Qume Manual

Maintenance/Training
September 1977
Printers

Sprint Micro 3 Series



FACIT
DATA
PRODUCTS

Sole distributor for
Western Europe

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CHAPTER I

INTRODUCTION AND DESCRIPTION

SCOPE AND ORGANIZATION OF THIS MANUAL.

This manual provides information for installing, operating, and maintaining the Qume Sprint Micro 3 Series Printers. Complete procedures for repair are included with schematic diagrams and an illustrated parts list to aid the maintenance technician.

This chapter describes the printer from an external viewpoint. The description includes specifications, capabilities, and interface connections and requirements.

Chapter II describes unpacking, initial installation and performance checks, warranty information, and service and training policies.

Chapter III is a basic outline on the operation of the printer.

Chapter IV discusses the theory of operation. This includes circuit descriptions where the approach or concept may not be normally encountered by the average repair technician.

Chapter V outlines routine and preventative maintenance procedures. Chapter V also lists special tools, test equipment, spare parts, and miscellaneous items that are required to maintain, troubleshoot, and repair the printer.

Troubleshooting, repair, and adjustments are described in Chapter VI. Procedures are suggested to isolate problems to within the mechanical or electrical portions. Electrical faults can then be isolated to a board level.

Chapter VII contains an illustrated parts list of the mechanical portion of the printer. From this, repair parts can be identified for ordering purposes, or the illustrations can be used as an assembly guide during mechanical repair.

Chapter VIII is a complete wiring and schematic diagram with assembly, or component placement, drawings for each board.

DESCRIPTION OF THE PRINTER.

The Sprint Micro 3 Series Printer is a high-performance, low-cost printer intended for use in automatic data systems. Its light weight and compactness, its ease of operation and dependability are important features in any application calling for a printer with intermediate output capacity. Such applications include small business systems in which printers constitute the principle output device, as well as larger data systems calling for a flexible terminal printer with high-quality print and word processing systems producing "camara ready" print. The printwheel provides a full 96-character set, including upper and lower case and special characters. Special models, such as the WideTrack and TwinTrack, add even greater dimension to the Sprint 3 series. The WideTrack expands the form width capabilities to 28 inches and retains all of the features of the Sprint 3 printer quality. The TwinTrack puts two complete printwheels on-line at the same time, expanding the character set to 192. The

TwinTrack can also be used to increase printing speed (over the center 15.3") to 75 cps by printing with both printwheels at the same time.

Printwheels are available in a variety of optional type styles and sizes.

On typical sequential text, the printer attains print speeds as high as 55 characters per second. The usefulness of the printer is not restricted to the line-sequential output, however. Both the vertical and horizontal placement of each character are under program control, with four degrees of freedom (right and left carriage movement; forward and reverse paper movement). A unique method of optical control permits accurate character placement. These features make the Sprint Micro 3 Series Printer suitable for X-Y plotting, and for applications where it is more convenient to have random output rather than conventional left-to-right or top-to-bottom operation. Character placement is done in increments of 1/120th inch horizontally and 1/48th inch vertically. Horizontal displacements up to the physical maximum of 13.1 inches and vertical displacements up to 21.3 inches may be programmed. The WideTrack and TwinTrack models will accept horizontal displacements up to the physical maximum of 26.3 inches.

The control and data interface is fully TTL-compatible. The printer uses a 13-bit binary weighted data bus and five unweighted strobe lines to enter the data into the printer input buffer. The strobe lines distinguish the operation to be performed and initiate the appropriate action on the part of the printer.

A significant feature of the printer is its mechanical simplicity. Mechanical functions have been replaced with electrical functions wherever possible, and the remaining inertia of the mechanism has been minimized by use of light-weight, low-moment components. By minimizing the number of moving parts, and by carefully optimizing the mechanical details, the designers have produced an exceptionally fast, quiet, and reliable serial printer. Mean time between failures exceeds 1,000 hours, and plug-in serviceability permits on-site repair with an absolute minimum of down time.

The Sprint 3 Micro Series printers have advantages for hard copy generation that are not shared by either the traditional slow speed serial printers or the expensive line printers. Print quality is equal to or better than that of the very best office typewriters. And they also have the ability to proportionately space. These basic characteristics, together with low cost, make the Sprint 3 Micro Series printers ideal for small systems that are "I/O bound" and larger systems that require a flexible terminal with a high readable output.

The new Qume Sprint Micro 3 Series printers incorporate a completely new electronics package based upon a true MOS microcomputer. This sharply reduces the number of electronic components and connections, and increases product reliability. The series includes a self-testing capability and self-compensating circuit boards that need no adjustments when they are replaced.

The Sprint Micro 3 Series has many models, options, and features. The basic models and options are introduced below.

S3/35, S3/45, and S3/55

These are the standard line of high speed character printers with respective printing rates of 35, 45, and 55 characters per second for average English text.

They offer the systems designer an alternative to slow serial devices such as the teletype and automatic electric typewriter, and to the expensive high-speed devices such as the line printer.

S3/X30, S3/X40

Offers the ultimate in print quality and printwheel life by using a special 88 or 92 character metalized printwheel.

S3/WIDE TRACK

Offers all of the advantages of the S3 series with increased width to 26.4 inches of printed line on a 28 inch (maximum) form. The WideTrack lends itself to large forms or plotting, or it can be used where two or more forms are printed side-by-side.

S3/TWINTRACK

Has two printing heads on a WideTrack frame. The dual print capability can be simultaneous, where both print stations are printing at the same time, or sequential (an option) where the second print station contains additional characters, and is moved into place automatically when needed. When printing simultaneously, speeds up to 75 characters per second can be achieved over the center 15.3". The TwinTrack interface requires the use of the $\overline{D2048}$ bit in the character input, directing the character selection to the right or left print station. The two print stations can contain different type styles, different alphabets, or symbols, and can each or both use the Twintellect and MultiColor options.

The TwinTrack Sequential Interface option remembers which station printed last. And when the next character is to be printed, it tests the $\overline{D2048}$ bit, comparing it with the last. The new character is then either printed by the head that is in place, or the carriage is automatically offset, and the character is printed by the other station. The carriage does not automatically return, but waits for the next character, and prints, or moves and prints, as the need may be.

The TwinTrack model lends itself to scientific formulas or foreign languages, where many special characters (up to 192) are needed on-line. In one of many uses, the TwinTrack can print English text on one half of the page while simultaneously typing a foreign language on the other half of the page.

OPTIONS AND FEATURES

Twintellect

The Twintellect option within the Sprint 3 Series allows the user to manually select a special character ROM for non-standard printwheels. The selection is made by positioning a switch when the special printwheel is installed. The special character ROM then selects the proper printwheel address, ribbon advance, and impression (hammer) intensity for the non-standard printwheel.

MultiColor

The Sprint 3 Series also includes a dual color fabric ribbon option where more than one print color is needed. By using two dual color ribbons on the TwinTrack model, up to four colors can be printed.

MultiColor [continued]

The MultiColor ribbon contains two colors. One is printed when the ribbon is in the lowered position, and one is printed with the ribbon in the raised position. A printer containing the MultiColor option is easily returned to normal ribbon operation by the operator. The ribbon lift guides are simply rotated 180° and a standard ribbon installed.

Self-Test

The Sprint Micro 3 printer self test feature verifies printer operation and simplifies service. During self test the microprocessor conducts a checkout of itself and many other printer functions. The status of each test can be instantly displayed on Qume's palm size option, the Micro 3 ActivityMonitor.

SPECIFICATIONS

Print Speed: Qume printer speed varies according to the sequence of characters being printed and whether the various capabilities of the printer (high speed electronic tab, printing right to left, etc.) are used properly. Speeds shown below are for average English text on one line, with electronic tab over spaces between words, and are shown in characters per second (cps).

Sprint Micro 3/35:	35 cps
Sprint Micro 3/45:	45 cps
Sprint Micro 3/55:	55 cps
Sprint Micro 3/X30:	30 cps (metallized wheel)
Sprint Micro 3/X40:	40 cps (metallized wheel)
Sprint Micro 3/WideTrack:	40 cps
Sprint Micro 3/TwinTrack:	75 cps (over 15.3" with simultaneous print)

Print: Full characters of electric typewriter quality, printed serially: variable intensity ballistic hammer automatically adjusts to one of six intensities according to character size. The six intensities can be externally programmed if desired.

Forms: Single sheets and continuous forms, with or without sprocket holes. The Sprint Micro 3 printer maximum forms width is 15 inches (38.1 cm). WideTrack and TwinTrack maximum forms width: 28 inches (71.1 cm).

Font: 96 character positions on "daisy" printwheel: Wide variety of standard font styles in 10 and 12 pitch and proportional spacing. Special and custom printwheels available for use with the Twintellect model.

Format:	Horizontal:
	Sprint Micro 3: 132 columns at 10 characters per inch; 158 columns at 12 characters per inch; proportional spacing in increments of 1/120 inch, left or right. Electronic tabbing and carriage return up to 13.1 inches (33.3 cm) at 400 ms maximum.
	Sprint Micro 3 WideTrack and Sprint Micro 3 TwinTrack: 264 columns at 10 characters per inch; 316 columns at 12 characters per inch; proportional spacing in increments of 1/120 inch, left or right. Electronic tabbing and carriage return up to 26.3 inches (66.8 cm) at 680 ms maximum.
	TwinTrack only: The left printwheel prints within the left 20.8 inches (columns 0 through 208 at 10 characters per inch) and the right printwheel prints within the right 20.8 inches (columns 55 through 263), making an area of 15.3 inches where both printwheels can print.
	Vertical:
	Spacing in increments of 1/48 inch up or down: slew rate at 5 inches (12.7 cm) per second.
Plotting:	Resolution of 5760 points per square inch.
Paper Feed:	Friction platen: pin feed platens, forms tractor, optional.
Ribbon:	Easy to handle cartridge with multi-strike carbon, single strike carbon, or fabric ribbon. Available in black, colors, or dual color fabric.
Printwheel:	Easily operator changeable. The TwinTrack model uses two printwheels.
Operator controls:	Horizontal forms positioning; vertical forms positioning; forms thickness, ribbon advance. The Twintellect option adds a switch for standard or non-standard printwheel.
Temperature:	Operating 50 to 105 degrees F (10 to 40 degrees C). Storage -40 to 170 degrees F (-40 to 76 degrees C).
Humidity:	Operating 10% to 90% RH (no condensation). Storage 2% to 98% RH (no condensation).
Physical:	Sprint Micro 3
	Weight: 28 pounds (12.7 kg) Width: 23.63 inches (60 cm) Height: 7.11 inches (18 cm) Depth: 13.5 inches (34.3 cm)

WideTrack

Weight:	37.2 pounds	(16.9 kg)
Width:	36.5 inches	(92.8 cm)
Height:	7.11 inches	(18 cm)
Depth:	13.5 inches	(34.3 cm)

TwinTrack

Weight:	40 pounds	(17.2Kg)
Width:	36.5 inches	(92.8 cm)
Height:	7.11 inches	(18 cm)
Depth:	13.5 inches	(34.3 cm)

Data Input: 13-bit parallel TTL levels plus control lines.

Power Requirements: Sprint Micro 3 Models except TwinTrack.

+ 5 VDC ± 3%	3.5 amps DC
+15 VDC ±10%	4.5 amps average (14 amps peak 20 ms max.)
-15 VDC ±10%	4.5 amps average (14 amps peak 20 ms max.)

TwinTrack

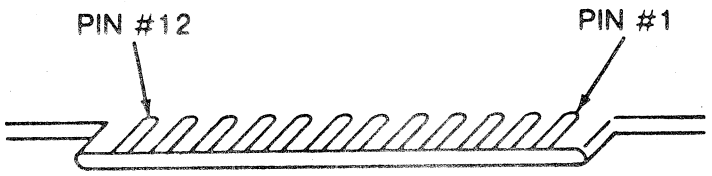
+ 5 VDC ± 3%	5.75 amps DC
+15 VDC ±10%	4.5 amps DC average (16 amps peak/20 ms max.)
-15 VDC ±10%	4.5 amps DC average (16 amps peak/20 ms max.)

All voltages must reach 90% of their final values in no less than 4 msecs and no more than 100 msecs. The absolute values of the +15 and -15 volt input must not differ by more than 2.0 volts during their rise or fall. The +5 volt input must reach 90% of its final value within 50 msecs of the +15 and -15 volt input.

All power connections are made through a single connector (Molex #09-01-1121-1), that attaches to a corresponding connector on the left side of the printer, as viewed from the rear. Pin allocations on the power connector are shown on the next page. Note that separate lines for high and low current supply distributions must be provided for all three supplies to prevent noise from being coupled from the carriage and printwheel motor drive circuits into the signal processing circuits. It is suggested tha the wire sizes recommended below be used for installation. For proper noise isolation, the +5 V logic supply return path must be isolated from the +15 V and -15 V supply ground return paths in the power supply and the power cable.

POWER CONNECTOR

POWER	PIN	WIRE SIZE
+15V High Current	3,4	2x18 AWG
+15V Low Current	6	1x18 AWG
-15V High Current	1,2	2x18 AWG
-15V Low Current	5	1x18 AWG
+ 5V Logic Current	7,8	2x18 AWG
+ 5V Power Current	12	1x18 AWG
Ground	9, 10, 11	3x18 AWG (or 7/32" tinned copper braid)

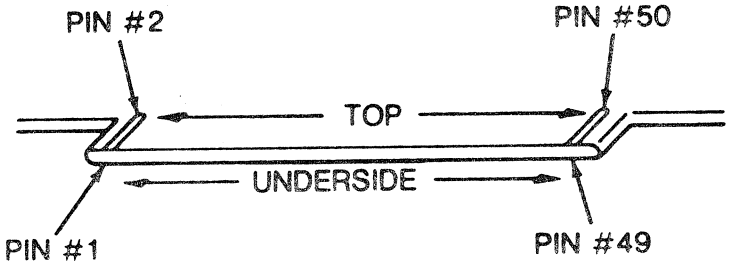


(As Viewed From Rear Of Printer)

POWER CONNECTOR (J2) ORIENTATION

CONTROL SIGNALS

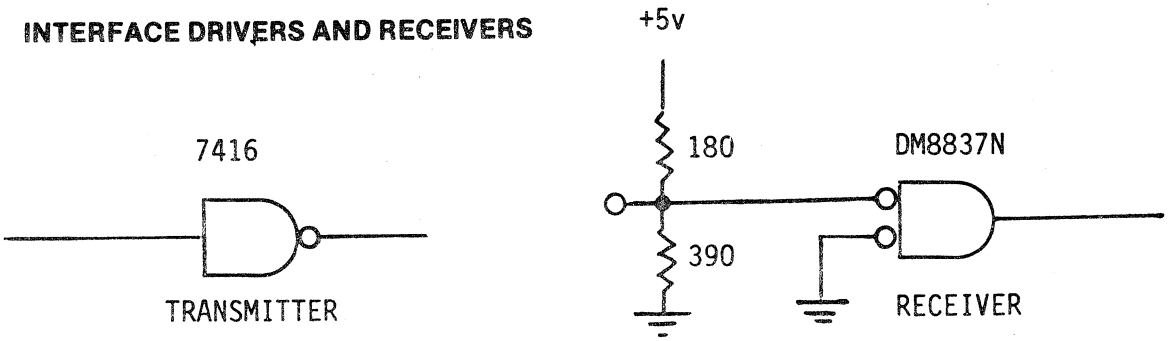
Control interface is provided through a dual 25-pin edge card connector (0.1" contact centers). Recommended connector is 3M #3415-0000. This mates with J1 (right side of the printer, as viewed from the rear). Recommended cable is 3M #3365, a 50-conductor ribbon type cable which has a 100 ohm characteristic impedance. Allocations on the control connector are given in the table on the opposing page.



(As Viewed From Rear Of Printer)

CONTROL CONNECTOR (J1) ORIENTATION

INTERFACE DRIVERS AND RECEIVERS



All input/output signals are active low.
Logic 1: $\leq$ 0.4v Logic 0: $\geq$ 2.4v
Data 1/2 thru 2048 have 1K pull-up resistor and are received by 74412's.

INTERFACE SIGNALS AND PIN ASSIGNMENTS

Connector: 3M #3415-0000

PIN	SIGNAL NAME	PIN	SIGNAL NAME
1	GND	26	TOP OF FORM STROBE (OPT)
2	DATA 1/2	27	GND
3	DATA 1	28	RIBBON LIFT COMMAND
4	DATA 2	29	GND
5	DATA 4	30	RIBBON OUT (OPT)
6	DATA 8	31	GND
7	DATA 16	32	PRINTER SELECT
8	DATA 32	33	GND
9	DATA 64	34	COVER INTERLOCK (OPT)
10	DATA 128	35	GND
11	DATA 256	36	GND
12	DATA 512	37	CHECK
13	DATA 1024	38	GND
14	DATA 2048	39	INPUT BUFFER READY (CHARACTER READY)
15	GND	40	GND
16	RESTORE	41	INPUT BUFFER READY (CARRIAGE READY)
17	GND	42	GND
18	CHARACTER STROBE	43	INPUT BUFFER READY (PAPER FEED READY)
19	GND	44	GND
20	CARRIAGE STROBE	45	INPUT BUFFER EMPTY
21	GND	46	GND
22	PAPER FEED MAIN STROBE	47	PRINTER READY
23	GND	48	GND
24	PAPER FEED AUXILIARY STROBE (OPT)	49	PAPER OUT (OPT)
25	GND	50	GND

NOTES

In all but the TwinTrack model, the signals on pins 39, 41, and 43 are consolidated (but gate isolated) and occur simultaneously. Only one of these INPUT BUFFER READY lines needs to be tested prior to each and every CHARACTER STROBE, CARRIAGE STROBE, PAPER FEED MAIN STROBE, PAPER FEED AUXILIARY STROBE, TOP OF FORM STROBE, or Queued RESTORE command.

The TwinTrack model signals for pins 39, 41, and 43 are shown in parentheses. The CARRIAGE READY and PAPER FEED READY signals are simultaneous, but the CHARACTER READY signal is independent. The ready signal for the particular command must be tested before the command can be strobed into the buffer.

BASIC SIGNAL INPUTS

The signals described below are the controlling inputs to the printer. Each signal line is briefly described by the action and interaction that it has on the printer. Signals that are output from the printer are described in later pages.

PRINTER SELECT (Pin 32)

Enables the printer for operation. All input signals except RIBBON LIFT COMMAND are ignored until the PRINTER SELECT line is low. Some status lines are unaffected: CHECK, RIBBON OUT, COVER INTERLOCK, and PAPER OUT.

RESTORE (Pin 16)

Initiates a restore sequence. Normally used before initial use if the printer has been idle for some time, or following a printer malfunction or power failure that caused a "check" condition (see BASIC SIGNAL OUTPUTS). The restore sequence consists of positioning the carriage at the leftmost position; synchronizing the printwheel; and resetting the carriage, printwheel, interface logic, and the internal "check" circuits. The microcomputer goes through its own reset sequence and begins program operation from the first byte of memory.

The printer can be strapped to provide either a direct or queued restore function. The direct restore command is executed immediately; any operation in progress is aborted and any command(s) held in the input command buffer is cleared out and never executed. The queued restore command, however, is normally converted into a command that is loaded into the input command buffer and forced to allow all previously received commands to be executed before the restore operation is begun. When the printer is in "CHECK", the queued restore is executed immediately. The queued/direct restore strap is on the #2 board (see the operation section of this manual). When strapping the TwinTrack model, both #2 boards must be queued restore, or both must be direct restore. Factory strapping is for queued restore.

Because the queued restore command is entered into the input command buffer, the INPUT BUFFER READY status line must be low prior to issuing a queued RESTORE command. While the INPUT BUFFER READY status is false (high), all commands issued, including a queued restore, will be ignored. When the printer is in "CHECK", the restore command can be issued regardless of the INPUT BUFFER READY status. Before issuing a queued restore in the TwinTrack model, any one, but at least one, of the ready signals (character, paper, or carriage) must be checked.

DATA LINES (Pins 2 - 14)

These thirteen lines contain binary-coded information representing an ASCII character, a carriage movement command, a paper feed command, or a TOF form length programming command.

When representing an ASCII character, only seven lines ($\overline{D1}$ through $\overline{D64}$) are used; the remaining lines are ignored except by the TwinTrack model. The TwinTrack model uses the $\overline{D2048}$ line to select the print station. If $\overline{D2048}$ is low, the right

print station prints; if $\overline{D2048}$ is high, the left print station prints. Further discussion of the ASCII code, printwheel address, and print intensities is given in the OPERATION Section of this manual.

When representing a carriage movement command, $\overline{D1/2}$ through $\overline{D512}$ designate the distance the carriage is to be moved in multiples of 1/60th of an inch. The $\overline{D1/2}$ bit indicates 1/2 times 1/60th, or 1/120th of an inch. A value of six is required for one character at 10 characters/inch. $\overline{D1024}$ determines the direction of carriage travel. If $\overline{D1024}$ is high, the carriage travels to the right; if it is low, the carriage travels to the left. The $\overline{D2048}$ bit is used in the WideTrack and TwinTrack models to represent 1024/60 inch.

When representing a paper feed command, $\overline{D1}$ through $\overline{D512}$ designate the number of vertical position increments to be moved, in multiples of 1/48th of an inch. $\overline{D1024}$ determines the direction of paper movement; a high moves the paper upward, and a low moves the paper downward. $\overline{D1/2}$ and $\overline{D2048}$ are ignored.

See the OPERATION Section for using $\overline{D1/2}$ through $\overline{D2048}$ in a TOF form length define command and during the external program mode.

$\overline{\text{CHARACTER STROBE}}$ (Pin 18)

When this signal is pulled low and valid character bits are on the data lines, the character code will be transferred into the input command buffer. Timing considerations are given later in this section. $\overline{\text{CHARACTER STROBE}}$ is also used when programming the TOF length (see $\overline{\text{TOP OF FORM STROBE}}$) and when using the external program mode. $\overline{\text{INPUT BUFFER READY}}$ status must be true (low) when the strobe is issued. In the TwinTrack model, $\overline{\text{CHARACTER READY}}$ must be true before the strobe is issued. TOF and external programming are described in the OPERATION Section.

$\overline{\text{CARRIAGE STROBE}}$ (Pin 20)

This signal, when pulled low, enters carriage movement data from the data lines into the input command buffer. Timing considerations are discussed later in this section. $\overline{\text{INPUT BUFFER READY}}$ status must be true when the strobe is issued. In the TwinTrack model, $\overline{\text{CARRIAGE READY}}$ is used instead of $\overline{\text{INPUT BUFFER READY}}$.

$\overline{\text{RIBBON LIFT COMMAND}}$ (Pin 28)

This signal raises and lowers the ribbon. If the level on this line is high (false), the ribbon will drop to the lower position; if the level is low (true), the ribbon will be raised to the printing position. The MultiColor option allows the printer to print in both the raised and lowered positions. The MultiColor ribbon has two colors, making the raised position one color, and the lowered position the other color. The ribbon lift command simultaneously raises or lowers both ribbons of a TwinTrack.

PAPER FEED MAIN STROBE (Pin 22)

When pulled low, this signal enters paper movement data into the input command buffer. In operations where a single platen is used, PAPER FEED MAIN STROBE drives the single platen. When the Dual Paper Drive option is installed, PAPER FEED MAIN STROBE drives the left platen. INPUT BUFFER READY status must be true when the strobe is issued. The TwinTrack uses PAPER FEED READY instead of the INPUT BUFFER READY signal.

PAPER FEED AUXILARY STROBE (Pin 24) (Optional)

When pulled low, this signal enters right platen paper movement data, assuming the Dual Paper Drive option is installed. INPUT BUFFER READY status must be true (low) when the strobe is issued. If the Dual Paper Drive is not installed, the right platen command will be entered into the input command buffer, but will be ignored by the printer when the attempt is made to execute the instruction. The TwinTrack model uses PAPER FEED READY instead of INPUT BUFFER READY.

TOP OF FORM STROBE (Pin 26) (Optional)

This signal advances the paper to the beginning of the next form. There are sixteen programmable lengths of form feed available. The length of form to be used must be programmed prior to issuing the TOF strobe. If the form length is not programmed prior to the TOP OF FORM STROBE, the default length of eleven inches will be issued. TOF programming is discussed in the OPERATION Section of this manual. INPUT BUFFER READY status must be true when the strobe is issued. In the TwinTrack model, any one, but at least one, of the ready signals (character, paper, or carriage) must be true (low) before a TOP OF FORM STROBE can be issued.

BASIC SIGNAL OUTPUTS

The output signals indicate the status of internal printer functions, and can be used by the external processor as flags for initiating data and control inputs.

PRINTER READY (Pin 47)

This signal indicates that the printer is generally ready to accept data and control inputs, that it has been selected, has the correct power applied, and is not in "CHECK".

INPUT BUFFER READY (Pin 39) (CHARACTER READY)
INPUT BUFFER READY (Pin 41) (CARRIAGE READY)
INPUT BUFFER READY (Pin 43) (PAPER FEED READY)

These three lines are identical, but are gate isolated in all Sprint 3 models except the TwinTrack. The TwinTrack signal designations are shown in parenthesis. The input buffer must be ready before any print or move command can be given. In the TwinTrack model, the three lines are separate signals. The TwinTrack PAPER

$\overline{\text{FEED READY}}$ and $\overline{\text{CARRIAGE READY}}$ signals are simultaneous, but with a different timing relationship to other signals than other Sprint 3 models. The $\overline{\text{CHARACTER READY}}$ signal is held false (high) during the complete paper move cycle.

For queued restore and top of form commands, any one of the ready lines being true (low) will allow the command to be strobbed in.

$\overline{\text{INPUT BUFFER EMPTY}}$ (Pin 45)

This signal indicates that the complete sixteen command input buffer is empty. It indicates that unless the customer strappable single command buffer is used, the printer will be able to accept a block of sixteen commands in quick succession ($\overline{\text{INPUT BUFFER READY}}$, or the TwinTrack equivalent, must still be tested prior to each command being strobed into the printer).

$\overline{\text{CHECK}}$ (Pin 37)

This signal indicates that a malfunction has occurred:

the carriage has been commanded to move, but the movement has not been completed; or

the printwheel has been commanded to move, but the movement has not been completed; or

the power supplies have failed.

Under these circumstances, the $\overline{\text{CHECK}}$ signal will be true (low) and no input commands will be accepted until the check condition has been cleared by correcting the malfunction and initiating either a $\overline{\text{RESTORE}}$ command or a power-up sequence. The $\overline{\text{CHECK}}$ signal disables the command input and generates the disable servo signal, turning off all high currect devices.

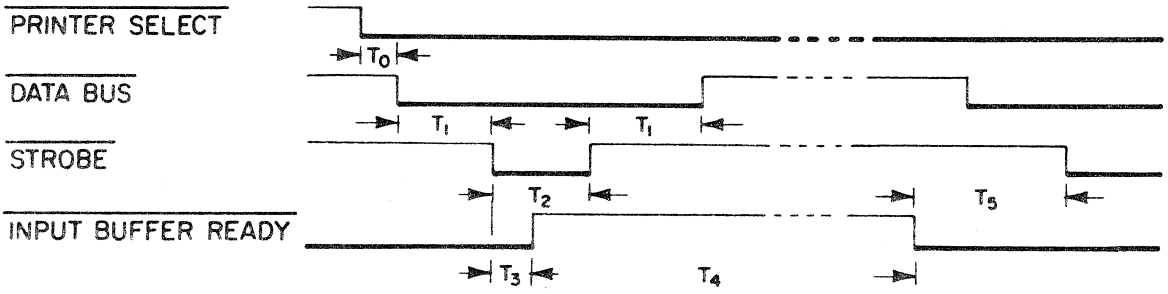
$\overline{\text{PAPER OUT}}$ (Pin 30) (Optional)

This signal indicates that the printer is out of paper. In printers not equipped with the paper out option, this line will always indicate a "paper available" (high) condition.

$\overline{\text{RIBBON OUT}}$ (Pin 30) (Optional)

This signal indicates that the printer is out of ribbon. In printers not equipped with the ribbon out option, this line will always indicate a "ribbon available" (high) condition. A jumper allows the End of Ribbon detection (EOR) to indirectly inhibit the $\overline{\text{INPUT BUFFER READY}}$ status from being "true" until a new ribbon is installed. (See Customer Strappable Features in the OPERATION Section of this manual.)

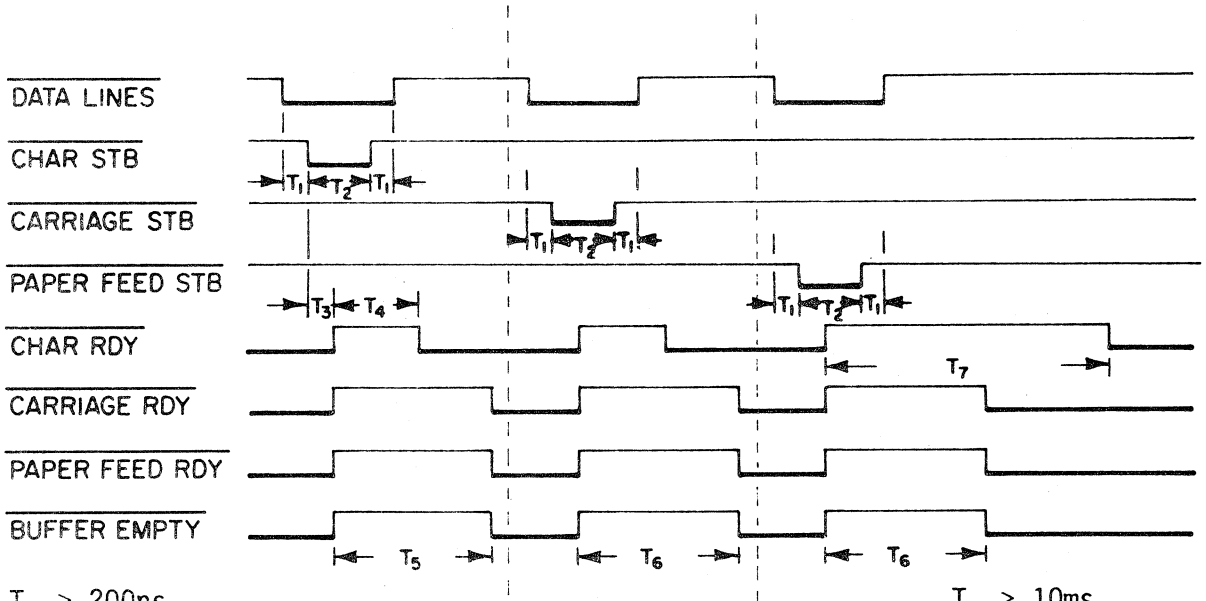
TIMING CONSIDERATIONS



SPRINT 3

T0 > 0 ns
T1 > 200 ns
T2 ≥ 750 ns
T3 ≤ 250 ns – 950 ns
T4 ≥ 20 usec
T5 ≥ 000 ns

*Any STROBE arriving during the time that the INPUT BUFFER READY line is false (> 2.4 Volts) will be ignored.



$T_1 \geq$ 200ns
$T_2 \geq$ 750ns
$T_3 \leq$ 250ns – 950ns
$T_4 \geq$ 20us

SPRINT 3 TWINTRACK

$T_5 \geq$ 10ms
$T_6 \geq$ 300us
$T_7 \geq$ 30ms

T1 through T4 times are the same relationship for all STB lines. The INPUT BUFFER READY lines will go false (high) for 20 to 800 usec after receiving any strobe. If the input buffer is full, INPUT BUFFER READY lines will remain false (high) until the command being executed is complete. Commands are executed in order of receipt.

$\overline{\text{COVER INTERLOCK}}$ (Pin 34) (Optional)

This signal indicates that the printer top cover is in place. In printers not equipped with the cover interlock, this line will always indicate the cover is in place. With this option installed, removing the top cover inhibits the inputs and stops the microprocessor from executing any new commands. (See Customer Strappable Features in the OPERATION Section of this manual.)

TIMING CONSIDERATIONS

The timing diagram shown on the opposing page illustrates the relationships between the data lines, the strobe input, and the internal ready line for all Sprint 3 Printers except the TwinTrack model. Timing considerations for the TwinTrack are given as a separate illustration.

TYPICAL COMMAND SEQUENCES

The Sprint Micro 3 printers have a sixteen command input buffer. The character, carriage, paper feed and TOF commands are first loaded into a single-command hardware buffer by their respective strobe input and are subsequently transferred, under program control, to a fifteen command first-in/first-out (FIFO) software buffer.

Commands sent to the printer are executed in order of receipt. A program controlled interlock routine decides which, if any, operations may occur simultaneously and controls the timing of the allowable "overlaps". The print cycle is divided into two parts:

(1) Position the printwheel and advance the ribbon.

(2) Fire the hammer.

In the TwinTrack model, both print stations can be positioning the printhweel or firing the hammer without interference to each other. However, as long as either print station is active within a print cycle, the print cycle interlock prevents new paper, carriage, or ribbon movement.

The Sprint 3 printer interlock program routine will always allow simultaneous paper movement and carriage motion. If the paper and/or the carriage motion mechanisms are executing a command and the microprocessor receives, from the input command buffer, a character print command, the interlock program routine will allow the first part of the print cycle to begin immediately. The second part of the print cycle, hammer fire, will begin only when there is no other operation in progress; all carriage, paperfeed, ribbon advance ribbon lift, or printwheel positioning operations must be completed before the hammer will fire. Once the microprocessor begins execution of the first part of a character print cycle, any new paper motion, carriage motion, TOF, or ribbon lift command will be deferred until the total print cycle is complete.

The interlock discussion on the previous page, and the example below describes the internal logic that is directed by the microprocessor within all Sprint 3 printers. While the logic circuits within the TwinTrack model remain the same as other Sprint 3 printers, command entry to the internal buffer is regulated differently. In the TwinTrack, there will never be printwheel positioning while the paper is moving. The TwinTrack immediately blocks character entry when a paper feed strobe or top of form is received. It will not accept characters until the paper move is completed. This restriction is true only for paper moves. The exact time relationship is different for the TwinTrack than for other Sprint 3 printers, but the sequence is the same. Both the normal Sprint 3 timing and the TwinTrack timing are shown following the example below.

EXAMPLE: Assume that the printer has just printed the last character of a writing line. The paper must now be advanced, the carriage returned to the left margin, type the first character on the new line, move the carriage to the right one character column width, print the second character, etc.

The commands might be received by the microprocessor from the sixteen command input buffer in the following sequence (we will discuss only the command sequence and not the specific data that would be unique for every situation).

paper feed
carriage motion
character print
carriage motion
character print
etc.

After completing the print cycle for the last character on the writing line, the processor would receive and begin execution of the paper feed command. As long as several commands are in queue in the input command buffer, the microprocessor will be able to begin processing them, if allowed, long before any command presently being executed can finish. Shortly after beginning the paper feed command, the microprocessor will receive and begin execution of the carriage motion command. While both the paper and carriage are moving the microprocessor will receive the character print command. Since it is allowed to begin the print cycle while paper and/or carriage movement is taking place, the microprocessor will go ahead and advance the ribbon and, if necessary, reposition the printwheel. The paper, carriage, ribbon feed, and printwheel mechanisms are now all operating at the same time. The next operation to take place is hammer fire; however, hammer fire will not begin until all other motion has stopped. Until the hammer has been fired, the microprocessor will not begin any new operations. Once hammer fire is complete, the next command, carriage movement, will begin. While the carriage is being moved one character column to the right the next character print operation will begin, allowing ribbon advance and printwheel repositioning, but deferring hammer fire until the carriage motion is completed.

CHAPTER II

INSTALLATION

INTRODUCTION

This chapter describes installation of the Sprint Micro 3 Series printers, including receiving, quality assurance inspection, and electrical interface. Warranty, service, and training policies are also described at the end of the section.

RECEIVING

Each printer is shipped in an individual carton attached to a wooden pallet. The following items are also included:

Power Connector (Qume P.N. 80033)
Hole Plugs (Printer with covers only)
Interface Connector Hood (Qume P.N. 80034)

Unpack the printer as follows:

- Inspect the container for external signs of damage. If any damage is observed, have the delivery agent note the damage on the shipping document. Some shippers may wish to be present when the container is opened if external damage is apparent.
- Open the outer container and remove the inner carton.
- Open the inner carton from the top and remove the cardboard spacer. The printer, bolted to its shipping pallet and wrapped in plastic, can now be withdrawn.
- Remove the plastic bag surrounding the printer.
- Using a 7/16" socket wrench, remove the four screws securing the printer to its shipping pallet.
- Install hole plugs in the printer cover (if ordered) in holes vacated by pallet screws.
- Remove any paper wrapped around the platen.
- Remove the top front cover by lifting up at the operator side of the printer.
- Using diagonal cutting pliers, cut and remove the two plastic ties securing the paper bail during shipping.
- Cut and remove the plastic tie securing the carriage assembly to the printer chassis.

- Examine the packing material closely to ensure that any small items ordered have been recovered (e.g. Power Connector Assembly Qume P.N. 80033 or Logic Connector Hood Assembly Qume P.N. 80034).

- Retain all packing materials for possible reshipment.

- Inspect the printer for scratches, dents, loose or damaged parts or other signs of damage. Note any evidence of such damage on the invoice, and file a claim with the carrier immediately, if the condition of the unit so warrants.

- Remove the middle printer cover as follows:

  - Remove the platen by grasping at each end, and depressing both latch mechanisms.

  - Remove the three 8/32 screws at the rear of the unit.

  - Unscrew the seven 10/32 captive screws inside the periphery of the cover.

  - Lift the center cover free, being very careful to disconnect any associated wiring.

- Inspect the interior of the entire unit. Look for loose or broken parts, evidence of electrical damage, or other signs of damage. Be sure that all printed circuit boards are seated securely in their sockets by pressing down on each one of the boards.

- If damage that might impair printer operation is detected, do not attempt to operate the printer. Contact Qume for advice and instructions.

- When the internal inspection is complete, replace the middle cover.

- Install the platen, a printwheel, and ribbon cartridge.

- Replace the top cover.

- Connect the data cable.

  Note: The ideal performance check uses the system with which the printer will operate, and executing a suitable exercise routine. However, if the system is not available, an alternate performance test for all Sprint 3 printers except the TwinTrack is given below.

- Connect the printer to the power supply. Turn power on and verify that supply voltages are within specification. On S3 printers check +5 V supply at test point indicated on P.C.B. #2; check ±15 V supply at the emitters of carriage drive transistors Q2 and Q1 (Q2 and Q1 are mounted on the heat sink at the right rear of the printer frame).

  + 5 VDC ± 3%
  + 15 VDC ±10%
  - 15 VDC ±10%

- Turn power off.
- Connect the printer to a Printer Exerciser/Tester.
- Apply power and verify that the carriage "restores" to the extreme left limit at a moderate velocity.
- Press the ribbon advance switch on the printer and verify that the ribbon both lifts and advances correctly.
- Insert a piece of paper into the platen.
- Pull the feed roller release lever forward and verify that this allows the paper to be aligned. Push feed roller release lever to the rear.
- On printers ordered with cover assemblies and cover interlock switch, verify that removing the top cover disables the printer (printer exerciser CHAR RDY, CARR RDY, PF RT RDY, and PF LFT RDY LED's will be OFF, only the PTR RDY LED will be ON).
- Replace top cover.
- If Top Of Form option has been ordered, verify that it works correctly. This function can be operated from the printer exerciser or, if ordered, from the "TOF" switch on the printer cover.
- Print one line of Test 5-1 from the exerciser. (See exerciser instructions for test details.) Verify that the characters are printed evenly and are consistant from side to side and top to bottom.
- Complete a 15 minute warm-up using printer exerciser Test 5-1 with vertical line spacing of six lines to the inch. Verify that print is equally dark through-out the printout (verifies proper ribbon advance).

In the Sprint Micro 3 Series printers the end of ribbon option is factory strapped so that it does not disable the printer and is only a status condition which provides a status signal to the interface. The Qume exerciser does not monitor this line. Only one of the two print stations and only part of the internal logic within the TwinTrack is exercised by the Printer Exerciser/Tester.

Self Test (no exerciser available)

An alternate check may be performed by grounding pin 2 of the 40 pin test point strip on P.C.B. #2. The printer must be powered down when securing a jumper between ground and pin 2. In this test the printer relies on a diagnostic test stored in its own micro processor memory. Instead of grounding pin 2, this test may be monitored and controlled by the Sprint Micro 3 ActivityMonitor (Qume P.N. 80740). When the activity monitor is connected to the 40 pin test point strip, the ON/OFF switch on the activity monitor panel starts the test. Special consideration must be made when testing the TwinTrack model. These considerations are described at the end of this test.

The diagnostic test performs the following:

ROM test.

I/O lines.

Executes a restore.

Carriage moves 114 times back and forth in diminishing movements.

Printwheel moves 96 times clockwise and counter clockwise.

Executes various combinations of forward and reverse paper feeds.

Concludes test with "Self Test" printed vertically. Ribbon lift, hammer acutation and ribbon advance are exercised during this print cycle.

Some printers with certain options have an extended self test that continues after the test above by printing a single line of the complete ASCII character set from the printwheel that is installed. Manual intervention is not necessary for the extended test.

TwinTrack printers can be made to self test if both #2 boards are jumpered from pin 2 of the 40 pin test point strip to ground. The printer must be powered down when the connections are made. The test begins when printer power is applied. The test proceeds as listed above, but both printwheels will print the "self test" vertically. If the printer contains the extended self test, the single line of ASCII characters will overlap as the one printwheel reaches the area that was already printed by the other printwheel.

The Sprint Micro 3 ActivityMonitor can be used to monitor the self test in the TwinTrack. However, the #2 board that is not connected to the activity monitor must have pin 2 of the 40 pin test point strip grounded. Both the activity monitor connection and the pin 2 grounding must be done while the printer is powered down. The activity monitor must be ON before the printer is powered up. When the activity monitor is used in this way, only half of the circuits are being monitored. To check the other half of the circuits, power the printer down and connect the activity monitor to the other #2 board, and ground pin 2 of the 40 pin test point strip where the activity monitor was last connected.

If two Sprint Micro 3 ActivityMonitors are available, connect one to each of the #2 boards in the TwinTrack. This must be done while the printer is powered down. Before powering up the printer, set both activity monitors to ON. The self test will begin when the printer is powered up, and the activity of each circuit will be displayed on the monitor panel.

WARRANTY, SERVICE, AND TRAINING

Qume products are warranted to be free from defects in material and workmanship for a period of 90 days after delivery. Qume's obligation under this warranty is limited to replacing or repairing, at its option, at its factory, any of the products (except expendable parts thereof) that within the warranty period are

returned to Qume and that are found to be defective in proper usage. Printers within warranty will be repaired at no charge. Buyer shall prepay transportation charges to the Qume factory.

Transportation from the Qume factory or repair depot will be paid by Qume only if the printer is repaired at no charge under the warranty agreement. All other repaired printers or assemblies will be returned to the buyer F.O.B. collect, and repair charges will be billed by separate invoice.

Before returning materials to Qume, the customer must request a Material Return Authorization Number. Qume will only accept authorized Replacement Assemblies (see Service Policy) or complete printers for replacement or repair if removed from assemblies.

Qume will ship repaired or replaced assemblies to customers within 30 days from receipt of assemblies.

Qume will accept certain assemblies for repair at standard charges. The terms, conditions and prices for repairs are specifically described in Qume publication number 30030, Qume Prices, Service and Spares.

Periodic service training classes are conducted at the Qume factory, and can conditionally be arranged at a customer location. Training availability and costs are described in Qume publication number 30030, Qume Prices, Service and Spares.

CHAPTER III

OPERATION

This chapter reviews the operator duties and functions, and describes the customer strappable features, the optional modes for external printwheel and hammer programming and Top of Form programming. For detailed printer operating instructions refer to the Operation Manual, Qume P.N. 32213.

TURNING ON THE PRINTER

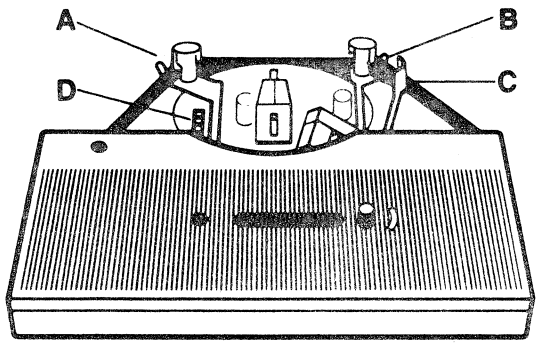
Printer power comes from a separate power supply. The ON/OFF switch location for the power supply will vary with the system configuration unless the optional Qume power supply is used. The Qume switching regulator power supply attaches to the rear of the printer, and appears to be a part of the printer. If the Qume switching regulator power supply is attached to the printer, the power ON/OFF switch is located on the right side of the printer (from the operator position) near the rear. The switch is a "push-push" type. That is to say, pushing the button once will toggle the switch to the opposite state. Pushing the button again will return the switch to the first state. If the power is not already ON when the power cord is connected to the source outlet, pressing the button once will turn it ON.

CHANGING RIBBONS

Sprint 3 printers will accommodate a variety of ribbons. The three basic ribbon types are carbon (multi-strike or single strike), cloth (in a large number of colors), and MultiColor (a variety of two-color cloth ribbons that require an optional ribbon guide). Cloth ribbons are an endless loop and require changing only when the loss of print quality requires it. Carbon ribbons have a clear section at the beginning and end, and must be changed when the supply spool is depleted.

Changing the ribbon is an operator function, and is done as follows:

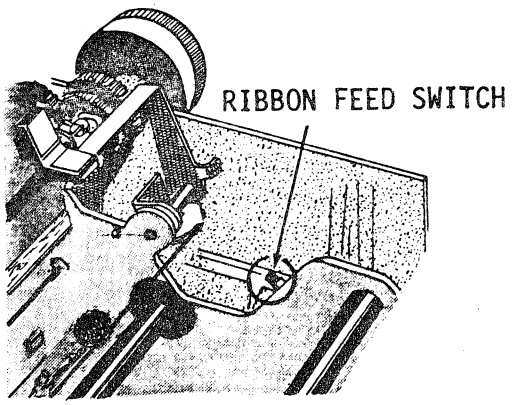
- Remove the top printer cover by lifting up at the front edges.
- Depress the red ribbon release lever shown as item D in the illustration.



RIBBON CARTRIDGE

CHANGING RIBBONS (continued)

- Lift out the cartridge and unthread from the two guides, A and B.
- Thread the new ribbon through the guides as shown, and around the outside of the tensioner, C, and snap the cartridge in place.
- Depress the ribbon feed switch (shown in the illustration below) until the clear leader disappears, or for a cloth ribbon, until it is feeding properly.

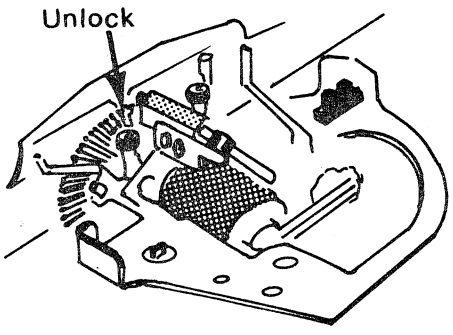


- Replace the top cover.

