Usermanual VERMPACK

Collection of landsurveying software for HP 41CX emulators

VERMPACK Version 2.0
released May 2014

Documentrevisions

Datum	Versions-nummer	Änderungen
12.04.2014	V1.0	first published manual
28.04.2014	V1.1	Additions to the point management
08.05.2014	V2.0	Transformed to a HP41-Module by Angel Martin
		Translated manual in english

Whats new in V2.0?

1. Version 2.0 comes as a module and so it is separated from the Hepax storage. Thanks so much for that, Angel Martin!

2. New program RENPKT : allows to rename pointnumbers

3. Program LSTPKT works better: It only shows used pointnumbers and at last gives the number of storable points left.

4. Input of unknown pointnumbers in the programs now does not any more deliver error messsages, but allows the input of correct pointnumbers or to break the program.

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1 Introduction

1.1 About VERMPACK

The HP41CX was one of the best programmable calculators of its time and has recently celebrated its 30th anniversary.

Even today, many of these devices with the practical UPN notation are active in circulation and used by engineers and technicians. There are lots of emulators of the HP41 today, for example *Olivier De Smet* has revived this computer with his app go41CX fully functional to life again. Unlike many other PC emulators this app makes it to a real mobile device again. Also V41, developed by *Warren Furlow* does wonderful work on Windows devices.

The surveying program package "VERMPACK" which is documented in this manual contains many programs that I have written during my studies for this device. Fortunately I found the source code after 25 years. VERMPACK is running on both emulators mentioned above.
VERMPACK comes as a module, especially compiled by *Angel Martin*. I thank him very much for that and thanks also for all the interesting explanations about the HP41 he offered to me.

Of course, I have added some new programs, for example a point management, which is very useful in combination with the magic HEPAX memory, and the reduction of distances for the ETRS89/UTM coordinate system and for the Gauss/Krueger coordinate system.

The programs for resection originate as far as I remember from our Professor of Surveying Dr. Hanns Severin Haase, but were adapted in some details because of the built- in VERMPACK point management and distance reduction.

The whole package is more interesting for HP41CX enthusiasts as for users who need to earn money in today's surveying.

Nevertheless the fairly simple knitted system is able to quickly perform calculations in particular, if no other means are available.

Also the program is interesting for trainees, who thus on their smartphone have a convenient and meaningful education accompanying calculation software for a very reasonable price.

1.2 Overview

All the programs of VERMPACK build a matched system, connected by the point management. Only a few programs do not require the point management.
The system uses the hepax module and is delivered in a module. Please load 3 empty hepax files in slot 1-3 and the VERMPACK.mod in slot 4.
A special overlay with graphical icons for the user mode supports the user in the orientation on the surface. (See the illustration on the title page).
All programs are called with and the appropriate FUNCTIONKEY .

Approximately 650 points can be stored in the hepax-system. All points are calculated in 2D and stored since the system was originally designed for cadastral tasks.
The program code is freely available and can easily be supplemented or modified as necessary.
The author is not liable for damage to software or hardware or economic losses arising from the use of the programs, unless these are due to gross negligence or intent on the part of the author, his agents, or his legal representatives.
Some registers and flags are reserved for certain values , and therefore should not be overwritten during the calculations:

reserved Registers	
REG 49	Point-Management
REG 48	Point-Management
REG 47	Reduction of distances and areas
REG 46	Reduction of distances and areas
REG 45	Reduction of distances and areas
REG 44	Reduction of distances and areas
REG 43	Point-Management
REG 42	Point-Management
REG 41	Point-Management
REG 40	Point-Management
REG 00	Point-Management
reserved Flags	
FLAG 01	Local Coordinate System is active
FLAG 02	Gauss-Krueger Coordinate System is ative
FLAG 03	ETRS89/UTM Coordinate System is active

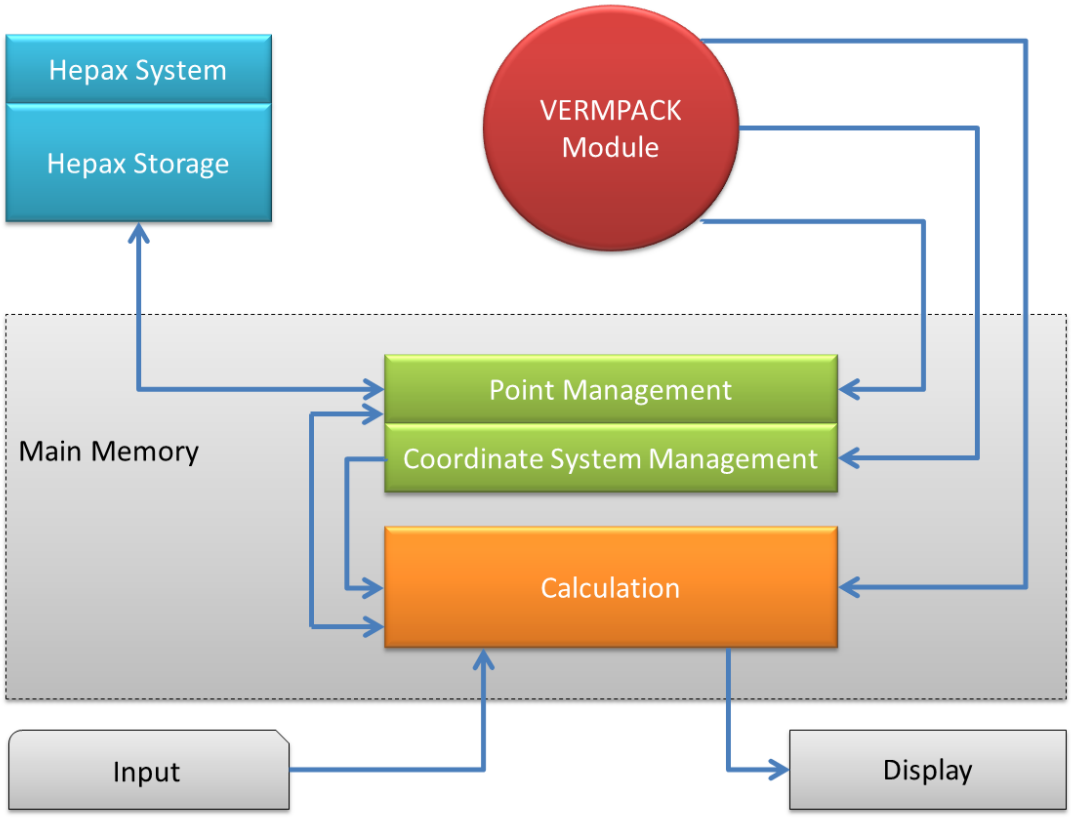
Please always make sure that the correct coordinate system is set (indicated by the flags). The coordinate system controls the reduction of distances and areas in the following Programs:

KOKLEIN SPRJNAT SGK FRSTAT FRMESS RIWI KREISM AREA
KOELEM SNATPRJ SKK FRABST

All keyboard tracks and all displayed distances and areas are measured distances and areas in the field, independent from the active coordinate system. So the user does not have to think about reduction.

1.3 Principles

The VERMPACK represents an integrative program system of various subprograms which work together with the Hepax system and Main Memory as follows:



To install VERMPACK, in go41cx switch of the calculator, load three empty HEPAX Memory Files in Slot 1-3 and the VERMPACK.MOD in slot 4 and switch on the hepax-system.

In V41 switch of the calculator, load the Hepax.mod in slot 1, the Hepax-mem.mod in slot 2 and the VERMPACK.MOD in slot 3. The V41 switches on by itself then.

Because the HEPAX Memory Files are just used for storing Coordinates, you can projectwise create HEPAX Memory Files and load them, if necessary.

2 Descriptions

In this Chapter the individual programs which are delivered with VERMPACK are described.

2.1 Pointmanagement

VERMPACK has a small point management, applicable to all functions in which coordinates are determined.
Each point is saved in the HEPAX memory as a file. The file name is corresponding to the pointnumber. In VERMPACK about 650 points can be stored in one project (i.e. in one Triple of HEPAX Memory files)
Note that the pointnumbers must be unique, must contain only numbers and have a length of a maximum of 5 digits! After the calculation of a point, the program asks for the corresponding pointnumber. When entering the pointnumber "0", the point is not saved.
In the created HEPAX file for the point, the coordinates in the order Easting, Northing are stored. In VERMPACK no point codes are provided, but only coordinates are stored. There are no heights managed.
If in a calculation program under a specified pointnumber no point is found, a corresponding message appears and the pointnumber can be corrected.

The following functions for point management are available:

2.1.1 Input Points

With the SET Command, new points can be entered.

Eingabe im User Modus	Display
E+ oder XEQ SETPKT	PKT EINGABE
	PNR?
1234567 R/S	RECHTS?
5869325 R/S	HOCH?
100.123 R/S	OK

If a point with the entered pointnumber exists, it can be decided whether to enter another pointnumber or to overwrite the coordinates of the corresponding point:

1=overwrite the coordinates
0=suggest a new pointnumber

This function is running, until another function is called.

2.1.2 Query Points

The GET Command is used to query Point information. The Poinnumber is entered, to get the coordinates in the display.

Input in User Mode	Display
[1/x] or [XEQ] GETPKT	PKT ABFRAGE
	PNR?
1234566 [R/S]	RECHTSWERT
[R/S]	HOCHWERT

If there is no Point to the given Pointnumber, there is the error message "PUNKT FEHLT" and the System asks again for a Pointnumber.

