THE TURBO-STICK

USER MANUAL

(Preliminary Version 1.0)

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KA

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Dear Customer:

We would appreciate your comments on improving the Turbo Stick and this manual.

Thank you.

Marketing
K A Design Group

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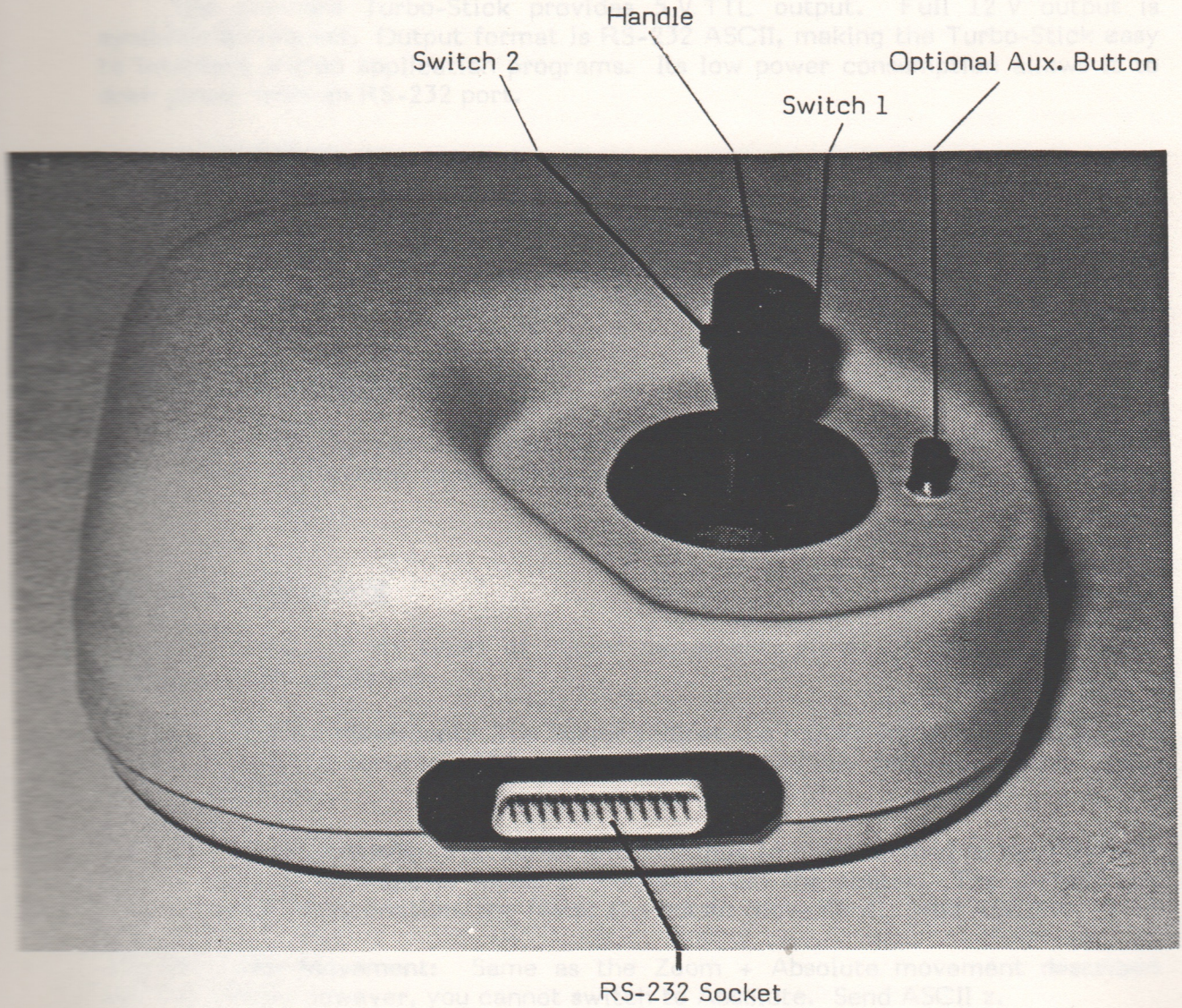
Chapter I

INTRODUCTION

The Turbo-Stick is a high-quality professional pointing device. Its many standard features include a resolution of 1 part in 4096 and six types of movement. These allow you to "change gears" and use the Turbo-Stick for both high-resolution accuracy and fast pointing speed.

This User Manual describes the Turbo-Stick and suggests ways to realize its full potential. It contains detail sufficient for most users. However, the Turbo-Stick Technical Manual is also available on request.



Chapter II

STANDARD FEATURES

This chapter lists the Turbo-Stick's standard features and provides a brief explanation for each of them. The standard features include:

High Resolution

The Turbo-Stick provides a resolution of up to 1 part in 4096. If your monitor has a resolution of 4096 x 4096, you can address each pixel with the cursor.

