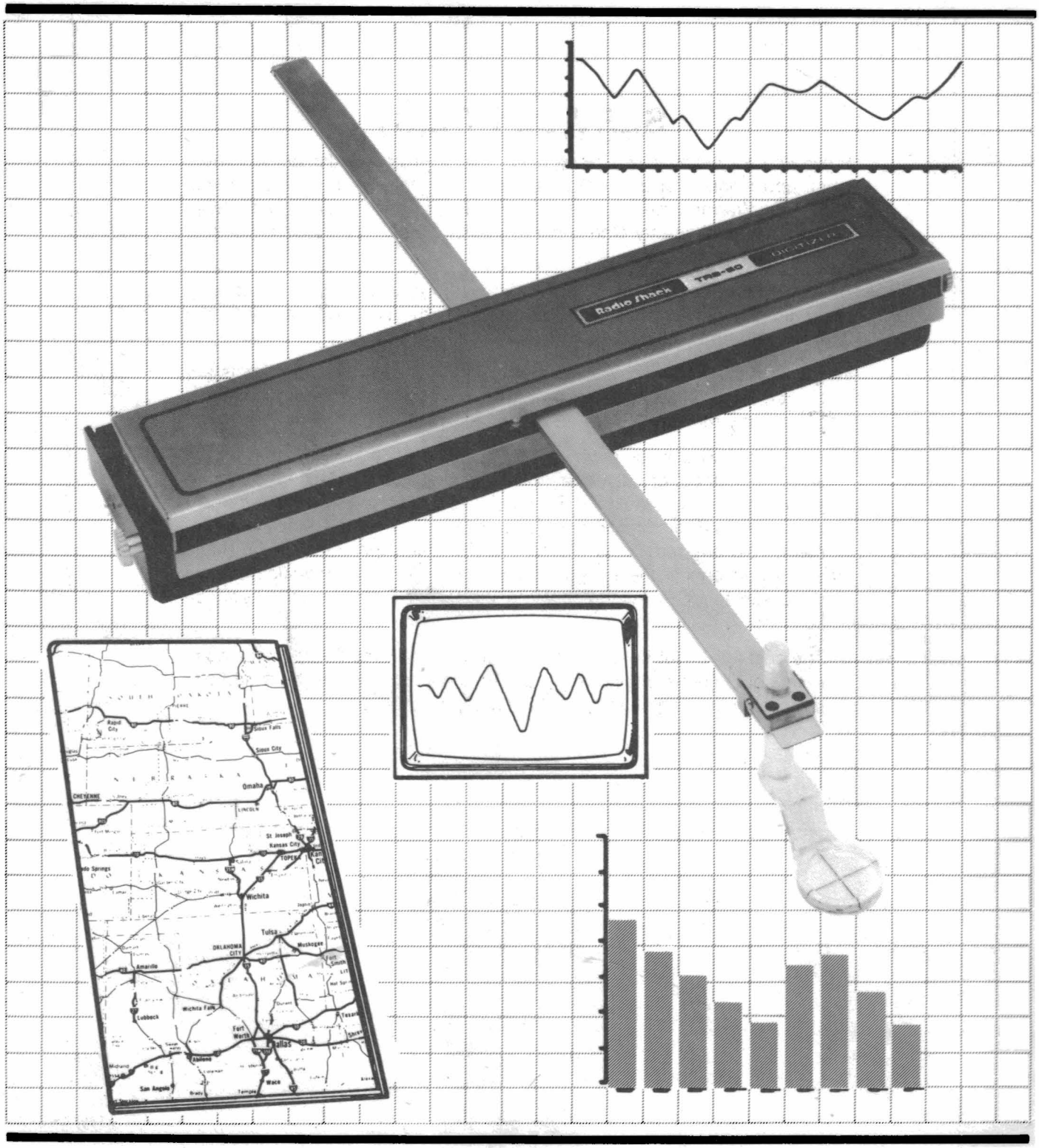
Radio Shack®

TRS-80

COMPUTER PRODUCTS

TRS-80®
DIGITIZER

Catalog No. 26-1195



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SERVICE POLICY

Radio Shack's nationwide network of service facilities provides quick, convenient, and reliable repair services for all of its computer products, in most instances. Warranty service will be performed in accordance with Radio Shack's Limited Warranty. Non-warranty service will be provided at reasonable parts and labor costs.

Because of the sensitivity of computer equipment, and the problems which can result from improper servicing, the following limitations also apply to the services offered by Radio Shack:

1. If any of the warranty seals on any Radio Shack computer products are broken, Radio Shack reserves the right to refuse to service the equipment or to void any remaining warranty on the equipment.
2. If any Radio Shack computer equipment has been modified so that it is not within manufacturer's specifications, including, but not limited to, the installation of any non-Radio Shack parts, components, or replacement boards, then Radio Shack reserves the right to refuse to service the equipment, void any remaining warranty, remove and replace any non-Radio Shack part found in the equipment, and perform whatever modifications are necessary to return the equipment to original factory manufacturer's specifications.
3. The cost for the labor and parts required to return the Radio Shack computer equipment to original manufacturer's specifications will be charged to the customer in addition to the normal repair charge.

TRS-80

Digitizer

Owner's Manual

Catalog Number 26-1195

Contents

Introduction

Congratulations for selecting this Radio Shack TRS-80 Digitizer.

You'll find it to be an easy-to-use, high-quality electronic measuring device that can be used with the following Radio Shack computers:

- Model I, Level II(16K)
- Model II
- Model III
- Color Computer

What exactly is a Digitizer? Basically, it's a device that describes a specific point on a sheet of paper in terms of its X-Y (Cartesian) coordinates. For example, if you didn't have a Digitizer and you wanted to describe the location of a particular point on an 8 1/2" X 11" sheet of paper, you would need to measure how far from the left edge that point is, then how far from the top edge it is.

A Digitizer does this for you. It tells you how far horizontally (the X-axis) and how far vertically (the Y-axis) that point is from the edge of the paper.

Note that the Digitizer does not do this totally "automatically", however. **The action of the Digitizer depends upon the program you're running in the Computer.** In this manual, we've included a sample program for use on different models of TRS-80's. The sample program includes an initialization routine which you will need to include in programs you write. See **Appendix A** for details.

We've also included a "skew adjustment" routine (see **Appendix B**) if you ever need to position your paper to true Cartesian coordinates.

Appendix C contains some additional information which you might find valuable when writing your own programs.

Specific uses of the Digitizer include the:

Creation of bar graphs and charts.

. Measurement of coordinates.
. Reading of maps.
. Computation of areas.
. Measurement of lengths.
. Calculation of volumes.
. Curving of averages.
. Scaling (up or down) of measurements.

And much more!

1/ Description of the Digitizer

When referring to the position of the Digitizer, we're assuming the Digitizer is facing you. That is, the back "connection" panel of the Digitizer is away from you--on the back side of the Digitizer.

When you move the Digitizer towards you, we'll call this "moving to the front." When you move it away from you, we'll refer to this as "moving to the back." Whenever you move it to the front or back, you're moving it along the "Y-axis."

When you move the Digitizer to the left or right (again assuming the Digitizer is facing you), this is movement on the "X-axis."

(1) TRAVERSE ARM. Moves left and right (X-axis) and front and back (Y-axis). (Note the Traverse Arm Stop at the end of the Arm away from the Cursor.)

