

Di-Metric Plus

*Geometric Digital Readout
Reference Guide*

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About This Guide

Welcome!

Optical Gaging Products (OGP) has produced this Reference Guide as part of its ongoing effort to provide users with useful, comprehensive documentation. This guide has been developed using new documentation standards and a new document design that enhances readability and makes it easier to find information.

We believe this guide will assist you in the use of Di-Metric Plus. If you should have any questions that are beyond this document's scope, please do not hesitate to contact your authorized OGP representative or OGP directly.

Organization

The *Di-Metric Plus Reference Guide* contains the following sections:

About This Guide (this section), describes this guide's content and organization, lists related publications, explains the documentation conventions used, and discusses the applicability of this guide to OGP Contour Projectors equipped with Di-Metric Plus which may no longer be in production.

Section 1, Introduction, provides a general overview of Di-Metric Plus. It also includes information about technical support and customer service.

Section 2, User Interface, describes all the components which are part of the user interface. This includes the control panel, joystick, and the optional Projectron III Automatic Edge Detection System and serial devices.

Section 3, Getting Started, introduces important preliminary concepts and conditions which must be understood before you can begin to use Di-Metric Plus. This section begins with a discussion of measurement concepts, including the Cartesian Coordinate System, and proceeds to an overview of finding points visually and by using Projectron.

Section 4, Using Di-Metric Plus, explains the best way to actually use Di-Metric Plus. Subjects covered include part staging and setup, setting an origin, axis alignment, and measuring Cartesian distances, lines, widths, circles or arcs, and angles. Also included is a special discussion of the **Store** and **Dev** buttons.

Appendix A, Filters and Collimator Lenses Used with Projectron III, contains a table to guide you in selecting the correct optics when you are using automatic edge detection.

Appendix B, Power-Up Self-Test and Diagnostics, describes a normal Di-Metric Plus power-up/self-test sequence, and also lists and defines codes which may be displayed by Di-Metric Plus.

Appendix C, Power Supply Checks and Adjustments, tells you where to find the Di-Metric Plus power supply, how to gain access to it, how to check its voltage output, and when and how to adjust that voltage.

Appendix D, CPU Option Switch Settings, introduces you to the CPU Option Switch (S1) which is mounted on the CPU board, describes its exact location and tells you how to access it, defines its purpose, and also defines the CPU options that it controls.

Appendix E, Microprocessor Parameters, defines the parameters that Di-Metric Plus requires to operate, and also lists and explains in detail the eleven parameters that are most important to you, the user. This appendix also describes how to view and print out current parameters, and when and how these parameters should be modified.

Appendix F, Projectron III Calibration, is a detailed discussion of the way the Projectron system works, and addresses such topics as key system components, mechanical adjustments, and electronic adjustments and calibration.

Appendix G, Understanding Di-Metric Plus Angle Calculations, examines the way Di-Metric Plus looks at angles, how angles appear different to Di-Metric Plus depending upon which quadrant they fall in, and how point entry order makes a difference in angle calculations.

Appendix H, Command Summary, shows how the Di-Metric Plus control panel buttons are functionally interchangeable with a PC keyboard, and goes on to demonstrate how you can use a PC to communicate with Di-Metric Plus.

Appendix I, Troubleshooting, uses a diagrammatic format to help you isolate the root of problems that may occur during a Di-Metric Plus work session, and goes on to prescribe probable solutions.

Related Publications




In addition to this guide, OGP provides the following documentation related to Di-Metric Plus:

- *SmartCheck Reference Guide*, (P/N 790060).
- *QL Series Contour Projectors Operation and Maintenance Manual*, (P/N 426295).
- Standard training reticle (P/N 790012) for testing and self training. This is used in most examples in the reference guide.

For a complete list of OGP documentation, contact your OGP sales or service representative.

Documentation Conventions

To help you locate, interpret, enter or select information easily, this guide uses consistent visual cues and standard text formats. For example, capital letters (or upper-case letters) are used to call attention to certain words and to help eliminate confusion and ambiguity. These documentation conventions are explained in the following table.

Type Style or Symbol	Used for	Examples and Explanations
bold or <i>italic</i>	<ul style="list-style-type: none"> Emphasized words 	<ul style="list-style-type: none"> Do not repeat this step Select <i>highest</i> possible magnification level
Bold, sans-serif typeface with Initial Caps	<ul style="list-style-type: none"> Buttons to be pressed 	<ul style="list-style-type: none"> Press the Print button
Initial Caps	<ul style="list-style-type: none"> Proper nouns Product names Comparators Sections, figures 	<ul style="list-style-type: none"> Use the Search Function Di-Metric Plus Contour Projectors See Section 1
ALL CAPS	<ul style="list-style-type: none"> Acronyms 	<ul style="list-style-type: none"> ASCII; OGP
○	<ul style="list-style-type: none"> Unlit LEDs on control panel buttons 	
●	<ul style="list-style-type: none"> Lit LEDs on control panel buttons 	
◐	<ul style="list-style-type: none"> Flashing LEDs on control panel buttons 	

Applicability of this Guide

The QL-20 and QL-30 are the models of OGP Contour Projectors currently in production which are equipped with Di-Metric Plus. This reference guide is written specifically for those two models.

However, we recognize that there are many other models of OGP Contour Projectors in the field that are equipped with Di-Metric Plus. Your model may be one of them. If you have one of these “older” models, you may notice the following differences:

- Your Contour Projector may have a horizontal, rather than a vertical, control panel.
- Major electronic components may be in different locations than what is described in this guide.
- Some repair, troubleshooting, and calibration procedures may not be the same for your model as what is documented in this guide’s Appendices.
- Some Di-Metric Plus equipment which is now standard may have been optional in the past.

Most of the time, these minor differences will not affect the performance of Di-Metric Plus on your Contour Projector. Regardless of machine configuration, Di-Metric Plus controls and operations always work in the same way.

These differences will be important, though, if you need to perform repair, troubleshooting or calibration of your Contour Projector. If you want to do any of these maintenance tasks yourself, consult this guide first. If this guide doesn’t make sense for your task, refer to the technical manuals that were shipped with your Contour Projector. And, as always, you are welcome to contact the OGP Service Department or other authorized OGP representative directly for help.

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This section provides an overview of Di-Metric Plus and describes its features and benefits. It also lists important hardware and software considerations.

What Is Di-Metric Plus?

Di-Metric Plus is a powerful, microprocessor-based measurement system that couples advanced electronic technology with conventional measurement methods. All OGP Contour Projectors equipped with power drives can use Di-Metric Plus. This measurement software is easy to use and will significantly increase your productivity.

Di-Metric Plus combines the features of advanced electronics, the clarity of a well-designed control panel, and the versatility of a joystick to make optical inspections extremely easy. With Di-Metric Plus you can measure parts quickly, precisely, and accurately.

The optional Projectron III automatic edge detection system can further enhance the productivity of your Contour Projector. This system, which is integrated with Di-Metric Plus, automatically seeks and finds a shadow edge of a part. This feature eliminates the time-consuming requirement of having to manually set the centerlines to an edge. With Projectron, measurement accuracy is also improved because the edge detection system is designed to be more precise and consistent than the human eye.

Features and Benefits

Di-Metric Plus has many features that dramatically increase the versatility of your Contour Projector and provide you with a wealth of benefits. Di-Metric Plus' features and functions, which are listed below, work to contribute to your productivity and add an expanded dimension to your measurement tasks.

Features	Benefits
Supports Projectron automatic edge detection	<ul style="list-style-type: none"> • Eliminates subjective measurement judgements
Joystick	<ul style="list-style-type: none"> • Selects/cancels points quickly and easily • Moves worktable quickly
Operator-oriented control panel design	<ul style="list-style-type: none"> • Self-prompting control panel with large, bright color-coded membrane buttons • Button LEDs indicate when functions are active • Membrane buttons are shop-hardened for use in an industrial environment • Large, easy-to-read digital displays
Rich functionality of control panel commands	<ul style="list-style-type: none"> • Productivity and versatility enhanced through use of such functions as Axis Align, Store, Dev, More Points, and Abs/Inc Zero
Serial port	<ul style="list-style-type: none"> • Can output data to an optional printer • Can also communicate with a PC, allowing you to interface with a Windows™-based measurement software package, such as OGP's SmartCheck

Overview of Di-Metric Plus Components

Although Di-Metric Plus is considered a software product, it also includes various hardware and firmware components. This section provides an outline of these components, in particular the ones that you can see and touch.

Hardware Components

Di-Metric Plus comes equipped with the following hardware components.

Standard

- Joystick to control worktable movement and to enter and cancel points
- Control panel with LED displays; unit definition and origin definition functions; and arrow, point entry, and geometric functions

Optional

- Serial printer to print out Di-Metric Plus data
- PC with measurement software for fully automatic geometric measurement.

These components are described in more detail in Section 2 of this guide. Other hardware components that you typically do not see or use (such as the CPU board and CPU option switch) are described in the Appendices.

Firmware and Software Components

Di-Metric Plus comes equipped with the following firmware/software components.

Standard

- Enhanced measurement software, which performs calculations quickly and easily
- Software which has the ability to measure geometric entities such as lines, widths, angles, and circular features
- Microprocessor parameters stored in EEROM, which you can calibrate and modify as the need arises

Optional

- Projectron automatic edge detection, which allows you to quickly and accurately seek and define important part features
- Print function, which allows you to print parameters and measurement data to a serial printer

Again, these and other components are described in more detail in other sections and in the Appendices of this guide.

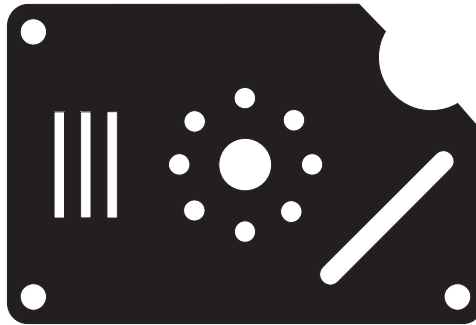
Standard Part for Measurements

OGP provides a standard part with all of its products, including Di-Metric Plus. This standard part is also known as the FastSTART reticle. You may use this reticle for testing and self training.

The OGP part number of this reticle is 790012, and it is shown in detail in Figures 1-1 and 1-2 below. As we wrote this guide, we have attempted to use the reticle as often as we could to illustrate how Di-Metric Plus works. You may in

turn wish to use the FastSTART reticle to work through the examples of this guide.

OGP FastSTART



(716)544-0400

FSTARTBL.CDR

Figure 1-1. Standard Part for Measurements, P/N 790012

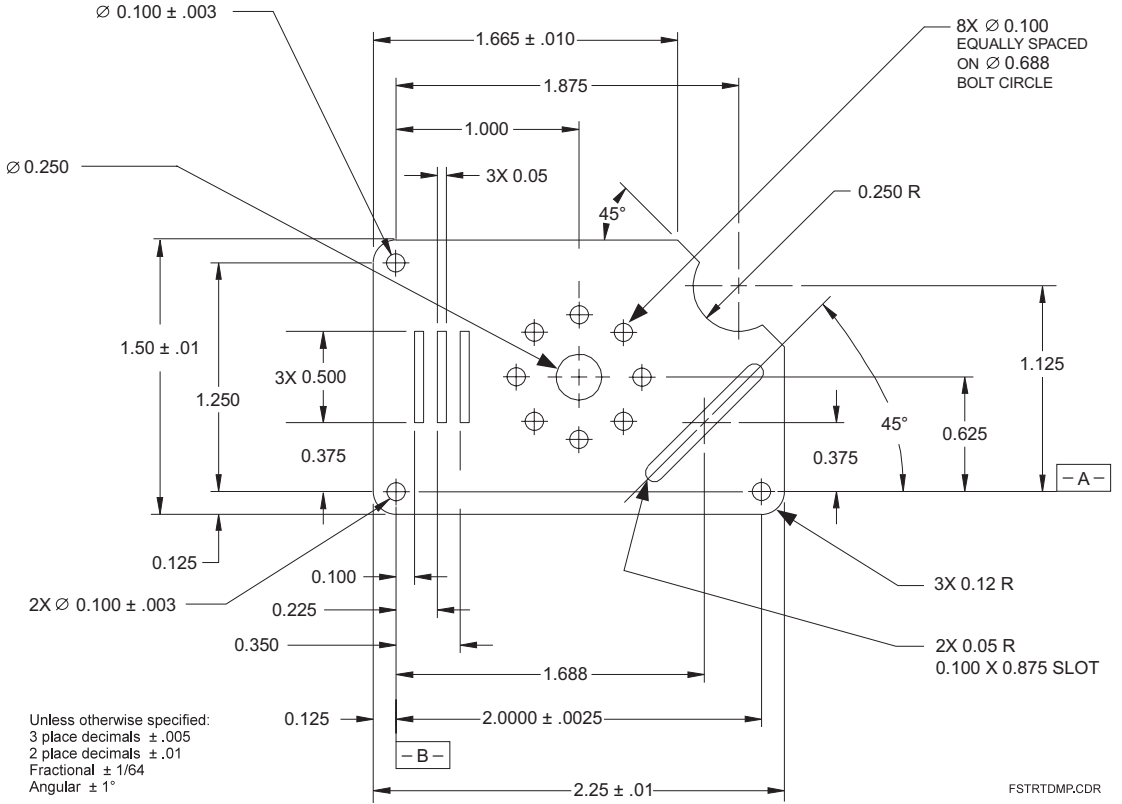


Figure 1-2. Dimensioned Drawing for OGP FastSTART Reticle

Technical Support and Customer Service

OGP offers service and support contracts that are tailored to meet your specific needs and protect the value of your investment:

- Hardware service contracts for cleaning, general inspection, preventive maintenance, and certification. Includes a discount on replacement parts and emergency service labor rates.
- Software support contracts with updates of software products, application assistance, remote diagnostics via modem (for systems equipped with PCs), and discounts on new software products.

For technical support and customer service, call (716) 544-0400.

To make the best use of Di-Metric Plus, it is important that you first become familiar with those components that you see and use whenever you measure with it. This section describes that user interface.

When you measure with Di-Metric Plus, you will use the following components most often:

- Control panel
- Joystick
- Projectron III automatic edge detector (optional)
- Serial devices (optional)

Control Panel

As implied by the name, the control panel contains all of the functions and displays that allow you to “control” Di-Metric Plus when you make measurements.

The control panel consists of several groups of brightly colored membrane buttons, and three LED digital readouts, also referred to as digital displays.

The membrane buttons have been color-coded according to function, with like colors having similar functions.

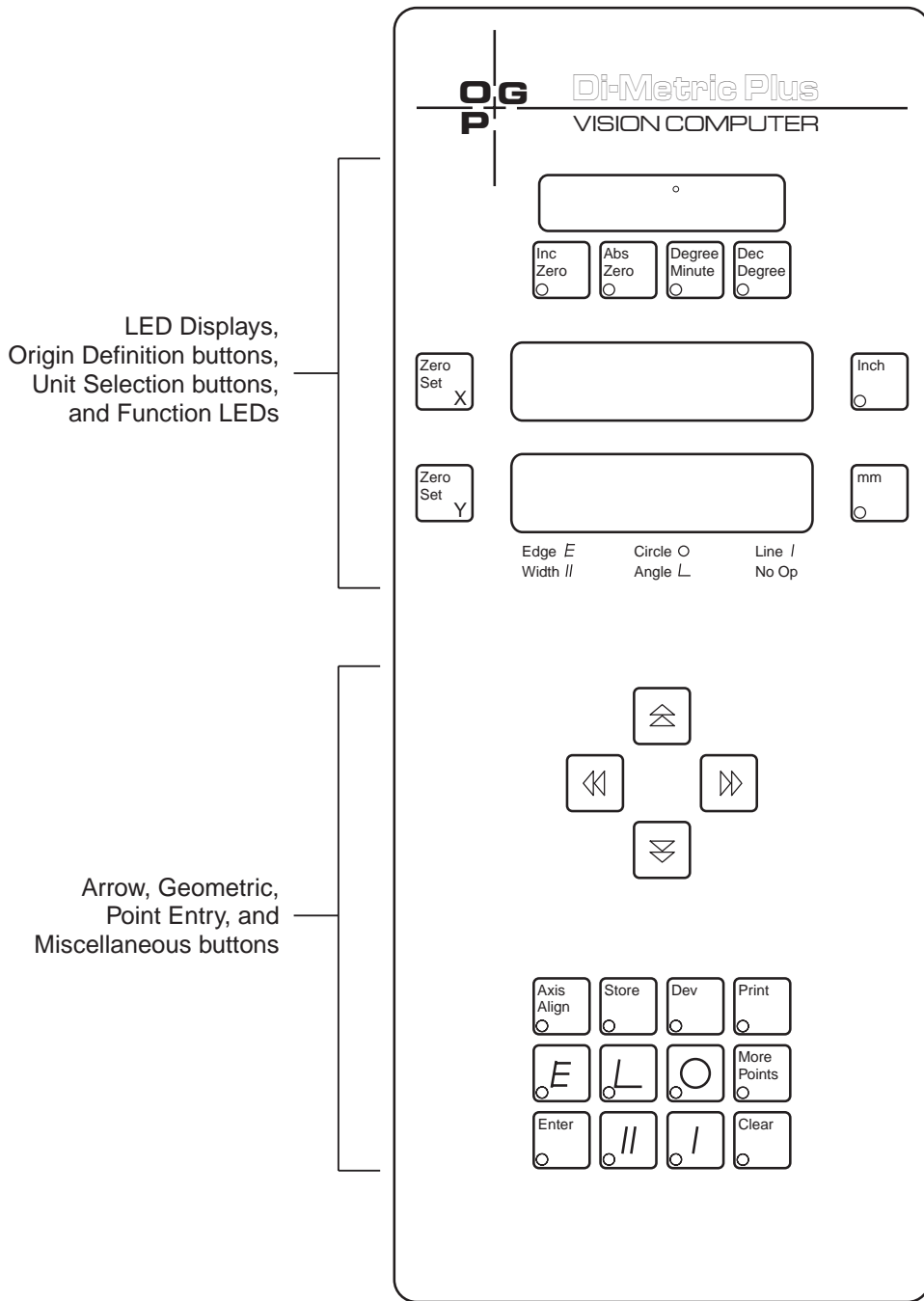
Figure 2-1 shows the Di-Metric Plus control panel in its entirety. In this figure, we have split the control panel into two parts as follows:

Top Half

- LED Displays, Origin Definition buttons, Unit Selection buttons, and Function LEDs

Bottom Half

- Arrow, Geometric, Point Entry, and Miscellaneous buttons



CPANEL.CDR

Figure 2-1. Di-Metric Plus Control Panel

LED Displays, Origin Definition, Unit Selection

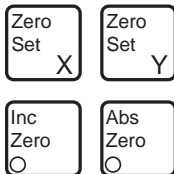
The top half of the control panel, shown in Figure 2-2, consists of three LED displays, four unit selection buttons, and four origin definition buttons. Also, directly below the LED displays, there are six function LEDs which are visible only under certain conditions.

LED Displays

The top LED display is also known as the **Protractor display**. It typically shows the current angle of the viewing screen centerlines in relation to a previously defined rotational zero point.

The bottom two LED displays are the **X and Y displays**. They usually show the X and Y position of the screen centerlines, but they also may show appropriate values of geometric functions as they are measured and defined.

Origin Definition buttons



The four origin definition buttons are in the upper left quadrant of the control panel. They are dark gray, and they consist of the following:

- **Zero Set X**
- **Zero Set Y**
- **Inc Zero**
- **Abs Zero**

These buttons all define viewing screen origins in some way:

- **Zero Set X** and **Zero Set Y** establish zero points in their respective axes
- **Abs Zero** and **Inc Zero** set absolute (permanent) and incremental (temporary) protractor zero points

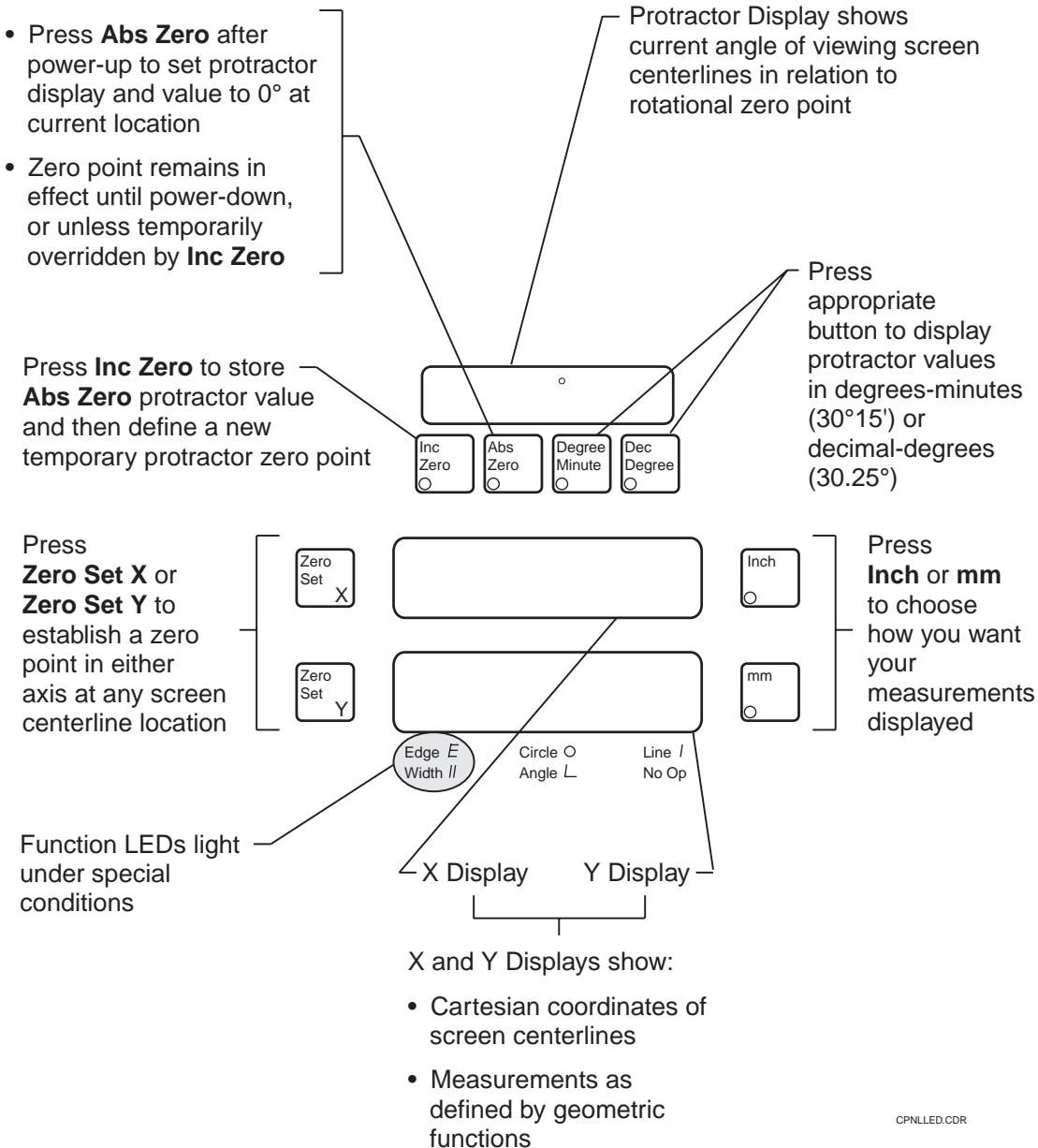
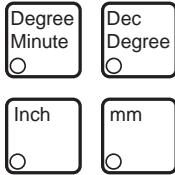


Figure 2-2. Di-Metric Plus LED Displays, Origin Definition Buttons, Unit Selection Buttons, and Function LEDs

Unit Selection buttons



The four unit selection buttons are in the upper right quadrant of the control panel. They are light gray, and they consist of the following:

- **Degree Minute**
- **Dec Degree**
- **Inch**
- **mm**

As their name indicates, these unit selection buttons affect the way that the LED displays show values:

- **Degree Minute** and **Dec Degree** buttons tell the Protractor display whether to show values in degrees and minutes, or degrees and decimals
- **Inch** and **mm** buttons affect whether the X and Y displays show values in English or metric units

Function LEDs

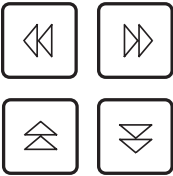
The six Function LEDs are directly beneath the Y display. They are not immediately noticeable, because they light only under certain conditions. The following table defines those conditions.

Function LED	When Activated
Width // Circle ○ Angle ∠ Line /	When geometric function has been defined with proper number of points entered
Edge E	When Projectron automatic edge finder has been activated
No Op	When any Arrow button has been pressed before Projectron was activated; or — When either Projectron button was pressed, but Projectron is not installed on your projector

Arrow, Geometric, Point Entry, Miscellaneous

The bottom half of the control panel, shown in Figure 2-3, consists of four arrow buttons, four geometric buttons, two point entry buttons, and six miscellaneous buttons.

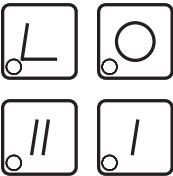
Arrow buttons



The four **Arrow** buttons are in the center of the control panel. These buttons are green.

- On current production models, these buttons work **only** when Projectron has been activated.
- When pressed and released when Projectron is active, these buttons will cause the worktable to move in the arrow direction until an edge is found.

Geometric buttons



The four geometric buttons are in the lower part of the group of twelve blue buttons at the bottom of the control panel. These four buttons have graphic icons on them. These icons represent the following four geometric figures:

- **Angle/Vertex**
- **Circle/Arc**
- **Width**
- **Line**

Angle/Vertex



The **Angle/Vertex** button is used to define two intersecting lines with a minimum of four points. See Section 4 for more detailed information on how to define an angle/vertex.

- Once you have defined an angle, the included and excluded angles formed by the lines' intersection will be displayed.
- A second push of this button will display the X and Y coordinates of the vertex.

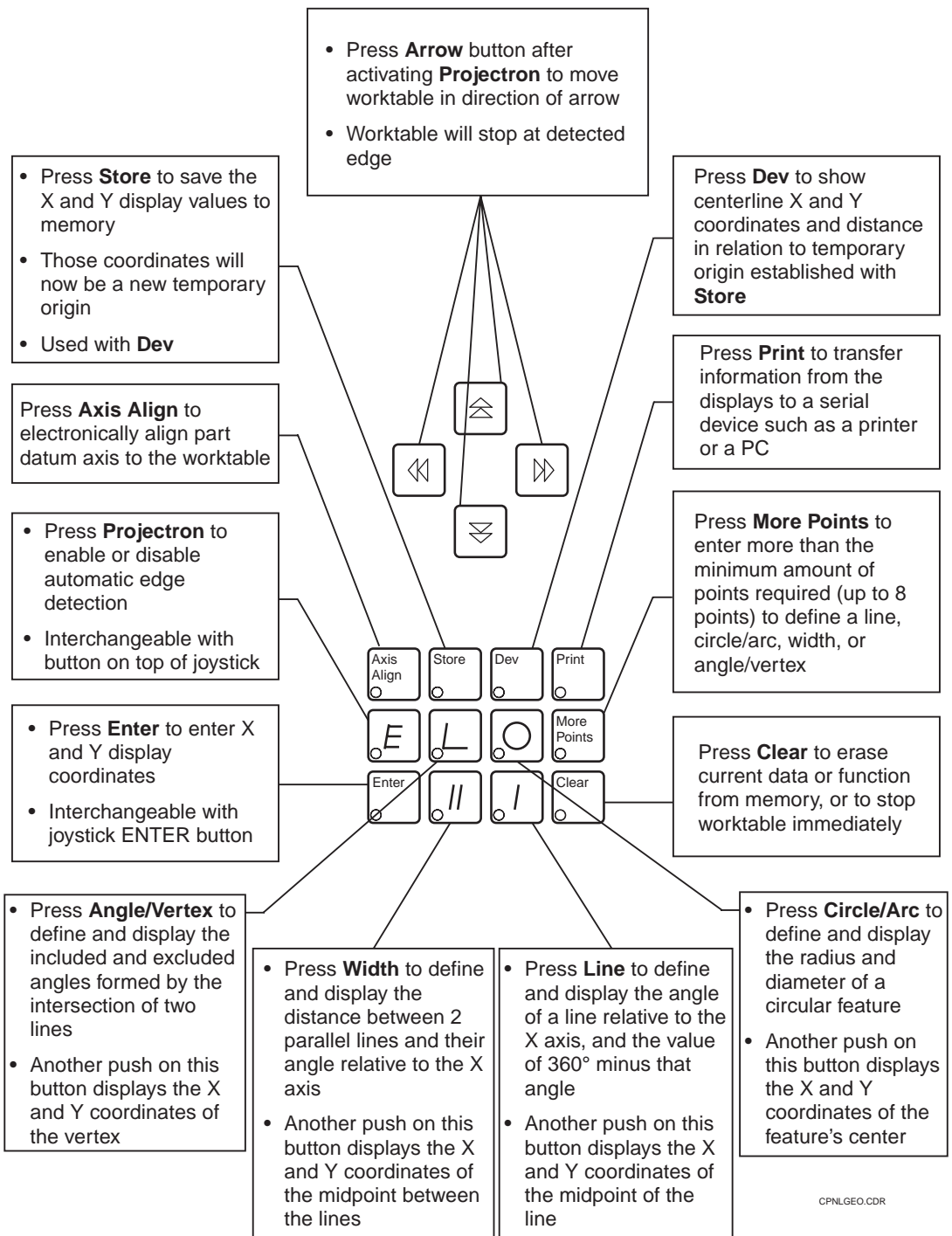


Figure 2-3. Di-Metric Plus Arrow, Geometric, Point Entry, and Miscellaneous Buttons

Circle/Arc



The **Circle/Arc** button is used to define a circle or a part of a circle with a minimum of three points. See Section 4 for more detailed information on how to define a circle/arc.

- Once you have defined a circular feature, its radius and diameter will be displayed.
- A second push of this button will display the X and Y coordinates of the feature's center.

Width



The **Width** button is used to define the distance between two parallel lines (or a line and a point) with a minimum of three points. See Section 4 for more detailed information on how to define a width.

- Once you have defined a width, the distance between the two parallel lines and their angle relative to the X axis will be displayed.
- A second push of this button will display the X and Y coordinates of the midpoint between the lines.

Line



The **Line** button is used to define a line with a minimum of two points. See Section 4 for more detailed information on how to define a line.

- Once you have defined a line, the angle of the line relative to the X axis, and the value of 360° minus that angle will be displayed.
- A second push of this button will display the X and Y coordinates of the midpoint of the line.

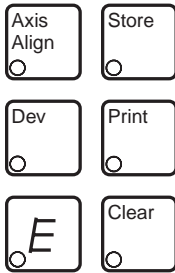
Point Entry buttons



The two point entry buttons are in opposite corners of the group of twelve blue buttons at the bottom of the control panel. See Section 4 for more detailed information regarding these two buttons.

- **Enter** is used to enter X and Y coordinates, usually as defined by the screen centerlines
- **More Points** is used to enter more than the minimum amount of points (up to eight points) required to define an angle/vertex, circle/arc, width, or line.

Miscellaneous buttons



The six remaining miscellaneous buttons are in the group of twelve blue buttons at the bottom of the control panel. They include the **Axis Align**, **Store**, **Dev**, **Print**, **Projectron (E)**, and **Clear** buttons.

- **Axis Align** is used to electronically align the part datum axis to the worktable.
- **Store** and **Dev** are used together to define a new temporary origin, and to measure from that origin.
- **Print** is used to transfer data from the LED displays to a serial device such as a printer.
- **Projectron (E)** is used to enable or disable automatic edge detection.
- **Clear** is used to erase current data or function from memory, or to stop worktable motion immediately.

These miscellaneous buttons and functions will be discussed in detail in throughout the remainder of this guide.

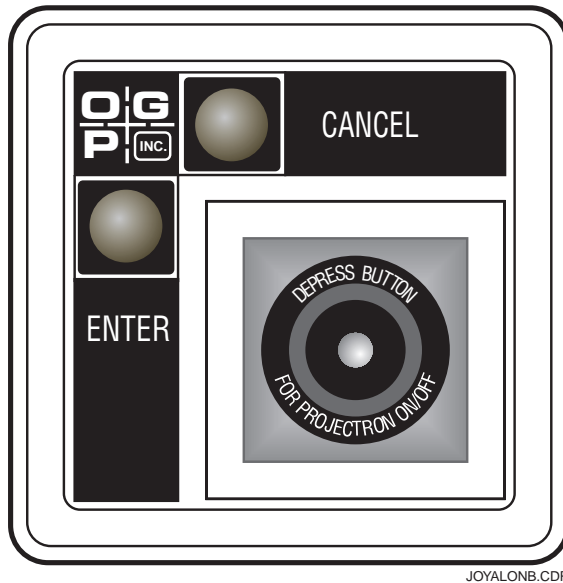
Joystick

The joystick is the primary control for all mechanical movement of the staged part. A view of the joystick is shown in Figure 2-4.

You can use the joystick to do the following:

- Use the lever to control the movement of the Contour Projector's worktable. As you move the worktable, the viewing screen image will track in the same direction as the joystick lever, as outlined below.

Move the joystick lever in this direction...	To make the worktable and screen image move in this direction...
Away from you	Up
Toward you	Down
To your right	To your right
To your left	To your left



JOYALONB.CDR

Figure 2-4. Top View of the Di-Metric Plus Joystick

- Use the lever to control worktable speed. The farther you move the lever from its center position, the faster the worktable will travel. Similarly, you can control and “walk” the worktable a little bit at a time by keeping the joystick lever close to the center position.
- Use the **ENTER** button to enter displayed X and Y coordinates. This button is interchangeable with the **Enter** button on the control panel.
- Use the **CANCEL** button to erase current data or function from memory, or to stop worktable immediately. This button is interchangeable with the **Clear** button on the control panel.
- Use the button on top of the joystick lever to turn Projectron automatic edge detection on or off. This button is interchangeable with the **E** button on the control panel. The use of Projectron will be described more fully in later sections of this guide.

Note

If you do not have Projectron automatic edge finder installed on your projector and you accidentally press either the button on top of the joystick lever or the **E** button on the control panel, the **No Op** LED (below the Y display) will light.

Projectron III Automatic Edge Detector

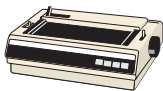


The optional Projectron allows you to measure objects more quickly and accurately by finding edges automatically. It also eliminates the need to set an edge visually.

You can turn Projectron on or off by pressing either the control panel button marked **E**, or by pressing the button on top of the joystick. Once it is activated, it stays on until you press the button again or until a point is found and entered. When Projectron is on, the X and Y displays show the coordinates of the most recently found edge, not the location of the worktable.

Projectron will be discussed in more detail in the remaining sections of this guide.

