Errata

Title & Document Type: 8082A Pulse Generator Operating and Service Manual

Manual Part Number: 08082-90003

Revision Date: September 1983

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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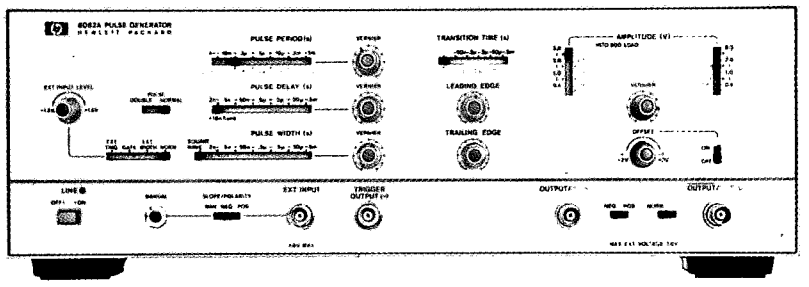
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

HP 8082A

OPERATING AND SERVICE MANUAL

PULSE GENERATOR 8082A



HEWLETT PACKARD

HP 8082A

PRODUCT SA

CCLO SPGS LOGIC MFG D200

JOHNSON,RICHARD E

OTE

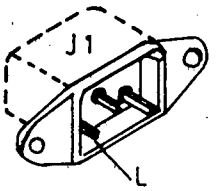
SUPERSEDES:
none

HP MODEL 80[illegible] PULSE GENERATOR

Serial Numbers: from 1822G2936 to 1822G3145

FL 1 LINE FILTER WIRING

It is possible that the Line Filter (FL 1) in instruments with S.N. as shown above may be wired incorrectly, causing F 1 to be in the neutral (return) side. To ensure that the Line Fuse F 1 is in the phase (Line) side of the line supply, perform the following whenever an instrument is received for service or repair.



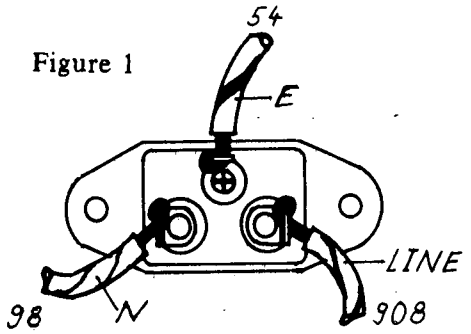
Remove the Power Cord and Fuse Cover. Using an Ohmmeter, check that there is a low resistance path (0 Ohm) between the line terminal (L) of the line connector and the tip of the fuse (Ensure that the fuse is not blown). If this is correct, the Line Filter (FL 1) is correctly installed and no further action is required.

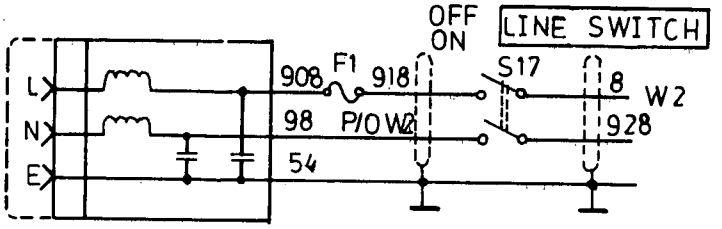
If not, check the Line Filter wiring against Figure 1 and correct the wiring as necessary.

Figure 1 shows the correct Line Filter wiring.

Figure 2 shows a part of Power Supply Schematic

Figure 1





FL1
LINE INPUT CONNECTOR
AND RF FILTER COMBINED

Figure 2

MI/cz/WA

1/84-B1

HEWLETT PACKARD

FOR MORE INFORMATION, CALL YOUR LOCAL HP SALES OR SERVICE OFFICE or East (201) 265-5000 • Midwest (312) 255-9800 • South (404) 955-1500 • West (213) 970-7500 or (415) 968-9200 OR WRITE, Hewlett-Packard, 1820 Embarcadero, Palo Alto, California 94303. IN EUROPE, CALL YOUR LOCAL HP SALES or SERVICE OFFICE OR WRITE, Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box, CH-1217 Meyrin 2 - Geneva, Switzerland. IN JAPAN, Yokogawa-Hewlett-Packard Ltd., 1-27-15, Yabe Sagamihara City, Kanagawa Prefecture, Japan 229.

9320-3500 (11/82)

Printed in U.S.A.

E N O T E

SUPERSEDES:

None

MODEL 8082A PULSE GENERATOR

Serial Numbers: 1822G3805 and below

RECOMMENDED REPLACEMENT OF A5 R218 / R221

On BD AY OFFSET 08082-66505, resistors R218 and R221 may be damaged by excessive power in worst case.
To improve the reliability of the current sources:

Replace R218 and R221 365 Ohm .25 Watt
with 365 Ohm .5 Watt HP PART NUMBER 0757-0810.

Whenever an instrument with the SN mentioned above is received for service or repair, perform the following procedure:

Remove	A5R218/R221	365 Ohm
Replace with	A5R218/R221	365 Ohm (P/N 0757-0810)

After replacement, the performance checks and if necessary the adjustments must be done.

Please update your O/S Manual to reflect this change.

HEWLETT PACKARD

FOR MORE INFORMATION, CALL YOUR LOCAL HP SALES OR SERVICE OFFICE or East (201) 265-5000 • Midwest (312) 255-9800 • South (404) 955-1500 • West (213) 970-7500 or (415) 968-9200 **OR WRITE,** Hewlett-Packard, 1820 Embarcadero, Palo Alto, California 94303. **IN EUROPE, CALL YOUR LOCAL HP SALES or SERVICE OFFICE OR WRITE,** Hewlett-Packard S.A., 7, rue du Bois-du-Lan Case Postale 365 CH 1217 Meyrin 1 - Geneva, Switzerland. **IN JAPAN,** Yokogawa-Hewlett-Packard Ltd., 1-27-15, Yabe Sagamihara City, Kanagawa Prefecture, Japan 229.

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SERVICE NOTE

SUPERSEDES:
None

MODEL 8160A PROGRAMMABLE PULSE GENERATOR

Serial Numbers: 2047G0605 and below

RECOMMENDED REPLACEMENT OF THE FUSEHOLDER

For the obsolete fuseholder, body (P/N 2110-0470) and fuseholder, cap (P/N 2110-0465) the below shown parts are the recommended replacement.

New parts:

XF1 Fuseholder, body	P/N 2110-0564
XF1 Fuseholder, cap	P/N 2110-0565
XF1 Nut Hex	P/N 2110-0569
XF1 Sleeve	P/N 08160-21701
XF1 Washer	P/N 1400-0090

Whenever an instrument with the SN mentioned above is received for repair because of a defective fuseholder, replace the complete fuseholder.
Refer to Figure 1 for the assembly of the new fuseholder parts.

NOTE:
The contacts of the fuseholder, body must be bended slightly to fit into the holes of board A13.

Please update your O/S Manual to reflect this change.

MI/mi/WO

12/84-B1

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FOR MORE INFORMATION, CALL YOUR LOCAL HP SALES OR SERVICE OFFICE or East (201) 265-5000 • Midwest (312) 255-9800 • South (404) 955-1500 • West (213) 970-7500 or (415) 968-9200 **OR WRITE,** Hewlett-Packard, 1820 Embarcadero, Palo Alto, California 94303. **IN EUROPE, CALL YOUR LOCAL HP SALES or SERVICE OFFICE OR WRITE,** Hewlett-Packard S.A., 7, rue du Bois-du-Lan Case Postale 365 CH 1217 Meyrin 1 - Geneva, Switzerland. **IN JAPAN,** Yokogawa-Hewlett-Packard Ltd., 1-27-15, Yabe Sagamihara City, Kanagawa Prefecture, Japan 229.

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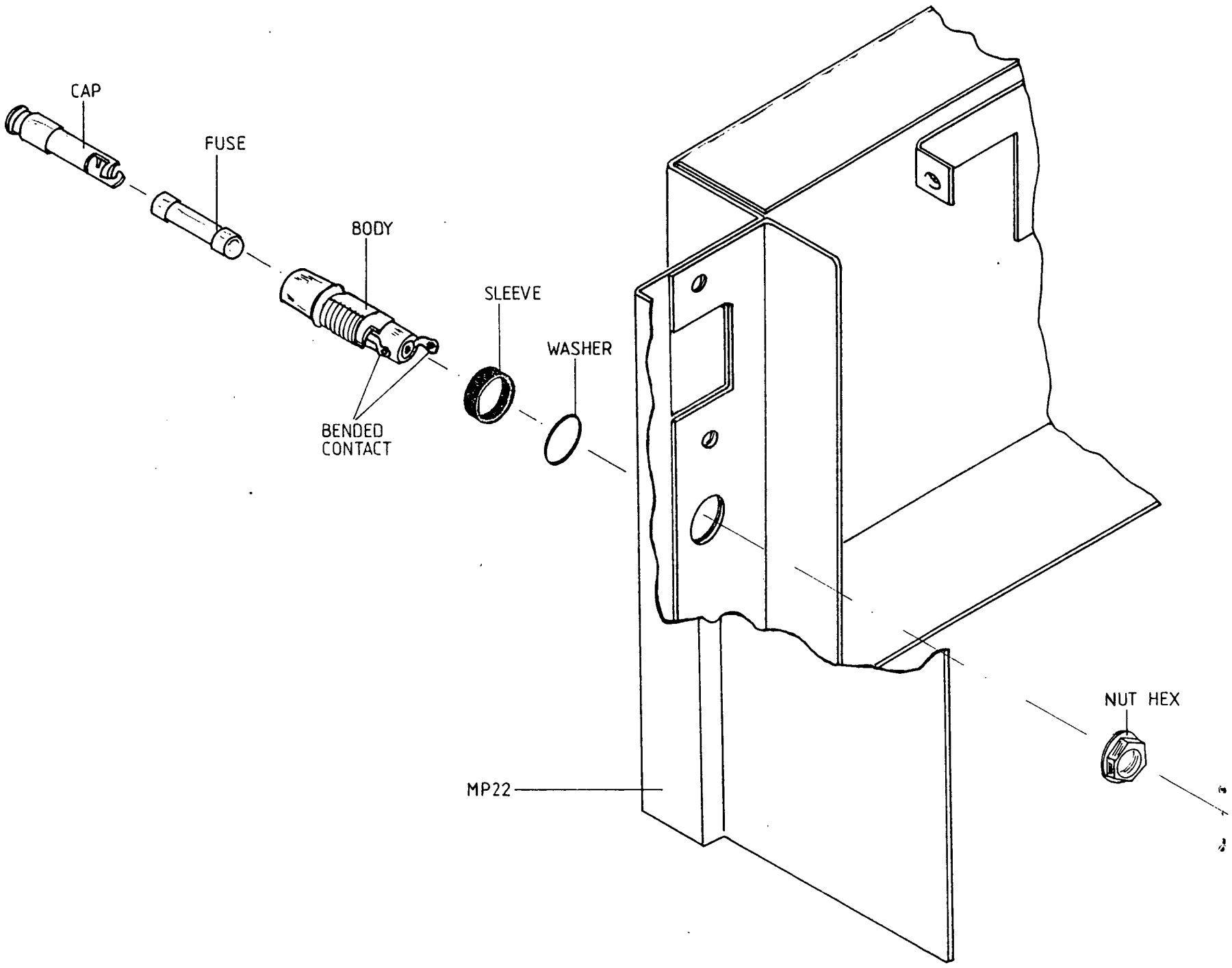
CAP
FUSE
BODY
SLEEVE
WASHER
BENDED
CONTACT
NUT HEX
MP22

SERVICE NOTE

SUPERSEDES:

None

MODEL 8161A PROGRAMMABLE PULSE GENERATOR

Serial Numbers: 2419G0535 and below

RECOMMENDED REPLACEMENT OF THE FUSEHOLDER

For the obsolete fuseholder, body (P/N 2110-0470) and fuseholder, cap (P/N 2110-0465) the below shown parts are the recommended replacement.

New parts:

XF1 Fuseholder, body	P/N 2110-0564
XF1 Fuseholder, cap	P/N 2110-0565
XF1 Nut Hex	P/N 2110-0569
XF1 Sleeve	P/N 08160-21701
XF1 Washer	P/N 1400-0090

Whenever an instrument with the SN mentioned above is received for repair because of a defective fuseholder, replace the complete fuseholder.
Refer to Figure 1 for the assembly of the new fuseholder parts.

NOTE:
The contacts of the fuseholder, body must be bended slightly to fit into the holes of board A13.

Please update your O/S Manual to reflect this change.

MI/mi/WO

12/84-B1

HEWLETT PACKARD

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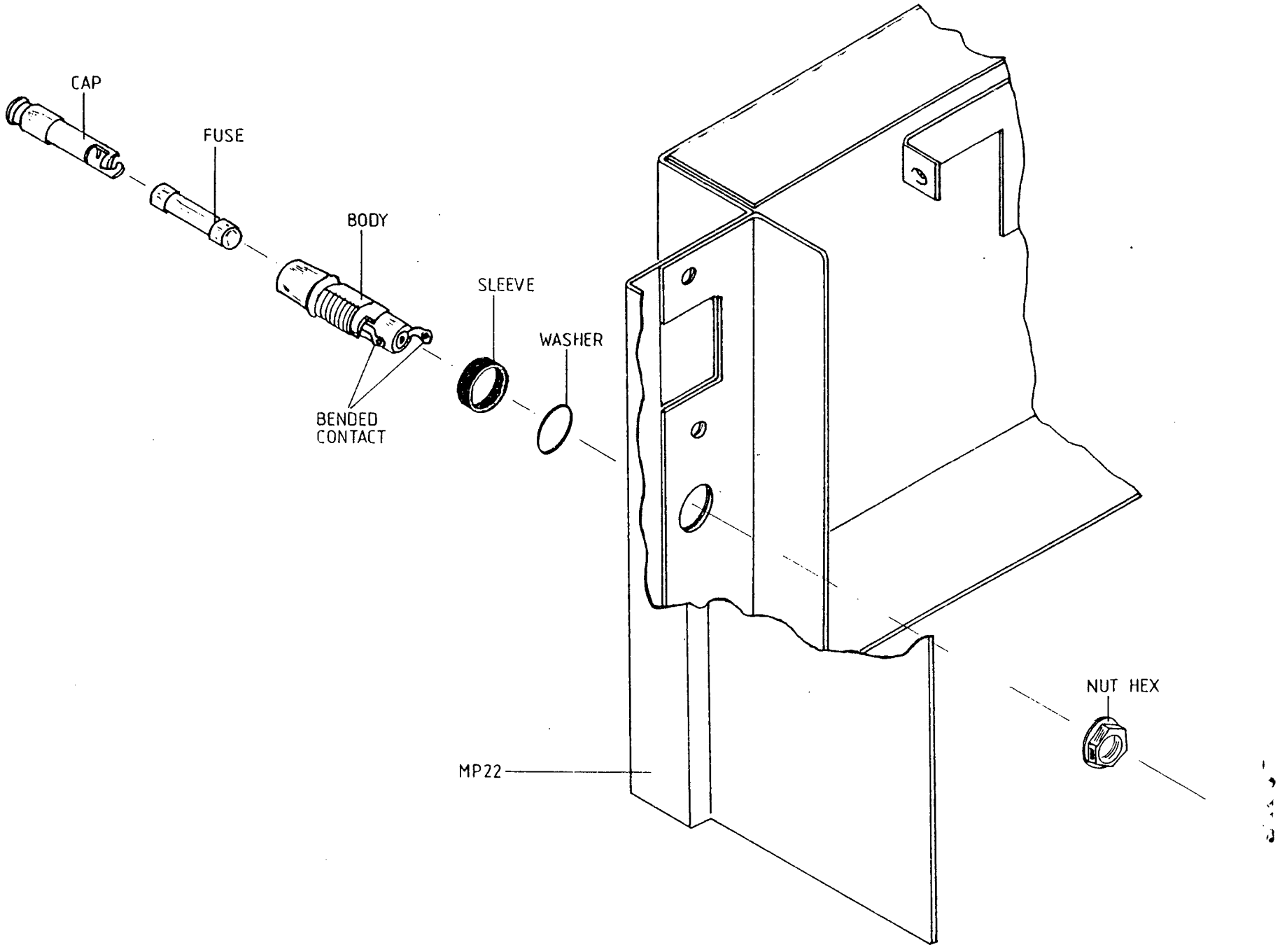

CAP
FUSE
BODY
SLEEVE
WASHER
BENDED
CONTACT
NUT HEX
MP22

HEWLETT PACKARD

MANUAL CHANGES

Manual for Model Number	8082A
Manual printed on	September 1983
Manual Part Number	08082-90003

Make all ERRATA corrections.

Check the following table for your instrument serial prefix/serial number and make the listed changes to your manual.

▶ New Item

Serial Prefix or Serial Number	Manual Changes	Serial Prefix or Serial Number	Manual Changes
ERRATA			
1822G03146 and above	1		

INDEX OF MANUAL CHANGES

MANUAL CHANGE	A1	A2	A3	A4	A5	A6	A7	A8	A9	FRAME	MISCELL.
ERRATA				U2,U3 X2, (X1,X2)	X4,(X4)					XF3,XF4	Page 6-18
1										MP34,35 MP36	

ERRATA

On Table 6-3, Replaceable Frame Parts List :

Add:	XF3	2110-0569	NUT HEX
	XF4	1400-0090	WASHER NEOPRENE

On Page 6-9/10, Replaceable Parts List :

	A4U2	should read	A4U3 ←
		1826-0111	IC-DUAL OP AMPL
	A4U3	should read	A4U2 ←
		5081-3009	IC SEALED PKG
	A4X2	should read	A4X1 ←
		1200-0548	SOCKET-IC 16 CONT
Add:	A4(X1)	5040-9314	LOCK CLIP 14 POL
	A4(X2)	5040-9316	LOCK CLIP 16 POL

On Page 6-12, Replaceable Parts List :

To	A5X4	1200-0588	SOCKET-IC 16 CONT
Add:	A5(X4)	5040-9316	LOCK CLIP 16 POL

On Page 6-18, change Grid Location G-2 from CR33 to CR39
and L-3 from R38 to R4
Add: D-2 R245

MANUAL CHANGE 1

On Page 6-5, Replaceable Parts List :

				Qty
Add:	MP34	2360-0201	SCREW	4
	MP35	2190-0918	WASHER	4
	MP36	3050-0016	WASHER	4

Specification

PULSE CHARACTERISTICS
(Source and load impedance 50 Ω)

Transition Times: ⩽ 1 ns to 0.5 ms in 6 ranges. First range from ⩽ 1 ns to 5 ns controls leading and trailing edges simultaneously; risetime and falltime may differ up to 25 % of the faster edge. For all other ranges, edges are independently variable up to 1:10.

Overshoot and Ringing: ⩽ ± 6 % of pulse amplitude, may increase to ± 10 % with amplitude vernier CCW.

Preshoot: ⩽ ± 5 % of pulse amplitude.

Linearity: Linearity aberration for both slopes ⩽ 5 % for transition times > 5 ns.

Output: Maximum amplitude is 5 V from 50 Ω into 50 Ω. Maximum output voltage is ± 5 V (amplitude + offset).

Offset: ± 2 V, into 50 Ω.

Baseline: 0 V ± 150 mV (max. amplitude range, offset switched off).

DC-Source Impedance: 50 Ω + 5 %, −10 %.

Reflection Coefficient (typical):

Attenuator setting	
ECL	5 %
0.5 – 1.0 V	5 %
1.0 – 2.0 V	8 %
2.0 – 5.0 V	15 %

Output Protection: Cannot be damaged by open or short circuits or application of external signals ⩽ ± 6 volts or ± 200 mA.

Attenuator: Two separate three step-attenuators reduce the outputs to 1 V. Vernier is common for both outputs and reduces the output to 0.4 V minimum. A further position provides ECL-compatible outputs (−0.9 V to −1.7 V typ. open circuit).

TIMING

Repetition Rate: > 250 MHz to < 1 kHz in 6 ranges.

Period Jitter: < 0.1 % + 50 ps.

Delay: < 2 ns to > 0.5 ms in 6 ranges plus typ 17 ns with respect to trigger output.

Delay Jitter: < 0.1 % + 50 ps.

Double Pulse: Up to 125 MHz max (simulates 250 MHz).

Variable Delay Time (max): > 50 % of period − 2 ns.

Pulse Width: < 2.3 ns min to > 0.5 ms max (6 ranges).

Width Jitter: < 0.1 % + 50 ps.

Width Duty Cycle (max): > 50 %.

Square Wave: A further position of the Pulse Width switch provides Square Wave output. (Delay and double pulse are disabled, max. Rep. Rate 250 MHz). Duty cycle is 50 % ± 10 % up to 100 MHz, 50 % ± 15 % for > 100 MHz.

Trigger Output: Negative-going square wave (50 % duty cycle typ.) > 500 mV from 50 Ω into 50 Ω. Internal 50 Ω load can be switched off by slide-switch on PC-board. Amplitude increases to ⩾ 1 V into 50 Ω up to 200 MHz.

Trigger Output Protection: Cannot be damaged by short circuit or application of external ± 200 mA.

EXTERNALLY CONTROLLED OPERATION

External Input

Input Impedance: 50 Ω ± 10 %. DC coupled.

Maximum Input: ± 6 V.

Trigger Level: Adjustable −1.5 V to +1.5 V.

Slope Control: Positive, negative or manual selectable. In the MAN-position all ext functions can be controlled by push button. Button pushed in simulates an "on-signal".

Sensitivity: Sine-wave > 200 mVpp, pulses > 200 mV.

Repetition Rate: 0 to > 250 MHz.

Ext - Controlled Modes

Ext Trigger: Rep rate is determined by external trigger signal. Trigger output delay 7 ns typical. Square wave mode is disabled.

Synchronous Gating: Rate generator starts with a half-period delay. Last pulse is of normal width even if gate ends during the pulse.

External Width: Output pulse width determined by width of drive input. Rep rate and delay are disabled.

GENERAL

Power Requirements: 100 V, 120 V, 220 V, 240 V rms (+5 %, −10 %) 48–440 Hz. Power consumption 85 VA max.

Environmental:
Operating Temperature: 0 to 55°C.
Storage Temperature: −40 to +70°C.
Humidity Range: 95 % R.H., 0 to 40°C.

Weight: Net 7.9 kg (17.44 lbs), shipping 8.9 kg (19.63 lbs).

Dimensions: 133 mm high, 426 mm wide, 345 mm deep (5.2 x 16.75 x 13.6 in).

OPTIONS

Option 907	Front Handle Kit
Option 908	Rack Flange Kit
Option 909	Rack Flange plus Front Handle Kit
Option 910	Additional Instrument Manual

Specifications describe the instrument's warranted performance. Supplement characteristics – identified by the word "typical" – are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

Data subject to change.

For more information, call your local HP Sales Office or East (301) 948-63 70 · Midwest (312) 255-98 00 · South (404) 955-15 00 · West (213) 877-12 82.
Or write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe: Hewlett-Packard SA, P. O. Box, CH 1217 Meyrin 2, Geneva, Switzerland.
In Japan: Yokogawa-Hewlett-Packard Ltd.,29-21 Takaido-Higashi 3-chome, Suginami-ku, Tokyo 168.

12–01
5952–9539

Published by Hewlett-Packard GmbH
Printed in the Federal Republic of Germany

OPERATING AND SERVICE MANUAL

8082A

PULSE GENERATOR

SERIAL NUMBERS

This manual applies directly to instrument with serial number 1822G02846 and higher. Any change made in instruments having serial numbers higher than the above number will be found in a "Manual Changes" supplement supplied with this manual. Be sure to examine the supplement for changes which apply to your instrument and record these changes in the manual. Backdating information for instruments with lower serial numbers can be found in Section 7 (yellow pages).

HERRENBERGER STR. 110, D-7030 BOBLINGEN
FEDERAL REPUBLIC OF GERMANY

MANUAL PART No. 08082-90003
MICROFICHE PART No. 08082-90503

PRINTED: SEP 1983

Printed in the Federal Republic of Germany

CONTENTS

CONTENTS

ILLUSTRATIONS

TABLES

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GENERAL – This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

OPERATION – **BEFORE APPLYING POWER** comply with the installation section. Additionally, the following shall be observed:

Do not remove instrument covers when operating.

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers and devices connected to it should be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

1–1 INTRODUCTION

1–2 The 8082A is a 250 MHz dual channel pulse source with variable leading and trailing edge transition times as fast as 1ns. It also has variable pulse frequency, delay, width, offset and amplitude. The normal/complement relationship and the polarity of either output can be reversed. Single pulse, double pulse and square wave operation are available. There are also four trigger modes:

1–3 **Normal Mode.** In this mode the 8082A operates as a self-contained pulse source with full control of the pulse parameters from the front panel controls.

1–4 **Ext Trig Mode.** In this mode the pulse and trigger output frequencies are determined by the frequency of an externally applied signal. The other pulse parameters are varied from the front panel controls.

1–5 **Gate Mode.** In this mode a gating signal enables the pulse and trigger outputs.

1–6 **External Width Mode.** In this mode the pulse frequency and width are determined by the frequency and width of an externally applied signal. The delay between input and output is fixed. The trigger output is the shaped trigger input signal.

1–7 ECL OUTPUT

1–8 The 8082A has an ECL position on each of its amplitude range switches. When either or both of the switches are set to this position, both 8082A outputs automatically deliver a fixed voltage swing of −0.9V to −1.7V typical (into an open circuit) for driving ECL logic.

Table 1–1 Specifications

These specifications apply when:

1) **both** outputs are terminated by a 50-Ω load,

2) the internal 50-Ω source impedance is selected.

PULSE CHARACTERISTICS
(Source and load impedance 50Ω)

Transition Times: ⩽ 1ns to 0.5ms in 6 ranges. First range from ⩽ 1ns to 5ns controls leading and trailing edges simultaneoulsy. For all other ranges transition times variable independently up to 1:10.

Difference between risetime and falltime is less than 25% of the faster transition time of the two.

Overshoot and Ringing: ⩽ ± 5% of pulse amplitude may increase to ± 10% with amplitude vernier CCW.

Preshoot: ⩽ ± 5% of pulse amplitude.

Linearity: Linearity aberration for both slopes ⩽ 5% for transition times > 5ns.

Output: Maximum amplitude is 5V from 50Ω into 50Ω. Maximum output voltage is ± 5V (amplitude + offset).

Offset: > ± 2V, into 50Ω

Baseline: 0V ± 150mV with offset switched off and amplitude range set to maximum. Other amplitude ranges reduce baseline proportionately.

DC-Source Impedance: 50Ω ± 5% .
Reflection Coefficient: Reflection is 2% typical for steps with 1ns rise time applied to output connector on all amplitude ranges except 5V range. On the 5V range, the reflection may be 15%.
Output protection: Cannot be damaged by open or short circuits or application of ext ⩽ ± 6 volts or ± 200mA independent of control settings.
Attenuator: Two separate three step-attenuators reduce the outputs to 1V. Vernier is common for both outputs and reduces the output to 0.4V minimum. A further position provides ECL-compatible outputs (–0,9V to –1,7V typ. open circuit).

TIMING

Repetition Rate: > 250 MHz to < 1 kHz in 6 ranges.

Period Jitter: < 0.1% + 50ps

Delay: < 2ns to > 0.5ms in 6 ranges **plus typ. 18ns fxd. with respect to trigger output.**

Delay Jitter: < 0.1% + 50ps

Double Pulse: Up to 125 MHz max. (simulates 250MHz). Min pulse spacing ⩾ 4ns.

Delay Duty Cycle: > 50%
Pulse Width: < 2ns to > 0.5ms in 6 ranges.

Width Jitter: < 0.1% + 50ps

Width Duty Cycle: > 50%
Square Wave: A further position of the Pulse Width switch provides Square Wave output. (Delay and double pulse are disabled, max. Rep. Rate 250 MHz). Duty cycle is 50% ± 10% up to 100 MHz, 50% ± 15% for > 100 MHz.

Trigger Output: Negative going Square Wave (50% duty cycle typ.) > 500mV from 50Ω into 50Ω. Internal 50Ω load can be switched off by slide-switch on PC-board. Amplitude increases to ⩾ 1V into 50Ω up to 200 MHz.
Trigger Output Protection: Cannot be damaged by short circuit or application of external ± 200mA.

EXTERNALLY CONTROLLED OPERATION

External Input

Input Impedance: 50Ω ± 10%. DC coupled.
Maximum Input: ± 6V

Trigger Level: Adjustable –1.5V to +1.5V.

Slope Control: Positive, negative or manual selectable. In the MAN-position all ext. functions can be controlled by push button. Button pushed in simulates an "on-signal".

Sensitivity: Sine-wave > 200mVpp, pulses > 200mV.

Repetition Rate: 0 to > 250 MHz.

Ext.-Controlled Modes

Ext. Trigger: There are approximately 7ns delay between the external input and the trigger output. Rep.-Rate is ext. controlled (is triggered by external signal). Trigger output provides the pulse-shaped input signal. Square wave mode is disabled.

Synchronous Gating: Gating signal turns rep. rate generator on. Last pulse is of normal width even if gate ends during the pulse.

External Width: Output pulse width determined by width of drive input. Rep. Rate and Delay are disabled. Trigger output provides shaped input signal.

OPTIONS

Option 907	Front Handle Kit
Option 908	Rack Flange Kit
Option 909	Rack Flange plus Front Handle Kit
Option 910	Additional Instrument Manual

GENERAL

Power Requirements: 100V, 120V, 220V, 240V (+5%, –10%) 48 – 440 Hz. Power consumption 85VA max .

Weight: Net 7.9 kg (17.44 lbs), shipping 8.9 kg (19.63 lbs).

Dimensions: 426mm wide, 145mm high, 380mm deep (16 3/4 ins. x 5 11/16 ins. x 15 ins.).

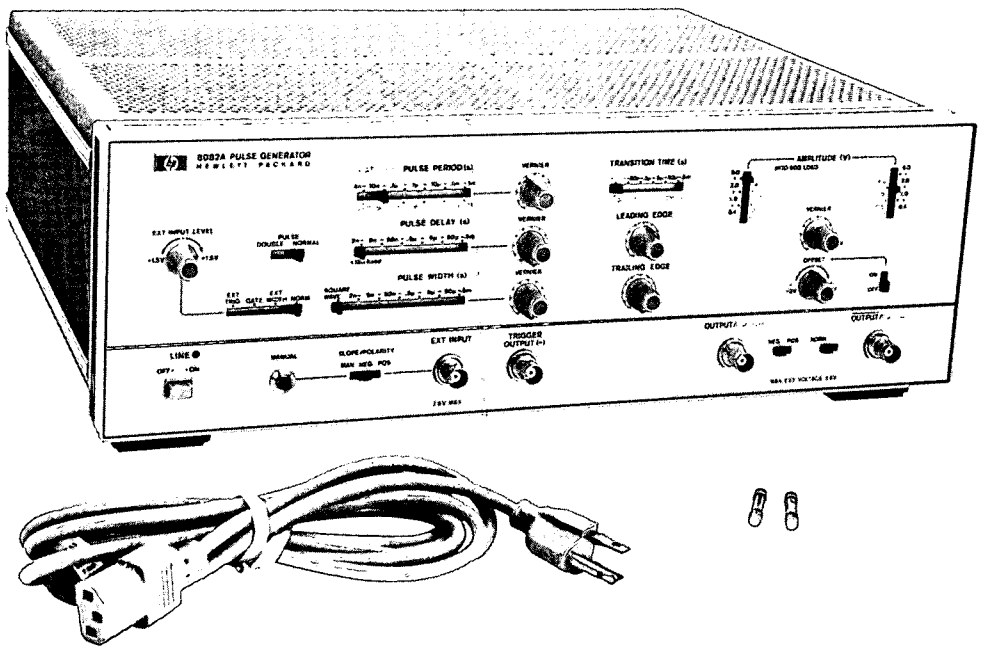
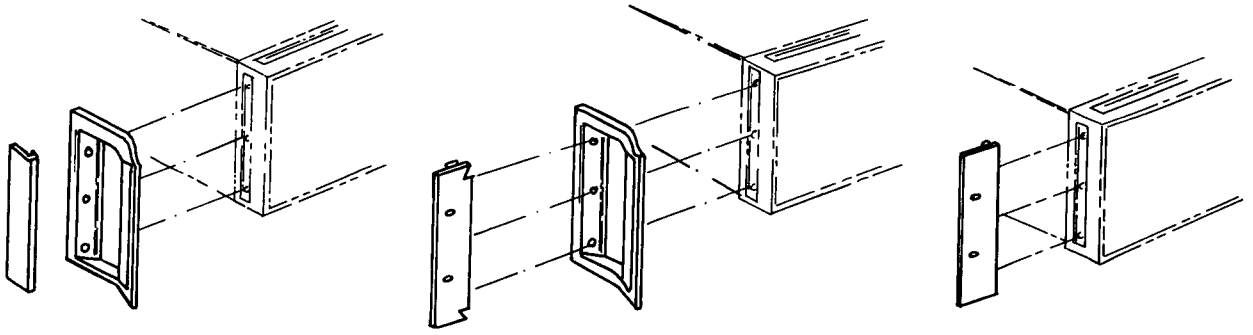


Figure 2–1. 8082A and Supplied Accessories



Front handle
Order Option 907

Rack flange with front handle
Order Option 909

Rack flange
Order Option 908

Figure 2–2. Available Accessories

2–1 GENERAL

2–2 Initial Inspection

2–3 Inspect the instrument and accessories for physical damage, and if damage is evident, refer to paragraph 2–19 for the recommended claim procedure and repacking information.

