## HP-35s Calculator Program Utility 1

## HMS+

**Programmer**: Dr. Bill Hazelton

**Date**: October, 2007.

| Line | Instruction | Display | User Instructions |
|---|---|---|---|
| C001 | LBL C | | Enter first angle. Press ENTER. |
| C002 | HMS→ | | Enter second angle. Press XEQ C ENTER. |
| C003 | x < > y | | |
| C004 | HMS→ | | (Angles must be in DDD.MMSS format) |
| C005 | + | | |
| C006 | →HMS | | |
| C007 | RTN | | Angle sum displayed (in HP notation) |

## Notes

(1) General program to add two angles, azimuths or directions in DDD.MMSS format (HP notation), and produce a result in the same format.

(2) Key in the first angle. Press ENTER. Key in the second angle. Stack will contain:

| Stack Register | Contents |
|---|---|
| T | |
| Z | |
| Y | First angle in D.MS (line 1) |
| X | Second angle in D.MS (line 2) |

Press XEQ C ENTER. The sum of the two angles in HP notation will be in the X register (line 1)

(3) Negative values will work correctly.

## Sample Computation

123° 45' 56" + 321° 54' 32" = 445° 40' 28"

### Storage Registers Used

None

### Labels Used

Label **C** Length = 21 Checksum = F341

Use the length (LN=) and Checksum (CK=) values to check if program was entered correctly. Use the sample computation to check proper operation after entry.

## HP-35s Calculator Program Utility 2

## HMS–

**Programmer**: Dr. Bill Hazelton

**Date**: October, 2007.

| Line | Instruction | Display | User Instructions |
|---|---|---|---|
| D001 | LBL D | | Enter first angle. Press ENTER. |
| D002 | HMS→ | | Enter second angle. Press XEQ D ENTER. |
| D003 | x < > y | | |
| D004 | HMS→ | | (Angles in DDD.MMSS format) |
| D005 | x < > y | | |
| D006 | – | | |
| D007 | →HMS | | |
| D008 | RTN | | Angle sum displayed (in HP notation) |

## Notes

(1) General program to get the difference between two angles, azimuths or directions in DDD.MMSS format (HP notation), and produce a result in the same format.

(2) Key in the first angle. Press ENTER. Key in the second angle. Stack will contain:

| Stack Register | Contents |
|---|---|
| T | |
| Z | |
| Y | First angle in DMS (line 1) |
| X | Second angle in DMS (line 2) |

Press XEQ D ENTER. The difference between the two angles in HP notation will be in the X register. The second angle will be subtracted from the first.

(3) Negative values will work correctly.

## Sample Computation

321° 54' 32" – 123° 45' 56" = 198° 08' 36"

### Storage Registers Used

None

### Labels Used

Label **D** Length = 24 Checksum = E0E0

Use the length (LN=) and Checksum (CK=) values to check if program was entered correctly. Use the sample computation to check proper operation after entry.

## HP-35s Calculator Program  Utility 3

# Enter Vector with D.MMSS Azimuth for Complex Number

**Programmer**: Dr. Bill Hazelton

**Date**: October, 2007.  **Mnemonic**: V for **V**ector Building

| Line | Instruction | Display | User Instructions |
|---|---|---|---|
| V001 | LBL V | | Press XEQ V ENTER. |
| V002 | 10 | | |
| V003 | STO I | | |
| V004 | RCL A | | |
| V005 | STO (I) | | ↱ STO (I) ( (I) is on the zero key) |
| V006 | 1 | | |
| V007 | STO + I | | |
| V008 | RCL D | | |
| V009 | STO (I) | | |
| V010 | 1 | | |
| V011 | STO + I | | |
| V012 | INPUT A | A? | Prompts for azimuth in D.MMSS |
| V013 | RCL A | | |
| V014 | HMS→ | | |
| V015 | STO A | | |
| V016 | INPUT D | D? | Prompts for distance (D?) |
| V017 | RCL A | | |
| V018 | COS | | |
| V019 | RCL × D | | |
| V020 | RCL A | | |
| V021 | SIN | | |
| V022 | RCL × D | | |
| V023 | 0 **i** 1 | | [Key in as 0, then **i**, then 1, press ENTER] |
| V024 | × | | |
| V025 | + | | |
| V026 | STO (I) | | |
| V027 | 10 | | |
| V028 | STO I | | |
| V029 | RCL (I) | | |
| V030 | STO A | | |
| V031 | 1 | | |
| V032 | STO + I | | |
| V033 | RCL (I) | | |
| V034 | STO D | | |
| V035 | 1 | | |
| V036 | STO + I | | |
| V037 | CLSTK | | |
| V038 | RCL (I) | | |
| V039 | RTN | | Complex number now in stack in X |

