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USER'S GUIDE FOR PASSIVE TARGET ACQUISITION PROGRAM TWO (PTAP-2--ETC(U)
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By

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A compilation of user information is offered for the software package "Passive Target Acquisition Program 2." Included are microcomputer specifications, general operating instructions, descriptions of special options, operating hints, and a complete listing of all programs. Examples are given to cover all phases of program operation, and contents are arranged to provide a continuous progression through the entire program set.

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CONTENTS

GENERAL INFORMATION

The software package for the Passive Target Acquisition Program 2 (PTAP-2) is specifically constructed for the Hewlett-Packard (HP) 9825A microcomputer with 24000 byte extended memory. Required also are three read only memory inserts (ROM). These ROM are:

1. 9872 plotter - general I/O - extended I/O

2. Matrix

3. String variable - advanced programming

Eight separate programs with adjuncts are stored sequentially in 32 files. The basic program set occurs on track zero, while a redundant set is stored on track one to serve as a protection against time loss due to tape failure, or to extend operating capability to two different sensor configurations. In sequential order, the files contain:

File No.	File Content
0	Index file
1	Blank file
2	Sound ranging program file
3	Sound ranging special function key storage
4	Effective wind and temperature for sound ranging
5	Sound ranging microphone coordinate storage
6	Number of sound ranging targets stored
7	Sound ranging target storage
8	Sound on sound adjustment program
9	Special function key storage for sound on sound
10	Effective wind and temperature for sound on sound
11	Sound on sound microphone coordinate storage
12	Visual meteorology program
13	Special function key storage for visual met
14	Flash ranging program
15	Flash ranging special function key storage
16	Flash ranging observation post (OP) coordinate storage
17	Flash ranging target number
18	Flash ranging target storage
19	Flash adjustment program
20	Flash adjustment special function key storage
21	Flash adjustment OP coordinate storage
22	Laser rangefinder program
23	Laser rangefinder special function key storage
24	Laser rangefinder OP coordinate storage
25	Laser rangefinder target number
26	Laser rangefinder target storage
27	Laser rangefinder adjustment program
28	Laser rangefinder adjustment special function key storage
29	Laser rangefinder adjustment OP coordinate storage

File No.	File Content
30	Laser rangefinder trilateration program
31	Laser rangefinder trilateration special function key storage

Redundancies in file structure such as files 3 and 9, 4 and 10, and 15 and 20 are employed to lessen tape wear and transport time and hence to reduce the possibility of tape failure.

Eight basic programs are available in PTAP-2; these are, in order of occurrence on file:

File No.	Program No.	Program
2	1	Sound ranging
8	2	Sound on sound adjustment
12	3	Visual meteorology
14	4	Flash ranging
19	5	Flash adjustment
22	6	Laser rangefinder
27	7	Laser rangefinder adjustment
30	8	Laser rangefinder trilateration

The functions of programs 1, 4, and 6 are the location and storage of targets. In these programs, coordinates and time of location are recorded for up to 100 targets. Automatic transfer to tape occurs when 10 or a multiple of 10 targets are located. If more than 100 targets are found, the 100 most recent are retained and stored. Storage also occurs automatically when a transfer is made from a location program to any other program in PTAP-2. When the PTAP-2 is in a specific location mode, all targets recorded in that mode may be reviewed via a printed list containing time of location and target coordinates. Certain essential data necessary for operation in the target mode are automatically stored on entry so that rapid conversion from location to fire adjustment and vice versa is possible. Specific details will be supplied when programs are discussed individually.

The purpose of programs 2, 5, and 7 is the adjustment of fire. In the adjustment mode, no targets are recorded, although individual printouts of target information are supplied. All adjustment programs function in two cycles. The first cycle is concerned with target location; the second cycle fixes the impact of an incoming round and supplies shift information to adjust fire onto the target. If an incoming round is found to be 100 meters or less from the target, the program calls for "fire for effect" and returns to await the next target. It might be observed that in sound and flash adjustment, no operation may be carried out unless specific survey information is available. In sound ranging, microphone coordinates are required; and in flash ranging, OP coordinates are required. The laser rangefinder adjustment program does not require that OP locations are known.

Certain "permanent" data are automatically stored on tape at the time of entry so that transfer from location to adjustment and vice versa may be made with minimum delay. Special options for this purpose will be discussed later in the general information section and in more detail in sections concerned with individual programs.

The PTAP-2 program complex has been constructed to operate at one of two levels. The first level is designed to require minimum training and degree of operator response. It is only necessary for an operator to answer a sequence of well-defined prompts and queries to maintain all essential program functions. Level two offers an enhanced version of level one performance and provides a more convenient and timely cycle of operation at a very modest increase in training level. Of primary importance in level two operation are the special function keys. Through use of this additional key block, such program enhancements as verification and editing of base parameters, rapid changes in program mode, automatic data transfer, target display, and other special features are available to the operator at the touch of a button. Discussions of program features which follow will be presented at level two. For level one performance, an operator needs to know only the loading procedure for the PTAP-2 digital cartridge and the correct manner of response to prompt/query sequences.

Before discussing loading and response techniques, we will familiarize the reader with the microcomputer console and keyboard configuration. We also suggest that the description of the HP 9825A calculator found in the calculator operation and programming manual be examined. A synopsis of console functions in the current context follows.

Across the top of the console from the operators left to right are, in order, the digital cartridge loading slot, the light emitting diode (LED) display register, and the strip printer. The LED display is the main point of communication between program and operator, and it is here that the statements, prompts, or queries which instigate program action will be found. The strip printer provides hard copy when required and is sometimes used to supply the operation with information which is too long for the LED display. At the far left of the display register, a large red LED is located. This LED indicates program operation; and when the LED is glowing, no communication is possible between operator and program. Below and to the left of the digital cartridge entry slot is a yellow LED. When glowing, this LED indicates that the tape drive is in operation, for example, when information is being transferred from tape to program or vice versa.

Four groups of keys are of interest to an operator using the PTAP-2 program complex. These are the numeric keys, the alphanumeric keys, the character keys, and the special function keys. Of major interest are the numeric keys located at the right of the keyboard. The numeric keys together with the alphanumeric key (continue) constitute the basic operating set for PTAP-2. No other keys are required for level one operation.

Action is initiated in the PTAP-2 program complex by operator response to prompts or queries. A prompt is a statement appearing on the LED display register or strip printer which indicates a specific operator action. In the majority of instances, this statement will be the entry of a numerical quantity available to the operator. An example of a prompt would be "enter easting, mike 1." To enter a numeric quantity, type the number from the numeric keys, then press (continue). A query is a request in the form of a direct question and may require a decision on the part of the operator. All queries encountered in PTAP-2 may be answered in the affirmative or negative. To respond in the affirmative, the operator presses (+) then (continue), to respond in the negative, (-) then (continue). At times a query may request specific numeric quantity. For example, a query might be "how many mikes are in sound base?" The operator might respond by pressing (6), then (continue) to indicate a six-microphone sound base. In general, the entry of a quantity during program operations is accomplished by typing the quantity from the numeric keys, then pressing (continue).

When a specific numeric key is pressed, the associated number or symbol will appear at the left of the display register. At the point when the number or symbol appears on the display, but before pressing (continue), a careful check should always be made to verify that no errors are present. Once a quantity is entered by pressing (continue), no simple procedure may exist for error recovery.

Correction of typed quantities subsequent to program entry may be made at level one or level two. For a correction at level one, locate the key marked "clear" at the upper left of the numeric key block. If a quantity is in error, (clear) should be pressed, causing the keyboard entry to be deleted and a question mark to appear on the left of the display register. The operator may then type the correct entry and press (continue). The "clear" key may be used as often as necessary until the correct quantity appears on the LED display.

Now locate the block of four keys marked "character" located in the upper central keyboard. These keys are of use in level two program function. In particular, (back) and (fwd) may be used to advantage in correcting quantities appearing on the LED display subsequent to entry.

An example of the use of these keys will be given in the following simulation of a PTAP-2 operative cycle. Assure that the PTAP-2 digital cartridge has not been inserted into the machine. Switch the microcomputer to "on." A "ready" symbol will appear at the left of the LED display register. Type the number 82135.67. This number will appear on the left of the display register exactly as it would if it were the response to some query arising in PTAP-2. Suppose that subsequent to entry it is discovered that the correct response was 83135.67. Press (fwd). A flashing red cursor will appear over the number 8. Each time the (fwd) key is pressed, the flashing cursor is moved one character to the right. If (back) is pressed, the cursor is moved one character to the left. Position the cursor over the incorrect character 2 and type the correct character 3. The number which appears will now be 83135.67 with the cursor appearing over the character 1. The number is now ready for entry. Now press (clear) and again type 82135.67. Suppose that it is discovered that an error exists in the rightmost digit, the proper number being 82135.69. Press (back). The flashing cursor will now be positioned over the character 7. Again, type the correct value. The number 82135.69 will now be ready for entry.

It is clear that use of the keys (fwd) and (back) can greatly facilitate correction of program responses prior to entry and result in a reduction of time and effort. The machine may now be switched off if desired.

The special function keys are a block of 12 keys located at the upper right of the keyboard. The keys are marked f_0, f_1, ..., f_{11} and are called special function keys 0, 1, ..., 11, respectively. These keys perform a major function in level two program operation, with each of the eight programs in the PTAP-2 complex having its own set of special function key options. In all possible cases, a redundancy of operation has been practiced to reduce the amount of information an operator must commit to memory. To initiate a special function option, the operator need only press (stop) and then the desired special function key. Special function options are generally designed to be used at specific points during the operative cycle. These options will be indicated in the discussions of individual programs which follow.

For all programs, the special function key 11 (f_{11}) generates an index/transfer program which may be used to transfer to any other program option in PTAP-2. If special function option 11 is used when in location mode, all targets located at the point of transfer are stored on tape before transfer and may be recalled when operation in the given mode is resumed. In location mode, special function option 8 may always be used to provide a printout of all targets and location times to the point at which the special function option is initiated. Special function key 10 (f_{10}) may be used to transfer from location to adjustment and vice versa. When transferring from location to adjustment mode, target times and locations to the time of transfer are stored on tape. It should be noted that as far as possible special function keys have been arranged so that special function key 6 (f_6) will in a natural cycle of operation be used earliest in the program, and progress will in general proceed to higher numbered special function keys. Additional information or special function keys will occur in natural sequence in the text.

When possible, use of a special function key will result in a statement identifying the option specified, either by a remark appearing on the display or a heading on the printer. For example, if special function key 10 (f_{10}) is pressed when the program is in the location mode, the comment "ADJUSTMENT MODE INITIATED" will appear on the display. If the program is in the adjustment mode and f_{10} is utilized, the comment "LOCATION MODE INITIATED" will result. If a key is inadvertently pressed which does not represent a function in the PTAP-2 program complex, the machine will "beep" once and the comment "WRONG KEY! PRESS (continue)" will be visible on the display.

Essential to level one operation is a self-loading index/transfer program which permits access to all PTAP-2 program options. Into an appropriately configurated HP 9825A microcomputer, load a PTAP-2 digital cartridge. Observe that entry is made at the slot located at the extreme upper left of the console. In loading, be sure that the smooth black back of the cartridge is toward the operator and the cartridge is easily but firmly pressed into place.

Now switch the machine to "on." If the digital cartridge was properly loaded, the yellow LED to the bottom left of the entry port should glow briefly, indicating that the index/transfer program is being loaded. The time for loading may vary due to the status of the tape at the last shutdown. When the program is loaded, the following will appear on the strip printed:

TO CALL DESIRED
PROGRAM

ENTER PROGRAM
NUMBER

PRESS CONTINUE
1 SOUND RANGING
2 SOUND ON SOUND
3 VISUAL MET
4 FLASH RANGING
5 FLASH ADJT
6 LASER RFDR.
7 LASER RFDR. ADJUSTMENT
8 LASER RFDR. TRILATERATION

On the LED display, the prompt "enter program number" will be visible. Since the first program to be discussed will be sound ranging, the operator should enter the number 1 in response to the prompt visible on the display. If for any reason the sequence encountered when attempting the loading procedure is not exactly as described, switch the microcomputer to "off" then to "on" again. If the problem is not corrected, press (stop); then type trk 1 from the alphanumeric and numeric keys. Now press (execute) and type ldp 0. Press execute. If program loads properly, one may continue operation, but the PTAP-2 tape should be replaced at the earliest possible time. If the index still does not appear, the microcomputer should be checked for malfunction.

At this time, the sound ranging program options should be loaded, and the query "are earlier targets stored?" should be visible on the display register. The reader should now turn to section 1 of the user's guide.

SECTION 1

A DESCRIPTION WITH EXAMPLES OF THE PROGRAM OPTIONS IN PTAP-2

SOUND RANGING

When the sound ranging program is selected, either from the initial self-loading index or by cross reference from another program, the following sequence of events will take place. After a brief display of the title "SOUND RANGING," the query "are earlier targets stored?" will appear. This query refers to the program capability of recording up to 100 targets and their times of location. Recorded targets and times are stored on tape when the targets located number 10 or a multiple thereof. Under such circumstances, target loss due to involuntary shutdown will never exceed 10. Targets are not stored when located, as tape wear could be excessive. Three exits are possible from the sound ranging mode. A general index/transfer program may be called through use of special function key 11 (f_{11}), the special function key 10 may be used to shift from location to fire adjustment mode directly, or special function key 5 may be used to call the visual met program. In each case, all recorded targets are stored on tape before transfer. The query "are earlier targets stored?" enables the operator to recall all targets located and stored in prior operative cycles. An affirmative response reinstates previous targets and numbers subsequent targets sequentially from the last recorded. For example, if 57 targets were located and stored during previous operating cycles, the first target located in the present cycle would be given the number 58. A negative response, on the other hand, causes all previous targets to be ignored and gives the first target located the number 1. If more than 100 targets are recorded, the 100 most recent are kept on record. The operator should answer this query in the negative.

The query "how many mikes in sound base?" which appears next may be answered with any number from 3 to 6. For the example to be considered, a standard six-microphone sound base will be employed, so the operator would enter 6 (Press (6), [continue]). The next query, "are mike coordinates stored?" makes reference to the automatic storage of the coordinates of all microphones used in the sound base. Storage is accomplished immediately after entry and coordinates are retained until altered or new coordinates are entered. If the existing sound base was entered during a previous cycle of operation, an affirmative response would reinstate those values in the current program. As no mike coordinates have been entered, the operator should give a negative response. The prompt "enter easting, mike 1" will appear on the display, and prompts will cycle through northing, then mikes 1 through 6. Enter the following microphone coordinates.

Mike	Easting	Northing
1	57886.00	39280.00
2	59232.00	39176.00
3	60540.00	39180.00
4	61925.00	38967.00
5	63470.00	38880.00
6	64617.00	38759.00

To enter a given coordinate, first type the numerical value as a decimal fraction, then press (continue). For example, to respond to the prompt "enter easting (meters), mike 1," type 57886.0, then press (continue). The prompt "enter northing (meters), mike 1" will follow, and the cycle will continue through mike 6. When all six mikes are entered, the red LED to the left of the display will glow briefly, indicating that microphone coordinates are being stored. Storage of microphone coordinates is made both for sound ranging and sound on sound adjustment simultaneously so that, after initial entry, both programs are available for immediate execution or cross reference.

If after microphone coordinates are entered, a verification is desired* when the query "is new met message available?" appears on the display, press (stop) then special function key 6 (f_6). A printed list of microphone coordinates as currently recorded will result. Discrepancies which arise from keyboard errors or problems in original mike surveys may now be corrected. If errors are found, an affirmative response may be given to the query "are mike coordinates correct?" If no errors are encountered. a positive response will cause a return to the query "is new met message available?" In case of error, the response to "which mike has error in coord?" allows a specific microphone to be corrected. When the mike number is entered, the display will contain the prompt "enter correct easting, mike _______," followed by "enter correct northing, mike _____," where the blank will read the number of the mike identified as being in error. After the correct coordinates of the first mike are entered, the query "are other coordinates in error?" allows the option of exiting the microphone correction mode with subsequent storage of mike coordinate data or of a return to the query "which mike has error in coord?" preparatory to further corrections. When cycle is completed, the program will return to the query "is new met message available?"

As a protection against voluntary shutdown, malfunction, or loss of power, met data are stored upon entry and retained until a new met message is entered. When the query "is new met message available?" appears, the met currently in the machine may be viewed by use of special function key 7 (f_7). Recall that initiation of a special function option is accomplished by pressing (stop), then the desired special function key. When special function key 7 is used, a listing of effective windspeed and wind direction and effective temperature as currently recorded in the machine will appear as a printout. If met is correct, a negative response will lead to the query "is brk time available, mike 1?" On the other hand, if the response is affirmative, the prompt "enter effective temp (C)" will appear. For our example, a temperature of 26.4°C should be entered. For subsequent queries, the values 3 knots and 3020 mils should be used for effective windspeed and wind direction, respectively. The query "is brk time available, mike 1?" then appears, and machine is ready to accept break times. At this point, if desired, a verification of met data entered above may be performed via special function key 7.

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*Such a verification is recommended as a routine measure and should be accomplished each time a new coordinate set is entered.

It may occur that break times are not available for all microphones because of the difficulty in reading strip charts or because of microphone malfunctions. This contingency is dealt with through the query "is brk time available, mike ____?" where the blank indicates an integer which will range sequentially from 1 to the specified number of microphones. If no data are available for a given microphone, a negative response causes that mike to be ignored. If data are available for less than three microphones only, an error message will appear on the display, and the run will be ignored. The machine will then return to the query "is met message available, mike 1?" in preparation for the next target.

The data entry phase for sound ranging starts with the query "is break time available, mike 1?" As an example of level one data entry, consider the following break times.

Mike	Break Time
1	1.190
2	*
3	.719
4	1.419
5	3.550
6	5.476

Answer the query "is break time available, mike 1?" in the affirmative. The program will respond with the prompt "enter break time, mike 1." Enter 1.190. When the value is entered, the number will appear on the printer. Answer the query "is break time available, mike 2?" in the negative. A single asterisk will appear on the printer indicating omitted data and the query/prompt cycle will continue. Enter the remaining data. When the break time from microphone 6 is correctly entered, the query "are break times correct?" will appear on the display. Examine the data listed on the printer. If all data are correct, answer the query in the affirmative. After a brief computational cycle, the following listing is obtained

SOUND	RANGING
TARGET	1
easting	59362.9
northing	33538.6
spread	153.5

The time of location is specified by answering the prompt "enter day, time of day ex 061350." The example 061350 would indicate the sixth day of the month at 1350 hours for the target location time. Answer this prompt in an appropriate fashion. The time will be added to the output given above.