2–4 Accessories

2–5 The following accessories are supplied with the standard instrument (Figure 2–1):

	HP Part Number
1A fuse (for 220/240V operation)	2110–0007
2A fuse (for 110/120V operation)	2110–0202
Power cord	see Figure 2–3
Operating and Service Manual	

For an additional manual, order option 910.

Handles are rack mounting flanges are delivered with the instrument only if the appropriate option (Figure 2–2) is ordered.

2–6 Power Cords

2–7 The instrument is supplied with one of the power cords shown in Figure 2–3.

2–8 INSTALLATION

2–9 Power Cord

2–10 The 3-wire power cable supplied with the 8016A, when connected to the appropriate power outlet, grounds the instrument cabinet and panels. To preserve this safety feature when operating the instrument from an outlet without a ground connection, use an appropriate adapter and connect the ground lead (green/yellow) to an external ground.

2–11 If the plug on the cable does not fit your power outlet, then cut the cable at the plug end and connect a suitable plug. The plug should meet local safety requirement and include the following features:

a. Minimum current rating of 2A
b. Ground connection
c. Cable clamp

The colour coding used in the cable will depend on the cable supplied (see Figure 2–3).

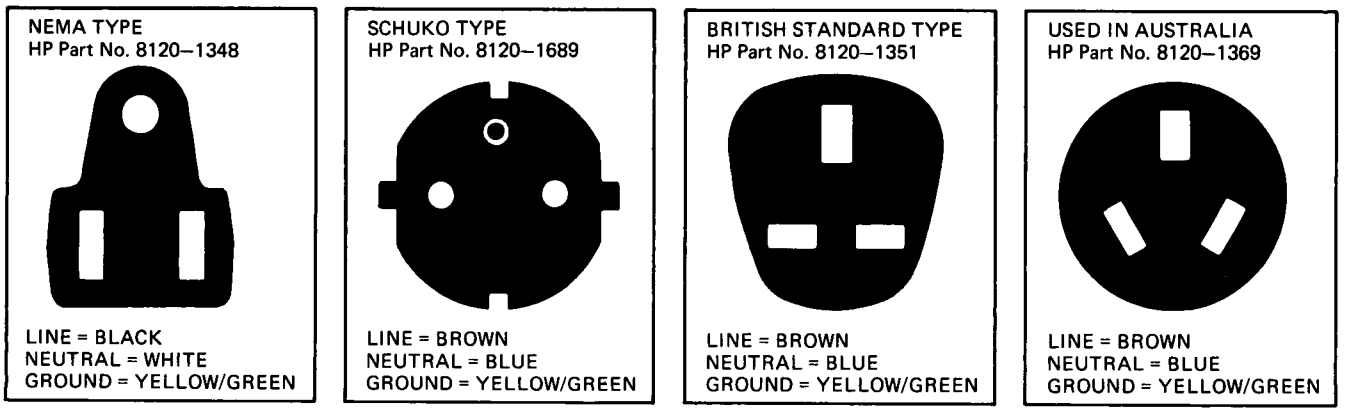


Figure 2–3. Power Cords

WARNING

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on:

a. If this instrument is to be energized via an auto-transformer for voltage reduction, make sure that the ground connection is not interrupted.

b. The power cable plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor (grounding).

c. The safety check (Table 5–27) shall be executed before connecting the instrument to the supply.

2–12 Power Source requirements

2–13 The instrument will operate from nominal ac line supplies of 100V, 120V, 220V or 240V (–10%, + 5%) at 48 Hz to 66 Hz. Two switches on the rear panel allow one of the four voltages to be selected.

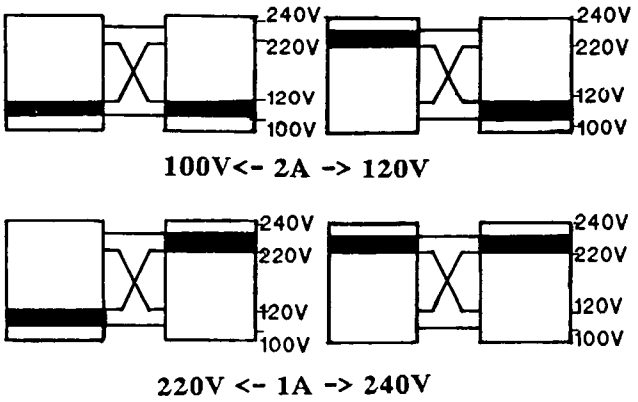


Figure 2–4. Switch Settings for the various Norminal Powerline Voltages

CAUTION

Before applying power to the instrument, check on the rear panel that the switch is set in accordance with local supply conditions.

2–14 To check the power requirements proceed as follows:

a. Remove the fuse and check its value:
for 220V/240V operation 1A
for 100V/120V option 2A

b. Check that the line selector switch positions corresponds to the local supply voltage. If they do not correspond use a screwdriver to change the switch positions.

c. Insert the correct fuse into the fuseholder.

d. Connect the power cable to the rear connector.

2–15 Temperature Requirements

2–16 The instrument operates within specifications when the ambient temperature is between 0°C (32°F) and 50°C (122°F). The word generator may be stored between –40°C (–40°F) and 75° (167°F).

2–17 RACK MOUNTING

2–18 Figure 2–2 shows the possible handle/rack-mounting configurations. If handles are fitted and subsequently need to be removed, the plastic trim must first be taken off as shown in Figure 2–5.

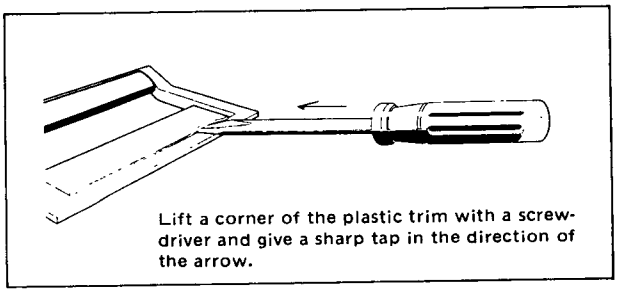


Figure 2–5. Removing Plastic Trim

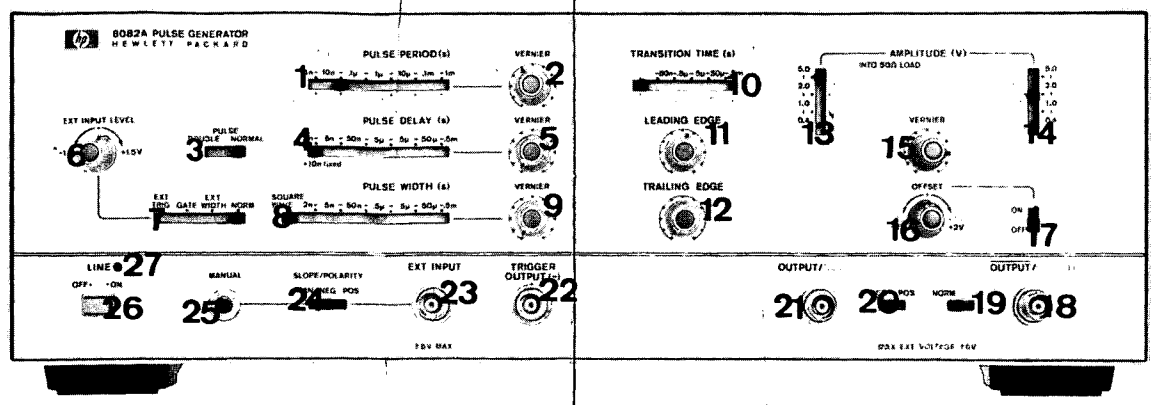
2–19 CLAIMS AND REPACKAGING

2–20 Claims for Damage

2–21 If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.

2–22 Repackaging for Shipment and Storage

2–23 If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag showing owner, address, model and serial number, and the repair required. The original shipping carton and packaging material may be re-usable but the Hewlett-Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packing is not available or re-usable.



1 RATE switch: for selecting the range of the pulse rate .

2 Rate VERNIER: for continuous adjustment of the repetition rate within the range selected on the RATE switch. Clockwise rotation increases the pulse period (reduces the rate).

3 PULSE DOUBLE/NORMAL switch: in the DOUBLE PULSE position the 8082A delivers two pulses for every trigger pulse – one pulse in phase with the trigger output and one delayed by the amount set on the PULSE DELAY controls. DOUBLE PULSE is not available in the EXT WIDTH mode and is automatically inhibited if selected. In the NORMAL position, for each trigger pulse, the 8082A delivers one pulse which is delayed on the trigger pulse by the amount set on the PULSE DELAY controls.

4 PULSE DELAY switch: for selecting the range of the pulse delay with respect to the trigger output in NORM, GATE and EXT TRIG modes. Has no effect in the EXT WIDTH and SQUARE WAVE modes.

5 Pulse delay VERNIER: for continuous adjustment of the pulse delay within the range selected on the PULSE DELAY switch. Clockwise rotation increases the delay.

6 EXT INPUT LEVEL control: defines the threshold level of the EXTERNAL INPUT over a range –1.5V to +1.5V .

7 Mode switch: selects either the internal (NORM) mode or one of three external modes (EXT WIDTH, GATE or EXT TRIG).

8 PULSE WIDTH switch: selects the range of the pulse width required in all modes except EXT WIDTH. When SQUARE WAVE is selected a square wave output of 50% duty cycle is produced. The frequency of the square wave depends on the PULSE PERIOD setting.

9 Pulse width VERNIER: for continuous adjustment of the pulse width within the range set on the PULSE WIDTH switch.

10 TRANSITION TIME switch: for selecting the range of leading and trailing edge transition times.

11 LEADING EDGE vernier: for continuous adjustment of the leading edge transition time within the range selected on the TRANSITION TIME switch. On the fastest range this vernier controls both leading and trailing edges.

12 TRAILING EDGE vernier: for continuous adjustment of the trailing edge transition time within the range selected on the TRANSITION TIME switch.

13 AMPLITUDE switch: for selecting the range of the output pulse amplitude available at the OUTPUT / $\overline{\text{OUTPUT}}$ connector. In the ECL position the OUTPUT / $\overline{\text{OUTPUT}}$ connector delivers pulses of fixed amplitude (–0.9V to –1.7V into an open circuit) and the amplitude vernier and the offset control are disabled.

14 AMPLITUDE switch: for selecting range of the output pulse amplitude available at the $\overline{\text{OUTPUT}}$ / OUTPUT connector. In the ECL position the $\overline{\text{OUTPUT}}$ / OUTPUT connector delivers pulses of fixed amplitude (–0.9V to –1.7V into an open circuit) and the amplitude vernier and the offset control are disabled.

15 Amplitude VERNIER: for continuous adjustment of pulse amplitude from both pulse outputs simultaneously within the ranges set on the AMPLITUDE switches.

16 OFFSET vernier: for adjustment of the baseline of both output pulses simultaneously over the range –2V to +2V.

17 OFFSET switch: for enabling/disabling the OFFSET vernier. In the OFF position the baseline of both outputs is zero volts.

18 $\overline{\text{OUTPUT}}$ / OUTPUT connector: BNC connector.

19 NORM / COMPL switch: reverses the duty cycle of the two outputs, what was the normal output becomes the complement and vice versa.

20 NEG/POS switch: determines the polarity of both output pulses.

21 OUTPUT / $\overline{\text{OUTPUT}}$ connector: BNC connector.

22 TRIGGER OUTPUT (–) connector: BNC connector, supplies negative square wave at a rate determined by the setting of the pulse period controls. Pulse delay is refered to the negative going edge of the trigger. In EXT TRIG and EXT WIDTH modes it will deliver a shaped version of the trigger input. In GATE mode it will deliver pulses at the rate set on the pulse period controls for as long as the gate is open.

23 EXT INPUT connector: BNC connector to which trigger pulses are applied in the EXT TRIG, GATE and EXT WIDTH modes.

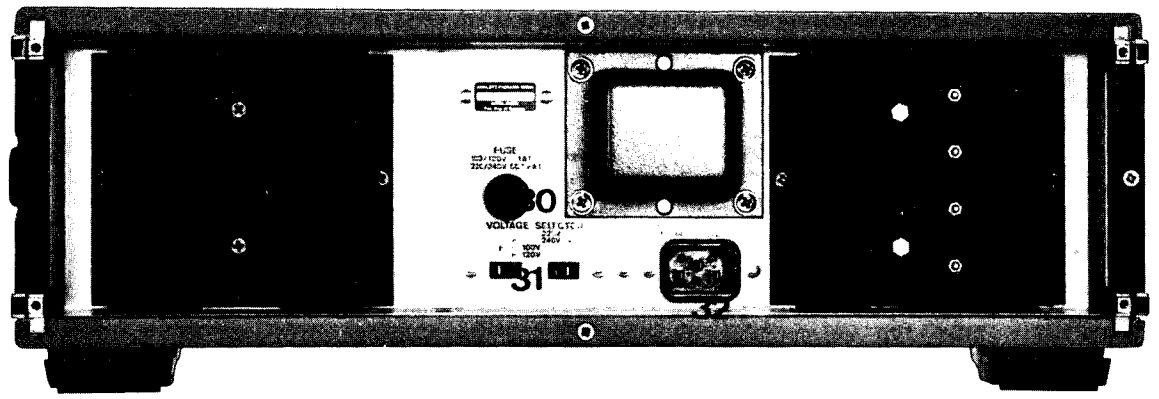
24 SLOPE / POLARITY switch determines whether a rising (POS) or falling (NEG) signal will trigger or gate the external input on. MAN position means that the external signal can be simulated by pressing the MANUAL button.

25 MANUAL button provides a means of initiating a single pulse (EXT TRIG mode) each time the button is pressed, a train of pulses (GATE mode) while the button is pressed, or a pulse whose width is equal to the time the button is pressed (EXT WIDTH mode).

26 LINE ON/OFF switch: press-for-on, press-for-off switch.

27 LINE lamp: glows when LINE ON/OFF switch is ON.

Figure 3–1. Controls and Connectors



REAR PANEL

30 Fuse
31 Line voltage selector See Section 2
32 Line connector

INTERNAL (See Figure 6–2)

A3S1 Trigger output 50Ω internal load on/off.

3–1 GENERAL

3–2 This section is divided into two parts. The first part gives some general notes on the operation of the 8082A together with operating instructions for each of the four operating modes:

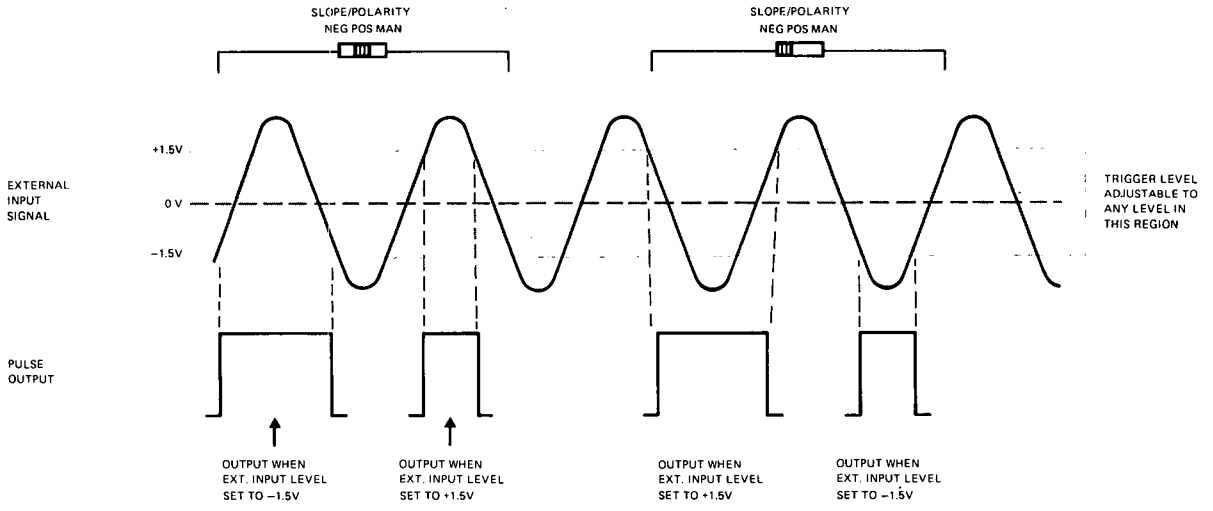
NORM operating mode
EXT WIDTH operating mode
GATE operating mode
EXT TRIG operating mode

Full setting-up instructions are given for Normal mode followed by any changes in control settings required for the other three modes. Stylized waveforms are given for each mode to show the resultant pulse shapes. For ease of operation the instructions will refer to Figure 3–1 which shows the controls identified by a reference number in a circle. The same reference numbers are used in the text when each control is mentioned.

3–3 The second part of this section gives applications information.

3–4 EXTERNAL INPUT CHARACTERISTICS

3–5 The SLOPE/POLARITY switch determines whether a rising (POS) or falling (NEG) signal will trigger or gate the external input on. Figure 3–2 shows the effects of these controls in the External Width mode.



NOTE: There is a fixed delay of ≤ 24ns after the input reaches the trigger level before the output responds.

Figure 3–2. Effect of External Input Controls

3–6 Any external input pulses must have an amplitude of at least 200mV peak-to-peak and must be at least 2ns wide at the level at which triggering is to occur.

3–7 If the SLOPE/POLARITY switch is set to MAN, the external signal can be simulated by pressing the MANUAL pushbutton. This button provides a means of initiating a single pulse (EXT TRIG mode) each time the button is pressed, a train of pulses (GATE mode) while the button is pressed, or a pulse whose width is equal to the time the button is pressed (EXT WIDTH mode).

3–8 SQUARE WAVE OPERATION

3–9 There is a Square Wave facility on the 8082A which produces a square wave output of 50% duty cycle in NORMAL mode. If Square Wave is selected in External Trigger or External Width modes, the output is a pulse shaped version of the trigger input (the output waveforms are the same as for External Width mode, see Figure 3–4). If Square Wave is selected in Gate mode, the output is a gated square wave, the repetition rate of which is set up on the pulse period controls.

3–10 OUTPUT AMPLITUDE CONTROLS

3–11 Vernier

3–12 Because the amplitude vernier is common to both outputs, the amplitude relationship of one output to the other is 1:1, 1:2 or 1:5.

3–13 ECL Outputs

3–14 To obtain normal and complement ECL compatible pulses from the two outputs, either one or both amplitude range switches should be set to the ECL position. The ECL levels supplied are −0.9V to −1.7V into an open circuit, i.e. without an external 50 ohm load. These output levels can be altered by changing the values of resistors R 5 (ECL amplitude) and R60 (ECL–DC offset) on board A5 (Amplitude Vernier and DC Offset board).

3–15 INCOMPATIBLE CONTROL SETTINGS

3–16 When operating the 8082A, the layout of the Pulse Period, Delay and Width controls helps to avoid incompatible settings as shown in Figure 3–3. Generally, the Pulse Period control should be farthest right but the controls can all be in a straight vertical line if the Pulse Period vernier is more clockwise than the other two verniers.

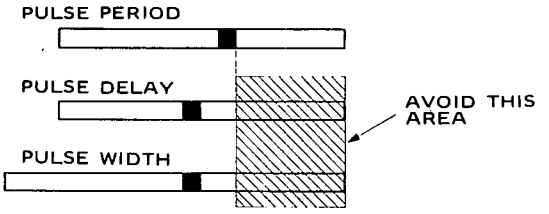


Figure 3–3. Positioning of Controls

3–17 NORM OPERATING MODE

3–18 In this mode the 8082A requires no external trigger signal to produce an output. Pulse rate, width, delay, transition times, amplitude and offset are all adjusted by the front panel controls.

3–19 The initial settings (listed below) are given to obtain a normal pulse waveform (Figure 3–4) for someone unfamiliar with the operation of the 8082A. Both pulse outputs and the trigger output should be connected to a high-frequency oscilloscope using a 50 ohm system. The oscilloscope (an HP 180C mainframe with 1810A plug-in or similar 1 GHz bandwidth sampling oscilloscope) should be set with the sweep time at 0.5μs/cm and with the sensitivity at 200mV/cm.

LINE (26)	ON
PULSE PERIOD (1)	1μ–10μ
VERNIER (2)	Mid-range
PULSE DELAY (4)	2n–5n
VERNIER (5)	CCW (2n)
PULSE WIDTH (8)	50n–.5μ
VERNIER (9)	CW (.5μ)
NORMAL/DOUBLE PULSE switch (3)	NORMAL
Mode Switch (7)	NORM
TRANSITION TIME (10)	50n–.5μ
LEADING EDGE (11)	Mid-range
TRAILING EDGE (12)	Mid-range
AMPLITUDE (13)	1.0–2.0
AMPLITUDE (14)	1.0–2.0
VERNIER (15)	CCW (1.0)
OFFSET ON/OFF switch (17)	OFF
NORM/COMPL switch (19)	NORM
NEG/POS switch (20)	POS

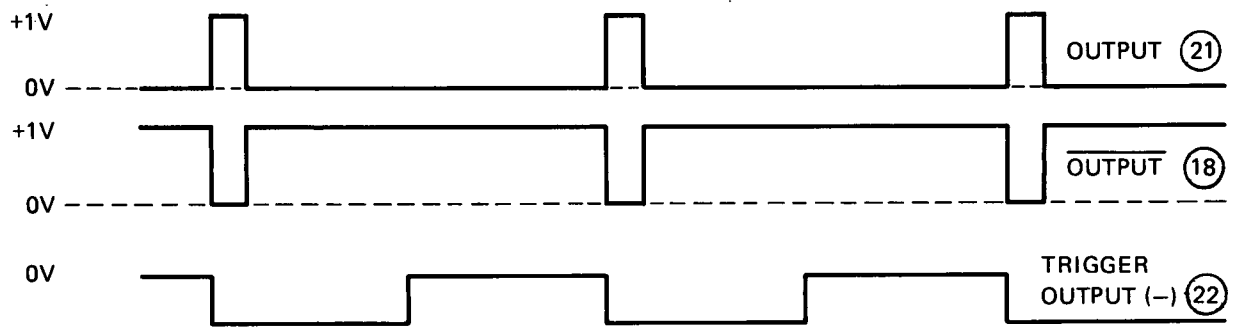


Figure 3–4. Pulse Output in NORM Mode

3–20 EXT WIDTH OPERATING MODE

3–21 In External Width mode, the pulse repetition rate and width are determined by the repetition rate and width (at the threshold set by the EXT INPUT LEVEL control) of an externally applied signal. In EXT WIDTH mode the PULSE PERIOD controls, the PULSE DELAY controls, the PULSE WIDTH controls and the DOUBLE/NORMAL PULSE switch have no effect on the pulse output. To obtain an output similar to that in Figure 3–5, adjust the controls as shown below. It is assumed that the controls are already set-up as described above for a Normal pulse; therefore only the alterations to these control settings will be given.

a. Set the Mode switch (7) to EXT WIDTH.

b. Apply an external trigger to the EXT INPUT (23) . The input should have the following characteristics:
Pulse shape – sine or square wave
Amplitude – between 200mV and 6V
Frequency – 14kHz

c. Set the EXT INPUT LEVEL (6) control as required to vary the switching threshold.

d. Set the SLOPE/POLARITY switch as required to trigger off the rising (POS) or falling (NEG) edge of the trigger.

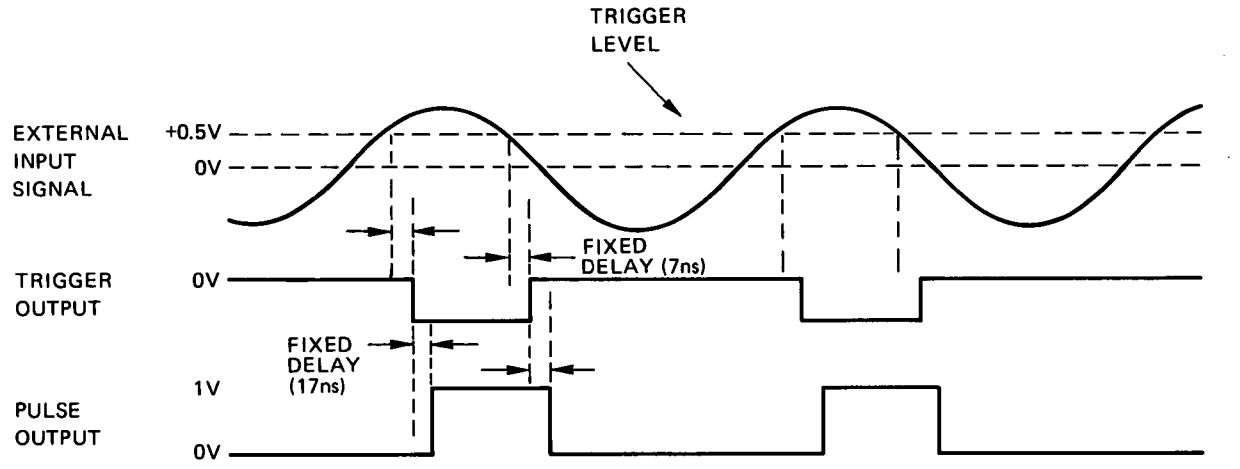


Figure 3–5. Pulse Output in External Width Mode

3–22 GATE OPERATING MODE

3–23 In Gate mode the repetition rate is defined by the rate controls but no output occurs until the voltage of an externally applied signal rises above (SLOPE/POLARITY switch set to POS) or falls below (SLOPE/POLARITY switch set to NEG) the level set on the EXT INPUT LEVEL control. The last pulse of a 'burst' is always of correct width even if the gate closes during the pulse. To obtain an output similar to that in Figure 3–6, adjust the controls as shown below. It is assumed that the controls are already set-up as described above for a pulse in External Width mode; therefore only the alterations to these controls settings will be given. Switching to External Width mode when in Gate mode can be used to check for correct functioning of the gate signal.

a. Set the Mode switch (7) to GATE.

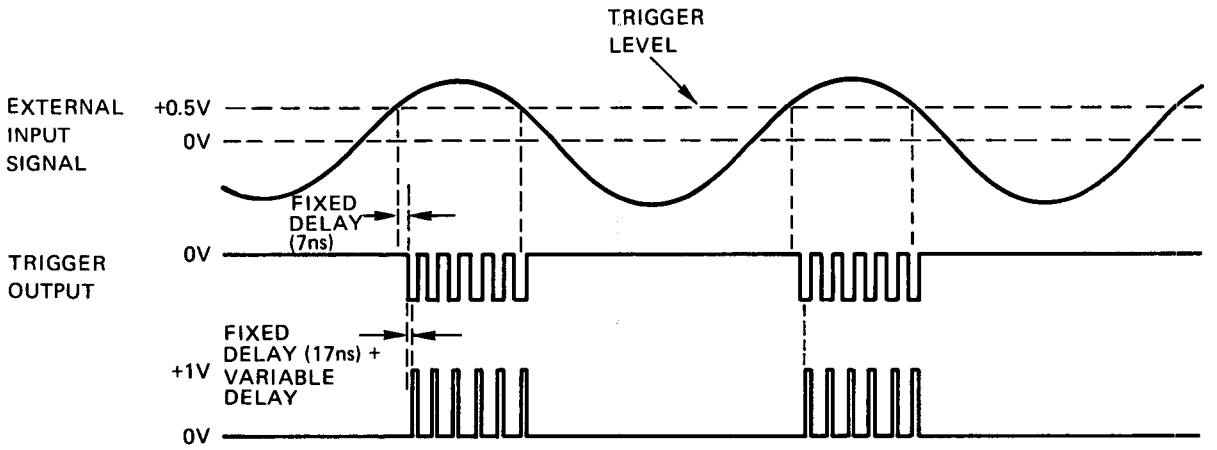


Figure 3–6. Pulse Output in Gate Mode

3–24 EXT TRIG OPERATING MODE

3–25 In External Trigger mode the pulse and trigger repetition rates are determined by the repetition rate of an externally applied signal. To obtain an output similar to that in Figure 3–7, adjust the controls as shown below. It is assumed that the controls are already set-up as described above for a pulse in Gate mode; therefore only the alterations to these control settings will be given.

a. Set the Mode switch (7) to EXT TRIG.

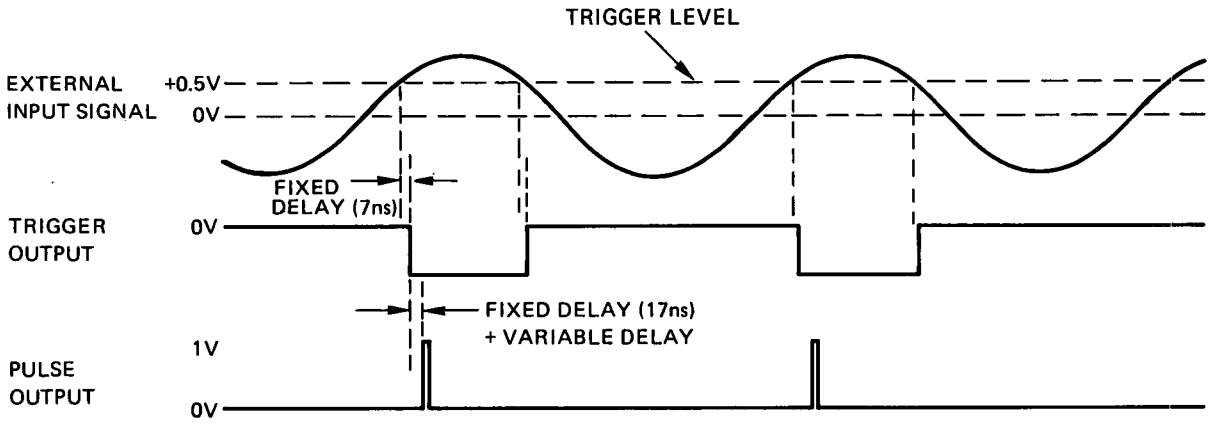


Figure 3–7. Pulse Output in External Trigger Mode

3–26 APPLICATIONS NOTES

3–27 The following section indicates some applications of the 8082A.

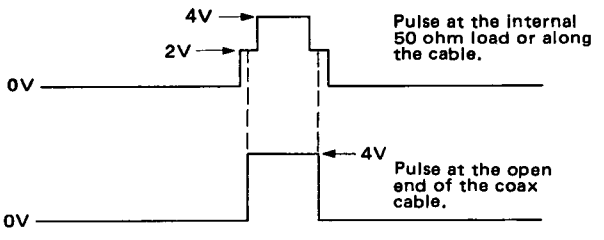


Figure 3–8. Stepped pulse with high-Z output

3–28 Digital Applications

3–29 The 8082A can be used to test the following digital integrated circuit (IC) logic families at their normal operating speeds:

	Propagation delay per gate
RTL	12ns – 27ns
DTL	30ns
TTL	12ns
Schottky TTL	3ns
ECL (including MECL III)	1ns – 4ns

For convenience of operation a special ECL output is available on the 8082A. This means that by simply setting either amplitude range switch to the ECL position, an output pulse width a voltage swing of –0.9V to –1.7V is produced into an open circuit.

When using the 8082A to test any of the above logic families, particularly the fast MECL III logic, it is important to operate with a 50 ohm transmission system. The coaxial cable does not need to be terminated at the IC and by a 50 ohm resistor; the internal 50 ohm termination of the 8082A is of sufficiently high quality to provide a clean pulse shape in almost all cases (see paragraph 3–31) without an external termination, even at the fastest transition times. This has the advantage that it enables the 50 ohm coaxial cable to be soldered directly to the pins of the IC under test without requiring a 50 ohm terminating resistor. It should be noted, however, that when no external termination is used, no connections can be made at any intermediate point along the transmission cable. For example, suppose the pulse on leaving the 8082A has 2V amplitude across an effective 25 ohms (50 ohm internal termination in parallel with 50 ohm cable); when the pulse reaches the IC its amplitude is doubled to 4V (open end reflection). This 4V is reflected back along the cable and is absorbed by the 50 ohm termination in the 8082A with only 2% typical reflection at amplitudes up to 4V. The effect of this action is to produce the stepped pulse shown in figure 3–8 at any intermediate point along the cable.

3–30 If a detailed analysis of IC waveshapes and timings is to be made, a 1 GHz sampling oscilloscope with a high impedance input probe should be used. The probe should be connected at the IC pin and not at any intermediate point along the 50 ohm cable.

3–31 If a number of IC's on one PC board are being driven from one point on the board and the printed circuit track is more than 10cm long, then an external 50 ohm resistor at the end of the 50 ohm system may be required to preserve the clean pulse shape at the IC input pins.

3–32 One point to remember, particularly when testing 1ns ECL, is the loss of edge speed due to the coaxial cable. However, the 8082A is fast enough to accommodate this edge speed degradation without exceeding the manufacturers specification. A 1.23 metre cable is available as HP Accessory number 10503A.

3–33 When testing flip-flops (Motorola MC1666 for example), two pulse generators are required, one to provide the clock input and one to provide the data input. One pulse generator is run in square wave mode and the other is run in external trigger and double pulse mode and is synchronized from the trigger output of the first pulse generator (Figure 3–9). Allowance must be made for the differential delay that will occur between the two outputs. This is caused by the fact that there is an extra 7ns delay in the second 8082A (24ns against 17ns) due to the delay between the trigger input and the trigger output. To preserve the correct timing relationship, therefore, between the two sets of pulse outputs, the data pulse output must be delayed by a further 7ns. This can be achieved by increasing the length of the data output transmission cable (delay is about 5ns per metre).

