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: 513/296-0330

Kurz-Kasch, Inc.
ELECTRONICS DIVISION
2876 Culver Avenue
Dayton, Ohio 45429

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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.

Company & State	Games People Play
Allied Leisure - Florida	Paddle Baddle Tennis Tourney Super Soccer Hesitation Footsball 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

Company & State	Games People Play
Atari/Kee - continued	Pursuit Anti Aircraft 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 Astroid 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

Company & State	Games People Play
Nutting & Assoc. - continued	Space Ball Wimbleton Table Tennis Missles Radar
PMC Inc. - Pennsylvania	Hockey Wam Bam I & II Aztec Tables Baseball Players Choice 1 on 1 Kennel Club Wall Games
PSE Inc. - California	Hodge Podge 1-2-4 Cocktail Table
Performance Enterprises - Florida	Wall Games Dart Game Par 90 Golf All Star Passing Motorcycle Race Quarter Horse 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 TWO

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

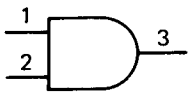
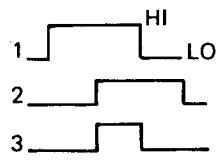
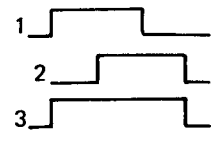
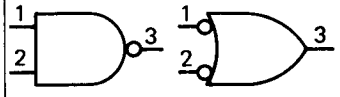
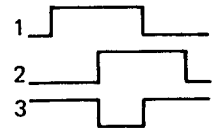
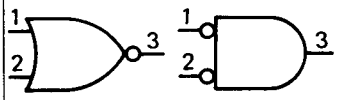
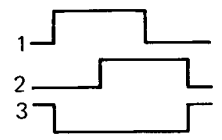
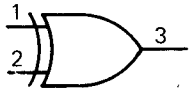
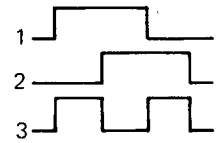
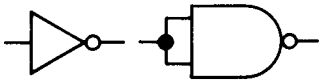
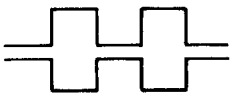
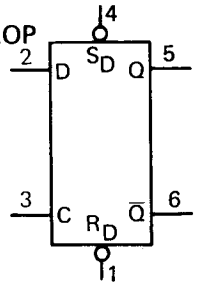
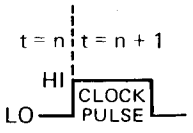
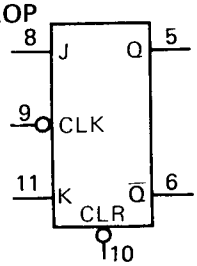
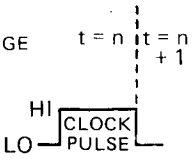
* Advise excessive stocking of these items

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
2N3644	TRANSISTOR
2N5449	TRANSISTOR
MFC6040	AUDIO AMPLIFIER
*IN4001	DIODE
*IN4720	DIODE

TTL & DTL
INTEGRATED CIRCUITS
Condensed Catalog

Table 1-1. Logic Symbology

SYMBOL	TRUTH TABLE/TIMING	OPERATION
AND GATE 	1 2 | 3 LO LO | LO LO HI | LO HI LO | LO HI HI | HI 	Output is HI only when all inputs are HI, otherwise output is LO. Rule applies for any number of inputs.
OR GATE 	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 all inputs are LO.
NAND GATE 	1 2 | 3 LO LO | HI LO HI | HI HI LO | HI HI HI | LO 	Output is LO only when all inputs are HI, otherwise output is HI.
NOR GATE 	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 all inputs are LO.
EXCLUSIVE OR GATE 	1 2 | 3 LO LO | LO LO HI | HI HI LO | HI HI HI | LO 	Output is HI when either but not both inputs are HI, otherwise output is LO.
INVERTERS 	IN OUT 	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 	t = n t = n + 1 D Q | Q LO LO | LO LO HI | LO HI LO | HI HI HI | HI  Truth Table valid only when S_D and R_D are both 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 $\overline{Q}$ HI and Q LO. A LO on R_D forces $\overline{Q}$ HI and Q LO. S_D and R_D predominate over all other inputs.
J-K MASTER SLAVE FLIP-FLOP 	t = n t = n + 1 J K 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  Truth Table valid only when CLR is HI	When CLR is HI and: 1. J and K are both LO, clock pulse has no effect on outputs Q and $\overline{Q}$. 2. J and K are at opposite logic levels, negative-going clock edge transfers J level to Q and K level to $\overline{Q}$. 3. J and K are both HI, each negative-going clock edge alternates outputs Q and $\overline{Q}$. 4. LO on CLR forces and holds Q LO and $\overline{Q}$ HI.

(002A)

TTL Numerical Index

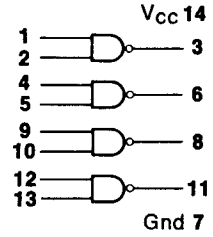
TTL Functional Index

*Free-Collector outputs

Ordering Information

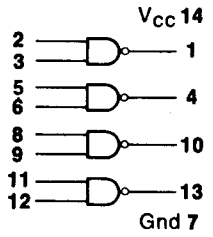
PACKAGE TYPE	54/74 Series		9600 Series	
	MILITARY	INDUSTRIAL	MILITARY	INDUSTRIAL
Ceramic Dual-in-Line	SW54XXJ	SW74XXJ	SW96XX-1P	SW96XX-2P
Plastic Dual-in-Line	—	SW74XXN	—	SW96XX-M

54/7400 Quad 2-input NAND Gate

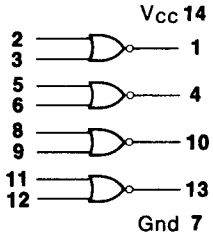


54/7401 Quad 2-input NAND Gate

Free-collector outputs

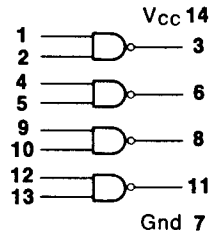


54/7402 Quad 2-input NOR Gate

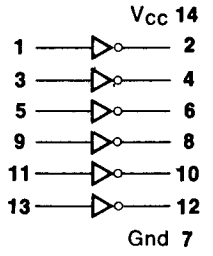


54/7403 Quad 2-input NAND Gate

Free-collector outputs

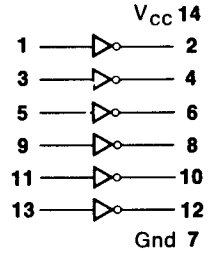


54/7404 Hex Inverter



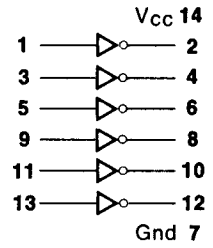
54/7405 Hex Inverter

Free-collector outputs



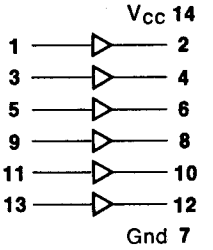
54/7406 Hex Inverting Buffer

Free-collector outputs, 30V rating

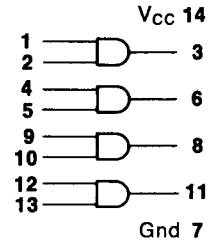


54/7407 Hex Buffer

Free-collector outputs, 30V rating

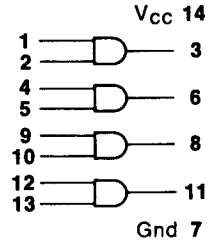


54/7408 Quad 2-input AND Gate

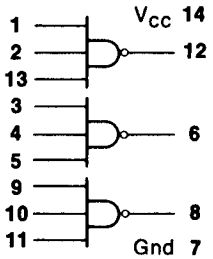


54/7409 Quad 2-input AND Gate

Free-collector outputs

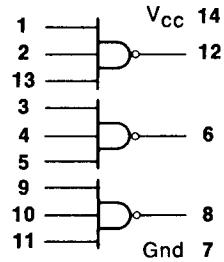


54/7410 Triple 3-input NAND Gate

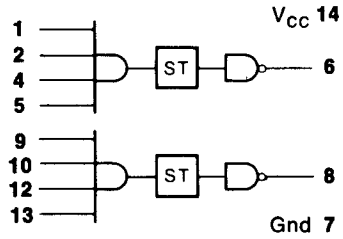


54/7412 Triple 3-input NAND Gate

Free-collector outputs

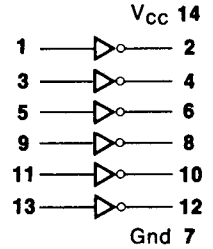


54/7413 Dual NAND Schmitt Trigger



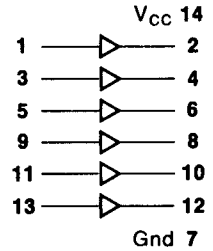
54/7416 Hex Inverting Buffer

Free-collector outputs, 15V rating

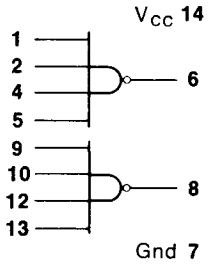


54/7417 Hex Buffer

Free-collector outputs, 15V rating

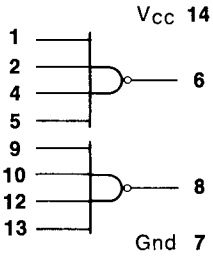


54/7420 Dual 4-input NAND Gate



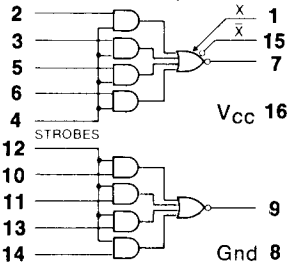
54/7422 Dual 4-input NAND Gate

Free-collector outputs



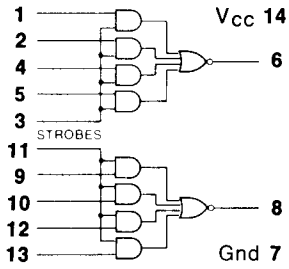
54/7423 Dual 4-input NOR Gate

with Strobe, expandable



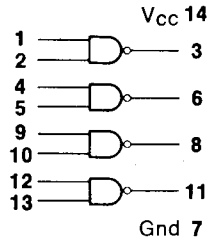
54/7425 Dual 4-input NOR Gate

with Strobe

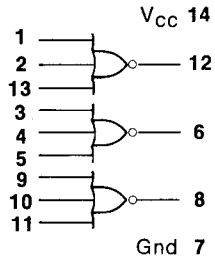


54/7426 Quad 2-input NAND Gate

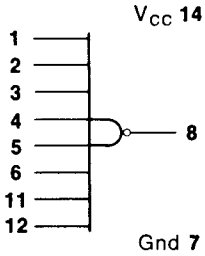
Free-collector outputs, 15V rating



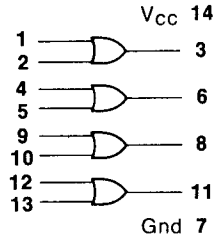
54/7427 Triple 3-input NOR Gate



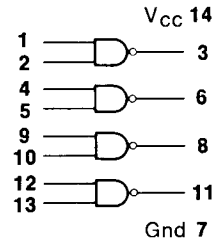
54/7430 8-input NAND Gate



54/7432 Quad 2-input OR Gate

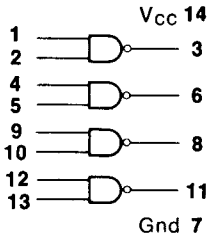


54/7437 Quad 2-input NAND Buffer

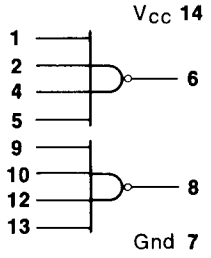


54/7438 Quad 2-input NAND Buffer

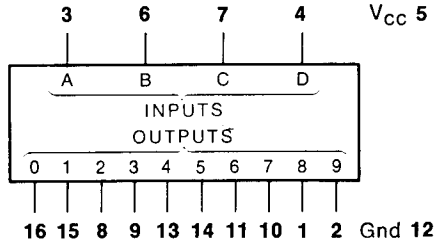
Free-collector outputs



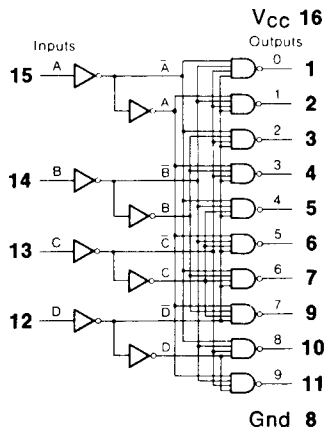
54/7440 Dual 4-input NAND Buffer



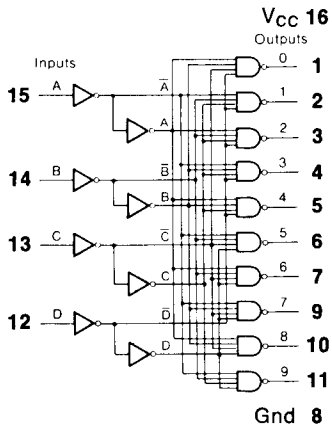
7441A BCD-to-Decimal Decoder/Driver



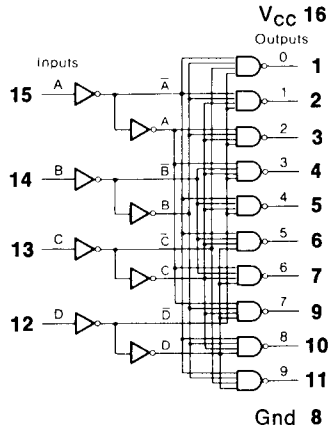
54/7442 BCD-to-Decimal Decoder



54/7443 EXCESS-3-to-Decimal Decoder

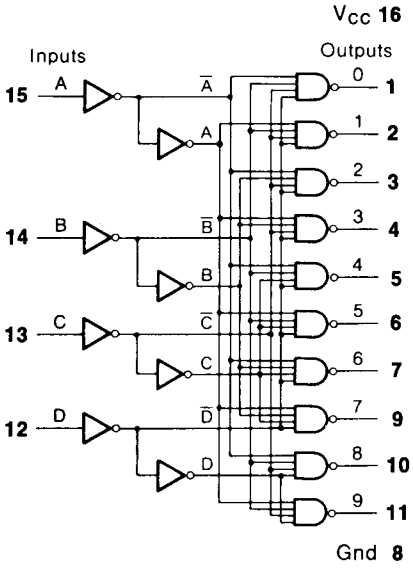


54/7444 EXCESS-3 GRAY-to-Decimal Decoder



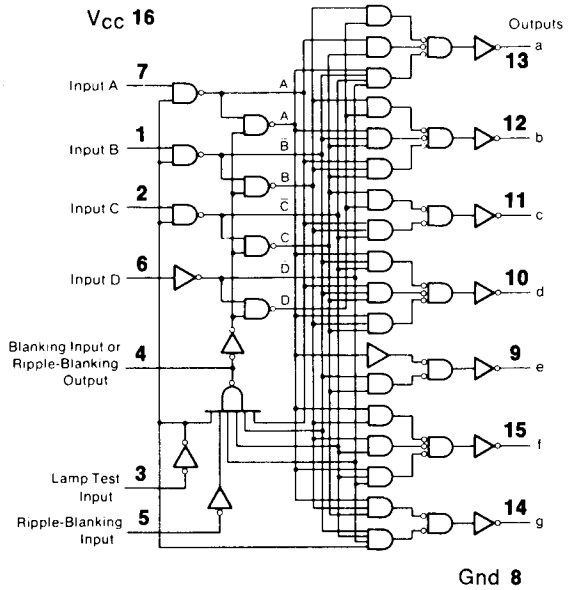
BCD-to-Decimal Decoder/Driver

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

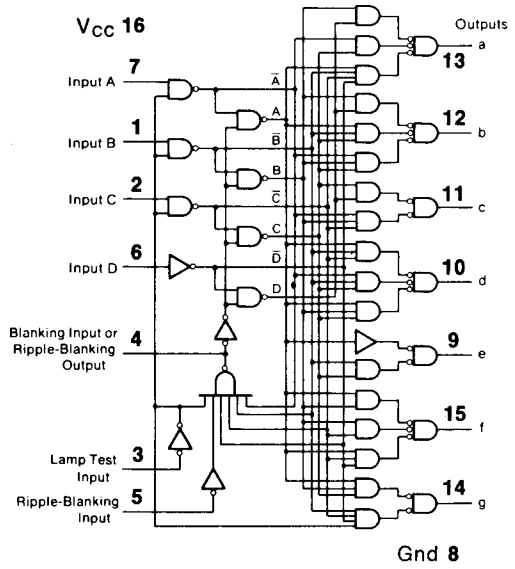


BCD-to-7-Segment Decoder/Driver

54/7446 30V/20mA output rating • **54/7447** 15V/20mA output rating
54/7446A 30V/40mA output rating • **54/7447A** 15V/40mA output rating

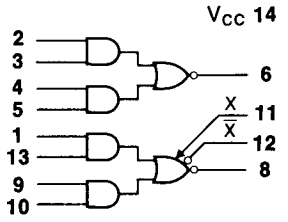


54/7448 BCD-to-7-Segment Decoder

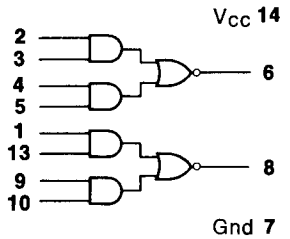


54/7450 Dual AND-OR-INVERT Gate

Expandable

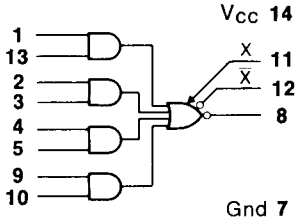


54/7451 Dual AND-OR-INVERT Gate

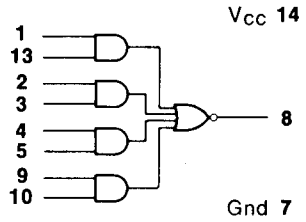


54/7453 Single AND-OR-INVERT Gate

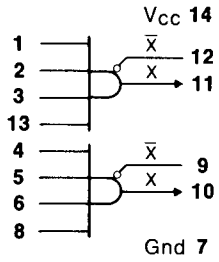
Expandable



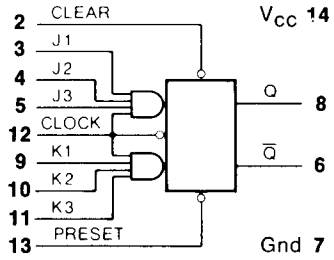
54/7454 Single AND-OR-INVERT Gate



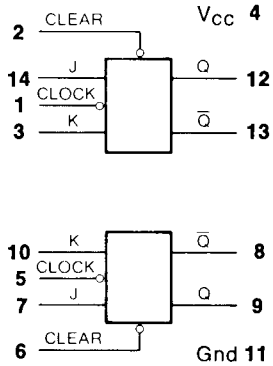
54/7460 Dual AND-OR Expander



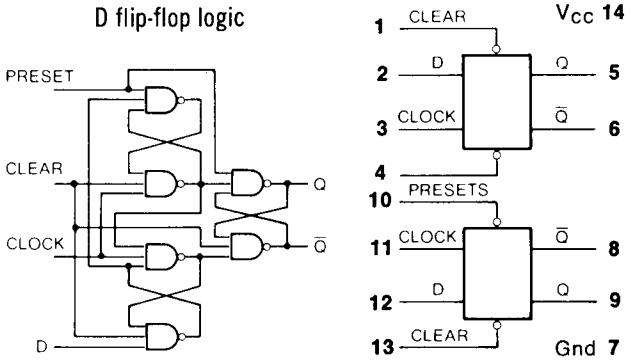
54/7472 J-K Flip-Flop



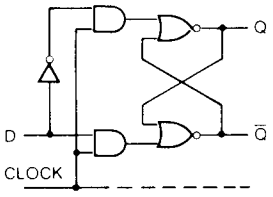
54/7473 Dual J-K Flip-Flop



54/7474 Dual D Flip-Flop



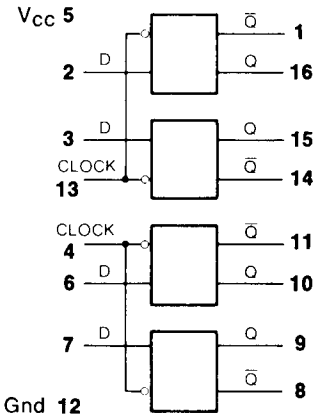
latch logic



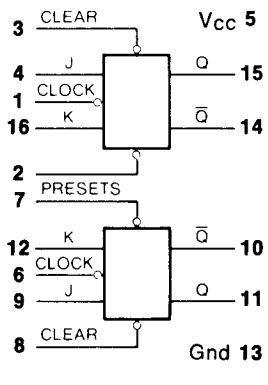
Truth Table

C	D	Q	Q_0
Low	Low	No Change	
Low	High	No Change	
High	Low	Low	High
High	High	High	Low

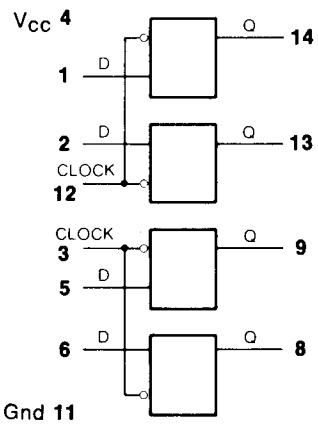
54/7475 Quad Latch



54/7476 Dual J-K Flip-Flop

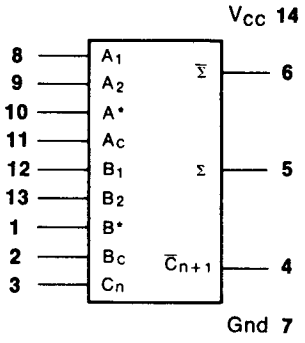


54/7477 Quad Latch*



*refer to 54/7475 logic

54/7480 Gated Full Adder



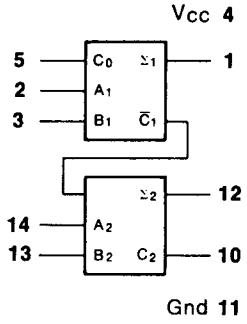
Truth Table

Cn	B	A	C̄n+1	Σ̄	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

$A = A_1 \cdot A_2 + \bar{A}_c$ $\quad B = B_1 \cdot B_2 + \bar{B}_c$

$A^* = \bar{A}_1 \cdot \bar{A}_2$ $\quad B^* = \bar{B}_1 \cdot \bar{B}_2$

54/7482 2-Bit Binary Full Adder



2-bit & 4-bit Adder Truth Table

ODD* bit positions:

INPUTS			OUTPUTS	
Cx-1	Ax	Bx	Σx	C̄x
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