This function is running, until another function is called.

2.1.3 List Points

The LIST Command lists all Pointfiles stored in the HEPAX System. All pointfiles are listet by their name. At last the number of points which can be stored is shown.

Input in User Mode	Display
[SQRT] or [XEQ] LISTPKT	PKT LISTE
	PUNKTNUMMER 1
Pointnumbers	...
number of storable points	FREI: 650

2.1.4 Rename Points

The REN Command is used to rename Pointnumbers. Therefore the old Pointnumber and the new Pointnumber must be entered.

Input in User Mode	Display
[LOG] or [XEQ] RENPKT	PNR AENDERN
	ALTE NR?
1000	NEUE NR?
2103	OK/GESCHEITERT

If there is no Pint with the old Pointnumber, or if a point already exists with the new Pointnumber, the program shows the error Message "GESCHEITERT", otherwise the message will be "OK"

2.1.5 Delete Points

With the DEL Command Points can be deleted.

Input in User Mode	Display
LN or XEQ DELPKT	PKT LOESCHEN
	PNR?
1234565 R/S	

This function is running, until another function is called.

2.2 Management of Coordinate Systems

VERMPACK works with three different Coordinate systems, the German *Gauß-Krüger*, *ETRS89/UTM* and *local systems*.

It is absolutely recommended to set the correct System, because only so the correct projections for distances and areas can be calculated. The Configuration of the coordinate system works with the programs SYSGK SYSUTM and SYSLOK.
The active system can be controlled with the Flags 1-3, which are especially reservedfor this job in VERMPACK.

Flag 1 : local System is active

Flag 2 : Gauß-Krueger System is active

Flag 3 : ETRS89/UTM System is active

The reductions are calculated with the middle coordinate of the area and not with coordinates of the used points themselves. So Gauß-Krueger-coordinates and ETRS89/UTM-coordinates can be entered without leading digits.

2.2.1 Local coordinate System

The program sets the active coordinate system to a local system with the scale 1.0000. No projrction is calculated for this system. It is used for engineering systems on construction sites.

Input in User Mode	Display
SIN or XEQ SYSLOK	SET LOKALSYS
	SYS: LOKAL

Flag 1 is active!

The coordinate system remains, until you change it.

2.2.2 Gauss-Krueger coordinate System

The program asks for the distance to the central meridian of the Gauss-Krueger system [km], the earth radius [km] and the mean ellipsoidic Height of the survey area [m]. If the ellipsoidic Height is not known, the NHN-Height can be used.

Input in User Mode	Display
R or XEQ SYSGK	SET GK-SYS
	ABST.MER/KM?
162 R/S	RADIUS/KM?
6381 R/S	H ELL/M?
145,025 R/S	SYS: GK

Flag 2 ist active!

The coordinate system remains, until you change it.

2.2.3 ETRS89/UTM coordinate System

The program asks for the distance to the central meridian of the ETRS89/UTM Zone [km], the earth radius [km] and the mean ellipsoidic Height of the GRS80 Ellipsoid of the survey area [m]. In Germany as a good value NHN + 45,00m can be used.

Input in User Mode	Display
X<>y or XEQ SYSUTM	SET SYS-UTM
	ABST.MER/KM?
162 R/S	ERDRADIUS/KM?
6381 R/S	HELL/M?
145,025 R/S	SYS: UTM

Flag 3 ist active!

The coordinate system remains, until you change it.

2.2.4 Distance Reduction (Nature Distance to projected Distance)

This calculates the projected length S_K of a natural distance S_N in the active coordinate system.

SNATUR = measured distance
SK = projected distance (Mapdistance)

Input in User Mode	Display
TAN or XEQ SNATPRJ	NATUR>KARTE
	S NATUR?
245,045 R/S	SK=245,089

In a local system both distances have the same length!

2.2.5 Distance Reduction (projected distance to Nature Distance)

This program calculates the natural distance S_N from a given Mapdistance S_K in the active coordinate system.

SKARTE = projected distance (Mapdistance)
SN = measured distance (natural distance)

Input in User Mode	Display
COS or XEQ SPRJNAT	KARTE↕NATUR
	S KARTE?
245,089 R/S	SN=245,045

In a local system both distances have the same length!

Formulas to Chapter 2:

local systems:

$$S_{Karte} = S_{Natur}$$

Gauss-Krueger and ETRS89/UTM:

$$S_{Karte} = S_{Natur} * \left[\left(1 - \frac{H_{ell}}{R}\right) * \left(1 + \frac{(E_m - 500)^2}{2R^2}\right) * M\right]$$

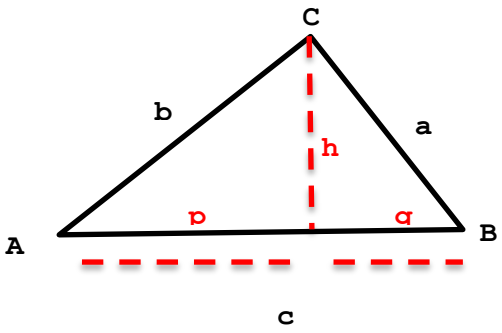
$$S_{Karte} = S_{Natur} \,/\, \left[\left(1 - \frac{H_{ell}}{R}\right) * \left(1 + \frac{(E_m - 500)^2}{2R^2}\right) * M\right]$$

Sgem = measured distance
Sproj = projected mapdistance
Hell = ellipsoidic Height in [m]
R = earth radius in [km]
Em = Easting of the central meridian in [km]
M = 1.0000 at Gauss-Krueger
M = 0.9996 at ETRS89/UTM

2.3 Triangle Calculations

2.3.1 Altitude and Linesegments

The program calculates from the three sides **a**, **b** and **c** of a triangle the height **h** and the segments **p** and **q**.

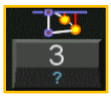


Input in User Mode		Display
0 or XEQ HHFP		DREIECK
		SEITE a?
5.81	R/S	SEITE b?
4.73	R/S	SEITE c?
3.91	R/S	P=3.411
	R/S	Q=0.499
	R/S	H=4.704

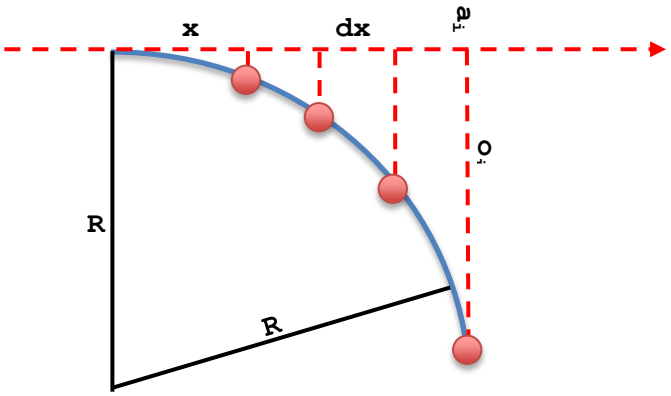
If the sides of the triangle must be calculated from coordinates, use the program „Direction Angle and Distance" to calculate the natural distances. Remember to use the correct coordinate system!

2.4 Circle- and Arc Calculations

2.4.1 Staking out Circlepoints from a Tangent



The program calculates abszissas a_i and ordinates o_i from a tangent onto an arc given by the radius **R**, the starting abszissa **x** und equal abszissa deltas **dx**.



Input in User Mode		Display
3 or XEQ ABKBT		RADIUS?
		RADIUS?
50.00	R/S	X?
5.00	R/S	dX?
0	R/S	A=5.00
	R/S	O=0.251

or

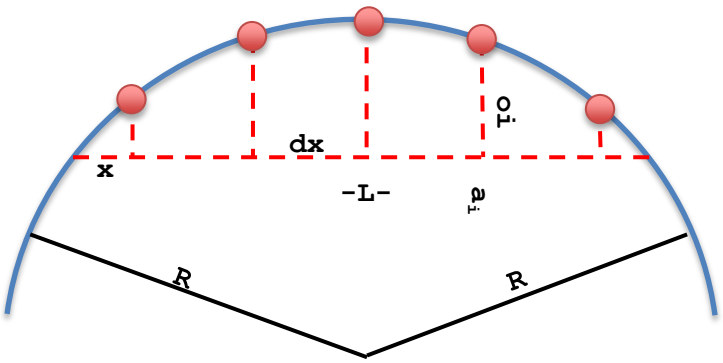
Input in User Mode		Display
3 or XEQ ABKBT		RADIUS?
	R/S	RADIUS?
50.00	R/S	X?
5.00	R/S	dX?
3.00	R/S	A=5.00
	R/S	O=0.251
	R/S	A=8.000
	R/S	O=0.644

In the first method **x** is entered, **dx** is zero. The corresponding ordinate **o** will be calculated for **x**.
In the second method **dX** is different from zero and the program calculates the first ordinate **o** and then further ordinates **o** at abszissas **a** at multiple distances of **dX**.

If the abszissa becomes longer than the radius, the program shows "ZU WEIT".

2.4.2 Staking out Circlepoints from a Chord

The program calculates ordinates o_i at given abszissas a_i on a chord of a circle with given radius **R**, starting abszissa **x** und delta abszissas **dx**.



