HP42S Alignment & Offsets
TECHNICAL ASSISTANCE

The program material, instructions and procedures contained in this book assume that the user has a working knowledge of both surveying and the general operation of the HP-42S calculator.

Technical assistance is limited to verification of the results shown in the various examples used in the book.

If you have any questions or suggestions regarding this book or other D'Zign publications, please feel free to call us. The number is (818) 507-7408, and someone is available to answer technical questions from 3:00 A.M. to 5:30 A.M. and from 4:30 P.M. to 6:30 P.M. (Pacific time), as a service to users from other time zones.

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The programs included in this booklet are designed to take full advantage of the power of the Hewlett-Packard HP42S calculator. Programming this calculator is really simple, but a bit confusing at first. We will try to walk you through some of the 'harder to find' steps as we proceed.

the operations index

To find a function for the first time, HP has provided an "Operations Index" on pages 310 through 335 of the instruction manual, which tells you exactly what keystrokes to use to type in the function you want.

Even better, this index gives you the page number that you can refer to if you want to know more about the function you are using. If, while typing in a program, you aren't sure how to input a particular function, simply refer to the Operations Index.

Another handy tool is the function catalog. When you stroke the shifted + key, a menu appears in the lower portion of the display. The leftmost key will take you into the function catalog, which contains ALL of the functions. Scroll up or down through the list until you come to the function you want, stroke the corresponding key, and the function is entered as a program step.

the programs

The programs included in this booklet have been separated into accessible sub-programs to allow them to be used with other programs at a later date. For instance, if you are using the HP42S Spiral Curves booklet, you will find that a number of the subroutines you need for this program are already in the calculator.

A number of the subroutines will already have been input if you are using programs from the book, "HP42S Surveying Solutions". If a program or subroutine has the same NAME as one you already have (from any D'Zign publication) it is the same as the one in this book.

If this is your first try at programming the 42, we recommend that you read Chapter 8 of the manual before beginning.

D'Zign
subroutines

Because of the way the calculator works, we will start by input of some subroutines.

Once the subroutine has been input, its name appears in the menu when you stroke , and all you have to do is add it as a step in the program you are typing in is stroke GTO or XEQ followed by keystroking the key corresponding to the subroutine to input the program step GTO XXX or XEQ XXX.

getting started

Begin by stroking the shift key, then the XEQ key. The display will show a menu which will be blank (if you haven't yet input any programs) except for .END. on the left. The keys just below each of the menu portions will correspond to the menu instruction above it. Stroke the key just below the .END. in the display.

Next, go into program mode by stroking the shifted key, and you should have a display similar to the one shown to the left. Begin typing in the program "YN".

quick tip

Program steps 03 and 05 use a function which stores the prompt to the menu, and at the same time assigns the key.

To access the function, stroke PGM.FCN KEI.
You'll receive a prompt, **KEY_**. Stroke the key number (we'll use 1 as the example), and you will get a prompt, **KEY 1 GTO__**.

In this case (step 03) answer 01 to complete the program step.

**next subroutine**

This one has 2 steps you'll want to review before you begin input:

02 \( \Sigma \text{REG} \) 00

To access this function, go to the "stat" menu (shifted divide key), and scroll down once. It's the second key from the right, and when you stroke it you will be prompted for the 00 to complete the program step.

03 \( \text{CL\Sigma} \)

This one is the leftmost key when you bring up the menu by stroking \( \text{R/S} \) key, then the key that corresponds to the menu listing "YN", the program just input.

To begin input, stroke the **shifted R/S** key, then the key that corresponds to the menu listing "YN", the program just input.

Scroll upward once with the key to put the pointer at step 00, and begin typing in the program steps shown to the right.

When you've finished stroke **EXIT** to leave program mode.

The step, **CF IND ST X**, (in the next group) is input through the FLAGS menu. To get to "IND", stroke the key, then stroke it again to bring up the menu containing "ST X".

Go back into program mode (\( \text{R/S} \)). The program pointer should still be at step **08 RTN**. Type in the additional steps shown on the next page.
We're going to add one more step, END. Input this step by stroking ENTER, type in END, and then stroke ENTER again.

Input of the END step has separated this program from the program YN. This general method of input will be used for almost all of the programs, starting at the 'top' of one program and then separating the two programs with an END as the last step of the new program. Using this method, we can put the programs in the menu where we want them.

back to work

This next one is the driver program for coordinate storage. start the input by going to CL, and scroll up to put the pointer at 00.

