

OEM MANUAL
SERIES 5099EN QIC-36 INTERFACE
STREAMING 1/4 INCH TAPE CARTRIDGE DRIVE



OPERATING AND SERVICE MANUAL NO. 63148-001

Rev. 1

FORWARD

This manual provides operating and service information for the Streaming 1/4 Inch Tape Cartridge Drive, Models 5099EN / 5125EN / 5150EN, Manufactured by Wangtek Incorporated, 41 Moreland Road, Simi Valley, California.

The content includes a detailed product description, specifications, installation and operation instructions. Also included are theory of operation, maintenance, troubleshooting, and parts removal and replacement instructions.

TECHNICAL SUPPORT

If for any reason you require product technical support, please contact the OEM or Distributor where you first purchased your equipment. If they cannot help you or at their direction, Wangtek Technical Support can be reached at:

WANGTEK Incorporated
41 Moreland Road
Simi Valley, CA. 93065

(805) 583-5255
Telex 650450
FAX (805) 583-8249

WANGTEK-Europe
Unit 1A, Apollo House
Calleva Industrial Park
Aldermaston, Reading
RG7 4QW England
44-7356-77746
Telex 851-848135
FAX 44-7356-6076

WARNING

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class B computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial or residential environment. This equipment is a Class B digital apparatus which complies with the Radio Interference Regulations, CRC c.1374.

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REVISIONS

REV CODE -----	DESCRIPTION -----	DATE -----
A	Initial Release	09/18/82
B	Drive Level I/O Description Added	10/16/82
C	Delete Series 8000 from Spec.	02/07/83
D	Change Voltages and Add Fig. 4	06/28/83
E	Add Schematics	07/03/84
F	Update Schematics	02/19/85
G	Incorporate 30062 Main Bd.	09/27/85
H	Incorporate 30509 Main Bd.	12/15/86

1.0 SCOPE

This specification describes the Wangtek Series 5000E streaming tape drive (hereinafter referred to as "drive") specifically designed for 10,000 bpi recording. The drive employs as storage media a data cartridge which is mechanically described per ANSI Standard X3.55 1977. The drive and cartridge are to be used as a read and write memory device in a digital computer system. The cartridge diagram is shown in Figure 1.1.

1.1 FEATURES

The Series 5000E streaming tape drive (Figure 1.0) is a family of innovative, low cost, highly reliable cartridge tape drives.

The drive will record and reproduce data onto and from cartridges which mechanically conform to the ANSI Standard and such cartridges will interchangeably.

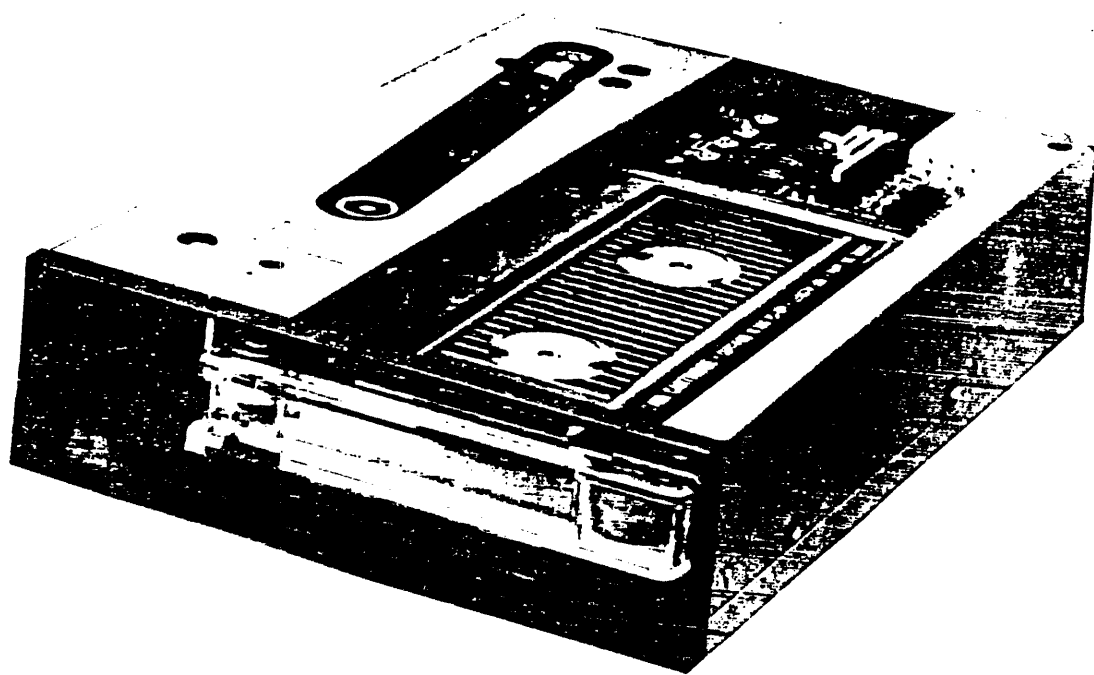
The drive can be utilized for either Winchester disk backup or general data storage in the streaming or start/stop mode or employed for use in the data distribution mode.

An optional intelligent formatter, available as a half-high expansion module or external to the drive, records either the QIC-24 or QIC-11 (Archive 8 inch) data format using the QIC-02 defined intelligent interface.

The drive can utilize either the 310 Oerstedts or 550 Oerstedts tape cartridges. The type of cartridge being used is transparent to the user, due to the drive's automatic capability to select the proper write current and read gain for the respective cartridge being utilized.

The drive also utilizes the QIC-24 track reference burst to automatically position the head to the center of Track 0. This feature minimizes misalignment of the head when reading tapes generated by other drives utilizing the QIC-24 data format.

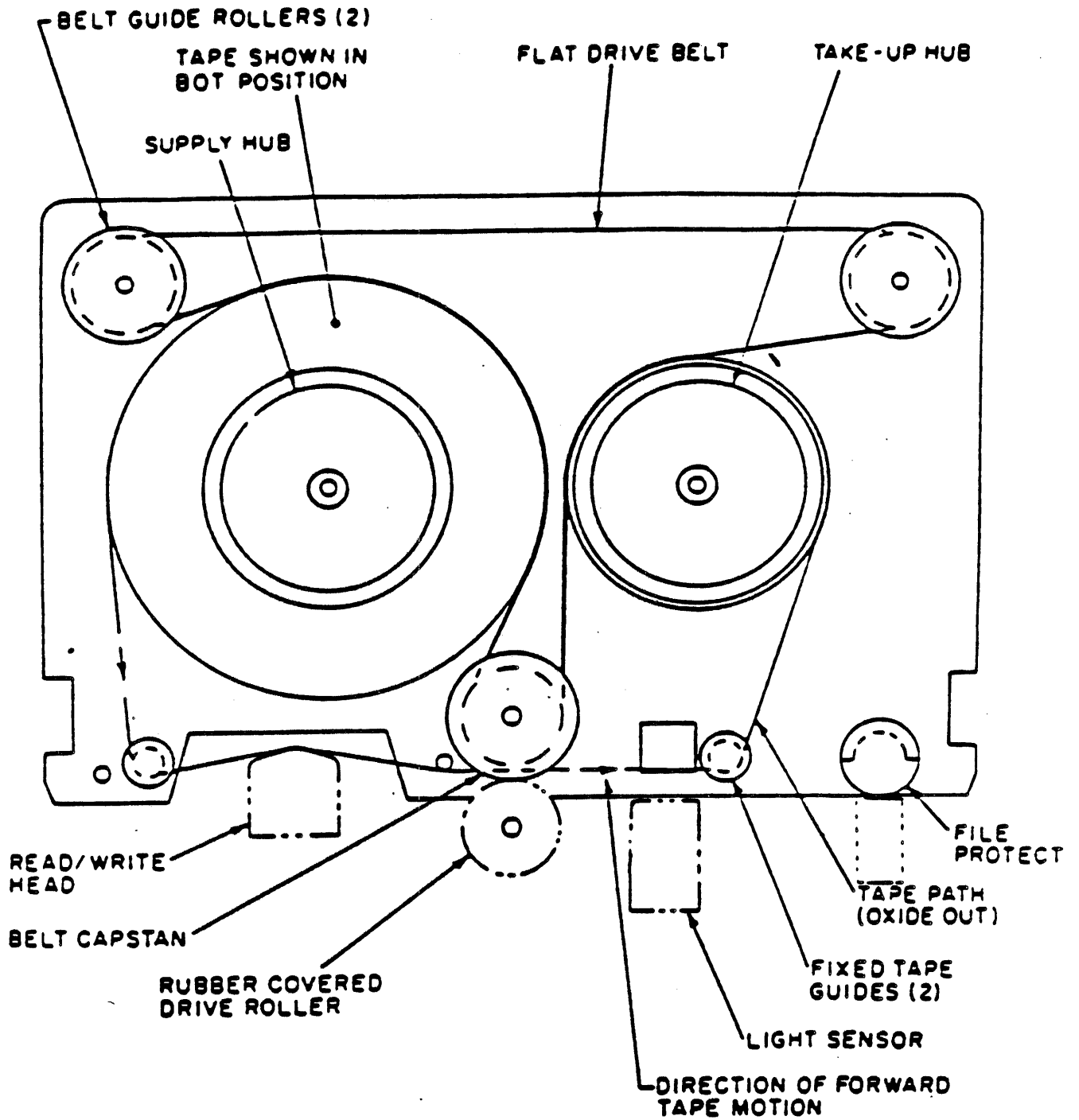
When the drive is in the WRITE mode, it will automatically position the Read/Write head assembly to the theoretical Track 0 position regardless of reference burst positioning.



Series 5000E Streaming Tape Drive

Figure 1.0

(ref. ANSI X3.55 - 1977)



ANSI Tape Cartridge

Figure 1.1

1.2 REFERENCE DOCUMENTS

ANSI X3B5/85-138 Unrecorded Magnetic Tape Cartridge Specification, 5th Draft
 ANSI X3.55 1982 Unrecorded Magnetic Tape Cartridge Specification
 ANSI X3B5/85-127A Unrecorded Magnetic Tape Cartridge Specification, 11th Draft
 3M DC600 XTD Cartridge specification
 3M DC600A Cartridge specification
 3M DC300XL Cartridge specification
 3M DC300XL/P Cartridge specification
 3M DC615A Cartridge specification
 3M DC615XTD Cartridge specification
 QIC-02 Intelligent Interface Standard, Rev. D
 QIC-24 Data Interchange Standard
 QIC-36 Basic Interface 1/4 inch Cartridge Tape Drive, Rev. B

1.3 SPECIFICATION SUMMARY

Details for each item listed below can be found in the body of this specification.

PARAMETER	VALUE
I. DATA	

TRANSFER RATE	90 Kbytes / second
RECORDING CODE	Group Code Recording (GCR)
RECORDING DENSITY	10,000 Bits / inch
HEAD FORMAT	Read while Write with Erase
NUMBER OF RECORDED TRACKS	Four or Nine
RECORDING METHOD	4 or 9 Track Serpentine
DATA RELIABILITY	8
SOFT ERROR RATE (READ)	< 1 Error in 10 ¹⁰ Bits
HARD ERROR RATE (READ)	< 1 Error in 10 ¹⁰ Bits
FORMATTED DATA CAPACITY	
9 TRACK DC300XL Tape	45 Megabytes
DC600A Tape	60 Megabytes
4 TRACK DC300XL Tape	20 Megabytes
DC600A Tape	26.7 Megabytes

II. MOTION	

SPEED	90 Inches / Second
SPEED VARIATION	
SHORT TERM	+ / - 7 %
LONG TERM	+ / - 3 %
START/STOP PERIOD	300 mSeconds Maximum

III. POWER

DC VOLTAGE	+12 VOLTS	+5 VOLTS
TOLERANCE	+/- 5%	+/- 5%
RIPPLE	500 mVolts	100 mVolts
CURRENT		
BASIC UNIT		
Standby	0.2 Amps	1.0 Amps
Operational	1.9 Amps	1.0 Amps
Max. Surge	4.2 Amps *	1.0 Amps
DRIVE AND FORMATTER		
Standby	0.3 Amps	3.0 Amps
Operational	2.4 Amps	3.0 Amps
Max. Surge	4.3 Amps *	3.0 Amps

* During starting, stopping, or reversing for a maximum of 122 milliseconds.

SUPPLY VOLTAGE RISE TIME

Minimum rise time to 95% of rated voltage
5 mSec. 5 mSec.

DISSIPATION *

BASIC UNIT	27.8 Watts nominal
BASIC UNIT and FORMATTER	43.8 Watts nominal

* Does not account for Start up surge current (less than 122 mSec.)

IV. ENVIRONMENTAL

OPERATING TEMP.	5 to 45 degrees C.
STORAGE TEMP.	- 30 to + 60 degrees C.
RELATIVE HUMIDITY	20 to 80% non-condensing

V. MACHINE RELIABILITY

MEAN TIME BETWEEN FAILURES	8,000 Hours @ 15% Duty Cycle
MEAN TIME TO REPAIR	0.5 Hours

VI. CONNECTORS

POWER CONNECTOR	AMP P/N 1-480424-0
POWER CONTACTS	AMP P/N 60619-1
SIGNAL CONNECTOR	3M P/N 3425

1.4 MODEL SPECIFICATION

To describe the specific drive model, the following system will be used:

Form of Model Number: S, N1, N2, 9, E, A1, N3, N4
Where:

N is numeric and A is alphanumeric.

N1 = Number of Tracks, first digit of two (0)

N2 = Number of Tracks, second digit of two (4 or 9)

A1 = Type of Formatter (G, K, or N)

G = Wangtek Single Board Formatter

K = Wangtek PC-36 IBM Controller/Formatter Board

N = No Formatter Included

N3, N4 = Type of Data Format (QIC-11 or QIC-24)

11 = QIC-11 Data Format

24 = QIC-24 Data Format

2.0 PHYSICAL SPECIFICATIONS

The drive consists of an aluminum casting which is the primary mechanical support for the internal elements and provides the mechanical support for mounting the drive. The primary elements of the drive are the magnetic head, the head carriage and stepper motor assembly, the capstan motor and drive assembly, the tape hole sensor assembly, the drive control board, the servo board, and the basic mechanical assembly to which all of the above are attached.

2.1 MOUNTING

The drive is designed to utilize the same mounting holes as the industry standard 5 1/4 inch Winchester and floppy disk drives. The drive can be mounted in any orientation except for that which would position the drive upside down, i.e. where the tape cartridge is mounted below the drive mechanism. Free air flow around the tape drive is required to prevent ambient operating temperature from exceeding 45 degrees Celsius during operation. If necessary, forced-air cooling should be used to achieve operating temperature requirements.

The design of an enclosure should incorporate a means of prevention from contamination, i.e. dust, lint, and other dust producing material, as the drive does not have a dust cover.

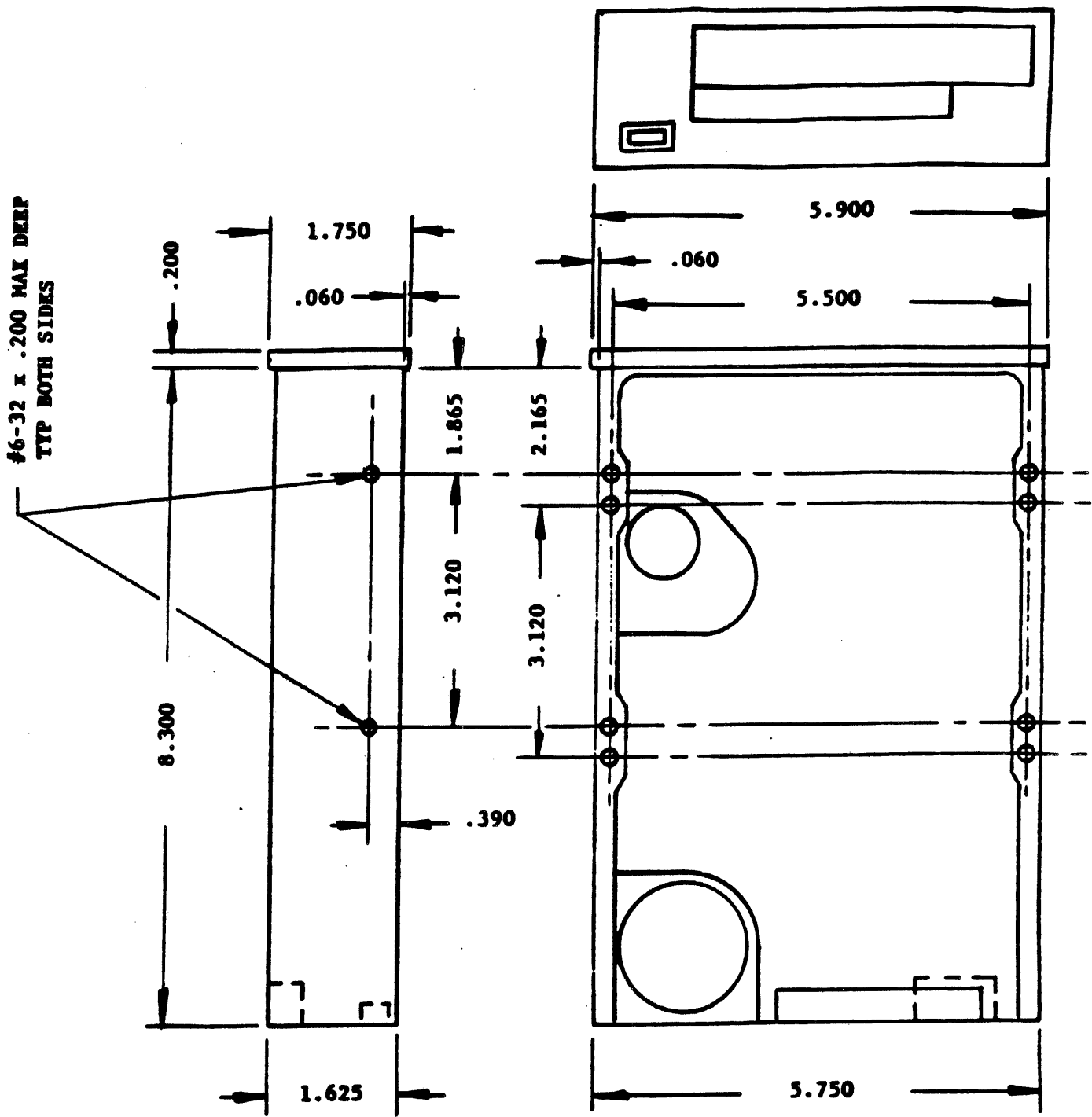
Heat dissipation from a single drive is normally 27.8 watts, 95 BTU/hour (Basic Drive). When the drive is mounted to allow free flow of air over the components, normal convection cooling will be sufficient to operate within the specified temperature range.

When forced air is introduced, the flow must be directed outward from the drive through a filter to avoid the introduction of contaminants. Do not intake air from the enclosure exterior and force it across the drive, as it will cause contamination in critical areas.

Eight 6-32 tapped mounting holes are provided on the bottom of the drive, in addition to four mounting holes on the drive side rails. When installed in either plane, horizontal or vertical, only three mounting screws are required to securely fasten the drive in place. The basic drive mounting holes are shown in Figure 2.0. The drive/formatter combination mounting holes are shown in Figure 2.1.

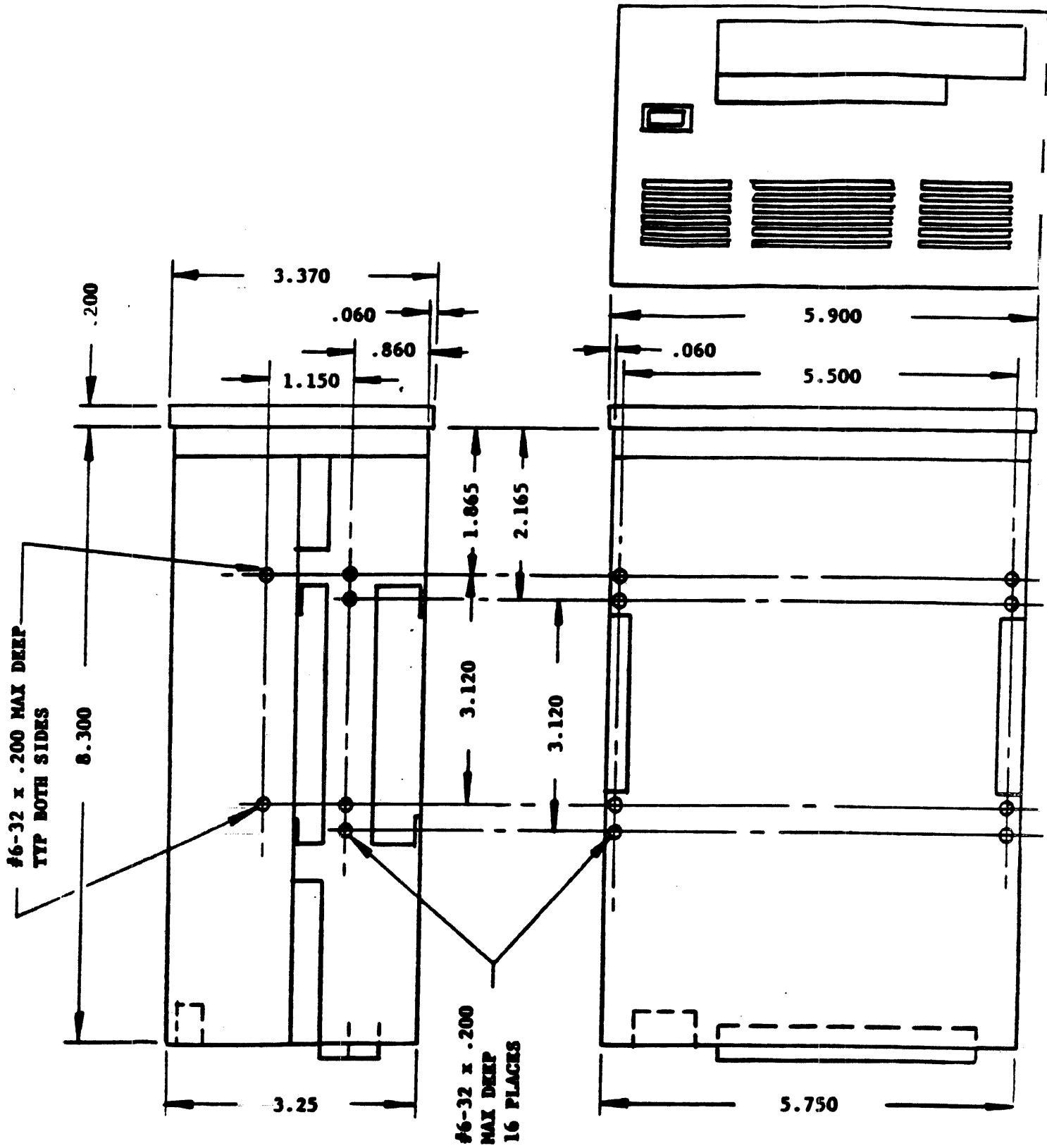
Any mounting schemes which the drive is an integral part of the structural integrity of the enclosure are not permitted.

The drive is manufactured and tested with several critical internal alignments, which must be maintained to guarantee data reliability. Therefore, it is recommended that the mounting hardware not introduce significant stress on the drive chassis.



Basic Drive Mounting Holes

Figure 2.0



Drive/Formatter Mounting Holes

Figure 2.1

2.2 ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE

Operational	+ 5 to + 45 degrees Celsius
Non-Operational	- 30 to + 60 degrees Celsius

NOTE: Assure that the base plate of the cartridge never exceeds + 45 degrees Celsius.

RELATIVE HUMIDITY

Operational	20 % to 80 % non-condensing
Non-Operational	0 % to 99 % non-condensing

THERMAL GRADIENT

Operational	Not to exceed 1.0 degrees C per minute.
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ALTITUDE

Operational	- 1000 to 15,000 feet
Non-Operational	- 1000 to 50,000 feet

SHOCK

Operational	2.5 g max., 1/2 sine wave, 11 mSec. duration on any axis.
Non-Operational*	30 g max., 1/2 sine wave, 11 mSec. duration on any axis.

* Packaged in Wangtek NTSA specified container.

VIBRATION

Operational	0.005 inch max. peak to peak displacement 0 to 63 Hz; 1 g max. acceleration 63 to 500 Hz.
Non-Operational	0.1 inch max. peak to peak displacement 0 to 17 Hz.; 1.5 g max. acceleration 17 to 500 Hz.

ACOUSTICAL NOISE

The drive, without a cartridge installed, will generate a maximum of 55 dBA, weighted over a period of 60 seconds and measured 1 meter from the drive in all axis.

SAFETY

The drive complies with UL, CSA, AND IEC 380 safety requirements. The UL recognized component number is E88192(S). This is the approval for the Wangtek Series 5000E cartridge tape drive. The Series 5000E cartridge tape drive is also certified by CSA (Canadian Standards Association) under Number LR 56870-1. The file number for IEC 380 compliance is 855050.

ELECTROMAGNETIC COMPATIBILITY

This equipment generates and uses radio frequency energy and if not installed and used correctly, that is, in strict accordance with the manufacturers instructions, may cause interference to radio and television reception. This drive has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by using one or more of the following measures.

- o Reorient the receiving antenna
- o Relocate the computer with respect to the receiver
- o Move the computer away from the receiver
- o Plug the computer into a different outlet so that the computer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems"

This booklet is available from the U.S. Government Printing Office, Washington DC 20402. Stock No. 004-000-00345-4.

2.3 PHYSICAL CHARACTERISTICS

DIMINSIONS

Basic Unit (Half Height)

Depth	8.5 inches	215,9 mm
Width	5.75 inches	146,1 mm
Height	1.625 inches	41,3 mm
Weight	2.4 Pounds	1.1 Kilograms

Drive with Intelligent Formatter (Full Height)

Depth	8.5 inches	215,9 mm
Width	5.75 inches	146,1 mm
Height	3.25 inches	82,6 mm
Weight	3.6 Pounds	1.6 Kilograms

FRONT BEZEL

Bezels are available in a full or half-high configuration. The bezels are available in either black or IBM PC AT grey. The half-high bezels are available with either four or three flanges, the three flange bezel having a flange missing from the bottom of the bezel which allows for mounting the drive on top of another component in a computer system.

2.4 INSTALLATION AND OPERATION

UNPACKING THE DRIVE

The drive is packaged in a protective container to minimize the possibility of damage during shipment. Before opening the container, inspect it for evidence of in-transit damage. Notify the carrier if damage is evident. The following is the recommended procedure for unpacking the drive:

1. Place the container on a flat surface.
2. Open the container and remove the drive(s).
3. Verify the contents of the shipping container by comparing contents with the packing list. Notify a Wangtek representative if a packing discrepancy is evident.
4. Verify the serial number of the drive(s) correspond to that shown on the shipping invoice.
5. Visually inspect the contents of the package for any physical damage. Notify the carrier immediately if there is any damage.

PRE-INSTALLATION CHECKOUT

Prior to applying power to the drive, the following procedure should be implemented:

1. Verify that there are no loose components on the drive.
2. Verify that when the tape cartridge is inserted, the head assembly loads properly.
3. Verify that the drive belt is installed properly.
4. Verify the integrity of the of the printed circuit board mounting.
5. Verify the security of all connectors, and ensure that they are properly oriented, i.e. pin 1 to pin1.

CARTRIDGE LOAD AND UNLOADING

The cartridge is loaded in the drive by placing the cartridge into the front loading slot with the tape door opening facing to the left of the drive. The tape is then loaded by pushing forward until the cartridge meets the rear reference and causes the latch to engage. At this point, the cartridge will eject slightly outside the confines of the front bezel and the head assembly will swing forward to contact the tape surface. This is shown in Figure 2.2.

The cartridge is unloaded from the drive by pushing the cartridge into the tape drive until the latch is released. At this time the cartridge will be released from the drive and will be ejected partially out of the drive assembly. The cartridge can be removed at this time. The cartridge unloading is shown in Figure 2.3.

2.5 PREVENTIVE MAINTENANCE

NOTE: Always remove power to the drive before doing any maintenance.

HEAD CLEANING PROCEDURE

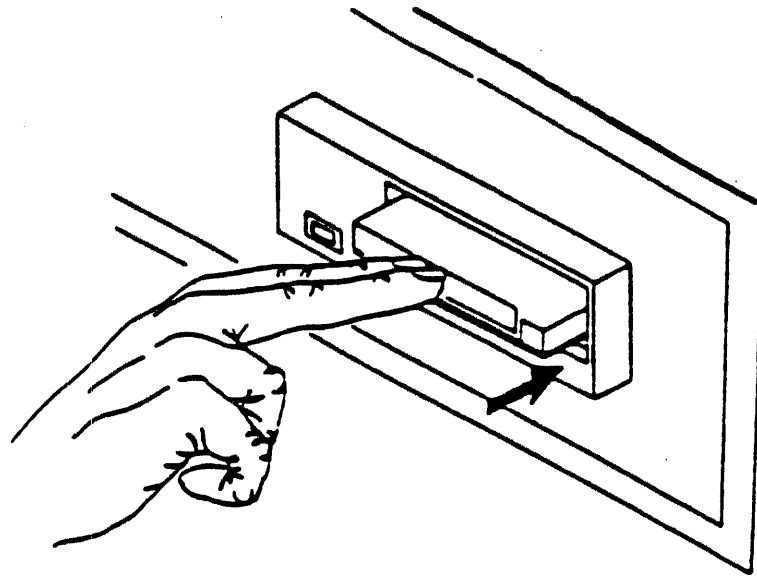
After insertion of a new cartridge, the recording head and the tape cleaners should be cleaned after approximately two hours of use, and every eight hours of use thereafter.

The recommended cleaning procedure is to use a lintless cotton swab soaked with Freon TF or IBM tape cleaner. Isopropyl alcohol will leave a residue on the head and should not be used at any time. For ease of use, the Perfect Data QIC-II Drive Head Cleaning Kit (P/N 102791-21) is also recommended. For users located in Europe, a similar head cleaning cartridge is available from DSS located at the following address:

Datenträger Sicherheits Service
Silvrestasse 14
7000 Stuttgart 60
West Germany Phone 07 11/33 73.17

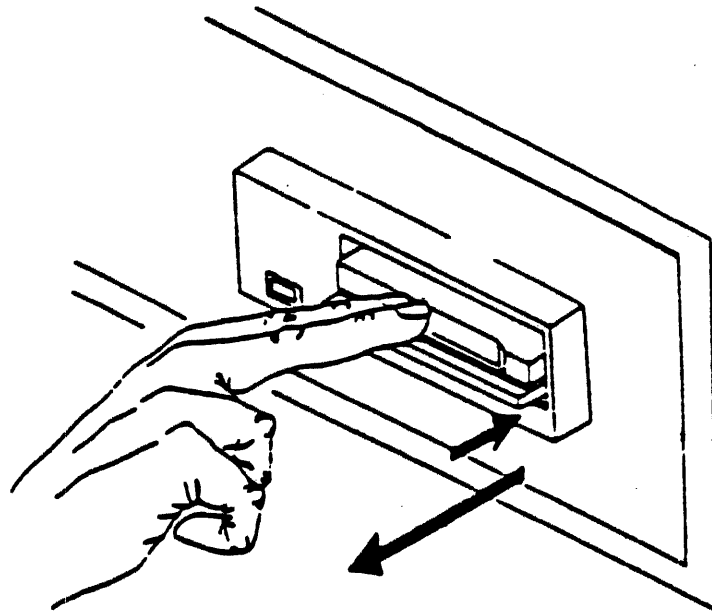
Cartridge Loading

Figure 2.2



Cartridge Unloading

Figure 2.3



2.6 TAPE CARTRIDGE

The tape cartridge used is an ANSI standard 1/4 inch tape (Figure 1.1). The following are recommended 3M tape cartridges to be utilized in the Series 5000E tape drive:

DC 600A	600 ft Data Cartridge
DC 300XL/P	450 ft Data Cartridge
DC 300XL	450 ft Data Cartridge
DC 615A	150 ft Data Cartridge
DC 600XTD	600 ft Data Cartridge

WRITE PROTECT FEATURE

The data on the data cartridge may be protected from erasure by turning the write protect indicator to the SAFE position.

HANDLING AND STORAGE

The tape cartridge must not be exposed to dirt, moisture, or temperature extremes. The user should never open the tape access cover to expose the tape when the cartridge is not in use, and should never physically touch the tape. The oils and acids of the hand can contaminate the tape surface, and magnetic coating.

