Part Number 425795

CLIP PLUS OPERATION AND MAINTENANCE MANUAL

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Introduction

HARDWARE OVERVIEW

The CLIP Plus Vision Computer System couples advanced electronic technology with conventional measurement methods to create a powerful and versatile control system.

The microprocessor-based logic system of CLIP Plus reduces the time required for consistent and accurate measurements. Inspection procedures that once took minutes to perform can now be accomplished in seconds.

Overlay chart-gages are not required as often during the measurement process. Alignment of part axes to worktable axes is a simple pushbutton operation. Radius, diameter, and centerpoint location of arcs and circles can be found instantly. Angles are calculated in less time than it takes you to rotate a protractor ring. Vertex position, point in space, and drilled corner relief calculations are all light work for CLIP Plus.

The attractive master control panel represents considerable research. The goal was a finished product that would be easy to use and maintain. The membrane type control buttons are clearly marked, and have been grouped and located according to their function. Two digital readouts display the results of your measurements in large, bright, numeric characters. The results can be displayed in either English or Metric — just press a button. The choice is yours.

Further simplification of the inspection process is offered in the optional Projectron III automatic electronic centerline system. This system, which is an integral part of CLIP Plus, automatically finds a shadow edge of a part being measured and displays the coordinates of that edge in the digital readouts. This feature eliminates the time-consuming requirement of having to manually set the centerlines to an edge. Measurement accuracy is enhanced because the need to make subjective decisions is eliminated.

An RS-232 serial coupling permits CLIP Plus to interface with the optional CLIP-Comp data assist system. The CLIP-Comp system features: a Hewlett-Packard computer and software that can be fully programmed to control your entire inspection procedure; a Hewlett-Packard Disk Drive unit stores programs and data for future reference; and an HP serial printer to generate printouts of your inspection programs.

Perhaps the capabilities of the CLIP Comp exceed your requirements at this time, but you still desire printouts of your work. This creates no problem at all, for CLIP Plus can interface through the RS-232 port to a wide range of serial printers.

It's easy to see that we at Optical Gaging Products, Inc. are very proud of the CLIP Plus Vision Computer. We are confident that the pride we feel as manufacturer will be shared by you, the user of this versatile system.

SOFTWARE OVERVIEW

The CLIP Plus system is designed to make your job easier and more rewarding by automating the more tedious details. We built electronic intelligence into the machine to allow it to perform the "monkey work," the time-consuming and repetitive steps. You could do these operations yourself with a calculator, chart gages, replacement screens, and the vernier rotary screen ring, but you have better things to be doing with your time and brains!

We will ease into this gently, by beginning with something you are already familiar with – measuring the size and location of various features. We will examine the appropriate measuring techniques one at a time. This should present no problems because, at its simplest level, the CLIP Plus is an excellent precision hand tool. You can easily use the crosshairs on the screen and the digital readout to manually determine the size and center of a circle, for example. There are several ways to move the measured image around on the screen. You can use arrow keys, a joystick, control knobs or handwheels depending on the model of contour projector.

Once you are comfortable with your ability to run the machine, we will discuss a few more simple steps through which you can teach the machine to run itself! Once you have trained CLIP Plus to grind out the dirty work, you can relax and take notes.

HANDBOOK OVERVIEW

We believe you will find the structure of this manual to be uniquely helpful. It is designed as an "information sandwich." When you turn the page, you will find a variety of charts and diagrams. These are:

- a labeled diagram of the mechanical structure.
- a labeled diagram of the keyboard, with brief explanations of the keys.
- a chart of the appropriate collimator and filters for various levels of magnification.

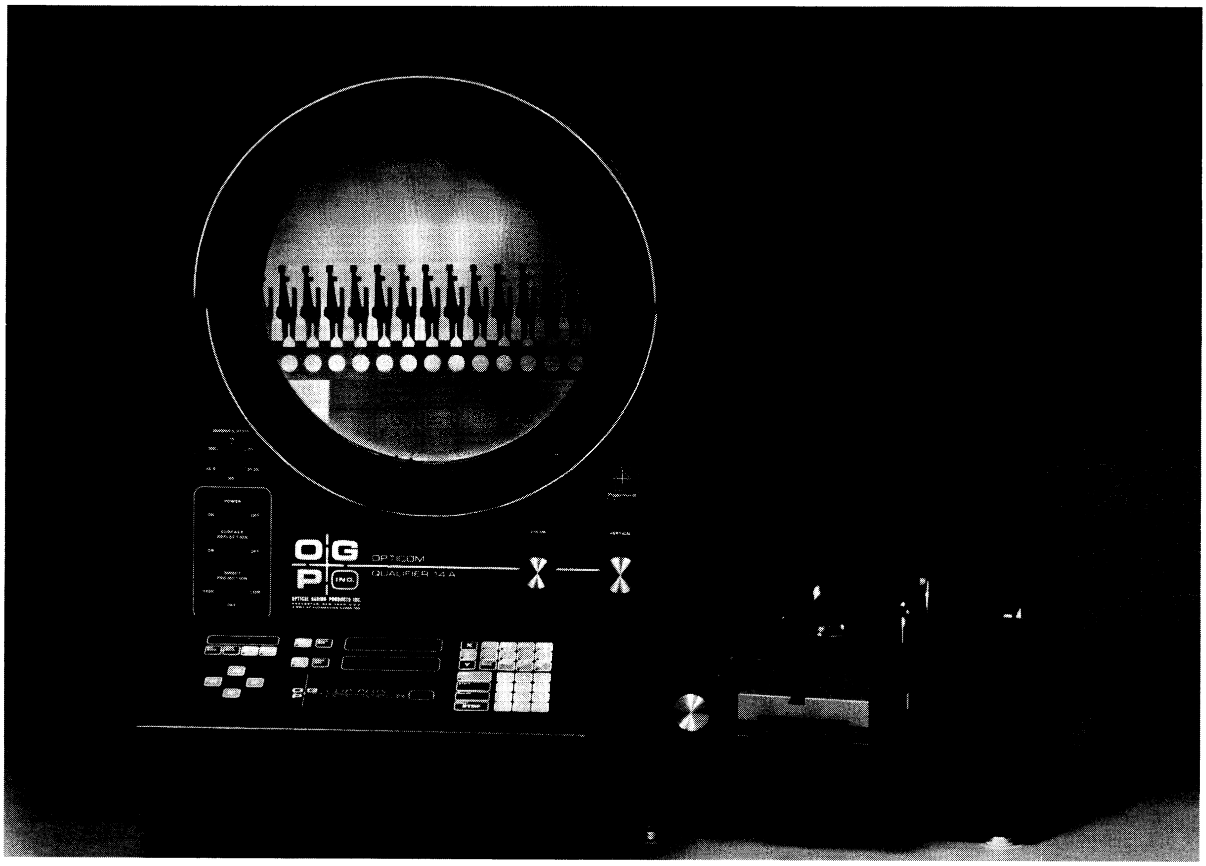
You may ignore most of these descriptions for the time being — we had to put them somewhere, and the front of the book seemed to be the logical place. When you need to find any of these facts in a hurry, you will know where to look.

These charts are followed by a brief lesson on starting the machine. Once that is accomplished, you can begin to master the tutorial material. We have divided the information you need to master into alternating "practice" and "theory" sections. The "practice" sections are "learn by doing" exercises. The "theory" sections will review material covered and prepare you for the next session at the keyboard.

Finally, the wordier reference material is in a set of separate appendices in the back. These deal with items such as set up, service and calibration, which are rarely encountered.

To review: we have placed the information you will need every day towards the front, in graphic form. The information you need rarely, if ever, goes in the back. In between, the tutorial material, which you need — right — *now!*

Mechanical Diagram



Keyboard Chart

Let's take a closer look at CLIP PLUS. Each button offers a function designed to add measurement productivity to your OGP Contour Projector. Consider these capabilities:

X—*Allows entry of X axis information from numeric keypad.*

Axis Align—*Electronically aligns the part coordinate axes to the work-table measurement axes, virtually eliminating the need for physical alignment of the part with the worktable.*

Polar Back—*Converts X and Y display values to Radius and Angle.*

Dist Back—*Captures current display contents for use as a reference and displays difference between captured values and current table position.*

More Points—*Allows entry of additional points for circle (more than three), line (more than two), width (more than three), and vertex (more than four). The maximum is eight points per function.*

Ɇ—*Enables automatic edge detection using the PROJECTRON III Automatic Electronic Centerline System. Coordinates of a detected edge will automatically be locked in the CLIP PLUS displays for subsequent storage or analysis.*

O—*Arc/Circle button gives radius and diameter of a circular feature defined by three or more points. A second push of the button displays the X and Y coordinates of the center.*

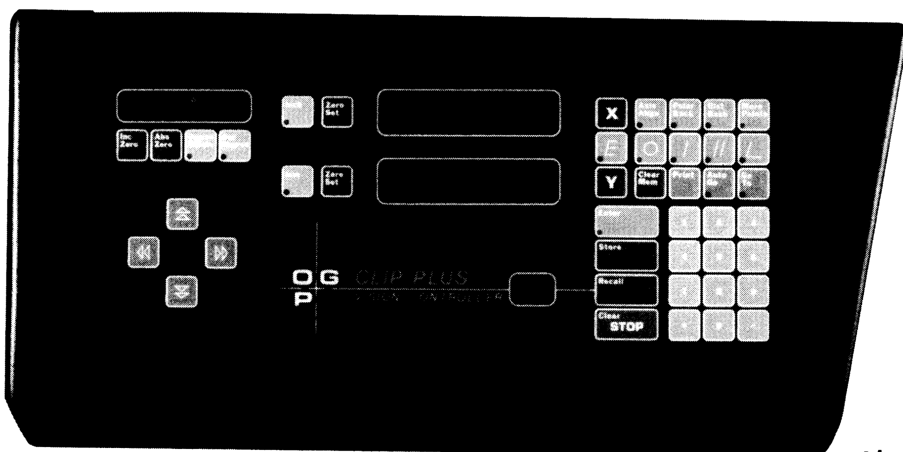
/—*Line button gives angle and midpoint of a line defined by two or more points.*

//—*Width button provides the distance between two lines and the angle and midpoint of the width by three or more points.*

∠—*Angle button gives the included and supplementary angles between two intersecting lines defined by measuring two or more points on each line. A second push of this button provides the X and Y coordinates of the intersection point.*

Y—*Allows entry of the Y axis information from numeric keypad.*

Clear Mem.—*Clears contents of the Program and/or Data Memories memory from the next memory location through block 99.*



Print—*The Print button controls the transfer of information in the CLIP PLUS display to a printer or computer system connected to it by an RS-232 cable.*

Auto Go—*Automatically sequences the contents of the Program Memory to position the stages to programmed locations.*

Go To—*Positions the stages to a location entered from the numeric keypad or retrieved from the Program Memory. If PROJECTRON III is enabled, the stages will automatically seek a projected shadow edge.*

Enter—*Copies the X and Y display values to the Data Memory at the current block and increments the block number.*

Store—*Stores the X and Y display values to Program and Data Memories at the current block and increments the block number.*

Recall—*Displays Program and Data Memory contents at current block number. By using numeric keypad, any block's contents can be displayed.*

Clear/STOP—*Displays current table position and stops motion.*

Numeric Keypad—*For position information or block number entry.*

Zero Set—*Independent zero buttons for each axis allow you to instantly establish a zero reference for X and Y values at any location.*

Inch—*Selects inches for displayed values and will instantly convert millimeter measurements to inches.*

mm—*Selects millimeters for displayed values and will instantly convert inch measurements to millimeters.*

Inc(remental) Zero—*Stores the current protractor angle value and causes the angle display to show the difference between the stored value and any subsequent values.*

Abs(olute) Zero—*On power up sets the angle display to zero at the current protractor position. Thereafter, return the display to the absolute reference.*

Degree Minute—*Selects Degree Minute mode for protractor angle display and angle functions.*

Dec Degree—*Selects Decimal Degrees mode for protractor angle display and angle functions.*

Motion Keypad—*Starts constant speed motion in the direction indicated by the selected button if edge detection is enabled. This causes a seek of a projected shadow edge in the direction indicated on the button.*

Filter and Collimator Chart

Projector Model	Magnification	Collimator Lens	Filter
OQ-14A	10X - 31.25X 50X - 100X	425998 425998	One Swing - In None
QL-14 C&S	10X 20X 31.25X 50X - 100X	424499 424499 424499 424499	Two Swing - Ins One Swing - In (Strong) One Swing - In (Weak) None
OQ-20 C&S **QL-20 C&S**	10X 20X	424499 424499	Two Swing - Ins One Swing - In (Strong)
OQ-30 C&S	10X - 20X 31.25X 50X - 100X	835602 835602 423710	Two Internal Green One Internal Green None
QL-30 C&S	10X - 20X 50X - 100X	426122 426122	Two Internal Green One Internal Green

Start Up

This section will instruct you in the basic operation of CLIP Plus.

DIAGNOSTIC CHECKS

Start by turning on the main power switch to your projector. Then wait while CLIP Plus runs through approximately five seconds of self tests. If any failure is detected by the microprocessor, a coded message will appear in the X readout. This message serves to identify the failure. Interpreting this message and taking subsequent remedial action will be covered on page H-9 of this manual.

At the end of the self-test, the X and Y readouts will display:

x -00.0000

y -00.0000

This display indicates that CLIP Plus is "cleared" and is ready to begin measurement. Pressing the ***X*** and ***Y*** zero buttons will always result in this display.

- Turn on the horizontal illumination system and wait a few seconds for the lamp to achieve full brightness. If you have mercury arc illumination, you should allow approximately five minutes for the lamp to reach full power. Consult the chart on page B-3 and swing in the appropriate filters and collimators for the level of magnification you are starting with.

- Carefully adjust the home position of the protractor ring to align the mark on the screen to its mate on the frame, and press the ***Abs(solute) Zero*** key. This sets the angle display to zero at the current position. You cannot establish a new "absolute" zero unless you turn CLIP Plus off, then on again, to clear the memory. If you wish to modify the position of the ring, use the ***Inc(remental) Zero*** key to aquaint the computer with the new zero. You can always get back to the original zero by pressing the ***Abs(solute) Zero*** key again.

- Select your units of measurement: For dimensional measurements, your choices are ***Inches*** or ***mm (millimeters)***. For angular measurements, you will need to select either the ***Degree Minute*** system, or the ***Decimal Degree*** system.

In this manual we will use ***bold italic*** typeface when refering to actual keys on the keyboard.

Basic Operations

CONVENTIONAL MEASUREMENT TECHNIQUES

The metrologist has two concerns: *what* things are, and *where* they are. You need to be able to measure various features, such as circles, lines, and angles, and to say where they are in relationship to one another.

When you first turn CLIP Plus on, it assumes that one spot in its area of possible motion is the center of the universe, and it measures all motion in terms of that "origin." As you move the stage away from this origin, the numbers in the X and Y displays change.

You have to start somewhere. And, if you don't like the place the machine has chosen to start counting from, you can always choose a new origin by pressing the two ***zero set*** buttons. We will not worry too much about this, yet, except to point out that all X and Y coordinates are statements of distance *from the origin.* We will discuss the "where" of the features in more detail *later.* We are *now* going to discuss the art of measuring a few simple shapes — a rectangle, a line, a width, a circle.

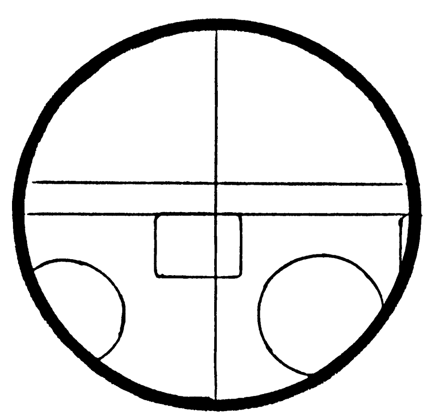
Note: When you first turn CLIP Plus on, it may set a "Keystone Correction Factor," to allow for deflection caused by the weight of the table as it moves away from its point of support. To keep this correction correct, **center the stage** *and move it all the way* **up** *before the machine is powered down. That way it will be in the correct position at power up.*

To perform a simple length and width measurement of a rectangular part,

A. Stage the sample part to the worktable and use the appropriate motion controls (knobs or joystick) to move the image of the part into view on the screen. Note that as you move the worktable, the X and Y readouts are counting.

B. Orient the part on the worktable so that one plane of its projected image is parallel to the horizontal centerline of the viewing screen (Figure 200-1).

Fig. 200-1



C. Use the motion controls and fine adjustments to position the image of the part as in figure 200-2. Press both ***zero*** buttons to clear the X and Y digital readouts.

D. Now, use the motion controls again to position the part image as in Figure 200-3. The X and Y readouts will be displaying the length and width of the rectangular opening on the part. (You should be seeing .200 displayed in the **Y** position display, and .260 in the **X** position display.)

Fig. 200-2

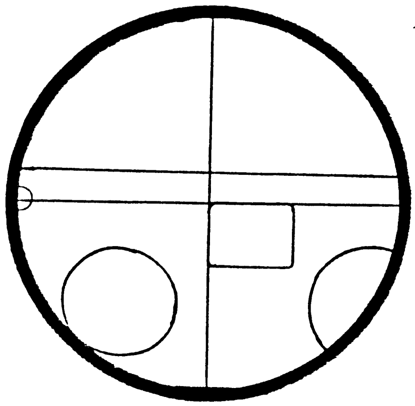
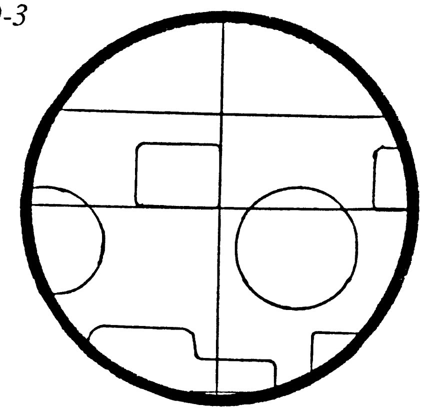


Fig. 200-3



*Note: If you want your results displayed in metric values, simply press the button marked **mm**. To escape from metric values, just press the **Inch** button and your results will again be displayed in English values. You may toggle between English and Metric at any time.*

HOW TO MEASURE A LINE

To measure a straight line segment,

A. Press the ***line*** button.

B. Position the screen centerlines at one end of the line segment being measured, and press the ***Enter*** button.

C. Position the screen centerlines at the other end of the line segment being measured, and press the ***Enter*** button again. The X display will now provide you with the angle of the line relative to the X axis, and the Y will show the complement of that angle. The LED on the ***line*** key will be blinking. Press it again, and the X and Y displays will provide you with the coordinates of the midpoint of the line.

The coordinates, incidentally, are in terms of the origin, the (0,0) point established the last time you pressed the ***zero*** buttons. As you have noticed, the one thing you have *not* measured is the length of the line. Unless your line is aligned with a main axis (more on this later), that information is not available. If you would like to know how far one end of your line segment is from the other in terms of X and Y distance, repeat this exercise, and press the ***zero*** buttons immediately after taking your first point.

You probably noticed the ***More points*** key blinking. This key permits you to use "more points" than the minimum required to define a shape. As a rule, a *line* is defined by two points, a *circle* or *width* by three points, and a *vertex* by four. Pressing the ***More points*** key allows you to enter up to eight points per shape, for enhanced precision.

If you used five points to define a line, for example, CLIP Plus would construct a "least squares" fit with all five of the data points. A circle also takes every data point into account, giving each one equal consideration. On the second depression of the line key, however, the "more points" centerpoint is computed between the ***First*** data point and the last one. Intervening points are ignored.

The ***Angle*** function, on the other hand, *always* uses the last two points to define the second line. If you used ***More points*** to define an ***Angle*** by six points, for example, CLIP Plus would construct a "least squares" fit for the line determined by the first four points, then use the last two for the second line. If you decided to take it to the limit, and define your angle with eight points, you would use up six of those points on one side, and the last two on the other. This means you can't ask for eight points, and use up four on each side.

The ***Width*** function operates in somewhat the same way. The difference is, this measurement program defines the second line by a single point, the *last* point. If you decided to use six points, for example, to measure the distance between two parallel lines (their width), then you would enter five points on one side, and one on the other. If you wanted to use eight points, the first seven would give you the first side, and the last point would fix the opposite side.

HOW TO MEASURE A WIDTH

If you wish to know the distance between two parallel lines on the workpiece, such as two opposite sides on any of the included rectangles, this is the key to use.

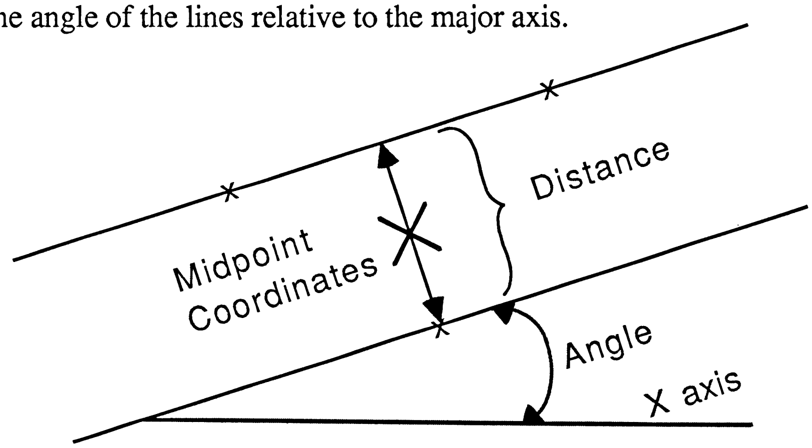
A. Press the ***Width*** key.

