e ^x	Q0016 VIEW A	{Read azimuth in D.MMSSss}
← GTO ENTER	Q0017 GTO (i)	{Compute another inverse or radial point}
C		{Exit Program Mode = key at lower left}

CHECKSUMS: LBL R : CK=D6CA LBL I : CK=7BA8 LBL Q : CK=A8C4

INVERSE TRAVERSE PROGRAM
RADIAL INVERSE PROGRAM (Continued)
For the HP-33s Calculator



TO RUN THE INVERSE TRAVERSE PROGRAM : XEQ I (XEQ %)

- ↗ 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 R/S
- ↖ (Next Beginning Point = This Ending Point)

TO RUN THE RADIAL INVERSE PROGRAM : XEQ R (XEQ 8)

- 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 R/S
- ↖ (Enter Next Radial Point)

NOTES :

LABEL O must be entered into the HP-33s.

AZIMUTH TRAVERSE PROGRAM RADIAL STUB PROGRAM

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ••	PRGM TOP	{•• = decimal point twice}
← + 9	S0001 LBL S	
2 1	S0002 21	
STO •	S0003 STO i	{• = decimal point}
→ X 1 4	S0004 SF 4	
→ X 1 0	S0005 SF 0	
XEQ +/-	S0006 XEQ O	
← GTO 5	S0007 GTO U	
← + 4	T0001 LBL T	
2 0	T0002 20	
STO •	T0003 STO i	{• = decimal point}
→ X 1 4	T0004 SF 4	
→ X 1 0	T0005 SF 0	
XEQ +/-	T0006 XEQ O	
← + 5	U0001 LBL U	
← 0 e ^x	U0002 INPUT A	{Enter azimuth to new point in D.MMSSss}
← 5	U0003 →HR	
STO 7	U0004 STO Q	
← 0 1/x	U0005 INPUT D	{Enter distance to new point}
RCL 7	U0006 RCL Q	
x◀▶y	U0007 x◀>y	
→ 4	U0008 θ,r → y,x	
RCL + x◀▶y	U0009 RCL+ N	
STO 3	U0010 STO Y	
x◀▶y	U0011 x◀>y	
RCL + Σ+	U0012 RCL+ E	
STO 2	U0013 STO X	
→ 0 2	U0014 VIEW X	{Read new X-coordinate}
→ 0 3	U0015 VIEW Y	{Read new Y-coordinate}
← GTO ENTER	U0016 GTO (i)	{Run another traverse or stub point}
C		{Exit Program Mode = key at lower left}

CHECKSUMS: LBL S : CK=507F

LBL T : CK=8EFD

LBL U : CK=CA75

**AZIMUTH TRAVERSE PROGRAM
RADIAL STUB PROGRAM (Continued)**

For the HP-33s Calculator



TO RUN THE AZIMUTH TRAVERSE PROGRAM : XEQ T (XEQ 4)

- ↗ Enter X-Coord. of Beginning Point R/S
- ↑ Enter Y-Coord. of Beginning Point R/S
- ↑ Enter Azimuth to New Point 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)

TO RUN THE RADIAL STUB PROGRAM : XEQ S (XEQ 9)

- Enter X-Coord. of Fixed Point R/S
- Enter Y-Coord. of Fixed Point R/S
- ↗ Enter Azimuth to New Point 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)

NOTES :

LABEL O must be entered into the HP-33s.

TRIANGLE PROGRAM – SSS

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + y^x	C0001 LBL C	
← 0 9	C0002 INPUT S	
STO $\Sigma+$	C0003 STO E	
← 0 9	C0004 INPUT S	
STO x^2	C0005 STO F	
← 0 9	C0004 INPUT S	
STO \sqrt{x}	C0007 STO G	
RCL $\Sigma+$	C0008 RCL E	
x^2	C0009 x^2	
RCL x^2	C0010 RCL F	
x^2	C0011 x^2	
+	C0012 +	
RCL \sqrt{x}	C0013 RCL G	
x^2	C0014 x^2	
–	C0015 –	
2	C0016 2	
RCL x $\Sigma+$	C0017 RCLx E	
RCL x x^2	C0018 RCLx F	
÷	C0019 ÷	
← COS	C0020 ACOS	
→ 5	C0021 →HMS	
STO 1	C0022 STO W	
RCL x^2	C0023 RCL F	
x^2	C0024 x^2	
RCL \sqrt{x}	C0025 RCL G	
x^2	C0026 x^2	
+	C0027 +	
RCL $\Sigma+$	C0028 RCL E	
x^2	C0029 x^2	
–	C0030 –	
2	C0031 2	
RCL x x^2	C0032 RCLx F	
RCL x \sqrt{x}	C0033 RCLx G	
÷	C0034 ÷	
← COS	C0035 ACOS	
→ 5	C0036 →HMS	
STO 5	C0037 STO U	
1 8 0	C0038 180	
← ENTER	C0039 LASTx	

TRIANGLE PROGRAM – SSS (Continued)
For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
–	C0040 –	
RCL 1	C0041 RCL W	
← 5	C0042 → HR	
–	C0043 –	
→ 5	C0044 → HMS	
STO 6	C0045 STO V	
← XEQ LN	C0046 GTO B	
C		{Exit Program Mode = key at lower left}

CHECKSUM: LBL C : CK=6727

TO RUN THE SIDE-SIDE-SIDE TRIANGLE PROGRAM : XEQ C (XEQ y^x)

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	{End of Program}

NOTES :

LABEL B must be entered into the HP-33s.

TRIANGLE PROGRAM – SAS

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + 1/x	D0001 LBL D	
← 0 9	D0002 INPUT S	
STO Σ+	D0003 STO E	
← 0 e ^x	D0004 INPUT A	
STO 1	D0005 STO W	
← 0 9	D0006 INPUT S	
STO x ²	D0007 STO F	
x ²	D0008 x ²	
RCL Σ+	D0009 RCL E	
x ²	D0010 x ²	
+	D0011 +	
2	D0012 2	
RCL x Σ+	D0013 RCLx E	
RCL x x ²	D0014 RCLx F	
RCL 1	D0015 RCL W	
← 5	D0016 →HR	
COS	D0017 COS	
X	D0018 X	
–	D0019 –	
√x	D0020 √x	
STO √x	D0021 STO G	
x ²	D0022 x ²	
RCL x ²	D0023 RCL F	
x ²	D0024 x ²	
+	D0025 +	
RCL Σ+	D0026 RCL E	
x ²	D0027 x ²	
–	D0028 –	
2	D0029 2	
RCL X x ²	D0030 RCLx F	
RCL X √x	D0031 RCLx G	
÷	D0032 ÷	
← COS	D0033 ACOS	
→ 5	D0034 →HMS	
STO 5	D0035 STO U	
1 8 0	D0036 180	
← ENTER	D0037 LASTx	
–	D0038 –	
RCL 1	D0039 RCL W	
← 5	D0040 → HR	

TRIANGLE PROGRAM – SAS (Continued)
For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
–	D0041 –	
➔ 5	D0042 ➔ HMS	
STO 6	D0043 STO V	
➔ XEQ LN	D0044 GTO B	
C		{Exit Program Mode = key at lower left}

CHECKSUM: LBL D : CK=9192

TO RUN THE SIDE-ANGLE-SIDE TRIANGLE PROGRAM : XEQ D (XEQ 1/x)

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	{End of Program}

NOTES :

LABEL B must be entered into the HP-33s.