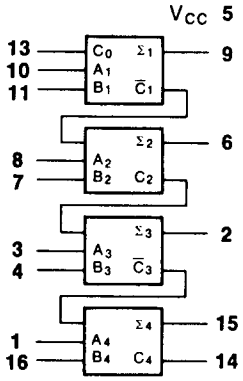
* X = 1 or 3

EVEN† bit positions:

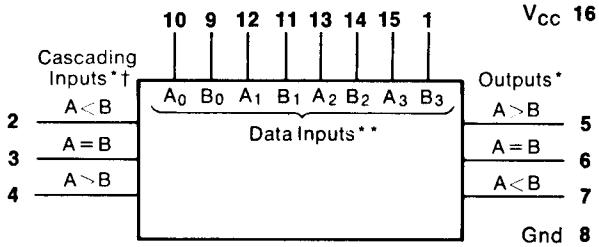
INPUTS			OUTPUTS	
C̄x-1	Ax	Bx	Σx	Cx
1	0	0	0	0
1	0	1	1	0
1	1	0	1	0
1	1	1	0	1
0	0	0	1	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	1

† X = 2 or 4

54/7483 4-Bit Binary Full Adder

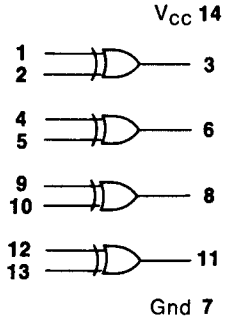


54/7485 4-Bit Magnitude Comparator

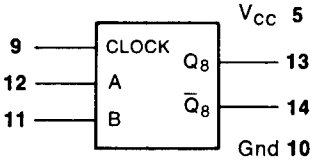


* a HIGH signal indicates a TRUE condition
† results from a comparison of lower-order bits
** inequality of these bits will override CASCADED inputs

54/7486 Quad Exclusive-OR Gate

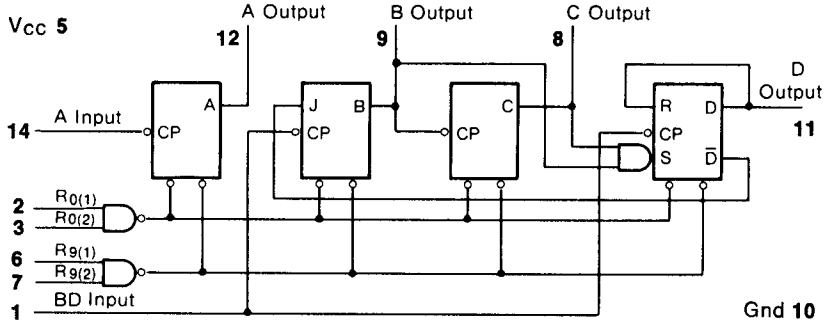


54/7491A 8-Bit Shift Register



Inputs at time tn		Q output at time tn+8
A	B	
0	0	0
0	1	0
1	0	0
1	1	1

54/7490 Decade Counter



Truth Tables

BCD Count Sequence*

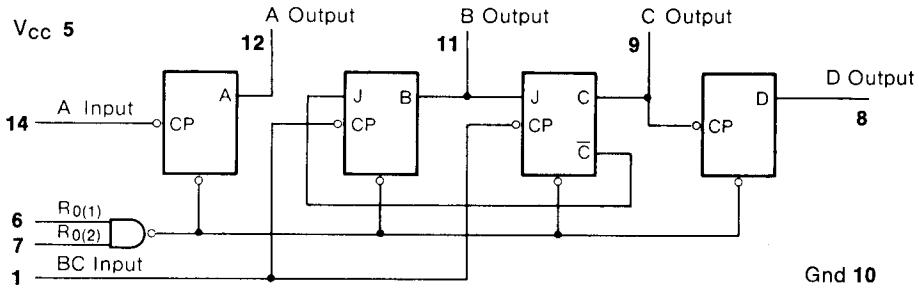
COUNT	OUTPUT			
	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Reset/Count

RESET INPUTS				COUNT
R0(1)	R0(2)	R9(1)	R9(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

* Output A connected to input BD $\quad$ ϕ = immaterial

54/7492 Divide-by-Twelve Counter

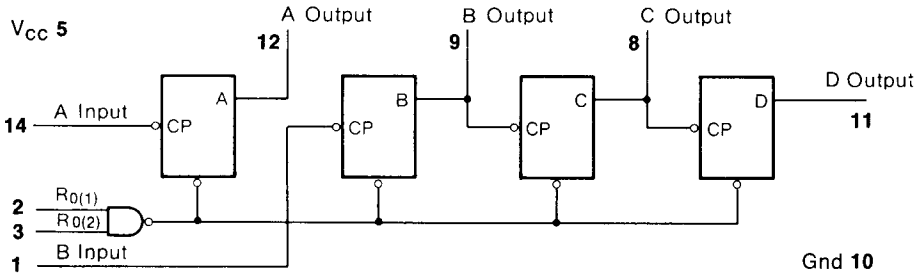


Truth Table

COUNT	OUTPUT			
	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	1	0	0	0
7	1	0	0	1
8	1	0	1	0
9	1	0	1	1
10	1	1	0	0
11	1	1	0	1

NOTE: Output A connected to input BC

54/7493 Divide-by-Sixteen Counter

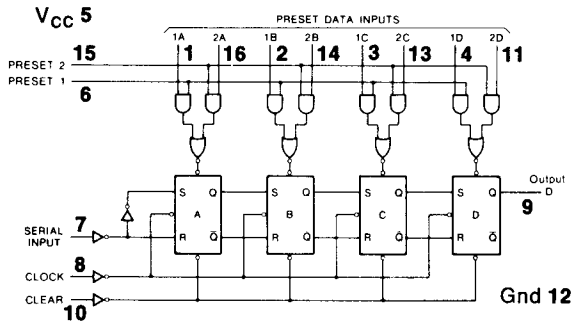


Truth Table

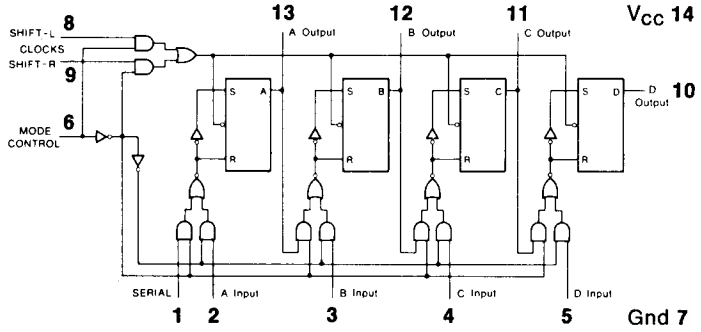
COUNT	OUTPUT			
	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

NOTE: Output A connected to input B

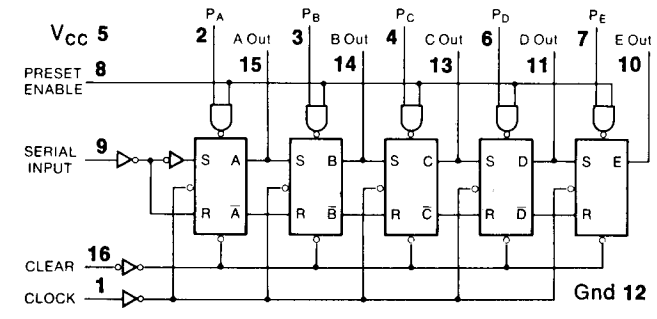
54/7494 4-Bit Shift Register



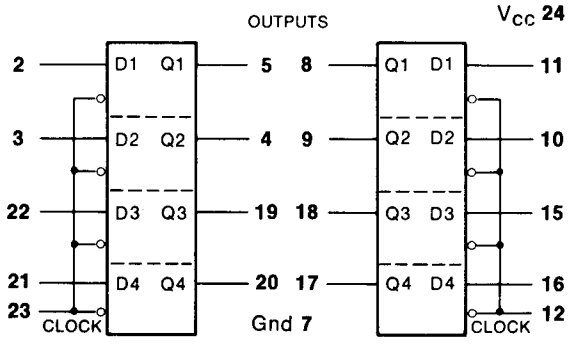
54/7495 4-Bit Reversible Register



54/7496 5-Bit Serial/Parallel Register

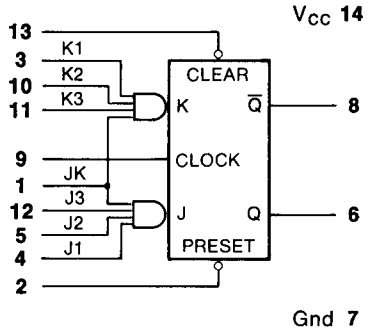


54/74100 8-Bit Bistable Latch*

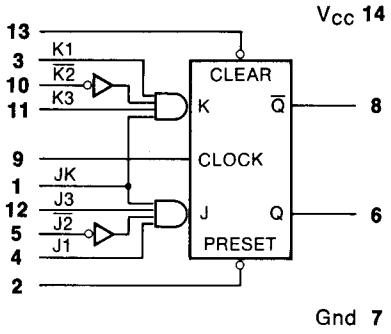


*refer to 54/7475 logic

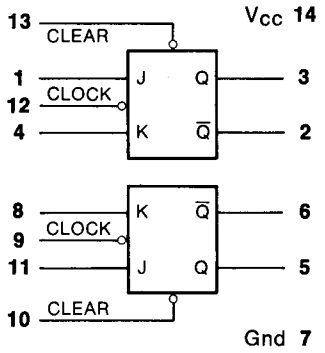
54/74104 Gated J-K Master-Slave Flip-Flop



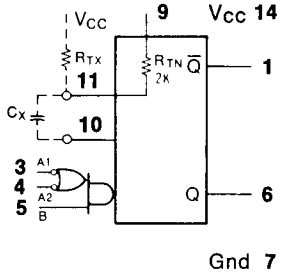
54/74105 Gated J-K Master-Slave Flip-Flop



54/74107 Dual J-K Flip-Flop



54/74121 Monostable Multivibrator

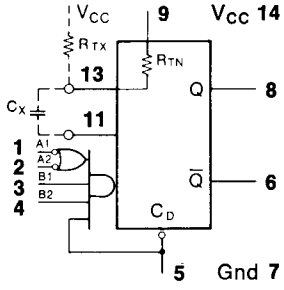


Triggering Truth Table

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

X = immaterial

54/74122 Retriggerable Multivibrator

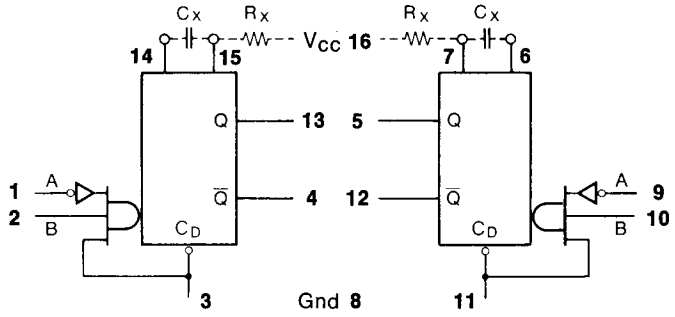


Triggering Truth Table

A1	A2	B1	B2	CD	RESPONSE
X	X	X	X	0	No Trigger
↓	0	X	X	X	No Trigger
↓	X	0	X	X	No Trigger
↓	1	1	1	1	Trigger
X	X	↓	0	X	No Trigger
1	1	↓	X	X	No Trigger
0	X	↓	1	1	Trigger

*A1 & A2 are logically interchangeable, as are B1 & B2.
X = immaterial

54/74123 Dual Retriggerable Multivibrator

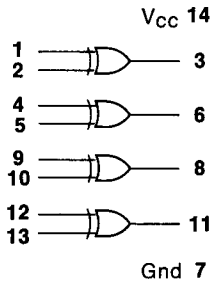


Triggering Truth Table

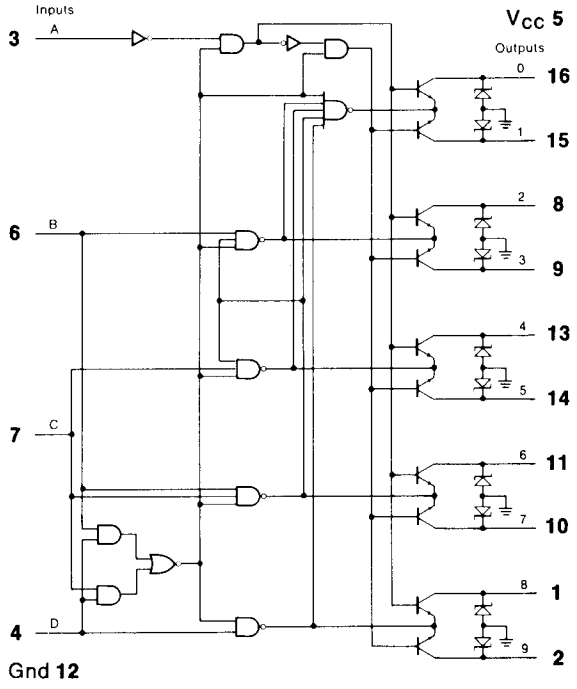
A	B	CD	*RESPONSE
X	X	0	No Trigger
↓	0	X	No Trigger
↓	1	1	Trigger
1	↓	X	No Trigger
0	↓	1	Trigger

X = immaterial

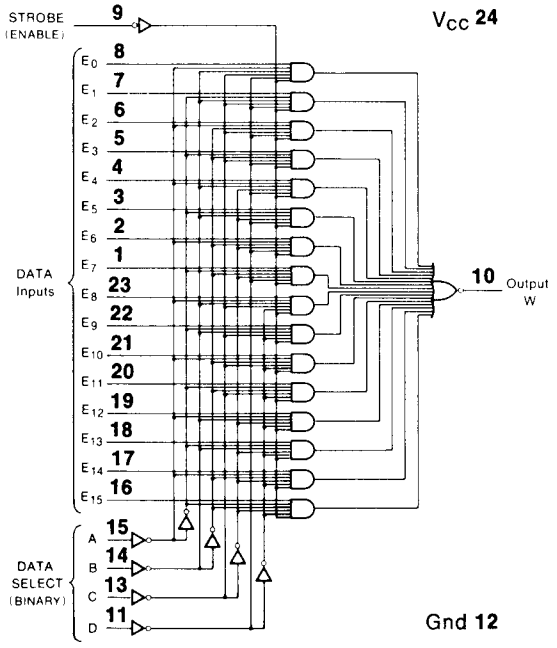
54/74136 Quad 2-input Exclusive-OR Gate



74141 BCD-to-Decimal Decoder/Driver

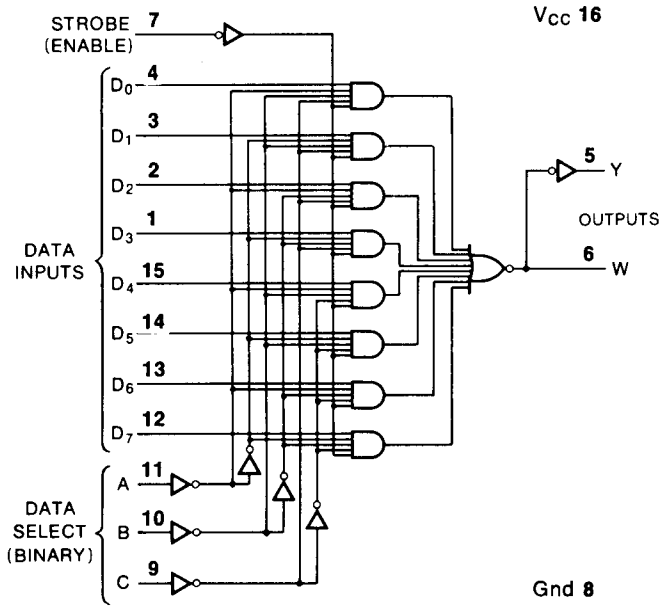


54/74150 16-Bit Data Selector/Multiplexer

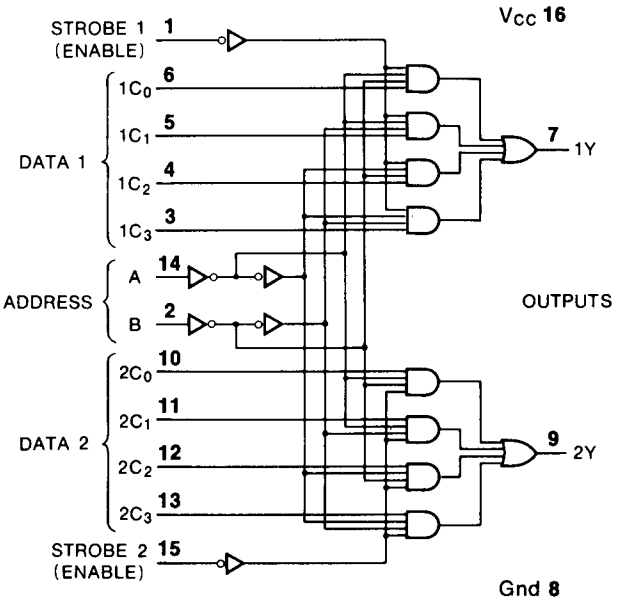


NOTE: 54145/74145 see page 5.

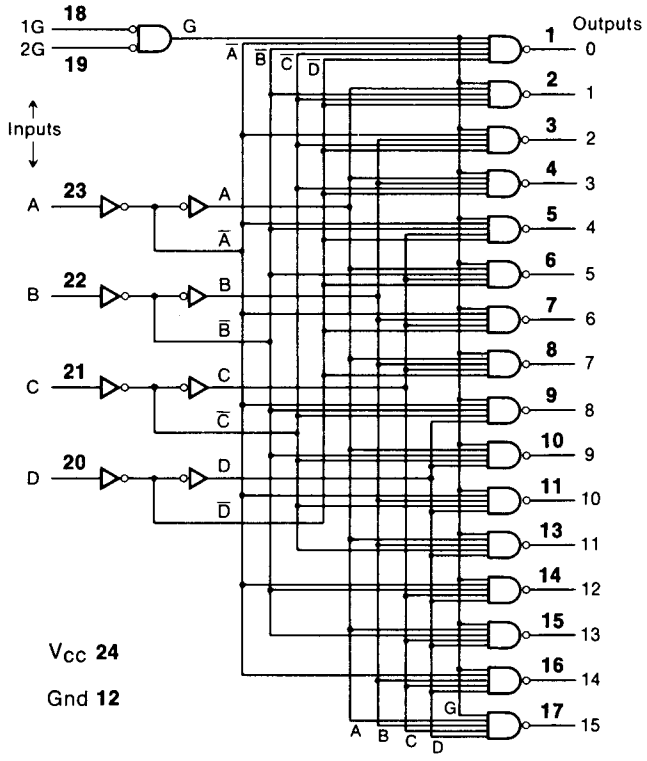
54/74151 8-Bit Data Selector/Multiplexer



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



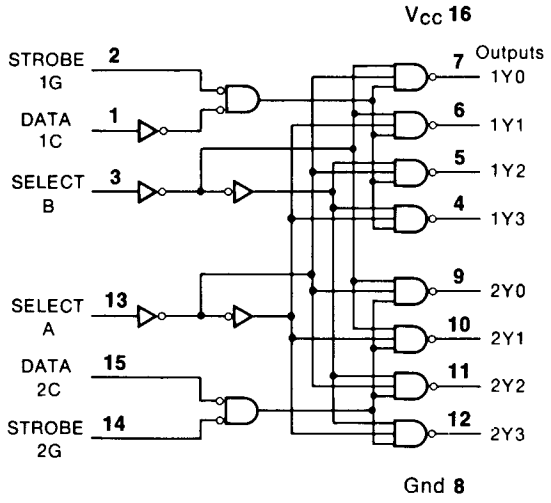
54/74154 4-Line-to-16-Line Decoder/Demultiplexer



Dual 2-Line-to-4-Line Decoder/Demultiplexer

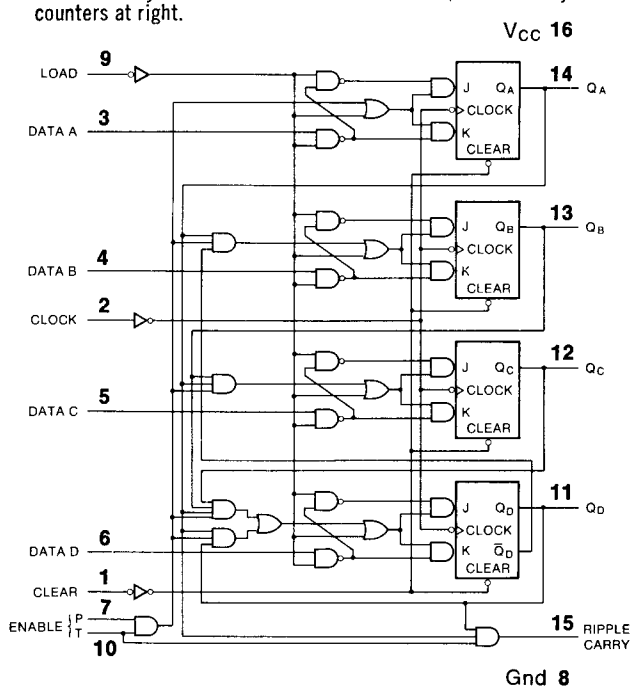
54/74155 Active pull-ups

54/74156 Free-collector outputs



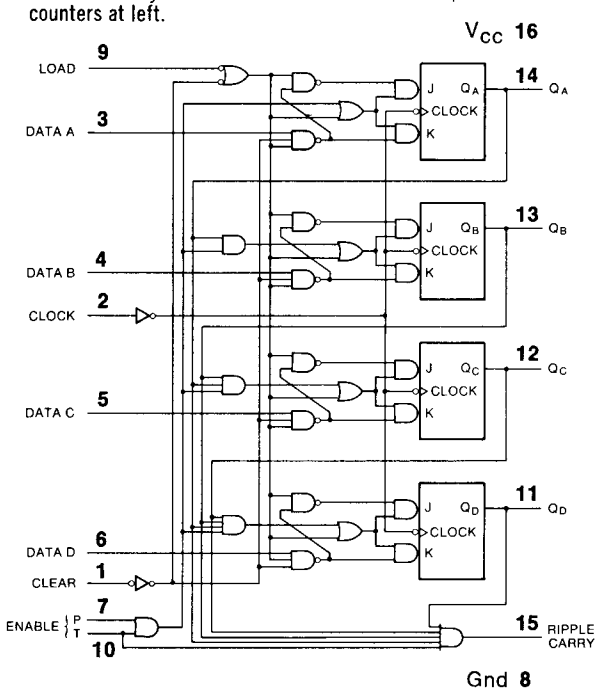
54/74160 4-Bit Synchronous Decade Counter

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

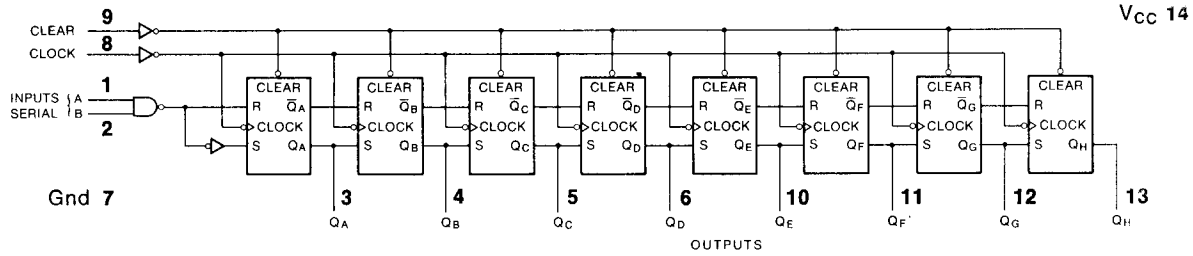


54/74163 4-Bit Synchronous Binary Counter

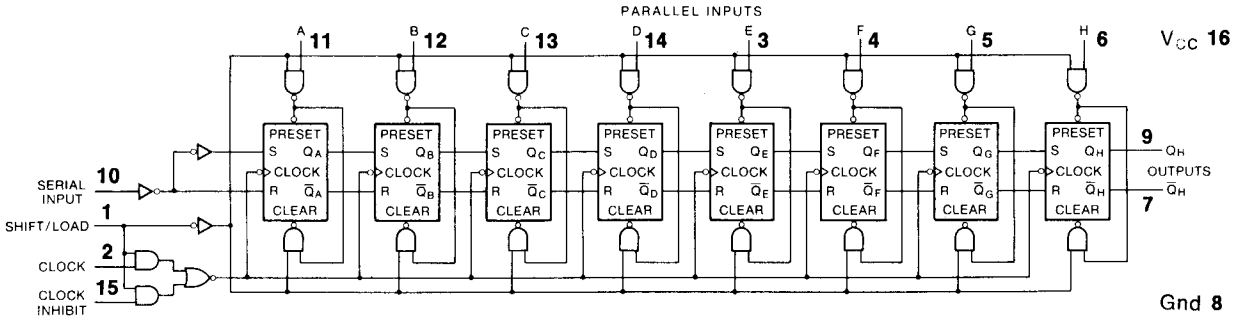
54161/74161 synchronous binary counters are similar; however the clear is asynchronous as shown for the 54160/74160 decade counters at left.