B. Enter two points on one side of the shape under consideration. (Place the screen centerlines on the point of interest, and press the ***Enter*** key.)

C. Enter one more point, on the opposite side. Since this one point will be used to define an entire line, *be sure* it is accurate!

The displays will now provide you with:

- the distance between the two lines.
- the angle of the lines relative to the major axis.



Press the *Width* key again and you will have:

- the coordinates of the midpoint.

The ***Width*** measurement function always assumes that the *last* point you enter is a "known accurate" point on the *second* side. This means that, should you use the ***More points*** feature, the extra points would have to be entered on the *first* side.

HOW TO USE THE ARC/CIRCLE FUNCTION

The arc/circle function is operated by entering three different locations on the circumference of an arc or circle. CLIP Plus then calculates the relative positions of these three points and provides the radius and diameter of the hole. It also gives the X and Y coordinates of the center point of the hole.

A. Press the ***Circle*** button. The LED in the corner of the button will glow solid red indicating that the circle function is operating. The ***Enter*** button will begin to flash, indicating that the circle function is awaiting information.

B. Move the worktable to locate three points along the circumference of the hole. Space them as far apart as possible. Press the ***Enter*** button after locating each point. On projectors equipped with a joystick, the button on the top of the stick may be pressed instead of the ***Enter*** button — they both perform the same function. After you have entered the third point, (or if you are using the ***More Points*** function, the last point) the LED in the ***Enter*** button will extinguish and the circle button will begin flashing. Look at the digital readouts and you will see two sets of numbers displayed. The number in the X readout is the radius of the hole, and the number in the Y readout is the diameter.

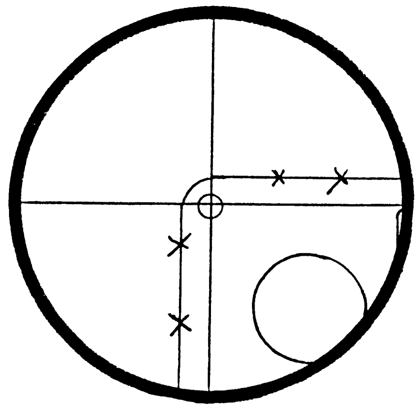
C. The flashing circle button means that more information is available. Therefore, press the circle button again and the readouts will display the X and Y coordinates of the center point of the hole. The indicator LED will now be solid red. Press it one more time, and it will go out.

HOW TO USE THE ANGLE FUNCTION

The angle function is operated by entering X and Y coordinates taken at two (or more) locations on each leg of an angle. CLIP Plus calculates the relative positions of these points and provides the included and supplementary angles formed, and also gives the X and Y coordinates of the vertex of the angle.

Based on the part shown in Figure 200-4, let's determine the location of the upper left hand corner to establish our point of origin.

Fig. 200-4



A. Press the ***angle*** button. The indicator LED in the corner of the button will glow solid red, and the LED in the ***enter*** button will begin to flash. This is the visual indication that the angle function is operating and awaiting information.

B. Move the worktable to locate two points along each leg of the angle. Press the ***enter*** button after locating each point. After you have entered the fourth point, the indicator LED in the angle button will begin to flash and the X and Y readouts will display the included and supplementary angles of the corner.

C. Press the ***angle*** button again, and the readouts will display the X and Y coordinates of the vertex of the corner.

Note: If you wished to use more than four points to define the angle, and told CLIP Plus so with the ***More Points*** *key, you should be aware that the additional points must be taken on the first leg of the angle. CLIP Plus assumes that the last two points taken are the "known accurate" points that define the second leg.*

These exercises demonstrate that CLIP Plus can be used as a simple digital readout.

ELECTRONIC ALIGNMENT

Any measurement techniques that you would perform on a conventionally–equipped projector can be done on CLIP Plus. This includes measurement by comparison, angular measurement, and measurement by motion, as described above.

The strength of CLIP Plus, lies in its ability to perform these techniques without having to rely on manual settings, chart gages, and the vernier rotary screen ring. Let's take a look at some of the advanced features of CLIP Plus and see what they can do.

HOW TO USE AXIS ALIGN

Before we discuss the process of aligning an axis, let's look at what an axis *is*. CLIP Plus examines parts in two dimensions — up-and-down, and side-to-side. The up-and-down direction is called the "Y axis." The side-to-side direction is called the "X axis." When you move the crosshairs further *up* on the part, the numbers in the **Y** display move in a positive direction. When you move the crosshairs towards the *right* side of the part, the numbers in the **X** display get larger.

The place where the X and Y values are both zero is, as we have already said, the origin. If you move in only one dimension, then only one display will change. If, for example, you move from the origin in the X direction only, the Y readout will continue to display zero. The X axis *is* that line along which the Y values are all zero. The Y axis *is* that line along which the X values are all zero. As a rule, some easily found straight edge on a part is given the honor of being the "main axis," or primary datum line. The "minor axis" is perpendicular (at right angles) to the main axis. All of the features of the part are measured in terms of their distances from these two axes.

You need to line up the axes of the part with the worktable axes of measurement before performing any measurements. This means making *sure* that the X axis of the part tracks with the X motion of the worktable. When this is done, any position on the X axis *of the part* will have a Y value of zero *in the readout.* The numbers in the readouts will resemble the numbers on the blueprint.

In conventional measurement, this involves the trial and error method of moving the part in its staging fixture until you have what appears to be perfect alignment. With CLIP Plus, the physical position of the part is not a factor. In other words, you can instruct CLIP Plus to "see" the part as aligned to the worktable axes of measurement, *regardless* of actual physical position in the X – Y plane. You do this by using the Axis align function.

Refer to figure 200-5 and you will see a simple rectangular part having length and width dimensions that we must measure.

In conventional measurement, you would physically align the top horizontal surface of the part to the worktable horizontal axis. With Axis align, simply locate two points on any surface of the part and input this data. CLIP Plus does the rest.

A. Stage the part to the worktable so that it appears skewed with respect to the viewing screen centerlines.

B. Move the worktable to position the part image so that the screen centerlines are located at some point in one of the surfaces (Figure 200-5). In this case, we have chosen a point on the upper surface of the part and we will refer to that point as Ref. 1. This will be the first of the two required locational references for the axis align function.

Fig. 200-5

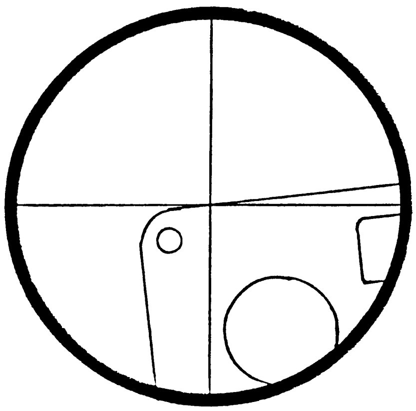
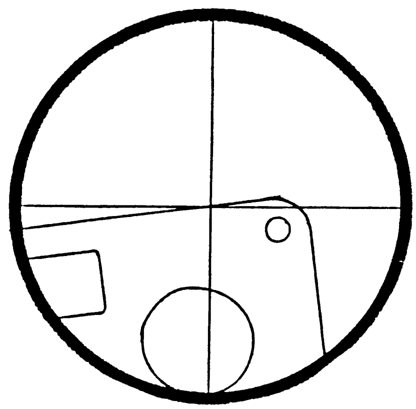


Fig. 200-6



C. Press the ***zero*** buttons to clear both the X and Y digital readouts. The first locational reference for Axis align must always have an X and Y value of (0,0).

D. Move to another point along the upper surface of the part image (Figure 200-7). This will be the second of the two required locational references and will be called Ref. 2. Try to keep the locational references as far from each other as possible.

E. Press the ***Axis align*** button and you will see the indicator LED in the corner of the button glow solid red. This is the visual indication that the Axis align function is operating. Note that the Y axis display shows zero. The part coordinate axes are now aligned electronically.

F. To escape from the Axis align function, press the ***Axis align*** button again. The indicator light will turn off and CLIP Plus will return to conventional measurement coordinates. To verify the fact that the part is aligned, center the crosshairs of the screen on a few more points along the surface aligned. At each of these points, the Y display will still read zero.

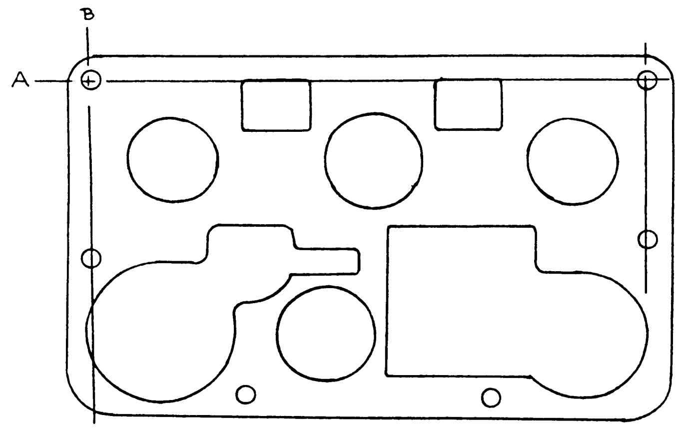
If you work with an electronically aligned part, you will need to get used to seeing the Axis align LED glowing steadily. It's not crying for attention, it's just letting you know that it's on the job. Resist the impulse to push it!

HOW TO ESTABLISH POINT OF ORIGIN FOR MEASUREMENTS

Measurement convention tells us that coordinate axis systems must have a point of origin. In other words, there is a location where X and Y would have a value of (0,0). This location would be the point, or more correctly termed, point of origin from which we would begin our measurements. We have already discussed one "brute force" approach to establishing an origin, namely, simply picking a spot, and pressing the two ***zero set*** buttons. There is a more elegant way.

Refer to Figure 200-7 and you will see a part in which lines A and B interesect at the center point of a circle.

Fig. 200-7



Measurement convention dictates that *unless otherwise noted* two intersecting datum lines will be treated as perpendicular to each other. Knowing this rule and using the information given in Figure 200-8 it makes sense that we establish our X axis along datum A, and the Y axis along datum B. Using the information given in the previous paragraph, we will establish the intersection point of datums A and B. The center point of the hole is our point of origin for measurement. This point will be logically given an X,Y value of (0,0). At this point we must stop and remember that since we have staged a new part to the worktable, the Axis align function must be implemented before proceeding with measurements.

Refer again to figure 200-7 and you will see that the horizontal line created by datum A extends through the center point of the hole in the upper right corner of the part. Since the center point of the hole in the upper left corner has a Y axis value of 0, the hole in the upper right corner will also have a Y axis value of 0. Therefore, we should establish our Axis align along Datum A, using the center of the holes as reference features.

To accomplish this, we could set the ***Axis align*** as we did in the preceding exercise by locating two points along the X axis and then move back to our point of origin to begin measurements.

There is an easier and faster way. CLIP Plus allows us to simplify this operation by taking our two locational readings at the *center points* of the two holes. This technique permits us to eliminate the extra steps involved in taking readings on the X axis, and then having to move back to the point of origin to begin measurement.

Before we can set to the center point of the hole, however, we must first locate that center point. In conventional measurement, we would use a radius chart-gage overlay to establish the center point. With the CLIP Plus Vision Computer, we can eliminate the chart-gage and subsequent subjective decisions. To do this, we will have to utilize the arc/circle function. Based on the part shown in Figure 200-8, let's calculate the center point location of the left hand hole to establish our point of origin.

Fig. 200-8

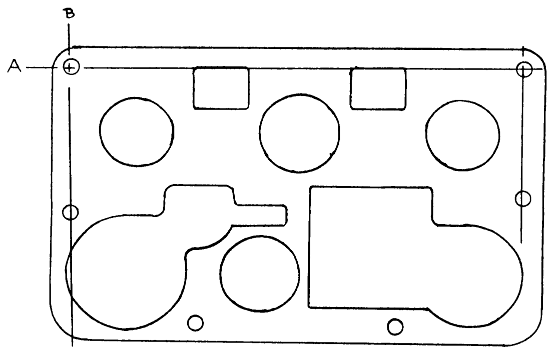
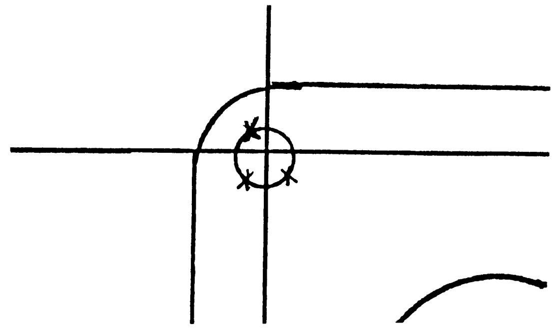


Fig. 200-9



A. Press the ***Circle*** button. The LED in the corner of the button will glow solid red indicating that the circle function is operating. The ***Enter*** button will begin to flash, indicating that the circle function is awaiting information.

B. Move the worktable to locate three points along the circumference of the hole. Space them as far apart as possible (Figure 200-9). Press the ***Enter*** button (or the button on top of the joystick) after locating each point. After you have entered the third point, the LED in the enter button will extinguish and the circle button will begin flashing.

C. The flashing ***Circle*** button means that more information is available. Therefore, press the ***Circle*** button again and the readouts will display the X and Y coordinates of the center point of the hole. The indicator LED will now be solid red.

Now that we have determined the center point coordinates for the left hand hole, we will establish our point of origin and the first locational reference for axis alignment by assigning an (X,Y) value of (0,0) to this location.

D. Press the ***zero*** buttons so that both digital readouts display all zeros. You have now assigned X and Y values of (0,0) to the point of origin.

How are you to know that it is the *center* of the circle you have assigned the values of (0,0) to? Simple. Bail out of the ***Circle*** function, by pressing the ***Circle*** button again. The LED on the ***Circle*** button will now go out, and the X and Y displays will show the position of the last point you took, offset from the origin by the radius of the circle.

Our next step will be to set the second locational reference at the center point of the right hand hole.

E. Press the ***Circle*** button so that the enter button begins to flash. Move the worktable to find three points along the circumference of the right hand hole and enter these points as you did in the previous example. Remember to press the ***Enter*** button after locating each point. Once the third point has been entered, the indicator LED will extinguish and the X and Y readouts will display the radius and diameter of the hole.

F. Press the ***Circle*** button again and the readouts will display the X and Y coordinates for the center point of the right hand hole. In addition, these coordinates represent the X and Y distance between the two holes. This will also be our second locational reference for the Axis align function.

G. Press the ***Axis align*** button and the indicator light in the corner of the button will glow solid red. As explained before, this is the visual indication that the Axis align function is operating and that the part coordinate axis has been electronically corrected to the worktable measurement axes.

In this exercise we established our point of origin, measured the radius and diameter of two holes, performed part alignment, and measured the X distance between the centers of the two holes.

Note: We can only measure the distance between two points when the value of one of the axes is constant. In this case, since the Y value along the X axis is zero, the X value of the second point taken is the accurate distance between the centers.

The point of this little summary is that with practice, you'll be able to perform all of the above measurements in less than a minute. Try that on a conventional contour projector and compare your times — and accuracy. You'll be completely amazed.

HOW TO USE THE ANGLE FUNCTION TO SET AN ORIGIN

As you recall, the angle function is operated by entering X and Y coordinates taken at two (or more) locations on each leg of an angle.

Refer back to Figure 200-4. Let's determine the vertex location of the upper left hand corner to establish our point of origin.

A. Press the ***angle*** button. The indicator LED in the corner of the button will glow solid red, and the LED in the ***enter*** button will begin to flash.

B. Move the worktable to locate two points along each leg of the angle. Press the ***enter*** button after locating each point. After you have entered the fourth point, the indicator LED in the angle button will begin to flash and the X and Y readouts will display the included and supplementary angles of the corner.

C. Press the ***angle*** button again, and the readouts will display the X and Y coordinates of the vertex of the corner.

D. To establish the vertex as our point of origin, simply press the ***zero*** buttons to clear the X and Y readouts. The angle function is now completed.

If you wish to establish axis alignment, simply perform another angle function at the upper right hand corner and use the vertex location as the second positional reference. You may be saying, "When did I establish the first positional reference?" Remember that our first positional reference for axis align must always have an X,Y value of (0,0).

Since we established our point of origin at the vertex of the upper left hand corner, and we assigned an X,Y value of (0,0) to this point, we have therefore, automatically established our first locational reference.

Note: Keep in mind that you use the ***zero set*** *buttons to establish your origin. Any time you press them, though, you wipe out your axis alignment, and must start from scratch, and re-align.*

There is one more unique use for the zero set buttons. Suppose the origin of the part was somewhere on the blueprint, instead of located on the part itself. In that case, you could choose a point at a convenient location, enter the coordinates of that point, and press the ***Zero Set*** buttons. This sequence will establish the coordinates for the point you choose as anything you choose.

So far, you have learned how to establish point of origin, set Axis align, measure lines and widths, and perform the circle and angle functions with CLIP Plus.

HOW TO USE THE JOYSTICK MOTION CONTROL

If you have purchased a contour projector with a joystick, it is mounted on the console near the CLIP Plus control panel. This joystick not only provides an infinitely variable power motion control to the worktable but also allows you to enter data for the circle, angle, line, and width functions and control the optional Projectron III system.

On projectors without the Projectron III system you can enter X and Y coordinates for the line, width, circle and angle functions by pressing the button on the top of the joystick. This can be used instead of the enter button.

If your projector is equipped with the Projectron III system, the joystick button can be used to control the on/off status of this option, as well as for entering X and Y coordinates.

HOW TO USE THE PRINT FUNCTION

The ***print*** function is used in conjunction with serial printers and prints out the contents of the digital readouts. If you have performed a circle function and the radius and diameter are being displayed in the readouts, simply press the ***print*** button and this information will appear in the printout as follows:

```
R+0.0370    D+0.0740    * Radius, Diameter    * B01
```

This operating procedure applies to the angle, line, width, and recall functions as well. The print function may be used *any* time. It is the equivalent of the "screen dump" function of personal computers, printing whatever is currently on display.

HOW TO USE THE DIGITAL PROTRACTOR

If you begin looking for a scale with degrees marked on it, you will be looking for quite a while. The *digital* protractor consists of a position sensor mounted invisibly inside the housing of the contour projector. This device keeps track of the rotational position of the ground glass screen, and displays that position in either degrees and minutes, or decimal degrees, on the appropriate LED readout.

When you first turn CLIP Plus on, you'll see hyphens in the LED readout, and the LED indicator on the ***Abs. Zero*** key will blink. Check to see if the reference mark on the screen is precisely aligned with its mate on the housing, or if the crosshairs are where desired. If all is well, press the ***Abs. Zero*** key. You will now see the hyphens vanish, to be replaced by zeros. The LED on the ***Abs. Zero*** key will also glow solid. This means that the rotational displacement of the screen is now, by definition, zero.

Suppose, though, that you need to rotate the screen. If, for example, you perform some measurements on a skewed rectangle in a workpiece, you may very well wish to have the crosshairs parallel to a side of that rectangle. In this situation, you would loosen the clamps that hold the screen, and rotate the screen until it was at the angle you wanted it to be. You would then press the ***Inc. Zero*** key, to establish a new reference zero. After securing all of the desired information concerning the feature, you may wish to return to your original frame of reference. In that case, pressing the ***Abs. Zero*** key again would cause the LED readout to show you how many degrees you have strayed from where you started. At that point, you would need to manually adjust the screen, until the LED readout was back to zero.

Projectron III Theory
Automatic Electronic Centerline System

If you have the optional Projectron III automatic electronic centerline system on your projector please read this section very carefully. If not, please turn directly to page F-1.

The Projectron III option further automates the measurement process. Photoelectric cells in the control head of the Projectron III system react when the shadow of an edge crosses the centerlines of the viewing screen. When Projectron III "finds" an edge, it automatically locks the digital readouts at that point. By automatically finding and locking to an edge, the projectron eliminates the need to manually set a feature to the screen centerlines, and the sometimes-inaccurate subjective decisions that result. This permits a level of measurement repeatability not attainable before.

MAIN COMPONENTS — PROJECTRON III

The main components of the Projectron III option include:

1. *X and Y digital readout.* Projectron III uses the standard CLIP Plus Vision Computer display.

2. *Control buttons.* Several additional keys are used to operate Projectron III. These include the

   [E]

   key, and the four arrow keys.

3. *Joystick control.* The pushbutton on the top of the joystick, if present, is used to enter X and Y coordinate data and as an on/off control for enabling Projectron III operation.

4. *Projectron optical head with sensor board,* contained within the projector. These two components control image sharpness and alignment, and edge detection electronics.

5. *Projectron interface board,* mounted on the reverse side of the CLIP Plus control panel. This board interprets voltages transmitted from the sensor board and signals the CLIP processor if a valid edge has been detected.

