Model 910/910 PLUS Maintenance Manual

TeleVideo Systems, Inc.

Model 910/910 PLUS Maintenance Manual

PART NO. 2002600

OCTOBER 1983

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PREFACE

Any comments and suggestions on this manual are welcome. Please address them to:

TeleVideo Systems, Inc.
1170 Morse Ave.
Sunnyvale, CA 94086

WARRANTY POLICY AND RETURNED MATERIAL PROCEDURE

WARRANTY

TeleVideo warrants that its products will be free from defects in material and workmanship for a period of 180 days from the date of shipment from the factory. If you receive a terminal that has been damaged in shipment, contact your carrier and process claim.

SERVICE UNDER WARRANTY

If you have any technical questions concerning your terminal, feel free to call your Customer Service Department. If your unit should happen to malfunction during the warranty period, please notify your Distributor. Your Distributor may repair the terminal or determine that it must be returned to TeleVideo.

RMA AND SHIPPING

If it's necessary to return the terminal to TeleVideo your Distributor will give you a Return Material Authorization (RMA). All communications regarding the terminal should reference this RMA number.

The terminal is to be shipped to TeleVideo at your expense. TeleVideo will repair the terminal at no cost to you and pay for shipping it back via best way surface. Any other method, such as air express, will be at your expense. Normal turnaround time is five days plus transportation time.

SERVICE OUT OF WARRANTY

If your terminal is out of warranty when it needs service, you should follow the same procedure to receive an RMA. You will be responsible for all shipping costs.

Should your company require a purchase order for out-of-warranty repairs, let us know the purchase order number when you call in. One purchase order may cover several repairs but we will give each item its own individual RMA number. This allows us to return each item quickly and not hold up the entire purchase order because of one item.

TECHNICAL ASSISTANCE

The Service Department is open from 7:00 p.m., Pacific Time, continuously, Monday through Friday. If the line is busy and your problem can wait, leave a message with the TeleVideo operator and your call will be returned at our first opportunity.

Be specific when describing the problem and failure history. The problem will be solved much quicker when described in a calm, accurate manner.

EXTENDED WARRANTY

TeleVideo offers an Extended Warranty Contract. To take advantage of this Extended Warranty, you must sign the Extended Warranty Contract and return it, together with full payment, to TeleVideo prior to the end of your normal warranty period. The extended warranty lasts for one year; the cost is $75.00.

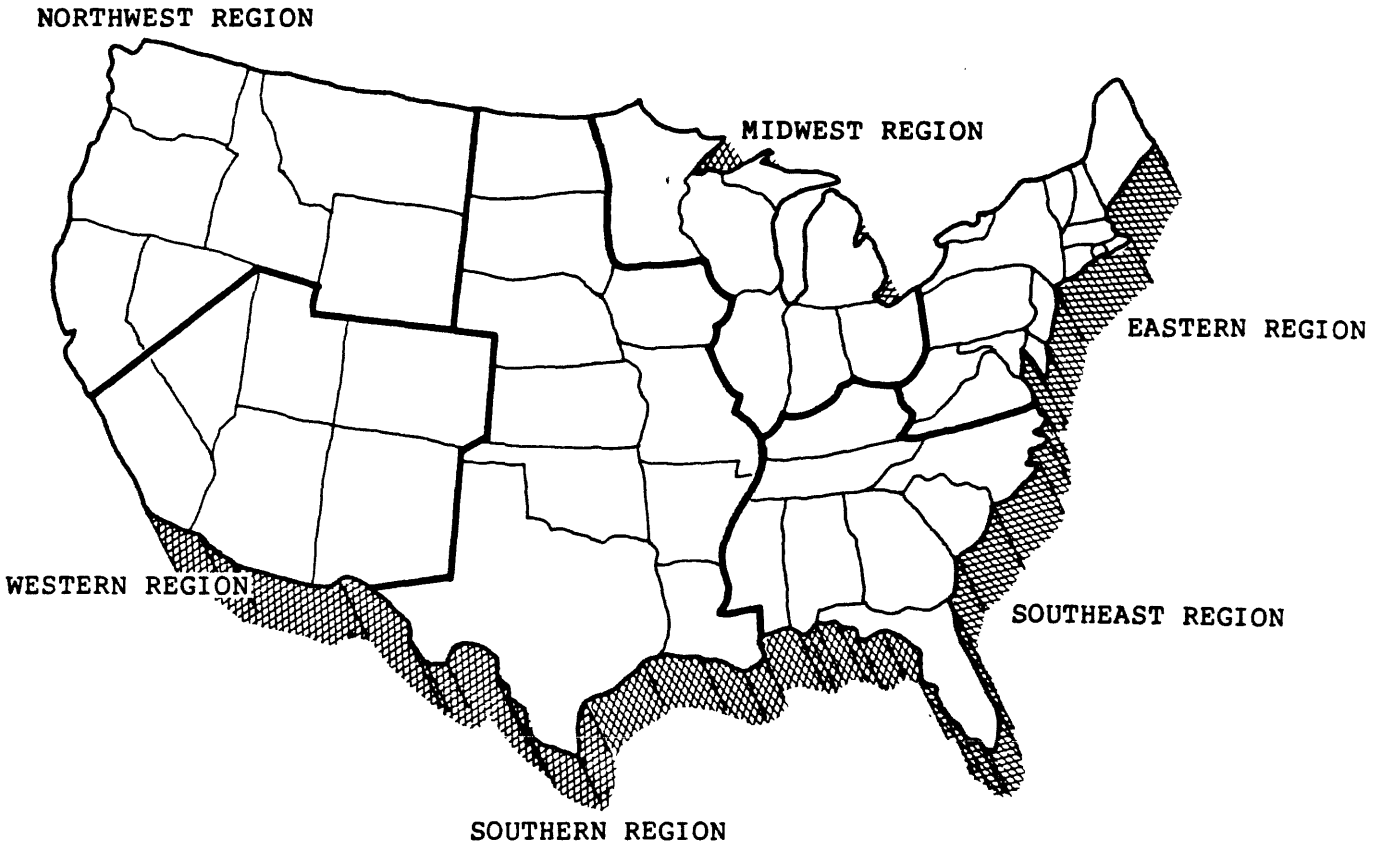
To renew the extended warranty for another year, the same procedure must be followed.

Shipping charges are not included in the Extended Warranty. This is the only expense you incur.

ORDERING SPARE PARTS

Parts are ordered directly from Terminal Spare Parts order entry at our corporate headquarters in Sunnyvale, California. Call (408) 745-7760 or (800) 538-8725 (outside California). For international customers Telex 910-339-9621, attention Terminal Spares Order Entry. Contract customers and institutions can order parts on a Purchase Order and be invoiced; please have Purchase Order number and TeleVideo part number ready at time of call. All ohter customers must order parts on a C.O.D. or cash-in- advance basis. There is a $50.00 minimum on all orders (except manuals).

For orders placed in California, add 6.5% sales Tax. There is a shipping and handling charge of $10.00 per order. There will be no drop shipments, so please include the shipping and billing addresses with your order. Shipments are made Best Way, which is UPS. Any special shipping requests will be accommodated, but any extra costs incurred will be added
to the invoice.



REGIONAL SALES OFFICE

WESTERN REGION

505 N. TUSTIN AVE.
SUITE 253
SANTA ANA, CA. 92705
(714) 557-6095

EASTERN REGION

202 JOHNSON RD.
SUITE A-107
ATRIUM 1
MORRIS PLAINS, NJ. 07950
(201) 267-8805

NORTHWEST REGION

1170 MORSE AVE
SUNNYVALE, CA. 94086
(408) 745-7760

SOUTHERN REGION

4560 BELTLINE RD.
SUITE 424
DALLAS, TX. 75293
(214) 980-9978

SOUTHEAST REGION

5901-C PEACHTREE-DUNWOODY RD.
SUITE 260
ATLANTA, GA. 30328
(404) 399-6464

MIDWEST REGION

125 E. LAKE ST.
SUITE 203
BLOOMINGDALE, ILL. 60108
(312) 351-9350

May 16, 1983
TERMINAL SPARE PART PRICE LIST
REVISED 9-13-83

DESCRIPTION	NEW P/N	LIST PRICE
MANUALS		
INSTAL & USER GUIDE 910	2002500	5.00
INSTAL & USER GUIDE 910PLUS	2004600	5.00
INSTAL & USER GUIDE 912/920	2001800	5.00
INSTAL & USER GUIDE 925	2003500	5.00
INSTAL & USER GUIDE 950	2002000	5.00
INSTAL & USER GUIDE 970	2244600	10.00
INSTAL & USER GUIDE 970/50	3090200	25.00
MAINTENANCE MANUAL 910/910PLUS	2002600	50.00
MAINTENANCE MANUAL 912/920	2001900	50.00
MAINTENANCE MANUAL 925	2003600	50.00
MAINTENANCE MANUAL 950	2002100	50.00
MAINTENANCE MANUAL 970	3002100	50.00
MODULES		
POWER SUPPLY MODULE	2195700	91.00
POWER SUPPLY MODULE 970	2225700	120.00
VIDEO MODULE	2195800	93.00
VIDEO MODULE 970	2226900	110.00
LOGIC BOARD 910 TTL	2014000	395.00
LOGIC BOARD 910 G/A	2014001	395.00
LOGIC BOARD 910PLUS TTL	2014002	395.00
LOGIC BOARD 910PLUS G/A	2246900	395.00
LOGIC BOARD 912/920B TTL	2009000	458.00
LOGIC BOARD 912/920C TTL	2009002	458.00
LOGIC BOARD 925 TTL	2015500	514.00
LOGIC BOARD 925 G/A	2015501	514.00
LOGIC BOARD 950 TTL	2009500	539.00
LOGIC BOARD 950 G/A	2009501	539.00
LOGIC BOARD 970	2021000	750.00
KEYBOARD ASSEMBLY 910/910PLUS	2090001	105.00
KEYBOARD ASSEMBLY 912B	2206500	105.00
KEYBOARD ASSEMBLY 912C	2090000	105.00
KEYBOARD ASSEMBLY 920B	2089900	126.00
KEYBOARD ASSEMBLY 920C	2090100	126.00
KYBD ASSEMBLY W/HOUSING 925/950	2090200	175.00
KYBD ASSEMBLY W/HOUSING 970	2183700	210.00
TUBE B/W P4 12"	2049100	179.00
TUBE GREEN P31 12"	2049300	179.00
TUBE GREEN P31 14"	2218700	192.00
OPTIONS		
PATTERN GENERATOR (912/950 INSTALLED)	2122300	200.00
DEMO PROGRAM EPROM 910	8000094	16.00
DEMO PROGRAM EPROM 910PLUS	8000073	16.00
DEMO PROGRAM EPROM 925	8000072	16.00
DEMO PROGRAM EPROM 950	8000074	16.00
DEMO PROGRAM EPROM 970	8000119	16.00
CONVERSION KIT 910	2169700	25.00

CONVERSION KIT 910PLUS	2169100	25.00
CONVERSION KIT 970/50	3007300	100.00
CONVERSION KIT CP/M WORDSTAR 925	2250900	100.00
CONVERSION KIT CP/M WORDSTAR 950	2187400	100.00
CURRENT LOOP KIT 910/910PLUS	2131000	50.00
CURRENT LOOP KIT 925	2131100	60.00
MEMORY KIT 2ND PAGE 912/920	2001400	35.00
MEMORY KIT 2ND PAGE 925/950	2001500	40.00
MEMORY KIT 3RD 4TH PAGE 950	2001600	80.00
MEMORY KIT 2ND 3RD 4TH PAGE 950	2231700	120.00

KITS

SP PTS LOGIC BOARD 910 TTL	2000600	112.22
SP PTS LOGIC BOARD 910 G/A	2225400	158.12
SP PTS LOGIC BOARD 910PLUS TTL	2000800	124.19
SP PTS LOGIC BOARD 910PLUS G/A	2225500	162.70
SP PTS LOGIC BOARD 912/920 TTL	2000000	150.80
SP PTS LOGIC BOARD 925 TTL	2001000	135.71
SP PTS LOGIC BOARD 925 G/A	2225300	181.61
SP PTS LOGIC BOARD 950 TTL	2000400	183.08
SP PTS LOGIC BOARD 950 G/A	2233000	218.90
SP PTS LOGIC BOARD 970	3208800	299.49
SP PTS MECH 910/910PLUS	2000900	60.23
SP PTS MECH 912/920	2000200	66.03
SP PTS MECH 925/950	2000500	54.05
SP PTS POWER SUPPLY/VIDEO MOD	2000100	134.28
SP PTS POWER SUPPLY/VIDEO MOD 970	3007100	115.99
SP PTS ADDITIONAL PARTS ALL	2000300	202.25
SP PTS MECH 970	3007200	80.73

ELECTRICAL COMPONENTS — CAPACITORS

CAP CERAMIC .02uF 50V	3018600	.72
CAP CERMAIC 150uF 50V 100%	3013800	.72
CAP CERAMIC 1.0uF 1KV SPARK GAP	2030900	2.04
CAP CERAMIC 220uF 50V	2195900	.72
CAP CERAMIC .01uF 50V	3017800	.72
CAP CERAMIC .01uF 16V 20%	2028700	.72
CAP CERAMIC 330PF 50V 20%	2029100	.72
CAP CERAMIC 3300uF 10V	3027600	.72
CAP CERAMIC .1uF 50V 10%	2030100	.72
CAP DIP MICA 10pF	2024100	.72
CAP ELECTROLYTIC (NON-P) 16uF 25V	2280000	4.63
CAP ELECTROLYTIC 22uF 15V	2025700	.72
CAP ELECTROLYTIC 2.2uF 25V 10%	2026500	.72
CAP ELECTROLYTIC 22uF 16V 20%	3018900	.72
CAP ELECTROLYTIC 22uF 50V	2026100	.72
CAP ELECTROLYTIC 4.4uF 35V 10%	2026900	2.08
CAP ELECTROLYTIC 10uF 16V 20%	2027300	.72
CAP ELECTROLYTIC 1uF 16V 10%	2027900	1.08
CAP ELECTROLYTIC 100uF 10V	2196000	.72
CAP ELECTROLYTIC 22uF 100V	2196100	.72
CAP ELECTROLYTIC 2.2KuF 10V	2196200	2.28
CAP ELECTROLYTIC 2.2KuF 16V	3016400	6.60
CAP ELECTROLYTIC 100uF 160V	2196300	6.60
CAP ELECTROLYTIC 22uF 160V	2196400	1.27
CAP ELECTROLYTIC 220uF 16V	2199300	.72
CAP ELECTROLYTIC 220uF 25V	3012700	.72

CAP ELECTROLYTIC 1000uF 16V	3018500	.72
CAP ELECTROLYTIC 3.3KuF 35V	2196500	6.91
CAP ELECTROLYTIC 3300uF 50V	3028100	5.94
CAP ELECTROLYTIC 2200uF 35V	3027500	3.24
CAP ELECTROLYTIC 4.7KuF 16V	2196600	6.56
CAP ELECTROLYTIC 4.7uF 16V	2196700	.72
CAP ELECTROLYTIC 470uF 35V	2198200	1.68
CAP MICA 20pF	2024300	.72
CAP MICA 100pF 50V 5%	2024700	.72
CAP MICA 47pF 50V 5%	2024900	.72
CAP MICA 150pF 500V 1%	2025100	.72
CAP MICA 330pF 500V 5%	2025300	.95
CAP MICA 390pF 500V 5%	2025500	1.07
CAP MONOLYTHIC.01uF 50V 10%	2028900	.72
CAP MONOLYTHIC 330pF 100V 20%	2029300	.72
CAP MONOLYTHIC 47pF 100V 5%	2029500	1.08
CAP MONOLYTHIC 68pF 1KV 20%	2029900	.72
CAP MONOLYTHIC .039uF 50V 10%	2030300	.72
CAP MONOLYTHIC .039uF 50V 5%	2030500	1.08
CAP MYLAR .1pF 100V	3016900	.72
CAP MYLAR .047pF 50V	3016800	.72
CAP MYLAR .0068uF 100V 5%	2028100	.72
CAP MYLAR .0068uF 200V	2196800	.72
CAP MYLAR .001uF 50V	2196900	.72
CAP MYLAR .01uF 50V	2197000	.72
CAP MYLAR .015uF 50V 5%	3013900	.72
CAP MYLAR .033uF 400V	3012600	.72
CAP MYLAR .039uF 50V	3014500	.72
CAP MYLAR .047uF 50V	2197100	.72
CAP MYLAR .47uF 50V	2197200	1.44
CAP MYLAR .47uF 100V	3018800	2.82
CAP MYLAR .1uF 600V	2197300	1.35
CAP MYLAR .1uF 800V 10%	3018400	.96
CAP MYLAR .047uF 400V	2197500	1.86
CAP TANTALUM .22uF 35V	2028500	.72
CAP TANTALUM .68uF 50V	2025900	1.74
CAP TANTALUM 2.2uF 35V	3027400	.72
CAP TANTALUM 3.3uF 50V 10%	2026300	2.40
CAP TANTALUM 10uF 25V 10%	2027100	1.98
CAP TANTALUM 4.7uF 16V 10%	2027500	.96
CAP TANTALUM 4.7uF 25V	3028400	.72
CAP TANTALUM .33uF 35V	2198100	1.20

DIODES - REGULATORS - TRANSISTORS

DIODE ZENER IN759A/RD12EB	2201600	1.82
DIODE ZENER IN747	2207000	.72
DIODE IN914	2047500	.72
DIODE IN920/KDS8513A	2201800	.90
DIODE IN4001	2047700	.91
DIODE IN4004/DS-130TB	2202200	1.00
DIODE IN5391/DS135D	2200600	.72
DIODE DSA17C/MR500	2201500	1.94
DIODE DS18/IDS135D	2201400	.72
DIODE DS113A/MRI-1000	2201700	6.29
DIODE LED MV55A RED	2048100	3.00
DIODE P6KE	2047900	4.20
DIODE PLR 817	3014700	.72
DIODE PFR 852	3025100	.72
DIODE BY251 3A 200V	3009800	.72

DIODE SWITCH IN4148	2048500	.72
REGULATOR LAS1512	2202500	35.00
REGULATOR LAS16CB	2126900	18.60
REGULATOR LAS1605	2126800	23.70
REGULATOR LAS1812	2202400	35.00
REGULATOR 78MO5	2126100	3.96
REGULATOR 79LO5AC	2126200	2.40
REGULATOR 3122P	3001700	6.18
REGULATOR 7912	3001800	3.18
REGULATOR SI-80506Z	2246400	31.86
TRANSISTOR 2N2219A	2045300	3.60
TRANSISTOR 2N2907A	2045900	.97
TRANSISTOR 2N3019	2045700	2.64
TRANSISTOR 2N3906/2SA495	2042200	.91
TRANSISTOR 2N4401/2SC1166	2045500	2.02
TRANSISTOR 2N5551/2SC983	2047100	2.59
TRANSISTOR 2N6121/2SC1173	2199700	4.00
TRANSISTOR 2N6124/2SA473	2202100	4.28
TRANSISTOR 2SC2373/MJE13006	2047300	4.63
TRANSISTOR KTC 1627A/MPSA06	2046700	2.07
TRANSISTOR 2N3904/KTC1815	2046500	4.50
TRANSISTOR B595	3001600	.72
TRANSISTOR KTC 2229Y	3011600	.72
TRANSISTOR KTC 1815Y	3014600	.72
TRANSISTOR KTA 1015Y	3016700	.72
TRANSISTOR KTC 200Y	3011700	.72

FIRMWARE

SYSTEM PROG EPROM 910	8000020	37.50
SYSTEM PROG EPROM 910PLUS	8000040	25.00
SYSTEM PROG ROM 912/920B (A49B1)	2033800	25.80
SYSTEM PROG ROM 912/920C (A49C1)	2034000	25.80
SYSTEM PROG EPROM 925 A	8000033	37.50
SYSTEM PROG EPROM 925 B	8000031	37.50
SYSTEM PROG ROM 950 (-001A)	8000001	18.90
SYSTEM PROG ROM 950 (-007A)	8000007	18.90
SYSTEM PROG EPROM 950 (043X)	8000043	37.50
SYSTEM PROG EPROM 950 (044X)	8000044	37.50
SYSTEM EPROM 970 (A82)	8000100	37.50
SYSTEM EPROM 970 (A87)	8000101	37.50
SYSTEM EPROM 970 (A99)	8000102	37.50
SYSTEM EPROM 970/950 (A82)	8000170	37.50
SYSTEM EPROM 970/950 (A87)	8000171	37.50
SYSTEM EPROM 970/950 (A99)	8000172	37.50
CHAR GEN EPROM 910/910PLUS	8000021	37.50
CHAR GEN ROM 910/910PLUS	8000016	18.90
CHAR GEN ROM 912/920 (A3-2)	2034600	14.94
CHAR GEN EPROM 925	8000021	37.50
CHAR GEN ROM 925	8000016	18.90
CHAR GEN ROM 950 (003A)	8000003	18.90
CHAR GEN ROM 950 (002A)	8000002	18.90
*KYBD EPROM PRO 910/910PLUS	8000019	21.00
**KYBD ENCDR PRO 910/910PLUS	2053200	22.50
KYBD ENCDR 910/910PLUS	2051800	22.50
KYBD CPU 925/950 8048 (U6)	8000009	37.50
KYBD CPU 970 8049 (A6)	8000103	37.50

* Used with KYBD ENCODER 2053200
**Used with KYBD EPROM 8000019

INTERGRATED CIRCUITS		
IC 74S00	2024000	2.20
IC 74LS00	2024200	1.72
IC 74LS03	2024400	1.72
IC 74S04	2024600	2.41
IC 74LS04	2024800	1.80
IC 74LS05	2025000	1.80
IC 74LS08	2025200	1.80
IC 74LS10	2025400	1.80
IC 74SL20	2025600	1.72
IC 74LS32	2025800	1.86
IC 74LS42	2026000	2.55
IC 74LS51	2026200	1.80
IC 74S74	2026400	3.58
IC 74H74	3023200	3.00
IC 74LS86	2026800	2.07
IC 74LS109	2027000	2.00
IC 74LS139	2027200	3.18
IC 74LS145	2170000	3.08
IC 74LS157	2027400	2.76
IC 74LS163	2027600	4.56
IC 74LS166	2027800	5.04
IC 74LS173	2028000	4.14
IC 74LS174	2028200	3.18
IC 74LS253	2028400	3.24
IC 74LS367	2028600	2.76
IC 74LS373	2028800	3.48
IC 74LS374	2029000	3.48
IC 75188N/1488	2029200	4.14
IC 75189AN/1489	2029400	4.14
IC TIL117	2029800	4.48
IC NE555	2030200	2.58
IC DP8304	2030400	17.59
IC AMD2111-4A	2030600	13.32
IC 2502HP	2030800	15.52
IC TMS9927/5027	2031000	81.76
IC P8035	2031200	41.05
IC H11G3	2034200	3.45
IC 7406	2034800	2.05
IC 4N38	2035000	4.32
IC 7414	2035400	1.92
IC 2114	2035800	9.75
IC 74LS245/N8T245N	2036200	5.76
IC 74LS191	2036600	2.70
IC 74LS273	2037600	3.48
IC 74S240	2037800	8.82
IC 74LS175	2038000	1.74
IC 74S32/629	2038800	1.80
IC 74LS11	2040000	1.14
IC 93S16PC	2040800	6.60
IC 74LS138	2041000	1.68
IC 74LS02	2041600	1.14
IC 74LS241	2042000	3.54
IC AM26LS31	2042400	7.92
IC AM26LS32	2042600	7.92

IC 74LS240	2044000	3.54
IC 74LS244	2044200	5.52
IC 74S174	2044600	3.96
IC 74LS14	2045800	1.44
IC 74LS164	2048200	3.00
IC 14040B	2245000	1.95
IC 6116	2049200	40.00
IC 6502A	2049600	28.94
IC 6545	2049800	66.24
IC 6551 1MHz	2155700	28.80
IC 6522A	2050200	27.21
IC Z80A SIO/2	2050600	58.00
IC Z80A CTC	2050800	16.80
IC Z80A CPU	2051000	21.18
IC Z80A DMA	2051200	56.76
IC 68B045 2 MHz	2052600	31.50
IC SY6551A-1 2MHz	2053000	24.00
IC SY6545A-1 2MHz	2052800	50.10
IC 910/910 PLUS GATE ARRAY	2057400	42.60
IC 925 GATE ARRAY	2057400	42.60
IC 950 GATE ARRAY A (A34)	2057600	23.88
IC 950 GATE ARRAY B (A37)	2057800	23.88
IC 74LS112	2138500	1.86
IC 74S251	2138600	2.28
IC 2K BY 8 RAM	2138700	28.20
IC 4116 16K DRAM	2139200	7.20
IC 9007 CRTC	2139900	54.00
IC 9006-135 BUFFER	2140000	33.00

RESISTORS & POTENTIOMETERS

RES CF 68 OHM 1/4W 5%	2051100	.72
RES CF 270 OHM 1/4W 5%	2051300	.72
RES CF 330 OHM 1/4W 5%	2051500	.72
RES CF 470 OHM 1/4W 5%	2051700	.72
RES CF 510 OHM 1/4W 5%	2051900	.72
RES CF 1K OHM 1/4W 5%	2052100	.72
RES CF 1.8K OHM 1/4W 5%	2052300	.72
RES CF 3.3K OHM 1/4W 5%	2052700	.72
RES CF 4.7K OHM 1/4W 5%	2053100	.72
RES CF 5.6K OHM 1/4W 5%	3013600	.72
RES CF 12K OHM 1/4W 5%	3013700	.72
RES CF 180 OHM 1/4W 5%	2053300	.72
RES CF 1M OHM 1/4W 5%	2031500	.72
RES CF 750 OHM 1/4W 5%	2031700	.72
RES CF 1.2K OHM 1/4W 5%	2031900	.72
RES CF 100K OHM 1/4W 5%	2032100	.72
RES CF 51K OHM 1/4W 5%	2032300	.72
RES CF 22 OHM 1/4W 5%	2033500	.72
RES CF 47K OHM 1/4W 5%	2033700	.72
RES CF 150 OHM 1/4W 5%	2033900	.72
RES CF 10K OHM 1/4W 5%	2034100	.72
RES CF 200 OHM 1/4W 5%	2034300	.72
RES CF 33 OHM 1/4W 5%	2034500	.72
RES CF 100 OHM 1/4W 1%	2034900	.72
RES CF 51 OHM 1/4W 5%	2036100	.72
RES CF 22K OHM 1/4W 5%	2036300	.72
RES CF 27K OHM 1/4W 5%	2037300	.72
RES CF 47 OHM 1/4W 5%	2037700	.72
RES CF 2.7K OHM 1/4W 5%	2038300	.72

RES CF 90 OHM 1/4W 5%	2177600	.72
RES CF 91 OHM 1/4W 5%	2038500	.72
RES CF 2.2K OHM 1/4W 5%	2038700	.72
RES CF 3.9K OHM 1/4W 5%	2177400	.72
RES CF 6.8K OHM 1.4W 5%	2039100	.72
RES CF 30K OHM 1/4W 5%	2039300	.72
RES CF 56K OHM 1/4W 5%	2039500	.72
RES CF 82 OHM 1/4W 5%	2144000	.72
RES CF 220 OHM 1/4W 5%	2040300	.72
RES CF 680 OHM 1/4W 5%	2037100	.72
RES CF 2K OHM 1/4W 5%	2036900	.72
RES PACK 1K OHM SIP 10%	2040500	1.58
RES PACK 6.2K OHM SIP 10%	2040700	1.73
RES PACK 10K OHM SIP 5%	2041100	2.04
RES PACK 4.7K OHM SIP 10%	2041300	1.20
RES PACK 1K OHM SIP 5%	2042700	3.00
RES PACK 2.2K OHM SIP	2230000	2.64
RES PACK 33 OHM DIP	2041700	2.64
RES CF 56K OHM 1/2W 5%	3016500	.72
RES CF 510 OHM 1/2W 5%	2045100	.72
RES CF 220 OHM 1/2W 5%	2186000	.72
RES CF 390 OHM 1/2W 5%	2176600	.72
RES CF 820 OHM 1/2W 5%	2186200	.72
RES CF 1.5K OHM 1/2W 5%	2186300	.72
RES CF 10K OHM 1/2W 5%	2186400	.72
RES CF 2.2M OHM 1/2W 5%	2186500	.72
RES WW 0.4 OHM 2W 10%	3019500	.72
RES WW 0.6 OHM 2W	2177100	.72
RES WW 0.4 OHM 2W 5%	3019700	.72
POT BRIGHTNESS & VERTICAL HEIGHT	2177700	1.06
POT VERTICAL LINEARITY	2177800	1.06
POT VIDEO B+	2177900	1.06
POT FOCUS	2180100	3.86
POT CONTRAST	2180200	2.77

TRANSFORMERS/COILS

TRANSFORMER FLYBACK KFS-00093	2201300	55.48
TRANSFORMER FLYBACK 970	2269000	58.32
TRANSFORMER HORIZ DR HDT19	2201200	4.08
TRANSFORMER POWER W/CON CRT858	2201100	129.24
TRANSFORMER POWER 970	2225600	127.68
TRANSFORMER BALUN	2186600	7.86
COIL 1.4uH 5%	2268900	2.00
COIL 200uF 5%	2268800	16.08
COIL INDUCTOR 27uH .3PIE	2201000	1.20
COIL LINEARITY ADJUSTABLE	2213600	7.20
COIL LINEARITY NON ADJUSTABLE	2200900	5.24
COIL LINEARITY 52 MHz	3013400	4.08
COIL WIDTH 9 MHz	3013500	2.22
COIL DEFLECTION YOKE W/CONN	2200800	31.63

MISCELLANEOUS

CRYSTAL 16MHZ OSC	2042800	27.00
CRYSTAL 23.814 MHZ (912/920)	2098600	11.11
CRYSTAL 5.7143 MHZ	2098601	7.85
CRYSTAL 1.8432 MHZ	2098602	8.16
CRYSTAL 8.0000 MHZ	2098603	4.80

CRYSTAL 13.6080 MHZ	2098605	8.70
CRYSTAL 23.814 K1114A (950)	2035200	37.08
CRYSTAL 21.2544 MHz OSC	2138900	20.40
CRYSTAL 13.4784 MHz	2141400	3.24
FUSE 4A 125V	3025300	.72
FUSE 3A 125V	2193100	.72
FUSE 1A 250V	2097000	.72
POWER ADAPTER PATTERN GEN	2176300	41.40
SPEAKER W/CONNECTOR	2152800	7,73
THERMISTER SDT-100	2180300	1.44
TRANSDUCER AUDIO KYBD 970	2215100	5.52
BATTERY 970	2050001	4.20
UPGRADE YOKE 970	3209400	50.00
ANGLE ADJUST(SCREEN TILT MECHANIZEM) 925/950	2108600	2.00

MECHANICAL COMPONENTS CASES		
TOP CASE 910/912	2151600	97.80
TOP CASE 920	2153800	97.80
TOP CASE 925/950	2141800	97.80
TOP CASE KEYBOARD 925/950	2204200	25.00
BOTTOM CASE 910/912/920	2151700	70.20
BOTTOM CASE 925/950	2141700	70.20
BOTTOM CASE KEYBOARD 925/950	2199100	35.00
BEZEL TOP CASE 925/950	2141900	20.00
BEZEL KEYBOARD 925/950	2198000	10.00
HOUSING ARM ASSEMBLY 970	2183400	60.72
HOUSING CRT 970	2188600	66.00
HOUSING MAIN ELECTRONIC 970	2188500	71.16
HOUSING KYBD TOP W/PALM REST 970	2188900	17.16
HOUSING KYBD BOTTOM W/PALM REST 970	2189000	35.16
COVER BACK HOUSING CRT 970	2188300	16.32
COVER SIDE HOUSING LOGIC BOARD 970	2188400	39.48
BEZEL CRT 970	2188800	15.48

KEYCAPS*		
KEYCAP DG 1X1 BLANK	2065800	.72
KEYCAP DG 1X1 SCULP BLANK 0	2161601	.72
KEYCAP DG 1X1 SCULP BLANK -7	2161900	.72
KEYCAP DG 1X1 SCULP BLANK +7	2161800	.72
KEYCAP DG 1X1 SCULP BLANK +14	2161700	.72
KEYCAP DG 1X1-1/2 BLANK	2072400	1.52
KEYCAP DG 1X1-1/2 SCULP BLANK +7	2161801	2.56
KEYCAP DG 1X2 SCULP BLANK 0	2251400	3.00
KEYCAP DG 1X8	2077400	1.98
KEYCAP DG 1X8 SCULP	2089700	3.00
KEYCAP LG 1X1 BLANK	2073000	.72
KEYCAP LG 1X1 SCULP BLANK 0	2161600	.72
KEYCAP LG 1X1 SCULP BLANK -7	2161901	.90
KEYCAP LG 1X1 LOW PRO BLANK	2076500	.72
KEYCAP LG 1X1 LOW PRO SCULP BLANK	2162101	.90
KEYCAP LG 1X1-1/4 BLANK	2077200	1.52
KEYCAP LG 1X1-1/4 SCULP BLANK +7	2161802	2.44
KEYCAP LG 1X1-1/2 BLANK	2072700	1.52
KEYCAP LG 1X1-1/2 SCULP BLANK -7	2161902	2.56
KEYCAP LG 2X1 SCULP BLANK 0	2251300	3.00

KEYCAP LG "L" RETURN	2077100	1.86
KEYCAP LG "L" BLANK (RETURN)	2077101	3.90
KEYCAP LG "L" SCULP RETURN	2089400	2.76
KEYCAP LG "L" SCULP BLANK (RETURN)	2161602	3.90
KEYCAP BLACK 1X1 BLANK	2053700	.90
KEYCAP BLACK 1X1-1/2 BLANK	2063300	1.80
KEYCAP BLACK 1X8	2077500	2.70
KEYCAP TAN 1X1 BLANK	2063800	.72
KEYCAP TAN 1X1-1/2 BLANK	2063600	1.50
KEYCAP SET 910/910PLUS	3046800	52.44
KEYCAP SET 912B	3046900	52.44
KEYCAP SET 912C	3047000	52.44
KEYCAP SET 920B	3047100	63.24
KEYCAP SET 920C	3047200	56.58
KEYCAP SET 925/950	3047300	79.29
KEYCAP SET 925/950 SCULP	3047400	59.10

*PART NUMBERS FOR PRINTED KEYCAPS CAN BE OBTAINED IN YOUR MAINTENANCE MANUAL OR THROUGH SPARES ORDER ENTRY, TELEVIDEO.

SWITCHES

KEYSWITCH	2199400	3.60
KEYSWITCH - ALPHA LOCK	2199500	6.22
SWITCH TOP ADJ 7 POS DIP	2174200	3.84
SWITCH TOP ADJ 10 POS DIP	2181000	3.90
SWITCH SIDE ADJ 10 POS DIP	2096800	5.70
SWITCH PUSHBUTTON	2096900	17.88
SWITCH POWER ON/OFF SPST	2097300	7.89
SWITCH POWER SELECT DPDT	2097400	6.92

LABEL KITS

KIT LABEL 910	3208100	20.00
KIT LABEL 910+	3208200	20.00
KIT LABEL 912C	3208300	20.00
KIT LABEL 920C	3208400	20.00
KIT LABEL 925	3208500	20.00
KIT LABEL 950	3208600	20.00
KIT LABEL 970	3208700	20.00

SHIPPING CARTONS

CARTON SHIP W/FOAM 910/912/920	2237200	10.00
CARTON SHIP W/FOAM 925/950	2237300	10.00
CARTON SHIP W/FOAM 970	2249700	10.00

MECHANICAL MISCELLANEOUS

BATTERY HOLDER	2050101	4.62
CABLE ASY KEYBOARD 912/920	2005900	25.08
CABLE ASY KEYBOARD 910	2005901	25.08
CABLE ASY KEYBOARD 925/950	2005700	10.92
CABLE ASY KEYBOARD 970	2216100	31.20
CABLE ASY MODEM RJ11	2135900	17.34
CABLE ASSY CURRENT LOOP 925	2005802	10.98
CONNECTOR 2 PIN RT ANGLE	2098703	.72

CONNECTOR 2 PIN STR WAF	2098800	.72
CONNECTOR 5 PIN STR WAF	2098802	.72
CONNECTOR 10 PIN WIRE WRAP	2189300	3.30
CONNECTOR 40 PIN HDR STRAIGHT	2098107	7.50
CONNECTOR KEYBOARD PCB 26PIN	2098701	4.21
CONNECTOR KEYBOARD RJ11 925/950	2097900	2.22
CONNECTOR KEYBOARD RJ12 PCB 970	2141200	3.90
CONNECTOR KEYBOARD RJ12 KYBD 970	2141100	3.90
CONNECTOR RIGHT ANGLE RS232	2097800	10.62
CONNECTOR RIGHT ANGLE METAL RS232	2165300	29.04
CONNECTOR STRAIGHT RS232	2174300	20.00
CONNECTOR BLUE MOLEX MALE	2217301	3.60
CONNECTOR BLUE MOLEX FEMALE	2217300	3.60
CONNECTOR RED MOLEX MALE	2217201	3.60
CONNECTOR RED MOLEX FEMALE	2217200	3.60
CONNECTOR WHITE MOLEX MALE	2217401	3.60
CONNECTOR WHITE MOLEX FEMALE	2217400	3.60
CORD POWER 6' 3 PRONG CONN	2109000	19.87
CORD POWER 3PIN W/PLUG & CONN	2291100	20.00
E-RING MINIMUM 25	2223600	5.70
EQL ASY SPACE BAR DAMPER	2096300	.72
EQL ASY SPACE BAR GUIDE STEM	2096200	.90
EQL ASY SPACE BAR KEY GUIDE	2091200	1.80
EQL ASY SPACE BAR KEYGUIDE ARM	2096400	3.60
FOOT KEYBOARD 925/950	2190600	.72
FOOT KEYBOARD 970	2212700	.72
FUSE HOLDER CLIP	2180400	.72
FUSE HOLDER PANEL MOUNT	2097200	21.00
INSULATION PAD TRANSISTOR	2180800	.72
INSULATOR PAD CRYSTAL	2099700	1.02
KNOB CONTRAST	2153000	.72
KEYSTOPPERS 100ea	2223800	12.00
PIVOTSHAFT MINIMUM 25	2197800	4.68
PLUG JUMPER 910/910PLUS	2098300	1.80
RETAINER BALUN	2164500	.72
SHIELD PLATE LOGIC BOARD 970	3000500	60.00
SHROUD CONN 910/912/920	2100200	10.00
SHROUD CONN MODEM 910/912/920	2100201	20.00
SHROUD CONN 925/950	2100100	10.00
SHROUD CONN MODEM 925/950	2100103	20.00
SPACER NYLON, PCB SNAP MTG	2164400	.90
SOCKET IC 14 PIN	2098403	.78
SOCKET IC 16 PIN	2098405	.72
SOCKET IC 18 PIN	2098400	.83
SOCKET IC 24 PIN	2098401	1.10
SOCKET IC 28 PIN	2098404	1.32
SOCKET IC 40 PIN	2098402	1.80
SOCKET IC 16 PIN LOW PROFILE	2174601	6.00
SPRING CRT GOUNDING	2210500	.72
THUMB WHEEL 970	2218800	1.44

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

PART LIST: KEYCAPS | PART NUMBER DATE 11/10/82
MODEL: 910/910PLUS KEYBOARD PAGE 1 OF 3
912C/920C KEYBOARD

DESCRIPTION	910/910PLUS PRINTED	912C/920C PRINTED	BLANK	COMMENTS
1X1 LIGHT GREY BLANK	-------	-------	2073000	
1X1 LIGHT GREY F1	-------	2073100	2073000	(1)
1X1 LIGHT GREY F2	-------	2073200	2073000	(1)
1X1 LIGHT GREY F3	-------	2073300	2073000	(1)
1X1 LIGHT GREY F4	-------	2073400	2073000	(1)
1X1 LIGHT GREY F5	-------	2073500	2073000	(1)
1X1 LIGHT GREY F6	-------	2073600	2073000	(1)
1X1 LIGHT GREY F7	-------	2073700	2073000	(1)
1X1 LIGHT GREY F8	-------	2073800	2073000	(1)
1X1 LIGHT GREY F9	-------	2073900	2073000	(1)
1X1 LIGHT GREY F10	-------	2074000	2073000	(1)
1X1 LIGHT GREY F11	-------	2074100	2073000	(1)
1X1 LG CHAR INSERT	-------	2074200	2073000	(1)
1X1 LG CHAR DELETE	-------	2074300	2073000	(1)
1X1 LG LINE DELETE	-------	2074400	2073000	(1)
1X1 LG LINE DELETE	-------	2074500	2073000	(1)
1X1 DARK GREY BLANK	-------	-------	2065800	
1X1 DARK GREY ESC	2072200	2072200	2065800	
1X1 DARK GREY 1/!	2065900	2065900	2065800	(2)
1X1 DARK GREY 2/@	2066000	2066000	2065800	
1X1 DARK GREY 3/#	2066100	2066100	2065800	
1X1 DARK GREY 4/$	2066200	2066200	2065800	
1X1 DARK GREY 5/%	2066300	2066300	2065800	
1X1 DARK GREY 6/^	2066400	2066400	2065800	
1X1 DARK GREY 7/&	2066500	2066500	2065800	
1X1 DARK GREY 8/*	2066600	2066600	2065800	
1X1 DARK GREY 9/(	2066700	2066700	2065800	
1X1 DARK GREY 0/)	2066800	2066800	2065800	
1X1 DARK GREY -/_	2066900	2066900	2065800	
1X1 DARK GREY =/+	2067000	2067000	2065800	
1X1 DARK GREY `/~	2067100	2067100	2065800	
1X1 DARK GREY \/|	2067200	2067200	2065800	
1X1 DG BACK SPACE	2067300	2067300	2065800	
1X1-1/2 DARK GREY TAB	2072600	2072600	2072400	
1X1 DARK GREY Q	2068700	2068700	2065800	
1X1 DARK GREY W	2068800	2068800	2065800	
1X1 DARK GREY E	2068900	2068900	2065800	
1X1 DARK GREY R	2069000	2069000	2065800	
1X1 DARK GREY T	2069100	2069100	2065800	
1X1 DARK GREY Y	2069200	2069200	2065800	
1X1 DARK GREY U	2069300	2069300	2065800	
1X1 DARK GREY I	2069400	2069400	2065800	

PARTLIST: KEYCAPS PART NUMBER DATE ____11/10/82____
MODEL: 910/910PLUS KEYBOARD PAGE _2__ OF __3_
912C/920C KEYBOARD

DESCRIPTION	910/910PLUS PRINTED	912C/920C PRINTED	BLANK	COMMENTS
1X1 DARK GREY O	2069500	2069500	2065800	
1X1 DARK GREY P	2069600	2069600	2065800	
1X1 DARK GREY[/]	2069700	2069700	2065800	
1X1-1/2 DG LINE FEED	2072500	2072500	2072400	
1X1-1/4 LG CLEAR SPACE	2077300	2077300	2077200	
1X1 LIGHT GREY CTRL	2075000	2075000	2073000	
1X1 DG ALPHA LOCK	2069900	2069900	2073000	
1X1 DARK GREY A	2070000	2070000	2065800	
1X1 DARK GREY S	2070100	2070100	2065800	
1X1 DARK GREY D	2070200	2070200	2065800	
1X1 DARK GREY F	2070300	2070300	2065800	
1X1 DARK GREY G	2070400	2070400	2065800	
1X1 DARK GREY H	2070500	2070500	2065800	
1X1 DARK GREY J	2070600	2070600	2065800	
1X1 DARK GREY K	2070700	2070700	2065800	
1X1 DARK GREY L	2070800	2070800	2065800	
1X1 DARK GREY ;/:	2070900	2070900	2065800	
1X1 DARK GREY '/"	2071000	2071000	2065800	
LIGHT GREY "L" RETURN	2077100	2077100	2077101	
1X1 LIGHT GREY BREAK	2075100	2075100	2073000	
1X1 DARK GREY BACK TAB	2069800	2069800	2065800	
1X1-1/2 LG SHIFT	2072800	2072800	2072700	
1X1 DARK GREY Z	2071100	2071100	2065800	
1X1 DARK GREY X	2071200	2071200	2065800	
1X1 DARK GREY C	2071300	2071300	2065800	
1X1 DARK GREY V	2071400	2071400	2065800	
1X1 DARK GREY B	2071500	2071500	2065800	
1X1 DARK GREY N	2071600	2071600	2065800	
1X1 DARK GREY M	2071700	2071700	2065800	
1X1 DARK GREY ,/<	2071800	2071800	2065800	
1X1 DARK GREY ./>	2071900	2071900	2065800	
1X1 DARK GREY //?	2072000	2072000	2065800	
1X1 DARK GREY {/}	2072100	2072100	2065800	
1X1 LIGHT GREY DEL	2075200	2075200	2073000	
1X1 LIGHT GREY PRINT(LP)	2077000	-------	2076500	(3)
1X1 LG CONV/BLOCK (LP)	-------	2076600	2076500	(3)
1X1 LG FUNCT (LP)	2076700	2076700	2076500	(3)
1X8 DARK GREY SPACE BAR	2077400	2077400	-------	
1X1 LG HOME (LP)	2076800	2076800	2076500	(3)
1X1 LG CURSER (LP)	2076900	2076900	2076500	(3)(4)
1X1 LG LINE ERASE	-------	2074600	2073000	(1)
1X1 LG PAGE ERASE	-------	2074700	2073000	(1)
1X1 LG SEND LING	-------	2075300	2073000	(1)
1X1 LG SEND PAGE	-------	2074900	2073000	(1)
1X1 DARK GREY 7	2068000	2068000	2065800	
1X1 DARK GREY 8	2068100	2068100	2065800	
1X1 DARK GREY 9	2068200	2068200	2065800	
1X1 DARK GREY 4	2067700	2067700	2065800	

PARTLIST: KEYCAPS PART NUMBER DATE 11/10/82

MODEL: 910/910PLUS KEYBOARD PAGE 3 OF 3
912C/920C KEYBOARD

DESCRIPTION	910/910PLUS PRINTED	912C/920C PRINTED	BLANK	COMMENTS
1X1 DARK GREY 5	2067800	2067800	2065800	
1X1 DARK GREY 6	2067900	2067900	2065800	
1X1 DARK GREY 1	2067400	2067400	2065800	
1X1 DARK GREY 2	2067500	2067500	2065800	
1X1 DARK GREY 3	2067600	2067600	2065800	
1X1 DARK GREY ,	2068500	2068500	2065800	
1X1 DARK GREY 0	2068300	2068300	2065800	
1X1 DARK GREY .	2068600	2068600	2065800	
1X1-1/2 LG ENTER	2072900	2072900	2072700	
1X1 DARK GREY -	2068400	2068400	2065800	

1) KEYCAPS ARE FOR 920C KEYBOARD ONLY.
2) SLASH BETWEEN TWO CHARACTERS (ie: 1/!) IS FOR CLARITY AND IS NOT PRINTED ON KEYCAP
3) LOW PROFILE KEYCAPS
4) SAME KEYCAPS CAN BE USED FOR ALL FOUR CURSER POSITIONS

SPARE PART KITS

The following are the terminal spare part kits available through TeleVideo Systems, Inc. Each model terminal has been designated the following spare part kits:

A) Main Logic
B) Power supply/Video module
C) Mechanical components
D) Additional parts

The suggested stocking levels have been identified as follows:

For the first 50 terminals lea of kits A, B, C, & D are suggested.
For the next 50 terminals add lea of kits A, & B
For the next 50 terminals add lea of kits A, B, C, & D
For the next 50 terminals add lea of kits A, & B

The list price of the spare part kits (as shown on the Terminal Spare Parts Price List) reflect a 25% discount, if the items were purchased seperately.

