



KURZ-KASCH

**COMPUTER GAMES
OPERATORS HANDBOOK**

INTRODUCTION

The age of video electronic amusement devices places unusual demands upon the service personnel who are connected with the industry. The electromechanical service personnel are now finding service problems steeped in complex electronic technology including digital logic. It is Kurz-Kasch's hope that this small booklet produced for the coin industry will help simplify the day-to-day maintenance problems you face in the field. This booklet is in no way intended to be a complete course in digital logic or television diagnostics. It is hoped, however, that the material presented here will help you overcome the trials of maintenance within this new era of video computer technology.

Kurz-Kasch Electronics is dedicated to producing efficient and versatile digital test equipment and making it available to designers and field service personnel at a price which represents a realistic combination of quality and required accuracy.

The logic probes are instruments which give answers. No interpretation or interpolation is required when testing or trouble-shooting digital circuits.

Through the Electronics Division's Center for Technical Development, home study courses are offered to keep technicians and field service personnel abreast of the changing technology. The courses are also designed to allow an easy transition from electronic, electrical and/or electromechanical skills to the digital logic domain.

Our engineers are working on tomorrow's test equipment and training material today. The LP-600 TV is our most recent example.

WANT TO KNOW MORE ?

CALL: Telephone 513/256-0338



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ELECTRONICS DIVISION
2876 Cedar Avenue
Dayton, Ohio 45422

TABLE OF CONTENTS

SECTION

- 1 GAMES LOGICAL OR NOT
 - 2 IC SPECIFIC INFORMATION
 - 3 LOGIC INTRODUCTION
 - 4 KURZ-KASCH LOGIC COURSE INFORMATION
 - 5 KURZ-KASCH PRODUCT INFORMATION
 - 6 GAME SYNC ANALYSIS
 - 7 MOTOROLA MONITOR SERVICE MANUAL
 - 8 TRANSISTOR CROSS REFERENCE GUIDE
 - 9 RECOMMENDED TOOLS AND TEST EQUIPMENT
- NOTES

GAMES LOGICAL OR NOT

SECTION ONE

KURZ-KASCH DATA BOOKS

The publishing department of Kurz-Kasch Electronics Division is trying to schedule the data book write-ups. To date we have seen or heard of over 110 digitally controlled games, most of them video type games. However, we are now seeing digitally controlled juke boxes, arcade pieces, bill changers and coin accumulators and selectors in vending equipment.

Due to the ever increasing number of machines and equipment which employ integrated circuits we need your help for the purpose of scheduling our data books.

The following list will help in the analysis of which are the more popular games and equipment.

<u>Company & State</u>	<u>Games People Play</u>
Allied Leisure - Florida	Paddle Baddle Tennis Tourney Super Soccer Hesitation Football Ricochet Zap Robot Super Shifter Wild Cycle
Amutronics - New Jersey	Team Hockey
Atari/Kee - California	Pong Pong Doubles Super Pong Quadra Pong/Elimination Space Race Gotcha World Cup Rebound/Spike Gran Trak 10/Formula K Gran Trak 20/Twin Racer Indi 800 Cocktail Pong Dr. Pong/Puppy Pong Dodgem Qwak Pin Pong Tank

<u>Company & State</u>	<u>Games People Play</u>
Atari/Kee - continued	Pursuit AntiAircraft Highway Touch Me
Chicago Dynamics - Illinois	TV Ping Pong TV Olympic Hockey -TV Tennis TV Goalie TV Pin Games
Control Sales - Iowa	Video Action
Digital Games - California	Model 174 Model 474 Model 574 Knockout
Electra Games - Illinois	Video Action Tables Pace Car Pro Pace Race UFO Chase
Electromotion - Pennsylvania	Electromotion
Exidy - California	Hockey Tennis Sting TV Pin Ball
Imaginative Game - Texas	Wall Games
Foreplay - California	-Rally
Gremlin Industries - California	Trapshoot Wall Games
Midway Manufacturing - Illinois	Winner II -Winner IV Asteroid -Leader Play Time Basketball Ballpark TV Flipper - Wheels Racer
Marquin Inc. - California	Marquin Tables Tankers
Meadows - California	Flim-Flam
Mirco - Arizona	Challenger Tables Champion Ping-Pong
Nutting & Assoc. - California	Computer Space I & II

<u>Company & State</u>	<u>Games People Play</u>
Nutting & Assoc. - continued	Space Ball Wimbledon Table Tennis Missles Radar
PMC Inc. - Pennsylvania	Hockey Warn Barn I & II Aztec Tables Baseball Players Choice 1 on 1 Kennel Club Wall Games
PSE Inc. - California	Hodge Podge I-2-4 Cocktail Table
Performance Enterprises - Florida	Wall Games Dart Game Par 90 Golf All Star Passing Motorcycle Race QuarterHorse Handball Jai Tai Pachinko
Ramtek - California	Clean Sweep Soccer - Hockey Wipe Out Baseball - Volly
U.B.I. - New Jersey (United Billiards Inc.)	Attack (Cocktail Table) Sportorama
Urban Industries - Kentucky	Wall Games Horoscope
U.S. Billiards - New York	TV Hockey TV Tennis Survival Cocktail Table
Volly - Canada	Cocktail Table Volly
Williams Elect. - Illinois	Pro Hockey Paddle Ball Pro Tennis

(See Fun) Olympic Tennis

BASIC CHIPS USED IN VIDEO GAMES

SECTION 'IWO

This section is a listing of the more commonly used integrated circuits (I.C.'s). Note the IC's are basically of the TTL Logic family.

*NE555	TIMER
NE556	DUAL TIMER
NE566	FUNCTION GENERATOR
UL 741	SINGLE OPERATIONAL AMPLIFIER
UL 747	DUAL OPERATIONAL AMPLIFIER
7400	QUAD 2-INPUT NAND GATE
7401	QUAD 2-INPUT NAND GATE
7402	QUAD 2-INPUT NOR GATE
7404	HEX INVERTER
7406	HEX INVERTING BUFFER
7408	QUAD 2-INPUT AND GATE
7410	TRIPLE 3-INPUT NAND GATE
7413	DUAL NAND SCHMITT TRIGGER
7420	DUAL 4-INPUT NAND GATE
7425	DUAL 4-INPUT NOR GATE w/STROBE
7427	TRIPLE 3-INPUT NOR GATE
7430	8-INPUT NAND GATE
7440	DUAL 4-INPUT NAND BUFFER
7448	BCD-to-7-SEGMENT DECODER
7450	DUAL AND-OR-INVERT GATE
* 7474	DUAL D FLIP-FLOP
7479	
7483	4-BIT BINARY FULL ADDER
7486	QUAD EXCLUSIVE-OR GATE
7490	DECADE COUNTER

* Advise excessive stocking of these items

7493	DIVIDE- by -TWELVE COUNTER
7495	4-BIT REVERSIBLE REGISTER
74107	DUAL J-K FLIP FLOP
74121	MONOSTABLE MULTIVIBRATOR
74145	BCD-to-DECIMAL DECODER/DRIVER
74153	DUAL 4-LINE-to-1-LINE DATA
74157	QUAD 2-IN DATA SELECT/MULTIPLEXER
74160	4 -BIT SYNCHRONOUS DECADE COUNTER
74161	4-BIT SYNCHRONOUS BINARY COUNTER
74163	4-BIT SYNCHRONOUS BINARY COUNTER
74164	8-BIT PARALLEL-OUT SERIAL SHIFT REGISTER
74165	PARALLEL-LOAD 8-BIT SHIFT REGISTER
74192	REVERSIBLE BCD DECADE COUNTER
74193	REVERSIBLE MODULO-16 BINARY COUNTER
9158	QUAD POWER GATE
* 9311 (74154)	4 -LINE-to-16-LINE DECODER/DEMULTIPLEXER
9314	QUAD LATCH
* 9316 (74161)	4 -BIT SYNCHRONOUS BINARY COUNTER
9322	QUAD 2-IN DATA SELECT/MULTIPLEXER
9602	DUAL MONOSTABLE MULTIVIBRATOR
*LM309	5-VOLT REGULATOR
LM311K	VOLTAGE COMPARATOR
LM323K	3-AMP 5-VOLT POSITIVE REGULATOR
*LM380	AUDIO POWER AMPLIFIER
LM3900	QUAD AMPLIFIER
CD4016AE	QUAD BILATERAL SWITCH

*MJE-200	TRANSISTOR
TIP-29	TRANSISTOR
TIP -31	TRANSISTOR
2N3566	TRANSISTOR
2N3643	TRANSISTOR
2-3644	TRANSISTOR
2N5449	TRANSISTOR
MFC6040	AUDIO AMPLIFIER
*IN4001	DIODE
*IN4720	DIODE

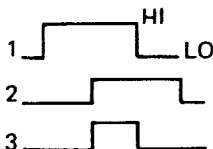
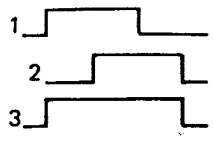
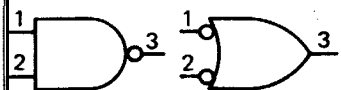
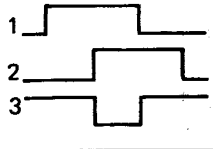
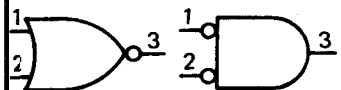
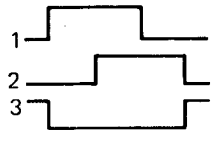
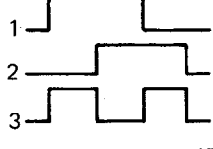
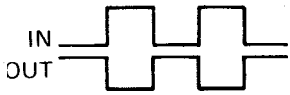
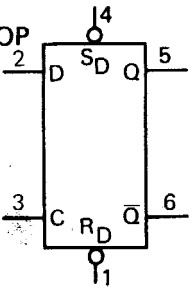
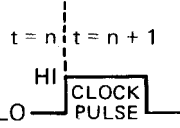
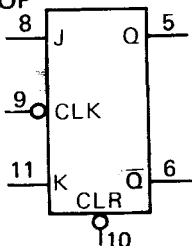
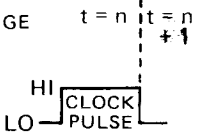


STELLAR
WARRIOR

MICROCIRCUITS

TTL & DTL
INTEGRATED CIRCUITS
Condensed Catalog

Table I-I. Logic Symbology

SYMBOL	TRUTH TABLE/TIMING	OPERATION																																										
AND GATE 	<table><tr><th>1</th><th>2</th><th>3</th></tr><tr><td>LO</td><td>LO</td><td>LO</td></tr><tr><td>LO</td><td>HI</td><td>LO</td></tr><tr><td>HI</td><td>LO</td><td>LO</td></tr><tr><td>HI</td><td>HI</td><td>HI</td></tr></table> 	1	2	3	LO	LO	LO	LO	HI	LO	HI	LO	LO	HI	HI	HI	Output is HI only when <u>all</u> inputs are HI, otherwise output is LO. Rule applies for any number of inputs.																											
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OR GATE 	<table><tr><th>1</th><th>2</th><th>3</th></tr><tr><td>LO</td><td>LO</td><td>LO</td></tr><tr><td>LO</td><td>HI</td><td>HI</td></tr><tr><td>HI</td><td>LO</td><td>HI</td></tr><tr><td>HI</td><td>HI</td><td>HI</td></tr></table> 	1	2	3	LO	LO	LO	LO	HI	HI	HI	LO	HI	HI	HI	HI	Output is HI when any input is HI. Output is LO only when <u>all</u> inputs are LO.																											
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NOR GATE 	<table><tr><th>1</th><th>2</th><th>3</th></tr><tr><td>LO</td><td>LO</td><td>HI</td></tr><tr><td>LO</td><td>HI</td><td>LO</td></tr><tr><td>HI</td><td>LO</td><td>LO</td></tr><tr><td>HI</td><td>HI</td><td>LO</td></tr></table> 	1	2	3	LO	LO	HI	LO	HI	LO	HI	LO	LO	HI	HI	LO	Output is LO when any input is HI. Output is HI only when <u>all</u> inputs are LO.																											
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EXCLUSIVE OR GATE 	<table><tr><th>1</th><th>2</th><th>3</th></tr><tr><td>LO</td><td>LO</td><td>LO</td></tr><tr><td>LO</td><td>HI</td><td>HI</td></tr><tr><td>HI</td><td>LO</td><td>HI</td></tr><tr><td>HI</td><td>HI</td><td>LO</td></tr></table> 	1	2	3	LO	LO	LO	LO	HI	HI	HI	LO	HI	HI	HI	LO	Output is HI when either <u>but not both</u> inputs are HI, otherwise output is LO.																											
1	2	3																																										
LO	LO	LO																																										
LO	HI	HI																																										
HI	LO	HI																																										
HI	HI	LO																																										
INVERTERS 		The 2-input NAND or NOR gate can be used as inverters by tying one input to a fixed level or tying both inputs together.																																										
D-TYPE FLIP-FLOP 	<table><tr><th colspan="2">$t = n$</th><th>$t = n + 1$</th></tr><tr><th>D</th><th>Q</th><th>Q</th></tr><tr><td>LO</td><td>LO</td><td>LO</td></tr><tr><td>LO</td><td>HI</td><td>LO</td></tr><tr><td>HI</td><td>LO</td><td>HI</td></tr><tr><td>HI</td><td>HI</td><td>HI</td></tr></table>  Truth Table valid only when S_D and R_D are both HI	$t = n$		$t = n + 1$	D	Q	Q	LO	LO	LO	LO	HI	LO	HI	LO	HI	HI	HI	HI	When both S_D (direct set) and R_D (direct reset) are HI, level at input D is transferred to output Q when input C (clock) goes HI. A LO on S_D forces $\bar{Q}$ HI and Q LO. A LO on R_D forces $\bar{Q}$ HI and Q LO. S_D and R_D predominate over all other inputs.																								
$t = n$		$t = n + 1$																																										
D	Q	Q																																										
LO	LO	LO																																										
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J-K MASTER SLAVE FLIP-FLOP 	<table><tr><th colspan="3">$t = n$</th><th colspan="3">$t = n + 1$</th></tr><tr><th>J</th><th>K</th><th>Q</th><th>Q</th><th>Q</th><th>Q</th></tr><tr><td>LO</td><td>LO</td><td>—</td><td colspan="3">NO CHANGE</td></tr><tr><td>LO</td><td>HI</td><td>—</td><td colspan="3">LO HI</td></tr><tr><td>HI</td><td>LO</td><td>—</td><td colspan="3">HI LO</td></tr><tr><td>HI</td><td>HI</td><td>LO</td><td colspan="3">HI LO</td></tr><tr><td>HI</td><td>HI</td><td>HI</td><td colspan="3">LO HI</td></tr></table>  Truth Table valid only when CLR is HI	$t = n$			$t = n + 1$			J	K	Q	Q	Q	Q	LO	LO	—	NO CHANGE			LO	HI	—	LO HI			HI	LO	—	HI LO			HI	HI	LO	HI LO			HI	HI	HI	LO HI			When CLR is HI and: 1. J and K are both LO, clock pulse has no effect on outputs Q and $\bar{Q}$. 2. J and K are at opposite logic levels, negative-going clock edge transfers J level to Q and K level to $\bar{Q}$. 3. J and K are both HI, each negative-going clock edge alternates outputs Q and $\bar{Q}$. 4. LO on CLR forces and holds Q LO and $\bar{Q}$ HI.
$t = n$			$t = n + 1$																																									
J	K	Q	Q	Q	Q																																							
LO	LO	—	NO CHANGE																																									
LO	HI	—	LO HI																																									
HI	LO	—	HI LO																																									
HI	HI	LO	HI LO																																									
HI	HI	HI	LO HI																																									

TTL Numerical Index

TEMPERATURE MILITARY	RANGE INDUSTRIAL	FUNCTION	PAGE
5400	7400	Quad 2-input NAND Gate	3
5401	7401	Quad 2-input NAND Gate	3
5402	7402	Quad 2-input NOR Gate	3
5403	7403	Quad 2-input NAND Gate	3
5404	7404	Hex Inverter	3
5405	7405	Hex Inverter	3
5406	7406	Hex Inverting Buffer	3
5407	7407	Hex Buffer	3
5408	7408	Quad 2-input AND Gate	3
5409	7409	Quad P-input AND Gate	3
5410	7410	Triple 3-input NAND Gate	3
5412	7412	Triple 3-input NAND Gate	3
5413	7413	Dual NAND Schmitt Trigger	3
5416	7416	Hex Inverting Buffer	3
5417	7417	Hex Buffer	3
5420	7420	Dual 4-input NAND Gate	4
5422	7422	Dual 4-input NAND Gate	4
5423	7423	Dual 4-input NOR Gate w/Strobe	4
5425	7425	Dual 4-input NOR Gate w/Strobe	4
5426	7426	Quad P-input NAND Gate	4
5427	7427	Triple J-input NOR Gate	4
5430	7430	a-input NAND Gate	4
5432	7432	Quad 2-input OR Gate	4
5437	7437	Quad 2-input NAND Buffer	4
5438	7438	Quad 2-input NAND Buffer	4
5440	7440	Dual 4-input NAND Buffer	4
—	7441A	BCD-to-Decimal Decoder/Driver	4
5442	7442	BCD-to-Decimal Decoder	4
5443	7443	EXCESS-3-to-Decimal Decoder	4
5444	7444	EXCESS3 GRAY-to-Decimal Decoder	4
5445	7445	BCD-to-Decimal Decoder/Driver	5
5446	7446	BCD-to-7Segment Decoder/ Driver	5
5446A	7446A	BCD-to-7Segment Decoder/ Driver	5
5447	7447	BCD-to-7Segment Decoder/ Driver	5
5447A	7447A	BCD-to-7Segment Decoder/ Driver	5
5448	7448	BCD-to-7Segment Decoder	5
5450	7450	Dual AND-OR-INVERT Gate	5
5451	7451	Dual AND-OR-INVERT Gate	5
5453	7453	Single AND-OR-INVERT Gate	5
5454	7454	Single AND-OR-INVERT Gate	6
5460	7460	Dual AND-OR Expander	6
5472	7472	J-K Flip-Flop	6
5473	7473	Dual J-K Flip-Flop	6
5474	7474	Dual D Flip-Flop	6
5475	7475	Quad Latch	6
5476	7476	Dual J-K Flip-Flop	6
5477	7477	Quad Latch	6
5480	7480	Gated Full Adder	7
5482	7482	P-Bit Binary Full Adder	7
5483	7483	4-Bit Binary Full Adder	7
5485	7485	4-Bit Magnitude Comparator	7

TEMPERATURE MILITARY	RANGE INDUSTRIAL	FUNCTION	PAGE
5486	7486	Quad Exclusive-OR Gate	7
5490	7490	Decade Counter	7
5491A	7491A	8-Bit Shift Register	7
5492	7492	Divide-by-Twelve Counter	8
5493	7493	Divide-by-Sixteen Counter	8
5494	7494	4-Bit Shift Register	8
5495	7495	4-Bit Reversible Register	8
5496	7496	5-Bit Serial/Parallel Register	8
54100	74100	I-Bit Bistable Latch	8
54104	74104	Gated J-K Master-Slave Flip-Flop	9
54105	74105	Gated J-K Master-Slave Flip-Flop	9
54107	74107	Dual J-K Flip-Flop	9
54121	74121	Monostable Multivibrator	9
54122	74122	Retriggerable Multivibrator	9
54123	74123	Dual Retriggerable Multivibrator	9
54136	74136	Quad 2-input Exclusive-OR Gate	9
—	74141	BCD-to-Decimal Decoder/ Driver	10
54145	74145	BCD-to-Decimal Decoder/ Driver	5
54150	74150	16-Bit Data Selector/Multiplexer	10
54151	74151	8-Bit Data Selector/ Multiplexer	10
54153	74153	Dual 4-Line-to-1-Line Data Selector/Multiplexer	10
5 4 1 5 4	74154	4-Line-to-16-Line Decoder/ Demultiplexer	11
54155	74155	Dual 2-Line-to-4-Line Decoder/ Demultiplexer	11
54156	74156	Dual 2-Line-to-4-Line Decoder/ Demultiplexer	11
54160	74160	4-Bit Synchronous Decade Counter	11
54161	74161	4-Bit Synchronous Binary Counter	11
54162	74162	4-Bit Synchronous Decade Counter	11
54163	74163	4-Bit Synchronous Binary Counter	11
54164	74164	I-Bit Parallel-Out Serial Shift Register	12
54165	74165	Parallel-Load 8-Bit Shift Register	12
54166	74166	8-Bit Shift Register	12
54174	74174	Hex D-Type Flip-Flop	12
54175	74175	Quad D-Type Flip-Flop	12
54,176:	74176	35 MHz Presettable Decade Counter/Latch	13
54177	74177	35 MHz Presettable Binary Counter/Latch	13
54180	74180	8-Bit ODD/EVEN Parity Generator/Checker	13
54181	74181	4-Bit Arithmetic Logic Unit	14
54182	74182	Look-Ahead Carry Generator	14
54192	74192	Reversible BCD Decade Counter	14
54193	74193	Reversible Module-16 Binary Counter	15
54198	74198	8-Bit Shift Register	16
54199	74199	8-Bit Shift Register	16
9601-1	9601-2	Retriggerable One-shot	16
9602-1	9602-2	Dual Retriggerable One-shot	16

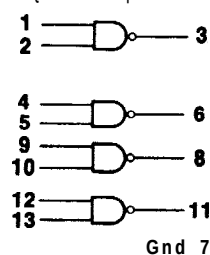
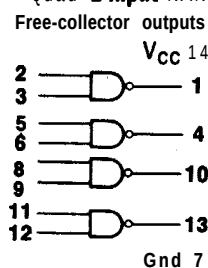
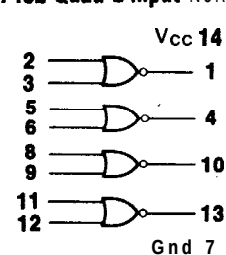
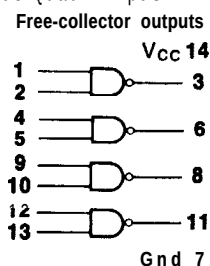
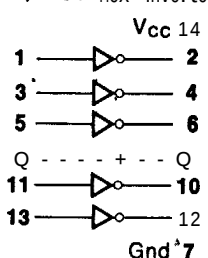
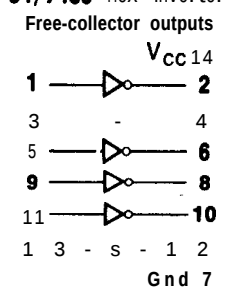
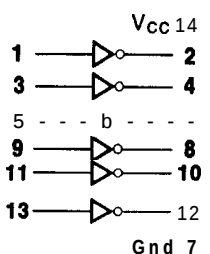
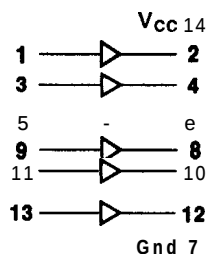
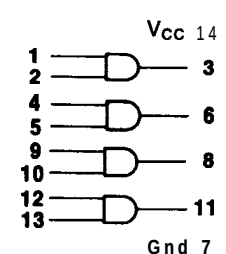
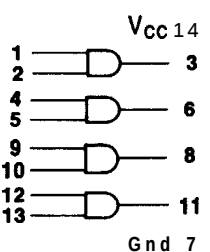
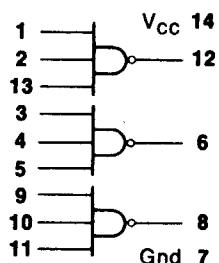
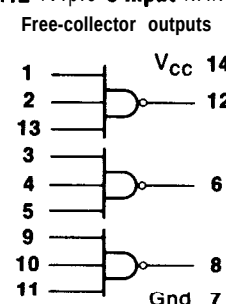
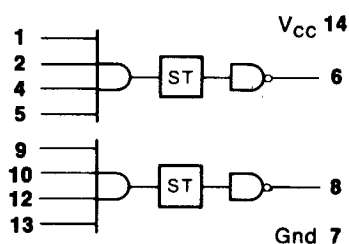
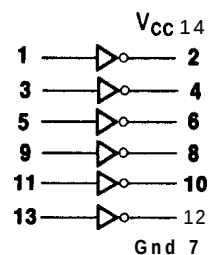
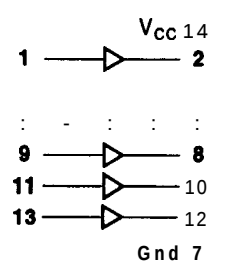
TTL Functional Index

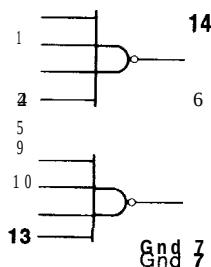
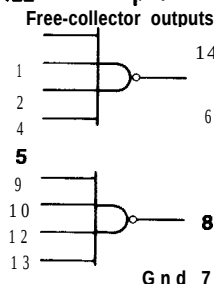
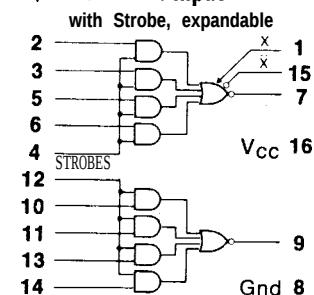
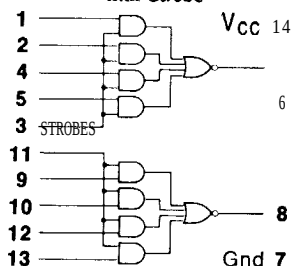
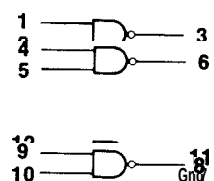
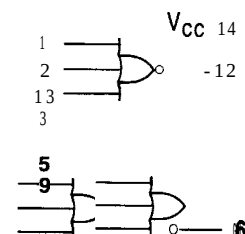
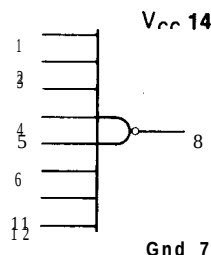
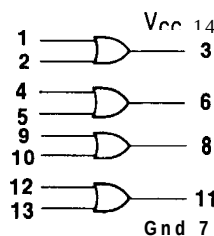
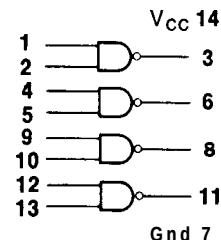
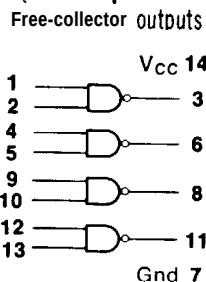
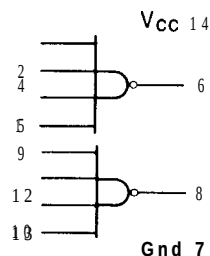
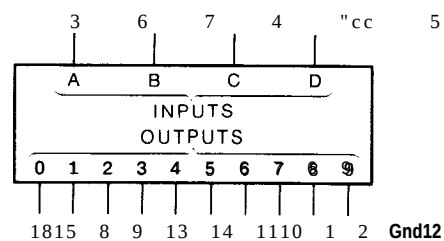
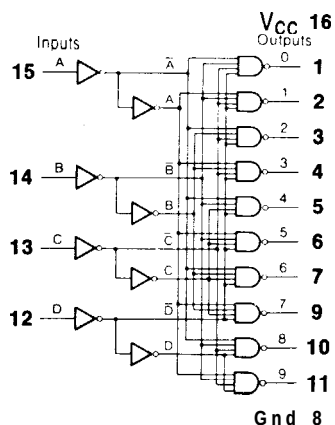
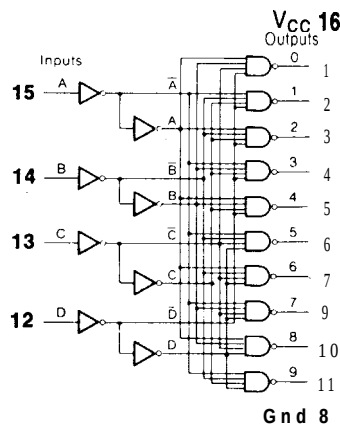
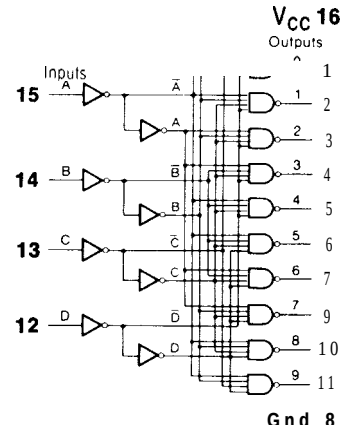
Gates	Page	Flip-Flops	Page	Arithmetic	Page
5400 Quad NAND	3	5472 J-K	6	5480 Gated Adder	7
5401 Quad NAND*	3	54104 Gated J-K	9	5482 P-Bit Adder	7
5403 Quad NAND*	3	54105 Gated J-K	9	5483 4-Bit Adder	7
5426 Quad NAND*	4	5473 Dual J-K	6	5485 4-Bit Comparator	7
5410 Triple NAND	3	5476 Dual J-K	6	54180 Parity Generator	13
5412 Triple NAND*	3	54107 Dual J-K	9	54181 4-Bit ALU	14
5413 Dual NAND Schmitt	3	5474 Dual D	6	54182 Look-Ahead Carry Gen.	14
5420 Dual NAND	4	54175 Quad D	12		
5422 Dual NAND*	4	54174 Hex D	12		
5430 Single 8 NAND	4			Multiplexers, Demultiplexers	
5408 Quad AND	3	Registers, latches		54150 16-Bit Multiplexer	10
5409 Quad AND*	3	5494 4-Bit Register	a	54151 8-Bit Multiplexer	10
5402 Quad NOR	3	5495 4-Bit Register	a	54153 Dual 4-Bit Multiplexer	10
5427 Triple NOR	4	5496 5-Bit Register	a	54154 4-to-16 Demultiplexer	11
5423 Dual NOR "	4	5491A 8-Bit Register	7	54155 Dual 1-to-4 Demultiplexer	11
5425 Dual NOR	4	54164 8-Bit Register	12	54156 Dual 1-to-4 Demultiplexer*	11
5450 Dual AND-OR-INVERT	5	54165 8-Bit Register	12		
5451 Dual AND-OR-INVERT	5	54166 8-Bit Register	12	Counters	
5453 Single AND-OR-INVERT	5	54198 8-Bit Register	16	5490 BCD Decade	7
5454 Single AND-OR-INVERT	6	54199 8-Bit Register	16	54192 Reversible BCD Decade	14
5460 Dual AND-OR Expander	6	5475 Quad Latch	6	54160 4-Bit Synchronous Decade	11
5432 Quad OR	4	5477 Quad Latch	6	54162 4-Bit Synchronous Decade	11
5486 Quad Exclusive-OR	7	54100 8-Bit Latch	a	54176 35 MHz Presettable Decade	13
54136 Quad Exclusive-OR*	9			5492 Divide-by-12	a
		Decoders/Drivers		5493 Divide-by-16	a
Inverters, Buffers		5442 BCD-to-Decimal	4	54193 Reversible Divide-by-16	15
5404 Hex Inverter	3	5445 BCD-to-Decimal*	5	54161 4-Bit Synchronous Binary	11
5405 Hex Buffer*	3	54145 BCD-to-Decimal	5	54163 4-Bit Synchronous Binary	11
5406 Hex Buffer*	3	7441A BCD-to-Decimal	4	54177 35 MHz Presettable Binary	13
5407 Hex Buffer*	3	74141 BCD-to-Decimal*	10		
5416 Hex Buffer*	3	5443 EXCESS-3-to-Decimal	4	Multivibrators	
5417 Hex Buffer	3	5444 GRAY-to-Decimal	4	54121	9
5437 Quad Buffer	4	5446 BCD-to-7-Segment*	5	54122	9
5438 Quad Buffer*	4	5446A BCD-to-7-Segment*	5	54123	9
5440 Dual Buffer*	4	5447 BCD-to-7-Segment*	5	9601	16
		5447A BCD-to-7-Segment*	5	9602	16
		5448 BCD-to-7Segment	5		

*Free-Collector outputs

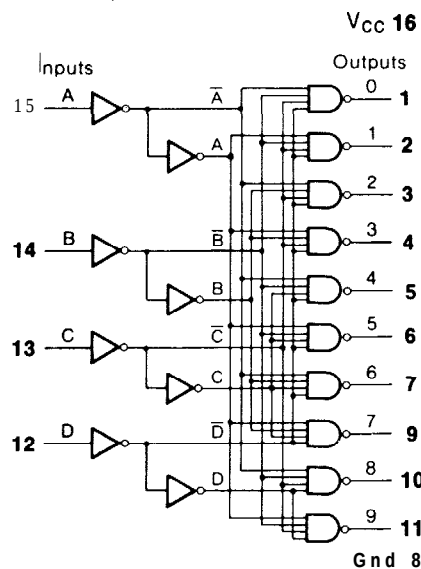
Ordering Information

PACKAGE TYPE	54/74 Series		9600 Series	
	MILITARY	INDUSTRIAL	MILITARY	INDUSTRIAL
Ceramic Dual-in-Line	SW54XXJ	SW74XXJ	SW96XX-1P	SW96XX-2P
Plastic Dual-in-Line	—	SW74XXN	—	SW96XX-M

