CADD/86-87

COMPUTER-AIDED-DRAFTING

M A N U A L

CADD/86-87-V134... 2D Computer Aided Drafting & Drawing

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NOTICE

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ACKNOWLEDGEMENT TO R. BUCKMINSTER FULLER

The word TENSEGRITY is an invention of R. Buckminster Fuller.

Tensegrity describes a structural-relationship principle that nature employs in all of her structuring; from individual atoms to entire solar systems.

Humanity will benefit as the principle of TENSEGRITY is more generally understood and utilized.

Further information is available in the following books by R. Buckminster Fuller:

1. SYNERGETICS
2. SYNERGETICS 2
3. TENSEGRITY

Introduction: CADD/86-87

The CADD/86-87 software pac transforms Hewlett-Packard's HP-86/87 personal computer into a personal engineering design and drafting system. Using CADD, almost anyone can generate precision artwork.

The current CADD/134 version is over 200,000 bytes of code. In order to maintain fast access to CADD's many functions, the entire program is memory resident. There is no slow program chaining.

A good word processing system offers many productivity advantages over a typewriter. CADD/86-87, a graphics processing system, offers similar advantages when drafting and drawing.

Companies using large CADD systems find CADD/86-87 a convenient way to provide all engineers, designers and technicians access to powerful computer assisted drafting and drawing tools without waiting in line for the big CADD system.

Companies using manual drafting methods find CADD/86-87 a supplement to their present system. Drawing, storing, recalling, rescaling, editing, and redrawing often used detail drawings with CADD/86-87 will save your draftsman time. Drawings can quickly be edited then redrawn on paper, mylar film, or sticky-back film. Technical drafting pens are now available to fit all HP plotters, 7225, 7470, and 7475 included.

Your suggestions and comments are welcome and encouraged. User feedback has resulted in many improvements and enhancements to CADD/86-87.

Table of Contents

HOW TO USE THIS MANUAL

This manual takes a learn-by-doing approach. This means that you should use your computer and run CADD/86-87 in conjunction with reading. By reading the manual chapters in sequence and following the step by step instructions, you will be guided through CADD/86-87's current capabilities. If you need additional support, call John Christy at 1-312-935-9714

CADD/86-87 User Instructions

SYSTEM REQUIREMENTS:

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190810

* HP-86/87 computer with a minimum of 192K RAM (256K with built in specialized symbols) & Plotter/Printer ROM.
* HP 5.25in or 3.5in disc drive (single or dual).
* HP-7225, 7470, 7475, 9872, 7580 or 7585 plotter.

GETTING STARTED:

1. Insert program disc in default disc drive.
2. Type: LOAD "CADD134-XX" (Use program name on disc label.
3. Press: END LINE
4. Wait for program to load. Red light on disc drive will go off.
5. Type: RUN Disc will again briefly go on and off and CRT will display system status messages.
6. You may remove the program disc and store in a safe, dust free place. If you intend to change formats, leave program disc in drive.
7. Insert a blank but initialized disc in any disc drive for data (drawing) storage.
8. Follow program prompts to set user units for the coordinate system.
9. When graphic screen with graphics cursor appears (a few seconds) you are ready to begin drafting.

NOTE ABOUT HP-86 CRT

Although this software automatically senses if you are using an HP-86 or HP-87, the default setting for CRT scaling is HP-87 type. When using an HP-86 and a standard HP monitor, the CRT may be scaled so that circles are round instead of oval by pressing the TYPE CRT softkey in the redraw menu. This special scaling for the 86 does make circles round (on CRT only) but is objectionable for the following reasons: 1) Less of the CRT is used for drawing. 2) Plot direction, label direction and angular cursor movement produce incorrect results. 3) Plots produce incorrect results. You should use HP-87 type CRT scaling even if you are using an HP-86 or HP-86B.

Another solution to the HP-86 CRT problem is to use a CRT which has an adjustable vertical height control. Simply reduce the vertical height until circles become round and use the HP-87 type CRT scaling. The HP monitors have this vertical height control but it does not have enough range to make the circles round. A good and low cost monitor to try is the Amdek 12 inch with the amber antiglare screen. The Amdek is available at many computer stores and it's vertical height control works just fine.

Can load and run programs from mass memory. Can pass control to another CPU High and Low Level HPIL control w/o separate 'I/O utilities' Reads HP41 data files, HP75 data cards, text files.
Random access of mass storage data files capability,

FORTH/Assembler ROM (64k bytes - 5/1984):

1) FORTH Language - 286 words in ROM Forth can call BASIC and vice versa three forth stacks: integer stack, subroutine stack and 4-level 64 bit floating point stack X,Y,Z,T, Last X. Multiple FORTH dictionaries in RAM may be maintained.
2) Includes Text Editor from Text Editor/ Formatter ROM
3) Assembler: Free form using mnemonics, Equates, Macros, etc. Produces Object and Listing files in RAM
4) Remote Keyboard Capability: Hook up terminal or PC w/terminal software to become full sized keyboard and screen of the HP71.

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END LINE

ISOTROPIC SCALING FOR THE HP-86

One problem in using the graphics capabilities of the HP-86 is that the firmware is based on isotropic scaling of the horizontal and vertical axes while the vertical to horizontal scale ratio of the monitor is 1.736. The effect is to elongate plots in the vertical dimension. Although the scaling can be corrected rather easily for screen plots and with a bit more difficulty for screen labels, separate programming is needed for external graphics printers and plotters. Conversely, the vertical elongation of the monitor image improves readibility of the text screen. The obvious solution is a switch selectable choice between the two formats.

While several hardware modifications have been proposed for this purpose, the method outlined below has the advantages of independent control of vertical scaling for both normal and graphics modes, switch selection between the two modes, and retention of the feed through signal capability for multiple monitors without permanent modification of the wiring or circuit board. These functions are accomplished by adding a 70 K ohm variable resistor bypassed by a switch to the circuit controlling the vertical height of the monitor image. The original circuit is shown in Figure 1 and the modified circuit in Figure 2.

Figure 1

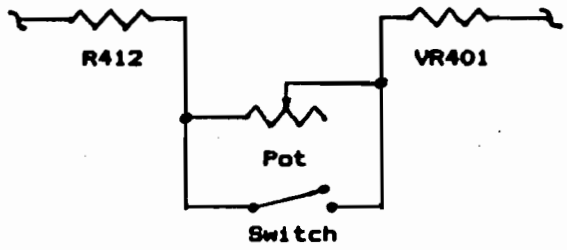

Figure 2

The following instructions are specific to the Hewlett-Packard 82913A 12 inch monitor, but the procedure should be generally applicable. A 70 K ohm variable resistor or potentiometer (50 to 100 K ohm should be satisfactory) and a single pole, single throw switch can be obtained from most electronics hobby stores.

1. Remove the retaining screws and the back of the monitor casing. If necessary, temporarily unsolder any wires interfering with moving the back sufficiently to reach the circuit board.

2. Locate resistor R412 on the main circuit board near the vertical height control VR401. R412 is identified on the foil side of the board.

3. Unsolder the lead wire of R412 nearer VR401, pull the resistor away from the board and straighten the unsoldered lead. Solder a short lead into the hole from which the R412 lead was removed.

4. Mount the potentiometer and switch to the back of the case by drilling appropriate holes to match the hardware. A convenient location is the flat area just above the legends for the control knobs.

5. Solder a wire from the disconnected lead of R412 to one of the end connections of the potentiometer and a second wire from the lead added in Step 3 to the center connection. These wires should be long enough for convenient attachment with the back removed.

6. Solder a short wire from one end connection of the switch to one of the wired connections of the potentiometer and a second wire from the other end connection of the switch to the remaining wired connection of the potentiometer.

7. Resolder any wires temporarily removed

HP Computer Museum
www.hpmuseum.net

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for access and reassemble the case. NOTE WELL: the excess length of the two wires from the circuit board to the potentiometer should be placed well over toward the side of the monitor where the front panel controls are located to remove them from the high voltage area of the circuitry. Otherwise signal distortion and poor image quality will result.

8. Connect the monitor, power up the system, and execute the FRAME command to provide a screen image for calibration.

9. Adjust the potentiometer to the midpoint of its range and set the switch for maximum frame size. The frame should be full size, about 144 mm wide and 150 mm high. Adjust the vertical size control if necessary.

10. Change the position of the added switch and adjust the potentiometer for a vertical image height of 86.4 mm or 0.6 times the horizontal width if it is not exactly 144 mm.

11. The modification can be easily removed by unsoldering the two added wires and re-connecting R412 to the circuit board.

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END LINE

A COMPUTER HORROR STORY

Story by Ed Keefe — This story begins with the purchase of an HP-86 desktop computer by the Computer Literacy Institute, where I work, have fun, lose sleep and sometimes pull out my hair. Being the knowledgeable experts that we envision outselves to be, we used the remainder of a grant to purchase other micros for use in training. For portability, we now have ten Osborne Exec I's. So much for alleged expertise, right? Naturally, to compound that fiasco, we purchased a 7470A Plotter, but decided that the graphics machine should work with the Osborne's (and Apples(and IBMs) as well as the HP-86. Now the fun begins.

I called the regional HP sales office to determine which RS-232C interface to buy. The sales rep warned me that he was not familiar with RS-232C. I believed him when we got the RS-232C-001 interface. Now that interface does plug handily into the HP-86 AND the option 001 plotter (this seems logical: an 001 interface for an 001 plotter, right?) Perversely wrong! No harm done, however. HP graciously corrected the error, and sent us a Standard RS-232C Interface. Now, with the right interface, we had the wrong connector. Someone forgot to tell us that another cable was needed to match the connectors on the plotter and the interface. Our technician was "thrilled" with the challenge of wiring and soldering all 72 pins of the adaptor cable. (We also specialize in alienating technicians.) Now, with all the right hardware, the plotter still did not work. So it was "back to the manuals time": all six of them. And all of three weekends with them. Still no clue why the machines would not work. Finally, in desperation, I called HP. I was transferred to three different regions of the country before I found someone who would talk RS-232C with me. After having a good chuckle about our "mistake" of not going HP-IB all the way, the Customer Engineer gave me the following configuration routine over the phone:

```
E$=CHR$(27)
 20   CONTROL 10,3;15
 30   CONTROL 10,4;10
 40   CONTROL 10,11;192
 50   CONTROL 10,14;19
 60   CONTROL 10,15;17
 70   CONTROL 10,9;137
 80   OUTPUT 10 ;E$&".M50;;;13;10:"
 90   OUTPUT 10 ;E$&".181;;17:"
100   OUTPUT 10 ;E$&".N;19:"
110   END
```

I asked the Customer Engineer where a person was supposed to find such a program: it's not in any of the manuals. The CE's witty reply was: "You are not supposed to find it in the manuals. You are supposed to call us." My next question was, naturally, "And just what would you like me to call you?" The amazing thing was that the routine actually worked. At least it gave out "Communication OK" on the plotter, just like the good book said it should. But thereafter it produced garbage: amazing as well!

This story reaches a climax three months later, when during semester break I had six uninterrupted days and nights to re-read all the HP manuals several times over, tear the interface apart and check the switches, and try, try, again and again. Just as I was about ready to admit defeat, my eye was caught by something in the plotter manual: an ESCape sequence that looked vaguely like one of the lines in the HP configuration routine, but where I had an "1", the book has an "I". What the heck, give it a try. It worked! The plotter started jigging and scratching away with the first, complete chart of its existence. It is now no longer a "boat anchor" but a real tool. The anticlimax came with the discovery that the same configuration routine can be inserted at the front end of the "setup" subprogram of the Graphics Presentation Pac, and the GP Pac is now useable. (The sequence of commands to perform this latter task go like this: LOAD "setup"/ UNSECURE "setup", "NO",2 / PURGE "setup"/ PACK/ (modify the "setup" program)/ STORE "setup"/ SECURE "setup","NOLIST",2). Now as long as the "Configure"option is bypassed during execution, the Pac remains relatively bug-free. I suppose there could be a moral to this story. What the moral might be I am not sure. I know that I learned a lot about the ins and outs of the 86, RS-232C, and the 7470A-001. And I learned that there is still more to learn. Perhaps the moral is that "dogged perservance" will finally get results. Somehow it reminds me of my recent attempts to make sense out of MCODE on the HP-41C. When I first see something I don't understand, it looks like a pile of crap. But keep on digging...you know...there just may be a pony beneath it all. [R/S]

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Ed Note — RS-232 is the most unstandard standard

USER DEFINED SYMBOLS LIBRARY

Anything that you draw and store in mass storage with the SAVE FILE routine can later be recalled as a symbol. (See GET FILE and SAVE FILE.)

Whenever you bring a drawing in from mass storage using the GET FILE routine, you are asked if you would first like to clear memory.

If you CLEAR MEMORY, the scaling of the coordinate system active when the drawing was stored is reinstated and the items of the drawing will redraw in exactly the same place as when they were originally drawn.

If you DO NOT CLEAR MEMORY when bringing in a file, the incoming file is considered a user library symbol file and added to any items already in memory. Also the coordinate system scaling curently active remains active. The incoming user symbol file will automatically be translated (moved) to the graphics cursor's current location based on any of nine user settable reference points (See 1 to 9). Before saving a file, you may set any or all of the nine reference points by using the shifted numeric keypad numbers one to nine. When bringing in a user symbol, you are asked which point to use as the reference for locating the symbol.

GRAPHICS TRANSFORMATIONS

Basic graphics transformations include translation (move), rotate, and scale. You may do these to any item or group of items with CADD-86/87 using the edit functions. You may also delete or replicate any item or items using edit.

There are a couple of ways to do scaling. The first way is to change the entire scaling of the coordinate system that you are working in. To access this routine press: CTRL Z. The second way is to retain the current coordinate system and use EDIT by pressing E then pressing G to get into group edit mode.

256 LAYERS

A layer number (0-255) is assigned to every item drawn with CADD. To change the current layer number, press CTRL L. When redrawing, you may redraw all layers or the currently selected layer. There is a softkey in the redraw menu which selects between all layers and the current layer when redrawing. To access the redraw menu, press: R (See Redraw).

KEYS WHICH HAVE SPECIAL MEANING WHILE USING CADD/86-87

ARROW KEYS (Moves the graphic cursor.)

If you just tap any of the arrow keys, the cursor will move one increment. If you hold an arrow key, the cursor will continue to move until you let up. You may set the increment by which the cursor moves by pressing special function key k14 or typing I. Notice that the cursor's current location is displayed in the upper left corner of the CRT.

ROLL KEY

Each line, box, polygon, circle, symbol or text string etc. that you draw is called an item. Pressing the ROLL key will sequentially move the graphics cursor forward in the list of items to the starting coordinates of each item that you have drawn, starting from the item displayed in the information line. The information line is located directly above the drawing area. Holding down the SHIFT key and pressing ROLL moves the cursor in the other direction through the list.

If the information line says ITEM=9, then pressing the ROLL key will move the cursor to ITEM 10. Pressing SHIFT ROLL would move the cursor to ITEM 8.

The graphics cursor on the screen and an internal pointer known as G_POINTER point to the same location when using the ROLL key. Whatever item is pointed to by the internal pointer is the item operated upon when using any of the edit functions. If after locating the cursor with the ROLL key, you move the screen cursor by using the arrow keys or the jump command, the internal pointer (G_POINTER) still points to the last item moved to with the ROLL key. When you draw another item, G_POINTER then points to the last item which you have drawn and indicates this with the information line.

+ & - KEYS

The plus and minus keys are similar to the roll key but only snap the cursor to items within a group. Whenever you zoom an area, the items within that area are automatically placed into group #8. To snap the cursor to items within the zoomed area, use the plus and minus keys. Using the roll key while working in a zoomed area usually causes your cursor to jump off screen and get lost. Use the + & - keys while working in a group. There may be up to eight groups active at any time. By pressing CTRL and G simultaneously, you may select which group is active by repeatedly pressing k1, the group number key.

I/R KEY (Located above the LEFT ARROW key.)

The ROLL key gets you to the start and sometimes the end point of an item. Often, as in the case of symbols, boxes, or polygons, there are many important points associated with an item. The I/R key works in conjunction with the ROLL and -CHAR keys. By pressing the I/R key, the item pointed to by using ROLL, SHIFT ROLL or + & - is erased, then redrawn. By so doing, you can see exactly which item is being pointed

to and the computer can find all of that item's important points. After using I/R, use -CHAR (explained below) to snap the cursor to the items important points.

-CHAR KEY (Located above the RIGHT ARROW key.)

After using the I/R key, the -CHAR key will sequence the graphic cursor to each important point of the item. If, for example, the item is a six sided polygon, the cursor would sequentially move to each vertex and the polygon's center upon each press of the -CHAR key. The cursor continues to loop around each important point as long as you keep pressing the -CHAR key.

1 TO 9

The keys 1 to 9 on the numeric keypad are used to snap the graphics cursor to any of nine reference locations set by the user. To set these points, move the cursor to the desired location then press shift 1-9.

When you store a file using the SAVE FILE softkey, these nine locations are stored with the file. When a new file is called in from mass storage using the GET FILE softkey, the nine reference locations of the new file override any current settings.

SPECIAL FUNCTION KEYS

When the program first comes on, a set of special function keys known as KEYS 1 are being displayed to the left of the drafting area. Notice that the label k1 KEYS 1 as well as some other key labels are being displayed in inverse video. Press k2. Notice that the key labels that are new are in inverse video. Press k3. Press k1 again. Press k4, lines. Press k1 again. The first three sets of keys, k1, k2, k3, are the main sets of special function keys. There are many other sets of keys that branch off of these first three sets. Special function keys k12, k13, and k14 usually remain the same because these functions are needed often. New users usually use softkeys but soon use the direct execute keys insted. Be sure to try all of the direct execute keys.

DIRECT EXECUTE KEYS

Getting from one set of functions to another using softkeys often involves branching through two of three sets of softkeys. Direct execute keys provide a direct path between major CADD functions. Try all of the following direct- execute keys. Observe how rapidly the graphics keylabels change. Direct- execute keys do not work when the computer is in alpha mode. Alpha mode is when the graphic display is not showing, usually when the computer is asking you to input some information.

A Arcs
a Auto dimension

B	Boxes
C	Circles
c	Display or alpha-dump COMMAND MENU
D	Digitize.. move CRT cursor to current location of plotter's pen.
E	Edit
F	Files
f	Find the center of two points
G	Group move, rotate, replicate, scale, and delete.
W [redacted]	Select group number, set group window, clear group, add item to group, put items of window into group.
H	Store cursor's horizontal coordinate (use with V & M).
I	Increment (set cursor movement increment)
J	Jump to a specified coordinate.
K	
L	Lines mode.
l	Set linetype.
CTRL L	Set layer number. (0-255)
M	Move to stored H&V coordinates.
m	Move plotter's pen to CRT cursor location.
N	
O	
P	Polygon mode.
p	Set plot direction. Affects cursor movement.
CTRL P	Set pen number.
Q	
R	Redraw mode.
S	Symbol mode.
T	Text mode.
U	
V	Store vertical coordinates of CRT cursor position
W	Windows ([redacted].
X	
Y	
Z	Zoom an area within coordinate system.
CTRL Z	Zoom in or out by resetting coordinate system user units.
0	Set plot direction to zero degrees.
shift 1-9	Set any of nine coordinate markers. These markers are stored with drawing on disc and used as reference points when merging user library symbol files.
1-9	Return CRT cursor to selected marker.
ROLL	Step CRT cursor forward through drawing.
shift ROLL	Step CRT cursor backwards through drawing.
+	Step cursor to items within active group.
-	Similar to plus key.
I/R	Erase then redraw the item which cursor is currently pointing to. By so doing, the action of the -CHAR key is defined.
-CHAR	Step CRT cursor through all of an item's important coordinates. Used in conjunction with the I/R key.
CTRL H	Graphics dump to printer (90 deg rotated view)
CTRL G	Graphics dump to printer (normal view)

SOFTKEY HIERARCHY

The indenting shows various levels of softkey nesting.

```
k1 KEYS 1

        k2 FILES
                k4  catalog -- Disc catalog and/or set mass storage
                               default device.
                k5  SAVEFILE -- Save drawing attributes & coordinates
                                on mass storage device.
                k6  GET-FILE -- Get drawing from mass storage.
                k7  DiscFree -- Check available disc space on the
                                default mass storage unit.
                k8  GSTORE -- Store CRT bit-plot.
                k9  GLOAD -- Get bit-plot from mass storage.
                k10 RE-DRAW
                        k1 << EXIT >> -- Return to graphics screen.
                        k2 CRT REDRAW -- Redraw to CRT.
                        k3 CLEAR ZOOM -- Clear partial redraw and
                                         zoom window.
                        k4 clearGRAPH -- Clear graphic screen but
                                         does not erase drawing from
                                         computer memory.
                        k5 RedraWindo -- Select an area for partial
                                         redraw.
                                k1  UN-ZOOM -- Same as CLEAR ZOOM.
                                k2  DO-ZOOM -- Sets redraw window.
                                k3  EXIT -- Return to redraw keys.
                                k4  SET lower left -- For window.
                                k5  SET upper right -- For window.
                                k6  Digitize lower left
                                k7  Digitize upper right
                        k7  PLOT -- Redraw to plotter.
                        k8  ID on/off -- Used to turn CRT information
                                         line on or off during
                                         redraw.  When info line is
                                         off, redraws are faster.
                        k9  Pen change -- When pen change is on,
                                          plotter stops when
                                          a new pen is
                                          required.
                        k10 type CRT -- Switch between HP-86 and
                                        HP-87 CRT type.
                        k12 Print martix -- Prints a listing of item#,
                                            type, and coordinates of
                                            drawing elements.
                        k13 Showall ON/OFF -- When on, items
                                              outside but passing
                                              through zoom window
                                              show up.
                        k14 SET plotter -- Set plotter address,
                                           pen speed and
                                           plotter limits.
                k11 JUMP -- Move graphic cursor to specified
```

coordinates. -- Also moves cursor to a specified item# if END LINE is pressed in response to coordinates prompt.

k3 KEYS 3
- k3 CHANGEgcursor -- Select different cursor type.
- k4 MOVpltr -- Move plotter's pen to CRT cursor location.
- k5 PEN -- Set pen number.
- k6 STEP+ -- Same as ROLL key, moves cursor.
- k7 STEP- -- Same as shift ROLL, moves cursor.
- k8 DIGITIZE -- Move CRT cursor to plotter's pen position.
- k9 SETscale -- Set or change user scale.
- k10 Zoom -- ZOOM any area to full size of CRT or plotter.
  - k1 UN-ZOOM -- clears zoom window
  - k2 DO-ZOOM -- zooms area
  - k3 EXIT
  - k4 SET_LL -- for zoom window
  - k5 SET_UR -- for zoom window
  - k6 digitize_LL
  - k7 digitize_UR
- k11 Formats -- Used to set system defaults that are used each time the program is loaded.
- k12 Auto-dimension -- Automatically draws extension lines, arrows, and text.
  - k4 SET POINT 1 --
  - k5 SET POINT 2 --
  - K6 SET TEXT POSITION, POINT 3
  - K7 DO AUTO-DIMENSION

k4 LINES
- k2 SET DIMENSION -- Used with CTR IF H & CTR IF V.
- k3 CTR IF H -- Draw horizontal line from center.
- k4 START -- Set start point of line.
- k5 END LINE -- Set end point of line, draw line.
- k6 PLOT DIRECTION -- Vector angle (slope). Affects cursor arrows.
- k7 LINETYPE
  - 1 Solid
  - 2 Dot at end point
  - 3 Dotted
  - 4 Short dash
  - 5 Long dash
  - 6 Dash-dot
  - 7 Dash-dash-space-dash-space
  - 8 Dash-dot-dot
  - k10 REPEAT -- Set distance between dots and dashes.
- k8 MOVE START
- k9 MOVE END
- k10 CTR IF V -- Draw vertical line from center.