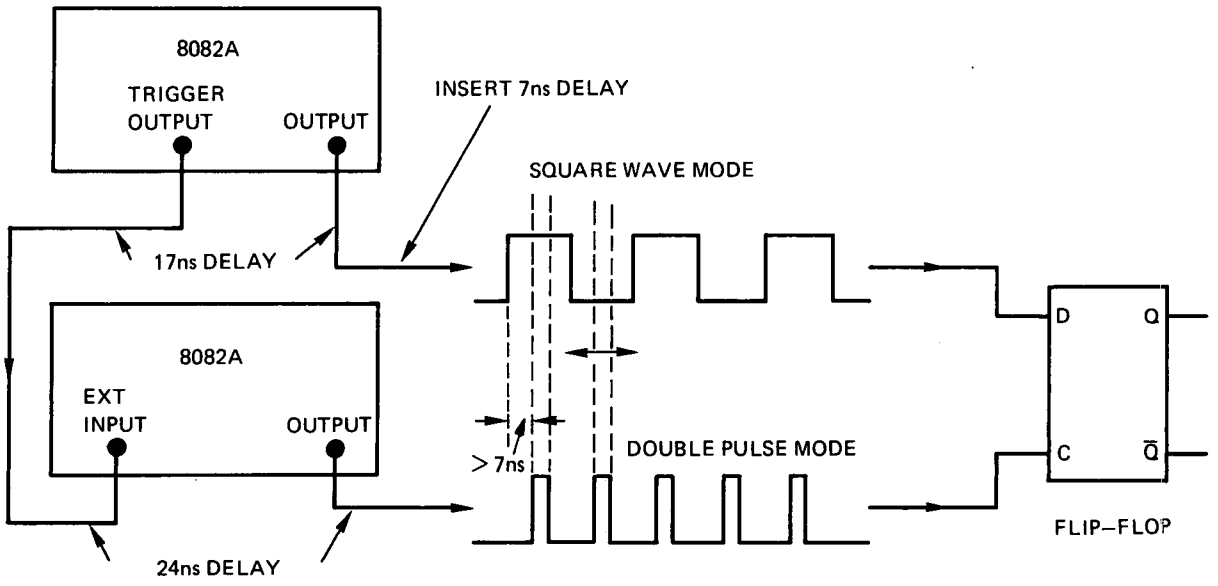


Figure 3–9. Flip-Flop Test Circuit

3–34 The minimum set-up time required for switching the flip-flop from '0' to '1' (or vice versa) can be measured as shown in Figure 3–10.
The pulse delay controls of the clock output are slowly decreased and because the output is in double pulse form, only the second pulse in each case advances towards the leading edge of its data input (in this case a '1'). The minimum set-up time is found when the flip-flop ceases to switch properly from '0' to '1'. The minimum set-up time for switching from '1' to '0' can then be found by switching to the complement of the data input and repeating the exercise.

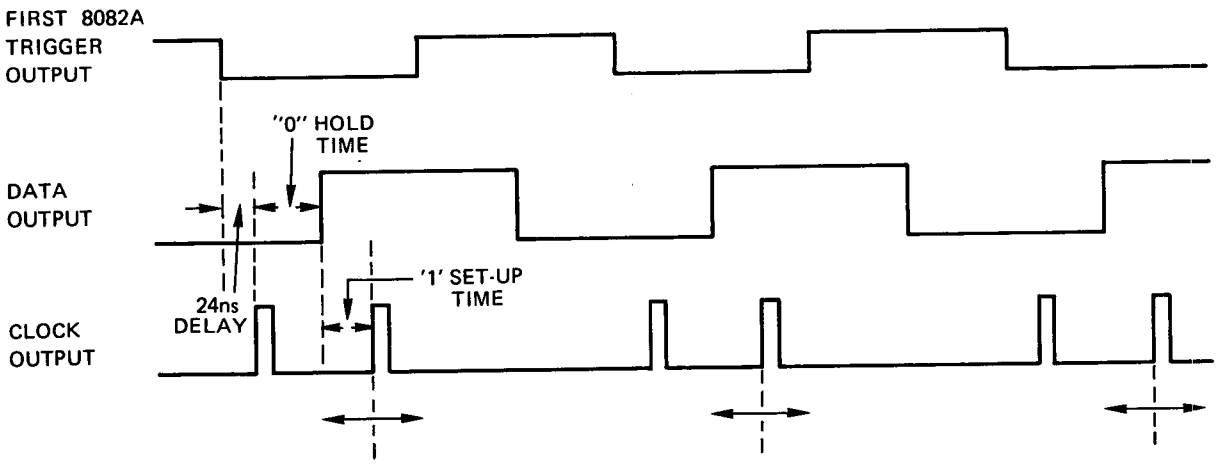


Figure 3–10. Flip-Flop Test Waveforms

3–35 The clock pulse transition times can be adjusted to observe the variation in the propagation delay of the flip-flop or to simulate edge degradation caused by a high fanout of the clock pulse line.

3–36 The 8082A can be used as a pulse shaper. When set to external width mode, an external signal (the output of a word generator for example) connected to the trigger input is available in pulse shaped form at the pulse output. Adjusting the trigger level control to the appropriate level helps to recover the shape of even badly distorted pulses.

3–37 The 8082A can also be used to generate noise pulses; the pulse width is set to minimum and the amplitude to 5V and then the transition times are increased. This has the effect of reducing the pulse amplitude and, in fact , the transition times can be increased until a spike of approximately 1ns width and 800mV amplitude (ECL amplitude) is produced (see Figure 3–11).
This can be set to the required dc level using the offset controls and connected to the logic circuit under test to simulate noise. The amplitude and offset of the noise spike can be varied and their effect on the circuit monitored.

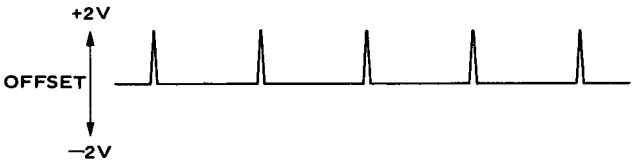


Figure 3–11. Noise Pulses

3–38 Analog Applications

3–39 The 8082A can also be used effectively in analog applications. Twisted pairs of transmission lines and differential amplifiers can be tested using the normal and complement outputs; the common amplitude vernier is very useful in this application for varying the amplitude of both outputs simultaneously. Trigger levels of Schmitt trigger circuits can be tested using output pulses with very slow transition times (as slow as 0.5ms).

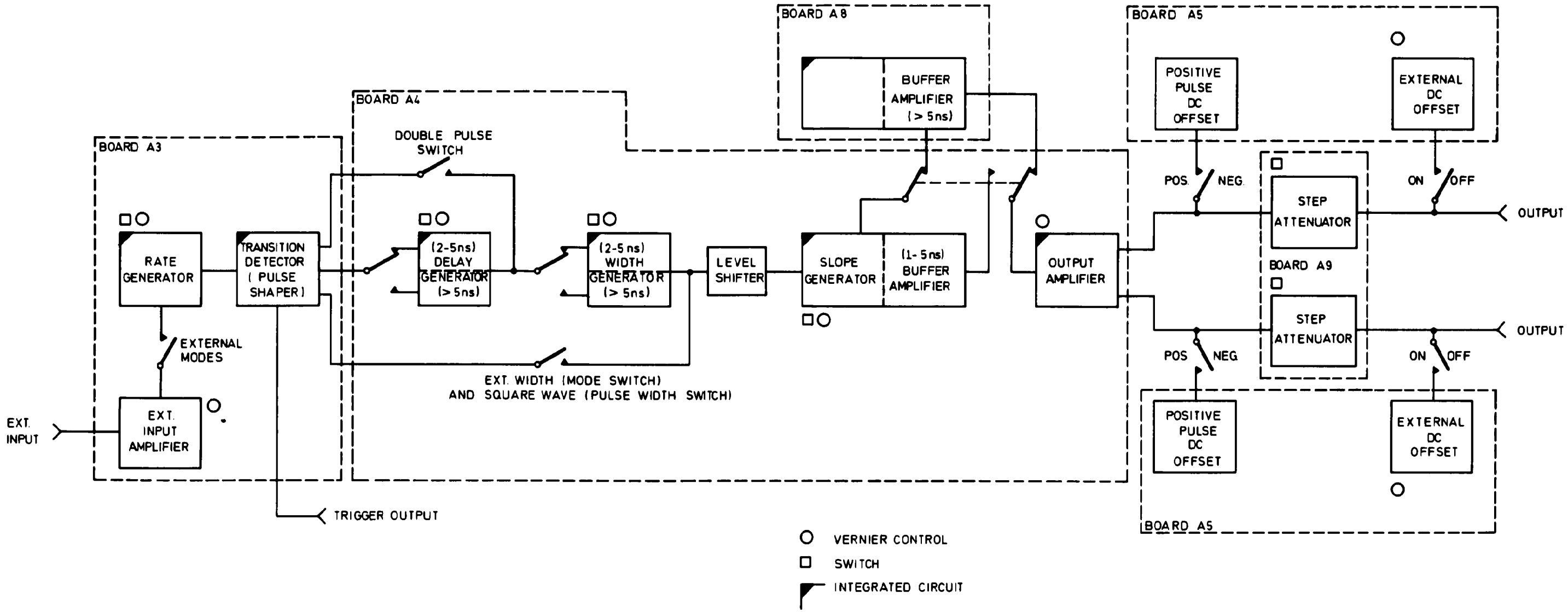


Figure 4–1. 8082A Pulse Generator – Block Diagram

4–1 INTRODUCTION

4–2 A basic block diagram of the 8082A is shown in figure 4–1 and this should be referred to when reading the following description. The pulse repetition rate is generated either internally by the Rate Generator or externally by an external input signal, depending on the mode of operation. The square wave output of the Rate Generator is input to the Transition Detector were it is pulse shaped to produce a train of 2ns wide spikes. These pulse spikes are then applied to the Delay and Width Generators. Each of these generators is divided into two parts for periods of 1–5ns or > 5ns and the incoming signal is routed into the appropriate part. The Output of the Width Generator is level shifted and input to the Slope Generator where the slope of the leading and trailing pulse edges is made variable (variable transition times).

4–3 If Double Pulse mode is selected, both the delayed and undelayed waveforms are input to the Width Generator. If External Width mode is selected, both the Delay and Width Generators are by-passed and the output of the Transition Detector is input to the level shifter.

4–4 The output of the Slope Generator is input to one of two Buffer Amplifiers dependent on the transition time setting (1–5ns or > 5ns). Normal and complement outputs from the Buffer Amplifier are then input to the dual channel Output Amplifier. Here the amplitude variation within ranges is added in the form of an Amplifier Vernier, which is common to both channels.

4–5 The positive pulse DC Offset circuits are responsible for shifting the voltage level of both channels from a negative level to a positive level, using the NEG/POS switch, if positive output pulses are required (the normal/complement relationship of the two channels is also automatically reversed when this action is performed) This means that either negative normal pulses or positive normal pulses are available from one output connector.

4–6 After being set to the correct polarity, the amplitude of both signals is set to the appropriate range using an active Step Attenuator circuit.

4–7 Finally the External DC Offset circuit provides an offset voltage to shift the baseline of both output signals together over the range –2V to +2V if required. This circuit can be switched off in which case both signal baselines are at 0V.

4–8 REPETITION RATE GENERATOR

4–9 The function of the repetition rate generator is to provide a train of pulses, approximately 2ns wide, for the delay generator or a 50% duty cycle waveform if square wave is selected; also to provide a train of 50% duty cycle square wave pulses for the output trigger. A block diagram of the unit is given in Figure 4–2 and a schematic diagram in Service Sheet 1.

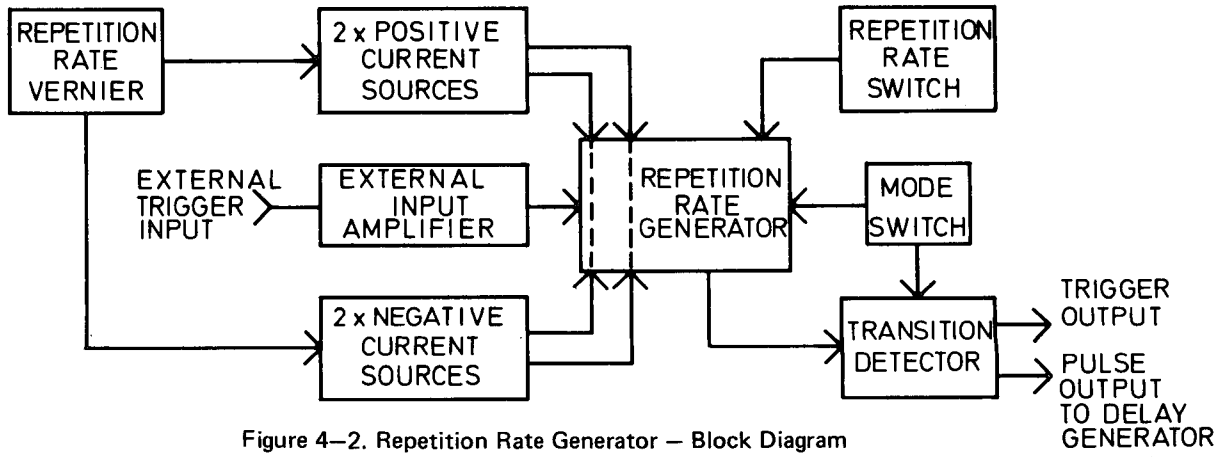


Figure 4–2. Repetition Rate Generator – Block Diagram

4–10 External Input Amplifier

4–11 In any mode except NORMAL mode, the output of the rate generator is controlled, either gated or triggered, by the external input amplifier. The amplitude of the external input signal is limited by a bridge circuit to approximately ± 2V. The signal then enters one side of a differential amplifier, the reference voltage on the other side of which is determined by the setting of the EXT. TRIG LEVEL control. Thus the threshold level of the input signal, i.e. the voltage level at which gating or triggering occurs, can be varied. The SLOPE/POLARITY switch determines whether a rising (POS) or falling (NEG) input signal will cause triggering or gating. If set to MAN, the switch disables the external input signal and enables the MANUAL button so that pressing the button simulates one pulse from the external input.

4–12 Rate Generator

4–13 In the NORMAL mode, the output of the pulse generator is derived from the rate generator. The rate generator consists of a ramp generator which feeds a Schmitt trigger to produce a 50% duty cycle square wave output. A simplified diagram of the circuit is shown in Figure 4–3.

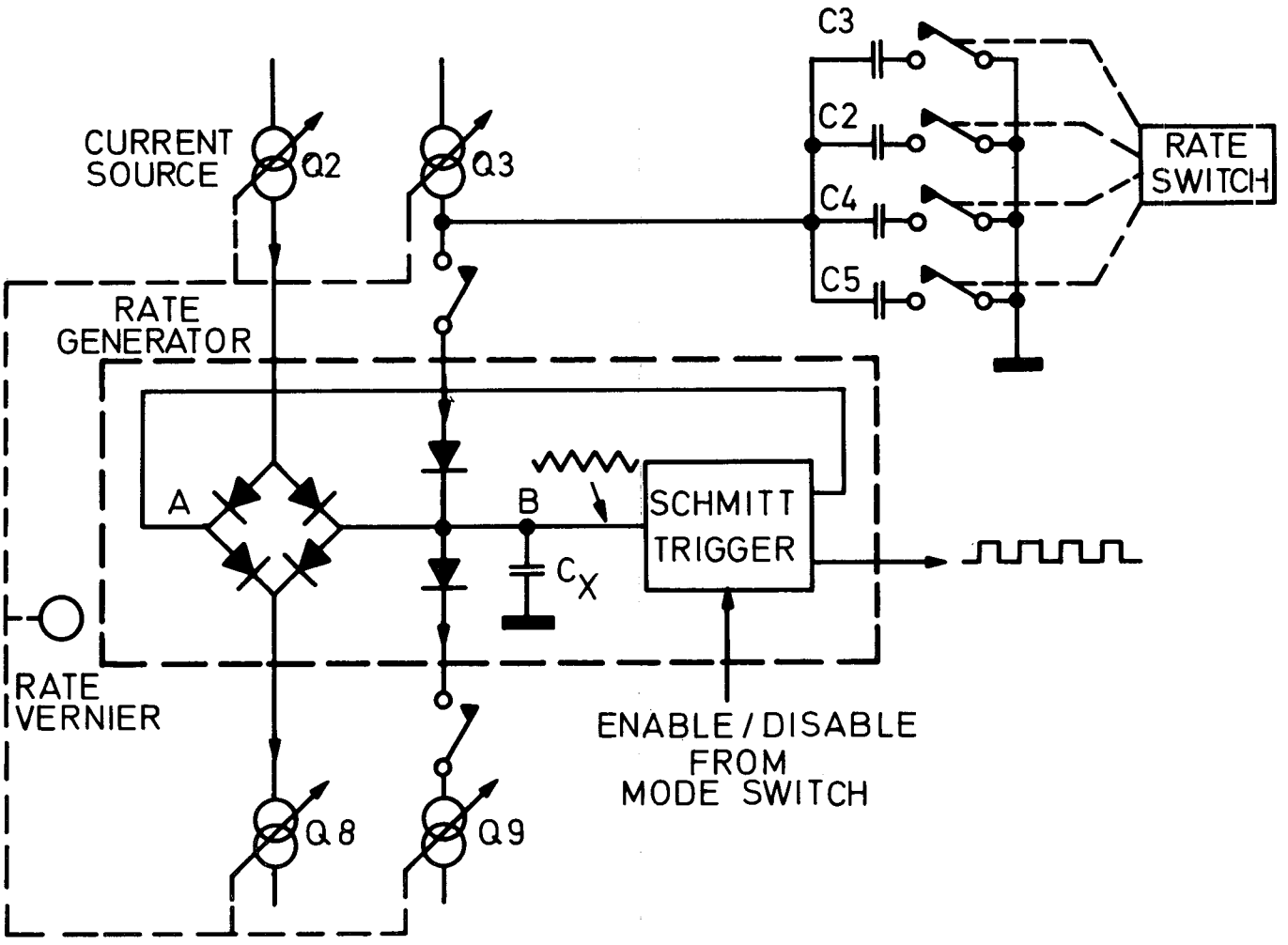


Figure 4–3. Rate Generator

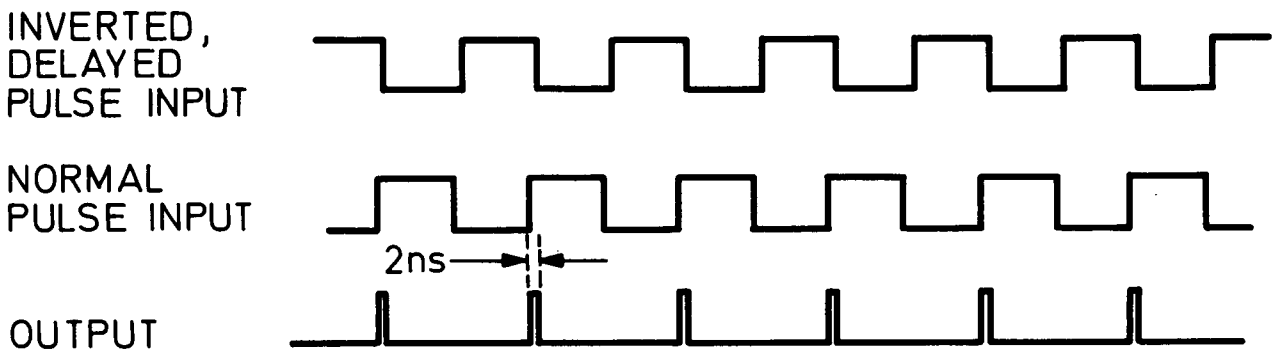


Figure 4–4. Transition Detector Pulse Output

4–14 Four current sources (Q2, Q3, Q8 and Q9) provide current for the rate generator; two of these sources (Q3 and Q9) are inhibited by logic switches (U6, Q4, Q5) when the repetition rate is set to the fastest range (100 – 250 MHz). Thus on the fastest range if capacitor C_X is discharged, point B is at a low level and the output of the Schmitt trigger is high. In this state current from source Q2 charges capacitor C_X and current from the Schmitt trigger flows into current sink Q8. When the charge on C_X has reached the threshold level of the Schmitt trigger, the output of the Schmitt trigger and hence the level at A goes to a low level. Current from Q2 now flows, via A back into the Schmitt trigger and C_X discharges into current sink Q8.

4–15 This action produces a triangular waveform at point B and a 50% duty cycle square wave at the Schmitt trigger output when both current sources Q2 + Q8 are equal. When the rate switch is set to any of the lower repetition rate ranges, current sources Q3 and Q9 and the extra capacitors (C2 – C5) are switched in. The circuit action is the same; the extra capacitors are required to provide the longer charge/discharge times. The repetition rate is adjusted within each range by the rate vernier, which adjusts the current from both current sources simultaneously.

4–16 The square wave output from the Schmitt trigger is used to drive the transition detector stage.

4–17 Transition Detector

4–18 This circuit produces two outputs; a trigger output and a pulse output for the delay generator. The trigger output is merely an inversion of the input, i.e. a negative 50% duty cycle square wave, and can be switched to either $>$500mV or $\geqslant$ 1V amplitude. The pulse output is produced by inverting and delaying the pulse input (delay produced by 2ns fixed delay line) and then presenting this waveform, together with the normal pulse input, to an AND gate. The resultant waveform is as shown in Figure 4–4. The pulse spikes produced are of constant width regardless of repetition rate and are input to the Delay Generator. In Square Wave mode the Transition Detector has no effect on the signal, i.e. the square wave passes straight through.

4–19 Repetition Rate Vernier

4–20 The repetition rate vernier produces a variable voltage (0V to 6.4V) into a differential amplifier (U5). The output of the differential amplifier drives a transistor Q1 which acts as a phase splitter for the two positive and two negative current sources.

4–21 DELAY AND WIDTH GENERATORS

4–22 The output of the Transition Detector is input to the Delay Generator integrated circuit (U2). The purpose of this circuit is to produce an output that is delayed on the input by the setting of the delay controls. The pulse width and shape remain unchanged. In double pulse mode, both the delayed and undelayed pulses are gated out to the Width Generator. The circuit is divided into two parts for delaying signals with different periods (2 to 5ns and $>$ 5ns) and the input signal is input to the appropriate part.

4–23 Figure 4–5 is a simplified diagram of the Delay Generator and should be referred to when reading the following description.

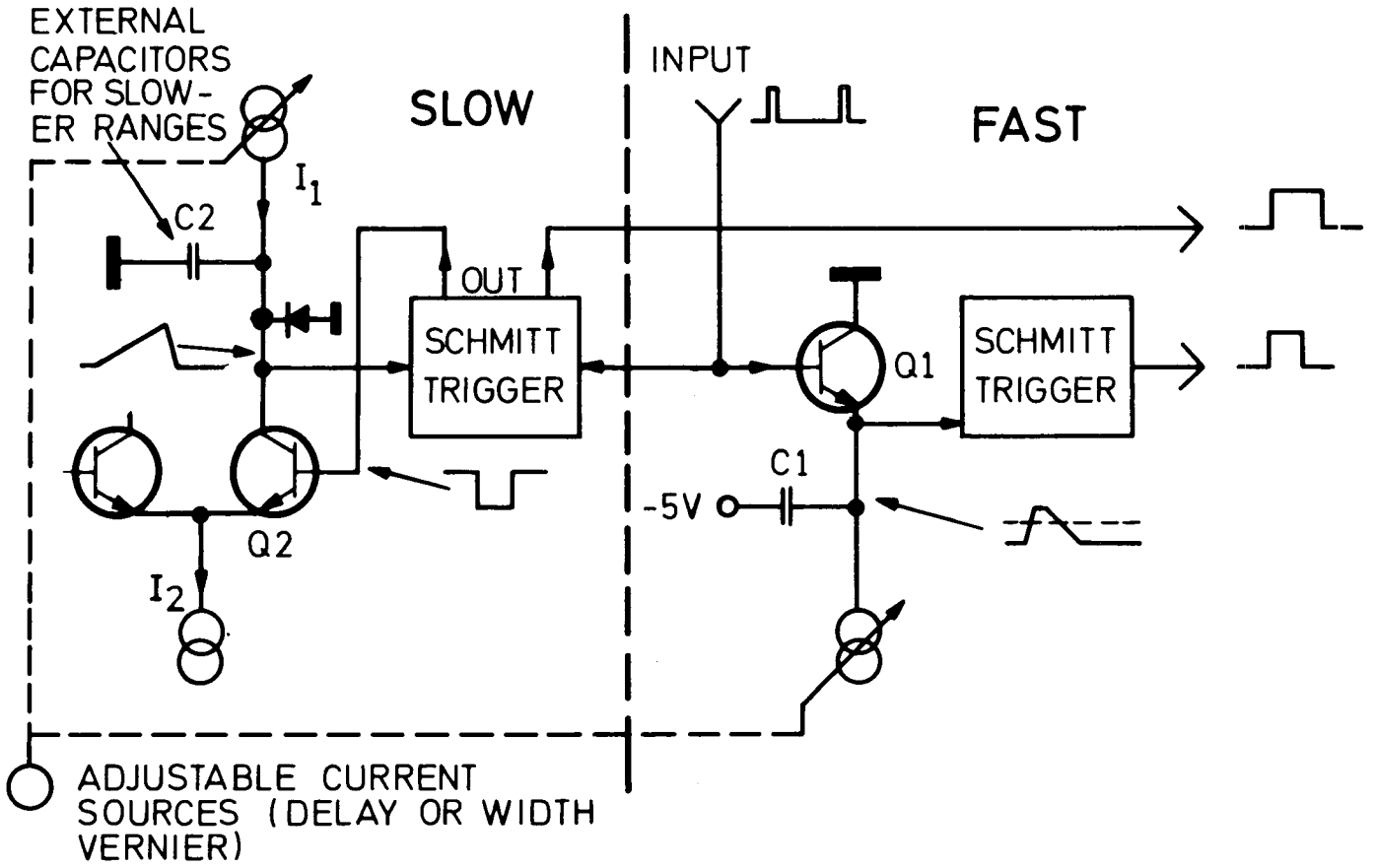


Figure 4–5. Delay Generator – Block Diagram

4–24 The input is common to both the slow and fast parts of the Delay Generator. If the delay range switch is set to 2–5ns, the fast section is used. In this case the 2ns wide pulse spike from the Transition Detector turns transistor Q1 on and rapidly charges internal capacitor C1. The Schmitt trigger turns on when its threshold level is reached. When the 2ns pulse goes low, transistor Q1 turns off and capacitor C1 discharges into the current sink. The rate of discharge is determined by the current setting (delay vernier). The Schmitt trigger turns off again when the voltage of C1 falls below the threshold level. Thus the output of the Schmitt trigger is a step wave of width dependent on the delay vernier setting.

4–25 If the delay range switch is set to any range > 5ns, the slow Delay Generator circuit is used. In this case, the 2ns wide pulse turns on the Schmitt trigger in the slow circuit and one of the outputs of this Schmitt trigger turns transistor Q2 off. Thus the current source connected to Q2 now starts to charge the external capacitor C2 (the value of this capacitor depends on the delay range switch setting). The Schmitt trigger turns off again when the voltage on C2 has reached the threshold level. Therefore transistor Q2 turns on again and as current I_2 is greater than I_1, capacitor C2 starts to discharge again. Thus the output of the Schmitt trigger is a square wave of width dependent on the delay range switch setting and the delay vernier setting.

4–26 The outputs of the two Schmitt triggers are OR'ed together and one of the two complementary outputs of the OR gate is passed through a 2ns delay line. The overall effect of the logic gating is to produce, at the Delay Generator output, a 2ns pulse that is delayed on the Delay Generator input by the delay control settings.

4–27 The output of the Delay Generator is input to the Width Generator integrated circuit (U4). The IC's used in both the Delay and Width Generator circuits are identical and the description of the Delay Generator operation in paragraphs 4–23 to 4–25 also applies to the Width Generator. The difference is in the output gating; the output of the Width Generator is a pulse of width

dependent on the width control settings. In Double Pulse mode, both the delayed and undelayed pulses are widened.

4-28 SLOPE GENERATOR

4-29 The function of the slope generator is to convert the leading and trailing edges of the input signal - derived from the width circuit - from "fixed" to "variable" transition times with stable amplitude. The generator and its control circuits are distributed over three boards - A4, A5 and A8 - and two corresponding schematics - 3a and 2b. Since the slope generator operation is dependent on the control circuits, these will be described first.

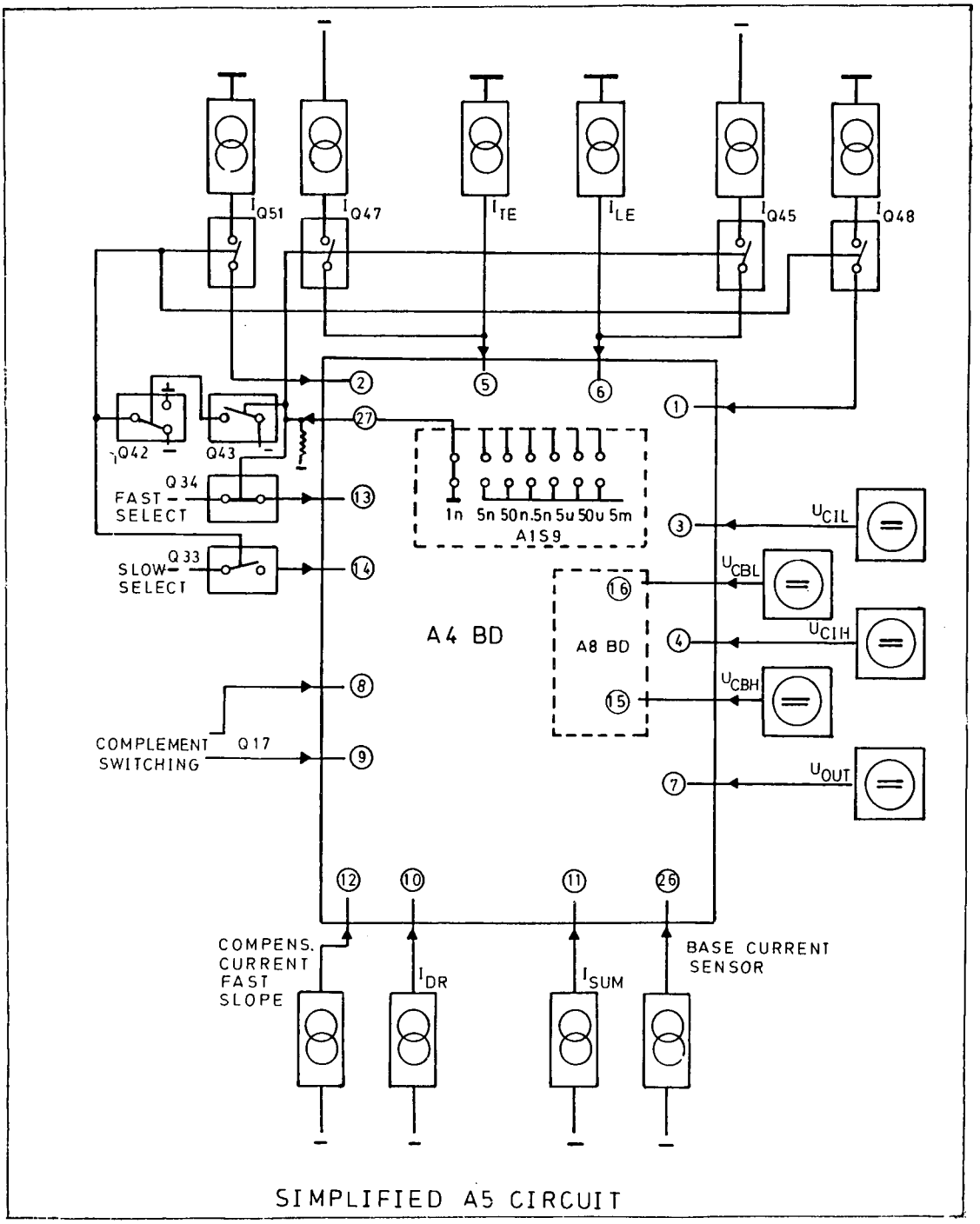


Figure 4-6a Simplified Control A5 Circuit

4-30 Reference to Schematic 3a and Figure 4-6a shows that the control circuit (A5) is comprised of several voltage controlled current sources (output dependent on LEE and TRE verniers), voltage sources and signal selector switches.

4-30a Current Sources

For edges < 5 ns the two range selection current sources Q48 and Q51 are switched off (external slope capacitors A4 C15-C22 on schematic 2b not used). Only LEE vernier (A1 R5) controls the LEE and TRE constant current sources Q53 and Q56. Current sinks Q45 andQ47 are disabled (under control of Q44/Q46) and Q38 base is adjusted, under the control of U8, to sink the current-sumoutput by the slope generator. Variation of Base current is also controlled by U8. Compensation current for fast slope is supplied (sunk) by Q58. Emitter current output (sunk) by Q40.

4-30b For edges > 5 ns, control of the current sources is basically the same as for the fast ranges with the differences that both verniers are active, Q48 and Q51 are biased on to provide a constant current which is sunk by Q45 and Q47, these being enabled via Q44 and Q46. Q58 is switched off.

4-31a Reference to schematic 2b and Figure 4-6b shows the slope generator circuit to be comprised of a set of range capacitors and associated selection circuitry, a voltage level shifter, a slope generator buffer amplifier for slopes < 5 ns (A4 U5) and a buffer amplifier for slopes > 5ns (A8 U1).

4-31b The operation of the circuit is as follows:

The incoming signal (from width circuit) is level shifted by Q69, Q70 etc. and input to the slope generator section of U5 as a normal and a complementary signal. The operation of the slope generator part of the circuit is best explained by referring to Figure 4-6c and the following description which can then be applied to the actual circuit of schematic 2b.

4-32 For transition times from 1 ns - 4.9 ns the four constant current Sources (IS1, IS2 and IS4) are switched off.