CHANGING PRINTWHEELS

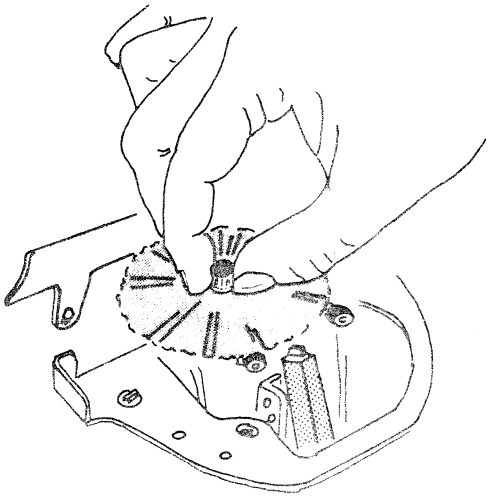
Changing the printwheel is an operator function, and can be done whenever a change in typeface is desired. The printwheel is changed as follows:

- Remove the top cover and ribbon as described in the paragraphs above.
- Unlock the printing mechanism by depressing the "O" (open) lever near the printwheel (see the illustration).



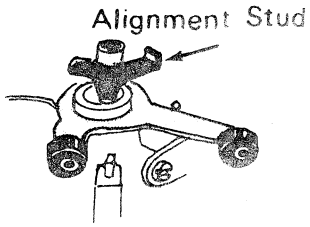
UNLOCK BUTTON

- Tilt the printing mechanism forward to an upright position.
- Lift the printwheel off by grasping firmly and pulling as shown in the illustration.



CHANGING THE PRINTWHEEL

- Place a new printwheel onto the hub, making sure that the hole in the printwheel engages the alignment stud (see the small illustration).



- Return the printing mechanism to the horizontal position.
- Lock the mechanism into place by depressing the lever marked "C" (close). There should be a definite "click" as the mechanism locks.
- Replace the ribbon cartridge and top cover as described previously.

PAPER CONTROLS

The paper controls are similar to those of a standard office typewriter. The multicopy selector lever is on the left, from the operator position, and controls the distance between the printing mechanism and the platen. The multicopy selector lever should be in the forward position (toward the operator) for single part forms, and one or more notches toward the rear as needed for thicker forms.

The right hand lever (paper release) releases pressure on the paper when the lever is in the forward position. This allows the paper to be positioned for proper tracking and alignment. When the paper release lever is allowed to return to the rear, normal paper tension is resumed.

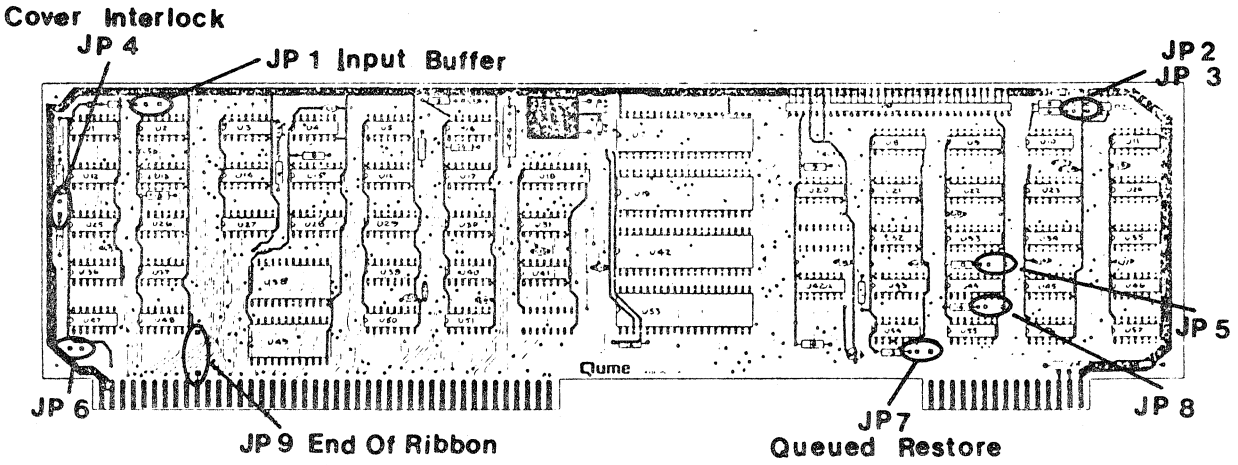
NOTE: When the optional pin feed platen or forms tractor is used, the paper release lever should remain in the forward (released) position.

The platen knobs at each end of the platen can be rotated to vertically position the paper. Fine adjustment can be made by pushing inward on the right-hand knob, releasing the platen from the drive motor gears. If the platen is not released from the motor when it is moved, manual paper movement will appear to "detent" every 1/12".

CUSTOMER STRAPPABLE FEATURES

Sprint 3 printers have four customer strappable features for broader versatility in the end user system. The features select queued or direct restore, enable or disable the cover interlock, provide a sixteen input or single input command buffer, and select the action taken by the printer when the end of ribbon is detected. When printers are shipped from the factory, they are strapped for queued restore, cover interlock enabled, sixteen command input buffer, and if equipped with an End of Ribbon Detector, the ribbon out signal is sent to the interface only.

The location of the customer strappable features is shown in the illustration below. All are on the #2 board. A description of the exact action of each feature follows the illustration.



CUSTOMER STRAPPABLE FEATURES

QUEUED/DIRECT RESTORE (JP-7)

When the JP-7 strap is in position, restore commands are entered into the input buffer as a normal command. Any commands that are not yet completed, and queued commands waiting in the input buffer will be completed before the restore is implemented. However, when the printer is in "check", a restore causes immediate cancellation of existing and queued commands, and the restore is executed immediately.

When the JP-7 jumper is not connected a restore command immediately aborts in-process commands, and initializes the printer. Any commands that may have been in the input buffer are lost.

COVER OPEN INTERLOCK ENABLE/DISABLE (JP-4)

When JP-4 is not connected, the Cover Open Interlock prevents any new operation, but does not interrupt an already in-process command. For printers that are not purchased with the optional cover interlock switch, the customer must either install an interlock switch, connected to J20 on the side frame or J4 on the motherboard, or must disable the interlock circuit.

Jumper JP-4 disables the interlock circuit when the connection is made. An open cover will not disable the printer.

SIXTEEN/SINGLE INPUT COMMAND BUFFER (JP-1)

The sixteen command input buffer can be disabled by connecting JP-1. When JP-1 is connected the input buffer becomes a single command input. Additional commands cannot be entered until the current command begins execution. Commands can be overlapped in execution, but only one will wait in queue in the input buffer.

END OF RIBBON DETECT (JP-9)

For printers that contain the End of Ribbon Detect option, the detected signal is sent only to the interface when JP-9 is open.

Placing a jumper on JP-9 causes an inhibit to the ready status signals when the end of ribbon signal is detected. With the ready status signals disabled, all commands already in queue in the input buffer, and in-process commands will be completed, but no new commands can be entered. There is enough ribbon after the end of ribbon detection to complete the possible maximum number of print commands that could be in the input buffer.

EXTERNAL PROGRAM MODE

Under normal operation the Sprint 3 printer is given a character to print, and the hammer intensity and ribbon advance are automatically calculated by the microprocessor. For special applications the hammer force and ribbon advance can be externally controlled. To do this the printer is given an ASCII SO (shift out) character and a $\overline{\text{CHARACTER STROBE}}$. All following characters must then contain the hammer intensity and ribbon advance information. The tables that follow show the additional bits that are needed and the normal intensities and ribbon advance. The ASCII character code is placed on the $\overline{\text{D1}}$ through $\overline{\text{D64}}$ lines as always, and the remaining lines are used for the external programming information.

PROPORTIONAL RIBBON ADVANCE
(RIBBON MOTOR STEPS)

CURRENT CHARACTER WIDTH (Ribbon Motor Steps)	LAST CHARACTER WIDTH (Ribbon Motor Steps)			
	5	4	3	2
5	5	4	4	3
4	4	4	3	3
3	4	3	3	3
2	3	3	3	2

EXTERNALLY PROGRAMMED
RIBBON ADVANCE

Ribbon Advance Increments	Character Print Command Data Lines	
	$\overline{D1024}$	$\overline{D1/2}$
2	0	0
3	0	1
4	1	0
5	1	1

EXTERNALLY PROGRAMMED
HAMMER INTENSITY

HAMMER INTENSITY	HAMMER "ON" TIME (ms)*	DATA LINES		
		D512	D256	D128
1	1.60	0	0	1
2	1.70	0	1	0
3	1.85	0	1	1
4	2.00	1	0	0
5	2.25	1	0	1
6	2.50	1	1	0

* These standard intensities do not apply to "X" models, or if the optional Twintellect switch is in the SPECIAL CHARACTER position.

CHAR-ACTER	ASCII BINARY CODE	ASCII HEX CODE	DECIMAL PRINTWHEEL ADDRESS	RELATIVE HAMMER FORCE	RIBBON ADVANCE
A	1000001	41	022	5	4
B	1000010	42	016	5	4
C	1000011	43	020	4	3
D	1000100	44	044	5	4
E	1000101	45	030	4	3
F	1000110	46	018	4	3
G	1000111	47	048	5	4
H	1001000	48	034	5	4
I	1001001	49	040	4	3
J	1001010	4A	058	5	3
K	1001011	4B	056	5	4
L	1001100	4C	042	4	3
M	1001101	4D	012	6	4
N	1001110	4E	038	5	4
O	1001111	4F	036	5	4
P	1010000	50	052	4	3
Q	1010001	51	054	5	4
R	1010010	52	026	5	4
S	1010011	53	028	4	3
T	1010100	54	032	4	4
U	1010101	55	046	5	4
V	1010110	56	060	4	4
W	1010111	57	008	6	4
X	1011000	58	064	5	3
Y	1011001	59	050	4	4
Z	1011010	5A	014	4	4
a	1100001	61	168	4	4
b	1100010	62	156	4	3
c	1100011	63	158	4	3
d	1100100	64	152	4	3
e	1100101	65	166	3	3
f	1100110	66	178	3	3
g	1100111	67	148	4	3
h	1101000	68	174	4	3
i	1101001	69	170	3	3
j	1101010	6A	144	3	3
k	1101011	6B	186	4	3
l	1101100	6C	154	3	3
m	1101101	6D	142	6	4
n	1101110	6E	164	4	3
o	1101111	6F	160	4	3
p	1110000	70	180	4	4
q	1110001	71	184	4	4
r	1110010	72	162	4	3
s	1110011	73	176	4	3
t	1110100	74	172	4	3
u	1110101	75	182	4	3
v	1110110	76	146	3	4

ASCII CODE *(continued)*

CHAR-ACTER	ASCII BINARY CODE	ASCII HEX CODE	DECIMAL PRINTWHEEL ADDRESS	RELATIVE HAMMER FORCE	RIBBON ADVANCE
w	1110111	77	000	5	4
x	1111000	78	150	4	3
y	1111001	79	188	4	4
z	1111010	7A	190	4	3
0	0110000	30	074	4	3
1	0110001	31	066	3	3
2	0110010	32	068	4	3
3	0110011	33	070	4	3
4	0110100	34	072	4	3
5	0110101	35	076	4	3
6	0110110	36	078	4	3
7	0110111	37	080	4	3
8	0111000	38	082	4	3
9	0111001	39	084	4	3
¢	0100000	20	004	4	3
!	0100001	21	136	3	2
"	0100010	22	140	2	3
#	0100011	23	092	4	3
$	0100100	24	088	5	3
%	0100101	25	094	6	4
&	0100110	26	138	5	4
'	0100111	27	108	2	2
(	0101000	28	120	4	2
)	0101001	29	116	4	2
*	0101010	2A	122	3	3
+	0101011	2B	090	3	3
,	0101100	2C	006	1	2
-	0101101	2D	086	2	3
.	0101110	2E	010	1	2
/	0101111	2F	132	4	3
:	0111010	3A	024	1	2
;	0111011	3B	062	1	2
<	0111100	3C	114	3	3
=	0111101	3D	096	3	3
>	0111110	3E	100	3	3
?	0111111	3F	130	3	3
@	1000000	40	124	6	4
[	1011011	5B	106	4	2
\	1011100	5C	126	4	4
]	1011101	5D	102	4	2
^	1011110	5E	128	2	3
_	1011111	5F	110	1	5
`	1100000	60	112	2	2
{	1111011	7B	098	4	3
|	1111100	7C	118	4	2
}	1111101	7D	134	4	3
~	1111110	7E	104	3	3
¬	1111111	7F	002	2	3

EXTERNAL PROGRAM MODE (continued)

The $\overline{D2048}$ line is used only by the TwinTrack model to specify the left or right print station. The printer stays in the external program mode until an ASCII SI (shift in) character is received. It then returns to normal.

It is often possible to externally program a completely non-standard printwheel. The ASCII code table shows the normal printwheel address for the ASCII characters and the hammer intensities and ribbon advance. By using a software conversion table, printwheel addresses can be given for non-standard printwheels, and the hammer and ribbon information can be externally programmed (within the standard values). This procedure is much easier, however, if a ROM (read only memory) is available for the particular non-standard printwheel. If a ROM is available, the Twintellect option can be used, and the operation is automatic again.

Twintellect

The Twintellect option switches an extra ROM in or out of use. The extra ROM is configured to handle a particular non-standard printwheel. All of the printwheel address information, hammer intensities and ribbon advance are pre-programmed into the ROM. When a standard printwheel is used on the printer, the operator manually switches to the standard program. This is a toggle switch that is located next to the ribbon advance switch.

Each non-standard printwheel type requires a unique ROM. Sprint 3 printers with the Twintellect option have the standard operating program, and an additional ROM for the special requirements of a particular printwheel. The TwinTrack model with two Twintellect options, however, can accept an additional ROM for each print station, making it possible to use one standard, and one non-standard printwheel, or two non-standard printwheels.

ROMs and printwheels are developed as needed. For the latest additions to the printwheel family, refer to the price catalog for printers and accessories (Qume P.N. 30032).

TOP OF FORM PROGRAMMING

Sprint 3 printers contain a top of form feature that advances the paper to the next heading, or ejects a page when single sheets are used. The Top of Form feature can be used by issuing a $\overline{\text{TOP OF FORM}}$ strobe or depressing the optional TOF push button. A standard or default value of eleven inches is used when no other top of form value has been previously entered.

Form length information can be entered to define one of sixteen form lengths. This information must be re-entered after each restore or power up. To enter form length information, an ASCII form feed (FF) command is placed on lines $\overline{D64}$ through $\overline{D1}$. The ASCII FF code is 0001100 (MSD, or $\overline{D64}$ line shown to the left). A binary value from the following table is also placed on the $\overline{D1024}$ through $\overline{D128}$ lines. With the FF and the binary code for the form length on the data lines, a $\overline{\text{CHARACTER STROBE}}$ is issued to enter the information.

TOP-OF-FORM

DATA BITS OF FF COMMAND				FORM LENGTH (INCHES)
$\overline{D1024}$	$\overline{D512}$	$\overline{D256}$	$\overline{D128}$	
0	0	0	0	11 (Note 2)
0	0	0	1	3
0	0	1	0	3.5
0	0	1	1	4
0	1	0	0	5
0	1	0	1	5.5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	8.5
1	0	1	0	9
1	0	1	1	10
1	1	0	0	11-2/3 (70 lines)
1	1	0	1	12
1	1	1	0	14
1	1	1	1	17

The data shown below will enter a form length of fourteen inches.

$\overline{\text{CHARACTER STROBE}}$ and		
$\overline{\text{DATA 1/2}}$	not used	
$\overline{\text{DATA 1}}$	0	
$\overline{\text{DATA 2}}$	0	
$\overline{\text{DATA 4}}$	1	
$\overline{\text{DATA 8}}$	1	ASCII FF (Form Feed)
$\overline{\text{DATA 16}}$	0	
$\overline{\text{DATA 32}}$	0	
$\overline{\text{DATA 64}}$	0	
$\overline{\text{DATA 128}}$	0	
$\overline{\text{DATA 256}}$	1	See Table 3-4
$\overline{\text{DATA 512}}$	1	
$\overline{\text{DATA 1024}}$	1	

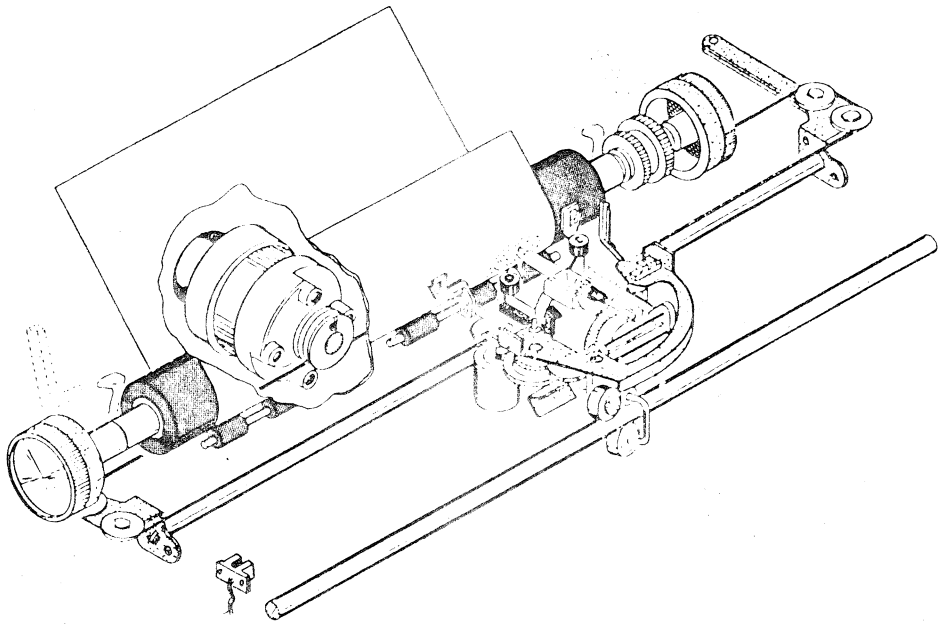
CHAPTER IV

THEORY OF OPERATION

INTRODUCTION

Mechanically the printer is similar and can be compared to a "fixed platen" typewriter originally marketed by the IBM Corporation and now produced by at least one other company. The paper is fed around a platen, using pinch rollers and the necessary guides exactly as in a typewriter. In the standard version of the printer, paper is friction fed. Options include a pin feed platen and an operator installed tractor feed mechanism. Paper is moved physically by a stepper motor, geared to drive the platen (and the tractor feed if it is attached). The stepper motor increments translate to 1/48 of an inch at the paper.

Just as it is in a fixed platen typewriter, the carriage with the printing element is positioned across the platen to the proper horizontal column on the paper. This is where the similarity ends. Carriage movement in the Qume printer is driven by a servo motor and a cable/pulley arrangement. (See the figure below.) Rigid guiderails and lightweight but rugged ball bearing assemblies allow the carriage to freely move horizontally with virtually no freedom in other directions. The entire carriage assembly design is aimed at low inertia and high rigidity for fast, accurate movement. The carriage servo system has stable positions every 1/120 of an inch at the paper.



SIMPLIFIED MECHANICAL CUTAWAY

The print station on the carriage consists of a ribbon mechanism with a feed motor and lift solenoid, a printwheel motor and printwheel, and a printhammer. The printwheel is lightweight plastic (sometimes metalized) with character dies at the end of individual spokes. When the proper character die is in position, the hammer strikes the rear of the die causing it to flex and strike the paper. The ribbon is between the paper and the printwheel, and is captured between the character die and the platen, depositing ink on the paper in the character form.

Mechanically the various models are similar enough that a basic understanding of one model will allow the reader familiarity with all of the models. Exact part exchangeability is obviously not possible in some cases, and is subtly impossible in other cases. But the basic mechanical function of the part is the same from one model to the next.

Ribbon lift and feed are separate sub-systems. Ribbon lift is a simple solenoid that is given a lift pulse, then a lower intensity hold current. The ribbon ad vance is a more complicated circuit (discussed in the electrical section of this chapter). Actual ribbon movement is driven by a small stepper motor that is a part of the carriage assembly.

From a mechanical standpoint, the printer works as follows:

- The carriage motor is made to rotate, feeding the rotational information back into the electronic control circuits.
- The rotation winds a cable onto a spool, or pulley, and unwinds another cable from the same spool.
- These cables pass around pullies at each end of the printer frame, and pull the carriage in the commanded direction.
- When the electronic control circuits determine that the movement is correct, the motor is commanded to stop moving.
- The printwheel motor moves independently, feeding back electronic information to the printwheel circuits. This movement can coincide with carriage movement.
- When the proper character is in the print position, the motor is commanded to stop.
- Either previously or during carriage movement, or during character positioning, the ribbon is lifted by activating the ribbon lift solenoid.
- As another independent action, the ribbon is advanced the proper number of increments for best ribbon conservation.
- When all other movement has stopped, the hammer is activated by the hammer solenoid.

INTRODUCTION (continued)

- The hammer moves toward the platen, forcing the character die to impress the character through the ribbon onto the paper. The last portion of the hammer travel is "free-flight" in that the hammer is no longer being propelled. The impact energy is controlled by inertia, or most directly by the initial velocity (see the electrical explanation for velocity control).

- When the hammer, printwheel spoke (character die), and ribbon collide with the platen, the printhammer is "bounced" back to its resting position. There is a small spring in the hammer assembly that keeps the hammer retracted when not in use. But by far the greatest return force is the "bounce" effect.

- Just before the next character is printed, the ribbon is advanced in proportion to the width of the character that was printed previously and the character that is about to be printed.

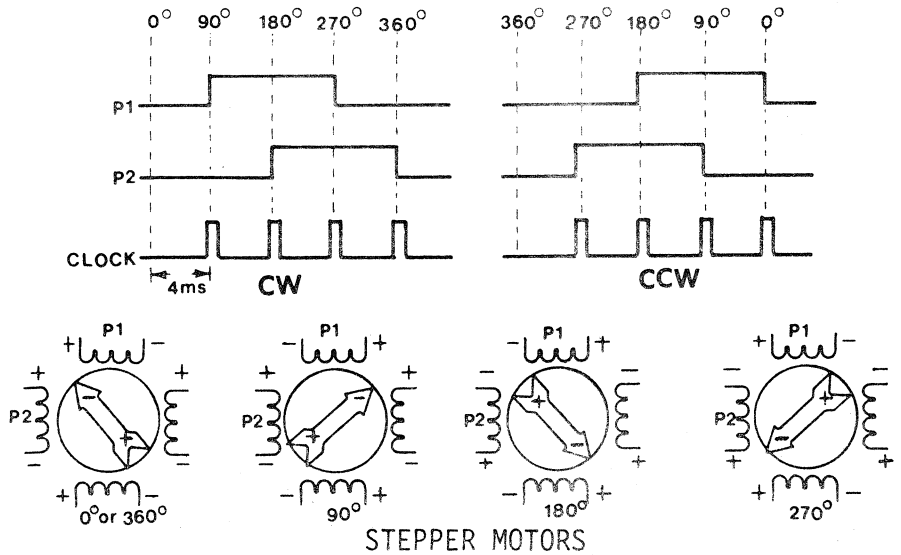
ELECTRICAL OPERATION

The figure on the following page shows a simplified block diagram of the printer. As this discussion progresses, the individual blocks will be explained, and finally the overall flow from block to block.

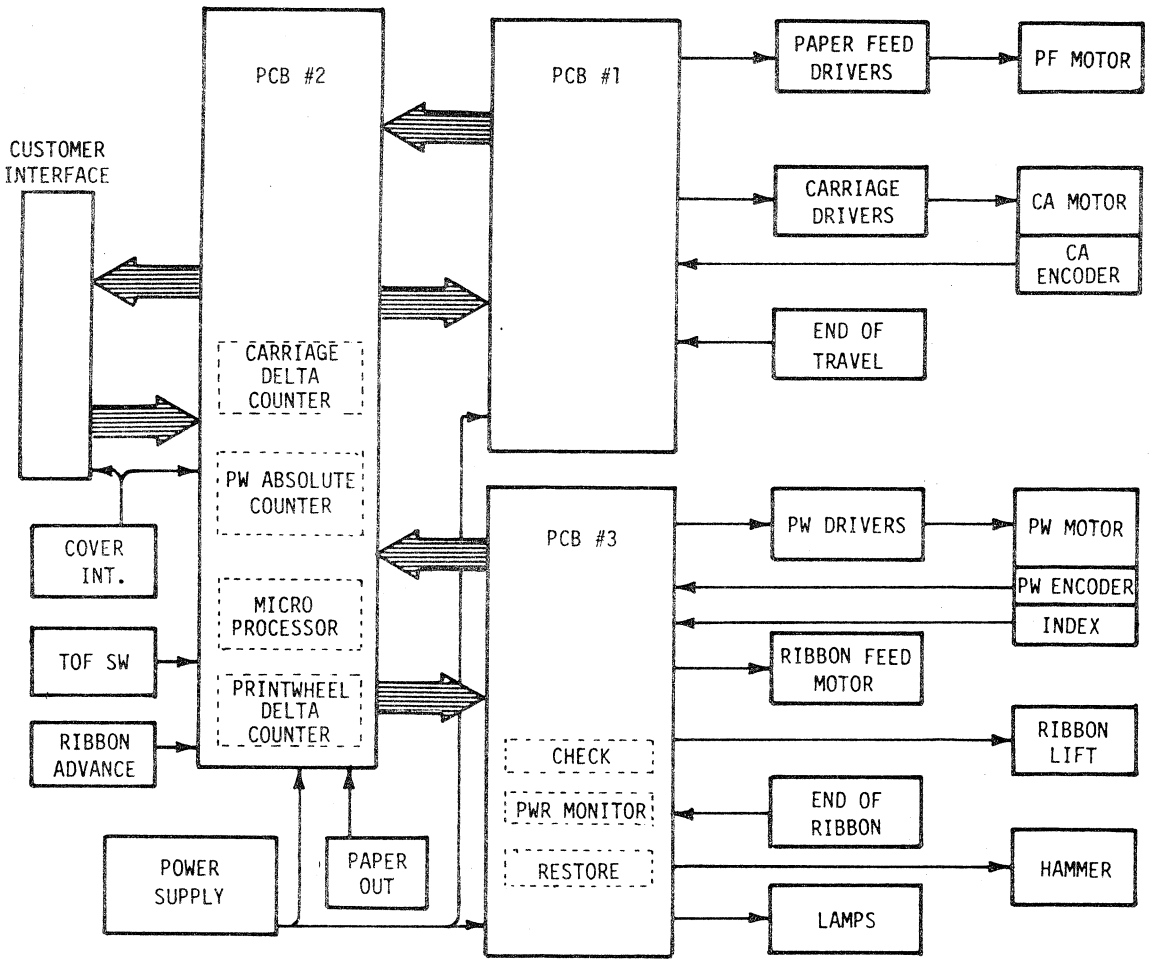
SPLIT-PHASE STEPPER MOTORS

The printer uses stepper motors for paper feed and ribbon feed. A short explanation of these conventional motors is given in the following paragraph for those who may not be familiar with them.

The motor can be explained as two pairs of field windings around a magnetic armature. The armature in the ribbon motor is a permanent magnet material for compactness. When the field coils are excited, the armature aligns to the magnetic field that is created. By changing the relationship of the fields, the motor armature aligns to one of four directions. The figure below is a simplified illustration of the relative fields and the direction of current flow to align the armature in each of the four directions.



STEPPER MOTORS



OVERALL BLOCK DIAGRAM

SPLIT-PHASE STEPPER MOTORS (continued)

Control for the stepper motors comes from two sources, Ø1 and Ø2, for each motor. They are driven by a circuit that places the motor field current in the proper sequence to move in either direction or hold, whatever is desired.

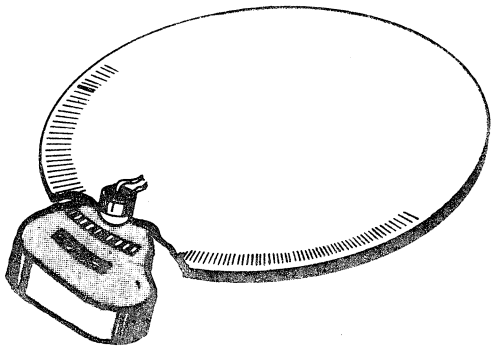
OPTICAL SERVO SYSTEMS

A servo system is a closed loop where a controlling circuit sends signals to a device that creates some kind of action. The resulting action in turn causes a change (is fed back) in the controlling input creating a new input to the action device. In this case, the action device is a servo motor and the action is rotation; the feedback from the the resulting action is from optical encoders on the motor shaft.

The printwheel and the carriage motors are DC servo motors. A DC servo motor is not essentially different from any ordinary motor except that it is designed for quick acceleration and deceleration and is part of a servo loop. Being a DC motor, it is reversible by changing the direction of flow in the field current.

The printwheel and carriage motors, while they are considerably different in size and duty, operate in the same manner. The printwheel motor has one addition that will be explained later.

The motor armature shaft extends from the rear of the motor. Attached to the extended shaft is an optical encoder disc. The disc is nothing more than a glass plate, silvered in radial patterns that appear similar to spokes of a wheel. Beneath the encoder disc are two photovoltaic cells spaced so that when one is exposed, the other is half covered by a silvered area. Above the encoder disc is a light emitting diode (LED). (See the illustration below.)



OPTICAL
ENCODER
(SIMPLIFIED)

Photovoltaic cells produce a voltage when stimulated by light. One of the cells is called encoder A, the other is called encoder B. As the shaft is rotated, each of the two cells, illuminated by the LED, produces a sinewave output directly proportional in frequency to the rate of rotation. Because of the cell spacing, the two sinewaves are phased 90 apart. The light source (LED) is inherently unstable with temperature, and ideally the encoder output should not be affected by environment. So, a compensator is built into the system.

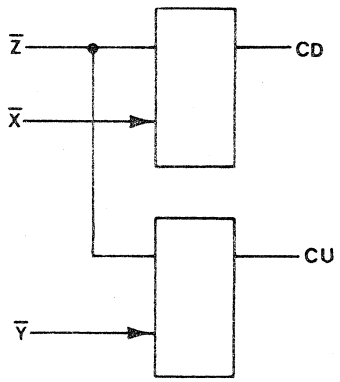
The temperature compensator consists of a third identical photovoltaic cell that is mounted outside of the influence of the encoder disc and is illuminated by the same light source. This cell is called the CLEAR cell. The output is taken from

the CLEAR cell, is amplified, and compared with a standard voltage. If the light output from the LED changes, the voltage output from the CLEAR cell changes. The difference is then given to the LED source circuit, and compensation is made to the LED current until the CLEAR cell reports the proper output.

The encoder outputs are used basically for four separate, but related, purposes - direction, velocity, distance and position lock. The carriage has a delta (Δ) counter on board #2 that is loaded indirectly by the carriage move command, and decremented by the carriage clock signal as movement progresses. The printwheel has two counters, a delta counter and absolute position counter. The PW delta counter (also on board #2) is loaded from the microprocessor and is decremented by the PW clock signal. The delta number that is loaded relates to the printwheel position and the desired printwheel address.

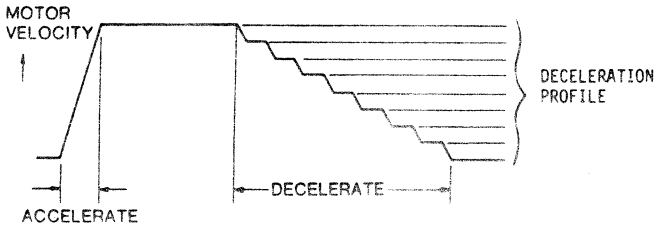
The printwheel absolute position counter circuit is related to degrees of rotation, or circular distance from an index point. The index point is established by a second LED that is optically coupled to a photo transistor through a single slot in the encoder disc. The index pulse that is generated resets the printwheel absolute counter.

The carriage direction is loaded by the carriage move command, but for the printwheel circuit to count up or down, it must know which direction the motor is turning. If movement were always commanded electrically, there would be no problem. But motion is sometimes forced mechanically by the operator. The counter follows any movement, no matter how slow. The $\overline{X}$, $\overline{Y}$ and $\overline{Z}$ signals are fed to flip-flops as shown in the simplified drawing below. The count up or count down signals are generated according to the relationship of the encoder signals.



DIRECTION FLIP-FLOP

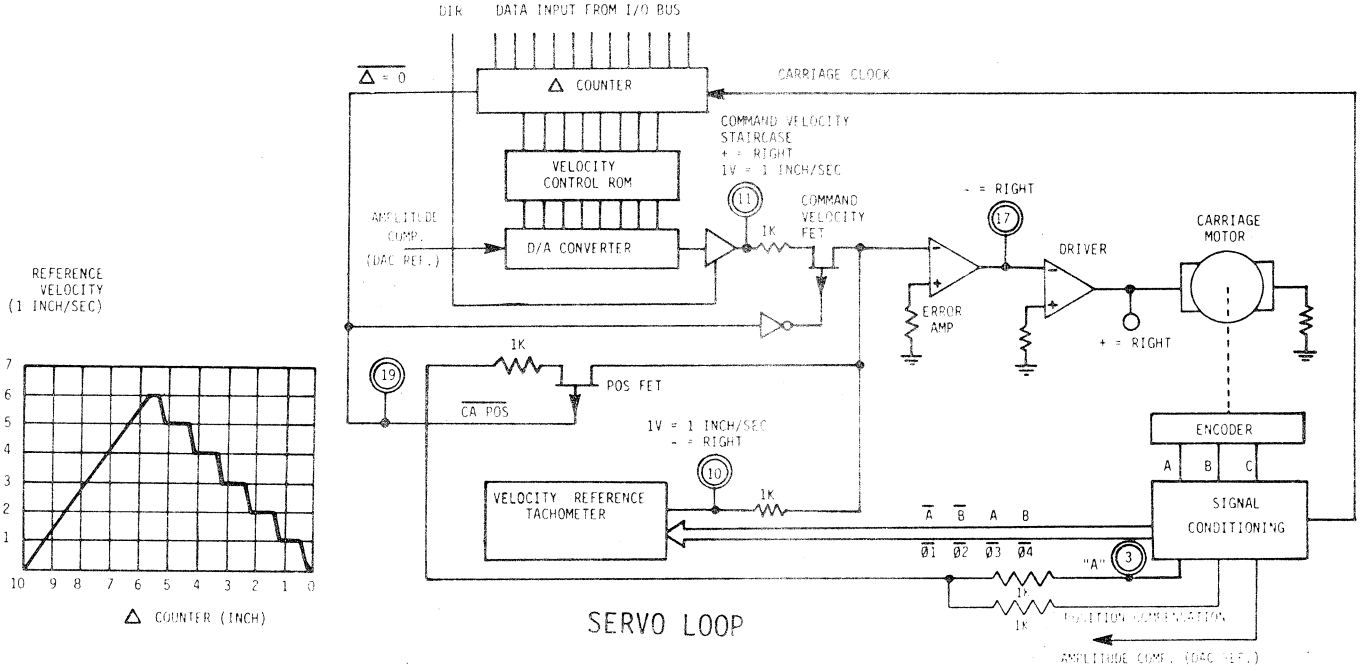
The delta counters, both printwheel and carriage, are loaded by the microprocessor. When a move is made, the extent of the move determines how much force is applied to the motor. Short moves would overshoot if full power were applied to the motor. As the movement progresses, the delta count decreases until the destination is near, and speed is then correspondingly reduced in steps. When the destination is reached, power is removed from the motor at a stable position. In practice this stable position appears to be a mechanical detent. As an attempt is made to move the motor, the force grows stronger, pushing it back to the stable position. With enough external force, the motor can be overcome, causing it to lock into another stable position. A visual representation of the acceleration/deceleration profile is shown on the next page.



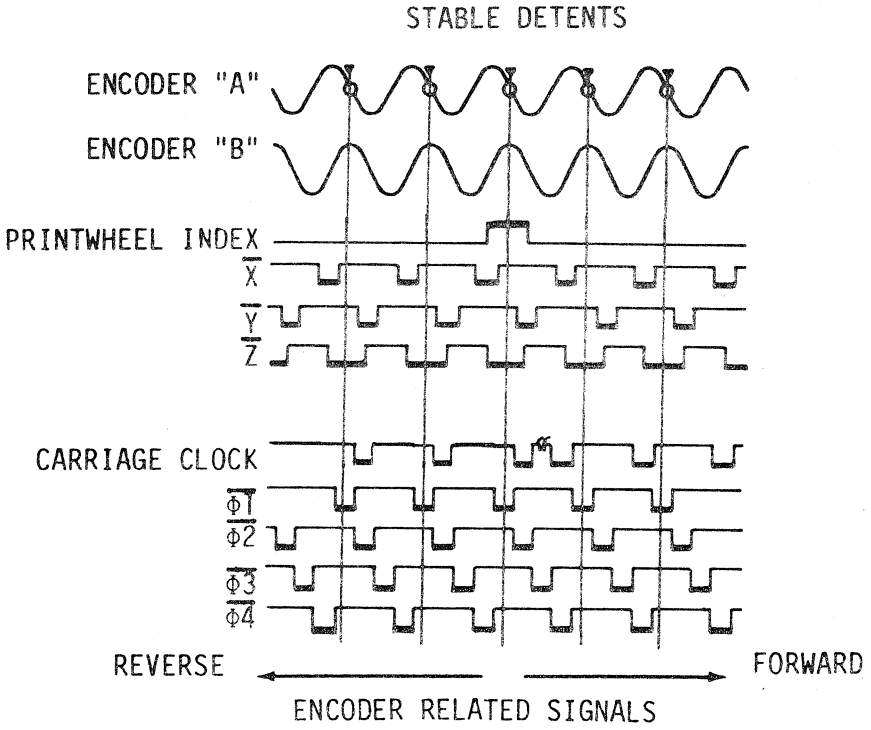
ACCELERATION PROFILE

THE SERVO LOOP

The figure below shows a block diagram of the carriage servo system. Both the carriage and printwheel servos are nearly identical, and the discussion below refers to both servo systems. The outputs of the A and B encoders are amplified, inverted, and digitized by Schmidt triggers. The Schmidt trigger remains at zero logic level



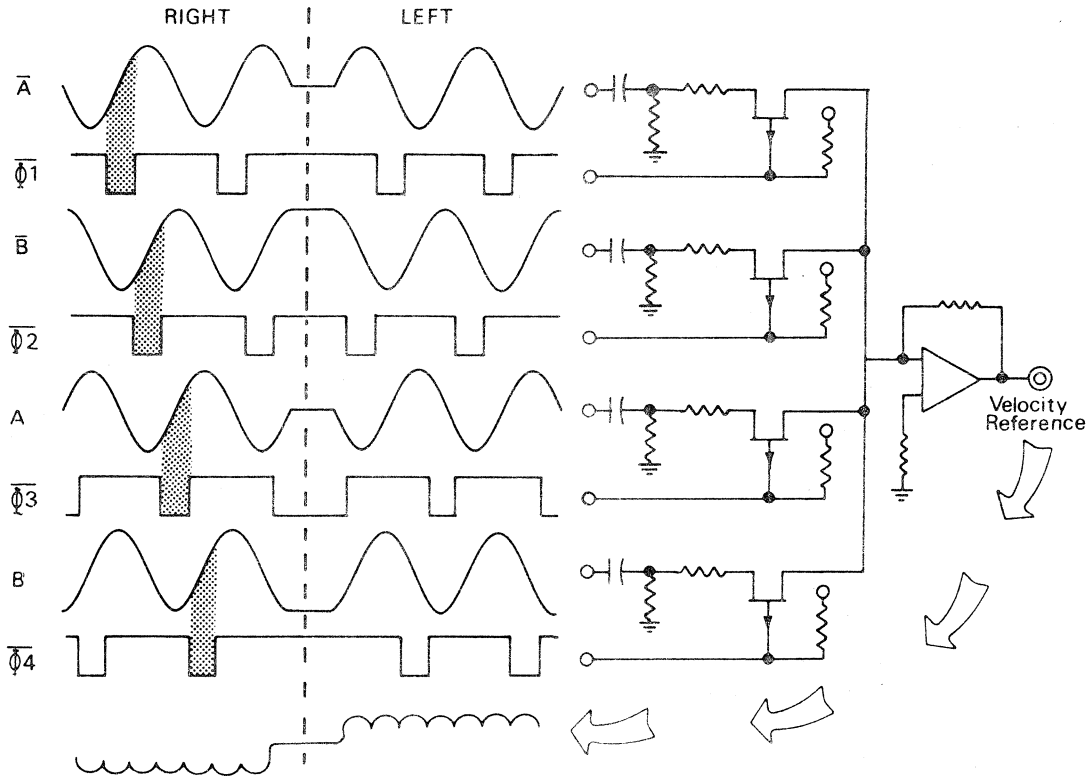
until the rising input reaches a critical voltage level. The output then quickly changes to full output. When the critical level is crossed by the decending portion of the sinewave, the logic level quickly returns to the opposite state. Three internal signals, $\overline{X}$, $\overline{Y}$ and $\overline{Z}$ are generated this way. The figure on the next page shows the encoder sinewaves and the signals generated from them. $\overline{X}$ is a portion of the positive peak of the encoder A sinewave. $\overline{Y}$ is an equal portion of an inverted A encoder sinewave (corresponds to, but not derived from the negative peak of encoder A). $\overline{Z}$ represents the most positive half of the excursion of the encoder B sinewave.



For accurate speed control, a series of timing signals must be generated. These timing signals are related to the exact axial position of the motor rather than to time itself. Φ1 (is pronounced "fee") is the period between the end of $\overline{X}$ and the beginning of $\overline{Y}$. Notice that Φ1 is the nearly straight portion of the decending encoder A sinewave. By differentiating the encoder A sinewave voltage during Φ1 time, the reference voltage for speed of rotation is obtained (faster rotation causes steeper angles and greater voltage). But, Φ1 is only a small portion of the revolution. Φ2 time is the same as $\overline{Y}$, and the natural phase relationship of the two encoder signals makes Φ2 the linear portion of the downward slope of the B encoder sinewave. Φ3 time is from the end of $\overline{Y}$ to the beginning of $\overline{X}$, or the downward slope of the inverted encoder A sinewave. Φ4 is the same as $\overline{X}$, and samples the linear portion of the downward slope of the inverted encoder B sinewave. By sampling Φ1 through Φ4 the differentiation takes place over the entire 360 of motion. The differentiated level is returned to the servo loop for velocity control. A simplified illustration of the velocity reference is shown on the following page.

When the servomotor "locks" into a stable position, a voltage derived from the amplified encoder A sinewave influenced by a compensation voltage feeds an op amp in the motor drive. Voltage is applied to the motor if it is not positioned properly. The voltage is either positive or negative, according to the direction of error. The motor responds, and soon reaches a "detent" position where the feedback is neither positive or negative. This is the position mode, and is entered when the delta count reaches zero.

When it is necessary to re-position the motor, the position mode is suspended by the new count in the delta counter. As motion begins, clock pulses are generated and are given to the Δ (delta) counter. The clock signals PW CLOCK AND CA CLOCK are generated directly or indirectly by the X, Y and Z signals. Both the carriage



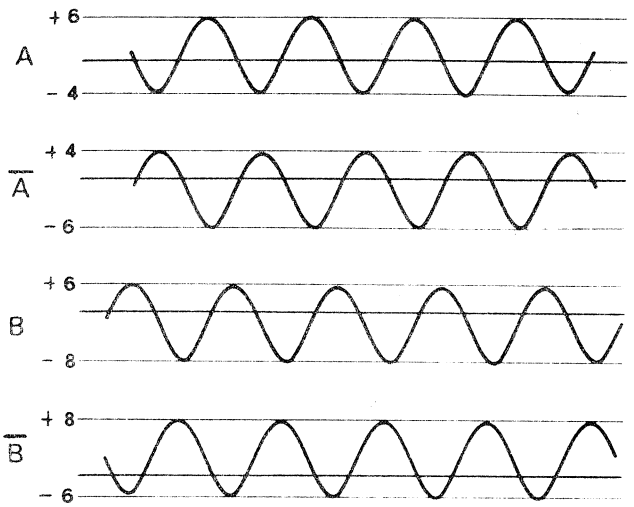
VELOCITY REFERENCE (Tachometer)

and printwheel delta counters are located on board 2. The delta count, is fed to a velocity control ROM and on to a digital-to-analog converter for the major control of the motor driver circuits. The delta count changing reduces the ROM command velocity, in steps, until the destination is reached. The position mode is again activated.

SERVO COMPENSATION

To accomplish the accuracy needed for good print quality standards the servo signals must be closely controlled. Slight mechanical variations in the encoder disc, the output of the encoder cells, and the gain and offset of the operational amplifiers are electronically compensated. The Sprint 3 printer boards contain no manual adjustments.

SERVO COMPENSATION (continued)



COMPENSATION SIGNALS

$AP = +6$

$\overline{AP} = +4$

$\overline{\overline{AP}} = -4$

$BP = +6$

$\overline{BP} = +8$

$$A\ SUM = \frac{AP + \overline{AP}}{2}$$

$$A\ SUM = \frac{6+4}{2} = 5$$

Position Compensation

$$= \frac{AP + \overline{\overline{AP}}}{2}$$

$$= \frac{6+(-4)}{2} = 1$$

$$B\ SUM = \frac{BP + \overline{BP}}{2}$$

$$= \frac{6+8}{2} = 7$$

Amplitude Compensation

$$= \frac{A\ SUM + B\ SUM}{2}$$

$$= \frac{5+7}{2} = 6$$

The amplified encoder sinewaves and the inverted encoder sinewaves are routed to peak detector circuits. Peak detectors are specialized applications for operational amplifiers. The peak detectors determine the highest positive value on the sinewave and generate signals shown in the illustrations on the following page as AP, $\overline{AP}$, BP and $\overline{BP}$. The illustration is actually an example, showing how the offset position compensation (for voltage offset) and amplitude compensation are calculated.

In the example the two encoder signals are, neither symetrical about ground potential, or equal in amplitude, one to the other. To compensate for this the signals are processed as follows:

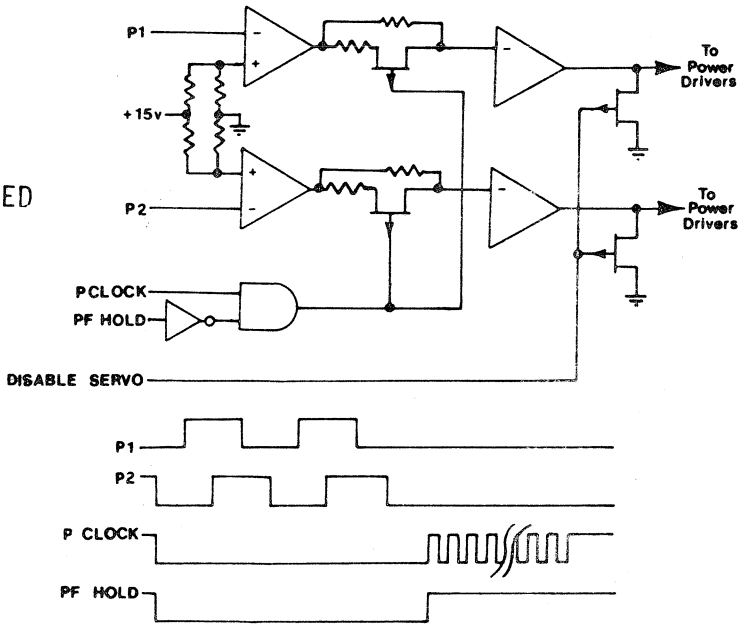
Position compensation developes an equalization that is used in the postion mode. The compensation is made for any offset (from zero) in the average, or center, voltage of the A encoder signal. To do this, the A sinewave is inverted to create the $\overline{A}$ sinewave (see the example). The positive peak voltage of A (expressed as AP) is averaged with the inverted positive peak voltage of $\overline{A}$ (expressed as $\overline{AP}$). In effect, AP is the negative peak voltage of A. The result is then inverted and electrically summed with the servo voltage (velocity reference) that controls the stable "detent" position.