(2) CURSOR. This allows you to identify a specific point. Simply place the circle in the center of the Cursor on the point you wish to define.

(3) SEND SWITCH. When you've defined the point you wish to describe, press the Send Switch down. To continuously send location signals to the Computer as you move the Cursor, hold the Switch down until two location signals are sent, then release. The Digitizer will continue sending location signals until you press the Send Switch again.

(4) CARRIAGE. The Carriage moves back and forth and carries the Traverse Arm. (See Figure 5.)

(5) BODY. This section contains the electronic components which identify the positions of the Cursor; it then sends those positions to the Computer.

(6) COVER. You will need to remove the Cover when you mount the Traverse Arm onto the Carriage.

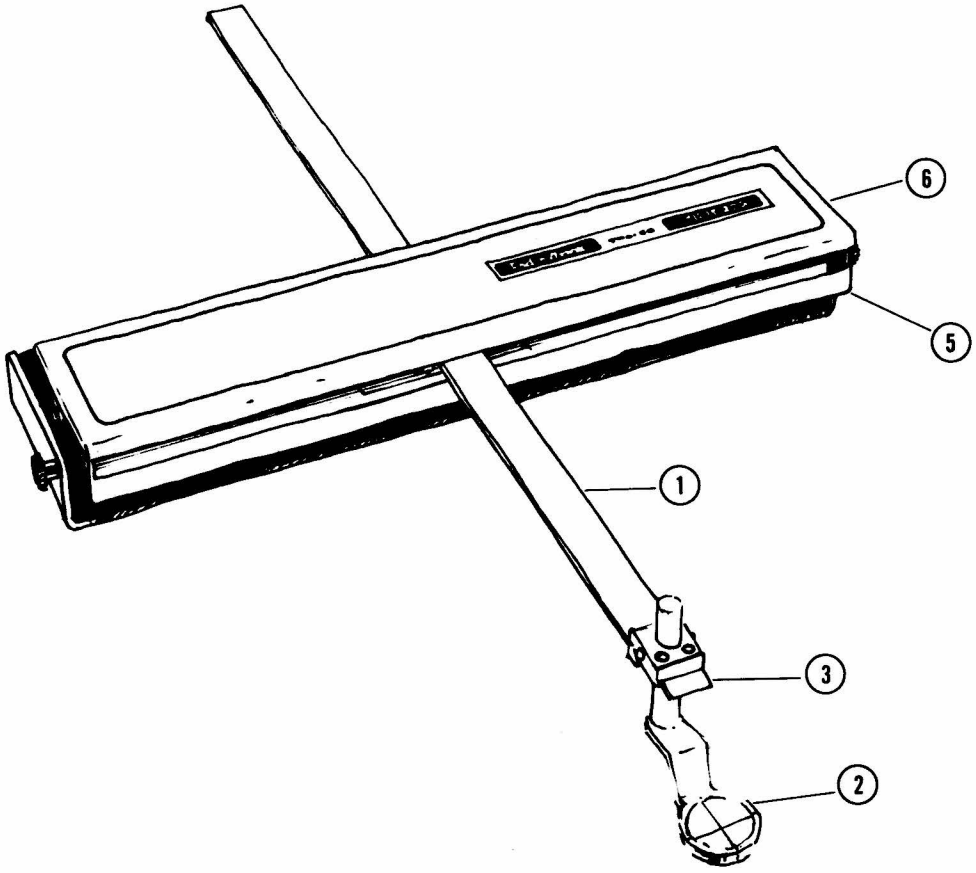


Figure 1. Digitizer (Front View)

(1) POWER CORD CONNECTOR (J2). Connect the round connector from the POWER PACK into this Connector.

(2) DATA AUDIO/RS-232 (J4). If you're connecting the Digitizer via the Tape jack of your Model I, Level II Computer or if you're using a TRS-80 Color Computer, use this (4-pin) connector.

(3) CASS/NORM. The setting of this Switch depends upon how (through which port) the Digitizer is connected to the Computer. For Computers equipped with RS-232-C, set to NORM. For Color Computers or Model I Level II cassette interface, set to CASS.

(4) RS-232 OUTPUT (J1). Connect the Digitizer to your Computer via this DB-25 (25-pin) connector when using Model I Level II, Model II, or Model III RS-232-C.

(5) RESET. Press this Switch to reset X-Y values to zero.

(6) POWER PACK. Plug the POWER PACK into an AC wall outlet; plug the round connector into the Power Connector (J2) on the back panel of the Digitizer. (See Figure 2.)

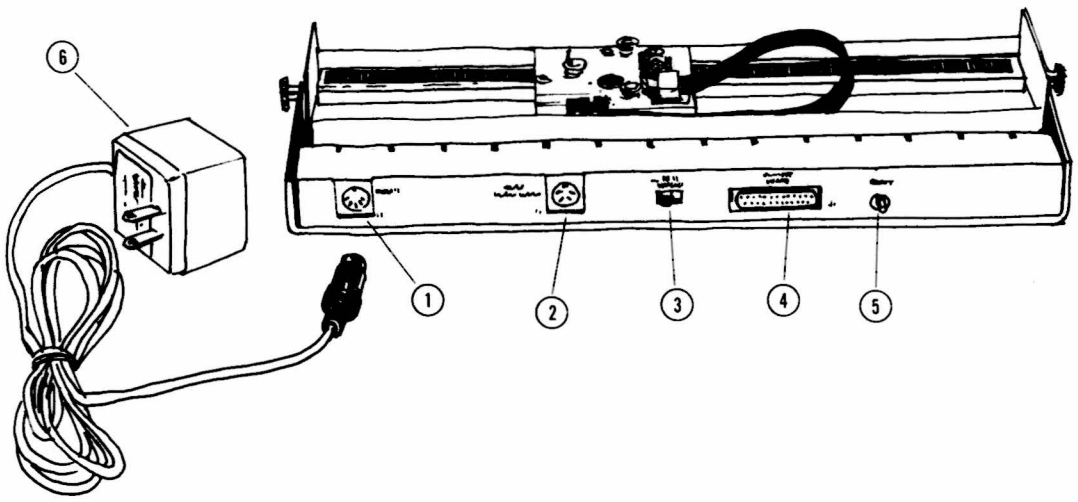


Figure 2. Digitizer (Rear View)

2/ Setting Up the Digitizer

When you're ready to set up the Digitizer for use, follow these steps:

1. Before setting up the Digitizer, be sure the Power Pack is **not** plugged in.

2. Carefully remove the Cover of the Digitizer by gently pushing up on both ends (see Figure 1).

3. Remove the plastic foam from the inside of the Digitizer. The Carriage should then move freely to the left and right. (See Figure 3.)

