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MODEL RS-660
TIMING SIMULATOR/WORD GENERATOR
USER'S MANUAL

SERIAL NO:

660-UA-7.3
31January, 1986

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SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures, and therefore do not appear elsewhere in this publication. These are recommended precautions that the operator must understand and apply during various phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

The operator must at all times observe safety precautions. Do not replace components or make adjustments inside the equipment with the power supply turned on. Under certain conditions, dangerous potentials may exist when the power switch is in the OFF position due to charges retained by capacitors. To avoid injury, always remove power, discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into the enclosure for the purpose of servicing the equipment except in the presence of someone who is capable of rendering aid.

I. INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model RS-660 Word Generator/Timing Simulator is a 16 channel, general purpose, digital signal generator. The unit is capable of operating at frequencies up to 20 MHz (50 nsec bit time) and incorporates the following key features:

Versatile operating modes; WORD GENERATOR or TIMING SIMULATOR.

Simplified front panel operation.

C R T display for added operating convenience.

Fully controllable cursor.

Selectable data formats; hexadecimal or binary.

Single step, repetitious or continuous operation.

First bit and programmable sync outputs.

Free running and gated output clocks.

External clock and trigger inputs.

External oscillator input for synchronous system operation.

Plug-in stored program card.

Remote control interfaces.

Combined line voltage selector and safety AC power connector.

Figure 1-1 is a front view of the Model RS-660 and illustrates the front panel operating controls.

Figure 1-2 illustrates the unit's rear panel features, including the optional interface connectors.

1.2 OPTIONS

1.2.1 Memory Option, 4K (Option 660-001)

This option provides the user with up to 65,536 programmable output bits in the Word Generator mode or 32,768 output bits in the Timing Simulator mode.

MODEL RS-660 REAR PANEL

FIGURE 1-2

1.3 APPLICATION OF THE RS-660

The Model RS-660 may be operated in either of two distinct modes - Word Generator or Timing Simulator. The most convenient mode depends upon the specific application and must be selected prior to loading the instrument. While operating in the Word Generator mode each and every data word is output for the same length of time; i.e., the period of the clock source. This mode is therefore best suited to applications where data transitions occur at regular intervals. In the Timing Simulator mode each word of data may be output for a unique period of time. This enables the instrument to generate waveforms, containing pulses, of extremely short duration in the midst of long time intervals.

The Model RS-660 may be directed to either output a programmed data pattern from 1 to 4096 times upon receipt of a trigger, or to repeat the pattern continuously. This function is applicable to both Word Generator and Timing Simulator modes.

Data may be loaded using either binary or hexadecimal. When dealing with waveforms it is usually more convenient to use binary, whereas data transfers are sometimes more conveniently dealt with using hexadecimal.

1.3.1 Application of the Word Generator Mode

Assuming that the desired output waveform has been examined and the Word Generator mode of operation has been selected as being the most appropriate, the next step entails selecting the number of data channels to be used and determing the period of the clock source. The clock period may be defined as the shortest time interval between any data level transitions on any channel. Having defined the clock period, the desired output waveform should be divided into time intervals, each being equal to one clock period. The number of bits per channel may now be defined and is equal to the number of time intervals required to generate one cycle of the desired waveforms. At this point the data memory may be loaded. In order to accomplish this the logic levels on all channels during the first time interval or word should be converted into 'ones' and 'zeros' and loaded into the data memory at word number one. This process should then be repeated for all subsequent words. If so desired, the device may be clocked by an external clock source. This provides for synchronous system operation or operation at frequencies not obtainable using the device's internal clock source.

1.3.2 Application of the Timing Simulator Mode

Having selected the Timing Simulator mode, the desired output waveform should be divided into a series of time intervals. A level transition on any channel constitutes the end of the previous time interval and the beginning of a new one. Once the desired number of channels have been selected the data/time memory may be loaded. For each word, both the logic levels on each channel and the relevant time interval must be programmed. The number of the last word may be determined by counting the number of words required to generate one complete cycle of the waveforms.

INPUT	RESIDENT LEVEL	ACTIVE EDGE	MAX. FREQ.	MIN. PULSE WIDTH
EXTERNAL OSCILLATOR	NONE	(+VE)	20MHz	25nS (SEE NOTE)
EXTERNAL CLOCK	HIGH	(+VE)	20MHz	25nS (LOW LEVEL)
EXTERNAL TRIGGER	HIGH	(-VE)	N/A	20nS (LOW LEVEL)

NOTE: For operation with an external oscillator, the incoming waveform should have a 50% duty cycle.

Output Signals: FREE-RUNNING OUTPUT CLOCK (FOCLK+), GATED OUTPUT CLOCK (GOCLK+), PROGRAM SYNC (PSYNC-), SYNC BIT 1 (SYNC1-) and DATA OUTPUTS 0-F.

Reference Appendix A for pin designation of rear panel connectors J7 and J8.

TTL compatible drivers, low ("0") = +0.4V max at +48mA dc, high ("1") = +2.4V min at -13mA dc or +2Vdc min at -42mA dc; rise and fall times = 10 nanoseconds maximum into terminated 120 ohm load and 10 feet of coax cable.

Skew:

Data Channel to Data Channel = 8 nanoseconds maximum

Gated Output Clock to Data Channel = 20 nanoseconds maximum

Gated Output Clock to Sync Output = 20 nanoseconds maximum

Free Running Output Clock to Gated Output Clock = 25 nanoseconds maximum

External Input Clock to Gated Output Clock = 30 nanoseconds maximum

Word Generator, Non-continuous Mode; External Trigger to Gated Output Clock = 50 ns max + (2 x CLOCK PERIOD)

Timing Simulator, Non-continuous Mode; External Trigger to Gated Output Clock = 150 nsec max + FIRST WORD PERIOD

Power:

200 watts; 120Vac $\pm$ 10%, 50/60 Hz; 100/220/240Vac, 50/60 Hz optional

Dimensions:

Height = 134 mm (5.25 in.)

Width = 432 mm (17 in.)

Depth = 430 mm (16.8 in.) including 46 mm (1.8 in.) for handles

Weight = 13.6 kg. (30 lbs.)

II. INSTALLATION AND MAINTENANCE

2.1 INSTALLATION

2.1.1 Unpacking and Inspection

The Model RS-660 is packed in a molded, plastic foam form, within a cardboard carton. The molded form holds the unit securely in the carton and absorbs any reasonable external shock, normally encountered in transit. Carefully remove the unit from the carton and inspect the exterior of the instrument for any signs of damage.

The shipping container and packing material should be retained, in case reshipment is required.

Included in the shipping container with the instrument are the instruction manual, power cord and external option accessories.

2.1.2 Mechanical Installation

The Model RS-660 is equipped with a collapsible tilt bail, which may be used to elevate the front of the instrument for convenient bench use.

The instrument may be mounted in a standard 19 inch rack with the optional rack-mount kit (option 660-007). To install, remove the small, decorative side panels located near the front of the instrument. Attach each of the rack-mount flanges, using the two screws supplied.

2.1.3 Electrical Installation

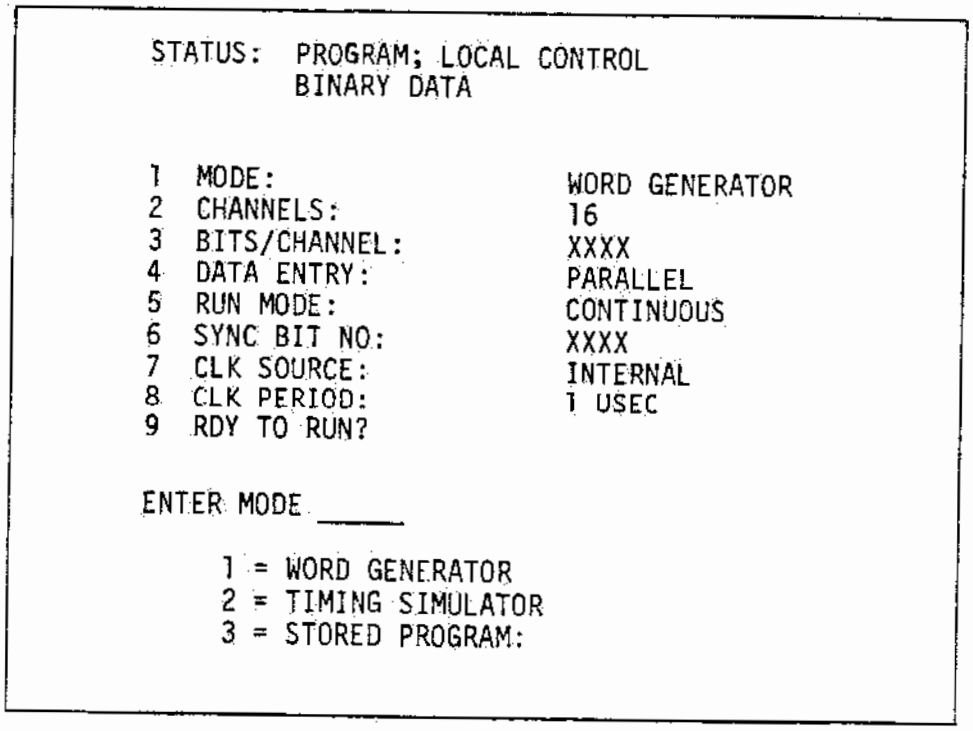
Prior to connecting power to the Model RS-660, confirm that the primary power source is compatible with the unit's source requirements. The Model RS-660 is fitted with a combined AC connector, fuse holder and voltage selector, on the rear panel. This enables the unit to be operated from the following power sources:

a) 100 Vac., 50/60 HZ., 2 amp fuse
b) 120 Vac., 50/60 HZ., 2 amp fuse
c) 220 Vac., 50/60 HZ., 1 amp fuse
d) 240 Vac., 50/60 HZ., 1 amp fuse

In order to select a different operating voltage, the following procedure should be adopted:

i) remove AC power cord.
ii) slide connector window over to cover AC receptacle.
iii) remove fuse by lifting fuse release lever.
iv) remove printed circuit board selector.
v) reorientate and install selector board, such that desired voltage will be visible upon reassembly.
vi) return fuse release lever to original position and install fuse of correct rating.
vii) slide window over, to cover fuse and check that desired operating voltage is now visible.

Figure 2.1
POWER-UP DISPLAY



Note XXXX = 1024 or 4096 depending on memory capacity.

TEST #1 WORD GENERATOR 16 CHANNEL

Procedure:

i) Having obtained a display that resembles that shown in figure 2.1 following application of power to the instrument, activate the keys marked "3" and ENTR respectively. Successively activate the following keys and observe that the resultant display is depicted by figure 2.2:

"9", "9", "0" and ENTR

Figure 2.2
STORED PROGRAM NO. 990 CONTROL DISPLAY

```
STATUS: PROGRAM; LOCAL CONTROL
        BINARY DATA

1 MODE:                    PGM 990 WRD GEN
2 CHANNELS:                16
3 BITS/CHAN:               16
4 DATA ENTRY:              PARALLEL
5 RUN MODE:                CONTINUOUS
6 SYNC BIT NO:             1
7 CLOCK SOURCE:            INTERNAL
8 CLOCK PERIOD:            0100 NSEC
9 RDY TO RUN?


ENTER NO. OF CHANNELS __
                1,2,4,8,16
```

Figure 2.4
STORED PROGRAM NO. 990 OUTPUT WAVEFORMS

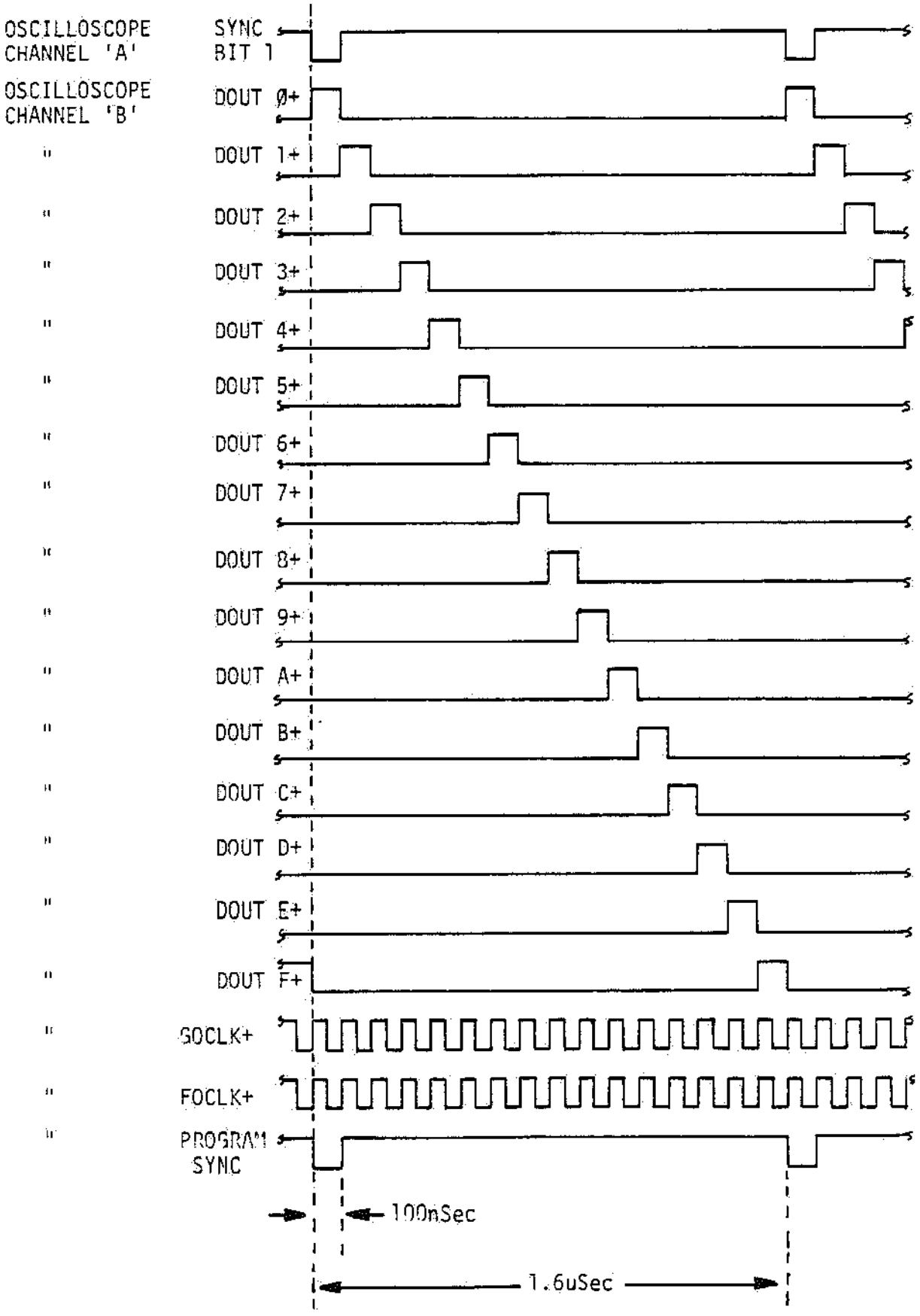


Figure 2.6
STORED PROGRAM NO. 991 DATA DISPLAY

WORD	CHANNEL 0123	CHANNEL 4567	WORD	CHANNEL 0123	CHANNEL 4567
1	1000	0000	17	XXXX	XXXX
2S	0100	0000	18		
3	0010	0000	19		
4	0001	0000	20		
5	0000	1000	21		
6	0000	0100	22		
7	0000	0010	23		
8	0000	0001	24		
9L	0000	0000	25		
10	XXXX	XXXX	26		
11			27		
12			28		
13			29		
14			30		
15			31		
16	XXXX	XXXX	32	XXXX	XXXX

NOTE: X=DON'T CARE

v) Set the unit to RUN and verify that the PROGRAM SYNC (BNC), gated output clock (GOCLK+), free running output clock (FOCLK+) and data output channels (DOUTØ through DOUT7+) bear the same relationships, to the SYNC BIT 1 (BNC), as depicted by figure 2.7. Reference appendix A for connector pin numbers.

TEST #3 WORD GENERATOR 4 CHANNEL

Procedure:

i) Call STORED PROGRAM number 992 and verify that the CONTROL and DATA displays resemble those depicted in figures 2.8 and 2.9.