*Attached are the kits currently available through TeleVideo.

SPARE PARTS KIT
MODEL: 910 TTL
LOGIC BOARD
PART NUMBER: 2000600

DATE___02/10/83___

PART #	DESCRIPTION
2029200	IC 75188N/1488
2029400	IC 75189AN/1489
2035800	IC 2114 RAM
2036200	IC 74LS245/N8T245N
2049600	IC 6502A 2MHz CPU
2051800	IC KYBD ENCODER 910/910PLUS
2052800	IC SY6545A-1 2MHz CRTC
2053000	IC SY6551A-1 2MHz UART
8000020	IC EPROM SYS PROG 910
2028700	CAP CERAMIC .01uf/16V 20% (2ea)

SPARE PARTS KIT DATE___02/10/83___
MODEL: 910 GATE ARRAY
LOGIC BOARD
PART NUMBER: 2225400

PART #	DESCRIPTION
2029200	IC 75188N/1488
2029400	IC 75189AN/1489
2035800	IC 2114 RAM
2036200	IC 74LS245/N8T245N
2049600	IC 6502A 2MHz CPU
2051800	IC KYBD ENCDR 910/910PLUS
2052800	IC SY6545A-1 2MHz CRTC
2053000	IC SY6551A-1 2MHz UART
8000020	IC EPROM SYS PROG 910
2057400	IC GATE ARRAY 910/925
2028700	CAP CERAMIC .01uf/16V 20% (2ea)

SPARE PARTS KIT DATE___02/10/83___
MODEL: 910PLUS TTL
LOGIC BOARD
PART NUMBER: 2000800

PART #	DESCRIPTION
2029200	IC 75188N/1488
2029400	IC 75189AN/1489
2035800	IC 2114 RAM
2036200	IC 74LS245/N8T245N
2049600	IC 6502A 2MHz CPU
2051800	IC KYBD ENCDR 910/910PLUS
2052800	IC SY6545A-1 2MHz CRTC
2053000	IC SY6551A-1 2MHz UART
8000040	IC EPROM SYS PROG 910PLUS
2028700	CAP CERAMIC .01uf/16V 20% (2ea)

SPARE PARTS KIT DATE___02/10/83___
MODEL: 910PLUS GATE ARRAY
LOGIC BOARD
PART NUMBER: 2225500

PART #	DESCRIPTION
2029200	IC 75188N/1488
2029400	IC 75189AN/1489
2035800	IC 2114 RAM
2036200	IC 74LS245/N8T245N
2049600	IC 6502A 2MHz CPU
2051800	IC KYBD ENCDR 910/910PLUS
2052800	IC SY6545A-1 2MHz CRTC
2053000	IC SY6551A-1 2MHz UART
8000040	IC EPROM SYS PROG 910PLUS
2057400	IC GATE ARRAY 910/925
2028700	CAP CERAMIC .01uf/16V 20% (2ea)

SPARE PART KITS DATE___02/10/83___
MODEL: ALL
ADDITIONAL PARTS
PART NUMBER: 2000300

PART #	DESCRIPTION
2024000	IC 74S00
2024200	74LS00
2024400	74LS03
2024600	74S04
2024800	74LS04
2025000	74LS05
2025200	74LS08
2025400	74LS10
2025600	74LS20
2025800	74LS32
2026000	74LS42
2026200	74LS51
2026600	74LS74
2138500	74LS112
2027400	74LS157
2027600	74LS163
2048200	74LS164
2027800	74LS166
2028000	74LS173
2028200	74LS174
2044200	74LS244
2138600	74LS251
2028400	74LS253
2028600	74LS367
2028800	74LS373
2029000	74LS374
2030200	NE555
2030400	DP 8304
2030600	AMD2111-4A
2044200	74LS244
2030900	CAP CERAMIC 1.0pf 1KV SPARK GAP
2047500	DIODE, IN914
2201700	DIODE DS 113A/MRI-1000
2201800	DIODE, IN920/KDS8513A
2202200	DIODE, IN4004/DS130TB
2180100	POT FOCUS 2M ohm
2177100	RESISTOR 0.6ohm WW 2W
2041300	RESISTOR PAC 4.7K ohm
2040700	RESISTOR PAC 6.2K ohm
2152800	SPEAKER 8ohm W/CONN
2097400	SWITCH, POWER SELECT, DPDT
2180300	THERMISTER, SDT-100
2201100	TRNF, POWER W/CONN (910/920/925/950)
2225600	TRNF, POWER W/CONN (970 ONLY)
2199700	TRANS 2N6121/25C1173
2202100	TRANS 2N6124/25A473

SPARE PARTS KIT DATE___02/10/83___
MODEL: 910/910PLUS
MECHANICAL
PART NUMBER: 2000900

PART #	DESCRIPTION
2005901	CABLE ASY KEYBOARD 910/910PLUS
2223700	FUSE 3A 125V (25EA)
2223300	FUSE 1A 250V (25EA)
2199400	KEYSWITCH (3ea)
2096800	SWITCH, SIDE ADJ 10 POS DIP
2097300	SWITCH, POWER ON/OFF SPST
2097800	CONNECTOR RIGHT ANGLE RS232
2100200	SHROUD, CONN 910/912/920
2180200	POT, CONTRAST

SPARE PARTS KIT: DATE___02/10/83___
MODEL: 910/910PLUS
912/920 925/950
POWER SUPPLY & VIDEO MODULE
PART NUMBER: 2000100

PART #	DESCRIPTION
2197300	CAP MYLAR, .1UF/600V (C504)
2199300	CAP ELECTROLYTIC 220UF (C305)
2200800	DEFLECTION YOKE W/CONN KYS-00060 (L202)
2201000	COIL INDUCTOR 27UH .3PIE (L302)
2213600	COIL LINEARITY ADJUSTABLE (L201)
2200900	COIL LINEARITY 5.4UH NON ADJUSTABLE (L201)
2200600	DIODE IN5391/DS135D (2ea)
2201500	DIODE DSA17C/MR500 (4ea)
2201600	DIODE, ZENER IN759A/RD12EB (D112)
2126800	REGULATOR, LAS1605 2A/5V (IC2)
2126900	REGULATOR, LAS16CB 2A/13.8V (IC1)
2176600	RESISTOR, CF 390 ohm 1/2w 5% (R102)
2201200	TRANSFORMER HORIZ DR HDT19 (T301)
2201300	TNFR FLYBACK KFS-00093 (T302)
2045500	TRANSISTOR 2N4401/2SC1166 (Q301)
2047100	TRANSISTOR 2N5551/2SC983 (Q103/Q105)
2047300	TRANSISTOR 2SC2233/MJE13006 (Q302)
2046700	TRANSISTOR KTC1627A/MPSA06 (Q102)
2280000	CAP NON POLARIZED 16uf/25V (C306)
2177700	POT 100K BRIGHT/VERT HEIGHT (SFR1/SFR4)
2177800	POT 2K VERT LINEARITY (SFR2)
2177900	POT 5K B+ 75VOLT ADJUST (SFR3)

Repairs Price List for Video Display Terminals

February 1, 1983

REPAIR	Price
Terminal Repair Charge (plus individual charges below)	$ 35.00

INDIVIDUAL REPAIR CHARGES	Price
Logic Board (910/910 PLUS)	$ 50.00
Logic Board (912/920)	65.00
Logic Board (925/950)	100.00
Logic Board (970)	120.00
Keyboard (910/912/920)	30.00
Keyboard (925/950/970)	50.00
Power Supply (all models)	50.00
Video Board (all models)	50.00
Current Loop Board (910/925)	25.00
Integral Modem	60.00

Service

Nationwide Field Service is available from General Electric Co. Instrumentation and Communication Equipment Service Centers. In Canada, service is available from Canadian General Electric Service Centers.

Out of Warranty

Customer to return defective module freight prepaid to the factory, 1170 Morse Avenue, Sunnyvale, CA 94086. TeleVideo will send repaired module, billing per above price schedule plus return freight.

Prices subject to change without notice.

TeleVideo Systems, Inc.

1170 Morse Avenue • Sunnyvale, CA 94086

California: Santa Ana (714) 557-6095; Sunnyvale (408) 745-7760 • Georgia: Atlanta (404) 399-6464
Texas: Dallas (214) 980-9978 • Illinois: Bloomingdale (312) 351-9350 • Massachusetts: Boston (617) 668-6891
New York/New Jersey: (201) 267-8805 • London 44-9905-6464

Terminal Maintenance Training Class

Subjects covered:	*Basic Operation* *Theory of Operation* *Overview of Schematics* *Debug to Module Level* *Interface Considerations* *Installable Options* *Lab* *Structured* *Operations*
Material provided:	*Maintenance Manuals* *Customer Service Notes* *Product Brochures* *Lunch Provided* *Certificate of Completion Awarded*
Time:	*Three 8-hour Sessions*
Price:	*$100.00 per person at TeleVideo Training Center* *$1200.00 (plus travel expenses outside USA) per class on-site, plus $100.00 per person over 10 students.*
Sign Up:	*Classes are scheduled on a demand basis. To enroll, contact Customer Service, TeleVideo, Sunnyvale, (408) 745-7760.*
Fees:	*All fees are due and payable 2 weeks prior to the first class session.*

TeleVideo Systems, Inc.

1170 Morse Avenue • Sunnyvale, CA 94086

California: Santa Ana (714) 557-6095; Sunnyvale (408) 745-7760 • Georgia: Atlanta (404) 255-9338
Texas: Dallas (214) 980-9978 • Illinois: Bloomingdale (312) 351-9350 • Massachusetts: Boston (617) 668-6891
• New York/New Jersey: (201) 267-8805 • London 44-9905-6464

MODEL 910

THEORY OF OPERATION

Section

4.1 Overview

4.2 Operating Clocks

4.3 Address Decoding

4.4 Terminal Memory

4.5 Display Fundamentals

4.6 Interrupt Signals

4.7 Video Generation

MODEL 910 THEORY OF OPERATION

4.1

OVERVIEW

The Model 910 terminal is a microprocessor-based product which employs a maximum of standard large-scale integration (LSI) circuits. This design approach helps simplify the printed circuit board and provides for a large degree of maintainability. Because the terminal is microprocessor based, with all communications and keyboard functions firmware controlled, the terminal's operation is quite easy to modify.

The microprocessor is, after initialization, totally interrupt driven, i.e., the microprocessor is normally idling unless it receives an interrupt, which is an input to the microprocessor indicating that data is available which must be processed. This operation is described in Section 4.6.

4.2

VIDEO CLOCK

The most basic block in the circuit is the video (or dot) clock. The frequency of the video clock is 13.608 megaHertz, produced by a crystal-controlled oscillator formed by part of Chip A22, the crystal Y2, and several other passive components (see Sheet 3 of the schematic).

This clock is used to shift video information out of a shift register (see Section 4.7) and is divided down to create the system clock.

System Clock - The system clock is created by dividing the video clock by eight to derive a system clock frequency of 1.701 mega Hertz. This function is performed by a presettable four-bit binary counter (A15, sheet 3) as follows: When the counter reaches its terminal count 15 or F_{16}, the next positive transition of the video clock loads a count of eight into the counter. This happens every eight counts of the video clock. The QC output of the counter is high for four counts and low for four counts, and is used to provide a symmetrical clock for the microprocessor system.

Keyboard Clock - The keyboard controller (A1, Sheet 5) has a self-contained oscillator which provides a clock for scanning the keyboard matrix. The frequency is controlled by C53 and R26, which are selected to produce a frequency of approximately 80 kiloHertz.

Baud Rate Clock - The communications baud rate clock is internal to the asynchronous communications interface adapter (ACIA) chip (A19, Sheet 4). Using a 1.8432 megaHertz crystal, the ACIA

(under firmware control) provides all of the 15 baud rates possible for the Model 910.

4.3

ADDRESS DECODING

The 6502A microprocessor is capable of addressing 65,536 bytes of memory. The Model 910 uses only a fraction of this capability, allowing a rather simple decode. The entire range of the 6502 is divided into four sections of 16,384 bytes each. The lowest section is reserved for system RAM, of which only 1024 bytes are used. The next highest section contains display RAM, of which only 2048 bytes are used. The second highest section is used for input/output parts, of which only 14 are used; the highest section contains system ROM, which is 4096 bytes (expandable to 8192 bytes).

Dividing the address range into four sections is accomplished using a 1 of 4 decoded (A17, Sheet 1) connected to address lines A14 and A15.

4.4

TERMINAL MEMORY

System ROM - System ROM consists of a single 4096-byte ROM (A45, Sheet 1). This chip is selected when the microprocessor is addressing within the range of $C000_{16}$ - $FFFF_{16}$. Since there is no other memory located in this range, it "looks like" F000-FFFF, which is the upper-most 4096 bytes of the address space.

It is possible, by moving a jumper and using a larger chip, to increase the system ROM to 8192 bytes.

System RAM - System RAM consists of 1024 bytes (A50 and A51, Sheet 1) of static RAM. These chips are selected when the microprocessor is addressing within the range of $0000 - 3FFF_{16}$. Again, since there is no other memory within this range, system RAM has an effective address range of $0000_{16} - 03FF_{16}$.

4.5

DISPLAY FUNDAMENTALS

The circuitry required to display data on the CRT other than the video circuitry (covered in 4.7) is divided into three sections:

- Display memory
- Character generation
- CRT Controller (CRTC)

The display memory consists of 2048 bytes of high-speed static RAM, which is 128 bytes more than required to store one screen (24 rows of 80 characters) or 1920 characters. These chips (A30, A31, A36, and A37, Sheet 2) are accessed by two sources: the microprocessor and the CRTC.

The CRTC causes a "read" of a location within the display RAM once during each cycle of the system clock, cycling completely through the memory ten times each frame (60 frames per second). This operation is called "screen refresh".

The data stored in the display RAM is changed or updated by the microprocessor as necessary due to keypresses or receipt of data from the computer. To allow for addressing the display RAM from two sources without effects on the screen, the address outputs from the microprocessor and the CRTC are connected to the display RAM through multiplexers (A25, A32, and A38, Sheet 2) which connect the CRTC's address lines during the first half of the system clock and the microprocessor address lines during the second half of the system clock.

When the CRTC addresses a location display RAM, the contents of the location being addressed are latched by a byte-wide latch (A43, Sheet 3). The output of this latch connects to the address line of a characger generator ROM (A48, Sheet 3) which contains data necessary to form characters on the screen. The data from the character-generator ROM is loaded into a shift register (A49, Sheet 3) and shifted out, one bit at a time, by the dot clock for use by the video circuitry.

4.6

INTERRUPT SIGNALS

As mentioned in the Overview section, the microprocessor is entirely interrupt driven in the Model 910. An interrupt is merely an input to the microprocessor which tells it to complete its present operation and then go to another location in the program. The microprocessor will respond to an interrupt within eight system clock period (or 4.7 microseconds).

There are two types of interrupts to the 6502:

- **Maskable (IRQ)**
- **Nonmaskable (NMI)**

The maskable interrupt can be disabled by the program, while the nonmaskable interrupt cannot. Therefore the nonmaskable interrupt has priority over the maskable interrupt.

In the Model 910, NMI is used for an interrupt from the keyboard encoder (A1, Sheet 5). When a key is pressed, the keyboard encoder senses it, times a delay for debounce, and pre-

sents data on its data outputs. When this data is ready, the data ready output (A1, pin 1G) is pulsed, setting a flip-flop (A7, Sheet 4) causing an NMI. During the NMI, routine data from the keyboard encodes is read and the flip-flop is reset.

IRQ is also used and is caused by two sources: the ACIA (A19, Sheet 4) and the vertical sync from the CRTC which occurs 60 times per second (if set for 60 Hertz operation). The interrupt from the ACIA indicates there are data to be sent to or received from the computer. The interrupt from the CRTC is used to time intervals used for repeat key, blinking, bell, etc. The IRQ from the ACIA is produced by its IRQ output. Vertical sync from the CRTC sets a flip-flop (A40, Sheet 4) which causes an IRQ. During the IRQ routine, the ACIA is checked to see if it has caused the interrupt. If so, the ACIA is serviced and data sent or received, after which the processor returns to where it was prior to the interrupt. If not, then the CRTC must have caused the interrupt.

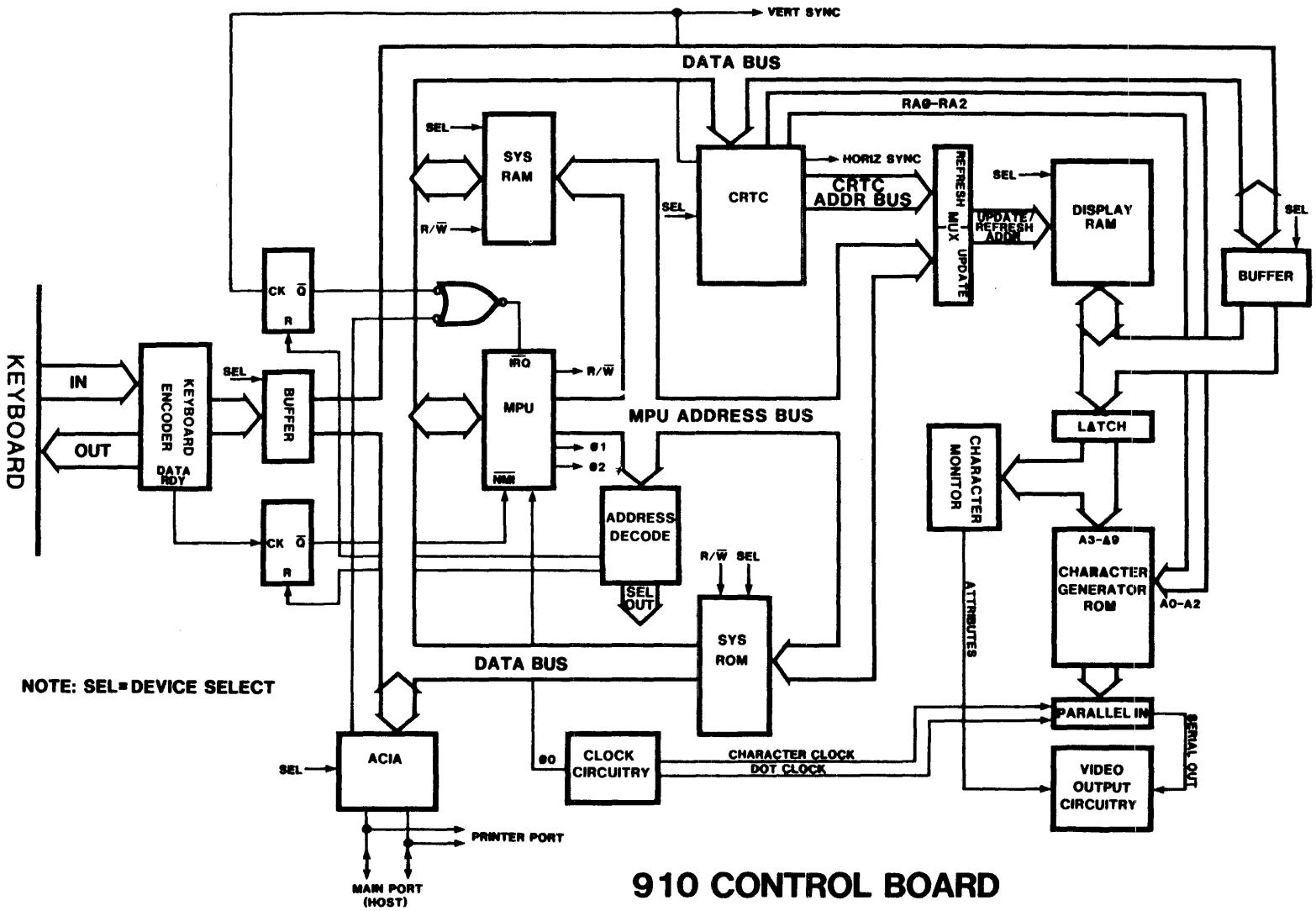
4.7

VIDEO GENERATOR

Control signals for the CRT monitor are generated by the CRTC, the attribute latch, and the output of the shift register mentioned in 4.5.

The CRTC generates the horizontal sync pulse and vertical sync pulse which define the horizontal and vertical dimensions of the display.

Through an amplifier in the monitor, the video output controls the electron beam in the CRT (turns it on and off). This is created by the stream of bits coming out of the shift register which combine with the attributes, cursor, and display enable, outputs from the CRTC, and the black on white/white on black control. This circuitry is shown in the top half of Sheet 4 of the schematic.



910 CONTROL BOARD

Figure 4-1

Model 910/910 PLUS MEMORY MAP

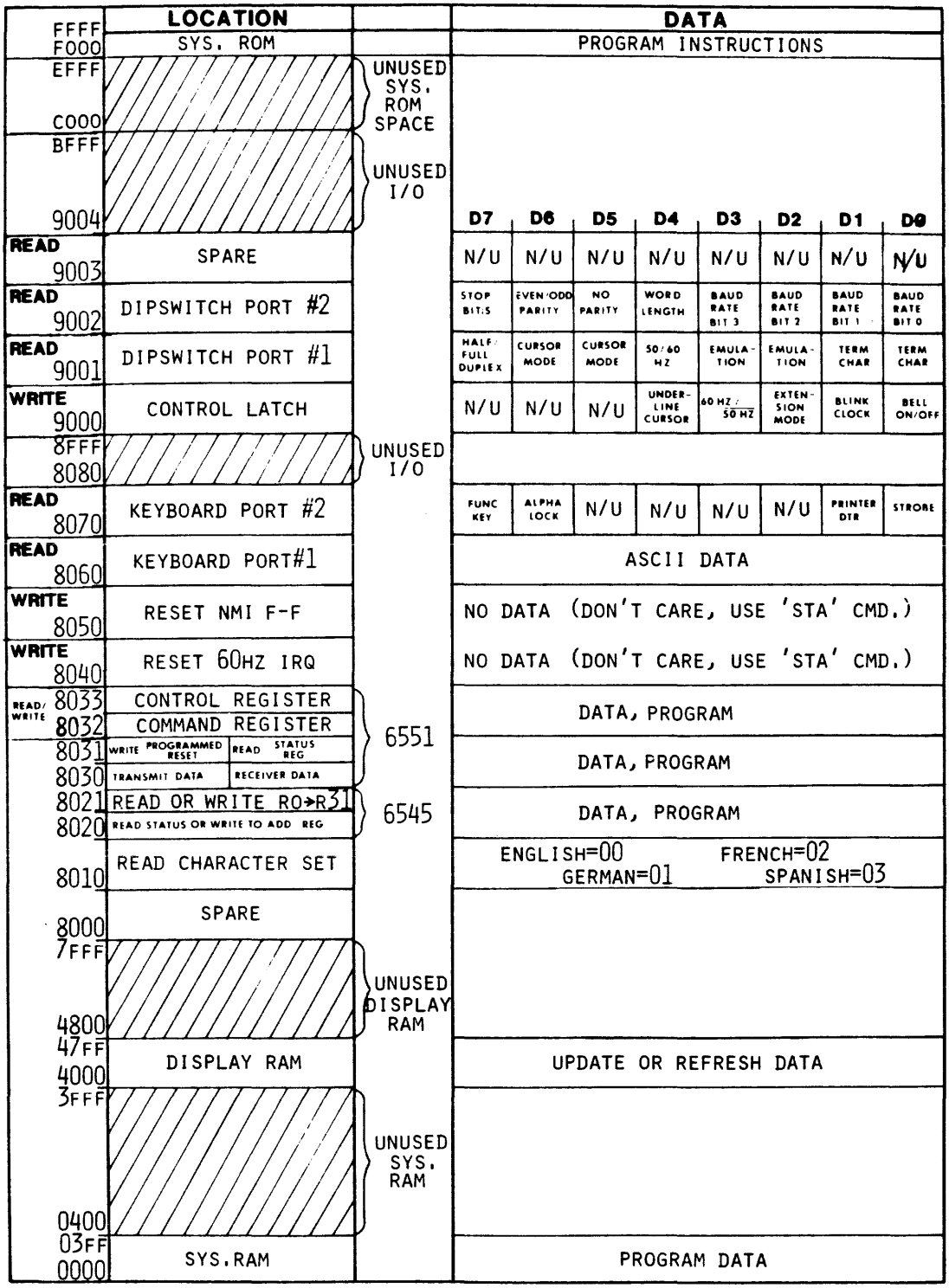


Table 4-1

8-Bit Microprocessor Family

SY6500

MICROPROCESSOR PRODUCTS

APRIL 1980

- Single 5 V ±5% power supply
- N channel, silicon gate, depletion load technology
- Eight bit parallel processing
- 56 Instructions
- Decimal and binary arithmetic
- Thirteen addressing modes
- True indexing capability
- Programmable stack pointer
- Variable length stack
- Interrupt capability
- Non-maskable interrupt
- Use with any type or speed memory
- Bi-directional Data Bus
- Instruction decoding and control
- Addressable memory range of up to 65 K bytes
- "Ready" input
- Direct memory access capability
- Bus compatible with MC6800
- Choice of external or on-board clocks
- 1 MHz, 2 MHz, and 3 MHz operation
- On-chip clock options
  * External single clock input
  * Crystal time base input
- 40 and 28 pin package versions
- Pipeline architecture

The SY6500 Series Microprocessors represent the first totally software compatible microprocessor family. This family of products includes a range of software compatible microprocessors which provide a selection of addressable memory range, interrupt input options and on-chip clock oscillators and drivers. All of the microprocessors in the SY6500 family are software compatible within the group and are bus compatible with the MC6800 product offering.

The family includes six microprocessors with on-board clock oscillators and drivers and four microprocessors driven by external clocks. The on-chip clock versions are aimed at high performance, low cost applications where single phase inputs or crystals provide the time base. The external clock versions are geared for the multi-processor system applications where maximum timing control is mandatory. All versions of the microprocessors are available in 1 MHz, 2 MHz, and 3 MHz maximum operating frequencies.

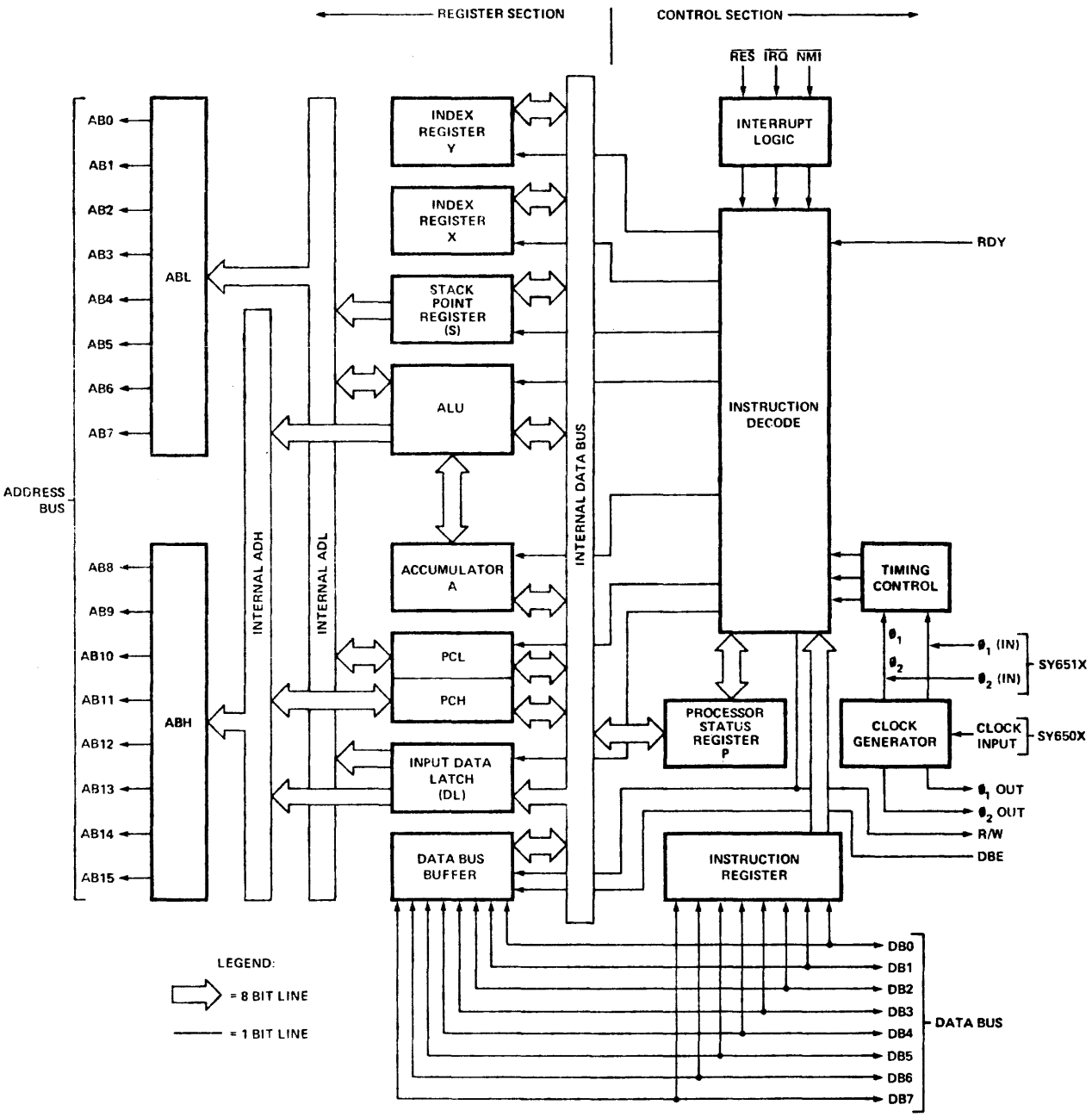
MEMBERS OF THE FAMILY

PART NUMBERS		CLOCKS	PINS	$\overline{IRQ}$	$\overline{NMI}$	RDY	ADDRESSING
Plastic	Ceramic						
SYP6502	SYC6502	On-Chip	40	√	√	√	16 (64 K)
SYP6503	SYC6503	"	28	√	√		12 (4 K)
SYP6504	SYC6504	"	28	√			13 (8 K)
SYP6505	SYC6505	"	28	√		√	12 (4 K)
SYP6506	SYC6506	"	28	√			12 (4 K)
SYP6507	SYC6507	"	28			√	13 (8 K)
SYP6512	SYC6512	External	40	√	√	√	16 (64 K)
SYP6513	SYC6513	"	28	√	√		12 (4 K)
SYP6514	SYC6514	"	28	√			13 (8 K)
SYP6515	SYC6515	"	28	√		√	12 (4 K)

COMMENTS ON THE DATA SHEET

The data sheet is constructed to review first the basic "Common Characteristics" – those features which are common to the general family of microprocessors. Subsequent to a review of the family characteristics will be sections devoted to each member of the group with specific features of each.

SY6500 INTERNAL ARCHITECTURE



NOTE:
1. CLOCK GENERATOR IS NOT INCLUDED ON SY651X.
2. ADDRESSING CAPABILITY AND CONTROL OPTIONS VARY WITH EACH OF THE SY6500 PRODUCTS.

D.C. CHARACTERISTICS

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.3 to +7.0	V
Input Voltage	V_{in}	-0.3 to +7.0	V
Operating Temperature	T_A	0 to +70	°C
Storage Temperature	T_{STG}	-55 to +150	°C

COMMENT

This device contains input protection against damage due to high static voltages or electric fields; however, precautions should be taken to avoid application of voltages higher than the maximum rating.

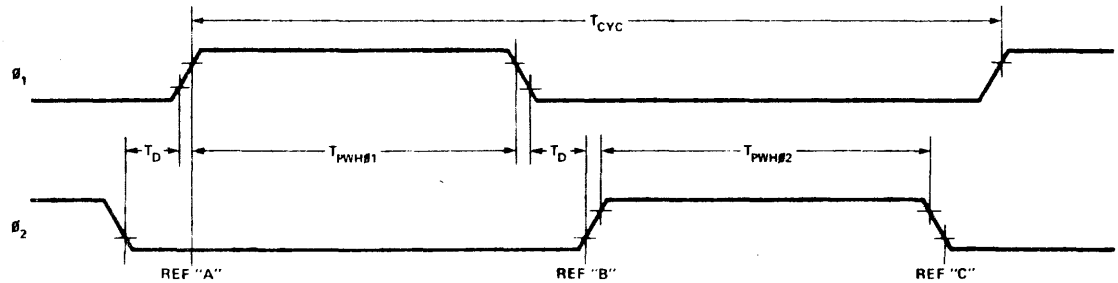
ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0V ± 5%, T_A = 0-70°C)

($\emptyset_1$, $\emptyset_2$ applies to SY651X, $\emptyset_{o\,(in)}$ applies to SY650X)

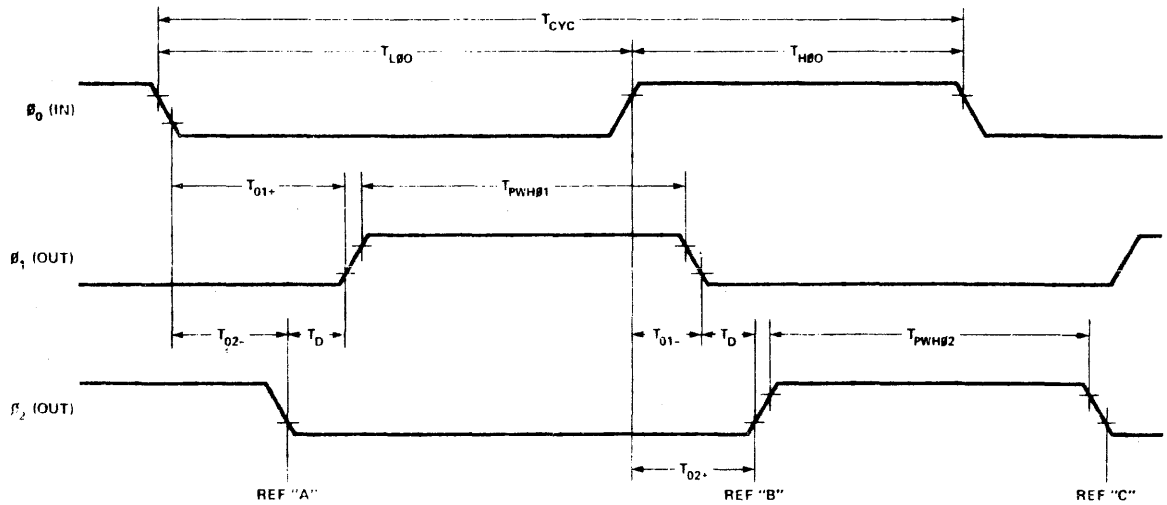
Symbol	Characteristic	Min.	Max.	Unit
V_{IH}	Input High Voltage			
	Logic, $\emptyset_{o\,(in)}$ (650X)	+2.4	V_{CC}	
	$\emptyset_1$, $\emptyset_2$ (651X)	V_{CC} - 0.5	V_{CC} + 0.25	V
V_{IL}	Input Low Voltage			
	Logic, $\emptyset_{o\,(in)}$ (650X)	-0.3	+0.4	
	$\emptyset_1$, $\emptyset_2$ (651X)	-0.3	+0.2	V
I_{IL}	Input Loading (V_{in} = 0 V, V_{CC} = 5.25 V) RDY, S.O.	-10	-300	μA
I_{in}	Input Leakage Current (V_{in} = 0 to 5.25 V, V_{CC} = 0)			
	Logic (Excl. RDY, S.O.)	–	2.5	μA
	$\emptyset_1$, $\emptyset_2$ (651X)	–	100	μA
	$\emptyset_{o\,(in)}$ (650X)	–	10.0	μA
I_{TSI}	Three-State (Off State) Input Current (V_{in} = 0.4 to 2.4 V, V_{CC} = 5.25 V) DB0-DB7	–	10	μA
V_{OH}	Output High Voltage (I_{LOAD} = -100μAdc, V_{CC} = 4.75 V) SYNC, DB0-DB7, A0-A15, R/W	2.4	–	V
V_{OL}	Output Low Voltage (I_{LOAD} = 1.6mAdc, V_{CC} = 4.75 V) SYNC, DB0-DB7, A0-A15, R/W	–	0.4	V
P_D	Power Dissipation			
	1 MHz and 2 MHz	–	700	mW
	3 MHz	–	800	mW
C	Capacitance (V_{in} = 0, T_A = 25°C, f = 1 MHz)			
C_{in}	$\overline{RES}$, $\overline{NMI}$, RDY, $\overline{IRQ}$, S.O., DBE	–	10	
	DB0-DB7	–	15	
C_{out}	A0-A15, R/W, SYNC	–	12	pF
$C_{\emptyset o(in)}$	$\emptyset_{o\,(in)}$ (650X)	–	15	
$C_{\emptyset_1}$	$\emptyset_1$ (651X)	–	50	
$C_{\emptyset_2}$	$\emptyset_2$ (651X)	–	80	

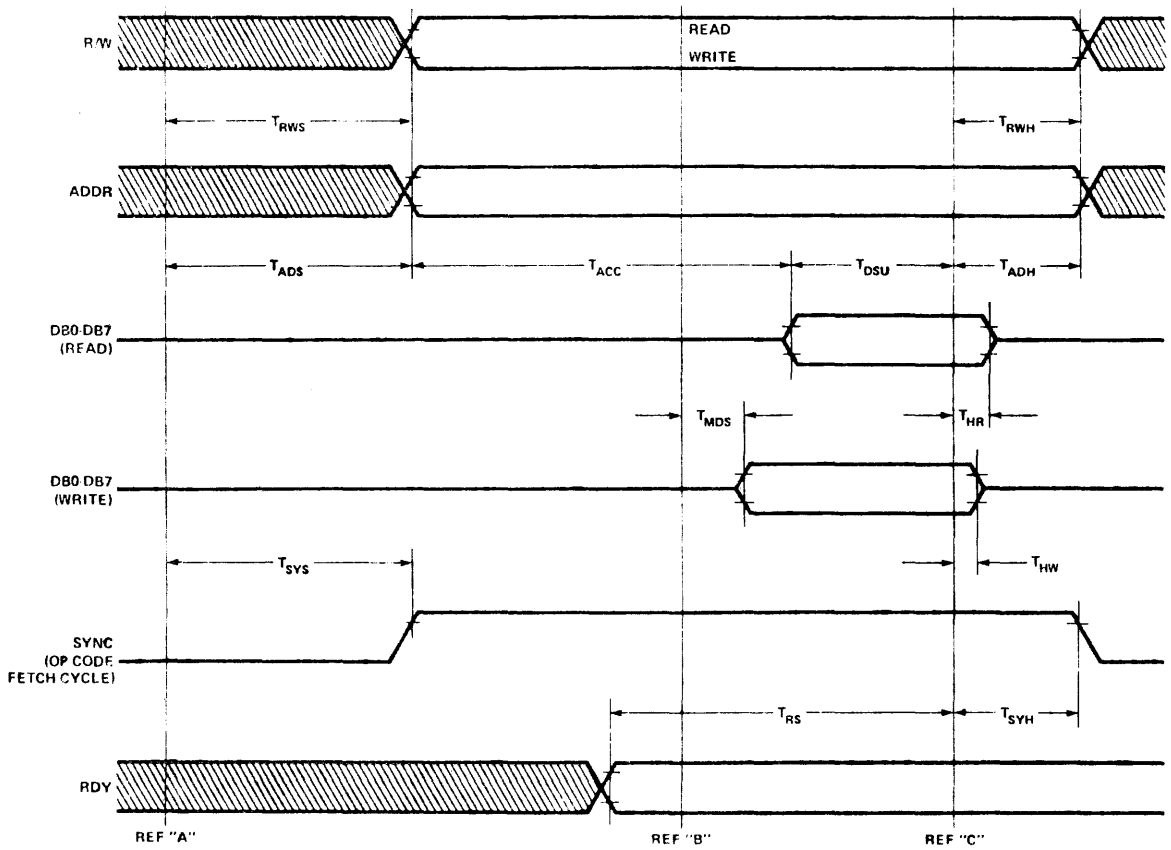
TIMING DEFINITIONS

SY651X INPUT CLOCK TIMING



SY650X INPUT CLOCK TIMING





DYNAMIC OPERATING CHARACTERISTICS

(V_{CC} = 5.0 ± 5%, T_A = 0° to 70°C)

Device Type	Parameter	Note	Symbol	1 MHz		2 MHz ⑥		3 MHz ⑦		Unit
				Min.	Max.	Min.	Max.	Min.	Max.	
651X	Cycle Time		T_{CYC}	1.00	40	0.50	40	0.33	40	μs
	$\emptyset_1$ Pulse Width		$T_{PWH\emptyset_1}$	430	–	215	–	150	–	ns
	$\emptyset_2$ Pulse Width		$T_{PWH\emptyset_2}$	470	–	235	–	160	–	ns
	Delay Between $\emptyset_1$ and $\emptyset_2$		T_D	0	–	0	–	0	–	ns
	$\emptyset_1$ and $\emptyset_2$ Rise and Fall Times	①	T_R, T_F	0	25	0	20	0	15	ns
650X	Cycle Time		T_{CYC}	1.00	40	0.50	40	0.33	40	μs
	$\emptyset_{o(IN)}$ Low Time	②	$T_{L\emptyset_o}$	480	–	240	–	160	–	ns
	$\emptyset_{o(IN)}$ High Time	②	$T_{H\emptyset_o}$	460	–	240	–	160	–	ns
	$\emptyset_o$ Neg to $\emptyset_1$ Pos Delay	⑤	T_{01+}	10	70	10	70	10	70	ns
	$\emptyset_o$ Neg to $\emptyset_2$ Neg Delay	⑤	T_{02-}	5	65	5	65	5	65	ns
	$\emptyset_o$ Pos to $\emptyset_1$ Neg Delay	⑤	T_{01-}	5	65	5	65	5	65	ns
	$\emptyset_o$ Pos to $\emptyset_2$ Pos Delay	⑤	T_{02+}	15	75	15	75	15	75	ns
	$\emptyset_{o(IN)}$ Rise and Fall Time	①	T_{RO}, T_{FO}	0	30	0	20	0	15	ns
	$\emptyset_{1(OUT)}$ Pulse Width		$T_{PWH\emptyset_1}$	$T_{L\emptyset_o}$-20	$T_{L\emptyset_o}$	$T_{L\emptyset_o}$-20	$T_{L\emptyset_o}$	$T_{L\emptyset_o}$-20	$T_{L\emptyset_o}$	ns
	$\emptyset_{2(OUT)}$ Pulse Width		$T_{PWH\emptyset_2}$	$T_{L\emptyset_o}$-40	$T_{L\emptyset_o}$-10	$T_{L\emptyset_o}$-40	$T_{L\emptyset_o}$-10	$T_{L\emptyset_o}$-40	$T_{L\emptyset_o}$-10	ns
	Delay Between $\emptyset_1$ and $\emptyset_2$		T_D	5	–	5	–	5	–	ns
	$\emptyset_1$ and $\emptyset_2$ Rise and Fall Times	①③	T_R, T_F	–	25	–	25	–	15	ns
650X 651X	R/W Setup Time		T_{RWS}	–	225	–	140	–	110	ns
	R/W Hold Time		T_{RWH}	30	–	30	–	15	–	ns
	Address Setup Time		T_{ADS}	–	225	–	140	–	110	ns
	Address Hold Time		T_{ADH}	30	–	30	–	15	–	ns
	Read Access Time		T_{ACC}	–	650	–	310	–	170	ns
	Read Data Setup Time		T_{DSU}	100	–	50	–	50	–	ns
	Read Data Hold Time		T_{HR}	10	–	10	–	10	–	ns
	Write Data Setup Time		T_{MDS}	20	175	20	100	20	75	ns
	Write Data Hold Time		T_{HW}	60	150	60	150	30	130	ns
	Sync Setup Time		T_{SYS}	–	350	–	175	–	100	ns
	Sync Hold Time		T_{SYH}	30	–	30	–	15	–	ns
	RDY Setup Time	④	T_{RS}	200	–	200	–	150	–	ns

NOTES:

① Measured between 10% and 90% points on waveform.