Input in User Mode		Display
2 or XEQ ABKBS		ABST.SEHNE
		RADIUS?
50.00	R/S	L SEHNE?
15.00	R/S	X?
5.00	R/S	dX?
0	R/S	A= 5.00
	R/S	O= 0.503

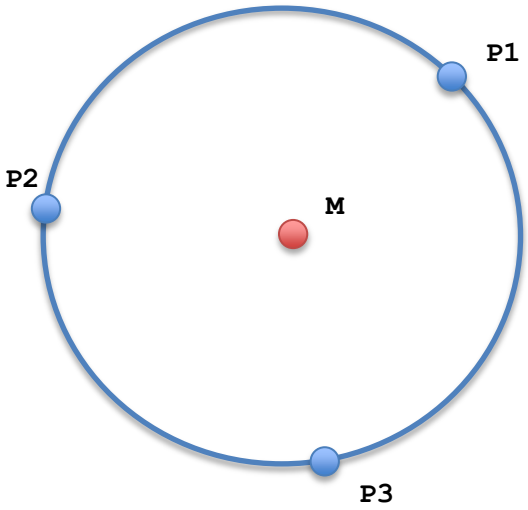
or

Input in User Mode		Display
2 or XEQ ABKBS		ABST.SEHNE
		RADIUS?
50.00	R/S	L SEHNE?
15.00	R/S	X?
5.00	R/S	dX?
3.00	R/S	A= 5.00
	R/S	O= 0.503
	R/S	A= 8.000
	R/S	O= 0.563

In the first method **x** is entered, **dx** is zero. The corresponding ordinate **o** will be calculated for **x**.
In the second method **dX** is different from zero and the program calculates the first ordinate **o** and then further ordinates **o** at abszissas **a** at multiple distances of **dX**.

2.4.3 Center of a Circle with 3 Points

The program calculates the center **M** and the radius **R** of a circle defined by three points **P1**, **P2** and **P3**, which are placed on the edge of the circle.



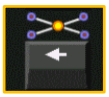
Input in User Mode		Display
6 or XEQ KREIS		KREISMITTELPKT
		P 1?
101	R/S	P2?
102	R/S	P3?
103	R/S	R=52,235
	R/S	YM=2586200,125
	R/S	XM=5715520,123
	R/S	PNR?
PNR or 0	R/S	

After the calculation the center will be stored, if the pointnumber differs from zero.

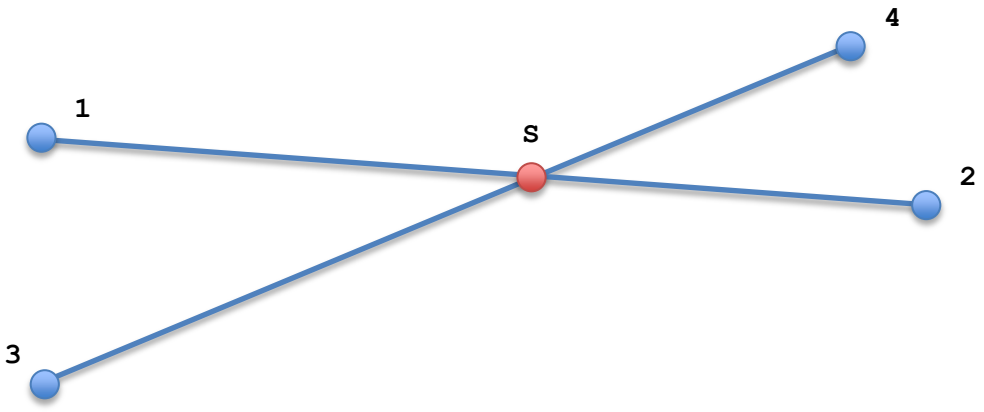
The radius is expected as natural distance, the projection is applied automatically.
Therefore use the programs SYSGK, SYSUTM or SYSLOK as explained in 2.2.

2.5 Intersections

2.5.1 Intersection of two Lines



The program calculates the intersection **S** oft wo lines, which are defined by the four points **P1-P2** und **P3-P4.**

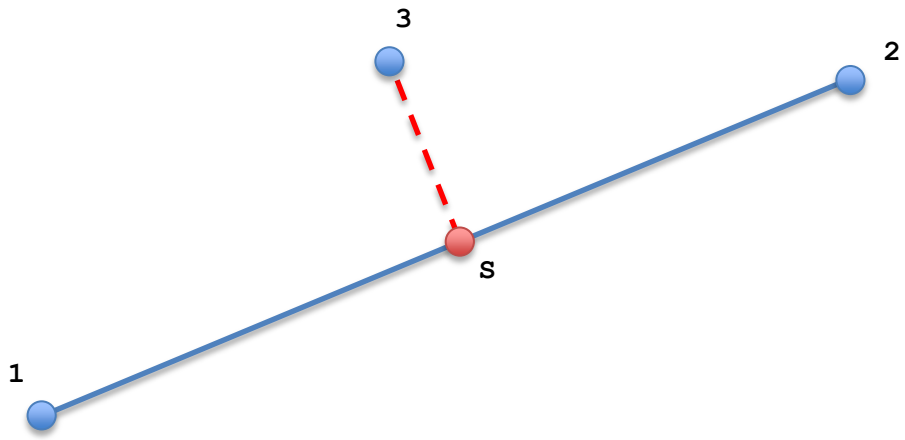


Input in User Mode		Display
<- or XEQ SGG		SCHNITT G/G
		P 1?
101	R/S	P2?
102	R/S	P3?
103	R/S	P4?
104	R/S	Y5=2581013,511
	R/S	X5=571552 0.123
	R/S	PNR 5?
PNR or 0	R/S	

After the calculation the intersection will be stored, if the pointnumber differs from zero.

2.5.2 Perpendicular on a Line

The program determines the base point **S** of a point **P3** on a straight line defined by the points **P1-P2.**

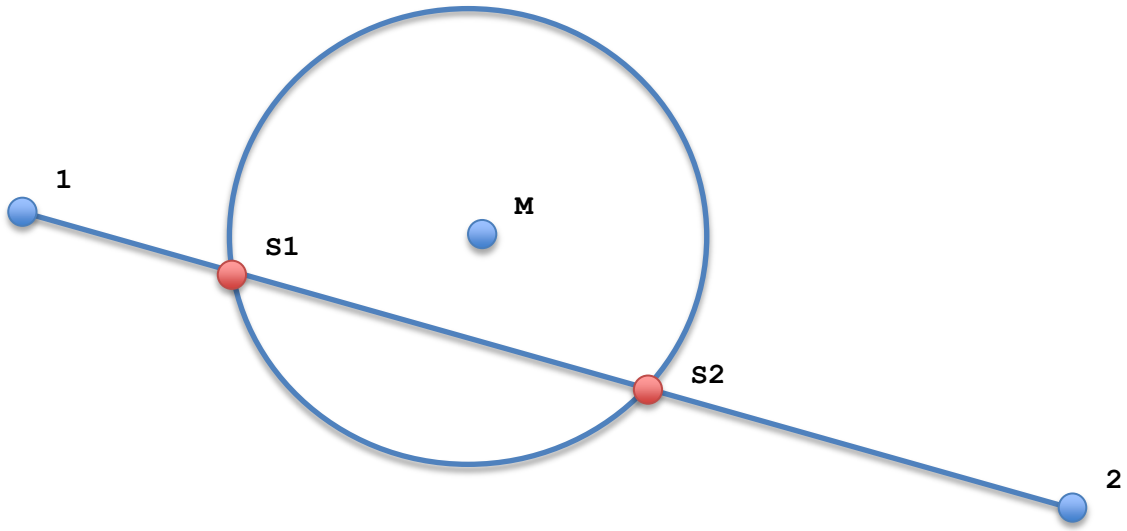


Input in User Mode		Display
EEX or XEQ SGP		LOTFUSSPUNKT
		P 17
101	R/S	P27
102	R/S	P37
103	R/S	YS=258 101 1.500
104	R/S	XS=57 155 12.195
	R/S	PNR 57
PNR or 0	R/S	

After the calculation the base point will be stored, if the pointnumber differs from zero.

2.5.3 Intersections of a Circle and a Line

The program determines the intersections S_1 and S_2 of a straight line given by the points **P1**-**P2** and a circle with radius **R** und Center **M**.