k5 BOXES

```
        k1  EXIT
        k2  DRAW/CTR -- Draw box from center based
                        on k10-k12 setting.
        k3  ROTATE -- Set rotation of box.
        k4  SET LOWER LEFT
        k5  SET UPPER RIGHT -- Draws box.
        k6  LINETYPE
        k7  MOVE LOWER LEFT
        k8  MOVE UPPER RIGHT
        k9  MOVE CENTER
        k10 SET CTR -- Sets location of box center to
                       cursor position.
        k11 SetHIGHT -- Set box height, width.
        k12 SetWIDTH -- Set box height, width.

k6 SYMBOLS
        k2  MENU -- Display menu of symbols. Select symbol.
        k3  SET SIZE -- Set symbol size.
        k4  DRAWsymbol
        k5  SELECT -- Select symbol without menu.
        k6  PLOT DIRECTION -- Set symbol rotation.
        k7  LINETYPE

k7 TEXT
        k1  ENTER TEXT
        k2  LABEL ORIGIN -- LORG
        k3  LABEL DIRECTION -- LDIR
        k4  CHARACTER SIZE -- CSIZE
        k5  ASPECT RATIO -- ASPECT
        k6  SLANT
        k7  GRAPHICS -- Return to graphics screen.
        k14 MOVE LAST -- Move cursor to last text position.

k8 CIRCLES
        k3  ARCS
                k4  set x1, y1
                k5  set x2, y2
                k6  set x3, y3
                k7  DRAW ARC
                k8  LINETYPE
                k10 CIRCLE RESOLUTION
        k4  SET CENTER
        k5  SET RADIUS
        k6  START DEGREES -- Default is 0 degrees.
        k7  STOP DEGREES -- Default is 360 degrees.
        k8  LINETYPE
        k9  DRAW CIRCLE
        k10 CIRCLE RESOLUTION

k9 POLYGONS
        k4  SET CENTER
        k5  SET RADIUS
        k6  NUMBER OF SIDES -- Default is 3.
        k7  ROTATION
        k8  LINETYPE
        k9  DRAW POLYGON

k10 FIND CENTER
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```
        k4  Set point 1
        k5  Set point 2
        k6  Goto horizontal center
        k7  Goto vertical center
        k8  Goto horizontal & vertical center

k11 COMMANDS
            Display commands
            Alpha-dump command menu (optional)

k12 EDIT
        k2  Attributes -- Change an item's attribute
                          such as linetype, rotation, etc.
        k3  SET item# -- Move CRT cursor to item.
        k4  SEARCH -- Find item near CRT cursor
                      (search window).
        k5  EDIT ITEM
                k1  EXIT
                k2  LOCATE -- Graphics cursor at item start.
                k5  NEXT -- Find next item in search window.
                k6  MOVE -- Move item.
                        k7  LOCATE -- Move cursor to item
                                      start.
                        k11 JUMP -- Move to specified
                                    coordinates.
                        k14 SET INCREMENT -- Of cursor
                                             movement.
                k7  DELETE -- Erase and purge item.
        k6  GROUPS
                k1  SetGroup --
                        k1 GROUP# -- press to select group
                                     one to eight.
                        k2 Set LL --
                        k3 Set UR --
                        k4 PutGroup -- Put items within
                                       window into group.
                        k5 Add item -- Adds item cursor is
                                       pointing to into
                                       current group.
                        k6 ClrGroup -- Clear all items
                                       of current group.
                        k7 EXIT -- return to main group
                                   softkeys.
                k2
                k3  SETrefer -- Set reference point for
                                group functions.
                k4  SEToffset -- Set offset point for
                                 group functions.
                k5  SETrotate -- Set degrees of rotation
                                 for group functions.
                k6  SETscale -- Set scale factor for
                                group functions.
                k7  EXIT -- return to main edit functions.
                k10 DO MOVE -- (Set reference & offset
                               first.)
                k11 DO ROTATE -- (Set rotate k5 first.)
                k12 DO SCALE -- (Set scale k6 first.)
                k13 DO DELETE -- (Use set group k1 first.)
```

k14 DO REPLICATE -- (Use k1 first.)

k7 PACK -- Rid matrix of purged item locations.

k13 RUB LAST -- Erase last item drawn.

k14 INCREMENT -- Set increment of cursor movement.

USING CADD/86-87... FUNCTION BY FUNCTION

*** k1 KEYS 1 ***

LINES:

There are two ways to draw a line. 1. START/END POINT.
2. CENTER POINT.

1. Move the graphics cursor to the start point of the line, press the START softkey (k4), move the cursor to the desired end of the line, press the END LINE softkey (k5). After pressing END LINE (k5), the line is drawn and START LINE (k4) is automatically set to END LINE (k5).

2. The second way to draw a line is by pressing the SET DIM softkey then typing in a length dimension then pressing either the CTR IF H or CTR IF V softkey. This second method assumes that the graphic cursor has been placed at the center point of the desired line.

LINES, START/END POINT:

1. Type: L to get into lines mode

2. Move graphic cursor to where you want a line to start from.

3. Press: k4 (START)

4. Now, using the arrow keys, move the graphic cursor to some other location.

5. Press: k5 (END of LINE)

At this point a line is drawn between the start point and end point. The program remembers these points. You can move the cursor to some other point and press k5 again. Another line will be drawn from the last end point to the new end point. You can always move to the start and end points of the line you have just drawn by pressing MOVE START (k8) or MOVE END (k9) or by pressing SHIFT ROLL or ROLL.

6. Press: k8 (MOVE START)

7. Press: k9 (MOVE END)

Notice that a solid line was drawn. You can select different line types by pressing k7 (LINETYPE).

8. Press: k7 (LINETYPE)

9. Press: k3 (dotted line)

10. Move the cursor to some point on the CRT.

11. Press: k4 (START)

12. Move the cursor somewhere else.

13. Press: k5 (END of LINE)

The line was drawn as a dotted line.

14. Press: k7 (LINETYPE)

Notice the label for k10 (REPEAT). k10 allows you to set the repeat factor for linetypes. The default repeat factor is 1. A smaller number will make the dots or dashes closer together. A larger number spreads them apart.

15. Press: k10 (REPEAT)

16. Type: 2

17. Press: END LINE

18. Press: k3 (dotted line)

19. Press: k4 (START)

20. Move the cursor somewhere.

21. Press: k5 (END of LINE)

Notice that the dotted line's dot repeat pattern is wider.

LINES, FROM CENTER POINT:

1. Press: k2 (SET DIMesion)

2. Type: 50 (Or some other number that makes sense in the scale that you are working in.)

3. Press: END LINE

4. Type: J (Puts you in the Jump mode. Same as pressing k11)

5. Type: RIGHT/2,TOP/2
(Places cursor in drawing area.)

6. Press: END LINE

7. Press: k3 (CTR IF H)

8. Press: k10 (CTR IF V)

9. Move the cursor somewhere.

10. Press: k10 (CTR IF V)

11. Press: k3

The line dimension that you set will remain until you change it again.

BOXES:

1. Type: B (or you could have pressed k1, then k5)
2. Move the cursor to the desired lower left corner of the box.
3. Press: k4 (SET LL)
4. Move the cursor to the desired upper right corner of box.
5. Press: k5 (SET UR)

As soon as k5 is pressed, the box is drawn.

6. Press: k7 (MOVE LL)
7. Press: k8 (MOVE UR)
8. Press: k11 (Set height, width.)
9. Type in a box dimension.
10. Move cursor to an open area.
11. Press: k10 (Set CTR)
12. Press: k2 (DRAW from CTR)

SYMBOLS:

This next sequence demonstrates the selection and use of the built in symbols. Symbol options include size, location, rotation, and linetype.

1. Type: S (or press k1 then press k6)
2. Press: k2 (MENU)
3. Press: k2 (SELECT)
4. Type: 2 (selecting a horizontal resistor)
5. Press: END LINE
6. Move cursor to any convenient location.
7. Press: k4 (DRAW SYMBOL)
8.
9.
10. Press: k3 (SET SIZE)
11. Type: 2 (set size to twice normal)
12. Press: END LINE

13. Press: k4 (DRAW SYMBOL)

14. Press: k3 (SET SIZE)

15. Type: .5 (set size to 1/2 normal)

16. Press: END LINE

17. Press: k4 (DRAW SYMBOL)

18. Press: k3 (SET SIZE)

19. Type: 1 (set size to normal)

20. Press: END LINE

21. Press: k4 (DRAW SYMBOL)

22. Press: k6 (PLOT DIRection)

23. Type: 45

24. Press: END LINE

25. Press: k4 (DRAW SYMBOL)

26. Type: 0 (resets plot direction to zero degrees)

Note: You may use the SET PLOT DIRECTION to set the way the arrow keys move. If you do not type 0 (zero) after using the plot direction function, the cursor movement arrows will operate in the direction they normally do plus the setting of the plot direction. For example: If PLOT DIRECTION is set to 180 degrees, the DOWN ARROW will move the cursor UP. The UP ARROW will move the cursor DOWN, etc. This feature is useful for angular cursor movement. Remember to reset the plot direction to zero degrees by simply typing a zero.

TEXT:

1. Type: T (or press k1 then k7)

There are five adjustable parameters associated with CADD/87 text:

1. LORG: Left, center, or right justify text. (9 options)
2. LDIR: (Label Direction) Rotate text 0 to 360 degrees.
3. CSIZE: (Character Size) Any text size.
4. ASPECT: Ratio of text size to text width.
5. SLANT: Text slant in degrees. (-89 to +89 degrees)

To adjust any of these parameters, press softkey k2-k6. The softkey labels always display the current setting.

2. Press: k7 (GRAPHICS)

3. Move the graphics cursor to a convenient spot.

4. Type: T (TEXT MODE)

5. Press: k1 (ENTER TEXT)

6. Type: CADD/87 TEST

7. Press: END LINE

8. Type: T

9. Press: k2 (LORG)

10. Type: 2

11. Press: END LINE

12. Press: k1 (ENTER TEXT)

13. Press: END LINE (use the previous text string again)

14. Type: T

15. Press: k2 (LORG)

16. Type: 8

17. Press: END LINE

18. Press: k1 (ENTER TEXT)

19. Press: END LINE (use the same text string again)

Try all of the text attribute softkeys to see what they can do. After text has been placed on the screen, it's easy to change any of the attributes via the edit functions, explained later.

CIRCLES:

1. Type: C (or press k1 then k8)

The general format for circles is to move the cursor to the center of the circle and press the SET CTR (k4) softkey. Next, move the cursor to any point along the radius and press the SET RADIUS (k5) softkey. The last step is to press the DRAW CIRCLE (k9) softkey.

Notice softkey k10, SET RESOlution. This softkey allows you to set the resolution (or roundness) of the circle. When the program first comes on, the circle resolution is set at 7.5 degrees. Circles made of 45 degree line segments don't look much like circles but they do draw fast. When you want circles to look like circles, set CIRCLE RESOLUTION to 15 or 7.5 degrees.

If you want a partial circle, use softkeys k6 and k7 to specify the start and stop degrees of the circle. Always specify the start

degrees less than the stop degrees. If you are starting at 270 degrees and want to go counterclockwise 180 degrees to 90 degrees, specify 270 for the start degrees and 450 (180+90) for the stop degrees.

You may specify the linetype of the circle by using k8, LINETYPE.

2. Move cursor to a convenient point.

3. Press: k4 (SET CTR)

4. Move cursor to a radius point.

5. Press: k5 (SET RADIus)

6. Press: k9 (DRAW CIRCLE)

POLYGONS:

1. Type: P (or press k1 then k9)

The format for polygons is similar to circles in that you set the center, set the radius, then press the draw polygon softkey. With polygons you may also set the number of sides and rotation.

NOTE: Setting the number of sides of a polygon and setting circle resolution for circles is different. With a polygon, the program always remembers the number of sides and the coordinates of each vertex. With circles, the program does not remember each vertex of the circle. The circle resolution feature is only an aid to speed up redrawing and not a way to use circles in place of polygons.

2. Press: k4 (SET CTR)

3. Move cursor.

4. Press: k5 (SET RADIUS)

5. Press: k9 (DRAW POLYGON)

6. Press: k6 (SIDES)

7. Type: 6

8. Press: END LINE

9. Press: k9 (DRAW POLYGON)

FIND CENTER:

1. Type: F (or press k1 then k10)

2. Move cursor to the first point

3. Press: k4 (SET PT1)

4. Move cursor to second point

5. Press: k5 (SET PT2)

6. Press: k6 (GO CENTER HORIZONTAL)

7. Press: k7 (GO CENTER VERTICAL)

8. Press: k8 (GO HORIZONTAL AND VERTICAL CENTER)

COMMANDS:

1. Type: c (or press k1 then k11)

2. Type: Any alpha-numeric key to continue or
CTRL A for an alpha-dump of CRT screen.

NOTE: You must have an HP or EPSON printer and the PRINTER TYPE and PRINTER ADDRESS set properly in the FORMATS section for the alpha-dump to work correctly.

RE-DRAW:

1. Type: R

You may redraw the entire drawing or any portion of it to the CRT or plotter. If you are zooming, redraw will draw the zoomed area. If you set a redraw window k5 (different than zoom), only the items in the redraw window area will redraw even though many more items might be showing on the CRT.

Softkey k1 EXIT returns you to the graphics display.

Softkey k2 CRT REDRAW first clears the crt then does a crt redraw using the settings of most of the other redraw softkeys. There are many times (for example after setting a zoom window or getting a new file) when the program sends you back to the redraw screen and waits for you to press the CRT REDRAW key.

Softkey k3 CLEAR ZOOM clears both the zoom window and redraw window settings.

Softkey k4 CLEAR GRAPH clears the graphics display but does not clear the computers memory.

Softkey k5 REDRAW WINDOW allows you to set a special redraw area. Only items in this area will redraw when you press CRT REDRAW or PLOT. k5 uses the same routine as zoom to set the area but k5 is different in that the area will not zoom.

Softkey k6 ALL LAYERS is for redrawing all layers or a selected layer. To select a layer, first exit redraw (k1) then press CTRL L. After selecting a layer, press R to get back to redraw. Pressing the ALL LAYERS softkey toggles between ALL LAYERS and the active layer#.

Softkey k7 PLOT redraws to your plotter using most of the other redraw

softkey settings.

Softkey k8 ID ON/OFF is a toggle which turns the CRT's information line on or off during redraw. Redraws are a little faster with the information line off.

Softkey k9 PEN CHANGE ON/OFF is a toggle between manual and automatic pen changing. When ON, the plotter pauses for manual pen changing.

Softkey k10 87/86 TYPE CRT changes the CRT between HP-86 and HP-87 type. Even if using an HP-86 or HP-86B, the prefered way is 87 type. There are low cost CRTs available which provide isotropic scaling for the HP-86 or HP-86B. Contact Tensegrity for more information.

Softkey k11 PRINT MATRIX prints a listing of any sequential range of item#, type, coordinates, pen#, layer#, linetype, and character size for each item within the selected range of items.

Softkey k12 SHOWALL ON/OFF is usually used when zooming. If OFF, only the items within the zoom window will redraw. Items which start outside the window but pass through do not draw with SHOWALL OFF. With SHOWALL ON, items passing through the window will also draw. The default is SHOWALL ON.

Softkey k14 SET PLOTTER is for setting a new plotter address, and/or changing the plotter's pen speed, and/or changing plotter limits.

2. Press: k2 (CRT REDRAW)

3. Type: R

4. Press: k7 (SETplotter)

5. Type: 705 (or whatever your plotter's address is)

6. Press: END LINE

7. Press: END LINE (Use default plot speed)

8. Press: END LINE (Use standard plot limits)

9. Prepare your plotter.

10. Press: k7 (PLOT)

11. Observe and follow any pen change prompts.

12. Type: R

13. Press: k5 (REDRAW WINDOW)

14. Move cursor to the lower left corner of the area you wish to redraw.

15. Press: k4 (SET_LL)

16. Move cursor to the upper right corner of the area you wish to redraw.

17. Press: k2 (DO ZOOM)

18. Press: k4 (clearGRAPH) This is optional, but try it now.

19. Press: k2 (CRT REDRAW)

20. Type: R

21. Press: k3 (CLEAR ZOOM)

22. Press: k2 (CRT REDRAW)

23. Type: R

24. Press: k1 (EXIT)

JUMP:

The jump routine allows you to position the graphics cursor by either of two ways. The first way is to specify the horizontal and vertical coordinates. You may enter numbers, variables, or expressions. The form is horizontal, comma, vertical.

The second possibility for jump is to specify an item number. To do this, press END LINE in response to the H & V location prompt. By pressing END LINE, the program branches to another routine that tells you how many items there are and asks you to enter an item number.

1. Type: J

2. Type: 1,1 (Or any cordinates within your user units.)

3. Press: END LINE

4. Type: J

5. Type: RIGHT/2, TOP/2

6. Press: END LINE

7. Type: J

8. Press: END LINE

9. Type: 1

10. Press: END LINE

EDIT:

1. Type: E

Under the general heading of EDIT, there are both group edits and single item edits. The edit functions allow you to alter attributes, move, replicate, rotate, scale, or delete an item or group of items.

A single item edit will be explained first.

SINGLE ITEM EDITS:

In order to EDIT an item, you must first locate it. There are a few ways.

1. Use ROLL & SHIFT ROLL.
2. If a group is active, use + & -.
3. If you know the item's number, Press: k3 SET ITEM NUMBER.
4. Use k4 SEARCH.

   To use SEARCH, move the cursor near the item in question then press k4 SEARCH. The located item will be erased then redrawn over and over until you press one the flashing softkeys. The flashing softkeys are to:

   k1 EXIT the search.
   k2 LOCATE the cursor at the found item.
   k5 FIND NEXT item within the search window.
   k6 MOVE the located item.
   k7 DELETE the located item.

   You must press the appropriate softkey when its flashing label is displayed.

Once an item is located press (k5) EDIT ITEM or (k2) ATTRIBUTES.

Use k5 to move or delete the item.

Use k2 to move or alter the item's attributes. For example linetype, text size, text slant, plot direction, etc. are attributes that might need changing.

By pressing k2 ATTRIBUTES, all of the item's attributes will be displayed along with a set of softkeys so that you can edit any of them.

GROUP EDITS:

If you need to do anything involving a group of items, press k6, GROUPS.

If the group has not yet been defined, press k1 SET GROUP.

EDIT/GROUPS/SET GROUP MENU:

When in the SET GROUP menu, first select one of the eight possible groups by pressing k1 GROUP# until the desired group number is displayed in the keylabel.

Next define the group's area by using k2 and k3 to set the lower left and upper right corners of the group.

Next press k4 PUT GROUP to actually command the system to put the items within the group window into the group.

You can snap the cursor to an item outside the group window and add that item to the group by pressing k5 ADD ITEM.

You can clear all items from a group by pressing k6 CLEAR GROUP.

You can return to the previous EDIT/ GROUPS menu by pressing k7 EXIT.

EDIT/GROUPS MENU:

To delete a group of items press k12 DO DELETE.

To scale a group press k6 SET SCALE then press k12 DO SCALE.

To rotate a group press k5 SET ROTATE then k11 DO ROTATE.

To move or replicate a group, do the following.

> Locate the cursor at any convenient point to serve as a reference point. Press k3 SET REFERENCE. Next, move the cursor away from the reference point the same distance you wish the group to be moved or replicated at. This new point is known as the offset point (The offset point can be any direction from the reference point). When the cursor is at the offset point press k4 SET OFFSET. The only thing left to do is press k10 DO MOVE or k14 DO REPLICATE.

RUB LAST:

Press: k13 (RUB LAST)

The last item drawn will be erased. If you press k13 again, another item will be erased.

INCREMENT:

1. Press: k14 (INCREMENT)

The increment routine sets whatever increment you want the cursor to move in.

2. Type: desired increment

3. Press: END LINE

***** k2 FILES *****

1. Press: k2 (FILES)

catalog:

1. Press: k4 (catalog)

The catalog function will display a catalog of what is on a disc. It also lets you select which disc drive. If you want a catalog of the currently active disc drive, press END LINE in response to the CRT prompt. If you want a catalog of a different drive, type the drive's mass storage unit specifier or volume label in response to the prompt as illustrated on the CRT.

2. Press: END LINE

SAVEFILE:

1. Press: k5 (SAVEFILE)

2. Type: TEST1

3. Press: END LINE

4. Type: :D700 (Simply press end line if drive 0 is active)

5. Press: END LINE (File gets saved now)

GET FILE:

With the GET FILE routine, you may add the new file to any existing items in the computer's memory or first clear memory then bring in the file.

GET FILE is also used to bring user defined symbols from mass storage to the drawing.

1. Press: k2 (FILES)

2. Press: k5 (GET FILE)

3. Type: TEST1 (or your own file name)

4. Press: END LINE

5. Press: END LINE (Default disc drive)

6. Type: CM (Clear drawing from memory)

7. Press: END LINE

8. Press: k2 (CRT REDRAW)

DiscFree:

1. Press: k7 (DiscFree)

2. Type: Any alpha-numeric key to continue

DiscFree checks the default mass storage unit. Use the catalog softkey to set the default mass storage unit.

GSTORE:

Store a bit-mapped image of CRT to disc file (used in conjunction with k9, GLOAD). Large files take time to redraw, even to the CRT. In order to save time, do a GSTORE of the CRT whenever you do a SAVEFILE. The next time you work on the file, do a GETFILE but don't redraw it. Use GLOAD instead. To just look at a drawing, use GLOAD alone.

1. Press: k2 (FILES)

2. Press: k8 (GSTORE)

3. Type: TEST1-G (or any filename)

4. Wait for disc light to go off.

GLOAD:

So that you can see GLOAD work, we're going to first clear the graphics display.

1. Type: R (Redraw softkeys)

2. Press: k4 (ClearGRAPH)

3. Press: k1 (Graphics)

4. Press: k2 (FILES)

5. Press: k9 (GLOAD)

6. Type: TEST1-G (or whatever filename previously used with GSTORE)

7. Press: END LINE

***** k3 KEYS SET 3 *****

1. Press: k3 (KEYS SET 3)

CHANGEgcurs: (change graphics cursor type)

1. Press: k3 (CHANGEgcurs)

2. Press: k3 (change back to original cursor type)

MOVpltr: (move plotter's pen to position of CRT graphics cursor)

1. Press: k4 (MOVpltr) same as typing: m

PEN:

You may select which pen your plotter uses by pressing CTRL P. If you have a single pen plotter, when plotting the program can stop and prompt you when a pen change is necessary. When you select a pen, that selection remains in effect and assigns that pen number to each item you draw until another pen is selected. There is a softkey in the redraw menu which turns automatic pen changing on and off.