② Measured at 50% points.

③ Load = 1 TTL load +30 pF.

④ RDY must never switch states within T_{RS} to end of $\emptyset_2$.

⑤ Load = 100 pF.

⑥ The 2 MHz devices are identified by an "A" suffix.

⑦ The 3 MHz devices are identified by a "B" suffix.

PIN FUNCTIONS

Clocks ($\emptyset_1$, $\emptyset_2$)

The SY651X requires a two phase non-overlapping clock that runs at the V_{CC} voltage level.

The SY650X clocks are supplied with an internal clock generator. The frequency of these clocks is externally controlled. Clock generator circuits are shown elsewhere in this data sheet.

Address Bus (A_0-A_{15}) (See sections on each micro for respective address lines on those devices.)

These outputs are TTL compatible, capable of driving one standard TTL load and 130 pF.

Data Bus (DB_0-DB_7)

Eight pins are used for the data bus. This is a bi-directional bus, transferring data to and from the device and peripherals. The outputs are three-state buffers, capable of driving one standard TTL load and 130 pF.

Data Bus Enable (DBE)

This TTL compatible input allows external control of the three-state data output buffers and will enable the microprocessor bus driver when in the high state. In normal operation DBE would be driven by the phase two ($\emptyset_2$) clock, thus allowing data output from microprocessor only during $\emptyset_2$. During the read cycle, the data bus drivers are internally disabled, becoming essentially an open circuit. To disable data bus drivers externally, DBE should be held low. This signal is available on the SY6512, only.

Ready (RDY)

This input signal allows the user to halt the microprocessor on all cycles except write cycles. A negative transition to the low state during or coincident with phase one ($\emptyset_1$) will halt the microprocessor with the output address lines reflecting the current address being fetched. This condition will remain through a subsequent phase two ($\emptyset_2$) in which the Ready signal is low. This feature allows microprocessor interfacing with low speed PROMS as well as fast (max. 2 cycle) Direct Memory Access (DMA). If ready is low during a write cycle, it is ignored until the following read operation. Ready transitions must not be permitted during $\emptyset_2$ time.

Interrupt Request ($\overline{IRQ}$)

This TTL level input requests that an interrupt sequence begin within the microprocessor. The microprocessor will complete the current instruction being executed before recognizing the request. At that time, the interrupt mask bit in the Status Code Register will be examined. If the interrupt mask flag is not set, the microprocessor will begin an interrupt sequence. The Program Counter and Processor Status Register are stored in the stack. The microprocessor will then set the interrupt mask flag high so that no further interrupts may occur. At the end of this cycle, the program counter low will be loaded from address FFFE, and program counter high from location FFFF, therefore transferring program control to the memory vector located at these addresses. The RDY signal must be in the high state for any interrupt to be recognized. A 3KΩ external resistor should be used for proper wire-OR operation.

Non-Maskable Interrupt ($\overline{NMI}$)

A negative going transition on this input requests that a non-maskable interrupt sequence be generated within the microprocessor.

$\overline{NMI}$ is an unconditional interrupt. Following completion of the current instruction, the sequence of operations defined for $\overline{IRQ}$ will be performed, regardless of the state interrupt mask flag. The vestor address loaded into the program counter, low and high, are locations FFFA and FFFB respectively, thereby transferring program control to the memory vector located at these addresses. The instructions loaded at these locations cause the microprocessor to branch to a non-maskable interrupt routine in memory.

$\overline{NMI}$ also requires an external 3KΩ resistor to V_{CC} for proper wire-OR operations.

Inputs $\overline{IRQ}$ and $\overline{NMI}$ are hardware interrupts lines that are sampled during $\emptyset_2$ (phase 2) and will begin the appropriate interrupt routine on the $\emptyset_1$ (phase 1) following the completion of the current instruction.

Set Overflow Flag (S.O.)

A NEGATIVE going edge on this input sets the overflow bit in the Status Code Register. This signal is sampled on the trailing edge of $\emptyset_1$.

SYNC

This output line is provided to identify those cycles in which the microprocessor is doing an OP CODE fetch. The SYNC line goes high during $\emptyset_1$ of an OP CODE fetch and stays high for the remainder of that cycle. If the RDY line is pulled low during the $\emptyset_1$ clock pulse in which SYNC went high, the processor will stop in its current state and will remain in the state until the RDY line goes high. In this manner, the SYNC signal can be used to control RDY to cause single instruction execution.

Reset ($\overline{RES}$)

This input is used to reset or start the microprocessor from a power down condition. During the time that this line is held low, writing to or from the microprocessor is inhibited. When a positive edge is detected on the input, the microprocessor will immediately begin the reset sequence.

After a system initialization time of six clock cycles, the mask interrupt flag will be set and the microprocessor will load the program counter from the memory vector locations FFFC and FFFD. This is the start location for program control.

After V_{CC} reaches 4.75 volts in a power up routine, reset must be held low for at least two clock cycles. At this time the R/W and SYNC signal will become valid.

When the reset signal goes high following these two clock cycles, the microprocessor will proceed with the normal reset procedure detailed above.

Read/Write (R/W)

This output signal is used to control the direction of data transfers between the processor and other circuits on the data bus. A high level on R/W signifies data into the processor; a low is for data transfer out of the processor.

PROGRAMMING CHARACTERISTICS

INSTRUCTION SET – ALPHABETIC SEQUENCE

ADC	Add Memory to Accumulator with Carry	DEC	Decrement Memory by One	PHA	Push Accumulator on Stack
AND	"AND" Memory with Accumulator	DEX	Decrement Index X by One	PHP	Push Processor Status on Stack
ASL	Shift left One Bit (Memory or Accumulator)	DEY	Decrement Index Y by One	PLA	Pull Accumulator from Stack
				PLP	Pull Processor Status from Stack
BCC	Branch on Carry Clear	EOR	"Exclusive or" Memory with Accumulator		
BCS	Branch on Carry Set			ROL	Rotate One Bit Left (Memory or Accumulator)
BEQ	Branch on Result Zero	INC	Increment Memory by One	ROR	Rotate One Bit Right (Memory or Accumulator)
BIT	Test Bits in Memory with Accumulator	INX	Increment Index X by One	RTI	Return from Interrupt
BMI	Branch on Result Minus	INY	Increment Index Y by One	RTS	Return from Subroutine
BNE	Branch on Result not Zero				
BPL	Branch on Result Plus	JMP	Jump to New Location	SBC	Subtract Memory from Accumulator with Borrow
BRK	Force Break	JSR	Jump to New Location Saving Return Address	SEC	Set Carry Flag
BVC	Branch on Overflow Clear			SED	Set Decimal Mode
BVS	Branch on Overflow Set	LDA	Load Accumulator with Memory	SEI	Set Interupt Disable Status
		LDX	Load Index X with Memory	STA	Store Accumulator in Memory
CLC	Clear Carry Flag	LDY	Load Index Y with Memory	STX	Store Index X in Memory
CLD	Clear Decimal Mode	LSR	Shift One Bit Right (Memory or Accumulator)	STY	Store Index Y in Memory
CLI	Clear Interrupt Disable Bit				
CLV	Clear Overflow Flag	NOP	No Operation	TAX	Transfer Accumulator to Index X
CMP	Compare Memory and Accumulator			TAY	Transfer Accumulator to Index Y
CPX	Compare Memory and Index X	ORA	"OR" Memory with Accumulator	TSX	Transfer Stack Pointer to Index X
CPY	Compare Memory and Index Y			TXA	Transfer Index X to Accumulator
				TXS	Transfer Index X to Stack Pointer
				TYA	Transfer Index Y to Accumulator

ADDRESSING MODES

Accumulator Addressing

This form of addressing is represented with a one byte instruction, implying an operation on the accumulator.

Immediate Addressing

In immediate addressing, the operand is contained in the second byte of the instruction, with no further memory addressing required.

Absolute Addressing

In absolute addressing, the second byte of the instruction specifies the eight low order bits of the effective address while the third byte specifies the eight high order bits. Thus, the absolute addressing mode allows access to the entire 65K bytes of addressable memory.

Zero Page Addressing

The zero page instructions allow for shorter code and execution times by only fetching the second byte of the instruction and assuming a zero high address byte. Careful use of the zero page can result in significant increase in code efficiency.

Indexed Zero Page Addressing – (X, Y indexing)

This form of addressing is used in conjunction with the index register and is referred to as "Zero Page, X" or "Zero Page, Y." The effective address is calcuated by adding the second byte to the contents of the index register. Since this is a form of "Zero Page" addressing, the content of the second byte references a location in page zero. Additionally due to the "Zero Page" addressing nature of this mode, no carry is added to the high order 8 bits of memory and crossing of page boundaries does not occur.

Indexed Absolute Addressing – (X, Y indexing)

This form of addressing is used in conjunction with X and Y index register and is referred to as "Absolute, X," and "Absolute, Y." The effective address is formed by adding the contents of X or Y to the address contained in the second and third bytes of the instruction. This mode allows the index register to contain the index or count value and the instruction to contain the base address. This type of indexing allows any location referencing and the index to modify multiple fields resulting in reduced coding and execution time.

Implied Addressing

In the implied addressing mode, the address containing the operand is implicitly stated in the operation code of the instruction.

Relative Addressing

Relative addressing is used only with branch instructions and establishes a destination for the conditional branch.

The second byte of the instruction becomes the operand which is an "Offset" added to the contents of the lower eight bits of the program counter when the counter is set at the next instruction. The range of the offset is −128 to +127 bytes from the next instruction.

Indexed Indirect Addressing

In indexed indirect addressing (referred to as (Indirect,X)), the second byte of the instruction is added to the contents of the X index register, discarding the carry. The result of this addition points to a memory location on page zero whose contents is the low order eight bits of the effective address. The next memory location in page zero contains the high order eight bits of the effective address. Both memory locations specifying the high and low order bytes of the effective address must be in page zero.

Indirect Indexed Addressing

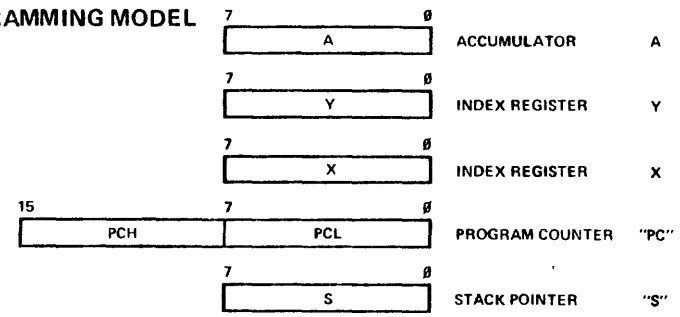
In indirect indexed addressing (referred to as (Indirect),Y), the second byte of the instruction points to a memory location in page zero. The contents of this memory location is added to the contents of the Y index register, the result being the low order eight bits of the effective address. The carry from this addition is added to the contents of the next page zero memory location, the result being the high order eight bits of the effective address.

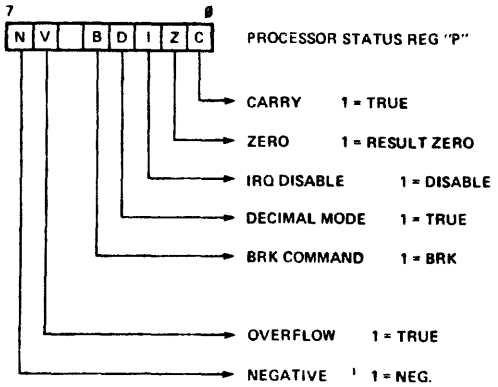
Absolute Indirect

The second byte of the instruction contains the low order eight bits of a memory location. The high order eight bits of that memory location is contained in the third byte of the instruction. The contents of the fully specified memory location is the low order byte of the effective address. The next memory location contains the high order byte of the effective address which is loaded into the sixteen bits of the program counter.

PROGRAMMING CHARACTERISTICS

PROGRAMMING MODEL





INSTRUCTION SET -- OP CODES, EXECUTION TIME, MEMORY REQUIREMENTS

MNEMONIC	OPERATION	IMMEDIATE OP	N	#	ABSOLUTE OP	N	#	ZERO PAGE OP	N	#	ACCUM OP	N	#	IMPLIED OP	N	#	(IND, X) OP	N	#	(IND), Y OP	N	#	Z PAGE, X OP	N	#	ABS, X OP	N	#	ABS, Y OP	N	#	RELATIVE OP	N	#	INDIRECT OP	N	#	Z PAGE, Y OP	N	#	CONDITION CODES N	Z	C	I	D	V
ADC	A + M + C → A (4)(1)	69	2	2	6D	4	3	65	3	2							61	6	2	71	5	2	75	4	2	7D	4	3	79	4	3										✓	✓	✓	-	-	✓
AND	A ∧ M → A (1)	29	2	2	2D	4	3	25	3	2							21	6	2	31	5	2	35	4	2	3D	4	3	39	4	3										✓	✓	-	-	-	-
ASL	C ← 7 0 ← 0				0E	6	3	06	5	2	0A	2	1										16	6	2	1E	7	3													✓	✓	✓	-	-	-
BCC	BRANCH ON C=0 (2)																															90	2	2							-	-	-	-	-	-
BCS	BRANCH ON C=1 (2)																															B0	2	2							-	-	-	-	-	-
BEQ	BRANCH ON Z=1 (2)																															F0	2	2							-	-	-	-	-	-
BIT	A ∧ M				2C	4	3	24	3	2																															M7	✓	-	-	-	M6
BMI	BRANCH ON N=1 (2)																															30	2	2							-	-	-	-	-	-
BNE	BRANCH ON Z=0 (2)																															D0	2	2							-	-	-	-	-	-
BPL	BRANCH ON N=0 (2)																															10	2	2							-	-	-	-	-	-
BRK	(See Fig. 1)													00	7	1																									-	-	-	✓	-	-
BVC	BRANCH ON V=0 (2)																															50	2	2							-	-	-	-	-	-
BVS	BRANCH ON V=1 (2)																															70	2	2							-	-	-	-	-	-
CLC	0 → C													18	2	1																									-	-	0	-	-	-
CLD	0 → D													D8	2	1																									-	-	-	-	0	-
CLI	0 → I													58	2	1																									-	-	-	0	-	-
CLV	0 → V													B8	2	1																									-	-	-	-	-	0
CMP	A-M (1)	C9	2	2	CD	4	3	C5	3	2							C1	6	2	D1	5	2	D5	4	2	DD	4	3	D9	4	3										✓	✓	✓	-	-	-
CPX	X-M	E0	2	2	EC	4	3	E4	3	2																															✓	✓	✓	-	-	-
CPY	Y-M	C0	2	2	CC	4	3	C4	3	2																															✓	✓	✓	-	-	-
DEC	M-1 → M				CE	6	3	C6	5	2													D6	6	2	DE	7	3													✓	✓	-	-	-	-
DEX	X-1 → X													CA	2	1																									✓	✓	-	-	-	-
DEY	Y-1 → Y													88	2	1																									✓	✓	-	-	-	-
EOR	A ⊻ M → A (1)	49	2	2	4D	4	3	45	3	2							41	6	2	51	5	2	55	4	2	5D	4	3	59	4	3										✓	✓	-	-	-	-
INC	M+1 → M				EE	6	3	E6	5	2													F6	6	2	FE	7	3													✓	✓	-	-	-	-
INX	X+1 → X													E8	2	1																									✓	✓	-	-	-	-
INY	Y+1 → Y													C8	2	1																									✓	✓	-	-	-	-
JMP	JUMP TO NEW LOC				4C	3	3																													6C	5	3				-	-	-	-	-	-
JSR	(See Fig. 2) JUMP SUB				20	6	3																																		-	-	-	-	-	-
LDA	M → A (1)	A9	2	2	AD	4	3	A5	3	2							A1	6	2	B1	5	2	B5	4	2	BD	4	3	B9	4	3										✓	✓	-	-	-	-

MNEMONIC	OPERATION	IMMEDIATE OP	N	#	ABSOLUTE OP	N	#	ZERO PAGE OP	N	#	ACCUM OP	N	#	IMPLIED OP	N	#	(IND, X) OP	N	#	(IND), Y OP	N	#	Z PAGE, X OP	N	#	ABS, X OP	N	#	ABS, Y OP	N	#	RELATIVE OP	N	#	INDIRECT OP	N	#	Z PAGE, Y OP	N	#	CONDITION CODES N	Z	C	I	D	V
LDX	M → X (1)	A2	2	2	AE	4	3	A6	3	2																			BE	4	3										✓	✓	-	-	-	-
LDY	M → Y (1)	A0	2	2	AC	4	3	A4	3	2																															✓	✓	-	-	-	-
LSR	0 → 7 0 → C				4E	6	3	46	5	2	4A	2	1										56	6	2	5E	7	3													0	✓	✓	-	-	-
NOP	NO OPERATION													EA	2	1																									-	-	-	-	-	-
ORA	A ∨ M → A	09	2	2	0D	4	3	05	3	2							01	6	2	11	5	2	15	4	2	1D	4	3	19	4	3										✓	✓	-	-	-	-
PHA	A → Ms S-1 → S													48	3	1																									-	-	-	-	-	-
PHP	P → Ms S-1 → S													08	3	1																									-	-	-	-	-	-
PLA	S+1 → S Ms → A													68	4	1																									✓	✓	-	-	-	-
PLP	S+1 → S Ms → P													28	4	1																									(RESTORED)					
ROL	7 0 C				2E	6	3	26	5	2	2A	2	1										36	6	2	3E	7	3													✓	✓	✓	-	-	-
ROR	C 7 0				6E	6	3	66	5	2	6A	2	1										76	6	2	7E	7	3													✓	✓	✓	-	-	-
RTI	(See Fig. 1) RTRN INT													40	6	1																									(RESTORED)					
RTS	(See Fig. 2) RTRN SUB													60	6	1																									-	-	-	-	-	-
SBC	A-M-C̄ → A (1)	E9	2	2	ED	4	3	E5	3	2							E1	6	2	F1	5	2	F5	4	2	FD	4	3	F9	4	3										✓	✓	(3)	-	-	✓
SEC	1 → C													38	2	1																									-	-	1	-	-	-
SED	1 → D													F8	2	1																									-	-	-	-	1	-
SEI	1 → I													78	2	1																									-	-	-	1	-	-
STA	A → M				8D	4	3	85	3	2							81	6	2	91	6	2	95	4	2	9D	5	3	99	5	3										-	-	-	-	-	-
STX	X → M				8E	4	3	86	3	2																															-	-	-	-	-	-
STY	Y → M				8C	4	3	84	3	2													94	4	2																	-	-	-	-	-	-
TAX	A → X													AA	2	1																									✓	✓	-	-	-	-
TAY	A → Y													A8	2	1																									✓	✓	-	-	-	-
TSX	S → X													BA	2	1																									✓	✓	-	-	-	-
TXA	X → A													8A	2	1																									✓	✓	-	-	-	-
TXS	X → S													9A	2	1																									-	-	-	-	-	-
TYA	Y → A													98	2	1																									✓	✓	-	-	-	-

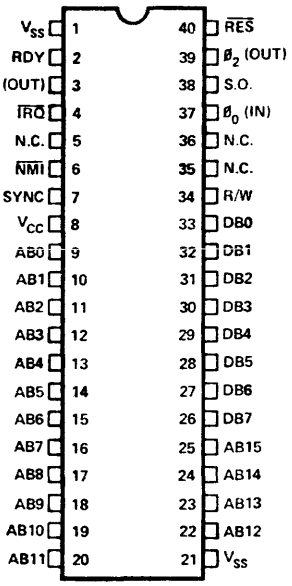
(1) ADD 1 TO "N" IF PAGE BOUNDARY IS CROSSED
(2) ADD 1 TO "N" IF BRANCH OCCURS TO SAME PAGE
ADD 2 TO "N" IF BRANCH OCCURS TO DIFFERENT PAGE
(3) CARRY NOT - BELOW
(4) IF IN DECIMAL MODE Z FLAG IS INVALID
ACCUMULATOR MUST BE CHECKED FOR ZERO RESULT

X INDEX X
Y INDEX Y
A ACCUMULATOR
M MEMORY PER EFFECTIVE ADDRESS
Ms MEMORY PER STACK POINTER

+ ADD
-- SUBTRACT
∧ AND
∨ OR
⊻ EXCLUSIVE OR
✓ MODIFIED

- NOT MODIFIED
M7 MEMORY BIT 7
M6 MEMORY BIT 6
N NO CYCLES
NO BYTES

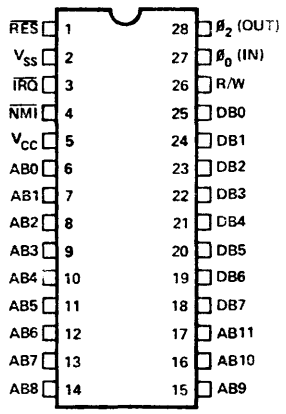
SY6502 – 40 Pin Package



Features

- 65K Addressable Bytes of Memory
- $\overline{IRQ}$ Interrupt
- $\overline{NMI}$ Interrupt
- On-the-chip Clock
  - √ TTL Level Single Phase Input
  - √ Crystal Time Base Input
- SYNC Signal
  (can be used for single instruction execution)
- RDY Signal
  (can be used for single cycle execution)
- Two Phase Output Clock for Timing of Support Chips

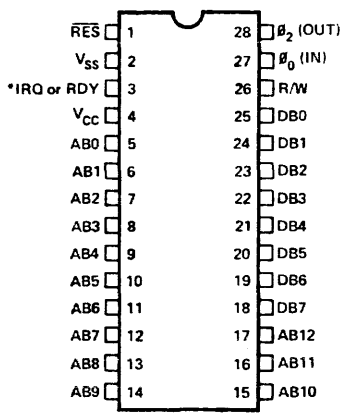
SY6503 – 28 Pin Package



Features

- 4K Addressable Bytes of Memory (AB00-AB11)
- On-the-chip Clock
- $\overline{IRQ}$ Interrupt
- $\overline{NMI}$ Interrupt
- 8 Bit Bi-Directional Data Bus

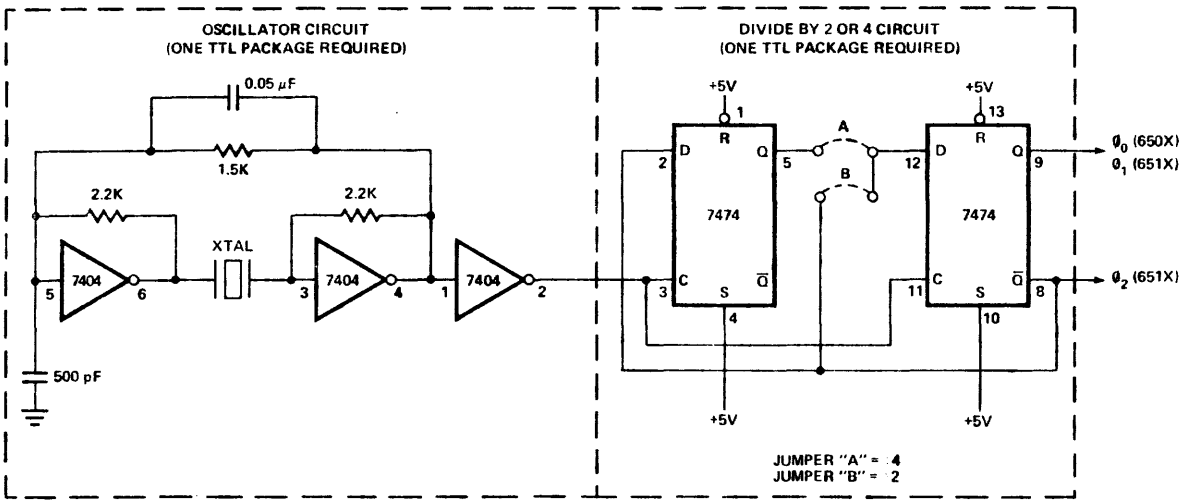
SY6504 & SY6507 – 28 Pin Package



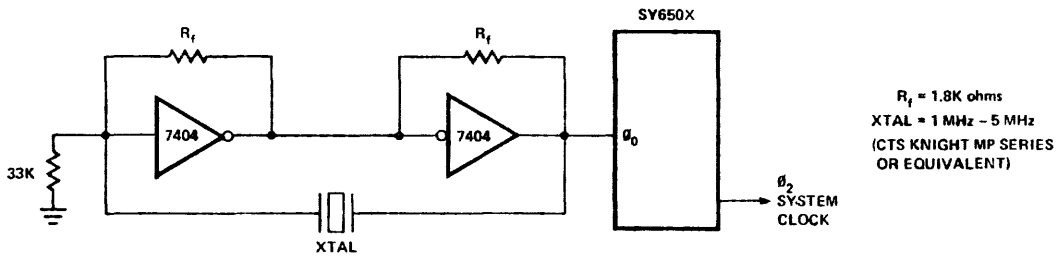
Features

- $\overline{IRQ}$ Interrupt (6504 only)
- RDY Signal (6507 only)
- 8K Addressable Bytes of Memory (AB00-AB12)
- On-the-chip Clock
- 8 Bit Bi-Directional Data Bus

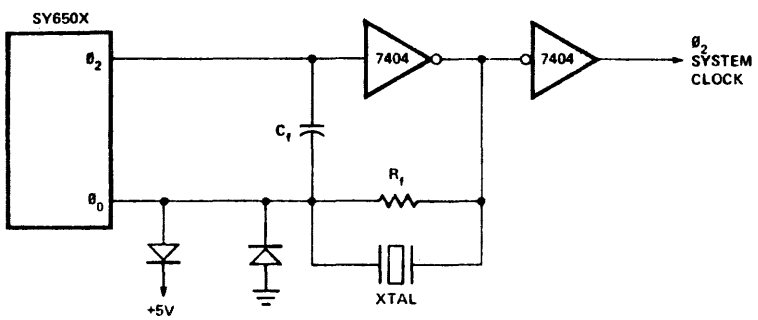
CLOCK GENERATION CIRCUITS



CRYSTAL FREQUENCY	OUTPUT FREQUENCY	
	2	4
3.579545 MHz	1.7897 MHz	0.894886 MHz
4.194304 MHz	2.097152 MHz	1.048576 MHz



R_f = 1.8K ohms
XTAL = 1 MHz – 5 MHz
(CTS KNIGHT MP SERIES
OR EQUIVALENT)



R_f = 330K ohms
C_f = 10 pF
XTAL – CTS KNIGHT MP SERIES
OR EQUIVALENT

Rockwell

R6500 Microcomputer System
DATA SHEET

CRT CONTROLLER (CRTC)

DESCRIPTION

The R6545-1 CRT Controller (CRTC) is designed to interface an 8-bit microprocessor to CRT raster scan video displays, and adds an advanced CRT controller to the established and expanding line of R6500 products.

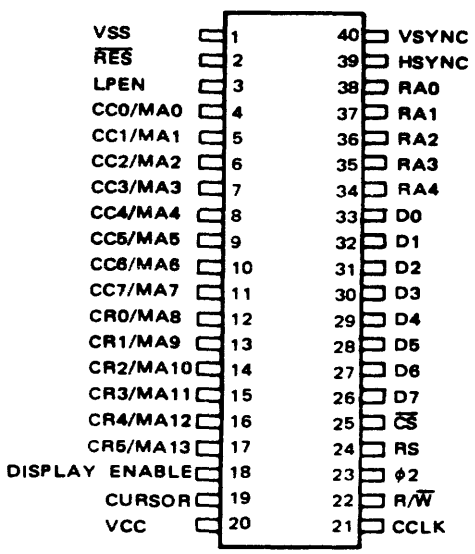
The R6545-1 provides refresh memory addresses and character generator row addresses which allow up to 16K characters with 32 scan lines per character to be addressed. A major advantage of the R6545-1 is that the refresh memory may be addressed in either straight binary or by row/column.

Other functions in the R6545-1 include an internal cursor register which generates a cursor output when its contents are equal to the current refresh address. Programmable cursor start and end registers allow a cursor of up to the full character scan in height to be placed on any scan lines of the character. Variable cursor display blink rates are provided. A light pen strobe input allows capture of the current refresh address in an internal light pen register. The refresh address lines are configured to provide direct dynamic memory refresh.

All timing for the video refresh memory signals is derived from the character clock input. Shift register, latch, and multiplex control signals (when needed) are provided by external high-speed timing. The mode control register allows non-interlaced video display modes at 50 or 60 Hz refresh rate. The internal status register may be used to monitor the R6545-1 operation. The $\overline{RES}$ input allows the CRTC-generated field rate to be dynamically-synchronized with line frequency jitter.

FEATURES

- Compatible with 8-bit microprocessors
- Up to 2.5 MHz character clock operation
- Refresh RAM may be configured in row/column or straight binary addressing
- Alphanumeric and limited graphics capability
- Up and down scrolling by page, line, or character
- Programmable Vertical Sync Width
- Fully programmable display (rows, columns, character matrix)
- Non-interlaced scan
- 50/60 Hz operation
- Fully programmable cursor
- Light pen register
- Addresses refresh RAM to 16K characters
- No external DMA required
- Internal status register
- 40-Pin ceramic or plastic DIP
- Pin-compatible with MC6845
- Single +5 ±5% Volt Power Supply



R6545-1 Pin Configuration

ORDERING INFORMATION

Part Number	Package Type	Frequency	Temperature Range
R6545-1P	Plastic	1 MHz	0°C to +70°C
R6545-1AP	Plastic	2 MHz	0°C to +70°C
R6545-1C	Ceramic	1 MHz	0°C to +70°C
R6545-1AC	Ceramic	2 MHz	0°C to +70°C

Specifications subject to change without notice
Document No. 29000 D67
December 1980

INTERFACE SIGNAL DESCRIPTION

CPU INTERFACE

ϕ2 (Phase 2 Clock)

The input clock is the system Phase 2 (ϕ2) clock and is used to trigger all data transfers between the system processor (CPU) and the R6545-1. Since there is no maximum limit to the allowable ϕ2 clock time, it is not necessary for it to be a continuous clock. This capability permits the R6545-1 to be easily interfaced to non-6500 compatible microprocessors.

R/$\overline{W}$ (Read/Write)

The R/$\overline{W}$ input signal generated by the processor is used to control the direction of data transfers. A high on the R/$\overline{W}$ pin allows the processor to read the data supplied by the R6545-1, a low on the R/$\overline{W}$ pin allows data on data lines D0-D7 to be written into the R6545-1.

$\overline{CS}$ (Chip Select)

The Chip Select input is normally connected to the processor address bus either directly or through a decoder. The R6545-1 is selected when $\overline{CS}$ is low.

RS (Register Select)

The Register Select input is used to access internal registers. A low on this pin permits writes (R/$\overline{W}$ = low) into the Address Register and reads (R/$\overline{W}$ = high) from the Status Register. The contents of the Address Register is the identity of the register accessed when RS is high.

D0-D7 (Data Bus)

D0-D7 are the eight data lines used to transfer data between the processor and the R6545-1. These lines are bidirectional and are normally high-impedance except during read cycles when the chip is selected ($\overline{CS}$ = low).

VIDEO INTERFACE

HSYNC (Horizontal Sync)

The HSYNC signal is an active-high output used to determine the horizontal position of displayed text. It may drive a CRT monitor directly or may be used for composite video generation. HSYNC time position and width are fully programmable.

VSYNC (Vertical Sync)

The VSYNC signal is an active high output used to determine the vertical position of displayed text. Like HSYNC, VSYNC may be used to drive a CRT monitor or composite video generation circuits. VSYNC time position and width are both programmable.

DISPLAY ENABLE (Display Enable)

The DISPLAY ENABLE signal is an active-high output used to indicate when the R6545-1 is generating active display information. The number of horizontal display characters per row and the number of vertical display rows are both fully programmable and together are used to generate the DISPLAY ENABLE signal. DISPLAY ENABLE can be delayed one character time by setting bit 4 of R8 equal to 1.

CURSOR (Cursor Coincidence)

The CURSOR signal is an active-high output used to indicate when the scan coincides with the programmed cursor position. The cursor position may be programmed to be any character in the address field. Furthermore, within the character, the cursor may be programmed to be any block of scan lines, since the start scan line and the end scan line are both programmable. The cursor position may be delayed by one character time by setting Bit 5 of R8 to A "1".

LPEN (Light Pen Strobe)

The LPEN signal is an edge-sensitive input used to load the internal Light Pen Register with the contents of the Refresh Scan Counter at the time the active edge occurs. The active edge of LPEN is the low-to-high transition.

CCLK (Clock)

The CCLK signal is the character timing clock input and is used as the time base for all internal count/control functions.

$\overline{RES}$

The $\overline{RES}$ signal is an active-low input used to initialize all internal scan counter circuits. When $\overline{RES}$ is low, all internal counters are stopped and cleared, all scan and video outputs are low, and control registers are unaffected. $\overline{RES}$ must stay low for at least one CCLK period. All scan timing is initiated when $\overline{RES}$ goes high. In this way, $\overline{RES}$ can be used to synchronize display frame timing with line frequency. $\overline{RES}$ may also be used to synchronize multiple CRTC's in horizontal and/or vertical split screen operation.

REFRESH RAM AND CHARACTER ROM INTERFACE

MA0-MA13 (Refresh RAM Address Lines)

These 14 signals are active-high outputs used to address the Refresh RAM for character storage and display operations. The starting scan address is fully programmable and the ending scan address is determined by the total number of characters displayed, which is also programmable, in terms of characters/line and lines/frame.

There are two selectable address modes for MA0-MA13:

In the straight binary mode (R8, Mode Control, bit 2 = "0"), characters are stored in successive memory locations. Thus, the software must be designed such that row and column character coordinates are translated into sequentially-numbered addresses. In the row/column mode (R8, Mode Control, bit 2 = "1"), MA0-MA7 become column addresses CC0-CC7 and MA8-MA13 become row addresses CR0-CR5. In this case, the software can manipulate characters in terms of row and column locations, but additional address compression circuits are needed to convert the CC0-CC7 and CR0-CR5 addresses into a memory-efficient binary address scheme.

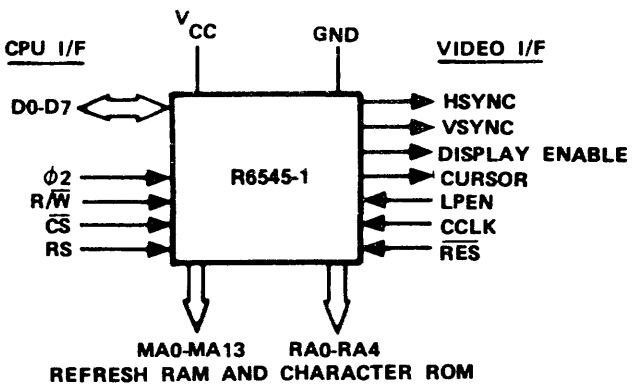
RA0-RA4 (Raster Address Lines)

These 5 signals are active-high outputs used to select each raster scan within an individual character row. The number of raster scan lines is programmable and determines the character height, including spaces between character rows.

INTERNAL REGISTER ORGANIZATION

$\overline{CS}$	RS	Address Register 4	3	2	1	0	Reg. No.	Register Name	Register Units	Read (R/$\overline{W}$ = High)	Write (R/$\overline{W}$ = Low)	Register Bit 7	6	5	4	3	2	1	0
1	X	X	X	X	X	X	X												
0	0	X	X	X	X	X	X	Address Register	Register No.		✓				4	3	2	1	0
0	0	X	X	X	X	X	X	Status Register	–	✓			6	5					
0	1	0	0	0	0	0	R0	Horizontal Total Char	No. of Characters/Row		✓	7	6	5	4	3	2	1	0
0	1	0	0	0	0	1	R1	Horizontal Displayed Char	No. of Characters/Row		✓	7	6	5	4	3	2	1	0
0	1	0	0	0	1	0	R2	Horizontal Sync Position	Character Position		✓	7	6	5	4	3	2	1	0
0	1	0	0	0	1	1	R3	YSYNC, HSYNC Widths	No. of Scan Lines, Characters		✓	7	6	5	4	3	2	1	0
0	1	0	0	1	0	0	R4	Vertical Total Rows	No. of Character Rows		✓		6	5	4	3	2	1	0
0	1	0	0	1	0	1	R5	Vertical Total Adjust Lines	No. of Scan Lines		✓				4	3	2	1	0
0	1	0	0	1	1	0	R6	Vertical Displayed Rows	No. of Character Rows		✓		6	5	4	3	2	1	0
0	1	0	0	1	1	1	R7	Vertical Sync Position	No. of Character Rows		✓		6	5	4	3	2	1	0
0	1	0	1	0	0	0	R8	Mode Control	–		✓	7	6	5	4	3	2	1	0
0	1	0	1	0	0	1	R9	Scan Line	No. of Scan Lines		✓				4	3	2	1	0
0	1	0	1	0	1	0	R10	Cursor Start Line	Scan Line No.		✓		6	5	4	3	2	1	0
0	1	0	1	0	1	1	R11	Cursor End Line	Scan Line No.		✓				4	3	2	1	0
0	1	0	1	1	0	0	R12	Display Start Address (H)	–		✓			5	4	3	2	1	0
0	1	0	1	1	0	1	R13	Display Start Address (L)	–		✓	7	6	5	4	3	2	1	0
0	1	0	1	1	1	0	R14	Cursor Position Address (H)	–	✓	✓			5	4	3	2	1	0
0	1	0	1	1	1	1	R15	Cursor Position Address (L)	–	✓	✓	7	6	5	4	3	2	1	0
0	1	1	0	0	0	0	R16	Light Pen Register (H)	–	✓				5	4	3	2	1	0
0	1	1	0	0	0	1	R17	Light Pen Register (L)	–	✓		7	6	5	4	3	2	1	0

Table 1. Overall Register Structure and Addressing



R6545-1 Interface Diagram

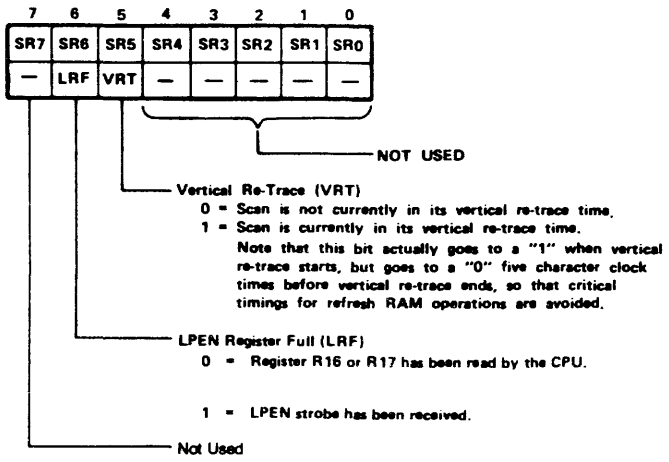
INTERNAL REGISTER DESCRIPTION

ADDRESS REGISTER

This 5-bit write-only register is used as a "pointer" to direct CRTC/CPU data transfers within the CRTC. Its contents is the number of the desired register (0-17). When $\overline{CS}$ and RS are low, then this register may be loaded; when $\overline{CS}$ is low and RS is high, then the register selected is the one whose identity is stored in this address register.

STATUS REGISTER (SR)

This 8-bit register contains the status of the CRTC. Only two bits are assigned, as follows:



NOTE: The Status Register takes the State, [–][0][1][–][–][–][–][–] immediately after power (V_{CC}) turn-on.

R0—HORIZONTAL TOTAL CHARACTERS

This 8-bit write-only register contains the total of displayed and non-displayed characters, minus one, per horizontal line. The frequency of HSYNC is thus determined by this register.

R1—HORIZONTAL DISPLAYED CHARACTERS

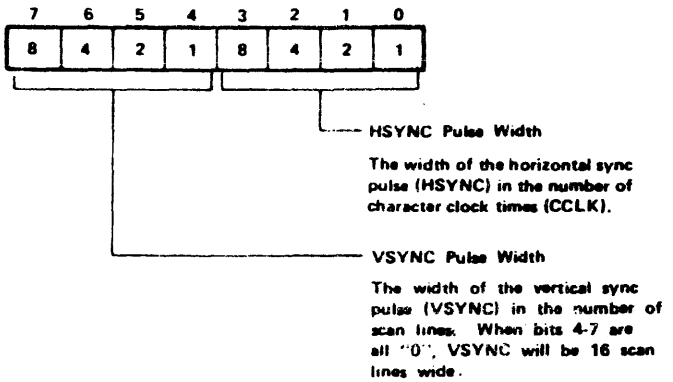
This 8-bit write-only register contains the number of displayed characters per horizontal line.

R2—HORIZONTAL SYNC POSITION

This 8-bit write-only register contains the position of the horizontal SYNC on the horizontal line, in terms of the character location number on the line. The position of the HSYNC determines the left to right location of the displayed text on the video screen. In this way, the side margins are adjusted.

R3—HORIZONTAL AND VERTICAL SYNC WIDTHS

This 8-bit write-only register contains the widths of both HSYNC and VSYNC, as follows:



Control of these parameters allows the R6545-1 to be interfaced to a variety of CRT monitors, since the HSYNC and VSYNC timing signals may be accommodated without the use of external one shot timing.

R4—VERTICAL TOTAL ROWS

The Vertical Total Register is a 7-bit register containing the total number of character rows in a frame, minus one. This register, along with R5, determines the overall frame rate, which should be close to the line frequency to ensure flicker-free appearance. If the frame time is adjusted to be longer than the period of the line frequency, then $\overline{RES}$ may be used to provide absolute synchronism.

R5—VERTICAL TOTAL LINE ADJUST

The Vertical Total Line Adjust Register (R5) is a 5-bit write-only register containing the number of additional scan lines needed to complete an entire frame scan and is intended as a fine adjustment for the video frame time.

R6—VERTICAL DISPLAYED ROWS

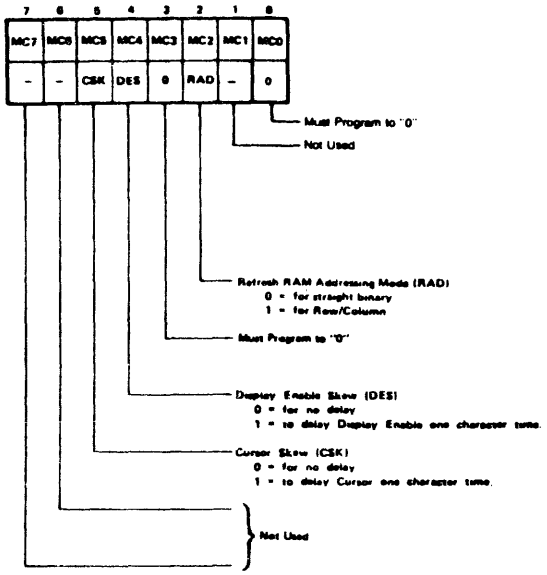
This 7-bit write-only register contains the number of displayed character rows in each frame.

R7—VERTICAL SYNC POSITION

This 7-bit write-only register is used to select the character row time at which the vertical SYNC pulse is desired to occur and, thus, is used to position the displayed text in the vertical direction.

R8—MODE CONTROL (MC)

This 8-bit write-only register selects the operating modes of the R6545-1, as follows:



R9—ROW SCAN LINES

This 5-bit write-only register contains the number of scan lines, minus one, per character row, including spacing.

R10—CURSOR START LINE
R11—CURSOR END LINE

These 5-bit write-only registers select the starting and ending scan lines for the cursor. In addition, bits 5 and 6 of R10 are used to select the cursor blink mode, as follows:

Bit 6	Bit 5	Cursor Blink Mode
0	0	Display Cursor Continuously
0	1	Blank Cursor Continuously
1	0	Blink Cursor at 1/16 Field Rate
1	1	Blink Cursor at 1/32 Field Rate

R12—DISPLAY START ADDRESS HIGH
R13—DISPLAY START ADDRESS LOW

These registers form a 14-bit register whose contents is the memory address of the first character of the displayed scan (the character on the top left of the video display, as in Figure 1). Subsequent memory addresses are generated by the R6545-1 as a result of CCLK input pulses. Scrolling of the display is accomplished by changing R12 and R13 to the memory address associated with the first character of the desired line of text to be displayed first. Entire pages of text may be scrolled or changed as well via R12 and R13.