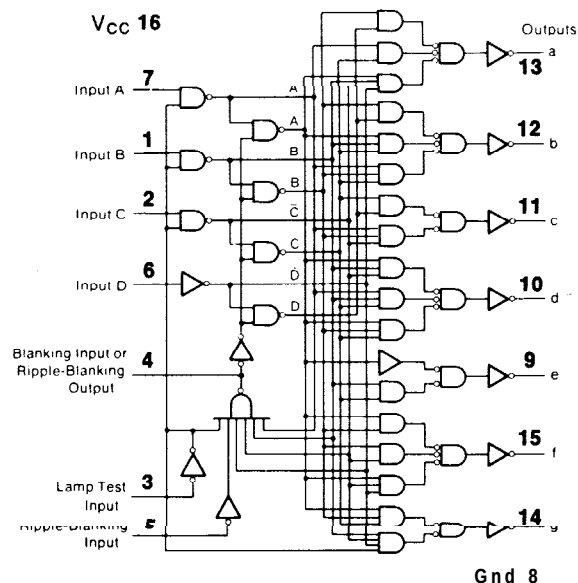
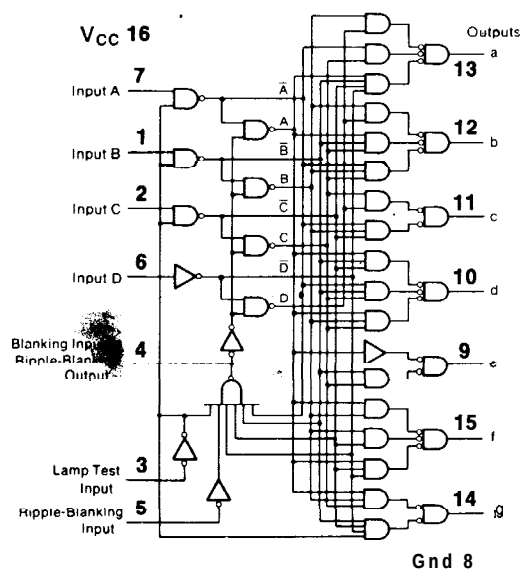
54/7400 Quad P-input NAND Gate**54/7401** Quad 2-input NAND Gate**54/7402** Quad 2-input NOR Gate**5417403** Quad P-input NAND Gate**54/7404** Hex Inverter**54/7405** Hex Inverter**54/7406** Hex Inverting Buffer**54/7407** Hex Buffer**54/7408** Quad 2-input AND Gate**54/7409** Quad 2-input AND Gate**54/7410** Triple 1-input NAND Gate**54/7412** Triple 3-input NAND Gate**54/7413** Dual NAND Schmitt Trigger**54/7416** Hex Inverting Buffer**54/7417** Hex Buffer

54/7420 Dual 4-input NAND Gate**54/7422 Dual 4-input NAND Gate****54/7423 Dual 4-input NOR Gate****54/7425 Dual 4-input NOR Gate****54/7426 Quad 2-input NAND Gate**Free-collector outputs, 15V rating
V_{CC} 14**54/7427 Triple J-input NOR Gate****54/7430 8-input NAND Gate****54/7432 Quad 2-input OR Gate****54/7437 Quad 2-input NAND Buffer****54/7438 Quad 2-input NAND Buffer****54/7440 Dual 4-input NAND Buffer****7441A BCD-to-Decimal Decoder/Driver****54/7442 BCD-to-Decimal Decoder****54/7443 EXCESS-3-to-Decimal Decoder****54/7444 EXCESS-3-to-Decimal Decoder**

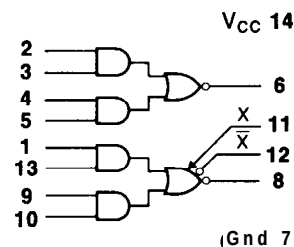
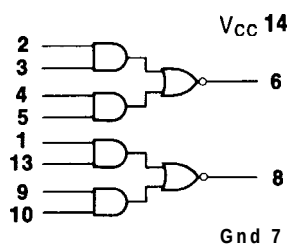
BCD-to-Decimal Decoder/Driver

54/7445 30V output rating**54/74145** 15V output rating

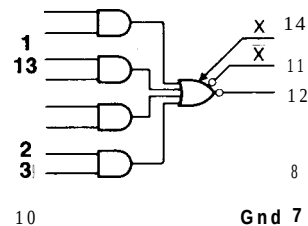
BCD-to-7-Segment Decoder/Driver

54/7446 30V/20mA output rating • **54/7447** 15V/20mA output rating**54/7446A** 30V/40mA output rating • **54/7447A** 15V/40mA output rating**54/7448** BCD-to-7-Segment Decoder**54/7450** Dual AND-OR-INVERT Gate

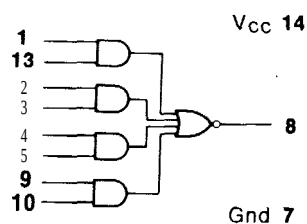
Expandable

**54/7451** Dual AND-OR-INVERT Gate**54/7453** Single AND-OR-INVERT Gate

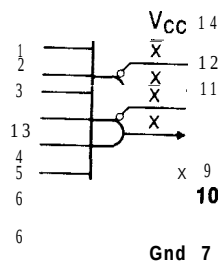
Expandable



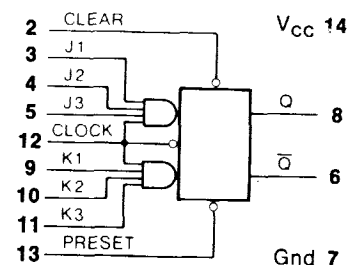
54/7454 Single AND-OR-INVERT Gate



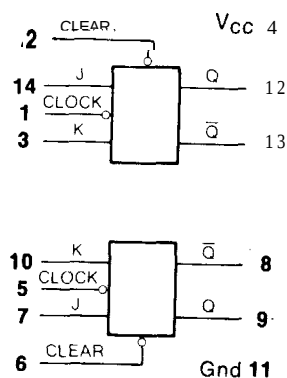
54/7460 Dual AND-OR Expander



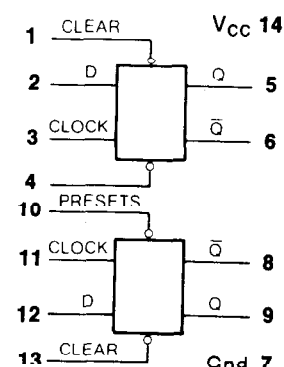
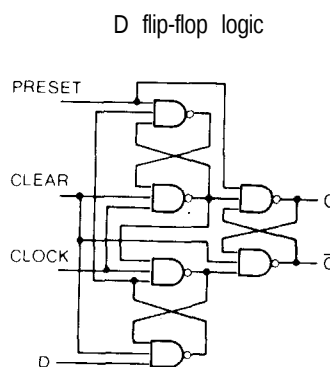
54/7472 J-K Flip-Flop



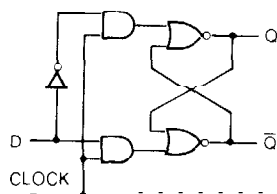
54/7473 Dual J-K Flip-Flop



54/7474 Dual D Flip-Flop



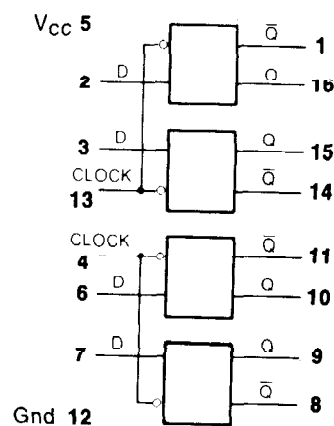
latch logic



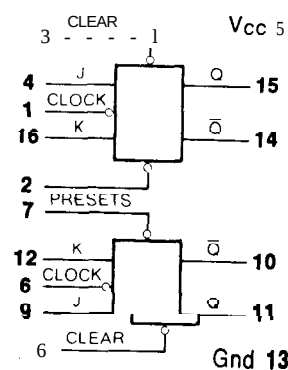
Truth Table

C	D	Q	Q-bar
Low	Low	No Change	No Change
Low	High	No Change	No Change
High	Low	Low	High
High	High	High	Low

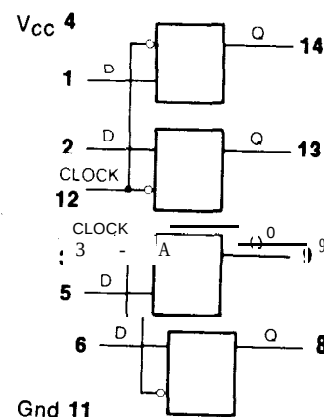
5417475 Quad latch



54/7476 Dual J-K Flip-Flop

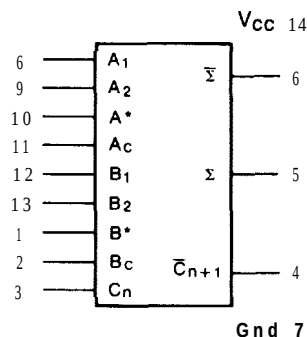


5417477 Quad latch*



*refer to 5417475 logic

54/7480 Gated Full Adder



Truth Table

Cn	B	A	C _{n+1}	Σ	Σ
0	0	0	1	1	0
0	0	1	1	0	1
0	1	0	1	0	1
0	1	1	0	1	0
1	0	0	1	0	1
1	0	1	0	1	0
1	1	0	0	1	0
1	1	1	0	0	1

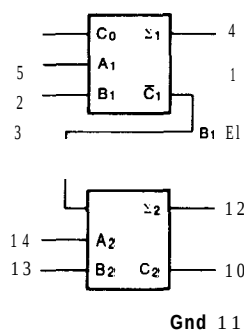
$$A = A_1 \cdot A_2 + \bar{A}_c$$

$$A^* = A_1 \cdot A_2$$

$$B = B_1 \cdot B_2 + \bar{B}_c$$

$$B^* = B_1 \cdot B_2$$

54/7482 2-Bit Binary Full Adder



Z-bit & 4-bit Adder Truth Table

ODD[†] bit positions:

INPUTS	OUTPUTS
C _{x-1} A _x B _x	Σ _x C _x
0 0 0	0 [*] 1
0 0 1	1 1
0 1 0	1 1
0 1 1	0 0
1 0 0	1 1
1 0 1	0 0
1 1 0	0 0
1 1 1	1 0

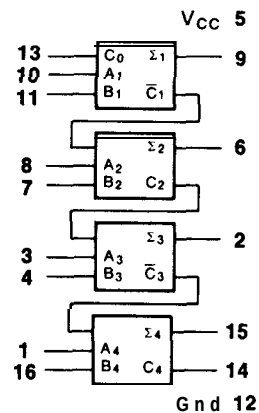
* X = 1 or 3

EVEN[†] bit positions:

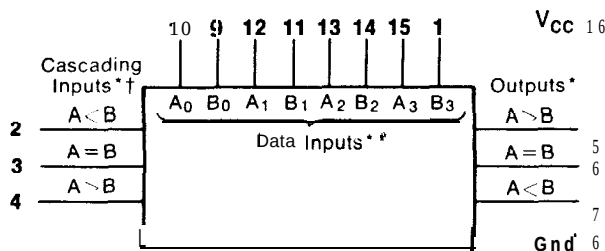
INPUTS	OUTPUTS
C _{x-1} A _x B _x	Σ _x C _x
1 0 0	0 0
1 0 1	1 0
1 1 0	1 0
1 1 1	0 1
0 0 0	1 0
0 0 1	0 1
0 1 0	0 1
0 1 1	1 1

† X = 2 or 4

54/7483 4-Bit Binary Full Adder



54/7485 4-Bit Magnitude Comparator

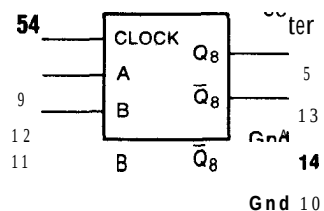
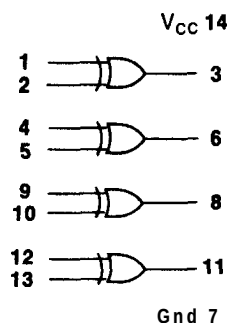


* a HIGH signal indicates a TRUE condition

† results from a comparison of lower-order bits

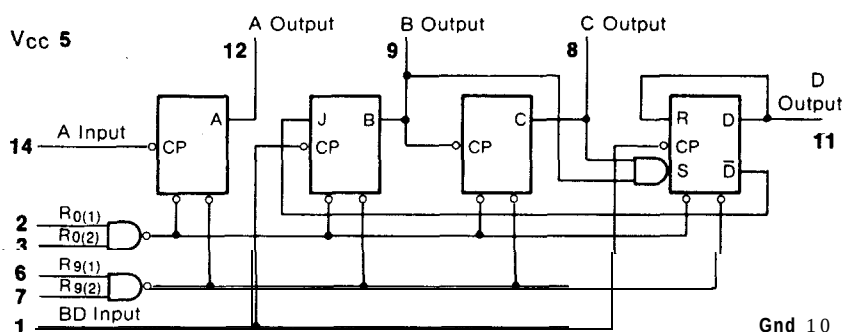
** inequality of these bits will override CASCADED inputs

54/7486 Quad Exclusive-OR Gate



Inputs at time t _n	Q output at time t _n +8
A B	
0 0	0
0 1	0
1 0	0
1 1	1

54/7490 Decade Counter



Truth Tables

BCD Count Sequence*

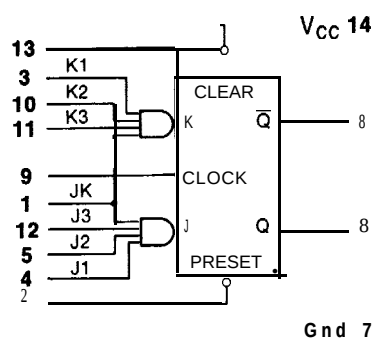
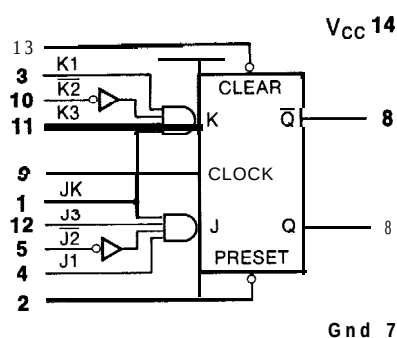
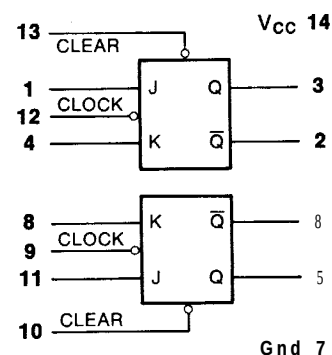
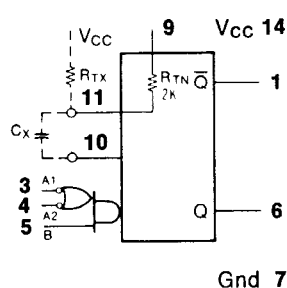
COUNT	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

* Output A connected to input BD

Reset/Count

RESET INPUTS	COUNT
R ₀₍₁₎ R ₀₍₂₎ R ₉₍₁₎ R ₉₍₂₎	
1 1 0 φ	0 0 0 0
1 1 φ 0	0 0 0 0
φ φ 1 1	1 0 0 1
φ 0 φ 0	Count
0 φ 0 φ	Count
0 φ φ 0	Count
φ 0 0 φ	Count

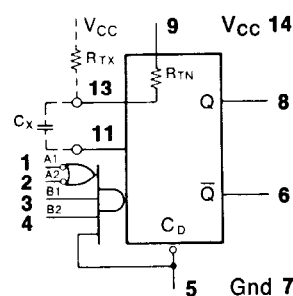
φ = immaterial

54/74104 Gated J-K Master-Slave Flip-Flop**54/74105** Gated J-K Master-Slave Flip-Flop**54/74107** Dual J-K Flip-Flop**54/74121** Monostable Multivibrator

Triggering Truth Table

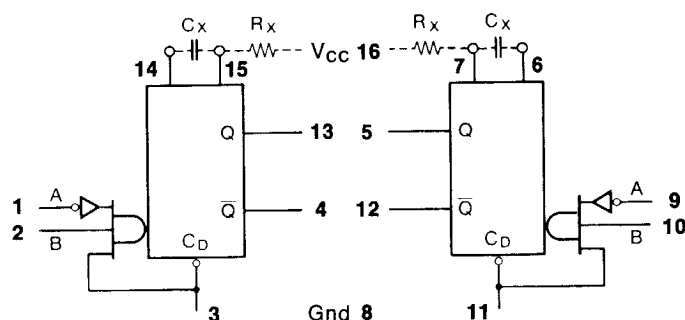
A1	A2	B	RESPONSE
1	1	1	No Trigger
0	X	X	Trigger
X	0	1	Trigger
1	0	X	No Trigger
0	X	1	No Trigger
0	1	X	No Trigger
X	X	0	No Trigger
1	1	1	Trigger

X = immaterial

54/74122 Retriggerable Multivibrator

Triggering Truth Table

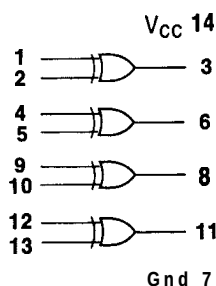
A1	A2	B1	B2	C _D	RESPONSE
X	X	X	X	0	No Trigger
1	0	X	X	X	No Trigger
0	X	0	X	X	No Trigger
1	1	1	1	1	Trigger
X	X	0	X	X	No Trigger
1	1	X	X	X	No Trigger
0	X	1	1	1	Trigger

* A1 & A2 are logically interchangeable, as are B1 & B2
X = immaterial**54/74123** Dual Retriggerable Multivibrator

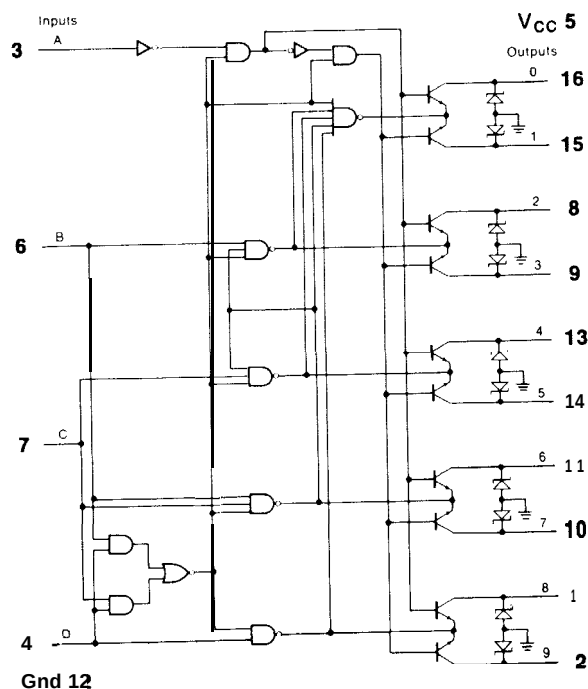
Triggering Truth Table

A	B	C _D	RESPONSE
X	X	0	No Trigger
1	0	X	No Trigger
0	1	1	Trigger
1	1	X	No Trigger
0	1	1	Trigger

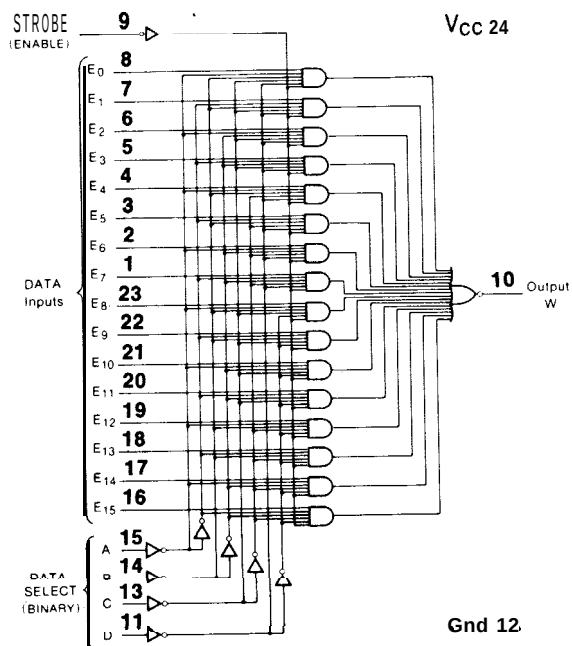
X = immaterial

54/74136 Quad 2-input Exclusive-OR Gate

74141 BCD-to-Decimal Decoder/Driver

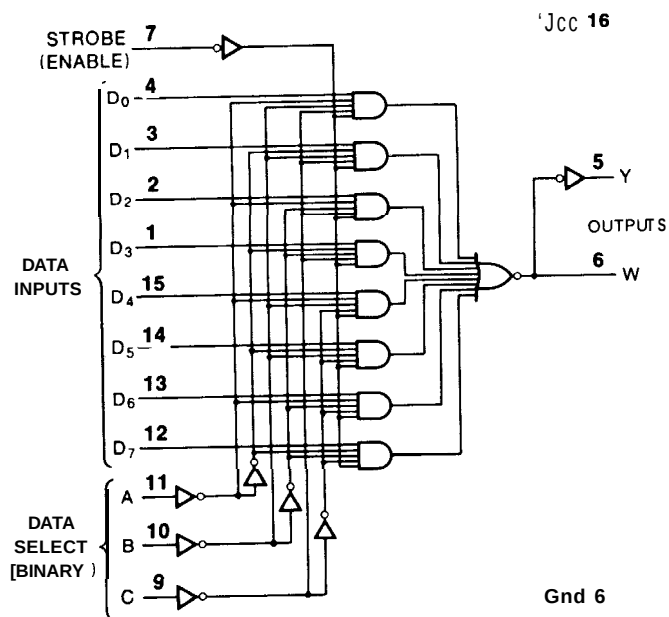


54/74150 16-Bit Data Selector/Multiplexer

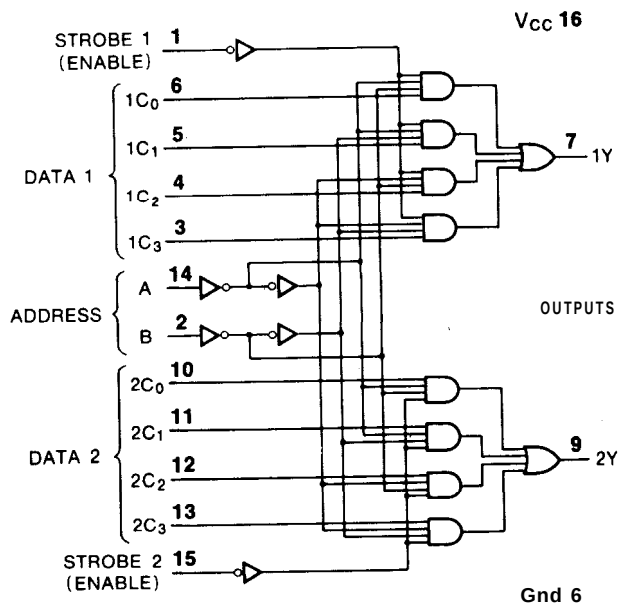


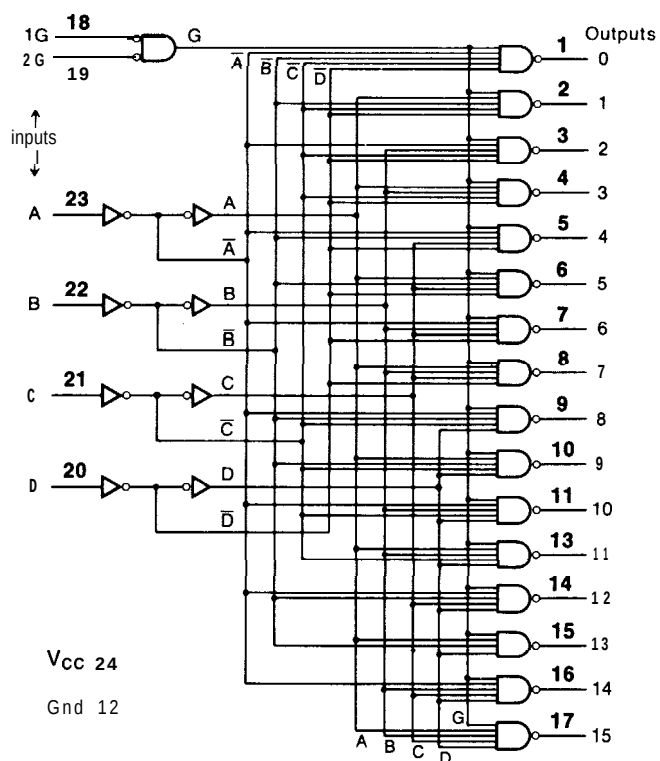
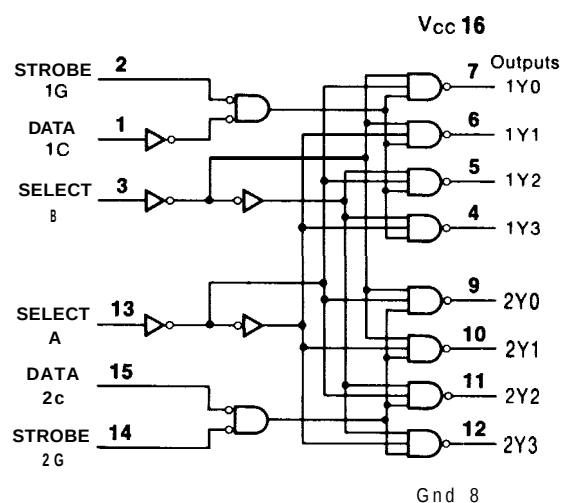
NOTE: 54145/74145 see page 5.

54/74151 8-Bit Data Selector/Multiplexer

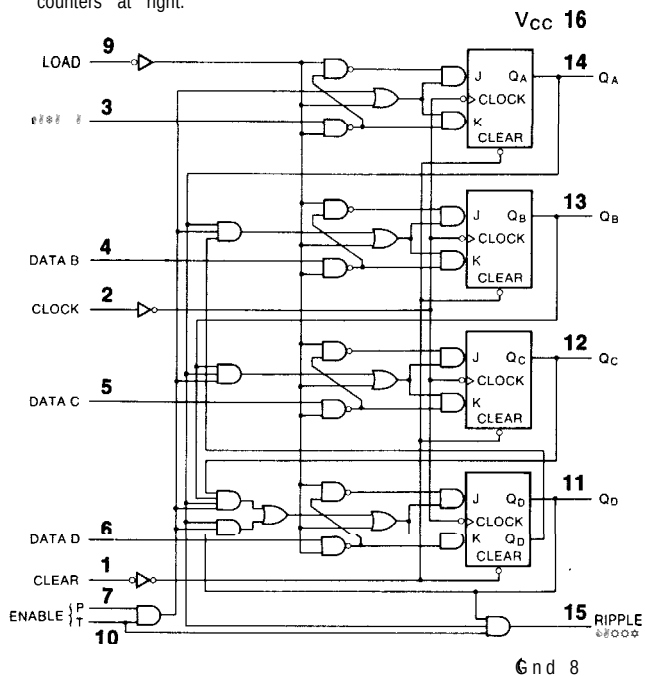


54/74153 Dual 4-Line-to-1-Line Data Selector/Multiplexer

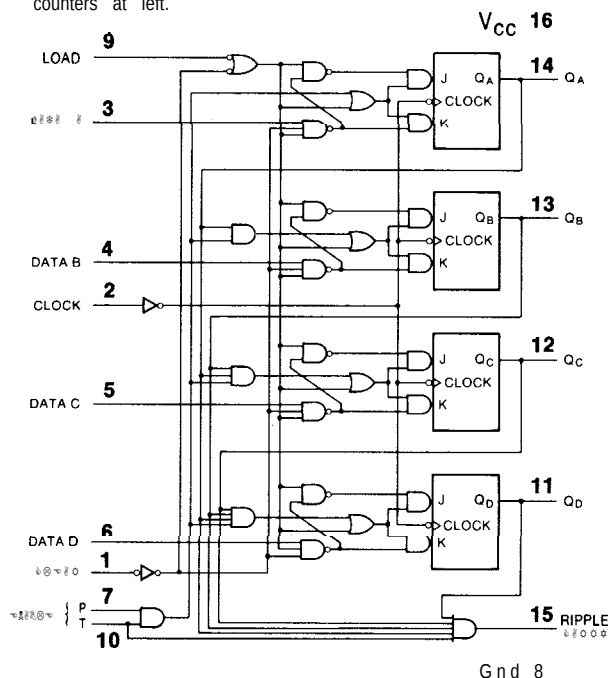


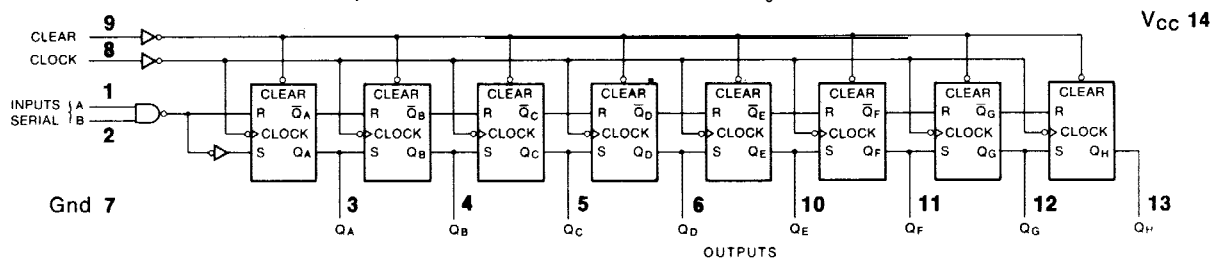
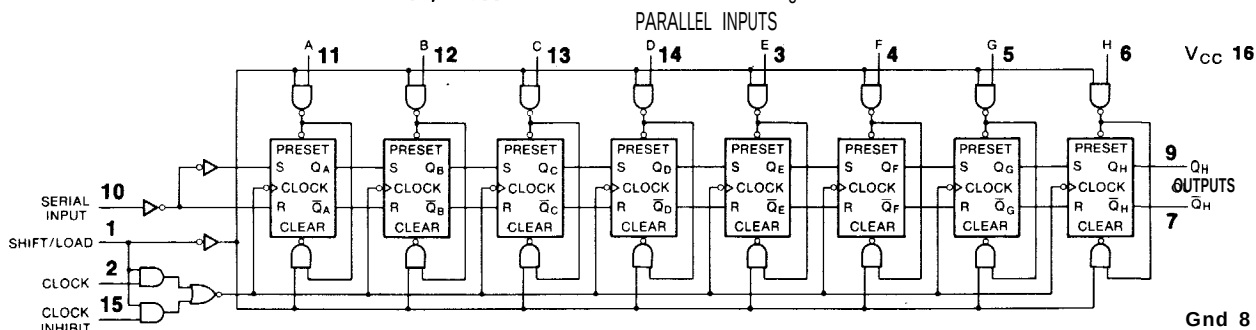
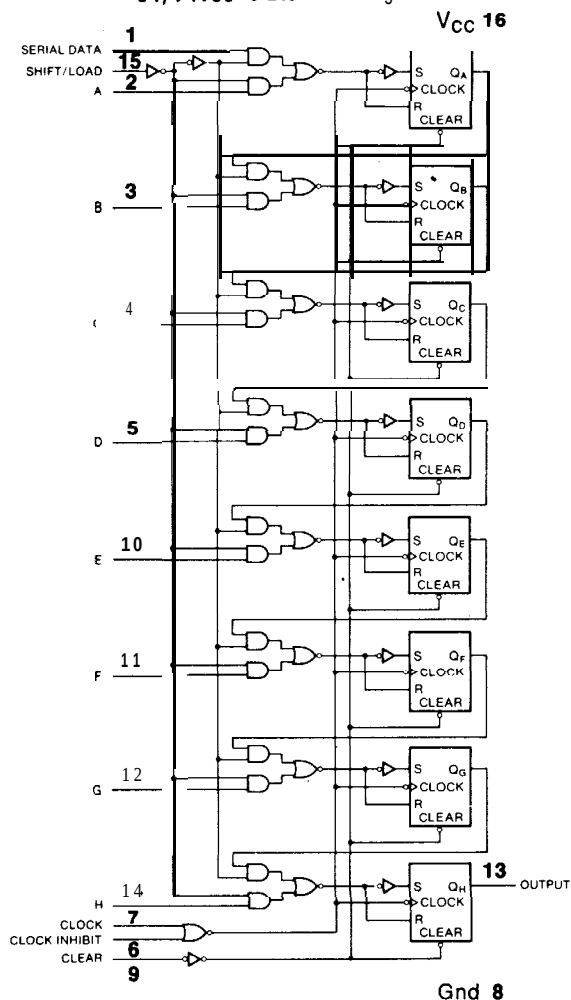
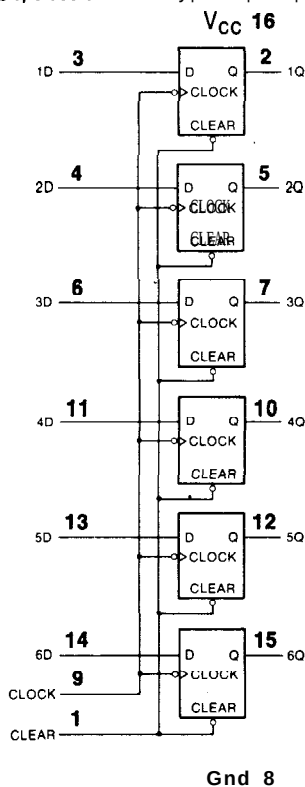
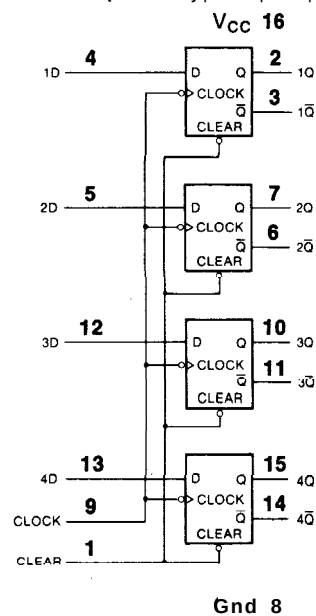
54/74154 4-Line-to-16-Line Decoder/Demultiplexer**Dual 2-Line-to-4-Line Decoder/Demultiplexer****54/74155** Active pull-ups**54/74156** Free-collector outputs**54/74160 4-Bit Synchronous Decade Counter**

54162/74162 synchronous decade counters are similar; however the clear is synchronous as shown for the 54163/74163 binary counters at right.