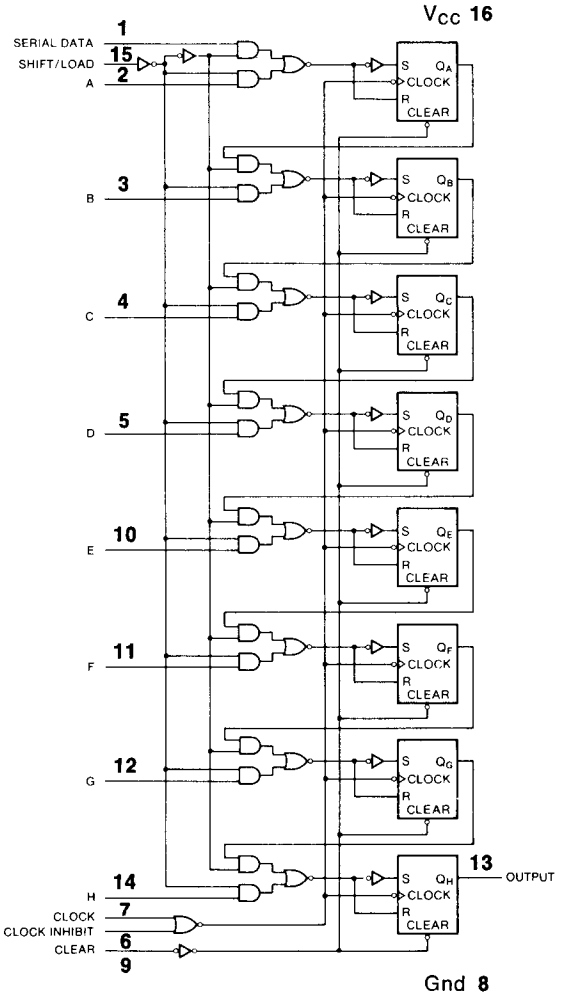
54/74164 8-Bit Parallel-Out Serial-Shift Register



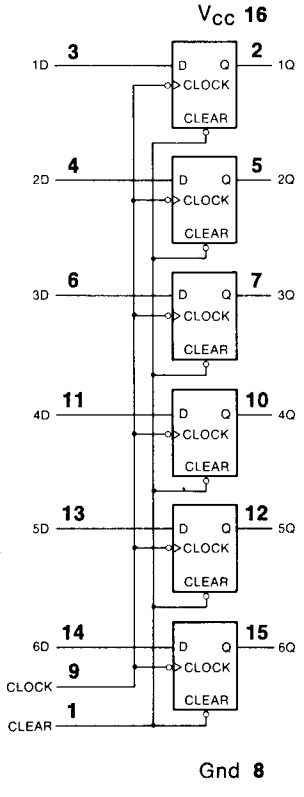
54/74165 Parallel-Load 8-Bit Shift Register



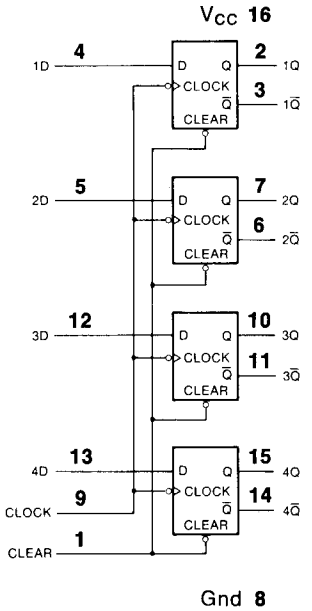
54/74166 8-Bit Shift Register



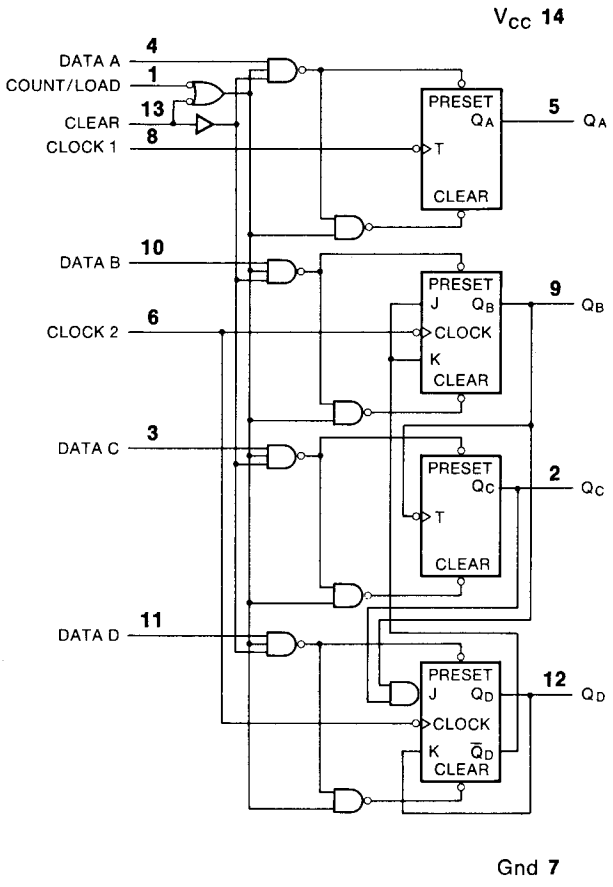
54/74174 Hex D-Type Flip-Flop



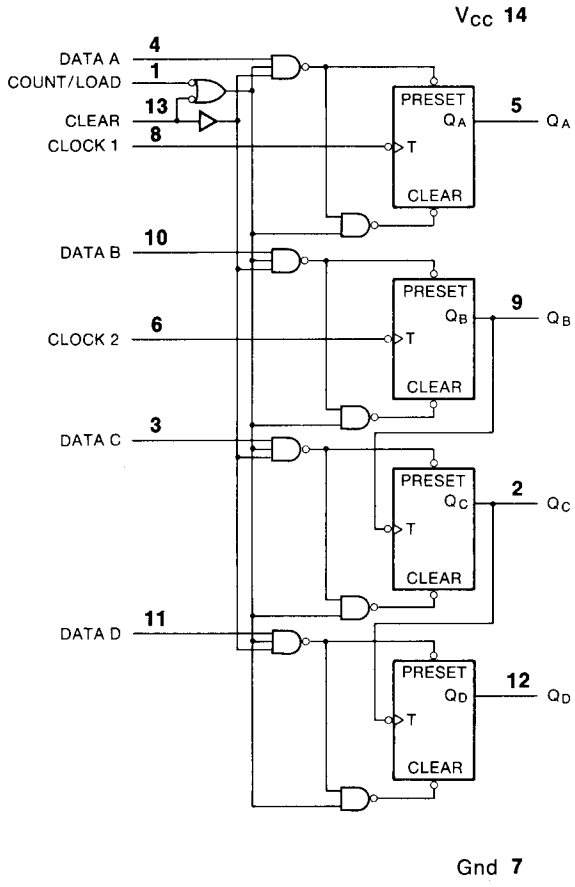
54/74175 Quad D-Type Flip-Flop



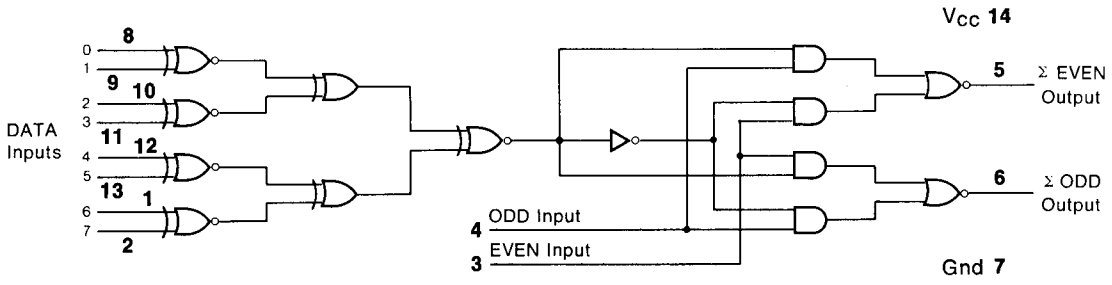
54/74176 35 MHz Presettable Decade Counter/Latch



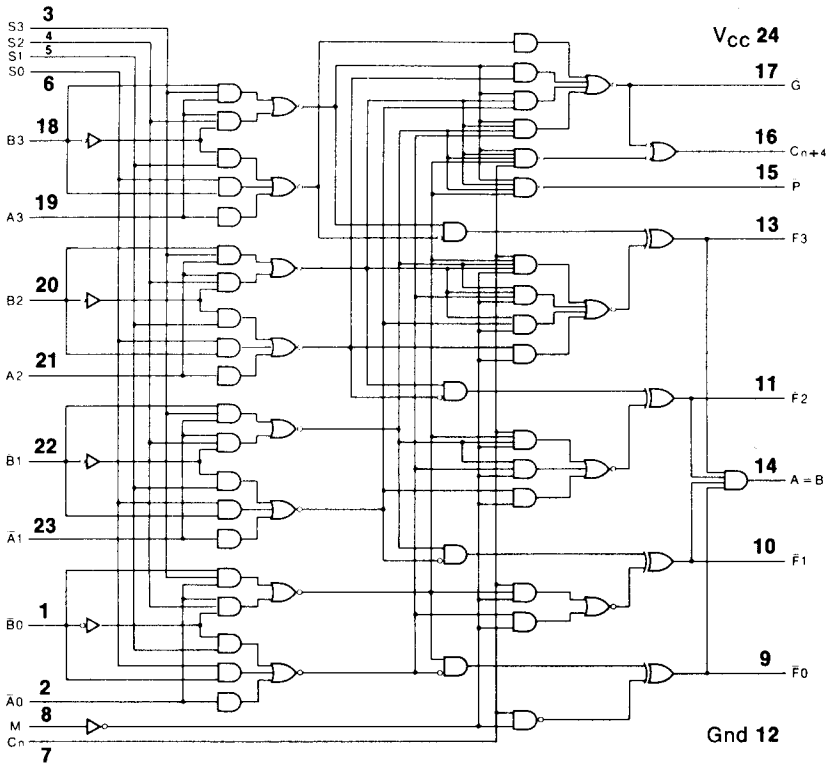
54/74177 35 MHz Presettable Binary Counter/Latch



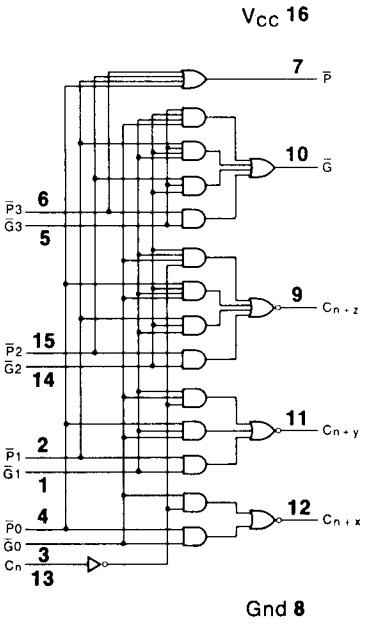
54/74180 8-Bit ODD/EVEN Parity Generator/Checker



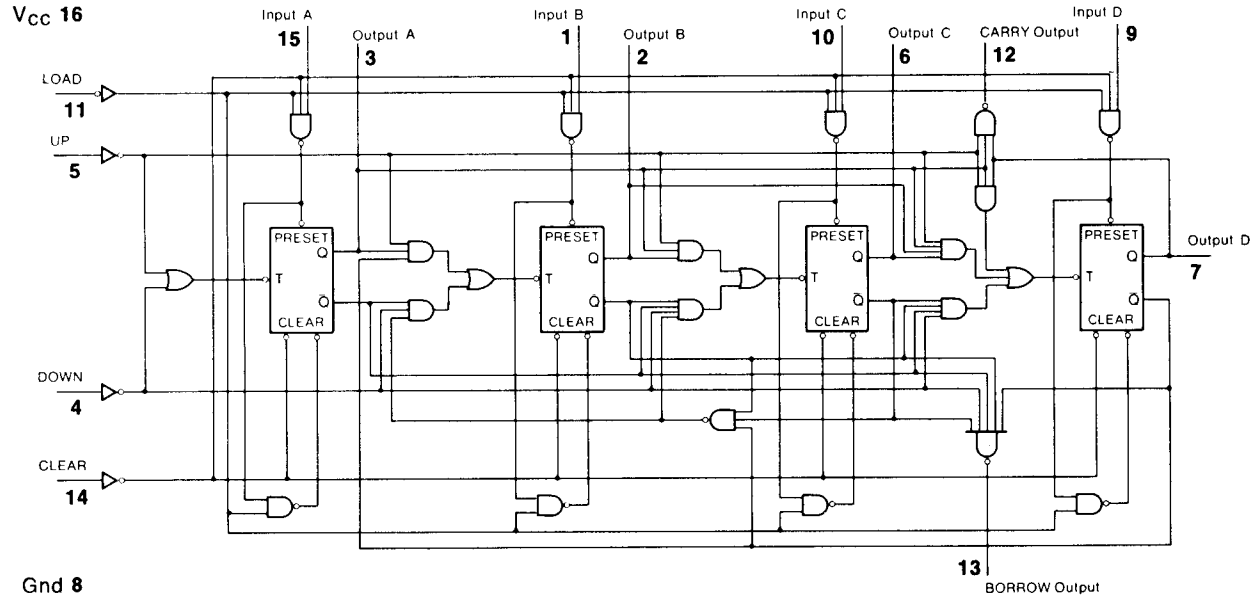
54/74181 4-Bit Arithmetic Logic Unit



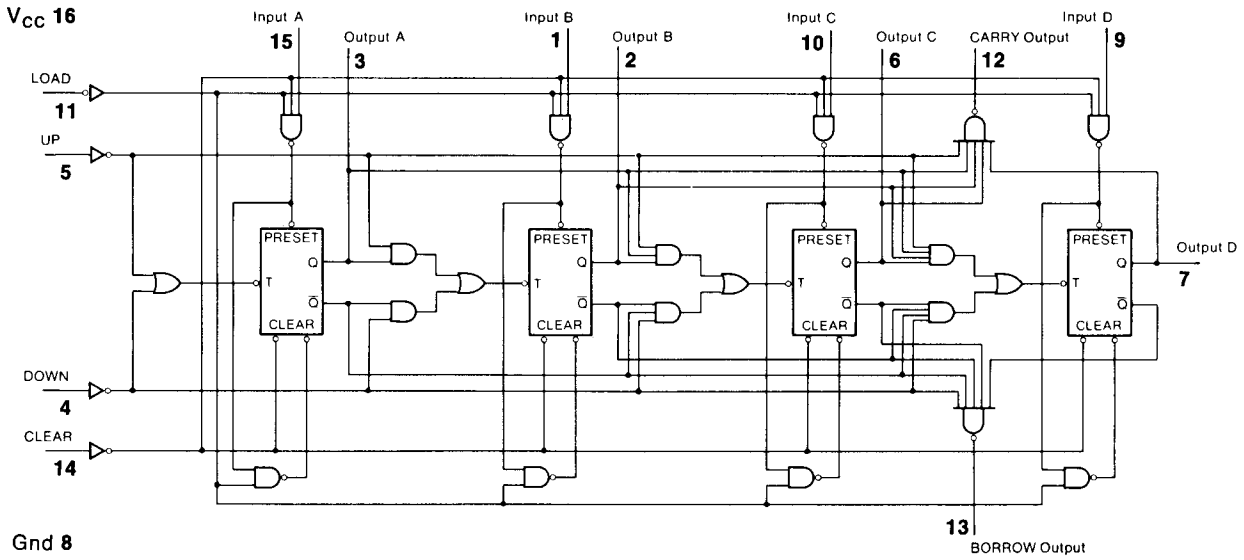
54/74182 Look-Ahead Carry Generator



54/74192 Reversible BCD Decade Counter



54/74193 Reversible Modulo-16 Binary Counter

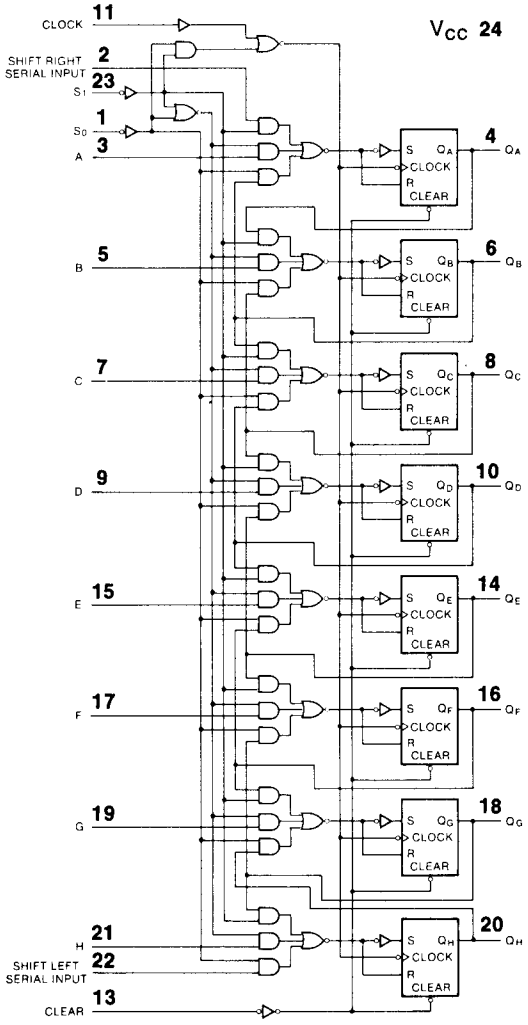


Operations Table

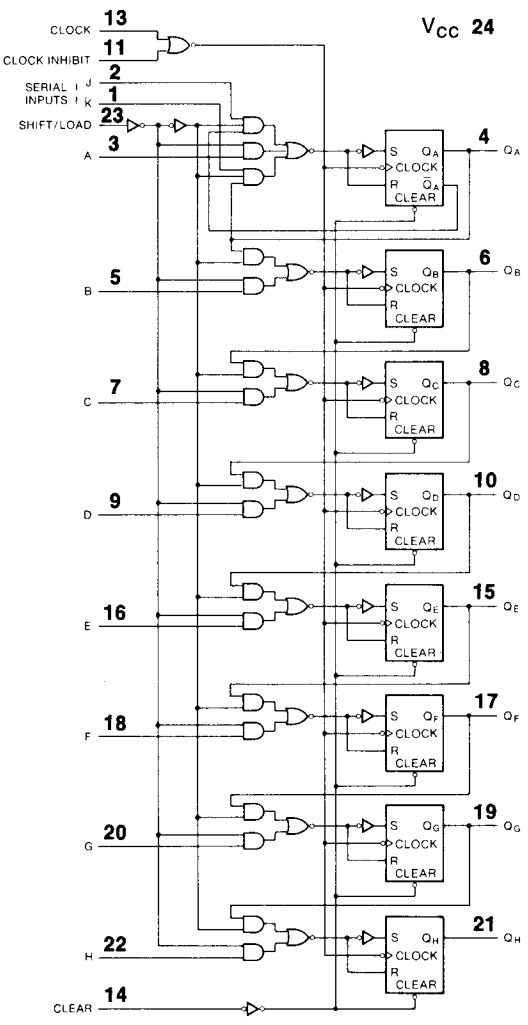
OPERATION	INPUTS UP CLOCK	DOWN CLOCK	CLEAR	LOAD	A, B, C, D	RESPONSE AT Q OUTPUTS
Clocking	↑	1	0	1	X	Count UP
	1	↑	0	1	X	Count DOWN
	0	↑	0	1	X	Q_A unchanged; others unchanged if Q_A is high
	↑	0	0	1	X	Q_A unchanged; others unchanged if Q_A is low
	↑	↑	0	1	X	Undefined for race conditions
Clearing	ϕ	ϕ	1	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

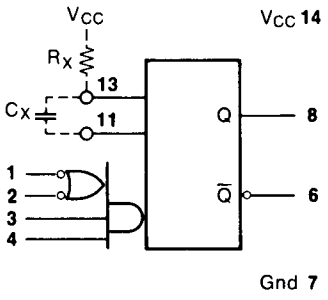
54/74198 8-Bit Shift Register



54/74199 8-Bit Shift Register



9601 Retriggerable One-Shot

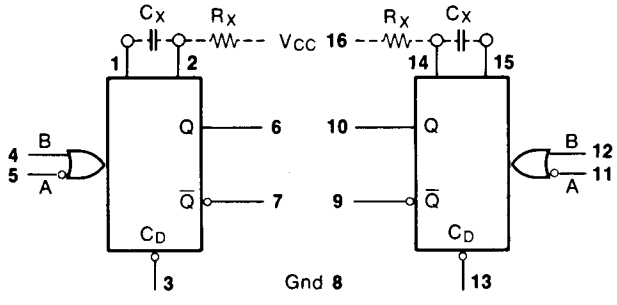


Triggering Truth Table

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

ϕ = immaterial

9602 Dual Retriggerable One-Shot



Triggering Truth Table

A	B	CD	RESPONSE
X	X	0	No Trigger
↓	0	X	No Trigger
↓	1	1	Trigger
1	↓	X	No Trigger
0	↓	1	Trigger