1. Press: k5 (PEN)

2. Enter a pen number.

3. Press: END LINE

STEP+: (the same as pressing the ROLL key)

1. Press: k6 (STEP+)

STEP-: (the same as pressing the SHIFT ROLL key)

1. Press: k7 (STEP-)

DIGITIZE: (the same as typing: d)

The digitize function moves the graphics cursor to where the plotter's pen is. DIGITIZE (d) is the opposite of MOVpltr (m).

1. Press: k8 (DIGITIZE)

2. Press the enter button on your plotter.

SETscale or CTRL Z: (to reset user units)

1. Press: k3 (KEYS SET 3)

2. Press: k9 (SETscale)

3. Follow CRT prompts.

6. Press: k2 (CRT REDRAW)

Zoom:

Zoom is used to expand any part of the drawing to the full size of your CRT. To work in the zoomed area, press the CRT REDRAW key in the redraw menu when zoom returns you to the redraw menu. You may plot the zoomed area by pressing the PLOT softkey. To clear the zoomed area, press the CLEAR ZOOM softkey in the redraw menu or press the UN-ZOOM softkey in the Zoom menu.

Whenever you zoom an area, the items in that area are automatically placed into group#8 and the active group is set to #8. To snap the

cursor to the various items in the zoomed area, use the plus and minus keys (see + & -).

Formats:

The format function allows you to edit a file on the program disc called Formats. The format file contains your system's default plotter and printer addresses and your printer type.

To use Formats, simply press the Format softkey. After the format softkeys appear, make any changes necessary and then press either the SAVE FORMAT key or the EXIT key.

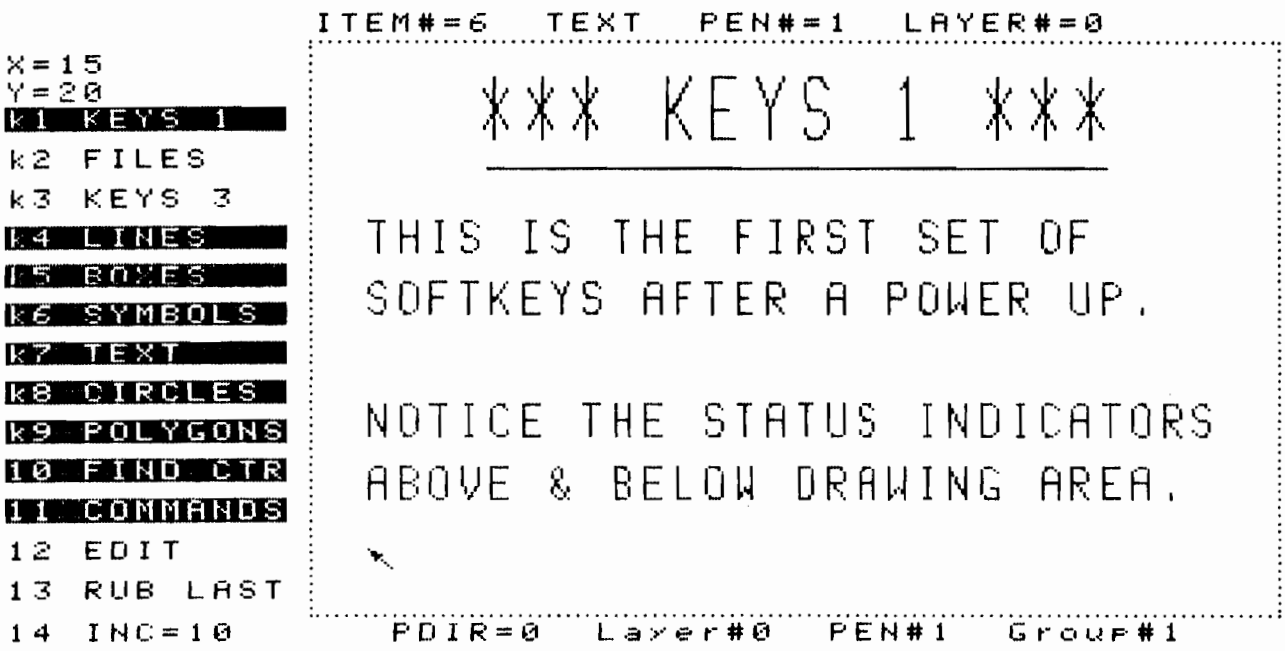
SAVE FORMAT will update the disc file so that the next time you load CADD/86-87, the new formats will be used.

The EXIT softkey changes the current formats but does not update the disc file.

Be sure the program disc is in any one of your disc drives before storing a new format with the SAVE FORMAT softkey.

Auto-dimension:

To use auto-dimension, locate the graphics cursor at one of the points to be dimensioned. Press k4 SET PT1. Next locate the cursor on the other point and press k5 SET PT2. Next move the cursor to the general area that you wish the text to be drawn. Press k6 SetTXTpt3. Finally press k7 Do DIMENSION. Extension lines, arrows, and text will automatically be centered and drawn. To erase any auto-dimension components, use the rub last key a number of times or any of the other edit functions.


ITEM#=6 TEXT PEN#=1 LAYER#=0
X=15
Y=20
k1 KEYS 1
k2 FILES
k3 KEYS 3
k4 LINES
k5 BOXES
k6 SYMBOLS
k7 TEXT
k8 CIRCLES
k9 POLYGONS
10 FIND CTR
11 COMMANDS
12 EDIT
13 RUB LAST
14 INC=10
*** KEYS 1 ***
THIS IS THE FIRST SET OF SOFTKEYS AFTER A POWER UP.
NOTICE THE STATUS INDICATORS ABOVE & BELOW DRAWING AREA.
PDIR=0 Layer#0 PEN#1 Group#1

ITEM#=2 LINE PEN#=1 LAYER#=0

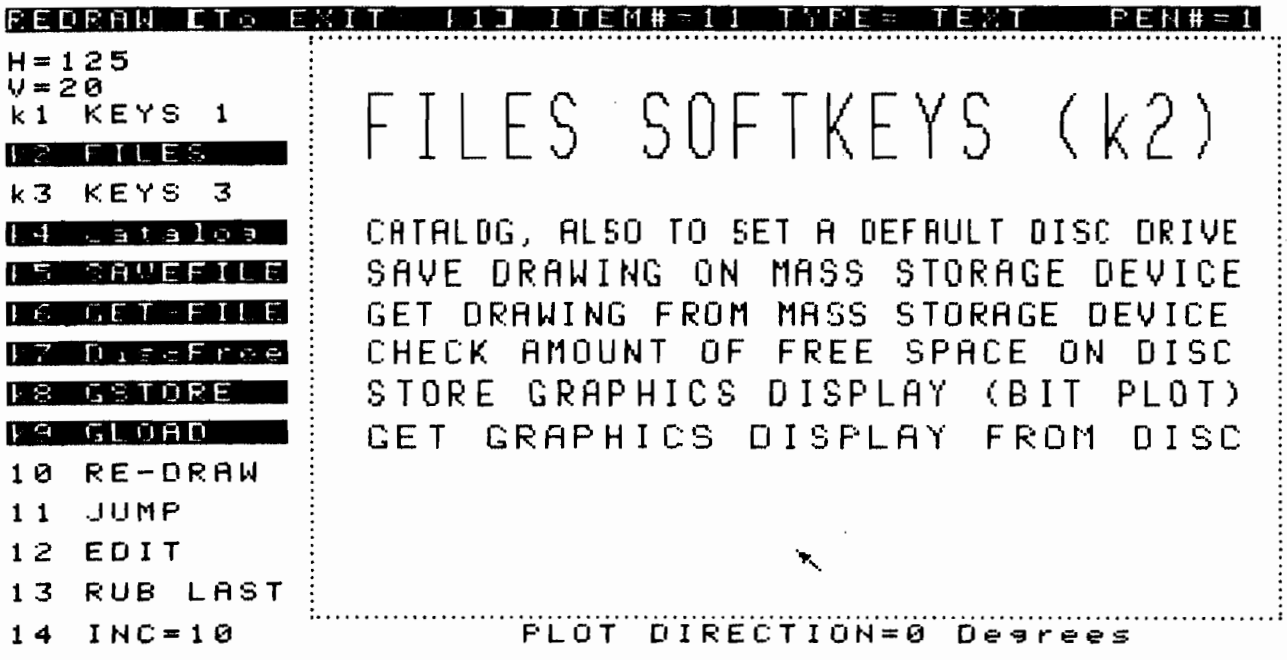
X=15
Y=10
k1 KEYS 1
k2 FILES
k3 KEYS 3
k4 catalog
k5 SAVEFILE
k6 GET-FILE
k7 DiscFree
k8 GSTORE
k9 GLOAD
10 RE-DRAW
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10

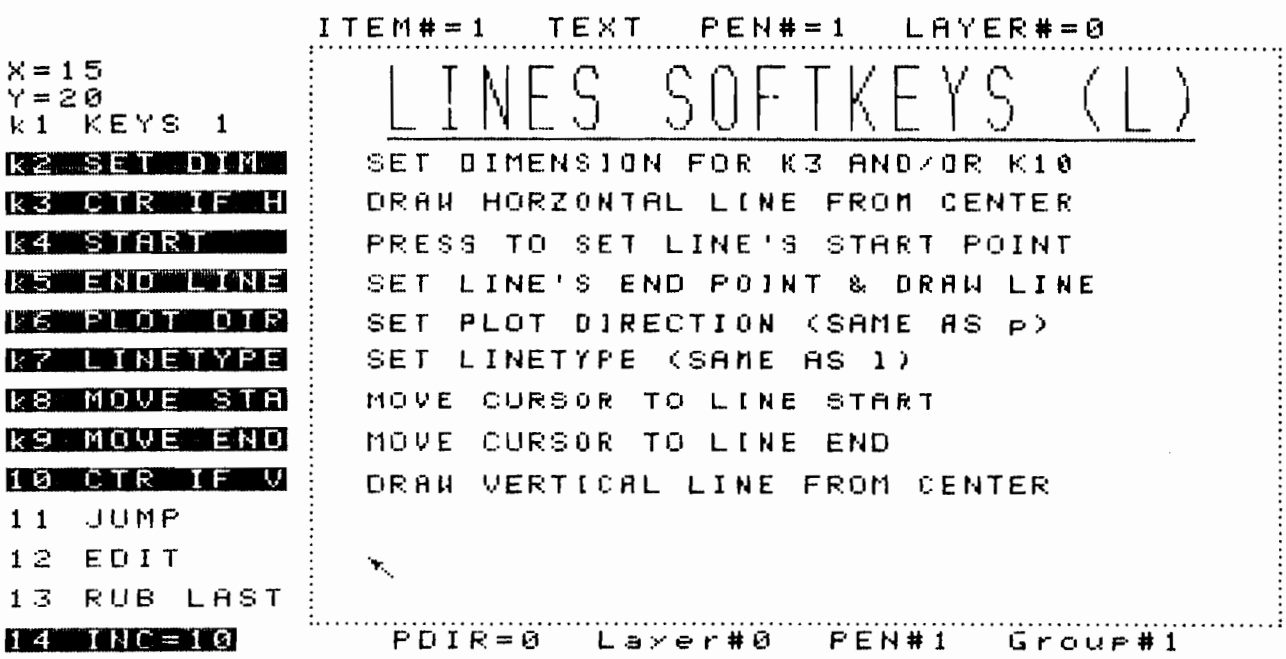
FILES SOFTKEYS

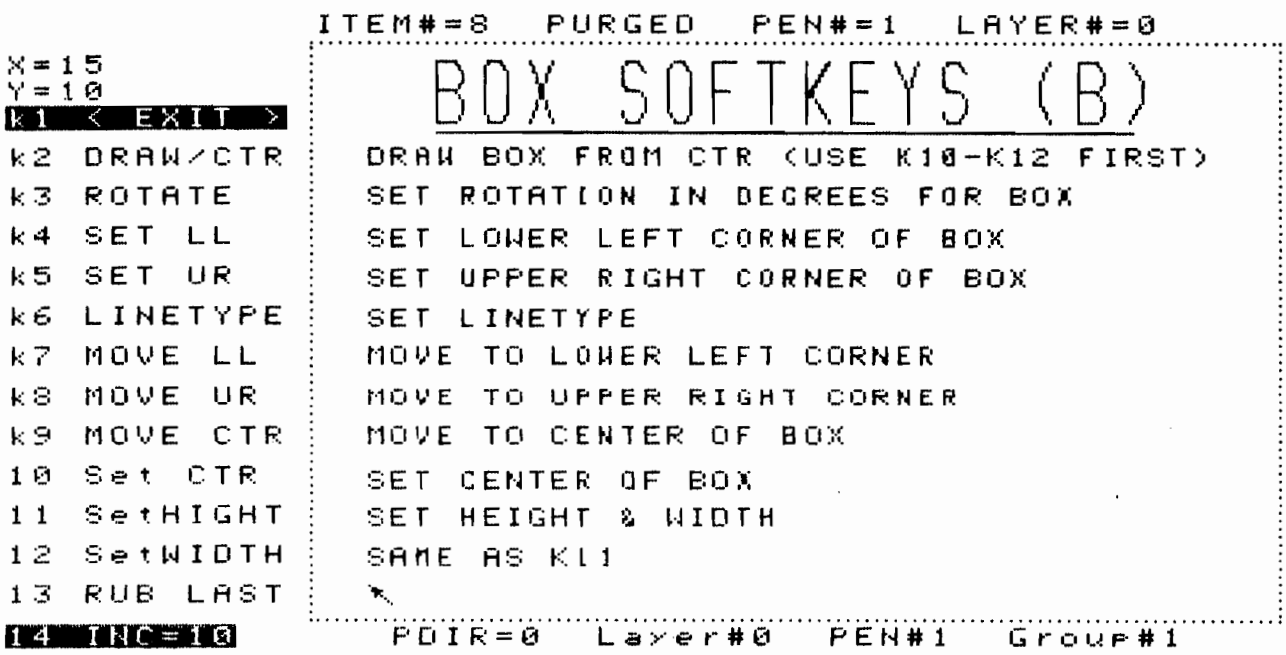
THE STATUS INDICATORS ABOVE DRAWING AREA RELATE TO THE CURRENT ITEM.

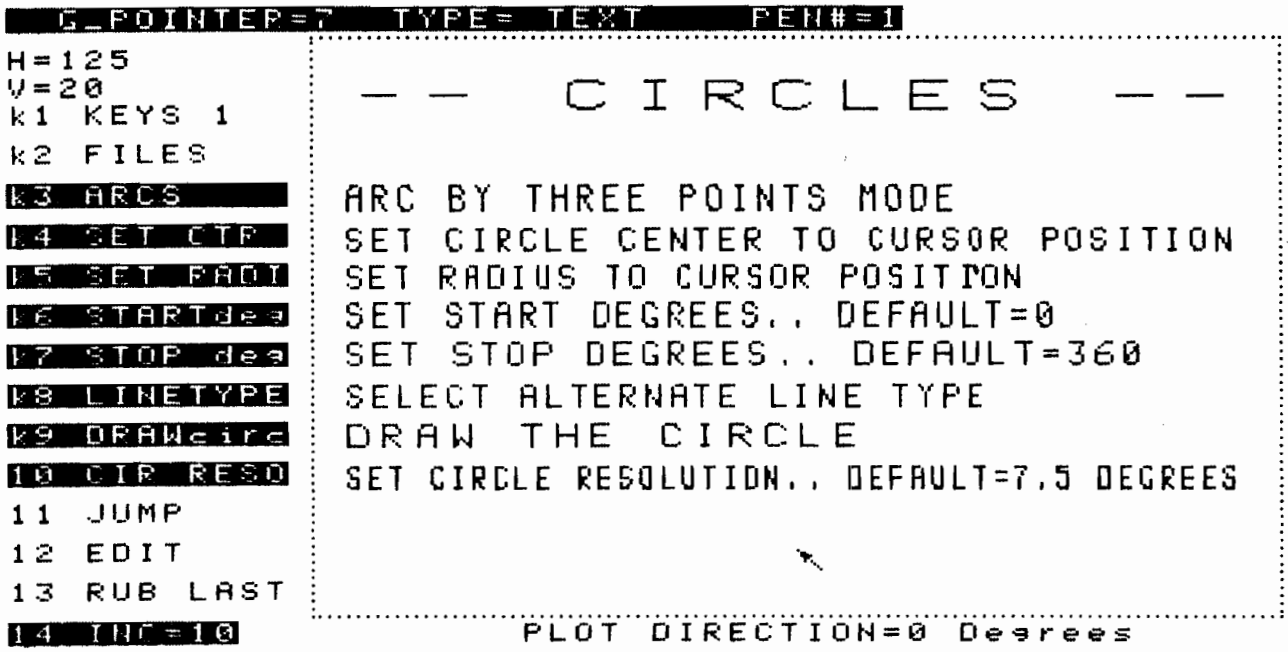
STATUS INDICATORS BELOW ARE GLOBAL SETTINGS.

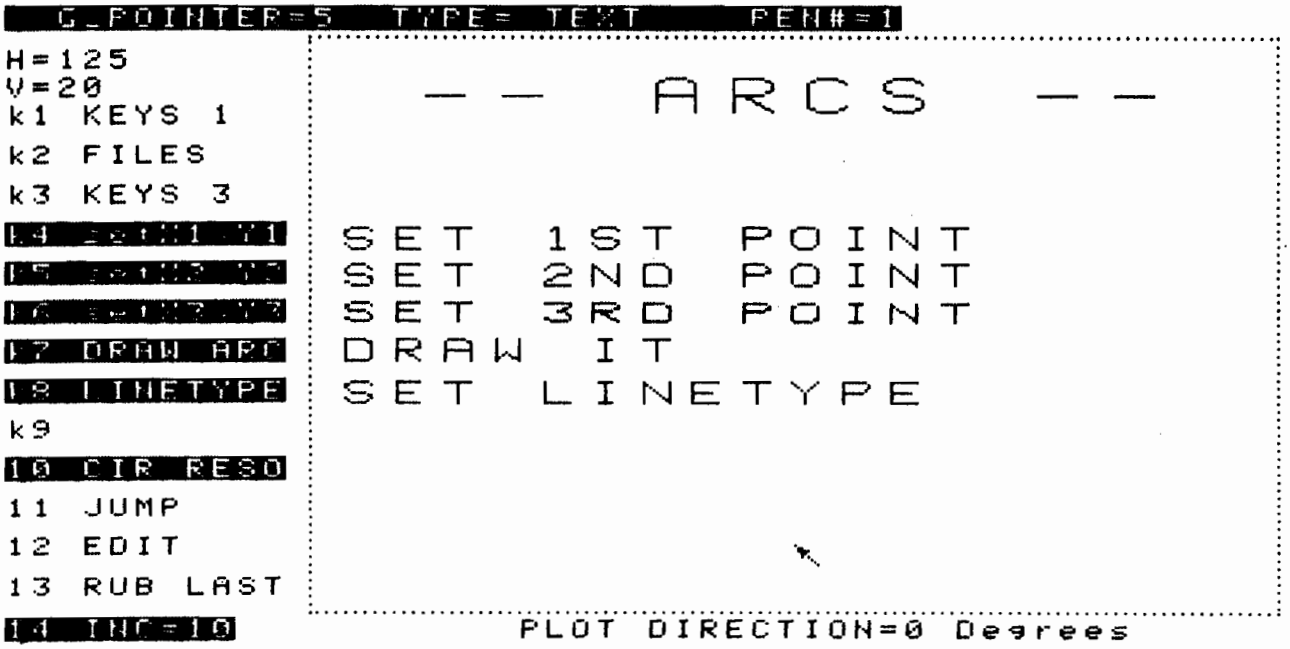
PDIR=0 Layer#0 PEN#1 Group#1

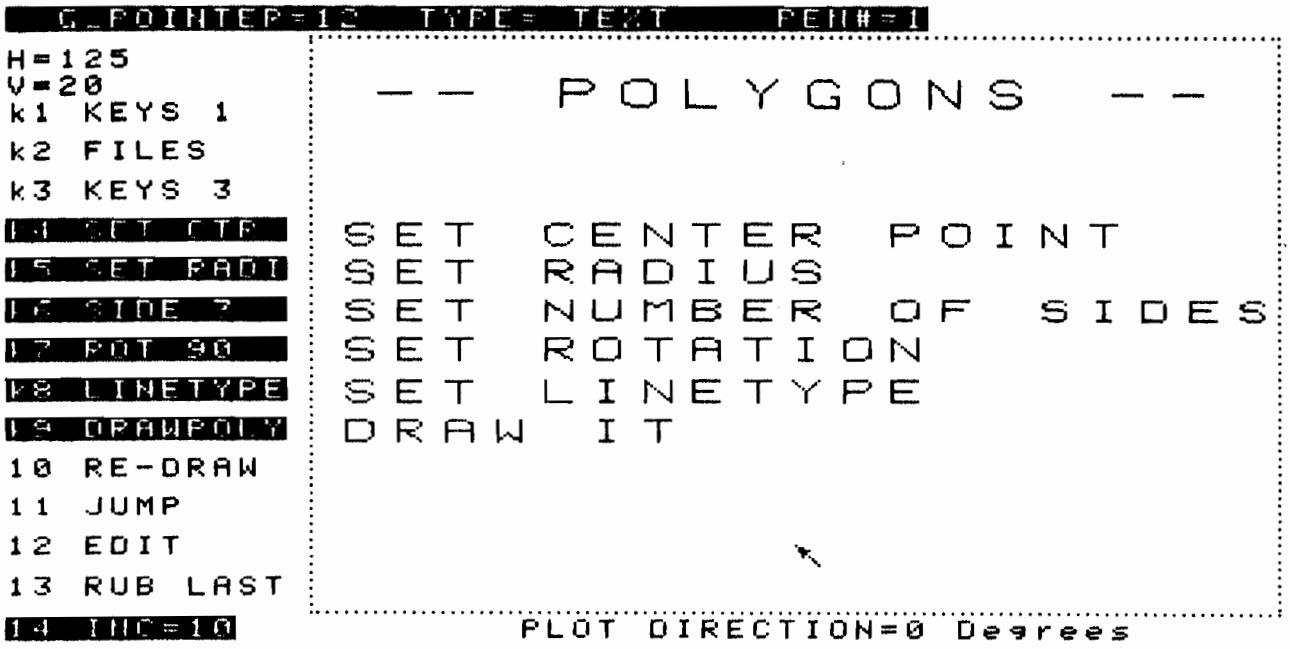

REDRAW [To EXIT [11] ITEM#=11 TYPE= TEXT PEN#=1
H=125
V=20
k1 KEYS 1
k2 FILES
k3 KEYS 3
k4 Catalog
k5 SAVEFILE
k6 GET-FILE
k7 DiscFree
k8 GSTORE
k9 GLOAD
10 RE-DRAW
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10
FILES SOFTKEYS (k2)
CATALOG, ALSO TO SET A DEFAULT DISC DRIVE
SAVE DRAWING ON MASS STORAGE DEVICE
GET DRAWING FROM MASS STORAGE DEVICE
CHECK AMOUNT OF FREE SPACE ON DISC
STORE GRAPHICS DISPLAY (BIT PLOT)
GET GRAPHICS DISPLAY FROM DISC
PLOT DIRECTION=0 Degrees