The query "is new met message available?" now permits an update of met data. Answer in the negative. The program is now at the data entry stage for target 2. Level two data entry will now be considered, together with the data edit mode. When the query "is break time available, mike 1?" appears, instead of answering the query, type 1.190; then press "continue." The break time will be entered and the entry listed as before; and the query "is break time available, mike 2?" will appear on the display. Answer the queries in the negative for mikes 2, 3, and 4. For mike 5, enter 3.550 and for mike 6, 5.476.

The listing on the printer should read:

```
1.190
  *
  *
  *
3.550
5.476
```

Answer the query "are break times correct?" in the negative. On the printer, the heading "BREAK TIME EDIT" will appear; and on the display "which mike has break time error?" will appear. Respond with 3. Following will be the prompt "enter correct break time, mike 3." Enter .719. On the printer should appear:

```
BREAK TIME EDIT

MIKE          3
          0.719
```

Answer the query "is another break time in error?" in the affirmative, and enter mike 4 as 1.419. Now answer the query "is another break time in error?" in the negative. After a brief cycle of operation, a listing should appear exactly similar to the last, but for target 2. The number listed as the spread is the radius of the smallest circle containing all internally generated target location estimates. The printed target is the median of these values.

The level two data entry procedure together with the edit mode provides a considerable enhancement of operation over level one performance. In general the advantage considerably outweighs the modest training effort required for correct utilization. However, level one performance is entirely adequate for basic program functions.

When computation of the target location is complete and the appropriate printout is provided, the display will read "enter day, time of day, ex 060945." This prompt provides a means for recording the day and time of day the target was located. For example, if the location took place at 2400 hours on the 6th of the month, the operator would enter 062400. Entry of this quantity completes the current cycle of operation.

When the machine is at the beginning of the data entry cycle and the display reads "is new met message available?" it is possible to exhibit the last 100 located targets in a printout. The list will contain time of target location, target easting, and target northing. To initiate the listing, press (stop) then special function key 8 (f_8). If less than 10 targets have been located, all targets will be listed with the display "ALL TARGETS LISTED!!!" appearing briefly before return to the beginning of the data entry phase. If more than 10 targets have been located, the list will proceed at demand in 10-target blocks until all are located. If more than 100 targets are found, the list will retain the 100 most current. At the 100th target, a brief message to this effect will appear.

If a change in mode of operation is desired, press (stop), then special function key 11 (f_{11}). This action causes all targets to be stored together with their times of location. An index of programs in PTAP-2 then appears on the printer, with the display reading "enter program number." At this time, any program in PTAP may be selected. This time is also a convenient time for shutdown. Special function key 10 may be used if it is desired to switch to sound on sound adjustment directly. When (f_{10}) is pressed, all target locations and location times are automatically stored. In sound on sound adjustment mode, (f_{10}) may be used to return to sound ranging.

THE BREAK TIME ASSISTANCE OPTION

The break time assistance option is a subprogram whose function is to assist in the reading of break times from a strip chart with poorly defined breaks or one which is complicated by multiple arrivals. To call this option, the program should be at the point of break time entry, that is, at the point at which the display reads "is brk time available, mike 1?" (Entrance may be made at the point at which the display reads "is new met message available?" But return will always be to the query "is brk time available, mike 1?") It will be assumed that the met message in the machine is current. Press (stop), then special function key 9 (f_9). The heading "BREAK TIME READING ASSISTANCE" will appear briefly, followed by the query "use coordinates of last target?" The purpose of this query is as follows. Suppose that a set of at least three break times may be identified from a strip chart complicated by multiple arrivals or with low intelligibility. Consider the example previously described. Suppose that mikes 1, 3, and 6 have reasonable traces and times 1.190, .719, and 5.476 may be read; but difficulty is encountered on traces for mikes 2, 4, and 5. Mikes 1, 3, and 6 are entered. The resulting target is easting 59363.3, northing 33522.8, with zero spread due to the fact that only three microphones were used to obtain the target location. When the display reads "is brk time available, mike 1?" press "stop," then (f_9) to initiate the break time reading assistance program. When the query "use coordinates of last target?" appears, respond in the affirmative. The answer to the query "which mike has sharpest break?" would in general be dictated by circumstances. In this case assume that mike 1 produces a clear sharp break. After response, the query "enter break time, mike 1?" would be answered by entering 1.190. At this point, a listing of calculated break times will occur, with mike 1 as 1.190, mike 2 as .362, mike 3 as .721, mike 4 as 1.413, mike 5 as 3.530, and mike 6 as 5.456.

The difference between arrival times as predicted by the program and given earlier are as follows:

(microseconds)

Mike 1	0
Mike 2	21
Mike 3	2
Mike 4	6
Mike 5	20
Mike 6	20

The break times predicted by the assistance program are sufficient to indicate where actual arrival times may be found.

A second use may occur as follows. Suppose that a strip chart occurs with sufficient multiple arrivals to make direct deciphering impractical. However, intelligence indicates that a target might be at some known point, or it is desired to determine if a target might be at some specified point. In any case, a break time or times is chosen as a basis, then the break time assistance program is called. In this case, the query "use coordinates of last target?" would be answered in the negative. A prompt then requests the easting and northing of an estimated target. Choose 59000, 33000 as an example. Assume that mike 1 was chosen for reference with break time 1.190. Predicted arrival times are:

Mike 1	1.190
Mike 2	.625
Mike 3	1.171
Mike 4	1.973
Mike 5	4.111
Mike 6	6.012

If the arrival times as earlier indicated are considered, differences between recorded and predicted values are:

(milliseconds)

Mike 1	0
Mike 2	242
Mike 3	452
Mike 4	0
Mike 5	561
Mike 6	536

In this situation the departure is at most about a half second, so that correct break time choice could probably be made except in cases of a high density of multiple arrivals. Upon completion of procedure, return is made to the point of awaiting new break times, and the display will read "is brk time available, mike 1?"

An additional special function key option for sound ranging and sound on sound adjustment has been added. Special function key 5 may now be used in either program to institute the visual met program. If special function key 5 is used, targets and location times are stored before transfer when appropriate. At this time, press (stop), then special function key 10 to initiate the sound on sound adjustment program.

SOUND ON SOUND ADJUSTMENT

If the sound on sound adjustment program is selected, either from the initial index program or from a cross reference, the following sequence of events may be expected. After a brief display of the program title, the query "how many mikes in sound base?" will appear. Like sound ranging, the sound on sound adjustment program will accept from three to six microphones. The example to be considered will employ six.

The next query to appear will be "are mike coordinates stored?" It might be noted that, if the example was completed in the sound ranging program description, microphone position coordinates have already been stored so that an affirmative response will reinstate these values. When coordinates are loaded, that is when the red LED to the left of the display is extinguished and the query "is new met message available?" appears, one may verify microphone coordinates by use of special function key 6 (f_6). If incorrect coordinates are encountered, corrections may be made through the editing program which is automatically initiated. If no discrepancies are found, a positive response to "are mike coordinates correct?" returns the program to the mainstream at the query "is new met message available?"

To verify if proper met is contained in the machine, special function key 7 (f_7) may be used. On pressing (stop), (f_7), a listing will be printed of effective wind and temperature values. Return is to the point of entry, so that the query "is new met message available?" will again appear on the display.

If the exercise offered in the discussion of sound ranging has been completed, correct met data will appear on the listing. If met is stored, a negative response is indicated; if not, give an affirmative response and enter appropriate data (26.4°C for effective temperature, 3 knots for effective windspeed, 3020 miles for effective wind direction).

A negative response to the query "is new met message available?" or entry of appropriate met data will be followed by the query "READY FOR TARGET DATA?" This expression will remain on display until the continue key is pressed. It is suggested that in light of the two-cycle nature of adjustment programs, the continue key should not be pressed until target data are ready for entry. If a new met message should be available during such a waiting period, new met data may be entered by pressing special function key 7 (f_7). Entry of new met data will lead again to the identical point in the program. Now assume that the data

Mike	Break Time
1	1.190
2	.383
3	.719
4	1.419
5	3.550
6	5.476

are available for the target. Press (continue) and enter data in exactly the same fashion as break times were entered in the sound ranging program. The following printout should result:

SOUND	RANGING
TARGET	
easting	59357.1
northing	33506.6
spread	290.6

(For a definition of spread, see description of the sound ranging program.)

Determination of the target leads to entry of the adjustment cycle. The display "READY FOR ADJUSTMENT DATA?" will remain on display until the continue key is pressed. It will be of advantage to leave the display visible and press (continue) only if adjustment data is ready for entry. Otherwise, it is possible to lose position in the operative cycle.

Now the following adjustment data will be given:

Mike	Break Time
1	1.300
2	.400
3	.700
4	1.400
5	3.600
6	5.500

Press (continue), then enter above data. A printout should result as follows:

ADJUSTMENT	1
left	99
drop	185
spread	1664.4

Since the shift resulted from an impact further than 100 meters from target, the option to perform another adjustment is given with the query "another adjusting round?" A negative response will end the operative cycle and return the machine to the point of awaiting data for the next target. An affirmative response initiates a new cycle for the second adjusting round and leads to the point of awaiting adjustment data. Give an affirmative response, press (continue), and enter:

Mike	Break Time
1	1.201
2	.391
3	.702
4	1.415
5	3.558
6	5.485

The accompanying printout should read:

```
ADJUSTMENT        2

right            11
drop             34
spread           490.3
FIRE             FOR
       EFFECT
```

Computations from this data set fix the impact of the adjustment round at less than 100 meters from the target. In this case, "FIRE FOR EFFECT" will appear as the last entry on the printed output. Under these circumstances, the program automatically returns to the data entry phase and "is new met message available?" will appear on the display. This completes the first cycle of operation.

The break time reading assistance program may be initiated at any time the display reads "READY FOR TARGET DATA?" or "READY FOR ADJUSTMENT DATA?" Answer the query "is new met message available?" in the negative, and when the display reads "READY FOR TARGET DATA?" call the break time reading assistance program by pressing (f_9). When the query "use of coordinates of last target?" appears, respond in the negative. This response indicates that a possible target is to be examined to see if it might be verified on the strip chart. To the query "enter easting, estimated target," respond with 59345.0. To the query "enter northing, estimated target," answer 33539. The query "which mike has sharpest break?" allows all break times to be normalized to the specified microphone. In this case use mike 1 and the break time 1.201. The resulting printout should read:

```
BREAK TIMES
NORMALIZED TO
MIKE                 1

mike                 1
brk time         1.201

mike                 2
brk time         0.383

mike                 3
brk time          .755

mike                 4
brk time         1.463

mike                 5
brk time         3.595

mike                 6
brk time         5.530
```

At this time, the program will have returned to the point of entry for the break time reading assistance program, "READY FOR TARGET BREAK TIMES?" will appear on the display. Press (continue) and enter the times from above. The resulting printout should be:

SOUND	RANGING
TARGET	
easting	59344.7
northing	33537.8
spread	10.1

The small spread indicated above is to be expected and simply reflects modeling consistency. Millisecond truncation of arrival times is largely responsible for the magnitude of the spread.

At this point, press (stop), then special function key 5 (f_5). This will introduce the visual met program.

Exit from the sound on sound adjustment program may always be made via the index/transfer program called by special function key 11 (f_{11}), as well as direct transfer to the sound ranging program through use of special function key 10.

VISUAL MET CALCULATION PROGRAM

When the visual met calculation program is accessed either from the initial index or by cross reference from another program, the following sequence of events is initiated. The title "VISUAL MET CALCULATION" will appear briefly on the display, and the heading "DATA SET 1" will be written on the printer. The first data prompt "enter dry bulb temp (C)" will then appear on the display. Note that the format for data entry for the visual met calculation program is tailored to the DA Form 6-48. As an example, temperature data will be:

dry bulb	15°C
wet bulb	8°C
time of day corr	0.6°C

Observe that as each data entry is made the value entered is simultaneously printed. When all temperature data are entered, the query "is input data correct?" permits correction of improperly entered data by repeating the data entry cycle. A negative response returns the program to mainline operation. A similar function will be performed for all data entries in the visual meteorology program.

Following the sequence of prompts related to effective temperature, the computed value will appear on the printer, the printed output should read:

DATA	SET	1
eff	temp	16.1

Having completed the effective temperature calculation, the program is ready to complete calculations for data set 1. The introductory query "compute effective wind?" permits the operator to calculate effective wind, in which case the query is answered in the affirmative, or to consider a new data set, in which case the answer is in the negative. A negative response may also be used to terminate the program. If a negative response is given, the query "another calculation?" will appear. An affirmative response initiates another cycle of computation and returns the program to the prompt "enter dry bulb temp (C)" with the heading "DATA SET 2" occurring on the printer. A negative response terminates the program with "PROGRAM COMPLETED" appearing on the display.

In the case of an affirmative response, the query "compute effective wind?" begins the wind computation cycle. The prompt "enter offset azimuth (deg)," followed by "enter offset distance (meters)," establishes the balloon launch point relative to station position. For the example to be considered, both quantities will be zero. The following balloon position data will be requested in sequence.

Balloon Height (m)	Elevation	Azimuth (deg)
sur	58.0	12.6
200	34.1	335.2
400	42.3	342.2
600	31.7	348.3
800	29.2	358.6

On completion of data entry, the calculation of effective met for the first data set is completed. On the printer will now appear:

```
DATA SET          1

                15.0
                 8.0
                 0.6

eff temp        16.1

sur             58.0
                12.6

200 m           34.1
               335.2

400 m           42.3
               342.2

600 m           31.7
               348.3

800 m           29.2
               358.6

eff windspd     10.6

eff wind dir  2759.1
```

The query "another calculation?" enables the operator to proceed to a second data set which can be initiated by an affirmative response, or to load the effective met data just calculated directly into the sound ranging and sound on sound adjustment programs. The query "is met data to be used now?" when answered in the affirmative accomplishes this objective. This action orients and formats the data preparatory to storage, then loads it into appropriate files. The heading "MET ORIENTATION INITIATED" will appear briefly on the display, followed by the query "how many mikes in sound base?" When this query is answered properly, the prompt "INITIATE DESIRED PROGRAM" permits transfer to sound ranging program via special function key 7 or sound on sound adjustment via special function key 8.

Press special function key 7. The comment "SOUND RANGING PROGRAM INITIATED" will appear on the display. Answer the resulting query/prompt sequence until "is new met message available?" appears on the display. Special function key 7 then should result in the listing:

MET VALUES

temp	16.1
windspd	10.6
wind dir	2759.

At this point, call the index (f_{11}) and proceed to the flash ranging program.

FLASH RANGING

The initiation of the flash ranging portion of PTAP-2 will result in a brief display of the heading "FLASH RANGING." As in all location programs in PTAP-2, the initial query will be "are earlier targets stored?" As in the sound ranging program, this query refers to the automatic storage of target coordinates and times. If this query is answered in the affirmative, all targets stored and retained in previous cycles of operation will be recalled, and targets located in the present cycle of operation will be numbered sequentially from the last recorded target.

Note that sound ranging target storage is slightly different from that of flash ranging in that the former only records target number, time, easting, and northing. The two latter programs also store target height. If the query is answered in the negative, all earlier targets are ignored, and the first target located in the present cycle will be given the number 1. Response to this query leads to the prompt "enter number of flash OPs." The program will permit from two to six, with the example considered involving four OPs at the positions:

OP	Easting	Northing	Height
1	50361.40	39503.22	405.0
2	51503.30	38803.10	412.0
3	52996.62	38175.16	428.5
4	53925.64	37836.61	410.9

The query "are OP coordinates stored?" relates to the automatic storage of OP coordinates on completion of entry, assuring that voluntary or accidental shutdown will cause minimal delay to operation. The operator should answer the query with a negative response. The prompt will then read "enter easting, OP 1." Correct response will cause the machine to demand in turn northing and height, then the prompts will cycle through OP-2, OP-3, and OP-4. On completion of the entry of height for OP-4, a pause in the program sequence will indicate storage of OP coordinates for flash ranging and flash adjustment.

After entry of all OP coordinates, the query "is data available, OP 1?" will appear. At this time one may verify the OP coordinate entries by pressing (stop), then the special function key f_6. This will cause OP coordinates in the machine to be listed on the printer for verification. Entrance is automatically made to an editing mode, and the query "are OP coordinates correct?" will appear. If no mistake is found, a negative response will return the machine to the query "is data available, OP 1?" If a mistake is found, say in the northing of OP 3, a negative response will result in the query "which OP is in error?" In this case the number 3 would be entered. The prompts "enter correct easting, OP 3," "enter correct northing, OP 3," and "enter correct height, OP 3" allow appropriate values to be entered. After coordinates are entered, the query "is additional editing necessary?" allows repetition of cycle, or causes new OP coordinates to be stored against shutdown. The operator should answer appropriately. When the editing cycle is completed, return is made to the query "is data available, OP 1?" This query introduces the data entry phase of operation. Suppose that the OPs in question made the following observations relative to a potential target.

OP	Azimuth	Vert Angle
1	3521	-6
2	3654	-6
3	3817	-8
4	3910	-6

The level one data entry phase for both flash ranging and flash adjustment begins with the query "is data available, OP 1?" If an affirmative response is received, the prompt "enter azimuth (mils) OP 1" will appear. Successful entry of the azimuth for OP 1 will cause the value to appear on the printer, and the query "is vertical angle available, OP 1?" Entry of a value for the vertical angle will cause the quantity to be printed, and the new query "is data available, OP 2?" to appear. If a negative response is given to this query, a single asterisk will be printed. If a negative response was given to the initial query, two asterisks will appear on the printer, one representing the azimuth and one the vertical angle of OP 1.

When a response has been received for all OPs, the program shifts to an editing phase to correct possible errors in entries. This phase is introduced by the query "is input data correct?" A positive response will exit the edit mode. A negative response will initiate the query "which OP is in error?" When an OP is specified, the prompt "enter correct azimuth, OP-" will appear, followed by "is vertical angle available, OP-?" Affirmative response to this query will result in the prompt "enter vertical angle, OP-." A negative response initiates the query "is other data in error?" An affirmative response repeats the editing cycle; a negative response exits the edit mode.