Figure 2.8
STORED PROGRAM NO.992 CONTROL DISPLAY

```
STATUS:  PROGRAM; LOCAL CONTROL
         BINARY DATA


1  MODE:                    PGM 992 WRD GEN
2  CHANNELS:                4
3  BITS/CHANNEL:            6
4  DATA ENTRY:              PARALLEL
5  RUN MODE:                CONTINUOUS
6  SYNC BIT NO:             3
7  CLOCK SOURCE:            INTERNAL
8  CLOCK PERIOD:            0500 USEC
9  RDY TO RUN?


ENTER NO. OF CHANNELS __
                  1,2,4,8,16
```

Figure 2.10
STORED PROGRAM NO. 992 OUTPUT WAVEFORMS

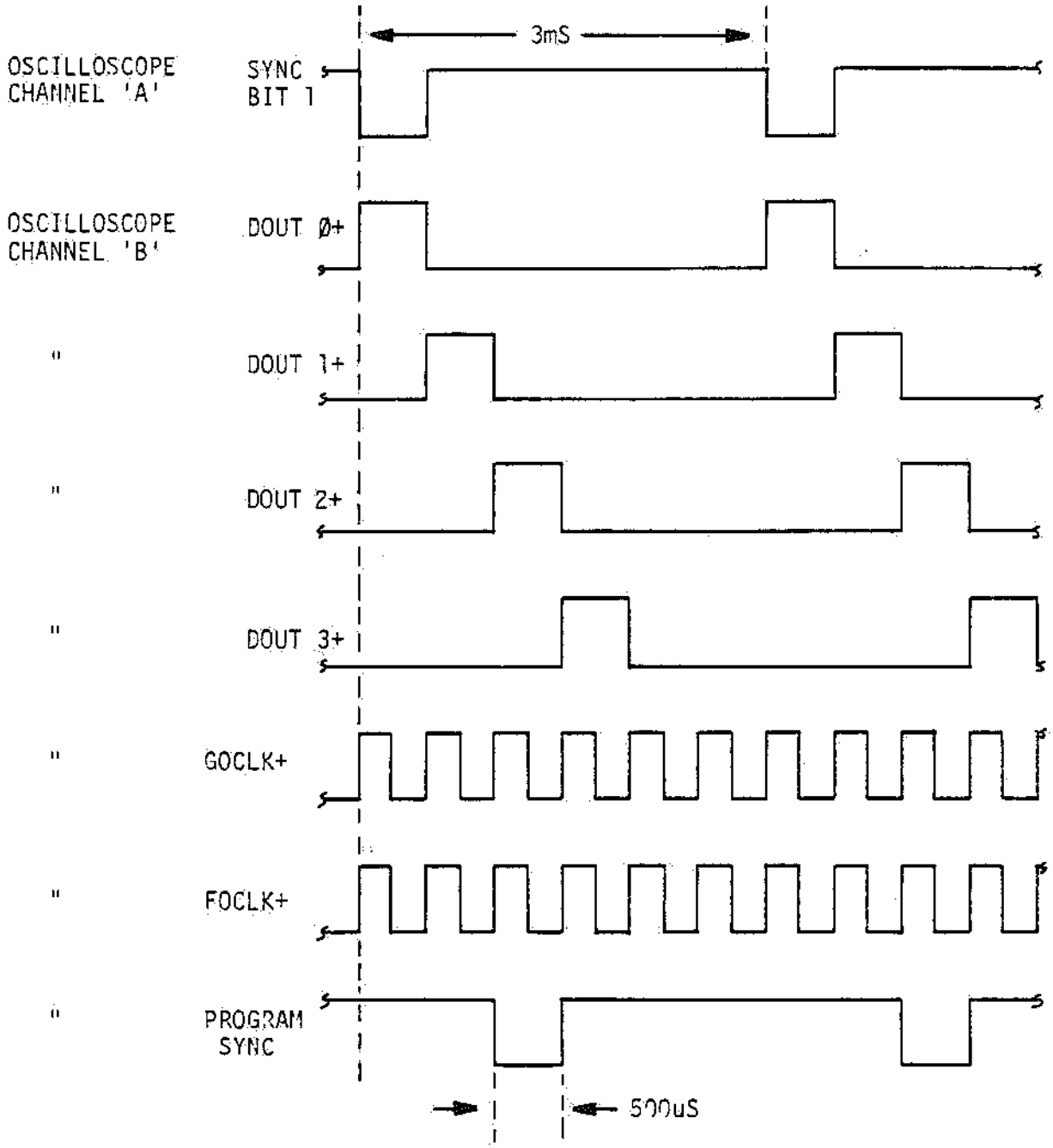


Figure 2.13
STORED PROGRAM NO. 993 OUTPUT WAVEFORMS

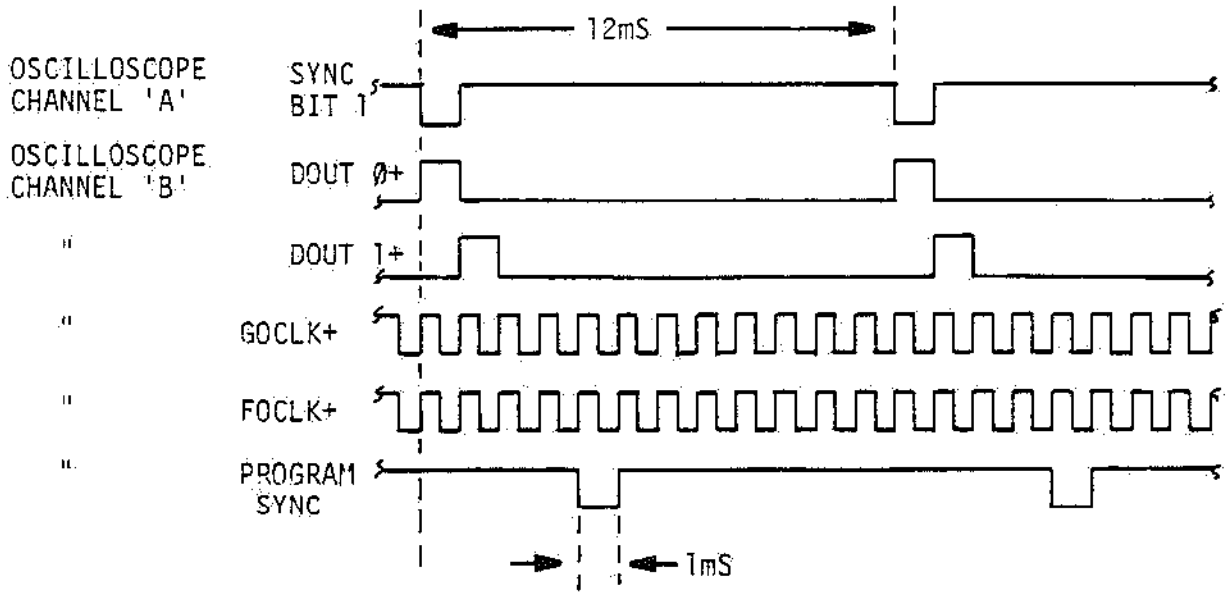


Figure 2.16
STORED PROGRAM NO. 994 OUTPUT WAVEFORMS

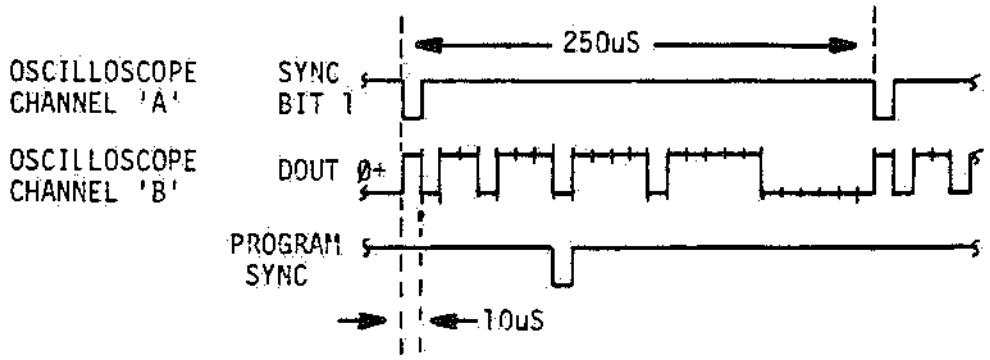
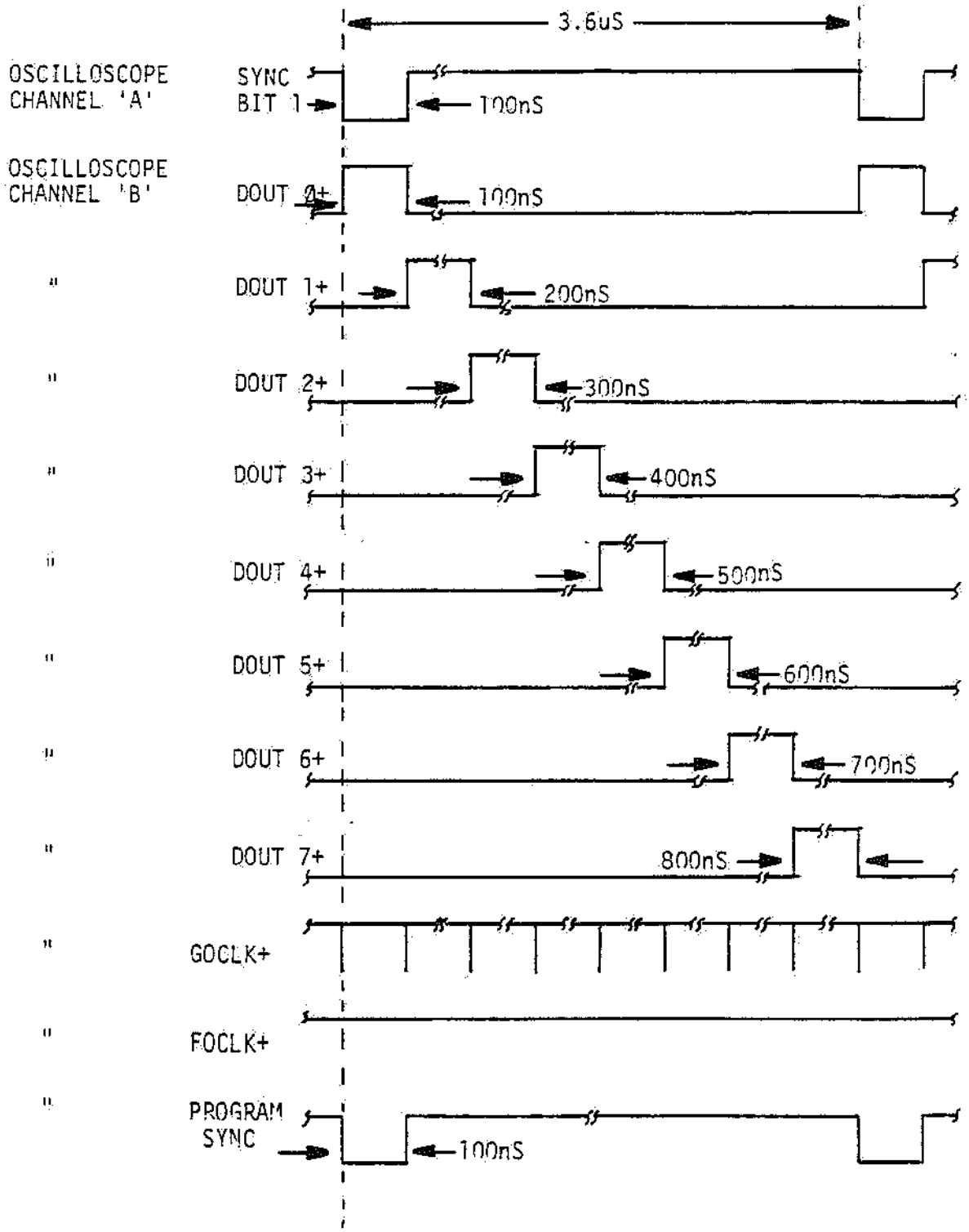


Figure 2.19
STORED PROGRAM NO. 995 OUTPUT WAVEFORMS



2.4 MAINTENANCE

Maintenance documentation for the RS-660 consists of the logic diagrams located in Appendix D and the service manual for the CRT (separately provided).

The RS-660 contains voltages hazardous to personnel, especially in the area of the CRT. Maintenance procedures therefore should only be conducted by qualified personnel.

In order to perform fault corrective maintenance, the user must be familiar with the RS-660 logic diagrams. Basically, the lower logic panel assembly includes the high speed word generator and timing simulator logic. The lower panel logic shares use of the memory card assembly with the remainder of the RS-660 assemblies. The remaining assemblies (front panel keyboard, CRT, CPU card) are simply the means of interfacing the operator with the word generator/timing simulator.

During power-up initialization, the CPU performs a memory test (Reference Section 2.2). If the CRT then results in the display shown in Figure 2.1, it may be assumed the CRT, CPU, and memory are functional. Until the RS-660 is set into the run mode, the lower logic panel assembly may be essentially disregarded as a source of problems. If the unit is capable of being programmed as indicated by the expected CRT displays, and yet generates incorrect output patterns when set to the run mode, the lower logic panel may be assumed to be the source of the problems.

III. LOCAL CONTROL OPERATION

This section describes the operation of the Model RS-660 under local control, using the front panel controls and indicators.

Initiation of communications between the Model RS-660 and a remote, controlling device causes the unit to go into remote control operation. (Note the status will only indicate REMOTE CONTROL when the remote communication requests a CRT display update; reference section 4.2.2) Depressing the HOME/RESET key returns control of the unit to the front panel and the Model RS-660 will remain in this mode until the remote controlling device again initiates communications.

3.1 CONTROLS AND INDICATORS

Figure 3.1 illustrates the front panel controls and indicators of the Model RS-660.

3.1.1 POWER Switch and LED

Activation of the POWER switch causes the Model RS-660 to execute its initialization routine which results in the POWER LED being illuminated and the CRT presenting the following display:

```
STATUS:  PROGRAM; LOCAL CONTROL
         BINARY DATA


1  MODE:              WORD GENERATOR
2  CHANNELS:          16
3  BITS/CHANNEL:      XXXX
4  DATA ENTRY:        PARALLEL
5  RUN MODE:          CONTINUOUS
6  SYNC BIT NO:       XXXX
7  CLK SOURCE:        INTERNAL
8  CLK PERIOD:        1 USEC
9  RDY TO RUN?

ENTER MODE _____

     1 = WORD GENERATOR
     2 = TIMING SIMULATOR
     3 = STORED PROGRAM:
```

Note XXXX = 1024 or 4096 depending on memory capacity.

3.1.2 Control Keys and Indicators

Three CONTROL keys are provided on the Model RS-660: SINGLE STEP, TRIGGER, and RUN/PROGRAM.

3.1.2.1 RUN/PROGRAM Key and LED

The RUN LED indicates whether the Model RS-660 is in the run (LED illuminated) or program (LED extinguished) mode. Its status may be changed by the activation of the RUN/PROGRAM key. Note that, when the unit is in the run mode, the following operations are illegal and are ignored:

i) single step
ii) attempts to display data if the CONTROL format is presently being displayed
iii) cursor manipulation when displaying data
iv) data modifications or format changes
v) attempts to modify items "1" through "4" in the CONTROL display

3.1.2.2 SINGLE STEP Key and LED

The SINGLE STEP LED illuminates when the device is in the single step mode. Its status may be reversed by the activation of the SINGLE STEP key.

3.1.2.3 TRIGGER Key and LED

The TRIGGER LED, when illuminated, indicates that the device requires a trigger. This situation will arise when one of the two following conditions exists:

i) The device is in the run, noncontinuous mode (RUN LED is illuminated and RUN MODE=XXXX REPETITIONS) and is waiting to generate the specified number of cycles. Activation of the TRIGGER key, or a high to low transition at the rear panel TRIGGER INPUT (EXTRIG-), will initiate the execution of the specified number of repetitions and extinguish the TRIGGER LED until the completion of the last cycle. Note that the TRIGGER LED is extinguished for a minimum of 100 ms and is therefore not an exact indication of program time.

ii) The device is in the single step mode (SINGLE STEP LED also illuminated), in which case, each activation of the TRIGGER key will cause the unit to output the next word of data.

3.1.4 Keyboard

The keyboard on the Model RS-660 includes 3 function keys (CE, FILL and ENTR) and 17 data keys of which three (C/nSEC, D/uSEC and E/mSEC) perform dual functions. Hexadecimal data is loaded using keys "0" through "F" whereas decimal data requires the use of keys "0" through "9" including the decimal point key if necessary. Binary data is loaded using keys "0" and "1" and units of time are loaded via the C/nSEC, D/uSEC and E/mSEC keys.

3.1.4.1 CE Key

This key is used to clear an invalid or erroneous entry and must be activated whenever the CRT is displaying INVALID.

3.1.4.2 FILL Key

The function of the FILL key is to enable the user to repeatedly load a previously defined data pattern into a specified memory area.

3.1.4.3 ENTR Key

Activation of the ENTR key signifies the completion of a particular keyboard entry and causes the cursor to be advanced to the next valid position. Note that data entries, in the DATA display, do not require activation of the ENTR key.

3.2 WORD GENERATOR MODE

This section describes the WORD GENERATOR mode of operation. When the RS-660 is operating in the WORD GENERATOR mode, the periods of succeeding output data words (or bits) are equal and determined by the period of the clock source (parameter no. 7).

3.2.1 Mode Selection

In order to select the WORD GENERATOR mode, the cursor must first be positioned to parameter no. 1. This may be accomplished either by using the two vertical cursor keys or the HOME key. At this time the entry menu in the lower portion of the display will read as follows:

```
ENTER MODE ____

  1 = WORD GENERATOR
  2 = TIMING SIMULATOR
  3 = STORED PROGRAM
```

3.2.5 Run Mode - WORD GENERATOR Mode

The run mode may be either continuous or may repeat the pattern generation from 1 through 4096 times. Accessing parameter no. "5" will result in the following entry:

```
ENTER RUN MODE -----

ENTER C FOR CONTINUOUS PATTERN
          OR
ENTER 1 THRU 4096 for NO. OF
PATTERN REPEATS PER TRIGGER
```

3.2.6 Sync Bit Number - WORD GENERATOR Mode

Selection of parameter no. "6" allows the user to define the sync bit number. The entry menu is as follows:

```
ENTER SYNC BIT NO. -----
     1 THRU XXXXX
```

Note that, in the event of the sync bit number being greater than the number of bits per channel, an asterisk will appear immediately following the sync bit number. In the DATA display, the sync word/bit is indicated by the letter "S" adjacent to the selected word or bit number.

3.2.7 Clock Source - WORD GENERATOR Mode

Parameter no. "7" enables selection of the CLOCK SOURCE and may be specified as either the internal RS-660 clock generator or a user's external clock. The clock source entry menu is shown below:

```
ENTER CLOCK SOURCE -

                1 = INTERNAL
                2 = EXTERNAL
```

3.2.8 Clock Period - WORD GENERATOR Mode

If the clock source has been defined as INTERNAL, parameter no. "8" may be accessed by the cursor to enter the desired period of the internal clock. The following entry menu will be displayed:

```
ENTER CLOCK PERIOD----SEC

  MS  .001 - 999
  US  .1   - 999
  NS   50, 100, 200, ---900
```

3.2.11 Single Step Mode Operation - WORD GENERATOR Mode

The Model RS-660 may be operated in the single step mode by activating the SINGLE STEP key instead of the RUN/PROGRAM key. This action will result in the following:

a) Data display is immediately invoked.
b) SINGLE STEP and TRIGGER LEDs are illuminated.
c) Cursor is initialized to WORD/BIT NO. 1.
d) DATA FORMAT, CONTROL/DATA, CURSOR direction and FILL keys are all ignored.
e) Data format is forced to binary data format.

Under these conditions, each activation of the TRIGGER key will cause the device to output the next data word bit, as indicated by the cursor advancement on the data display.

The HOME key performs a slew function in the SINGLE STEP mode. Activating the HOME key will result in the display of the word HOME and a scratch pad area. A decimal value, representing the desired word/bit number, may be entered via the keyboard followed by depression of the ENTR key. The device will output all words/bits from the one previously designated by the CURSOR to the one entered via the keyboard.

Note that if the desired word number is less than the number of the word previously designated by the cursor, the generator will wrap around via the last word.

The SINGLE STEP mode may be exited by activating either the SINGLE STEP key again or the RUN/PROGRAM key. In the latter case, the device will immediately enter the RUN mode.

3.3 TIMING SIMULATOR MODE

In the TIMING SIMULATOR mode, the periods of a channel's succeeding bits are independently programmable.

3.3.1 Mode Selection

In order to select the TIMING SIMULATOR mode of operation, the following procedure should be followed:

a) Select CONTROL DISPLAY.
b) Position cursor to parameter no. "1".
c) Enter "2" via the keyboard in accordance with the entry menu.
d) Depress the ENTR key.

3.3.2 Channel Selection - TIMING SIMULATOR Mode

The TIMING SIMULATOR mode provides for eight output channels. Parameter no. "2" permits enabling from 1 to 8 of the available channels. To

are in decimal and require the use of the ENTR key, whereas data entries do not. Note also that selecting a 50 nsec period for any word will cause the device to automatically insert a second 50 nsec word. These two words are indicated as A and B. If the SYNC word happens to be a 50 ns word, the SYNC pulse will occur coincidently with the A word.

3.3.8 Run Mode Operation - TIMING SIMULATOR Mode

The run mode for TIMING SIMULATOR operates in exactly the same fashion as the run mode for WORD GENERATOR (ref. Section 3.2.10). Note that the device may not be operated in single step while in the TIMING SIMULATOR mode.