RS-232 ASCII Output

The standard Turbo-Stick provides 5 V TTL output. Full 12 V output is available on request. Output format is RS-232 ASCII, making the Turbo-Stick easy to interface within application programs. Its low power consumption allows it to draw power from an RS-232 port.

Automatic Cursor Control

Allows you to instruct the Turbo-Stick to place the cursor at specified coordinates. Simply send the coordinates to the Turbo-Stick in ASCII.
Example: send $0523, 4095 CRLF. For details, see Section VI.6.

Fingertip Microswitches

The handle incorporates two microswitches that are always at your fingertips. You can use them to switch between types of movement or you can define them in software.

Six Types of Movement

Select one of six types of cursor movement, either by sending an ASCII character or by jumpering.

i) **Absolute Movement:** The cursor follows the movement of the joystick and moves 16 parts in 4096. A coarse but extremely fast movement. Send ASCII a.

ii) **Rate Movement:** The cursor will continue to move as long as the handle is held at an angle of about 15 degrees from the center. The greater the angle of inclination, the faster the cursor movement. Send ASCII r.

iii) **Zoom Movement:** Same as the Zoom + Absolute movement described below; however, you cannot switch to Absolute. Send ASCII z.

iv) **Unmapped Absolute Movement:** The unmapped output of the joystick. You can use it to create your own mapping. Send ASCII decimal 2.

v) **Zoom + Absolute Movement:** Zoom is a high-resolution mode within a small imaginary window. When you reach the edge of this imaginary window, the window will "rate" in the direction of motion. Pushing the left button (on the handle of the joystick) will put the Turbo-Stick in Absolute movement for as long as the button is depressed. Send ASCII decimal 1.

vi) **Rate + Absolute Movement:** A combination of Rate and Absolute movements. Pressing the left button (in the handle) will put the Turbo-Stick into Absolute Movement for as long as the button remains depressed. Otherwise, the Turbo-Stick will be in the Rate mode. Send ASCII decimal 0.

Three Types of Output

Select one of three types of output either by jumpering or by sending an ASCII character to the Turbo-Stick.

i) **Discontinuous (or Delta) output:** data is output only when there is a change in the position of the handle or when there is a change in switch state. Send ASCII decimal 7.

ii) **Continuous output:** Data is output in a continuous, uninterrupted flow. Send ASCII decimal 6.

iii) **Output on Computer Request Only:** A string of bytes is output only when specifically asked for. The Turbo-Stick can be asked by sending the appropriate ASCII character. Send an ASCII ? (question mark).

Baud Rates

You can select from one of the following baud rates: 300, 900, 1200, 2400, 4800, 9600, 19,200. Selection is made by a jumper.

Jumpers

The Turbo-Stick provides many jumpers so that it can be wired to power-up in a specific, user-selected state. See Appendix F. Note that jumpers can be overruled by the software.

Extra Cost Custom Configurations

Bit-pad emulation (Summagraphics) can be obtained by sending the appropriate ASCII character to the Turbo-Stick. Similarly, a Z-axis can be selected by sending an ASCII character and then pressing the RIGHT button on the handle. See appendix for details on these configurations and on mouse emulation.

Chapter III

INSTALLATION

This chapter describes how to provide power to the Turbo-Stick and how to connect it to a host computer or terminal.

a. Power Supply

The Turbo-Stick can be powered from:

1. The RS-232 port of the host computer or terminal;

2. An external power supply you already own; or

3. The optional power supply you may have ordered from us.

b. Input and Output Voltage: 5 Volts or 12 Volts?

The Turbo-Stick can be ordered as either a 5 V TTL output version or a full RS-232 12 V output version.

For the 5V version	For the 12V version
Power Supply should provide +5V	Power Supply should provide +12V, -12V, and +5V OR: +15V, -15V and +5V

See the connection diagram in Section III.c for power supply connection details.

Note 1: Do not attempt to change the output voltage yourself; it can only be done at the factory.