The programs OUT and IN are used as subroutines by other programs, but PIN (Point IN) and POUT (Point OUT) may also be used from the menu for storing and recalling coordinates. To store a pair of coordinates by point number with PIN, input the point number and execute PIN. The program will prompt you for the north coordinate. Input it and stroke the R/S key, which will bring up a prompt for the east coordinate. Input it and stroke R/S. The coordinate pair is stored under the point number you used.

To recall the coordinates, input the point number and execute POUT. The northing will be in the y-register and the easting in the x-register.
Another one to look at; the + symbol is "append", which adds to what is already in the alpha register.

The symbol, \( E \), is "line feed", and we use it to control the display. You can input it by stroking

\[ \text{ALPHA} \uparrow \text{PUNC} \uparrow \text{PUNC} \]

This short subroutine can just be added to the end of the programs just input. It's the one that does the prompting when you use "IN".

When you type in the END (last step) it becomes separated from the other programs.

You should have the hang of it now, so go to the top of "YN", and type in a long one:

```
01 LBL "C+" 42 - 02 CF 29 43 "N" 03 FIX 00 44 X 04 ABS 45 "N" 05 ST 18 46 FC? 10 06 XEQ 47 IP 07 CLX 48 XEQ 01 08 PROMPT 09 CLA 10 RCL 11 "ST Z" 12 LBL 13 "N-" 14 XEQ 15 01 16 "IND ST X" 17 LBL 18 "N-" 19 RCl 20 "ST Y" 21 ADV 22 RCL 23 "W" 24 LBL 05 25 RTN 26 "L" 27 RCL 28 XEQ 29 "L+" 30 RTN 31 RCL 32 "L-" 33 LBL "DMS" 34 RCL 35 "MS" 36 "ST X" 37 CLA 38 XEQ 39 "ST X" 40 XEQ 41 "ST Y" 42 - 43 FS?C 44 15 45 "N=2" 46 "N=" 47 XEQ 48 IND ST X 49 RTN 50 XEQ 51 "ST X" 52 RTN 53 XEQ 54 "ST Y" 55 RTN 56 XEQ 57 "ST X" 58 RTN 59 XEQ 60 "ST Y" 61 RTN 62 XEQ 63 "ST X" 64 RTN 65 XEQ 66 "ST Y" 67 RTN 68 XEQ 69 "ST X" 70 RTN 71 XEQ 72 "ST Y" 73 RTN 74 XEQ 75 "ST X" 76 RTN 77 XEQ 78 "ST Y" 79 RTN 80 XEQ 81 "ST X" 82 XEQ "DMS" 83 +/-
```

37 \( \text{L"E "N =?"} \)
The first program in the last group handles the **display** of the coordinates. The second does the **display** of angles.

### Stationing Output

The next program is shorter, and may be used independently as a subroutine for layout programs you may want to write yourself.

Step 05 **1E2**, is input by stroking the key, **E**, (third row down, second from the right), then the number.

Nothing will happen until you input the next step, usually 'times' or 'divide'.

This one can go above the last one. Go to "STA", up to 00, and begin.

<table>
<thead>
<tr>
<th>LBL</th>
<th>Code</th>
<th>Function</th>
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<tbody>
<tr>
<td>01</td>
<td>16</td>
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<td>RT RT</td>
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<tr>
<td>03</td>
<td>30</td>
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<td>W RT.</td>
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<td>06</td>
<td>29</td>
<td>KEY 2 GTO 01</td>
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<tr>
<td>07</td>
<td>30</td>
<td>&quot;AZIM&quot;</td>
</tr>
<tr>
<td>08</td>
<td>31</td>
<td>KEY 5 GTO 00</td>
</tr>
<tr>
<td>09</td>
<td>33</td>
<td>Menu</td>
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<td>10</td>
<td>33</td>
<td>SELECT OUTPUT</td>
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<tr>
<td>11</td>
<td>34</td>
<td>LBL 02</td>
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<tr>
<td>12</td>
<td>35</td>
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<td>36</td>
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<td>37</td>
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<td>44</td>
<td>KEY 2 GTO 03</td>
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<tr>
<td>23</td>
<td>46</td>
<td>KEY 4 GTO 04</td>
</tr>
</tbody>
</table>

Keep right on going, put this next one on top of the last one. We are almost finished with subroutines.
Go to "YN", and scroll up past the label, to put the pointer at the first step above the END.