A convenient level two option exists in the data entry phase. When the query "is data available, OP 1?" appears on the display, the azimuth may be entered directly. This will result in the quantity appearing on the printer, and the query "is vertical angle available, OP 1?" appearing on the display. At this time the vertical angle may be entered directly.

When data from all OPs have been entered and the program has exited the edit mode, the flash ranging target is computed. If the above data have been properly entered, the printout should read:

```
FLASH          RANGING
TARGET               1

easting        47198.8
northing       29802.1
height           359.4
spread            27.9
```

This output is the coordinates of the first target to be located and is given the number 1 as indicated. Recall that each pair of lines of sight from OP to target leads to a target estimate. The coordinate-wise median of the set of estimates is taken as the true target coordinates, and the radius of the smallest circle containing all estimates is the spread.

After target 1 has been located, the prompt "enter day, time of day, ex 060945" appears. This prompt allows the target to be located in time; a six-digit number is to be entered for which the first two digits from left to right are the day of the month and the last four are time. If the day of the month is a single number, it should be prefixed by a zero. Then April 9 at 1430 would appear as 091430. Upon entry of the time, the machine returns to the query "is data available, OP 1?" or the beginning of the data entry cycle.

Whenever the machine is in the data entry cycle, a list of targets may be obtained by pressing "stop," then special function key 8 (f_8). The listing will be titled "FLASH RANGING TARGET LISTING" and will present all targets in 10-item blocks. After each set of 10 targets, the query "next 10 targets?" will appear; affirmative answers will lead to a list of all targets, at which time the display "ALL TARGETS LISTED!!!" will precede return to the data entry phase. A negative response at any time will lead directly to the data entry phase.

A special option is automatically entered in the case that only one OP should report. As an example, in the data entry phase, answer "is data available, OP 1?" in the affirmative and enter azimuth 3521 and vertical angle -6. Then answer negative to "is data available, OP 2?" etc. When a negative answer is received for "is data available, OP 4?" the heading "OP 1 REPORTING" will appear on the printer, and the display will read "enter distance to target, OP 1?" When an estimate of distance is given, the machine will list look angles for all remaining OPs. The next flash may then be picked up by the other OPs and a better target location result. In the example, the distance happens to be 10202. Entry of this quantity results in the listing:

```
OP        1
 REPORTING
dist to target
      10202

set azimuth
OP        2
at     3654

set vert ang
OP         2
at        -7

set azimuth
OP        3
at     3817

set vert ang
OP         3
at        -8

set azimuth
OP        4
at     3910

set vert ang
OP         4
at        -7
```

Compare these values with the table of angles supplied.

If only two stations report, a warning "WARNING - ONLY 2 OP REPORTING!!!" will appear. Since only one estimate is available, the spread will be zero.

At least one vertical angle must be entered. If not, an error message "ERROR - NO HEIGHT DATA" will result with subsequent return to data entry mode. Special function key 11 (f_{11}) may be used to store target information and to call the index/transfer program exactly as described in earlier discussions.

The usual index/transfer program is available via special function key 11 (f_{11}); however, one may directly access the flash adjustment program by use of special function key 10 (f_{10}). All located targets and target numbers will automatically be stored at this time.

FLASH ADJUSTMENT

The general mechanisms of the flash adjustment program are similar to those of flash ranging, but with a few notable exceptions. The flash adjustment program makes no provision for storage of targets, and the first query after initiation is "enter number of flash OPs?" Following the example given in the discussion of the flash ranging program, four OPs will be considered. Those coordinates are repeated here for convenience.

OP	Easting	Northing	Height
1	50361.40	39503.22	405.00
2	51503.30	38803.10	412.00
3	52996.62	38175.16	428.50
4	53925.64	37836.61	410.00

At the query "are OP coordinates stored?" if the flash ranging example has been completed, one may answer in the affirmative; if not, a negative response will initiate the OP coordinate entry cycle which requests in turn the easting, northing, and height of OP 1 through OP 4 in ascending order. In either case, when the query "READY FOR TARGET DATA?" appears, verify that coordinates are properly recorded in the machine by pressing (stop), then special function key 6 (f_6). If all events have taken place without error, a printout should appear listing all OP coordinates. At this time the display should read "are OP coordinates correct?" If no mistake can be found, a positive response returns the machine to the query "READY FOR TARGET DATA?" If an error is encountered, the operator is asked to supply the number of the OP in question, then easting, northing, and height. Note that a complete set of coordinates must be entered even if only one coordinate is in error. This practice results in considerably less operator response than coordinate by coordinate queries. As each set of coordinates is entered, the query "are other coordinates in error?" allows exit from the editing mode or a repetition of the editing cycle. On completion of editing, the new coordinates are stored against shutdown, and the machine returns to the query "READY FOR TARGET DATA?" When flash adjustment data are available, press (continue) which will initiate the data entry phase. For the sake of brevity, it will be merely noted at this time that the data entry phase of flash adjustment is identical to that described in the discussion of flash ranging. For the initial target, enter the data:

OP	Azimuth	Vert Angle
1	3521	-6
2	3654	-6
3	3817	-8
4	3910	-6

The subsequent printout should read:

```
FLASH           RANGING
        TARGET

easting         47199.4
northing        29803.8
height            353.1
spread             29.7
```

This output is identical to the earlier flash ranging printout, and the flash ranging discussion may be consulted for a description of spread.

At this time the display should read "READY FOR ADJUSTMENT DATA?" This query will remain on display until adjustment data are available, at which time the data entry cycle is entered by pressing (continue). Since target and adjustment data entry phases are identical, it is suggested that as a reminder of cycle, displays should be permitted to remain until appropriate data are ready for entry. Now press (continue) and enter the following adjustment data:

OP	Azimuth	Vert Angle
1	3532	-7
2	3648	*
3	3827	-9
4	3900	-6

The corresponding printout then should read:

ADJUSTMENT	1
right	201
add	352
up	13
spread	2447.1

The size of the shift data and spread would indicate a poor location, and data would be suspect. At this time, the query "another adjusting round?" will be answered in the affirmative. Initiate the adjustment cycle and enter:

OP	Azimuth	Vert Angle
1	3520	-5
2	*	*
3	3815	-7
4	3910	*

The resulting printout should read:

ADJUSTMENT	2
left	17
drop	19
down	12
spread	176.3
FIRE EFFECT	FOR

This adjustment is adequate as reflected by the "fire for effect" indicator. The program is now awaiting new target data. It should be emphasized that the display "READY FOR TARGET DATA?" should be allowed to remain until new target data are available. Otherwise, loss of position in the operative cycle may result.

As a final exercise, initiate the target cycle and enter:

OP	Azimuth	Vert Angle
1	3451	-6
2	3587	-7
3	3758	*
4	*	*

The resulting printout should be:

FLASH	RANGING
TARGET	2
easting	47944.5
northing	29894.4
height	352.7
spread	8.5

Now initiate the adjustment cycle and enter:

OP	Azimuth	Vert Angle
1	3454	-7
2	3581	*
3	*	*
4	3859	*

The subsequent printout should read:

ADJUSTMENT	FOR
TARGET	2
right	36
add	23
down	59
spread	665.4
FIRE	FOR
EFFECT	

The program now is ready for the next target.

The auxiliary "ONE OP" subprogram in the flash adjustment program is identical in operation to the one described in the discussion of flash ranging.

At this time, call the index/transfer program by pressing (stop) then special function key 11 (f_{11}). The operator should now transfer to the laser rangefinder program. Recall that the special function key 10 (f_{10}) may be used to exit the flash adjustment program and serves as a convenient link between flash ranging and flash adjustment.

LASER RANGEFINDER

In a manner similar to that of sound and flash ranging, the laser rangefinder program proceeds from a briefly displayed heading to the initial query "are earlier targets stored?" Comments pertinent to target storage for the laser rangefinder program are identical to those regarding flash ranging and will not be repeated. The query "total number of laser OPs?" when answered, leads to the query "are OP coordinates stored?" Automatic storage of laser rangefinder OP coordinates, coordinate display, and editing options follow a line exactly similar to that of the flash ranging or flash adjustment programs; and for brevity, the description will be omitted. As an example, answer the query "are earlier targets stored?" in the negative. To the query "total number of laser OPs?" the operator should answer 4. Answer the query "are OP coordinates stored?" in the negative, then enter:

OP	Easting	Northing	Height
1	0.0	0.0	0.0
2	59231.1	29315.2	405
3,4	0.0	0.0	0.0

After entry, the program will automatically store the coordinates. After data storage is complete, the data entry phase begins. At this point, it is convenient to verify the laser rangefinder OP coordinates. Press (stop), then special function key 6 (f_6). OP coordinates will appear on the printer with the query "are OP coordinates correct?" Answer appropriate queries or prompts. When verification of data has been completed, the machine again will return to the data entry phase. Enter the following data:

OP	Range	Azimuth	Vert Angle
2	9820.1	178	-5.2

Observe that on specification of the OP, the heading OP 2 appears on the printer. As data are entered, they are listed on the printer for verification. When range, azimuth, and elevation have been entered for target 1, the query "is input data correct?" allows a repeat of the data entry cycle if an error is encountered. If no error occurs, an affirmative response leads to the printout:

LASER	RFDR
TARGET	1
easting	60938.4
northing	38985.6
height	354.9

Enter appropriate location time as indicated.

When return is made to the data entry phase, enter the data:

OP	Range	Azimuth	Vert Angle
2	8540.4	1400	-.5

The printout now should be:

LASER	RFDR
TARGET	2
easting	67607.4
northing	30981.3
height	400.8

Again enter day and time of day.

At the beginning of the data entry phase, press (stop), then special function key 8 (f_8).

The printout should be:

LASER	RFDR
TARGET	LIST
target	1
time	----
easting	60938
northing	38986
height	355
target	2
time	----
easting	67607
northing	30981
height	401

When all targets are listed, display will briefly read "ALL TARGETS LISTED!!!" and return to the data entry phase. Exit from the laser rangefinder mode may be made via special function key 11 (f_{11}), which calls the general index and simultaneously stores all target locations and the target number. Special function key 10 (f_{10}) may be used to store targets as above and will automatically institute the laser rangefinder adjustment program. In that mode special function key 10 (f_{10}) will reinitiate the laser rangefinder program. Special function key 9 (f_9) may be used to call the laser rangefinder trilateration program. A discussion of this program will be found under that heading. The operator should now use special function key (f_{10}) to call the laser rangefinder adjustment program.

LASER RANGEFINDER ADJUSTMENT

Adjustment for the laser rangefinder differs from sound on sound adjustment or flash adjustment in that the position of the OP is not required. As in the other fire adjustment techniques mentioned above, no provision is made for target storage, therefore, the program begins with the query "which OP is reporting?" Recalling the example used in the laser rangefinder program, enter 2. The display will then read "READY FOR TARGET DATA?" following the pattern set by sound and flash adjustment. When ready, press (continue). Recall that the data from laser rangefinder were:

OP	Range	Azimuth	Vert Angle
2	9820.1	178	-5.2

Enter data as in laser rangefinder program. The program will then respond with "READY FOR ADJUSTMENT DATA?" Enter the data:

OP	Range	Azimuth	Vert Angle
2	9830	178	-5.2

Observe that the adjustment round will be downrange to the right of the target so that the correction should be to the left and drop.

The printout should read:

```
ADJUSTMENT          1

left                2
drop               10
up                  0
FIRE               FOR
          EFFECT
```

The "fire for effect" tag will appear on the printout when the adjustment round is no greater than 100 meters from the target. In this case the machine returns to the query "READY FOR TARGET DATA?" in preparation for the next run. The displays "READY FOR TARGET DATA?" and "READY FOR ADJUSTMENT DATA?" will always remain until action is initiated by pressing (continue). This status serves to indicate the current operating cycle, and (continue) should not be pressed until the operator is ready for data entry.

Now press (continue), then enter the data:

OP	Range	Azimuth	Vert Angle
2	8540.4	1400	-.5

followed by the adjustment data:

OP	Range	Azimuth	Vert Angle
2	8620	1410	-.7

For this case the printout will read:

```
ADJUSTMENT          1

left               94
add                68
up                  2
```

and the display will read "another adjusting round?" One now has the option of accepting the adjustment or performing an additional one. Answer the query in the affirmative, and enter:

OP	Range	Azimuth	Vert Angle
2	8550	1402	-.4

The printout then should read:

ADJUSTMENT	2
left	13
add	15
down	1
FIRE EFFECT	FOR

The display will read "READY FOR TARGET DATA?" awaiting next input. If a new OP is to be considered, press (stop), then special function key 6 (f_6). The query "NEW OP?" will appear on the display. The program will be activated when the (continue) button is pressed. The display may be used as a reminder when awaiting OP reports. Targets from differing OPs will be numbered in sequence. If a special function key is pressed by mistake, the machine will beep and the message "WRONG KEY*** press (continue)" will appear. When (continue) is pressed, the machine will revert to the data entry stage.

A normal exit from the laser rangefinder adjustment program may be made with a special function key 11 (f_{11}). However, special function key 10 (f_{10}) may be used if it is desired to shift to the laser rangefinder mode. In fact, this key may be used to alternate between programs. The operator should now examine the section describing the laser rangefinder trilateration program.

LASER RANGEFINDER TRILATERATION

The laser rangefinder trilateration program may be employed to determine the location and orientation of a laser rangefinder OP. Required are two points of known survey visible to the OP and within range of the instrument. Required also is a crude orientation determined by compass or any means available.

Once a preliminary orientation has been established, it is required for the OP in question to determine ranges and angle data as will be demonstrated in the following example. Coordinates of survey points are:

Survey Pt	Easting	Northing	Height
1	67607.4	30981.3	401.0
2	60938.5	38985.7	355.1

Now assume that after a preliminary orientation, OP 1 observes the following:

Survey Pt	Range	Azimuth	Vert Angle
1	8540.4	1600	-.5
2	9820.1	*	-5.2

At this point, call the laser rangefinder trilateration program. It will generally occur that this program will be initiated when the existing mode of operation is laser rangefinder or laser rangefinder adjustment.

In this case, time may be saved by use of special function key 7 (f_7). If at any point in the operative cycle of either program the key (stop) is pressed, followed by (f_7), all target locations and the total number of targets will be stored when applicable, and the laser rangefinder trilateration program will be initiated. A reverse capability also exists. From the trilateration program, direct access to the laser rangefinder and laser rangefinder adjustment programs may be made via special function keys 8 and 9. This capability will be mentioned in more detail later in the discussion.

After initiation, the general flow of events is as follows. A brief display of the program title is followed by the query "what is total number of OPs?" This expression constitutes a link between the laser rangefinder and trilateration programs. Up to six different laser rangefinder OPs may be simultaneously considered, but it must be stressed that the number established in the laser rangefinder program and the one employed in trilateration must agree; otherwise, errors may result.

Recall that in the discussion of the laser rangefinder program, the example given called for four OPs. Ops 1, 3, and 4 were assumed unknown and 0 was entered for all coordinates. OP 2 was specified. If this exercise has not been completed, do so at this time.

To the query "what is total number of OPs?" enter four. When the query reads "what OP is to be located?" press (stop), then special function key 6 (f_6) to obtain a listing of those laser rangefinder OP coordinates present in the machine. These should read:

OP LASER	COORDINATES RFDR
OP	1
easting	0.0
northing	0.0
height	0.0
OP	2
easting	59231.1
northing	29315.2
height	405.0
OP	3
easting	0.0
northing	0.0
height	0.0

OP	4
easting	0.0
northing	0.0
height	0.0

If there is no problem with the coordinate listing, answer the query "what OP is to be located?" by 1. At this point the coordinates of survey points 1 and 2 will be requested. If the above listing is in error, it is suggested that the laser rangefinder program be recalled via special function key 8 and the exercise as discussed earlier be carefully performed.

When the height of survey point 2 is entered, the display will contain the prompt "rough azimuth to survey pt 1?" At this time it is suggested that a verification of the survey point coordinates entered be performed. Press (stop) then special function key 7 (f_7). The following listing should appear on the printer:

```
COORDINATES              OF
SURVEY               POINTS

survey point              1
easting   67607.4
northing  30981.3
height      401.0

survey point              2
easting   60938.5
northing  38985.7
height      355.1
```

The display should contain the query "are survey pt entries correct?" Suppose that a typing error occurred in the northing of survey point 1 and the height of survey point 2. Give a negative response to the query. The query "which point is in error?" may be answered by either 1 or 2. Use 1. A prompt "enter correct easting, sv pt 1" will be followed by a similar request for northing and height. All data must be entered as requested. The query "is other survey pt in error?" must now be answered in the affirmative. Upon completion of data entry, the program will resume at the prompt "rough azimuth to survey pt 1?" Enter the value 1600.

Range and vertical angle to survey points 1 and 2 are now requested. Upon satisfactory entry, the resulting printout should appear giving the desired location and orientation.

This listing will read:

COORDINATES	
OP	1
easting	59231.1
northing	29315.3
height	405.2
*BACK	AZIMUTHS*
survey pt	1
	1400
survey pt	2
	178

From the back azimuths listed, a precise orientation is possible.

The display now should read "is another OP location desired?" At this point it may be worthwhile to demonstrate the insensitivity of the algorithm to the value of the approximate azimuth. Answer the above query in the affirmative. Now press (stop), then special function key 6 (f_6). Observe that the listing now contains the coordinates of OP 1 as estimated by the trilateration program. Now the attempt will be made to locate OP 3. Reenter the same survey points as before; but as an approximate azimuth, use 2000. Continue to enter ranging data. The resulting printout should be identical to that of OP 1. Now repeat the procedure for an approximate azimuth of 1200 but for OP 4; again the printout should be identical. When the query "is another OP location desired?" appears, answer in the negative. The expression "PROGRAM COMPLETED!!!" will now appear on the display. Use special function key 6 (f_6) to observe what coordinate locations have been determined. OP 1, OP 3, and OP 4 should be identical and represent the coordinates of OP 1 as determined by the trilateration program. OP 2 is the true coordinates. Now special function keys 8 and 9 (f_8 and f_9) may be used to access in order the laser rangefinder adjustment and laser rangefinder programs. Call the former. When the query "are OP coordinates stored?" appears, answer in the affirmative; then use special function key 6 (f_6) to display coordinates. Note that these are the coordinates located by the trilateration program. Now enter the following data:

OP	Range	Azimuth	Vert Angle
4	9820.1	178	-5.2

The printout should be:

LASER	RFDR
TARGET	1
easting	60938.4
northing	38985.7
height	355.1

This serves as a verification of the cross coupling of the laser rangefinder and laser rangefinder trilateration programs.