A properly handled tape cartridge will provide long reliable service. Broken, chipped, or damaged cartridges should be replaced immediately. Any attempt to utilize a damaged cartridge may result in damage to the tape drive.

Storage of the tape cartridges should be in accordance with the manufacturers recommendations. Never place the cartridge near any device which may generate a strong magnetic field.

3.0 ELECTRICAL SPECIFICATIONS

3.1 POWER SUPPLY REQUIREMENTS

Power for the drive is supplied through a connector. The AMP P/N for the connector is 1-480424-0. The AMP P/N for the female contacts is 60619-1. Four of these contacts are required. The connector is configured as follows:

Pin	1	+12 VDC
	2	+12VDC RETURN
	3	+5 VDC RETURN
	4	+5 VDC

The power connector configuration is the same for the basic drive and formatter. The +12 and +5 volt returns are tied together at the drive. However, it is recommended that the host system tie the returns together at the power supply. Also, the return lines are tied to chassis ground via a PCBA mounting screw. There is also an option which allows the board ground and chassis ground to be isolated, if required.

The voltage measured at the power input connector should be as follows:

INPUT	TOL.	RANGE	MAX. RIPPLE
+12V	5%	11.4 to 12.6V	500 mV p-p
+5V	5%	4.75 to 5.25V	100 mV p-p

The minimum supply voltage rise time measured at the power input connector is as follows:

+12V input (0 to 11.4 V)	5 mSec minimum
+5V input (0 to 4.75)	5 mSec minimum

The power supply voltages should be turned on simultaneously.

3.2 INTERFACE REQUIREMENTS FOR THE BASIC DRIVE

There are three types of Basic Drive Main Boards used in the Wangtek Series 5000E tape drive. All of these boards will be discussed separately as there are some differences. The characteristics which are common to all boards are listed below:

SIGNAL LEVELS

All voltage measurements are made at the drive connector with the terminators installed.

Standard TTL signal levels are used at the signal lines to the formatter as follows:

FALSE, logic 0 (High) = 2.4 to 5.25 VDC
TRUE, logic 1 (Low) = 0.0 to 0.55 VDC

Standard TTL signal levels are required on signal lines to the Basic Drive as follows:

FALSE, logic 0 (High) = 2.0 to 5.25 VDC
TRUE, logic 1 (Low) = 0.0 to 0.80 VDC

SIGNAL TERMINATION

The recommended termination is 220 ohms to +5 VDC, and 330 ohms to ground. The resistor network tolerance shall be +/- 10%.

SIGNAL LOADING

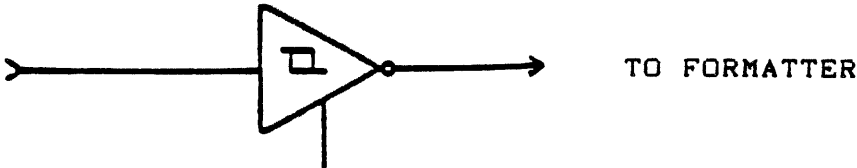
Signals transmitted from the drive are capable of driving two termination networks and a single TTL load. Signals received by the drive are loaded by only one TTL load at each drive plus the necessary termination network. It is recommended that the formatter not load the signal lines from the drive by more than termination network and one TTL load. (Figure 3.0)

INTERFACE CONNECTOR

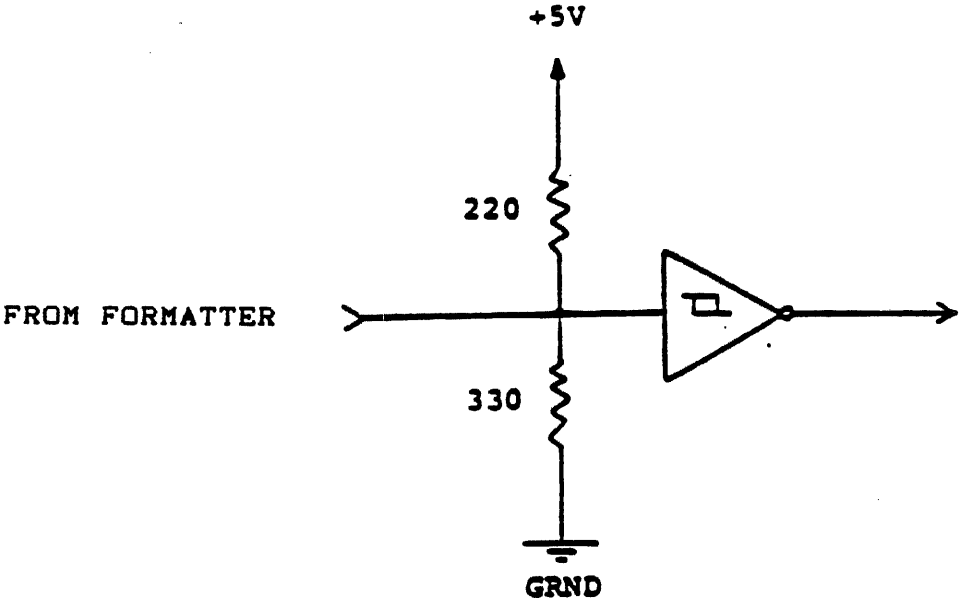
The recommended interface connector on the Series 5000E drive is a 50 conductor flat ribbon cable. This cable does not require shielding. But, in some systems, shielding may be required, e. g. add-on subsystem. The maximum length of the cable should be no longer than 10 feet. The recommended connector is 3M P/N 3425 or equivalent.

Interface Signal
Drivers and Receivers

Figure 3.0



TYPE 74S240



TYPE 74LS14

3.3 POWER TRANSIENTS AND ON/OFF CONDITIONS

No power transients which exceed the limits specified in the power supply specification should exist on the power lines delivered to the drive under any condition.

The following shall be true during periods of power application and removal:

To avoid spurious input commands being seen by the drive, the controller should have a fail-safe method of maintaining the drive in an unselected state (SLT = False) during periods of power application and removal. If it does then the following shall be true:

During Power Removal -----

Presently or previously in the read or any other non-write mode: No writing or erasing which shall render previously recorded data unrecoverable shall occur during the power removal period.

Presently in the write mode: The recording and erase operation shall be unpredictably shut down, hence the block must be re-recorded.

Previously in the write mode (i.e., stopped in a gap after a write operation): No writing or erasing shall occur which shall render previously recorded data unrecoverable.

During Power Application -----

No writing or erasing shall occur which shall render previously written data unrecoverable.

4.0 PERFORMANCE SPECIFICATION

When the drive is operated within the previously described conditions, the following performance shall be achieved:

4.1 TAPE MOTION - STEADY STATE

BIT PERIOD DEFINITIONS

The nominal bit period and the corresponding nominal data transfer rates are shown below:

Nominal Bit Period	1.11 microseconds
Nominal Data Transfer Rate	900,000 bits/Sec

LONG TERM TOLERANCES

The long term average of the nominal bit period at 10,000 flux reversals per inch (frpi) will be within +/- 3%. The bit period shall be as the RDP signal at the drive interface and is defined as being measured over 150 inches (3.81 m) of tape or more.

SHORT TERM TOLERANCES

The short term average bit period at 10,000 frpi will be within +/- 7% of the long term average bit period during recording.

4.2 TAPE MOTION - STARTING AND STOPPING

The start distance and period are defined as the period from application of the state (either forward or reverse) command to when 95% of the final long term speed is reached, exclusive of short term speed changes. The nominal period and distances for starting are shown below.

The stop distance is the actual tape distance traveled during the stop period. During the stop period, which begins when the Drive motion command is set false, the tape shall stop. The nominal period and distances for stopping are shown below.

CONDITION	PERIOD (NOMINAL)	DISTANCE
		NOM IN.
STARTING	98 mSec	3.650
STOPPING	114 mSec	7.203

4.3 RELIABILITY AND FAILURE

The failure definitions listed in this section should be used in conjunction with the Wangtek, Inc. Warranty and also the recommended maintenance schedule; neither of which is contained in this document.

CRITICAL FAILURE

Critical failure is defined as a persistent failure of the drive. Failures caused by operator error, mishandling, power failure, power supply out of specification, out of specification drive controller, interface malfunction including I/O connectors, operation in an adverse (out of specification) environment will not be considered as critical failures.

Multiple repairs required to correct the same failure shall be considered as one failure. Only critical failures will be used in the computation of MTBF.

INFANT MORTALITY FAILURE

Infant mortality failure is defined as a critical failure which occurs during the first 140 hours of operation after installation. These failures, irrespective of frequency, will not be considered in computation of the MTBF.

DUTY CYCLE

The drive duty cycle is defined as follows:

$$\frac{\text{Tape Motion Time}}{\text{Power On Time}} \times 100$$

The typical usage duty cycle of the drive is 15%.

PRODUCT RELIABILITY

The Mean Time Between Failures (MTBF) of the drive is defined as follows:

$$\text{MTBF} = \frac{\text{Power On Hours}}{\text{Number of Critical Failures}} \times 100$$

Based on a typical usage duty cycle of 15%, the MTBF of the drive shall be 8,000 Hours.

Scheduled adjustment and/or replacement of a part or sub-assembly is not considered as a critical failure, therefore it is not considered in computation of MTBF.

5.0 MAIN BOARD ASSEMBLY #30051-XXX INTERFACE

The Main Board assembly number is located to the right of the J1 connector near the center of the board and just below HDR 2 pins. For a more detailed location, see Figure 5.0.

INTERFACE CHARACTERISTICS

There are 25 signal lines at the Basic Tape Drive Interface. Eighteen (18) lines are used for signals that are generated by the formatter, seven (7) lines are used for signals that are generated by the Basic Drive.

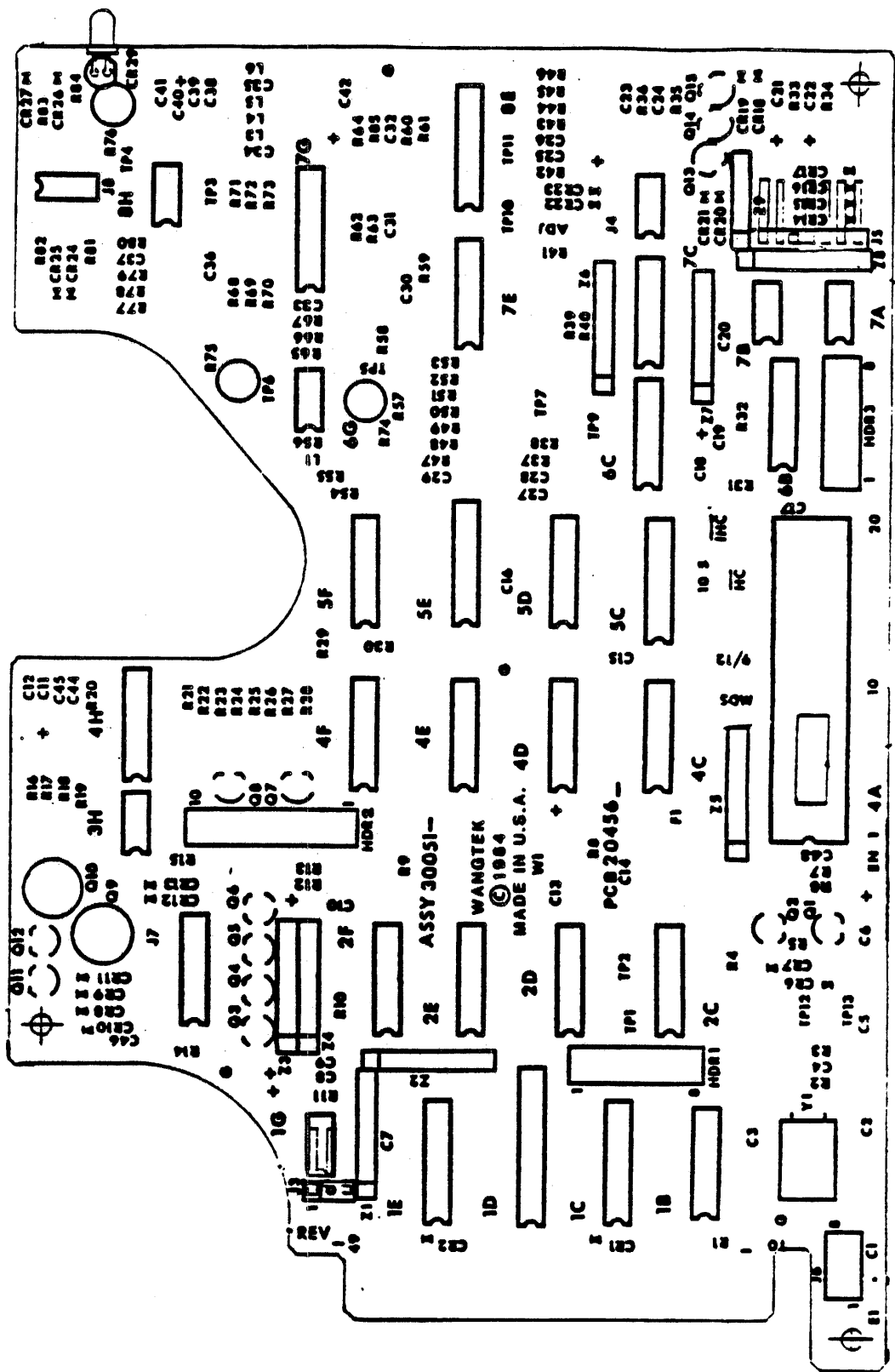
I/O PIN ASSIGNMENTS

PIN#	MNEMONIC	TO	DESCRIPTION
----	-----	--	-----
02	GO -	D	Go control for capstan motor
04	REV -	D	Direction control for capstan
06	TR3 -	D	Track Select Bit #3 (MSB)
08	TR2 -	D	Track Select Bit #2
10	TR1 -	D	Track Select Bit #1
12	TRO -	D	Track Select Bit #0 (LSB)
14	RST -	D	Reset
16	DS3 -	D	Drive Select #3 control
18	DS2 -	D	Drive Select #2 control
20	DS1 -	D	Drive Select #1 control
22	DS0 -	D	Drive Select #0 control
24	HC -	D	High Write Current selected
26	RDP -	F	Read Data Pulse output
28	UTH -	F	Upper Tape Hole position code
30	LTH -	F	Lower Tape Hole position code
32	SEL -	F	Drive Selected response
34	CIN -	F	Cartridge In response
36	USF -	F	Unsafe cartridge response
38	TCH -	F	Tachometer pulses
40	WDA -	D	Write Data signal
42	WDA +	D	Write Data signal (inverse)
44	THD-	D	Threshold Level
46	HSD -	D	High Speed select control
48	WEN -	D	Write Enable control
50	EEN -	D	Erase Enable control

NOTE: All odd pins are signal returns which should be connected to the ground at both the drive (D) and formatter (F).

Main Board

Figure 5.0



The block diagram in Figure 5.1 depicts the functional building blocks for the drive with Main board assembly 30051-XXX installed. The CPU will execute a recalibration and initialization algorithm at power up, reset, or upon cartridge insertion that will last approximately three (3) seconds with no search feature ("EN" jumper installed) or eight (8) seconds with the QIC-24 search feature ("EN" jumper not installed).

The CPU then begins to scan the Formatter/Controller signals to determine which drive control functions are to be performed. Scanned signals DSO-3, TRO-3, REV, and GO will initiate the control functions in the following priority:

1. Track Positioning
2. Tape Hole Responses
3. Motion Control

The scanning operations will be aborted while track positioning and tape start/stop operations are in progress.

5.1 DAISY CHAINING

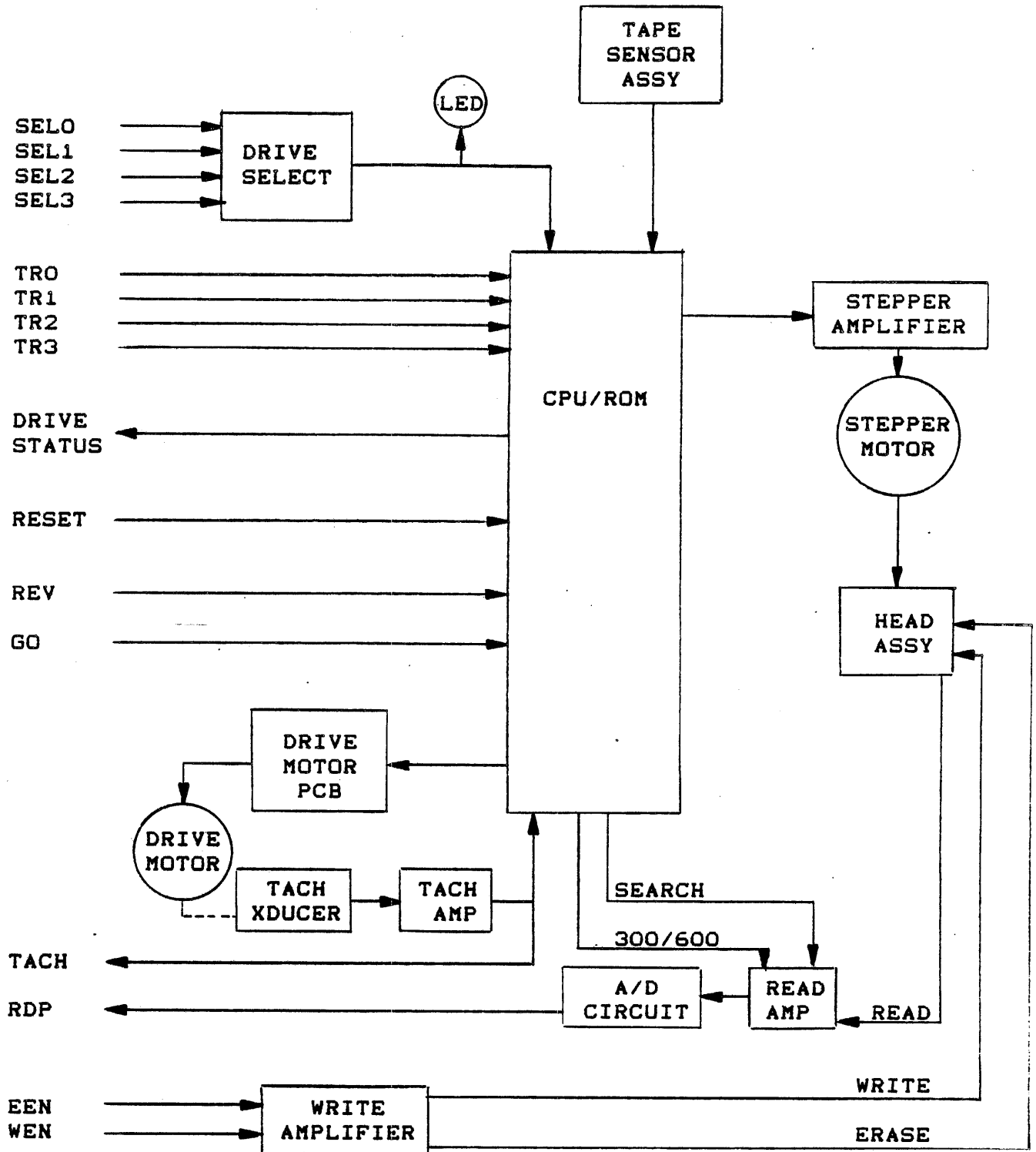
The drive may be configured by the user to be constantly selected or selected by any one of four available discrete select lines. In order to constantly select the drive, a jumper must be placed across pins 8 and 9 of Header 1 on the Main board, as shown in Figure 5.2. Also illustrated in Figure 5.2 are the Daisy chaining jumper locations on Header 1, which allow up to four drives to run from one formatter board, and the recommended drive and terminator locations for Daisy chain operation.

5.2 CAPSTAN MOTOR CONTROL

Two signal lines from the QIC-36 interface control the motion of the capstan motor. They are "GO" control and "Direction" control. Typical tape motion control timing is detailed in Figure 5.3. The assertion of GO is found by the scan, causes tape motion in the direction specified by the state of the REV line. When REV is high, the tape motion is in the forward direction, and when REV is low, the tape will move in the reverse direction. When the tape is in motion, it is permissible to change the state of the track address (TRO-3), but the change will be ignored until tape motion has stopped, or with a change in the REV signal level, which causes a track positioning sequence to occur. Changing the level of REV causes tape motion to stop and restart in the opposite direction. The removal of the cartridge causes the capstan motor to stop.

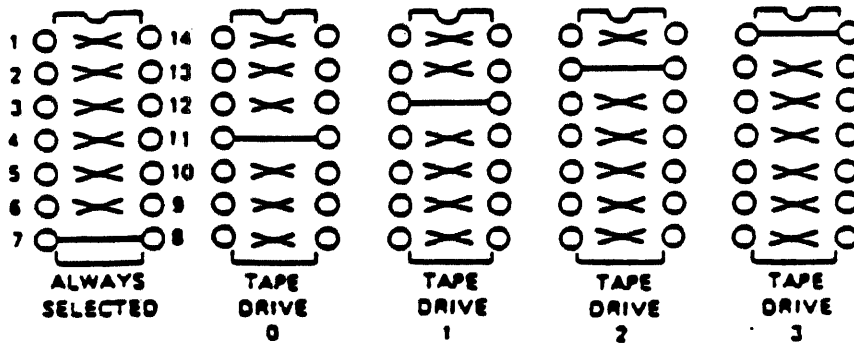
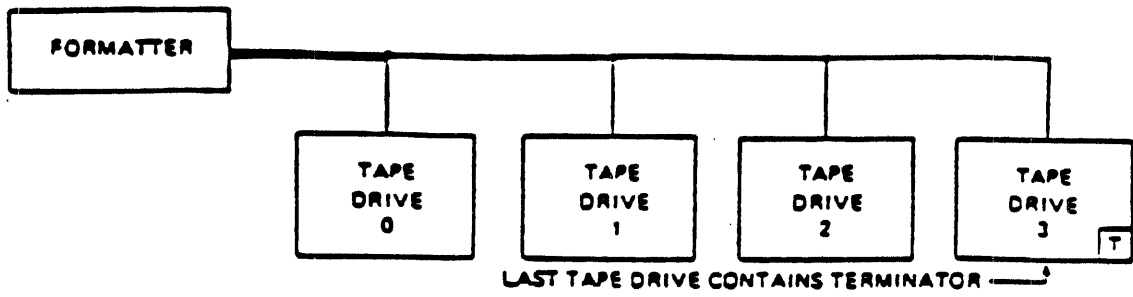
Main Board Assy #30051 Functional Block Diagram

Figure 5.1



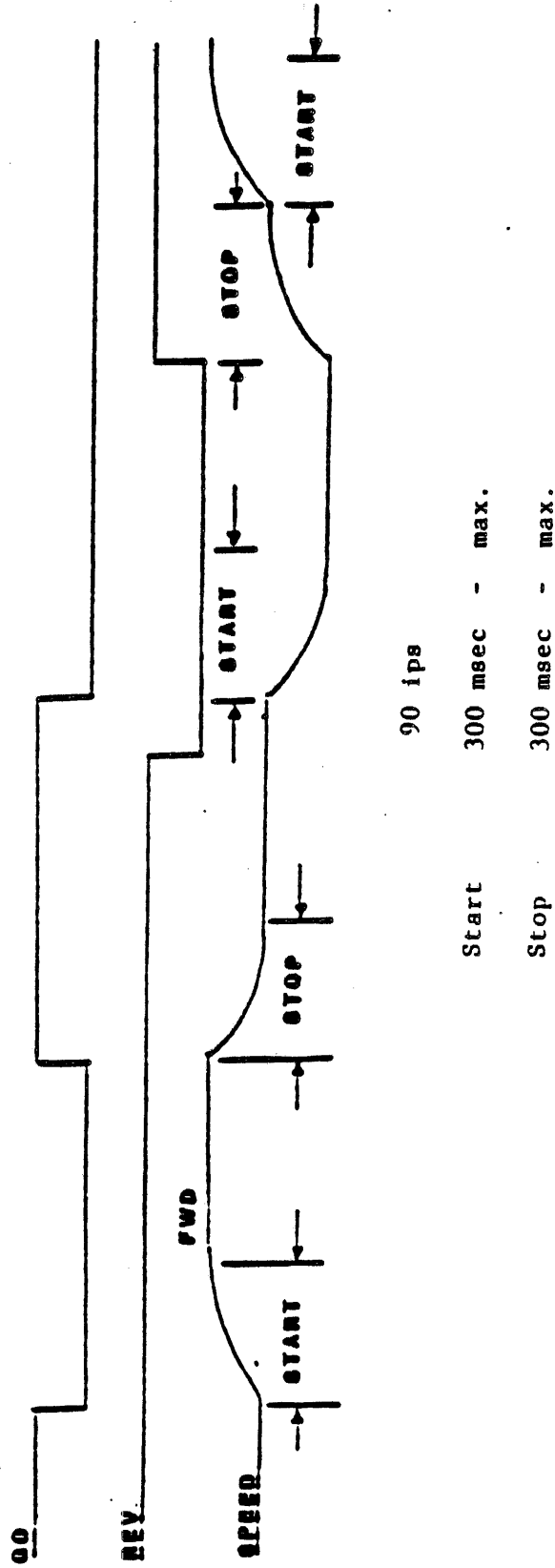
Drive Daisy Chaining and Select Jumper Positioning

Figure 5.2



Tape Motion Control Timing

Figure 5.3



5.3 TAPE POSITION CODE SIGNALS

The tape position code signals are generated by the CPU and are defined by the table below:

UTH	LTH	Description
---	---	-----
1	1	Beginning of Tape (BOT)
0	1	End of Tape (EOT)
1	0	Early Warning (EW)
0	0	Data recording zone (lost during initial load)

When a new cartridge is inserted into the drive, the position of the tape within the cartridge is unknown. It is recommended that the formatter/controller move the tape to BOT to establish a reference point. This is not required if the drive is configured for QIC-24 operation, i.e. the "EN" jumper not installed on the Main board.

If the scanning operation does not detect any further motion commands, the tape will move forward until BOT is sensed and is immediately stopped. Once tape motion is commenced, the Formatter/Controller will detect the Load Point, then the Data Recording Zone, followed by the Early Warning, and EOT, whereby a tape stop sequence is initiated. If REV and GO are subsequently asserted, reverse tape motion occurs and is analogous to the sequence in the forward direction described above.

5.4 TRACK AND HEAD SELECTION

Selection of one of the two heads is performed by the TRO select bit. When false, head zero is selected; when true, head one is selected. Head zero is used for reading or writing in the forward direction only, while head one is used exclusively in the reverse direction.

The assertion of a RESET signal causes the head assembly to initiate a recalibration routine, which takes approximately 8 seconds for drives configured in the QIC-24 format, and approximately 3 seconds for the (search disabled) QIC-11.

With either the 4 or 9 track models, track selection is accomplished with the TR 1-3 select bit signal lines. Track positioning takes 400 mSec per track nominal. The maximum track positioning period is 594 mSec, non-inclusive of deceleration and acceleration times (maximum of 300 mSec each).

5.5 CARTRIDGE IN PLACE

Cartridge In (CIN) is a drive generated signal indicating that the tape cartridge is inserted in the drive correctly.

5.6 RESET

The Reset (RST) is a Formatter/Controller generated signal, which performs the same sequence of events as a power up routine. The minimum reset pulse width measured at the drive interface is 13 microseconds.

5.7 UNSAFE

The Unsafe (USF) is a drive generated signal indicating that the inserted tape cartridge cannot be written on (Write Protected). The file protect tab on the cartridge is in the SAFE position.

5.8 TACHOMETER PULSES

The Tachometer Pulses (TCH) are generated by the drive, where each pulse equals 141 mils +/-3% of tape movement.

5.9 WRITE AND ERASE CONTROLS

The write and erase circuits are depicted in Figure 5.4. The interface signals which control the circuits are "Write Enable Control" (WEN), and "Erase Enable Control" (EEN).

The state of the "Write Data Signal" (WDA+, WDA-) determines if positive or negative current flows through the selected head. Only the inverse states of the write data signal pair is allowed. The write drivers are disabled during a power up/down sequence and while the SAFE switch is enabled.

The erase function is enabled by "Erase Enable Control" (EEN), and is an internally generated AC signal which is used to drive the erase pole. The Erase drivers are disabled during a power up/down sequence and while the SAFE switch is enabled. The erase drivers are only enabled while the drive is at Track 0.

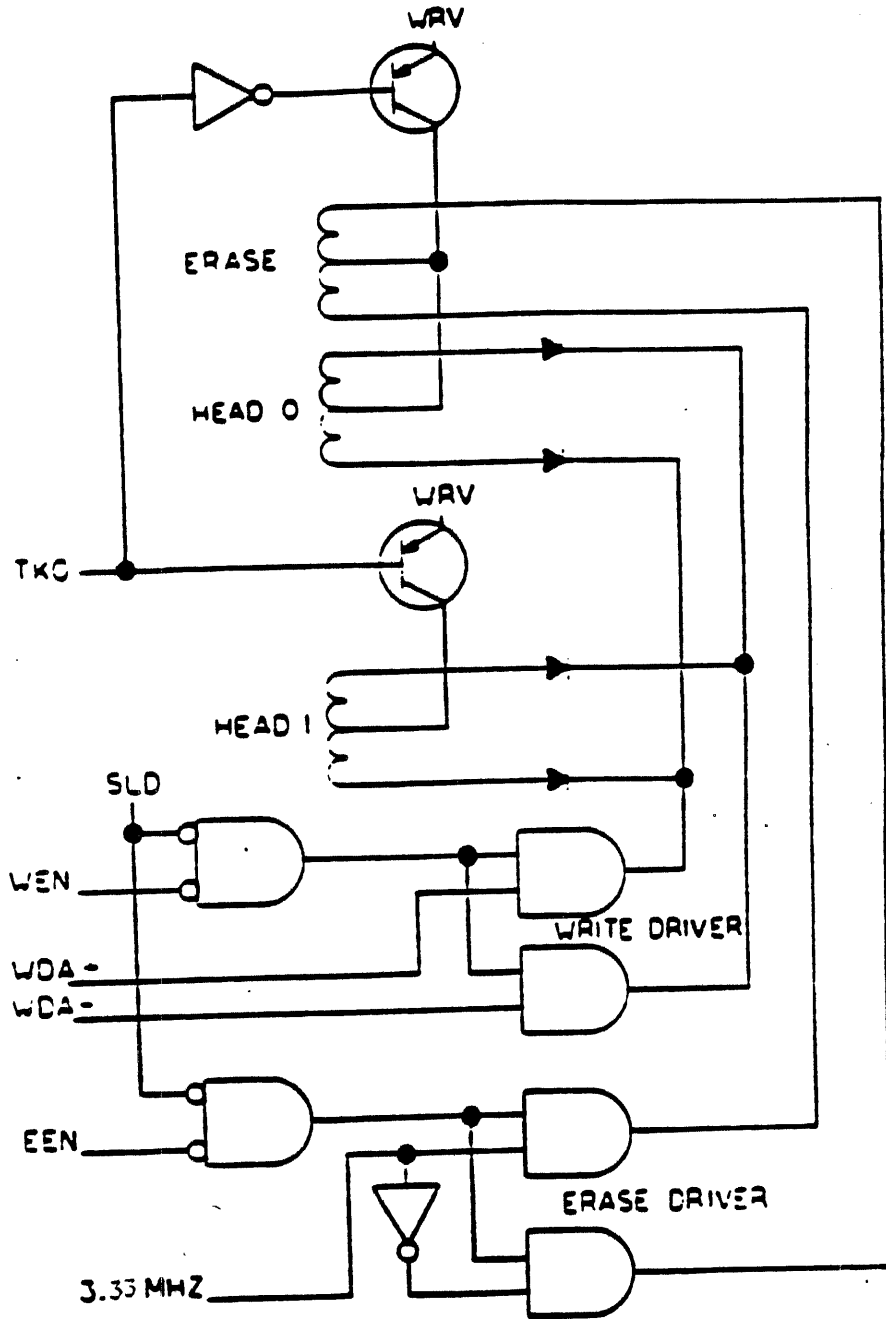
When write is enabled, data transitions must occur with the following intervals:

1.11uSec, 2.22uSec, 3.33uSec.... +/-1%

The recording code must comply with the above requirements.

Write and Erase Controls

Figure 5.4



5.10 READ DATA

Read data from the the tape is first amplified, passed through a differentiator filter circuit, amplified again before being passed through a comparator and a limiter circuit. The signal is digitized prior to output to the "Read Data Output" (RDP). The read data logic diagram is depicted in Figure 5.5.

