Ushikata Area-Curvimeter

X-PLAN F/F.C series

X-PLAN300F/300F.C
X-PLAN380F/380F.C
X-PLAN460F/460F.C
X-PLAN520F/520F.C
X-PLAN620F/620F.C

Operation Manual

Ushikata
Tokyo Japan

X-PLAN *F* / *F.C* series

Preface

Thank you for using the X-PLAN F/F.C series. The F/F.C series have taken over every function with which the former X-PLAN 360Cll+ and 360C+ were equipped, and have even better features, including larger and easier paper coverage.

X-PLAN's measurements are classified into two categories.

Basic measurements:	(x,y) coordinates, Area, Length of line segment, Length of total outline, Radius
Special measurements:	Centroid, Triangular area, Angle, Center of circle (arc), Radial distance, Contour-based volume, Revolutionary solid's volume･surface area･center of gravity

The F series offer both Basic and Special measurements. The F.C can offer only Basic measurements. The last three of the special measurements are possible for the first time with the F, making this device useful in other fields besides architecture/civil engineering/survey.

In addition, both F& F.C have been supplied with a "Mouse" key. With this key, you may assimilate menu selection using a familiar "mouse" operation to set up or to confirm measuring conditions, which was a somewhat cumbersome process with the old models.

The coordinate marking function is a very important feature of the F/F.C. Pressing the Mark key when coordinates are displayed on the X-PLAN display, you can mark that coordinate point in the drawing. You can specify those marking coordinates through your PC as well, further enhancing the effectiveness of this function.

Besides the Operation manual and the Interfacing manual, a Quick Reference User's manual is available. As it offers various kinds of operational examples, we recommend trying those examples with your X-PLAN in hand. Utilizing this Quick Reference User's manual could save you a lot of time.

Please visit our website(http://www.ushikata.co.jp) on a regular basis so that you may possibly download guides, manuals, etc. in addition to our company/ product information.

This manual is to be used for both the F series and the F.C series. Explanations on the Special measurements apply to the F series only.

Ushikata Mfg. Co., Ltd.

INDEX

(Appendix)   ● Structure of Mouse menu
                  ● CP memorandum

1.   EXAMPLE OF USAGE 1   -------   Measurement of Area

Measuring the area of the diagram shown at right

(Key)   Scale ratio   :   1/200
        Unit of measure   : m^2
        Calculated to the 2nd decimal place
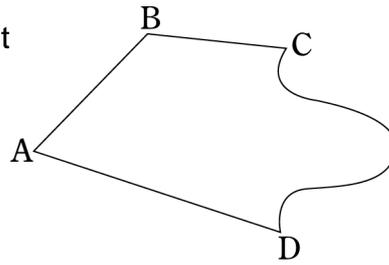
(Display)	(Procedure)
*** ***	1. Attach printer if necessary. 2. Switch power on.
X-PLANxxxF V4.0 BAT=40H C.P. 1	The remaining power indication, which is approximate, and loaded measuring condition number will appear on the display for about 2 seconds.
KEY EXPLANATION? YES or NO	First display when printer is attached.
0.	First display when printer is not attached

◆ Setting up measurement conditions:

3. Press [SET].

1 MEAS FUNC Y/N SPECIAL N	4. Since special measurements are not necessary, press [NO].
1 MEAS FUNC Y/N COOR (X.Y) N	5. Since coordinates will not be plotted, press [NO].
1 MEAS FUNC Y/N LINE SEG (d) N	6. Since line segment length is not necessary, press [NO].
1 MEAS FUNC Y/N AREA (A) N	7. Since area will be measured, press [YES].

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ LINE  (L)        N      │
└─────────────────────────┘
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ RADIUS    (r)    N      │
└─────────────────────────┘
```

8. Since total length (circumference) is not necessary, press [NO].

9. Since radius is not necessary, press [NO].

```
┌─────────────────────────┐
│ 2 UNIT         Y/N      │
│  m               Y      │
└─────────────────────────┘
```

unit

10. Since the unit of measure is m^2 (m), press [Yes]. -- If another unit is displayed, the proper **unit category** (Metric, English or Special) must be searched out using the [NO] key, then, when found, must be chosen using the [YES] key. Next, the proper

must be searched out using the [NO] key and, when found, chosen using the [YES] key.
--> See < 5. Measuring Units >

```
┌─────────────────────────┐
│ 3 SCALE        Y/N      │
│ SCALE RATIO      Y      │
└─────────────────────────┘
```

11. Scale ratio can now be entered by selecting "SCALE RATIO ASSIGNMENT" (press[YES]).

```
┌─────────────────────────┐
│ SCALE RATIO             │
│ RX             1.       │
└─────────────────────────┘
```

12. To enter the ratio scale denominator of 200, press number keys [2],[0],[0]. Press [YES] to enter.

```
┌─────────────────────────┐
│ SCALE RATIO             │
│ RY           200.       │
└─────────────────────────┘
```

13. Since, in this example, the vertical and horizontal scale ratios are the same, simply press [YES].

```
┌─────────────────────────┐
│ 6 D.P PLACE   Y/N       │
│           D.P FULL      │
└─────────────────────────┘
```

14. To program the X-PLAN to calculate to the 2nd decimal place, press [2]. Or, press simply press [YES].
 [NO] until "2" appears. When "2" appears, press [YES]. The measurement will be rounded to two decimal places.

```
┌─────────────────────────┐
│ 7 NUMBERING    Y/N      │
│ WITHOUT #ing     Y      │
└─────────────────────────┘
```

15. Since the Automatic Numbering function will not be used in this case, press [YES] at "WITHOUT #ING".
  -->see < 8. Automatic Numbering Function.>

```
┌─────────────────────────┐
│                         │
│                0.       │
└─────────────────────────┘
```

16. Setting of measurement conditions complete.

◆ Measurement Operation: Now one can begin measuring the diagram. Press [P/NP] in order to set to "PRINT".

pt.A -- [S/P]	17. Place the center of the Trace Lens at pt. A and press [S/P] (START/POINT).
pt.B -- [S/P]	18. Move the center of the Trace Lens to pt. B. It is not necessary to trace the straight line between pt. A and pt. B. Press [S/P].
pt.C -- [S/P]	19. Press [S/P] at pt. C. (This step is omissible without affecting the measurement results.)
pt.C -- [CON]	20. Since the line between pt. C and pt. D is curved, press [CON] (CONTINUOUS) at pt. C to trace the line in Continuous Mode. The Continuous Mode Indicator will be illuminated red.
pt.C ~~ pt.D	21. Trace the line from pt. C to pt. D.
pt.D -- [CON]	22. Since the line from pt. D to pt. A is straight, press [CON] at pt. D to return to Straight Line Mode (Point Mode). The indicator light will switch off.
pt.A -- [S/P]	23. When [S/P] is pressed at pt. A, two beeps will sound and the measurement will automatically be completed. Pressing [END] at pt. D is also possible. --> See <4-3-B.Straight Line Supplement Function>

24. Measurement complete.   Area measurement will be displayed on the screen and printed. The unit symbol will appear as "m" but this means "m^2"

```
AREA
A            123.45 m
```
(value is arbitrary)

```
   *PRINTOUT*
END
 A         123.45 m
```

2.   EXAMPLE OF USAGE 2   ----   Measurement of Coordinates

After indicating the coordinates of known pts. A and B, the coordinates of pts. P_1, P_2 and P_3 will be plotted.

(Key)
Scale ratio:
   Will be calculated automatically

6
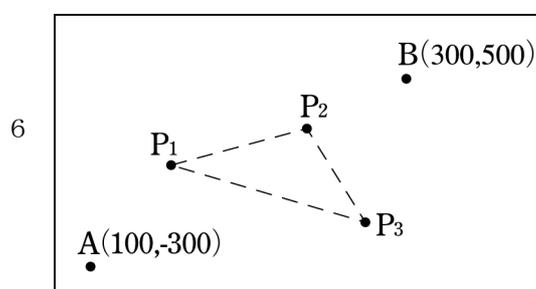
based on the coordinates of known
pts. A and B.
Unit of measure: m
Coordinate system: Standard
   (X-axis:horizontal,Y-axis:vertical)
Calculated to the 2nd decimal place
   (Display)   (Procedure)

It is assumed that the X-PLAN has been switched off following the completion of
EXAMPLE OF USAGE 1.

        ***   1. Switch power on.

X-PLANxxxF   V4.0
BAT=40H   C.P. 1

The remaining power indication, which is rough
though, and loaded measuring condition number will
appear on the display for about 2 seconds.

KEY EXPLANATION?
YES or NO

First display when printer is attached.

0.

First display when printer is not attached.

◆ Setting up conditions of measurement.

2. Press [SET].

1 MEAS FUNC   Y/N
SPECIAL   N

3. Since special measurements are not
   necessary, press [NO].

1 MEAS FUNC   Y/N
COOR   (X.Y)   N

4. Since coordinates will be plotted,
   press [YES].

1 MEAS FUNC   Y/N
LINE SEG (d)   N

5. Since line segment length is not
   necessary, press [NO].

1 MEAS FUNC   Y/N
AREA   (A)   Y

6. Since area will not be measured, press [NO].

7

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ LINE  (L)        N      │
└─────────────────────────┘
```

7. Since total length (circumference) is not
   necessary, press [NO].

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ RADIUS     (r)   N      │
├─────────────────────────┤
│ 2 UNIT         Y/N      │
│  m               Y      │
└─────────────────────────┘
```

8. Since radius is not necessary, press
   [NO].

9. When selecting the unit of measurement,
   the previous assignment will be displayed
   (in this case, the unit of EXAMPLE OF
   USAGE 1). The same unit (m) will be used.
   Press [YES].

```
┌─────────────────────────┐
│ 3 SCALE        Y/N      │
│ SCALE RATIO      Y      │
└─────────────────────────┘
```

10. This display inquires about assigning the
    scale ratio.   Since in this diagram the
    scale ratio will automatically be set
    later, disregard.   Simply press [SET].

```
┌─────────────────────────┐
│ SCALE RATIO             │
│ RX          200.        │
└─────────────────────────┘
```

11. For the same reason as given above,
    disregard display and press [SET].   Note
    that the "200" displayed is the scale
    ratio from the previous usage.

```
┌─────────────────────────┐
│ SCALE RATIO             │
│ RY          200.        │
└─────────────────────────┘
```

12. Once again, disregard display and press
    [SET].

```
┌─────────────────────────┐
│ 4 AXIS         Y/N      │
│ STAND AXIS       Y      │
└─────────────────────────┘
```

13. Since the Standard Coordinate system will
    be used, press [YES].

```
┌─────────────────────────┐
│ AXIS ORIGIN             │
│ PRESS S/P               │
└─────────────────────────┘
```

14. Since the method of determination for
    these axes (axis origin, assigned X-axis)
    is unnecessary, press [NO].
    --> See <4-1. Measuring Coordinates>

```
┌─────────────────────────┐
│ INPUT COORDINATE        │
│ X1            0. m       │
└─────────────────────────┘
```

15. To input x=100 for pt. A, press [1], [0],
    [0], [YES].

```
┌─────────────────────────┐
│ INPUT COORDINATE        │
│ Y1            0. m       │
└─────────────────────────┘
```

16. To input y=-300 for pt. A, press [3],
    [0], [0], [+/-], [YES].

```
┌─────────────────────────┐
│ COORDIN. (X1.Y1)        │
│ PRESS S/P               │
└─────────────────────────┘
```

17. Set the center of the Trace Lens to pt. A
    and press [S/P] (as instructed in the   .
    display).

```
┌─────────────────────────┐
│ INPUT COORDINATE        │
│ X2            0. m      │
└─────────────────────────┘
```

18. To input x=300 for pt. B, press [3]. [0], [0], [YES].

```
┌─────────────────────────┐
│ INPUT COORDINATE        │
│ Y2            0. m      │
└─────────────────────────┘
```

19. To input y=500 for pt. B, press [5], [0],], [0], [YES].

```
┌─────────────────────────┐
│ COORDIN. (X2.Y2)        │
│ PRESS S/P               │
└─────────────────────────┘
```

20. As with step 17, set the center of the Tracer Lens to pt. B and press [S/P].

```
┌─────────────────────────┐
│ INPUT COORDINATE        │
│ X3            0. m      │
└─────────────────────────┘
```

21. If there is a third known point, input its coordinates starting with the x coordinate in this step. In this example there is only two, so press [NO].

```
┌─────────────────────────┐
│ 6 D.P PLACE   Y/N       │
│           D.P   2       │
└─────────────────────────┘
```

22. Assignment of decimal place. In this example it is the same as the previous   . example, so simply press [YES].

```
┌─────────────────────────┐
│ 7 NUMBERING   Y/N       │
│ WITHOUT #ing     Y      │
└─────────────────────────┘
```

23. To make it easier to identify the points in the measurement results, the Automatic   . Numbering Function will be used to number each point. Press [NO] to continue to the next display.