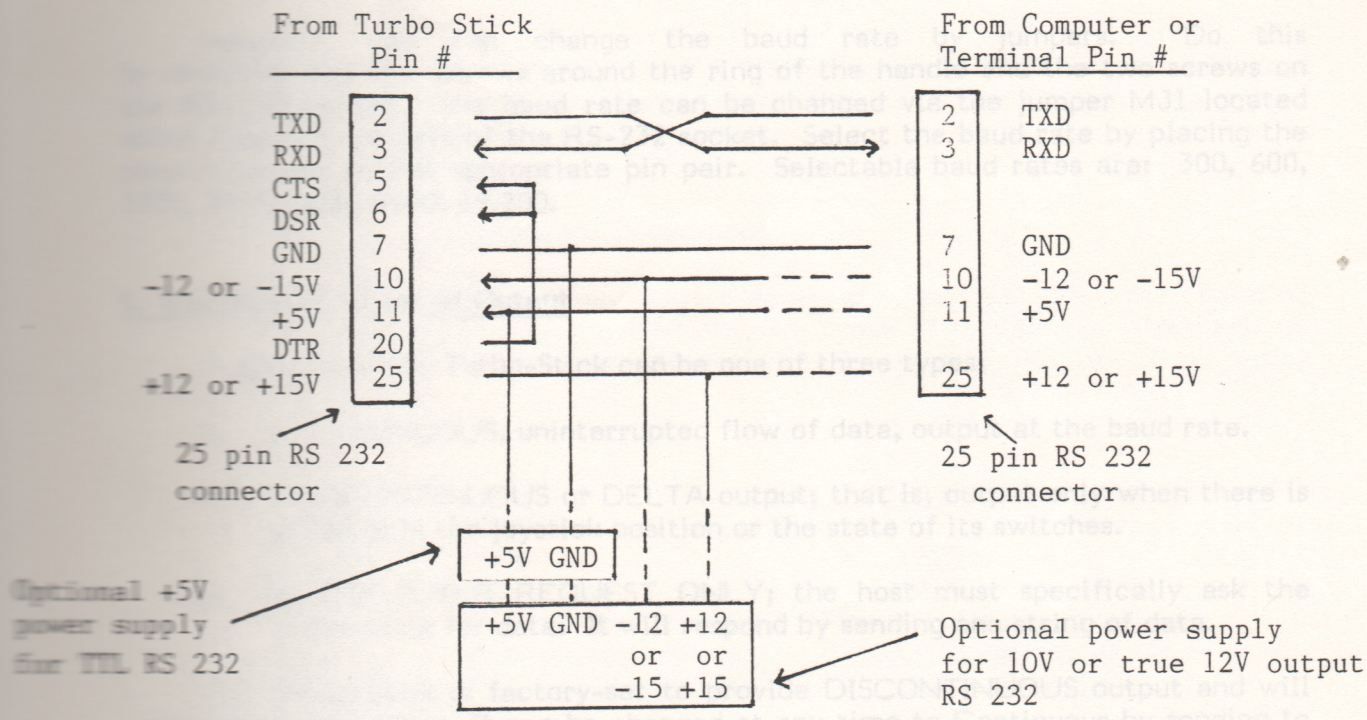
Note 2: For a 12V output, use a 15V power sup ply. A 12V power supply will result in a 10V output.

c. The "No-Handshake" Connection

The Turbo-Stick's EIAC RS-232 interface allows easy connection. In general, it is simpler to use a "no-handshake" connection, but the Turbo-Stick can also be used with a full modem, handshake connection. See Section III.d below.

The diagram below illustrates a three-wire, no-handshake connection.

c. Three Wire No-Handshake Connection



d. Full Modem "Handshake" Connection

A full-modem, handshake connection is certainly possible with the Turbo-Stick. However, the no-handshake connection is simpler.

e. Matching the Baud Rate

The baud rate setting on the Turbo-Stick is 9,600 baud unless another baud rate was specifically requested.

However, you can change the baud rate by jumpers. Do this by removing the four screws around the ring of the handle and the two screws on the RS-232 socket. The baud rate can be changed via the jumper MJ1 located about 1 inch to the left of the RS-232 socket. Select the baud rate by placing the plastic jumper on the appropriate pin pair. Selectable baud rates are: 300, 600, 1200, 2400, 4800, 9600, 19,200.

f. Matching the Type of Output

Output from the Turbo-Stick can be one of three types:

1. a CONTINUOUS, uninterrupted flow of data, output at the baud rate.

2. a DISCONTINUOUS or DELTA output; that is, output only when there is a change in the joystick position or the state of its switches.

3. on COMPUTER REQUEST ONLY; the host must specifically ask the Turbo-Stick for data. It will respond by sending one string of data.

The Turbo-Stick is factory-set to provide DISCONTINUOUS output and will power-up in that state. It can be changed at any time to Continuous by sending to it an ASCII decimal 6 or to Computer Request by sending an ASCII ? (question mark). You can revert to Discontinuous by sending an ASCII decimal 7.

Note: The Turbo-Stick can be jumpered so that it powers up in either Continuous output or Discontinuous output. See Appendix F for jumper positions.

