ramtek

# CURSOR CONTROLLER

# (JOYSTICK)

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## NOTICE

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Ramtek

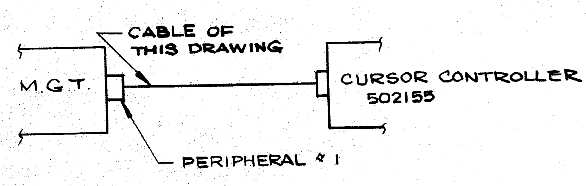
# CURSOR CONTROLLER (Joystick), MGT 6000 Series

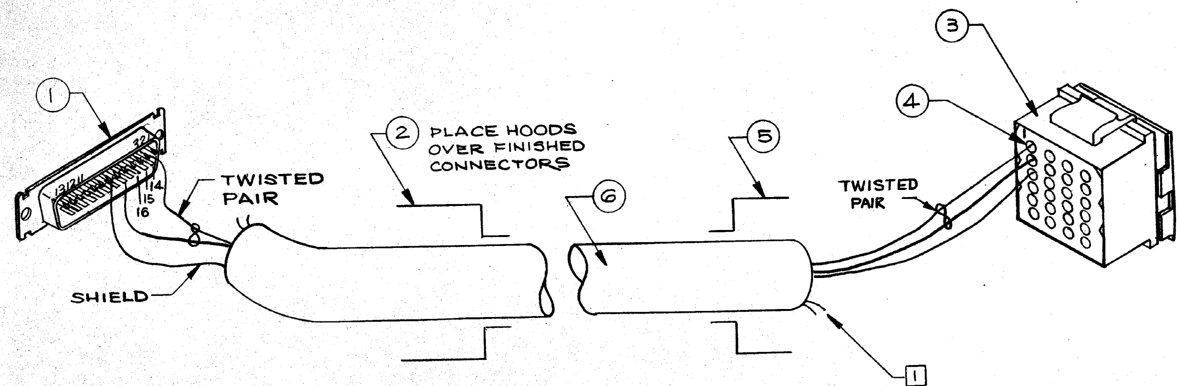
Cable Assembly Drawing #503671 adapts the Cursor Controller (Joystick) to the 6000 Series.

When used with a 6000 Series Colorgraphic Computer Terminal and Cable #503671 the Joystick operations are identical to the information contained in the Joystick manual, with one exception: only cursor Ø is defined.

Cable #503671 is designed to interface the Joystick to peripheral part #1 on the 6000 Series. For information regarding the peripheral part #1 consult the 6000 Series Theory of Operation Manual.

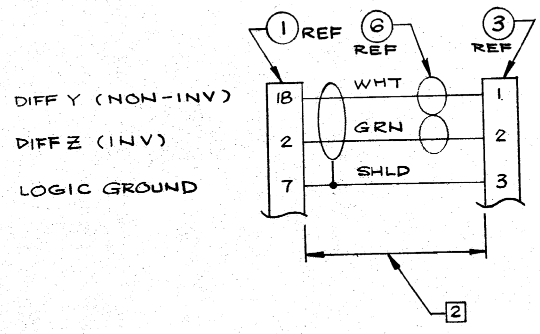
| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | APVD | DATE |
| A | REL PER ECO# 0208 | F. Loo | 12-15-77 |




NOTES:

1. CUT REMAINING 2 WIRES FROM CABLE BOTH ENDS.
2. FINISHED CABLE LENGTH:
   - −01 4' ± 3"
   - −02 10' ± 6"
   - −03 SEE MARKETING CONFIGURATOR 1000' ± 10' MAX.




SEE SEPARATE L/M

| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|
| LIST OF MATERIALS | | | |

| | | | |
|---|---|---|---|
| | TOLERANCES<br>UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES.<br>.XX .XXX ANG | DO NOT SCALE DRAWING | RAMTEK |
| | MATL | SIGNATURES / DATE | TITLE: MGT CURSOR CONTROLLER CABLE ASSY |
| | | DWN Henry Chou 12/13/77 | |
| | | CHK [signature] 12-15-77 | SIZE C |
| 502155 | FINISH | ENG [signature] 22 DEC 77 | SCALE — |
| NEXT ASSY | | APVD [signature] 12-17-77 | DWG NO. 503671 REV A |
| | | | SHT 1 OF 1 |

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## 1.0 INTRODUCTION

The Ramtek Cursor Controller is an interactive peripheral device used to position a cursor upon a video graphic display. The Cursor Controller consists of a joystick, four status switches (Enter, Track, Visible and Blink), four channel select switches, and power switch. The controller interactively positions the cursor via the joystick, controls cursor status with the Visible and Blink status switches and informs the CPU of current cursor coordinates and status by the Enter and Track switches.

The controller is designed to interface directly with Ramtek's GX100 and GX100B Multiplexer or 9000 Series Serial Link boards using the serial input channels. The Cursor Controller and Ramtek's Trackball operate with the Multiplexer or Serial Link in an identical manner. Both use serial transmission lines to send data to the display generator. The Multiplexer/Serial Link stores cursor coordinates and status while generating the cursor video image. The Cursor Controller does not store cursor coordinates, but issues increment/decrement commands which in turn update the cursor position on the screen. The rate of increment/decrement commands issued by the controller, (hence how fast the cursor moves on the screen), is directly proportional to the amount of displacement of the joystick from its center position.

FIGURE 1-1 JOYSTICK

## 1.1 JOYSTICK OPERATION

The controller is a directional "rate" device and not a positional control device. That is, when the joystick is moved in any direction from the center (at rest) position, the cursor begins to move slowly in the direction the stick was displaced. The further the joystick is displaced from center, the faster the cursor moves in that direction. When the joystick is held in a constant position, the cursor moves across the screen at a constant rate. Release of the joystick returns the stick back to its spring-loaded center position and stops cursor movement.

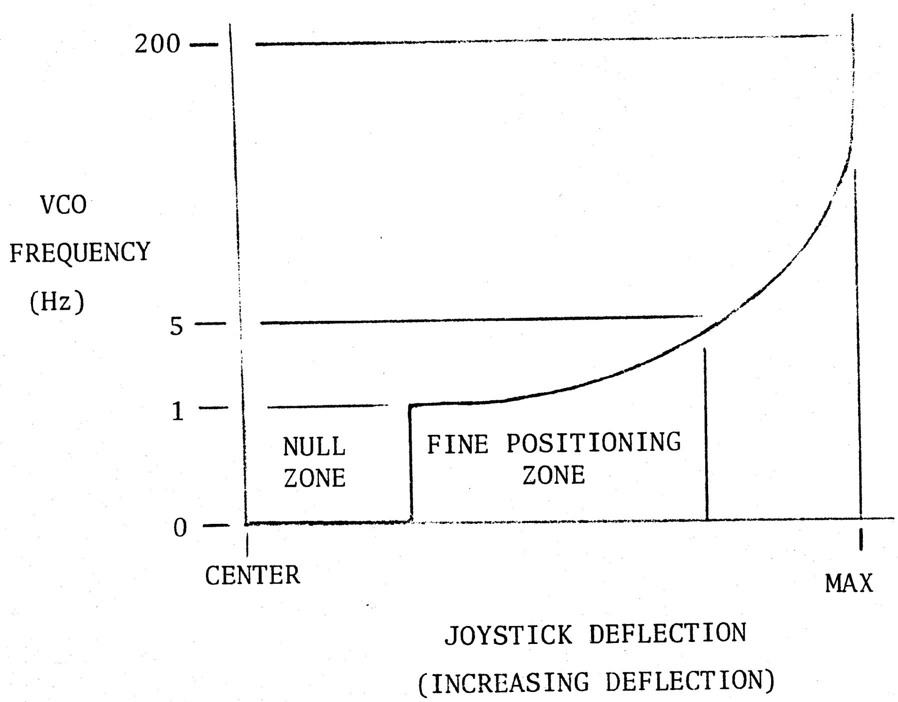
The joystick may be displaced at any angle even though it feels easier to move the stick directly up, down, right or left. When viewed from the front, the position of the stick corresponds exactly with the direction of the cursor movement:

| Push the Stick: | The Cursor Moves: |
|---|---|
| Forward | Up |
| Backward | Down |
| Left | Left |
| Right | Right |

The rate of cursor movement in any axis is infinitely variable from about 1 element/sec when the stick is barely displaced ($\simeq 5^{\circ}$ deflection) to a maximum of traversing the screen from one edge to the other in about 3 seconds (Full deflection). This mode of operation is used to move the cursor quickly from point to point.

A second mode of joystick operation allows one element cursor movement in any direction to easily and accurately position the cursor on a single screen element. To move the cursor one element only, the joystick is slightly displaced or "bumped". This action causes the cursor to move one element or line in the direction of joystick displacement. The cursor will not move any more elements until the stick is released and "bumped" again, or displaced further to start cursor movement as defined in the above mode.

This unique feature of Ramtek's cursor controller allows the operator to be assured of moving the cursor one and only one element in any direction for ease in accurate positioning. The joystick displacement versus rate of cursor movement curve is not linear but exponential in nature as shown below.



There exists a small null zone around the center (at rest) position of the stick so that minimal displacements do not cause cursor movement. This prevents the cursor from "creeping" on the screen when the stick is centered. The null zone also allows the cursor controller to be used without bothersome trim adjustments to worry about and to compensate for drift effects.

## 1.2 POWER SUPPLY REQUIREMENTS

| | | |
|---|---|---|
| 105 - 135 VAC | 47 to 440 Hz | ½ Amp max. |
| 210 - 250 VAC | 47 to 440 Hz | ¼ Amp max. |

Power is applied to the cursor controller by a lighted rocker switch on top of the unit. The supply is fused with the fuseholder on the back of the controller. The unit is supplied with a convenient 6 foot power cord.

## 2.0 INSTALLATION, MAINTENANCE AND OPERATION

### 2.1 INITIAL INSPECTION

Each Ramtek Cursor Controller is carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect operating order upon receipt. To confirm this, the system should be inspected for physical damage in transit. Check major component assemblies to determine if any assemblies or screws have been loosened by vibration. Tighten any loose screws or mounting hardware as required. Inspect input receptacles for foreign material which may impair electrical contact when cable connections are made. Also, check for supplied accessories. If there is damage or deficiency, see the warranty contained in this manual.

### 2.2 INSTALLATION

The unit is self contained and may be mounted on a convenient table or desk within viewing range of the associated monitor.

Power is applied to the cursor controller through a 6 foot power cord of the conventional NEMA 3-wire system. The unit may be ordered for either 105-135 VAC (½ amp fuse) or 210-250 VAC (¼ amp fuse), 47-440 Hz in line frequency. The fuseholder is on the rear of the unit.

## 2.3 CABLES AND CONNECTORS

The connector for the controller is found on the back of the unit. It is a 24 pin Burndy:

Female P/N #SMS 24 R-1

its mate is:

Male P/N #SMS 24 P-1

The hood protector is suggested:

P/N #SMS 24 H-1

Using 24 gage wire, the connector pins are:

P/N #SM 20 ID 27

Refer to Table 2-1 for Burndy pin assignments.

Refer to Section 4-4 for schematic of cable drawing #502202.

BURNDY PIN ASSIGNMENTS

| PIN ASSIGNMENT | FUNCTION |
|---|---|
| 1 | Ch 1 Y-Inverting differential serial output |
| 2 | Ch 1 Z-Non-inverting |
| 3 | Logic common (for Ch 1 and Ch 2) |
| 5 | Ch 2 Y- |
| 6 | Ch 2 Z- |
| 7 | Logic Common |
| 9 | Ch 3 Y- |
| 10 | Ch 3 Z- |
| 11 | Logic Common |
| 13 | Ch 4 Y- |
| 14 | Ch 4 Z- |
| 15 | Logic common (Ch 4) |
| 22 | +5V Test Point |
| 23 | Chassis (Earth) Ground |
| 24 | Logic Ground |

TABLE 2-1

## 2.4 CONTROL

### STATUS SWITCH OPERATION

Four status switches determine the status of the cursor on the screen and inform the CPU of current cursor coordinates. These switches are:

| | |
|---|---|
| Visible | This alternate action switch turns the cursor on and off. Cursor coordinates are not affected by the position of this switch. |
| Blink | The Blink switch is an alternate action switch that, when on, causes the cursor to blink at approximately a one-per-second rate. When Blink is off, the cursor remains steady on the screen. Cursor coordinates remain unaffected by Blink. |
| Enter | Enter is a momentary switch which causes current cursor coordinates and status to be sent to the CPU regardless of the position of any status switch or the position of the joystick. If the Enter switch is held on, the cursor controller ceases to function until the switch is released. As soon as Enter is released, the cursor controller resumes normal action. |
| Track | When on, this alternate action switch causes every new coordinate to be entered into the CPU. Every movement of the cursor is defined to be a |

| | |
|---|---|
| Track (Continued) | change in coordinates. When the Track switch is off, the cursor still moves on the screen, but the coordinates are not issued to the CPU. |

ALTERNATE ACTION SWITCHES

Visible

Blink

Track

Changing the condition of any of these switches will cause one word to be issued from the cursor controller *if the enter switch is not depressed.* A change in condition is defined as moving any switch from its present position to its alternate position (i.e., from off to on *or* from on to off).