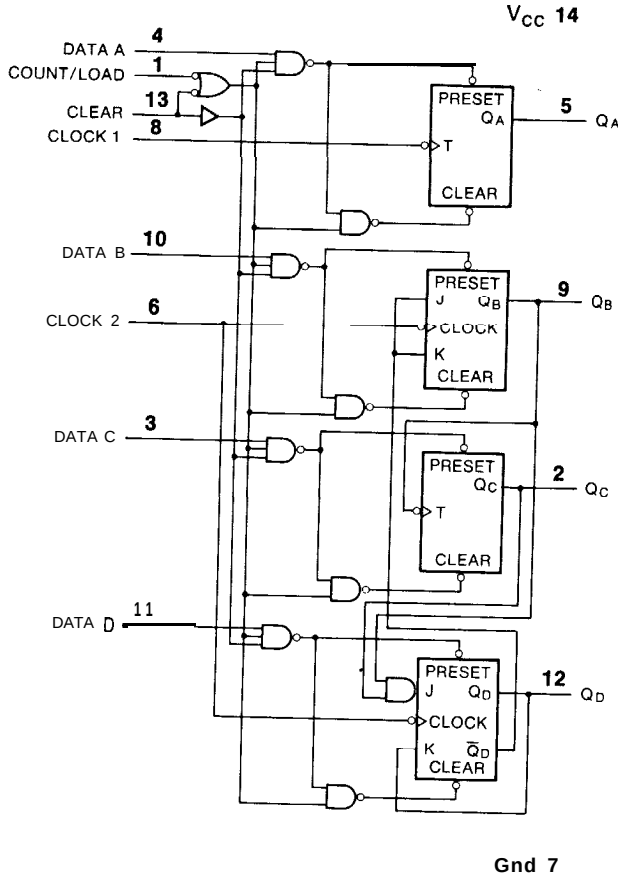
**54/74161 4-Bit Synchronous Binary Counter**

54161/74161 synchronous binary counters are similar; however the clear is asynchronous as shown for the 54160/74160 decade counters at left.

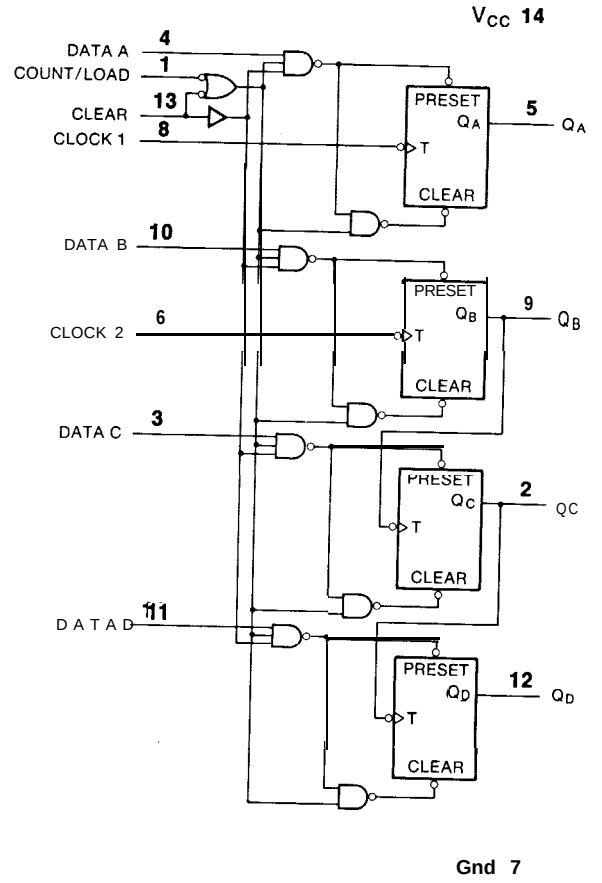


54/74164 8-Bit Parallel-Out Serial-Shift Register**54/74165 Parallel-Load 8-Bit Shift Register****54/74166 8-Bit Shift Register****54/74174 Hex D-Type Flip-Flop****54/74175 Quad D-Type Flip-Flop**

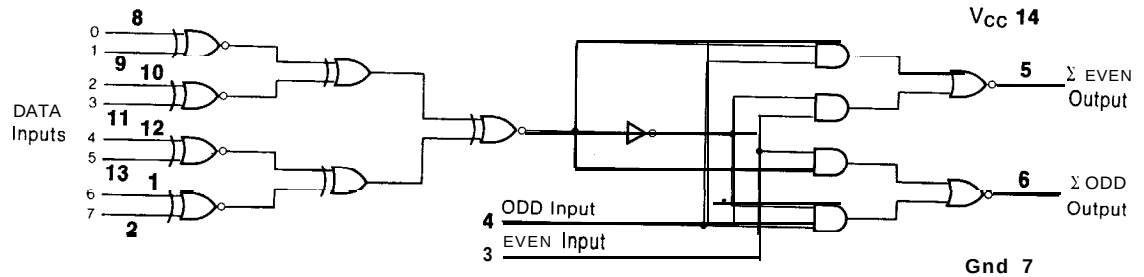
54/74176 35 MHz Presettable Decade Counter/latch



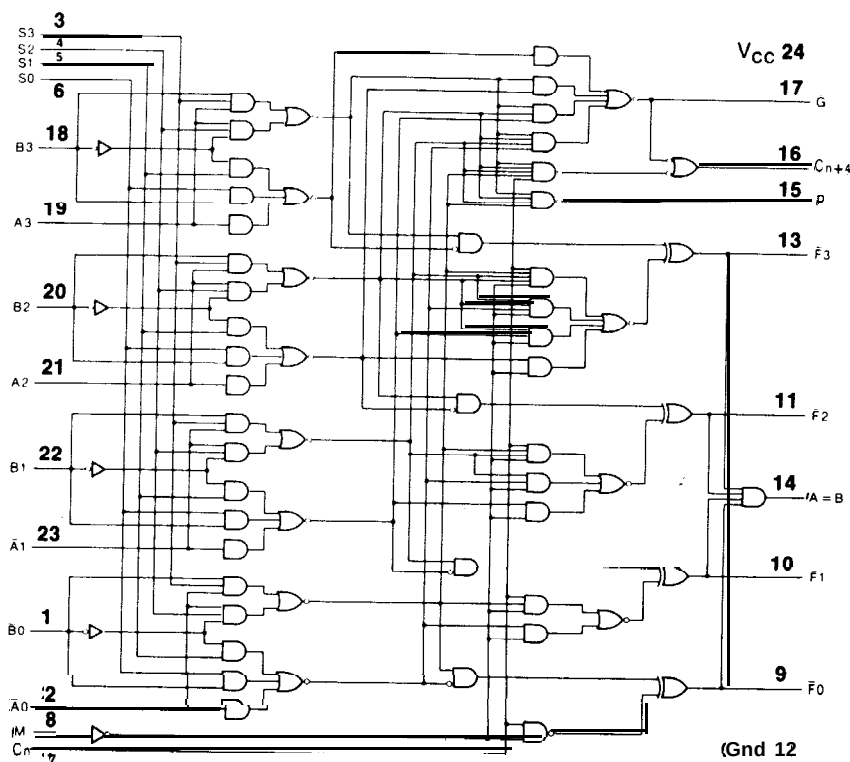
54/74177 35 MHz Presettable Binary Counter/latch



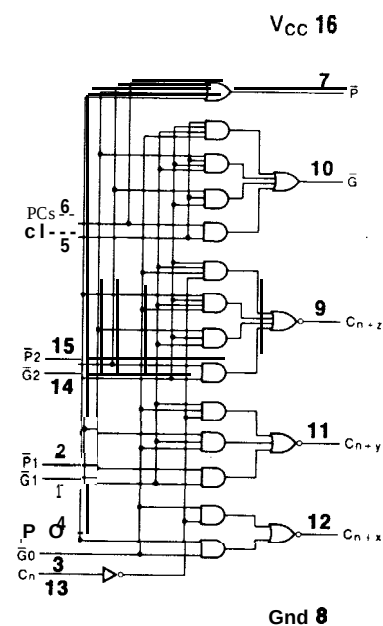
54/74180 8-Bit ODD/EVEN Parity Generator/Checker



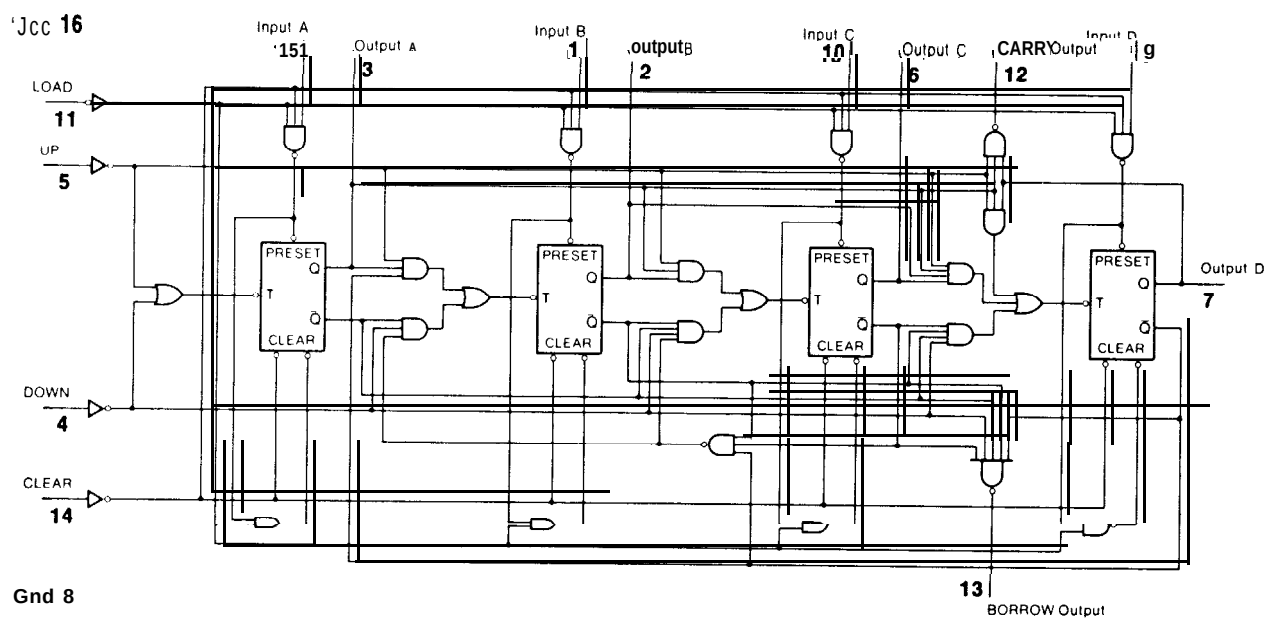
54/74181 4-Bit Arithmetic Logic Unit

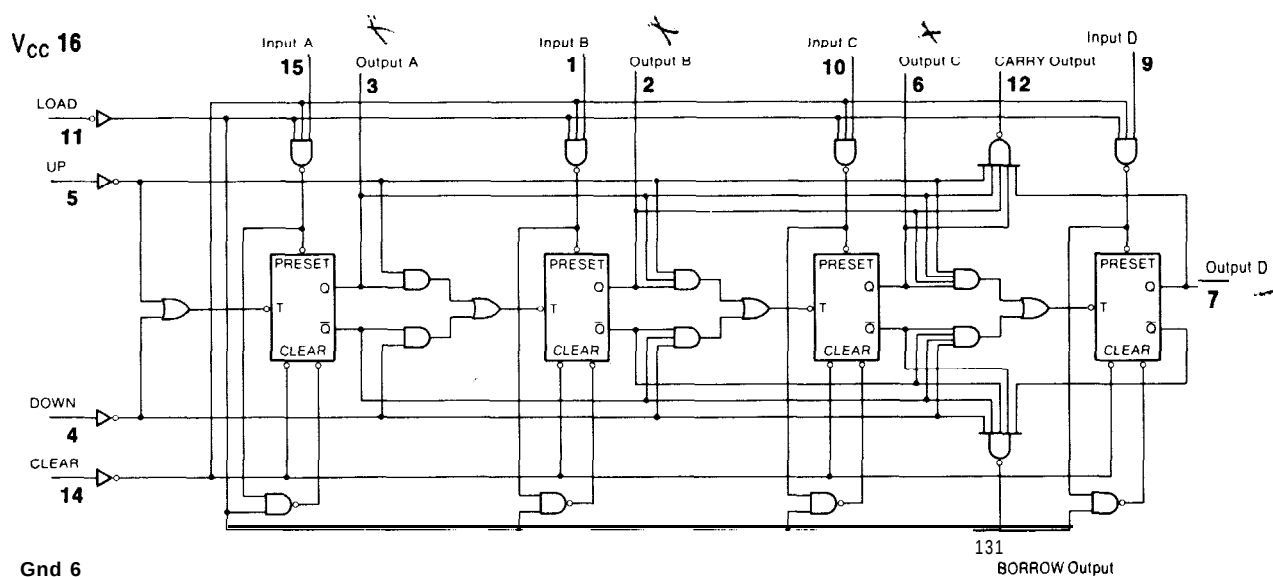


54/74182 Look-Ahead Carry Generator



54/74192 Reversible BCD Decade Counter

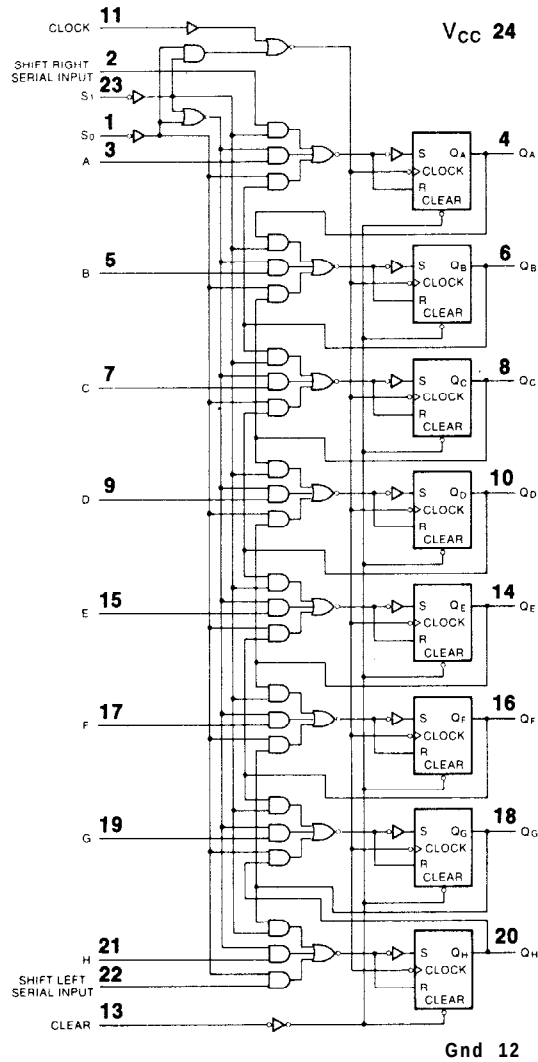
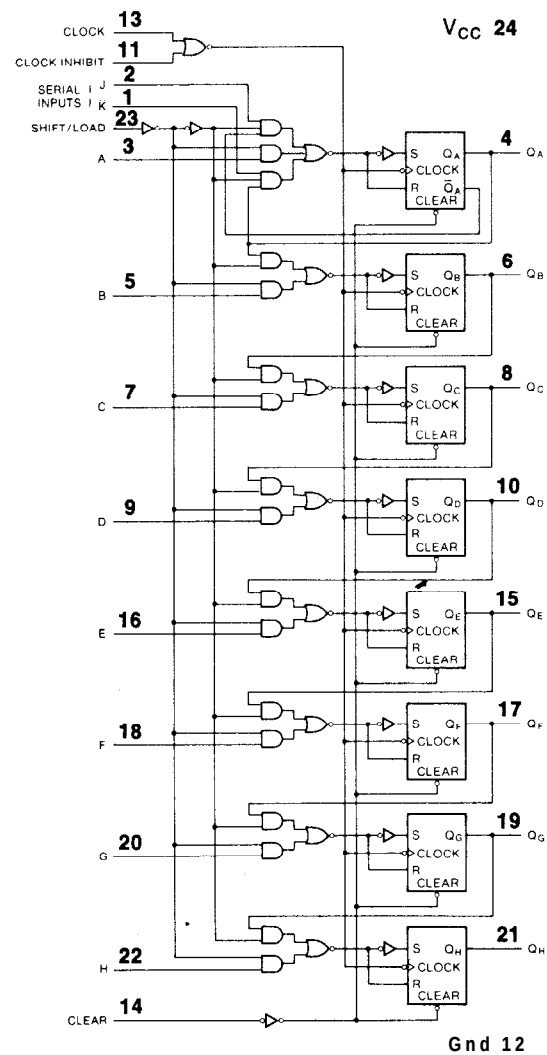
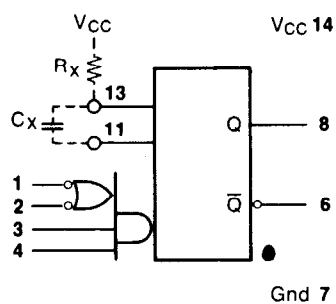


54/74193 Reversible Modulo-16 Binary Counter

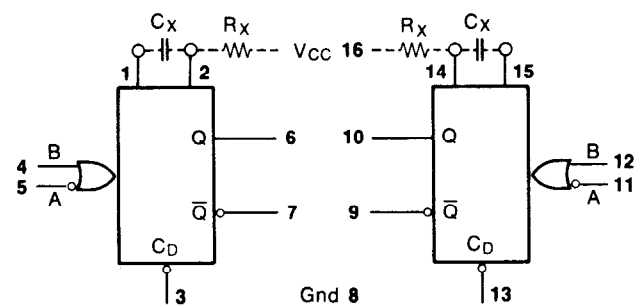
Operations Table

OPERATION	UP CLOCK	DOWN CLOCK	INPUTS CLEAR	LOAD	A, a, C, D	RESPONSE AT Q OUTPUTS
Clocking		1	0	1	X	Count UP
	1		0	1	X	Count DOWN
	0		0	1	X	Q _A unchanged; others unchanged if Q _A is high
		0	0	1	X	Q _A unchanged; others unchanged if Q _A is low
			0	1	X	Undefined for race conditions
Clearing	ϕ	ϕ	1	X	X	All 0's
Loading	1	1	0	1	X	No change
	ϕ	ϕ	0	0	PRESET DATA	Preset to A, B, C, D input data

X = irrelevant ϕ = high level recommended

54/74198 8-Bit Shift Register**54/74199 8-Bit Shift Register****9801 Retriggerable One-Shot****Triggering Truth Table**

Pin 1	Pin 2	Pin 3	Pin 4	RESPONSE
High	High	ϕ	ϕ	No Trigger
Low	ϕ	High	High	Trigger
Low	ϕ	Low	Low	No Trigger
ϕ	High	High	High	Trigger
ϕ	High	Low	ϕ	No Trigger
ϕ	Low	ϕ	ϕ	No Trigger

 ϕ = immaterial**9802 Dual Retriggerable One-Shot****Triggering Truth Table**

A	B	C _D	RESPONSE
X	X	0	No Trigger
ϕ	0	X	No Trigger
ϕ	1	1	Trigger
1	ϕ	X	No Trigger
0	ϕ	1	Trigger

X = immaterial

DTL Numerical Index

TEMPERATURE RANGE		FUNCTION	PAGE	TEMPERATURE RANGE		FUNCTION	PAGE
MILITARY	INDUSTRIAL			MILITARY	INDUSTRIAL		
705-1*	705-2*	Dual J-K Clocked Flip-Flop	19	937-1	937-2	Hex Inverter	20
706-1*	706-2*	Dual J-K Clocked Flip-Flop	19	938	838	Decade Counter	20
708-1*	708-2*	Dual J-K Clocked Flip-Flop	19	939	839	Divide-by-Sixteen Counter	20
709-1*	709-2*	Dual J-K Clocked Flip-Flop	19	941-1	941-2	Monostable Multivibrator	20
727-1	727-2	Quad 2-input Expander Diodes	19	944-1	944-2	Dual 4-input NAND Power Gate	20
728-1	727-2	Monostable Multivibrator	19	945-1	945-2	R-S/J-K Clocked Flip-Flop	20
729-1	729-2	Dual Lamp Driver	19	946-1	946-2	Quad P-input NAND Gate	20
736-1	736-2	Hex Inverter	19	948-1	948-2	R-S/J-K Clocked Flip-Flop	20
737-1	737-2	Hex Inverter	19	949-1	949-2	Quad 2-input NAND Gate	20
744-1	744-2	Dual Power Gate	19	950-1	950-2	Pulse Triggered Flip-Flop	20
751-1	751-2	Monostable Multivibrator	19	951-1	951-2	Monostable Multivibrator	20
770-1	770-2	IO-input Complementary Gate	19	957-1	957-2	Quad 2-input Buffer	21
771-1	771-2	IO-input Complementary Gate	19	958-1	958-2	Quad 2-input Power Gate	21
772-1	772-2	Triple R-6 Flip-Flop	19	961-1	961-2	Dual 4-input NAND Gate	21
773-1	773-2	Triple R-S Flip-Flop	19	962-1	962-2	Triple 3-input NAND Gate	21
774-1	774-2	Triple 3-input AND Gate	19	963-1	963-2	Triple 3-input NAND Gate	21
775-1	775-2	Triple 3-input AND Gate	19	1900	1800	Dual 5-input NAND Gate	21
776-1	776-2	Dual AND-OR Gate	19	1902	1802	8-input NAND Gate	21
777-1	777-2	Dual AND-OR Gate	19	1904	1804	IO-input NAND Gate	21
778-1	778-2	Dual 4-input Complementary Gate	19	1905	1805	IO-input NAND Gate	21
779-1	779-2	Dual 4-input Complementary Gate	19	1906	1806	Quad 2-input AND Gate	21
—	781-2	Tachometer Driver	19	1907	1807	Quad 2-input AND Gate	21
930-1	930-2	Dual 4-input NAND Gate	20	1908	1808	Quad P-input OR Gate	21
932-1	932-2	Dual 4-input Buffer	20	1910	1810	Quad 2-input NOR Gate	21
933-1	933-2	Dual 4-input Expander Diodes	20	1912	1812	Quad Exclusive-OR Gate	21
936-1	936-2	Hex Inverter	20	1913	1813	Quad Latch	21
				1914	1814	Quad Latch	21

*705=9093; 706=9099; 708=9094; 709=9097

Ordering Information

Package Suffix Letters: F=Ceramic Flat Pack M=Plastic Dual-in-Line P=Ceramic Dual-in-Line

Flat Pack stocked only in Military Temperature Range; Plastic stocked only in Industrial Temperature Range.

DTL Functional Index

NAND Gates	Page
946 Quad	20
949 Quad	20
962 Triple	21
963 Triple	21
930 Dual 4	19
961 Dual 4	21
1900 Dual 5	21
1902 Single 8	21
1904 Single 10	21
1905 Single 10	21

AND, AND-OR Gates	
1906 Quad AND	21
1907 Quad AND	21
774 Triple AND	19
775 Triple AND	19
778 Dual Complementary	19
779 Dual Complementary	19
770 Single 10 Complementary	19
771 Single 10 Complementary	19
776 Dual AND-OR	19
777 Dual AND-OR	19

Inverters, Buffers, Power Gates	
736 Hex Inverter*	19
737 Hex Inverter*	19
936 Hex Inverter	20
937 Hex Inverter	20
957 Quad Buffer	21
932 Dual Buffer	20
958 Quad Power Gate*	21
744 Dual-Power Gate*	19
944 Dual Power Gate*	20
729 Dual Lamp Driver*	19

*Free-Collector outputs

OR, NOR Gates; Expanders	Page
1908 Quad OR	21
1912 Quad Exclusive-OR	21
1910 Quad NOR	21
727 Quad Expander	19
933 Dual Expander	20

Flip-Flops	
945 R-S/J-K	20
948 R-S/J-K	20
950 Pulse Triggered	20
705 Dual J-K	19
706 Dual J-K	19
708 Dual J-K	19
709 Dual J-K	19
772 Triple R-S	19
773 Triple R-S	19

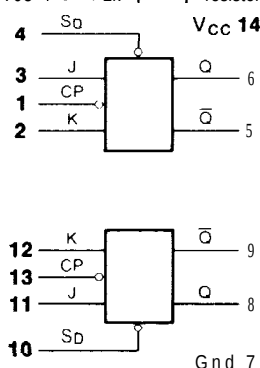
latches	
1913 Quad Latch	21
1914 Quad Latch	21

Counters	
938 BCD Decade	20
939 Divide-by-16	20

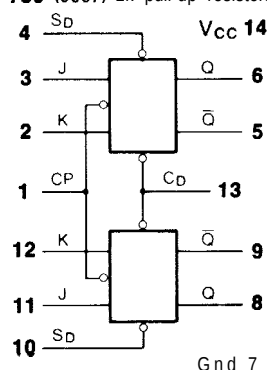
Multivibrators	
728	19
751	19
781 Tachometer Driver	19
941	20
951	20

Dual J-K Clocked Flip-Flop

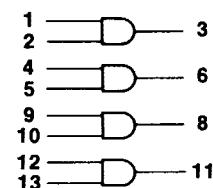
Separate clocks

705 (9093) 6k pull-up resistors**708** (9094) 2k pull-up resistors**Dual J-K Clocked Flip-Flop**

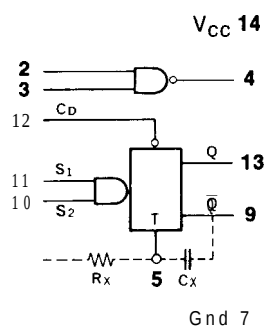
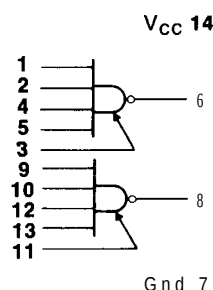
Common clocks, common reset

708 (9099) 6k pull-up resistors**709** (9097) 2k pull-up resistors**727 Quad 2-input Expander**

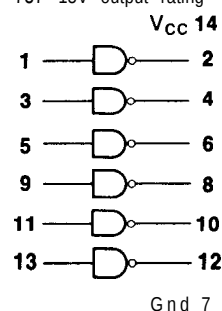
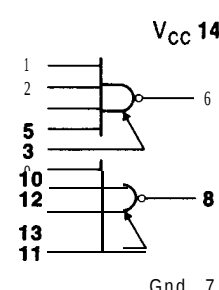
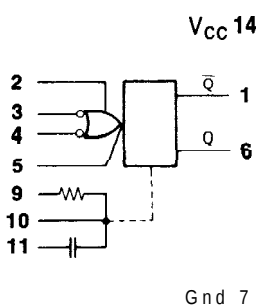
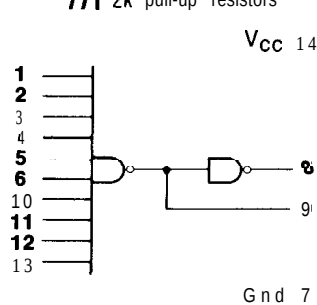
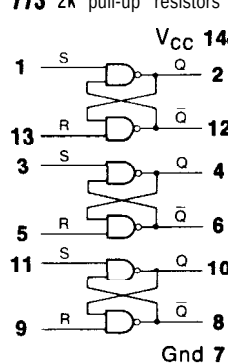
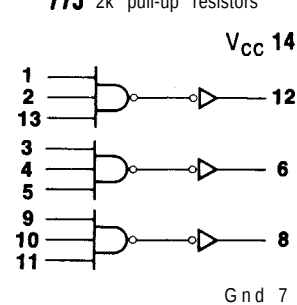
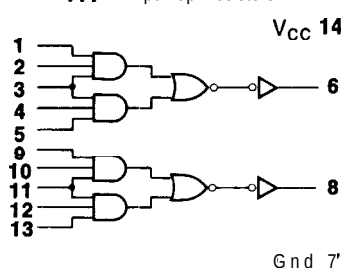
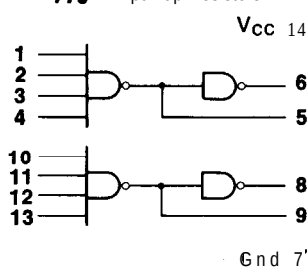
Diodes



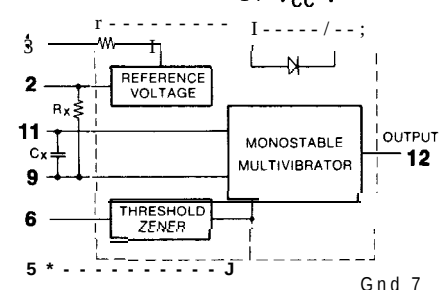
Gnd 7

728 Monostable Multivibrator**729 Dual lamp Driver**Free-collector outputs, 100 mA
Expandable**Hex Inverter**

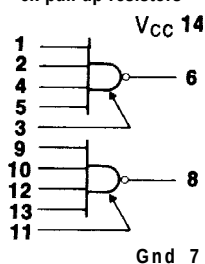
Free-collector outputs

738 8V output rating**737** 15V output rating**744 Dual Power Gate**Free-collector outputs, 15V/40 mA
Expandable**751 Monostable Multivibrator****10-input Complementary Gate****770** 6k pull-up resistors**771** 2k pull-up resistors**Triple R-S Flip-Flop****772** 6k pull-up resistors**773** 2k pull-up resistors**Triple 3-input AND Gate****774** 6k pull-up resistors**775** 2k pull-up resistors**Dual AND-OR Gate****778** 6k pull-up resistors**777** 2k pull-up resistors**Dual 4-input Complementary Gate****778** 6k pull-up resistors**779** 2k pull-up resistors**781 Tachometer Driver**

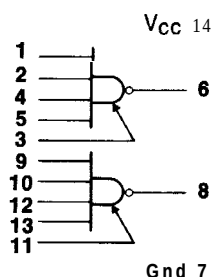
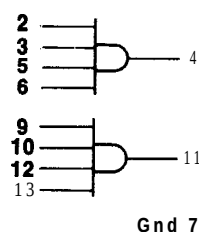
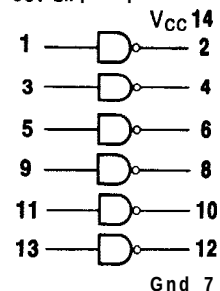
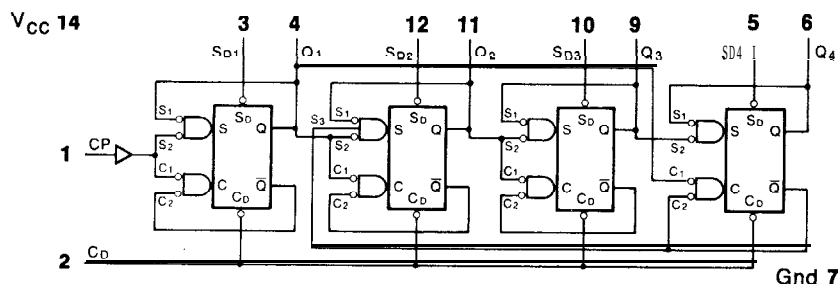
14 Vcc 1



*Optional low-level trigger input available on special order.