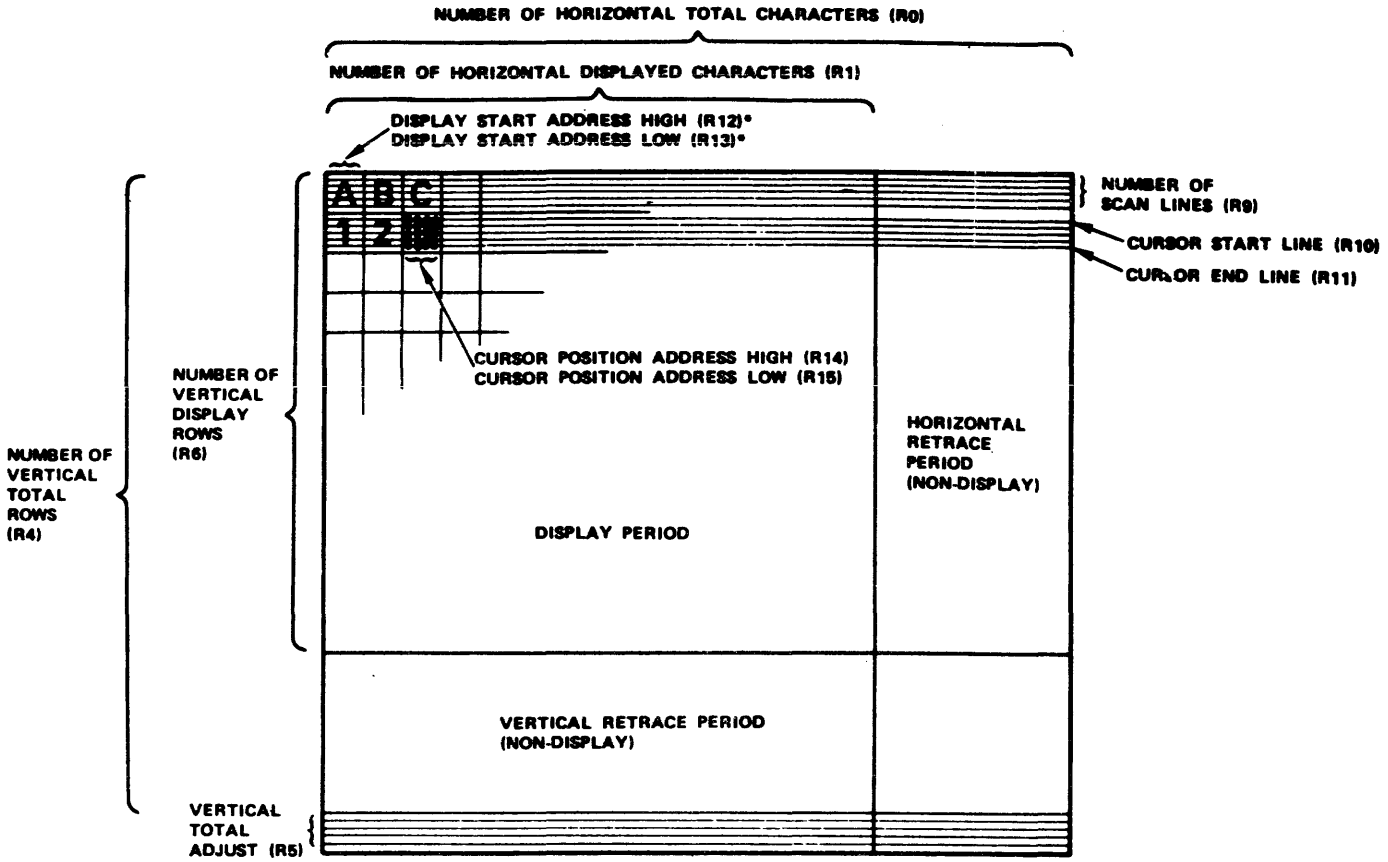


Figure 1. Video Display Format

R14—CURSOR POSITION HIGH
R15—CURSOR POSITION LOW

These registers form a 14-bit register whose contents is the memory address of the current cursor position. When the video display scan counter (MA lines) matches the contents of this register, and when the scan line counter (RA lines) falls within the bounds set by R10 and R11, then the CURSOR output becomes active. Bit 5 of the Mode Control Register (R8) may be used to delay the CURSOR output by a full CCLK time to accommodate slow access memories.

R16—LIGHT PEN HIGH
R17—LIGHT PEN LOW

These registers form a 14-bit register whose contents is the light pen strobe position, in terms of the video display address at which the strobe occurred. When the LPEN input changes from low to high, then, on the next negative-going edge of CCLK, the contents of the internal scan counter is stored in registers R16 and R17.

REGISTER FORMATS

Register pairs R12/R13, R14/R15, and R16/R17 are formatted in one of two ways:

(1) Straight binary, if register R8, bit 2 = "0".

(2) Row/Column, if register R8, bit 2 = "1". In this case the low byte is the Character Column and the high byte is the Character Row.

DESCRIPTION OF OPERATION

VIDEO DISPLAY

Figure 1 indicates the relationship of the various program registers in the R6545-1 and the resultant video display.

Non-displayed areas of the Video Display are used for horizontal and vertical retrace functions of the CRT monitor. The horizontal and vertical sync signals, HSYNC and VSYNC, are programmed to occur during these intervals and are used to trigger the retrace in the CRT monitor. The pulse widths are constrained by the monitor requirements. The time position of the pulses may be adjusted to vary the display margins (left, right, top, and bottom).

REFRESH RAM ADDRESSING

Shared Memory Mode (R8, bit 3 = "0")

In this mode, the Refresh RAM address lines (MA0-MA13) directly reflect the contents of the internal refresh scan character counter. Multiplex control, to permit addressing and selection of the RAM by both the CPU and the CRTC, must be provided external to the CRTC. In the Row/Column address mode, lines MA0-MA7 become character column addresses (CC0-CC7) and MA8-MA13 become character row addresses (CR0-CR5).

ADDRESSING MODES

Row/Column

In this mode, the CRTC address lines (MA0-MA13) are generated as 8 column (MA0-MA7) and 6 row (MA8-MA13) addresses. Extra hardware is needed to compress this addressing into a straight binary sequence in order to conserve memory in the refresh RAM.

Binary

In this mode, the CRTC address lines are straight binary and no compression circuits are needed. However, software complexity is increased since the CRT characters cannot be stored in terms of their row and column locations, but must be sequential.

USE OF DYNAMIC RAM FOR REFRESH MEMORY

The R6545-1 permits the use of dynamic RAMS as storage devices for the Refresh RAM by continuing to increment memory addresses in the non-display intervals of the scan. This is a viable technique, since the Display Enable signal controls the actual video display blanking. Figure 2 illustrates Refresh RAM addressing for the case of binary addressing for 80 columns and 24 rows with 10 non-displayed columns and 10 non-displayed rows.

TOTAL = 90

DISPLAY = 80

TOTAL = 34

DISPLAY = 24

0	1	2	3		76	77	78	79	80	81		89
80	81	82	83		156	157	158	159	160	161		169
160	161	162				237	238	239	240			249
240	241	242				317	318	319	320			329
1680	1681	1682				1757	1758	1759	1760			1769
1760	1761	1762				1837	1838	1839	1840			1849
1840	1841	1842				1917	1918	1919	1920			1929
1920	1921	1922				1997	1998	1999	2000			2009
2000	2001	2002				2077	2078	2079	2080			2089
2640	2641	2642				2717	2718	2720				2729

Figure 2. Memory Addressing Example (80 x 24)

CURSOR OPERATION

A one character wide cursor can be controlled by storing values into the Cursor Start Line (R10) and Cursor End Line (R11) registers and into the Cursor Position Address High (R14) and Cursor Position Low (R15) registers.

Bits 5 and 6 in the Cursor Start Line High Register (R10) control the cursor display and blink rate as follows:

Bit 6	Bit 5	Cursor Operating Mode
0	0	Display Cursor Continuously
0	1	Blank Cursor Continuously
1	0	Blink Cursor at 1/16 Field Rate
1	1	Blink Cursor at 1/32 Field Rate

The cursor of up to 32 characters in height can be displayed on and between the scan lines as loaded into the Cursor Start Line (R10) and Cursor End Line (R11) Registers.

The cursor is positioned on the screen by loading the Cursor Position Address High (R14) and Cursor Position Address Low (R15) registers with the desired refresh RAM address. The cursor can be positioned in any of the 16K character positions. Hardware paging and data scrolling is thus allowed without loss of cursor position. Figure 3 is an example of the display cursor scan line.

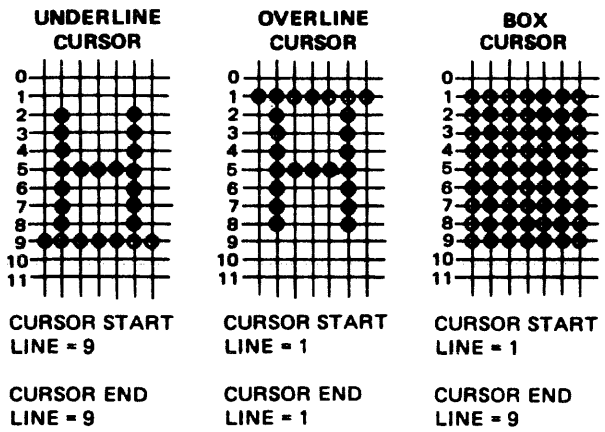


Figure 3. Cursor Display Scan Line Control Examples

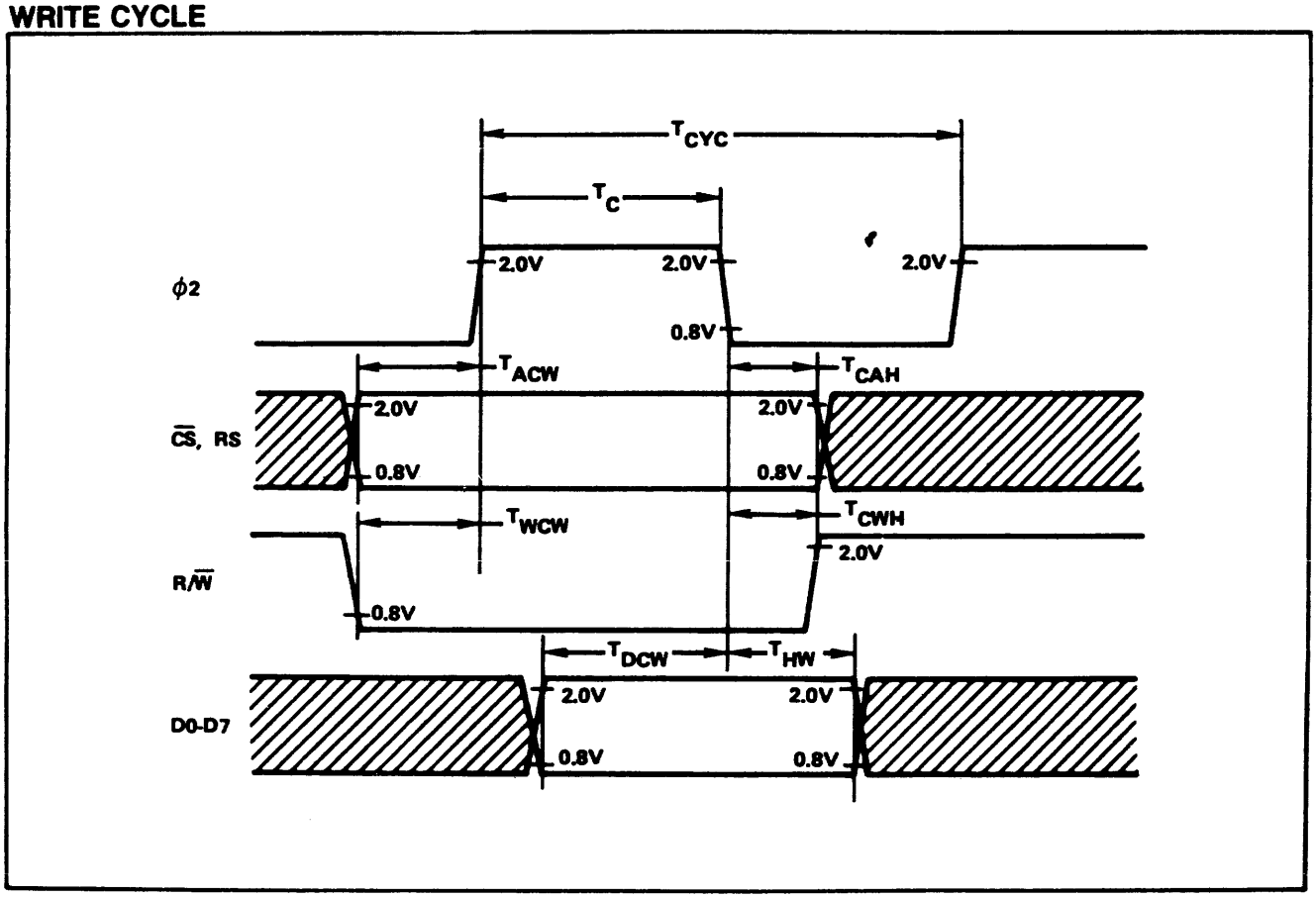
MPU WRITE TIMING CHARACTERISTICS

(V_{CC} = 5.0V ±5%, T_A = 0 to 70°C, unless otherwise noted)

Characteristic	Symbol	1 MHz		2 MHz		Unit
		Min	Max	Min	Max	
Cycle Time	T_{CYC}	1.0	–	0.5	–	μs
Ø2 Pulse Width	T_C	440	–	200	–	ns
Address Set-Up Time	T_{ACW}	180	–	90	–	ns
Address Hold Time	T_{CAH}	0	–	0	–	ns
R/$\overline{W}$ Set-Up Time	T_{WCW}	180	–	90	–	ns
R/$\overline{W}$ Hold Time	T_{CWH}	0	–	0	–	ns
Data Bus Set-Up Time	T_{DCW}	265	–	100	–	ns
Data Bus Hold Time	T_{HW}	10	–	10	–	ns

(t_r and t_f = 10 to 30 ns)

WRITE CYCLE



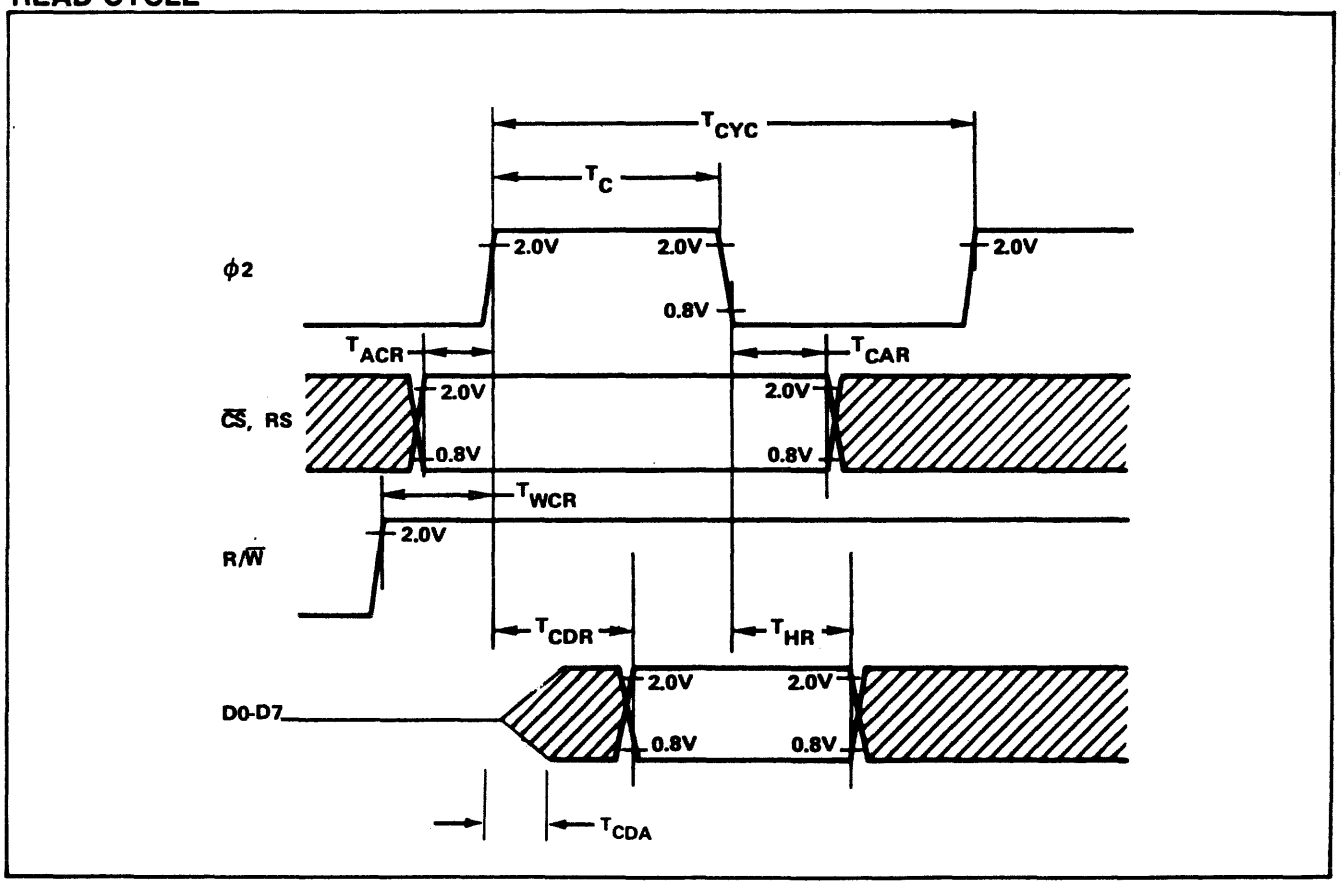
MPU READ TIMING CHARACTERISTICS

(V_{CC} = 5.0V ±5%, T_A = 0 to 70°C, unless otherwise noted)

Characteristic	Symbol	1 MHz		2 MHz		Unit
		Min	Max	Min	Max	
Cycle Time	T_{CYC}	1.0	–	0.5	–	µs
Ø2 Pulse Width	T_C	440	–	200	–	ns
Address Set-Up Time	T_{ACR}	180	–	90	–	ns
Address Hold Time	T_{CAR}	0	–	0	–	ns
R/$\overline{W}$ Set-Up Time	T_{WCR}	180	–	90	–	ns
Read Access Time	T_{CDR}	–	340	–	150	ns
Read Hold Time	T_{HR}	10	–	10	–	ns
Data Bus Active Time (Invalid Data)	T_{CDA}	40	–	40	–	ns

(t_r and t_f = 10 to 30 ns)

READ CYCLE



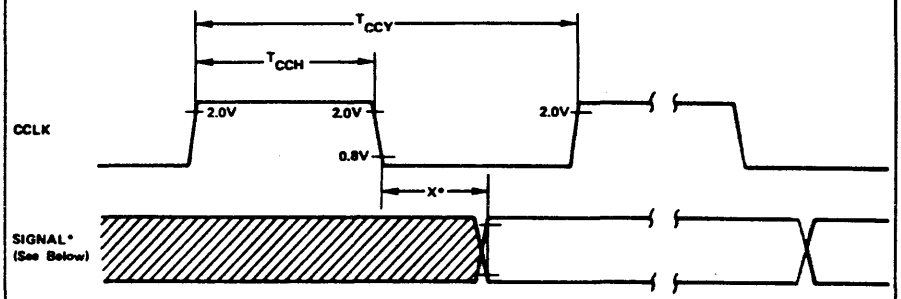
MEMORY AND VIDEO INTERFACE CHARACTERISTICS

(V_{CC} = 5.0V ±5%, T_A = 0 to 70°C, unless otherwise noted)

Characteristics	Symbol	1 MHz		2 MHz		Units
		Min	Max	Min	Max	
Char. Clock Cycle Time	T_{CCY}	0.4	40	0.4	40	µs
Char. Clock Pulse Width	T_{CCH}	200	–	200	–	ns
MA0-MA13 Propagation Delay	T_{MAD}	–	300	–	300	ns
RA0-RA4 Propagation Delay	T_{RAD}	–	300	–	300	ns
DISPLAY ENABLE Prop. Delay	T_{DTD}	–	450	–	450	ns
HYSNC Propagation Delay	T_{HSD}	–	450	–	450	ns
VSYNC Propagation	T_{VSD}	–	450	–	450	ns
Cursor Propagation Delay	T_{CDD}	–	450	–	450	ns
LPEN Strobe Width	T_{LPH}	150	–	150	–	ns
LPEN to CCLK Delay	T_{LP1}	20	–	20	–	ns
CCLK to LPEN Delay	T_{LP2}	0	–	0	–	ns

t_r, t_f = 20 ns (max)

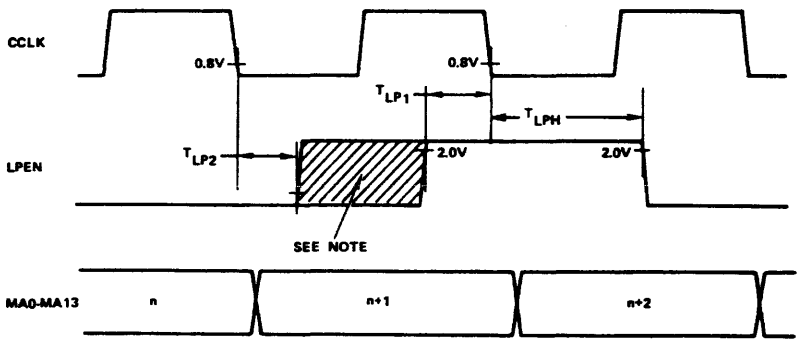
SYSTEM TIMING DEFINITIONS



*

SIGNAL	SIGNAL SYMBOL (X)
MA0-MA13	T_{MAD}
RA0-RA4	T_{RAD}
DISPLAY ENABLE	T_{DTD}
HSYNC	T_{HSD}
VSYNC	T_{VSD}
CURSOR	T_{CDD}

LIGHT PEN STROBE TIMING DEFINITIONS



NOTE:

SLASH AREA DEFINES THE "WINDOW" IN WHICH AN LPEN POSITIVE EDGE WILL CAUSE ADDRESS N+2 TO LOAD INTO LIGHT PEN REGISTER. TRANSITIONS ON EITHER SIDE OF THIS "WINDOW" WILL RESULT IN UNPREDICTABLE VALUES BEING LOADED INTO THE LIGHT PEN REGISTER.

SPECIFICATIONS

Maximum Ratings

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.3 to +7.0	Vdc
Input Voltage	V_{IN}	-0.3 to +7.0	Vdc
Operating Temperature Range	T_{OP}	0 to +70	°C
Storage Temperature	T_{STG}	-55 to 150	°C

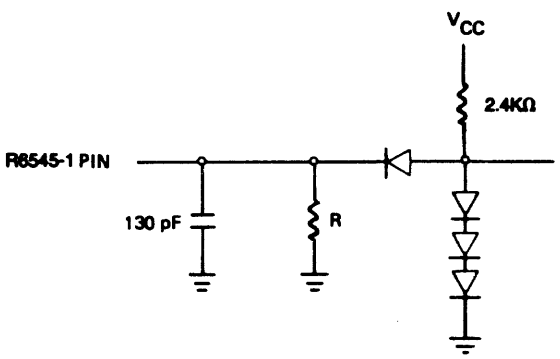
All inputs contain protection circuitry to prevent damage due to high static discharges. Care should be taken to prevent unnecessary application of voltages in excess of the allowable limits.

Electrical Characteristics

(V_{CC} = 5.0V ±5%, T_A = 0-70°C, unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
Input High Voltage	V_{IH}	2.0	V_{CC}	Vdc
Input Low Voltage	V_{IL}	0.3	0.8	Vdc
Input Leakage (Ø2, R/$\overline{W}$, $\overline{RES}$, $\overline{CS}$, RS, LPEN, CCLK)	I_{IN}	–	2.5	μAdc
Three-State Input Leakage (D0-D7) (V_{IN} = 0.4 to 2.4V)	I_{TSI}	–	10.0	μAdc
Output High Voltage I_{LOAD} = 205 μAdc (D0-D7) I_{LOAD} = 100 μAdc (all others)	V_{OH}	2.4	–	Vdc
Output Low Voltage I_{LOAD} = 1.6 mAdc	V_{OL}	–	0.4	Vdc
Power Dissipation	P_D	–	1000	mW
Input Capacitance				
Ø2, R/$\overline{W}$, $\overline{RES}$, $\overline{CS}$, RS, LPEN, CCLK	C_{IN}	–	10.0	pF
D0-D7		–	12.5	pF
Output Capacitance	C_{OUT}	–	10.0	pF

TEST LOAD



R=11KΩ FOR D0-D7
=24KΩ FOR ALL OTHER OUTPUTS

PART NUMBER
R6551

Rockwell

R6500 Microcomputer System
DATA SHEET

Asynchronous Communication Interface Adapter (ACIA)

The R6551 Asynchronous Communication Interface Adapter (ACIA) provides a program-controlled interface between 8-bit microprocessor-based systems and serial communication data sets and modems.

With its on-chip baud rate generator, the R6551 is capable of transmitting at 15 different program-selectable rates between 50 baud and 19,200 baud, and receiving at either the transmit rate or at 16 times an external clock rate. The R6551 has programmable word lengths of 5, 6, 7, or 8 bits; even, odd or no parity; 1, 1-1/2 or 2 stop bits.

With the R6551, a crystal is the only required external support component – eliminating the multiple-component support that is typically needed.

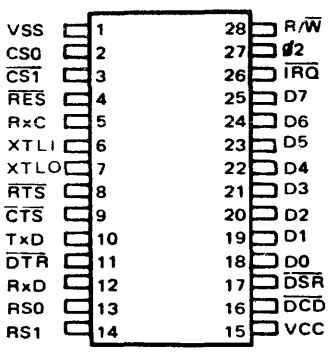
In addition, the R6551 is designed for maximum programmed control from the CPU, to simplify hardware implementation. A control register and a separate command register permit the CPU to easily select the R6551's operating modes and check data, parameters and status.

FEATURES

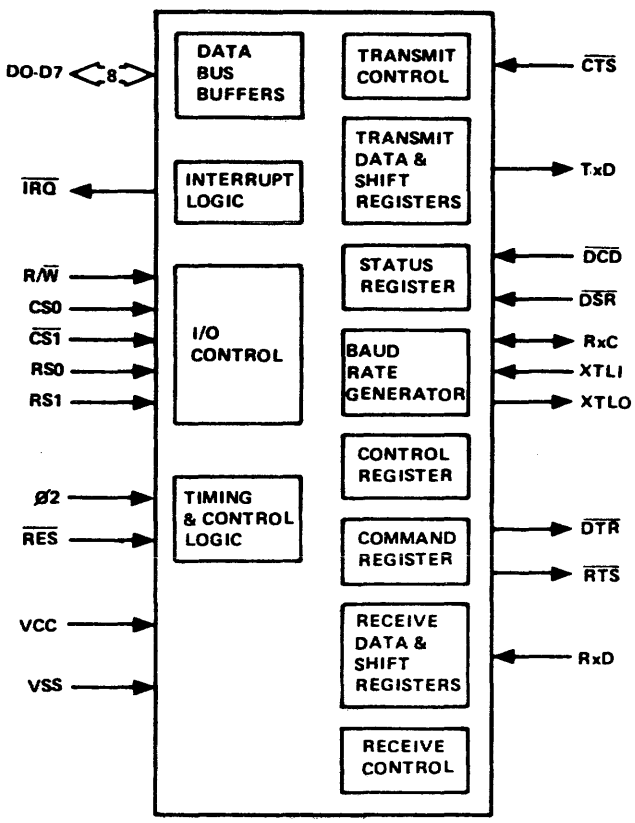
- Compatible with 8-bit microprocessors
- Full duplex or half duplex operation with buffered receiver and transmitter
- 15 programmable Baud Rates (50 to 19,200)
- Receiver data rate may be identical to baud rate or may be 16 times the external clock input
- Data set/modem control functions
- Programmable word lengths, number of stop bits, and parity bit generation and detection
- Programmable interrupt control
- Software reset
- Program-selectable serial echo mode
- Two chip selects
- 2 MHz or 1 MHz clock rate
- Single +5V ±5% power supply
- 28-pin plastic or ceramic DIP
- Full TTL compatibility

Ordering Information

Order Number	Package Type	Frequency	Temperature Range
R6551P	Plastic	1 MHz	0°C to +70°C
R6551AP	Plastic	2 MHz	0°C to +70°C
R6551C	Ceramic	1 MHz	0°C to +70°C
R6551AC	Ceramic	2 MHz	0°C to +70°C



R6551 Pin Configuration

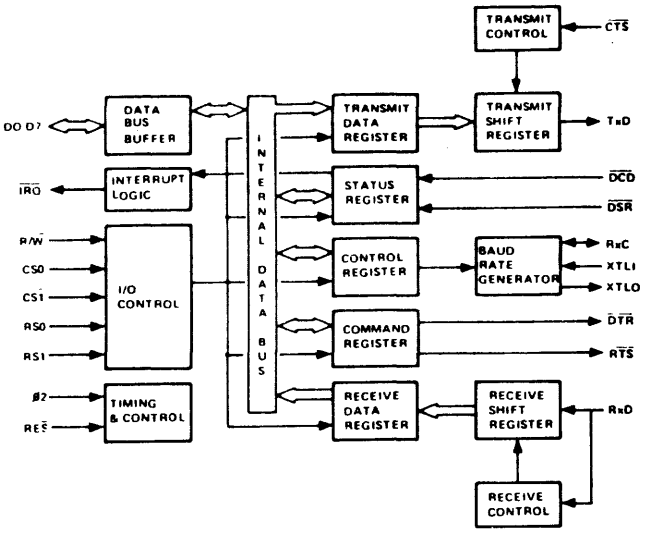


R6551 Interface Diagram

Asynchronous Communication Interface Adapter (ACIA)

Specifications subject to change without notice
Document No. 29000 D53
Rev. 1, January 1981

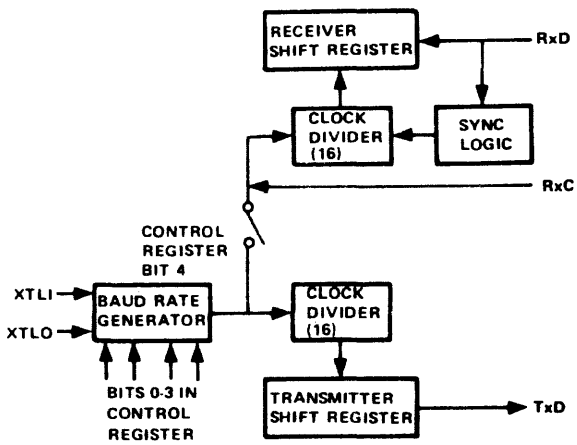
INTERNAL ORGANIZATION



R6551 Block Diagram

Transmitter/Receiver

Bits 0-3 of the Control Register select the divisor used to generate the baud rate for the Transmitter. If the Receiver clock is to use the same baud rate as the Transmitter, then RxC becomes an output pin and can be used to slave other circuits to the R6551.



Transmitter/Receiver Clock Circuits

Transmit and Receive Data Registers

These registers are used as temporary data storage for the 6551 Transmit and Receive circuits. The Transmit Data Register is characterized as follows:

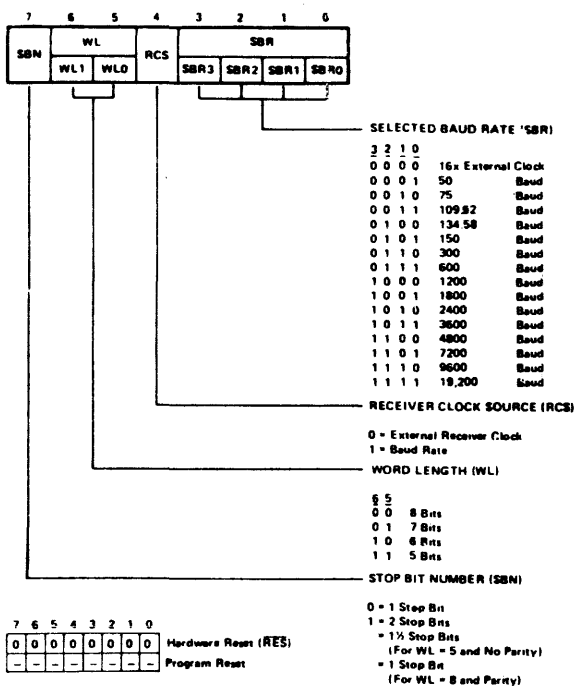
- Bit 0 is the leading bit to be transmitted.
- Unused data bits are the high-order bits and are "don't care" for transmission.

The Receive Data Register is characterized in a similar fashion:

- Bit 0 is the leading bit received.
- Unused data bits are the high-order bits and are "0" for the receiver.
- Parity bits are not contained in the Receive Data Register, but are stripped-off after being used for external parity checking. Parity and all unused high-order bits are "0".

Control Register

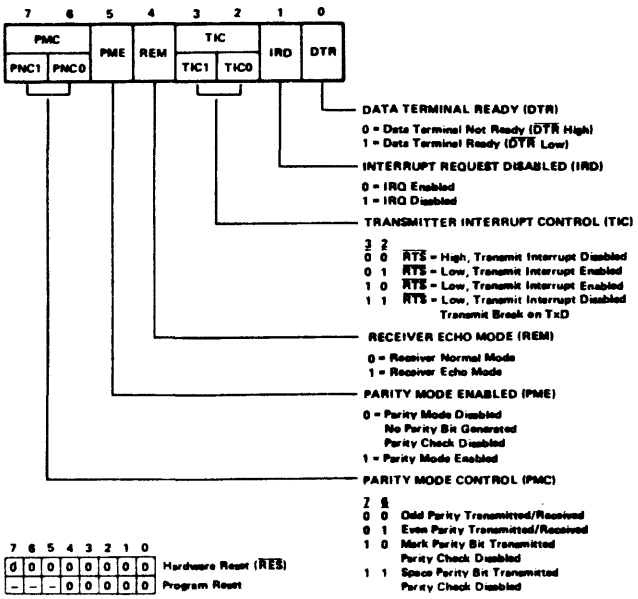
The Control Register selects the desired baud rate, frequency source, word length, and the number of stop bits.



R6551 Control Register

Command Register

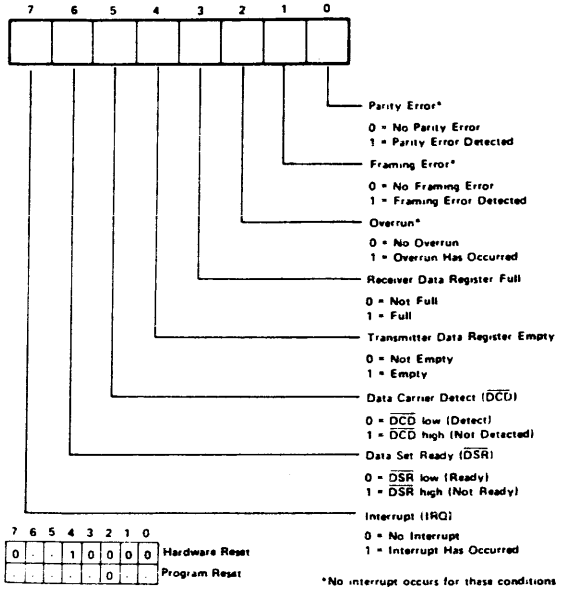
The Command Register controls specific modes and functions.



R6551 Command Register

Status Register

The Status Register reports the status of various R6551 functions



R6551 Status Register

INTERFACE SIGNAL DESCRIPTION

$\overline{RES}$ (Reset)

During system initialization a low on the $\overline{RES}$ input will cause internal registers to be cleared.

Ø2 (Input Clock)

The input clock is the system Ø2 clock and is used to synchronize all data transfers between the system microprocessor and the R6551.

R/$\overline{W}$ (Read/Write)

The R/$\overline{W}$ is generated by the microprocessor and is used to control the direction of data transfers. A high on the R/$\overline{W}$ pin allows the processor to read the data supplied by the R6551. A low on the R/$\overline{W}$ pin allows a write to the R6551.

$\overline{IRQ}$ (Interrupt Request)

The $\overline{IRQ}$ pin is an interrupt output from the interrupt control logic. It is an open drain output, permitting several devices to be connected to the common $\overline{IRQ}$ microprocessor input. Normally a high level, $\overline{IRQ}$ goes low when an interrupt occurs.

D0-D7 (Data Bus)

The D0-D7 pins are the eight data lines used to transfer data between the processor and the R6551. These lines are bi-directional and are normally high-impedance, except during Read cycles when the R6551 is selected.

CS0, $\overline{CS1}$ (Chip Selects)

The two chip select inputs are normally connected to the processor address lines either directly or through decoders. The R6551 is selected when CS0 is high and $\overline{CS1}$ is low.

RS0, RS1 (Register Selects)

The two register select lines are normally connected to the processor address lines to allow the processor to select the various R6551 internal registers. The following table indicates the internal register select coding:

RS1	RS0	Write	Read
0	0	Transmit Data Register	Receiver Data Register
0	1	Programmed Reset (Data is "Don't Care")	Status Register
1	0	Command Register	
1	1	Control Register	

Note that only the Command and Control registers are read/write. The Programmed Reset operation does not cause any data transfer, but is used to clear Bits 0 through 4 in the Command Register and Bit 2 in the Status Register. The Programmed Reset is slightly different from the Hardware Reset ($\overline{RES}$); these differences are described in the individual register definitions.

ACIA/Modem Interface Signal Description

XTLI, XTLO (Crystal Pins)

These pins are normally directly connected to the external crystal (1.8432 MHz) used to derive the various baud rates. Alternatively, an externally generated clock may be used to drive the XTLI pin, in which case the XTLO pin must float. XTLI is the input pin for the transmit clock.

TxD (Transmit Data)

The TxD output line is used to transfer serial NRZ (non-return-to-zero) data to the modem. The LSB (least significant bit) of the Transmit Data Register is the first data bit transmitted and the rate of data transmission is determined by the baud rate selected, or under control of an external clock (as selected by the Control Register).

RxD (Receive Data)

The RxD input line is used to transfer serial NRZ data into the ACIA from the modem, LSB first. The receiver data rate is either the programmed baud rate or the rate of an externally generated receiver clock (as selected by the Control Register).

RxC (Receive Clock)

The RxC is a bi-directional pin which serves as either the receiver 16x clock input or the receiver 16x clock output. The latter mode results if the internal baud rate generator is selected for receiver data clocking.

$\overline{RTS}$ (Request to Send)

The $\overline{RTS}$ output pin is used to control the modem from the processor. The state of the $\overline{RTS}$ pin is determined by the contents of the Command Register.

$\overline{CTS}$ (Clear to Send)

The $\overline{CTS}$ input pin is used to control the transmitter operation. The enable state is with $\overline{CTS}$ low. The transmitter is automatically disabled if $\overline{CTS}$ is high.

$\overline{DTR}$ (Data Terminal Ready)

This output pin is used to indicate the status of the R6551 to the modem. A low on $\overline{DTR}$ indicates the R6551 is enabled and a high indicates it is disabled. The processor controls this pin via bit 0 of the Command Register.

$\overline{DSR}$ (Data Set Ready)

The $\overline{DSR}$ input pin is used to indicate to the R6551 the status of the modem. A low indicates the "ready" state and a high, "not-ready". $\overline{DSR}$ is a high-impedance input, and must be connected. If unused, it should be driven high or low, but not switched.

$\overline{DCD}$ (Data Carrier Detect)

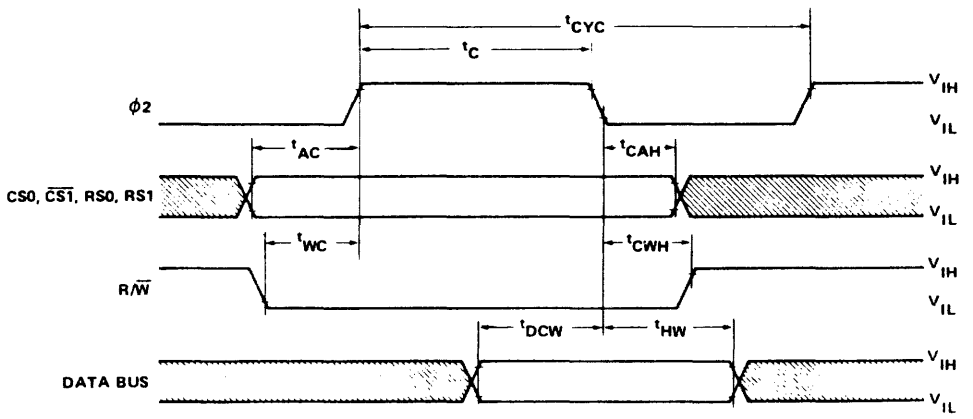
The $\overline{DCD}$ input pin is used to indicate to the R6551 the status of the carrier-detect output of the modem. A low indicates that the modem carrier signal is present and a high, that it is not. Like $\overline{DSR}$, $\overline{DCD}$ is a high-impedance input, and must be connected.

READ/WRITE CYCLE CHARACTERISTICS

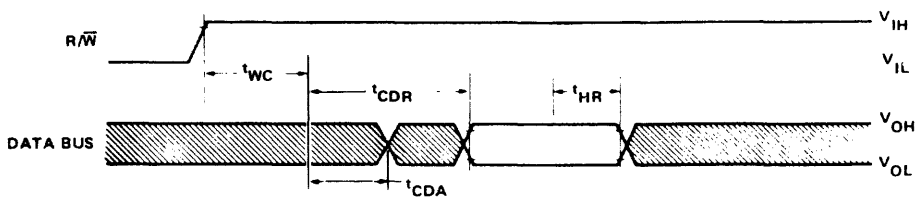
(V_{CC} = 5.0V ±5%, T_A = 0 to 70°C, unless otherwise noted)

Characteristic	Symbol	1 MHz		2 MHz		Unit
		Min	Max	Min	Max	
Cycle Time	t_{CYC}	1.0	40	0.5	40	μs
Ø2 Pulse Width	t_C	400	–	200	–	ns
Address Set-Up Time	t_{AC}	120	–	70	–	ns
Address Hold Time	t_{CAH}	0	–	0	–	ns
R/$\overline{W}$ Set-Up Time	t_{WC}	120	–	70	–	ns
R/$\overline{W}$ Hold Time	t_{CWH}	0	–	0	–	ns
Data Bus Set-Up Time	t_{DCW}	150	–	60	–	ns
Data Bus Hold Time	t_{HW}	20	–	20	–	ns
Read Access Time (Valid Data)	t_{CDR}	–	200	–	150	ns
Read Hold Time	t_{HR}	20	–	20	–	ns
Bus Active Time (Invalid Data)	t_{CDA}	40	–	40	–	ns

(t_r and t_f = 10 to 30 ns)



Write Timing Characteristics



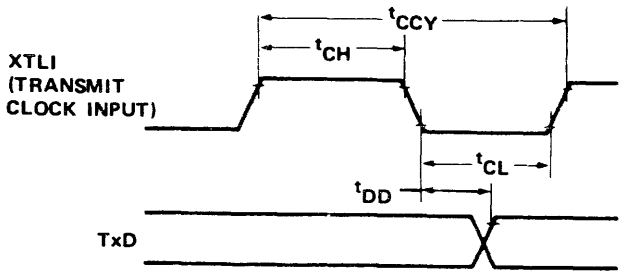
Read Timing Characteristics

TRANSMIT/RECEIVE CHARACTERISTICS

Characteristic	Symbol	1 MHz		2 MHz		Unit
		Min	Max	Min	Max	
Transmit/Receive Clock Rate	t_{CCY}	400*	–	400*	–	ns
Transmit/Receive Clock High Time	t_{CH}	175	–	175	–	ns
Transmit/Receive Clock Low Time	t_{CL}	175	–	175	–	ns
XTLI to TxD Propagation Delay	t_{DD}	–	500	–	500	ns
$\overline{RTS}$ Propagation Delay	t_{DLY}	–	500	–	500	ns
$\overline{IRQ}$ Propagation Delay (Clear)	t_{IRQ}	–	500	–	500	ns

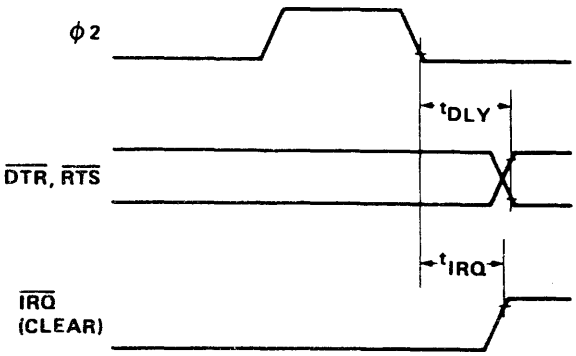
(t_r, t_f = 10 to 30 ns)

*The baud rate with external clocking is: Baud Rate = $\frac{1}{16 \times T_{CCY}}$

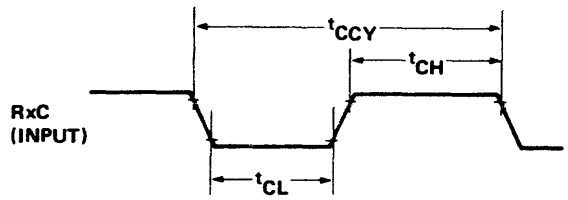


NOTE: TxD rate is 1/16 TxC rate

Transmit Timing with External Clock



Interrupt and Output Timing

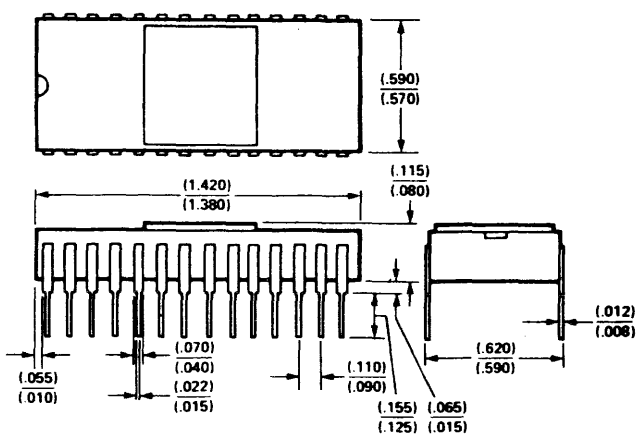


NOTE: RxD rate is 1/16 RxC rate

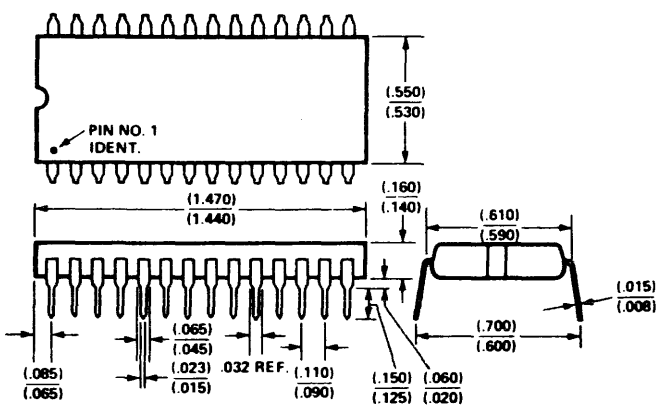
Receive External Clock Timing

PACKAGE OUTLINES

28 LEAD CERAMIC



28 LEAD PLASTIC



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	ENGINEER RELEASE		
	B	PROD REL PER ECO 80,116		
	B1	PROD REL PER ECO 123,162,163,204,212,386		

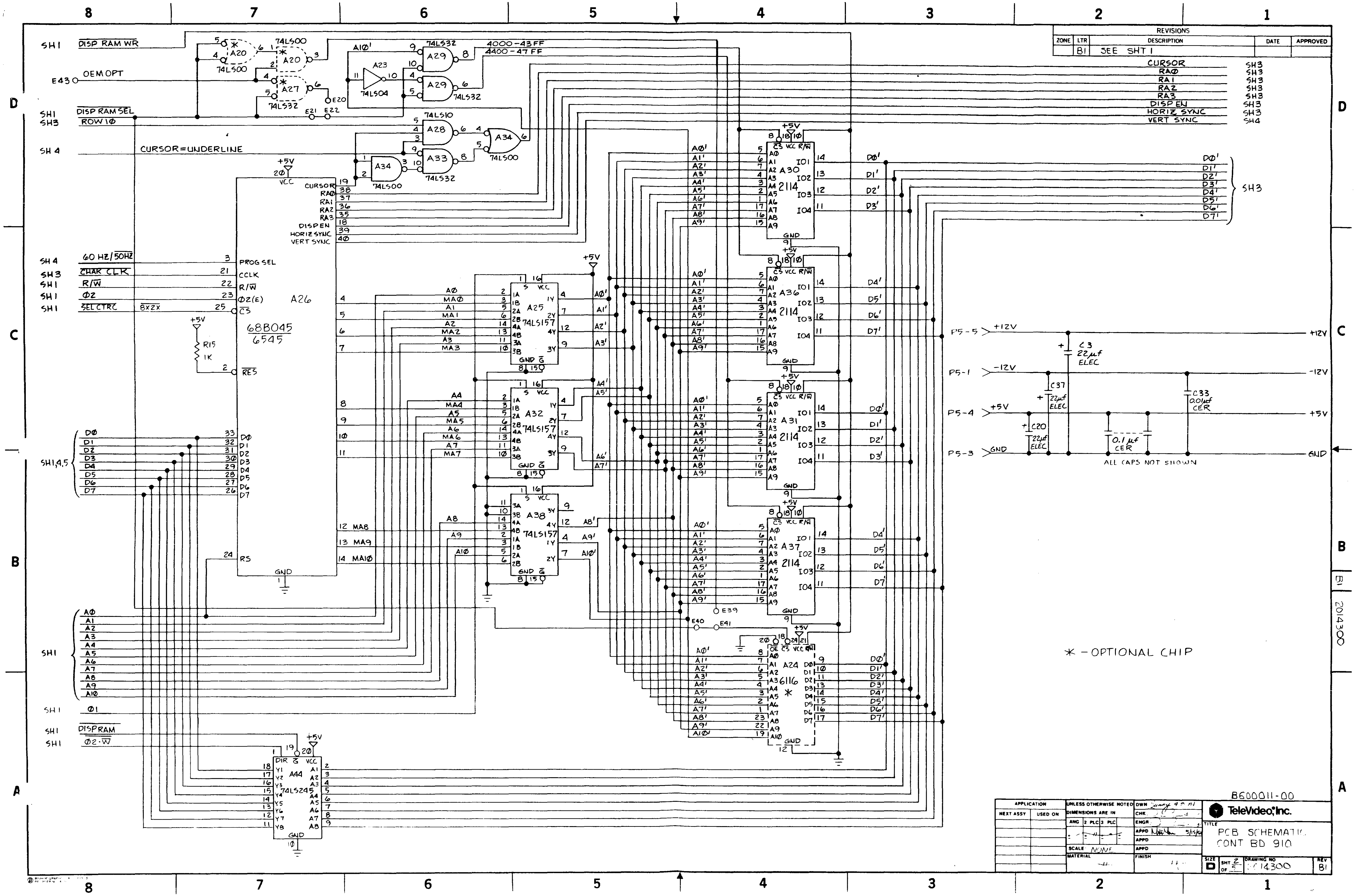
A39 6502A

CHAR CLK
NMI
VERTSYNC/IRQ
IRQ (ACIA)
RESET
SO
SYNC
R/W
Ø2
Ø1
DØ D1 D2 D3 D4 D5 D6 D7
AØ A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15
RDY
Ø0
R8 1K
A46 74LS10
A4 555
R13 3.3K
R12 1M
R14 47K
CR1 IN914
C14 10µf
C22 0.01µf
C23 0.01µf
R22 4.7K
C28 0.01µf
A22 7404
A45 2332
A50 2114
A51 2114
A17 74LS139
A9 74LS00
A23 74LS04
A33 74LS32
A29 74LS32
A21 74LS08
A47 74LS02
A7 74LS74
RP1 4.7K
RP4 1K
RZ1 1K
A16 74LS138
A4 74LS04
A23 74LS04
SET DISP RAM
CHAR CLK
9XXØ
8000-8FFF
4000-7FFF
0000-3FFF
9XX1
9XX2
Ø2·W
CONTROL LATCH
DIPSWITCH PORT #1
DIPSWITCH PORT #2
DISP RAM SEL
DISP RAM WR
DISP RAM
SYS RESET
8XØX 8X1X 8X2X 8X3X 8X4X 8X5X 8X6X 8X7X
CHAR SET SEL PD
SEL CRTC
SEL ACIA
RESET IRQ
RESET NMI
KYBD PORT #1
KYBD PORT #2
SH2 SH3 SH4 SH5

APPLICATION		UNLESS OTHERWISE NOTED	DWN	TeleVideo, Inc.
NEXT ASSY	USED ON	DIMENSIONS ARE IN	CHK	
		ANG ± PLC .3 PLC	ENGR	TITLE PCB SCHEMATIC
			APPD 3/13/84	CONT BD 910
		SCALE NONE	APPD	
		MATERIAL	APPD	
			FINISH	SIZE D SHT 1 OF 5 DRAWING NO 2014300 REV B1

B60011.00

B1 204300



ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B1	SEE SHT 1		

B600011-00

TeleVideo, Inc.