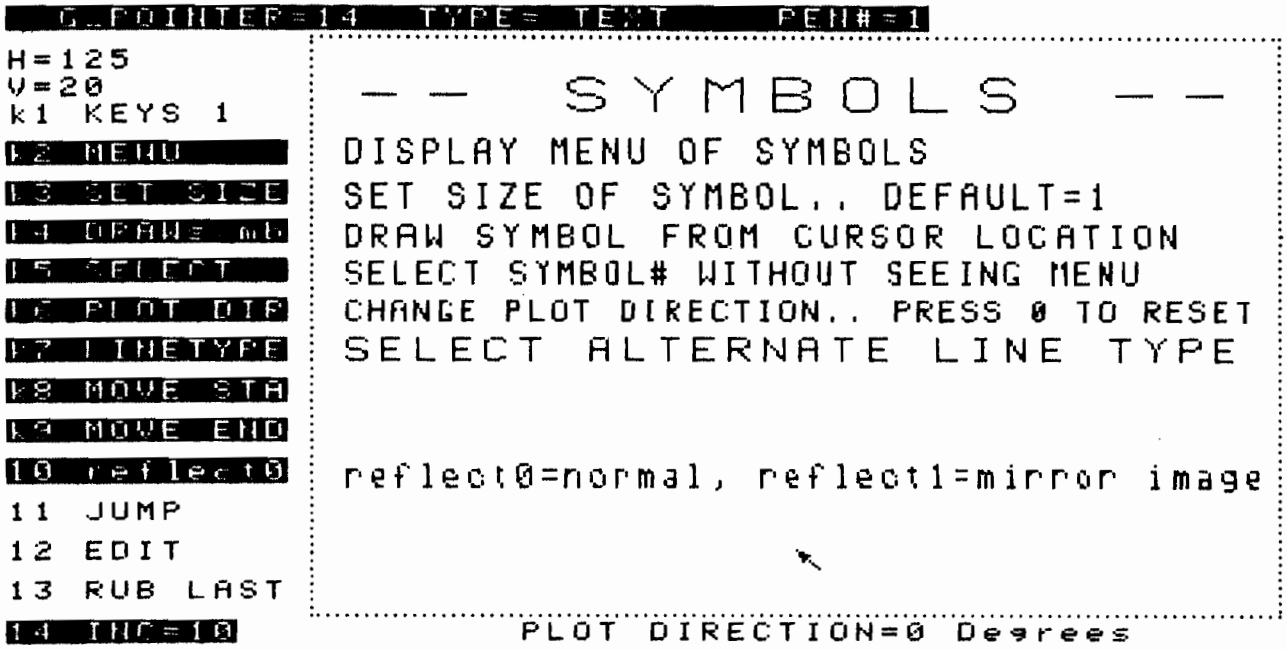

ITEM#=1 TEXT PEN#=1 LAYER#=0
X=15
Y=20
k1 KEYS 1
k2 SET DIM
k3 CTR IF H
k4 START
k5 END LINE
k6 PLOT DIR
k7 LINETYPE
k8 MOVE STA
k9 MOVE END
10 CTR IF V
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10
LINES SOFTKEYS (L)
SET DIMENSION FOR K3 AND/OR K10
DRAW HORZONTAL LINE FROM CENTER
PRESS TO SET LINE'S START POINT
SET LINE'S END POINT & DRAW LINE
SET PLOT DIRECTION (SAME AS p)
SET LINETYPE (SAME AS 1)
MOVE CURSOR TO LINE START
MOVE CURSOR TO LINE END
DRAW VERTICAL LINE FROM CENTER
PDIR=0 Layer#0 PEN#1 Group#1

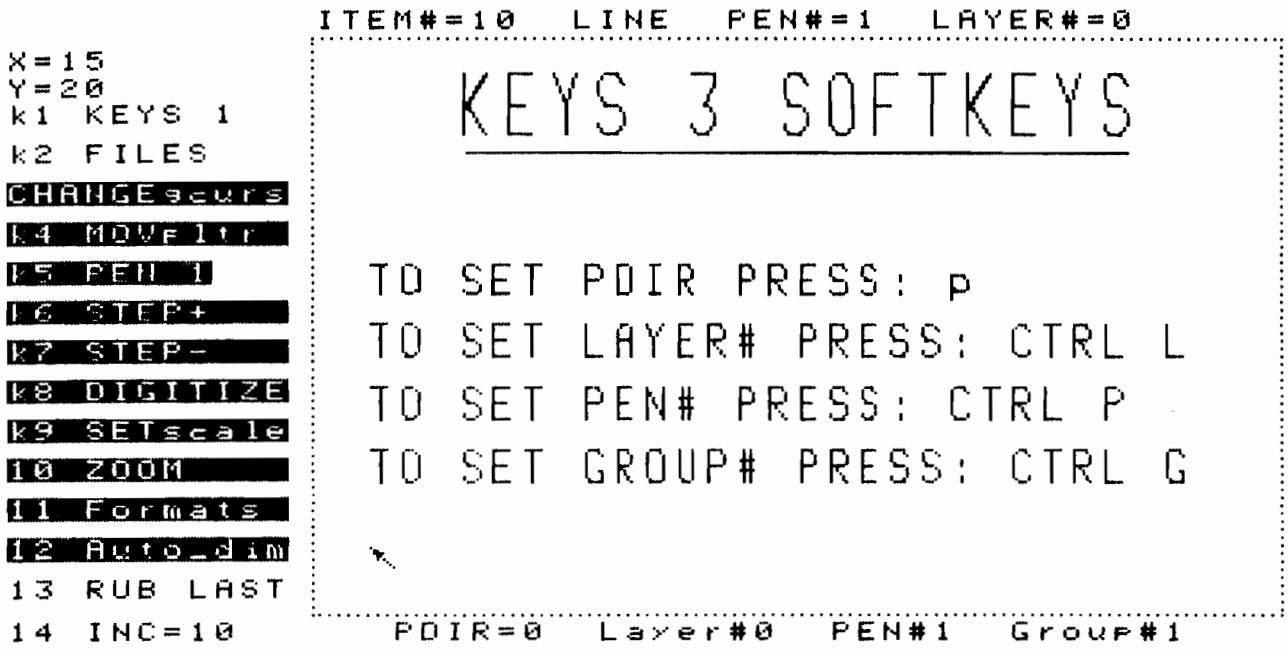

ITEM#=8 PURGED PEN#=1 LAYER#=0
X=15
Y=10
k1 < EXIT >
k2 DRAW/CTR
k3 ROTATE
k4 SET LL
k5 SET UR
k6 LINETYPE
k7 MOVE LL
k8 MOVE UR
k9 MOVE CTR
10 Set CTR
11 SetHIGHT
12 SetWIDTH
13 RUB LAST
14 INC=10
BOX SOFTKEYS (B)
DRAW BOX FROM CTR (USE K10-K12 FIRST)
SET ROTATION IN DEGREES FOR BOX
SET LOWER LEFT CORNER OF BOX
SET UPPER RIGHT CORNER OF BOX
SET LINETYPE
MOVE TO LOWER LEFT CORNER
MOVE TO UPPER RIGHT CORNER
MOVE TO CENTER OF BOX
SET CENTER OF BOX
SET HEIGHT & WIDTH
SAME AS K11
PDIR=0 Layer#0 PEN#1 Group#1

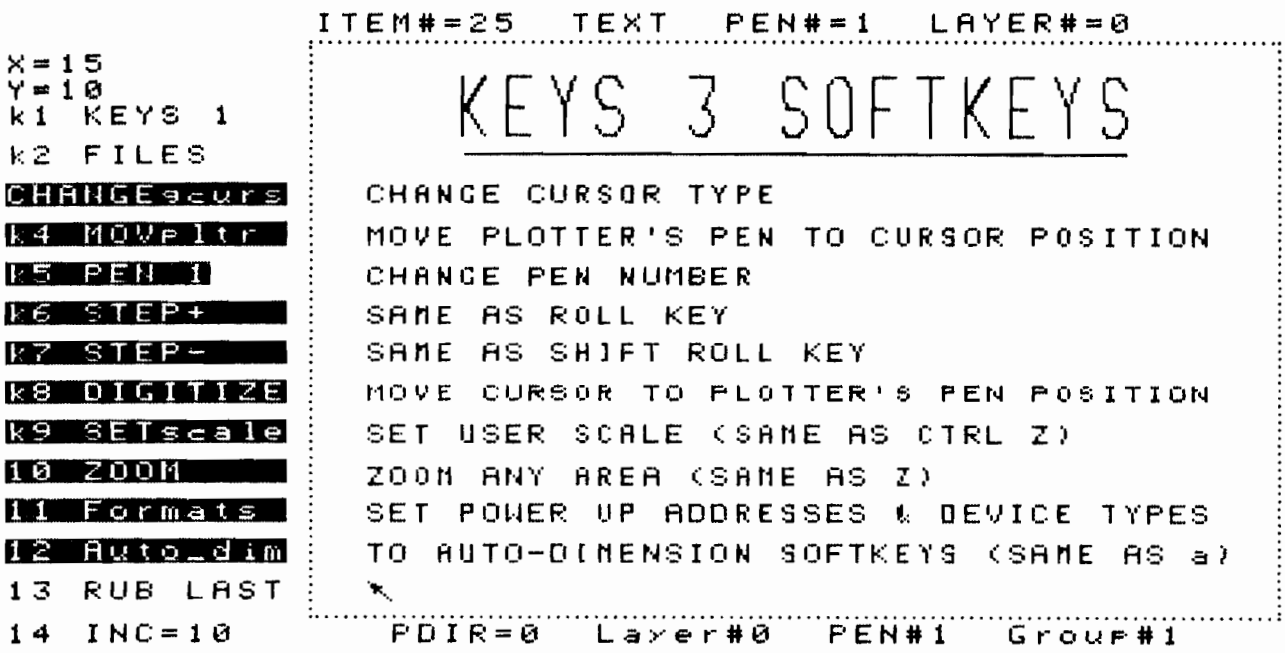

G_POINTER=7 TYPE= TEXT PEN#=1
H=125
V=20
k1 KEYS 1
k2 FILES
k3 ARCS
k4 SET CTR
k5 SET RADI
k6 STARTdeg
k7 STOP deg
k8 LINETYPE
k9 DRAWcirc
10 CIR RESO
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10
-- CIRCLES --
ARC BY THREE POINTS MODE
SET CIRCLE CENTER TO CURSOR POSITION
SET RADIUS TO CURSOR POSITION
SET START DEGREES.. DEFAULT=0
SET STOP DEGREES.. DEFAULT=360
SELECT ALTERNATE LINE TYPE
DRAW THE CIRCLE
SET CIRCLE RESOLUTION.. DEFAULT=7.5 DEGREES
PLOT DIRECTION=0 Degrees


G_POINTER=5 TYPE= TEXT PEN#=1
H=125
V=20
k1 KEYS 1
k2 FILES
k3 KEYS 3
k4 X1 Y1
k5 X2 Y2
k6 X3 Y3
k7 DRAW ARC
k8 LINETYPE
k9
10 CIR RESO
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10
-- ARCS --
SET 1ST POINT
SET 2ND POINT
SET 3RD POINT
DRAW IT
SET LINETYPE
PLOT DIRECTION=0 Degrees

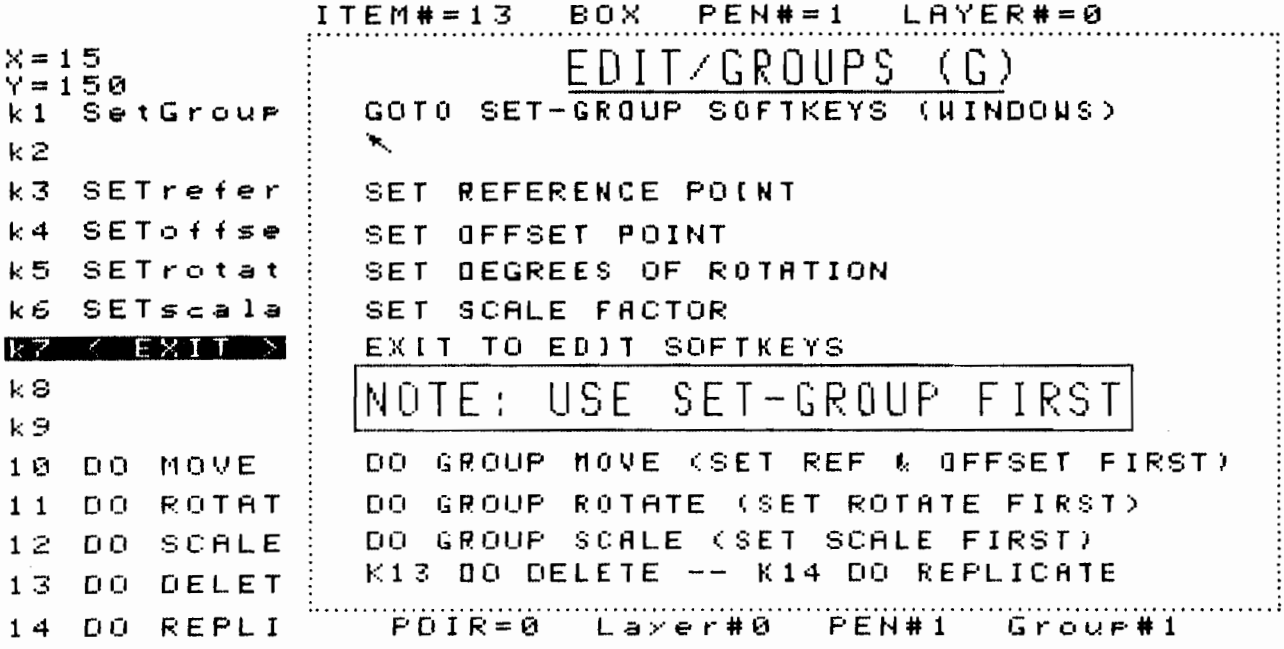

C_POINTER=12 TYPE= TEXT PEN#=1
H=125
V=20
k1 KEYS 1
k2 FILES
k3 KEYS 3
f4 SET CTR
f5 SET RADI
f6 SIDE ?
f7 ROT 90
f8 LINETYPE
f9 DRAWPOLY
10 RE-DRAW
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10
-- POLYGONS --
SET CENTER POINT
SET RADIUS
SET NUMBER OF SIDES
SET ROTATION
SET LINETYPE
DRAW IT
PLOT DIRECTION=0 Degrees

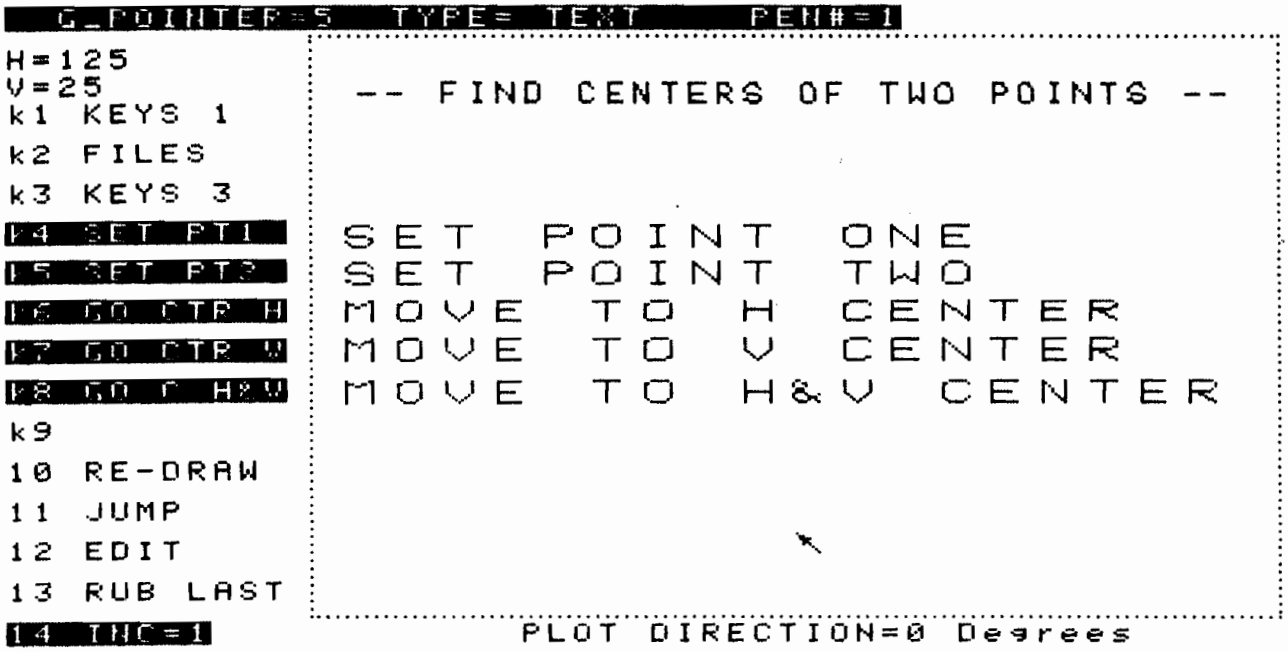

G_POINTER=14 TYPE= TEXT PEN#=1
H=125
V=20
k1 KEYS 1
f2 MENU
f3 SET SIZE
f4 DRAW= mb
f5 SELECT
f6 PLOT DIR
f7 LINETYPE
f8 MOVE STA
f9 MOVE END
10 reflect0
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10
-- SYMBOLS --
DISPLAY MENU OF SYMBOLS
SET SIZE OF SYMBOL.. DEFAULT=1
DRAW SYMBOL FROM CURSOR LOCATION
SELECT SYMBOL# WITHOUT SEEING MENU
CHANGE PLOT DIRECTION.. PRESS 0 TO RESET
SELECT ALTERNATE LINE TYPE
reflect0=normal, reflect1=mirror image
PLOT DIRECTION=0 Degrees


ITEM#=10 LINE PEN#=1 LAYER#=0
X=15
Y=20
k1 KEYS 1
k2 FILES
CHANGEscurs
k4 MOVFltr
k5 PEN 1
k6 STEP+
k7 STEP-
k8 DIGITIZE
k9 SETscale
10 ZOOM
11 Formats
12 Auto_dim
13 RUB LAST
14 INC=10
KEYS 3 SOFTKEYS
TO SET PDIR PRESS: p
TO SET LAYER# PRESS: CTRL L
TO SET PEN# PRESS: CTRL P
TO SET GROUP# PRESS: CTRL G
PDIR=0 Layer#0 PEN#1 Group#1


ITEM#=25 TEXT PEN#=1 LAYER#=0
X=15
Y=10
k1 KEYS 1
k2 FILES
CHANGEcurs
k4 MOVpltr
k5 PEN 1
k6 STEP+
k7 STEP-
k8 DIGITIZE
k9 SETscale
10 ZOOM
11 Formats
12 Auto_dim
13 RUB LAST
14 INC=10
KEYS 3 SOFTKEYS
CHANGE CURSOR TYPE
MOVE PLOTTER'S PEN TO CURSOR POSITION
CHANGE PEN NUMBER
SAME AS ROLL KEY
SAME AS SHIFT ROLL KEY
MOVE CURSOR TO PLOTTER'S PEN POSITION
SET USER SCALE (SAME AS CTRL Z)
ZOOM ANY AREA (SAME AS Z)
SET POWER UP ADDRESSES & DEVICE TYPES
TO AUTO-DIMENSION SOFTKEYS (SAME AS a)
PDIR=0 Layer#0 PEN#1 Group#1

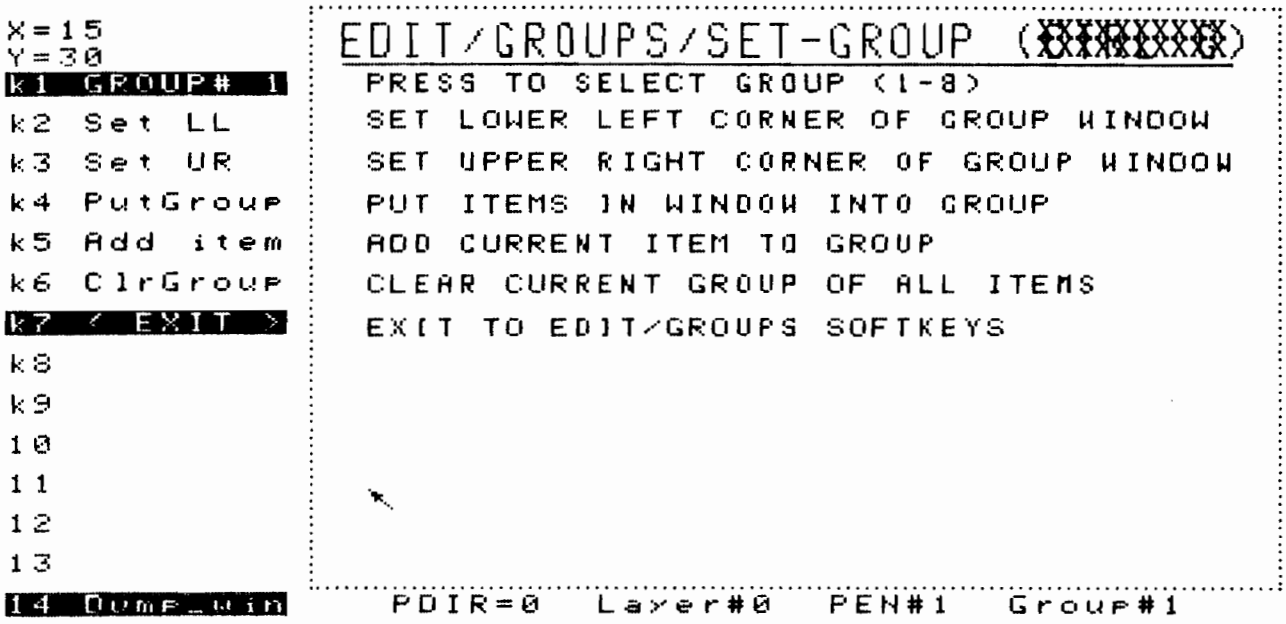
```
                                ITEM#=24   TEXT   PEN#=1   LAYER#=0
X=15
Y=20
k1 KEYS 1                       EDIT SOFTKEYS (E)
k2 attribut                     CHANGE THE CURRENT ITEM'S ATTRIBUTES
k3 SET item#                    IF KNOWN YOU MAY ENTER ITEM# TO EDIT
k4 SEARCH                       SEARCH FOR ITEM NEAR CURSOR
k5 EDIT item                    MOVE OR DELETE CURRENT ITEM
k6 <GROUPS>                     GOTO EDIT/GROUP SOFTKEYS
k7 PACK                         ELIMINATE PURGED ITEM LOCATIONS
k8
k9                              NOTE: ATTRIBUTES (K2) IS A GOOD WAY TO
10 RE-DRAW                      MAKE CHANGES WITHOUT REDRAWING ITEM.
11 JUMP
12 EDIT                         ↖
13 RUB LAST
14 INC=10                         PDIR=0   Layer#0   PEN#1   Group#1
```