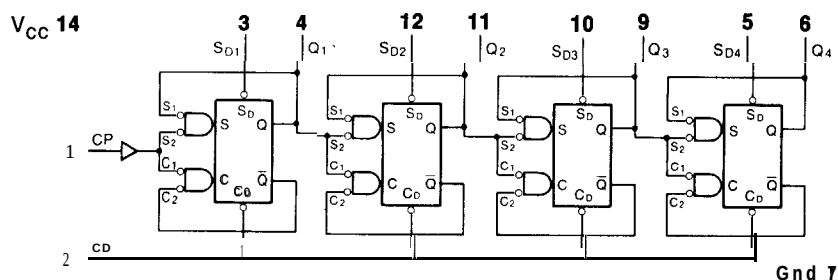
930 Dual 4-input NAND GateExpandable
6k pull-up resistors**932 Dual 4-input Buffer**

Expandable

**933 Dual 4-input Expander Diodes****Hex Inverter**936 6k pull-up resistors
937 2k pull-up resistors**838/938 Decade Counter**

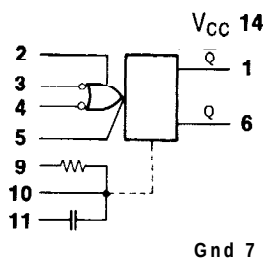
Truth Table

	Q ₁	Q ₂	Q ₃	Q ₄
0	LOW	LOW	LOW	LOW
1	HIGH	LOW	LOW	LOW
2	LOW	HIGH	LOW	LOW
3	HIGH	HIGH	LOW	LOW
4	LOW	LOW	HIGH	LOW
5	HIGH	LOW	HIGH	LOW
6	LOW	HIGH	HIGH	LOW
7	HIGH	HIGH	HIGH	LOW
8	LOW	LOW	LOW	HIGH
9	HIGH	LOW	LOW	HIGH
0	LOW	LOW	LOW	LOW

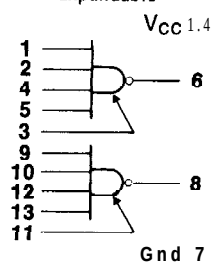
839/939 Divide-by-Sixteen Counter

Truth Table

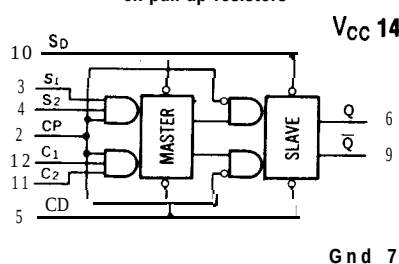
	Q ₁	Q ₂	Q ₃	Q ₄
0	LOW	LOW	LOW	LOW
1	HIGH	LOW	LOW	LOW
2	LOW	HIGH	LOW	LOW
3	HIGH	HIGH	LOW	LOW
4	LOW	LOW	HIGH	LOW
5	HIGH	LOW	HIGH	LOW
6	LOW	HIGH	HIGH	LOW
7	HIGH	HIGH	HIGH	LOW
8	LOW	LOW	LOW	HIGH
9	HIGH	LOW	LOW	HIGH
10	LOW	HIGH	LOW	HIGH
11	HIGH	HIGH	LOW	HIGH
12	LOW	LOW	HIGH	HIGH
13	HIGH	LOW	HIGH	HIGH
14	LOW	HIGH	HIGH	HIGH
15	HIGH	HIGH	HIGH	HIGH
0	LOW	LOW	LOW	LOW

941 Monostable Multivibrator**944 Dual 4-input NAND Power Gate**

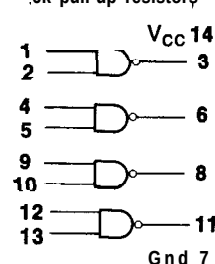
Expandable



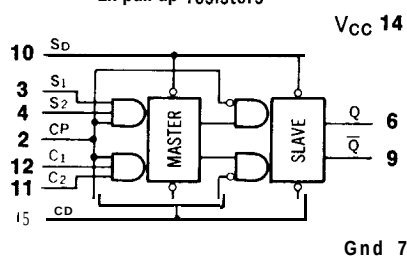
6k pull-up resistors

**946 Quad 2-input NAND Gate**

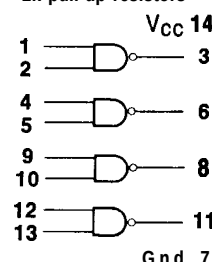
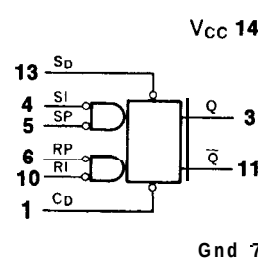
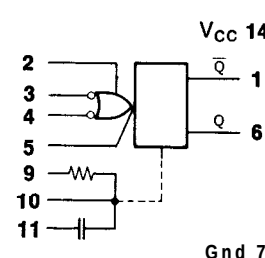
6k pull-up resistors

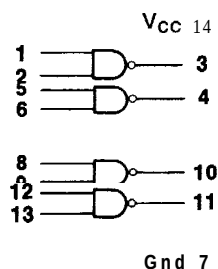
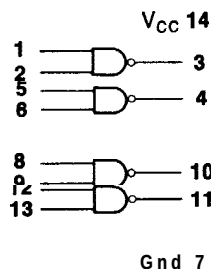
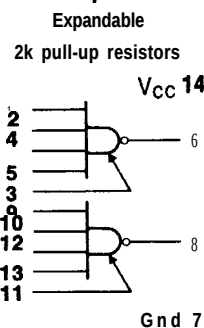
**946 R-S/J-K Clocked Flip-Flop**

2k pull-up resistors

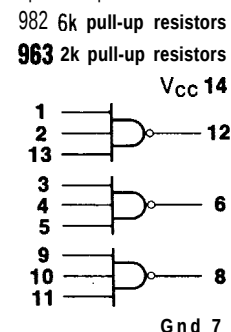
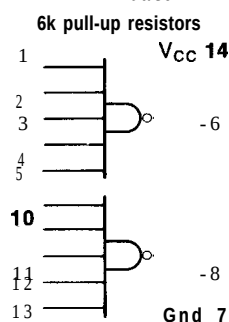
**949 Quad 2-input NAND Gate**

2k pull-up resistors

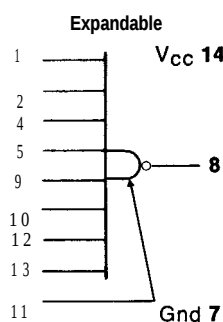
**950 Pulse Triggered Flip-Flop****951 Monostable Multivibrator**

957 Quad **2-input** Buffer958 Quad **2-input** Power Gate981 Dual **4-input** NAND Gate

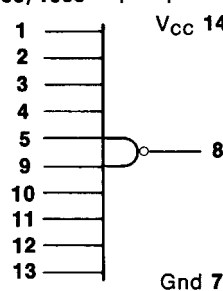
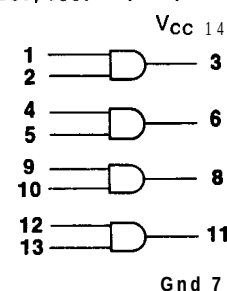
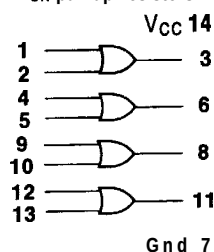
Triple 1-input NAND Gate

1800/1900 Dual **5-input** NAND Gate

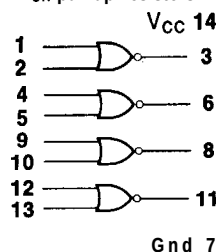
1802/1902 1-input NAND Gate



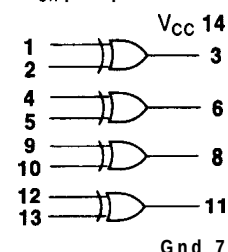
1-input NAND Gate

1804/1904 6k pull-up resistors
1805/1905 2k pull-up resistorsQuad **2-input** AND Gate1806/1906 6k pull-up resistors
1807/1907 2k pull-up resistors1808/1908 Quad **2-input** OR Gate

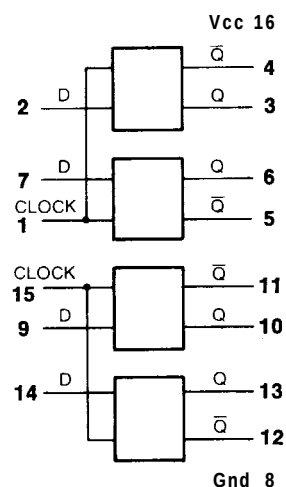
1810/1910 Quad 1-input NOR Gate



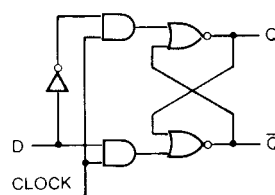
1812/1912 Quad Exclusive-OR Gate



1813/1913 Quad latch



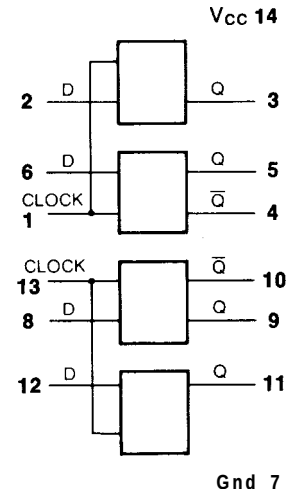
latch logic



Truth Table

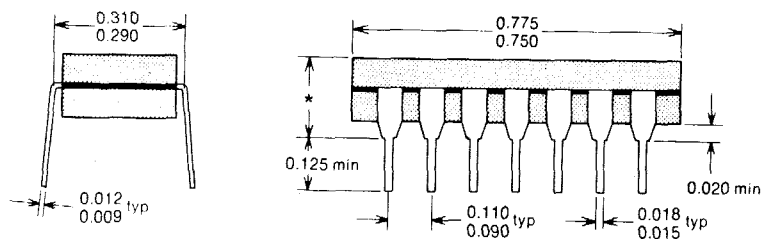
C	D	Q	Q̄
Low	Low	No Change	No Change
Low	High	No Change	No Change
High	Low	Low	High
High	High	High	Low

1814/1914 Quad latch

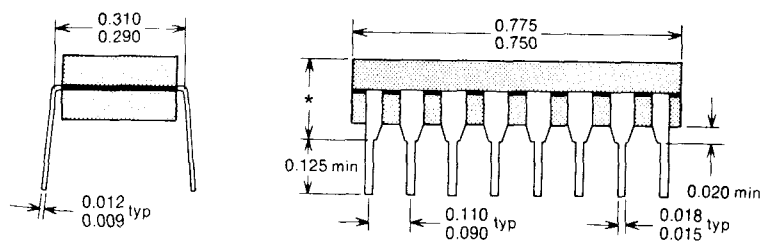


Dual-in-line (D.I.P.)

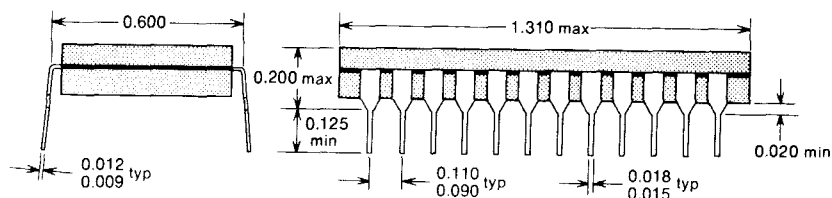
14 Pin Ceramic or Plastic



16 Pin Ceramic or Plastic

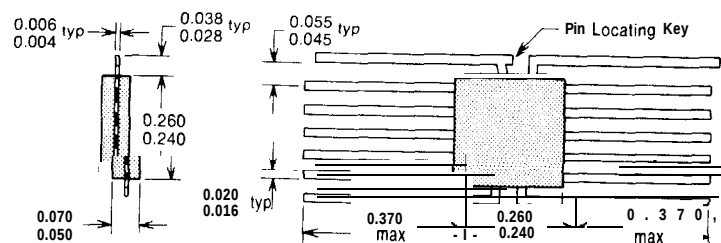


24 Pin Ceramic or Plastic



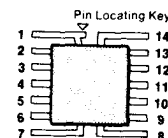
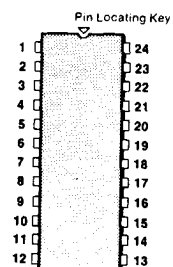
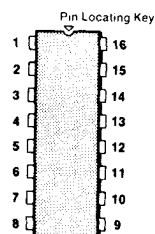
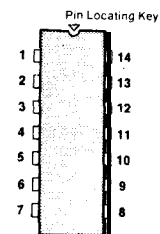
* 0.200 max = ceramic 0.170 max = plastic

14 Pin Ceramic Flat Pack



All dimensions in inches.

Pin Identification



STEWART-WARNER MICROCIRCUITS DIVISION

STEWART-WARNER CORPORATION

730 EAST EVELYN AVENUE, SUNNYVALE, CALIFORNIA 94066

PHONE 408/245-9200 • TWX 910-339-9210

IC INTRODUCTION

The following section will inform the user of this handbook as to what to expect when testing an integrated circuit. We recommend that you correlate the logic levels typically found (i.e. 1, 0 or P) as: high being 2.4VDC to Vcc (supply voltage typically 5VDC); low being 0.0VDC; 0.8VDC pulsing being any change of state from high to low or low to high. For your convenience, the probes are color coded with lights to represent the logic states.

Red = 1 or high White = 0 or low
Blue = Pulsing or change of state

A typical example of the use of a probe as equated to the use of a truth table is as follows:

2 INPUT NOR

A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

A	B	Y
WHITE	WHITE	RED
RED	WHITE	WHITE
WHITE	RED	WHITE
RED	RED	WHITE

Consider now a complex device (i.e. an eight input nand gate 7430). If you were to continue a truth table using only ones (1s) and zeros (0s) and if you were to expand it out fully, you would have 40,320 data input, bits. Therefore we need a method of abbreviating the truth table. You will note the three input nomenclatures for the following truth tables.

A - H input gates
Y output
 $\bar{Y}$ inverted Y output
 $\bar{Q}$ flip-flop output
 $\bar{Q}$ inverted Q output
X . . irrelevant (any state)

The X nomenclature indicates that any signal level may be present at that gate at that time and it will not, affect the output condition of the device. That is, because the other inputs are set in a particular fashion, the change of state will not affect it.

I.C. LOGIC DESIGN (LDP-1B)

The I.C. Logic Design Program (LDP-1B) is ideal for engineers and technicians who are beginning to design, test, or repair equipment using I.C.'s. The course is based on working with standard I.C. logic devices as they are offered by manufacturers.

Completion of the course will enable the student to operate effectively when designing or analyzing. An outline of the lessons follows.

1. Logic Elements: This beginning lesson covers the AND, OR and inverter gates. Also included is a discussion of symbolic notation.
2. I.C. Logic Families: A study of each of the popular logic families including RTL, DTL, TTL, and ECL.
3. Complex Logic Elements: The student is taught the operational logic of standard packages containing more than one logic function. NAND, NOR, AND-OR-Invert and exclusive OR are covered. Also, Negative logic is studied.
4. Boolean Algebra & Theorems: Boolean Identities are taught. Also included are the theorems required to minimize logic circuits.
5. DeMorgan Theorem of Negation: This important theorem is taught in detail. Many practical examples are given.
6. Karnaugh Maps: This lesson teaches the student to minimize and graphically represent any logic circuit.
7. R/S Flip-Flop: The basic memory circuit is taught and its Truth Table studied. Included is the clocked R/S and Master-Slave.
8. Type D Flip-Flop: A study of the Type D and the Master-Slave Type D. The Truth Table is developed and studied.
9. JK Flip-Flop: This lesson teaches the student the operation of the Master-Slave JK Flip-Flop.
10. Pulse Forming Circuits: The student is taught to design bounce elimination circuits, one-shots, squaring circuits and a free running multivibrator using I.C. logic elements.

DIGITAL CIRCUIT DESIGN (DDP-1B)

This course covers the entire family of digital circuits; gates, flip-flops and trigger circuits. The unique format used in the text has the student designing complex circuits from basic building blocks. An emphasis has been placed on wave-forms and how they are generated by each circuit.

When finished with the DDP-1B the student will be able to design or troubleshoot any digital circuit using transistors or I.C.'s. An outline of the lessons follows.

1. Transistor Action: A study of alpha (α) and beta (β). Common Biasing techniques and DC analysis are included.
2. Semiconductor Diodes: A graphic study of the operation of diodes when forward and reverse biased. The effects of temperature and thermal derating are also covered.
3. Transistor Switching: This lesson includes the study of load lines, and DC switching parameters as they relate to transistor data sheets. Also a model of a transistor is developed. Use of the model simplifies the understanding of switching circuits.
4. Inverters: A step-voltage waveform, inversion, the transistor inverter and thermal derating are taught in this lesson. A design procedure and example are given.
5. Emitter Followers: A study of the operation of an emitter-follower circuit is given. Collector dissipation is included. A design procedure and example are given.
6. Diode Gates: Covers circuits using diodes as AND and OR gates. Truth Tables are also studied. A design procedure and example are given.
7. Diode-Transistor Gates: In this lesson the student is taught how to design logic gates using diodes and transistors as circuit elements. A design procedure and example are given.
8. Resistor-Transistor Gates: The student learns how to design a logic gate using resistors and transistors as circuit elements. A design procedure and example are given.
9. NAND/NOR Gates: The design of logic gating circuits using transistors connected in series and parallel is taught. A design procedure and example are given.
10. S/R Flip-Flops: A pulse waveform is studied in detail. Also the design of a set-reset flip-flop is taught. A design procedure and example are given.
11. Bistable Flip-Flop: Differentiation networks, commutating capacitors and bi-stable circuits are taught. A design example and procedure are given.
12. Astable Flip-Flops: The square-wave waveform is studied. The design of an **astable** flip-flop is taught. A design example and procedure are given.
13. Monostable Flip-Flop: The design of a "one-shot" is taught. A design procedure and example are given.
14. Schmitt Trigger Circuits: This lesson teaches the student to design trigger circuits having a specific UTP and LTP. A design and procedure and example are given.

What the well dressed SHOP is wearing



ELECTRONICS DIVISION
Kurz-Kasch, Inc.

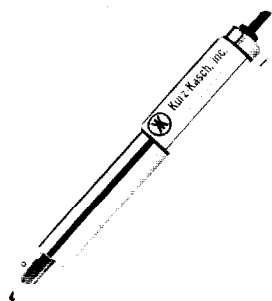
Box 1246

2876 Culver Avenue

Dayton, Ohio 45401

Tel. (513) 296-0330

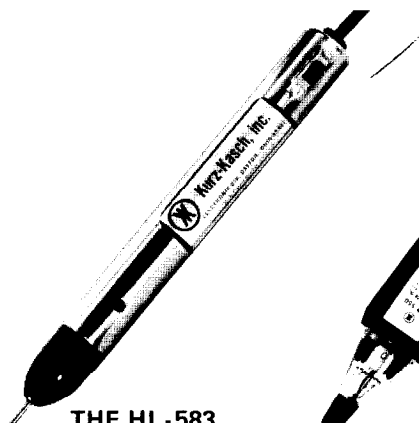
Due to the ever increasing demand for service of coin operated machines, Kurz-Kasch Electronics, Inc. has dedicated itself to this marketplace. We know the need for test equipment, tools, and literature to back up products which have been manufactured as rapidly as the video games. Since the advent of TV games, we have seen over 100 different styles of digitally controlled equipment. All machines of this variety require service, it is inevitable! Therefore, Kurz-Kasch has developed a complete service package for the coin industry which you can purchase direct from the factory. Immediate delivery on all products; and educational seminars are available at your request.



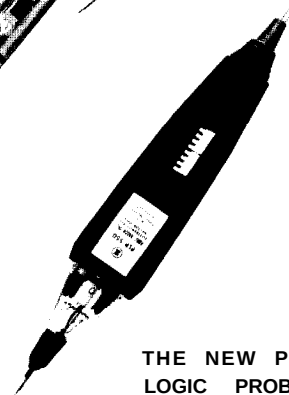
**THE LP-520
DIGITAL LOGIC
PROBE**
for PCB checkout.



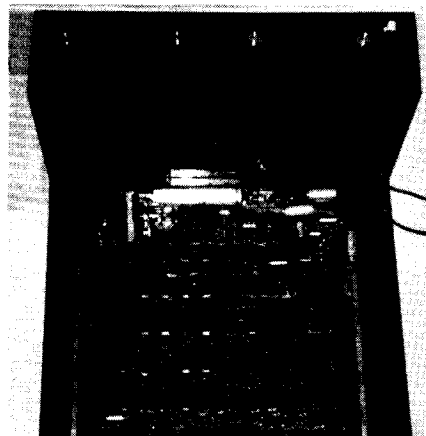
**THE LP-600 TV
PROBE**
for instant isolation
of trouble in either
the CRT/VIDEO
or Printed Circuit
Board.



**THE HL-583
HI-LO PULSER**
Used in conjunction
with the LP-520
for isolation of
troublesome circuit
or IC.



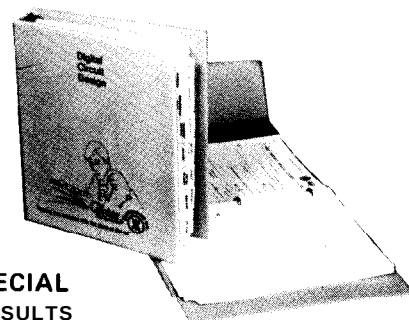
**THE NEW PLP-550
LOGIC PROBE**



SPECIAL TEST FIXTURE
and accessories that
speed checkout.

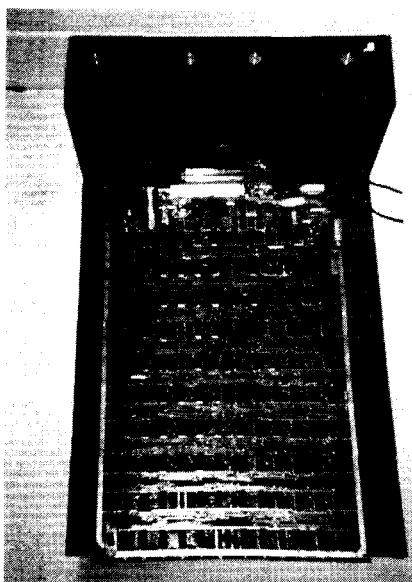


IC TEST CLIP
and insertion tool
TC-59069



**SPECIAL
RESULTS**
M.O.A. approved
home study courses.

TF-650-5A .



Program Card List for TF-650 (Test Fixture)

Card Number	Game	Manufacturer
100	Paddle Battle	Allied Leisure
	Pong	Atari
	Super Pong	Atari
	Rebound	Atari
	Winner I & II	Midway
101	Pong Doubles	Atari
102	Quadra Pong	Atari
103	Space Race-Astroid	Atari/Midway
104	Gotcha	Atari
105	Tennis Tourney	Allied Leisure
106	Football	Allied Leisure
107	TV Ping Pong	Chicago Dynamics
108	Dual 474	Digital Games
	Knockout 574	Digital Games
109	-Winner IV	Midway
110	Leader	Midway/Ramtek
	Wipe Out	Midway/Ramtek
111	Challenger	Mirco
	Rally	Mirco
112	Computer Space I	Nutting
113	Computer Space II	Nutting
114	Aztec	PMC
115	Clean Sweep	Ramtek
116	Paddle Ball	Williams
117	Pro Tennis	Williams
	Pro Hockey	Williams
118	Crossfire	Atari
119	TV Tennis	U.S. Billiards
	TV Hockey	U.S. Billiards
120	Basketball	Midway
121	Baseball	Ramtek/Midway
	Ballpark	Ramtek/Midway
122	Tank	Kee

Card Number	Game	Manufacturer
123	GT IO- Form K	Atari/Kee
124	GT 20 - Twin Racer	Atari/Kee
125	Ping Pong	Atari
126	Qwak	Atari
127	-Wheels - Racer	Midway
128	-Anti-Aircraft	Atari
129	Street Burner	Allied Leisure
130	Highway	Atari
131	Pursuit	Kee
132	Tankers	Fun Games
133	Zap	Allied
134	Robot	Allied
135	Ricochet	Allied
136	Hesitation	Allied
37	TV Pin Pong	Chicago Dynamics
38	TV Goalie	Chicago Dynamics
139	TV Tennis	Chicago Dynamics
140	TV Olympic Hockey	Chicago Dynamics
141	Video Action	Control Sales
142	Survival	U.S. Billiards
143	Pace Car Pro	Electra
144	Pace Race	Electra
145	UFO Chase	Electra
146	TV Pin Ball	Exidy
147	Sting	Exidy
148	Hockey Tennis	Exidy
149	TV Super Flipper	Chicago Coin
150	Playtime	Midway
151	TV Flipper	Midway
152	Champion Ping Pong	Mirco
153	Space Ball	Nutting
154	Wimbledon	Nutting
155	Missiles Radar	Nutting
156	Table Tennis	Nutting
157	Hockey	PMC
158	Warn Barn	PMC
159	1 on 1	PMC
160	Soccer	Ramtek
161	-Hockey	Ramtek
162	Trapshoot	Gremlin
	Playball	Gremlin
163	-Volley	Ramtek
164	Olympic Tennis	Williams
165	Touch Me	Atari
166	Drop Zone	Meadows
167	Wheels II	Midway
168	Flim Flam	Meadows
169	Air Hockey	Brunswick
170	Hunt Club	Chicago Coin
171	Big League	Chicago Coin
172		
173		
174		
175-200	Reserved for New Games.	

KURZ-KASCH'S NEW TV
TEST PROBE - LP-600 TV

This new piece of diagnostic test equipment designed by Kurz-Kasch is the operators answer to troubleshooting his video games. The LP-600 TV allows the operator to probe two (2) key test points and by reading the lighting scheme indicated by the probe, determine where the failure mode lies: (i.e. the monitor or the computer). As an example: (no video - the TV screen is black), at first look you determine the TV has power going to it because the filament is lit in the neck of the picture tube. However, at this point you don't know 'whether the TV is bad or the computer is bad. So you take our, your LP-600 TV probe, connect it to points indicated below. If the lights in the probe illuminate the computer is good and the TV is bad. If the lights in the probe don't illuminate the computer is bad and the TV is good.

Here is how the LP-600 TV works.

The basic concept of digital sync generation is to produce a pulse train from a master clock and after counting these pulses you have a train with a duration of approximately 63.5 u sec; the time required for the beam of the TV to make one sweep across the screen before being reset to make the second sweep. In addition, the number of sweeps are counted to equate one field so the beam can retrace the screen and start its sweeping again. Since a TV uses 525 line resolution each field utilizes 262.5 lines, whereas our displays use 261 lines per field repeatedly.

Consider now our 14.31818 MHZ clock after being divided by 2-the result is a 7.159 MHZ signal which has been shaped into a purely digital signal. The time for one pulse to occur is

$T = 1/F$ Where T = time X

1 = constant

$F = (7.159 \times 10^6)$

Therefore $X = 1/(7.159 \times 10^6)$

$X = (.13968 \times 10^{-6})$

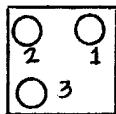
$x = .140 \text{ u sec}$

One pulse from the clock flip-flop occurs within .140 u sec. Now if you multiply the H counter output which is, $4H + 64H + 128H = (452) \times (.140 \times 10^{-6}) = 63.28 \text{ u sec}$. the time between resets (one sweep) which creates H sync. Secondly, if you multiply the V counter output which is, $1V + 4V + 256V = 261; (261) \times (63.28 \times 10^{-6}) = 16,516.08 \text{ u sec}$. $16,516 \text{ u sec} = 16.516 \text{ m sec}$ the time between V sync where the beam retraces the screen.

Therefore as we can see each H sync occurs every 63.28 u sec and each v sync occurs every 16.516 m sec. Now then if either counter is not counting properly the respective timing relationship will be off and the reset period will be off the indicator lamp of the probe will not illuminate. You would then know you have a bad board instead of a bad TV.

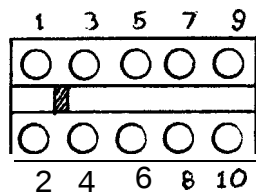
Where to connect your probe.

The first place to connect to is the +5VDC and GND of the computer board. Then decide which pattern is affiliated with your TV.



Pattern 1
(Hitachi-Zenith)

Pin 1 - Ground
Pin 2 - Video and Sync
Pin 3 - Audio



Pattern 2
(Motorola)

Pin 1 - Video and Sync
Pin 2 - Ground
Pin 4 - Audio

Whichever pattern you have, here is the procedure: (with game on)

1. Touch the tip of the probe to the appropriate terminal.
2. Interpret the lights.

EXAMPLES:

1. No video (Hitachi TV)
 - A. Touch terminal - if red light indicates PCB is OK, TV is bad.
2. Scrambled sync (not TV)
 - A. Touch pin - if white light does not illuminate the PCA is bad and the monitor is OK and vice-versa.



Kurz-Kasch, Inc.

ELECTRONICS DIVISION
Box 1246
2876 Culver Avenue
Dayton, Ohio 45401
Telephone 513 / 296-0330

END USER PRICE SCHEDULE EFFECTIVE 6/1/75

EQUIPMENT

PART NUMBER	DESCRIPTION	1-24 NET PRICE
LP-510	TTL Logic Probe	49.00
LP-520	TTL Logic Probe	77.00
LP-520-G	TTL Logic Probe (Gating Option)	97.00
LP-520-GM	TTL Logic Probe (Gating and Memory Option)	112.00
LP-520-GMS	TTL Logic Probe (Gating, Memory and Speed Option)	122.00
LP-520-GS	TTL Logic Probe (Gating and Speed Option)	107.00
LP-520-M	TTL Logic Probe (Memory Option)	92.00
LP-520-MS	TTL Logic Probe (Memory and Speed Option)	102.00
LP-520-S	TTL Logic Probe (Speed Option)	87.00
LP-527	TTL Logic Probe (With BNC Connector)	97.00
LP-520-002	TTL Logic Probe (Student Proof)	87.00
LP-520-013	TTL Logic Probe (G.E. Computer)	121.00
LP-530	HTL Logic Probe	49.00
LP-540	HTL Logic Probe	77.00
LP-540-M	HTL Logic Probe (Memory Option)	92.00
LP-540-G	HTL Logic Probe (Gating Option)	97.00
LP-540-GM	HTL Logic Probe (Gating and Memory Option)	112.00
LP-540-GMS	HTL Logic Probe (Gating, Memory, and Speed Option)	122.00
LP-560	RTL Logic Probe	87.00
LP-560-M	RTL Logic Probe (Memory Option)	89.00
LP-575	C-MOS Logic Probe (Digit display)	99.00
LP-575-M	C-MOS Logic Probe (Digit display with Memory Option)	114.00
LP-575-GM	C-MOS Logic Probe (Digit display with Gating and Memory Option)	134.00
LP-576	C-MOS Logic Probe	87.00
LP-576-M	C-MOS Logic Probe (Memory Option)	102.00
LP-576-GM	C-MOS Logic Probe (Gating and Memory Option)	122.00
LG-580	TTL Square wave generator	99.00
LG-581	HTL Square wave generator	99.00
HL-583	Universal Hi Lo Pulser (5-1 5V TTL/HTL/C-MOS)	96.00
PLP-550	HTL/TTL/C-MOS Probe	237.00
K-592	C-MOS, TTL, HTL IC tester (battery power)	199.95
K-593	C-MOS, TTL, HTL IC tester AC power	325.00
PBB-1501	PBB-1 Power Board (Battery operated)	49.95
PBB-1502	PBB-2 Power Board (5 volt model)	99.95
PBA-1503	PBB-3 Power Board (0-15 volt model)	99.95
JV-1505	Junction Verifier AC Power	44.95

All model logic probes maybe furnished with co-axial cable and BNC connector at \$20.00 each.

Equipment Quantity Discounts

1-24 probes net price
25-49 probes net price less 10%
50-99 probes net price less 15%
100 UP probes net price less 20%

ACCESSORIES

PART NUMBER	DESCRIPTION	1-24 NET PRICE
Replacement Lamp Kit		
RB-510	colored bulbs	3.00
R B-51 0C	clear bulbs	3.00
R B-520	colored bulbs	3.00
RB-520-C	clear bulbs	3.00
R B-520-002	colored bulbs	3.75
RB-520-002C	clear bulbs	3.75
R B-530	colored bulbs	3.00
RB-530C	clear bulbs	3.00
R B-540	colored bulbs	3.00
R B-540C	clear bulbs	3.00
R B-560	colored bulbs	7.20
RB-560C	clear bulbs	7.20
RB-576C	clear bulbs	3.00

PROBE TIP ADAPTORS

A520-1	2 1/4" Long .025 Square	3.50
A520-2	3" Long .031 x .062	3.50
A520-5	7 1/4" Long .025 Square	3.50
A520-6	7 1/4" Long .031 x .062	3.50
A520-7	7 1/4" Long Grabber	4.50

Note: Special adaptors available to your specifications.

PROBE TIP CONVERSION KIT COLORED WELLS WITH CLEAR BULBS

RTC-510	For LP-510 & LP-530 Series	6.25
RTC-520	For LP-520 & LP-540 Series	7.00
RF-5	Fuse, LP-520-002 (0940005) Pkg/5	6.00
RLG-1	"G" Probe Gating Lead Assembly	7.50
	"G" Probe Gating Connector	
PP-1	Probe Pouch	3.00

I C TESTER ACCESSORIES

I C-590-96	Cable Assembly, Remote, 18"	24.95
TC-590-89	IC Pin Extending Test Clip	6.29

Accessory Quantity Discounts

1-24 net price
25-49 net price less 10%
50-99 net price less 15%
100 UP net price less 20%

Terms: Net 30 days
FOB: Dayton, Ohio

Minimum order \$15.00

Prices are subject to change without notice

SECTION 6

GAME SYNC ANALYSIS

This section reviews the normal digital sync chain found in Phase I video games.