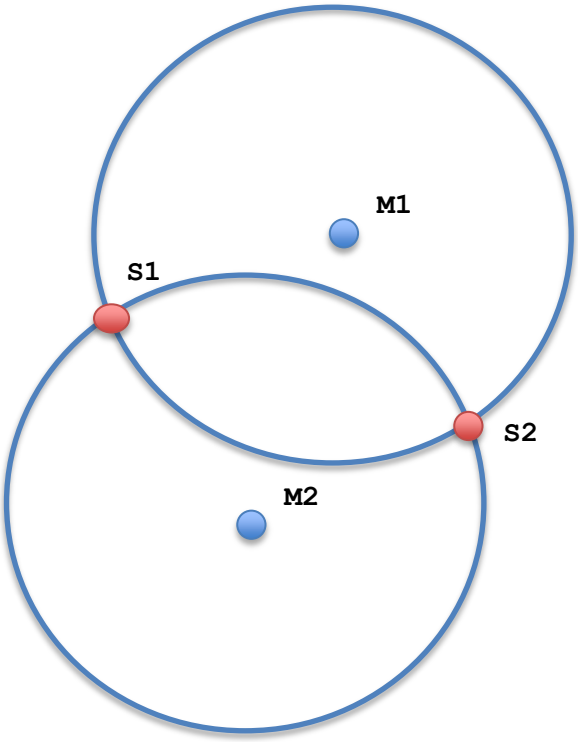


Input in User Mode		Display
EEX or XEQ SGP		SCHNITT G/K
		P 1?
101	R/S	P2?
102	R/S	PM?
103	R/S	RADIUS?
75.005	R/S	Y 1=258 197 1.749
	R/S	X 1=57 1 1057.8 14
PNR or 0	R/S	PNR 1?
	R/S	Y2=258 1064.837
	R/S	X2=57 1094 1.454
	R/S	PNR 2?
PNR or 0	R/S	

If there is no solution, then the message „KEIN SCHNITT" will be shown.
If there is only one solution, S_1 and S_2 have the same coordinates.
After the calculation the two intersections will be stored, if the pointnumbers differ from zero.

2.5.4 Intersections of two Circles

The program calculates the intersections S_1 und S_2 of two circles defined by the centers M_1 und M_2 and the radius R_1 und R_2.



Input in User Mode		Display
[EEX] or [XEQ] SGP		SCHNITT K/K
		M 1?
10 1	R/S	M2?
102	R/S	RADIUS 1?
40.000	R/S	RADIUS 2?
50.005	R/S	Y 1=258 1004.720
	R/S	X 1=57 10960.280
PNR or 0	R/S	PNR 1?
	R/S	Y2=2580960.280
	R/S	X2=57 1 1004.765
	R/S	PNR 2?
PNR or 0	R/S	

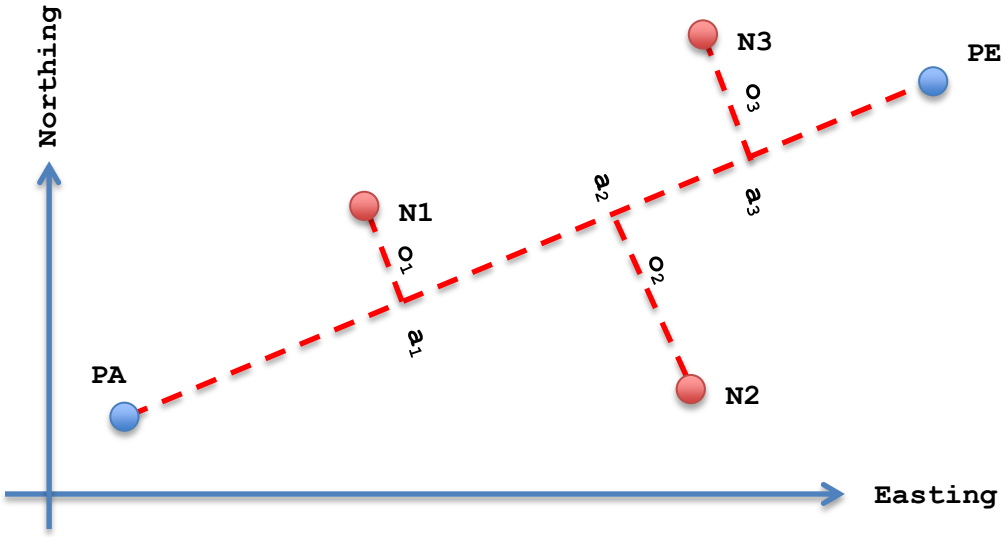
If there is no solution, then the message „KEIN SCHNITT" will be shown.
If there is only one solution, S_1 and S_2 have the same coordinates.
After the calculation the two intersections will be stored, if the pointnumbers differ from zero.

2.6 Transformations

All transformation programs work with 2 points given in two coordinate systems. Every method transforms coordinates from a source system to a destination system.

2.6.1 Orthogonal point calculation

With this method ordinates **o** und abszissas **a** in a net of aligning bases are transformed to coordinates **x**,**y** of a superior coordinate system. Start- and endpoint **A(x,y)** and **E(x,y)** of the base line, ordinates o_i and abszissas a_i are given.



Input in User Mode		Display
8 or XEQ KOKLEIN		KLEINPUNKTE
		PA?
101	R/S	PE?
102	R/S	Soll?
14.16	R/S	Z=50.000000
	R/S	Q=0.998663
	R/S	O=0.706 162
	R/S	A=0.706 162
	R/S	FS=0.0 19
6.25	R/S	ORDINATE?
-4.65	R/S	ABSZISSE?
	R/S	Y=2580960.280
	R/S	X=5711004.765
	R/S	PNR?
PNR or 0	R/S	

After input of **P_A**, **P_E** and the measured distance **Sae** the following information is displayed:

< : direction angle T_{AE}
q : scale factor $S_{calculated}/S_{measured}$
o : $Y_E-Y_A/S_{calculated}$
a : $X_E-X_A/S_{calculated}$
FS : $S_{calculated}-S_{measured}$

xi,yi : coordinates of points given by abszissa and ordinate

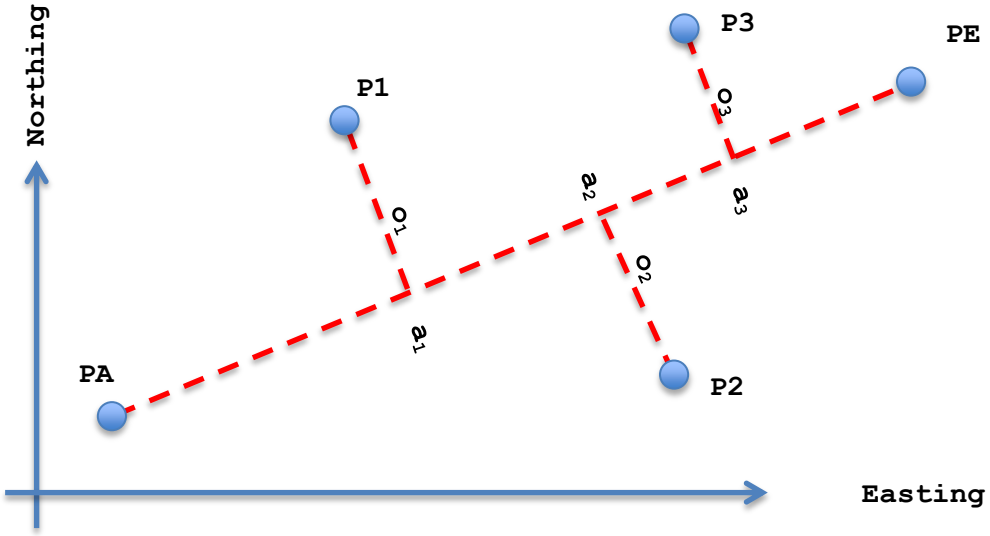
Abszissas and ordinates are entered as measured distance, the projection distortion is considered. This divides the projection distortion from the scale factor, and so the real scale factor between measured distances and calculated distances are shown!

Therefore use the programs SYSGK , SYSUTM or SYSLOK as explained in 2.2.

After the calculation the calculated point will be stored, if the pointnumbers differ from zero.

2.6.2 Calculation of Abszissa and Ordinate

This is the inversion of the orthogonal point calculation. Here the points **A** and **E** in the superior system are given with **x,y** and their abszissas **a** and ordinates **o**. Abszissas a_i and Ordinates o_i of further given points $P_i(x_i,y_i)$ are calculated. This can be used, if points should be controlled which were given by abszissa and ordinate on a line in old fieldbooks.



Input in User Mode		Display
9 or	XEQ KOELEM	ORT.ELEMENTE
		ABSZISSE 17
10.00	R/S	ORDINATE 17
3.00	R/S	ABSZISSE 27
24.16	R/S	ORDINATE 27
3.00	R/S	P 17
10 1	R/S	P27
102	R/S	∠= 50.000000
	R/S	O= 100 1263
6.25	R/S	O=0.700000
-4.65	R/S	A= 7.000000
	R/S	F5= -0.0 18
	R/S	PI?
3	R/S	O= 3 1.240
	R/S	A= - 1 1.16
	R/S	

After input of abszissas **a**, ordinates **o** and the coordinates **x,y** of point **A** and **E** the following information is displayed:

< : direction angle T_{AE}
q : scale factor $S_{calculated}/S_{measured}$
o : $Y_E-Y_A/S_{calculated}$
a : $X_E-X_A/S_{calculated}$
FS : $S_{calculated}-S_{measured}$

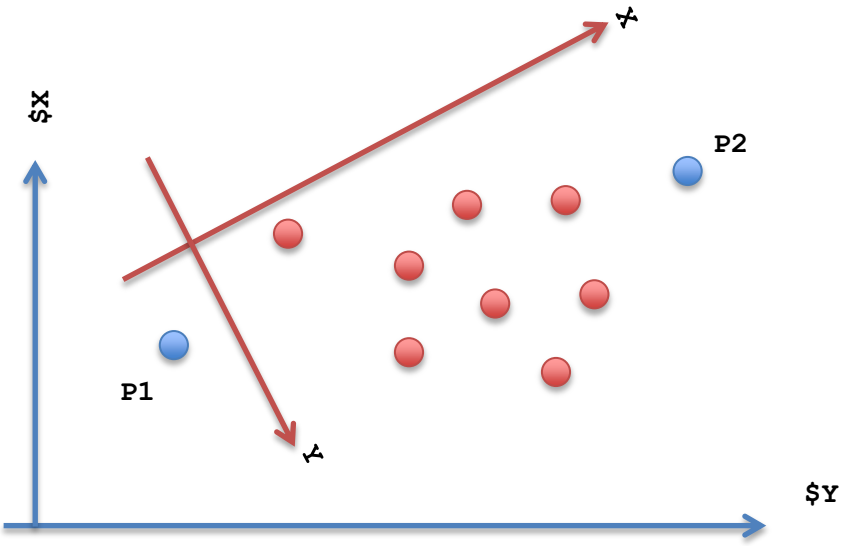
o_i : ordinates of given points i
a_i : abszissas of given points i

Abszissas and ordinates are shown as measured distance, the projection distortion is considered. This divides the projection distortion from the scale factor, and so the real scale factor between measured distances and calculated distances are shown!