Amplitude compensation develops an equalization for any difference between the peak-to-peak value of A and the peak-to-peak value of B. To do this AP is averaged with $\overline{AP}$, resulting in a signal called A SUM. BP is averaged with $\overline{BP}$ to get B SUM. A SUM and B SUM are then averaged to get the amplitude compensation signal called DAC. REF. DAC. REF is given to the digital to Analog converter affecting the velocity control voltage that is sent to the servo drive.

PAPER FEED

When paper is not feeding, the paper feed motor is held in a fixed position by a reduced current level. When paper is to be moved, the holding current is removed and heavy pulses of current are sent to the stepper motor coils. The figure below shows a simplified block diagram of the paper feed circuitry. The number of move increments and the direction of movement is converted by the microprocessor into signals called $\overline{P1}$ and $\overline{P2}$. If $\overline{P1}$ leads $\overline{P2}$ the paper moves upward (normal). If $\overline{P2}$ leads $\overline{P1}$ the paper moves downward (reverse). The paper feed motor moves one step for each transition of $\overline{P1}$ or $\overline{P2}$. Counting is done by the microprocessor on board 2 and sent to amplifier circuits on board 1. Shortly after the motor reaches the destination, the current is alternated between drive and hold levels. This continues for 50 ms, keeping a relatively high average holding currect to prevent overshot from the physical mass.

PAPER FEED

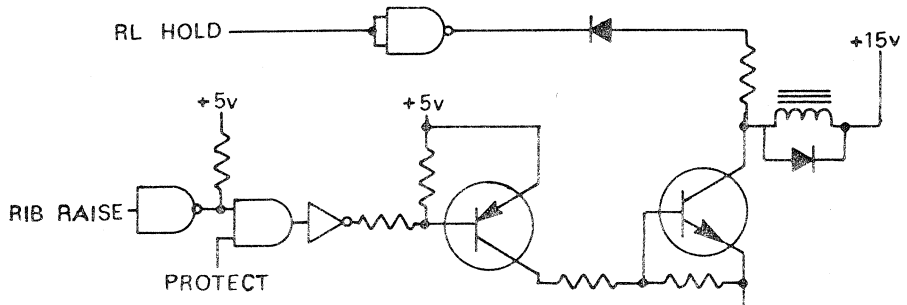


RIBBON FEED

The ribbon feed is a stepper motor that is always fed in the same direction. The control signals are very similar to the paper feed circuits, but ribbon feed does not have the chopped interval. The controlling signals, $\overline{R1}$ and $\overline{R2}$, are generated by the ROM circuit on board 2. The ribbon feed drivers are on board 3.

RIBBON LIFT

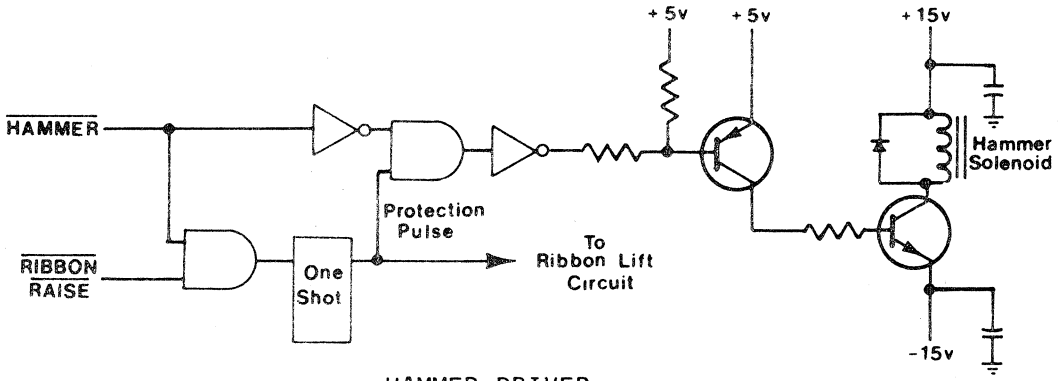
The figure following shows a simplified diagram of the ribbon lift circuit. When the ribbon is in the lowered position it is at rest, with no current flowing through the lift solenoid. To raise the ribbon, two signals, $\overline{\text{RIB RAISE}}$ and RL HOLD, are generated on board 2 and sent to the driver circuitry on board 3. The ribbon lift hold current is enough to keep the ribbon in position once it is lifted, but is not strong enough to overcome the inertia of the mechanism for quick action. The ribbon raise current is strong enough to quickly lift the ribbon, but would overheat and destroy the coil if left on for extended periods. $\overline{\text{RIB RAISE}}$ is assured to be only a short duration by qualifying it with a short protection pulse signal (35 ms) from a "one-shot" on board 3.



RIBBON LIFT

HAMMER DRIVER

The hammer driver circuit is located on board 3, with the controlling signal coming from board 2. The figure below shows a simplified diagram of the hammer driver circuit. The $\overline{\text{HAMMER}}$ signal varies in length according to the intensity that is required for the particular character being printed. As the $\overline{\text{HAMMER}}$ signal is held ON longer, the hammer is driven through more of its travel distance, creating greater velocity and consequently more impact. The $\overline{\text{HAMMER}}$ signal duration is approximately 1.6 ms to 2.5 ms in six steps. Hammer driver current is much too high to remain for extended periods. The coil and circuit is protected by qualification with a "one-shot" that will turn off the signal after 35 ms in the events of a logic failure that would sustain hammer current for a longer time.



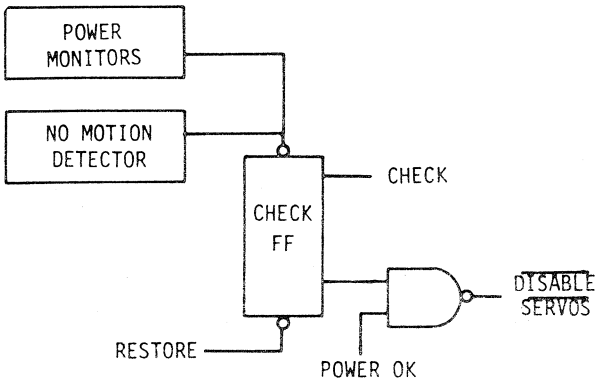
HAMMER DRIVER

CHECK

The check circuit is located on board 3, and is shown in simplified form on the next page. The +5 V, +15 V and -15 V power supplies are monitored by comparison circuits and precision Zener diodes. The +5 volt supply can not drop below 4.5 volts for more than one microsecond without setting the check flip-flop. The 15 volt supplies can drop 2 volts, but more than 2 volts for a period of 1 1/2 milliseconds sets check.

Carriage motion is monitored by the $\overline{\text{CA CLK}}$ and $\overline{\text{CA POS}}$ signals. The $\overline{\text{CA CLK}}$ signal is derived from carriage direction and the $\overline{X}$, $\overline{Y}$ and $\overline{Z}$ signals on board 1. Whenever the carriage motor is moving, $\overline{\text{CA CLK}}$ will continue to change state. $\overline{\text{CA POS}}$ is high until the carriage reaches the proper destination. Both of these signals are used to re-trigger a "one-shot" with a 15 ms timeout. If the carriage is not in position, and a $\overline{\text{CA CLK}}$ (carriage movement) has not reset the "one-shot" before the 15 ms timeout, check is set. When the carriage reaches its position, the "one-shot" will timeout, but the output is blocked from setting check by the $\overline{\text{CA POS}}$ signal.

The printwheel signals PW POS and Ø1M operate to set check in exactly the same manner as the carriage signals when the printwheel is not in position, and is not moving. The DISABLE SERVOS signal is generated by check, and disables all high currect devices.



CHECK

DIGITAL CONTROL SECTION

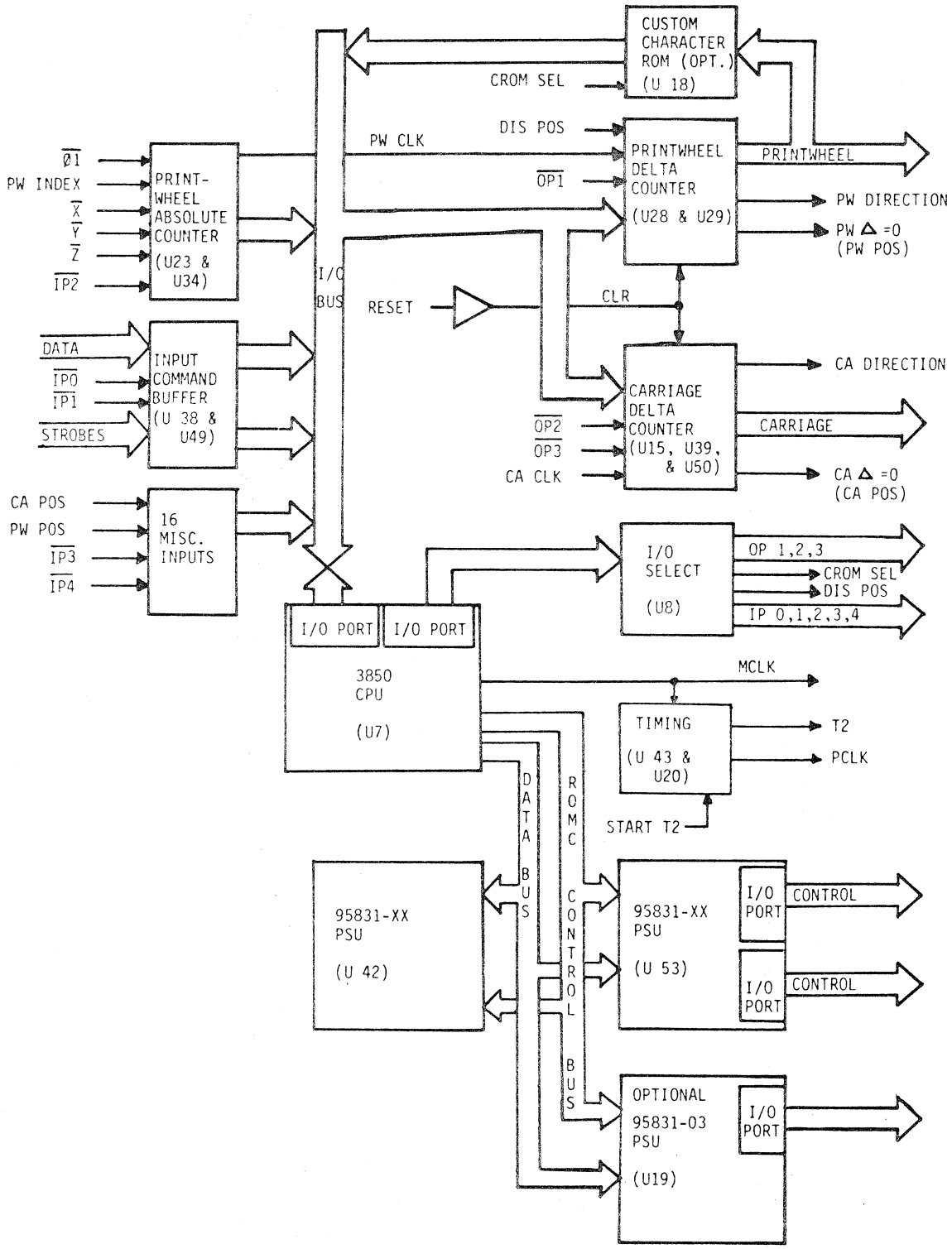
Many of the various processes and operations within the Sprint 3 printer are coordinated and controlled by a microprocessor and some related support devices. The microprocessor is in part of central processing unit (CPU) chip, the 3850. The 3850 requires an accompanying program storage unit (PSU) or other equivalent device. The Sprint 3 printer uses the matching 3851 PSU. The figure on the opposing page shows the digital control section of the printer. All of the blocks shown are located on the #2 board.

Each PSU is a read-only memory (ROM) that has 1024 computer words of eight bits each. It also has two eight-bit input/output (I/O) ports. For those who are not familiar with ROM's. A ROM is a matrix of junctions. Each individual junction can be addressed as a unique point. Each junction may or may not be electrically connected. Those junctions that are connected are said to be "1" bits. Those that are not connected are zero bits.

A ROM can be thought of as being organized into sets. In this case eight sets are addressed identically and simultaneously. Each unique junction that is addressed contributes a "1" bit or "zero" toward the eight-bit computer word. It is common, though it is not a physical description, to refer to the computer word positions as columns and rows. One column and row designation forms a single address for the complete 8-bit computer word. By incrementing, decrementing, or substituting the address number, the microprocessor can read any word position sequentially or at random.

WHAT IS A MICROPROCESSOR?

Large Scale Integration (LSI) technology has progressed to the point where a complete computer can now be put onto one or two chips. The microprocessor that is used in the Sprint 3 is one such device. It has all of the sections that are normal to a



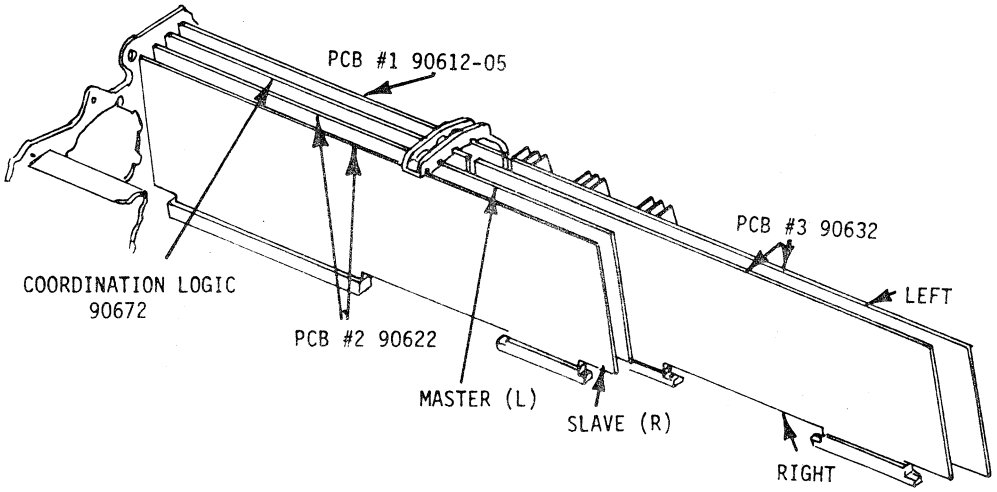
DIGITAL CONTROL

central processing unit (CPU). There is a 64 byte random access memory for temporary internal storage, an arithmetic logic unit, two I/O ports, control unit and instruction register, and an accumulator register. Memory addressing and timing comes from the PSU chip, but the clock signal is generated by the CPU.

The microprocessor program (contained in the PSU) is read by the CPU, and according to the states of the many variables, performs one or more actions. For example a series of instructions may control carriage velocity, or a single instruction may determine the hammer intensity.

TWINTRACK

Unlike other Sprint 3 printers, the TwinTrack has two independent print stations. Each printwheel requires the complete servo system that is normally on board #3. Because of this the TwinTrack contains two #3 boards, one for the left printwheel, and one for the right printwheel. These servo boards must in turn be controlled by a microprocessor. Each printwheel can be doing different things at different times, so two microprocessors are necessary, requiring two #2 boards. The #2 and #3 boards that are used in the TwinTrack are basically interchangeable with other Sprint 3 boards of the same board number. We chose to continue calling these boards by their original Sprint 3 designations to avoid confusion. The TwinTrack PC board layout is shown below.



TWINTRACK PCB LOCATIONS

TwinTrack Coordination Logic

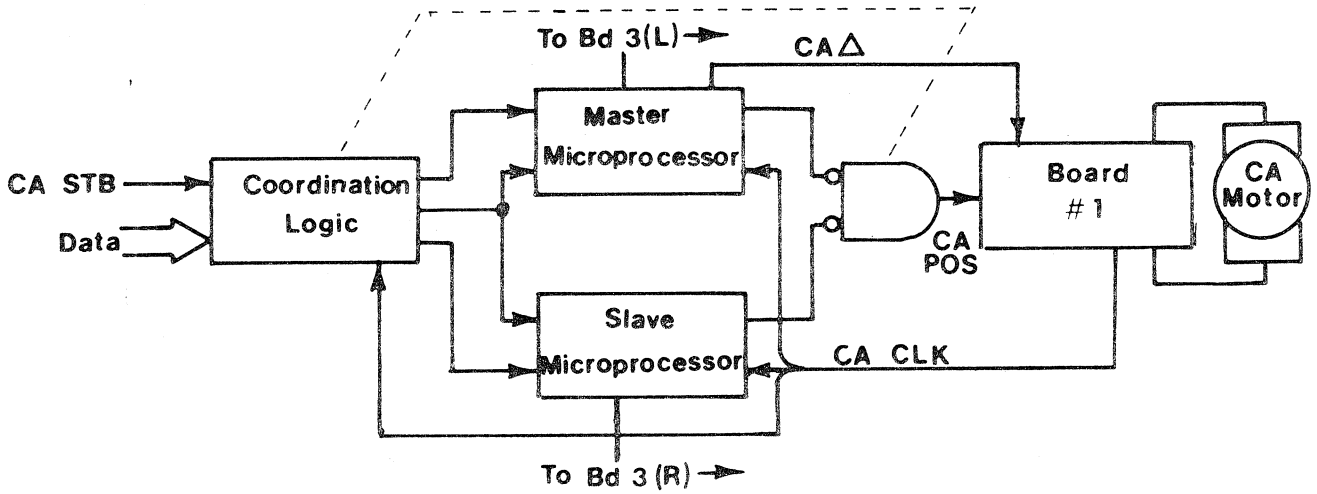
With two microprocessors there must be some coordination between them, or chaos would result. The coordination logic board controls the interface lines, sending the incoming commands to the proper microprocessor. The two microprocessors have no interconnections with each other and are not aware that the other exists. Without coordination, one microprocessor could be printing a character, and the other, unaware of the in-process print cycle, might move the carriage or paper.

The coordination logic assigns a master/slave relationship to the two microprocessors. The controlling microprocessor for the left printwheel is the master, the other is the slave. Only the master receives paper move commands.

TwinTrack Coordination Logic [continued]

Printwheel commands are given to the left or right controller as is designated by the $\overline{D2048}$ bit in the command. Carriage commands are given to both microprocessors. Only the master microprocessor issues the delta count information to board #1, but both microprocessors must be ready to begin carriage movement to generate the CA POS signal that starts board #1 into action on the carriage move. In other words, neither can be busy completing a previous instruction.

As the carriage moves, the carriage clock (CA CLK) signals are returned to both microprocessors to decrement the delta count. Both delta counters must reach zero (which should be the same time) to have the CA POS signal low, indicating that the carriage is in position. The illustration shows a simplified block diagram of the coordination logic, and the basic logic flow.



TWINTRACK COORDINATION LOGIC

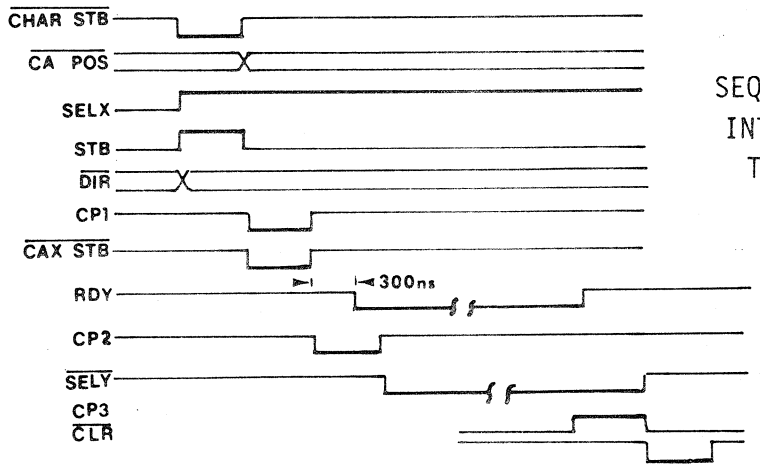
The coordination logic prevents carriage and paper feed commands from conflicting by allowing only one of either of those two instructions into the microprocessor input buffer at a time. For either a carriage or paper instruction to be strobed in, both microprocessor input buffers must be ready, and both must be empty. This does not mean that there could not be carriage, paper, or print instructions already in progress.

Any paper move command (except a zero increment) entering the coordination logic, inhibits subsequent print commands until the paper move is completed. Any in-process print cycle will be completed before the paper move is started. The paper clock enable signal is used to know when paper motion is complete. The PF HOLD current is chopped for 28 ms after movement is stopped to prevent overshoot and dampen the tendency to mechanically oscillate. At the end of this 28 ms period, the paper has completed all movement and settled into position. This is when the coordination logic will allow new print commands to be entered. However, a carriage move can be entered during a paper move execution or a paper move can be entered during a carriage move execution and the two processes will overlap to some extent.

Print commands (character codes) can be strobbed in at any time that both microprocessor input buffers are ready, and a paper feed is not in progress. Another print command or a carriage move can be in progress without affecting print command entry.

Sequential Interface

The Sequential option to the TwinTrack adds to the complexity of the coordination logic. All portions of the sequential logic are within the Sequential option version of the coordination logic board. A timing diagram for this version is shown below.



SEQUENTIAL INTERFACE TIMING

The sequential logic sets a flip-flop when a character for the right printwheel is strobed in. It resets the same flip-flop if the left print station is to print. If the character is for the same printwheel as the previous character (as determined by the state of the flip-flop) the strobe is sent directly to the proper #2 board. The character code is passed through the multiplexer by the SELY signal. The character and the strobe are then entered into the input buffer of that board for action when all else is ready.

If an incoming character reaches the coordination logic, and is not for the same printwheel as the last character, a delay and carriage move sequence is started. The character code is strobed into a holding register within the coordination logic. The SELX signal is generated, causing a set value (from jumpers on the coordination logic board) to be placed on the data lines. A carriage strobe is created, strobbing the set value to the #2 board. The left or right value (D1024) for the carriage move is generated by the Direction flip-flop. The Direction flip-flop is set or reset by the sequence between the previous left or right character command and the current character command.

The same circuits that generate the carriage strobe also generate the SELY signal to select the data input from the storage register. When the carriage movement is completed, the ready signal causes a character strobe, loading the stored character to be printed. After a small delay, the SELX and SELY flip-flop are cleared, making way for the next character.

CHAPTER V

MAINTENANCE

When properly maintained, the Qume Sprint 3 Series Printers will give excellent service for very long periods of time. The maintenance guidelines given below are for a normal office environment and normal or moderate use. If the environmental conditions are severe or if the use is heavier than moderate, the time between maintenance checks should be shortened accordingly.

As a general precaution when maintaining Qume printers, use only the solvents and lubricants that are recommended. Never over lubricate, expecting to stretch the time between maintenance periods. Over lubrication may cause immediate problems in the printhammer area, and could cause serious problems in other areas.

MONTHLY OR AS REQUIRED

Check the printer each month or sooner for general cleanliness and accumulated fiber buildup from paper stock. Carefully clean the carriage assembly with a soft-bristle brush. Lightly moisten a soft cloth with one of the low-residue solvents listed below.

Formula 409
Fantastik
Zoom

Clean any ink residue or splatter from the plastic and metal parts with the moistened cloth. DO NOT SPRAY OR DRIP SOLVENT DIRECTLY INTO THE INTERIOR OF THE MACHINE.

Printwheel

After some length of service the printwheel will accumulate ink and paper fibers, making a noticeable difference in print quality. Before print deterioration is noticed, remove and clean the printwheel as follows.

Place the printwheel in a shallow dish or container. Pour a low-residue cleaner (one of those mentioned above) over the printwheel until it is barely covered. Let it soak for a minute or two. Using a type-cleaning brush or medium stiffness toothbrush, remove caked areas that have not disolved.

CAUTION: This cleaning procedure can spatter ink on clothing and surrounding objects. Take the necessary precautions to avoid ruining clothing or other objects.

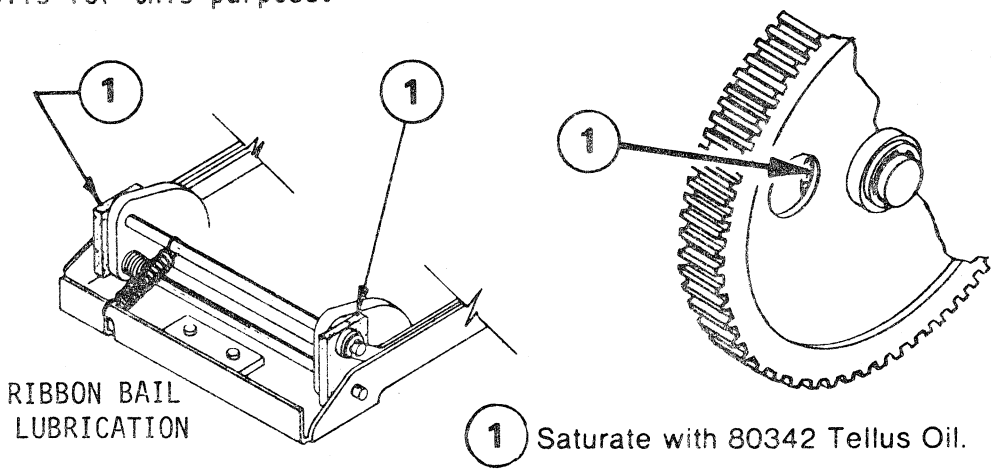
When the printwheel is clean, wipe lightly with a soft lint-free cloth and re-install it on the printer.

EVERY SIX MONTHS OR 1000 PRINTING HOURS

Ribbon Lift

Saturate the oiler pads within the ribbon lift mechanism and paper feed gear with a medium grade oil (Shell "Tellus 25" or equivalent). See the figure

below for the oiler pad location. Do not use "household" or "all purpose" oils for this purpose.



RIBBON BAIL LUBRICATION

(1) Saturate with 80342 Tellus Oil.

Platen

Clean the platen surface or other rubber parts whenever necessary or as a general housekeeping maintenance.

- Remove the platen from the printer.
- With a soft cloth or tissue dampened with FEDRON platen cleaner, wipe all ink residue and accumulated soil from the platen.

CAUTION

Do not use or accidentally spill platen cleaner on any of the plastic parts.

WARNING

Use eye protection when handling cleaning solutions or solvents. The platen cleaner is flammable and toxic and must be used only in a well ventilated area. Read and observe all directions and cautions that are stated on the label.

- After cleaning, place one drop of Tellus oil, or equivalent, under each spacer sleeve adjacent to the platen knobs.

EVERY SIX MONTHS OR 1000 PRINTING HOURS (continued)

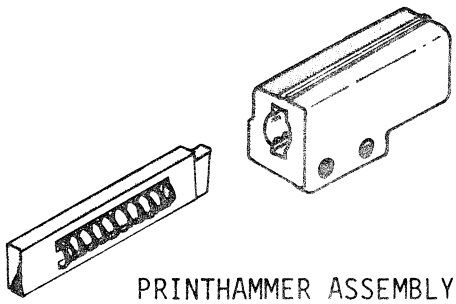
. Re-install the platen in the printer.

Hammer*

. Remove the rear hammer armature stop.

. Carefully remove the hammer assembly. Be careful not to bend or loosen the return spring in the center of the hammer. (See the figure.)

– The "X" model has a round barrel, and the return spring is around the hammer.



PRINTHAMMER ASSEMBLY

. Remove the spring from the hammer and clean both the hammer and the spring by soaking in isopropyal alcohol. Use a cotton swab (Q-tip or other brand equivalent) to remove stubborn spots. DO NOT BEND OR DEFORM THE SPRING.

. Clean the inside of the hammer guide assembly with a cotton swab and isopropyl alcohol, being careful not to drip alcohol into the interior of the printer.

. Allow the parts to dry thoroughly.

. Place one or two drops of watch oil (80341) on the hammer.

. Spread the oil to a thin layer over the surface. A cotton swab or finger tip can be used for this.

DO NOT OVER OIL.

. Re-assemble the spring to the hammer.

. Replace and adjust the rear hammer armature stop as directed in the adjustment section of this manual.

*Some early model wedge hammers should be cleaned and lubricated every 300 printing hours or six months, whichever comes first. See Sprint Micro 3 Series Tech Bulletin: Number 4 for identification of these parts.

EVERY SIX MONTHS OR 1000 PRINTING HOURS (continued)

- Replace and adjust the rear hammer armature stop as directed in the adjustment section of this manual.

Printer Cover

Clean soiled covers using a soft cloth moistened with one of the low-residue cleaners mentioned on the previous page. Do not spray the cleaner on the printer as the overspray will enter portions of the mechanism where it would be undesirable.

SUPPORT EQUIPMENT LIST

The following is a consolidated listing of the supplies and equipment required to support the Sprint Micro 3 printers at the field service or depot maintenance levels.

TOOLS AND TEST EQUIPMENT

The table on the following page lists the tools and test equipment that are required for maintenance and repair of Qume high-speed character printers. If equivalent items are available, they may be substituted for those listed. Repairmen on routine field service calls should be provided with one of each of the items in the table in addition to the normal complement of hand tools.

SPARES

Repairmen making routine service calls should have one each of the complete subassemblies listed in the Field Service Spares listing in addition to a spare printwheel and ribbon cartridge.

TOOLS AND TEST EQUIPMENT

TOOLS	PART NUMBER
Printwheel Adjustment Tool, Outer Collett	80471
Printwheel Adjustment Tool, Inner Collett	80472
Printwheel Adjustment Tool, Disc	80758
Platen Gauge Adjustment Tool	80751
Hammer Angle Adjustment Tool	80739
Printed Circuit Extender Set	99025-03
Cable Tension Gauge	80738
Ribbon Guide Adjustment Tool	80833
Return Limit Ring Gauge	73046
TEST EQUIPMENT	
Printer Exerciser	99000
Portable Exerciser	80630
Oscilloscope	Tektronix 465
Multimeter	Simpson 260
ActivityMonitor	80740
LUBRICANTS	
Watch Oil (Moebius Oil "Art. 8000")	80341
Tellus Oil (Shell Oil "Tellus 25")	80342
Polygrease	80346
MISCELLANEOUS	
Isopropyl Alcohol	-----
Platen Cleaning Fluid	Fedron
Heavy Duty Degreaser	Formula 409
Thread Locking Fluid, Loctite #222	85160-01
Loctite #06, Super Bonder Adhesive	85161-01
Dusting Brush, Soft Bristle	-----
Type Cleaning Brush, Stiff Bristle	-----
Lint-Free Cloths	-----

RECOMMENDED FIELD SERVICE SPARES

Part #	Description	Printer Population 100	500	1000
80023	Carriage Motor Final Asy	1	3	8
80032	Cradle Asy	1	1	2
80037	Pulley Asy - Idler	1	2	3
80046	Paper Feed Motor Asy	1	2	4
80057	Clutch Asy, Ribbon Drive	1	3	6
80142	Bail - Feed Roller	2	4	8
80160	Lever - Feed Roller Disable	1	2	3
80186	Lever - Impression Control	1	1	2
80202	Gear - Idler, Paper Drive	1	1	2
80207	Ribbon Drive, Stepper Motor	1	1	2
80336	P/W Motor - Encoded	1	4	7
80368	Photon Module - Carriage Home	2	5	8
80369	Armature Asy - Hammer	1	1	2
80374-01	Pad - P.W. Motor Stop	2	5	10
80374-02	Pad - Ribbon Bail Stop	2	5	10
80379	Coil Ribbon Lift	2	4	8
80380	Bail Asy - Ribbon Lift	1	1	2
80358	Link Asy - Guide Bearing	1	2	3
80610	Power Resistor 5 OHM	1	2	3
80686-02	Hammer	1	3	5
80687-02	Hammer Guide	1	1	2
80713	Spring Hammer	1	3	5
85127	Cable Carriage Drive	1	3	5
90612	P.C. Asy Card #1	1	3	5
90622	P.C. Asy Card #2	1	3	5
90632	P.C. Asy Card #3	1	3	5

RECOMMENDED FIELD SERVICE SPARES

Model 3/35	Part #
Printed Circuit Board 1	90612-00
Printed Circuit Board 2	90622-00
Printed Circuit Board 3	90632-00
Carriage Assembly	80028-14

Model 3/45	Part #
Printed Circuit Board 1	90612-01
Printed Circuit Board 2	90622-00
Printed Circuit Board 3	90632-01
Carriage Assembly	80028-15

Model 3/55	Part #
Printed Circuit Board 1	90612-02
Printed Circuit Board 2	90622-00
Printed Circuit Board 3	90632-02
Carriage Assembly	80028-16

Model 3/X30	Part #
Printed Circuit Board 1	90612-03
Printed Circuit Board 2	90622-01
Printed Circuit Board 3	90632-02
Carriage Assembly	80028-17

Model 3/X40	Part #
Printed Circuit Board 1	90612-04
Printed Circuit Board 2	90622-01
Printed Circuit Board 3	90632-04
Carriage Assembly	80028-18

Model 3/WideTrack	Part #
Printed Circuit Board 1	90612-05
Printed Circuit Board 2	90622-00
Printed Circuit Board 3	90632-05
Carriage Assembly	80028-19

Model 3/TwinTrack	Part #
Printed Circuit Board 1	90612-05
Printed Circuit Board 2	90622-00
Printed Circuit Board 3	90632-02
Coordination Logic	90672
Carriage Assembly	[redacted]
	80028-40

CHAPTER VI

TROUBLESHOOTING & REPAIR

GENERAL

Troubleshooting is complicated by the interrelationship between printer and controller. The printer obeys the commands of the external controller without question: If the carriage is commanded to move in the wrong direction, it will do so. Before attempting to troubleshoot the printer, be sure that the contoller and interface are operating properly. If it is determined that the controller and interface are operating correctly, use the procedures below to isolate the problem so that you can either replace the defective board or be advised by Qume customer service personnel what action to take to correct the problem.

Troubleshooting is further complicated in the TwinTrack model by board duplication and the coordination logic. Special considerations for TwinTrack troubleshooting are discussed later in this section.

DIAGNOSTIC PROCEDURES

This procedure utilizes the optional Micro 3 ActivityMonitor to isolate faults. The other equipment required is a digital voltmeter capable of measuring the power supply voltages.

- Remove the printer top and middle covers.
- Disconnect the data cable from the printer.
- Using a digital voltmeter, measure the power supply voltages at the test points on each board. They should be within the tolerances specified in below.

  + 5V ± 3% - 4.85V to 5.15V
  +15V ±10% - 13.5 V to 16.5 V
  -15V ±10% - 13.5 V to 16.5 V

- Temporarily turn the printer OFF.
- Connect the activity monitor cable to the 40 pin connector at the top of board 2. The cable connector is labeled FRONT on the side that must be toward the front (operator side) of the printer.
- Place the ON/OFF switch on the activity monitor to ON.
- Return power to the printer; the diagnostic will begin immediately. The activity lamps will show change, but the first two tests do not move the printer.
- If the test stops prematurely, there will be a status indicator shown by the activity monitor lamps. The interpretation of these lamps is given on the bottom of the activity monitor and also in the table on page 6-3.

If the lamps show that the test stopped during the carriage or printwheel tests, the CONTINUE button can be pressed to cause the logic to skip to the next test. A complete test description is given later in the text to aid troubleshooting.

- If the non-extended self test completes without problems, it will automatically restart. The test can be stopped by placing the activity monitor ON/OFF switch to the OFF position. With the switch in the OFF position, the printer will accept instructions from the interface lines.

  The extended self test (automatically included in certain printer options) will complete only once. To make the extended self test repeat, depress either CONTINUE or the RESTART button on the activity monitor.

TEST DESCRIPTIONS

ROM TEST

This test is to determine if the 3851 PSU ROMs containing the diagnostic and the printer programs on board 2 is good. It adds all the bytes in the main program and the diagnostic program to develop a single-byte sum, excluding carries, which should be zero. The last byte in the diagnostic program is adjusted to be the two's complement of the sum of all the previous bytes.

Since the microprocessor is very fast, this test executes in a fraction of a second and will be seen as a fast blink on the TEST lights if the memory is OK.

A ROM failure causes the test to stop and the eight I/O bit lights display the actual sum. The CONTINUE button will not be active, since continuing the diagnostic may cause unusual things to occur if the main program or the diagnostic program is incorrectly stored in the ROM.

IMPORTANT: The test itself may not finish if the diagnostic program part of the ROM or the 3850 CPU or the power-up logic is defective.

I/O LINES TEST

This test is to determine if the I/O lines are operating properly. These lines are used for data communication between the microprocessor and the 74S412 buffers, printwheel absolute counter, printer status, and printwheel and carriage delta counters. Any shorts to ground, +5V, or each other either directly or through faulty components will cause improper operation. Opens are also checked.

The test sends out a pattern which will light a single bit light, starting with bit zero and proceeding sequentially to bit 7. After each pattern is output, it is input and compared to the pattern output. If the two patterns are different, the test stops and the bit lights display the erronous pattern input. The bit lights should be watched during the test so that if it fails the expected pattern (the pattern output), will be known. If the line is low (ground), the light lights.

DIAGNOSTIC TEST PATTERN

TEST	TEST LIGHT PATTERN	OPERATION	IF TEST STOPS LAMPS INDICATE
ROM	0011	Adds all bytes of printer and diagnostic ROM programs. Sum must be zero.	Actual Sum.
I/O LINES	0001	Writes and reads each bit of I/O lines for isolating bus line shorts. Compares written pattern to read pattern.	Actual pattern that caused error. Expected pattern can be deduced from lighting sequence.
RESTORE	0110	Executes Restore part of Printer program.	Not meaningful. Malfunctions can be seen by visual inspection.
CARRIAGE	0010	Carriage moves 114 times, back and forth, in diminishing movements, and sent to home and Limit. All bit positions of carriage delta are checked.	00000001 - Check 00000010 - Timed Out 00000100 - Limit on home 00001000 - Limit not found
PRINT WHEEL	0100	Slowly moves printwheel and stops at position 00. Printwheel moves 96 times, clockwise and counter clockwise in diminishing movements, and sent to index. All bit positions of printwheel delta are checked.	00000001 - Counter 00000010 - Timed Out 00000100 - No index at end
PAPER FEED	0101	Executes various combinations of forward and reverse paper feeds and character printing. Ends with "Self Test" printed vertically.	Does not stop. Errors seen in visual inspection.
TEST OVER	0111		

NOTES: Continue test button is effective only after an error stop in either the CARRIAGE test, or the PRINTWHEEL test after the initial move to position 00. A second RESTORE is performed just before the PAPER FEED test. Restore, Paper feed, Ribbon Lift, Hammer, and Ribbon Advance errors are detected exclusively by visual inspection (during PAPER FEED test except RESTORE). Diagnostic does not test Ribbon Drop; nor does it test the external I/O interface which includes status lines, control lines, and data lines and associated circuitry.

I/O LINES TEST (continued)

The CONTINUE button will not be active because the tests following are dependent on the I/O lines working satisfactorily.

RESTORE TEST

This test is necessary at this time to establish a reference for the carriage and printwheel tests following it. It uses the actual Restore part of the printer program.

The carriage should be observed during this test. Failure to execute the Restore will cause the test to "hang up" in one of four program loops described below.

In the first loop, the carriage is slowly moved to the left until the carriage limit is sensed. The carriage may not move, in which case any one of a number of things can be wrong. Maybe the carriage delta counter is not receiving the data (hexadecimal 1007) or the counter output is not getting to the analog section, or the latter is inoperative, or the carriage limit sensing is faulty. If the carriage delta counter is not receiving the data, the port selection logic may be inoperative. OP2 and OP3 should be going low and high. The carriage may go in the wrong direction if the direction bit is lost. Or the carriage may travel at the wrong speed, indicating a faulty delta counter, velocity ROM, or analog section. Finally, the carriage may not find the limit and go into check, in which case maybe the carriage limit senser is faulty or selection logic IP4 is inoperative or the connection between the limit senser and the I/O lines is missing.

In the second loop, the carriage is sent to the right out of the limit. If the carriage doesn't move right, make sure it is not in check. The data output to the carriage delta counter is hexadecimal 0001.

In the third loop, a hexadecimal 07 is repeatedly sent to the printwheel delta counter until the printwheel passes position 00, the printwheel index position, at lower case "w". The printwheel may not turn, or it may turn too fast and/or it may never stop. Similar reasoning may be applied to the printwheel index which also uses IP4 selection.

In the fourth loop, printwheel position mode is sensed and the program loops until the condition is true. IP3 is selected for this sensing.

IMPORTANT: The CONTINUE button will not be active if the printer fails the Restore test, and the bit lights will not be relevant.

CARRIAGE TEST

This test contains two program loops. The first and main loop does the following:

1. Removes and saves the direction bit from a RAM register containing the last carriage delta output to the carriage delta counter.

2. Subtracts a constant from the resulting delta magnitude of 1 above.

CARRIAGE TEST (continued)

3. Tests the result of 2 above. If it is less than zero, the main loop is done and the program branches to the second loop.

4. Complements the direction bit saved in 1 above and combines it with the new delta of 2 above.

5. Sets a time limit for the carriage travel.

6. Outputs the delta of 4 above.

7. Tests position mode. If true, goes to step 1.

8. Tests the elapsed time. If it is over the value set in 5 above, sets bit light value and jumps to error routine (described later).

9. Tests if check occurred. If so, sets bit light value and jumps to error routine.

10. Jumps to step 7.

Initialization for the main loop is with the first carriage delta value and a jump to step 5.

After successfully completing the main loop, the program outputs a carriage delta which should send the carriage almost to home position, initializes a 1/2 step counter, and then jumps into the second loop at step 2. The second loop:

1. Outputs a hexadecimal 1001 (1/2 step left) to the carriage delta counter.

2. Tests for carriage position mode and carriage limit. If both are true, exists loop. If not in position, repeats this step.

3. If in position mode but not at limit, decrements 1/2 step counter and tests it. If it is not zero, jumps to step 1.

4. If the 1/2 step counter is at zero, sets bit light pattern and jumps to error routine.

After completing the second loop, the 1/2 step counter is tested. If it is at the value it was initialized to, the bit light pattern is set and program jumps to error routine. The carriage should not be at the limit on the 'home'.

IMPORTANT: Notice that the second loop does not test for a check condition. After passing the first loop without a check, the chances of having a check in the second loop are remote. A check in the second loop will "hang up" the test, and the bit lights will not be relevant. Furthermore, the CONTINUE button will not be operative.

PRINTWHEEL TEST

This test also has two program loops, of which the second loop is the main one.

PRINTWHEEL TEST (continued)

The first loop does one thing--send the printwheel to the index. It does this by testing whether the printwheel is in position 00, outputting a hexadecimal 01 to the printwheel delta counter if it is not at the index, briefly waiting, and then jumping to the beginning of the loop.

IMPORTANT: If the printwheel absolute position counter is faulty, the printwheel may not stop and will "hang up" at this point in the test. The bit lights will not be relevant if this happens and the CONTINUE button will not be effective.

After completing the first loop (not necessarily proving that the printwheel is really at the index), the program initializes the first printwheel delta value and the first value of the software-controlled printwheel absolute position counter and jumps into the main loop at step 7. The main loop:

1. Removes and saves the direction bit from a RAM register containing the last printwheel delta output to the printwheel delta counter.

2. Subtracts a constant from the resulting delta magnitude of 1 above.

3. Tests the result of 2 above. If it is less than zero, the main loop is done and the program branches to the final operation in this test.

4. Complements the direction bit saved in 1 above.

5. Updates the software-controlled printwheel absolute counter using the new delta in step 2 and based on the direction bit in 4 above (either adds or subtracts the delta to/from the counter).

6. Combines the new direction with the new delta.

7. Sets a time limit for the printwheel motion.

8. Outputs the delta of 6 above to the printwheel delta counter.

9. Checks for printwheel position mode. If false, tests elapsed time. If not over the value in 7 above, repeats this step. Otherwise, sets bit light pattern and branches to error routine (described later).

10. In position mode, the printwheel absolute position counter is input and compared to its software-controlled counterpart. If the two counters are not equal, sets bit light pattern and branch to error routine.

11. Jumps to step 1.

Following successful completion of the main loop, the program outputs a printwheel delta that should send the printwheel to the index. The index is tested after position mode is established and short delay. If the printwheel is not at the index, the bit light pattern is set and the program jumps to the error routine.

Another Restore is performed at this point to initialize the carriage to home, and to initialize the RAM registers for main printer program use for the following test.

PAPER FEED TEST

This test uses the main printer program. Just prior to the command input part of the main program, the program branches to the diagnostic program if the Micro 3 ActivityMonitor is connected. The diagnostic then loads a printwheel or a paper feed command into the next available position in the software input buffer, tests the buffer to see if it is full, and sets an appropriate 'comeback code'. The diagnostic then jumps to the point in the main printer program which is just after where it stores a command into the software input buffer.

As long as the 'comeback code' is not a buffer full type, the above happens and the main program executes the commands in the buffer as though they came in through the external I/O interface.

When the software input buffer is full, the diagnostic ceases to load it until it becomes empty so it can adjust buffer pointers. It does this because four bytes at the end of that buffer are used by the diagnostic program.

The result of the paper feed test is a vertical printing of SELF TEST produced by a series of complex combinations of printwheel and paper feed commands. If the printer is working satisfactorily, the printing is reasonably evenly spaced (allowing for paper slippage) and spelled as above.

At the beginning of this test the ribbon should lift. It is not dropped at the conclusion of this test but is dropped at the beginning of the diagnostic. During the test, take note of the ribbon feed operating just prior to the printing of each letter.

IMPORTANT: This test has no internal checks and does not stop if a malfunction occurs. The results are seen during and after the test as mentioned above.

ERROR ROUTINE

This routine is used for all tested error conditions. Just before the program branches to it, it sets the bit light pattern to be displayed in the bit lights for the identification of the error, and it also sets the address of where the program may jump when the CONTINUE button is depressed. The routine displays the bit light pattern, delays, tests the CONTINUE button, and either branches to the address set if it was depressed, or branches back to the beginning of the error routine.

In the case of the ROM Test and the I/O Lines Test, the address set is the error routine so the CONTINUE button is not effective. In the Carriage Test it is the start of the Printwheel Test, and in the Printwheel Test it is the start of the Paper Feed Test.

TEST POINTS

The following three pages list the signals that are found on the printed circuit board test points. The lists are organized by printed circuit board numbers in numberical order.