LIGHTING CONSIDERATIONS — PROJECTRON III

The Projectron III sensor board holds five image sensors which "read" the level of light passing through the optical system. When detecting the presence of light, the sensors will allow current to flow to the projectron interface board. Each sensor is factory preset to allow a maximum of either 8.5 or 9.0 volts, depending on your model contour projector. The Projectron III system is designed to operate over the full range of magnification lenses offered with our projectors (10x to 100x). This requires that the sensors work over an extremely wide range of illumination levels, which can exceed the receptive range of even the highest-quality photodetectors used by Projectron III. To compensate for this effect, specially designed filters and collimators are used with Projectron III systems to keep light levels within acceptable limits.

> **High light level warnings** are transmitted to the user as an **HL** appearing in the CLIP Plus X Y axis digital readout. Ignoring this warning can result in unaccurate measurements. Whenever you are using Projectron III, please consult the chart on page B-3 to select the proper combination of filters and collimator lenses to keep the illumination at acceptable levels.

Other conditions besides collimator lenses and filters can affect light level. These include collimation of the light source, age of illuminating lamps, and gain adjustments at the sensor board. These areas will all be covered at length in the maintenance section of this manual.

PART GEOMETRY CONSIDERATIONS

We suggest that edges being measured with Projectron III have a minimum viewing width of .250" on the screen. In addition, the minimum radius of curvature must be .125" as seen on the viewing screen. If a part image does not meet these standards, simply select a higher level of magnification.

Typically, the detected edge will be perpendicular to the axis of measurement. The commonly encountered exception, however, is in detecting points on the circumference of an arc or circle. Try to ensure that your readings are as close as possible to perpendicular to the axis of measurement. If this is not possible, try to maintain a minimum angle of 30 degrees between the axis of measurement and the edge.

WALL EFFECT

Wall effect is an optical phenomenon that occurs when inspecting thick, highly-polished parts with horizontal illumination. A gage block is a perfect example. The polished surface parallel to the axis of illumination acts as a mirror when struck by stray light. The optical system transmits the reflection of the stray light to the viewing screen in the form of an aura, or fuzzy edge. The fuzzy edge then appears as a badly focused second edge immediately adjacent to the actual edge. When using Projectron III, wall effect makes holes measure smaller than they actually are, and solid areas larger.

These amounts are actually quite small (typically .0001" to .0002") and Projectron III compensates for this by applying factory-set correction factors. You may encounter unusual parts, however, that due to substantial thickness and/or mirror finishes will require you to *modify* the existing correction factors. This operation is covered in the maintenance section of this manual.

Like many other well-designed products, Projectron III is far easier to *use* than it is to *explain*! Now that you know *about* Projectron III, it is time to put this knowledge to work. Go to the next page, put your hands on the keyboard, and some more hands-on experience!

HOW TO USE PROJECTRON III

This exercise will demonstrate how Projectron III finds an edge.

A. Turn on the main power and the horizontal illumination of your projector. If your projector has mercury arc illumination, allow *at least five minutes* warmup for the lamp to attain full brightness.

B. Stage a part of known length to the worktable and then move the worktable so that the screen centerlines are located about one-half inch on the screen from one edge of the part.

C. Press the projectron control button (the button inscribed with the speedlined E) and the Projectron III system will be enabled. *(Note: If your projector is fitted with the joystick motion control, you may also enable Projectron by pressing the button on the top of the stick.)* The indicator in the corner of the *E* button will glow solid red, which is the visual indication that the system is enabled.

D. Select a magnification and focus the image on the viewing screen. If the image appears too small, move to a higher magnification.

E. Refer to the **filter and collimator chart** and select the filter appropriate for the projector and magnification that you have selected.

   WARNING! If the **X** or **Y** display reads **HL**, the light source is too **H**igh **L**evel for the given magnification. If you are seeing **HL** now, ***STOP.*** Consult the **filter and collimator chart** on page B-3 before proceeding.

F. Zero the X and Y readouts. Now, press and release the motion control button (arrow key) to move the part towards, the screen centerlines. Remember to use the axis of measurement which is perpendicular to the edge being sought.

Projectron III will now keep the worktable in motion *until* the projected edge of the part crosses the viewing screen centerlines. Projectron III will then lock the X and Y readouts precisely at the point where the edge was detected, and all worktable motion will cease.

You will notice that the edge will slightly overshoot the viewing screen centerlines after the power motion is shut down. This is a perfectly normal situation caused by the inertia of the moving worktables. Measurement accuracy is in no way affected. To verify this, zero the X and Y readouts at this point and use the projectron to find the next edge. CLIP Plus will automatically originate this measurement from the actual edge even though the centerlines were not positioned there. Since you have measured a part of known length, simply compare the known length of the part to the value displayed in the CLIP Plus readout. They will be equal.

To escape from the Projectron III function, merely press the projectron control button (either panel or joystick mounted) and the projector will return to manual control.

The Projectron III system can be used with any of the measurement functions available with the CLIP Plus Vision Computer.

ADVANCED MEASUREMENT TECHNIQUES

CIRCLE FUNCTION

Now, perform a circle function using the projectron to locate the three required points.

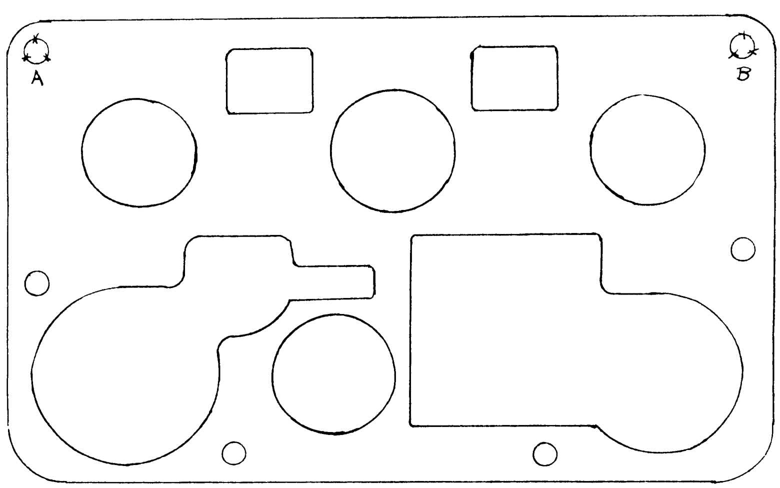
A. Move the worktable so that the centerlines are located near the edge of a hole. Enable the projectron and the circle function. The indicator light on the projectron and ***Circle*** buttons will glow solid red, and the ***Enter*** button will begin to flash.

B. Move the worktable with either the manual or arrow controls so that the edge of the hole crosses the screen centerlines. Once the edge crosses the centerlines, the digital readouts will lock up as before.

C. Press the ***Enter*** button and Projectron III is now ready to find the next edge. Continue this "***E***, find and enter" until all three points have been entered. Be sure that these points are as far apart as possible on the circumference.

After the third point has been entered, the projectron indicator light will extinguish, and the X and Y displays will indicate the radius and diameter of the circle. The LED on the ***circle*** key will begin to flash. Press it, and you will have the coordinates of the *centerpoint.* Press the ***circle*** key again, and you will be out of the circle function. The LED on the ***circle*** key will go out, and the X and Y displays will give you the coordinates of the *current stage position.*

If you have not done anything to CLIP Plus since the last lesson, the coordinates of the centerpoint and the current stage position will be in terms of the axis you aligned during the previous session. Otherwise, these locations will be in terms of machine coordinates — the arbitrary X axis, Y axis, and origin CLIP Plus takes for granted unless you tell it otherwise. If you wish to align your axis using the projectron, simple follow the steps above to measure the holes labeled **A** and **B** below. When you have the coordinates of the centerpoint of circle **A**, press the ***Zero Set*** buttons. When you have the coordinates of the centerpoint of circle **B**, press the ***Axis Align*** button.



ANGLE FUNCTION

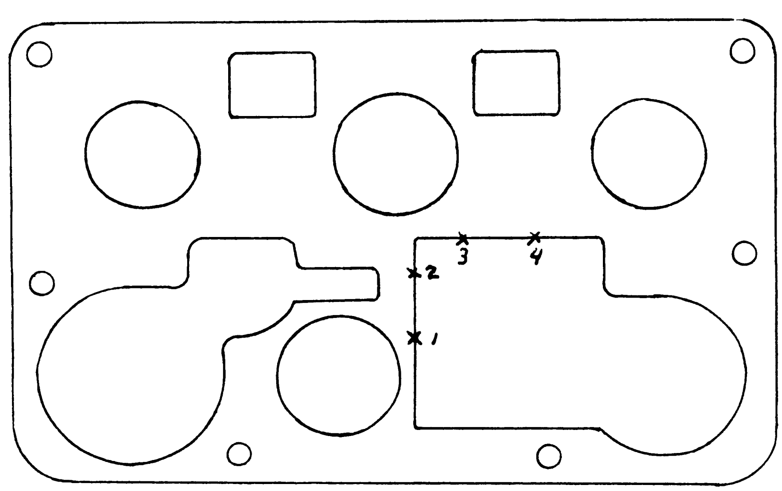
The ***Angle*** function with Projectron III is performed the same as the ***Circle*** function. The only difference is that *four* rather than *three* reference points must be entered. Since you may have a projector fitted with joystick control, we'll work this exercise with the joystick, rather than with the projectron and enter buttons.

A. Move the part so that the centerlines are near one corner. Enable the projectron by pressing the joystick button, and then press the angle button. The indicator light on the projectron and ***Angle*** buttons will glow solid red, and the ***Enter*** button will begin to flash.

B. Press the projectron button, and move the worktable so that the edge of the part crosses the screen centerlines (Ref. 1). Once the edge crosses the centerlines the digital readouts will lock up. Press the joystick button to input these coordinates to the CLIP Plus Vision Computer. In the circle exercise, we used the ***Enter*** button to do this.

C. Press the projectron button again, and move the worktable to locate another point (Ref. 2) and when the projectron locks the readouts, press the joystick button again. You have now entered two sets of X and Y coordinates from one leg of the angle. Notice that the ***Enter*** button is still flashing. This is a visual reminder to you that two more sets of (X,Y) coordinates must be taken on the other leg of the angle before the angle function is completed.

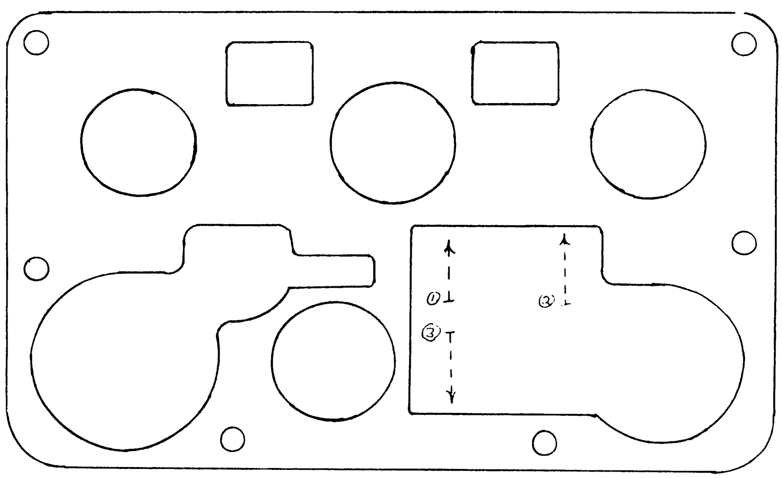
*Note: When the **Enter** button is flashing, the button on the joystick functions only as an alternate **Enter** key. You need to press the projectron **E** button to arm it between points.*



D. Find two points (Refs. 3 & 4) on the other leg of the angle and, as before, enter these coordinates with the joystick button. The angle function is completed and the included and supplementary angles of the corner will be displayed in the X and Y readouts respectively. Should you wish the (X/Y) coordinates of the vertex, simply press the ***Angle*** button and they will be displayed in the readouts.

LINE AND WIDTH

Approach the edges from the perpendicular direction. The illustration below suggests approaches to measure the width of the shape in the lower right of the workpiece using a three-point width function. Each point is found using Projectron.



If you have Projectron III and a joystick control, you now know several reasons for gratitude. By using Projectron III to automatically find edges, you eliminate the inaccuracy of manual positioning. The joystick control eliminates the inconvenience of moving your hand back and forth from the adjustment knobs to the keyboard.

Keypad Theory

USING THE NUMERIC KEYPAD

By now the landmarks on the sample workpiece should be familiar. You have spent a great deal of time examining the item directly.

Normally, though, you will first meet the workpiece in blueprint form. Since we can't go against the normal job flow forever, we will now consider the *blueprint* of the part you have been examining. You have had the pleasure of using CLIP Plus to examine the workpiece, and pull numbers from it. Now, we will reverse the process. We will read the numbers from the blueprint, and use them to examine the workpiece.

This means that you will use the numbers on the blueprint to tell CLIP Plus where the various features are.

DRIVING THE WORKTABLE BY THE NUMBERS

You probably are wondering why you have an ***X*** key, a ***Y*** key, and a numeric keypad. One reason is speed. If the workpiece is aligned, and you know the coordinates of a desired worktable position, you can enter these coordinates from the keyboard, then tell the CLIP Plus Vision Computer to find the spot.

A. Press the ***X*** button.
B. Enter the desired X coordinates, using the numeric keypad.
C. Press the ***Y*** button.
D. Enter the desired Y coordinates, using the numeric keypad.
E. Press the ***Go to*** key – and stand back! The CLIP Plus servo motors will drive the worktable to its assigned destination with greater speed and precision than you could hope to match.

Projectron III can also be programmed from the keyboard, so that CLIP Plus will seek and find the edge *nearest* the destination, when the edge is not exactly where expected. We will cover this aspect in detail — later.

When you know a series of X-Y positions (for example, if you are reading them off a blueprint!) you can key these in ahead of time. Then, when you press the ***Go to*** key, the worktable will go to the first position specified. Press it again, and it will go to the next one. It can do this as many as 99 times in a row!

Sound good? Let's go one better. See the ***Auto Go*** key? Press it, and the machine runs itself, automatically going from one requested location to the next, until the entire sequence is completed. At each stop, CLIP Plus will pause to allow you to set to the real (as opposed to the nominal) position, or to make some other judgment. The length of this pause is adjustable. (see Appendix page H-17).

(If you wish to stop the worktable motion, press the ***Clear/STOP*** key.)

When you key in a sequence of positions, you are …

PROGRAMMING CLIP PLUS

This is easier than it sounds!

A. Press the ***X*** button.
B. Enter the desired X coordinates, using the numeric keypad.
C. Press the ***Y*** button.
D. Enter the desired Y coordinates, using the numeric keypad.
E. Press the ***Store*** key.
F. Repeat, for next location.

This process continues until you have "programmed" all of the locations you wish to store in the CLIP Plus memory.

If you look at the "block counter," the two-character LED at the lower left side of the numeric keypad, you will see it move from ***01*** through ***99***, as you add one worktable position after another. This enables you to keep track of where you are.

CORRECTING A PROGRAM

If you should later discover than one of the positions needed to be corrected, you can "recall" the X and Y coordinates for that position by following these steps:

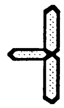
A. Go to the correct block. You can use the numeric keypad to enter the block number of the position that needs correcting. (If the target block is less than 10, enter a zero first — 02, 07, etc.) Or, you can use the *minus* (-) key on the keypad to back up one block at a time. Conversely, the *decimal point* (.) key will take you forward one block at a time.

B. Press the ***Recall*** button TWICE, to retrieve (Recall) the information stored at that block.

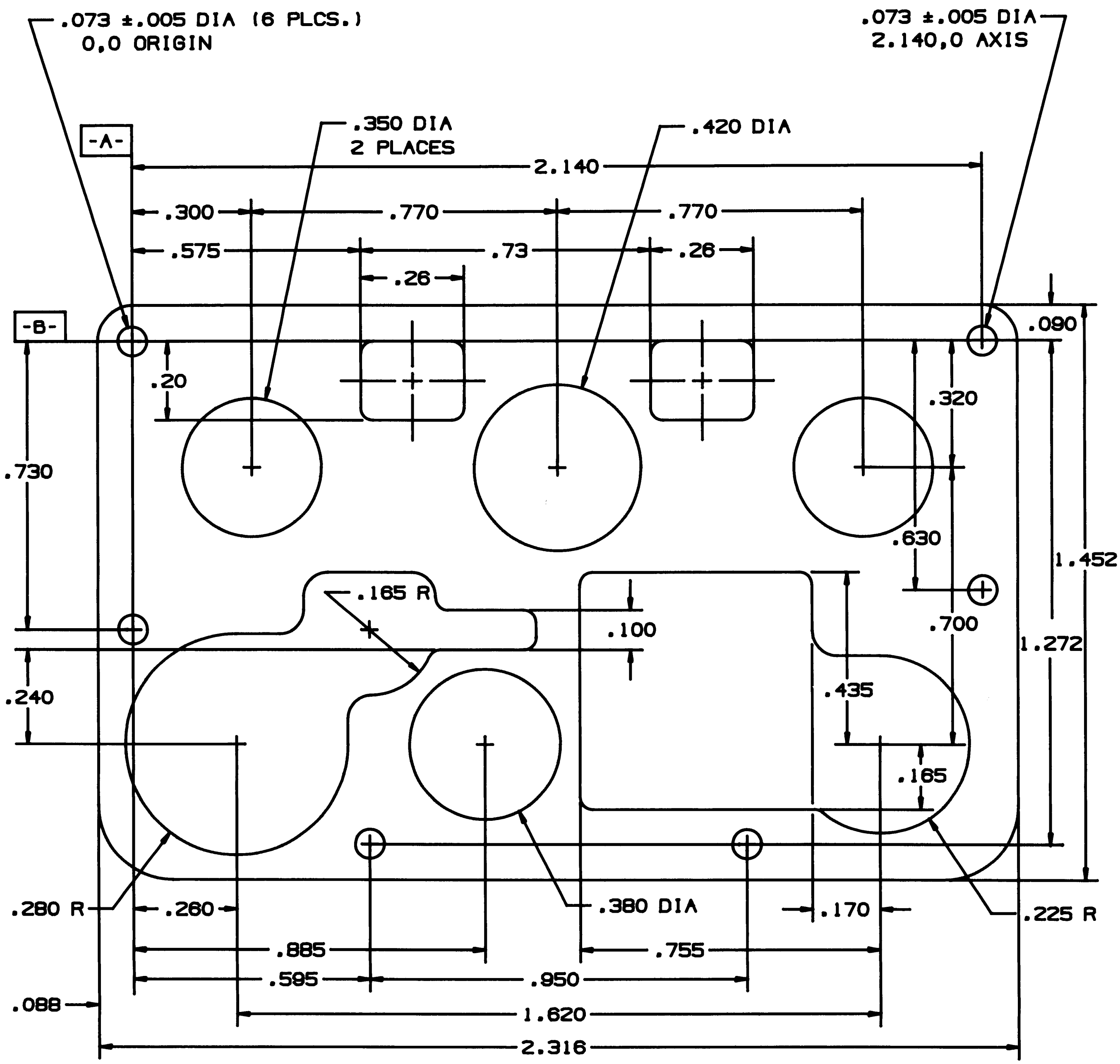
C. Correct it, by re-entering the X, the Y, or both coordinates if need be, and pressing the ***Store*** key again. This will store the desired value in that block.

D. Press the ***Recall*** button one more time, to return to normal operating mode.

*(A note for the curious: yes, there is a reason for pressing the **Recall** button twice. And, you will discover the reason in a later lesson. Meanwhile, just trust us, and follow directions!)*

The values entered from the keypad can be as large as a positive or negative 19.9999 inches, if your CLIP Plus is operating in the "Inch" mode. If it has been set, using one of the internal switches, to the "High Resolution Inch" mode, the values entered can be as large as a positive or negative 19.99999. You gain one more decimal point of precision, but lose room for the - (negative) sign. The solution we have adopted is to run the 1 and the – *together* in this mode, when necessary. The result is a curious hybrid character like this: 

In your next session at the keyboard, you will enter a series of coordinates to define several features on the sample part you've grown to know so well. You may wish to compare the numbers entered to the dimension listed on the schematic and try to guess which items we are looking at.



PROGRAMMING PRACTICE

When programming CLIP Plus, you do not need to worry about the ***Axis Align*** function. That task can wait until you are ready to inspect the workpiece.

A word of explanation is called for before we begin pushing numbers into CLIP Plus. What we will be entering will be the coordinates of a sequence of points. CLIP Plus does not go looking for shapes, but only for isolated points. We can impose an interpretation upon a set of points, but that is a separate operation. That is to say, we cannot tell CLIP Plus to find a circle, or where a circle should be. We can tell CLIP Plus to remember four locations — the three points which define the circle, and the computed center. But, there are limits to this technique, which we will consider in more detail later. Now, to the work:

To be sure you are starting at the beginning, set the block counter to ***01***, using either the ***01*** sequence of keystrokes, or pressing the – (minus) key on the keypad to climb back down the memory ladder.

HOW TO SPECIFY A CIRCLE

A. Press the *X* key. The *X* LED display will go blank. Use the numeric keypad to type in the number *.884*

B. Press the *Y* key. The *Y* display will now blank out. Use the numeric keypad to type in the number *-.225*. Press the ***Store*** key.

The block counter still reads ***01***, since you have just stored your first set of coordinates, but have not yet pressed another key.

C. Press the *X* key. (the block counter will now jump to ***02***.) Use the numeric keypad to type in the number *1.252*.