Assume that the currents ITE and ILE, as fixed by the transition time settings are 10 mA and 20 mA respectively, then Isum = 30 mA (Isum=ILE+ITE). If the output from the previous stage, the level shifter, is input to the slope generator as shown at a and b, then at time t1 transistor Q1 turns on and Q2 turns off. Thus the only current source that can now supply constant current sink Isum is ITE (10 mA). Thus the deficiency of 20 mA is made up by the intrinsic capacitance of Q1 which discharges. This provides the slope of c from t1 to t2. When the voltage has dropped to the level at t2 (slightly lower than the potential of voltage source V2), diode CR3 starts to conduct and prevents the voltage from falling any further.

4-33 At time t3, transistor Q1 turns off and Q2 turns on. The current source ITE (10 mA) cannot now drain into Isum and so it starts to re-charge the intrinsic capacitance of Q1 (slope of c from t3 to t4). When the voltage level of point c reaches t4 (slightly higher potential than voltage source V1), diode CR1 starts to conduct and holds the voltage at this level.

4-34 The same action as described above controls the voltage levels at point d. Thus it can be seen that the transition times of the pulses at points c and d depend on the currents from the two sources (ITE and ILE) which in turn depend on the transition time settings.

4-35 For transition times 5 to 50ns (slow range), only the current sources IS1, IS2, IS3 and IS4 are switched on. (IQ47 = IQ51; IQ45 = IQ48) This provides a constant current path as shown in Figure 4-6c in order to keep CR5 and CR6 forward biased. For transition times greater than 50ns, 4 pairs of additional external capacitors (C15 to C22) are switched in to supplement the intrinsic capacitances of Q1 and Q2. Reference to 4-6c shows these capacitors as CX1 and CX2 which must have the same value +/- 1%.

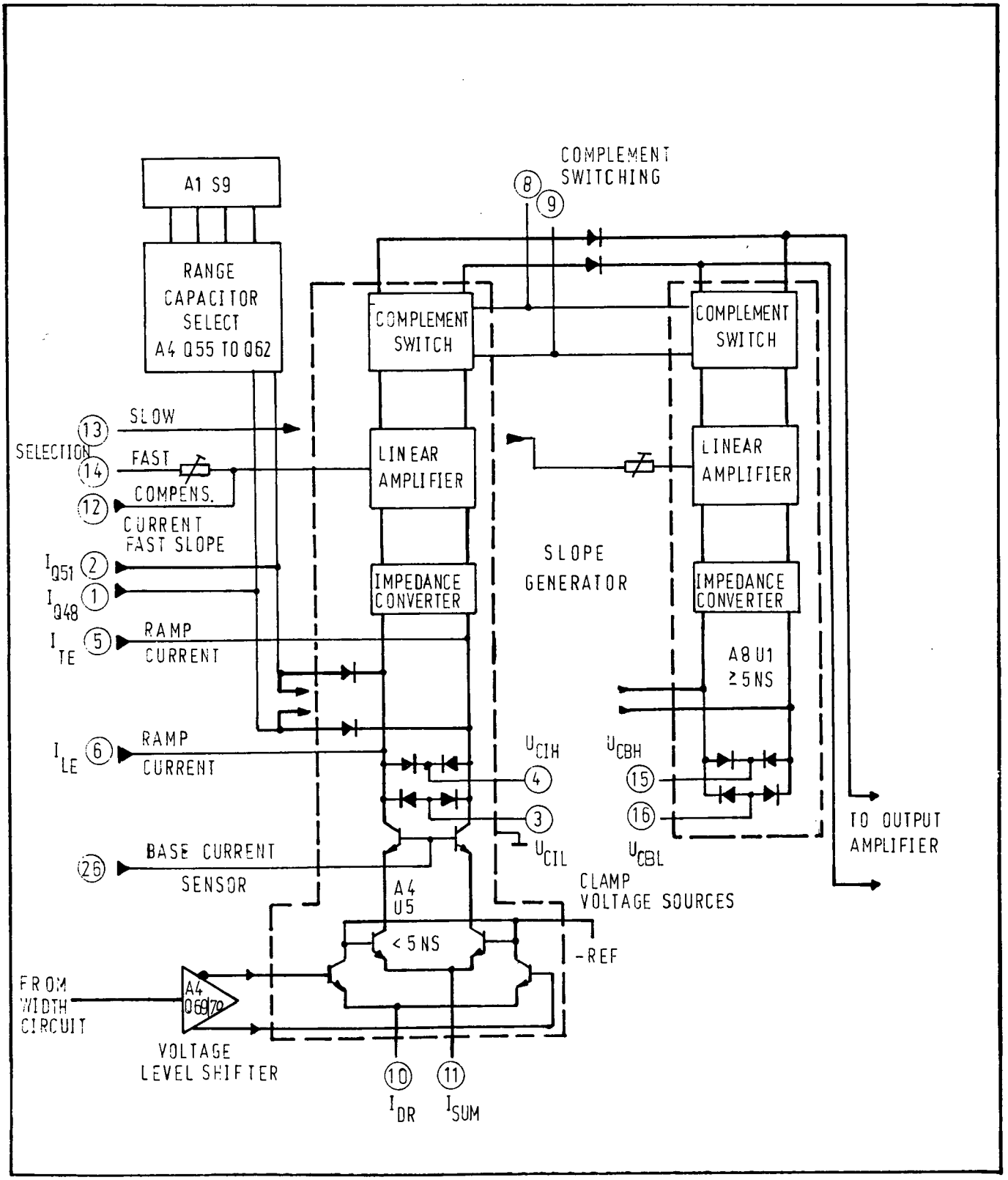


Figure 4-6b Simplified Slope Generator Circuit

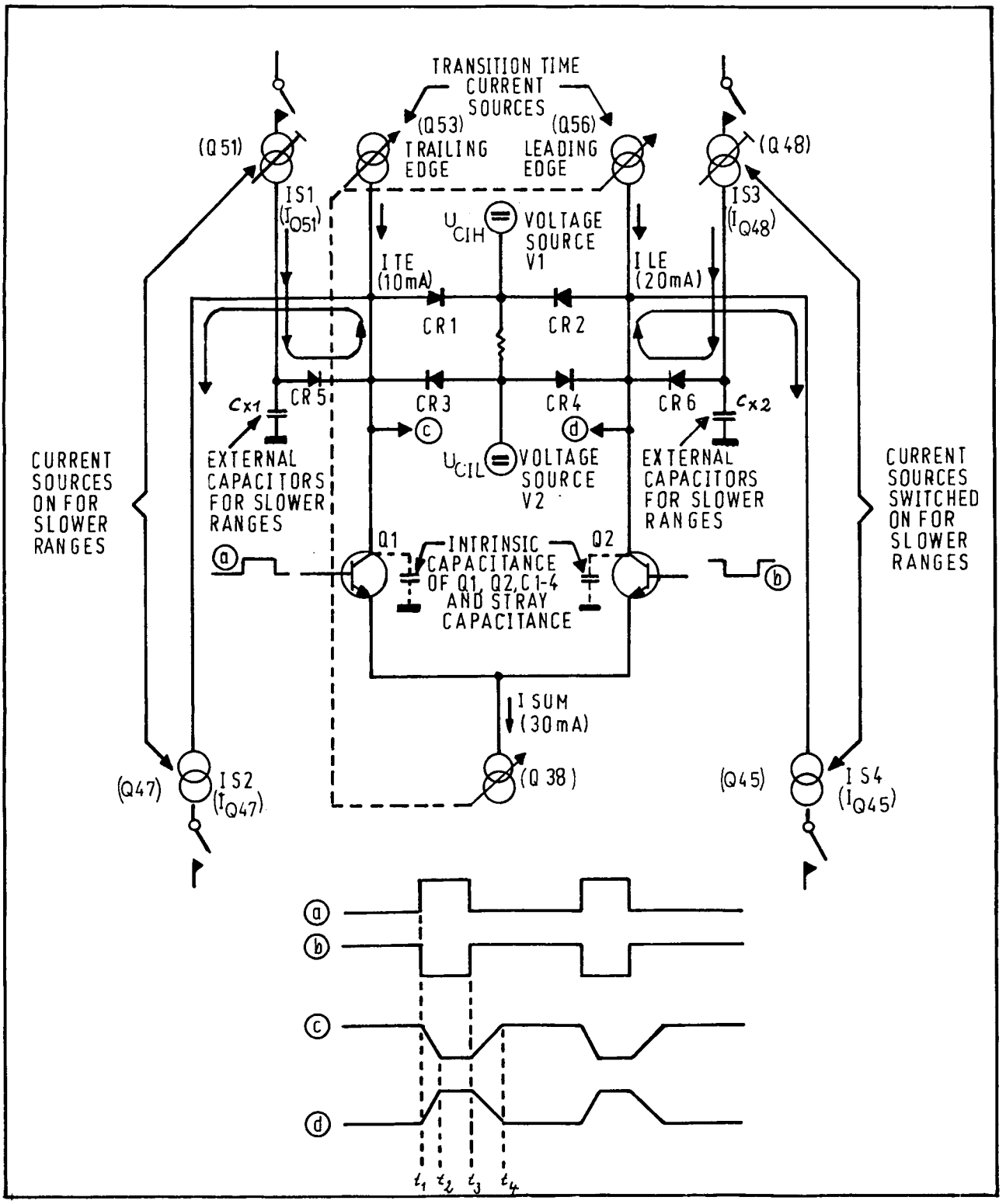


Figure 4-6c. Slope generator operation and waveforms.
References in brackets are for Schematic 3a comparison.

4-36 BUFFER AMPLIFIERS

4-37 The outputs of the slope generator (normal and complement) are input to one of two buffer amplifiers dependent on the transition time settings (1 - 4.9 ns or > 5 ns). The buffer amplifier for the fast ranges is in the same IC as the slope generator (U5). The buffer amplifier for the slow ranges is on sub-assembly A8. The changeover is accomplished by switching the current sources and -25 V supplies and by the fact that in the fast range the diodes within U5 (pins 14 and 15) are reversed biased so preventing signal flow between U5 and A8 U1. Refer to Q33, 34, 42, 43 on Service Sheet 3a. As shown in Service Sheet 2b, the circuits in the Buffer Amplifier provide a low-to-high impedance converter, a linear amplifier and a facility for normal/complement switching.

4-38 8082A OUTPUT AMPLIFIER AND VERNIER ATTENUATOR.

4-39 The function of the output amplifier and offset generator is to amplify the two signals output from the slope generator to required Amplitude and offset. The associated circuit components are distributed over three boards - A5, A4 and A9 - and three corresponding schematics - 3b, 2c and 4.

4-40 Complement switching (schematic 3b)

These signals 8 and 9 are input to the slope generator (schematic 2b) but are part of the output modes function (schematic 3 b). They provide UNC1 and UNC2.

4-41 Reference to schematic 2c, 3b and Figure 4-7 shows that the circuit consists basically of the output amplifier (A4 U6), three active vernier current sources, four offset generators, two attenuators (each selectable for 2 steps - 8dB or 14dB attenuation) and their control devices.

4-42 **Output amplifier (also called active vernier) functions as follows:**

The **outputs from the slope generator (schematic 2b)** are input to the output amplifier U6. There are two attenuating elements per attenuator stage (see Figure 4-8), one for normal and one for complement output, and three attenuator stages in parallel to increase the dynamic range of attenuation. The attenuator uses the current-sharing principle of a differential amplifier. As Figure 4-8 shows, each attenuating stage is a differential amplifier connected so that the signal current flows into (or out of) the common emitters. The output current is taken from one of the collectors and fed to the external resistor, which converts output current to voltage.

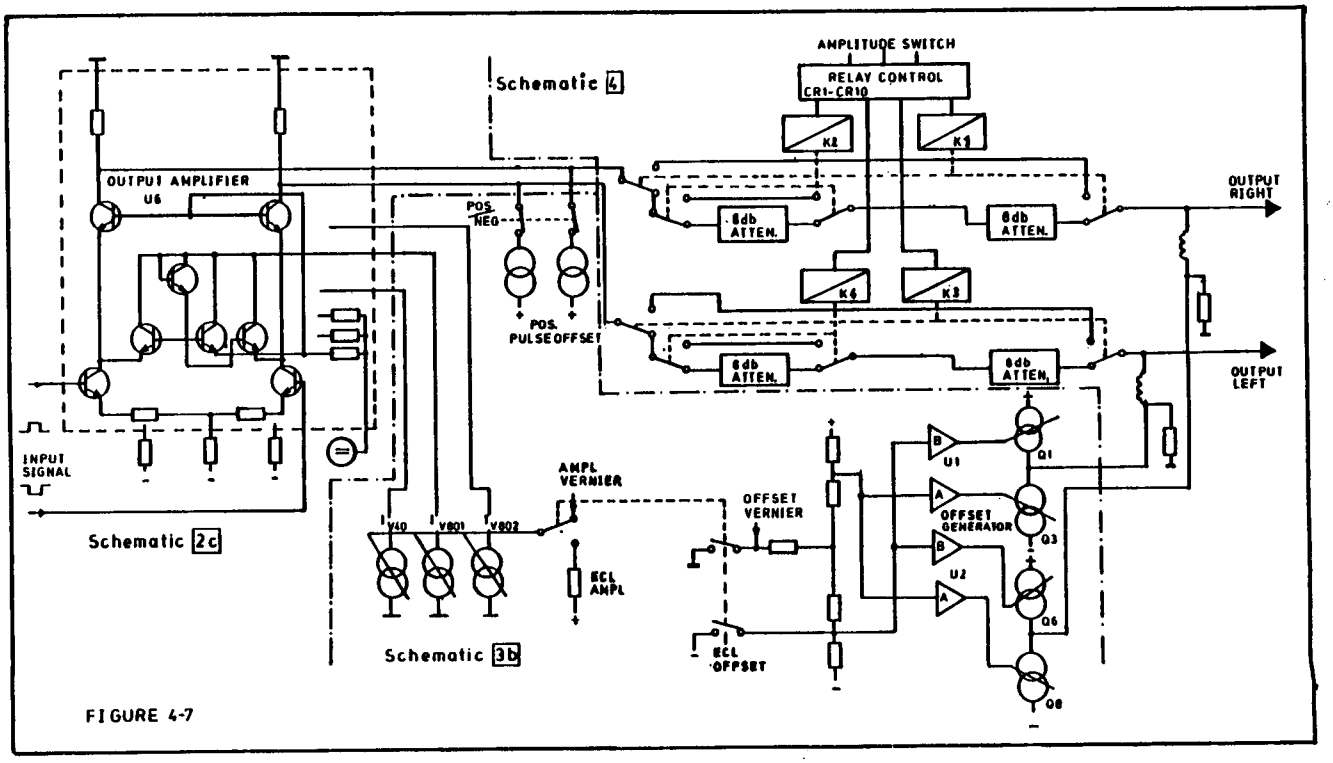


Figure 4-7

In a differential amplifier the current flow in each collector is proportional to the potential difference between the two bases. Thus, by varying the potential Vv (See Figure 4-8) on the base of one of the transistors, the current Iout can be controlled. However, because of the characteristic of the base-emitter voltage of each transistor, the attenuation has a logarithmic characteristic.

The input signal controls the share of current source I which flows through each input transistor. Similarly, Vv controls the current in both attenuator transistors Q1, Q2 or Q3, Q4 (Figure 4-8). Suppose that Vv sets an attenuation factor of 2 and, for simplicity, I = 1 mA. If the input is such that I is shared equally, then I1 = 0.5 mA and I-I1 = 0.5 mA. Also Ix = 1/2 I1 = 0,25 mA and Iy = 1/2 (I-I1) = 0,25 mA. Now, suppose that the input changes the sharing of current I so that I1 = 0,2 mA, and I-I1 = 0,8 mA, then Iy = 0.4 mA and Ix = 0.1 mA. In either case, the sum Ix + Iy remains constant, and is in fact constant for all input signals and attenuation ratios. Therefore a constant current source (controlled by the amplitude vernier) can be used to supply the current Iy + Ix.

If Iv = I, then Iout = Iout = 0

If Iv = 0, then Iout = Iout = 0,5 I

4-43 An advantage of being able to use the one current source to supply both elements of each attenuator is that the relationship of input control current to output (signal) current is essentially linear but a slight non-linearity is due to emitter-bulk resistances and hFE and must be compensated for. This is done by a segmented approximation using U3A, U3B, U4B on A5 (Service Sheet 3b) and the three sets of attenuating differential amplifier in U6.

4-44 DC OFFSET FOR POSITIVE PULSE OUTPUTS

4-45 The signal levels from the Output Amplifier need to be level shifted from negative to positive if positive pulse outputs are required. This is achieved by the Positive Pulse DC Offset circuits (one for each channel - see Service Sheets 2c and 3b). If the NEG/POS switch is set to POS, two actions occur, the normal/complement relationship of the signals is switched in the Buffer Amplifier and the Positive Pulse DC Offset circuit is switched on to raise the signal levels from negative to positive.

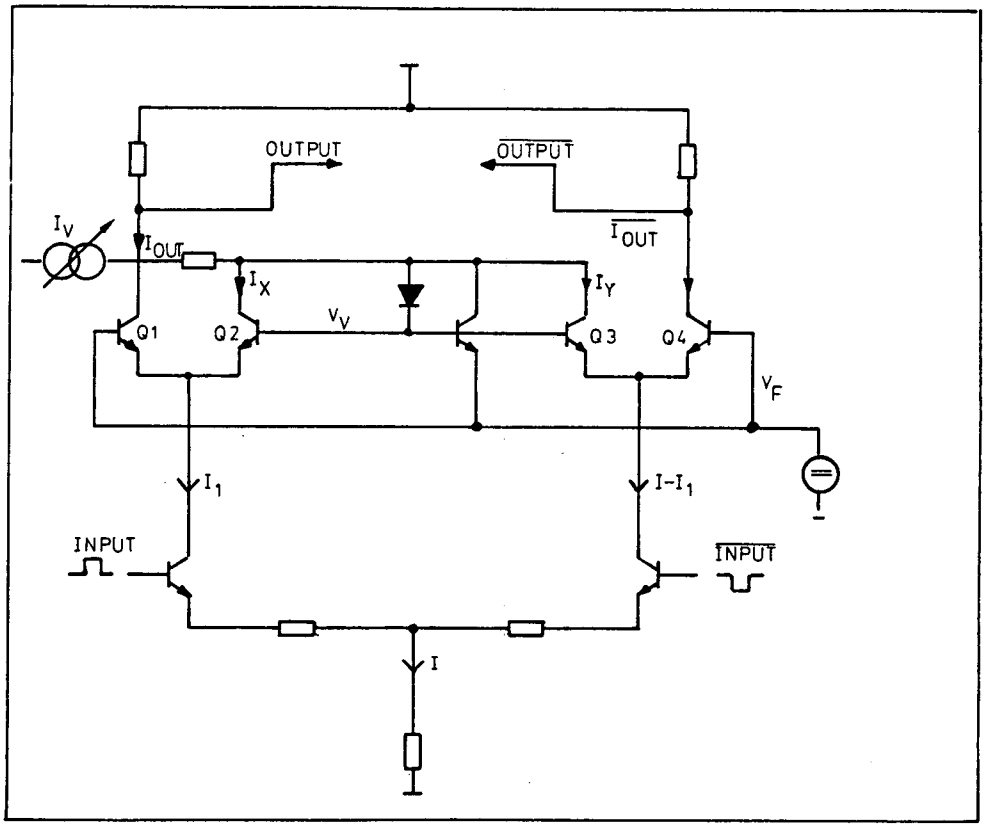


Figure 4-8 Operating principle for each stage of active vernier

4-46 STEP ATTENUATOR

4-47 The amplitude of the output pulses is controlled by a Step Attenuator (one for each channel - see Service Sheet 4). The amplitude range switch selects different combinations of attenuators via a diode matrix (CR1 to CR19). Attenuators used provide 8dB (voltage -2.5) and 14 dB (voltage -5) of attenuation.

4-48 EXTERNAL DC OFFSET

4-49 The output pulse baseline can be adjusted over the range -2 V to + 2V using the External DC Offset circuit (Service Sheet 3b). Both output channels are controlled by a common vernier and the circuit can also be switched off in which case the pulse baselines are at 0 V.

4-50 ECL MODE

4-51 Reference to schematic 3b shows that if Amplitude switch is set to ECL the Offset vernier A1 R8 is without any influence (Q14 switched on). Also Q15 is switched on and a fixed neg Offset is applied. The ECL amplitude is done by A5 R5 (Amplitude vernier A1 R7 is not active).

5–1 GENERAL

5–2 This section contains information on the removal of covers and assemblies, performance verification and recalibration procedures, safety checks and troubleshooting procedures.

5–3 Before attempting to remove covers, assemblies or components, disconnect the instrument from the ac line supply. It is advisable also to leave the instrument for a few minutes after disconnecting from the line to enable capacitors to discharge.

5–4 REMOVAL OF COVERS

5–5 The top, bottom and side covers can be removal by releasing the captive screw at the rear of each cover and sliding the respective cover to the rear.

5–6 REMOVAL OF ASSEMBLIES (See Figure 6–1)

5–7 General

5–8 Remove the instrument top cover and remove the metal retaining strip across the top rear of the boards.

5–9 Power Supply Board – Assembly 2

5–10 Cut the two plastic straps securing the connector to the rear of the board. Ease the connector off the end of the board.

5–11 Ease the board out of its connector on the rear of the Mother board (A1).

5–12 Repetition Rate Generator Board – Assembly 3

5–13 Disconnect the four coaxial cables from the Output Amplifier board (A3).

5–14 Ease the board out of its connector on the rear of the Mother board (A1).

5–15 Output Amplifier Board – Assembly 4

5–16 Disconnect the two coaxial cables from the Step Attenuator board (A9).

5–17 Disconnect the four coaxial cables from the Repetition Rate board (A4).

5–18 Disconnect the two flat cables from the Offset board (A5) at board A4 end.

5–19 Remove the two screws securing board A4 heat sink to the rear of the frame.

5–20 Carefully ease the board out of its connector on the Mother board (A1) and withdraw it through the cut-out in the rear of the frame.

5–21 Buffer Amplifier Board – Assembly 8

5–22 First remove the Output Amplifier board (A4) from the instrument.

5–23 Remove the screw securing board A8 to board A4 and carefully separate the two boards.

5–24 Output Amplifier Board (A4) – Hybrid Circuit Renewal

5–25 First remove the Output Amplifier board (A4) from the instrument.

5–26 Remove the four screws securing the heat sink to the board and remove the hybrid circuit.

5–27 When fitting the new hybrid circuit, thermal compound must be used to give good thermal contact between the circuit and the heat sink (compound part number 6040–0265).

5–28 Offset Board – Assembly 5

5–29 Disconnect the two flat cables from the Output Amplifier board (A4) at board A4 end.

5–30 Disconnect the flat cable from the Step Attenuator board (A9) at board A5 end.

5–31 Ease the board out of its connector on the rear of the Mother board (A1).

5–32 Mother Board – Assembly 1

5–33 First remove boards A2, A3, A4 and A5.

5–34 Remove the eight knobs from the front panel using an Allen key.

5–35 Remove the nuts securing the four BNC connectors to the front panel.

5–36 Disconnect the two wires from the Manual pushbutton at their connectors on the Mother board.

5–37 Remove the two screws securing the power ON/OFF switch to the Mother board.

5–38 Remove the two screws securing the Mother board to the front panel and remove the board.

5–39 PERFORMANCE CHECKS

5–40 Performance checks (Table 5–1 to 5–13) give the procedures for verifying that the 8082A is working to the specifications. The checks should be performed in sequence from 5–1 to 5–13.

For Adjustments and Safety Check refer to paragraph 5–41 on page 5–13.

Table 5–1. Test Equipment and Accessories for Performance Checks

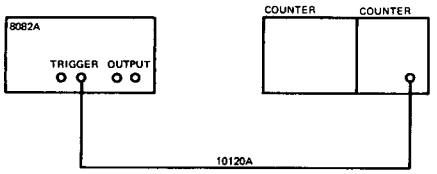
INSTRUMENT	BRIEF SPECIFICATION	RECOMMENDED MODEL
Pulse Generator	10 MHz square wave output with 50% duty cycle	HP 8011A
Counter	Frequency range 0–50 MHz	5245L
	Prescaler plug-in	5252A
Oscilloscope	Dual Channel, 50 MHz bandwidth, 5mV/div. sensitivity, sweep speeds 5ns/div. to 2s/div. with sweep delay.	HP 180A with plug-ins 1801A and 1820A
Sampling Oscilloscope	Dual Channel, 1 GHz bandwidth, 1mV/div. sensitivity, sweep speeds 10ns/div. to 2s/div. 50–Ω input impedance.	Tek 760 with 7T11 7S11 and S–3A
Digital Voltmeter	100V range to 4 significant figures. Accuracy ±0.05% ±1 digit.	HP 3440A with plug-in 3443A
Test Oscillator	Frequency range 10 Hz – 10 MHz	HP 651A
Test Oscillator	Frequency range 10 to 500 MHz	HP 3200B

ACCESSORIES

50Ω co-axial cable terminated with BNC male connectors (4 required)	HP 10120A
Connector BNC male to N female (2 required)	HP 1250–0077
Connector BNC male to N male (2 required)	HP 1250–0780
50Ω Feed-through termination (2 required)	HP 11048B/C
Pulse Adder	HP 15104A
20dB Attenuator, 50Ω (2 required)	HP 8491A

PERFORMANCE CHECKS

Table 5–2. Performance Check – Repetition Rate



STEP

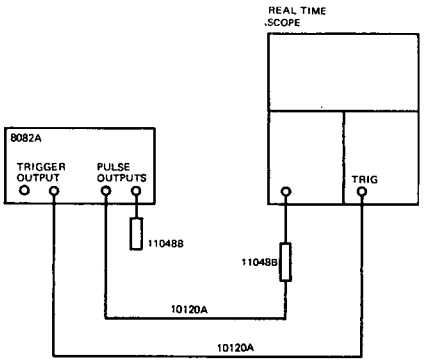
1 8082A settings: 5252A settings:

1	REPETITION RATE	250M–100M	Max. count
2	VERNIER	CCW	rate
3	NORM/DOUBLE	NORM	
4	DELAY	2n–5n	
5	VERNIER	CCW	
7	MODE SWITCH	NORM	
8	WIDTH	2n–5n	
9	VERNIER	CCW	
10	TRANSITION TIME	1n–5n	
11	LEADING VERNIER	CCW	
12	TRAILING VERNIER	CCW	

2 Measure the frequency as follows:

REPETITION RATE 1	VERNIER 2	COUNTER	RESULT
250M–100M	CCW	0.1m	> 250M
250M–100M	CW	0.1m	< 100M
100M–10M	CCW	0.1m	> 100M
100M–10M	CW	0.1m	< 10M
10M–1M	CCW	0.1m	> 10M
10M–1M	CW	0.1m	< 1M
1M–100K	CCW	1m	> 1M
1M–100K	CW	1m	< 100K
100K–10K	CCW	10m	> 100K
100K–10K	CW	10m	< 10K
10K–1K	CCW	0.1s	> 10K
10K–1K	CW	0.1s	< 1K

Table 5–3. Performance Check – Delay (Slow)



STEP

1 8082A settings:

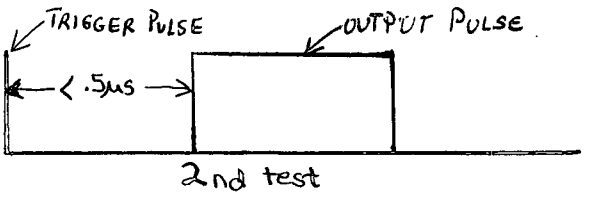
2	RATE VERNIER	CW
13	AMPLITUDE	2.0–5.0

Falling edge use scope neg. slope

2 Set trigger pulse on first line of graticule and measure time between trig and output pulse (leading edges)

Scope – and ext trigger

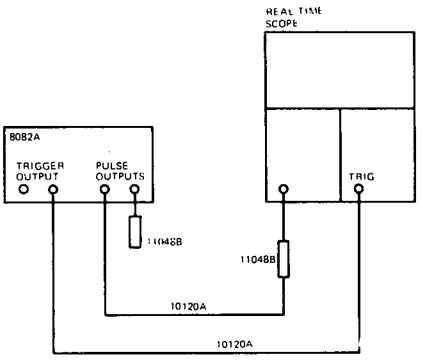
	8082A RATE 1	DELAY 4	VERNIER 5	WIDTH 8	Sweep time	RESULT
1	1M–0.1M	50n–0.5μ	CW	50n–0.5μ	0.1μs	> 0.5μs
2	1m–0.1M	0.5μ–5μ	CCW	50n–0.5μ	0.1μs	< 0.5μs
3	0.1M–10K	0.5μ–5μ	CW	0.5μ–5μ	1μs	> 5μs
4	0.1M–10K	5μ–50μ	CCW	0.5μ–5μ	1μs	< 5μs
5	10K–1K	5μ–50μ	CW	0.5μ–5μ	10μs	> 50μs
6	10K–1K	50μ–0.5m	CCW	5μ–50μ	10μs	< 50μs
7	10K–1K	50μ–0.5m	CW	5μ–50μ	0.1ms	> 500μs



2nd test

PERFORMANCE CHECKS

Table 5–4. Performance Check – Width (Slow)



STEP

1 8082A settings:

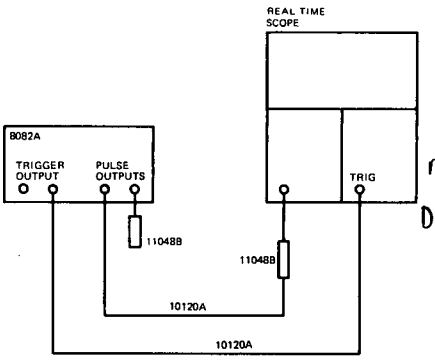
13 AMPLITUDE	2.0–5.0
14 AMPLITUDE	0.4–1.0
15 AMP. VERNIER	CW

4 delay 5n-50n ccw
2 rate vernier cw

2 Measure the width:

8082A				
RATE 1	WIDTH 8	VERNIER 9	Sweep time	RESULT
1M–0.1M	50n–0.5μ	CW	0.1μs	> 0.5μs
1M–0.1M	0.5μ–5μ	CCW	0.1μs	< 0.5μs
0.1M–10K	0.5μ–5μ	CW	1μs	> 5μs
0.1M–10K	5μ–50μ	CCW	1μs	< 5μs
10K–1K	5μ–50μ	CW	10μs	> 50μs
10K–1K	50μ–0.5m	CCW	10μs	< 50μs
10K–1K	50μ–0.5m	CW	0.1ms	> 0.5ms

Table 5–5. Performance Check – Jitter



main @ 10μs/div
DLY @ .05μs/div

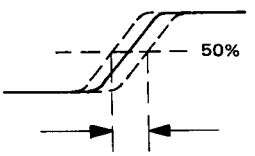
STEP

Period jitter

1 8082A settings:

1 REPETITION RATE	0.1M–10K
4 DELAY	2n–5n
5 VERNIER	CCW
8 WIDTH	0.5μ–5μ
9 VERNIER	CCW

2 Turn rep. rate vernier (2) to get a 10 division period display on screen. Set scope delay until the second leading edge is visible



3 Check period jitter: < 1 cm ≃ 0.1%

Delay jitter

4 8082A settings:

1 REP. RATE	10K–1K
2 VERNIER	CW
4 DELAY	5μ–50μ
8 WIDTH	5μ–50μ

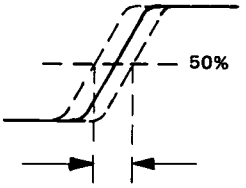
Scope:
Turn delay to 10 cm.

5 Turn delay vernier (5) for 50μs delay.

6 Set scope delay until leading edge is visible.

PERFORMANCE CHECKS

Table 5–5. (cont'd)



7 Check delay jitter < 0.5 cm $\approx 0.1\%$

Width jitter

8 8082A settings: scope settings:

1	REP. RATE	10K–1K	Turn delay to 10 cm.
2	VERNIER	CW	
8	WIDTH	5μ–50μ	
9	VERNIER	for a 50μs display	

9 Set scope delay CCW until the trailing edge is visible.

10 Check width jitter: < 0.5 cm $\approx 0.1\%$

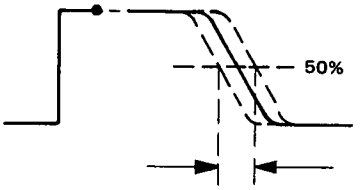
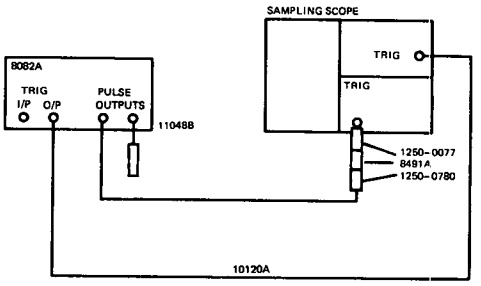


Table 5–6. Performance Check – Width (Fast)



STEP

1 8082A settings:

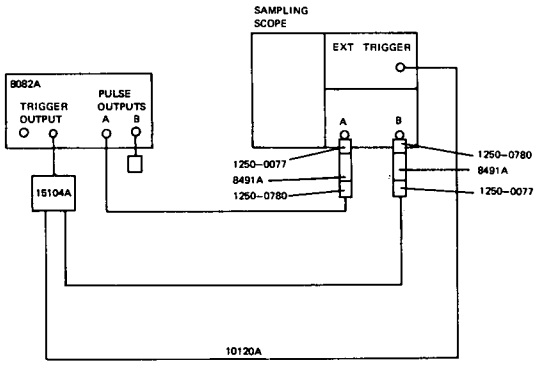
1	REPETITION RATE	250M–100M
2	VERNIER	CCW
4	DELAY	2n–5n
5	VERNIER	CCW

2 Check the following:

8082A			SCOPE		
RATE 1	WIDTH 8	VERNIER 9	Main swp	exp. swp	RESULT
250M–100M	2n–5n	CCW	10n	2n	< 2ns
100M–10M	2n–5n	CW	10n	2n	> 5ns
100M–10M	5n–50n	CCW	10n	2n	< 5ns
10M–1M	5n–50n	CW	0.2μ	20n	> 50ns
10M–1M	50n–0.5μ	CCW	0.2μ	10n	< 50ns

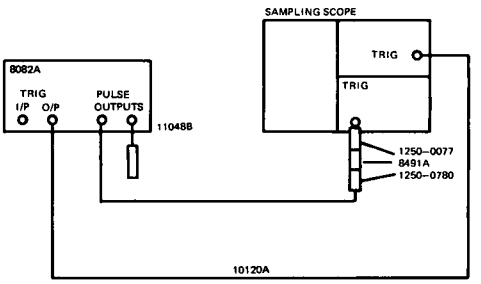
PERFORMANCE CHECKS

Table 5–7. Performance Check – Delay (Fast)



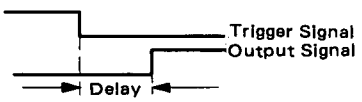
STEP		
1	8082A settings:	
	8 WIDTH	2n–5n
2	Set channel B on first line of graticule. Measure time between neg. trig. and pos. (leading edge) output pulse.	