Serial Devices



You can also add an optional serial printer and/or PC to your personal configuration of Di-Metric Plus. Either of these types of serial devices can be connected to the serial port found behind the control panel.



You can use a serial printer in the following ways:

- Print the data that appears in the three LED displays at any time by pressing the **Print** button on the control panel. This data could include X and Y coordinates and protractor angle, or data applicable to a geometric function, such as the diameter and radius of a circle. Pressing the **Print** button will **always** print out whatever is currently shown in the displays.
- Print Di-Metric Plus microprocessor parameters as they are currently set. See Appendix E, “Microprocessor Parameters,” for more information.

In addition, you may connect a PC to the Di-Metric Plus serial port, in which case you may also connect a printer to Di-Metric Plus through the PC. With a PC, you can add the following capabilities:

- You can communicate with Di-Metric Plus through a Windows-based measurement software package, such as OGP’s SmartCheck.
- Every Di-Metric Plus command has a keyboard equivalent, you can use a PC with a terminal emulation program to communicate with Di-Metric Plus. See Appendix H, “Command Summary,” for more information.

Note

When connecting any serial device to Di-Metric Plus, you must be sure that you are using the proper cabling, and that Di-Metric Plus and the device are communicating at the proper baud rate (see Appendix E).

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Section 3

Getting Started

This section will introduce you to the important geometric measurement concepts that Di-Metric Plus is based upon. These include the Cartesian coordinate system, protractor measurement, and linear and angular units of measurement.

Also included in this section is an overview of the two methods of finding points, both visually and using the Projectron automatic edge detector. Finally, we will detail a Di-Metric Plus power-up sequence, and the correct way to find points using both methods.

Measurement Concepts

All Di-Metric Plus measurements are calculated from one or more coordinate points. For example, distance is defined as the amount of separation between two points.

To measure objects, it helps to understand how points are shown and how the distance between the points is measured.

Cartesian Coordinates

All points entered, calculated and reported by Di-Metric Plus have locations that correspond to Cartesian coordinates.

The Cartesian coordinate system uses two axes to define the location of a point. The X axis is horizontal and runs left and right. The Y axis is vertical and runs up and down. The two axes intersect at a single point called the **origin**, where X and Y both equal zero. The two axes are perpendicular to each other.

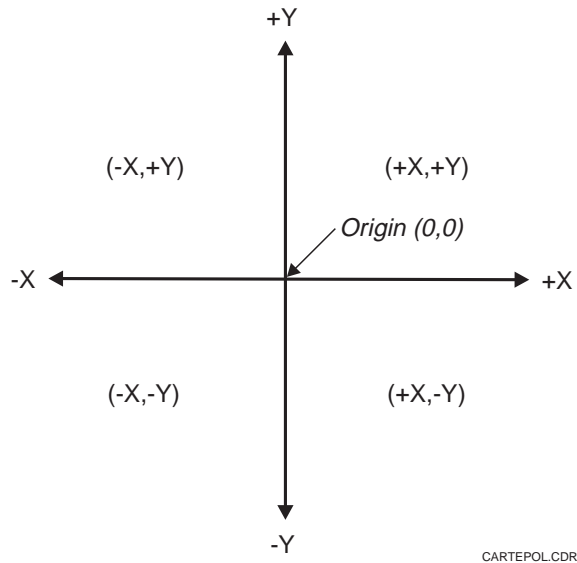


Figure 3-1. Polarity of Cartesian Coordinates

The direction of movement along the axes away from the origin is either positive or negative. This direction of movement is called polarity. Coordinates along the X axis to the right of the origin are positive; coordinates to the left of the origin are negative. Coordinates along the Y axis above the origin are positive; coordinates below the origin are negative.

The two axes form a grid pattern on a two-dimensional XY plane. This XY plane has four quadrants. Points in each quadrant are shown with plus and minus signs that denote the polarity of X and Y, as shown in Figure 3-1.

Cartesian coordinates are often referred to as XY locations. Each point has two coordinates describing the distance and direction from the origin. These coordinates are expressed in shorthand form as an X and Y value separated by a comma, and enclosed in parentheses — (X,Y). Figure 3-2 illustrates the XY locations of four points, one in each quadrant, and what their shorthand forms would be.

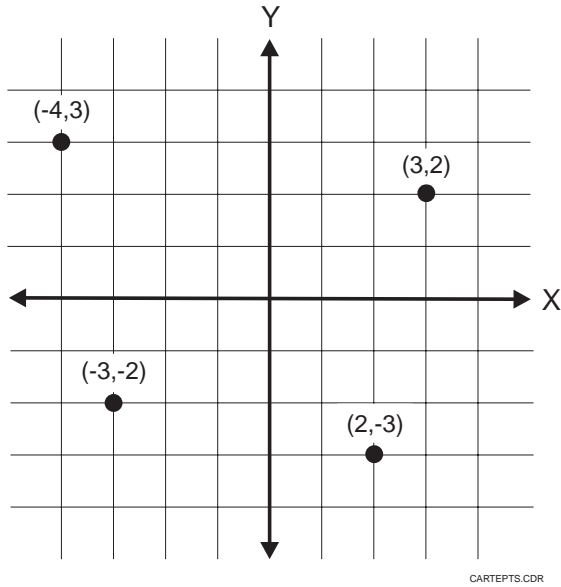


Figure 3-2. Cartesian Coordinate Locations

When using Di-Metric Plus, the X display on the control panel normally shows the X coordinate of the screen centerlines in relation to an origin which you have already defined. Similarly, the Y display shows the Y coordinate of the screen centerlines (see Figure 3-3 below).

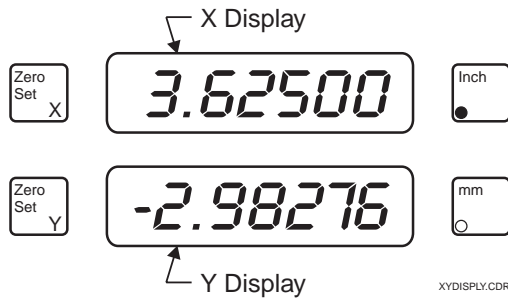


Figure 3-3. Di-Metric Plus X and Y Displays

Protractor Measurement

One way angular values can be determined with Di-Metric Plus is by setting a zero reference point and manually rotating the viewing screen in either direction. See Section 4 for more detailed information regarding this procedure.

Di-Metric Plus assigns a positive direction to counterclockwise rotation of the viewing screen. When measuring rotation in a counterclockwise direction, Di-Metric Plus will count up from zero to 180.00° for the first half of a full rotation, and then will switch signs and count down from -179.99 to zero for the second half of the rotation (see Figure 3-4).

Angular values are displayed on the Protractor display, which is the top LED display on the control panel.

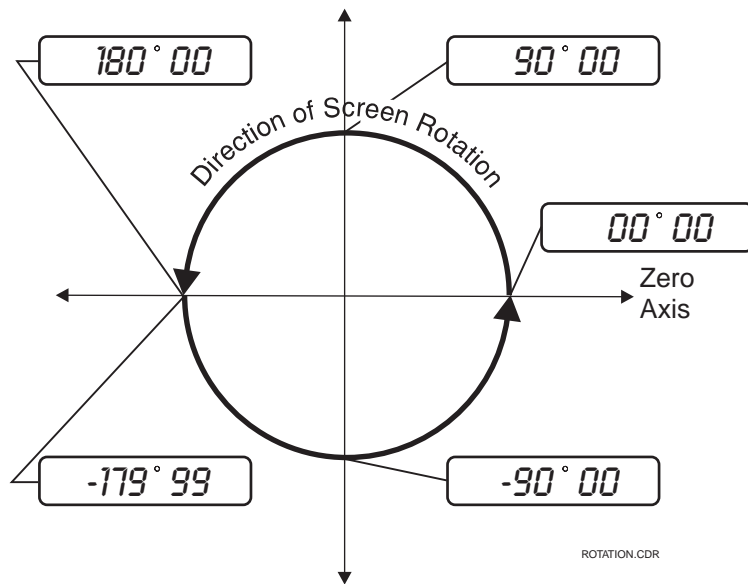


Figure 3-4. Di-Metric Plus Protractor Measurement Direction

Units of Measurement

Measurements can be specified with linear or angular units.

Linear Units of Measurement

Di-Metric Plus linear distances can be displayed in either English or metric units. English units are shown in inches, and metric units are shown in millimeters.

Di-Metric Plus displays inches with up to two digits (and an optional minus sign) to the left of the decimal point, and five digits to the right of the decimal point. Alternately, Di-Metric Plus can display millimeters with up to three digits to the left of the decimal point, and four digits to the right. For example:

- Inches: 2.01559
- Millimeters 51.1960



When you turn on your Contour Projector, Di-Metric Plus will display linear distances in inches. This is the default parameter setting. You can confirm that Di-Metric Plus is displaying English units if the **Inch** LED glows red and remains lit.

Note

If you want Di-Metric Plus to power up in metric mode, please see Appendix E, "Microprocessor Parameters."



To display distances in millimeters, press the **mm** button. When you do, the **Inch** LED will go out, and the **mm** LED will glow red and remain lit. Now, the displayed X and Y coordinates will be converted to millimeters (the inch values are multiplied by 25.4).

If you wish, you can toggle back and forth between English and metric display at any time by pressing the appropriate button. All values are converted immediately.

Angular Units of Measurement

Di-Metric Plus angular measurements done with the protractor are displayed either in decimal-degrees or degree-minutes. As discussed previously, Di-Metric Plus shows protractor values in the LED display at the top of the control panel.

Di-Metric Plus displays angular values with up to three digits (and an optional minus sign) to the left of the degree symbol, and two digits to its right.

For decimal-degree values, the two digits displayed to the right of the degree symbol represent hundredths of a degree, from 00 to 99. For degree-minute values, those two digits represent minutes; since there are 60 minutes in a degree, minutes displayed will range from 00 to 59. For both decimal-degree and degree-minute displays, the three digits to the left of the degree symbol are whole degrees.



When you turn on your Contour Projector, Di-Metric Plus will display protractor values in decimal-degrees. This is the default parameter setting. You can confirm that Di-Metric Plus is in the decimal-degree mode if the **Dec Degree** LED glows red and remains lit.

Note

If you want Di-Metric Plus to power up in degree-minute mode, please see Appendix E, "Microprocessor Parameters."



To display protractor values in degrees and minutes, press the **Degree Minute** button. When you do, the **Dec Degree** LED will go out, and the **Degree Minute** LED will glow red and remain lit.

You can toggle back and forth between the above two protractor display modes at any time by pressing either button.

Finding Points

When using Di-Metric Plus, there are two ways to find points:

- By manually moving the worktable so that the screen centerlines visually line up with a desired point.
- By using the optional Projectron III automatic edge detector to seek and find points which coincide with a part's edge.

Comparisons

Which method is better? As in most things, that depends. Each method has its advantages and disadvantages.

In general, the **visual method** of lining up part features with screen centerlines:

- Requires a fair degree of operator skill and experience to find points accurately
- Is an excellent method for quickly checking part dimensions where extreme accuracy may not be important

In contrast to the visual method of finding points, **Projectron edge detection**:

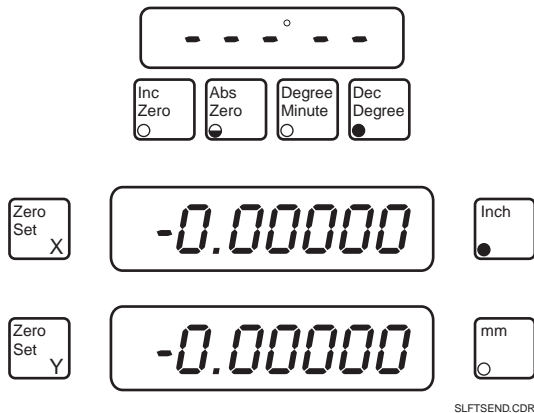
- Requires a little time for the operator to get used to
- Once mastered, is accurate and consistent, which makes it the preferred method for finding points

Powering Up Di-Metric Plus

Before you can find points, you must first power up your Contour Projector and Di-Metric Plus.

To power up:

1. Check to make sure that the Contour Projector is connected to an AC power source.
2. Turn on main power to the Contour Projector.
3. Di-Metric Plus will now take a few seconds to run a self-test routine. The complete routine is described in Appendix B of this guide, but in brief, the following will happen:
 - You will hear a beep, the button and function LEDs will flash on and go off in a specific order, and the X and Y displays will show a succession of numbers. Eventually, the displays will remain stable.
 - If Di-Metric Plus **has passed** its self-test, the displays will look like this:



- If Di-Metric Plus **has failed** its self-test, it will show a two-digit code in the X display. The meaning of this code can be found in Appendix B.
4. Assuming that the self-test has been passed, turn on your Contour Projector's horizontal illumination and wait for it to warm up completely. If your machine is equipped with mercury arc illumination, this may take up to five minutes.

Once you have powered up, you would normally go on to set up a part, including the following steps:

- Stage a part
- Set Absolute Zero
- Electronically align the axis of the worktable to the X axis of the part
- Define an origin for the part

However, we will save a discussion of these steps for Section 4 of this guide. For right now, simply stage the FastSTART reticle in a staging fixture, select an appropriate magnification, and bring the reticle within view and focus.

Finding Points Visually

Once you have the FastSTART reticle staged as described above, you are ready to find a point.

To find a point visually, follow these steps:



1. Using the joystick, move the worktable so that the viewing screen centerlines line up directly with any point on an edge of the FastSTART reticle. Be as accurate as possible — this method depends heavily on your skill!

- The X and Y displays show the Cartesian coordinates of the reticle edge point that directly lines up with the screen centerlines. Watch the displays as you move the worktable. You will see the X and Y displays dynamically track the centerline coordinate position as the reticle moves.

2. Once you have precisely lined up the desired edge point with the screen centerlines, stop the worktable. The intersection of the centerlines defines the point which you have found and mentally selected for future action.
3. **If you had entered a geometric function** before finding the point, the control panel **Enter** button LED would be flashing. Once you had found the desired point, you could press the control panel **Enter** button or the **ENTER** button on the joystick to enter the point into Di-Metric Plus memory. Point entry will be discussed in detail in Section 4.



Tip

- When using the joystick, if you keep the lever very close to the center position, you can control worktable motion more precisely.

Finding Points with Projectron

You already know that Projectron edge detection works by electronically detecting the shadow formed by a part's edge. But before we explore the use of Projectron any further, we have to discuss Projectron's main components, and the conditions affecting its operation.

Projectron Components

We have outlined Projectron's user interface components in previous sections of this guide. To explain in a little more detail:

- You can toggle Projectron on or off either by pressing the **E** button on the control panel, or by pressing the button on the end of the joystick lever.
- Once activated, Projectron will seek an edge in a direction defined by the joystick, or by one of the control panel arrow keys.
- Projectron communicates its results through the X and Y displays.

Projectron's user interface is obviously important to you — you want to know how to manipulate it and control it. It is also important for you to know a little bit about Projectron's electronic components, and how they operate. The two main Projectron electronic hardware components that you don't see and touch every day include:

- **Projectron Sensor Head Assembly.** This assembly is made of two parts — the Projectron optical head, and the Projectron sensor board (also known as the “Cyclops” board). The Sensor Head Assembly is located within your Contour Projector, behind the mirror. The main edge detection components, an array of photoelectric diodes that detect light, are on the Cyclops board. (For a detailed discussion of the mechanical and electronic calibration of the Sensor Head Assembly, see Appendix F.)
- **Projectron Interface Board.** This board is mounted on the back of the control panel, and it is connected to the Control Panel Display board, the Cyclops board, and the main “brain” of Di-Metric Plus, the CPU board. As you might guess judging from these connections, the Projectron Interface board acts as a “go-between.” It interprets signals received from the Cyclops board and then tells both the Control Panel Display board and the CPU board when a valid edge has been detected.

Conditions Affecting Projectron Operation

Projectron requires specific conditions to operate effectively. These include:

- A specific range of lighting intensity
- A minimum part feature size
- Correct wall effect parameters

Lighting

Projectron requires a specific lighting range to detect an edge, and it cannot operate when illumination is extremely strong or extremely weak.

Once Projectron is activated, Di-Metric Plus will signal if there is too much light by showing the following on the X display —



— where **HL** is an abbreviation for “high light.”

This display will remain in effect either until Projectron is deactivated, or until the light path has been dimmed by the addition of collimator lenses and/or filters. Depending on the model of your Contour Projector and your current magnification, you may need to introduce a variety of filters and/or lenses into the light path. See Appendix A, “Filters and Collimator Lenses Used with Projectron III,” for more details.

If illumination is too weak, as may be the case if too many filters are applied or the projector lamps are old, Di-Metric Plus will not alert you directly. However, if you are trying to use Projectron but it fails to detect any edges at all, you may assume that the light is too dim, and try to compensate for it.

Collimation of the light source is another important Projectron lighting consideration. Again, see Appendix F for a detailed method to collimate the light source of your particular Contour Projector.

Part Feature Size

To operate effectively, Projectron requires the following minimum part geometry:

- Feature size of at least 0.250 inches on the viewing screen
- Radius size of at least 0.125 inches on the viewing screen

If you try to measure a part feature or radius any smaller than this, Projectron may not be able to detect it. Since the viewing screen image is what Projectron “looks at,” the simplest remedy is to increase viewing screen magnification to bring small features into Projectron’s detection range.

Wall Effect

Wall effect is an optical phenomenon that occurs when inspecting thick, highly-polished parts using direct illumination. The polished surface acts as a mirror that reflects the light and can affect the position of the edge.

To compensate for wall effect, Di-Metric Plus applies predetermined correction factors. These factors, which reside in the default parameter settings, have been set at OGP. Sometimes, though, if you are measuring unusual parts that are very thick or have mirror finishes, these default parameters may not fully correct for wall effect. In some cases, you must recalculate and modify OGP’s factory presets. Please refer to Appendix E, “Microprocessor Parameters,” for more details.

Using Projectron

Assuming that you have powered up your Contour Projector and the FastSTART reticle is —

- Staged,
- At a comfortable magnification,
- In view, and
- In focus

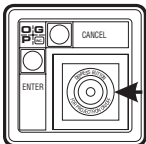
— follow these steps to find points using Projectron:



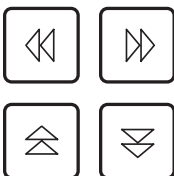
1. Press the control panel **E** button, or the button on the joystick lever, to activate Projectron.



2. You will see the **E** button LED glow red and remain lit. This means that Projectron is active. To exit the Projectron function at any time, simply press **E** again.
3. If there is too much light present for Projectron to operate, you may receive an **HL** warning on the X display. Whether or not you receive this warning, however, bring the proper filters and/or collimator lenses into the light path to modify light intensity so that it falls within Projectron's detection range (refer to Appendix A).



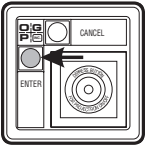
4. Using either the joystick or the arrow keys, maneuver the worktable so that the viewing screen centerlines pass over an edge that you want to target for detection.
 - If you use the arrow keys, just press the appropriate key once and release it. The worktable will move in the direction that you indicated, as Projectron seeks an edge.
 - If you use the joystick, seek an edge horizontally or vertically only.



5. As soon as the target edge passes under the centerlines, the X and Y displays will “lock up” and display the coordinates of the detected edge point.

Note

You may notice that the worktable stopped slightly past the centerlines. **This is normal.** The servo mechanisms for the worktable motion control have a certain amount of momentum, and have caused the worktable to overshoot the centerlines slightly. The X and Y coordinates shown in the displays are the true coordinates of the detected edge.



6. **If you had entered a geometric function** before finding the point, the control panel **Enter** button LED would be flashing. Once you had found the desired point, you could press the control panel **Enter** button or the **ENTER** button on the joystick to enter the point into Di-Metric Plus memory. Point entry will be discussed in detail in Section 4.

Tip

- When seeking an edge with Projectron, approach the target edge at an approximate right angle.

Section 4

Using Di-Metric Plus

This section will begin by demonstrating how to set an Absolute Zero position for the screen protractor, and to stage and set up a part. We will then go on to the procedures for setting an origin and aligning the part axis to the worktable.

After outlining these preliminary steps, we will begin to explore ways to actually use Di-Metric Plus. Once you have worked through this section, you will know how to measure:

- A distance along one or two axes
- A straight line
- A width
- A circle or arc
- An angle
- Part features which are not related to the origin

Setting Screen Protractor Absolute Zero

You need to know how to stage and set up a part before you can do any useful work with Di-Metric Plus. However, even before staging a part, you must power up your Contour Projector and set an Absolute Zero axis. Once Absolute Zero is set, Di-Metric Plus knows what axis to refer to when displaying angles with the protractor.

Assuming that you have powered up your Contour Projector as described in Section 2, follow these steps to set Absolute Zero:



1. Look at the control panel and confirm that the **Absolute Zero** button LED is flashing. This means that Di-Metric Plus is waiting for you to specify an Absolute Zero axis.
2. Loosen the protractor ring knob and visually line up the white mark on the ring with its mate on the frame. Retighten the knob.
3. Press the **Absolute Zero** button on the control panel. The **Absolute Zero** LED will stop flashing and remain lit. The protractor ring is now set to 0° in Di-Metric Plus memory. To confirm this, look at the Protractor display at the top of the control panel. This is what you should see:



From this point on, Di-Metric Plus will refer to this Absolute Zero axis when displaying screen ring rotation. If you now loosen the protractor ring knob and rotate the ring counterclockwise, Di-Metric Plus will interactively count off degrees in a positive direction. If you perform the same action but rotate the ring clockwise, Di-Metric Plus will count off degrees in a negative direction.

Once Absolute Zero is set, it remains in effect until you turn off your Contour Projector.

To measure an angle by turning the protractor screen ring, you may sometimes need to specify a new **temporary** zero axis for Di-Metric Plus to measure from. To do this, you will use **Inc Zero**. This procedure will be detailed later in this section.

Calibrating Screen Protractor for Thermal Variation

Because of variations in workplace temperature, your Contour Projector's protractor ring may expand or contract slightly. This expansion/contraction may also change the ring's circumference, which could introduce very slight inaccuracies when you use the protractor to measure angles. To correct for this, you need to recalibrate your Contour Projector so that one rotation of the protractor ring equals exactly 360°.

To compensate for any variations in room temperature, we recommend that the following procedure be followed at least daily on power-up:



1. Make sure your Contour Projector is powered up, and you have set Absolute Zero as described in the previous subsection, "Setting Screen Protractor Absolute Zero." The **Abs Zero** LED will glow red and stay lit.
2. Loosen the protractor ring knob and rotate the protractor ring one turn counterclockwise, visually lining up the white mark on the frame with its mate on the ring as accurately as possible.
3. Look at the protractor display. If the display shows that one rotation of the protractor ring is $360 \pm 0.05^\circ$ (or $360 \pm 0^{\circ}3'$), go to step 4 below. If the display shows that one rotation of the protractor ring does not fall within that range, see Appendix E, page E-8, "Parameter 25 — Protractor Encoder Factor," to set a more permanent calibration factor.



4. Press **Inc Zero** and **Abs Zero** at the same time. Both button LEDs will now flash, and the protractor display will go blank.
5. Rotate the ring one turn counterclockwise again, visually lining up the two white marks as accurately as possible. **Make sure that you do not rotate the protractor ring mark past the frame mark!** (If you do pass up the frame mark, press **Abs Zero** again, and go back to step 2.)



6. Press **Abs Zero**. The **Abs Zero** LED will glow red and remain lit and the **Inc Zero** LED will go out. This indicates that Absolute Zero has been set and a compensation factor has been entered for thermal variation. This compensation factor will remain in effect until the Contour Projector is powered down.

Staging a Part

You must stage a part correctly to be able to measure it accurately. This staging process is described below.

1. Make sure the screen protractor is aligned and Absolute Zero is set.
2. Clear the stage of any obstructions.
3. Mount the part securely in a fixture. Make sure the part is stable and cannot be moved.
 - You can position the part anywhere on the worktable, in any type of fixture.
 - To ensure that you are getting an accurate view of your part on the viewing screen, it must be mounted so that the part is square to your Contour Projector's light path — its "optical axis." Figure 4-1 shows the correct and incorrect ways to do this.

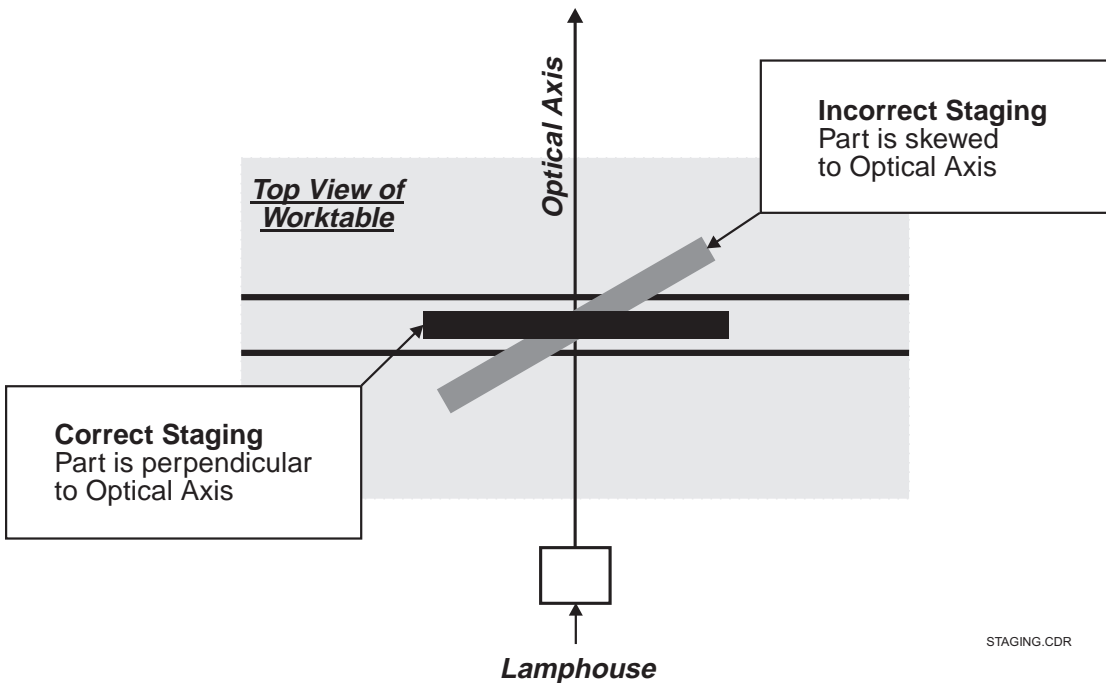


Figure 4-1. Correct and Incorrect Ways to Stage a Part

4. If you can't see the part on the viewing screen, move the worktable until one of the part's edges appears, close to one of the screen centerlines.
5. Visually align the part's primary axis with one of the centerlines.
 - If the primary axis is horizontal, position the part so that its horizontal edge is approximately parallel to the horizontal centerline (see Figure 4-2).
 - Similarly, if the primary axis is vertical, make sure the part's vertical edge is approximately parallel to the vertical centerline.

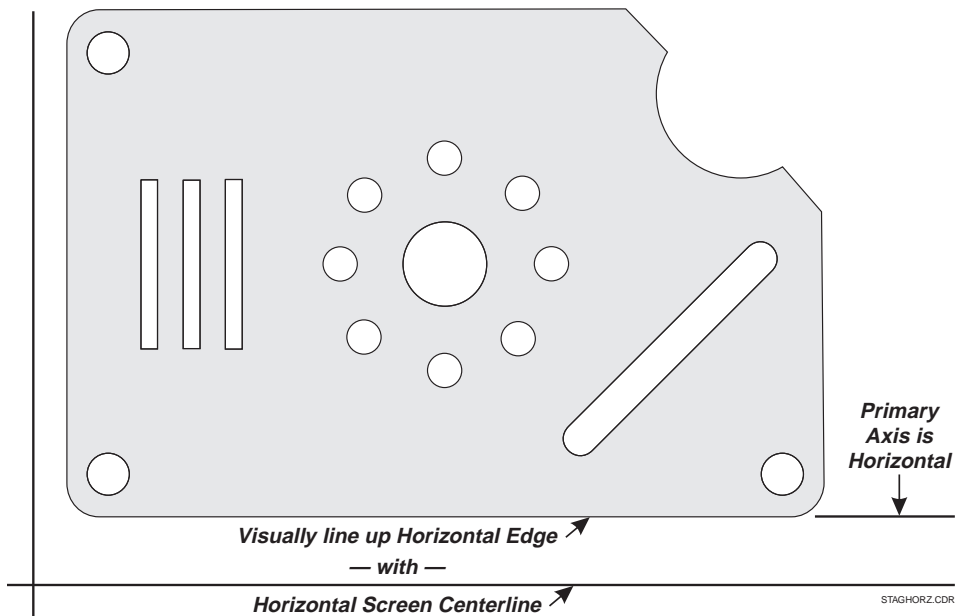


Figure 4-2. Aligning Horizontal Edge to Horizontal Screen Centerline

Why Do You Have to Set Up a Part?

When you first power up your Contour Projector, Di-Metric Plus assumes that it is at its “home” position, based on the worktable’s position at power-up. Obviously this is a variable position, because the worktable can be powered down or up from any location in its travel.

When you mount a part in a fixture or place it on the worktable, the X and Y coordinates displayed on the control panel are still based on the **worktable’s** power-up position. Di-Metric Plus does not know where your part is or how it is aligned. You must provide that information each time you stage a part. To do this, you need to specify the staged part’s origin and axis alignment, as described below.

Setting an Origin

You can set an origin either visually or by using Projectron. Which method you choose often depends on the specific features of the part you are measuring.

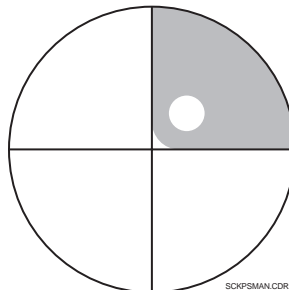
Many parts have datums that define a logical origin. However, this is not always true — sometimes you are free to choose the origin that makes the most sense to you.

Setting an Origin Visually

For the purpose of the following example, we will assume that the left vertical and bottom horizontal edges of the FastSTART reticle are datums. The lower left corner of the reticle is the intended origin.

To set this origin visually:

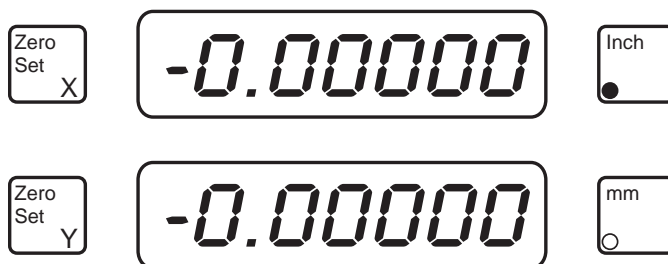
1. Use the joystick to move the edges of the reticle so that they align with the viewing screen centerlines as shown below:





2. Press **Zero Set X** and **Zero Set Y**.

- Di-Metric Plus has set the intersection of the horizontal and vertical screen centerlines as the origin for your part.
- To confirm this, look at the X and Y displays. They should be as shown in Figure 4-3 below.



XYZEROED.CDR

Figure 4-3. X and Y Displays Set to Zero to Define Origin

Setting an Origin with Projectron

It is sometimes more accurate and efficient to use Projectron in conjunction with a geometric function to determine the location of an origin. For example, to use this method for the FastSTART reticle:

1. Assume the reticle's bottom horizontal and left vertical edges are legs of an angle whose vertex will also be the origin, as shown in Figure 4-4.
2. Use the Angle/Vertex function, preferably in conjunction with Projectron, to find the exact location of the vertex. (Follow steps 1 through 8 of the procedure, "Using the Angle/Vertex Function to Measure an Angle," detailed on page 4-30 of this section.)
3. While the vertex coordinates are displayed, press **Zero Set X** and **Zero Set Y**. Once again, you have defined the lower left corner of the reticle as the origin.

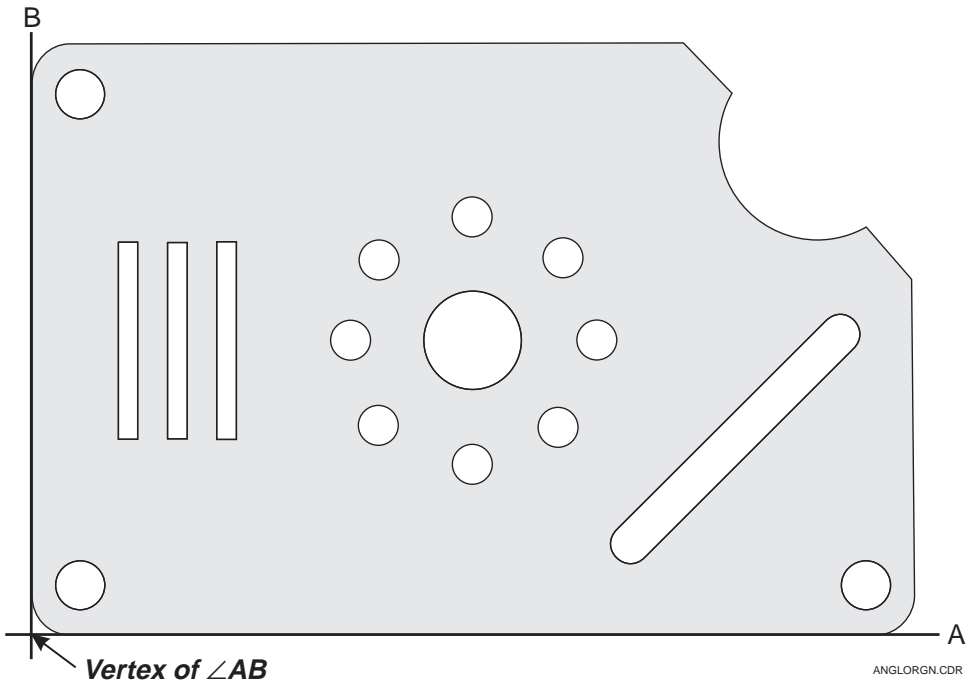


Figure 4-4. Origin Defined in Terms of the Vertex of an Angle

Sometimes your part may have intersecting datums, with the intersection point defined in terms of a geometric object which is not on an edge. An example of this is shown in Figure 4-5. In this case, it would make sense to use Projectron to find the center of Hole A, which could then be designated as the origin by pressing **Zero Set X** and **Zero Set Y**. The procedure defining the measurement of a circle/arc will be described in detail later in this section.