D. Press the *Y* key. Use the numeric keypad to type in the number *-.225*. Press the ***Store*** key.

You will see the block counter increase to ***03*** with the first keystroke after you press the ***Store*** key — unless, of course, that keystroke is a *number,* a –, *clear,* or a *period.*

F. Press the *X* key. Use the numeric keypad to type in the number *1.07*.

G. Press the *Y* key. Use the numeric keypad to type in the number *-.53*. Press the ***Store*** key.

Pause now, and turn these three stored points into a circle.

A. Reset the block counter to ***01***.

B. Press the ***Circle*** key.

C. Press the ***Recall*** key twice, so that its LED is glowing steadily. You will now be presented with the number that you just placed in memory.

D. The ***Enter*** key is flashing, demanding to be fed a number. Press it, and it will accept the coordinates displayed — the ones you just called up from memory.

E. The block counter will go up to ***02***, the ***Enter*** key will continue flashing, and the contents of the display will change, since you are now peeking into a different memory location. Press the ***Enter*** key again, to supply the second point needed.

F. The block counter will go up to ***03***. Press the ***Enter*** key one more time, and it will go out. The block counter will still read ***03***. The display will show you the radius and diameter of the circle. If you have followed directions, you will have a radius of .208, and a diameter of .416. The ***Circle*** key will now be flashing.

G. Press the ***Circle*** key again, and the indicator light on it will glow steadily. The display will show you the coordinates of the centerpoint : X = 01.0680, and Y = –00.3220.

H. Press the period (.) key, to move the block counter up to block ***04***. Press the ***Store*** button, and you will have the coordinates of the centerpoint on record.

If you are curious, you may try to locate this circle on the blueprint.

(Note: You can store the centerpoint, but not the radius and diameter. The centerpoint is a set of coordinates, the only numbers the Go To command can cope with. This holds true for every function which produces a computed value on the first poke of the flashing key, and a set of coordinates on the second poke, of the steadily glowing key. You cannot store shapes, only the coordinates of the points used to define them, and/or the coordinates of the point defined by them.)

HOW TO SPECIFY A WIDTH

A. Set the block counter to ***05***.

B. Press the X key. Use the numeric keypad to type in the number .6.

C. Press the Y key. Since the Y value is zero, you could use the numeric keypad to type in the number .000, and press the ***Store*** key. It is faster to omit the keypad, and simply type ***Y***, ***Store***. This literally specifies nothing, or *zero*, as the Y value at this X location.

D. Press the ***X*** key. Use the numeric keypad to type in the number *.8*.

E. Press the ***Y*** and the ***Store*** keys.

F. Press the ***X*** key. Use the numeric keypad to type in the number *.8*.

G. Press the ***Y*** key. Use the numeric keypad to type in the number -*.2*. Press the ***Store*** key.

Set the block counter back to ***05***, and invoke the ***Width*** function. Enter ***Recall***ed values, as you did for the Circle. You will now see the computed width (00.2000), and the angle these lines form relative to the major axis (000.00). (Since CLIP Plus *assumes* that the lines which define the width are parallel, it also assumes that both lines are rotated the same amount from the major axis.) It makes no difference to CLIP Plus where the numbers amount from the major axis.) It makes no difference to CLIP Plus where the numbers come from — its own sensors in the now, its memory of past input, or your say-so. It will use whatever it is given to complete the assigned task. Set the block counter to ***08***, and ***Store*** the computed coordinates of the centerpoint (X=.8000, Y = -00.1000).

HOW TO SPECIFY A VERTEX

Now that you have gained experience at the art of placing coordinates into the memory of CLIP Plus, we will omit most of the words, and simply list the numbers for the next exercises. The procedure, as you recall, is:

A. Set the block counter.
B. Press the X key.
C. Type the X coordinate.
D. Press the Y key.
E. Type the Y coordinate.
F. Press the ***Store*** key.
G. Reset the block counter, and run a (interpretive) program, if so desired, on recalled values. Set the block counter, store the computed results, set the block counter, continue.

Now, enter the following values:

X	Y	Block
1.125	-.621	09
1.125	-1.0	10
1.2	-.585	11
1.64	-.585	12
Coordinates of vertex		13
(1.1250)	(-00.585)	

HOW TO SPECIFY A LINE

We will now tell CLIP Plus about a line. Enter the following values:

X	Y	Block
.3	-.32	14
1.840	-.32	15
Coordinates of midpoint		16
(1.0700)	(-00.3200)	

You have two sets of coordinates salted away for future reference. To turn them into a line, select the ***Line*** option, and ***Recall*** blocks ***14*** and ***15***. CLIP Plus will now display the angle of the line relative to the major axis, the "datum." Press the ***Line*** key again, for the coordinates of the midpoint of the line. Set the block counter to ***16*** and ***Store*** that too.

This session is repeated in table form below. You will have the opportunity to fill in the blanks later. We are also including a blank version of this form in the appendix, for you to copy and use in your own work.

DON'T TOUCH THAT ***Go To!*** Unless you've aligned the part, CLIP Plus has no idea where it is or, for that matter, where you want it to go TO! Instead, go to the blueprint, and see if you can pick out the features you have described. Or, go to the next lesson, for another serving of information.

Feature	**Coordinates (Program)**		**Block #**	**Coordinates (Data)**		**Block #**	**Deviation**
	X	**Y**		**X**	**Y**		
Circle	.884	-.225	01			01	
	1.252	-.225	02			02	
	1.07	-.53	03			03	
	Centerpoint		04			04	
	(1.068)	(-.322)					
Width	.6	0	05			05	
	.8	0	06			06	
	.8	-.2	07			07	
	Centerpoint		08			08	
	(.80)	(-.10)					
Vertex	1.125	-.621	09			09	
	1.125	-1.0	10			10	
	1.2	-.585	11			11	
	1.64	-.585	12			12	
	Centerpoint		13			13	
	(1.125)	(-.585)					
Line	.3	-.32	14			14	
	1.84	-.32	15			15	
	Centerpoint		16			16	
	(1.070)	(-.320)					

Running a CLIP Plus Program

PROGRAM AND DATA MEMORIES

Congratulations. You have just finished *programming* CLIP Plus. Be assured, though, that you have not programmed yourself out of a job! You have simply learned to automate some of its more tedious aspects. Let's talk a little more about what you've done.

By storing coordinates in the last exercise, you created a *template*, an ideal picture of the part as it should be. You can now use the stored image as a standard to compare actual parts to. With a basis of comparison embedded in CLIP Plus's memory, you can detect with precision how far reality varies from the ideal.

You have noticed, by now, that the keyboard has several memory-related keys. In addition to the ***Recall*** key, you have used the ***Enter*** key, and the ***Store*** key. Yes, you need them both. You are dealing, you see, with *two — different — memories!* One, which we refer to as the "Program" memory, contains the standard or reference description of the part to be inspected. The other, the "data" memory, is used for comparisons *to* this standard. The two memories have different functions, and even different physical characteristics. The "data" memory is transient. Turn off CLIP Plus, and the information stored there evaporates. In contrast, the "program" memory is "non-volatile." This means if you enter a set of coordinates today, using the ***Store*** key, that program, that template, will still be there tomorrow. Even if the power fails. It will stay until thrown out. It will not leave on its own.

As a rule, the "data" memory imitates, and tags along with the "program" memory. The ***Store*** key, for example, places the same coordinates and information into both the "program" memory and the "data" memory. In contrast to this, the ***Enter*** key "enters" coordinates into the "data" memory alone. Putting information into one or both memories is fairly easy. But how do you get it out?

With the ***Recall*** key, of course! This is another "two for one" proposition. To select a block in both the program memory and the data memory, simply enter the number of the block desired, then press ***Recall.*** The ***Recall*** indicator light will begin to flash, and the X and Y displays will show you the contents of "data" memory at that block. To see what is in the "program" memory, press the ***Recall*** key again. The LED on the key will glow steadily, and you may see a *new* set of numbers in the X and Y displays, spelling out the contents of the "program" memory. Press the ***Recall*** key one more time, and the indicator LED on it will go out, and your X and Y displays will indicate the *current table position.*

When you are at the desired block, you can enter any numbers you please *after* pressing the X and/or the Y keys. ***Store*** will put them into both memories, ***Enter*** into only the "data" memory. (Unless you press the X or Y keys *first,* you change the block counter, not the display.)

Once you have entered a program, you can also use ***Recall*** to check your numbers. You can step through the entire sequence with the . (period) and – (minus) keys. If the ***Recall*** LED is flashing, you will see the coordinates stored in the data memory. If the ***Recall***

LED is glowing steadily, you will see the contents of the program memory. While you are "in the recall mode," the X and Y displays will reflect the contents of the memories, NOT the position of the work table. Furthermore, as you change numbers in these memories, the worktable will not move.

To start a program running, you will have to tell the CLIP Plus Vision Computer where to start. You can use the numeric keypad to call the computer's attention to block ***01***. Another method for moving from block to block a step at a time is with the period (.) and minus (–) keys on the numeric keypad. The period will increment the block counter one position, and the minus will take you back a step. You can set the block counter to the desired position, then use either the ***Auto Go*** or the ***Go To*** key to launch the inspection from that point.

One obvious place where two memories are better than one is in the ***Distance Back*** mode. The ***Go To*** key will move the workpiece to the place where a feature should be, according to the "program" memory. You then move the crosshairs to where the feature actually is, and press the ***Enter*** key, to lodge it in the "data" memory. The CLIP Plus now has two points on record to compare, and, when you press the ***Dist(ance) Back*** key it will gladly announce any discrepancies.

Another, more sophisticated form of cooperation between the two memories actually permits you to compare invisible features! Did you ever, for example, *see* the center point of a hole? How about a *shape* made up of such center points? Well, you just programmed CLIP Plus to look for such a thing! In the last exercise of the last set, you entered the two coordinates defining a *line*. What you did not know at the time was that the points you entered were for the centers of two circles! The information you entered came from the blueprint for the workpiece. When you "run" the part, you will need to use the ***Circle*** key to find where the centers are on the workpiece. Then, select the indicated block, and press the ***Enter*** key to place each center point in that block in the memory.

(Using the ***Dist(ance) Back*** key to compare the contents of the two memories is the topic of a later lesson. This is true "multi-point" inspection. It can be done with CLIP Plus.)

Now that you know how the two memories work together, you can go to the next practice section, and align the part. Use the numeric keypad to set the block counter back to ***01***. Press the ***Auto Go*** key, and CLIP Plus will begin to drive the worktable to preset locations. At each point, follow the directions to inspect the feature. To keep a running tally of how faithful the part is to the blueprint, write the numbers down or if you have a printer attached, press the ***Print*** key after each transaction. (In the ***Auto Go*** mode, all points are automatically printed out.)

CLIP Plus is programmed to pause briefly after attaining each position. This should give you enough time to take the nearest data point. If you do not like to have the computer set the pace, though, you can simply step through the sequence at your leisure with the***Go To*** key. You can adjust the ***Auto Go*** dwell with parameter 26. See page H-17.

Note: If the ***Auto Go*** *sequence stops by itself, CLIP Plus has either run to the end of memory, or the worktable has been driven to a limit switch.*

ERASING A PROGRAM

One last memory-related operation you need to be aware of is the use of the ***Clear Mem.*** key. Again, this is a dual-purpose feature. On the one hand, if you wish to inspect *different* parts from the *same* run, you will only need to clear the "data" memory after each inspection, so that the next part you examine will once again be compared against the same stored standard.

On the other hand, you will occasionally need to inspect a different *kind* of part. In that case, you will need to erase the CLIP Plus *program* memory, so that you can re-program it. And, here is how to do it:

A. Press the ***Clear Mem*** key. The light on it will begin to blink.
B. If you are *sure* you want to continue, press the ***Clear Mem*** key again. The light on it will now light steadily.
C. Make a decision:

> **To bail out now** — press the ***Clear Mem*** or ***Clear*** key again.
> **To erase only the data memory** — press the ***Enter*** key.
> **To erase the PROGRAM and data memories** — press the ***Store*** key.

When you have completed these steps, erasing will begin at the current block location, and continue from there to the last block. If you want a clean slate, you will need to set the block counter to **01** first. As usual, whatever you do to the *program* memory is echoed in the *data* memory.

Be forewarned, and be careful. It is possible to erase a lot of work in microseconds!

AUTOMATED INSPECTION

The ***Axis Align*** process has not yet been automated. If you have not done so already, you will need to *align* the part yourself before running the CLIP Plus program. Use the two tiny reference holes on the top of the sample work piece.

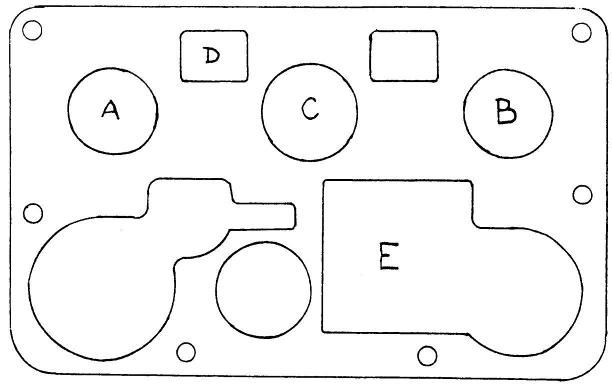
A. Measure the hole on the top left. Use the ***Circle*** function, and enter three points. The radius and diameter of the circle will be displayed in the **X** and **Y** position readouts, and the ***Circle*** button will flash.

B. Press the ***Circle*** button again. You will now see useless numbers displayed in the **X** and **Y** position readouts. These coordinates are meaningless, since the part has not yet been aligned. They refer back to an arbitrary location in the worktable's range of motion, which CLIP Plus will call (0,0) until told otherwise. Press the two ***Zero Set*** buttons, to inform CLIP Plus in no uncertain terms that *this* position on the route of the traveling work table is *to be regarded as* the origin, (0,0), the point from which all numbering must commence! Press the ***Circle*** button again.

C. Measure the hole at the top right corner, in the same way. This time, when you bring up the **X** and **Y** coordinates, press the ***Axis Align*** key, and watch the **Y** display go to zero. The **X** display now will tell you how far apart the centers of the two holes are. It should be about 2.140 inches. Set the block counter to **01**, so that you can start at the beginning. You are now ready to run the CLIP Plus program you entered.

INSPECTING A CIRCLE

The first feature you will examine is the circle labeled **C** in the diagram below.



A. Press the ***Circle*** key. The ***Enter*** key will begin to flash. Enter the required three points. The block counter stays in place, this time.

B. The ***Circle*** key will now begin to flash, and the readouts will display the radius and diameter of the circle.

C. Press the ***Circle*** key again, to get the X and Y coordinates of the centerpoint. Set the block counter to ***04***, and press the ***Enter*** key. This places the coordinates of the center into the "data" memory at the same address as the center you stored in the "program" memory.

Now that we have corresponding values tucked away in memory, we will be able to make comparisons.

You can compare the size of the circle by *indirect* means, using the ***Print*** feature. If, for example, you pressed the ***Print*** key after obtaining the radius and diameter of the circle on the master part, you could press the ***Print*** key again when running the workpiece. You could compare the two hard (paper) copies, to see if these values are correct.

INSPECTING A WIDTH

The width we will be looking at is feature **D** in the illustration above. By now, the process should be familiar.

A. Press the ***Width*** key.

B. Enter three points — two on the first side, the last on the second side.

C. Press the flashing ***Width*** button, to find out what the measured values are for the angle and midpoint.

D. Press the ***Width*** button again, to secure the coordinates of the midpoint. Press the ***Enter*** key to file it away for future reference.

INSPECTING A VERTEX (ANGLE)

The angle we will study is the upper left corner of feature **E**. Press the ***Vertex*** button, and take your first two points on the left side of this cutout, your last two on the top side. Press the ***Vertex*** key again, and get the X and Y coordinates for the intersection point. And once more, the ***Enter*** key to provide raw material for comparisons.

COMPARING A LINE

So far, there has been a very nice one-to-one correspondence between the points we entered in the last lesson, and the ones we actually took in this lesson. Now, lest you become too comfortable, we will throw you a curve.

As you recall, in the last lesson the last feature we programmed CLIP Plus to look for was a line. We stored the coordinates for each of the two points required, then stored the resulting computed values. Three blocks in memory, right? But wait! The line joins the centers of two circles! To be specific, the two circles labeled **A** and **B** in the illustration.

We will need to measure these circles, find the centers, then place the values into "data" memory at the proper block locations. It is necessary to remember the block numbers where we ***store***d the values we will want to compare. Run the inspection. Then when the computed results are presented, *re-set* the block counter when need be, to enter them into the same "data" memory at the right blocks.

We will not, for the purposes of this exercise, concern ourselves unduly with the size of the circles. The length of the line should give us ample indication as to how precisely the circles are *placed.* But, before we confuse the machine by asking it about the line, we need to dig out the points it will need to define the line. We will begin by measuring the circle on the left, **A**.

A. Press the ***Circle*** key. The ***Enter*** key will begin to flash. Enter the required three points. The ***Circle*** key will now begin to flash, and the readouts will display the radius and diameter of the circle. Ignore this information. Press the ***Circle*** key again, to get the information we are *really* after, the X and Y coordinates of the centerpoint.

B. Set the block counter to ***14***, since the numbers we have just extracted must be compared to the numbers we stored in block ***14*** in the last lesson.

C. Press the ***Enter*** key, to place the coordinates just measured into block ***14*** of the "data" memory. Press the ***Dist***ance ***Back*** key to see how well you've done.

D. Repeat the whole process, for the circle on the right, **B**. This time, place the coordinates for the centerpoint in block ***15.***

E. Press the ***Line*** key. CLIP Plus will now expect two points. Press ***14 Recall***, and the ***Enter*** key. That extracts one point for CLIP Plus's consideration, the coordinates for the center of circle **A**. The block counter should automatically increment to ***15***, and the display will show you what is stored in the "data" memory at that spot. Press the ***Enter*** key to snag that value. That's the other point, the center of circle **B**.

F. Set the block counter to ***16***. Press the ***Enter*** key, to save the midpoint of the line. Press the ***Dist*ance *Back*** key to compare what you expected to what you have.

One final observation: Be thankful that we did not use for an example the angle formed by the centerpoints of the four major circles on the workpiece! It can be done. It is not easy.

PANTOGRAPH PROGRAMMING

It is possible that you will need to program the CLIP Plus Vision Computer to inspect workpieces that do not exist yet; parts that are only a gleam in an engineer's eye, or lines and numbers on a blueprint. You have learned how to do this already, by using the numeric keypad. This is a handy skill to have because it permits you to wring the maximum precision from CLIP Plus.

This is also the hard way of doing things. Had we told you before now of the pantograph alternative, you may never have bothered learning to program with the keypad! Be assured, though, that you now possess skills comfortably in excess of everyday requirements, and equal to extraordinary demands.

The "Pantograph" alternative can be used whenever you have a prototype, a physical unit, to follow. When this is the case, you simply *measure* the item *directly*, ***Store*** the results, and use the ***Store***d image as the reference. Let's walk through that again:

A. Clamp the prototype into the work table.
B. Align the workpiece.
C. Measure a point or feature.
D. Press the ***Store*** key.
E. Repeat steps C and D until you have taken an appropriate number of measurements.

When, for example, you are measuring a circle, you can ***Store*** the coordinates of the points you take and the center *directly* from the model part. Then, when running subsequent parts, you can extract the same data from the equivalent circle, and use the ***Dist***ance ***Back*** key to see how the two compare.

If you have the Projectron III option, you can use it in conjunction with the ***Auto Go*** feature to further automate the inspection process. You will, in fact, have a robot on your hands — a device which can *seek, find*, and *act* on what it finds. Of course, someone will need to tell CLIP Plus *how* to seek. This extra power does require an extra step, the "programmed seek."

Projectron III cannot be programmed to "look around." It can only "seek" in one axis. And, you need to tell it *which* axis to seek in. This means that, if you are using the "pantograph" approach, you would need to do the following:

A. Using the joystick or other motion controls, place the crosshairs *near* the edge you wish CLIP Plus to look for.
B. Arm the projectron.
C. Press the appropriate *arrow* key.
D. Press the ***Store*** key.

When you press the arrow key, you send the projectron a-hunting in the specified direction. You *also* establish the seek direction — the one true path. Projectron III will remember that, *as well as* the found edge. In the future, when inspecting parts CLIP Plus has been thus programmed for, Projectron III will expect to find the edge in the same place, give or take a preset amount. It will ignore any edges between where it is, and the neighborhood you have programmed it to seek in.

PROJECTRON PROGRAMMING

If you do not have the part in front of you, you can still use the numeric keypad to spell out the projectron seek axis and direction. Use a copy of the blueprint to map out a route which will take you through the most important features of the work piece. Pencil on that blueprint the block number and block type required to save the coordinates for each point on the route. Then, to program each "seek block":

A. Specify the *non*-seek axis first, by pressing either the X or Y key, then the value assigned to this coordinate for the seek.

B. Specify the *seek* axis next, by using the other axis key (Y or X), then enter the approximate value of the coordinate sought.

C. Press the projectron (***E)*** key.

D. Press the ***Store*** key.

E. Press the ***Go To*** key.

When CLIP Plus is running in the ***Auto Go*** mode, each point the projectron is programmed to find is automatically saved to the data memory. This means that, *if* you made *every* move a seek, your data memory blocks would all fill themselves in the course of the inspection run. You could clamp in the test part, align it, set the block counter to **01**, press ***Auto Go***, and sit back.