3.4 FILL FUNCTION

Except while operating in the run or single step modes, the fill function may be invoked by activating the FILL key. In order to perform this operation, the desired data pattern should first have been entered. Activating the FILL key will result in the RS-660 requesting, by means of the CRT display, the following information:

1) PATTERN START WORD/BIT.
2) PATTERN END WORD/BIT.
3) NO. OF PATTERN REPEATS.
4) START FILL AT WORD/BIT.
5) RDY TO EXECUTE? PUSH ENTR.

Once all of these parameters have been entered, activating the ENTR key initiates the execution of the fill and results in the following:

1) The device will first verify that enough memory exists to perform the fill as directed.
2) Assuming that this condition is satisfied, the fill function will be executed.
3) The Model RS-660 will exit from the fill mode upon completion.

Note that while the function is being executed, the CRT will display the message "FILLING" and all front panel controls are locked out. The fill mode may be aborted at any stage prior to activating the ENTR key, for the last time, by activating the CONTROL/DATA key.

3.5 STORED PROGRAM MODE

The stored program mode enables the user to call and execute "programs" (control parameters and the data/time tables) which have been previously stored in EPROMs (erasable programmable read only memories).

Using 4K x 8 EPROMs the stored program card provides the user with a maximum of 24K x 8 of storage.

3.5.1 Operation

The stored program mode may be accessed as follows:

1) access the CONTROL display and position the cursor to parameter "1". The following entry menu will be displayed:

```
ENTER MODE __
    1 = WORD GENERATOR
    2 = TIMING SIMULATOR
    3 = STORED PROGRAM
```

2) enter "3" via the keyboard; the menu will now request the number of the desired stored program:

```
ENTR STRD PGM NO. ---
```

3) entering a valid number will result in the RS-660 memories being loaded with the specified program.

The Model RS-660 may now be operated in either the run or single step modes. Note that valid stored program numbers lie in the range from 000 through 999; however, the numbers 990 through 999 are reserved for Interface Technology verification programs. These stored programs may be called whether or not the stored program card is installed.

Note also that, once a stored program has been called, both the control parameters and the data may be modified by the user. However, the device will no longer remain in the stored program mode.

3.5.2 Programming

The Model RS-660 plug-in stored program card may be ordered as option number 660-006 and is supplied without EPROMs. This card is to be installed in card slot J3 as indicated on the Model RS-660 top assembly drawing 10011157 contained in Appendix D.

be listed in any particular sequence in the directory. The end of the directory must be identified by the delimiter "FF" which happens to be the unprogrammed state of the EPROMs. It is recommended that the user leave spare locations at the end of his directory, in order that other programs may be added at a later date.

Each stored program consists of the following:

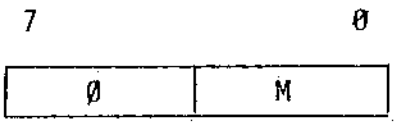
i) Two bytes which specify the last EPROM location used by the particular stored program.
ii) Twelve control bytes which contain all the information required to define the parameters in the CONTROL display.
iii) As many bytes of data/time as the program requires, starting with data word/bit number 1 in the 15th byte of the stored program EPROM contents.

The formats of the EPROM contents are summarized in tables 3-1 and 3-2.

TABLE 3.1 (continued)
STORED PROGRAM EPROM DATA FORMAT

	EPROM ADDRESS	EPROM DATA	COMMENTS
Data	'aaaa+14	DD	Reference table 3.4 for Word Generator 16 channel
	+15	DD	" " " " " " 8 "
			" " " " " " 4 "
			" " " " " " 2 "
			" " " " " " 1 "
			Reference table 3.5 for Timing Simulator
Program end	'AAAA	DD	

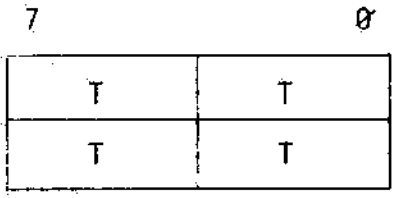
TABLE 3.3
STORED PROGRAM EPROM DATA FORMAT
CLOCK PERIOD MULTIPLIER AND DIGITS



clock period multiplier; M = $C_{(HEX)}$ ⇒nSec

M = $D_{(HEX)}$ ⇒uSec

M = $E_{(HEX)}$ ⇒mSec

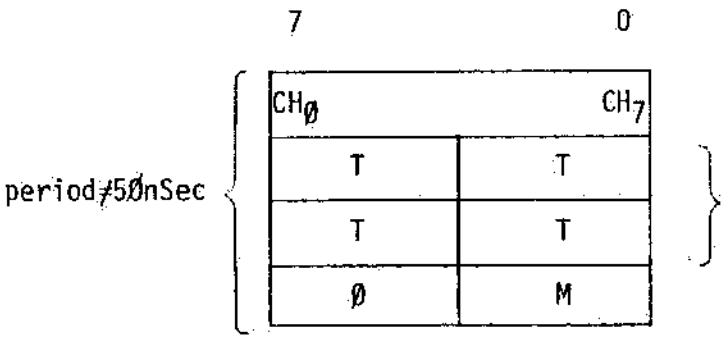


MSDs of clock period (BCD) 3 digits +
LSDs of clock period (BCD) decimal point.

NOTE 1: T = $F_{(HEX)}$ ⇒ decimal point.

NOTE 2: clock period is irrelevant in Timing Simulator and external clock Word Generator modes.

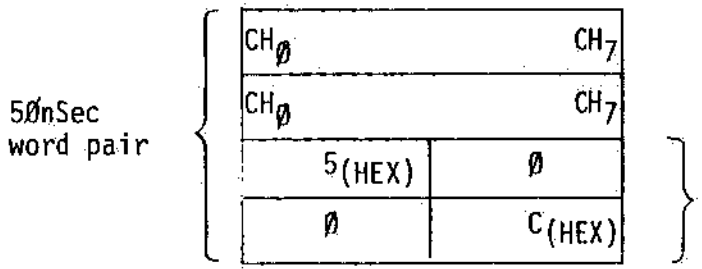
TABLE 3.5
STORED PROGRAM DATA FORMAT
TIMING SIMULATOR DATA AND TIME



data word n

period digits for data word n (BCD)
3 digits + decimal point.
T = $F_{(HEX)}$ ⇒ decimal point.

period multiplier for data word n
M = $C_{(HEX)}$ ⇒ nSec, M = $D_{(HEX)}$ ⇒ uSec, m = $E_{(HEX)}$ ⇒ mSec



data word nA
data word nB

designates 5Ø nSec word pair

IV REMOTE CONTROL OPERATION

This section describes the operation of the Model RS-660 while under remote control from one of the following optional interfaces:

a) IEEE Std 488-1978
b) RS-232C/TTY

These interfaces provide various degrees of control of the Model RS-660, and permit the loading and reading of the memory, definition of the parameters, starting and stopping of the unit, and reading the unit status of the Model RS-660.

NOTE: Paragraphs 4.1, 4.1.1 and 4.1.2 have been deleted.

Pages 4-2 through 4-11 have been deleted.

4.2.2 Operation

All data communication with the Model RS-660 controller interfaces is accomplished using a limited set of ASCII characters. Control is accomplished using the characters K,L,N,P,Q,R,S,T,U,V,W,X,Y and Z. Hexadecimal data use the ASCII characters 0,1...9, A,...F. The ASCII comma is used as an instruction delimiter. All other ASCII characters are ignored. This enables the user to imbed a carriage return/line feed in his transmitted data for local page formatting.

When operating under remote control, the CRT display data does not reflect prior user remote programming until the RS-660 receives an ASCII "Q".

Table 4-1 provides a summary of the protocol for the RS-660 controller interfaces and is applicable to both the IEEE STD-488 and RS-232-C interfaces. Table 4-2 provides a detailed description of the controller interfaces' protocol.

TABLE 4-2
DETAILED PROTOCOL DESCRIPTION
FOR CONTROLLER INTERFACES

UPDATE CRT

Control: Q

Updates the CRT to display current programming parameters.

RETURN TO LOCAL CONTROL

Control: L

Causes the unit to return to local control. Also resets machine and stops.

RESET

Control: R

Causes the following:
1. Stops the generator if running.
2. Resets Word Generator/Timing Simulator Memory to word/bit number 1.

READ UNIT STATUS

Control: U
Response: d CR/LF

U = Read unit status control character
2 = Remote, programming mode (stopped)
3 = Remote, running
4 = Remote, running, waiting for trigger

LOAD PARAMETERS

Control/Data:

POw, c, bbbbb, llll, sssss, i, ttttm,
P1w,
P2c,
P3 bbbbb,
P4 llll,
P5 sssss,
P6 i,
P7 ttttm,

w: Mode
1 = Word Generator
2 = Timing Simulator

c: Number of output channels
Word Generator - 1, 2, 4, 8, F (F used to specify 16 channels)
Timing Simulator - 1, 2, 4, 8

TABLE 4-2
(CONTINUED)

LOAD TIMING SIMULATOR DATA

Control/Data: Xaaaa, ddttttm, ..., ddttttm,

X: Load Timing Simulator control character.
aaaa: Number of first time interval to be loaded.
ddttttm: Data (hex); reference Table 4-4.
Comma: Used as instruction delimiter.

READ TIMING SIMULATOR DATA

Control: Vaaaa, nnnn,

Response Data: ddttttm, ddttttm, ..., ddttttm, CR/LF

V: Read Timing Simulator control character.
aaaa: Number of first time interval to be read.
nnnn: Number of intervals to be read (50/50 nsec intervals count as one).
ddttttm: Data (hex); reference Table 4-4.
Comma: Used as instruction delimiter.

EXECUTE FILL

Control: Naaaaa, bbbbb, ccccc, nnnnn,

N: Execute fill control character.
aaaaa: First word/bit of data to be repeated (decimal).
bbbbb: Last word/bit of data to be repeated (decimal).
ccccc: Number of times pattern must be repeated (decimal).
nnnnn: Number (decimal) of first word/bit where pattern is to be repeated.
Comma: Used as instruction delimiter.

READ STORED PROGRAM MENU

Control: M

Response: nnn, nnn, ..., nnn, CR/LF

Outputs the program number (decimal) of all programs in the stored program EPROM card.

LOAD STORED PROGRAM

Control: Knnn,

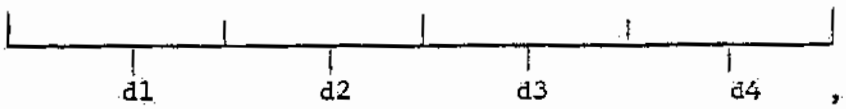
K: Load stored program control character.
nnn: Stored program number (decimal - nnn $\neq$ 0)
Comma: Used as instruction delimiter.

This function transfers the desired stored program from the stored program EPROM card to the RS-660 generator.

TABLE 4-3
WORD GENERATOR DATA CONFIGURATION

Number of Channels																
16	Channel No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	Bit No.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	Channel No.	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
	Bit No.	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
4	Channel No.	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
	Bit No.	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
2	Channel No.	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Bit No.	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1	Channel No.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bit No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Character



Notes:

1) All Word Generator data are formatted in hex for transfer over the interface; i.e., $0 \leq d \leq F$.

4.2.3 Operating Example

Table 4-5 provides an example of remote programming the RS-660. The example program performs the following:

a) Resets the unit.
b) Transmits parameter table to unit.
c) Transmits word generator data to unit.
d) Places unit in run mode.
e) Reads the unit status.
f) Triggers the device a number of times.
g) Places the unit in programming mode.
h) Returns the unit to local control.

Once all of the data is loaded into the RS-660, the test program is started. The source of the trigger inputs may be manual or automatic. Note that the same control character is used to start and/or stop the unit.

Data that is underlined is transmitted from the RS-660.

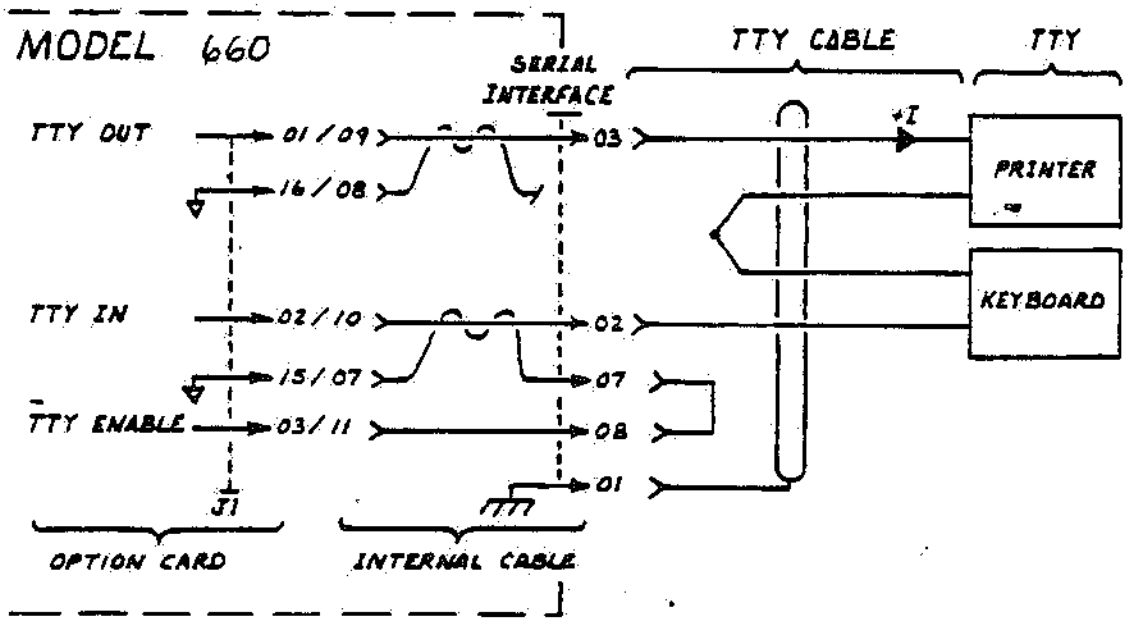
4.3 RS-232C/TTY CONTROLLER INTERFACE

The Model RS-660's RS-232-C controller interface is available as option number 660-003 and is a factory installed option.

4.3.1 Preparation For Use

The Model RS-660's rear panel connector, designated as SERIAL INTERFACE, is configured to connect to the cable of an RS-232-C terminal. Alternately, the RS-660 may be used as an RS-232C terminal by connecting the supplied terminal cable to the SERIAL INTERFACE connector and connecting the other end to the user's calculator or computer. The supplied cable is end interchangeable.

A teletype (TTY) may also be connected to the SERIAL INTERFACE connector. The following diagram illustrates the TTY cable construction:



Note that the internal RS-660 cable which plugs into the option card must be rotated 180° for TTY operation, such that pin 09 of the cable plugs into pin 01 of card socket J1.

V. INTERFACE POD

This section describes the features and operation of the Model RS-660 optional interface pod.

5.1 GENERAL DESCRIPTION

The interface pod (option 660-010) has been developed to extend the versatility and flexibility of the RS-660 Timing Simulator/Word Generator. The pod may be used, in conjunction with the RS-660, to generate digital signal sequences that are either TTL or CMOS compatible. The Model RS-660 outputs are terminated, at the pod, to reduce transmission line effects. The CMOS compatible outputs are open-collector drivers with 470 pull-up resistors. The pod further accepts either TTL or CMOS trigger and/or clock inputs, converts them as necessary, and transmits them to the RS-660. The purpose of the interface pod is to save time and money in applications which would otherwise require the engineer to develop costly, special purpose converters.

5.2 OPERATIONAL DESCRIPTION

The interface pod is connected to the RS-660 by plugging the cable connectors P1 and P2 into receptacles J7 (DATA Ø-7 & OUTPUT CLOCKS) and J8 (DATA 8-F & INPUT CLOCKS) respectively, on the rear panel of the RS-660. Additionally, the user selects either TTL or CMOS compatible inputs and outputs by means of four jumper plugs, P1 through P4 located inside the pod. Reference drawing number 10011310.

In order to configure the inputs and outputs as CMOS compatible, these jumper plugs should be installed such that pin 1 on each plug mates with pin 1 on its socket. Installing the plugs, such that pin 1 on each plug mates with pin 8 on its socket, will result in the inputs and outputs being configured as TTL compatible.

The pod is connected to the user's circuit via hook type probes. These provide the sixteen data outputs, two clock outputs, external clock and trigger inputs and four returns. Reference appendix C for signal/pin listing and probe color coding.

Note that when the pod is configured as CMOS compatible, the user's logic supply (VDD and GND) must be supplied to the two banana jacks on the rear panel of the pod.

If desired, the probe connector may be disconnected and connection made to the user's system via an alternative cable and connector. A list of compatible connector types is provided in section 5.3.