Table 5–8. Performance Check – Square Wave Duty Cycle



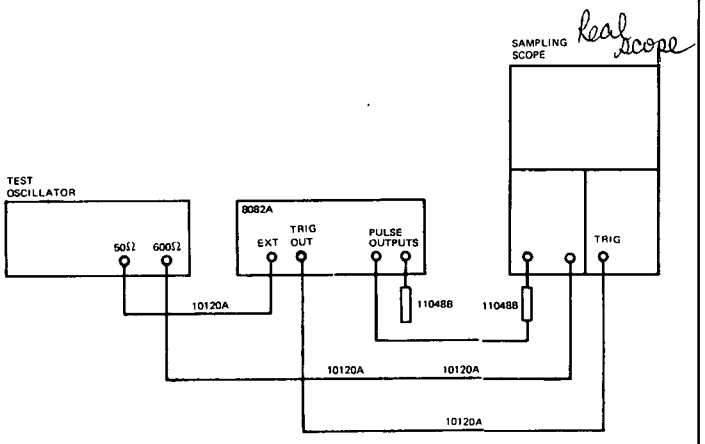
STEP		
1	8082A settings:	
	1 REPETITION RATE	250M–100M
	2 VERNIER	CCW
2	Measure duty cycle	Limit > 35% < 65%
3	Turn rate vernier (2) CW.	
4	Measure duty cycle at 100 MHz	Limit > 35% < 65%
5	Set rep. rate (1) to 100M–10M and turn rate vernier (2) CCW.	
6	Measure duty cycle at 100 MHz	Limit > 35% < 65%
7	Turn rate vernier (2) CW.	
8	Measure duty cycle at 10 MHz	Limit > 40% < 60%
9	Set rep rate (1) to 10M–1M.	
10	Measure duty cycle at 1 MHz	Limit > 40% < 60%

8082A				SCOPE		
RATE 1	VERNIER 2	DELAY 4	VERNIER 5	meantime	expanded	RESULT fxd del typ 18ns
10M–1M	CCW	2n–5n	CCW	20n	5n	> 16ns < 19ns
10M–1M	CCW	2n–5n	CW	20n	5n	fxd del + > 5ns
10M–1M	CCW	5n–50n	CCW	20n	5n	fxd del + < 5ns
10M–1M	CCW	5n–50n	CW	20n	10n	fxd del + > 50ns
10M–1M	middle	50n–500n	CCW	50n	10n	fxd del + < 50ns



PERFORMANCE CHECKS

Table 5–9. Performance Check – External Functions



STEP

1 8082A settings:

4	DELAY	50μ–0.5m
5	VERNIER	CCW
6	EXT INPUT LEVEL	middle
7	MODE SWITCH	EXT. TRIG.
8	WIDTH	50μ–0.5m
9	VERNIER	CCW
24	SLOPE POLARITY	POS

Test oscillator settings: 1KHz, 1V

FREQUENCY VERNIER	1
FREQUENCY RANGE	1K
OUTPUT	1V

2 EXT TRIGGER

Pulse should appear only during positive slope of sine wave. Pulse is variable by width and delay and its trig. point is variable by EXT INPUT LEVEL (6).

3 Set SLOPE POLARITY (24) to MAN and press MAN button (25): Only one pulse must occur.

4 Set SLOPE POLARITY (24) to NEG. Pulse should appear only during negative slope of sine wave. Pulse is variable by width and delay and its trig. point is variable by EXT INPUT LEVEL (6).

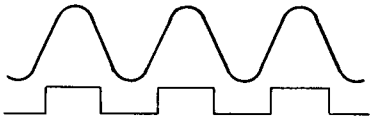
5 EXT WIDTH

Set MODE SWITCH (7) to EXT WIDTH.

Set SLOPE POLARITY (24) to POS.

Table 5–9. (cont'd)

6 Pulse must only occur during the positive part of the sinewave. It should only be variable by EXT INPUT LEVEL (6), independent of width, delay and rep. rate.



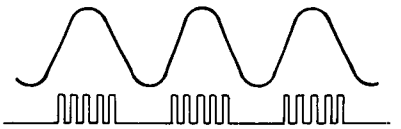
7 Repeat with SLOPE/POLARITY (24) set to NEG. This time a pulse must only occur during the negative part of the sinewave.

8 GATE

Set the 8082A as follows:

1	REPETITION RATE	10K–1K
2	VERNIER	CCW
4	DELAY	50μ–0.5m
5	VERNIER	CCW
7	MODE SWITCH	GATE
8	WIDTH	50μ–0.5m
9	VERNIER	middle
24	SLOPE POLARITY	POS

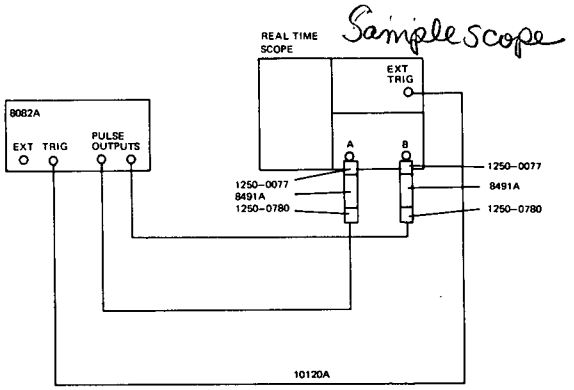
9 Leading edges of output pulses must only occur during positive part of sinewave. Pulses are available by all controls (rep. rate, width, delay, ext. input level).



10 Set the SLOPE POLARITY (24) to NEG. Pulses must only occur during negative slope of sinewave.

PERFORMANCE CHECKS

Table 5–10. Performance Check – Transition Time



STEP

1 8082A settings:

1	REPETITION RATE	250M–100M
2	VERNIER	CW
4	DELAY	2n–5n
8	WIDTH	2n–5n
13	AMPLITUDE	2.0–5.0
14	AMPLITUDE	2.0–5.0
10	TRANSITION	1n–5n
11	VERNIER	CCW

2 Adjust the width vernier for 50% duty cycle.

3 Adjust the scope for a full screen display, set to Expand and centre the leading edge of the pulse on the display.

4 Measure transition time between 10% and 90% points. < 1ns

5 Centre trailing edge on the display and measure transition time between 10% and 90% < 1ns

6 Repeat 1 to 4 with NEG/POS switch (20) in NEG position.

7 Repeat 1 to 4 with NORM/COMPL switch (19) set to COMPL.

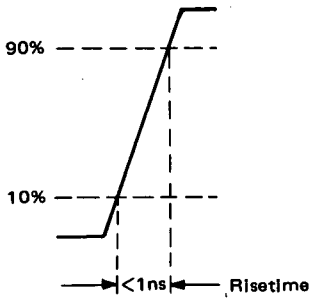
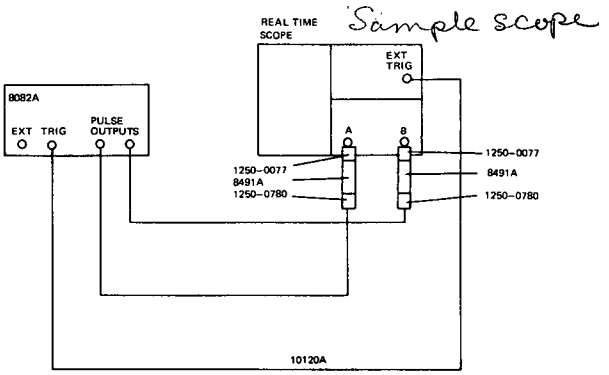


Table 5–11. Performance Check – Pre-shoot, Overshoot, Rining and Linearity



STEP

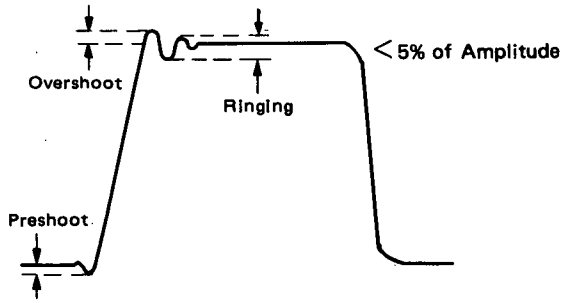
1 8082A settings:

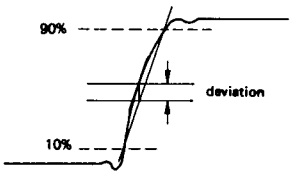
1	REP RATE	10m–1m
8	WIDTH	50n–0.5n
10	TRANSITION TIME	5n–50n
19	NORM/COMPL SWITCH	NORM
20	NEG/POS SWITCH	POS

2 Adjust width vernier for a 50% duty cycle and 8 div vertically.

3 Adjust leading vernier 11 and trailing vernier 12 for 10ns transition time.

4 Measure, with reference to diagrams below, preshoot, overshoot, ringing and linearity.





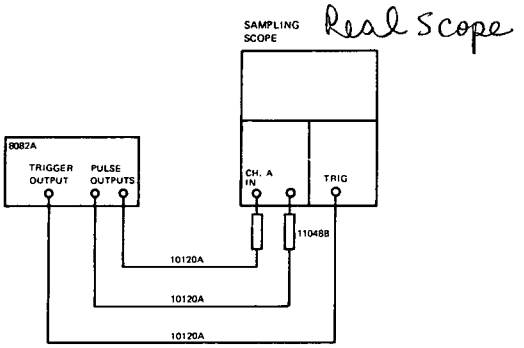
deviation from a straight line between the 10% and 90% points should not exceed 5% of the peak voltage.

5 Repeat with the NEG/POS switch (20) set to NEG.

6 Repeat with the NORM/COMPL switch (19) set to COMPL.

PERFORMANCE CHECKS

Table 5–12. Performance Check – Amplitude



STEP

1 8082A settings:

1	REPETITION RATE	10K–1K
2	VERNIER	CCW
8	WIDTH	SQUARE WAVE

2 Set the baseline of the scope to zero.

3 Measure the amplitude of both outputs as follows:

8082A		
AMPLITUDE 13, 14	VERNIER 15	RESULT
5.0–2.0	CW	> 5V
5.0–2.0	CCW	< 2V
2.0–1.0	CW	> 2V
2.0–1.0	CCW	< 0.8V
1.0–0.5	CW	> 1.0V
1.0–0.5	CCW	< 0.5V

4 Set NORM/COMPL switch (19) to COMPL and repeat step 3.

5 Switch either AMPLITUDE switch (13 or 14) to ECL and measure the level and amplitude.

Value is double if 50 ohm load is removed.

6 Set AMPLITUDE to 5.0–2.0, MODE SWITCH (7) to EXT TRIG, SLOPE POLARITY (24) to MAN and adjust the scope for a baseline reference. Set OFFSET switch (17) to ON and turn OFFSET VERNIER (16) from CW to CCW.

7 Baseline should shift from ≥ –2V to ≥ +2V.

PERFORMANCE CHECKS

Table 5–13. Performance Check Record (1 of 4)

Hewlett-Packard Company
Model 8082A
Pulse Generator
Serial No.....

Tested by .....

Date .....

Table No.	Check Description	Results		
		Min.	Actual	Max.
5–2	REPETITION RATE VERNIER 250M–100M CCW 250M–100M CW 100M–10M CCW 100M–10M CW 10M–1M CCW 10M–1M CW 1M–100K CCW 1M–100K CW 100K–10K CCW 100K–10K CW 10K–1K CCW 10K–1K CW	250M 100M 10M 1M 100K 10K 1K		 100M 10M 1M 100K 10K 1K
5–3	Delay (slow) RATE DELAY VERNIER WIDTH 1M–0.1M 50n–0.5μ CW 50n–0.5μ 1m–0.1M 0.5μ–5μ CCW 50n–0.5μ 0.1M–10K 0.5μ–5μ CW 0.5μ–5μ 0.1M–10K 5μ–50μ CCW 0.5μ–5μ 10K–1K 5μ–50μ CW 0.5μ–5μ 10K–1K 50μ–0.5m CCW 5μ–50μ 10K–1K 50μ–0.5m CW 5μ–50μ	0.5μs 5μs 50μs 500μs		 0.5μs 5μs 50μs
5–4	Width (slow) RATE WIDTH VERNIER 1M–0.1M 50n–0.5μ CW 1M–0.1M 0.5μ–5μ CCW 0.1M–10K 0.5μ–5μ CW 0.1M–10K 5μ–50μ CCW 10K–1K 5μ–50μ CW 10K–1K 50μ–0.5m CCW 10K–1K 50μ–0.5m CW	0.5μs 5μs 50μs 0.5ms		 0.5μs 5μs 50μs

PERFORMANCE CHECKS

Table 5–13. Performance Check Record (2 of 4)

Table No.	Check Description	Results		
		Min.	Actual	Max.
5–5	Jitter			
	Period jitter			0.1 %
	Delay jitter			0.1 %
	Width jitter			0.1 %
5–6	Width (fast)			
	RATE WIDTH VERNIER			
	250M–100M 2n–5n CCW			2ns
	100M–10M 2n–5n CW	5ns		
	100M–10M 5n–50n CCW			5ns
	10M–1M 5n–50n CW	50ns		
	10M–1M 50n–0.5μ CCW			50ns
5–7	Delay (fast)			
	RATE VERNIER DELAY VERNIER			
	10M–1M CCW 2n–5n CCW	16ns	(D*)	19ns
	10M–1M CCW 2n–5n CW	D+5ns		
	10M–1M CCW 5n–50n CCW			D+5ns
	10M–1M CCW 5n–50n CW	D+50ns		
	10M–1M middle 50n–500n CCW			D+50ns
	* Fixed delay, typically 18ns			
5–8	Square Wave Duty cycle			
	RATE VERNIER			
	250–100M CCW	35%		65%
	250–100M CW	35%		65%
	100M–10M CCW	35%		65%
	100M–10M CW	40%		60%
	10M–1M CW	40%		60%

PERFORMANCE CHECKS

Table 5–13. Performance Checks Record (3 of 4)

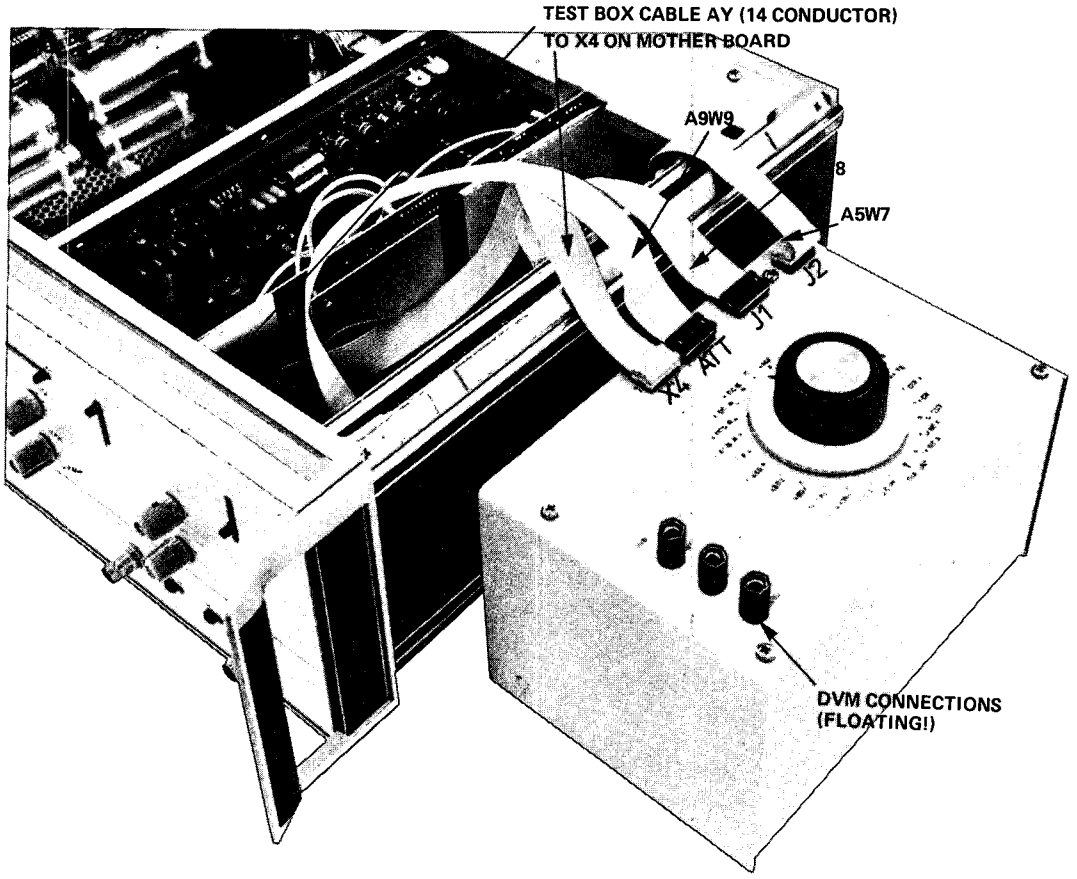
Table No.	Check Description	Results		
		Min.	Actual	Max.
5–9	External Functions MODE / SLOPE Ext trigger / POS — Output pulse during positive slope Ext trigger / MAN — Single pulse. Ext.trigger / NEG — Output pulse during negative slope. Ext width / POS — Output pulse during positive part of input. Ext width / NEG — Output pulse during negative part of input. Gate / POS — Leading edges of output during positive part of input. Gate / NEG — Leading edges of output during negative part of input.			
5–10	Transition Time NEG/POS / NORM/COMPL Leading edge / POS / NORM Trailing edge / POS / NORM Leading edge / NEG / NORM Trailing edge / NEG / NORM Leading edge / NEG / COMPL Trailing edge / NEG / COMPL Leading edge / POS / COMPL Trailing edge / POS / COMPL			1ns 1ns 1ns 1ns 1ns 1ns 1ns 1ns

PERFORMANCE CHECKS

Table 5–13. Performance Check Record (4 of 4)

Table No.	Check Description			Results		
				Min.	Actual	Max.
5–11	Preshoot, Overshoot, Rining and Linearity					
		NEG/POS	NORM/COMPL			
	Preshoot	POS	NORM			5%
		NEG	NORM			5%
		NEG	COMPL			5%
		POS	COMPL			5%
	Overshoot	POS	NORM			5%
		NEG	NORM			5%
		NEG	COMPL			5%
		POS	COMPL			5%
	Ringing	POS	NORM			5%
		NEG	NORM			5%
		NEG	COMPL			5%
		POS	COMPL			5%
	Linearity	POS	NORM			5%
		NEG	NORM			5%
		NEG	COMPL			5%
		POS	COMPL			5%
5–12	Amplitude					
	AMPLITUDE	VERNIER	NORM/COMPL			
	5.0–2.0	CW	NORM	5V		
	5.0–2.0	CCW	NORM			2V
	2.0–1.0	CW	NORM	2V		
	2.0–1.0	CCW	NORM			0.8V
	1.0–0.5	CW	NORM	1.0V		
	1.0–0.5	CCW	NORM			0.5V
	5.0–2.0	CW	COMPL	5V		
	5.0–2.0	CCW	COMPL			2V
	2.0–1.0	CW	COMPL	2V		
	2.0–1.0	CCW	COMPL			0.8V
	1.0–0.5	CW	COMPL	1.0V		
	1.0–0.5	CCW	COMPL			0.5V
	ECL			HI–0.45V typ LO–0.85V typ		
		OFFSET VERNIER				
	5.0–2.0	CW		–2V		
		CCW		+2V		

ADJUSTMENTS



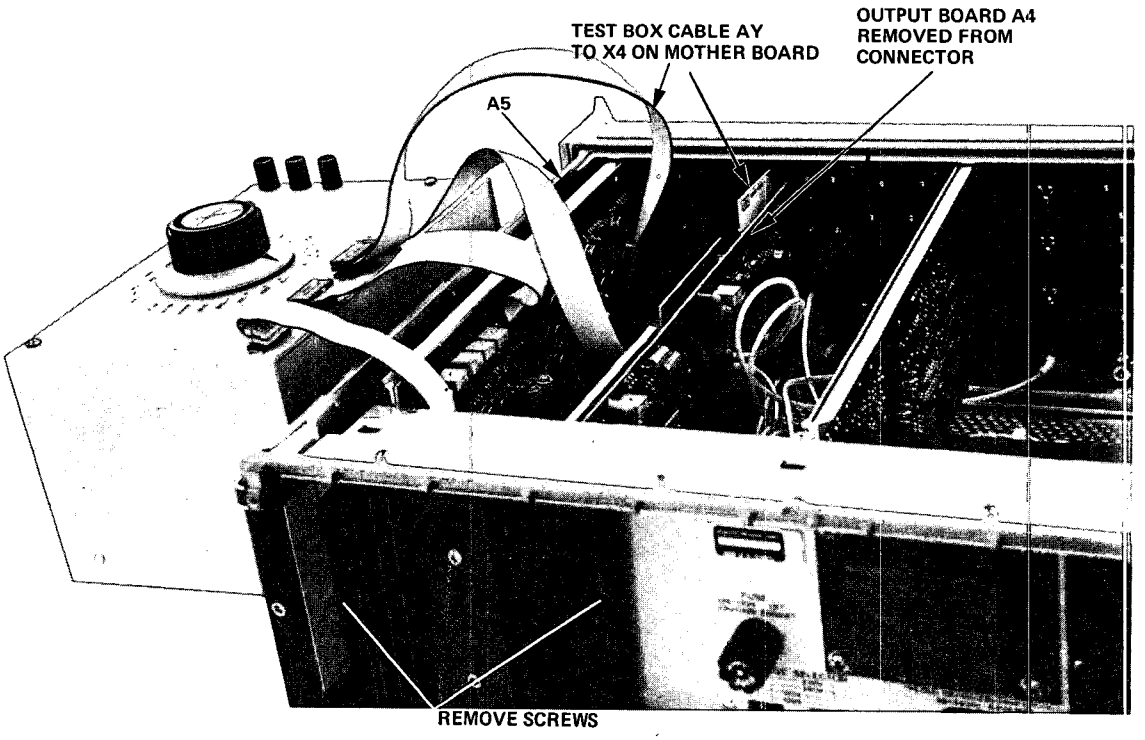


Figure 5–1. Connections between Test Box 15265A and 8082A.

ADJUSTMENTS

5–41 INTERNAL CHECKS AND ADJUSTMENTS

5–42 The internal checks and adjustments section (Tables 5–14 to 5–26) gives the procedure for adjusting a serviceable instrument to bring it within specification. The checks should be performed in the order in which they appear. A summary of adjustments and selectable components is presented in Table 5–14. Figure 5–2 at the end of this section gives the locations of the adjustments.

NOTE: Ensure that BOTH outputs of the 8082A are terminated by a 50 Ω load whenever pulse measurements or adjustments are to be made.

5–43 TROUBLESHOOTING USING THE 15265A TEST BOX

5–44 The Test Box is designed to facilitate troubleshooting and adjustments of the current sources in Board A5. It is connected in place of Board A4 and simulates the load presented to Board A5. A switch on the Test Box selects the parameter for monitoring on the externally-connected DVM. The checks and adjustments which can be performed by the Test Box are summarized in Table 5–16.

5–45 To connect the Test Box, refer to Figure 5–1 and use the following procedure:

Switch 8082A off. Remove the 8082A top cover. Remove the two screws from the Output Amplifier (board A4) heat sink on the rear of the 8082A. Unplug the Output Amplifier from its connector by about 2 cm and carfully push the connector-end of the board to one side.

Disconnect the three ribbon cables:

A5 W8 from A4 J1
A5 W7 from A4 J2
A9 W9 from A5 J-ATT

Connect the extender board to the X4 socket (socket from which board A4 has been disconnected).

Connect the other extender cable to the J-ATT connector on board A5.

Connect the ends of cables J1, J2, J-ATT and X5 to the Test Box as shown in Figure 5–1.

Connect DVM (floating mode, auto range) and verify operation of Test Box by performing first check in Table 5–16.

5–46 SAFETY CHECK

5–47 This check (Table 5–27) should be performed following the internal checks and adjustments to verify the instrument safety.

5–48 TROUBLESHOOTING TIPS

5–49 The quadruple AND gate A3 U6 in the rep rate circuit can be damaged if the −5V or −10V supplies are shorted to ground.

5–50 Instruments with serial numbers 1410G00430 and below may be liable to latch-up when switching transition times from 5–50μ to 50μ–0.5m. If this occurs, insert diode CR 37 (partnumber 1901–0040) in series with A5 Q37 (anode to collector).

WARNING

Any interuption of the protective (grounding) conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. The opening of covers or removal of parts, except those to which access can be gained by hand, may expose live parts, and also accessible terminals may be live.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Table 5–14. Summary of adjustable and factory-selected components

Component	Adjusts	Table in which adjustment is described
A2 R7	+10V power supply	5–17
A2 R10	–5V power supply	5–17
A2 R21	–10V power supply	5–17
A2 R29	–25V power supply	5–17
A3 R6	Max rep rate	5–18
A3 R5	Min rep rate	5–18
A3 R77*	SW duty cycle < 100 MHz rep rate	5–18
A3 R87 A3 R92*	Duty cycle in gate mode	5–25
A4 R38*	Maximum delay	5–19
A4 R42*	Double pulse	5–26
A4 R43	Width adjust	5–24
A4 R88*	Max width	5–19
A4 R240	Min width	5–24
A4 R214 A4 R232	Risetime (fast), rolloff, overshoot neg baseline shift	5–20
A4 L(CR32) A4 L(CR33)	Risetime (fast), overshoot	5–20
A4 R253	Output amplifier	5–20
A5 R142*	Slow transition time in the first integrator range (1–5μs)	5–20
A5 R147 A5 R148	Integrator (working window)	5–16 (8), 5–20
A5 R161 A5 R162	A8-adjust (working window)	5–16 (8)
A5 R213 A5 R230	Integrator minimum current	5–22
A5 R136 A5 R217	Dual slope, slope equivalence	5–22 (5)
A5 R171 A5 R172	Integrator (slow ranges)	5–16 (5), 5–22
A5 R210	Internal supply voltage for integrator	5–16 (10) 5–20
A5 R80 A5 R81 A5 R115	Positive pulse baseline tracking	5–23
A8 R16 A8 R17	Integrator buffer amplifier (slow ranges)	5–21

* Factory-selected

Table 5–15. Test Equipment and Accessories for Internal Checks and Adjustments

INSTRUMENT	BRIEF SPECIFICATION	RECOMMENDED MODEL
Pulse Generator	10 MHz square wave output with 50% duty cycle	HP 8011A
Counter	Frequency range 0–50 MHz	5245L
	Prescaler plug-in	5252A
Oscilloscope		HP 180A with plug-ins 1801A and 1820A
Sampling Oscilloscope	Dual Channel, 1 GHz bandwidth, 1mV/div. sensitivity, sweep speeds 10ns/div. to 2s/div. 50–Ω input impedance.	HP 180A with plug-in 1810A
Digital Voltmeter	100V range to 4 significant figures. Accuracy ±0.05% ±1 digit.	HP 3440A with plug-in 3443A
Test Oscillator	Frequency range 10 Hz – 10 MHz	HP 651A
Test Oscillator	Frequency range 10 to 500 MHz	HP 3200B
Test Box		15265A
ACCESSORIES		
50Ω co-axial cable terminated with BNC male connectors (4 required)		HP 10120A
Connector BNC male to N female (2 required)		HP 1250–0077
Connector BNC male to N male (2 required)		HP 1250–0780
50Ω Feed-through termination (2 required)		HP 11048B/C
Pulse Adder		HP 15104A
20dB Attenuator, 50Ω (2 required)		HP 8491A

Table 5–16. Test and Adjustments Performed by Test Box 15265A

Classification of tests:

Class A These tests can only be performed using the Test Box.

Class B Conventional methods can be used instead.

Class C The Test Box checks a sub-function of Board A5. A final adjustment using the complete 8082A (i.e. with Board A4 operational) is necessary.

NOTE: DVM must be floating.

Test No.	Class	Purpose	Selector setting	DVM reading
1	–	Self test	–14V	–14V ± 0.5V
2	B	Transition time switch function	S9A	
		1n–5n		< 80mV
		5n–0.5m (approx equal to A5 R166/167 voltage to ground).		–25V ± 100mV
3	B	Current source values:		
		transition time switch 1n–5n	I_{Q51}	< 10mV
			I_{Q48}	< 10mV
		transition time switch 5n–50n	I_{Q51}	285 ± 25mV
		($I_{Q51} \approx V_{A5R211}/147\Omega$)	I_{Q48}	285 ± 25mV
		($I_{Q48} \approx V_{A5R213}/147\Omega$)	I_{DR}	85 ± 10mV
		(For this measurement, connect collector A5 Q58 via approx. 510Ω to ground.)		
		($I_{DR} \approx V_{A4\ R180}/38.3\Omega$)		(10mV = 1mA).

Test No.	Class	Purpose	Selector setting	DVM reading
4		Trans time switch 1n–5n.		
4a	B	Leading edge vernier CCW	I_{SUM}	510mV ± 40mV
		leading edge vernier CW	I_{SUM}	90mV ± 30mV
		(I_{SUM} ≈ voltage across A4 R174 divided by 13,3 ohm)		10mV ≈ 1mA
4b	B	Leading edge vernier CCW	I_{LE}	255mV ± 20mV
		leading edge vernier CW	I_{LE}	45mV ± 15mV
		(I_{LE} ≈ voltage across A4 L21 divided by R_{L21} ohm)		10mV ≈ 1mA
4c	B	Leading edge vernier CCW	I_{TE}	255mV ± 20mV
		leading edge vernier CW	I_{TE}	45mV ± 15mV
		(I_{TE} ≈ voltage across A4 L20 divided by R_{L20} ohm)		10mV ≈ 1mA
4d	B	Leading edge vernier CCW	I_{DR}	285mV ± 30mV
		(For this measurement, connect collector of A5 Q58 via approx 510 Ω to ground.)		
		leading edge vernier CW	I_{DR}	20mV + 10mV / – 5mV
		(For this measurement, connect collector of A5 Q58 via approx 510 Ω to ground.)		
		(I_{DR} ≈ voltage across A4 R180 divided by 38,3 ohm)		10mV ≈ 1mA
		(Value depends on A5 R142 – factory selected.)		
4e	A, C	Rotating leading edge vernier		
		from CW to CCW		constant
		preadjust A5 R136	DIF I	ΔU ± 20mV
				100mV ≈ 1mA
		preadjust A5 R217	DIF I	minimum
				– 25mV ± 15mV

*If Test Box is used

Table 5–16. (Continued)

Test No.	Class	Purpose	Selector setting	DVM reading
5	A	Leading and trailing edge vernier CCW, on switching trans time from 1n–5n to greater ranges no difference in I_{LE} (I_{TE}) should be present:		
		adjust A5 R172	I_{LE}	$\Delta U \pm 1mV$
		adjust A5 R171	I_{TE}	$\Delta U \pm 1mV$
		(See Table 5–22)		10mV ≈ 1mA
6	C	Trans time switch to 5n–50n. Leading and trailing edge vernier CW. Tests 4e and 5 must be done first:		
		preadjust A5 R213	I_{LE}	9mV ± 1mV
		preadjust A5 R230	I_{TE}	9mV ± 1mV
		(see Table 5–22)		10mV ≈ 1mA

Test No.	Class	Purpose	Selector setting	DVM reading
7	A	Check Test 4e in the 5–50n	DIF I	as Test 4e
8	B	Clamp voltages adjust:		
		Adjust A5 R148 (voltage A5 Q32 emitter to ground)	U_{CIL}	–14.78V ± 5mV
		Adjust A5 R147 (voltage A5 Q31 emitter to ground)	U_{CIH}	–14.50V ± 5mV
		adjust A5 R161 (depends on A5 R147) (voltage A5 Q35 emitter to ground)	U_{CBH}	–13.54V ± 5mV
		adjust A5 R162 (depends on A5 R148)	U_{CBL}	–14.33V ± 5mV
		NOTE: refer to Table 5–20		

Test No.	Class	Purpose	Selector setting	DVM reading
9	B	Norm/compl voltages: switching the norm/comp-switch	U_{NC1}	–11.75V/–11.05V ± 100mV
			U_{NC2}	–11.05V/–11.75V ± 100mV
		(U_{NC1} ≈ voltage from A5 X5 pin 1 to ground) (U_{NC2} ≈ voltage from A5 X5 pin 2 to ground)		
10	B	Internal integrator supply voltage:		
		adjust A5 R210	U_{OUT}	–6.90V
		(U_{OUT} ≈ voltage emitter A5 Q30 to ground)		–7.2 to –6.77V is permissible. See Table 5–20).