SPRINT MICRO 3 PCB #1 TEST POINTS

TEST POINT	SIGNAL NAME
1	"AP" (A sine wave positive peak)
2	"$\overline{A}$" (Inverted A sine wave)
3	"A" (A sine wave)
4	"A SUM"
5	AMPLITUDE COMPENSATION
6	"$\overline{A}$P" (Inverted A sine wave positive peak)
7	"$\overline{B}$" (Inverted B sine wave)
8	"B" (B sine wave)
9	POSITION COMPENSATION
10	VELOCITY REFERENCE (TACHOMETER)
11	COMMAND VELOCITY STAIRCASE
12	"$\overline{B}$P" (Inverted B sine wave positive peak)
13	"BP" (B sine wave positive peak)
14	not used
15	"B SUM"
16	"Z THRESHOLD"
17	CAM DRIVER
18	CURRENT WAVEFORM
19	$\overline{\text{CA POS}}$
20	not used

SPRINT MICRO 3 PCB #2 TEST POINTS

TEST POINT	SIGNAL NAME	TEST POINT	SIGNAL NAME
1	TEST CONT (Self Test)	18	$\overline{B1}$ (I/O BUS)
2	DIAG (Self Test)	19	I/O PORT 0 Bit 0
3	+5 VDC	20	I/O PORT 0 Bit 1
4	GROUND	21	I/O PORT 0 Bit 2
5	WRITE CLOCK	22	I/O PORT 0 Bit 3
6	GROUND	23	I/O PORT 4 Bit 7
7	MASTER CLOCK (2 MHz)	24	not used
8	DIAG RST (Self Test)	25	not used
9	I/O PORT 0 Bit 6	26	I/O PORT 5 Bit 1
10	I/O PORT 0 Bit 5	27	I/O PORT 4 Bit 6
11	$\overline{OP4}$ (Output 4)	28	$\overline{START}$ T2
12	$\overline{B6}$ (I/O BUS)	29	not used
13	$\overline{B7}$ (I/O BUS)	30	not used
14	I/O PORT 0 Bit 7	31	GROUND
15	$\overline{B4}$ (I/O BUS)	32	$\overline{B2}$ (I/O BUS)
16	$\overline{B5}$ (I/O BUS)	33	$\overline{B3}$ (I/O BUS)
17	$\overline{B0}$ (I/O BUS)		

SPRINT MICRO 3 PCB #3 TEST POINTS

TEST POINT	SIGNAL NAME
1	AMPLITUFE COMPENSATION
2	PWM DRIVE
3	"$\overline{A}$P" (Inverted A sine wave positive peak)
4	"AP" (A sine wave positive peak)
5	CURRENT WAVEFORM
6	"PWM BASE"
7	"$\overline{A}$" (Inverted A sine wave)
8	"A SUM"
9	COMMAND VELOCITY STAIRCASE
10	POSITION COMPENSATION
11	$\overline{\text{PW POSITION}}$
12	"B" (B sine wave)
13	"$\overline{B}$" (Inverted B sine wave)
14	VELOCITY REFERENCE (TECHOMETER)
15	not used
16	"BP" (B sine wave positive peak)
17	"B SUM"
18	"Z THRESHOLD"
19	-5 VDC (Regulated)
20	"BP" (Inverted B sine wave positive peak)
21	"$\overline{\text{PW INDEX}}$"
22	"PWM"
23	"A" (A sine wave)
24	not used
25	not used

SPRINT MICRO 3

MICRO I/O ROUTINE

A Sprint Micro 3 PCB #2 is a microcomputer, dedicated to controlling the SM3 printer mechanism and receiving commands from the customer's controller via the data interface (J1). The microcomputer chip set must receive data from the hardware input command buffer; the printwheel absolute position counter; sixteen miscellaneous inputs; and, optionally, the custom character ROM. The microcomputer must output data to the printwheel and carriage delta counters. These transfers of data are made via the 8 bit I/O bus. The following list indicates what data is passed from the I/O bus to a printer circuit or from which printer circuit to the I/O bus by the input (e.g. IP2) and output (e.g. OP3) commands.

I/O STATUS	I/O SIGNAL		
$\overline{\text{IP 0}}$	CODED	→	$\overline{\text{B7}}$
"	STROBE	→	$\overline{\text{B6}}$
"	(see Note 1)	→	$\overline{\text{B5}}$
"	D1024 (DIR)	→	$\overline{\text{B4}}$
"	D2048 (or RIB LIFT)	→	$\overline{\text{B3}}$
"	D512	→	$\overline{\text{B2}}$
"	D256	→	$\overline{\text{B1}}$
"	D128	→	$\overline{\text{B0}}$
$\overline{\text{IP 1}}$	D1/2	→	$\overline{\text{B7}}$
"	D64	→	$\overline{\text{B6}}$
"	D32	→	$\overline{\text{B5}}$
"	D16	→	$\overline{\text{B4}}$
"	D 8	→	$\overline{\text{B3}}$
"	D 4	→	$\overline{\text{B2}}$
"	D 2	→	$\overline{\text{B1}}$
"	D 1	→	$\overline{\text{B0}}$

Note 1:

The coded strobe indicates which customer or printer originated signal has loaded data into the input command buffer.

Strobe or Signal Name	U38 Pin #	3	5	7
	I/O Bus Line	$\overline{\text{B7}}$	$\overline{\text{B6}}$	$\overline{\text{B5}}$
Paper Feed Auxiliary Strobe		1	0	1
Paper Feed Main Strobe		1	0	0
Top of Form Strobe		0	1	1
Character Strobe		0	1	0
Carriage Strobe		0	0	1
EN REST		1	1	1

I/O STATUS	I/O SIGNAL	
$\overline{\text{IP 2}}$	PW ADDR 128	→ $\overline{\text{B7}}$
"	PW ADDR 64	→ $\overline{\text{B6}}$
"	PW ADDR 32	→ $\overline{\text{B5}}$
"	PW ADDR 16	→ $\overline{\text{B4}}$
"	PW ADDR 8	→ $\overline{\text{B3}}$
"	PW ADDR 4	→ $\overline{\text{B2}}$
"	PW ADDR 2	→ $\overline{\text{B1}}$
"	PW ADDR 1	→ $\overline{\text{B0}}$
$\overline{\text{IP 3}}$	$\overline{\text{CHECK}}$	→ $\overline{\text{B7}}$
"	$\overline{\text{COVER INT}}$ ($\overline{\text{EOR}}$)	→ $\overline{\text{B6}}$
"	$\overline{\text{HEAVY PW}}$	→ $\overline{\text{B5}}$
"	$\overline{\text{MOVE RIBBON SW}}$	→ $\overline{\text{B4}}$
"	RIBBON LIFT	→ $\overline{\text{B3}}$
"	T2	→ $\overline{\text{B2}}$
"	$\overline{\text{PW POS}}$	→ $\overline{\text{B1}}$
"	$\overline{\text{STD ROM}}$	→ $\overline{\text{B0}}$
$\overline{\text{IP 4}}$	RDY EN	→ $\overline{\text{B7}}$
"	$\overline{\text{TOF}}$	→ $\overline{\text{B6}}$
"	$\overline{\text{TEST CONT}}$	→ $\overline{\text{B5}}$
"	$\overline{\text{DIAG}}$	→ $\overline{\text{B4}}$
"	Auxiliary PF	→ $\overline{\text{B3}}$
"	$\overline{\text{PW INDEX}}$	→ $\overline{\text{B2}}$
"	$\overline{\text{CA LIMIT}}$	→ $\overline{\text{B1}}$
"	$\overline{\text{CA POS}}$	→ $\overline{\text{B0}}$
$\overline{\text{CROM SEL}}$	CROM DO8	→ $\overline{\text{B7}}$
"	CROM DO7	→ $\overline{\text{B6}}$
"	CROM DO6	→ $\overline{\text{B5}}$
"	CROM DO5	→ $\overline{\text{B4}}$
"	CROM DO4	→ $\overline{\text{B3}}$
"	CROM DO3	→ $\overline{\text{B2}}$
"	CROM DO2	→ $\overline{\text{B1}}$
"	CROM DO1	→ $\overline{\text{B0}}$

I/O STATUS		I/O SIGNAL
$\overline{\text{OP 1}}$	$\overline{\text{B7}}$ →	PW DIRECTION
"	$\overline{\text{B6}}$ →	PW Δ 64
"	$\overline{\text{B5}}$ →	PW Δ 32
"	$\overline{\text{B4}}$ →	PW Δ 16
"	$\overline{\text{B3}}$ →	PW Δ 8
"	$\overline{\text{B2}}$ →	PW Δ 4
"	$\overline{\text{B1}}$ →	PW Δ 2
"	$\overline{\text{B0}}$ →	PW Δ 1
$\overline{\text{OP 2}}$	$\overline{\text{B7}}$ →	CA Δ 128
"	$\overline{\text{B6}}$ →	CA Δ 64
"	$\overline{\text{B5}}$ →	CA Δ 32
"	$\overline{\text{B4}}$ →	CA Δ 16
"	$\overline{\text{B3}}$ →	CA Δ 8
"	$\overline{\text{B2}}$ →	CA Δ 4
"	$\overline{\text{B1}}$ →	CA Δ 2
"	$\overline{\text{B0}}$ →	CA Δ 1
$\overline{\text{OP 3}}$	$\overline{\text{B7}}$ →	--------
"	$\overline{\text{B6}}$ →	--------
"	$\overline{\text{B5}}$ →	--------
"	$\overline{\text{B4}}$ →	CA DIRECTION
"	$\overline{\text{B3}}$ →	CA Δ 2048
"	$\overline{\text{B2}}$ →	CA Δ 1024
"	$\overline{\text{B1}}$ →	CA Δ 512
"	$\overline{\text{B0}}$ →	CA Δ 256

REPAIR

The following tells how to restore the high-speed printer to normal operation after replacing or repairing major parts and subassemblies. Step-by-step procedures are given for the mechanical alignment.

A preliminary word of caution is in order. Despite its apparent mechanical simplicity, the printer is a highly sophisticated piece of machinery. In many cases, the tolerances and adjustments that are carefully established on the assembly line are not obvious to the untrained eye. Yet, failure to observe these tolerances can result in degraded output quality, excessive stress, accelerated wear, and unnecessary premature failures. Only qualified personnel should attempt repair of high-speed character printers, and even these should be sure beforehand that they have read and understood the instructions thoroughly. Above all, resist the impulse to tamper with adjustments or to disassemble parts of the mechanism indiscriminately. If in doubt, contact Qume Technical Support for advice and instructions.

For the most part, the tools and equipment required for these adjustments are already available in the serviceman's tool kit. Whenever special tools, alignment fixtures, or test equipment are called for, they are noted prominently in the text. Section IV contains a consolidated listing of special tools and support equipment.

ROUTINE PROCEDURES

Cover Removal

The Sprint Micro 3 printer has a three-piece plastic cover. The uppermost section is a snap-on lid that protects the operator from carriage and printwheel movements during normal operation. To remove the top cover grasp the front edge firmly, and lift upward. The top cover snaps back into place in the same way.

Removing the top cover is an operator function, and must be done to replace the ribbon cartridge or exchange printwheels for various type styles. When replacing the top cover, be sure that the interlock switch is activated. The interlock switch is at the left-rear corner of the top cover, and disables the printer while the top is open (if this option is installed).

Middle Section

(1) Remove the platen by grasping at each end, and depressing both latch mechanisms.

(2) Remove the three 8/32 screws at the rear of the unit.

(3) Unscrew the seven 10/32 captive screws inside the periphery of the cover.

(4) Lift the center cover section free of the printer chassis. Be careful to disconnect any associated wiring.

(5) If the printer is to be run with the covers off, a jumper must be placed on J20 or J4, where the interlock switch connection was removed. The particular option configurations of the printer will determine which is the easiest to jumper.

CIRCUIT BOARDS

Standard Sprint 3 control electronics are contained on three printed circuit boards, each having edge connectors that mate with corresponding connectors on the mother board.

For purposes of identification, these assemblies are numbered sequentially, beginning at the rear of the printer. The board at the rear of the unit is thus PCB #1; that nearest the front of the unit is PCB #3. The TwinTrack model uses the same printed circuit boards, but has a second #2 and #3 board. All of these boards (1, 2 and 3) are interchangable between Sprint 3 models. In other words a #2 board can be used as a #2 board in all models including the TwinTrack. If the options are the same. Likewise with the #3 board, etc. The TwinTrack model has, however, one printed circuit board, and the mother boards (2 of them), that are not interchangable except within the TwinTrack model.

Removing and replacing electronic assemblies is routine. Using extractors, however, makes this task easier and minimizes the possibility of damage to the printed circuit boards. Always turn power OFF before removing or replacing any assembly. Connectors on the mother board are staggered, making it impossible to insert a printed circuit board in the wrong mother board position. When replacing printed circuit boards, be certain that they are seated firmly in their mating connectors.

Selected Resistors

Printed circuit boards #1 and #3 each have a factory selected resistor in the servo compensation circuit. These resistors are selected at the factory, and require no further attention unless some component within the circuit is changed. If the circuit is repaired or modified, the value of the selected resistor must be verified and/or re-selected. The selection procedure is outlined below.

Tools needed are: Oscilloscope - dual trace with 2 probes
Resistance decade box
Printer exerciser (P.N. 80630-04, -05, or 99000-00, -01)
or a system that will operate the printer as given below

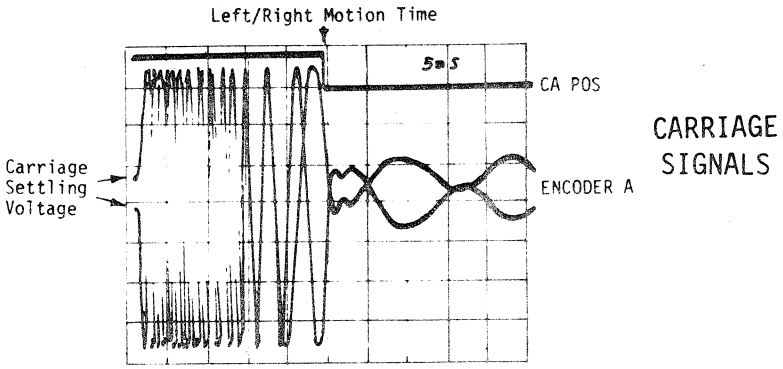
Board #1:

- Remove, by unsoldering, the selected resistor (see the specific revision level logic schematics for the R number and physical location).
- In the place of the resistor, connect a resistance decade box, initially set to 1,000 OHMS.
- Connect an oscilloscope probe to TP19 on circuit board #1 (CA POS).
- Connect a second oscilloscope probe to TP3, circuit board #1 (Encoder A).
- Using the printer exerciser, cause the carriage to move alternately right and left 0.1 inches (12 increments of 1/120 inches). This movement should be at the center of the carriage motion; directly in front of the motor pulley. The ribbon cartridge must be in place during this test.

Selected Resistors [continued]

- Set the oscilloscope to trigger on the CA POS probe, and display the encoder A signal at nearly full screen in height and centered vertically.

- Vary the carriage strobe rate (on the exerciser) until the servo settling waveform is displayed on the screen (see the waveform below).



- Vary the resistance decade box (usually between 0.5k OHMS and 1.5k OHMS) to change the right to left and left to right carriage motion times.

- Adjust the resistance until both motions show identical times.

- Observe the encoder A waveform. The settling voltage may vary slightly, but must be within ±3 volts of the average center voltage of the entire waveform. The settling voltage is easiest, and most accurately observed at the beginning of the waveform. The beginning point starts from the settled voltage of the previous cycle.

- If the settling voltage is not within ±3 volts of the center, adjust the resistor decade box until it is within the specification.

- Observe the carriage travel time again. The left-to-right and right-to-left movements must be within 3 ms of the same time. In some cases the resistance must be varied to a compromise point. But the encoder A settling voltage must be within ±3 volts of the center and the right/left left/right movements must be within 3 ms of each other.

- Boards that cannot be adjusted to the above specifications are defective, and must be repaired. Check all op-amps and associated components within the circuit.

- When a resistance value is found that allows both the settling voltage and the movement time to be within specifications, select a 1% resistor at the nearest value to that shown on the decade box.

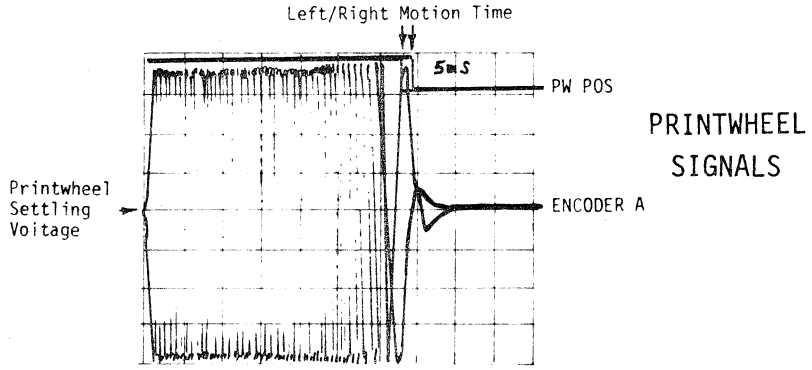
- Insert and solder the selected resistor.

- Recheck the encoder A settling voltage (±3 volts) and the difference in travel time for the two directions (with 3 ms). If these values are not within specification, the resistor (R209) must be re-selected, repeating the steps above.

Selected Resistors [continued]

Board #3:

- Remove the resistor by unsoldering.
- In the place of the resistor, connect a resistance decade box, initially set to 1,000 OHMS.
- Connect an oscilloscope probe to TP11 on board #3 (PW position).
- Connect a second oscilloscope probe to TP23 on board #3 (encoder A).
- With the printer exerciser, alternately move the printwheel 47 characters clockwise, and 47 characters counterclockwise (w and % will do this).
- Vertically center the waveform on the screen.
- Vary the character strobe rate (on the exerciser) until the servo setting waveform is displayed on the screen (see the waveform below).



- Vary the resistance decade box to change the settling voltage level of the encoder A signal until the voltage is either centered in both directions or is symetrical about center in both directions. The final settling voltage is most accurately reflected at the beginning of the following cycle, shown as the starting point on the oscilloscope.
- The encoder A display must be centered vertically on the screen during this test or the values are meaningless. The settling voltage must be within ±2 volts of the average encoder voltage. The average encoder voltage will be the zero line in the middle of the oscilloscope graticule if the display is centered properly.
- Check the other trace for the difference in motion times between clockwise and counterclockwise. The difference between the two directions should not exceed 4 ms.
- If a selected resistance cannot be chosen that allows the encoder A settling voltage for each direction of travel to be within ±2 volts of center, and the time difference between the two motions to be 4 ms or less, the board is defective, and must be repaired. Check the operational amplifier and associated components within the circuit.

Selected Resistors [continued]

- When a resistance value is found that allows both parameters to be within specification, select a 1% resistor of the nearest value to that shown on the decade box.

- Insert and solder the selected resistor.

- Re-check the settling voltage and the difference in the motion time. If the settling voltage is not within ±2 volts and the difference in motion is not 4 ms or less, the resistor must be re-selected using the steps above.

MECHANICAL ALIGNMENT

Although mechanical misalignment can result in noisy operation or in damage to the equipment, the first indication is usually a visible deterioration of the print quality. Symptoms frequently observed include characters that are too light or dark, characters that are heavier at the top or at the bottom edge, characters that appear to taper and become uneven at one or both extremes of carriage travel, and characters that seem to fade out at the horizontal line is scanned. Maladjustment occasionally produces positional inaccuracies that are most evident in the smeared appearance of overprinted characters or in the ragged "picket-fence" aspect of the horizontal lines.

Misalignment of the printer is seldom the result of ordinary wear. More often it is attributable to an accident, or to physical abuse of the printer. Any unit subject to a violent shock should be checked carefully for visible evidence of such maladjustment. However, re-adjustment will also be indicated as a matter of routine, whenever any of the following components and subassemblies are repaired or replaced:

Printwheel carriage
Printwheel servomotor
Printhammer solenoid
Ribbon lift solenoid
Carriage servomotor
Paper feed stepper motor
And/or platen drive gears
Plastic card guide

A complete re-alignment will seldom be called for, but, you must be careful to restore any and all adjustments that may have been disturbed. We therefore recommend that you read the following section carefully before beginning any repair. The preface to each procedure enumerates the conditions that make the particular adjustment necessary.

Note that the alignment procedures are grouped, as follows:

Printhammer adjustments
Platen adjustments
Paper feed roller adjustments
Carriage adjustments
Ribbon adjustments
Mother board alignment

Some of the adjustments that are given have interaction. We therefore recommend that all the procedures in a given group be performed at the same time. Observe the order of adjustments carefully, and take special note of those few cases where adjustments in one group necessitate re-checking adjustments in another.

PRINTHAMMER

Printhammer misadjustment usually produces characters that are too light, too dark, or uneven. Occasionally, however, a faulty adjustment will cause noisy operation or printwheel breakage. Printhammer adjustments should be made as a group, and in the given order. Check all adjustments first. Do not change hammer adjustments unless there is known trouble, or a check shows one or more dimensions out of specification. All platen adjustments must be correct and hammer cleaning and lubrication performed before the hammer adjustments are made.

Complete realignment of the printhammer assembly is necessary whenever any of the following parts have been removed or replaced:

Printhammer
Printhammer actuating solenoid
Armature limit bumpers
Printwheel servomotor

Printhammer Vertical Alignment

This procedure requires a special alignment tool (#80739), a screwdriver, and a 3/16" wrench or nut driver. The alignment tool gauges the angle and vertical position of the printhammer. However, because of possible tolerance buildup, final adjustment must be made with print quality as the criteria.

(1) Remove all power to the printer.

(2) Remove the top cover.

(3) Remove the platen by grasping at both ends, and depressing both latch mechanisms.

(4) Remove the ribbon cartridge and printwheel.

(5) Loosen the two printhammer retaining screws (A) that secure the printhammer housing to the carriage.

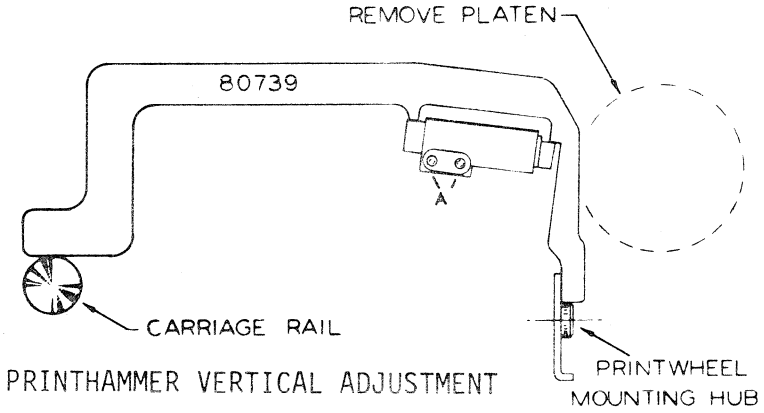
Most Sprint 3 Printers

(6) Install the printhammer alignment gauge (#80739), as shown in the figure. Be certain that the upper carriage is locked in its normal operating position. Check this by pushing down on the C (close) button near the end of the printwheel motor.

(7) Move the printhammer assembly into alignment. The movable hammer should contact the fixture lightly at both ends, as shown in the diagram.

Printhammer Vertical Alignment [continued]

(8) Hold the printwheel housing in the aligned position, and re-tighten the two retaining screws. This completes the vertical alignment.



PRINTHAMMER VERTICAL ADJUSTMENT

S3/X30 and S3/X40 Models Only

(6) Install the metalized printwheel on the printwheel motor hub. Be sure that the printwheel is correctly seated, and that the printwheel is not damaged or worn.

(7) Verify that the printwheel motor assembly is locked into the normal operating position by pressing down on the "C" button.

(8) Verify that the Multiple Copy Selector Lever is in the extreme forward position (toward the operator).

(9) Gently push the hammer against the printwheel spoke until the font character lightly touches the platen.

(10) Observe the contact between the hammer face and the back of the character font. When the character font is lightly touching the platen, the hammer face should be flat against the back side of the font. If there is space at the top or bottom, adjust the hammer angle for best contact.

After adjusting the printhammer vertical position, it is a good idea to run a print sample and check the evenness of the impression. Vertical misalignment produces characters that are darker at the top or bottom edge. If characters are heavier at the top or bottom, it may be necessary to raise or lower the adjustment slightly, so that the hammer is more nearly horizontal. Uniform appearance of the sample is the ultimate criterion to be applied. A small adjustment can be made by loosening only the screw closest to the printwheel, and moving the printhammer slightly. Before re-adjusting the hammer, however, be sure to check the platen height adjustment as described later in this section. Maladjustment of the platen can produce much the same result as faulty printhammer alignment, so the platen should be checked before concluding that the printhammer is to blame for a visible defect.

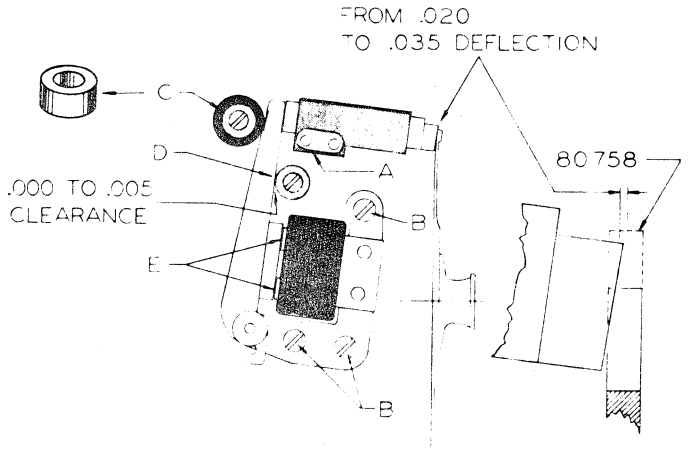
Hammer Armature Core Adjustment

Before the hammer armature core is adjusted, the platen and hammer vertical adjustments must be made. Because this adjustment is made following the hammer vertical adjustment, it is assumed that the power is off, and the top cover and printwheel are both removed. Qume special tool, 80758, is used for this adjustment (see PRINTWHEEL INDEX ALIGNMENT for an illustration of this tool).

(1) Install the alignment disc (P.N. 80758) where the printwheel normally resides. With the printwheel motor tilted back to attach the alignment disc, "This Side Up" should be visable. This can be secured with a discarded printwheel center hub.

(2) Rotate the disc until the notch on the flattened portion is toward the hammer. Be sure the alignment disc is securely seated on the printwheel motor shaft.

(3) Using a 3/16" wrench, loosen the retaining nut at the opposite end of the eccentric forward limit bumper. (Item D in the figure below.)



HAMMER ARMATURE CORE ADJUSTMENT

(4) Rotate the bumper beneath screw D to the maximum possible clearance between the bumper and the armature. Do not re-tighten, this adjustment will be completed later.

(5) Loosen the three screws (B) holding the armature core.

(6) Pinch and hold the armature lever against the core piece, and position the entire assembly so that the hammer extends .020" to .035" into the slot on the alignment disc. There are two scribed lines on the flat edge of the alignment disc to aid this measurement.

(7) While still holding the assembly in position, tighten the three screws (B).

(8) Hold the armature core to the polepiece.

(9) With a screwdriver, rotate the eccentric bumper (D) to within .000" to .005" of the hammer armature.

Hammer Armature Core Adjustment [continued]

(10) While holding the adjustment with a screwdriver, tighten the nut at the opposite end of D.

(11) Loosen the retaining nut at the opposite end of screw (C).

(12) Place the ring gauge (P.N. 73046) over the plastic bumper on C. If no ring gauge is available, use a .65" (.063" -.000 +.005) spacer or feeler gauge.

(13) While holding the armature against the core, rotate the eccentric screw (E) until the ring gauge lightly touches the hammer armature.

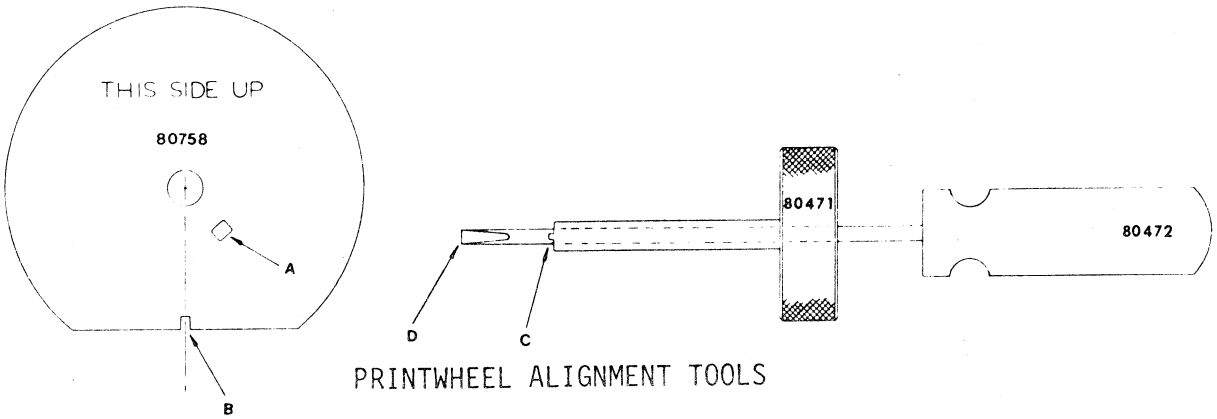
(14) Continue to hold the eccentric screw with the screwdriver; and tighten the retaining nut at the other end of the screw. The hammer armature will be held by the gauge during this part of the operation.

(15) Remove the gauge from the bumper.

PRINTWHEEL INDEX ADJUSTMENT (HUB)

Although the printwheel index adjustment is not technically a printhammer adjustment, it should be checked when the printhammer adjustments are made. Printhammer maladjustment can produce symptoms ranging from poor print quality to physically breaking the printwheel spokes. The printwheel should not be adjusted until after all other adjustments are perfect, and then only if the misalignment is visable.

The printwheel index adjustment requires the special tools illustrated below. DO NOT ATTEMPT ADJUSTMENT WITHOUT THESE TOOLS.



PRINTWHEEL ALIGNMENT TOOLS

WARNING

This adjustment is made with the printer energized. Keep hands and tools clear of the carriage and printwheel, except as specifically instructed in the text.

(1) Remove the top cover, if it is not already off.

(2) Bypass the cover interlock switch if necessary by placing a small bit of folded paper into the opening to hold the switch lever. The interlock switch is located at the left rear of the top cover opening (as seen from the operator position).

(3) Disconnect the data cable from the printer unit, and apply power.

(4) Extend the printhammer and verify that the lower case "w" is squarely in front of the printhammer. If it is aligned properly, skip the remaining procedure, otherwise continue.

(5) Release the carriage locking lever by depressing the "O" button on the carriage.

(6) Remove the printwheel by grasping firmly at the hub, and pulling away from the shaft.

(7) Briefly activate the ribbon feed switch inside the lower right portion of the carrier travel area. The ribbon will raise and advance, then return to the lowered position. When the ribbon returns to the lowered position, the printwheel will index to a "home position", where the lower case 'w' is in the printing position (index pointer on the "X" models).

(8) Using the collet adjusting tool and the concentric screwdriver, hold the shaft with the screwdriver and loosen the hub collet. The collet loosens by twisting the knurlled knob of the tool counterclockwise.

(9) Mount the alignment disc on the printwheel hub with the "UP" side away from the motor. The "UP" marking references the flat surface, not the rotation.

(10) Place the ring gauge (P.N. 73046) over the plastic return stop bumper behind the armature, causing the printhammer to extend.

(11) While holding the motor shaft with the screwdriver portion of the adjustment tool, rotate the disc (but not the motor shaft) until the extended tip of the printhammer engages (or aligns with) the cut in the flat edge of the disc.

(12) Carefully tighten the collet hub by turning the knurlled knob clockwise. DO NOT tighten with brut force. A very snug fit is sufficient.

(13) Remove the alignment tools, the disc, and the ring gauge.

(14) Re-mount the printwheel onto the motor shaft.

(15) Briefly activate the ribbon feed switch again.

(16) Verify that the lower case "w" is squarely in front of the printhammer. If it is not, remove the printwheel and repeat the adjustment.
*For the "X" models, verify that the printwheel index pointer is exactly straight up.

(17) When the adjustment is complete, return the carriage to the operating position, and press the "C" button to lock it into place.

PLATEN ADJUSTMENTS

Platen misalignment usually causes variation in print quality over the width of the page, ragged lines, lines that taper, or lines that gradually fade from side to side. Difficulty in accurate overprinting may also indicate platen maladjustment. The platen should be aligned routinely when any of the following items are replaced:

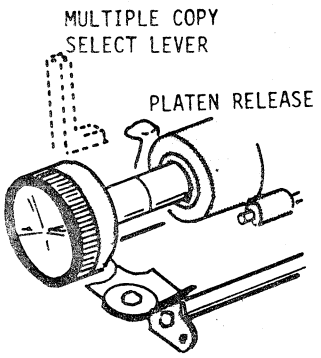
Paper Feed Stepper Motor
Paper Feed Idler Gear
Carriage
Printwheel Servo Motor

Adjustments within this group are highly interdependent, and should be performed as a group, in the order that is given. These adjustments bring the platen alignment to within specifications, but the final criteria should be print quality.

Platen Depth

(1) Remove the top and middle cover sections. Cover removal instructions are given in the first portion of this section of the manual.

(2) Place the multiple copy select lever in the extreme forward position. The forms thickness lever is behind the platen on the top left side. Be sure that the platen is properly seated and latched into position (the two platen releases have returned to the latched position).

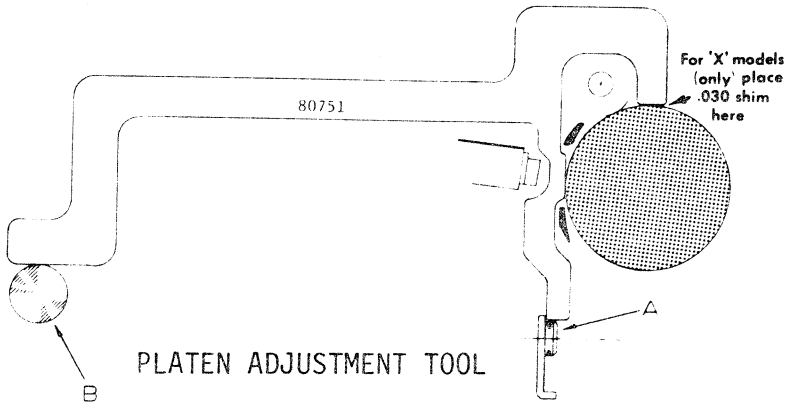


(3) Tilt the carriage forward, and remove the printwheel (as described in OPERATION).

(4) Return the carriage to the operating position, and lock into place by depressing the "C" button.

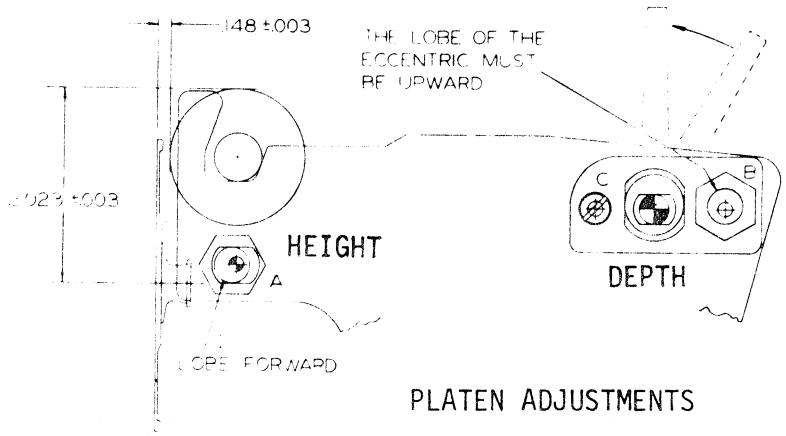
(5) Manually position the carriage to the end of travel on the side that is to be adjusted.

(6) Place the alignment tool (80751) on the platen, printwheel hub, and front carriage rail as shown in the following illustration.



PLATEN ADJUSTMENT TOOL

(7) The figure below shows the adjustment on the platen frame assembly. The adjustment locations are the same for each end, and are "mirror images" of each other. Each adjustment has a slotted locking screw, and 5/8" hex adjustment eccentric. With a screwdriver, loosen, but do not remove, the two lock screws.



PLATEN ADJUSTMENTS

(8) Using the hex eccentric, adjust the plate until the forward edge of the platen barely touches the flattened vertical edge of the alignment gauge.

(9) When the adjustment is correct, tighten the lock screws, and repeat the procedure for the opposite end of the platen.

Platen Height

(1) Place the alignment gauge (80751) as shown on the previous page. This is the same tool, in the same place as for the depth adjustment.Note that the "X" models require a .030" shim beneath the gauge (the platen is adjusted .030" lower).

(2) Loosen the locking screw for the eccentric. (See the illustration.)

(3) Adjust until the top of the platen barely touches the gauge.

(4) Re-tighten the locking screw, being careful not to change the adjustment.

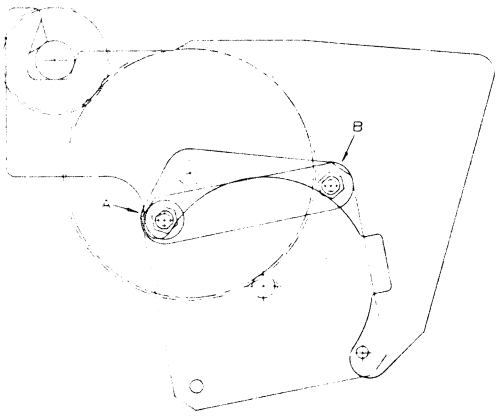
PLATEN ADJUSTMENTS (continued)

Platen Drive Gear Adjustment

Adjust the platen drive gear for minimum backlash in the paper feed gear train. A drive mechanism that is too tight will bind, causing poor vertical positioning. A mechanism that is too loose causes poor registration and overprinting, or uneven lines.

The gear train is adjusted at the factory, but must be checked when any of the platen adjustments are made, or when a paper feed motor is replaced. The illustration below shows the location of the adjustment screws. Access to the screw labeled A is through a hole in the intermediate gear (the large black gear).

(1) Loosen the two retaining screws, A and B. These should be loose enough to allow adjustment, but retain the position without being held.



PLATEN GEAR DRIVE ADJUSTMENT

(2) Move the intermediate gear into both of the other gears. This should gently bottom without binding.

(3) Re-tighten the securing screws, and check for backlash or binding. The large gear should be able to slide in and out on the shaft (within the limits of the endplay) but it should not have any rotation motion.

(4) Rotate the platen knob to verify that there is no binding or backlash at some other point in the rotation. The paper feed motor will exert some resistance, even without power.

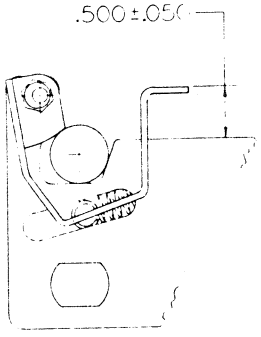
(5) If the gear cannot be adjusted to eliminate backlash, the condition must be corrected by replacing worn parts. However, the quality of the printout should determine if that is necessary.

Platen Latch Adjustment

(1) Remove the platen by pressing both releases, and lifting the platen.

(2) Loosen the locking screw (slot head). See the illustration for the screw location.

(3) Adjust the eccentric slightly in the desired direction.



PLATEN LATCH ADJUSTMENT

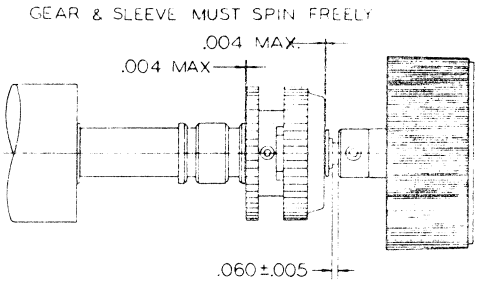
Platen Latch Adjustment [continued]

(4) Replace the platen, and measure the distance shown in the illustration. If necessary, repeat steps (1), (2) and (3) until the adjustment is correct. Do NOT attempt to adjust with the platen in place.

(5) Re-tighten the locking screw, and replace the platen.

Platen Release Adjustment

The figure below shows the required spacings and tolerances for the platen release mechanism. Under normal circumstances this adjustment will not be required. If adjustment is required, remove the platen and adjust by loosening the set screws.



PLATEN RELEASE ADJUSTMENT

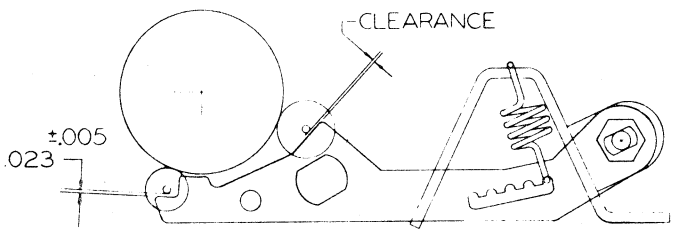
PAPER FEED ROLLER ADJUSTMENTS

Feed rollers that are not properly adjusted may cause the paper to "creep" sideways or become misaligned as the paper passes through. All of the paper feed roller adjustments are interdependent, and should be performed as a group.

Remove all power from the unit when making these adjustments.

Feed Roller Depth

The figure below shows the mechanical details of one of the four feed roller arms. The arm is spring loaded from an adjustable pivot point. By moving the arm toward the front or rear, the roller alignment is adjusted. All four arms must be adjusted, one at a time, to assure proper tracking.



FEED ROLLER DEPTH

(1) Using two wrenches, loosen the adjustment on one arm. Loosen only enough to allow movement with finger pressure.

(2) Adjust the front clearance to the value shown. The front and rear clearance should be approximately equal.

(3) Re-tighten the adjustment screws, being careful that the adjustment does not change when the screw is tightened.

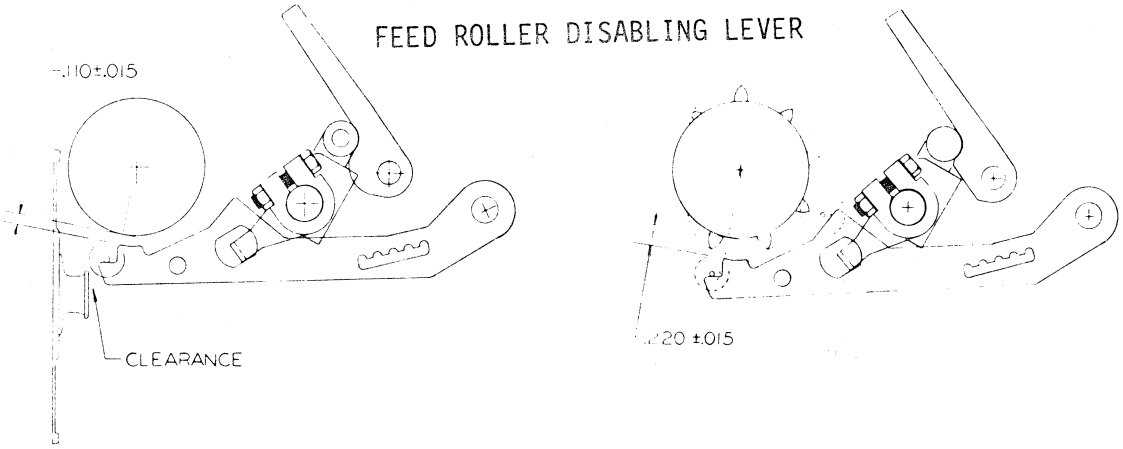
(4) Adjust the other three arms in the same manner. Before operating the unit, manually slide the carriage over the entire travel to verify that there is no interferrence between the front portion of the arm and the printwheel hub.

Feed Roller Disabling Lever Adjustment

(1) Remove the platen from the unit.

(2) Carefully lift the cradle assembly (under the platen) and allow it to lay back, out of the way. Do not stretch the springs that are attached to the assembly.

(3) Move the paper release all the way forward; replace the platen. Place a gauge between the platen and one lever arm. (See the illustration for the proper gauge thickness for friction platen or pin feed.)



FRICTION PLATEN SHORT PIN FEED

(4) Adjust the arm for zero clearance by loosening the clamp, and changing the position of the lever.

(5) Re-tighten the clamp, making sure that the adjustment does not change when doing so.

(6) Adjust the other three arms in the same manner.

(7) Re-install the cradle assembly and the platen.

PAPER FEED ROLLER ADJUSTMENTS (continued)

(8) With the paper release lever in the forward position, manually move the carriage over the entire range of movement. Check to be sure that there is adequate clearance between each of the paper feed rollers and the printwheel hub.

(9) Return the paper release lever to the rear position, and check that all of the rollers engage the platen.

CARRIAGE CABLE TENSION ADJUSTMENT

Cable tension should be checked routinely during preventive maintenance inspections or whenever the carriage is removed and replaced. Cable tension is maintained by spring tension on one idler pulley at the right side of the printer. Adjust the cable tension as follows:

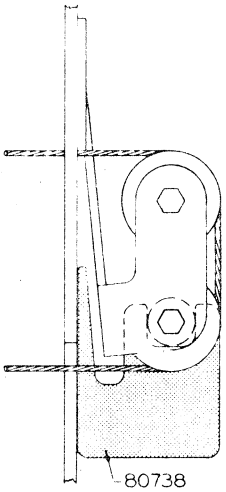
Most Sprint 3 Printers

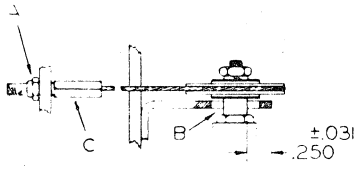
(1) Slide the adjustment tool, 80738, along the side frame as shown in the illustration.

(2) Hold the cable (C in the illustration) and use a 3/16" wrench, to adjust the nut (A) until the bearing assembly (B) is centered in the gauge as shown. Either, or both ends of the cable may be adjusted, whichever is convenient, but DO NOT TWIST THE CABLE.

S3/55, S3/WideTrack, and S3/TwinTrack

(1) While holding the cable end (C), adjust at A until the bearing assembly (B) is centered in the hole of the side bracket as shown in the illustration.





CARRIAGE CABLE ADJUSTMENT

LEFT MARGIN PHOTO SENSOR

The optical sensor sets the beginning point for carriage travel. It is used only during the RESTORE sequence, which is issued in initialization and reset sequences.

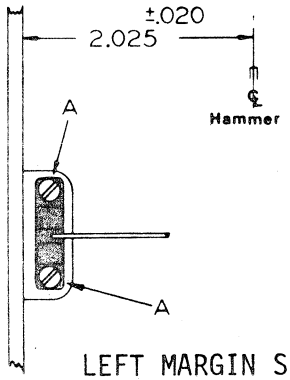
(1) Initialize the printer by removing power, then returning the power. The carriage should move to the left side of the travel.

LEFT MARGIN PHOTO SENSOR (continued)

(2) Using a graduated rule or other suitable measuring instrument, measure the distance from the printhammer axis to the frame (see the illustration).

(3) If the distance must be adjusted, loosen the two mounting screws on the photo sensor, and move the assembly.

(4) When the adjustment has been moved, re-initialize the printer by power OFF/ON. The carriage will move to the adjusted location.