Peak shift data is as follows for recording areas where the signal amplitude is not less than 25% of nominal:

+/- 0.41 microseconds @ 90 IPS

In areas where the signal amplitude (measured at test points 5 and 6) is less than 25% of nominal, peak shift could possibly be as high as 1/2 a data transition period.

5.11 DRIVE SELECT

The drive can be configured to be selected by any one of the select lines, or to be constantly selected. The select signal is sent to the activity LED and the CPU on the Main board. At the time that the drive is not selected, the drive CPU will respond to a reset command only.

5.12 TRACK REFERENCE BURST SEEK

The Track Reference Burst Seek sequence is initiated each time the drive receives a RST or CIN; either one of these two signals will initiate a rewind sequence until BOT is sensed.

This feature eliminates the head alignment differences of tapes generated on other drives. The drive searches and positions the head to compensate for alignment differences up to 9 mils (12 steps). This feature is only incorporated in drives which are configured for QIC-24 data format, i.e. those drives which do not have a jumper installed at the "EN" location.

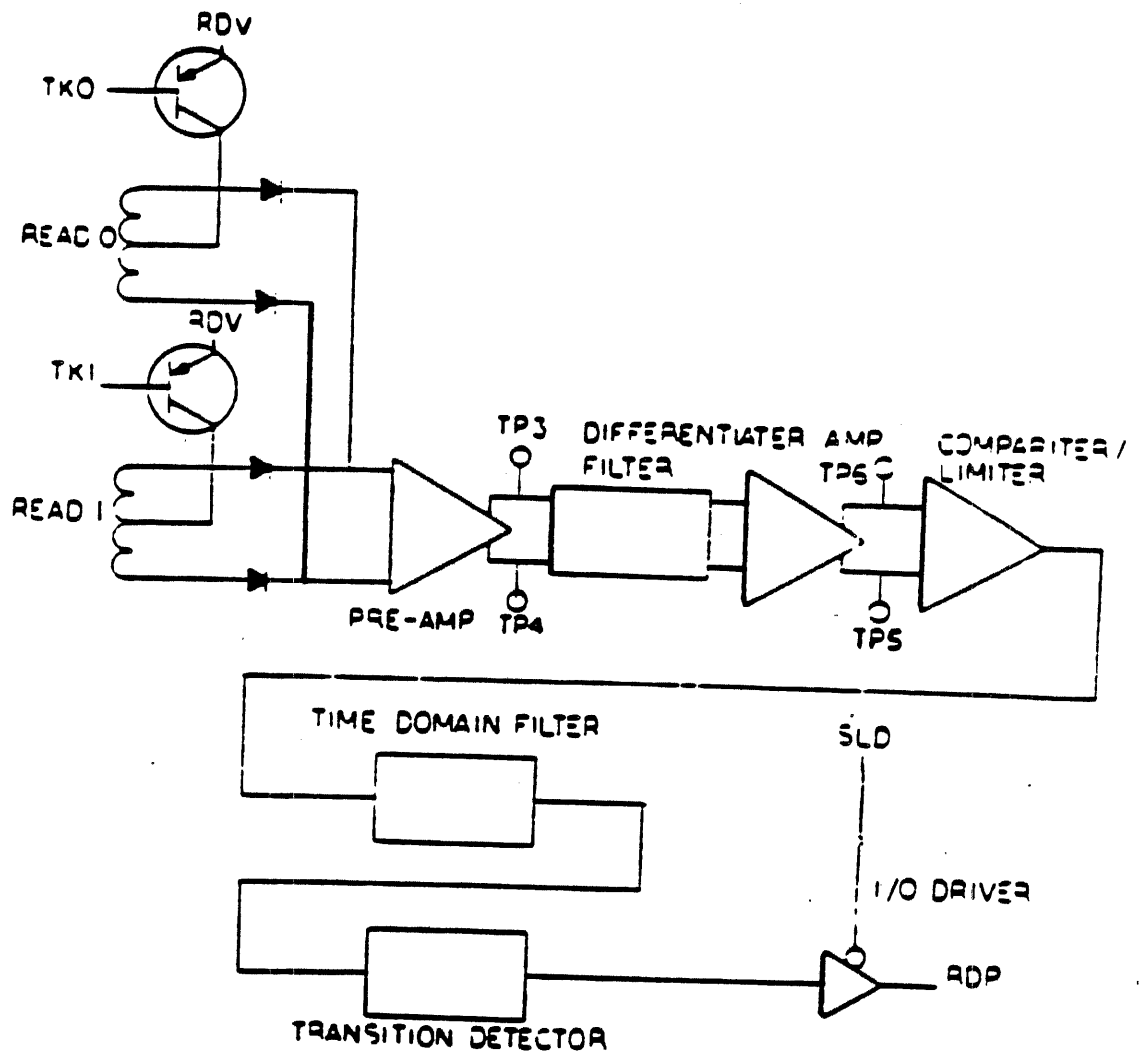
The drive will also read QIC-11 tape (Archive 8 inch format) without the QIC-24 reference burst, but will not correct for head misalignment.

To ensure that the tapes are interchangeable, the drive automatically defaults to theoretical Track 0 whenever a Write operation is initiated, and rewrites the track reference burst.

If a reference burst is not found in the Read Data mode, the drive automatically defaults to a mechanical Track 0 reference.

Read Data Logic

Figure 5.5



The following is the sequence of events which occur during a Track Seek:

1. Determine tape type. This is done to set proper Write currents for tape, by measuring the distance from BOT to LP. The DC 300 tape cartridges have a distance of 36 inches between BOT and Load Point and the DC 600 tape has a distance of 48 inches between BOT and Load Point.
2. The read gain is lowered to approximately 75% of nominal value. The head is positioned below the Track 0 reference point, then positioned up until a defined threshold level is reached. The number of steps is recorded. The same sequence takes place from above the Track 0 reference point. This sequence is repeated three times and the steps (above and below) are calculated to determine the center of the reference burst.

Future track steps are referenced to the position defined in step # 2 above.

5.13 SATURATION RECORDING

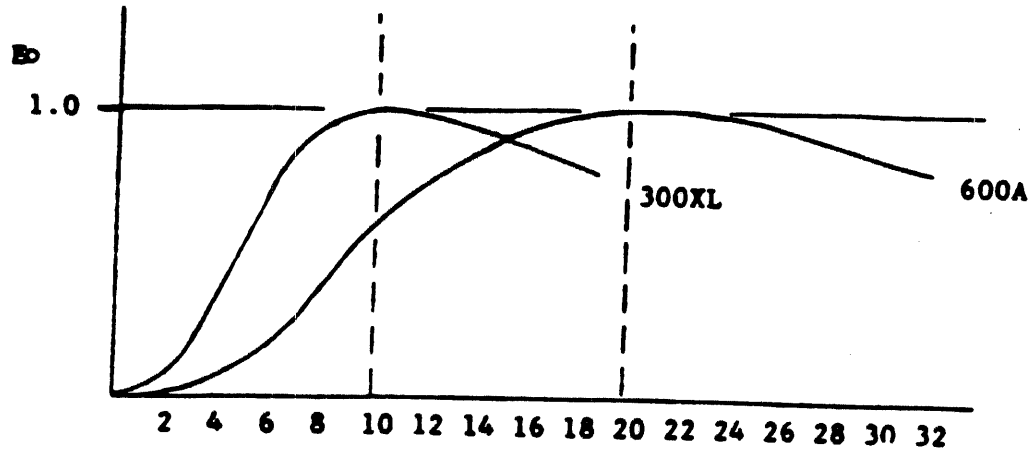
The drive automatically determines whether the inserted cartridge is a DC 300XL or DC 600A, thus making the type of tape being used transparent to the user.

The DC 600A tape requires twice as much current to reach its maximum amplitude. Utilizing the ANSI criteria to determine the operating current, the current for the DC 300XL tape is 20 mAmps peak to peak and the DC 600A tape requires 40 mAmps peak to peak.

Any compromise current will result in over saturating the 300XL tape causing a loss of resolution, and under saturating the 600A tape, making it vulnerable to extremes in amplitude modulation. Figure 5.6 depicts the respective saturation curves.

Tape Coercivity vs Write Current

Figure 5.6



Saturation Curve

5.14 BOARD CONFIGURATION

The board is configured in four different configurations for specific applications. The assembly numbers, jumper locations, and applications are given below. The configuration number (-XXX) will be marked on the board to the right of the assembly number.

ASSY 30051-001

Jumpers Header 1-Pins 5-12
IHC
Application QIC-24 , Search function, Auto tape type selection

ASSY 30051-002

Jumpers Header 1-Pins 5-12
EN, IHC
Application QIC-11, No Search function, DC 300/XL tape only

ASSY 30051-003

Jumpers Header 1-Pins 5-12
EN, HC
Applications QIC-11, No Search function, Tape type selected by Formatter/Controller

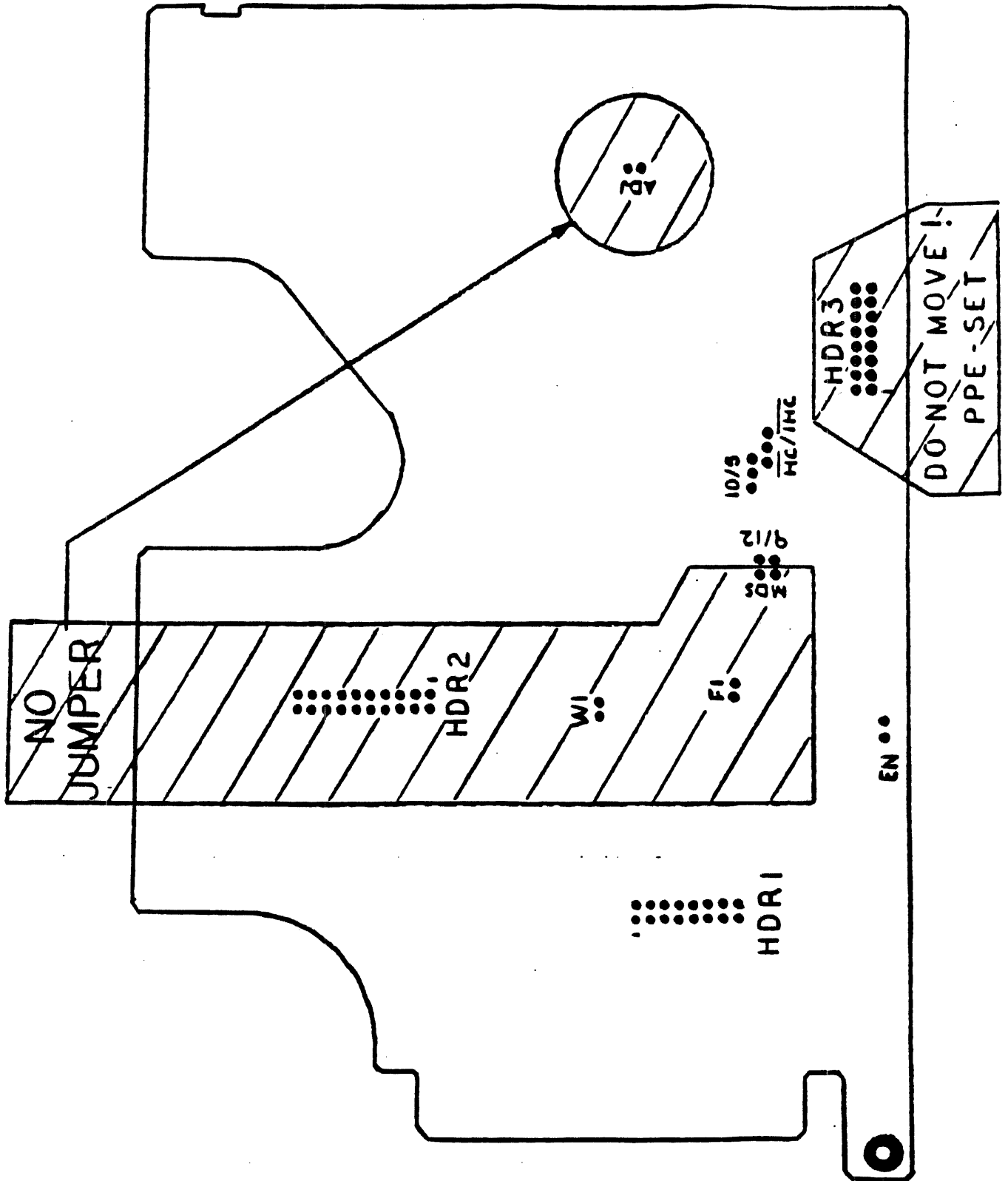
ASSY 30051-004

Jumpers Header 1-Pins 5-12
IHC, Wire 2E-5 to 2E-6
Applications QIC-24, Search function, Auto tape type selection, used with Formatter P/N 20481
(Tach pulses not gated during the Search mode)

NOTE: The jumpers (2) located on Header 3 will be in one of four locations and should not be changed as they control the head stepper motor start phase. Also, the 9/12 jumper may or may not be inserted, this will have no effect on drive performance. The jumper locations are illustrated in Figure 5.7.

Main Board Assy #30051 Jumper Locations

Figure 5.7



5.15 JUMPER DESCRIPTIONS

The various jumpers for the 30051-XXX board and a description of their functions is given below:

- "EN" When installed, disables the QIC-24 Track 0 search function and also the internal tape type determination function.
- "MDS" Reserved for future product use.
- "9/12" When installed, Track locations will always be to QIC-24 9TRK/12TRK specified locations. This jumper has been hard wired on the circuit board. Therefore, there will be no jumper installed at this location.
- "HC" When installed, write current and read gains selected by the "HC" interface control line from the formatter/controller.
- "IHC" When installed, write current and read gains are selected as a function of the microprocessor tape type determination routine.
- "10" Hard wired on board. Selects 10 Megahertz microprocessor clock frequency.
- "5" For Wangtek internal use only.
- "F1" When installed and microprocessor deselected, forces drive to move tape from BOT to EOT and change head positions from Track 0 to Track 8 and repeat this operation until jumper removed or power removed. Microprocessor is deselected by moving jumper on HDR 1 from 5-12 position to 1-16 position.
- "W1" Reserved for future product use.
- "ADJ" When installed, lowers read amplifier gain by approximately 25%. For Wangtek internal use only.

"HDR2" These are special option jumpers for specific applications.

PINS 1-20

If installed, Read Threshold is a function of the "WEN" line. This is an etched jumper on the circuit board, therefore no jumper shall be installed at this location.

PINS 2-19

If installed, Read Threshold is a function of the "THD" interface control line. This jumper must not be installed without first removing the etch at HDR2 PINS 1-20.

PINS 8-13

PINS 3-18

If installed, Erase drivers tied to the on board Erase Clock. This is an etched jumper on the circuit board, therefore no jumper shall be installed at this location.

PINS 4-17

If installed, Erase drivers are tied to "EEN" line for the purpose of bias recording. This jumper must not be installed without first removing the etch at HDR2 PINS 3-18 and 8-13.

"HDR3" This header has two jumpers which control the start phase of the stepper motor at the recalibration position. These jumpers should not be moved as the Track 0 reference location will be changed.

PINS 1-16

5-12

When installed, Motor Phase 1 is selected.

PINS 2-15

6-11

When installed, Motor Phase 2 is selected.

PINS 3-14

7-10

When installed, Motor Phase 3 is selected.

PINS 4-13

8-9

When installed, Motor Phase 4 is selected.

6.0 MAIN BOARD ASSEMBLY #30062-XXX INTERFACE

The Main Board assembly number is located to the right of the J1 connector near the center of the board and just below HDR 2 pins. For a more detailed location, see Figure 6.0.

INTERFACE CHARACTERISTICS

There are 25 signal lines at the Basic Tape Drive Interface. Seventeen (17) lines are used for signals that are generated by the formatter, eight (8) lines are used for signals that are generated by the Basic Drive.

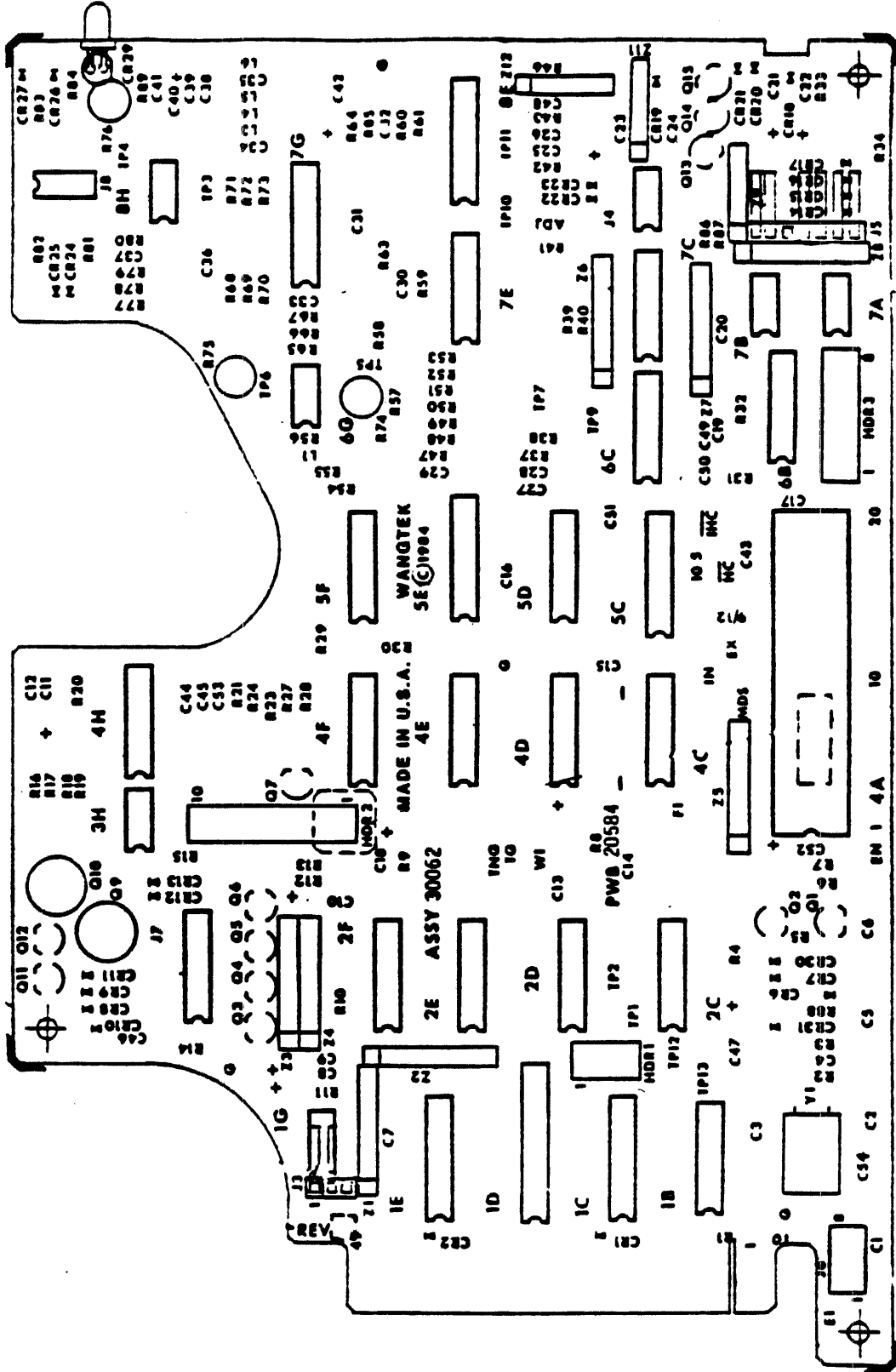
I/O PIN ASSIGNMENTS

PIN#	MNEMONIC	TO	DESCRIPTION
----	-----	--	-----
02	GO -	D	Go control for capstan motor
04	REV -	D	Direction control for capstan
06	TR3 -	D	Track Select Bit 3 (MSB)
08	TR2 -	D	Track Select Bit 2
10	TR1 -	D	Track Select Bit 1
12	TRO -	D	Track Select Bit 0 (LSB)
14	RST -	D	Reset
16	FLT -	F	Drive Fault Status
18	MODE-	D	Recording Mode control
20	DS1 -	D	Drive Select #1 control
22	DS0 -	D	Drive Select #0 control
24	HC -	D	High Write Current selected
26	RDP -	F	Read Data Pulse output
28	UTH -	F	Upper Tape Hole position code
30	LTH -	F	Lower Tape Hole position code
32	SEL -	F	Drive Selected response
34	CIN -	F	Cartridge In response
36	USF -	F	Unsafe cartridge response
38	TCH -	F	Tachometer pulses
40	WDA -	D	Write Data signal
42	WDA +	D	Write Data signal (inverse)
44	THD-	D	Threshold Level
46	HSD -	D	High Speed select control
48	WEN -	D	Write Enable control
50	EEN -	D	Erase Enable control

NOTE: All odd pins are signal returns which should be connected to the ground at both the drive (D) and formatter (F).

Main Board

Figure 6.0



The block diagram in Figure 6.1 depicts the functional building blocks for the drive with Main board assembly 30062-XXX installed. The CPU will execute a recalibration and initialization algorithm at power up, reset, or upon cartridge insertion that will move the head down to "Recalibration" position. At this time, no other tape motion will occur until a "GO" command is issued at the drive interface. When the "GO" command is issued, The drive will move tape to BOT, then determine tape type (300/600), and then perform a Track 0 reference burst search (only if "EN" jumper is not installed).

The CPU then begins to scan the Formatter/Controller signals to determine which drive control functions are to be performed. Scanned signals DSO-1, TRO-3, REV, and GO will initiate the control functions in the following priority:

1. Track Positioning
2. Tape Hole Responses
3. Motion Control

The scanning operations will be aborted while track positioning and tape start/stop operations are in progress.

6.1 DAISY CHAINING

The drive may be configured by the user to be constantly selected or selected by any one of two available discrete select lines. In order to constantly select the drive, a jumper must be placed across pins 4 and 5 of Header 1 on the Main board, as shown in Figure 6.2. Also illustrated in Figure 6.2 are the Drive Select jumper locations on Header 1. The drive can be selected to operate as either Drive 0 or Drive 1, although Daisy Chaining is not recommended for the 30062-XXX Main Board Assembly.

6.2 CAPSTAN MOTOR CONTROL

Two signal lines from the QIC-36 interface control the motion of the capstan motor. They are "GO control" and "Direction control". Typical tape motion control timing is detailed in Figure 6.3. The assertion of GO is found by the scan, causes tape motion in the direction specified by the state of the REV line. When REV is high, the tape motion is in the forward direction, and when REV is low, the tape will move in the reverse direction. When the tape is in motion, it is permissible to change the state of the track address (TRO-3), but the change will be ignored until tape motion has stopped, or with a change in the REV signal level, which causes a track positioning sequence to occur. Changing the level of REV causes tape motion to stop and restart in the opposite direction. The removal of the cartridge causes the capstan motor to stop.

Main Board Assy #30062 Block Diagram

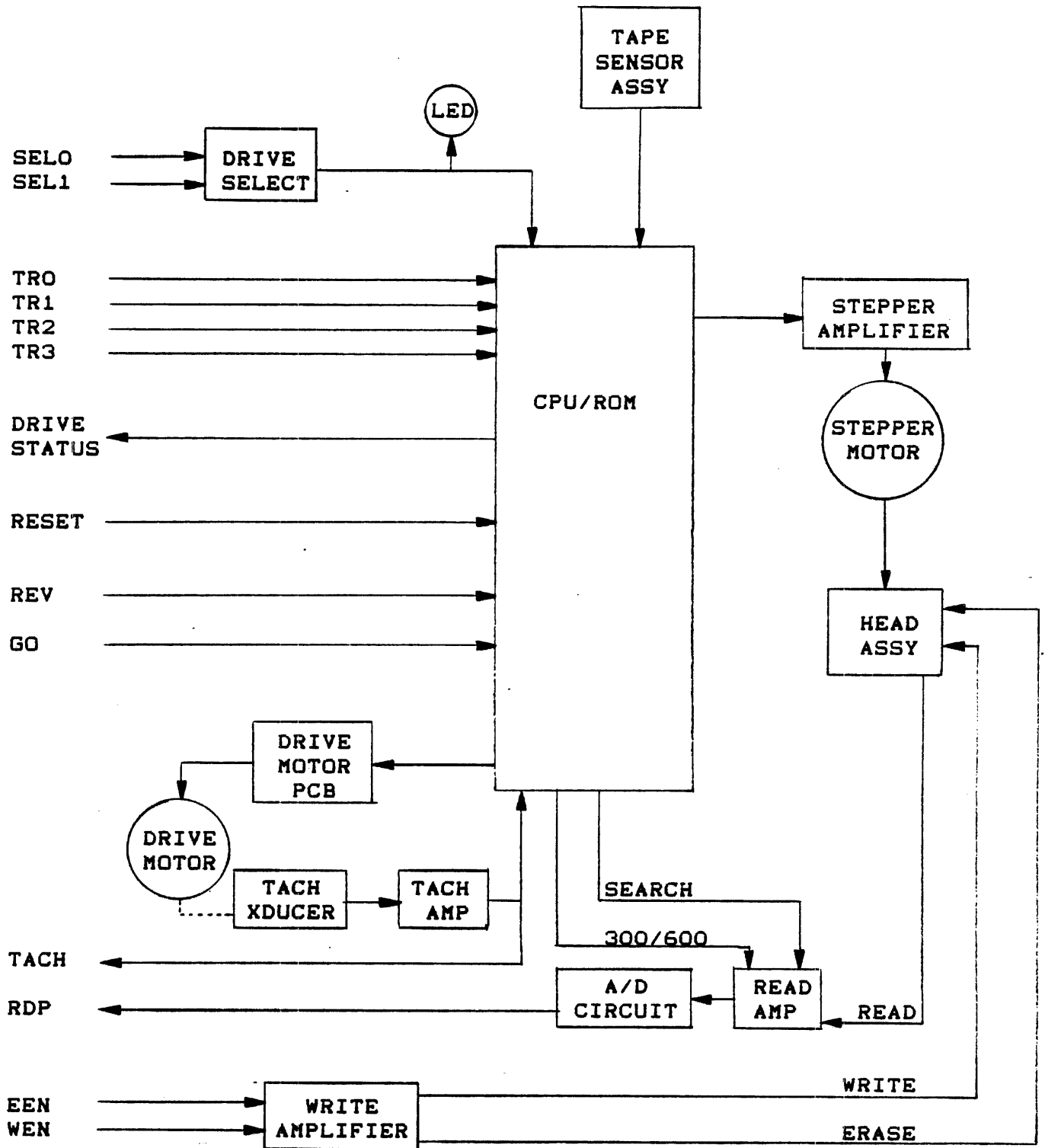
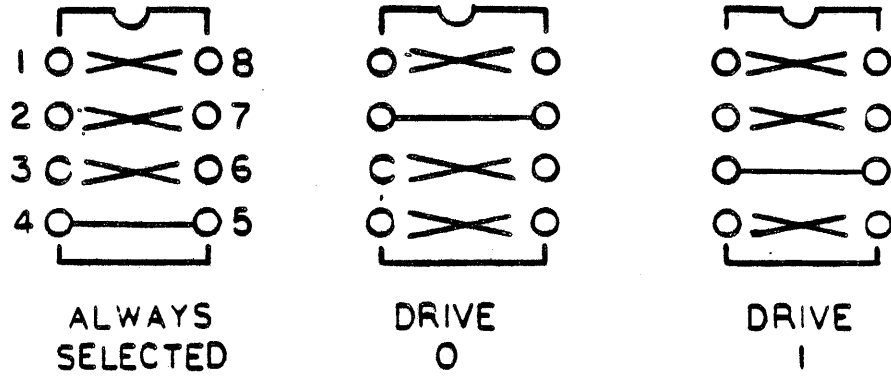


Figure 6.1

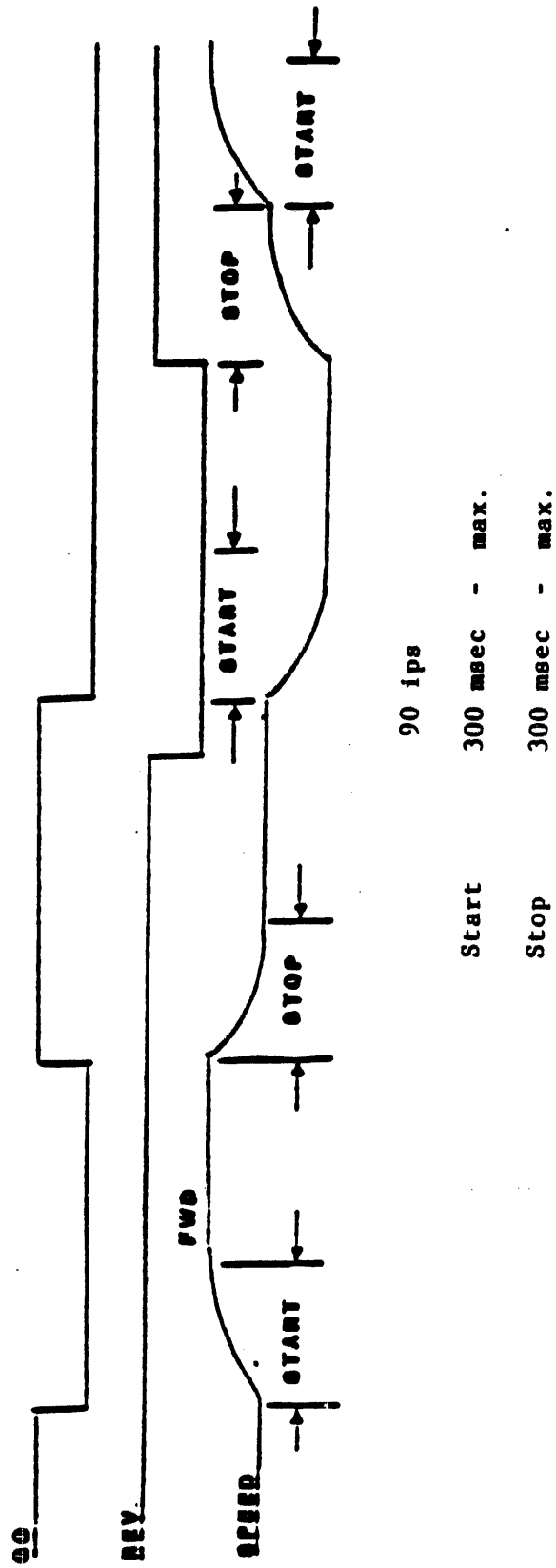
Main Board Assy #30062 Select Jumpers

Figure 6.2



Tape Motion Control Timing

Figure 6.3



6.3 TAPE POSITION CODE SIGNALS

The tape position code signals are generated by the CPU and are defined by the table below:

UTH	LTH	Description
---	---	-----
1	1	Beginning of Tape (BOT)
0	1	End of Tape (EOT)
1	0	Early Warning (EW)
0	0	Data recording zone (lost during initial load)

When a new cartridge is inserted into the drive, the position of the tape within the cartridge is unknown. The drive then moves the tape in the reverse direction to BOT to establish a reference point.

If the scanning operation does not detect any further motion commands, the tape will move forward until BOT is sensed and is immediately stopped. Once tape motion is commenced, the Formatter/Controller will detect the Load Point, then the Data Recording Zone, followed by the Early Warning, and EOT, whereby a tape stop sequence is initiated. If REV and GO are subsequently asserted, reverse tape motion occurs and is analogous to the sequence in the forward direction described above.

6.4 TRACK AND HEAD SELECTION

Selection of one of the two heads is performed by the TRO select bit. When false, head zero is selected; when true, head one is selected. Head zero is used for reading or writing in the forward direction only, while head one is used exclusively in the reverse direction.

The assertion of a RESET signal causes the head assembly to initiate a recalibration routine, which moves the head carriage down to a mechanical reference point.

In either the 4 or 9 track models, track selection is accomplished with the TR 1-3 select bit signal lines. Track positioning takes 400 mSec per track nominal. The maximum track positioning period is 596 mSec, not inclusive of tape deceleration and acceleration (maximum of 300mSec each).

6.5 CARTRIDGE IN PLACE

Cartridge In (CIN) is a drive generated signal indicating that the tape cartridge is inserted in the drive correctly.

6.6 RESET

The Reset (RST) is a Formatter/Controller generated signal, which performs the same sequence of events as a power up routine. The minimum reset pulse width measured at the drive interface is 13 microseconds.

6.7 UNSAFE

The Unsafe (USF) is a drive generated signal indicating that the inserted tape cartridge cannot be written on (Write Protected). The file protect tab on the cartridge is in the SAFE position.