Chapter IV

USE

The Turbo-Stick is a very powerful, flexible device. This chapter will help you uncover its myriad abilities. Before using the Turbo-Stick, please make sure that it has been installed correctly (see Chapter III for details).

a. Selecting from the Six Types of Movement

The Turbo-Stick has the ability to be a very fast, yet accurate, pointing device. It can provide any of the following six types of movement. Further, the type of movement can be changed at any time by sending the ASCII character shown:

Type of Movement	Obtain by Sending
1. Rate Movement	ASCII r
2. Absolute Movement	ASCII a
3. Unmapped Absolute Movement	ASCII decimal 2
4. Rate + Absolute Movement	ASCII decimal 0
5. Zoom + Absolute Movement	ASCII decimal 1
6. Zoom Movement	ASCII z

a.1. Rate Movement (4096 x 4096 resolution)

If you tilt the handle of the Turbo-Stick about 15° away from the center, the cursor coordinates will start to change by increments of 1. The coordinate range is 0000,0000 to 4095,4095. A larger tilt of the handle will cause the coordinates to change by increments of 4, while a still greater tilt of the handle will produce change by increments of 8. Thus, the greater the inclination of the handle, the faster the cursor movement.

This movement gives the user the capacity to use the Turbo-Stick's high resolution at three resolution vs. pointing speed trade-offs. Non-standard movement rates can be provided on a custom basis.

However, for very fast and coarse movement, the Absolute Movement is recommended.

a.2. Absolute Movement (4096 x 4096 resolution)

An extremely fast movement, recommended for moving rapidly over distances.

The position of the handle holds a direct relationship to the coordinates: In the extreme lower left position, the handle is at coordinates 0000,0000. Move it to the upper right corner, and the coordinates will now be 4095,4095. Absolute

Movement makes it possible to move to the approximate target area in a split second.

In Absolute Movement, coordinates increment by 16, the fastest increment available in a standard Turbo-Stick.

a.3. Unmapped Absolute Movement (256 x 256 Resolution)

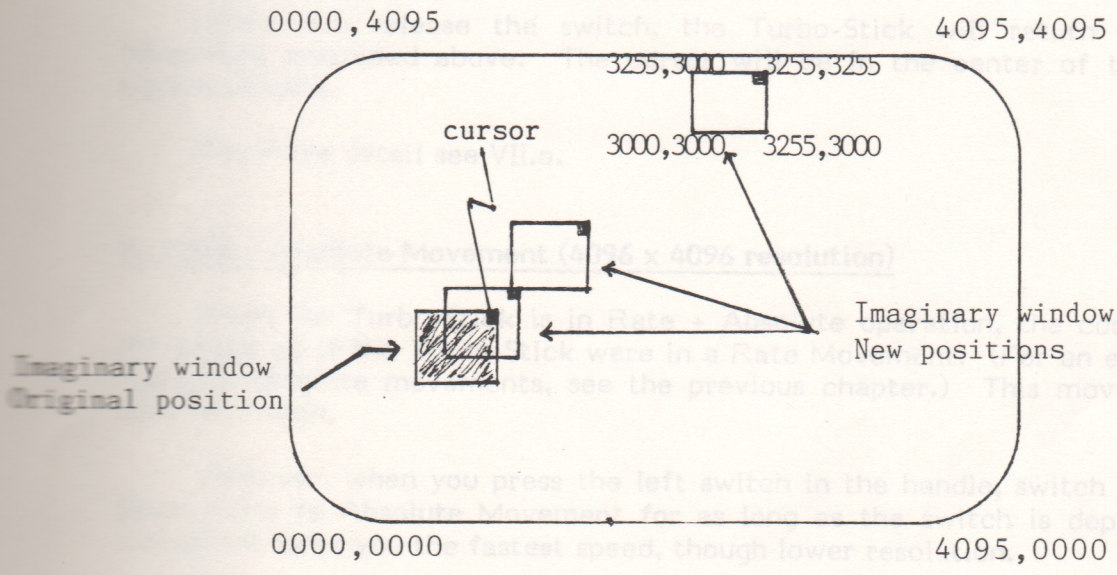
The output from the handle of the Turbo-Stick is converted directly into coordinates, in increments of 1. This provides a coordinate range of 0000,0000 to 0255,0255. You can use this movement to create your own mapping.

a.4. Zoom Movement (4096 x 4096 resolution)

Note: In this manual, the word Zoom does not have the same meaning as zooming in on an image to magnify it.

Imagine a small square window with a field of 256 x 256. Moving the handle will cause the coordinates to increment by 1. However, when the cursor reaches the edge of this imaginary window, the whole window will "rate" in the direction of cursor motion.

In Rate Movement, the speed depends on the angle of inclination of the handle. The greater the inclination, the faster the speed of movement.



Chapter V

THE TWO SPECIAL TYPES OF MOVEMENT

This chapter assumes an understanding of Chapter IV, and goes on to describe the "Zoom + Absolute" and "Rate + Absolute" Movements.