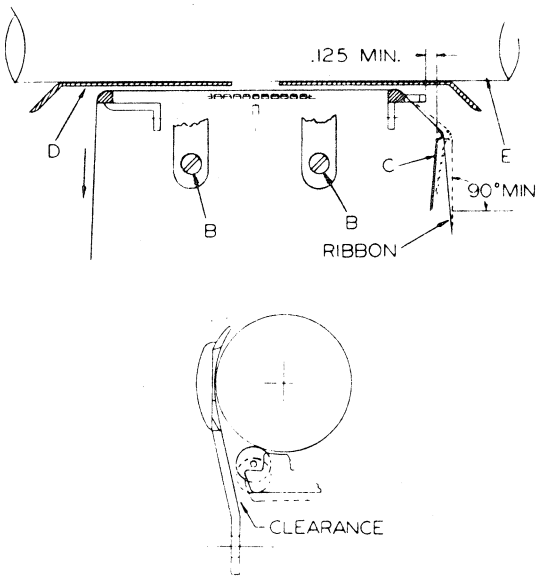


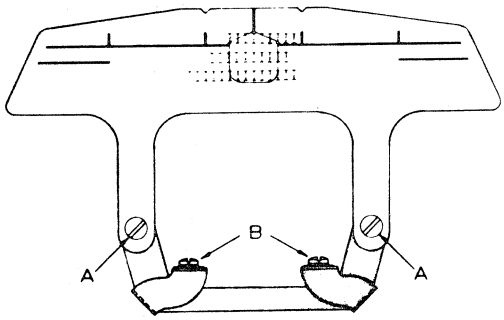
LEFT MARGIN SENSOR

CARD GUIDE ADJUSTMENT

The card guide must operate with both proper clearance and alignment. Adjust with power off and the multicopy select lever forward. Loosen the two mounting screws (B) shown in the illustration below. The card guide should lightly touch the platen along the entire working surface of the guide. Be sure that when the adjustment is made, there is clearance between the guide and the front platen rollers (see the lower illustration).

To set the card guide height, type several lines of capital I's at 6 lines per inch spacing. Adjust the guide by loosening the two screws (A) shown in the illustration. At 6 lines/inch, two lines should "rest" on the guide lines, while the center line is between the guide lines. The vertical mark, indicating the print position, should point directly at the center of the letter (see the illustration below).





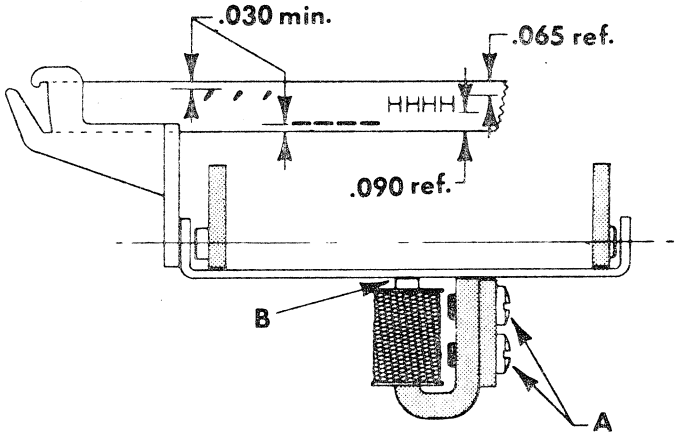
CARD GUIDE ADJUSTMENT

RIBBON LIFT HEIGHT

(1) Print a few characters, alternating between the apostrophe (') and the underscore (_).

(2) Examine the ribbon to be sure that the characters are centered on the ribbon. If the ribbon is a dual color, the characters will be centered on one of the two colors.

The illustration shows a single width ribbon, properly aligned. If adjustment is necessary proceed as follows.



RIBBON LIFT HEIGHT ADJUSTMENT

(1) Release the ribbon cartridge by depressing the red release lever.

(2) The ribbon cartridge can either be removed or set askew so that the feed motor will not feed ribbon if it rotates. The ribbon can, but need not, be unthreaded from the lift guides.

(3) Loosen the two coil mounting screws (A) shown in the drawing above.

(4) Activate the ribbon lift by depressing and holding the ribbon advance button. The ribbon motor will also spin, but this is of no consequence.

(5) Adjust the lift height while maintaining the coil-lift bail contact at B in the drawing. If, during the adjustment, the lift bail separates from the magnet, release the ribbon advance briefly, then re-activate. (The initial lift pulse is much greater, and will re-establish the magnetic contact.)

(6) When the height is properly adjusted, re-tighten the coil mounting screws (A).

(7) Release the ribbon advance button.

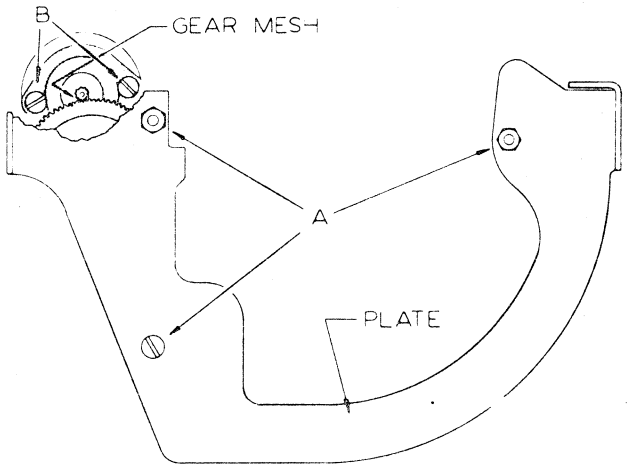
(8) Replace the ribbon cartridge, and check the printing height.

(9) Repeat the adjustment if necessary.

RIBBON DRIVE GEAR ADJUSTMENT

The drive gear on the ribbon motor must rotate freely while meshing with the larger gear on the ribbon clutch. At the same time, only a minimum of backlash is allowable. Adjust if necessary as follows:

(1) Loosen, but do not remove, the two motor mounting screws (B).



RIBBON DRIVE GEAR

(2) Adjust the motor position as necessary.

(3) Re-tighten the two mounting screws (B).

(4) If the motor mounting screws do not allow enough adjustment latitude, loosen the three screws at A, and re-position the plate.

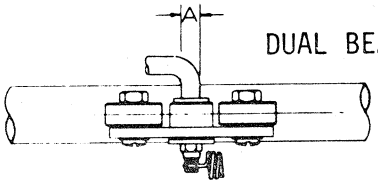
DUAL CARRIAGE BEARING ALIGNMENT

The S3/55, WideTrack and TwinTrack printers have a dual bearing on the bottom shaft of carriage carrier. The part details are different between the S3/55 and the wide models, but both are adjusted the same. Alignment is necessary only if the carriage or bearing carrier is replaced. Align as follows:

(1) Before the carriage is installed in the printer, place a 1/2" carriage shaft in the dual bearing carrier.

(2) Hook up the tensioner spring so the bearing carrier loads against the shaft.

(3) Carefully observe the alignment of the shaft and bearings. The centerline of the shaft and the centerline of both bearings should be exactly in line (see the illustration).



DUAL BEARING ASSEMBLY

DUAL CARRIAGE BEARING ALIGNMENT (continued)

(4) Move the shaft back and forth. The bearing carrier must not tilt or rock as the shaft changes direction. If it does, the bearing carrier needs alignment.

(5) Alignment is made by grasping the link at point A with pliers and bending the link slightly.

(6) If adjustment is made, re-check the alignment, and repeat the adjustment if necessary.

RIBBON LIFT SPACING

(1) Remove any paper from the printer. Remove the printer top cover.

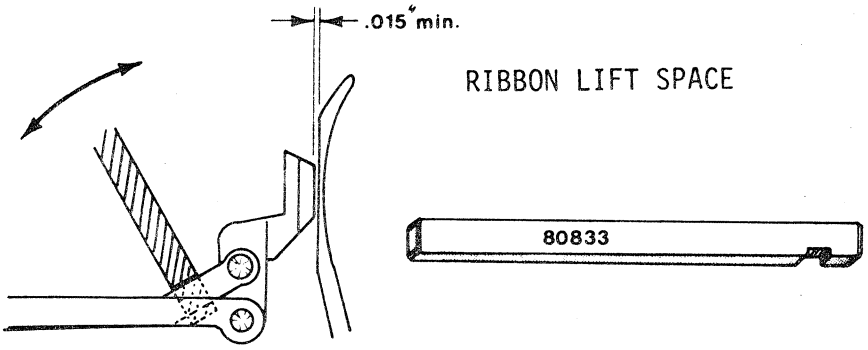
(2) Place the Multiple Copy Selector Lever in the extreme forward position (toward the operator).

(3) Remove the ribbon cartridge.

(4) Raise the ribbon lift guides by pressing downward on the bar portion of the bail assembly (over the lift coil).

(5) Gently place a 0.15 inch thickness gauge between the card guide and one of the ribbon guides. (See the figure below.) The thickness gauge should touch both the card guide and the ribbon guide, but not deflect them. There may be a small movement within ribbon guide assembly, however, because of tolerances in the rivets.

(6) Place the .015 inch thickness gauge between the card guide and the other ribbon guide. The gauge should touch both as described in the step above.



If either or both of the ribbon guides requires adjustment, proceed as follows:

(1) Place the adjusting tool, Qume P.N. 80833, on the ribbon lift link that is to be adjusted (see the figure). The ribbon lift link is the inner of the two pieces of metal.

RIBBON LIFT SPACING (continued)

(2) While holding pressure to keep the tool from slipping off, gently move the tool to adjust the ribbon lift guide. Lifting upward on the outer end of the tool decreases clearance between the card guide and ribbon lift guide. Downward increases clearance. DO NOT OVERFORM.

(3) Re-check the clearance with the .015 inch thickness gauge.

(4) When the ribbon lift guide properly clears the card guide, the ribbon to printwheel clearance should not be closer than .030 inches.

RIBBON TRACKING

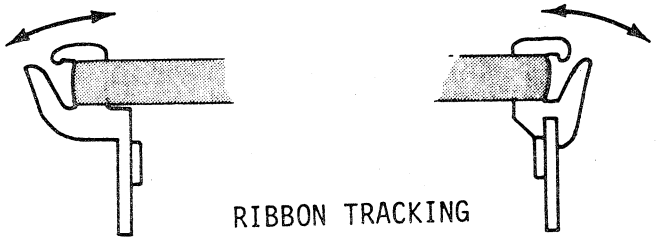
(1) Replace the ribbon, but do not replace the printer top cover.

(2) With power ON, depress the ribbon advance button, and observe the ribbon as it move across between the lift arms.

(3) If any ribbon "curling" is present, determine which guide is causing it.

(4) Carefully twist the arm to be adjusted outward to correct "curling" at the top of the ribbon, or inward to correct "curling" at the bottom of the ribbon. (See the illustration below.)

(5) Check the adjustment by depressing the ribbon advance button again, and observing the ribbon as it travels across between the lift guides. Re-adjust if necessary.



RIBBON TRACKING

MOTHERBOARD ALIGNMENT

If difficulty is encountered when inserting or removing the power and data connectors at the rear of the chassis, re-aligning the motherboard may help.

(1) Remove all power from the unit.

(2) Remove the top and middle cover sections.

(3) Remove the printed circuit boards from the inside of the printer.

(4) Loosen, but do not remove, the eight pan-head screws that hold the motherboard.

(5) Insert the power and data connectors. Be sure that both connectors are well seated onto the motherboard connector.

MOTHERBOARD ALIGNMENT (continued)

(6) Tighten the jackscrews on the connectors.

(7) Tighten the eight motherboard mounting screws.

(8) Replace the printed circuit cards and the covers. Be sure that all printed curcuit cards are securely seated, and the board switches are in the proper positions.

COVER INTERLOCK

The cover interlock switch should be adjusted to faithfully disable the printer when the top cover is removed, while never falsely disabling the printer when the cover is in place. Adjust as follows:

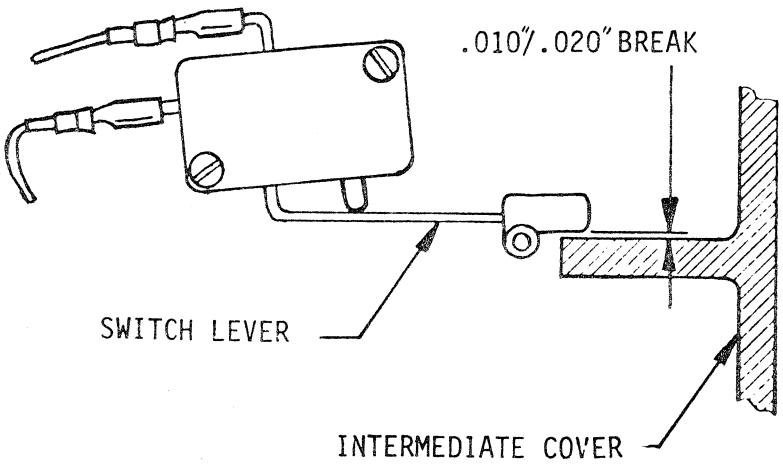
(1) Remove the top cover.

(2) Lightly depress the interlock switch to its limit.

(3) Slowly release the switch until a "click" is heard and felt. Note the position of the switch lever, it should be within .010" to .020" of resting against the intermediate cover.

(4) If necessary slightly bend the switch lever to conform to the proper spacing.

(5) After adjusting, check that the switch lever travels at least .035" from the resting position before the "click" is heard.



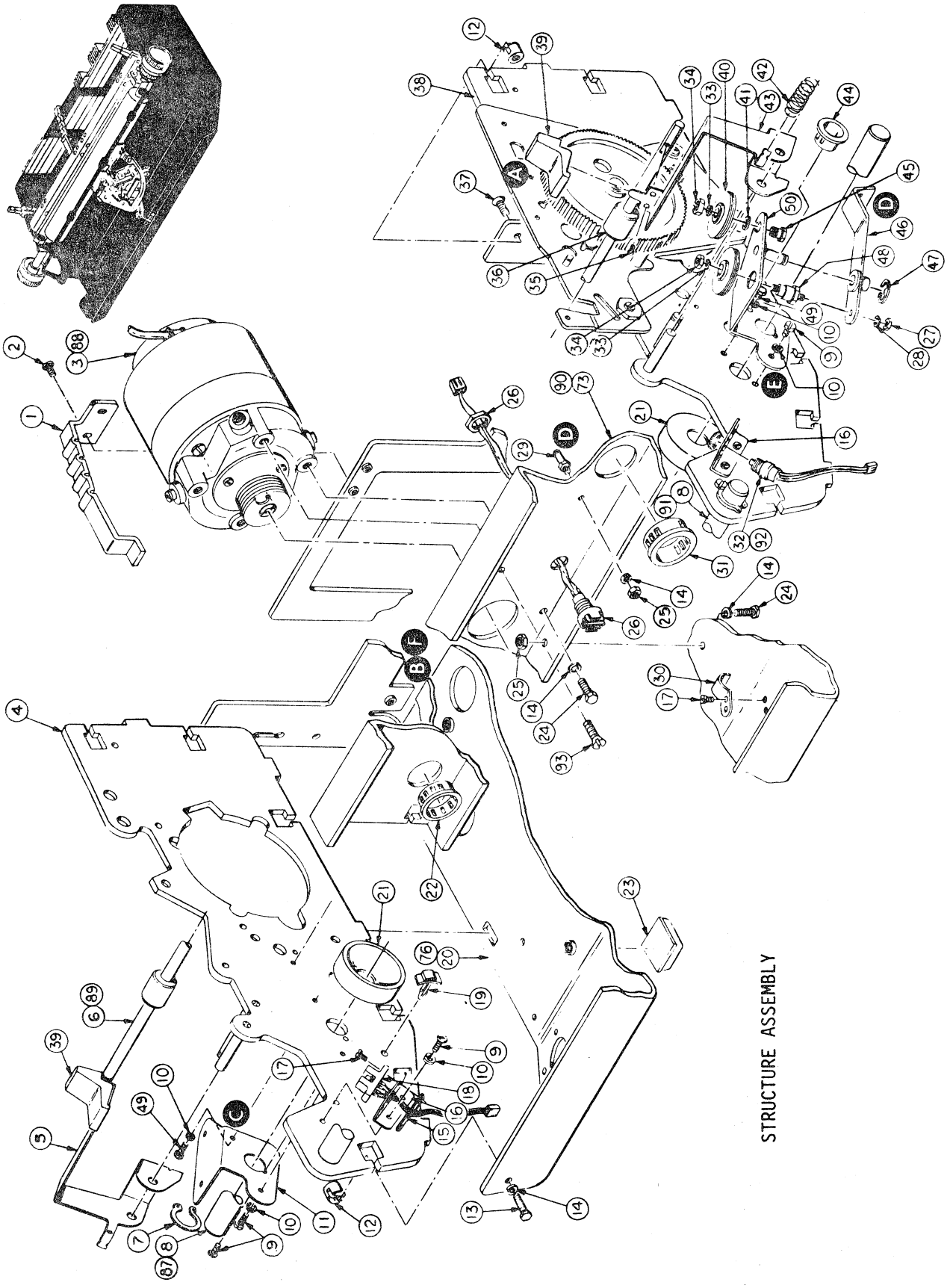
CHAPTER VII

ILLUSTRATED PARTS LIST

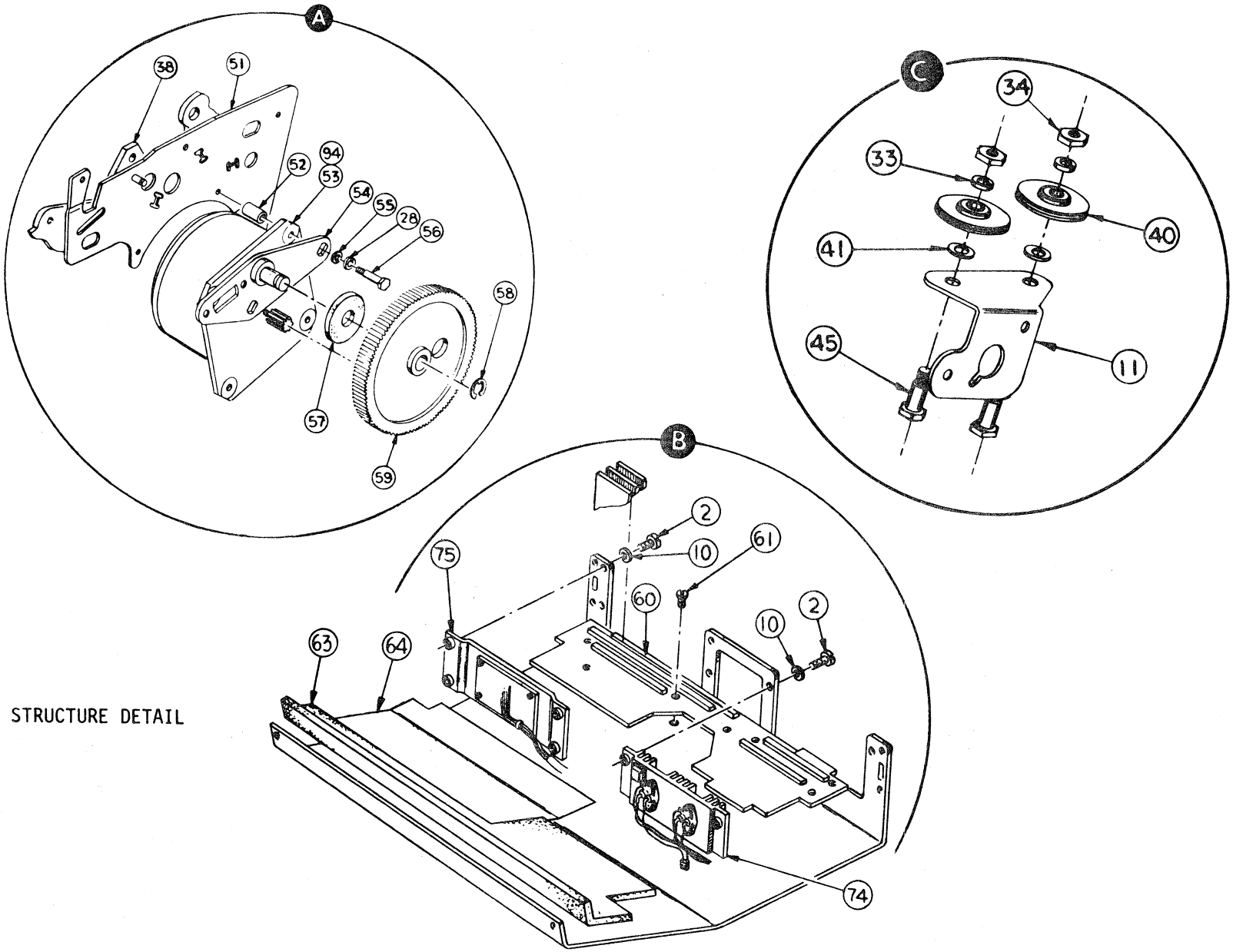
The following pages contain illustrated parts lists for the various Sprint Micro 3 printer models. Each group is identified by the shaded portion in the overall printer drawing that is on the same page. Where specific models require different parts, those parts are shown in separate illustrations, and identified in a separate list. These illustrated parts lists can be used as an assembly guide and to identify missing or broken parts when repairing a printer.

To order parts, visually locate the part on the drawing, then use the index number to locate the part number from the list on the accompanying page. For parts pricing, refer to Qume Prices, Service and Spares (Qume P.N. 30030).

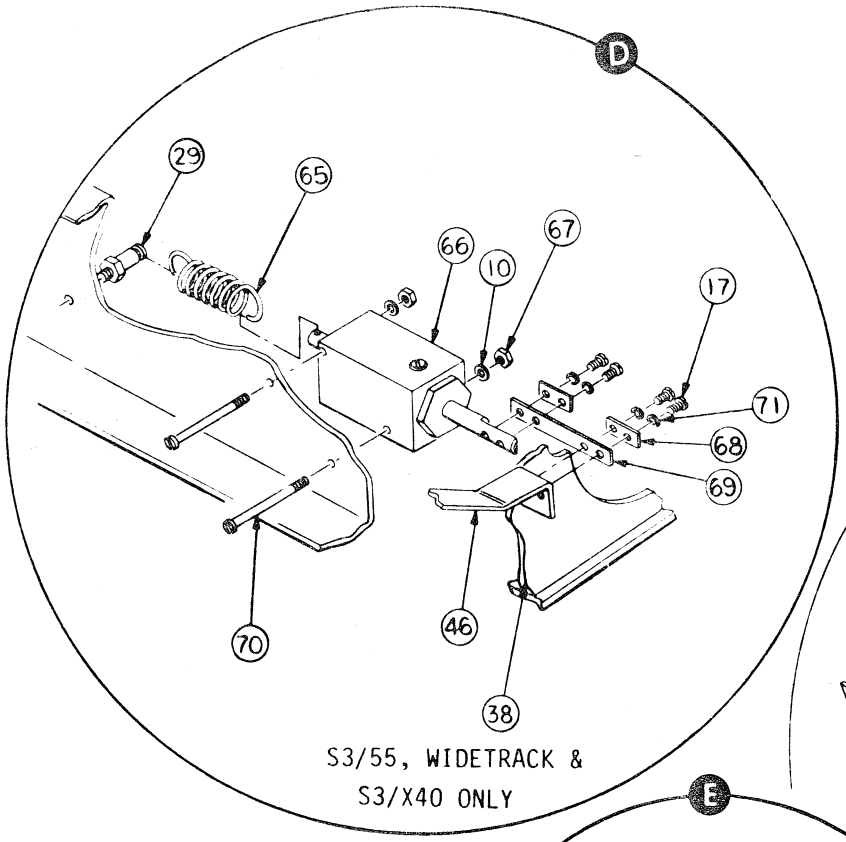
When replacing parts, refer to Section VI of this manual for alignment and adjustment procedures.



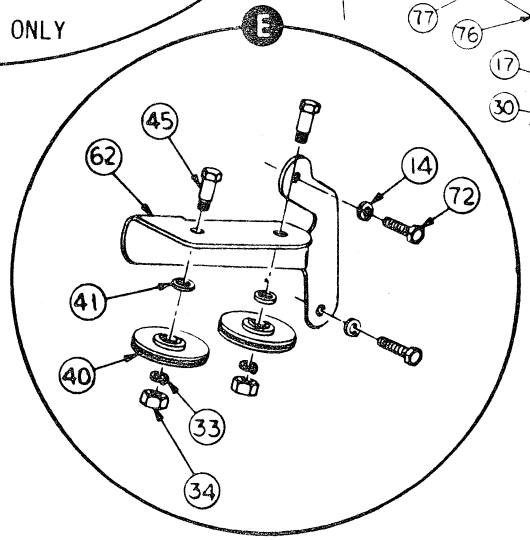
STRUCTURE ASSEMBLY



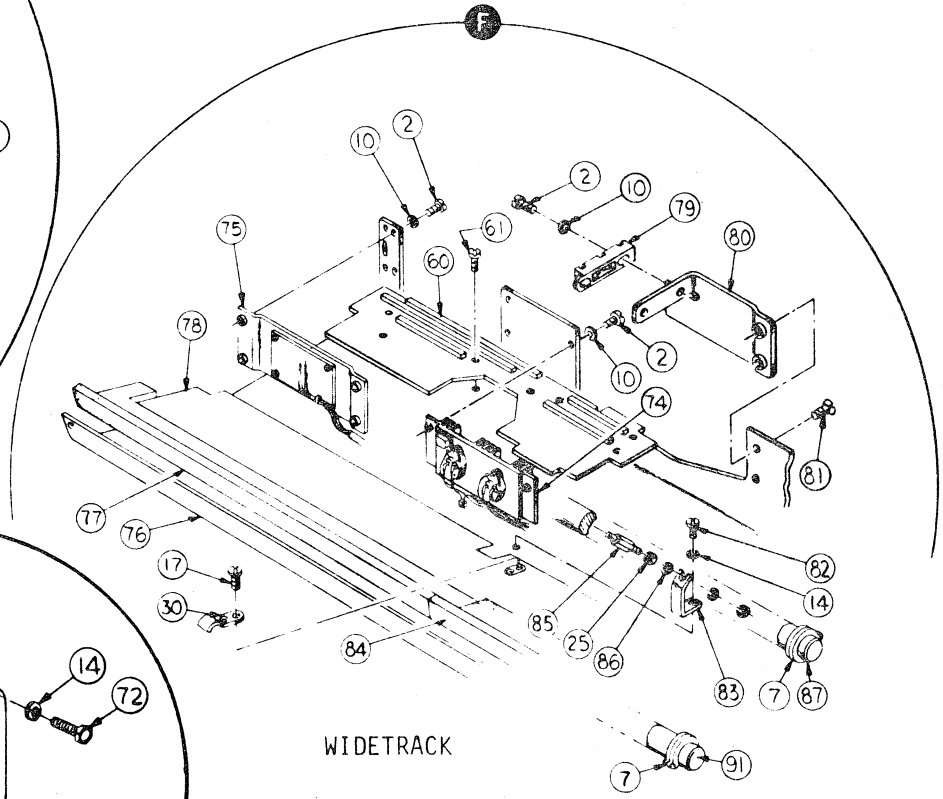
STRUCTURE DETAIL



S3/55, WIDETRACK &
S3/X40 ONLY



STRUCTURE DETAIL



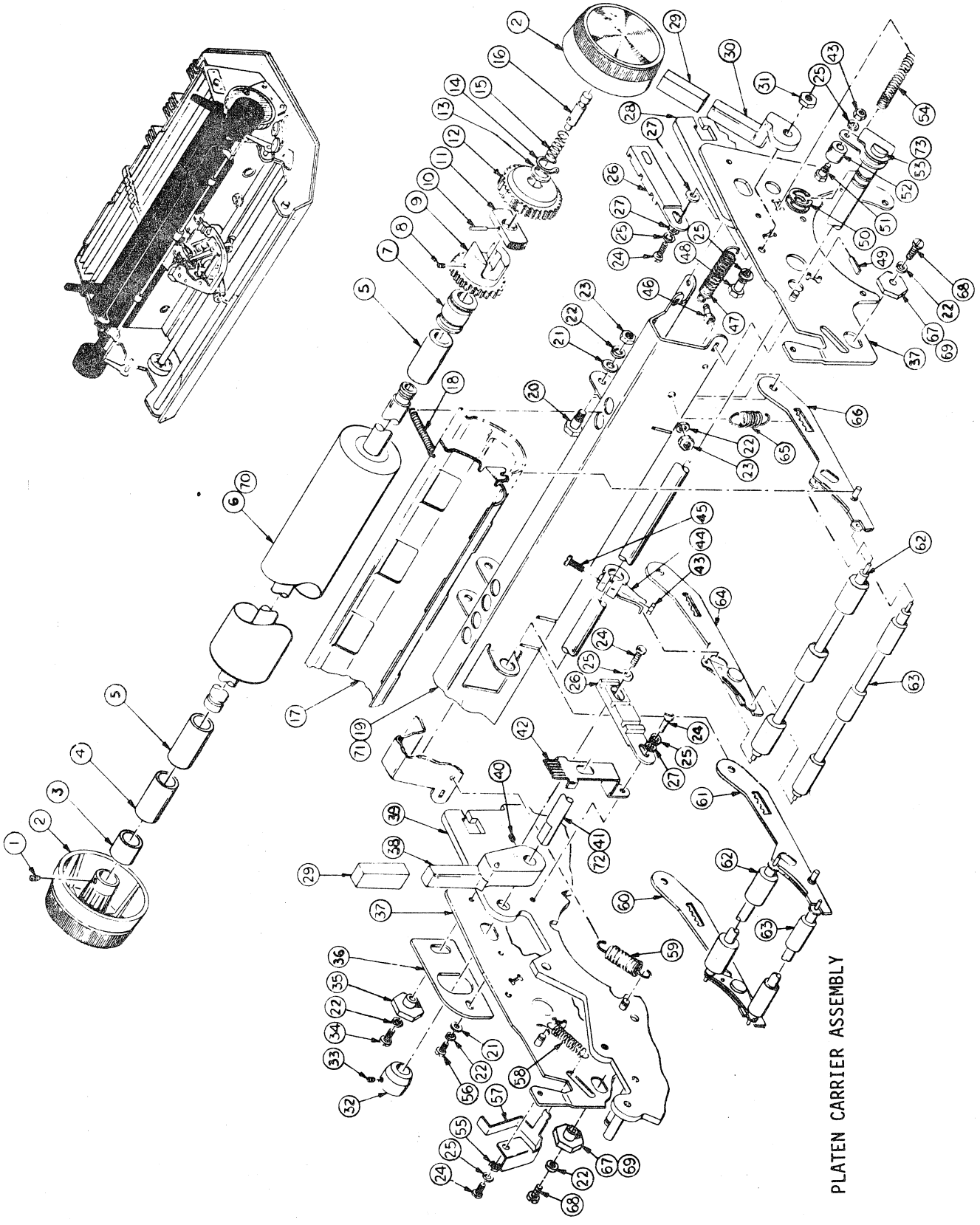
WIDETRACK

STRUCTURE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION
1	80408	Clamp, Printed Circuit Board
2	85006-05	Screw 6-32 x .312, Pan Hd.
3	80023-01	Motor/Encoder Assy. (S3/45 and S3/X30)
	80023-02	Motor/Encoder Assy. (S3/35)
	80023-03	Motor/Encoder Assy. (S3/55 and S3/X40)
4	80048	Frame Assy., Left Side
5	80257-01	Arm, Bail Roller, Left
6	80259-01	Shaft, Bail Rollers
7	85129-50	Retaining Ring (5555-50)
8	80116-01	Shaft, Carriage Guide
9	85006-04	Screw 6-32 x .250, Pan Hd.
10	85124-06	Washer #6, Helical Lock
11	80106-02	Bracket, Pulley Mount, Left
12	80220	Nut, Frame Mounting
13	85058-10	Screw 10-32 x .625, Hex Hd.
14	85124-10	Washer #10, Helical Lock
15	80405	Bar Nut, Photo Sensor
16	80404	Bracket, Photo Sensor
17	85004-04	Screw 4-40 x .250, Pan Hd.
18	99120	Photo Sensor Assy.
19	85159	Snap Grip, Wire Fastening
20	80049-01	Pan Assy., Bottom, Unslotted
	80049-02	Pan Assy., Bottom, Slotted
21	80719	Bumper, Carriage Deceleration
22	85157-02	Snap Bushing (SB-875-11)
23	85152-01	Foot (SJ-5023)
24	85058-08	Screw 10-32 x .500, Hex Hd.
25	85122-10	Nut 10-32, Hex
26	80610-01	Resistor Assy. (5 OHM, 25 Watts)
27	85122-08	Nut 8-32, Hex
28	85124-08	Washer #8, Helical Lock
29	80666	Stud, Spring
30	80246	Clamp, Carriage Cable
31	85157-03	Snap Bushing (SB-1093-15)
32	99119-01	Switch Assy., Ribbon Advance
33	85124-05	Washer #5, Helical Lock
34	85122-05	Nut 5-40, Hex
35	85074-04	Screw 4-40 x .250, Flat Hd.
36	80329	Roller Assy., Platen Bail
37	85068-10	Screw 10-32 x .625, Flat Hd.
38	80050	Frame Assy., Right Side
39	80320-01	Lever, Bail Platen (Bright Chrome)
	80320-02	Lever, Bail Platen (Charcoal Grey)
	80320-03	Lever, Bail Platen (Cordovan Brown)
40	80037	Pulley Assy., Idler
41	80109	Washer, Pulley
42	80237	Spring, Extension
43	80257-02	Arm, Bail Roller, Right
44	85157-04	Snap Bushing (SB-625-8)
45	80523	Screw, Cable Pulley
46	80673	Lever Assy., Dashpot
47	85128-25	Retaining Ring (5133-25)

STRUCTURE ASSEMBLY
(Continued)

ITEM	PART NUMBER	DESCRIPTION
48	80107	Stud, Pulley
49	85056-04	Screw 6-32 x .250, Hex Hd.
50	80684	Bracket and Stud Assy.
51	80040	Frame Assy., Platen
52	80197-01	Spacer, Motor Mounting (With .15 Thick Plate)
	80197-02	Spacer, Motor Mounting (With .08 Thick Plate)
53	80046-01	Motor Assy., Paper Feed (Low Current)
	80046-02	Motor Assy., Paper Feed
54	80339-00	Plate Assy., Idler Gear, Right
55	85125-08	Washer #8, Narrow
56	85057-14	Screw 8-32 x .875, Hex Hd.
57	80398	Washer, Lubrication
58	85128-31	Retaining Ring (X5133-31)
59	80202	Gear, Idler
60	90602-00	Motherboard, Printer
61	85008-08	Screw 10-32 x .500, Pan Hd.
62	80685	Bracket, Flexure Pulley
63	80449	Pad, Acoustical, Bottom Pan
64	80418	Shield, Bottom Pan
65	80664	Spring, Cable Tension
66	80674	Dashpot Cylinder Assy.
67	85122-06	Nut 6-32, 1/4 Hex
68	80671	Plate, Flexure
69	80665	Flexure, Dashpot
70	85006-20	Screw 6-32 x 1.250, Pan Hd.
71	85124-04	Washer #4, Helical Lock
72	85058-12	Screw 10-32 x .750, Hex Hd.
73	80223	Brace, Motor Mount
74	80712-00	Carriage Driver Heatsink Assy.
75	90092-01	Paper/Printwheel Heatsink Assy.
76	88078-01	Pan Assy., Bottom, Unslotted (WideTrack and TwinTrack)
	88078-02	Pan Assy., Bottom, Slotted (WideTrack and TwinTrack)
77	81818	Pad, Acoustical, Left Side (WideTrack and TwinTrack)
78	81819	Shield, Bottom Pan (WideTrack and TwinTrack)
79	88073	Guide, PCB Mounting (WideTrack)
80	81852	Bracket Assy., PCB Mounting (WideTrack)
81	85068-06	Screw 10-32 x .375, Flat Hd. (WideTrack and TwinTrack)
82	85008-05	Screw 10-32 x .312, Pan Hd. (WideTrack and TwinTrack)
83	80855	Bracket, Rail Support (WideTrack and TwinTrack)
84	81817	PAD, Acoustical, Right Side (WideTrack and TwinTrack)
85	80856	Post, Rail Support (WideTrack and TwinTrack)
86	85125-10	Washer #10, Regular (WideTrack and TwinTrack)
87	80852	Carriage Shaft, Rear (WideTrack and TwinTrack)
88	80023-04	Motor/Encoder Assy. (WideTrack and TwinTrack)
89	80259-02	Shaft, Bail Rollers (WideTrack and TwinTrack)
90	88044	Brace, Motor Mount (WideTrack and TwinTrack)
91	80116-02	Shaft, Carriage Guide (WideTrack and TwinTrack)
92	99119-02	Switch Assy., Ribbon Advance (WideTrack and TwinTrack)
93	85068-08	Screw 10-32 x .500, Flat Hd. (WideTrack and TwinTrack)
94	80046-07	Motor Assy., Paper Feed (Low Current) (WideTrack and TwinTrack)
	80046-08	Motor Assy., Paper Feed (WideTrack and TwinTrack)



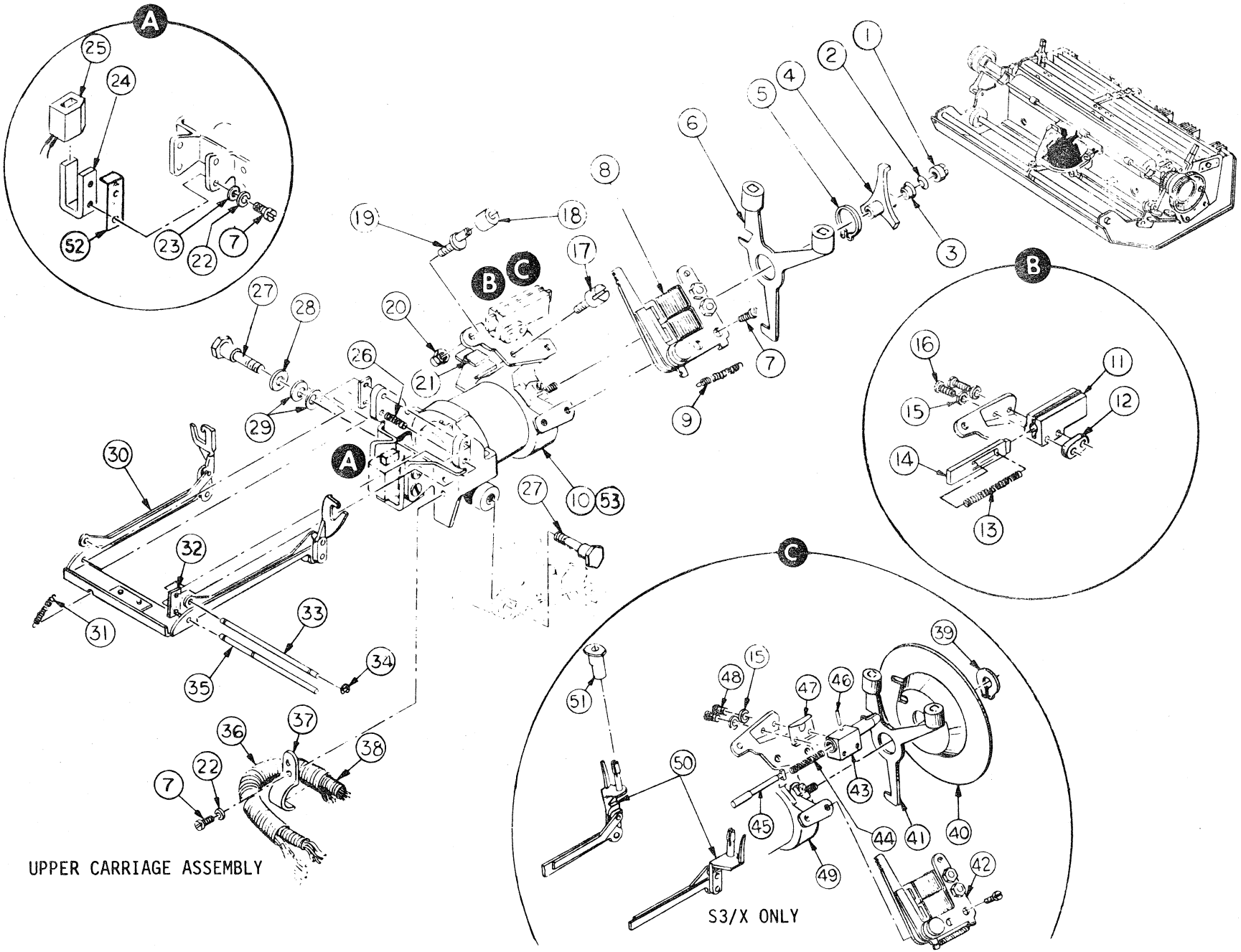
PLATEN CARRIER ASSEMBLY

PLATEN CARRIER ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION
1	85207-02	Set Screw 8-32 x .125, Splined Socket
2	80045-01	Knob Assy., Platen, Charcoal Grey
	80045-02	Knob Assy., Platen, Cordovan Brown
3	80513-02	Spacer, Platen (.620)
4	80515	Sleeve Bearing, Platen
5	80513-01	Spacer, Platen
6	80205-01	Platen, Assy.
7	80514	Sleeve, Right Platen
8	85206-04	Set Screw 6-32 x .250, Splined Socket
9	80175	Gear, Tractor Drive
10	85237-04	Groove Pin .062 x .500
11	80176	Platen Driver
12	80177	Platen Gear
13	80857	Shim, Platen Assy.
14	85145-31	Retaining Ring, 5100-31
15	80198	Spring, Compression
16	80594	Shaft, Push, Platen
17	80032-03	Cradle Assy., Standard
	80032-01	Cradle Assy., Special
18	80334	Spring, Extension, Cradle
19	80130	Brace, Platen
20	80159	Screw, Shoulder, Feed Roll Arm
21	85125-08	Washer #8, Narrow
22	85124-08	Washer #8, Helical Lock
23	85122-08	Nut 8-32, Hex
24	85006-05	Screw 6-32 x .312, Pan Hd.
25	85124-06	Washer #6, Helical Lock
26	80306	Guide, PCB Mounting
27	85125-06	Washer #6, Narrow
28	80050	Frame Assy., Right Side
29	80707-01	Cap, Lever, Charcoal Grey
	80707-02	Cap, Lever, Cordovan Brown
	80707-03	Cap, Lever, Chrome Plated
30	80160	Lever, Feed Roll Disable
31	80620	Shoulder Nut, Feed Roll Disable Lever
32	80184	Eccentric, Impression Control
33	85206-03	Set Screw 6-32 x .187 Splined Socket
34	85007-06	Screw 8-32 x .375, Pan Hd.
35	80181	Eccentric, Platen Rear
36	80183	Plate, Impression Control Adjustment
37	80040	Frame Assy., Platen
38	80186	Lever, Impression Control
39	80048	Frame Assy., Left Side
40	85207-04	Set Screw 8-32 x .500, Splined Socket
41	80185-01	Shaft, Impression Control
42	80187	Detent, Impression Control
43	85122-66	Nut 6-32, Hex
44	80142	Bail, Feed Roll
45	85056-10	Screw 6-32 x .625, Hex Hd.
46	80172	Screw Stud, Platen Assy. Spring
47	80236	Spring, Extension
48	85056-07	Screw 6-32 x .437, Hex Hd.