Therefore use the programs SYSGK, SYSUTM or SYSLOK as explained in 2.2.

2.6.3 Helmert Transformation

The helmert transformation transforms points from a start system **$X,$Y** to a target system **X,Y**. The program works with 2 identical points P_1 and P_2 given in both systems and a number of points $P_i(\$X_i,\$Y_i)$ just given in the start system. These have to be calculated into the target system $P_i(X_i,Y_i)$.



Input in User Mode		Display
EEX or XEQ KOKLEIN		HELMERTTRAFO
		P1 ZIEL?
101	R/S	P2 ZIEL?
102	R/S	P1 START?
63	R/S	P2 START?
55	R/S	Z=229.949998
	R/S	Q= 1.000002
	R/S	D= 1.0000000
	R/S	R= 1.0000000
	R/S	FS= -0.003
	R/S	Y START?
9032.256	R/S	X START?
8000.20	R/S	YZ= 1000.023
	R/S	XZ= 1000.008
	R/S	PNR?
PNR or 0	R/S	

After input of the two identical points in both systems the following information is displayed:

< : direction angle T_{AE}
q : scale factor $S_{calculated}/S_{measured}$
o : $Y_E-Y_A/S_{calculated}$
a : $X_E-X_A/S_{calculated}$
FS : $S_{calculated}-S_{measured}$

X_i,Y_i : coordinates of points calculated from the start system **X_i,Y_i**

After the transformation of each point the transformed point will be stored, if the pointnumbers differ from zero.

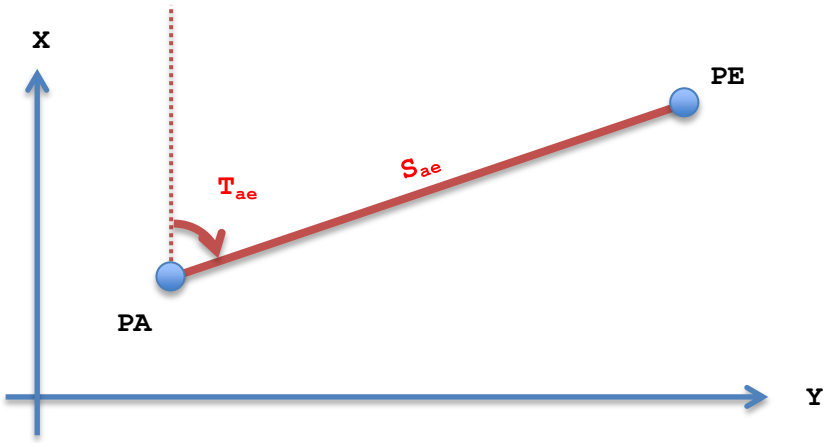
Note: If the transformed points are saved with the same pointnumbers, the coordinates of the startsystem of these points are lost. So the points must get new pointnumbers, if the old coordinates are still needed.

2.7 Polar Methods

VERMPACK supports polar measurements. The 3 programs Resection, Stakeout and surveying new points are closely related.

2.7.1 Direction Angle and Distance

The program calculates from the coordinates of two known points **PA** and **PE** the natural distance S_{ae} and the direction angle of T_{ae}.



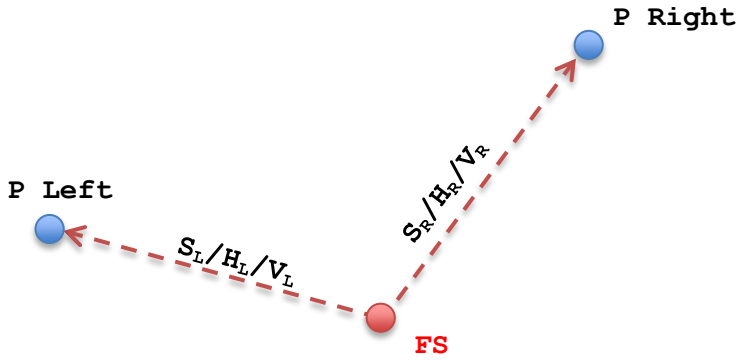
Input in User Mode		Display
CHS or XEQ RIWI		RIWI/STRECKE
		PA?
101	R/S	PE?
102	R/S	Sae = 14.141
	R/S	Tae = 50.0000

Be sure to use the wright coordinate system, to regard the wright projection!

Therefore use the programs SYSGK, SYSUTM or SYSLOK as explained in 2.2.

2.7.2 Resection – Calculate the Station

This program determines the coordinates of a Resection **FS** with polar measurements to two known points **P1** and **P2** (Distances **S**, horizontal distances **H** and vertical Angles **V**).



Be sure to use the wright coordinate system, to regard the wright projection!

Therefore use the programs SYSGK, SYSUTM or SYSLOK as explained in 2.2.

Input in User Mode		Display
STO or XEQ FRSTAT		FR.STATION.
		P LINKS?
101	R/S	P RECHTS?
102	R/S	Z LINKS?
99.9825	R/S	S LINKS?
15.23	R/S	Z RECHTS?
100.2365	R/S	S RECHTS?
12.98	R/S	R LINKS?
102.2564	R/S	R RECHTS?
275.5689	R/S	SLR= 14.142
	R/S	FS=0.023
	R/S	M= 1.0000256
	R/S	M= 1?
R/S or 0	R/S	YS= 10 12.633
	R/S	XS= 1008.509
PNR or 0	R/S	

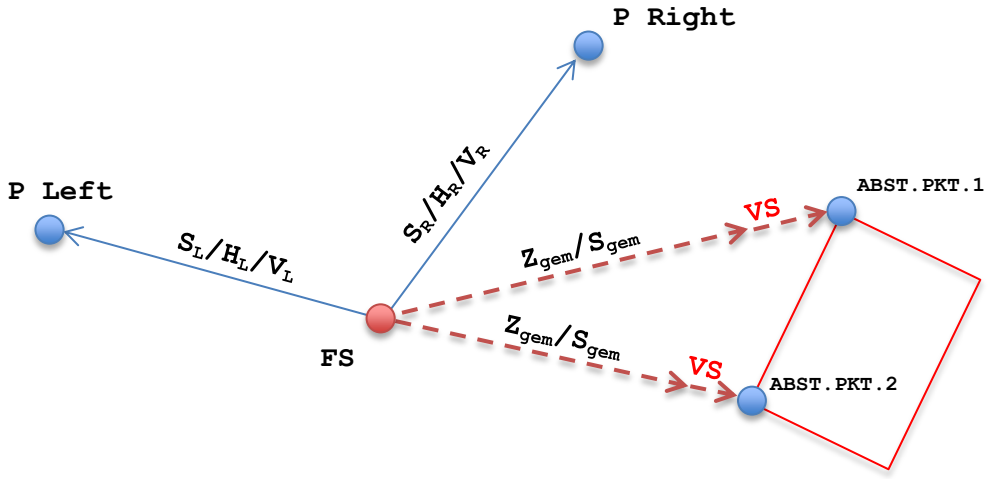
After entering the measurements the following values are displayed as information:

SLR : Distance between P_{LEFT} und P_{RIGHT}
FS : Difference between SLR and the distance calculated from coordinates
M : Scale factor, should be 1. Enter R/S on the question "M= 1?" to change the scale to 1.000, or 0 to use the calculated scale.

2.7.3 Resection – Stakeout Points

This program is directly related to the resection program. Staking out known points **ABST.PKT** from the resection **FS** is possible.

The program calculates the target direction **$R** and the target distance **$S** to the point to be staked out.
After setting the direction it is possible to iterate to the correct position by further measurements. For this purpose the improvements of the distance VS from the current prism location to the target are displayed after every new measurement.



Be sure to use the wright coordinate system, to regard the wright projection!

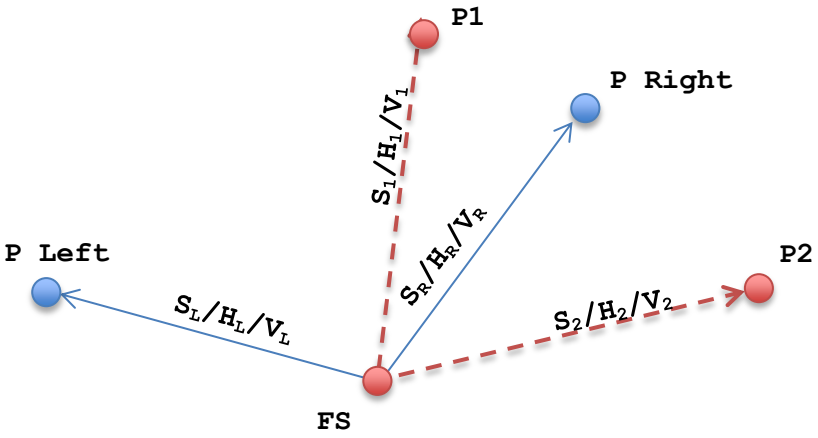
Therefore use the programs SYSGK, SYSUTM or SYSLOK as explained in 2.2.