6.8 TACHOMETER PULSES

The Tachometer Pulses (TCH) are generated by the drive, where each pulse equals 141 mils +/-3% of tape movement.

6.9 WRITE AND ERASE CONTROLS

The write and erase circuits are depicted in Figure 6.4. The interface signals which control the circuits are "Write Enable Control" (WEN), and "Erase Enable Control" (EEN).

The state of the "Write Data Signal" (WDA+, WDA-) determines if positive or negative current flows through the selected head. Only the inverse states of the write data signal pair is allowed. The write drivers are disabled during a power up/down sequence and while the SAFE switch is enabled.

The erase function is enabled by "Erase Enable Control" (EEN), and is an internally generated AC signal which is used to drive the erase pole. The erase drivers are disabled during a power up/down sequence and while the SAFE switch is enabled. The Erase drivers are only enabled while the drive is at Track 0 moving tape in the forward direction.

When write is enabled, data transitions must occur with the following intervals:

1.11uSec, 2.22uSec, 3.33uSec.... +/-1%

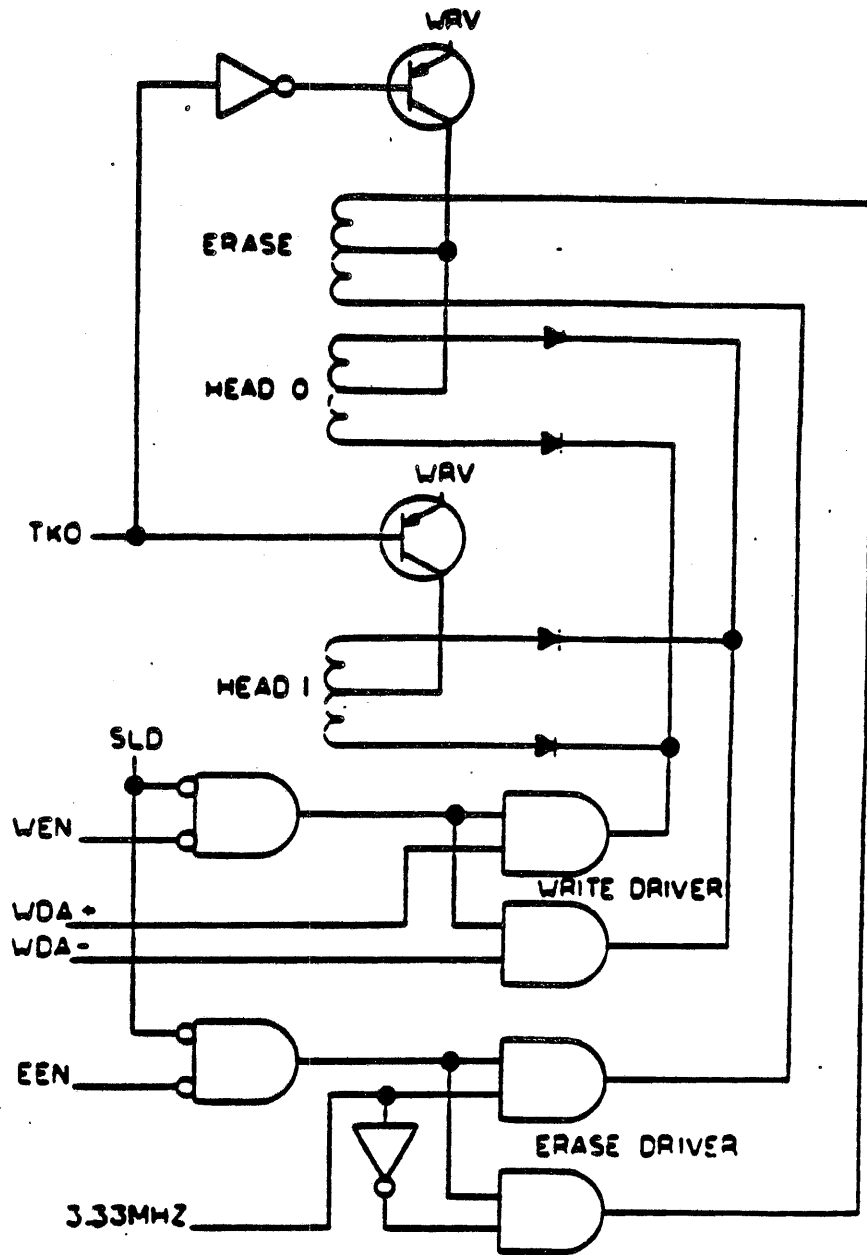
The recording code must comply with the above requirements.

6.10 READ DATA

Read data from the the tape is first amplified, passed through a differentiator filter circuit, amplified again before being passed through a comparator and a limiter circuit. The signal is digitized prior to output to the "Read Data Output" (RDP). The read data logic diagram is depicted in Figure 6.5.

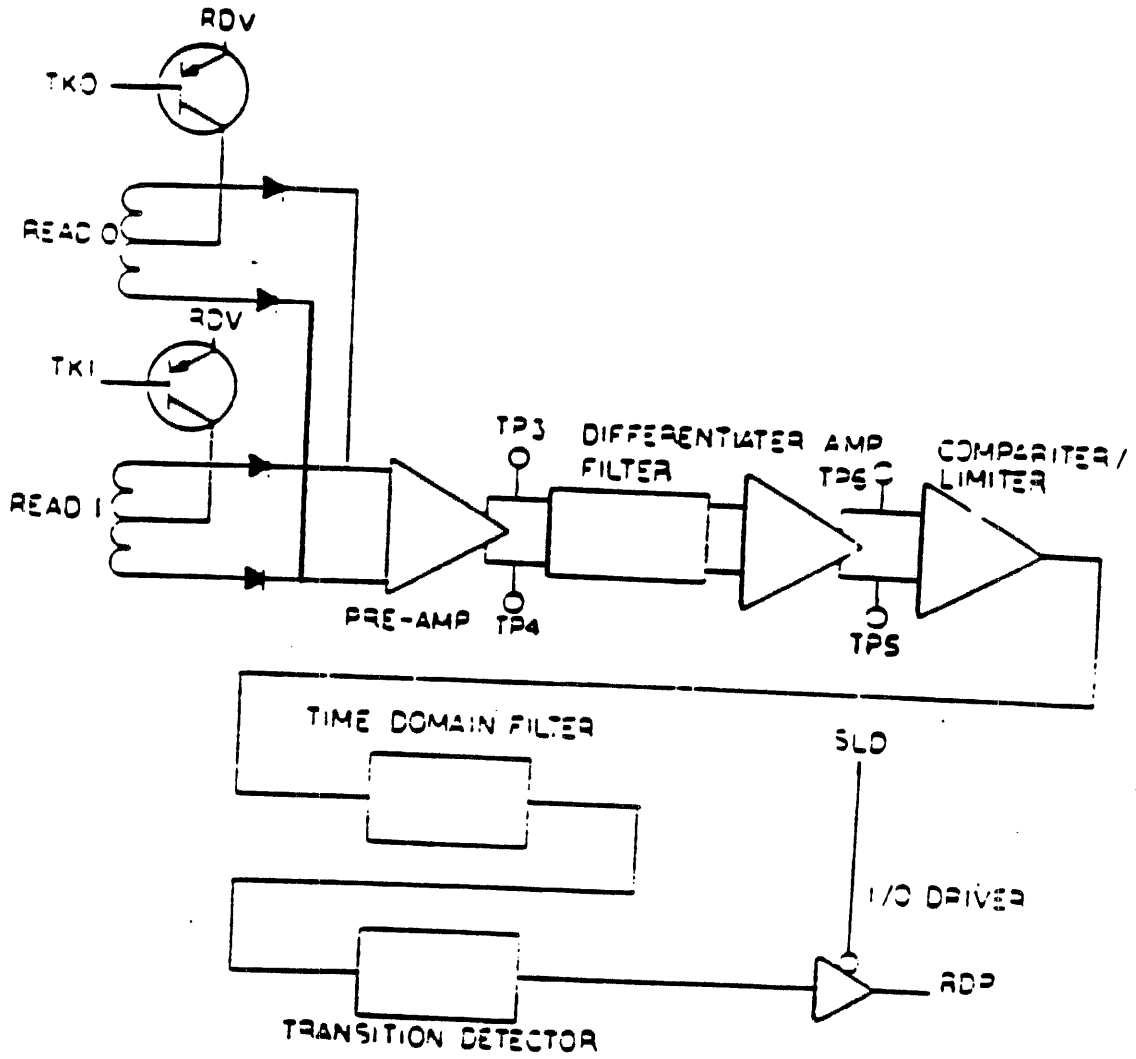
Write and Erase Controls

Figure 6.4



Read Data Logic

Figure 6.5



Peak shift data is as follows for recording areas where the signal amplitude is not less than 25% of nominal:

+/- 0.41 microseconds @ 90 IPS

In areas where the signal amplitude (measured at test points 5 and 6) is less than 25% of nominal, peak shift could possibly be as high as 1/2 a data transition period.

6.11 DRIVE SELECT

The drive can be configured to be selected by any one of the two select lines, or to be constantly selected. The select signal is sent to the activity LED and the CPU on the Main board. At any time that the drive is not selected, the drive CPU will respond to a reset command only.

6.12 TRACK REFERENCE BURST SEEK

The Track Reference Burst Seek sequence is initiated each time the drive receives a RST or CIN; either one of these two signals will initiate a rewind sequence until BOT is sensed.

This feature eliminates the head alignment differences of tapes generated on other drives. The drive searches and positions the head to compensate for alignment differences up to 9 mils(12 steps). This feature is only incorporated in drives which are configured for QIC-24 data format, i.e. those drives which do not have a jumper installed at the "EN" location.

The drive will also read QIC-11 tape (Archive 8 inch format) without the QIC-24 reference burst, but will not correct for head misalignment.

To ensure interchangeability, the drive automatically defaults to theoretical Track 0 whenever a Write operation is initiated, and rewrites the track reference burst.

If a reference burst is not found in the Read Data mode, the drive automatically defaults to a mechanical Track 0 reference.

The following is the sequence of events which occur during a Track Seek:

1. Determine tape type. This is done to set proper Write currents and Read Amp gains for tape type by monitoring the distance from BOT to LP. This is done by counting the number of tach pulses from BOT to LP. The DC 600A tape having a distance of 48 inches and the DC 300 cartridge having a distance of 36 inches between BOT and LP.
2. The read gain is lowered to approximately 75% of nominal value. The head is positioned below the Track 0 reference point, then positioned up until a defined threshold level is reached. The number of steps is recorded. The same sequence takes place from above the Track 0 reference point. This sequence is repeated three times and the steps (above and below) are averaged to determine the center of the reference burst.

Future track steps are referenced to the position defined in step # 2 above.

6.13 SATURATION RECORDING

The drive automatically determines whether the inserted cartridge is a DC 300XL or DC 600A, thus making the type of tape being used transparent to the user. This is true only when the "EN" jumper is not installed.

The DC 600A tape requires twice as much write current in order to saturate the media and produce maximum amplitude. Utilizing the ANSI criteria to determine the operating current, the current for the DC 300XL tape is 20 mAmps peak to peak and the DC 600A tape requires 40 mAmps peak to peak.

Any compromise current will result in over saturating the 300XL tape causing a loss of resolution, and under saturating the 600A tape, making it vulnerable to extremes in amplitude modulation. The saturation curves are shown in a previous section (5.13) in Figure 5.6.

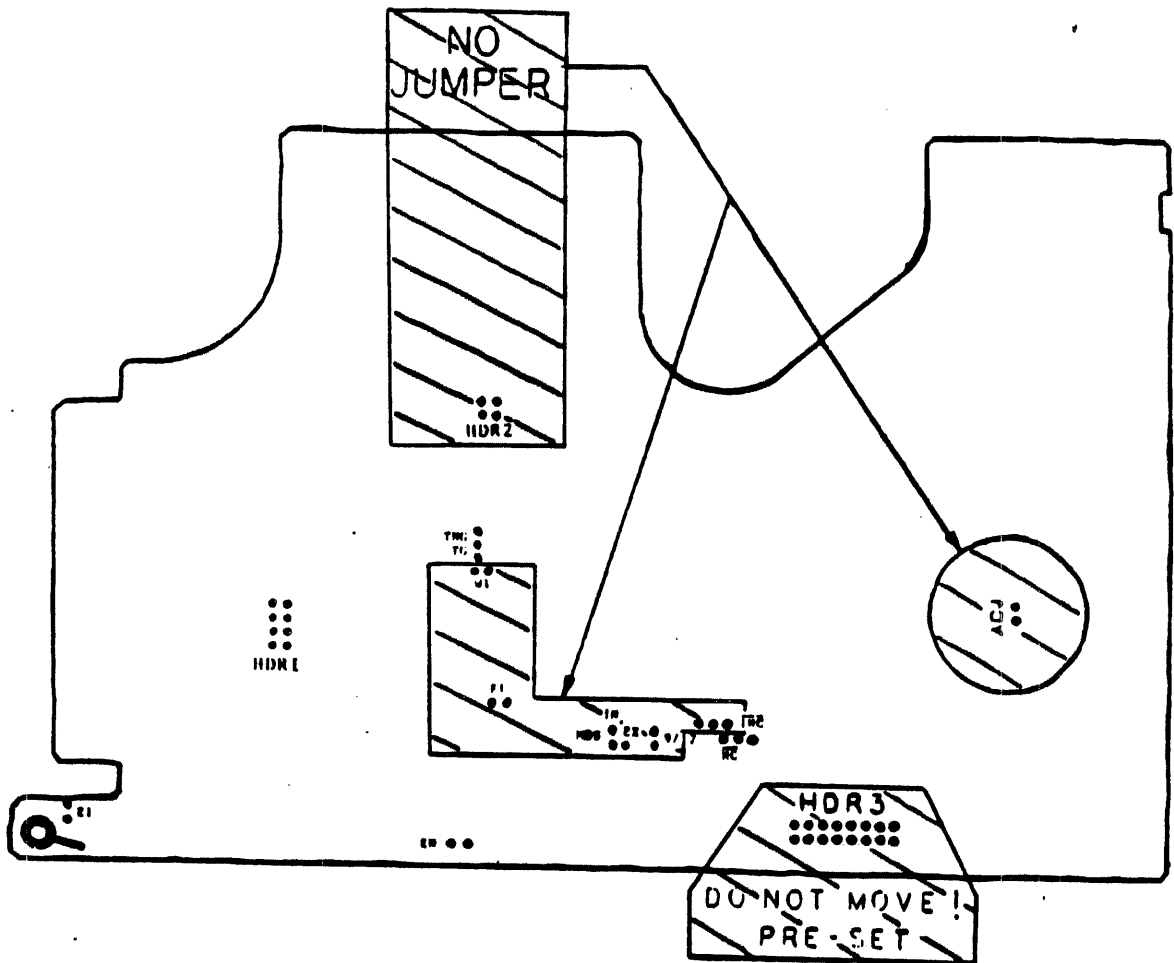
6.14 MAIN BOARD CONFIGURATIONS

The main board can be configured in several variations to accommodate a wide variety of applications. The assembly numbers, jumper locations, and applications are too numerous to list in this document. Should you have a specific application request, please contact Wangtek marketing. The configuration number (-XXX) will be marked on the board to the right of the assembly number.

NOTE: The jumpers (2) located on Header 3 will be in one of four locations and should not be changed as they control the head stepper motor start phase. Also, the 9/12 jumper need not be inserted as it is hard wired on the circuit board. The jumper locations are illustrated in Figure 6.6.

Main Board Assy #30062 Jumper Locations

Figure 6.6



6.15 JUMPER DESCRIPTIONS

The various jumpers for the 30062-XXX board and a description of their functions is given below:

- "E1" When installed, ties the Main board logic ground to chassis ground.
When not installed, Main board logic ground isolated from chassis ground via a 0.47 microfarad ceramic capacitor.
- "EN" When installed, disables the QIC-24 Track 0 search function. Tape type determination (300/600) will be performed after a RESET command as soon as GO command is issued.
When not installed, QIC-24 Track 0 search function and tape determination will be performed after a RESET command as soon as the GO command is issued.
- "MDS IN" Reserved for future product use.
- "MDS EX" Reserved for future product use.
- "9/12" When installed, Track locations will always be to QIC-24 9TRK specified locations. This jumper has been hard wired on the circuit board. Therefore, there will be no jumper installed at this location.
- "HC" When installed, write current and read gains selected by the "HC" interface control line from the formatter/controller.
- "IHC" When installed, write current and read gains are selected as a function of the microprocessor tape type determination routine.
- "10" Hard wired on board. Selects 10 Megahertz microprocessor clock frequency.
- "5" For Wangtek internal use only.
- "F1" When installed, exercise mode enabled when drive and microprocessor are not selected. Moves tape from BOT to EOT and changes head positions from Track 8 to Track 6 to Track 4 to Track 0 and repeats. Microprocessor is deselected by moving jumper on HDR 1 from 2-7 position to 1-8 position.
- "W1" Reserved for future product use.
- "ADJ" When installed, lowers read amplifier gain by approximately 25%. For Wangtek internal use only.

"HDR2" These are special option jumpers for specific applications.

PINS 1-20

If installed, Read Threshold is a function of the "WEN" line. This is an etched jumper on the circuit board, therefore no jumper shall be installed at this location.

PINS 2-19

If installed, Read Threshold is a function of the "THD" interface control line. This jumper must not be installed without first removing the etch at HDR2 PINS 1-20.

"TNG" When installed, the tachometer pulses are transmitted to the formatter/controller at all times that the tach signals are present.

"TG" When installed, the tachometer pulses are gated in a way that the signals are not transmitted to the formatter/controller during the QIC-24 reference burst search operation.

"HDR1" These are drive select jumpers. Only one (1) jumper is to be placed in the HDR1 location.

PINS 1-8

If installed, Microprocessor will be selected as a function of Drive Select. Drive will respond to motion and reset commands only if the drive is selected by the formatter. This jumper must be installed if the drive is to be used in the Daisy Chain configuration.

If not installed, Microprocessor is always selected. Drive will respond to motion and reset commands independent of drive select from formatter. This jumper must be installed in conjunction with the "F1" jumper in order for the self test operation to function.

PINS 2-7

If installed, drive is selected as a function of "SEL 0" interface control line.

PINS 3-6

If installed, drive is selected as a function of the "SEL 1" interface control line.

PINS4-5

If installed, drive is permanently selected.

"HDR3" This header has two jumpers which control the start phase of the stepper motor at the recalibration position. These jumpers should not be moved as the Track 0 reference location will be changed.

PINS 1-16

5-12

When installed, Motor Phase 1 is selected.

PINS 2-15

6-11

When installed, Motor Phase 2 is selected.

PINS 3-14

7-10

When installed, Motor Phase 3 is selected.

PINS 4-13

8-9

When installed, Motor Phase 4 is selected.

7.0 MAIN BOARD ASSEMBLY #30509-XXX INTERFACE

The Main Board assembly number is located to the right of the J1 connector near the center of the board and just below IC 4D. For a more detailed location, see Figure 7.0. This board is used in 30132-XXX and 30134-XXX assemblies only.

INTERFACE CHARACTERISTICS

There are 25 signal lines at the Basic Tape Drive Interface. Seventeen (17) lines are used for signals that are generated by the formatter, eight (8) lines are used for signals that are generated by the Basic Drive.

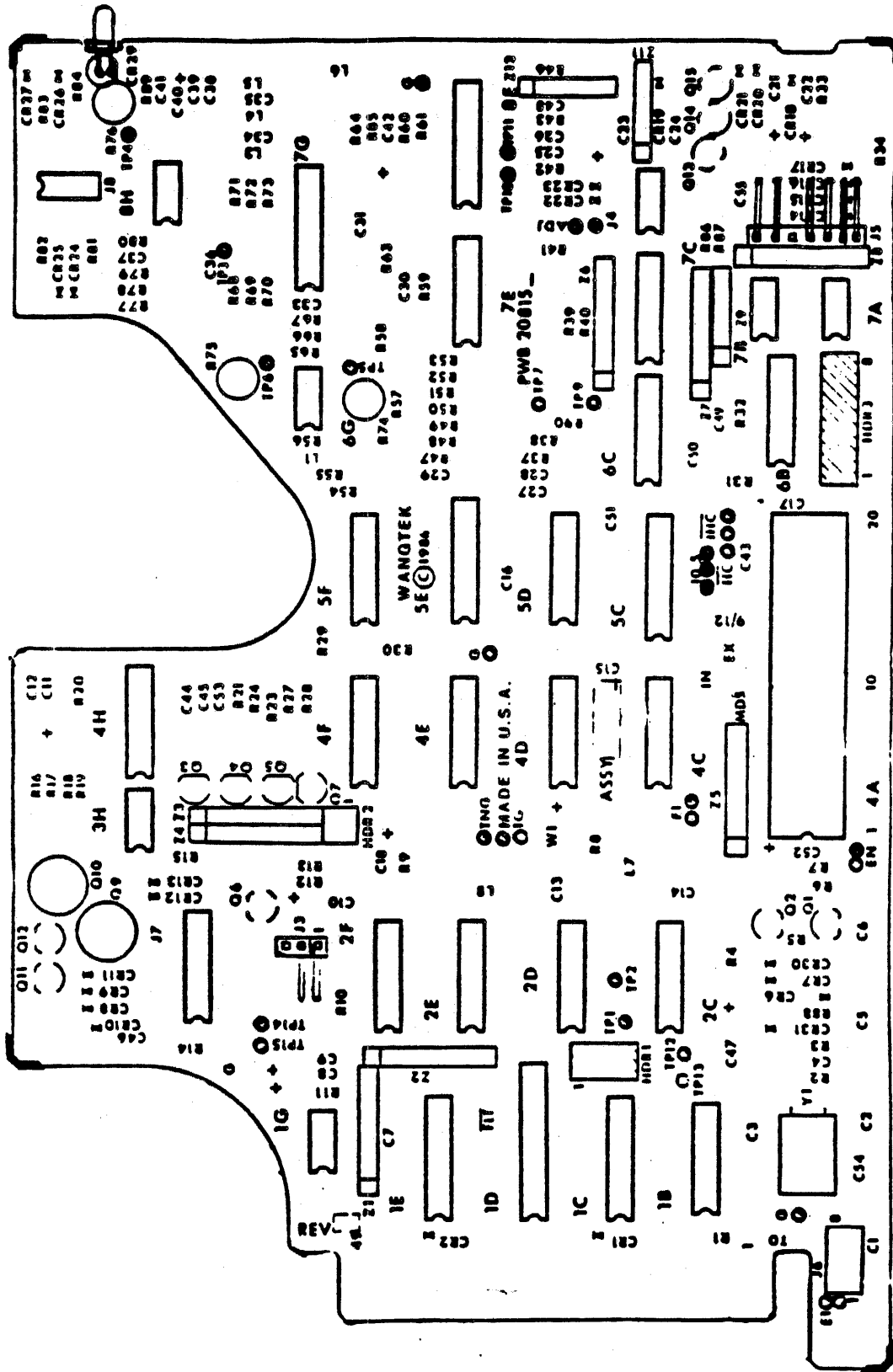
I/O PIN ASSIGNMENTS

PIN#	MNEMONIC	TO	DESCRIPTION
----	-----	--	-----
02	GO -	D	Go control for capstan motor
04	REV -	D	Direction control for capstan
06	TR3 -	D	Track Select Bit 3 (MSB)
08	TR2 -	D	Track Select Bit 2
10	TR1 -	D	Track Select Bit 1
12	TRO -	D	Track Select Bit 0 (LSB)
14	RST -	D	Reset
16	FLT -	F	Drive Fault Status
18	MODE-	D	Recording Mode control
20	DS1 -	D	Drive Select #1 control
22	DS0 -	D	Drive Select #0 control
24	HC -	D	High Write Current selected
26	RDP -	F	Read Data Pulse output
28	UTH -	F	Upper Tape Hole position code
30	LTH -	F	Lower Tape Hole position code
32	SEL -	F	Drive Selected response
34	CIN -	F	Cartridge In response
36	USF -	F	Unsafe cartridge response
38	TCH -	F	Tachometer pulses
40	WDA -	D	Write Data signal
42	WDA +	D	Write Data signal (inverse)
44	THD-	D	Threshold Level
46	HSD -	D	High Speed select control
48	WEN -	D	Write Enable control
50	EEN -	D	Erase Enable control

NOTE: All odd pins are signal returns which should be connected to the ground at both the drive (D) and formatter (F).

Main Board

Figure 7.0



The block diagram in Figure 7.1 depicts the functional building blocks for the drive with Main board assembly 30509-XXX installed. The CPU will execute a recalibration and initialization algorithm at power up, reset, or upon cartridge insertion that will move the head down to "Recalibration" position. At this time, no other tape motion will occur until a "GO" command is issued at the drive interface. When the "GO" command is issued, The drive will move tape to BOT, then determine tape type (300/600), and then perform a Track 0 reference burst search (only if "EN" jumper is not installed).

The CPU then begins to scan the Formatter/Controller signals to determine which drive control functions are to be performed. Scanned signals DSO-1, TRO-3, REV, and GO will initiate the control functions in the following priority:

1. Track Positioning
2. Tape Hole Responses
3. Motion Control

The scanning operations will be aborted while track positioning and tape start/stop operations are in progress.

7.1 DAISY CHAINING

The drive may be configured by the user to be constantly selected or selected by any one of two available discrete select lines. In order to constantly select the drive, a jumper must be placed across pins 4 and 5 of Header 1 on the Main board, as shown in Figure 7.2. Also illustrated in Figure 7.2 are the Drive Select jumper locations on Header 1. The drive can be selected to operate as either Drive 0 or Drive 1, although Daisy Chaining is not recommended for the 30509-XXX Main Board Assembly, as the terminators are soldered into the board and must be removed if the drives are to be daisy chained.

7.2 CAPSTAN MOTOR CONTROL

Two signal lines from the QIC-36 interface control the motion of the capstan motor. They are "GO control" and "Direction control". Typical tape motion control timing is detailed in Figure 7.3. The assertion of GO is found by the scan, causes tape motion in the direction specified by the state of the REV line. When REV is high, the tape motion is in the forward direction, and when REV is low, the tape will move in the reverse direction. When the tape is in motion, it is permissible to change the state of the track address (TRO-3), but the change will be ignored until tape motion has stopped, or with a change in the REV signal level, which causes a track positioning sequence to occur. Changing the level of REV causes tape motion to stop and restart in the opposite direction. The removal of the cartridge causes the capstan motor to stop.

Main Board Assy #30509 Block Diagram

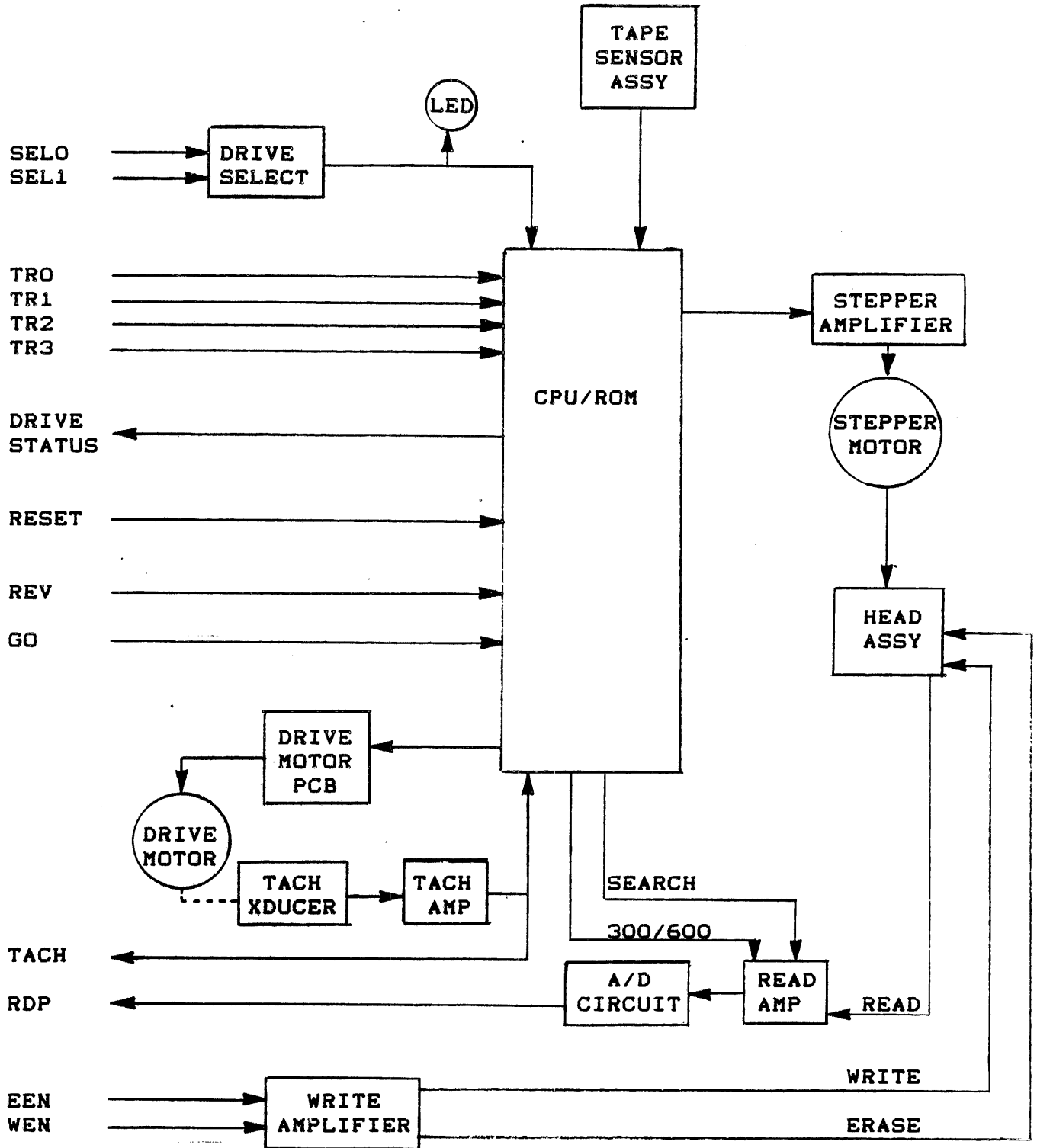
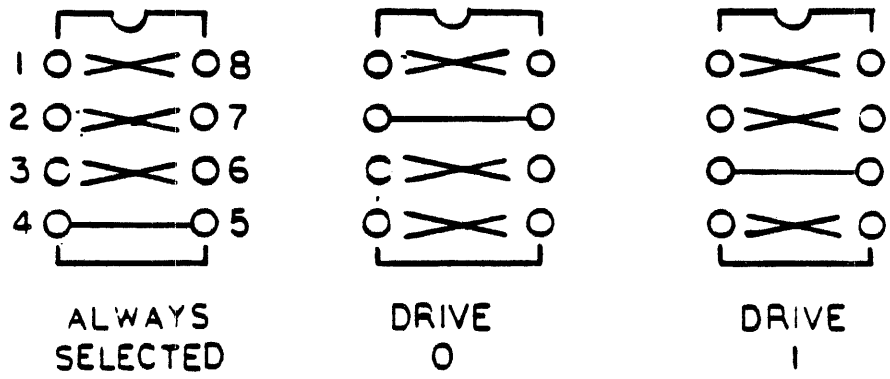


Figure 7.1

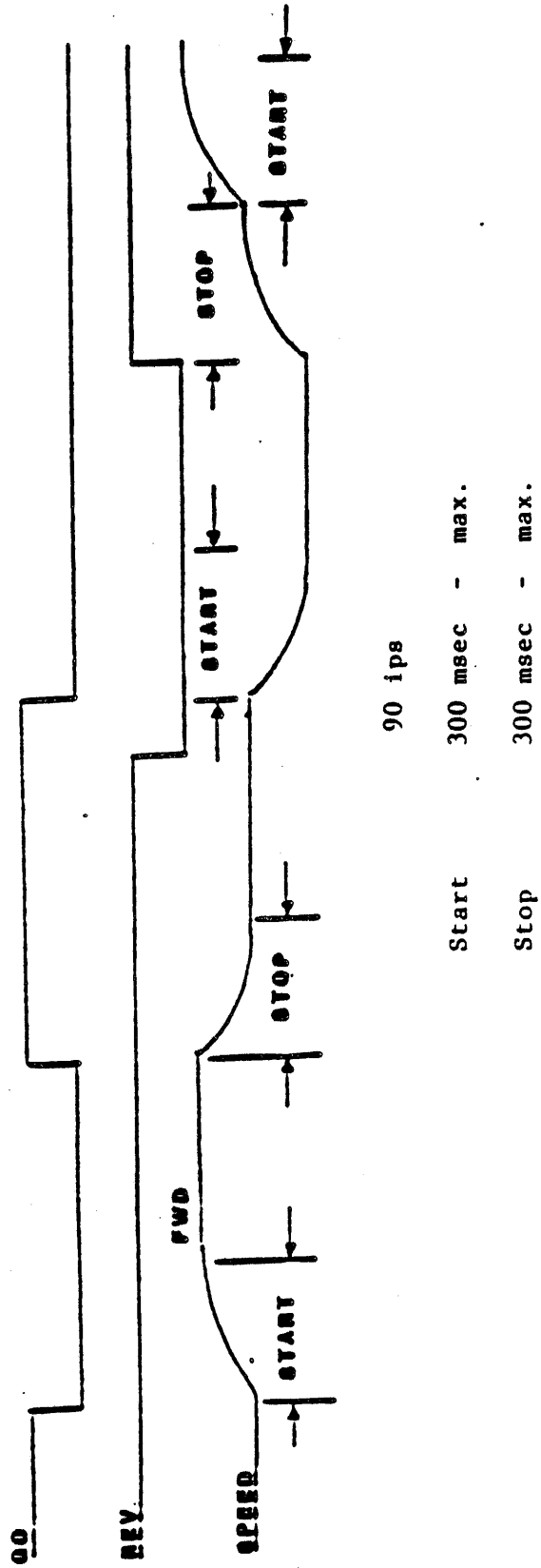
Main Board Assy #30509 Select Jumpers

Figure 7.2



Tape Motion Control Timing

Figure 7.3



7.3 TAPE POSITION CODE SIGNALS

The tape position code signals are generated by the CPU and are defined by the table below:

UTH	LTH	Description
---	---	-----
1	1	Beginning of Tape (BOT)
0	1	End of Tape (EOT)
1	0	Early Warning (EW)
0	0	Data recording zone (lost during initial load)

When a new cartridge is inserted into the drive, the position of the tape within the cartridge is unknown. The drive then moves the tape in the reverse direction to BOT to establish a reference point.