```
┌─────────────────────────┐
│ 7 NUMBERING   Y/N       │
│ #ing IN PLOT     N      │
└─────────────────────────┘
```

24. When [YES] is pressed here, a number will be printed with the coordinates of each. point to be plotted.
    → See <8. Automatic Numbering Function>

```
┌─────────────────────────┐
│                         │
│           0.            │
└─────────────────────────┘
```

25. Setting of conditions complete.

◆ Operation of measurement: Now one can begin plotting the coordinates of pts. P$_1$, P$_2$ and P$_3$.

pt.P$_1$ -- [S/P]   26. Set the center of the Trace Lens to P$_1$ and press [S/P].

pt.P$_2$ -- [S/P]   27. Next, set Lens center to P$_2$ and press [S/P].

pt.P$_3$ -- [S/P]   28. Repeat the procedure for P$_3$.

X 12.12 m	
Y 21.21 m	

The coordinates of each point will be displayed as on left.

(values are arbitrary)

```
   *PRINTOUT*
 # 1.
 X              12.12 m
 Y              21.21 m
 # 2.
 X             -99.99 m
 Y             777.88 m
 # 3.
 X             333.44 m
 Y          -11111.90 m
```

29. Measurement complete.

NOTE: 1.   If [YES] is pressed in step 5 of this example, line segment length can also be measured (the same applies for circumference in step 7).

        2.   If the X-PLAN is switched off, its memory of the spatial relationships between known points, machine and axes will be lost.

3.   EXPLANATION OF THE APPARATUS

(1) COMPOSITION
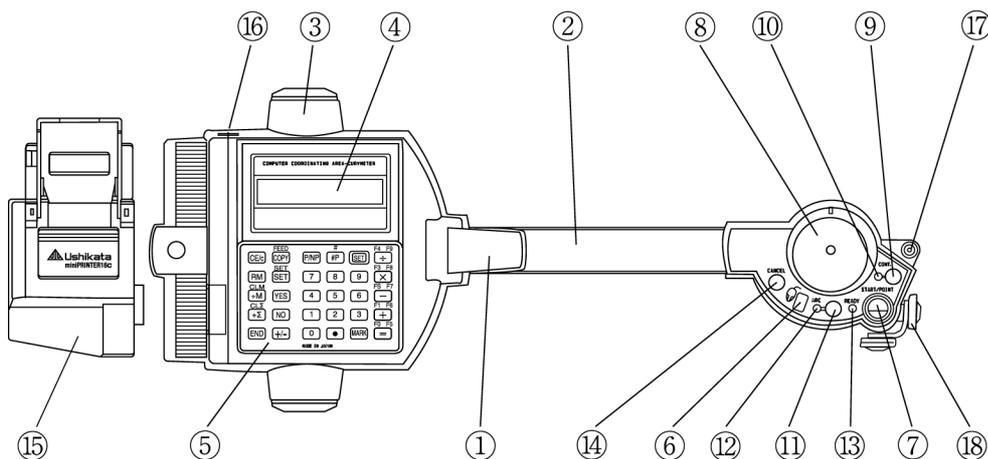
1.   Power Switch   Turn on by lifting up.   Simultaneously unlocks the Tracer Arm.

2. Tracer Arm   Arm oscillates approximately 115° and has a measurement area of approximate 380 mm in width.   When the limit of oscillation is approached during measurement, a warning will be displayed on the screen accompanied by a beeping alarm.

3. High Friction Roller   Eliminates slipping and allows precise measurement of diagrams.

4. LCD Display   Displays various operational messages and measuring results on a two line screen.

5. LCD Contrast   Rotate to the left or right while pressing lightly to adjust to a favorable contrast.

6. Mouse Key   Initiates menu selections in the mouse mode.

7. Start/Point Key ([S/P])   Command key for beginning measurements and plotting each measurement point. (*Hereafter, pressing this key will be referred to as* "**Pointing**".)

8. Tracer Lens   Large revolving eccentric lens allows for easy vision.

9. Continuous Key ([CON])   Switches back and forth between Continuous Measurement Mode for curved lines and Point Mode for straight lines.

10. Continuous Indicator   When this lamp is illuminated red, the X-PLAN is set in the Continuous Measurement Mode.

11. Arc Key ([ARC])   When measuring an arc, press this key near the center of the arc to switch into Arc Measurement Mode.

12. Arc Indicator   When this lamp is illuminated red, the X-PLAN is set in the Arc Measurement Mode.

13. Ready Indicator   Keys can only be used when this lamp is illuminated green. **(READY MODE)**

14. Cancel Key ([CAN])   When this key is pushed immediately following [S/P] key or [ARC] key input, that input will be canceled and the measurement will be allowed to continue from that point.

15. Mini-Printer   The X-PLAN will automatically detect the

(Model 16c)   presence or absence of this printer.

16. AC Charger Jack   Plug in the AC charger for recharging.
                            The X-PLAN can be used while recharging.

17. Marker Hole   Insert a writing utensil tip in to this
                            hole to mark the coordinate point.

18. Fine Adjustment Roller Press the Rollers slightly and rotate to pinpoint the
     (only for F series)   target coordinate point. These rollers are designed
                             not to touch the paper while not pressed.

(2) COMPOSITION OF OPERATIONAL PANEL KEYS

FEED			#		F4 F9
CE/c	COPY	P/NP	#P	SFT	÷
SET					F3 F8
RM	SET	7	8	9	×
CLM					F2 F7
+M	YES	4	5	6	—
CLΣ					F1 F6
+Σ	NO	1	2	3	+
					F0 F5
END	+/−	0	●	MARK	=

There are some keys which possess primary and secondary functions.
The function written on the key surface is the primary function .   The
function written above the key in red is the secondary function and is
used in combination with the [SFT] key.   For example, the secondary
function FEED is available by pressing [SFT] and then [COPY]. **To
show that FEED is a secondary function, it will be indicated as
FEED$_2$ in this manual.**

◆ Primary function keys (independent functions)

[CE/C]   Clear Entry / Clear key.
                    1)   Clears the value on display to zero.
                    2)   Erases error situations.
                    3)   Cancels measurement.
                    4)   Interrupts printing.
                    When pressed during calculations with the Fundamental
                 Operations of Arithmetic (+,-,x,), only the last entry will be
                  cleared (Clear Entry).   If pressed again, the entire calculation
                 will be cleared.

[RM]   Recall Memory key.   Values accumulated with [+M] will be
displayed.

[+M]   Plus Memory key.   Adds displayed figures to internal memory.

[+Σ]   Plus Sigma key.   Adds results of measurements.   For
details see < 7. Measurement Results Accumulation And
Averaging Functions >

[END]   End key.   Completes measurement. Repeatedly pressing this
key will recall AREA and TOTAL LENGTH measurements to the
display.   These results will remain stored until [S/P] is pressed
at the beginning of the next measurement.

[COPY]   Copy key.   Prints display without affecting calculation or
measurement.

[SET]   Set key.   Sets various conditions necessary for measurement
operations. If pressed continuously (or repeatedly), displays
conditions set previously.

[YES]   Yes key.   Affirms options posed by display.

[NO]   No key.
       1)   Rejects options posed by display.
       2)   Recalls alternative measurement results to display during
            measurement of a diagram (before pressing [END].)
       3)   Displays accumulation figures obtained with [+Σ] key.

[+/-]   Plus / Minus key.
       1)   Changes the sign of the displayed figure. It is pressed last
            when entering numbers. For example, "-100" would be
            entered by pressing [1], [0], [0], and then [+/-].
       2)   Measured angle results (narrower angles) can be
            changed to wider ones:(360° - measured angle).

[P/NP]   Print / No Print key.
       1)   Switches between "PRINT" and "DO NOT PRINT".
       2)   Switches between "SEND DATA TO COMPUTER" and
            "DO NOT SEND DATA TO COMPUTER".

[#P]   Number Print key.   Using this key, any value can be
(1) printed, or (2) sent to the external computer.
For example, press [2], [3], [#P] to print or send
"#23.".

[SFT]   Shift key.   Shifts to secondary function keys.

[+] [-] [x] [÷] **(F1 F2 F3 F4)**	Fundamental Operations of Arithmetic keys. When the X-PLAN is connected to a computer, these will automatically become primary function keys [F1], [F2], [F3], and [F4] respectively.
[=] **(F0)**	Equals key. When the X-PLAN is connected to a computer, this automatically becomes the [F0] function key.
[0] - [9]	Number Input keys.
[.]	Decimal key. At the decimal placement selection display, this key can be used to select the "floating decimal point"

expression.

[MARK]	Mark key. Used to initiate and terminate the Mark Mode. → See <10. Coordinate point marking operation>.

◆ Secondary function keys (used in combination with [SFT] key).

CLM$_2$	Clear Memory key. This key clears the memory to zero.
CLΣ$_2$	Clear Sigma key. Clears accumulated and averaged values in Sigma function to zero.
FEED$_2$	Feed key. Feeds paper into the printer. Press continuously to print out blank lines.
SET$_2$	Interface Set key. Assigns communication conditions (protocol) necessary when interfacing with a computer. The use of the printer has no effect on this function.
#$_2$	Automatic Numbering Function key. Assigns beginning numbers when giving automatic numbers to identify measurement results. See < 8. Automatic Numbering Function >.
F5$_2$ - F9$_2$	Function keys. Can be used when the X-PLAN is interfaced with a computer.

4.   MEASUREMENT FUNCTIONS

The X-PLAN can make 12 kinds of measurements as follows.

Basic measurements

Coordinates,　Segment Length,　Area,　Total Length (or circumference),
Radius

Special measurements

Centroid,　Triangular area,　Angle,　Center of arc,
Radial distance,　Contour-based volume,　Revolutionary solid

<Measurements which can be made at the same time>
Coordinates, Segment Length, Area, Total Length, Radius, Centroids

<measurements to be measured independently of the others>
Triangular area, Angle, Center of arc, Radial distance,
Contour-based volume,　Revolutionary solid

(1)　Measuring Coordinates

A.　Types of coordinate systems

1. **Standard Coordinate system**　　---

4 AXIS	Y/N
STAND AXIS	Y

The system used in ordinary Geometry where the X-axis is horizontal and
the Y-axis is vertical.

2. **Survey Coordinate system**　　---

4 AXIS	Y/N
SURV AXIS	N

The land surveying system used in the field of Surveying where the Meridian
(vertical)is the X-axis and due east (horizontal) is the Y-axis.

3. **Machine Coordinate system**　　---

4 AXIS	Y/N
MACH.AXIS	N

A system established by the X-PLAN where the direction of the Tracer Arm
is

designated as the X-axis, and the Y-axis is perpendicular (direction of the
roller axis).　The Tracer Point (center of the lens) is considered the origin
(0,0) immediately upon the power being turned on.

Y　　　　　　　　　　X　　　　　　　　　　Y

1 5

X

```
 x<0 │ x>0          x>0 │ x>0
 y>0 │ y>0          y<0 │ y>0
─────┼─────  X    ─────┼─────  Y
 x<0 │ x>0          x<0 │ x<0
 y<0 │ y<0          y<0 │ y>0
```

Standard System   **Survey System**   ● **Machine System**

●
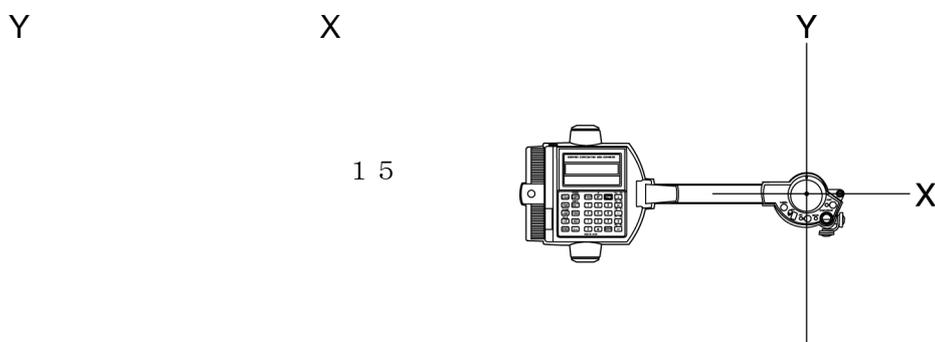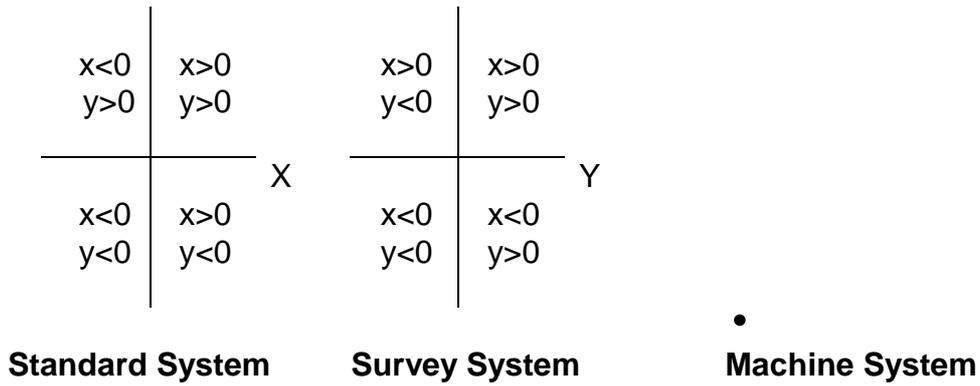
B. Methods of defining axes   ---   for use with Standard and Survey
                                     Systems

When plotting coordinate values, it is necessary to correspond the
X-PLAN and the diagram.   There are three methods of doing this.
a) Origin Bias - **X-axis Assignment**

Defining the X- and Y-axes by 'pointing' the zero origin bias and pt. P in the
positive direction of the X-axis.   One is later able to move the coordinate
axes
by applying the bias value to the origin bias.

```
        Y                              X

                                       │ P
              P                        │
──────────────── X          ──────────────── Y
        0                              0
```

Standard Coordinate   Survey Coordinate
     SYSTEM   SYSTEM
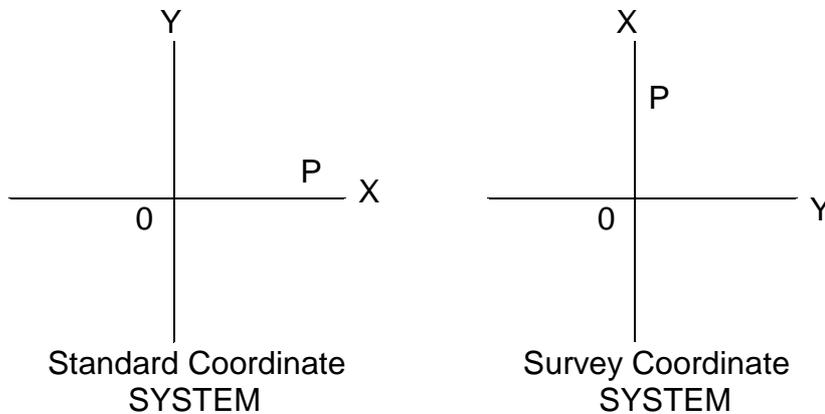
(Display)	(Procedure)

```
┌──────────────────────┐
│ 4 AXIS        Y/N     │
│ STAND AXIS      Y     │
└──────────────────────┘
```

1. As an example, choose STANDARD COORDINATE
   system.   Press [YES].

```
┌──────────────────────┐
│ INPUT COORDINATE      │
│ X1           100.0 m  │
└──────────────────────┘
```

If known coordinate points were used to define the
coordinate system last time, this display will appear.
Press [NO].

```
┌─────────────────────┐ }
│ AFFINE   ( 1)       │
│ X           100.0 m │
└─────────────────────┘
```

If the Affine method was used last time to define the coordinate system, this display will appear.
Press [NO].

```
┌─────────────────────┐
│ AXIS ORIGIN         │
│ PRESS S/P           │
└─────────────────────┘
```

   2. 'Point' at pt. O (press [S/P]).

```
┌─────────────────────┐
│ ON X-AXIS(+)        │
│ PRESS S/P           │
└─────────────────────┘
```

   3. 'Point' at pt. P.   Here, it is best for
      pt.P to be as far from pt.O as possible.

In this example, the location of the origin bias will be shifted from coordinates (0,0) to coordinates (100, 500), so continue as follows.