ITEM#=13 BOX PEN#=1 LAYER#=0
X=15
Y=150
k1 SetGroup
k2
k3 SETrefer
k4 SEToffse
k5 SETrotat
k6 SETscala
k7 < EXIT >
k8
k9
10 DO MOVE
11 DO ROTAT
12 DO SCALE
13 DO DELET
14 DO REPLI
EDIT/GROUPS (G)
GOTO SET-GROUP SOFTKEYS (WINDOWS)
SET REFERENCE POINT
SET OFFSET POINT
SET DEGREES OF ROTATION
SET SCALE FACTOR
EXIT TO EDIT SOFTKEYS
NOTE: USE SET-GROUP FIRST
DO GROUP MOVE (SET REF & OFFSET FIRST)
DO GROUP ROTATE (SET ROTATE FIRST)
DO GROUP SCALE (SET SCALE FIRST)
K13 DO DELETE -- K14 DO REPLICATE
POIR=0 Layer#0 PEN#1 Group#1


G_POINTER=5 TYPE= TEXT PEN#=1
H=125
V=25
k1 KEYS 1
k2 FILES
k3 KEYS 3
f4 SET PT1
f5 SET PT2
f6 GO CTR H
f7 GO CTR V
f8 GO C H&V
k9
10 RE-DRAW
11 JUMP
12 EDIT
13 RUB LAST
14 INC=1
-- FIND CENTERS OF TWO POINTS --
SET POINT ONE
SET POINT TWO
MOVE TO H CENTER
MOVE TO V CENTER
MOVE TO H&V CENTER
PLOT DIRECTION=0 Degrees

For the latest version of this menu press: W

After using this menu press: G (to do group operations)

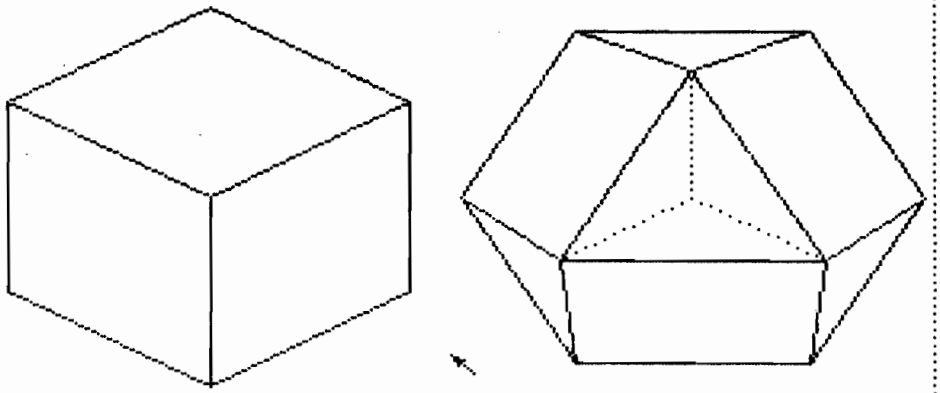


REDRAW [T= EXIT [1] ITEM#=51 TYPE= TEXT PEN#=1

H=125
V=40

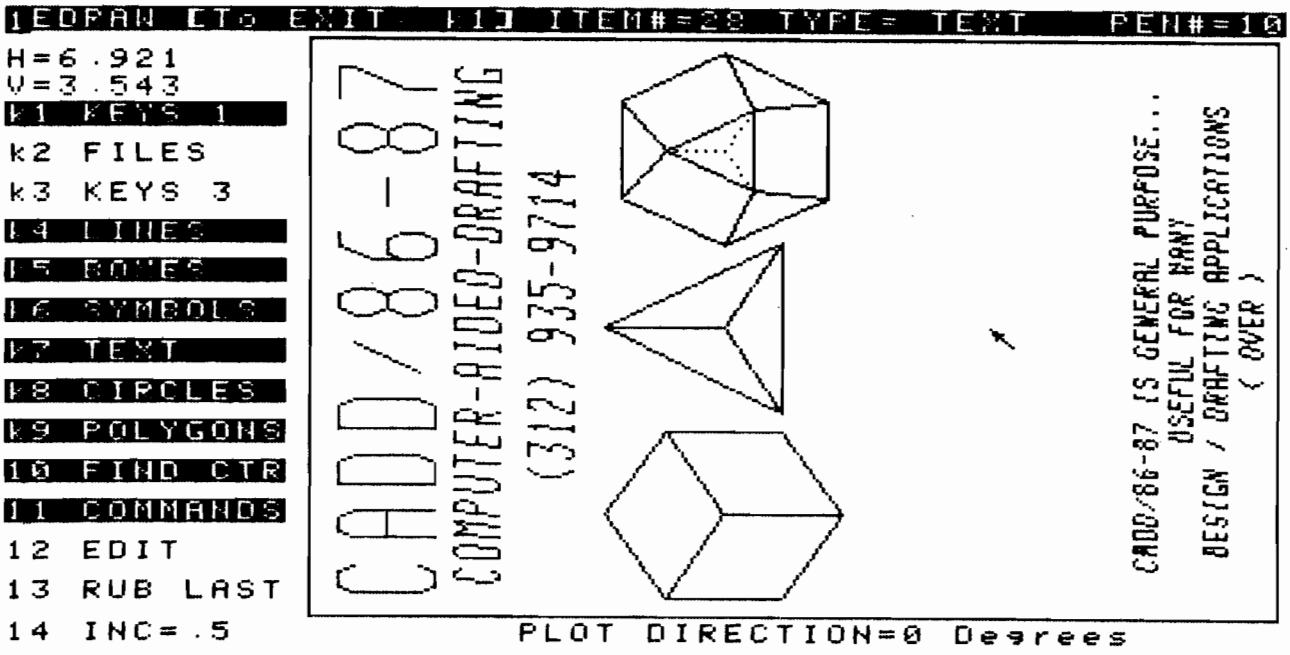
F1 KEYS 1
k2 FILES
k3 KEYS 3
F4 LINES
F5 BOXES
F6 SYMBOLS
F7 TEXT
F8 CIRCLES
k9 POLYGONS
10 FIND CTR
11 COMMANDS
12 EDIT
13 RUB LAST
14 INC=10

CADD/86-87 2D DRAFTING



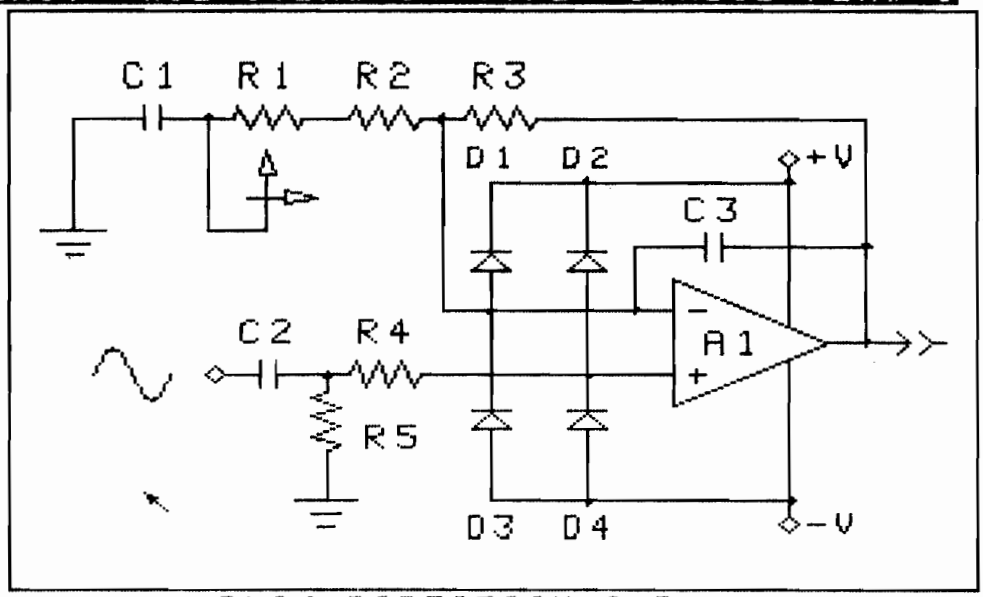
COMPUTER DRAFTING BY TENSEGRITY INC.

PLOT DIRECTION=0 Degrees


[EDPAN [to EXIT [1] ITEM#=20 TYPE= TEXT PEN#=10
H=6.921
V=3.543
k1 KEYS 1
k2 FILES
k3 KEYS 3
k4 LINES
k5 BOXES
k6 SYMBOLS
k7 TEXT
k8 CIRCLES
k9 POLYGONS
10 FIND CTR
11 COMMANDS
12 EDIT
13 RUB LAST
14 INC=.5
CADD/86-87
COMPUTER-AIDED-DRAFTING
(312) 935-9714
CADD/86-87 IS GENERAL PURPOSE...
USEFUL FOR MANY
DESIGN / DRAFTING APPLICATIONS
(OVER)
PLOT DIRECTION=0 Degrees

REDRAW [To EXIT: k1] ITEM#=84 TYPE= SYMBOL PEN#=1

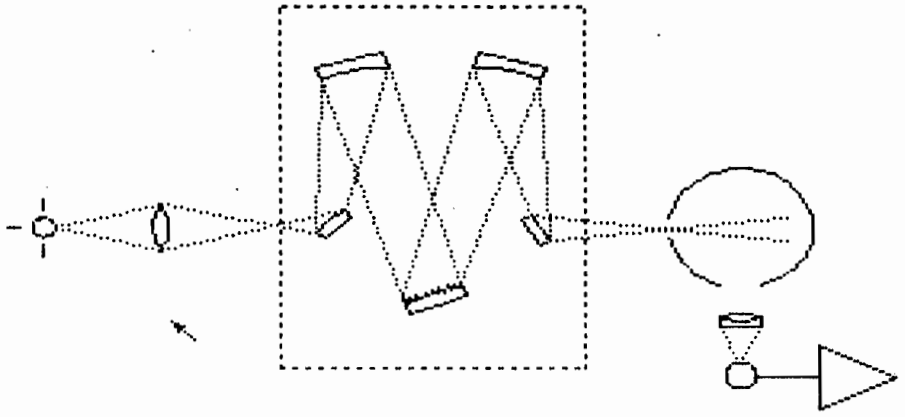
H=35
V=30
k1 KEYS 1
k2 FILES
k3 KEYS 3
k4 Catalog
k5 SAVEFILE
k6 GET-FILE
k7 Disc-Free
k8 GSTORE
k9 GLOAD
10 RE-DRAW
11 JUMP
12 EDIT
13 RUB LAST
14 INC=10



PLOT DIRECTION=0 Degrees

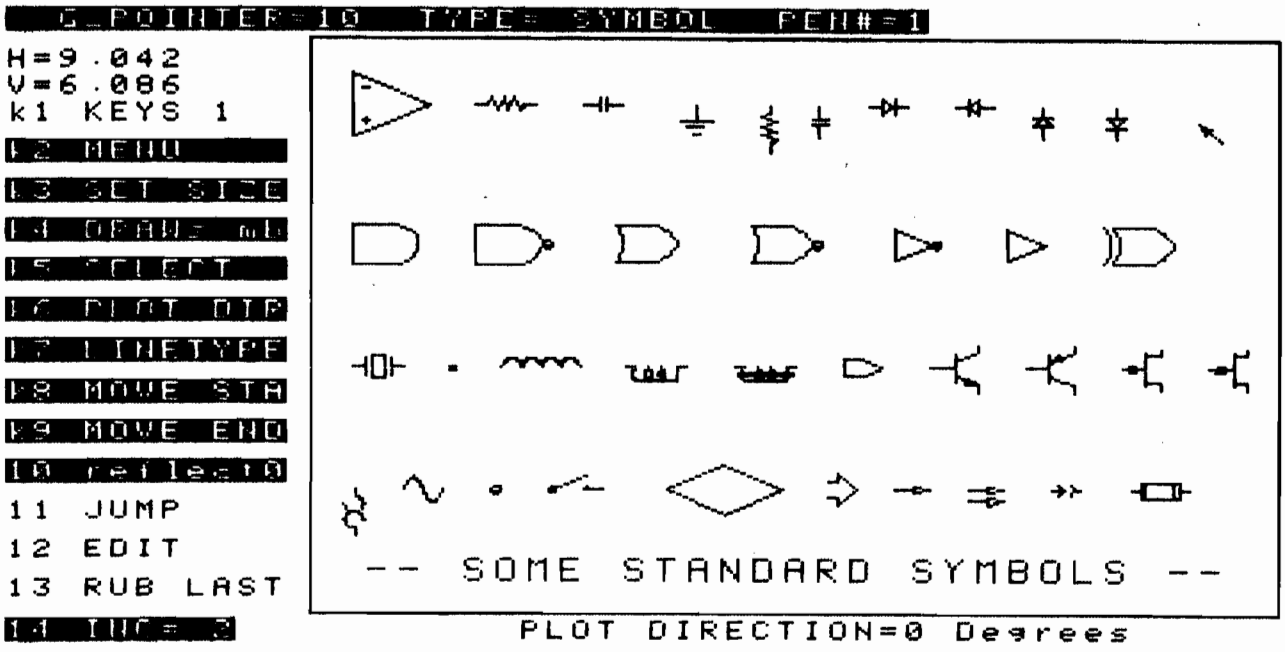
```
REDRAW [T=  EXIT   [11] ITEM#=22 TYPE= TEXT    PEN#=1
H=48.158
V=60
k1 KEYS 1
k2 FILES
k3 KEYS 3
k4 LINES
k5 BOXES
k6 SYMBOLS
k7 TEXT
k8 CIRCLES
k9 POLYGONS
10 FIND CTR
11 COMMANDS
12 EDIT
13 RUB LAST
14 INC=10
```

THE FILE NAME FOR THIS DRAWING IS DJ-4 (USE THE FILES THEN GET FILE SOFTKEY)



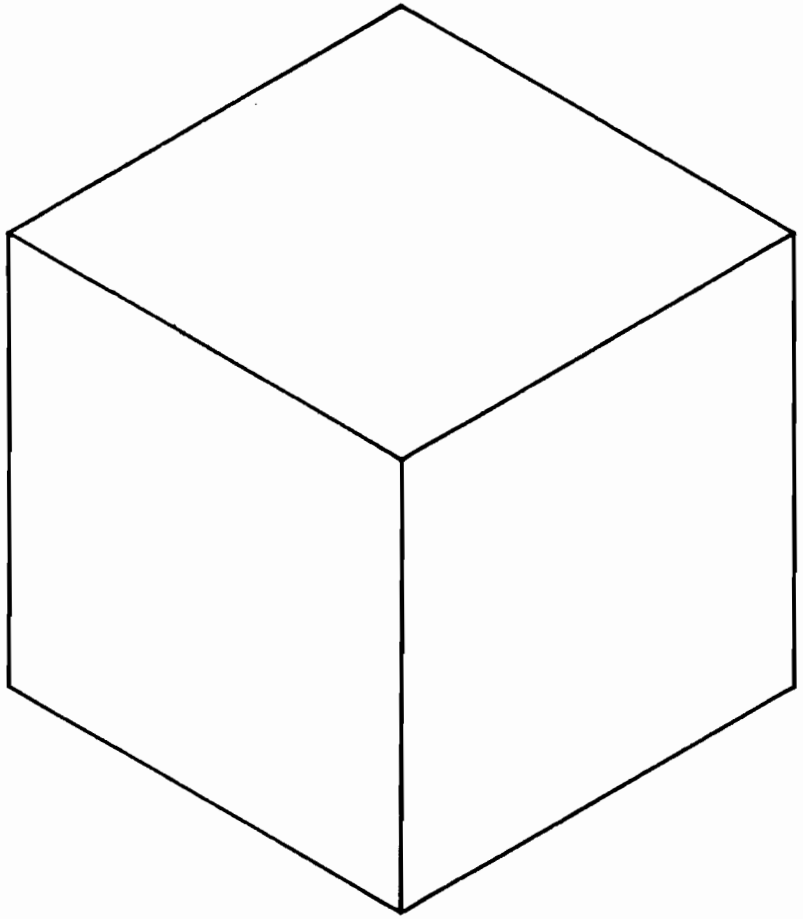
CADD/86-87 TEST DRAWING FOR DJ LABORATORIES, STOW, MASS. 01775
BY TENEGRITY, INC., CHICAGO, IL., MARCH 20, 1987

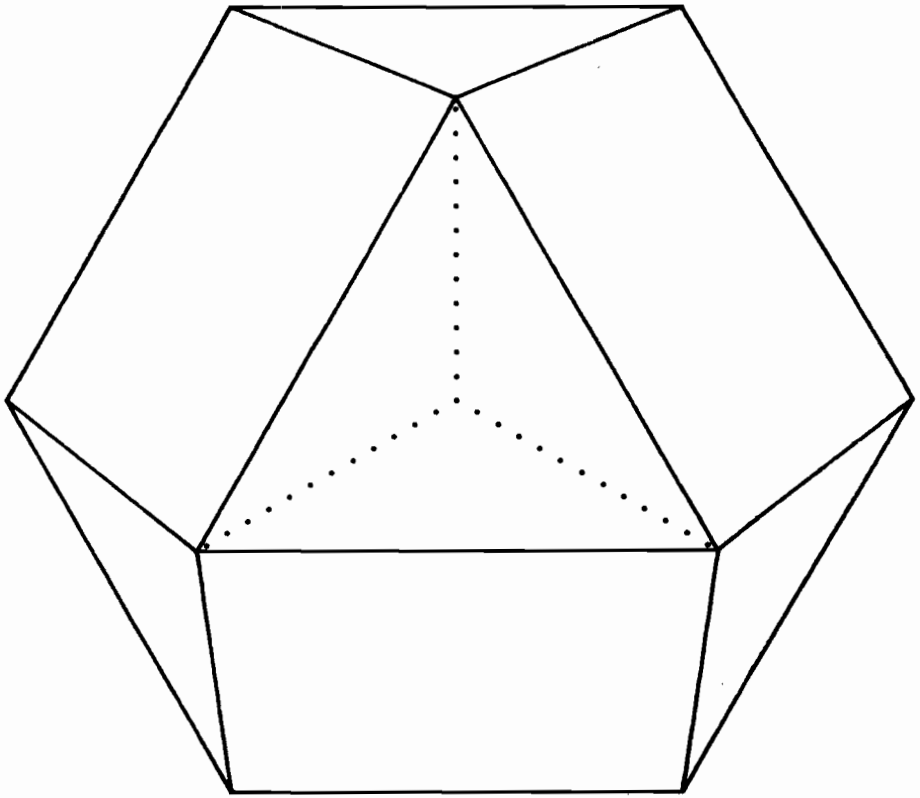
PLOT DIRECTION=0 Degrees


G_POINTER=10 TYPE= SYMBOL PEN#=1
H=9.042
V=6.086
k1 KEYS 1
F2 MENU
F3 SET SIZE
F4 DRAW= nb
F5 SELECT
F6 PLOT DIR
F7 LINETYPE
F8 MOVE STR
F9 MOVE END
10 reflect0
11 JUMP
12 EDIT
13 RUB LAST
14 INC= 2
-- SOME STANDARD SYMBOLS --
PLOT DIRECTION=0 Degrees