APPENDICIES

APPENDIX A

INPUT/OUTPUT SIGNAL LISTING

Rear Panel Connector (J7, DATA 0-7 & OUTPUT CLOCKS)

SIGNAL	MNEMONIC	SIGNAL PIN NO.	RETURN PIN NO.
DATA OUTPUT CHANNEL Ø	DOUTØ+	01	14
" " " 1	DOUT1+	02	15
" " " 2	DOUT2+	03	16
" " " 3	DOUT3+	04	17
" " " 4	DOUT4+	05	18
" " " 5	DOUT5+	06	19
" " " 6	DOUT6+	07	20
" " " 7	DOUT7+	08	21
GATED OUTPUT CLOCK	GOCLK+	09	22
FREE RUNNING OUTPUT CLOCK	FOCKL+	10	23
VCC (+5Vdc)	VCC	11	24

Rear Panel Connector (J8, DATA 8-F & INPUT CLOCKS)

SIGNAL	MNEMONIC	SIGNAL PIN NO.	RETURN PIN NO.
DATA OUTPUT CHANNEL 8	DOUT8+	01	14
" " " 9	DOUT9+	02	15
" " " A	DOUTA+	03	16
" " " B	DOUTB+	04	17
" " " C	DOUTC+	05	18
" " " D	DOUTD+	06	19
" " " E	DOUTE+	07	20
" " " F	DOUTF+	08	21
EXTERNAL INPUT CLOCK	EXCLK+	09	22
EXTERNAL TRIGGER INPUT	EXTRIG-	10	23
VCC (+5Vdc)	VCC	11	24

APPENDIX B

CARD READER INTERFACE SIGNAL LISTING

* * * DELETED * * *

APPENDIX C

INTERFACE POD I/O SIGNAL LISTING

Pod Connector (J3, USER I/O)

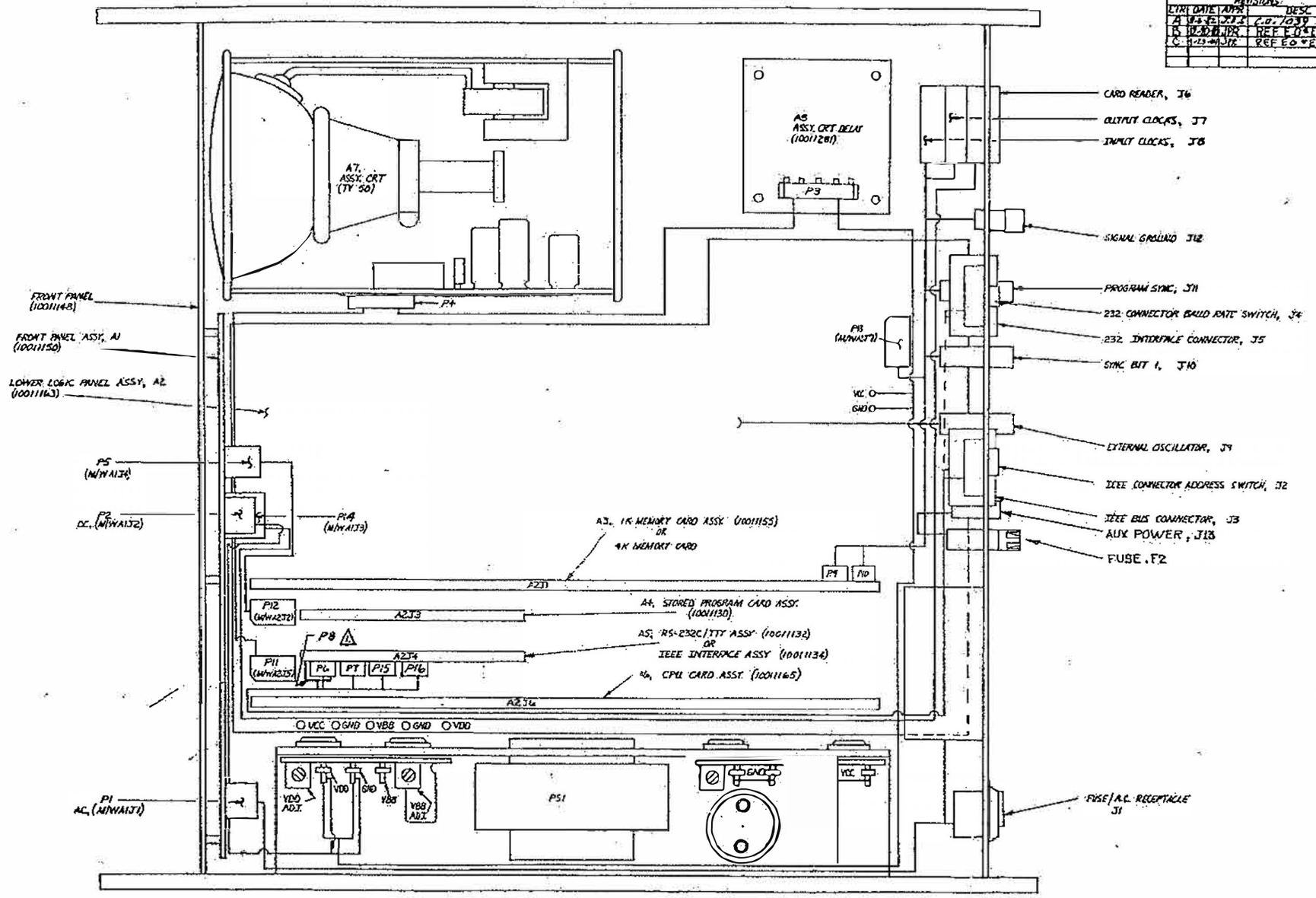
SIGNAL	MNEMONIC	SIGNAL PIN NUMBER	SIGNAL PROBE COLOR BODY	SIGNAL PROBE COLOR TIP	RETURN PIN NUMBER	RETURN PROBE COLOR BODY	RETURN PROBE COLOR TIP
DATA OUTPUT CHAN. Ø	CDOUT Ø+	Ø1	BLACK	BROWN	Ø2	-	-
" " " 1	CDOUT 1+	Ø3	"	RED	Ø4	-	-
" " " 2	CDOUT 2+	Ø5	"	ORANGE	Ø6	BLACK	BLACK
" " " 3	CDOUT 3+	Ø7	"	YELLOW	Ø8	-	-
" " " 4	CDOUT 4+	Ø9	"	GREEN	1Ø	-	-
" " " 5	CDOUT 5+	11	"	BLUE	12	-	-
" " " 6	CDOUT 6+	13	"	VIOLET	14	-	-
" " " 7	CDOUT 7+	15	"	GREY	16	BLACK	BLACK
" " " 8	CDOUT 8+	17	"	WHITE	18	-	-
" " " 9	CDOUT 9+	19	BROWN	BLACK	2Ø	-	-
" " " A	CDOUT A+	21	"	BROWN	22	-	-
" " " B	CDOUT B+	23	"	RED	24	-	-
" " " C	CDOUT C+	25	"	ORANGE	26	BLACK	BLACK
" " " D	CDOUT D+	27	"	YELLOW	28	-	-
" " " E	CDOUT E+	29	"	GREEN	3Ø	-	-
" " " F	CDOUT F+	31	"	BLUE	32	-	-
GATED OUTPUT CLOCK	CGOCLK+	33	"	VIOLET	34	-	-
FREE RUNNING OUTPUT CLOCK	CFOCLK+	35	"	GREY	36	BLACK	BLACK
EXTERNAL INPUT CLOCK	CEXCLK+	37	"	WHITE	38	-	-
EXTERNAL INPUT TRIGGER	CEXTRIG-	39	RED	BLACK	4Ø	-	-

APPENDIX D

LOGIC DIAGRAMS

Top Assembly	10011157
Front Panel Assembly	10011150
Lower Logic Panel Assembly	10011163
CPU Card Assembly	10011165
1K Memory Card Assembly	10011155
IEEE Interface Card Assembly	10011134
Serial Interface Card Assembly	10011132
Stored Program Card Assembly	10011130
CRT Delay Assembly	10011281
Interface Pod Assembly	10011310
4K Memory Card	10011418

REVISIONS			
LTR	DATE	APP'D	DESC.
A	9-15-82	[illegible]	E.O. 1039
B	11-30-83	JPR	REF E.O. #E414
C	4-23-84	JPR	REF E.O. #E480



⚠ FOR IEEE INTERFACE ON RS-440 S/N-001 THRU S/N-050 CONNECT P8 TO A5J3 SUCH THAT PIN 1 OF P8 MATES WITH PIN 18 OF A5J3. FOR IEEE INTERFACE ON RS-440 S/N-051 AND UPWARD CONNECT P8 TO A5J3 WITH CORRESPONDING PIN NUMBERS.

NOTES: UNLESS OTHERWISE SPECIFIED

interface TECHNOLOGY

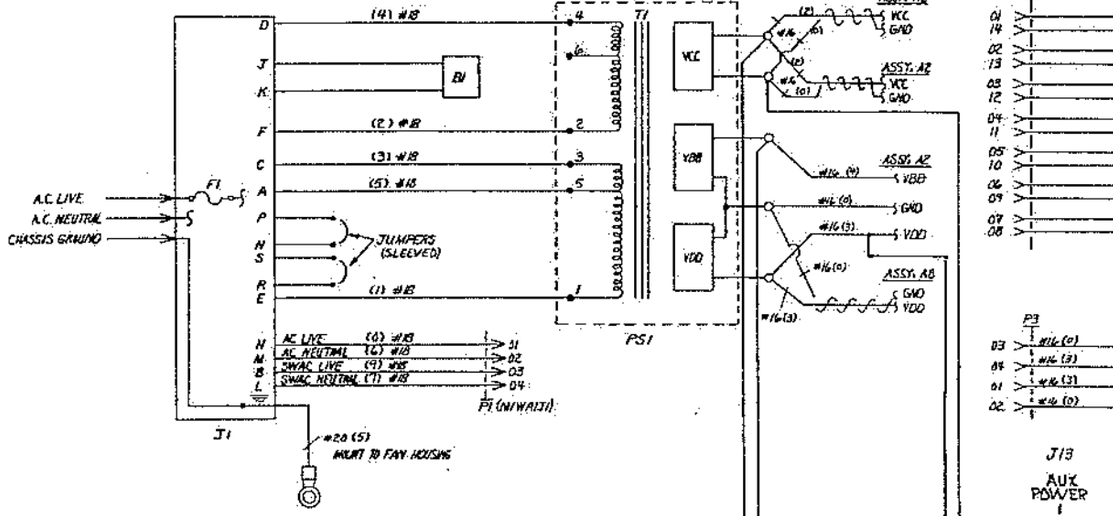
Drawn: NTS	Approved: [illegible]	Released by: R.K.
Date: 6-15-79		Date: 5-23-84

RS-440 TOP ASSEMBLY

SHT 1 OF 2	55613	1001115

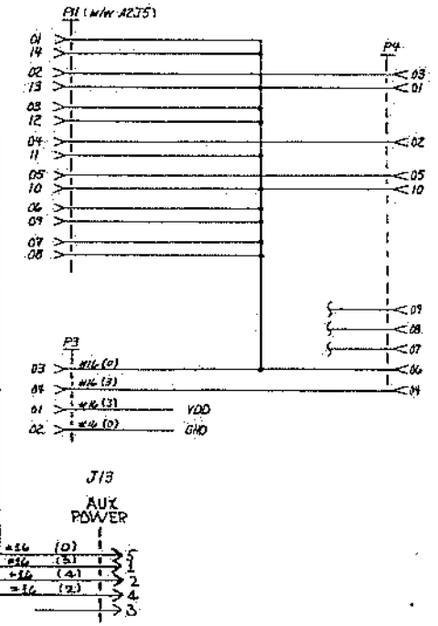
REVISIONS			
LTR	DATE	APPR	DESC.
			REF CNT'L DF 2

A.C. WIRING



CRT HARNESS

NOTE: P4 NUMBERING APPLIES TO CONNECTOR ONLY. NUMBERING ON CRT UNIT IS REVERSED.



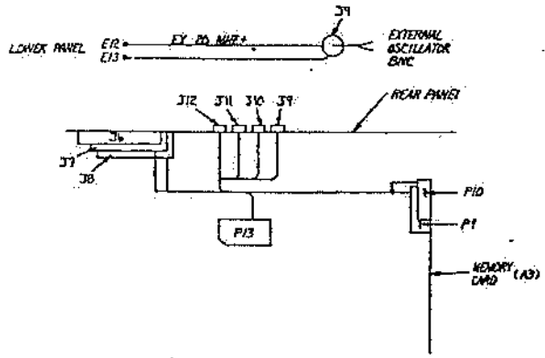
RS-660 I/O CABLE

NOTE: CONNECTORS J7 AND J8 MUST BE ASSEMBLED TO REAR PANEL PRIOR TO CABLE ASSEMBLY.

P9		J7
P9-11	DOUT 0+	01
P9-06		14
P10-11	DOUT 1+	02
P10-06		15
P10-12	DOUT 2+	03
P10-05		16
P9-12	DOUT 3+	04
P9-05		17
P9-14	DOUT 4+	05
P9-03		18
P10-14	DOUT 5+	06
P10-03		19
P10-15	DOUT 6+	07
P10-02		20
P9-15	DOUT 7+	08
P9-02		21
P13-13	GACLK+	09
P13-04		22
P13-14	FXCLK+	10
P13-03		23
P13-16	VCC	11
GND STUD	GND	24

P9		J8
P9-10	DOUT 8+	01
P9-07		14
P10-10	DOUT 9+	02
P10-07		15
P10-13	DOUT A+	03
P10-04		16
P9-13	DOUT B+	04
P9-04		17
P9-16	DOUT C+	05
P9-01		18
P10-16	DOUT D+	06
P10-01		19
P10-09	DOUT E+	07
P10-08		20
P9-09	DOUT F+	08
P9-08		21
P13-01	EXCLK+	09
P13-08		22
P13-10	EXTRIG-	10
P13-07		23
P13-15	VCC	11
GND STUD	GND	24

P3-12	SYNC 1-	SYNC BIT 1 BNC (J10).	
P3-05		" " " GND.	
P3-11	PSYNC-	PROGRAM SYNC BNC (J11).	
P3-04		" " GND.	
P3-01		GND. STUD	J12
P3-02		GND. STUD	



A.C. POWER WIRING AND CABLE HARNESSES

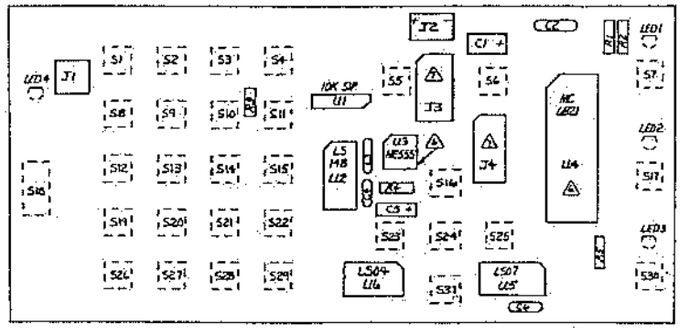
interface TECHNOLOGY

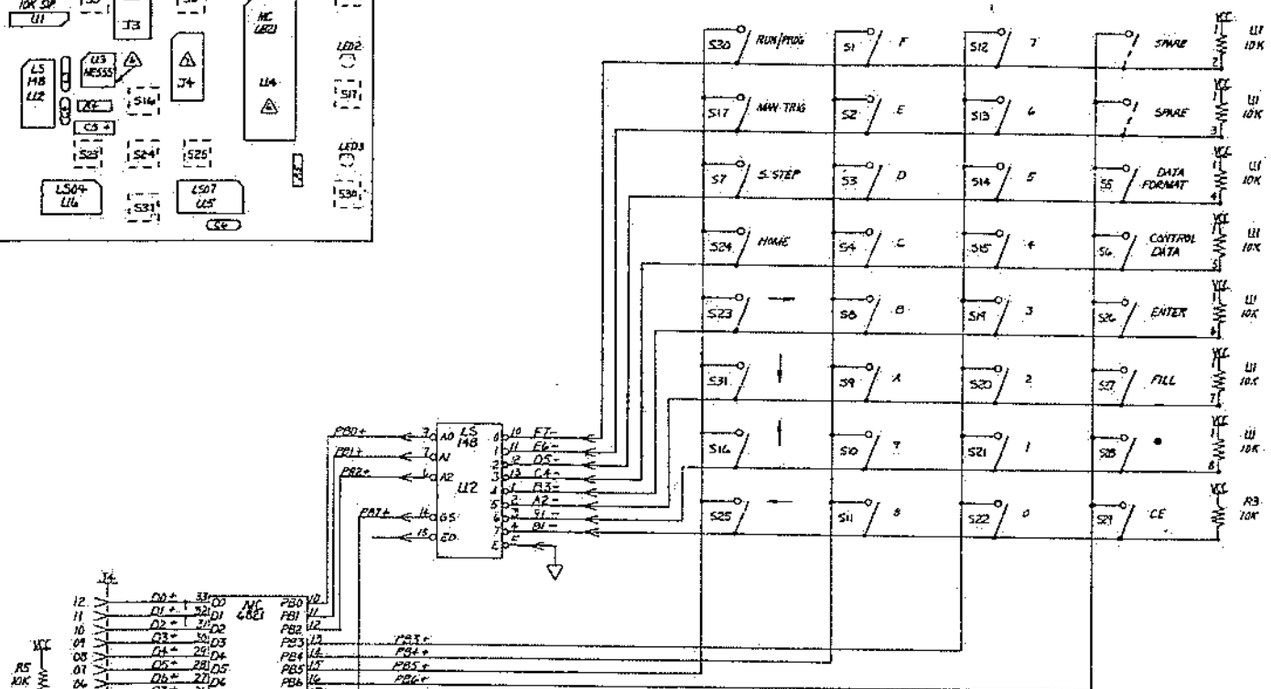
SCALE NTS		DRAWN BY RK
DATE 7-23-79		

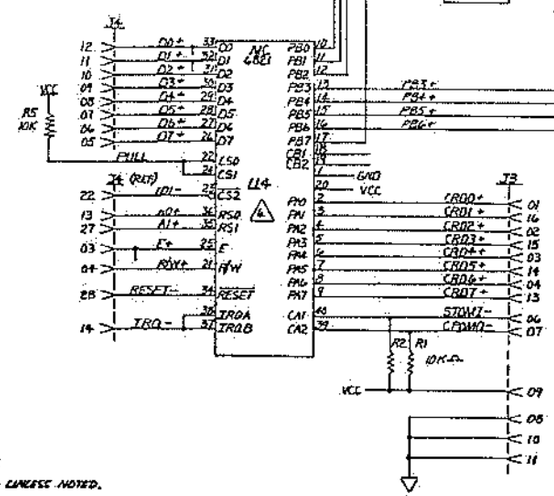
RS-660 TOP ASSEMBLY

CNT'L NO. 2 | SIZE | DRAWING NUMBER

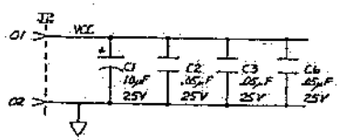
REVISIONS			
LTR	DATE	APPR.	DESC.
A	8-11-81	[illegible]	ADDED XC FOR F+

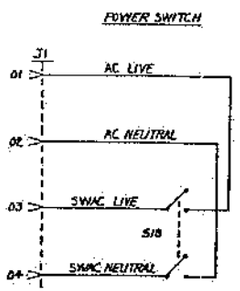


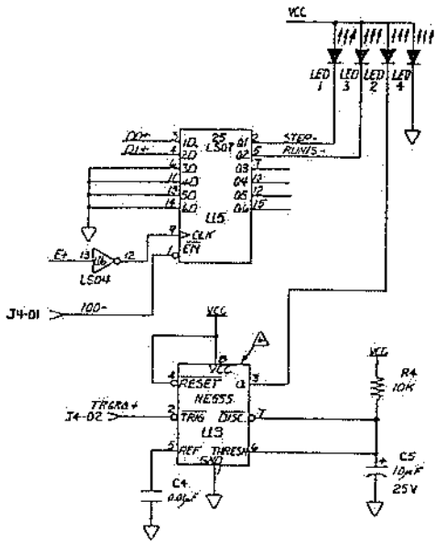












⚠ H-P DESIGNATES HIGH PROFILE SOCKET.

⚠ ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.