TRIANGLE PROGRAM – SAA

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + $\Sigma+$	E0001 LBL E	
← 0 9	E0002 INPUT S	
STO $\Sigma+$	E0003 STO E	
← 0 e^x	E0004 INPUT A	
STO 1	E0005 STO W	
← 0 e^x	E0006 INPUT A	
STO 5	E0007 STO U	
← 5 →HR	E0008 →HR	
RCL 1	E0009 RCL W	
← 5 →HR	E0010 →HR	
+	E0011 +	
1 8 0	E0012 180	
x◀▶y	E0013 x<>y	
–	E0014 –	
→ 5 →HMS	E0015 →HMS	
STO 6	E0016 STO V	
RCL $\Sigma+$	E0017 RCL E	
RCL 5	E0018 RCL U	
← 5 →HR	E0019 →HR	
SIN	E0020 SIN	
÷	E0021 ÷	
STO 7	E0022 STO Q	
RCL 6	E0023 RCL V	
← 5 →HR	E0024 →HR	
SIN	E0025 SIN	
X	E0026 X	
STO x^2	E0027 STO F	
RCL 7	E0028 RCL Q	
RCL 1	E0029 RCL W	
← 5 →HR	E0030 →HR	
SIN	E0031 SIN	
X	E0032 X	
STO \sqrt{x}	E0033 STO G	
← XEQ LN	E0034 GTO B	



{Exit Program Mode = key at lower left}

CHECKSUM: LBL E : CK=A02D

TRIANGLE PROGRAM – SAA (Continued)
For the HP-33s Calculator



TO RUN THE SIDE-ANGLE-ANGLE TRIANGLE PROGRAM : XEQ E (XEQ Σ+)

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	{End of Program}

NOTES :

LABEL B must be entered into the HP-33s.

TRIANGLE PROGRAM – ASA

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + x^2	F0001 LBL F	
← 0 e^x	F0002 INPUT A	
STO 6	F0003 STO V	
← 0 9	F0004 INPUT S	
STO $\Sigma+$	F0005 STO E	
← 0 e^x	F0006 INPUT A	
STO 1	F0007 STO W	
← 5	F0008 →HR	
RCL 6	F0009 RCL V	
← 5	F0010 →HR	
+	F0011 +	
1 8 0	F0012 180	
$x\leftarrow y$	F0013 $x\leftarrow y$	
–	F0014 –	
→ 5	F0015 →HMS	
STO 5	F0016 STO U	
RCL $\Sigma+$	F0017 RCL E	
RCL 5	F0018 RCL U	
← 5	F0019 →HR	
SIN	F0020 SIN	
÷	F0021 ÷	
STO 7	F0022 STO Q	
RCL 6	F0023 RCL V	
← 5	F0024 →HR	
SIN	F0025 SIN	
X	F0026 X	
STO x^2	F0027 STO F	
RCL 7	F0028 RCL Q	
RCL 1	F0029 RCL W	
← 5	F0030 →HR	
SIN	F0031 SIN	
X	F0032 X	
STO \sqrt{x}	F0033 STO G	
← XEQ LN	F0034 GTO B	

{Exit Program Mode = key at lower left}

CHECKSUM: LBL F : CK=C4EC

TRIANGLE PROGRAM – ASA (Continued)
For the HP-33s Calculator



TO RUN THE ANGLE-SIDE-ANGLE TRIANGLE PROGRAM : XEQ F (XEQ x²)

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	{End of Program}

NOTES :

LABEL B must be entered into the HP-33s.

TRIANGLE PROGRAM – SSA

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ••	PRGM TOP	{•• = decimal point twice}
← + √x	G0001 LBL G	
→ X 1 • 0	G0002 SF 10	{• = decimal point}
← 0 9	G0003 INPUT S	
STO Σ+	G0004 STO E	
← 0 9	G0005 INPUT S	
STO x ²	G0006 STO F	
RCL Σ+	G0007 RCL E	
← ÷ 4	G0008 x>y?	
0	G0009 0	
STO •	G0010 STO i	{• = decimal point}
← 0 e ^x	G0011 INPUT A	
STO 5	G0012 STO U	
← 5	G0013 →HR	
SIN	G0014 SIN	
RCL Σ+	G0015 RCL E	
÷	G0016 ÷	
STO 7	G0017 STO Q	
RCL X x ²	G0018 RCLx F	
1	G0019 1	
x◀▶y	G0020 x<>y	
–	G0021 –	
→ ÷ 2	G0022 x≤0?	
STO •	G0023 STO i	{• = decimal point}
→ ÷ 3	G0024 x<0?	
→ STO RCL x◀▶y	RCL +/- R/S RCL 9 RCL +/- RCL COS RCL 5	
	RCL 4 RCL % RCL +/- RCL x◀▶y ENTER	
	G0025 NO SOLUTION	
RCL •	G0026 RCL i	{• = decimal point}
→ ÷ 3	G0027 x<0?	
→ +	G0028 RTN	
RCL 7	G0029 RCL Q	
RCL X x ²	G0030 RCLx F	
← SIN	G0031 ASIN	
→ 5	G0032 →HMS	
STO 6	G0033 STO V	
← 5	G0034 →HR	
RCL 5	G0035 RCL U	
← 5	G0036 →HR	
+	G0037 +	

TRIANGLE PROGRAM – SSA (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
1 8 0	G0038 180	
x◀▶y	G0039 x◀▶y	
–	G0040 –	
➡ 5	G0041 →HMS	
STO 1	G0042 STO W	
← ENTER	G0043 LASTx	
SIN	G0044 SIN	
RCL 7	G0045 RCL Q	
÷	G0046 ÷	
STO √x	G0047 STO G	
RCL •	G0048 RCL i	{• = decimal point}
➡ ÷ 6	G0049 x=0?	
← XEQ LN	G0050 GTO B	
➡ STO RCL 9 RCL +/- RCL COS RCL 5 RCL 4 RCL % RCL +/-		
RCL x◀▶y R/S 1 ENTER	G0051 SOLUTION 1	
XEQ LN	G0052 XEQ B	
1 8 0	G0053 180	
RCL 6	G0054 RCL V	
← 5	G0055 →HR	
–	G0056 –	
➡ 5	G0057 →HMS	
STO 6	G0058 STO V	
← 5	G0059 →HR	
RCL 5	G0060 RCL U	
← 5	G0061 →HR	
+	G0062 +	
1 8 0	G0063 180	
x◀▶y	G0064 x<>y	
–	G0065 –	
➡ 5	G0066 →HMS	
STO 1	G0067 STO W	
← ENTER	G0068 LASTx	
SIN	G0069 SIN	
RCL 7	G0070 RCL Q	
÷	G0071 ÷	
STO √x	G0072 STO G	
➡ STO RCL 9 RCL +/- RCL COS RCL 5 RCL 4 RCL % RCL +/-		
RCL x◀▶y R/S 2 ENTER	G0073 SOLUTION 2	
← XEQ LN	G0074 GTO B	
C		{Exit Program Mode = key at lower left}