The word issued will contain the new status of all three switches with all joystick bits zero and the enter bit zero.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | T | B | V |
| +x | -x | +y | -y | E | | | |

#1

MOMENTARY SWITCH

Enter

Pressing the Enter switch unconditionally causes one word to be issued from the cursor controller. The word issued will contain the Enter bit set along with the current status of Track, Blink and Visible, while all joystick bits will be zero, as in #2 below. Further transmission of *any* word is inhibited until the Enter switch is released.

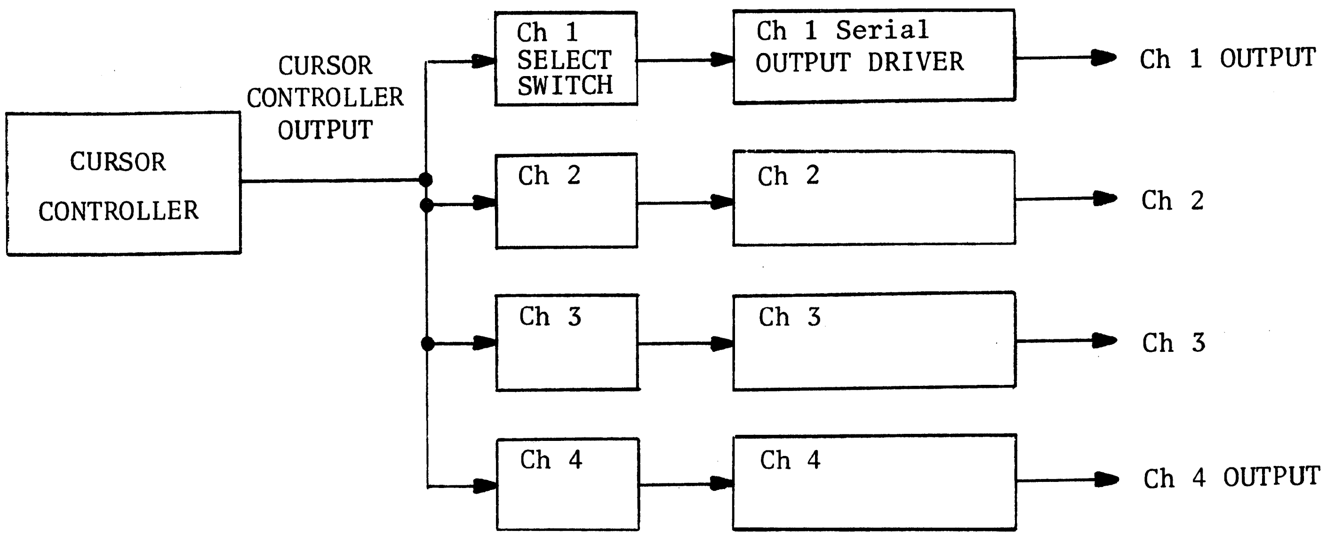
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | T | B | V |
| +x | -x | +y | -y | E | | | |

#2

Note that if the Enter switch is held down and other status switch positions are changed, the change in condition of these other switches will not be sent until the Enter switch is released. A word is always issued upon release of the Enter switch of the form of #1 above.

CHANNEL SELECT SWITCHES

Using the four channel select switches, the operator can control up to four cursors simultaneously with one cursor controller unit. These alternate action switches cause the output of the controller to be distributed to the output channel(s) selected by the switches. When a switch for any channel is on, the output of the controller appears on the serial output for that channel. When the switch is off, the serial output for that channel goes to an idle or no transmission mode. The following block diagram depicts the 4 output channels that could correspond to four multiplexer/serial link inputs:




Any combination of switches can be "on" simultaneously including all "on" or all "off."

A word of caution in using the status select switches.

The channel select switches should *NEVER* be changed while moving the cursor with the joystick or while switching the status switches. Since the controller operates with a serial output line, changing the channel select switches while the unit is transmitting may cause unpredictable results of cursor movement or status.

As long as the joystick is centered and the status switches are stationary, the channel select switches can be changed at will with no effects. Power does *not* need to be off to change the channel select switches.

## 2.5 REPACKING FOR SHIPMENT

The following paragraphs contain a general guide for repackaging of the Ramtek Cursor Controller for shipment. It is recommended that the original packing material be retained. Instructions are given if original or new packing is to be used.

The purchaser must obtain prior approval from RAMTEK to return equipment to be repaired at the factory in California.

If the equipment is to be shipped to RAMTEK for service or repair, attach a tag to the chassis identifying the owner and indicate the service or repair to be accomplished. Include the model number and full serial number of the equipment. In any correspondence, identify the equipment by model number and serial number.

If the original container is to be used, proceed as follows:

a. Place chassis in original container as previously packed.
b. Ensure that container is well sealed with strong tape or metal bands.

If original container is not available, proceed as follows:

a. Wrap chassis in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of chassis and protect connectors and panel face with cardboard strips.

c. Place equipment and inner container in heavy carton or wooden box and seal with strong tape or metal bands.

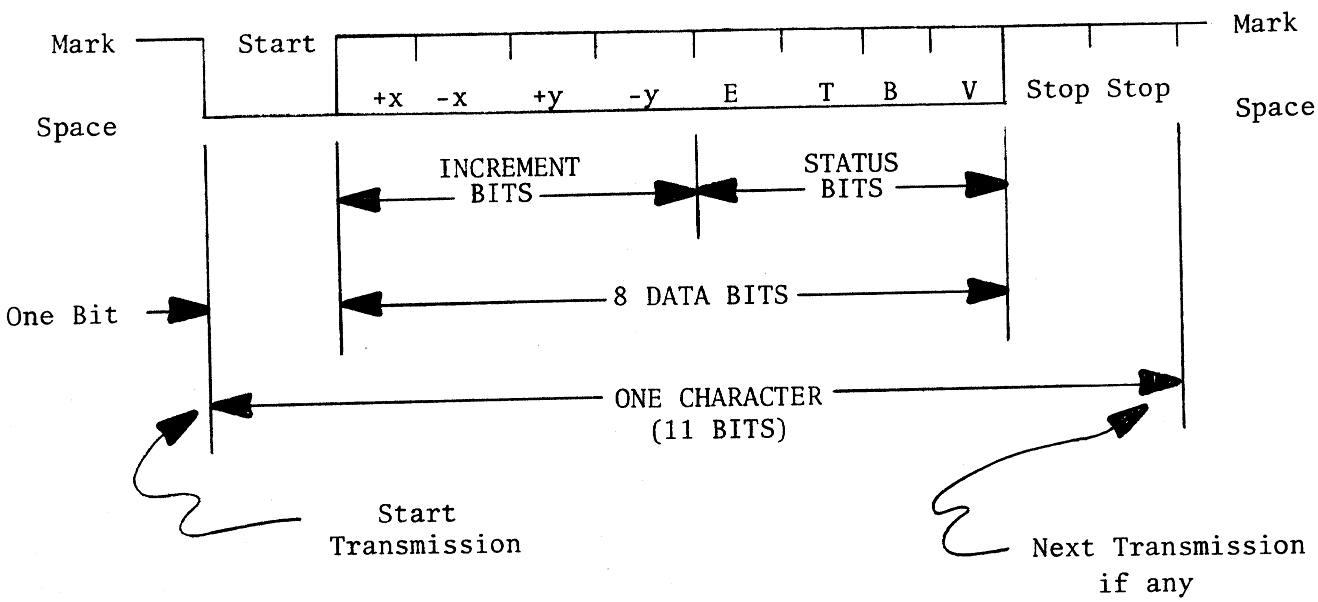
d. Mark shipping container with "DELICATE INSTRUMENT", "FRAGILE", etc.

## 3.0 THEORY OF OPERATION

### 3.1 SERIAL TRANSMISSION DEFINITIONS

#### 3.1.1 TRANSMISSION FORMAT

The output of the cursor controller is a differential serial line with the following output character format:




The Start Bit is shifted out first, Stop Bits last.

One character transmitted from the cursor controller consists of 11 Bits:

1 Start Bit

8 Data Bits, and

2 Stop Bits.

Parity checks are not possible as the controller does not generate parity. A parity bit for the controller cannot be specified. There are always two stop bits.

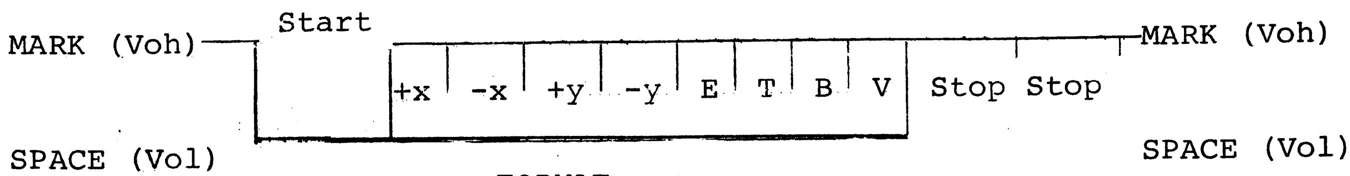
The controller transmits at 9600 baud. This means that the data bits are serially shifted out at 9,600 bits/sec. The maximum character rate of the controller then is:

$$\text{CHARACTER RATE}_{\text{Max}} = \frac{9600 \text{ Bits/Sec}}{11 \text{ Bits/Char}} \cong 873 \text{ Char/Sec}$$

Although the maximum character rate is 873 char/sec, the actual rate at which the controller outputs characters is dependent upon how far the joystick is displaced. Typically when the joystick is displaced to its limit in any direction, the controller transmits about 200 char/sec maximum.

### 3.1.2 TRANSMISSION DEVICE

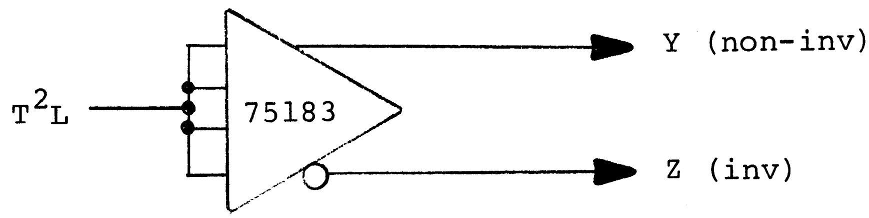
The controller uses dedicated TTL level differential drivers for each output channel, each driver capable of driving up to 1,000 feet of shielded, twisted-pair cable. The signals are truly differential with the driver using a single +5V supply. (Output levels of the drivers are shown in the following example with the transmission format given as a reference:)




FORMAT

| | Y (non -inv) | Z (inv) |
|---|---|---|
| MARK (Voh) | HIGH | LOW |
| SPACE (Vol) | LOW | HIGH |

OUTPUT LEVEL TABLE - TTL LEVELS

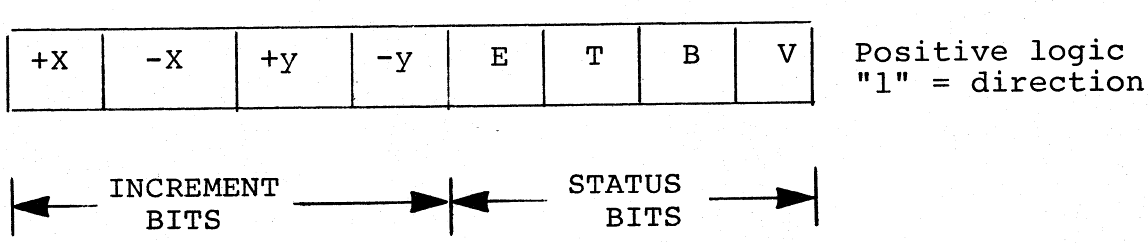



DRIVER STRUCTURE

The output drivers are Texas Instruments Type SN75183 dual line driver or equivalent. See Texas Instruments specifications for more detailed information on the driver characteristics.

### 3.1.3 OUTPUT WORD FORMAT

The output word of the cursor controller contains 8 data bits defined by the following diagram.



### 3.1.4 INCREMENT BITS

These four bits are valid only during displacement of the joystick. They indicate direction of cursor movement.

| | |
|---|---|
| +X (Right) | Indicates the cursor should move one high resolution element to the right. If the cursor controller is connected to a low resolution display system, two words will be required to move the cursor one low resolution element. |
| -X (Left) | Indicates the cursor should move one high resolution element to the left. Again, two words are required to move the cursor one low resolution element. Note that the +X and -X bits are never set simultaneously. |
| +y (Up) | Indicates cursor movement one high resolution line up the screen. Two words are required to move the cursor up one low resolution line. |
| -y (Down) | Indicates cursor movement one high resolution line down the screen. Again, two words are required to move the cursor down one low resolution line. Note that the +y and -y bits are never set simultaneously. |

Both X (horizontal) and y (vertical) motion commands can occur simultaneously in one word. However, due to the asynchronous rates generated by the joystick and the internal timing circuits, simulataneous occurrence is rare.

OUTPUT WORD FORMAT

| +X | -X | +y | -y | E | T | B | V |
|---|---|---|---|---|---|---|---|

Positive Logic
"1" = On

|◄— INCREMENT BITS —►|◄— STATUS BITS —►|

(REPEAT)

3.1.5 STATUS BITS

The status bits are always valid for every word transmitted by the cursor controller. They indicate current positions of the status switches.

E (Enter) Indicates the "enter" switch has been pressed on the cursor controller. Causes an interrupt to be generated in the multiplexer/serial link causing cursor coordinates to be entered into the CPU.