HEWLETT PACKARD

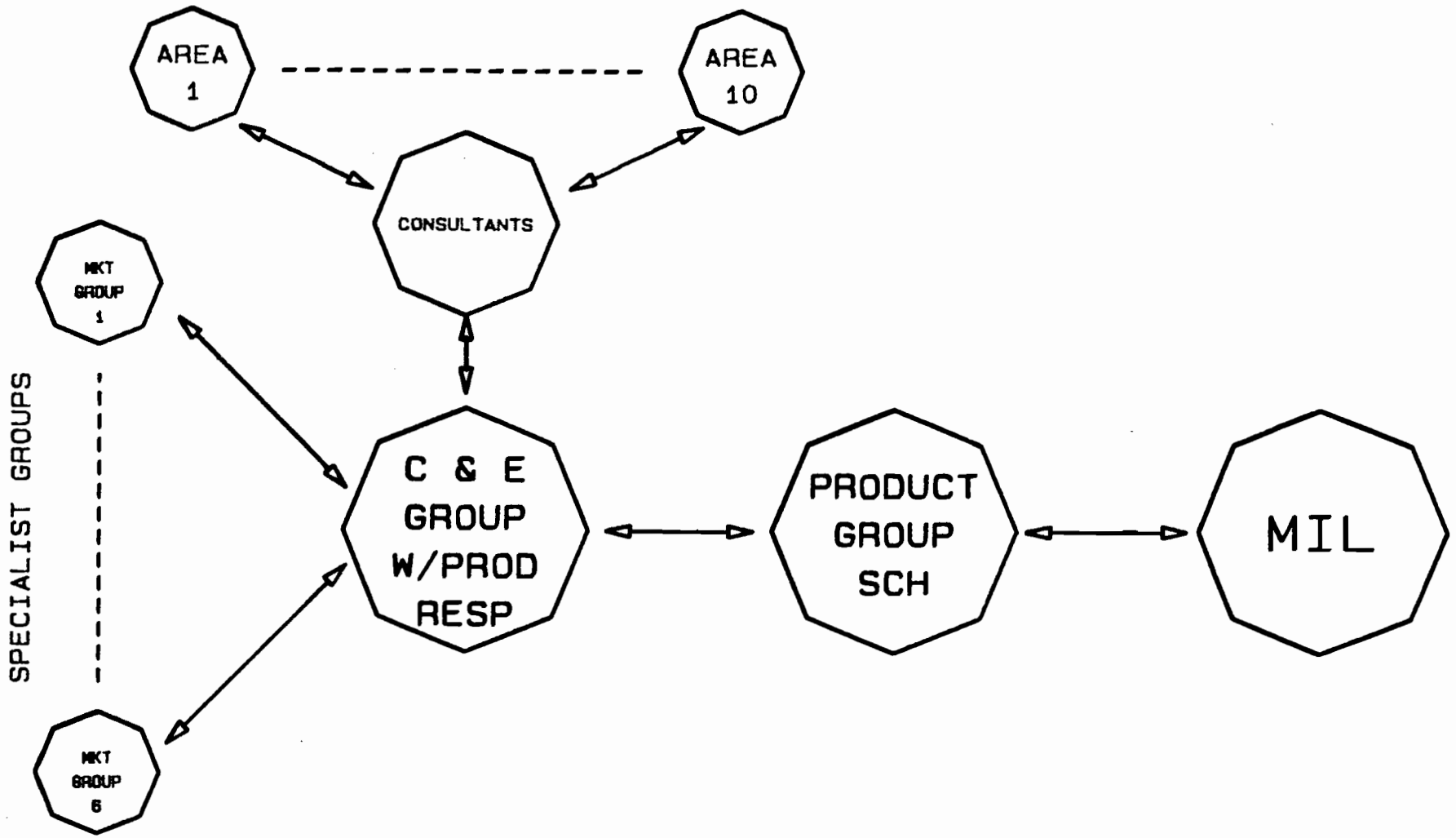
CADD/86-87 2D DRAFTING

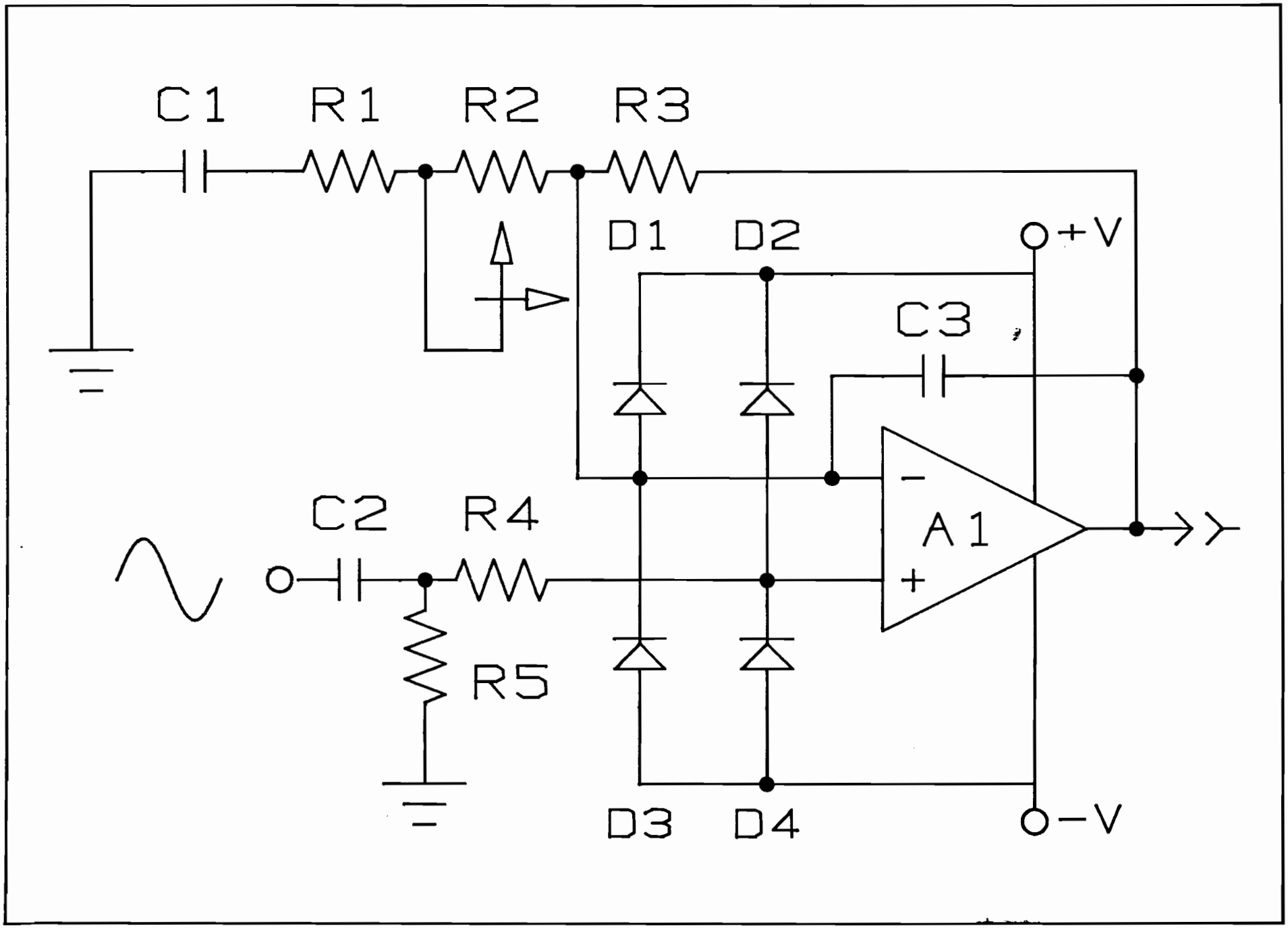


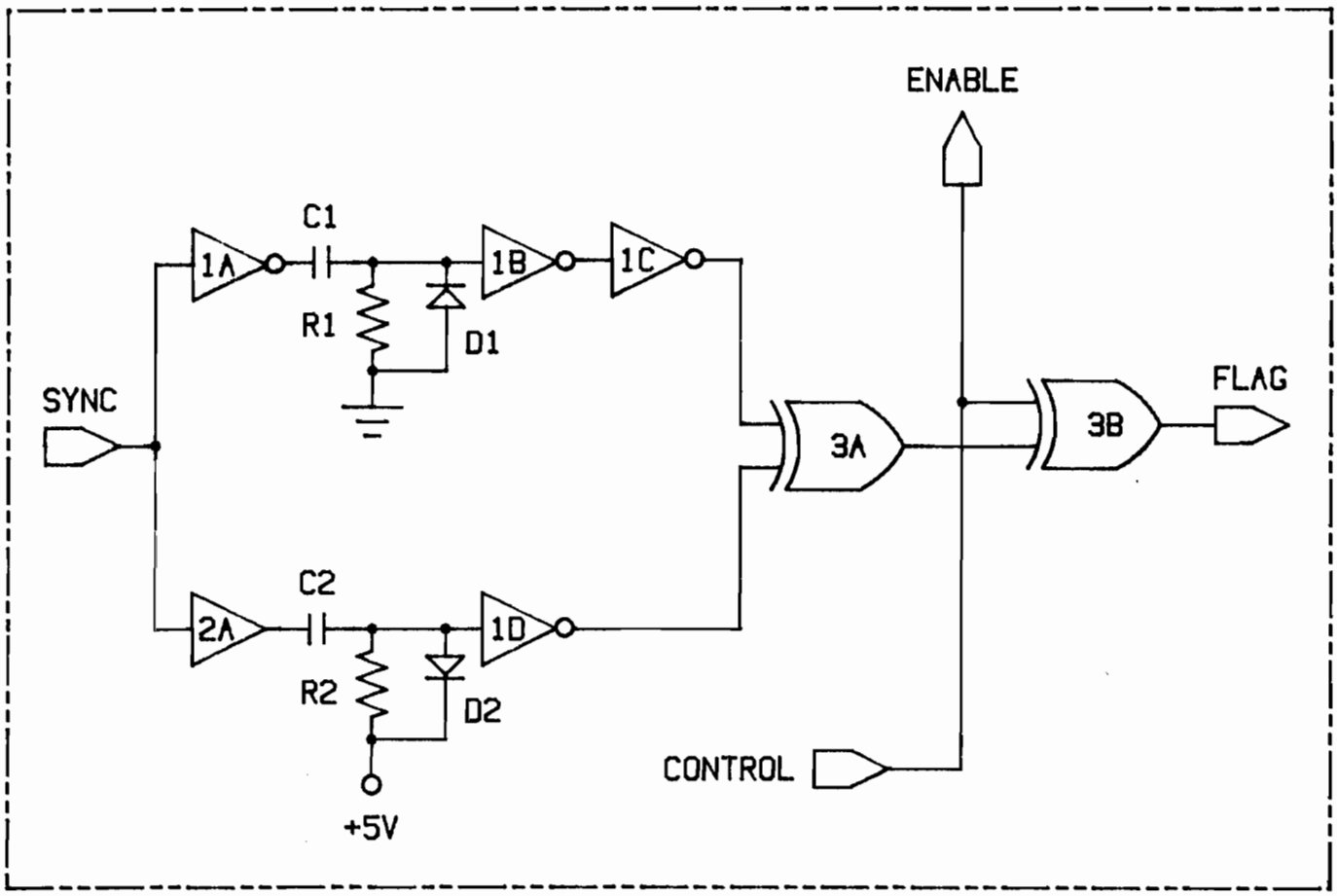


COMPUTER DRAFTING BY TENSEGRITY INC.

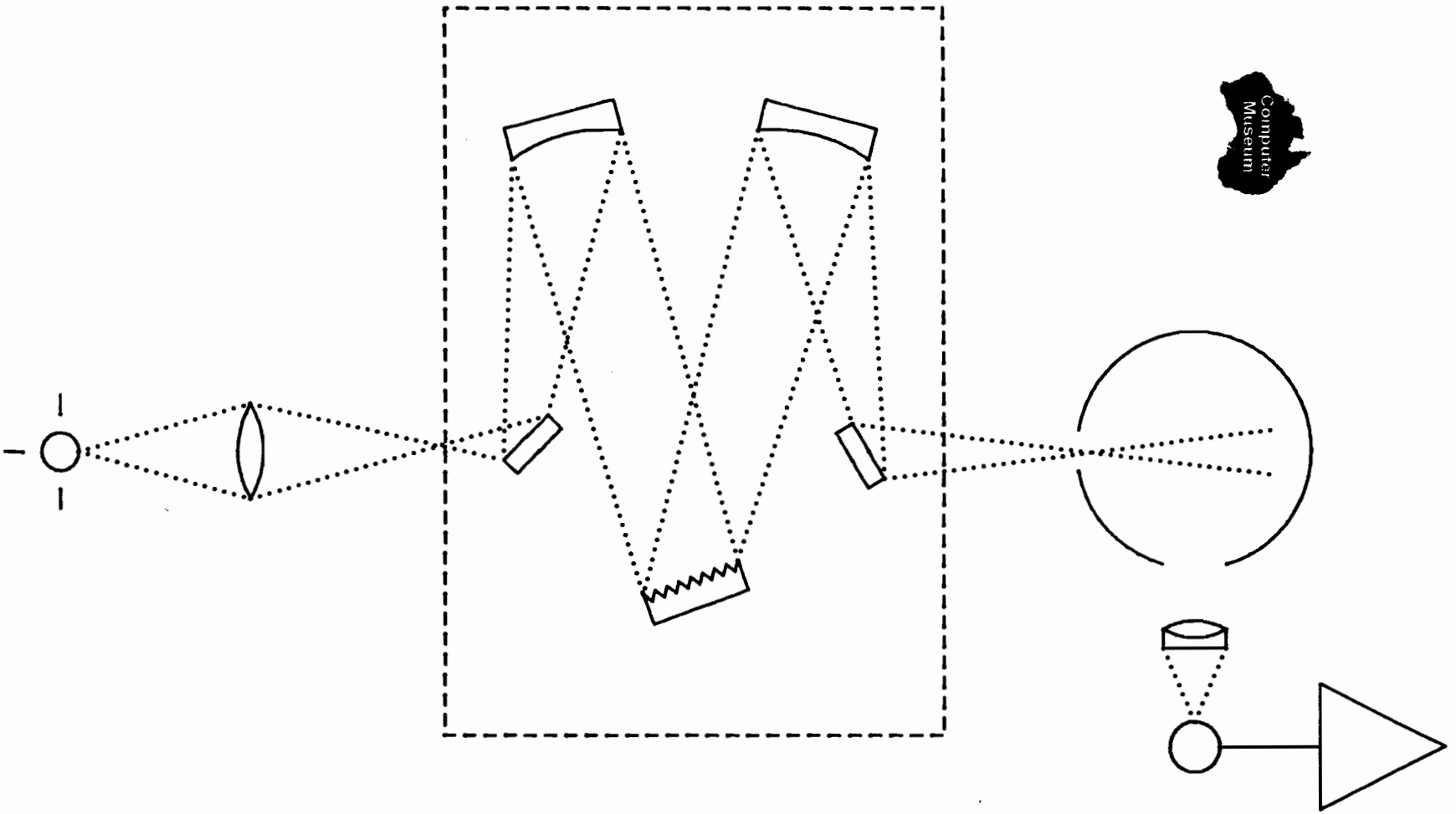
ORGANIZATION




C1
R1
R2
R3
D1
D2
+V
C3
C2
R4
A1
R5
D3
D4
-V

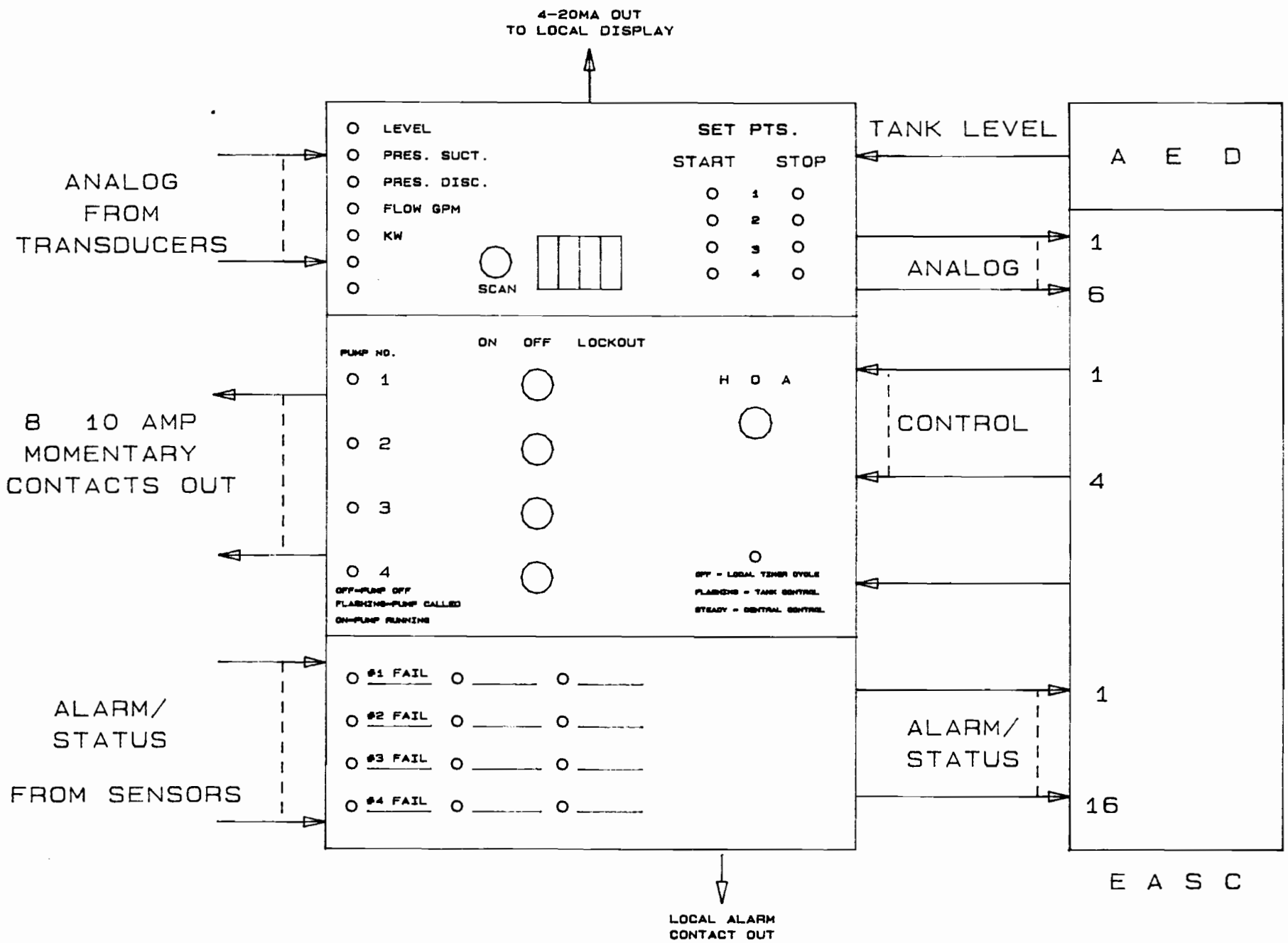

ENABLE
C1
1A
1B
1C
R1
D1
SYNC
FLAG
3A
3B
C2
2A
1D
R2
D2
CONTROL
+5V

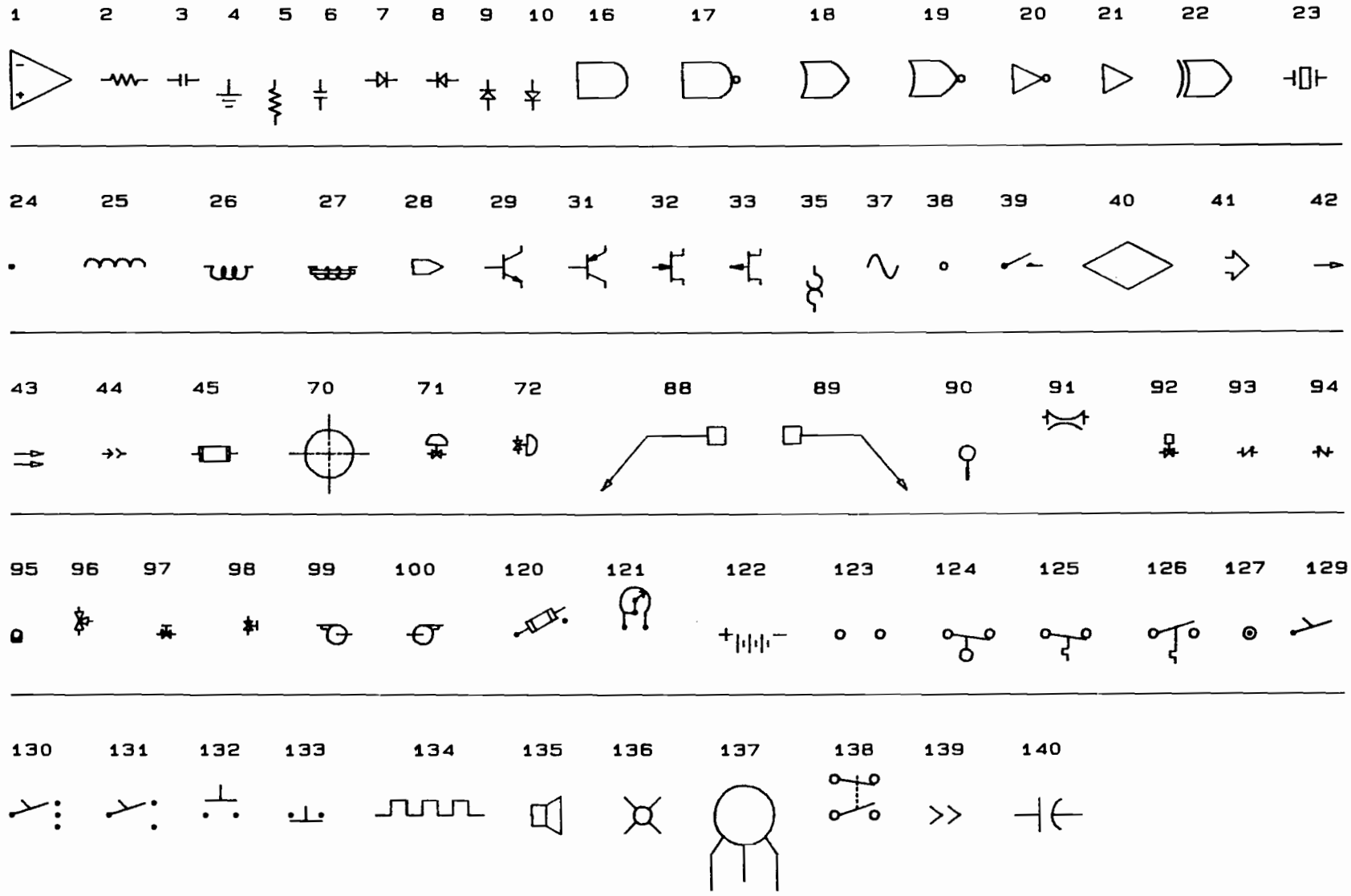
THE FILE NAME FOR THIS DRAWING IS DJ-4 (USE THE FILES THEN GET FILE SOFTKEY)



CADD/86-87 TEST DRAWING FOR DJ LABORATORIES, STOW, MASS. Ø1775

BY TENSEGRITY, INC., CHICAGO, IL., MARCH 2Ø, 1983


4-20MA OUT
TO LOCAL DISPLAY
LEVEL
PRES. SUCT.
PRES. DISC.
FLOW GPM
KW
SCAN
SET PTS.
START
STOP
1
2
3
4
TANK LEVEL
A E D
ANALOG
FROM
TRANSDUCERS
ANALOG
1
6
PUMP NO.
ON
OFF
LOCKOUT
H O A
1
2
3
4
8 10 AMP
MOMENTARY
CONTACTS OUT
CONTROL
1
4
OFF=PUMP OFF
FLASHING=PUMP CALLED
ON=PUMP RUNNING
OFF = LOCAL TIMER CYCLE
FLASHING = TANK CONTROL
STEADY = CENTRAL CONTROL
#1 FAIL
#2 FAIL
#3 FAIL
#4 FAIL
ALARM/
STATUS
FROM SENSORS
ALARM/
STATUS
1
16
E A S C
LOCAL ALARM
CONTACT OUT



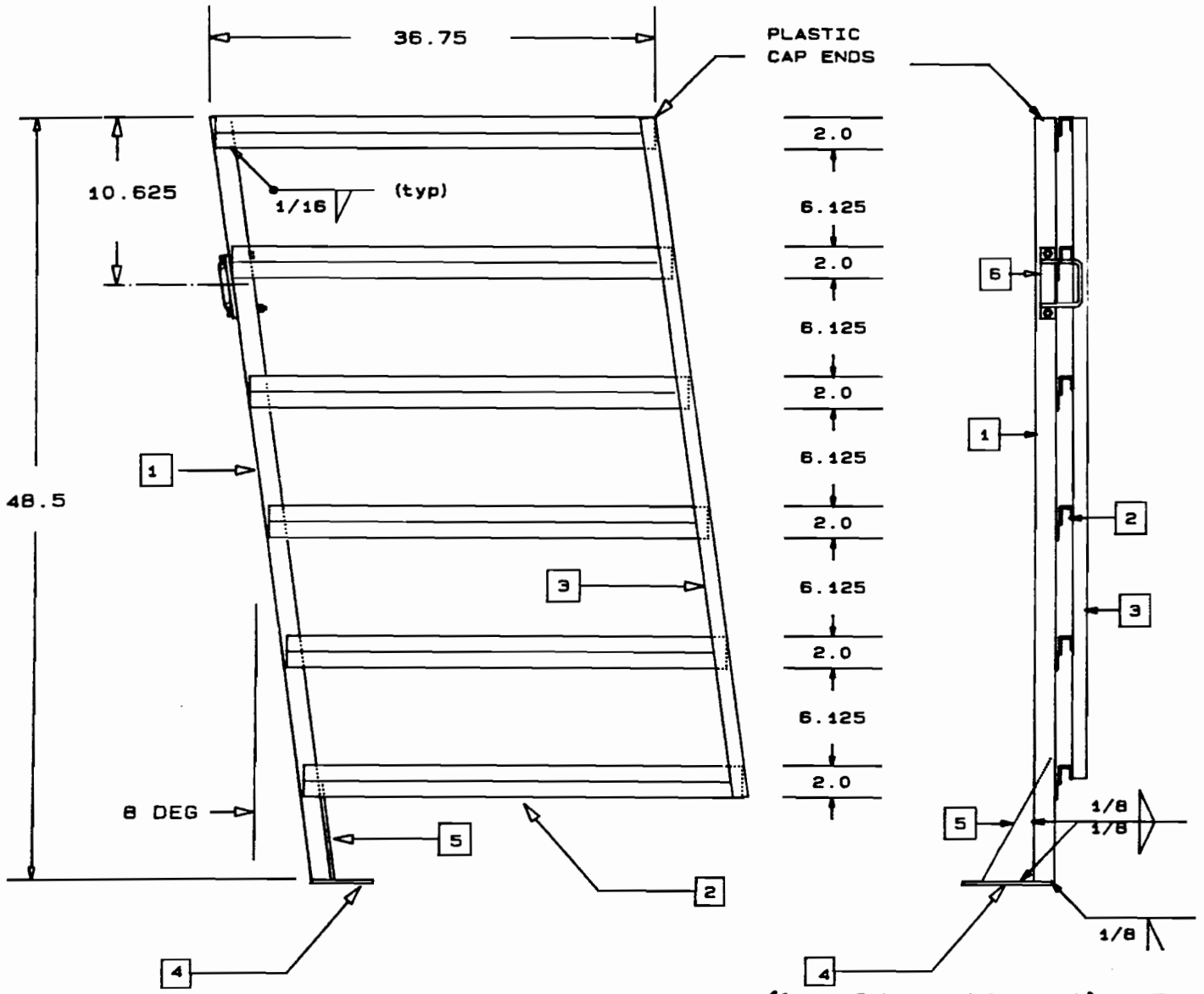
CADD/86-87 ELECTRONIC SYMBOLS

LY_ LINE PRODUCTS, INC.