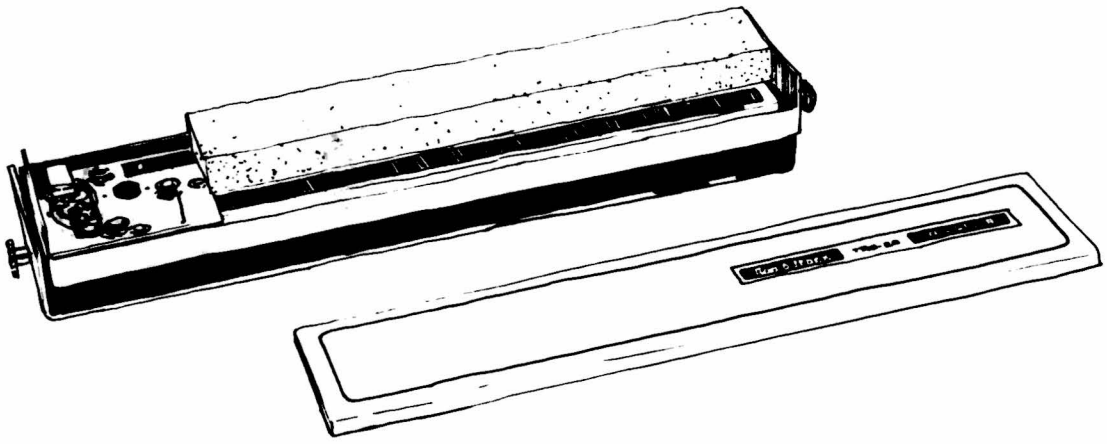


Figure 3. Unpacking the Digitizer

4. Gently reverse the position of the Cursor (on the end of the Traverse Arm) by turning it around so that it is not under the Traverse Arm. (See Figure 4.) Note that the "bottom" of the Traverse Arm has a delicate grid (with black stripes). The "top" of the Arm is bare metal.

Caution: The silver and black grid on the Traverse Arm and inside the Digitizer are part of the measuring system. Be careful not to scratch these grids.

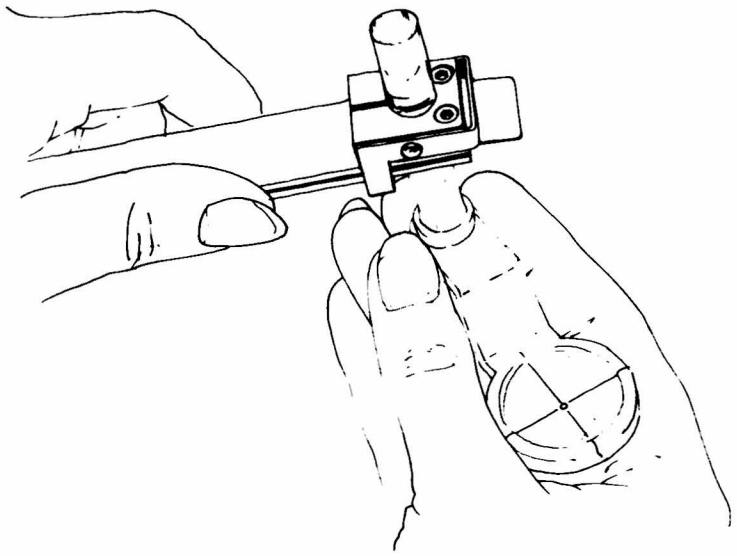


Figure 4. Cursor

5. With your left hand, hold the Carriage in place while holding the Traverse Arm in your right hand with the Cursor towards you.

6. Place the groove on the left side of the Traverse Arm against Pulley #1 so that the Arm Stop (on the end of the Arm, on the left side) is just behind Pulley #1. (See Figure 5.)

7. Gently push the Traverse Arm along Pulley #1 until Pulley #2 is encountered. Then place Pulley #2 into the groove on the right side of the Arm so that it moves smoothly. (See Figure 5.)

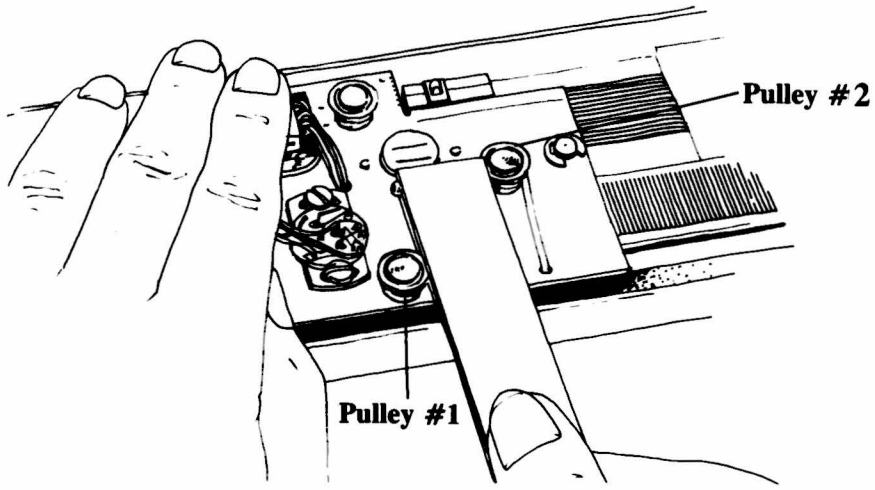


Figure 5. Inserting the Traverse Arm

8. Move the Arm backwards until the Arm Stop meets Pulley #3. Gently move the end of the Traverse Arm that is in the pulleys to the right to allow the Arm Stop to get past Pulley #3. (See Figure 6.)

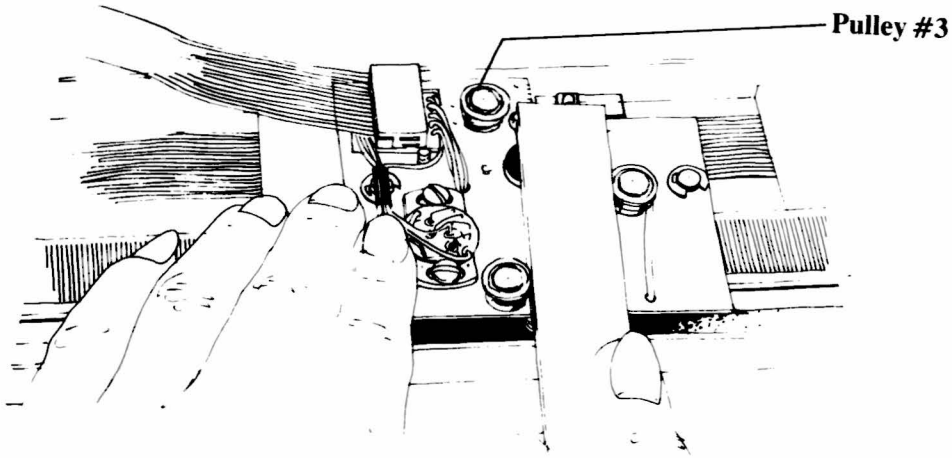


Figure 6

9. Once the Arm Stop has passed Pulley #3, straighten the Arm and push it backwards along the pulley. Be sure that Pulley #3 is in groove on the left side of the Arm. (Figure 7.)

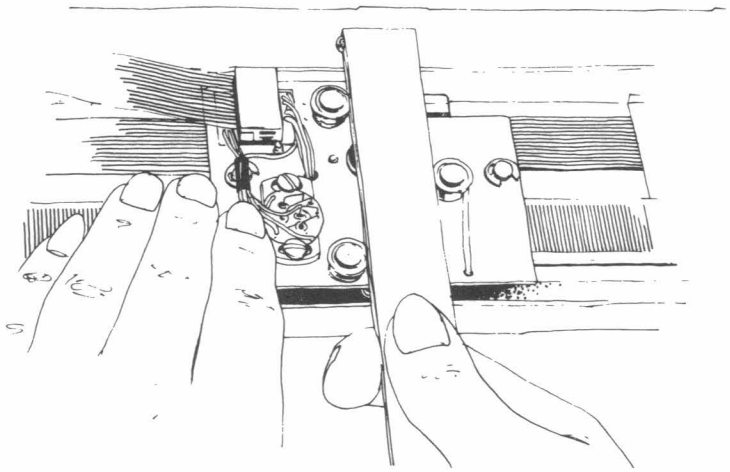


Figure 7

10. Replace the Cover.

Connecting the Digitizer to Your Computer

You have several options when connecting your TRS-80 to the Digitizer:

- If you're using a Model I Level II (with RS-232-C), Model II, or Model III, you can connect the Computer to the Digitizer via the Computer's RS-232-C Jack, using the Digitizer's J1 port.
- If you're using a Model I Level II without RS-232-C or a Color Computer, connect the Computer to the Digitizer's J4 port.
- If your Model I doesn't have RS-232-C interface (or even if it does), you can connect the Digitizer through Tape port on the back of the Keyboard.