X = immaterial

DTL Numerical Index

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945-1	945-2	R-S/J-K Clocked Flip-Flop	20
946-1	946-2	Quad 2-input NAND Gate	20
948-1	948-2	R-S/J-K Clocked Flip-Flop	20
949-1	949-2	Quad 2-input NAND Gate	20
950-1	950-2	Pulse Triggered Flip-Flop	20
951-1	951-2	Monostable Multivibrator	20
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*705=9093; 706=9099; 708=9094; 709=9097

Ordering Information

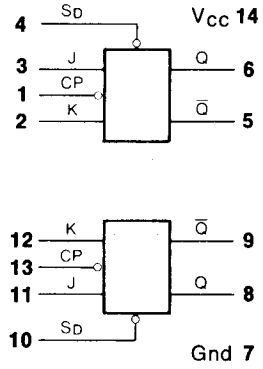
Package Suffix Letters: F=Ceramic Flat Pack M=Plastic Dual-in-Line P=Ceramic Dual-in-Line

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

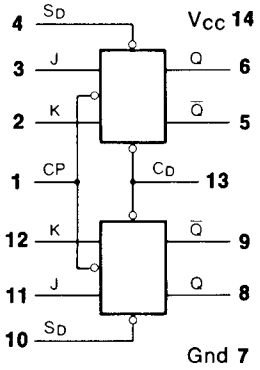
DTL Functional Index

*Free-Collector outputs

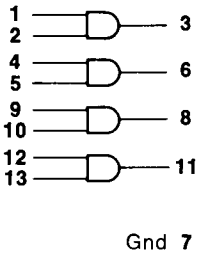
Dual J-K Clocked Flip-Flop
Separate clocks
705 (9093) 6k pull-up resistors
708 (9094) 2k pull-up resistors



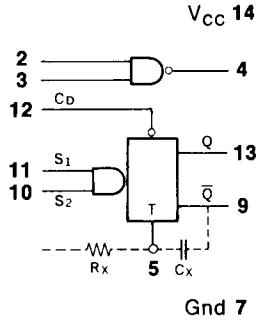
Dual J-K Clocked Flip-Flop
Common clocks, common reset
706 (9099) 6k pull-up resistors
709 (9097) 2k pull-up resistors



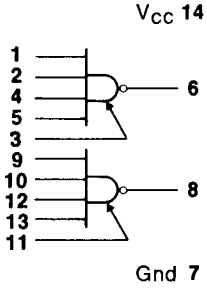
727 Quad 2-input Expander Diodes



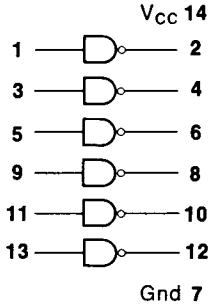
728 Monostable Multivibrator



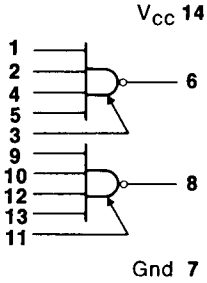
729 Dual Lamp Driver
Free-collector outputs, 100 mA
Expandable



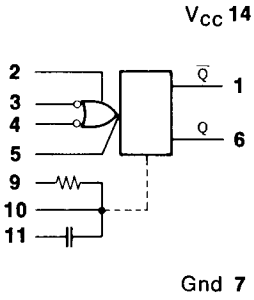
Hex Inverter
Free-collector outputs
736 8V output rating
737 15V output rating



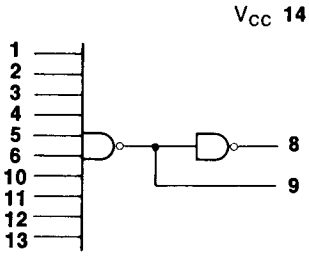
744 Dual Power Gate
Free-collector outputs, 15V/40 mA
Expandable



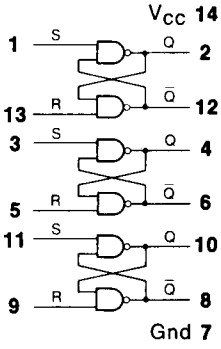
751 Monostable Multivibrator



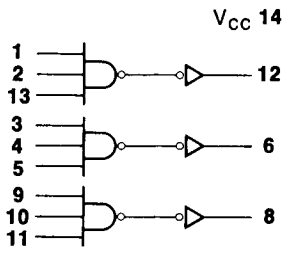
10-input Complementary Gate
770 6k pull-up resistors
771 2k pull-up resistors



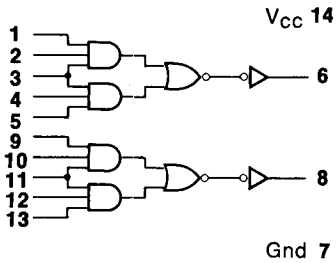
Triple R-S Flip-Flop
772 6k pull-up resistors
773 2k pull-up resistors



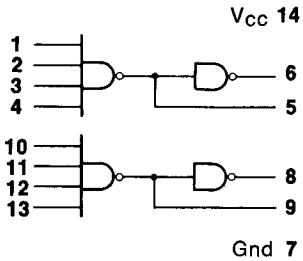
Triple 3-input AND Gate
774 6k pull-up resistors
775 2k pull-up resistors



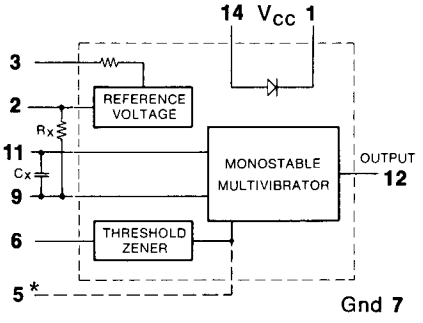
Dual AND-OR Gate
776 6k pull-up resistors
777 2k pull-up resistors



Dual 4-input Complementary Gate
778 6k pull-up resistors
779 2k pull-up resistors



781 Tachometer Driver

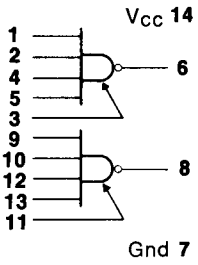


*Optional low-level trigger input available on special order.

930 Dual 4-input NAND Gate

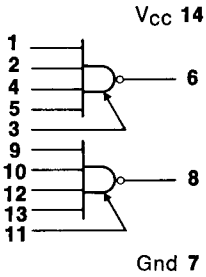
Expandable

6k pull-up resistors

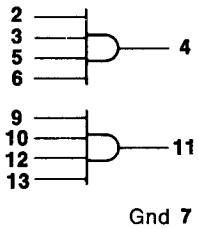


932 Dual 4-input Buffer

Expandable



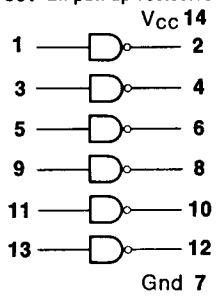
933 Dual 4-input Expander Diodes



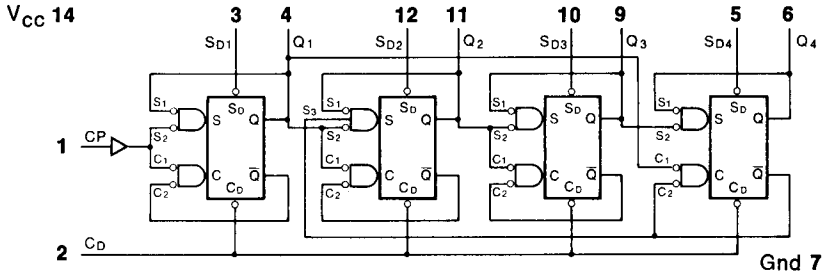
Hex Inverter

936 6k pull-up resistors

937 2k pull-up resistors



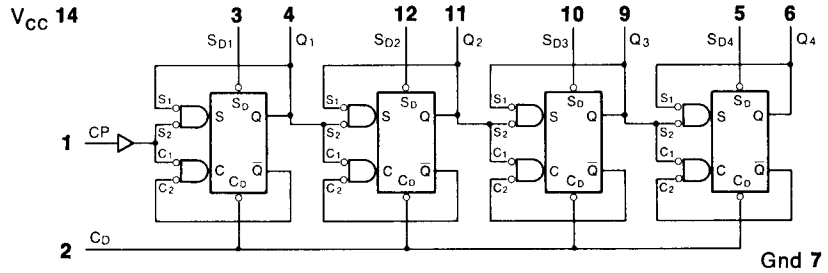
838/938 Decade Counter



Truth Table

	Q1	Q2	Q3	Q4
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

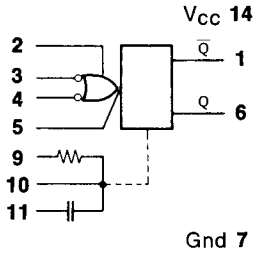
839/939 Divide-by-Sixteen Counter



Truth Table

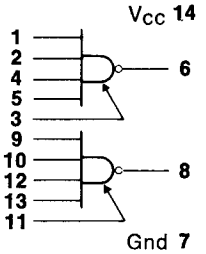
	Q1	Q2	Q3	Q4
0	LOW	LOW	LOW	LOW
1	HIGH	LOW	LOW	LOW
2	LOW	HIGH	LOW	LOW
3	HIGH	HIGH	LOW	LOW
4	LOW	LOW	HIGH	LOW
5	HIGH	LOW	HIGH	LOW
6	LOW	HIGH	HIGH	LOW
7	HIGH	HIGH	HIGH	LOW
8	LOW	LOW	LOW	HIGH
9	HIGH	LOW	LOW	HIGH
10	LOW	HIGH	LOW	HIGH
11	HIGH	HIGH	LOW	HIGH
12	LOW	LOW	HIGH	HIGH
13	HIGH	LOW	HIGH	HIGH
14	LOW	HIGH	HIGH	HIGH
15	HIGH	HIGH	HIGH	HIGH
0	LOW	LOW	LOW	LOW

941 Monostable Multivibrator



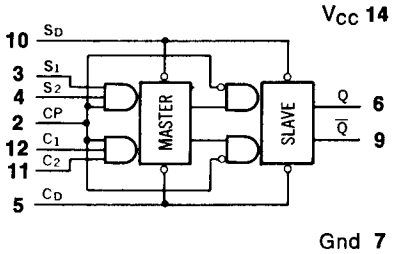
944 Dual 4-input NAND Power Gate

Expandable



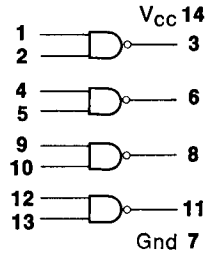
945 R-S/J-K Clocked Flip-Flop

6k pull-up resistors



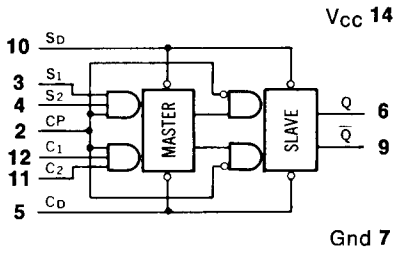
946 Quad 2-input NAND Gate

6k pull-up resistors



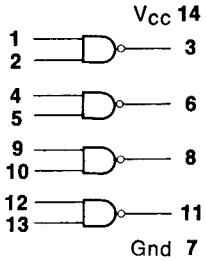
948 R-S/J-K Clocked Flip-Flop

2k pull-up resistors

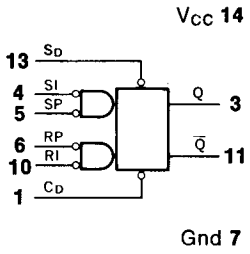


949 Quad 2-input NAND Gate

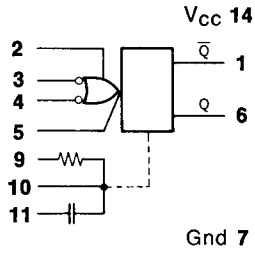
2k pull-up resistors



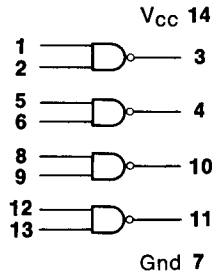
950 Pulse Triggered Flip-Flop



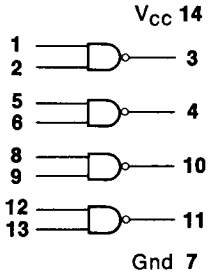
951 Monostable Multivibrator



957 Quad 2-input Buffer



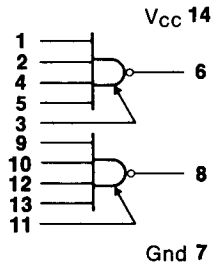
958 Quad 2-input Power Gate



961 Dual 4-input NAND Gate

Expandable

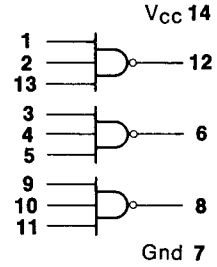
2k pull-up resistors



Triple 3-input NAND Gate

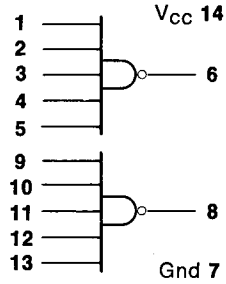
962 6k pull-up resistors

963 2k pull-up resistors



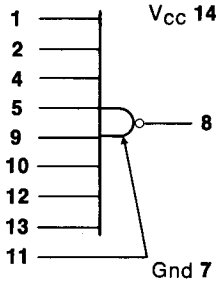
1800/1900 Dual 5-input NAND Gate

6k pull-up resistors



1802/1902 8-input NAND Gate

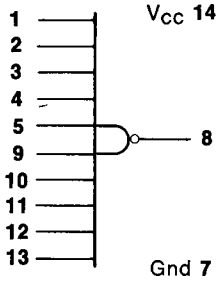
Expandable



10-input NAND Gate

1804/1904 6k pull-up resistors

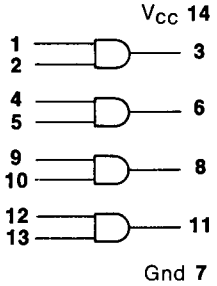
1805/1905 2k pull-up resistors



Quad 2-input AND Gate

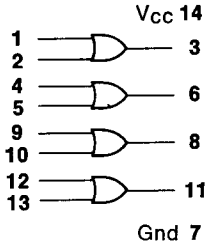
1806/1906 6k pull-up resistors

1807/1907 2k pull-up resistors



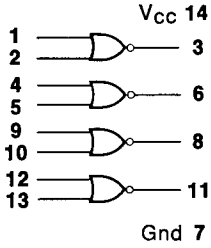
1808/1908 Quad 2-input OR Gate

6k pull-up resistors



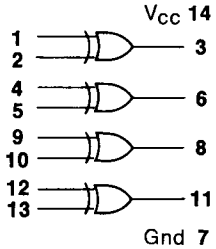
1810/1910 Quad 2-input NOR Gate

6k pull-up resistors

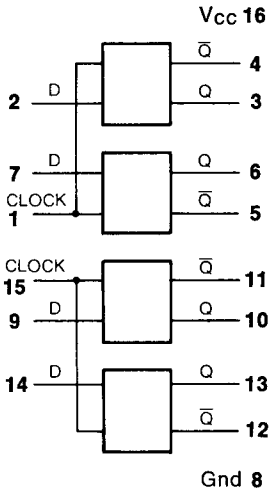


1812/1912 Quad Exclusive-OR Gate

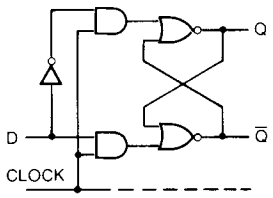
6k pull-up resistors



1813/1913 Quad Latch



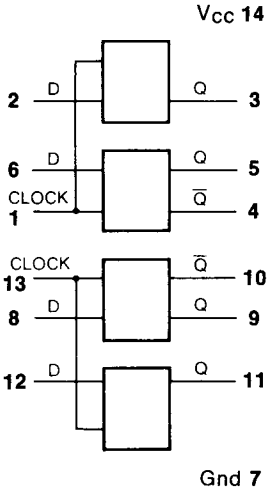
latch logic



Truth Table

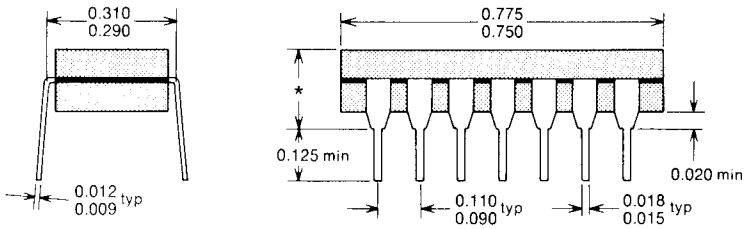
C	D	Q	$\overline{Q}$
Low	Low	No Change	
Low	High	No Change	
High	Low	Low	High
High	High	High	Low

1814/1914 Quad Latch

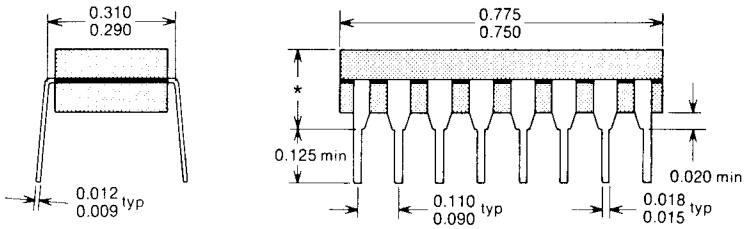


Dual-in-Line (D.I.P.)

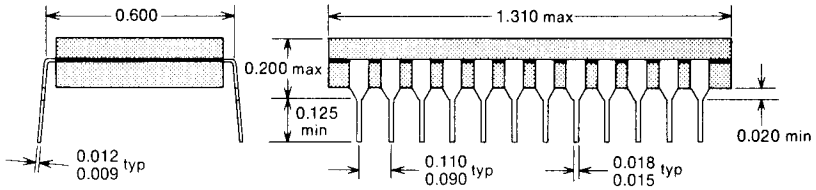
14 Pin Ceramic or Plastic



16 Pin Ceramic or Plastic

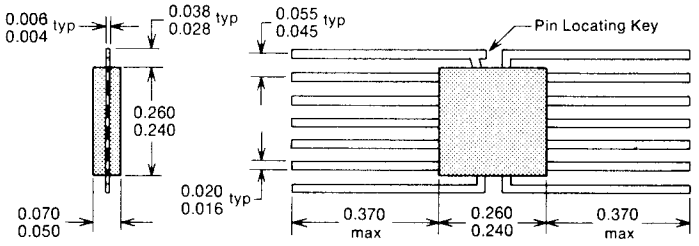


24 Pin Ceramic or Plastic



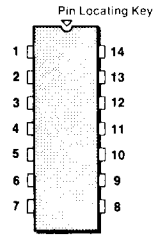
* 0.200 max = ceramic 0.170 max = plastic

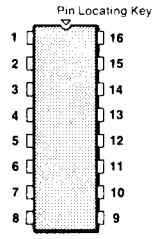
14 Pin Ceramic Flat Pack

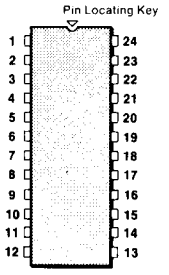


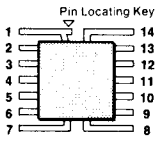
All dimensions in inches.

Pin Identification









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PRINTED IN U.S.A. 8-73

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
$\underline{Y}$	output
$\overline{Y}$	inverted Y output
$\underline{Q}$	flip-flop output
$\overline{Q}$	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 incluced are the theroems 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-Flops: 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 (d) and beta (p). 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

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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.

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THE HL-583 HI-LO PULSER
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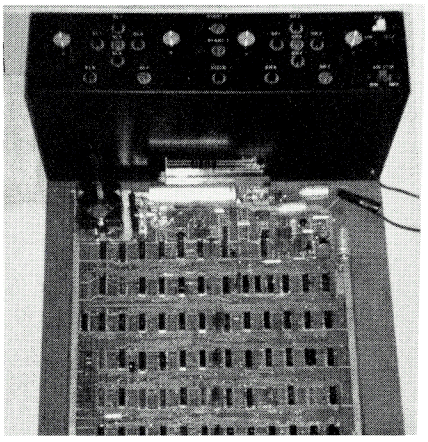

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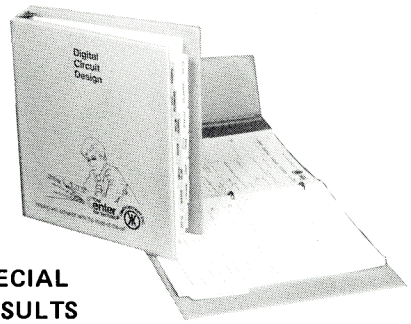

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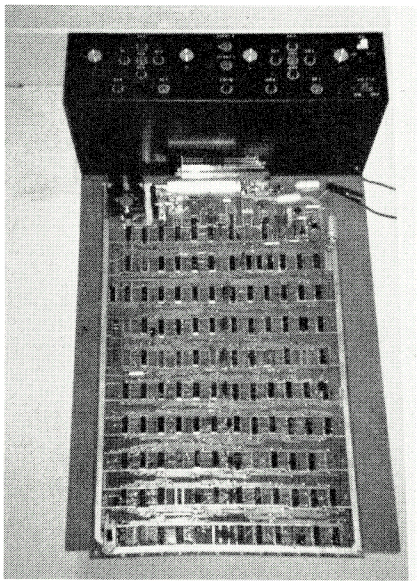


Program Card List for TF-650 (Test Fixture)

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	Footsball	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
123	GT 10 – 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
137	TV Pin Pong	Chicago Dynamics
138	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	Wimbleton	Nutting
155	Missles Radar	Nutting
156	Table Tennis	Nutting
157	Hockey	PMC
158	Wam Bam	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 TVto 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
$F = (7.159 \times 10^6)$

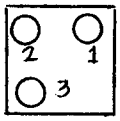
Therefore $X = 1/(7.159 \times 10^6)$
$X = (.13968 \times 10^{-6})$
X = .140 u sec

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) x (.140 x 10-6) = 63.28 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) x (63.28x 10-6) = 16,516.08 u sec. 16,516 u sec. = 16.516 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.

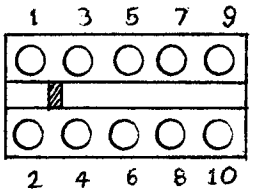
The first place to connect to is the +5VDC and GND of the computer board. Then decide which pattern is affiliated with your TV.



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. Interprete 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 PCB is bad and the monitor is OK and vice-versa.