TRIANGLE PROGRAM – SSA (Continued)
For the HP-33s Calculator



CHECKSUM: LBL G : CK=4135

TO RUN THE SIDE-SIDE-ANGLE TRIANGLE PROGRAM : XEQ G (XEQ \sqrt{x})

Enter Length of First Side	R/S	
Enter Length of Second Side	R/S	
Enter Angle After (DMS)	R/S	
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}
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}

NOTES :

LABEL B must be entered into the HP-33s.

INTERSECTION PROGRAM – LL

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ••	PRGM TOP	{•• = decimal point twice}
← + COS	L0001 LBL L	
→ X 2 4	L0002 CF 4	
→ X 1 0	L0003 SF 0	
XEQ +/-	L0004 XEQ O	{Get line 1 X,Y,AZ}
RCL LN	L0005 RCL B	
← 5	L0006 →HR	
TAN	L0007 TAN	
1/x	L0008 1/x	
STO RCL	L0009 STO J	{Slope of line 1 = m1}
→ X 2 0	L0010 CF 0	
XEQ +/-	L0011 XEQ O	
RCL e ^x	L0012 RCL A	
← 5	L0013 →HR	
TAN	L0014 TAN	
1/x	L0015 1/x	
STO SIN	L0016 STO K	{Slope of line 2 = m2}
RCL %	L0017 RCL I	
RCL SIN	L0018 RCL K	
RCL X ^x √y	L0019 RCLx H	
-	L0020 -	
STO 7	L0021 STO Q	{Y-Intercept of line 2 = b2}
RCL RCL	L0022 RCL J	
RCL X Σ+	L0023 RCLx E	
+	L0024 +	
RCL - x◀▶y	L0025 RCL- N	{Computes b2 - b1}
RCL RCL	L0026 RCL J	
RCL - SIN	L0027 RCL- K	{Computes m1 - m2}
÷	L0028 ÷	
STO 2	L0029 STO X	{X = (b2 - b1)/(m1 - m2)}
RCL X SIN	L0030 RCLx K	
RCL + 7	L0031 RCL+ Q	
STO 3	L0032 STO Y	{Y = m2*X + b2}
→ 0 2	L0033 VIEW X	{Computed intersection X-Coord}
→ 0 3	L0034 VIEW Y	{Computed intersection Y-Coord}
RCL 2	L0035 RCL X	
RCL - Σ+	L0036 RCL- E	
RCL 3	L0037 RCL Y	
RCL - x◀▶y	L0038 RCL- N	
← 4	L0039 y,x →θ,r	

INTERSECTION PROGRAM – LL (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
STO 1/x	L0040 STO D	
➔ 0 1/x	L0041 VIEW D	{Distance from first point to intersection}
RCL 2	L0042 RCL X	
RCL – $\sqrt{x/y}$	L0043 RCL– H	
RCL 3	L0044 RCL Y	
RCL – %	L0045 RCL– I	
➔ 4	L0046 y,x → θ ,r	
STO 1/x	L0047 STO D	
➔ 0 1/x	L0048 VIEW D	{Distance from second point to intersection}
➔ + C	L0049 RTN	{Exit Program Mode = key at lower left}

CHECKSUM: LBL L : CK=B7E1

TO RUN THE LINE–LINE INTERSECTION PROGRAM : XEQ L (XEQ COS)

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	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	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 :

- LABELS O and Z must be entered into the HP-33s.
- 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

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + TAN	M0001 LBL M	
→ X 2 4	M0002 CF 4	
→ X 1 0	M0003 SF 0	
XEQ +/-	M0004 XEQ O	{Get line X,Y,AZ}
RCL LN	M0005 RCL B	
← 5	M0006 →HR	
TAN	M0007 TAN	
1/x	M0008 1/x	
STO SIN	M0009 STO K	{Slope of line}
x ²	M0010 x ²	
1	M0011 1	
+	M0012 +	
STO e ^x	M0013 STO A	{Quadratic coefficient A}
RCL %	M0014 RCL I	
RCL SIN	M0015 RCL K	
RCL X ^x √y	M0016 RCL x H	
-	M0017 -	
STO 7	M0018 STO Q	{Y-Intercept}
→ X 2 0	M0019 CF 0	
→ X 1 4	M0020 SF 4	
XEQ +/-	M0021 XEQ O	{Get radius point X,Y}
← 0 8	M0022 INPUT R	{Get radius}
RCL 7	M0023 RCL Q	
RCL - %	M0024 RCL- I	
RCL X SIN	M0025 RCLx K	
RCL - ^x √y	M0026 RCL- H	
2	M0027 2	
X	M0028 x	
STO LN	M0029 STO B	{Quadratic coefficient B}
RCL ^x √y	M0030 RCL H	
x ²	M0031 x ²	
RCL %	M0032 RCL I	
x ²	M0033 x ²	
+	M0034 +	
RCL 8	M0035 RCL R	
x ²	M0036 x ²	
-	M0037 -	
RCL 7	M0038 RCL Q	
x ²	M0039 x ²	
+	M0040 +	