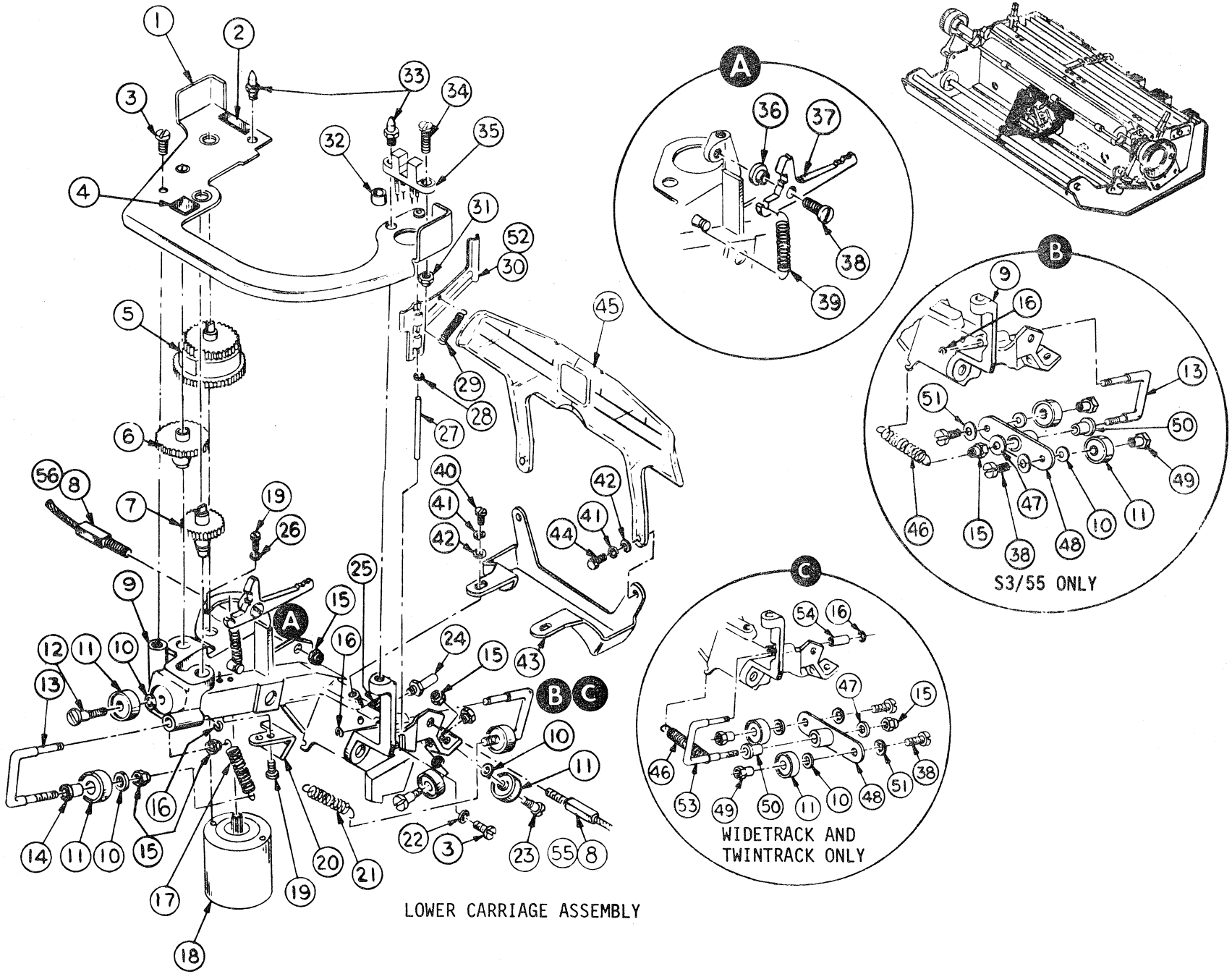
PLATEN CARRIER ASSEMBLY (Continued)

ITEM	PART NUMBER	DESCRIPTION
49	80132	Wedge
50	85128-37	Retainer, E-Ring, 5133-37
51	80149	Screw, Cam Follower
52	80150	Roller, Cam Follower
53	80036-01	Shaft Assy., Feed Roll Disable
54	80333	Spring, Cam Follower
55	80156	Eccentric, Platen Latch
56	85007-05	Screw 8-32 x .312, Pan Hd.
57	80141	Latch, Platen
58	80234	Spring, Extension
59	80237	Spring, Extension
60	80041	Arm Assy., Feed Roll, Left Outer
61	80042	Arm Assy., Feed Roll, Left Inner
62	80154	Shaft Assy., Rear Feed Roll
63	80153	Shaft Assy., Front Feed Roll
64	80044	Arm Assy., Feed Roll, Right Inner
65	80598	Spring, Feed Rollers
66	80043	Arm Assy., Feed Roll, Right Outer
67	80182	Eccentric, Platen Front
68	85007-08	Screw 8-32 x .500, Pan Hd.
69	80781	Eccentric, Platen Front (S3X and TwinTrack)
70	80205-03	Platen Assy. (WideTrack and TwinTrack)
71	88043	Brace, Platen (WideTrack and TwinTrack)
72	80185-02	Shaft, Impression Control (WideTrack)
73	80036-02	Shaft Assy., Feed Roll Disable (WideTrack and TwinTrack)


A
B
C
UPPER CARRIAGE ASSEMBLY
S3/X ONLY

UPPER CARRIAGE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION
1	80256	Pilot, Printwheel
2	85140-10	Belleville Washer, 18.18
3	80407	Collet, Print Disk Hub
4	80376	Hub, Print Disk
5	85145-50	Retaining Ring, 5100-50
6	80375-01	Latch Assy., Print Motor
7	85004-04	Screw 4-40 x .250, Pan Hd.
8	80369-02	Armature Assy., Hammer
9	80387	Spring
10	80336-01	Motor/Encoder Assy., Printwheel (S3/55 Only)
11	80687-02	Hammer Guide, Glazed
12	80784	Nut Plate, Hammer Guide
13	80713	Spring, Hammer
14	80686-02	Hammer, Glazed
15	85124-03	Washer #3, Helical Lock
16	85003-10	Screw 3-48 x .625, Pan Hd.
17	80849	Eccentric, Hammer Arm Stop
18	80136	Bumper, Hammer Arm
19	80135	Eccentric, Hammer Arm Stop
20	85137-05	Nut 5-40, Self Locking
21	80374-02	Pad, Ribbon Bail Stop
22	85124-04	Washer #4, Helical Lock
23	85125-04	Washer #4, Narrow
24	80851	Core, Ribbon Magnet
25	80379	Coil, Ribbon Lift
26	80343	Spring, Ribbon Lift Shaft
27	80248	Pivot, Print Motor Housing
28	85187-01	Shim
29	85140-01	Belleville Washer
30	80380-01	Bail Assy., Ribbon Lift
31	80476	Spring, Ribbon Bail
32	80403	Pad, Ribbon Lift Lubrication
33	80155	Shaft, Ribbon Links
34	85128-06	Retaining Ring, Y 5133-6
35	80158	Shaft, Ribbon Bail
36	80614	Spring, Carriage Conductors
37	80246	Clamp, Carriage Cable
38	80613	Spring, Inner Carriage Conductors
39	85243-50	Retaining Ring, 5101-50 (S3X)
40	80766	Stabilizer, Printwheel (S3X)
41	80375-01	Latch Assy., Print Motor (S3X)
42	80369-03	Armature Assy., Hammer (S3X)
43	80716	Guide, Hammer (S3X)
44	80728	Spring, Hammer (S3X)
45	80717	Hammer, Character Model (S3X)
46	85000-01	Dowel Pin (S3X)
47	80718	Retainer, Hammer Guide (S3X)
48	85003-07	Screw 3-48 x .437, Pan Hd. (S3X)
49	80336-03	Motor/Encoder Assy., Printwheel (S3X)
50	80819	Bail Assy., Ribbon Lift (S3X)
51	80797	Thimble, Ribbon (S3X)
52	80401-01	Shim, Ribbon Magnet (S3X)
53	80336-02	Motor/Encoder Assy., Printwheel (S3/35, S3/45, WideTrack and TwinTrack)



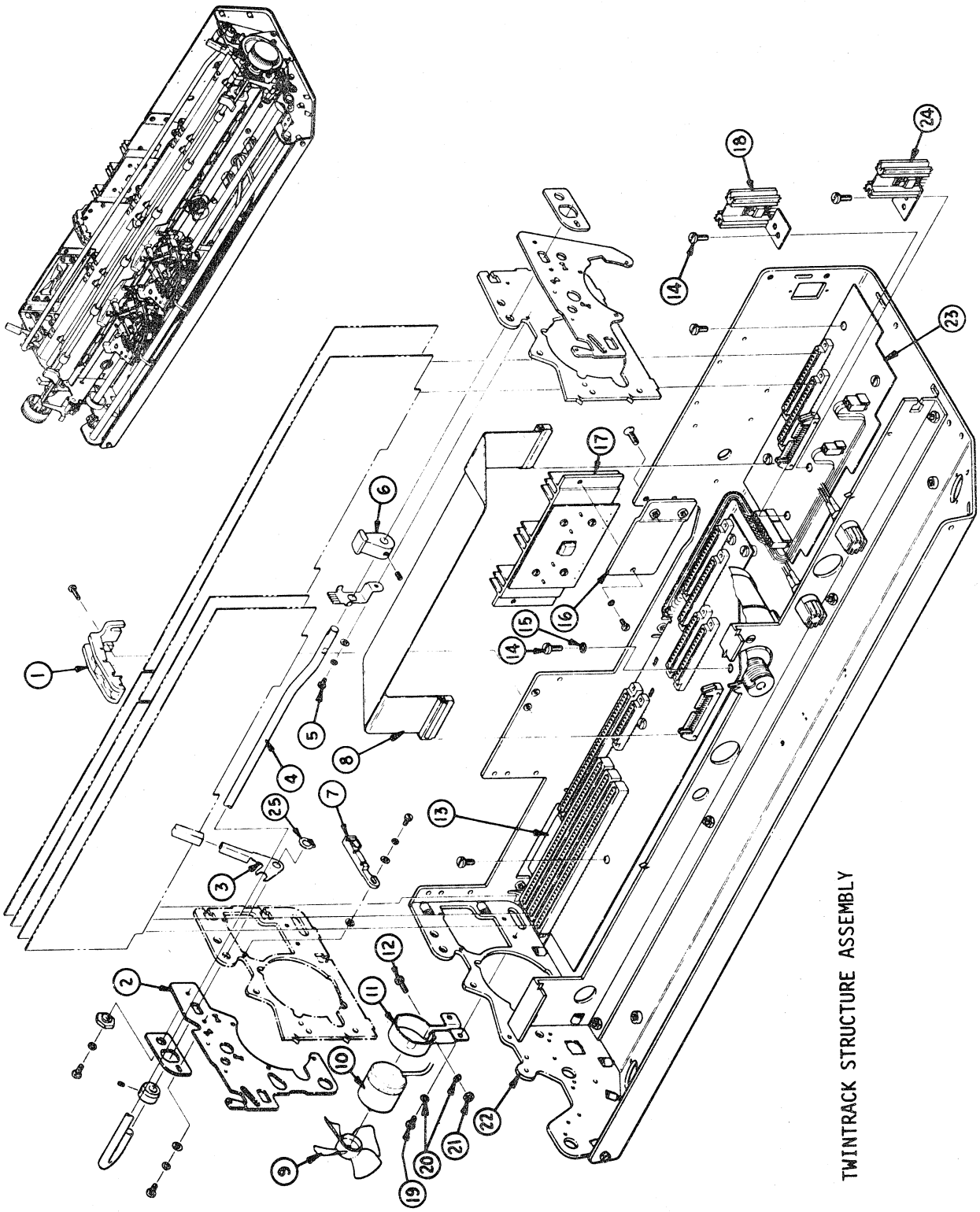
LOWER CARRIAGE ASSEMBLY

LOWER CARRIAGE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION
1	80058	Plate Assy., Ribbon Drive
2	80409	Polyurethane Tape
3	85004-04	Screw 4-40 x .250, Pan Hd.
4	80410	Polyurethane Tape
5	80057-00	Clutch Assy., Ribbon Drive
6	80218	Idler Gear 44T, Ribbon Drive
7	80367	Gear Assy., 36 Teeth
8	85127-01	Cable, Carriage Drive
9	80356	Frame Assy., Carriage
10	80105	Washer, Guide Roller
11	85144-01	Ball Bearing
12	80104	Screw, Front Guide Bearing
13	80102	Link, Guide Bearing
14	80330	Bushing, Guide Bearing
15	85137-05	Nut 5-40, Self Locking
16	85138-12	Retaining Ring, 5103-12
17	80119	Spring, Front Carriage Preload
18	80207	Stepper Motor, Ribbon Drive
19	85004-03	Screw 4-40 x .187, Pan Hd.
20	80406	Shutter, Photo Sensor
21	80601	Spring, Rear Carriage Preload
22	85125-04	Washer #4, Narrow
23	80103	Screw, Guide Bearing
24	80253	Stud, Print Motor Latch
25	80374-01	Pad, Carriage Stop
26	85124-04	Washer #4, Helical Lock
27	80316	Shaft, Tension Arm Pivot
28	80386	Washer
29	80387	Spring, Ribbon Tension Arm
30	80315	Tension Arm, Ribbon Drive
31	85137-04	Nut 4-40, Self Locking
32	80465	Spacer
33	80296	Screw Stud, Ribbon Drive
34	85004-06	Screw 4-40 x .376, Pan Hd.
35	80368	Photon Module
36	80217	Bearing
37	80219	Latch, Ribbon
38	85004-05	Screw 4-40 x .312, Pan Hd.
39	80304	Spring, Ribbon Box Latch
40	85003-04	Screw 3-48 x .250, Pan Hd.
41	85124-03	Washer #3, Helical Lock
42	85125-03	Washer #3, Narrow
43	80357	Bracket Assy., Line/Card Guide
44	85053-04	Screw 3-48 x .250, Hex Hd.
45	80312-01	Line/Card Guide
46	80681	Spring, Dual Bearing Carrier
47	85126-05	Washer #5, Regular
48	80655	Bearing Carrier Assy.
49	80114	Bushing, Ball Bearing
50	80657	Bushing, Bearing Carrier
51	85140-10	Belleville Washer, 18.18
52	81914	Tension Arm Assy., Ribbon Drive (S3X)

LOWER CARRIAGE ASSEMBLY (Continued)

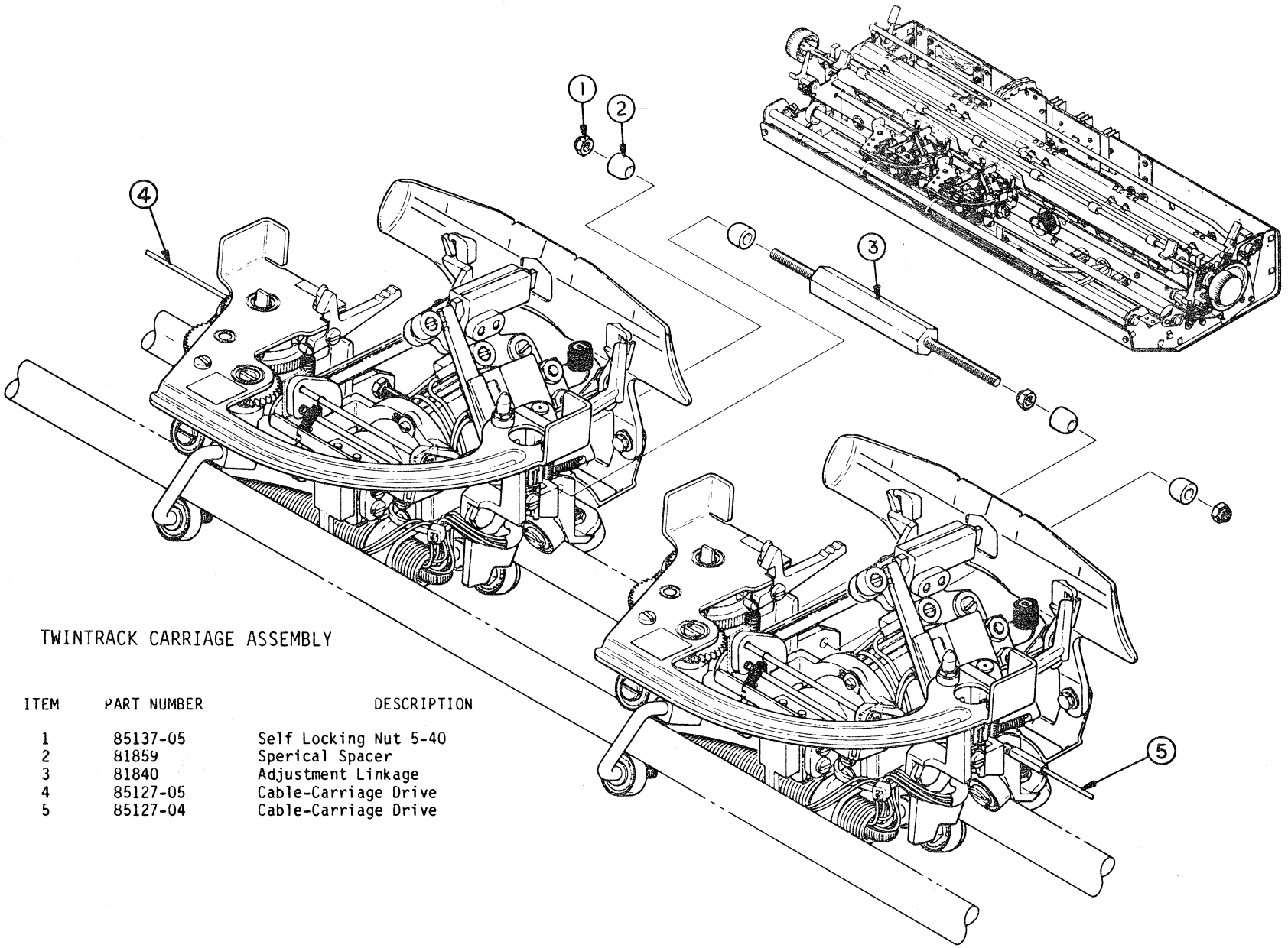
ITEM	PART NUMBER	DESCRIPTION
53	80853	Link Rear (WideTrack and TwinTrack)
54	80854	Sleeve (WideTrack and TwinTrack)
55	85127-02	Cable, Carriage Drive, R.H. (WideTrack)
56	85127-03	Cable, Carriage Drive, L.H. (WideTrack)



TWINTRACK STRUCTURE ASSEMBLY

TWINTRACK STRUCTURE ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION
1	81837	Clamp - Printed Circuit Board
2	81849	Platen Frame Assy. (Left)
3	81829	Impression Lever
4	81828-02	Shaft Impression Control
5	85006-04	Screw 6-32, .250 Pan Hd.
6	81839	Impression Control
7	81846	Guide - PCB Mounting
8	99114	Cable Assy.
9	85414	FAN C.C.W.
10	81815-02	Motor Cable Assy.
11	81830	Bracket - Motor
12	85007-08	Screw 8-32, .50 Pan Hd.
13	90692	Motherboard (Left)
14	85008-09	Screw 10-32, .562 Pan Hd.
15	85162-10	Internal Star Washer
16	81854	Bracket Assy. Heat-Sink
17	90752	Carriage Driver Assy.
18	81803-01	Printwheel Drive Assy. S3-TT-75 (Left)
19	85007-05	Screw 8-32, .312 Pan Hd.
20	85124-08	Lock Washer Helical
21	85122-08	Hex Nut
22	81848	Side Frame Assy. (Left)
23	90682	Motherboard (Right)
24	81803-02	Printwheel Drive Assy. S3-TT-75 (Right)
25	85129-31	Retaining Ring



TWINTRACK CARRIAGE ASSEMBLY

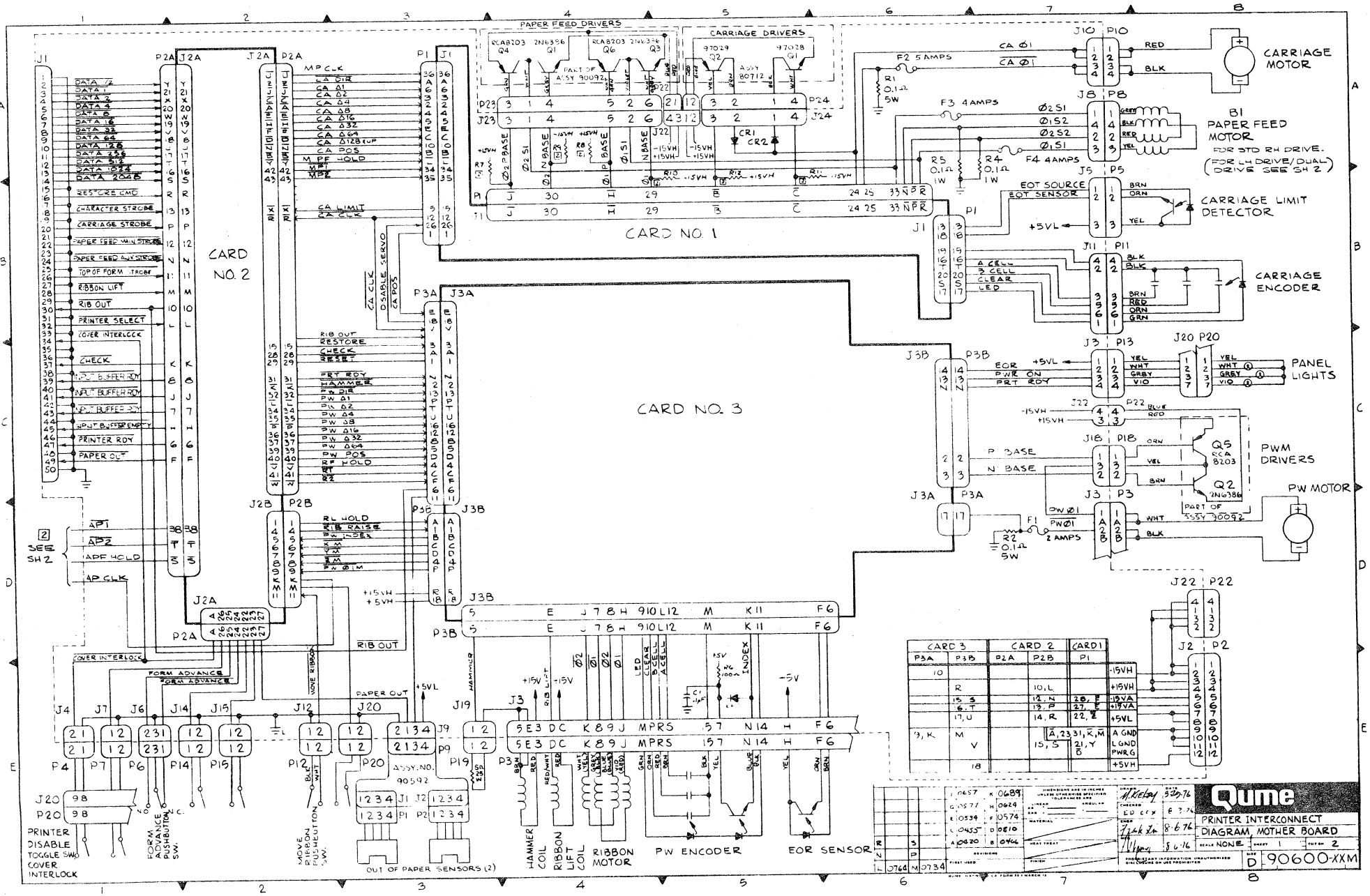
ITEM	PART NUMBER	DESCRIPTION
1	85137-05	Self Locking Nut 5-40
2	81859	Sperical Spacer
3	81840	Adjustment Linkage
4	85127-05	Cable-Carriage Drive
5	85127-04	Cable-Carriage Drive

CHAPTER VIII

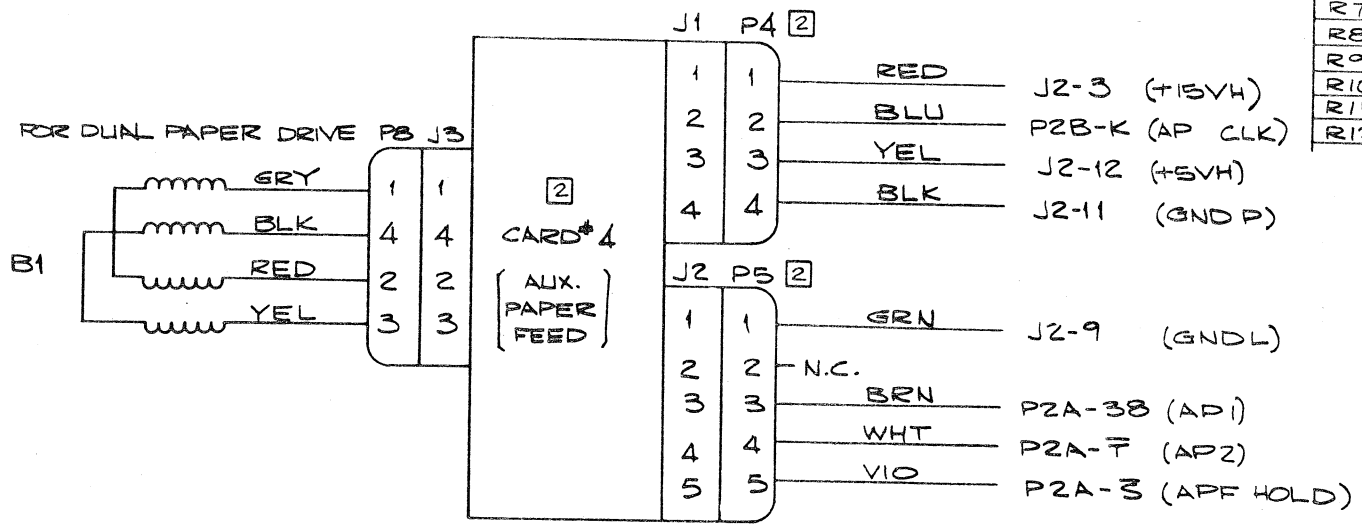
SCHEMATICS

SCHEMATIC INDEX

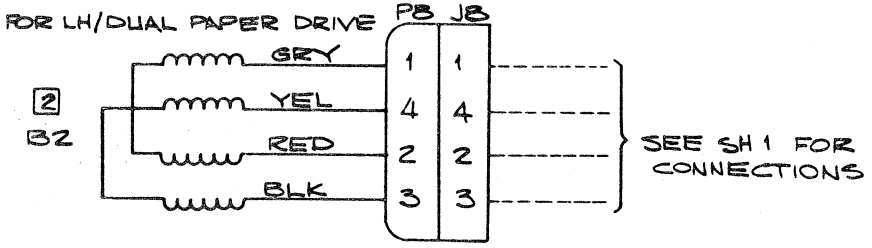
DESCRIPTION	PAGE
Motherboard (90600)	8-2
Printed Circuit Board #1 (90610)	8-4
Printed Circuit Board #2 (90620)	8-8
Printed Circuit Board #3 (90630)	8-14
TwinTrack Motherboard - Right (90680)	8-18
TwinTrack Motherboard - Left (90690)	8-19
TwinTrack Coordinating Logic (90670)	8-21
Auxiliary Paper Drive Option (90700)	8-26
Paper Out Option (90590)	8-27


CARD NO. 1
CARD NO. 2
CARD NO. 3
PAPER FEED DRIVERS
CARRIAGE DRIVERS
CARRIAGE MOTOR
B1 PAPER FEED MOTOR
FOR STD RH DRIVE.
(FOR LH DRIVE/DUAL DRIVE SEE SH 2)
CARRIAGE LIMIT DETECTOR
CARRIAGE ENCODER
PANEL LIGHTS
PWM DRIVERS
PW MOTOR
PRINTER DISABLE TOGGLE SW
COVER INTERLOCK
FORM ADVANCE PUSHBUTTON S.W.
MOVE RIBBON PUSHBUTTON S.W.
OUT OF PAPER SENSORS (2)
HAMMER COIL
RIBBON LIFT COIL
RIBBON MOTOR
PW ENCODER
EOR SENSOR
PRINTER INTERCONNECT DIAGRAM, MOTHER BOARD
Qume
D 90600-XXM

8-2



RESISTOR CHART			
DESG	-00	-01	-02
R7	–	470Ω	–
R8	–	↑	–
R9	–	↑	–
R10	–	↑	–
R11	–	↑	–
R12	–	470Ω	–



NOTES:

1. THIS SCHEMATIC IS VALID FOR ASSY'S-
   90602-00 REV K ECN 0778
   90602-01 REV K ECN 0778
   90602-02 REV K ECN 0734

[2] DESIGNATED COMPONENTS ARE USED ON -02 ASSY'S ONLY.

90600-XX M

M	0734			
REVISIONS				
FIRST USED				

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE LINEAR .XX ± .XXX ± ANGULAR ±
MATERIAL
HEAT TREAT
FINISH

DRAWN	FC	5/31/77
CHECKED	FC	5/31/77
ENGR.	FS	6/17/77
MFG.		

PROPRIETARY INFORMATION. UNAUTHORIZED DISCLOSURE OR USE PROHIBITED.

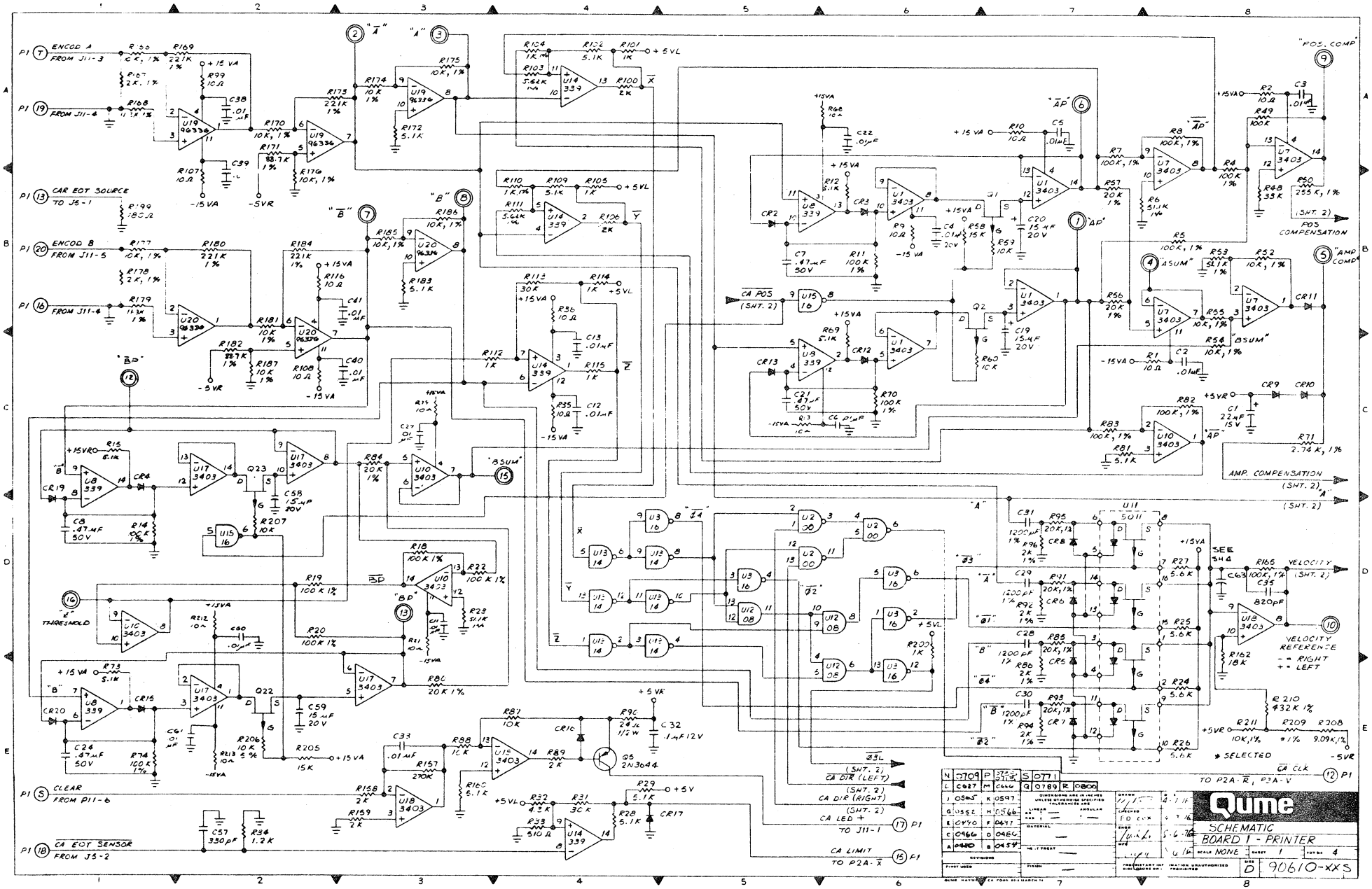
Qume

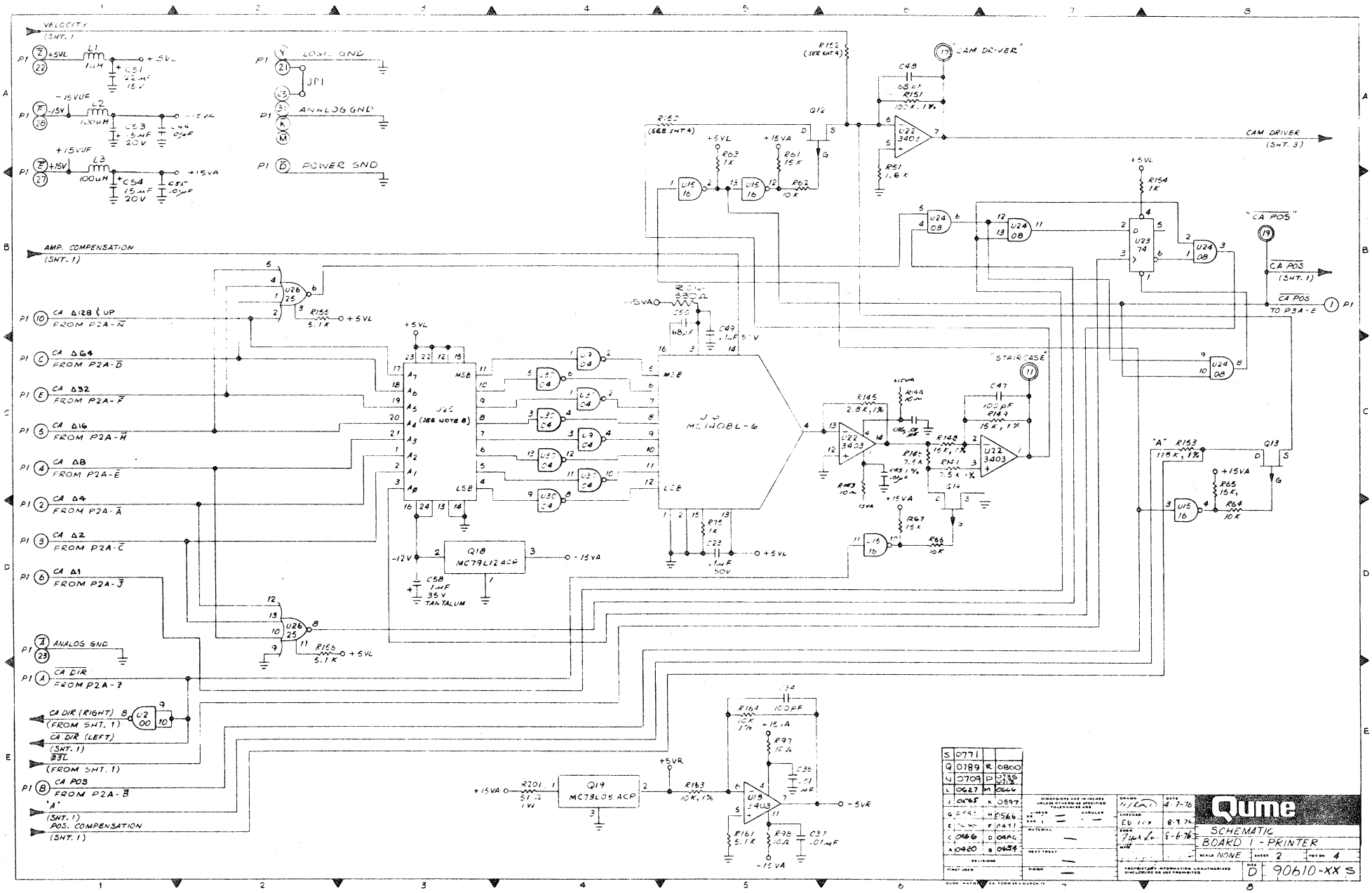
PRINTER INTERCONNECTION DIAGRAM MOTHER BOARD

SCALE | SHEET 2 | TOTAL SH 2

SIZE C | 90600-XX M

QUME – HAYWARD, CA. FORM 60-8 JUNE '78


P1 (7) ENCOD A FROM J11-3
P1 (19) FROM J11-4
P1 (13) CAR EOT SOURCE TO J5-1
P1 (20) ENCOD B FROM J11-5
P1 (16) FROM J11-4
P1 (5) CLEAR FROM P11-6
P1 (18) CA EOT SENSOR FROM J5-2
"A"
"B"
"BP"
"AP"
"ASUM"
"BSUM"
"POS. COMP"
"AMP COMP"
CA POS (SHT. 2)
ANP. COMPENSATION (SHT. 2)
"A" (SHT. 2)
"B" THRESHOLD
CA DIR (LEFT) (SHT. 2)
CA DIR (RIGHT) (SHT. 2)
CA LED + TO J11-1 (17) P1
CA LIMIT TO P2A-X (15) P1
TO P2A-R, P3A-V (12) P1
CA CLK
VELOCITY (SHT. 2)
VELOCITY REFERENCE
- = RIGHT
+ = LEFT
SEE SH 4
* SELECTED
SCHEMATIC
BOARD 1 - PRINTER
Qume
90610-XXS



S	0771		
Q	0189	R	0800
N	0709	P	0335 0418
L	0627	M	0644
J	0685	K	0897
G	0550	H	0566
E	0411	F	0411
C	0466	D	0466
A	0420	B	0434

REVISIONS

FIRST USED

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: LINEAR ANGULAR

MATERIAL —

HEAT TREAT —

FINISH —

DRAWN — DATE 4-7-76

CHECKED — 8-9-76

ENG — 8-6-76

MFG —

PROPRIETARY INFORMATION, UNAUTHORIZED DISCLOSURE OR USE PROHIBITED

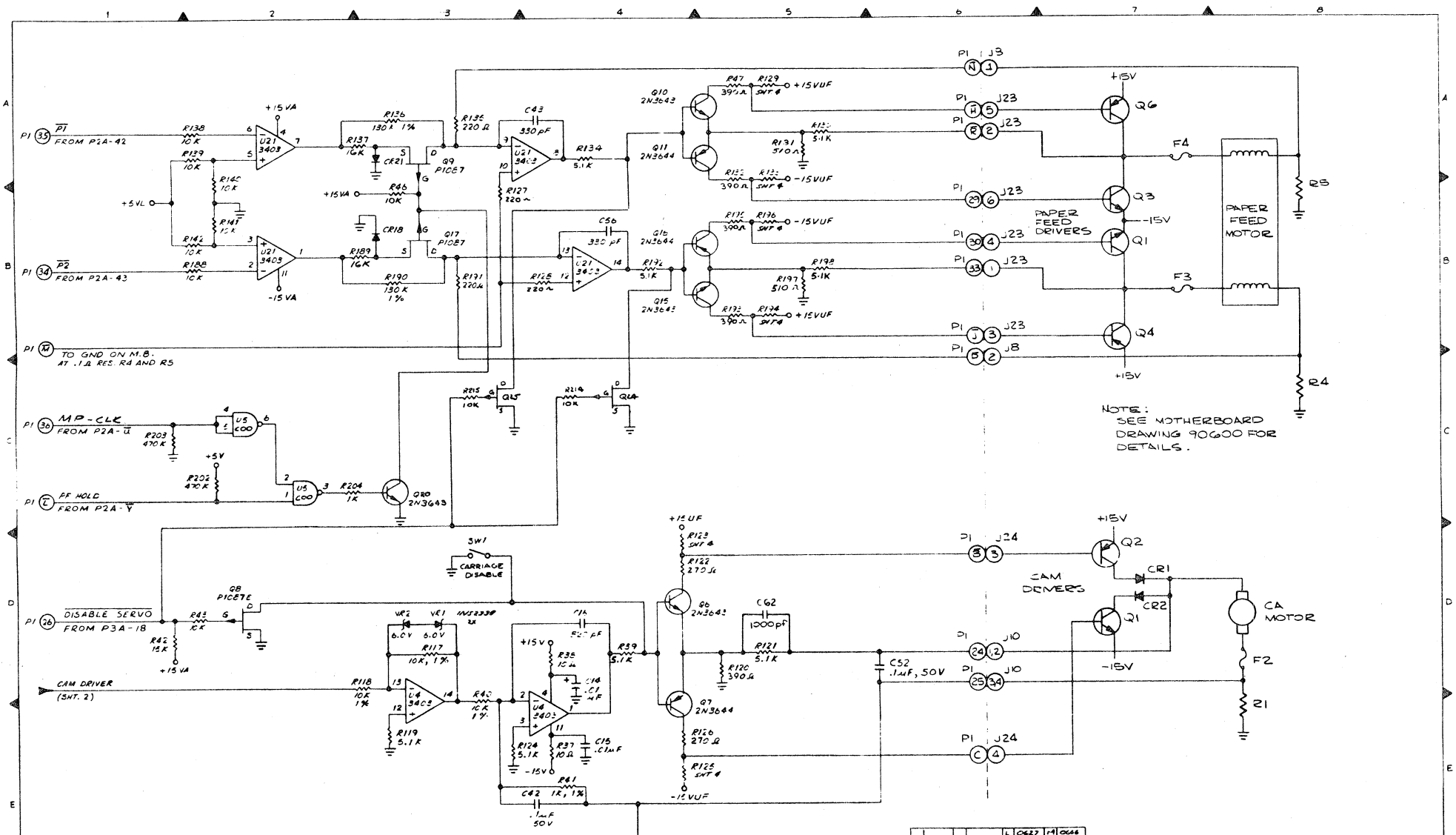
Qume

SCHEMATIC

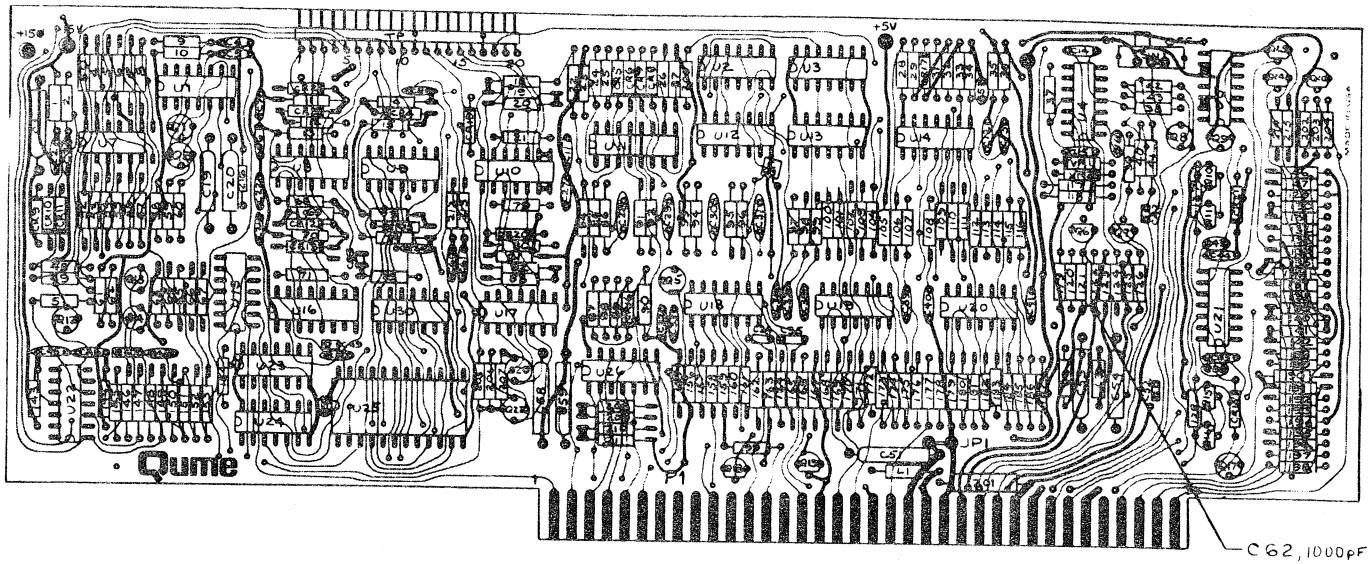
BOARD 1 - PRINTER

SCALE NONE SHEET 2 OF 4

SIZE D 90610-XX S


P1 (35) P1 FROM P2A-42
P1 (34) P2 FROM P2A-43
P1 (N) TO GND ON M.B. AT .1Ω RES. R4 AND R5
P1 (36) MP-CLK FROM P2A-U
P1 (C) PF HOLD FROM P2A-Y
P1 (26) DISABLE SERVO FROM P3A-18
CAM DRIVER (SHT. 2)
+15VA
-15VA
+5VL
+5V
+15V
-15V
+15VUF
-15VUF
+15UF
SW1 CARRIAGE DISABLE
Q9 P10E7
Q17 P10E7
Q8 P10E7E
Q10 2N3643
Q11 2N3644
Q14 2N3643
Q15 2N3643
Q16 2N3643
Q20 2N3643
Q6 2N3643
Q7 2N3644
Q2
Q1
Q6
Q3
Q1
Q4
PAPER FEED DRIVERS
PAPER FEED MOTOR
CAM DRIVERS
CA MOTOR
F4
F3
F2
R5
R4
R1
CR1
CR2
CR18
CR21
J3
J23
J24
J10
J8
NOTE: SEE MOTHERBOARD DRAWING 90600 FOR DETAILS.
(18) "CURRENT WAVEFORM" 10 AMP/VOLT + = LEFT − = RIGHT

| | | |



DASH NUMBER	-00	-01	-02	-03	-04	-05	-06
MODEL USED ON	53/35	53/45	53/55	53/x30	53/x40	52/40 WT	CUSTOMER SPECIAL
R150	4.12K, 1%	4.12K, 1%	4.32K, 1%	4.12K, 1%	4.32K 1%	4.53K, 1%	4.32K, 1%
R152	1.33K, 1%	1.74K, 1%	1.65K, 1%	1.74K, 1%	1.65K, 1%	1.54K, 1%	1.65K 1%
R123	470Ω, 5%	470Ω, 5%	470Ω, 5%	470Ω, 5%	470Ω, 5%	470Ω, 5%	NONE
R125	↕	↕	↕	↕	↕	↕	↕
R129							
R133							
R194							
R196	470Ω, 5%	470Ω, 5%	470Ω, 5%	470Ω, 5%	470Ω, 5%	470Ω, 5%	NONE
U25	95819	95819	95818	95819	95818	95819	95818
JP1	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSED
C68	220pf	330 pf	330pf	330pF	330pF	330pF	NONE

NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL .01μF CAPACITORS ARE 25V
2. ALL RESISTORS ARE 5% 1/4W
3. ALL 1% RESISTORS ARE 1/8W
4. ALL DIODES ARE IN4154
5. ALL GROUNDS ARE ANALOG
6. ALL FETS ARE P1087E
7. THIS SCHEMATIC IS VALID FOR THE FOLLOWING ASSEMBLY:
   - 53/35 - 00 'R' ECN0800
   - 53/45 - 01 'R' ECN0800
   - 53/55 - 02 'R' ECN0800
   - 53/x30 03 'R' ECN0800
   - 53/x40-04 'R' ECN0800
   - WT40-05 'S' ECN10771
   - SPECIAL - 06 'P' ECN0789

				J	0582	K	0597	
S	0771			G	0552	H	0566	
Q	0789	R	0800	E	0490	F	0497	
N	0773	-	715 0735	C	0466	D	0486	
L	0627	M	0446	A	0420	B	0454	