```
┌─────────────────────┐
│ 5 BIAS ORIGIN       │
│ XB          0. m    │
└─────────────────────┤
│ 5 BIAS ORIGIN       │
│ YB          0. m    │
└─────────────────────┘
```

   4. Press [1], [0], [0], [YES].

   5. Press [5], [0], [0], [YES].

b) Plotting points of known coordinates

Defining the coordinate axes by plotting two or three points of known coordinate location from the diagram. This method can be applied only when the scale ratio along both of the X- and Y-axes are equal.

The scale ratio will automatically be calculated and set according to the coordinates of the known points. (Previous values will be ignored.)
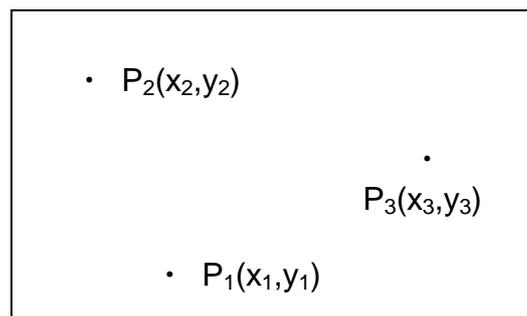
```
┌───────────────────────────────┐
│                               │
│   ·  P₂(x₂,y₂)                │
│                               │
│                         ·     │
│                    P₃(x₃,y₃)  │
│                               │
│      ·  P₁(x₁,y₁)             │
│                               │
└───────────────────────────────┘
```
$P_2(x_2,y_2)$ $P_3(x_3,y_3)$ $P_1(x_1,y_1)$

(KNOWN POINTS)

(Display)	(Procedure)

```
┌─────────────────────┐
│ AXIS ORIGIN         │
│ PRESS S/P           │
└─────────────────────┘
```

1. Press [NO].
   --> Ignore Origin Bias - X-axis assignment (B.a).

```
INPUT COORDINATE
X1              0. m
```

2. Input "x_1" for the x-coordinate of
   pt. P_1, press [YES].

```
INPUT COORDINATE
Y1              0. m
```

3. Input "y_1", press [YES].

        pt.P_1 -- [S/P]

4. 'Point' at pt. P_1.

```
INPUT COORDINATE
X2              0. m
```

5. Input "x_2", press [YES].

```
INPUT COORDINATE
Y2              0. m
```

6. Input "y_2", press [YES].

        pt.P_2 -- [S/P]

7. 'Point' at pt. P_2.

```
INPUT COORDINATE
X3              0. m
```

8. Input "x_3", press [YES].
   * If only two points are given, press [NO] here. *

```
INPUT COORDINATE
Y3              0. m
```

9. Input "y_3", press [YES].

        pt.P_3 -- [S/P]

10. 'Point' at pt. P_3.

     -- end of definition --

(Note)

  When defining coordinate axes using three known points, the coordinate axes
  position and reduced scale which result from the spatial relationships of
  (P_1, P_2), (P_2, P_3), and (P_3, P_1) will be averaged to obtain one set of fixed
  coordinate axes and one reduced scale. If any one set of (x,y) coordinate
  values is more than 5 mm off of its location as prescribed by calculations
  based on the other two sets of (x,y) coordinate values, the warning message
  shown below will be displayed. The measurement, nevertheless, can be
  continued.

```
** WARNING      **
OUT OF CORD ERR.
```
----- Inconsistency developing in the definition
      of coordinate axes.(Continuation possible.)

c) Affine Transformation Method

The Affine transformation can be applied to define new coordinate systems using a maximum of 25 known points. This definition method can be used even when both scale ratios in the X and Y directions are different.

* The least mean square method is used to cover so many points.

```
 ·  P_n(x_n,y_n)
                \
                   ≈≈≈
                      \
                            ·
                          P₂(x₂,y₂)
 ·  P₁(x₁,y₁)
```
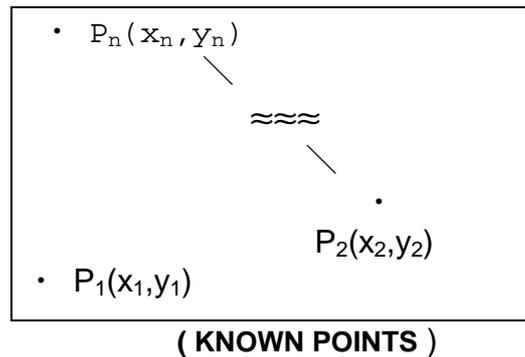
(KNOWN POINTS)

(Display)	(Procedure)

AXIS ORIGIN PRESS S/P	1. Press [NO]. → Ignore "Origin Bias - X-axis assignment ".
INPUT COORDINATE X1 0. m	2. Press [NO]. → Ignore "Plotting Points of Known Coordinates".
AFFINE (1) X 0. m	3. Input "x_1" for the x-coordinate of pt. P_1, press [YES].
AFFINE (1) Y 0. m	4. Input "y_1" for the y-coordinate of pt. P_1, press [YES].
AFFINE (1) PRESS S/P	5. `Point` at pt. P_1.
⇓ ⇓ ⇓	*Repeat "3", "4" and "5" for pt. P_n.*
AFFINE (n) PRESS S/P	6. `Point` at pt. P_n.
AFFINE (n+1) X 0. m	7. Press [NO] when no more known coordinate points are left.

1 9

```
┌─────────────────────────┐
│ AFFINE ( X, Y )         │
│ SUCCESSFUL END          │
└─────────────────────────┘
```

8. With a beep sound, this display will appear for a short time.

** The Affine transformation method needs at least 3 known points for the mathematical solution.

d) Correspondence of diagram and coordinate axes

Method of plotting the origin and X-axis direction at two peaks of each diagram. In the case of the diagram shown below, pt. A, which is the point of origin of the measurement, becomes the origin of the axes. Pt. B, which is the next to be 'pointed' in the measurement, becomes the point for the positive direction of the X-axis. The bias becomes the (x,y) coordinates of pt. A.

A→B→C

(Display)   (Procedure)

⇓   ⇓
⇓   ⇓

```
┌─────────────────────────┐
│    (standard    or      │
│    survey selected)     │
└─────────────────────────┘
```
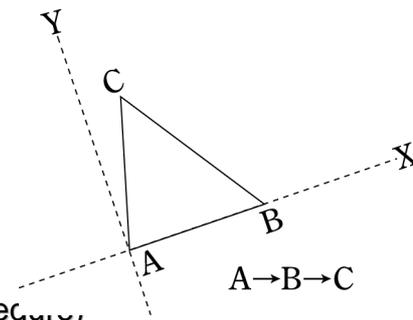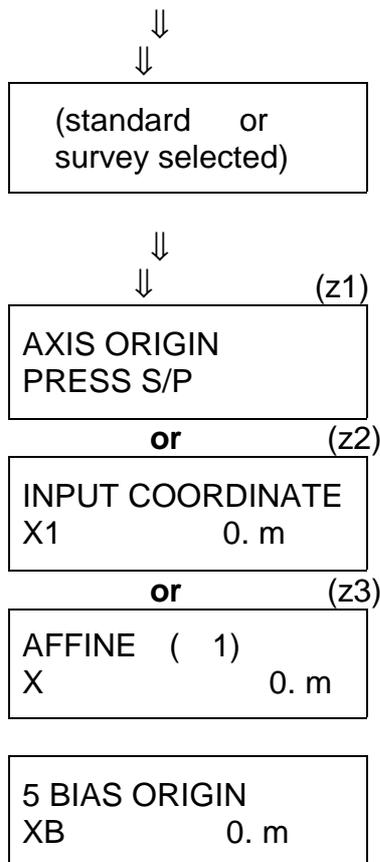
1. Select either STANDARD COORDINATE system or SURVEY COORDINATE system.

⇓   ⇓
⇓   (z1)   ⇓

```
┌─────────────────────────┐
│ AXIS ORIGIN             │
│ PRESS S/P               │
└─────────────────────────┘
```
        or   (z2)

```
┌─────────────────────────┐
│ INPUT COORDINATE        │
│ X1           0. m       │
└─────────────────────────┘
```
        or   (z3)

```
┌─────────────────────────┐
│ AFFINE   ( 1)           │
│ X              0. m     │
└─────────────────────────┘
```

2. Ignore "origin bias and X-axis assignment" , "plotting points of known coordinates" or "Affine" displays. Press [SET] for z1, or press [NO] for z2 and z3.
   ➔ **Diagram and Coordinate Axes Correspondence Function will take effect.**

```
┌─────────────────────────┐
│ 5 BIAS ORIGIN           │
│ XB           0. m       │
└─────────────────────────┘
```

3. Input the bias origin x-coordinate of pt.A.   If "0" applies, simply press [YES].

2 0

```
┌─────────────────────────┐
│ 5 BIAS ORIGIN           │
│ YB            0. m      │
└─────────────────────────┘
```

4. Input the bias origin y-coordinate of pt.A. If the figure shown in the display is correct, simply press [YES].

⇓
⇓   ⇓

The coordinate axes will be defined for each diagram measured (each time [END] key is pressed).

(2)   Measuring Segment Length

Explanation of how to measure the space between any two points shown on the right.The length of segment CD will be that of a curved line segment, and the length of segment EF will be the length of an arc.
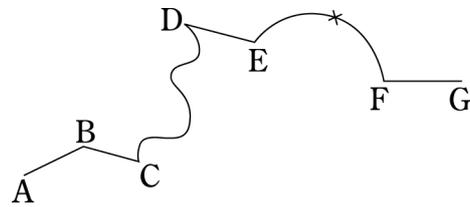
(Display)   (Procedure)
_____

⇓

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ LINE SEG (d)       N    │
└─────────────────────────┘
```

When [YES] is pressed at this display, segment length can be measured

⇓

1.   'Point' at pt. A.
2.   'Point' at pt. B.

```
┌─────────────────────────┐
│ LINE SEG                │
│ d        215.55 m       │
└─────────────────────────┘
```

The length of segment AB will be displayed as on left. The same applies for the following:

3.'Point' at pt. C.   -->   Output for BC.
4. Press [CON] at pt. C to switch to Continuous mode and trace the curved line segment to pt. C.   At pt. D,   press [CON] again to return to Point mode, then press [S/P].
● If [S/P] is not pushed at pt. D, the measurement will continue to pt. E and the result will be the length of segment CE.
    --> *Output for length of segment CD.*

5. 'Point' at pt. E.   -->   Output for DE.

2 1

6. Press [ARC] near the center of arc
   EF to switch to Arc Mode.
7. 'Point' at pt. F.   -->   Output for
    arc length of segment EF.
8. 'Point' at pt. G.   -->   Output for FG.

--Measurement complete--

(Example of PRINTOUT)
   d   211.83 m
   d   121.59 m
   d   559.57 m
   d   999.99 m
   d   343.11 m
   d   818.91 m   (values are arbitrary)

(3)   Measuring Area

The area in the diagram on the right
will be measured.

  Starting point :   pt. A

(Display)   (Procedure)

⇓
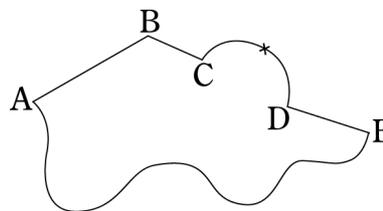
Press [YES] at this display to measure
area.

```
1 MEAS FUNC   Y/N
AREA        (A)     Y
```

⇓
1. 'Point' at pt. A.
2. 'Point' at pt. B.
3. 'Point' at pt. C.
  *Diagrams can also be measured
  counter-clockwise.*

```
AREA
A       -123.456 m
```

The area display will appear in this
manner during measurement. These
figures are displayed just for
convenience, they hold no significant meaning.

4. Press [ARC] near the center of arc
   CD to switch to Arc Mode.
5. 'Point' at pt. D.
6. Press [CON] at pt. E.   *There is no need to
    press [S/P] before pressing [CON] here as
    individual segments are not being measured.*

7. Accurately trace the curved segment between pt. E and pt. A.

8. When the Trace Lens center arrives at pt. A, the measurement will automatically be completed and a beeping noise will sound. There is no need to push [END].
→ See <Auto-close Function> below.

AREA
A   54689.23 m

(value is arbitrary)

9. The area measurement result will be displayed as on left.   The unit displayed reads "m", but actually means "m^2".

A. Auto-close Function

When the measurement of area and/or centroid is assigned for a diagram (regardless of additional assignments for plotting of coordinates or measurement of segment length, total length, or radius), the X-PLAN will automatically complete the measurement when the starting point is approached **within 0.5 mm** (such as in the example above).   Therefore, it poses no problem if an operator happens to forget the starting point for a measurement.

B. Straight Line Supplement Function

When measuring in order from pt. A to pt. F, if the line between the last and first points is straight, the [END] key can be pressed at pt.F instead of continuing on to pt.A. The X-PLAN will automatically supplement the straight line between pt. F and pt. A to calculate the area.
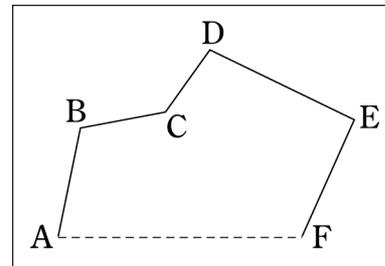
(4)   Measuring Total Length (and circumference)

This will be explained using the same diagram used to explain the measurement of segment length. In this case, the total length referred to is the length between pt. A and pt. G, or the sum of the segment lengths.
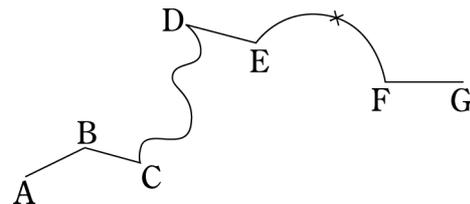
Please note that this process is also used for measuring circumference. For convenience, "total length" will hereafter include circumference.

(Display)	(Procedure)

⇓

Press [YES] at this display to measure total length (or circumference).

⇓

```
1 MEAS FUNC   Y/N
LINE      (L)      Y
```

The method of measurement is approximately the same as that for measurement of segment length.

1. 'Point' at pt. A.
2. 'Point' at pt. B.
3. Press [CON] at pt. C to switch to Continuous mode.   Trace the curved line between pt. C and pt. D.   At pt. D press [CON] once again to return to Point mode. It is not necessary to press [S/P] at pt. D.

```
LINE
L        2000.09 m
```

The display during measurement may appear as such.   The value displayed will be the total length measured so far.

4. 'Point' at pt. E.
5. Press [ARC] at the middle of arc EF (Arc mode).
6. 'Point' at pt. F.
7. 'Point' at pt. G.
8. Press [END] to complete measurement.

(Example of PRINTOUT)

```
END
L        3233.89 m
```

The reason for not 'pointing' at pts. C and D is that it is not necessary to separate the segment lengths at those points.
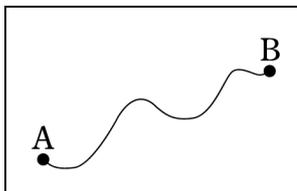
In a diagram such as the one on the left, it would be more convenient to press [CON] (switching to Continuous mode) and then press [S/P] at pt. A than in the opposite order ([S/P] -> [CON]).