Input in User Mode		Display
SST or XEQ FRABST		POLARSTECK.
		ABST.PKT?
103	R/S	$S=25.086
	R/S	$R=357.5928
99.9958	R/S	Z GEM?
25.369	R/S	S GEM?
100.2365	R/S	VS=-0.281

After entering the point to be staked out, the calculated distance **$S** and the calculated direction **$R** are displayed. The direction **$R** has to be set in the total station. The distance **$S** must be marked by the prism as good as possible.
Then the first measurement to the prism must be done. Vertical angle $\mathbf{Z_{gem}}$ and distance $\mathbf{S_{gem}}$ must be entered and the program calculates the improvement **VS** for the distance to the target. For negative **VS**, move the prism forward, for positive **VS** move it backward.
If **VS** is small enough according to the task, the target is reached.

2.7.4 Resection – Measure new Points

This program is directly related to the resection program. Measuring new points **PI** from the resection **FS** with the polar method is possible.



Be sure to use the wright coordinate system, to regard the wright projection!

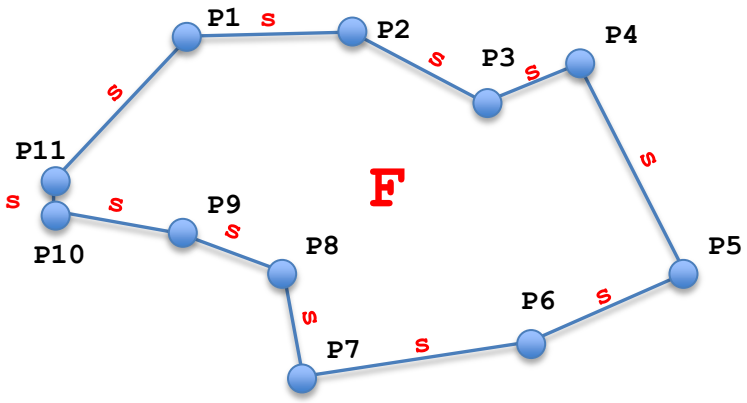
Therefore use the programs SYSGK, SYSUTM or SYSLOK as explained in 2.2.

Input in User Mode		Display
RCL or XEQ FRMESS		POL.AUFMASS
		R∠I↓?
32.1245	R/S	Z↓I↓?
100.2598	R/S	S↓I↓?
19.23	R/S	YI= 103 1.342
	R/S	XI= 10 12.960
	R/S	PNR?
PNR or 0	R/S	

2.8 Areacalculation

2.8.1 Area of a Polygon

The program calculates the area **F** of a polygon with given vertices. By the way the distances **s** between the actual and the last entered point are shown.

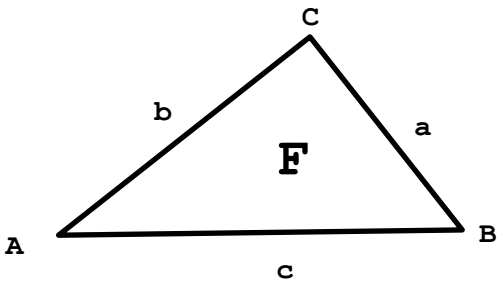


Use the programs SYSGK, SYSUTM or SYSLOK as explained in 2.2. This divides the projection distortion from the scale factor. The displayed distances and the area are shown in natural dimensions.
To close the area, use the first pointnumber also as the last pointnumber.
Then the calculated area is shown after displaying the last distance.
Arcs are not possible.

Input in User Mode		Display
R/S or XEQ AREA		KALK.AREA
		P 1?
101	R/S	P2I3?
102	R/S	S= 14.141
. . .	R/S	. . .
bei PNR=P1	R/S	F= 10048.49

2.8.2 Heron's Formula

This program calculates the area of a triangle given by the three sides **a**, **b** and **c**.



Input in User Mode		Display
[.] or [XEQ] HERON		FLA.HERON
		SEITE a?
5.81	[R/S]	SEITE b?
4.73	[R/S]	SEITE c?
3.91	[R/S]	F=9.195

If the sides of the triangle must be calculated from coordinates, to calculate the natural distances, use the program „Direction Angle and Distance". Remember to use the correct coordinate system!

3 Appendix

3.1 Listings

These are the original listings. Angel Martin has partially modified and improved the code in the module in order to increase the speed.
HEPAX-Functions are listed as "XROM 7,xx".

Punktverwaltung

LBL "VERWALT"	**LBL "DELPKT"**	**LBL "GETP"**	XROM 07,27
LBL "SETPKT"	"PKT LOESCHEN"	SF 25	FC? 25
"PKT EINGABE"	AVIEW	FIX 00	GTO 07
AVIEW	PSE	STO 00	CF 25
PSE	LBL 03	CLA	SF 28
LBL 00	SF 25	ARCL 49	"OK"
CF 29	FIX 00	0	PROMPT
FIX 00	"PNR?"	XROM 07,36	FIX 03
"PNR?"	PROMPT	FC? 25	GTO "RENPKT"
PROMPT	STO 00	GTO 06	LBL 07
STO 00	CLA	CF 25	SF 28
"RECHTS?"	ARCL 00	RCL 48	"GESCHEITERT"
PROMPT	XROM 07,23	1000	PROMPT
STO 01	CF 25	/	FIX 03
"HOCH?"	FIX 03	0.002	GTO "RENPKT"
PROMPT	GTO 03	+	LBL 08
STO 02	**LBL "SETP"**	RCL 48	1
XEQ "SETP"	RCL 00	+	ST+ 41
GTO 00	X=0?	XROM 07,18	RCL 42
LBL "GETPKT"	RTN	FIX 03	10
"PKT ABFRAGE"	SF 25	CLX	/
AVIEW	CLA	RTN	STO 42
PSE	FIX 00	LBL 06	1
LBL 01	ARCL 00	"PUNKT FEHLT"	-
SF 25	3	PROMPT	X<0?
FIX 00	XROM 07,07	"RICHTIGE NR?"	RTN
"PNR?"	FC? 25	PROMPT	XEQ 08
PROMPT	XEQ 10	STO 49	RTN
STO 00	SF 25	GTO "GETP"	**LBL "LSTPKT"**
CLA	FIX 03	**LBL "RENPKT"**	"PKT LISTE"
ARCL 00	001.002	"PNR AENDERN"	AVIEW
0	XROM 07,32	AVIEW	PSE
XROM 07,36	CF 25	PSE	FIX 0
FC? 25	CLX	"ALTE NR"	XROM 7,10
GTO 05	RTN	PROMPT	XROM 7,12
CF 25	LBL 10	STO 43	6
001.002	"ERSETZEN1/0?"	"NEUE NR"	/
XROM 07,18	PROMPT	PROMPT	"FREI: "
FIX 03	STO X	STO 42	ARCL X
"Y="	X>0?	0	PROMPT
ARCL 01	GTO 04	STO 41	FIX 3
PROMPT	"NEUE PNR?"	XEQ 08	END
"X="	PROMPT	RCL 42	
ARCL 02	STO 00	RCL 43	
PROMPT	GTO "SETP"	+	
GTO 01	LBL 04	STO 43	
LBL 05	CLA	FIX IND 41	
"PUNKT FEHLT"	ARCL 00	CF 28	
PROMPT	XROM 07,05	CLA	
FIX 03	RTN	ARCL 43	
GTO 01		SF 25	

Streckenreduktion

```
LBL "REDUKT"
LBL "SPRJNAT"
"KARTE>NATUR"
AVIEW
PSE
LBL 02
"S KARTE?"
PROMPT
RCL IND 44
/
"SN="
ARCL X
PROMPT
GTO 02
LBL "SNATPRJ"
"NATUR>KARTE"
AVIEW
PSE
LBL 03
"S NATUR?"
PROMPT
RCL IND 44
*
"SK="
ARCL X
PROMPT
GTO 03
LBL "SYSGK"
"SET GK-SYS"
AVIEW
PSE
XEQ "REDUK"
CF 01
SF 02
CF 03
47
STO 44
"SYS: GK"
AVIEW
PSE
CLX
GTO "SYSGK"
LBL "SYSUTM"
"SET UTM-SYS"
AVIEW
PSE
XEQ "REDUK"
RCL 47
0.9996
*
STO 46
CF 01
CF 02
SF 03
46
STO 44
"SYS: UTM"
AVIEW
PSE
CLX
GTO "SYSUTM"
LBL "SYSLOK"
"SET LOKALSYS"
AVIEW
PSE
SF 01
CF 02
CF 03
1
STO 45
45
STO 44
"SYS: LOKAL"
AVIEW
PSE
CLX
GTO "SYSLOK"
LBL "REDUK"
"ABST.MER<KM>?"
PROMPT
X^2
2
/
"RADIUS<KM>?"
PROMPT
STO 00
X^2
/
1
+
"H ELL<M>?"
PROMPT
1000
/
RCL 00
/
CHS
1
+
*
STO 47
RTN
END
```