PCB SCHEMATIC CONT BD 910

SIZE D SHT 2 DRAWING NO 2014300 REV B1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B1	SEE SHT1		

SH2 HORIZ SYNC
SH2 DISP EN
SH2 CURSOR
SH1 Ø1
SH2 DØ' D1' D2' D3' D4' D5' D6' D7'
SH2 RAØ RA1 RA2
SH2 RA3

CHADØ CHAD1 CHAD2 CHAD3 CHAD4 CHAD5 CHAD6 CHAD7

ATTRIBUTE

74LS32 A29 — 74LS04 A23 — 74LS08 A46 — 74LS02 A47 — 74LS32 A35 — 74LS02 A47 — 74LS32 A35 — 74LS32 A35 — 74LS08 A46 — 74LS32 A35

RP1 4.7K — RP1 4.7K — RP1 4.7K — RP4 1K

A40 74S74 1/2 — A41 74LS174 — A42 74LS174 — A49 74LS166 — A48 2332 — A43 74LS374 — A15 74LS163

CHARACTER SET SELECT — E4 E5 E6 E7

Y2 XTAL 13.608 MHZ — C30 10pf — R23 330 — R24 750 — R17 1.8K — R18 470 — A22 74S04 — A22 74S04 — A23 74LS04 — A22 74S04 — A28 74LS10

HORIZ SYNC B SH4
HORIZ SYNC SH4
DEL DISP EN SH4
DEL CURSOR SH4
HALF INTENSITY SH4
ATT BLK SH4
UNDERLINE SH4
REV VIDEO SH4
BLINK SH4
BLANK SH4
DC CARRY
SHIFT CLOCK
DOT SERIAL SH4
1 SET DISP RAM SH1
CHAR CLK SH1,2
CHAR CLK SH1
BITØ SH5
BIT1 SH5
ROW1Ø SH2,4
RAØ SH4

APPLICATION		UNLESS OTHERWISE NOTED	DWN Sunny 4.2.91	B600011-00
NEXT ASSY	USED ON	DIMENSIONS ARE IN	CHK 4.20.91	TeleVideo, Inc.
		ANG 2 PLC 3 PLC	ENGR 4.21.91	TITLE PCB SCHEMATIC CONT BD 910
		SCALE NONE	APPD 5/3/91	
		MATERIAL	FINISH	SIZE D SHT 3 OF 3 DRAWING NO 2014300 REV B1

2014300

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B1	SEE SHT 1		

SH3 HORIZ SYNC B
SH3 RA0
SH3 BLINK
SH4 BLINK CLK
SH3 BLANK
SH3 DOT SERIAL
SH3 ROW 10
SH3 UNDERLINE
SH3 DEL CURSOR
SH3 REV VIDEO
SH5 BOW/WOB
SH3 DEL DISP EN
SH3 ATT BLK
SH3 HALF INTENSITY
SH3 HORIZ SYNC
SH2 VERT SYNC

A34 74LS00 · A28 74LS10 · A22 74S04 · A13 74LS00 · A13 74LS00 · A34 74LS00 · A14 74LS86 · A14 74LS86 · A14 74LS86 · A12 7406 · A13 74LS00 · A12 7406 · A13 74LS00 · A21 74LS08 · A12 7406 · A22 74S04 · A14 74LS86 · A12 7406

HORIZ SYNC → P2-1
+5V · R2 22 · C2 4.7µF
VIDEO SHIELDGND → P2-3
R4 750 · R5 1K · R7 1K · R6 68 · R3 270 · R27 1K · CR3 1N914 · Q2 2N2219
VIDEO → P2-4
E10 E11 E12 E13
COMP V + TTL VIDEO → P2-6
VERT SYNC → P2-5
VERT SYNC / IRQ SH1

RP1 4.7K · +5V · A40 74S74
SH1 RESET IRQ 8X4X
SH5 DATA RDY
SH1 8X5X RESET NMI

RP4 1K · +5V · A7 ½ 74LS74
NMI SH1
DTR SH5

DTR · +5V · 4.7K · A5 75189
P4-20 DTR
P3-3 RxD
P6-3 RxD
P3-5 CTS
P3-8 DCD 12
P3-6 DSR 13
SW2 · E14 E15 E16
C5 C7 C6 C8 330pf

74LS00 · A9 · +12V · A10 75188 · -12V
TXD MODEM → P6-2
TXD → P3-2
RTS → P3-4
DTR E17 E18 E19
SERIAL DATA, PRINTER → P4-3
DTR EN 10 · S2 → P3-20

SH1 SEL ACIA (8X3X)
SH1 R/W
SH1 Ø2
SH1 AØ
SH1 A1
SH1,2,5 DØ D1 D2 D3 D4 D5 D6 D7
ACIA 6551A-1 · A19 · +5V · RP1 4.7K · Y1 1.8432 MHZ
IRQ (ACIA) SH1
RxC → P6-12
SH1 SYS RESET
SH1 CONTROL LATCH

74LS174 A18 · BELL · EXT · SPARE E42
A21 74LS08 · +5V · R16 68 · R20 330 · R19 330 · Q1 2N2219
P7-2 SPEAKER
P7-1
BLINK CLK SH4
60HZ / 50HZ SH2
CURSOR = UNDERLINE SH2

SH3 ROW 10 (1620 HZ)
P6-13

APPLICATION		UNLESS OTHERWISE NOTED	DWN	5600011-00
NEXT ASSY	USED ON	DIMENSIONS ARE IN	CHK	TeleVideo, Inc.
		ANG 2 PLC 3 PLC	ENGR	TITLE PCB SCHEMATIC CONT BD 910
		SCALE NONE	APPD	
		MATERIAL	FINISH	SIZE D · SHT 4 OF 5 · DRAWING NO 2014300 · REV B1

B1 | 2014300

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B1	SEE SHT 1		

SH1 CHAR SET SEL RD 8X1X
SH1 DIPSWITCH PORT # 2 9XX2
SH1 DIPSWITCH PORT # 1 9XX1
SH1 KYBD PORT # 1 8X6X
SH1 KYBD PORT # 2 8X7X

RP4 1K 1K 1K 1K
+5V
A1 AY-5-3600 / KR-3600
P1-4 SHIFT
P1-6 CONTROL
A12 7406
P1-20 P1-16 P1-21 P1-17 P1-22 P1-18 P1-23 P1-19 P1-26 P1-8 P1-9 P1-10 P1-11 P1-12 P1-13 P1-14 P1-15
FREQ CONT C35 20pf R25 100K
R26 1K RP4 1K 1K
C32 0.039 µf
E8 E9
SH4 DTR
P1-5 FUNC KEY
P1-3 ALPHA LOCK KEY

A2 2716
E23 E25 E27 E29 E31 E33 E35 E37 E24 E26 E28 E30 E32 E34 E36 E38

A3 74LS367
A8 74LS367

DATA RDY SH4
D7 D6 D5 D4 D3 D2 D1 D0 SH1,2,4

RP2 1K
S1
1 BD RT3
2 BD RT2
3 BD RT1
4 BD RTØ
5 WD LNGTH
6 PAR
7 O/E
8 STP BITS
9 TCHAR 1
1Ø
TCHARØ R1 1K

A11 74LS367
A6 74LS367

S2
1 EM1
2 EMØ
3 50/60
4 CURSOR
5 CURSOR
6 F/HDX
7 BOW/WOB
RP3 1K

A52 74LS367

BOW/WOB SH4
SH3 BITØ
SH3 BIT1

P1-1 P1-2 P3-1 P3-7 P4-1 P4-7

NOTE:
P6 IS A 14- OR 16-PIN DIP SOCKET FOR OPTION BOARD CONNECTION. * PINS Ø & 15 ARE PINS 1 & 16 IF A 16-PIN SOCKET IS INSTALLED FOR P6.

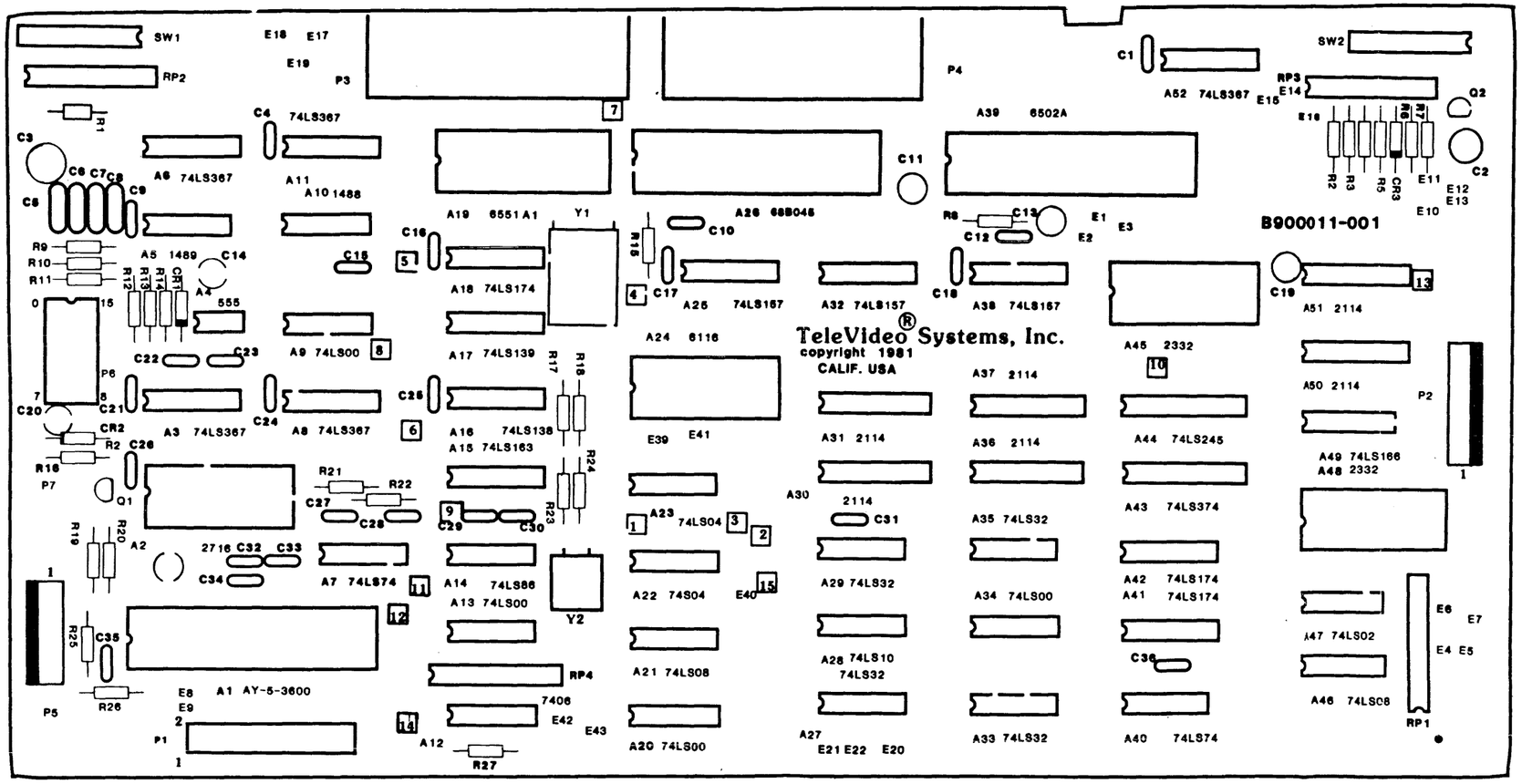
+12V → P6-1, P6-14
-12V → P6-5, P6-10
+5V → P6-6, P6-9, P6-7, P6-8

*P6-15 RxD+ → P3-12
*P6-Ø RxD- → P3-24
P3-25 TxD+ → P6-11
P3-13 TxD- → P6-4
CURRENT LOOP COMM (OPTIONAL)

B600011-00

APPLICATION		UNLESS OTHERWISE NOTED	DWN	TeleVideo, Inc.
NEXT ASSY	USED ON	DIMENSIONS ARE IN	CHK	
		ANG 2 PLC 3 PLC	ENGR	TITLE: PCB SCHEMATIC CONT BD 910
			APPD	
		SCALE: NONE	APPD	
		MATERIAL	FINISH	SIZE D, SHT 5 OF 5, DRAWING NO 2014300, REV B1

B1 2014300



910 CONTROL BOARD
REV B

NOTES UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE VALUED IN OHMS ±5% AND ARE 1/4 WATT.
2. ALL CAPACTOR ARE VALUED IN MICOFARADS ±10% AND ARE 50 VDC.
3. DRAWINGS COMFORM WITH TELEVIDEO SPEC. NO S000000-001.
4. THIS SCHEMATIC ALSO USED FOR CONTROL BD 910 + G/A.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	PROD REL PER ECO 249		3/14/82
	A2	PROD REL PER ECO 0379		
	A3	PROD REL PER ECO 0400		
	A4	PROD REL PER ECO 0516, 0521, 0529		
	A5	REVISED PER ECO 2001		

+5V
A27 6502A
R28 1K
RDY
SH3 CHAR CLK
SH4 NMI
SH4 VERT SYNC / IRQ
SH4 IRQ (ACIA)
A28 74LS08
RESET
SO
SYNC
GND GND
R/W
Ø2
Ø1
D0 D1 D2 D3 D4 D5 D6 D7
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15

R6 3.3K
R8 1M
C4 0.1uf
C6 0.01uf
A4 555
RST THR DIS TRG GND CV OUT
R7 47K
CR1 IN914
C5 10uf 16V
RP2 4.7K
A7 7406
C9 0.01uf

A29 74LS00
A21 74S04
A30 74LS139
1G 2G 1A 1B 2A 2B
1Y0 1Y1 1Y2 1Y3 2Y0 2Y1 2Y2 2Y3
8000-BFFF
4000-7FFF
R25 4.7K E1 E2 E3
A38 2532
CS1 CS2
A31 2114
A32 2114
CS R/W IO1 IO2 IO3 IO4
0000-3FFF
C000-FFFF
9XXØ

SH3 Ø2 · R/W
SH3 DISP RAM

PII-20
SH2,3,4 R/W
SH2,3,4 Ø2
SH2,3 Ø1
SH2,4,5 D0 D1 D2 D3 D4 D5 D6 D7

A34 74LS32
CONTROL LATCH SH4
9XX1 DIPSWITCH PORT #1 SH5
9XX2 DIPSWITCH PORT #2 SH5
4000-7FFF SH3
DISP RAM WR SH2
SYS RESET SH4

R24 4.7K
A37 74LS138
G2A G2B VCC G1
8XØX
8X1X CHAR SET SEL RB SH5
8X2X SEL CRTC SH2
8X3X SEL ACIA SH4
8X4X RESET IRQ SH4
8X5X RESET NMI SH4
8X6X KYBD PORT #1 SH5
8X7X KYBD PORT #2 SH5

AØ SH2,4 PII-3
A1 SH2,4 PII-5
A2 SH2 PII-7
A3 SH2 PII-8
A4 A5 A6 A7 A8 A9 A10 SH2

B600011-002

APPLICATION		UNLESS OTHERWISE NOTED	DWN H. Hwe 1-11-82
NEXT ASSY	USED ON	DIMENSIONS ARE IN	CHK 3/14/82
2014405	—	ANG ± PLC ± PLC	ENGR 3/14/82
		SCALE NONE	APPD
		MATERIAL	FINISH

TeleVideo, Inc.
TITLE: PCB SCHEMATIC CONT BD 910 G/A
SIZE D | SHT 1 OF 5 | DRAWING NO 2014301 | REV A5

2014301 A5

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A5	SEE SHT 1		

A20 6545A-1 CRTC

A19 74LS157 · A23 74LS157 · A26 74LS157 · A13 6116 · A14 74LS245 · A35 74LS04

SH5 60HZ/50HZ · SH3 CHAR CLK · SH1 R/W · SH1 Ø2 · SH1 SEL CTRC 8X2X

CURSOR · RAØ · RA1 · RA2 · RA3 · DISPEN · HORZ SYNC · VERT SYNC

SH3 CURSOR, RAØ, RA1, RA2, RA3, DISP EN, HORIZ SYNC, VERT SYNC

SH3,4 → P11-22, P11-23

SH1,4,5 DØ–D7

SH1 AØ–A10, Ø1

SH3 PAGE ONE · Ø2·W · DISP RAM WR

SH1 DISP RAM

SH3 DØ'–D7'

P5-5 +12V → +12V (C3 22uF ELEC)

P5-1 -12V → -12V (C2 22uF ELEC)

P5-4 +5V (C7 22uF ELEC; C1~C43 0.1uF CER; C20 10uf 25V) → +5V

P5-3 GND → GND

ALL CAPS NOT SHOWN

+5V → P6-6, P6-9, P11-1, P11-2

+12V → P6-1, P6-14, P11-6

-12V → P6-5, P6-10, P11-14

NOTE: P6 IS A14 - OR 16 - PIN DIP SOCKET FOR OPTION BOARD CONNECTION. *PINS 0 & 15 ARE PINS 1 & 16 IF A16 - PIN SOCKET IS INSTALLED FOR P6.

E33 → P11-25

* P6-15	RXD+	P3-12
* P6-Ø	RXD-	P3-24
P3-25	TXD+	P6-11
P3-13	TXD-	P6-4

CURRENT LOOP COMM (OPTIONAL)

B600011-002

APPLICATION		UNLESS OTHERWISE NOTED DIMENSIONS ARE IN	DWN H. Hwr 12-31-81
NEXT ASSY	USED ON		CHK J. Rusak 1/6/82
2014405	—	ANG 2 PLC 3 PLC	ENG
			APPD
		SCALE: NONE	APPD
		MATERIAL	APPD
			FINISH

TeleVideo, Inc.

TITLE: PCB SCHEMATIC CONT BD 910 G/A

SIZE D · SHT 2 OF 5 · DRAWING NO. 2014301 · REV A5

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A5	SEE SHT 1		

74LS32 A34

SH2 HORIZ SYNC

HORIZ SYNC B SH4

SH1 SYS RESET

SH2 CURSOR

SH2 DISP EN

SH2 VERT. SYNC.

SH1 R/W

SH1 Ø1

SH1 Ø2

SH1 4000-7FFF

SH4 BLINK CLOCK

SH5 BOW/WOB

SH4 CURSOR =BLOCK

SH2 RA3

A22 GATE ARRAY 70200-11B

H.SYNC, SYS.RST, CURSOR IN, DISP EN., VERT.SYNC, R/W, Ø1, Ø2, 4000-7FFF, BLINK CLK, BOW/WOB, CURSOR=BLOCK, CHAD7, RA3, RAØ, RA1, RA2, CHAD3, CHAD2, CHAD1, CHADØ, DOTCLK, SER SYNC, PG 1 SEL, PG 2 SEL, DOT CLK, SH. SET DR ATT., VDD, VSS, PG.ONE, PG.TWO, DISP.RAM, Ø2·W, ROW 10, VIDEO, HALF INT., COMP.VID., L/P ATT.

PAGE ONE SH2

DISP.RAM SH1,2

Ø2·W SH1,2

ROW 10 SH4

VIDEO SH4 → P11-17

HALF INTENSITY SH4 → P11-26

COMPOSITE VIDEO SH4

+5V, RP4 4.7K, E35, E34

SET DISP RAM → P3-1, P4-1

DC CARRY

SHIFT CLOCK → P11-21

RP3 4.7K

A12 74LS374: DØ' D1' D2' D3' D4' D5' D6' D7' → CHADØ CHAD1 CHAD2 CHAD3 CHAD4 CHAD5 CHAD6

A18 74LS166

A17 2332

SH2 RAØ RA1 RA2

RP3 4.7K, E4 E6 E5 E7

WZ WT

74LS02 A24, 74LS08 A28, 74LS00 A29, A35 74LS04

A25 TC 74LS163

A21 74S04, 74LS00 A29, 74LS02 A24

Y2 XTAL 13.608 MHZ, C18 10pf, R17 330, R14 750, R16 470, R15 1.8K, 74S04 A21

E36 E37

CHAR CLK SH1

CHAR CLK SH1

BIT Ø SH5

BIT 1 SH5

P1-1, P1-2, P3-7, P4-7, P6-7, P6-8, P11-9, P11-19

APPLICATION		UNLESS OTHERWISE NOTED	DWN H. Huc 1-4-82	TeleVideo, Inc.
NEXT ASSY	USED ON	DIMENSIONS ARE IN	CHK Thomas 2/8/82	
2014805	—	ANG ± PLC .3 PLC	ENGR	TITLE
			APPD	PCB SCHEMATIC
		SCALE: NONE	APPD	CONT BD 910 G/A
		MATERIAL	APPD	
			FINISH	SIZE D SHT 3 OF 5 DRAWING NO 2014301 REV A5

B600011-002

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A5	SEE SHT 1		

SH3 HORIZ SYNC B → HORZ SYNC → P2-1
SH2 VERT SYNC → VERT SYNC → P2-5
VERT SYNC/IRQ → SH1
SH1 RESET IRQ 8X4X
SH3 VIDEO
SH3 HALF INTENSITY
SH3 COMPOSITE VIDEO
P10-8
P10-9
P10-5
SH5 DATA RDY
SH1 8X5X RESET NMI
P4-20 DTR
P3-3 RXD
P6-3 RXD
P3-5 CTS
P3-8 DCD
P3-6 DSR
SHI SEL ACIA (8X3X)
R/W
Ø2
AØ
A1
DØ
D1
D2
D3
SH1,2,5 D4
D5
D6
D7
SH1 SYS RESET
SH1 CONTROL LATCH
SH3 ROW 10 (1620 HZ)
P6-13

4.7K RP4 +5V
A21 74S04
74S74 A36
R21 750
R20 1K
R23 1K
R22 270
E10 E11 E12 E13
CR2 IN914
Q2 2N2219
R19 22
C18 4.7µF
R27 10K
R26 33
VIDEO SHIELD GND → P2-3
VIDEO → P2-4
COMP V + TTL VIDEO → P2-6
A7 7406
E38 E39 E40 E41 E42 E43
P10-10
P10-11
P10-7
4.7K RP3 +5V
74LS74 A16
NMI → SH1
DTR → SH5
+5V DTR 4.7K
75189 A10
E14 E15 E16 SW2
C14 C13 C16 C15 330pf
A7 7406
4.7K +5V RP4
+12V
1488 A9
TXD MODEM → P6-2
TXD → P3-2
C10 330pf
RTS → P3-4
C17 330pf
E17 E18 E19
DTR C11 330pf
C12 330pf
SERIAL DATA, PRINTER → P4-3
DTR EN S2 → P3-20
-12V
A15 ACIA 6551A-1
A29 74LS00
RP4 4.7K
IRQ (ACIA) → SH1
RXC → P6-12
P10-13
P10-4
P10-6
P10-2
P10-12
E45 E44
Y1 1.842 MHZ
XTAL1 XTAL2
RST DSR GND
A11 74LS174
SPARE
BELL
EXT
+5V R3 68 → P7-2 SPEAKER
R4 330
R5 330
Q1 2N2219 → P7-1
A28 74LS08
BLINK CLK → SH3
A7 7406
4.7K +5V R18
CURSOR = BLOCK → SH3

APPLICATION	
NEXT ASSY	USED ON
2014405	—

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN ANG 2 PLC 3 PLC
SCALE: NONE
MATERIAL
FINISH
DWN H.Hsu 1-4-82
CHK J.Lewis 2/1/82
ENGR
APPD
APPD
APPD

B60011-002
TeleVideo, Inc.
TITLE: PCB SCHEMATIC CONT BD 910 G/A
SIZE D | SHT 4 OF 5 | DRAWING NO 2014301 | REV A5

2014301 A5

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A5	SEE SHT 1		

SH1 { CHAR SET SEL RD 8X1X; DIPSWITCH PORT #2 9XX2; DIPSWITCH PORT #1 9XX1 }

DATA RDY → SH4

A1 AV-5-3600 KR-3600

P1-4, P1-6, P1-20, P1-16, P1-21, P1-17, P1-22, P1-18, P1-23, P1-19, P1-26, P1-8, P1-9, P1-10, P1-11, P1-12, P1-13, P1-14, P1-15

SHIFT, CONTROL, RDY, VDD -12V, B1–B9, Y0–Y8, X0–X7, LO/RD DELAY, GND, AK0

A7 74Ø6 ×2; RP2 4.7K ×4; R1 1K; R2 100K; C1 20pf; C8 0.039 µf; E8, E9; FREQ CONT

A2 2716: A8–A10, D7–D0, OE, CE, GND; E23–E38

S1: 1 BDRT3, 2 BDRT2, 3 BDRT1, 4 BDRTØ, 5 WD LNGTH, 6 PAR, 7 O/E, 8 STP BITS, 9 TCHAR1, 10 TCHARØ

RP1 4.7K; R9 1K

S2: 1 EM1, 2 EMØ, 3 50/60, 4 CURSOR, 5 CURSOR, 6 F/HDX, 7 BOW/WOB

RP5 4.7K

A6 74LS367: 1BDRT3, 2BDRT2, 3BDRT1, 4BDRTØ, 5WD LNGTH, 6PAR → P11-13, P11-12, P11-11, P11-10, P11-16, P11-15

A5 74LS367: 1BDRT3, 2BDRT2, 3BDRT1, 4BDRTØ, 5WD LNGTH, 6PAR → P11-18, P11-24

A33 74LS367: 1BDRT3, 2BDRT2, 3BDRT1, 4BDRTØ, 5WD LNGTH, 6PAR → D4, D5, D6, D7, DØ, D1

A3 74LS367: 1BDRT3, 2BDRT2, 3BDRT1, 4BDRTØ, 5WD LNGTH, 6PAR → D3, D2, D1, DØ

A8 74LS367: 1BDRT3, 2BDRT2, 3BDRT1, 4BDRTØ, 5WD LNGTH, 6PAR → D6, D7, D1, DØ

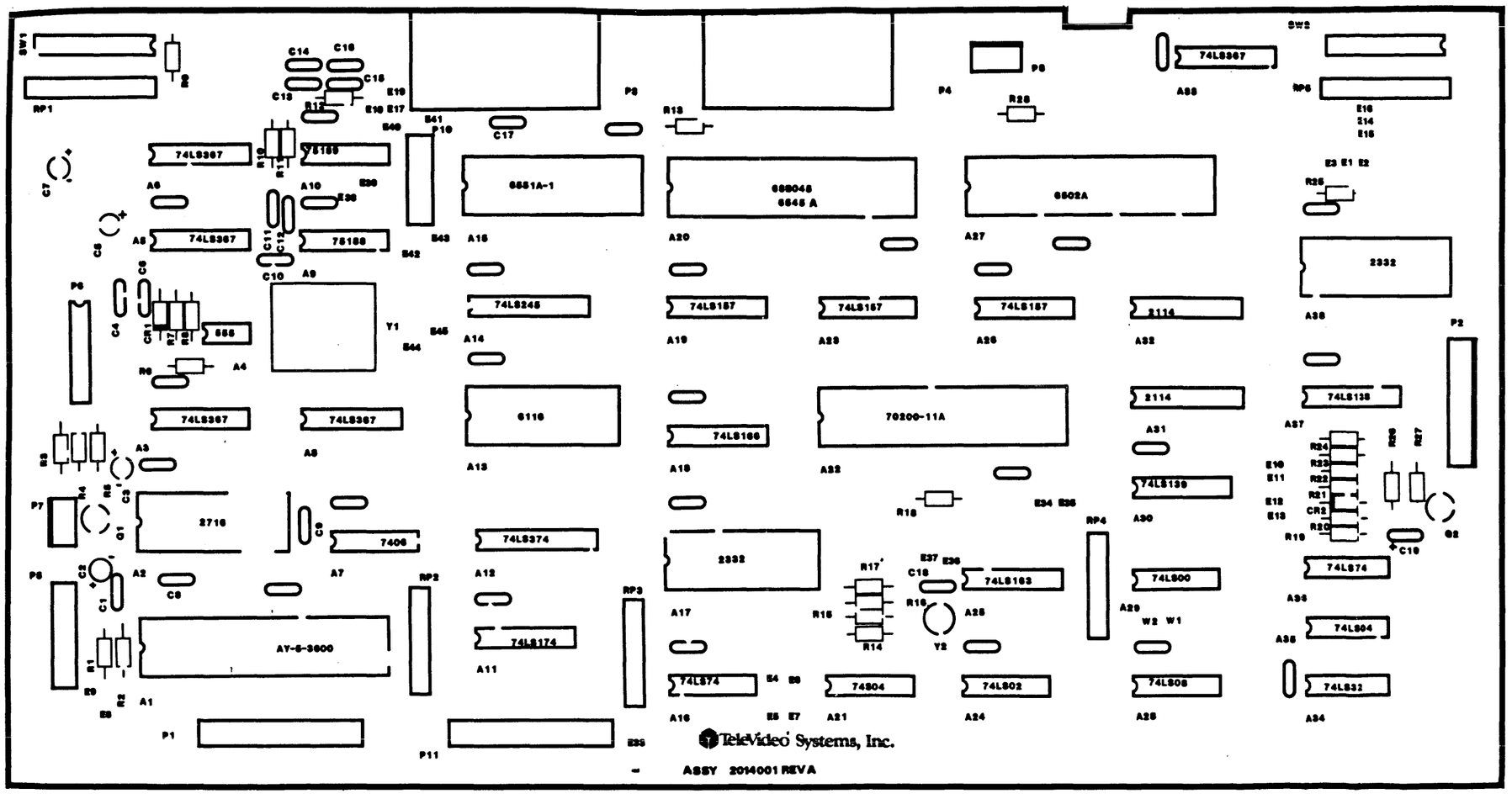
SH4 DTR
P1-5 FUNC KEY
P1-3 ALPHALOCK KEY
SH1 KYBD PORT #1 8X6X
SH1 KYBD PORT #2 8X7X
SH3 BITØ
SH3 BIT1

50/60 HZ ← SH 2
BOW/WOB ← SH4
D7, D6, D5, D4, D3, D2 ← SH1,2,4
D1, DØ

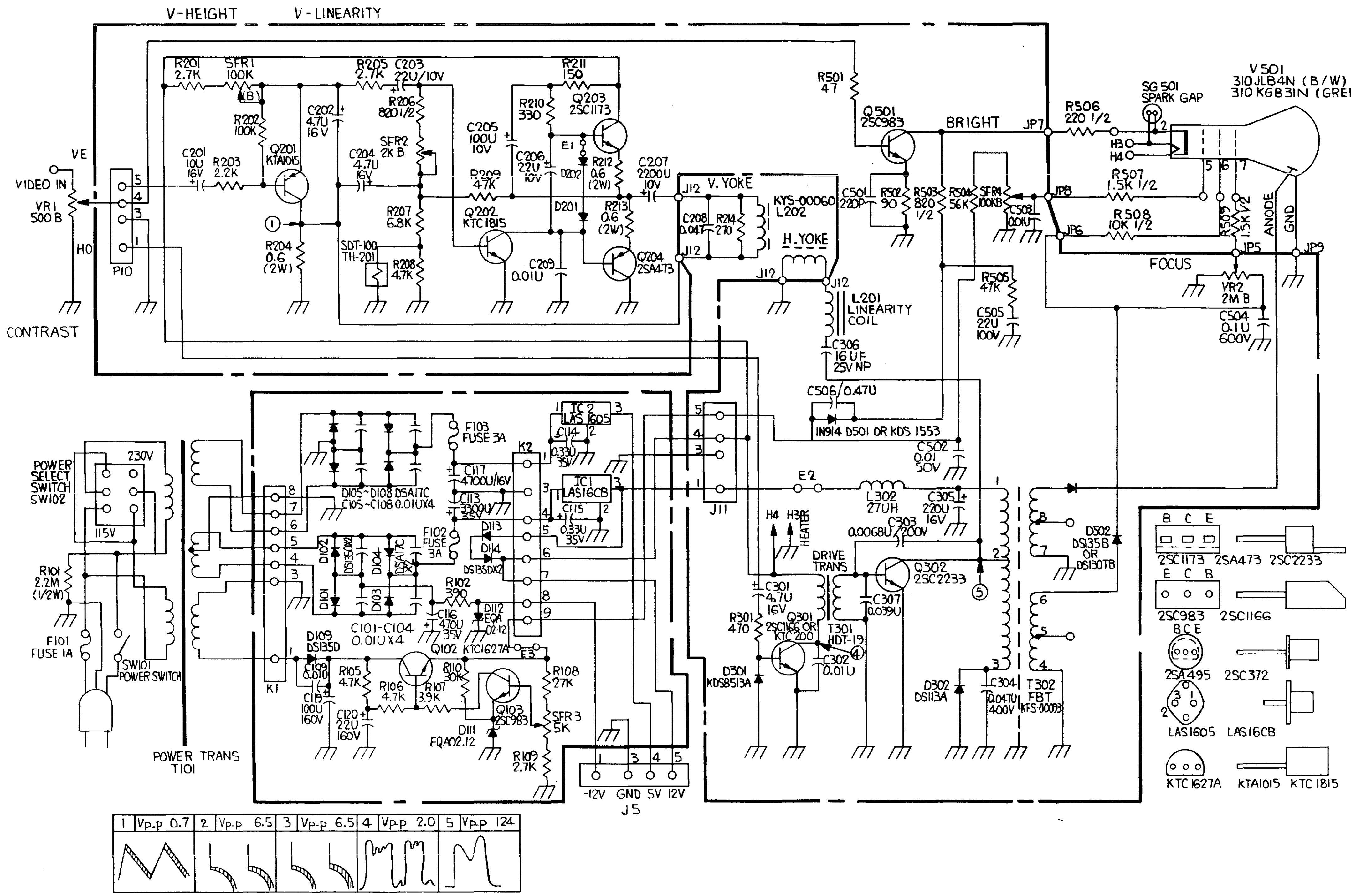
B600011-002

APPLICATION		UNLESS OTHERWISE NOTED	DWN H. Hart 1-6-82	TeleVideo, Inc.
NEXT ASSY	USED ON	DIMENSIONS ARE IN	CHK	TITLE: PCB SCHEMATIC CONT BD 910 G/A
2014405	—	ANG ± PLC .3 PLC	ENGR	
		SCALE: NONE	APPD	
		MATERIAL	FINISH	SIZE D; SHT 5 OF 5; DRAWING NO 2014301; REV A5

2014301 A5



910 GATE ARRAY
CONTROL BOARD
REV A



1. ALL RESISTANCE VALUES IN OHM K=1,000 M=1,000,000.
2. ALL CAPACITOR VALUES IN FARAD U=10^{-6} P=10^{-12}
3. UNLESS OTHERWISE STATED, WORKING VOLTAGES OF CAPACITORS ARE 50 VOLTS.
4. THIS SCHEMATIC DIAGRAM COVERS BASIC OR REPRESENTATIVE CHASSIS ONLY. THERE MAY BE SOME COMPONENT OR PARTIAL SCHEMATIC DIFFERENCE BETWEEN ACTUAL CHASSIS AND THE SCHEMATIC DIAGRAM.

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED

PARTS LIST

APPLICATION: NEXT ASSY / USED ON

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN

DWN H.Hur 2/8/83
ENGR S.M. Kim 2/8/83

TeleVideo, Inc.