(5)   Measuring Radius

The Arc mode can define an arc using three points and automatically calculate the radius at the same time. Using the diagram on the right as an example, directions follow.

(Display)	(Procedure)

$\Downarrow$
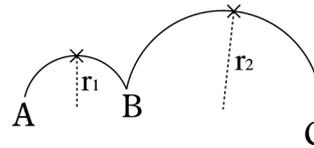
Press [YES] at this display to measure radius.

$\Downarrow$

```
1 MEAS FUNC   Y/N
RADIUS    (r)    Y
```

1. 'Point' at pt. A.
2. Press [ARC] at a mid-point of arc AB (Arc mode).

```
RADIUS
r   ON ARC COMP m
```

← Display while in Arc mode.

3. 'Point' at pt. B. --> Output of r_1

```
RADIUS
r        614.18 m
```

Radius will be displayed as such.

(value is arbitrary)

4. Press [ARC] at a mid-point of arc BC (Arc mode).
5. 'Point' at pt. C. --> Output of r_2

(Measurement complete)

(PRINTOUT)
```
r        399.89 m
r        530.01 m
```

```
XA        41.51 m
YA        33.27 m
```

When simultaneously plotting coordinates, this display will appear. The "A" for the midpoint coordinates stands for ARC.

* Even when not measuring radius, the [ARC] key is available to define arcs using three points. *

(6) Special Measurement

6-1. Measuring centroid

The centroid (X,Y) of any indeterminate shape can be measured accurately. The 3

2 5
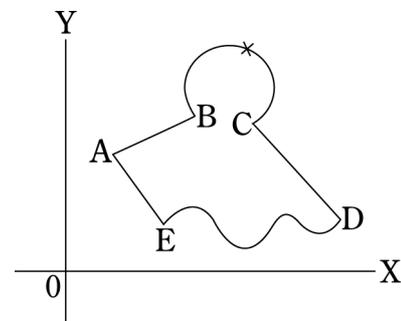
measurement modes (Point/Continuous/Arc)
can be freely used for this measurement.
The diagram on the right will be used as
an example. (Scale: 1/1   Unit: mm)

(Display)	(Procedure)
	⇓
1 MEAS FUNC Y/N SPECIAL N	Press [YES] at this display to perform a special measurement.
1 MEAS FUNC Y/N CENTROID (X.Y) N	Press [YES] for the Centroid measurement.
1 MEAS FUNC Y/N COOR (X.Y) N	Since the coordinates of Point A, B, C, etc. are not necessary, press [NO].
	⇓
| | | |	Press [NO] at the selections of Segment Length, Area, Total Length and Radius. Select "mm" and input a scale ratio of 1/1.
4 AXIS Y/N STAND AXIS N	Press [YES] to choose STANDARD COORDINATE system.
AXIS ORIGIN PRESS S/P	'Point' at pt. O (press [S/P]).
ON X-AXIS(+) PRES S/P	'Point' at a plus coordinate point of the X-axis to specify the direction of the X-axis.
5 BIAS ORIGIN XB 0. m	Press [YES] to input XB = 0.
5 BIAS ORIGIN YB 0. m	Press [YES]. (YB = 0)

(Display)	(Procedure)

6 D.P PLACE Y/N D.P FULL	Press [1] to select the 1st decimal place.

7 NUMBERING Y/N WITHOUT #ing Y	Press [YES] at "WITHOUT #ING".

1. 'Point' at A and B.
2. Press [ARC] at a midpoint of arc BC.
3. Press [S/P] at C and D.
4. Press [CON] at D to switch to Continuous Mode and trace the curved line between D and E.

CENTROID	While a centroid is being measured, the display shown at left appears blinking.

5. Press [CON] again at E to switch to Point Mode.

6. Press [S/P] at A. (auto-closed)

(measurement complete)

XG 30.7mm YG 27.1mm	The (X,Y) coordinates of the measured centroid are displayed as on left.

XG :   X coordinate value of centroid
YG :   Y coordinate value of centroid

(Printout)
END
XG   30.7mm
YG   27.1mm
(values are arbitrary)

If [MARK] is pressed while XG and YG appear, that centroid point can be marked on the drawing following the mark leading display.

6-2.   Measuring triangular area

The area of a single triangle can be measured using an expression of < Base x Height ÷ 2 = Area >. Only the Point Mode is available for this measurement. Point the three apexes, and the longest side and height will be obtained to calculate the area.
(Scale: 1/100   Unit: m)
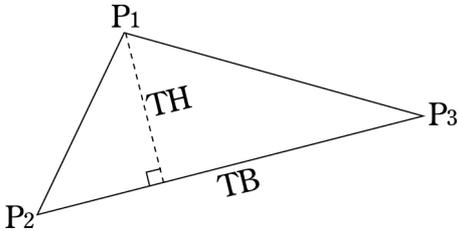
(Display)   (Procedure)

⇓

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ SPECIAL          N      │
└─────────────────────────┘
```

Press [YES] at this display to perform a special measurement.

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ TRI AREA (TA)    N      │
└─────────────────────────┘
```

Press [YES] at this display to measure triangular area.

```
┌─────────────────────────┐
│ 2 UNIT         Y/N      │
│   m              Y      │
└─────────────────────────┘
```

Select "m".

```
┌─────────────────────────┐
│ 3 SCALE        Y/N      │
│ SCALE RATIO      Y      │
└─────────────────────────┘
```

Press [YES] to select the scale ratio input.

```
┌─────────────────────────┐
│ SCALE RATIO             │
│ RX              1.      │
└─────────────────────────┘
```

Input [1], [0], [0] and press [YES].

```
┌─────────────────────────┐
│ SCALE RATIO             │
│ RY            100.      │
└─────────────────────────┘
```

Press [YES].
(This process is available only when RX = RY.)

```
┌─────────────────────────┐
│ 6 D.P PLACE    Y/N      │
│         D.P FULL        │
├─────────────────────────┤
│ 7 NUMBERING    Y/N      │
│ #ing AFT PLOT    N      │
└─────────────────────────┘
```

Press [1] to select the 1st decimal place, and then press [YES].

Press [YES] at this display to select "Numbering after Plotting".

  1. Point at P_1.
 2. Point at P_2.
  3. Point at P_3.   (auto-closed)

```
┌─────────────────────────┐
│ TRI AREA                │
│ #ing AFT PLOT    N      │
└─────────────────────────┘
```

While a triangular area measurement is being performed, the display shown at left appears blinking.

(measurement complete)

```
┌─────────────────────────┐
│ TRI AREA                │
│ A            7.1 m      │
└─────────────────────────┘
```

The measured triangular area will be displayed as on left.

```
┌─────────────────────────┐
│ BASE                    │
│ TB           6.2 m      │
└─────────────────────────┘
```

Base length will appear as on left after pressing [END].

```
HEIGHT
TH          2.3 m
```

Height will appear as on left after pressing [END] once again.

(Printout)
```
END
# 1.
A          7.1 m
TB         6.2 m
TH         2.3 m
```
(values are arbitrary)

6-3. Measuring angle

A single angle, which is contained by two sides, can be measured. Only the Point Mode is available for the measurement. When the three points are "pointed", the vertex angle of the second point can be obtained.
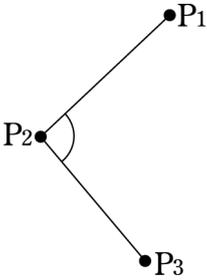
Angle Units available: (1) degree & minute   (2) Degree (*2nd decimal*)
                                         (3) gon (*2nd decimal* (4) radian (*4th decimal*)

(Display)	(Procedure)

⇓

```
1 MEAS FUNC   Y/N
SPECIAL          N
```
Press [YES] at this display to perform a special measurement.

```
1 MEAS FUNC   Y/N
ANGLE     (An)   N
```
Press [YES] at this display to measure angle.

```
1 MEAS FUNC   Y/N
ANGLE     (An)   N
```
Press [YES] at this display to measure angle.

```
2 ANGLE UNIT Y/N
deg/min          Y
```
Select "degree & minute" expression.

```
7 NUMBERING   Y/N
WITHOUT #ing     N
```

Press [YES] at this display to select
"no number print".

1. Point at P_1.
2. Point at P_2.
3. Point at P_3.   (auto-closed)

```
ANGLE
```

While an angle measurement is being
performed, the display shown at left
appears blinking.

(measurement complete)

```
ANGLE
An              95°53'
```

The measured angle will be displayed
as on left.

*The display of narrower angles have priority over
that of wider counterparts:($360°$ - narrower angle).*

```
ANGLE
An              264°07'
```

The above-mentioned wider angle will be
displayed as on left by pressing [+/-].

*Either the narrower angle or the wider angle which ever is
displayed can be accumulated by using the +Σ key.*

(Printout)
```
END
An              95°53'
```
(values are arbitrary)

6-4.   Measuring center of arc

(X,Y) coordinates of the center
point of an arc can be measured
by pointing its two end points
and a midpoint. Either the [S/P]
or the [ARC] key can be used to
point that midpoint.
(Scale: 1/1   Unit: mm)

(Display)   (Procedure)

⇓

Press [YES] at this display to perform
a special measurement.

```
1 MEAS FUNC   Y/N
SPECIAL           N
```

3 0

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │     Press [YES] at this display to measure
│ ARC CENTER (X.Y) N      │     center of arc.
└─────────────────────────┘

                                          ⇓
           │
           │                     Select "mm" and input a scale ratio of 1/1.
            │

┌─────────────────────────┐
│ 4 AXIS         Y/N      │     Press [YES] to choose STANDARD
│ STAND AXIS     N        │     COORDINATE system.
└─────────────────────────┘

┌─────────────────────────┐
│ AXIS ORIGIN             │     'Point' at pt. O (press [S/P]).
│ PRESS S/P               │
└─────────────────────────┘

┌─────────────────────────┐
│ ON X-AXIS(+)            │     'Point' at a plus coordinate point of
│ PRESS S/P               │     the X-axis to specify the direction of
└─────────────────────────┘     the X-axis.

┌─────────────────────────┐
│ 5 BIAS ORIGIN           │     Press [YES] to input XB = 0.
│ XB          0. m        │
└─────────────────────────┘

┌─────────────────────────┐
│ 5 BIAS ORIGIN           │     Press [YES]. (YB = 0)
│ YB          0. m        │
└─────────────────────────┘

┌─────────────────────────┐
│ 6 D.P PLACE    Y/N      │     Press [1] to select the 1st decimal
│         D.P FULL        │     place.
└─────────────────────────┘

┌─────────────────────────┐
│ 7 NUMBERING    Y/N      │     Press [YES] at "WITHOUT #ING".
│ WITHOUT #ing   Y        │
└─────────────────────────┘
                                 1. Press [S/P] at P$_1$.
                                 2. Press [S/P] or [ARC] at P$_2$.
                                      ( P$_2$ is a midpoint of the arc. )
                                 3. Press [S/P] at P$_3$.   (auto-closed)

┌─────────────────────────┐
│ ARC CENTER              │  ←  While the arc center is being measured,
│                         │     the display shown on left will appear
└─────────────────────────┘     blinking.

   (measurement complete)
```

XP　　　　13.6mm YP　　　　10.4mm	The (X,Y) coordinates of the measured arc center are displayed as on left. **XP** :　X coordinate value of arc center **YP** :　Y coordinate value of arc center

(Printout)
END
XP　　　　13.6mm
YP　　　　10.4mm
(values are arbitrary)

If [MARK] is pressed while XP and YP
are displayed, that arc center point
can be marked on the drawing by
following the mark leading display.

6-5.　Measuring radial distance

Once any center point gets defined,
concentric distances of different
points can be measured consecutively
without defining the center point again.

(Scale: 1/10000000　　Unit: km)
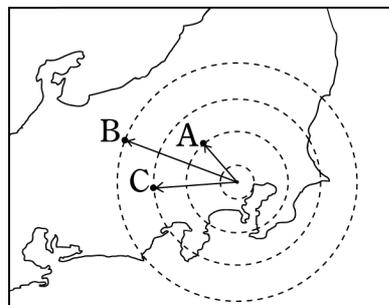
(Display)	(Procedure)
	⇓
1 MEAS FUNC　Y/N SPECIAL　　　　　N	Press [YES] at this display to perform a special measurement.
1 MEAS FUNC　Y/N CON.DIS　(RL)　N	Press [YES] at this display to measure radial distances.
2 UNIT　　　　　Y/N km　　　　　　　　Y	Unit = km is selected.
3 SCALE　　　　Y/N SCALE RATIO　　Y	Scale ratios need to be specified.
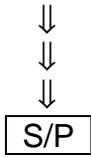
```
          ⇓                          Input RX=RY=10000000, 1st decimal
          ⇓                          placement, no number printing, etc.
          ⇓
        ┌───────┐                    Press the S/P switch to initiate specifying
        │  S/P  │                     the control point.
        └───────┘                    ( This becomes usable anytime after selecting the
                                      radial distance measurement.)
```

┌─────────────────────────┐   With the S/P pressed, this display appears.
│ CONTROL POINT   │
│ PRESS S/P   │
└─────────────────────────┘

   Control point --   S/P   Press S/P at the control point, and then
                                     the following display will appear while a long
┌─────────────────────────┐   beep sounds.
│ CONTROL POINT   │
│ DEFINED   │
└─────────────────────────┘

┌─────────────────────────┐   A display like this will keep blinking when radial
│ CONCENTRIC DIS.   │   distances are being measured.
│ RL   234.5km   │
└─────────────────────────┘
       (blinking)   When a print-out is necessary, press S/P at each
                                     point to measure. Press END to end

measurement.
┌─────────────────────────┐   With the END pressed, the blinking stops.
│ CONCENTRIC DIS.   │
│ RL   234.5km   │
└─────────────────────────┘

    (Printout)
  END
  RL   234.5km
  (values are arbitrary)

6-6. Measuring contour-based volume

By applying the mean both section method[*1]
to contour sections, topographic volumes
such as mountains can be measured. Trace
contour lines, and the volume of included
topography will get calculated. The ARC
key is available in this measurement.
  (Scale: 1/5000, Unit= m, Interval of contour: 10m)
  (*1) Volume= (both section areas x interval distance)/2
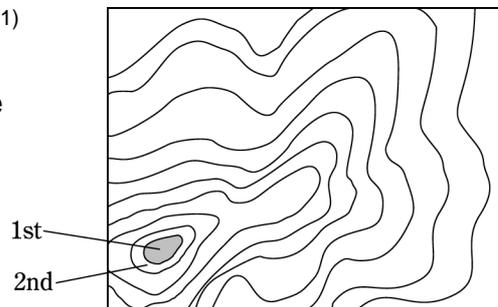
        1st
        2nd

  (Display)   (Procedure)
──

                              ⇓

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ SPECIAL          N      │
└─────────────────────────┘
```

Press [YES] at this display to perform a special measurement.