T (Track) Indicates the "track" switch is on. Causes an interrupt to be generated in the multiplexer/serial link only if one of the increment bits is set (indicating the joystick is being used). Interrupts are not generated for changes in status switches.

B (Blink) Indicates the "blink" switch is on. Causes the cursor to blink at approximately a one per second rate.

V (Visible) Indicates the "visible" switch is on. Makes the cursor appear on the screen.

## 3.2 SYSTEM BLOCK DIAGRAM

Refer to Figure 3-1, System Block Diagram - for the following discussion.

Serial transmissions from the cursor controller are directed by the sequencer, so all logical discussion should revolve around the sequencer. The sequencer normally sits in the idle state waiting for a change in status or an interrupt request from the joystick.

When one of the status switches is touched and a change in status is seen by the sequencer, the sequencer loads the serial transmission device with current status data, acknowledges the change in status, then waits until the transmission is complete. When transmission is done, the sequencer returns to the idle state and waits for another change in status or an interrupt request from the joystick.

If there is no pending change in status to be transmitted when the joystick is moved and gives an interrupt request to the sequencer, the sequencer loads the serial transmission device with the proper joystick data (depending upon whether the interrupt came from x or y) and also loads current status data, acknowledges the interrupt request, then waits until the transmission is complete. Upon a complete transmission, the sequencer again returns to the idle state and waits for another change in status or an interrupt request from the joystick.

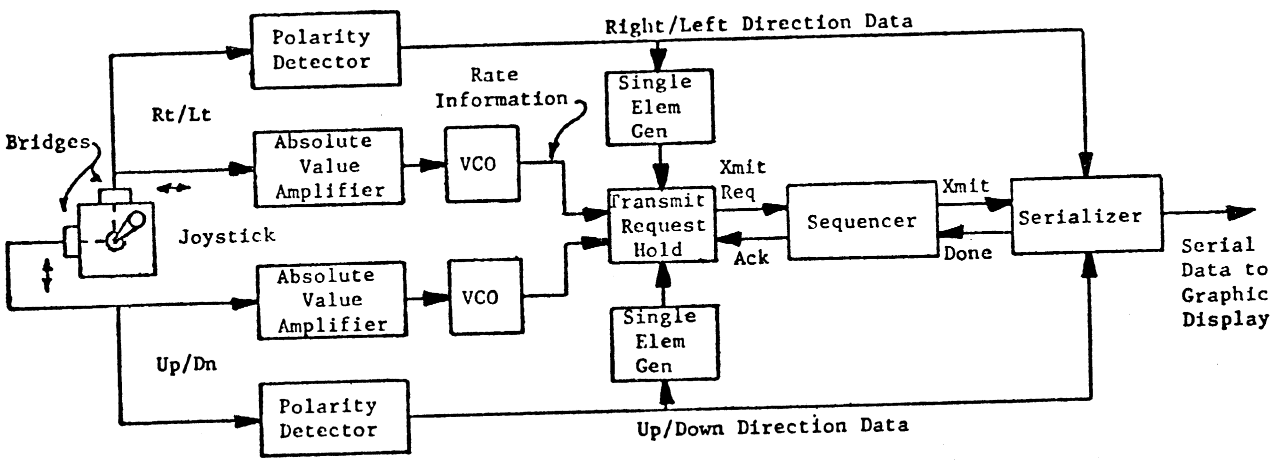



FIGURE 3-1 SYSTEM BLOCK DIAGRAM

Note that the change in status loop of the sequencer has priority over joystick data. In other words, if a change in status and an interrupt request from the joystick come up simultaneously, the sequencer will always service the change in status first and then the interrupt requests because a change in status is more important than joystick data.

Note also that while the sequencer is servicing an interrupt, another interrupt can occur and the sequencer will attend to it as soon as the current word has been successfully transmitted. No interrupt requests will be lost as long as the requests do not occur more frequently than the time it takes to shift out two serial words. Two words are specified because if the joystick is displaced at a $45^{o}$ angle, the sequencer will usually alternate between shifting out words with X data and words with Y data, so maximum X requests can occur only every other word. Similarly Y requests can occur only every other word as a maximum rate.

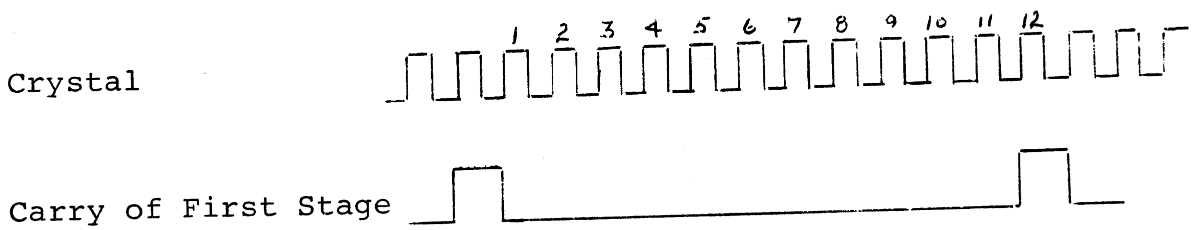
If these maximum interrupt request rates are exceeded, requests will be lost, but the words shifted out will not be distorted. Words will not be overwritten or destroyed due to the sequencer waiting until an entire word has been shifted out before the next request is serviced.

## 3.3 LOGIC DESCRIPTION

### 3.3.1 CURSOR CONTROLLER (Ref. Dwg. #501879, Sh. 2)

The system clock, BAUDCLK, hereon referred to as simply "CLOCK", is generated by a 921.6 KHZ crystal oscillator and three 74161 binary counters which divide the crystal frequency down to the baud rate desired. The counters are wired to count synchronously between states to allow all counter outputs to be synchronous to each other.

The first stage divides the crystal frequency by 12 (twelve) so that the carry output is one crystal frequency cycle wide occurring every 12 cycles.




The second and third stages count the number of carry outputs of the first stage such that a square wave of the following frequencies are obtained from their outputs:

| STAGE | PIN | FREQUENCY (KHZ) | BAUD RATE | COMMENTS |
|---|---|---|---|---|
| 1 | 15 (Carry) | 76.800KHZ | - | 921.600KHZ 12= 76.800KHZ |
| 2 | 14 | 38.400 | - | |
| 2 | 13 | 19.200 | - | Period (s) |
| 2 | 12 | 9.600 | 9600 | 104.167 s |
| 2 | 11 | 4.800 | 4800 | 208.333 |
| 3 | 14 | 2.400 | 2400 | 416.667 |
| 3 | 13 | 1.200 | 1200 | 833.333 |
| 3 | 12 | .600 | 600 | 1,666.667 |
| 3 | 11 | .300KHZ | 300 | 3,333.333 s |

The minimum baud rate allowable without overrun of interrupt requests will be discussed in the serial transmission section.

The Δ status section of logic provides glitch free status data for transmission and generates the change in status transmission request for the sequencer.

The nand gate latch inputs (1E, 1F) are connected directly to the status switches. 1E and 1F clean up switch contact bounce. The two sets of 74LS174 D flip-flops and the 74S85 comparator essentially act as a synchronous edge detector. Refer to one of the D flops as the "is now" flop and the other as the "was" flop.

If the status switches are unmoved, what "was" is equal to "is now" and the comparator output remains equal causing CHGSTAT to remain low. This is the steady state condition for no change in status.

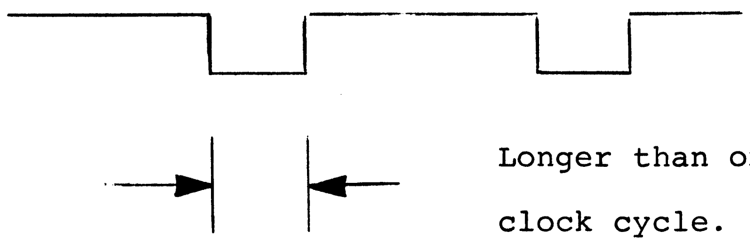
When a status switch is changed, what the status switch "was" is no longer equal to what the status switch "is now" and the comparator output goes low causing CHGSTAT to go high and set the STATREQ 74LS109 JK flip-flop (3D6). The sequencer will recognize this set flop as a change in status and cycle accordingly. The STATREQ flop is reset by the sequencer with the one clock wide signal ACKSTAT.

Note that CHGSTAT is a one clock wide pulse only and not a level. The comparator will be at the unequal for only one clock cycle until what "was" catches up again with what "is now".

The $\Delta$ X $\Delta$ Y section of logic generates the interrupt requests from the joystick and provides the necessary gating of the increment data.

CHGX is a synchronous negative edge detect of the interrupt line, INTX, from the joystick. INTX is a variable frequency TTL level signal whose frequency is dependent upon the amount of deflection of the joystick. If the joystick is centered, INTX does not transition. INTX can be of any duty cycle as long as its "off" time is longer than one clock cycle.

INTX




If INTX transitions from high to low, CHGX pulses and sets the XREQ flip-flop (3E6). The sequencer will recognize the set flop as an interrupt request from the joystick and cycle accordingly. The sequencer resets CHGX with the one clock wide signal ACKINT. Having XREQ set gates the x direction increment data RIGHT and LEFT to the serial transmitter. If the XREQ flop is not set, x direction data is not transmitted.

This discussion also applies for the y direction. Note that XREQ and YREQ are or'ed together to become INTREQ, the actual interrupt request line to the sequencer.

The sequencer processes and services all change in status and interrupt requests and loads the serial device for transmission.

The sequencer consists of a state controller from #0501877(3C) and two JK flip-flops (4C) labeled "A" and "B".

On the sequencer flow chart, refer to the circles as states, with state indicated by a two digit binary code. The idle state then becomes state 0 with the wait state being state 3. The right digit of the state designation refers to the condition of flip-flop "A" while the left digit is the condition of flip-flop "B".

The prom directs which state the flip-flops should move to on the next clock cycle through the signals SETA, SETB, AND +RESET. It determines which line to activate by examining which state the flops are currently in, if there are any interrupt requests, and if the transmitter has finished transmission of the last word.

The prom examines the current state of the flip-flops through signals FLOPA and FLOPB. It checks whether any change in status or interrupt requests exist through the previously discussed signals STATREQ and *INTREQ, and it knows when the transmitter is finished through the signal *DONE.

The sequencer acknowledges change in status and interrupt requests, and loads the transmitter by decoding the state of the flip-flops in the prom. *ACKSTAT is a one clock wide signal which acknowledges change in status requests while *ACKINT acknowledges interrupt requests. The transmitter is loaded with data for transmission by signal "*XMIT" which is also one clock cycle wide.

It is easiest to troubleshoot the sequencer using the sequencer flow chart and the logic diagram. For instance, if FLOP a = 1 and FLOP B = 0, then the signals *XMIT' and "*ACKINT" should be active. (i.e., "*XMIT" = "*ACKINT" = 0)

The serial transmission section assembles data from the STATUS and X Y sections into a word and provides this serial word to the output drivers for transmissions.

The serial transmission section consists of an 8 Bit shift register (74166), an end of transmission counter (74161) a JK flip-flop (74LS109) and a nand gate.

The *XMIT signal from the sequencer controls the shift register with a low causing a load and a high enabling transmission. The nand gate and the JK flop act as a ninth bit to the shift register in which the start bit is loaded.

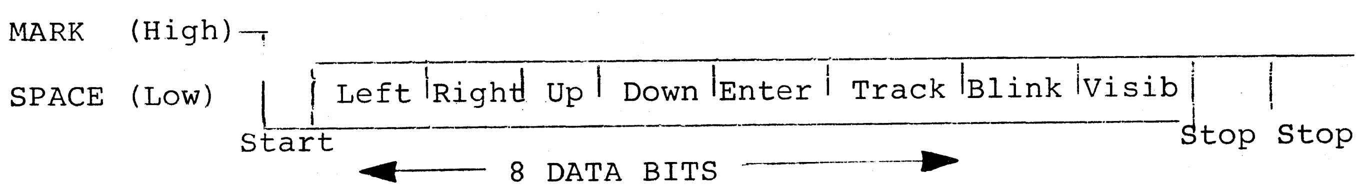
A serial word contains 11 Bits of data, one bit being one clock cycle long. The 11 Bits are:

1 Start Bit

8 Data Bits, and

2 Stop Bits

Signal DATA has the following format:




Signal DATA remains high (Marking) when a word is not being transmitted. This is obtained by continually running the shift register at all times and putting in a high on the shift register's serial input, Pin 1.

The end of transmission counter controls the length of word outputted. The counter is loaded with signal *XMIT and the carry output ENDXMIT is used to inform the sequencer that the entire word has been transmitted including two stop bits.

### 3.3.2 DETERMINING MAXIMUM TRANSMISSION SPEEDS

When fully displaced, the joystick generates about 200 interrupts per second per axis. Since the sequencer usually alternates between outputting x and y words, the maximum transmission speed required to fully support the joystick is about 400 words per second. Since one word consists of 11 Bits, a list can be compiled of baud rates versus the maximum word rate that baud will support. Simply divide the baud rate in bits/sec by 11 Bits/word to obtain the maximum word rate for each baud.

| BAUD RATE (BITS/SEC) | WORD RATE (WORDS/SEC) |
|---|---|
| 9600 | 873 |
| 4800 | 436 |
| 2400 | 218 |
| 1200 | 109 |
| 600 | 56 |
| 300 | 27 |

It is obvious from the above chart that to utilize the joystick to its fullest capability, the baud rate should not be lower than 4800 baud. However, the cursor controller can operate with baud rates less than 4800 baud, but the cursor will move slower when the joystick is fully displaced.