INTERSECTION PROGRAM – LC (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
2	M0041 2	
RCL X 7	M0042 RCLx Q	
RCL X %	M0043 RCLx I	
–	M0044 –	
STO y^x	M0045 STO C	{Quadratic coefficient C}
RCL LN	M0046 RCL B	
x^2	M0047 x^2	
4	M0048 4	
RCL X e^x	M0049 RCLx A	
RCL X y^x	M0050 RCLx C	
–	M0051 –	
STO 1/x	M0052 STO D	{Quadratic discriminant}
➔ ÷ 3	M0053 $x < 0?$	{If no solution, display and exit}
➔ STO RCL $x \leftarrow y$	RCL +/- R/S RCL 9 RCL +/- RCL COS RCL 5	
RCL 4 RCL % RCL +/- RCL $x \leftarrow y$ ENTER	M0054 NO SOLUTION	
RCL 1/x	M0055 RCL D	
➔ ÷ 3	M0056 $x < 0?$	
➔ +	M0057 RTN	
\sqrt{x}	M0058 \sqrt{x}	
RCL – LN	M0059 RCL– B	
2	M0060 2	
RCL X e^x	M0061 RCLx A	
÷	M0062 ÷	
STO 2	M0063 STO X	
STO 5	M0064 STO U	
RCL X SIN	M0065 RCLx K	
RCL + 7	M0066 RCL+ Q	
STO 3	M0067 STO Y	
STO 6	M0068 STO V	
RCL $^x\sqrt{y}$	M0069 RCL H	
RCL – 2	M0070 RCL– X	
RCL %	M0071 RCL I	
RCL – 3	M0072 RCL– Y	
➔ 4	M0073 $y, x \rightarrow \theta, r$	
$x \leftarrow y$	M0074 $x \leftrightarrow y$	
1 8 0	M0075 180	
+	M0076 +	
➔ 5	M0077 \rightarrow HMS	
STO 0	M0078 STO Z	
STO 1	M0079 STO W	
➔ STO RCL 9 RCL +/- RCL COS RCL 5 RCL 4 RCL % RCL +/- RCL $x \leftarrow y$ R/S 1 ENTER		

INTERSECTION PROGRAM – LC (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
	M0080 SOLUTION 1	
➔ R/S	M0081 PSE	
➔ 0 2	M0082 VIEW X	{X-Coordinate 1}
➔ 0 3	M0083 VIEW Y	{Y-Coordinate 1}
➔ 0 0	M0084 VIEW Z	{Azimuth from CC to PT 1}
RCL 1/x	M0085 RCL D	
➔ ÷ 6	M0086 x=0?	{If single solution, exit}
➔ +	M0087 RTN	
√x	M0088 √x	
+/-	M0089 +/-	
RCL - LN	M0090 RCL- B	
2	M0091 2	
RCL X e ^x	M0092 RCLx A	
÷	M0093 ÷	
STO 2	M0094 STO X	
RCL X SIN	M0095 RCLx K	
RCL + 7	M0096 RCL+ Q	
STO 3	M0097 STO Y	
RCL ^x √y	M0098 RCL H	
RCL - 2	M0099 RCL- X	
RCL %	M0100 RCL I	
RCL - 3	M0101 RCL- Y	
← 4	M0102 y,x →θ,r	
x◀▶y	M0103 x<>y	
1 8 0	M0104 180	
+	M0105 +	
➔ 5	M0106 → HMS	
STO 0	M0107 STO Z	
➔ STO RCL 9 RCL +/- RCL COS RCL 5 RCL 4 RCL % RCL +/- RCL x◀▶y R/S 2 ENTER	M0108 SOLUTION 2	
➔ R/S	M0109 PSE	
➔ 0 2	M0110 VIEW X	{X-Coordinate 2}
➔ 0 3	M0111 VIEW Y	{Y-Coordinate 2}
➔ 0 0	M0112 VIEW Z	{Azimuth from CC to PT 2}
➔ +	M0113 RTN	
C		{Exit Program Mode = key at lower left}

CHECKSUM: LBL M : CK=580F

INTERSECTION PROGRAM – LC (Continued)

For the HP-33s Calculator



TO RUN THE LINE–CIRCLE INTERSECTION PROGRAM : XEQ M (XEQ TAN)

Enter X-Coord. of Point on Line	R/S	
Enter Y-Coord. of Point on Line	R/S	
Enter Azimuth of Line	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	
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 X-Coord. of Intersection 2	R/S	
Read Y-Coord. of Intersection 2	R/S	
Read Azimuth, Rad. Pt. to Intersection 2	R/S	{End of Program}

NOTES :

LABELS O and Z must be entered into the HP-33s.

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

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + x◀▶y	N0001 LBL N	
→ X 2 3	N0002 CF 3	
→ X 1 4	N0003 SF 4	
→ X 1 0	N0004 SF 0	
XEQ +/-	N0005 XEQ O	{Get radius point 1 x,y}
← 0 8	N0006 INPUT R	{Get radius length 1}
STO 9	N0007 STO S	
→ X 2 0	N0008 CF 0	
XEQ +/-	N0009 XEQ O	{Get radius point 2 x,y}
← 0 8	N0010 INPUT R	{Get radius length 2}
RCL $x\sqrt{y}$	N0011 RCL H	
RCL – $\Sigma+$	N0012 RCL– E	
RCL %	N0013 RCL I	
RCL – x◀▶y	N0014 RCL– N	
← 4	N0015 y,x → θ ,r	
STO 4	N0016 STO T	{Distance CC1 to CC2}
x◀▶y	N0017 x<>y	
STO e^x	N0018 STO A	{Azimuth CC1 to CC2}
RCL 9	N0019 RCL S	
RCL + 8	N0020 RCL+ R	
RCL 4	N0021 RCL T	
← ÷ 4	N0022 x>y?	{Is CC1 to CC2 > R1+R2}
→ X 1 3	N0023 SF 3	{True = no solution}
RCL 9	N0024 RCL S	
RCL – 8	N0025 RCL– R	
← y^x	N0026 ABS	
RCL 4	N0027 RCL T	
← ÷ 3	N0028 x<y?	{Is CC1 to CC2 < R1-R2 }
→ X 1 3	N0029 SF 3	{True = no solution}
→ X 3 3	N0030 FS 3?	{If no solution, display and exit}
→ STO RCL x◀▶y	RCL +/- R/S RCL 9 RCL +/- RCL COS RCL 5	
	RCL 4 RCL % RCL +/- RCL x◀▶y ENTER	
	N0031 NO SOLUTION	
→ X 3 3	N0032 FS 3?	
→ +	N0033 RTN	
RCL 9	N0034 RCL S	
x^2	N0035 x^2	
RCL 8	N0036 RCL R	
x^2	N0037 x^2	