END USER PRICE SCHEDULE EFFECTIVE 6/1/75

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

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 (5-15V TTL/HTL/C-MOS)	96.00
PLP-550	**HTL/TTL/C-MOS Probe**	**237.00**
IC-592	C-MOS, TTL, HTL IC tester (battery power)	199.95
IC-593	C-MOS, TTL, HTL IC tester AC power	325.00
PBB-1501	PBB-1 Power Board (Battery operated)	49.95
PBD-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
RB-510C	clear bulbs	3.00
RB-520	colored bulbs	3.00
RB-520-C	clear bulbs	3.00
RB-520-002	colored bulbs	3.75
RB-520-002C	clear bulbs	3.75
RB-530	colored bulbs	3.00
RB-530C	clear bulbs	3.00
RB-540	colored bulbs	3.00
RB-540C	clear bulbs	3.00
RB-560	colored bulbs	7.20
RB-560C	clear bulbs	7.20
RB-576C	clear bulbs	3.00
	PROBE TIP ADAPTORS	
A520-1	2¾" Long .025 Square	3.50
A520-2	3½" Long .031 x .062	3.50
A520-5	7¼" Long .025 Square	3.50
A520-6	7¼" Long .031 x .062	3.50
A520-7	7¼" 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
PP-1	"G" Probe Gating Connector Probe Pouch	3.00
	I C TESTER ACCESSORIES	
IC-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 $\overline{\text{CLOCK}}$ signals to the logic circuits of the computer.

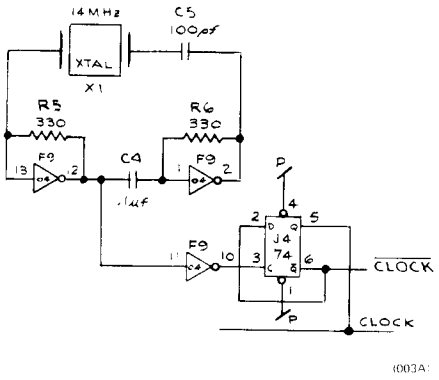


Figure 2-2. Computer Clock

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 $\overline{\text{256H}}$. These submultiples are distributed to various logic circuits of the computer for timing and signal development purposes. The development of the H SYNC, $\overline{\text{H SYNC}}$, H BLANK, $\overline{\text{H BLANK}}$, H RESET, and $\overline{\text{H RESET}}$ 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.

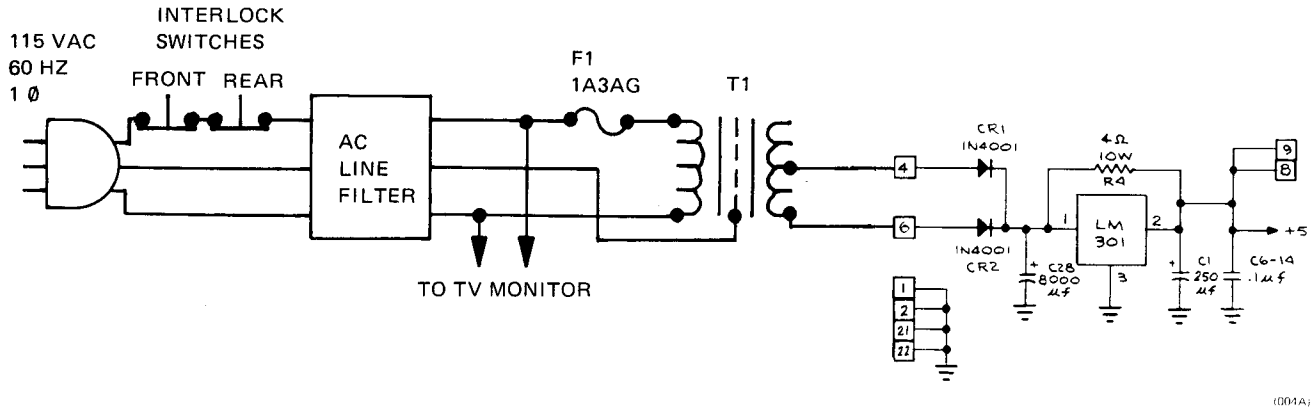


Figure 2-1. Power Supply

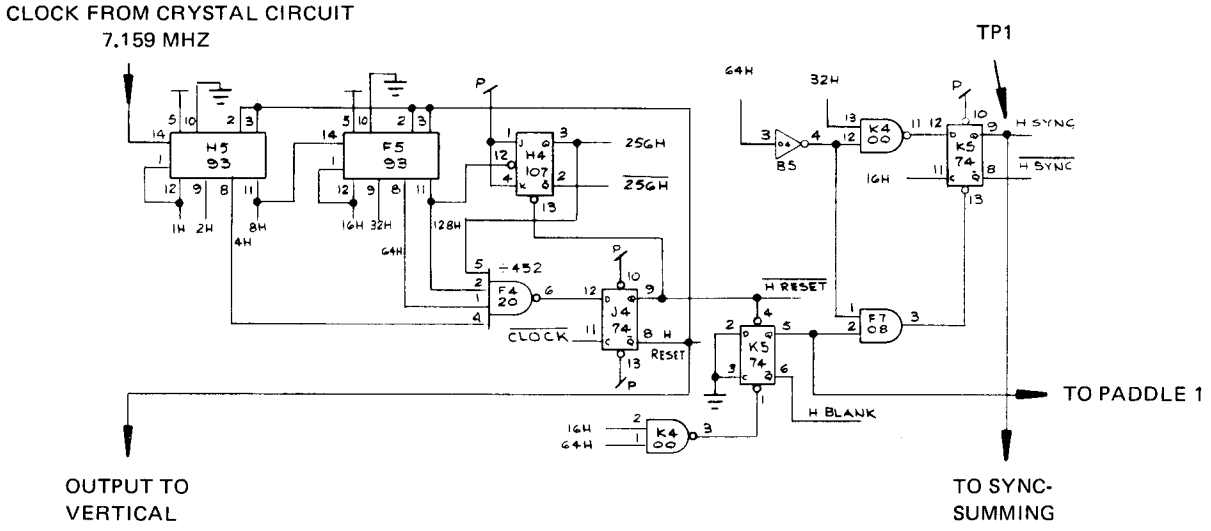


Figure 2-3. Horizontal Sync and Blanking Circuitry

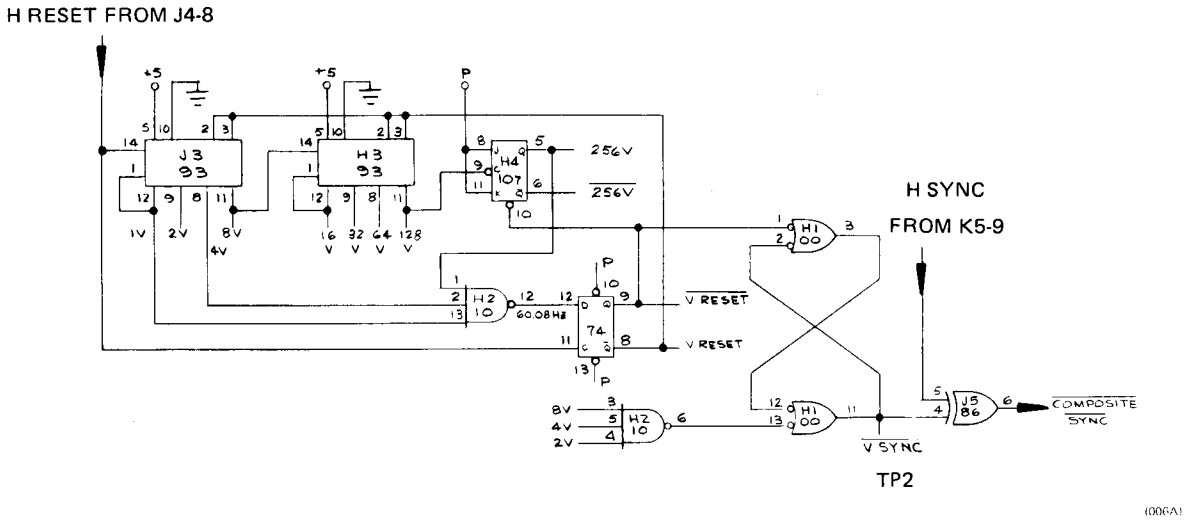
2-8. Each TV line of the Rebound game is approximately 63 usec long, which is equivalent to the time it takes the counter to count 453 CLOCK pulses after being reset. At the count of 452, the 256H, 128H, and 4H signals are all high. As a result, the output of NAND gate F4-6 goes low. When the next $\overline{\text{CLOCK}}$ pulse occurs, the Q output of flip-flop J4-9/8 goes low and the $\overline{Q}$ 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 $\overline{Q}$ 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 $\overline{Q}$ output to go low, which establishes the leading edge of the $\overline{\text{H BLANK}}$ 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 K4-11 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, K5-11, 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 $\overline{Q}$ output goes high, which forms the leading edge of the $\overline{\text{H SYNC}}$ 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 $\overline{\text{H SYNC}}$ 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 and $\overline{\text{H BLANK}}$ signals. The $\overline{\text{H SYNC}}$ and $\overline{\text{H BLANK}}$ are both used by other circuits of the computer, and the H SYNC signal is used by circuits of the computer and is sent to the TV monitor via the sync summing and video summing circuits.

2-10. VERTICAL SYNC CIRCUITRY

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 $\overline{\text{256V}}$. These submultiples are distributed to various logic circuits of the computer for timing and signal development purposes. The development of the $\overline{\text{V RESET}}$, V RESET, and $\overline{\text{V SYNC}}$ 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.

2-12. It requires 1/60.08 second to develop one field of the TV picture for the Rebound game, which is the time it takes the counter to count 262 H RESET pulses after being reset. At the count of 261, the 256V, 4V, and 1V signals are all high. As a result, the output of NAND gate H2-12 goes low. When the next H RESET pulse occurs, the Q output ($\overline{\text{V RESET}}$) of flip-flop J2-9/8 goes low and the $\overline{Q}$ out-



(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 $\overline{Q}$ 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 H1-3/11 causes the output at pin H1-11 to go low, which forms the leading edge of the $\overline{\text{V SYNC}}$ 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 $\overline{\text{V SYNC}}$ 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 $\overline{\text{V SYNC}}$ pulses are applied to pin 4. The logic of the exclusive OR gate causes the $\overline{\text{V SYNC}}$ pulse to be serrated by the H SYNC pulses. Serrating the $\overline{\text{V SYNC}}$ 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 2-10a). 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.

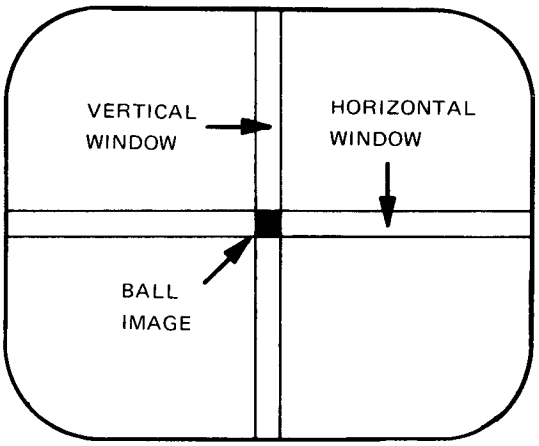
2-65. If the ball window signal occurs at the same frequency as the sync signal, the window appears in the same place each TV field. However, if the window signal that produces horizontal ball motion is delayed so that it counts one more clock pulse than horizontal sync, the window created in the next 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.

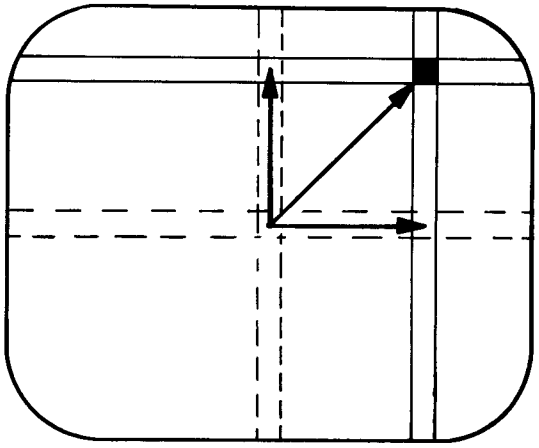
2-67. The horizontal motion circuit uses 9316 counters, which are almost identical to the 7493 counters of the horizontal sync circuit; the counters of both circuits are run in parallel by the same clock. The 7493 counters always start counting from zero. The count of the 9316, however, is started from 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

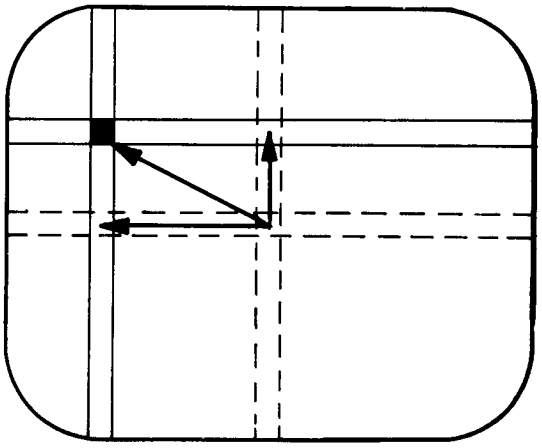
2-69. The vertical ball motion circuit is almost identical to the horizontal motion circuit with the following exceptions. This circuit creates a horizontal window that moves vertically and, therefore, different inputs are used. The electron beam is blanked out during its vertical retrace, so $\overline{\text{V BLANK}}$ is used to turn the electron beam on and off at the right times. $\overline{\text{H SYNC}}$ 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

1012A-1

Figure 2-10. Ball Image Generation

MOTOROLA service manual

FILE VP11

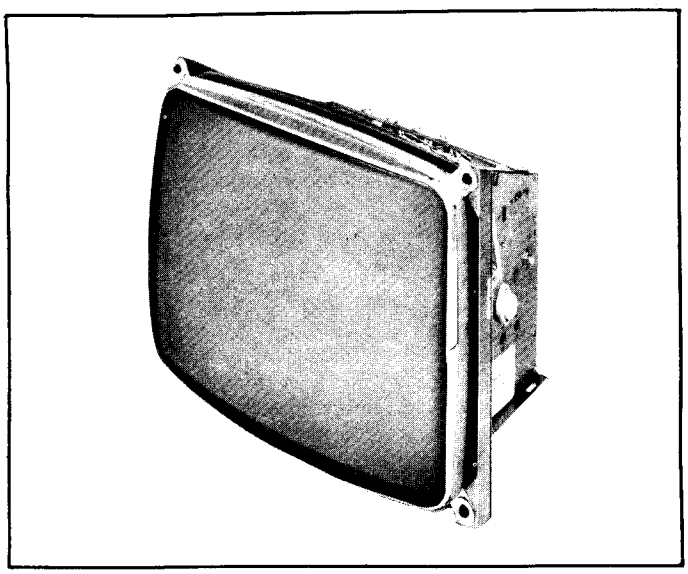
VISUAL DISPLAY PRODUCTS

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			470 Ω

TABLE OF CONTENTS

MOTOROLA INC. *Consumer Products Division* FRANKLIN PARK, ILLINOIS 60131

PART NO. 68P65130A66 1-74 PRICE $1.00

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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.

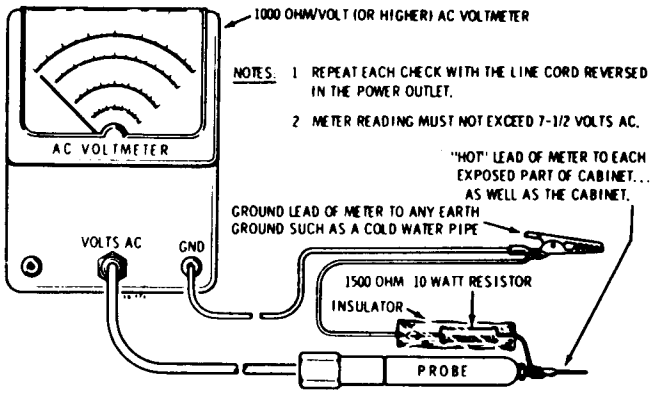
4. An ISOLATION TRANSFORMER should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect 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.

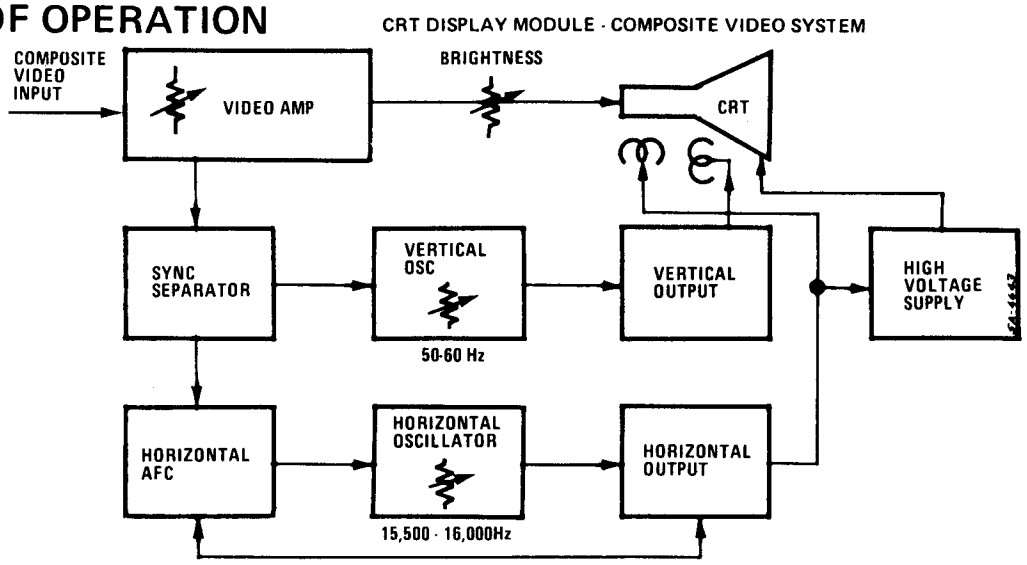
A 1000 ohm per volt AC voltmeter is prepared by shunting it with a 1500 ohm, 10 watt resistor. The safety test is made by contacting one meter probe to any portion of the unit exposed to the operator such as the cabinet trim, hardware, controls, knobs, etc., while the other probe is held in contact with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

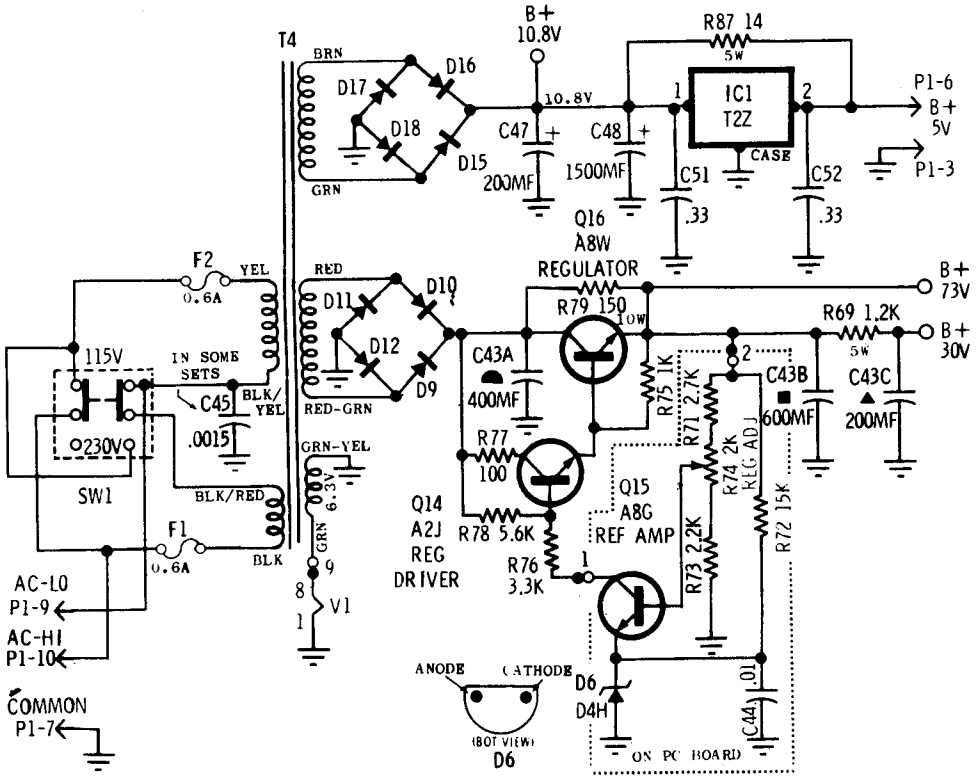
The above test should be repeated with the power plug reversed, when applicable.

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

THEORY OF OPERATION



Block Diagram



POWER SUPPLY

The power supply is a transformer operated, full wave, regulated supply which maintains constant output voltage with input variations of ± 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.

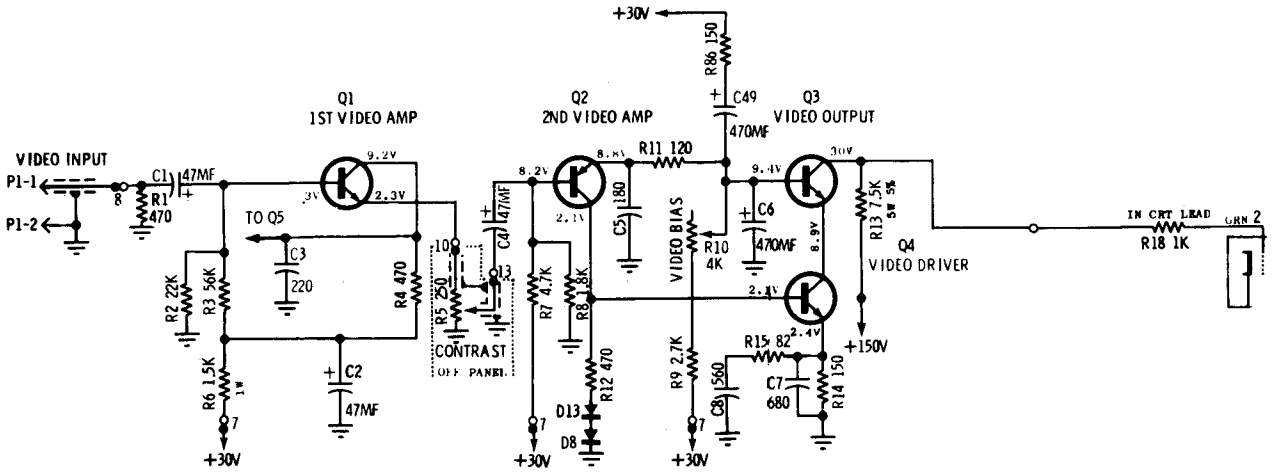
The output voltage of the regulator appears at the emitter of Q16. This voltage is divided between R71, R74 and R73. The voltage appearing on the arm of potentiometer R74 is a reference input to the base of Q15.

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.