If the scanning operation does not detect any further motion commands, the tape will move forward until BOT is sensed and is immediately stopped. Once tape motion is commenced, the Formatter/Controller will detect the Load Point, then the Data Recording Zone, followed by the Early Warning, and EOT, whereby a tape stop sequence is initiated. If REV and GO are subsequently asserted, reverse tape motion occurs and is analogous to the sequence in the forward direction described above.

7.4 TRACK AND HEAD SELECTION

Selection of one of the two heads is performed by the TRO select bit. When false, head zero is selected; when true, head one is selected. Head zero is used for reading or writing in the forward direction only, while head one is used exclusively in the reverse direction.

The assertion of a RESET signal causes the head assembly to initiate a recalibration routine, which moves the head carriage down to a mechanical reference point.

Track selection is accomplished with the TR 1-3 select bit signal lines. Track positioning takes 400 mSec per track nominal. The maximum track positioning period is 596 mSec, not inclusive of tape deceleration and acceleration (maximum of 300mSec each).

7.5 CARTRIDGE IN PLACE

Cartridge In (CIN) is a drive generated signal indicating that the tape cartridge is inserted in the drive correctly.

7.6 RESET

The Reset (RST) is a Formatter/Controller generated signal, which performs the same sequence of events as a power up routine. The minimum reset pulse width measured at the drive interface is 13 microseconds.

7.7 UNSAFE

The Unsafe (USF) is a drive generated signal indicating that the inserted tape cartridge cannot be written on (Write Protected). The file protect tab on the cartridge is in the SAFE position.

7.8 TACHOMETER PULSES

The Tachometer Pulses (TCH) are generated by the drive, where each pulse equals 141 mils +/-3% of tape movement.

7.9 WRITE AND ERASE CONTROLS

The write and erase circuits are depicted in Figure 7.4. The interface signals which control the circuits are "Write Enable Control" (WEN), and "Erase Enable Control" (EEN).

The state of the "Write Data Signal" (WDA+, WDA-) determines if positive or negative current flows through the selected head. Only the inverse states of the write data signal pair is allowed. The write drivers are disabled during a power up/down sequence and while the SAFE switch is enabled.

The erase function is enabled by "Erase Enable Control" (EEN), and is an internally generated AC signal which is used to drive the erase pole. The erase drivers are disabled during a power up/down sequence and while the SAFE switch is enabled. The Erase drivers are only enabled while the drive is at Track 0 moving tape in the forward direction.

When write is enabled, data transitions must occur with the following intervals:

1.11uSec, 2.22uSec, 3.33uSec.... +/-1%

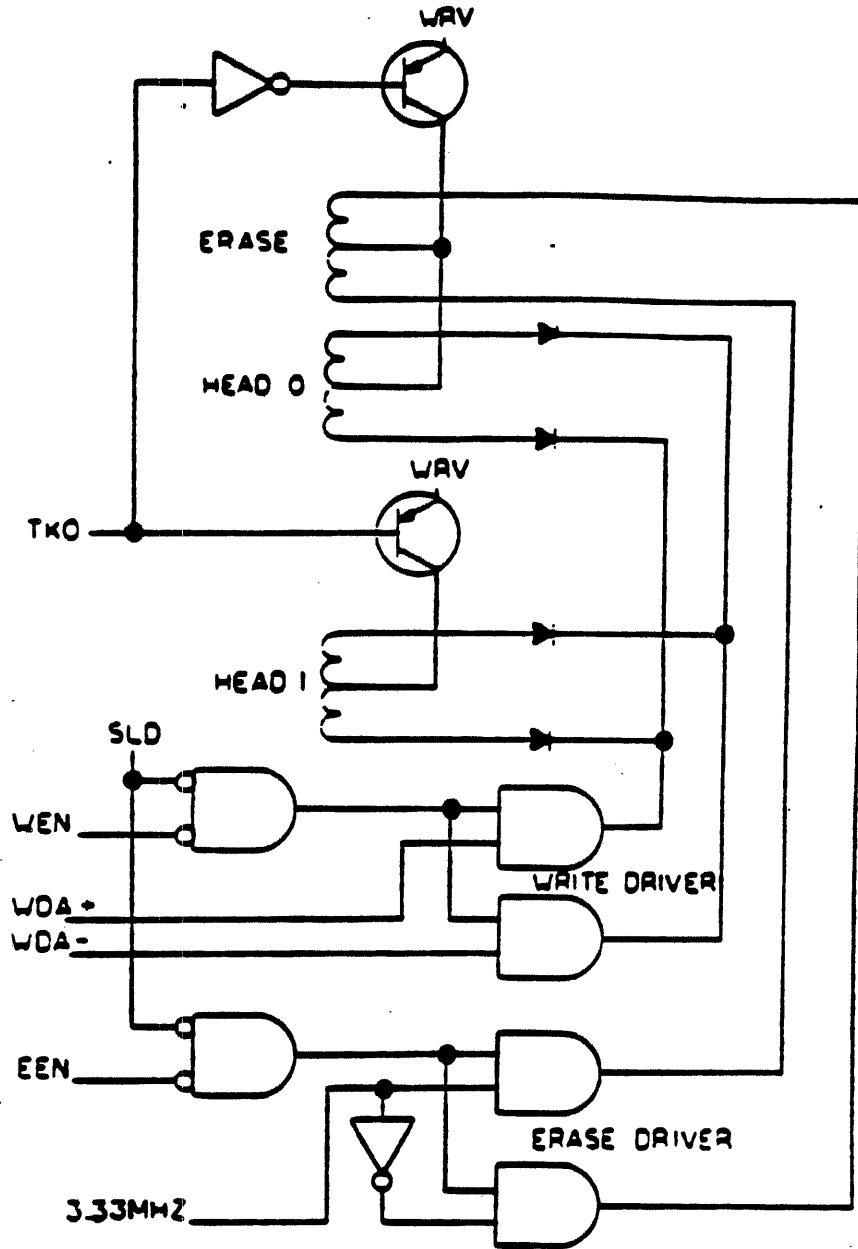
The recording code must comply with the above requirements.

7.10 READ DATA

Read data from the tape is first amplified, passed through a differentiator filter circuit, amplified again before being passed through a comparator and a limiter circuit. The signal is digitized prior to output to the "Read Data Output" (RDP). The read data logic diagram is depicted in Figure 7.5.

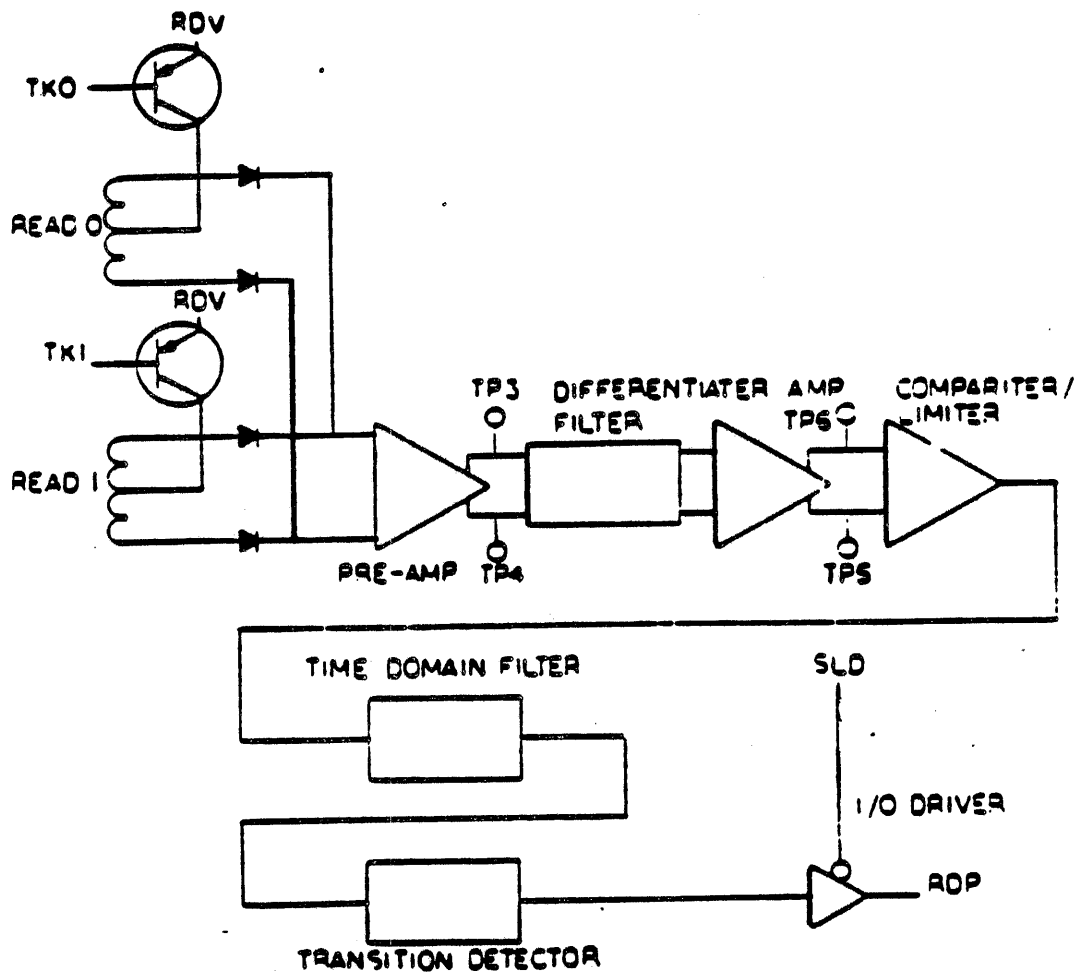
Write and Erase Controls

Figure 7.4



Read Data Logic

Figure 7.5



Peak shift data is as follows for recording areas where the signal amplitude is not less than 25% of nominal:

+/- 0.41 microseconds @ 90 IPS

In areas where the signal amplitude (measured at test points 5 and 6) is less than 25% of nominal, peak shift could possibly be as high as 1/2 a data transition period.

7.11 DRIVE SELECT

The drive can be configured to be selected by any one of the two select lines, or to be constantly selected. The select signal is sent to the activity LED and the CPU on the Main board. At any time that the drive is not selected, the drive CPU will respond to a reset command only.

7.12 TRACK REFERENCE BURST SEEK

The Track Reference Burst Seek sequence is initiated each time the drive receives a RST or CIN; either one of these two signals will initiate a rewind sequence until BOT is sensed.

This feature eliminates the head alignment differences of tapes generated on other drives. The drive searches and positions the head to compensate for alignment differences up to 9 mils(12 steps). This feature is only incorporated in drives which are configured for QIC-24 data format, i.e. those drives which do not have a jumper installed at the "EN" location.

The drive will also read QIC-11 tape (Archive 8 inch format) without the QIC-24 reference burst, but will not correct for head misalignment.

To ensure interchangeability, the drive automatically defaults to theoretical Track 0 whenever a Write operation is initiated, and rewrites the track reference burst.

If a reference burst is not found in the Read Data mode, the drive automatically defaults to a mechanical Track 0 reference.

The following is the sequence of events which occur during a Track Seek:

1. Determine tape type. This is done to set proper Write currents and Read Amp gains for tape type by monitoring the distance from BOT to LP. This is done by counting the number of tach pulses from BOT to LP. The DC 600A tape having a distance of 48 inches and the DC 300 cartridge having a distance of 36 inches between BOT and LP.
2. The read gain is lowered to approximately 75% of nominal value. The head is positioned below the Track 0 reference point, then positioned up until a defined threshold level is reached. The number of steps is recorded. The same sequence takes place from above the Track 0 reference point. This sequence is repeated three times and the steps (above and below) are averaged to determine the center of the reference burst.

Future track steps are referenced to the position defined in step # 2 above.

7.13 SATURATION RECORDING

The drive automatically determines whether the inserted cartridge is a DC 300XL or DC 600A, thus making the type of tape being used transparent to the user. This is true only when the "EN" jumper is not installed.

The DC 600A tape requires twice as much write current in order to saturate the media and produce maximum amplitude. Utilizing the ANSI criteria to determine the operating current, the current for the DC 300XL tape is 20 mAmps peak to peak and the DC 600A tape requires 40 mAmps peak to peak.

Any compromise current will result in over saturating the 300XL tape causing a loss of resolution, and under saturating the 600A tape, making it vulnerable to extremes in amplitude modulation. The saturation curves are shown in a previous section (5.13) in Figure 5.6.

7.14 MAIN BOARD CONFIGURATIONS

The main board can be configured in several variations to accommodate a wide variety of applications. The assembly numbers, jumper locations, and applications are too numerous to list in this document. Should you have a specific application request, please contact Wangtek marketing. The configuration number (-XXX) will be marked on the board to the right of the assembly number.

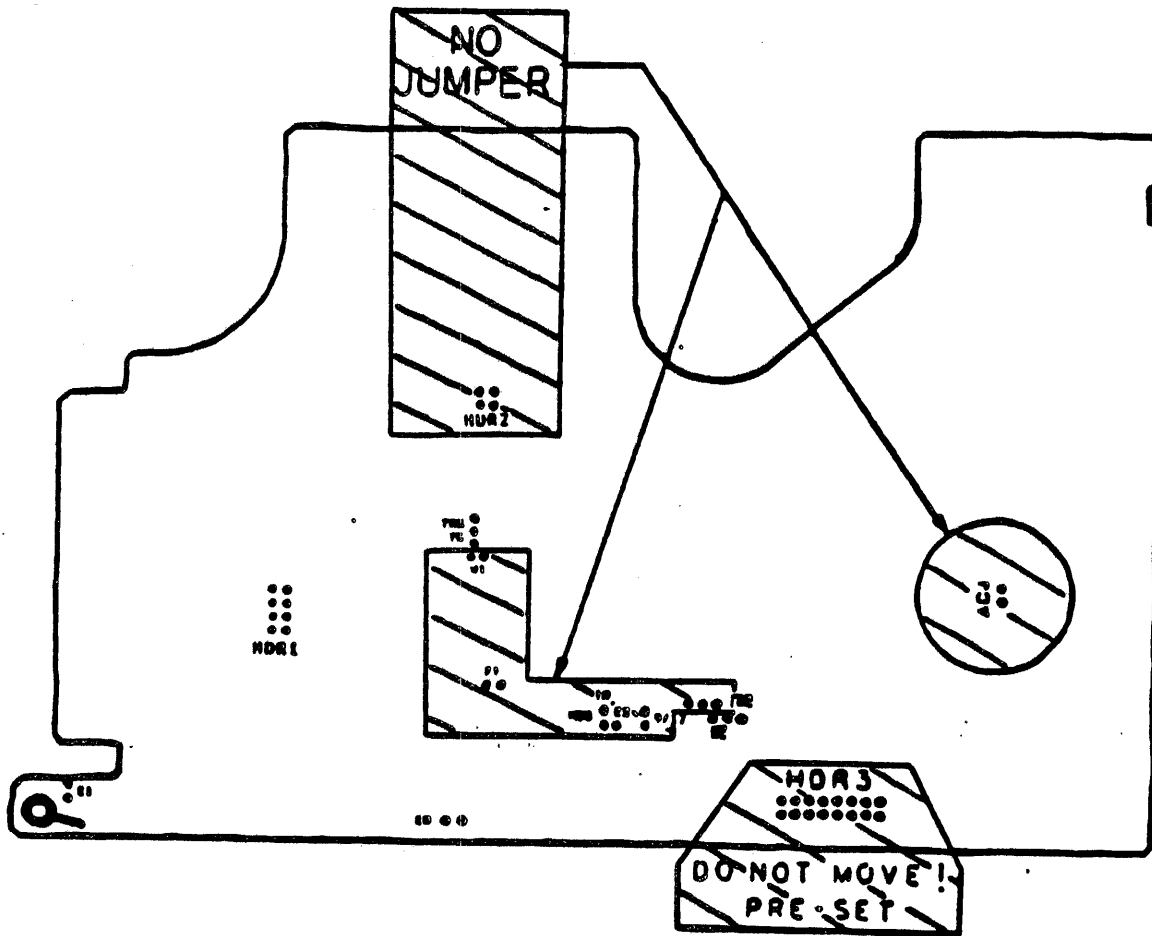
The Basic Drive Main Board Dash number configuration is as follows:

30509-X YY				AVAILABLE JUMPERS
X	LED COLOR	L7 & L8	uP	
0	RED	JUMPER	ROM	E1 EN IHC/HC TG/TNG HDR 1
1	GREEN	JUMPER	ROM	
2	YELLOW	JUMPER	ROM	
3	RED	CHOKE	ROM	
4	GREEN	CHOKE	ROM	
5	YELLOW	CHOKE	ROM	
6	RED	JUMPER	EPROM	
7	GREEN	JUMPER	EPROM	
8	YELLOW	JUMPER	EPROM	

NOTE: The jumpers (2) located on Header 3 will be in one of four locations and should not be changed as they control the head stepper motor start phase. Also, the 9/12 jumper need not be inserted as it is hard wired on the circuit board. The jumper locations are illustrated in Figure 6.6.

Main Board Assy #30509 Jumper Locations

Figure 7.6



7.15 JUMPER DESCRIPTIONS

The various jumpers for the 30509-XXX board and a description of their functions is given below:

- "E1" When installed, ties the Main board logic ground to chassis ground.
When not installed, Main board logic ground isolated from chassis ground via a 0.47 microfarad ceramic capacitor.
- "EN" When installed, disables the QIC-24 Track 0 search function. Tape type determination (300/600) will be performed after a RESET command as soon as GO command is issued.
When not installed, QIC-24 Track 0 search function and tape determination will be performed after a RESET command as soon as the GO command is issued.
- "MDS IN" Reserved for future product use.
- "MDS EX" Reserved for future product use.
- "9/12" When installed, Track locations will always be to QIC-24 9TRK specified locations. This jumper has been hard wired on the circuit board. Therefore, there will be no jumper installed at this location.
- "HC" When installed, write current and read gains selected by the "HC" interface control line from the formatter/controller.
- "IHC" When installed, write current and read gains are selected as a function of the microprocessor tape type determination routine.
- "10" Hard wired on board. Selects 10 Megahertz microprocessor clock frequency.
- "5" For Wangtek internal use only.
- "F1" When installed, exercise mode enabled when drive and microprocessor are not selected. Moves tape from BOT to EOT and changes head positions from Track 8 to Track 6 to Track 4 to Track 0 and repeats. Microprocessor is deselected by moving jumper on HDR 1 from 2-7 position to 1-8 position.
- "W1" Reserved for future product use.
- "ADJ" When installed, lowers read amplifier gain by approximately 25%. For Wangtek internal use only.

"HDR2" These are special option jumpers for specific applications.

PINS 1-20

If installed, Read Threshold is a function of the "WEN" line. This is an etched jumper on the circuit board, therefore no jumper shall be installed at this location.

PINS 2-19

If installed, Read Threshold is a function of the "THD" interface control line. This jumper must not be installed without first removing the etch at HDR2 PINS 1-20.

"TNG" When installed, the tachometer pulses are transmitted to the formatter/controller at all times that the tach signals are present.

"TG" When installed, the tachometer pulses are gated in a way that the signals are not transmitted to the formatter/controller during the QIC-24 reference burst search operation.

"HDR1" These are drive select jumpers. Only one (1) jumper is to be placed in the HDR1 location.

PINS 1-8

If installed, Microprocessor will be selected as a function of Drive Select. Drive will respond to motion and reset commands only if the drive is selected by the formatter. This jumper must be installed if the drive is to be used in the Daisy Chain configuration.

If not installed, Microprocessor is always selected. Drive will respond to motion and reset commands independent of drive select from formatter. This jumper must be installed in conjunction with the "F1" jumper in order for the self test operation to function.

PINS 2-7

If installed, drive is selected as a function of "SEL 0" interface control line.

PINS 3-6

If installed, drive is selected as a function of the "SEL 1" interface control line.

PINS4-5

If installed, drive is permanently selected.

"HDR3" This header has two jumpers which control the start phase of the stepper motor at the recalibration position. These jumpers should not be moved as the Track 0 reference location will be changed.

PINS 1-16

5-12

When installed, Motor Phase 1 is selected.

PINS 2-15

6-11

When installed, Motor Phase 2 is selected.

PINS 3-14

7-10

When installed, Motor Phase 3 is selected.

PINS 4-13

8-9

When installed, Motor Phase 4 is selected.

8.0 BASIC DRIVE - THEORY OF OPERATION

8.1 GENERAL THEORY OF OPERATION

This section provides a functional description of the cartridge tape drive. Although the Main Boards are different, their functions are nearly identical. Any differences in the two boards will be noted.

Two primary sources of input signals are received by the drive. These are Power input and Command signals from Formatter/Controller.

The command signals, with the exception of read/write, are combined with the internally generated signals to provide multiplexed data. Decoding is accomplished by the microprocessor (CPU), which performs five basic functions:

1. Decodes formatter/controller signals.
2. Sends signals to the formatter/controller.
3. Receives signals from the sensor assemblies.
4. Controls the drive motor speed.
5. Controls the stepper motor positioning.

A crystal oscillator (10MHz) and associated logic control the CPU and the system timing. A 50-pin connector provides the interface between the external formatter/controller and the drive. All internal and external connectors and routing information are listed in Table 8.0.

Table 8.0 Connectors

Connector -----	Destination -----
J1	To/From Formatter/Controller
J2	To Capstan Motor
J3	From Tachometer Sensor
J4	To/From CIN and Tape Hole Sensor
J5	To Stepper Motor
J6	Main/Motor Board Interconnect
J7	To/From Write/Erase Heads
J8	To/From Read Heads

8.2 MAJOR COMPONENT FUNCTIONS

CARTRIDGE

The cartridge tape has several distinct physical features designed for industry use which are listed below:

1. Three Reference Locators
2. Position Sense Holes
3. Mirror Mechanism
4. File Protect Mechanism
5. Tape Cover Door
6. Capstan Drive Wheel

The three reference points are positioned on the tape cartridge base and case to prevent improper insertion into the tape drive. A spring-loaded ball on the drive tensions the cartridge base plate against all reference points.

The cartridge in position sensor is located in the capstan/hole sensor assembly. It is activated via a switch connected to the drive capstan, which triggers as the drive capstan contacts the cartridge capstan roller. When activated, the signal is routed to the drive CPU to indicate that a cartridge is in place and the drive is now ready to accept further commands.

The cartridge has a rotatable plug which can be manually positioned by the user to protect the data on tape from being erased or written over. A microswitch in the capstan/hole sensor assembly detects this plug position and routes the signal to the CPU which then inhibits the write/erase amplifier circuitry, if activated.

The mirror mechanism is located within the cartridge casing, and is utilized for tape position detection by deflecting the infra-red emitter light through the holes of the tape itself to the phototransistors.

The cartridge door and capstan do not generate any signals to the drive, but are an integral part of the cartridge assembly. The capstan wheel is driven by the drive capstan and in turn, causes the tape reels to turn and move tape. The cartridge door protects the tape from contaminants when not in use.

SENSOR ASSEMBLY

The Sensor Assembly is designed to detect tape hole positions (BOT, EOT, LP, EW) utilized by the drive to determine tape position and tape status

An infra-red emitter located on the sensor housing, emits a light to the mirror mechanism opposite the emitter within the cartridge casing, creating a light field.

As the tape hole passes through this field, light passes through these holes and strikes either one or both of the phototransistors located in the sensor housing perpendicular to the emitter. The phototransistor signals are then sent to the drive CPU via the flex cable and J4 connector, where they are processed to determine tape position.

Connector J4 also routes the CIN and SAFE signals to the drive CPU for processing.

HEAD STEPPER MOTOR ASSEMBLY

The head stepper motor assembly physically positions the read/write heads to the specified track.

The stepper motor assembly is connected through connector J5 with six wires. Two of these wires are twelve (12) volt lines for the individual motor windings. The other four wires receive electrical impulses derived from the drive CPU and amplified by two dual peripheral drivers (7A and 7B) in order to move the stepper motor the desired number of steps.

Interface signals, TR1-3, determine the desired track location and are transmitted to the drive CPU. The CPU converts these signals into discrete mechanical movements referred to as steps. Each step represents one phase transition of the stepper motor, which is equal to 15 degrees of movement. The steps are incremented/ decremented in a logical sequence to move the stepper motor the desired number of steps for the required track selected.

The head positioning mechanism is a lead screw type. The stepper motor is composed of this shaft connected to the motor windings. The shaft is attached to a threaded sleeve which is attached to the magnetic head mounting assembly.

The shaft/screw will rotate as a result of motor stepping, while the nut moves up and down and with it the head assembly. Depending on the sequence of inputs, the motor will rotate the shaft in a clockwise or counter-clockwise direction. Twenty four (24) step pulses will rotate the shaft 360 degrees. With this type of mechanism, precise (0.744 mil) positioning is accomplished with minimum effort.

MAGNETIC HEAD

The head assembly consists of a closed magnetic circuit constructed of laminated high permeability metal with wound coils for inducing and detecting flux reversals on magnetic tape. The head assembly has read, write, and erase functions and also utilizes two tape cleaner blades at each end of the assembly.

The magnetic head is designed to be compatible with either the QIC-24 or QIC-11 data format guidelines. It has two track capability, due to the two read heads, two write heads, and full width erase bar.

The head receives write/erase commands from the formatter/controller, which are routed to the appropriate write and erase driver circuits on the Main board and to the head via connector J7.

Read signal are routed from the head to the Main board via connector J8. The signals are then routed to the amplifier and peak detector where they are digitized. The digital signal is routed to the time domain filter before being transmitted to the I/O connector J1.

The write and erase heads cannot be enabled simultaneously, with the exception of Track 0 where they are both activated, at which time all data on all tracks is erased from the tape.

The erase signal is AC driven. The signal is derived from the CPU clock signal which is divided by three through a series of flip-flops.

The magnetic head assembly is depicted in Figure 7.0.

DRIVE MICROPROCESSOR

The CPU contains most of the drive control circuitry, including memory and I/O circuitry from the formatter/controller and drive subsystems.

The microprocessor functions are as follows:

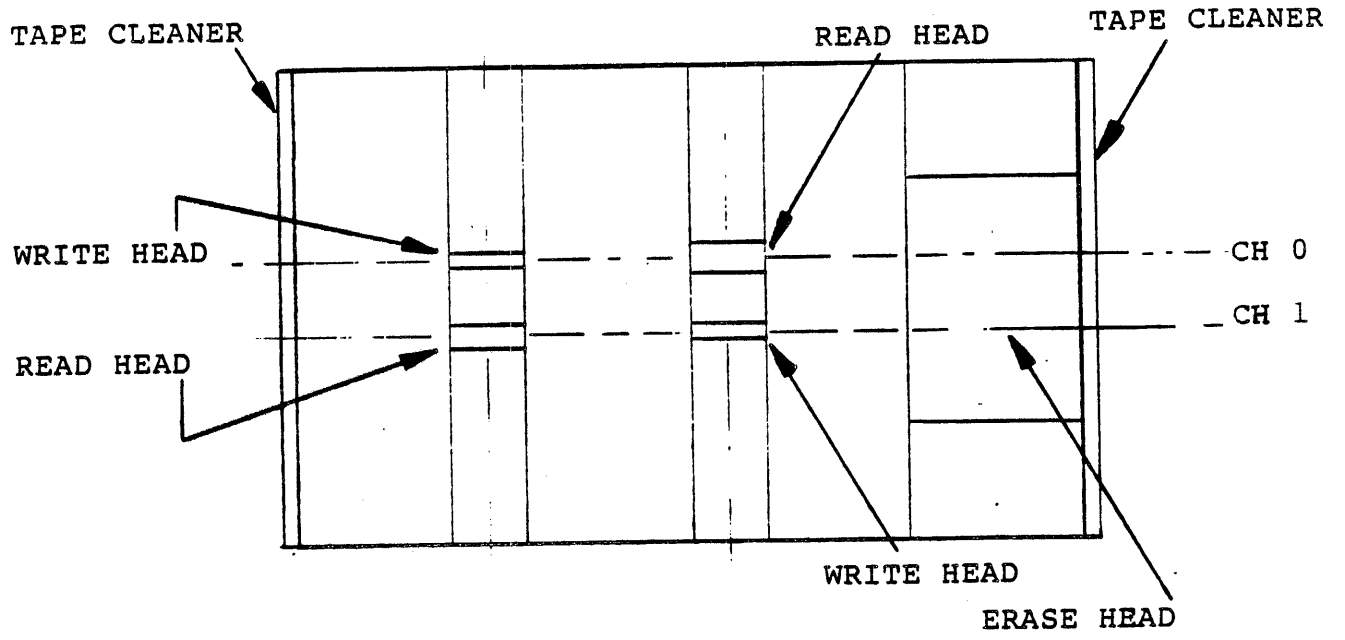
Coordinate system activities and perform all addressing, data manipulation, and arithmetic functions.

The major features of the microprocessor are as follows:

- o 8 bit bus
- o Clock on pin XTAL2 connected to external oscillator
- o RESET - active LOW initiates CPU on power-up
- o INT - active LOW initiates priority interrupt servicing
- o Ports A and B - bi-directional data ports
- o 2K X 8 ROM - containing masked firmware
- o 128K X 8 RAM
- o 256K Peripheral File
- o 32 I/O lines to control data commands
- o Internal 13 bit Timer

Magnetic Head Assembly

Figure 8.0



The CPU utilizes a control program to ensure correct sequencing and coordination of the drive functions.

The microcode firmware breaks down into two major sections which are the main and subsystem programs.

The following activities are included in the main program:

After RESET:

- o initializes the CPU
- o initializes all ports
- o clears memory and register locations
- o position head to recalibration position
- o scanning for formatter/controller commands

The subsystem subroutines include the following:

- o absolute head positioning
- o capstan motor start/stop
- o head selection
- o track positioning
- o speed control for capstan motor
- o tape hole scanning
- o track reference burst positioning
- o tape type determination
- o over/under velocity errors
- o tape break error
- o tape torque error

Main Board # 30051 does not perform the last three (3) subroutines.

8.3 DETAILED THEORY OF OPERATION - MAIN BOARD ASSEMBLY #30051

All commands are initiated through the formatter/controller, and directed to the CPU of the basic drive.

The initial command sent to the drive is RESET, on interface connector J1-pin 14 to CPU pin 4. Upon receipt of the RESET command, the CPU initiates an initialization routine which initializes two ports and clears memories and registers.