Type in LBL "ALIGN" and scroll up once. Stroke ENTER and type in END, then stroke ENTER again to separate the programs. Begin typing in the program, starting with step 02.

```
01 LBL "ALIGN"
02 XEQ "CL"
03 XEQ "FC0"
04 FS? 55
05 SF 08
06 SF 81
07 CLST
08 STO "A"
09 LBL 04
10 CLMENU
11 "COORD"
12 KEY 1 GTO 01
13 "SPRAY"
14 KEY 3 GTO 03
15 "GRID"
16 KEY 5 GTO 05
17 MENU
18 CF 21
19 "SELECT OPTIONS"
20 AVIEW
21 SF 21
22 STOP
23 GTO 02
24 LBL 01
25 SF 02
26 STOP
27 GTO 02
28 LBL 03
```

Put this next one on top of the program "STA".

```
01 LBL "LC1"
02 RCL- "E"
03 X><Y
04 RCL- "N"
05 >POL
06 FIX 02
07 "H. Dist. = 21 FS? 20
08 ARL ST X
09 -`
10 R+ 24 AVIEW
11 FS? 20
12 XEQ 00
13 0 27 LBL 00
14 X><Y
```

At this point you're probably wondering if it will ever end. The next program is the last of the subroutines.
Proof-read everything. While you are doing the proof-reading look, in particular, for any steps or parts of steps which are in "ALPHA", but shouldn't be. It works the other way, too. Check that the steps which are meant to be in alpha are.

use it to check it

Some of the subroutines can be checked by using them. You can test "PIN" and "POUT" this way. Try storing a point with "PIN" (see page 5), clear the stack, put the point number back in and execute "POUT". This should bring the coordinates back into the registers.

At this point, check "C+" by just executing it. You should now have the same coordinates in the registers, but they should be labeled with the point number and the "N= " and "E= ", as shown to the left.

Programs "IN" and "OUT" can also be checked by execution. Put a different set of coordinates into the registers (northing , easting) and execute "IN". Clear the stack and execute "OUT". If the same new coordinates are back in the registers, the routine works.

Input 12.34567, clear the ALPHA register (CLA) and execute "DMS", then stroke ENTER. The alpha display should show 12°34'56.7".

Stroke , and execute "B+A". The display should show AZ = 12°34'56.7". If it does, it's okay. Stroke , and execute "A+B". Now the display should show N 12°34'56.7" E.

Programs "IN" and "OUT" can also be checked by execution. Put a different set of coordinates into the registers (northing , easting) and execute "IN". Clear the stack and execute "OUT". If the same new coordinates are back in the registers, the routine works.

Input 12.34567, clear the ALPHA register (CLA) and execute "DMS", then stroke ENTER. The alpha display should show 12°34'56.7".

Stroke , and execute "B+A". The display should show AZ = 12°34'56.7". If it does, it's okay. Stroke , and execute "A+B". Now the display should show N 12°34'56.7" E.
Try those last two routines using all four quadrants, one at a time, so that the subroutines are all checked too.

Input the number, 1234.567, clear the ALPHA register, and execute "STA". Next, stroke ENTER to see the alpha register. It should show 12+34.567 now. If it doesn't, something is wrong (it can also be seen by using "AVIEW").

the main program

This one can go on top of "YN", too. Scroll up to 00, and begin typing it in. It is a long one, so take your time.
Add in the last step, 376 END, and it's done. Now it has to be proof-read and it'll be ready to go to work for you.

One quick check on this last program, it should contain 852 bytes. Keep in mind something that surveyors run into all of the time, though. Compensating error.

Speaking of bytes, the programming you have just entered (if you entered the whole book) contains 2182 bytes. There are a number of the programs and/or subroutines that are duplicates of some you may have already had installed from other of our publications.

Appendix 'A' lists and compares these with those used in other program books and booklets we have currently on the market.

**sizing**

With all of your programs in, size for maximum coordinate storage as follows:

1. Size to **0025**

2. Check the available memory (hold down the key under **MEM**, in CATALOG), and jot down the number. Divide by 9, and add 23 to this new number.