## Notes

(1) A program that allows the user to enter a vector as two separate components, azimuth and distance, with the azimuth in D.MMSS (HP format), and have it converted to a complex number, with the azimuth component in decimal degrees.

(2) Calculator should be set in DEGREES mode. Press MODE, then 1.

(3) Because the calculator uses data entry into the A and D storage registers to allow simple prompting, there is the potential of this program deleting any data already in those storage registers. This could be a problem if this program was called as a sub-routine from within another program. To avoid this problem, the program copies the contents of storage register A to storage register 10, and the contents of storage register D to storage register 11. At the conclusion of the program, the values are copied back into storage registers A and D.

(4) Because the program replaces everything that was on the stack before it ran, the stack is cleared of all data before the result of the calculation is returned to the stack.

(5) While copying back the contents of registers 10 and 11, the program stores the result of the calculation in storage register 12.

(6) If using a program that requires storage registers 10, 11 and 12, change the value of 10 in lines V002 and V027 to a suitable number, so that the set of three storage registers selected aren't used elsewhere.

## Operation

Press XEQ V ENTER.

The calculator prompts with A? to enter the azimuth in degrees, minutes and seconds (HP notation). Key in the azimuth and press R/S.

The calculator prompts with D? to enter the distance. Key in the distance and press R/S.

The calculator displays the complex number representing the vector in the X register, or line 2 of the display. The remainder of the stack is zeros.

## Examples

1. 63° 15' 47" and 105.528 will give a complex number of 105.5280 θ 63.2631 in polar mode (with FIX 4 set for the display), or 47.4765 **i** 94.2451 in rectangular mode.

2. 128° 15' 47" and 105.528 will give a complex number of 105.5280 θ 128.2631, or –65.3506 **i** 82.8580.

3. 237° 15' 47" and 105.528 will give a complex number of 105.5280 θ –122.7369, or –57.0677 **i** –88.7662.

4. 333° 15' 47" and 105.528 will give a complex number of 105.5280 θ –26.7369, or 94.2451 **i** –47.4765.

5. 397° 15' 47" and 105.528 produce 105.5280 θ 37.2631, or 83.9859 **i** 63.8946.

## Storage Registers Used

| | |
|---|---|
| **A** | Stores the azimuth value, initially in D.MMSS, then in decimal degrees. |
| **D** | Stores the distance value. |
| **I** | Used to store the value for indirect addressing of registers 10, 11 and 12. |
| 10 | Temporary storage for the contents of storage register A while the program runs. |
| 11 | Temporary storage for the contents of storage register D while the program runs. |
| 12 | Temporary storage for the answer while copying back A and D. |

## Labels Used

Label **V** Length = 128 Checksum = 39FE

Use the length (LN=) and Checksum (CK=) values to check if program was entered correctly. Use the sample computation to check proper operation after entry.