SELF STORING END RAIL

MODEL 3300

9-5/8" RISE



ITEM	PART NO.
1	24221
2	24222
3	24223
4	24224
5	24225
6	24226

(Left Hand) Part No 24113

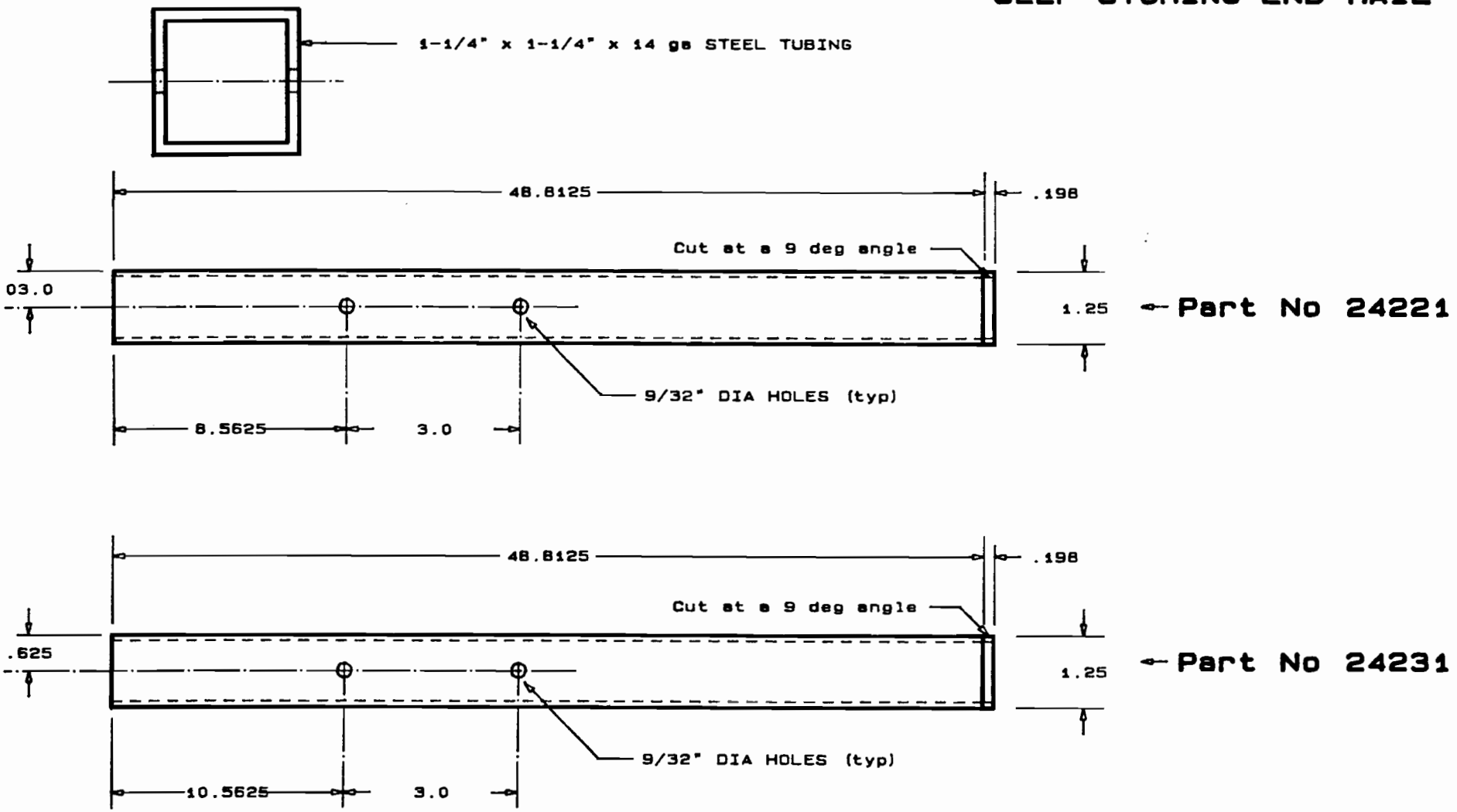
(Right Hand) Part No 24114

DRAWN BY H.LYMAN JULY 7, 1983

LY_ LINE PRODUCTS, INC.

MAIN VERTICAL POST

SELF STORING END RAIL



SEE ITEM [1] PART NO'S 24112 THRU 24119

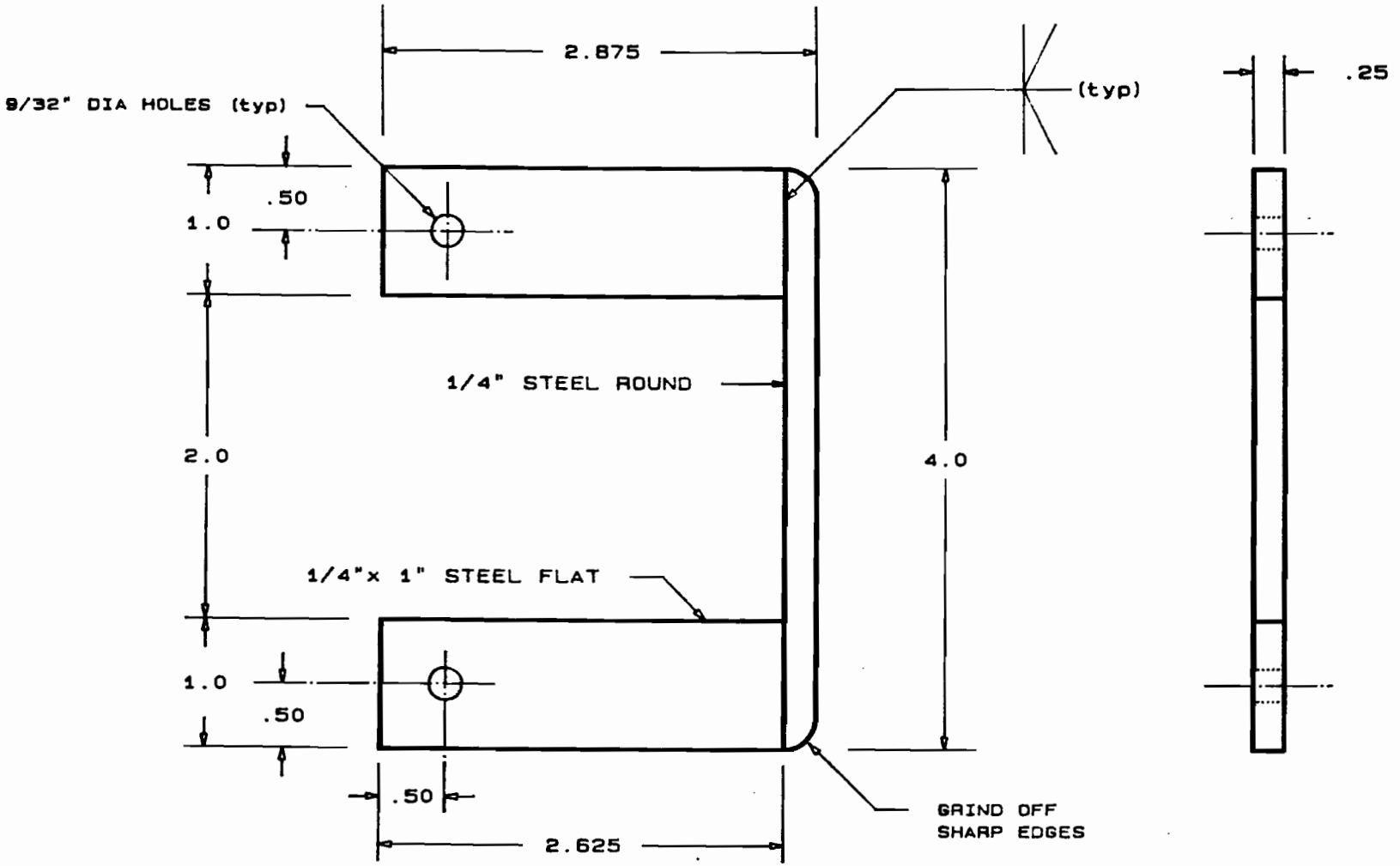
DRAWN BY H.LYMAN JULY 11, 1983

LLF LY_ LINE PRODUCTS, INC.

RAIL GUIDE

SELF STORING END RAIL

SEE ITEM 5 PART NO'S 24112 THRU 24119



DRAWN BY H.LYMAN JULY 13, 1983

Part No 24226

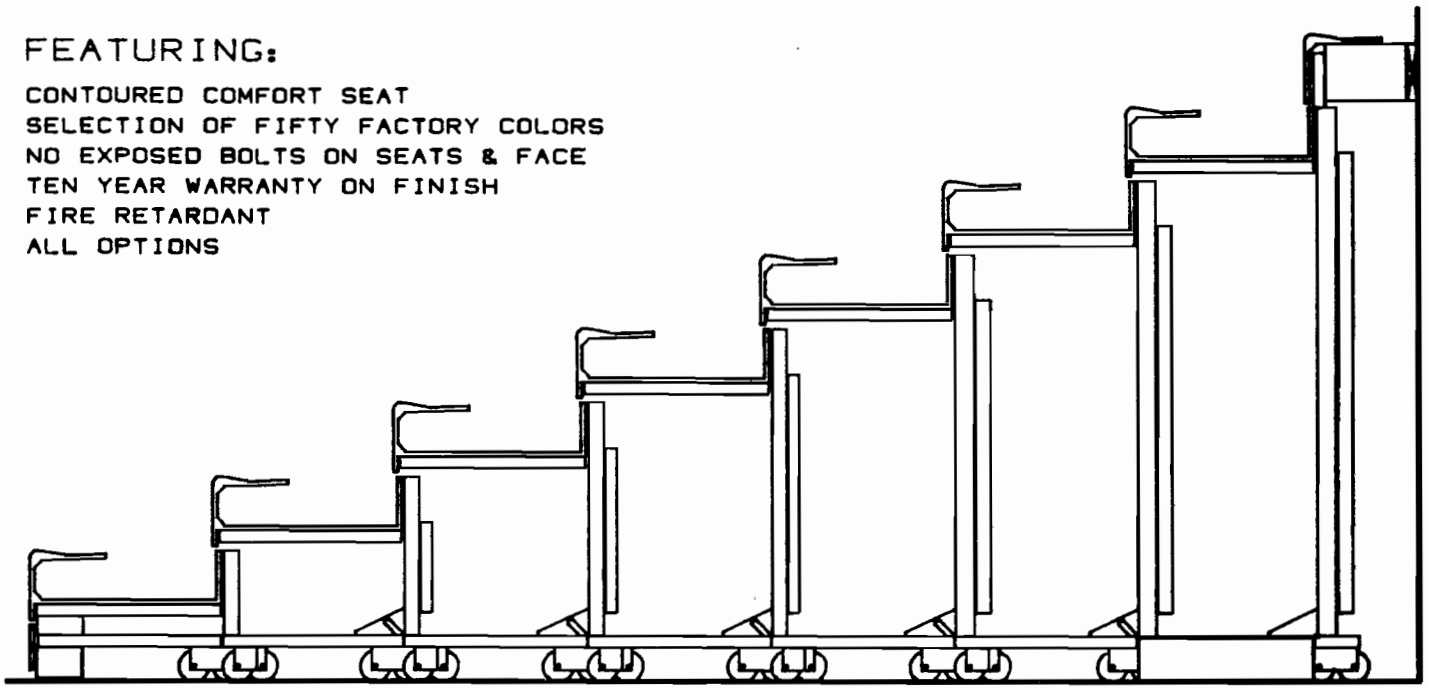
INNOVATOR

GYMNASIUM SEATING

REINFORCED STRUCTURAL FIBERGLASS

FEATURING:

CONTOURED COMFORT SEAT
SELECTION OF FIFTY FACTORY COLORS
NO EXPOSED BOLTS ON SEATS & FACE
TEN YEAR WARRANTY ON FINISH
FIRE RETARDANT
ALL OPTIONS



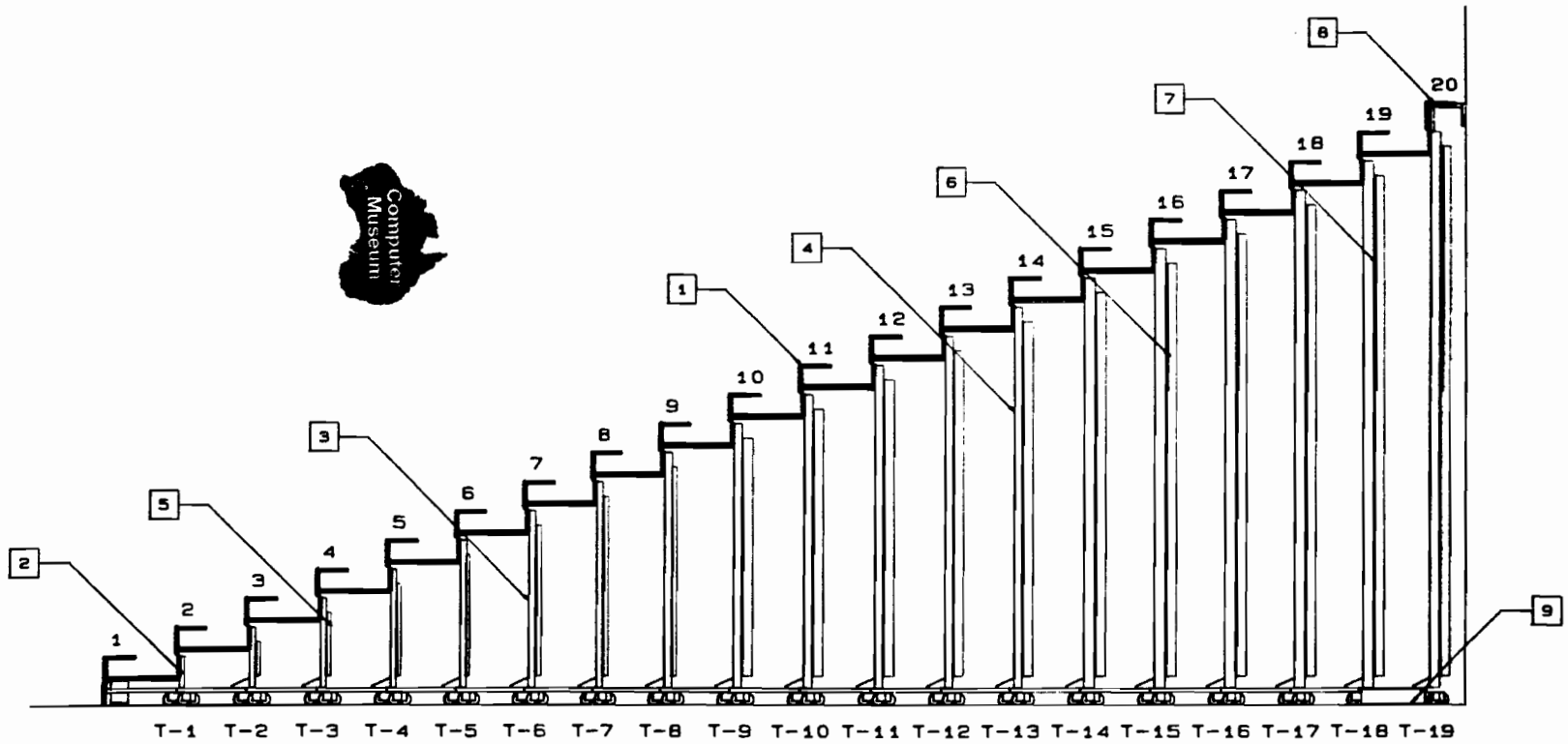
FOR INFORMATION, CATALOG AND SPECIFICATIONS - WRITE:

HUGH M. LYMAN, JR.
PRESIDENT
LY_ LINE PRODUCTS, INC.
Box 38
Enumclaw, Wash 98022

LLF LY_ LINE PRODUCTS, INC.

INNOVATOR II
WALL ATTACHED
END VIEW

ITEM	DESCRIPTION	DRAWING or PART NUMBERS
1	DECK SECTION	25002.1
2	1st TIER COLUMN	24101
3	2nd thru 8th TIER COLUMN	24102
4	9th thru 19th TIER COLUMN	24103
5	2nd thru 8th DIA. BRACE	24332/24338 & 24432/24438
6	9th thru 19th DIA. BRACE	24339/24349 & 24439/24449
7	15th thru 19th SECONDARY DIA. BRACES	24365/24369 & 24465/24469
8	TOP SEAT & COLUMN WALL ATTACHMENT	25002.2
9	BACK COLUMN FLOOR ATTACHMENT	24002.3

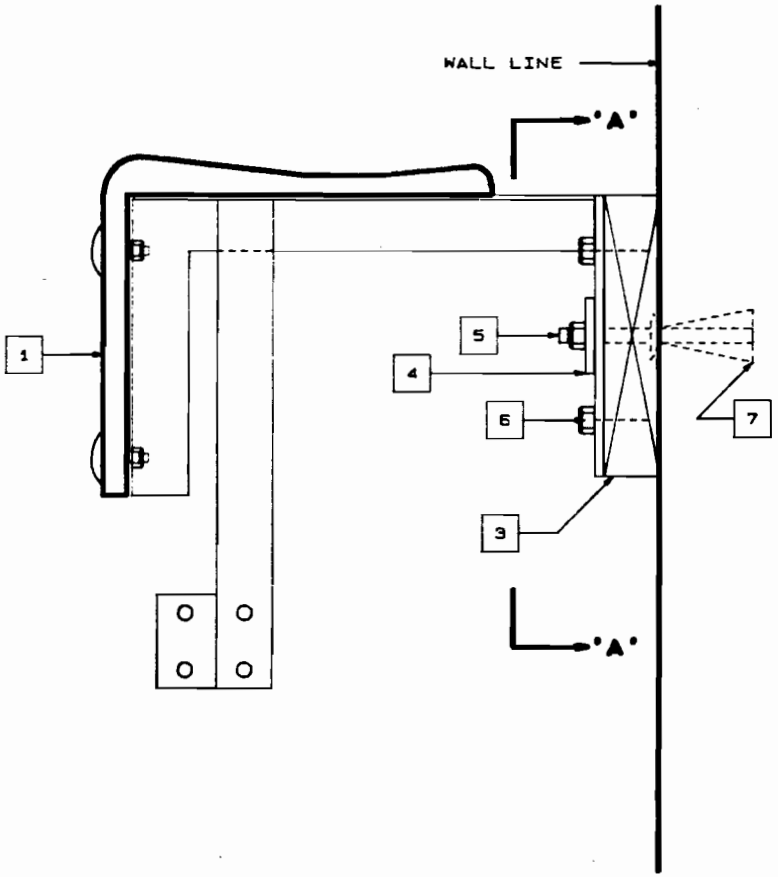


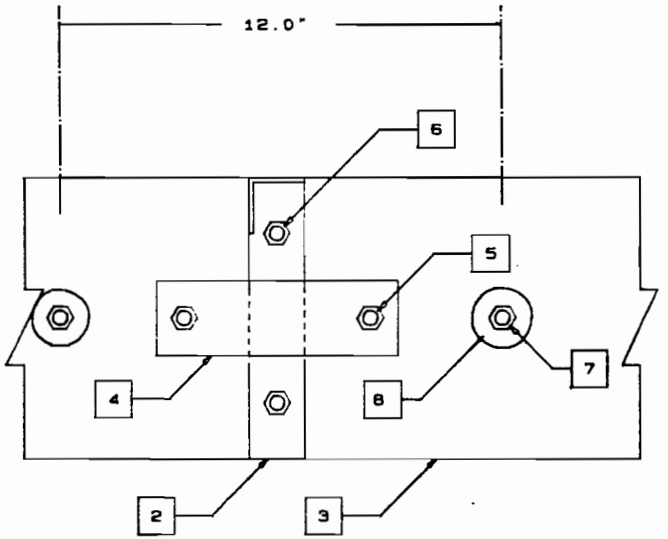
DRAWN BY H.LYMAN SEPT 3, 1983

DRAWING NO. 25002

LY_LINE PRODUCTS, INC.

TOP SEAT & WALL ATTACHMENT





SECTION 'A-A'

ITEM	DESCRIPTION	PART or DRAWING NO.
1	FIBERGLASS SEAT/RISER	25701 THRU 25704
2	WALL BRACKET	25120
3	2x8 FIR WALL BUCK	24725
4	ATTACHMENT BAR	24240
5	3/8 x 2-1/2 CARRIAGE BOLT	
6	3/8 x 1-1/2 LAG BOLT	
7	1/2" DYNA BOLT WALL ANCHOR	
8	1/2" FLAT WASHER	

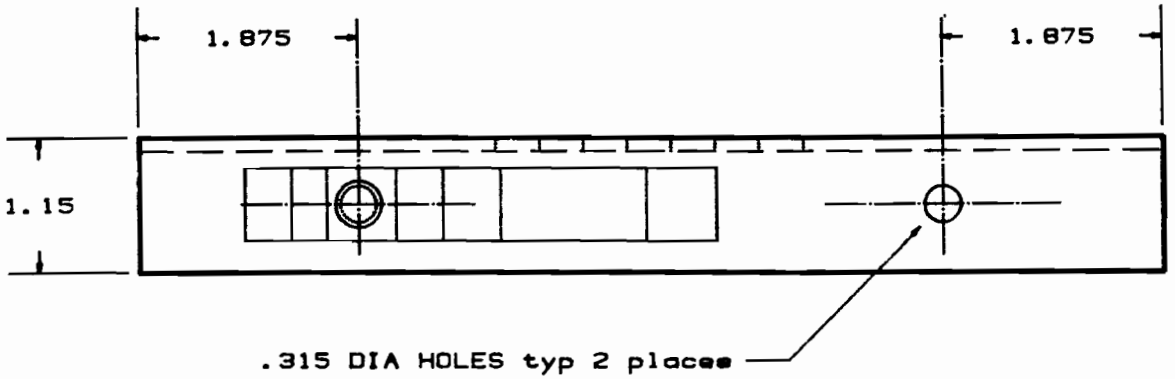
DRAWN BY H.LYMAN SEPT 13, 1983

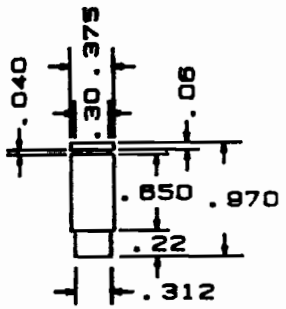
DRAWING NO. 25002.2

LY_ LINE PRODUCTS, INC.