Note that one word is required to move the cursor one element or one line so that at 300 baud it would require about 20 seconds to get across a high resolution screen.

The drive logic is used to convert the serial output of the serial transmission logic into the differential signals compatible, with the GK100, GK100B Multiplexer Cards and the 9000 Serial Link CARDS. The outputs are selectable with the channel select switches.

When a channel is de-selected, the serial line must remain in the no-transmission or marking (High) state. The pullups on the 75183 insure that this condition is held when the switch for that channel is off. When the switch is on, the signal DATA is routed to the driver and transmission takes place.

Power on reset *PØWER resets the sequencer to the idle state, resets the interrupt requests from the joystick to zero, sets the status request to one so that the present status will be transmitted upon power on and sets the serial output to the marking (High) or no transmission state.

### 3.3.3 JOYSTICK CONTROLLER (Ref. Dwg. #501987, Sh. 1)

The logic depicts the formation of DOWN, UP, RIGHT, and left along with increment X and Y signal generation. The signals after being derived from differential amplifiers are driven through an inter connect cable to the Cursor Controller logic, Dwg. #501879.

## 4.0 CIRCUIT DIAGRAMS

### 4.1 INTRODUCTION

This section contains the circuit/logic diagrams to aid in operation and maintenance of the Ramtek Cursor Controller.

General schematic notes and an explanation of the terms and symbols which apply to all the schematic and assembly drawings are shown in Figure 4-1. In general, the drawings conform to MIL-STD-806C and ANSI Y32.14.

Components such as resistors, capacitors and transistors are shown with part numbers on the schematic, all other logic elements are labeled with a three digit *type* number. *Type* numbers have been assigned as follows:

000-999 AND gates

100-199 NAND gates

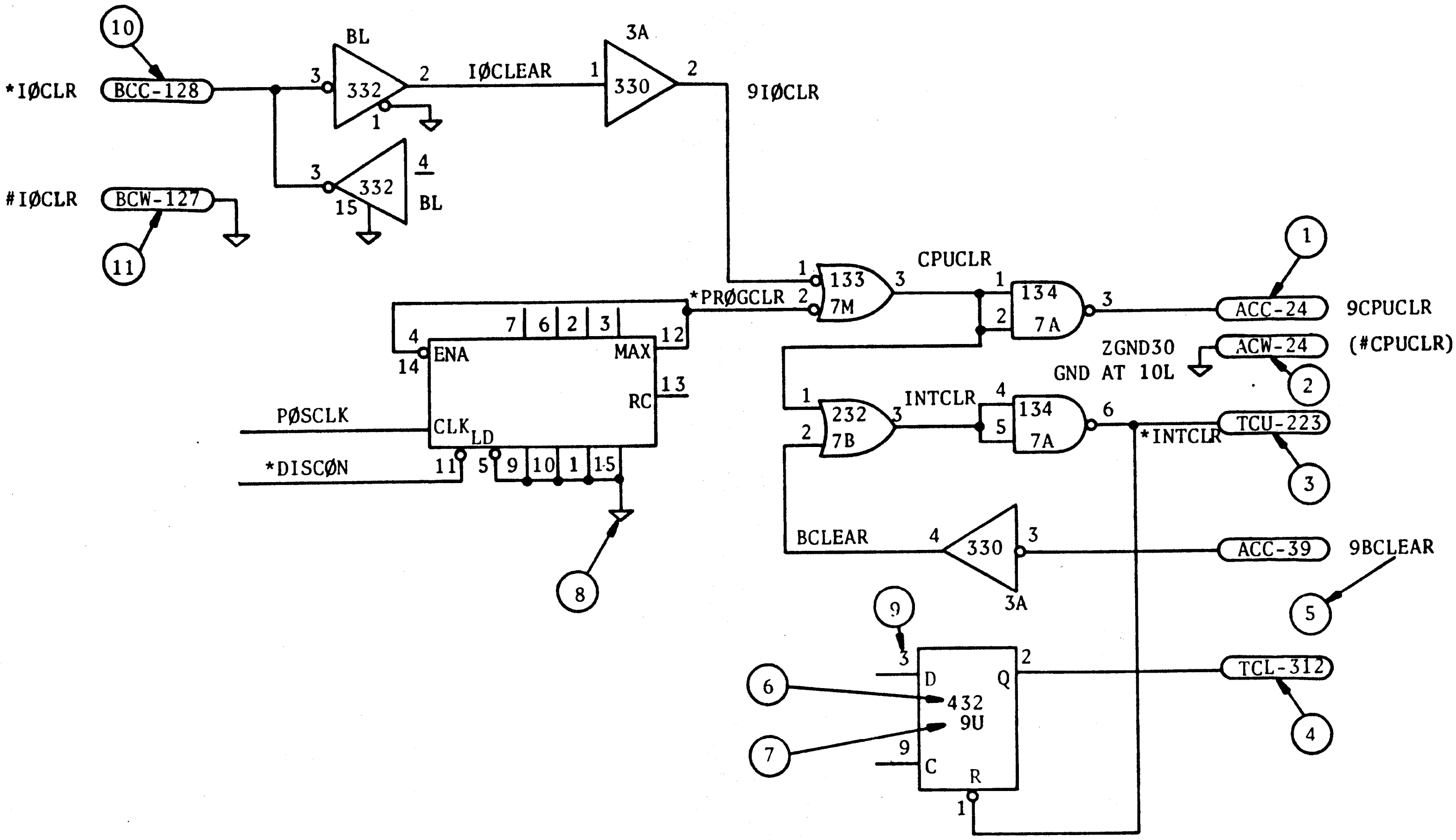
200-299 OR gates

300-399 NOR gates, inverters, drivers and receivers

400-499 Flip-flops and memories

500-599 LSI and MSI components

700-899 Special components




LEGEND:

(1) "A" connector component side, pin number.

(2) "A" connector non-component side, pin number.

(3) Test connector upper, pin number.

(4) Test connector lower, pin number.

(5) Term name.

(6) Device type number.

(7) Device location.

(8) Signal ground.

(9) Pin number on device

(10) "B" connector component, pin number.

(11) "B" connector non-component side, pin number.

TYPICAL SCHEMATIC NOTES

FIGURE 4-1

The three digit IC *type* numbers shown on the schematic diagrams are identical to the last three digits of the Ramtek part number for the same type.

## 4.2 REPLACEABLE PARTS

This section contains information for ordering replacement parts. Lists of materials for all the major assemblies are included in Section 4-4 of this manual. The lists of material includes the Ramtek part number, description and quantity.

## 4.3 ORDERING INFORMATION

To obtain replacement parts, address order inquiry to Ramtek Corporation, 585 N. Mary Avenue, Sunnyvale, California 94086. Identify parts by their Ramtek part numbers listed in the column headed "Part Number." Include equipment model number and serial number.

## 4.4 LOGIC CONFIGURATIONS

Assy. Dwg. Cursor Controller - 501878

Cursor Controller Logic Schematic - 501879

Joystick Controller Rate/Direction Encode - 501986

Joystick Controller Rate/Direction Encode - 501987

Cable Assy. Max. Dist. to Joystick or Keyboard External - 502202

Wiring Diagram Cursor - 502159

Cursor Assembly - 502155

PRODUCTION ORDER | JOB NO:

| PREPARED BY: | | ORIG REQUEST | PARTS AVAIL | BACK-ORDER |
|---|---|---|---|---|
| PRODUCTION MGR: | PRODUCTION UNITS (ASSY) | | | |
| | SCHEDULED — BEGIN | | | |
| | SCHEDULED — COMPLETION | | | |

| ITEM NO | PART NUMBER | PART DESCRIPTION | PART REQMNTS EA | | TOT | | ISS | STD COST EA | STD COST TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3850102 | CABLE, CONTOUR 50 COND | A/R | | | | | | |
| 2 | | WIRE, TWISTED PAIR #22GA | 7" | | | | | | |
| 3 | | | | | | | | | |
| 4 | 8606101 | TERMINAL, SLIP-ON | 1. | | | | | | |
| 5 | 8604040 | CONT. SOCKETS, 26-24GA BURNDY SC24M-1027 | 15 | | | | | | |
| 6 | 8604047 | CONT. SOCKETS, 20-22 GA BERG 47439 | 84 | | | | | | |
| 7 | 8631103 | TERMAL, RING | 2 | | | | | | |
| 8 | | | | | | | | | |
| 9 | 8601034 | CONN, 3PIN BERG 65039-034 | 2 | | | | | | |
| 10 | 8601023 | CONN, 14 PIN BERG 65039-023 | 1 | | | | | | |
| 11 | 8601013 | CONN, 24 PIN BERG 65039-013 | 3 | | | | | | |
| | | | | | | | | | |
| 12 | 8601192 | CONN QIKMATE 24PIN BURNDY SMS 24R1 | 1 | | | | | | |
| | | TOTAL | | | | | | | |

| | | SIGNATURES | | DATE |
|---|---|---|---|---|
| PARTS ISSUD BY | | DWN | R C Lindsay | 9-2-75 |
| PARTS RCVD BY | | CHK | [signature] | 11-17-7[illegible] |
| TO INVTY CRDS | | ENG | [signature] | 11-17-7[illegible] |
| TO ACCOUNT | | APVD | [signature] | 11-17-7[illegible] |

RAMTEK

TITLE: WIRING DIAG. CURSOR

| REV | SHEET | DWG NO: |
|---|---|---|
| G | 1 OF 1 | 502159 |

LIST OF MATERIALS

| PRODUCTION ORDER | | ORIG REQUEST | PARTS AVAIL | BACK-ORDER | JOB NO: |
|---|---|---|---|---|---|
| PREPARED BY: | | | | | |
| PRODUCTION MGR: | PRODUCTION UNITS (ASSY) | | | | |
| | SCHEDULED BEGIN | | | | |
| | SCHEDULED COMPLETION | | | | |

| ITEM NO | PART NUMBER | PART DESCRIPTION | PART REQMNTS EA | TOT | | ISS | STD COST EA | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 1 | 502007 | CURSOR ROUTING ASSY | 1 | | | | | |
| 2 | 501924 | CURSOR BASE | REF | | | | | |
| 3 | 501925 | CURSOR TOP | REF | | | | | |
| 4 | 501986 | JOYSTICK CONT. ASSY BD | 1 | | | | | |
| 5 | 501878 | CURSOR CONT ASSY BD | 1 | | | | | |
| 6 | 502127 | PANEL, CURSOR CONTROL | 1 | | | | | |
| 7 | 502159 | WIRING DIAG | REF | | | | | |
| 8 | | | | | | | | |
| 9 | 8601192 | CONN, QIKMATE BURNDY SMS 24R-1 | REF | | | | | |
| 10 | 1040100 | JOYSTICK - MEASUREMENT SYS 521 | 1 | | | | | |
| 11 | 2300031 | FUSE HOLDER, BUSS HKP-HH | 1 | | | | | |
| 12 | 2300022 | FUSE 1A, S/B | 1 | | | | | |
| 13 | 3852104 | POWER CORD BELDEN 17407 | 1 | | | | | |
| 14 | 8603100 | STRAIN RELIEF, HAYCO SR 7P2 | 1 | | | | | |
| 15 | | | | | | | | |
| 16 | | SCREW, FLT HD, X RECESS #2-56 x 3/8 LG SS | 4 | | | | | |
| 17 | 9050048 | SWITCH, MINI-PADDLE C-H SC3CX185 | 7 | | | | | |
| 18 | 9050049 | SWITCH, " " CH SC3GX185 | 1 | | | | | |
| 19 | 9050051 | SWITCH, ROCKER C-H SC2XE192-96 | 1 | | | | | |
| 20 | | | | | | | | |
| 21 | | SCREW, FLT HD, X RECESS #8-32 x 5/8" LG SS | 3 | | | | | |
| 22 | | FLT HD, X-RECESS #6-32 x 1/2" LG, SS | 1 | | | | | |
| 23 | | PAN HD, X RECESS #4-40 x 1/4" LG, SS | 4 | | | | | |
| 24 | | SCREW, FLT HD, X-RECESS #2-56 x 3/8" LG, SS | 4 | | | | | |
| 25 | | | | | | | | |
| 26 | | FLAT WASHER - #4 | 4 | | | | | |
| | | TOTAL | | | | | | |