Of course, there is a price to pay for this leisure. This would rule out the ***circle line***, ***vertex***, and ***width*** programs, and give you only isolated and unconnected points to evaluate. Since the computed values are more useful points of comparison, you will probably want to reserve blocks of memory for them.

A. Using your blueprint, secure the coordinates for each point which you will need to compute.

B. ***Store*** each of these critical coordinates in the appropriate block as a plain vanilla ***Go To***, instead of as a projectron seek.

C. Note carefully the number of the block you ***Store*** each set of coordinates in. Pencil all of the block numbers onto the blueprint you are using.

When you run the program, the cross hairs will center on the non-seek target point, pause, then go on to the next point. Since you haven't asked CLIP Plus to look for anything, it will not find or ***Enter*** anything.

Now, *after* you have examined each part in the mode, you will have information stored in the data memory of each block. You would then fill in the blanks, and place the proper values in the data memory of the non-seek blocks. If, for example, the non-sought feature was the centerpoint of a circle, you would:

A. Reset the block counter to the *first* point taken to define the circle.

B. Press the ***Circle*** key.

C. Press the ***Recall*** key once, so that its LED is blinking. You will now be presented with the coordinates the projectron sought and found.

D. The ***Enter*** key is flashing, demanding to be fed a number. Press it, and it will accept the coordinates displayed — the ones you just called up from memory.

E. The block counter will increment, the ***Enter*** key will continue flashing, and the contents of the display will change, since you are now peeking into a different memory location. Press the ***Enter*** key again, to supply the second point needed.

F. The block counter will advance once more. Press the ***Enter*** key one more time, and its LED will go out. The block counter will still be the same. The display will show you the radius and diameter of the circle. The ***Circle*** key will be flashing, now.

G. Press the ***Circle*** key again, and the indicator light on it will glow steadily. The display will show you the coordinates of the centerpoint.

H. Press the period (.) key, to move the block counter up *one more block*. Press the ***Enter*** button, and you will have the coordinates of the centerpoint in the data memory, ready for comparisons.

When you step through the program with the ***Recall*** feature, you will see something interesting happen. Each non-seek block you call up (computed value, such as centerpoint of circle) will appear in the X and Y displays, as usual. When you reach a "seek block," however, the key for the sought axis will light up, as will the projectron key.

We have covered the details of placing reference values in the *program* memory, and of capturing testable measurements in the *data* memory. The only thing we need to look at now is the mechanics of comparing the one to the other; the real to the ideal; the standard to the actual product.

DISTANCE BACK KEY

The "deviation" keys (***Dist. Back*** and ***Polar Back***) will give you the difference in position between:

- the coordinates stored in the current block, and
- the coordinates on display.

Sound simple? That would never do! Let's elaborate. The "current block" has, you recall, *two* memories occupying the same address! The "program" memory, and the "data" memory. But, despair not. As you recall, pressing the ***Recall*** key once makes its LED begin to blink, and accesses the data memory. Pressing it again makes it glow steadily, and reaches a little deeper, into the program memory. The LEDs on the deviation keys work the same way:

◦ *one poke* — makes the *data* memory at the indicated block one part of the comparison, and causes the LED to blink.

◦ *another poke* — makes the *program* memory at the indicated block the value compared to, and makes the LED glow steadily.

◦ *a third poke* — and you are out of the "deviation" mode.

A very simple example will demonstrate how this works.

A. Position the screen centerlines at the origin, so that the displays are all zeroes.

B. Set the block counter to ***01***.

C. Press the ***Dist. Back*** key once.

D. Step through the blocks by pressing the period and minus keys. The numbers should look familiar, but reversed — negative numbers are positive, and positive, negative.

Puzzled? Remember, you set the display to show the origin. The blocks, however, contain a sequence of coordinates at various distances away from the origin. The ***Dist. Back*** key now provides you with the distance back *from* the contents of the block *to* the coordinates displayed at first — in this case, (0,0).

Move the worktable so that one axis remains zero, and the other, a nice round number — (0,.5) for example. Repeat this exercise, and observe the consistent displacement of the numbers. Press the ***Dist. Back*** key twice, and you can compare the value displayed at the beginning to those in the "program" memory blocks.

You could also measure a feature, such as a circle, get the coordinates of the centerpoint "on display," then compare *that* point to those in memory by using one of the deviation keys.

Let's repeat:

A. Get a number on display.

B. Press the deviation key, to determine how far that number deviates from the contents of the memory of choice in the block of choice.

Get a number on display. That's the starting point. So far, so good. Clear enough? Then, let's elaborate! The "number on display" can show you the position of the worktable. The "number on display" can *just* as easily show you the contents of the "data" or "program" memory.

Your *starting point* can be a set of coordinates ***Recalle***d from either a data, or a program memory.

Review the last A and B instructions. Get a number, compare the number. So, let's get a number.

A. Press the ***Recall*** key *once.*

B. Select one of the blocks you have already programmed.

C. Press the ***Dist. Back*** key *once.* The display will now go to zeros.

Why? Look at the keypad. The LEDs on both the ***Dist. Back*** key and the ***Recall*** key are blinking. This means that *both* features are reaching into the "data" memory at the same block, and the difference between a thing and itself is zero.

D. Use the period and minus keys to move the block counter. You will now see how far the other locations stored in the data memory blocks are from the location you called up to be the starting point.

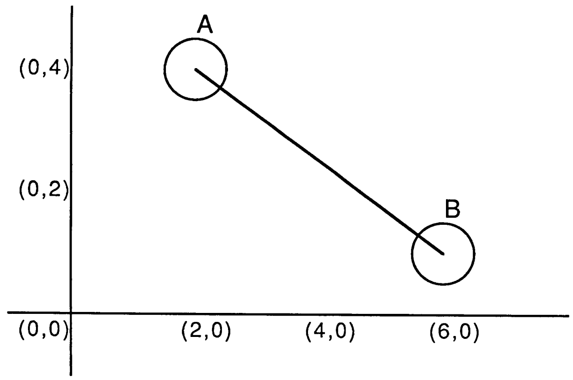
E. Return to the block you started with. Press the ***Dist. Back*** key again. It will now reach into the *program* memory at that location, and tell you how far it varies from the value you started with — the coordinates ***Recall***ed from the *data* memory at that block.

You can start with any set of coordinates from any source:

- Coordinates of a worktable position,
- Coordinates of a computed value,
- Recalled coordinates from *data* memory, and
- Recalled coordinates from *program* memory.

And, you can compare your starting point to either memory in any block. In rectangular (Cartesian) coordinates, using the ***Dist. Back*** key, or in Polar coordinates (angle and radial distance), using the ***Polar Back*** key.

The following illustration should help to clarify the nuances of deviation systems.



We are interested in the relationship between the center of circle **A,** and the center of circle **B**. The centerpoint of **A** is at location (2,4). The centerpoint of **B** is at location (6,1). How are we to express the differences, in rectangular, and in polar coordinates?

In **rectangular** coordinates, the distance *from* **A** *to* **B** is (4,-3) — down three units, and over four. To get from **A** to **B** requires 3 steps in the negative direction on the **Y** axis, and 4 steps in the positive direction on the **X** axis.

Conversely, if we start at **B**, the deviation is (-4,3) — up three steps, and back four.

In **polar** coordinates, we take a short cut. We go *directly from* **A** *to* **B**, and learn that they are 5 units apart, at an angle of -36.87. To get from **A** to **B**, you would need to turn 36.87 degrees clockwise, and go five steps. Conversely, to get from **B** to **A**, you would need to turn 143.13 degrees in a counterclockwise (positive) direction, and go *back* five steps.

In both cases, the angle is that of the line joining the points, as compared to the major **(X)** axis.

SUMMATION

Which steps are required to go from a blueprint to an evaluation of a real product? We would recommend the following:

A. Select the critical dimensions from the blueprint.

B. Select points to evaluate:
   1. Points directly measured
   2. Points computed from measured features

C. Program CLIP Plus to find those points:
   1. Using numeric keypad, without the projectron
   2. Using numeric keypad, with the projectron
   3. Pantograph entry, without the projectron
   4. Pantograph entry, with the projectron
   5. Mix of seek and non-seek points, with the projectron

D. Align and test the part, in accordance with decisions made at step C.

E. Compare critical values for conformity to specs
   1. Using ***Dist. Back*** modes
   2. Using ***Polar Back*** modes
   3. Using printouts of program memory and inspection run

You have, by this point, mastered the use of a powerful set of tools. The uses you make of these features are limited only by your imagination. Please let us know of your experiences with the manual and with CLIP Plus, so that we can continue to improve both, and serve you better.

Appendices

CHECKING AND ADJUSTING THE POWER SUPPLY

Operating voltages for the CLIP Plus Vision Computer are controlled by an externally-mounted power supply located near the CLIP Plus assembly. The power supply locations vary according to the model contour. The power supply receives input voltage from the main power source of the projector and then outputs the following voltages.

Voltage	Purpose
+5VDC	provides power to Projectron III interface board, and CPU (central processing unit) board (located at bottom of CLIP Plus) which control X,Y motion, digital readouts, normal, and special functions.
+12VDC –12VDC	provides power to RS-232 interface port, Projectron III cyclops board, and Projectron III interface board.

Note: The power supply does not require scheduled testing. Testing is necessary only for troubleshooting, repair, or after replacement of electronic components.

CHECKING AND ADJUSTING VOLTAGES

The power supply is encased in a rectangular sheet metal housing measuring 8" x 4.5" x 1.5". Location varies with projector models. Please refer to the chart below for the location on the power supply on your projector.

Projector Model	Power Supply Location
OQ-14A	Remove the rear access plate and pull out the servo control to gain access. Mounted on side of servo control tray, which is attached to rear access plate.
QL-14 C&S QL-20 C&S QL-30 C&S	Mounted on the back inside wall of the CLIP Plus Housing. The black trim cover and the master control panel must be removed to gain access.
OQ-20 C&S	Mounted to the underside of the CLIP Plus Chassis. The large black trim piece covering the CLIP Plus must be removed to gain access.
OQ-30 C&S	Mounted on the left inside wall of the CLIP Plus Housing. To gain access, look at the underside of the CLIP Plus mount and you will see a sixteen inch wide door. This door is hinged at its back side (nearest OQ-30) and is secured by a slotted screw on its leading edge. Loosen this screw, and very carefully swing the door down and back. This door must be handled carefully as the CPU board is mounted to its inside surface. Look directly into the CLIP Plus housing and you'll see the remote power supply mounted to the left wall.

All testing is performed at the terminal strip. If your power supply has adjustable pots, connect the multimeter to the appropriate + and – terminals for V1, V2, and V3, and test for the following voltages:

V1: +5 VDC
V2: +12 VDC
V3: –12 VDC

If your power supply is not so equipped, continue reading.

To check the +12VDC and –12VDC, do this:

A. Connect the – lead of a 24 VDC multimeter to the terminal screw labeled G2.

B. Connect the + lead to the terminal screw marked +12 and check the voltage being displayed on the multimeter. The reading must be exactly +12VDC.

C. Now connect the + lead to the terminal screw marked –12 and again check the multimeter display. The reading must be *exactly* –12VDC. These two voltages are *not* adjustable. Should your test voltages not meet specifications, the entire power supply must be returned to Optical Gaging Products for replacement.

To test the +5VDC supply, do the following:

A. Connect the – lead of the multimeter to the terminal screw labeled G1. Connect the + lead to the terminal screw labeled +5.
B. Check that the voltage being displayed on the multimeter is +5VDC +/–5%. Should the test voltage not fall within these tolerances, an adjustment may be made at the potentiometer located immediately to the left of the G1 screw. Voltage is increased by gently turning the screw in a clockwise direction. If you find that the potentiometer screw is at the end of its travel and voltage is still not correct, return the power supply to Optical Gaging Products for replacement.

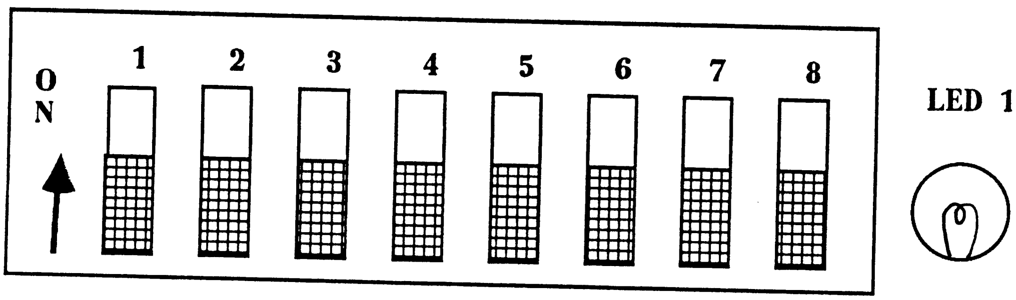
Power supply testing and adjustment is now completed.

Understanding The CPU Option Switch

This switch is labeled S1 and is in the upper right corner of the CPU (Central Processing Unit) board located at the bottom of the CLIP Plus chassis. The CPU option switch controls ON/OFF status of basic control functions of the CLIP Plus (Figure 400-1).

Figure 400-1

S1 Options



This switch is comprised of eight slider switches which have been numbered for identification and are explained as follows:

Slider #		*Purpose*
1	**Off**	— polar axis counts up by degrees from zero to 180 in counter-clockwise direction.
	On	— polar axis is swapped. Counts up by degrees from 0 to 180 in clockwise direction.
2	**Off**	— sets X and Y display resolution to .0001 inch/.002mm.
	On	— high resolution: sets X and Y display resolution to .00005 inch/.001mm.
3	**Off**	— disables Projectron III interface.
	On	— enables Projectron III interface.
4	**Off**	— sets X and Y display to indicate + for table movement down and to the left, – or movement up and to the right of the centerlines.
	On	— swaps X and Y sign. Readouts will display – for movement up and to right, + for movement down and to left of centerlines.
5	**Off**	— interfaces CLIP Plus to CLIP Comp option.
	On	— echoes RS-232 input. To be used by qualified service personnel only.
6	**Off**	— set to **Off** for CLIP Plus
	On	— set to **On** for Di-Metric Plus
7	**Off**	— used in conjunction with high resolution slider number 2. Tells CLIP Plus to round-off fifty millionths digit by increments of five (.00005", .00010", .00020").
	On	— disables round-off.
8	**Off**	— write protects parameter memory.
	On	— write enables parameter memory. This will be covered in the section on use and adjustment of parameters.

The CPU option switch is factory preset to interface CLIP Plus precisely to your contour projector. If you should ever need to move any of these sliders, *be sure* that you are fully acquainted with the above information *first.*

> **WARNING:** A red LED (light emitting diode) indicator shows when slider number eight is on. *Never* power-down when this red LED is illuminated. The memory of CLIP Plus may be corrupted. In this case, the parameters would have to be re-programmed.

CPU OPTION SWITCH SETTINGS

Since the CPU option switch is factory preset, the likelihood of your having to perform any adjustment here is quite remote. We realize, however, that a situation may occur requiring that you perform some adjustment to this switch. Please refer to the chart below, which shows the CPU option switch slider positions for each OGP contour projector.

Model	Joystick Pot Position	CPU Option Switch Settings 1	2	3	4	5	6	7	8	Reverse Pins U21 X	U23 Y
OQ-14A	Optional	Off	Off	*	Off	Off	Off	Off	Off	Out	In
QL-14	Not used	Off	Off	*	Off	Off	Off	Off	Off	Out	In
QL-20	Not used	Off	Off	*	Off	Off	Off	Off	Off	Out	In
QL-30	Not used	Off	Off	*	Off	Off	Off	Off	Off	Out	In
OQ-20	Down/Left	Off	Off	*	Off	Off	Off	Off	Off	In	In
OQ-30	Up/Right	Off	Off	*	Off	Off	Off	Off	Off	Out	In

Note: **on if Projectron III is installed, otherwise leave **off**.*

You may note, however, that this chart mentions two additional areas which we have not covered previously.

The first of these is *joystick pot position.* This refers to the physical positioning of the joystick in the console of your projector. Two potentiometers (pots) protrude, perpendicular to each other, from the sides of each joystick assembly. These pots are used as a reference to position the joystick properly so that worktable direction as seen on the viewing screen will follow the joystick direction.

The second area mentioned refers to the reversing pins. These pins are located on PROMs (Programmable Read Only Memory) U21 and U23. Both of these PROMs are on the upper edge of the CPU board.

The pins, depending on their position, control the direction of counts coming from the measurement encoders. Their location on the PROMs is denoted by an arrow marked on the surface of the CPU board. The word **reverse** is printed next to these arrows.

If you should find it necessary to change reversing pin position, do the following:

A. Slide a small screwdriver under one end of the PROM and, very gently, pry upward until the end begins to lift about 1/16 inch. Move to the opposite end of the PROM and repeat this step. Continue to move from one end to the other until the PROM is free from the socket. Never use undue force.

B. Bend the reversing pin slightly outward from the body of the PROM. Do not distort the pin when bending.

C. Before reinstalling, *be sure* that the notched end of the PROM is facing the notch painted at the end of the socket.

D. Place the PROM very gently back into the socket and be sure that the remaining pins enter their assigned places.

When in doubt, call. If you are not sure how to use these switches, please contact your authorized OGP service personnel *before* attempting adjustments.

HOW TO ADJUST X AND Y COUNT RATIOS

CLIP Plus responds to counts (input) from the X and Y measurement encoders by digitizing and displaying this information as inch or MM values on the X and Y readouts. Several different encoders are available with OGP contour projectors, and each of these encoders requires a different count ratio for accurate interface with CLIP Plus.
Count ratios are adjusted in a manner similar to the one we used for adjusting count direction. That is, pin position PROMs U21 and U23 will determine count ratio. Refer to the following chart to determine count ratio:

Encoder Type	Count Ratio U21 X	Count Ratio U23 Y	Nominal Encoder Factors X	Nominal Encoder Factors Y
.001 mm Scale	X4	X4	0.3937008	0.3937008
.002 mm Scale	X4	X4	0.7874016	0.7874016
635 Counts/Rev Rotary Encoder	X4	X1	0.3937008	0.3937008

Then, refer to this chart to determine pin position:

Count Ratio	Number 1 Pins	Number 2 Pins
X1	Out	Out
X2	In	Out
X4	In	In

Refer to the CPU board and once again locate PROMs U21 and U23. You'll see that numbers 1 and 2 pins are clearly marked on the face of the CPU board. Determine the desired pin position from the above charts and make pin adjustments in the same manner as you did for the CPU option switch. This completes adjustment of X and Y count ratios.

SELF-TESTS AND DIAGNOSTICS

When you first turn the projector on, all of the button indicator lamps will turn on simultaneously. They will then extinguish one by one, starting with the ***axis align*** and finishing with the ***clear*** button.

Once the diagnostic check of the projector's functions has been completed, the X readout will momentarily display two digits followed by a decimal point, then two more digits. This identifies the current version of firmware used to program CLIP Plus. Be sure to provide this version number when you contact Optical Gaging Products for service information.

If any failure is detected in the microprocessor, a coded message will appear in the X readout. This message serves to identify the failure. Interpreting this message and taking subsequent remedial action are covered below.

Finally, the X and Y readouts will both display 8.8.8.8.8.8. This indicates that the light emitting diodes which form the decimal points and seven segments of each number are working properly. Every number displayed on a digital readout is composed of a certain number of LED segments. The number eight requires seven segments, which are the most segments necessary to form any one number. This explains why the number eight is used for the test. It follows that if any segments were missing, CLIP Plus would not be able to properly display numerical results.

Should any of the decimal points be missing, or any of the eights appear incomplete, please contact your authorized OGP service representative.

Both readouts will hold the above display for approximately one second and will then cycle over to the basic coordinate position display.

Interpreting Microprocessor Error Codes

Error codes are displayed in the X readout if a failure is detected in the microprocessor during power-up. The chart lists the error codes and their causes:

Code	Cause
01	6809 Hardware Stack Pointer Hardware
02	Stack RAM failure
03	U,X,Y,D register failure in 6809 processor
04	Math Failure (6809 failed an addition problem)
05	General RAM failure
06	ROM 0 checksum failure
07	ROM 1 checksum failure
08	IRQ Timer Failure

All components mentioned in this chart are located on the CPU board.

Should you have questions regarding the testing of these individual components, please contact a qualified OGP service representative, or contact us directly.

Understanding Parameters

The capability of the CLIP Plus Vision Computer to perform complex measurement calculations is controlled by the microprocessor-based logic system. Like any computer, CLIP Plus must be "fed" certain basic information before it can properly function. This information is conveyed by means of *parameters*. A parameter is a number which tailors the logic system of a particular contour projector.

Every CLIP Plus vision computer comes assigned with a set of normal (basic) parameters for each of its functions. Because of the wide range of contour projectors to which the CLIP Plus is fitted and minute variances in measured performance, we have found that the parameters must occasionally be adjusted.

The CLIP Plus has been programmed with 28 different parameters. You will only need to be familiar with the fourteen listed on the following pages.