SECTION 2

PROGRAM LISTINGS

LISTING

INDEX/TRANSFER

PROGRAM

FILE 0

PTAP - 2

```
0: prt "TO CALL DESIRED PROGRAM";spc
1: prt "ENTER PROGRAM   NUMBER";spc
2: prt "PRESS CONTINUE";spc
3: prt "1 SOUND RANGING"
4: prt "2 SOUND ON SOUND"
5: prt "3 VISUAL MET."
6: prt "4 FLASH RANGING"
7: prt "5 FLASH ADJT."
8: prt "6 LASER RFDR."
9: prt "7 LASER RFDR.      ADJUSTMENT"
10: prt "8 LASER RFDR.      TRILATERATION";spc 2
11: ent "enter program number",N
12: if N=1;ldf 2
13: if N=2;ldf 8
14: if N=3;ldf 12
15: if N=4;ldf 14
16: if N=5;ldf 19
17: if N=6;ldf 22
18: if N=7;ldf 27
19: if N=8;ldf 30
20: end
*11145
```

LISTING

SOUND RANGING

PROGRAM

FILE 1

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE SOUND RANGING PROGRAM

FILE 2

f_0: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_1: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_2: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_3: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_4: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_5: *dsp "VISUAL MET. PROGRAM INITIATED"; rcf 6, G; rcf 7, U[*]; ldp12

f_6: *cont "mike"

f_7: *cont "met 1"

f_8: *cont "TARGET"

f_9: *cont "timing"

f_{10}: *dsp "ADJUSTMENT MODE INITIATED"; rcf 6, G; rcf 7, U[*]; ldp8

f_{11}: *cont "INDEX"

```
0: dim A[6,3],B[6,3],C[10],D[6,7],E[6,3],M[6],T[10],Q[3],X[6,2],S[3]
1: dim Q$[8],P[10],H[6],Z[2,2],G[6],Y[6],O[10,4]
2: dim U[100,3],N[6],R[2]
3: dsp "            SOUND RANGING";ldk 3;ldf 4,r1,r4
4: ent "are earlier targets stored ?",Q$;if Q$="-";ina U:0;gto 6
5: ldf 6,G;ldf 7,U[*]
6: ent "how many mikes in sound  base ?",N
7: 0→N[4]
8: ent "are mike coordinates stored ?",Q$
9: if Q$="-";gto 12
10: ldf 5,A[*]
11: gto 24
12: fxd 0;for I=N to 1 by -1
13: dsp "enter easting,(meters).mike",N+1-I
14: ent "",A[I,1]
15: dsp "enter northing,(meters) mike",N+1-I
16: ent "",A[I,2]
17: next I;gto 23
18: ent "are mike coordinates correct ?",Q$;if Q$="+";gto 24
19: ent "which mike has error in coord. ?",r26
20: fxd 0;dsp "enter correct easting,mike",r26;ent "",A[N-r26+1,1]
21: dsp "enter correct northing,mike",r26;ent "",A[N-r26+1,2]
22: ent "are other coordinates in error ?",Q$;if Q$="+";gto 19
23: rcf 5,A[*];rcf 11,A[*];fdf 5
24: 0→r11;0→r12
25: for I=1 to N;A[I,1]→Y[I];A[I,2]→G[I];next I
26: for I=1 to N;r11+Y[I]→r11;r12+G[I]→r12;next I;r11/N→r11;r12/N→r12
27: for I=1 to N;A[I,1]-r11→A[I,1];A[I,2]-r12→A[I,2];next I
28: if abs(A[N,1]-A[1,1])#abs(A[N,2]-A[1,2]);gto 34
29: if A[N,1]-A[1,1]=A[N,2]-A[1,2];gto 32
30: if A[N,1]-A[1,1]>0;gto 42
31: sfg 5;gto 40
32: if A[N,2]-A[1,2]>0;gto 42
33: sfg 5;gto 40
34: if max(abs(A[N,1]-A[1,1]),abs(A[N,2]-A[1,2]))=abs(A[N,2]-A[1,2]);sfg 12
35: if flg12;gto 37
36: gto 38
37: gsb "rot1"
38: if A[N,1]-A[1,1]>0;gto 42
39: sfg 5
40: for I=N to 1 by -1;A[I,1]→B[N-I+1,1];A[I,2]→B[N-I+1,2];next I
41: sfg 4;gto 44
42: for I=1 to N
43: A[I,1]→B[I,1];A[I,2]→B[I,2];next I
44: if flg12;gto 46
45: for I=1 to N;Y[I]→A[I,1];G[I]→A[I,2];next I;gto 47
46: for I=1 to N;Y[I]+r12→A[I,1];G[I]-r11→A[I,2];next I
47: if N[4]=1;0→N[4];gto 51
48: ent "is new met. message available ?",Q$
49: if Q$="+";cfg 8;gto "met"
50: sfg 8
51: ina M:0
52: fxd 0
53: for I=N to 1 by -1;fxd 0
54: dsp "is brk. time available,mike",N-I+1,"?";ent "",Q$
*20950
```

```
55: if Q$="-";gto 59
56: if Q$="+";gto 58
57: 1)M[I];val(Q$))A[I,3];gto 60
58: 1)M[I];dsp "enter break time,mike",N+1-I;ent "",A[I,3]
59: if M[I]=0;prt "                *";gto 61
60: fxd 3;prt A[I,3]
61: next I;spc 2;fxd 0
62: ent "are break times correct ?",Q$
63: if Q$="+";gto 72
64: prt " BREAK TIME EDIT";spc
65: ent "which mike has break time error?",r30
66: fxd 0;prt "mike",r30
67: dsp "enter correct break time,mike",r30;ent "",A[N-r30+1,3]
68: fxd 3;prt A[N-r30+1,3];spc
69: 1)M[N-r30+1]
70: ent "is another break time in error ?",Q$;if Q$="+";gto 65
71: spc
72: 0)r5;for I=N to 1 by -1;if M[I]=0;gto 74
73: r5+1)r5;A[I,3])B[N+1-r5,3]
74: next I
75: if r5>=3;gto 77
76: dsp "ERROR-less than 3 mikes entered";wait 5000;gto 48
77: if r5=N;gto 88
78: for I=N-r5+1 to N;B[I,3])B[I-N+r5,3];next I
79: for I=r5+1 to N;9999999)B[I,3];next I
80: if flg4;gto 82
81: gto 86
82: for I=r5 to 1 by -1;B[I,3])Y[r5-I+1];next I
83: for I=N to 1 by -1;M[I])G[N-I+1];next I
84: for I=1 to r5;Y[I])B[I,3];next I
85: for I=1 to N;G[I])M[I];next I
86: r5)r26
87: gto 94
88: if flg4;gto 90
89: gto 94
90: for I=r5 to 1 by -1;B[I,3])Y[r5-I+1];next I
91: for I=N to 1 by -1;M[I])G[N-I+1];next I
92: for I=1 to r5;Y[I])B[I,3];next I
93: for I=1 to N;G[I])M[I];next I
94: r5-1)C[1];r5-2)C[2];C[1]C[2]/2)C[3];r5)C[4]
95: deg
96: r5)r26
97: 0)r5)r6)r7;337.5)C[5]
98: if flg10;cfg 10;gto 103
99: for I=1 to N;r5+M[I])r5
100: if M[I]=0;gto 102
101: B[I,1])B[r5,1];B[I,2])B[r5,2]
102: next I
103: r26)r5
104: for I=1 to C[1]
105: B[I+1,1]-B[I,1])D[I,1];B[I+1,2]-B[I,2])D[I,2]
106: \(D[I,1]D[I,1]+D[I,2]D[I,2]))D[I,3];D[I,3]/C[5])D[I,4]
107: (B[I+1,1]+B[I,1])/2)X[I,1];(B[I+1,2]+B[I,2])/2)X[I,2]
108: D[I,1])S[1];D[I,2])S[2];gsb "atan2"
109: if S[3]>270;S[3]-360)S[3]
*14577
```

```
110: S[3]-90→S[3]
111: S[3]→D[I,5];next I
112: r3/283.16→Q[1];C[5]C[5]Q[1]→Q[2];√Q[1]-1→Q[3]
113: deg
114: r1→S[1];r2→S[2];gsb "atan2"
115: S[3]→B
116: √(r1r1+r2r2)→W
117: for I=1 to C[1];B[I,3]-B[I+1,3]→D[I,6];D[I,5]-B+90→G[I];next I
118: for I=1 to C[1];D[I,6]Q[3]→E[I,1]
119: D[I,3]cos(G[I])(-W)/Q[2]→E[I,2]
120: D[I,6]+E[I,1]+E[I,2]→D[I,6]
121: next I
122: rad
123: for I=1 to C[1];if abs(D[I,6]/D[I,4])>1;gto 125
124: asn(D[I,6]/D[I,4])→H[I];gto 126
125: D[I,6]/D[I,4]/abs(D[I,6]/D[I,4])→C[6];asn(C[6])→H[I]
126: if flg4;gto 128
127: H[I]+(D[I,5]/180)→P[I];gto 129
128: (-H[I]+(D[I,5]/180)→P[I]
129: next I
130: gto 148
131: "met":deg;if flg8;cfg 8;gto 94
132: ent "enter effective temp.(C.)",r3
133: r3+273.16→r3;20.06√r3→r4
134: ent "enter eff. wind speed(knots)",r8
135: ent "enter eff. wind direction(mils)",r9
136: r8*.5146789→r8;r9/17.7777778→r9;-r8sin(r9)→r1;-r8cos(r9)→r2
137: if flg12;gto 139
138: rcf 4,r1,r4;rcf 10,r1,r4;gto 50
139: -r2→F;r1→r2;F→r1;rcf 4,r1,r4;rcf 10,r1,r4;gto 50
140: "atan2":if S[2]=0;gto 145
141: atn(S[1]/S[2])→S[3]
142: if S[2]<0;S[3]+180→S[3];ret
143: if S[3]>0;ret
144: S[3]+360→S[3];ret
145: if S[1]=0;0→S[3];ret
146: if S[1]>0;90→S[3];ret
147: 270→S[3];ret
148: deg
149: 0→M;rdm S[2]
150: for I=1 to C[2];I+1→K
151: for J=K to C[1]
152: M+1→M
153: 1→Z[1,1];-tan(-180+P[I]*180/π)→Z[1,2];1→Z[2,1]
154: -tan(-180+P[J]*180/π)→Z[2,2]
155: X[I,1]-tan(-180+P[I]*180/π)X[I,2]→S[1]
156: X[J,1]-tan(-180+P[J]*180/π)X[J,2]→S[2]
157: inv Z→Z;mat ZS→R;R[1]→O[M,1]→O[M,3];R[2]→O[M,2]→O[M,4]
158: next J
159: next I
160: rdm S[3]
161: rad
162: rdm T[10];ina T:-9999999
163: rdm P[10];ina P:-9999999
164: (r5-1)(r5-2)/2→C[10];C[10]-1→r13
*13028
```

```
165: for J=1 to r13
166: for K=J to C[10];O[K,1]→T[K]
167: O[K,2]→P[K]
168: next K
169: max(T[*])→r8;max(P[*])→r9
170: if O[J,1]=r8;-999999→T[J];gto 176
171: for Z=J to C[10];if r8≠O[Z,1];gto 173
172: Z→L
173: next Z
174: O[J,1]→r14;r8→O[J,1];r14→O[L,1]
175: if O[J,2]=r9;-9999999→P[J];gto 180
176: for Z=J to C[10];if r9≠O[Z,2];gto 178
177: Z→L
178: next Z
179: O[J,2]→r14;r9→O[J,2];r14→O[L,2]
180: -9999999→T[J];-9999999→P[J]
181: next J
182: if C[10]mod2=0;gto 184
183: int(C[10]/2)+1→r8;O[r8,1]→r13;O[r8,2]→r14;gto 186
184: C[10]/2→r8;r8+1→C[8];r8→C[9];(O[C[8],1]+O[C[9],1])/2→r13
185: (O[C[8],2]+O[C[9],2])/2→r14
186: if flg2;gto 196
187: for I=1 to C[1]
188: r13-B[I,1]→Y[1];r14-B[I,2]→Y[2];I+1→S
189: r13-B[S,1]→Y[3];r14-B[S,2]→Y[4]
190: D[I,3]D[I,3]→Y[5];Y[3]Y[3]+Y[4]Y[4]→Y[6];Y[1]Y[1]+Y[2]Y[2]→G[1]
191: \G[1]→G[2];\Y[6]→G[3];(G[1]+Y[6]-Y[5])/2G[2]G[3]→G[4]
192: acs(G[4])→G[5];sin(G[5]/2)→G[6];\(1+G[6]G[6])→R
193: D[I,6](R-1)→D[I,7];D[I,6]+D[I,7]→D[I,6];next I
194: sfg 2;gto 122
195: 0→r5;for I=1 to N;r5+M[I]→r5;next I
196: if r5=3;gto 197
197: if flg12;gsb "rot2"
198: fxd 0;prt "SOUND RANGING   TARGET ",G+1;spc
199: fxd 1;prt "easting",r13+r11;spc
200: prt "northing",r14+r12;spc
201: gsb "spread"
202: prt "spread",max(T[*]);spc
203: G+1→G
204: ent "enter day,time of day ex. 061350",r33
205: fxd 0;prt "time",r33;spc 2
206: if Gmod100=0;dsp "100 TARGETS RECORDED!!!";wait 4000
207: Gmod10→r32;if r32mod10=0;gto 210
208: 11-r32→r32
209: r13+r11→U[r32,1];r14+r12→U[r32,2];r33→U[r32,3];gto 215
210: r13+r11→U[1,1];r14+r12→U[1,2];r33→U[1,3]
211: for I=90 to 1 by -1;U[I,1]→U[I+10,1];U[I,2]→U[I+10,2];U[I,3]→U[I+10,3]
212: next I
213: rcf 6,G;rcf 7,U[*]
214: for I=1 to 10;0→U[I,1]→U[I,2]→U[I,3];next I
215: for I=1 to N;A[I,1]→Y[I];A[I,2]→G[I];next I
216: ldf 5,A[*];cfg 12
217: sfg 1;cfg 2;cfg 3;cfg 7;gto 27
218: "rot1":ina Y:0;ina G:0
219: deg;for I=1 to N;-A[I,2]→Y[I];A[I,1]→G[I];next I
*19187
```

```
220: for I=1 to N;Y[I]→A[I,1];G[I]→A[I,2];next I
221: ret
222: "rot2":deg;r14→Y[1];-r13→Y[2]
223: Y[1]→r13;Y[2]→r14;ret
224: "timing":
225: dsp " BREAK TIME READING ASSISTANCE";wait 2000
226: ent "use coordinates of last target? ?",Q$
227: if Q$="+";gto 233
228: ent "enter easting,estimated target",r13;r13-r11→r13
229: prt "ESTIMATED TARGET";spc
230: prt "easting",r13+r11
231: ent "enter northing,estimated target",r14;r14-r12→r14
232: prt "northing",r14+r12;spc
233: if flg12;gto 235
234: gto 236
235: -r14→Y[1];r13→G[1];Y[1]→r13;G[1]→r14
236: ent "which mike has sharpest break ?",N[1]
237: fxd 0;dsp "enter break time,mike",N[1];ent "",N[2]
238: ldf 5,A[*]
239: for I=1 to N;A[I,1]-r11→B[I,1];A[I,2]-r12→B[I,2];next I
240: if flg12;gto 242
241: gto 244
242: for I=1 to N;-B[I,2]→Y[I];B[I,1]→G[I]
243: Y[I]→B[I,1];G[I]→B[I,2];next I
244: √(r1r1+r2r2)→W
245: for I=1 to N;(r13-B[I,1])(r13-B[I,1])+(r14-B[I,2])(r14-B[I,2])→G[I]
246: r1(B[I,1]-r13)+r2(B[I,2]-r14)→Y[I]
247: (-Y[I]+√(Y[I]Y[I]+(r4r4-WW)G[I]))/(r4r4-WW)→T[I];next I
248: T[N-N[1]+1]-N[2]→N[3]
249: for I=1 to N;T[I]-N[3]→T[I];next I
250: prt "BREAK TIMES     NORMALIZED TO   MIKE",N[1];spc 2
251: for I=N to 1 by -1
252: fxd 0;prt "mike",N-I+1
253: fxd 3;prt "brk. time",T[I];spc ;next I
254: spc 2
255: cfg 12;1→N[4];gto 24
256: "mike":ldf 5,A[*]
257: prt "MIKE COORDINATES";spc
258: for I=N to 1 by -1
259: fxd 0;prt "mike",N-I+1;fxd 1;prt "easting",A[I,1];prt "northing",A[I,2]
260: spc 1;next I;spc 2
261: gto 18
262: "met1":deg
263: prt "MET. VALUES";spc
264: fxd 1;prt "temp.",r3-273.16;spc
265: prt "wind spd.",√(r1^2+r2^2)/.5146789;spc
266: if flg12;-r2→S[1];r1→S[2];gsb "atan2"
267: if flg12;gto 269
268: -r1→S[1];-r2→S[2];gsb "atan2"
269: S[3]*17.77777778mod6400→S[3]
270: fxd 0;prt "wind dir.",S[3];spc 2
271: gto 48
272: "spread":ina T:0
273: if flg12;gto 275
274: for I=1 to C[10];√((O[I,3]-r13)^2+(O[I,4]-r14)^2)→T[I];next I;ret
*4420
```

```
275: for I=1 to C[10];\((O[I,3]+r14)^2+(O[I,4]-r13)^2)}T[I];next I;ret
276: "TARGET":prt "  SOUND RANGING    TARGET LIST";spc ;0}S[1]
277: for I=1 to int(G/10)+1
278: if 10(I-1)<=G;I-1}L
279: next I
280: fxd 0;for I=10(L+1) to 11-G+10L by -1;prt "target",10(L+1)-I+1
281: prt "time",U[I,3]
282: prt "easting",U[I,1];prt "northing",U[I,2];spc 2
283: S[1]+1}S[1]
284: if S[1]mod10>0;gto 286
285: ent "list next 10 targets ?",Q$;if Q$="-";gto 47
286: next I
287: dsp "      ALL TARGETS LISTED!!!";wait 4000;gto 47
288: "INDEX":rcf 6,G;rcf 7,U[*]
289: prt "TO CALL DESIRED PROGRAM";spc
290: prt "ENTER PROGRAM   NUMBER";spc
291: prt "PRESS CONTINUE";spc
292: prt "1 SOUND RANGING"
293: prt "2 SOUND ON SOUND"
294: prt "3 VISUAL MET."
295: prt "4 FLASH RANGING"
296: prt "5 FLASH ADJT."
297: prt "6 LASER RFDR."
298: prt "7 LASER RFDR.   ADJT."
299: prt "8 LASER RFDR.   TRILATERATION";spc 2
300: ent "enter program number",N
301: if N=1;ldp 2
302: if N=2;ldp 8
303: if N=3;ldp 12
304: if N=4;ldp 14
305: if N=5;ldp 19
306: if N=6;ldp 22
307: if N=7;ldp 27
308: if N=8;ldp 30
309: end
*16071
```