5. REFER TO 100/149 FOR PCB

4. RESISTORS R1 THRU R5 10K-Ω ¼W CARBON COMPOSITION

3. CAPACITOR C4 IS A .01μF AT 25V CERAMIC DISC.

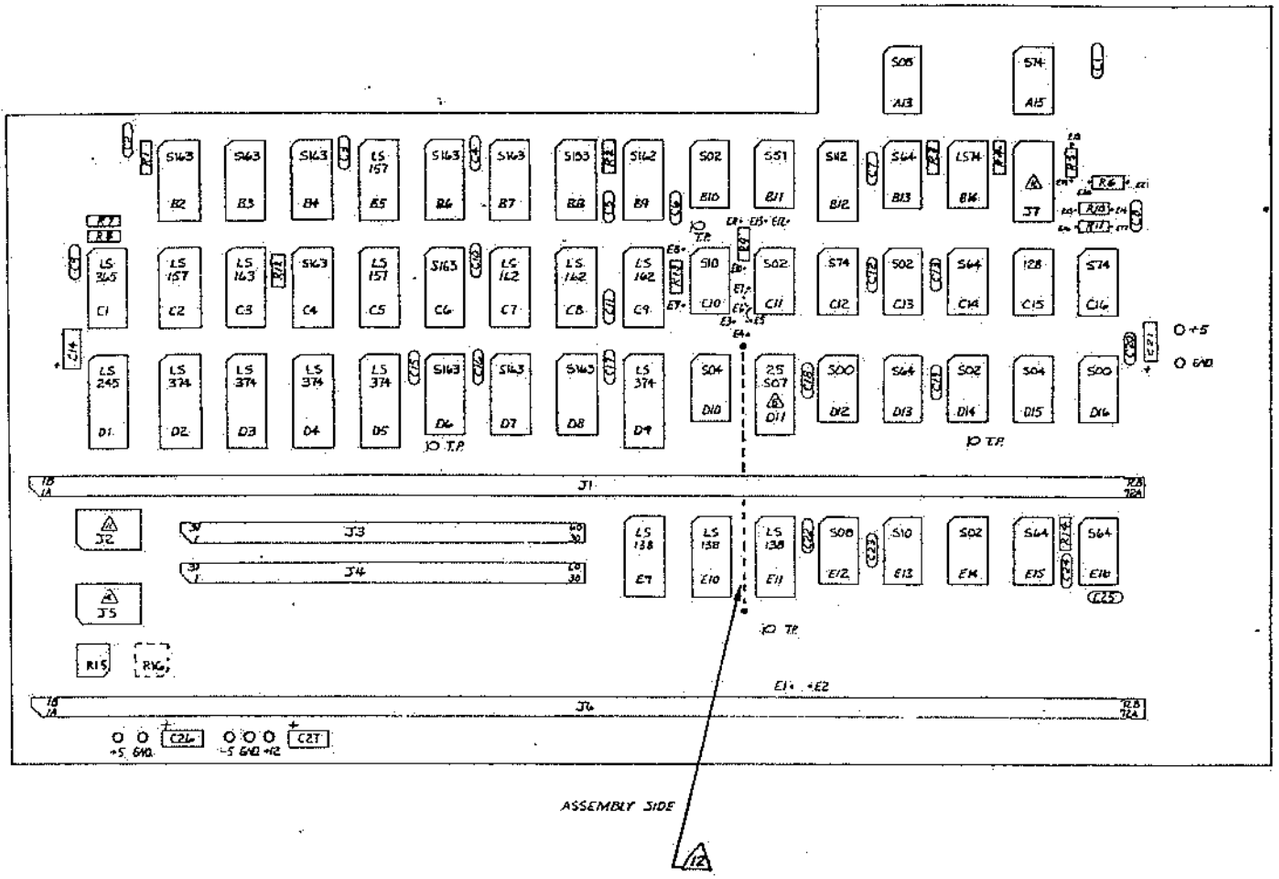
2. CAPACITORS C2, C3, C6 ARE .05μF AT 25V CERAMIC DISC.

1. CAPACITORS C1 & C5 ARE 10μF AT 25V ELECTROLYTIC.

NOTES: UNLESS OTHERWISE SPECIFIED

interface TECHNOLOGY		
SCALE: NTS	APPROVED BY: [illegible]	DRAWN BY: R.T.P.
DATE: 1-15-79		DATE/REV:
ASSY/LBD RS660 FRONT PANEL		
SIZE A	DWG NO.	REV

REVISIONS			
LTR	DATE	APPR	DESC
A	4-16-81	JC	C.O. 1087
B	5-5-81	J.L.	C.O. 1187
C	4-4-82	J.L.	C.O. 1296



⚠4 ADD A GROUND JUMPER ON BACKSIDE OF BOARD FROM GROUND PLANE IN ROW C TO GROUND PLANE IN ROW E.

⚠3 HIGH PROFILE SOCKETS DESIGNATED H-P.

10. FOR EXTERNAL OSCILLATOR OPERATION, DISCONNECT JUMPER E5 TO E6, AND MAKE JUMPER CONNECTION E6 TO E7.

9. COMPONENTS SHOWN BY BROKEN LINES ARE OPTIONAL.

⚠8 INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED

7. REFER TO 1001162 FOR PCB.

6. RESISTOR R16 IS A 100K Ω POT.

5. RESISTOR R15 IS A 820 Ω POT.

4. RESISTORS R5, R6, R9-R11, R13 ARE 270 Ω ½ W CARBON COMP.

3. RESISTORS R1-R4, R7, R8, R12, R14 ARE 1K Ω ¼W CARBON COMP.

2. CAPACITORS C1-C13, C15-C20, C22-C25, ARE .05μF AT 25V CERAMIC DISC.

1. CAPACITORS C14, C21, C26, & C27 ARE 10μF AT 25V ELECTROLYTIC.

NOTES: UNLESS OTHERWISE SPECIFIED

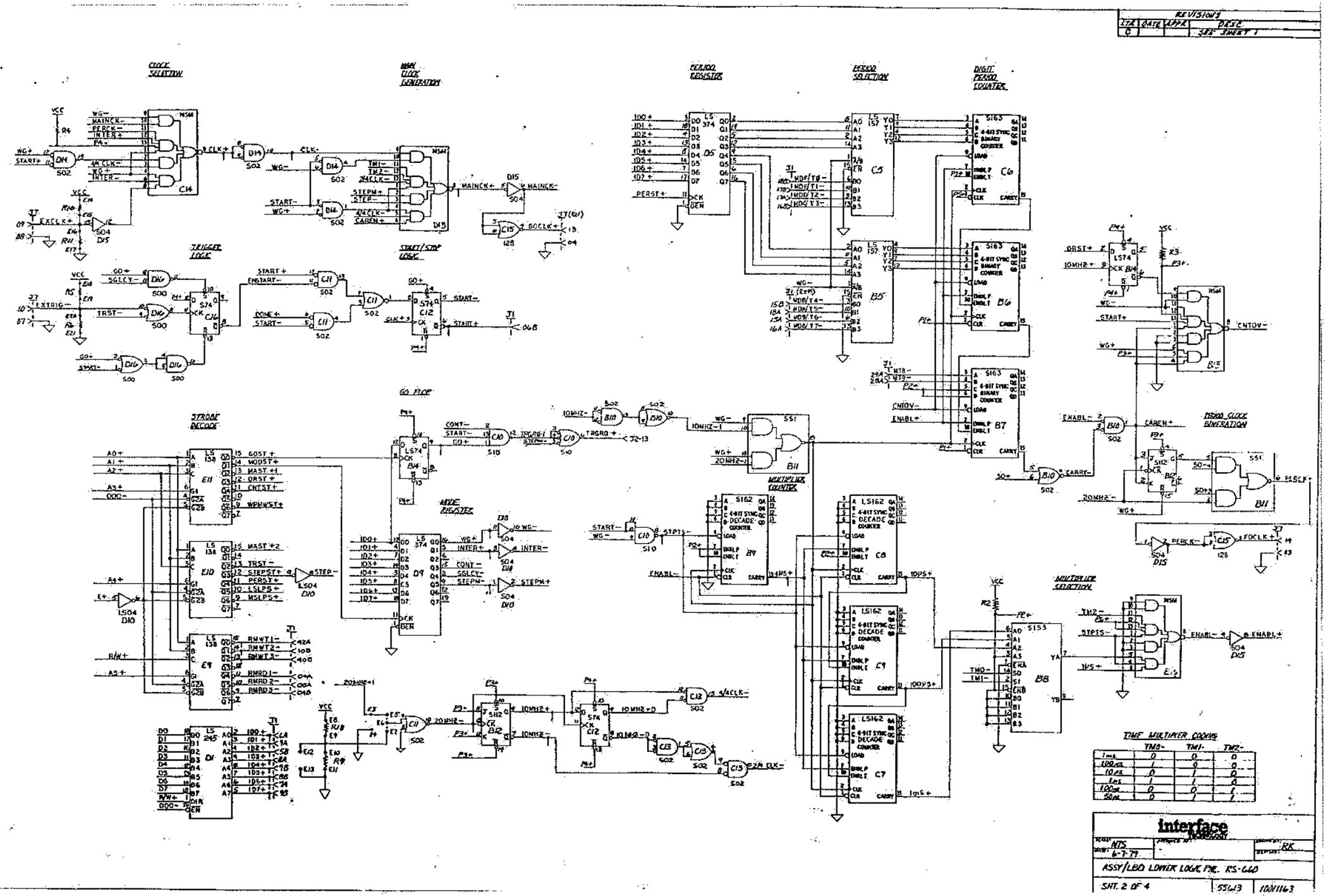
interface TECHNOLOGY

SCALE NTS | DRAWN BY B.K. Runge | DESIGNED BY RE

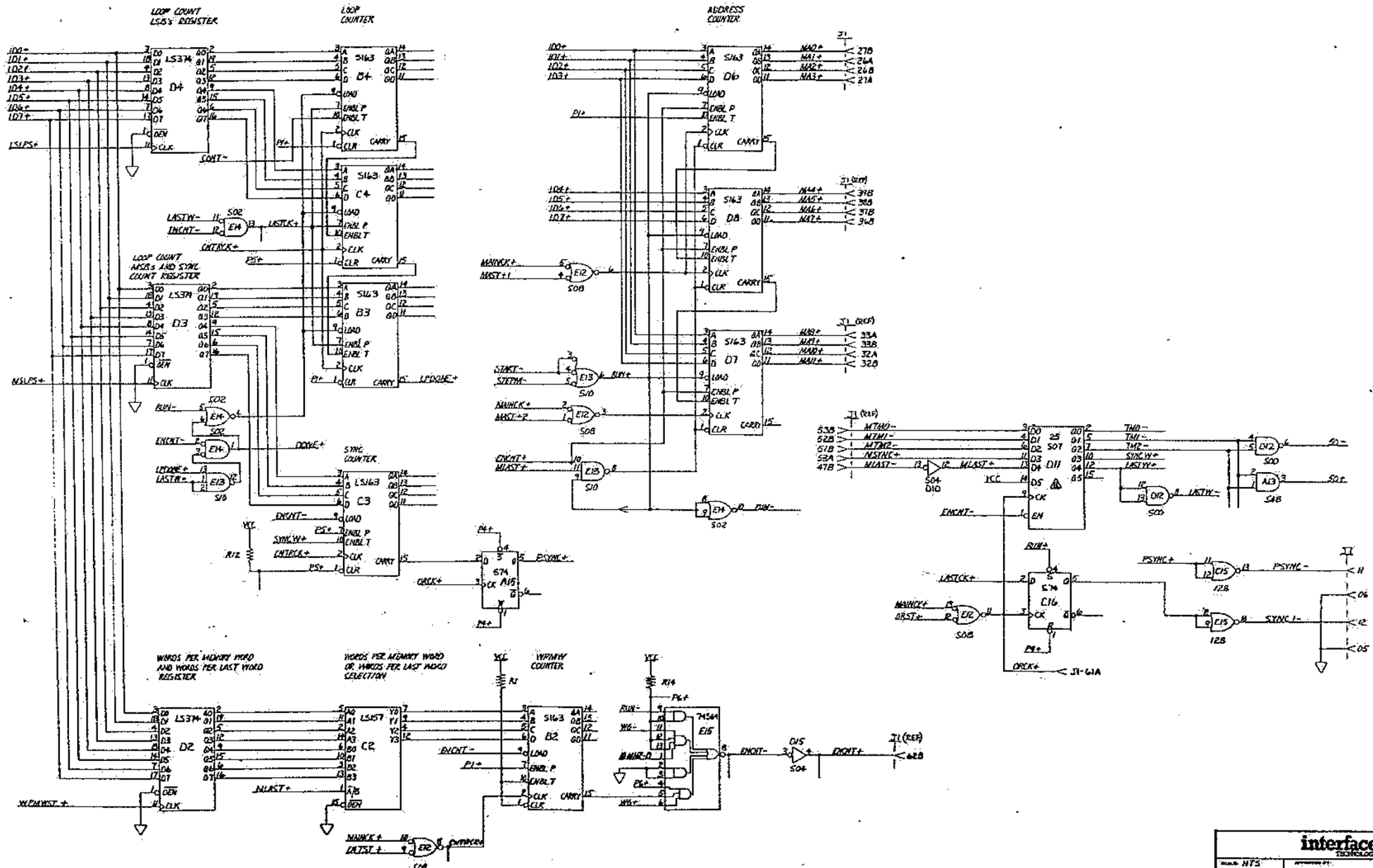
DATE 6-15-79 | CHECKED

ASSY 1 LED LOWER LOGIC PAL. RS-LED

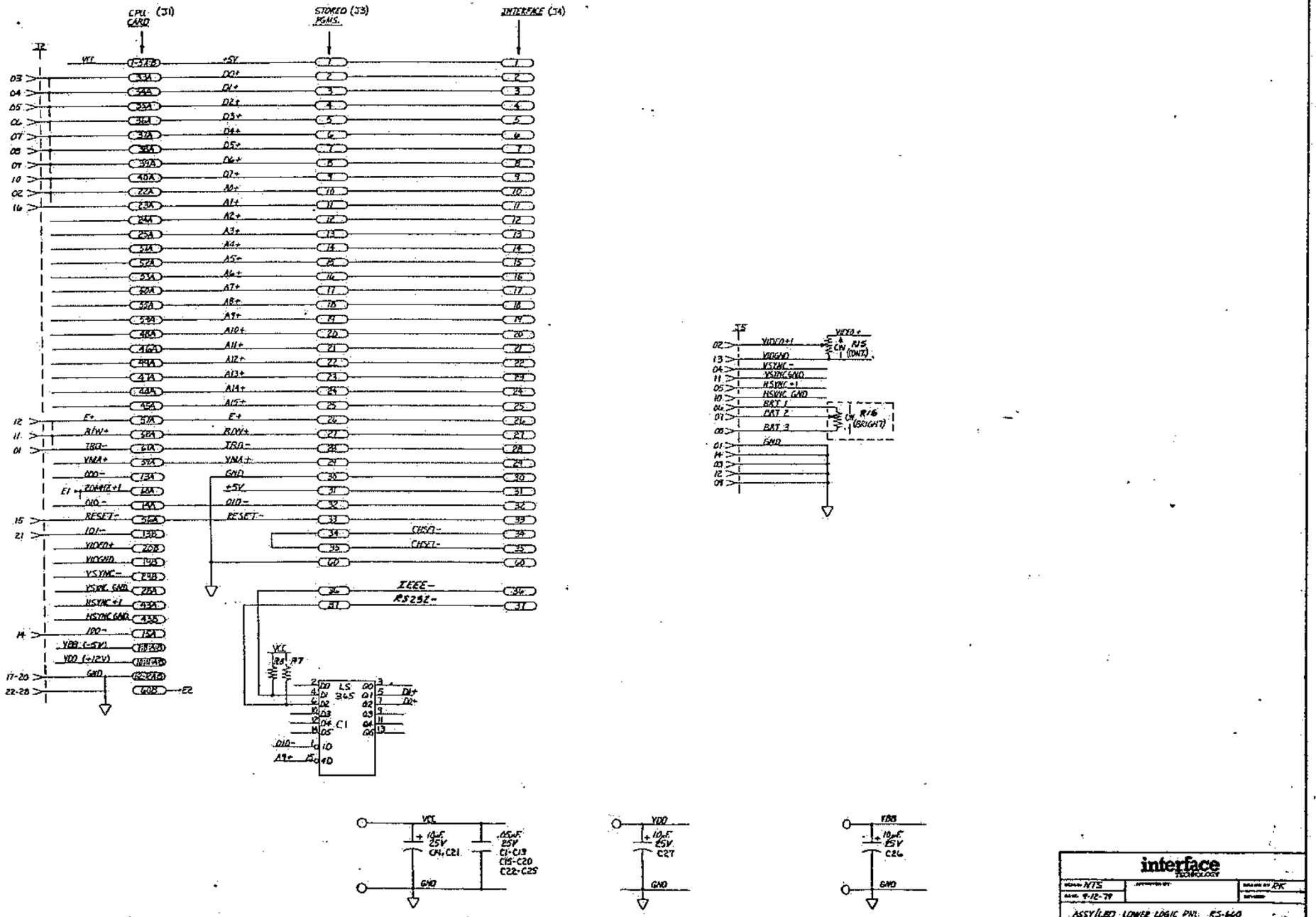
SHT 1 OF 4 | 55613 | 1001163


REVISIONS
LTR DATE APPR DESC
C SEE SHEET 1
CLOCK SELECTION
MAIN CLOCK GENERATION
PERIOD REGISTER
PERIOD SELECTION
DIGIT PERIOD COUNTER
TRIGGER LOGIC
START/STOP LOGIC
GO FLOP
STROBE DECODE
MUX REGISTER
MULTIPLIER COUNTER
MAIN CLOCK GENERATION
MULTIPLIER SELECTION
TIME MULTIPLIER CODING
TM0- TM1- TM2-
1mS 0 0 0
100 uS 0 0 1
10 uS 0 1 0
1mS 0 1 1
100mS 1 0 0
50mS 1 0 1
Interface
SCALE NTS
DRAWN 6-7-79
APPROVED BY -
DESIGNED BY RK
ASSY/LBD LOWER LOGIC PNL RS-660
SHT. 2 OF 4
55613
1001163

REVISIONS			
LTR	DATE	APPR	DESC.
C			SEE SHEET 1

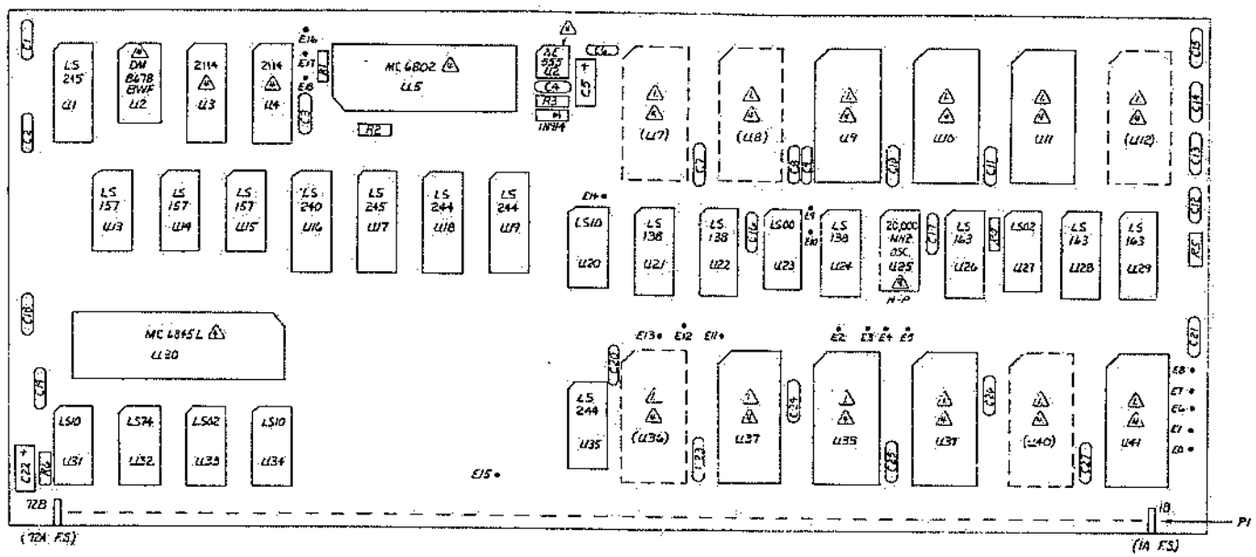


REVISIONS			
LTR	DATE	APPR	DESC.
C			SEE SHEET 1



interface TECHNOLOGY			
DRAWN NTS	APPROVED BY:	RELEASED BY DK	
DATE 9-12-79			
ASSY/LBD LOWER LOGIC PNL RS-660			
SHT 4 OF 4	SCALE	PART NO.	