Upon completion of the initialization, the CPU begins scanning for signals on the 8 bit bus which enters from either the formatter/controller or the sensor assembly.

The first signal processed is Cartridge in Place (CIN- J4 pin 3); this signal indicates to the CPU that a cartridge is loaded and positioned correctly in the drive.

The CPU must assure that the read/write heads are positioned on Track 0 prior to accepting any read/write commands. This is coordinated through the Sensor, Capstan Motor, and Stepper Motor assemblies under CPU control.

The formatter/controller initiates tape movement with GO (J1 pin 2) and REV (J1 pin 4). These commands are processed by the CPU and routed via from the Main board to the driver board through connector J6, pins 1 and 2 respectively.

The signals are then logically applied through the motor driver board and move the Capstan Motor in either of the two directions. The current flows in a clockwise direction through J2 pin 2 (motor +), or counter-clockwise through J2 pin 1 (motor -). Refer to Table 7.1 for motion control logic.

TABLE 8.1 Capstan Motor Logic

ON BUS		ON PORT	
REV	GO	FWD	REV
---	--	---	---
0	0	0	0
1	0	0	0
0	1	1	0
1	1	0	1

After tape is up to speed, the CPU scans for BOT, LP, EW, or EOT using signals generated in the infrared Sensor Assembly. Infrared light is emitted from the sensor. The UTH signal is routed through connector J4 pin 7, and the LTH signal through J4 pin 5. The signals are fed into two comparators and stored in a D type flip-flop.

The scanned signals are routed to the CPU's 8 bit bus from IC 6C pin 9 and pin 5 respectively.

When the CPU senses BOT, tape motion is stopped and the CPU is ready to position the head.

The STEP ENABLE signal is generated from the CPU port C7, pin 35, as an active LOW.

The signal is inverted and logically nanded with the CPU-generated stepper control signals which are routed to two places: stepper motor, connector J5 pins 7, 6, 5, and 4 combined with SAFE from connector J4 pin 1 to disable the write command.

The stepper motor receives these three signals and initiates rotation of the shaft which mechanically positions the head to Track 0 on the tape.

Upon completion of the above steps, the tape is positioned at BOT and the head at Track 0. At this point the drive is ready to begin the primary functions of read/write/erase, which are directed by signals directly routed to/from the formatter/controller.

The controlling signals from the formatter/controller are: Write Enable Control (WEN J1 pin 48), Erase Enable Control (EEN J1 pin 50), and Write Data (WDA+ J1 pin 42 and WDA- J1 pin 40).

Writing to the tape is controlled by WEN and the two Write Data lines (WDA+ and WDA-).

If the SAFE signal is not active, WEN will allow current to flow to the selected write head. WDA+ and WDA- define the data to be written. The write head is selected by the formatter/controller at TRO (J1 pin 12). When this signal is false, head 0 is selected, when true (low), head 1 is selected.

The Erase function is enabled by EEN, and is routed through circuitry which provides as an output to connector J7 pin 7 and 8.

An internally generated AC signal energizes the erase pole only when the tape is at Track 0, through connector J7 pin 7, and only if SAFE is Low (False) at connector J4 pin 1.

Read signals are detected by the head as flux transitions, and transmitted to connector J8 pins 8 and 2 or 4 and 6, channel 0 and channel 1 respectively.

Data read from the head is first amplified, then passed through a differentiator and filter circuitry. The data is amplified again before passing through a comparator and limiter circuit.

Prior to being transmitted to the formatter/controller, the data is passed through a time domain filter and becomes an output as Read Pulse Output - RDP (J1 pin 26).

As the drive brings the tape up to speed, monitoring by the CPU is accomplished by the data received from the tachometer (J3 pins 1 and 3). The tachometer pulses are generated by the magnetic sensor on the capstan motor, and routed through a series of amplifiers, then becomes an input to the interrupt (INT- active LOW) input of the CPU, which will correct for any variations in speed.

8.4 DETAILED THEORY OF OPERATION - MAIN BOARD ASSEMBLY #30062

All commands are initiated through the formatter/controller, and directed to the CPU of the basic drive.

The initial command sent to the drive is RESET, on interface connector J1-pin 14 to CPU pin 14. Upon receipt of the RESET command, the CPU initiates an initialization routine which initializes two ports and clears memories and registers.

Upon completion of the initialization, the CPU begins scanning for signals on the 8 bit bus which enters from either the formatter/controller or the sensor assembly.

The first signal processed is Cartridge in Place (CIN- J4 pin 3); this signal indicates to the CPU that a cartridge is loaded and positioned correctly in the drive.

The CPU must assure that the read/write heads are positioned on Track 0 prior to accepting any read/write commands. This is coordinated through the Sensor, Capstan Motor, and Stepper Motor assemblies under CPU control.

The formatter/controller initiates tape movement with GO (J1 pin 2) and REV (J1 pin 4). These commands are processed by the CPU and routed via the Main board to the driver board through connector J6, pins 1 and 2 respectively.

The signals are then logically applied through the motor driver board and move the Capstan Motor in either of the two directions. The current flows in a clockwise direction through J2 pin 2 (motor +), or counter-clockwise through J2 pin 1 (motor -). Refer to Table 8.2 for motion control logic.

TABLE 8.2 Capstan Motor Logic

ON BUS		ON PORT	
REV	GO	FWD	REV
---	--	---	---
0	0	0	0
1	0	0	0
0	1	1	0
1	1	0	1

After tape is up to speed, the CPU scans for BOT, LP, EW, EOT using signals generated in the infrared Sensor Assembly. Infrared light is emitted from the sensor. The UTH signal is routed through connector J4 pin 7, and the LTH signal through J4 pin 5. The signals are fed into two comparitors and stored in a D type flip-flop.

The scanned signals are routed to the CPU's 8 bit bus from IC 6C pin 9 and pin 5 respectively.

When the CPU senses BOT, tape motion is stopped and the CPU is ready to position the head.

The STEP ENABLE signal is generated from the CPU port C7, pin 35, as an active LOW.

The signal is inverted and logically nanded with the CPU-generated stepper control signals which are routed to two places: stepper motor, connector J5 pins 7,6,5, and 4 combined with SAFE from connector J4 pin 1 to disable the write command.

The stepper motor receives these three signals and initiates rotation of the shaft which mechanically positions the head to Track 0 on the tape.

Upon completion of the above steps, the tape is positioned at BOT and the head at Track 0. At this point the drive is ready to begin the primary functions of read/write/erase, which are directed by signals directly routed to/from the formatter/controller.

The controlling signals from the formatter/controller are: Write Enable Control (WEN J1 pin 48), Erase Enable Control (EEN J1 pin 50), and Write Data (WDA+ J1 pin 42 and WDA- J1 pin 40).

Writing to the tape is controlled by WEN and the two Write Data lines (WDA+ and WDA-).

If the SAFE signal is not active, WEN will allow current to flow to the selected write head. WDA+ and WDA- define the data to be written. The write head is selected by the formatter/controller at TRO (J1 pin 12). When this signal is false, head 0 is selected, when true (low), head 1 is selected.

The Erase function is enabled by EEN, and is routed through circuitry which provides as an output to connector J7 pin 7 and 8.

An internally generated AC signal energizes the erase pole only when the tape is at Track 0, through connector J7 pin 7, and only if SAFE is Low (False) at connector J4 pin 1.

Read signals are detected by the head as flux transitions, and transmitted to connector J8 pins 8 and 2 or 4 and 6, channel 0 and channel 1 respectively.

Data read from the head is first amplified, then passed through a differentiator and filter circuitry. The data is amplified again before passing through a comparator and limiter circuit.

Prior to being transmitted to the formatter/controller, the data is passed through a time domain filter and becomes an output as Read Pulse Output - RDP (J1 pin 26).

As the drive brings the tape up to speed, monitoring by the CPU is accomplished by the data received from the tachometer (J3 pins 1 and 3). The tachometer pulses are generated by the magnetic sensor on the capstan motor, and routed through a series of amplifiers, then becomes an input to the interrupt (INT- active LOW) input of the CPU, which will correct for any variations in speed.

8.5 DETAILED THEORY OF OPERATION - MAIN BOARD ASSEMBLY #30509

All commands are initiated through the formatter/controller, and directed to the CPU of the basic drive.

The initial command sent to the drive is RESET, on interface connector J1-pin 14 to CPU pin 14. Upon receipt of the RESET command, the CPU initiates an initialization routine which initializes two ports and clears memories and registers.

Upon completion of the initialization, the CPU begins scanning for signals on the 8 bit bus which enters from either the formatter/controller or the sensor assembly.

The first signal processed is Cartridge in Place (CIN- J4 pin 3); this signal indicates to the CPU that a cartridge is loaded and positioned correctly in the drive.

The CPU must assure that the read/write heads are positioned on Track 0 prior to accepting any read/write commands. This is coordinated through the Sensor, Capstan Motor, and Stepper Motor assemblies under CPU control.

The formatter/controller initiates tape movement with GO (J1 pin 2) and REV (J1 pin 4). These commands are processed by the CPU and routed via the Main board to the driver board through connector J6, pins 1 and 2 respectively.

The signals are then logically applied through the motor driver board and move the Capstan Motor in either of the two directions. The current flows in a clockwise direction through J2 pin 2 (motor +), or counter-clockwise through J2 pin 1 (motor -). Refer to Table 8.3 for motion control logic.

TABLE 8.3 Capstan Motor Logic

ON BUS		ON PORT	
REV	GO	FWD	REV
---	--	---	---
0	0	0	0
1	0	0	0
0	1	1	0
1	1	0	1

After tape is up to speed, the CPU scans for BOT, LP, EW, EOT using signals generated in the infrared Sensor Assembly. Infrared light is emitted from the sensor. The UTH signal is routed through connector J4 pin 7, and the LTH signal through J4 pin 5. The signals are fed into two comparitors and stored in a D type flip-flop.

The scanned signals are routed to the CPU's 8 bit bus from IC 6C pin 9 and pin 5 respectively.

When the CPU senses BOT, tape motion is stopped and the CPU is ready to position the head.

The STEP ENABLE signal is generated from the CPU port C7, pin 35, as an active LOW.

The signal is inverted and logically nanded with the CPU-generated stepper control signals which are routed to two places: stepper motor, connector J5 pins 7,6,5, and 4 combined with SAFE from connector J4 pin 1 to disable the write command.

The stepper motor receives these three signals and initiates rotation of the shaft which mechanically positions the head to Track 0 on the tape.

Upon completion of the above steps, the tape is positioned at BOT and the head at Track 0. At this point the drive is ready to begin the primary functions of read/write/erase, which are directed by signals directly routed to/from the formatter/controller.

The controlling signals from the formatter/controller are: Write Enable Control (WEN J1 pin 48), Erase Enable Control (EEN J1 pin 50), and Write Data (WDA+ J1 pin 42 and WDA- J1 pin 40).

Writing to the tape is controlled by WEN and the two Write Data lines (WDA+ and WDA-).

If the SAFE signal is not active, WEN will allow current to flow to the selected write head. WDA+ and WDA- define the data to be written. The write head is selected by the formatter/controller at TRO (J1 pin 12). When this signal is false, head 0 is selected, when true (low), head 1 is selected.

The Erase function is enabled by EEN, and is routed through circuitry which provides as an output to connector J7 pin 7 and 8.

An internally generated AC signal energizes the erase pole only when the tape is at Track 0, through connector J7 pin 7, and only if SAFE is Low (False) at connector J4 pin 1.

Read signals are detected by the head as flux transitions, and transmitted to connector J8 pins 8 and 2 or 4 and 6, channel 0 and channel 1 respectively.

Data read from the head is first amplified, then passed through a differentiator and filter circuitry. The data is amplified again before passing through a comparator and limiter circuit.

Prior to being transmitted to the formatter/controller, the data is passed through a time domain filter and becomes an output as Read Pulse Output - RDP (J1 pin 26).

As the drive brings the tape up to speed, monitoring by the CPU is accomplished by the data received from the tachometer (J3 pins 1 and 3). The tachometer pulses are generated by the magnetic sensor on the capstan motor, and routed through a series of amplifiers, then becomes an input to the interrupt (INT- active LOW) input of the CPU, which will correct for any variations in speed.

9.0 MAINTENANCE CHECKS AND ADJUSTMENTS

This section contains the maintenance checks and adjustments that are to be performed during the normal life period of the drive.

The following equipment is recommended for the checks and adjustments described:

1. Lint free cotton swabs
2. Freon TF or IBM tape head cleaner
3. Dual trace oscilloscope
4. Blank tape cartridge
5. Azimuth and Track alignment cartridge *
6. Wangtek tape drive exerciser *
7. Wangtek head azimuth adjustment tool *
8. 5/64 inch hex wrench with ball tip
9. 3/32 inch hex wrench
10. .035 inch hex wrench
11. Small flat blade screwdriver
12. #1 Phillips head screwdriver
13. Tape drive power supply (+5 and +12VDC/50W)

* NOTE: The tools noted with an asterisk (*) can be procured from Wangtek only after completion of the certified training program given by Wangtek.

9.1 HEAD CLEANING PROCEDURE

The head cleaning procedure assures that the head is free of contamination to ensure the proper head to tape compliance and prevent loss of data.

The head should be cleaned after 2 hours of use with a new cartridge, and every 8 hours of operation thereafter.

It may be necessary to dock the head in order to gain access to the head for cleaning, due to some mounting schemes.

To dock the head, press inward on the tape carriage plate where the cartridge is normally inserted. Stop pushing when the travel is restricted and the latching mechanism releases. The carriage plate will automatically slide out (approximately 3/8 inch). At this point, the head is docked.

Clean the head using the cotton swab soaked in the head cleaning solution. Be sure to clean the tape cleaner blades as well. NEVER clean the capstan with the head cleaner solution as severe damage may result. If it becomes necessary to clean the capstan, use a cotton swab with soaked with water only.

Return the head to the Ready (to load tape) position by pushing the carriage plate until it's motion is restricted from any further travel.

Another method of cleaning the head, which is easier to perform, is to use the Perfect Data QIC II Drive Head Cleaning Kit (Part No. 102791-21) or the DSS head cleaning kit (available in Europe) which consists of a tape cartridge form factor with a cleaning pad and an arm as means of moving the cleaning pad across the head. The cartridge is simply inserted in the drive in the same fashion as a tape cartridge. Prior to inserting the cleaning cartridge, apply a few drops of the cleaning solution to the pad. After insertion of the cartridge, proceed to move the handle up and down to clean the entire head surface. After cleaning, remove the cartridge and proceed with normal tape operation.

9.2 HEAD TRACK ALIGNMENT AND AZIMUTH CHECK PROCEDURE

This procedure is written with reference to use of the Wangtek Alignment Tester (Wangtek P/N T-10123) to control tape motion and functions. Other methods of control are available through various test equipment vendors, all of which cannot be discussed in this document. Should there be any question regarding application of certain test equipment, please contact Wangtek Product Support Department.

NOTE: Head Azimuth and Track Alignment should be performed only by Wangtek trained personnel. Any alignment by non-trained personnel shall void warranty.

Connect scope probes to Test Points 3 and 4 of the Main Board and ground at the Ground Test Point. The scope shall be set to operate in the differential amplifier mode.

Loosen the front head locking screw and the stepper motor collar set screw before beginning the alignment procedure. This is required only if the alignment has been found to be out of specification.

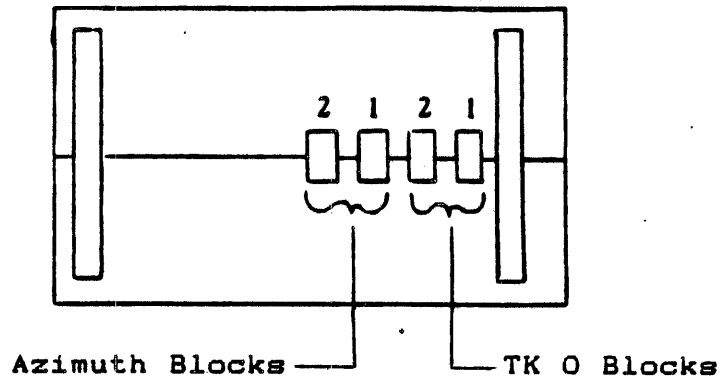
The head alignment sets the position of the read/write gaps on the tape. The azimuth adjustment sets the lateral angle of the head to the path of the tape. For proper data interchange between cartridge tape drives, the head must be aligned properly.

Connect the basic drive (1/2 high) to a power supply and some form of exerciser to run tape from BOT to EOT (with Head 0 and 1 selectable) and back.

Ensure that the "EN" jumper is installed on the Main board.

Load a Wangtek Precision Azimuth/Track Alignment Tape cartridge (P/N 30007-001) in the drive. The alignment cartridge is a precision tool. Never stop or change direction except when the tape is at BOT or EOT. Upon completion of this procedure, the tape will be at EOT. It is assumed that the tape will be at EOT when the procedure is started. If it is not, the tape should be run REV to BOT and then FWD to EOT before continuing.

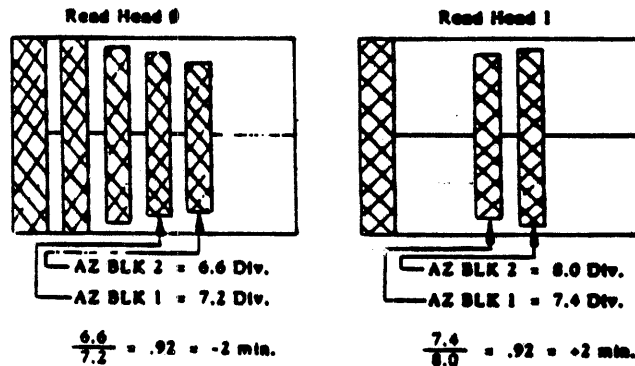
Reverse tape to BOT. While the tape is moving in the Reverse direction, use the stepper single step mode to find the Track 0 Burst. With Read Head 0 selected, position the stepper up/down until the amplitude of TK BLK 1 = TK BLK 2. Adjust the Azimuth with the azimuth adjust tool (P/N 200119-001) until the amplitude of AZ BLK 1 = AZ BLK 2. The TK and AZ signals in the reverse direction are shown below:



While adjusting Azimuth, ensure that the correct null (AZ BLK 1 and 2 equal) is located. A false null exists, but the amplitude is about five (5) times lower amplitude than when the correct null is located.

From BOT, run FWD reading head 0. Adjust Azimuth until AZ BLK 1 = AZ BLK 2. Switch to Read Head 1. Adjust scope gain until the larger of AZ BLK 1 or AZ BLK 2 is equal to eight (8) divisions. Measure the smaller of the two (2) AZ BLKS and insure that the smaller of the two blocks is greater than 6.3 divisions. This insures that Read Head 1 and Read Head 0 are within six (6) minutes of arc. Next adjust the Azimuth until the error of both heads is the same from perfect null (equal amplitude difference).

Example:



Once Azimuth is properly adjusted, carefully tighten and torque (2 inch-pounds) the head mounting screws, being certain that the Azimuth blocks don't move from their proper alignment. These screws are shown in Figure 9.0.

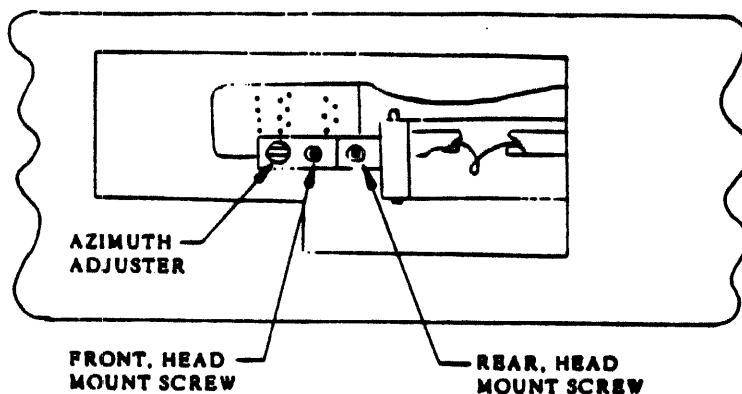


FIGURE 9.0

Now that the Azimuth is adjusted and locked, continue to Read Head 0 in the forward direction. In the single step mode, step the head up/down until Track Block 1 = Track Block 2. If Track Block 1 is larger than Track Block 2 and one step of the stepper motor causes Track Block 2 to be larger than Track Block 1, choose the step which appears to be the closest to null (equal amplitudes).

Once the head is positioned over TRK 0 (Track Block 1 = Track Block 2) allow the tape to continue FWD until it stops at EOT. Mark the stepper motor rotor and housing with a removable marking pen such as a grease pencil. Once at EOT, place the stepper control switch in the multi-step mode and step down 98 steps. Remove the cartridge and scope probes from the drive.

Gently (without moving the stepper motor shaft), insert the ALLEN wrench into the locking collar set screw, from the outer edge of the drive. Using the ALLEN wrench as a lifting tool, gently slide the locking collar up toward the stepper lead screw nut. Set the stepper nut and locking collar lugs in line and separated by a .003 inch shim. (See Figure 9.1)

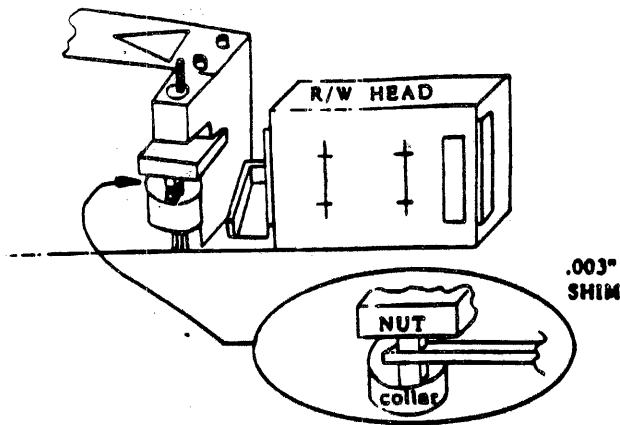
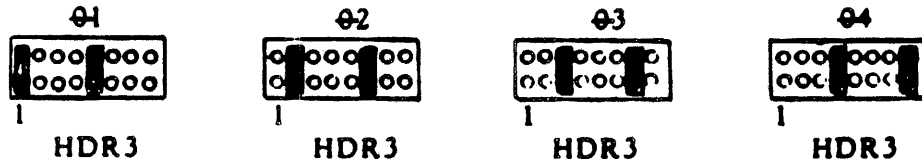


Figure 9.1

Once the collar is in the correct location, carefully torque the set screw to 1 in. lbs and remove the wrench. In the multi-step mode, step the head UP 98 steps and remove the .003" shim. Now step the head DOWN 121 steps. Check that there is no contact between the stepper nut and the locking collar lugs while the motor is stepping down (this checks the .003" clearance set with the shim). At step 121, the nut and collar will hit. Note the stepper phase illuminated on the alignment tester. Adjust the "HDR 3" jumpers to match the stepper phase indicated on the alignment tester. The "HDR 3" jumper/phase locations are shown below:



In the multi-step mode, step the head up/down 121 steps making sure the nut and collar lugs do not make contact during the upward and downward motion, only at the bottom of the 121 steps. If the lugs hit, then the track alignment procedure must be repeated paying particular attention to the lug alignment and separation.

Re-install the stepper motor cable (P5) to the main board (J5). Insert a scratch cartridge and assert "GO" momentarily. Verify that the stepper Resets then moves up to Track 0, indicated by the mark applied earlier in the procedure.

Insert the alignment tape and REV to BOT. Then read FWD with Head 0 selected. Verify that the Azimuth and Track Blocks are as previously set. If they are not, it will be necessary to re-align the section which is not within specification.

10.0 REPLACEMENT PROCEDURE

NOTE: All power should be disconnected prior to proceeding with any replacement of components on the drive. Also, the formatter/controller and chassis must be removed (if installed) in order to gain access to the components on the Main board.

10.1 DRIVE BELT

Without a cartridge installed and the baseplate in the unloaded position, gently grasp the drive belt and remove it by pulling upward. The belt should slide easily over the capstan spindle.

With the drive still in the unloaded position, gently install the new belt over the motor pulley and the capstan drive pulley. Rotate the capstan by hand to seat the drive belt in the center of each pulley.

10.2 FRONT BEZEL

Remove the screws at either side of the bezel. There will be two screws if the drive has a half high bezel, and four screws if the drive has a full high bezel. (Figure 10.0)

Remove the front bezel by pulling straight out away from the drive.

Making sure that the flat connector cable is secure to the chassis, carefully re-install the front bezel. Install the mounting screws and tighten being sure not to overtighten as the bezel may become damaged.

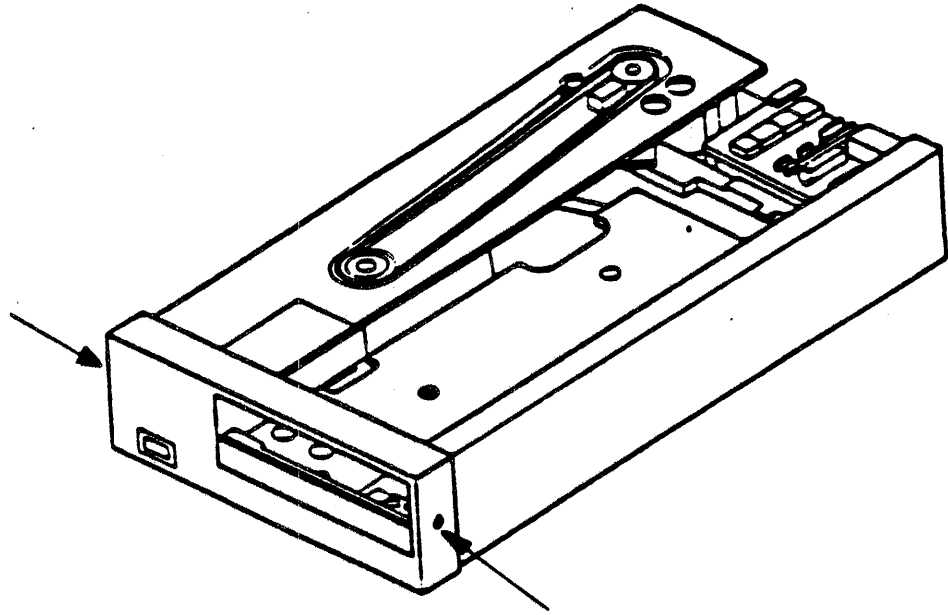
Check that the front bezel is correctly installed by loading a cartridge, checking that there is no interference between the bezel and cartridge base plate.

10.3 LEFT RAIL

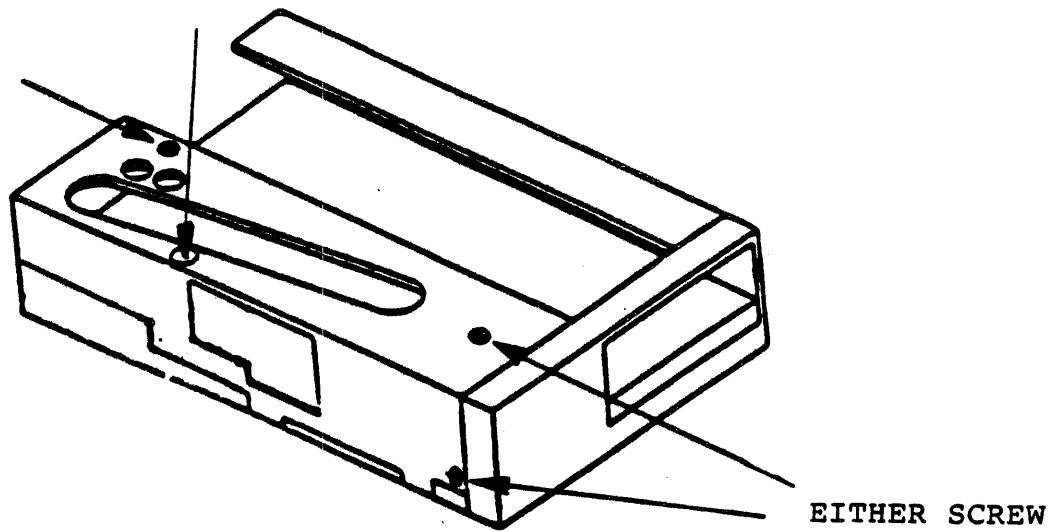
Remove three mounting screws that secure the left rail to the chassis (Figure 10.1). These screws are accessed from the top of the drive. Take note as to the presence of a spacer at the rear mounting screw and save this spacer.

Lift the rail away from the drive taking precautions not to damage the flex cable which is mounted under the rail.

CAUTION: The head assembly is now unprotected. Be careful not to damage the head flexures or the sensor housing the UTH/LTH flexure and components.



Front Bezel
Figure 10.0



Left Rail
Figure 10.1

Installation of the left rail is made easier if the drive belt is first removed, as described earlier in this section. With a finger holding the cartridge eject slide back against the spring tension, install the rail in the opposite order of removal. Check that the spacer is properly installed under the rear of the rail and that the flat connector cable is not damaged during installation.

10.4 RIGHT RAIL

Remove the three screws that secure the rail to the chassis. (Figure 10.2)

Lift the rail from the chassis.

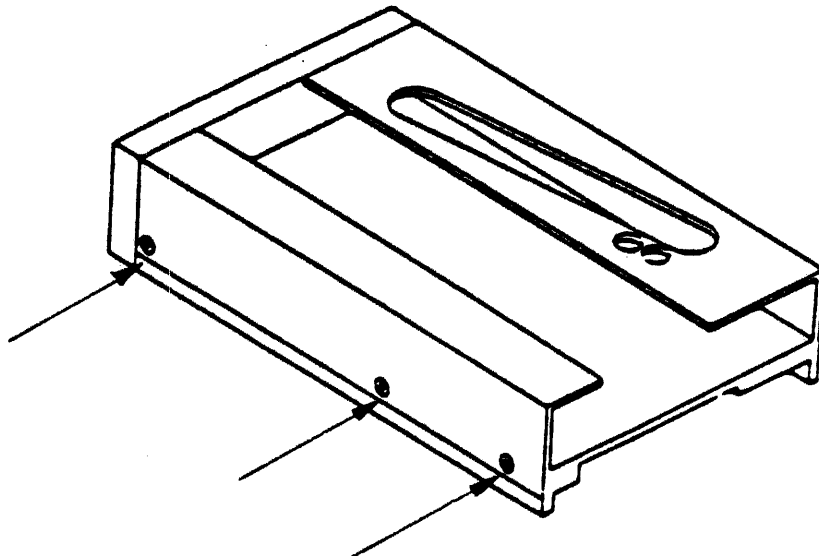
Re-install the rail by reversing the removal procedure.

10.5 MOTOR DRIVER BOARD

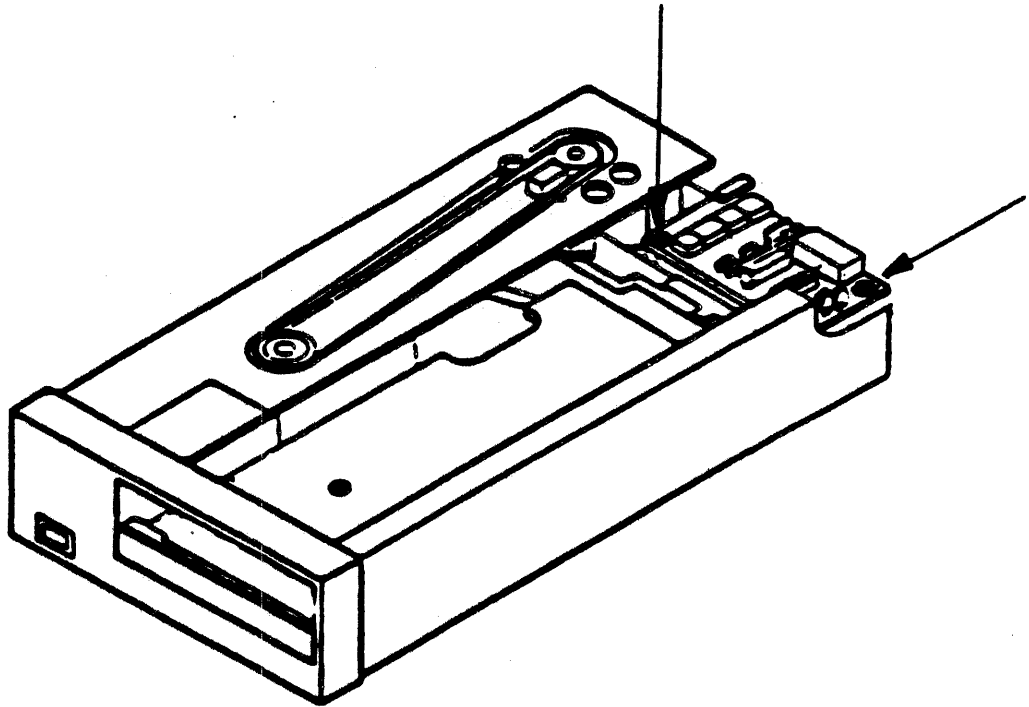
Remove the connector to the capstan motor by pulling straight back from the header.