Note: The Model III cassette circuitry cannot be used for serial communications with the Digitizer.

If a Model I is connected to the Digitizer through the Computer's RS-232-C Jack (via J4 on the Digitizer), program changes are required before you can connect the components via the Digitizer J1 port and Computer Tape Jack. This is because of differences in the signals sent through the

Computer's RS-232 and Cassette ports. In other words, a program that is running when connection is via the cassette port will not run when connection is via the RS-232 port (and vice versa).

Before connecting the Digitizer to your Computer, see your Computer's operation manual for correct connection of peripherals, locations of the RS-232-C jacks, and proper power-up procedures.

3/ Using the Digitizer

Once the paper has been positioned and the Digitizer properly connected and powered-up, you'll find the Digitizer extremely simple to use.

Positioning the Paper

Before you begin using the Digitizer, we suggest you tape the paper you're working on (i.e., the document which contains information you want to digitize) down on a flat, level working surface, such as a table.

The Digitizer can then be positioned on any side of the paper. However, the Computer must be told where the Digitizer is so that the coordinates come out the way you expect.

For instance, if the Digitizer is facing you (the way we've described it throughout this manual), the X-coordinate is specified by moving the Carriage to the left or right and the Y-coordinate is specified by moving the Traverse Arm forward and backward.

On the other hand, if you position the Digitizer on the right side of the paper, the X-coordinate is then specified by moving the Traverse Arm to the left or right and the Y-coordinate is specified by moving the Carriage forward and backward.

To compensate for differences such as these, the Computer must be "told" which is the X-axis and which is the Y-axis. An Skew Adjustment Routine (sometimes referred to as "axis rotation") allows you to define the X-Y axis on any particular document. For details on Skew Adjustment, see **Appendix B.**

Once you've positioned the paper and Digitizer, do not move them or the values the Digitizer returns will be inaccurate in respect to the original origin.

When you are ready to use the Digitizer, be sure there's enough room around the Digitizer for movement of the Traverse Arm.

SEND Switch

When you've positioned the Cursor and are ready to read information about a specific point on the document to the Computer, gently press down on the Send Switch. If you're measuring a line and need continuous measurements, hold down on the Switch until two points have been sent to the Computer, then release. The Digitizer will continue sending the location of the Cursor until you press the Send Switch again.

Note that there is a delay between the first point and the second point transmitted. This prevents sending two points to the Computer when you press the Send Switch momentarily.

RESET Switch

Whenever you press the RESET Switch (located on the back panel of the Digitizer), you will reset the values of the X-Y coordinates to zero.

This means that the origin (the point where X and Y are made zero) can be relocated anywhere in the working area simply by moving the Cursor over a point and pressing Reset.

4/ Sample Session

The following discussion refers to the sample program listed in **Appendix A.** Note that this program does not require the Skew Adjustment Routine. See **Appendix A** for specific instructions about the program.

Remember...the following discussion describes how this particular program (i.e., software) works and is used solely to illustrate the operation of the Digitizer (that is, when to press Send, what direction to move the Cursor, what happens when you press RESET, etc.). The software you use may affect the operation of the Digitizer since it is simply a piece of equipment (hardware) which is totally software dependent.

1. First type in the appropriate program for your TRS-80. (All programs do the same thing; only the "driver" routines are different.)

2. Position a piece of paper in front of the Digitizer and tape it down so it won't move.

3. Draw a point on the paper. Measure 1" from that point and draw another point.

4. RUN the program by typing: **RUN** <ENTER>

5. When the Main Menu appears, the first thing you'll have to do is set the Scale. To do this, press <1>.

6. Position the Cursor directly on top of the first point.

7. Press the RESET Switch on the back of the Digitizer. (That will specify the point as (0,0)).

8. Press the Send Switch, then release it.

9. Position the Cursor over the second point.

10. Press the Send Switch again and release it.

11. When your Computer asks **WHAT UNIT OF MEASURE ARE YOU USING?**, type **10 FEET** <ENTER>.

12. When the Computer ask **HOW MANY 10 FEETS LONG WAS THE**

REFERENCE DISTANCE?, type 1 <ENTER>.

(This will set a 1":10' relationship; e.g., 1" on the paper will equal 10 feet.)

13. Return to the Main Menu by pressing any key.

14. Now press <2> so you can measure the length of a line.

    (Use the same 1" line.)

15. When the Computer tells you to **PLACE THE CURSOR OVER THE FIRST POINT...**, do so and s the Send Switch.

    Note: The values enclosed in parenthses indicate the current X-Y coordinates.

16. When the Computer tells you to **PLACE THE CURSOR OVER THE SECOND POINT...**, do so and press the Send Switch again.

17. The Computer will then tell you the actual distance on paper (or close to it!). In this case, the distance is **LINEAR DISTANCE = 1.0000 INCHES.**

    Then the Computer will tell you the distance this represents according to the scale you specified (1" = 10'): **SCALE DISTANCE = 1.0000 10 FEET** unit.

5/ Troubleshooting and Maintenance

You can expect to have virtually trouble-free use of your TRS-80 Digitizer. However, if you should have any problems, check the following list. If you still can't remedy the problem, see your local Radio Shack service technician.

Symptom	Cure
Problems at start-up	Check power connection. Check that NORM/CASS Select switch is properly set. Check RS-232 or Cassette interface connection. Press RESET (be sure it "clicks" when you press it).
Measurement Inaccuracy	Wipe the silver and black grids on both the Traverse Arm and Carriage with soft, lint-free cloth or tissue paper. Do not use solvents to clean the grids. Check that all cables are properly connected.

6/ Specifications

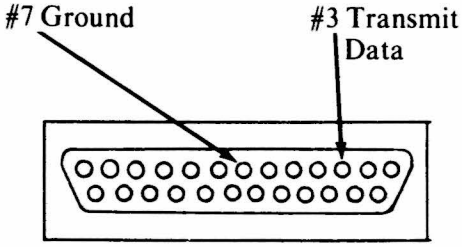
Technical Data
- Resolution .010" (.025mm)
- Accuracy + -.02" (.050mm)

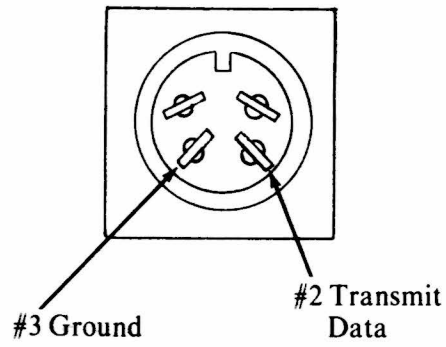
Power
- 110 VAC 60 Hz
  - 5 Watts
  - 50 MA AC

Working Area
- Maximum 11" X 17"

Physical Dimensions
- Body
  - 15 3/4" (Length)
  - 4 3/8" (Width)
  - 2" (Height)
- Traverse Arm/Cursor
  - 21 3/4" (Length)
  - 3/4" (Width)
  - 3 1/8" (Height)

Environmental Characteristics
- Temperature
  - Operating 15 to 40 Degrees C. (59 to 104 Degrees F.)
  - Storage -40 to 71 Degrees C. (-40 to 160 Degrees F.)
- Humidity 95% Relative Humidity at 40 Degrees C.