## HP-35s Calculator Program Utility 4

# Extract Real and Imaginary Parts of a Complex Number

**Programmer**: Dr. Bill Hazelton

**Date**: October, 2007. **Mnemonic**: X for e**X**tract Co-ordinates

| Line | Instruction | Display | User Instructions |
|---|---|---|---|
| X001 | LBL X | | Press XEQ X ENTER. |
| X002 | 10 | | |
| X003 | STO I | | |
| X004 | R↓ | | |
| X005 | STO (I) | | ↱ STO (I) ( (I) is on the zero key) |
| X006 | ARG | | |
| X007 | COS | | |
| X008 | RCL (I) | | |
| X009 | ABS | | |
| X010 | × | | |
| X011 | RCL (I) | | |
| X012 | ARG | | |
| X013 | SIN | | |
| X014 | RCL (I) | | |
| X015 | ABS | | |
| X016 | × | | |
| X017 | RTN | | Components now on stack |

## Notes

(1) The program is designed to operate with the complex number on the stack in the X register (line 2 of the display).

(2) The program stores the vector in storage register 10 for quick retrieval during operation. If this storage register is in use, change the value in line X002 to a suitable number that doesn't clash with other needs.

(3) The program will work regardless of the display mode for complex numbers, and regardless of the angle unit mode of the calculator.

(4) The program will over-write values in the stack prior to it being called.

## Operation

(1) Put the complex number into the X register on the stack, either by keying it in, or by recalling it there from wherever it is stored.

(2) Press XEQ X ENTER. The program returns the real (or Northing or Y) component or co-ordinate to the Y register (line 1 of the display), and the imaginary part or co-ordinate (or Easting or X) to the X register (line 2 of the display).

## Examples

1. The complex number 123.0000 **i** 456.0000 is on the stack. The result is 123.0000 in the Y register and 456.000 in the X register.

2. The complex number 100.0000 θ 45.0000 is on the stack. The result is 70.7107 in the Y register and 70.7107 in the X register.

3. The complex number 100.0000 θ 230.0000 is on the stack. The result is –64.2788 in the Y register and –76.6044 in the X register.

### Storage Registers Used

**I** Used for the indirect addressing of storage register 10.

10 Used to store the complex number during operations.

### Labels Used

Label **X** Length = 53 Checksum = C46D

Use the length (LN=) and Checksum (CK=) values to check if program was entered correctly. Use the sample computation to check proper operation after entry.

## HP-35s Calculator Program Utility 5

# Enter Vector with D.MMSS Azimuth for Complex Number, but check for a negative distance

**Programmer**: Dr. Bill Hazelton

**Date**: December, 2007. **Mnemonic**: **W** for Vector **W**rangling

| Line | Instruction | Display | User Instructions |
|---|---|---|---|
| W001 | LBL W | | Press XEQ W ENTER. |
| W002 | 10 | | |
| W003 | STO I | | |
| W004 | RCL A | | |
| W005 | STO (I) | | ↱ STO (I) ( (I) is on the zero key) |
| W006 | 1 | | |
| W007 | STO + I | | |
| W008 | RCL D | | |
| W009 | STO (I) | | |
| W010 | 1 | | |
| W011 | STO + I | | |
| W012 | INPUT A | A? | Prompts for azimuth in D.MMSS |
| W013 | RCL A | | |
| W014 | HMS→ | | |
| W015 | STO A | | |
| W016 | INPUT D | D? | Prompts for distance (D?) |
| W017 | RCL D | | |
| W018 | $x \geq 0$? | | |
| W019 | GTO W023 | | |
| W020 | ABS | | |
| W021 | STO D | | |
| W022 | SF 3 | | |
| W023 | RCL A | | |
| W024 | COS | | |
| W025 | RCL × D | | |
| W026 | RCL A | | |
| W027 | SIN | | |
| W028 | RCL × D | | |
| W029 | 0 **i** 1 | | [Key in as 0, then **i**, then 1, press ENTER] |
| W030 | × | | |
| W031 | + | | |
| W032 | STO (I) | | |
| W033 | 10 | | |
| W034 | STO I | | |
| W035 | RCL (I) | | |
| W036 | STO A | | |
| W037 | 1 | | |
| W038 | STO + I | | |

| | | | |
|---|---|---|---|
| W039 | RCL (I) | | |
| W040 | STO D | | |
| W041 | 1 | | |
| W042 | STO + I | | |
| W043 | CLSTK | | |
| W044 | RCL (I) | | |
| W045 | RTN | | Complex number now in stack in X |