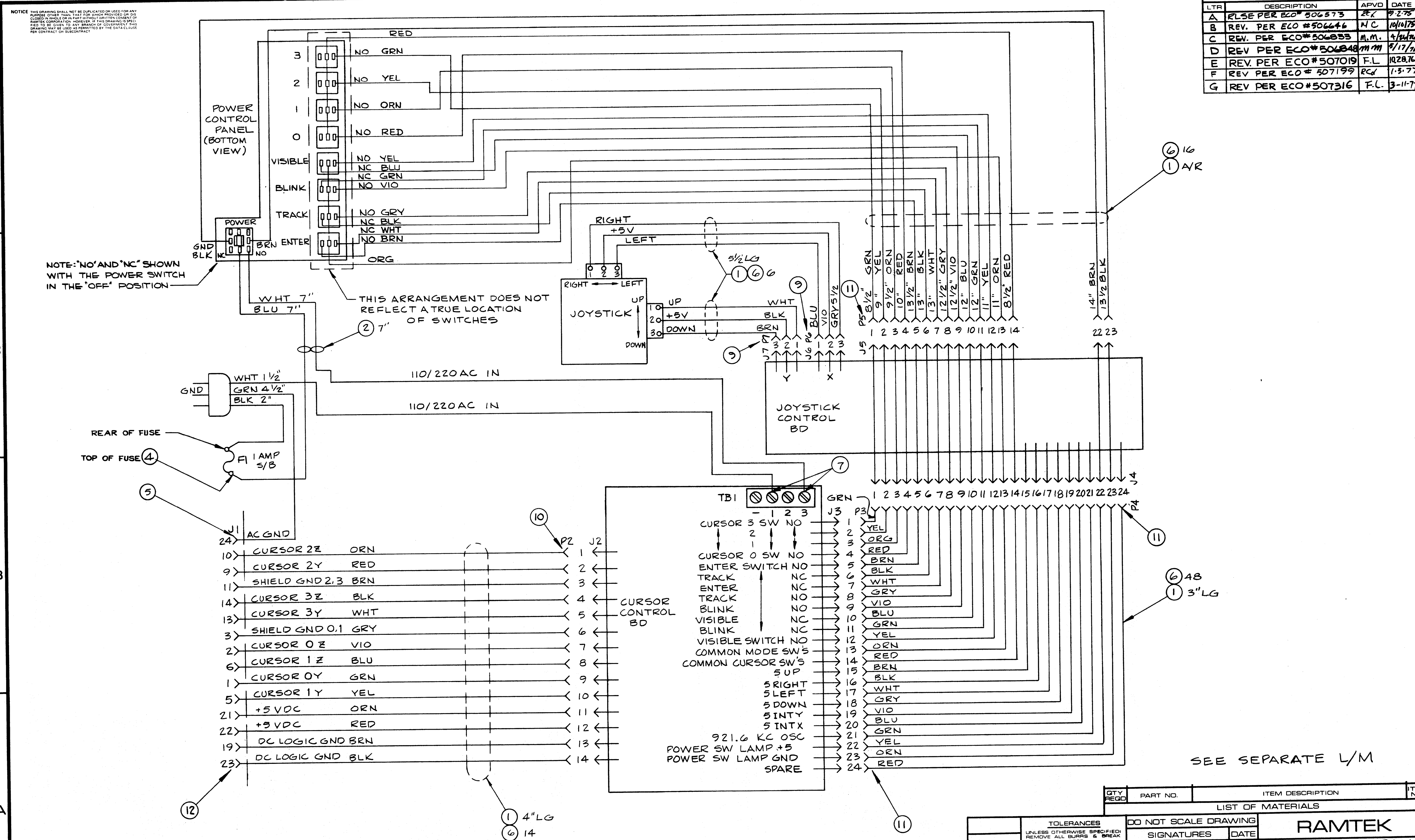
| | | SIGNATURES | DATE | RAMTEK |
|---|---|---|---|---|
| PARTS ISSUD BY | | DWN R.C. Lindsey Jr | 8-15-75 | TITLE: CURSOR ASSY |
| PARTS RCVD BY | | CHK Ron | 11-17-75 | |
| TO INVTY CRDS | | ENG Ron | 11-17-75 | REV C / SHEET 1 OF 1 / DWG NO: 502155 |
| TO ACCOUNT | | APVD Ron | 11-17-75 | |

**LIST OF MATERIALS**

RC1030

NOTICE THIS DRAWING SHALL NOT BE DUPLICATED OR USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH PROVIDED OR DISCLOSED IN WHOLE OR IN PART WITHOUT WRITTEN CONSENT OF RAMTEK CORPORATION. HOWEVER, IF THIS DRAWING IS SPECIFIED TO BE GIVEN TO ANY BRANCH OF GOVERNMENT THIS DRAWING MAY BE USED AS PERMITTED BY THE DATA CLAUSE PER CONTRACT OR SUBCONTRACT

| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | APVD | DATE |
| A | RLSE PER ECO# 506573 | | 9-2-75 |
| B | REV. PER ECO #506646 | NC | 10/10/75 |
| C | REV. PER ECO#506833 | M.M. | 4/26/76 |
| D | REV PER ECO#506848 | mm | 5/17/76 |
| E | REV. PER ECO#507019 | F.L. | 10.28.76 |
| F | REV PER ECO# 507199 | RCd | 1-3-77 |
| G | REV PER ECO#507316 | F.L. | 3-11-77 |




| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|

LIST OF MATERIALS

TOLERANCES: UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES. .XX .XXX ANG

MATL —

FINISH —

502155 — NEXT ASSY

DO NOT SCALE DRAWING

| SIGNATURES | | DATE |
|---|---|---|
| DWN | R.C. Lindquist | 9-2-75 |
| CHK | [signature] | 11-17-75 |
| ENG | [signature] | 11-17-75 |
| APVD | [signature] | 11-17-75 |

RAMTEK

TITLE: WIRING DIAGRAM CURSOR

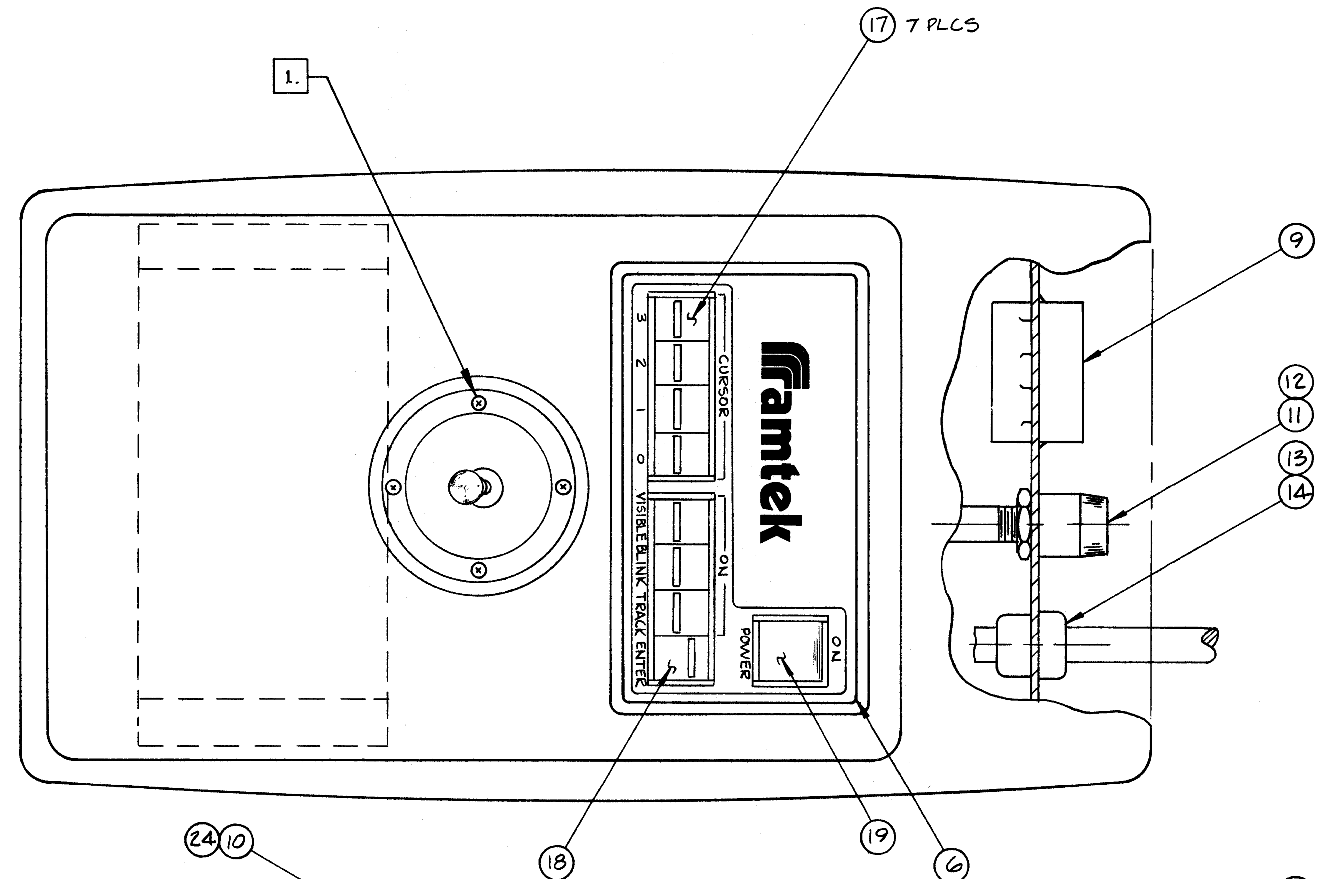
SIZE D — SCALE 1/1 — SHT 1 OF 1 — DWG NO. 502159 — REV G

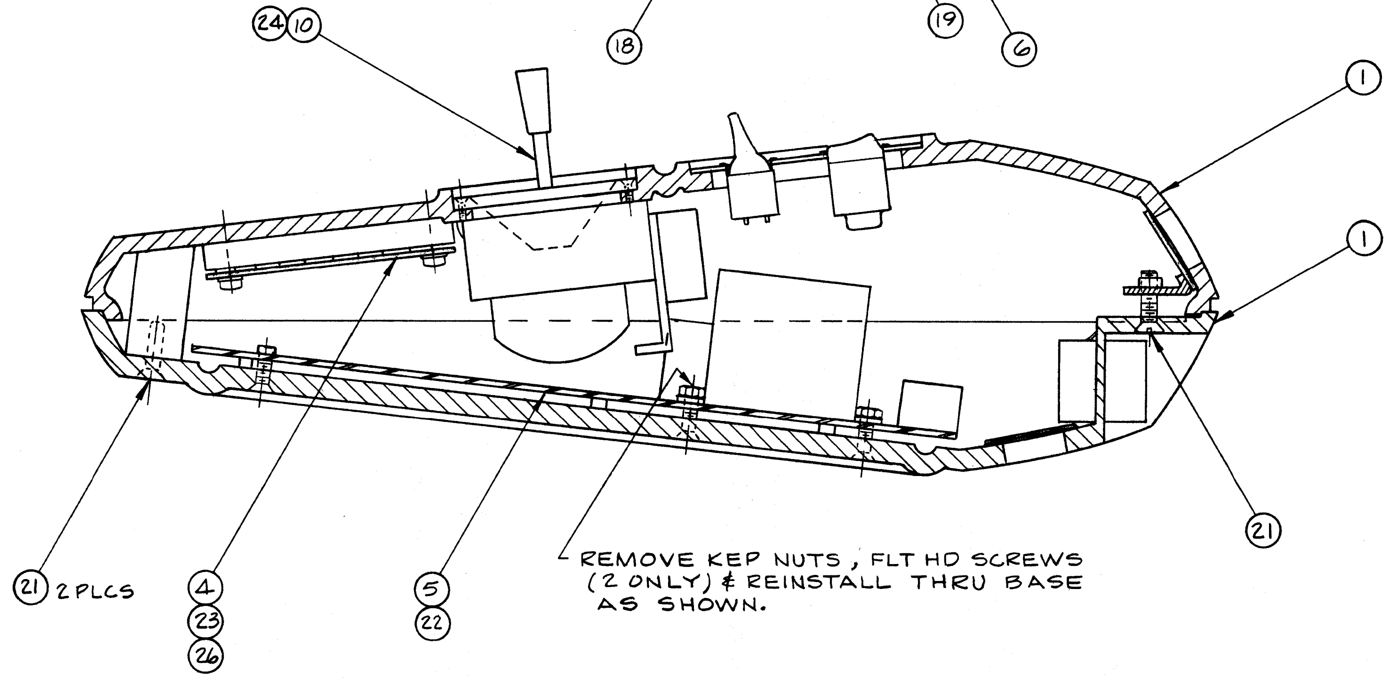
501003 REV: A

| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | APVD | DATE |
| A | RLSE PER ECO # 506575 | RCL | 8-13-75 |
| B | REV PER ECO # 506848 | MM | 5/17/76 |
| C | REVISED PER ECO 507034 | | 9-29-76 |

NOTES:

1. REMOVE & DISCARD 4 EACH, 2-56 × 1/4 FLAT HEAD MACHINE SCREWS SUPPLIED WITH JOYSTICK ASSY. INSTALL ITEM # 16 OF L/M 4 EACH 2-56 × 3/8 FLAT HEAD MACHINE SCREWS.