LISTING

SOUND ON SOUND

ADJUSTMENT PROGRAM

FILE 7

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE SOUND ON SOUND ADJUSTMENT PROGRAM

FILE 8

f_0: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_1: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_2: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_3: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_4: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_5: *dsp "VISUAL MET. PROGRAM INITIATED"; ldp12

f_6: *cont "mike"

f_7: *cont "met 1"

f_8: *beep; dsp "WRONG KEY! PRESS (continue)"; gto 10

f_9: *cont "timing"

f_{10}: *dsp "LOCATION MODE INITIATED"; ldp2

f_{11}: *cont "INDEX"

```
0: dim A[6,3],B[6,3],C[10],D[6,7],E[6,3],M[6],T[10],Q[3],X[6,2],S[3]
1: dim Q$[7],P[10],H[6],Z[2,2],G[6],Y[6],O[10,6]
2: dim N[6],R[2]
3: dsp "     SOUND ON SOUND ADJUSTMENT";wait 3000
4: ldk 9;0→A
5: ldf 10,r1,r4
6: ent "how many mikes in sound base ?",N
7: 0→N[4]
8: ent "are mike coordinates stored ?",Q$
9: if Q$="-";gto 12
10: ldf 11,A[*]
11: gto 26
12: fxd 0;for I=N to 1 by -1
13: dsp "enter easting,(meters),mike",N+1-I
14: ent "",A[I,1]
15: dsp "enter northing,(meters) mike",N+1-I
16: ent "",A[I,2]
17: next I;gto 23
18: ent "are mike coordinates correct ?",Q$;if Q$="+";gto 50
19: ent "which mike has error in coord. ?",r26
20: fxd 0;dsp "enter correct easting,mike",r26;ent "",A[N-r26+1,1]
21: dsp "enter correct northing,mike",r26;ent "",A[N-r26+1,2]
22: ent "are other coordinates in error ?",Q$;if Q$="+";gto 19
23: rcf 5,A[*]
24: rcf 11,A[*]
25: fdf 11
26: 0→r11;0→r12
27: for I=1 to N;A[I,1]→Y[I];A[I,2]→G[I];next I
28: for I=1 to N;r11+Y[I]→r11;r12+G[I]→r12;next I;r11/N→r11;r12/N→r12
29: for I=1 to N;A[I,1]-r11→A[I,1];A[I,2]-r12→A[I,2];next I
30: if abs(A[N,1]-A[1,1])#abs(A[N,2]-A[1,2]);gto 36
31: if A[N,1]-A[1,1]=A[N,2]-A[1,2];gto 34
32: if A[N,1]-A[1,1]>0;gto 44
33: sfg 5;gto 42
34: if A[N,2]-A[1,2]>0;gto 44
35: sfg 5;gto 42
36: if max(abs(A[N,1]-A[1,1]),abs(A[N,2]-A[1,2]))=abs(A[N,2]-A[1,2]);sfg 12
37: if flg12;gto 39
38: gto 40
39: gsb "rot1"
40: if A[N,1]-A[1,1]>0;gto 44
41: sfg 5
42: for I=N to 1 by -1;A[I,1]→B[N-I+1,1];A[I,2]→B[N-I+1,2];next I
43: sfg 4;gto 46
44: for I=1 to N
45: A[I,1]→B[I,1];A[I,2]→B[I,2];next I
46: if flg12;gto 48
47: for I=1 to N;Y[I]→A[I,1];G[I]→A[I,2];next I;gto 49
48: for I=1 to N;Y[I]+r12→A[I,1];G[I]-r11→A[I,2];next I
49: if N[4]=1;0→N[4];gto 54
50: if A=1;gto 53
51: ent "is new met message available ?",Q$
52: if Q$="+";cfg 8;gto "met"
53: sfg 8
54: ina M;0
*7407
```

```
55: if A=0;fxd 0;dsp "    READY FOR TARGET DATA ?";stp
56: if A=1;fxd 0;dsp "   READY FOR ADJUSTMENT DATA ?";stp
57: fxd 0
58: for I=N to 1 by -1;fxd 0
59: dsp "is brk. time available,mike",N-I+1,"?";ent "",Q$
60: if Q$="-";gto 64
61: if Q$="+";gto 63
62: 1→M[I];val(Q$)→A[I,3];gto 64
63: 1→M[I];dsp "enter break time,mike",N+1-I;ent "",A[I,3]
64: if M[I]=0;prt "              *";gto 66
65: fxd 3;prt A[I,3]
66: next I;spc 2;fxd 0
67: ent "are break times correct ?",Q$
68: if Q$="+";gto 77
69: prt "BREAK TIME EDIT";spc
70: ent "which mike has break time error?",r33
71: fxd 0;prt "mike",r33
72: dsp "enter correct break time,mike",r33;ent "",A[N-r33+1,3]
73: fxd 3;prt A[N-r33+1,3];spc
74: 1→M[N-r33+1]
75: ent "is another break time in error ?",Q$;if Q$="+";gto 70
76: spc
77: 0→r5;for I=N to 1 by -1;if M[I]=0;gto 79
78: r5+1→r5;A[I,3]→B[N-r5+1,3]
79: next I
80: if r5>=3;gto 82
81: dsp "ERROR-less than 3 mikes entered";wait 5000;gto 51
82: if r5=N;gto 93
83: for I=N-r5+1 to N;B[I,3]→B[I-N+r5,3];next I
84: for I=r5+1 to N;9999999→B[I,3];next I
85: if flg4;gto 87
86: gto 91
87: for I=r5 to 1 by -1;B[I,3]→Y[r5-I+1];next I
88: for I=N to 1 by -1;M[I]→G[N-I+1];next I
89: for I=1 to r5;Y[I]→B[I,3];next I
90: for I=1 to N;G[I]→M[I];next I
91: r5→r26
92: gto 99
93: if flg4;gto 95
94: gto 99
95: for I=r5 to 1 by -1;B[I,3]→Y[r5-I+1];next I
96: for I=N to 1 by -1;M[I]→G[N-I+1];next I
97: for I=1 to r5;Y[I]→B[I,3];next I
98: for I=1 to N;G[I]→M[I];next I
99: r5-1→C[1];r5-2→C[2];C[1]C[2]/2→C[3];r5→C[4]
100: deg
101: r5→r26
102: 0→r5→r6→r7;337.5→C[5]
103: if flg10;cfg 10;gto 108
104: for I=1 to N;r5+M[I]→r5
105: if M[I]=0;gto 107
106: B[I,1]→B[r5,1];B[I,2]→B[r5,2]
107: next I
108: r26→r5
109: for I=1 to C[1]
*5624
```

```
110: B[I+1,1]-B[I,1]→D[I,1];B[I+1,2]-B[I,2]→D[I,2]
111: √(D[I,1]D[I,1]+D[I,2]D[I,2])→D[I,3];D[I,3]/C[5]→D[I,4]
112: (B[I+1,1]+B[I,1])/2→X[I,1];(B[I+1,2]+B[I,2])/2→X[I,2]
113: D[I,1]→S[1];D[I,2]→S[2];gsb "atan2"
114: if S[3]>270;S[3]-360→S[3]
115: S[3]-90→S[3]
116: S[3]→D[I,5];next I
117: r3/283.16→Q[1];C[5]C[5]Q[1]→Q[2];√Q[1]-1→Q[3]
118: deg
119: r1→S[1];r2→S[2];gsb "atan2"
120: S[3]→B
121: √(r1r1+r2r2)→W
122: for I=1 to C[1];B[I,3]-B[I+1,3]→D[I,6];D[I,5]-B+90→G[I];next I
123: for I=1 to C[1];D[I,6]Q[3]→E[I,1]
124: D[I,3]cos(G[I])(-W)/Q[2]→E[I,2]
125: D[I,6]+E[I,1]+E[I,2]→D[I,6]
126: next I
127: rad
128: for I=1 to C[1];if abs(D[I,6]/D[I,4])>1;gto 130
129: asn(D[I,6]/D[I,4])→H[I];gto 131
130: D[I,6]/D[I,4]/abs(D[I,6]/D[I,4])→C[6];asn(C[6])→H[I]
131: if flg4;gto 133
132: H[I]+(D[I,5]/180)π→P[I];gto 134
133: (-H[I]+(D[I,5]/180)π→P[I]
134: next I
135: gto 153
136: "met":deg;if flg8;cfg 8;gto 99
137: ent "enter effective temp.(C.)",r3
138: r3+273.16→r3;20.06√r3→r4
139: ent "enter eff. wind speed(knots)",r8
140: ent "enter eff. wind direction(mils)",r9
141: r8*.5146789→r8;r9/17.7777778→r9;-r8sin(r9)→r1;-r8cos(r9)→r2
142: if flg12;gto 144
143: rcf 4,r1,r4;rcf 10,r1,r4;fdf 11;gto 53
144: -r2→F;r1→r2;F→r1;rcf 4,r1,r4;rcf 10,r1,r4;fdf 11;gto 53
145: "atan2":if S[2]=0;gto 150
146: atn(S[1]/S[2])→S[3]
147: if S[2]<0;S[3]+180→S[3];ret
148: if S[3]>0;ret
149: S[3]+360→S[3];ret
150: if S[1]=0;0→S[3];ret
151: if S[1]>0;90→S[3];ret
152: 270→S[3];ret
153: deg
154: 0→M;rdm S[2]
155: for I=1 to C[2];I+1→K
156: for J=K to C[1]
157: M+1→M
158: 1→Z[1,1];-tan(-180+P[I]*180/π)→Z[1,2];1→Z[2,1]
159: -tan(-180+P[J]*180/π)→Z[2,2]
160: X[I,1]-tan(-180+P[I]*180/π)X[I,2]→S[1]
161: X[J,1]-tan(-180+P[J]*180/π)X[J,2]→S[2]
162: inv Z→Z;mat ZS→R;R[1]→O[M,1]→O[M,3];R[2]→O[M,2]→O[M,4]
163: next J
164: next I
*18595
```

```
165: rdm S[3]
166: rad
167: rdm T[10];ina T:-9999999
168: rdm P[10];ina P:-9999999
169: (r5-1)(r5-2)/2→C[10];C[10]-1→r13
170: for J=1 to r13
171: for K=J to C[10];O[K,1]→T[K]
172: O[K,2]→P[K]
173: next K
174: max(T[*])→r8;max(P[*])→r9
175: if O[J,1]=r8;-999999→T[J];gto 181
176: for Z=J to C[10];if r8#O[Z,1];gto 178
177: Z→L
178: next Z
179: O[J,1]→r14;r8→O[J,1];r14→O[L,1]
180: if O[J,2]=r9;-9999999→P[J];gto 185
181: for Z=J to C[10];if r9#O[Z,2];gto 183
182: Z→L
183: next Z
184: O[J,2]→r14;r9→O[J,2];r14→O[L,2]
185: -9999999→T[J];-9999999→P[J]
186: next J
187: if C[10]mod2=0;gto 189
188: int(C[10]/2)+1→r8;O[r8,1]→r13;O[r8,2]→r14;gto 191
189: C[10]/2→r8;r8+1→C[8];r8→C[9];(O[C[8],1]+O[C[9],1])/2→r13
190: (O[C[8],2]+O[C[9],2])/2→r14
191: if flg2;gto 201
192: for I=1 to C[1]
193: r13-B[I,1]→Y[1];r14-B[I,2]→Y[2];I+1→S
194: r13-B[S,1]→Y[3];r14-B[S,2]→Y[4]
195: D[I,3]D[I,3]→Y[5];Y[3]Y[3]+Y[4]Y[4]→Y[6];Y[1]Y[1]+Y[2]Y[2]→G[1]
196: \G[1]→G[2];\Y[6]→G[3];(G[1]+Y[6]-Y[5])/2G[2]G[3]→G[4]
197: acs(G[4])→G[5];sin(G[5]/2)→G[6];\(1+G[6]G[6])→R
198: D[I,6](R-1)→D[I,7];D[I,6]+D[I,7]→D[I,6];next I
199: sfg 2;gto 127
200: 0→r5;for I=1 to N;r5+M[I]→r5;next I
201: if r5=3;gto 202
202: if flg12;gsb "rot2"
203: if A=1;gto 214
204: fxd 0;prt " SOUND RANGING        TARGET";spc
205: fxd 1;prt "easting",r13+r11;spc
206: prt "northing",r14+r12;spc
207: gsb "spread"
208: prt "spread",max(T[*]);spc 3
209: if A=1;gto 211
210: r11+r13→r30;r12+r14→r31;1→A
211: for I=1 to N;A[I,1]→Y[I];A[I,2]→G[I];next I
212: ldf 11,A[*];cfg 12
213: sfg 1;cfg 2;cfg 3;gto 29
214: fxd 0;prt "ADJUSTMENT",G+1;spc
215: if r13+r11-r30<0;gto 217
216: fxd 0;prt "LEFT",r13+r11-r30;spc ;gto 218
217: fxd 0;prt "RIGHT",abs(r13+r11-r30);spc
218: if r14+r12-r31<0;gto 220
219: prt "DROP",r14+r12-r31;spc ;gto 221
*27650
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```
220: prt "ADD",abs(r14+r12-r31);spc
221: fxd 1;gsb "spread"
222: prt "SPREAD",max(T[*]);spc 2;fxd 0
223: if \((r13+r11-r30)^2+(r14+r12-r31)^2))100;gto 227
224: for I=1 to N;A[I,1]}Y[I];A[I,2]}G[I];next I
225: ldf 11,A[*];cfg 12;sfg 1;cfg 2;cfg 3;0}A
226: prt "FIRE          FOR     EFFECT";spc 2;gto 29
227: for I=1 to N;A[I,1]}Y[I];A[I,2]}G[I];next I
228: ldf 11,A[*];cfg 12
229: cfg 2;cfg 3
230: ent "another adjusting round ?",Q$
231: if Q$="+";1}A;G+1}G;gto 29
232: 0}A}G;gto 29
233: "rot1":ina Y:0;ina G:0;deg;for I=1 to N;-A[I,2]}Y[I];A[I,1]}G[I];next I
234: for I=1 to N;Y[I]}A[I,1];G[I]}A[I,2];next I;ret
235: "rot2":deg;r14}Y[1];-r13}Y[2];Y[1]}r13;Y[2]}r14;ret
236: "timing":
237: dsp " BREAK TIME READING ASSISTANCE";wait 2000
238: ent "use coordinates of last target ?",Q$
239: if Q$="+";gto 242
240: ent "enter easting,estimated target",r13;r13-r11}r13
241: ent "enter northing,estimated target",r14;r14-r12}r14
242: if flg12;gto 244
243: gto 245
244: -r14}Y[1];r13}G[1];Y[1]}r13;G[1]}r14
245: ent "which mike has sharpest break ?",N[1]
246: fxd 0;dsp "enter break time,mike",N[1];ent "",N[2]
247: ldf 11,A[*]
248: for I=1 to N;A[I,1]-r11}B[I,1];A[I,2]-r12}B[I,2];next I
249: if flg12;gto 251
250: gto 252
251: for I=1 to N;-B[I,2]}Y[I];B[I,1]}G[I];Y[I]}B[I,1];G[I]}B[I,2];next I
252: \(r1r1+r2r2)}W
253: for I=1 to N;(r13-B[I,1])(r13-B[I,1])+(r14-B[I,2])(r14-B[I,2])}G[I]
254: r1(B[I,1]-r13)+r2(B[I,2]-r14)}Y[I]
255: (-Y[I]+\(Y[I]Y[I]+(r4r4-WW)G[I]))/(r4r4-WW)}T[I];next I
256: T[N-N[1]+1]-N[2]}N[3]
257: for I=1 to N;T[I]-N[3]}T[I];next I
258: fxd 0;prt "BREAK TIMES     NORMALIZED TO   MIKE",N[1];spc 2
259: for I=N to 1 by -1;fxd 0;prt "mike",N-I+1
260: fxd 3;prt "brk. time",T[I];spc ;next I
261: spc 2
262: cfg 12;1}N[4];gto 26
263: "mike":ldf 11,A[*]
264: prt "MIKE COORDINATES";spc
265: for I=N to 1 by -1
266: fxd 0;prt "mike",N-I+1;fxd 1;prt "easting",A[I,1];prt "northing",A[I,2]
267: spc ;next I
268: spc 2
269: gto 18
270: "met1":deg
271: prt "MET. VALUES";spc
272: fxd 1;prt "temp.",r3-273.16;spc 1
273: prt "wind spd.",\(r1^2+r2^2)/.5146789;spc
274: if flg12;-r2}S[1];r1}S[2];gsb "atan2"
*12328
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```
275: if flg12;gto 277
276: -r1}S[1];-r2}S[2];gsb "atan2"
277: S[3]*17.77777778mod6400}S[3]
278: fxd 0;prt "wind dir.",S[3];spc 2
279: gto 51
280: "spread":ina T:0
281: if flg12;gto 283
282: for I=1 to C[10];\((O[I,3]-r13)^2+(O[I,4]-r14)^2)}T[I];next I;0}A;ret
283: for I=1 to C[10];\((O[I,3]+r14)^2+(O[I,4]-r13)^2)}T[I];next I;0}A;ret
284: "INDEX":
285: prt "TO CALL DESIRED PROGRAM";spc
286: prt "ENTER PROGRAM   NUMBER";spc
287: prt "PRESS CONTINUE";spc
288: prt "1 SOUND RANGING"
289: prt "2 SOUND ON SOUND"
290: prt "3 VISUAL MET."
291: prt "4 FLASH RANGING"
292: prt "5 FLASH ADJT."
293: prt "6 LASER RFDR."
294: prt "7 LASER RFDR.     ADJT."
295: prt "8 LASER RFDR.     TRILATERATION";spc 2
296: ent "enter program number",N
297: if N=1;ldp 2
298: if N=2;ldp 8
299: if N=3;ldp 12
300: if N=4;ldp 14
301: if N=5;ldp 19
302: if N=6;ldp 22
303: if N=7;ldp 27
304: if N=8;ldp 30
*4365
```