3. Re-size to the number you just calculated.

4. To calculate the number of points you can store, divide the number you jotted down by 18, subtract 1.
user's instructions

Bring up the program by stroking

prompt: SELECT OPTIONS

If you want to input a grid-to-ground factor, stroke

If you want coordinates calculated and output stroke

If you are calculating angle-distance ties for layout, stroke

If you are planning to use the grid factor, it should be the first option selected. After you have selected the option(s) you want, stroke

Different prompts will appear, depending on the options you have selected. Prompts when Grid has been selected are marked (G), prompts which appear when Coord has been selected are marked (C) and prompts which appear when Output is selected are marked (L).

(G) prompt: Grid Ground Factor?

Input the factor and stroke

(c) prompt: First Pt. # for Coord. Storage?

Input the point number you want to start with for the calculated coordinates. Stroke

(l) prompt: SELECT OUTPUT
For angle right output of the angles stroke

For azimuth output of the angles stroke

(L)prompt: Instrument at?

Input the point number of the instrument station and stroke

If was selected, the following two prompts will also appear:

prompt: N =?

Input the north coordinate, stroke R/S

prompt: E =?

Input the east coordinate for the point and stroke R/S

(L)prompt: Backsight?

This prompt only appears if angle right output was chosen. Input the point number for the backsight point, stroking either NEW or NEW. If "NEW" was chosen, input the coordinates of the point in the same manner as described above.

(L)(C)prompt: Known Station Pt.#?

Input the point number which will correspond to the beginning station you are going to use. If it is a new pair of coordinates, again follow the input instructions above.
(L)(C) prompt: **Station?**

Input the beginning station and stroke **R/S**

(LoC) prompt: **Tangent Bearing?**

Input the bearing of the tangent and stroke **ENTER**

Input the quadrant code, in the up-station direction, and stroke **R/S**

prompt: **XX+XX.XXX**

At this point you may begin your calculations, using the menu for input.

**INPUT OFFSET**

**INPUT STATION**

No constant selected → **BEGIN CURVE**

both constants selected → **CLEAR CONSTANT**

**using constants**

When you input a constant and stroke **SET** a prompt, "**Station Interval?**" appears. If it is a station interval, stroke **E** , and the indicator block will show **E** . Answer the prompt **XX** if the constant is an offset, and the indicator block will show **XX**.

If both a station interval and an offset constant are stored, the indicator block will show **SET**.

Constants are cleared in the same way by stroking the **CLEAR** key.
Note: When a station interval constant is requested, an additional prompt, **Next B.C.?**, appears. This is to prevent overrun of the station.

**prompt: Next B.C.?**

If there is a curve in the alignment ahead, input the B.C. station and stroke \( R/S \)

or

If there is no curve in the alignment ahead, input a station that is past the end of the work area, stroke \( R/S \)

**using curves**

Curved portions of the alignment can be included in the calculations, with or without offsets. If offsets are calculated, they are calculated as **radial** offsets to the current station.

Input the B.C. station and stroke \( R/S \)

When the B.C. station is displayed, calculate any needed offsets, and then stroke \( R/S \)

**prompt: Central Angle?**

Input the value (°."') of the central angle. If the curve is to the left, stroke the \( \leftarrow \) key. Stroke \( R/S \)

**prompt: Radius?**

Input the radius of the curve, stroke \( R/S \)

The output will be the central angle, the radius and the length of the curve.

If a station which is upstation of the end of the curve is input, the station at the E.C. will be displayed instead.
Intentionally inputting a station which is too large is the correct procedure! It's faster than input of the longer station, with decimal feet included, and it also uses the (more accurate) calculated length, rather than the rounded off value.

station and offset

The prompt bar will be displayed with the beginning station above it, as shown on page 14.

If you want to calculate offsets at this station, input the offset, stroke

If you do not want offsets at this station, input the station you want and then stroke then

If you want the default offset, stroke

If you want a different offset, input the offset and then stroke

The output will depend on which options you have selected. After each output, the previous station is again displayed.

If you want an additional offset at this station, input the offset and then stroke or

If a station interval constant is set stroke to bring up the next station.

or

Input the next station and stroke

The station is only output with the first offset. The other calculations at the same station will be labeled "@ XX' Rt" or "@ XX' Lt".
The keystroke example will use the alignment illustrated below. The location of the manholes to be installed in the street are offsets from points on the centerline of the street.

Working from the existing traverse, with the instrument at point #1, the example uses point #2 as a backsight.