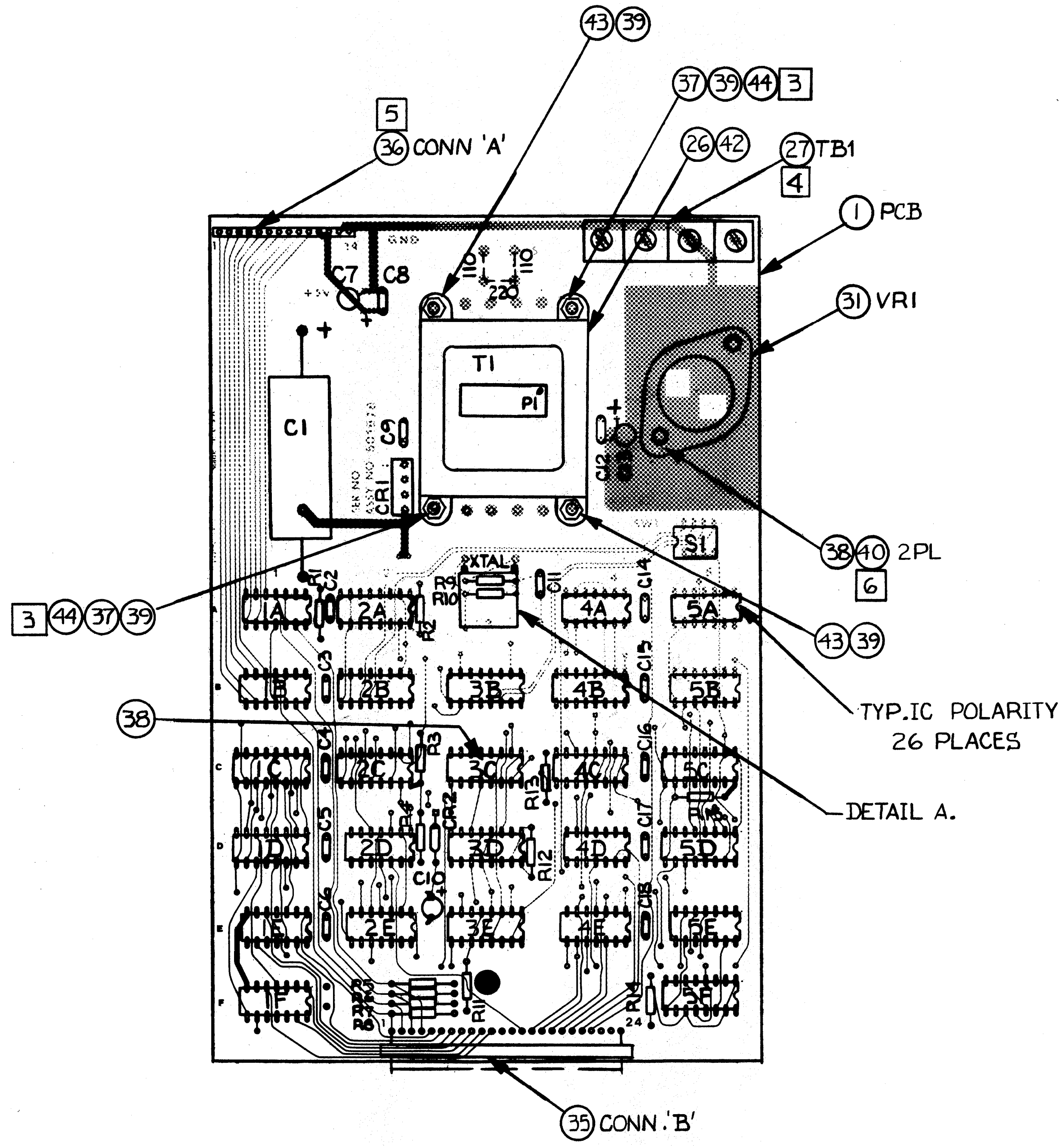

| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|

LIST OF MATERIALS

| | | | | | |
|---|---|---|---|---|---|
| TOLERANCES UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES. .XX ± .XXX ± ANG ± | DO NOT SCALE DRAWING | | | RAMTEK | |
| | SIGNATURES | | DATE | | |
| | DWN | R C Lindsay Jr | 7-29-75 | TITLE CURSOR ASS'Y | |
| MATL — | CHK | | 8-20-75 | | |
| FINAL | ENG | | 8-20-75 | SIZE D SCALE 1/1 SHT 1 OF 1 | DWG NO. 502155 REV C |
| NEXT ASSY — FINISH — | APVD. | | 11-17-75 | | |

501003 REV A

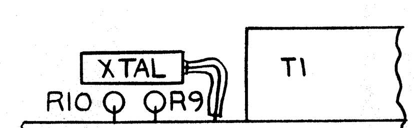
| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | APVD | DATE |
| A | RLSE. PER ECO # 506573 | RCL | 8/21/75 |
| B | REV. PER ECO # 506776 | NITA | 3/8/76 |
| C | REV. PER ECO # 506858 | JE. | 7/12/76 |
| | DCN INCORP # 311 | T.CI | 6/23/77 |




COMP - SIDE 5

NOTES:

1. ABOVE TRANSFORMER, SOLDER TWO VERTICAL JUMPER WIRES AS SHOWN FOR 110 VOLTS; SOLDER ONE HORIZONTAL JUMPER ONLY FOR OPTIONAL 220 VOLTS.
2. INSTALL CLEAR VINYL SLEEVING ON BOTH LEADS OF CRYSTAL, RTV CRYSTAL TO PCB AS SHOWN IN DETAIL A.
3. USE NYLON FLAT WASHERS ON CIRCUIT SIDE OF BOARD.
4. CUT FLANGES OFF TERMINAL. BLOCK BEFORE INSTALLATION.
5. MOUNT CONN. A & CONN. B ON COMPONENT SIDE OF BOARD.
6. ASSEMBLE ITEM NO. 38 & 40 (BRASS HARDWARE) ON ITEM 31 BEFORE SOLDERING.




DETAIL A.

| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|

LIST OF MATERIALS

| | | | |
|---|---|---|---|
| TOLERANCES | UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES. .XX ± .XXX ± ANG ± | | |
| MATL | | | |
| FINISH | | | |
| 502155 | NEXT ASSY | | |

| DO NOT SCALE DRAWING | | |
|---|---|---|
| SIGNATURES | | DATE |
| DWN | H. NGUYEN | 11/28/77 |
| CHK | Ron | 11/17/75 |
| ENG | Ron | 11/17/75 |
| APVD | Ron | 11/17/75 |

**RAMTEK**

TITLE: ASSY DWG CURSOR CONTROLLER

| SIZE | SCALE | DWG NO. | REV |
|---|---|---|---|
| C | 1/1, SHT 1 OF 1 | 501878 | C |

0501014 REV: A

PRODUCTION ORDER

| PREPARED BY: | | ORIG REQUEST | PARTS AVAIL | BACK-ORDER | JOB NO: |
|---|---|---|---|---|---|
| PRODUCTION MGR: | PRODUCTION UNITS (ASSY) | | | | |
| | SCHEDULED — BEGIN | | | | |
| | SCHEDULED — COMPLETION | | | | |

| ITEM NO | PART NUMBER | PART DESCRIPTION | PART REQMNTS EA | | TOT | | ISS | STD COST EA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 501988 | P.C.B. FAB | 1 | | | | | | |
| 2 | 501987 | LOGIC DIAG | REF | | | | | | |
| 3 | 1301311 | INTEGRATED CIRCUIT, 7414 (A3) | 1 | | | | | | |
| 4 | 1301328 | I.C., LM3900 (A1,2,4) | 3 | | | | | | |
| 5 | 8608001 | I.C. SOCKET 14 PIN (A1,4) | 2 | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | 3109155 | RESISTOR, 1.5M, 1/4W, ±5% (R6,7,15,16, R36,37,45,46) | 8 | | | | | | |
| 9 | 3109225 | 2.2M (R39,9,47,17) | 4 | | | | | | |
| 10 | 245 | 2.4M (R23,53) | 2 | | | | | | |
| 11 | 475 | 4.7M (R24,54) | 2 | | | | | | |
| 12 | 156 | 15M (R4,8,25,34,38,55) | 6 | | | | | | |
| 13 | 391 | 390Ω (R13,20,21,43,50,51) | 6 | | | | | | |
| 14 | 202 | 2K (R29,30,59,60) | 4 | | | | | | |
| 15 | | | | | | | | | |
| 16 | 303 | 30K (R27,57) | 2 | | | | | | |
| 17 | 124 | 120K (R10,11,14,18, R40,41,44,48) | 8 | | | | | | |
| 18 | 244 | 240K (R26,56) | 2 | | | | | | |
| 19 | 3109474 | 470K 1/4W, ±5% (R22,52) | 2 | | | | | | |
| 20 | 3104178-3 | 178K 1/8W ±1% (R2,5,32,35) | 4 | | | | | | |
| 21 | 3104182-3 | RESISTOR, 182K, 1/8W ±1% (R1,3,31,33) | 4 | | | | | | |
| 22 | 3109514 | RESISTOR, 510K, 1/4W, ±5% (R12,19 R42,49) | 4 | | | | | | |
| 23 | | | | | | | | | |
| 24 | 6706336 | CAPACITOR, 33uf (C1) | 1 | | | | | | |
| 25 | 6702223 | CAPACITOR, .022µf (C9,14) | 2 | | | | | | |
| 26 | 6701104-2 | CAPACITOR, 0.1µf, VARADYNE (C4,15,16) | 3 | | | | | | |
| 27 | 6706685 | CAPACITOR, 6.8µf (C3,5-8,10-13) | 9 | | | | | | |
| 28 | 6701103 | CAPACITOR, .01uf (C2) | 1 | | | | | | |
| 29 | 3202201 | DIODE, IN4454 (CR5-8,10,11,17-20,22,23) | 12 | | | | | | |
| 30 | 3202208 | DIODE, IN270 (CR1-4, 12,21,24) | 4 | | | | | | |
| 31 | 8602006 | CONNECTOR, A&B (BERG 65274-2) | 1 | | | | | | |
| 32 | 8602001 | CONNECTOR, C&D (BERG 65275-1) | 2 | | | | | | |
| 33 | | | | | | | | | |
| 34 | 3201119 | TRANSISTOR, 2N3646 (Q1,2) | 2 | | | | | | |
| 35 | | | | | | | | | |
| 36 | | | | | | | | | |
| | | TOTAL | | | | | | | |

| | | SIGNATURES | DATE | RAMTEK |
|---|---|---|---|---|
| PARTS ISSUD BY | | DWN | J. O'CONNOR | 3/31/75 | TITLE: JOYSTICK CONTROLER RATE/DIRECTION ENCODE |
| PARTS RCVD BY | | CHK | [signature] | 4-4-75 | |
| TO INVTY CRDS | | ENG | [signature] | 4/13/75 | REV D — SHEET 1 OF 1 |
| TO ACCOUNT | | APVD | [signature] | 11-17-75 | DWG NO: 501986 |

LIST OF MATERIALS

RC1030

# PRODUCTION ORDER

| PREPARED BY: | | ORIG REQUEST | PARTS AVAIL | BACK-ORDER | JOB NO: |
|---|---|---|---|---|---|
| PRODUCTION MGR: | PRODUCTION UNITS (ASSY) | | | | |
| | SCHEDULED BEGIN | | | | |
| | SCHEDULED COMPLETION | | | | |

| ITEM NO | PART NUMBER | PART DESCRIPTION | PART REQMNTS EA | TOT | | ISS | STD COST EA | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 1 | 501880A | P.C.B. | 1 | | | | | |
| 2 | 501879 | LOGIC DIAG | REF | | | | | |
| 3 | 1301 133 | I.C., 1E, 1F, 4D, 5B (74LS00) | 4 | | | | | |
| 4 | 136 | 5E (74LS20) | 1 | | | | | |
| 5 | 300 | 5A (7404) | 1 | | | | | |
| 6 | 309 | 1A, 1B (75183) | 2 | | | | | |
| 7 | 330 | 2D, 4A (74LS04) | 2 | | | | | |
| 8 | 334 | 2E, 4E (74LS02) | 2 | | | | | |
| 9 | 409 | 5D (74166) | 1 | | | | | |
| 10 | 432 | 1C, 1D, 4B (74LS174) | 3 | | | | | |
| 11 | 435 | 3D, 3E, 4C, 5F (74LS109) | 4 | | | | | |
| 12 | 517 | 2A, 2B, 3B, 5C (74161) | 4 | | | | | |
| 13 | 1301 530 | 2C (74S85) | 1 | | | | | |
| 14 | 501877 | I.C. 3C (IS610) | 1 | | | | | |
| 15 | | | | | | | | |
| 16 | 3109471 | RES. COMP, R9, R10 (470Ω, 1/4W, 5%) | 2 | | | | | |
| 17 | 3109332 | RES. COMP, R1-3, R11-15 (3.3K, 1/4W, ±5%) | 8 | | | | | |
| 18 | 3109103 | RES. COMP, R4-R8 (10K, 1/4W, 5%) | 5 | | | | | |
| 19 | 6701104-2 | CAP., C8, C9, C12 (0.1μf, CERAMIC .2 SPACE) | 3 | | | | | |
| 20 | 6706336 | CAP, C7, 10, 13 (33μf, 20V, DIPPED TANTALUM) | 3 | | | | | |
| 21 | 6703198 | CAP. C1 (1900μf, 15V SPRAGUE) | 1 | | | | | |
| 22 | 6701103 | CAP., C2-6, C11, C14-18 (.01μf, VARADYNE .2 SPACE) | 11 | | | | | |
| 23 | 3202201 | DIODE, CR2 (IN4454) | 1 | | | | | |
| 24 | | | | | | | | |
| 25 | 9101123 | CRYSTAL OSC., XTAL (921.6 KHz) | 1 | | | | | |
| 26 | 6904019 | XFMR, T1 (DPC 16-1500) | 1 | | | | | |
| 27 | 8609117 | TERMINAL BLOCK, TB1 (GFTC-4) | 1 | | | | | |
| 28 | 8608002 | SOCKET, 16 PIN | 1 | | | | | |
| 29 | 9050004 | DIP SWITCH, S1 | 1 | | | | | |
| 30 | | | | | | | | |
| 31 | 1301344 | REGULATOR 5V, VR1 (LM340K) | 1 | | | | | |
| 32 | | | | | | | | |
| 33 | 3200017 | DIODE BRIDGE, CR1 (MDA942A-1) | 1 | | | | | |
| 34 | | | | | | | | |
| 35 | 8602001 | CONNECTOR, 'B' (BERG 65275-001) | 1 | | | | | |
| 36 | 8602006 | CONNECTOR, 'A' (BERG 65274-2) | 1 | | | | | |
| | | TOTAL | | | | | | |

| | | SIGNATURES | | DATE | RAMTEK |
|---|---|---|---|---|---|
| PARTS | ISSUD BY | DWN | J. O'CONNOR | 3/31/75 | TITLE: CURSOR CONTROLLER |
| | RCVD BY | CHK | [signature] | 4-3-75 | |
| TO INVT. CRDS | | ENG | | | |
| TO ACCOUNT | | APVD | | | REV C · SHEET 1 OF 2 · DWG NO: 501878 |