TITLE: PCB SCHEMATIC DIARAM POWER SUPPLY VIDEO MONITOR

SIZE D SHT 1 OF 1 DRAWING NO. 2281900

2281900

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B											
1												
2	1									A40	IC 74S74	2026400
3	1									A4	IC NE 555	2030200
4	1									A39	IC 6502A Micro	2049600
5	1									A17	IC 74LS139	2027200
6	1									A16	IC 74LS138	2041000
7	1									A45	IC EP 32K 350ns Sys Prg 910	8000020
8	1									A48	IC ROM 32K 450ns Char Gen	8000016
											910	
9	1									A44	IC 74LS245	2036200
10	2									A50,51	IC 2114ICB RAM	2035800
11	1									A24	IC 6116 RAM 150ns	2049200
12	1									A43	IC 74LS374	2029000
13	1									A49	IC 74LS166	2027800
14	1									A1	IC Encoder Kybd 910	2051800
15	5									A3,5,8,11,52	IC 74LS367	2028600
16	1									A7	IC 74LS74 (TI,SIG)	2026600
17	1									A5	IC 75189AN	2029400
18	1									A10	IC 75188N	2029200
19	1									A19	IC SY6551A-1 2MHz(SYN,AMI)	2053000
20	2									A18,41	IC 74LS174	2028200

NOTES:

TITLE	DATE	
PCB ASSY CONTROL BOARD 910	1-14-83	TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B											
41	8									R1,5,7,8,15,21,	Res CF 1K .25W 5%	2052100
										26,27		
42												
43	1									R2	Res CF 22 .25W 5%	2033500
44	2									R6,16	Res CF 66 .25W 5%	2051100
45	3									R19,20,23	Res CF 330 .25W 5%	2051500
46	1									R18	Res CF 470 .25W 5%	2051700
47	1									R17	Res CF 1.8K .25W 5%	2052300
48	3									RP2,3,4	Res Pk 1K 10P SIP	2040500
49	1									RP1	Res Pk 4.7K 10P SIP	2041300
50	1									C30	Cap Mica 10pf	2024100
51	3									C3,20,37	Cap Elect 22uf 15V	2025700
52	1									C14	Cap Elect 10uf 16V 20%	2027300
53	3									C22,23,28	Cap Cer .01uf	2028700
54	1										Cap Tant 10uf 25V 10%	2027100
55	1									C35	Cap Mica 20pf	2024300
56	1									C32	Cap Mono .039uf 50V 10%	2030300
57	4									C2,11,13,19	Cap Tant 4.7uf 16V 10%	2027500
58	4									C5-8	Cap Cer 330pf 50V 20%	2029100
59	19									Unmarked	Cap Cer .1uf 50V 10%	2030100
60	2									CR1,3	Diode IN914	2047500

NOTES:

TITLE PCB ASSY CONTROL BOARD 910

DATE 1-14-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL										REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B												
1													
2	1										A40	IC 74S74 TI/SIG/NAT/AMD	2026400
3	1										A4	IC NE 555	2030200
4	1										A39	IC 6502A SYN/MOS	2049600
5	1										A17	IC 74LS139 TI/SIG/NAT/FAIR/	2027200
												AMD	
6	1										A16	IC 74LS138 TI/SIG/NAT/FAIR/	2041000
												AMD	
7													
8	1										A48	IC 2332 450ns Char Gen ROM	8000016
												910	
9	1										A44	IC 74LS245	2036200
10	2										A50,51	IC 2114ICB Static RAM GTE/	2035800
												TI/NEC/FUJ	
11	1										A24	IC 6116 RAM 150ns HIT/OKI/	2049200
												TOS/MIT/MOS	
12	1										A43	IC 74LS374	2029000
13	1										A49	IC 74LS166	2027800
14	1										A1	IC Kybd Encoder 910 GEN/IN/	2051800
												SGC	
15	5										A3,5,8,11,52	IC 74LS367	2028600

NOTES:

TITLE	DATE	
PCB ASSY CONTROL BOARD 910 PLUS	1-14-83	TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B											
36	1									R14	Res CF 47K .25W 5%	2033700
37	1									R12	Res CF 1M .25W 5%	2031500
38	1									R25	Res CF 100K .25W 5%	2032100
39	1									R3	Res CF 270 .25W 5%	2051300
40	2									R4,24	Res CF 750 .25W 5%	2031700
41	8									R1,5,7,8,15,21,	Res CF 1K .25W 5%	2052100
										26,27		
42												
43	1									R2	Res CF 22 .25W 5%	2033500
44	2									R6,16	Res CF 68 .25W 5%	2051100
45	3									R19,20,23	Res CF 330 .25W 5%	2051500
46	1									R18	Res CF 470 .25W 5%	2051700
47	1									R17	Res CF 1.8K .25W 5%	2052300
48	3									RP2,3,4	Res PD 1K 10%	2040500
49	1									RP1	Res DIP 4.7K 10P	2041300
50	1									C30	Cap Mica 10pf	2024100
51	3									C3,20,37	Cap Elect 22uf 15V	2025700
52	1									C14	Cap Elect 10uf 16V 20%	2027300
53	3									C22,23,28	Cap Cer .01uf	2028700
54	1									Unmarked	Cap Tant 10uf 25V 10%	2027100
55	1									C35	Cap Mica 20pf	2024300

NOTES:

TITLE PCB ASSY CONTROL BOARD 910 PLUS

DATE 1-14-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B											
77	2									P2,5	Conn 5P STR Wafer	2098802
78	1									P7	Conn 2P STR Wafer	2098800
79												
80												
81	1									A45	IC Sys Prog EPROM 910 Plus	8000040
82												
83												
84												
85												
86												
87												
88												

NOTES:

TITLE PCB ASSY CONTROL BOARD 910 PLUS

DATE 1-14-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	A											
1												
2												
3												
4												
5	1									A4	IC NE 555	2030200
6	1									A27	IC 6502A Micro	2049600
7	1									A30	IC 74LS139	2027200
8	1									A37	IC 74LS138	2041000
9	1									A38	IC EP 32K 350ns Sys Prg 910	8000020
10	1									A17	IC ROM 450ns Char Gen 910	8000016
11	1									A14	IC 74LS245	2036200
12	2									A31,32	IC 2114 ICB RAM	2035800
13	1									A13	IC 6116 RAM 150ns	2049200
14	1									A12	IC 74LS374	2029000
15	1									A18	IC 74LS166	2027800
16	1									A1	IC Encoder Kybd 910	2051800
17	5									A3,5,6,8,33	IC 74LS367	2028600
18	2									A16,36	IC 74LS74	2026600
19	1									A10	IC 75189AN	2029400
20	1									A9	IC 75188N	2029200
21	1									A15	IC SY6551A-1 UART 2MHz	2053000

NOTES:

TITLE

PCB ASSY CONTROL BOARD 910 GATE ARRAY

DATE

1-13-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	A											
43	1									R22	Res CF 270 Ohm 1/4W 5%	2051300
44	2									R14,21	Res CF 750 Ohm 1/4W 5%	2031700
45	4									R1,20,23,28	Res CF 1K 1/4W 5%	2052100
46	1									R19	Res CF 22 Ohm 1/4W 5%	2033500
47	1									R3	Res CF 68 Ohm 1/4W 5%	2051100
48	3									R4,5,17	Res CF 330 Ohm 1/4W 5%	2051500
49	1									R1	Res CF 470 Ohm 1/4W 5%	2051700
50	1									R15	Res CF 1.8K 1/4W 5%	2052300
51	1									R26	Res CF 33 Ohm 1/4W 5%	2034500
52	1									R27	Res CF 10K 1/4W 5%	2034100
53												
54	2									RP1,5	Res Pk 4.7K Ohm 10P SIP	2041300
55	3									RP2-4	Res Pk 4.7K Ohm 8P SIP	2042900
56												
57												
58	1									C18	Cap Mica 10pf 50V 5%	2024100
59	3									C2,3,7	Cap Elec 22uf 15V -10% to	2025700
											+100%	
60	1									C5	Cap Elec 10uf 16V 20%	2027300
61	27									C6,9,21-43	Cap Cer .01uf 16V 20%	2028700
62	1									C4	Cap Cer .1uf 50V 10%	2030100

NOTES:

TITLE

PCB ASSY CONTROL BOARD 910 GATE ARRAY

DATE

1-14-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B											
84	1									P6	Socket IC, DIP 16P	2098405
85	2									P3,4	Conn 25P PCB D-Sub Fem	2097800
86	1									P1	Plug 26P RT 3	2098701
87	2									P2,5	Conn 5P Str Wafer	2098802
88	1									P7	Conn 2P Str Wafer	2098800
89												
90												
91												
92												
93												
94												

NOTES:

TITLE
PCB ASSY CONTROL BOARD 910+ GATE ARRAY

DATE
1-14-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	A											
1												
2												
3												
4												
5	1									A4	IC NE 555	2030200
6	1									A27	IC 6502A Micro	2049600
7	1									A30	IC 74LS139	2027200
8	1									A37	IC 74LS138	2041000
9	1									A38	IC EP 32K 350ns Sys Prg 910+	8000040
10	1									A17	IC ROM 450ns Chan Gen 910	8000016
11	1									A14	IC 74LS245	2036200
12	2									A31,32	IC 2114 ICB RAM	2035800
13	1									A13	IC 6116 RAM 150ns	2049200
14	1									A12	IC 74LS374	2029000
15	1									A18	IC 74LS166	2027800
16	1									A1	IC Encoder Kybd 910	2051800
17	5									A3,5,6,8,33	IC 74LS367	2028600
18	2									A16,36	IC 74LS74	2026600
19	1									A10	IC 75189AN	2029400
20	1									A9	IC 75188N	2029200
21	1									A15	IC SY6551A-1 UART 2MHz	2053000

NOTES:

TITLE	DATE	
PCB ASSY CONTROL BOARD 910+ GATE ARRAY	1-14-83	TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL										REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B												
43	1										R22	Res CF 270 Ohm 1/4W 5%	2051300
44	2										R14,21	Res CF 750 Ohm 1/4W 5%	2031700
45	4										R1,20,23,28	Res CF 1K 1/4W 5%	2052100
46	1										R19	Res CF 22 Ohm 1/4W 5%	2033500
47	1										R3	Res CF 68 Ohm 1/4W 5%	2051100
48	3										R4,5,17	Res CF 330 Ohm 1/4W 5%	2051500
49	1										R1	Res CF 470 Ohm 1/4W 5%	2051700
50	1										R15	Res CF 1.8K 1/4W 5%	2052300
51	1										R26	Res CF 33 Ohm 1/4W 5%	2034500
52	1										R27	Res CF 10K 1/4W 5%	2034100
53													
54	2										RP1,5	Res Pk 4.7K Ohm 10P SIP	2041300
55	3										RP2-4	Res Pk 4.7K Ohm 8P SIP	2042900
56													
57													
58	1										C18	Cap Mica 10pf 50V 5%	2024100
59	3										C2,3,7	Cap Elec 22uf 15V -10% to	2025700
												+100%	
60	1										C5	Cap Elec 10uf 16V 20%	2027300
61	27										C6,7,21-43	Cap Cer .01uf 16V 20%	2028700
62	1										C4	Cap Cer .1uf 50V 10%	2030100

NOTES:

TITLE: PCB ASSY CONTROL BOARD 910+ GATE ARRAY

DATE: 1-14-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	B											
63	1									C1	Cap Mica 20pf 50V 10%	2024300
64	1									C8	Cap Mono .039uf 50V 10%	2030300
65	1									C19	Cap Tant 4.7uf 16V 10%	2027500
66	8									C10-17	Cap Cer 330pf 50V 20%	2029100
67	1									C20	Cap Tant 10uf 25V 10%	2027100
68												
69												
70												
71	2									CR1,2	Diode IN914	2047500
72												
73	2									Q1,2	Tran 2N4401 NPN/Silicon	2045500
74												
75	1									Y2	Crystal 13.608 MHz	2098605
76	1									Y1	Crystal 1.8432 MHz	2098602
77												
78												
79	2									SW1,2	Switch 10 Pos DIP	2096800
80												
81	3									A13,17,38	Socket IC, DIP 24P	2098401
82	4									A1,20,22,27	Socket IC, DIP 40P	2098402
83	1									A15	Socket IC, DIP 28P	2098404

NOTES:

TITLE

PCB ASSY CONTROL BOARD 910+ GATE ARRAY

DATE

1-14-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
	A											
84	1									P6	Socket IC, 16 Pin	2098405
85	2									P3,4	Conn 25P PCB D-Sub Fem	2097800
86	1									P1	Plug 26P RT 3	2098701
87	2									P2,5	Conn 5P STR Wafer	2098802
88	1									P7	Conn 2P STR Wafer	2098800
89												
90												
91												
92												
93												
94												

NOTES:

TITLE PCB ASSY CONTROL BOARD 910 GATE ARRAY

DATE 1-14-83

TeleVideo Systems, Inc.

VIDEO MONITOR/POWER SUPPLY SCHEMATICS AND PARTS LIST

TeleVideo Systems, Inc.
1170 Morse Ave., Sunnyvale, CA 94086
(408) 745-7760 TWX 910-338-7633 "TVI VIDEO"

VIDEO MONITOR

The video monitor contains two sections: the vertical amplifier and the horizontal amplifier. These amplifiers provide the voltages necessary to drive the CRT yoke, which deflects the electron beam across the CRT.

The electron beam, which is generated by the CRT electron gun, sweeps across and down the screen to create scan lines (see section on character generation). The beam's movement is driven by vertical and horizontal sweep rates, which are determined by the display circuitry on the logic board. The horizontal sweep is approximately 16 KHz, the vertical sweep 60 Hz for domestic and 50 Hz for European applications.

The horizontal synch pulses coming into the video monitor are inverted and amplified by transistor Q301. This signal is then coupled across the drive transformer T301 and applied to the base of the ouptut transistor Q302. Q302's output drives both horizontal yoke windings, as well as the step-up transformer that produces the anode voltage and the grid voltage for the CRT grid in the neck of the CRT. Since high-frequency magnetic fields are produced and then broken, the flyback transformer is necessary to provide high voltages for the horizontal scans.

These horizontal scans start in the upper left corner and scan across to the upper right corner. Once the scan reaches the end of the line, a blank appears where the video beam is turned off and retraced to the beginning of the next scan line.

The vertical synch pulses coming into the video monitor are converted to a sawtooth waveform. Initially, this pulse goes from a negative leading edge to a positive falling edge and passes through transistor Q202, which inverts it to its usable form.

At that point, the pulse goes from a +2-volt leading edge to a -2.5-volt falling edge. Timing is critical since 250 horizontal scan lines (which comprise the total number of horizontal scan lines on the CRT) occur within one sawtooth pulse. Therefore, the sawtooth pulse has to be proportional to all previous pulses or the timing will be off for the vertical as well as the horizontal sweep.

When the vertical sweep is negative, Q201 conducts and C202 discharges. During the positive portion, Q201 cuts off and allows C202 to charge. While C202 is charging, the electron beam scans.

The vertical sweep scans from top to bottom. Once it reaches the bottom of the page, a blank occurs when the video beam is turned off and is retraced to the top of the screen. At that point, C202 discharges. After the retrace, the beam turns off again and begins its scan routine.

Adjusting SFR1 (vertical height) and SFR2 (vertical linearity) changes the rate of C202's charge, and therefore the slope of the sawtooth pulse.

POWER SUPPLY

Voltages are created and regulated as follows: A 9.8 AC voltage is rectified by diodes D105 and D108, resulting in a 9-volt output. These 9 volts are then filtered through C117 and applied at the 5-volt regulator IC2.

The raw AC voltages for the positive and negative 12 DC voltage are derived from the center top of the secondary winding of D101. The diodes D101 and D102 form a full-wave rectifier that converts the 37-volt AC waveform to a 20-volt DC level. This DC voltage is then filtered by C116 and stabilized to -12 volts by a zener-regulated circuit that consists of a resistor (R102) and the zener diode (D112).

Diodes D103 and D104 also form a full-wave rectifier that converts the 37-volt AC waveform to a +20-volt DC level.

This DC voltage is filtered by C113 and applied to the 13.8-volt regulator IC1. The 13.8 output, in turn, is dropped 1.6 volts across diodes D113 and D114 to achieve the desired +12 volts DC.

A 79-volt AC waveform is applied to the half-wave rectifier D109, which is filtered by C119. The resulting 95-volt DC level is then regulated by a series voltage regulator. The reference element is the positive 12-volt zener diode D111. The sensing and control elements are transistors Q103 and Q102.

The high voltages needed to drive the CRT tube V501 are derived from the flyback transformer T302 on the video module.

TUBE SPECIFICATION

12 INCH 90 DEGREE, HIGH RESOLUTION

DISPLAY TUBE

310KGB 31

The 310KGB31 is a 12 inch 90 degree high resolution, rectangular display tube primarily intended for use as a alpha-numerical and graphic display tube for computer peripheral devices. The tube is provided with banded type integral implosion protection (with mounting lugs). The tube features a low reflectance high contrast screen.

ELECTRICAL DATA

Heating
Indirect by AC or DC:
Heater voltage. . . . . .12.0 volts
Heater current. . . . . 75 nA

Focusing Method. . . . . Electrostatic

Deflection Method. . . . . Magnetic

Deflection Angles (Approx.)
Diagonal. . . . . 90 degrees
Horizontal. . . . . 78 degrees
Vertical. . . . . 61 degrees

Anode voltage . . . . . 15,000 max. volts
8,000 min. volts

Using high voltage with this tube internal flash-overs may occur, which may cause damage to the cathode of the tube and to various circuit components on the video monitor board. Therefore it is necessary to provide protective circuits using spark-gaps etc. These should be connected as illustrated in figure #1 below.

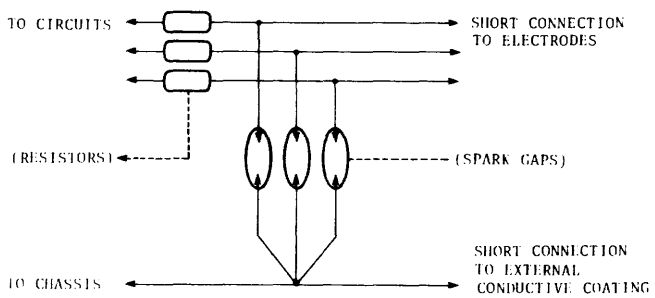


Figure 1.

No other connections between external conductive coating and chassis are permissible.

OPTICAL DATA

Faceplate	Filterglass
Anti-reflection treatment	No
Screen	Aluminized
Appearance	Low Reflective

A:
The dark-colored screen, in combination with the filterglass, produces the low reflectivity (equivalent to a 20% light transmission filterglass) for easy-to-see display.

MECHANICAL DATA

Tube Dimensions:

Overall length	278.8 max. mm
Greatest dimensions of tube (excluding lugs)	
Diagonal	318.5 +/- 2.7 mm
Width	279.6 +/- 2.7 mm
Heigth	218.7 +/- 2.7 mm
Useful screen dimensions (projected)	
Diagonal	295.0 min. mm
Width	257.0 min. mm
Heigth	195.0 min. mm

Pin Position Alignment	Pin No 5 aligns approx. with anode contact.
Operating Position	Any
Weight (approx.)	3.2 kg
Implosion Protection	Tension band (with mounting lugs)

GENERAL CONSIDERATIONS:

1. Tube handling. Care should be taken not to scratch the tube.

2. Impact. The tubes should never be exposed to impacts of more than 30G during handling or transportation.

3. Grounding. The external conductive coating of the tube should be grounded with multiple contacts (e.g. a contact plate having many fingers.) Poor contact might cause local heating resulting in tube leakage.

WARNING

SHOCK HAZARD:

The high voltage at which the tube is operated may be very dangerous. Design of the equipment should include safeguards to prevent the user from coming in contact with the high voltage. Extreme care should be taken in the servicing or adjustment of any high voltage circuit.

Caution must be exercised during the replacement or servicing of the tube since a residual electrical charge is stored within the tube. Before handling the tube remove any undersible residual high voltage charge from the tube, by shorting the anode contact button to the frame of the terminal as illustrated in figure #2. Discharging the high voltage to isolated metal parts sucha as cabinets and control brackets may produce a shock hazard.

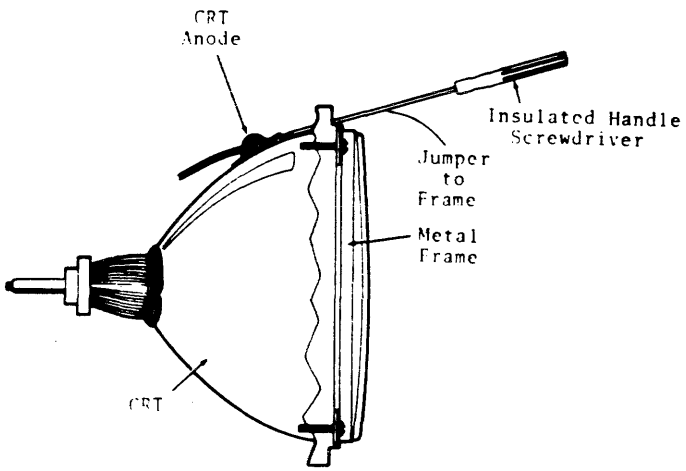
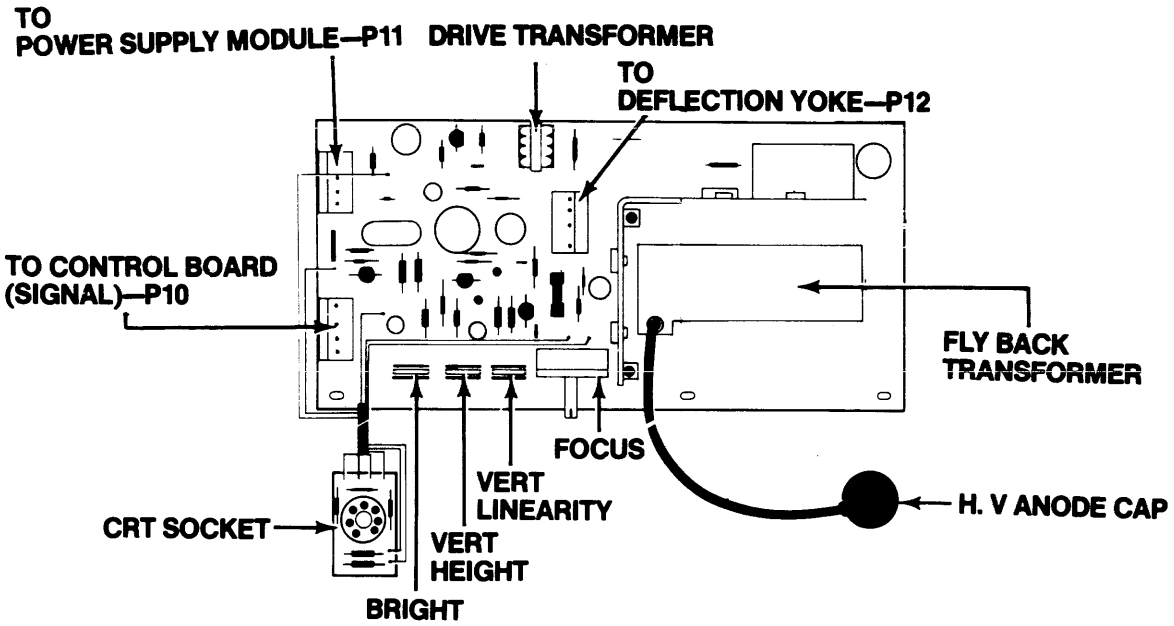
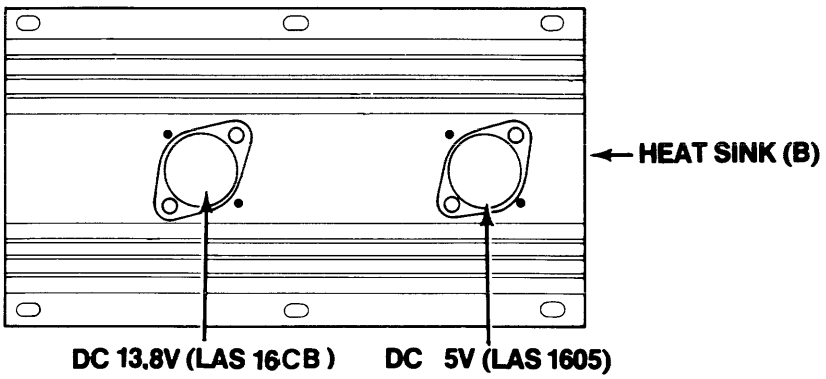
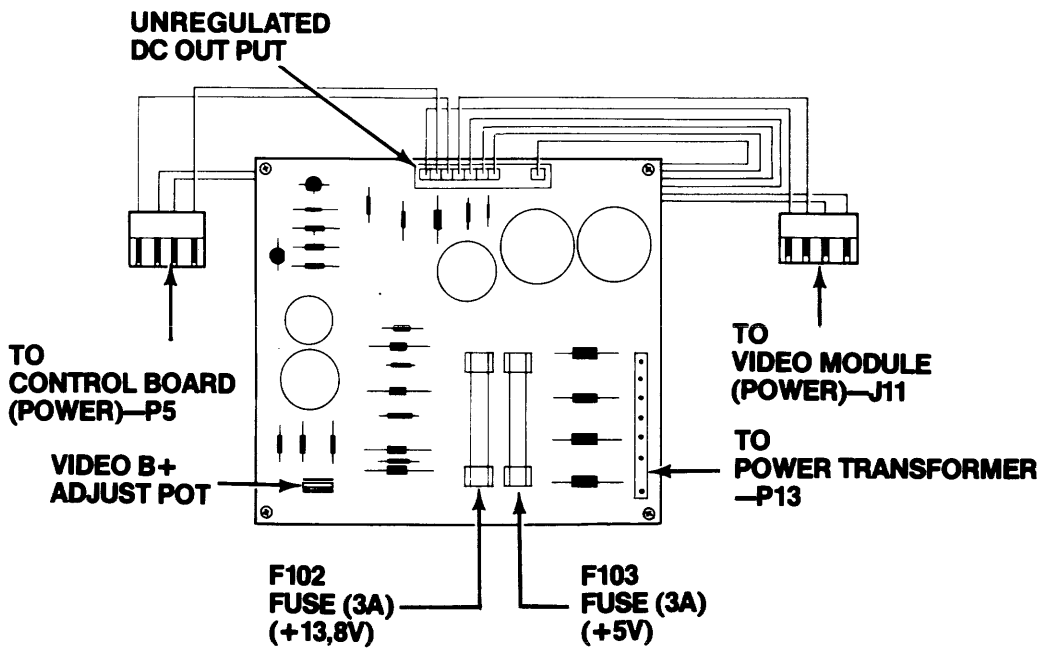


Figure 2



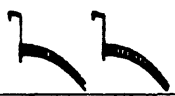
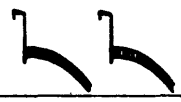
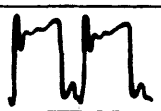
VIDEO MONITOR MODULE





POWER SUPPLY MODULE

TR WAVEFORM and VOLTAGE

Transistor			Base(In)			Collector(Out)			Emitter(GND)		
Location	Parts	Function	Vtg DC V	Vtg AC Vp-p	Wave Form	Vtg DC V	Vtg AC Vp-p	Wave Form	Vtg DC V	Vtg AC Vp-p	Wave Form
IC	LAS1512	Regulation	12	2.5		12	0.0	—	0.0	0.0	—
IC	LAS1605	〃		1.6		5	0.0	—	0.0	0.0	—
IC	LAS1812	〃		0.1		-12	0.0	—	0.0	0.0	—
IC	LAS16CB	〃		1.4		13.8	0.0	—	0.0	0.0	—
Q102	2SC509	〃	78.7	0.0	—	86.4	1.5		98.0	0.0	—
Q103	2SC983	〃	12.0	0.0	—	75.7	0.0	—	11.9	0.0	—
Q201	2SA495	Vert Pree Drive	2.0	3.0		0.6	0.57		1.0	1.7	
Q202	2SC372	Vert Drive	0.68	0.5		8.0	6.5		0.0	0.0	—
Q203	2SC1173	Vert Out	9.36	6.5		12	0.0	—	8.76	6.5	
Q204	2SA473	Vert Out	8.0	6.5		0.0	0.0	—	8.6	6.5	
Q301	2SC735	Horiz Drive	-0.25	0.64		12	20		0.0	0.0	—
Q302	2SC2233	Horiz Out	-0.08	6		12.8	124		0.0	0.0	—
Q501	2SC963	Video Amp	0.4	3		76.8	25		-0.8	2.8	
D302	DS-113A	Damping	12.8	132							

DC Voltage reading taken with VTVM from point indicated to chassis ground.

AC Voltage reading taken with Oscilloscope from point indicated to chassis ground

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
1										R101	2.2M Ohm 1/2W CFR	2186500
2										R102	390 Ohm 1/2W CFR	2186100
3										R105,106,208	4.7K Ohm 1/4W CFR	2053100
4										R107	3.9K Ohm 1/4W CFR	2177400
5										R108	27K Ohm 1/4W CFR	2037300
6										R109,201,205	2.7K Ohm 1/4W CFR	2038300
7										R110	30K Ohm 1/4W CFR	2039300
8										R202	100K Ohm 1/4W CFR	2032100
9										R203	2.2K Ohm 1/4W CFR	2038700
10										R204,212,213	0.6 Ohm 2W Wire Wound Res	2177100
11										R206,503	820 Ohm 1/2W CFR	2186200
12										R207	6.8K Ohm 1/4W CFR	2039100
13										R209,505	47K Ohm 1/4W CFR	2033700
14										R210	330 Ohm 1/4W CFR	2051500
15										R211	150 Ohm 1/4W CFR	2033900
16										R214	270 Ohm 1/4W CFR	2051300
17										R301	470 Ohm 1/4W CFR	2051700
18										R501	47 Ohm 1/4W CFR	2037700
19										R502	90 Ohm 1/4W CFR	2177600
20										R504	56K Ohm 1/4W CFR	2039500
21										R506	220 Ohm 1/2W CFR	2186000

NOTES:

TITLE: VIDEO MONITOR AND POWLR SUPPLY PARTS LIST

DATE: 1-13-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
22										R507,509	1.5K Ohm 1/2W CFR	2186300
23										R508	10K Ohm 1/2W CFR	2186400
24										SFR1, SFR4	100K Ohm Pot	2177700
25										SFR2	2K Ohm Pot	2177800
26										SFR3	5K Ohm Pot	2177900
27										VR1	500 Ohm Pot	2180200
28										VR2	2M Ohm Pot	2180100
29										TH201	1.1K Ohm Thurmister	2180300
30										C101-109	0.01uF 16V Ceramic 20%	2028700
31										C113	3,300uF 35V Electrolytic	2196500
32										C114,115	0.33uF 35V Tantal	2198100
33										C116	470uF 35V Electrolytic	2198200
34										C117	4700uF 16V Electrolytic	2196600
35										C119	110uF 160V Electrolytic	2196300
36										C120	22uF 160V Electrolytic	2196400
37										C201	10uF 16V Electrolytic	2027300
38										C202,204	4.7uF 16V Tantal	2027500
39										C203	22uF 15V Electrolytic	2025700
40										C205	100uF 10V Electrolytic	2196000
41										C206	22uF 10V Electrolytic	2196100
42										C207	2200uF 10V Electrolytic	2196200

NOTES:

TITLE VIDEO MONITOR AND POWER SUPPLY PARTS LIST DATE 1-13-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
43										C208	0.047uF/50V Mylar	2197100
44										C209	0.001uF/50V Mylar	2196900
45										C301	4.7uF/16V Electrolytic	2196700
46										C302	0.01uF/50V Mylar	2197000
47										C303	0.0068uF/200V Mylar	2196800
48										C304	0.047uF/400V Mylar	2197500
49										C305	220uF/16V Electrolytic	2199300
50										C306	16uF/25V NP	2280000
51										C307	0.039uF/50V Mylar	2030500
52										C501	220PF 50V Ceramic	2195900
53										C502	0.01uF/50V	2197000
54										C503	0.01uF 50V Ceramic	2028900
55										C504	0.1uF 600V Mylar	2197300
56										C505	22uF 100V Electrolytic	2196100
57										C506	0.47uF 50V Mylar	2197200
58										SG501	1KV Spark Gap	2030900
59										SW101	SPST 115V 10A/230V 5A Pwr SW	2097300
60										SW102	DPDT 115/230V Power Line	2097400
											Slide Switch	
61										F101	1A/250V	2097000
62										F102,103	3A/125V	2193100

NOTES:

TITLE	DATE	
VIDEO MONITOR AND POWER SUPPLY PARTS LIST	1-13-83	TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
63										M003	Fuse Clip	2180400
64										Q102	KTC 1627A or MPS-A06	2046700
65										Q103,501	2SC983 or 2N5551	2193200
66										Q201	KTA 1015 or 2N3906	2042200
67										Q202	KTC11815 or 2N3904	2046500
68										Q203	2SC1173 or 2N6121	2199700
69										Q204	2SA473 or 2N6124	2202100
70										Q301	KTC 200(2SC1166) or 2N4401	2045500
71										Q302	2SC2233 or MJE13006	2047300
72										IC1	LAS 16CB 13.8V Regulator	2126900
73										IC2	LAS 1605 5V Regulator	2126800
74										V501	B & W Pr 12"	2049100
75										V501	CRT Green P31 12"	2049300
76										D101-108	DS 135D or 1N5391 Rectifier	2200600
77										D109	DS 135C Rectifier	2201400
78										D111,112	EQA01-12 or 1N759A Zener	2201600
											Diode	
79										D302	DS-113A or MRI-1000 Damper	2201700
											Diode	
80										D501	1N914 or KDS1553 Switching	2047500
											Diode	

NOTES:

TITLE VIDEO MONITOR AND POWER SUPPLY PARTS LIST

DATE 1-13-83

TeleVideo Systems, Inc.

ITEM/ FIND NO.	QTY PER ASSM/REV LEVEL									REFERENCE/ DESIGNATOR	NOMENCLATURE/DESCRIPTION	PART NUMBER/REMARKS
81										D502	DS-130TB or 1N4004 600V	2202200
											Rectifier	
82										D201,202,301	KDS-8513A or 1N920 Silicon	2201800
											Diode	
83										D113,114	DS 135D Rectifier	2200600
84										L202	KYS-00060 D.Y Coil	2200800
85										L201	5.4uH Linearity Coil	2200900
86										L201	Adjustable Linearity Coil	2213600
87										L302	27uH Inductor Coil	2201000
88										T101	Power Transformer	2201100
89										T301	Drive Transformer	2201200
90										T302	Flyback Transformer	2201300

NOTES:

TITLE VIDEO MONITOR AND POWER SUPPLY PARTS LIST DATE 1-13-83

TeleVideo Systems, Inc.

TERMINAL TROUBLESHOOTING GUIDE

Document 2191400
Revision B

28 February 1983

TeleVideo Systems, Inc.
1170 Morse Avenue
Sunnyvale, California 94086

1. INTRODUCTION

This is a general troubleshooting guide to be used with the Operator's Manual, Maintenance Manual, and Service Bulletins as required. By following the procedures described here, you should be able to quickly isolate and repair most field failures.

The following sections are included:

	Page
Overview of Terminal Modules	2-1
Functional Description of Modules	3-1
Troubleshooting the Logic Board	4-1
Visual Inspection	4-1
Large Scale Integration Failures	4-2
Data Line Operation	4-3
Debugging Tables for TTL Boards	4-4
Debugging Tables for GA Boards	4-12
Troubleshooting the Keyboard	5-1
Visual Inspection	5-1
Debugging Table	5-3
Troubleshooting the Video Monitor	6-1
Visual Inspection	6-1
Debugging Guide	6-3
Troubleshooting the Power Supply	7-1
Visual Inspection	7-1
Debugging Guide	7-2

2. OVERVIEW OF TERMINAL MODULES

The design of TeleVideo® terminals permits fast fault isolation since the terminal hardware is divided into four main modules:

1. Video monitor
2. Power supply
3. Main logic board
4. Keyboard

The video monitor and power supply are common to all TeleVideo terminals and may be freely interchanged. Terminal keyboards are interchangeable, as outlined in the section on the keyboard. The main logic board is the only module that provides each terminal with its unique characteristics.

The quickest and easiest way to isolate the malfunctioning module is to exchange (swap) each module with a known good module. Once the faulty module is identified, refer to the appropriate troubleshooting table.

WARNING!

High voltages are retained by the CRT tube and capacitors even after power has been turned off. As soon as you open the case, clip one end of a wire to the chassis. Attach the other end of the wire to an insulated screwdriver. Being careful not to touch the metal part of the screwdriver, gently slip the metal end of the screwdriver under the cap of the anode, as shown in Figure 2-1.

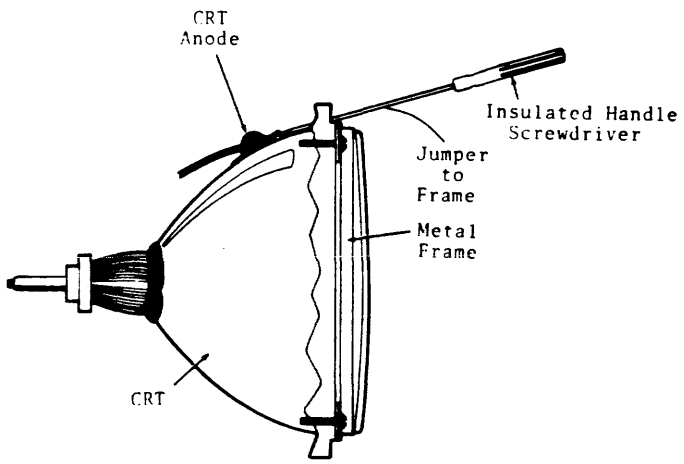


Figure 2-1 Discharging Voltages

3. FUNCTIONAL DESCRIPTION OF MODULES

Logic Board

The logic board processes and controls all data received and transmitted, and generates the video and sync signals required to display data.

The logic board consists of the following five functional areas:

1. Display processor
2. Display generator
3. Keyboard interface
4. Main port interface
5. Printer port interface

Power Supply

The power supply provides DC operating voltages to all circuits in the terminal. The power supply contains two user-replaceable 3 AG-type fuses.

Video Monitor

The video monitor contains horizontal, vertical, and intensity modulation circuits which produce a television-type conventional noninterlaced raster display on the screen. Character signals received from the display generator cause intensified dots to appear at precise intervals on a raster line. These dots, when combined with other dots on other raster lines above and/or below a given line, produce characters.

Keyboard

910/910 PLUS/912C/920C--This keyboard sends matrixed data via a ribbon cable to the logic board, where the ASCII code is generated.

This data is encoded in the 910/910 PLUS by the keyboard encoder (position A1) and in the 912C/920C by the CPU (position A54) and the multiplexers (positions A68 and A69).

The keyboards for these models are all functionally interchangeable. The 910/910 PLUS keyboard has a PRINT keycap where 912C/920C models have a BLOCK/CONV keycap. The 920C keyboard is also fitted with an additional top row of function and editing keys.

925/950--On this keyboard, data is encoded by a microprocessor on the keyboard (position U6) and sent in an ASCII serial data stream to the logic board via the coiled cable. On the logic board, the keyboard interface circuits convert the keyboard data from serial to parallel data for input to the display processor circuitry. All detachable keyboards are identical and interchangeable.

4. TROUBLESHOOTING THE LOGIC BOARD

Visual Inspection

With the Logic Board Installed--Turn off power to the terminal, open the case, and check the following possible problem areas:

* Internal and external switch settings: are they all correct?

* Socketed chips: are they all plugged tightly into their sockets?

* Connectors: look for

  Loose or damaged connectors

  Broken or loose securing clips on pins at connectors

  Bad crimps

  Dirty contacts

* Wires: are any broken, loose, or frayed?

* Components: are any overheated or burned?

With the Logic Board Removed--Make these inspections with the logic board removed. The procedure for removing the logic board varies slightly according to the model. Follow the appropriate directions for your model.

910/910 PLUS/912C/920C

To remove the logic board:

1. Turn the power off.

2. On the logic board, disconnect:

   P1 (keyboard input)
   P2 (video signals)
   P3 (RS232C port) if connected
   P4 (printer port) if connected
   P5 (voltage connector)
   P6 (modem connector) if connected
   P7 (speaker connector)

3. Remove the four (910/910 PLUS) or six (912C/920C) securing screws on the logic board.

4. Carefully remove the logic board.

1. Turn the power off.

2. On the logic board, disconnect:

   P1 (keyboard input)
   P3 (RS232C port) if connected
   P4 (printer port) if connected
   P6 (modem connector) if connected

3. Carefully slide the logic board half way out of the terminal and disconnect:

   P2 (video signals)
   P5 (voltage connector)

4. Carefully slide the logic board entirely out of the terminal.

With the logic board removed, inspect the logic board for:

* Overheated or burned components
* Missing or broken components
* Cracked, broken, or lifted traces
* Poor solder joints (loose solder balls, cold solder joints, or solder bridges)
* Bent pins

STOP!

If defects are found, correct them and recheck the terminal before continuing.

If nc defects are found, reinstall the logic board before proceeding with the procedures in the next section, Large Scale Integration Failures.

Large Scale Integration Failures

Since most failures involve Large Scale Integration (LSI) chips, this step will quickly repair most failures encountered. Exchange all socketed chips, one at a time, with known good chips. If the logic board malfunctions after the chips are swapped, confirm the operation of the data lines described in the next section, Data Line Operation.

NOTE!

The remainder of this guide involves troubleshooting to the component level and requires schematics, an oscilloscope, a working knowledge of transistor-transistor logic (TTL), and basic debugging skills.

Data Line Operation

Confirm that the data lines are operating properly before proceeding further.

NOTE!

It is beyond the scope of this bulletin to list all possible data line problems.

The best place to check the data lines is directly from the CPU (see page 1 of the schematics). There should be activity on all data lines and the signals should range from 0 (ground) to +4.5 to +5.0 volts. If the malfunction persists after you have confirmed proper operation of the data lines, follow the procedures in the next section, Debugging Tables.

Debugging Tables

NOTE!

The items listed in the tables in this section are only suspect areas; they should not be automatically replaced when the symptoms listed are present.

Table 4-1 910/910 PLUS Logic Board Debugging Guide

Symptom	Suspect Areas Part No.	Position	Schematic Page
No video	6502	A39	1 of 5
	6545	A26	2 of 5
	2114	A30, A31, A36, A37	2 of 5
	or		
	6116	A24	2 of 5
	Crystal	Y2	3 of 5
	74LS163	A15	3 of 5
	2332	A45	1 of 5
	2N2219	Q2	4 of 5
Distorted video	6502	A39	1 of 5
	6545	A26	2 of 5
	6116	A24	2 of 5
	or		
	2114	A30, A31, A36, A37	2 of 5
	2332	A48	3 of 5
	74LS166	A49	3 of 5
Horizontal bar across screen	6545	A26	2 of 5
	74S04	A22	4 of 5
Loss of underline, reverse video, blinking, or blanking	74LS174	A42	3 of 5
	6545	A26	2 of 5
Loss of half intensity	74LS175	A41	3 of 5
	6545	A26	2 of 5
Loss of all attributes	6545	A26	2 of 5
	74S74	A40*	3 of 5
Unable to transmit data	75188	A10	4 of 5
	6551A	A19	4 of 5
Unable to receive data	75189	A5	4 of 5
	6551A	A19	4 of 5
Poor/no printing	75189	A5	4 of 5
	75188	A10	4 of 5
	6551A	A19	4 of 5
Incorrect/no keyboard response	AY-5-3600	A1	5 of 5
	2716	A2**	5 of 5

Notes
*Must be a Texas Instruments part.
**If used.

Table 4-1 Continued

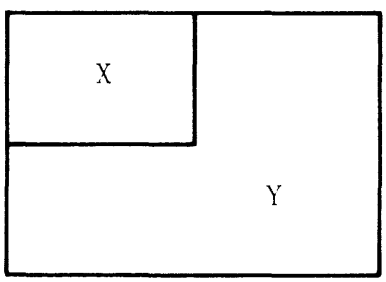
Symptom	Suspect Areas Part No.	Position	Schematic Page
SHIFT or CTRL keys do not function	A6-5-3600	A1	5 of 5
	7406	A12	5 of 5
	RP4		5 of 5
ALPHA LOCK or FUNCT keys do not function	AY-5-3600	A1	5 of 5
	74LS364	A8	5 of 5
	RP4		5 of 5
Keys repeat	AY-5-3600	A1	5 of 5

*Must be a Texas Instruments part.
**If used.

Table 4-2 912/920 Logic Board Debugging Guide

Symptom	Suspect Areas Part No.	Position	Schematic Page
No video, no beep	8035	A54	1 of 6
	5027	A23	4 of 6
	23.814-MHz Crystal	X1	4 of 6
	74LS109	A56	4 of 6
	74LS163	A57	4 of 6
	System ROMs	A49	2 of 6
	System ROMs	A50*	2 of 6
	2332	A3	5 of 6
No video, constant beep	5027	A23	4 of 6
	2114 RAM, page 1	A6, A8, A10, A12	3 of 6
	2114 RAM, page 2	A5, A7, A9, A11	3 of 6
Horizontal bar across screen	5027	A23	4 of 6
	74LS08	A32	5 of 6
	74LS05	A14	5 of 6
Bad video or incorrect character displayed in:			
Area X of screen**	2114 RAMs	A8	3 of 6
	2114 RAMs	A12	3 of 6
Area Y of screen**	2114 RAMs	A6	3 of 6
	2114 RAMs	A10	3 of 6
Bad video on entire screen	74LS157	A24, A25, A26	3 of 6
	74LS00	A40	3 of 6
	8035	A54	1 of 6
	5027	A23	4 of 6

Notes
* If installed
**



Areas X and Y of Screen

Table 4-2 Continued

Symptom	Suspect Areas Part No.	Position	Schematic Page
Distorted characters	2316	A3	5 of 6
	8035	A54	1 of 6
	2114 RAMs	A5 through A12	3 of 6
Unable to transmit	75188	A59	2 of 6
	74LS157	A78	2 of 6
	2502	A48	2 of 6
Unable to receive	75189	A60	2 of 6
	74LS157	A78	2 of 6
	2502	A48	2 of 6
Loss of blinking or blanking	74LS74	A35	4 of 6
	5027	A23	4 of 6
Loss of half intensity	74LS74	A16	5 of 6
	74LS03	A15	5 of 6
	5027	A23	4 of 6
Loss or underlining/reverse video	74LS74	A28	5 of 6
	74LS74	A29	5 of 6
	5027	A23	4 of 6
Incorrect or no keyboard input	8035	A54	1 of 6
	74LS253	A68	1 of 6
	74LS253	A69	1 of 6
ALPHA LOCK, SHIFT, CTRL, or Function keys do not function	74LS364	A76	1 of 6
	74LS42	A58	1 of 6
Unable to select one or more baud rates	74LS163 Counter	A70 through A73	6 of 6
	Baud rate switch	S1	6 of 6
	74LS00 Nand Gate	A74	6 of 6

Table 4-3 925 Logic Board Debugging Guide

Symptom	Suspect Areas Part No.	Position	Schematic Page
No beep, no video	13.6080-MHz Crystal	Y2	7 of 7
	74LS00	A55	4 of 7
	74LS139	A37	4 of 7
	6502A	A60	1 of 7
	6545A-1	A59	2 of 7
Constant beep, no video	6502A	A60	1 of 7
	6545A-1	A59	2 of 7
	74LS223	A44	7 of 7
Horizontal bar	74504	A16	7 of 7
	6545A-1	A59	2 of 7
Bad video	10uf cap	C41	1 of 7
	74LS74	A6	4 of 7
	6545A-1	A59	2 of 7
Distorted characters	74LS166	A30	2 of 7
	2332	A31	2 of 7
Unable to transmit to computer	75188	A34	5 of 7
	6551	A32	5 of 7
	74LS32	A26	5 of 7
Unable to receive from computer	75189	A9, A17	5 of 7
	6551	A32	5 of 7
Unable to transmit to printer	75188	A34, A25	5 of 7
	74LS32	A26	5 of 7
	6551	A32	5 of 7
Unable to receive from printer	75189	A9, A19	5 of 7
	74LS32	A26	5 of 7
	75188	A25	5 of 7
Loss of any video attribute	74LS173	A19, A20, A21	3 of 7
	74LS245	A40	2 of 7
	74LS374	A39	2 of o7
	2332	A50, A49	1 of 7
No keyboard communication*	1.8432-MHz Crystal	Y1	5 of 7
	6551	A33	5 of 7
	6502A	A60	1 of 7

*Refer also to Service Bulletin 2, Eliminating Keyboard Lockup

Table 4-3 Continued

Symptom	Suspect Areas Part No.	Position	Schematic Page
Unable to select switch bank S1	Switch	S1	6 of 7
	74LS244	A53, A52	6 of 7
	Resistor pack	RP5	6 of 7
Unable to select switch bank S2	Switch	S2	6 of 7
	74LS244	A51, A52, A53	6 of 7
	Resistor pack	RP1	6 of 7
Unable to select switch bank S3	Switch	S3	6 of 7
	74LS244	A43, A51,	6 of 7
	Resistor pack	RP4	6 of 7

Table 4-4 950 Logic Board Debugging Guide

Symptom	Suspect Areas Part No.	Position	Schematic Page
No video, no beep	6502	A53	1 of 7
	6551	A49, A50 A51	5 of 7
	6545	A56	2 of 7
	Program ROMs	A41, A42	1 of 7
	User ROMs	A52	1 of 7
	Character Generator ROMs	A32, A33	4 of 7
	23.824-MHz Crystal	OSC1	6 of 7
	74LS163	A3	6 of 7
	74LS109	A6	6 of 7
No video, constant beep	6545	A56	2 of 7
	2114 RAMs	A25, A26, A27, A28	3 of 7
Horizontal bar across screen	6545	A56	2 of 7
	2114 RAMs	A25, A26, A27, A28	3 of 7
Bad video, one section of screen	2114	A25	3 of 7
	2114	A26	3 of 7
	2114	A27	3 of 7
	2114	A28	3 of 7
Bad video on only one page			
Page 1	6116	A37	3 of 7
Page 2	6116	A34	3 of 7
Page 3	6116	A35	3 of 7
Page 4	6116	A36	3 of 7
Bad video on entire screen	74LS157	A43 through A46	2 of 7
	6545	A55	2 of 7
	6502	A53	1 of 7
Distorted characters	2332	A32, A33	4 of 7
	74LS166	A22, A23	4 of 7
	6502	A53	1 of 7
	All 2114's	A25 through A28	3 of 7

Table 4-4 Continued

Symptom	Suspect Areas Part No.	Position	Schematic Page
Unable to transmit to system	1488	A48	5 of 7
	74LS32	A58	5 of 7
	6551	A50	5 of 7
	74LS157	A59	5 of 7
Unable to receive from system	1489	A57	5 of 7
	74LS08	A29	5 of 7
	6551	A51	5 of 7
Unable to transmit to printer	1488	A39	5 of 7
	74LS32	A58	5 of 7
	6551	A51	5 of 7
	74LS157	A59	5 of 7
Unable to receive from printer	1489	A40	5 of 7
	6551	A51	5 of 7
Loss of any video attribute	74LS174	A19	4 of 7
	74LS157	A20	4 of 7
	74LS174	A21	4 of 7
Incorrect or no keyboard input	6502	A53	1 of 7
	6551	A49	3 of 7
Unable to select one or more baud rates	6502	A53	1 of 7
	6552	A54	7 of 7
	74LS367	A65, A66	7 of 7
	RP 2		7 of 7
	RP 3		7 of 7
	Switch 1		7 of 7

"Gate Array" Logic board, Supplement Debugging Guide

Although the components are laid out differently, "Gate Array" boards are completely interchangable with TTL boards. When troubleshooting the "Gate Array" Logic boards care should be taken when handling the CMOS devices. The "Gate Array" chip positions are listed below. When exchanging these custom CMOS chips one must be grounded to earth ground to avoid damage to the chip from static discharge.