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ VOLUME   (GV)    N      │
└─────────────────────────┘
```

Press [YES] at this display to measure Contour-based volume.

```
┌─────────────────────────┐
│ 2 UNIT          Y/N     │
│  m               Y      │
└─────────────────────────┘
```

Unit = m is selected.

```
┌─────────────────────────┐
│ 3 SCALE         Y/N     │
│ SCALE RATIO      Y      │
└─────────────────────────┘
```

Scale ratios need to be specified.

$$\Downarrow$$
$$\Downarrow$$
$$\Downarrow$$
```
┌───────┐
│  S/P  │
└───────┘
```

Input RX=RY= 5000, 2nd decimal placement, no number printing, etc.

Press the S/P switch to initiate measuring the 1st contour section.
（This becomes usable anytime after selecting the radial distance measurement.)
Press S/P once again to start with the 1st contour section.

```
┌─────────────────────────┐
│ CONTOUR   1             │
│                         │
└─────────────────────────┘
         (Blinking)
```

```
┌─────────────────────────┐
│ CONTOUR   1             │
│ GA        678.9   m     │
└─────────────────────────┘
```

The result of measurement will appear on the display like this.

(Printout)
GA   678.9 m
(values are arbitrary)

```
┌─────────────────────────┐
│ CONTOUR   2             │
│                         │
└─────────────────────────┘
```

Press S/P to measure the 2nd contour section.

$$\approx$$
$$\approx$$

Press S/P to measure the n contour section.

```
┌─────────────────────────┐
│ CONTOUR   n             │
│ GA        5432.1 m      │
└─────────────────────────┘
```

(Printout)
GA   5432.1 m
(values are arbitrary)

```
┌─────────────────────────┐
│ CONTOUR INTERVAL        │
│ H              10. m    │
└─────────────────────────┘
```

Press YES to input 10 for the interval of contour.
After inputting 10, press YES again to get volume.

```
┌─────────────────────────┐
│ VOLUME                  │
│ GV    102030405.6 m     │
└─────────────────────────┘
```

.

(Printout)
GV   102030405.6 m
(values are arbitrary)

♦ Another interval can be input, if YES is pressed
   again at this point.

♦ Number of measured contours continues to be
   counted up until the volume gets calculated.

```
┌─────────────────────────┐
│ CONTOUR NUMBER          │
│ CLEARED                 │
└─────────────────────────┘
```

← The counting of measured contours gets
   Cleared when the CE/C key is pressed.

6-7. Measuring volume, surface area and center of gravity of revolutionary solid

With solids generated by rotating a section
Around a straight line, their volumes, surface
areas and centers of gravity can be obtained
simply by measuring the section with the F
series.
   (Scale: 1/5,   Unit= cm)

Rotation axis
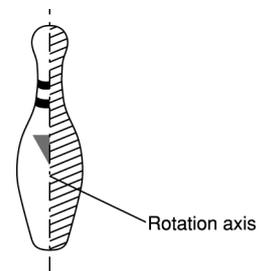
Sections located on one side of the
rotating line are to be measured.

───
(Display)   (Procedure)
───

⇓
Press [YES] at this display to perform
a special measurement.

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ SPECIAL          N      │
└─────────────────────────┘
```

Press [YES] at this display to measure
revolutionary solid.

```
┌─────────────────────────┐
│ 1 MEAS FUNC    Y/N      │
│ REV.VOL   (VA)   N      │
└─────────────────────────┘
```

Unit = cm is selected.

```
┌─────────────────────────┐
│ 2 UNIT         Y/N      │
│ cm               Y      │
└─────────────────────────┘
```

```
┌─────────────────────────┐
│ 3 SCALE        Y/N      │      Scale ratios need to be specified.
│ SCALE RATIO    Y        │
└─────────────────────────┘

          ⇓                      Input RX=RY= 5, XB=YB=0, 1st decimal
          ⇓                      placement, no number printing, etc.
          ⇓
       ┌───────┐                 Press the S/P switch to initiate specifying
       │  S/P  │                 the location of the rotating axis.
       └───────┘                   ( This becomes usable anytime after selecting the
                                    revolutionary solid measurement.)

┌─────────────────────────┐      Press S/P at the origin of the rotation axis.
│ ROT.AXIS ORIGIN         │      (This origin point may be merely one point on the
│ PRESS S/P               │        rotation axis line.)
└─────────────────────────┘

        (Printout)
X0              0.0 cm
Y0              0.0 cm

┌─────────────────────────┐      Press S/P at another point of the rotation axis.
│ ROT.AXIS (+)            │        X value of this point > X of the origin point
│ PRESS S/P               │
└─────────────────────────┘

        (Printout)
XX              9.6 cm
YX              0.0 cm

┌─────────────────────────┐      This success message will be displayed while
│ ROTATION AXIS           │      a long beep sounds
│ DEFINED                 │
└─────────────────────────┘

          ⇓
 ( measuring the section)         Measure the section in the same manner as
          ⇓                       the area measurement.
┌─────────────────────────┐      The left display will keep blinking while measuring
│ REVOLUTION              │      the revolutionary solid.
│                         │      Press END at the end.
└─────────────────────────┘
        (Blinking)

--- end of measurement---
┌─────────────────────────┐      The volume of the revolutionary solid will appear
│ ROTATION VOLUME         │      on the display.
│ VA          554.1cm     │
└─────────────────────────┘

┌─────────────────────────┐      Pressing END, the surface area measurement
│ SURFACE AREA            │      will appear.
│ VF          424.0cm     │
└─────────────────────────┘
```

XV	10.4cm
YV	0.0cm

Pressing END once again, the center of gravity (x,y) will appear.

(Printout)

VA   554.1cm
VF   424.0cm
XV   10.4 cm
YV   0.0 cm

(values are arbitrary)

Note:

1) When CE/C is pressed while the measured results are displayed, the definition of the rotation axis gets cleared.

2) To sum up or average a few revolutionary solids, use +Σ for memory calculation. (Center of gravity of synthesized solids and hollow solids can be handled.)

3) Press +Σ after each solid is measured (after pressing END). With hollow solids, use +/- (change sign key) for memory subtraction.

4) With NO, the sum, average, synthesized values or measurement number can be viewed.

5) When measuring revolutionary solids which do not have the same axis, volumes and surface areas can be summed up, but centers of gravity cannot be handled.

6) The current rotating axis gets cleared if any of the axis settings like bias origin XB or YB alters.

5. MEASURING UNITS

(1) Types of Units   (Angle units are explained in "angle measuring" section.)

Unit System	Length Units	Area Units
Metric	mm cm m km	mm^2 cm^2 m^2 a(are) ha km^2
English	in ft yd mi	in^2 ft^2 yd^2 ac(acre) mi^2
Asian(*)	寸 尺 間	寸^2 尺^2 坪
Non-standard	User Unit (U)	User Unit (U^2)

<> The superscripted "2" in the area units are not displayed on the screen or printout.

<>When two units are displayed at the same time such as "km/ha" or "yd/ac", the 1st unit is to be used for length and the 2nd for area.

(*) The above "Asian" unit system refers to the traditional units used in some Asian countries including Japan, and this unit system is available only in the oriental model of the X-PLAN.

(2) Method For Unit Selection (English = Imperial)

```
----------------------------    [YES]                    [NO] ⇒⇒
| UNIT SYS      Y/N  |     ⇒        ----------------------------
| METRIC          Y |              | 2 UNIT          Y/N   |------
----------------------------       | mm               N |    |-----
                                   ----------------------------- cm  |    |-------
        [NO]                          ---------------------------- m      |      |--------
         ⇓                                 ----------------------- m/a |      |------
         ⇓                                      ----------------------- km/ha|    |
                                                   -------------------------- km  |
                                                        ----------------------------

----------------------------    [YES]                    [NO] ⇒⇒
| UNIT SYS      Y/N  |     ⇒        ----------------------------
| ENGLISH         Y |              | 2 UNIT          Y/N   |------
----------------------------       | in               N |    |-----
                                   ----------------------------- ft |    |---------
        [NO]                             ---------------------------- yd      |      | ------
                                                   ----------------------- yd/ac |      |
         ⇓                                              ------------------------  mi  |
         ⇓                                                   ----------------------------

----------------------------    [YES]                    [NO] ⇒⇒
| UNIT SYS      Y/N |     ⇒   ----------------------------
| ASIAN           N |             | 2 UNIT        Y/N |--------
----------------------------      |                  N |      |----------
                                   -------------------------- 尺  |        |
        [NO]                             ---------------------- 間/坪 |
         ⇓                                      --------------------
         ⇓                         (available only in the oriental model)
----------------------------------  [YES]  ----------------------------
| UNIT SYS          Y/N |     ⇒    | 2 UNIT          Y/N  |
| NON-STANDARD      Y |     ⇐    | OPTION SYS (U) N |
----------------------------------  [NO]   ----------------------------
```
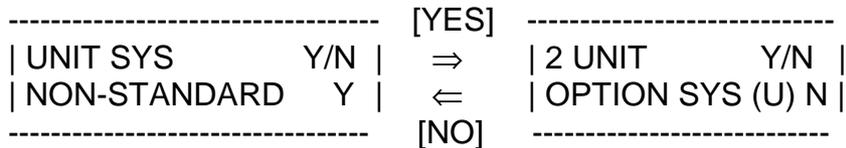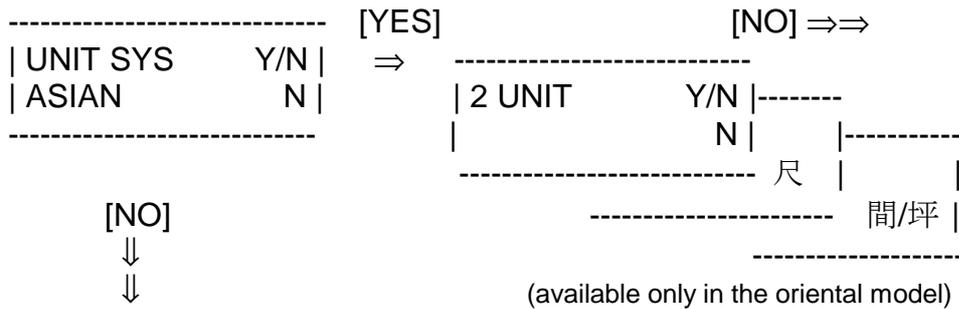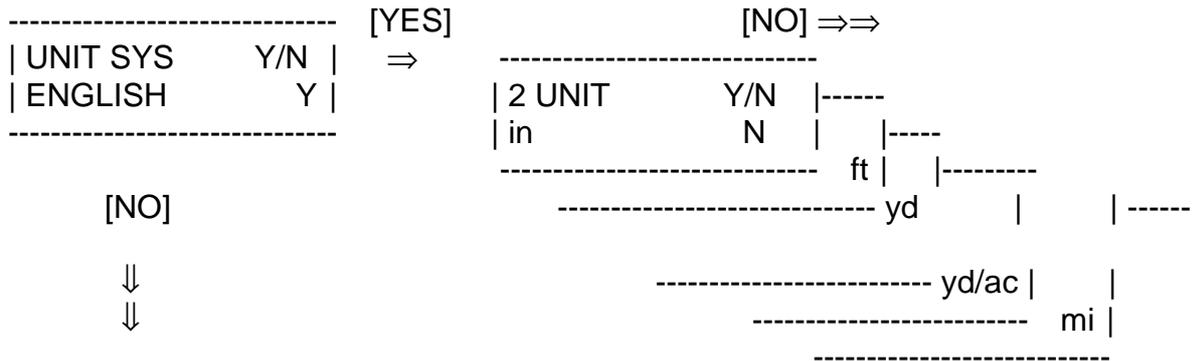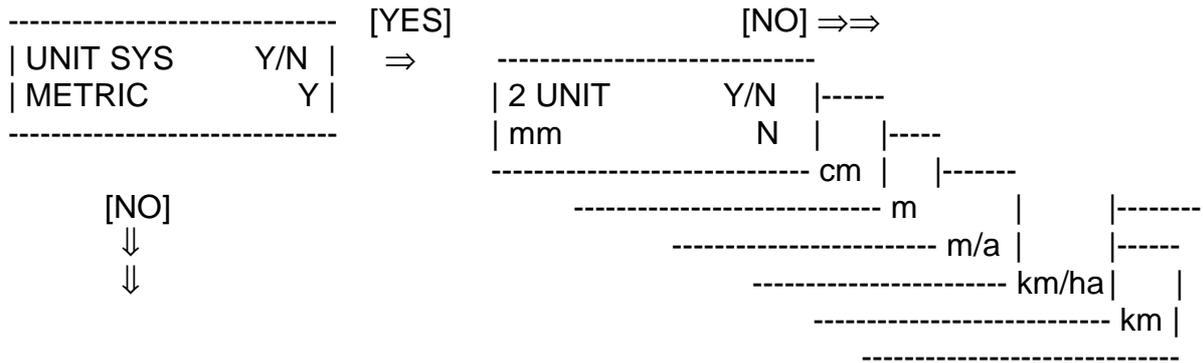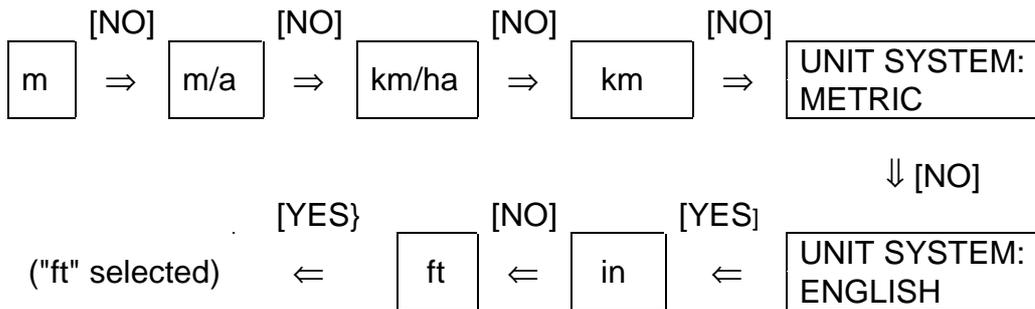
The unit symbols are displayed in the orders shown in the above diagram. When selecting a certain unit, the category to which it belongs must first be selected, followed by the selection of the specific unit.

For example, to select the "ft" unit when starting from the display showing "m", the procedure is as follows:

```
        [NO]         [NO]          [NO]         [NO]
 ┌─────┐      ┌─────┐      ┌──────┐      ┌─────┐      ┌──────────────┐
 │  m  │  ⇒   │ m/a │  ⇒   │ km/ha│  ⇒   │ km  │  ⇒   │ UNIT SYSTEM: │
 └─────┘      └─────┘      └──────┘      └─────┘      │ METRIC       │
                                                      └──────────────┘

                                                           ⇓ [NO]
          [YES}         [NO]          [YES]
                  ┌─────┐      ┌─────┐      ┌──────────────┐
 ("ft" selected)  ⇐  │ ft  │  ⇐   │ in  │  ⇐   │ UNIT SYSTEM: │
                  └─────┘      └─────┘      │ ENGLISH      │
                                           └──────────────┘
```

(3) Using the User's Unit (U)

This function is useful when using a unit not listed in the unit chart.