Parameter No.	Function	
01	X (Horizontal) encoder factor	
02	Y (Vertical) encoder factor	
03	Sign of Squareness Runout (0 = Plus, 1 = minus)	
04	Squareness Runout Correction Factor	
05	BAUD Rate for RS-232 Interface	
06	AC Servo	(0 = No, 1 = Yes)
07	DC Servo	(0 = No, 1 = Yes)
08	Hi-Speed Servo	(0 = No, 1 = Yes)
09	X Axis Wall Effect Correction Factor	
10	Y Axis Wall Effect Correction Factor	
25	P Encounter Factor, U38 Muli=X1-X2-X4, Rev> Pin=In-Out	
26	Auto Go Dwell	
27	Default Inch/MM Units, 0=In, 1=MM	
28	Default Prot Ring Mode, 0= Dec Deg, 1= Deg/Min	

In section I we will take a closer look at the preceding list to find out just what all of the names and numbers mean. Section II will cover how to input the new parameters to the CLIP Plus.

> **WARNING:** Before moving on to the next sections, be sure that you have read and fully understood the descriptions of the CPU option switch function and operation. In addition, *be sure* that the X and Y count ratios are configured to the encoders fitted to your projector before you attempt to modify parameters 01 and 02.

SECTION I — Determining Parameter Values

PARAMETER 01 — X (HORIZONTAL) ENCODER FACTOR

Let's assume that we have staged a six-inch gage block with half-round jaws to the worktable to check our X axis of measurement. After measuring the block we find that CLIP Plus tells us that the length of the block is 5.9990 inches. We know that the block is exactly 6.0000 inches long, but CLIP doesn't seem to agree.

What do we do now? Very simply, we have to re-educate CLIP Plus by calculating and entering a new *parameter 01.*

The CLIP Plus system comes with a nominal encoder factor of .7874016* assigned to parameter 01. We know from the exercise above that this value must be changed for proper measurement. To do this we always divide the known length (6.0000 inches) by the length displayed in the X readout (5.9990 inches) and then multiply the quotient by the nominal amount of .7874016. The resulting number (in this case .7875327) will be input as the new parameter 01.

Our calculation will look like this:

6.0000 divided by 5.9990 = 1.0001666 X 0.7874016 = 0.7875327
(known) (readout) (quotient) (nominal) (new)

The only thing remaining to be done is to input the new parameter 01 to CLIP Plus. This will be covered after this section is completed.

PARAMETER 02 — Y (VERTICAL) ENCODER CORRECTION FACTOR

This calculation is performed exactly the same as shown in parameter 01, except that you are measuring vertically and will be taking your readings from the Y digital readout. The nominal encoder correction factor for parameter will be .7874016*.

* *(Generally the CLIP Plus Vision Computer comes pre-programmed to interface with the .002mm resolution glass scale. This means that both the X and Y encoder correction factors (parameters 01 and 02) are set at .7874016. Should you have different type encoders, you will have to set the nominal encoder correction values by the following chart. This must be done before any measurement is performed.)*

Encoder Type	Nominal Encoder Factors X	Y
.001 MM Scale	0.3937008	0.3937008
.002 MM Scale	0.7874016	0.7874016
635 Counts/Rev Rotary Encoder	0.3937008	0.3937008

If you have entered a new encoder correction factor and your measurements are still incorrect, you can recalculate by multiplying the quotient by the new correction factor. It is not necessary to return to the nominal factor and start over.

PARAMETER 03 — SIGN OF SQUARENESS RUNOUT

Let's say that you are going to check for squareness by staging a granite square to the worktable and measuring the right hand vertical surface (as seen on the viewing screen) from bottom to top. Now assume that when you reach the top of the granite the screen centerlines indicate a point .0004 inches to the right of the vertical surface. This is called squareness runout and can be compensated for by telling CLIP Plus two things, the direction of the correction (parameter 03), and the amount (parameter 04).

We have to tell CLIP Plus what *direction* to take to compensate for the runout. This parameter has been programmed to accept only two commands, 0 or 1, which are defined as follows:

0 = plus (compensate to *right* of vertical centerline)
1 = minus (compensate to *left* of vertical centerline)

We're going to tell CLIP Plus to compensate to the left since the screen centerlines are indicating some point to the right of the vertical surface. Parameter 03 will therefore be a 1. Conversely, if the centerlines were indicating a point to the left of the vertical surface, we would make parameter 03 a 0.

PARAMETER 04 — SQUARENESS RUNOUT CORRECTION

Note: Use of parameter 04 is not recommended for squareness correction except for the model OQ-14A contour projector.

This parameter works in conjunction with parameter 03. In parameter 03 we told CLIP Plus in what direction to compensate. Now, we'll tell it how *far* to compensate. Remember we said that the squareness runout was .0004 inches over the full travel of the Y axis. For this exercise, let's assume that the full travel is 4.0000 inches. To calculate the correction factor, simply divide the amount of runout by the full Y travel distance of the projector. The resulting quotient will be our correction factor.

For this calculation, the runout value of .0004 inches will be entered as 4.0. In other words, we will enter the number of .0001" increments of runout measured in the Y travel. The calculation would look like this:

4.0	divided by	4.	=	1.0
(runout)		(Y travel)		(correction factor)

Parameter 04 will have a value of 1.0 and will be entered as such.

PARAMETER 05 — BAUD RATE FOR RS - 232 INTERFACE

The baud rate affects the speed of serial communication between CLIP Plus and external devices, such as CLIP-Comp and line printers. Every CLIP Plus comes programmed to a standard baud rate of 1200 which is denoted by a parameter 05 value of 07. If your projector is to be equipped with the CLIP-Comp interface, the baud rate must be changed to 9600. This is done by entering a parameter 05 value of 14.

Including the two mentioned above, the CLIP Plus is able to recognize a total of fifteen baud rates. The rates and their respective parameter value are as follows:

RS-232 Baud Rate	Parameter 05 Value
75	01
110	02
134.5	03
150	04
300	05
600	06
1200(standard)	07
1800	08
2000	09
2400	10
3600	11
4800	12
7200	13
9600(CLIP-comp)	14
19200	15

The additional baud rates are necessary should you encounter a serial printer which requires a baud rate other than 1200. Simply locate the baud rate of the serial printer on this chart and enter its respective parameter 05 value to CLIP Plus.

PARAMETERS 06, 07, 08 — SERVO DESIGNATIONS

These three parameters adapt CLIP Plus to the type of servo being used to drive the X and Y table motion.

At Optical Gaging Products, Inc., we use servos specifically tailored to particular projector capabilities. Refer to the chart below for a description of the various servos available.

Parameter No.	Entry Codes	Servo Type and Application	
06	0 or 1	AC Servo	OQ-14B (not equipped with CLIP Plus)
07	0 or 1	DC Servo	OQ-14A, QL-14, OQ-20, OQ-30, QL-30
08	0 or 1	Hi-Speed Servo	QL-14S, QL-20S, OQ-20S, OQ-30S

The entry codes are the figures you will enter as the parameters. 0 = no and 1 = yes. All these parameters are listed under one heading since only one type of servo can be used in a particular projector. If you have a high speed servo, you would enter a 0 for parameters 06 and 07 and a 1 for parameter 08. If you have a DC servo, enter a 0 for 06, 1 for 07, and 0 for parameter 08. In any case, *only one* of these parameters may have a value of 1.

PARAMETER 09, 10 — X,Y WALL EFFECT COMPENSATION

Wall effect is an optical phenomenon that occurs when inspecting thick, highly-polished parts with horizontal illumination. A gage block is a perfect example. The polished surface parallel to the horizontal illumination axis acts as a mirror when struck by stray light, which appears on the viewing screen as an aura or fuzzy edge. The fuzzy edge then appears as a badly focused second edge immediately adjacent to the actual edge.

Wall effect is always a potential problem, especially for Projectron III automatic electronic centerline option. If the wall effect is severe enough, Projectron III could lock on a "false" edge. This obviously would result in incorrect measurements.

Each CLIP Plus, when equipped with Projectron III, comes with parameters 09 and 10 programmed with a default value of .0001" to compensate for wall effect. This moves the shadow edge into the light by .0001".

To check for wall effect, we will measure a precision gage block with the Projectron III and compare the displayed measurements against the known. First, we measure the two outside surfaces of the block, and then we'll wring a straight jaw to each end of the block and measure the two inside surfaces. If wall effect exceeds standard accuracy specifications, we will then calculate a correction factor and input that factor to CLIP Plus as a parameter change. Wall effect check and correction is performed as follows:

A. Turn on the horizontal illumination and select the lowest magnification lens on your projector. Refer to the Projectron III filter chart on page B-3 and set the filtering to match the magnification.

B. Stage a three inch precision gage block to the worktable, and enable the Projectron III system.

C. Use Projectron to find one edge of the gage block. Once the edge is found, zero the X and Y readouts. Now, use the projectron to measure to the opposite end of the gage block.

D. Compare the result displayed in the readout to the known length of the block. The difference, if any, will be the total wall effect on the outside surfaces of the block. Note the displayed length on a sheet of paper.

E. Wring a straight jaw to each end of the gage block, and repeat the above procedure on the inside surfaces. Write down this displayed measurement.

F. Repeat steps C thru E at every magnification on your projector. Remember to write down the displayed measurement in each case.

G. Subtract the inside surface measurement from the outside surface measurement for each level of magnification. The difference will be the total amount of wall effect present.

Total allowable wall effect varies according to level of magnification. Refer to the chart below to find wall effect total instrument reading (TIR)/magnification level.

Magnification level:	**10X**	**20X**	**31.25 and higher**
Wall effect TIR:	**.0003**	**.0002**	**.0001**

To calculate the wall effect correction factor, use this formula: (We'll use hypothetical values for this exercise)

(outside surface measurement)		(inside surface measurement)		(TIR)		(number of surfaces)	(wall effect correction factor)
3.0006	minus	**2.9998**	=	.0008	/	**4 =**	**.0002**

The wall effect correction factor of .0002 will become the new parameter value. The above procedure is used for both parameters 09 and 10. The only difference is the axis of measurement that being corrected — 09 for the X axis, 10 for the Y.

An example of a parameter printout is contained on page H-46 of this manual.

PARAMETER 25 — PROTRACTOR FACTOR

CLIP Plus senses rotation of the screen ring by counting pulses from a rotary encoder. The value in parameter 25 might occasionally need to be adjusted to give a protractor display change of exactly 360 degrees for one rotation of the screen ring.

To calculate the new value for parameter 25, rotate the screen ring to line up the marks on the stationary and the rotary positions of the ring assembly. Select ***Dec***imal ***Degree*** mode, it it's not already enabled, and press ***Inc***(remental) ***Zero***.

Rotate the screen ring one turn and line up the marks as exactly as you can. Let's assume the protractor display now reads 01.04, and the current value for parameter 25 is 010.77882.

The new value will be:

360.00	**divided by**	**361.04 =**	**0.99719**	**X**	**10.77882 =**	**10.74777**
(known)		(readout)	(quotient)		(nominal)	(new)

PARAMETER 26 — AUTO GO DWELL

The parameter defines the length of time that CLIP Plus will pause between Auto Go blocks. The unit of time used the length of time the program takes to complete one complete internal cycle.

To determine the correct value for this parameter, use trial and error. (*Only you can tell what pause you prefer*!)

PARAMETER 27 — DEFAULT INCH/MM UNITS

PARAMETER 28 — DEFAULT PROTRACTOR RING MODE

Because you may wish to use metric units of measure most of the time (parameter 27), or degree-minutes (parameter 28), these two parameters control which state CLIP Plus "wakes up" in.

Note that you *always* have the ability to choose either mode; these parameters allow you to save a keystroke or two each day.

SECTION II — ENTERING AND ADJUSTING PARAMETERS

Before we can enter new parameter values, CLIP Plus must be *write enabled.* To do this, remove the cover panel from the CLIP Plus Vision Computer and locate switch number S1. This switch is located in the upper right hand corner of the CPU board at the bottom of the CLIP Plus chassis. Find slider number 8 and push it toward the top of the printed circuit board until the red LED to its immediate right lights up.

The CLIP Plus Vision Computer is now ready to receive information.

> WARNING: A red LED (light emitting diode) indicator shows when slider number eight is on, and the machine is write enabled. *Never* power-down when this red LED is illuminated. The memory of the CLIP Plus may be corrupted. Should that happen, the parameters would have to be re-programmed.

Set the cover panel back in place and look at the digital readouts. They will display the following information:

X	P01-01

Y	0

The P01-01 displayed in the X readout is easier to interpret if broken down as follows:
P/01/01

The letter **P** means parameter. The next two digits indicate that this is parameter **01**. The final two digits relate to the number displayed in the Y readout. They specify that the number shown in the Y readout is the *first* digit in parameter 01. If the final set of digits in the X readout was 04, we would know that the number shown in the Y readout was the *fourth* digit in parameter 01.

The parameters are dealt with one digit at a time. We could envision the **Y** display as a single digit "window," moved "vertically" from one parameter to another, and "horizontally," from digit to digit *within* a parameter.

To make things even more interesting, the CLIP Plus treats decimal points as digits, and identifies them by the letter **P**. Therefore, the nominal value of parameter 01, as we were shown, would appear as 0P7874016 rather than 0.7874016.

Note: a zero must always precede the decimal point when storing values for parameters 01, 02, and 04.

To *view* a selected parameter and the individual digits within it we would press the membrane switches that are inscribed with arrows. *Changing* parameter values is a separate operation accomplished by pressing the switches marked **inch** and **MM**. The following chart summarizes the parameter options, and the use of the membrane keys in navigating them. The letter n in this chart represents any appropriate digit. P, of course, is still the decimal point.

Parameter Number	Format	Effect
01	0Pnnnnnnn	X (Horizontal) Encoder Factor
02	0Pnnnnnnn	Y (Vertical) Encoder Factor
03	0 or 1	Sign of squareness runout
04	0Pnnnnnnn	Squareness Runout Factor
05	01 through 15	Baud Rate options
06	0 or 1	AC Servo
07	0 or 1	DC Servo
08	0 or 1	High Speed Servo
09	nPnnnnnnn	X (Horizontal) Wall Effect
10	nPnnnnnnn	Y (Vertical) Wall Effect
25		P Encounter Factor
26		Auto Go Dwell
27	0 or 1	Default Inch/MM (0=In, 1=MM)
28	0 or 1	Default Protactor Ring (0=Dec. Deg., 1 = Deg/Min)

The illustration above shows the function of each membrane switch when viewing and modifying parameters. Let's run through an exercise in which you will first tell CLIP Plus to *display* a certain parameter.

Previously, we write-enabled CLIP Plus by moving slider number 8 on switch S1 to the *on* position. The LED next to the switch lit up and the X readout displayed P01-01. You'll remember that this was basic information regarding parameter 01. For this exercise we want to *examine* parameter 02, so we'll do the following:

Press the "up" arrow switch once. The X readout will display P02-01. This indicates that parameter 02 is now available for examination. The Y readout displays a 0 which is the first digit of parameter 02. Remember that a zero always precedes the decimal point (P) when storing values for parameters 01, 02, and 04.

Let's instruct CLIP Plus to *display* the rest of the parameter.

A. Press the "right" arrow switch once and the X readout will display P02-02. The Y readout will display a P as the second digit of the parameter. As you'll recall, this is how CLIP Plus shows a decimal point.
B. Continue pressing the "right" arrow switch and the Y readout will display in single, consecutive digits the remainder of parameter 02. When you reach the final digit of the parameter, the X readout will display P02-09. Assuming that the parameter has a nominal value of 0P7874016, the Y readout will display a 6, which is the final digit.
C. To move back to the first digit of the parameter, press the "left" arrow switch until the X readout displays P02-01. The Y readout will again display a 0.

Note: The keys autorepeat in the parameter adjust mode. If you hold a key down, the display will continue to increment, until you release the key. It is not necessary to press the key repeatedly.

Let's perform our final exercise in which we'll actually change the value of a parameter. In this case, we want to change a parameter 01 from a value of 0P7874016 to a new value of 0P7174086.

A. Since we left off with parameter 02, we must first tell CLIP Plus to move back to parameter 01. Press the "down" arrow switch once and the X readout will display P01-01.

B. Look at the new value for parameter 01 and you'll see that we need to change the fourth digit from an 8 to a 1. Press the "right" arrow switch until the X readout displays P01–04 and Y readout displays an 8. The 8 is the number we want to change.

C. Press the ***MM*** switch once and the Y readout will display a 7. The X readout will not change. Keep pressing the ***MM*** switch until the Y readout counts down to a 1. The fourth digit has been changed from an 8 to a 1.

If you should maintain pressure on the ***MM*** switch, the Y readout will count *down* to 0, automatically scroll to 9, and continue to count down. When you press the ***Inch*** switch, the Y readout would count *up* to 9, roll over to 0, and continue back to 9.

D. Look again at the value for parameter 01 and you'll see that we also want to change the eighth digit from a 1 to an 8. Press the "right" arrow switch until the X readout displays P01-08 and the Y readout displays a 1.

E. Press the ***Inch*** switch to make the Y readout count up to the number 8. The eighth digit now has a new value of 8 and parameter 01 has a new value of 0P7174086.

F. Press the "left" arrow switch until the X readout again displays P01-01 and the Y readout displays a 0. As you are counting backwards through the parameter LED, you can check your work by watching the numbers as they appear in the Y readout.

G. Move slider number 8 on switch S1 back to its original position and the LED will extinguish. Press the ***Clear*** button on the control panel and the X and Y readouts will again display current position. The CLIP Plus Vision Computer is now ready to perform measurements based on the new parameter 01.

Or, instead of using the ***Inch*** and ***MM*** keys, you can select the appropriate digit in the parameter, and simply push the desired replacement on the numeric keypad.

You can press the key to advance the digit position (equivalent to the right arrow) and the – key to back up one digit position (equivalent to the left arrow). So entering the default X parameter is as easy as:

A. Use the up & down arrow keys as needed to select parameter P01 - 01.
B. Type in, using the digits 0 - 9 and period key, the sequence 0.7874016.
C. You're done!

This completes the section on parameters.

Mechanical And Electronic Considerations: Projectron III

The Projectron III automatic electronic centerline has been designed to be a maintenance-free system. Minor adjustments may be required at time of delivery, or if the projector is moved after setup. Normally, however, the projectron is a "set and forget" system.

Adjustments to Projectron III are both mechanical and electronic. The key rule to remember is that all *mechanical* adjustments must meet specifications before any *electronic* adjustments may be performed.

The projectron sensor head is attached directly to the main mirror assembly of the projector and consists of two main parts:

1. The "cyclops" (sensor) board, which contains a photolectric cell that reads when the shadow of an edge crosses the centerlines of the viewing screen.

2. The projectron head itself, to which the "cyclops" board is fitted. The projectron head serves to direct the viewing screen image to the photocell on the "cyclops" board. The head is adjustable for both image alignment and focus.

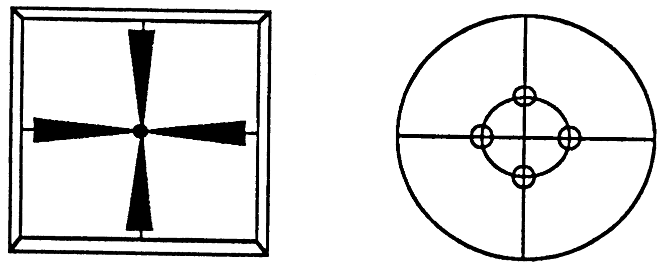
PROJECTRON III — SENSOR HEAD LOCATIONS

Access to the projectron head is accomplished by several different methods, depending on what model projector you have. Refer to the chart below for access instructions.

Projector Model	Access Procedure
OQ-14A QL-14 QL-20 QL-30	Stand behind the projector. Remove the 10-32 button head screws which secure the rear panel. Remove the panel and set to one side along with the screws. The projectron head assembly is mounted directly on top of the main mirror assembly.
QL-14 XL-14 Style	Stand behind the projector. Unlock and remove the maintenance door. Reach inside, and use a small slot-tip screwdriver to release the clamp securing the vent hose to the surface illumination housing. While inside, carefully unplug the two wires running from the surface fan assembly mounted to the underside of the hood. Use the same screwdriver to remove the slot head screw directly below the maintenance door opening. The hood assembly may now be lifted free. You will find the projectron sensor head mounted directly on top of the main mirror assembly.
OQ-20	Stand behind the projector. Remove the three 10-32 button head screws which secure the top-hat shaped rear panel. Remove the panel and set it to one side along with the screws. You will see the projectron sensor head attached directly to the rear of the main mirror assembly.
OQ-30	Unlock and swing open the left side access door (as viewed from in front of the projector). You will find the projectron sensor head mounted on an "L" bracket attached to the right side of the mirror assembly.

Every Projectron III system is shipped with a test reticle and a test screen. (Figure 400-3) These pieces come wrapped in a small tissue packet in the accessories box shipped with your projector. Be careful *not* to discard this packet when you are unloading the accessories. It will be *impossible* to align Projectron III without them.

Figure 400-3



Test Reticle **Test Screen**

Note: Before performing any adjustments to the Projectron III system, please be sure that the following requirements have been met:

1. The viewing screen centerlines must be aligned precisely to the worktable measurement axes, and perfectly centered with respect to the axis of rotation of the screen ring.

2. The horizontal collimator must be centered and focused perfectly on the tungsten lamp filament. If illumination is by mercury-arc, the collimator must be focused on the anode and cathode poles inside the lamp.

These two requirements must always be treated as *mandatory* checks when adjusting Projectron III. Read on and we'll show you how to perform these checks, step by step.