Table 5–16. (Continued)

Test No.	Class	Purpose	Selector setting	DVM reading	
11	B	Amplitude vernier check: amplitude vernier CW (attenuator not in ECL-mode).	I_{V801} I_{V802} I_{V40} I_V	0V + 0mV/–20mV 0V + 0mV/–20mV 0V + 0mV/–60mV 0V + 0mV/–80mV	
		amplitude vernier CCW (attenuator not in ECL-mode).	I_{V801} I_{V802} I_{V40} I_V	3.4V ±0.2V 2.1V ±0.2V 3.4V ±0.2V 2.87V ±0.3V	
		attenuator in ECL-mode	I_{V801} I_{V802} I_{V40} I_V	3.35V ±0.3V 1.35V ±0.15V 3.4V ±0.3V 2.55V ±0.25V	
		Scale factors: I_{V801}, I_{V802}: 5V ≈ 80mA I_{V40}: 5V ≈ 40mA I_V: 5V ≈200mA I_{V801} ≈ $V_{A5\ Q20}$ EMITTER-GND/5 ohm. I_{V802} ≈ $V_{A5\ Q21}$ EMITTER–GND/5 ohm. I_{V40} ≈ $V_{A5\ Q21}$ EMITTER-GND/10 ohm. I_V ≈ $I_{V801} + I_{V802} + I_{V40}$			

Test No.	Class	Purpose	Selector setting	DVM reading	
12	C	Pos pulse: tracking offset	$I_{POS\ A}$ $I_{POS\ B}$	typ. 1.9/5.3V typ. 1.9/5.3V	
		This adjustment (A5 R80, R81, R115) must be made with the whole instrument (see Table 5–23).			
13	B	Ext dc-offset: ext offset on, vernier CCW + CW (not ECL)	$I_{DC\ A}$ $I_{DC\ B}$	±2.25V ±2.25V	±0.15V ±0.15V
		(can be measured at each of the 2 8082A pulse output jacks, which must be terminated by 50 ohm).			
		in ECL position	$I_{DC\ A}$ $I_{DC\ B}$	–0.45V –0.45V	±50mV ±50mV

ADJUSTMENTS

Table 5–17. Power Supply

STEP

1 8082A settings:

1 REPETITION RATE	250M–100M
2 VERNIER	CCW
3 NORM/DOUBLE	NORM
4 DELAY	2n–5n
5 VERNIER	CCW
6 EXT INPUT LEVEL	middle
7 MODE SWITCH	EXT TRIG
8 WIDTH	2n–5n
9 VERNIER	CCW
10 TRANSITION TIME	1n–5n
11 LEADING VERNIER	CCW
12 TRAILING VERNIER	CCW
13 AMPLITUDE	0.4–1
14 AMPLITUDE	0.4–1
15 AMP VERNIER	CW
16 OFFSET VERNIER	middle
17 OFFSET SWITCH	OFF
19 NORM/COMPL	NORM
20 NEG/POS SWITCH	NEG
24 SLOPE POLARITY	POS

2 Set the DVM to auto-range and connect it between GND and the voltage TP's.

3 Measure and adjust the following points:

TP + 10V	Adjust A2 R7 to + 10V ± 20mV
TP – 5V	Adjust A2 R10 to – 5V ± 10mV
TP – 10V	Adjust A2 R21 to – 10V ± 20mV
TP – 25V	Adjust A2 R29 to – 25V ± 30mV

Table 5–18. Rep. Rate

STEP

1 8082 settings:

3 DOUBLE /NORMAL	NORMAL
4 DELAY	2n–5n
5 VERNIER	CCW
7 MODE SWITCH	NORM
8 WIDTH	2n–5n
9 VERNIER	CCW
10 TRANSITION TIME	1n–5n
11 LEADING VERNIER	CCW
12 TRAILING VERNIER	CCW

Counter Setting:

Sensitivity	1V
Max. count rate	350 MHz

2 Measure and adjust the frequency as follows:

8082A		COUNTER		
REP. RATE 1	VERNIER 2	TIME BASE	ADJUST	RESULT
250M–100M	CCW	0.1ms	A3 R6	255 ± 0.5 MHz
100M–10M	CW	0.1ms	A3 R5	9.3 ± 0.1 MHz

A3 R6 affects highest rep rate only (CCW).

A3 R5 affects all ranges below and including 100M–10M (CW).

A3 R77 affects duty cycle at 100MHz (10MHz)

ADJUSTMENTS

Table 5–19. Delay and Width (Verniers CW)

STEP		
1	8082A settings:	
	1 REPETITION RATE 10M–1M	
	2 VERNIER	CW
	4 DELAY	as required, but not 2n–5n
	5 VERNIER	CW
	8 WIDTH	as required, but not 2n–5n
	9 VERNIER	CW
2	A4 R38 affects the delay in all ranges (except 2n–5n) when the vernier is CW. Range of values for A4 R38 is 100 kΩ upwards, increase in resistance increases delay. This adjustment is done at the factory.	
5	Max width in all ranges (except 2n–5n) can be increased when the vernier is CW) by increasing A4 R88. Range of values is 100 kΩ upwards. This adjustment is done at the factory.	

ADJUSTMENTS

Table 5–20. Amplitude, Risetime, Overshoot (1n–5n Transition Time)

1 8082A settings:

1 REPETITION RATE	10M–1M (VERNIER for 5 MHz)
3 DOUBLE/NORM	NORM
7 MODE SWITCH	EXT WIDTH
8 WIDTH	SQUARE WAVE
10 TRANSITION TIME	1n–5n, VERNIERS CW
13 AMPLITUDE	2.0–5.0
14 AMPLITUDE	2.0–5.0
18,21 Both outputs must be terminated by 50 ohms at all times	
20 NEG/POS SWITCH	NEG

2 Verify tests 8, 10 in Table 5–16.

3 Adjust A4 R214, R232 for max output voltages $>$5.15V and $<$5.35V, then optimize settings for acceptable pulse shape.

NOTE: A5 R210 may be re-adjusted if difficulty is experienced in reaching the maximum amplitude with the A4 R214/232 adjustment (– 7.2V to – 6.7V is permissible; 100mV variation means about 60mV output amplitude variation). Increasing voltage in negative direction increases the overshoot.
See Table 5–16 test 10.

4 Re-adjust A4 R214 for a baseline shift $>$30mV and $<$70mV (worst case: both channels, norm and compl, ampl. vernier CW, neg. pulse). Observe baseline while rotating amplitude vernier between CW and CCW. The best setting has been found to be – 40mV.

affect perturbation on pulse (adj. for best perturbation and knee in pulse at min. vernier)

5 Set amplitude vernier CCW (i.e. 2V output). If a hook is apparent at the start of the positive going edge, adjust A4 R214, then A4 R232, for an acceptable pulse shape. Repeat steps 3 and 4 adjust for best compromise.

6 Turn amplitude vernier CW and transition time verniers CCW. Adjust A4 R253 for –6.3 ± 0.1V at R253 wiper (TP 16).

7 Set 8082A transition time to 1n–5ns LE-vernier CW. Select A5 R142 for a transition time $>$6.5ns and $<$7.5ns in the worst case of both edges.
NOTE: A5 R142 has possible values 1.87 K ... 3.01 K.

8 Verify tests 4, 8, 10 in Table 5–16.
Measure transition times, overshoot and ringing. LE-Vernier CCW.
NOTE:

1. fast edges have greater overshoot and ringing than slower ones.
2. positive output pulses will be slightly faster than negative ones.
3. A4 R214, R232 also affect transition time and overshoot (but see steps 3, 4, 5 above).
4. Transition times and overshoot are affected by the inductors (wires) parallel to A4 CR32, CR33. A 1-cm variation of wire length is allowed, corresponding to 30ps in transition time, 0.7 % absolute in overshoot.
5. It is permissible to re-adjust U_{CIH} (Table 5–16 Test 8) in the range – 14.44V to – 14.51 V ± 5mV, and U_{CIL} in the range – 14.78V to – 14.84 V ± 5mV, without re-adjusting U_{CBH} and U_{CBL}.

   This decreases the transition times by about 40ps and increases overshoot by about 1 % absolute compared with the values given in Table 5–16 Test 8. If these adjustments are made, repeat steps 3 to 5.

ADJUSTMENTS

Table 5–21. Amplitude, Risetime, Overshoot (Slower Transition Times)

STEP

1 8082A settings: as previous table, except:

1/2 REP RATE about 2 MHz
10 TRANSITION TIME 5n–50n, VERNIERS CW
13/14/15 AMPLITUDE max.

2 Verify tests 3b, 4e, 5, 6, 7, 8, 10 of Table 5–16.

3 Adjust A8 R16, R17 for max output voltage $>$5.1V then optimize settings for acceptable pulse shape.

4 If possible, re-adjust A8 R16 for a baseline shift $\approx -$ 40mV, ampl. vernier CW (worst case: both channels, norm and compl).

5 Set amplitude vernier CCW (i.e. 2V output). If a hook is apparent at the start of the positive going edge, adjust A4 R16, then A4 R17, for an acceptable pulse shape. Repeat steps 3 and 4 and adjust for best compromise.

6 With max output voltage, and with transition time verniers CW, compare the output amplitudes (in both channels and for norm and compl. pulses) in the fastest transition time range with those in any of the slower ranges. If the pulse amplitudes are not within 100mV of each other, increase the smaller amplitude (step 3 of this, or previous, table).

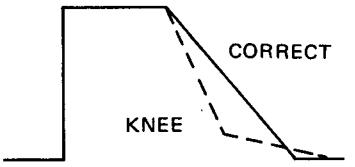
Table 5–22. Pulse Shape and Transition Times

STEP

1 8082A settings:

10 TRANSITION TIME	5n–50n
11 LEADING VERNIER	CCW
12 TRAILING VERNIER	CW

2 If trailing edge has a knee, adjust A5 R136, R217 for a constant slope.



3 Set leading edge vernier CW. Rotate trailing edge vernier, observing leading edge.
Re-adjust A5 R136 for a constant leading edge slope.

4 Set trailing edge vernier CW. Rotate leading edge vernier observing trailing edge.
Re-adjust A5 R136 for a constant trailing edge slope.
(A 5% variance in slope is usual).

5 Increase rep. rate until waveform is triangular (may possibly be distorted). Verify that the amplitude decreases.

6 Re-adjust A5 R171, R172 for a clean triangular waveform.

7 Repeat steps 2 to 4.

8 Set both transition time verniers CW and adjust A5 R213 (230) for leading (trailing) edge times of 65ns. (This adjustment affects only the CW transition time of range 5n–50n and slower).

9 Repeat steps 2 to 8 if adjustment was made in step 8.

ADJUSTMENTS

Table 5–23. Positive Pulse Baseline

STEP

1 Set 8082A for positive output pulses.

2 Observe right channel baseline shift while rotating amplitude vernier. Adjust A5 R81 for minimum baseline shift (a fixed dc offset may be present).

3 Adjust A5 R80 for zero dc offset in right channel.

4 Adjust A5 R115 for zero dc offset in left channel.

5 Carry out septs 1 to 4 for normal and compl modes, with transition times of 1n–5n and 5n–50n, and with transition time verniers CCW and CW. Re-adjust A5 R80, R81, R115 for the best compromise. Baseline shift should not exceed ± 100mV in the 5–2V attenuator range.

Table 5–24. Width

STEP

1 8082A settings:

1 REP RATE	ABOUT 20 MHz
8 WIDTH	2–5ns
9 WIDTH VERNIER	CW
10 TRANSITION TIME	1–5ns
11 VERNIER	CCW

2 Set A4 R43 for a 7ns pulse width.

3 Set 8082A to max rep rate, min delay, min width. Set A4 R240 for a pulse width of about 2.00 ns or about 50 % duty cycle. Optimize adjustments for the worst case of norm/compl. right/left channel.

4 Set pulse width selector to SW.
Observe pulse amplitude and baseline shift while varying rep rate between 250 MHz and 100 MHz.
(± 3 % variance is usual).

Table 5–25. Double Pulse

STEP

1 8082A settings:

1, 2 REP RATE	10 MHz approx
8, 9 WIDTH	Min
3 DOUBLE PULSE/NORM	DOUBLE PULSE
4 DELAY	5n–50n
5 VERNIER	CCW

2 Verify pulses are equal in width.
First pulse width can be adjusted by selecting A4 R42 values in the range 1.6 to 10 kΩ. This adjustment is done at the factory.

3 If A4 R42 is changed, repeat tables 5–24 and 5–25.

Table 5–26. Gate

STEP

1 8082A settings:

1 REP RATE	Max
8, 9 WIDTH	Min
7 MODE SWITCH	GATE

2 Drive 8082A from a 5 MHz, 50 % duty cycle source (approx values).

3 Adjust A3 R87 for a correct first pulse.

4 Set the 8082A to SQUARE WAVE.

5 Re-adjust A3 R87 and A4 R240, if necessary. (If re-adjusted, verify step 3).

6 If A3 R87 adjustment is not successful, connect resistor between A3 J3 (SW output, A3 U2 pin 7) and –10V (at A3 C13). Values lie in range 1.2 kΩ to 5.6 kΩ.

NOTE: For instruments with serial numbers 1410G00270 and below: disconnect ground leads at A4 Q69 and Q70 of the coax cables which link the width circuit (A4 U4) to the level shifter (A4 Q69, Q70).

7 Repeat steps 2 to 5.
Set ampl. vernier (15) CCW (i.e. 2V). Vary the frequency and duty cycle of the gate source and observe the output, from both channels of the 8082A, while varying the frequency (from 250 MHz –100 MHz) in the following modes: NEG, POS, NORM, COMP and SQUAREWAVE, PULSE. The pulse fluctuation should be less than 5 % while the pulse width should not exceed 2.3 ns.

SAFETY CHECK

Table 5–27. Safety Check

1 Disconnect power cord from line, visually inspection interior for any sign of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine cause and remedy.

2 Check resistance from 8082A cabinet to ground pin on power plug with suitable ohmmeter. The reading must be less than one ohm. Flex the power cord while making this measurement to detect any intermittent discontinuity. Check internal ground connections on boards and frame. Also check resistance of any front or rear panel ground terminals marked ⏚

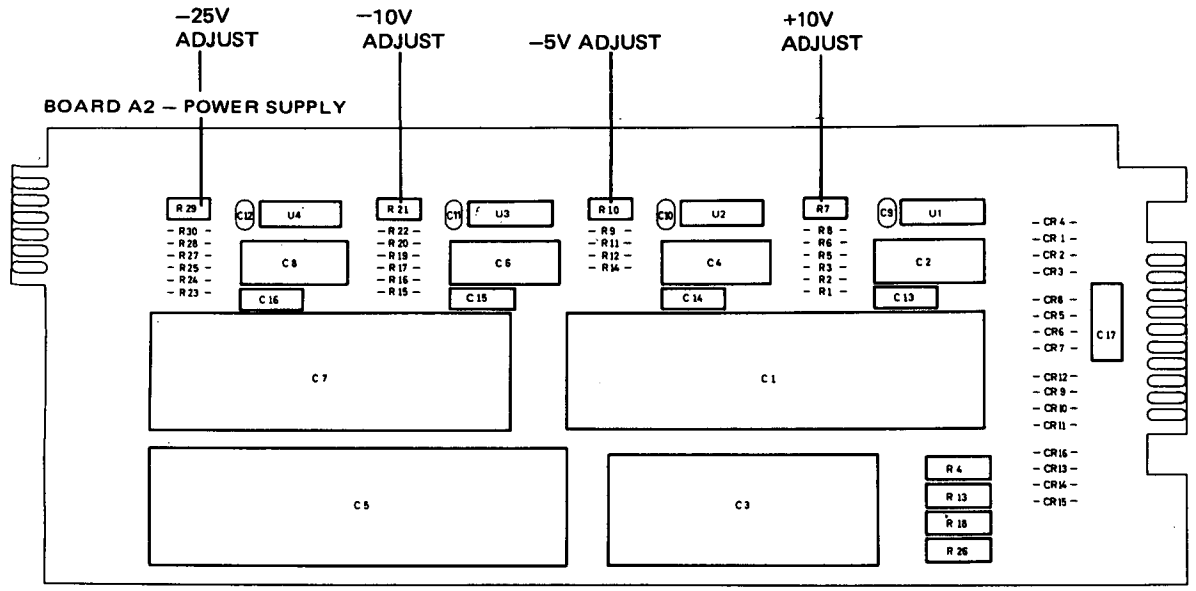
3 Check resistance from 8082A cabinet to line and neutral (tied together) with the power switch on and the power source disconnected. The minimum acceptable resistance is two megohms. Replace any component which results in a failure or refer to production Memo or Service Note issued by product division for alternate action.

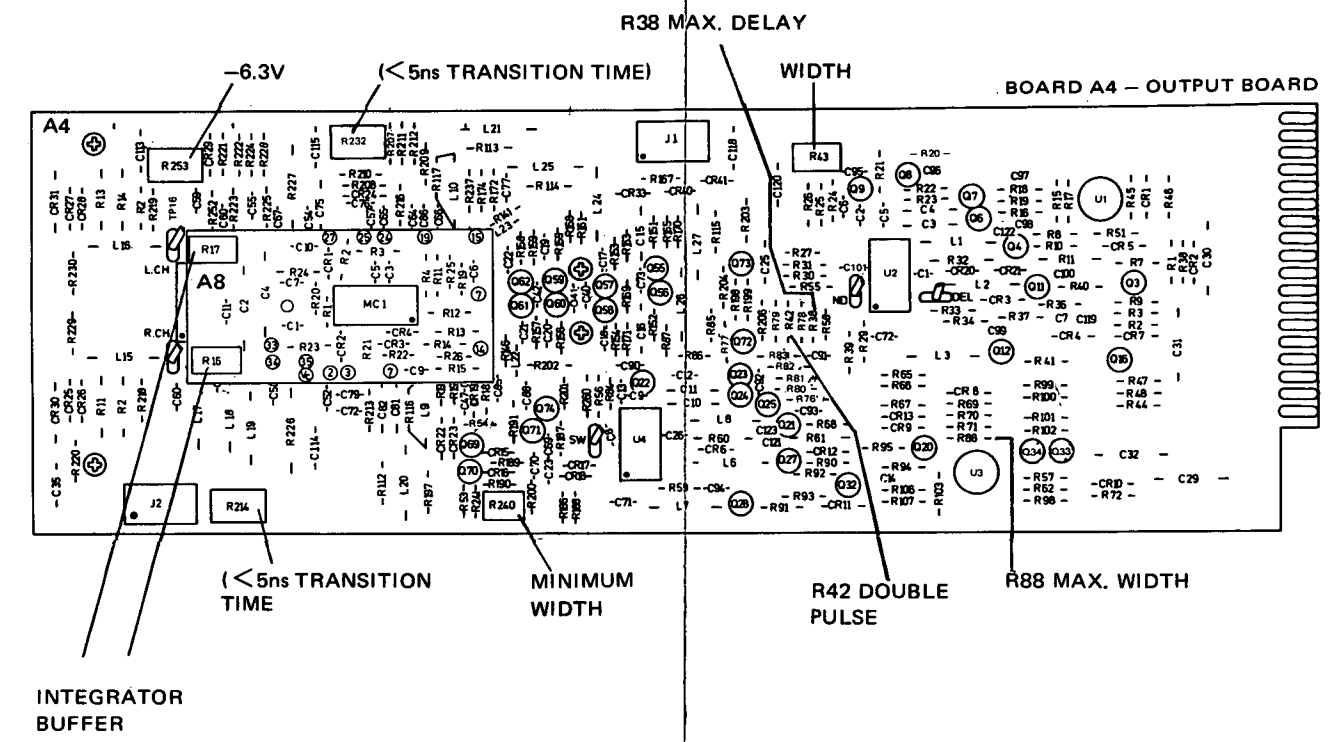
4 Check line fuse to verify that the proper value is installed.

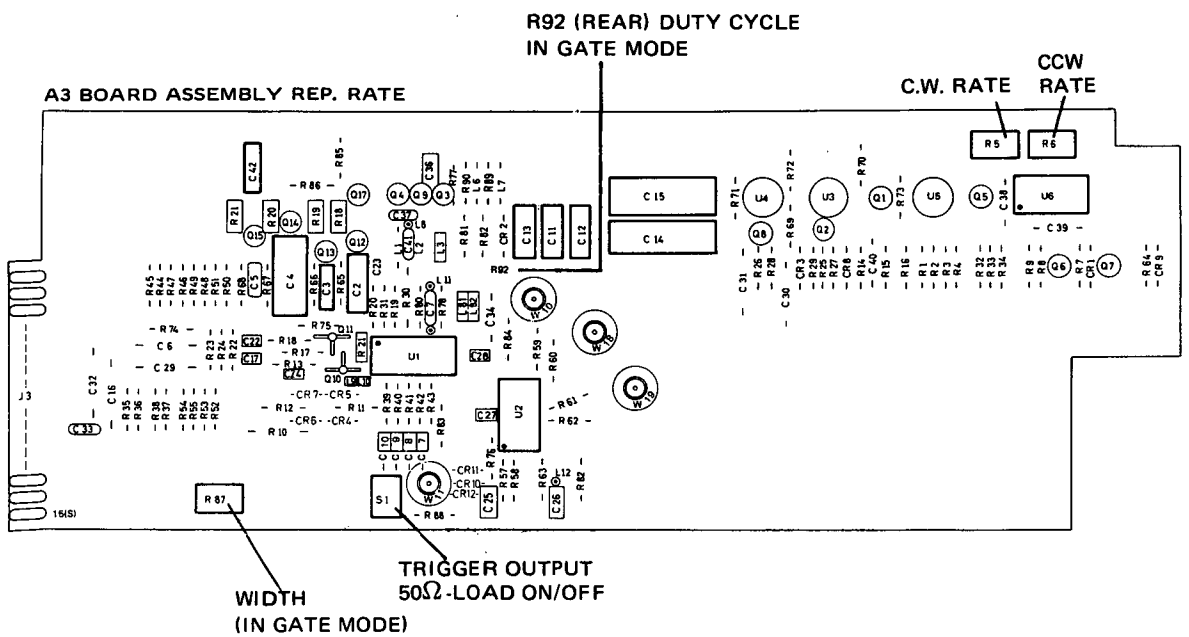
5 Check that the plastic safety cover is installed inside the base of the 8082A, below the line fuse.

6 Check that all coaxial and flat cables inside the 8082A are properly connected. Check that all boards and the heatsink on the chassis are properly connected. Make sure that board A8 is properly connected to board A4.

7 Inform Hewlett-Packard (internally, the responsible product division) of any repeated failures in the above tests or any other safety features.







Refer to Figure 6–1 for board location

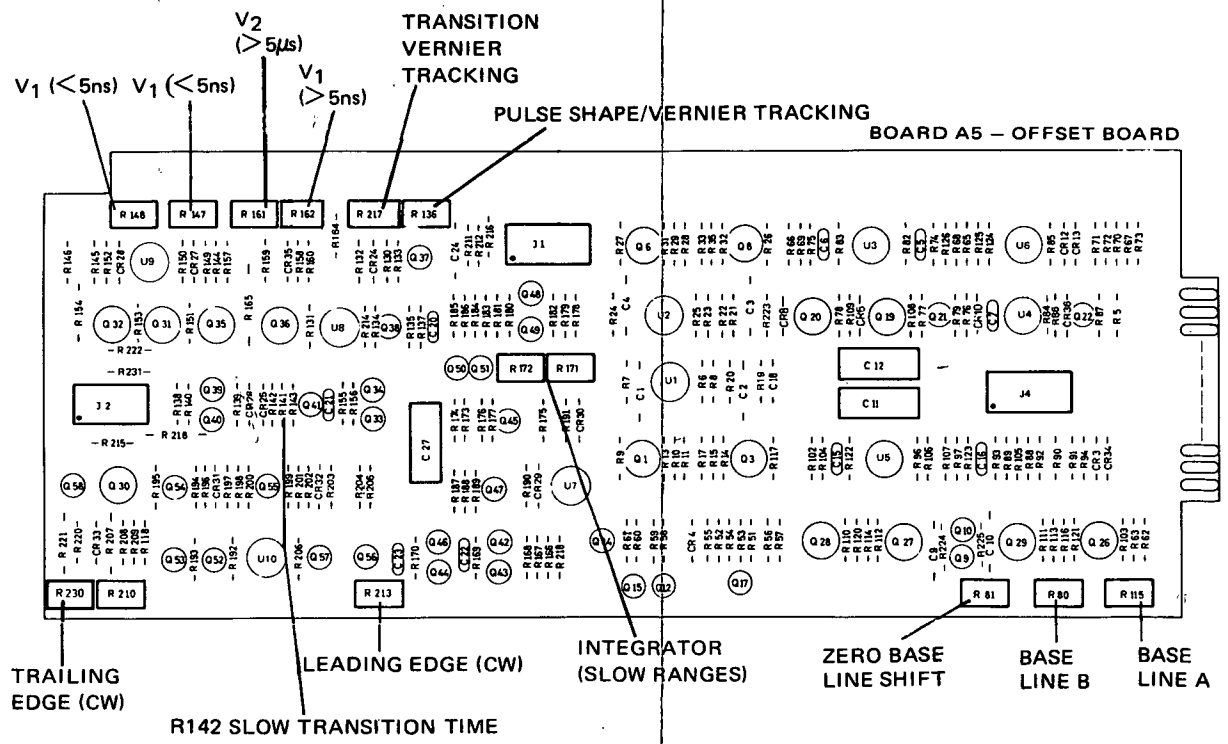


Figure 5–2. Location of adjustment controls

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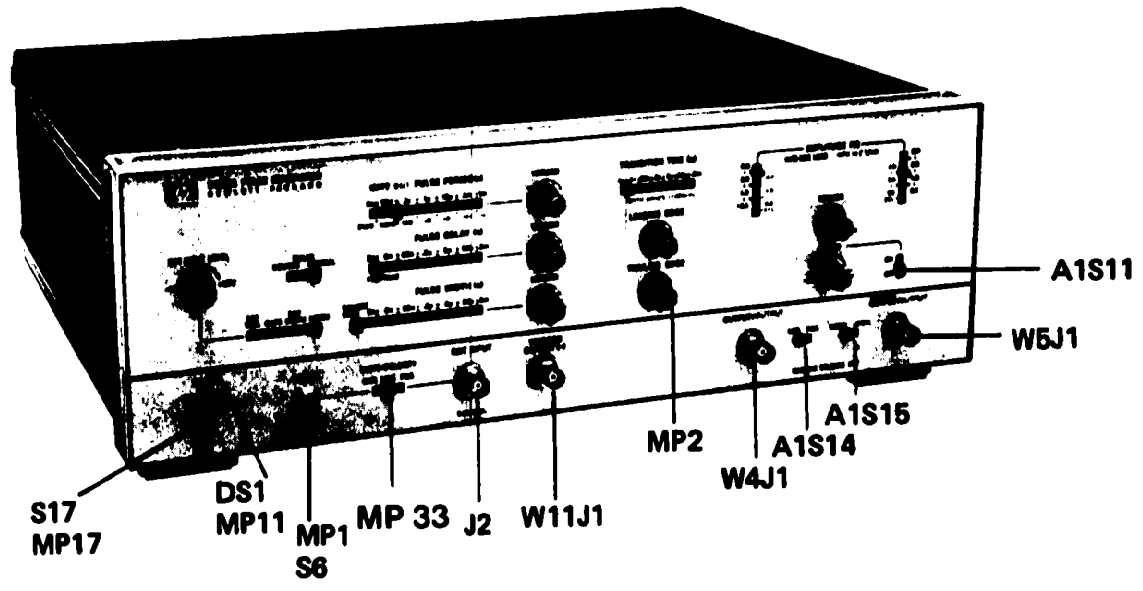


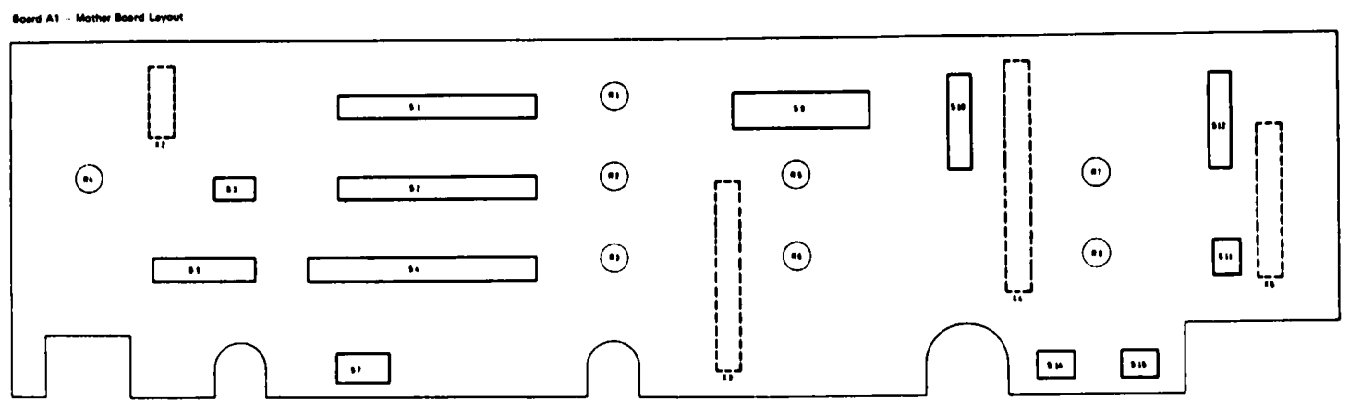


Figure 6–1. Mainframe parts identification

DIAGRAMS AND REPLACEABLE PARTS

6–1 INTRODUCTION

6–2 This section contains the circuits, component location diagrams and the lists of replaceable parts. Waveforms shown with the circuits are included for quidance only and failure to observe identical results should not be automatically taken as indication of a fault. Tables 6–1 and 6–2 provide information relating to the replaceable parts lists and the circuit diagrams.

6–3 ORDERING INFORMATION

6–4 General

6–5 The replaceable parts tables list parts in alpha-numerical order of their reference designators and indicate the description and HP stock number of each part, together with any applicable notes.

6–6 To order a replacement part, address order or enquiry either to your authorized Hewlett-Packard sales representative or to:

CUSTOMER SERVICE
Hewlett-Packard Company,
333 Logue Avenue,
Mountain View, California 94040

or, in Western Europe, to:

Hewlett-Packard (Schweiz) SA
Rue du Bois-du-Lan 7
1217 Meyrin 2
Geneva

6–7 Specify the following information for each part:

a) Model and complete serial number of instrument.

b) Hewlett-Packard stock number.

c) Circuit reference stock number.

d) Description

To order a part not listed, give a complete description of the part and include its function and location.

Table 6–1. Component Designators

A	= assembly	U	= micro-circuit
B	= motor	P	= plug
BT	= battery	Q	= transistor
C	= capacitor	R	= resistor
CP	= coupler	RT	= thermistor
CR	= diode	S	= switch
DL	= delay line	T	= transformer
DS	= lamp	TB	= terminal board
F	= fuse	TP	= test point
FL	= filter	V	= vacuum, tube, neon bulb, photocell, etc.
HR	= heater		
J	= jack/connector	VR	= voltage regulator
K	= relay	W	= cable
L	= inducer	X	= socket
M	= meter	Y	= crystal

Components mounted on an assembly are identified by prefixing the component reference designator by the assembly designator. Thus, for example, A4CR9 is diode 9 on assembly 4.

Designators of components mounted on the frame receive no prefix.