2. CIRCUIT DESCRIPTION

2-1. POWER SUPPLY

2-2. The power supply circuitry for the Rebound computer is shown in Figure 2-1. Input single-phase, 60 Hz, 115 vac power is routed through the front and rear interlocks, an ac line filter, and a 1A fuse to the primary of transformer T1. This transformer steps the input voltage down to 16.5 vac (under load), which is then applied to the rectifying, filtering, and regulating circuits of the computer.

2-3. The 16.5 vac output of T1 is full-wave rectified by diodes CR1 and CR2, and the pulsating dc output of these diodes is filtered by capacitor C28. A voltage regulator composed of integrated circuit LM309 or LM309K and resistor R4 receives the filtered dc voltage and provides a highly regulated +5 vdc output to the circuits of the computer. Resistor R4 increases the current capacity of the power supply. Capacitors C1 and C6 through C14 provide filtering for the +5 vdc bus.

2-4. COMPUTER CLOCK

2-5. Figure 2-2 shows the circuitry of the computer clock. Inverting amplifiers F9-12 and F9-2, resistors R5 and R6, capacitors C4 and C5, and crystal X1 form the oscillator portion of the clock circuit. Crystal X1 is in the feedback circuit of the oscillator and functions as a 14.3181 MHz narrow-band filter. Thus, the oscillator circuit is forced to oscillate at a frequency of 14.3181 MHz. The 14.3181 MHz signal taken from the output of amplifier F9-12 is routed through inverter F9-10 to the input of flip-flop J4-5/6. This flip-flop divides the input signal by 2 and delivers 7.159 MHz CLOCK and CLOCK signals to the logic circuits of the computer.

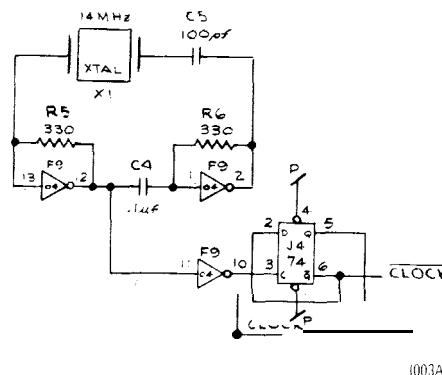


Figure 2-2. Computer Clock

2-6. HORIZONTAL SYNC CIRCUITRY

2-7. Horizontal sync for the TV monitor and timing signals for various circuits of the computer are supplied by the circuitry shown in Figure 2-3. This circuitry is composed of a counter circuit (H5, F5, and H4); NAND gates F4-6, K4-3, and K4-11; AND gate F7-3; inverter D4-4; and flip-flops J4-9/8, K5-5/6, and K5-9/8. The counter receives the 7.159 MHz CLOCK signal from the computer clock and produces numerous submultiples of the CLOCK signal that are designated 1H, 2H, 4H, 8H, 16H, 32H, 64H, 128H, 256H, and 256H. These submultiples are distributed to various logic circuits of the computer for timing and signal development purposes. The development of the H SYNC, H SYNC, H BLANK, H BLANK, H RESET, and H RESET signals is discussed in the following paragraphs. Development and timing of other signals related to the submultiples of the CLOCK signal are discussed in other portions of this manual.

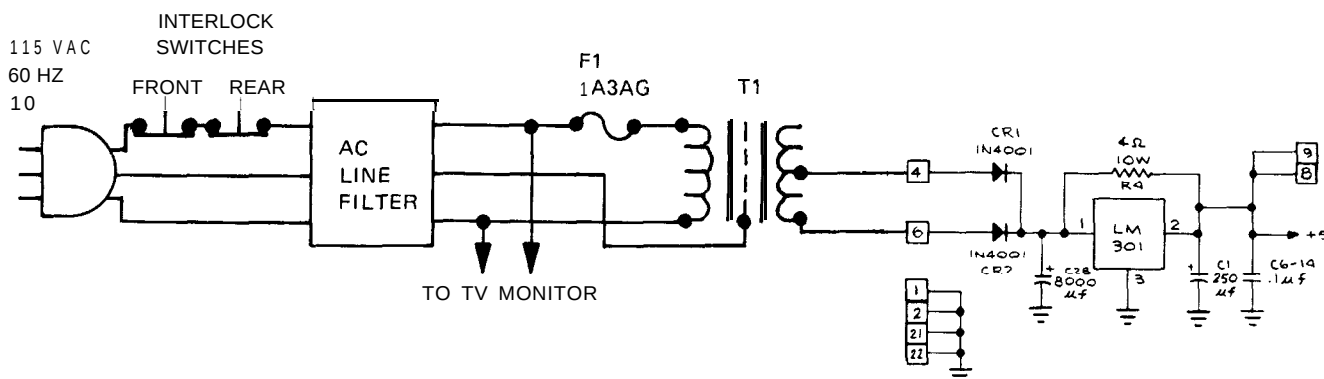
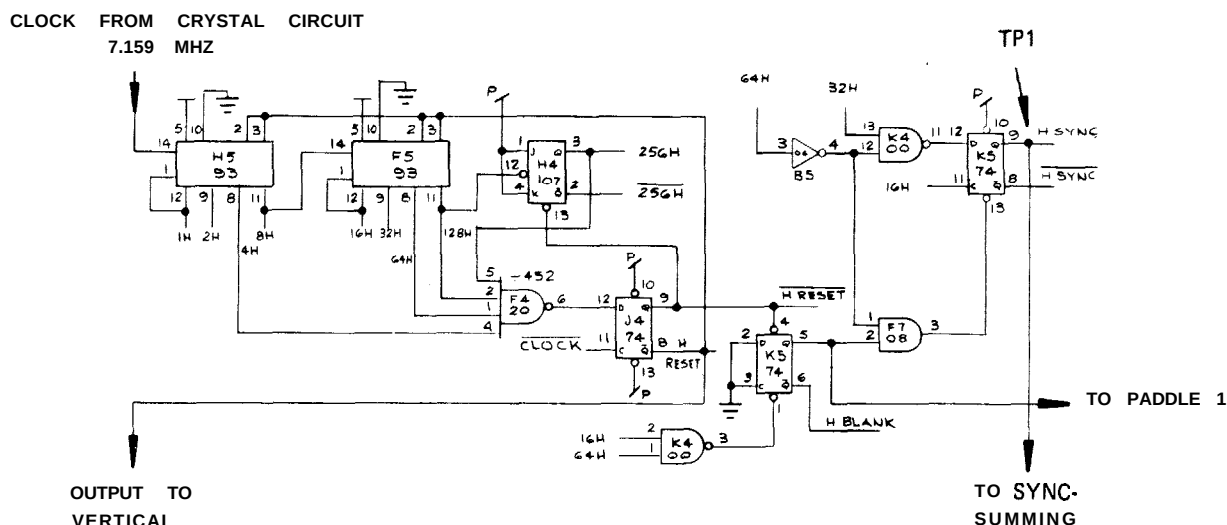


Figure 2-1. Power Supply

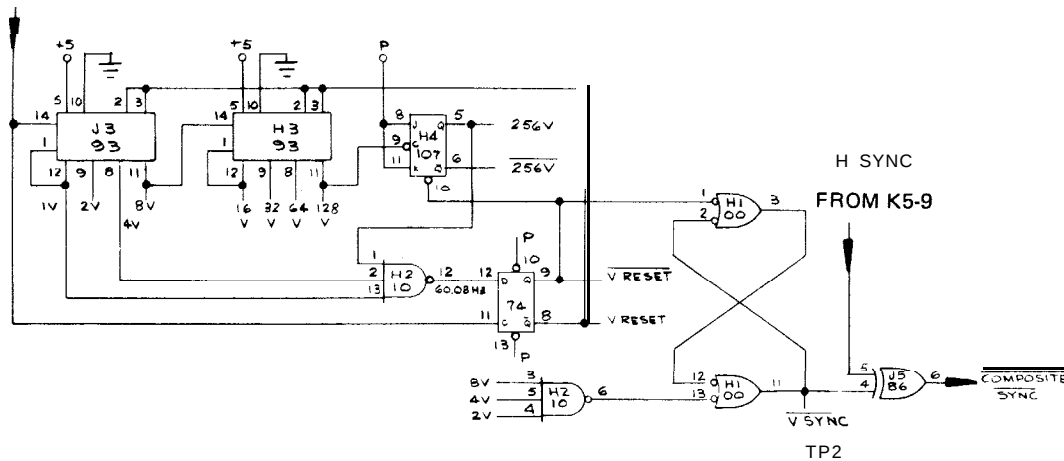


2-8. Each TV line of the Rebound game is approximately 63 usec long, which is equivalent to the time it takes the counter to count 453 CLOCK pulses after being reset. At the count of 452, the 256H, 128H, and 4H signals are all high. As a result, the output of NAND gate F4-6 goes low. When the next CLOCK pulse occurs, the Q output of flip-flop J4-9/8 goes low and the $\bar{Q}$ output goes high. The Q output is used to reset flip-flop H4-3/2 of the counter, to set flip-flop K5-5/6, and for other signal development purposes on the computer. The $\bar{Q}$ output of J4-9/8 is used to reset counters H5 and F5 and is also sent to the vertical sync circuitry.

2-9. Setting flip-flop K5-5/6 causes the $\bar{Q}$ output to go low, which establishes the leading edge of the H BLANK pulse, and the Q output to go high, which establishes the leading edge of the H BLANK pulse. The H BLANK pulse is sent to the paddle logic and to AND gate F7-3. Before the count 64H is reached, the output of inverter B5-4 is high. Therefore, the output of AND gate F7-3 is high. Signals 16H and 32H are both high at the count of 48. Consequently, the output of NAND gate K4-1 1 goes low, and the clock input (pin 11) of flip-flop K5-9/8 is enabled. With a low applied to pin K5-12 and highs applied to pins K5-10, K5-1 1, and K5-13 of flip-flop K5-9/8, the Q output of the flip-flop goes low, which forms the leading edge of the H SYNC pulse, and the $\bar{Q}$ output goes high, which forms the leading edge of the H SYNC pulse. At the count of 64, the 64H signal goes high, causing flip-flop K5-9/8 to change states and form the trailing edge of the H SYNC and H SYNC pulses. At the count of 80, the 16H and 64H signals are high, causing a low to be applied to the clear input (pin 1) of flip-flop K5-5/6. As a result, the flip-flop changes state and thereby forms the trailing edges of the H BLANK

2-11. Vertical sync for the TV monitor and signal development and timing signals for various circuits of the computer are supplied by the vertical sync circuitry, which is shown in Figure 2-4. The vertical sync circuitry is composed of a counter circuit (J3, H3, and H4), NAND gates H2-12 and H2-6, and flip-flops J2-9/8 and H1-3/11. During operation, the counter receives the H RESET signal from the horizontal sync circuitry and produces numerous submultiples of the H RESET signal that are designated 1V, 2V, 4V, 8V, 16V, 32V, 64V, 128V, 256V, and 256V. These submultiples are distributed to various logic circuits of the computer for timing and signal development purposes. The development of the V RESET, V RESET, and V SYNC signals is discussed in the following paragraphs. Development and timing of other signals related to the submultiples of the H RESET signal are discussed in other portions of the manual.

H RESET FROM J4-8



(006A)

Figure 2-4. Vertical Sync and Sync Summing Circuitry

put (V RESET) goes high. The Q output is used to reset flip-flop H4 of the counter, to set flip-flop H1-3/11, and for other timing and signal development purposes on the computer. The $\bar{Q}$ output is used to reset counters J3 and H3 and is also used for other timing and signal development purposes on the computer.

2-13. Setting flip-flop H1-3/1 causes the output at pin HI-11 to go low, which forms 'the leading edge of the V SYNC pulse. Fourteen H RESET pulses later, signals 8V, 4V, and 2V are all high. Consequently, the output of NAND gate H2-6 goes low, which resets flip-flop H1-3/11. Resetting flip-flop H1-3/11 forms the trailing edge of the V SYNC pulse, which is sent to sync summing gate J5-6 and to other circuits of the computer for signal timing and developmental purposes.

2-14. SYNC SUMMING

2-15. Exclusive OR gate J5-6 (shown in Figure 2-4) is used for sync summing. H SYNC pulses are applied to pin 5 of this gate, and V SYNC pulses are applied to pin 4. The logic of the exclusive OR gate causes the V SYNC pulse to be serrated by the H SYNC pulses. Serrating the V SYNC pulse keeps the horizontal oscillator of the TV monitor synchronized during vertical retrace. The output of the exclusive OR gate is sent to the video summing circuit and consists of a serrated vertical sync pulse (containing 14 serrations) followed by 248 horizontal sync pulses. Therefore, one field of the TV picture consists of 248 viewable lines. Since no interlace provisions are incorporated into the circuitry of the computer, successive fields are laid approximately on top of one another, resulting in a picture frame

that contains approximately 248 lines. This frame is repeated 30.04 times per second.

2-60. BALL MOTION

2-61. The ball image is created by intensifying the TV display at the intersection of narrow horizontal and vertical windows (Figure 2-1 Oa). The two windows are moved independent of each other by the ball direction and speed circuits. When the horizontal and vertical windows move at the same speed (Figure 2-10b), the ball will appear to travel across the display at a 45° angle. A faster vertical window speed (Figure 2-10c) will cause the ball to move faster in the horizontal direction and vice versa.

2-62. HORIZONTAL BALL MOTION

2-63. The horizontal ball motion circuit is almost identical in construction to the horizontal synchronization circuit. The major difference between the two circuits is that the counting process of the horizontal ball motion circuit can be controlled and it is this fact that is used to produce a counting differential between the sync circuit counting and the counting of the horizontal motion window.

2-64. This counting differential is used to create a window that has the appearance of moving across the CRT screen. If the window is created in a slightly different place during each TV field, the window appears to move in much the same way the illusion of movement is created on the movie screen by the film in the motion picture projector. Even though ball motion consists only of a series of shifted

ball images, the illusion of motion results from a combination of persistence of the image on the CRT phosphor and the persistence of the retinal after-image in the human eye. Thus, the human eye, unable to cope with the speed the ball image is shifted, interprets the information as real movement.

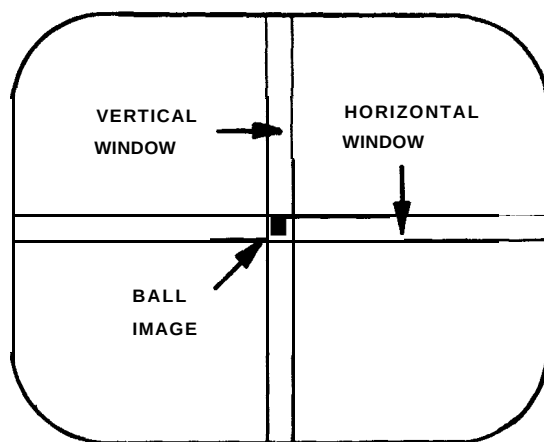
2-65. If the ball window signal occurs at the same frequency as the sync signal, the window appears in the same place each TV field. However, if the window signal that produces horizontal ball motion is delayed so that it counts one more clock pulse than horizontal sync, the window created in the next field is shifted one clock pulse to the right. If the signal is delayed yet another pulse, the resultant ball window is shifted two clock pulses to the right of the original position. The TV monitor electron beam sweeps 60 fields per second. If the vertical window is shifted one clock pulse per field, the ball will appear to move quite rapidly in the horizontal plane.

2-66. Horizontal ball motion direction is dependent on whether the horizontal motion signal is counted faster or slower than the horizontal sync signal. If it is counted at a faster rate (less clock pulses), the ball window will move left. If it is counted slower (more pulses), the window will move to the right. If it is counted at the same rate, the window does not shift either way. The velocity of the window motion is controlled by varying the distance the window is shifted per TV field. If the window is shifted one clock pulse per field, it appears to move half as fast as if it were shifted two clock pulses per field.

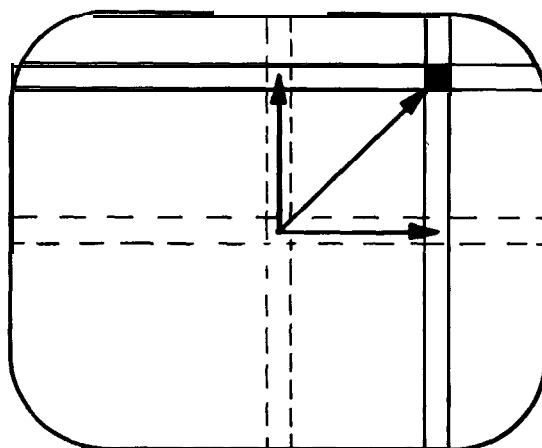
2-67. The horizontal motion circuit uses 9316 counters, which are almost identical to the 7493 counters of the horizontal sync circuit; the counters of both circuits are run in parallel by the same clock. The 7493 counters always start counting from zero. The count of the 9316, however, is started from a predetermined number. This predetermined number is generated by the ball direction and speed circuit and is known as the motion code. It is this binary motion code that produces the shift differential between the horizontal sync counting and the counting of the horizontal ball motion circuit.

2-68. VERTICAL BALL MOTION

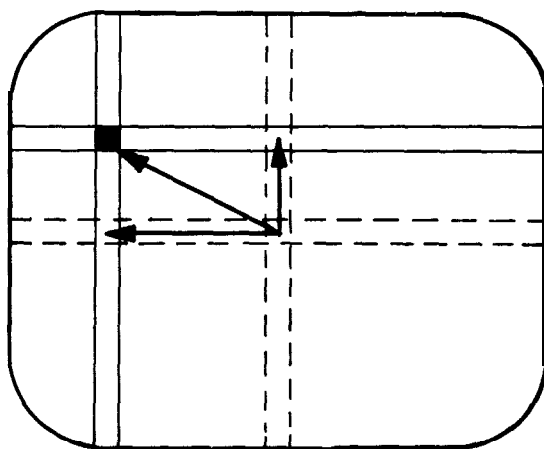
2-69. The vertical ball motion circuit is almost identical to the horizontal motion circuit with the following exceptions. This circuit creates a horizontal window that moves vertically and, therefore, different inputs are used. The electron beam is blanked out during its vertical retrace, so V BLANK is used to turn the electron beam on and off at the right times. H SYNC provides the clock for the counters so that the horizontal window is created after the right number of horizontal lines. This circuit does not use a J-K flip-flop as a ninth bit for the counter because the largest number it needs to count is 272. The horizontal motion counters need to count to 455.



a. Ball Still



b. Equal Window Speeds



c. Faster Vertical Window

(012A)

Figure Z-10. Ball Image Generation

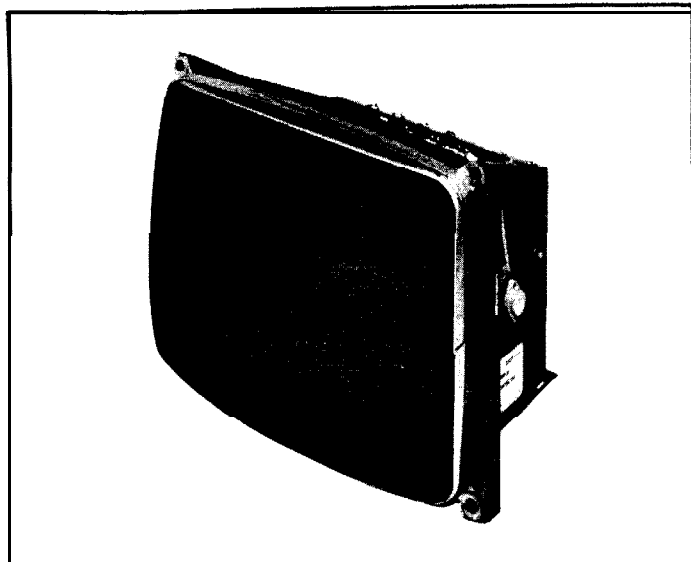


MOTOROLA

service manual

FILE VP11

VISUAL
DISPLAY PRODUCTS



CHASSIS

19VP102
C19VP102
23VP102

MODEL

XM500-10
XM500-11
XM700-10

GENERAL INFORMATION

These models are transistorized monitors designed for the video game market.

The chassis permits incorporation of optional operating control locations and provides support for the CRT.

Circuitry includes four stages of video amplification, a two stage audio amplifier, sync and deflection circuits and a regulated power supply. An additional 5 volt 1.5 amp supply is included to power external logic systems. The picture tube is a 110 degree deflection CRT with implosion protection. Composite video is fed to the monitor through a connector mounted on the rear of the chassis.

Rear panel controls include Horizontal Hold, Vertical Hold, Contrast, Brightness and Volume. The width control (on some models) is mounted on a bracket at the rear of the chassis. Additional service controls are mounted on the plated circuit panel, and are accessible from the rear of the chassis.

The chassis utilizes plug-in etched panel construction with components mounted on the top side and plated wiring on the bottom. Component reference numbers and circuit legend are printed on the board to aid in servicing. Horizontal, vertical output and regulator transistors plus regulator IC are mounted on two vertical side brackets which serve as a heat sink and CRT support.

ELECTRICAL SPECIFICATIONS

Power Rating: 80 watts nominal.

Source: 120/240V AC at 50/60 cycles.

Video Input: 0.5 to 2.5 volts composite PP (sync negative).

Audio Output: 5 watts peak.

CAUTION

NO WORK SHOULD BE ATTEMPTED ON ANY EXPOSED MONITOR CHASSIS BY ANYONE NOT FAMILIAR WITH SERVICING PROCEDURES AND PRECAUTIONS.

MODEL BREAKDOWN CHART

MODEL	CHASSIS	LINE VOLTAGE & FREQ	CRT	INPUT IMPEDANCE
XM500-10	19VP102	Wired for 120V AC 60 cycle	See V1 in Replacement Parts List	-
XM500-11	C19VP102	Switch selected 120/240V AC at 50/60 cycles		1.5K
XM700-10	23VP102			470n

TABLE OF CONTENTS

CHASSIS PARTS	
LOCATION	8,9,10
CHASSIS SCHEMATIC	
DIAGRAMS	11,12,13
REPLACEMENT PARTS	
LISTS	14-18
SAFETY WARNING : : : .	2
SERVICENOTES	7
THEORY OF	
OPERATION	3

SAFETY WARNING

CAUTION: NO WORK SHOULD BE ATTEMPTED ON AN EXPOSED MONITOR CHASSIS BY ANYONE NOT FAMILIAR WITH SERVICING PROCEDURES AND PRECAUTIONS.

1. SAFETY PROCEDURES should be developed by habit so that when the technician is rushed with repair work, he automatically takes precautions.

2. A GOOD PRACTICE, when working on any unit, is to first ground the chassis and to use only one hand when testing circuitry. This will avoid the possibility of carelessly putting one hand on chassis or ground and the other on an electrical connection which could cause a severe electrical shock.

3. Extreme care should be used in HANDLING THE PICTURE TUBE as rough handling may cause it to implode due to atmospheric pressure (14.7 lbs. per sq. in). Do not nick or scratch glass or subject it to any undue pressure in removal or installation. When handling, safety goggles and heavy gloves should be worn for protection. Discharge picture tube by shorting the anode connection to chassis ground (not cabinet or other mounting parts). When discharging, go from ground to anode or use a well insulated piece of wire. When servicing or repairing the monitor, if the cathode ray tube is replaced by a type of tube other than that specified under the Motorola Part Number as original equipment in this Service Manual, then avoid prolonged exposure at close range to unshielded areas of the cathode ray tube. Possible danger of personal injury from unnecessary exposure to X-ray radiation may result.

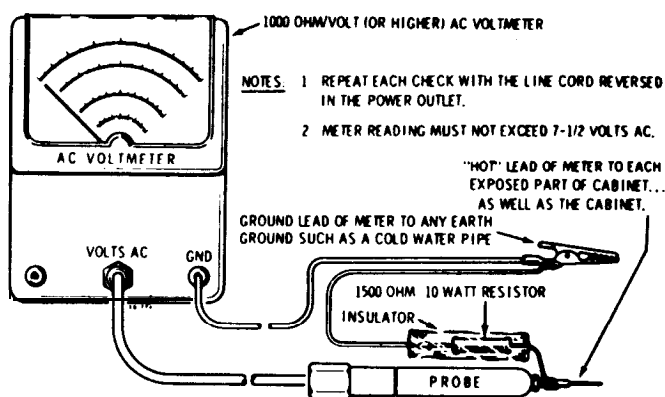
4. An ISOLATION TRANSFORMER should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect the chassis and its components from being damaged by accidental shorts of the circuitry that may be inadvertently introduced during the service operation.

5. Always REPLACE PROTECTIVE DEVICES, such as fishpaper, isolation resistors and capacitors and shields after working on the unit.

6. If the HIGH VOLTAGE is adjustable, it should always be ADJUSTED to the level recommended by the manufacturer. If the voltage is increased above the normal setting, exposure to unnecessary X-ray radiation could result. High voltage can accurately be measured with a high voltage meter connected from the anode lead to chassis.

7. BEFORE RETURNING A SERVICED UNIT, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock. DO NOT USE A LINE ISOLATION TRANSFORMER WHEN MAKING THIS TEST.

In addition to practicing the basic and fundamental electrical safety rules, the following test, which is related to the minimum safety requirements of the Underwriters Laboratories should be performed by the service technician before any unit which has been serviced is returned.



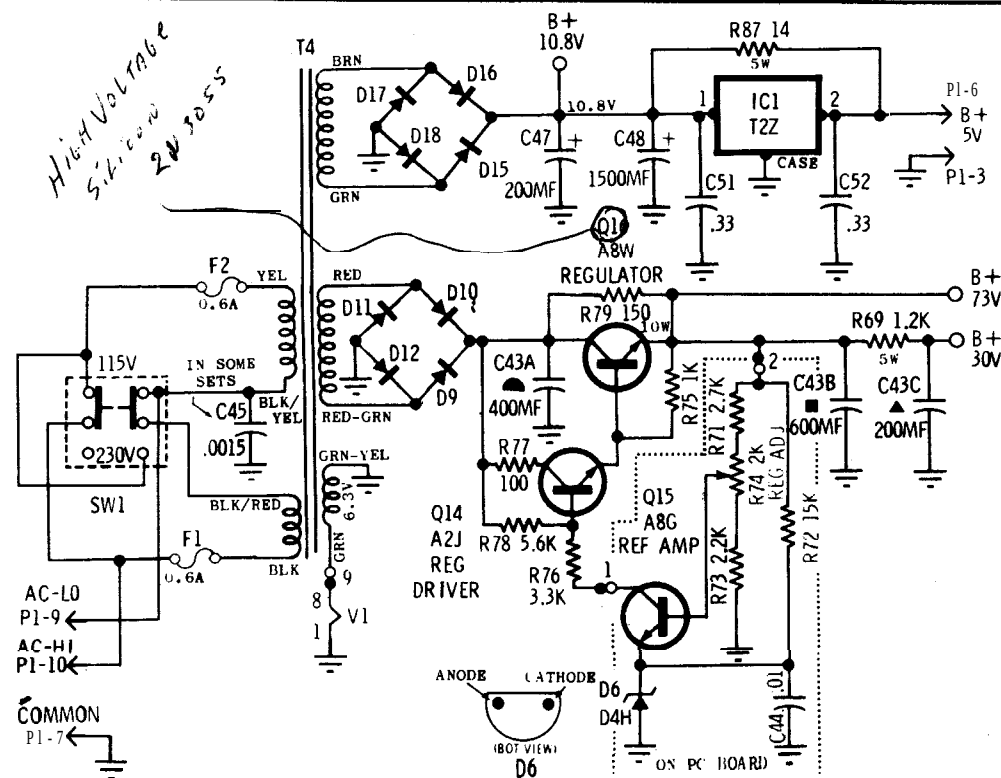
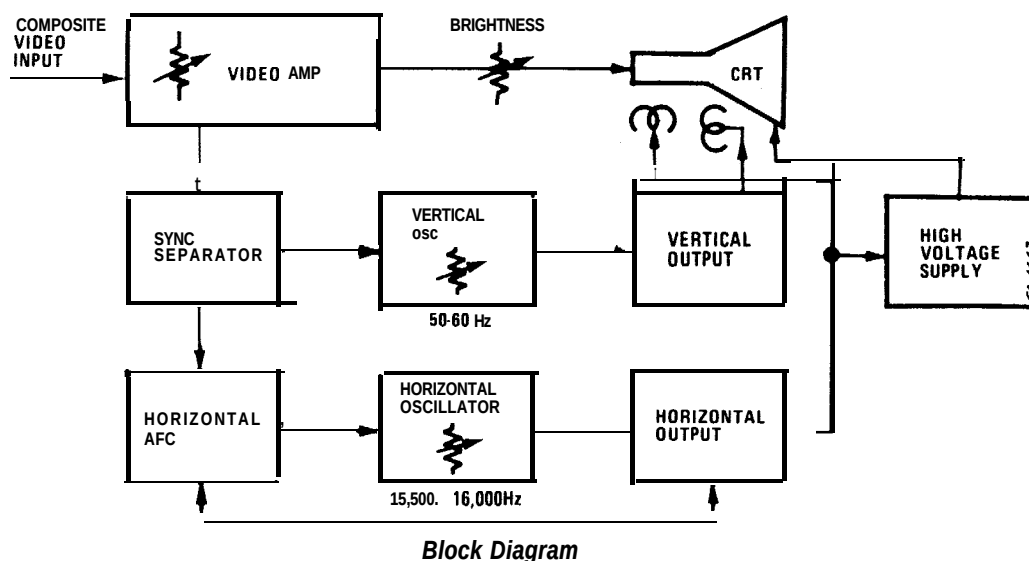
Voltmeter Hook-up for Safety Check.

A 1000 ohm per volt AC voltmeter is prepared by shunting it with a 1500 ohm, 10 watt resistor. The safety test is made by contacting one meter probe to any portion of the unit exposed to the operator such as the cabinet trim, hardware, controls, knobs, etc., while the other probe is held in contact with a good "earth" ground such as a cold water pipe.

The AC voltage indicated by the meter may not exceed 7½ volts. A reading exceeding 7½ volts indicates that a potentially dangerous leakage path exists between the exposed portion of the unit and "earth" ground. Such a unit represents a potentially serious shock hazard to the operator.

The above test should be repeated with the power plug reversed, when applicable.

NEVER. RETURN A MONITOR which does not pass the safety test until the fault has been located and corrected.



POWER SUPPLY

The power supply is a transformer operated, full wave, regulated supply which maintains constant output voltage with input variations of $\pm 15\%$. A switch (SW1) is provided to allow operation from 115/230 volts, 50/60Hz. The regulator is a series pass circuit. Q16 is the series pass transistor, Q15 the reference amplifier and Q14 the output driver.

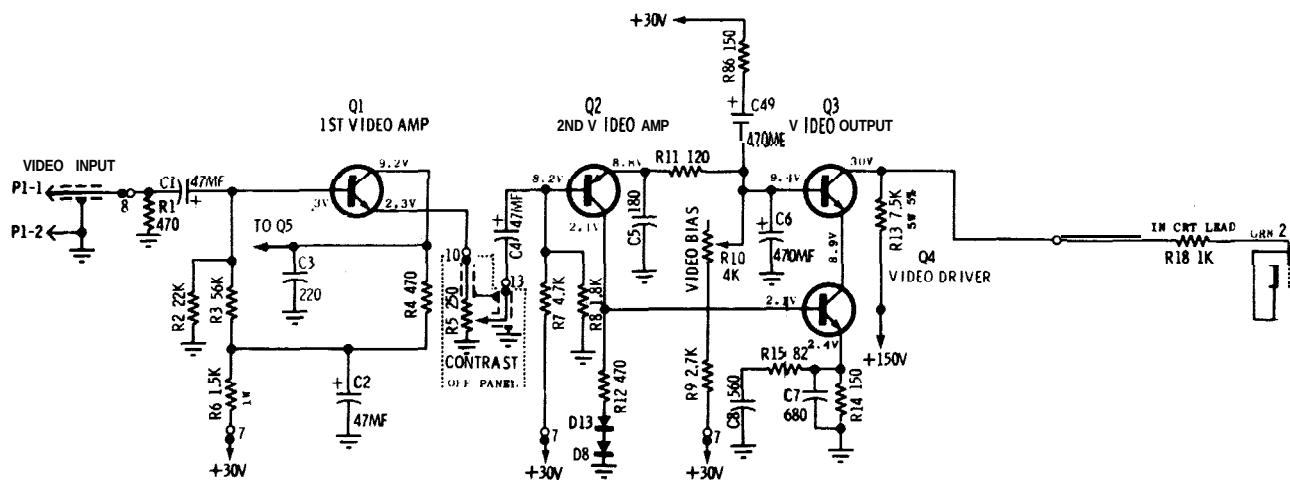
The output voltage of the regulator appears at the emitter of Q16. This voltage is divided between R71, R74 and R73. The voltage appearing on the arm of potentiometer R74 is a reference input to the base of Q15.

A temperature compensated zener diode (D6) is used to establish a fixed reference voltage at the emitter of Q15. R72 provides a bias current for D6, establishing its operating point.

An increase in output voltage will result in an increase of voltage at the base of Q15. Since the emitter of Q15 is held at a fixed reference voltage, the change in base voltage will turn Q15 on harder, reducing its collector voltage. This reduces forward bias for Q14 resulting in less emitter current and less base current for Q16. Q16 will conduct less, lowering the output voltage.

R79 provides a shunt current path for Q16 allowing it to run cooler, improving reliability. C44 is an RF noise filter.