Input the conversion number per 1 mm for the User Unit (U).   For example, 1 nautical mile = 1852 m = 1.852×10^6 mm.   Therefore, the conversion number to input is 1 mm = 0.000000540 nautical miles.   To do so, follow these steps.

(Display)	(Procedure)
UNIT SYS　　　Y/N NON-STANDARD　　Y	1. Select "NON-STANDARD", press [YES].
2 UNIT　　　　Y/N OPTION SYS (U)　　N	2. Press [YES].
OPT UNIT VALUE U　　　　　　1.	3. Input the conversion number 　0.00000054.
OPT UNIT VALUE U　　0.00000054	4. Press [YES].　User Unit input is 　complete.

6. SCALE RATIO

(1) How to Assign Scale Ratio

There are three methods for assigning reduced (or enlarged) scale ratios.

A. Scale ratio input	------	| 3 SCALE　　　Y/N |

```
                                        | SCALE RATIO      Y |
                                        ------------------------------
                                        ------------------------------
    B.  Manual scale ratio adjustment -----   | 3 SCALE         Y/N  |
                                        | MAN.SCALE      Y   |
                                        ------------------------------
```

C. Automatic calculation of scale ratio based on known point coordinates.   ----------   *See Example Of Usage 2*
(available when horizontal and vertical scale ratios are equal.)

*In B and C above, the calculated scale ratio can subsequently be
 viewed using the input method in A.*
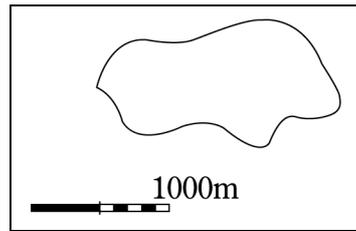

A. Scale ratio input

Method for inputting the denominator of the reduced (or enlarged) scale ratio of
a diagram. For example, for a reduced scale ratio of 1/100, the denominator of
100 will be entered. In the case of enlarged scale ratios (such as for microscope
photographs) an enlargement of 10 times should be considered as 1/0.1, and
the denominator of 0.1 should be entered.

(Display)	(Procedure)
| ```
3 SCALE          Y/N
SCALE RATIO       N
``` | 1. Choose scale ratio input.    Press [YES]. |
| ```
SCALE RATIO
RX          200.
``` | 2. The previously entered scale ratio denominator (along the X-axis) will be displayed. Input [1], [0], [0], [YES], according to this example. |
| ```
SCALE RATIO
RY          100.
``` | 3. The scale ratio denominator which was assigned for the X-axis will be displayed. If the scale ratio along the Y-axis is equal to that along the X-axis, simply press [YES]. If not, input the scale ratio denominator for the Y-axis. |


B. Manual Scale Ratio Adjustment

Method of automatically calculating the scale ratio by measuring
the standard length shown in the diagram key (REFERENCE DISTANCE).

In the example on the right, a scale of 1000 m is shown on the diagram. Once this line segment is measured with the X-PLAN, the scale ratio will be calculated automatically.

1000m

(Display)	(Procedure)

```
3 SCALE        Y/N
MAN.SCALE        Y
```

1. Choose Manual Scale Adjustment. Press [YES].

```
MAN.SCALE(X)
CX            1. m
```

2. Enter the diagram key of 1000 m. Press [1], [0], [0], [0], [YES].

```
MAN.SCALE(X) 1st
PRESS S/P
```

3. 'Point' at the left edge of the segment in the diagram key (starting point).

```
MAN.SCALE(X) 2nd
PRESS S/P
```

4. 'Point' at the right edge of the segment.   *This measurement can be done from right to left as well.*

```
MAN.SCALE(Y)
CY        1000. m
```

5. Simply press [YES].
   *If a different scale is given for the Y-axis (vertical), repeat the the Y-axis (vertical),

   repeat the procedure.*

The diagram scale and the dimensions of the diagram have now been corresponded and the scale ratio will be calculated automatically.

(2) Caution regarding cases in which vertical and horizontal scale ratios are different

```
Y   1/200
```

When a diagram has two scale ratios, such as the one on the right, the ratio denominators must be specified properly. RX=100, RY=200 must be entered into the X-PLAN. Thus, the coordinate axes and their respective scale ratios correspond.

```
        |                              |
        |                              |
        |                              |
        |                              |
        |                    1/100     |
      0 |_____ X
```

1. When measuring only area or contour-based volume, entering the data oppositely (i.e. RX=200, RY=100) will not affect the area measurement result. The area calculation will   not be affected by the position of the X-PLAN or the directions of the axes.

2. When measuring segment length, total length, coordinates, centroid, or radial distance,

   one must input the coordinate axes assignment   (origin point - X-axis assignment method or an error will occur.   → *(error message)*

   The X-axis, Y-axis, and their   -------------------------------
   respective scale ratios must | **   WARNING   ** |
   be assigned. | RX.RY NOT SAME |
                                                ----

3. Radius, triangular area, center of arc
   or revolutionary solid cannot be measured.   → The same error message as
                                                   above will appear.

4. The [ARC] key cannot be used.   → The above message will appear.

   When the horizontal and vertical scale ratios differ, what may appear as an arc is not actually an arc, and the Arc Mode is nullified.

(3) Scale ratio calculation at the scale input display

The X-PLAN's calculator function is available even at the scale input display. This is especially useful if you have scale ratios whose numerator is not 1, or if you want to make the scale ratios include some factor so that the measured results may show an estimation of some sort.

   Example: to input a ratio of 27/1000

(Display)	(Procedure)
	Press [CE/C], [3], [SET] in this order.
3 SCALE Y/N SCALE RATIO Y	Press [YES] to select the scale ratio input.

```
┌─────────────────────────────┐
│ SCALE RATIO                 │
│ RX                    1.    │
└─────────────────────────────┘
```

Here calculate this way with the X-PLAN.
        1000 ÷ 27 =
And press [SET] or [YES].

```
┌─────────────────────────────┐
│ SCALE RATIO                 │
│ RX   37.03703704            │
└─────────────────────────────┘
```

Then, the denominator,   which was necessary for the X-PLAN, has been input.

7. Decimal placement

```
┌─────────────────────────────┐
│ 6  D.P.PLACE     Y/N        │
│           D.P. FULL         │
└─────────────────────────────┘
```

Decimal placement can be specified at this display.
 1) Press [NO] :   FULL → 0 → 1 → ······   → 9 → FULL
 2) Direct input of decimal place number
Press [YES] as required.

8. AUTOMATIC NUMBERING FUNCTION

```
--------------------------------     ------------------------------     ------------------------------
| 7 NUMBERING   Y/N |             | 7 NUMBERING   Y/N|             | 7 NUMBERING   Y/N |
| #ing IN PLOT        Y           |      | #ing AFT PLOT   Y   |         | WITHOUT #ing
Y      |
--------------------------------     ------------------------------     ------------------------------
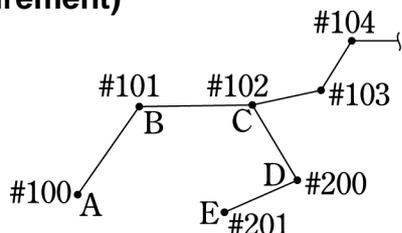  (1) Numbering during               (2) Numbering after                  (3) No numbering
      plotting                           plotting
```

(1)   Numbering during plotting (or measurement)

When 'pointing' each point A, B, C...
and printing (or outputting to a
computer) each assigned number, follow
these instructions:

1. Press [1], [0], [0], [#$_2$], to enter the   starting number. If
   not specifically assigned, the starting number will be "1".

                                                    (PRINTOUT)
2.   'Point' pt. A   --   Output: #100   # 100.
   'Point' pt. B   --   Output: #101   X   0.000 m
   'Point' pt. C   --   Output: #102   Y   0.000 m
                                                 # 101.
3.   Press [2], [0], [0], [#$_2$].   The new   X
   1.501 m
   starting number becomes "200".   Y   0.000 m
                                                 d   1.501 m

4 3

4. 'Point' pt. D -- Output: #200
   'Point' pt. E -- Output: #201

Using this procedure, printout results as
shown on right can be obtained.   As each
plotted (or measured) point can be numbered
automatically, this is very useful for
organizing data.

**Pressing [END] will reset the starting
  number to 1.**

# 102.	
X	2.479 m
Y	-1.333 m
d	1.653 m
# 200.	
X	2.004 m
Y	-2.512 m
d	1.271 m
# 201.	
X	1.013 m
Y	-1.900 m
d	1.165 m

(2) Numbering after plotting (or measurement)

When measuring the areas of the
figures in the diagram on right
and numbering the resulting
measurements to be printed (or
outputted to a computer),
proceed as follows:

#101 B   #200 C

#100 A   #201 D

1. Press [1], [0], [0], [#₂].   The starting number will be "100".

2. Measure area A. ---   Output: #100 Area Value
   Measure area B. ---   Output: #101 Area Value

3. Press [2], [0], [0], [#₂].   Starting number becomes "200".

4. Measure area C. ---   Output: #200 Area Value   (PRINTOUT)
   Measure area D. ---   Output: #201 Area Value   END
                                                          # 100.

* When power is turned off, the starting   A   1.111 m
number returns to "1".
                                                        END
* During or after measurement, simply   # 101.
  press [#₂] to view the current number.   A   2.222 m

* Any desired number can be printed using   END
  the primary function [#P] key without   # 200.
  affecting the automatic numbering function.   A   3.121 m

                                                        END
                                                     # 201.
                                                     A   1.286 m

9. MEASUREMENT RESULTS ACCUMULATION AND AVERAGING FUNCTIONS

Using the [+Σ] key, accumulated and averaged values can be determined for area, segment/total length, radius, coordinates, centroid, triangular area, angle, or arc center, radial distance, contour-based volume, and revolutionary solid measurements.

Among the "Triangular AREA" results, the area can be accumulated, but the base and height cannot. The area of each contour section measured for contour-based volume calculation cannot be accumulated, either.

Accumulation and averaging of revolutionary Solids are detailed where how to measure the revolutionary solids are explained.

The type of measurement to be accumulated or averaged is determined when [+Σ] is pushed for the first time during an operation.

$A=a_2$ $L=l_2$

M_2

$A=a_1$ $L=l_1$

M_1

$A=a_3$ $L=l_3$

M_3

Using the accumulation of the areas of the three figures in the diagram to the right   as an example, this function will be explained:

(Display)	(Procedure)
	1. Measure the area and total length of M_1.

A a1 m	2. Display for area value a_1.
	   If total length l_1 is displayed,
	   press [END] to display area measurement.

	3. Press [+Σ]. -- Accumulate a_1. 4. Measure the area and total length of M_2.

A a2 m	5. Display for area value a_2.
	   If total length l_2 is displayed,
	   press [END] to display area measurement.

	6. Press [+Σ]. -- Accumulate a_2.
	   *If total length l_2 is displayed here, the [+Σ]
	    key cannot be pressed.*
	7. Measure the area and total length of M_3.

```
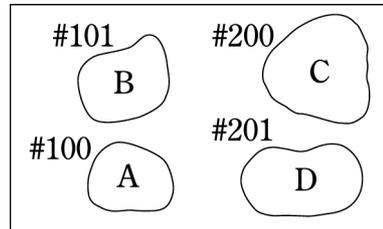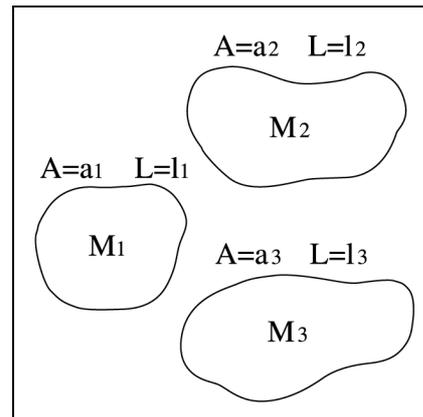-----------------------
A            a3   m
-----------------------
```

8. Display for area value a_3.
9. Press [+Σ]. --   Accumulate a_3.
10. Results:
       Cumulative total = $a_1+a_2+a_3$
       Average = cumulative total/3
       Total number of accumulations = 3

◆The results can be viewed by pressing [NO].

```
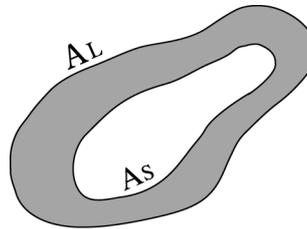----------------------------        ---------------------------        ----------------------------
| AV.             | [NO]    | NO. OF MEAS        | [NO]                 |
TOTAL            |
|  A        14.634 m |   ⇒  | n            3.   |   ⇒  | ΣA      43.901 m |
----------------------------        ---------------------------        ----------------------------
     (average)                      (total number of)                   (cumulative total)
                                    ( accumulations)
```

    *   The [+Σ] key only works once for a particular measurement result so
        as to avoid duplication within the accumulation.

    *   [CLΣ₂] clears the accumulation result.

◆How to measure the area of a donut-shaped diagram

First, measure the area of the larger
ring and press [+Σ]. Next, measure the
area of the smaller ring. Push [+/-] to
change the result to a negative value.
Finally, accumulate this value using
the [+Σ] key.

$$AREA = A_L - A_S$$

10. Coordinate point marking operation

(1) Specifying (X,Y) values to mark

    a. *Centroids and Centers of arcs*
        These two kinds of coordinate points can be marked after measuring
them.
        Press the MARK key while their X and Y values are shown on the display,
        and the "Mark Leading Display" will appear.

    b. *Computer-specified coordinate points*

Use the SD command to specify X and Y values to mark from external computers.

c. *Arbitrary input coordinate points*

Arbitrary X and Y values can be input in the following manner.

(Display)	(Procedure)

Non-coordinate value displayed	1. When (X,Y) coordinates need to be input for marking, exclude any displays showing other coordinate values. For example, get the Zero display by pressing [CE/C].
	2. Press [MARK].
INPUT X TO MARK XM 0.mm	3. Input X value of the mark point, and then press [YES].
INPUT X TO MARK YM 0.mm	4. Input Y value of the mark point, and then press [YES]. As a result, a "Mark Leading display" as shown below will appear.

(2) Mark Leading Display

The Mark Leading Display symbolically indicates the upward/downward/leftward/rightward direction and distance of movement to the target point.