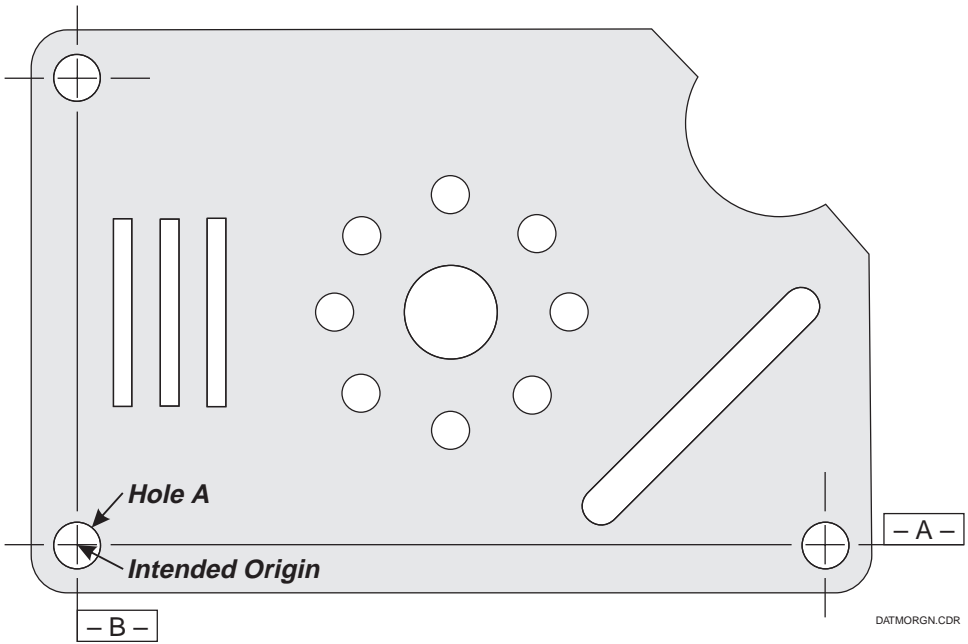


Figure 4-5. Origin Defined in Terms of a Geometric Object Not On an Edge

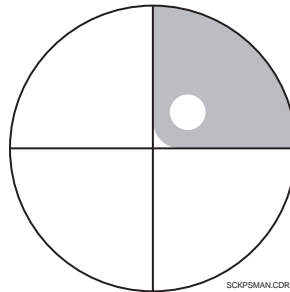
Setting Axis Alignment

Setting axis alignment is the final step in the setup process. Even though you may have staged a part and defined an origin, you also must ensure that a part edge or datum is electronically aligned with the worktable.

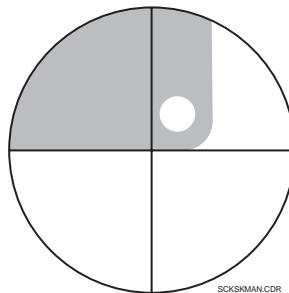
Setting Axis Alignment Visually

For the purposes of the following example, we will once again use the FastSTART reticle. To set its axis alignment visually:

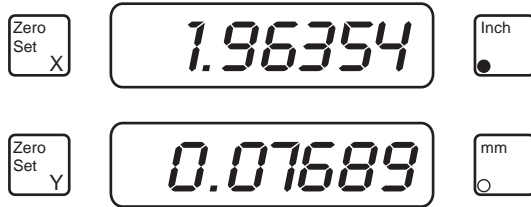
1. Assume that you have staged the FastSTART reticle and have just defined its lower left corner as the origin. The X and Y displays are zeroed, and the viewing screen looks like this:



2. Move the reticle along the X axis in a positive direction. Since you will be defining the bottom edge of the reticle as the X axis, keep that edge lined up with the horizontal screen centerline.
3. Stop at a second point on the bottom edge of the reticle, as far away as possible from the origin. The screen will now look like this:



The point now defined by the centerlines is the **alignment point**. The X and Y displays show the coordinates of this alignment point based on the motion of the worktable away from the origin. For example, the X and Y displays may show something like this:

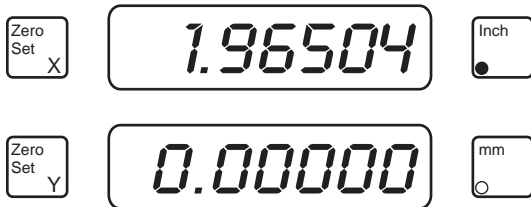


XYNOALGN.CDR

Notice that neither display shows a zero value. This is because there may have been both X and Y worktable motion away from the origin.



4. Press the **Axis Align** button — the **Axis Align** LED will now glow red and remain lit. This action creates a coordinate reference system whose origin is at the vertex of the reticle's lower left corner, and whose positive X axis passes through the alignment point. The X and Y displays may now show this:



XYALIGND.CDR

Notice that when you press **Axis Align**, the Y display shows all zeros. Di-Metric Plus has electronically rotated its “home” Cartesian coordinate grid to coincide with that of the part, making the bottom reticle edge the **new X axis, with a Y value of zero**. From now on, Di-Metric Plus will electronically translate all XY motions of the worktable to XY coordinates of the reticle.

Once axis alignment is set, it will remain in effect until:

- You press **Axis Align** again, or —
- You press **Zero Set X** and/or **Zero Set Y**. When you do this, Di-Metric Plus assumes you are resetting an origin, and will want to recalculate axis alignment based on the new origin.

Setting Axis Alignment with Projectron

Alternately, you can use Projectron to help you set axis alignment. To set axis alignment for the FastSTART reticle, follow the same procedure as outlined in “Setting Axis Alignment Visually,” with the following exceptions:



1. Instead of defining the alignment point by visually lining up the reticle’s bottom edge with the screen centerlines (step 3 above), you can press the **E** button and use Projectron to detect an alignment point anywhere on the bottom edge.



2. Immediately after you have detected the alignment point, press **Axis Align**. **Do not** press the **E** button first — this would exit the Projectron function, and would also clear the detected XY values that Di-Metric Plus needs to align the axis.

The previous example shows how to use Projectron to align an axis that is **along a part edge**. In the real world, however, you may want to specify a datum which **doesn't fall on an edge** as an alignment axis. In Figure 4-6, for example, notice that Datum A would be a good alignment axis. The best way to make it one is to:

1. Use Projectron and the Circle/Arc function to define the center of Hole A. (See “Measuring a Circle/Arc” on page 4-24 of this section for detailed instructions.)
2. Press **Zero Set X** and **Zero Set Y** to set this point as the origin.
3. Use Projectron and the Circle/Arc function to define the center of Hole B.
4. Press **Axis Align** to specify Datum A as the alignment axis.

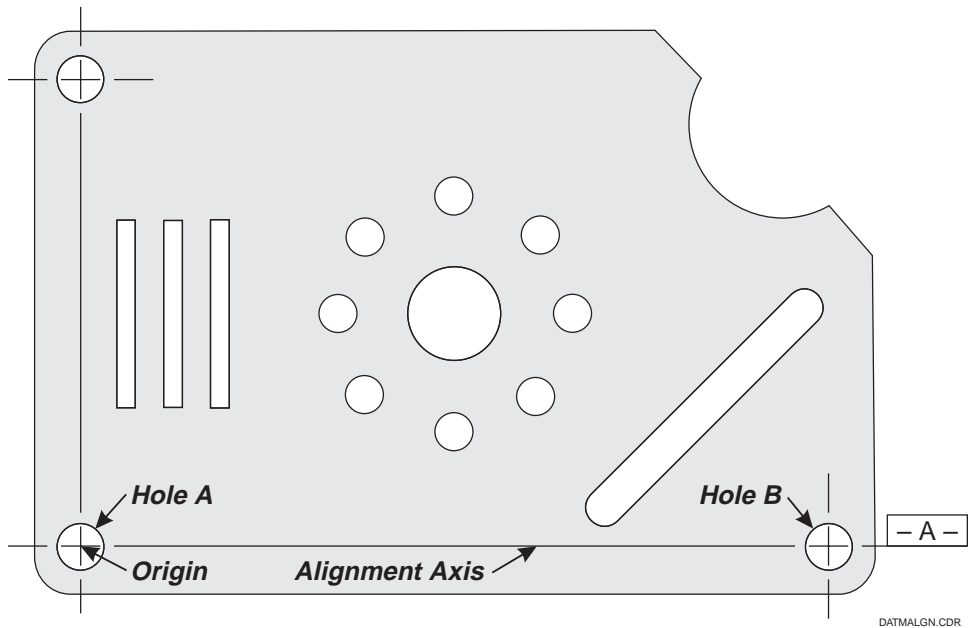


Figure 4-6. Alignment Axis Defined in Terms of Geometric Objects

Measuring with Di-Metric Plus

Now that you have fully grasped the preliminary steps of part staging, setup, origin definition, and axis alignment, you can proceed to the task that Di-Metric Plus excels at — measuring. The remainder of this section will explain, step-by-step, the easiest way to use Di-Metric Plus to measure distances, lines, widths, circles or arcs, and angles. You will also learn how to use **Store** and **Dev** to measure part features which are not related to the origin.

From here on in this section, unless otherwise specified, we will assume that you already have your part staged and set up, with an origin defined and axis aligned.

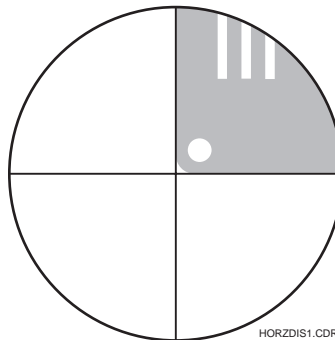
Measuring a Distance

You can use Di-Metric Plus to measure distances, along one axis or two axes. You can either do this visually, or use Projectron.

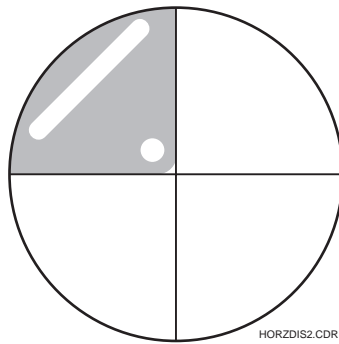
Measuring a Distance Along One Axis from the Origin

You can quickly and easily use the screen centerlines to measure horizontal or vertical distances from the origin. For example, perform the following steps to measure the width of the FastSTART reticle:

1. Assuming that you have set the origin as the lower left corner of the reticle, and the screen centerlines are resting at that point, the viewing screen should look like this:



- Use the joystick to move the worktable so that the centerlines line up directly with the right vertical edge of the reticle. The screen should now look like this:



- Look at the X display. It will now show the reticle's width, and it should look something like this:



You can also use the above procedure to measure any vertical distance from the origin.

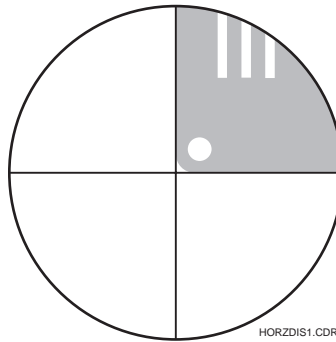
Alternately, you can use Projectron to help you measure X and Y distances from the origin. In the above example, an easy way to measure the reticle's width is to use Projectron to detect any point along the right vertical edge. Once that edge is detected, the X display will show the reticle's width.

As you know, you often need to measure the distance between two points where neither of the points is at the origin. The best way to do this is to use the Store and Dev functions. This procedure will be detailed at the end of this section.

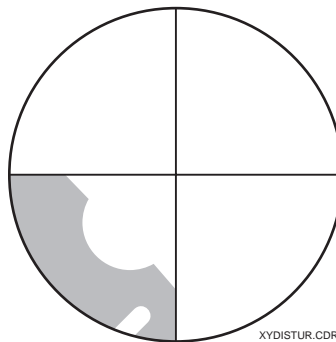
Measuring a Distance Along Two Axes from the Origin

You can also use the screen centerlines to measure both horizontal and vertical distances from the origin. For example, you could perform the following steps to simultaneously measure the FastSTART reticle's width and height:

1. Assuming that you have set the origin as the lower left corner of the reticle, and the screen centerlines are resting at that point, the viewing screen should look like this:



2. Use the joystick to move the worktable so that the centerlines line up directly with the upper right corner of the reticle. The screen should now look like this:



3. Look at the X and Y displays. The X display will show the horizontal distance or reticle width, and the Y display will show the vertical distance or reticle height. The X and Y displays should look something like this:



XYDSPYUR.CDR

Again, you can use Projectron to measure X and Y distances from the origin. Using the above example, you could find the X and Y coordinates of the reticle's upper right corner by using the Angle/Vertex function, either with or without Projectron. See "Using the Angle/Vertex Function to Measure an Angle" on page 4-30 of this section for details regarding this procedure.

Measuring a Line

The Line function is one of the four geometric functions of Di-Metric Plus. Using this function, you can measure any straight line on any part.

To use the Line function, you will need to find and enter at least two points which are on the line.

For example, to measure the left side of the 45° slot on the FastSTART reticle, follow these steps:



1. Press the **Line** button to enter the function. The **Line** LED will glow red and remain lit.



2. Once **Line** has been pressed, the **Enter** button LED will begin flashing. This means that Di-Metric Plus is waiting for you to enter the first point defining the line.



3. At the same time that the **Enter** LED begins to flash, the **More Points** LED will also begin to flash.
 - Specifying more than two points to define a line is optional. If you press **More Points** at any time before you find and enter the second line point, the **More Points** LED will glow red and remain lit. You can then enter up to a total of eight points. The number of points you have entered will be reflected in the Protractor display.
 - If you enter more than two points, Di-Metric Plus will construct a “best-fit line” based on all points entered.
 - You can exit the More Points function any time after the third point has been found and entered by pressing **More Points** again. The **More Points** LED will go out, and Di-Metric Plus will assume that you have defined a line. See step 7 below.

4. Use Projectron or the visual method to find the first point on the left side of the slot (see Figure 4-7). Try to select a point toward one end of the line, but make sure that you do not specify a point that is on the arc of the slot.



5. Once you have found the first line point, press **Enter**. **Enter** will continue to flash, and if **More Points** has not been pressed, it will also continue to flash.

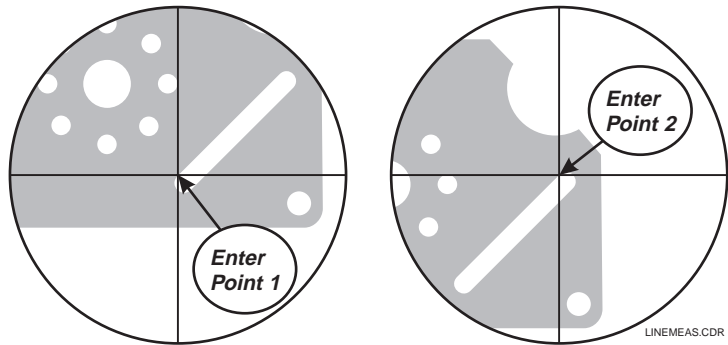
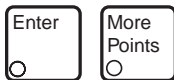


Figure 4-7. Finding and Entering Points to Measure a Line

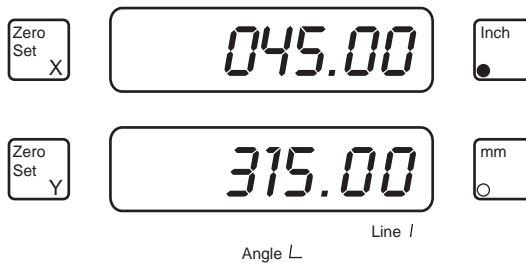


6. Use Projectron or the visual method to locate the second point on the left side of the slot and press **Enter** again. Once **Enter** has been pressed the second time, the **Enter** LED will go out (unless you have pressed **More Points**) because you have satisfied the minimum line measurement requirements.

- If you did not press **More Points**, its LED will stop flashing and will go out after you enter the second line point.



7. Once Di-Metric Plus has enough information to define a line, the **Line** LED will begin flashing. The X display will now show the **angle of the line relative to the X axis** (which is always displayed as a positive number), and the Y display will show **360° minus that angle**. After measuring the reticle slot, for example, the X and Y displays should look something like this:



Note

The order in which you enter points affects the way Di-Metric Plus displays angles. See Appendix G, “Understanding Di-Metric Plus Angle Calculations,” for more information.



8. The **Line** LED is still flashing, meaning more information is available. Press **Line** again. The **Line** LED will glow red and remain lit, and the X and Y displays will now show the **Cartesian coordinates of the midpoint of the line**.

Note

The Line function does not measure the length of a line directly. Instead, it determines **midpoint coordinates** in relation to the origin and the alignment axis, and **line angle** relative to the X and alignment axes.



9. Press **Line** again. The **Line** LED will now go out and you will exit the function.

Measuring a Width

You can use the Width function to measure the distance between two parallel lines, or between a line and a point.

To use the Width function, you will need to find and enter at least three points.

For example, to measure the width of the 45° slot on the FastSTART reticle, follow these steps:



1. Press the **Width** button to enter the function. The **Width** LED will glow red and remain lit.



2. Once **Width** has been pressed, the **Enter** button LED will begin flashing. This means that Di-Metric Plus is waiting for you to enter the first point defining the width.



3. At the same time that the **Enter** LED begins to flash, the **More Points** LED will also begin to flash.
 - Specifying more than three points to define a width is optional. If you press **More Points** at any time before you find and enter the third width point, the **More Points** LED will glow red and remain lit. You can then enter up to a total of eight points. The number of points you have entered will be reflected in the Protractor display.
 - If you enter more than three points, Di-Metric Plus assumes that all except for the last point are on the first line.
 - You can exit the More Points function any time after the fourth point has been found and entered by pressing **More Points** again. The **More Points** LED will go out, and Di-Metric Plus will assume that you have defined a width. See step 8 below.

4. Use Projectron or the visual method to find a point on one side of the slot (see Figure 4-8). Try to select a point toward one end of the slot, but make sure that you do not specify a point that is on the slot's arc.



5. Once you have found the first width point, press **Enter**. **Enter** will continue to flash, and if **More Points** has not been pressed, it will also continue to flash.

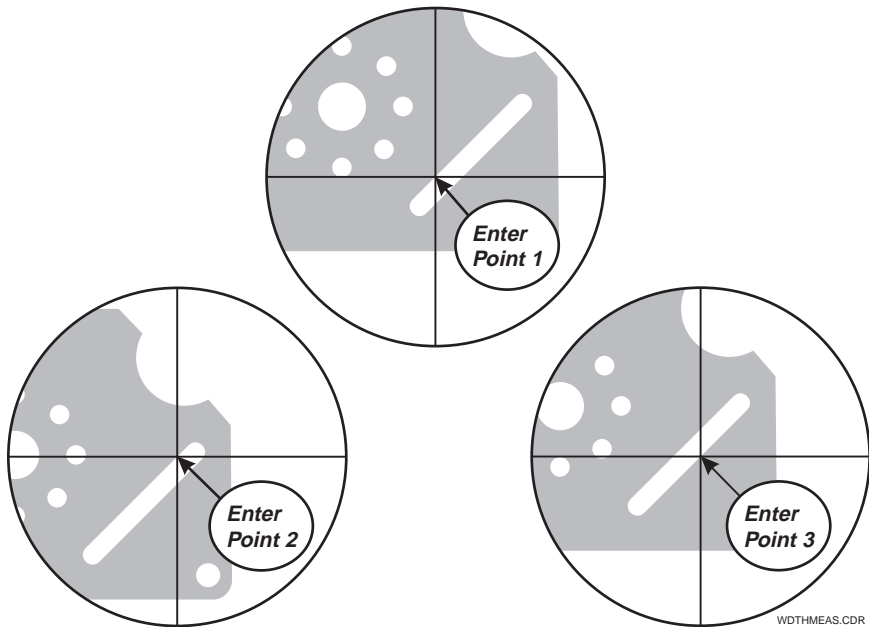
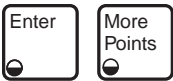
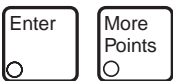


Figure 4-8. Finding and Entering Points to Measure a Width



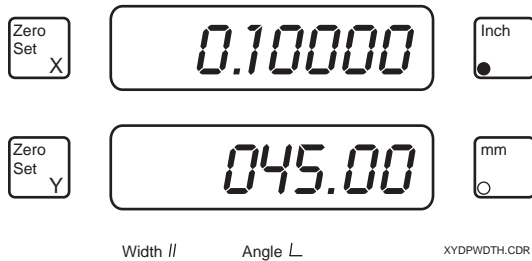
6. Use Projectron or the visual method to find a second point on the same side of the slot as the point that was entered in step 4 above. Press **Enter** again. **Enter** will continue to flash, and if **More Points** has not been pressed, it will also continue to flash.



7. Use Projectron or the visual method to find a third point on the opposite side of the slot. **This point entry will define the entire second parallel line — it is important to be as accurate as possible in locating it.** Press **Enter** again.
 - Once **Enter** has been pressed the third time, the **Enter** LED will go out (unless you have pressed **More Points**) because you have satisfied the minimum width measurement requirements.
 - If you did not press **More Points** before you entered the third point, the **More Points** LED will go out.



- Once Di-Metric Plus has enough information to define a width, the **Width** LED will begin flashing. The X display will now show the **perpendicular distance between the sides of the slot**, and the Y display will show the **angle of the slot relative to the X and alignment axes**. The X and Y displays should look something like this:



Note

The order in which you enter points affects the way Di-Metric Plus displays angles. See Appendix G, “Understanding Di-Metric Plus Angle Calculations,” for more information.



- The **Width** LED is still flashing, meaning more information is available. Press **Width** again. The **Width** LED will glow red and remain lit, and the X and Y displays will now show **Cartesian coordinates of a point on the centerline of the width** (in this example, the centerline of the slot).



- Press **Width** again. The **Width** LED will now go out and you will exit the function.

Measuring a Circle/Arc

You can use the Circle/Arc function to measure the radius and diameter of any circle or part of a circle.

To use the Circle/Arc function, you will need to find and enter at least three points.

For example, to measure the radius and diameter of the large circle in the center of the FastSTART reticle, follow these steps:



1. Press the **Circle/Arc** button to enter the function. The **Circle/Arc** LED will glow red and remain lit.



2. Once **Circle/Arc** has been pressed, the **Enter** button LED will begin flashing. This means that Di-Metric Plus is waiting for you to enter the first point defining the circle.



3. At the same time that the **Enter** LED begins to flash, the **More Points** LED will also begin to flash.
 - Specifying more than three points to define a circle/arc is optional. If you press **More Points** at any time before you find and enter the third circle point, the **More Points** LED will glow red and remain lit. You can then enter up to a total of eight points. The number of points you have entered will be reflected in the Protractor display.
 - You can exit the More Points function any time after the fourth point has been found and entered by pressing **More Points** again. The **More Points** LED will go out, and Di-Metric Plus will assume that you have defined a circle. See step 8 below.
4. Use Projectron or the visual method to find a point on the circumference of the circle (see Figure 4-9).



5. Once you have found the first circumference point, press **Enter**. **Enter** will continue to flash, and if **More Points** has not been pressed, it will also continue to flash.

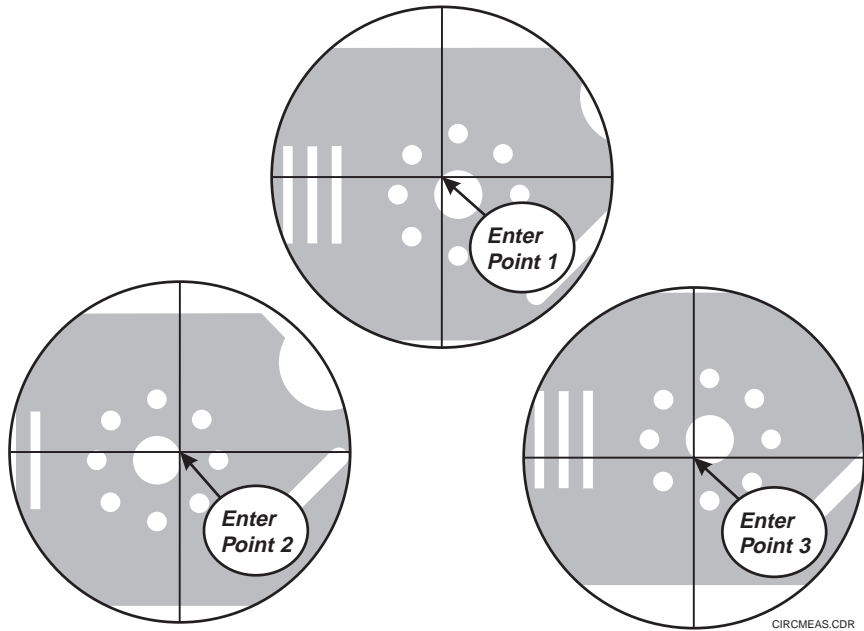
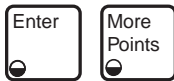
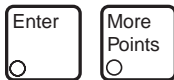


Figure 4-9. Finding and Entering Points to Measure a Circle/Arc



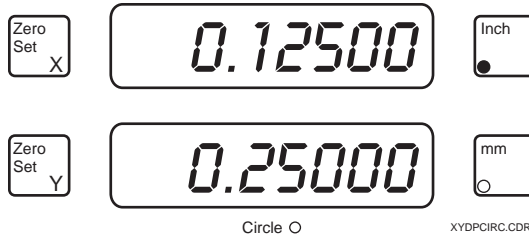
6. Use Projectron or the visual method to find a second point on the circumference of the circle. In this and subsequent steps, try to keep all point entries equally spaced from each other. Press **Enter** again. **Enter** will continue to flash, and if **More Points** has not been pressed, it will also continue to flash.



7. Use Projectron or the visual method to find a third point on the circumference of the circle. Press **Enter** again.
 - Once **Enter** has been pressed for the third time, the **Enter** LED will go out (unless you have pressed **More Points**) because you have satisfied the minimum circle/arc measurement requirements.
 - If you did not press **More Points** before you entered the third point, the **More Points** LED will go out.



8. Once Di-Metric Plus has enough information to define a circle, the **Circle/Arc** LED will begin flashing. The X display will now show the **circle's radius**, and the Y display will show the **circle's diameter**. The X and Y displays should look something like this:



9. The **Circle/Arc** LED is still flashing, meaning more information is available. Press **Circle/Arc** again. The **Circle/Arc** LED will glow red and remain lit, and the X and Y displays will now show the **Cartesian coordinates of the center of the circle or arc**.



10. Press **Circle/Arc** again. The **Circle/Arc** LED will now go out and you will exit the function.

Measuring an Angle/Vertex

There are two ways you can measure an angle with Di-Metric Plus:

- By rotating the viewing screen
- By using the Angle/Vertex function

Rotating the Viewing Screen to Measure an Angle

This method is purely visual, and relies on your ability to line up viewing screen centerlines with the desired angles.

In the first example illustrated below, assume that the FastSTART reticle has been staged in a haphazard way. This is all right for our purposes, because in order to measure an angle by rotating the viewing screen, you don't need to define an origin or align an axis before starting. We will assume, though, that you have already set Absolute Zero.

To use the viewing screen rotation method to measure the angle in the upper right corner of the skewed FastSTART reticle, follow these steps:

1. Use the joystick to position the worktable as shown in Figure 4-10, step **A**, so that the vertex of the angle you want to measure is precisely lined up with the intersection of the screen centerlines.

Hint – You know you have done this when, **without moving the worktable**, you can rotate the viewing screen and the centerlines will line up with the angle legs.

2. Loosen the protractor ring knob and rotate the viewing screen counterclockwise (as shown in step **A**) until the horizontal centerline is aligned with the top edge of the reticle. Lightly retighten the knob.

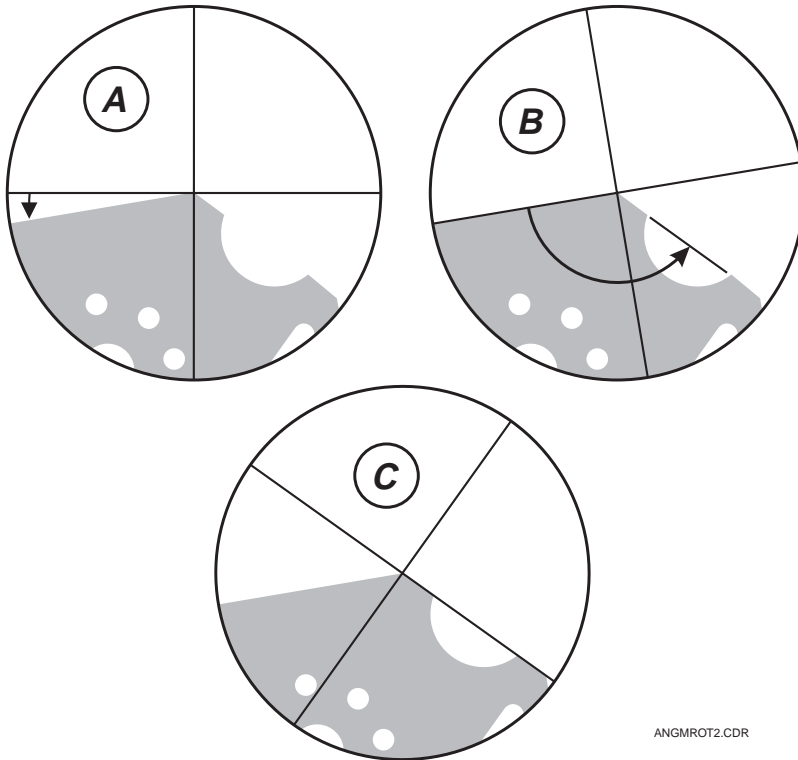
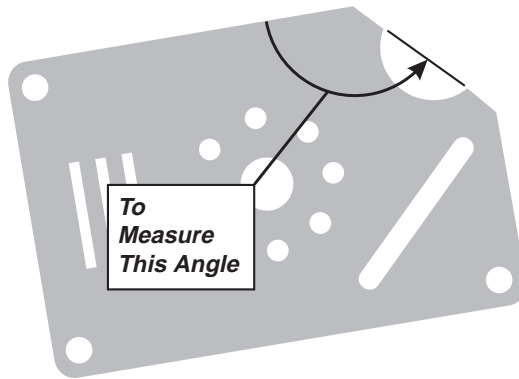


3. Press the **Inc Zero** button.

- Pressing this button overrides **Abs Zero**, establishing a new temporary zero point for angular measurements. The Protractor display will now show all zeros.



- The **Inc Zero** LED will glow red and remain lit, while the **Abs Zero** LED will go out.



ANGMROT2.CDR

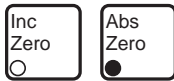
Figure 4-10. Measuring an Angle by Rotating the Viewing Screen

- Loosen the protractor ring knob and continue to rotate the viewing screen counterclockwise until the horizontal centerline is aligned with the other edge defining the angle (Figure 4-10, steps **B** and **C**). The angle measurement will be shown in the Protractor display at the top of the control panel, and it should look something like this:



Since you rotated the screen counterclockwise, the angle displayed will be positive. If you had rotated the screen clockwise, the value would have been negative. For more information on how Di-Metric Plus displays angles, see Appendix G.

- To return the viewing screen to your starting point:



- Press **Abs Zero**. The **Inc Zero** LED will go out, and the **Abs Zero** LED will glow red and remain lit. The Protractor display will now show how many degrees you have rotated the screen away from Absolute Zero.
- Rotate the viewing screen clockwise while watching the Protractor display. When the display shows all zeros, stop rotating the screen and tighten the protractor ring knob.

Using the Angle/Vertex Function to Measure an Angle

When using the Angle/Vertex function to measure an angle, you will use Projectron or the visual method to find and enter at least four points.

In this example, we will assume that the FastSTART reticle is staged, an origin has been defined, the axis has been aligned to the worktable, and Absolute Zero has been set.

To use the Angle/Vertex function to measure the same angle in the upper right corner of the FastSTART reticle, follow these steps:



1. Press the **Angle/Vertex** button to enter the function. The **Angle/Vertex** LED will glow red and remain lit.
2. Once **Angle/Vertex** has been pressed, the **Enter** button LED will begin flashing. This means that Di-Metric Plus is waiting for you to enter the first point defining the angle.
3. At the same time that the **Enter** LED begins to flash, the **More Points** LED will also begin to flash.
 - Specifying more than four points to define an angle is optional. If you press **More Points** at any time before you find and enter the fourth angle point, the **More Points** LED will glow red and remain lit. You can then enter up to a total of eight points. The number of points you have entered will be reflected in the Protractor display.
 - If you enter more than four points, Di-Metric Plus assumes that all except the last two points are on the first leg of the angle.
 - You can exit the More Points function any time after the fifth point has been found and entered by pressing **More Points** again. The **More Points** LED will go out, and Di-Metric Plus will assume that you have defined an angle/vertex. See step 7 below.



4. Use Projectron or the visual method to find a point close to the vertex on one leg of the angle (see Figure 4-11). Once you have found the point, press **Enter**. **Enter** will continue to flash, and if **More Points** has not been pressed, it will also continue to flash.
5. Use Projectron or the visual method to find a second and third point on the legs of the angle, as shown in Figure 4-11. After finding each point, press **Enter**. **Enter** will continue to flash, and if **More Points** has not been pressed, it will also continue to flash.



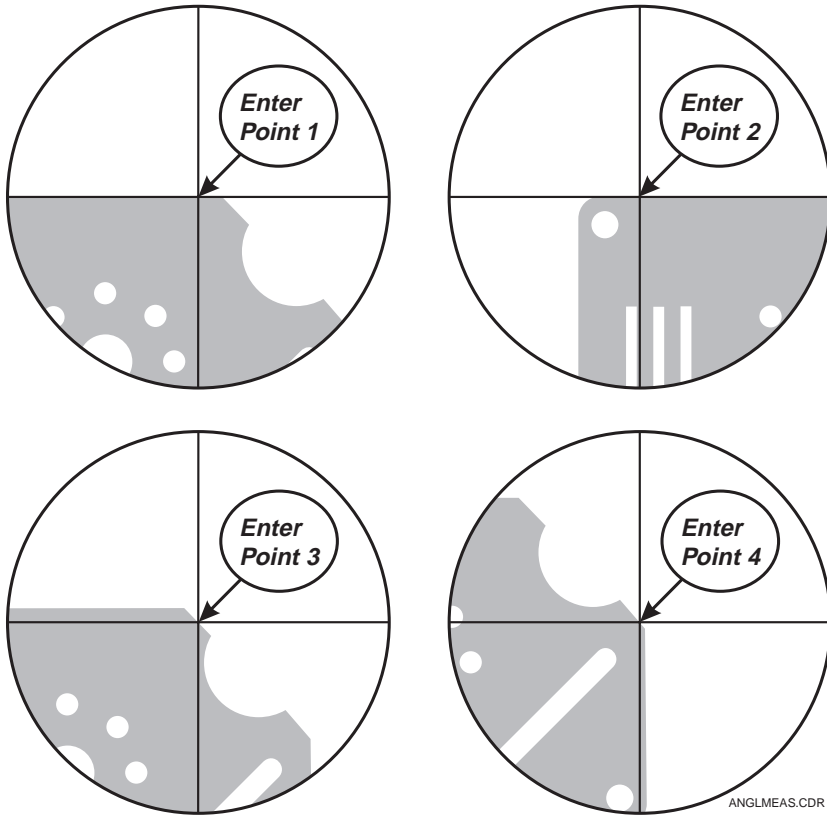
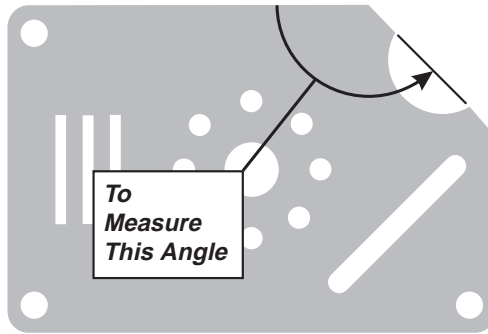


Figure 4-11. Finding and Entering Points to Measure an Angle/Vertex



6. Use Projectron or the visual method to find the final point on the second leg of the angle. Press **Enter** again.
 - Once **Enter** has been pressed for the fourth time, the **Enter** LED will go out (unless you have pressed **More Points**) because you have satisfied the minimum angle measurement requirements.
 - If you did not press **More Points** before you entered the fourth point, the **More Points** LED will go out.