LISTING

VISUAL MET

PROGRAM

FILE 11

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE VISUAL MET PROGRAM

FILE 12

```
f0:   *beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f1:   beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f2:   beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f3:   beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f4:   beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f5:   beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f6:   *cont "ORIENT"
f7:   *dsp "SOUND RANGING PROGRAM INITIATED"; ldp2
f8:   *dsp "SOUND ON SOUND PROGRAM INITIATED"; ldp8
f9:   beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f10:  beep; dsp "WRONG KEY!***PRESS (continue)"; gto 5
f11:  *cont "INDEX"
```

```
0: dim K[5,4],L[2,5],W[2,5],J[5],I[5],V[8],S[3],F[5],Q$[1],T[2],H[2],U[2]
1: dim E[3],A[6,3]
2: ldk 13
3: dsp "    VISUAL MET. CALCULATION";wait 3000
4: 1→Z
5: sfg 1
6: fxd 0;prt "DATA SET",Z;spc 2
7: fxd 1;ent "enter dry bulb temp. (C.)",r10;if flg1;prt r10
8: ent "enter wet bulb temp. (C.)",r11;if flg1;prt r11
9: .6215→E;1.98624→R;597.3→L;18.016→M;.24→C;.441→W;990→P
10: r10+273.16→r10;r11+273.16→r11;r10-r11→D
11: (ML/R)(1/273.16-1/r11)→E[1];6.11exp(E[1])→E[2]
12: (1-.0005E[2])E[2]→E[3];E*E[3]/(P-E[3])→H[1];(LH[1]-CD)/(WD+L)→H[2]
13: (1+H[2]/E)r10/(1+H[2])-273.16→T[1]
14: (3T[1]+(r10-273.16))/4→T[2]
15: ent "enter time of day correction",r13;if flg1;prt r13;spc 2
16: if flg1;ent "is temperature data correct ?",Q$;if Q$="-";gto 7
17: T[2]+r13→r14
18: fxd 1;prt "eff. temp.",r14;spc 2
19: ent "compute effective wind ?",Q$;if Q$="-";gto 83
20: fxd 1;ent "enter offset azimuth(deg.)",J[1];if flg1;prt J[1]
21: ent "enter offset distance(meters)",V[4];if flg1;prt V[4];spc 2
22: if flg1;ent "is offset data correct ?",Q$;if Q$="-";gto 20
23: fxd 0;deg
24: 0→F[1];.9→F[2];1.9→F[3];2.9→F[4];3.9→F[5]
25: fxd 0;ent "enter sur. elevation angle(deg.)",A;if flg1;fxd 1;prt "sur.",A
26: fxd 1;ent "enter sur. azimuth angle(deg.)",B;if flg1;prt B;spc
27: if flg1;ent "is data entry correct ?",Q$;if Q$="-";gto 25
28: ent "enter 200M elevation angle(deg.)",I[2];if flg1;prt "200M",I[2]
29: ent "enter 200M azimuth angle(deg.)",J[2];if flg1;prt J[2];spc
30: if flg1;ent "is data entry correct ?",Q$;if Q$="-";gto 28
31: ent "enter 400M elevation angle(deg.)",I[3];if flg1;prt "400M",I[3]
32: ent "enter 400M azimuth angle(deg.)",J[3];if flg1;prt J[3];spc
33: if flg1;ent "is data entry correct ?",Q$;if Q$="-";gto 31
34: ent "enter 600M elevation angle(deg.)",I[4];if flg1;prt "600M",I[4]
35: ent "enter 600M azimuth angle(deg.)",J[4];if flg1;prt J[4];spc
36: if flg1;ent "is data entry correct ?",Q$;if Q$="-";gto 34
37: ent "enter 800M elevation angle(deg.)",I[5];if flg1;prt "800M",I[5]
38: ent "enter 800M azimuth angle(deg.)",J[5];if flg1;prt J[5];spc 2
39: if flg1;ent "is data entry correct ?",Q$;if Q$="-";gto 37
40: for I=1 to 5
41: V[4]sin(J[I])→K[I,1];V[4]cos(J[I])→K[I,2];2I→J;I+1→O
42: if O=6;gto 44
43: 100J/tan(I[O])→V[4]
44: next I
45: 55/tan(A)→D;Dsin(B)→U[1];Dcos(B)→U[2]
46: (U[1]-K[1,1])/15→U[1];(U[2]-K[1,2])/15→U[2]
47: \(U[1]U[1]+U[2]U[2])/.5146789→V[6];U[1]→S[1];U[2]→S[2];gsb "atan2"
48: S[3]→V[5];(V[5]+180)mod360→V[5]
49: if V[5]>90;gto 51
50: -sin(V[5])V[6]→L[2,1];-V[6]cos(V[5])→W[2,1];gto 56
51: if V[5]>180;gto 53
52: -cos(V[5]-90)V[6]→L[2,1];sin(V[5]-90)V[6]→W[2,1];gto 56
53: if V[5]>270;gto 55
54: sin(V[5]-180)V[6]→L[2,1];cos(V[5]-180)V[6]→W[2,1];gto 56
*22094
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55: cos(V[5]-270)V[6])L[2,1];-sin(V[5]-270)V[6])W[2,1]
56: \(L[2,1]L[2,1]+W[2,1]W[2,1]))K[1,4]
57: for I=1 to 4;I+1)J;(K[J,1]-K[I,1])/60(F[J]-F[I]))L[1,J]
58: (K[J,2]-K[I,2])/60(F[J]-F[I]))W[1,J];L[1,J]/.5146789)L[2,J]
59: W[1,J]/.5146789)W[2,J];\(L[2,J]^2+W[2,J]^2))K[J,4];next I
60: if K[3,4]>=K[2,4];gto 68
61: abs(K[3,4]-K[1,4]))V[7];if V[7]<=2;gto 65
62: K[3,4])S;L[2,3])S[1];W[2,3])S[2]
63: gsb "atan2"
64: gto 78
65: K[2,4])S;L[2,2])S[1];W[2,2])S[2]
66: gsb "atan2"
67: gto 78
68: K[3,4]-2K[2,4])V[7];if V[7]>0;gto 74
69: .2L[2,1]+.5L[2,2]+.15L[2,3]+.075L[2,4]+.075L[2,5])S[1]
70: .2W[2,1]+.5W[2,2]+.15W[2,3]+.075W[2,4]+.075W[2,5])S[2]
71: \(S[1]S[1]+S[2]S[2]))V[8])S
72: gsb "atan2"
73: gto 78
74: .4L[2,1]+.3L[2,3]+.15L[2,4]+.15L[2,5])S[1]
75: .4W[2,1]+.3W[2,3]+.15W[2,4]+.15W[2,5])S[2]
76: \(S[1]S[1]+S[2]S[2]))V[8])S
77: gsb "atan2"
78: S[3]*17.777778+3200)r9;if r9<6400;gto 80
79: r9-6400)r9
80: gto 81
81: fxd 1;prt "eff. wind spd.",S;spc
82: fxd 1;prt "eff. wind dir.",r9;spc 2
83: ent "another calculation ?",Q$;if Q$="+";cfg 1;Z+1)Z;gto 5
84: ent "is met. data to be used now ?",Q$;if Q$="+";gto "ORIENT"
85: dsp "      PROGRAM COMPLETED!!!";wait 3000;gto "INDEX"
86: "atan2":if S[2]=0;gto 91
87: atn(S[1]/S[2]))S[3]
88: if S[2]<0;S[3]+180)S[3];ret
89: if S[3]>0;ret
90: S[3]+360)S[3];ret
91: if S[1]=0;0)S[3];ret
92: if S[1]>0;90)S[3];ret
93: 270)S[3];ret
94: "ORIENT":dsp "   MET. ORIENTATION INITIATED";wait 2000;ldf 11,A[*]
95: ent "how many mikes in sound base ?",N
96: if abs(A[N,2]-A[1,2])>abs(A[N,1]-A[1,1]);sfg 12
97: r14+273.16)r3;20.06\r3)r4
98: S*.5146789)S;r9/17.7777778)r9;-Ssin(r9))r1;-Scos(r9))r2
99: if flg12;-r2)F;r1)r2;F)r1
100: rcf 4,r1,r4;rcf 10,r1,r4
101: dsp "    INITIATE DESIRED PROGRAM";stp
102: "INDEX":
103: prt "TO CALL DESIRED PROGRAM";spc
104: prt "ENTER PROGRAM   NUMBER";spc
105: prt "PRESS CONTINUE";spc
106: prt "1 SOUND RANGING"
107: prt "2 SOUND ON SOUND"
108: prt "3 VISUAL MET."
109: prt "4 FLASH RANGING"
*2879
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110: prt "5 FLASH ADJT."
111: prt "6 LASER RFDR."
112: prt "7 LASER RFDR.      ADJUSTMENT"
113: prt "8 LASER RFDR.      TRILATERATION";spc 2
114: ent "enter program number",N
115: if N=1;ldp 2
116: if N=2;ldp 8
117: if N=3;ldp 12
118: if N=4;ldp 14
119: if N=5;ldp 19
120: if N=6;ldp 22
121: if N=7;ldp 27
122: if N=8;ldp 30
123: end
*190
```

LISTING

FLASH RANGING

PROGRAM

FILE 13

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE FLASH RANGING PROGRAM

FILE 14

f_0: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_1: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_2: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_3: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_4: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_5: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_6: *cont "OP"

f_7: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_8: *cont "TARGET"

f_9: *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18

f_{10}: *dsp "ADJUSTMENT MODE INITIATED"; rcf 17, G; rcf 18, Z[*]; ldp19

f_{11}: *cont "INDEX"

```
0: dim P[6,3],A[6,2],Q$[7],M[6],Y[6],G[6],B[6],C[10],E[2,2],O[2],F[2]
1: dim X[10,5],T[6],D[6],U[10],V[10],Z[100,4],S[3],Q[3],R[10]
2: dim N[6],I[30],J[6,2]
3: ldk 15
4: dsp "          FLASH RANGING";wait 3000
5: deg
6: .1→I[1];.2→I[2];.6→I[3];1→I[4];1.5→I[5];2.2→I[6];3→I[7];3.9→I[8]
7: 5→I[9];6.2→I[10];7.4→I[11];8.9→I[12];10.4→I[13];12.1→I[14];13.9→I[15]
8: 15.8→I[16];17.8→I[17];19.9→I[18];22.2→I[19];24.6→I[20];27.1→I[21]
9: 29.8→I[22];32.6→I[23];35.5→I[24];38.5→I[25];41.6→I[26];44.9→I[27]
10: 48.3→I[28];51.8→I[29];55.4→I[30]
11: ent "are earlier targets stored ?",Q$;if Q$="-";gto 13
12: ldf 17,G;ldf 18,Z[*];gto 14
13: ina Z:0
14: ent "enter number of flash OPs",N;rdm M[N]
15: rdm N[N]
16: ent "are OP coordinates stored ?",Q$
17: if Q$="-";gto 20
18: ldf 16,P[*]
19: gto 31
20: fxd 0;for I=1 to N;dsp "enter easting,OP",I;ent "",P[I,1]
21: dsp "enter northing,OP",I;ent "",P[I,2]
22: dsp "enter height,OP",I;ent "",P[I,3]
23: next I;gto 30
24: ent "are O.P. coordinates correct ?",Q$;if Q$="+";gto 31
25: ent "which O.P. is in error ?",O
26: fxd 0;dsp "enter correct easting,O.P.",O;ent "",P[O,1]
27: dsp "enter correct northing,O.P.",O;ent "",P[O,2]
28: dsp "enter correct height,O.P.",O;ent "",P[O,3]
29: ent "are other coordinates in error ?",Q$;if Q$="+";gto 25
30: rcf 16,P[*];rcf 21,P[*];fdf 16
31: for I=1 to N;P[I,1]→Y[I];P[I,2]→G[I];next I
32: 0→r1;0→r2;for I=1 to N;r1+Y[I]→r1;r2+G[I]→r2;next I;r1/N→r1;r2/N→r2
33: for I=1 to N;P[I,1]-r1→G[I];P[I,2]-r2→Y[I];next I
34: ina M:0
35: ina N:0
36: fxd 0
37: 0→r3;0→r4;for I=1 to N;dsp "is data available,OP",I,"?";ent "",Q$
38: if Q$="-";gto 52
39: if Q$="+";gto 41
40: 1→M[I];r3+M[I]→r3;val(Q$)/17.77777778→A[r3,1];prt val(Q$);gto 43
41: 1→M[I];r3+M[I]→r3;dsp "enter azimuth(mils),OP",I
42: ent "",A[r3,1];prt A[r3,1];A[r3,1]/17.7777778→A[r3,1]
43: dsp "is vert. angle available,OP",I,"?";ent "",Q$
44: if Q$="-";gto 51
45: if Q$="+";gto 47
46: 1→N[I];r4+1→r4;val(Q$)/17.77777778→A[r4,2];prt val(Q$);spc ;gto 50
47: 1→N[I];r4+1→r4
48: dsp "enter vertical angle(mils),OP",I;ent "",A[r4,2]
49: prt A[r4,2];spc ;A[r4,2]/17.77777778→A[r4,2]
50: G[I]→G[r3];Y[I]→Y[r3];gto 54
51: G[I]→G[r3];Y[I]→Y[r3];gto 53
52: prt "                *"
53: prt "                *";spc
54: next I;spc
*9705
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```
55: if flg1;cfg 1;gto 57
56: gsb "EDIT"
57: if r4=0;dsp "ERROR!-NO HEIGHT DATA";wait 5000;gto 37
58: if r3≠2;gto 60
59: dsp "WARNING-ONLY TWO OPs REPORTING!";wait 3000;gto 61
60: if r3=1;gto "one OP"
61: for I=1 to r3;tan(A[I,1])→D[I];G[I]-D[I]Y[I]→B[I]
62: next I
63: r3→C[1];r3-1→C[2];0→M
64: for I=1 to C[2];I+1→K
65: for J=K to C[1]
66: M+1→M
67: 1→E[1,1];-D[I]→E[1,2];1→E[2,1];-D[J]→E[2,2];B[I]→F[1];B[J]→F[2]
68: inv E→E;mat EF→O;O[1]+r1→X[M,1]→X[M,4];O[2]+r2→X[M,2]→X[M,5]
69: next J
70: next I
71: r3(r3-1)/2→C[3];C[3]-1→C[4]
72: ina V:-9999999;for I=1 to C[3];X[I,1]→V[I];next I;gsb "median"
73: C[10]→r10
74: ina V:-9999999;for I=1 to C[3];X[I,2]→V[I];next I;gsb "median"
75: C[10]→r11
76: gsb "height"
77: ina V:-9999999;for I=1 to C[3];X[I,3]→V[I];next I;gsb "median"
78: C[10]→r14;gto 94
79: "median":ina U:-999999
80: for J=1 to C[4]
81: for K=J to C[3];V[K]→U[K];next K
82: max(U[*])→r6
83: if V[J]=r6;gto 88
84: for Z=J to C[3];if r6≠V[Z];gto 86
85: Z→L
86: next Z
87: V[J]→r8;r6→V[J];r8→V[L]
88: -9999999→U[J]
89: next J
90: if C[3]mod2=0;gto 92
91: int(C[3]/2)+1→r6;V[r6]→C[10];ret
92: C[3]/2→r6;r6+1→C[5];r6→C[6]
93: (V[C[6]]+V[C[5]])/2→C[10];ret
94: prt "FLASH RANGING   TARGET ",G+1;spc
95: fxd 1;prt "easting",r10;spc
96: prt "northing",r11;spc
97: prt "height",r14;spc
98: for I=1 to M;√((X[I,4]-r10)^2+(X[I,5]-r11)^2)→R[I];next I
99: prt "spread",max(R[*]);spc
100: ina B:0;ina R:0
101: G+1→G
102: ent "enter day,time ex.122130",H
103: fxd 0;prt "time",H;spc 2
104: if Gmod100=0;dsp "100 TARGETS RECORDED!!!";wait 4000
105: Gmod10→r24;if r24mod10=0;gto 109
106: 11-r24→r24
107: r10→Z[r24,1];r11→Z[r24,2];r14→Z[r24,3];H→Z[r24,4];ldf 16,P[*]
108: cfg 1;ina M:0;gto 31
109: r10→Z[1,1];r11→Z[1,2];r14→Z[1,3];H→Z[1,4]
*16606
```

```
110: for I=90 to 1 by -1;Z[I,1])Z[I+10,1];Z[I,2])Z[I+10,2];Z[I,3])Z[I+10,3]
111: Z[I,4])Z[I+10,4]
112: next I
113: rcf 17,G;rcf 18,Z[*]
114: for I=1 to 10;0)Z[I,1])Z[I,2])Z[I,3])Z[I,4]:next I
115: cfg 1;ldf 16,P[*];ina M:0;gto 31
116: "height":for I=1 to N
117: P[I,1])X[I,1];P[I,2])X[I,2];P[I,3])X[I,3]
118: next I
119: 0)r4;for I=1 to N;if N[I]=0;gto 121
120: r4+1)r4;X[I,1])X[r4,1];X[I,2])X[r4,2];X[I,3])X[r4,3]
121: next I
122: for I=1 to r4
123: \((r10-X[I,1])^2+(r11-X[I,2])^2))X[I,2];if A[I,2]>0;gto 125
124: X[I,3]-X[I,2]tan(-A[I,2]))X[I,3]:gto 126
125: X[I,3]+X[I,2]tan(A[I,2]))X[I,3]
126: next I
127: for I=1 to r4;int(X[I,2]/1000))r28;X[I,2]/1000-r28)r29
128: if r28=0;gto 132
129: if r28>0;gto 131
130: X[I,3]+I[30])X[I,3];gto 133
131: (I[r28+1]-I[r28])r29+I[r28]+X[I,3])X[I,3];gto 133
132: I[1]r29+X[I,3])X[I,3]
133: next I
134: ret
135: "atan2":if S[2]=0;gto 140
136: atn(S[1]/S[2]))S[3]
137: if S[2]<0;S[3]+180)S[3];ret
138: if S[3]>0;ret
139: S[3]+360)S[3];ret
140: if S[1]=0;0)S[3];ret
141: if S[1]>0;90)S[3];ret
142: 270)S[3];ret
143: "one OP":
144: for I=1 to N;if M[I]=0;gto 148
145: prt "OP",I,"    REPORTING";spc 2
146: dsp "enter distance to target,OP",I;ent "",r15;I)L
147: prt "dist. to target",r15;spc
148: next I
149: for M=1 to 3;P[L,M])Q[M];next M
150: for I=1 to N;P[I,1]-Q[1])P[I,1];P[I,2]-Q[2])P[I,2]
151: P[I,3]-Q[3])P[I,3]
152: next I
153: A[1,1])A[L,1];A[1,2])A[L,2]
154: r15cos(abs(A[L,2])))r16;if A[L,2]>0;gto 156
155: P[L,3]-r16tan(abs(A[L,2])))Z;gto 157
156: P[L,3]+r16tan(abs(A[L,2])))Z
157: r16sin(A[L,1]))X;r16cos(A[L,1]))Y
158: for I=1 to N;if M[I]#0;gto 167
159: X-P[I,1])S[1];Y-P[I,2])S[2];gsb "atan2"
160: S[3]*17.77777778)A[I,1]
161: Z-P[I,3])S[1];r16)S[2];gsb "atan2"
162: if S[3]>90;gto 164
163: S[3])A[I,2];gto 165
164: S[3]-360)A[I,2]
*32419
```

```
165: prt "set azimuth     OP",I,"at",A[I,1];spc
166: prt "set vert. ang.  OP",I,"at",A[I,2]*17.77777778;spc
167: next I
168: spc
169: ldf 16,P[*]
170: sfg 7;ina M:0;gto 31
171: "OP":
172: prt " OP COORDINATES";spc
173: for I=1 to N
174: fxd 0;prt "OP",I;fxd 1;prt "easting",P[I,1];prt "northing",P[I,2]
175: prt "height",P[I,3];spc ;next I
176: spc
177: gto 24
178: "TARGET":prt "FLASH RANGING   TARGET LISTING";spc ;0)S[1]
179: for I=1 to int(G/10)+1
180: if 10(I-1)<=G;I-1)L
181: next I
182: fxd 0;for I=10(L+1) to 11-G+10L by -1;prt "target",10(L+1)-I+1
183: spc ;prt "time",Z[I,4]
184: spc ;prt "easting",Z[I,1];spc ;prt "northing",Z[I,2];spc
185: prt "height",Z[I,3];spc 3
186: S[1]+1)S[1]
187: if S[1]mod10>0;gto 189
188: ent "next 10 targets ?",Q$;if Q$="-";gto 31
189: next I
190: dsp "       ALL TARGETS LISTED!!!";wait 3000;gto 31
191: "INDEX":rcf 17,G;rcf 18,Z[*]
192: prt "TO CALL DESIRED PROGRAM";spc
193: prt "ENTER PROGRAM   NUMBER";spc
194: prt "PRESS CONTINUE";spc
195: prt "1 SOUND RANGING"
196: prt "2 SOUND ON SOUND"
197: prt "3 VISUAL MET."
198: prt "4 FLASH RANGING"
199: prt "5 FLASH ADJT."
200: prt "6 LASER RFDR."
201: prt "7 LASER RFDR.     ADJUSTMENT"
202: prt "8 LASER RFDR.     TRILATERATION"
203: spc 2
204: ent "enter program number",N
205: if N=1;ldp 2
206: if N=2;ldp 8
207: if N=3;ldp 12
208: if N=4;ldp 14
209: if N=5;ldp 19
210: if N=6;ldp 22
211: if N=7;ldp 27
212: if N=8;ldp 30
213: "EDIT":ent "is input data correct ?",Q$
214: if Q$="+";gto 244
215: prt "   INPUT EDIT";spc
216: ina J;0
217: r3)r31;r4)r33
218: for I=N to 1 by -1;if M[I]=0;gto 220
219: A[r31,1])J[I,1];r31-1)r31
*18161
```

```
220: next I
221: for I=N to 1 by -1;if N[I]=0;gto 223
222: A[r33,2]→J[I,2];r33-1→r33
223: next I
224: ent "which OP is in error ?",r30
225: prt "OP",r30
226: dsp "enter correct azimuth,OP",r30;ent "",r32;prt "azimuth",r32
227: r32/17.7777778→J[r30,1];1→M[r30]
228: dsp "is vert. ang. available,OP",r30," ?";ent "",Q$
229: if Q$="-";0→N[r30]→J[r30,2];prt "       *";gto 235
230: if Q$="+";gto 232
231: val(Q$)→r32;gto 233
232: dsp "enter correct vert. ang.,OP",r30;ent "",r32
233: prt "vert. ang.",r32;spc
234: r32/17.7777778→J[r30,2];1→N[r30]
235: ent "is any other OP in error ?",Q$
236: if Q$="+";r3→r31;gto 224
237: 0→r3;for I=1 to N;0→A[I,1];if M[I]=0;gto 239
238: r3+1→r3;J[I,1]→A[r3,1];P[I,1]-r1→G[r3];P[I,2]-r2→Y[r3]
239: next I
240: 0→r4;for I=1 to N;0→A[I,2];if N[I]=0;gto 242
241: r4+1→r4;J[I,2]→A[r4,2]
242: next I
243: sfg 1;gto 57
244: ret
*6867
```