Appendix A/ Sample Programs and Driver Routines

The programs listed in this can be used with the appropriate TRS-80's. These programs actually serve two purposes:

- They show you how to use the Digitizer.
- They provide driver and initialization routines necessary for you to write your own digitizing programs.

Note that areas shaded in gray are the driver and initialization routines. You will have to include these routines in programs you write.

If you need to include a Skew Adjustment routine (to define "true" Cartesian coordinates, see **Appendix B**).

Model I, Level II Cassette Interface

```
100 ' RADIO SHACK DIGITIZER DEMONSTRATION PROGRAM
110 ' MODEL I LEVEL II VERSION
120 ' COPYRIGHT 1982 TANDY CORPORATION
130 '
140 ' INITIALIZE PROGRAM
150 '
160 DEFINT I-N
170 FOR I = 32512 TO 32677
180 READ J
190 POKE I, J
200 NEXT I
210 POKE 16526, 0
220 POKE 16527, 127
230 '
1000 ' MAIN MENU
1010 '
1020 CLS
1030 PRINT TAB(10); "RADIO SHACK DIGITIZER DEMONSTRATION PROGRAM"
1040 PRINT@192, "PLEASE ENTER YOUR CHOICE:"
1050 PRINT
1060 PRINT "          (1) SET SCALE"
1070 PRINT "          (2) MEASURE DISTANCE BETWEEN CONSECUTIVE POINTS"
1080 PRINT "          (*) EXIT PROGRAM"
1090 A$ = INKEY$: IF A$ = "" THEN 1090
```

```
1100 FOR I = 1 TO 3
1110 IF MID$ ("12*",I,1) = A$ THEN ON I GOTO 2000, 3000, 4000
1120 NEXT I
1130 GOTO 1090
1140 '
2000 ' SET SCALE
2010 '
2020 CLS
2030 PRINT TAB(22); "SET MEASUREMENT SCALE"
2040 PRINT
2050 PRINT "PLACE CURSOR OVER FIRST REFERENCE POINT, PRESS SEND SWITCH."
2060 GOSUB 5000
2070 PRINT
2080 X1 = X
2090 Y1 = Y
2100 PRINT "PLACE CURSOR OVER SECOND REFERENCE POINT, PRESS SEND SWITCH."
2110 GOSUB 5000
2120 PRINT
2130 DX = X - X1
2140 DY = Y - Y1
2150 DS = SQR ( DX*DX + DY*DY )
2160 INPUT "WHAT UNIT OF MEASURE ARE YOU USING"; UN$
2170 PRINT "HOW MANY "; UN$; "S LONG WAS THE REFERENCE DISTANCE";
2180 INPUT D0
2190 SC = D0 / DS
2200 PRINT
2210 PRINT "SCALE SET AT"; D0; UN$; "S PER INCH."
2220 PRINT
2230 PRINT "PRESS ANY KEY FOR MENU."
2240 A$ = INKEY$: IF A$ = "" THEN 2240
2250 GOTO 1000
2260 '
3000 ' MEASURE DISTANCE BETWEEN TWO POINTS
3010 '
3020 CLS
3030 PRINT TAB(15); "MEASURE DISTANCE BETWEEN TWO POINTS"
3040 PRINT
3050 PRINT "PLACE CURSOR OVER FIRST POINT, PRESS SEND SWITCH."
3060 GOSUB 5000
3070 X1 = X
3080 Y1 = Y
3090 PRINT
3100 PRINT "PLACE CURSOR OVER SECOND POINT, PRESS SEND SWITCH."
3110 GOSUB 5000
3120 PRINT
3130 DX = X - X1
3140 DY = Y - Y1
3150 DS = SQR ( DX*DX + DY*DY )
3160 DS = .01 * FIX ( DS *100 + .5 )
```

```
3170 PRINT USING "LINEAR DISTANCE = ##.## INCHES."; DS
3180 PRINT "SCALE DISTANCE ="; SC * DS; UN$; "S."
3190 PRINT
3200 PRINT "PRESS ANY KEY TO RETURN TO MENU."
3210 A$ = INKEY$: IF A$ = "" THEN 3210
3220 GOTO 1000
3230 '
4000 ' END PROGRAM
4010 '
4020 CLS
4030 PRINT @ 537, "PROGRAM ENDED"
4040 PRINT
4050 END
4060 '
5000 ' GET (X,Y) COORDINATES
5010 '
5020 J = USR(0)
5030 IF J = 0 PRINT "CANCELLED": GOTO 5020
5040 X = 256 * PEEK (J) + PEEK (J + 1)
5050 Y = 256 * PEEK (J + 2) + PEEK (J + 3)
5060 X = X + 65536 * (X > 32767)
5070 Y = Y + 65536 * (Y > 32767)
5080 X = .01 * X
5090 Y = .01 * Y
5100 PRINT USING "LOCATION:  (###.##,###.##)"; X; Y
5110 RETURN
5120 '
6000 ' DATA TABLE FOR MACHINE-LANGUAGE SUBROUTINE
6010 '
6020 DATA 205,52,127,33,0,0,194,154,10,33,174,127,229,17,166
6030 DATA 127,6,4,205,40,127,7,7,7,7,119,205,40,127,182,119
6040 DATA 35,5,194,18,127,225,195,154,10,26,19,254,64,218,49
6050 DATA 127,198,9,230,15,201,205,43,0,183,192,205,161,127
6060 DATA 202,52,127,243,205,97,127,123,254,88,194,52,127,33
6070 DATA 166,127,6,8,205,161,127,202,78,127,205,97,127,210
6080 DATA 78,127,115,35,5,194,78,127,201,205,137,127,205,156
6090 DATA 127,200,17,0,7,205,144,127,205,156,127,179,15,95,21
6100 DATA 194,107,127,123,47,230,127,95,205,144,127,55,201,197
6110 DATA 1,88,0,195,148,127,197,1,51,0,195,148,127,197,1,167
6120 DATA 0,11,120,177,194,148,127,193,201,211,255,205,130,127
6130 DATA 219,255,230,128,201
```