Model No.	Televideo Part Number	Location
910, 910Plus	2057400	A22
925	2057400	A39
950, Chip A	2057600	A34
Chip B	2057800	A37

Follow the procedure in the begining of this section for a visual inspection of the logic board.

Table 4-5 910/910 PLUS GA Logic Board Debugging Guide

Symptom	Suspect Areas Part No.	Position	Schematic Page
No video	6545A-1	A20	2 of 5
	6502	A27	1 of 5
	6116	A13	2 of 5
	Crystal	Y2	3 of 5
	2532	A38	1 of 5
	74LS163	A25	3 of 5
	74LS166	A18	3 of 5
	2N2219	Q2	4 of 5
	70200-11B	A22	3 of 5
Distorted video	6545A-1	A20	2 of 5
	6116	A13	2 of 5
	70200-11B	A22	3 of 5
	74LS166	A18	3 of 5
	2532	A38	1 of 5
Horizontal Bar across screen	6545A-1	A20	2 of 5
	74LS08	A37	2 of 5
Loss of Attribute	70200-11B	A22	3 of 5
	6545A-1	A20	2 of 5
Unable to Transmit to Computer or printer	75188	A9	4 of 5
	6551A-1	A15	4 of 5
Unable to Receive from Computer or printer	75189	A10	4 of 5
	6551A-1	A15	4 of 5
Inncorect/ no keyboard response	AY-5-3600	A1	5 of 5
	2716	A2	5 of 5
	74LS367	A3,A8	5 of 5
Shift or CTRL keys inoperative	AY-5-3600	A1	5 of 5
	7406	A7	5 of 5
	resistor pack	RP2	5 of 5
Alpha Lock or Funct keys inoperative	AY-5-3600	A1	5 of 5
	74LS367	A8	5 of 5
	resistor pack	RP2	5 of 5
Repeating keys	AY-5-3600	A1	5 of 5

Table 4-6 925 GA Logic Board Debugging Guide

Symptom	Suspect Areas Part No.	Position	Schematic page
No video/ no beep	Crystal	Y2	6 of 6
	70200-11A	A39	3 of 6
	74LS139	A38	3 of 6
	6502	A11	1 of 6
	6545A-1	A28	2 of 6
Constant beep/ no video	6545A-1	A28	2 of 6
	74LS273	A26	6 of 6
	6502	A11	1 of 6
Horizontal bar across screen	6545A-1	A28	2 of 6
	74S04	A40	3 of 6
Bad video	10uF cap	C28	1 of 6
	6545A-1	A28	2 of 6
	70200-11a	A39	3 of 6
Distorted characters	2332	A17	2 of 6
	74LS166	A12	2 of 6
Loss of Attribute	70200-11A	A39	3 of 6
	2333	A14,A15	1 of 6
No transmit to computer or printer	75188	A23	4 of 6
	6551A-1	A4	4 of 6
	74LS32	A24	4 of 6
No receive from computer or printer	75189	A2	4 of 6
	6551A-1	A4	4 of 6
No keyboard response	Crystal	Y3	4 of 6
	6551A-1	A5	4 of 6
	6502	A11	1 of 6
Unable to select S1	Switch	S1	5 of 6
	74LS244	A3,A41	5 of 6
	resistor pack	RP1	5 of 6
Unable to select S2	Switch	S2	5 of 6
	74LS244	A3,A41, A34	5 of 6
	resistor pack	RP2	5 of 6
Unable to select S3	Switch	S3	5 of 6
	74LS244	A34,A29	5 of 6
	resistor pack	RP4	5 of 6

Table 4-7 950 GA Logic Board Debugging Guide

Symptom	Suspect Areas Part No.	Position	Schematic Page
No video/ no beep	6502	A11	1 of 7
	6551	A29,A33	5 of 7
		A36	
	6545	A6	2 of 7
	740012	A34	4 of 7
	2532	A20,A25	1 of 7
	2332	A30,A31	4 of 7
	Crystal	OSC 1	4 of 7
No video/ constant beep	6545	A6	2 0f 7
	6116	A3	3 of 7
Horizontal bar across screen	6545	A6	2 of 7
	7406	A39	6 of 7
Bad video	6116	A8,A13	3 of 7
		A17,A22	3 of 7
	74LS157	A7,A12	2 of 7
		A16,A21	2 of 7
	6545	A6	2 of 7
	6502	A11	1 of 7
	740012	A34	4 of 7
Distorted characters	2332	A30,A31	4 of 7
	740012	A34	4 of 7
	740012	A37	6 of 7
Loss of Attributes	740012	A34	4 of 7
Unable to transmit to computer	75188	A18	5 of 7
	74LS32	A19	5 of 7
	6551	A29	5 of 7
	74LS157	A28	5 of 7
Unable to receive from computer	75189	A9	5 of 7
	740012	A37	6 of 7
	6551	A29	5 of 7
Unable to transmit to printer	75188	A23	5 of 7
	74LS32	A24	5 of 7
	6551	A33	5 of 7
	74LS157	A28	5 of 7
Unable to receive from printer	75189	A32	5 of 7
	6551	A33	5 of 7
Inncorect/ no keyboard response	6551	A36	5 of 7
	6502	A11	1 of 7
	74LS32	A19	5 of 7

Table 4-7 continued

Symptom	Suspect Areas Part No.	Position	Schematic Page
Unable to select S1	Switch	S1	7 of 7
	resistor pack	RP1,RP2	7 of 7
	74LS367	A1,A4	7 of 7
	6552	A43	7 of 7
	6502	A11	1 of 7
Unable to select S2	Switch	S2	7 of 7
	resistor pack	RP2	7 of 7
	74LS367	A4,A38 A42	7 of 7
	6552	A43	7 of 7
	6502	A11	1 of 7

5. TROUBLESHOOTING THE KEYBOARD

Visual Inspection

With the Keyboard Installed--Turn off power to the terminal. Check keyboard alignment; are any keys binding on the cover?

Open the top case.

910/910 PLUS/912/920

Remove the two screws from the bottom front corners of the terminal. Carefully tip the top case back until it rests on a firm surface.

NOTE!

The terminal will now be top heavy and may tip over if there is not sufficient table space to support the top.

925/950

Remove the four screws from the bottom of the keyboard case. Carefully life off the top of the keyboard case and set it aside.

Check the following areas:

* Key switches:

  Foreign objects (e.g., paperclips, staples, matches)

  Liquid residue (e.g., coffee, soft drinks)

  Broken keyswitches

  Missing or incorrectly placed keycaps

* Cables:

  Broken wires

  Loose wires at connectors

  Creased, kinked, or cut cables

* Connectors:

  Loose or damaged connectors

  Bent pins

  Dirty contacts

NOTE!

If defects are found, correct them and recheck the terminal before continuing.

With the Keyboard Removed--Make the following inspections with the keyboard removed from its case. The procedure for removing the keyboard varies slightly according to the model.

910/910 PLUS/912/920

To remove the keyboard:

1. Unplug the ribbon cable from the logic board.
2. Remove the two securing screws and washers from the inner bottom corners of the keyboard.
3. Carefully remove the keyboard from the surrounding case.

925/950

To remove the keyboard:

1. Disconnect on the keyboard:

   P6 (speaker connector)
   P7 (keyboard cable)

2. Remove the four screws from the bottom corners of the keyboard case.
3. Carefully remove the keyboard from the bottom case.

Inspect the keyboard for:

* Overheated, damaged, or burned components
* Cracked, shorted, broken, or lifted traces
* Poor solder joints (loose solder balls, cold solder joints, or solder bridges)
* Broken, loose, or frayed wires

NOTE!

If any defects are found, correct them and recheck before continuing.

Table 5-1 Keyboard Debugging Guide

Symptom	Suspect Areas	Models
One key inoperative/ intermittent	Respective keyswitch	A
	Open trace/bad solder joint	A
	8048 keyboard CPU, position U6	B
Several keys inoperative/intermittent	Open/shorted trace	A
	Broken/loose jumper	A
	Defective ribbon cable	C, D
	Bent pin at ribbon cable connectors	C, D
	8048 keyboard CPU, position U6	B
	10K ohm resistor packs, positions RP2, RP3	B
	10K ohm resistor, position R3	B
All keys inoperative	Open/shorted trace	A
	Defective ribbon or keyboard cable	A
	8048 keyboard CPU, position U6	B
	7805 +5V regulator, position V1	B
	5.7143-MHz crystal, position X1	B
SHIFT, FUNCT, or ALPHA LOCK keys	10K ohm resistor pack, position RP2	
	8048 keyboard CPU, position U6	B
CTRL key inoperative	10K ohm resistor pack, position R2	
	8048 keyboard CPU, position U6	B
Incorrect characters	Shorted trace	A
	Shorted/improperly plugged ribbon cable	C, D
	8048 keyboard CPU, position U6	B

Legend
A = All
B = 925/950
C = 910/910 PLUS
D = 912/920

Table 5-1 Continued

Symptom	Suspect Areas	Models
Keys repeat	Respective keyswitch*	B, D
	Shorted trace	A
	Shorted ribbon cable	C, D
	8048 keyboard CPU, position U6	B

Legend
A = All
B = 925/950
C = 910/910 PLUS
D = 912/920

Note
*On the 910/910 PLUS terminals, a key which is shorted will not repeat on power up. Instead, any key pressed will repeat until another key is pressed.

6. TROUBLESHOOTING THE VIDEO MONITOR

Visual Inspection

With the Video Monitor Installed--Turn off power to the terminal, open the case, and check the following possible problem areas:

* Connectors: look for

  Loose or damaged connectors

  Broken or loose securing clips on pins at connectors

  Bad crimps

  Dirty contacts

* Wires: are any broken, loose, or frayed?

* Components: are any overheated, leaking, or burned?

If any defects are found, correct them and recheck the terminal before continuing.

With the Video Monitor Removed--The following inspections should be made with the video monitor removed.

To remove the video monitor:

1. With the power off and the cover removed, disconnect the following connections on the video monitor:

   J10 (signal input)
   J11 (DC power)
   J12 (yoke)

2. Disconnect the following parts on the CRT tube:

   CRT socket (small printed circuit board at rear of tube)

   Anode lead (SEE WARNING ON PAGE 2-1)

   Ground wire

3. Remove the three securing screws on the video monitor.

4. Carefully remove the video monitor.

With the video monitor removed, inspect it for:

* Overheated, leaking, or burned components
* Missing or broken components
* Cracked, broken, or lifted traces
* Poor solder joints (loose solder balls, cold solder joints, or solder bridges)
* Bent pins

NOTE!

If defects are found, correct them and recheck the terminal before continuing.

If no defects are found, reinstall the video monitor.

Apply power.

WARNING!

High voltages are present on the video logic board. USE EXTREME CARE during troubleshooting.

The four adjustments which can be made to the video board are listed in Table 6-1. The controls are shown in Figure 6-1.

Table 6-1 Video Board Adjustments

Problem	Control
Characters are too bright or too dim	Brightness
Whole screen is too tall or too short	Height
Characters are not even in height from the top to the bottom of the screen	Linearity
Characters are not sharp	Focus

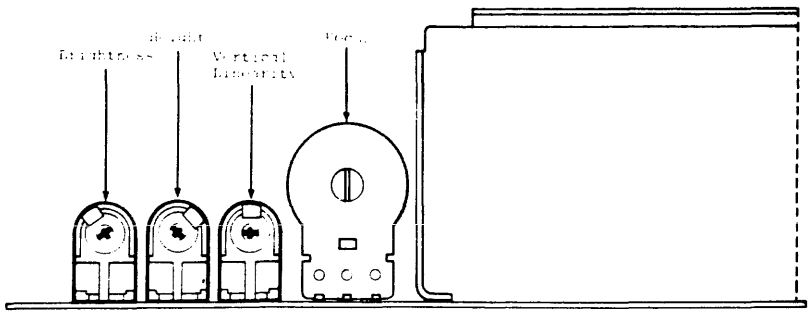


Figure 6-1 Location of Controls on Video Board

Debugging Guide

This section will help you troubleshoot specific malfunctions. Table 6-2 lists voltage levels and wave forms.

SYMPTOM: No Vertical Deflection

1. Check Q201 collector for vertical deflection.

   a. If it is present, proceed to Step 2.

   b. If it is not present, check the base of Q201.

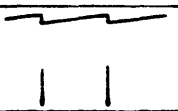
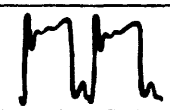
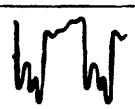
   c. If vertical deflection is present at the base, isolate the Q201 collector to see if signal is being pulled down. If there is still no output at Q201, suspect Q201.

   d. If vertical deflection is not present at the base, troubleshoot between the base of Q201 and P10 pin 5 (vertical sync signal from the logic board).

2. Check Q202 collector for vertical deflection.

   a. If it is present, proceed to Step 3.

   b. If it is not present, check the base of Q202.

Transistor			Base(In)			Collector(Out)			Emitter(GND)		
Location	Parts	Function	Vtg DC V	Vtg AC Vp-p	Wave Form	Vtg DC V	Vtg AC Vp-p	Wave Form	Vtg DC V	Vtg AC Vp-p	Wave Form
IC	LAS1512	Regulation	12	2.5		12	0.0		0.0	0.0	
IC	LAS1605	〃		1.6		5	0.0		0.0	0.0	
IC	LAS1812	〃		0.1		-12	0.0		0.0	0.0	
IC	LAS16CB	〃		1.4		13.8	0.0		0.0	0.0	
Q102	2SC509	〃	78.7	0.0		86.4	1.5		98.0	0.0	
Q103	2SC983	〃	12.0	0.0		75.7	0.0		11.9	0.0	
Q201	2SA495	Vert Pree Drive	2.0	3.0		0.6	0.57		1.0	1.7	
Q202	2SC372	Vert Drive	0.68	0.5		8.0	6.5		0.0	0.0	
Q203	2SC1173	Vert Out	9.36	6.5		12	0.0		8.76	6.5	
Q204	2SA473	Vert Out	8.0	6.5		0.0	0.0		8.6	6.5	
Q301	2SC735	Horiz Drive	-0.25	0.64		12	20		0.0	0.0	
Q302	2SC2233	Horiz Out	-0.08	6		12.8	124		0.0	0.0	
Q501	2SC983	Video Amp	0.4	3		76.8	25		-0.8	2.8	
D302	DS-113A	Damping	12.8	132							

DC Voltage reading taken with VTVM from point indicated to chassis ground.

AC Voltage reading taken with Oscilloscope from point indicated to chassis ground

Table 6-2 Voltage Levels and Waveforms

c. If vertical deflection is present at the base, isolate the Q202 collector to see if signal is being pulled down. If there is still no output at Q202, suspect Q202.

d. If vertical deflection is not present at the base, troubleshoot back from the base of Q202.

3. Check the negative side of C207 for vertical deflection.

a. If vertical deflection is present, the vertical drive section of the video monitor is good. If a vertical problem still exists, check the following areas:

Connections
CRT socket
Related components (small pcb at neck of CRT)

b. If vertical deflection is not present at C207, check the Q203 emitter.

c. If vertical deflection is not present at the Q203 emitter, check the base of Q203.

d. If vertical deflection is present at the base, suspect Q203.

e. If not present at the base of Q203, troubleshoot back.

f. If Q203 emitter is good, check Q204 emitter.

g. If vertical deflection is not present at Q204 emitter, check the base of A204.

h. If present at base, suspect A204.

i. If not present at base, troubleshoot back from Q204.

NOTE!

Since Q203 and Q204 are a matched set of push/pull amplifiers, replace both if one require replacement.

SYMPTOM: No Horizontal Deflections

1. Check the Q301 deflector for horizontal deflections.

a. If horizontal deflections are present, proceed to Step 2.

b. If not present, check the base of Q301.

c. If horizontal deflections are present at the base, isolate the Q301 collector to see if signal is being pulled down.

d. If there is no output at the Q301 collector, suspect Q301.

e. If horizontal deflections are not present at the base of Q301, troubleshoot between the base of Q301 and P10 pin 1 (horizontal sync signal from the logic board).

2. Check the Q302 deflector for horizontal deflections.

a. If horizontal deflections are present, proceed to Step 3.

b. If not present, check the base of Q302.

c. If horizontal deflections are present at the base, isolate the Q302 collector to see if signal is being pulled down.

d. If there is no output at the Q302 collector, suspect A302.

e. If horizontal deflections are not present at the base of Q301, suspect T301 (drive transformer) or Q302.

f. If the proper signal is present at Q302 collector, suspect the following areas:

C306
L201

SYMPTOM: No Video

1. Suspect the following areas:

L302
Q302
Q301
T302 (FBT)
C305
Q501

2. Check for cracked, broken, or lifted traces.

SYMPTOM: Jittery Screen

1. Make sure that yoke connector J12 is not dirty.

2. Suspect C504.

3. Check for

   * Bad crimps

   * Poor solder joints (loose solder balls, cold solder joints, or solder bridges)

SYMPTOM: Poor Linearity

1. If horizontal linearity is the problem, check L201.

2. If vertical linearity is the problem, check the following:

   a. Adjust SFT 2 (linearity potentiometer)

   b. Q203 and Q204

SYMPTOM: Fuses Blow and/or Voltage is Low

1. Check T302 (FBT)

2. Check for cracked, broken, or lifted traces.

7. TROUBLESHOOTING THE POWER SUPPLY

Visual Inspection

With the Power Supply Installed--Turn off power to the terminal, open the case, and check the following possible problem areas:

* Connectors: look for

  Loose or damaged connectors

  Broken or loose securing clips on pins at connectors

  Bad crimps

  Dirty contacts

  Depressed pins in connectors

* Wires: are any broken, loose, or frayed?

* Components: are any overheated, leaking, or burned?

* Bad fuse

  NOTE!

  Check the fuse with an ohm meter. Do not rely on a visual check.

* Loose fuse holder

If defects are found, correct them and recheck the terminal before continuing.

With the Power Supply Removed--The following inspections should be made with the power supply removed.

To remove the power supply:

1. Turn the power off and remove the cover.
2. Unplug the power cord from the wall outlet.
3. Disconnect K1 (AC input) on the power supply.
4. Disconnect J11 on the video monitor.
5. Disconnect J5 on the logic board.
6. Remove the securing screws on the power supply (four on the 925/950; three on 910/910 PLUS/912/920).
7. Carefully remove the power supply.

With the Power Supply Removed--Inspect the power supply for:

* Overheated, leaking, or burned components
* Bad crimps
* Bad connectors/connections

NOTE!

If defects are found, correct them and recheck the terminal before continuing.

Disassemble the power supply by removing the four securing screws and spacers which hold the small pcb on the heat sink.

Debugging Guide

This section will help you troubleshoot specific malfunctions. Table 6-2 lists voltage levels and waveforms.

SYMPTOM: No +5V DC

1. Remove F103 and check for approximately +13V on one side of the fuseholder.

   a. If correct voltage is not present, suspect the following areas:

      C105 through C108

      D105 through D108

      Bad crimps

      Loose or damaged connectors

      Broken or loose securing clips on pins at connectors

   b. If correct voltage is present, suspect the following areas:

      F103 (fuse)

      LAS1605

      C114

      C113

      Bad crimps

      Loose or damaged connectors

      Broken or loose securing clips on pins at connectors

SYMPTOM: +5V DC is Low

1. Check the following areas:

   LAS1605

   Bad crimps

   Loose or damaged connectors

   Broken or loose securing clips on pins at connectors

SYMPTOM: No +12V DC or 13.8V DC

1. Remove F102 and check for +24V on one side of the fuseholder.

   a. If correct voltage is not present, suspect the following areas:

      C101 through C104
      D101 through D104
      Bad crimps
      Bad connectors/connections
      Broken or loose clips

   b. If correct voltage is present, suspect the following areas:

      LAS15CB/LAS16CB

      C115

      C113

      Bad crimps

      Loose or damaged connectors

      Broken or loose securing clips on pins at connectors

SYMPTOM: +12V DC or +13.8V DC is Low

1. Check the following areas:

   LAS15CB\LAS16CB

   C113

   Bad crimps

   Loose or damaged connectors

   Broken or loose securing clips on pins at connectors

SYMPTOM: No -12V DC

1. Check the following areas:

   C101 and C102

   D101 and D102

   D112

   C116

   Bad crimps

   Loose or damaged connectors

   Broken or loose securing clips on pins at connectors

SYMPTOM: No +75V DC

1. Check the following areas:

   C109 (can be removed; do not need to be replaced)
   C120
   C119
   Q102
   Q103

SYMPTOM: +75V DC is Low

1. Adjust SFR3.

2. If +75V DC cannot be adjusted, check the following areas:

   Q103
   C109

If no defects are found, reinstall the video monitor. Make sure the securing screws are locked tight before proceeding.

Apply power.

Service Bulletin

Issue No. 3

ELIMINATING STATIC SENSITIVITY IN LOGIC BOARDS

Some early 910s contain a Revision A logic board, which may be sensitive to static discharge or line noise due to ground loops on the logic board.

The modification described in this bulletin will eliminate this sensitivity.

TOOLS REQUIRED

1. 25-watt soldering iron
2. Solder
3. Solder sucker
4. X-ACTO knife or razor blade

PARTS REQUIRED

1. 22-gauge jumper wire

NOTE!

Use care when modifying or repairing any high-density logic board. ANY DAMAGE INCURRED WHILE PERFORMING THIS MODIFICATION MAY RESULT IN INCREASED COSTS FOR FACTORY REPAIR.

PROCEDURE

1. Cut the traces on the component side of the logic board as shown in Figure 3-1.

2. Install one jumper on the solder side of the logic board as shown in Figure 3-2.

3. Make sure there are no shorts along the jumper wire.

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TeleVideo Systems Inc., 1170 Morse Ave., Sunnyvale, CA

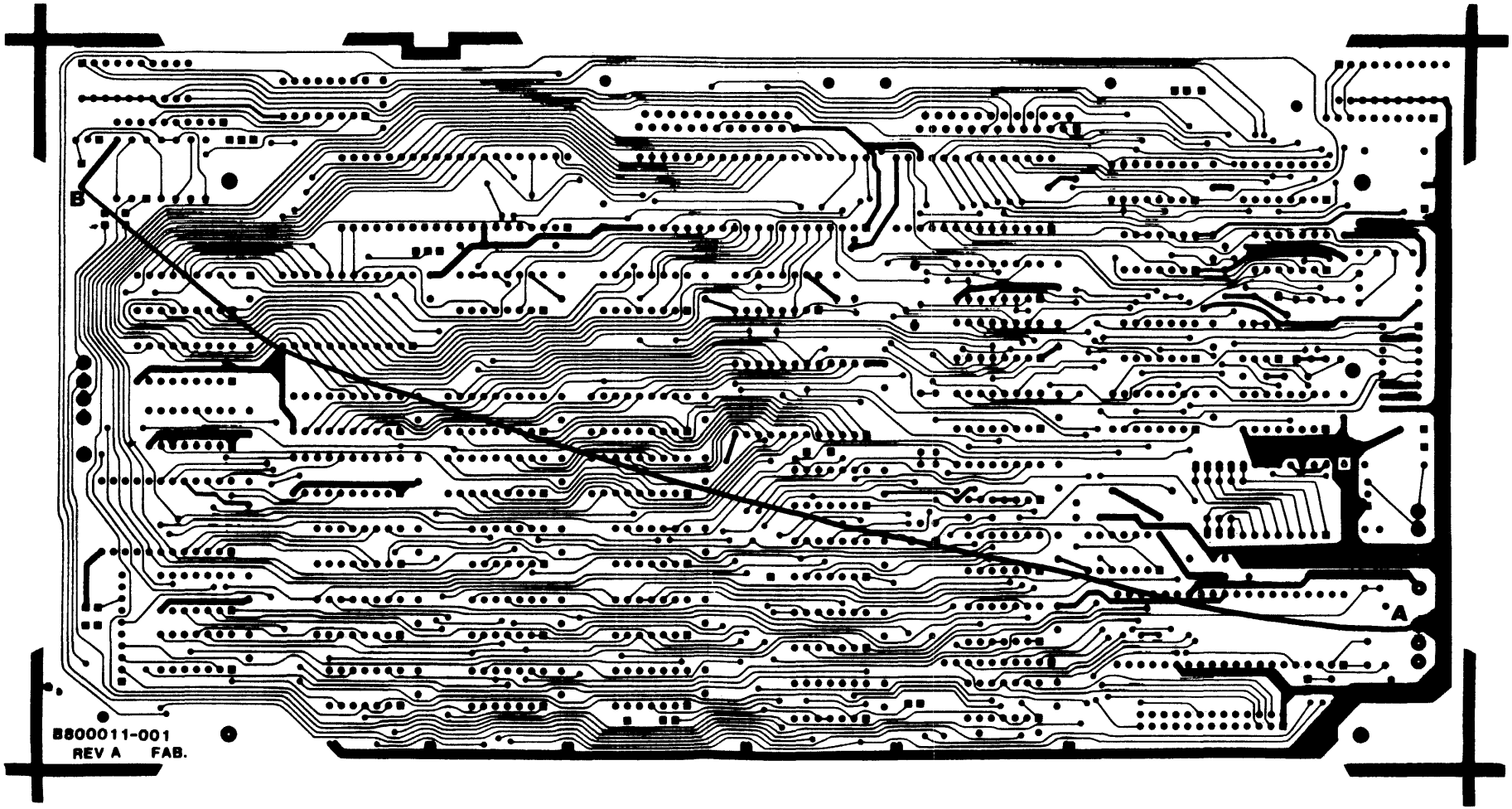


Figure 3-2 Location of Trace to be Installed on Solder Side of Logic Board

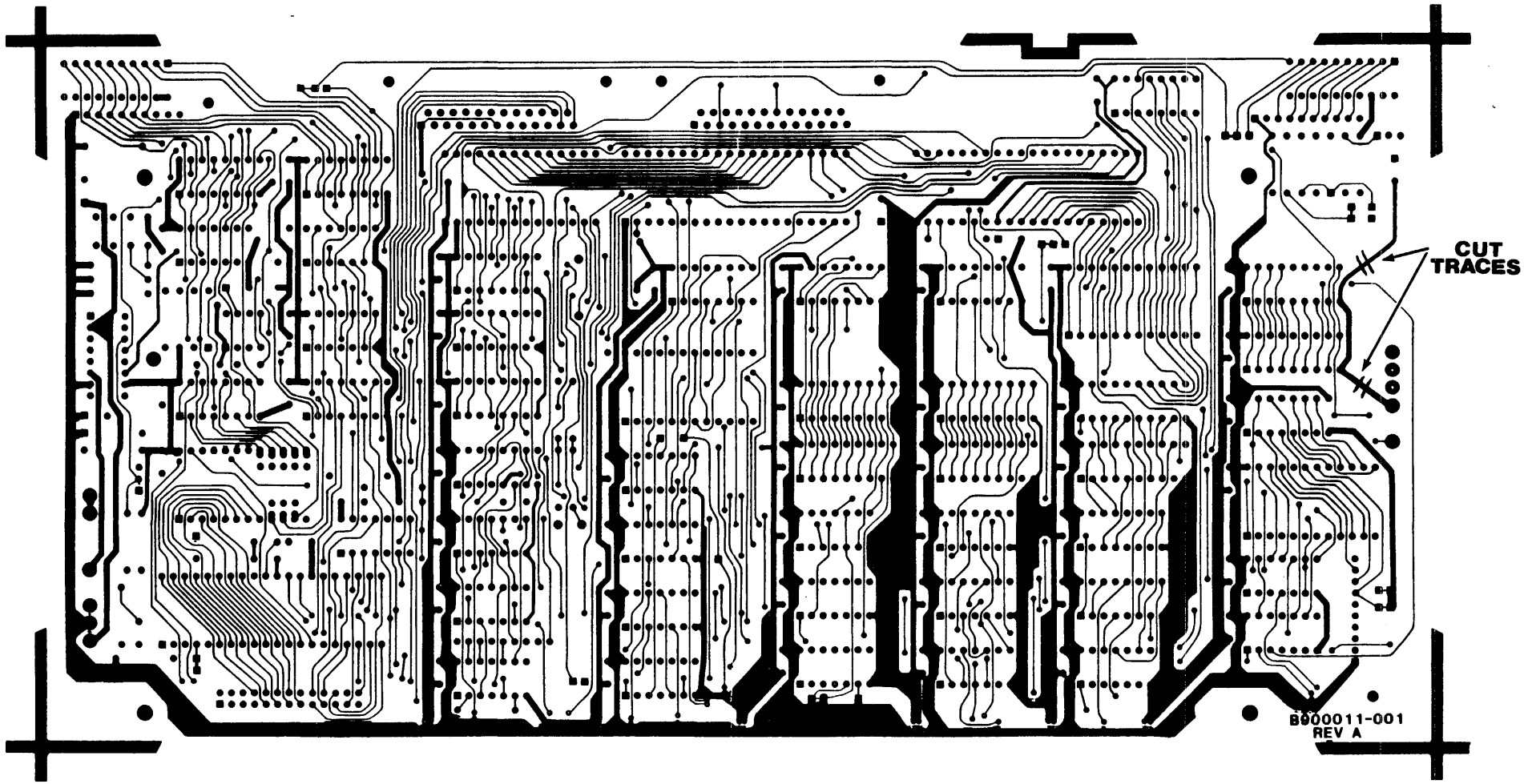
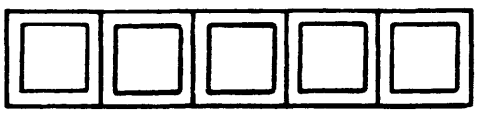


Figure 3-1 Location of Cuts to be Made on Component Side of the Logic Board

ELIMINATING LOSS OF VIDEO BY UPGRADING THE POWER SUPPLY

If you suspect that the power supply is causing loss of video, upgrading the power supply may correct the problem. To determine whether the power supply is the cause, measure the voltage on pin 5 of plug P5 on the logic board when the terminal is in the fail mode. (Refer to Figure 4-1).



Pins	1	2	3	4	5
	-12v	Not Used	Grd	+5V	+12V

Figure 4-1 Top View of P5

The reading should be between 11.4V and 12.6V. If the P5-5 reading is below 11.4V, modify the power supply using this procedure.

TOOLS REQUIRED

1. Volt meter
2. 25-watt soldering iron
3. Solder
4. Needle nose pliers
5. Medium Phillips-head screwdriver

PARTS REQUIRED

1. One 0.22uf/35V Tantalum capacitor

PROCEDURE

1. Make sure the power has been turned off.

2. Remove the power supply from the terminal.

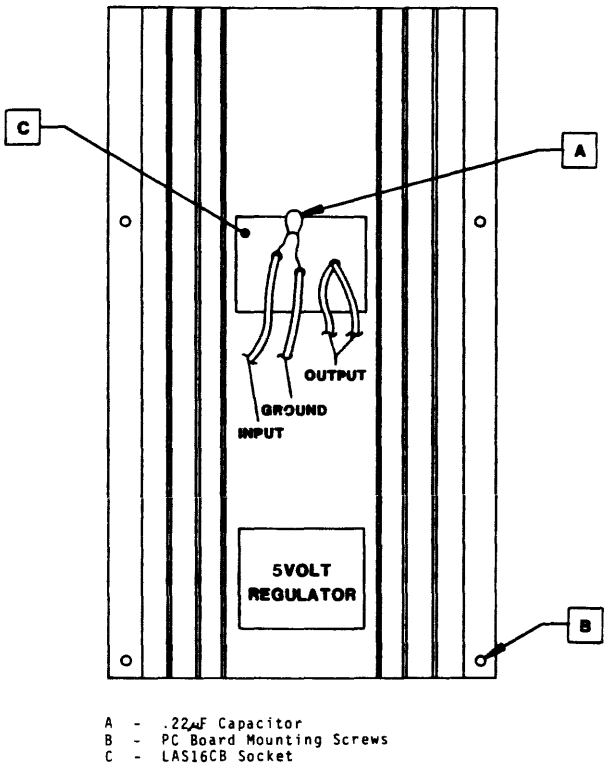
3. Separate the printed circuit board from the heat sink by removing plug K2 and the four screws and spacers from the corners of the board. Set the printed circuit board aside.

4. Inspect the capacitors which are mounted on the socket used for the 13.8V regulator (either LAS15CB or LAS16CB). If two 0.22uf capacitors are in place, remove the one on the output and proceed to Step 6. Remove all other capacitors which you find. Refer to Figure 4-2.

ALL

NOTE!

Do not perform any modifications to the other regulator, as it is the 5 volt supply and does not need to be changed.



A - .22μF Capacitor
B - PC Board Mounting Screws
C - LAS16CB Socket

Figure 4-2 Power Supply Heat Sink with PCB Removed

5. Install the 0.22uf capacitor on the input side of the regulator, observing polarity requirements. (Refer to Figure 4-2.)

6. Reassemble the power supply board and mount it in the terminal.

7. Reconnect all cables.

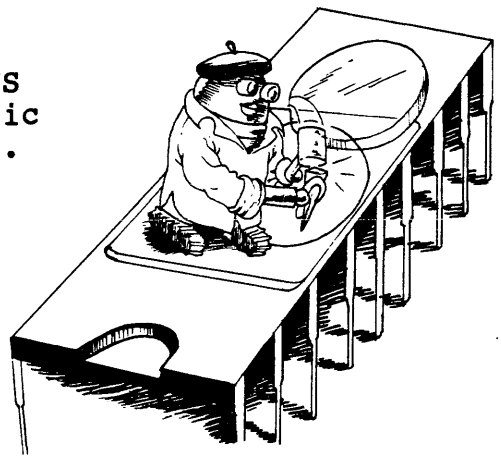
The modification is now complete.

Service Bulletin

Issue No. 7

UPDATED

UPGRADING A MODEL 910 TO A 910 PLUS



You can change a 910 to a 910 PLUS in terminals using either TTL logic boards or gate array logic boards. Simply follow the procedures described in this bulletin.

TOOLS REQUIRED

1. 25-watt soldering iron
2. Solder
3. Solder sucker
4. Needle nose pliers

PARTS REQUIRED

1. 910 PLUS conversion kit (Part No. 2169100) containing:

   A. 910 PLUS system EPROM (Part No. 8000040)
   B. 910 PLUS label (Part No. 2154301)
   C. 910 PLUS Operator's Manual (Document No. 2004600)

2. 0.031-gauge jumper wire (on TTL logic boards only)

PROCEDURE

The procedure varies depending on the type of logic board. To determine the type installed in your terminal, look at the chip in location A22 on the logic board. TTL boards have a 14-pin chip in that location, while gate array boards have a 40-pin chip.

A. On TTL Logic Boards

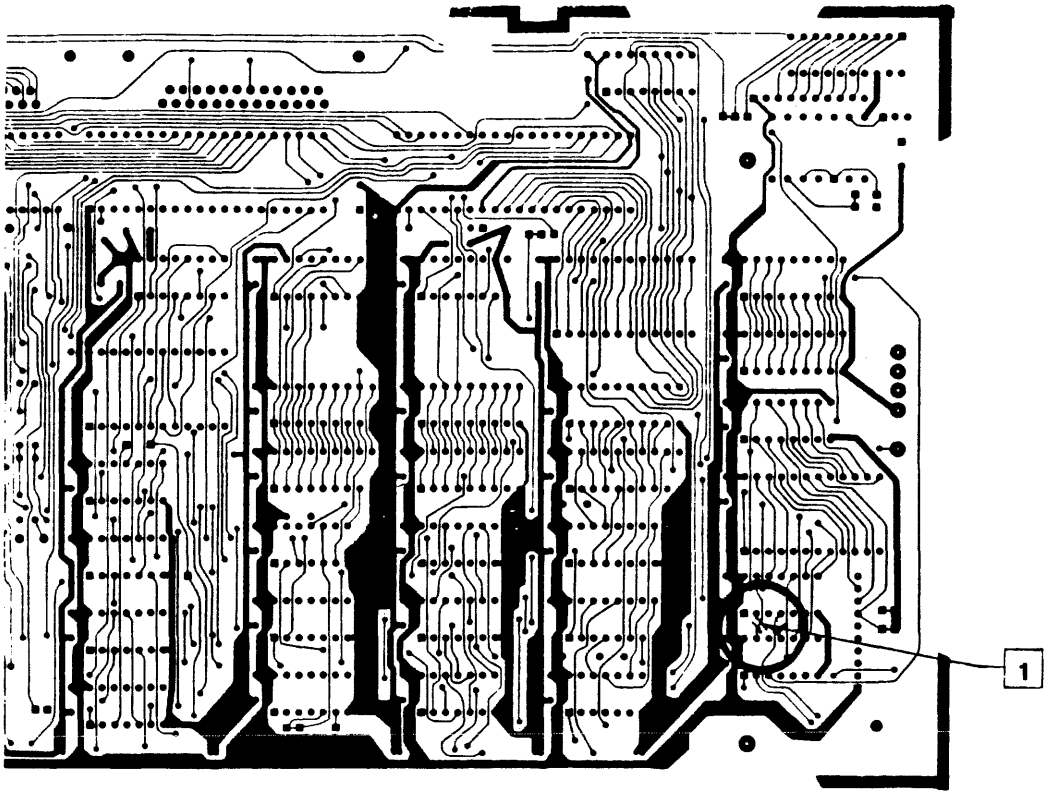
1. Replace the 910 system EPROM (Part No. 8000020) in location A45 with the 910 PLUS system EPROM (Part No. 8000040). Make sure that the notch in the top of the chip points in the same direction as that in the other ICs.

NOTE!

This step essentially converts the 910 to a 910 PLUS. However, unless you make the cuts and jumpers described in steps 2 and 3, the screen cannot clear to half intensity spaces.

2. Cut the trace from A46-13 to A47-13 as shown in Figure 7-1.

910

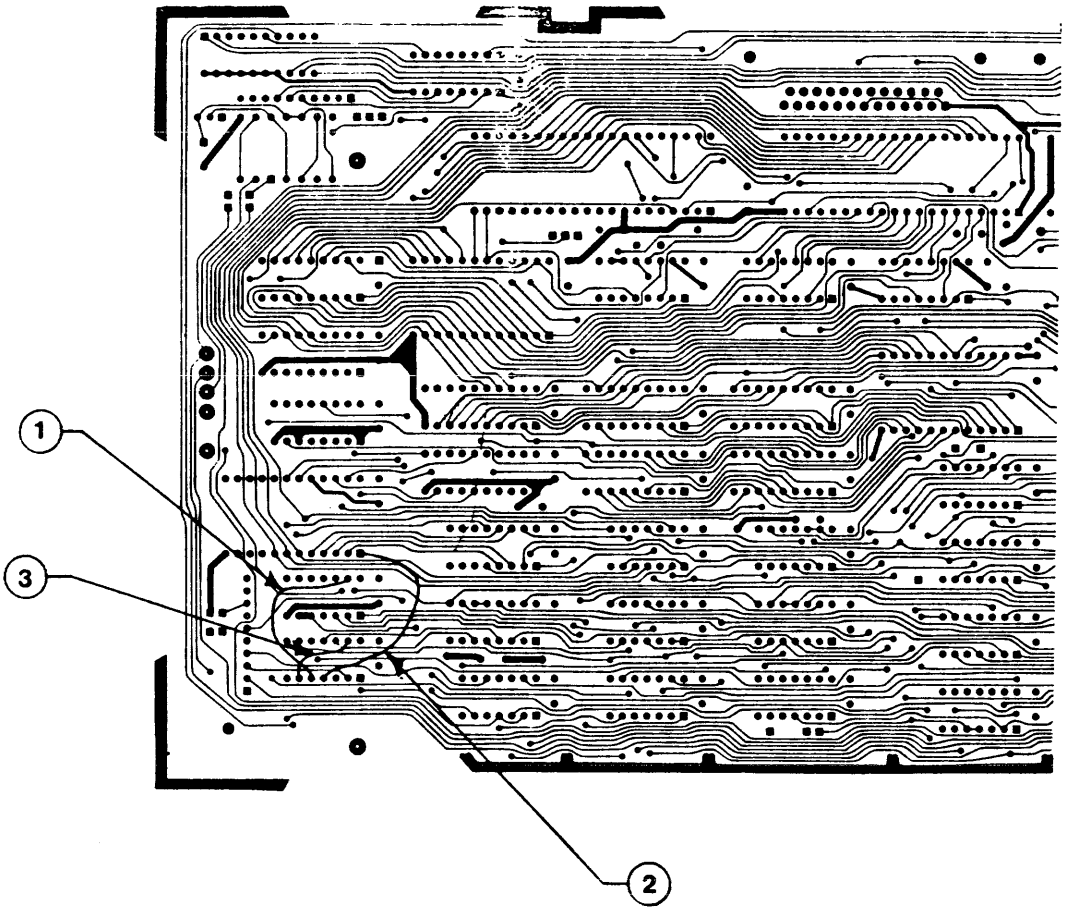


1 CUT TRACE FROM A46-13 TO A47-13

Figure 7-1 Location of Trace to be Cut on Logic Board

3. Add the following jumpers, as shown in Figure 7-2.

A47-13 to A46-5
A46-4 to A48-1
A46-6 to A46-13



(1) ADD JUMPER A47-13 TO A46-5

(2) ADD JUMPER A46-4 TO A48-1

(3) ADD JUMPER A46-6 TO A46-13

Figure 7-2 Location of Jumpers to be Added to Logic Board

4. Replace the 910 label with the 910 PLUS label.

5. When you have completed the modification, change the schematic as shown in Figure 7-3.

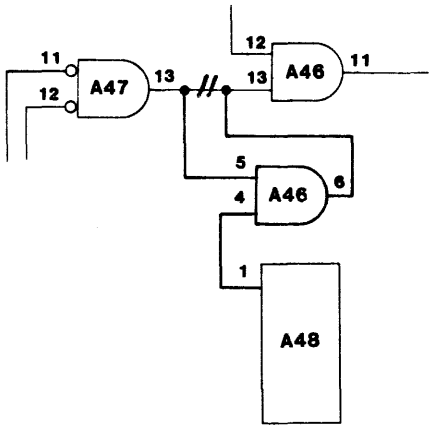


Figure 7-3 Revised Schematic, Page 3 of 5

B. On Gate Array Logic Boards

1. Replace the 910 system EPROM (Part No. 8000020) in position A38 with the 910 PLUS system EPROM (Part No. 8000040). Make sure that the notch in the top of the chip points in the same direction as that in the other ICs.

2. Move the jumper plug (Part No. 2098300) from position W1 to position W2 as shown in figure 7-4. For reference, the jumper plug appears on page 3 of 5 of the gate array board schematics.

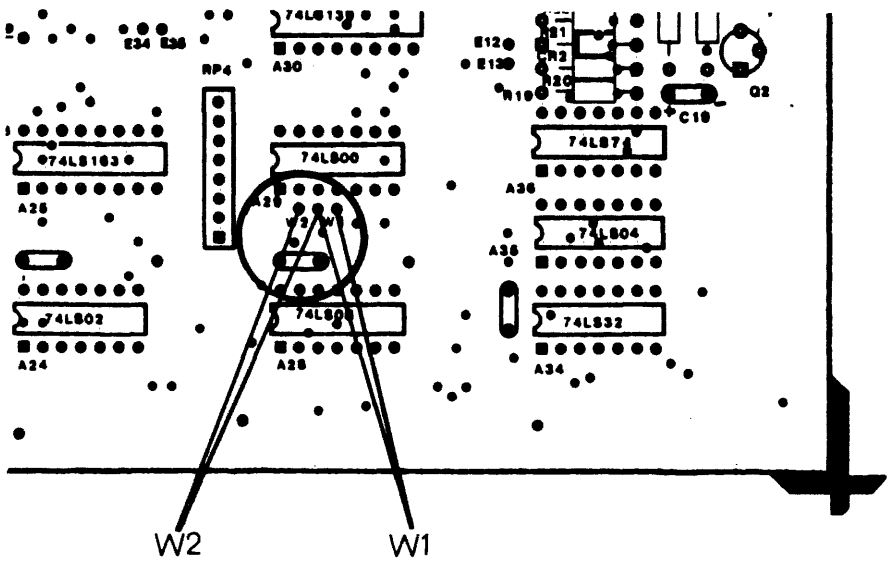


Figure 7-4 Position of Jumper Plug

Service Bulletin UPDATED Issue No. 8

UPGRADING THE 910, 910 PLUS KEYBOARD ENCODER

The keyboard encoder circuitry on the logic board of the 910 and the 910 PLUS contains either a single, programmed keyboard encoder at location A1, or a nonprogrammed keyboard encoder at A1 and an EPROM at A2.