LISTING

FLASH ADJUSTMENT

PROGRAM

FILE 18

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE FLASH ADJUSTMENT PROGRAM

FILE 19

```
f0:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f1:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f2:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f3:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 18
f4:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f5:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f6:     *cont "OP"
f7:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f8:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f9:     *beep; dsp "WRONG KEY**PRESS (continue)"; gto 15
f10:    *dsp "LOCATION MODE INITIATED"; ldp14
f11:    *cont "INDEX"
```

```
0: dim P[6,3],A[6,2],Q$[7],M[6],Y[6],G[6],B[6],C[10],E[2,2],O[2],F[2]
1: dim X[10,5],T[6],D[6],U[10],V[10],Z[100,4],S[3],Q[3],R[10]
2: dim N[6],I[30],J[6,2]
3: dsp "          FLASH ADJUSTMENT";ldk 20;wait 1000
4: deg;0→A
5: .1→I[1];.2→I[2];.6→I[3];1→I[4];1.5→I[5];2.2→I[6];3→I[7];3.9→I[8]
6: 5→I[9];6.2→I[10];7.4→I[11];8.9→I[12];10.4→I[13];12.1→I[14];13.9→I[15]
7: 15.8→I[16];17.8→I[17];19.9→I[18];22.2→I[19];24.6→I[20];27.1→I[21]
8: 29.8→I[22];32.6→I[23];35.5→I[24];38.5→I[25];41.6→I[26];44.9→I[27]
9: 48.3→I[28];51.8→I[29];55.4→I[30]
10: ina Z:0
11: ent "enter number of flash OPs",N;rdm M[N]
12: rdm N[N]
13: ent "are OP coordinates stored ?",Q$
14: if Q$="-";gto 17
15: ldf 21,P[*]
16: gto 28
17: fxd 0;for I=1 to N;dsp "enter easting,OP",I;ent "",P[I,1]
18: dsp "enter northing,OP",I;ent "",P[I,2]
19: dsp "enter height,OP",I;ent "",P[I,3]
20: next I;gto 27
21: ent "are OP coordinates correct ?",Q$;if Q$="+";gto 28
22: ent "which O.P. is in error ?",O
23: fxd 0;dsp "enter correct easting,O.P.",O;ent "",P[O,1]
24: dsp "enter correct northing,O.P.",O;ent "",P[O,2]
25: dsp "enter correct height,O.P.",O;ent "",P[O,3]
26: ent "are other coordinates in error ?",Q$;if Q$="+";gto 22
27: rcf 16,P[*];rcf 21,P[*]
28: for I=1 to N;P[I,1]→Y[I];P[I,2]→G[I];next I
29: 0→r1;0→r2;for I=1 to N;r1+Y[I]→r1;r2+G[I]→r2;next I;r1/N→r1;r2/N→r2
30: for I=1 to N;P[I,1]-r1→G[I];P[I,2]-r2→Y[I];next I
31: if flg7;gto 36
32: gto 35;if A=0;gto 33
33: fxd 0;dsp "   READY FOR TARGET DATA ?";stp
34: gto 36
35: fxd 0;dsp "  READY FOR ADJUSTMENT DATA ?";stp
36: ina M:0
37: ina N:0
38: fxd 0
39: 0→r3;0→r4;for I=1 to N;dsp "is data available,OP",I," ?";ent "",Q$
40: if Q$="-";gto 54
41: if Q$="+";gto 43
42: 1→M[I];r3+1→r3;val(Q$)/17.77777778→A[r3,1];prt val(Q$);gto 45
43: 1→M[I];r3+M[I]→r3;dsp "enter azimuth(mils),OP",I
44: ent "",A[r3,1];prt A[r3,1];A[r3,1]/17.7777778→A[r3,1]
45: dsp "is vert. angle available,OP",I,"?";ent "",Q$
46: if Q$="-";gto 53
47: if Q$="+";gto 49
48: 1→N[I];r4+1→r4;val(Q$)/17.77777778→A[r4,2];prt val(Q$);spc ;gto 52
49: 1→N[I];r4+1→r4
50: dsp "enter vertical angle(mils),OP",I;ent "",A[r4,2]
51: prt A[r4,2];spc ;A[r4,2]/17.7777778→A[r4,2]
52: G[I]→G[r3];Y[I]→Y[r3];gto 56
53: G[I]→G[r3];Y[I]→Y[r3];gto 55
54: prt "               *"
*4607
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55: prt "                *";spc
56: next I;spc
57: if flg2;cfg 2;gto 59
58: gsb "EDIT"
59: if r4=0;dsp "ERROR!-NO HEIGHT DATA";wait 5000;gto 39
60: if r3≠2;gto 62
61: dsp "WARNING-ONLY TWO OPs REPORTING!";wait 3000;gto 63
62: if r3=1;gto "one OP"
63: for I=1 to r3;tan(A[I,1])→D[I];G[I]-D[I]Y[I]→B[I]
64: next I
65: r3→C[1];r3-1→C[2];0→M
66: for I=1 to C[2];I+1→K
67: for J=K to C[1]
68: M+1→M
69: 1→E[1,1];-D[I]→E[1,2];1→E[2,1];-D[J]→E[2,2];B[I]→F[1];B[J]→F[2]
70: inv E→E;mat EF→O;O[1]+r1→X[M,1]→X[M,4];O[2]+r2→X[M,2]→X[M,5]
71: next J
72: next I
73: r3(r3-1)/2→C[3];C[3]-1→C[4]
74: ina V:-9999999;for I=1 to C[3];X[I,1]→V[I];next I;gsb "median"
75: C[10]→r10
76: ina V:-9999999;for I=1 to C[3];X[I,2]→V[I];next I;gsb "median"
77: C[10]→r11
78: gsb "height"
79: ina V:-9999999;for I=1 to C[3];X[I,3]→V[I];next I;gsb "median"
80: C[10]→r14;gto 96
81: "median":ina U:-999999
82: for J=1 to C[4]
83: for K=J to C[3];V[K]→U[K];next K
84: max(U[*])→r6
85: if V[J]=r6;gto 90
86: for Z=J to C[3];if r6≠V[Z];gto 88
87: Z→L
88: next Z
89: V[J]→r8;r6→V[J];r8→V[L]
90: -9999999→U[J]
91: next J
92: if C[3]mod2=0;gto 94
93: int(C[3]/2)+1→r6;V[r6]→C[10];ret
94: C[3]/2→r6;r6+1→C[5];r6→C[6]
95: (V[C[6]]+V[C[5]])/2→C[10];ret
96: if A=1;gto "flashreg"
97: fxd 0;prt " FLASH RANGING        TARGET ";spc
98: fxd 1;prt "easting",r10;spc
99: prt "northing",r11;spc
100: prt "height",r14;spc
101: for I=1 to M;√((X[I,4]-r10)^2+(X[I,5]-r11)^2)→R[I];next I
102: prt "spread",max(R[*]);spc 2
103: ina B:0;ina R:0
104: r10→r15;r11→r16;r14→r17
105: cfg 2;ldf 21,P[*];ina M:0;1→A;gto 28
106: "height":for I=1 to N
107: P[I,1]→X[I,1];P[I,2]→X[I,2];P[I,3]→X[I,3]
108: next I
109: 0→r4;for I=1 to N;if N[I]=0;gto 111
*2925
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110: r4+1→r4;X[I,1]→X[r4,1];X[I,2]→X[r4,2];X[I,3]→X[r4,3]
111: next I
112: for I=1 to r4
113: √((r10-X[I,1])^2+(r11-X[I,2])^2)→X[I,2];if A[I,2]>0;gto 115
114: X[I,3]-X[I,2]tan(-A[I,2])→X[I,3];gto 116
115: X[I,3]+X[I,2]tan(A[I,2])→X[I,3]
116: next I
117: for I=1 to r4;int(X[1,2]/1000)→r28;X[I,2]/1000-r28→r29
118: if r28=0;gto 122
119: if r28>0;gto 121
120: X[I,3]+I[30]→X[I,3];gto 123
121: (I[r28+1]-I[r28])r29+I[r28]+X[I,3]→X[I,3];gto 123
122: I[1]r29+X[I,3]→X[I,3]
123: next I
124: ret
125: "atan2":if S[2]=0;gto 130
126: atn(S[1]/S[2])→S[3]
127: if S[2]<0;S[3]+180→S[3];ret
128: if S[3]>0;ret
129: S[3]+360→S[3];ret
130: if S[1]=0;0→S[3];ret
131: if S[1]>0;90→S[3];ret
132: 270→S[3];ret
133: "one OP":
134: for I=1 to N;if M[I]=0;gto 138
135: prt "OP",I,"    REPORTING";spc 2
136: dsp "enter distance to target,OP",I;ent "",r15;I→L
137: prt "dist. to target",r15;spc
138: next I
139: for M=1 to 3;P[L,M]→Q[M];next M
140: for I=1 to N;P[I,1]-Q[1]→P[I,1];P[I,2]-Q[2]→P[I,2]
141: P[I,3]-Q[3]→P[I,3]
142: next I
143: A[1,1]→A[L,1];A[1,2]→A[L,2]
144: r15cos(abs(A[L,2]))→r16;if A[L,2]>0;gto 146
145: P[L,3]-r16tan(abs(A[L,2]))→Z;gto 147
146: P[L,3]+r16tan(abs(A[L,2]))→Z
147: r16sin(A[L,1])→X;r16cos(A[L,1])→Y
148: for I=1 to N;if M[I]#0;gto 157
149: X-P[I,1]→S[1];Y-P[I,2]→S[2];gsb "atan2"
150: S[3]*17.77777778→A[I,1]
151: Z-P[I,3]→S[1];r16→S[2];gsb "atan2"
152: if S[3]>90;gto 154
153: S[3]→A[I,2];gto 155
154: S[3]-360→A[I,2]
155: prt "set azimuth,OP",I," at",A[I,1];spc
156: prt "set vert. ang., OP",I," at ",A[I,2]*17.77777778;spc
157: next I;spc
158: ldf 21,P[*]
159: sfg 7;ina M:0;gto 28
160: "flashreg":
161: prt "ADJUSTMENT",G+1;spc
162: if r15-r10<0;gto 164
163: prt "right",r15-r10;spc ;gto 165
164: prt "left",abs(r15-r10);spc
*23298
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165: if r16-r11<0;gto 167
166: prt "add",r16-r11;spc ;gto 168
167: prt "drop",abs(r16-r11);spc
168: if r17-r14<0;gto 170
169: prt "up",r17-r14;spc ;gto 171
170: prt "down",abs(r17-r14);spc
171: for I=1 to M;\((X[I,4]-r10)^2+(X[I,5]-r11)^2)→R[I];next I
172: fxd 1;prt "spread",max(R[*]);spc 2;ina R:0
173: if \((r16-r11)^2+(r15-r10)^2)>100;gto 176
174: prt "   FIRE     FOR        EFFECT";spc 2
175: ina R:0;gto 178
176: ent "another adjusting round ?",Q$
177: if Q$="+";G+1→G;1→A;gto 179
178: "EXIT":0→A;0→G
179: cfg 2;ldf 21,P[*];ina M:0;cfg 1;gto 15
180: "OP":
181: prt "OP COORDINATES";spc
182: for I=1 to N
183: fxd 0;prt "OP",I;fxd 1;prt "easting",P[I,1];prt "northing",P[I,2]
184: prt "height",P[I,3];spc ;next I
185: spc
186: gto 21
187: "INDEX":
188: prt "TO CALL DESIRED PROGRAM";spc
189: prt "ENTER PROGRAM   NUMBER";spc
190: prt "PRESS CONTINUE";spc
191: prt "1 SOUND RANGING"
192: prt "2 SOUND ON SOUND"
193: prt "3 VISUAL MET."
194: prt "4 FLASH RANGING"
195: prt "5 FLASH ADJT."
196: prt "6 LASER RFDR."
197: prt "7 LASER RFDR.     ADJUSTMENT"
198: prt "8 LASER RFDR.     TRILATERATION";spc 2
199: ent "enter program number",N
200: if N=1;ldp 2
201: if N=2;ldp 8
202: if N=3;ldp 12
203: if N=4;ldp 14
204: if N=5;ldp 19
205: if N=6;ldp 22
206: if N=7;ldp 27
207: if N=8;ldp 30
208: wait 1000
209: wait 1000
210: "EDIT":ent "is input data correct ?",Q$
211: if Q$="+";gto 240
212: prt "   INPUT EDIT";spc
213: ina J:0
214: r3→r31;r4→r33
215: for I=N to 1 by -1;if M[I]=0;gto 217
216: A[r31,1]→J[I,1];r31-1→r31
217: next I
218: for I=N to 1 by -1;if N[I]=0;gto 220
219: A[r33,2]→J[I,2];r33-1→r33
*24653
```

```
220: next I
221: ent "which OP is in error ?",r30;prt "OP",r30
222: dsp "enter correct azimuth,OP",r30;ent "",r32;prt "azimuth",r32
223: r32/17.77777778→J[r30,1];1→M[r30]
224: dsp "is vert. ang. available,OP",r30,"?";ent "",Q$
225: if Q$="-";0→N[r30]→J[r30,2];gto 231
226: if Q$="+";gto 228
227: val(Q$)→r32;gto 229
228: dsp "enter correct vert. ang.,OP",r30;ent "",r32
229: prt "vert. ang.",r32;spc
230: r32/17.77777778→J[r30,2];1→N[r30]
231: ent "is any other OP in error ?",Q$
232: if Q$="+";r3→r31;gto 221
233: 0→r3;for I=1 to N;0→A[I,1];if M[I]=0;gto 235
234: r3+1→r3;J[I,1]→A[r3,1];P[I,1]-r1→G[r3];P[I,2]-r2→Y[r3]
235: next I
236: 0→r4;for I=1 to N;0→A[I,2];if N[I]=0;gto 238
237: r4+1→r4;J[I,2]→A[r4,2]
238: next I
239: sfg 2;gto 59
240: ret
*31508
```