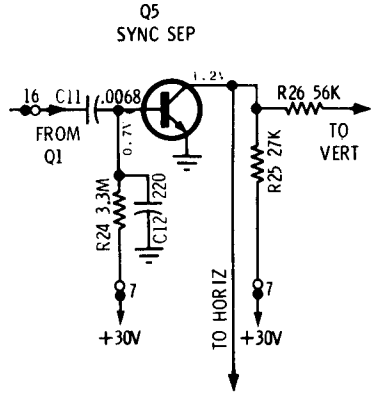
VIDEO AMPLIFIER

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.

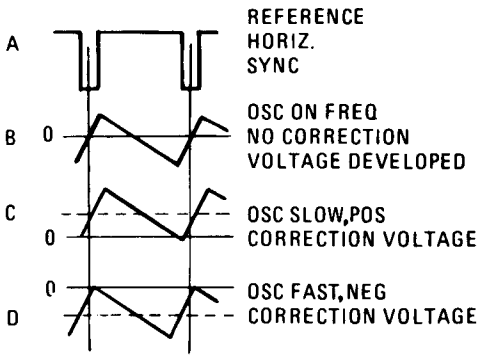
SYNC SEPARATOR

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. C11 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.



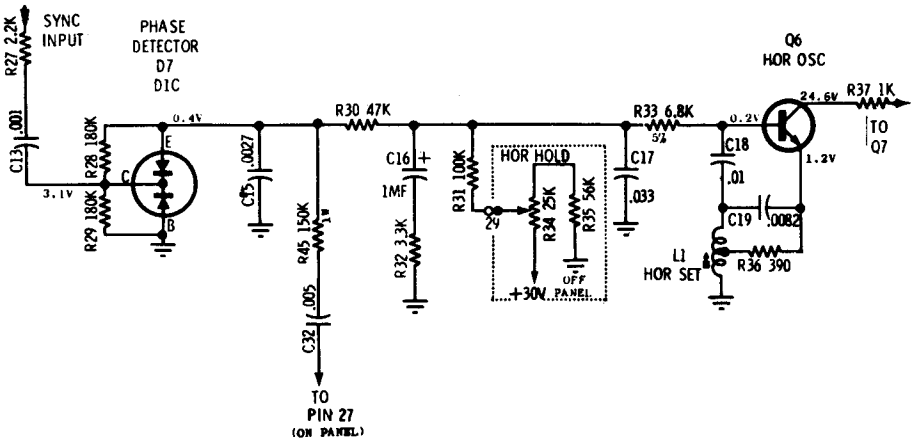
PHASE DETECTOR

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.

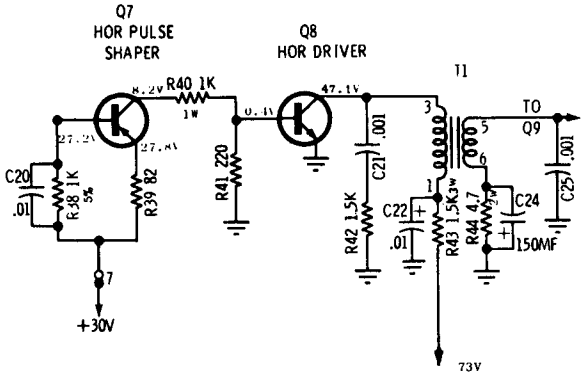


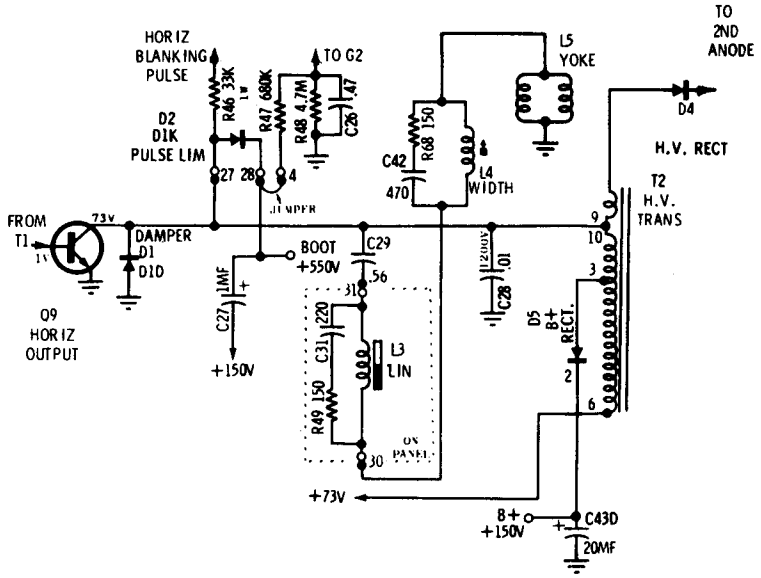
HORIZONTAL OSCILLATOR

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.

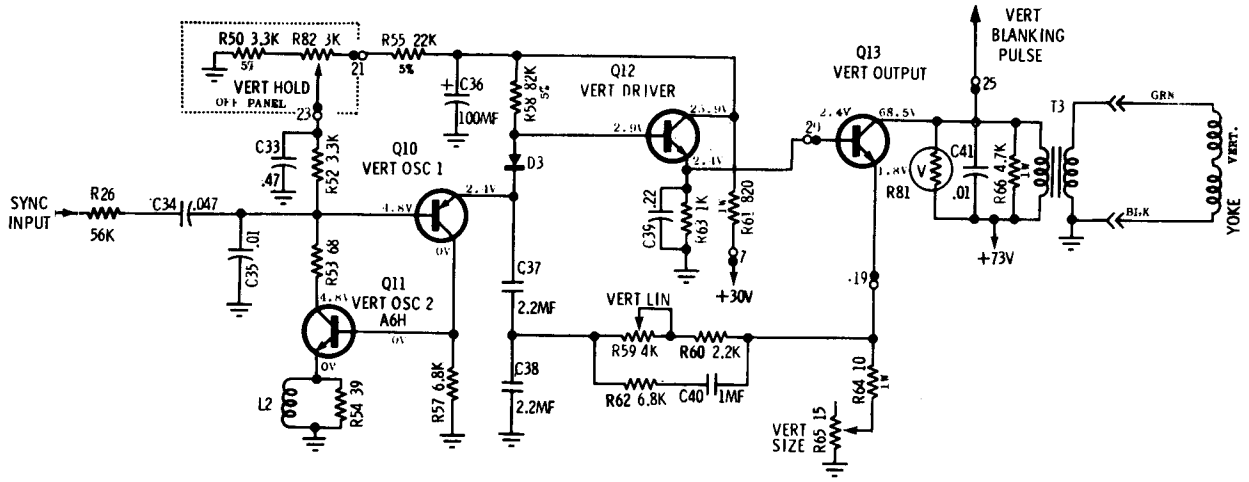




HORIZONTAL OUTPUT

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.

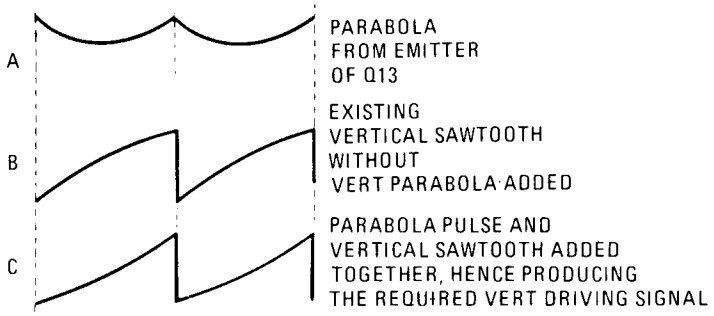


VERTICAL OSCILLATOR DRIVER AND OUTPUT

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.

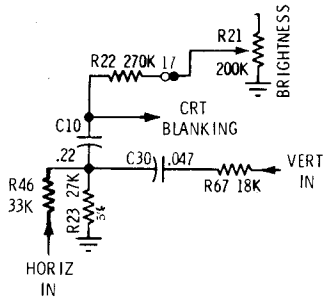
T3 matches the collector of Q13 to the vertical yoke. When Q13 is cut off during vertical retrace, a high voltage pulse is developed across the primary of T3. To limit this pulse to a safe value a varistor, R81, is connected across the primary. R66 and C41 provide damping to shape the collector pulse 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.



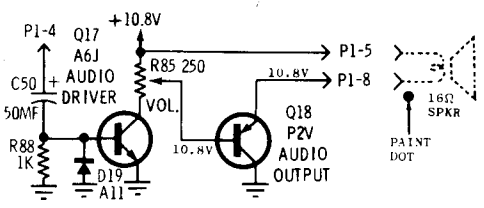
RETRACE BLANKING

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.

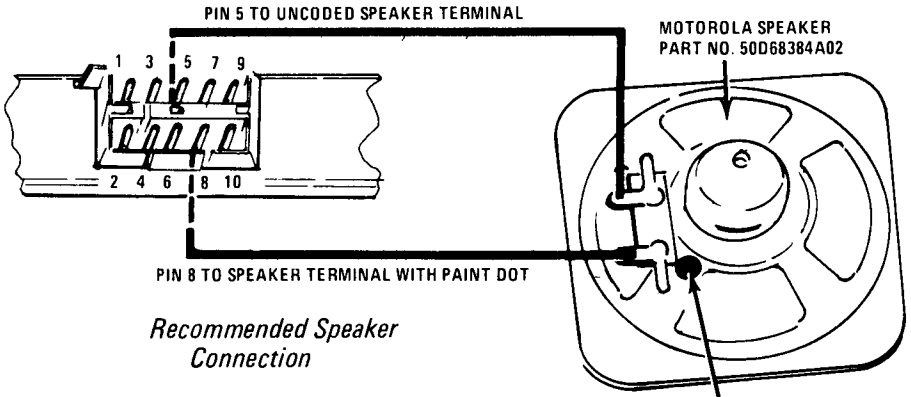
NOTE: Use caution when tightening transistor mounting screws. If the screw threads are stripped by excessive pressure, a poor electrical and mechanical connection will result.

CRT REPLACEMENT

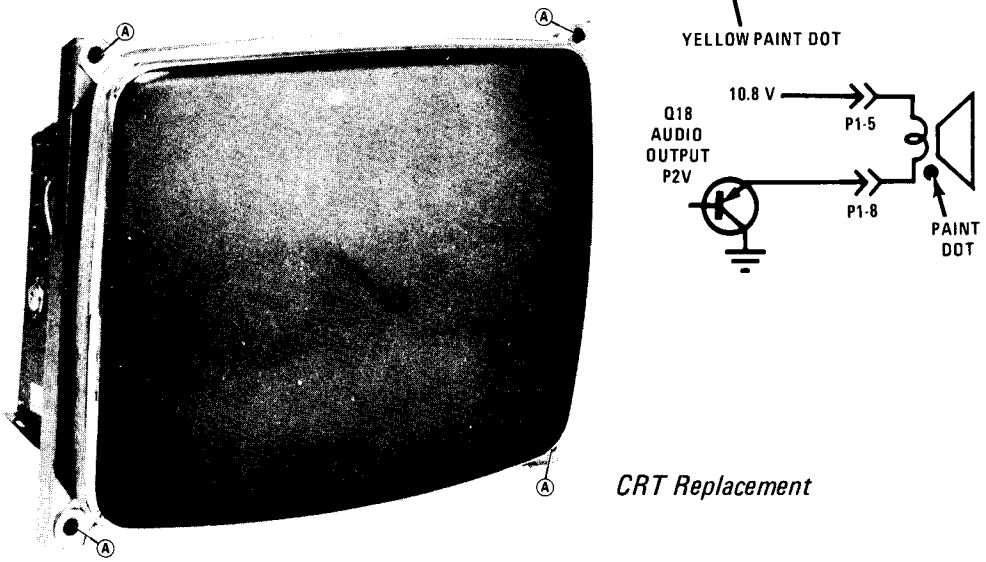
Use extreme care in handling the CRT as rough handling may cause it to implode due to atmospheric pressure. Do not nick or scratch glass or subject it to any undue pressure in removal or installation. Use goggles and heavy gloves for protection.

1. Discharge CRT by shorting 2nd anode to GND. Remove CRT socket, yoke and 2nd anode lead.

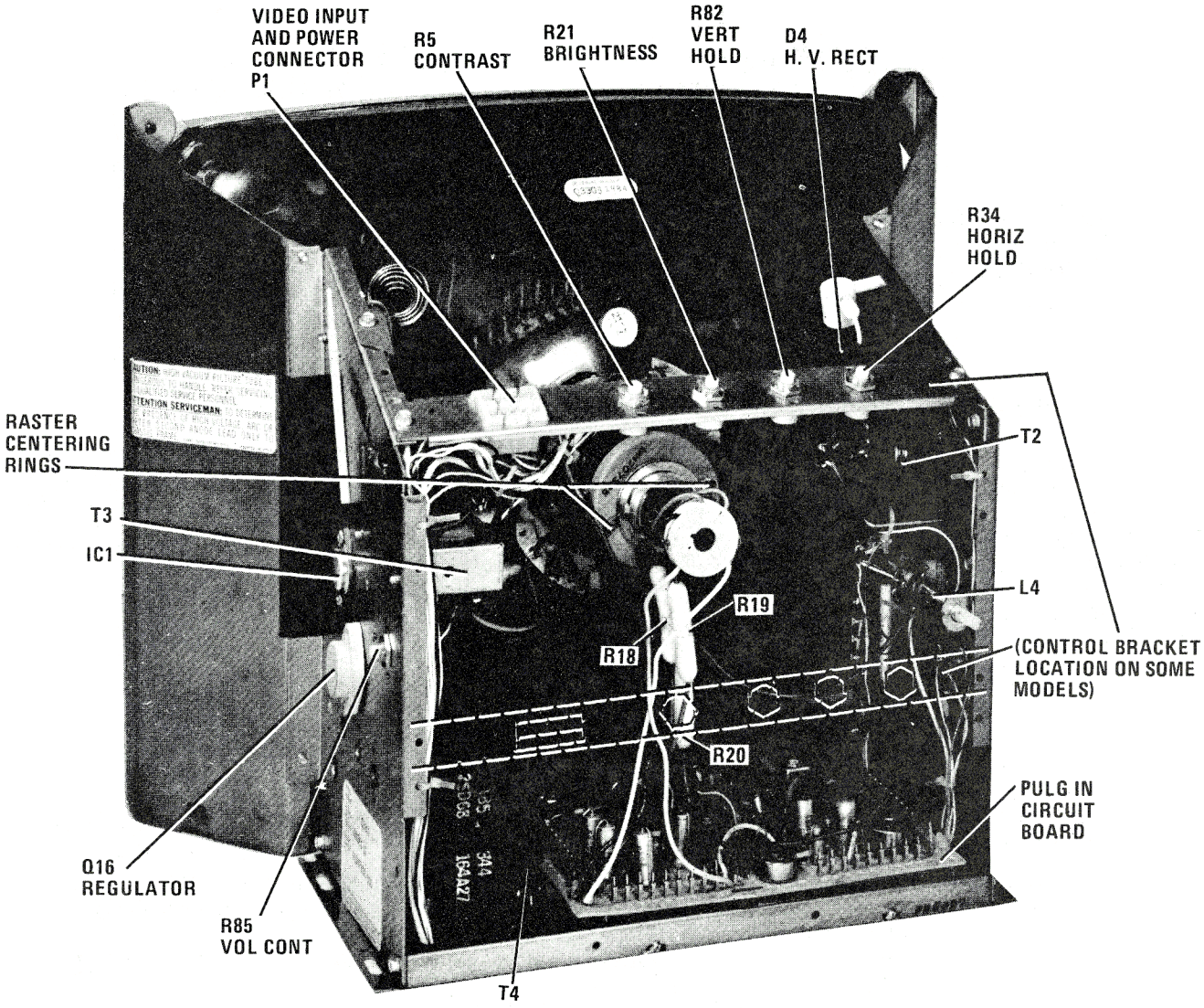
2. Remove CRT from chassis by removing four screws Ⓐ at corners.