```
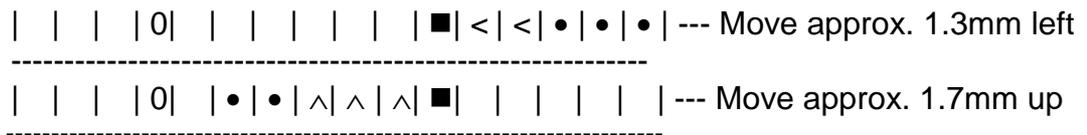                    (X-PLAN's display)
  ----------------------------------------------------------------
 |   |   |   | 3 |  |→|→|→|→|→| ■ |   |   |   |   |   | --- horizontal movement
  ----------------------------------------------------------
 |   |   |   | 2 |   |   |   |   |   |   | ■ |↓|↓|↓|↓|   | --- vertical movement
  ----------------------------------------------------------
               |               |
               |               +------- location of point to mark
           +--- distance to the point to mark ( unit: cm )
```

The above display indicates that the X-PLAN be moved right by 3 cm and downward by 2 cm.

```
                 (X-PLAN's display)
  -----------------------------------------------------
 | Horizontal || Move right  ⇒      |  ■          | ⇐ Move left              |
 | distance   ||                    |  |          | ---   1st line
 |------------------------------------------------------------------|
 | Vertical   || Move upward ⇑      | ■ |⇓ Move down              |
 | distance   ||                    |  |          | ---   2nd line
```

As the marker hole approaches the marking location, more distance-sensitive
indicators will appear.

Distance indicators (1) → ← ↑ ↓ …. 2mm each
(2) > < ∧ ∨ …. 0.5mm each
(3)   •   ….   0.1mm each

```
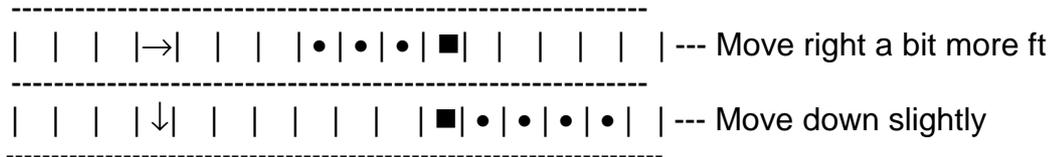--------------------------------------------
| | | | 0| | | | | | |■|<|<|•|•|•| --- Move approx. 1.3mm left
---------------------------------------------------------
| | | | 0| |•|•|∧|∧|∧|■| | | | | | --- Move approx. 1.7mm up
-----------------------------------------------------------------------
```

When the distance indicators come to consist of only dots (•), an arrow to
show the movement direction will appear in the 4th column.

```
-----------------------------------------------------------
| | | |→| | | |•|•|•|■| | | | | | --- Move right a bit more ft
---------------------------------------------------------
| | | |↓| | | | | | |■|•|•|•|•| | --- Move down slightly
-----------------------------------------------------------------------
```

The fine adjustment rollers make it easy to pinpoint the mark point. Press the
roller to make it touch the paper and rotate. When the maker hole is set at
the   target point, the following display will appear.

	0							I				
	0							I				

Mark the point with a pen while carefully holding the X-PLAN so as not to
move. Press [MARK] again or press [CE/C] to get out of the Mark Mode. Use
one of the 2 marking caps in different diameters (0.3 and 0.5 mm) when
necessary.

(Mark "out of range" error)

```
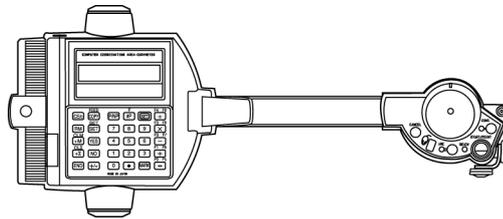** ERROR        **
OUT OF RANGE
```

If the input coordinates are beyond the marking range, an
error message as on left will appear.   Press [CE/C] to
release the error.

11. OPERATIONAL FUNCTIONS

(1) Power On and Off

As the power On/Off lever gets lifted, the X-PLAN is turned on and the tracer arm is released for move. To turn it off, the lever needs to be pushed down so as to fix the tracer arm.

(Tracer arm fixed position: Power Off)

(2) Measurement Modes

The X-PLAN features three measurement modes to measure the contours of a diagram.

A. Point Mode

The method of 'pointing' the extremes of a straight line contour using the [S/P] key.   --> **[S/P]**

B. Continuous Mode

Used to trace the contour of a curved line.   --> **[CON]**

C. Arc Mode

Used to define an arc using three points.   --> **[ARC]**

● When plotting coordinates using the Continuous Mode, coordinate values (x,y) will be displayed on the screen, but will not appear in the printout. (They will, however, be outputted to a computer.)

(3) Automatic Power Shut-off Function

If the X-PLAN is left on for 20 minutes unattended, it will automatically shut off. However, during measurement (from the time [S/P] is pressed until [END] is pressed) this function will not go into effect.

Even if the power is shut off, the measurement conditions entered will remain in memory, but the definition of the coordinate axes will be erased.

* This function can be nullified by one of the X-PLAN's commands when interfaced with an external computer. *

(4) Direct Mode For Setting Conditions

To jump directly to a desired condition setting screen, press the number key (1-7) which corresponds to the necessary condition setting screen (refer to the table below), and then press [SET] to proceed to that screen.

For example, to proceed directly to the screen for coordinate axes definition, press [4], [SET].   ----->

```
------------------------------
|4 AXIS              Y/N |
|STAND AXIS        Y              |
------------------------------
```

⇓ **Screen Access Number**

1	Measuring condition selection
2	Measuring unit selection
3	Scale ratio setting
4	Coordinate axes definition
5	Origin bias setting
6	Decimal point setting
7	Automatic numbering selection

(5) How to Set Printer Paper

1. Insert the lead end of a new roll of paper into the printer.

2. Press [FEED$_2$] ([SFT] + [COPY]) to feed the paper securely into the printer.

   Note: Hold [COPY] key down after pressing [SFT] once for continuous FEED function.

3. Insert the roller pin into the paper roll and set it into the
paper roll holder on the printer.

● Thermal paper is used in the X-PLAN mini-printer so only the
front side can be printed on.   Please take care to set the paper
properly.*

(6) Overall Procedure For Measurement Operation

This is a complete explanation of the order in which the displays appear and the
procedures (already explained individually) to be followed.

(Display)	(Procedure)

	1. Switch on power.
	   A remaining power indication and loaded CP
	   number appear for about 2 seconds.

```
X-PLANxxxF      V4.0
BAT=40H       C.P.1
```

(Initial display with printer attached)

```
KEY EXPLANATION?
YES or NO
```

2. If [YES] is pressed here, a simple
explanation of all the keys will be
printed (this is not usually
necessary). To interrupt printing,
press [CE/C]. If a printout is
unnecessary, press [NO], [CE/C], or
[SET].

⇓ [NO],[YES]
or [CE/C]

```
SET EXPLANATION?
YES or NO
```

3. If [YES] is pressed, the conditions
most recently set in the X-PLAN will
be printed.   If the conditions are
the same in the present measurement,
the measurement can be commenced
immediately.   However, the previous
definition of the coordinate axe
cannot be used and, if necessary,
must be redefined.
 * **To proceed directly to the screen
for coordinate axes definition,
press [4], [SET].***

⇓ [NO],[YES]
or [CE/C]

(Initial display without printer attached)

```
            0.
```

4. Ready Mode.

⇓ [SET]

5. Press [SET] to begin setting
measurement conditions.

Internal Settings Selection

| 1. Measuring Conditions |
| 2. Measuring Units |

6. Select and set the 7 kinds of
conditions here. If the displayed
condition is correct for the present

```
| 3. Scale Ratio          |          measurement, press [SET] simply and
| 4. Coordinate axes      |          continue to the next condition to be
| 5. Origin Bias          |          set. The measurement of a diagram
| 6. Decimal Point        |          can also be commenced during the
| 7. Automatic Numbering  |          condition setting process.   If, for
----------------------------------         example, upon setting the scale
                                            ratio (3), the remaining conditions
             ⇓                            are correct for the present
             ⇓                        measurement, the diagram measurement
                                     can be commenced.
```

* Direct mode selection can be used to conveniently select a specific condition.
* Displays or measurements can be printed whenever necessary by pressing [P/NP].

```
---------------------------------       7. Ready Mode.
|                               |
|              0.               |
|                               |
---------------------------------
```

```
             ⇓
-----------------------------
|      Measurement          |       8. Proceed with the execution of the
|           of              |          necessary measurements (among
|        drawing            |          coordinates, area, segment/total
-----------------------------          length, radius, centroid, triangular
                                         area, angle, and arc center, radial distance,
                                        contour-based volume, revolutionary solid)
                                       to be performed on the diagram(s).
```

```
             |
             |
-----------------------------       9. Addition,subtraction,multiplication
|      Calculating          |          and division can be performed. The
|       functions           |          measurement results of procedure 8
| *Addition                 |          above can be used to make further
| *Subtraction              |          calculations. The X-PLAN can also be
| *Multiplication           |          used as a calculator independently
| *Division                 |          of measurement function.
|*Memory Function           |
-----------------------------
```

```
             |
             |
*************************       10. Measured coordinate points such as
*        Marking        *           centroids and centers of arcs can be
* coordinate point      *           marked on the drawing by using the
*************************           MARK key.
                                     Any input coordinate points and
                                    computer-specified points can also
                                   be marked on site.
```

11. Upon completion of all work, switch power off.   Everything other than coordinate axes definition, accumulated and averaged values (+Σ), and measurement results will be stored in the X-PLAN's memory.

10.   Mouse-like Operation for condition setting

Besides the SET key, a unique "Mouse Key" is available to set and confirm measuring conditions. Once the Mouse Key, which is located on the left below the tracer lens , is pressed down, "M" will appear in the upper right of the display. This M remains displayed until the Mouse mode is cleared by pressing the mouse key again or by pressing [END] or [CE/C].

◆ Confirmation of the settings   **(Confirmation mode)**
As the tracer arm moves down, so the display shifts down as shown below.
On the other hand, up-movement of the tracer arm shifts the display up. Movement of the rollers shifts the messages in the same direction, right and left.

Rollers: ← right   left→

| MEAS FUNC | M |
| XG X d A L r | |

All of the selected measuring functions are displayed.

↑ ↓   Arm up & down

| UNIT | M |
| mm | |

A selected unit is displayed.

↑ ↓

| SCALE:RATIO | M |
| RX | 1. |

A selected way of scaling is displayed.

↑ ↓

| AXIS:STAND | M |

A selected coordinate system is displayed

↑ ↓

| BIAS ORIGIN | M |
| XB | 0.mm |

The input value of bias origin is displayed

↑ ↓

| D.P.PLACE | M |
| D.P.1 | |

The selected decimal placement is displayed.

↑ ↓

```
┌─────────────────────────┐
│ #ING              M     │     The selected way of data numbering is displayed.
│ WITHOUT #ing            │
└─────────────────────────┘
        ↑ ↓
┌─────────────────────────┐
│ AUTO CLOSE        M     │     It is confirmed that the auto-closing function is
│ YES                     │     activated.
└─────────────────────────┘
        ↑ ↓
┌─────────────────────────┐
│ AUTO POWER OFF M        │     It is confirmed that the auto-power-cut-off function
│ YES                     │     is activated.
└─────────────────────────┘
        ↑ ↓
┌─────────────────────────┐
│ COND. PRINT       M     │     The current settings can be print out, if [YES] is
│ NO                      │     pressed ( if the printer is attached ).
└─────────────────────────┘
```

◆ How to set measuring conditions **(Setting mode)**

Press [S/P] at required displays, and then the M starts blinking. In this blinking status(setting mode), setting can be done. The currently selected setting will appear in the upper line of the display. Moving the arm slightly up or down, it will get out of the setting mode but get into the confirmation mode when the M is steadily displayed.

When the X-PLAN moves right or left in the setting mode, selection items shift right or left in the 2nd line of the display. Position your selected item at the extreme left position (on the right of the blinking ＊) , and press [S/P]. Then the setting will be finished and the blinking of the M will stop and appear as a steady display.

Multiple selections can be made for basic measurements. In this case, the blinking ＊ means that the extreme left item is selected for measuring, while the blinking _ (under-bar) means that it is not selected. Pressing [S/P] once changes ＊ into _ and vice versa.

Special measurements
┌──┐
│ **XG**: centroid   **TA**: triangular area   **An**: angle   **XP:** center of arc │
│ **RL**: radial distance   **GV**: contour-based volume   **VA**: revolutionary solid │
└──┘
Basic measurements
┌──┐
│ **X**: coordinates   **d**: segment length   **A**: area   **L**: total length   **r**: radius │
└──┘

Now press the mouse key and the mouse mode will begin.

(Measuring Functions)
```
┌─────────────────────────┐
│ SPECIAL:XG        M     │     The selected item (for example, XG here) is
│ ←＊XG TA An XP     →     │     displayed in the upper line.
└─────────────────────────┘                    Items to appear in the lower line
```

SPECIAL : NONE, XG, TA, An, XP, RL, GV, VA
BASIC : X, d, A, L, r

```
┌─────────────────────────┐
│ UNIT              M      │
│ mm                      │
└─────────────────────────┘
```

A selected unit is displayed.
Items to appear in the lower line
UNITsystem: m ft 尺 OPTION
UNIT : mm cm m m/a km/ha km
in ft yd yd/ac mi
寸 尺 間/坪 , U

```
┌─────────────────────────┐
│ SCALE:RATIO       M      │
│  ＊RATIO MANUAL         │
└─────────────────────────┘
```

A selected way of scaling is displayed.
Items to appear in the lower line
RATIO MANUAL

```
┌─────────────────────────┐
│ AXIS:STAND        M      │
│ ←＊STAND SURVEY        │
└─────────────────────────┘
```

A selected coordinate system is displayed.
Items to appear in the lower line
AXIS: MACHINE STAND SURVEY
STAND : SETTING GIVEN_POINTS AFFINE
SURVEY : SETTING GIVEN_POINTS AFFINE

```
┌─────────────────────────┐
│ BIAS ORIGIN       M      │
│ XB           0.mm       │
└─────────────────────────┘
```

The input value of bias origin is displayed.
Items to appear in the lower line
XB YB

```
┌─────────────────────────┐
│ D.P.PLACE         M      │
│ D.P.FULL                │
└─────────────────────────┘
```

The selected decimal placement is displayed.
Items to appear in the lower line
0 1 2 3 4 5 6 7 8 9 FULL

```
      (data numbering)
┌─────────────────────────┐
│ #ING              M      │
│ WITHOUT #ing            │
└─────────────────────────┘
```

The selected way of data numbering is displayed.
Items to appear in the lower line
WITHOUT IN_PLOT AFT_PLOT

```
┌─────────────────────────┐
│ AUTO CLOSE        M      │
│ YES                     │
└─────────────────────────┘
```

It is confirmed that the auto-closing function is activated.
Items to appear in the lower line
 YES NO