LISTING

LASER RANGEFINDER

PROGRAM

FILE 21

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE LASER RANGEFINDER PROGRAM

FILE 22

f_0: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 22

f_1: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 22

f_2: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 22

f_3: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 22

f_4: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 22

f_5: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 22

f_6: *cont "LOP"

f_7: *dsp "TRILATERATION PROGRAM INITIATED"; rcf 25, G; rcf 26, U[*]; ldp30

f_8: *cont "TARGET"

f_9: *dsp "TRILATERATION PROGRAM INITIATED"; rcf 25, G; rcf 26, U[*]; ldp30

f_{10}: *dsp "ADJUSTMENT MODE INITIATED"; rcf 25, G; rcf 26, U[*]; ldp27

f_{11}: *cont "INDEX"

```
0: dim P[6,3],Q$[1],U[100,4],S[3]
1: ldk 23
2: 0→G;deg
3: dsp "        LASER RANGEFINDER";wait 3000
4: ent "are earlier targets stored ?",Q$;if Q$="+";gto 6
5: ina U:0;0→G;gto 7
6: ldf 25,G;ldf 26,U[*]
7: ent "total number of laser OP's ?",N
8: ent "are OP coordinates  stored ?",Q$;if Q$="-";gto 10
9: ldf 24,P[*];gto 22
10: fxd 0;for I=1 to N
11: dsp "enter easting,OP",I;ent "",P[I,1]
12: dsp "enter northing,OP",I;ent "",P[I,2]
13: dsp "enter height,OP",I;ent "",P[I,3]
14: next I;gto 21
15: ent "are OP coordinates in  error ?",Q$;if Q$="-";gto 22
16: ent "which OP is in error ?",O
17: fxd 0;dsp "enter correct easting OP",O;ent "",P[O,1]
18: dsp "enter correct northing OP",O;ent "",P[O,2]
19: dsp "enter correct height OP",O;ent "",P[O,3]
20: ent "are other coordinates in error ?",Q$;if Q$="+";gto 16
21: rcf 24,P[*]
22: ent "which OP is reporting ?",r0
23: fxd 0;prt "OP",r0;spc
24: fxd 0;dsp "enter range to target,OP",r0;ent "",r20
25: fxd 1;prt "range",r20
26: fxd 0;dsp "enter azimuth to target,OP",r0;ent "",r18
27: fxd 1;prt "azimuth",r18
28: fxd 0;dsp "enter vert. ang. to target,OP",r0;ent "",r19
29: fxd 1;prt "vert. ang.",r19;spc 2
30: r19/17.777777778→r19
31: ent "is input data correct ?",Q$;if Q$="-";gto 24
32: if r19>=0;gto 34
33: -r20sin(abs(r19))→r21;gto 35
34: r20sin(r19)→r21
35: r20cos(abs(r19))sin(r18/17.77777778)→r22
36: r20cos(abs(r19))cos(r18/17.7777778)→r23
37: r22+P[r0,1]→r22;r23+P[r0,2]→r23;r21+P[r0,3]→r21
38: fxd 0;prt "LASER RFDR.     TARGET",G+1;spc
39: fxd 1;prt "easting",r22
40: prt "northing",r23
41: prt "height",r21
42: G+1→G
43: ent "enter day,time of day**as 082100",H
44: fxd 0;prt "time",H;spc 2
45: if Gmod100=0;dsp "100 TARGETS RECORDED!!!";wait 4000
46: Gmod10→r10;if r10mod10=0;gto 49
47: 11-r10→r10
48: r22→U[r10,1];r23→U[r10,2];r21→U[r10,3];H→U[r10,4];gto 22
49: r22→U[1,1];r23→U[1,2];r21→U[1,3];H→U[1,4]
50: for I=90 to 1 by -1;U[I,1]→U[I+10,1];U[I,2]→U[I+10,2]
51: U[I,3]→U[I+10,3];U[I,4]→U[I+10,4];next I
52: rcf 25,G;rcf 26,U[*]
53: for I=1 to 10;0→U[I,1]→U[I,2]→U[I,3]→U[I,4];next I
54: gto 22
*4797
```

```
55: "LOP":
56: prt "LASER RFDR.   OP   COORDINATES";spc
57: for I=1 to N
58: fxd 0;prt "OP",I;fxd 1;prt "easting",P[I,1];prt "northing",P[I,2]
59: prt "height",P[I,3];spc
60: next I;spc ;gto 15
61: "TARGET":1→L
62: prt "LASER RFDR."
63: prt "TARGET LIST";spc ;0→S
64: for I=1 to int(G/10)+1
65: if 10(I-1)<=G;I-1→L
66: next I
67: fxd 0;for I=10(L+1) to 11-G+10L by -1;prt "target",10(L+1)-I+1
68: prt "time",U[I,4]
69: prt "easting",U[I,1];prt "northing",U[I,2]
70: prt "height",U[I,3];spc 2
71: S+1→S
72: if Smod10>0;gto 74
73: ent "next 10 targets ?",Q$;if Q$="-";gto 22
74: next I
75: dsp "      ALL TARGETS LISTED!!!";wait 3000;gto 22
76: "atan2":if S[2]=0;gto 81
77: atn(S[1]/S[2])→S[3]
78: if S[2]<0;S[3]+180→S[3];ret
79: if S[3]>0;ret
80: S[3]+360→S[3];ret
81: if S[1]=0;0→S[3];ret
82: if S[1]>0;90→S[3];ret
83: 270→S[3];ret
84: "INDEX":rcf 25,G;rcf 26,U[*]
85: prt "TO CALL DESIRED PROGRAM";spc
86: prt "ENTER PROGRAM   NUMBER";spc
87: prt "PRESS CONTINUE";spc
88: prt "1 SOUND RANGING"
89: prt "2 SOUND ON SOUND"
90: prt "3 VISUAL MET."
91: prt "4 FLASH RANGING"
92: prt "5 FLASH ADJT."
93: prt "6 LASER RFDR."
94: prt "7 LASER RFDR.     ADJUSTMENT"
95: prt "8 LASER RFDR.     TRILATERATION";spc 2
96: ent "enter program number",N
97: if N=1;ldp 2
98: if N=2;ldp 8
99: if N=3;ldp 12
100: if N=4;ldp 14
101: if N=5;ldp 19
102: if N=6;ldp 22
103: if N=7;ldp 27
104: if N=8;ldp 30
105: end
*24352
```

LISTING

LASER RANGEFINDER

ADJUSTMENT PROGRAM

FILE 26

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE LASER RANGEFINDER ADJUSTMENT PROGRAM

FILE 27

```
f0:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f1:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f2:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f3:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f4:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f5:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f6:    *dsp "NEW OP?"; 0→r24; gto 4
f7:    *dsp "TRILATERATION PROGRAM INITIATED"; ldp30
f8:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f9:    *beep; dsp "WRONG KEY***PRESS (continue)"; gto "EXIT"
f10:   *dsp "LOCATION MODE INITIATED"; ldp22
f11:   *cont "INDEX"
```

```
0: dim P[6,3],Q$[1]
1: deg;ldk 28
2: 0}r24
3: dsp "  LASER RANGEFINDER ADJUSTMENT";wait 2000
4: fxd 0;ent "which OP is reporting ?",r0
5: prt "OP",r0;spc
6: dsp "   READY FOR TARGET DATA ?";stp
7: prt "target data";gto 10
8: fxd 0;dsp "  READY FOR ADJUSTMENT DATA ?";stp
9: prt "adjustment data"
10: fxd 0;dsp "enter range to target,OP",r0,"?";ent "",r20
11: fxd 1;prt "range",r20
12: fxd 0;dsp "enter azimuth to target,OP",r0,"?";ent "",r18
13: fxd 1;prt "azimuth",r18
14: fxd 0;dsp "enter vert. ang.to target,OP",r0,"?";ent "",r19
15: fxd 1;prt "vert. ang.",r19;spc
16: r19/17.77777778}r19
17: ent "is input data correct ?",Q$;if Q$="-";gto 10
18: if r19>=0;gto 20
19: -r20sin(abs(r19))}r21;gto 21
20: r20sin(r19)}r21
21: r20cos(abs(r19))sin(r18/17.7777778)}r22
22: r20cos(abs(r19))cos(r18/17.7777778)}r23
23: r22+P[r0,1]}r22;r23+P[r0,2]}r23;r21+P[r0,3]}r21
24: if r24=1;gto 27
25: r22}r25;r23}r26;r21}r27
26: 1}r24;gto 8
27: fxd 0;prt "ADJUSTMENT",Q+1;spc
28: if r25-r22<0;gto 30
29: prt "right",r25-r22;spc ;gto 31
30: prt "left",r22-r25;spc
31: if r26-r23<0;gto 33
32: prt "add",r26-r23;spc ;gto 34
33: prt "drop",r23-r26;spc
34: if r21-r27>0;gto 36
35: prt "up",r27-r21;spc 2;gto 37
36: prt "down",r21-r27;spc 2
37: if \((r25-r22)^2+(r26-r23)^2+(r27-r21)^2)>100;gto 39
38: prt "FIRE        FOR        EFFECT";spc 2;0}Q;0}r24;gto 6
39: ent "another adjusting round ?",Q$
40: if Q$="+";1}r24;Q+1}Q;gto 8
41: 0}Q;0}r24;gto 6
42: "INDEX":
43: prt "TO CALL DESIRED PROGRAM";spc
44: prt "ENTER PROGRAM   NUMBER";spc
45: prt "PRESS CONTINUE";spc
46: prt "1 SOUND RANGING"
47: prt "2 SOUND ON SOUND"
48: prt "3 VISUAL MET."
49: prt "4 FLASH RANGING"
50: prt "5 FLASH ADJT."
51: prt "6 LASER RFDR."
52: prt "7 LASER RFDR.     ADJUSTMENT"
53: prt "8 LASER RFDR.     TRILATERATION";spc 2
54: ent "enter program number",N
*16388
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55: if N=1;ldp 2
56: if N=2;ldp 8
57: if N=3;ldp 12
58: if N=4;ldp 14
59: if N=5;ldp 19
60: if N=6;ldp 22
61: if N=7;ldp 27
62: if N=8;ldp 30
63: gto 65
64: "EXIT":gto 8;if r24=0;gto 6
65: end
*6707
```

LISTING

LASER RANGEFINDER

TRILATERATION PROGRAM

FILE 29

PTAP - 2

LISTING OF SPECIAL FUNCTION KEYS FOR THE LASER RANGEFINDER TRILATERATION PROGRAM

FILE 30

f_0: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 4

f_1: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 4

f_2: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 4

f_3: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 4

f_4: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 4

f_5: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 4

f_6: *cont "LOP"

f_7: *cont "SVPT"

f_8: *dsp "L. R. ADJUSTMENT MODE INITIATED"; rcf 24, P[*]; ldp27

f_9: *dsp "L. R. LOCATION MODE INITIATED"; rcf 24, P[*]; ldp22

f_{10}: *beep; dsp "WRONG KEY***PRESS (continue)"; gto 4

f_{11}: *cont "INDEX"

```
0: dim P[6,3],Q$[1],G[2,3],R[2],F[2],E[2,2],O[2],X[2],S[3]
1: dim V[2],H[2]
2: ldf 24,P[*];ldk 31
3: dsp "LASER RANGEFINDER TRILATERATION";wait 3000
4: ent "what is total number of OPs ?",N
5: ent "what OP is to be located ?",r2
6: fxd 0;prt "locate",r2;spc 2
7: fxd 0;for I=1 to 2;dsp "easting(meters),survey pt.",I,"?";ent "",G[I,1]
8: dsp "northing(meters),survey pt.",I,"?";ent "",G[I,2]
9: dsp "height(meters),survey pt.",I,"?";ent "",G[I,3];next I;gto 20
10: 0→r1;dsp "are survey pt. entries correct?";ent "",Q$
11: if Q$="+";gto 20
12: dsp "which point is in error ?";ent "",r0
13: fxd 0;dsp "enter correct easting,sv. pt.",r0;ent "",G[r0,1]
14: dsp "correct northing,sv. pt.",r0,"?";ent "",G[r0,2]
15: dsp "enter correct height,sv. pt.",r0,"?";ent "",G[r0,3]
16: if r1=1;gto 20
17: ent "is other survey pt. in error ?",Q$;if Q$="-";gto 20
18: if r0=1;2→r0;1→r1;gto 13
19: 1→r0→r1;gto 13
20: ent "rough azimuth to survey pt. 1 ?",A
21: fxd 0;prt "rough az.",A;A/17.7777778→A;spc 2
22: fxd 0
23: for I=1 to 2
24: fxd 0;prt "survey pt.",I
25: dsp "enter range to survey pt.",I;ent "",R[I]
26: fxd 1;prt "range",R[I];fxd 0
27: dsp "enter v. ang. to sur. pt.",I,"?";ent "",V[I]
28: fxd 1;prt "vert. ang.",V[I];V[I]/17.7777778→V[I];fxd 0;spc 2
29: ent "is input data correct ?",Q$;if Q$="-";gto 22
30: R[I]cos(V[I])→R[I];R[I]sin(V[I])→H[I]
31: next I
32: G[1,1]+R[1]sin((A+180)mod360)→X[1]
33: G[1,2]+R[1]cos((A+180)mod360)→X[2]
34: for I=1 to 10
35: (X[1]-G[1,1])^2+(X[2]-G[1,2])^2-R[1]^2→F[1]
36: (X[1]-G[2,1])^2+(X[2]-G[2,2])^2-R[2]^2→F[2]
37: 2(X[1]-G[1,1])→E[1,1];2(X[2]-G[1,2])→E[1,2]
38: 2(X[1]-G[2,1])→E[2,1];2(X[2]-G[2,2])→E[2,2]
39: inv E→E;mat EF→O;ara X-O→X;next I
40: prt "   COORDINATES";prt "OP",r2;spc
41: fxd 1;prt "easting",X[1]
42: prt "northing",X[2]
43: prt "height",.5(G[1,3]-H[1]+G[2,3]-H[2]);spc 2
44: prt "*BACK AZIMUTHS*";spc
45: -X[1]+G[1,1]→S[1];-X[2]+G[1,2]→S[2];gsb "atan2"
46: fxd 0;prt "survey pt. 1",S[3]*17.7777778;spc
47: -X[1]+G[2,1]→S[1];-X[2]+G[2,2]→S[2];gsb "atan2"
48: prt "survey pt. 2",S[3]*17.7777778;spc 2
49: X[1]→P[r2,1];X[2]→P[r2,2];(G[1,3]-H[1]+G[2,3]-H[2])/2→P[r2,3]
50: ent "is another OP location desired ?",Q$
51: if Q$="+";gto 5
52: dsp "       PROGRAM COMPLETED!!!";stp
53: "LOP":
54: prt " LASER RFDR.   OP COORDINATES";spc
*13980
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55: for I=1 to N
56: fxd 0;prt "OP",I;fxd 1;prt "easting",P[I,1];prt "northing",P[I,2]
57: prt "height",P[I,3];spc ;next I;spc
58: gto 5
59: "atan2":if S[2]=0;gto 64
60: atn(S[1]/S[2])→S[3]
61: if S[2]<0;S[3]+180→S[3];ret
62: if S[3]>0;ret
63: S[3]+360→S[3];ret
64: if S[1]=0;0→S[3];ret
65: if S[1]>0;90→S[3];ret
66: 270→S[3];ret
67: "SVPT":prt "COORDINATES OF  SURVEY POINTS";spc
68: for I=1 to 2;fxd 0;prt "survey point",I
69: fxd 1;prt "easting",G[I,1];prt "northing",G[I,2]
70: prt "height",G[I,3];spc ;next I;spc
71: gto 10
72: "INDEX":
73: prt "TO CALL DESIRED PROGRAM";spc
74: prt "ENTER PROGRAM   NUMBER";spc
75: prt "PRESS CONTINUE";spc
76: prt "1 SOUND RANGING"
77: prt "2 SOUND ON SOUND"
78: prt "3 VISUAL MET."
79: prt "4 FLASH RANGING"
80: prt "5 FLASH ADJT."
81: prt "6 LASER RFDR."
82: prt "7 LASER RFDR.     ADJUSTMENT"
83: prt "8 LASER RFDR.     TRILATERATION";spc 2
84: ent "enter program number",N
85: if N=1;ldp 2
86: if N=2;ldp 8
87: if N=3;ldp 12
88: if N=4;ldp 14
89: if N=5;ldp 19
90: if N=6;ldp 22
91: if N=7;ldp 27
92: if N=8;ldp 30
93: end
*17719
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