HOW TO ALIGN THE VIEWING SCREEN CENTERLINES

The first requirement mentioned above is concerned with two areas:

1. Alignment of the viewing screen centerlines to the worktable measurement axes.
2. Alignment of the viewing centerlines to the axis of rotation of the rotary screen ring.

HOW TO ALIGN THE VIEWING SCREEN CENTERLINES TO THE WORKTABLE MEASUREMENT AXES

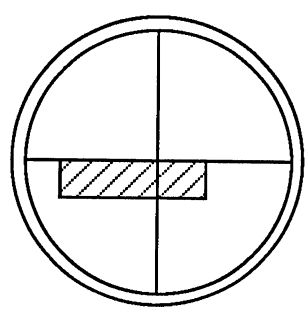
A. Turn on the horizontal illumination system, and select the lowest magnification available.

B. Loosen the optical rotary screen ring lock knob and rotate the ring until the vernier position reads zero degrees. Lock the screen ring in this position.

C. Stage a two inch, or longer, precision parallel on the worktable surface. Use the motion controls to align the top edge of the parallel as close as possible to the horizontal viewing screen centerline.

D. Loosen the thumbscrew clamps which secure the glass screen. By moving the glass screen only, precisely align the horizontal viewing screen centerline with the top edge of the image of the precision parallel, (see Figure 400-4 below). Gently retighten the thumbscrew clamps.

Figure 400-4



E. Move the worktable so that the viewing screen centerlines are indicating a point at one end of the horizontal surface of the precision parallel (see diagram on left, below). Now, move the worktable horizontally until the centerlines are indicating a point at the opposite end of the precision parallel's horizontal surface (see Figure 400-5A). We want to ensure that the centerlines maintain "contact" with the image of the horizontal surface of the precision parallel.

Figure 400-5

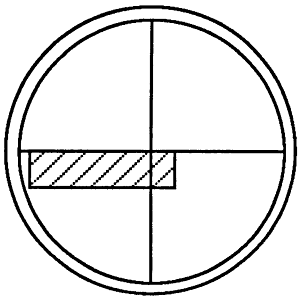
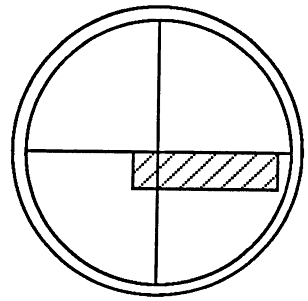


Figure 400-5A



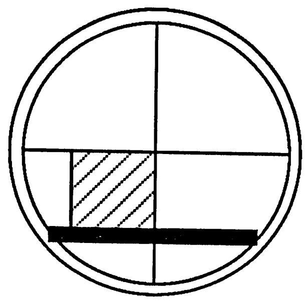
F. After tramming the length of the precision parallel, you may find that the centerlines are slightly offset from the image of the horizontal surface. Should this occur, it will be necessary to repeat Step D until the centerline to precision parallel surface alignment is perfect.

HOW TO ALIGN THE VIEWING SCREEN CENTERLINES TO THE AXIS OF ROTATION OF THE ROTARY SCREEN RING.

A. Remove the precision parallel and place a granite square on the worktable surface. Ensure that the base of the square is parallel to, and even with, the vertical edge of one of the machined table slots. If available, lay two .500 inch dowel pins into the table slot and butt the base of the precision square against the pins. Ensure that the pins are bearing against the vertical and not angled surface of the slot.

B. Move the worktable to align the viewing screen centerlines precisely at the vertex of one corner of the square. (Figure 400-6)

Fig. 400-6



C. Press the zero buttons to clear the X and Y digital readouts. Zero the digital protractor ring. Loosen the screen ring lock knob and rotate the screen ring clockwise to the 180 degree position. Retighten the lock and visually note the amount of error between the surface of the square and the screen centerlines.

D. If any error exists, (let's say that the viewing screen centerlines are indicating a hypothetical point somewhere to the right of the corner vertex) move the worktable until the centerlines are, once more, indicating the corner vertex of the square. Note the amount of error being displayed in the X and Y readouts. (For this example we'll assume that the total error was .00006" on both X and Y axes.) Next, move the worktable to eliminate exactly one-half (.0003") of the indicated error.

F. Slowly, by turning the eccentric adjuster screws (located at 3, 6, 9 and 12 o'clock on the circumference of the rotary screen ring), move the glass screen horizontally and vertically to position the centerlines *exactly* at the corner vertex.

G. Release the screen ring lock knob and rotate the screen ring clockwise to the 0 degree position. Retighten the lock knob and again visually note the amount of error between the precision square and the screen centerlines. Repeat steps D and E at this time.

H. Rotate the screen ring back to the 180 degree position and repeat the above alignment procedure until all error has been eliminated.

I. Once all error has been eliminated, you will be able to rotate the screen ring through a full 360 degree travel and the centerline to precision square alignment will remain constant.

Note: Turning the eccentrics may cause misalignment between the viewing screen centerlines and the worktable axis of measurement. It is highly suggested that you restage the precision parallel to the worktable and repeat steps A - F of the procedure we just described

Collimation may be performed by utilizing either of two techniques. The first technique use the collimation assistance lens, (included with projectors equipped with Projectron III) and the second technique requires use of a hand-held mirror.

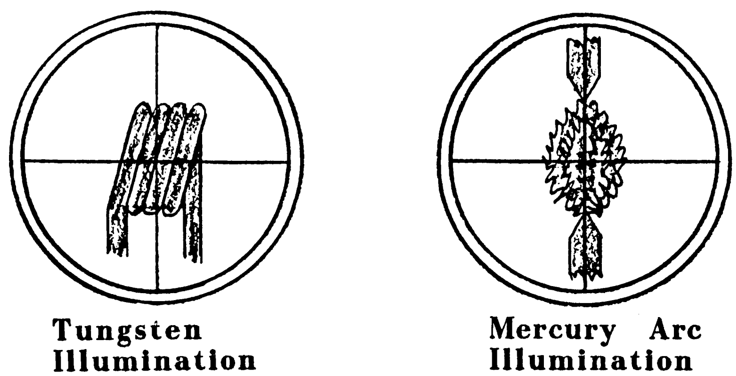
HOW TO USE THE COLLIMATION ASSISTANCE LENS

A. Remove a magnification lens from the single lens mount, or turret and replace it with the collimation assistance lens.

B. Turn on the horizontal illumination system and allow the lamp thirty seconds warm-up to achieve full intensity. If your projector is equipped with mercury-arc illumination, allow approximately five minutes warm-up time.

C. On the viewing screen, you will see what appears to be an aperture. In the center of this aperture will be an image of the filament of the projection lamp. With mercury-arc illumination, you'll see an image of the anode and cathode of the lamp. (See Figure 400-7 below.)

Figure 400-7



D. Depending on what model projector you have, you will find a small joystick protruding either from the side, or the front, of the horizontal lamphouse. This joystick allows you to center the image of the lamp on the viewing screen. Move the joystick in a circular motion until the image of the lamp is located precisely in the center of the viewing screen.

E. For systems which move the front receiving lens for focus (OQ-14A) you must position the lens at the midpoint of its travel. This rule also applies to any OQ-30 fitted with auto focus.

Adjustment to midpoint is performed as follows:

1. For the OQ-14A, use the focus knob to move the receiving lens to the end of its travel nearest the worktable. On the OQ-30, use the buttons on the Vidiprobe console.
2. For the OQ-14A, move the receiving lens back into its housing approximately one inch. This will be midpoint, as total focus travel is two inches. On the OQ-30, the receiving lens would be moved approximately one and one-half inches, as total focus travel is three inches.

F. Loosen the set screw on the horizontal lamphouse to allow the collimator assembly to slide freely. On the OQ30, this set screw is located at the top of the lamphouse. Now, slide the collimator assembly out until the image on the viewing screen is out of focus.

G. Slowly slide the collimator assembly back into the lamphouse until the image of the filament appears focused on the viewing screen. Now, very slowly, slide the collimator assembly in further until a second set of filaments appears sandwiched between the first set of filaments. Since the filament is wound in the shape of a coil, you are seeing both the front and rear surfaces of the coil.

H. If your projector is equipped with mercury-arc illumination, you would simply slide the collimator assembly into the lamphouse until the image of the anode and cathode of the lamp appears focused on the screen.

I. Focusing the collimator is completed. Retighten the set screw in the lamphouse to secure the collimator assembly.

J. Remove the collimator assistance lens from the lens mount or turret, and reinstall the projection lens.

Note: If space is available in your lens turret, the collimation assistance lens may be left permanently in place.

The instructions for use of the collimation assistance lens are completed. Next we'll demonstrate the second technique, collimation with a mirror.

HOW TO PERFORM COLLIMATION WITH A MIRROR

A. Select the lowest magnification lens available, and then loosen the set screw on the horizontal lamphouse to allow the collimator assembly to slide freely.

B. Slide the collimator assembly out until the image of the filament, or with mercury-arc, the anode and cathode, appears focused on the viewing screen. Center the image of the lamp to the screen centerlines by repeating step D of the previous exercise.

C. Hold a small mirror in front of the horizontal collimator to direct the light onto a wall or ceiling approximately thirty to forty feet distant. It is suggested that the room lights be dimmed or completely extinguished for this procedure. Slide the collimator assembly out until the image of either the filament or the anode and cathode appears badly focused on the wall or the ceiling.

D. Now, slowly slide the collimator assembly into the lamphouse until the filament begins to appear in focus. As in the previous demonstration, you are seeing the curved surface of the filament nearest the lens.

E. Continue, very slowly, to slide the collimator assembly in until a second image begins to appear sandwiched between the coils of the first image. This image is the curved surface of the filament farthest from the lens. When both images are in best focus, retighten the set screw in the lamphouse to secure the collimator assembly.

F. With mercury-arc, merely slide the collimator assembly until the image of the anode and cathode appear focused on the wall or ceiling. Secure the collimator assembly with the lamphouse set screw.

Collimation adjustments are now completed. We can now proceed with Projectron III Mechanical Adjustment.

HOW TO ALIGN THE PROJECTRON SENSOR HEAD

A. Remove the "cyclops" board from the projectron head and substitute the test screen. Position the test screen to appear, face up, as shown in Figure 400-8 below, and then secure it with the four 4-40 screws used for the "cyclops" board. *Be careful not to overtighten the screws.*

B. Turn on the main power and the horizontal illumination. Set the magnification level at 10X and ensure that no filters are in the light beam. We must have unfiltered light for this adjustment.

C. Stage the test reticle to the worktable, and with the X and Y fine motion controls, align the centerlines of the viewing screen as is indicated in the figure on the right. Please recheck this alignment periodically during the remainder of this procedure.

Our objective now is to align the viewing screen image with the centerlines of the test screen. When properly aligned, the image on the test screen will appear as in Figure 400-9 on the right.

Figure 400-8

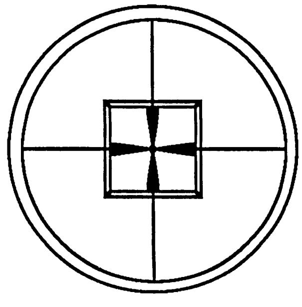
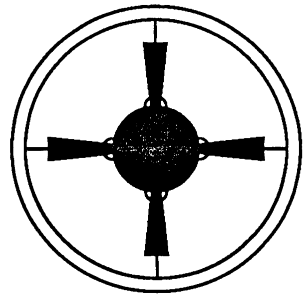


Figure 400-9



OQ-14A only: Due to tight clearances between the projectron head and the barrel-like optical housing of the OQ-14A, you will need to hold a small mirror above the test screen at about a forty-five degree angle to properly view the image.

If you find that the image of the test reticle is misaligned to the test screen centerline, continue on as follows:

A. Back off each of the 6-32 cap screws securing the projectron head to the main mirror assembly approximately one-quarter turn.

B. Use the two 8-32 jacking screws in the base of the projectron head to align the screen image as in Figure 400-9. Once the image is aligned, retighten the four 6-32 cap screws.

C. On the OQ-30, the projectron sensor head is mounted on a bracket attached to the main mirror assembly. The alignment jacking screws are in the base of this bracket, and not in the base of the projectron head as found on the other projectors. In addition four rather than two jacking screws are used on the OQ-30 and each is secured by one 10-32 hex nut.

You may find that the image is again misaligned after you tighten the 6-32 screws. This is common, and sometimes requires that you repeat steps A and B above until alignment is perfect. *Please do not accept less than perfect alignment here,* as the accuracy of the Projectron III system will be seriously affected. It is also wise to recheck alignment of the test reticle and viewing screen centerlines at this time.

This completes projectron sensor head alignment procedure. Now we'll move on to adjusting the focus of the sensor head.

HOW TO FOCUS THE PROJECTRON III SENSOR HEAD

The image on the test screen must be in sharp focus for proper edge definition. If the image appears at all fuzzy, proceed with these steps:

A. Loosen the two 4-40 set screws on the barrel of the projectron head to allow the T-shaped knob protruding from the side to slide freely.

B. Slide this knob up or down until sharp focus is achieved, and retighten the 4-40 set screws. If you are working on an OQ-14A, you will need an assistant to help as it is impossible to hold the mirror, hold the T-knob, and tighten the set screws with only two hands!

C. Remove the projectron test screen from the projectron head and re-install the "cyclops" board. Remember to re-connect the black ribbon cable to the "cyclops" board.

HOW TO PERFORM PROJECTRON III ELECTRICAL ADJUSTMENTS

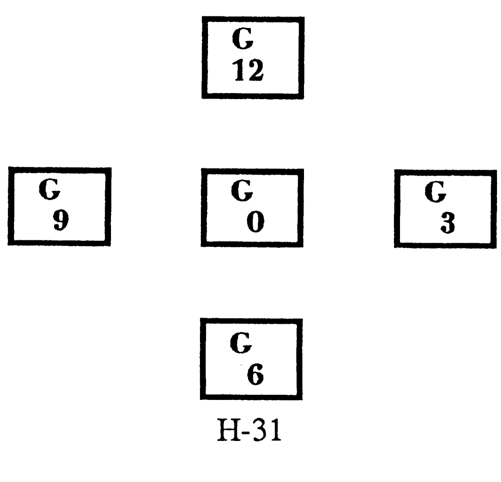
The Projectron III electrical adjustments are performed at the "cyclops" board mounted on the projectron sensor head.

Look at the top of the "cyclops" board and you will see six test points and five blue potentiometers. The potentiometers control the voltage (gain) to the photoelectric cells on the reverse side of the "cyclops" board, and the test points are used to check that voltage.

Each potentiometer has been assigned a corresponding test point, and they are identified on the following chart:

Potentiometer	G0	G3	G6	G9	G12	GND
Test Point	TP0	TP3	TP6	TP9	TP12	—

The G in the potentiometer reference code stands for gain, which is a term used to define amount of current flow. The numbers 1 thru 12 relate to positions of the photoelectric cells on the "cyclops" board as compared to the face of a clock. Refer to the illustration below:



Maximum operating voltage for the photoelectric cells is 8VDC and is checked and adjusted as follows:

A. Turn on the horizontal illumination and set the magnification to 10x with maximum filtering or 50x with no filters. Refer to page B-3 for filtering ratios.

B. Connect a multimeter lead to the test point marked GND. Connect the + lead to the test point marked TP0 and check the voltage being displayed. If it is not 8VDC the potentiometer must be adjusted.

C. Find the G0 potentimeter and carefully turn its brass adjusting screw either right or left until the correct voltage is displayed. Disconnect the + lead from TP0.

D. Connect the + lead to TP3 and repeat step B, and if necessary step C. Continue this pattern until all of the test points have been checked.

Should you encounter a potentiometer that will only pass a maximum of 7.75VDC, set the rest of the potentiometers to this voltage. The Projectron III will function efficiently in the range from 7VDC to 8VDC. Voltage readings may be affected by lamp age, and dirty optics, therefore it is advised that this test only be conducted with a nearly new lamp, and reasonably clean optics. The important point to remember is that all five test point voltages must be set *equally.*

Once you have completed checking all of the test points, conduct the Projectron III Electrical adjustments.

Installation and Set Up Procedures

This first section applies to the OQ-14A optical comparator only. The OQ-14A is shipped with CLIP Plus packed in a separate container. The QL-14, QL-20, OQ-20, and OQ-30 comparators are shipped with CLIP Plus already in place.

INSTALLING CLIP PLUS — OQ-14A

A. Remove CLIP Plus from its packing box and set to one side.

B. Remove and discard all packaging material from the CLIP Plus control cables protruding from the front of the OQ-14A.

C. On the base of the CLIP Plus you will see four sheet metal screws which secure the black trim cover to the CLIP Plus chassis. Remove these four screws and carefully remove the cover. Set this piece to one side.

D. Disconnect the multi-colored ribbon cable from the control panel and set the panel face down on a clean, padded surface. With the control panel removed, you will be able to look directly into the CLIP Plus.

E. Hold the CLIP Plus over the mounting bracket protruding from the front of the comparator and have an assistant thread the control cables through the hole in the back of the CLIP Plus chassis.

F. The CLIP Plus may now be carefully slid into position over the mounting bracket and secured with the three wingnut thumbscrews provided.

G. Match the number/letter coding on the control cable plugs to the corresponding codes on the macks protruding from the printed circuit board in the bottom of the CLIP Plus. For your convenience, the plug and jack codes are as follows:

PLUG	JACK	FUNCTION
P4	J4	DC Input
P6	J6	X Scale Input
P7	J7	Y Scale Input
P8	J8	Rotary Screen Input

The plugs and jacks may now be connected.

F. If the Projectron III option has been selected, you will find a black ribbon cable included with the control cables. This cable will be plugged into the corresponding terminal strip protruding from the right hand edge of the piggy-back board mounted on the underside of the control panel.

G. Reconnect the ribbon cable to the control panel and very carefully set the panel into position on the CLIP Plus chassis. Place the black trim cover into position over the CLIP Plus, and secure with the four sheet metal screws provided.

The basic set-up of the CLIP Plus computer, as applied to the OQ-14A, is now completed.

INSTALLING CLIP PLUS — OQ-30

The OQ-30 comes to you with CLIP Plus already installed. However, the encoder cables for the X and Y movement are not connected. This situation exists because the worktable and its associated cables are shipped in a separate container. Once the worktable assembly has been attached to the mainrame of the OQ-30, the encoder cables may be connected as follows:

A. Look under the CLIP Plus mount protruding from the front of the OQ-30 and you will find a sixteen inch wide access door. This door is hinged at its back side (nearest OQ-30) and is secured by a slotted screw on its leading edge. Loosen this screw and very gently swing the door down and back.

B. Attached to the inside surface of the door is the CPU board. In the upper right corner of this board you will see the two jacks (J5 and J7) to which the X and Y encoder plugs (P6 and P7) must be connected.

Connect these plugs and close the access door. Tighten the slotted locking screw and the job is completed.

Once the power and control cables are connected, CLIP Plus may be powered-up for diagnostic tests.

Note: No installation instructions are needed for our other projectors as these come with CLIP Plus fully installed and plug-coupled.

CLIP Plus Operation And Service

The Clip-Comp Data Assist System interfaces directly to CLIP Plus through the RS–232 coupling which is located on the bottom or back of the CLIP Plus housing. Look at the back of the computer and you will find an outlet labeled "Data Communications." Find the interface cable marked RS-232 and plug the appropriate end into this outlet. Plug the other end of this cable into the RS-232 outlet on the bottom of the CLIP Plus. Refer to the HP user manual and connect the rest of the Clip-Comp components together with the appropriate cables. Plug the AC line cords from the Clip-Comp system into approved ground protected outlets and the basic hook-up is completed.

THEORY OF OPERATION

This section concerns troubleshooting the electronic components of the CLIP Plus Vision Computer. Only a qualified technician with considerable experience in integrated circuit repair should be authorized to perform these tests.

We will first describe theory of operation of the system, and then follow with a full troubleshooting guide.

POWER SUPPLY

The self-contained switching power supply plugs into J4 on the CPU board, and provides +5 VDC and +/– 12VDC for the CPU, display PCB, and Projectron III.

CPU BOARD

All machine functions are controlled by the Motorola 6809 microprocessor (U5) on the CPU board. The functional areas of the CPU board are as follows:

1. Input/Output (I/O)
2. Memory
3. Control

INPUT/OUTPUT

This functional area of the CPU board may be broken down further into On-board I/O and Off-board I/O.

- On-board I/O includes:

    1. Glass Scale input.
    2. Serial communications
    3. Parallel I/O.

GLASS SCALE INPUT

The input from the glass scale is a quadrature square wave comprising two channels — A and B. The lead/lag relationship between the Channel A and Channel B signals indicates the direction of encoder rotation. These signals are input to the prescaler circuit on the CPU board.

The prescaler functions as an eight-bit signed accumulator, counting up or down, from zero, as the Channel A and Channel B inputs are translated to count-up and count-down signals.

Each count is directly proportional to the displacement of the scale. To prevent the prescaler from overflowing, its contents are read frequently. Each time it is read, the contents are added to a tally. The tally contains the total number of encoder counts accumulated since a "zero" button was last pressed. Reading the prescaler automatically causes the value in the prescaler to be reset to zero.

There is a prescaler input for each axis. All machines have X and Y axes. All models have P axis capability, but require additional P axis hardware (protractor display, screen ring encoder, etc.) to show protractor information.