If your board contains both chips (A1 and A2) and you have problems with the keyboard encoder circuitry, you can replace them with a single programmed keyboard encoder.

The procedure involves removing both chips, installing jumpers in that area of the logic board, and replacing them with a programmed keyboard encoder.

TOOLS REQUIRED

1. 25-watt soldering iron
2. Solder
3. Needle nose pliers
4. Solder sucker

PARTS REQUIRED

1. Programmed keyboard encoder chip A1 (Part No. 2051800)
2. Optional 40-pin socket for encoder A1 (Part No. 2098402)
3. 0.031-gauge jumper wire

PROCEDURE

NOTE!

Be careful when you modify or repair any high-density logic board. ANY DAMAGE INCURRED WHILE PERFORMING THIS MODIFICATION MAY RESULT IN INCREASED COSTS FOR FACTORY REPAIR.

1. Carefully remove the 40-pin keyboard encoder located on the logic board at A1. If the encoder was soldered directly to the logic board, make sure that all the solder has been removed. This protects the solder pads on the logic board from being damaged.

2. Remove the EPROM from location A2.

910/910+

3. Solder eight jumpers at the locations shown in Figure 8-3. The traces between these locations were cut at the factory.

E23 to E24
E25 to E26
E27 to E28
E29 to E30
E31 to E32
E33 to E34
E35 to E36
E37 to E38

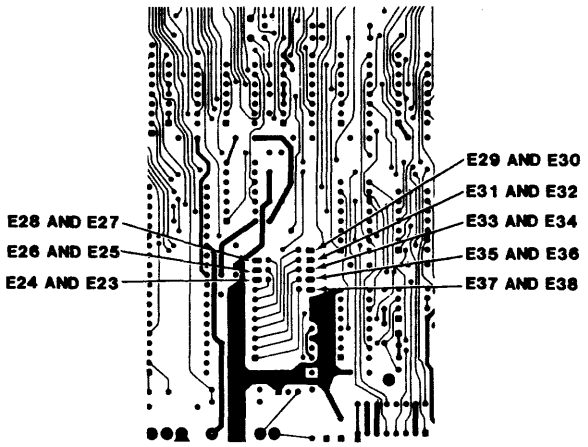


Figure 8-1 Location of Jumpers to be Installed

4. Solder a 40-pin socket at location A1. (This step is optional)

5. Install the new 40-pin encoder in location A1.

Figure 8-4 shows the schematic after the modification has been made.

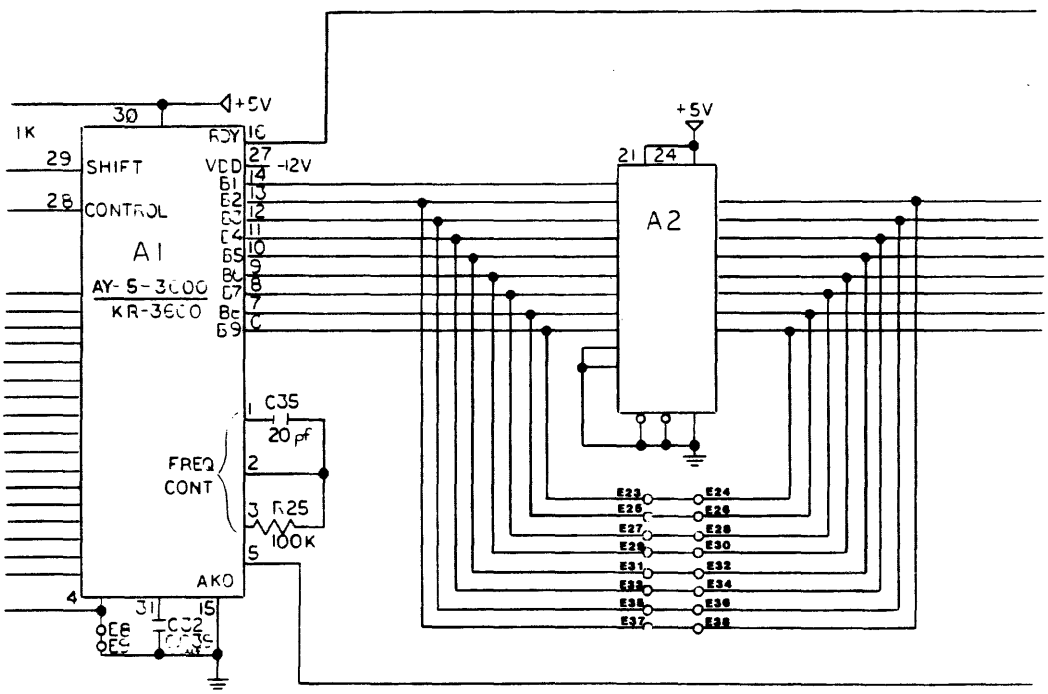


Figure 8-2 Revised Schematic, Page 5 of 5

MODIFYING THE PRINTER PORT DATA LINE

When the data line on the printer port is disabled, it may be held at an incorrect state. This procedure, which consists of making cuts and installing jumpers on Revision A logic boards, corrects that problem.

TOOLS REQUIRED

1. 25-watt soldering iron
2. Wire dikes
3. Solder
4. Solder sucker
5. X-ACTO knife or razor blade

PARTS REQUIRED

1. 0.031-gauge jumper wire

PROCEDURE

1. On the solder side of the logic board, cut both of the traces to pin 12 of the IC (located at A10 as shown in Figure 9-1).

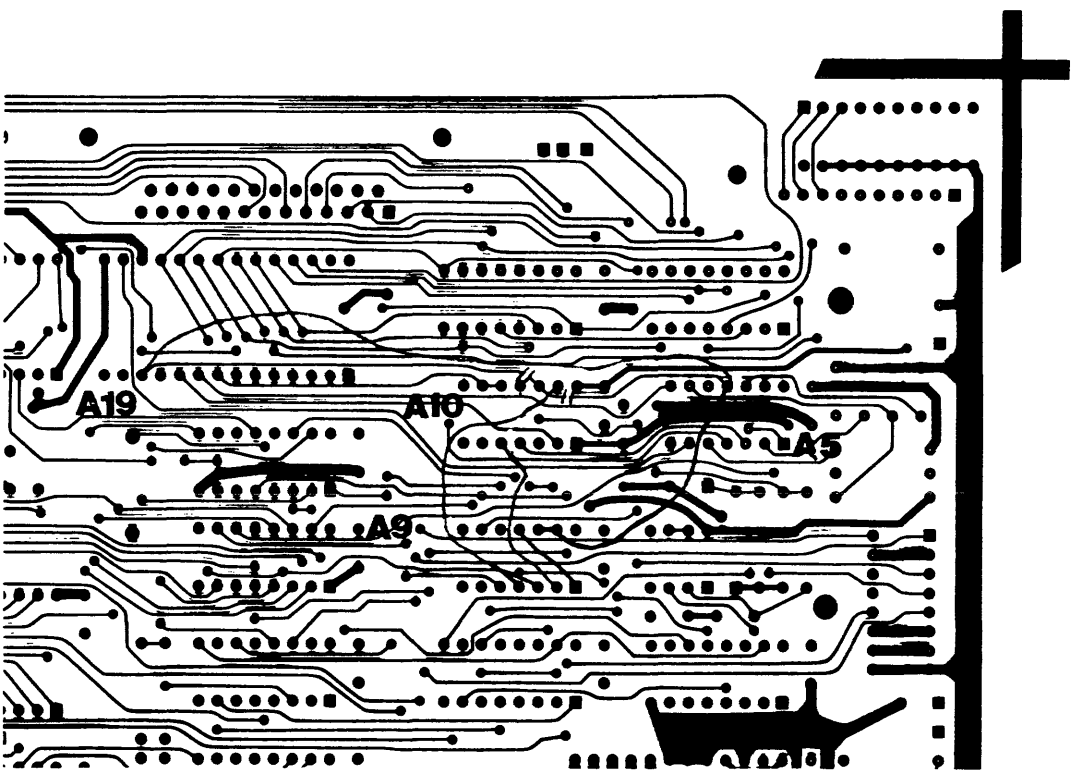


Figure 9-1 Cuts and Jumpers on Solder Side of Logic Board

910

2. On the component side, cut the trace which lies in between pins 1 and 2 of the IC located at A10 (as shown in Figure 9-2).

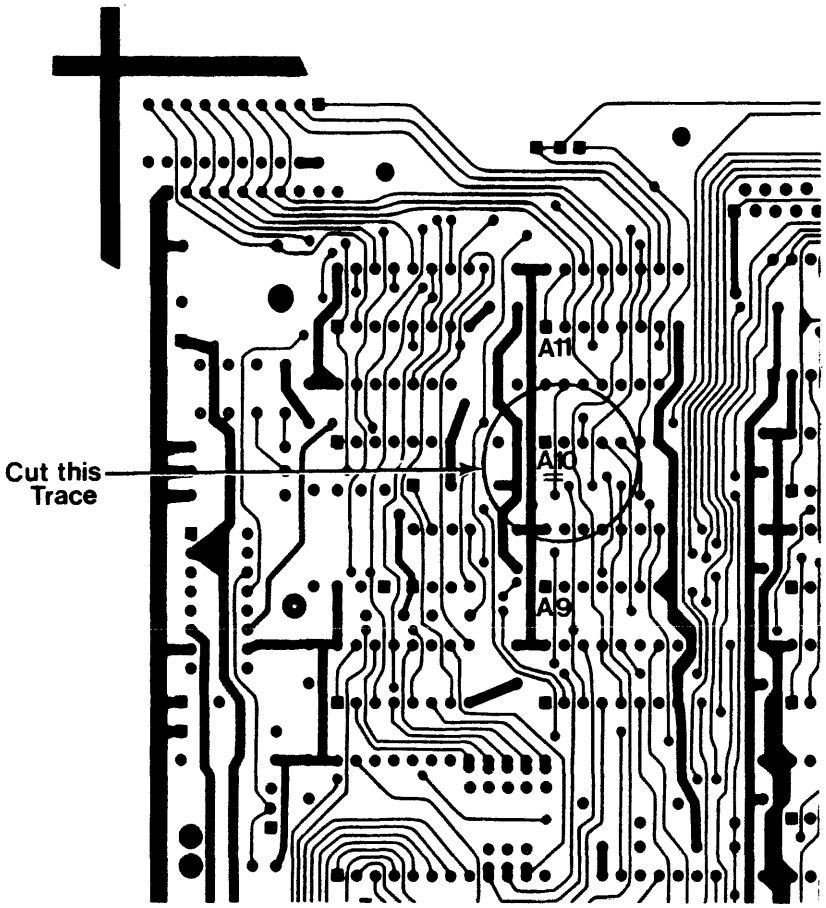


Figure 9-2 Cut on Component Side of Logic Board

3. Install the following jumpers:

A9 pin 12 to A9 pin 13
A9 pin 12 to A5 pin 11
A5 pin 11 to A19 pin 12
A9 pin 11 to A9 pin 1
A9 pin 2 to A10 pin 5
A9 pin 3 to A10 pin 12
A10 pin 12 to A10 pin 13

Refer to Figure 9-1.

4. Figure 9-3 shows the revised schematic.

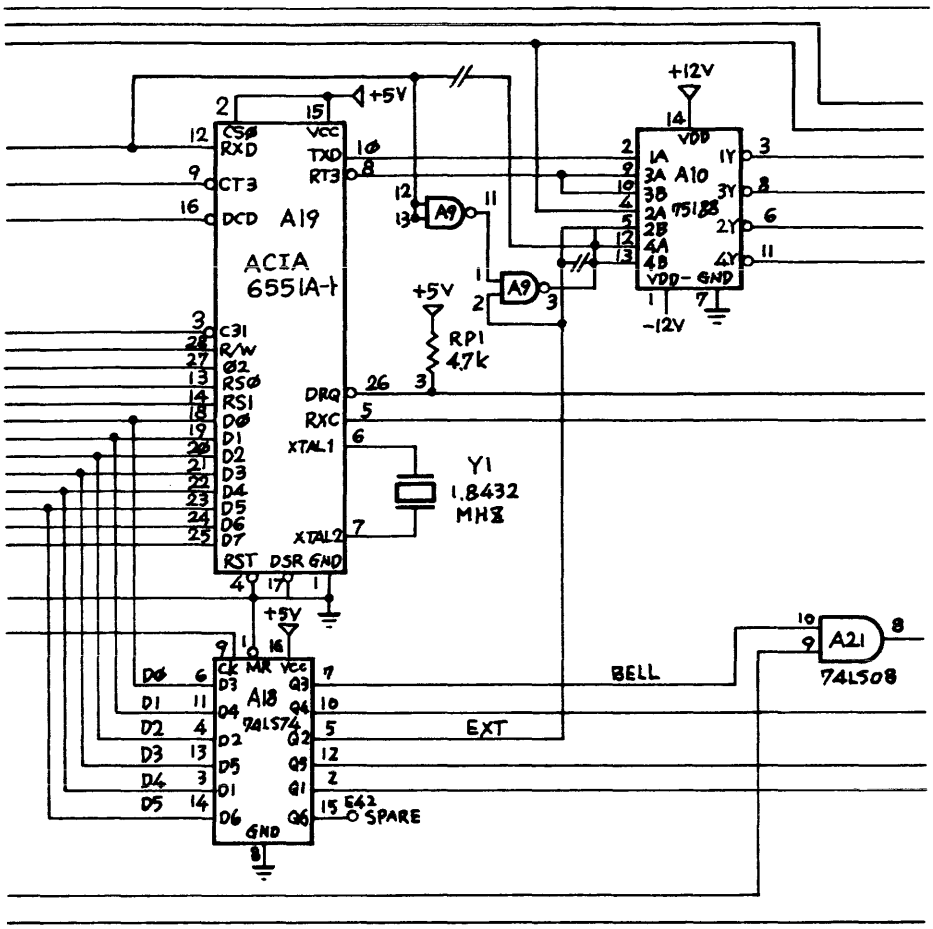


Figure 9-3 Revised Schematic, Page 4 of 5

Service Bulletin UPDATED Issue No. 15

CURRENT LOOP INSTALLATION INSTRUCTIONS

Introduction

Install the current loop when the terminal is located more than 50 feet and less than 1000 feet from the computer, or when the device connected to the RS232 port (P3) requires current loop.

Configuration

The current loop feature must be configured for either half or full duplex mode, and for an active or passive terminal state.

Either the terminal or the computer must provide a 20mA current source to drive a current loop signal. If the terminal provides the current source, configure the current loop board for an active state. If the computer provides the current source, configure the current loop board for a passive state.

The full duplex mode requires two current sources, one for the transmit loop and one for the receive loop. The half duplex mode requires only one current source for the single transmit and receive loop.

Tools Required

1. 25-watt soldering iron
2. Solder sucker
3. Solder
4. Medium Phillips screwdriver
5. Jumper wire

Parts Required

Depending on your terminal model, one of two current loop kits is enclosed.

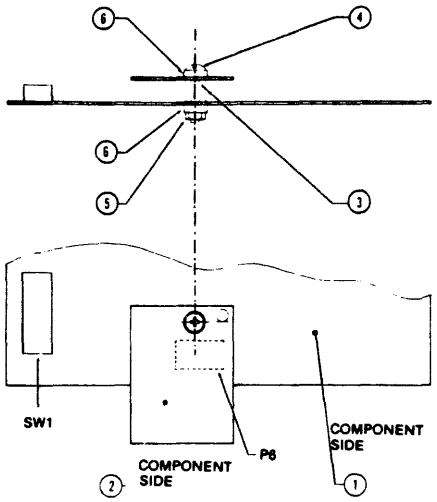
1. For the 910, 910 PLUS terminals (Part No. 2131000)

   This kit includes:
   - Current loop board
   - Installation instructions
   - Nylon space
   - Screw
   - Hex nut
   - Nylon washers (2)

2. For 925 models (Part No. 2131100)

   This kit includes:
   - Contents of 910, 910 PLUS kit
   - Ribbon cable

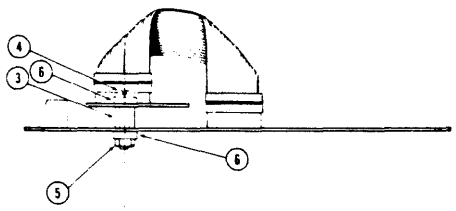
ALL

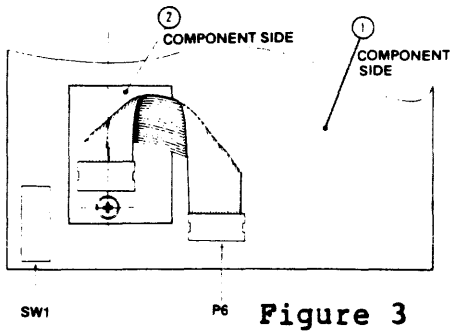


1. 910, 910 PLUS BOARD
2. CURRENT LOOP BOARD
3. NYLON SPACER
4. SCREW
5. HEX NUT
6. NYLON WASHER

Figure 2

Current Loop Board in Socket on 910, 910 PLUS TTL or Gate Array Logic Board

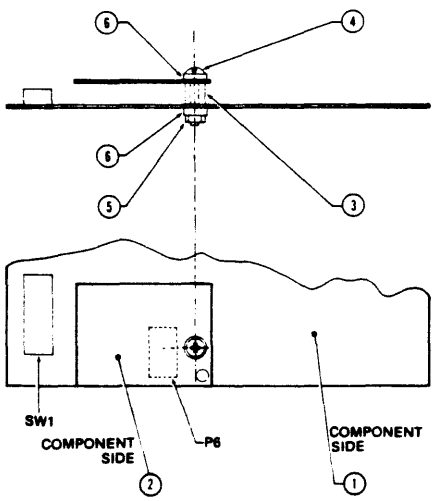




1. 925 TTL BOARD
2. CURRENT LOOP BOARD
3. NYLON SPACER
4. SCREW
5. HEX NUT
6. NYLON WASHER

Figure 3

Current Loop Board Installed with Cable on 925 TTL Logic Board



1. 925 GATE ARRAY BOARD
2. CURRENT LOOP BOARD
3. NYLON SPACER
4. SCREW
5. HEX NUT
6. NYLON WASHER

Figure 4

Current Loop Board in Socket on 925 Gate Array Logic Board

Procedure

1. Inspect the current loop board for damage caused by shipping (i.e., bent pins, cracked circuit board, etc.).

2. Configure the current loop board to match the requirements of the system you want to interface with. See Figure 1 for jumper locations and Table 1 for configuration combinations. Note that the half duplex mode requires jumpers in the connector pins of the cable, as well as on the current loop board.

3. Remove the the screws beneath the terminal that hold the terminal cover in place. Remove the cover.

4. **910, 910 PLUS (TTL and gate array logic boards):** Insert the current loop board connector pins into the 16-pin socket* at P6 on the logic board, as shown in Figure 2. Secure with mounting hardware.

   925, TTL Logic Board: Mount the current loop board on the logic board, as shown in Figure 3. Connect it to 16-pin socket at P6* with a 16-pin ribbon. Secure with mounting hardware.

   925, Gate Array Logic Board: Insert the current loop board connector pins into the 16-pin socket at P6 on the logic board, as shown in Figure 4. Secure with mounting hardware.

6. Replace the terminal cover and the screws that hold it in place. Be careful not to overtighten the screws.

7. Connect the computer to the terminal at the RS232 port (P3), using a RS232 cable. See Table 1 for the necessary pin connector assignments.

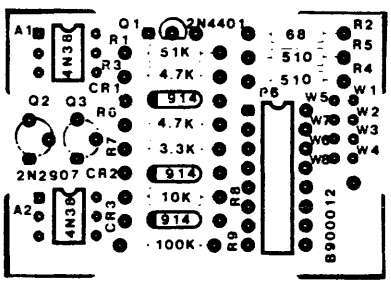


Figure 1 Location of Jumpers on Current Loop Board

* Some early models were shipped without a 16-pin IC socket in location P6. If your terminal doesn't have a socket at P6, install a standard 16-pin IC socket. These sockets are available from most computer vendors or from TeleVideo (Part No. 2098405)

Table 1 lists the possible current loop configurations and the correct pin connector assignments for the RS232 cable.

In full duplex mode, you must select a transmit and a receive state. That means that four pins will be connected. The terminal can supply the voltage (i.e. active state) for either or both loops. If the computer supplies it, the terminal is in the passive state.

In half duplex mode, there is a single transmit and receive loop. Therefore, only two pins need to be connected. The terminal can supply the voltage (i.e. active state) for this loop. If the computer provides it, the terminal is in the passive state.

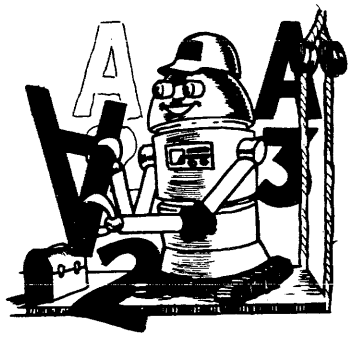
Table 1

Cuts, Jumpers, and P3 Configuration

Mode	State	Cuts	Jumpers	P3 Assigns.
Full Duplex	Active Transmit	W2 to W3	W1 to W2 W3 to W4	13+ 25-
	Active Receive	W6 to W7	W5 to W6 W7 to W8	24+ 12-
	Passive Transmit	None	None	25+ 13-
	Passive Receive	None	None	12+ 24-
Half Duplex	Active Transmit/ Receive	None	W1 to W2 P3-12 to P3-13	24+ 07-
	Passive Transmit/ Receive	None	P3-12 to P3-13	25+ 24-

If you have any questions, call the Terminal Support Group at at 408 745-7760.

910/910 PLUS JUMPER OPTIONS AND PORT CONNECTORS



The 910/910 PLUS logic board contains many jumpers and several ports. This bulletin gives you information about them in tabular form. Refer to your User's Guide or Maintenance Manual for more information.

Table	Description
17-1	Lists the jumpers which are called out on the logic board, the schematic page where they can be found, and a description of the purpose of the jumper
17-2	Lists the ports on the logic board, their use, and the pin assignments

Table 17-1a Logic Board Jumpers

Jumper No.*	Schematic Page No.	Description
E1, E2, E3	1 of 5	Increase system ROM size from 4096 to 8192 bytes
E4, E5, E6, E7	3 ot 5	Selects alternate character set
E8, E9	5 of 5	Ties A1 pin 4 to ground and makes keyboard encoder a receive-only device
E10 through E13	4 of 5	Activates composite video option
E14, E15, E16	4 of 5	Enables Data Set Ready at RS232 port (P3-6)
E17, E18, E19	4 of 5	Enables Request to Send at RS232C port (P3-20)
E20, E21, E22	2 of 5	Not used
E23 through E38**	5 of 5	Disables/enables A2
E39 through E43	2 of 5	Not used

*Jumpers normally traced/not traced are listed in Table 17-1b.
**These jumpers are not labeled.

910/910+

Normally Traced	Normally Not Traced
E1 to E2	E2 to E3
E4 to E5	E5 to E6
E6 to E7	E12 to E13
E8 to E9	E15 to E16
E10 to E11	E17 to E18
E14 to E15	E20 to E21
E18 to E19	E39 to E43
E21 to E22	
E23 through E38*	

*If A2 is installed, these jumpers are factory cut.

Table 17-2 Ports and Associated Pin Assignments

Port No.	Description	Pin No.	Function
P1	Keyboard data input		
		1	Ground
		2	Ground
		3	ALPHA LOCK key input
		4	SHIFT key input
		5	FUNCT key input
		6	Control key input
		7	Not used
		8	X0 input
		9	X1 input
		10	X2 input
		11	X3 input
		12	X4 input
		13	X5 input
		14	X6 input
		15	X7 input
		16	Y1 input
		17	Y3 input
		18	Y5 input
		19	Y7 input
		20	Y0 input
		21	Y2 input
		22	Y4 input
		23	Y6 input
		24	Not used
		25	Not used
		26	Y8 input

Table 17-2 Continued

Port No.	Description	Pin No.	Function
P2	Video output		
		1	Horizontal sync
		2	Index pin (not installed)
		3	Ground
		4	Video output
		5	Vertical sync
		6	Composite video output (not installed)
P3	RS232C		
		1	Frame ground
		2	Transmit data output
		3	Receive data input
		4	Request to Send output
		5	Clear to Send input
		6	Data Set Ready input
		7	Signal ground
		8	Data Carrier Detect input
		12	Current loop, + receive
		13	Current loop, - transmit
		20	Data Terminal Ready output
		24	Current loop, - receive
		25	Current loop, + transmit
P4	Printer		
		1	Frame ground
		3	Transmit data output
		7	Signal ground
		20	Printer ready input
P5	Power supply		
		1	-12 volt supply
		2	Index pin (not installed)
		3	Ground
		4	+5 volt supply
		5	+12 volt supply

Table 17-2 Continued

Port No.	Description	Pin No.	Function
P6	Optional current loop or modem		
		0	Current loop, to P3-24
		1	+12 volt supply
		2	Transmit data to modem
		3	Receive data from modem
		4	Current loop, from P3-13
		5	-12 volt supply
		6	+5 volt supply
		7	Ground
		8	Ground
		9	+5 volt supply
		10	-12 volt supply
		11	Current loop, from P3-25
		12	Clock input to modem
		13	Speaker output from modem
		14	+12 volt supply
		15	Current loop, to P3-12
P7	Speaker		
		1	Speaker output
		2	+5 volt supply

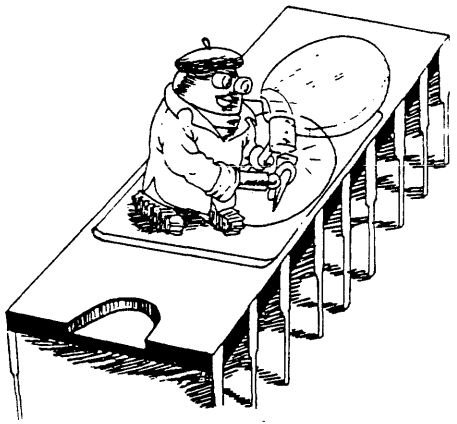
091382 SB17 910/910 PLUS

Service Bulletin

Issue No. 23

HOW TO TELL A TTL LOGIC BOARD FROM A GATE ARRAY LOGIC BOARD

TeleVideo® now uses new gate array logic boards in the 910, 910 PLUS, 925, and 950 terminals. Since these boards have fewer components, they are more reliable. Troubleshooting is also simplified.



Although the components are laid out differently, gate array boards are completely interchangable with TTL boards.

Table 23-1 gives the part number and the location of the gate array chips for each of the models.

Table 23-1 Location of Gate Array Chip(s)

Model No.	Part Number	Location
910, 910 PLUS	2057400	A22
925	2057400	A39
950, Chip A	2057600	A34
Chip B	2057800	A37

Table 23-2 shows the quickest way to determine which type of board is installed in your terminal.

Table 23-2 Determining Type of Logic Board

Model No.	Type of Board	Look for
910, 910 PLUS	TTL	Chip in A22 (14-pin package)
	Gate Array	Chip in A22 (40-pin package)
925	TTL	Size (10"x 12")
	Gate Array	Size (7" x 12")
950	TTL	Color (Blue)
	Gate Array	Color (Green)

You can also determine the type of board you have by comparing it to the illustrations that follow.

ALL

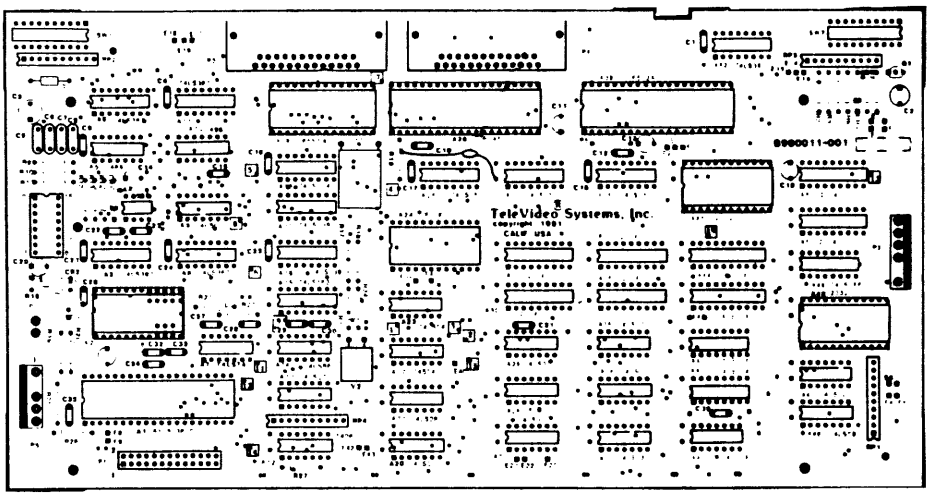


Figure 23-1A 910 or 910 PLUS TTL Logic Board

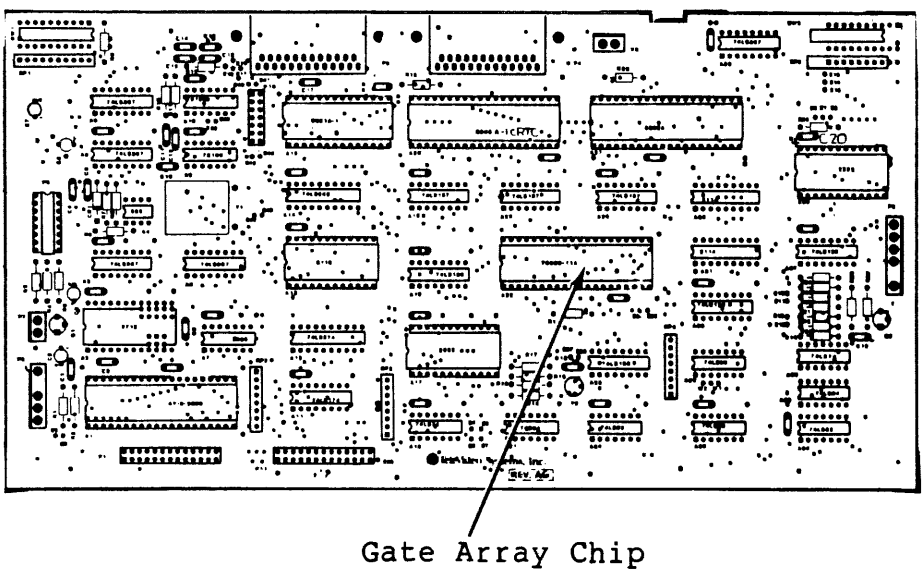


Figure 23-1B 910 or 910 PLUS Gate Array Logic Board

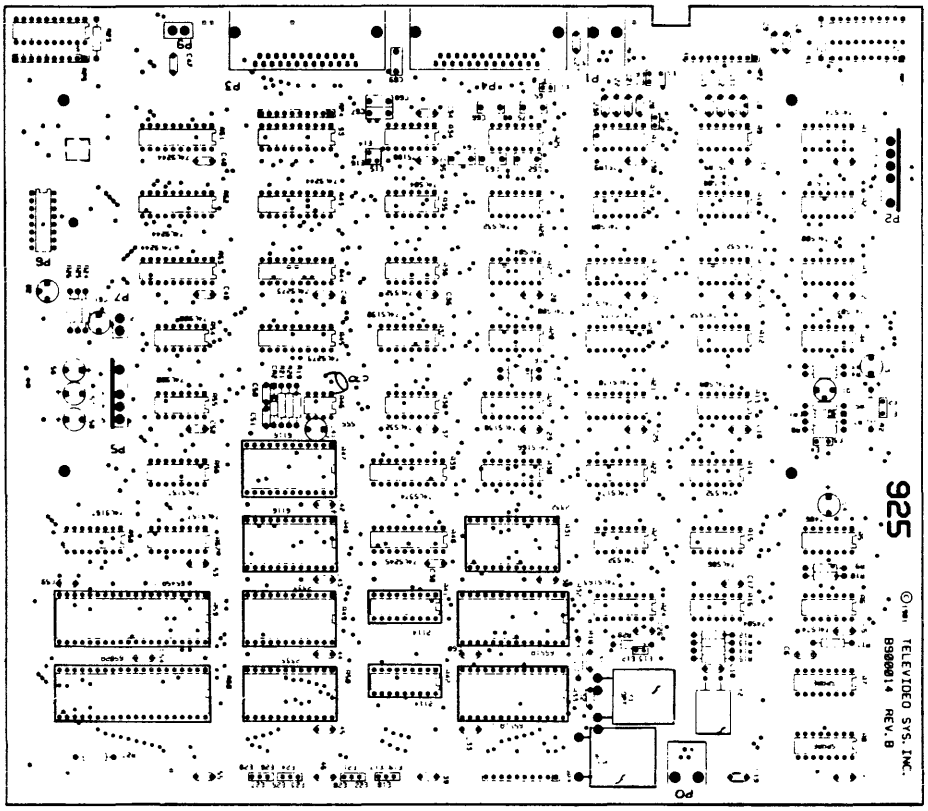


Figure 23-2A 925 TTL Logic Board

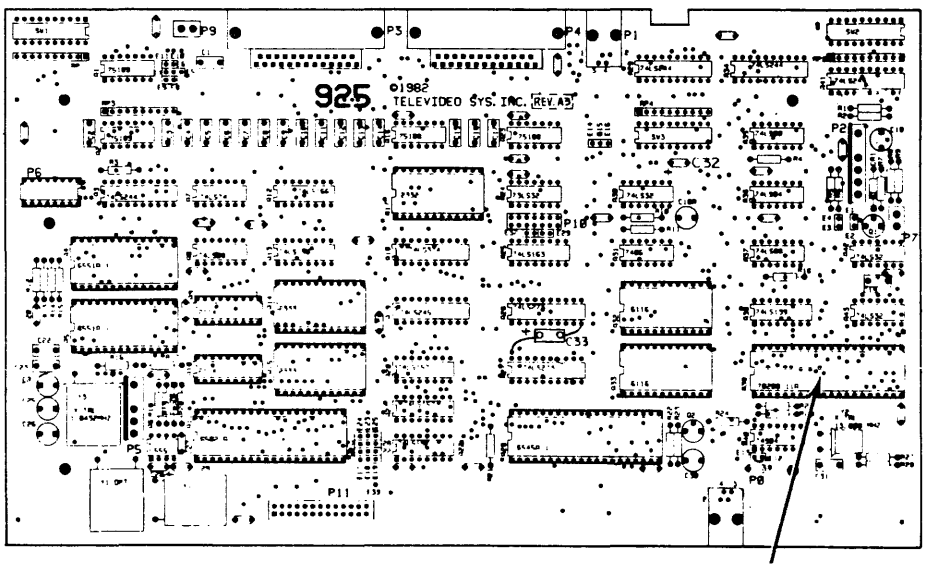


Figure 23-2B 925 Gate Array Logic Board

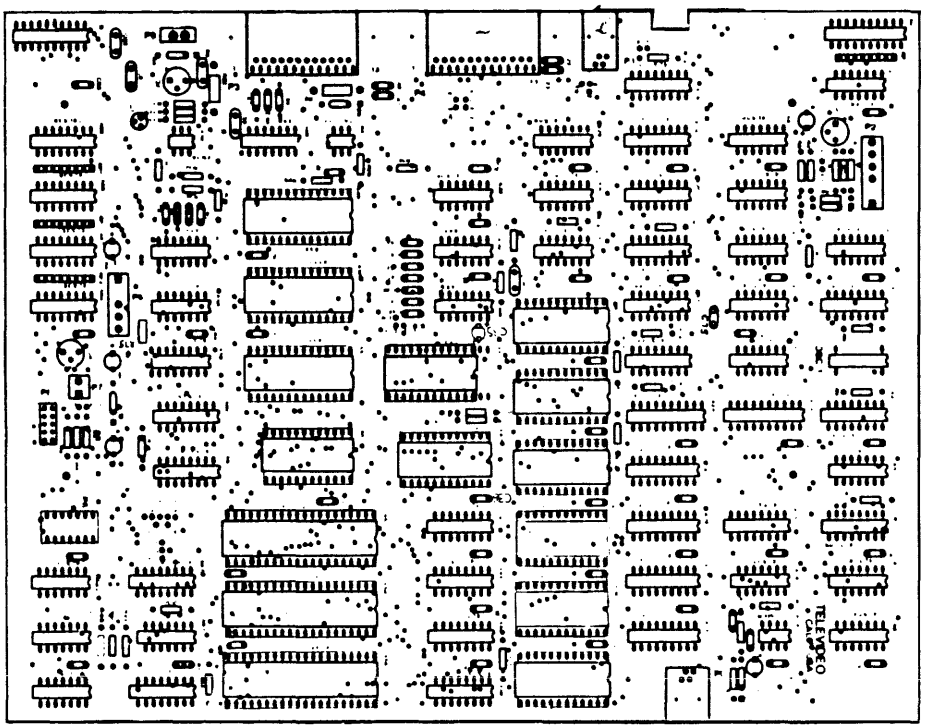


Figure 23-3A 950 TTL Logic Board

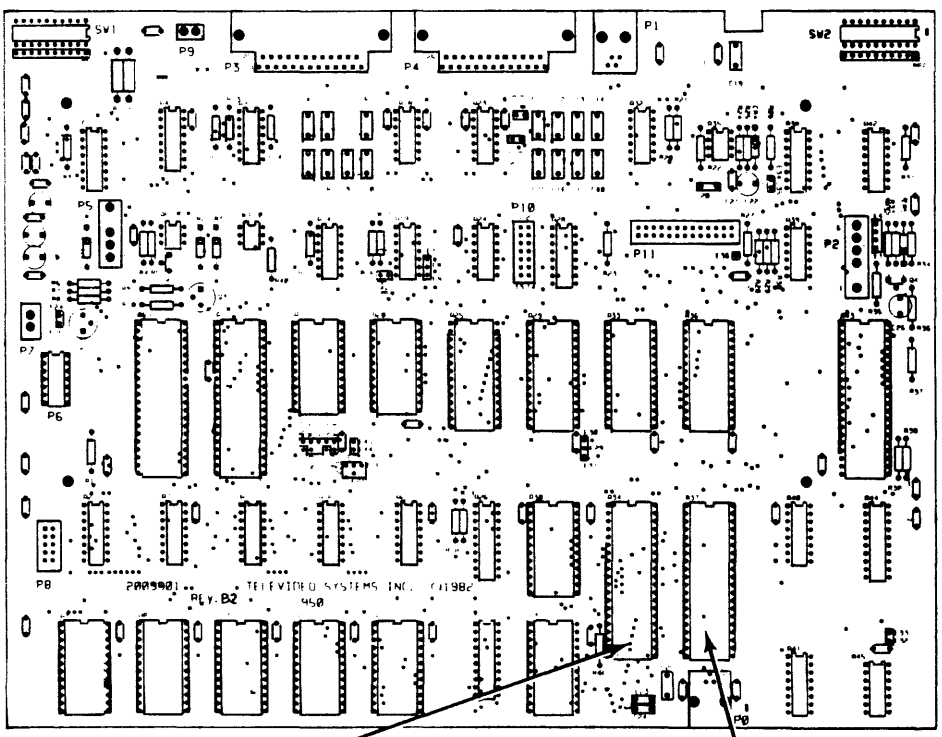


Figure 23-3B 950 Gate Array Logic Board

Service Bulletin

Issue No. 24

TESTING THE 6502 ADDRESS LINE

With a 6502 address line tester, you can test all address lines on any logic board that uses a 6502 chip.

When the 6502 receives instruction hex EA (a NOP), it does nothing except increment the program counter and read the next instruction. If the next instruction is also a NOP, the microprocessor is forced to count through all 65,536 possible addresses on its 16-bit address bus.

If you then monitor the address bus lines with an oscilloscope, each address line will display a square wave, with a period twice that of the next lower address line. This gives you a predictable set of signals to trace.

TOOLS REQUIRED

1. Wire cutters
2. Soldering iron
3. Solder

PARTS REQUIRED

1. 40-pin wire wrap socket (not available from TeleVideo)
2. 6502 microprocessor (Part No. 2049600)
3. Jumper wire

PROCEDURE

Construction of test assembly:

1. Cut pins 26 through 33 on the bottom of the wire wrap socket by about 1/4 inch. This will prevent them from making contact with the pins in the socket of the pcb (see Figure 24-1).

2. Wire pins 29, 31, and 33 to pin 1 (ground), and pins 26, 27, 28, 30, and 32 to pin 8 (+5V) to force the hex EA instruction on the data bus (see Figure 24-1).

3. Plug the 6502 into the wire wrap socket. Make sure that its notch faces in the same direction as the notch on the wire wrap socket (see Figure 24-1).

ALL

Operation of test assembly:

1. Remove the 6502 CPU from the board to be tested and set it aside.

2. Install the test assembly (with a known good 6502) in the wire wrap socket. Make sure that the notch faces in the same direction as that on the other chips.

3. Apply power to the logic board.

4. Inspect the address lines for the wave forms listed in Table 1.

5. If you do not detect any pulses on the address lines, check for the following signals:

   Pin 2 Ready (should be high)
   8 +5V
   37 Phase 0 clock
   38 Set overflow (should be high)
   40 Reset (should be high)

   If any of these inputs are held in an incorrect state, the microprocessor will not work. Before continuing, correct any problems with these lines.

Figure 24-1 shows a top and a bottom view of the wire wrap socket.

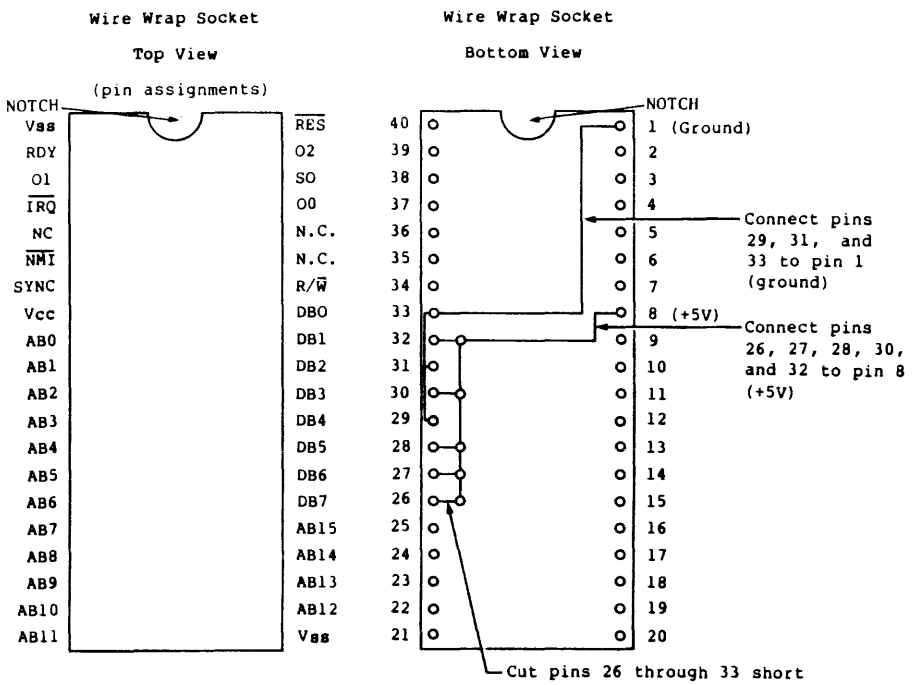


Figure 24-1 Wire Wrap Socket

Table 1

Expected Wave Forms

Pin No	Name	Wave form
1	Vss	Ground
2	RDY	+5V
3	O1 (out)	.6u second period square wave
4	IRQ	+5V noisy
5	N.C.	Ground
6	NMI	+5V noisy
7	SYNC	1.2u second period square wave
8	Vcc	+5V
9	AB0	2.4u second period square wave
10	AB1	4.8u second period square wave
11	AB2	9.6u second period square wave
12	AB3	19.2u second period square wave
13	AB4	38.4u second period square wave
14	AB5	76.8u second period square wave
15	AB6	150u second period square wave
16	AB7	.3m second period square wave
17	AB8	.6m second period square wave
18	AB9	1.2m second period square wave
19	AB10	2.4m second period square wave
20	AB11	4.8m second period square wave
21	Vss	Ground
22	AB12	9.6m second period square wave
23	AB13	19.2 second period square wave
24	AB14	38.4m second period square wave
25	AB15	76.8m second period square wave
26	DB7	Tied high
27	DB6	Tied high
28	DB5	Tied high
29	DB4	Tied low
30	DB3	Tied low
31	DB2	Tied low
32	DB1	Tied high
33	DB0	Tied low
34	R/W	4V to 4.5V noisy
35	N.C.	Ground noisy
36	N.C.	Ground noisy
37	O0 (in)	.6u second period square wave with ringing
38	S.O.	+5V noisy
39	O2 (out)	.6u second period square wave
40	RES	+5V noisy

Service Bulletin

Issue No. 26

C306 RELATED FAILURES

Some TeleVideo® terminals shipped during the latter months of 1982 may experience a problem with capacitor C306 on the video module. The symptoms include, but are not limited to:

No video
Bad video
No horizontal deflection
Blowing fuse F102 on the power supply

The suspect capacitor is blue in color and is rated at 20uF, 50V. This capacitor must be replaced with TSI Part No. 2280000 (16uF, 25V nonpolarized capacitor).

If your terminal has experienced one of these symptoms and the suspect capacitor is installed, contact Customer Service, Terminal Division (800/438-8725 x 439 outside California, or 408/745-7760 x 439 in California).

We will have a replacement capacitor sent to you at no charge, or arrange for the module or terminal to be returned to TeleVideo for warranty repair.

ALL

TeleVideo Systems Inc., 1170 Morse Ave Sunnyvale CA