Remove the two screws securing the board to the chassis, (Figure 10.3) and lift the motor board away from the chassis being careful not to bend the pins on the solder side of the board.

Install the replacement motor driver board in the reverse order of the removal procedure. Take caution to insure that the motor board connector pins are aligned properly in the main board receptacle. Also take care to assure that the connector to the motor is inserted properly.



Right Rail
Figure 10.2



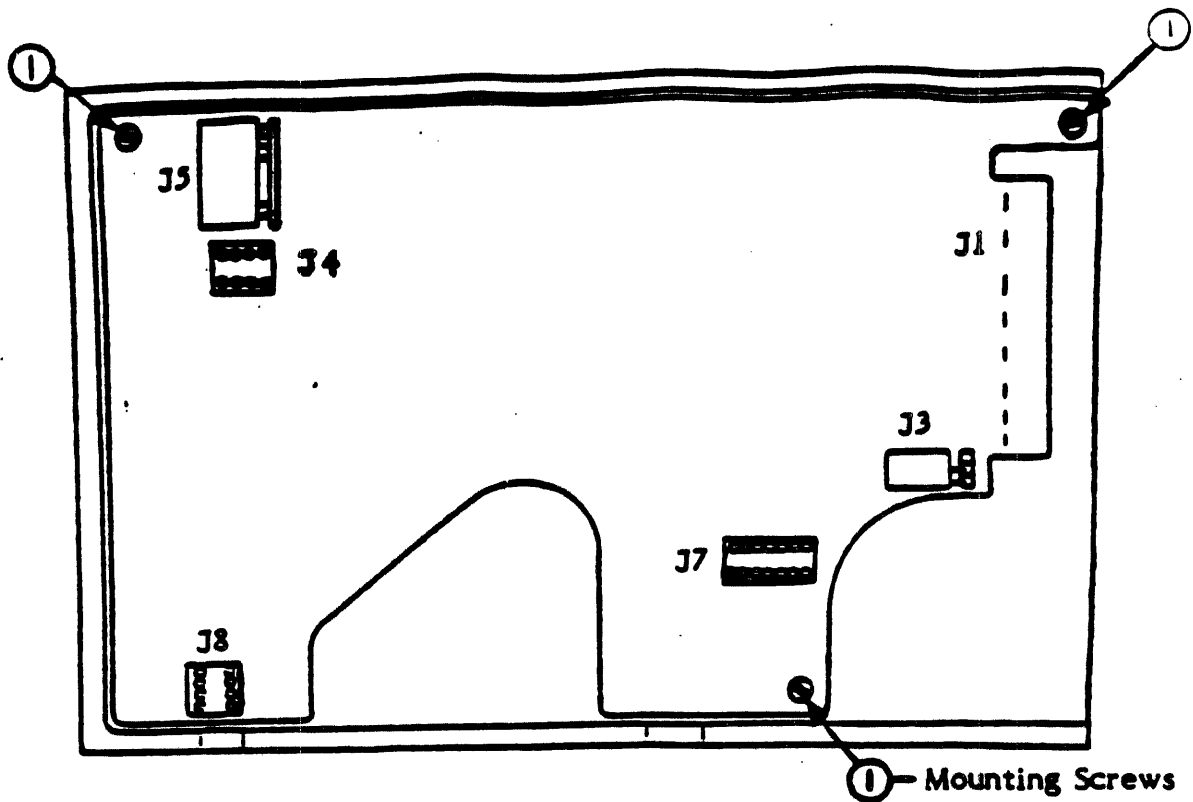
Motor Driver Board
Figure 10.3

10.6 MAIN BOARD

Carefully remove the five (5) connectors from the main board. These connectors are J4, J7, and J8 which are removed by pulling straight up from the board by the connector body only, as they are extremely fragile. Connectors J3 and J5 are removed by pulling at right angles from the main board away from the connector pins.

Remove the three (3) screws that attach the main board. (Figure 10.4) Carefully lift the main board from the chassis. This is accomplished by lifting the end of the board near the motor above the motor and sliding the board away from the chassis until the L.E.D. clears the mounting hole in the chassis.

To install the main board, remove the connector cables from the chassis cavity before sliding the L.E.D. into the chassis slot. After the L.E.D. is located in the chassis slot, lower the main board to the chassis mounting holes, taking precautions not to mis-align the pins from the motor driver board. Install the three mounting screws making sure that the star washer is placed in the mounting hole located nearest the J6 connector. Replace the connectors on the board. Insure that all the jumper locations are configured in the same way as the previous (replaced) board.



Main Board
Figure 10.4

10.7 DRIVE MOTOR

Remove the drive belt as described in section 10.1.

Remove the left rail as described in section 10.3.

Unplug the motor connector which plugs into the motor driver board and the tach connector which plugs into the main board at J3.

Remove the three (3) screws that mount the motor to the chassis, saving the spacers and the screw head insulator. (Figure 10.5)

Lift the drive motor out of the chassis.

Installation is the reverse of the removal procedure, being sure to install all spacers and the insulator prior to tightening all the screws.

10.8 FORMATTER CHASSIS

Remove the front bezel as described in section 10.2.

Remove the cable from the formatter/controller (if installed) to the basic drive main board.

Loosen the four (4) mounting screws that connect the formatter chassis to the drive and slide the formatter chassis sideways with respect to the drive.

Install the chassis in the reverse order of the removal procedure.

Drive Motor Mounting
Figure 10.5

11.0 TROUBLESHOOTING GUIDE FOR THE BASIC DRIVE

NOTE: This troubleshooting guide is meant to be a guide only. It does not go into a detailed theory regarding the troubleshooting procedure. For a more detailed theory, the Wangtek training class is recommended.

11.1 INITIAL CHECKS

Prior to the initiation of any troubleshooting procedure, check the drive and associated system components for any obvious problems.

It is advisable to check the cables, interface connectors, host system, tape cartridge, and power supply for obvious defects prior to removing the drive for troubleshooting.

Check the drive connectors, jumpers, and terminators for proper placement according to configuration desired, and that these are seated properly.

11.2 SYMPTOMS ANALYSIS

The following list describes some of the symptoms and the recommended procedure to correct the failure.

POWER MALFUNCTION

1. No +5 VDC and/or +12 VDC to Motor driver board.

Check for shorts on the board. If any are found, replace the suspected component or the motor driver board.

Insure that the power supply connector is installed properly.

2. No +5 VDC and/or +12 VDC to the Main board.

Insure that the interconnection pins are seated properly from the Motor board to the Main board.

Check for shorts on the Main board. If any are found, return the drive to an authorized Wangtek repair depot for repairs.

TAPE MOTION MALFUNCTION

1. Drive will not run in any mode.

Insure that the motor turns freely by hand. If not, replace the motor assembly.

Check that "GO" is asserted at the QIC-36 bus at pin 4. If asserted, but no tape motion is observed, return unit to a certified Wangtek repair center.

2. Motor "runs away" (into very high speed).

Replace shorted component on Motor Driver Board or Motor Driver Board.

3. Motor turns but does not drive cartridge.

Change cartridge and clean capstan. If this does not correct the problem, return the unit to an authorized Wangtek repair center.

4. Motor starts to drive cartridge but stops immediately.

Adjust tach transducer to motor pulley clearance to 0.003 inches. If this does not correct the problem, return the unit to an authorized Wangtek repair center.

5. Motion causes excessive noise.

Replace Drive Motor.

STATUS MALFUNCTION

1. No UTH or LTH signals.

Insure that J4 connector is seated properly.

Insure that the microprocessor is seated correctly at location 4A on the main board.

If the problem is not resolved by either of the above means, return the unit for repair to an authorized Wangtek repair center.

2. UTH and/or LTH present at all times.

Check the tape cartridge to ensure that the tape is properly wound on the reels.

Return the unit to a Wangtek authorized repair center for repair.

3. SAFE signal not functioning.

Insure that the J4 connector is seated properly.

Insure that a cartridge is installed in the drive. The SAFE switch is mechanically gated with the CIN switch.

4. CIN signal not functioning.

Insure that the J4 connector is seated properly.

Replace the cartridge, again checking the signal function.

5. L.E.D. not lighting.

Check continuity of the L.E.D., replacing the L.E.D. if necessary.

Insure that the host is actually selecting the drive. Also check the jumper location at HDR 1 for proper orientation.

6. L.E.D. always lit.

Insure that the drive is actually deselected by the host. Also insure that the jumper at HDR 1 is not in the location which always selects the drive. (See section pertaining to board assembly number for particular application)

DATA MALFUNCTION

1. Drive will not read or write.

Insure that +12 VDC is present on the main board.

Insure that the head is making contact with the tape surface when the cartridge is loaded.

Replace the cartridge and repeat the procedure.

If none of the above procedures produces the desired results, return the unit to an authorized Wangtek repair center.

2. Drive will not read all tracks.

Insure that the TR0-3 signals are accepted at the QIC-36 buss at pins 12, 10, 8, and 6 respectively.

Insure that the proper firmware is installed for the use intended.

Check that the stepper motor is rotating during track change commands. If not, return the unit to an authorized Wangtek repair center.

3. Drive will not read on one track.

Return the drive to an authorized Wangtek repair center.

4. Drive will not write but will read previously written tape.

Insure that the cartridge is not write protected.

Check that the SAFE signal is functioning properly.

Check the write driver transistors for shorted or opened components and replace as necessary.

If none of the above procedures produces the desired results, return the unit to an authorized Wangtek repair center.

5. Drive will not erase previously written information.

Insure that the cartridge is not write protected.

Check that the SAFE signal is functioning properly.

Check the erase driver transistors for shorted or opened components and replace as necessary.

If none of the above procedures produces the desired results, return the unit to an authorized Wangtek repair center.

6. Excessive errors in read while write mode but not in read only mode.

Return the unit to an authorized Wangtek repair center.

7. Excessive errors in read only but not in read after write mode.

Check the Track alignment of the head and adjust as necessary.

Check the Azimuth alignment of the head and adjust as necessary.

If none of the above procedures produces the desired results, return the unit to an authorized Wangtek repair center.

8. Excessive data errors in all modes.

Check the Track alignment of the head and adjust as necessary.

Check the Azimuth alignment of the head and adjust as necessary.

If none of the above procedures produces the desired results, return the unit to an authorized Wangtek repair center.

12.0 SPARE PARTS LIST

All assemblies listed are available for purchase as spare replacement parts.

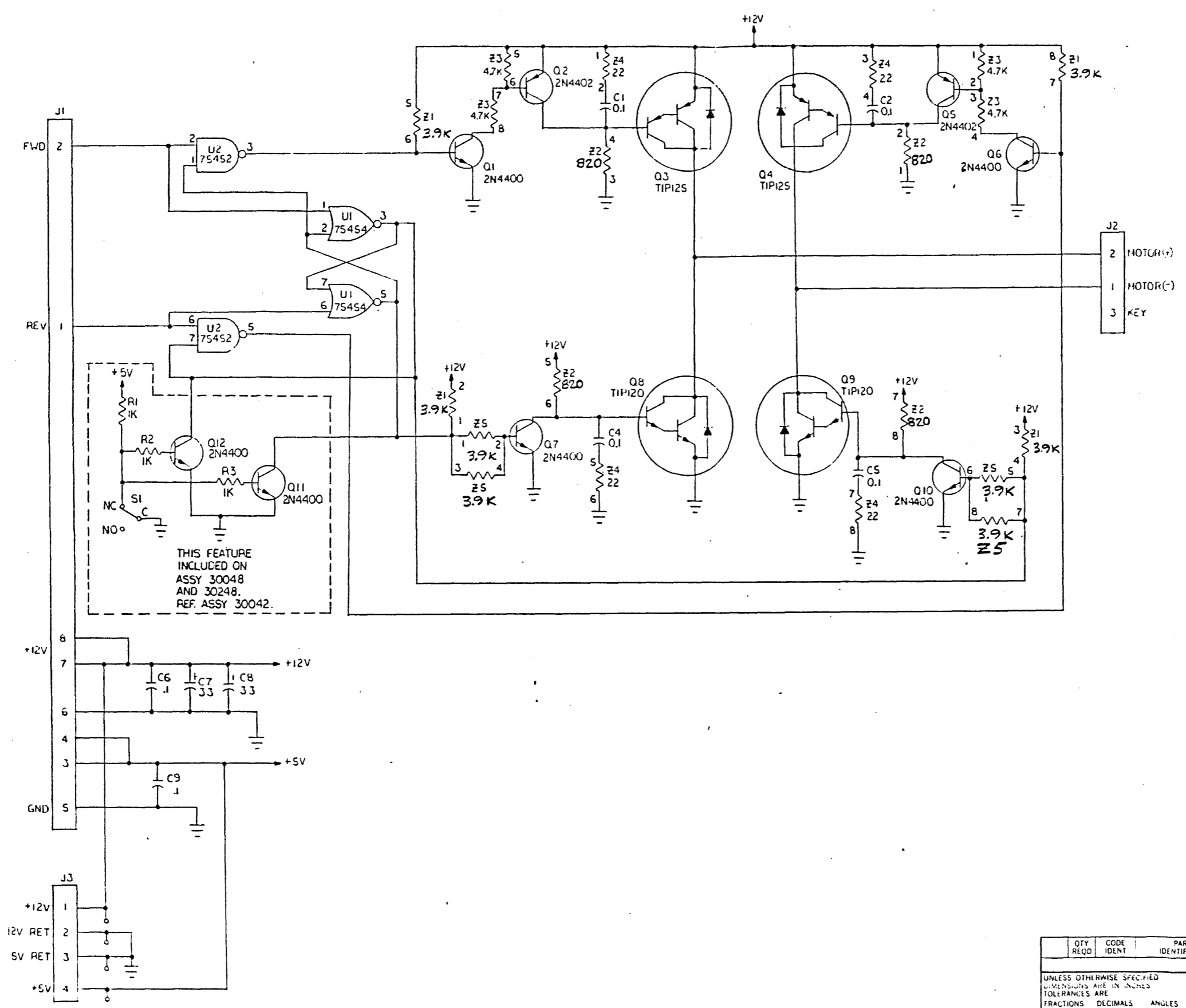
If an assembly has been determined to be defective and is not on the spare parts list, the drive must be returned to an authorized Wangtek repair center.

DESCRIPTION	PART NUMBER
Motor Driver Board	30148-001
Drive Motor Assembly	30041-001
Drive Belt	20120-001
Side Rail - Right	20520-001
Side Rail - Left	30512-001
Microprocessor, Basic Drive	20701-001
Front Bezel - 1/2 High, 3 Flange, Black	30015-004
Front Bezel - 1/2 High, 3 Flange, Grey	30015-005
Front Bezel - 1/2 High, 4 Flange, Black	30016-004
Front Bezel - 1/2 High, 4 Flange, Grey	30016-005
Front Bezel - Full High, 4 Flange, Black	30017-004
Front Bezel - Full High, 4 Flange, Grey	30017-005
Formatter Chassis Assembly	30033-009
* Wangtek Azimuth Adjustment Tool	200119-001
* Wangtek Azimuth and Track Alignment Tape	30007-001
* Wangtek + /- 5 Step Offset Tape	30407-001
* Wangtek Precision Shutter Cartridge	T-10077
* Wangtek Alignment Test Station	T-10123
* NOTE: These items will be supplied only after completion of the Wangtek Training Course.	

13.0 SCHEMATIC DIAGRAMS

The schematic diagrams for the three different versions of the Main board and the motor drive board are shown in the following pages. These schematic diagrams are subject to change without notice.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
A		PRODUCTION RELEASE	2/1/84	WJE
B		SEE ECO 500	11/2/84	WJE
B1		SEE ECO 908	7/30/85	WJE
B2		SEE ECO 1090	12/10/85	WJE



THIS FEATURE INCLUDED ON ASSY 30048 AND 30248. REF. ASSY 30042.

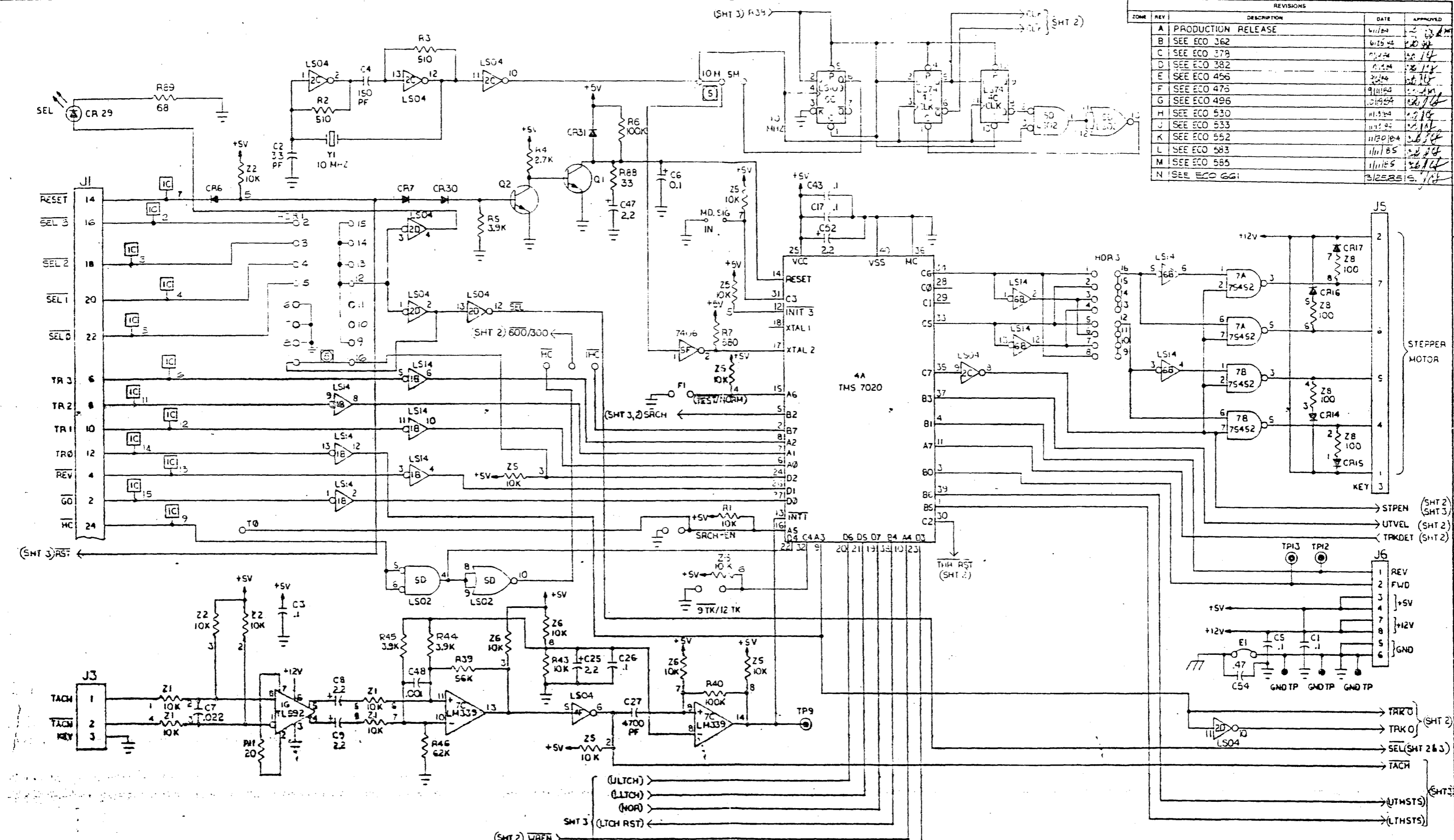
2. ALL CAPACITORS ARE IN MICROFARADS.
 1. ALL RESISTORS ARE IN OHMS ± 5%, 1/4 W
 NOTES: UNLESS OTHERWISE SPECIFIED.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES " " " " " "		CONTRACT NO.	
MATERIAL		APPROVALS	DATE
FINISH		DRAWN: JAE-SEP	2/1/84
NEXT ASSY USED ON		CHECKED: [Signature]	2/1/84
APPLICATION		DO NOT SCALE DRAWING	
SIZE	CODE IDENT NO.	DRAWING NO.	REV
D		40006	B2
SCALE	SHEET 1 OF 1		

wangtek
 SCHEMATIC,
 MOTOR DRIVER

30048	5000 BLK II
30148	5000 PLK I & II
NEXT ASSY	USED ON
APPLICATION	DO NOT SCALE DRAWING

REVISIONS			
ZONE	REV	DESCRIPTION	DATE
A		PRODUCTION RELEASE	4/10/84
B		SEE ECO 362	6/15/84
C		SEE ECO 379	7/24/84
D		SEE ECO 382	8/1/84
E		SEE ECO 456	9/11/84
F		SEE ECO 476	9/19/84
G		SEE ECO 496	10/19/84
H		SEE ECO 530	11/13/84
J		SEE ECO 533	11/29/84
K		SEE ECO 552	11/30/84
L		SEE ECO 583	11/1/85
M		SEE ECO 585	11/1/85
N		SEE ECO 661	3/22/86

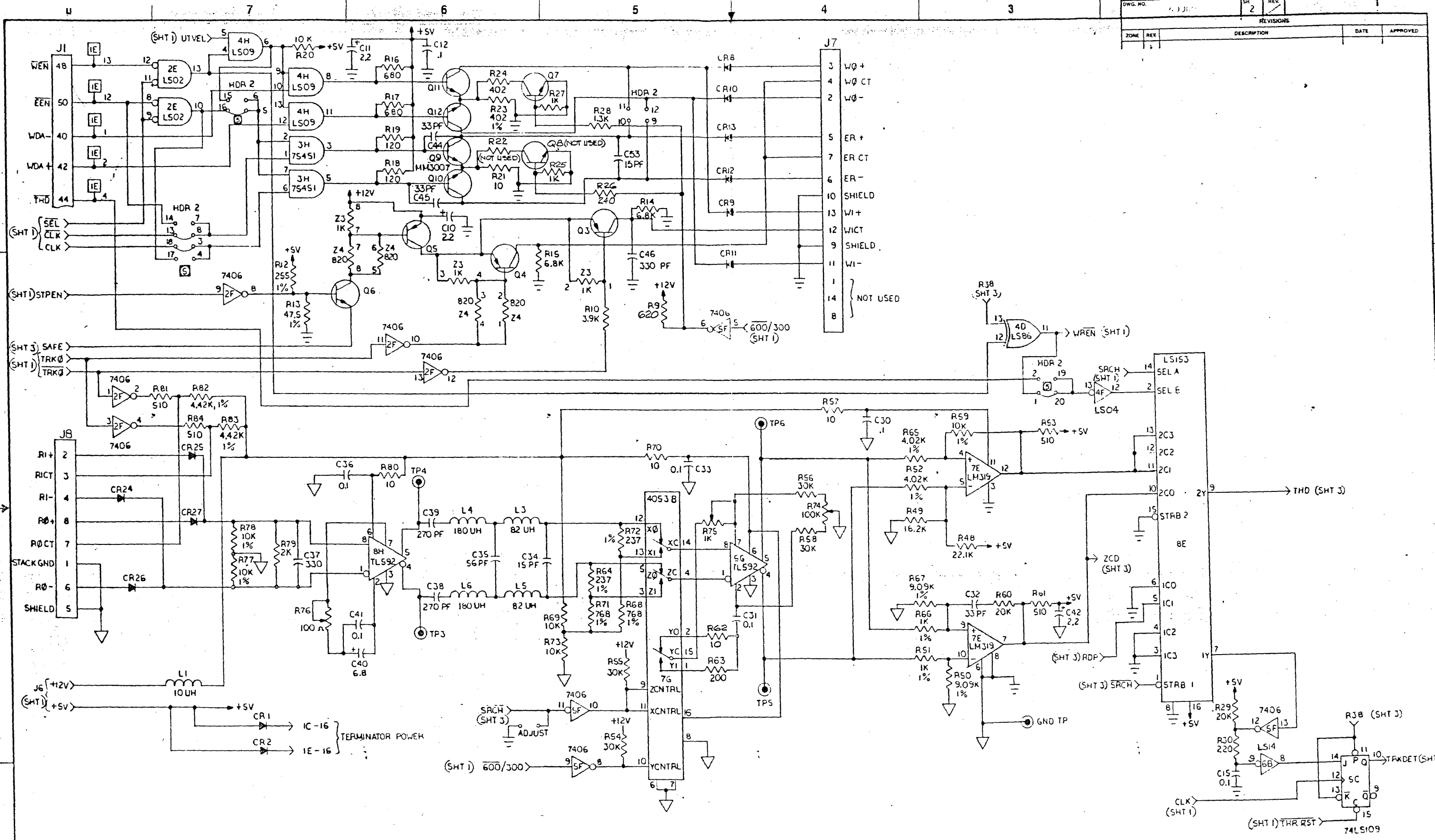


① CUT ETCH TO CHANGE JUMPER CONFIGURATION
 1. ALL PNP TRANSISTORS ARE 2N4402
 2. ALL NPN TRANSISTORS ARE 2N4400
 3. ALL CAPACITORS ARE IN MICROFARADS.
 4. ALL RESISTORS ARE IN OHMS 5%, 1/4 W.
 NOTES: UNLESS OTHERWISE SPECIFIED.

CITY		FROM	PART OR IDENTIFYING NO.	QUANTITY	DESCRIPTION	MATERIAL SPECIFICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES						
PARTS LIST						
APPROVALS			DATE			
DRAWN			4/10/84			
CHECKER			4/10/84			
ISSUED			4/10/84			
MATERIAL		30051		5000		FORM
NEXT ASSY		USED ON		APPLICATION		
DO NOT SCALE DRAWING		SCALE		40012		



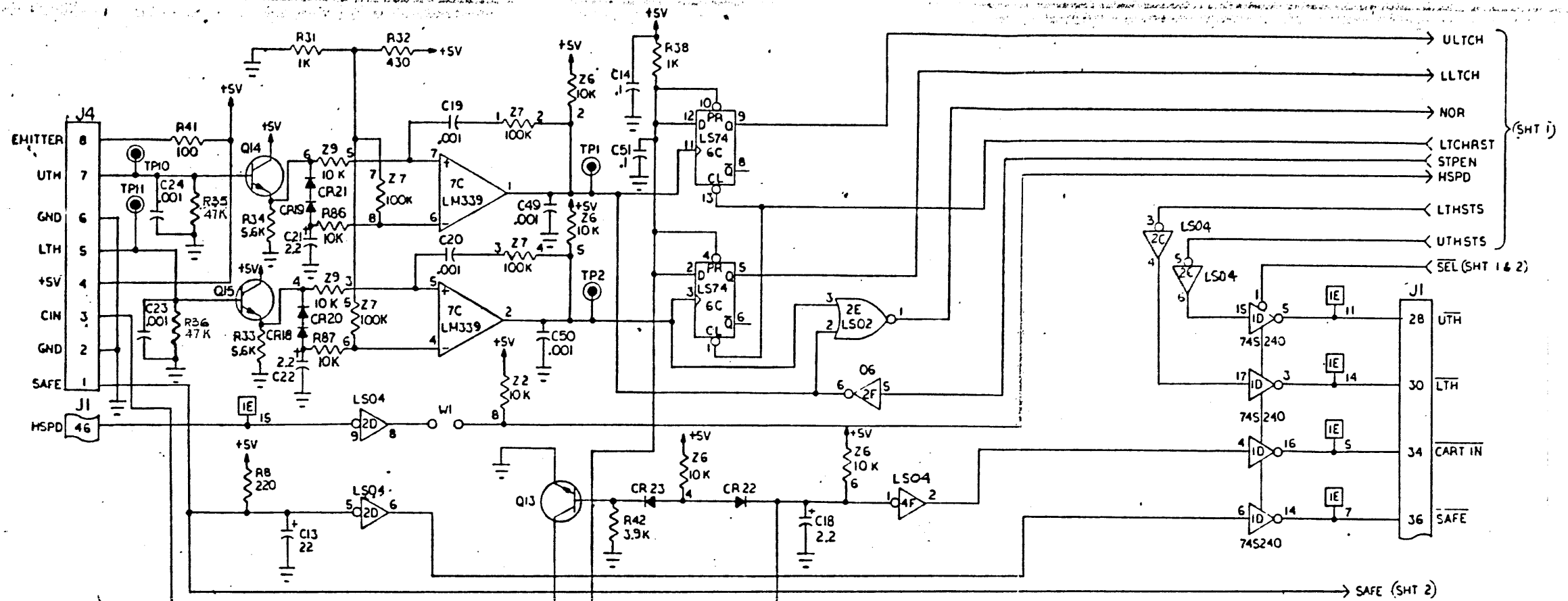
SOLEMAN, MAIN BOARD
 600/300



PARTS LIST		APPROVALS		DATE	
QTY	FSCM	DESIGNED	CHECKED	ISSUED	REV.
REQD	NO.	BY	BY	DATE	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX .XXX					
MATERIAL					
FINISH					
NEXT ASSY USED ON					
CONTRACT NO.					
DRAWN J. JAEGER 4/10/84					
ISSUED					
SIZE FSCM NO. DWG. NO. 10010					

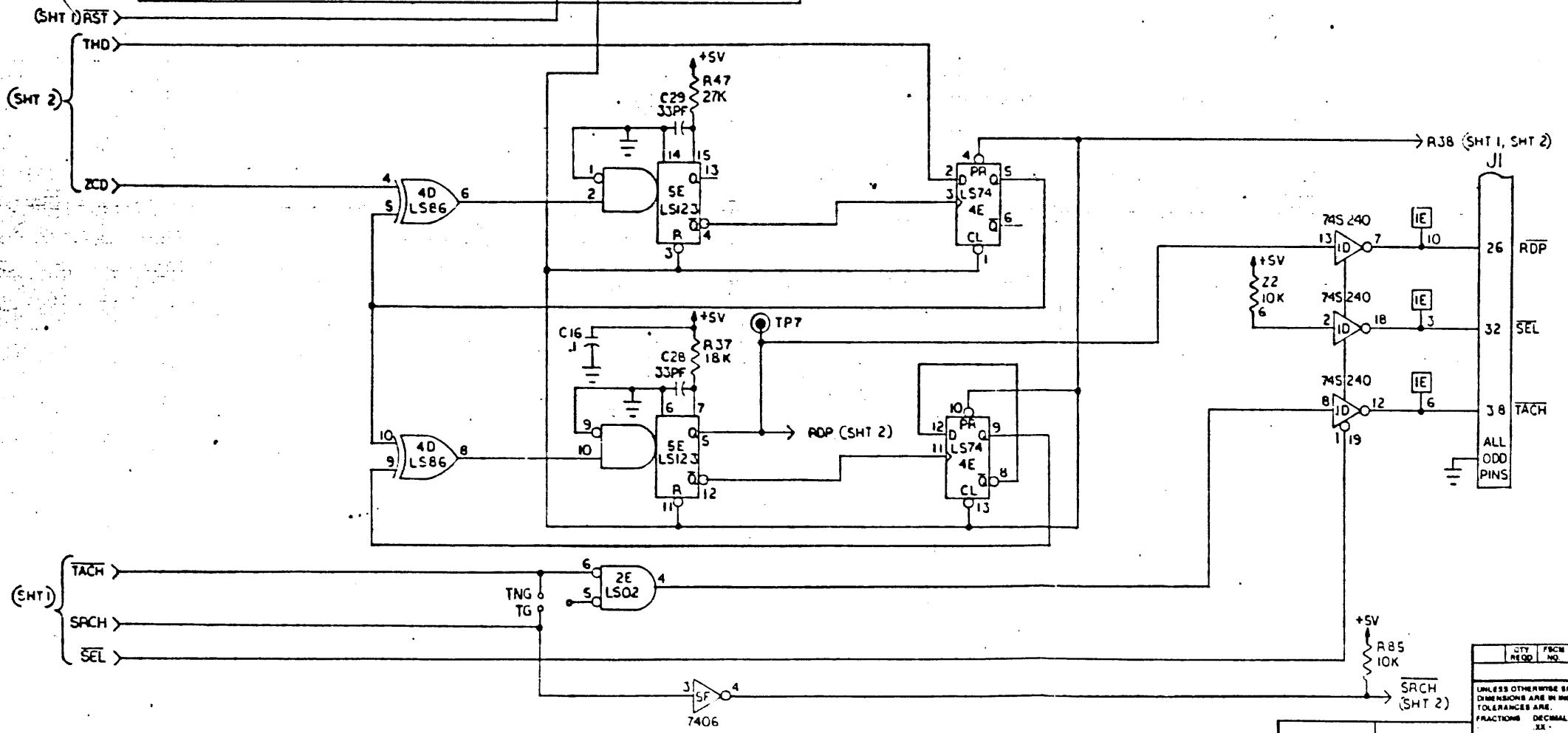
wangtek
SUN VALLEY, CA 94086

SCHEMATIC, MAIN BOARD
600/300



LC. POWER CONNECTIONS

LOC.	TYPE	PWR	GND
1B, 6B	74LS14	14	7
K, IE	220/330 TERM	16	8
ID	74S240	20	10
2C, 2D, 4F	74LS04	14	7
4C, 4E, 6C	74LS74	14	7
1G, 6G, 8H	TL592	6	3
4A	70X10	25	4J
4H	74LS09	14	7
5E	74LS123	16	8
2F, 5F	7406	14	7
2E, 5D	74LS02	14	7
3H	75451	8	4
4D	74LS86	14	7
7A, 7B	75452	8	4
7C	LM339	3	12
7E	LM319	11	3
8E	74LS153	16	8
5C	74LS109	16	8
7G	4053 B	16	8