INTERSECTION PROGRAM – CC (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
–	N0038 –	
RCL 4	N0039 RCL T	
x^2	N0040 x^2	
+	N0041 +	
2	N0042 2	
RCL X 9	N0043 RCLx S	
RCL X 4	N0044 RCLx T	
÷	N0045 ÷	
← COS	N0046 ACOS	
STO 1/x	N0047 STO D	{Delta1/2}
RCL e^x	N0048 RCL A	
RCL + 1/x	N0049 RCL+ D	
RCL 9	N0050 RCL S	
→ 4	N0051 $\theta, r \rightarrow y, x$	
RCL + $x \leftarrow y$	N0052 RCL+ N	
STO 3	N0053 STO Y	
STO 6	N0054 STO V	
$x \leftarrow y$	N0055 $x \leftrightarrow y$	
RCL + $\Sigma+$	N0056 RCL+ E	
STO 2	N0057 STO X	
STO 5	N0058 STO U	
RCL $\Sigma+$	N0059 RCL E	
RCL – 2	N0060 RCL– X	
RCL $x \leftarrow y$	N0061 RCL N	
RCL – 3	N0062 RCL– Y	
← 4	N0063 $y, x \rightarrow \theta, r$	
$x \leftarrow y$	N0064 $x \leftrightarrow y$	
1 8 0	N0065 180	
+	N0066 +	
→ 5	N0067 → HMS	
STO 0	N0068 STO Z	{Azimuth CC1 to Solution 1}
STO RCL	N0069 STO J	
→ STO RCL 9 RCL +/- RCL COS RCL 5 RCL 4 RCL % RCL +/- RCL $x \leftarrow y$ R/S 1 ENTER	N0070 SOLUTION 1	
→ R/S	N0071 PSE	
→ 0 2	N0072 VIEW X	{X-Coordinate 1}
→ 0 3	N0073 VIEW Y	{Y-Coordinate 1}
→ 0 0	N0074 VIEW Z	{Azimuth CC1 to Solution 1}
RCL $\sqrt[x]{y}$	N0075 RCL H	
RCL – 2	N0076 RCL– X	
RCL %	N0077 RCL I	

INTERSECTION PROGRAM – CC (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
RCL - 3	N0078 RCL- Y	
← 4	N0079 y,x →θ,r	
x◀▶y	N0080 x<>y	
1 8 0	N0081 180	
+	N0082 +	
→ 5	N0083 → HMS	
STO 0	N0084 STO Z	
STO SIN	N0085 STO K	
→ 0 0	N0086 VIEW Z	{ Azimuth CC2 to Solution 1 }
RCL 1/x	N0087 RCL D	
→ ÷ 6	N0088 x=0?	{ If single solution, exit }
→ +	N0089 RTN	
RCL e ^x	N0090 RCL A	
RCL - 1/x	N0091 RCL- D	
RCL 9	N0092 RCL S	
→ 4	N0093 θ,r → y,x	
RCL + x◀▶y	N0094 RCL+ N	
STO 3	N0095 STO Y	
x◀▶y	N0096 x<>y	
RCL + Σ+	N0097 RCL+ E	
STO 2	N0098 STO X	
RCL Σ+	N0099 RCL E	
RCL - 2	N0100 RCL- X	
RCL x◀▶y	N0101 RCL N	
RCL - 3	N0102 RCL- Y	
← 4	N0103 y,x →θ,r	
x◀▶y	N0104 x<>y	
1 8 0	N0105 180	
+	N0106 +	
→ 5	N0107 → HMS	
STO 0	N0108 STO Z	{ Azimuth CC1 to Solution 2 }
STO COS	N0109 STO L	
→ STO RCL 9 RCL +/- RCL COS RCL 5 RCL 4 RCL % RCL +/-	N0110 SOLUTION 2	
RCL x◀▶y R/S 2 ENTER		
→ R/S	N0111 PSE	
→ 0 2	N0112 VIEW X	{ X-Coordinate 2 }
→ 0 3	N0113 VIEW Y	{ Y-Coordinate 2 }
→ 0 0	N0114 VIEW Z	{ Azimuth CC1 to Solution 2 }
RCL ^x √y	N0115 RCL H	
RCL - 2	N0116 RCL- X	
RCL %	N0117 RCL I	

INTERSECTION PROGRAM – CC (Continued)
For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
RCL - 3	N0118 RCL- Y	
← 4	N0119 y,x →θ,r	
x◀▶y	N0120 x<>y	
1 8 0	N0121 180	
+	N0122 +	
→ 5	N0123 → HMS	
STO 0	N0124 STO Z	
STO TAN	N0125 STO M	
→ 0 0	N0126 VIEW Z	{Azimuth CC2 to Solution 2}
→ +	N0127 RTN	
C		{Exit Program Mode = key at lower left}

CHECKSUM: LBL N : CK=1248

TO RUN THE CIRCLE-CIRCLE INTERSECTION PROGRAM : XEQ N (XEQ x◀▶y)

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	
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	
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 :

- LABEL O must be entered into the HP-33s.
- 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

HORIZONTAL CURVE PROGRAM

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ••	PRGM TOP	{•• = decimal point twice}
← + $\sqrt[x]{y}$	H0001 LBL H	
→ X 1 • 0	H0002 SF 10	{• = decimal point}
← ⇐ 2	H0003 CLVAR S	
1 8 0	H0004 180	
→ COS	H0005 π	
÷	H0006 ÷	
STO SIN	H0007 STO K	
→ STO RCL 1/x RCL $\Sigma+$ RCL COS RCL 4 RCL e^x ENTER	H0008 DELTA	
→ R/S	H0009 PSE	
← 0 e^x	INPUT A	{Enter Delta}
← 5	H0011 →HR	
2	H0012 2	
÷	H0013 ÷	
STO e^x	H0014 STO A	{Delta/2 in A}
← 0 1/x	H0015 INPUT D	
1 0 0	H0016 100	
RCL X SIN	H0017 RCLx K	
RCL 1/x	H0018 RCL D	{Enter Degree of Curve}
← 5	H0019 →HR	
→ ÷ 4	H0020 $x>0?$	
÷	H0021 ÷	
STO 8	H0022 STO R	
→ ÷ 6	H0023 $x=0?$	
← 0 8	H0024 INPUT R	{If Degree = 0, Enter Radius}
→ ÷ 6	H0025 $x=0?$	
XEQ 3	H0026 XEQ Y	{If Radius = 0, Compute It}
RCL e^x	H0027 RCL A	
→ ÷ 6	H0028 $x=0?$	
XEQ 2	H0029 XEQ X	{If Delta = 0, Compute It}
RCL e^x	H0030 RCL A	
→ ÷ 6	H0031 $x=0?$	
← XEQ $\sqrt[x]{y}$	H0032 GTO H	{If no Valid Delta Angle}
RCL 8	H0033 RCL R	
→ ÷ 6	H0034 $x=0?$	
← XEQ $\sqrt[x]{y}$	H0035 GTO H	{If no Valid Radius}
1 0 0	H0036 100	
RCL X SIN	H0037 RCLx K	
RCL ÷ 8	H0038 RCL÷ R	