A regulated 1.5 amp, 5V DC supply is used to power circuits external from the monitor. Its operation is similar to the 73V regulator except all of the circuitry is contained in one IC package.



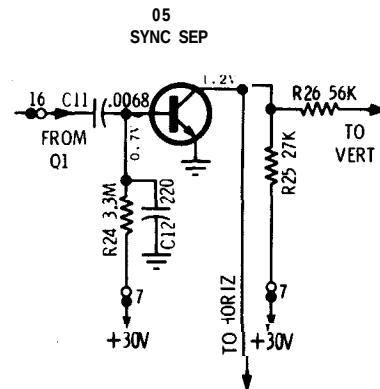
VIDEO AMPLIFIER

The video amplifier has four stages incorporating devices Q1, Q2, Q3 and Q4. The first stage, Q1, functions as an emitter follower. The low output impedance of the first stage permits use of a low resistance contrast control which furnishes flat video response over its entire range without the need for compensation. The collector output of Q1 is used to drive the sync separator. C3 provides high frequency roll off to limit the collector output to the bandwidth required to pass synchronization signals. Q2 is a common emitter stage and is directly coupled to Q4. Q3 and Q4 are connected in a cascode configuration. This common emitter-common base connection greatly reduces the effect of Miller capacity compared with a conventional single transistor video output stage. C6 provides a ground for video at the base of Q3, the grounded base transistor of the video output cascode pair. Diodes D13 and D8 provide temperature compensation for the video output stages.

The video bias control R10, is used to set the quiescent collector voltage of Q3. C5, C7, C8 and R15 are used for high frequency compensation. The video amplifier output is direct coupled to the control grid of the CRT through R18 which is used to isolate Q3 from transients that may occur as a result of CRT arcing.

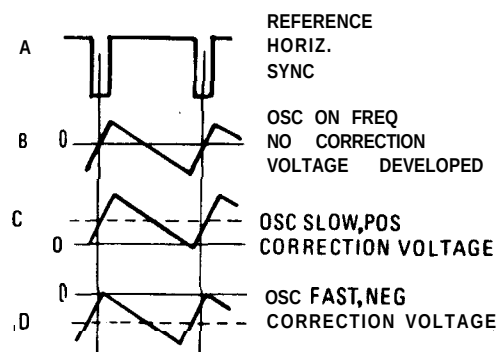
SYNC SEPARATOR

The sync separator employs a single stage, Q5, to recover sync from the composite video signal. A single stage sync separator is adequate due to the high impedance of the following stages. The video input to the sync separator is black positive. C1 1 is charged by the peak base current that flows when the positive peak of the input takes Q5 to saturation. This charge depends on the peak to peak input to Q5 and thus makes the bias for Q5 track the amplitude of the input signal. As a result Q5 amplifies only the positive peaks of the input signal. The initial bias current through R24 sets the clipping level.



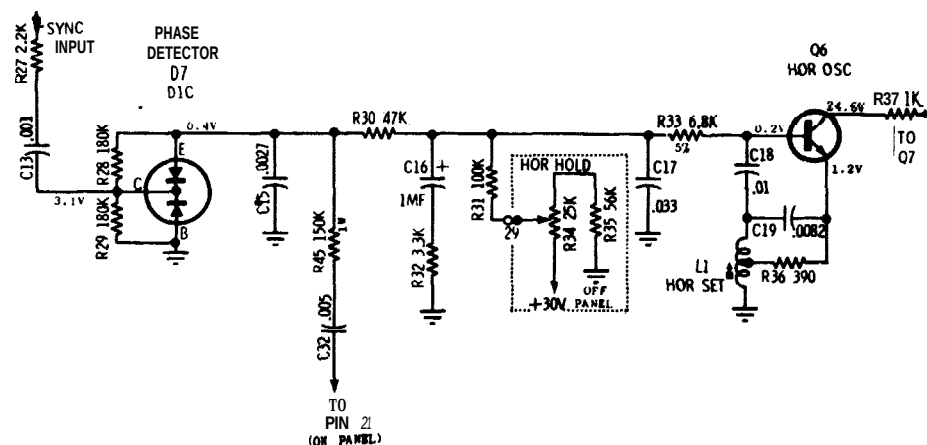
PHASE DETECTOR

The Phase Detector consists of two diodes in a keyed clamp circuit. Two inputs are required to generate the required output, one from the sync separator and one from the horizontal deflection system. The required output must be of the correct polarity and amplitude to correct phase differences between the input sync and the horizontal time base. The horizontal collector pulse is integrated into a sawtooth by R45 and C15. During sync time both diodes in D7 conduct, shorting C15 to ground.



The sawtooth on C15 is thus clamped to ground at sync time. If the horizontal time base is in phase with the sync, the sync pulse will occur when the sawtooth is passing through its AC axis and the net charge on C15 will be zero. (Figure B). If the horizontal time base is lagging the sync, the sawtooth on C15 will be clamped to ground at a point negative from the AC axis. This will result in a positive DC charge on C15. (Figure C). This is the correct polarity to cause the horizontal oscillator to speed up to correct the phase lag.

Likewise, if the horizontal time base is leading the sync, the sawtooth on C15 will be clamped at a point positive from its AC axis, resulting in a net negative charge on C15 which is the required polarity to slow the horizontal oscillator (Figure D). R30, C17, C16 and R32 comprise the phase detector filter. The bandpass of this filter is chosen to provide correction of horizontal oscillator phase without ringing or hunting.

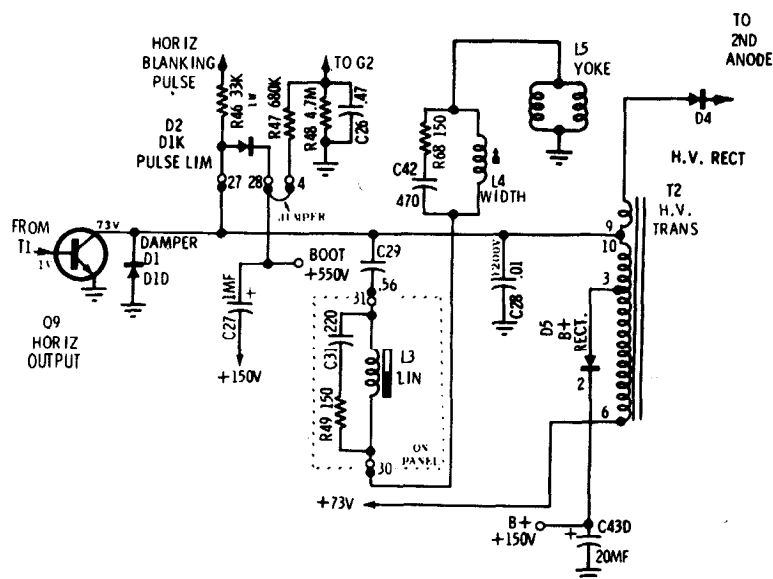
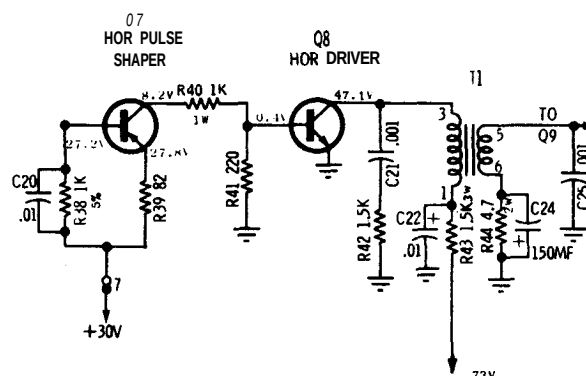


HORIZONTAL OSCILLATOR

Q6 is employed in a modified type of Hartley oscillator. The operating frequency of this oscillator is sensitive to its base input voltage. This permits control by the output of the phase detector and also by the setting of the horizontal hold control, R34. The horizontal hold range is set by adjustment of the core of L1.

PULSE SHAPER & HORIZONTAL DRIVER

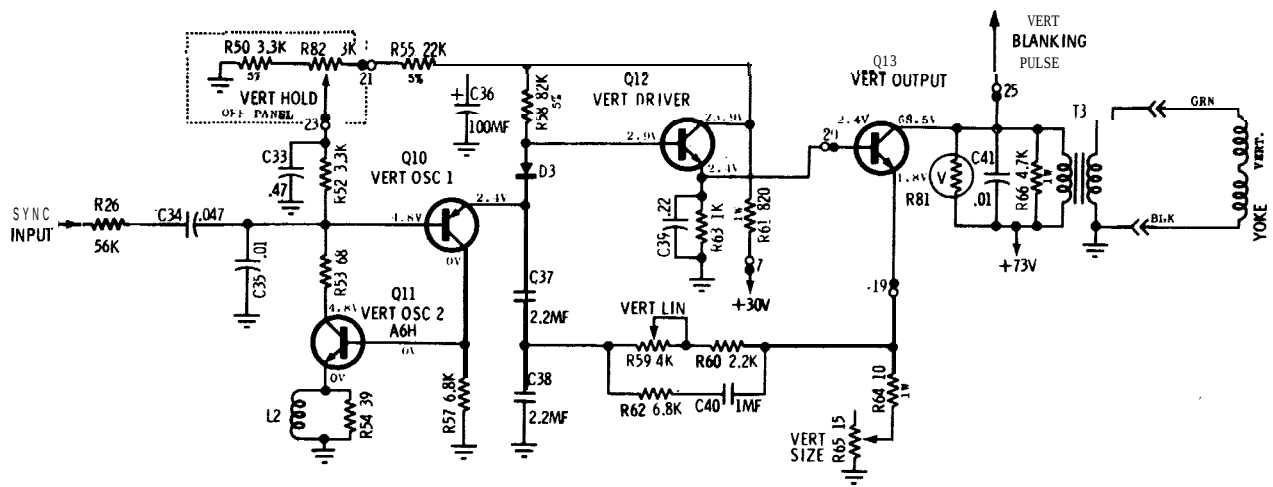
Q7 is used as a buffer stage between the horizontal oscillator and the horizontal driver. It provides isolation for the horizontal oscillator as well as a low impedance drive for the horizontal driver. R38 and C20 form a time constant which shapes the oscillator output to the required duty cycle (approximately 50%), to drive the horizontal output circuitry. The horizontal driver stage, Q8 operates as a switch to drive the horizontal output transistor through T1. Because of the low impedance drive and fast switching times furnished by Q7, very little power is dissipated in Q8. C21 and R42 provide damping to suppress ringing of the primary of T2 when Q8 goes into cutoff.



HORIZONTAL OUTPUT

The secondary of T1 provides the required low drive impedance for Q9. R44 and C24 form a time constant for fast turn-off of the base of Q9. Q9 operates as a switch which, once each horizontal period, connects the supply voltage across the parallel combination of the horizontal deflection yoke and the primary of T2. The required sawtooth of deflection current through the horizontal yoke is formed by the L-R time constant of the yoke and output transformer primary. The horizontal retrace pulse charges C27 through D2 to provide operating voltage for G2 of the CRT. Momentary transients at the collector of Q9, should they occur, are limited to the voltage on C27 since D2 will conduct if the collector voltage exceeds this value.

The damper diode, D1, conducts during the period between retrace and turn on of Q9. C28 is the retrace tuning capacitor. C29 blocks DC from the deflection yoke. L3 is a magnetically biased linearity coil which shapes deflection current for optimum trace linearity. L4 is a series width control. C31 and R49, C42 and R68 are damping network components for the linearity and width controls. C43D is charged through D5 developing the video supply voltage.

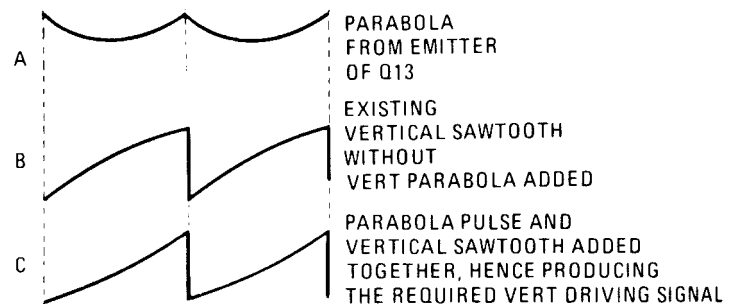


VERTICAL OSCILLATOR DRIVER AND OUTPUT

Sync from the collector of Q5 is integrated by R26 and C35. Q10 and Q11 are connected as a regenerative switch. The series combination of C37 and C38 charges through R58 and D3 until Q10 turns on. This occurs when the emitter of Q10 exceeds its base voltage and causes current to flow into the base of Q11, turning that device on. When Q10 and Q11 conduct, C37 and C38 are discharged to nearly zero. Q10 and Q11 then shut off and the cycle repeats. The setting of R82 determines the repetition rate of the charge and discharge of C37 and C38. The waveform generated is a positive going ramp or sawtooth with a fast retrace to zero. D3 provides a small incremental voltage above ground to overcome the forward base-emitter drop of the two following stages. Q12 is an emitter follower used to transform the high impedance drive sawtooth to a low impedance drive for Q13.

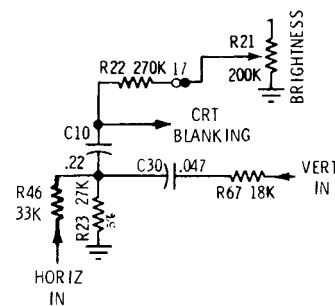
T3 matches the collector of Q13 to the vertical yoke. When Q13 is cut off during vertical retrace, a high voltage pulse is developed across the primary of T3. To limit this pulse to a safe value a varistor, R81, is connected across the primary. R66 and C41 provide damping to shape the collector pulse so it may be used for retrace blanking. Since the primary impedance of T3 decreases with current, the degree to which the primary shunts the reflected load impedance varies with collector current. This would result in severe vertical non-linearity unless some compensation is employed.

Resistors R59 and R60 couple the emitter voltage of Q13 to the junction of C37 and C38. Since this path is resistive, the waveform coupled back will be integrated into a parabola by C38. This results in a pre-distortion of the drive sawtooth as shown in Figure C. This is done to compensate for the non linear charging of C37 and C38 and the changing impedance of the primary of T3. An additional feedback path through R62 and C40 serves to optimize the drive waveshape for best linearity.



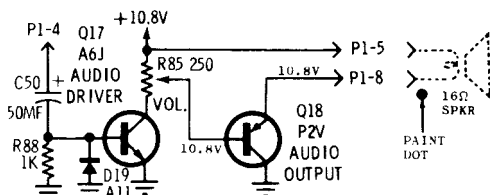
RETRACE BLANKING

Both vertical and horizontal retrace blanking are provided by positive pulses applied to the CRT cathode. The collector pulse from the horizontal output transistor is placed across R23 through R46. The vertical collector voltage is differentiated by C30 to remove the sawtooth portion of the waveform. The remaining pulse appears across R23. The mixed vertical and horizontal pulses on R23 are coupled to the CRT cathode by C10.



AUDIO AMPLIFIER

Q17 and Q18 form a DC coupled "switching tone burst amplifier". An input signal biases Q17 on, in turn driving Q18 into conduction. When the signal is removed both stages return to a quiescent mode. Coupling capacitor C50, diode D19 and resistor R88 establish a bias voltage which is signal dependent. Volume control R85 sets the peak to peak level for the output stage.



ETCHED BOARD CIRCUIT TRACING

-Component reference numbers are printed on top and bottom of the plug-in circuit board to facilitate circuit tracing. In addition, control names and board terminal numbers are also shown and are referenced on the chassis schematic diagram in this manual.

Transistor elements are identified as follows: E — emitter, B — base, and C — collector

COMPONENT REMOVAL

Removing components from the etched board is facilitated by the fact that the circuitry (plating) appears on one side of the board only and the component leads are inserted straight through the holes and are not bent or crimped.

It is recommended that a solder extracting gun be used to aid in component removal. An iron with a temperature controlled heating element would be desirable since it would reduce the possibility of damaging the board due to over-heating.

The nozzle of the soldering gun is inserted directly over the component lead and when sufficiently heated, the solder is drawn away leaving the lead free from the copper plating. This method is particularly suitable in removing multi-terminal components.

NOTE: Misadjustment of the low voltage regulator, or the horizontal oscillator may result in damage to the Horizontal Output Transistor or pulse limiter diode. The following procedures are recommended to insure reliable operation.

REGULATOR ADJUSTMENT

1. Connect monitor to AC line supply. Adjust supply to 120 volts (240 on some models).
2. Apply test signal to proper input. Signal should be of same amplitude and sync rate as when monitor is in service.
3. Adjust vertical and horizontal oscillator controls until display is synced.
4. Connect a DC digital voltmeter or other precision accuracy voltmeter to the emitter of the regulator output transistor, (or any 73 volt test point).
5. Adjust the regulator control R74, on circuit board for an output of 73 volts. Do not "run" the regulator control through its range or damage to the monitor may result.
6. When adjustment is complete, the AC line supply can be varied between 105 and 130 volts to check for proper regulator operation. With regulator operating properly, changes in display size should be negligible.

HORIZONTAL OSCILLATOR ADJUSTMENT

1. Set the horizontal hold potentiometer to mid-range (R34).
2. Adjust core of horizontal hold coil L1 until the horizontal blanking lines are vertical.
3. Rotate potentiometer R34 through its full range. Display should go out of sync in each direction and hold in sync at the center of its range. Retouch L1 as necessary to center the hold range.

VIDEO AMPLIFIER BIAS ADJUSTMENT

Adjust video bias control R10 for 30 volts DC on collector of video output transistor Q3 with no signal input.

Disconnect cable from video input jack if necessary to eliminate noise.

POWER TRANSISTOR REPLACEMENT

When replacing any "plug-in" transistor, i.e., the horizontal or vertical output, please observe the following precautions:

1. The transistor sockets are not "Captive", that is, the transistor mounting screws also secure the socket. When installing the transistor, the socket must be held in its proper location. This location is indicated by flanges on the socket which fit into

the heat sink.

2. When replacing the output transistors, silicone grease (Motorola Part No. 11M490487) should be applied evenly to both sides of the mica insulator.

3. All transistor mounting screws must be tight before applying power to the receiver. This insures proper cooling and electrical connections.

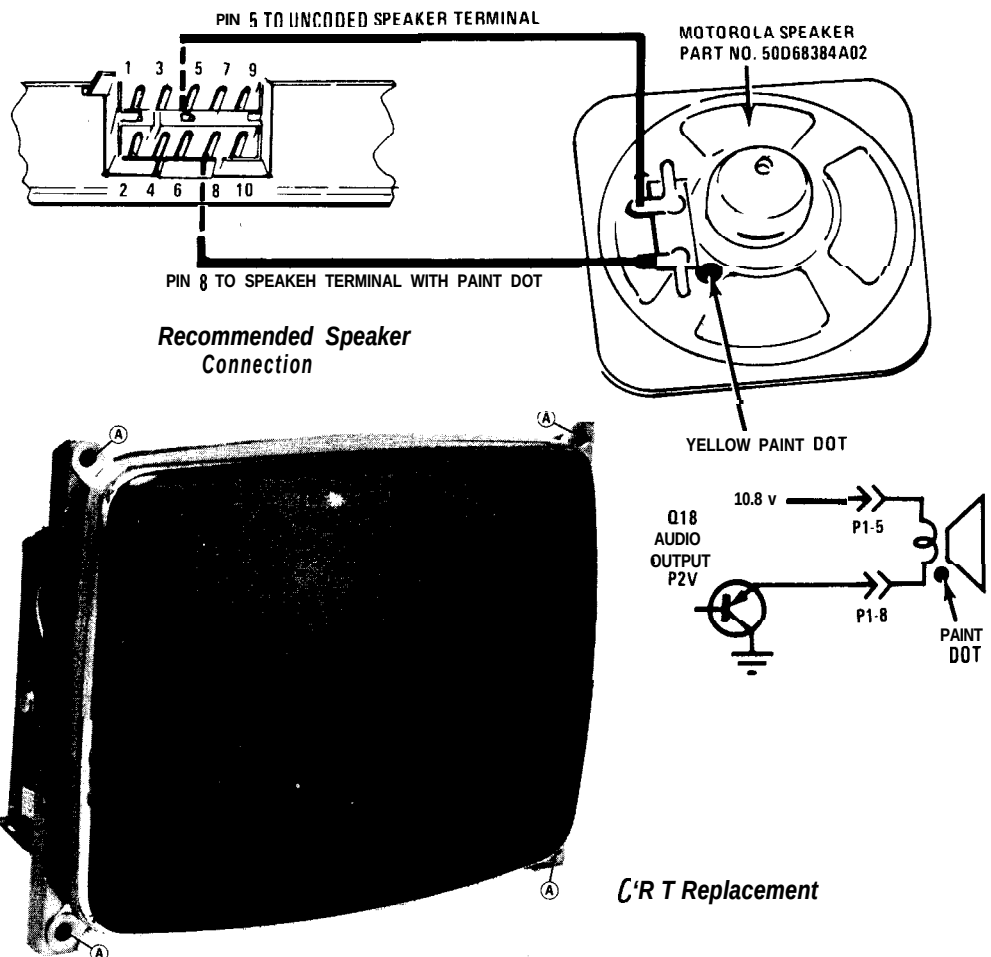
NON-COMPLIANCE WITH THESE INSTRUCTIONS CAN RESULT IN FAILURE OF THE TRANSISTOR AND/OR ITS RELATED COMPONENTS.

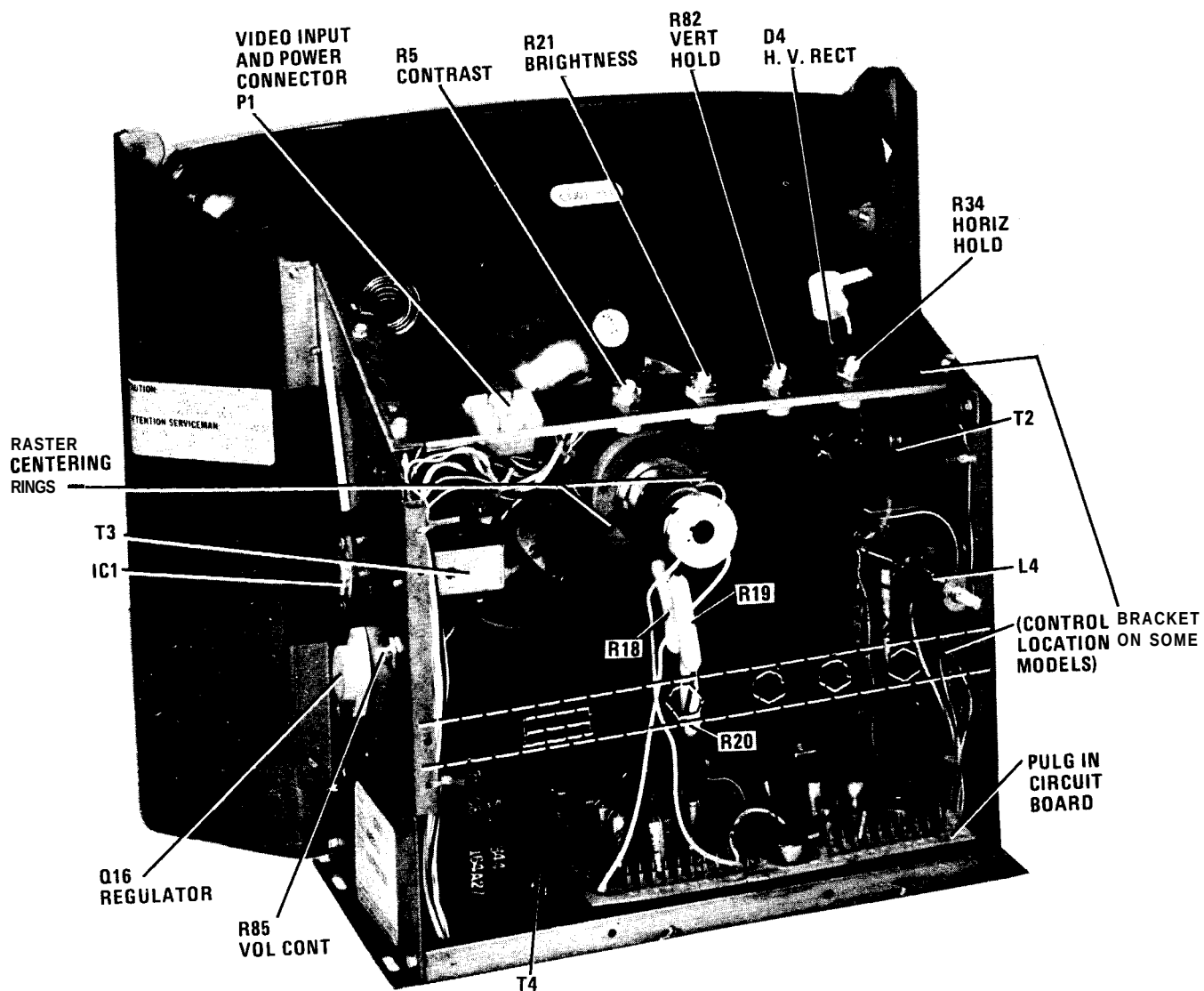
NOTE: Use caution when tightening transistor mounting screws. If the screw threads are stripped by excessive pressure, a poor electrical and mechanical connection will result.

CRT REPLACEMENT

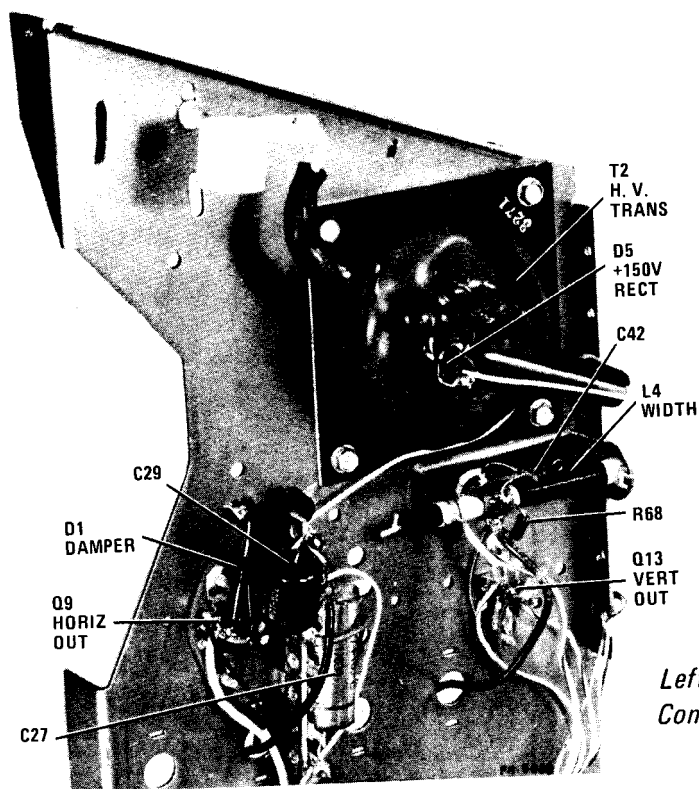
Use extreme care in handling the CRT as rough handling may cause it to implode due to atmospheric pressure. Do not nick or scratch glass or subject it to any undue pressure in removal or installation. Use goggles and heavy gloves for protection.

1. Discharge CRT by shorting 2nd anode to GND. Remove CRT socket, yoke and 2nd anode lead.
2. Remove CRT from chassis by removing four screws (A) at corners.