Not only does the Turbo-Stick have the ability to "change gears," but it also offers two unique types of movement. These give you the ability to "change gears" by pressing the microswitch in the handle. This button is always at your fingertips, so changing gears is convenient.

1. Zoom + Absolute Movement (4096 x 4096 resolution)

An extremely powerful movement for graphics applications.

Note: The word "zoom" does not have the same meaning as zooming in on an image to magnify it.

Imagine a small square window on the screen with a field of 256 x 256. Moving the handle will cause the coordinates to increment by 1. However, when the cursor reaches the edge of this imaginary window, the WHOLE WINDOW will start to "rate" in the direction of the cursor's motion. (If you aren't sure of the meaning of "Rate" movement, see Chapter IV.)

But it's possible to move faster: to go to a far spot on the screen, press the left switch in the handle--switch 1. The cursor will now move as if the Turbo-Stick was in the Absolute Movement: increment by 16's.

When you release the switch, the Turbo-Stick will return to the Zoom Movement described above. The cursor will be in the center of the imaginary square window.

For more detail see VII.a.

b. Rate + Absolute Movement (4096 x 4096 resolution)

When the Turbo-Stick is in Rate + Absolute operation, the coordinates will increment as if the Turbo-Stick were in a Rate Movement. (For an explanation of Rate or Absolute movements, see the previous chapter.) This movement allows high resolution.

However, when you press the left switch in the handle, switch 1, the Turbo-Stick shifts to Absolute Movement for as long as the switch is depressed. This movement gives you the fastest speed, though lower resolution.

Therefore, to move to a particular target:

1. Press and hold the switch and move to the approximate area;

2. Let go of the switch to return the handle to approximate center position. Now hone in with high precision.

c. The Difference Between Rate + Absolute and Zoom + Absolute Movements

Both movements will put the Turbo-Stick into high-speed Absolute for as long as the left switch on the handle, switch 1, is depressed.

Both Rate and Zoom provide the high resolution needed to hone in on the target. However, in Zoom the cursor imitates the movements of the handle, while in Rate the cursor continues to move for as long as the handle is held away from the center.

Thus in Zoom, if you stop moving the handle, the cursor will stop moving too.

Selection between Rate + Absolute and Zoom + Absolute is generally a matter of user preference.

For more detail see VII.b.

Chapter VI

USING THE TURBO-STICK IN APPLICATION PROGRAMS

(This chapter assumes an understanding of previous chapters.)

The Turbo-Stick was designed to be flexible, responsive, and yet be easy to program. All information is sent and received in ASCII. And both the data format and transmission can be custom-ordered, so you may not have to make any changes to your current software. You can also emulate bit-pads or mice.

a. Checking for Turbo-Stick Presence

The presence and functioning of the Turbo-Stick can be checked at any time by putting it in or on Computer Request Only output type. To do this, send an ASCII ? (question mark). The Turbo-Stick will shift into Computer Request Only, and, since a request is made, will send out one string of bytes.

It will continue to remain in this output type, so remember to send an ASCII decimal 7 to put it into Discontinuous (or Delta). You cal also send ASCII decimal 6 if you wish to have Continuous output.

Of course, you don't have to do anything if you want to stay in Computer Request Only type of output.

b. Initializing the Turbo-Stick

As part of the initialization, ALWAYS put the Turbo-Stick in one of the six desired types of movement. (See Chapter on Movements for details.)

To do this, simply send to the Turbo-Stick the appropriate ASCII decimal character described in the table below, or use jumpers as described in Appendix F.

Type of Movement	Obtain by Sending
1. Rate Movement	ASCII r
2. Absolute Movement	ASCII a
3. Unmapped Absolute Movement	ASCII decimal 2
4. Rate + Absolute Movement	ASCII decimal 0
5. Zoom + Absolute Movement	ASCII decimal 1
6. Zoom Movement	ASCII z

c. Automatic Cursor Control

This feature allows you to command the Turbo-Stick to place the cursor at a desired location. It functions in Rate movement and Zoom movement.

Example: Suppose we want to place the cursor at 0523,4096. Send the following ASCII characters:

Byte	Description	ASCII Character
1	Delimiter	$
2-5	X-coordinate	0523
6	Separator	,
7-10	Y-coordinate	4095
11-12	Delimiter	CRLF

Note: This feature will not work if the Turbo-Stick is in Absolute or Unmapped Absolute movement.

d. Using the Two Microswitches

These two switches can help make the Turbo-Stick not only a **point** device, but also a **select** device.

We strongly recommend that switch 2 (the switch on the right) be used as a "select" button. Incidentally, switch 2 is completely software definable, and will work irrespective of whether switch 1 is depressed.