HORIZONTAL CURVE PROGRAM (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
➡ 5	H0039 →HMS	
STO 1/x	H0040 STO D	{Degree Of Curve}
RCL e ^x	H0041 RCL A	
TAN	H0042 TAN	
RCL X 8	H0043 RCLx R	
STO 4	H0044 STO T	{Tangent Length}
RCL e ^x	H0045 RCL A	
SIN	H0046 SIN	
2	H0047 2	
X	H0048 x	
RCL X 8	H0049 RCLx R	
STO y ^x	H0050 STO C	{Chord Length}
RCL 8	H0051 RCL R	
RCL 8	H0052 RCL R	
RCL e ^x	H0053 RCL A	
COS	H0054 COS	
X	H0055 x	
-	H0056 -	
STO TAN	H0057 STO M	{Mid-Ordinate Distance}
RCL 8	H0058 RCL R	
RCL e ^x	H0059 RCL A	
COS	H0060 COS	
÷	H0061 ÷	
RCL - 8	H0062 RCL- R	
STO Σ+	H0063 STO E	{External Distance}
RCL e ^x	H0064 RCL A	
RCL ÷ SIN	H0065 RCL÷ K	
RCL X 8	H0066 RCLx R	
RCL X 8	H0067 RCLx R	
STO 9	H0068 STO S	{Sector Area}
STO √x	H0069 STO G	
RCL e ^x	H0070 RCL A	
COS	H0071 COS	
RCL X y ^x	H0072 RCLx C	
2	H0073 2	
STO X e ^x	H0074 STOx A	
÷	H0075 ÷	
RCL X 8	H0076 RCLx R	
STO - √x	H0077 STO- G	{Segment Area}
RCL 8	H0078 RCL R	
RCL X 4	H0079 RCLx T	
RCL - 9	H0080 RCL- S	
STO x ²	H0081 STO F	{Fillet Area}

HORIZONTAL CURVE PROGRAM (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
RCL e^x	H0082 RCL A	
➔ 5	H0083 →HMS	
➔ x◀▶y e^x	H0084 x<> A	
RCL ÷ SIN	H0085 RCL÷ K	
RCL X 8	H0086 RCLx R	
STO COS	H0087 STO L	{Length Of Curve}
➔ STO RCL 1/x RCL Σ+ RCL COS RCL 4 RCL e^x ENTER	H0088 DELTA	
➔ R/S	H0089 PSE	
➔ 0 e^x	H0090 VIEW A	
➔ 0 1/x	H0091 VIEW D	
➔ 0 4	H0092 VIEW T	
➔ 0 COS	H0093 VIEW L	
➔ 0 8	H0094 VIEW R	
➔ 0 y^x	H0095 VIEW C	
➔ 0 TAN	H0096 VIEW M	
➔ 0 Σ+	H0097 VIEW E	
➔ 0 9	H0098 VIEW S	
➔ 0 \sqrt{x}	H0099 VIEW G	
➔ 0 x^2	H0100 VIEW F	
➔ STO RCL E RCL % R/S RCL 9 RCL 4 RCL e^x ENTER	H0101 PI STA	
RCL - 4	H0102 RCL- T	
ENTER	H0103 ENTER	
RCL + COS	H0104 RCL+ L	
R/S	H0105 STOP	
➔ +	H0106 RTN	
➔ + 2	X0001 LBL X	{Compute Delta From R}
RCL 8	X0002 RCL R	
➔ ÷ 6	X0003 x=0?	
➔ +	X0004 RTN	
➔ 0 4	X0005 INPUT T	
RCL ÷ 8	X0006 RCL÷ R	
➔ ATAN	X0007 ATAN	
STO e^x	X0008 STO A	
➔ ÷ 4	X0009 x>0?	
➔ +	X0010 RTN	
➔ 0 COS	X0011 INPUT L	
RCL X SIN	X0012 RCLx K	
RCL ÷ 8	X0013 RCL÷ R	
2	X0014 2	

HORIZONTAL CURVE PROGRAM (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
÷	X0015 ÷	
STO e ^x	X0016 STO A	
➡ ÷ 4	X0017 x>0?	
➡ +	X0018 RTN	
⬅ 0 y ^x	X0019 INPUT C	
2	X0020 2	
÷	X0021 ÷	
RCL ÷ 8	X0022 RCL÷ R	
⬅ ASIN	X0023 ASIN	
STO e ^x	X0024 STO A	
➡ ÷ 4	X0025 x>0?	
➡ +	X0026 RTN	
⬅ 0 TAN	X0027 INPUT M	
RCL 8	X0028 RCL R	
RCL TAN	X0029 RCL M	
-	X0030 -	
RCL ÷ 8	X0031 RCL÷ R	
⬅ COS	X0032 ACOS	
STO e ^x	X0033 STO A	
➡ ÷ 4	X0034 x>0?	
➡ +	X0035 RTN	
⬅ 0 Σ+	X0036 INPUT E	
RCL + 8	X0037 RCL+ R	
RCL 8	X0038 RCL R	
x◀▶y	X0039 x<>y	
÷	X0040 ÷	
⬅ COS	X0041 ACOS	
STO e ^x	X0042 STO A	
➡ +	X0043 RTN	
⬅ + 3	Y0001 LBL Y	{ Compute R from Delta }
RCL e ^x	Y0002 RCL A	
➡ ÷ 6	Y0003 x=0?	
➡ +	Y0004 RTN	
⬅ 0 4	Y0005 INPUT T	
RCL e ^x	Y0006 RCL A	
TAN	Y0007 TAN	
÷	Y0008 ÷	
STO 8	Y0009 STO R	
➡ ÷ 4	Y0010 x>0?	
➡ +	Y0011 RTN	
⬅ 0 COS	Y0012 INPUT L	
RCL X SIN	Y0013 RCLx K	

HORIZONTAL CURVE PROGRAM (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
RCL ÷ e ^x	Y0014 RCL÷ A	
2	Y0015 2	
÷	Y0016 ÷	
STO 8	Y0017 STO R	
➡ ÷ 4	Y0018 x>0?	
➡ +	Y0019 RTN	
← 0 y ^x	Y0020 INPUT C	
RCL e ^x	Y0021 RCL A	
SIN	Y0022 SIN	
2	Y0023 2	
X	Y0024 x	
÷	Y0025 ÷	
STO 8	Y0026 STO R	
➡ ÷ 4	Y0027 x>0?	
➡ +	Y0028 RTN	
← 0 TAN	Y0029 INPUT M	
1	Y0030 1	
RCL e ^x	Y0031 RCL A	
COS	Y0032 COS	
-	Y0033 -	
÷	Y0034 ÷	
STO 8	Y0035 STO R	
➡ ÷ 4	Y0036 x>0?	
➡ +	Y0037 RTN	
← 0 Σ+	Y0038 INPUT E	
RCL e ^x	Y0039 RCL A	
COS	Y0040 COS	
1/x	Y0041 1/x	
1	Y0042 1	
-	Y0043 -	
÷	Y0044 ÷	
STO 8	Y0045 STO R	
➡ +	Y0046 RTN	
C		{Exit Program Mode = key at lower left}

CHECKSUMS: LBL H : CK=AE89 LBL X : CK=8BEE LBL Y : CK=9608

HORIZONTAL CURVE PROGRAM (Continued)

For the HP-33s Calculator



TO RUN THE HORIZONTAL CURVE PROGRAM : XEQ H (XEQ \sqrt{y})

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 STATION”}
Read the PC and PT Stations	R/S	{End of Program}