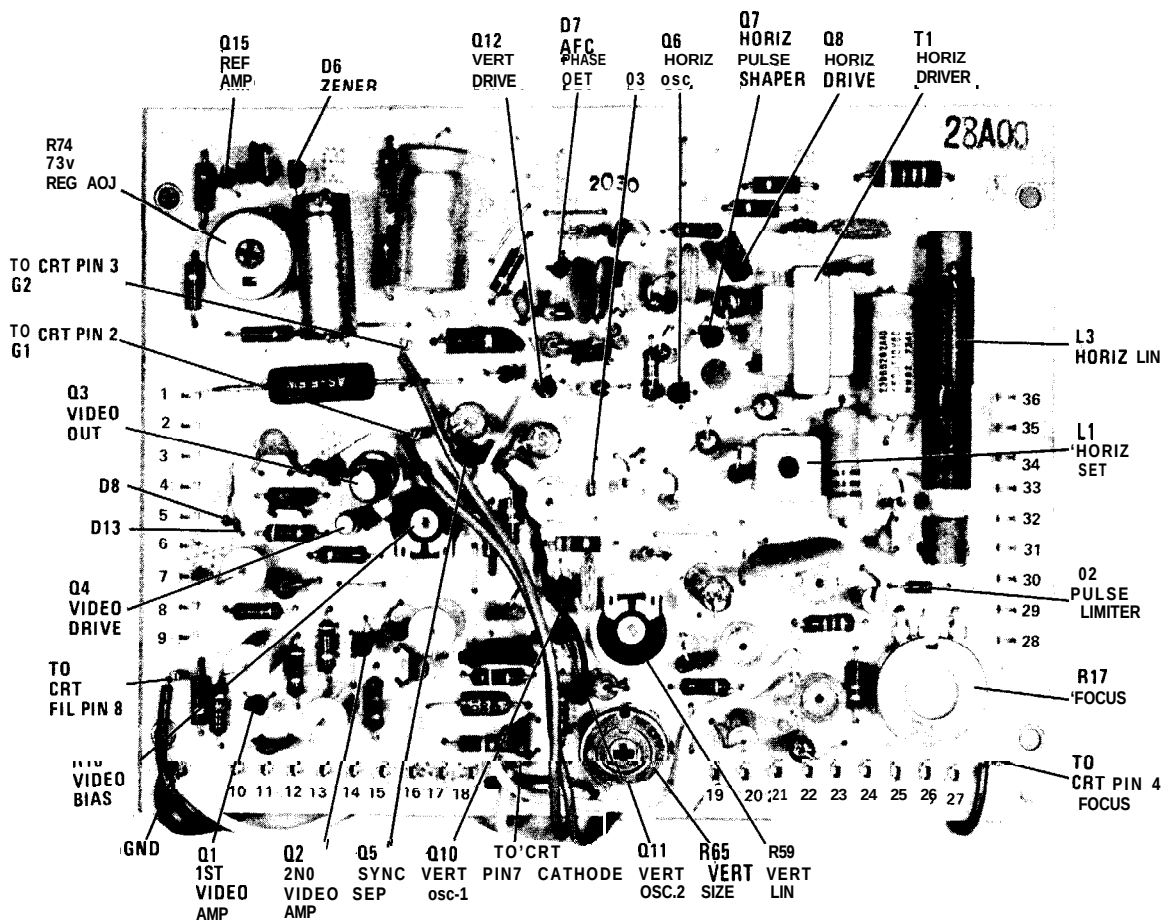




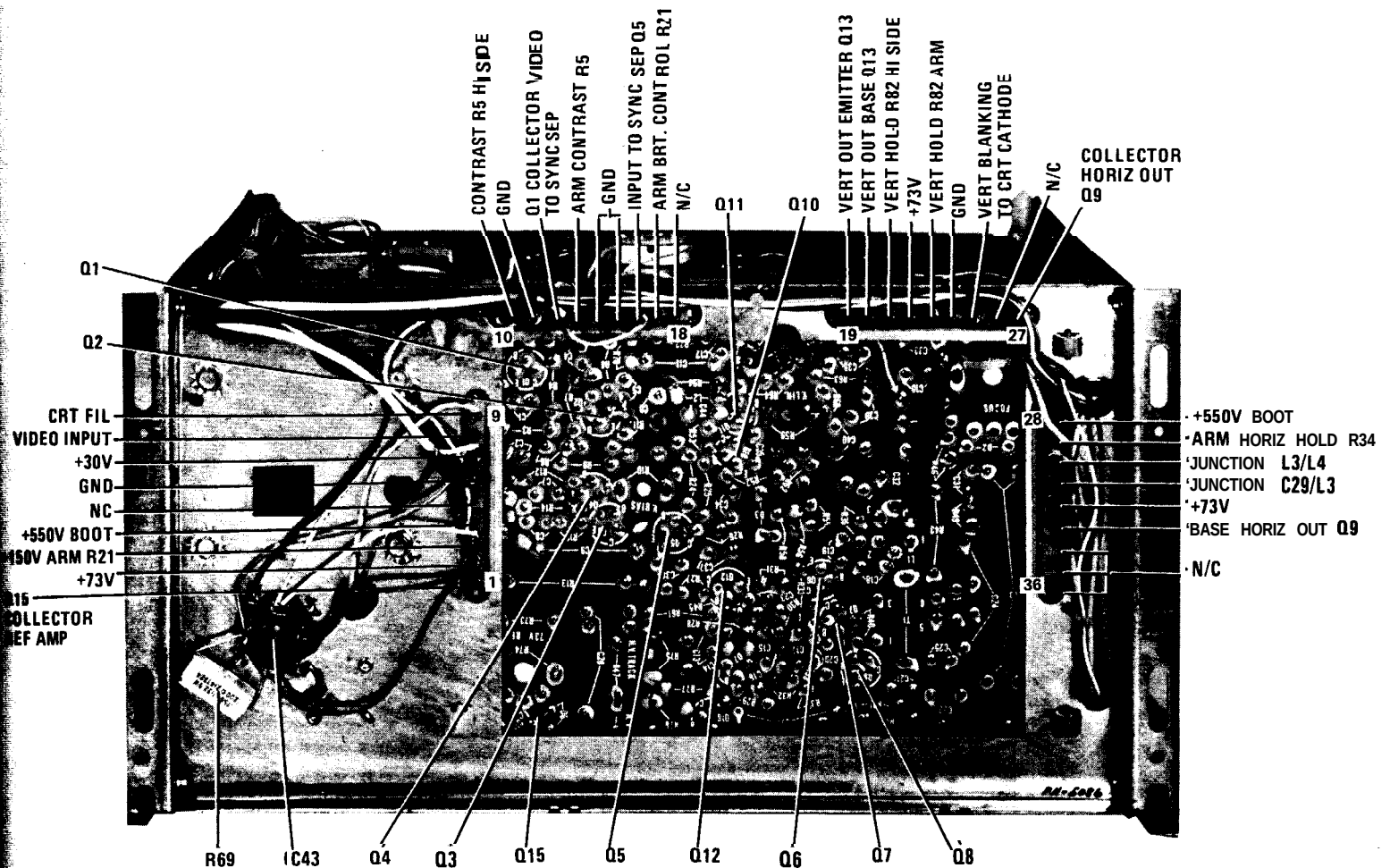
Chassis Rear View - Component Location



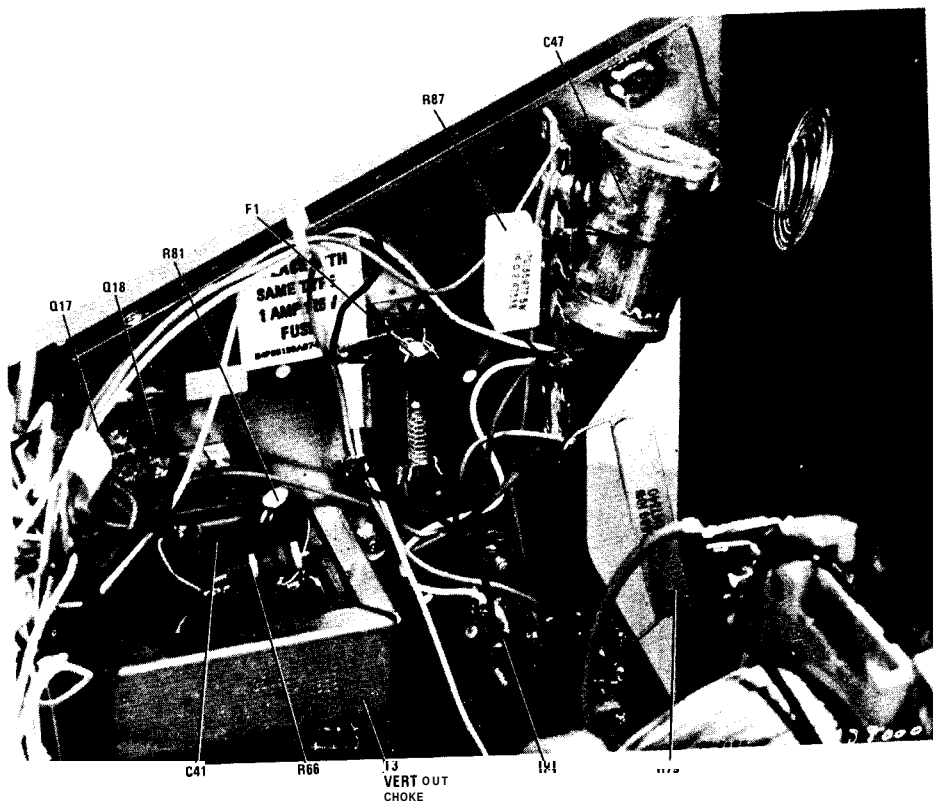
Left Side Panel - Component Location



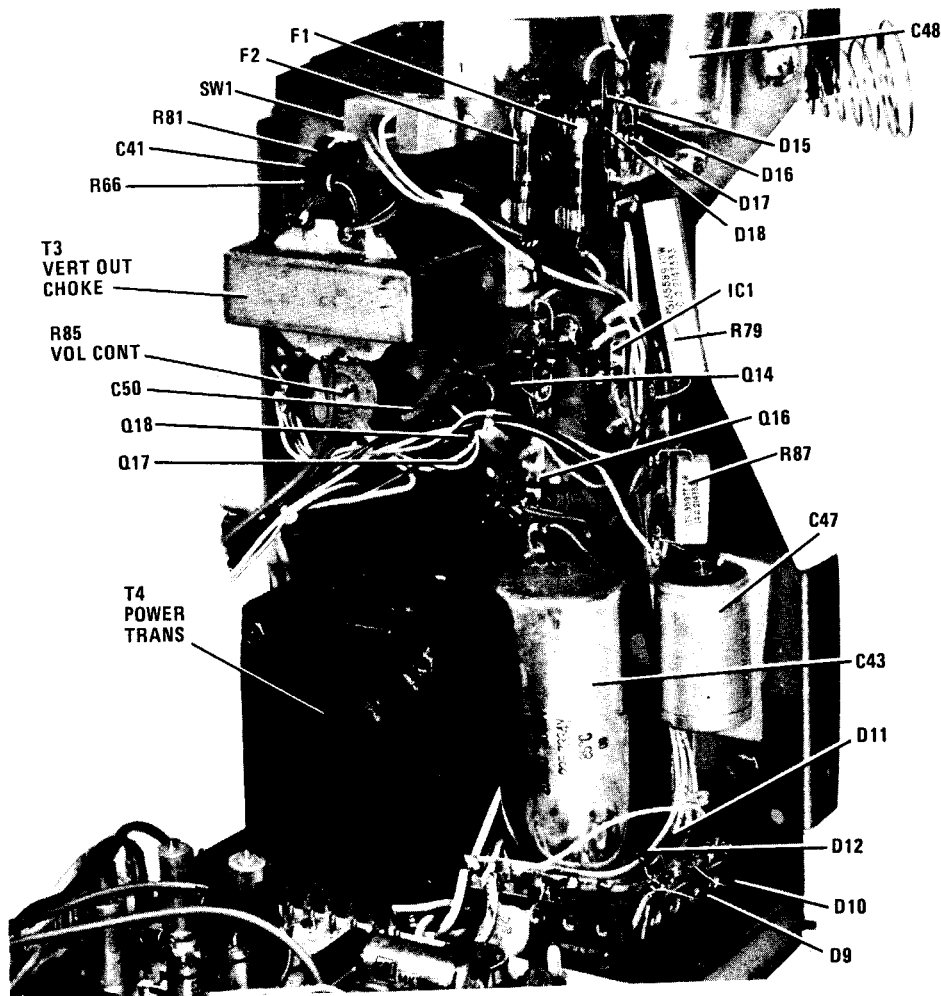
Circuit Board Top View - Component and Terminal Location



Chassis and Circuit Board Bottom View - Component and Terminal Location

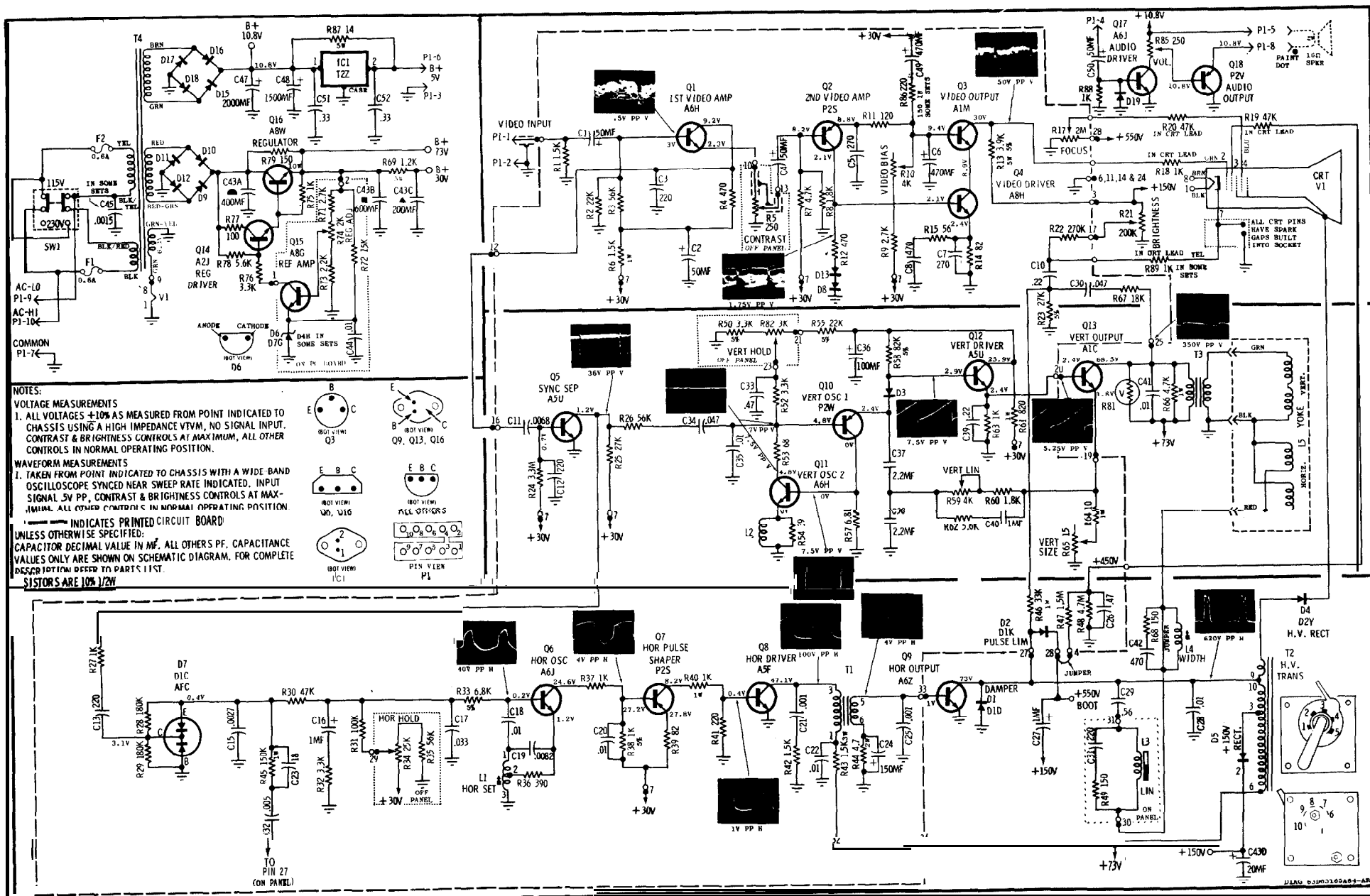


MODEL XM500-10 *Right Side Panel – Component Location*

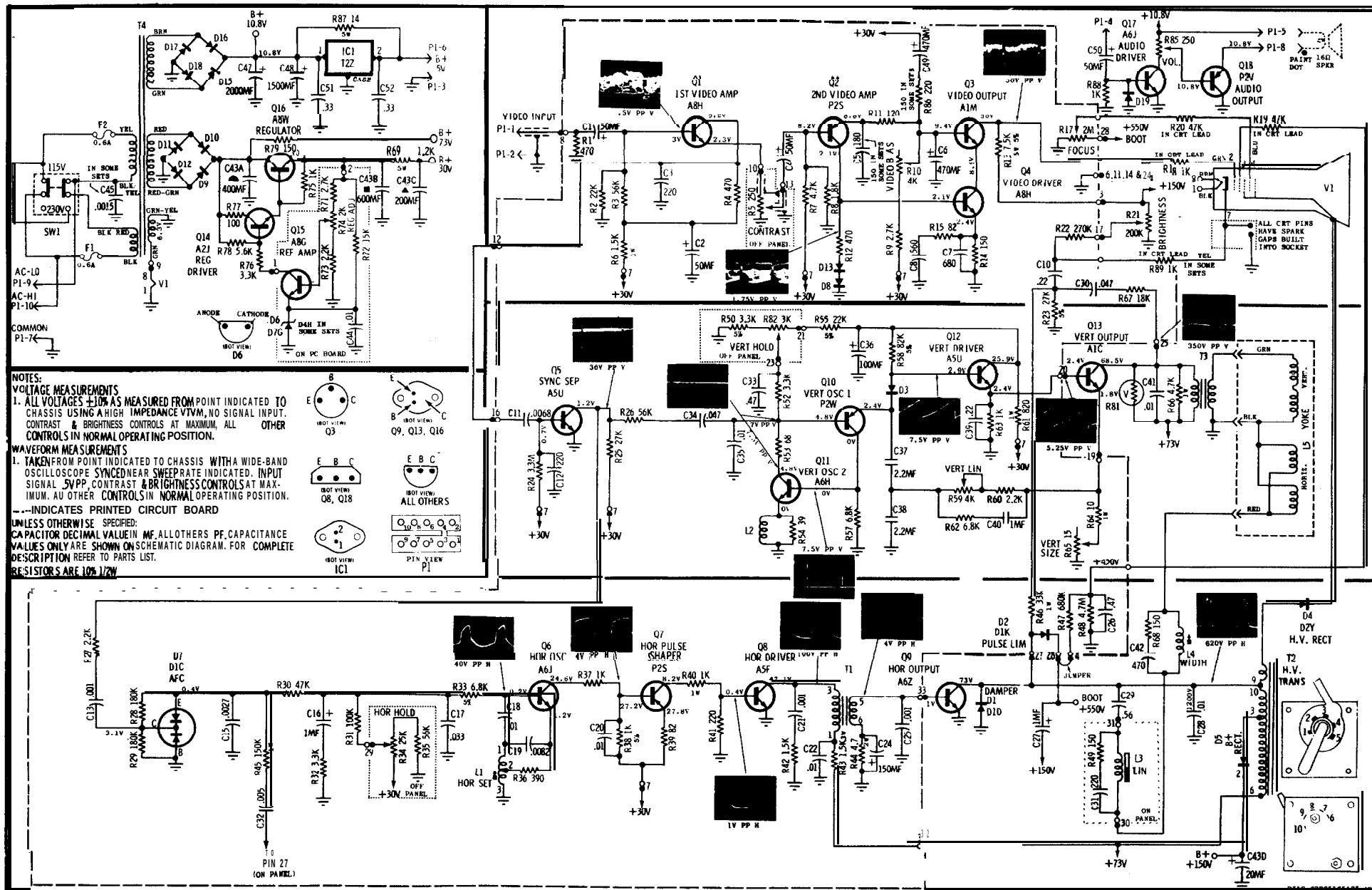


MODEL XM500-11 *Right Side Panel – Component Location*
XM700-10





Model XM500-11 Schematic Diagram



Model XM700-10 Schematic Diagram

REPLACEMENT PARTS LIST **MODEL XM500-10-CHASSIS 19VP102**

REF. NO.	PART NUMBER	DESCRIPTION	REF. NO.	PART NUMBER	DESCRIPTION
ELECTRICAL PARTS			COILS & CHOKES		
	1Y25016A75	MONITOR PANEL: "V24A"; complete KT321KM	L1	24D68822A08	HORIZ SET
CAPACITORS			L2	24D68801A67	COMPENSATING: 2000 mh
C1	23C65282A41	50 mf 50V Lvtic	L3	24D69163A18	HORIZ LINEARITY
C2	23C65282A41	50 mf 50V Lvtic	L4	24V25000A74	HORIZ WIDTH: incl's C42 & R68
C3	21S180D10	220 pf 20% 100V X5F (Use 21R132503)	L5	24D68523A15	DEFLECTION YOKE
C4	23C65282A41	50 mf 50V Lvtic	TRANSISTORS		
C5	21S180E78	270 pf 10% 500V X5F	31	48S137171	1ST VIDEO: A6H
C6	23S10255A78	470mf 16V Lvtic	Q2	48S137127	2ND VIDEO: P2S
C7	21S180E78	270 pf 10% 500V X5F	Q3	48S134919	VIDEO OUTPUT: A1M
C8	21S180E53	470 pf 10% 500V X5F	Q4	48S137317	VIDEO DRIVER: A8H
C10	8S10191B67	.22 mf 10% 250V polyester	Q5	48S137115	SYNC SEPARATOR: A5U
C11	8S10191A59	.022 mf 10% 1 oov polyester	a6	48S137172	HORIZ OSCILLATOR: A6J
C12	21S180D10	220 pf 20% 100V X5F (Use 21 R 132503)	Q7	48S137127	HORIZ PULSE SHAPER: P2S
C13	21S180E51	.001 mf 10% 500V X5F	Q8	48S137093	HORIZ DRIVER: A5F
C15	21S180C41	.0027 mf 10% 500V Z5F (Use 21K121699)	oo	48S134995	HORIZ OUTPUT: A6Z
C16	23S10229A07	1.0 mf +40-20% 15V Lvtic (Use 23C43280A17)	Q10	48S137173	VERT OSCILLATOR (1): P2W
C17	8S10191890	.033 mf 10% 160V polyester	Q11	48S137171	VERT OSCILLATOR (2): A6H
C18	8S10299A73	.01 mf 10% 100V poly carb	a12	48S137115	VERT DRIVER: A5U
C19	8S10299A74	.0082 mf 10% 160V poly carb	Q13	48S134900	VERT OUTPUT: A1C
C20	8S10191898	.01 mf 10% 250V polyester	Q14	48S134952	REGULATOR DRIVER: A2J
C21	21S180B51	.001 mf 10% 500V X5F	o15	48S137315	REFERENCE AMP: A8G
C22	8S10191B98	.01 mf 10% 160V polyester	Q16	48S137368	REGULATOR: A8W
C24	23D65282A40	150mf 10V Lvtic	a17	48S137172	AUDIO DRIVER: A6J
C25	21S180E51	.001 mf 10% 500V X5F	Q18	48S137168	AUDIO OUTPUT: P2V
C26	8S10212B53	.47 mf 10% 630V mtiz poly	CONTROLS		
C27	8S10212A11	1.0 mf 10% 630V mtiz poly	R5	18D68222A34	CONTRAST: 250 ohms
C28	8S10571A05	.008 mf 5% 1200V	R10	18D66401A54	VIDEO BIAS: 4K
C29	8S10212D33	.56 mf 10% 260V mtiz poly	R17	18D67858A12	FOCUS: 2 meg
C30	8S10191A32	.047 mf 10% 250V polyester	R21	18D68222A35	BRIGHTNESS: 200K
C31	21S180B87	220 pf 10% 500V X5F	R34	18D68222A37	HORIZ HOLD: 25K
C32	21S180D34	.005 mf 20% 1KV Z5F (Use 21S180D31)	R59	18D66401A54	VERT LINEARITY: 4K
C33	8S10212A69	.47 mf 10% 100V mtiz poly	R65	17D65820A38	VERT SIZE: 15 ohms
C34	8S10191A32	.047 mf 10% 160V polyester	R74	17D65820A37	REGULATOR ADJUST: 2K
C35	8S10191898	.01 mf 10% 250V polyester	R82	18D68222A36	VERT HOLD: 3K
C36	23S10255A60	100 mf 63V Lvtic	R85	18D68222A34	VOLUME: 250 ohms
C37	8S10212A20	2.2 mf 10% 100V mtiz poly	RESISTORS		
C38	8S10212A20	2.2 mf 10% 100V mtiz poly	R2	6S125568	22K 10 1/2W
C39	8S10191867	.22 mf 10% 250V polyester	R3	6S127541	56K 10% 1/2W
C40	8S10212A10	1.0 mf 10% 100V mtiz poly (Use 8S10191A46)	R4	6S127633	470 10% 1/2W
C41	8S10064A06	.01 mf 10% 600V Mylar	R6	6S128955	1500 10% 1W
C42	21S180A71	470 pf 10% 500V X5F	R7	6S121847	4700 10% 1/2W
C43	23C65807A47	400 mf/125V; 600 mf/100V; 200 mf/50V; 20 mf/200V Lvtic	R8	6S122445	1800 10% 1/2W
C44	21S180E60	.01 mf +80-20% 50V Z5V	R9	6S119926	2700 10% 1/2W
C45	21S10330A05	.0015 mf 20% 1.4KV Z5U	R11	6S128226	120 10% 1/2W
C47	23S10255A11	2000 mf 35V Lvtic	R12	6S127633	470 10% 1/2W
C48	23S10255A30	1500 mf 30V Lvtic	R13	17S10731A01	3900 5% 5W ww
C49	23S10255A31	470 mf 40V Lvtic	R14	6S127516	82 10% 1/2W
C51	8S10191C49	.33 mf 10% 100V polyester	R15	6S131412	56 10% 1/2W
C52	8S10191C49	.33 mf 10% 1 OOV polyester	R18	- - - -	Part of CRT Socket Assembly
DIODES & RECTIFIERS			R19	- - - -	Part of CRT Socket Assembly
D1	48S134921	DIODE, silicon: D1D; damper	R20	- - - -	Part of CRT Socket Assembly
D2	48S134978	DIODE, silicon: D1K; pulse limiter	R22	6S129296	270K 10% 1/2W
D3	48D67120A11	DIODE, low power	R23	6S10053667	27K 5% 1/2W
D4	48S137114	RECTIFIER, H.V.: silicon; D2Y	R24	6S127538	3.3 meg 10% 1/2W
D5	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R25	6S121300	27K 10% 1/2W
D6	48S137266	DIODE, silicon: zener; D4H	R26	6S127541	56K 10% 1/2W
D7	48S134917	DIODE, dual: D1C; AFC	R27	6S129875	2200 10% 1/2W
D8	48D67120A 11	DIODE, low power	R28	6S125531	180K 10% 1/2W
D9	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R29	6S125531	180K 10% 1/2W
D10	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R30	6S125892	47K 10% 1/2W
D11	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R31	6S125534	100K 10 1/2W
D12	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R32	6S124506	3300 10% 1/2W
D13	48D67120A11	DIODE, low power	R33	6S10053C53	6800 5% 1/2W
D15	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R35	6S127541	56K 10% 1/2W
D16	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R36	6S125545	390 10% 1/2W
D17	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R37	6S121301	1000 10% 1/2W
D18	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)	R38	6S10053C33	1000 5% 1/2W
FUSES			R39	6S127516	82 10% 1/2W
F1	658139183	FUSE: 1A-125V	R40	6S127547	1000 10% 1W
INTEGRATED CIRCUITS			R41	6S127099	220 10% 1/2W
IC1	*51S10707A01	INTEGRATED CIRCUIT: T2Z	R42	6S127513	1500 10% 1/2W
			R43	17S10130007	1500 10% 3W fxd mtl film
			R44	17S10159A04	4.7 10% 2W ww
			R45	6S120141	150K 10% 1W
			R46	6S127634	33K 10% 1W
			R47	6S129417	1.5 meg 10% 1/2W
			R48	6S10053D21	4.7 meg 10% 1/2W
			R49	6S124797	150 10% 1/2W
			R50	6S10053C45	3300 5% 1/2W
			R52	6S124506	3300 10% 1/2W
			R53	6S129874	68 10% 1/2W
			R54	6S131972	39 10% 1/2W
			R55	6S10053C65	22K 5% 1/2W
			R57	6S119930	6800 10% 1/2W
			R58	6S129793	82K 5% 1/2W
			R60	6S122445	1800 10% 1/2W
			R61	6S10053F29	820 10% 1W
			R62	6S127006	5600 10% 1/2W
			R63	6S121301	1000 10% 1/2W
			R64	6S10053F 17	10 10% 1W
			R66	6S129064	4700 10% 1W

MODE L XM500-1 O-CHASSIS 19VP102 (CONT.)

REF. NO.	PART NUMBER	DESCRIPTION	REF. NO.	PART NUMBER	DESCRIPTION
R67	65122848	18K 10% 1/4W		42B25158A01	CLAMP, metal: defl yoke mtg
R68	6S124797	160 10% 1/4W		42D65864A54	CONNECTOR, 2nd anode
R69	173647132	1200 10% 3w ww (Use 17S136197)		31 D70080804	CONNECTOR, PC panel: 9
R71	6S119926	2700 10% 1/4W	P1	15S10183A22	Contact; on chassis
R72	6S124551	15K 10% 1/4W		39S10184A52	CONNECTOR, plug: 10
R73	65129875	2200 10% 1/4W		5869911A01	contact; less contacts (power)
R75	6S121301	1000 10% 1/4W		26C66745A05	CONTACT, plug: for power
R76	6S124506	3300 10% 1/4W		14-562353	connector 15S10183A22
R77	6S129221	100 10% 1/4W		14C68842A04	GROMMET, plastic: PC panel
R78	65127005	5600 10% 1/4W		*14S10550A02	mtg
R79	178135589	150 10% 10W ww		2S7051	HEAT SINK: C13
R81	6C66263A08	VARISTOR (Use 6S66263A16)		5S10281A03	INSULATOR, mice; transistor
R86	65124797	150 10% 1/4W		47C66082A04	socket: Q9, Q13, & Q16 (Use
R87	178135977	14 10% 5W WW		3S136050	14A543810)
R88	6S121301	1000 10% 1/4W		*9067555827	INSULATOR, molded rubber: SS
R89	---	Pert of CRT Socket		9S10548A01	rect cap/H. v. transf
TRANSFORMERS				9C63825A01	INSULATOR, transistor cover:
T1	25D67440A03	HORIZ DRIVER		41D65987A01	Q16
T2	24D69781817	H. V. TRANSFORMER: complete			NUT, hex: 3/8-32; ctrl
T3	25D65840A22	VERT OUTPUT (Use 25D65840B23)			mtg
T4	25D68164A27	POWER			RIVET, drive pin: nylon;
MISCELLANEOUS ELECTRICAL PARTS					H. v. transf mtg
V1	20WP4	CRT			ROD, adjustment: width coil;
	50D68384A02	SPEAKER: 4" PM			L4
MECHANICAL PARTS					SCREW, tpg: 6-20 x 1/2 clu
	*9D66133A34	CAP, SS Rectifier (H.V. Transf pri/sec lead)			pa" hd: Q9, Q13, Q16 & IC mtg

MODEL XM500-11 - CHASSIS C19VP102

ELECTRICAL PARTS

- IY25016A89 MONITOR PANEL: "V28A"; complete KT346KM

CAPACITORS

C1	23C65282A41	50 mf 50V Lytic
C2	23C65282A41	50 mf 50V Lytic
C3	21S180D10	220 pf 20% 100V X5F (Use 21 R 132503)
C4	23C65282A41	50 mf 50V Lytic
C5	21S180E78	270 pf 10% 500V X5F
C6	23S10255A78	470 mf 16V Lytic
C7	21S180E78	270 pf 10% 500V X5F
C8	21S180853	470 pf 10% 500V X5F
C10	8S10191B67	.22 mf 10% 250V polyester
C11	8S10191A54	.0068 mf 10% 160V polyester
C12	21S180D10	220 pf 20% 100V X5F (Use 21R132503)
C13	21 R132503	220 pf 10% 100V X5F
C15	21S180C41	.0027 mf 10% 500V Z5F (Use 21K121699)
C16	23S10229A07	1.0 mf +40-20% 15V Lytic (Use 23C43280A17)
C17	8S10191B90	.033 mf 10% 160V polyester
C18	8S10299A73	.01 mf 10% 100V poly carb
C19	8S10299A74	.0082 mf 10% 160V poly carb
C20	8S10191B98	.01 mf 10% 250V polyester
C21	21S180B51	.001 mf 10% 500V X5F
C22	8S10191B98	.01 mf 10% 160V polyester
C23	21S180C52	18 pf 5% 500V NPO
C24	23D65282A40	150 mf 10V Lytic
C25	21S180B51	.001 mf 10% 500V X5F
C26	8810212853	.47 mf 10% 630V mtlz poly
C27	8S10212A11	1.0 mf 10% 630V mtlz poly
C28	8S10571A06	.01 mf 5% 1200V poly prop foil
C29	8810212033	.56 mf 10% 250V mtlz poly
C30	8S10191A32	.047 mf 10% 250V polyester
C31	21S180B87	220 pf 10% 500V X5F
C32	21S180D34	.005 mf 20% 1KV Z5F (Use 21S180D31)
C33	8S10212A69	.47 mf 10% 100V mtlz poly
C34	8S10191A32	.047 mf 10% 160V polyester
C35	8S10191B98	.01 mf 10% 250V polyester
C36	23S10255A60	100 mf 63V Lytic
C37	8S10212A20	2.2 mf 10% 100V mtlz poly
C38	8S10212A20	2.2 mf 10% 100V mtlz poly
C39	8810191867	.22 mf 10% 250V polyester
C40	8S10212A10	1.0 mf 10% 100V mtlz poly (Use 8S10191A46)
C41	8S10064A06	.01 mf 10% 600V Mylar
C42	21S180A71	470 pf 10% 500V X5F
C43	23C65807A47	400 mf/125V; 600 mf/100V; 200 mf/50V; 20 mf/200V Lytic
C44	21S180E60	.01 mf +80-20% 50V Z5V
C45	21S10330A05	.0015 mf 20% 1.4KV Z5U
C47	23S10255A11	2000 mf 35V Lytic
C48	23S10255A30	1500 mf 30V Lytic

C49	23S10255A31	470 mf 40V Lytic
C50	23D65282A41	50 mf 50V Lytic
C51	8S10191C49	.33 mf 10% 100V polyester
C52	8S10191C49	.33 mf 10% 100V polyester

DIODES & RECTIFIERS

D1	48S134921	DIODE, silicon: DID; damper
D2	48S134978	DIODE, silicon: D1K; pulse limiter
D3	48D67120A11	DIODE, low power
D4	48S137114	RECTIFIER, H.V.: silicon; D2Y
D5	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191 A07)
D6	48S137266	DIODE, silicon: zener; D4H
D7	48S134917	DIODE, dual: D1C; AFC
D8	48D67120A11	DIODE, low power
D9	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)
D10	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191 A07)
D11	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191 A07)
D12	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)
D13	48D67120A11	DIODE, low power
D15	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)
D16	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)
D17	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)
D18	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)
D19	48D67120A11	DIODE, low power

FUSES

F1	65S138725	FUSE: .6A-125V
F2	653138725	FUSE: .6A-125V

INTEGRATED CIRCUITS

IC1	51S10707A01	INTEGRATED CIRCUIT: T22
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COILS & CHOKES

L1	24D68822A08	HORIZ SET
L2	24D68801 A67	COMPENSATING: 2000 uh
L3	24D69163A18	HORIZ LINEARITY
L4	24V25000A74	HORIZ WIDTH: incs C42 & R68
L5	24D68523A15	DEFLECTION YOKE

TRANSISTORS

Q1	48S137171	1ST VIDEO: A6H
Q2	488137127	2ND VIDEO: P2S

MODEL XM500-11-CHASSIS 19VP102 (CONT.)