REVISIONS

FIRST USED

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: LINEAR ± .XX ± .XXX; ANGULAR ±; MATERIAL; HEAT TREAT; FINISH

PROPRIETARY INFORMATION UNAUTHORIZED DISCLOSURE OR USE PROHIBITED

QUME HAYWARD, CA FORM 824 MARCH 76

DRAWN	F NABONNE	DATE 7-19-76
CHECKED	ED COX	8-3-76
ENGR	Frank Lu	8-6-76
MFG		

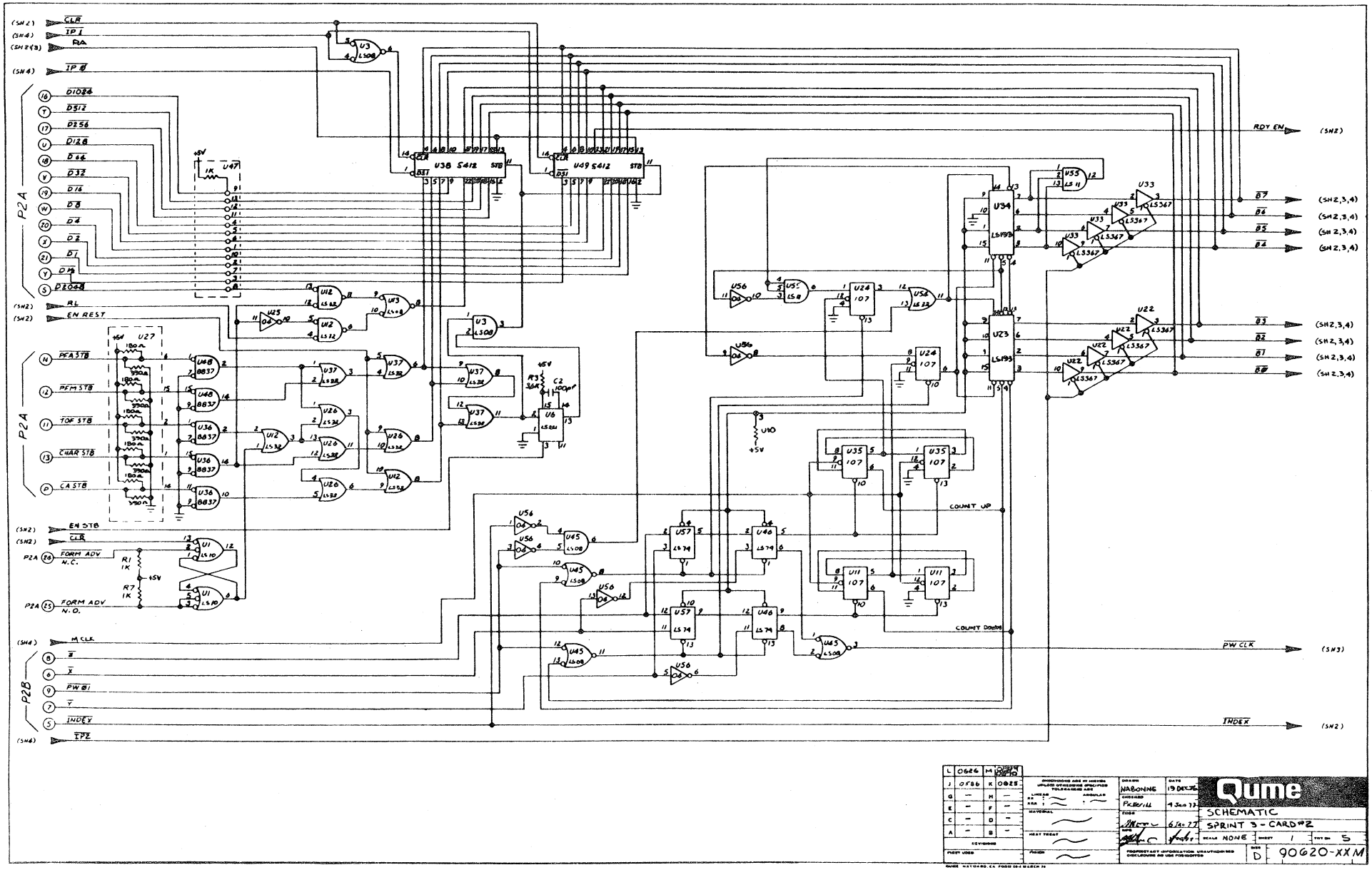
Qume

SCHEMATIC

BOARD 1 - PRINTER

SCALE NONE | SHEET 4 | TOT SH 4

SIZE D | 90610-XXS



L	0624	M	0625
J	0586	K	0625
G	—	H	—
E	—	F	—
C	—	D	—
A	—	B	—

REVISIONS

DRAWN	NABONNE	DATE	19 DEC 76
CHECKED	PICERILLI		4 Jan 77
ISSUE			6 Jan 77
MFG			

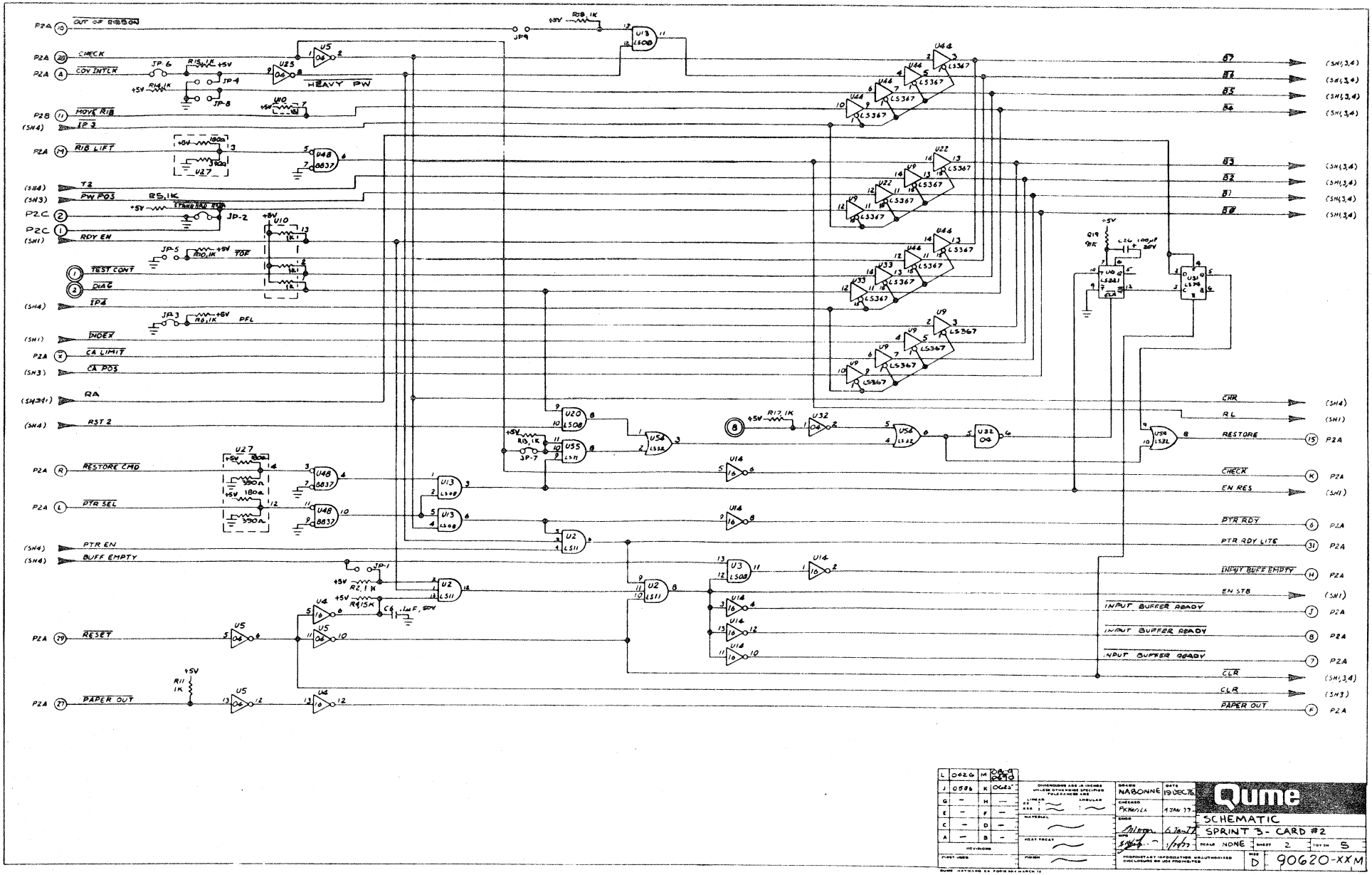
Qume

SCHEMATIC

SPRINT 5 - CARD #2

SCALE NONE SHEET 1 TOTAL SHEETS 5

SIZE D 90620-XXM



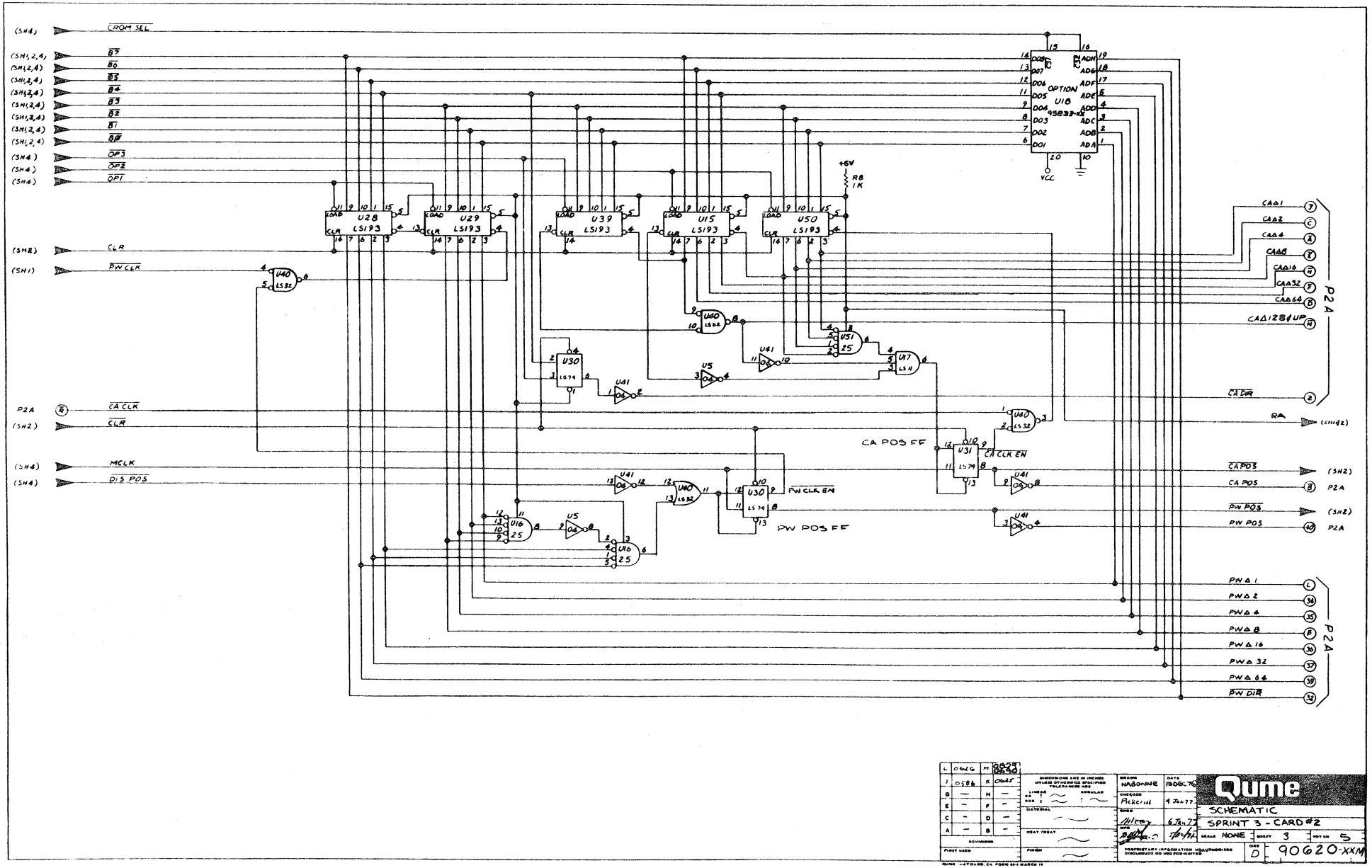
DRAWN	NABONNE	DATE	19 DEC. 76
CHECKED	PKNeill		4 JAN 77
ENGR			
	Wilson		6 Jan 77
			1/6/77

Qume

SCHEMATIC
SPRINT 5 - CARD #2

SCALE NONE | SHEET 2 | TOTAL SHEETS 5

SIZE D | 90620-XXM



DRAWN	HASBROUCK	DATE	19DEC76
CHECKED	Peterson		4 Jan 77
ENGR	Milroy		6 Jan 77
MFG			7 Jan 77

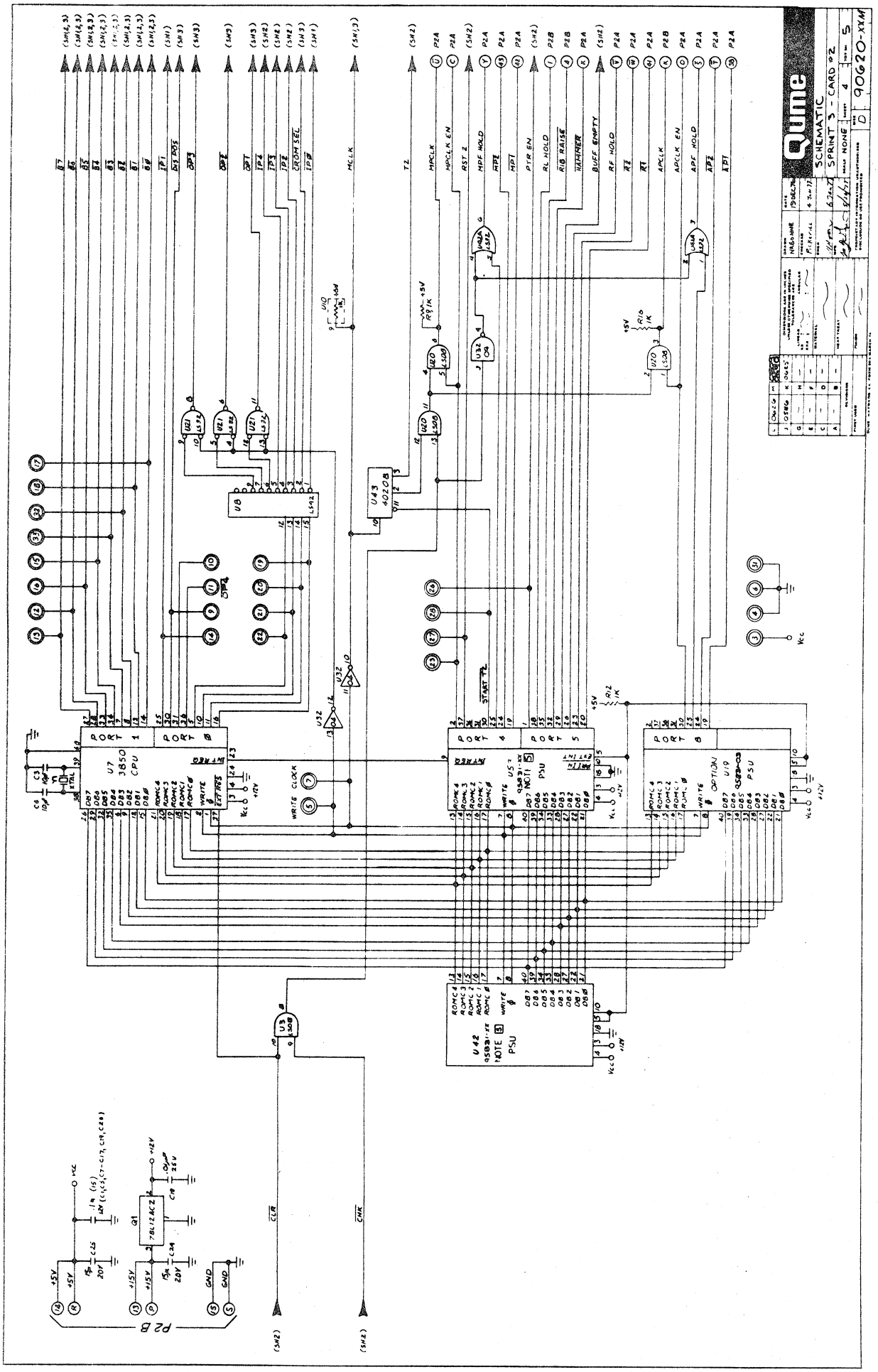
Qume

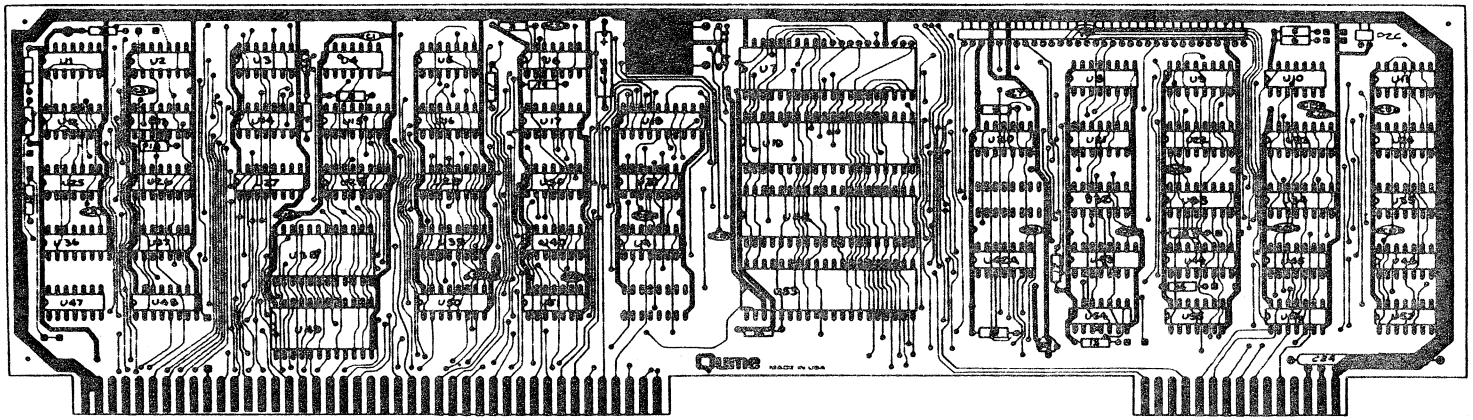
SCHEMATIC

SPRINT 3 - CARD #2

SCALE NONE | SHEET 3 | OF 5

DWG D 90620-XXM


Qume
SCHEMATIC
SPRINT 5 - CARD #2
90620-XXM
U7 3850 CPU
U42 9383-XX PSU
U5? 9383-XX PSU
U10 OPTION
U8 LS42
U43 4020B
U32 04
U10 S08
U30 S08
U31 S32
U33 S08
U34 S32
U3 S08
U1 74LS14
P2B
P2A
MCLK
MPCLK
MPCLK EN
RST 2
MPF HOLD
MPF
MPI
PTR EN
RL HOLD
RIB RAISE
WATHER
BUFF EMPTY
RF HOLD
RT
APCLK
APCLK EN
APF HOLD
APF
ATBT
START TR
WRITE CLOCK
+5V
+12V
-5V
GND
Vcc



DASH No.	C28	C29	U18	U19	U42 [5]	U53 [5]	PZC
90622-00				95831-03	95831-02 OR 95831-05	95831-01 OR 95831-04	-
-01	-	-	95833-02	95831-03	95831-05	95831-04	-
-02	-	-	-	-	-	-	-
-03	-	-	95832-01	95831-03	95831-02 OR 95831-05	95831-01 OR 95831-04	-
-04	33 pf 200V	560pf 200V	-	-			-
-05	-	-	-	95831-03			-
-06	-	-	-				-
-07	-	-	95833-03				PZC
N/A							
-09	-	-	95833-04	95831-03	95831-05	95831-06	-

NOTES:

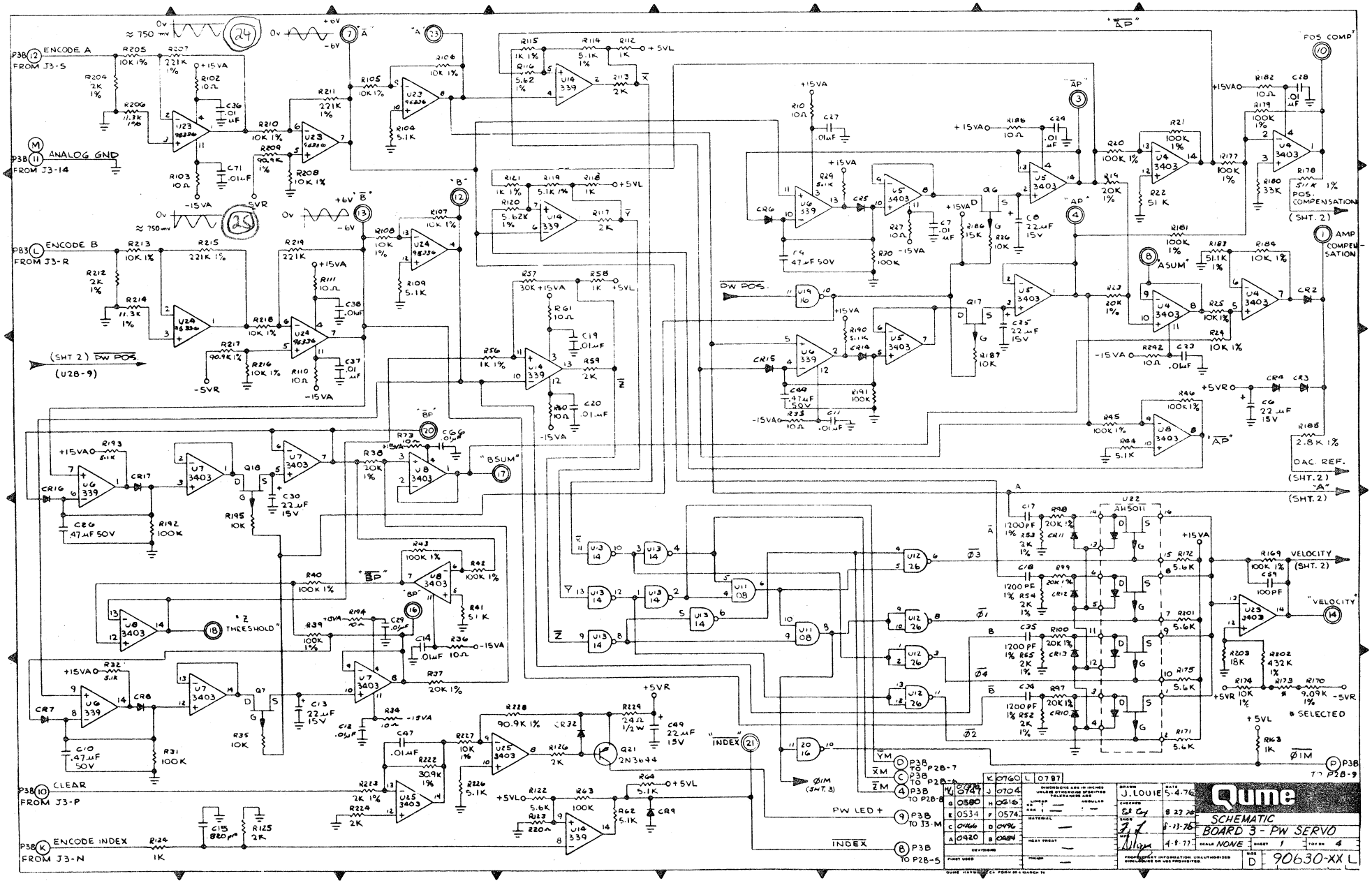
UNLESS OTHERWISE SPECIFIED:

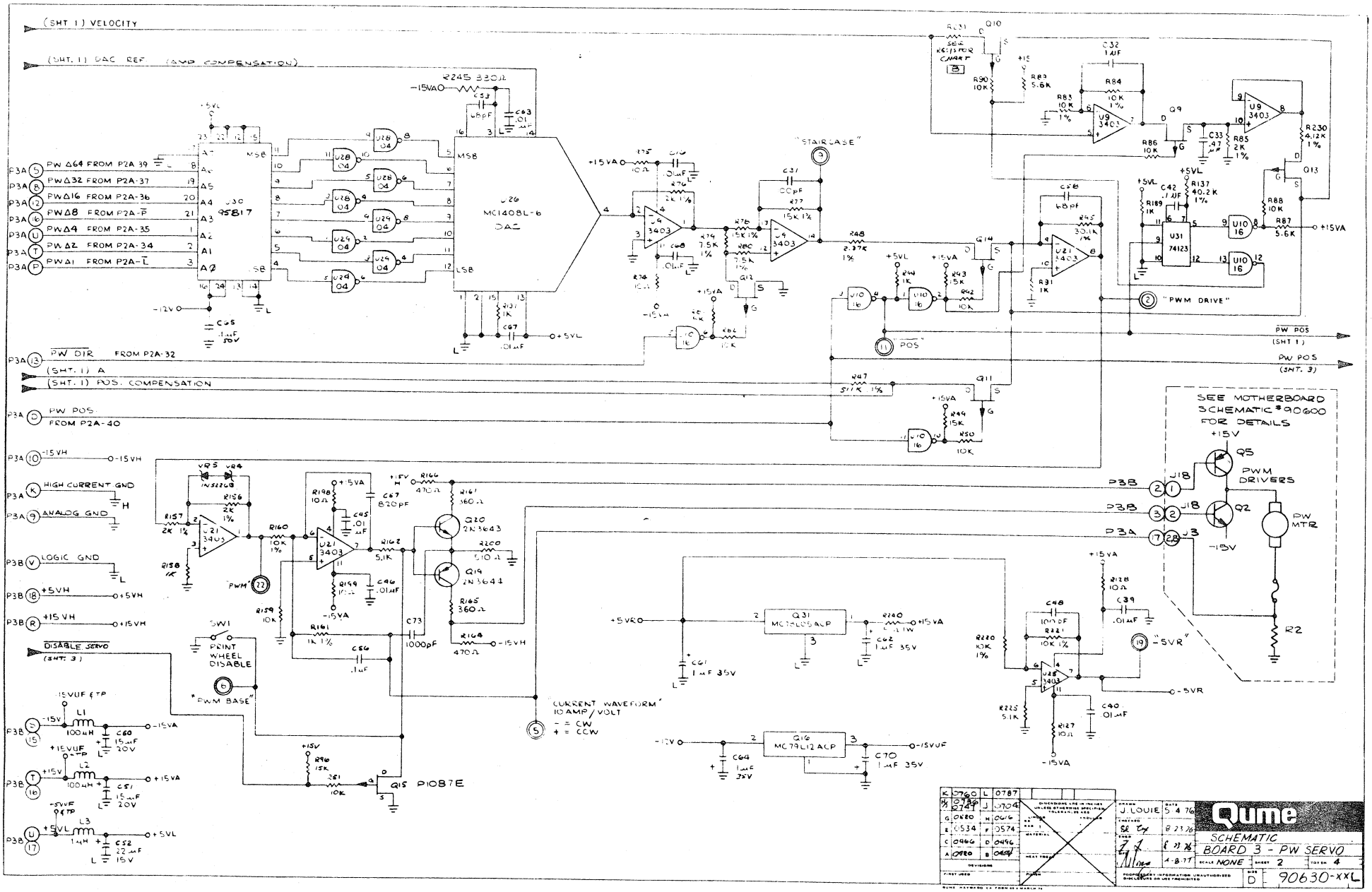
1. ALL RESISTOR ARE 1/4W 5%
2. ALL DIODES ARE IN4154.
3. ALL FILTER CAPS. .1μF; 12V.
4. THIS SCHEMATIC IS VALID FOR FOLLOWING ASSEMBLY REV "L" PCN 0690

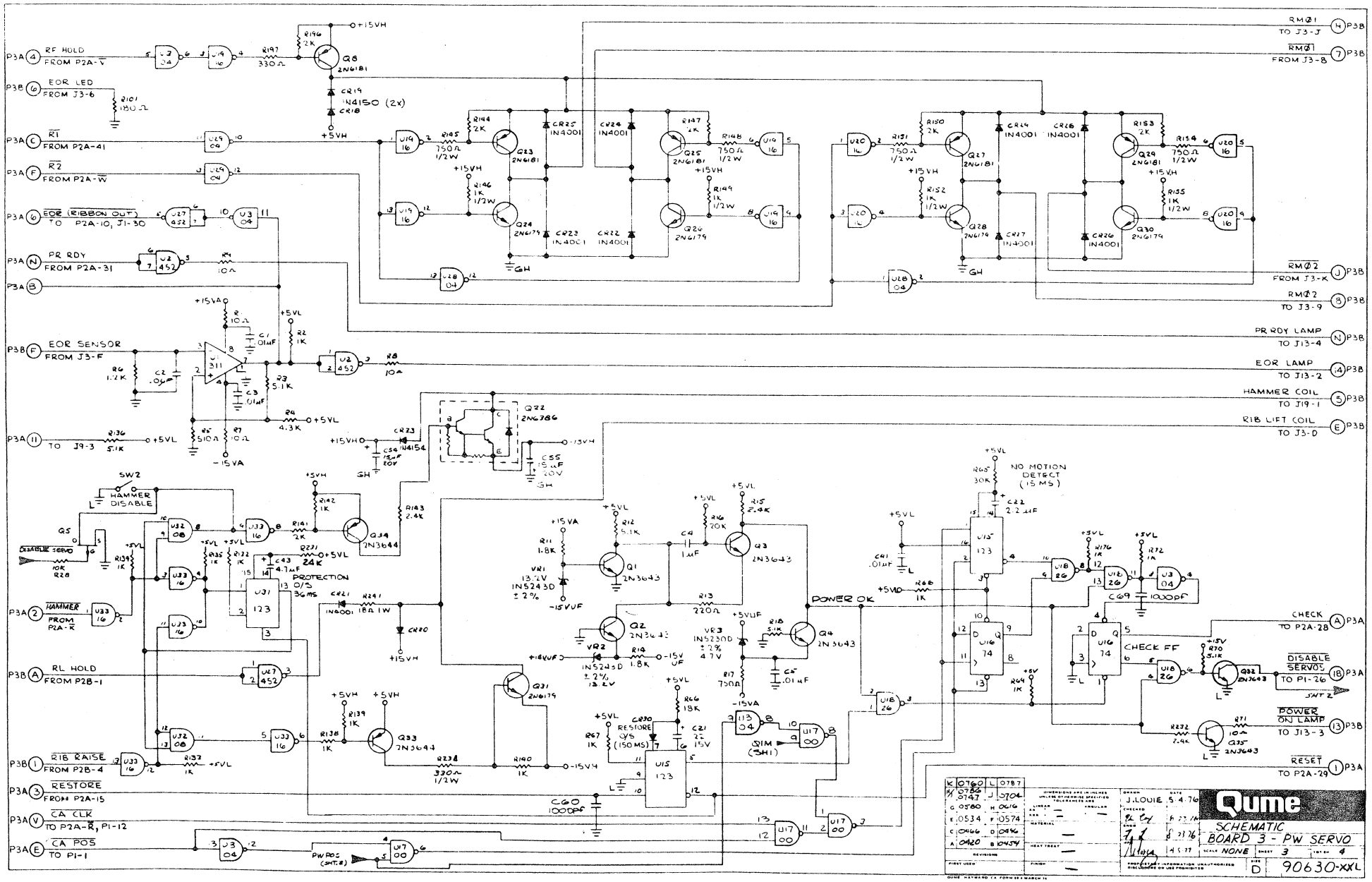
[5] XX SOCKETS MUST HAVE 95831-04 IC U53 AND 95831-02 IC U42.
ALL OTHERS CAN HAVE, AS A SET, 95831-04 IN U53 AND 95831-05 IC U42 OR 95831-01 IN U53 AND 95831-02 IN U42.

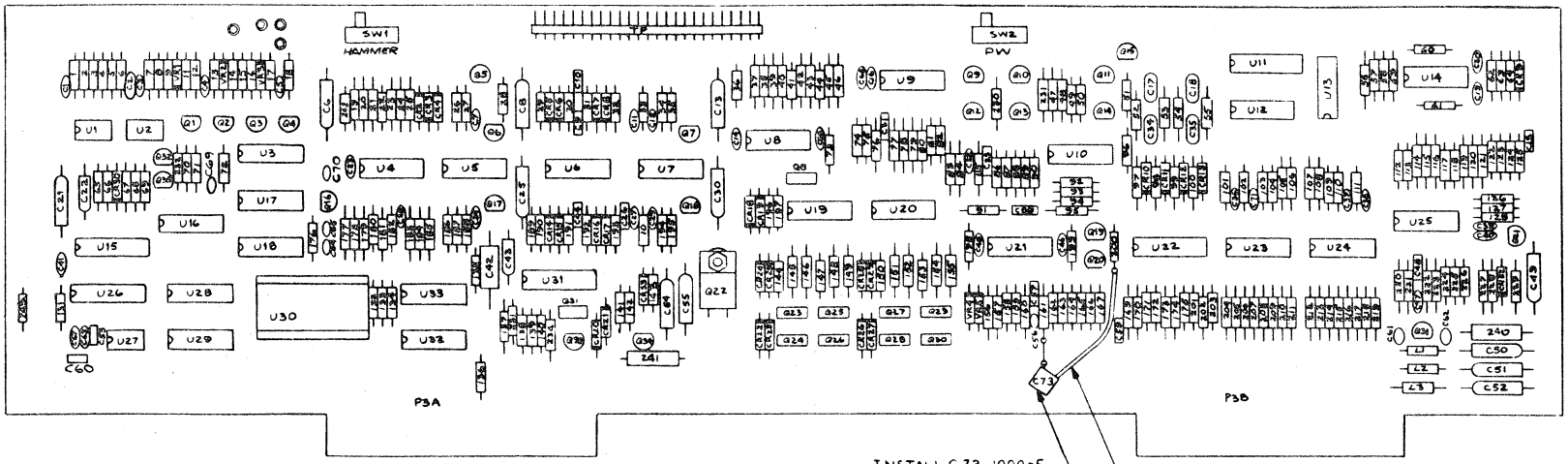
L	0626	M	0628	DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: LINEAR .XX ± .XXX ANGULAR ±	DRAWN F.NABONNE	DATE 18 JAN 77	Qume
J	0586	K	0625		CHECKED		SCHEMATIC
G		H			ENGR		SPRINT 3 - CARD #2
E		F		MATERIAL	DATE 1/84	4/82	SCALE NONE SHEET 5 TOT SH 9
C		D					SIZE D 90620-XXM
A		B		HEAT TREAT			
REVISIONS				FINISH	PROPRIETARY INFORMATION. UNAUTHORIZED DISCLOSURE OR USE PROHIBITED.		
FIRST USED							

QUME HAYWARD CA FORM 004 MARCH 76


P3B (12) ENCODE A FROM J3-S
P3B (11) ANALOG GND FROM J3-14
P3B (L) ENCODE B FROM J3-R
P3B (K) ENCODE INDEX FROM J3-N
P3B (10) CLEAR FROM J3-P
(SHT 2) PW POS (U28-9)
"A"
"B"
"BP"
"Z THRESHOLD"
"BSUM"
"ASUM"
"AP"
POS COMP
AMP COMPENSATION
DAC. REF. (SHT. 2)
VELOCITY (SHT. 2)
"VELOCITY"
PW POS.
INDEX
PW LED +
ØIM (SHT. 3)
P3B TO P28-7
P3B TO P28-6
P3B TO P28-8
P3B TO J3-M
P3B TO P28-5
P3B TO P28-9
* SELECTED
SCHEMATIC
BOARD 3 - PW SERVO
90630-XX L
J. LOUIE
5-4-76
8-27-76
5-13-76
4-8-77
SCALE NONE


(SHT. 1) VELOCITY
(SHT. 1) DAC REF (AMP COMPENSATION)
P3A 5 PW Δ64 FROM P2A 39
P3A 8 PW Δ32 FROM P2A-37
P3A 12 PW Δ16 FROM P2A-36
P3A 6 PW Δ8 FROM P2A-F
P3A 21 PW Δ4 FROM P2A-35
P3A U PW Δ2 FROM P2A-34
P3A T PW Δ1 FROM P2A-L
U30 95817
U26 MC1408L-6 DAC
MSB
LSB
2245 330Ω
-15VAO
+15VAO
-12V O
+5VL
"STAIRCASE"
"PWM DRIVE"
PW POS (SHT 1)
PW POS (SHT. 3)
P3A 13 PW DIR FROM P2A-32
(SHT. 1) A
(SHT. 1) POS. COMPENSATION
P3A D PW POS FROM P2A-40
"POS"
SEE MOTHERBOARD SCHEMATIC #90600 FOR DETAILS
+15V
PWM DRIVERS
Q5
Q2
PW MTR
-15V
P3B 2 J18
P3B 3 J18
P3A 17 28 J3
R2
P3A 10 -15VH O-15VH
P3A K HIGH CURRENT GND
P3A 9 ANALOG GND
P3B V LOGIC GND
P3B 18 +5VH O+5VH
P3B R +15VH O+15VH
DISABLE SERVO (SHT. 3)
SW1 PRINT WHEEL DISABLE
"PWM BASE"
"PWM" 22
VR5 VR4 IN5226B
Q20 2N3643
Q19 2N3644
Q15 P1087E
CURRENT WAVEFORM 10 AMP/VOLT - = CW + = CCW
Q31 MC79L05ACP
Q16 MC79L12ACP
+5VRO
-12V O
-5VR
"-5VR" 19
L1 100uH
L2 100uH
L3 1uH
-15VUF
+15VUF
-15VA
+15VA
+5VL
P3B 15
P3B 16
P3B 17
C60 15mF 20V
C51 15mF 20V
C52 22mF 15V
C61 1mF 35V
C62 1mF 35V
C64 1mF 35V
C70 1mF 35V
C73 1000pF
C56 .1uF
C46 .01uF
C45 .01uF
C67 820pF
C48 100pF
C39 .01uF
C90 .01uF
R160 10K 1%
R161 1K 1%
R162 5.1K
R164 470Ω
R165 360Ω
R166 470Ω
R167 360Ω
R200 510Ω
R198 10Ω
R199 10Ω
R128 10Ω
R127 10Ω
R220 10K 1%
R221 10K 1%
R225 5.1K
R156 2K 1%
R157 2K 1%
R158 1K
R159 10K
R96 15K
R51 10K
R128 10Ω
K 0760 L 0787
J 0704
H 0740 0747
G 0820 N 0646
E 0534 F 0574
C 0466 D 0496
A 0980 B 0494
REVISIONS
J. LOUIE 5 4 76
8 23 76
8 23 76
1-8-77
SCALE NONE SHEET 2 TOTAL 4
Qume
SCHEMATIC
BOARD 3 - PW SERVO
SIZE D 90630-XXL


P3A 4 RF HOLD FROM P2A-T
P3B 6 EOR LED FROM J3-6
P3A C R1 FROM P2A-41
P3A F R2 FROM P2A-W
P3A 6 EOR (RIBBON OUT) TO P2A-10, J1-30
P3A N PR RDY FROM P2A-31
P3A B
P3B F EOR SENSOR FROM J3-F
P3A 11 TO J9-3
P3A 2 HAMMER FROM P2A-K
P3B A RL HOLD FROM P2B-1
P3B 1 RIB RAISE FROM P2B-4
P3A 3 RESTORE FROM P2A-15
P3A V CA CLK TO P2A-R, P1-12
P3A E CA POS TO P1-1
RM01 TO J3-J 4 P3B
RM01 FROM J3-8 7 P3B
RM02 FROM J3-K J P3B
RM02 TO J3-9 8 P3B
PR RDY LAMP TO J13-4 N P3B
EOR LAMP TO J13-2 14 P3B
HAMMER COIL TO J19-1 5 P3B
RIB LIFT COIL TO J3-D E P3B
CHECK TO P2A-28 A P3A
DISABLE SERVOS TO P1-26 18 P3A
POWER ON LAMP TO J13-3 13 P3B
RESET TO P2A-29 1 P3A
SW2 HAMMER DISABLE
DISABLE SERVO
PROTECTION 0/S 36ms
POWER OK
NO MOTION DETECT (15 MS)
CHECK FF
RESTORE O/S (150 MS)
QIM (3HI)
PWRDS (SHT. 2)
SHT 2
Q1 2N3643
Q2 2N3643
Q3 2N3643
Q4 2N3643
Q5
Q8 2N6181
Q22 2N6786
Q23 2N6181
Q24 2N6179
Q25 2N6181
Q26 2N6179
Q27 2N6181
Q28 2N6179
Q29 2N6181
Q30 2N6179
Q31 2N6179
Q32 2N3643
Q33 2N3644
Q34 2N3644
Q35 2N3643
CR19 IN4150 (2x)
CR18
CR25 IN4001
CR24 IN4001
CR23 IN4001
CR22 IN4001
CR27 IN4001
CR26 IN4001
CR21 IN4001
CR20
VR1 13.2V IN5243D ±2%
VR2 IN5243D ±2% 13.2V
VR3 IN5230D ±2% 4.7V
+15VH
+5VH
+5VL
+15VA
-15VA
-15VH
-15VUF
+5VUF
GH
U1 311
U2 452
U3 04
U7 452
U8 04
U15 123
U16 74
U17 00
U18 26
U19 16
U20 16
U26 04
U27 A52
U31 123
U32 08
U33 16
U13 04
R1 10Ω
R2 1K
R3 5.1K
R4 4.3K
R6 1.2K
R7 10Ω
R8 10Ω
R9 510Ω
R11 1.8K
R12 5.1K
R13 220Ω
R14 1.8K
R15 2.4K
R16 20K
R17 750Ω
R18 5.1K
R64 1K
R65 30K
R66 1K
R67 1K
R69 18K
R70 5.1K
R71 10Ω
R72 1K
R131 750Ω 1/2W
R132 1K 1/2W
R133 1K 1/2W
R134 750Ω 1/2W
R135 1K 1/2W
R136 5.1K
R137 750Ω 1/2W
R138 1K
R139 1K
R140 1K
R141 2K
R142 1K
R143 2.4K
R144 2K
R145 750Ω 1/2W
R146 1K 1/2W
R147 2K
R148 750Ω 1/2W
R149 1K 1/2W
R150 2K
R151 750Ω 1/2W
R152 1K 1/2W
R153 2K
R154 750Ω 1/2W
R155 1K 1/2W
R176 1K
R227 24K
R228 10K
R231 10Ω
R232 2.4K
R238 330Ω 1/2W
R241 18Ω 1W
C1 .01μF
C2 .05μF
C3 .01μF
C4 1μF
C5 15μF 20V
C6 15μF 20V
C21 22 15V
C22 2.2μF
C41 .01μF
C43 4.7μF
C69 1000pF
C830 .01μF
C830 1000pF
CR30
CR23 1N4154
SW2
Qume
SCHEMATIC
BOARD 3 - PW SERVO
90630-XXL
J. LOUIE 5-4-76
SCALE NONE
SHEET 3 OF 4
SIZE D



INSTALL C73 ,1000pF
CAP. FROM R161 TO R200

INSERT SLEEVING ON ONE UNCUT
CAP. LEAD (P/N 94130-24)

NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS IN OHMS, ¼W. 5%.
2. ALL DIODES ARE IN4154.
3. ALL .01μF CAPACITORS ARE 25V.
4. ALL 1% RESISTORS ARE 1/8 W.
5. ALL GROUNDS ARE ANALOG.
6. ALL FETS ARE P1087E.
7. THIS SCHEMATIC IS VALID FOR THE FOLLOWING ASSEMBLYS.