VERTICAL CURVE (& TANGENT) PROGRAM

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + 6	V0001 LBL V	
→ X 1 ● 0	V0002 SF 10	{● = decimal point}
→ STO RCL E RCL 6 RCL % R/S RCL 9 RCL 4 RCL e ^x ENTER	V0003 PVI STA	{PVI station in feet or meters}
STO y ^x	V0004 STO C	
STO 4	V0005 STO T	
→ STO RCL E RCL 6 RCL % R/S RCL Σ+ RCL COS RCL Σ+ ENTER	V0006 PVI ELE	{PVI elevation or POT if tangent}
STO 1/x	V0007 STO D	
STO 5	V0008 STO U	
→ STO RCL √x RCL 8 R/S RCL % RCL x◀▶y ENTER	V0009 GR IN	{G1% into PVI}
STO %	V0010 STO I	
→ STO RCL √x RCL 8 R/S RCL +/- RCL 5 RCL 4 ENTER	V0011 GR OUT	{G2% out of PVI = G1 if tangent}
STO +/-	V0012 STO O	
1 0 0	V0013 100	
STO ÷ %	V0014 STO+ I	{G1% to decimal}
STO ÷ +/-	V0015 STO+ O	{G2% to decimal}
→ STO RCL 6 RCL y ^x R/S RCL COS RCL Σ+ RCL x◀▶y ENTER	V0016 VC LEN	{Zero if tangent grade}
2	V0017 2	
÷	V0018 ÷	
STO COS	V0019 STO L	{=L/2}
STO - y ^x	V0020 STO- C	{=PVC station}
STO + 4	V0021 STO+ T	{=PVT station}
RCL X %	V0022 RCLx I	
STO - 1/x	V0023 STO- D	{=PVC elevation}
RCL COS	V0024 RCL L	
RCL X +/-	V0025 RCLx O	
STO + 5	V0026 STO+ U	{=PVT elevation}
RCL +/-	V0027 RCL O	
RCL - %	V0028 RCL- I	
4	V0029 4	
RCL X COS	V0030 RCLx L	{=2L}
→ ÷ 1	V0031 x≠0?	
÷	V0032 ÷	
STO SIN	V0033 STO K	{(G2-G1)/2L or 0 if tangent}
→ STO RCL 9 RCL 4 RCL e ^x R/S RCL % RCL x◀▶y RCL y ^x ENTER		

VERTICAL CURVE PROGRAM (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
	V0034 STA INC	{ Station increment }
STO E	V0035 STO P	
← + RCL	J0001 LBL J	
← 0 9	J0002 INPUT S	{ Enter station of any point }
XEQ SIN	J0003 XEQ K	
RCL 9	J0004 RCL S	
RCL Σ+	J0005 RCL E	
→ 0 Σ+	J0006 VIEW E	{ Read elevation of point }
RCL E	J0007 RCL P	
STO + 9	J0008 STO+ S	
← XEQ RCL	J0009 GTO J	
← + SIN	K0001 LBL K	
RCL - 4	K0002 RCL- T	
STO 2	K0003 STO X	
RCL X +/-	K0004 RCLx O	
RCL + 5	K0005 RCL+ U	
STO Σ+	K0006 STO E	
RCL 2	K0007 RCL X	
→ ÷ 4	K0008 x>0?	{ On out tangent? }
→ +	K0009 RTN	
RCL 9	K0010 RCL S	
RCL - y ^x	K0011 RCL- C	
STO 2	K0012 STO X	
RCL X %	K0013 RCLx I	
RCL + 1/x	K0014 RCL+ D	
STO Σ+	K0015 STO E	
RCL 2	K0016 RCL X	
→ ÷ 2	K0017 x≤0?	
→ +	K0018 RTN	{ On in tangent? }
RCL X %	K0019 RCLx I	
RCL 2	K0020 RCL X	
x ²	K0021 x ²	
RCL X SIN	K0022 RCLx K	
+	K0023 +	
RCL + 1/x	K0024 RCL+ D	
STO Σ+	K0025 STO E	
→ +	K0026 RTN	{ On vertical curve }
C		{ Exit Program Mode = key at lower left }

CHECKSUMS: LBL V : CK=8E3C LBL J : CK=1FAC LBL K : CK=27FF

VERTICAL CURVE PROGRAM (Continued)

For the HP-33s Calculator



TO RUN THE VERTICAL CURVE PROGRAM : XEQ V (XEQ 6)

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 }
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

For the HP-33s Calculator



PROGRAM ENTRY SEQUENCE

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ●●	PRGM TOP	{●● = decimal point twice}
← + e ^x	A0001 LBL A	
→ X 1 4	A0002 SF 4	
→ X 1 0	A0003 SF 0	
← ⇐ 2	A0004 CLVARS	
XEQ +/-	A0005 XEQ O	{Get First Point X, Y}
→ X 2 0	A0006 CF 0	
← + 1	W0001 LBL W	
RCL 2	W0002 RCL X	
STO 6	W0003 STO V	
RCL 3	W0004 RCL Y	
STO 1	W0005 STO W	
XEQ +/-	W0006 XEQ O	{Get Next Point X, Y}
RCL 6	W0007 RCL V	
RCL X 3	W0008 RCLx Y	
RCL 2	W0009 RCL X	
RCL X 1	W0010 RCLx W	
-	W0011 -	
STO + x ²	W0012 STO+ F	
RCL 2	W0013 RCL X	
RCL - 6	W0014 RCL- V	
RCL 3	W0015 RCL Y	
RCL - 1	W0016 RCL- W	
← 4	W0017 y,x →θ,r	
STO + E	W0018 STO+ P	
RCL 2	W0019 RCL X	
RCL Σ+	W0020 RCL E	
← ÷ 1	W0021 x≠y?	{If Next X ≠ First X}
← XEQ 1	W0022 GTO W	{Loop Back For Next Point}
RCL 3	W0023 RCL Y	
RCL x◀▶y	W0024 RCL N	
← ÷ 1	W0025 x≠y?	{If Next Y ≠ First Y}
← XEQ 1	W0026 GTO W	{Loop Back For Next Point}
RCL x ²	W0027 RCL F	{After Next = First, Show Results}
2	W0028 2	
÷	W0029 ÷	
STO x ²	W0030 STO F	
4 3 5 6 0	W0031 43,560	
÷	W0032 ÷	
STO e ^x	W0033 STO A	

AREA BY COORDINATES PROGRAM (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
➡ 0 x ²	W0034 VIEW F	
➡ 0 e ^x	W0035 VIEW A	
➡ 0 E	W0036 VIEW P	
➡ +	W0037 RTN	
C		{Exit Program Mode = key at lower left}

CHECKSUMS: LBL A : CK=132E LBL W : CK=F9FD

TO RUN THE AREA BY COORDINATES PROGRAM : XEQ A (XEQ e^x)

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}

NOTES :

LABEL O must be entered into the HP-33s.