7. Once Di-Metric Plus has enough information to define an angle, the **Angle/Vertex** LED will begin flashing. The X display will now show the **value of the angle**, and the Y display will show the **value of 360° minus the angle**. The X and Y displays should look something like this:



XYDPYANG.CDR

Note

The order in which you enter points affects the way Di-Metric Plus displays angles. See Appendix G, “Understanding Di-Metric Plus Angle Calculations,” for more information.



8. The **Angle/Vertex** LED is still flashing, meaning more information is available. Press **Angle/Vertex** again. The **Angle/Vertex** LED will glow red and remain lit, and the X and Y displays will now show the **Cartesian coordinates of the vertex of the angle**.



9. Press **Angle/Vertex** again. The **Angle/Vertex** LED will now go out and you will exit the function.

Measuring Features Not Related to the Origin

You often need to measure part features which are not related to a part origin or datum. The locations of these features may be expressed in terms of their distances from non-datum edges or features.

For example, look at Figure 4-12 below:

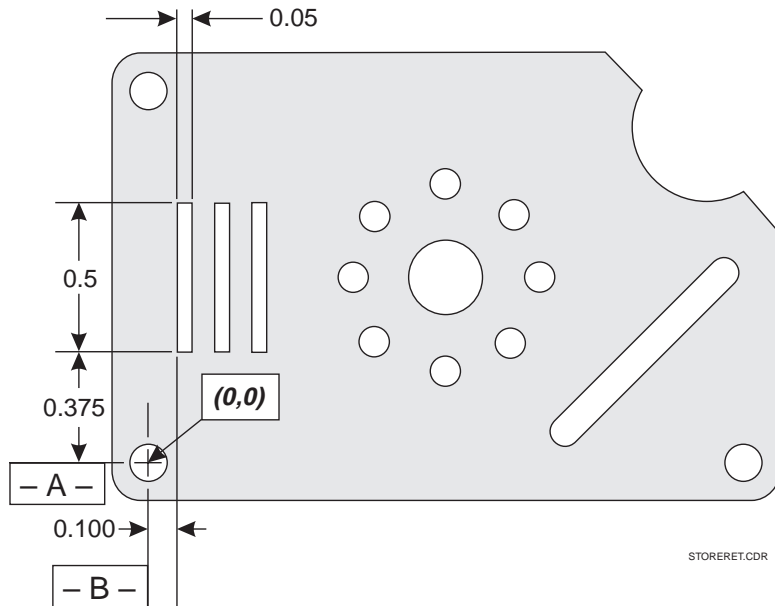


Figure 4-12. Part Dimension Not Related to the Origin

In this figure, we can see that the lower left corner of the slot is dimensioned in relation to Datums A and B, but the slot's width and height are dimensioned only in relation to its lower left corner. In order to measure the slot, you need to temporarily reset the origin. You can use the Store and Dev functions to do this.

To measure the left slot on the FastSTART reticle, follow these steps:



1. Begin by finding the coordinates of the lower left corner in relation to the origin. To start, press the **Angle/Vertex** button. The **Angle/Vertex** LED will glow red and remain lit, and the **Enter** and **More Points** LEDs will begin flashing.

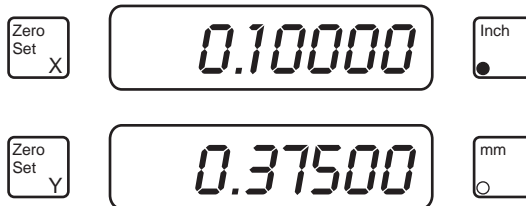
2. Use Projectron or the visual method to find and enter four points which define the angle formed by the lower left corner of the left slot. (See page 4-30 of this section, "Using the Angle/Vertex Function to Measure an Angle," for more detailed instructions.)



3. After the fourth point has been entered, the **Angle/Vertex** LED will begin to flash, and the **Enter** and **More Points** LEDs will go out. The X and Y displays will now show the included and excluded angles formed by the lower left corner of the slot.



4. Press the **Angle/Vertex** button again. The **Angle/Vertex** LED will glow red and remain lit, and the X and Y displays will now show the **Cartesian coordinates of the lower left corner of the slot in relation to the origin**. The displays should look something like this:



XVSTORE.CDR



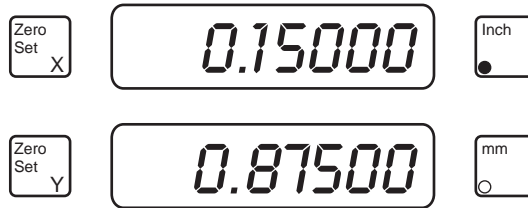
5. Press the **Store** button. The **Store** LED will glow red and remain lit. Pressing this button locks the XY coordinates found in step 4 above into memory.



- Press the **Angle/Vertex** button. The **Angle/Vertex** LED will go out and you will exit the function.



- Find the Cartesian coordinates of the **upper right corner of the slot** in relation to the origin by repeating steps 1 through 4 above, using the two legs of the angle formed by that corner. At the end of these steps, the **Angle/Vertex** LED will glow red and remain lit, and the X and Y displays will show the **coordinates of the upper right corner in relation to the origin**. The displays should look something like this:



XYSTORE2.CDR



- Press the **Dev** button. The **Dev** LED will begin flashing. The X and Y displays will now show the **Cartesian coordinates of the upper right corner of the slot in relation to the lower left corner of the slot**, which you established as a temporary origin in step 5 above. The displays should look something like this:



XYSTORE3.CDR



- Press **Dev** again. The **Dev** LED will glow red and remain lit. The X display will now show the **straight-line distance between the two corners of the slot**, and the Y display will show the **angle of the imaginary line connecting the two corners**.



10. Press **Dev** again. The **Dev** LED will go out and you will exit the function. The X and Y displays will now show the coordinates of the upper right corner of the slot in relation to the original (0,0) point.



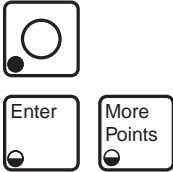
11. Press **Store** again. The **Store** LED will go out and you will exit the function. The temporary origin established in step 5 has been cleared from memory.



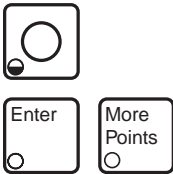
12. Press **Angle/Vertex** again. The **Angle/Vertex** LED will go out and you will exit the function.

Using Store/Dev to Measure Polar Coordinates

You can also use Store and Dev to measure polar coordinates. In the following example, assume that the center of the hole located in the lower left part of the FastSTART reticle is the origin. To measure the eight smaller holes in relation to and surrounding the large hole in the center of the reticle, follow these steps:



1. Begin by finding the coordinates of the large center hole in relation to the origin. To start, press the **Circle/Arc** button. The **Circle/Arc** LED will glow red and remain lit, and the **Enter** and **More Points** LEDs will begin flashing.

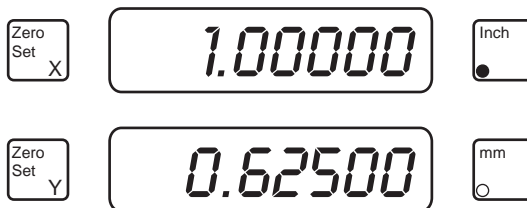


2. Use Projectron or the visual method to find and enter three points on the circumference of the large hole. (See “Measuring a Circle/Arc” on page 4-24 of this section for more detailed instructions.)



3. After the third circumference point has been entered, the **Circle/Arc** LED will begin to flash, and the **Enter** and **More Points** LEDs will go out. The X and Y displays will now show the radius and diameter of the hole.

4. Press the **Circle/Arc** button again. The **Circle/Arc** LED will glow red and remain lit, and the X and Y displays will now show the **Cartesian coordinates of the center of the hole in relation to the origin**. The displays should look something like this:



XYPSTORE.CDR



5. Press the **Store** button. The **Store** LED will glow red and remain lit. Pressing this button locks the XY coordinates found in step 4 above into memory.



6. Press the **Circle/Arc** button. The **Circle/Arc** LED will go out and you will exit the function.
7. Refer to Figure 4-13 below and locate Hole 1.

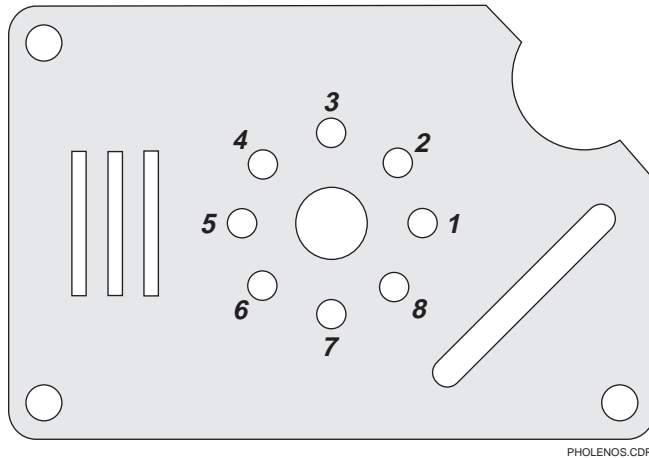
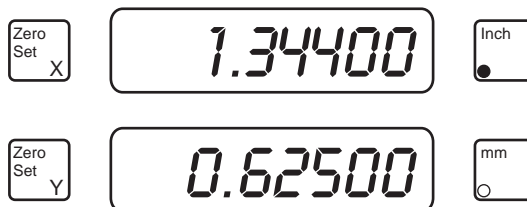


Figure 4-13. Small Holes in Relation to Center Hole



Find the Cartesian coordinates of the center of Hole 1 by repeating steps 1 through 4 above, locating and entering points on the circumference of the hole. At the end of these steps, the **Circle/Arc** LED will glow red and remain lit, and the X and Y displays will show the **coordinates of the center of Hole 1 in relation to the origin**. The displays should look something like this:



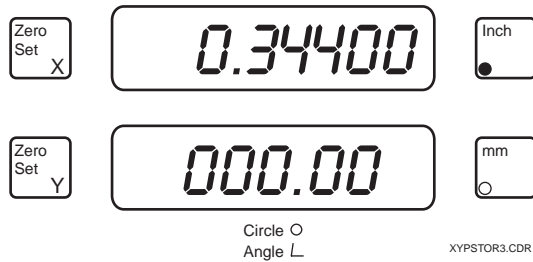
XYPSTOR2.CDR



- Press the **Dev** button. The **Dev** LED will begin flashing. The X and Y displays will now show the **Cartesian coordinates of the center of Hole 1 in relation to the center of the large hole**, which you established as a temporary origin in step 5 above.



- Press **Dev** again. The **Dev** LED will glow red and remain lit. The X display will now show the **straight-line distance between the centers of the large central hole and Hole 1**, and the Y display will show the **angle of the imaginary line connecting those two centers**. In effect, these displayed values reflect the polar coordinates of Hole 1, based on an origin at the center of the large hole. The displays should look something like this:



- Press **Dev** again. The **Dev** LED will go out and you will exit the function. The X and Y displays will now show the coordinates of the center of Hole 1 in relation to the original (0,0) point.



- Press **Circle/Arc** again. The **Circle/Arc** LED will go out and you will exit the function. The X and Y displays will show the current coordinates of the centerlines in relation to the origin.

12. Repeat steps 7 through 11 above for Holes 2 through 8. In each case, the X display will show the straight-line distance between the center of the large hole and that of the small hole, and the Y display will show the angle of the imaginary line connecting those two centers — the polar coordinates of each small hole in relation to the large hole. In this way, you can verify that measurements agree with the reticle's dimensioned drawing.

The following table illustrates the angle value (shown in the Y display) that you should find for each hole. In each case, the X display should show an approximate radius value of 0.344.

Hole	Angle
1	0
2	45
3	90
4	135
5	180
6	225
7	270
8	315



13. After Holes 2 through 8 have been measured, press **Store**. The **Store** LED will go out and you will exit the function. The temporary origin established at the center of the large hole has been cleared from memory.

Appendix A

Filters and Collimator Lenses Used with Projectron III

Projector Model	Magnification	Collimator Lens	Filter
OQ-14A, & OQ-14B	10X - 31.25X	622500	One Swing-In
	50X - 100X	622500	None
QL14, QL-214, LT-14, & QL-20	10X	606500	Two Swing-Ins
	20X	606500	One Swing-In (Dark)
	31.25X	606500	One Swing-In (Light)
	50X - 100X	606500	None
OQ-20	10X	622300	Two Swing-Ins
	20X	622300	One Swing-In (Dark)
	50X - 100X	622300	None
OQ-30A, OQ-30B, & QL-30	10X - 20X	605000	Two Internal Green
	50X - 100X	605300	One Internal Green

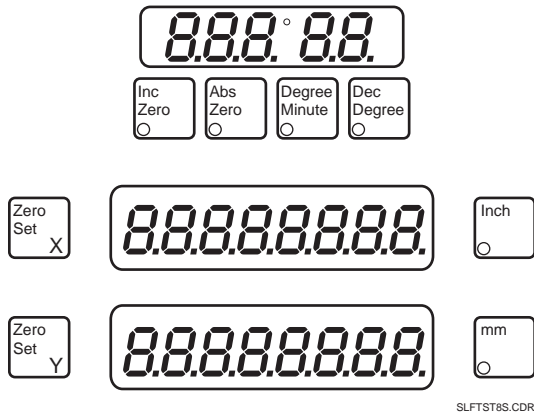
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Self-Test Sequence

Upon power-up, Di-Metric Plus will take a few seconds to run a self-test sequence. This sequence is described below.

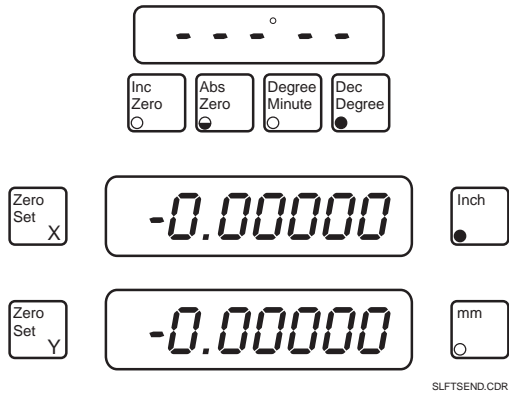
1. When the main power switch is turned on, Di-Metric Plus should beep for a second, and then all control panel button LEDs will simultaneously glow red and remain lit.
2. At the same time that the button LEDs light, the Function LEDs will also light. The Function LEDs appear directly beneath the Y display, and during normal operation light only under certain conditions (see Section 2).
3. While the button LEDs remain lit, the Function LEDs will go out in the following order:
 - **Edge E**, **Width //**, **Circle O**, and **Angle \angle** will go out simultaneously.
 - **No Op** will then go out, followed by **Line /**.
4. After the Function LEDs have gone out, all of the button LEDs will go out simultaneously.

- The X and Y displays, and the Protractor display, will now cycle to show the following for about one second:



This is a test of the light emitting diodes that make up the characters and decimal points. Please note if any numeral segments or decimal points are missing.

- While the Y display and Protractor display continue to show the same series of eights and decimals, the X display will briefly show two digits followed by a decimal point, and then two more digits. This number identifies the current version of firmware that Di-Metric Plus is using. Again, make a mental note of this number. You may need to provide it to OGP at some later point.
- Finally, the control panel will cycle to the following display:



When you see this, you know that Di-Metric Plus has completed and passed its self-test, and is awaiting your input.

Microprocessor Codes

While running a self-test, Di-Metric Plus may detect irregularities in its microprocessor. In these cases, a two-digit microprocessor code will be shown in the X display.

The following chart lists these codes, along with their causes. All components listed in the “Cause” column are resident on the CPU board.

Code	Cause
01	CPU Hardware Stack Pointer Hardware
02	Stack RAM Failure
03	U,X,Y,D Register Failure in CPU
04	Math Failure (CPU Failed in Addition Problem)
05	General RAM Failure
06	ROM 0 Checksum Failure
07	ROM 1 Checksum Failure
08	IRQ Timer Failure

If You Need Help

We sincerely hope it doesn't happen — but you may need help. Sometimes when you power up, the self-test sequence doesn't proceed normally. Perhaps a specific LED fails to light, or a microprocessor code may be displayed. Or you just may see something that confuses you.

If anything out of the ordinary happens at power-up, please call the OGP Service Department at (716) 544-0400. If you do call, it would be helpful if you could be specific regarding what you think is unusual in your power-up sequence. If possible, we will also need to know what version of firmware you are running. The more information we have, the quicker we can help you.

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Appendix C

Power Supply Checks and Adjustments

Di-Metric Plus has its own power supply to control operating voltages. The power supply is mounted behind the control panel, within the Di-Metric Plus compartment.

Normally, the Di-Metric Plus power supply does not need regularly scheduled maintenance. However, you may need to test and adjust it after repairing or replacing electronic components, or in the normal course of electronic troubleshooting.

The Di-Metric Plus power supply receives input voltage from your Contour Projector's main power supply. It outputs power at the following voltages:

- **+5 VDC power** is provided to the Projectron Interface board, the CPU board, and the Control Panel Display board.
- **+12 VDC and -12 VDC power** is provided to the RS-232 serial port, the Projectron Cyclops board, and the Projectron Interface board.

Locating the Power Supply

To locate the Di-Metric Plus power supply, refer to Figure C-1 and perform the following steps:

1. Ensure that main power to your Contour Projector is off.
2. Locate and remove the three socket head screws which secure the control panel. These screws are on the outside right wall of the Di-Metric Plus compartment.
3. Once the socket head screws have been removed, you can swing open the control panel to gain access to the compartment interior. The control panel itself is hinged on its left side, and it swings open to the left.
4. You will find the power supply mounted on its side on the interior back wall of the Di-Metric Plus compartment. The power supply is in a rectangular metal case, and the case dimensions are approximately 8" high x 4" wide x 1½" deep.

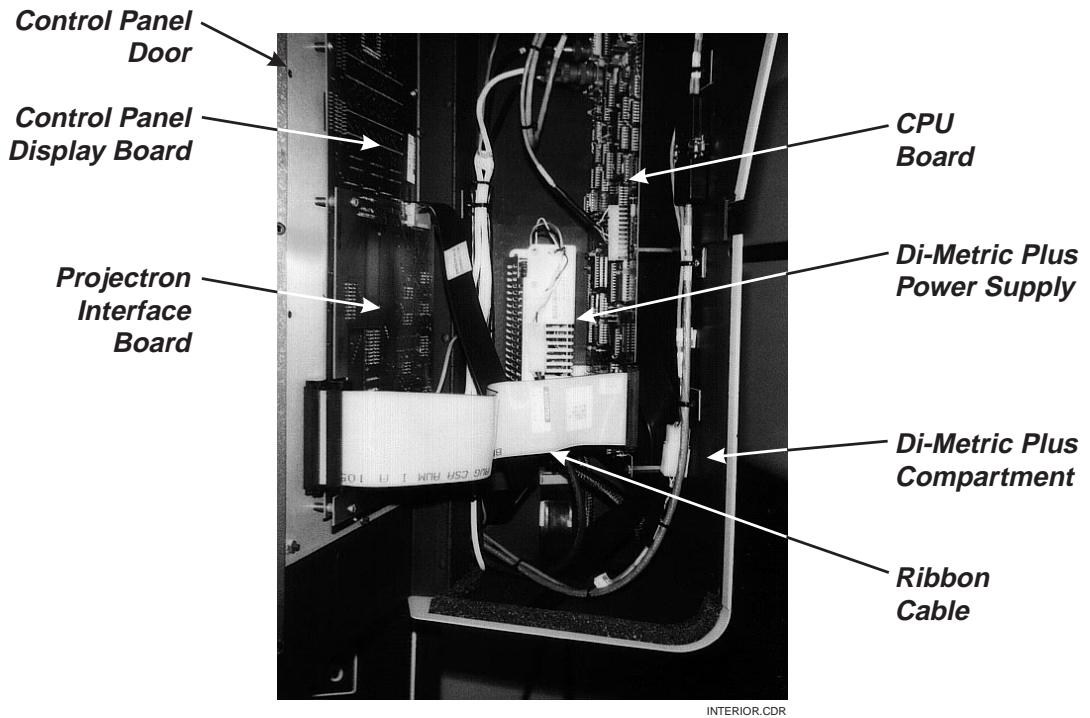


Figure C-1. Di-Metric Plus Compartment with Control Panel Door Opened.

Testing the Power Supply

To test the Di-Metric Plus power supply voltages, perform the following steps:

1. Power up the Contour Projector.

WARNING



When your Contour Projector is powered up, 110 VAC is present at the Di-Metric Plus power supply. This is a shock hazard. DO NOT TOUCH POWER SUPPLY AC CONNECTIONS WHEN MAIN POWER IS ON! To do so may lead to personal injury and/or damage to the equipment.

CAUTION

The voltage checks described below should be performed *only* by someone who has technical and/or field service expertise, and who is also knowledgeable about electricity. Should a short circuit accidentally occur during this procedure, there is a hazard of damage to the equipment.

2. Locate the CPU board, which is mounted on standoffs on the right interior wall of the Di-Metric Plus compartment.
3. Test points for the three power supply voltages — +5 VDC, +12 VDC, and -12 VDC — are located on the CPU board. Refer to Figure C-2 to find these three test points, as well as the GND test point. All four test points are labeled on the CPU board. You can leave the CPU board installed in the compartment while testing power supply voltages.
4. Using a multimeter, **connect the black lead to the GND test point, and the red lead to the -12 VDC test point.** With these connections made, the multimeter should display a reading **between -11.6 V and -12.4 V.** If the multimeter reading falls within this range, proceed to step 5 below. If the reading does not fall within this range, you must replace the power supply. Contact the OGP Service Department at (716) 544-0400 for help.
5. Using a multimeter, **connect the black lead to the GND test point, and the red lead to the +12 VDC test point.** With these connections made, the multimeter should display a reading **between +11.6 V and +12.4 V.** If the multimeter reading falls within this range, proceed to step 6 below. If the reading does not fall within this range, you must contact the OGP Service Department at (716)544-0400 for a replacement power supply.
6. Using a multimeter, **connect the black lead to the GND test point, and the red lead to the +5 VDC test point.** With these connections made, the multimeter should display a reading **between 4.75 V and 5.25 V.** If the multimeter reading falls within this range, the power supply is operating normally and you don't need to test it further. If the multimeter reading does not fall within this range, leave the multimeter connected to the +5 VDC and GND test points, and go to the next topic, "Adjusting the +5 V Power Supply Output."

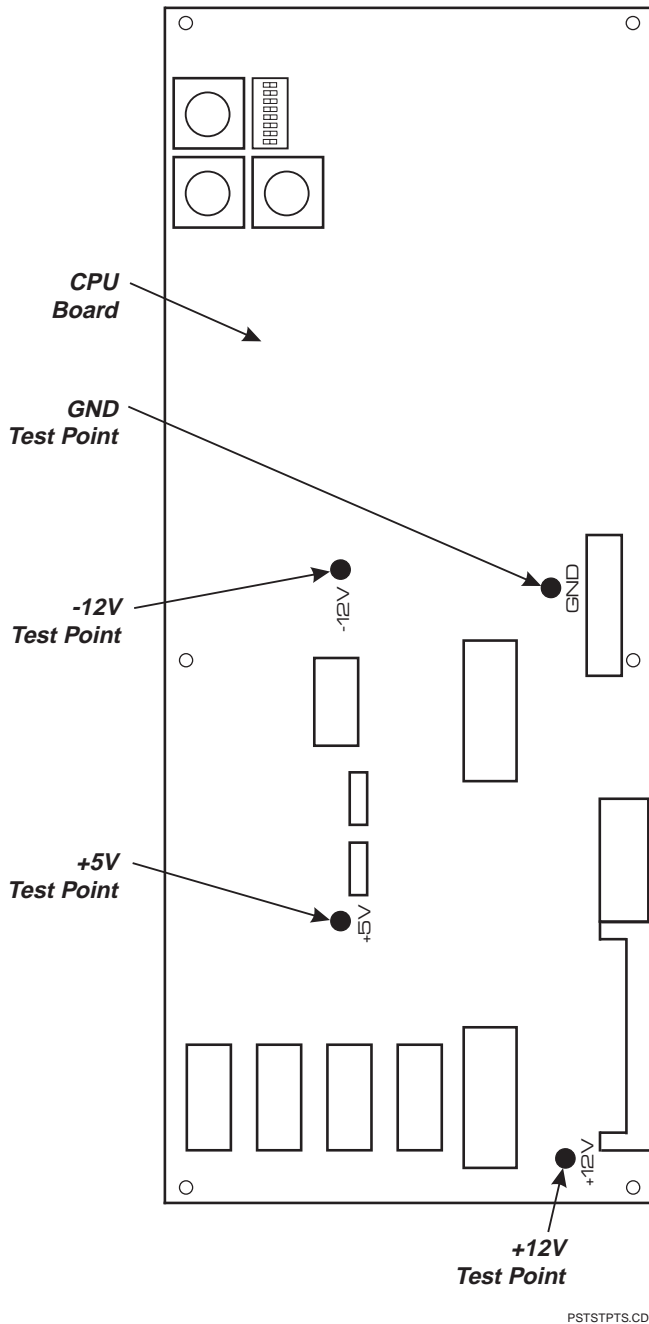


Figure C-2. Di-Metric Plus Power Supply Voltage Test Points

Adjusting the +5 V Power Supply Output

To adjust the +5 V output, perform the following steps:

1. Turn off the main power to the Contour Projector, and also disconnect the power cord from the wall.
2. Locate the gray ribbon cable that is attached to the CPU board at one end, and the Control Panel Display board (and the Projectron Interface board, if your machine is equipped with Projectron) at the other end (see Figure C-1). Pull the ribbon cable straight out to disconnect it from the CPU board. Leave the other end of the ribbon cable attached, and let it hang loosely, so that it is out of your way.
3. Locate the two small socket head screws which fasten the power supply to the back wall of the Di-Metric Plus compartment. These two screws screw into the power supply from the opposite side of the wall. While holding the power supply with your left hand, remove these two screws.
4. Place the power supply at the base of the Di-Metric Plus compartment, while ensuring that all cables and wires remain attached to it. Set the power supply on its back, so that you are looking down on the side that is louvered.
5. Reconnect the gray ribbon cable to the CPU board.
6. Plug in and power up the Contour Projector. When the machine is powered up, do not touch the area of the power supply where AC power is present (see Figure C-3).

WARNING



When your Contour Projector is powered up, 110 VAC is present at the Di-Metric Plus power supply. This is a shock hazard. DO NOT TOUCH POWER SUPPLY AC CONNECTIONS WHEN MAIN POWER IS ON! To do so may lead to personal injury and/or damage to the equipment.

7. Locate the two small holes in the lower left part of the power supply case. The +5 VDC potentiometer is beneath the left hole (see Figure C-3).
8. Use a small insulated screwdriver to adjust the voltage of the +5 VDC potentiometer. While observing the results on the multimeter, turn the potentiometer clockwise to increase voltage or counterclockwise to decrease voltage until the multimeter displays a reading between 4.75 and 5.25 VDC. If you cannot adjust the voltage to fall within this range, call the OGP Service Department at (716) 544-0400 to order a replacement power supply.
9. Testing is complete. After powering down and unplugging the Contour Projector, reinstall the power supply and make sure that all electrical connections are secure.

WARNING



**110 VAC PRESENT
IN THIS AREA —
DO NOT TOUCH!**

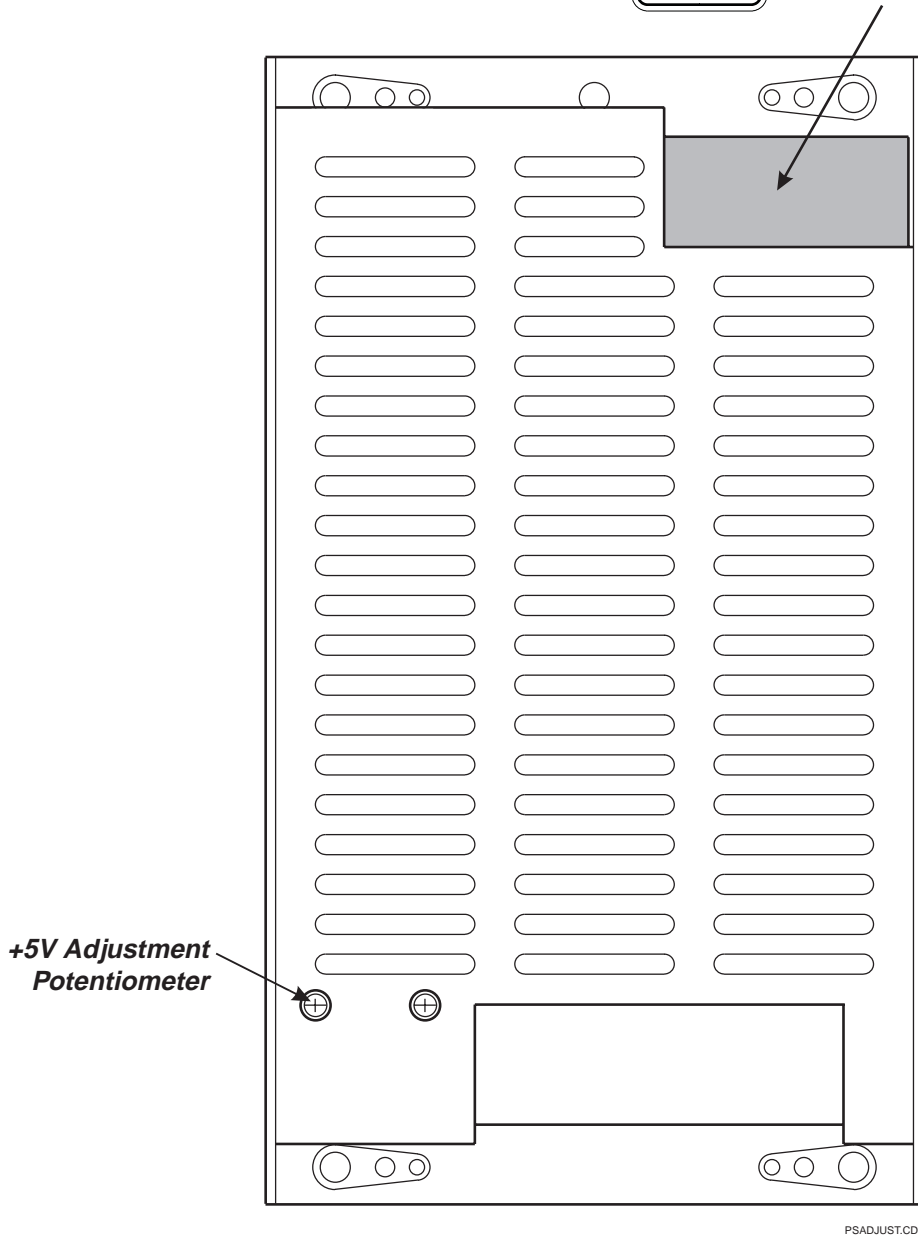


Figure C-3. Di-Metric Plus Power Supply +5 VDC Adjustment

CPU Option Switch Settings

The CPU option switch, also known as S1, is located in the extreme upper left of the CPU board. The option switch is made up of a series of eight numbered slider switches, as shown in Figure D-1.

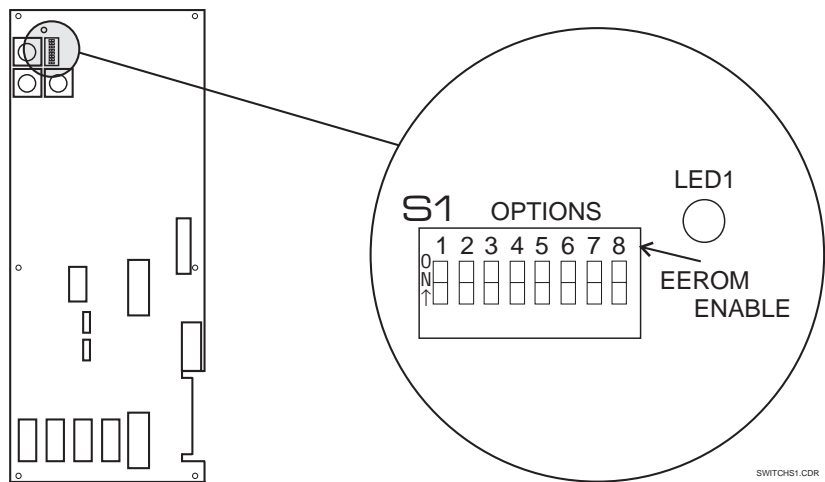


Figure D-1. Di-Metric Plus CPU Option Switch S1

Note that Slider 8 is labeled EEROM ENABLE. When this slider is set in the ON position, parameter memory is write-enabled, allowing you to change Di-Metric Plus parameters (see Appendix E). When Slider 8 is ON, the LED (LED1) which is adjacent to the switch will glow red and stay lit.

CAUTION

DO NOT power down your Contour Projector when LED1 is lit and parameter memory is write-enabled. When power-down occurs under these conditions, Di-Metric Plus parameter memory may be corrupted, and all parameters must then be reprogrammed.

Note

Before write-enabling parameter memory, perform a parameter printout as described in Appendix E. If a power-down should accidentally occur while parameter memory is write-enabled and this leads to memory corruption, you will have a reference to then re-enter parameters manually.

The S1 slider switches control the ON/OFF status of the basic control functions of Di-Metric Plus. These status conditions are defined in the following table.