```
┌─────────────────────────┐
│ AUTO POWER OFF M         │
│ YES                     │
└─────────────────────────┘
```

It is confirmed that the auto-power-cut-off function is activated.
Items to appear in the lower line
 YES NO

```
   (measuring conditions print)
┌─────────────────────────┐
│ COND. PRINT       M      │
│ NO                      │
└─────────────────────────┘
```

The current settings can be printed out, if [YES] is pressed (in the case of printer attached).
Items to appear in the lower line
NO SET_COND. DATA_ID

By pressing [MOUSE], [END], or [CE/C], the mouse mode can be terminated.

♦ setting flow

```
┌─────────────────────────┐
│  SPECIAL MEASUREMENT    │
└─────────────────────────┘
           ↓
┌──────┐   ┌────┐   ┌────┐   ┌────┐   ┌────┐   ┌────┐   ┌────┐   ┌────┐
│ NONE │←─→│ XG │←─→│ TA │←─→│ An │←─→│ XP │←─→│ RL │←─→│ GV │←─→│ VA │
└──────┘   └────┘   └────┘   └────┘   └────┘   └────┘   └────┘   └────┘
   ↓
┌─────────────────────────┐
│  BASIC MEASUREMENT      │
└─────────────────────────┘
           ↓
┌───┐   ┌───┐   ┌───┐   ┌───┐   ┌───┐
│ X │←─→│ d │←─→│ A │←─→│ L │←─→│ r │
└───┘   └───┘   └───┘   └───┘   └───┘
```

11. Memory for measuring condition sets

(Abbreviations used: **MC** = Measuring Condition(s)   **C.P.**= Combination Parameter)

Up to 15 combinations of the following MC can be saved in memory for later re-use.

● Measuring functions
   Basic measurements: Coordinates, Segment length, Area, Total length, Radius
   Special measurements: Centroid, Triangular area, Angle, Center of arc, Radial
                      distance, Contour-based volume, Revolutionary solid
● Measuring conditions
   Unit, Scale adjustment, Coordinate system, Decimal placement,
   Automatic numbering

Numbers 1 to 15 are used to save a MC set in memory, and the same number is to be used for reloading.

Saving MC sets in memory

(Display)	(Procedure)
	Press [CE/C] and then keep pressing [SET] until a long beep sounds.
C.P.1 C.P.LOAD Y/N	The left display is asking if it is necessary to recall (load) the saved C.P. Here, press [NO] for not loading.
C.P.1 C.P.SAVE Y/N	The left display is asking if it is necessary to save the current settings for later re-use. Here, press [YES] to do so.
SAVE C.P.1 C.P.1 Y/N	You are asked if it is to be saved as CP NO.1. Just press [YES] for it. As [NO] is pressed continuously, the CP NO. goes up. When your CP number is displayed, press [YES]. Or, your CP number may be input with numeral keys. (1 −15)

```
            C.P.1
C.P.PRINT      Y/N
```

After a long beep sounds, the left display appears. Press [YES] for print, or [NO] for no print.   This display does not appear when no printer is attached.

```


            0.
```

End display.

Hint: *The saved MC, for example, can be reloaded with its CP No., and then be saved again as another number after modification.*

Loading an MC set from memory

(Display)	(Procedure)
	Press [CE/C] and then keep pressing [SET] until a long beep sounds.

```
            C.P.1
C.P.LOAD       Y/N
```

The left display is asking if it is necessary to recall (load) the saved C.P.   Here, press [YES].

```
LOAD        C.P.1
C.P.1          Y/N
```

You are asked if CP NO.1. needs to be recalled Just press [YES] for it.
As [NO] is pressed continuously, the CP NO. goes up. When your CP number is displayed, press [YES]. Or, your CP number may be input with numeral keys. (1 –15)

```
            C.P.1
C.P.SAVE       Y/N
```

The left display is asking if this CP set needs to be saved as another.   Press [CE/C] for disregard.

```


            0.
```

End display.

Note:
   (1) Turning on while pressing [CE/C] (memory reset), the currently selected CP is
        cleared to the factory defaults. The other CP sets are stored in memory as they   are.

```
            C.P.3∗
C.P.LOAD       Y/N
```

(2)The CP number with ∗ shows that the loaded CP has been changed. This change is cleared   by the above memory reset.

(Display)	(Procedure)

Press [CE/C] and then keep pressing [SET] until a long beep sounds.

C.P.1 C.P.LOAD Y/N	The left display is asking if it is necessary to recall (load) the saved C.P. Here, press [NO] for not loading.

C.P.1 C.P.SAVE Y/N	The left display is asking if it is necessary to save the current settings for later re-use. Here, press [NO] not to do so.

C.P.1 C.P.PRINT Y/N	This is asking if CP.1 should be printed or not. Press [YES] for print, or [NO] for no print. This display does not appear when no printer is attached. If [NO] is pressed continuously, the CP No. goes up. Press [YES] when your CP appears, and it will be printed. You can also input your CP number directly following the pressing of [YES].

CP=ALL will appear as the CP No. goes up

with   [NO]. If ALL is selected, CP 1-15, and the

                                  currently modified CP, if any, will be

printed out.   [.] can be used to specify ALL

directly. [0] can   be used to get back to the

currently selected   CP.

0.	This end display will appear after pressing [CE/C].

11. CALCULATING FUNCTIONS

(The X-PLAN's Fundamental Operations of Arithmetic keys ([+], [-], [x], and [÷]) cannot be used when it is connected to a computer. When connected to a computer, these keys act as FUNCTION keys.)

For the explanation below, the following abbreviations will be used:

(Measurement Results)	(Accumulated Results)	(Register value)
A -- area	$\bar{x}$ -- average	M -- memory value
L -- total length	n -- number of	calculated using

accumulations [+M]. Displayed

d -- segment length   Σ --   cumulative   by pressing [RM]

r -- radius   total   # -- automatic

TB -- Base length   number recalled

TH -- Height   using [$\#_2$]

RL -- Radial distance

GV -- Volume

VA -- Revolutionary volume

VF -- Revolutionary surface area

Area (A) includes both ordinary area (double meridian distance method) and triangular area (diagonal and perpendicular method).

Using The Calculation Keys

| (1st term) | (Operator) | (2nd term) | (continuing→) |

1. Pressing an operator key in place of [=] allows the continuation of a calculation.
2. The [+M] key can be used with 1st term, 2nd term and result values.
3. When a value is not specifically entered before pressing the [=] key:
   a. when adding or subtracting, the 2nd term value will be calculated as 0; or
   b. when multiplying or dividing, the displayed value (i.e. 1st term value) will be adopted as the 2nd term value.
4. The decimal point position will be displayed according to the previously set setting for decimal place. All digits of 1st and 2nd values will be used for calculation, and the result will be rounded to the nearest decimal place as determined by the setting for decimal place.
5. The first time [CE/C] is pressed, only the last entry will be deleted (clear entry). If pressed again, the entire calculation will be cleared (all clear).
6. The calculating functions are not applied to all coordinate values and angles.
7. Input numbers (such as User's unit coefficients, marking coordinates, scale ratios, reference distances for manual scale ratio adjustment, known coordinate values, Affine coordinates and bias origin) can be calculated using the four operator keys.

12. Battery

1) Regarding battery charging and remaining power

It is recommendable to recharge the battery for 7 hours after "** LOW BATTERY**" appears. If used properly in this way, the battery may be recharged about 500 times.

Recharing before the "** LOW BATTERY**" sign may gradually shorten the capacity of battery (the Memory Effect). In that case, the remaining power indication could become quite inaccurate over time.

Recharging for more than 7 hours may accelerate deterioration of the battery.

2) Remaining power indication

A remaining power indication will be displayed for about 2 seconds just after the unit is powered on. This number reads a rough working time for which the X-PLAN will be available without recharging. The indication is as follows.

```
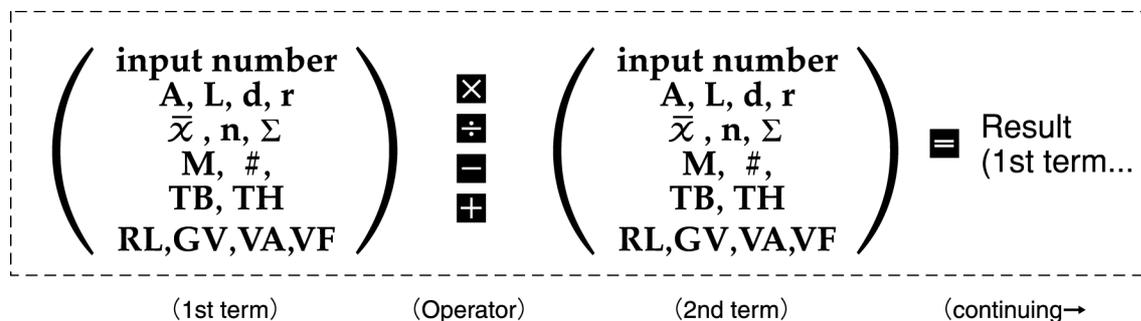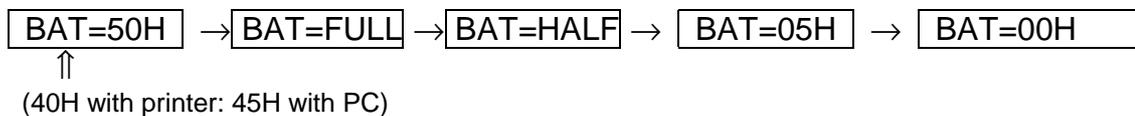X-PLANxxxF      V4.0
BAT=40H         C.P.1
```

BAT=40H means that the battery will run for about 40 hours. This indication varies as follows.

| BAT=50H | → | BAT=FULL | → | BAT=HALF | → | BAT=05H | → | BAT=00H |

⇑

(40H with printer: 45H with PC)

12.   OTHER TIPS AND CAUTIONS

1. The X-PLAN may, on occasion, fail to function properly (e.g. erroneous numbers are displayed) for no apparent reason. This situation can usually be rectified by initializing the memory.

To initialize the memory, switch on power while pressing [CE/C].

2. The X-PLAN may be used on or near magnetic materials without impacting its operation.

3. Please take care to keep surfaces on which the X-PLAN is being used clear of   dust and debris as it may adversely affect performance.

4.The included gauge template is resistant to heat and humidity, and has an

accurate 10cm x 10cm square printed on it.   Please use it to occasionally
check the accuracy of the X-PLAN. As long as any discrepancies in area and
length measurements are within a margin of 0.1%, no problem is posed.

5.The printer paper is thermal, so it may discolor naturally over time due to
humidity or heat. It is recommended to make copies of measurement results
on different paper for long-term filing. Also, humid or warm places are not
suitable for storage of extra printer paper.

13.   SPECIFICATIONS

Display	LCD 16 characters x 2 lines	
Measuring Range	X-PLAN300F/F.C	Vertical: 300mm
	X-PLAN380F/F.C	Vertical: 380mm
	X-PLAN460F/F.C	Vertical: 460mm
	X-PLAN520F/F.C	Vertical: 520mm
	X-PLAN620F/F.C	Vertical: 620mm
	All models	Horizontal: 20000mm
Resolution	0.01 mm	
Accuracy	Within a 0.1% margin of error (for area/length accuracy confirmation, use included gauge template)	
Interface	RS-232C (full duplex) built-in	

Power	Rechargeable NiCd battery
	 *Recharge with attached AC charger:
	  approx. 7 hours.
	 *Maximum usage time with fully charged battery:
	  approx. 50 hours (without printer).	

Dimensions		*body*	*case*	*weight*
& Weight (body)	300F	288x162x47mm	417x198x66mm	920g
	380F	334x162x47mm	417x198x66mm	890g
	460F	380x162x47mm	417x198x66mm	900g
	520F	415x162x47mm	467x198x66mm	920g
	620F	472x162x47mm	509x198x66mm	940g
	300F.C	288x162x47mm	417x198x66mm	910g
	380F.C	334x162x47mm	417x198x66mm	880g
	460F.C	380x162x47mm	417x198x66mm	890g
	520F.C	415x162x47mm	467x198x66mm	910g

620F.C   472x162x47mm   509x198x66mm   930g

Accessories	User's Manuals
	AC charger/adaptor
	Gauge Template
	Case
	Marking pen guides(0.3mm and 0.5mm in diameter)
	Marking pin holder with needle

Options	Mini-Printer 16c (thermal)
	Roll paper (thermal)
	Interface Cable **(Available lengths: 2m / 5m / 10m)**
	* Please specify the name of computer to be used.

X-PLAN **F/FC** series　　CP memorandum

S/N: _____

CP No.	C.P.1	C.P.2	C.P.3	C.P.4	C.P.5	C.P.6	C.P.7	C.P.8	C.P.9	C.P.10	C.P.11	C.P.12	C.P.13	C.P.14	C.P.15
Special　centroid															
triangular															
center of arc															
angle															
Radial distance															
Contour-based volume															
Revolutionary solid															
Basic　(X,Y)															
Segment length															
area															
Total length															
radius															
Unit															
Scale　ratioX															
ratioY															
Coordinate system															
Decimal placement															
Auto-numbering															
memo															

Angle units　:　……　degree&minute　Degree　gon　radian

Units :　……　mm　cm　m　m/a　km/ha　km　in　ft　yd　yd/ac　mi　寸　尺　間/坪　Options(U)

Scaling :　……　ratio input　manually measured ratios

Coordinate systems:　……　Machine　Standard　Survey

Auto numbering :　……　Without　In plot　After plot

Structure of Mouse menu

- **Measuring Functions**
  - Special
    - None
    - XG(centroid)
    - TA(triangular)
    - An(angle)
    - XP(arc center)
    - RL(radial)
    - GV(volume)
    - VA(revolutionary)
  - Basic
    - X(coordinate)
    - d(segment length)
    - A(area)
    - L(total length)
    - r(radius)
  - Unit system
  - OPTION
    - /
    - U
- **Unit system**
  - Unit
    - m
      - mm
      - cm
      - m
      - m/a
      - km/ha
      - km
    - ft
      - in
      - ft
      - yd
      - yd/ac
      - mi
- **Scale adjustment**
  - Scale ratio
    - RX(in X)
    - RY(in Y)
  - Manual
    - CX(in X)
    - CY(in Y)
- **Coordinate axes**
  - Machine
  - Standard
    - axis
    - xy value
    - Affine
  - Survey
    - axis
    - xy value
    - Affine
- **Bias origin**
  - XB(in X)
  - YB(in Y)
- **Decimal placement**
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9
  - FULL
- **Numbering**
  - without
  - IN_PLOT
  - AFT_PLOT
- **Auto close**
  - YES
  - NO
- **Auto power off**
  - NO
  - YES
- **Conditions print**
  - NO
  - YES
  - Data_ID