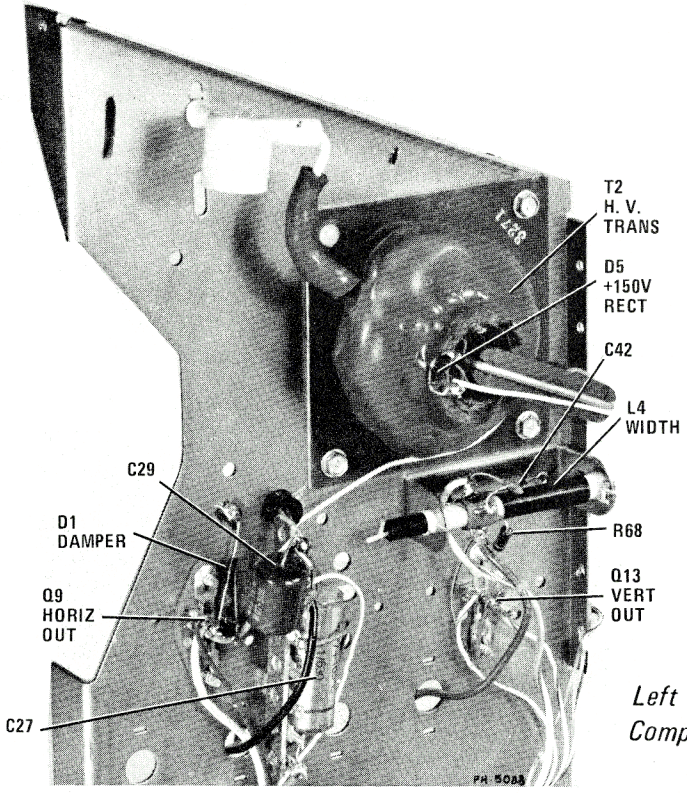
Recommended Speaker Connection



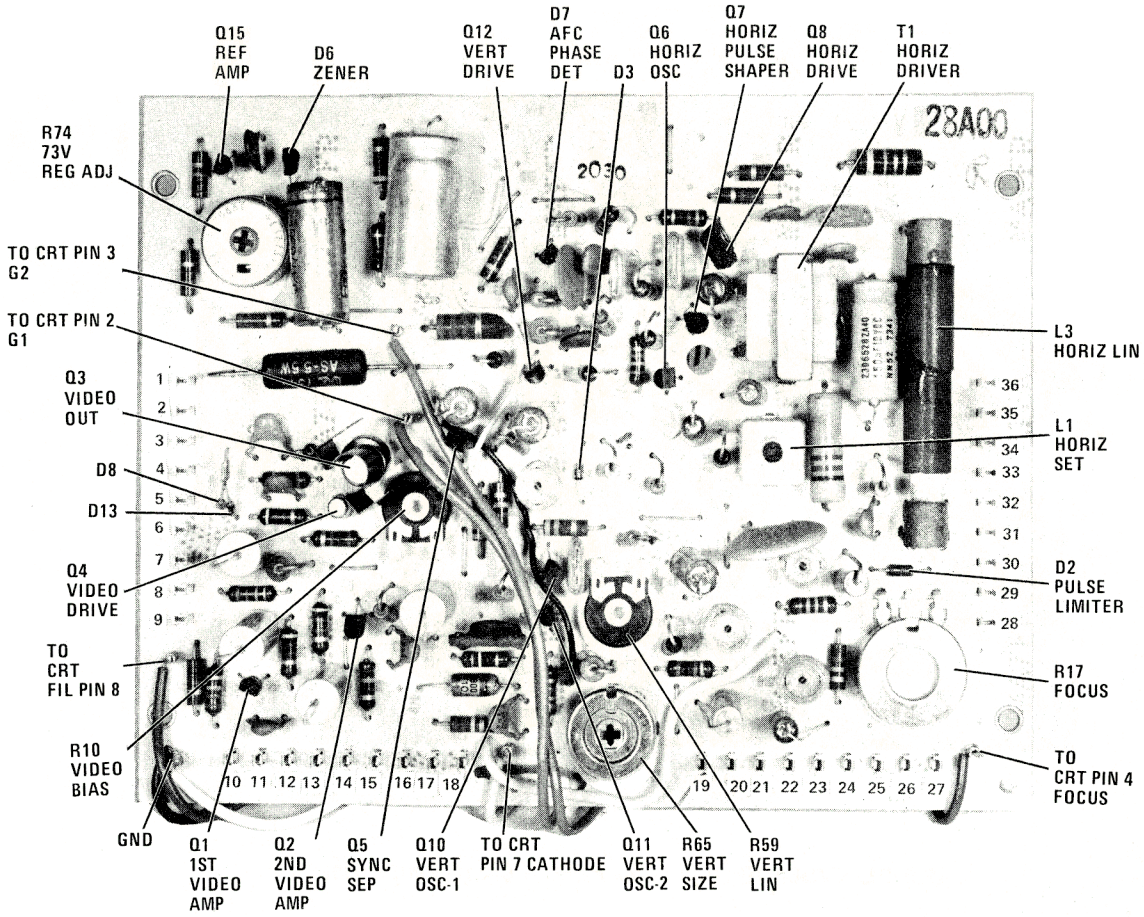
CRT Replacement



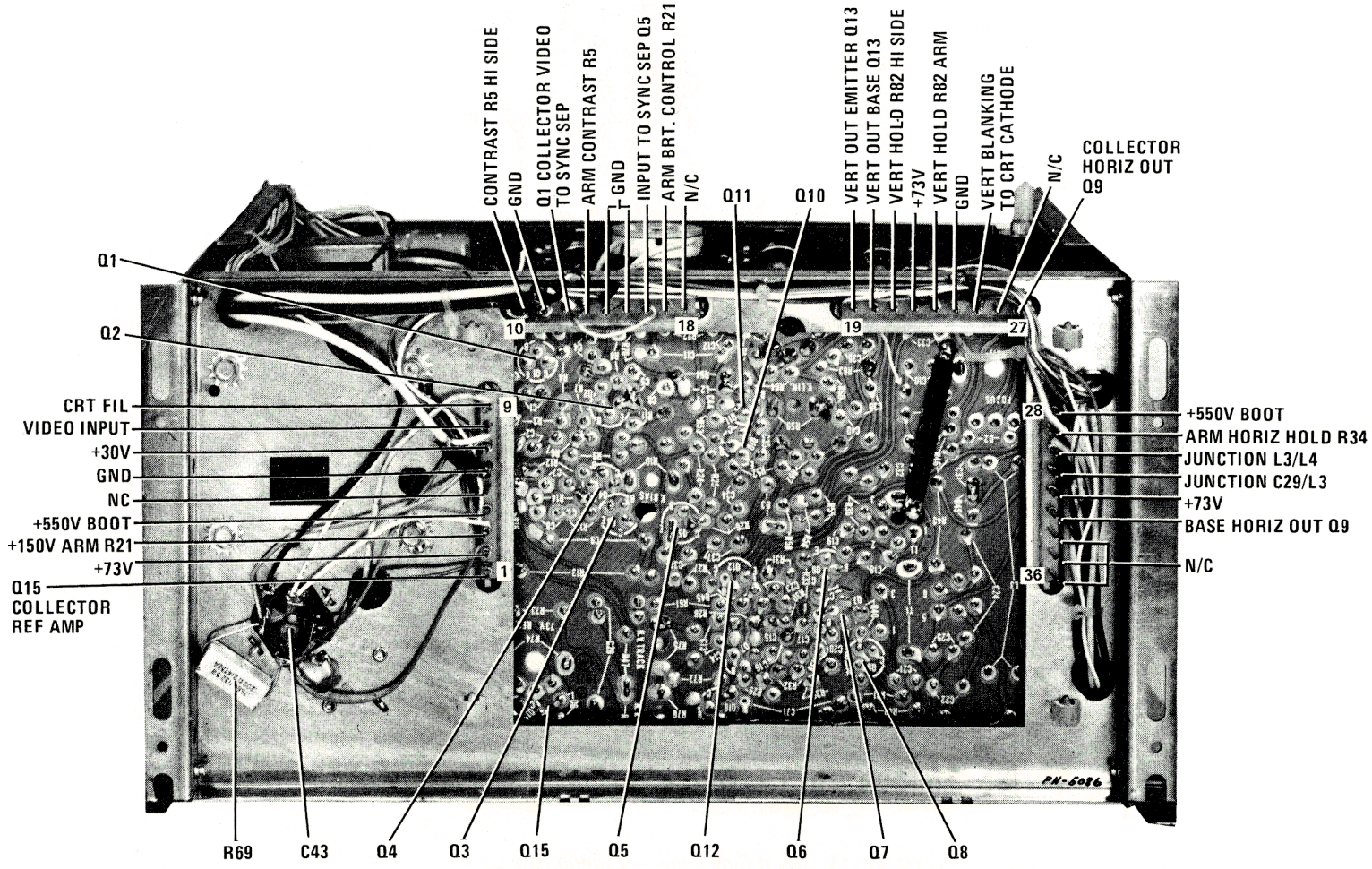
Chassis Rear View – Component Location



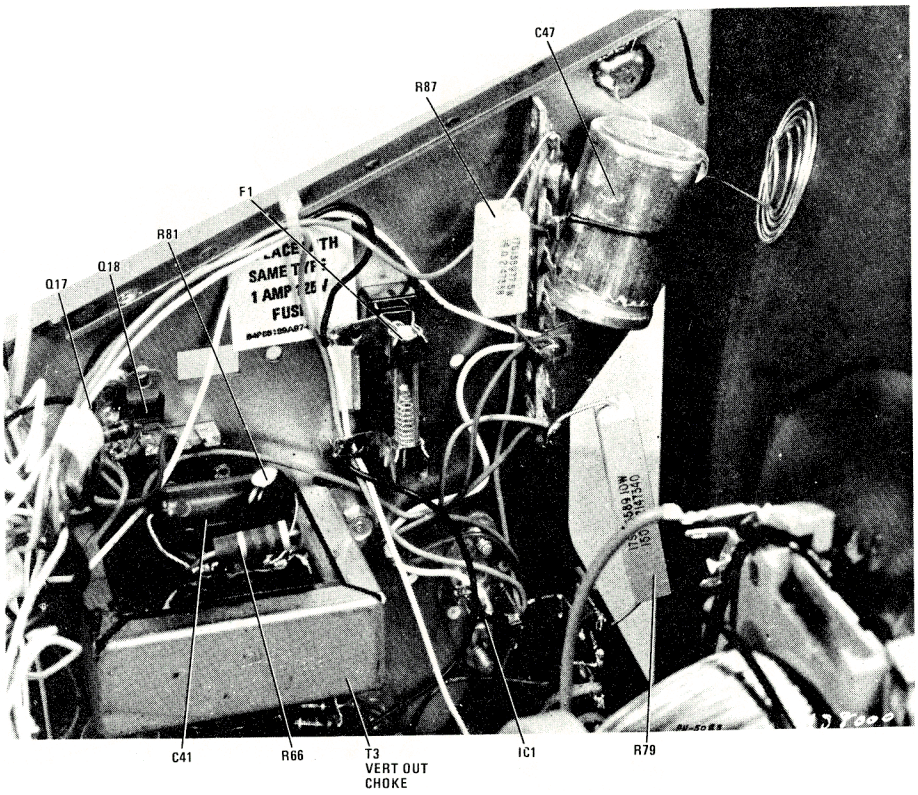
Left Side Panel – Component Location



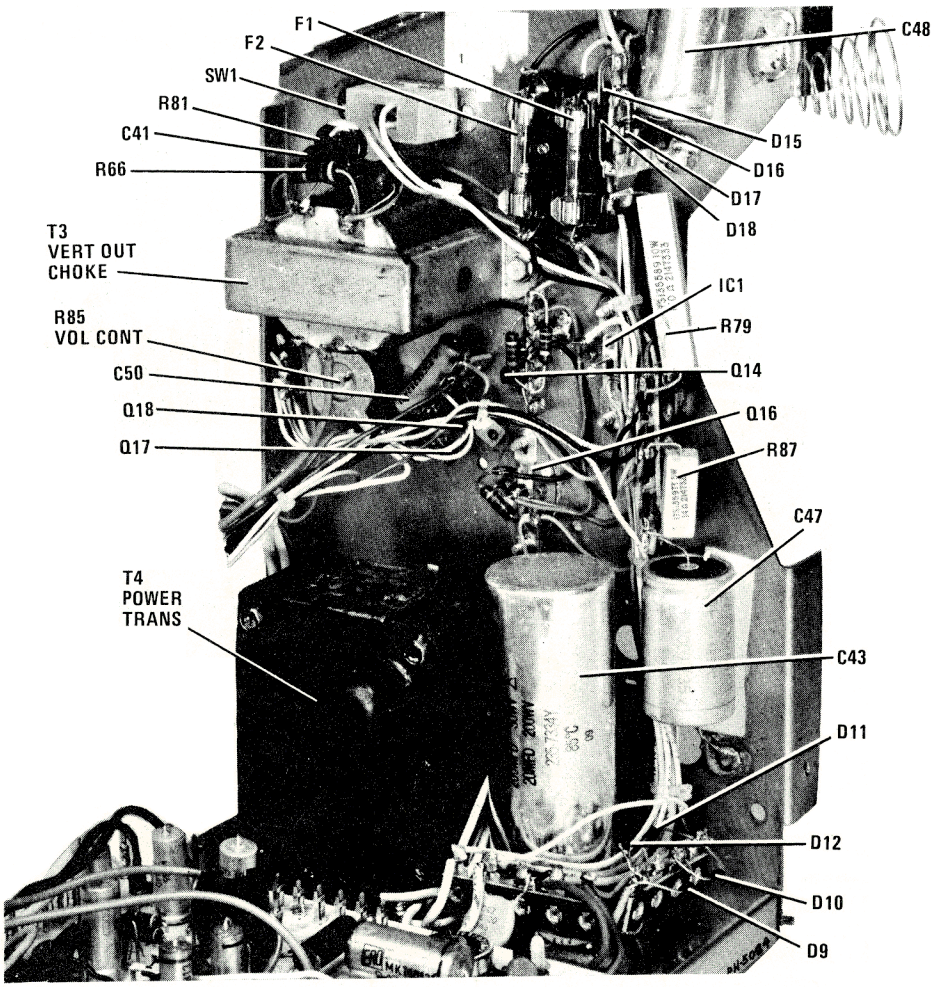
Circuit Board Top View – Component and Terminal Location



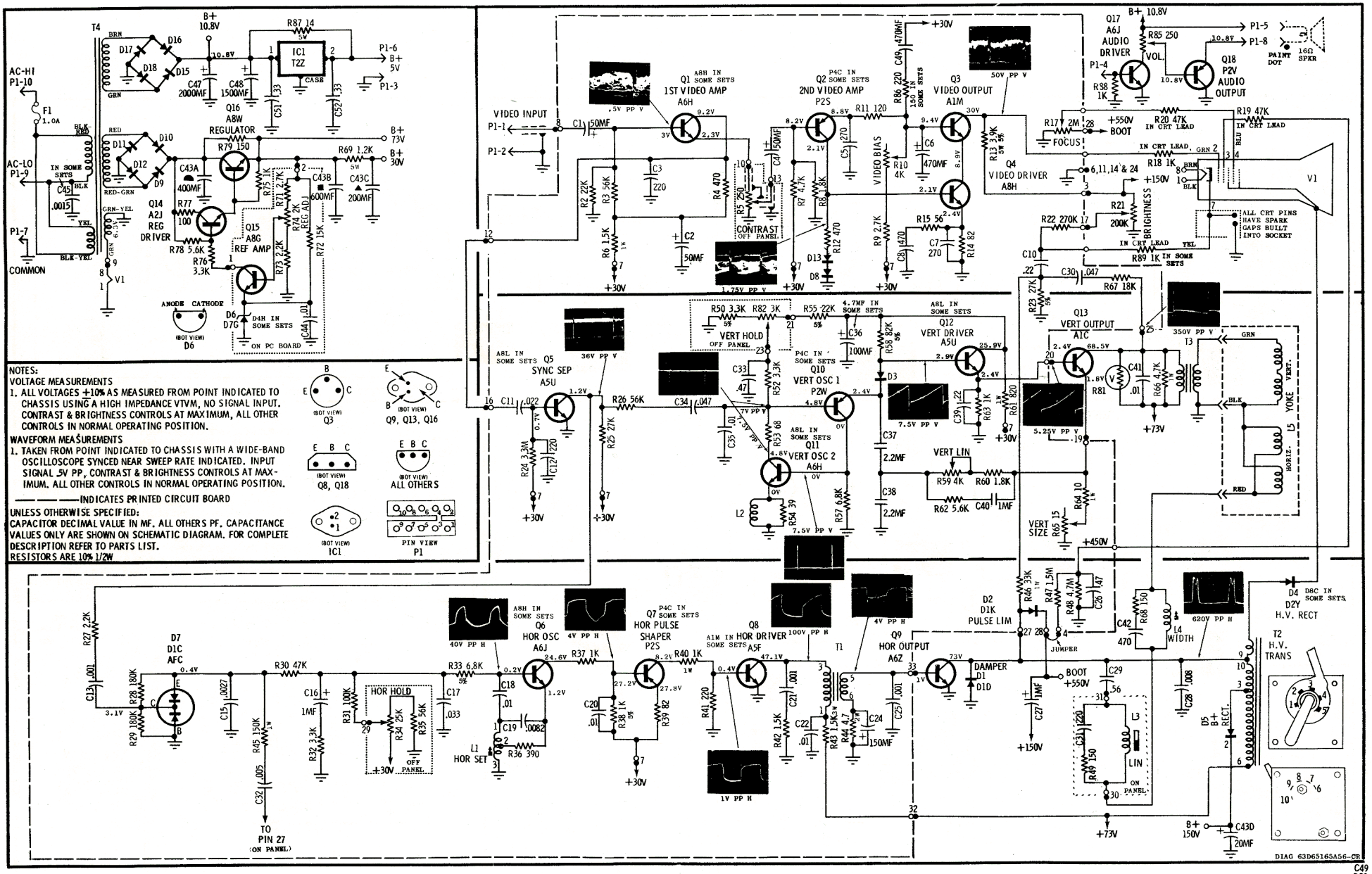
Chassis and Circuit Board Bottom View – Component and Terminal Location



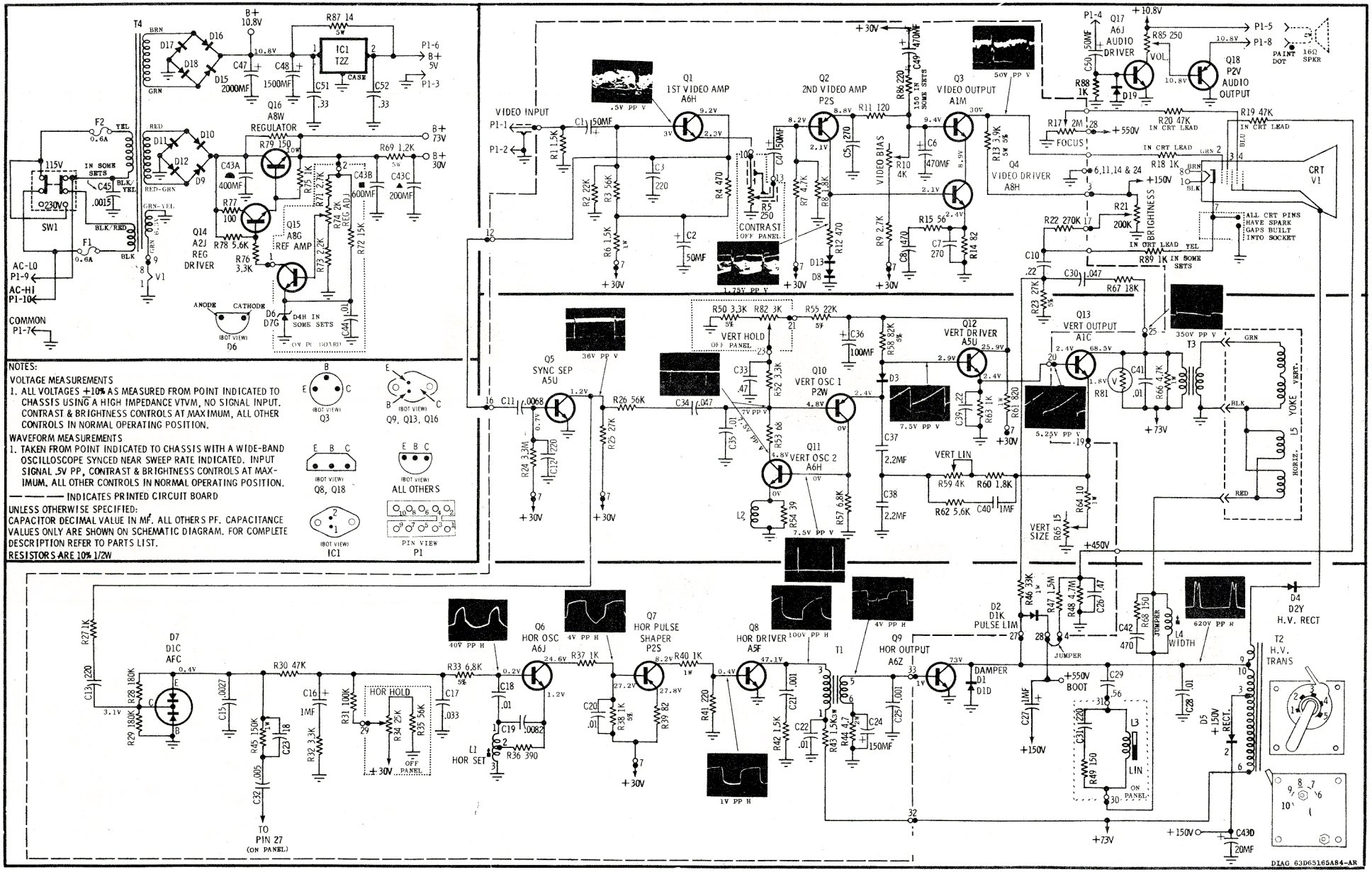
MODEL XM500-10 *Right Side Panel – Component Location*



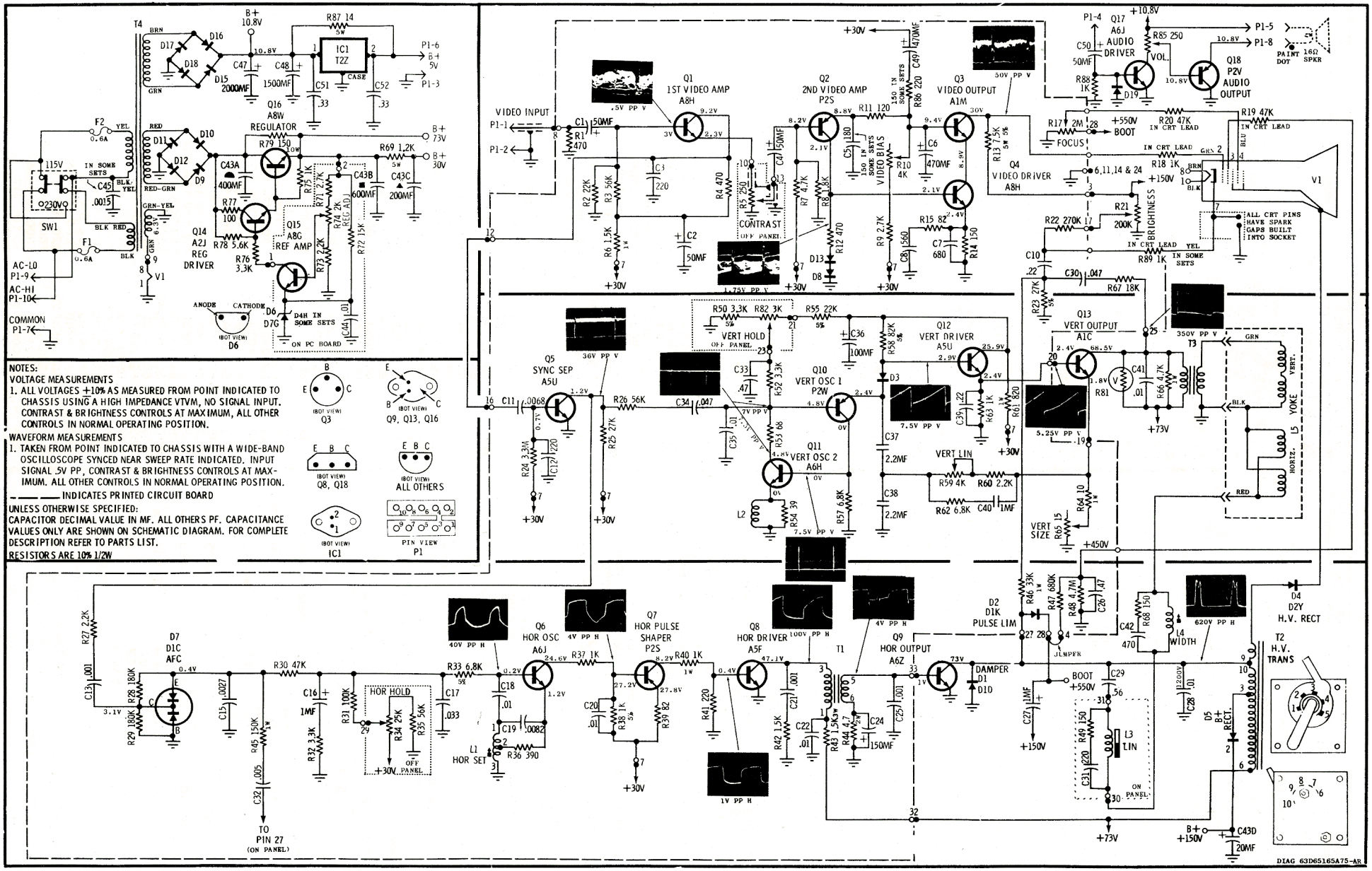
MODEL XM500-11 *Right Side Panel – Component Location*
XM700-10



Model XM500-10 Schematic Diagram



Model XM500-11 Schematic Diagram



Model XM700-10 Schematic Diagram

REPLACEMENT PARTS LIST
MODEL XM500-10-CHASSIS 19VP102

REF. NO.	PART NUMBER	DESCRIPTION
ELECTRICAL PARTS		
	1Y25016A75	MONITOR PANEL: "V24A"; complete KT321KM
CAPACITORS		
C1	23C65282A41	50 mf 50V Lytic
C2	23C65282A41	50 mf 50V Lytic
C3	21S180D10	220 pf 20% 100V X5F (Use 21R132503)
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	21S180B53	470 pf 10% 500V X5F
C10	8S10191B67	.22 mf 10% 250V polyester
C11	8S10191A59	.022 mf 10% 100V polyester
C12	21S180D10	220 pf 20% 100V X5F (Use 21R132503)
C13	21S180B51	.001 mf 10% 500V 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
C24	23D65282A40	150 mf 10V Lytic
C25	21S180B51	.001 mf 10% 500V X5F
C26	8S10212B53	.47 mf 10% 630V mtlz poly
C27	8S10212A11	1.0 mf 10% 630V mtlz poly
C28	8S10571A05	.008 mf 5% 1200V
C29	8S10212D33	.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	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 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
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	48S137266	DIODE, silicon: zener; D4H
D7	43S134917	DIODE, dual: D1C; AFC
D8	48D67120A 11	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)
FUSES		
F1	65S139183	FUSE: 1A-125V
INTEGRATED CIRCUITS		
IC1	*51S10707A01	INTEGRATED CIRCUIT: T2Z

REF. NO.	PART NUMBER	DESCRIPTION
COILS & CHOKES		
L1	24D68822A08	HORIZ SET
L2	24D68801A67	COMPENSATING: 2000 mh
L3	24D69163A18	HORIZ LINEARITY
L4	24V25000A74	HORIZ WIDTH: incls C42 & R68
L5	24D68523A15	DEFLECTION YOKE
TRANSISTORS		
Q1	48S137171	1ST VIDEO: A6H
Q2	48S137127	2ND VIDEO: P2S
Q3	48S134919	VIDEO OUTPUT: A1M
Q4	48S137317	VIDEO DRIVER: A8H
Q5	48S137115	SYNC SEPARATOR: A5U
Q6	48S137172	HORIZ OSCILLATOR: A6J
Q7	48S137127	HORIZ PULSE SHAPER: P2S
Q8	48S137093	HORIZ DRIVER: A5F
Q9	48S134995	HORIZ OUTPUT: A6Z
Q10	48S137173	VERT OSCILLATOR (1): P2W
Q11	48S137171	VERT OSCILLATOR (2): A6H
Q12	48S137115	VERT DRIVER: A5U
Q13	48S134900	VERT OUTPUT: A1C
Q14	48S134952	REGULATOR DRIVER: A2J
Q15	48S137315	REFERENCE AMP: A8G
Q16	48S137368	REGULATOR: A8W
Q17	48S137172	AUDIO DRIVER: A6J
Q18	48S137168	AUDIO OUTPUT: P2V
CONTROLS		
R5	18D68222A34	CONTRAST: 250 ohms
R10	18D66401A54	VIDEO BIAS: 4K
R17	18D67858A12	FOCUS: 2 meg
R21	*18D68222A35	BRIGHTNESS: 200K
R34	18D68222A37	HORIZ HOLD: 25K
R59	18D66401A54	VERT LINEARITY: 4K
R65	17D65820A38	VERT SIZE: 15 ohms
R74	17D65820A37	REGULATOR ADJUST: 2K
R82	18D68222A36	VERT HOLD: 3K
R85	18D68222A34	VOLUME: 250 ohms
RESISTORS		
R2	6S125568	22K 10 ½W
R3	6S127541	56K 10% ½W
R4	6S127633	470 10% ½W
R6	6S128955	1500 10% 1W
R7	6S121847	4700 10% ½W
R8	6S122445	1800 10% ½W
R9	6S119926	2700 10% ½W
R11	6S128226	120 10% ½W
R12	6S127633	470 10% ½W
R13	*17S10731A01	3900 5% 5W WW
R14	6S127516	82 10% ½W
R15	6S131412	56 10% ½W
R18	– – – –	Part of CRT Socket Assembly
R19	– – – –	Part of CRT Socket Assembly
R20	– – – –	Part of CRT Socket Assembly
R22	6S129296	270K 10% ½W
R23	6S10053C67	27K 5% ½W
R24	6S127538	3.3 meg 10% ½W
R25	6S121300	27K 10% ½W
R26	6S127541	56K 10% ½W
R27	6S129875	2200 10% ½W
R28	6S125531	180K 10% ½W
R29	6S125531	180K 10% ½W
R30	6S125892	47K 10% ½W
R31	6S125534	100K 10% ½W
R32	6S124506	3300 10% ½W
R33	6S10053C53	6800 5% ½W
R35	6S127541	56K 10% ½W
R36	6S125545	390 10% ½W
R37	6S121301	1000 10% ½W
R38	6S10053C33	1000 5% ½W
R39	6S127516	82 10% ½W
R40	6S127547	1000 10% 1W
R41	6S127099	220 10% ½W
R42	6S127513	1500 10% ½W
R43	17S10130B07	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% ½W
R48	6S10053D21	4.7 meg 10% ½W
R49	6S124797	150 10% ½W
R50	6S10053C45	3300 5% ½W
R52	6S124506	3300 10% ½W
R53	6S129874	68 10% ½W
R54	6S131972	39 10% ½W
R55	6S10053C65	22K 5% ½W
R57	6S119930	6800 10% ½W
R58	6S129793	82K 5% ½W
R60	6S122445	1800 10% ½W
R61	6S10053F29	820 10% 1W
R62	6S127005	5600 10% ½W
R63	6S121301	1000 10% ½W
R64	6S10053F17	10 10% 1W
R66	6S129064	4700 10% 1W

MODEL XM500-10-CHASSIS 19VP102 (CONT.)