DCN 311 (4-25-77) LIST OF MATERIALS

# PRODUCTION ORDER

JOB NO:

| PREPARED BY: | | ORIG REQUEST | PARTS AVAIL | BACK-ORDER |
|---|---|---|---|---|
| PRODUCTION MGR: | PRODUCTION UNITS (ASSY) | | | |
| | SCHEDULED — BEGIN | | | |
| | SCHEDULED — COMPLETION | | | |

| ITEM NO | PART NUMBER | PART DESCRIPTION | PART REQMNTS EA | | TOT | | ISS | STD COST EA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 37 | | SCREW, PN HD #6-32, SST | 2 | | | | | | |
| 38 | 0799605 | SCREW, PN HD #4-40x3/8, BRASS | 2 | | | | | | |
| 39 | 0799406 | KEP NUT #6 | 4 | | | | | | |
| 40 | 0799402 | KEP NUT #4 | 2 | | | | | | |
| 41 | 9551102 | WAKEFIELD THERMAL JOINT | A/R | | | | | | |
| | | COMPOUND TYPE 120 | | | | | | | |
| 42 | 0400100 | XMFR BRKT (SIGNAL XMFR CO. 24-BR) | 1 | | | | | | |
| 43 | 0799902 | SCREW, FLAT HD #6-32x1/2, SST | 2 | | | | | | |
| 44 | 0799458 | FLAT WASHER-NYLON #6 | 2 | | | | | | |
| | | TOTAL | | | | | | | |

| | | SIGNATURES | | DATE |
|---|---|---|---|---|
| PARTS | ISSUD BY | | DWN | | |
| | RCVD BY | | CHK | | |
| TO INVTY CRDS | | | ENG | | |
| TO ACCOUNT | | | APVD | | |

RAMTEK

TITLE: CURSOR CONTROLLER

| REV | SHEET | DWG NO: |
|---|---|---|
| C | 2 OF 2 | 501878 |

LIST OF MATERIALS

RC1039

| PRODUCTION ORDER | | | | | JOB NO: |
|---|---|---|---|---|---|
| PREPARED BY: | | ORIG REQUEST | PARTS AVAIL | BACK-ORDER | |
| PRODUCTION MGR: | PRODUCTION UNITS (ASSY) | | | | |
| | SCHEDULED — BEGIN | | | | |
| | SCHEDULED — COMPLETION | | | | |

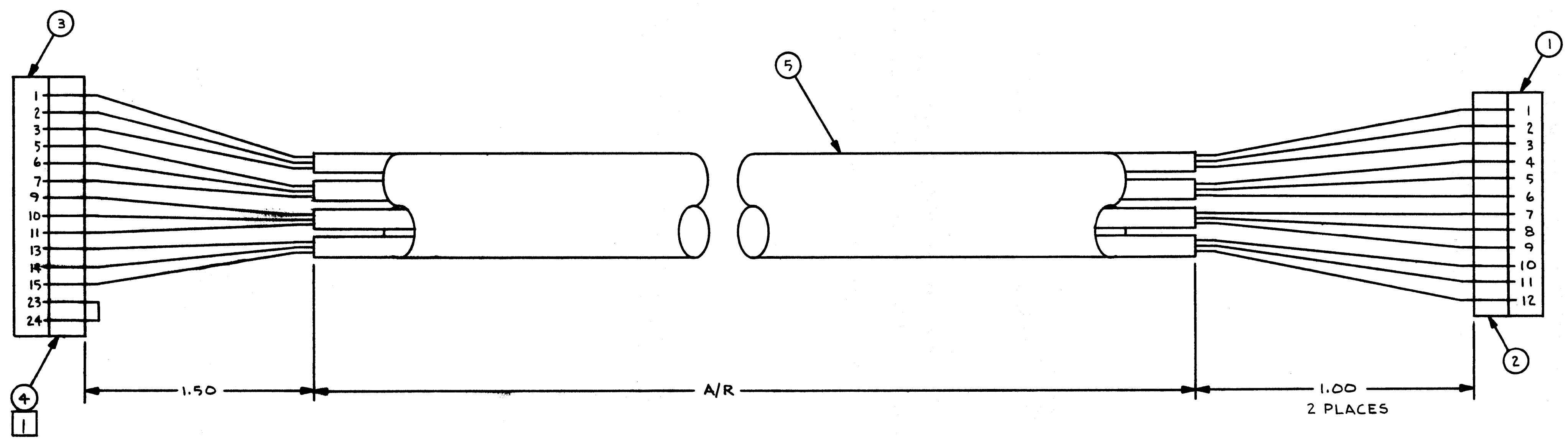
| ITEM NO | PART NUMBER | PART DESCRIPTION | PART REQMNTS EA | | TOT | | ISS | STD COST EA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 8601090 | CONN 12 PIN PLUG BURNDY SMS12P-1 | 1 | | | | | | |
| 2 | 8605550 | HOOD, CONN 12 PIN BURNDY SMS12H-1 | 1 | | | | | | |
| 3 | 8601093 | CONN 24 PIN PLUG BURNDY SMS24P-1 | 1 | | | | | | |
| 4 | 8605551 | HOOD, CONN 24 PIN BURNDY SMS24H-1 | 1 | | | | | | |
| 5 | 3899202 | CABLE BELDEN 8725 | A/R | | | | | | |
| 6 | 8604002 | CONTACT | 26 | | | | | | |
| | | TOTAL | | | | | | | |

| | | SIGNATURES | | DATE | RAMTEK |
|---|---|---|---|---|---|
| PARTS | ISSUD BY | DWN | M. Colar | 10/10/75 | |
| | RCVD BY | CHK | [signature] | 1-12-76 | TITLE: CABLE ASSY, MUX TO JOYSTICK OR KEYBOARD EXTERNAL |
| TO INVTY CRDS | | ENG | [signature] | 1-12-76 | |
| TO ACCOUNT | | APVD | [signature] | 1-12-76 | REV A / SHEET 1 OF 1 / DWG NO: 502202 |

DCN-321 **LIST OF MATERIALS**

RC1030

| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | APVD | DATE |
| A | RLSE. PER ECO #506584 | MC | 1-8-76 |
| | DCN INCORP. #322 | T.L.F. | 6/27/77 |




NOTE:
[1] MARK WITH ASSY NUMBER AND REV. LETTER.

SEE SEPARATE L.M.

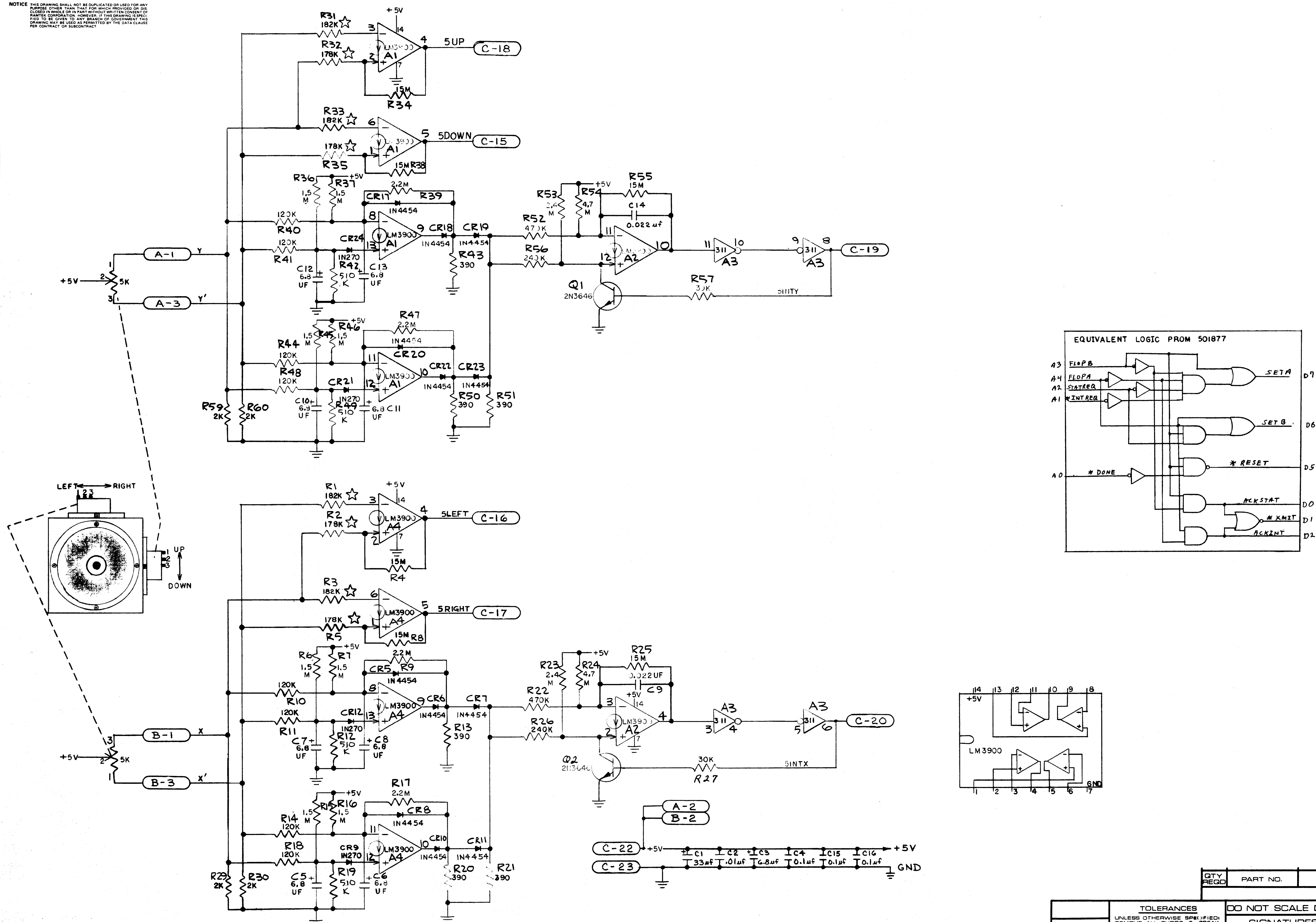
| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|
| LIST OF MATERIALS | | | |

| | | | |
|---|---|---|---|
| | | TOLERANCES UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES. .XX ±1/4" .XXX — ANG — | |
| KEYBOARD | 502156 | MATL SEE L.M. | |
| CURSOR | 502155 | FINISH | |
| | NEXT ASSY | | |

| DO NOT SCALE DRAWING | | | RAMTEK |
|---|---|---|---|
| SIGNATURES | | DATE | |
| DWN | M. Colan | 10/9/75 | TITLE CABLE ASSY, MUX DIST. TO JOYSTICK OR KEYBOARD EXTERNAL |
| CHK | [signature] | 1-12-76 | |
| ENG | [signature] | 1-12-76 | SIZE D · SCALE — · SHT 1 OF 1 · DWG NO. 502202 · REV A |
| APVD | [signature] | 1-12-76 | |

501003 REV A

| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | APVD | DATE |
| A1 | REL PER ECO 506575 | Ron | 8-20-75 |
| B | REV PER ECO 506646 | MC | 10/10/75 |
| C | REL PER ECO #507316 | F.L. | 3-11-77 |




NOTES:
1. ALL RESISTORS 1/8 WATT, 5%
EXCEPT ☆ 1%

| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED REMOVE ALL BURRS & BREAK ALL SHARP EDGES.
.XX .XXX ANG

MATL

FINISH

501986
NEXT ASSY

DO NOT SCALE DRAWING

| SIGNATURES | | DATE |
|---|---|---|
| DWN | A.E.Schm | 01-28-75 |
| CHK | A.E.Schm | 03/07/75 |
| ENG | A.E.Schm | 01-28-75 |
| APVD | Ron | 11-17-75 |