QTY REQD	FRCH NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX .XXX

CONTRACT NO. APPROVALS DATE

DRAWN I. JAEGER 4/10/61

CHECKED

ISSUED

SIZE FRCH NO. DWG NO. 40012

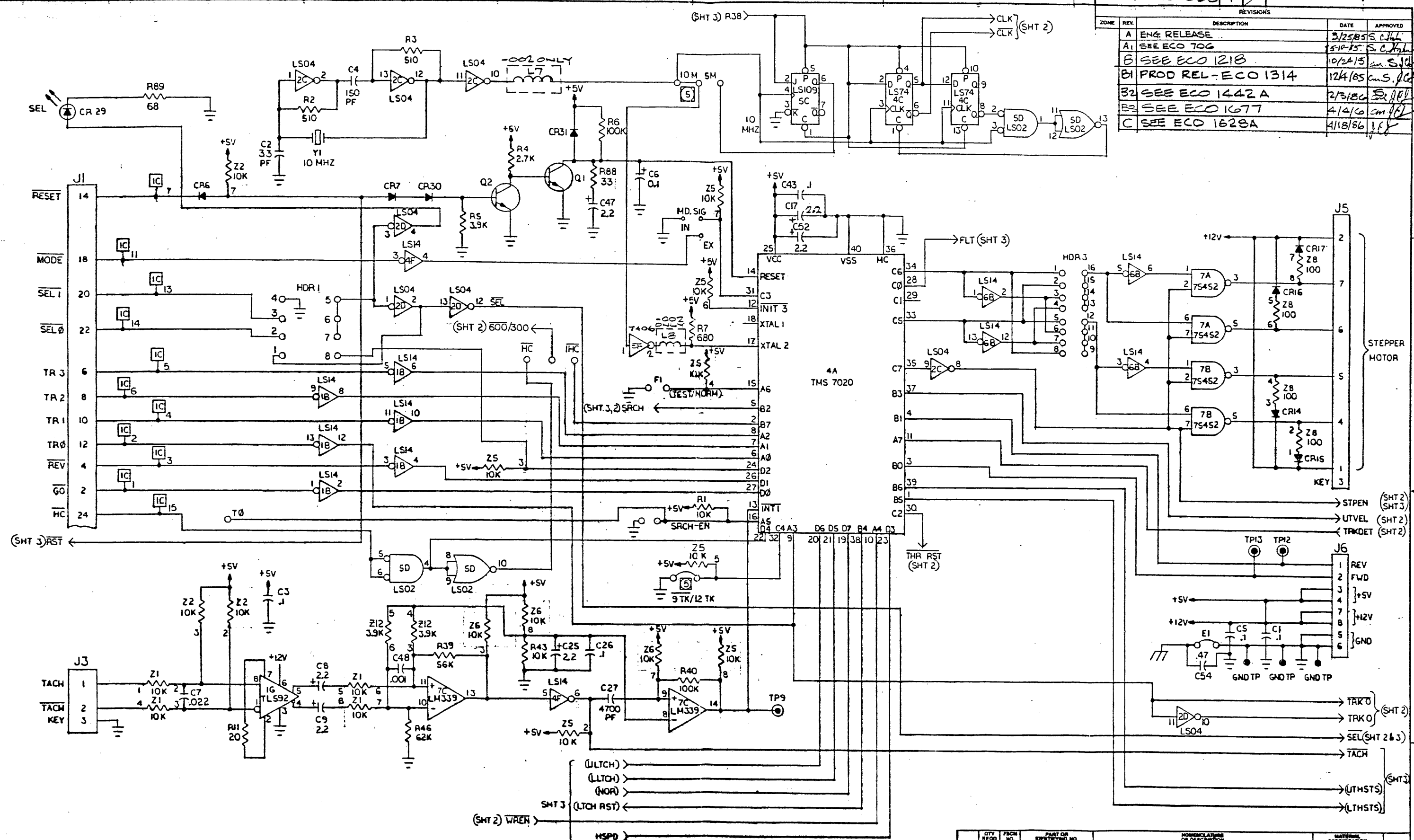
REV N



SCHEMATIC, MAIN BOARD
60/100

DWG. NO. 40043-000 SH 1 REV 1

ZONE	REV.	DESCRIPTION	DATE	APPROVED
A	ENG. RELEASE		3/25/85	S. C. J.
A1	SEE ECO 706		5-10-85	S. C. J.
B	SEE ECO 1218		10/24/85	S. C. J.
B1	PROD REL - ECO 1314		12/4/85	S. C. J.
B2	SEE ECO 1442 A		2/3/86	S. C. J.
B3	SEE ECO 1677		4/14/86	S. C. J.
C	SEE ECO 1628A		4/18/86	S. C. J.

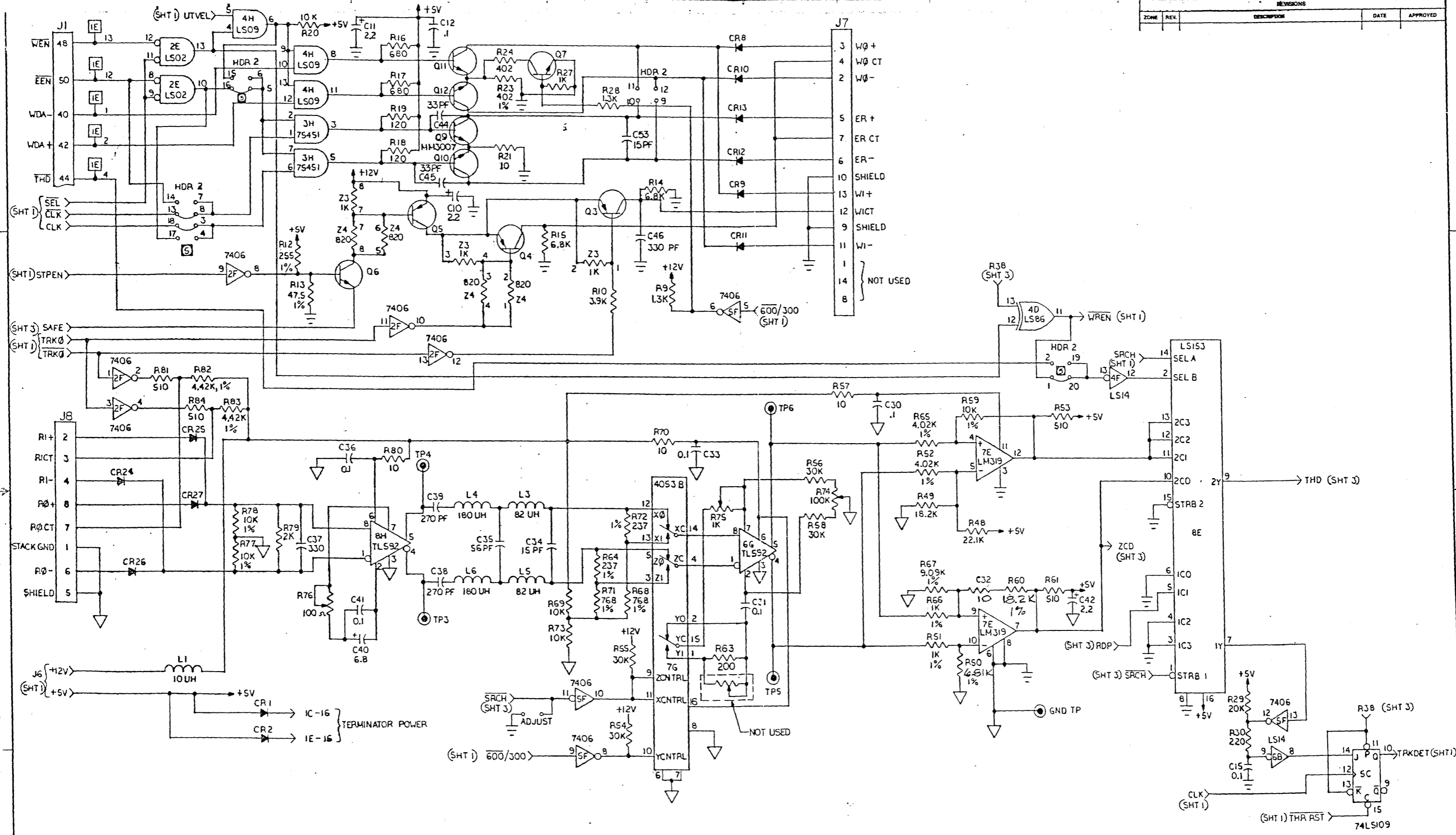


[S] CUT ETCH TO CHANGE JUMPER CONFIGURATION
 4. ALL PNP TRANSISTORS ARE 2N4402
 3. ALL NPN TRANSISTORS ARE 2N4400
 2. ALL CAPACITORS ARE IN MICROFARADS.
 1. ALL RESISTORS ARE IN OHMS 5%, 1/4 W.
 NOTES: UNLESS OTHERWISE SPECIFIED.

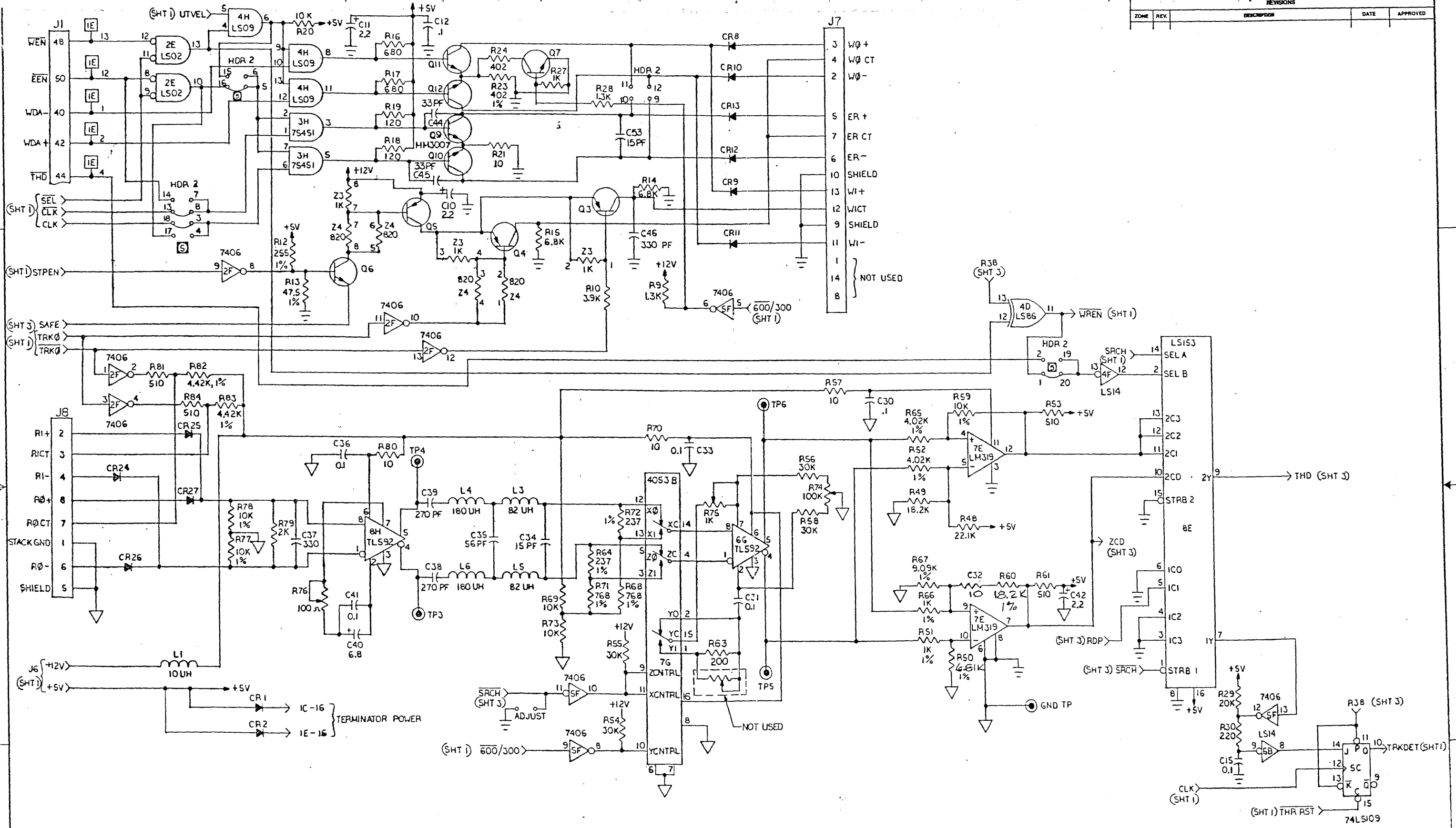
TABULATION BLOCK		
DASH NO.	DESCRIPTION	USED ON
-001	MAIN B/D 300/600	30062
-002	SPECIAL FCC CONFIG	30250

QTY	FRCH	PART OR IDENTIFYING NO.	HOMOLOGATION OR DESCRIPTION	MATERIAL SPECIFICATION
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.		
FRACTIONS DECIMALS ANGLES		APPROVALS DATE		
± .005 ± .010 ± .020		DRAWN E. STROH 3/25/85		
MATERIAL		CHECKED		
FRESH		ISSUED [Signature] 5-9-85		
NEXT ASSY USED ON		SIZE FRCH NO. DWG. NO. REV		
APPLICATION		D 40043-000 C		
DO NOT SCALE DRAWING		SCALE SHEET 1 OF 3		

SRI VALLEY, CA 95066
 SCHEMATIC, MAIN BOARD
 600/300



QTY	FSCM	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .005 ± .001 ± .005 ± .001 ± .005 ± .001			CONTRACT NO.	wangtek SUN VALLEY, CA 94086
MATERIAL			APPROVALS	
30062			CHECKED	SCHEMATIC, MAIN BOARD 600/300
NEXT ASSY USED ON			ISSUED	
APPLICATION			DO NOT SCALE DRAWING	SIZE / FSCM NO. DWG. NO. RE D / 40043-000 C

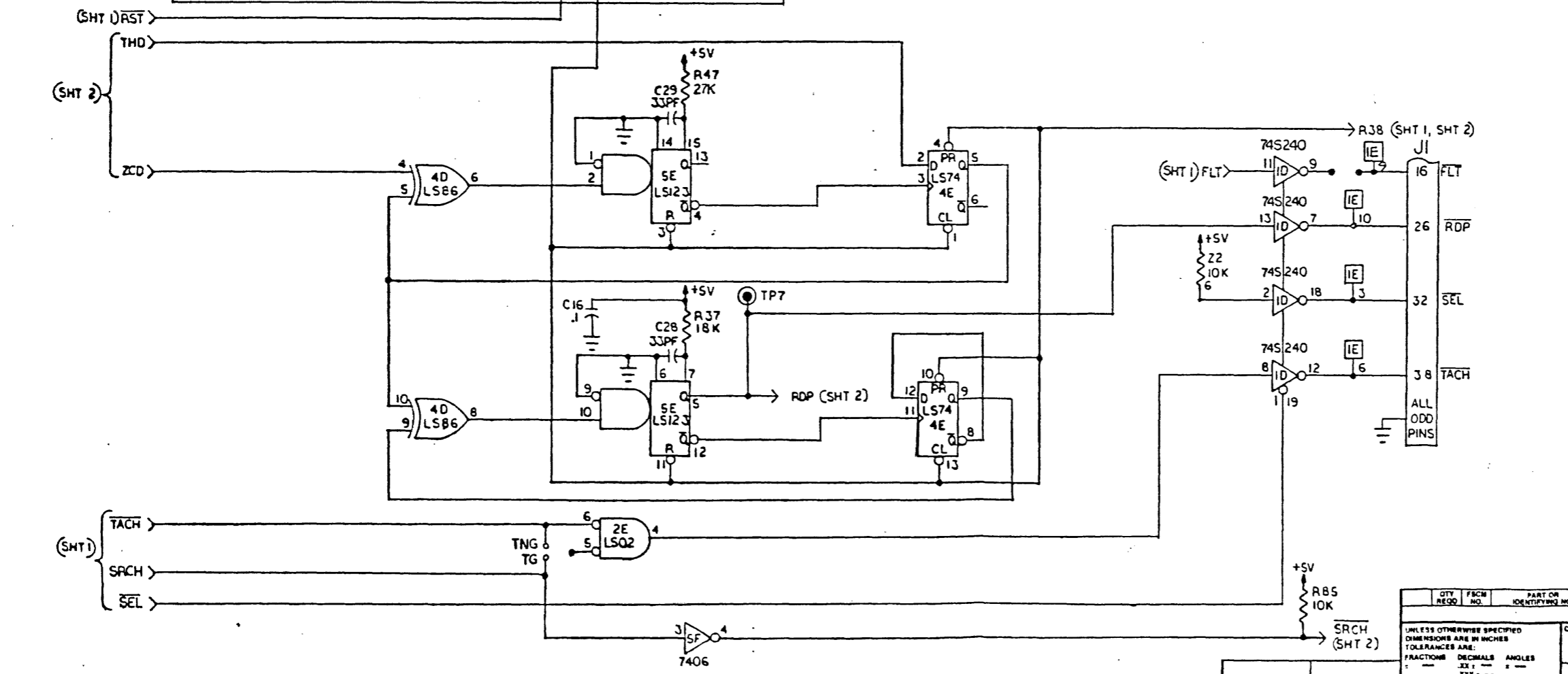
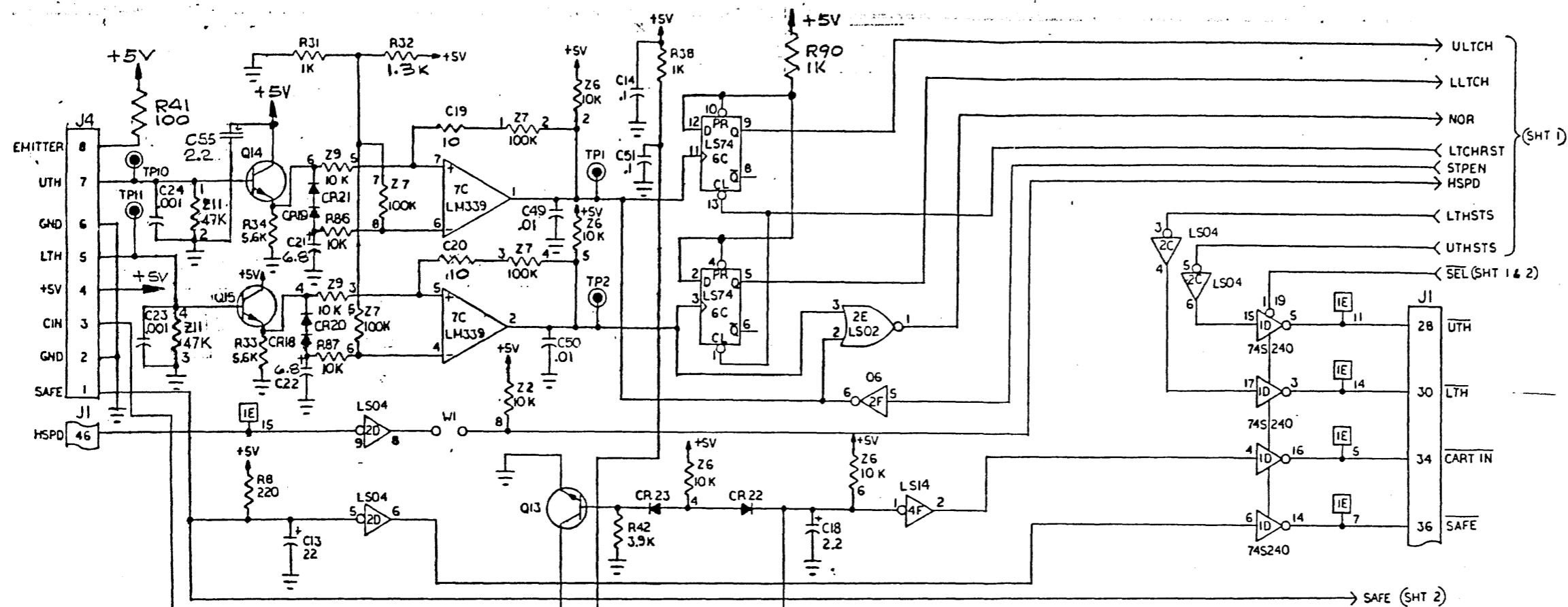


PARTS LIST		APPROVALS		DATE	
QTY	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION		MATERIAL SPECIFICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX = ± .XXX = ±					
MATERIAL		DRAWN		DATE	
FINISH		CHECKED		DATE	
NEXT ASSEMBLY USED ON		ISSUED		DATE	
APPLICATION		DO NOT SCALE DRAWING		SCALE	

wangtek
SUN VALLEY, CA 94086

SCHEMATIC, MAIN BOARD
600/300

SIZE: FSCM NO. DWG. NO. 40043-000 C
SCALE: SHEET 2 OF 3



IC POWER CONNECTIONS

LOC.	TYPE	PWR	GND
1B, 6B, 4F	74LS14	14	7
1C, 1E	220/330 TERM	16	8
1D	74S240	20	10
2C, 2D	74LS04	14	7
4C, 4E, 6C	74LS74	14	7
1G, 6G, 8H	TL592	6	3
4A	7000	25	40
4H	74LS09	14	7
5E	74LS123	16	8
2F, 5F	7406	14	7
2E, 5D	74LS02	14	7
3H	75451	8	4
4D	74LS86	14	7
7A, 7B	75452	8	4
7C	LM339	3	12
7E	LM319	11	3
8E	74LS153	16	8
5C	74LS109	16	8
7G	4053 B	16	8

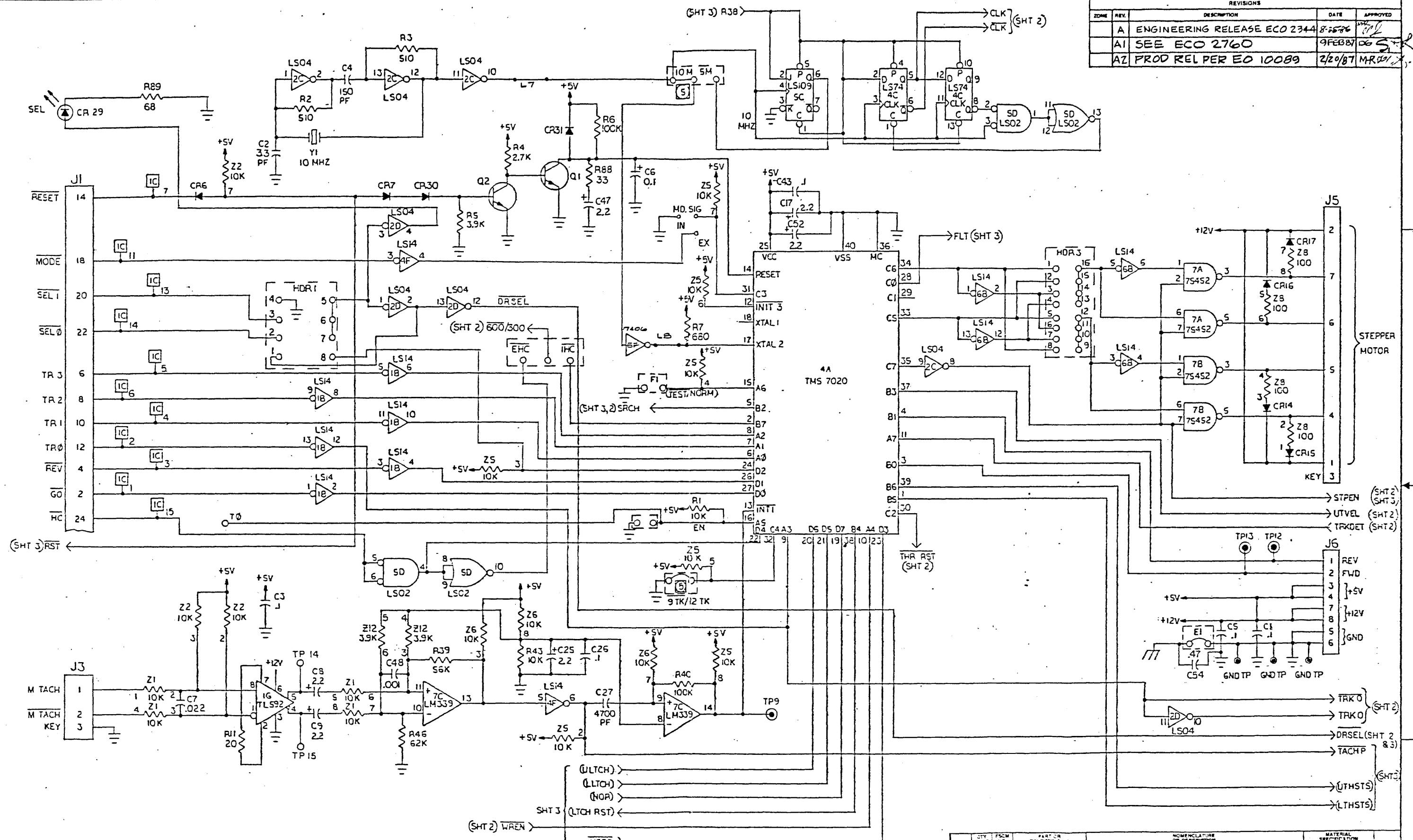
QTY REQD	FRCH NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.		
FRACTIONS	DECIMALS	ANGLES	APPROVALS	
± .005	± .001	± .001	DATE	
MATERIAL		DRAWN		
FINISH		CHECKED		
ISSUED		SCALE		
NEXT ASSY		USED ON		SIZE FRCH NO.
APPLICATION		DO NOT SCALE DRAWING		DWG. NO.
				40043-000 C
				SHEET 3 OF 3



SCHEMATIC, MAIN BOARD
600/300

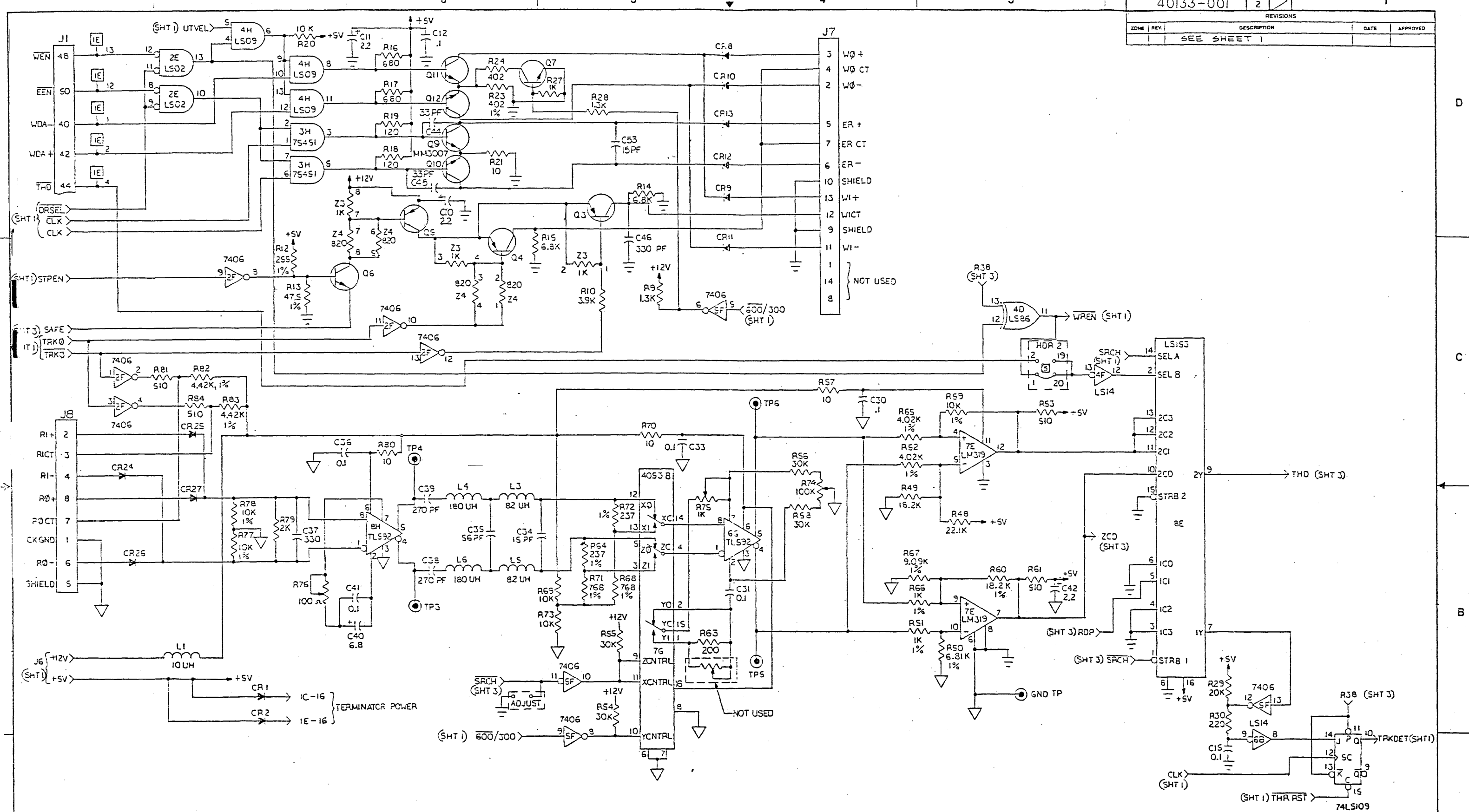
40043-000 C

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	ENGINEERING RELEASE ECO 2344	8-25-86	
	A1	SEE ECO 2760	9 FEB 87	
	AZ	PROD REL PER EO 10089	2/20/87	MR...



[5] CUT ETCH TO CHANGE JUMPER CONFIGURATION
 1. ALL PNP TRANSISTORS ARE 2N4402
 2. ALL NPN TRANSISTORS ARE 2N4400
 3. ALL CAPACITORS ARE IN MICROFARADS.
 4. ALL RESISTORS ARE IN OHMS 5%, 1/4 W.
 NOTES: UNLESS OTHERWISE SPECIFIED.

QTY	PSCH	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		CONTRACT NO.		
30062 5000		APPROVALS DATE		
NEXT ASSY USED ON		CHECKED		
APPLICATION		ISSUED		
DO NOT SCALE DRAWING		SCALE		
		SCHEMATIC, DRIVE ELECTRONICS (QIC-24/11)		
		SIZE PSCH NO. DWG. NO. 40133-001 REV. A2		
		SHEET 1 OF 3		



QTY		FSCM	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
PARTS LIST					
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES =					
MATERIAL		CONTRACT NO.		APPROVALS	
FINISH		DATE		DRAWN	
NEXT ASSY		ISSUED		CHECKED	
USED ON		SCALE		SIZE (FSCM NO.)	
APPLICATION		DO NOT SCALE DRAWING		DWG. NO. 40133-001 REV. A2	
				SHEET 2 OF 3	

wangtek
 SAN VALLEY, CA 90088
 SCHEMATIC, DRIVE ELECTRONICS
 (QIC-24/11)