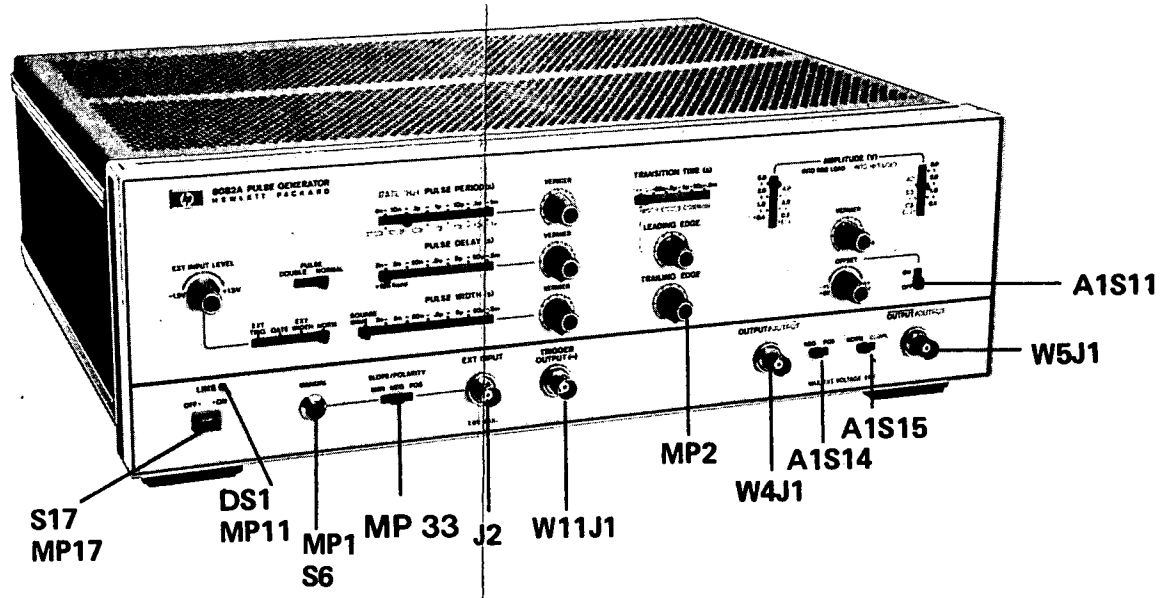
Table 6–2. Manufacturers' Code Numbers and Abbreviations for Parts List

Abbreviations

A	AMPERE(S)	H	HENRY(IES)	NPN	NEGATIVE POSITIVE	RWV	REVERSE WORKING
ASSY	ASSEMBLY	HG	MERCURY		NEGATIVE		VOLTAGE
		HP	HEWLETT PACKARD	NSR	NOT SEPARATELY		
BD	BOARD(S)	HZ	HERTZ		REPLACEABLE	S-B	SLOW BLOW
BH	BINDER HEAD					SCR	SILICON CONTROLLED
BP	BANDPASS	IF	INTERMEDIATE FREQ				RECTIFIER
		IMPG	IMPREGNATED	OBD	ORDER BY	SE	SELENIUM
C	CENTI (10^{-2})	INCD	INCANDESCENT		DESCRIPTION	SEC	SECOND(S)
CAR	CARBON	INCL	INCLUDE(S)	OH	OVAL HEAD	SECT	SECTION(S)
CCW	COUNTERCLOCKWISE	INS	INSULATION(ED)	OX	OXIDE	SI	SILICON
CER	CERAMIC	INT	INTERNAL			SIL	SILVER
CMO	CABINET MOUNT ONLY			P	PEAK	SL	SLIDE
COAX	COAXIAL	K	KILO (10^3)	PC	PRINTED (ETCHED)	SP	SINGLE POLE
COEF	COEFFICIENT	KG	KILOGRAM		CIRCUIT(S)	SPL	SPECIAL
COMP	COMPOSITION			PF	PICOFARADS	ST	SINGLE THROW
CONN	CONNECTOR(S)	LB	POUND(S)	PHL	PHILLIPS	STD	STANDARD
CRT	CATHODE-RAY TUBE	LH	LEFT HAND	PIV	PEAK INVERSE		
CW	CLOCKWISE	LIN	LINEAR TAPER		VOLTAGE(S)	TA	TANTALUM
		LOG	LOGARITHMIC TAPER	PNP	POSITIVE-NEGATIVE-	TD	TIME DELAY
D	DECI (10^{-1})	LPF	LOW PASS FILTER(S)		POSITIVE	TFL	TEFLON
DEPC	DEPOSITED CARBON	LVR	LEVER	P/O	PART OF	TGL	TOGGLE
DP	DOUBLE POLE			PORC	PORCELAIN	THYR	THYRISTOR
DT	DOUBLE THROW	M	MILLI (10^{-3})	POS	POSITION(S)	TI	TITANIUM
		MEG	MEGA (10^6)	POT	POTENTIOMETER(S)	TNLDIO	TUNNEL DIODE(S)
ELECT	ELECTROLYTIC	MET FILM	METAL FILM	P-P	PEAK TO PEAK	TOL	TOLERANCE
ENCAP	ENCAPSULATED	MET OX	METAL OXIDE	PRGM	PROGRAM	TRIM	TRIMMER
EXT	EXTERNAL	MFR	MANUFACTURER	PS	POLYSTYRENE		
		MINAT	MINIATURE	PWV	PEAK WORKING	U	MICRO (10^{-6})
F	FARAD(S)	MOM	MOMENTARY		VOLTAGE		
FET	FIELD-EFFECT	MTG	MOUNTING			V	VOLTS
	TRANSISTOR(S)	MY	MYLAR	RECT	RECTIFIER(S)	VAR	VARIABLE
FH	FLAT HEAD			RF	RADIO FREQUENCY	VDCW	DC WORKING VOLT(S)
FIL H	FILLISTER HEAD	N	NANO (10^{-9})	RFI	RADIO FREQUENCY		
FXD	FIXED	N/C	NORMALLY CLOSED		INTERFERENCE	W	WATT(S)
		NE	NEON	RH	ROUND HEAD	W/	WITH
G	GIGA (10^9)	N/O	NORMALLY OPEN		OR	WIV	WORKING INVERSE
GE	GERMANIUM	NOP	NEGATIVE POSITIVE		RIGHT HAND		VOLTAGE
GL	GLASS		ZERO (ZERO TEMPER	RMO	RACK MOUNT ONLY	W/O	WITHOUT
GRD	GROUNDED		ATURE COEFFICIENT)	RMS	ROOT MEAN SQUARE	WW	WIREWOUND

Manufacturer's Code Numbers

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
GM005	DEUTSCHE VITROHM GMBH & CO	GERMANY	
00501	ILLUMINATED PRODUCTS INC	ANAHEIM CA	92803
00779	AMP INC	HARRISBURG PA	17105
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
02114	FERROXCUBE CORP	SAUGERTIES NY	12477
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
11502	TRW INC BOONE DIV	BOONE NC	28607
12697	CLAROSTAT MFG CO INC	DOVER NH	03820
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
16546	U S CAPACITOR CORP	BURBANK CA	91504
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
23880	STANFORD APPLIED ENGINEERING INC	SANTA CLARA CA	95050
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
24931	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS IN	46227
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	63017
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VILLAGE IL	60007
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTELFUSE INC	DES PLAINES IL	60016
76381	3M COMPANY	ST PAUL MN	55101
79727	C-W INDUSTRIES	WARMINSTER PA	18974
82389	SWITCHCRAFT INC	CHICAGO IL	60630
95146	ALCO ELECTRONIC PRODUCTS INC	LAWRENCE MA	01843



Board A1 – Mother Board Layout

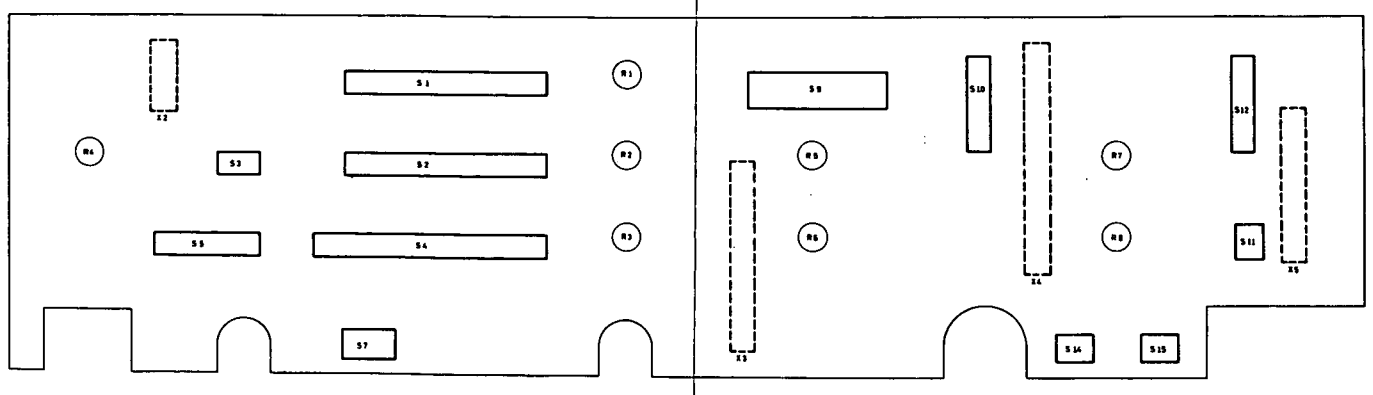


Figure 6–1. Mainframe parts identification

DIAGRAMS AND REPLACEABLE PARTS

6–1 INTRODUCTION

6–2 This section contains the circuits, component location diagrams and the lists of replaceable parts. Waveforms shown with the circuits are included for quidance only and failure to observe identical results should not be automatically taken as indication of a fault. Tables 6–1 and 6–2 provide information relating to the replaceable parts lists and the circuit diagrams.

6–3 ORDERING INFORMATION

6–4 General

6–5 The replaceable parts tables list parts in alpha-numerical order of their reference designators and indicate the description and HP stock number of each part, together with any applicable notes.

6–6 To order a replacement part, address order or enquiry either to your authorized Hewlett-Packard sales representative or to:

CUSTOMER SERVICE
Hewlett-Packard Company,
333 Logue Avenue,
Mountain View, California 94040

or, in Western Europe, to:

Hewlett-Packard (Schweiz) SA
Rue du Bois-du-Lan 7
1217 Meyrin 2
Geneva

6–7 Specify the following information for each part:

a) Model and complete serial number of instrument.

b) Hewlett-Packard stock number.

c) Circuit reference stock number.

d) Description

To order a part not listed, give a complete description of the part and include its function and location.

Table 6–1. Component Designators

A	= assembly	U	= micro-circuit
B	= motor	P	= plug
BT	= battery	Q	= transistor
C	= capacitor	R	= resistor
CP	= coupler	RT	= thermistor
CR	= diode	S	= switch
DL	= delay line	T	= transformer
DS	= lamp	TB	= terminal board
F	= fuse	TP	= test point
FL	= filter	V	= vacuum, tube, neon bulb, photocell, etc.
HR	= heater		
J	= jack/connector	VR	= voltage regulator
K	= relay	W	= cable
L	= inducer	X	= socket
M	= meter	Y	= crystal

Components mounted on an assembly are identified by prefixing the component reference designator by the assembly designator. Thus, for example, A4CR9 is diode 9 on assembly 4.

Designators of components mounted on the frame receive no prefix.

Table 6–2. Manufacturers' Code Numbers and Abbreviations for Parts List

Abbreviations

A	AMPERE(S)	H	HENRY(IES)	NPN	NEGATIVE POSITIVE	RWV	REVERSE WORKING
ASSY	ASSEMBLY	HG	MERCURY		NEGATIVE		VOLTAGE
		HP	HEWLETT PACKARD	NSR	NOT SEPARATELY		
BD	BOARD(S)	HZ	HERTZ		REPLACEABLE	S-B	SLOW BLOW
BH	BINDER HEAD					SCR	SILICON CONTROLLED
BP	BANDPASS	IF	INTERMEDIATE FREQ				RECTIFIER
		IMPG	IMPREGNATED	OBD	ORDER BY	SE	SELENIUM
C	CENTI (10^{-2})	INCD	INCANDESCENT		DESCRIPTION	SEC	SECOND(S)
CAR	CARBON	INCL	INCLUDE(S)	OH	OVAL HEAD	SECT	SECTION(S)
CCW	COUNTERCLOCKWISE	INS	INSULATION(ED)	OX	OXIDE	SI	SILICON
CER	CERAMIC	INT	INTERNAL			SIL	SILVER
CMO	CABINET MOUNT ONLY			P	PEAK	SL	SLIDE
COAX	COAXIAL	K	KILO (10^3)	PC	PRINTED (ETCHED)	SP	SINGLE POLE
COEF	COEFFICIENT	KG	KILOGRAM		CIRCUIT(S)	SPL	SPECIAL
COMP	COMPOSITION			PF	PICOFARADS	ST	SINGLE THROW
CONN	CONNECTOR(S)	LB	POUND(S)	PHL	PHILLIPS	STD	STANDARD
CRT	CATHODE-RAY TUBE	LH	LEFT HAND	PIV	PEAK INVERSE		
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		LOG	LOGARITHMIC TAPER	PNP	POSITIVE NEGATIVE	TD	TIME DELAY
D	DECI (10^{-1})	LPF	LOW-PASS FILTER(S)		POSITIVE	TFL	TEFLON
DEPC	DEPOSITED CARBON	LVR	LEVER	P/O	PART OF	TGL	TOGGLE
DP	DOUBLE POLE			PORC	PORCELAIN	THYR	THYRISTOR
DT	DOUBLE THROW	M	MILLI (10^{-3})	POS	POSITION(S)	TI	TITANIUM
		MEG	MEGA (10^6)	POT	POTENTIOMETER(S)	TNLDIO	TUNNEL DIODE(S)
ELECT	ELECTROLYTIC	MET FILM	METAL FILM	P-P	PEAK-TO-PEAK	TOL	TOLERANCE
ENCAP	ENCAPSULATED	MET OX	METAL OXIDE	PRGM	PROGRAM	TRIM	TRIMMER
EXT	EXTERNAL	MFR	MANUFACTURER	PS	POLYSTYRENE		
		MINAT	MINIATURE	PWV	PEAK WORKING	U	MICRO (10^{-6})
F	FARAD(S)	MOM	MOMENTARY		VOLTAGE		
FET	FIELD EFFECT	MTG	MOUNTING			V	VOLTS
	TRANSISTOR(S)	MY	MYLAR	RECT	RECTIFIER(S)	VAR	VARIABLE
FH	FLAT HEAD			RF	RADIO FREQUENCY	VDCW	DC WORKING VOLT(S)
FIL H	FILLISTER HEAD	N	NANO (10^{-9})	RFI	RADIO FREQUENCY		
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G	GIGA (10^9)	N/O	NORMALLY OPEN		OR	WIV	WORKING INVERSE
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75915	LITTELFUSE INC	DES PLAINES IL	60016
76381	3M COMPANY	ST PAUL MN	55101
79727	C-W INDUSTRIES	WARMINSTER PA	18974
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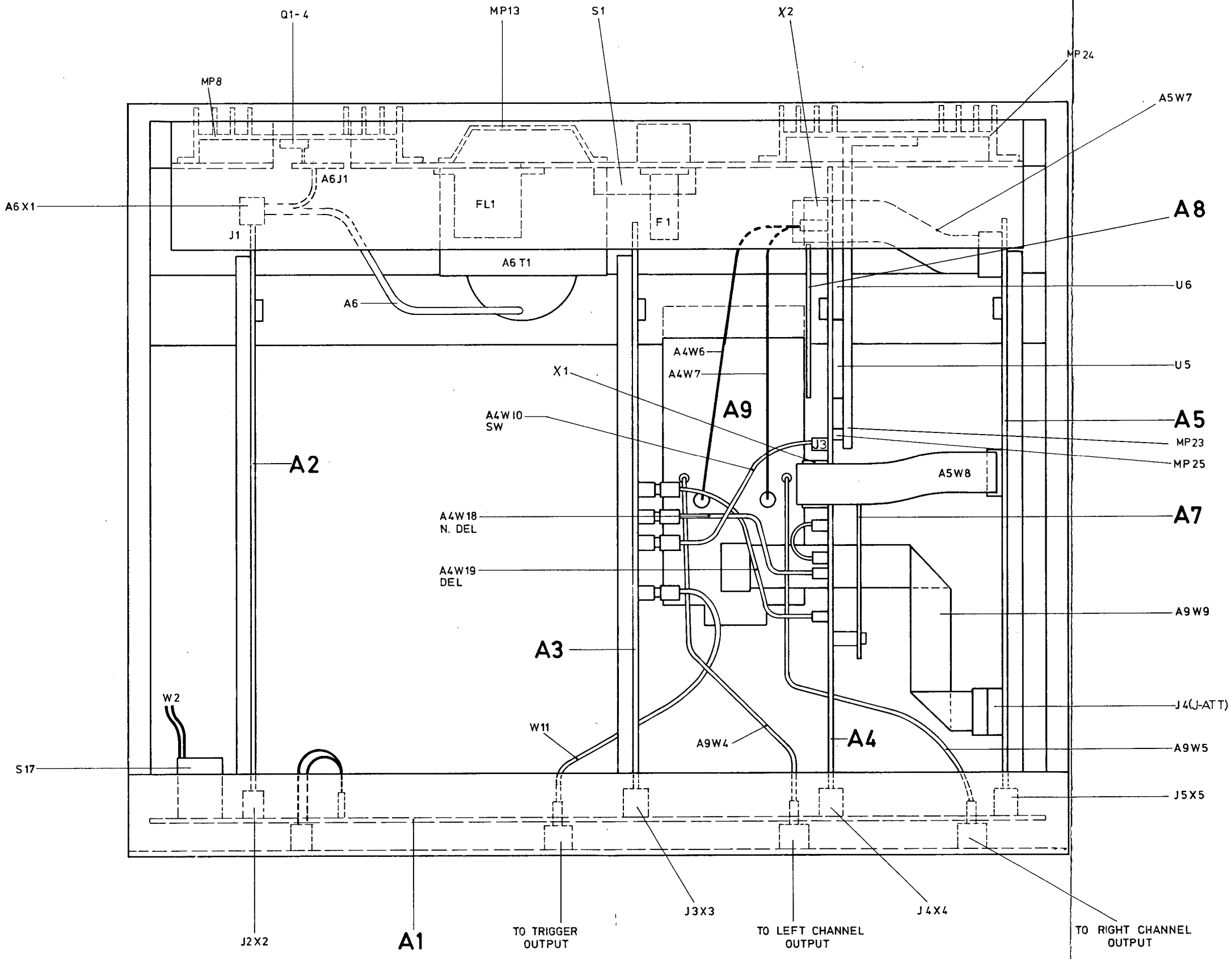


Figure 6–1. (cont'd)

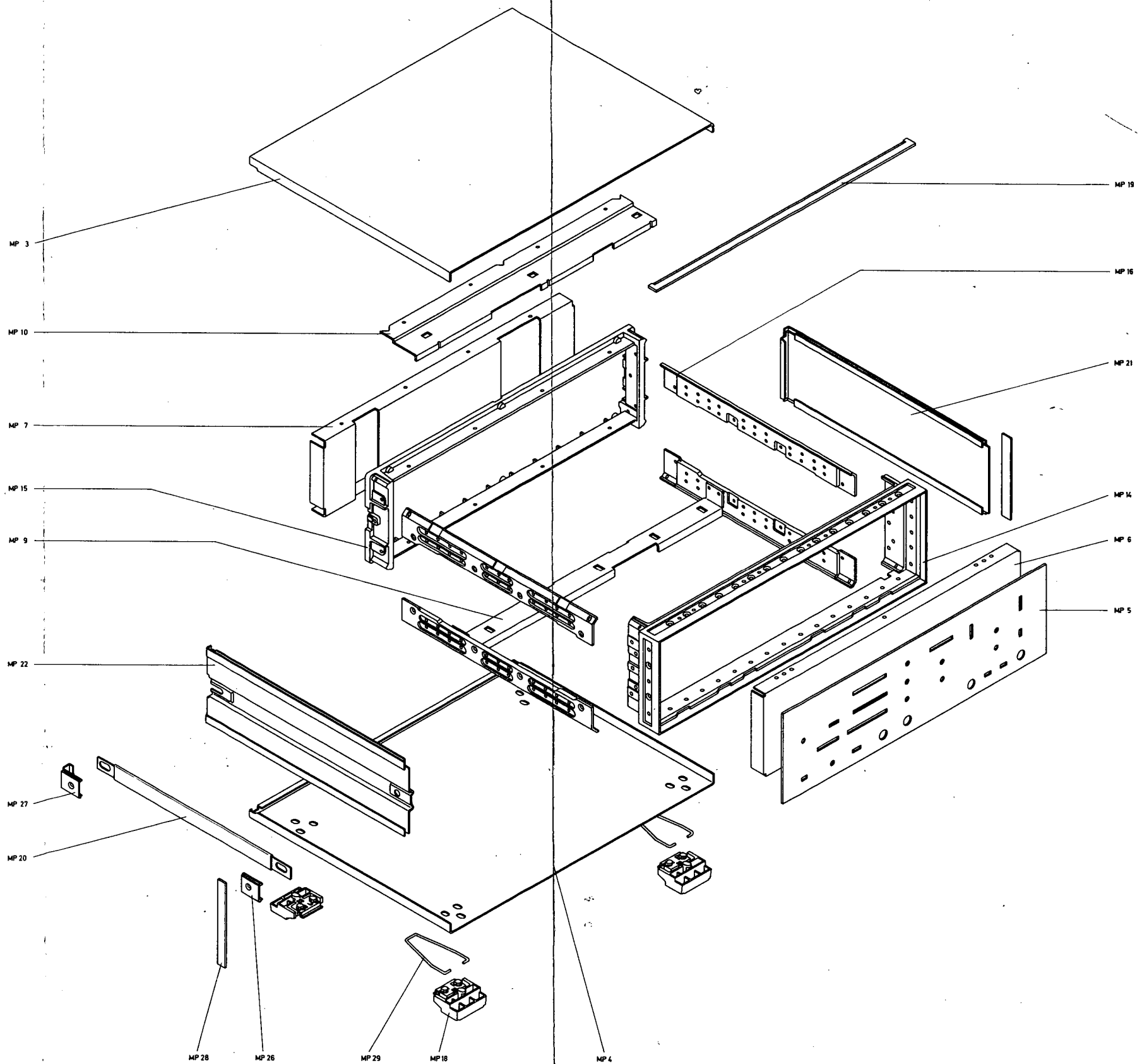


Figure 6–1. (cont'd)

FRAME

Table 6–3. Replaceable Parts

REFERENCE DESIGNATOR	CD	H-P PART NUMBER	DESCRIPTION
A1	4	08082-66501	BD AY MOTHER
A2	5	08082-66502	BD AY PWR SUP
A3	6	08082-66503	BD AY REP RATE
A4	7	08082-66504	BD AY OUTPUT
A5	8	08082-66505	BD AY OFFSET
A6	5	08082-61601	CBL AY-XFMR
A8	1	08082-66508	BD AY AMP BUFFER
A9	2	08082-66509	BD AY ATTENUATOR
DS1	0	2140-0092	LAMP INCD 5V
F1	4	2110-0007	FUSE 1A 250V
F1	1	2110-0202	FUSE .5A 250V
J2	8	1250-0519	CONN-RF BNC
MP1	0	0370-0914	BEZEL-PB KNOB
MP2	2	0370-1005	KNOB BASE PTR
MP3	0	08015-04102	COVER-TOP
MP4	1	08015-04103	COVER-BOTTOM
MP5	3	08082-00201	PANEL-FRONT
MP6	4	08082-00202	PANEL-SUB
MP7	2	08082-60204	PANEL AY-REAR
MP8	6	08082-21101	HEAT SINK
MP9	6	08082-01202	BRACKET BD PC
MP10	5	08082-01201	BRACKET BD PC
MP11	4	1450-0404	LENS PILOT LIGHT
MP12	5	1460-1345	TILT STAND
MP13	0	5000-8908	CVR XFMR OLV BLK
MP14	6	5020-8803	FRAME-FRONT
MP15	7	5020-8804	FRAME-REAR
MP16	4	5020-8835	CORNSTRUT-UNTHRD
MP17	2	5040-1124	KNOB-PBTN POWER
MP18	8	5040-7201	FOOT
MP19	9	5040-7202	TRIM STRIP-TOP
MP20	1	5060-9802	STRAP-HANDLE AY
MP21	4	5060-9855	COVER SIDE
MP22	1	5060-9878	COVER SIDE 12IN
MP23	4	08082-01101	HEAT SINK
MP24	7	08082-21102	HEAT SINK
MP25	8	08082-24701	SPACER
MP26	8	5040-7219	CAP,HANDLE-FRONT
MP27	1	5040-7220	CAP,HANDLE-REAR
MP28	8	5001-0439	TRIM SIDE 5.25
MP29	2	5040-7221	FOOT REAR
MP30	8	08082-20501	FRAME-IC
MP31	4	08082-04105	PLATE MTG
MP32	0	08082-04101	COVER SAFETY
MP33	1	08082-04102	COVER SWITCH
MP34		2360-0261	SCREW QTY4
MP35		2190-0978	WASHER QTY4
Q1	6	1853-0212	XSTR 2N5194 SI
Q2	6	1853-0212	XSTR 2N5194 SI
Q3	6	1853-0212	XSTR 2N5194 SI
Q4	6	1853-0212	XSTR 2N5194 SI
R1	3	2100-3861	R-VAR 50K 10%
R2	3	2100-3861	R-VAR 50K 10%
R3	3	2100-3861	R-VAR 50K 10%
R4	4	2100-2492	R-VAR 5K 20% .5W
R5	9	2100-3859	R-VAR 10K 10%
R6	9	2100-3859	R-VAR 10K 10%
R7	4	2100-2492	R-VAR 5K 20% .5W
MP36		3050-0016	washer QTY 4
R8	4	2100-2492	R-VAR 5K 20% .5W
S6	1	3101-0052	SW PBTN SPST
S17	2	3101-1720	SW PBTN DPDT
U5	7	5081-3012	IC SLOPE
U6	8	5081-3013	IC VERNIER/OUTP
W2	7	08082-61611	CBL AY-PWR SHLD.
W4	8	08082-61604	CBL AY-SHLD II
W5	8	08082-61604	CBL AY-SHLD II
W7	6	08082-26507	BD PC
W11	1	08082-61607	CBL AY-SHLD V
XF1	8	2110-0564	FUSEHOLDER BODY
XF2	9	2110-0565	FUSEHOLD CAP/UL
XF3		2110-0569	nut hex
XF4		1400-0090	washer neoprene

Table 6–3. Replaceable Parts

REFERENCE DESIGNATOR	CD	H-P PART NUMBER	DESCRIPTION
A1		08082-66501	BD AY MOTHER
A1 J2	4	1251-0472	CONN PC 12CONT R
A1 J3	9	1251-2035	CONN PC2X15.156D
A1 J4	8	1251-2026	CONN PC 36CONT R
A1 J5	2	1251-1626	CONN PC 12CONT
A1 S1	3	5040-1109	SLIDE AY-PC SW
A1 S2	3	5040-1109	SLIDE AY-PC SW
A1 S3	3	5040-1109	SLIDE AY-PC SW
A1 S4	3	5040-1109	SLIDE AY-PC SW
A1 S5	3	5040-1109	SLIDE AY-PC SW
A1 S7	9	3101-1313	SW SLIDE DP3T
A1 S8	0	08015-61904	SLIDE AY
A1 S10	3	5040-1109	SLIDE AY-PC SW
A1 S11	0	3101-1596	SW SLIDE DPDT
A1 S12	3	5040-1109	SLIDE AY-PC SW
A1 S14	0	3101-1596	SW SLIDE DPDT
A1 S15	0	3101-1596	SW SLIDE DPDT
A2		08082-66502	BD AY PWR SUP
A2 C1	7	0180-2340	C-F 3600UF 30V
A2 C2	7	0180-0039	C-F 100UF 12V
A2 C3	1	0180-2352	C-F 6000UF 15V
A2 C4	7	0180-0039	C-F 100UF 12V
A2 C5	7	0180-2340	C-F 3600UF 30V
A2 C6	7	0180-0039	C-F 100UF 12V
A2 C7	2	0180-2171	C-F 2600UF 40V
A2 C8	2	0180-0050	C-F 40UF 50V
A2 C9	6	0160-3456	C-F 1000PF 1000V
A2 C10	6	0160-3456	C-F 1000PF 1000V
A2 C11	6	0160-3456	C-F 1000PF 1000V
A2 C12	6	0160-3456	C-F 1000PF 1000V
A2 C13	3	0180-0374	C-F 10UF 20V
A2 C14	3	0180-0374	C-F 10UF 20V
A2 C15	7	0180-0229	C-F 33UF 10V
A2 C17	9	0160-3722	C-F .22UF,160V
A2 C116	3	0180-0374	C-F 10UF 20V
A2 CR1	7	1901-0731	DIO-PWR 400V 1A
A2 CR2	7	1901-0731	DIO-PWR 400V 1A
A2 CR3	7	1901-0731	DIO-PWR 400V 1A
A2 CR4	7	1901-0731	DIO-PWR 400V 1A
A2 CR5	7	1901-0731	DIO-PWR 400V 1A
A2 CR6	7	1901-0731	DIO-PWR 400V 1A
A2 CR7	7	1901-0731	DIO-PWR 400V 1A
A2 CR8	7	1901-0731	DIO-PWR 400V 1A
A2 CR9	7	1901-0731	DIO-PWR 400V 1A
A2 CR10	7	1901-0731	DIO-PWR 400V 1A
A2 CR11	7	1901-0731	DIO-PWR 400V 1A
A2 CR12	7	1901-0731	DIO-PWR 400V 1A
A2 CR13	7	1901-0731	DIO-PWR 400V 1A
A2 CR14	7	1901-0731	DIO-PWR 400V 1A
A2 CR15	7	1901-0731	DIO-PWR 400V 1A
A2 CR16	7	1901-0731	DIO-PWR 400V 1A
A2 R1	4	0757-0421	R-F 825 1% .125W
A2 R2	3	0757-0280	R-F 1K1% .125W F
A2 R3	5	0757-0290	R-F 6.19K1%
A2 R4	2	0811-1661	R-F .39 5% 2W PW
A2 R5	0	0757-0401	R-F 100 1% .125W
A2 R6	5	0757-0422	R-F 909 1% .125W
A2 R7	6	2100-3351	R-TRMR 500 10%
A2 R8	9	0698-3492	R-F 2.67K1%
A2 R9	9	0757-0418	R-F 619 1% .125W
A2 R10	6	2100-3351	R-TRMR 500 10%
A2 R11	2	0757-0429	R-F 1.82K1%
A2 R12	3	0757-0280	R-F 1K1% .125W F
A2 R13	3	0811-0929	R-F .51 5% 2W PW
A2 R14	8	0757-0417	R-F 562 1% .125W
A2 R15	4	0757-0421	R-F 825 1% .125W
A2 R16	3	0757-0280	R-F 1K1% .125W F
A2 R17	5	0757-0290	R-F 6.19K1%
A2 R18	3	0811-0929	R-F .51 5% 2W PW
A2 R19	0	0757-0401	R-F 100 1% .125W
A2 R20	5	0757-0422	R-F 909 1% .125W
A2 R21	6	2100-3351	R-TRMR 500 10%
A2 R22	9	0698-3492	R-F 2.67K1%
A2 R23	6	0757-0431	R-F 2.43K1%
A2 R24	3	0757-0280	R-F 1K1% .125W F
A2 R25	7	0757-0440	R-F 7.5K 1%.125W
A2 R26	1	0812-0066	R-F .33 5% 2W
A2 R27	0	0757-0401	R-F 100 1% .125W
A2 R28	8	0757-0441	R-F 8.25K1%
A2 R29	7	2100-3352	R-VAR 1K .5W
A2 R30	4	0757-0273	R-F 3.01K1%
A2 R31	4	0757-0801	R-F 150 1% .5W
A2 U1	0	1820-0439	IC-LIN VOLT REG
A2 U2	0	1820-0439	IC-LIN VOLT REG
A2 U3	0	1820-0439	IC-LIN VOLT REG
A2 U4	0	1820-0439	IC-LIN VOLT REG
A3		08082-66503	BD AY REP RATE
A3 C1	3	0160-4386	C-F 33PF 5% 200V
A3 C2	1	0160-3716	C-F .022UF10%250
A3 C3	0	0160-0597	C-F 1500PF 400V
A3 C4	6	0160-3646	C-F .22UF 50V
A3 C5	8	0180-0197	C-F 2.2UF 20V
A3 C6	7	0180-0229	C-F 33UF 10V
A3 C7	6	0160-3878	C-F .001UF 100V
A3 C8	6	0160-3878	C-F .001UF 100V
A3 C9	6	0160-3878	C-F .001UF 100V
A3 C10	6	0160-3878	C-F .001UF 100V
A3 C11	5	0160-4213	C-F .10UF 20%
A3 C12	5	0160-4213	C-F .10UF 20%
A3 C13	5	0160-4213	C-F .10UF 20%
A3 C14	7	0180-0039	C-F 100UF 12V
A3 C15	7	0180-0039	C-F 100UF 12V
A3 C16	3	0180-0374	C-F 10UF 20V
A3 C17	6	0160-3878	C-F .001UF 100V
A3 C18	9	0160-4209	C-F .010UF 20%
A3 C19	9	0160-4209	C-F .010UF 20%
A3 C20	9	0160-4209	C-F .010UF 20%
A3 C21	9	0160-4209	C-F .010UF 20%
A3 C22	6	0160-3878	C-F .001UF 100V
A3 C23	6	0160-3878	C-F .001UF 100V
A3 C24	6	0160-3878	C-F .001UF 100V
A3 C24	9	0160-4209	C-F .010UF 20%
A3 C25	9	0160-4209	C-F .010UF 20%
A3 C26	9	0160-4209	C-F .010UF 20%
A3 C27	6	0160-3878	C-F .001UF 100V
A3 C28	6	0160-3878	C-F .001UF 100V
A3 C29	7	0180-0229	C-F 33UF 10V