However, since switch 1 is used to change between Zoom and Absolute when the stick is in the Zoom + Absolute movement, and used to change between Rate and Absolute when the stick is in the Rate + Absolute movement, the following limitations apply in software defining switch 1:

1. Can be fully defined in Rate movement.
2. Can be fully defined in Absolute movement.
3. Can be fully defined in Unmapped Absolute movement.
4. Can be fully defined in Zoom movement.
5. Remember that in Rate + Absolute movement, the user will keep switch 1 depressed whenever he wants to change to Absolute motion. Therefore, use the switch with caution. You may want to determine whether the user is selecting Absolute movement.
6. The same as (5) above applies for Zoom + Absolute movement.

e. Using the Bell

The Turbo-Stick is equipped with a bell that beeps. It can be made to beep every time switch 1 and/or switch 2 is pressed by sending the ASCII character e (Enable bell).

This feature can be disabled by sending ASCII d (Disable bell).

You can also make the bell beep at any time you wish. Send the ASCII character b (Beep bell).

The bell feature has been provided to give the user audio feedback when a switch is pressed. You can also program it to beep on error conditions.

Chapter VII

DETAILED EXPLANATIONS OF THE TWO SPECIAL MOVEMENTS

a. For Zoom + Absolute

The high-resolution Zoom mode allows precision drawing on the screen. To move to another part of the screen, a few inches away, press the left microswitch in the handle of the Turbo-Stick. (This puts the Turbo-Stick in Absolute, a movement that is 16 times faster than Zoom.) Keep the switch pressed and move the handle to reach, approximately, the intended position. Now release the little switch and you will be back in Zoom movement so that you can hone in precisely onto target.

If the second microswitch, switch 2, has been configured in the application software as a "select" button, it will be possible to select with switch 2 at all times--it doesn't matter whether you are in Zoom or Absolute movement.

The Zoom + Absolute movement provides a much faster, more natural human interface.

This provides for more concentration to the task at hand, faster finish time, and fewer mistakes. All this leads to higher quality and productivity.

b. For Rate + Absolute

Let's say you are using the Turbo-Stick in the Rate + Absolute movement. The cursor will be "rating." The big advantage of "rating" is that you can select the speed/resolution trade-offs you want.

Tilting the handle about 15° away from the center and holding it there provides a movement of 1 part in 4096. However, if you want to move a little faster than that, simply tilt the handle a few more degrees and you will start to move 4 parts in 4096--four times faster. And for still more speed, you can angle the handle further to provide 8 parts in 4096 movements.

To reach a particular target, therefore, you may elect to "accelerate" from 1 part in 4096 to 4 parts and to 8 parts, stay at that speed for about a second, and "decelerate" to a stop at the target.

This sequence is not unlike that of a car starting as the light turns green, accelerating, maintaining cruising speed, and then decelerating to a stop at the next intersection. (Of course, there are no speed limits here.)

For very fast movement, however, you can always rely on your Turbo-Stick to zip through the screen at a top speed of 16 parts in 4096 whenever you press the left microswitch in the handle.

Let's assume in this example that switch 2, the switch on the right, is software defined to be a "select" button. Then the user can easily move to a menu, using the Absolute movement. If he overshoots, he can always rate back.

c. Application Examples

Many, many applications have been found for the Turbo-Stick. Think of it as an extremely flexible device that changes coordinates. Changing coordinates can be used to control another device, or more traditionally, used to move the cursor on the screen.

Here are some examples that indicate the broad range of applications possible with the Turbo-Stick.

1. Using it to move robot arms: The Turbo-Stick provides 2 axes (x and y). However, press switch 1 and you can be in two other axes. Press switch 2 and you have two more. Finaly, pressing switch 1 and switch 2 will bring the total up to 8 available axes. (Robots generally have up to 6 degrees of freedom.) You can also use the optional rotary switch to control other functions. A little software goes a long way! And RS-232 ASCII output is easy to program with.

2. Using it to control: Don't limit your self to cursor movements. We know of a user who uses the Turbo-Stick's regular coordinate change to control a microscopy device.

Appendix A

USING THE OPTIONAL 12-POSITION ROTARY SWITCH

The Rotary switch's output ranges from 0 to B. This switch can be very useful in applications that need control from the Turbo-Stick. For quantity orders, we can custom imprint the functions of the Rotary switch positions.

Appendix B

USING THE OPTIONAL AUXILIARY BUTTON

Using the optional auxiliary button is simple. Just think of it as another switch that can be fully software defined. The switch provides ASCII decimal output of either 0 (not depressed) or 1 (depressed).