53/35	-00	"K"	PCN 0787
53/45	-01	"K"	PCN 0787
53/55	-02	"K"	PCN 0787
53/X30	-03	"K"	PCN 0787
53/X40	-04	"K"	PCN 0787
WT40	-05	"K"	PCN 0787

B

RESISTOR CHART	
UNIT	RESISTOR
53/35 -00	R231, 1.27K, 1%
53/45 -01	R231, 1.37K, 1%
53/55 -02	R231, 1.54K, 1%
53/X30 -03	R231, 1.05K 1%
53/X40 -04	R231, 1.27K, 1%
WT40 -05	R231, 1.54K, 1%

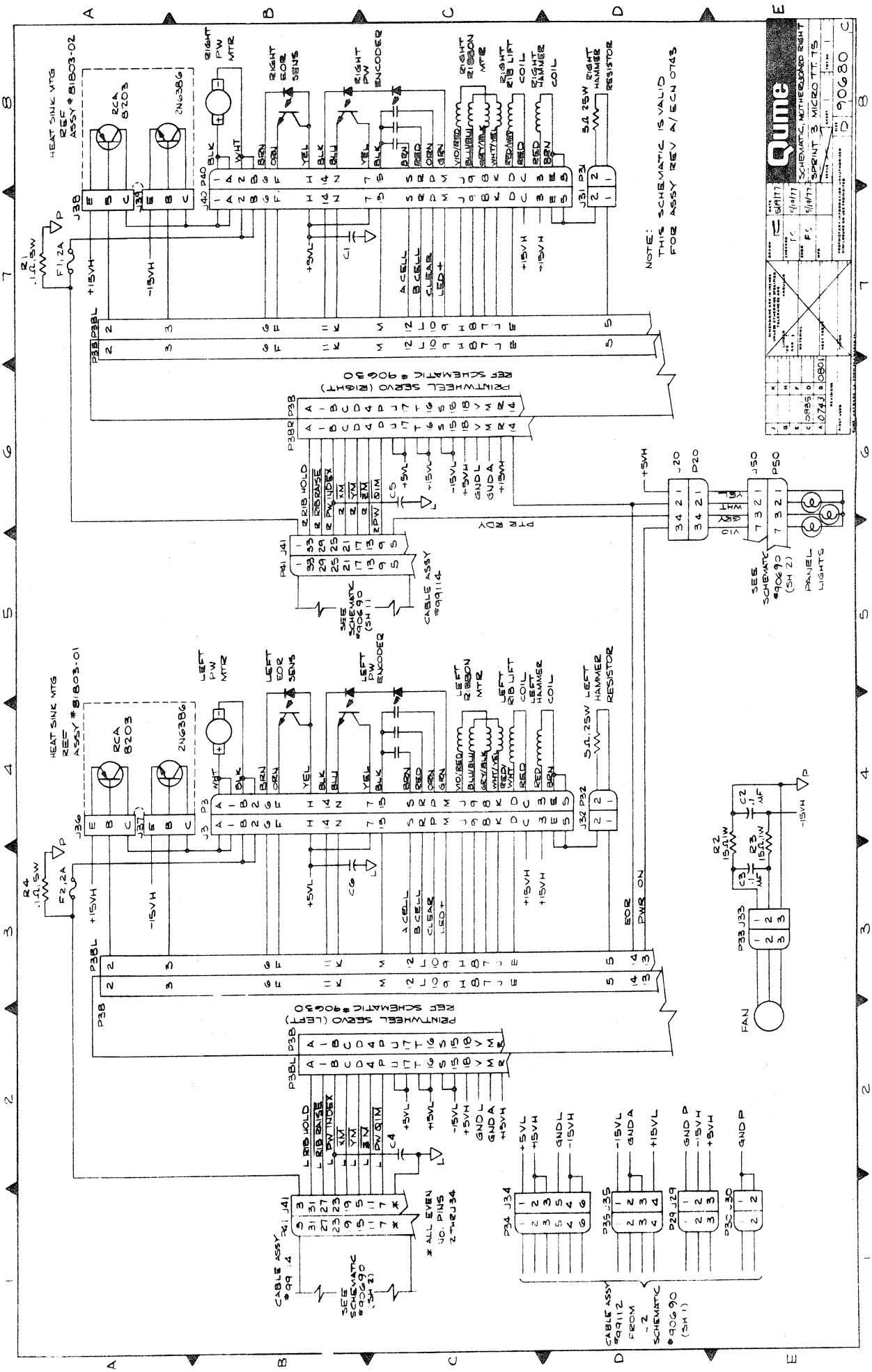
K	0760	L	0787
½	0736 0747	J	0704
G	—	H	0616
E	—	F	—
C	—	D	—
A	—	B	—

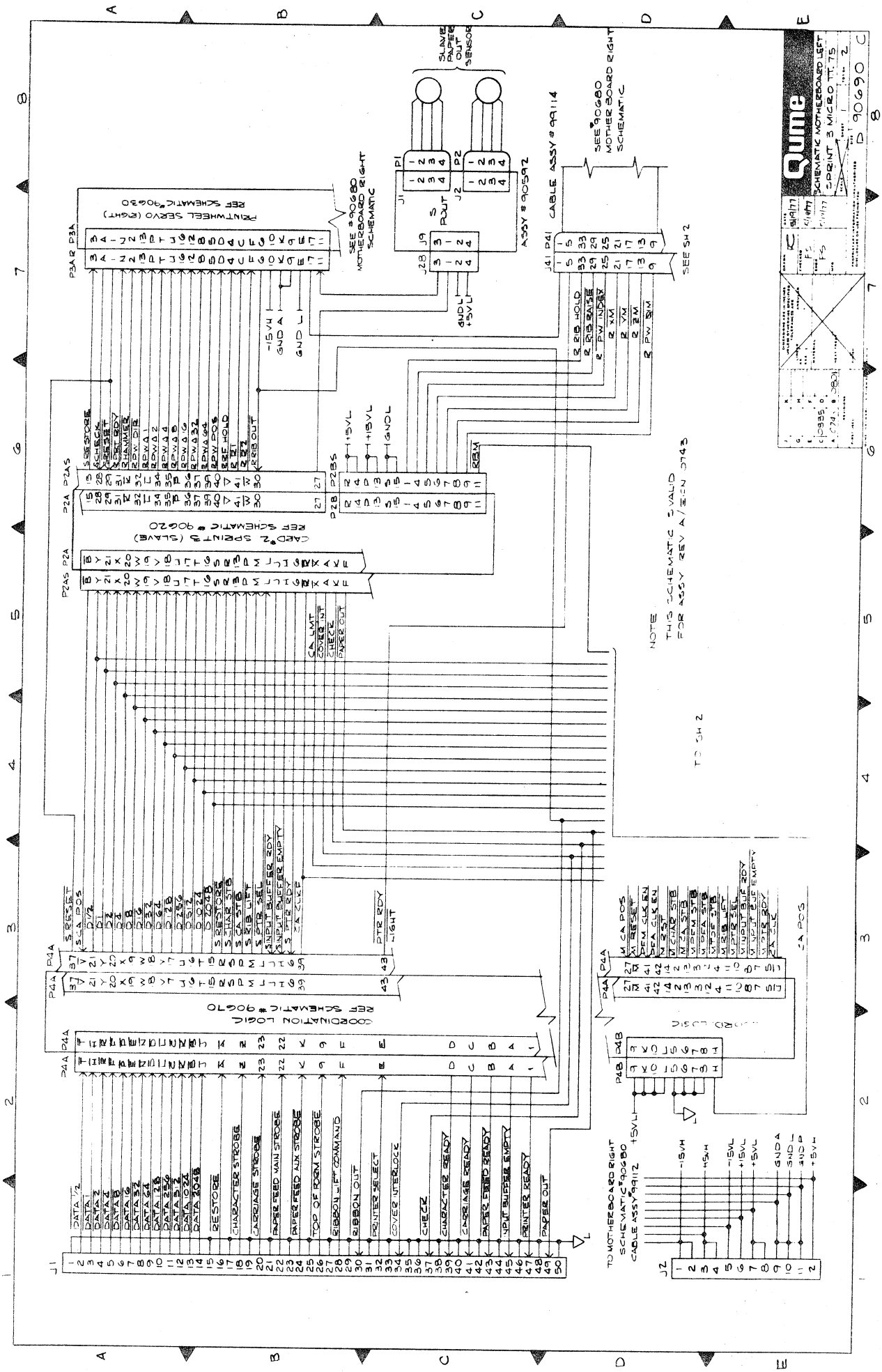
REVISIONS
PROD'T USED

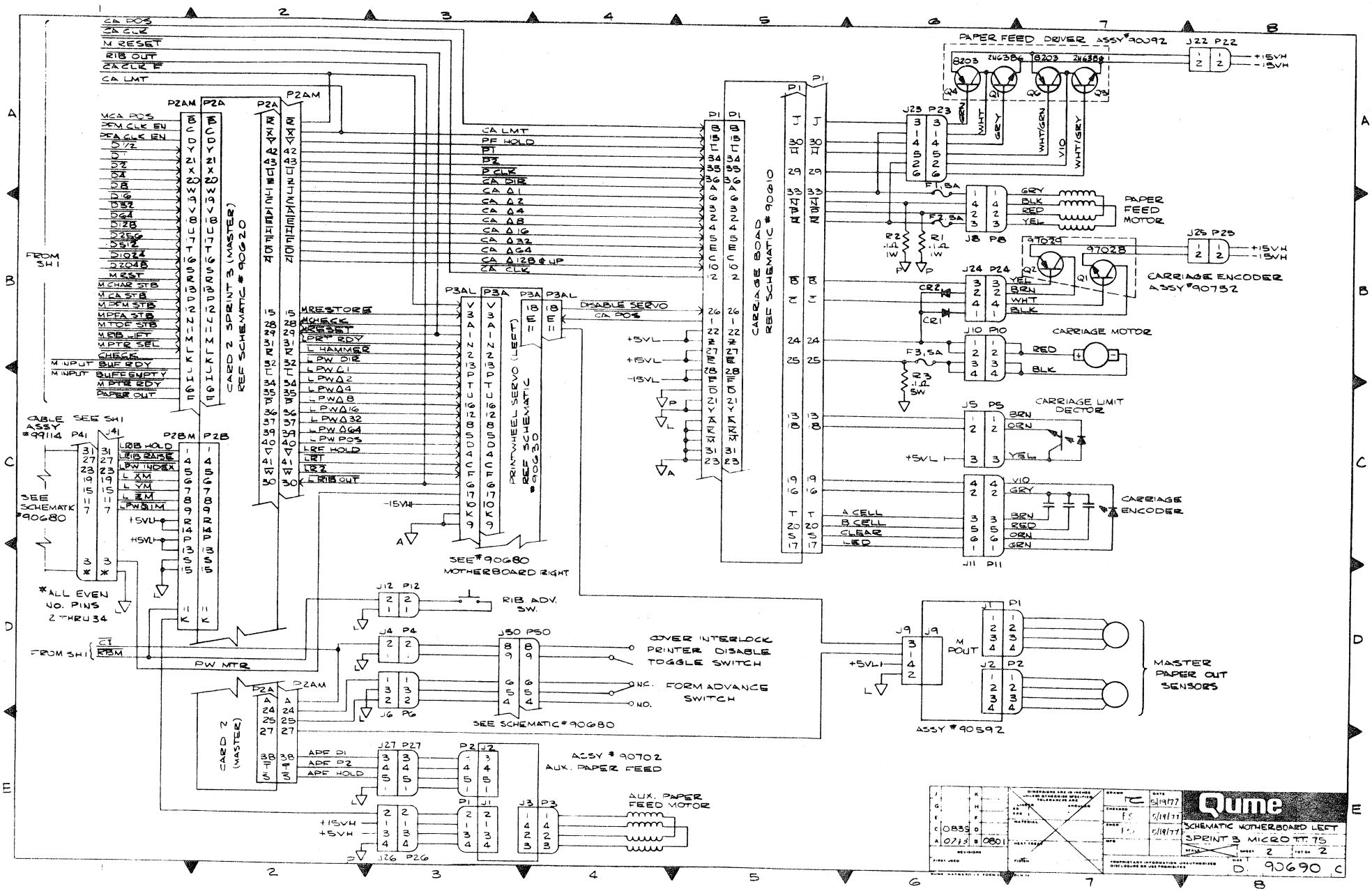
DRAWN NABONNE — DATE 5 JAN 77
CHECKED 1/77
ENG'R
SIZE 1/77

Qume
SCHEMATIC
BOARD 3 - PW SERVO
SCALE NONE — SHEET 4 — TOTAL SH 4
SIZE D — 90690-XX L

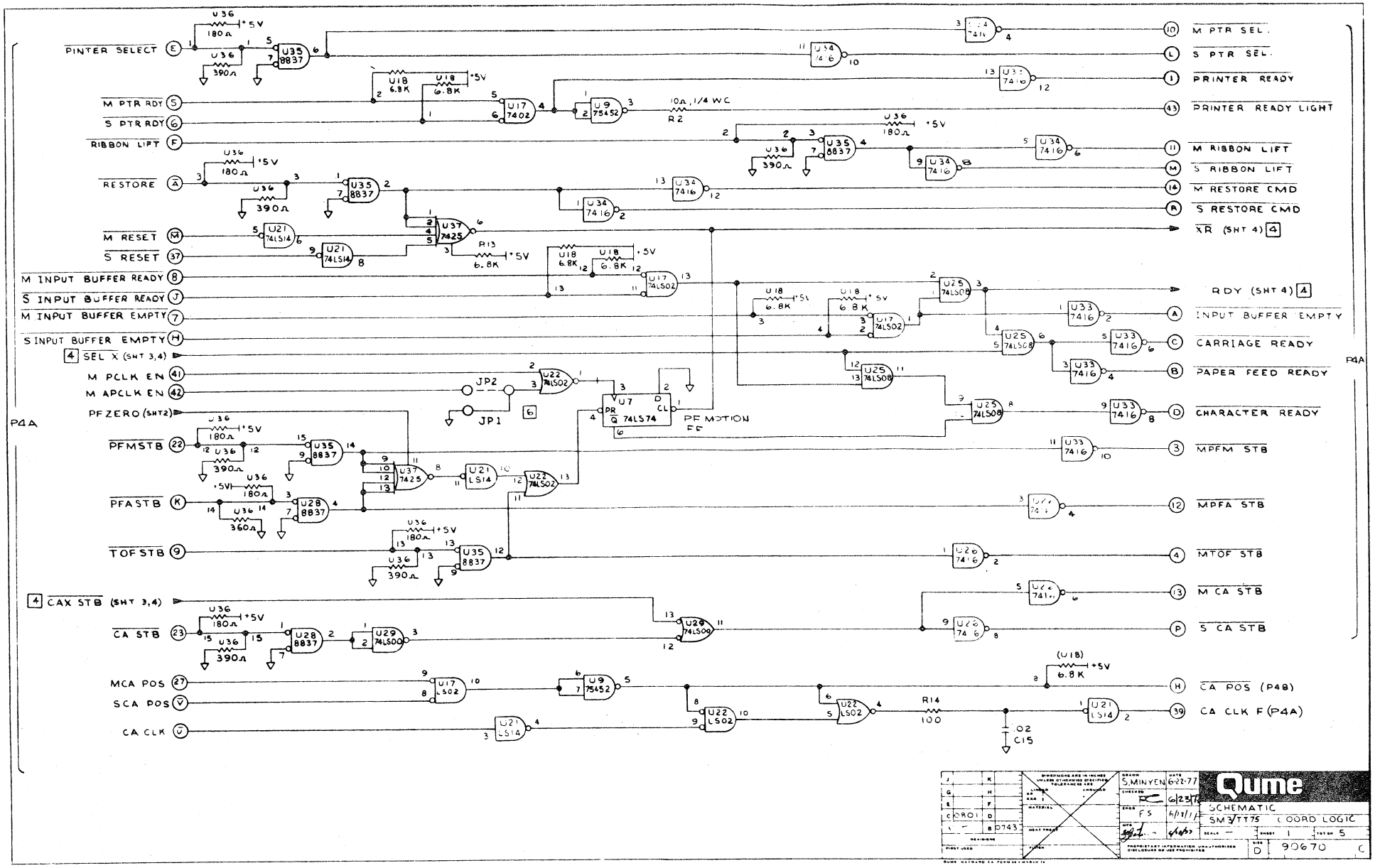
PROPRIETARY INFORMATION UNAUTHORIZED DISCLOSURE OR USE PROHIBITED

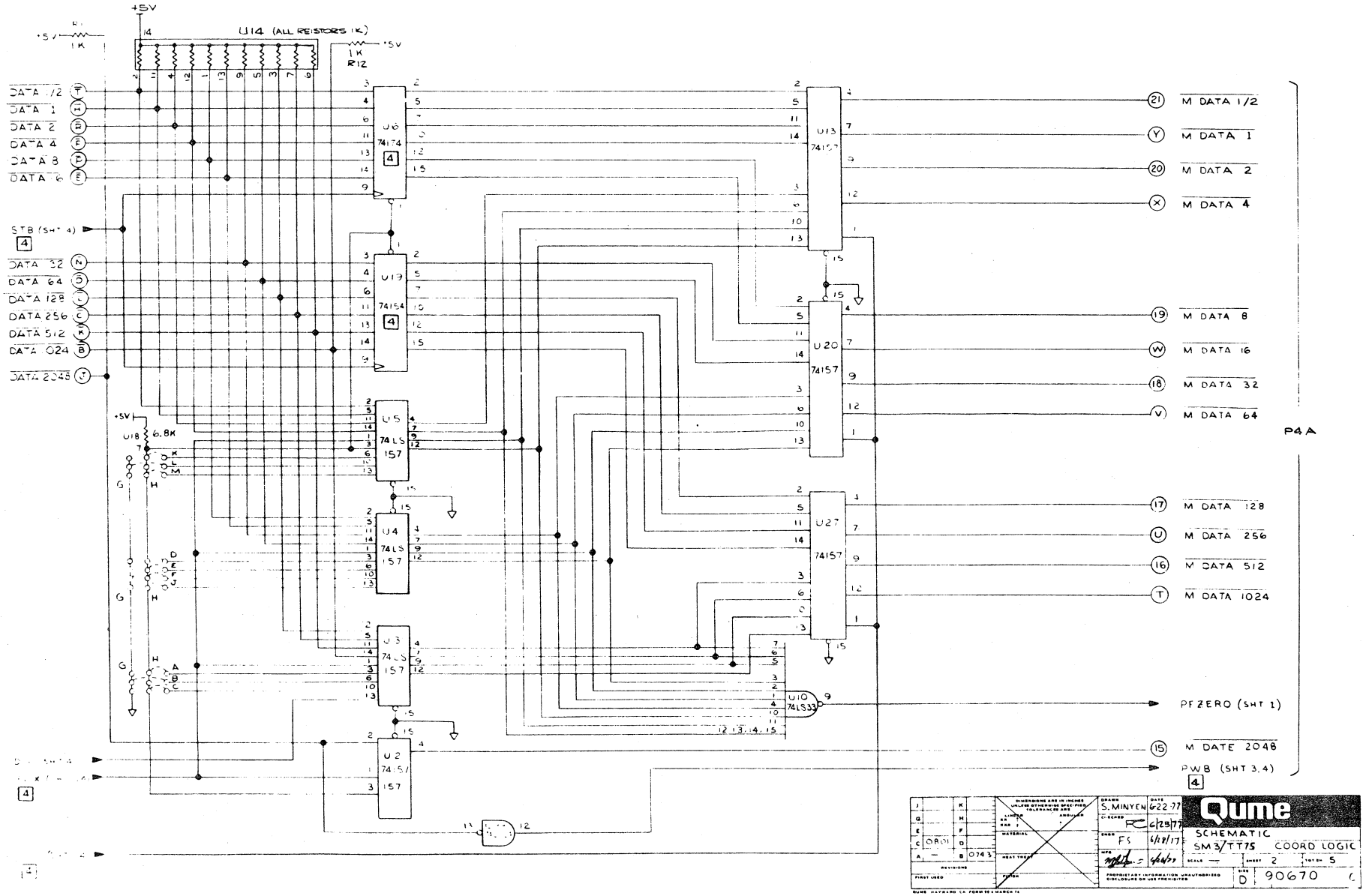

Qume
SCHEMATIC, MOTHERBOARD RIGHT
SPRINT 3 MICRO TT TS
90680
NOTE: THIS SCHEMATIC IS VALID FOR ASSY REV A/ ECN 0743
HEAT SINK MTG REF ASSY # 81803-02
RCA 8203
2N6386
RIGHT PW MTR
RIGHT EOR SENS
RIGHT PW ENCODER
RIGHT RIBBON MTR
RIGHT RIB LIFT COIL
RIGHT HAMMER COIL
5.4, 25W RIGHT HAMMER RESISTOR
PRINTWHEEL SERVO (RIGHT) REF SCHEMATIC # 90630
HEAT SINK MTG REF ASSY # 81803-01
LEFT PW MTR
LEFT EOR SENS
LEFT PW ENCODER
LEFT RIBBON MTR
LEFT RIB LIFT COIL
LEFT HAMMER COIL
5.4, 25W LEFT HAMMER RESISTOR
PRINTWHEEL SERVO (LEFT) REF SCHEMATIC # 90630
CABLE ASSY #99114
CABLE ASSY #99112
SEE SCHEMATIC #90690 (SH 1)
SEE SCHEMATIC #90690 (SH 2)
PANEL LIGHTS
FAN
PWR ON
EOR


Qume
SCHEMATIC MOTHERBOARD LEFT
D 90990 C
PRINT 3 MICRO TT 75
PRINTWHEEL SERVO (RIGHT)
REF SCHEMATIC #90630
SEE #90680 MOTHERBOARD RIGHT SCHEMATIC
SLAVE PAPER OUT SENSOR
ASSY # 90592
CABLE ASSY # 99114
SEE #90680 MOTHER BOARD RIGHT SCHEMATIC
CARD #2 SPRINT 3 (SLAVE)
REF SCHEMATIC # 90620
NOTE
THIS SCHEMATIC IS VALID
FOR ASSY REV A / SER 0943
TO SH 2
COORDINATION LOGIC
REF SCHEMATIC # 90670
TO MOTHERBOARD RIGHT
SCHEMATIC 90680
CABLE ASSY 99112
DATA 1/2
DATA 1
DATA 2
DATA 4
DATA 8
DATA 16
DATA 32
DATA 64
DATA 128
DATA 256
DATA 512
DATA 1024
DATA 2048
2ESTORE
CHARACTER STROBE
CARRIAGE STROBE
PAPER FEED MAIN STROBE
PAPER FEED AUX STROBE
TOP OF FORM STROBE
RIBBON LIFT COMMAND
RIBBON OUT
PRINTER SELECT
COVER INTERLOCK
CHECK
CHARACTER READY
CARRIAGE READY
PAPER FEED READY
INPUT BUFFER EMPTY
PRINTER READY
PAPER OUT


CA POS
CA CLK
M RESET
RIB OUT
CA CLR *
CA LMT
CARD 2 SPRINT 3 (MASTER)
REF SCHEMATIC #90620
FROM SH1
CABLE ASSY #99114
SEE SCHEMATIC #90680
*ALL EVEN NO. PINS 2 THRU 34
PW MTR
CARD 2 (MASTER)
PRINTWHEEL SERVO (LEFT)
REF SCHEMATIC #90630
SEE #90680 MOTHERBOARD RIGHT
CARRIAGE BOARD
REF SCHEMATIC # 90610
PAPER FEED DRIVER ASSY #90592
PAPER FEED MOTOR
CARRIAGE MOTOR
CARRIAGE LIMIT DECTOR
CARRIAGE ENCODER
CARRIAGE ENCODER ASSY #90752
RIB ADV. SW.
COVER INTERLOCK PRINTER DISABLE TOGGLE SWITCH
FORM ADVANCE SWITCH
SEE SCHEMATIC #90680
ASSY #90702 AUX. PAPER FEED
AUX. PAPER FEED MOTOR
MASTER PAPER OUT SENSORS
ASSY #90592
Qume
SCHEMATIC MOTHERBOARD LEFT
SPRINT 5 MICRO TT 75
D. 90690 C

8-20


PINTER SELECT
M PTR RDY
S PTR RDY
RIBBON LIFT
RESTORE
M RESET
S RESET
M INPUT BUFFER READY
S INPUT BUFFER READY
M INPUT BUFFER EMPTY
S INPUT BUFFER EMPTY
SEL X (SHT 3,4)
M PCLK EN
M APCLK EN
PFZERO (SHT2)
PFMSTB
PFASTB
TOFSTB
CAX STB (SHT 3,4)
CA STB
MCA POS
SCA POS
CA CLK
M PTR SEL.
S PTR SEL.
PRINTER READY
PRINTER READY LIGHT
M RIBBON LIFT
S RIBBON LIFT
M RESTORE CMD
S RESTORE CMD
XR (SHT 4)
RDY (SHT 4)
INPUT BUFFER EMPTY
CARRIAGE READY
PAPER FEED READY
CHARACTER READY
MPFM STB
MPFA STB
MTOF STB
M CA STB
S CA STB
CA POS (P48)
CA CLK F (P4A)
PF MOTION FF
JP1
JP2
R2
R13
R14
P4A
P4A
Qume
SCHEMATIC
SM3/TT75 COORD LOGIC
S.MINYEN
6-22-77
90670
C



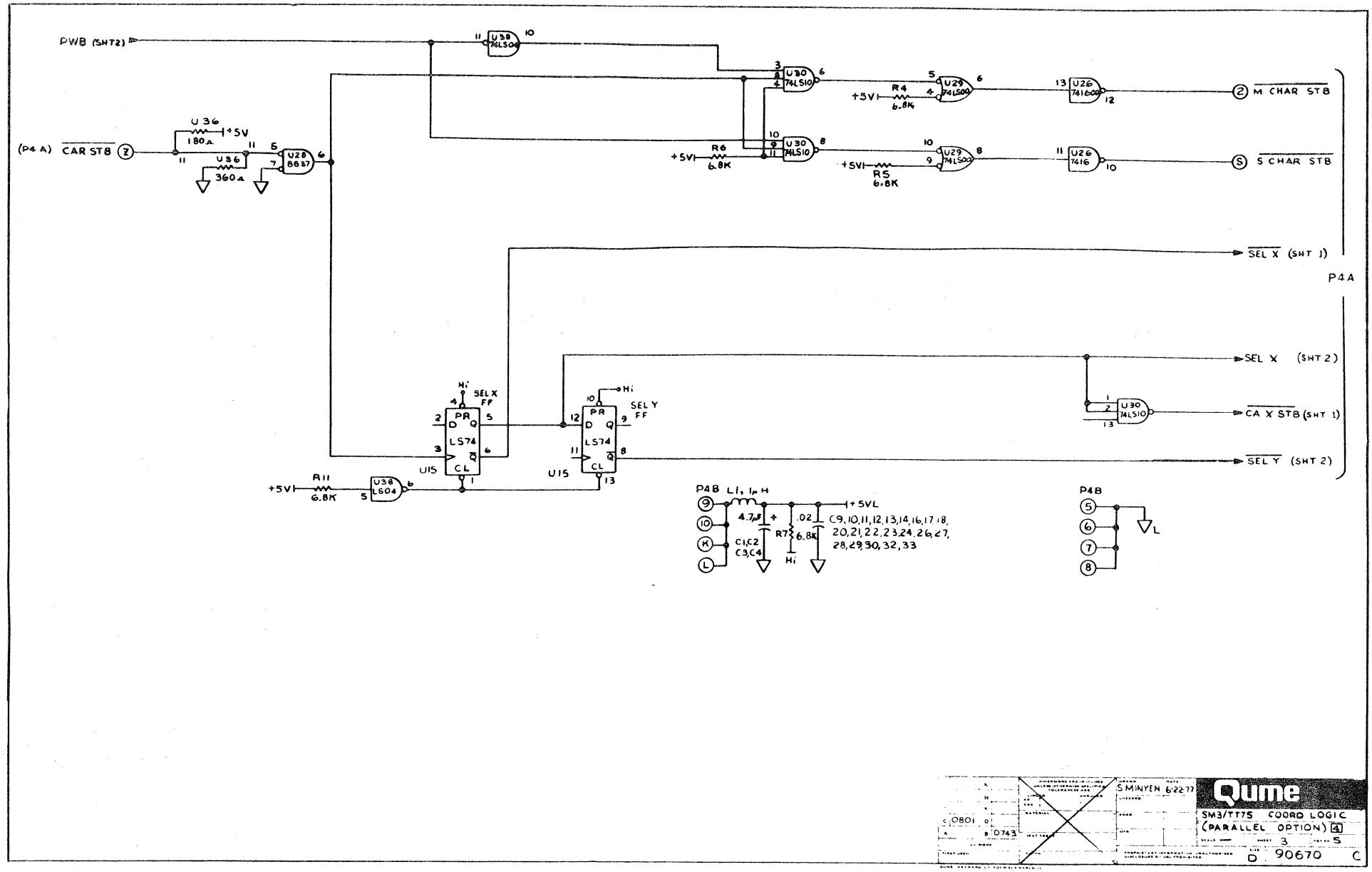
DRAWN	S. MINYEN	6-22-77
CHECKED	RC	6/29/77
ENGR	FS	6/29/77
MFG		
SCALE	—	SHEET 2 TOTAL 5
SIZE	D	90670 C

Qume

SCHEMATIC

SM3/TT75 COORD LOGIC

PROPRIETARY INFORMATION. UNAUTHORIZED DISCLOSURE OR USE PROHIBITED



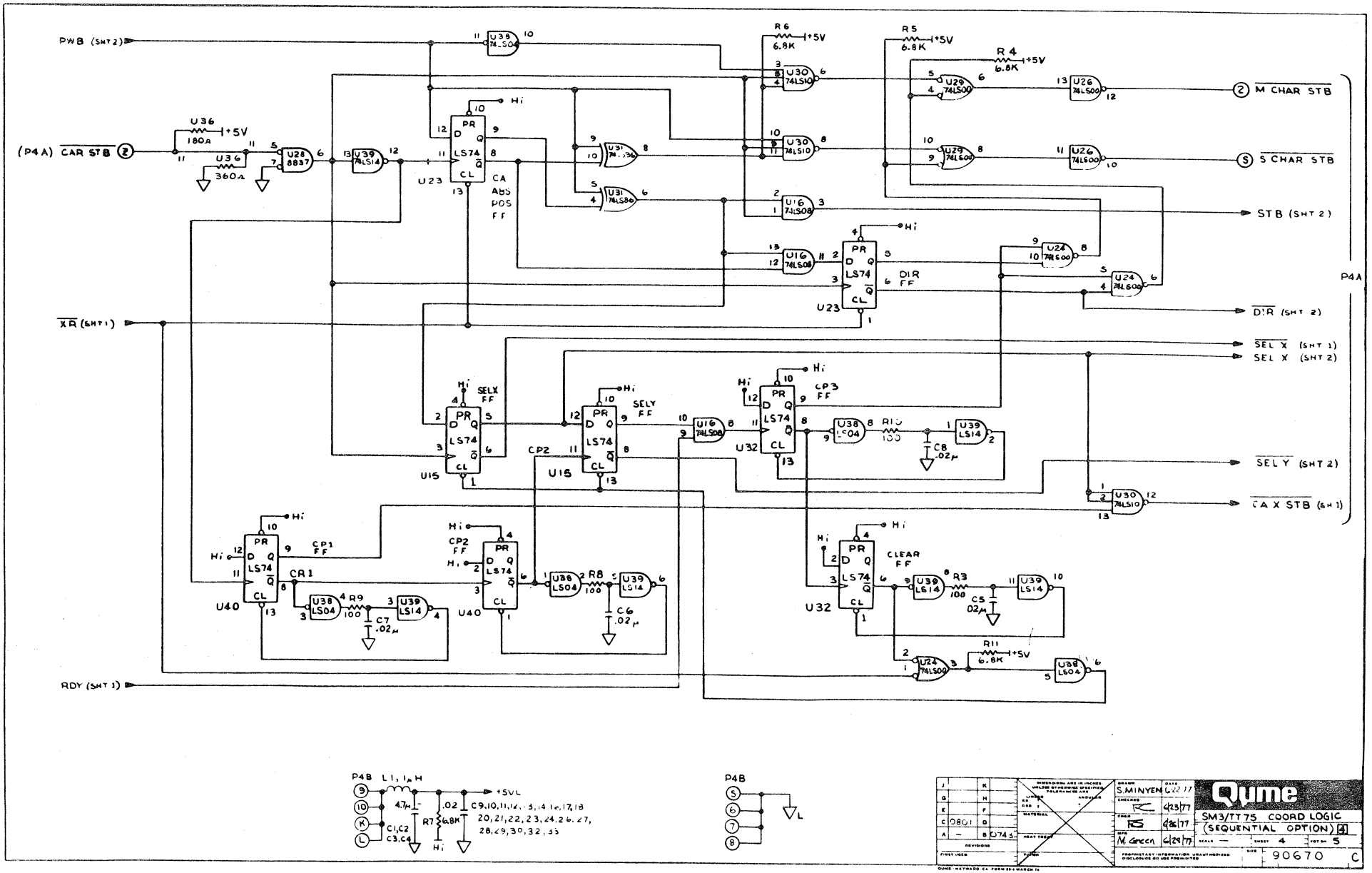
S MINYEN 6-22-77

Qume

SM3/TT75 COORD LOGIC (PARALLEL OPTION) 4

SCALE 3 SHEET 5

D 90670 C



J		K			
G		H			
E		F			
C	0801	D			
A	—	B	0745		

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCE ON ARE ANGULAR

MATERIAL

HEAT TREAT

FINISH

REVISIONS

FIRST ISSUED

DRAWN	S.MINYEN	6.22.77
CHECKED		6/23/77
ENGR	RS	6/28/77
MFG	M. Green	6/29/77

PROPRIETARY INFORMATION (UNLESS NOTED) DISCLOSURE OR USE PROHIBITED

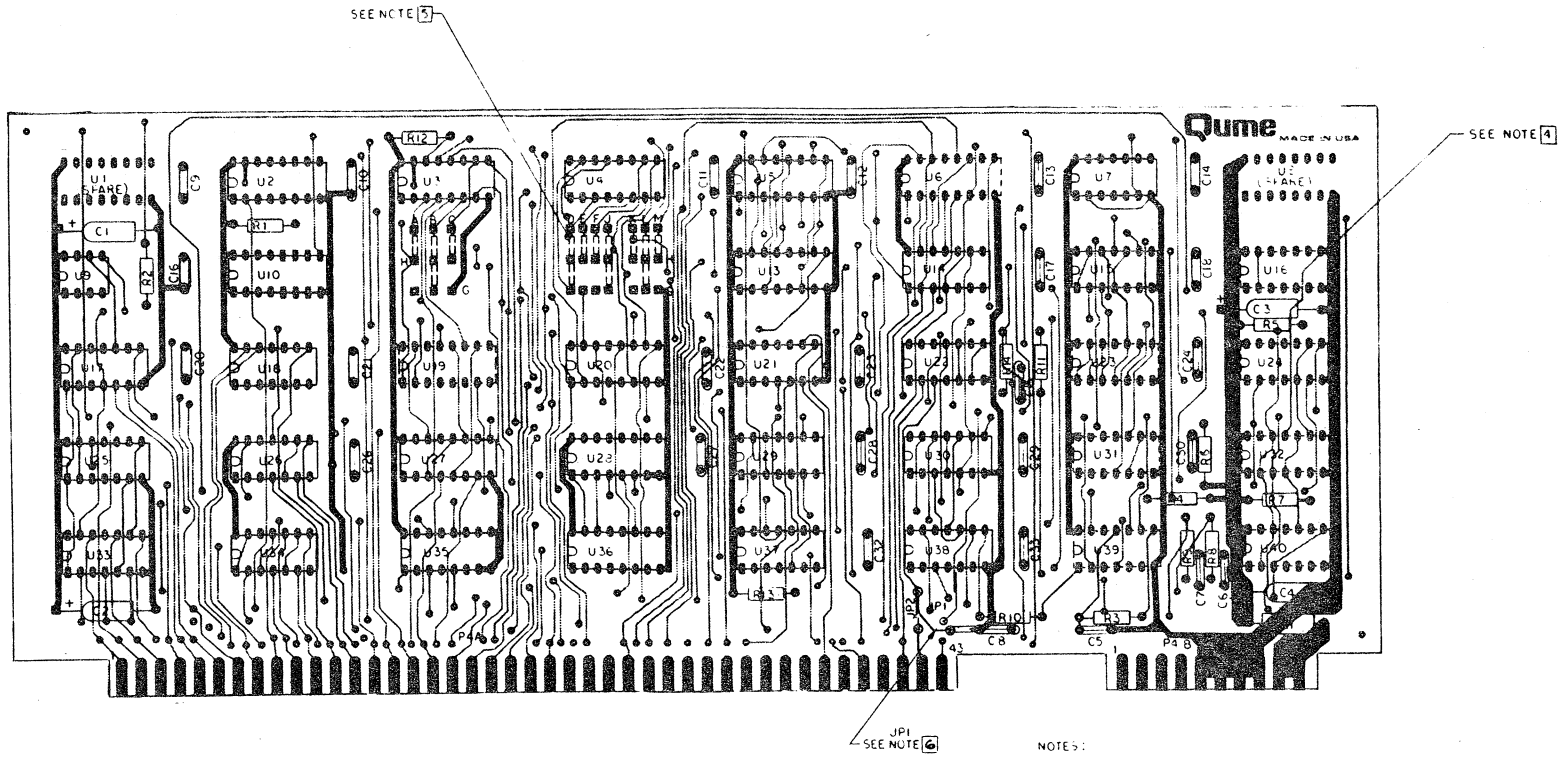
Qume

SM3/TT 75 COORD LOGIC (SEQUENTIAL OPTION) 4

SCALE — SHEET 4 OF SH 5

SIZE 90670 C

QUME HAYWARD CA FORM 29-1 MARCH 76



DASH No. CHART				
ASSY DASH No.	-01 (SH 3)	-02 (SH 4)	-03 (SH 3)	-04 (SH 4)
DESCR.	PARALLEL	SEQUENTIAL	PARALLEL DUAL PAPER	SEQUENTIAL DUAL PAPER
U6	—	74174	—	74174
U19	—	74174	—	74174
U16	—	74LS08	—	74LS08
U23	—	74LS74	—	74LS74
U32	—	74LS74	—	74LS74
U40	—	74LS74	—	74LS74
U31	—	74LS86	—	74LS86
U39	—	74LS14	—	74LS14
U24	—	74LS00	—	74LS00
JPA-JPM	OPEN	CLOSED	OPEN	CLOSED
JP1	CLOSED	CLOSED	OPEN	OPEN
JP2	OPEN	OPEN	CLOSED	CLOSED

LAST USED REF DESIG.
U40, C23, R13, L1, JP2

NOTES:
UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
2. CAPACITORS C1, C2, C3 AND C4 ARE 4.7 MFD. 10V, 20%.
3. ALL CAPACITORS ARE 0.02 MFD., 50V, 20%

4. SHEET 3 IS FOR PARALLEL LOGIC OPTION
SHEET 4 IS FOR SEQUENTIAL LOGIC OPTION
SEE DASH NO. CHART.

5. ALL JUMPERS AS SHOWN ARE USED ON SEQUENTIAL -02 VERSON ONLY.

6. FOR DUAL DRIVE OPTION CUT JUMPER "JP1" INSTALL JUMPER "JP2" (90672-03,-04)

7. THIS SCHEMATIC VALID FOR 90672-01 REV B PCN 0743
90672-02 REV B PCN 0743
90672-03 REV B PCN 0743
90672-04 REV B PCN 0743

J		K					
G		H					
E		F					
C	0801	D					
A	—	B	0743				
REVISIONS							
FIRST USED							

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: LINEAR .XX ±, .XXX ±; ANGULAR ±; MATERIAL; HEAT TREAT; FINISH

DRAWN	S MINYEN	DATE 6-22-77
CHECKED		6/23/77
ENGR.	F SHAH	4-12-77
MFG		

PROPRIETARY INFORMATION. UNAUTHORIZED DISCLOSURE OR USE PROHIBITED.

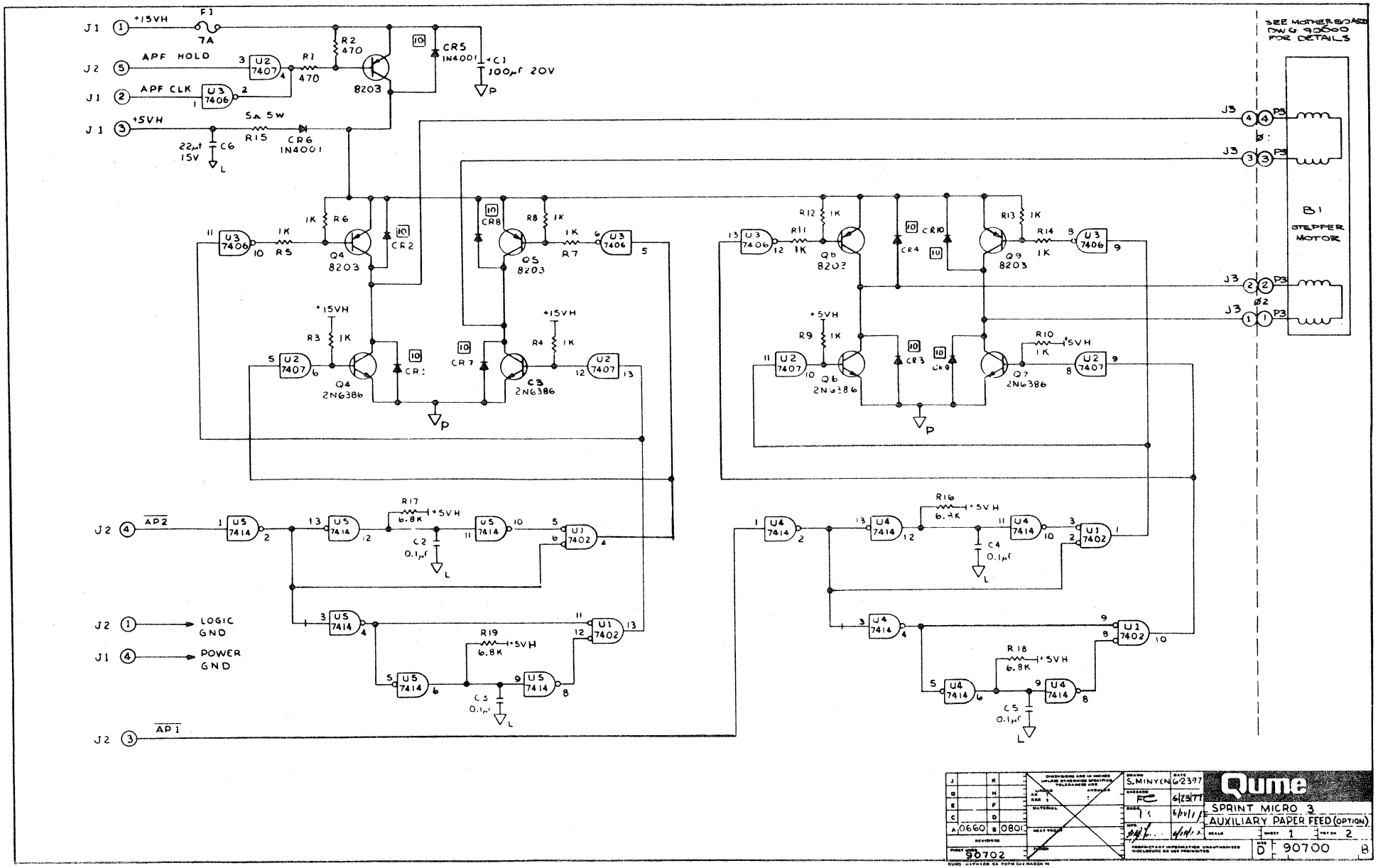
Qume

SCHEMATIC
SM3/TT75 COORD. LOGIC

SCALE 2X | SHEET 5 | TOTAL SH 5

SIZE D | 90670-XX | C

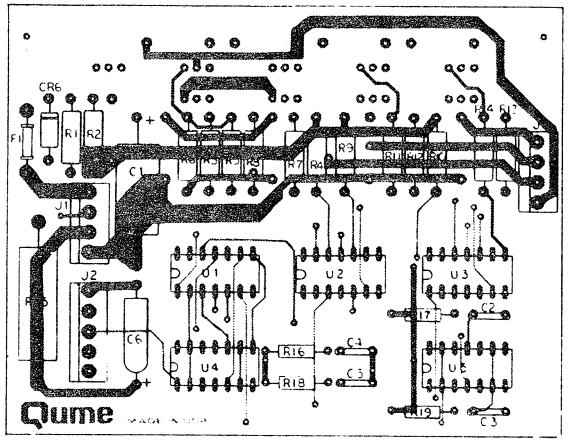
GUIDE HAYWARD, CA FORM 804 MARCH 74



DRAWN	S. MINYEN	6/23/77	Qume
CHECKED	FC	6/23/77	SPRINT MICRO 3
ENG	TS	6/24/77	AUXILIARY PAPER FEED (OPTION)
MFG			SCALE 1 SHEET 1 TOTAL 2
APPROVED			SIZE D 90700 B

A .0660 B .0801

90702



LAST USED
C6, R19, CR6, F1, U5

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS, 1/4 W, 5%.
2. RESISTORS R16, R17, R18 AND R19 ARE 1/2W, 5%, R15 5W, 5%.
3. ALL CAPACITORS ARE 0.1 MFD, 12V
4. CAPACITOR C1, 100 MFD, 20V, CAPACITOR C6, 22 MFD, 15V.
5. ALL DIODES ARE IN4001.
6. J1-4 "POWER GND"
7. J2-1 "LOGIC GND"
8. PROVISIONS MADE ON PC LAYOUT FOR IN4001 DIODES MAY BE LEFT OUT IF TRANSISTOR TYPES 2N6041 & 2N6044 ARE USED
9. THIS SCHEMATIC VALID FOR ASSY REV "A" PCN 0660
10. DESIGNATES COMPONENTS ARE NOT USED.

J		K						
G		H						
E		F						
C		D						
A	0660	B	0601					

REVISIONS

PROOF USED

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: LINEAR ± ; ANGULAR ± ; XXX ± ; ; MATERIAL SEE B/M 90702 ; HEAT TREAT —— ; FINISH ——

DRAWN S LEONG 11-25-77

CHECKED 6/23/77

ENGR FS 6/21/77

MFG 6/24/77

PROPRIETARY INFORMATION. UNAUTHORIZED DISCLOSURE OR USE PROHIBITED.

Qume

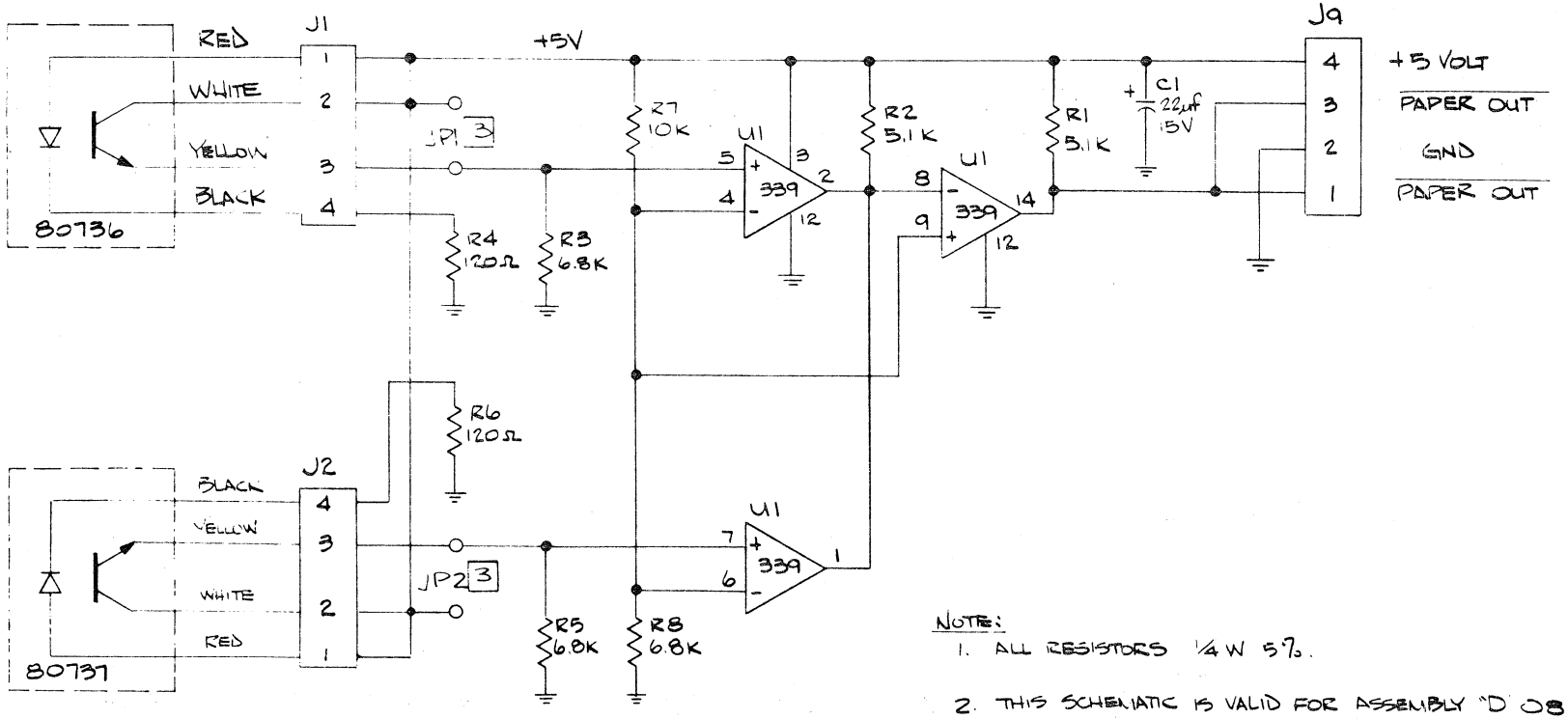
SCHEMATIC - SPRINT MICRO 3
AUX. PAPERFEED BOARD.

SCALE 2X | SHEET 2 | TOT SH 2

SIZE D | 90700 | B

QUME - HAYWARD, CA. FORM 00-2 MARCH 74

90590 E



NOTE:
1. ALL RESISTORS 1/4 W 5%.
2. THIS SCHEMATIC IS VALID FOR ASSEMBLY "D" 0845

[3]

DASH No.	JP1	JP2
-01	OPEN	CLOSED
-02	CLOSED	OPEN
-03	OPEN	OPEN

J		K	
G		H	
E	0345	F	
C	0487 / 0502	D	0759
A	0443	B	0469

REVISIONS
FIRST USED

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
LINEAR XX ± XXX ±
ANGULAR ±
MATERIAL —
HEAT TREAT —
FINISH —

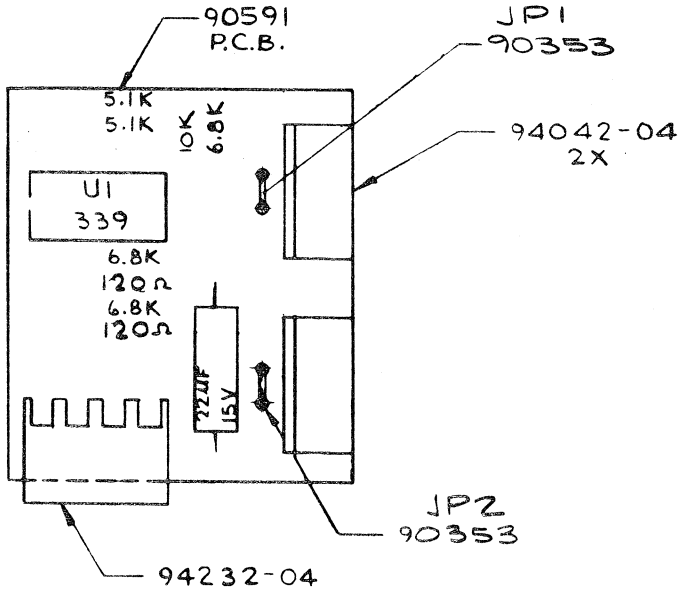
DRAWN DAN FONG 7-77
CHECKED 7/77
ENGR. 7-77
MFG. 7/11/77

PROPRIETARY INFORMATION. UNAUTHORIZED DISCLOSURE OR USE PROHIBITED.

Qume
SCHEMATIC
PAPER OUT - PCB
SCALE — SHEET 1 TOT SH 1
SIZE B 90590 E

DASH No.	DESCRIPTION	JP1	JP2
-01	REAR ONLY	OPEN	CLOSED
-02	BOTTOM ONLY	CLOSED	OPEN
-03	REAR & BOTTOM	OPEN	OPEN

REVISION TABLE	
ASSEMBLY	FABRICATION
B	A
C	B
D	B



NOTE:

ALL RESISTORS ARE 1/4 W 5%

J		K		DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED TOLERANCES ARE	DRAWN J. LOUIE	DATE 4-19-76	Qume
G		H		LINEAR XX ± — XXX ± — ANGULAR : —	CHECKED		PAPER OUT – PCB
E		F		MATERIAL —	ENGR.		ASSEMBLY DRAWING
C	0487	D	0845		MFG	4-30-76	SCALE 2 TO 1 SHEET 1 TOT SH 1
A	0443	B	0469	HEAT TREAT —			
REVISIONS					PROPRIETARY INFORMATION. UNAUTHORIZED DISCLOSURE OR USE PROHIBITED.		SIZE B 90592 D
FIRST USED —				FINISH —			

QUME · HAYWARD, CA. FORM 88-4 MARCH 74