## Special Note

This program is designed to work with the B program (Closure 5) that computes a traverse closure and area, but allows for curves in the polygon boundary. In the Closure 5 program, the way to signal that an entered side is a chord is to enter a negative distance. This would ordinarily result in a complex number that was perfectly valid for computation, which meant that there was no simple way to signal the entry of a chord. The V program (Utility 3) was modified to check if the distance was negative, and if so, to set Flag 3, take the absolute value of the distance, and then proceed as before. The Closure 5 program checks if Flag 3 is set when the W sub-program returns, and processes the line based on the state of Flag 3.

## Notes

(1) A program that allows the user to enter a vector as two separate components, azimuth and distance, with the azimuth in D.MMSS (HP format), and have it converted to a complex number, with the azimuth component in decimal degrees. If the distance entered is negative, the value is made positive and Flag 3 is set to indicate the negative distance.

(2) Calculator should be set in DEGREES mode. Press MODE, then 1.

(3) Because the calculator uses data entry into the A and D storage registers to allow simple prompting, there is the potential of this program deleting any data already in those storage registers. This could be a problem if this program was called as a sub-routine from within another program. To avoid this problem, the program copies the contents of storage register A to storage register 10, and the contents of storage register D to storage register 11. At the conclusion of the program, the values are copied back into storage registers A and D.

(4) Because the program replaces everything that was on the stack before it ran, the stack is cleared of all data before the result of the calculation is returned to the stack.

(5) While copying back the contents of registers 10 and 11, the program stores the result of the calculation in storage register 12.

(6) If using a program that requires storage registers 10, 11 and 12, change the value of 10 in lines W002 and W033 to a suitable number, so that the set of three storage registers selected aren't used elsewhere.

## Operation

Press XEQ W ENTER.

The calculator prompts with A? to enter the azimuth in degrees, minutes and seconds (HP notation). Key in the azimuth and press R/S.

The calculator prompts with D? to enter the distance. Key in the distance and press R/S.

The calculator displays the complex number representing the vector in the X register, or line 2 of the display. The remainder of the stack is zeros.

## Examples

1. 63° 15' 47" and 105.528 will give a complex number of 105.5280 θ 63.2631 in polar mode (with FIX 4 set for the display), or 47.4765 **i** 94.2451 in rectangular mode.

2. 128° 15' 47" and 105.528 will give a complex number of 105.5280 θ 128.2631, or –65.3506 **i** 82.8580.

3. 237° 15' 47" and 105.528 will give a complex number of 105.5280 θ –122.7369, or –57.0677 **i** –88.7662.

4. 333° 15' 47" and 105.528 will give a complex number of 105.5280 θ –26.7369, or 94.2451 **i** –47.4765.

5. 397° 15' 47" and 105.528 will produce 105.5280 θ 37.2631, or 83.9859 **i** 63.8946.

6. 63° 15' 47" and –105.528 will give a complex number of 105.5280 θ 63.2631 in polar mode, or 47.4765 **i** 94.2451 in rectangular mode. This is not what would be expected in normal mathematical work, but a consequence of always taking the distance to be positive.

7. 128° 15' 47" and –105.528 will give a complex number of 105.5280 θ 128.2631, or –63.3506 **i** 82.8580. Again, not standard mathematically.

### Storage Registers Used

| | |
|---|---|
| **A** | Stores the azimuth value, initially in D.MMSS, then in decimal degrees. |
| **D** | Stores the distance value. |
| **I** | Used to store the value for indirect addressing of registers 10, 11 and 12. |
| 10 | Temporary storage for the contents of storage register A while the program runs. |
| 11 | Temporary storage for the contents of storage register D while the program runs. |
| 12 | Temporary storage for the answer while copying back A and D. |

### Labels Used

Label **W** Length = 146 Checksum = A1A3

Use the length (LN=) and Checksum (CK=) values to check if program was entered correctly. Use the sample computation to check proper operation after entry.