If we assume that none of the coordinates are in storage, we can use #3 for the number at 10+00, and #4 as our first number for calculations.

**keystrokes**

To begin, call up the program and get the first prompt by stroking \( XEQ \)
SELECT OPTIONS

**First Pt# for Coord. Storage?**

keystrokes:

```
SELECT OUTPUT

**Instrument at?**

keystrokes:

```

**N =?**

keystrokes:

```

**E =?**

keystrokes:

```

**Backsight?**

keystrokes:

```

**N =?**

keystrokes:

```

**Known Station Pt.#?**

keystrokes:

```

**N =?**

keystrokes:

```

**E =?**

keystrokes:

```

**N =?**

output:

```

**Tangent Bearing?**

keystrokes:

```

**display:**

```

```
display: 10+05.000
keystrokes:

output: 10+05.000 R 10.00 Rt
#5 N = 998.3530
E = 1011.08584
Δ Rt = 346°20'58.9"
H. Dist = 371.78

output: 

Central Angle?
keystrokes:

Radius?
keystrokes:

output: 

display: 12+00.000
keystrokes:

output: 

display: 13+36.936
keystrokes:

output: 

Central Angle =

Radius = 500.0000
Length = 150.6074

display: 14+22.436
keystrokes:

display: 15+73.043
keystrokes:
The example used both coordinate output and layout (SPRAY) options, but could have used either one by itself. Or GRID. Using two options gives you an idea of what the output should look like for each.

When you use the program with coordinate option, the points are stored. This means that the actual lengths between the manholes can be found by inversing. With this in mind, the program is also handy for design work on storm and sanitary sewers.

It can also be used to set R/W points along the property lines of subdivisions during either the design or layout phases.

For rough grade staking, the limits of a street may be set without setting centerline first, and just sprayed in. A much faster method than setting the centerline and then occupying the curve points to offset them.
### APPENDIX 'A'

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<th>Spiral Solutions</th>
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<th>EDM Slope Staking</th>
<th>Triangle Solutions</th>
<th>Surveying Solutions</th>
<th>bytes</th>
<th>program name</th>
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This is a free newsletter, primarily for surveyors who have HP42S calculators. Each issue contains the latest news concerning the field and office programming, any glitches which may have shown up, and tips for modification of the programs (usually suggested by the users themselves).

This is the only way we know of to establish communication between the surveyors using this calculator. If you purchased this book directly from D'Zign you are already on the mailing list . . . if you got it from one of our distributors, you may not be.

Take a minute to send us a postcard, say "42" on it somewhere, and we'll send you the newsletters as they are published.

D'Zign land survey & development
P.O. Box 11570, Glendale, CA 91226
MORE HP42S PROGRAMS

Vertical Curves (booklet, $8.00)

Calculates CONTINUOUS vertical alignment without changing back and forth between Grade and Curve routines. Also calculates vertical intersections, symmetrical or asymmetrical vertical curves. Solves for station when the elevation is known, or the station can be given, to calculate the elevation.

Spiral Curves (booklet, $9.50)

Calculate the coordinates to any station, or offset to a station, within a spiral system. Options include coordinate output, auto-inverse, or both.

Calculates intersections of the entrance or exit spiral with a circular curve or straight line.

Triangle Solutions (booklet, $8.00)

The 42S version of the most complete triangle solutions program ever available. Solves with any of the following knowns: ASA SAA SAS SSA SSS Area-SS Area-AA Area-SA.

Topography (booklet, $8.00)

This one turns your 42S into a manual data collector, complete with a labeling system that you can customize to suit the type of topo work you do.

All shots are stored as finished data, by shot number, for later output. Choice of 3-D coordinates or Station-Offset-Elevation for the output.

EDM Slope Staking (booklet, $8.00)

Set up anywhere near an alignment and slope stake it. Sets slope stakes from the remote instrument location directly. Includes a three-point resection program for finding the instrument's location. All data needed to mark the stake is output (or may be stored), and there is a subroutine for setting the reference stake.

Urban Survey Programs (book, $20.00)

Contains programs for stakeout (or design) of street intersections, returns, culs-de-sac, bulbs and knuckles. A special program calculates and prorates blocks from the street intersections (with auto-store and auto-inverse of the points) from the street intersection setups for A.L.T.A. surveys.

Also contains layout programs for curb and gutter, or storm/sanitary sewers, which can store the data and later print out cut sheets before leaving the job site.