REF. NO.	PART NUMBER	DESCRIPTION	REF. NO.	PART NUMBER	DESCRIPTION
Q3	488134919	VIDEO OUTPUT: A1M	R58	65129793	82K 5% 1/2W
Q4	485137317	VIDEO DRIVER: A8H	R60	6S122445	1800 10% 1/2W
Q5	485137115	SYNC SEPARATOR: A5U	R61	6S10053F29	820 10% 1W
Q6	485137172	HORIZ OSCILLATOR: A6J	R62	63127005	5600 10% 1/2W
Q7	488137127	HORIZ PULSE SHAPER: P2S	R63	65121301	1000 10% 1/2W
Q8	48S137093	HORIZ DRIVER: A5F	R64	6S10053F17	10 10% 1W
Q9	48S134995	HORIZ OUTPUT: A6Z	R66	6S129064	4700 10% 1W
Q10	488137173	VERT OSCILLATOR (1): P2W	R67	6S122848	18K 10% 1/2W
Q11	488137171	VERT OSCILLATOR (2): A6H	R68	6S124797	150 10% 1/2W
Q12	485137115	VERT DRIVER: A5U	R69	175647132	1200 10% 3w ww (Use 17S136197)
Q13	48S134900	VERT OUTPUT: A1C	R71	6S119926	2700 10% 1/2W
Q14	485134952	REGULATOR DRIVER: A2J	R72	6S124551	15K 10% 1/2W
Q15	486137315	REFERENCE AMP: A8G	R73	6S129875	2200 10% 1/2W
Q16	488137368	REGULATOR: A6J	R75	68121301	1000 10% 1/2W
Q17	485137172	AUDIO DRIVER: A6J	R76	6S124506	3300 10% 1/2W
Q18	488137168	AUDIO OUTPUT: P2V	R77	65129221	100 10% 1/2W
CONTROLS			R78	6S127005	5600 10% 1/2W
R5	18D68222A34	CONTRAST: 250 ohms	R79	175135589	150 10% 10W WW
R10	18D66401A54	VIDEO BIAS: 4K	R81	6C66263A08	VARISTOR (Use 6S66263A16)
R17	18D67858A12	FOCUS: 2 meg	R86	6S124797	150 10% 1/2W
R21	18D68222A35	BRIGHTNESS: 200K	R87	176135977	14 10% 5W WW
R34	18D68222A37	HORIZ HOLD: 25K	R88	6S121301	1000 10% 1/2W
R59	18D66401A54	VERT LINEARITY: 4K	R89	---	Part of CRT Socket
R65	17D65820A38	VERT SIZE: 15 ohms	SWITCHES		
R74	17D65820A37	REGULATOR ADJUST: 2K	SW1	40S10624A01	SWITCH, slide: DP DT (115V-230V)
R82	18D68222A36	VERT HOLD: 3K	TRANSFORMERS		
R85	18D68222A34	VOLUME: 250 ohms	T1	25D67440A03	HORIZ DRIVER
RESISTORS			T2	24069791817	H. V. TRANSFORMER: complete
R1	65127513	1500 10% 1/2W	T3	25D65840A22	VERT OUTPUT (Use 25D65840B23)
R2	6S125568	22K 10 1/2W	T4	25068 164A27	POWER
R3	6S127541	56K 10% 1/2W	MISCELLANEOUS ELECTRICAL PARTS		
R4	6S127633	470 10% 1/2W	V1	20WP4	CRT
R6	6S128955	1500 10% 1W		50D68384A02	SPEAKER: 4" PM
R7	6S121847	4700 10% 1/2W	MECHANICAL PARTS		
R8	6S122445	1800 10% 1/2W		.9D66133A34	CAP, SS Rectifier (H.V. Transf pri/sec lead)
R9	6S119926	2700 10% 1/2W		42B25158A01	CLAMP, metal: deflt yoke mtg
R11	6S128226	120 10% 1/2W		42D65864A54	CONNECTOR, 2nd anode
R12	6S127633	470 10% 1/2W		31 D70080B04	CONNECTOR, PC panel: 9
R13	17S10731A01	3900 5% 5w ww			Contact; on chassis
R14	65127516	82 10% 1/2W	P1	15S10183A22	CONNECTOR, plug: 10
R15	65131412	56 10% 1/2W		39S10184A52	Contact; less confects (power)
R18	---	Part of CRT Socket Assembly		15S10630A01	CONTACT, plug: for power
R19	---	Part of CRT Socket Assembly			connector 15S10183A22
R20	---	Part of CRT Socket Assembly		586991 1A01	COVER, nylon: slide switch;
R22	6S129296	270K 10% 1/2W			SW1
R23	6S10053C67	27K 5% 1/2W			GROMMET, plastic: PC panel
R24	6S127538	3.3 meg 10% 1/2W		26C66745A05	mtg
R25	65121300	27K 10% 1/2W		14A562353	HEAT SINK: Q3
R26	68127541	56K 10% 1/2W			INSULATOR, mica; transistor
R27	68121301	1000 10% 1/2W			socket: Q9, Q13, Q16 & IC
R28	65125531	180K 10% 1/2W		14C68842A04	(Use 14A543810)
R29	6S125531	180K 10% 1/2W			INSULATOR, molded rubber: SS
R30	65125892	47K 10% 1/2W		.14S10550A02	rect cap/H. V. transf
R31	65125534	100K 10% 1/2W			INSULATOR, transistor cover:
R32	6S124506	3300 10% 1/2W		257051	Q16
R33	6S10053C53	6800 5% 1/2W			NUT, hex: 3/8-32; ctrl
R35	6S127541	56K 10% 1/2W		5510281 A03	mtg
R36	65125545	390 10% 1/2W			RIVET, drive pin: nylon;
R37	6S121301	1000 10% 1/2W		47C66082A04	H. V. transf mtg
R38	6510053033	1000 5% 1/2W			ROD, adjustment: width coil;
R39	6S127516	82 10% 1/2W			L4
R40	6S127547	1000 10% 1W		3S136050	SCREW, tpg: 6-20 x 1/2 clu
R41	65127099	220 10% 1/2W			pan hd; Q9, Q13, Q16 & IC mtg
R42	6S127513	1500 10% 1/2W		9D7555827	SOCKET, CRT: incls leads
R43	17S10130B07	1500 10% 3W fxd mtl film			& resistors
R44	17S10159A04	4.7 10% 2w ww		9S10548A02	SOCKET, fuse: dual; F1 &
R45	6S120141	150K 10% 1W			F2
R46	6S127634	33K 10% 1W		9C63825A01	SOCKET, IC & transistor: Q9,
R47	65129417	1.5 meg 10% 1/2W			Q13, Q16 & IC1
R48	6S10053D21	4.7 meg 10% 1/2W		41 D65987A01	SPRING, special: CRT aquadag
R49	65124797	150 10% 1/2W			grnd
R50	6S10053C45	3300 5% 1/2W			
R52	6S124506	3300 10% 1/2W			
R53	6S129874	68 10% 1/2W			
R54	68131972	39 10% 1/2W			
R65	6S10053C65	22K 5% 1/2W			
R57	6S119930	6800 10% 1/2W			

MODEL XM700-10-CHASSIS 23VP102

ELECTRICAL PARTS

1Y25016A96

MONITOR PANEL: "V30A";
complete KT361LM

CAPACITORS

C1 23C65282A41

C2 23C65282A41

C3 21S180D10

C4 23C65282A41

50 mf 50V Lytic
50 mf 50V Lytic
220 pf 20% 100V X5F (Use
21R132503)
50 mf 50V Lytic

C5

C6

C7

C8

C10

C11

C12

C13

C15

C16

21S180E47

23S10255A78

21S180C01

21S180B85

8S10191B67

8S10191A54

21S180D10

21S180B51

21S180C41

23S10229A07

180 pf 10% 500V N150

470 mf 16V Lytic

680 pf 10% 500V X5F

560 pf 10% 500V X5F

.22 mf 10% 250V polyester

.0068 mf 10% 160V polyester

220 pf 20% 100V X5F

(Use 21R132503)

.001 mf 10% 500V X5F

.0027 mf 10% 500V Z5F (Use

21K121699)

1.0 mf +40-20% 15V Lytic (Use

23C43280A17)

MODEL XM700-10-CHASSIS 23VP102 (CONT.)

REF. NO.	PART NUMBER	DESCRIPTION	REF. NO.	PART NUMBER	DESCRIPTION
C17	8510191890	.033 mf 10% 160V polyester	Q13	48S134900	VERT OUTPUT: A1C
C18	8S10299A73	.01 mf 10% 100V poly carb	Q14	48S134952	REGULATOR DRIVER: A2J
C19	8S10299A74	.0082 mf 10% 160V poly carb	Q15	48S137315	REFERENCE AMP: A8G
C20	8510191698	.01 mf 10% 250V polyester	Q16	48S137368	REGULATOR: A8W
C21	218180851	.001 mf 10% 500V X5F	Q17	488137172	AUDIO DRIVER: A6J
C22	8S10191898	.01 mf 10% 160V polyester	Q18	488137168	AUDIO OUTPUT: P2V
C24	23D65282A40	150 mf 10V Lvtic			
C25	21S180851	.001 mf 10% 50V X5F			
C26	8510212853	.47 mf 10% 630V mtlz poly			
C27	8S10212A11	1.0 mf 10% 630V mtlz poly			
C28	8S10571A06	.01 mf 5% 1200V poly prop foil			
C29	8S10212D33	.56 mf 10% 250V mtlz poly			
C30	8S10191A32	.047 mf 10% 250V polyester			
C31	218180887	220 pf 10% 500V X5F			
C32	21S180D34	.005 mf 20% 1 KV Z5F (Use 21S180D31)			
C33	8S10212A69	.47 mf 10% 100V mtlz poly			
C34	8S10191A32	.047 mf 10% 160V polyester			
C35	8S10191B98	.01 mf 10% 250V polyester			
C36	23S10255A60	100 mf 63V Lvtic			
C37	8S10212A20	2.2 mf 10% 100V mtlz poly			
C38	8S10212A20	2.2 mf 10% 100V mtlz poly			
C39	8S10191B67	.22 mf 10% 250V polyester			
C40	8S10212A10	1.0 mf 10% 100V mtlz poly (Use 8S10191A46)			
C41	8S10064A06	.01 mf 10% 600V Mylar			
C42	21S180A71	470 pf 10% 500V X5F			
C43	23C65807A47	400 mf/125V; 600 mf/100V; 200 mf/50V; 20 mf/200V Lvtic			
C44	21S180E60	.01 mf +80-20% 50V Z5V			
C45	21S10330A05	.0015 mf 2.0% 1.4KV Z5U			
C47	23S10255A11	2000 mf 35V Lvtic			
C48	23S10255A30	1500 mf 30V Lvtic			
C49	23S10255A31	470 mf 40V Lvtic			
C50	23D65282A41	50 mf 50V Lvtic			
C51	8S10191C49	.33 mf 10% 100V polyester			
C52	8S10191C49	.33 mf 10% 100V polyester			
DIODES & RECTIFIERS					
D1	48S134921	DIODE, silicon: D1D; damper			
D2	48S134978	DIODE, silicon: D1K; pulse limiter			
D3	48D67120A11	DIODE, low power			
D4	48S137114	RECTIFIER, H.V.: silicon: D2Y			
D5	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D6	488137266	DIODE, silicon: zener; D4H			
D7	48S134917	DIODE; dual: D1C; AFC			
D8	48D67120A11	DIODE, low power			
D9	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D10	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D11	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D12	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D13	48D67120A11	DIODE, low power			
D15	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D16	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D17	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D18	48S191A05	RECTIFIER, silicon: 91A05 (Use 48S191A07)			
D19	48D67120A11	DIODE, low power			
FUSES					
F1	65S138725	FUSE: .6A-125V			
F2	65S138725	FUSE: .6A-125V			
INTEGRATED CIRCUITS					
IC1	51S10707A01	INTEGRATED CIRCUIT: T2Z			
COILS & CHOKES					
L1	24D68822A08	HORIZ SET			
L2	24068801 A67	COMPENSATING: 2000 mh			
L3	24D69163A18	HORIZ LINEARITY			
L4	24V25000A74	HORIZ WIDTH: inclcs C42 & R68			
L5	24D68523A 15	DEFLECTION YOKE			
TRANSISTORS					
Q1	48S137171	1ST VIDEO: A6H			

MODEL XM700-10-CHASSIS 23VP102 (CONT.)

IEF. NO.	PART NUMBER	DESCRIPTION	REF. NO.	PART NUMBER	DESCRIPTION
TRANSFORMERS				5869911A01	GROMMET, plastic: PC panel mtg
T1	25D67440A03	HORIZ DRIVER		26C66745A05	HEAT SINK: Q3
T2	● 24069791B17	H. V. TRANSFORMER: complete		14A562353	INSULATOR, mica; transistor socket: Q9, Q13, & Q16
T3	25D65840A22	VERT OUTPUT (Use 25D65840B23)		14C68842A04	(Use 14A543810) INSULATOR, molded rubber: SS
T4	25D68164A27	POWER		14S10550A02	rect cap/U. V. transf INSULATOR, transistor cover:
MISCELLANEOUS ELECTRICAL PARTS				2S7051	Q16 NUT, hex: 3/8-32; ctrl mtg
V1	23JEP4	CRT		5S10281A03	RIVET, drive pin: nylon; H. V. transf mtg
	50D68384A02	SPEAKER: 4" PM		47C66082A04	ROD, adjustment: width coil; L4
MECHANICAL PARTS				3S136050	SCREW, tpg: 6-20 x 1/4 clu pan hd: Q9, Q13, Q16 & IC mtg
	● 9D66133A34	CAP, SS Rectifier (H.V. Transf pri/sec lead)		9D67555B27	SOCKET, CRT: incl leads & resistors
	42B25158A01	CLAMP, metal: defl yoke mtg		9S10548A02	SOCKET, fuse: dual; F1 & F2
	42V25009A31	CONNECTOR, 2nd anode complete		9C63825A01	SOCKET, IC & transistor: Q9, Q13, Q16 & IC1
	31 D70080B04	CONNECTOR, PC panel: 9 Contact; on chassis		41D65987A01	SPRING, special: CRT aquadag grnd
P1	15S10183A22	CONNECTOR, plug: 10 Contact; less contacts (power)			
	39S10184A52	CONTACT, plug: for power connector 15S10183A22			
	15S10630A01	COVER, nylon: slide switch; SW1			

*DENOTES PARTS APPEARING IN ANY LIST FOR FIRST TIME

TELEDYNE PACKARD BELL COLOR TELEVISION

CHASSIS 98C38, 98C42, 98C44

Deflection Module DFM1

Q302	Horiz. Osc.	99S034	M331
Q303	Horiz. Predriver	99S077-1	MPS6517
Q304	Horiz. Driver	99S102-1	MPSU04
Q305	Sync. Splitter	99S070-1	MPSA06
Q306	Vert. Switch	99S060-1	2554401
9307	Vert. Predriver	99S061-1	2N5961
Q308	Vert. Driver	99S101-1	2N4924
Q309	Power	99S099-1	2N6107
Q310	Power	99S100-1	2N5496
Q311	Horiz. Output	99S079-1	Refer to Teledyne
Q312	Sync.	99S034	M321
			MSD6102

Power Supply Module RPM1

Q602	Transistor	99S103-1	RCA410 or DELCO 7934987
Q604	Transistor	99S083-1	2N5494

Audio Module AUM1

IC501	Removed from circuit		
Q502	Audio Driver	ggsoga-1	MPSA05
Q503	Audio Output	99S091-1	MPSU01
Q504	Audio Output	99S092-1	MPSU51

Video Module VIM1

Q701	2nd Video	99S036	M331
Q702	3rd Video	99S070-1	MPSA06
Q703	4th Video	99S033	MPC033
Q704	5th Video	99S084-1	2N2927
Q705	Vertical Blanker	99S034	M321
Q706	Video Output (RED)	99S063-1	MPSU10 or RCA2N6176
Q707	Video Output (Green)	99S063-1	MPSU10
Q708	Video Output (Blue)	99S063-1	MPSU10

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E 162 → TR-67 → A62

MOTOROLA MODEL XM 500-11 & XM 700-10

<u>Circuit Designation</u>	<u>Device</u>	<u>MDP Part Number</u>	<u>Application</u>	<u>Motorola SPD Replacement Part</u>	<u>(2N) Equivalent</u>
Q-1	T	482137171	1st Video: A6H		2N4400
Q-2	T	488137127	2nd Video: P2S		2N4403
Q-3	T	48S134919	Video Output: A1M		2N3500
Q-4	T	48S137317	Video Driver: A8H		2N4400
Q-5	T	488137172	Sync Separator: A6J		2N4400
Q-6	T	48S137317	Horiz. Oscillator: A5U		2N4400
Q-7	T	488137127	Horiz. Pulse Shaper: P2S		2N4403
Q-8	T	488137093	Horiz. Driver: A5F		2N3500
Q-9	T	488137203	Horiz. Output: A6Z MJ3030	2N5157 2	2N3902
Q-10	T	48S137173	Vert. Oscillator (1): P2W		2N4403
Q-11	T	48S137171	Vert. Oscillator (2): A6H		2N4400
Q-12	T	48S137115	Vert. Driver: A5U		2N4400
Q-13	T	48S134900	Vert. Output: A1C MJ3029	/	2N5151
Q-14	T	48S134952	Regulator Driver: A2J		2N4400
Q-15	T	48S137315	Reference Amp: A8G		2N4409
Q-16	T	48S137368	Regulator: A8W	#	2N3442
Q-17	T	483137172	Audio Driver: A6J		2N4400
Q-18	T	48S134988	Audio Output: P2V		2N4030
ICI	IC	51S10707A01	5 V. Regulator: T2Z		
D-1	D	48S134921	Silicon: D1D; Damper		1N4007*
D-2	D	48S134978	Silicon: D1K; Pulse Limiter	3-	1N4007*
D-3	D	48D67120A11	Low Power	2-	1N4005
D-4	D	48S137114	H.V.; Sel D3S		VARO
D-5	R	48S191A05	Silicon: 91A05		1N4005
D-6 & a	D	48D67130A11	Low Power		1N448
D-7	D	48S134917	Dual; D1C; Detector MSD6102	6-	1N914**
D-9, 10, 11, & 12	D	48S191A05	Low Voltage Supply		2N4400
					6-1N4001

Motorola Display Products
Export and Parts
455 E. North Avenue
Carol Stream, ILL 60187

Attention: Parts Dept.

(312) 690-1400

*Motorola Only
**2 Required

ZENITH CHASSIS 19EB12

<u>Device No.</u>	<u>Zenith P/N</u>	<u>Cross Reference</u>	<u>WEP No.</u>
Q201	121-713	NJ225	713
A202	121-821	DTS0713 or 2SC1004	740A
	or	or ZSC642A	
	121-758	A702	
Q203	121-985	2Sc643A	N/A
Q401	121-699	2-4248	717
Q402	121-671	2N3569	735
Q403	121-446	MPS6516	717
Q404	121-895	SPS907 or EL438	N/A
Q405	121-975	121-888 or EL403	N/A
	or		
8703	121-982	121-888	N/A
Q406	121-868	D40N3	N/A
Q704	121-888	SPS2104 or X32C5198	N/A
		or TEH0147	
CR207	103-248	Information not available	
CR401-CR402	103-142-01	at this time.	
CR701-CR705		Will be supplied	
CR101	103-23	as soon as	
CR201	103-193	possible.	
CR202	103-239-02		
CR203-CR206	212-76		

For further information or to purchase parts directly from
the factory, please contact:

Zenith Radio Corp.
Export and Parts
1900 N. Austin Avenue
Chicago, ILL 60639

Attention: Mrs. Vigil

(312) 745-4993

ZENITH DISTRIBUTORS

Quick Reference Telephone Index

Telephone Number

518-465-2351	Albany	Henzel-Powers, Inc.
505-243-7863	Albuquerque(El Paso Branch)	Albert Mathias & Co., Inc.
806-376-4722	Amirillo	Amarillo Hardware Co.
404-691-0730	Atlanta	Graybar Electric, Inc.
301-644-2900	Baltimore	The Jos. M. Zamoiski Co.
319-359-1301	Bettendorf(Des Moines Branch)	A.A. Schneiderhahn Co.
406-248-7771	Billings	Midland Implement Co., Inc.
205-252-3182	Birmingham	Hart-Greet, Inc.
716-633-8305	Buffalo (Cheektowaga). . .	Joseph Strauss Co., Inc.
802-864-6835	Burlington	Vermont Hardware Co., Inc.
617-547-8000	Cambridge	*Northeastern Distributors, Inc.
717-761-0241	Camp Hill	Peirce-Phelps, Inc.
304-342-1171	Charleston, W.Va.	Eskew, Smith & Cannon
704-344-8621	Charlotts	Allison-Erwin Company
615-266-4805	Chattanooga	McWhorter-Weaver & Co.
312-379-9400	Chicago (Northlake) . . .	Zenith Radio Dist. Corp.
716-633-8305	Cheektowaga(Buffalo). . .	Joseph Strauss Co.
513-853-6000	Cincinnati	The Knodel-Tygrett Co.
216-243-9900	Cleveland	Graybar Electric Co., Inc.
803-256-7426	Columbia, S.C.(Charlotte)	Allison-Erwin Company
614-261-0331	Columbus	The Tracy-Wells Company
213-724-2400	Commerce (Los Angeles) . .	Sues, Young & Brown, Inc.
201-272-2800	Cranford	Zenith Radio Corp. of N.J.
214-691-5555	Dallas	The Stewart Company
513-224-9623	Dayton	V.J. McGranahan, Inc.
303-355-2345	Denver	McCollum-Law Corp.
515-244-3157	Des Moines	A.A. Schneiderhahn Co.
313-869-7900	Detroit	Radio Dist. Co.
915-533-1686	El Paso	Albert Mathias & Co., Inc.
701-293-1811	Fargo(Minneapolis Branch)	Reinhard Brothers, Co.
501-782-8944	Ft. Smith	Taylor Distributing Co., Inc.
219-423-2361	Ft. Wayne	Wayne Hardware Co., Inc.
209-268-8544	Fresno	B.J. DeJarnatt Wholesale Co.
616-241-6581	Grand Rapids	J.A. White Dist. Co.
414-499-3171	Green Bay	Moreley-Murphy Co.
203-527-7107	Hartford(North Haven Br.)	The Plymouth Elec. Co.
314-731-4680	Hazelwood(St.Louis). . . .	Hollander & Co., Inc.
808-524-5533	Honolulu	VHY Home & Industrial Prod.
713-675-6521	Houston	Automatic Dist. Corp.
317-898-0670	Indianapolis	Rodefild Co., Inc.
601-362-5464	Jackson	McKee & McRae, Inc.
904-356-4812	Jacksonville	Cain & Bultman, Inc.
814-266-8713	Johnstown	Cambria Equipment Co.
615-523-1157	Knoxville	Graybar Electric Co., Inc.
304-453-3555	Kenova (Williamson Br.) . .	Persinger Supply Co., Inc.
301-322-2000	Landover	The Jos. M. Zamoiski Co.
913-888-4800	Lenexa (Kansas City) . . .	Zenith Dist. Corp. of Kansas
501-376-2457	Little Rock	Graybar Elec. Co.

213-724-2400	Los Angeles (Commerce) . . .	Sues, Young & Brown, Inc.
502-634-4701	Louisville	Monarch Equipment Co.
901-362-1500	Memphis	Woodson & Bozeman, Inc.
305-625-0461	Miami	Cain & Bultman, Inc.
414-453-7200	Milwaukee	Moreley-Murphy Company
612-927-9781	Minneapolis	Reinhard Brothers Co.
205-479-1471	Mobile	Nelson Radio & Supply Co., Inc.
615-242-2655	Nashville	McWhorter-Weaver & Co.
504-821-4110	New Orleans	George H. Hehleleitner & Co., Inc.
212-245-1400	New York City	Zenith Radio Corp. of N.Y.
203-28803821	North Haven	The Plymouth Electric Co.
312-379-9400	Northlake (Chicago)	Zenith Radio Dist. Corp.
405-236-4351	Oklahoma City	Thurman Magbee Corp.
402-558-8200	Omaha	Truesdell Dist. Corp.
215-477-9000	Philadelphia	Peirce-Phelps, Inc.
602-275-7801	Phoenix	Electrical Equipment Co.
412-681-5500	Pittsburgh	J.A. Williams Co.
207-775-5661	Portland, Maine	Nelson & Small, Inc.
503-226-4044	Portland, Oregon	Electrical Dist., Inc.
401-331-8320	Providence	Ballou, Johnson & Nichols Co.
919-828-9100	Raleigh	Warren Dist. Corp.
317-966-1571	Richmond, Ind. (Indianapolis)	Rodefald Co., Inc.
804-285-9066	Richmond, Va.	Elliott & Bottom Corp.
716-454-5100	Rochester	Chapin-Owen Company, Inc.
916-929-6790	Sacramento	Zenith Dist. Corp. of N. Cal.
517-752-7191	Saginaw	Radio Dist. Co.
314-731-4680	St. Louis (Hazelwood)	Hollander & Co., Inc.
703-387-0406	Salem (Williamson Branch) . .	Persinger Supply Co., Inc.
801-487-0701	Salt Lake City	Wells Dist. Co.
512-227-2491	San Antonio	Thiele Co., Inc.
714-235-6511	San Diego	Electric Supplies Dist. Co.
415-621-8545	San Francisco	Zenith Dist. Corp. of N.CA.
206-682-8282	Seattle	Seattle Pacific Sales Co.
318-423-0533	Shreveport	Tri-States Dist. Co., Inc.
509-534-0611	Spokane	Columbia Electric
417-862-4475	Springfield	Hollander Dist. Co., Inc.
219-388-1458	South Bend (Ft. Wayne Br.) . .	Wayne Hardware Co., Inc.
315-474-1251	Syracuse	Onondaga Supply Co., Inc.
813-229-6571	Tampa	Cain & Bultman, Inc.
812-232-0461	Terre Haute	Walker Electric Co., Inc.
419-241-8271	Toledo	McGranahan Distributing Co.
301-322-2000	Youngstown (Cleveland Br.) .	Graybar Elec. Co., Inc.
316-263-2271	Washington (Landover)	The Jos. M. Zamoiski Co.
304-235-1400	Wichita	The S.A. Long Company, Inc.
	Williamson	Persinger Supply Co., Inc.

CANADIAN DISTRIBUTORS

902-667-3307	Amherst, Nova Scotia, Canada . .	Waldale Ltd.
403-253-7171	Calgary, Alberta	Bow River Equip. Ltd.
403-455-7171	Edmonton, Alberta	Bruce Robinson Elec.
514-342-0210	Montreal, Quebec	Zenith Radio Corp. of Can.
416-255-2324	Toronto, Canada	Zenith Radio Corp. of Can.
604-879-4631	Vancouver, B.C.	Major Appliances Div. of Acklands, Ltd.
204-783-7011	Winnipeg, Manitoba	Major Appliances Div. of Acklands, Ltd.

HITACHI SALES CORPORATION OF AMERICA

National Headquarters Office: 48-50 34th St.
Long Island City, N.Y. 11101
Tel. 212-361-3090

Eastern Regional Office: 4850 34th St.
Long Island City, N.Y. 11101
Tel. 212-361-3090

Mid-Western Regional Office: 1400 Morse Ave.
Elk Grove Villiage
Chicago, Ill. 60007
Tel. 312-593-7500

South-Western Regional Office: 1121 Round Table Dr.
Dallas, Texas 75247
Tel. 214-638-5820

Western Regional Office: 2550 Santa Fe Ave.
Redondo Beach, CA 90278
Tel. 213-644-3655

HITACHI SALES CORPORATION OF HAWAII

743-G Waiakamilo Rd.
Honolulu, Hawaii 96817
Tel. 808-841-0431

HITACHI SALES CORPORATION OF PANAMA

Edificio Vallarino
Calle 32
Avenida **Justo** Arosemena
Panama City, Panama
Tel. **25-0315, 3899**

MGA

MITSUBISHI INTERNATIONAL CORPORATION

7045 North **Ridgeway** Avenue
Linclonwood, Illinois 60645

ZENITH RADIO CORPORATION

1900 **N.** Austin Ave.
Chicago, Illinois

TRANSISTORS (for Hitachi)

C 3	TR 201	0573474	silicon	2SC682 A
C 4	TR 202	0573474	silicon	2SC682 A
C 4	TR 203	2320141	silicon	2SC717
C 5	TR 251	2320041	silicon	2SC460 B
C 6	TR 252	2320051	silicon	2SC856
B 4	TR 401	2320041	silicon	2SC460 B
B 5	TR 402	0573131	germanium	2SB77 C
B 5	TR 403	2320596	silicon	2SC458 C / D
A 6	TR 404	2320647	silicon	2SC1213 C / D
B 6	TR 405	2320631	silicon	2SA673 B / C
D 5	TR 502	2320514	germanium	2SA15 V
E 3	TR 503	2320591	silicon	2SC458 B / C
D 4	TR 551	2320471	silicon	2SC535 B / C
D 4	TR 552	2320596	silicon	2SC458 C / D
E 4	TR 601	2320591	silicon	2SC458 B / C
E 4	TR 602	2320423	germanium	2SB77 C / D
E 5	TR 603	2320596	silicon	2SC458 C / D
D 5	TR 604	2320651	silicon	2SC1061 C
E 5	TR 605	0573166	germanium	2SB337 B
E 5	TR 701	0573480	silicon	2SC458 B
E 5	TR 702	2320631	silicon	2SA673 B / C
F 5	TR 703	0573212	germanium	2SB468
F 2	TR 901	2320541	germanium	2SB337 A / B
F 3	TR 902	2320646	silicon	2SC1213 B / C
C 5	CR 201	0275005	Diode-Germanium	1N60
D 5	CR 251	0575001	Diode-Germanium	1N34A
C 6	CR 252	2330351	Diode-Silicon	1S2076
A 4	CR 401	0575005	Diode-Germanium	1N60
B 4	CR 402	0575005	Diode-Germanium	1N60
D 5	CR 501	2330351	Diode-Silicon	132076
D 4	CR 551	0575001	Diode-Germanium	1N34A
D 4	CR 552	0575001	Diode-Germanium	1N34A
D 3	CR 553	0575001	Diode-Germanium	1N34A
E 4	CR 701	0575001	Diode-Germanium	1N34A
F 4	CR 702	0575001	Diode-Germanium	1N34A
F 6	CR 703	2330551	Diode-Silicon	V09C
D 6	CR 704	2330251	Diode-Silicon	V06C
F 6	CR 705	2330251	Diode-Silicon	V06C
F 6	CR 706	2330033	Diode-Silicon	HS20/1
F 2	CR 901	2330251	Diode-Silicon	V06C
F 2	CR 902	2330251	Diode-Silicon	V06C
F 2	CR 903	2330251	Diode-Silicon	V06C
F 2	CR 904	2330251	Diode-Silicon	V06C
F 3	CR 905	2330302	Diode-Zener	AW01-07

TRANSISTORS & ICs - MGA

Q 101	260P24901	Silicon	NPN	2SC11871
Q 102	260P1760	"	"	2SC763
Q 103	260P13001	"	PNP	2SA353-AC
Q 201	260P06904	"	NPN	2SC454-B
Q 241	260-10301	"	"	2SC154C
Q "	260P22101	"	"	2SC1103
Q 401	260-21002	"	PNP	2SA15-V/R
Q 402	260P19503	"	NPN	2SC945
Q 403	260P19503	"	NPN	2SC945
Q 404	260P24803	"	"	2SC1161
Q 501	260P12002	"	"	2SC281-B
Q 502	260P12401	"	"	2SD204
Q 503	260P08901	"	"	2SC940
Q 701	260P14103	"	"	2SC458-C
Q 702	"	"	"	"
Q 703	260P07704	"	"	2SC712-D
Q 704	260P14102	"	"	2SC458-B
Q 705	260P07703	"	"	2SC712-CD
Q 706	"	"	"	"
Q 901	260-20101	"	"	2SD155
Q 902	260P04001	"	"	2SC620-C
IC 311	266P00103	Integrated Circuit M5113P		
IC 341	266P30201	Integrated Circuit NPC200C		

DIODES & OTHERS

D 101	264P01305	Germanium	1N60
D 102	264P00801	"	1N34A
D 103	264-01305	"	1N60
D 104	"	"	"
D 241	264P00801	"	1N34A
D 341	264P04705	Silicon	SR1FM-2 (BB-126)
D 401	"	"	"
D 501	264P01305	Germanium	1N60
D 502	"	"	"
D 503	"	"	"
D 504	264P09101	Silicon	FG2N
D 505	264P06603	"	SR1HM-8
D 506	264P08902	Selenium	US25/1AS
D 701	264P01305	Germanium	1N60
D 702	264P00801	"	1N34A
D 703	"	"	"
D 901	264P09001	Silicon	F14A
D 902	"	"	"
D 903	"	"	"
D 904	"	"	"
D 905	264P04003	"	RD16A (BB-126)

DIODES & OTHERS CONT'D

RV 401	265P01501	Varistor	SC-02
RV 402	265-03503	"	TVS-1/2D
RV 901	"	"	"
RT 401	265P00601	Thermistor	23D28

TRANSISTORS (CONT'D)

PLACE	SYMBOL NO.	STOCK NO.	DESCRIPTION
D 4	TH 551	0576057	Thermistor D-1E
D 3	TH 552	0576038	Thermistor D-2B
E 5	TH 601	0576057	Thermistor D-1E
A 5	VA 401	2330611	Varistor HV46

SECTION 9
HAND TOOLS TYPE "A"

<u>Manufacturer's Part No.</u>	<u>Manufacturers Name</u>	<u>Description</u>	<u>Manufacturer's Price</u>
1. 4213	Union	Steel Utility Box, 13 $\frac{1}{2}$ "x 6 $\frac{1}{2}$ " x 5 5/8	\$3.38
2. 95AE	Erem	Diagonal Cutters	6.22
3. 11D	Erem	Long Narrow Chain nose	4.95
*4. A90MS	Hunter	Tip-Dykes	6.64
5. "A"	Erem	Tweezers	3.71
6. MS-2	Hunter	Scribe	1.10
7. No. 1	Xacto	Knife	.65
8. No. 16	Xacto	Blades	.60
9. X-A30-6	Hunter	Pliers	1.81
10. 99-PS-40	Xcelite	Hex Kit	7.80
11. PS-140	Xcelite	Screw Driver Nut Compact Set	6.00
12. 99-PS-51MM	Xcelite	Nut Driver	9.45
13. W-TCP	Weller	Soldering Iron	26.15
*14. WRAP	Kester	.031 Flux Core Solder	4.18
15. SS011	Soldapullt	Solder Sucker	5.95
*16. 40-4-5	Soder-Wick	#4 size	1.47
*17. TC 590-89	Kurz-Kasch	IC Test Clip and IC Insertion Tool	6.29
18. No.7	Master	Pad Lock	1.95
19. 47100	Amp	Super Champ (Wire Strippers)	7.05

RECOMMENDED TEST EQUIPMENT

<u>Manufacturer's Part Number</u>	<u>Manufacturer's Name</u>	<u>Description</u>	<u>Manufacturer's Price</u>
1.	Kurz-Kasch	Universal TF-650 Test Fixture	350.00
2. 101-135	Kurz-Kasch	Universal Test Unit Program Cards	15.00 or 25.00
3. D83	Telequipment	50MHZ Dual-Trace Oscillator	800.00
4. V4	Telequipment	Dual-Trace Amp for D83	295.00
5. S2A	Telequipment	Dual Time Base for D83	400.00
6. DM64	Telequipment	10MHZ Dual-Trace Oscillator	1,095.00
7. 465	Tektronix	100MHZ Dual-Trace Oscillator	1,725.00
8. Option 5	Tektronix	TV Sync Separator	100.00
9.	Kurz-Kasch	LP-520 Logic Probe	77.00
10.	Kurz-Kasch	HL-583 Logic Pulser	96.00
11.	Kurz-Kasch	LP-600 TV Probe	97.00