SERIAL COMMUNICATIONS

The CLIP Plus Vision Computer features a serial port with RS-232 compatible voltage levels and is considered data communications equipment (DCE). DCE transmits data on the standard DB-25 connecter pin 3, and receives data on pin 2. CLIP Plus should be connected to data terminal equipment (DTE), which receives data on pin 3, and transmits on pin 2.

A four-bit D type latch (U12), controlling a baud rate generator IC (U11) allows the baud rate to be programmed from the CLIP Plus keyboard, via the "modify parameters" procedure.

Parallel-to-serial data conversion (and vice versa) is accomplished by a Motorola Asynchronous Communications Interface Adapter (ACIA: U13). Line driver and line receiver ICs (U9, U10) shift the TTL signal levels to RS-232C compatible signal levels.

PARALLEL I/O

A Motorola Peripheral Interface Adapter (PIA) — (U15) is used for parallel I/O. Port B is used for spare inputs. Both Port A and B are buffered (U18, 19).

- Off-board I/O includes these other P.C. boards:

    1. Keyboard/display P.C. Board
    2. Projectron Interface Board

MEMORY

16K of RAM (U2) is available for the microprocessor stack and "scratchpad" memory. An 8K EEROM (U1) is used to store the information in "program" memory, as well as the parameters unique to the machine. The operating machine program and utilities are stored in two 16K x 8K EPROMs: ROM0 and ROM1.

The program which runs the machine is stored in ROM0 and ROM1 (U3, U4). ROM1 (U3) also contains the floating point math utilities.

CONTROL — INTERRUPT TIMER

A 555 timer circuit (U16, C21, C22, R6, R7) wired to the PIA produces interrupt pulses every 1.75 milliseconds. When interrupted, the 6809 reads the prescalers before continuing program execution.

WATCHDOG TIMER

To ensure that the program is running properly, the reset line is gated with a count-down timer. The timer is reloaded (by writing to a specific address) each interrupt cycle. If the 6809 "gets lost" (noise, etc.) and the interrupt routine is not running, the 6809 will reset after 28 ms (16 counts X 1.75 M-sec/count). The watchdog components are U47, U48.

KEYBOARD/DISPLAY P.C. BOARD

The keyboard/display P.C. board is the primary means by which the user and CLIP Plus communicate. Input from the keyboard allows the user to inform the machine of the desired action to be taken. Output via the two seven-segment LED displays, protractor display, block legend LEDs, and LEDs on the keyboard allows CLIP Plus to inform the user of the current machine status.

The membrane keyboard plugs into the keyboard/display P.C. board with single-row connectors.

KEYBOARD

The function of the keyboard/display P.C. board is to interface the membrane keyboard to CLIP Plus. This involves two tasks:

1. Lighting the proper LEDs on the membrane keyboard, and
2. Allowing the CLIP Plus to determine which key, if any, is pressed.

LIGHT EMITTING DIODES — LEDS

Each LED on the membrane keyboard is represented as a bit in a particular memory location. Four bit D-type latches are used on the keyboard/display P.C. board to retain the status (on/off) for each LED. The LED bits are active (LED ON) when low.

KEYS

All keys form a matrix of rows and columns. Each column is represented as a bit in an output byte from the keyboard/display PC board.. Each row is represented as a bit in an input byte to the keyboard/display PC board.

The matrix is scanned by writing a "low" (0V) to only one column at a time, then reading the row byte. Each row is a bit in the row byte and is normally pulled up to +5V. When a key is pressed, the column and row associated with that key are shorted together. If the column happens to be the one currently selected (has a "low" written to it), the bit in the row byte, associated with the key which has been pressed, will be forced to the low (0V) state.

If any bits are low in the row input byte, a key is currently pressed. The bit which is low determines the row in which the key was pressed. The column is identified by the currently selected column. In this way, a keystroke is detected and identified.

DISPLAY

The other function of the keyboard/display P.C. board is to light the X, Y displays, protractor display and block LED legends, as directed by the CPU board.

SEVEN SEGMENT DISPLAYS

The actual information to be displayed is written to latch/decoder/driver integrated circuits. These ICs latch the binary data, decode it to seven-segment format, and drive the individual LEDs in the seven-segment displays.

BLOCK LEDS

There are three LED light bars on the keyboard/display P.C. board. These six LEDs provide backlighting for the "not enabled", circle, angle, line, width and "edge" legends in the membrane keyboard.

Four-bit latches store the data regarding the on/off status of the LED light bars. This data is routed through an inverting relay driver IC, which actually lights the block LEDs.

COMMAND SUMMARY

All commands *to* the CLIP Plus via the RS-232 interface must be terminated with an ASCII carriage return character (CR) optionally followed by an ASCII line feed character (LF). CLIP Plus recognizes both UPPER and lower case characters. Remember this, if it seems that the CLIP Plus is not responding to a command.

Some special commands deserve explanation:

SEEK

Send to the CLIP Plus Vision Computer a destination whose coordinates will take the center-line past the edge of interest.

X^+00.0000Y+00.0000G<CR><LF> — or —
X+00.0000Y^+00.0000G<CR><LF>

The "^" indicates the axis in which to seek the edge.

CLIP Plus responds:

"X+00.0000 Y+00.0000 *LD*<CR><LF>" Valid edge location
"X+00.0000 Y+00.0000 *FL*<CR><LF>" Failed or missed edge

NEARPOINT

Tells CLIP Plus at what distance (relative distance, not an absolute position) to stop (short of the nominal edge location given in a "SEEK" command) before actually arming Projectron to find the edge. Normally CLIP Plus is sent a "NEARPOINT" followed by a "SEEK" command. If no nearpoint is specified before a "SEEK" command, a default "NEARPOINT" is 0.100 inches.

Send to CLIP Plus the desired "NEARPOINT": X+00.0000Y+00.0000N <CR><LF>
No response from CLIP Plus

CLEAR MACHINE

Send to CLIP Plus:

X0Y0I<CR><LF>

CLIP Plus places zeroes in the X and Y displays

MODIFY PARAMETERS

Send to CLIP Plus: c<CR><LF> {Lower case C}

CLIP Plus enters "Modify Parameters" mode.

Send to CLIP Plus while in "Modify Parameters" mode: C<CR><LF> {upper case C}

CLIP Plus exits "Modify Parameters" mode, resumes normal operation.

Send to CLIP Plus while in "Modify Parameters" mode: T<CR><LF> {Upper case T}

CLIP Plus initiates a "Parameter Dump" via the RS-232 port. (See "Modify Parameters" procedure.

PROJECTRON DIAGNOSTICS

Send to CLIP Plus: jj<CR><LF> {Lower case "jj"}

CLIP Plus enters "Projectron Diagnostics" mode.

PRINTING

All messages *from* CLIP Plus are terminated with <CR><LF>. Zeros are shown in the example command lines to show the format of the numbers. The commands which result in printed output are T (Print key) and P (no keyboard equivalent — used by CLIP-Comp calculator).

P produces this result: "X+00.0000 Y+00.0000 **<CR><LF>," where X and Y are in *machine* coordinates.

T produces this result: "X+00.0000 Y+00.0000 *POSITION * where X and Y are in *part* coordinates

KEY CODES

Each CLIP Plus key has an ASCII equivalent, which means that a remote computer can exactly simulate an operator pressing keys. On the following page is a list of the key codes and typical responses.

ASCII Code	*Key (if any)*	*Typical Command Line* **(<CR>=Carriage Return)**
A	Auto Go	B01A<CR>
B	(Block counter information follows)	B01<CR>
C	Clear	C<CR>
D	(Enter Modify Parameters mode)	D<CR>
E	Enter	E<CR>
G	Go To	B01G<CR>
I	Inch	I<CR>
J	(Joystick button pressed)	J<CR>
K	Clear memory	B01K<CR>K<CR>S<CR>
M	mm	M<CR>
N	(Set nearpoint)	X+00.0001 Y+00.0001N<CR>
P	(Print Machine Coordinates)	P<CR>
Q	(Query mode)	Q<CR>
R	Recall	B01R<CR>
S	Store	S<CR>
T	Print (prints Part Coordinates)	P<CR>
U	X Zero Set	U<CR>
V	Y Zero Set	Y<CR>
W	(Wall effect modification)	X+00.0001 Y+00.0001 W<CR>
X	X	X1.5<CR>
Y	Y	Y1.5<CR>
Z	(X & Y Zero command)	Z<CR>
a	Abs Zero	a<CR>
c	Circle	B01cR<CR>R<CR>E<CR>E<CR>E<CR>T<CR>cT<CR>c<CR>
d	Dec Degrees	d<CR>
e	Edge	eh<CR>
h	Up arrow	eh<CR>
i	Inc Zero	i<CR>
j	(Projectron Diagnostics if another j follows)	j<CR>j<CR>
l	Line;	B01lR<CR>R<CR>E<CR>E<CR>T<CR>lT<CR>l<CR>
m	Deg Min	m<CR>
p	More Points	B01cpE<CR>E<CR>E<CR>E<CR>E<CR>E<CR>Ec<CR>
r	Dist Back	B01R<CR>R<CR>r<CR>
s	Axis Align	X.1Y.1G<CR>s<CR>
v	Angle (Vertex)	B01vR<CR>R<CR>E<CR>E<CR>E<CR>E<CR>T<CR>vT<CR>v<CR>
w	Width	B01wR<CR>R<CR>E<CR>E<CR>E<CR>T<CR>wT<CR>w<CR>
y	Down Arrow	ey<CR>
z	Polar Back	B01R<CR>R<CR>z<CR>
0-9	0-9 digit entry	X1G<CR>
.	. (decimal point, advance)	X1.5<CR>
-	- (minus sign, back up)	Y-1.5<CR>
<	Left Arrow	e<<CR>
>	Right Arrow	e><CR>
^	(Seek identifier this axis)	X^1.5G<CR>
*	Comment delimiter	*This is a comment, ignored by CLIP Plus*<CR>

PARAMETER DUMP

Previously we mentioned creating a printout of a parameter dump. A parameter dump printout provides us with a listing of all twenty-eight parameters and their respective values.

To create a printout of a parameter dump, do the following:

A. Connect a serial printer to the RS-232 port located on the underside of the CLIP Plus chassis. Ensure that the baud rate of the printer matches that of parameter number 05. Turn on the main power switch to your projector.

B. Go to the CPU option switch (labeled S1) inside the CLIP Plus, and carefully move slider number eight forward. The red LED immediately to the right of the switch will begin to glow.

C. Press the print button, and the printer will create one copy of the parameter listing as shown on the following page.

D. Once the printout has been created, return slider number eight to the OFF position, and disconnect the printer from the RS-232 serial port.

Never power-down when the red LED is illuminated. The memory of the CLIP Plus may be corrupted. If this happens, the parameters will have to be re-programmed.

CLIP PLUS PARAMETER DUMP

DATE____________

MACHINE MODEL & S/N_______________

READOUT S/N_________________

ROMO, ROM1 Firmware Version: 01.04 06-10-87

PROJECTRON INTERFACE

```
      1=OFF---SWAPS SIGN OF X WALL EFFECT
      2=OFF---   "    "   " Y  "     "
      3=OFF---N/A
      4=OFF--- "
      5=OFF--- "
      6=OFF--- "
      7=OFF--- "
      8=OFF--- "
```

CPU OPTION SWITCH S1 CONTENTS:

SLIDER #, FUNCTION WHEN 'ON'.

```
      1=OFF---POLAR AXIS SWAP
      2=OFF---HIGH RES.00005 IN. .001 MM
      3=ON----ENABLES PROJECTRON INTERFACE
      4=OFF---X,Y SIGN SWAP ^>=+
      5=OFF---ECHOES RS-232  INPUT, OFF FOR CALCULATOR
      6=OFF---OFF FOR CLIP PLUS, ON FOR DI-METRIC  4 SW 6
      7=OFF---DISABLES 0/5 INCH, 0/2 MM DISPLAY ROUNDOFF
      8=OFF---WRITE ENABLES EEPROM, NORMALLY 'OFF'
```

PARAMETERS AS STORED - CAUTION: DO NOT OPERATE IF ANY "?" MARKS APPEAR IN THE DATA AS THEY FLAG UNINITIALIZED DATA WHICH SHOULD BE SET VIA THE MODIFY PARAMETERS PROCEDURE!!!

PARAMETER NUMBER	BYTE#,VALUE 123456789	FUNCTION
01	0.7874016	X Encoder Factor, U21 Mult=X1-X2-X4, rev pin=in-out
02	0.7874016	Y Encoder Factor, U23 Mult=X1-X2-X4, rev pin=in-out
03	1	Sign of squareness runout, 0=+,1=-
04	0.5	Squareness runout, 10 micro inch/inch increments
05	07=1200/1	RS-232 BAUD rate/stop bits
06	1	1=AC SERVO
07	0	1=ANALOG 650/550 SERVO
08	0	1=DIGITAL SERVO
09	0.00010	Default PJ X axis wall effect
10	0.00010	Default PJ Y axis wall effect
11	0.016	Default PJ near point
12	0	X SERVO sign, 0=+, 1=-
13	0.10	X SERVO ramp start point
14	02	X SERVO creep speed
15	6	X SERVO accel constant
16	04	X SERVO manual arrow jog speed
17	04	X axis seek speed
18	0	Y SERVO sign, 0=+, 1=-
19	0.10	Y SERVO ramp start point
20	25	Y SERVO creep speed
21	6	Y SERVO accel constant
22	07	Y SERVO manual arrow jog speed
23	07	Y Axis Seek Speed
24	0.13	Keystone Corrector
25	010.77882	P ENCODER FACTOR, U38 MULT=X1-X2-X4, REV> PIN=IN-OUT
26	050	AUTO GO DWELL
27	0	DEFAULT INCH/MM UNITS, O=IN, 1=MM
28	1	DEFAULT PROT RING MODE, O=DEC DEG, 1= DEG/MIN

Troubleshooting Guide

This Troubleshooting Guide lists causes of an observed condition from most probable to least probable. Check all items listed in the guide before attempting further troubleshooting.

PROBLEM	PROBABLE CAUSES	SOLUTION
Readout inoperative (No LEDs, no table motion)	No logic supply voltage	Check remote power supply to be sure it is getting AC power.
	+5 VDS, +12 VDC, or −12 VDC supply not functioning	Refer to +5, +12, −12 VDC test points on CPU board.
	Bad power logic cable connection	Check P4 on CPU Board. If voltage not present, replace power supply.
	Defective I/O ribbon cable/connector	Check 50-conductor ribbon cable from CPU board to keyboard display PCB.
All LEDs on, no keyboard functions	Program on CPU not running. Defective CPU	Replace 6809 CPU.
	Defective crystal	Verify 4.0000 MHz. If not present, replace X1.
System functions normally, then stops. Displays show E with some number following.	Defective CPU if number is 1,2, 3, or 4	Replace 6809 on CPU PCB.
	IRQ failure if number is 8	Check for 1.75 msec pulses at U16, pin 3. If present, check for similar signals at IRQ test point (above U15). If not present, replace U15.
After readout has been operational for a while, one axis display lights. The other is dark, and the projector stops functioning.	Defective crystal on CPU PCB	Check frequency of X1. If none, replace X1 or U5 on CPU PCB.

PROBLEM	PROBABLE CAUSES	SOLUTION
After readout has been operational for a while, one axis display lights. The other is dark, and the projector stops functioning.	Defective IRQ timer on CPU PCB	Check for 1.75 msec pulses at U16 pin 3. If not present, replace U16 and C21. If present, check at IRQ test point. If not there, replace U15.
One axis stops counting.	Corrupted encoder factor	Verify parameters 01, 02, and 25.
	Defective encoder	Swap encoder cables at CPU. If problem changes axis, replace that encoder.
	Defective counting circuit on CPU PCB	Square wave inputs should be at channels A and B when table is in motion. Use oscilloscope to trace these through the rest of the circuit.
X or Y axis loses counts.	Defective counter on CPU PCB	Replace U22 or U24 on CPU PCB.
	Defective encoder	Swap X and Y encoder cables at CPU PCB. If problem goes into other axis, replace encoder.
	Wrong parameters	See section pertaining to parameters.
Device connected to serial port is inoperative.	Wrong switch setting	Locate switch S1 on CPU PCB. Slider number 5 must be ON.
	Improper baud rate	Verify correct baud rate selection. See section on parameters.
	Wrong cable used (terminations)	See command summary for correct pin assignments.
	Defective line drivers	Check frequency at U13 pins 3 and 4 on CPU PCB. Should be 16 times the desired baud rate. If not, replace U11 and U12.

PROBLEM	PROBABLE CAUSES	SOLUTION
Erroneous display(s), false codes.	Defective display decoder/driver ICs	Replace U4 if false codes are on left side of displays. Replace U5 if false codes are on right side of displays.
False LED patterns and bar displays.	Switch S1-6 set to wrong position	Check switch and correct.
	Defective bus transceivers	Replace U15 and U6 on display PCB.
Readout starts normally, then stops.	Address problem on CPU PCB detected	Possibly defective U6, U8, U12, U13, U14, U15, U20, U32, U33, U42, or U44.
Keyboard switches inoperative.	Defective switch	Send switch panel to OGP for replacement.
	No tone generator	Replace defective component.
Tables take off in any direction upon power-up.	Defective "arrow' button on keyboard	Check switch on keyboard.
	Defective driver on power supply/motor drive	See schematic for P/S details.
	Defective DC servo port (high speed servos)	If tables stop with P2 disconnected on CPU PCB, replace U18, U19, or U15.
	Defective joystick	Unplug P4 on CPU PCB. If stage stops, replace joystick.
	Analog circuit failure (not for OQ-14A)	Disconnect power P4 from CPU PCB. Listen for relay click when P4 is reinserted in PCB. If no click is heard, replace relay K1. If relay energizes, relay is not the problem; check Q1.

PROBLEM	PROBABLE CAUSES	SOLUTION
Tables take off in any direction upon power-up.	CPU failure	Disconnect P4 from CPU PCB and then reinsert. If relay clicks and table moves, check U15 pin 10. A logic high means CPU is controlling the relay. A logic low means the CPU is not addressing the relay. Check U17 pin 3. A high indicates replacement of U17 needed; low indicates replacement of Q1 needed.
Will not stop on edge. Y display shows HL. More than 8.0 VDC detected at cyclops board test points.	Too much light	Turn surface illumination off. Use appropriate filter. Adjust collimator lens. Adjust cyclops gain.
	Excessive line voltage	Regulate AC line voltage.
Stops on some edges, misses others.	Light level near high or low threshold level	Change light level.
	Edge out of focus	Adjust focus. Center projection lamp.
	Cyclops board out of adjustment electronically	Adjust gain pots on cyclops board.
	Projectron interface board out of alignment. Sum null voltage not 0 volts +/– tolerance	Adjust pot R3. If unable to adjust with R3, then replace projectron interface board.
	Conditions: 1. Tolerance is 10% of detector output voltages at cyclops board. 2. Measure sum null voltage when in a shadow seek mode on both X and Y axes.	

PROBLEM	PROBABLE CAUSES	SOLUTION
Stops on some edges, misses others.	3. Screen must be unobstructed (Full light condition).	Turn off surface illumination. Check optical path for obstructions.
	4. Cyclops board output voltages must be matched to within 10% of each other.	
	Poor shadow contrast	
	Part size	Minimum screen image of .2 inch required in axis being measured.
	Part geometry	Shadow edge must form angle of 30 degrees or more with axis of measurement being used.
Shadow edge stops slightly off screen center line.	Table overshoot due to inertia	Normal condition. No action required — accuracy of measurement is not affected.
Shadow edge detects location slightly off viewing screen centerlines.	Viewing screen not centered	Center viewing screen.
	Projectron sensor head not centered to viewing screen centerlines	Center projectron sensor head.
	Large wall effect condition	Modify wall effect correction factor.
Measuring error.	Collimation lens set incorrectly	Adjust collimator lens
	Part out of focus	Adjust focus.
	Incorrect wall effect correction factor	Modify wall effect correction factor.
	Surface illumination on	Turn surface illumination off.
Cyclops board has no output at some test points, or more than +/– .15V of offset.	Defective cyclops board	Replace cyclops board.

INDEX

Feedback Form/Problem Report

Please return this form with your comments regarding the manual, features of the program, and reports of any software or operational problems you may encounter, so that we may continue to offer the best products possible. Thank you!

Feedback Section

Comments on the CLIP Plus software: ______________________________

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Comments on the CLIP Plus manual: ______________________________

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Suggestions for improvement to the package: ______________________

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Suggestions for improvement to the manual: ______________________

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Problem Report

Date: ____

Time: ____

Type of Problem: ______________________________________

____

What you were doing when the problem occurred: ________________

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Notes: ____

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Please complete and return this form to:

Optical Gaging Products Inc.
850 Hudson Avenue
Rochester, NY 14621

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Feature	Coordinates (Program) X Y	Block #	Coordinates (Data) X Y	Block #	Deviation

We at Optical Gaging Products Inc. believe this manual will assist you in the use of your CLIP Plus Vision Computer. In creating this manual, our primary objective was to ensure that every facet of operation and maintenance was covered as comprehensively as possible. Should questions arise that are beyond the scope of this manual, please do not hesitate to contact your authorized Optical Gaging Products, Inc. representative, or contact us directly:

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