Model I/III RS-232

```
100 ' RADIO SHACK DIGITIZER DEMONSTRATION PROGRAM
110 ' MODEL I/III VERSION FOR RS-232
120 ' COPYRIGHT 1982 TANDY CORPORATION
130 '
140 ' INITIALIZE PROGRAM
150 '
160 DEFINT I-N
170 '
180 ' INITIALIZE RS-232
190 '
200 OUT 232,0
210 OUT 233,85
220 OUT 234,252
230 '
1000 ' MAIN MENU
1010 '
1020 CLS
1030 PRINT TAB(10); "RADIO SHACK DIGITIZER DEMONSTRATION PROGRAM"
1040 PRINT@192, "PLEASE ENTER YOUR CHOICE:"
1050 PRINT
1060 PRINT "          (1) SET SCALE"
1070 PRINT "          (2) MEASURE DISTANCE BETWEEN CONSECUTIVE POINTS"
1080 PRINT "          (*) EXIT PROGRAM"
1090 A$ = INKEY$: IF A$ = "" THEN 1090
1100 FOR I = 1 TO 3
1110 IF MID$ ("12*",I,1) = A$ THEN ON I GOTO 2000, 3000, 4000
1120 NEXT I
1130 GOTO 1090
1140 '
2000 ' SET SCALE
2010 '
2020 CLS
2030 PRINT TAB(22); "SET MEASUREMENT SCALE"
2040 PRINT
2050 PRINT "PLACE CURSOR OVER FIRST REFERENCE POINT, PRESS SEND SWITCH."
2060 GOSUB 13000
2070 PRINT
2080 X1=X
2090 Y1=Y
2100 PRINT "PLACE CURSOR OVER SECOND REFERENCE POINT, PRESS SEND SWITCH."
2110 GOSUB 13000
2120 PRINT
2130 DX = X - X1
2140 DY = Y - Y1
2150 DS = SQR ( DX*DX + DY*DY )
2160 IF DS = 0 PRINT "YOU MUST MOVE CURSOR": PRINT: GOTO 2100
2170 INPUT "WHAT UNIT OF MEASURE ARE YOU USING"; UN$
2180 PRINT "HOW MANY "; UN$; "S LONG WAS THE REFERENCE DISTANCE";
2190 INPUT D0
```

```
2200 SC = D0 / DS
2210 PRINT
2220 PRINT "SCALE SET AT"; D0; UN$; "S PER INCH."
2230 PRINT
2240 PRINT "PRESS ANY KEY FOR MENU."
2250 A$ = INKEY$: IF A$ = "" THEN 2250
2260 GOTO 1000
2270 '
3000 ' MEASURE DISTANCE BETWEEN TWO POINTS
3010 '
3020 CLS
3030 PRINT TAB(15); "MEASURE DISTANCE BETWEEN TWO POINTS"
3040 PRINT
3050 PRINT "PLACE CURSOR OVER FIRST POINT, PRESS SEND SWITCH."
3060 GOSUB 13000
3070 X1 = X
3080 Y1 = Y
3090 PRINT
3100 PRINT "PLACE CURSOR OVER SECOND POINT, PRESS SEND SWITCH."
3110 GOSUB 13000
3120 PRINT
3130 DX = X - X1
3140 DY = Y - Y1
3150 DS = SQR ( DX*DX + DY*DY )
3160 DS = .01 * FIX ( DS *100 + .5 )
3170 PRINT USING "LINEAR DISTANCE = ##.## INCHES."; DS
3180 PRINT "SCALE DISTANCE ="; SC * DS; UN$; "S."
3190 PRINT
3200 PRINT "PRESS ANY KEY TO RETURN TO MENU."
3210 A$ = INKEY$: IF A$ = "" THEN 3210
3220 GOTO 1000
3230 '
4000 ' END PROGRAM
4010 '
4020 CLS
4030 PRINT @ 537, "PROGRAM ENDED"
4040 PRINT
4050 END
4060 '
10000 ' READ ONE CHARACTER FROM RS-232
10010 '
10020 J = INP (234): IF J < 127 THEN 10020
10030 J = INP (235) AND 127: RETURN
10040 RETURN
10050 '
11000 ' GET AN 8-DIGIT STRING OF COORDINATES
11010 '
11020 GOSUB 10020: IF J <> 88 THEN 11020
11030 D$="": FOR I=1 TO 8: GOSUB 10020: D$=D$+CHR$(J): NEXT: RETURN
11040 '
12000 ' CONVERT 4 HEX DIGITS TO DECIMAL
```

```
12010 '
12020 DE=0
12030 FOR I=0 TO 3
12040 J=ASC ( MID$ (HX$,I+1,1) ) -48
12050 IF J > 9 LET J = J - 7
12060 DE = DE + J * 16↑ (3-I)
12070 NEXT I
12080 IF DE > 32767 LET DE = DE - 65536
12090 DE = .01 * DE
12100 RETURN
12110 '
13000 ' GET (X,Y) COORDINATES
13010 '
13020 GOSUB 11000
13030 HX$ = LEFT$ (D$,4)
13040 GOSUB 12000
13050 X = DE
13060 HX$ = RIGHT$ (D$,4)
13070 GOSUB 12000
13080 Y = DE
13090 PRINT USING "LOCATION: (###.##,###.##)"; X; Y
13100 RETURN
```