REVISIONS			
LTR	DATE	APPR	DESC
A	4-5-79		C.O. 1891



ASSEMBLY SIDE

1. H-P DESIGNATES HIGH-PROFILE SOCKET.
2. RESISTORS R1 IS 10K-Ω, R2 IS 3K-Ω, R3 IS 22K-Ω, R4-R16 ARE 1K-Ω, ALL ARE ¼W CARBON COMP.
3. CAPACITOR C4 IS A .01μF AT 25V CERAMIC DISC.
4. CAPACITORS C1-C3, C6-C27 ARE .05μF AT 25V CERAMIC DISC.
5. CAPACITORS C5 & C22 ARE 10μF 25V ELECTROLYTIC
6. ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.
7. REFER TO 1001164 FOR PCB.
8. JUMPER E16-E17 — RAM ENABLE TO 6802 (DISABLE).

EPROM TYPE	JUMPER INSTALLATIONS				ACTIVE LOCATIONS	BYPASS CAPACITORS
TMS 2516 →	E2-E3,	E4-E5,	E7-E8,	E12-E13, E14-E15	U7-U12, U36-U41	C9, C13, C23, C27.
TMS 2716 →	E0-E1,	E3-E4,	E6-E7,	E12-E13, E14-E15.	U7-U12, U36-U41	
INTEL 2716 →	E2-E3,	E4-E5,	E7-E8,	E12-E13, E14-E15	U7-U12, U36-U41	C9, C13, C23, C27.
INTEL 2732 →	E2-E3,	E4-E5,	E9-E10,	E11-E12, E14-E15	U36, U37, U38, U39, U41	C7, C9, C10, C13, C14, C23, C24, C26, C27.

NOTES: UNLESS OTHERWISE SPECIFIED

EPROM PART NO.'S 1001391-XX

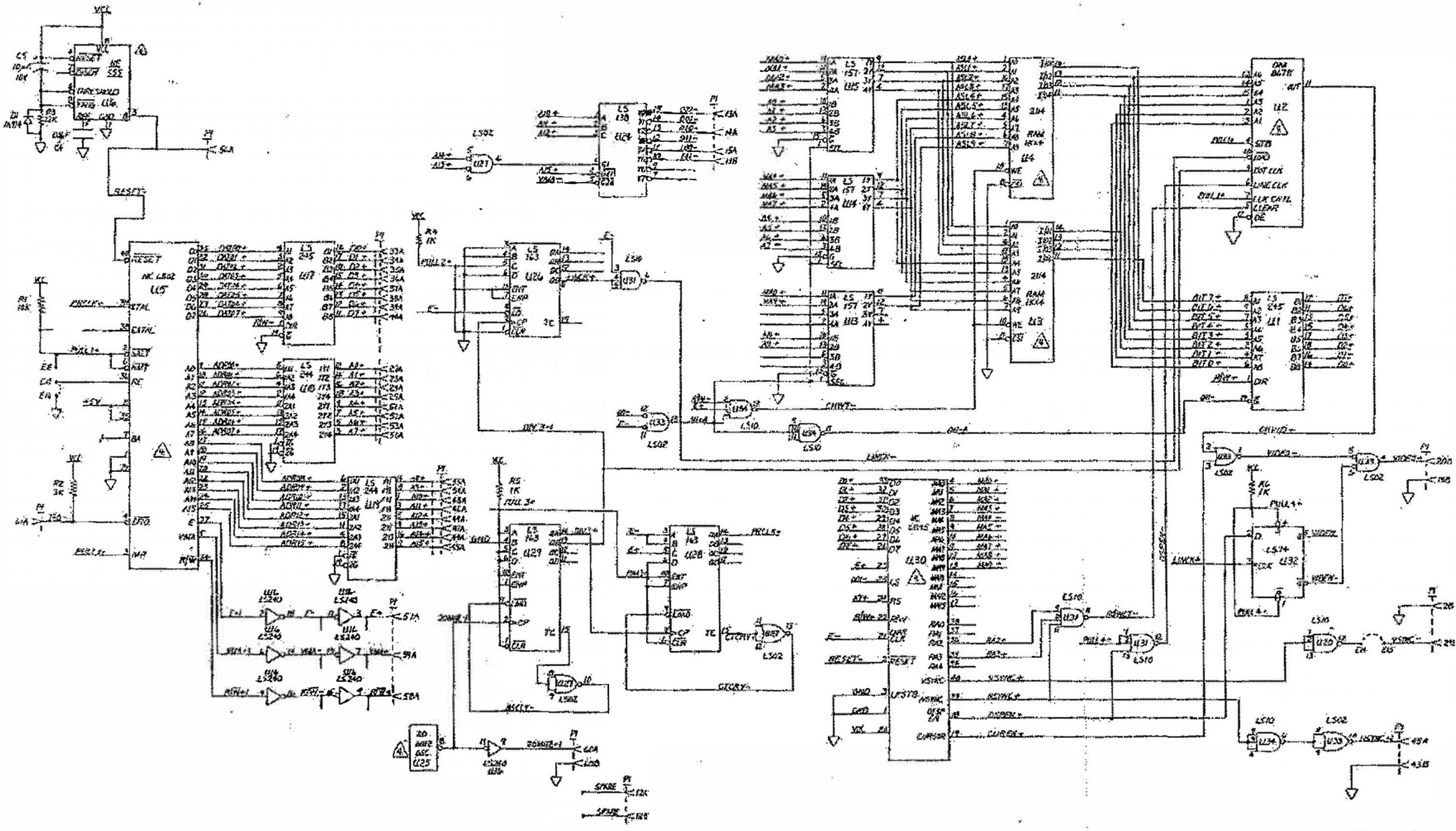
U7	U8	U9	U10	U11	U12	U36	U37	U38	U39	U40	U41
NA	-11	-13	-15	-17	NA	NA	-12	-14	-16	NA	-18
NA	-01	-03	-05	-07	NA	NA	-02	-04	-06	NA	-08
NA	-11	-13	-15	-17	NA	NA	-12	-14	-16	NA	-18
NA	NA	NA	NA	NA	NA	NA	-21	-22	-23	NA	-24

interface TECHNOLOGY

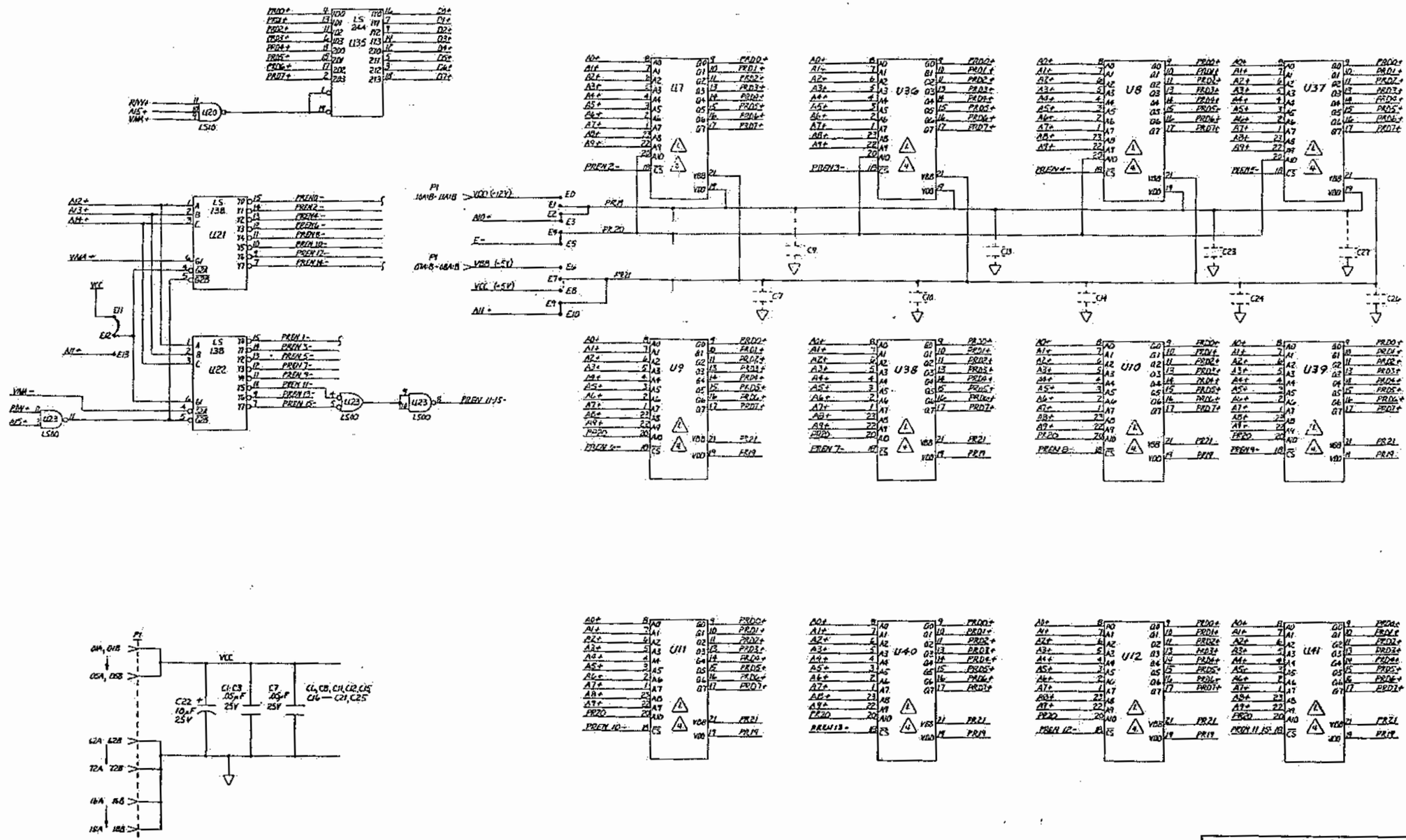
SCALE: NTS	APPROVED BY:	DRAWN BY: RK
DATE: 6-5-79		CHECKED

ASSY/LBD RS-660 CPU CARD

SHT. 1 OF 3	SST-13	DRAWING NUMBER 1001165

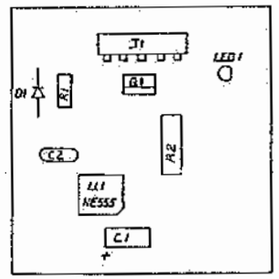


interface TECHNOLOGY		
DRAWN M.E.S.		
DATE 7-12-79		
ASSY/LBD RS-600 CPU CARD		
SHT 2 OF 3	SSU3	1001165

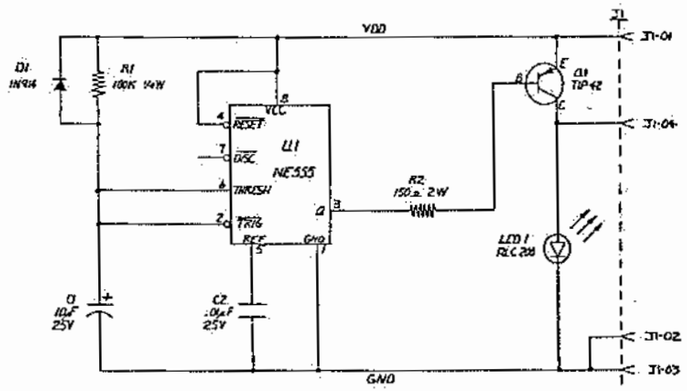


interface TECHNOLOGY	
SCALE: NTS	DRAWN BY: AJK
DATE: 6-6-79	APPROVED:
ASSY/LBD RS-660 CPU CARD	
SHT 3 OF 3	5563

A	4-9-84	J.K.G.	SEE ECO B453



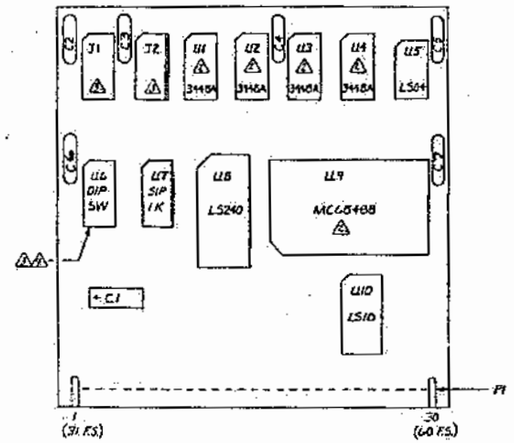
COMPONENT SIDE

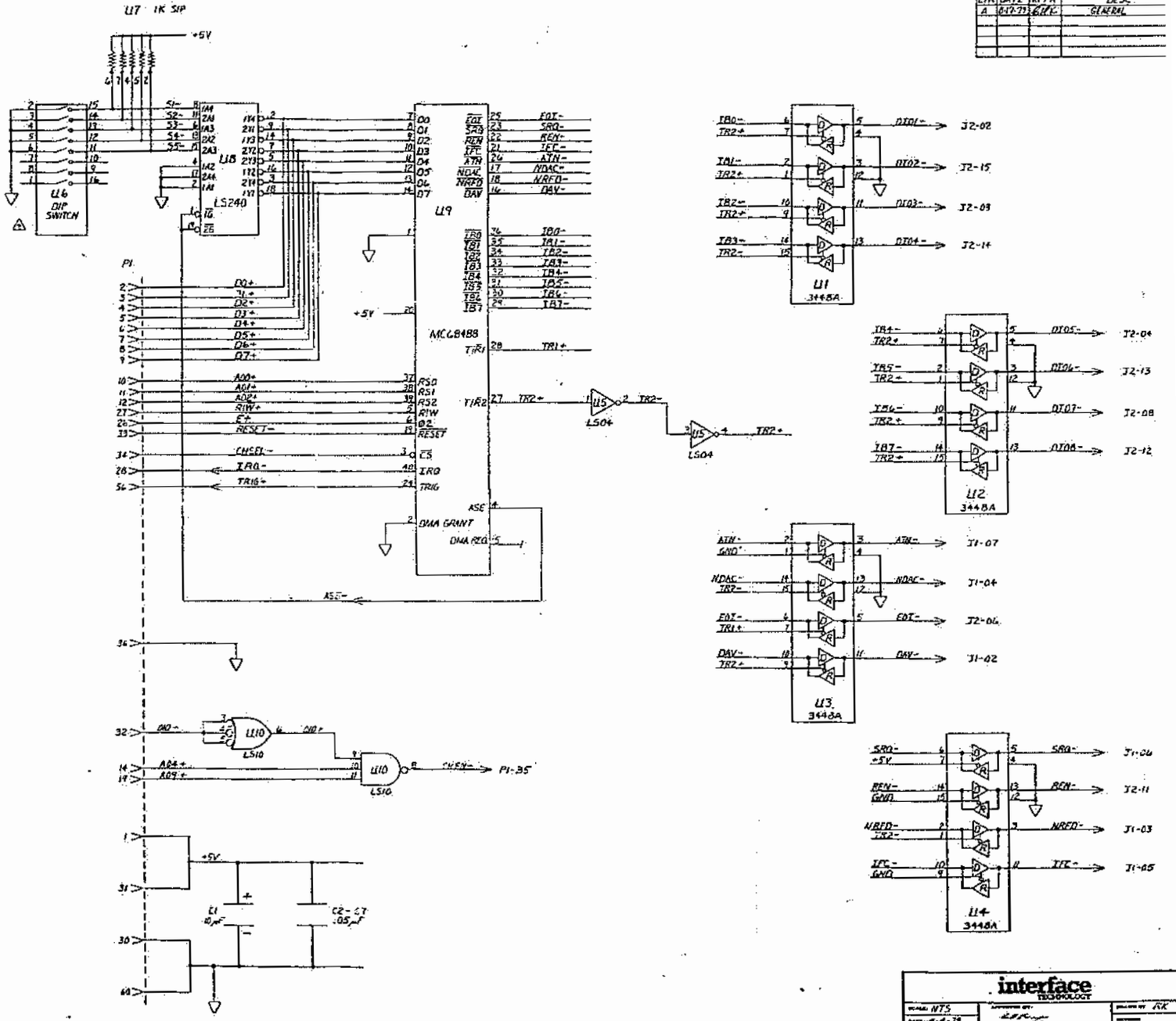


5. REF 1001200 FOR PCB
4. RESISTOR R2 IS A 150Ω 2W CARBON COMP.
3. RESISTOR R1 IS A 100KΩ 1/4W CARBON COMP.
2. C2 IS A .01μF AT 25V CERAMIC DISC CAPACITOR.
1. C1 IS A 10μF AT 25V TANTALUM CAPACITOR.

NOTES: UNLESS OTHERWISE SPECIFIED.

interface TECHNOLOGY		
SCALE: NTS DATE: 6-1-79	APPROVED BY: G.K.R.	DRAWN BY: RE
ASSY LBO RS-460 CRT DELAY CIRCUIT AB		
SHT 1 OF 1	55613	1001281





REVISIONS			
LTR	DATE	APPR	DESC
A	6-12-79	GRFC	GENERAL

⚠ FOR MODEL 488, INSTALL 5 POSITION DIP SWITCH WITH SWITCH NO. 1 IN SOCKET W12. FOR RS-660, INSTALL CABLE TO REAR PANEL.

⚠ H.P. DENOTES HIGH PROFILE SOCKET.

⚠ ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED. REFER TO 1001133 FOR PCB.