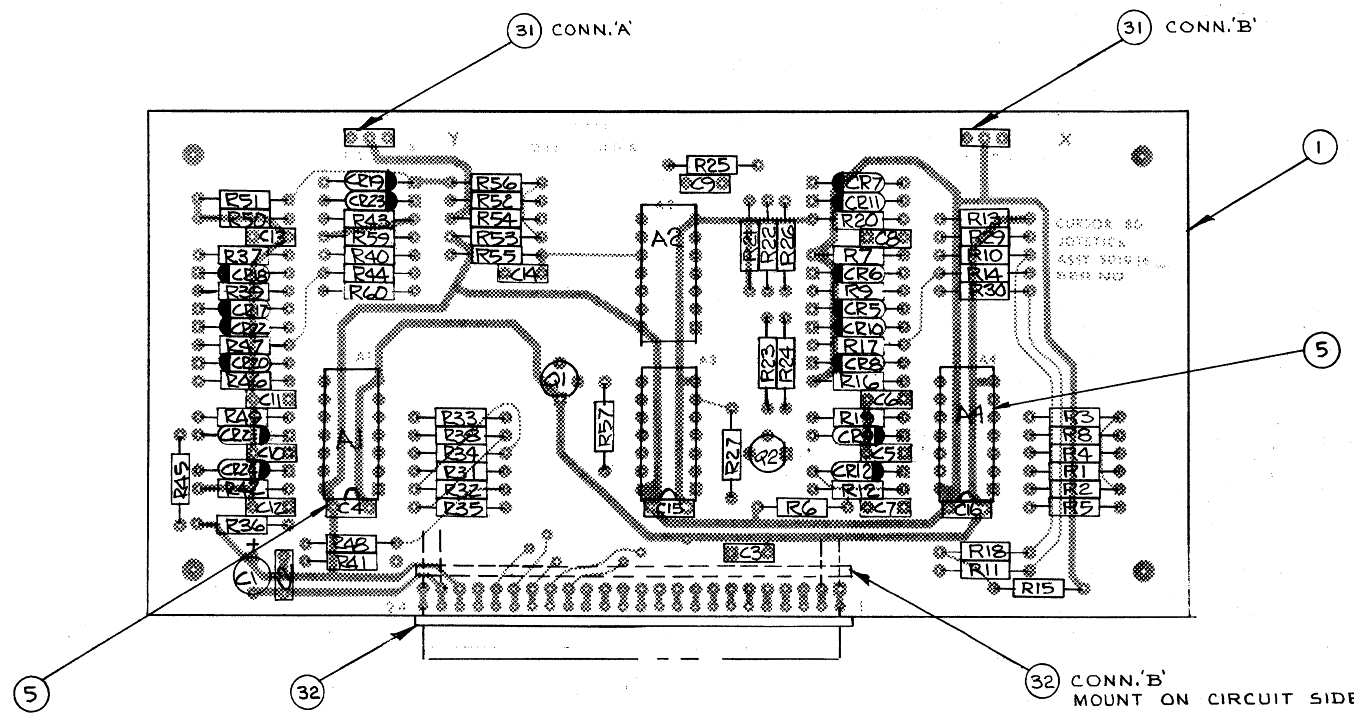
RAMTEK

TITLE: JOYSTICK CONTROLER RATE/DIRECTION ENCODE

SIZE D | SCALE | SHT 1 OF 1 | DWG NO. 501987 | REV C

REVISIONS

| LTR | DESCRIPTION | APVD | DATE |
|---|---|---|---|
| A1 | RLSE PER ECO #506573 | RCd | 8-21-75 |
| B | REV. PER ECO # 506646 | NC | 10/10/75 |
| C | REV PER ECO #506820 | Dave | 9/7/76 |
| D | REV. PER ECO # 507403 | KLD | 5/13/77 |




| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|

LIST OF MATERIALS

| NEXT ASSY | TOLERANCES | SIGNATURES | DATE |
|---|---|---|---|
| 502155 | UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES. .XX .XXX ANG | DWN D. Langer | 8/6/75 |
| | MATL | CHK Ron | 11-17-75 |
| | FINISH | ENG Ron | 11-17-75 |
| | | APVD Ron | 11-17-75 |

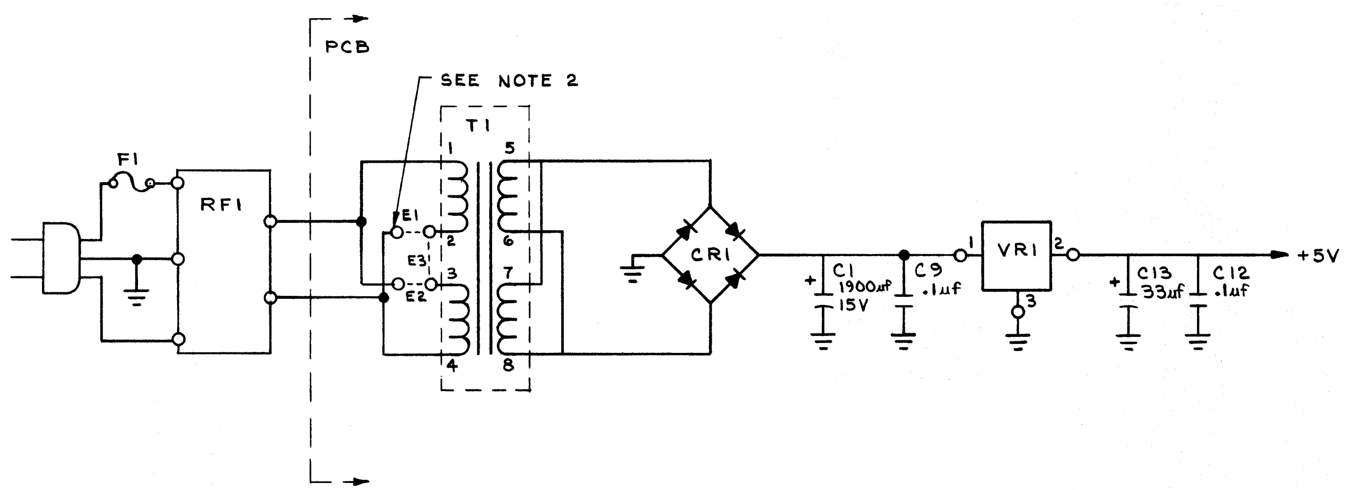
DO NOT SCALE DRAWING

RAMTEK

TITLE: ASSY : JOYSTICK CONTROLLER RATE / DIRECTION ENCODER

SIZE D | SCALE 2/1 | SHT 1 OF 1 | DWG NO. 501986 | REV. D

| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | APVD | DATE |
| A | PROD REL PER ECO 506573 | | |
| B | REL PER ECO #507316 | F.L. | 3-11-77 |




POWER SUPPLY

NOTES:

1. ALL RESISTORS ARE 1/4 WATT.
2. USE JUMPERS E1 & E2 FOR 110V ; E3 ONLY FOR 220V.

| QTY REQD | PART NO. | ITEM DESCRIPTION | ITEM NO. |
|---|---|---|---|

LIST OF MATERIALS

| | | |
|---|---|---|
| 501878 | TOLERANCES UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES. .XX .XXX ANG | MATL |
| NEXT ASSY | | FINISH |

DO NOT SCALE DRAWING

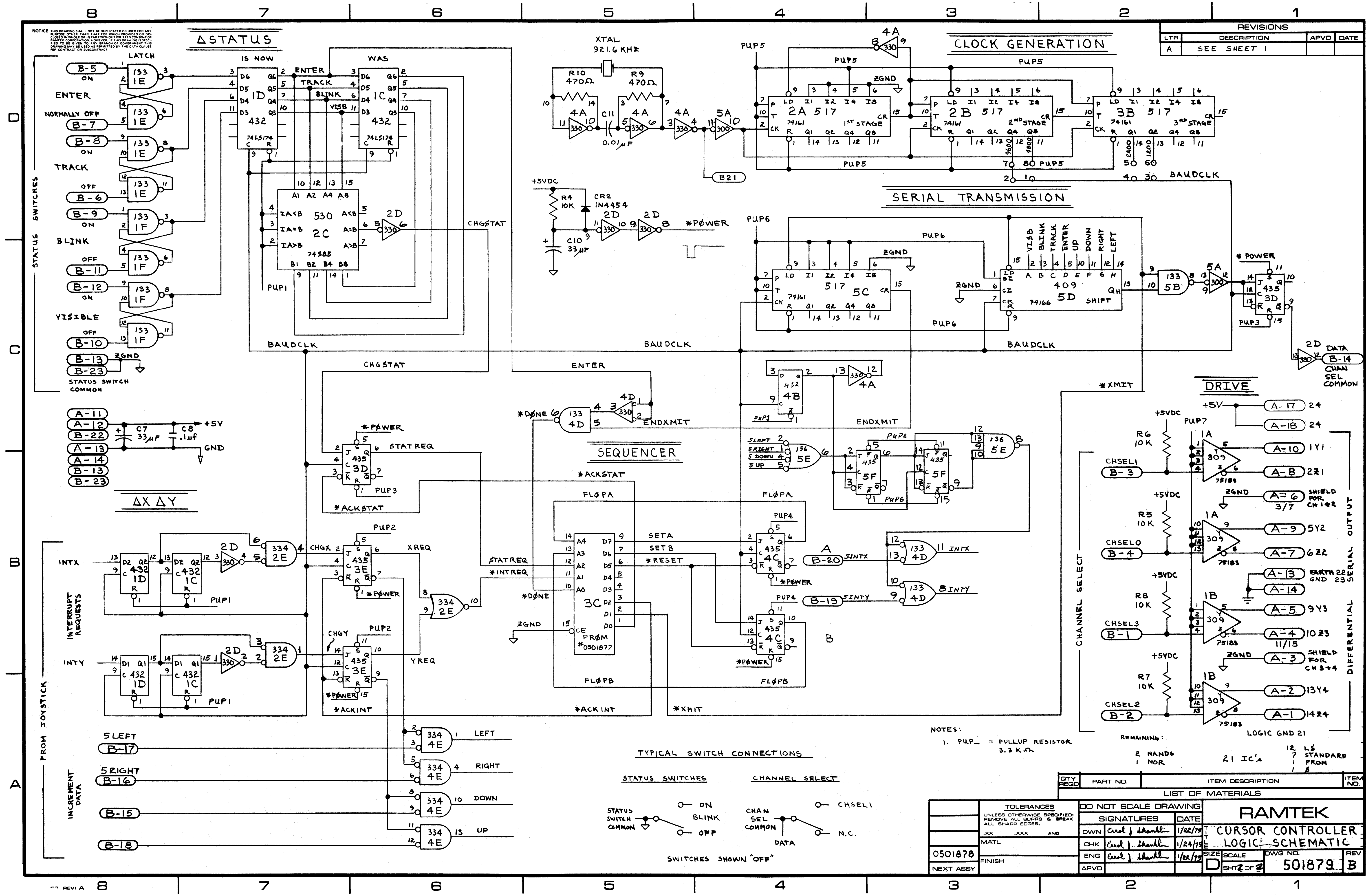
| SIGNATURES | | DATE |
|---|---|---|
| DWN | D. Langes | 8-4-75 |
| CHK | Ron | 11-17-75 |
| ENG | Ron | 11-17-75 |
| APVD | Ron | 11-17-75 |

RAMTEK

TITLE: CURSOR CONTROLLER LOGIC SCHEMATIC

| SIZE | SCALE | DWG NO. | REV |
|---|---|---|---|
| D | SHT 1 OF 2 | 501879 | B |

501003 REV: A



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ΔSTATUS
IS NOW
WAS
LATCH
ENTER
NORMALLY OFF
TRACK
BLINK
VISIBLE
STATUS SWITCHES
STATUS SWITCH COMMON
BAUDCLK
CHGSTAT
XTAL 921.6 KHZ
CLOCK GENERATION
1ST STAGE
2ND STAGE
3RD STAGE
SERIAL TRANSMISSION
VISB BLINK TRACK ENTER UP DOWN RIGHT LEFT
SHIFT
*POWER
ENDXMIT
*XMIT
DATA
CHAN SEL COMMON
ΔX ΔY
INTX
INTY
INTERRUPT REQUESTS
FROM JOYSTICK
INCREMENT DATA
5 LEFT
5 RIGHT
LEFT
RIGHT
DOWN
UP
SEQUENCER
*ACKSTAT
FLØPA
FLØPB
SETA
SETB
*RESET
STATREQ
*INTREQ
*DØNE
PRØM #0501877
*ACKINT
XREQ
YREQ
CHGX
CHGY
DRIVE
CHSEL1
CHSEL0
CHSEL3
CHSEL2
CHANNEL SELECT
DIFFERENTIAL SERIAL OUTPUT
SHIELD FOR CH 1+2
SHIELD FOR CH 3+4
EARTH GND
LOGIC GND 21
NOTES:
1. PUP_ = PULLUP RESISTOR 3.3 KΩ
REMAINING: 2 NANDS 1 NOR
21 IC's
12 LS 7 STANDARD 1 PROM 1 S
TYPICAL SWITCH CONNECTIONS
STATUS SWITCHES
CHANNEL SELECT
STATUS SWITCH COMMON
ON BLINK OFF
CHAN SEL COMMON
CHSEL1 N.C.
DATA
SWITCHES SHOWN "OFF"
REVISIONS
LTR DESCRIPTION APVD DATE
A SEE SHEET 1
QTY REQD PART NO. ITEM DESCRIPTION ITEM NO.
LIST OF MATERIALS
TOLERANCES UNLESS OTHERWISE SPECIFIED: REMOVE ALL BURRS & BREAK ALL SHARP EDGES.
DO NOT SCALE DRAWING
SIGNATURES DATE
DWN 1/22/75
CHK 1/24/75
ENG 1/22/75
APVD
MATL
FINISH
0501878
NEXT ASSY
RAMTEK
CURSOR CONTROLLER LOGIC SCHEMATIC
SIZE D SCALE SHT 2 OF 2
DWG NO. 501879
REV B

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