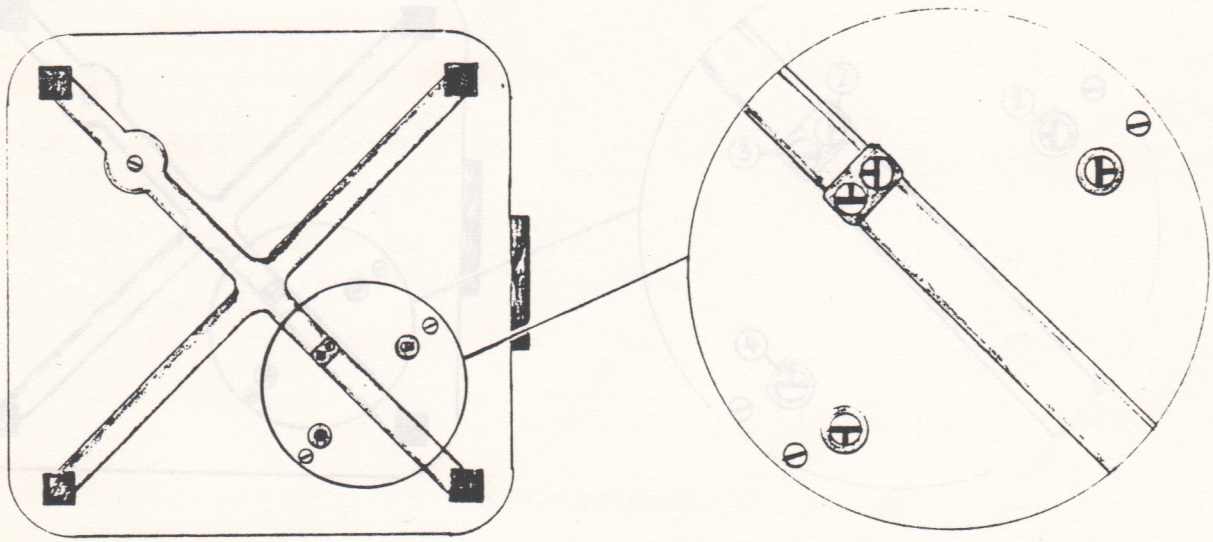
Appendix C

HOW TO CHANGE BETWEEN RETURN-TO-CENTER AND NO-RETURN HANDLE ACTION

This is an optional feature, so this part may not apply to your Turbo-Stick.

Return-to-Center Mode:

Turn the Turbo-Stick upside down. At its base there should be four slotted dowels visible in three holes. Each dowel has a small indicator at its end. Use a screwdriver and turn the dowels as shown below:

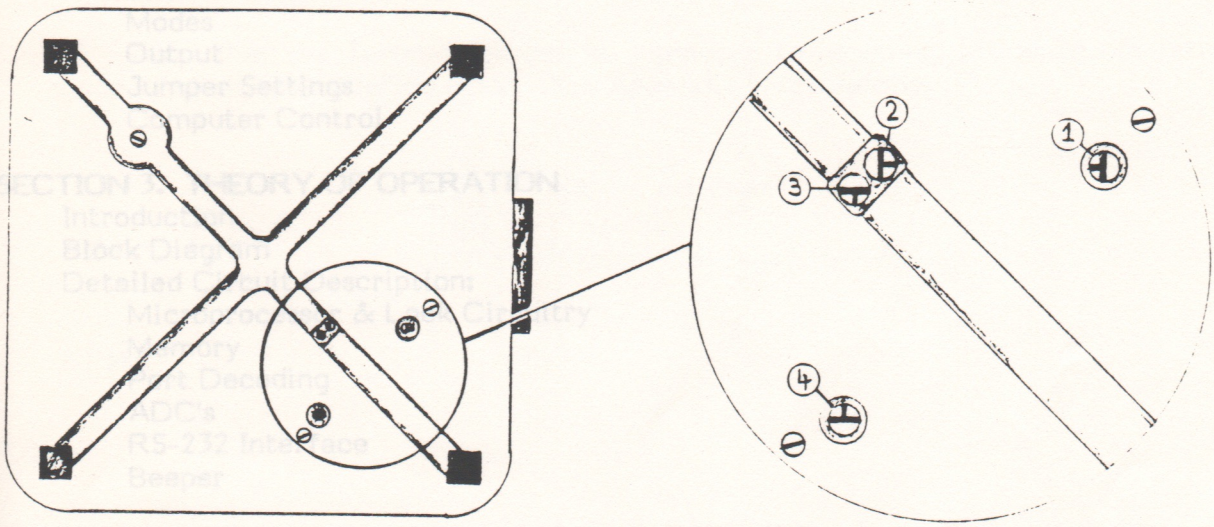


Friction Mode (or No-Return-to-Center Mode)

Turn the TURBO-STICK upside down as shown in the drawing. At its base there should be four slotted dowels visible in three holes. Each dowel has a small indicator at its end. Use a screwdriver to turn the dowels, one at a time, into the direction shown below using the following procedure:

1. push joystick to far left and turn dowel #1 as shown.
2. push joystick to the far right and turn dowel #2 as shown.
3. push joystick to the far bottom and turn dowel #3 as shown.
4. push joystick to the far top and turn dowel #4 as shown.