NOTES: UNLESS OTHERWISE SPECIFIED

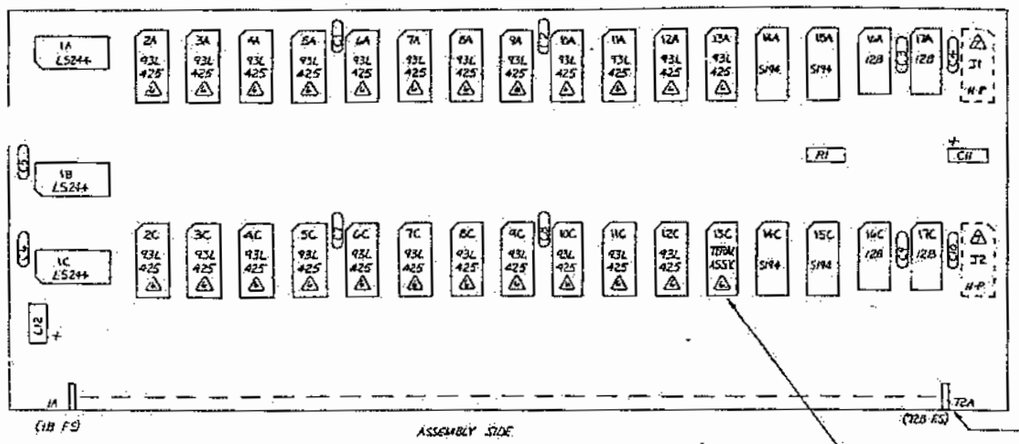
interface TECHNOLOGY

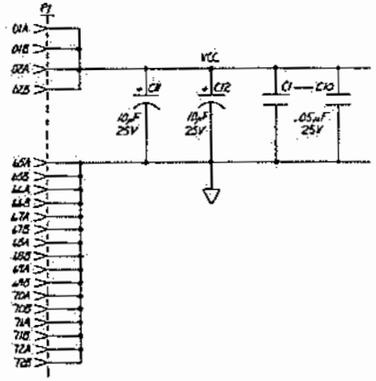
SCALE NTS | DRAWN BY RK

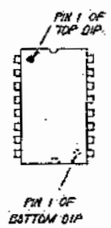
DATE 9-4-79

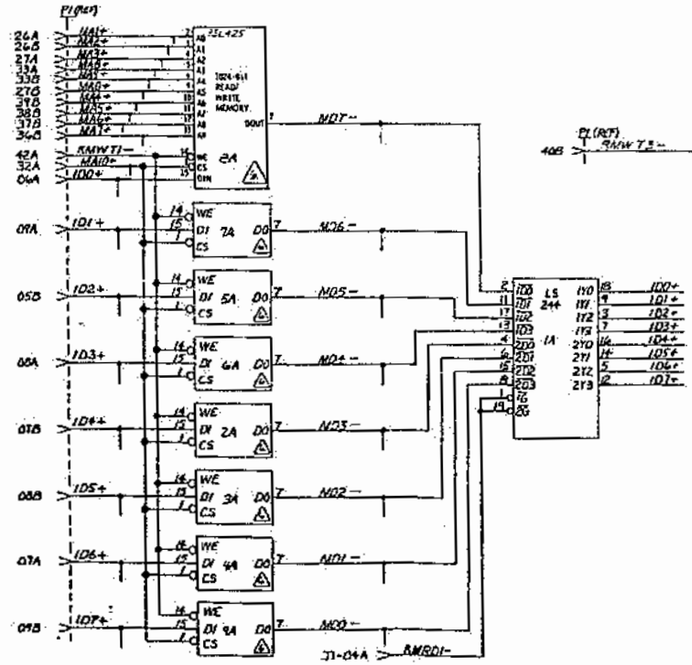
ASSY/LBO IEEE INTERFACE CARD

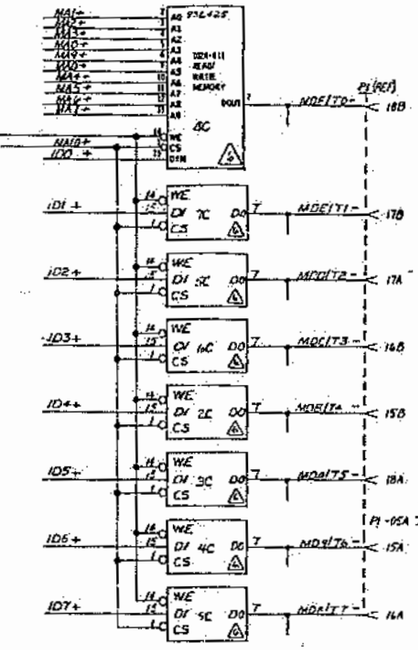
SHT 1 OF 1 | 55613 | 1001134

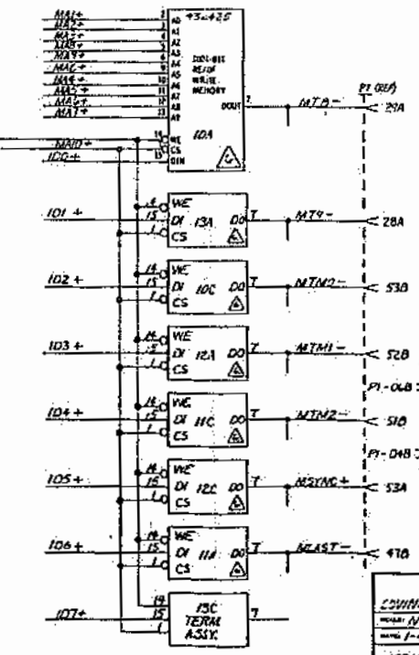












NOTES:

1. 93L425 INSTALLED IN 23 PLACES. ADDRESS LINES MA8+ THRU MA9+ ARE CONNECTED TO A0 THRU A9 OF ALL 23 CHIPS.
2. REF. 100111-54 FOR PCB.
3. CAPACITORS C11 & C12 ARE 10μF AT 25V ELECTROLYTIC.
4. CAPACITORS C1 THRU C10 ARE .05μF AT 25V CERAMIC DISC.
5. RESISTOR R1 IS A 1KΩ 1/4W CARBON COMP.
6. ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.

⚠ H-P DESIGNATES HIGH PROFILE SOCKETS.

REVISIONS

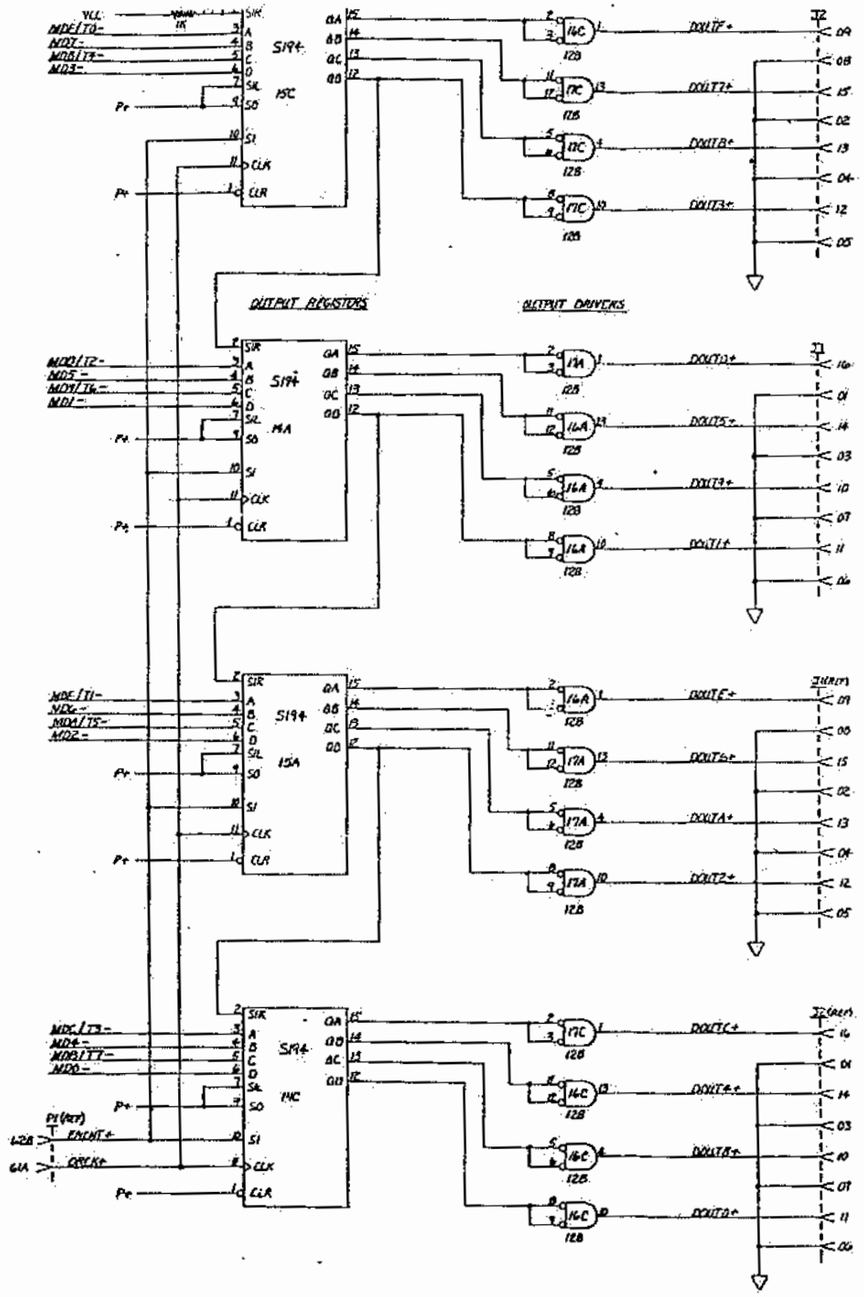
LTR	DATE	APPR	DESC

interface TECHNOLOGY

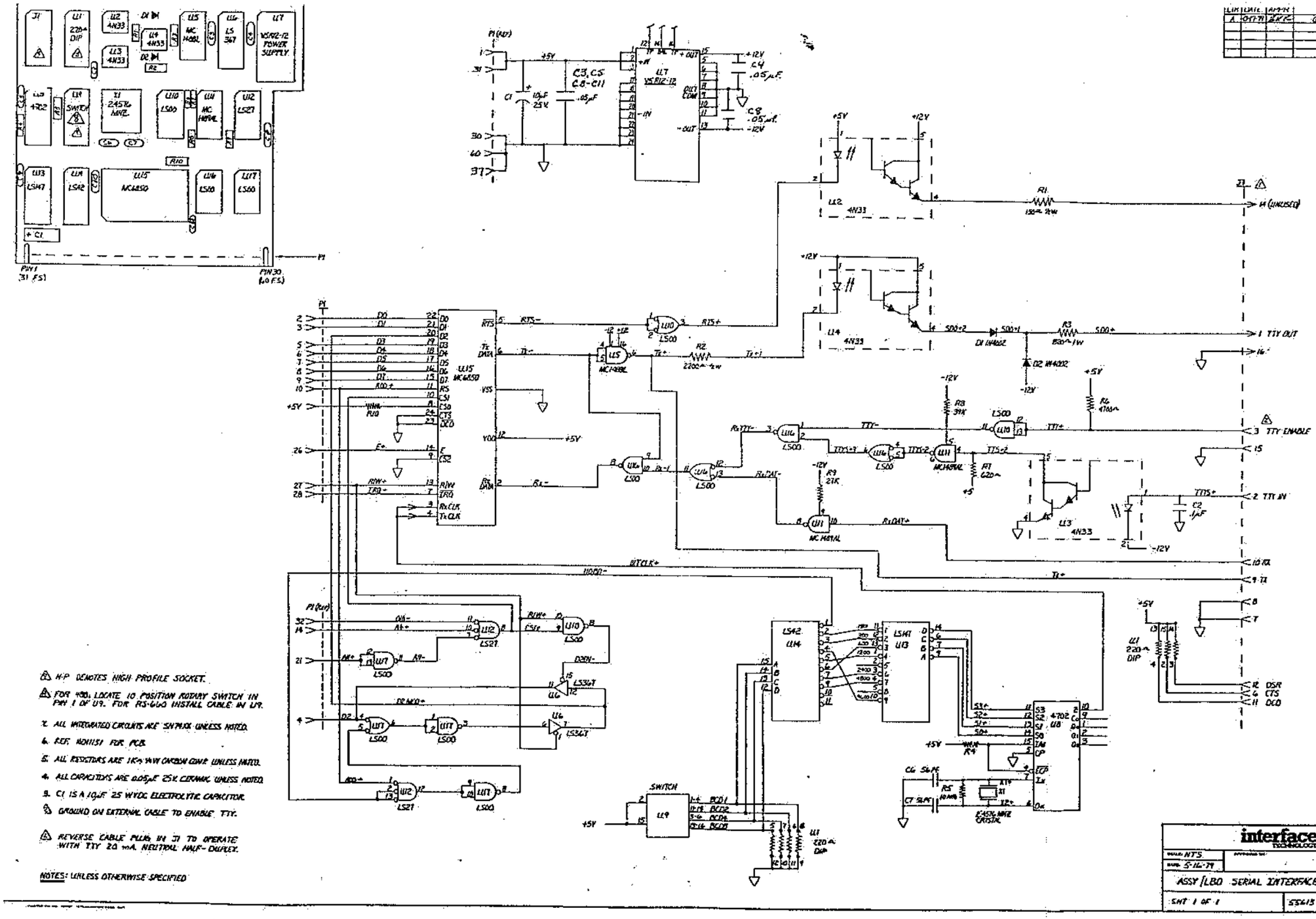
DWG NO.		SA. NO.
SCALE NTS	APPROVED BY	DRAWN BY
DATE 1-4-79	BKC	APPROVED

ASSY LBD, RS-660 1K MEMORY CARD

SHEET 1 OF 2



interface TECHNOLOGY		
SCALE: NTS	APPROVED BY:	DRAWN BY: RK
DATE: 1-6-79		REVISED
ASSY LBD RS-660 1K MEMORY CARD		
SHT 2 OF 2	5543	10011155



LTR	DATE	APPVD	DESC
A	5-11-79	RK	ORIGIN

⚠ H-P DENOTES HIGH PROFILE SOCKET.

⚠ FOR "00, LOCATE 10 POSITION ROTARY SWITCH IN PIN 1 OF U9. FOR RS-660 INSTALL CABLE IN U9.

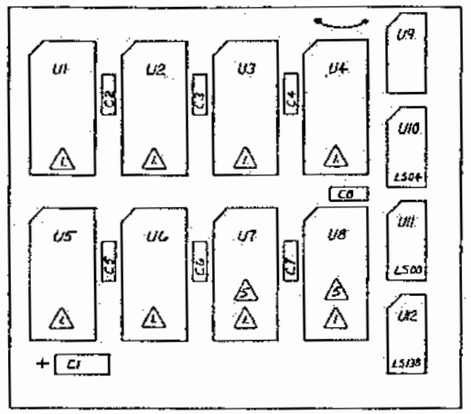
1. ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.
2. REF. 1001151 FOR PCB.
3. ALL RESISTORS ARE 1K-5% 1/4W CARBON COMP. UNLESS NOTED.
4. ALL CAPACITORS ARE .05µF 25V. CERAMIC UNLESS NOTED.
5. C1 IS A 10µF 25 WVDC ELECTROLYTIC CAPACITOR.
6. GROUND ON EXTERNAL CABLE TO ENABLE TTY.

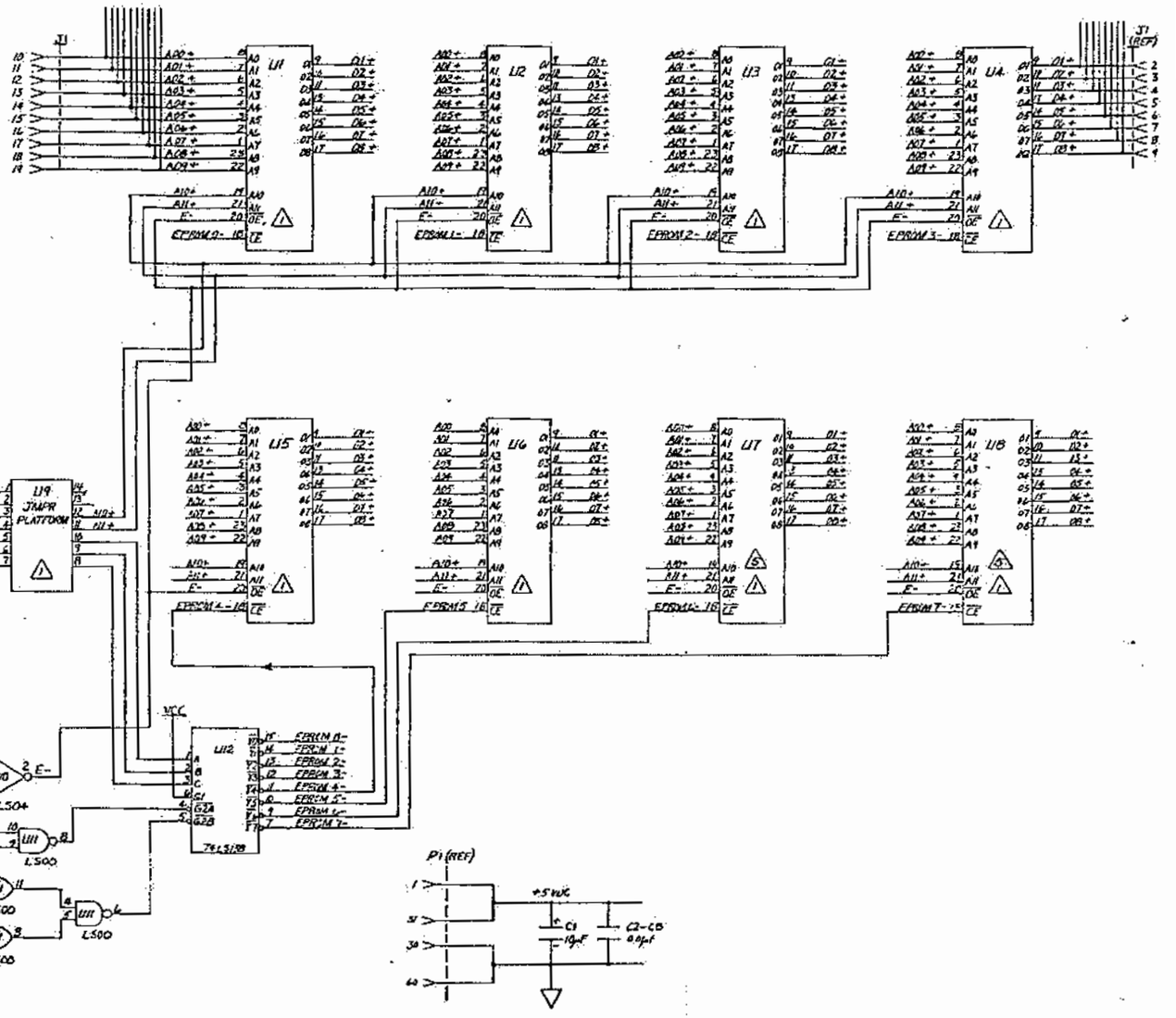
⚠ REVERSE CABLE PLUG IN J1 TO OPERATE WITH TTY 20 mA. NEUTRAL HALF-DUPLEX.