Schnittberechnungen

```
LBL "SGG"
"SCHNITT G/G"
AVIEW
PSE
XEQ "GSU1"
XEQ "GSU2"
RCL 10
RCL 04
-
RCL 33
*
RCL 11
RCL 05
-
RCL 32
*
-
RCL 30
RCL 33
*
RCL 31
RCL 32
*
-
/
STO 34
XEQ "GSU3"
END
LBL "SGP"
"LOTFUSSPUNKT"
AVIEW
PSE
XEQ "GSU1"
"P3?"
PROMPT
STO 49
16
STO 48
XEQ "GETP"
RCL 16
RCL 04
-
RCL 30
*
RCL 17
RCL 05
-
RCL 31
*
+
RCL 30
X^2
RCL 31
X^2
+
/
STO 34
XEQ "GSU3"
```

```
LBL "SGK"
"SCHNITT G/K"
AVIEW
PSE
LBL 03
"P1?"
PROMPT
STO 49
4
STO 48
XEQ "GETP"
"P2?"
PROMPT
STO 49
7
STO 48
XEQ "GETP"
"PM?"
PROMPT
STO 49
10
STO 48
XEQ "GETP"
"RADIUS?"
PROMPT
RCL IND 44
*
STO 13
RCL 07
RCL 04
-
STO 14
RCL 08
RCL 05
-
STO 15
RCL 10
RCL 04
-
RCL 14
*
RCL 11
RCL 15
*
+
RCL 14
X^2
+
/
STO 16
RCL 14
*
RCL 04
+
```

```
RCL 16
RCL 15
*
RCL 05
+
STO 15
RCL 14
RCL 04
-
RCL 15
RCL 05
+
RCL 04
-
SQRT
RCL 14
RCL 11
X<>Y
-
RCL 17
X<>Y
P-R
RCL 05
+
STO 02
X<>Y
RCL 04
+
STO 01
FIX 03
"Y1="
ARCL 01
PROMPT
"X1="
```

```
PROMPT
FIX 00
"PNR1?"
PROMPT
STO 00
X=0?
GTO 02
XEQ "SETP"
LBL 02
RCL 11
RCL 16
+
RCL 17
X<>Y
P-R
RCL 05
+
STO 02
X<>Y
RCL 04
+
STO 01
FIX 03
"Y2="
ARCL X
PROMPT
"X2="
ARCL 02
PROMPT
FIX 00
"PNR2?"
PROMPT
STO 00
X=0?
GTO "SGK"
XEQ "SETP"
GTO "SGK"
LBL 01
"KEIN SCHNITT"
PROMPT
GTO 03
END
```

```
END                 STO 14              ARCL 02
```

Unterprogramme Schnittberechnungen 1-3

```
01 LBL "GSU1"       23 LBL "GSU2"       45 LBL "GSU3"
02 "P1?"            24 "P3?"            46 RCL 31
03 PROMPT           25 PROMPT           47 RCL 34
04 STO 49           26 STO 49           48 *
05 4                27 10               49 RCL 05
06 STO 48           28 STO 48           50 +
07 XEQ "GETP"       29 XEQ "GETP"       51 STO 02
08 "P2?"            30 "P4?"            52 RCL 30
09 PROMPT           31 PROMPT           53 RCL 34
10 STO 49           32 STO 49           54 *
11 7                33 13               55 RCL 04
12 STO 48           34 STO 48           56 +
13 XEQ "GETP"       35 XEQ "GETP"       57 STO 01
14 RCL 07           36 RCL 13           58 0
15 RCL 04           37 RCL 10           59 STO 03
16 -                38 -                60 FIX 03
17 STO 30           39 STO 32           61 "YS="
18 RCL 08           40 RCL 14           62 ARCL 01
19 RCL 05           41 RCL 11           63 PROMPT
20 -                42 -                64 "XS="
21 STO 31           43 STO 33           65 ARCL 02
22 RTN              44 RTN              66 PROMPT
                                        67 FIX 00
                                        68 "PNR S?"
                                        69 PROMPT
                                        70 STO 00
                                        71 X=0?
                                        72 RTN
                                        73 XEQ "SETP"
                                        74 FIX 03
                                        75 RTN
                                        76 END
```

Kreismittelpunkt aus drei Randpunkten

```
LBL "KREISM"            -                   X=0?
"KREISMITTELPKT"        RCL 14              GTO "KREISM"
AVIEW                   COS                 FIX 00
PSE                     *                   STO 00
LBL 02                  +                   XEQ "SETP"
"P1?"                   RCL 15              FIX 03
PROMPT                  /                   GTO "KREISM"
STO 49                  CHS                 LBL 01
4                       STO 16              "KEIN KREIS"
STO 48                  RCL 13              PROMPT
XEQ "GETP"              COS                 GTO 02
"P2?"                   *                   END
PROMPT                  RCL 07
STO 49                  RCL 04
7                       +
STO 48                  2
XEQ "GETP"              /
"P3?"                   +
PROMPT                  STO 01
STO 49                  RCL 13
10                      SIN
STO 48                  RCL 16
XEQ "GETP"              *
RCL 07                  CHS
RCL 04                  RCL 08
-                       RCL 05
RCL 08                  +
RCL 05                  2
-                       /
R-P                     +
X<>Y                    STO 02
STO 13                  0
RCL 10                  STO 03
RCL 04                  RCL 02
-                       RCL 05
RCL 11                  -
RCL 05                  X^2
-                       RCL 01
R-P                     RCL 04
X<>Y                    -
STO 14                  X^2
RCL 13                  +
-                       SQRT
CHS                     STO 17
SIN                     RCL IND 44
2                       /
*                       FIX 03
X=0?                    "R="
GTO 01                  ARCL 17
STO 15                  PROMPT
RCL 10                  "YM="
RCL 07                  ARCL 01
-                       PROMPT
RCL 14                  "XM="
SIN                     ARCL 02
*                       PROMPT
RCL 11                  "PNR M?"
RCL 08                  PROMPT
```

Schnitt Kreis-Kreis

```
LBL "SKK"
"SCHNITT K/K"
AVIEW
PSE
LBL 03
"M1?"
PROMPT
STO 49
4
STO 48
XEQ "GETP"
"M2?"
PROMPT
STO 49
7
STO 48
TAN
TAN
XEQ "GETP"
"RADIUS 1?"
PROMPT
RCL IND 44
*
STO 06
"RADIUS 2?"
PROMPT
RCL IND 44
*
STO 09
RCL 08
RCL 05
-
STO 10
RCL 07
RCL 04
-
STO 11
R-P
STO 12
X^2
RCL 06
X^2
+
RCL 09
X^2
-
RCL 12
2
*
/
STO 13
X^2
CHS
RCL 06
X^2
+
SQRT
STO 14
RCL 10
RCL 12
/
STO 15
RCL 11
RCL 12
/
STO 16
RCL 14
*
CHS
RCL 13
RCL 15
*
+
RCL 05
+
STO 02
RCL 14
RCL 15
*
RCL 16
*
RCL 15
RCL 13
*
+
RCL 05
+
STO 02
RCL 16
RCL 13
*
RCL 15
RCL 14
*
-
RCL 04
+
STO 01
"Y2="
ARCL X
PROMPT
"X2="
ARCL 02
PROMPT
FIX 00
"PNR2?"
PROMPT
STO 00
X=0?
GTO 02
XEQ "SETP"
LBL 02
FIX 03
GTO 03
END
```

Orthogonalberechnungen

```
LBL "KOHELM"        "XZ="           LBL "KOKLEIN"       STO 02
"HELMERTTRAFO"      ARCL 02         "KLEINPUNKTE"       "X="
AVIEW               PROMPT          AVIEW               ARCL 02
PSE                 FIX 00          PSE                 PROMPT
"P1 ZIEL?"          "PNR?"          "PA?"               FIX 00
PROMPT              PROMPT          PROMPT              "PNR?"
STO 49              STO 00          STO 49              PROMPT
10                  X=0?            10                  STO 00
STO 48              GTO 01          STO 48              X=0?
XEQ "GETP"          END             XEQ "GETP"          GTO 01
"P2 ZIEL?"                          "PE?"               XEQ "SETP"
PROMPT                              PROMPT              GTO 01
STO 49                              STO 49              END
13                                  13
STO 48                              STO 48
XEQ "GETP"                          XEQ "GETP"
"P1 START?"                         0
PROMPT                              STO 04
STO 49                              STO 05
4                                   STO 07
STO 48                              "Sae?"
XEQ "GETP"                          PROMPT
"P2 START?"                         RCL IND 44
PROMPT                              *
STO 49                              STO 08
7                                   XEQ "KO"
STO 48                              LBL 01
XEQ "GETP"                          "ORDINATE?"
XEQ "KO"                            PROMPT
LBL 01                              RCL IND 44
"Y START?"                          *
PROMPT                              RCL 04
RCL 04                              -
-                                   "ABSZISSE?"
"X START?"                          PROMPT
PROMPT                              RCL IND 44
RCL 05                              *
-                                   RCL 05
R-P                                 -
RCL 17                              R-P
*                                   RCL 17
X<>Y                                *
RCL 18                              X<>Y
+                                   RCL 18
X<>Y                                +
P-R                                 X<>Y
X<>Y                                P-R
RCL 10                              X<>Y
+                                   RCL 10
STO 01                              +
FIX 03                              STO 01
"YZ="                               FIX 03
ARCL X                              "Y="
PROMPT                              ARCL X
X<>Y                                PROMPT
RCL 11                              X<>Y
+                                   RCL 11
STO 02                              +
```