Slider	Status	Purpose
1	OFF	Protractor counts up from 0° to 180° in counterclockwise direction
	ON	Protractor counts up from 0° to 180° in clockwise direction
2	OFF	Sets screen resolution to 0.0001 inch (0.002 mm)
	ON	Sets screen resolution to 0.00005 inch (0.001 mm)
3	OFF	Disables Projectron III
	ON	Enables Projectron III
4	OFF	Sets X and Y displays to indicate "+" for worktable motion which is down or to the left, "-" for worktable motion which is up or to the right
	ON	Sets X and Y displays to indicate "+" for worktable motion which is up or to the right, "-" for worktable motion which is down or to the left
5	OFF	Interfaces Di-Metric Plus to CMS
	ON	Interfaces Di-Metric Plus to SmartCheck
6	OFF	Disables Di-Metric Plus
	ON	Enables Di-Metric Plus
7	OFF	Enables round-off of fifty millionths digit by increments of five (0.00005", 0.00010", etc.)
	ON	Disables round-off
8	OFF	Write-protects parameter memory
	ON	Write-enables parameter memory

S1 slider positions have been preset at the factory. The default settings for current production models are listed below.

Model	1	2	3	4	5	6	7	8
QL-20	OFF	ON	See Note below	OFF	OFF	ON	OFF	OFF
QL-30	OFF	ON	See Note below	OFF	OFF	ON	OFF	OFF

Note

Switch 3 should be set to ON if Projectron III is installed, OFF otherwise.

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Appendix E

Microprocessor Parameters

Di-Metric Plus uses baseline numerical settings to perform measurements. These baseline settings are known as microprocessor parameters.

Di-Metric Plus parameters are preset at the factory, but they may need to be checked occasionally. Due to temperature variations, mechanical wear, and a number of other factors, your Contour Projector's initial calibration may eventually need to be modified. Because of conditions which may affect calibration, you need to know:

- What the preset nominal parameters were, and
- What calculations and adjustments can be made to those nominals so your Contour Projector can continue providing accurate measurements.

Di-Metric Plus has been programmed with 38 parameters. Of these, the eleven listed in the table below are the most important to the Di-Metric Plus user. The procedure to adjust these parameters will be detailed in the following subsections.

Parameter Number	Function
01	X (Horizontal) Encoder Factor
02	Y (Vertical) Encoder Factor
05	Baud Rate for RS-232 Interface
06	AC Servo (0 = No, 1 = Yes)
07	DC Servo (0 = No, 1 = Yes)
08	High Speed Servo (0 = No, 1 = Yes)
09	X Axis Wall Effect Correction Factor
10	Y Axis Wall Effect Correction Factor
25	Protractor Encoder Factor
27	Default Inch/mm Units (0 = Inch, 1 = mm)
28	Default Protractor Mode (0 = Dec Deg, 1 = Degree Minute)

Parameters 01 and 02 — Encoder Factors

Parameters 01 and 02 are the **X and Y (horizontal and vertical) encoder factors**.

An encoder factor is a numerical constant that the microprocessor uses to correlate worktable movement (as measured by a glass scale) to the X and Y displays.

The current Contour Projectors which may be equipped with Di-Metric Plus, the QL-20 and QL-30, come equipped with 0.001 mm glass scales. The nominal X and Y encoder factors for both machines is **0.3937008**.

If you have a Di-Metric Plus Contour Projector which is no longer in production, your machine may be equipped with a different resolution glass scale or rotary encoder than that of current models. If this is true for you, contact the OGP Service Department at (716) 544-0400. We can help you find out what the nominal encoder factor should be for your machine.

Calculating Adjusted Encoder Factors

If you suspect that your contour projector is not measuring accurately, you may need to take the following steps:

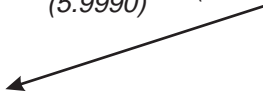
1. Refer to “Accessing Parameters,” found later in this Appendix, and verify that the current nominal parameter for both 01 and 02 is 0.3937008. If current 01/02 parameters are not 0.3937008, reset them to that value (see “Modifying Parameters” on page E-16 of this Appendix), then go to step 2 below.
2. You will need to measure known lengths in both axes, and then compare those known lengths to the lengths shown in the X and Y displays. To obtain accurate known lengths, we recommend the use of the optional OGP Video and Comparator Certification Reticule, Part Number 425404. As you make your measurements, write down the known and displayed lengths. If they differ from each other, go to step 3.
3. Place the length values into the equations below to find an adjusted encoder factor. These equations are valid for both the X and Y axes.

$$\frac{(\textit{known length})}{(\textit{displayed length})} = (\textit{quotient})$$


$$(\textit{quotient}) \times (\textit{nominal}) = \textbf{Adjusted Encoder Factor}$$

For example, using the previous equations, for a known length of **6.0000** and a displayed length of **5.9990**, the result would be:

$$\frac{(6.0000)}{(5.9990)} = (1.0001667)$$

$$(1.0001667) \times (0.3937008) = \mathbf{0.3937664}$$


4. Refer to “Modifying Parameters,” found later in this Appendix, and follow the procedure to change parameters 01 and/or 02 to the adjusted encoder factor found in step 3.
5. Use the OGP Certification Reticle to check X and Y measurement accuracy. If displayed lengths still differ from known lengths, recalculate by multiplying the quotient by the adjusted encoder factor.

Parameter 05 — Baud Rate

Parameter 05 is the **baud rate for Di-Metric Plus RS-232 interface**. Baud rate refers to speed of data transfer. Baud rate is synonymous with bits per second, or BPS.

Di-Metric Plus data can be transmitted via RS-232 interface to serial devices such as printers and PCs. On Di-Metric Plus, the user can reset the baud rate, because different serial devices require different rates of data transfer. 1200 BPS is the most common baud rate, and it is also the Di-Metric Plus default. All available Di-Metric Plus baud rates are illustrated in the following table.

Baud Rate	Parameter 05	Baud Rate	Parameter 05
75	01	2000	09
110	02	2400	10
134.5	03	3600	11
150	04	4800	12
300	05	7200	13
600	06	9600**	14
1200*	07	19200	15
1800	08		

*Default **For OGP SmartCheck Interface

If you need to change parameter 05 to a value other than the default of 07 (1200 baud), refer to “Modifying Parameters,” found later in this Appendix, for detailed instructions.

Parameters 06, 07, and 08 — Servos

The current Contour Projectors which may be equipped with Di-Metric Plus, the QL-20 and QL-30, have DC servos driving the X and Y worktable motion. However, some Contour Projectors currently in the field but not in production may be equipped with either AC or High Speed servos.

In general, if your Contour Projector’s worktable responds to your joystick or arrow button commands, parameters 06, 07, and 08 are set correctly. For reference, though, the following table illustrates how parameters 06, 07, and 08 should be set, assuming you know which type of servo your machine has installed. If you are not sure which servo your Contour Projector has, call the OGP Service Department at (716) 544-0400 for guidance.

Servo Type	Parameter 06	Parameter 07	Parameter 08
DC Servo (QL-20, QL-30)	0	1	0
AC Servo (OQ-14B)	1	0	0
High Speed Servo	0	0	1

If you need to verify or change servo parameters 06, 07, or 08, refer to later subsections of this Appendix for detailed instructions.

Parameters 09 and 10 — Wall Effect

Parameters 09 and 10 are the **X and Y (horizontal and vertical) wall effect correction factors**.

Wall effect is an optical phenomenon that occurs when inspecting thick, highly-polished parts using direct illumination. The polished surface acts as a mirror that reflects the light and can affect the position of a Projectron-detected edge.

To compensate for wall effect, Di-Metric Plus applies predetermined wall effect correction factors. Default correction factors for both axes have been set at the factory. These default settings have been developed to compensate for a wide range of wall effect conditions, and should not normally be changed.

Sometimes, though, you may need to calculate a specific wall effect correction factor for a certain part or set of conditions when you are planning to detect edges with Projectron.

Calculating Wall Effect Correction Factors

To recalculate wall effect correction factors, perform the following procedure:

1. Make sure your Contour Projector is powered up, horizontal illumination is turned on and warmed up, and Absolute Zero is set.
2. Wall effect differs slightly depending upon magnification, so select the magnification which you plan to use for this set of measurements. Also, make sure the correct collimator lenses and filters are in place for Projectron.
3. Stage a precision gage pin to the worktable. (For our example, we will assume you are using a 0.2500 inch pin.) Depending upon which axis you are checking, line up the pin visually with either the horizontal or vertical screen centerline. You should eventually check wall effect on both axes.
4. Use Projectron to find one edge of the pin. Once the edge is found, zero the X and Y displays and then use Projectron and the arrow keys to find the other edge of the pin. Write down the resulting Projectron-measured value.
5. Place the Projectron-measured value and the known value into the equations below to find a wall effect correction factor. These equations are valid for both the X and Y axes.

$$(known\ value) - (displayed\ value) = (wall\ effect)$$

$$\frac{(wall\ effect)}{(number\ of\ edges)} = \text{Wall Effect Correction Factor}$$

For example, using these equations, for a known value of **0.2500** and a displayed value of **0.2504**, the result would be:

$$(0.2500) - (0.2504) = (-0.0004)$$

$$\frac{(-0.0004)}{(2)} = -0.0002$$

To enter the new wall effect correction factors, refer to “Modifying Parameters,” found later in this Appendix, for detailed instructions. When entering the new parameter 09 or 10, disregard the sign and only enter the appropriate digits.

7. Locate and remove the three socket head screws on the outside right wall of the Di-Metric Plus compartment, and swing the control panel door open. Find the Projectron Interface board, which is mounted on standoffs on the rear surface of the control panel door. There is a dip switch mounted at the top left of the Projectron Interface board, on the component side of the board (see Figure E-1). Switch 1 controls the sign of the X axis wall effect, and switch 2 controls the sign of the Y axis wall effect.
 - If your newly calculated wall effect correction factor is **negative**, verify that switch 1 (X axis) and/or switch 2 (Y axis) are set to the **OUT** position. (This is the default position of these two switches.) In this case, switches 1 and/or 2 would be even with switches 3 through 8.
 - If your newly calculated wall effect correction factor is **positive**, push switch 1 (X axis) and/or switch 2 (Y axis) to the **IN** position. In this case, switches 1 and/or 2 would be in farther than switches 3 through 8.

When these switches are set in the correct position, Di-Metric Plus can determine in which direction to apply the wall effect correction factor.

8. Repeat step 4 to ensure that wall effect has been corrected for. If necessary, you may need to recalculate the wall effect correction factor or reset the position of switches 1 and/or 2.

Note

Parameters 31 through 36 do not currently control wall effect, and are reserved for future use. These parameters should remain set at .00000.

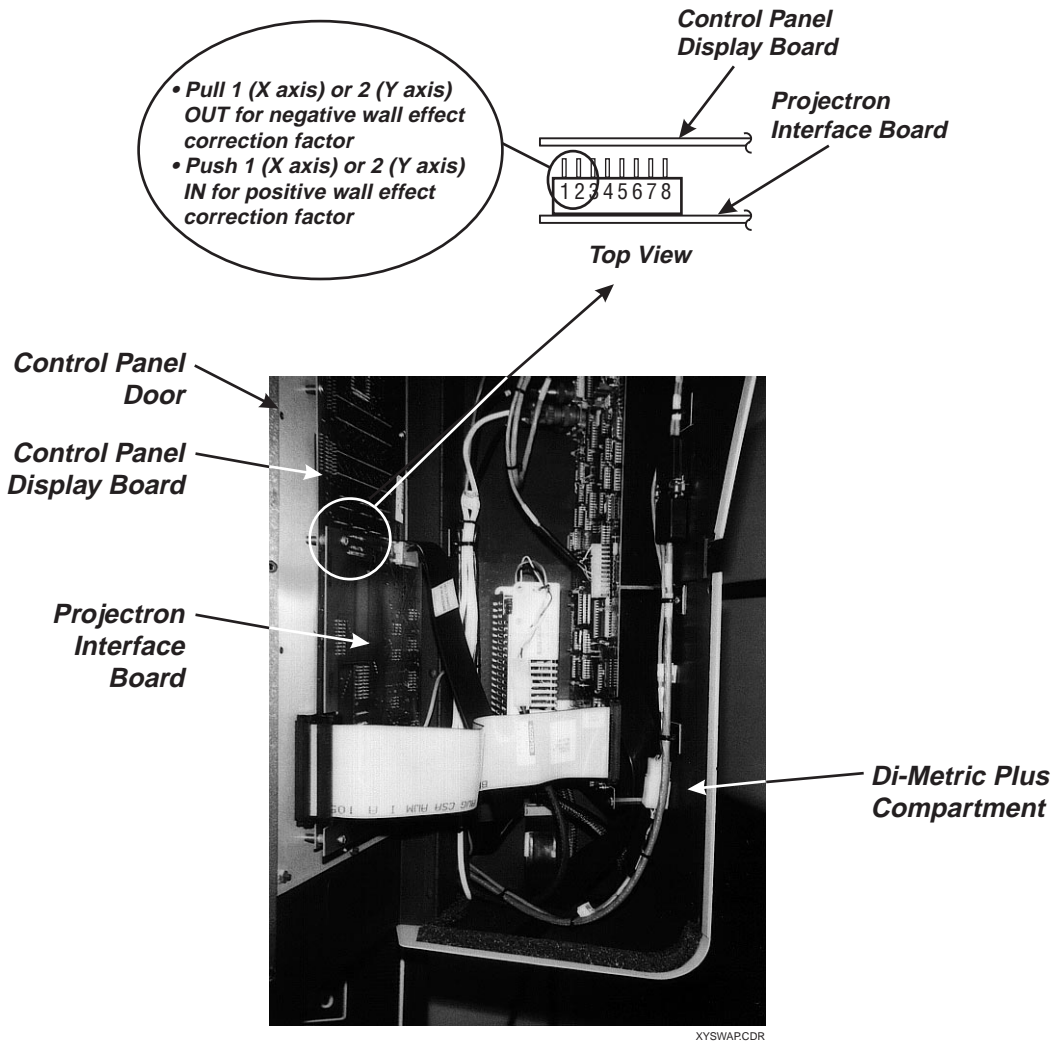


Figure E-1. Setting Direction of X/Y Wall Effect Correction Factor

Parameter 25 — Protractor Encoder Factor

Parameter 25 is the viewing screen **protractor encoder factor**.

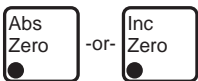
Di-Metric Plus senses rotation of the protractor ring by counting pulses from a rotary encoder. This encoder is acted upon by a constant value resident in parameter 25, and then displayed in degrees on the protractor display. The nominal factors entered in parameter 25 at the factory are **83.83089** (for 20-inch diameter viewing screens) and **53.72589** (for 30-inch diameter viewing screens).

Occasionally, your Contour Projector may need to be recalibrated so that one rotation of the protractor ring equals exactly 360°. There are two ways to do this:

- If one screen rotation equals $360 \pm 0.05^\circ$, it is probably due to variation in ambient temperature. To rectify this, you can follow a thermal variation calibration procedure to enter a temporary protractor encoder factor which will override parameter 25 as long as the machine is powered up.
 - Thermal calibration should be performed at least daily upon power-up of your Contour Projector. This procedure is described in Section 4, “Calibrating Screen Protractor for Thermal Variation.”
- If one screen rotation is either greater than 360.05° or less than 359.95° , you will need to recalculate and enter a new parameter 25 value. This procedure is described below.

Calculating an Adjusted Protractor Encoder Factor

Follow these steps to calculate a modified protractor encoder factor:



1. Make sure your Contour Projector is powered up, and the **Dec Degree** button is pressed.
2. Loosen the protractor ring knob and visually line up the white mark on the ring with its mate on the frame.
3. If you have not set Absolute Zero, press the **Absolute Zero** button. If Absolute Zero has already been set, press **Inc Zero** instead.
4. Rotate the protractor ring one turn counterclockwise and visually line up the white marks as accurately as possible. Look at the protractor display.
 - **If the protractor display shows a positive value**, add 360 to it to obtain the number of degrees in one rotation. Write down that value.
 - **If the protractor display shows a negative value**, that value is the number of degrees in one rotation. Write down that value, instead.

- Substitute the values found in step 4 into the following equations to find an adjusted protractor encoder value.

$$\frac{(\text{known degrees in 1 rotation})}{(\text{displayed degrees in 1 rotation})} = (\text{quotient})$$

$$(\text{quotient}) \times (\text{nominal}) = \text{Adjusted Protractor Encoder Factor}$$

For example, using the previous equations, for displayed degrees of **361.04** and using a current nominal of **53.72589**, the result would be:

$$\frac{(360.00)}{(361.04)} = (0.99712)$$

$$(0.99712) \times (53.72589) = \mathbf{53.57116}$$

- Refer to “Modifying Parameters,” found on page E-16 of this Appendix, and follow the procedure to change parameter 25 to the adjusted protractor encoder factor found in step 5.
- Repeat step 4 to check the accuracy of your new protractor encoder factor. If necessary, recalculate.

Parameters 27 and 28 — Default Units of Measurement

Parameters 27 and 28 control the units of measurement that Di-Metric Plus defaults to upon power-up. The parameter settings for these defaults are specified in the table below. Refer to “Modifying Parameters,” found later in this Appendix, and follow the procedure to change parameters 27 or 28.

Parameter	Setting	Power-up Mode
27	1	mm
	0	Inch
28	1	Degree Minute
	0	Dec Degree

Parameter Printout

You may wish to have a printout of the Di-Metric Plus parameters which are currently in effect. For example, it may be helpful for you to know what all parameters are at a glance. It may also be wise to have a printed record of the baseline parameters so that if the parameters become corrupted, you can then refer to the printout and re-enter the original parameters.

To execute a parameter printout, perform the following steps:

1. If your Contour Projector is on, power it down.
2. Locate the Di-Metric Plus RS-232 serial port, which protrudes through the rear wall of the Di-Metric Plus compartment.
3. Using proper cabling, connect a serial printer to the serial port.
4. Turn on main power to the Contour Projector, and then turn on the printer.
5. Locate and remove the three socket head screws which secure the control panel. These screws are on the outside right wall of the Di-Metric Plus compartment.
6. Once the socket head screws have been removed, you can swing open the control panel to gain access to the compartment interior. The control panel door is hinged on its left side, and it swings open to the left.
7. You will see the CPU board mounted on standoffs on the right side of the Di-Metric Plus compartment. Locate the CPU option switch (S1), which is located in the extreme upper left of the CPU board. The option switch is made up of a series of eight numbered slider switches, as shown in Figure E-2.

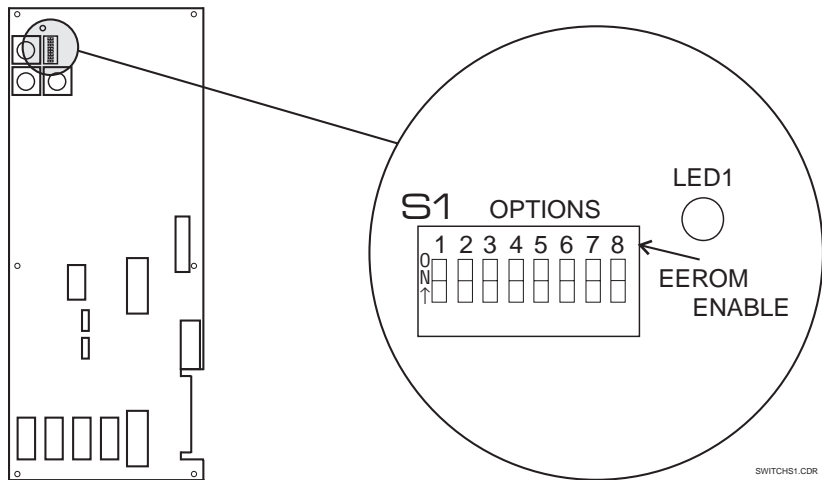


Figure E-2. Di-Metric Plus CPU Option Switch S1

8. Push slider 8, at the end of the CPU option switch, in the direction of the arrow to the **ON** position. This action write-enables parameter memory. The red LED immediately above the option switch (**LED1**) will glow red and remain lit as long as the option switch is write-enabled.

CAUTION

DO NOT power down your Contour Projector when LED1 is lit and parameter memory is write-enabled. When power-down occurs under these conditions, Di-Metric Plus parameter memory may be corrupted, and all parameters must then be reprogrammed.

9. Determine the baud rate of the serial printer.
 - **If the baud rate is 1200** and you are reasonably sure that other printers have not been used to print out parameters or that baseline parameters have not been changed, go to step 10.
 - **If the baud rate is not 1200**, or if the parameters have been previously changed, refer to other subsections of this Appendix, and follow the appropriate procedures to ensure that the parameter 05 setting is correctly matched to your printer.
10. Press the **Print** button on the control panel.
 - If baud rate is set correctly, Di-Metric Plus will print out current parameter settings on the serial printer. See Figure E-3 for a sample parameter printout.
 - If baud rate is not set correctly, the serial printer will not respond and nothing will be printed. Follow the appropriate procedures to reset the baud rate to the correct setting.
11. Once the parameter printout has been executed, return slider 8 of the CPU option switch to **OFF**. LED1 will go out.
12. Power down the Contour Projector, then disconnect the printer from the serial port. Resecure the Di-Metric Plus compartment.



```

Clip Plus/Di-Metric Plus Parameter Dump
Date-----
Machine Model & S/N-----
Readout S/N-----
ROM0/ROM1 Firmware Version: 01.24 06-18-93

```

CPU OPTION SWITCH S1 CONTENTS:

```

SLIDER #, FUNCTION WHEN 'ON'.
1=OFF---POLAR AXIS SWAP
2=ON----HIGH-RES .00005 IN, .001 MM
3=OFF---ENABLES PROJECTRON INTERFACE
4=OFF---X,Y SIGN SWAP ^>=+
5=OFF---ECHOES RS-232 INPUT, OFF FOR CALCULATOR, ON FOR PRINTER
6=ON----OFF = CLIP PLUS, ON = DI-METRIC
7=OFF---DISABLES 0/5 INCH, 0/2 MM DISPLAY ROUND OFF.
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 BYTE #, VALUE FUNCTION