SUPPORT PROGRAMS

For the HP-33s Calculator



LABEL O ENTRY SEQUENCE (Enter Point Coordinates)

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ••	PRGM TOP	{•• = decimal point twice}
← + +/-	O0001 LBL O	
→ X 1 • 0	O0002 SF 10	{• = decimal point}
→ X 1 1	O0003 SF 1	
→ X 3 0	O0004 FS? 0	
→ X 2 1	O0005 CF 1	
→ X 3 0	O0006 FS? 0	
→ STO RCL x ² RCL % RCL 8 RCL 9 RCL 4 ENTER	O0007 FIRST	
→ R/S	O0008 PSE	
→ X 3 1	O0009 FS? 1	
→ STO RCL x◀▶y RCL Σ+ RCL 2 RCL 4 ENTER	O0010 NEXT	
→ R/S	O0011 PSE	
← 0 2	O0012 INPUT X	{Enter first/next X-coordinate}
STO x√y	O0013 STO H	
→ X 3 0	O0014 FS? 0	
STO Σ+	O0015 STO E	{If first point}
← 0 3	O0016 INPUT Y	{Enter first/next Y-coordinate}
STO %	O0017 STO I	
→ X 3 0	O0018 FS? 0	
STO x◀▶y	O0019 STO N	{If first point}
→ X 3 4	O0020 FS? 4	
→ +	O0021 RTN	{Return if X/Y only}
9 9 9 +/-	O0022 -999	
ENTER	O0023 ENTER	
STO e ^x	O0024 STO A	
← 0 e ^x	O0025 INPUT A	{Enter first/next azimuth}
← ÷ 1	O0026 x≠y?	{Leave -999 to calculate azimuth}
GTO 0	O0027 GTO Z	{If azimuth was entered}
← 0 2	O0028 INPUT X	{Enter X-Coordinate of point on line}
← 0 3	O0029 INPUT Y	{Enter Y-Coordinate of point on line}
← ⇐ 1	O0030 CLx	
STO e ^x	O0031 STO A	{Set Azimuth to zero for limits test}
RCL x√y	O0032 RCL H	
RCL - 2	O0033 RCL- X	
→ ÷ 6	O0034 x=0?	{If X1=X2 then}
GTO 0	O0035 GTO Z	{Leave azimuth = 0}
9 0	O0036 90	
STO e ^x	O0037 STO A	{Set Azimuth to 90 for limits test}

SUPPORT PROGRAMS (Continued)

For the HP-33s Calculator



<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← ↵ 1	O0038 CLx	
RCL %	O0039 RCL I	
RCL - 3	O0040 RCL- Y	
→ ÷ 6	O0041 x=0?	{ If Y1=Y2 then }
GTO 0	O0042 GTO Z	{ Leave azimuth = 90 }
← 4	O0043 y,x →θ,r	
x ← ► y	O0044 x <> y	
1 8 0	O0045 180	
+	O0046 +	
→ 5	O0047 →HMS	
STO e ^x	O0048 STO A	
← + 0	Z0001 LBL Z	
RCL e ^x	Z0002 RCL A	
← 5	Z0003 →HR	
1 8 0	Z0004 180	
← ÷ 4	Z0005 x>y?	
← ↵ 1	Z0006 CLx	{ If 180 is larger than azimuth, subtract 0 }
-	Z0007 -	{ Otherwise subtract 180 }
STO e ^x	Z0008 STO A	
E 9 +/-	Z0009 1E -9	{ Small number for avoiding trig errors }
STO +/-	Z0010 STO O	
9 0	Z0011 90	
RCL e ^x	Z0012 RCL A	
← ÷ 6	Z0013 x=y?	{ If azimuth = 90, subtract a small number }
RCL - +/-	Z0014 RCL- O	
STO e ^x	Z0015 STO A	
RCL e ^x	Z0016 RCL A	
→ ÷ 6	Z0017 x=0?	{ If azimuth = 0, substitute a small number }
RCL +/-	Z0018 RCL O	
STO e ^x	Z0019 STO A	
RCL e ^x	Z0020 RCL A	
→ 5	Z0021 →HMS	
STO e ^x	Z0022 STO A	
→ X 3 0	Z0023 FS? 0	
STO LN	Z0024 STO B	{ If first azimuth }
→ +	Z0025 RTN	
C		{ Exit Program Mode = key at lower left }

CHECKSUMS: LBL O : CK=0078 LBL Z : CK=1F1C

SUPPORT PROGRAMS (Continued)

For the HP-33s Calculator



LABEL B ENTRY SEQUENCE (Display Triangle Results)

<u>Keystrokes</u>	<u>Display</u>	<u>Comments</u>
← R/S		{Enter Program Mode}
← XEQ ••	PRGM TOP	{•• = decimal point twice}
← + LN	B0001 LBL B	
RCL 5	B0002 RCL U	{Angle opposite first side}
RCL Σ+	B0003 RCL E	{Length of first side}
R/S	B0004 STOP	
RCL 6	B0005 RCL V	{Angle opposite second side}
RCL x ²	B0006 RCL F	{Length of second side}
R/S	B0007 STOP	
RCL 1	B0008 RCL W	{Angle opposite third side}
RCL √x	B0009 RCL G	{Length of third side}
R/S	B0010 STOP	
RCL 1	B0011 RCL W	
← 5	B0012 →HR	
SIN	B0013 SIN	
2	B0014 2	
÷	B0015 ÷	
RCL X Σ+	B0016 RCLx E	
RCL X x ²	B0017 RCLx F	
STO e ^x	B0018 STO A	
→ 0 e ^x	B0019 VIEW A	{Area of the triangle}
→ +	B0020 RTN	
C		{Exit Program Mode = key at lower left}

CHECKSUM: LBL B : CK= EF40

PROGRAM VERSION NOTES

For the HP-33s Calculator



NOTES ON THE 04-01-2010 VERSION:

This version differs from the November 20, 2008 version only in Label O. It adds 9 lines that check for $X1=X2$ or $Y1=Y2$ when entering a second point to compute an azimuth.

NOTES ON THE 11-20-2008 VERSION:

This version differs from the January 22, 2008 version only in a few typographic fixes. If your 01-22-2008 version is working, there is no need to make any changes.

NOTES ON THE 01-22-2008 VERSION:

This version differs from the December 28, 2007 version only in Label Z on line Z0009. The checksum also differs as a result.

NOTES ON THE 12-28-2007 VERSION:

This version differs from the July 30, 2007 version in only two program segments:

Label Z was removed from the H.MMSS arithmetic function. To subtract angles, press the +/- key after entering the second angle.

Label O was modified and Label Z was added. This change allows the program to handle trigonometry errors that occur in the cardinal directions.

If modifying the older version, delete Label Z in the HH.MMSS function first, then modify Label O and add the new Label Z.