REF. NO.	PART NUMBER	DESCRIPTION
R67	6S122848	18K 10% ½W
R68	6S124797	150 10% ½W
R69	17S647132	1200 10% 3W WW (Use 17S136197)
R71	6S119926	2700 10% ½W
R72	6S124551	15K 10% ½W
R73	6S129875	2200 10% ½W
R75	6S121301	1000 10% ½W
R76	6S124506	3300 10% ½W
R77	6S129221	100 10% ½W
R78	6S127005	5600 10% ½W
R79	17S135589	150 10% 10W WW
R81	6C66263A08	VARISTOR (Use 6S66263A16)
R86	6S124797	150 10% ½W
R87	17S135977	14 10% 5W WW
R88	6S121301	1000 10% ½W
R89	– – – –	Part of CRT Socket
TRANSFORMERS		
T1	25D67440A03	HORIZ DRIVER
T2	*24D69791B17	H. V. TRANSFORMER: complete
T3	25D65840A22	VERT OUTPUT (Use 25D65840B23)
T4	25D68164A27	POWER
MISCELLANEOUS ELECTRICAL PARTS		
V1	20WP4	CRT
	50D68384A02	SPEAKER: 4" PM
MECHANICAL PARTS		
	*9D66133A34	CAP, SS Rectifier (H.V. Transf pri/sec lead)
	42B25158A01	CLAMP, metal: defl yoke mtg
	42D65864A54	CONNECTOR, 2nd anode
	31D70080B04	CONNECTOR, PC panel: 9 Contact; on chassis
P1	15S10183A22	CONNECTOR, plug: 10 Contact; less contacts (power)
	39S10184A52	CONTACT, plug: for power connector 15S10183A22
	5B69911A01	GROMMET, plastic: PC panel mtg
	26C66745A05	HEAT SINK: Q3
	14A562353	INSULATOR, mica; transistor socket: Q9, Q13, & Q16 (Use 14A543810)
	14C68842A04	INSULATOR, molded rubber: SS rect cap/H. V. transf
	*14S10550A02	INSULATOR, transistor cover: Q16
	2S7051	NUT, hex: 3/8-32; ctrl mtg
	5S10281A03	RIVET, drive pin: nylon; H. V. transf mtg
	47C66082A04	ROD, adjustment: width coil; L4
	3S136050	SCREW, tpg: 6-20 x ½ clu pan hd; Q9, Q13, Q16 & IC mtg
	*9D67555B27	SOCKET, CRT: incls leads & resistors
	9S10548A01	SOCKET, fuse: F1
	9C63825A01	SOCKET, IC & transistor: Q9, Q13, Q16 & IC1
	41D65987A01	SPRING, special: CRT aquadag grnd

MODEL XM500-11 - CHASSIS C19VP102

ELECTRICAL PARTS

	*1Y25016A89	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 21R132503)
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	21S180B53	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	21R132503	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	8S10212B53	.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	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	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 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: 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	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 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	24D68801A67	COMPENSATING: 2000 uh
L3	24D69163A18	HORIZ LINEARITY
L4	24V25000A74	HORIZ WIDTH: incls C42 & R68
L5	24D68523A15	DEFLECTION YOKE

TRANSISTORS

Q1	48S137171	1ST VIDEO: A6H
Q2	48S137127	2ND VIDEO: P2S

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

REF. NO.	PART NUMBER	DESCRIPTION
Q3	48S134919	VIDEO OUTPUT: A1M
Q4	48S137317	VIDEO DRIVER: A8H
Q5	48S137115	SYNC SEPARATOR: A5U
Q6	48S137172	HORIZ OSCILLATOR: A6J
Q7	48S137127	HORIZ PULSE SHAPER: P2S
Q8	48S137093	HORIZ DRIVER: A5F
Q9	48S134995	HORIZ OUTPUT: A6Z
Q10	48S137173	VERT OSCILLATOR (1): P2W
Q11	48S137171	VERT OSCILLATOR (2): A6H
Q12	48S137115	VERT DRIVER: A5U
Q13	48S134900	VERT OUTPUT: A1C
Q14	48S134952	REGULATOR DRIVER: A2J
Q15	48S137315	REFERENCE AMP: A8G
Q16	48S137368	REGULATOR: A6J
Q17	48S137172	AUDIO DRIVER: A6J
Q18	48S137168	AUDIO OUTPUT: P2V
CONTROLS		
R5	18D68222A34	CONTRAST: 250 ohms
R10	18D66401A54	VIDEO BIAS: 4K
R17	18D67858A12	FOCUS: 2 meg
R21	*18D68222A35	BRIGHTNESS: 200K
R34	18D68222A37	HORIZ HOLD: 25K
R59	18D66401A54	VERT LINEARITY: 4K
R65	17D65820A38	VERT SIZE: 15 ohms
R74	17D65820A37	REGULATOR ADJUST: 2K
R82	18D68222A36	VERT HOLD: 3K
R85	18D68222A34	VOLUME: 250 ohms
RESISTORS		
R1	6S127513	1500 10% ½W
R2	6S125568	22K 10 ½W
R3	6S127541	56K 10% ½W
R4	6S127633	470 10% ½W
R6	6S128955	1500 10% 1W
R7	6S121847	4700 10% ½W
R8	6S122445	1800 10% ½W
R9	6S119926	2700 10% ½W
R11	6S128226	120 10% ½W
R12	6S127633	470 10% ½W
R13	*17S10731A01	3900 5% 5W WW
R14	6S127516	82 10% ½W
R15	6S131412	56 10% ½W
R18	– – – –	Part of CRT Socket Assembly
R19	– – – –	Part of CRT Socket Assembly
R20	– – – –	Part of CRT Socket Assembly
R22	6S129296	270K 10% ½W
R23	6S10053C67	27K 5% ½W
R24	6S127538	3.3 meg 10% ½W
R25	6S121300	27K 10% ½W
R26	6S127541	56K 10% ½W
R27	6S121301	1000 10% ½W
R28	6S125531	180K 10% ½W
R29	6S125531	180K 10% ½W
R30	6S125892	47K 10% ½W
R31	6S125534	100K 10% ½W
R32	6S124506	3300 10% ½W
R33	6S10053C53	6800 5% ½W
R35	6S127541	56K 10% ½W
R36	6S125545	390 10% ½W
R37	6S121301	1000 10% ½W
R38	6S10053C33	1000 5% ½W
R39	6S127516	82 10% ½W
R40	6S127547	1000 10% 1W
R41	6S127099	220 10% ½W
R42	6S127513	1500 10% ½W
R43	17S10130B07	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% ½W
R48	6S10053D21	4.7 meg 10% ½W
R49	6S124797	150 10% ½W
R50	6S10053C45	3300 5% ½W
R52	6S124506	3300 10% ½W
R53	6S129874	68 10% ½W
R54	6S131972	39 10% ½W
R55	6S10053C65	22K 5% ½W
R57	6S119930	6800 10% ½W
R58	6S129793	82K 5% ½W
R60	6S122445	1800 10% ½W
R61	6S10053F29	820 10% 1W
R62	6S127005	5600 10% ½W
R63	6S121301	1000 10% ½W
R64	6S10053F17	10 10% 1W
R66	6S129064	4700 10% 1W
R67	6S122848	18K 10% ½W
R68	6S124797	150 10% ½W
R69	17S647132	1200 10% 3W WW (Use 17S136197)
R71	6S119926	2700 10% ½W
R72	6S124551	15K 10% ½W
R73	6S129875	2200 10% ½W
R75	6S121301	1000 10% ½W
R76	6S124506	3300 10% ½W
R77	6S129221	100 10% ½W
R78	6S127005	5600 10% ½W
R79	17S135589	150 10% 10W WW
R81	6C66263A08	VARISTOR (Use 6S66263A16)
R86	6S124797	150 10% ½W
R87	17S135977	14 10% 5W WW
R88	6S121301	1000 10% ½W
R89	– – – –	Part of CRT Socket
SWITCHES		
SW1	40S10624A01	SWITCH, slide: DP DT (115V-230V)
TRANSFORMERS		
T1	25D67440A03	HORIZ DRIVER
T2	*24D69791B17	H. V. TRANSFORMER: complete
T3	25D65840A22	VERT OUTPUT (Use 25D65840B23)
T4	25D68164A27	POWER
MISCELLANEOUS ELECTRICAL PARTS		
V1	20WP4	CRT
	50D68384A02	SPEAKER: 4" PM
MECHANICAL PARTS		
	*9D66133A34	CAP, SS Rectifier (H.V. Transf pri/sec lead)
	42B25158A01	CLAMP, metal: defl yoke mtg
	42D65864A54	CONNECTOR, 2nd anode
	31D70080B04	CONNECTOR, PC panel: 9 Contact; on chassis
P1	15S10183A22	CONNECTOR, plug: 10 Contact; less contacts (power)
	39S10184A52	CONTACT, plug: for power connector 15S10183A22
	15S10630A01	COVER, nylon: slide switch; SW1
	5B69911A01	GROMMET, plastic: PC panel mtg
	26C66745A05	HEAT SINK: Q3
	14A562353	INSULATOR, mica; transistor socket: Q9, Q13, & Q16 (Use 14A543810)
	14C68842A04	INSULATOR, molded rubber: SS rect cap/H. V. transf
	*14S10550A02	INSULATOR, transistor cover: Q16
	2S7051	NUT, hex: 3/8-32; ctrl mtg
	5S10281A03	RIVET, drive pin: nylon; H. V. transf mtg
	47C66082A04	ROD, adjustment: width coil; L4
	3S136050	SCREW, tpg: 6-20 x ½ clu pan hd; Q9, Q13, Q16 & IC mtg
	*9D7555B27	SOCKET, CRT: incls leads & resistors
	9S10548A02	SOCKET, fuse: dual; F1 & F2
	9C63825A01	SOCKET, IC & transistor: Q9, Q13, Q16 & IC1
	41D65987A01	SPRING, special: CRT aquadag grnd

MODEL XM700-10-CHASSIS 23VP102

ELECTRICAL PARTS		
	1Y25016A96	MONITOR PANEL: "V30A"; complete KT361LM
CAPACITORS		
C1	23C65282A41	50 mf 50V Lytic
C2	23C65282A41	50 mf 50V Lytic
C3	21S180D10	220 pf 20% 100V X5F (Use 21R132503)
C4	23C65282A41	50 mf 50V Lytic
C5	21S180E47	180 pf 10% 500V N150
C6	23S10255A78	470 mf 16V Lytic
C7	21S180C01	680 pf 10% 500V X5F
C8	21S180B85	560 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	21S180B51	.001 mf 10% 500V X5F
C15	21S180C41	.0027 mf 10% 500V Z5F (Use 21K121699)
C16	23S10229A07	1.0 mf +40–20% 15V Lytic (Use 23C43280A17)

MODEL XM700-10 - CHASSIS 23VP102 CONT'D ON NEXT PAGE

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

REF. NO.	PART NUMBER	DESCRIPTION
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
C24	23D65282A40	150 mf 10V Lytic
C25	21S180B51	.001 mf 10% 500V X5F
C26	8S10212B53	.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	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	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 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: 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	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 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	24D68801A67	COMPENSATING: 2000 mh
L3	24D69163A18	HORIZ LINEARITY
L4	24V25000A74	HORIZ WIDTH: incls C42 & R68
L5	24D68523A15	DEFLECTION YOKE

TRANSISTORS

Q1	48S137171	1ST VIDEO: A6H
Q2	48S137127	2ND VIDEO: P2S
Q3	48S134919	VIDEO OUTPUT: A1M
Q4	48S137317	VIDEO DRIVER: A8H
Q5	48S137115	SYNC SEPARATOR: A5U
Q6	48S137172	HORIZ OSCILLATOR: A6J
Q7	48S137127	HORIZ PULSE SHAPER: P2S
Q8	48S137093	HORIZ DRIVER: A5F
Q9	48S134995	HORIZ OUTPUT: A6Z
Q10	48S137173	VERT OSCILLATOR (1): P2W
Q11	48S137171	VERT OSCILLATOR (2): A6H
Q12	48S137115	VERT DRIVER: A5U
Q13	48S134900	VERT OUTPUT: A1C
Q14	48S134952	REGULATOR DRIVER: A2J
Q15	48S137315	REFERENCE AMP: A8G
Q16	48S137368	REGULATOR: A8W
Q17	48S137172	AUDIO DRIVER: A6J
Q18	48S137168	AUDIO OUTPUT: P2V

CONTROLS

R5	18D68222A34	CONTRAST: 250 ohms
R10	18D66401A54	VIDEO BIAS: 4K
R17	18D67858A12	FOCUS: 2 meg
R21	18D68222A35	BRIGHTNESS: 200K
R34	18D68222A37	HORIZ HOLD: 25K
R59	18D66401A54	VERT LINEARITY: 4K
R65	17D65820A38	VERT SIZE: 15 ohms
R74	17D65820A37	REGULATOR ADJUST: 2K
R82	18D68222A36	VERT HOLD: 3K
R85	18D68222A34	VOLUME: 250 ohms

RESISTORS

R1	6S127633	470 10% ½W
R2	6S125568	22K 10 ½W
R3	6S127541	56K 10% ½W
R4	6S127633	470 10% ½W
R6	6S128955	1500 10% 1W
R7	6S121847	4700 10% ½W
R8	6S122445	1800 10% ½W
R9	6S119926	2700 10% ½W
R11	6S128226	120 10% ½W
R12	6S127633	470 10% ½W
R13	17S10731A02	7500 5% 5W WW
R14	6S124797	150 10% ½W
R15	6S131412	56 10% ½W
R18	– – – –	Part of CRT Socket Assembly
R19	– – – –	Part of CRT Socket Assembly
R20	– – – –	Part of CRT Socket Assembly
R22	6S129296	270K 10% ½W
R23	6S10053C67	27K 5% ½W
R24	6S127538	3.3 meg 10% ½W
R25	6S121300	27K 10% ½W
R26	6S127541	56K 10% ½W
R27	6S129875	2200 10% ½W
R28	6S125531	180K 10% ½W
R29	6S125531	180K 10% ½W
R30	6S125892	47K 10% ½W
R31	6S125534	100K 10% ½W
R32	6S124506	3300 10% ½W
R33	6S10053C53	6800 5% ½W
R35	6S127541	56K 10% ½W
R36	6S125545	390 10% ½W
R37	6S121301	1000 10% ½W
R38	6S10053C33	1000 5% ½W
R39	6S127516	82 10% ½W
R40	6S127547	1000 10% 1W
R41	6S127099	220 10% ½W
R42	6S127513	1500 10% ½W
R43	17S10130B07	1500 10% 3W fxd mtl film
R44	17S10159A04	4.7 10% 2W WW
R45	6S120141	150K 10% 1W
R46	6S127634	33K 10% 1W
R47	6S128229	680K 10% ½W
R48	6S10053D21	4.7 meg 10% ½W
R49	6S124797	150 10% ½W
R50	6S10053C45	3300 5% ½W
R52	6S124506	3300 10% ½W
R53	6S129874	68 10% ½W
R54	6S131972	39 10% ½W
R55	6S10053C65	22K 5% ½W
R57	6S119930	6800 10% ½W
R58	6S129793	82K 5% ½W
R60	6S129875	2200 10% ½W
R61	6S10053F29	820 10% 1W
R62	6S119930	6800 10% ½W
R63	6S121301	1000 10% ½W
R64	6S10053F17	10 10% 1W
R66	6S129064	4700 10% 1W
R67	6S122848	18K 10% ½W
R68	6S124797	150 10% ½W
R69	17S647132	1200 10% 3W WW (Use 17S136197)
R71	6S119926	2700 10% ½W
R72	6S124551	15K 10% ½W
R73	6S129875	2200 10% ½W
R75	6S121301	1000 10% ½W
R76	6S124506	3300 10% ½W
R77	6S129221	100 10% ½W
R78	6S127005	5600 10% ½W
R79	17S135589	150 10% 10W WW
R81	6C66263A08	VARISTOR (Use 6C66263A16)
R86	6S124797	150 10% ½W
R87	17S135977	14 10% 5W WW
R88	6S121301	1000 10% ½W
R89	– – – –	Part of CRT Socket

SWITCHES

SW1	40S10624A01	SWITCH, slide: DP DT (115V-230V)

MODEL XM700-10 - CHASSIS 23VP102 CONT'D ON NEXT PAGE

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

REF. NO.	PART NUMBER	DESCRIPTION
TRANSFORMERS		
T1	25D67440A03	HORIZ DRIVER
T2	*24D69791B17	H. V. TRANSFORMER: complete
T3	25D65840A22	VERT OUTPUT (Use 25D65840B23)
T4	25D68164A27	POWER
MISCELLANEOUS ELECTRICAL PARTS		
V1	23JEP4	CRT
	50D68384A02	SPEAKER: 4" PM
MECHANICAL PARTS		
	*9D66133A34	CAP, SS Rectifier (H.V. Transf pri/sec lead)
	42B25158A01	CLAMP, metal: defl yoke mtg
	42V25009A31	CONNECTOR, 2nd anode complete
	31D70080B04	CONNECTOR, PC panel: 9 Contact; on chassis
P1	15S10183A22	CONNECTOR, plug: 10 Contact; less contacts (power)
	39S10184A52	CONTACT, plug: for power connector 15S10183A22
	15S10630A01	COVER, nylon: slide switch; SW1
	5B69911A01	GROMMET, plastic: PC panel mtg
	26C66745A05	HEAT SINK: Q3
	14A562353	INSULATOR, mica; transistor socket: Q9, Q13, & Q16 (Use 14A543810)
	14C68842A04	INSULATOR, molded rubber: SS rect cap/H. V. transf
	14S10550A02	INSULATOR, transistor cover: Q16
	2S7051	NUT, hex: 3/8-32; ctrl mtg
	5S10281A03	RIVET, drive pin: nylon; H. V. transf mtg
	47C66082A04	ROD, adjustment: width coil; L4
	3S136050	SCREW, tpg: 6-20 x ½ clu pan hd; Q9, Q13, Q16 & IC mtg
	9D67555B27	SOCKET, CRT: incls leads & resistors
	9S10548A02	SOCKET, fuse: dual; F1 & F2
	9C63825A01	SOCKET, IC & transistor: Q9, Q13, Q16 & IC1
	41D65987A01	SPRING, special: CRT aquadag grnd

*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	2N4401
Q307	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	99S090-1	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

HEAD OFFICE

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Los Angeles, Calif. 90064

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MOTOROLA MODEL XM 500-11 & XM 700-10

Circuit Designation	Device	MDP Part Number	Application	Motorola SPD Replacement Part	(2N) Equivalent
Q-1	T	482137171	1st Video: A6H		2N4400
Q-2	T	48S137127	2nd Video: P2S		2N4403
Q-3	T	48S134919	Video Output: A1M		2N3500
Q-4	T	48S137317	Video Driver: A8H		2N4400
Q-5	T	48S137172	Sync Separator: A6J		2N4400
Q-6	T	48S137317	Horiz. Oscillator: A5U		2N4400
Q-7	T	48S137127	Horiz. Pulse Shaper: P2S		2N4403
Q-8	T	48S137093	Horiz. Driver: A5F		2N3500
Q-9	T	48S137203	Horiz. Output: A6Z	MJ3030 2N5157	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	48S137172	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		1N4007*
D-3	D	48D67120A11	Low Power		1N4005
D-4	D	48S137114	H.V.; Sel D3S		VARO
D-5	R	48S191A05	Silicon: 91A05		1N4005
D-6 & 8	D	48D67130A11	Low Power		
D-7	D	48S134917	Dual; D1C; Detector	MSD6102	1N914**
D-9, 10, 11, & 12	D	48S191A05	Low Voltage Supply		2N4400

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

Device No.	Zenith P/N	Cross Reference	WEP No.
Q201	121-713	NJ225	713
A202	121-821 or 121-758	DTS0713 or 2SC1004 or ZSC642A A702	740A
Q203	121-985	2Sc643A	N/A
Q401	121-699	2N4248	717
Q402	121-671	2N3569	735
Q403	121-446	MPS6516	717
Q404	121-895	SPS907 or EL438	N/A
Q405	121-975 or	121-888 or EL403	N/A
Q703	121-982	121-888	N/A
Q406	121-868	D40N3	N/A
Q704	121-888	SPS2104 or X32C5198 or TEH0147	N/A
CR207	103-248	Information not available at this time. Will be supplied as soon as possible.	
CR401-CR402 CR701-CR705	103-142-01		
CR101	103-23		
CR201	103-193		
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

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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)	Rodefeld 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.
	Youngstown (Cleveland Br.).	Graybar Elec. Co., Inc.
301-322-2000	Washington (Landover) . . .	The Jos.M. Zamoiski Co.
316-263-2271	Wichita	The S.A. Long Company, Inc.
304-235-1400	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	1S2076
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	260P10301	"	"	2SC154C
"	260P22101	"	"	2SC1103
Q 401	260P21002	"	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	260P20101	"	"	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	264P01305	"	1N60
D 104	"	"	"
D 241	264P00801	"	1N34A
D 341	264P04705	Silicon	SR1FM-2 (BB-126)
D 401	"	"	"
D 501	264P01305	Germanium	IN60
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	265P03503	"	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"

	Manufacturer's Part No.	Manufacturers Name	Description	Manufacturer's Price
1.	4213	Union	Steel Utility Box, 13½"x 6½" 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

	Manufacturer's Part Number	Manufacturer's Name	Description	Manufacturer's Price
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