Orthogonalberechnungen

LBL "KOELEM"	X<>Y	**LBL "KO"**
"ORT.ELEMENTE"	RCL 11	RCL 07
AVIEW	+	RCL 04
PSE	STO 02	-
"ABSZISSE 1?"	"A="	RCL 08
PROMPT	ARCL 02	RCL 05
STO 10	PROMPT	-
"ORDINATE 1?"	GTO 01	R-P
PROMPT		STO 16
STO 11		STO 17
"ABSZISSE 2?"		X<>Y
PROMPT		STO 18
STO 13		RCL 13
"ORDINATE 2?"		RCL 10
PROMPT		-
STO 14		RCL 14
"P1?"		RCL 11
PROMPT		-
STO 49		R-P
4		STO 19
STO 48		RCL 17
XEQ "GETP"		/
"P2?"		STO 17
PROMPT		X<>Y
STO 49		RCL 18
7		-
STO 48		STO 18
XEQ "GETP"		FIX 06
XEQ "KO"		"<="
LBL 01		ARCL X
"PI?"		PROMPT
PROMPT		"Q="
STO 49		ARCL 17
21		PROMPT
STO 48		RCL 18
XEQ "GETP"		SIN
RCL 21		RCL 17
RCL 04		*
-		"O="
RCL 22		ARCL X
RCL 05		PROMPT
-		RCL 18
R-P		COS
RCL 17		RCL 17
*		*
X<>Y		"A="
RCL 18		ARCL X
+		PROMPT
X<>Y		RCL 19
P-R		RCL 16
X<>Y		-
RCL 10		CHS
+		FIX 03
STO 01		"FS="
FIX 03		ARCL X
"O="		PROMPT
ARCL X		RTN
PROMPT		END

Freie Stationierung mit Absteckungs- und Aufnahmemodul

```
LBL "FREIEST"   R-P          STO 00      -
LBL "FRSTAT"    STO 10       X#0?        FIX 03
"FR.STATION"    XEQ 00       XEQ "SETP"  "VS="
AVIEW           CHS          GTO 04      ARCL X
PSE             RCL 22       LBL "FRABST" PROMPT
"P LINKS?"      +            "POL.ABSTECK" CLX
PROMPT          XEQ 01       AVIEW       GTO 02
STO 49          STO 11       PSE         LBL 00
4               RCL 10       RCL 21      CLX
STO 48          RCL 15       RCL 11      X<>Y
XEQ "GETP"      FIX 03       -           LBL 03
"P RECHTS?"     "SLR="       STO 17      X<=Y?
PROMPT          ARCL X       FIX 00      GTO 01
STO 49          PROMPT       "ABST.PKT?" RTN
7               -            PROMPT      LBL 01
STO 48          "FS="        STO 49      400
XEQ "GETP"      ARCL X       33          +
RCL 07          PROMPT       STO 48      RTN
RCL 04          RCL 15       XEQ "GETP"  LBL "FRMESS"
-               RCL 10       RCL 33      "POL.AUFMASS"
RCL 08          /            RCL 31      AVIEW
RCL 05          FIX 07       -           PSE
-               "M="         RCL 34      RCL 21
R-P             ARCL X       RCL 32      RCL 11
STO 15          PROMPT       -           -
XEQ 00          FIX 05       R-P         STO 17
STO 22          STO 10       RCL 10      "R<I>?"
FIX 04          "M=1 ?"      /           PROMPT
"Z LINKS?"      PROMPT       STO 19      RCL 17
PROMPT          1            RCL IND 44  -
SIN             X=Y?         /           XEQ 03
"S LINKS?"      STO 10       FIX 03      "Z<I>?"
PROMPT          RCL 16       "$S="       PROMPT
RCL IND 44      *            ARCL X      SIN
*               RCL 11       PROMPT      "S<I>?"
*               X<>Y         XEQ 00      PROMPT
STO 16          P-R          RCL 17      RCL IND 44
"Z RECHTS?"     X<>Y         +           *
PROMPT          RCL 04       XEQ 03      *
SIN             X<>Y         STO 18      P-R
"S RECHTS?"     -            FIX 04      X<>Y
PROMPT          STO 01       "$R="       RCL 31
RCL IND 44      STO 31       ARCL X      +
*               FIX 03       PROMPT      STO 01
*               "YS="        LBL 02      "YI="
STO 23          ARCL 01      "Z GEM?"    ARCL X
"R LINKS?"      PROMPT       PROMPT      PROMPT
PROMPT          X<>Y         X#0?        X<>Y
STO 21          RCL 05       STO 12      RCL 32
"R RECHTS?"     X<>Y         RCL 12      +
PROMPT          -            SIN         STO 02
RCL 21          STO 02       RCL 19      "XI="
-               STO 32       RCL 20      ARCL X
STO 18          "XS="        -           PROMPT
RCL 23          ARCL 02      X<>Y        "PNR?"
P-R             PROMPT       /           PROMPT
RCL 16          "PNR S?"     "S GEM?"    STO 00
-               PROMPT       PROMPT      X#0?
```

Freie Stationierung mit Absteckungs- und Aufnahmemodul

```
XEQ "SETP"
GTO "FRMESS"
LBL 04
END
```

Flächenberechnungen

```
LBL "HERON"
"FLA.HERON"
AVIEW
PSE
LBL 00
"SEITE a?"
PROMPT
STO 00
"SEITE b?"
PROMPT
STO 01
+
"SEITE c?"
PROMPT
STO 02
+
2
/
STO 03
RCL 00
-
RCL 03
RCL 01
-
*
RCL 03
RCL 02
-
*
RCL 03
*
SQRT
FIX 02
"F="
ARCL X
PROMPT
RCL 00
RCL 01
+
RCL 02
+
FIX 03
"U="
ARCL X
PROMPT
GTO 00
END
```

```
LBL "AREA"
"KALK.AREA"
AVIEW
PSE
0
STO 07
"P1?"
PROMPT
STO 49
STO 10
1
STO 48
XEQ "GETP"
LBL 01
"P<I>?"
PROMPT
STO 49
RCL 10
-
x=0?
SF 04
RCL 49
4
STO 48
XEQ "GETP"
XEQ 02
XEQ 03
FS?C 04
XEQ 04
GTO 01
LBL 02
RCL 05
RCL 02
-
RCL 04
RCL 01
+
*
2
/
RCL IND 44
X^2
/
ST+ 07
RTN
LBL 03
RCL 05
RCL 02
-
X^2
RCL 04
RCL 01
-
X^2
+
SQRT
RCL IND 44
/
```

```
FIX 03
"S="
ARCL X
PROMPT
RCL 05
STO 02
RCL 04
STO 01
RTN
LBL 04
FIX 02
"F= "
RCL 07
ABS
ARCL X
PROMPT
GTO "AREA"
END
```

Höhe und Höhenfußpunkt im Dreieck

```
LBL "HHFP"
"DREIECK"
AVIEW
PSE
LBL 00
"SEITE a?"
PROMPT
X^2
"SEITE b?"
PROMPT
STO 00
X^2
-
"SEITE c?"
PROMPT
STO 01
X^2
+
RCL 01
/
2
/
FIX 03
"P="
ARCL X
PROMPT
RCL 01
-
CHS
"Q="
ARCL X
PROMPT
X^2
CHS
RCL 00
X^2
+
SQRT
"H="
ARCL X
PROMPT
GTO 00
END
```

Bogenabsteckung von der Tangente und der Sehne

```
LBL "ABKBS"                END
"ABST.SEHNE"
AVIEW
PSE
"RADIUS?"
PROMPT
STO 00
"L SEHNE?"
PROMPT
2
/
STO 01
RCL 00
/
ASIN
COS
CHS
1
+
RCL 00
*
STO 02
LBL 01
"X?"
PROMPT
STO 03
"dX?"
PROMPT
STO 04
X=0?
SF 04
LBL 02
FIX 03
RCL 03
"A="
ARCL X
PROMPT
CHS
RCL 01
+
X^2
CHS
RCL 00
X^2
+
SQRT
RCL 02
+
RCL 00
-
"O="
ARCL X
PROMPT
FS?C 04
GTO 01
RCL 04
ST+ 03
GTO 02
```

```
LBL "ABKBT"
"ABST.TANG."
AVIEW
PSE
"RADIUS?"
PROMPT
STO 00
LBL 01
"X?"
PROMPT
STO 01
"dX?"
PROMPT
STO 02
X=0?
SF 04
LBL 02
FIX 03
RCL 01
"A="
ARCL X
PROMPT
RCL 00
X^2
RCL 01
X^2
-
X<0?
GTO 03
SQRT
CHS
RCL 00
+
"O="
ARCL X
PROMPT
FS?C 04
GTO 01
RCL 02
ST+ 01
GTO 02
LBL 03
"ZU WEIT"
PROMPT
GTO 01
END
```