```

NUMBER 123456789
01-----0.3937335-----X ENCODER FACTOR, U21 MULT=X1-X2-X4, REV. PIN=IN-OUT
02-----0.3937008-----Y ENCODER FACTOR, U23 MULT=X1-X2-X4, REV. PIN=IN-OUT
03-----0-----SIGN OF SQUARENESS RUNOUT, 0=+, 1=-
04-----0.0-----SQUARENESS RUNOUT, 10 MICRO INCH/INCH INCREMENTS
05-----07=1200/1-----RS-232 BAUD RATE/STOP BITS
06-----0-----1=AC SERVO
07-----1-----1=ANALOG 650/550 SERVO
08-----0-----1=DIGITAL SERVO
09-----0.00010-----DEFAULT PJ X AXIS WALL EFFECT turret pos #4 / no switch
es
10-----0.00010-----DEFAULT PJ Y AXIS WALL EFFECT turret pos #4 / no switch
es
11-----0.016-----DEFAULT PJ NEAR POINT
12-----1-----X SERVO SIGN, 0=+, 1=-
13-----0.17-----X SERVO RAMP START POINT!
14-----10-----X SERVO CREEP SPEED
15-----6-----X SERVO ACCEL CONSTANT
16-----00-----X SERVO MANUAL ARROW JOG SPEED
17-----45-----X AXIS SEEK SPEED
18-----0-----Y SERVO SIGN, 0=+, 1=-
19-----0.13-----Y SERVO RAMP START POINT
20-----25-----Y SERVO CREEP SPEED
21-----6-----Y SERVO ACCEL CONSTANT
22-----00-----Y SERVO MANUAL ARROW JOG SPEED
23-----79-----Y AXIS SEEK SPEED
24-----0.05-----KEYSTONE CORRECTOR
25-----053.59551-----P ENCODER FACTOR, U38 MULT=X1-X2-X4, REV. PIN=IN-OUT
26-----100-----AUTO GO DWELL
27-----0-----DEFAULT INCH/MM UNITS, 0=IN, 1=MM
28-----0-----DEFAULT PROT RING MODE, 0=DEC DEG, 1=DEG/MIN
29-----0-----not used
30-----0-----not used
31-----0.00000-----X wall effect turret pos'n #1
32-----0.00000-----Y wall effect turret pos'n #1
33-----0.00000-----X wall effect turret pos'n #2
34-----0.00000-----Y wall effect turret pos'n #2
35-----0.00000-----X wall effect turret pos'n #3
36-----0.00000-----Y wall effect turret pos'n #3
37-----0-----Sign of Y correction, 0=+, 1=-
38-----00.0-----Y axis compression correction .00001"/" increments
EOT

```

Figure E-3. Di-Metric Plus Parameter Printout

Accessing Parameters

Before changing parameters, you must first be able to access them as they are currently set in Di-Metric Plus memory. To access Di-Metric Plus parameters, perform the following steps:

1. Locate the CPU option switch, as described in steps 5, 6, and 7 of the of the previous subsection, “Parameter Printout.”
2. Push slider 8, at the end of the CPU option switch, in the direction of the arrow to the ON position. This action write-enables parameter memory. The red LED immediately above the option switch (LED1) will glow red and remain lit as long as the option switch is write-enabled.

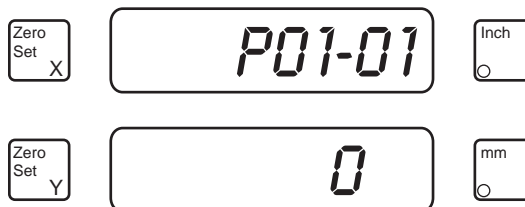
CAUTION

DO NOT power down your Contour Projector when LED1 is lit and parameter memory is write-enabled. When power-down occurs under these conditions, Di-Metric Plus parameter memory may be corrupted, and all parameters must then be reprogrammed.

Note

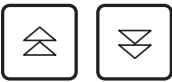
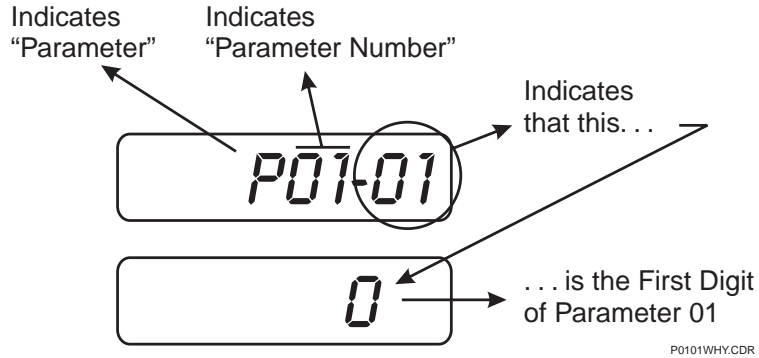
Before attempting to change parameters, perform a parameter printout as described in the previous subsection. If a power-down should accidentally occur while parameter memory is write-enabled and this leads to memory corruption, you will have a reference to then re-enter parameters manually.

3. Swing the control panel door partially closed and look at the X and Y displays. They should look like this:



P0101.CDR

The meaning of this display format is shown below:



4. To move from parameter to parameter, press the **Up Arrow** button to go up through the parameter **numbers** (for example, from *P01-01* to *P02-01*), or press the **Down Arrow** button to go down through the parameter numbers (for example, from *P08-01* to *P07-01*).



5. To move within a parameter, press the **Right Arrow** button to go up through the parameter **digits** (for example, from *P07-03* to *P07-04*), or press the **Left Arrow** button to go down through the parameter digits (for example, from *P05-04* to *P05-03*).
6. As you move up or down from parameter to parameter (shown in the X display), or left or right from parameter digit to parameter digit (also shown in the X display), the Y display will always show whatever actual number is resident in that particular parameter or digit.
7. Parameter decimal points are treated as digits which take up a full digit space. A decimal point is indicated by the letter "P."
8. For Parameters 01 and 02, Di-Metric Plus requires the encoder factor to begin with a zero and a decimal point, which would be expressed as "0P" (for example, *0P3937008*).

9. The following table summarizes the number of digits allowed for each particular parameter. In this table, “n” indicates a digit, and “P” indicates a decimal point.

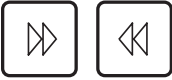
Parameter Number	Format	Parameter
01	0Pnnnnnnn	X (Horizontal) Encoder Factor
02	0Pnnnnnnn	Y (Vertical) Encoder Factor
05	01 thru 15	Baud Rate Options
06	0 or 1	AC Servo (0 = No, 1 = Yes)
07	0 or 1	DC Servo (0 = No, 1 = Yes)
08	0 or 1	High Speed Servo (0 = No, 1 = Yes)
09	Pnnnnn	X (Horizontal) Wall Effect
10	Pnnnnn	Y (Vertical) Wall Effect
25	nnnPnnnnn	Protractor Encoder Factor
27	0 or 1	Default Inch/mm (0 = Inch, 1 = mm)
28	0 or 1	Default Protractor Mode (0 = Dec Degree, 1 = Degree Minute)

Modifying Parameters

Now that you know how to access parameters as they are currently set, you can also modify parameters to calibrate Di-Metric Plus measurements. To modify parameters, perform the following steps:



1. Move to the parameter that you want to modify by pressing the appropriate **Up Arrow** or **Down Arrow** buttons. If you press and hold these buttons, they will autorepeat and continue to increment until the button is released.



2. Once you have reached the parameter that you want to modify, move to the digit that you need by pressing the appropriate **Right Arrow** or **Left Arrow** buttons. Again, if you press and hold these buttons, they will autorepeat.

3. Once you have reached the parameter and digit that you want, you can change the digit indicated in the Y display by following these steps:



- Press the **Inch** button to change the digit in the Y display in an **upward** direction (the X display will not change). If you press and hold the **Inch** button, it will make the Y display digit autorepeat upward, eventually rolling it over from 9 to 0, and then count up to 9 again.



- Press the **mm** button to change the digit in the Y display in a **downward** direction (the X display will not change). Again, if you press and hold the **mm** button, it will make the Y display digit autorepeat downward, eventually rolling it over from 0 to 9, and then count down to 0 again.

- Once you have set the desired digit within the Y display, you have reprogrammed that digit.

4. You can continue to reprogram Y display digits by navigating through and within parameters by pressing the appropriate **Arrow** buttons, and then using **Inch** and **mm** to set the appropriate Y display digits. When you are finished, you can check your work by navigating backward through the digit positions and parameter numbers, checking to make sure that the desired number is displayed in the Y display as you go.

5. When done, move slider 8 on the CPU option switch back to the OFF position. LED1 should go out.



6. If you need to, you can press the **Clear** button to bring the X and Y displays back to their current coordinates.

Projectron III Calibration

The Projectron III edge detection system is extremely reliable and accurate, but it may need to be recalibrated from time to time to maintain that high level of accuracy.

The following adjustments can help maintain Projectron's accuracy:

- Preliminary mechanical adjustments to your Contour Projector
- Mechanical adjustments to Projectron components
- Electronic adjustments to Projectron components

It is important to remember that all mechanical calibration, both for your Contour Projector and for Projectron itself, must be performed **before** any Projectron electronic elements can be effectively adjusted.

Preliminary Mechanical Adjustments

The following preliminary mechanical adjustments must be made to your Contour Projector before you can calibrate Projectron components:

- Adjusting collimation of horizontal illumination
- Centering viewing screen axis of rotation
- Aligning screen centerlines to worktable XY axis
- Calibrating magnification accuracy

Adjusting Collimation

When adjusting collimation of horizontal illumination, you are ensuring that horizontal light is emerging parallel to your Contour Projector's optical centerline. If Projectron is to make accurate measurements, collimation is an important factor.

Tests for Proper Collimation

In general, if your Contour Projector collimation is properly adjusted, the following two conditions will be present:

- The viewing screen will be evenly illuminated, with no hot spots or shadows.
- When focusing an image on the viewing screen, that image will remain in one place, and will not shift in any direction as you focus.

If your Contour Projector exhibits symptoms contrary to this, collimate horizontal illumination either by using the collimation assistance lens or by using a mirror, as described in the following two subsections.

Using the Collimation Assistance Lens

All Contour Projectors equipped with Projectron are also equipped with a collimation assistance lens. To use this lens to collimate horizontal illumination, perform the following steps:

1. Turn on mercury arc horizontal illumination and allow a full five-minute warm-up time.
2. Bring the collimation assistance lens into the optical path by selecting "C" on the rotary turret assembly.
3. You will see a circle of light projected on the viewing screen. Within that circle, an image of the anode and cathode of the mercury arc lamp will appear.
4. Locate the small set screw which is on the top left side of the horizontal lamphouse (see Figure F-1). This is the collimator set screw, which secures the collimator assembly within the lamphouse. Loosen the collimator set screw slightly.
5. Grasp the collimator assembly with your right hand and slide it within its housing until the image of the anode and cathode appears focused on the screen.

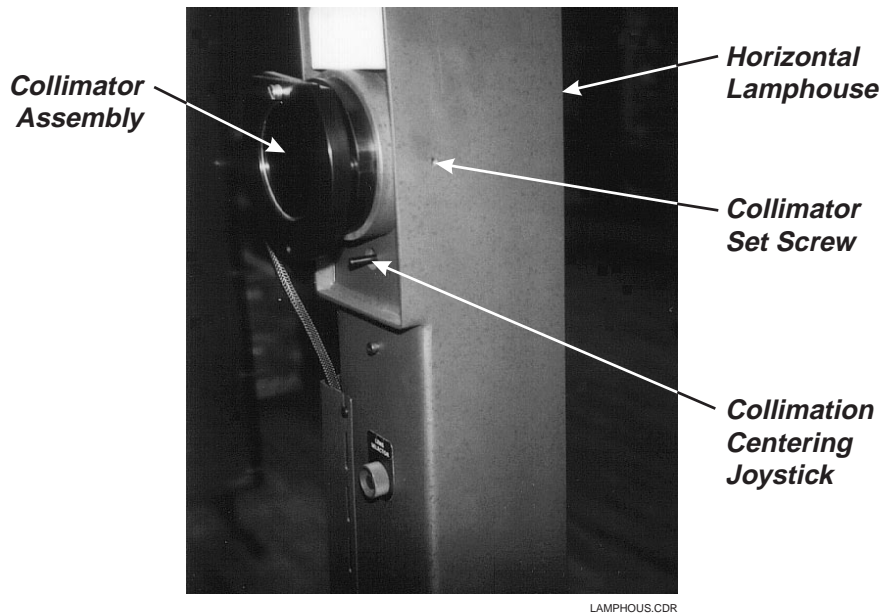


Figure F-1. Horizontal Illumination Collimation Adjustment Controls, On Side and Rear of Lamphouse

6. While holding the collimator assembly steady and in focus with your right hand, use your left hand to retighten the collimator set screw that you loosened in step 4. While tightening this set screw, make sure that the lamp image stays in focus.
7. Locate the collimation centering joystick that is on the back and toward the top of the horizontal lamphouse, just below the collimator assembly (see Figure F-1).
8. Move the collimation centering joystick to precisely center the lamp image within the center of the circle of projected light.
9. Rotate the collimation assistance lens away within the lens turret, bring any magnification into effect, and stage a simple part.
10. Test for proper collimation by ensuring that:
 - The viewing screen is evenly illuminated.
 - When focusing the part image on the viewing screen, that image remains completely stationary as you focus on it.

When the above two conditions have been satisfied, horizontal illumination collimation is complete.

Collimating with a Mirror

If your Contour Projector is not a current production model, it may not have a collimation assistance lens. However, you can still collimate the horizontal illumination by using a small, hand-held mirror. To do this, perform the following steps:

1. Turn on mercury arc horizontal illumination and allow a full five-minute warm-up time.
2. Swing the lowest magnification lens (preferably 10X) into the light path.
3. Locate the small set screw which is on the top left side of the horizontal lamphouse (see Figure F-1). This is the collimator set screw, which secures the collimator assembly within the lamphouse. Loosen the collimator set screw slightly.
4. Grasp the collimator assembly and slide it within its housing until you see an image of the cathode and anode of the mercury arc lamp focused on the viewing screen. Leave the collimator assembly at this position, with the lamp image in focus.
5. Locate the collimation centering joystick that is on the back and toward the top of the horizontal lamphouse, just below the collimator assembly (see Figure F-1).
6. Move the collimation centering joystick to center the lamp image on the viewing screen.
7. Turn off or dim the room lights.
8. Have an assistant hold a small mirror at a 45° angle to the path of light that is emerging from the collimator assembly, bouncing the collimator light onto a wall or ceiling twenty to thirty feet from the Contour Projector.
9. While your assistant holds the mirror steady, use your right hand to slide the collimator assembly in until the lamp image appears focused on the wall or ceiling.
10. While holding the collimator assembly steady with your right hand, use your left hand to retighten the collimator set screw that you loosened in step 3. While tightening this set screw, make sure that the image of the lamp remains in focus on the wall or ceiling.
11. Test for proper collimation by performing step 10 of the previous subsection, "Using the Collimation Assistance Lens." When the conditions of that step have been satisfied, collimation is complete.

Centering Viewing Screen Axis of Rotation

This calibration procedure ensures that the center of your viewing screen remains stationary as you rotate the screen. To perform this procedure, follow these steps:

1. Make sure your Contour Projector is powered up, horizontal illumination is on, and lamps are fully warmed up.
2. Loosen the protractor ring knob and visually line up the white mark on the ring with its mate on the frame. Retighten the knob.
3. Select a comfortable magnification level, and stage the Projectron reticle, Part Number 424433, which shipped with your Contour Projector. This reticle should look like this:



When staging the reticle, don't be concerned about whether it is perpendicular to the screen centerlines.

4. Use the joystick to align the reticle center with the centerlines of the viewing screen. Be as accurate as possible.
5. Press **Zero Set X** and **Zero Set Y**.
6. Loosen the protractor ring knob and rotate the viewing screen approximately 180° counterclockwise. Retighten the knob.
7. Look for any offset between the screen centerlines and the center of the reticle.
 - **If there is no offset**, the viewing screen axis of rotation is already centered and needs no further calibration. Go to the next subsection, "Aligning Screen Centerlines to Worktable XY Axis."
 - **If there is an offset**, go to the next step of this procedure.



8. Use the joystick to move the worktable until the center of the reticle is precisely aligned with the screen centerlines again.
9. Note the amount of offset shown in the X and Y displays. Halve each offset amount, making sure you retain the associated positive and/or negative signs. For example, if the original X-axis offset is -0.006 and the Y-axis offset is -0.004, the halved values would be -0.003 (X-axis) and -0.002 (Y axis). Write down the halved offsets.
10. Use the joystick to move the worktable until the X and Y displays show the values obtained in step 9 above.
11. Locate the four viewing screen eccentric screws. These screws are at the circumference of the screen, at the 3, 6, 9, and 12 o'clock positions, and they will be used to correct the screen offset. At this point, though, just make sure that all four screws are touching the edge of the viewing screen.
12. Move the overlay chart clamps over the viewing screen to keep it from falling out while you are adjusting its position.
13. Loosen and swing away the viewing screen clamps which are holding it in its fixed position.
14. Use the four eccentric screws to move the screen glass until the centerlines are directly aligned with the reticle center. To avoid cracking the glass by applying too much pressure to it, adjust the eccentric screws in pairs. For example, if you need to move the glass down vertically, loosen the 6 o'clock eccentric screw slightly before tightening the 12 o'clock eccentric.
15. Loosen the protractor ring knob and rotate the viewing screen 180° counterclockwise again. Retighten the knob.
16. Check again for any offset between the screen centerlines and the center of the reticle. If there is an offset, zero the X and Y displays and then repeat steps 8 through 16 again until all offset has been eliminated. You will know that the screen axis of rotation has been centered when you can rotate the viewing screen through its entire 360° travel while the centerlines remain stationary over the center of the reticle.
17. With the overlay chart clamps over the viewing screen glass and the viewing screen clamps still loosened, go to the next subsection, "Aligning Screen Centerlines to Worktable XY Axis."

Aligning Screen Centerlines to Worktable XY Axis

This calibration procedure ensures that your viewing screen centerlines are perfectly aligned with the X and Y travel of your Contour Projector's worktable.

The centerline alignment procedure described below assumes that you have just performed the calibration procedure described in the previous subsection, "Centering Viewing Screen Axis of Rotation." This means that:

- The viewing screen glass should be held in position as described in steps 11 through 13 of "Centering Viewing Screen Axis of Rotation." The glass should be held in position by the four eccentric screws and overlay chart clamps, while the viewing screen clamps should be loosened.
- The worktable is positioned so that the screen centerlines are perfectly centered over the central dot of the Projectron reticle.

To go on to perform centerline alignment, follow these steps:

1. Move the worktable horizontally so that the reticle is to the extreme right or left of the viewing screen.
2. Observe the offset of the horizontal centerline in relation to the central dot on the reticle.
3. Place your fingertips on the viewing screen glass and gently rotate it so that the horizontal centerline is precisely aligned with the central dot on the reticle.
4. Move the worktable so that it travels horizontally across the full width of the viewing screen. As the reticle moves across the viewing screen, the center of the reticle should maintain a perfect alignment with the horizontal centerline. If alignment is not exact, repeat all steps above until X-axis alignment is achieved.
5. When you are satisfied that the horizontal screen centerline has been properly aligned with the worktable X axis, permanently fasten the viewing screen glass into position with the viewing screen clamps.

Calibrating Magnification

In order for Projectron to be able to measure accurately, you must first ensure that your Contour Projector is magnifying accurately. If the main mirror is improperly tilted so that magnification is skewed in any axis, this will lead to measurement errors. To compensate for mirror tilt and magnification error, you may need to adjust the main mirror.

The following magnification calibration procedure requires the use of the **OGP Magnification Checker Kit, Part Number 113200**. This kit consists of:

- A reticle containing a master line and four sizes of precision circles.
- A precision glass scale for measuring features of the above reticle at all magnifications. The scale is fitted with knobs to help you position it against the viewing screen.

Before beginning the magnification calibration procedure, make sure you have performed all preliminary mechanical adjustments to your Contour Projector. These include:

- Collimation
- Centering the viewing screen axis of rotation
- Aligning the screen centerlines to the worktable XY axis

Assuming that the above procedures have been performed, the first step in the magnification calibration procedure is to see if your Contour Projector is currently measuring accurately at all magnifications. To determine this, perform the following steps:

1. Make sure your Contour Projector is powered up, horizontal illumination is on, and the lamp is fully warmed up.
2. Select your lowest magnification level.
3. Stage the magnification reticle on the worktable and position the 0.2500 inch circle in the center of the screen. Make sure that the reticle is staged so that:
 - **Its chrome side is facing the Contour Projector relay lens.** For current production models equipped with Di-Metric Plus, the QL-20 and QL-30, the chrome side should be turned away from the operator.
 - **It is precisely perpendicular to the optical axis.**

4. Look at the precision glass scale. You will see arc lines on it, each of which matches one of the four precision circles on the reticle.
5. Hold the precision glass scale by the knobs and lightly press it against the surface of the viewing screen. Align the image of the magnified reticle circle with the matching arc lines on the scale. If your lowest magnification level is 10X, use the arc lines labeled, “.2500 10X.” If your lowest magnification level is 20X, use the arc lines labeled, “.2500 20X,” and so on.
6. The image of the magnified reticle circle should precisely match the arc lines of the glass scale, measuring to the inside edges of the arc lines.
 - If the image of the circle does not reach the arc lines, the magnified reticle circle is measuring “**short.**”
 - If the image of the circle runs past the arc lines, the magnified reticle circle is measuring “**long.**”
7. If the screen image does not quite match the arc lines of the scale, align the left inside arc line of the scale with the left edge of the screen image.
8. Hold the scale stationary with one hand. Press **Zero Set X** with the other hand.
9. Move the worktable horizontally until the right inside arc line is aligned with the right edge of the screen image. The X display will now show the horizontal magnification error. Write down this value and whether it is short or long, as well as the magnification you are currently using.
10. Align the bottom inside arc line of the scale with the bottom edge of the screen image.
11. Hold the scale stationary with one hand. Press **Zero Set Y** with the other hand.
12. Move the worktable vertically until the top inside arc line is aligned with the top edge of the screen image. The Y display will now show the vertical magnification error. Write down this value and whether it is short or long, as well as the magnification you are currently using.
13. Move the worktable to position the reticle screen image near the edge of the screen at each of the four quadrants — at the 3, 6, 9, and 12 o’clock positions. At each quadrant, perform steps 5 through 12 above.
14. Select the next higher magnification level and perform steps 5 through 13 above. Continue this procedure for all magnification lenses. (At the higher magnification levels, you may need to use one of the smaller diameter reticle circles, so that the entire image fits within a quadrant.)



15. Compare all horizontal and vertical magnification error values that you have recorded with the allowable magnification errors listed in the table below.
- OGP specifications allow different magnification errors depending on magnification level. In all cases, though, the allowable magnification errors, as specified in the following table, are measured **radially from the screen centerlines**.
 - If the horizontal and/or vertical magnification errors are within the tolerance listed in the following table, no further calibration is needed.
 - If the horizontal and/or vertical magnification errors are not within the tolerance listed in this table, you will need to adjust the tilt of the mirror. Go to the following subsections of this Appendix for instructions.

Magnification Level	Allowable Magnification Error
10X	0.0006 Inch
20X to 50X	0.0003 Inch
50X and up	0.0001 Inch

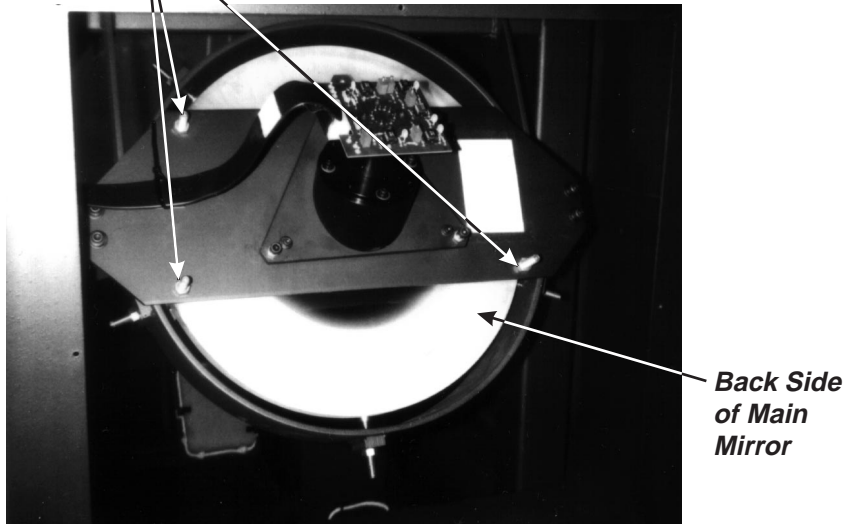
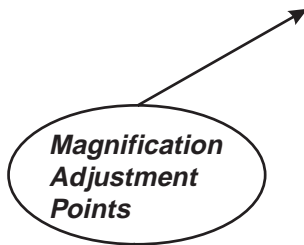
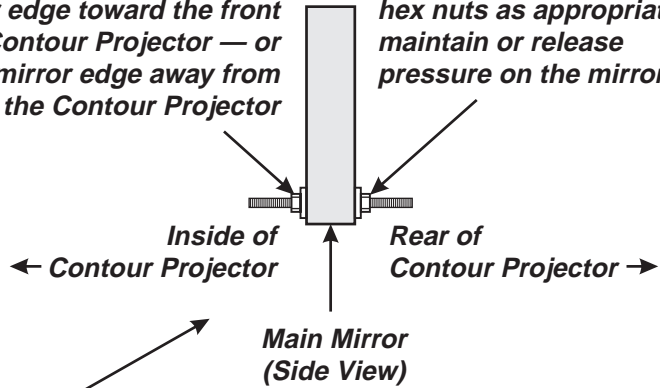
Locating the Magnification Adjustment Points

To locate the control points for magnification adjustment, follow these steps:

1. Locate the rear panel, which is at eye level on the back of the Contour Projector.
2. Remove the 10-32 button screws which secure the rear panel.
3. Remove the rear panel and set it to one side, along with the screws.
4. As you are looking into the rear compartment of the Contour Projector, you are facing the rear side of the main mirror assembly. There are three magnification adjustment points which control the tilt of the mirror (see Figure F-2).

Adjust these hex nuts counterclockwise to move mirror edge toward the front of the Contour Projector — or clockwise to move mirror edge away from the front of the Contour Projector

Tighten or loosen these hex nuts as appropriate to maintain or release pressure on the mirror



ADJSTMAG.CDR

Figure F-2. Location of Magnification Adjustment Points

Adjusting Mirror Tilt and Magnification

Magnification calibration is controlled by moving various points on the edge of the main mirror toward or away from the viewing screen. To perform this magnification calibration procedure, follow these steps:

1. Refer to table below to determine where changes should be made to calibrate the position of the mirror edge.
2. To move a mirror edge **IN**, grasp the hex nut pressing against the **front face** of the main mirror (see Figure F-2). Turn the hex nut counterclockwise to release pressure on the mirror edge, allowing the edge to move forward toward the viewing screen. Then, tighten the hex nut pressing against the opposite face of the mirror to hold the mirror secure.
3. To move a mirror edge **OUT**, grasp the hex nut pressing against the **rear face** of the main mirror. Turn the hex nut counterclockwise to release pressure on the mirror edge. Then, tighten the hex nut on the opposite face of the mirror to push the edge away from the viewing screen.
4. If any mirror edges are moved in or out at any time, magnification accuracy must be rechecked, at all magnifications and in all quadrants.

Problem	Adjustment
Y Axis Long at Top	Adjust pairs of nuts at TOP adjustment point to move top edge of mirror IN, toward the viewing screen
Y Axis Long at Bottom	Adjust pairs of nuts at BOTH BOTTOM adjustment points to move bottom edge of mirror IN, toward the viewing screen
Y Axis Short at Top	Adjust pairs of nuts at TOP adjustment point to move top edge of mirror OUT, away from the viewing screen
Y Axis Short at Bottom	Adjust pairs of nuts at BOTH BOTTOM adjustment points to move bottom edge of mirror OUT, away from the viewing screen
X Axis Long at Left	Adjust pairs of nuts at BOTTOM RIGHT adjustment point (as you are facing the back of the mirror) to move right edge of mirror IN, toward the viewing screen
X Axis Long at Right	Adjust pairs of nuts at BOTTOM LEFT adjustment point (as you are facing the back of the mirror) to move left edge of mirror IN, toward the viewing screen
X Axis Short at Left	Adjust pairs of nuts at BOTTOM RIGHT adjustment point (as you are facing the back of the mirror) to move right edge of mirror OUT, away from the viewing screen
X Axis Short at Right	Adjust pairs of nuts at BOTTOM LEFT adjustment point (as you are facing the back of the mirror) to move left edge of mirror OUT, away from the viewing screen

Mechanical Adjustments to Projectron

Once your Contour Projector's preliminary mechanical adjustments have been made, you can go on to calibrate the Projectron components themselves. Again, mechanical Projectron calibration must be done before electronic calibration.

You will be calibrating the **Projectron sensor head assembly**. This assembly is attached to the back of your Contour Projector's main mirror. The sensor head assembly consists of the following two parts:

- **The Projectron sensor board**, also called the "Cyclops" board. This board contains photoelectric diodes that detect light and the shadows of edges that cross their field of view.
- **The Projectron head**, which optically directs the viewing screen image to the photoelectric diodes on the Cyclops board. The Cyclops board sits on top of and is attached to the Projectron head. The head is adjustable for image focus, tilt, and alignment.

Locating the Projectron Sensor Head Assembly

For the current production Contour Projector models which are equipped with Di-Metric Plus and Projectron, the Projectron sensor head assembly is located in the rear of the Contour Projector. If you have not previously accessed this area to calibrate magnification, as described in the previous subsection of this Appendix, follow these steps to find the Projectron sensor head assembly:

1. Locate the rear panel, which is at eye level on the back of the Contour Projector.
2. Remove the 10-32 button screws which secure the rear panel.
3. Remove the rear panel and set it to one side, along with the screws.
4. As you are looking into the rear compartment of the Contour Projector, you are facing the rear side of the main mirror assembly. The Projectron sensor head assembly is mounted directly on top of the main mirror assembly (see Figure F-3).

Adjusting Projectron Head Focus, Tilt, and Alignment

Calibration of Projectron head focus, tilt, and alignment is the only mechanical adjustment that can be made to Projectron itself. In order to mechanically calibrate the Projectron head, perform the following steps:

1. Turn the Contour Projector main power to OFF.

CAUTION

Main power should be OFF whenever you remove or install the Cyclops board.

If the Cyclops board is bumped while main power is ON and a short circuit accidentally occurs, there is a hazard of damage to the equipment.

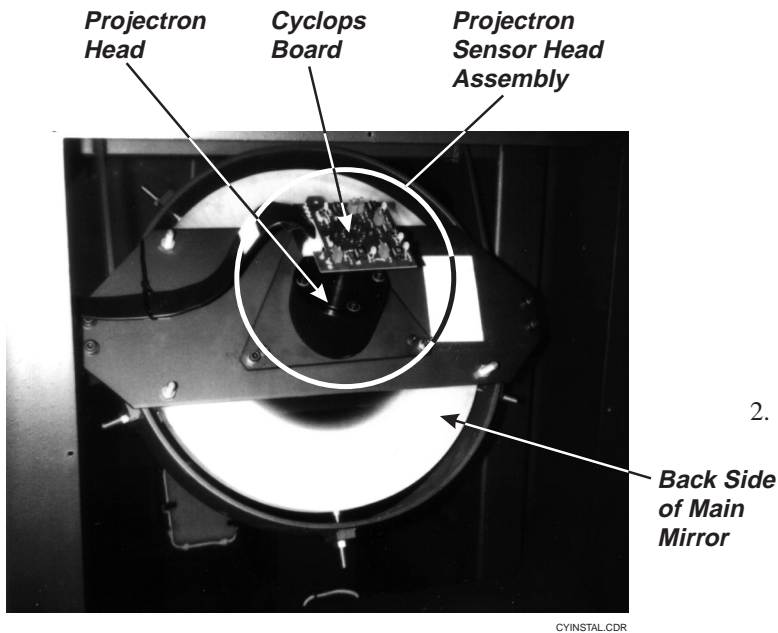
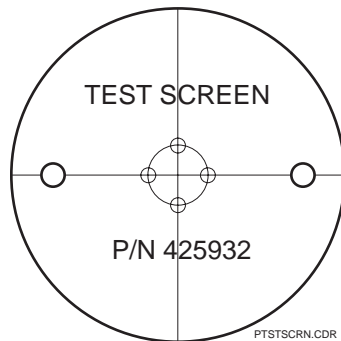


Figure F-3. Location of Projectron Sensor Head Assembly

2. Locate the ribbon cable which is attached to the left side of the Cyclops board. Remove the ribbon cable.
3. While holding the Cyclops board in place, remove the four 4-40 screws which attach it to the Projectron head. Set two of the screws aside for use in step 6 below.
4. Remove the Cyclops board from the head. Place the board in a static shielded bag and set it aside.
5. Locate the **Projectron test screen, Part Number 425932**. This test screen

ships with every Projectron-equipped Contour Projector. The Projectron test screen is made of clear plastic, and it looks like this:



6. Use two of the 4-40 screws removed in step 3 above to attach the Projectron test screen to the Projectron head. The test screen should be attached so that it is face up and right side up as you are looking at it when you are facing the rear of the Contour Projector (see Figure F-4).
7. Turn Contour Projector main power and horizontal illumination to ON. Wait five minutes for the lamp to warm up fully.

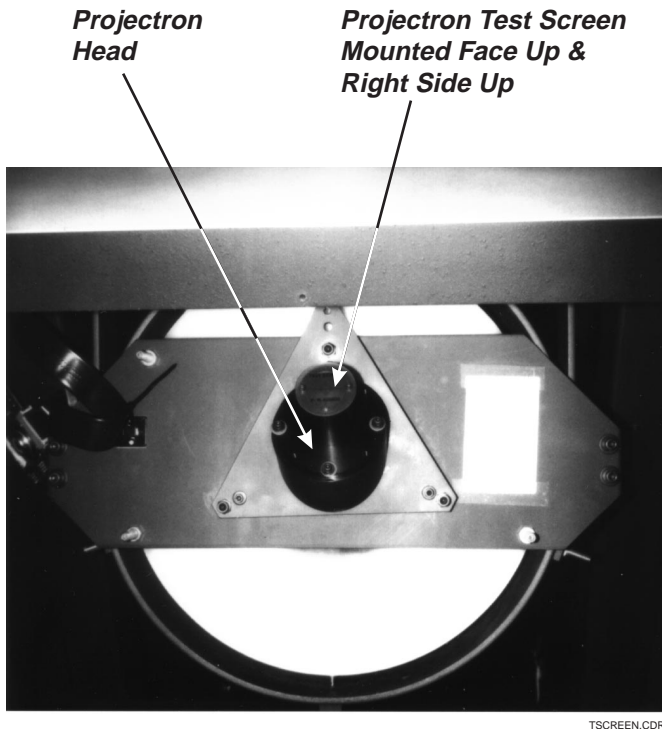
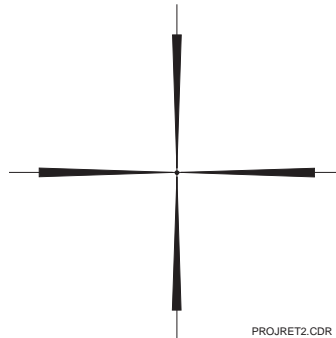


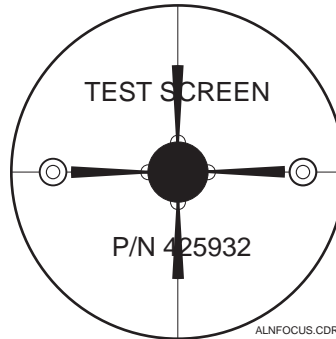
Figure F-4. Projectron Head with Test Screen, P/N 425932, Installed

8. Set the magnification level at 10X.
9. Ensure that there are **no filters** in the light path. This procedure requires completely unfiltered light.
10. Locate the **Projectron reticle, Part Number 424433**. This reticle was used to center the viewing screen axis of rotation and also to align the screen centerlines to the worktable XY axis, as described in previous subsections of this Appendix. The Projectron reticle is mounted in a 35mm slide holder, and it looks like this:



11. Stage the Projectron test reticle to the worktable so that the reticle centerlines align precisely with the viewing screen centerlines. You may have to move the reticle in its staging block by hand to achieve alignment of both sets of centerlines. Once alignment has been achieved, secure the reticle so that it does not slip. Also, check the alignment of the reticle and the viewing screen periodically throughout the remainder of this procedure to make sure the reticle remains in position.

12. Go to the rear of the Contour Projector and look at the Projectron test screen, mounted in place of the Cyclops board. You should see an image of the staged Projectron test reticle projected on the test screen. (This projection is possible because the main mirror allows some light to pass through it to the Projectron sensor head assembly.) If the Projectron head is satisfactorily adjusted for focus, tilt, and alignment, the image on the test screen will look like this:

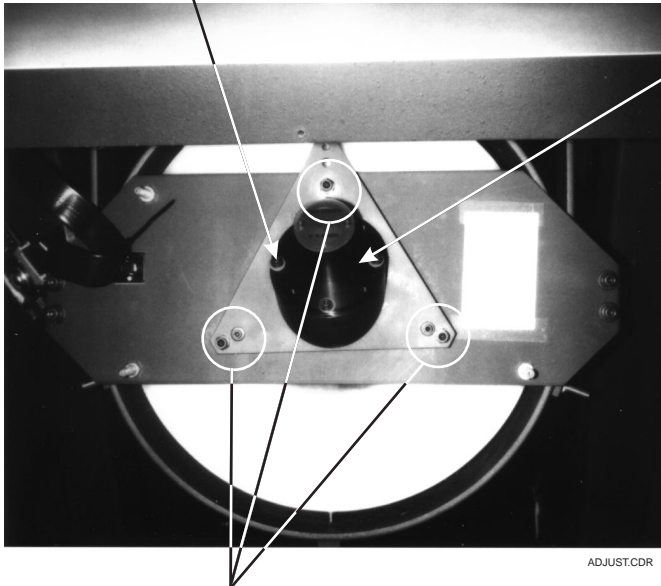


If the image does not look like this, perform steps 13, 14, and/or 15, as needed.

13. If the image on the test screen is fuzzy, you will need to **adjust image focus**:
 - Slightly loosen the three small set screws on the barrel of the Projectron head. This will allow the cap screw which projects from the right side of the barrel to slide freely up and down in its slot (see Figure F-5).
 - Slide the cap screw up or down until sharp focus is attained on the test screen.
 - Retighten the small set screws on the barrel. Make sure focus is maintained while tightening the set screws.
14. If the image on the test screen has uneven lighting in the background, or if there are shadows toward any edge of the test screen field of view, you will need to **adjust tilt**:
 - Adjust the pairs of push/pull screws at the corners of the triangular plate that the sensor head is mounted upon. This will compensate for tilt, as the triangular plate corners are moved toward and away from the mirror (see Figure F-5).
 - When all background lighting is even and edge shadows have been eliminated, tilt is satisfactory.

TO ADJUST ALIGNMENT

Loosen 4 cap screws at base of Projectron head and slide head until reticle dot lines up with center of test screen



TO ADJUST FOCUS

Loosen set screws at base of Projectron head barrel, then slide barrel up or down to focus

TO ADJUST TILT

Adjust pairs of push/pull screws to move triangular plate corners toward or away from mirror

Figure F-5. Adjustment Points for Mechanical Calibration of Projectron Components

15. If the central dot on the test reticle is shifted off center when projected and magnified onto the test screen, you will need to **adjust alignment**:
 - Slightly loosen each of the cap screws which secure the sensor head to the main mirror assembly approximately 1/4 turn counterclockwise (see Figure F-5).
 - Move the sensor head by hand until the test reticle image is centered on the test screen.
 - Retighten the cap screws. Make sure alignment is maintained while retightening them.
16. After the head has been focused and aligned, turn the Contour Projector main power to **OFF**, reinstall the Cyclops board, and connect the ribbon cable to the board.

Electronic Adjustments to Projectron

The final step in calibrating your Projectron system is the electronic adjustment of Projectron components. Before attempting this procedure, make sure that you have made all mechanical adjustments to your Contour Projector and to the Projectron sensor head assembly, as described in previous subsections of this Appendix.

Calibrating Projectron Gain Levels

As previously mentioned, the Projectron Cyclops board contains an array of photoelectric diodes. These diodes detect light and the shadows of edges that cross their field of view.

The photoelectric diodes are adjustable for current flow, or gain. The amount of gain regulates the light sensitivity of the diodes.

Gain adjustments to the photoelectric diodes are made at the Cyclops board. Look at the top of the Cyclops board as it is mounted on the Projectron head. You will see six test points on the left side of the board, and five blue rectangular potentiometers scattered around the board (see Figure F-6). The potentiometers control the amount of gain traveling to the photoelectric diodes, and the test points are used to test that gain.

There are five potentiometers and five corresponding photoelectric diodes. The potentiometers are mounted on the top side of the Cyclops board, and the diodes are mounted on the bottom side of the board. Each potentiometer controls the gain for a specific diode. Again, refer to Figure F-6 to see which potentiometer controls gain to which diode.

Just as there are five potentiometers and corresponding diodes, there are also five test points (and GND) which correspond to the five potentiometers. Test point number designations match potentiometer number designations. For example, TP0 tests the gain of G0, TP3 tests the gain of G3, and so on.

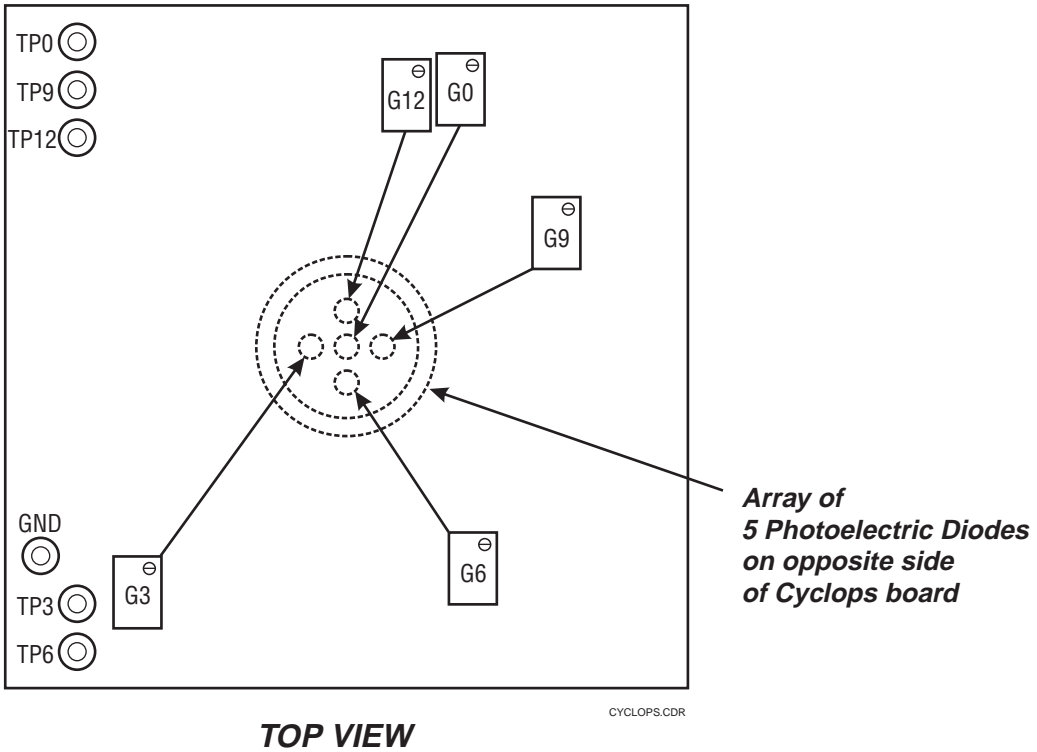


Figure F-6. Potentiometers and Test Points for Photoelectric Diodes on Cyclops Board

To adjust the gain traveling to the Projectron photoelectric diodes, follow these steps:

1. Make sure all optics on your Contour Projector are clean. Also, these adjustments work best when your lamp is nearly new.
2. Turn Contour Projector main power and horizontal illumination to **ON**. Wait five minutes for the lamp to warm up fully.

CAUTION

When connecting leads to test points or adjusting potentiometers in the following procedure, use care to touch only those parts of the Cyclops board necessary to carry out calibration. When the main power is **ON**, there is a potential for a short circuit, which could lead to damage to the equipment.

3. Set the magnification to either 10X with maximum filtering, or 50X with no filtering.
4. Check and adjust the gain of G0 by performing these steps:
 - Using a multimeter, connect the black lead to GND and the positive lead to TP0.
 - The voltage displayed on the multimeter should be close to the optimum of 8 VDC.
 - If the voltage is not 8 VDC, try to attain it by adjusting potentiometer G0. Carefully turn the adjusting screw of G0 in either direction until 8 VDC is displayed on the multimeter.
 - If you cannot attain 8 VDC for G0, adjust the gain to be as close as possible to that value. The photoelectric diodes will operate over a wide range of voltages, as long as all five diode gains are balanced. Make a note of the final gain reached for G0.
5. Repeat step 4 above for all remaining pairs of test points and potentiometers, starting with TP3 and G3. In each case, your goal is to match the final gain attained for G0.
6. If it is impossible to match all five gain values, you may need to replace the Cyclops board. Contact the OGP Service Department at (716) 544-0400 for help.

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Appendix G

Understanding Di-Metric Plus Angle Calculations

If two different people use Di-Metric Plus to measure the angle of the same line or vertex, they may get different answers. This is because the angle values that Di-Metric Plus reports for a line or vertex are dependent on the order in which the points defining that line/vertex have been entered. This will be explained more fully in the remainder of this Appendix.

How Di-Metric Plus Reports Line Angles

A line can be represented by several different angles. For example, 90° is the same as -270° . Since this can be confusing, Di-Metric Plus has been programmed with an internal subroutine that forces all line angles to be reported as a positive value between 0° and 360° .

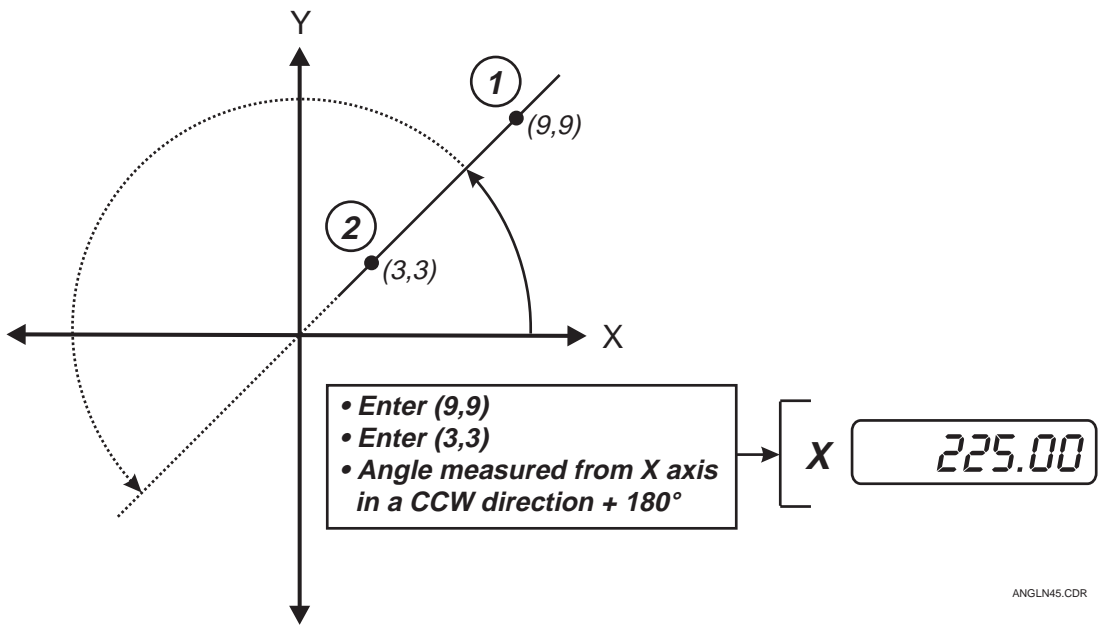
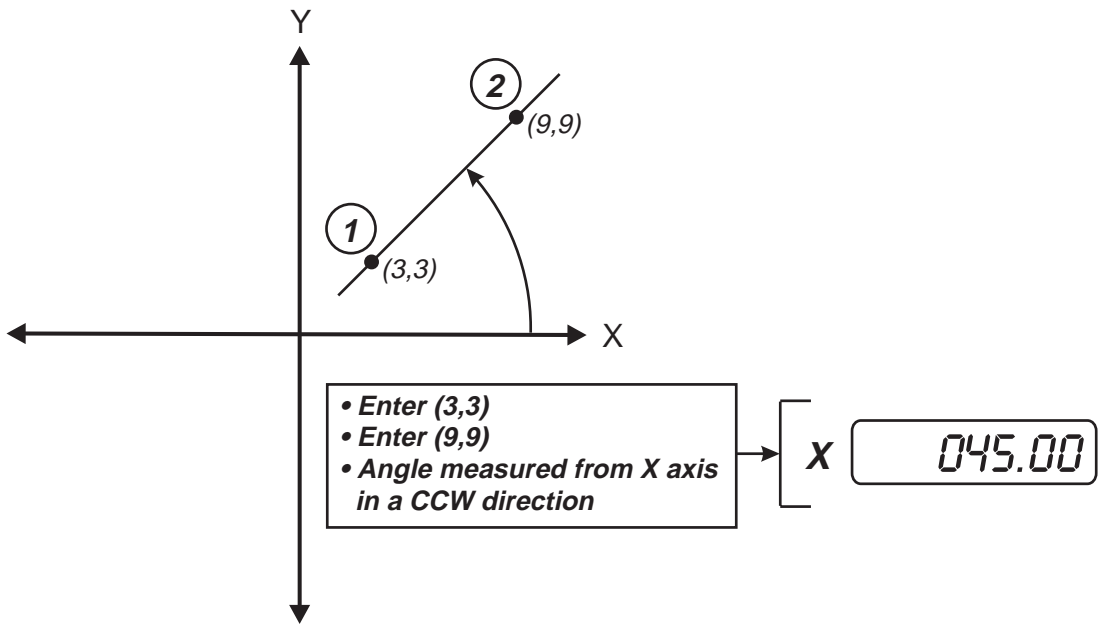
The line angle that is shown in the X display depends on the order in which the **first two points are entered**. To show how this works in Di-Metric Plus, let's assume that the first two points on the line are (X_1, Y_1) and (X_2, Y_2) . If the points are entered so that Y_2 is greater than Y_1 , the angle reported will be measured from the X axis (0°) to the line in a counterclockwise direction. This would always return an angle value between 0° and 180° .

For an example of the above, let's look at a line intersecting the points $(3,3)$ and $(9,9)$. If the $(3,3)$ point is entered first and the $(9,9)$ point second, Y_2 would be greater than Y_1 , and the angle would be measured from the X axis in a counterclockwise direction to get an angle value that Di-Metric Plus would report as 45° (see Figure G-1, top).

If the first two points are entered in the opposite order, so that Y_2 is less than Y_1 , the angle reported will be the same as described above **plus** 180° . This will always display a positive angle value between 180° and 360° .

Using our same two points of $(3,3)$ and $(9,9)$, if you were to enter the $(9,9)$ point first, the angle reported would be 45° plus 180° , or **225°** (see Figure G-1, bottom).

In both cases, the angle value shown in the Y display is equal to 360° **minus** the angle value shown in the X display.



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Figure G-1. How Point Entry Order Affects Reported Angle of a Line

How Di-Metric Plus Reports Vertex Angles

When you measure an angle with the Angle/Vertex function, Di-Metric Plus requires you to enter points on two separate, intersecting lines. Each of these lines is subject to the rules described in “How Di-Metric Plus Reports Line Angles.” This will give you two separate line angles, with $\angle 1$ being the angle of the first line that you measure and $\angle 2$ the angle of the second line measured.

For the sake of discussion, let's assume that the included angle is the angle that you want to measure, and the excluded angle is 360° minus the absolute value of the included angle. Figure G-2, then, shows you how Di-Metric Plus arrives at an included angle with the points entered in the order shown. First, Di-Metric Plus measures the angle of the lower leg relative to the X axis, and this becomes $\angle 1$. Next, Di-Metric Plus measures the angle of the upper leg relative to the X axis, designating the result as $\angle 2$. Finally, $\angle 1$ is subtracted from $\angle 2$, and the resulting included angle is shown in the X display, while the excluded angle is shown in the Y display.

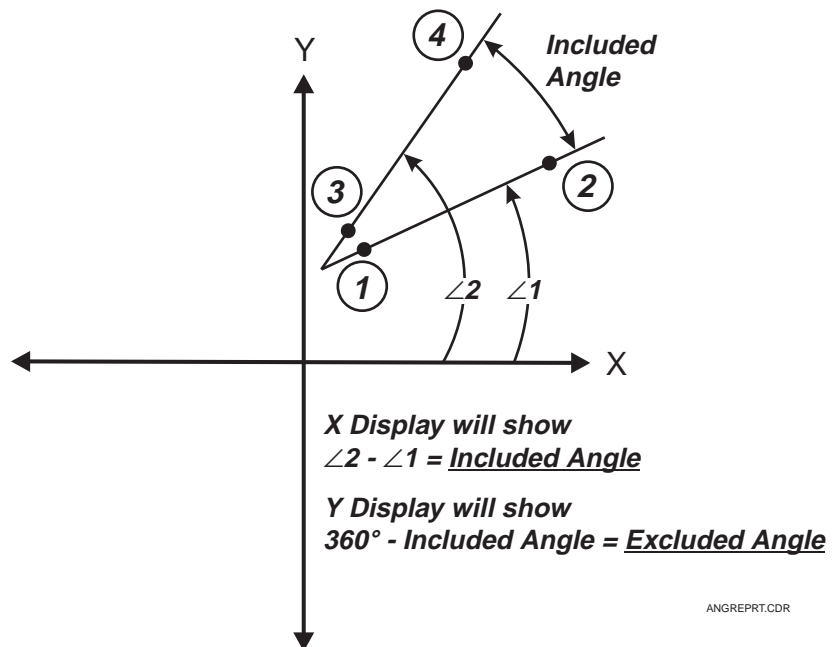


Figure G-2. Basic Model for Di-Metric Plus Angle Reporting

Examples of Angle Measurements in All Quadrants

Figures G-3 through G-6 illustrate the proper point entry order required to determine the size of included angles in all four Cartesian quadrants. Each illustration also shows the X and Y displays resulting from each set of point entries.

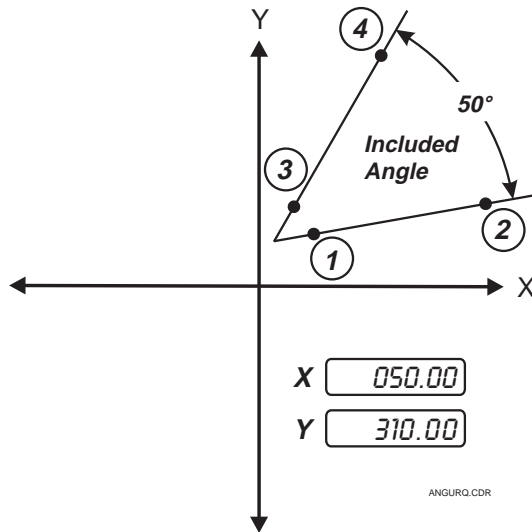


Figure G-3. Measuring an Angle in the Upper Right Cartesian Quadrant

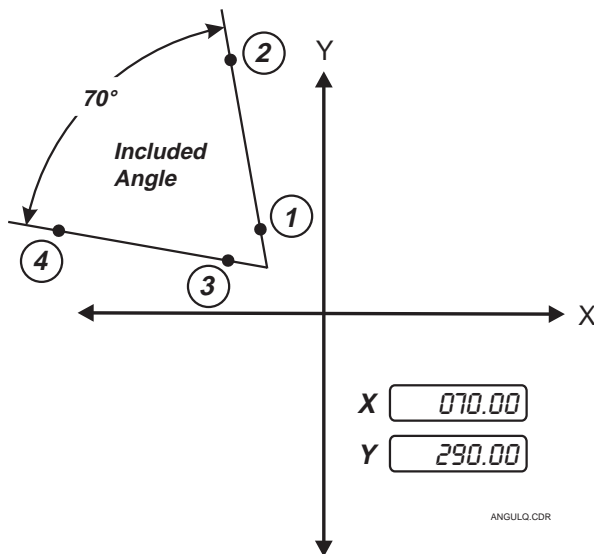


Figure G-4. Measuring an Angle in the Upper Left Cartesian Quadrant

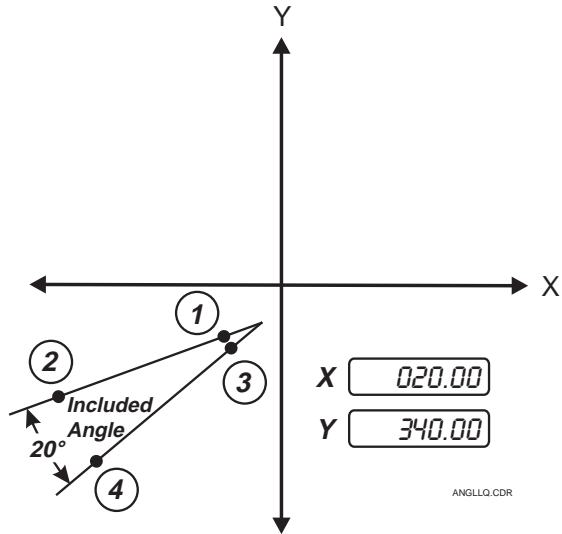


Figure G-5. Measuring an Angle in the Lower Left Cartesian Quadrant

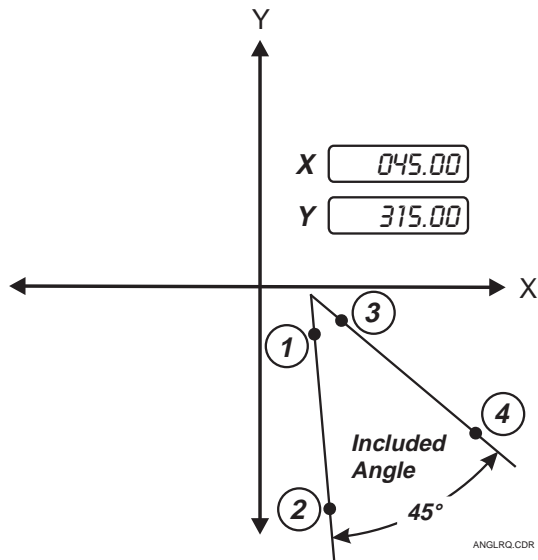


Figure G-6. Measuring an Angle in the Lower Right Cartesian Quadrant

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While you may be very familiar with the Di-Metric Plus control panel, you can also use a PC and a terminal emulation program to send commands directly to Di-Metric Plus. If you choose to communicate with Di-Metric Plus in this way, you will need to know the following:

- Each Di-Metric Plus control panel button or command has a PC keyboard ASCII equivalent (see table beginning on next page).
- All keyboard commands **to Di-Metric Plus from the PC** must be terminated with an ASCII carriage return (<CR>), followed by an optional ASCII line feed (<LF>). Similarly, all commands **from Di-Metric Plus to the PC** will be terminated with a <CR><LF>.
- You may connect the PC to Di-Metric Plus via RS-232 serial cabling. The cable should be connected to the serial port which protrudes through the rear wall of the Di-Metric Plus compartment, and also connected to your PC's serial port.
 - If you wish, you may also connect a printer to your PC, and then connect the PC to the Di-Metric Plus serial port. This will allow Di-Metric Plus to communicate with you via printouts.
- All serial data originating from Di-Metric Plus is transmitted at eight data bits, one stop bit, no parity.

ASCII Codes and Corresponding Di-Metric Plus Commands

If you want to use a PC and keyboard to communicate commands to Di-Metric Plus, refer to the following table of ASCII codes and Di-Metric Plus command equivalents. Brief summaries of corresponding Di-Metric Plus command interpretations have been included in this table to help you. Also, please note that Di-Metric Plus recognizes a distinction between UPPER and lower case letters.

ASCII Code	Button or Command	Command Interpretation
C	Clear	Press Clear button, current values or function deleted
E	Enter	Press Enter button, current point entered
G	(Go To)	Go to position defined
I	Inch	Press Inch button, all measurements displayed in inches
J	Joystick	Press joystick button, toggle Projectron ON or OFF
M	mm	Press mm button, all measurements displayed in millimeters
N	(Set Nearpoint)	Defines distance from edge before Projectron is armed (see "Special Commands," following table)
P	(Serial Print Command)	Print internal machine coordinates
Q	(Query)	Asks Di-Metric Plus for current software version
S	Store	Press Store button, store current value in memory
T	Print	Press Print button, print contents of X and Y displays
U	Zero Set X	Press Zero Set X button, set current point as X axis origin

ASCII Code	Button or Command	Command Interpretation
V	Zero Set Y	Press Zero Set Y button, set current point as Y axis origin
Z	(X and Y Zero Command)	Press Zero Set X and Zero Set Y
a	Abs Zero	Press Abs Zero button, set current protractor zero point
c	Circle/Arc	Press Circle/Arc button, enter circle/arc definition mode, Di-Metric Plus is ready for points to be entered defining circle or arc
d	Dec Degree	Press Dec Degree button, angular measurements will be displayed in degrees and decimals (for example, 3.25°)
e	Projectron	Press Projectron button, toggle Projectron edge detection ON or OFF
h	Up Arrow	Press Up Arrow button, seek edge in upward direction (used with Projectron only)
i	Inc Zero	Press Inc Zero button, set temporary protractor zero point (overrides Abs Zero)
l	Line	Press Line button, enter line definition mode, Di-Metric Plus is ready for points to be entered defining line
m	Degree Minute	Press Degree Minute button, angular measurements will be displayed in degrees and minutes (for example, 3° 15')

ASCII Code	Button or Command	Command Interpretation
p	More Points	Press More Points button, Di-Metric Plus is ready to accept entry of more than the minimum number of points required to define geometric objects
s	Axis Align	Press Axis Align button, Di-Metric Plus aligns worktable axis with previously defined part X axis
v	Angle/Vertex	Press Angle/Vertex button, enter angle definition mode, Di-Metric Plus is ready for points to be entered defining angle or vertex
w	Width	Press Width button, enter width definition mode, Di-Metric Plus is ready for points to be entered defining width
y	Down Arrow	Press Down Arrow button, seek edge in downward direction (used with Projectron only)
0-9	0-9	0-9 digit entry
<	Left Arrow	Press Left Arrow button, seek edge in leftward direction (used with Projectron only)
>	Right Arrow	Press Right Arrow button, seek edge in rightward direction (used with Projectron only)
	(Seek Character)	Seek along this axis (see "Special Commands," following table)
*	(Comment Delimiter)	All characters between asterisks are ignored by Di-Metric Plus

ASCII Code	Button or Command	Command Interpretation
/	Joystick Enter	Press joystick Enter button, current point entered
\	Joystick Cancel	Press joystick Cancel button, current function or worktable motion canceled
[enable X/Y Zero and Axis Align	X/Y Zero and Axis Align buttons are valid (<i>SmartCheck interface only</i>)
]	disable X/Y Zero and Axis Align	X/Y Zero and Axis Align buttons are not valid (<i>SmartCheck interface only</i>)

Special Commands

The following special commands, referred to in the table above, need further explanation:

1. **Seek (^)** - This command instructs Di-Metric Plus to go to a destination whose coordinates will take the centerlines past the edge of interest, with the caret symbol indicating the axis in which to seek that edge. For example, to tell Di-Metric Plus to seek an edge horizontally, a typical command might be:

X[^]+nn.nnnn Y+nn.nnnn G<CR><LF>

In the above example, the two *+nn.nnnn* digits represent the X and Y coordinates that you want Di-Metric Plus to go to, the [^] indicates “seek along the X axis” (because it immediately follows the X), and the *G* indicates “go to.” Spaces placed in commands are optional and are ignored by Di-Metric Plus. If you wanted to tell Di-Metric Plus to seek an edge vertically, the command might be:

X+nn.nnnn Y[^]+nn.nnnn G<CR><LF>

After carrying out the **Seek** command, Di-Metric Plus could respond in one of two ways. One response might be:

*X+nn.nnnn Y+nn.nnnn *LD*<CR><LF>*

In the above example, Di-Metric Plus is reporting the coordinates of the point where it found an edge while traveling to the point that you specified. **LD** is Di-Metric Plus shorthand for “valid edge location.”

After performing a **Seek** command, Di-Metric Plus may also respond with this statement:

```
X+nn.nnnn Y+nn.nnnn *FL*<CR><LF>
```

In this example, Di-Metric Plus reports that it could not find an edge. *FL* is an abbreviation for “failed edge.”

2. **Nearpoint (N)** - This command tells Di-Metric Plus when to arm Projectron, specifying that Projectron should be armed at a relative distance away from a **Seek** command location. Normally, Di-Metric Plus is sent a **Nearpoint** command immediately followed on the next line by a **Seek** command. For example:

```
X+nn.nnnn Y+nn.nnnn N<CR><LF>  
X^+nn.nnnn Y+nn.nnnn G<CR><LF>
```

In the first line of the above example, the *+nn.nnnn* digits represent the X and Y distance away from the nominal edge location that you want Di-Metric Plus to arm Projectron, and *N* specifies “nearpoint.” In the second line, Di-Metric Plus is being told to seek an edge along the X axis, with the two *+nn.nnnn* digits representing the final destination coordinates.

If no nearpoint is specified before giving a **Seek** command, Di-Metric Plus will assign a default nearpoint of 00.1000 inches.

3. **Print (T)** instructs Di-Metric Plus to print out the current contents of the X and Y displays, or the *part coordinates* based on the currently defined origin. A **T** command would prompt Di-Metric Plus to respond:

```
X+nn.nnnn Y+nn.nnnn P+n.nn *POSITION* Bnn<CR><LF>
```

In the above example, the *+nn.nnnn* digits represent the current contents of the X and Y displays, and the *+n.nn* digits represent the current contents of the protractor display. *POSITION* indicates that the printed X and Y display values are part coordinates. The *Bnn* digits which follow *POSITION* represent block number, which is not used in Di-Metric Plus.

If slider 8 or the CPU option switch is ON and Di-Metric Plus parameters are write-enabled, the **T** command will instruct Di-Metric Plus to perform a parameter printout (see Appendix E for details).

4. **Serial Print (P)** instructs Di-Metric Plus to print out *internal machine coordinates*, based on a (0,0) coordinate position at power-up. A **P** command would prompt Di-Metric Plus to respond:

```
X+nn.nnnn Y+nn.nnnn ** Bnn<CR><LF>
```

In the above example, the *+nn.nnnn* digits represent the current machine coordinates, and the double asterisks indicate it is **not** a set of part coordinates. Again, *Bnn* indicates a block number, not used by Di-Metric Plus.

You will find a series of Di-Metric Plus troubleshooting diagrams on the following pages. The diagrams cover the following functional areas:

- Power-Up
- Self Test
- Worktable Motion
- Control Panel Operation
- Serial Devices
- Projectron Operation

These diagrams are intended to help you isolate the causes of problems that may occur during a Di-Metric Plus work session. Each diagram also defines several possible solutions.

Hopefully, you will not need to look further than the next few pages to solve any problems that you may be experiencing with Di-Metric Plus. If you feel you need more help at any time, though, keep in mind that our Service Department is only a phone call away at (716) 544-0400.

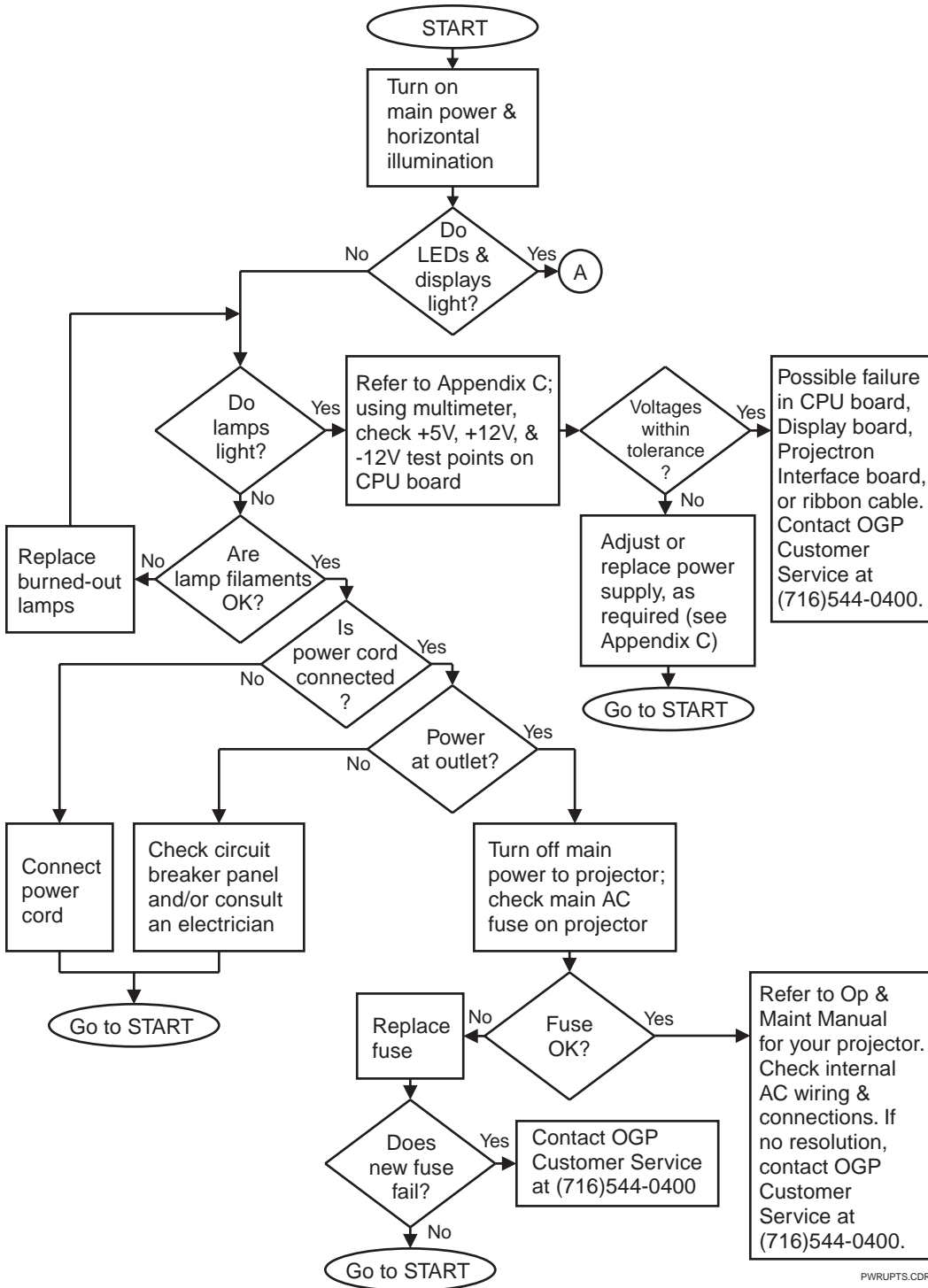
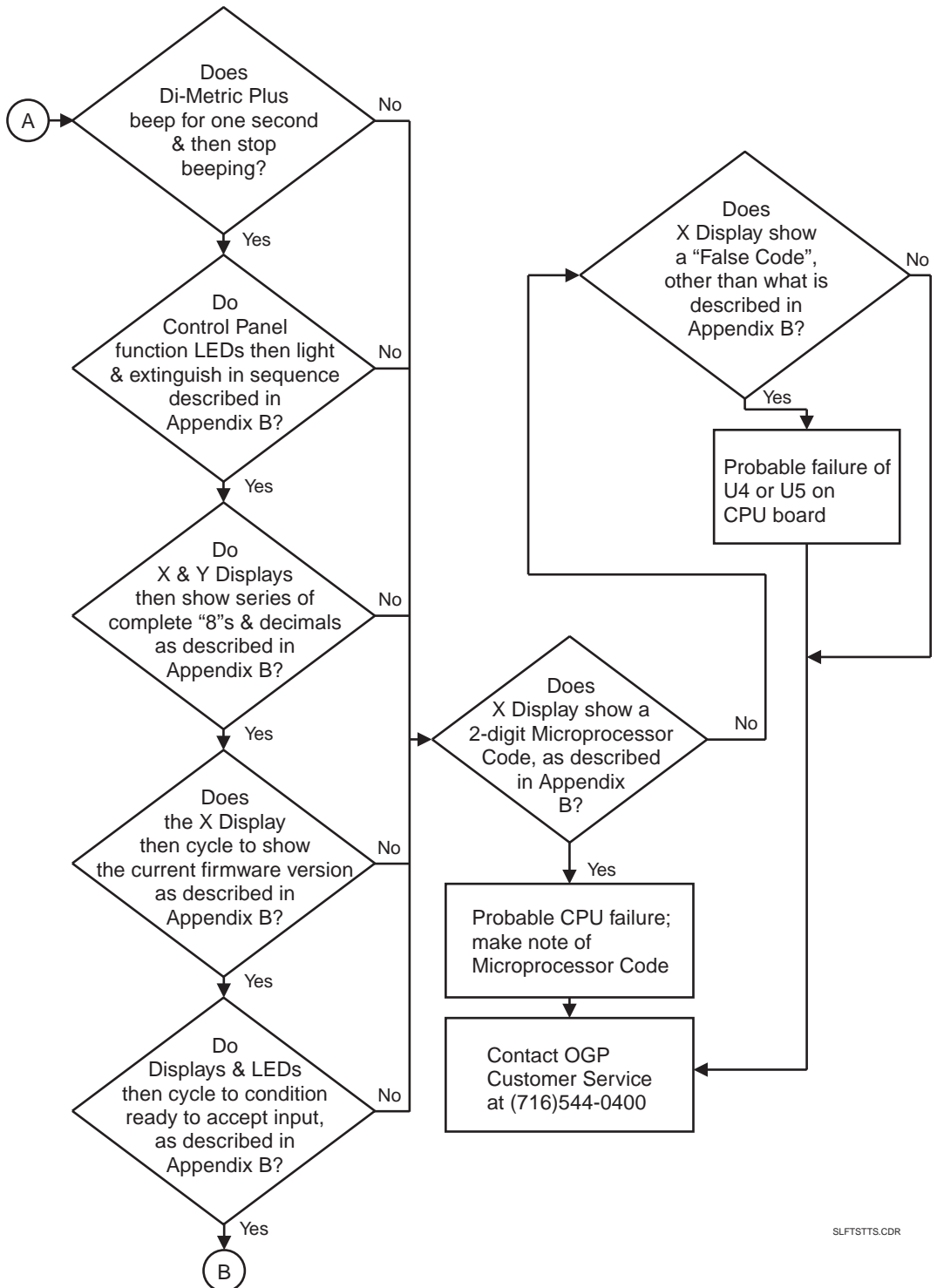
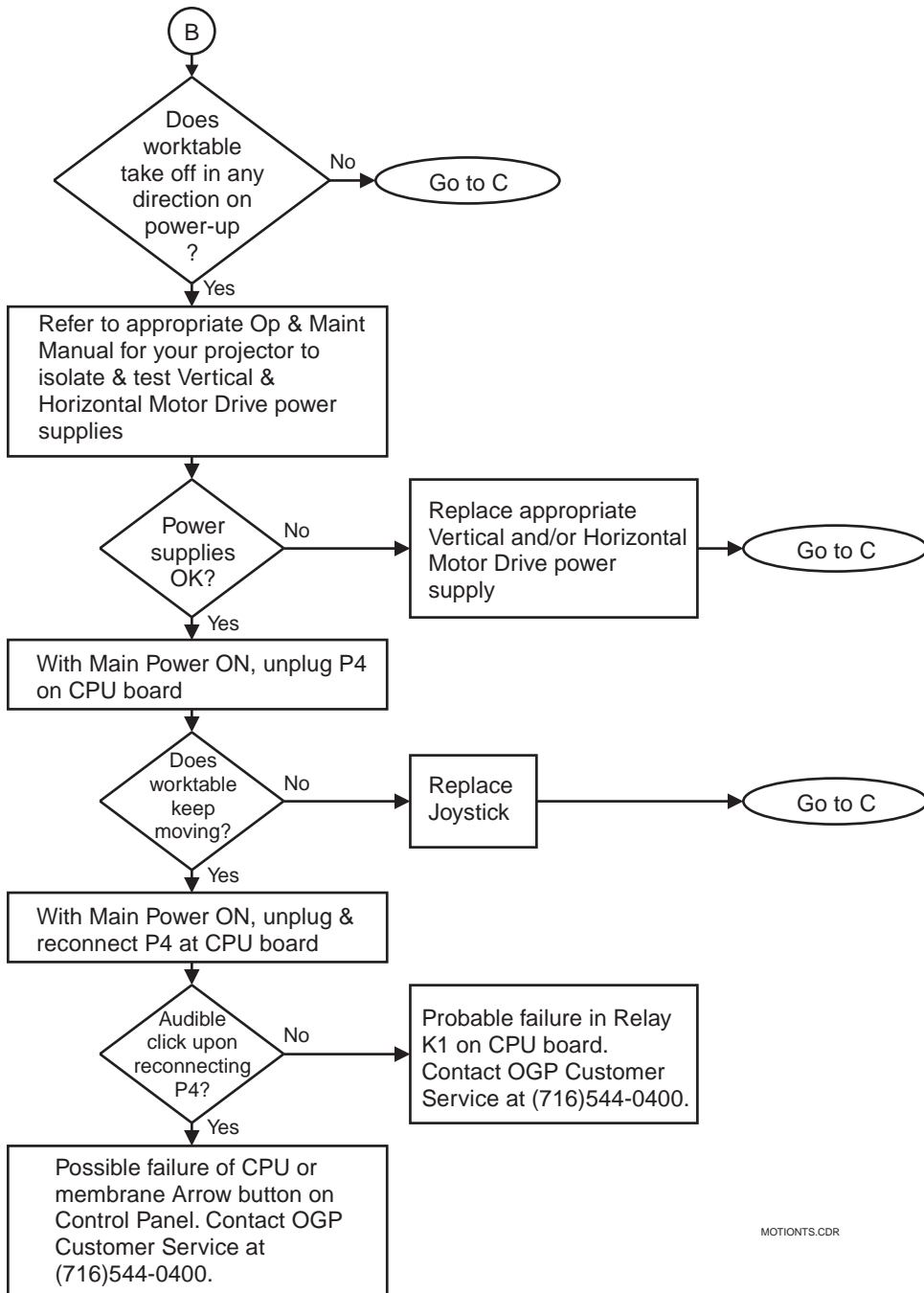


Figure I-1. Power-Up Troubleshooting Diagram



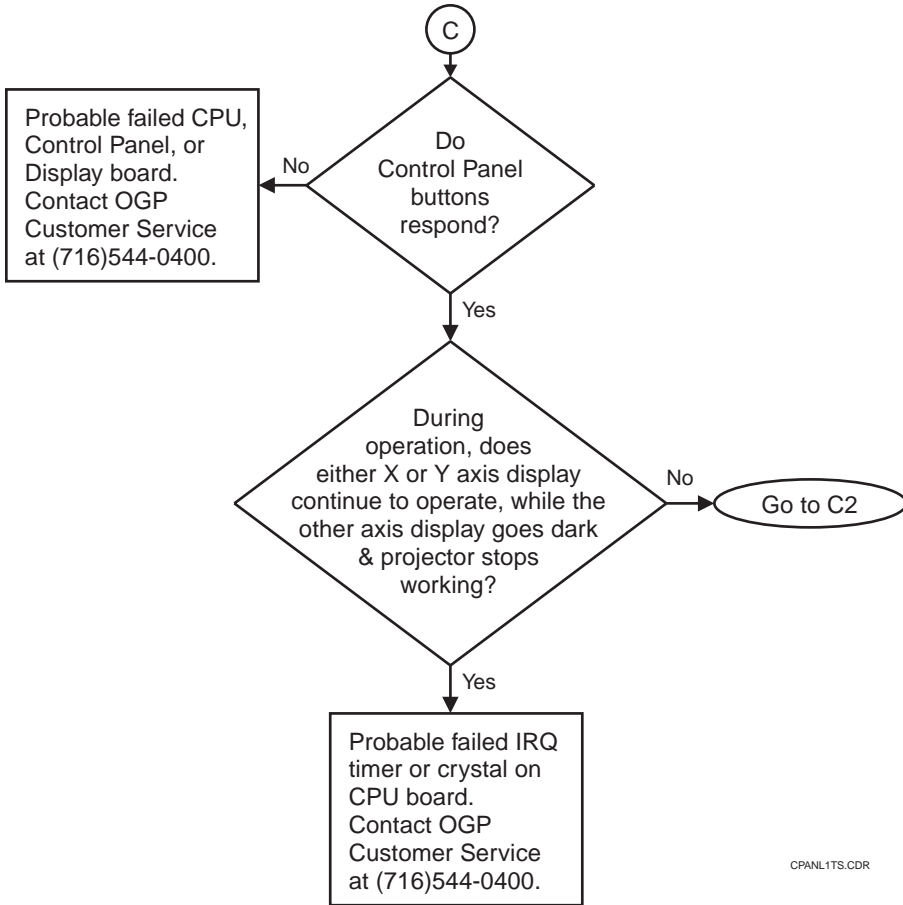
SLFTSTTS.CDR

Figure I-2. Self Test Troubleshooting Diagram



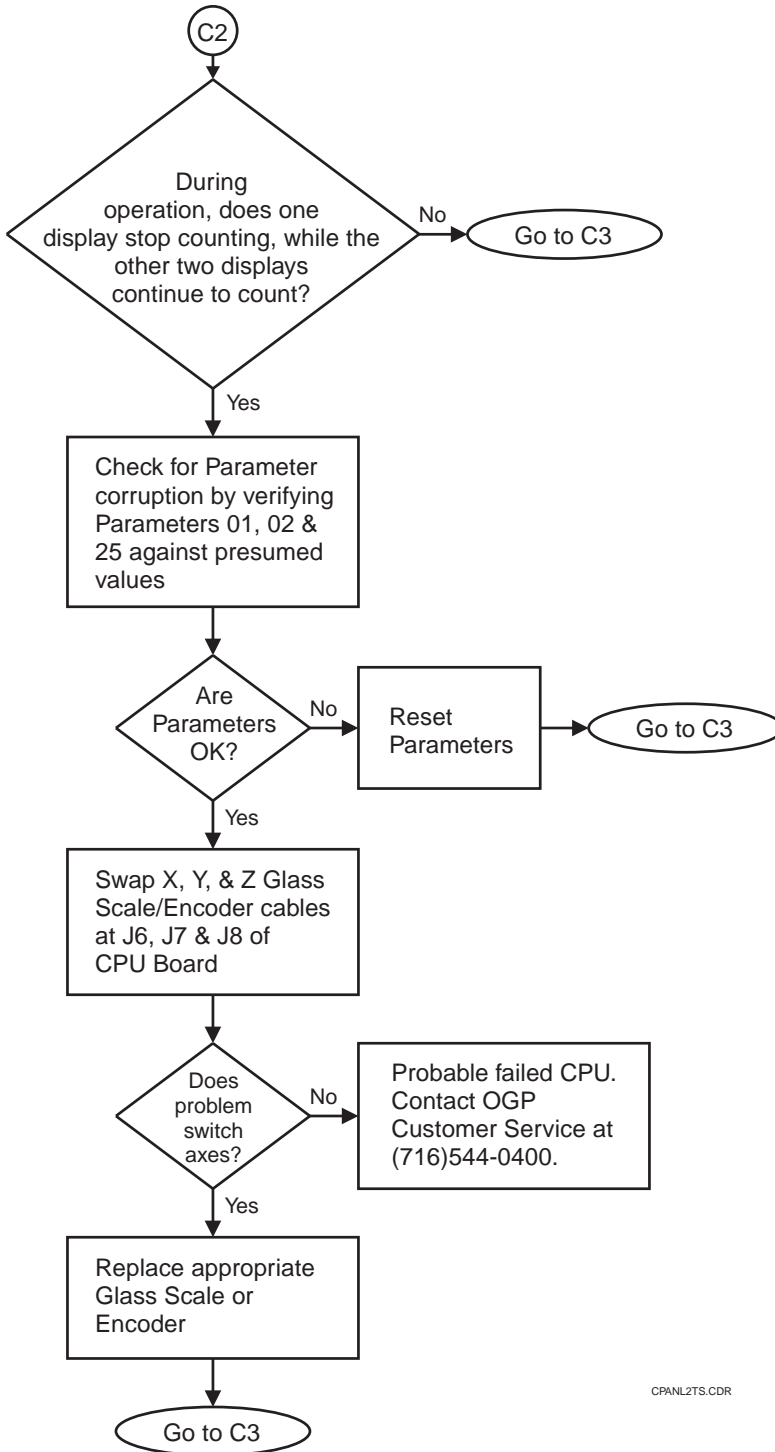
MOTIONTS.CDR

Figure I-3. Worktable Motion Troubleshooting Diagram



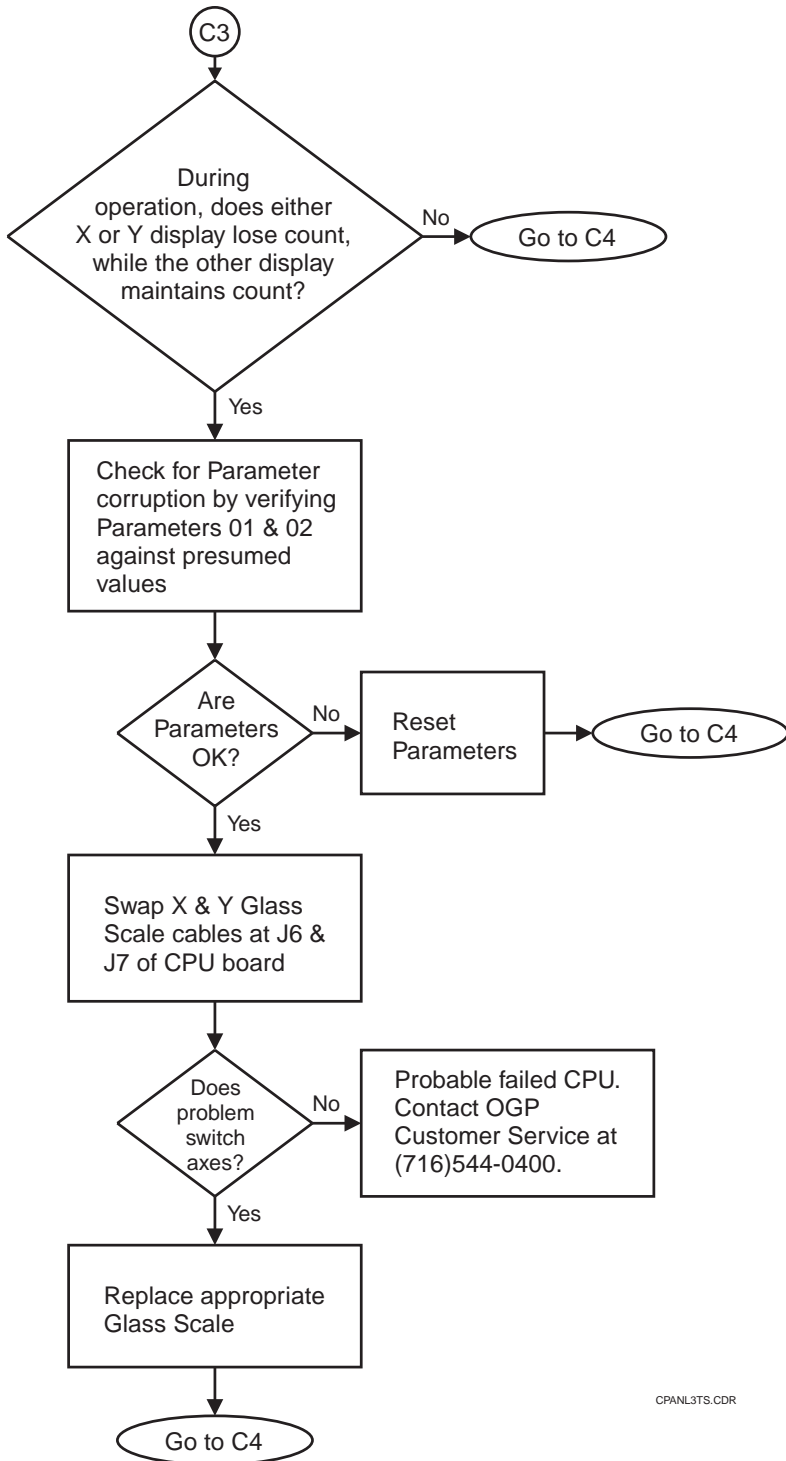
CPANL1TS.CDR

Figure I-4. Control Panel Operation Troubleshooting Diagram (Sheet 1 of 4)



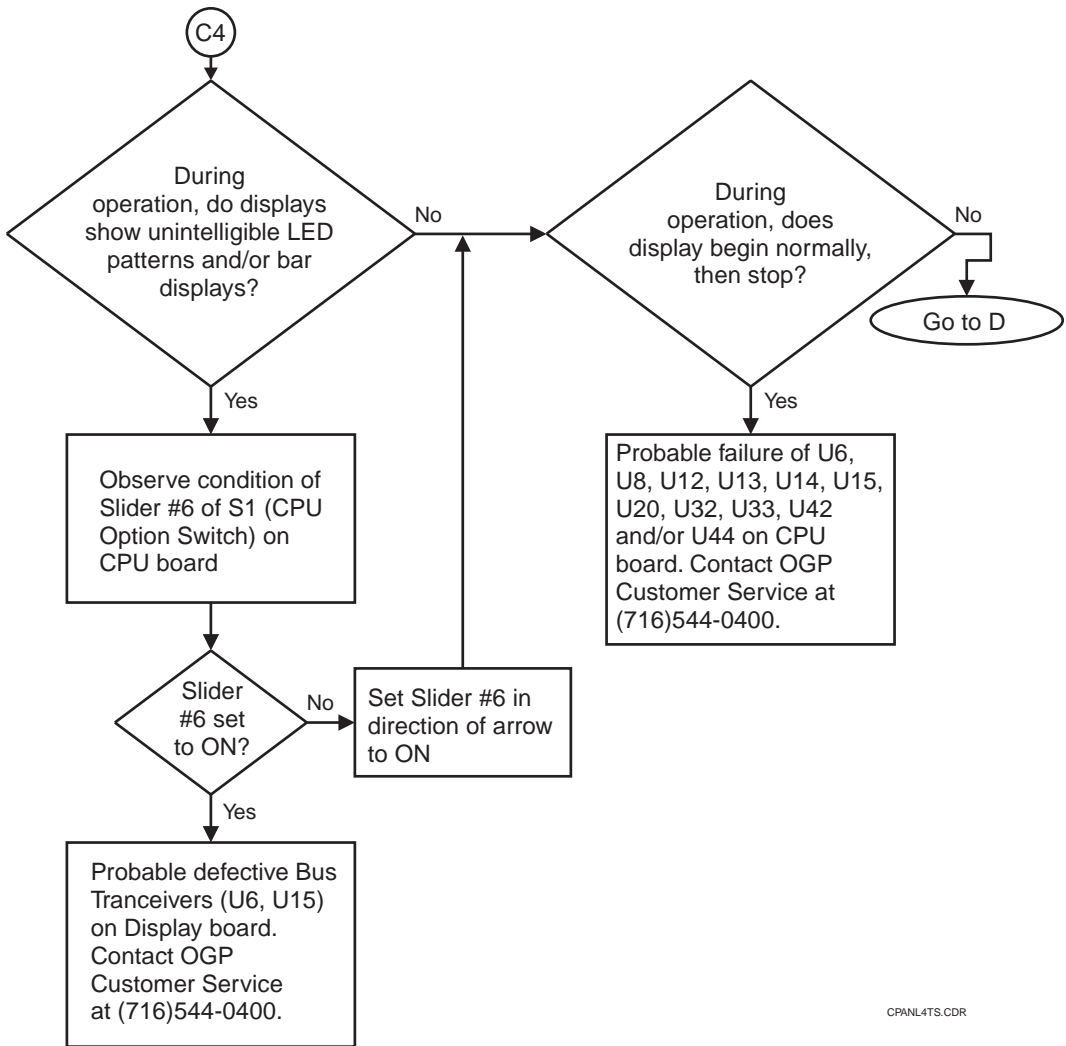
CPANL2TS.CDR

Figure I-4. Control Panel Operation Troubleshooting Diagram (Sheet 2 of 4)



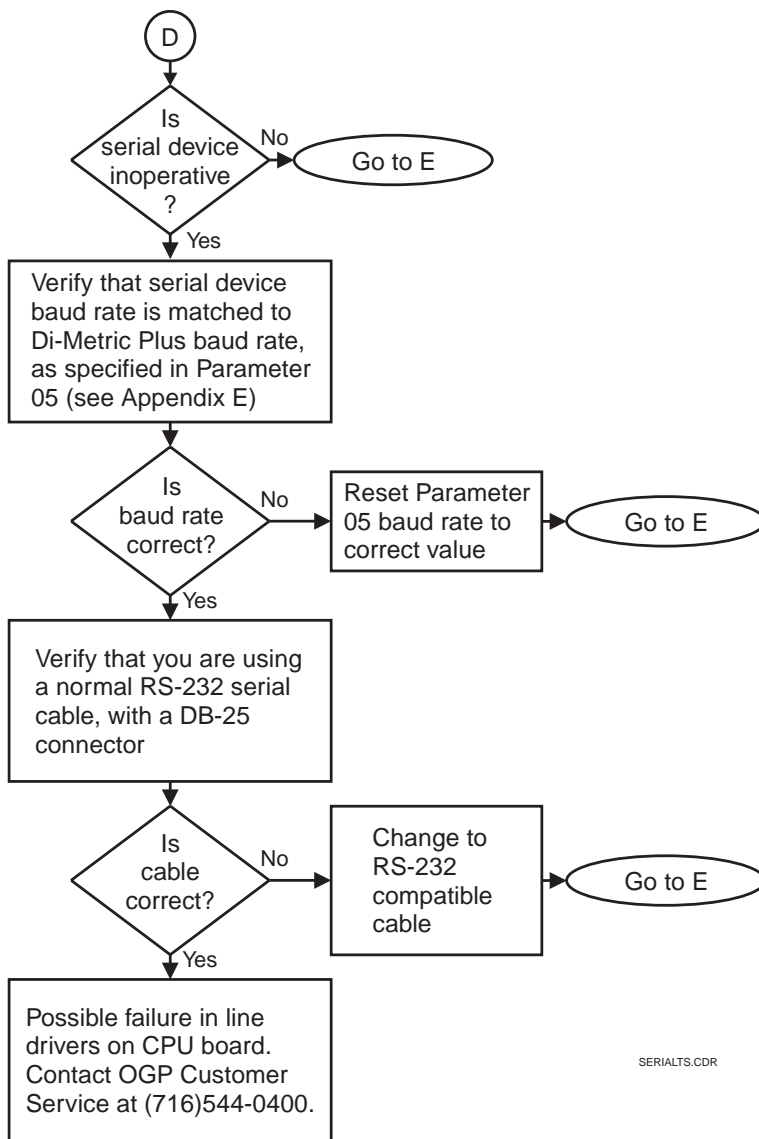
CPANL3TS.CDR

Figure I-4. Control Panel Operation Troubleshooting Diagram (Sheet 3 of 4)



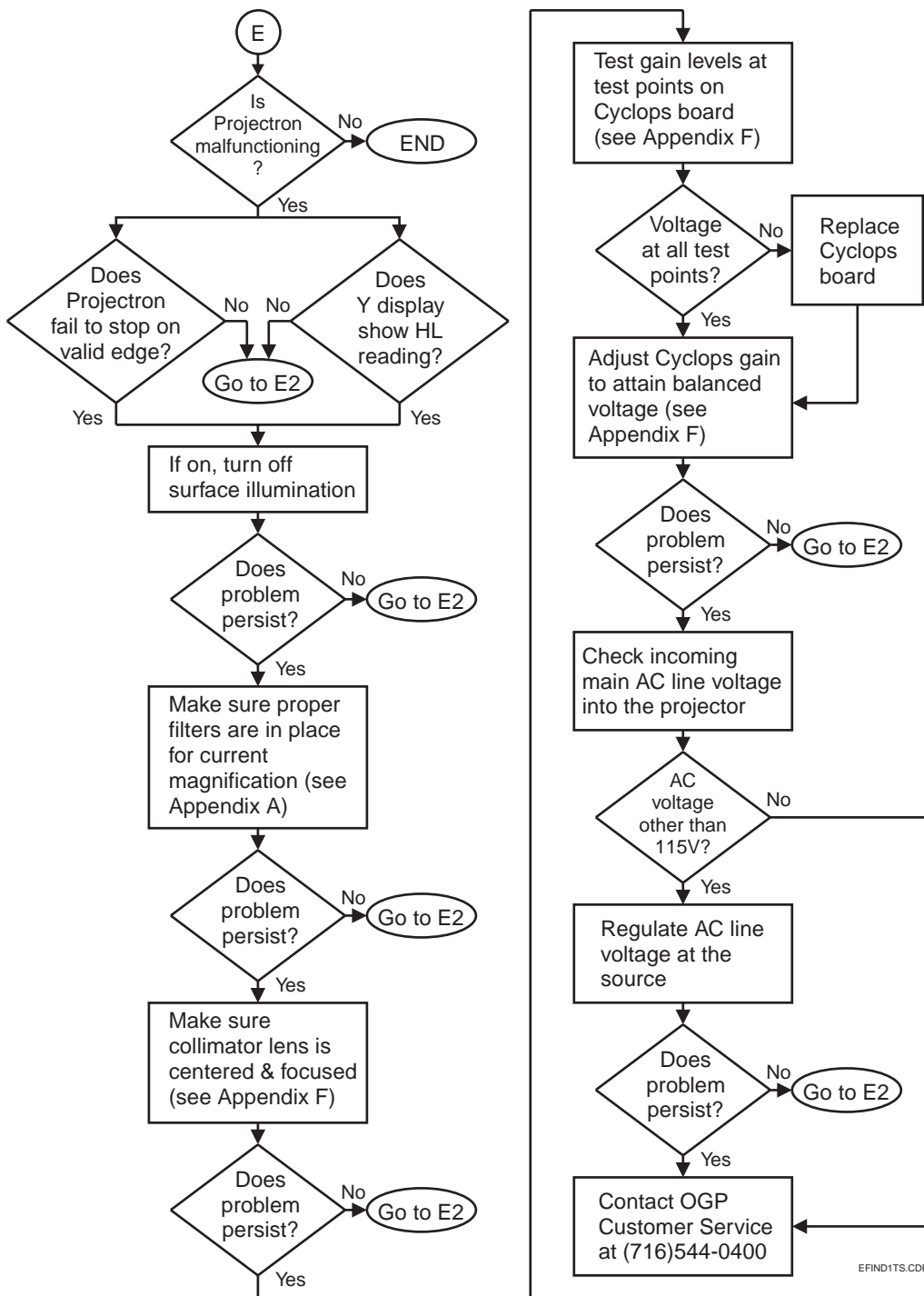
CPANL4TS.CDR

Figure I-4. Control Panel Operation Troubleshooting Diagram (Sheet 4 of 4)



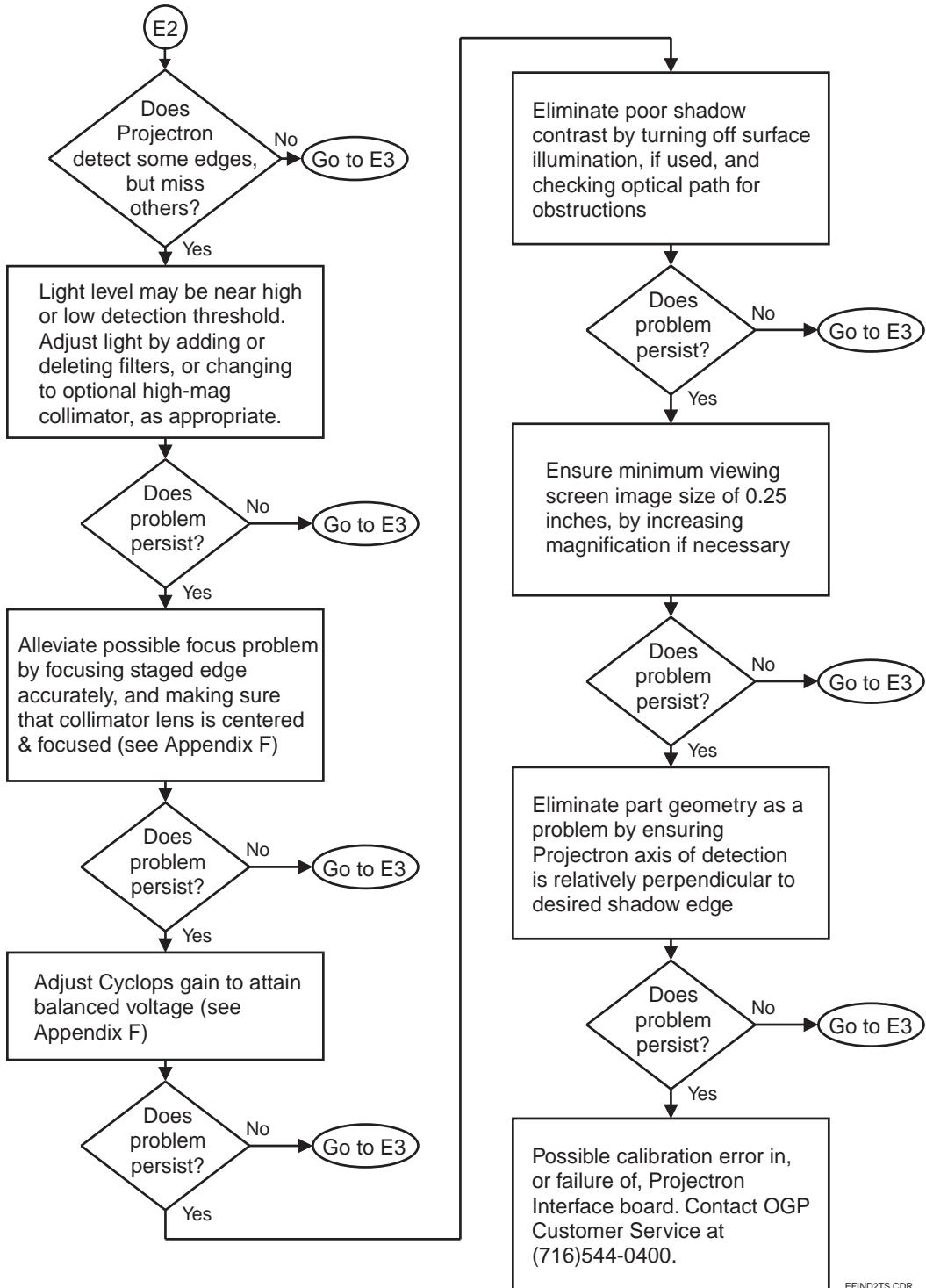
SERIALTS.CDR

Figure I-5. Serial Devices Troubleshooting Diagram



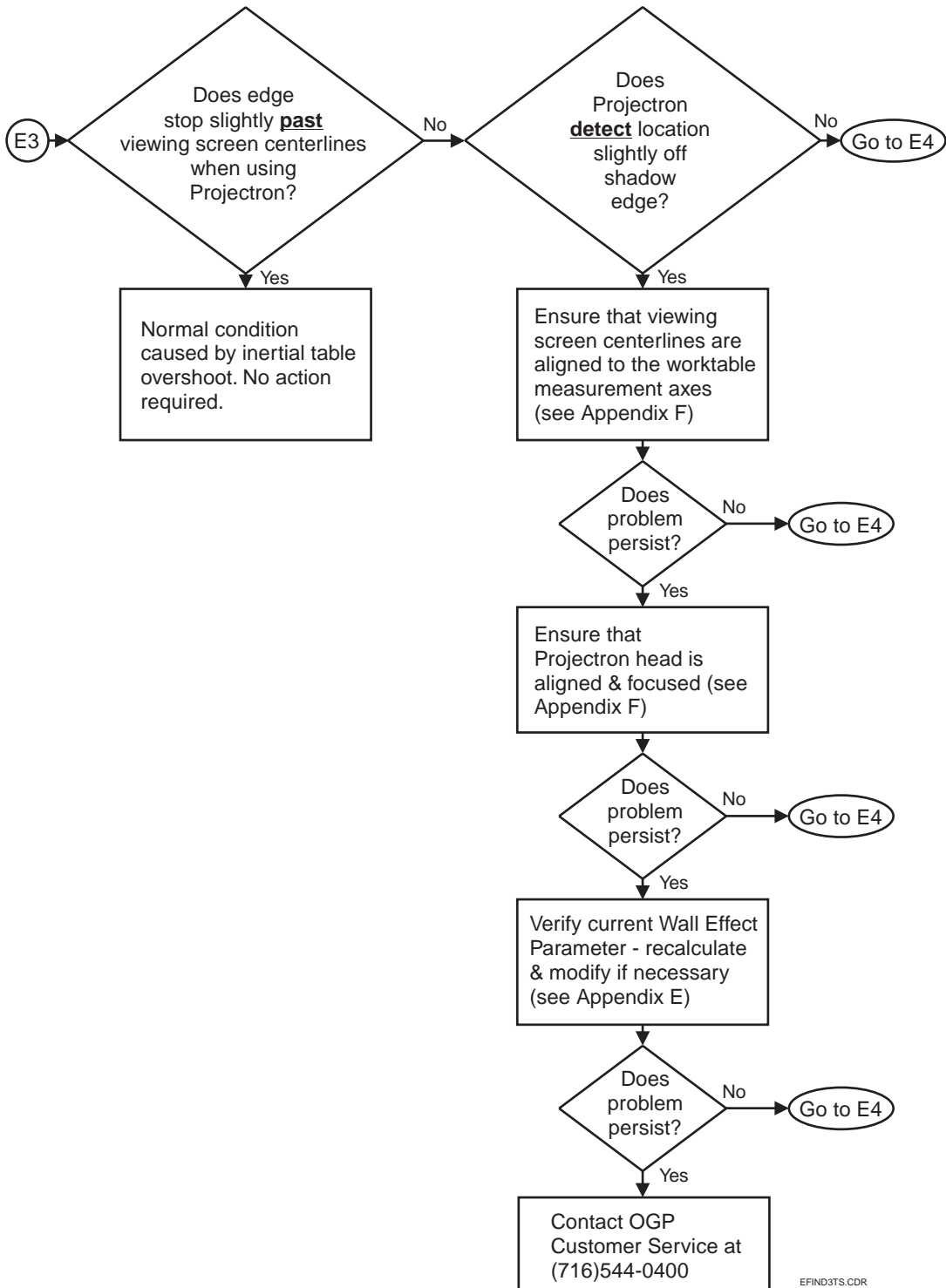
EFIND1TS.CDR

Figure I-6. Projectron Operation Troubleshooting Diagram (Sheet 1 of 4)



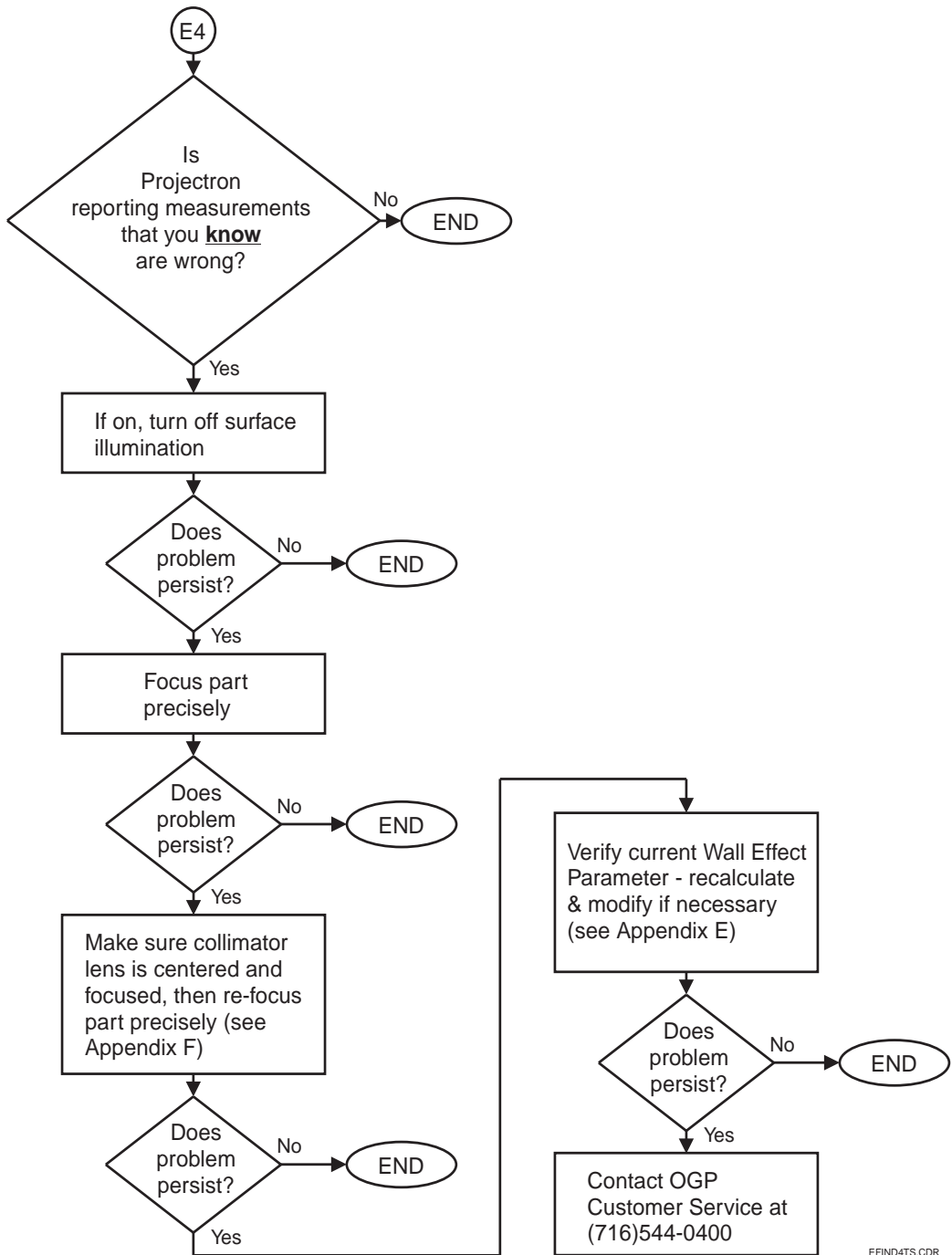
EFIND2TS.CDR

Figure I-6. Projectron Operation Troubleshooting Diagram (Sheet 2 of 4)



EFIND3TS.CDR

Figure I-6. Projectron Operation Troubleshooting Diagram (Sheet 3 of 4)



EFIND4TS.CDR

Figure I-6. Projectron Operation Troubleshooting Diagram (Sheet 4 of 4)

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User Feedback

OGP's documentation serves a wide range of users. In an attempt to meet every user's needs, we welcome your feedback.

The following three forms are provided to make it easier for you to respond to us:

- Use the **Di-Metric Plus Feedback and Evaluation Form** to tell us your opinion of our products, our technical support, and our publications. It would be most helpful if you could complete this form **after** you have become familiar with your Contour Projector and have had the opportunity to use and assess Di-Metric Plus, OGP's technical services, and this guide.
- Use the **Documentation Enhancement Request Form** to submit your suggestions for improving the documentation. Also, if you notice any technical errors or omissions associated with this guide, use this form to point them out to us.
- Use the **System/Software Enhancement Request Form** if you have any ideas or suggestions for enhancing any OGP products.

We rely on our customers' help as we continue to improve our products and services. Thanks, in advance, for your cooperation.

Optical Gaging Products, Inc.

Di-Metric Plus Feedback and Evaluation Form

Your feedback is very important. We value your opinion of our products, our technical support and our publications. Your comments will help us to continually improve our products and services.

After using Di-Metric Plus for several months, please take a few moments to complete this feedback and evaluation form, and return it to Marketing Communications, Optical Gaging Products, Inc., 850 Hudson Ave., Rochester, NY 14621. If you prefer, you may FAX this form to us at (716) 544 - 0131. Thank you!

1. Please tell us about yourself and your work with Di-Metric Plus.

Your job function _____ Years of experience: _____

How often do you use Di-Metric Plus? All/most of the day Several times/day
 Several times/week Once a week or less

2. Please provide some background about your experience and training.

Did you receive any training on Di-Metric Plus? Yes No If yes, how many days? ___

If yes, who provided the training? OGP employee Manufacturer's representative

Do you consider your training to be sufficient? Yes No

If you did not receive any training, how did you learn to operate/use it? _____

Did you have previous experience with this machine or one similar to it? Yes No

What is your level of comfort in using Di-Metric Plus? High Med Low

3. Please indicate how strongly you agree or disagree with the following statements about the software and OGP technical support.

	Strongly Agree	Agree	Neutral/ Not Sure	Disagree	Strongly Disagree
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--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

Is easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Is easy to learn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Strongly Agree	Agree	Neutral/ Not Sure	Disagree	Strongly Disagree
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Responses provided in reasonable time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Staff helpful and friendly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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Information is accurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information is well-organized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Writing is clear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Illustrations are clear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Manual has enough examples	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Examples are helpful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Instructions are complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Manual's quality consistent with product	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. Please identify which parts of the manual you use the most or least, and what you think is still needed.

What sections of the manual do you refer to most often? _____

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What topics, if any, should be added to the manual? _____

Are there any functions of your job that this manual doesn't address? _____

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7. Please provide any additional comments or suggestions that you may have.

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Addendum A

The following information was misstated in the first printing of this reference guide. OGP regrets any inconvenience this may have caused our customers.

This addendum is effective on January 15, 1997, and should be included with the Di-Metric Plus Reference Guide, First Printing, November 1995.

Point Entry



Once a geometric measurement function (Line, Width, Circle/Arc, or Angle/Vertex) has been selected, you may enter points in one of two ways:

- By pressing the control panel **Enter** button, or —
- By pressing the button on the joystick lever.

Note

The joystick **ENTER** and **CANCEL** buttons do not enter or cancel points at any time.

If a geometric function has not been selected, the button on the joystick lever turns Projectron on or off.

Using Projectron and Entering Points

You may use Projectron to find edge points, and then you may enter those points in one of two ways — by using the control panel and joystick motion control alone, or by using the control panel in conjunction with the button on the joystick lever.

To use the control panel and joystick motion control alone, follow these steps:



1. Press the control panel **E** button to activate Projectron.



2. You will see the **E** button LED glow red and remain lit, indicating Projectron is active. To exit the Projectron function at any time, simply press **E** again.



3. Press the appropriate geometric function button (**Line, Width, Circle/Arc,** or **Angle/Vertex**) to activate the function.

4. Using either the joystick lever or arrow keys, maneuver the worktable so that the viewing screen centerlines pass over a target edge point to detect it.

- If you use the arrow keys, just press the appropriate key once and release it. The worktable will move in the direction that you indicated, as Projectron seeks an edge.
- If you use the joystick lever, seek an edge horizontally or vertically only.



5. As soon as the target edge passes under the centerlines, the X and Y displays will “lock up” and display the coordinates of the detected edge point.



6. Press the control panel **Enter** button to enter the point into Di-Metric Plus memory. The **E** button LED will remain lit, and Projectron will remain active.

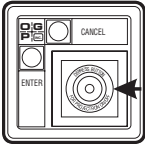
7. Repeat steps 4 through 6 above until the appropriate amount of points have been entered for the geometric function you have selected.

To use the control panel in conjunction with the button on the joystick lever, follow these steps:

1. Press the appropriate geometric function button (**Line, Width, Circle/Arc,** or **Angle/Vertex**) to activate the function.
2. Press the control panel **E** button to activate Projectron.

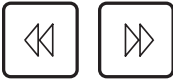


3. You will see the **E** button LED glow red and remain lit, indicating Projectron is active.



4. Using either the joystick lever or arrow keys, maneuver the worktable so that the viewing screen centerlines pass over a target edge point to detect it.

- If you use the arrow keys, just press the appropriate key once and release it. The worktable will move in the direction that you indicated, as Projectron seeks an edge.
- If you use the joystick lever, seek an edge horizontally or vertically only.



5. As soon as the target edge passes under the centerlines, the X and Y displays will “lock up” and display the coordinates of the detected edge point.
6. Press the button on the joystick lever to enter the point into Di-Metric Plus memory. The **E** button LED will go out, and Projectron will become inactive.



Note

Whenever a geometric measurement function is active, pressing the joystick lever button will simultaneously disarm Projectron and enter the selected point into Di-Metric Plus memory.



7. Press the **E** button again to re-activate Projectron.
8. Repeat steps 4 through 7 above until the appropriate amount of points have been entered for the geometric function you have selected.



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