Model II

```
100 REM RADIO SHACK DIGITIZER DEMONSTRATION PROGRAM
110 REM COPYRIGHT 1982 TANDY CORPORATION
120 REM
130 REM ************************************************************
140 REM *  INITIALIZE SETCOM PARAMETERS BEFORE RUNNING PROGRAM      *
150 REM *                                                           *
160 REM *  SETCOM A=(300,8,N,2)                                     *
170 REM ************************************************************
180 REM
190 REM
200 DEFINT I-N
210 REM
220 REM SET UP USR CALL TO READ A BYTE FROM RS-232
230 REM
240 DIM A% (8)
250 FOR I = 0 TO 8
260 READ A, B
270 D = D + A + B
280 C = A + 256 * B
290 IF C > 32767 THEN C = C - 65536
300 A% (I) = C
310 NEXT I
320 IF D <> 2050 THEN PRINT: PRINT "DATA ERROR": GOTO 4030
330 REM
340 REM DATA LIST
350 REM
360 DATA 229,62,96,207,225,32,249,120,230,127,119
370 DATA 35,54,0,62,2,201,0
380 REM
1000 REM MAIN MENU
1010 REM
1020 CLS
1030 PRINT TAB(18); "RADIO SHACK DIGITIZER DEMONSTRATION PROGRAM"
1040 PRINT
1050 PRINT
1060 PRINT
1070 PRINT "      (1) SET SCALE"
1080 PRINT "      (2) MEASURE DISTANCE BETWEEN POINTS"
1090 PRINT "      (+) EXIT PROGRAM    ";
1100 PRINT
1110 PRINT
1120 PRINT "PLEASE ENTER YOUR CHOICE  ";
1130 A$ = INKEY$: IF A$ = "" THEN 1130
1140 ON INSTR("12+",A$) GOTO 2000, 3000, 4000
1150 GOTO 1130
1160 REM
```

```
2000 REM SET SCALE
2010 REM
2020 CLS
2030 PRINT TAB(30); "SET MEASUREMENT SCALE"
2040 PRINT
2050 PRINT "PLACE CURSOR OVER FIRST REFERENCE POINT, PRESS SEND SWITCH."
2060 GOSUB 8000
2070 PRINT
2080 X1 = X
2090 Y1 = Y
2100 PRINT "PLACE CURSOR OVER SECOND REFERENCE POINT, PRESS SEND SWITCH."
2110 GOSUB 8000
2120 PRINT
2130 DX = X1 - X
2140 DY = Y1 - Y
2150 DS = SQR ( DX*DX + DY*DY )
2160 IF DS = 0 THEN PRINT: PRINT "POINTS MUST DIFFER.": PRINT: GOTO 2100
2170 INPUT "WHAT UNIT OF MEASURE ARE YOU USING"; UN$
2180 PRINT "HOW MANY "; UN$; "S LONG WAS THE REFERENCE DISTANCE";
2190 INPUT D0
2200 SC = D0 / DS
2210 PRINT
2220 PRINT "SCALE SET TO"; SC; UN$; "S PER INCH."
2230 PRINT
2240 PRINT "PRESS ANY KEY FOR MENU."
2250 A$ = INKEY$: IF A$ = "" THEN 2250
2260 GOTO 1000
2270 REM
3000 REM MEASURE DISTANCE BETWEEN TWO POINTS
3010 REM
3020 CLS
3030 PRINT TAB(23); "MEASURE DISTANCE BETWEEN TWO POINTS"
3040 PRINT
3050 PRINT "PLACE CURSOR OVER FIRST POINT, PRESS SEND SWITCH."
3060 GOSUB 8000
3070 X1 = X
3080 Y1 = Y
3090 PRINT
3100 PRINT "PLACE CURSOR OVER SECOND POINT, PRESS SEND SWITCH."
3110 GOSUB 8000
3120 PRINT
3130 DX = X1 - X
3140 DY = Y1 - Y
3150 DS = SQR ( DX*DX + DY*DY )
3160 DS = .01 * FIX ( DS * 100 + .5 )
3170 PRINT USING "LINEAR DISTANCE = ##.## INCHES."; DS
3180 PRINT "SCALE DISTANCE ="; SC * DS; UN$; "S."
3190 PRINT
3200 PRINT "PRESS ANY KEY TO RETURN TO MENU."
```

```
3210 A$ = INKEY$: IF A$ = "" THEN 3210
3220 GOTO 1000
3230 REM
4000 REM EXIT PROGRAM
4010 REM
4020 CLS
4040 PRINT @ 834, "PROGRAM ENDED"
4050 END
4060 REM
5000 REM READ ONE CHARACTER FROM THE RS-232
5010 REM
5020 J = 0
5030 DEF USR 0 = VARPTR (A% (0))
5040 J = USR0 (J)
5050 RETURN
5060 REM
6000 REM GET AN 8-DIGIT STRING OF COORDINATES
6010 REM
6020 GOSUB 5000: IF J <> 88 THEN 6020
6030 D$ = "": FOR I=1 TO 8: GOSUB 5040: D$ = D$ + CHR$ (J): NEXT I
6040 RETURN
6050 REM
7000 REM CONVERT 4 HEX DIGITS TO DECIMAL
7010 REM
7020 DE=0
7030 FOR I = 0 TO 3
7040 J = ASC ( MID$ (HX$,I+1,1) ) - 48
7050 IF J > 9 THEN J = J - 7
7060 DE = DE + J * 16↑ (3-I)
7070 NEXT I
7080 IF DE > 32767 THEN DE = DE - 65536
7090 DE = .01 * DE
7100 RETURN
7110 REM
8000 REM GET ONE SET OF (X,Y) COORDINATES
8010 REM
8020 GOSUB 6000
8030 HX$ = LEFT$ (D$,4)
8040 GOSUB 7000
8050 X = DE
8060 HX$ = RIGHT$ (D$,4)
8070 GOSUB 7000
8080 Y = DE
8090 PRINT USING "LOCATION:  (###.##,###.##)"; X; Y
8100 RETURN
```

Color Computer

```
100 ' RADIO SHACK DIGITIZER DEMONSTRATION PROGRAM
110 ' COLOR COMPUTER VERSION
120 ' COPYRIGHT 1982 TANDY CORPORATION
130 '
140 ' INITIALIZE PROGRAM
150 '
160 CLEAR 50, 15615
170 DEFINT I-N
180 '
190 ' SET UP USR CALL
200 '
210 FOR I = 15616 TO 15896
220 READ J
230 K = K + J
240 POKE I, J
250 NEXT I
260 IF K <> 27491 THEN PRINT "DATA ERROR!": END
270 DEFUSR0 = 15616
280 '
1000 ' MAIN MENU
1010 '
1020 CLS
1030 PRINT "    DIGITIZER DEMONSTRATION"
1040 PRINT: PRINT "PLEASE SELECT:"
1050 PRINT
1060 PRINT "    (1) SET SCALE"
1070 PRINT "    (2) MEASURE DISTANCE"
1080 PRINT "    (*) EXIT PROGRAM"
1090 A$ = INKEY$: IF A$ = "" THEN 1090
1100 FOR I = 1 TO 3
1110 IF MID$ ("12*",I,1) = A$ THEN ON I GOTO 2000, 3000, 4000
1120 NEXT I
1130 GOTO 1090
1140 '
2000 ' SET SCALE
2010 '
2020 CLS
2030 PRINT "      SET MEASUREMENT SCALE"
2040 PRINT
2050 PRINT "PLACE CURSOR OVER FIRST POINT,"
2060 PRINT "PRESS SEND SWITCH."
2070 GOSUB 5000
2080 PRINT
2090 X1 = X: Y1 = Y
2100 PRINT "PLACE CURSOR OVER SECOND POINT,"
2110 PRINT "PRESS SEND SWITCH."
2120 GOSUB 5000
2130 PRINT
2140 DX = X - X1: DY = Y - Y1
```

```
2150 DS = SQR ( DX*DX + DY*DY )
2160 IF DS = 0 THEN PRINT "YOU MUST MOVE CURSOR!": GOTO 2100
2170 INPUT "WHAT UNIT OF MEASURE"; UN$
2180 PRINT "HOW MANY "; UN$; "S LONG"
2190 INPUT "WAS THE REFERENCE DISTANCE";D0
2200 SC = D0 / DS
2210 PRINT
2220 PRINT "SCALE ="; D0; UN$; "S/INCH"
2230 PRINT
2240 PRINT "PRESS ANY KEY FOR MENU"
2250 A$ = INKEY$: IF A$ = "" THEN 2250
2260 GOTO 1000
2270 '
3000 ' MEASURE DISTANCE BETWEEN TWO POINTS
3010 '
3020 CLS
3030 PRINT TAB(8); "MEASURE DISTANCE"
3040 PRINT
3050 PRINT "PLACE CURSOR OVER FIRST POINT,"
3060 PRINT "PRESS SEND SWITCH."
3070 GOSUB 5000
3080 X1 = X : Y1 = Y
3090 PRINT
3100 PRINT "PLACE CURSOR OVER SECOND POINT,"
3110 PRINT "PRESS SEND SWITCH."
3120 GOSUB 5000
3130 PRINT
3140 DX = X - X1
3150 DY = Y - Y1
3160 DS = SQR ( DX*DX + DY*DY )
3170 DS = .01 * FIX ( DS *100 + .5 )
3180 PRINT "DISTANCE"; DS; "INCHES"
3190 PRINT "("; SC * DS; UN$; "S)"
3200 PRINT
3210 PRINT "PRESS ANY KEY FOR MENU"
3220 A$ = INKEY$: IF A$ = "" THEN 3220
3230 GOTO 1000
3240 '
4000 ' END PROGRAM
4010 '
4020 CLS
4030 PRINT "PROGRAM ENDED"
4040 END
4050 '
5000 ' GET (X,Y) COORDINATES
5010 '
5020 J = USR0 (0)
5030 IF PEEK(15632) = 0 THEN 5020
5040 X = 256 * PEEK(15619) + PEEK(15620)
5050 Y = 256 * PEEK(15621) + PEEK(15622)
5060 IF X > 32767 THEN X = X - 65536
5070 IF Y > 32767 THEN Y = Y - 65536
```

```
5080 X = .01 * X
5090 Y = .01 * Y
5100 RETURN
5110 '
6000 ' USR ROUTINE DATA LIST
6010 '
6020 DATA 22,0,197,0,0,0,0
6030 DATA 0,0,0,0,0,0,0,0,0
6040 DATA 0,129,48,45,17,129,57
6050 DATA 47,10,129,65,45,9
6060 DATA 129,70,46,5,128,7
6070 DATA 132,15,57,76,40,253
6080 DATA 57,31,65,95,55,2
6090 DATA 141,224,41,25,72,72
6100 DATA 72,72,52,2,55,2
6110 DATA 141,212,41,13,52,2,83
6120 DATA 38,233,53,4,234,224
6130 DATA 53,2,170,224,31,20,57
6140 DATA 52,16,142,1,136,48,31
6150 DATA 38,252,53,16,57,52,22
6160 DATA 134,127,142,0,10
6170 DATA 183,255,2,246,255,0
6180 DATA 196,127,200,127,39,6
6190 DATA 48,31,38,240,32,5,68
6200 DATA 138,128,37,230,31,16
6210 DATA 231,140,146,53,22,57
6220 DATA 52,4,141,214,39,13
6230 DATA 246,255,34,86,37,246
6240 DATA 198,196,90,38,253
6250 DATA 141,187,53,4,57,79
6260 DATA 198,7,52,6,246,255,34
6270 DATA 141,174,86,36,2,99,228
6280 DATA 70,106,97,38,241,68
6290 DATA 53,4,234,224,57
6300 DATA 141,206,230,141,255,89
6310 DATA 39,14,141,220,52,4
6320 DATA 246,255,34,23,255,140
6330 DATA 232,224,196,1,57,26,80
6340 DATA 52,118,51,141,255,55
6350 DATA 141,223,230,141,255,58
6360 DATA 39,60,129,88,39,15
6370 DATA 23,255,50,40,239,134,3
6380 DATA 23,255,105,74,38,250
6390 DATA 32,229,167,192,198,8
6400 DATA 52,4,141,190,167,192
6410 DATA 106,228,38,248,53,4
6420 DATA 51,141,255,9,23,255,40
6430 DATA 41,16,31,2,23,255,33
6440 DATA 41,9,16,175,141,254
6450 DATA 243,237,141,254,241
6460 DATA 53,118,28,175,57
```