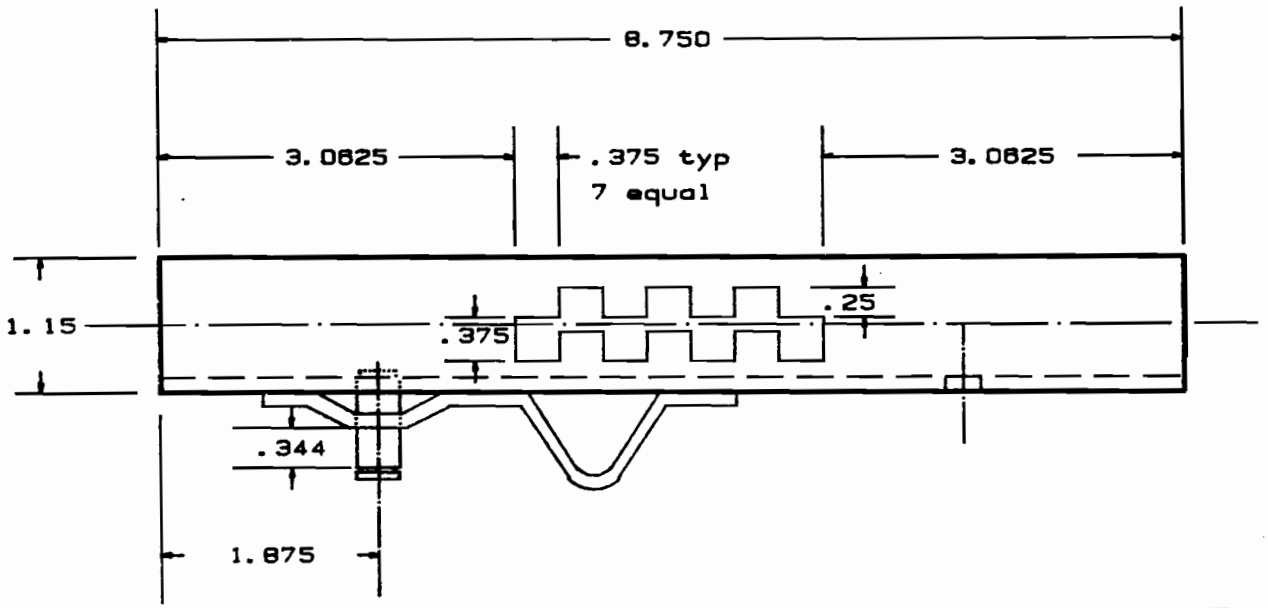
STOP BAR

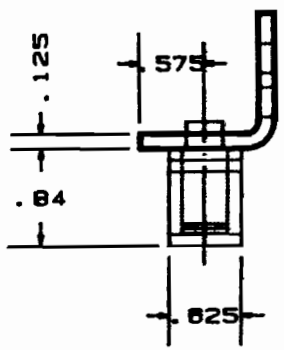
RIGHT HAND SHOWN





AXLE





(Right) Part No 24217

(Left) Part No 24218

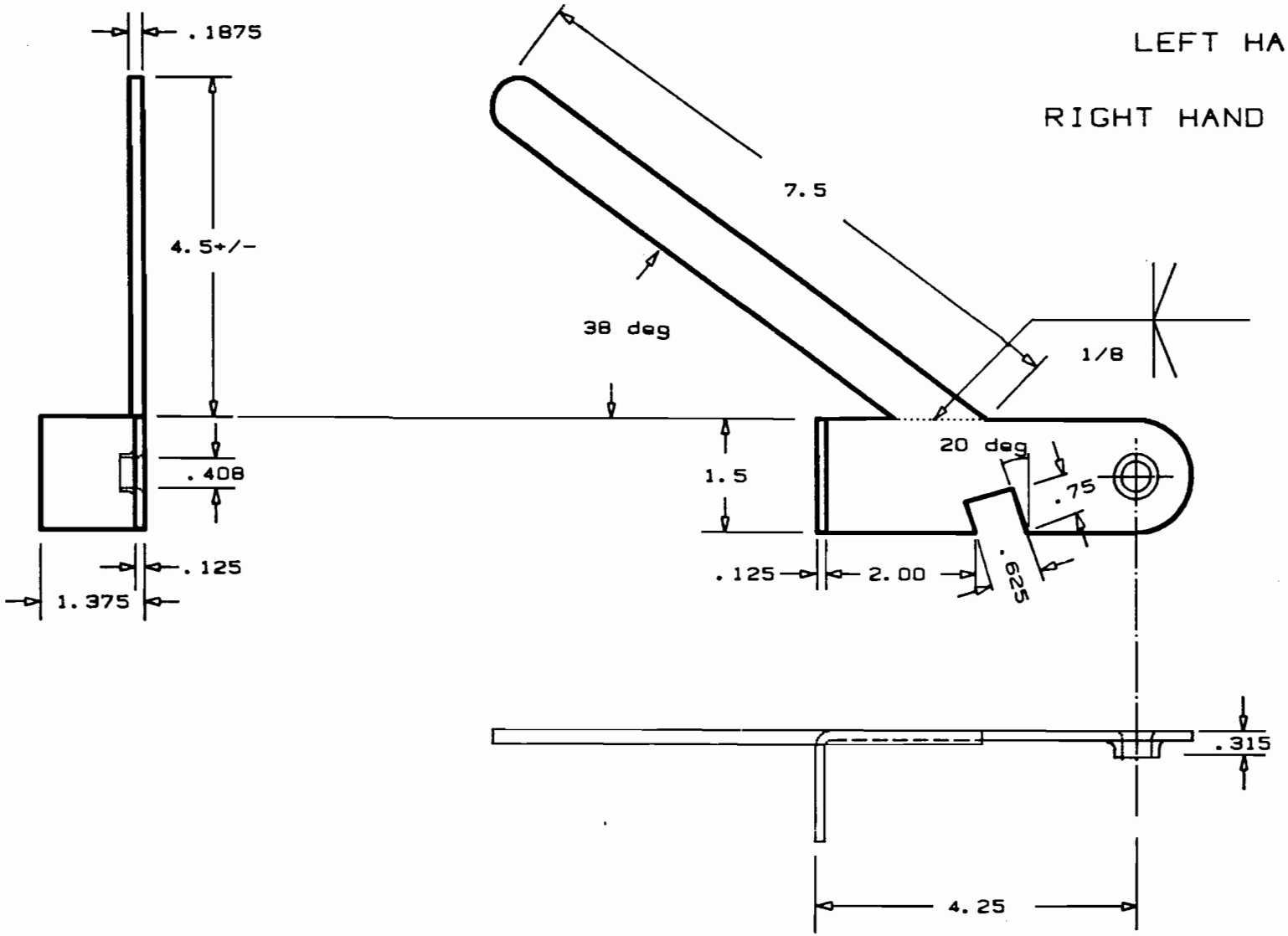
DRAWN BY H. LYMAN MAY 30, 1983

LY_ LINE PRODUCTS, INC.

TIER CATCH

LEFT HAND SHOWN

RIGHT HAND OPPOSITE



DRAWN BY H. LYMAN MAY 19, 1983

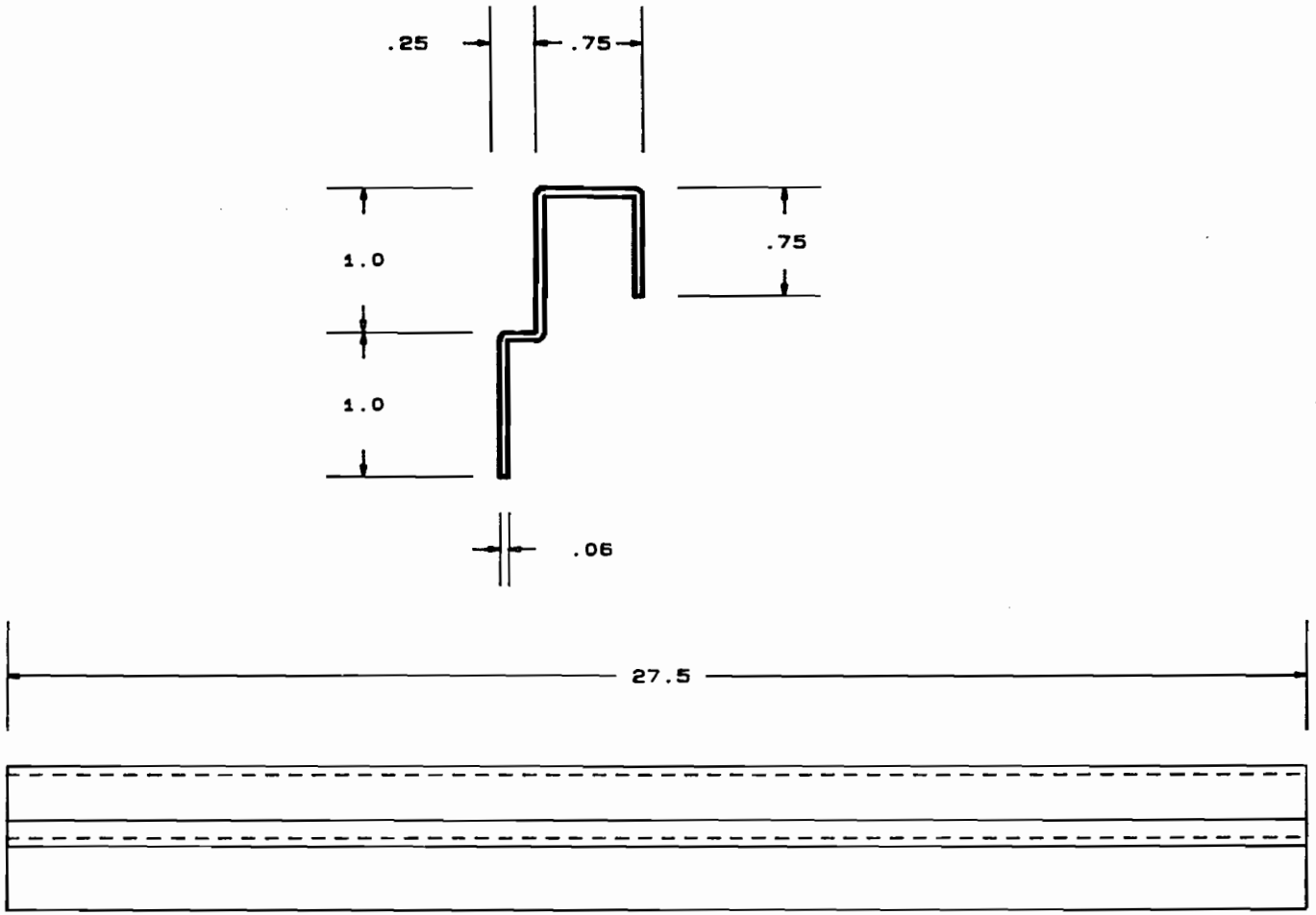
(right) Part No 24213
(left) Part No 24214

LLP LY_ LINE PRODUCTS, INC.

HORIZONTAL RAIL

SELF STORING END RAIL

MODEL 2400

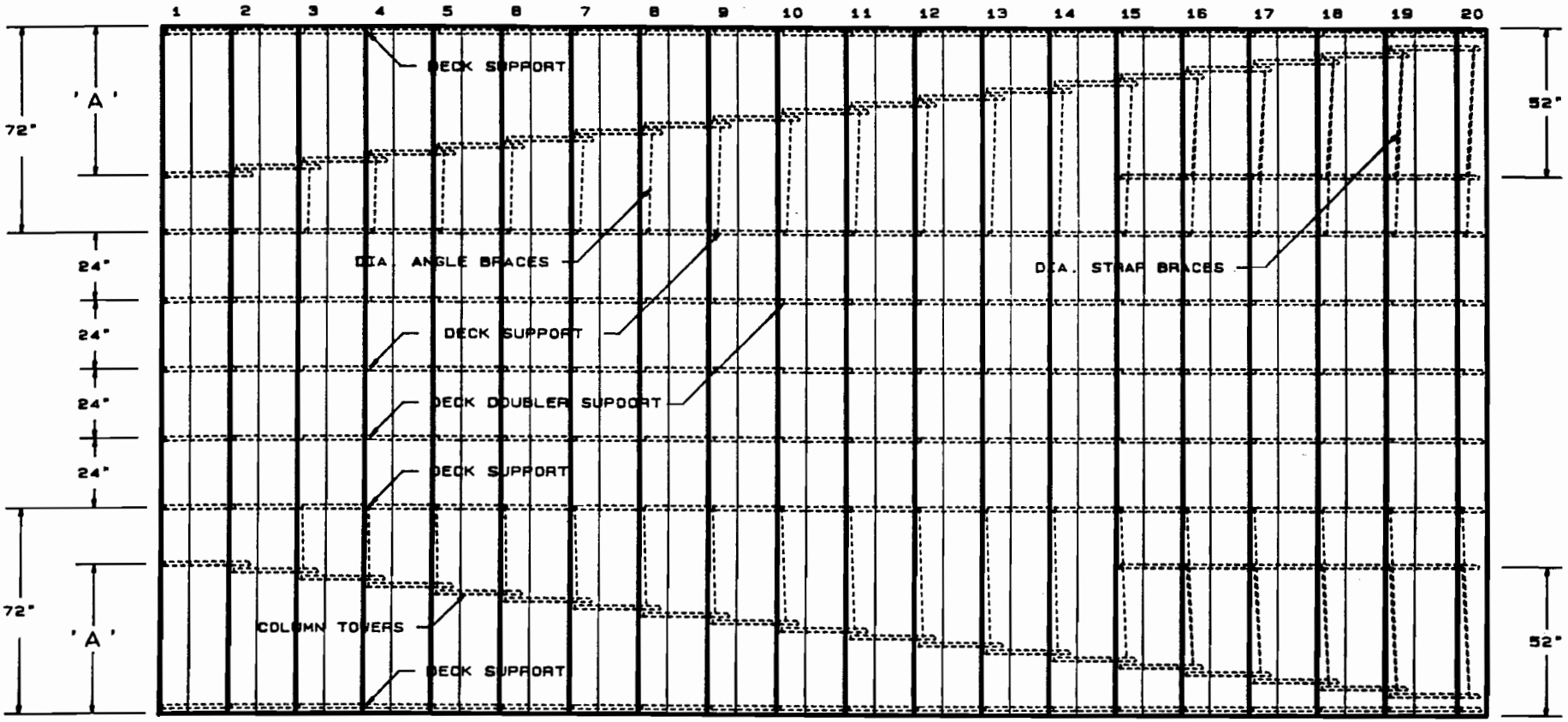


DRAWN BY H.LYMAN JULY 12, 1983

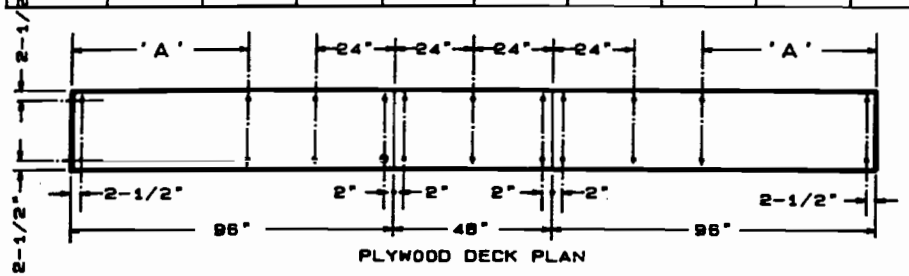
Part No 24222

LLF LY_ LINE PRODUCTS, INC.

INNOVATOR II
PLAN VIEW



TIER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
DIM 'A'	52	49-1/2	47	44-1/4	42	39-1/2	37	34-1/2	32-1/4	29-3/4	27-1/4	24-3/4	22-1/4	19-3/4	17-1/4	14-3/4	12-1/4	9-3/4	7-1/4



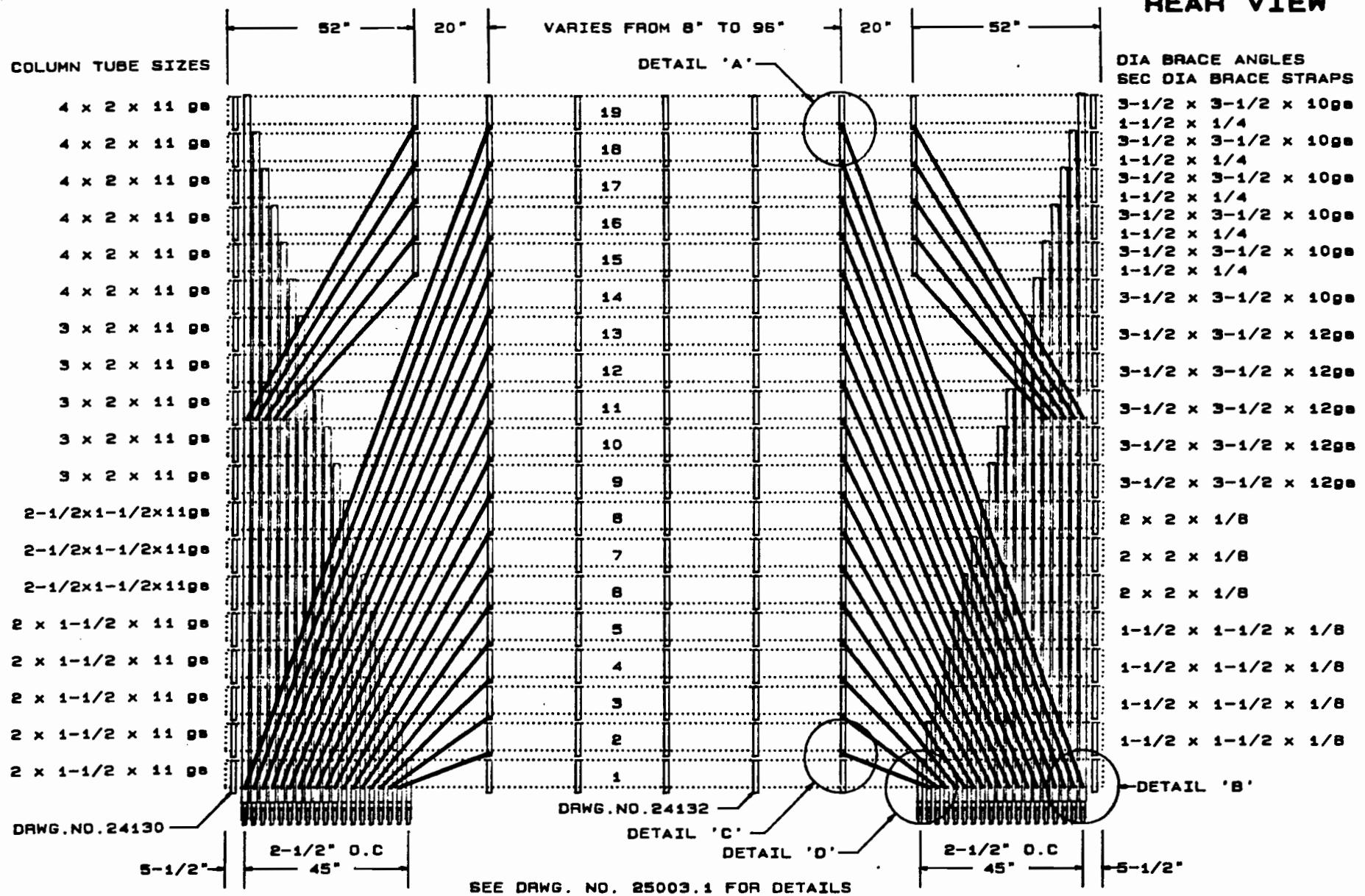
PLYWOOD DECK PLAN

DRWAN BY H.LYMAN SEPT 5, 1983

20'-0" SECTION
DRAWING NO. 25004

LY_ LINE PRODUCTS, INC.

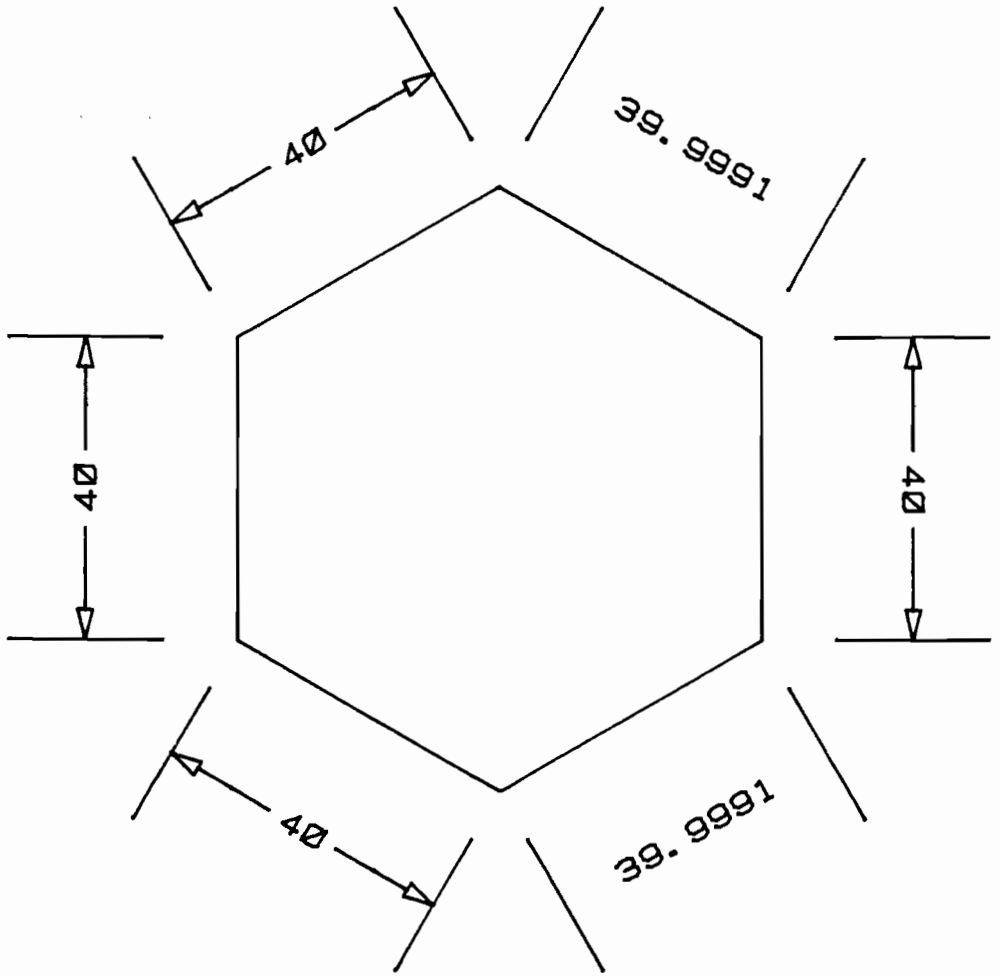
INNVOATOR II
REAR VIEW



SEE DRWG. NO. 25003.1 FOR DETAILS

DRAWN BY H.LYMAN SEPT 3, 1983

DRAWING NO. 25003


40
39.9991
40
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39.9991

Dimensioning is fast and easy with Auto-dimension.