Note that the joystick is viewed upside down.



Appendix D

WHAT THE TECHNICAL MANUAL CONTAINS

Should you want more detail, the Turbo-Stick Technical Manual is available. Its table of contents is:

SECTION 1. GENERAL INFORMATION
- Introduction
- Technical Specifications
- External Appearance

SECTION 2. OPERATION
- System Configuration
- RS-232 Interface
- Joystick
- Power Supply
- Operating Procedure:
  - Introduction
  - Buttons
  - Modes
  - Output
  - Jumper Settings
  - Computer Control

SECTION 3. THEORY OF OPERATION
- Introduction
- Block Diagram
- Detailed Circuit Description:
  - Microprocessor & Lock Circuitry
  - Memory
  - Port Decoding
  - ADC's
  - RS-232 Interface
  - Beeper

SECTION 4. TROUBLESHOOTING AND MAINTENANCE
- General
- ADC Adjustment

SECTION 5. PARTS AND SCHEMATICS
- Replaceable Electrical Parts
- Schematics
- Circuit Board Illustrations

If ordering from the Continental United States, please send a check for $20.00 to:

KA Design Group, 6300 Telegraph Avenue, Oakland, CA 94609. (415) 654-6300.

Ask for the Turbo-Stick Technical Manual. Please give your Turbo-Stick version number. (This is NOT the same as the manual's version number.)

Appendix E

MOUSE EMULATION/BIT PAD EMULATION (OPTIONAL)

Your Turbo-Stick is an extremely flexible device that can easily emulate lesser devices such as mice and bit pads.

Note that the full power of the Turbo-Stick--the fast point-and-select capability--cannot be completely realized when it is emulating lesser devices.

To invoke mouse emulation (emulates the M1 and M2 mouse of Mouse Systems Corporation), send the ASCII character decimal 3.

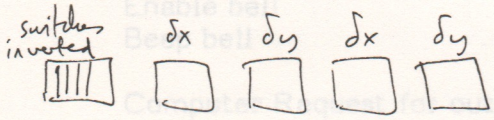
To invoke bit pad emulation (emulates the Summagraphics bit pad), send the ASCII character decimal 4.

To return to normal Turbo-Stick output, send the ASCII character decimal 5.

The emulation feature of the Turbo-Stick allows you to use the Turbo-Stick without making modification to your software (assuming your software is written to accept mouse or bit-pad input).

Note that the Turbo-Stick can be jumpered to power-up in mouse emulation mode or bit-map emulation mode. See Appendix F for details.

mouse : 5 bytes.



bit pad = ?

Appendix F

REFERENCE: JUMPER POSITIONS AND ASCII INPUT

The Turbo-Stick is equipped with jumpers so that it powers up in a jumpered mode. Note that any jumpered setting can be overruled by sending the appropriate ASCII character to the Turbo-Stick.

Standard Setting	Jumper Position	Effect	ASCII Character Received by Turbo-Stick from Host	
x	0	Rate + Absolute Movement	0	no trailing CRLF - gets confused!
	1	Zoom + Absolute Movement	1	
	2	Unmapped Absolute Movement	2	
	3	Mouse Emulation	3	
	4	Bit-pad Emulation	4	
x	5	Regular Turbo-Stick Output	5	
	6	Continuous Output	6	
x	7	Discontinuous (Delta) Output	7	
		Disable bell	d	- after mode set
		Enable bell	e	
		Beep bell	b	
		Computer Request for output	?	
		Zoom movement	z	
		Absolute movement	a	
		Automatic Cursor Control (Example)	$ 0000,4095 CRLF	

STANDARD SPECIFICATIONS

Technical Specifications

• Type	The Turbo-Stick
• Resolution	1 part in 4096
• External Interface	Full EIA RS-232 serial interface
	5V TTL output (standard)
	12V output (optional)
• RS-232 Transmission format	1 start bit
	8 data bits
	no parity
	1 stop bit
	custom formats available
• Baud Rate	Selectable from 300 to 19.2K
	Factory-set at 9.6K
• Power Consumption	1W @ 5V (0.5 W optional)
• Weight	0.8 kg (1.75 lb)
• Dimensions	W = 20 cm (8")
	D = 20 cm (8")
	H = 10 cm (4")
• Data Format	8 bit ASCII, 20 bytes

Example

te #: 1	2	3	4	5	6	7	8	9	10-13	14	15-18	19-20
	Joystick				Aux.		Aux.		X		Y	Delimiter
Delimiter	button 1		button 2		button		Rot. Switch		Value		Value	
$	0	,	1	,	0	,	5	,	1513	,	0028	CR LF