Appendix B/ Skew Adjust Routine

Before starting to write programs for your Digitizer, there are several standard subroutines that you should understand. These routines allow you to manipulate the data of the Digitizer so that it will be more useful to you.

Your Digitizer is designed to output X and Y coordinates that are orthogonal and oriented perpendicular to (X-axis) and parallel to (Y-axis) the edge of the Traverse Arm. Often, you will be digitizing from documents with an X and Y axis system of its own. Using scaling and offsetting, you can get the coordinates of the microcomputer to correspond to the coordinates of your map, but to make them correspond exactly, you must physically align the Digitizer very precisely to the orientation of the axes of your document. This is a tedious process.

However, it is possible to program your Computer to compute a new set of X and Y coordinate values which are at an angle to the coordinate values of the Digitizer and these new coordinates can be aligned to the coordinates of your document.

In the Skew Adjustment Routine, it is assumed that the coordinate pairs for points in a plane are being generated to some X and Y axis set. If first the coordinates X0 Y0 of some point 0 on the baseline of coordinate system are measured, then the coordinates XP and YP can be determined from the coordinates X and Y according to the formulas:

X prime = X cos theta + Y sin theta

Y prime = -X sin theta + Y cos theta

These formulas assume that the two axis systems have coincident origins and that they are both orthogonal.

Note that the following is a "stand-alone" routine. It is not written to automatically be used with the Sample Programs. However, if your particular programming needs calls for Skew Adjustment, include the routine in your digitizing program.

```
60000 ' ROUTINE TO HANDLE COORDINATE ROTATION
60010 '
60020 ' runs on:  Model I Level II
60030 '           Model I Disk Basic
60040 '           Model II Disk Basic
60050 '           Model III Level III
60060 '           Model III Disk Basic
60070 '           Color Basic
60080 '           Extended Color Basic
60090 '
60100 ' entry:  X0 = reference point's unrotated X coord
60110 '         Y0 = reference point's unrotated Y coord
60120 '         XP = reference point's rotated X coord
60130 '         YP = reference point's rotated Y coord
60140 '          X = unknown point's unrotated X coord
60150 '          Y = unknown point's unrotated Y coord
60160 '
60170 ' exit:   XR = unknown point's rotated X coord
60180 '         YR = unknown point's rotated Y coord
60190 '
60200 ' routine uses ST and CT internally
60210 '
60220 ' calculate sine theta
60230 '
60240 ST = (X0*YP/Y0 - XP) / (X0*X0/Y0 + Y0)
60250 '
60260 ' calculate cosine theta
60270 '
60280 CT = (XP + Y0*YP/X0) / (X0 + Y0*Y0/X0)
60290 '
60300 ' calculate rotated X and Y coordinates
60310 '
60320 XR = X*CT - Y*ST
60330 YR = Y*CT + X*ST
60340 '
60350 RETURN
```

Appendix C/ Technical and Programming Information

When you first begin to run a program, you'll sometimes find it useful to identify a specific point on your document or sheet of paper as 0,0. Then position the Cursor over that point and press RESET. That will define that point in the program as 0,0 and all other measurements will be made in terms of that origin for that run of the program.

Moving the Origin -- Each time the RESET button at the back of your Digitizer is pressed, the X and Y coordinate registers are made zero. In this way, the origin, the point where X and Y are zero, can be relocated anywhere in the working area of your Digitizer simply by moving the Cursor over a point and pressing the RESET button.

But, if the document you wish to digitize has a coordinate system and the area you wish to work in has no point where X and Y are zero, you must use a routine to move the origin outside the working area.

This is done by finding a point with known X and Y coordinates inside the working area; resetting the X and Y coordinates with the cursor over this known point; and then, under program control, adding the known X value of the coordinates of this point to the X coordinate and the known Y value to the Y coordinate read from the Digitizer each time a new set of coordinates is digitized.

An offset is added to the X and Y coordinates. Use this procedure on a map with latitude and longitude. Zero the Digitizer over the intersection of a known latitude and longitude and use their values as offset values. Then, with proper scaling, all the points digitized afterwards will display in latitude and longitude.

Scaling the X and Y Coordinates -- The simple concept of scale causes much confusion because of the many ways it is expressed. A common method in mapping is to express scale as:

1 inch = 20 miles

Scale is also expressed as a simple ratio, without units as in engineering drawings:

Drawing Scale = 1:2

which means the drawing has been scaled down (or up) by two times.

These two methods are the same so long as the units or measurement are used to define the scale as in the first method above.

Area Measurement and Curve Integration -- The basic approach here is to sum up strips of area equal to X*Y. To measure the area inside a figure, the area under the upper portion of the figure is considered positive and the area under the lower negative.

If the Cursor is moved along a curve, it will measure positive area when moving from left to right (increasing X values) and negative areas when moving from right to left (decreasing X).

Line Length Measurement -- The basic approach of most programs for line length measurement is the summation of successive hypotenuses. The length of the curve here is represented by the Pythagorean Theorem.

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