NOTES: UNLESS OTHERWISE SPECIFIED

interface TECHNOLOGY

DRAWN NTS		DESIGNED BY RK
DATE 5-14-79		APPROVED
ASSY /LBO SERIAL INTERFACE CARD		
SHT 1 OF 1	55613	DRAWING NUMBER 1001132





4 REF 1001139 FOR PCB.

5 OMIT FOR -002

4 -002 (RS-L60)

4 -001 (MODEL 4681)

3 CAPACITORS C2-C8 ARE 0.01 µF CERAMIC

2 CAPACITOR C1 IS 10µF 25 V.

EPROM TYPE	TO U9 PIN NO. 12	11	10	9	8
	FROM U9 PIN NO.				
2758	1	3	2	4	5
2716	2	3	4	5	6
2732	2	4	5	6	7
2516	2	3	4	5	6

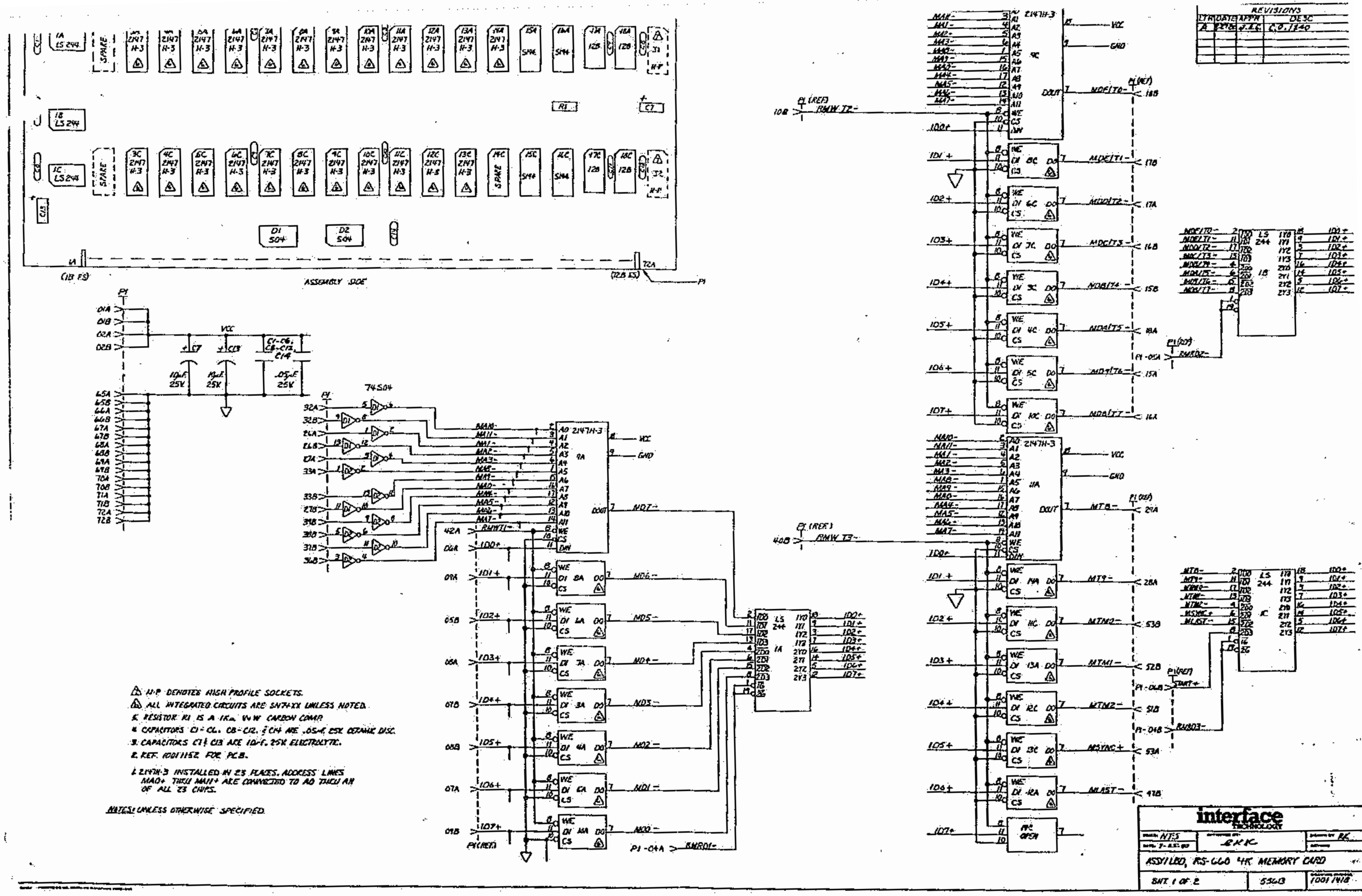
1 U1-U8 MAY USE INTEL 2758, 2716, 2732 OR TI 2516; INSTALL FOLLOWING JUMPERS ON U9.

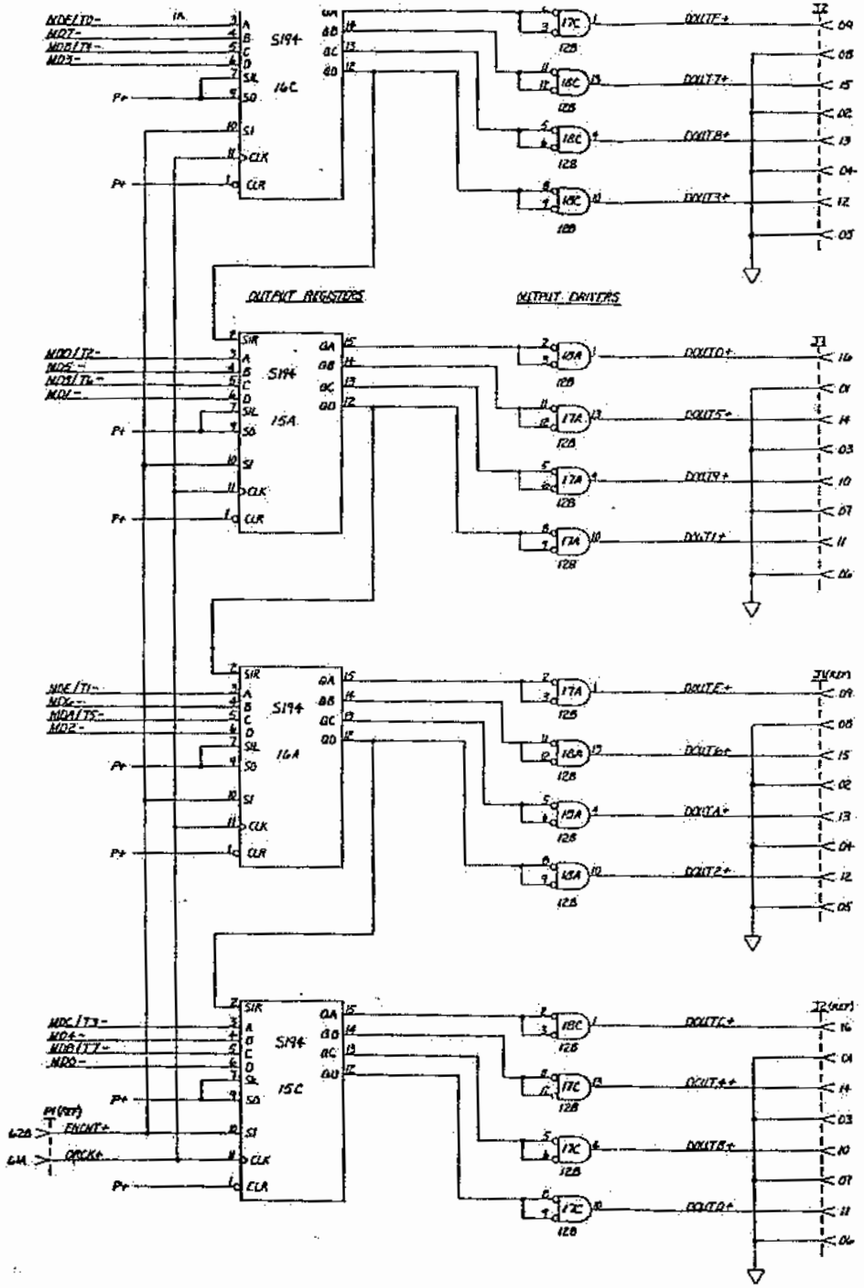
NOTES:

A	8-17-79	AKC	ADDED -002
B	9-6-79	RK	PER ECR 0003

interface TECHNOLOGY

SCALE: N.T.S.	APPROVED BY:	DRAWN BY: A.T.K.
DATE: 1-8-79	3-9-79	
ASSY/LBD, STORED PGM CARD		
SHT. 1 OF 1	55613	1001139


REVISIONS
ASSEMBLY SIDE
74S04
2147H-3
VCC
GND
SPARE
⚠ H-P DENOTES HIGH PROFILE SOCKETS.
⚠ ALL INTEGRATED CIRCUITS ARE SN74XX UNLESS NOTED.
5. RESISTOR R1 IS A 1KΩ W.W CARBON COMP.
4. CAPACITORS C1-C6, C8-C12, & C14 ARE .05μF, 25V CERAMIC DISC.
3. CAPACITORS C7 & C13 ARE 10μF, 25V ELECTROLYTIC.
2. REF. 10011152 FOR P.C.B.
1. 2147H-3 INSTALLED IN 23 PLACES. ADDRESS LINES MA0+ THRU MA11+ ARE CONNECTED TO A0 THRU A11 OF ALL 23 CHIPS.
NOTES: UNLESS OTHERWISE SPECIFIED.
interface TECHNOLOGY
NTS
7-25-80
RKK
ASSY/LED, RS-660 4K MEMORY CARD
SHT 1 OF 2
55603
10011418



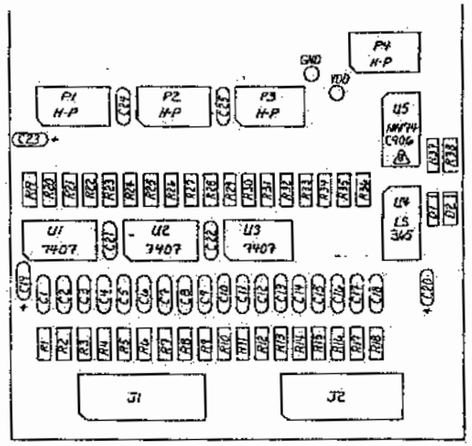
LTR	DATE	APPR	DESC.
A			PER SHEET 1

interface TECHNOLOGY

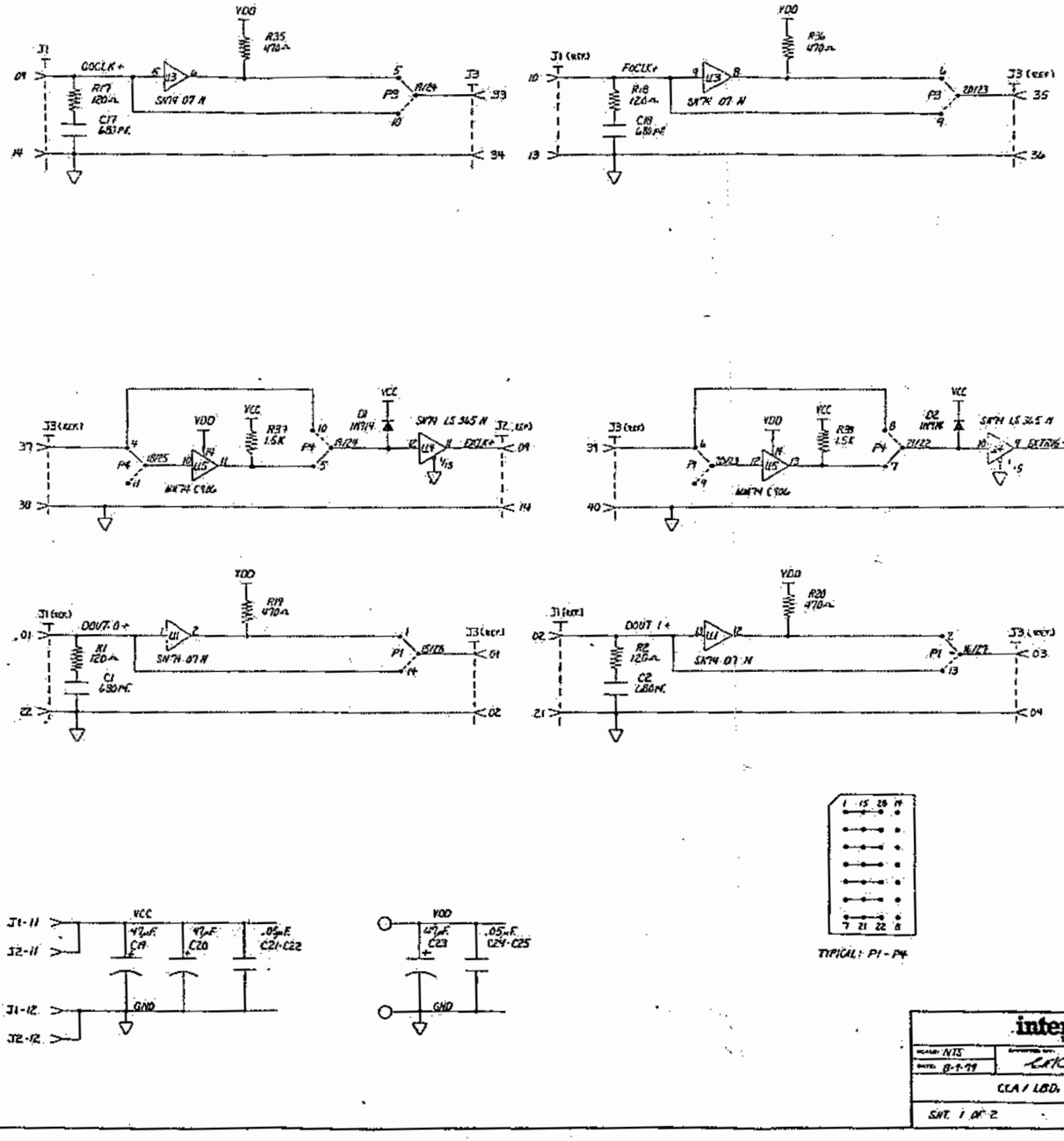
Date: NTS		Drawn by: RK
Date: 7-25-80		

ASSY/LBD RS-460 4K MEMORY CARD

SHT 2 OF 2	55613	1001 1448



ASSEMBLY SIDE



10. P1-P4 INSTALLED SUCH THAT PIN 1 TO PIN1 DENOTES CMOS.
P1-P4 INSTALLED SUCH THAT PIN 1 TO PIN 8 DENOTES TTL.
9. REF. 1001 1309 FOR PCB.
8. ALL INTEGRATED CIRCUITS ARE SN74 XX UNLESS NOTED
7. D1 AND D2 ARE 1N914 DIODES.
6. R37 AND R38 ARE 1.5KΩ 1/4W CARBON COMP. RESISTORS.
5. R19-R36 ARE 470Ω 1/4W CARBON COMP. RESISTORS.
4. R1-R18 ARE 120Ω 1/4W CARBON COMP. RESISTORS.
3. C21, C22, C24 AND C25 ARE .05μF AT 25 WVDC. CERAMIC DISC CAPACITORS.
2. C1-C18 ARE 680 pF AT 25 WVDC. CERAMIC DISC CAPACITORS.
1. C19, C20 AND C23 ARE 47μF AT 25 WVDC. TANTALUM CAPACITORS.

NOTES: UNLESS OTHERWISE SPECIFIED

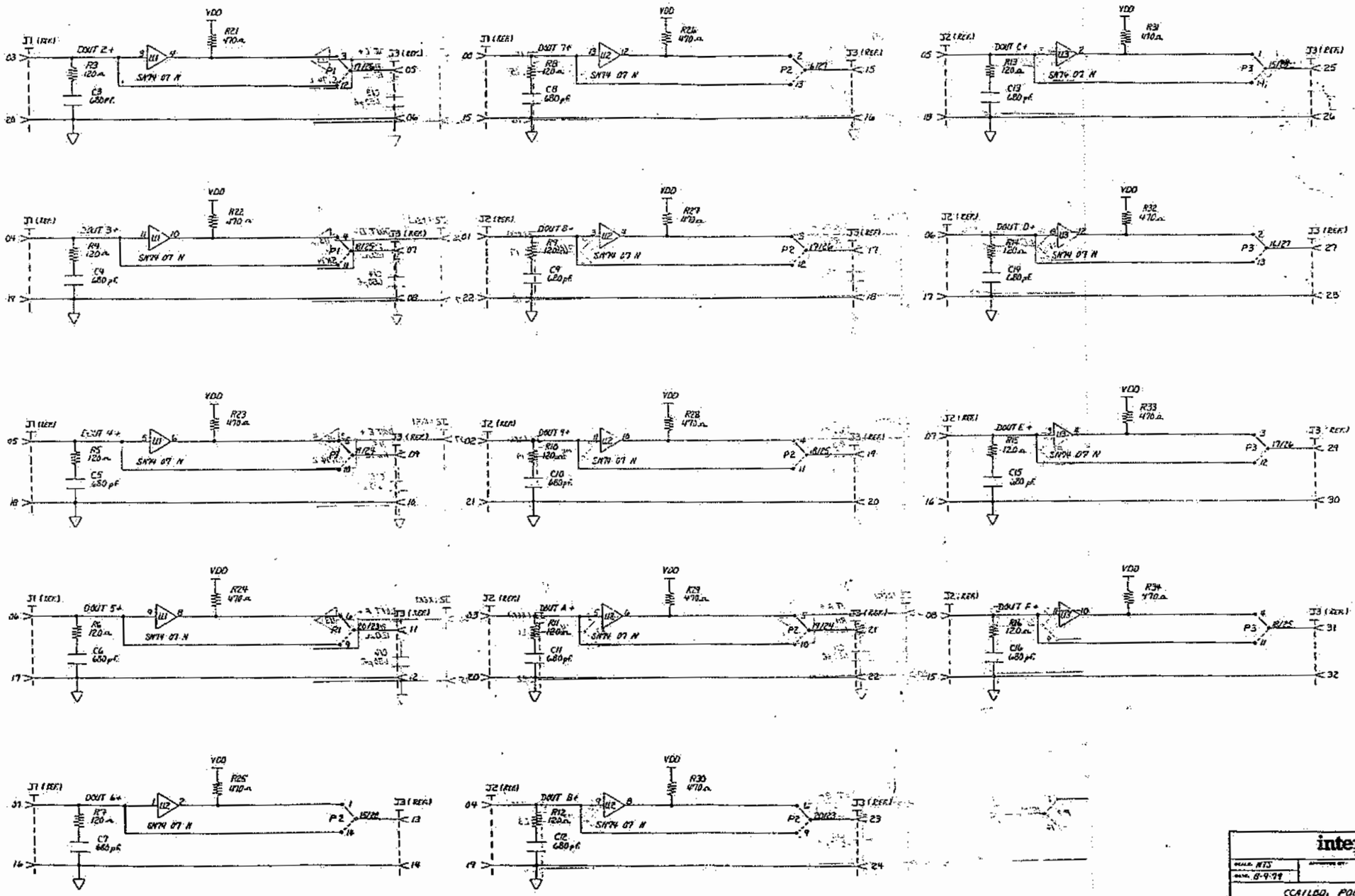
TYPICAL: P1 - P4

SCALE: NTS	APPROVED BY: A.K.	DRAWN BY: R.K.
DATE: 8-1-79		CHECKED

interface TECHNOLOGY

CCA / LBD. POD

SHT. 1 OF 2	55613	1001 1310



interface TECHNOLOGY

SCALE: NTS		DRAWN BY: EK
DATE: 8-9-99		
CCA/LOG. POD		
SHT. 2	5543	1001 1310

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