Table 6–3. Replaceable Parts

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A3	C30	3	0180-0374	C-F 10UF 20V
A3	C31	3	0180-0374	C-F 10UF 20V
A3	C32	1	0180-0116	C-F 6.8UF 35V TA
A3	C34	3	0180-0291	C-F 1UF 35V
A3	C36	9	0160-4209	C-F .010UF 20%
A3	C37	9	0160-4209	C-F .010UF 20%
A3	C38	3	0180-0291	C-F 1UF 35V
A3	C39	3	0180-0291	C-F 1UF 35V
A3	C40	3	0180-0291	C-F 1UF 35V
A3	C41	9	0160-2055	C-F .01UF CER
A3	C42	6	0180-0228	C-F 22UF 15V
A3	CR1	2	1910-0034	DIO GE 25V .1A
A3	CR2	1	1901-0040	DIO SI .05A 30V
A3	CR4	1	1901-0040	DIO SI .05A 30V
A3	CR5	1	1901-0040	DIO SI .05A 30V
A3	CR6	1	1901-0040	DIO SI .05A 30V
A3	CR7	1	1901-0040	DIO SI .05A 30V
A3	CR9	2	1910-0034	DIO GE 25V .1A
A3	CR10	1	1901-0040	DIO SI .05A 30V
A3	CR11	1	1901-0040	DIO SI .05A 30V
A3	CR12	1	1901-0040	DIO SI .05A 30V
A3	J1	1	1250-0835	JACK RECEP STRAI
A3	J2	1	1250-0835	JACK RECEP STRAI
A3	J3	1	1250-0835	JACK RECEP STRAI
A3	J4	1	1250-0835	JACK RECEP STRAI
A3	L1	6	9100-2257	COIL MOLDED CHOK
A3	L2	4	5081-1972	INDUCTANCE 2BEAD
A3	L3	4	5081-1972	INDUCTANCE 2BEAD
A3	L4	4	5081-1972	INDUCTANCE 2BEAD
A3	L5	4	5081-1972	INDUCTANCE 2BEAD
A3	L6	6	9100-2257	COIL MOLDED CHOK
A3	L7	6	9100-2257	COIL MOLDED CHOK
A3	L8	3	9170-0029	FERRITE BEAD
A3	L9	3	9170-0029	FERRITE BEAD
A3	L10	3	9170-0029	FERRITE BEAD
A3	L11	3	9170-0029	FERRITE BEAD
A3	L12	3	9170-0029	FERRITE BEAD
A3	L13	0	9100-2251	COIL-CHOKE .22UH
A3	Q1	1	1854-0215	XSTR SI 2N3904
A3	Q2	2	1853-0036	XSTR SI 2N3906
A3	Q3	2	1853-0036	XSTR SI 2N3906
A3	Q4	2	1853-0036	XSTR SI 2N3906
A3	Q5	1	1854-0215	XSTR SI 2N3904
A3	Q6	1	1854-0215	XSTR SI 2N3904
A3	Q7	1	1854-0215	XSTR SI 2N3904
A3	Q8	1	1854-0215	XSTR SI 2N3904
A3	Q9	1	1854-0215	XSTR SI 2N3904
A3	Q10	2	1853-0284	TRANSISTOR
A3	Q11	2	1853-0284	TRANSISTOR
A3	Q12	2	1853-0036	XSTR SI 2N3906
A3	Q13	2	1853-0036	XSTR SI 2N3906
A3	Q14	2	1853-0036	XSTR SI 2N3906
A3	Q15	2	1853-0036	XSTR SI 2N3906
A3	Q17	1	1854-0215	XSTR SI 2N3904
A3	R1	6	0698-3449	R-F 28.7K1%
A3	R2	3	0757-0280	R-F 1K1% .125W F
A3	R3	3	0698-3157	R-F 19.6K 1%.125
A3	R4	9	0757-0434	R-F 3.65K1%
A3	R5	1	2100-3207	R-VAR 5K 10%
A3	R6	1	2100-3207	R-VAR 5K 10%
A3	R7	3	0757-0280	R-F 1K1% .125W F
A3	R8	4	0757-0273	R-F 3.01K1%
A3	R9	4	0757-0273	R-F 3.01K1%
A3	R10	4	0757-0710	R-F 75 1% .25W F
A3	R11	3	0757-0420	R-F 750 1% .125W
A3	R12	3	0757-0420	R-F 750 1% .125W
A3	R13	1	0698-4418	R-F 205 1% .125W
A3	R14	3	0757-0438	R-F 5.11K1%
A3	R15	8	0698-3152	R-F 3.48K 1%
A3	R16	3	0757-0438	R-F 5.11K1%
A3	R17	3	0757-0420	R-F 750 1% .125W
A3	R18	0	0757-0394	R-F 51.1 1%
A3	R19	0	0757-0394	R-F 51.1 1%
A3	R20	0	0757-0394	R-F 51.1 1%
A3	R21	7	0698-0082	R-F 464 1% .125W
A3	R22	4	0757-0463	R-F 82.5K1%
A3	R23	4	0757-0421	R-F 825 1% .125W
A3	R24	9	0698-3153	R-F 3.83K1%
A3	R25	4	0698-4453	R-F 402 1% .125W
A3	R26	4	0698-4453	R-F 402 1% .125W
A3	R27	2	0757-0411	R-F 332 1% .125W
A3	R28	2	0757-0411	R-F 332 1% .125W
A3	R29	3	0698-3157	R-F 19.6K 1%.125
A3	R30	0	0757-0716	R-F 162 1% .25W
A3	R31	3	0698-3446	R-F 383 1% .125W
A3	R32	9	0757-0442	R-F 10K1% .125W
A3	R33	4	0757-0273	R-F 3.01K1%
A3	R34	4	0757-0273	R-F 3.01K1%
A3	R35	0	0757-0419	R-F 681 1% .125W
A3	R36	3	0757-0412	R-F 365 1% .125W
A3	R37	0	0757-0419	R-F 681 1% .125W
A3	R38	3	0757-0412	R-F 365 1% .125W
A3	R39	0	0757-0394	R-F 51.1 1%
A3	R40	0	0757-0394	R-F 51.1 1%
A3	R41	0	0757-0394	R-F 51.1 1%
A3	R42	0	0757-0394	R-F 51.1 1%
A3	R43	0	0757-0401	R-F 100 1% .125W
A3	R44	9	0757-0442	R-F 10K1% .125W
A3	R45	3	0757-0280	R-F 1K1% .125W F
A3	R46	9	0757-0442	R-F 10K1% .125W
A3	R47	3	0757-0280	R-F 1K1% .125W F
A3	R48	9	0757-0442	R-F 10K1% .125W
A3	R49	3	0757-0280	R-F 1K1% .125W F
A3	R50	9	0757-0442	R-F 10K1% .125W
A3	R51	3	0757-0280	R-F 1K1% .125W F
A3	R52	0	0757-0394	R-F 51.1 1%
A3	R53	8	0757-0409	R-F 274 1% .125W
A3	R54	0	0757-0394	R-F 51.1 1%
A3	R55	8	0757-0409	R-F 274 1% .125W
A3	R56	0	0757-0394	R-F 51.1 1%
A3	R57	4	0757-0273	R-F 3.01K1%
A3	R58	8	0698-0083	R-F 1.96K1%
A3	R59	0	0757-0394	R-F 51.1 1% .25W
A3	R60	0	0757-0394	R-F 51.1 1%
A3	R61	6	0757-0407	R-F 200 1% .125W
A3	R62	0	0757-0401	R-F 100 1% .125W
A3	R63	7	0698-0082	R-F 464 1% .125W
A3	R64	3	0757-0280	R-F 1K1% .125W F
A3	R65	9	0683-8245	R-F 820K5% .25W
A3	R66	9	0683-8245	R-F 820K5% .25W
A3	R67	9	0683-8245	R-F 820K5% .25W
A3	R68	9	0683-8245	R-F 820K5% .25W
A3	R69	9	0757-0442	R-F 10K1% .125W
A3	R70	0	0757-0419	R-F 681 1% .125W
A3	R71	9	0757-0442	R-F 10K1% .125W
A3	R72	0	0757-0419	R-F 681 1% .125W
A3	R73	9	0757-0442	R-F 10K1% .125W
A3	R74	6	0698-4413	R-F 154 1% .125W
A3	R75	5	0757-0274	R-F 1.21K1%

Table 6–3. Replaceable Parts (cont'd)

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A3	R76	0	0757-0401	R-F 100 1% .125W
A3	R77	9	0757-0476	R-F 301K 1% .125
A3	R78	0	0757-0394	R-F 51.1 1%
A3	R81	0	0757-0394	R-F 51.1 1%
A3	R82	0	0757-0394	R-F 51.1 1%
A3	R83	3	0757-0438	R-F 5.11K1%
A3	R84	0	0757-0394	R-F 51.1 1%
A3	R85	2	0757-0346	R-F 10 1% .125W
A3	R86	6	0757-0283	R-F 2K1% .125W F
A3	R87	1	2100-3207	R-VAR 5K 10%
A3	R88	0	0757-0394	R-F 51.1 1%
A3	R89	6	0698-4455	R-F 536 1% .125W
A3	R90	6	0698-4455	R-F 536 1% .125W
A3	R91	9	0757-0434	R-F 3.65K1%
A3	S1	3	3101-1341	SW SLIDE SPDT
A3	U1	6	5081-3011	IC DIG REP RATE
A3	U2	5	5081-3010	IC SEALED PKG
A3	U3	7	1826-0111	IC-DUAL OP AMPL
A3	U4	7	1826-0111	IC-DUAL OP AMPL
A3	U5	7	1826-0111	IC-DUAL OP AMPL
A3	U6	5	1820-0054	IC 7400N EQUIV
A3	VR3	2	1902-0049	DIO-ZNR 6.19V 5%
A3	VR8	3	1902-3002	DIO 2.37V 5%
A4			08082-66504	BD AY OUTPUT
A4	C1	4	0160-3470	C-F .01UF 50V
A4	C2	3	0160-4386	C-F 33PF 5% 200V
A4	C3	2	0180-0349	C-F .82UF 35V
A4	C4	6	0180-2050	C-F .082UF 35V
A4	C5	4	0160-4220	C-F 8200PF 5%
A4	C6	4	0160-3884	C-F 680PF 100V
A4	C7	4	0160-3470	C-F .01UF 50V
A4	C8	4	0160-3470	C-F .01UF 50V
A4	C9	3	0160-3875	C-F 22PF 5% 200V
A4	C10	2	0180-0349	C-F .82UF 35V
A4	C11	6	0180-2050	C-F .082UF 35V
A4	C12	4	0160-4220	C-F 8200PF 5%
A4	C13	4	0160-3884	C-F 680PF 100V
A4	C14	4	0160-3470	C-F .01UF 50V
A4	C15	2	5080-1089	CAPACITOR-SELECT
A4	C16	2	5080-1089	CAPACITOR-SELECT
A4	C17	0	0160-5042	C-F .082UF
A4	C18	0	0160-5042	C-F .082UF
A4	C19	4	0160-5278	C-F 8200PF 50V
A4	C20	4	0160-5278	C-F 8200PF 50V
A4	C21	5	0160-5279	C-F 820PF 50V
A4	C22	5	0160-5279	C-F 820PF 50V
A4	C23	3	0160-4386	C-F 33PF 5% 200V
A4	C25	4	0160-4212	C-F .068UF 20%
A4	C26	4	0160-3470	C-F .01UF 50V
A4	C29	6	0180-2795	C-F 39UF 15V
A4	C30	7	0180-0229	C-F 33UF 10V
A4	C31	6	0180-2795	C-F 39UF 15V
A4	C32	1	0180-0116	C-F 6.8UF 35V TA
A4	C35	4	0160-4212	C-F .068UF 20%
A4	C40	4	0160-3470	C-F .01UF 50V
A4	C41	4	0160-3470	C-F .01UF 50V
A4	C42	4	0160-3470	C-F .01UF 50V
A4	C47	4	0160-3470	C-F .01UF 50V
A4	C50	4	0160-3470	C-F .01UF 50V
A4	C52	4	0160-3470	C-F .01UF 50V
A4	C54	4	0160-3470	C-F .01UF 50V
A4	C55	4	0160-3470	C-F .01UF 50V
A4	C57	4	0160-3470	C-F .01UF 50V
A4	C58	4	0160-3470	C-F .01UF 50V
A4	C59	4	0160-3470	C-F .01UF 50V
A4	C60	4	0160-3470	C-F .01UF 50V
A4	C61	4	0160-3470	C-F .01UF 50V
A4	C64	4	0160-3470	C-F .01UF 50V
A4	C65	4	0160-3470	C-F .01UF 50V
A4	C66	4	0160-3470	C-F .01UF 50V
A4	C67	4	0160-3470	C-F .01UF 50V
A4	C69	0	0160-0571	C-F 470PF20% CER
A4	C70	0	0160-0571	C-F 470PF20% CER
A4	C71	4	0160-3470	C-F .01UF 50V
A4	C72	4	0160-3470	C-F .01UF 50V
A4	C73	4	0160-3470	C-F .01UF 50V
A4	C75	8	0180-0197	C-F 2.2UF 20V
A4	C76	4	0160-3470	C-F .01UF 50V
A4	C77	4	0160-3470	C-F .01UF 50V
A4	C78	4	0160-3470	C-F .01UF 50V
A4	C79	4	0160-3470	C-F .01UF 50V
A4	C81	8	0180-0197	C-F 2.2UF 20V
A4	C82	8	0180-0197	C-F 2.2UF 20V
A4	C83	4	0160-3470	C-F .01UF 50V
A4	C85	4	0160-3470	C-F .01UF 50V
A4	C86	4	0160-3470	C-F .01UF 50V
A4	C87	4	0160-3470	C-F .01UF 50V
A4	C88	4	0160-3470	C-F .01UF 50V
A4	C90	4	0160-3470	C-F .01UF 50V
A4	C91	4	0160-3470	C-F .01UF 50V
A4	C92	4	0160-3470	C-F .01UF 50V
A4	C93	4	0160-3470	C-F .01UF 50V
A4	C94	4	0160-3470	C-F .01UF 50V
A4	C95	4	0160-3470	C-F .01UF 50V
A4	C96	4	0160-3470	C-F .01UF 50V
A4	C97	4	0160-3470	C-F .01UF 50V
A4	C98	4	0160-3470	C-F .01UF 50V
A4	C99	4	0160-3470	C-F .01UF 50V
A4	C100	4	0160-3470	C-F .01UF 50V
A4	C101	4	0160-3470	C-F .01UF 50V
A4	C112	4	0160-4212	C-F .068UF 20%
A4	C113	4	0160-4212	C-F .068UF 20%
A4	C114	4	0160-4212	C-F .068UF 20%
A4	C118	4	0160-4212	C-F .068UF 20%
A4	C119	4	0160-3470	C-F .01UF 50V
A4	C120	4	0160-4212	C-F .068UF 20%
A4	C121	4	0160-3470	C-F .01UF 50V
A4	C122	4	0160-3470	C-F .01UF 50V
A4	C123	4	0160-3470	C-F .01UF 50V
A4	CR2	1	1901-0040	DIO SI .05A 30V
A4	CR3	1	1901-0040	DIO SI .05A 30V
A4	CR4	8	1910-0022	DIO GE 5V 3.5NS
A4	CR5	1	1901-0040	DIO SI .05A 30V
A4	CR6	1	1901-0040	DIO SI .05A 30V

Table 6–3. Replaceable Parts (cont'd)

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A4	CR7	1	1901-0040	DIO SI .05A 30V
A4	CR9	1	1901-0040	DIO SI .05A 30V
A4	CR10	1	1901-0040	DIO SI .05A 30V
A4	CR11	8	1910-0022	DIO GE 5V 3.5NS
A4	CR12	1	1901-0040	DIO SI .05A 30V
A4	CR13	1	1901-0040	DIO SI .05A 30V
A4	CR15	7	1901-0533	DIO HOT CARR
A4	CR16	7	1901-0533	DIO HOT CARR
A4	CR17	8	1901-0518	DIO HOT CARRIER
A4	CR18	8	1901-0518	DIO HOT CARRIER
A4	CR20	1	1901-0040	DIO SI .05A 30V
A4	CR21	1	1901-0040	DIO SI .05A 30V
A4	CR25	3	1901-0050	DIO SW 80V 200MA
A4	CR26	3	1901-0050	DIO SW 80V 200MA
A4	CR27	3	1901-0050	DIO SW 80V 200MA
A4	CR28	3	1901-0050	DIO SW 80V 200MA
A4	CR32	7	1901-0533	DIO HOT CARR
A4	CR33	7	1901-0533	DIO HOT CARR
A4	CR39	1	1901-0040	DIO SI .05A 30V
A4	CR40	1	1901-0040	DIO SI .05A 30V
A4	CR41	1	1901-0040	DIO SI .05A 30V
A4	L1	4	5081-1972	INDUCTANCE 2BEAD
A4	L2	4	5081-1972	INDUCTANCE 2BEAD
A4	L3	4	5081-1972	INDUCTANCE 2BEAD
A4	L6	4	5081-1972	INDUCTANCE 2BEAD
A4	L7	4	5081-1972	INDUCTANCE 2BEAD
A4	L8	4	5081-1972	INDUCTANCE 2BEAD
A4	L9	4	5081-1972	INDUCTANCE 2BEAD
A4	L10	4	5081-1972	INDUCTANCE 2BEAD
A4	L11	8	9140-0118	COIL-CHOKE 500UH
A4	L12	8	9140-0118	COIL-CHOKE 500UH
A4	L13	8	9140-0118	COIL-CHOKE 500UH
A4	L14	8	9140-0118	COIL-CHOKE 500UH
A4	L15	5	5081-1973	INDUCTANCE 3BEAD
A4	L16	5	5081-1973	INDUCTANCE 3BEAD
A4	L17	5	5081-1973	INDUCTANCE 3BEAD
A4	L18	5	5081-1973	INDUCTANCE 3BEAD
A4	L19	5	5081-1973	INDUCTANCE 3BEAD
A4	L20	8	9100-1665	COIL-FXD 3.3 MH
A4	L21	8	9100-1665	COIL-FXD 3.3 MH
A4	L22	3	9170-0029	FERRITE BEAD
A4	L23	3	9170-0029	FERRITE BEAD
A4	L24	4	5081-1972	INDUCTANCE 2BEAD
A4	L25	8	9100-1665	COIL-FXD 3.3 MH
A4	L26	4	5081-1972	INDUCTANCE 2BEAD
A4	L27	8	9100-1665	COIL-FXD 3.3 MH
A4	L28	3	9170-0029	FERRITE BEAD
A4	L29	3	9170-0029	FERRITE BEAD
A4	L30	6	9140-0158	COIL-CHOKE 1 UH
A4	L31	6	9140-0158	COIL-CHOKE 1 UH
A4	MP3	6	1600-0457	CTCT 14 FINGER
A4	MP4	6	1600-0457	CTCT 14 FINGER
A4	MP5	7	1600-0341	CTCT 9FINGER
A4	MP6	7	1600-0341	CTCT 9FINGER
A4	Q3	2	1853-0036	XSTR SI 2N3906
A4	Q4	2	1853-0036	XSTR SI 2N3906
A4	Q6	1	1854-0215	XSTR SI 2N3904
A4	Q7	1	1854-0215	XSTR SI 2N3904
A4	Q8	1	1854-0215	XSTR SI 2N3904
A4	Q9	1	1854-0215	XSTR SI 2N3904
A4	Q11	1	1854-0215	XSTR SI 2N3904
A4	Q12	1	1854-0215	XSTR SI 2N3904
A4	Q16	2	1853-0036	XSTR SI 2N3906
A4	Q20	2	1853-0036	XSTR SI 2N3906
A4	Q21	2	1853-0036	XSTR SI 2N3906
A4	Q22	1	1854-0215	XSTR SI 2N3904
A4	Q23	1	1854-0215	XSTR SI 2N3904
A4	Q24	1	1854-0215	XSTR SI 2N3904
A4	Q25	1	1854-0215	XSTR SI 2N3904
A4	Q27	1	1854-0215	XSTR SI 2N3904
A4	Q28	1	1854-0215	XSTR SI 2N3904
A4	Q32	2	1853-0036	XSTR SI 2N3906
A4	Q33	1	1854-0215	XSTR SI 2N3904
A4	Q34	1	1854-0215	XSTR SI 2N3904
A4	Q55	2	1853-0036	XSTR SI 2N3906
A4	Q56	2	1853-0036	XSTR SI 2N3906
A4	Q57	2	1853-0036	XSTR SI 2N3906
A4	Q58	2	1853-0036	XSTR SI 2N3906
A4	Q59	2	1853-0036	XSTR SI 2N3906
A4	Q60	2	1853-0036	XSTR SI 2N3906
A4	Q61	2	1853-0036	XSTR SI 2N3906
A4	Q62	2	1853-0036	XSTR SI 2N3906
A4	Q69	2	1853-0284	TRANSISTOR
A4	Q70	2	1853-0284	TRANSISTOR
A4	Q71	2	1853-0036	XSTR SI 2N3906
A4	Q72	2	1853-0036	XSTR SI 2N3906
A4	Q73	1	1854-0215	XSTR SI 2N3904
A4	Q74	2	1853-0036	XSTR SI 2N3906
A4	R1	7	0757-0424	R-F 1.1K1% .125W
A4	R2	4	0757-0273	R-F 3.01K1%
A4	R3	8	0698-3160	R-F 31.6K1%
A4	R7	9	0757-0442	R-F 10K1% .125W
A4	R8	9	0757-0442	R-F 10K1% .125W
A4	R9	9	0757-0418	R-F 619 1% .125W
A4	R10	9	0757-0418	R-F 619 1% .125W
A4	R11	6	0757-0720	R-F 243 1% 1/4W
A4	R15	6	0757-0449	R-F 20K1% .125W
A4	R16	5	0683-1055	R-F 1M5% .25W CC
A4	R17	5	0757-0274	R-F 1.21K1%
A4	R18	5	0757-0274	R-F 1.21K1%
A4	R19	6	0757-0449	R-F 20K1% .125W
A4	R20	5	0683-1055	R-F 1M5% .25W CC
A4	R21	5	0683-1055	R-F 1M5% .25W CC
A4	R22	5	0757-0274	R-F 1.21K1%
A4	R23	6	0757-0449	R-F 20K1% .125W
A4	R24	5	0683-1055	R-F 1M5% .25W CC
A4	R25	6	0757-0449	R-F 20K1% .125W
A4	R26	5	0757-0274	R-F 1.21K1%
A4	R27	1	0698-3113	R-F 100 5% .125W
A4	R29	0	0757-0394	R-F 51.1 1%
A4	R30	6	0757-0283	R-F 2K1% .125W F
A4	R31	4	0757-0273	R-F 3.01K1%
A4	R32	6	0757-0720	R-F 243 1% 1/4W
A4	R33	0	0757-0394	R-F 51.1 1%
A4	R34	0	0757-0401	R-F 100 1% .125W
A4	R36	9	0698-0084	R-F 2,15K 1%.125
A4	R37	9	0698-0084	R-F 2,15K 1%.125
A4	R38	7	0757-0440	R-F 7.5K 1%.125W
A4	R40	8	0698-3441	R-F 215 1% .125W
A4	R41	8	0698-3441	R-F 215 1% .125W
A4	*R42	3	0757-0438	R-F 5.11K1%
A4	R43	2	2100-3274	R-VAR 10K 10%
A4	R44	3	0757-0438	R-F 5.11K1%
A4	R45	2	0757-0289	R-F 13.3K1%
A4	R46	6	0757-0407	R-F 200 1% .125W
A4	R47	6	0757-0283	R-F 2K1% .125W F
A4	R48	6	0698-3150	R-F 2.37K1%
A4	R51	6	0757-0283	R-F 2K1% .125W F

Table 6-3. Replaceable Parts (cont'd)

REFERENCE DESIGNATOR	CD	H-P PART NUMBER	DESCRIPTION
A4 R53	0	0698-3378	R-F 51 5% .125W
A4 R54	0	0698-3378	R-F 51 5% .125W
A4 R55	0	0757-0394	R-F 51.1 1%
A4 R56	9	0757-0434	R-F 3.65K1%
A4 R57	3	0757-0438	R-F 5.11K1%
A4 R58	0	0698-3378	R-F 51 5% .125W
A4 R59	0	0757-0394	R-F 51.1 1%
A4 R60	6	0757-0720	R-F 243 1% 1/4W
A4 R61	6	0757-0720	R-F 243 1% 1/4W
A4 R62	9	0757-0442	R-F 10K1% .125W
A4 R65	9	0757-0442	R-F 10K1% .125W
A4 R66	9	0757-0442	R-F 10K1% .125W
A4 R67	9	0757-0418	R-F 619 1% .125W
A4 R68	9	0757-0418	R-F 619 1% .125W
A4 R69	6	0757-0283	R-F 2K1% .125W
A4 R70	8	0698-3160	R-F 31.6K1%
A4 R71	4	0757-0273	R-F 3.01K1%
A4 R72	7	0757-0424	R-F 1.1K1% .125W
A4 R76	6	0757-0449	R-F 20K1% .125W
A4 R77	6	0757-0449	R-F 20K1% .125W
A4 R78	6	0757-0449	R-F 20K1% .125W
A4 R79	6	0757-0449	R-F 20K1% .125W
A4 R80	5	0757-0274	R-F 1.21K1%
A4 R81	5	0757-0274	R-F 1.21K1%
A4 R82	5	0757-0274	R-F 1.21K1%
A4 R83	5	0757-0274	R-F 1.21K1%
A4 R84	4	0698-4073	R-F 1M10% .125W
A4 R85	4	0698-4073	R-F 1M10% .125W
A4 R85	3	0757-0438	R-F 5.11K1%
A4 R86	4	0698-4073	R-F 1M10% .125W
A4 R87	4	0698-4073	R-F 1M10% .125W
A4 R90	8	0698-3441	R-F 215 1% .125W
A4 R90	3	0757-0438	R-F 5.11K1%
A4 R91	8	0698-3441	R-F 215 1% .125W
A4 R92	9	0698-0084	R-F 2,15K 1%.125
A4 R93	9	0698-0084	R-F 2,15K 1%.125
A4 R95	2	0757-0289	R-F 13.3K1%
A4 R98	9	0757-0434	R-F 3.65K1%
A4 R100	3	0757-0438	R-F 5.11K1%
A4 R101	3	0757-0438	R-F 5.11K1%
A4 R102	9	0757-0434	R-F 3.65K1%
A4 R103	4	0757-0405	R-F 162 1% .125W
A4 R106	6	0757-0283	R-F 2K1% .125W F
A4 R107	6	0698-3150	R-F 2.37K1%
A4 R112	9	0757-0442	R-F 10K1% .125W
A4 R113	9	0757-0442	R-F 10K1% .125W
A4 R114	9	0757-0442	R-F 10K1% .125W
A4 R115	9	0757-0442	R-F 10K1% .125W
A4 R116	7	0698-0082	R-F 464 1% .125W
A4 R117	7	0698-0082	R-F 464 1% .125W
A4 R141	1	0698-3113	R-F 100 5% .125W
A4 R146	1	0698-3113	R-F 100 5% .125W
A4 R151	4	0698-4073	R-F 1M10% .125W
A4 R152	4	0698-4073	R-F 1M10% .125W
A4 R153	4	0698-4073	R-F 1M10% .125W
A4 R154	4	0698-4073	R-F 1M10% .125W
A4 R155	4	0698-4073	R-F 1M10% .125W
A4 R156	4	0698-4073	R-F 1M10% .125W
A4 R157	4	0698-4073	R-F 1M10% .125W
A4 R158	4	0698-4073	R-F 1M10% .125W
A4 R159	0	0698-5176	R-F 510 5% .125W
A4 R161	0	0698-5176	R-F 510 5% .125W
A4 R163	0	0698-5176	R-F 510 5% .125W
A4 R165	0	0698-5176	R-F 510 5% .125W
A4 R167	5	0698-5999	R-F 4.7K5% .125W
A4 R168	5	0698-5999	R-F 4.7K5% .125W
A4 R169	5	0698-5999	R-F 4.7K5% .125W
A4 R170	5	0698-5999	R-F 4.7K5% .125W
A4 R171	8	0698-6750	R-F 220K10%
A4 R172	3	0698-3454	R-F 215K1% .125W
A4 R174	0	0698-3427	R-F 13.3 1%
A4 R180	0	0698-3435	R-F 38.3 1%
A4 R186	0	0698-3378	R-F 51 5% .125W
A4 R187	0	0698-3378	R-F 51 5% .125W
A4 R188	8	0698-6750	R-F 220K10%
A4 R189	6	0698-5180	R-F 2K5% .125W
A4 R190	6	0698-5180	R-F 2K5% .125W
A4 R191	4	0698-3447	R-F 422 1% 1/8W
A4 R195	0	0698-3378	R-F 51 5% .125W
A4 R196	0	0698-3378	R-F 51 5% .125W
A4 R197	6	0698-4413	R-F 154 1% .125W
A4 R198	7	0757-0200	R-F 5.62K1%
A4 R199	0	0698-3154	R-F 4.22K 1%
A4 R200	8	0698-6750	R-F 220K10%
A4 R201	8	0698-6750	R-F 220K10%
A4 R202	7	0757-0416	R-F 511 1% .125W
A4 R203	3	0757-0438	R-F 5.11K1%
A4 R204	3	0698-4428	R-F 1.69K1%
A4 R206	2	0757-0411	R-F 332 1% .125W
A4 R207	4	0757-0405	R-F 162 1% .125W
A4 R208	7	0757-0416	R-F 511 1% .125W
A4 R210	6	0757-0449	R-F 20K1% .125W
A4 R211	9	0757-0442	R-F 10K1% .125W
A4 R212	3	0757-0438	R-F 5.11K1%
A4 R213	3	0698-3438	R-F 147 1% .125W
A4 R214	5	2100-3350	R-VAR 200 10%
A4 R216	3	0698-3438	R-F 147 1% .125W
A4 R217	7	0698-4125	R-F 953 1% .125W
A4 R218	7	0698-4125	R-F 953 1% .125W
A4 R219	5	0757-0290	R-F 6.19K1%
A4 R220	5	0757-0290	R-F 6.19K1%
A4 R221	7	0698-0082	R-F 464 1% .125W
A4 R222	1	0757-0444	R-F 12.1K1% .125W
A4 R223	9	0757-0442	R-F 10K1% .125W
A4 R224	9	0757-0442	R-F 10K1% .125W
A4 R225	6	0757-0069	R-F 121 1% .25W
A4 R226	8	0757-1001	R-F 56.2 1% .5W
A4 R227	8	0757-1001	R-F 56.2 1% .5W
A4 R228	6	0757-0069	R-F 121 1% .25W
A4 R229	2	0698-4435	R-F 2.49K1%
A4 R230	2	0698-4435	R-F 2.49K1%
A4 R232	2	2100-3349	R-VAR 100 -+10%
A4 R237	0	0757-0394	R-F 51.1 1%
A4 R240	2	2100-3274	R-VAR 10K 10%
A4 R241	6	0698-5180	R-F 2K5% .125W
A4 R242	9	0698-3111	R-F 30 5% .125W
A4 R243	9	0698-3111	R-F 30 5% .125W
A4 R244	8	0757-1001	R-F 56.2 1% .5W
A4 R245	8	0757-1001	R-F 56.2 1% .5W
A4 R252	0	0757-0394	R-F 51.1 1%
A4 R253	2	2100-3349	R-VAR 100 -+10%
A4 R260	0	0757-0394	R-F 51.1 1%
A4 U1	7	1826-0111	IC-DUAL OP AMPL
A4 U2	7	~~1826-0111~~ 5081-3009	IC-DUAL OP AMPL
A4 U3	2	~~5081-3009~~ ~~1826-0111~~	IC SEALED PKG
A4 U4	2	5081-3009	IC SEALED PKG
A4 VR1	6	1902-0126	DIO 2.61V 5% .4W
A4 VR8	6	1902-0126	DIO 2.61V 5% .4W
A4 VR19	5	1902-3137	DIO 8.06V 2% .4W
A4 VR22	9	1902-0202	DIO-ZNR 15V 5%
A4 VR23	9	1902-0202	DIO-ZNR 15V 5%

A4(X1) 5040-9314 LOCK clip 14 pol
A4(X2) 5040-9316 LOCK CLIP 16 Pol

Table 6–3. Replaceable Parts (cont'd)

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A4	VR24	6	1902-0126	DIO 2.61V 5% .4W
A4	VR29	6	1902-3104	DIO 5.62V 5% .4W
A4	VR30	6	1902-0522	DIO 6V 5% 5W
A4	VR31	6	1902-0522	DIO 6V 5% 5W
A4	VR42	1	1902-0064	DIO 7.5V 5% .4W
A4	W3	7	08082-61603	CBL AY-SHLD I
A4	W10	0	08082-61606	CBL AY-SHLD IV
A4	W16	9	08082-61605	CBL AY-SHLD III
A4	W17	9	08082-61605	CBL AY-SHLD III
A4	W18	9	08082-61605	CBL AY-SHLD III
A4	W19	9	08082-61605	CBL AY-SHLD III
A4	~~X2-A1~~	8	1200-0548	SKT IC ~~14CONT~~ 16 CONT
A4	X2	6	1200-0588	SOCKET IC
A5			08082-66505	BD AY OFFSET
A5	C1	4	0180-0309	C-7 4.7UF 10V
A5	C2	4	0180-0309	C-7 4.7UF 10V
A5	C3	4	0180-0309	C-7 4.7UF 10V
A5	C4	4	0180-0309	C-7 4.7UF 10V
A5	C5	9	0160-4209	C-F .010UF 20%
A5	C6	9	0160-4209	C-F .010UF 20%
A5	C7	9	0160-4209	C-F .010UF 20%
A5	C9	3	0180-0374	C-F 10UF 20V
A5	C10	3	0180-0374	C-F 10UF 20V
A5	C11	7	0180-0039	C-F 100UF 12V
A5	C12	7	0180-0039	C-F 100UF 12V
A5	C15	9	0160-4209	C-F .010UF 20%
A5	C16	9	0160-4209	C-F .010UF 20%
A5	C20	9	0160-4209	C-F .010UF 20%
A5	C21	9	0160-4209	C-F .010UF 20%
A5	C22	8	0180-0197	C-F 2.2UF 20V
A5	C23	8	0180-0197	C-F 2.2UF 20V
A5	C24	3	0180-0291	C-F 1UF 35V
A5	C27	0	0180-0058	C-F 50UF 25V
A5	CR4	1	1901-0040	DIO SI .05A 30V
A5	CR6	1	1901-0040	DIO SI .05A 30V
A5	CR8	1	1901-0040	DIO SI .05A 30V
A5	CR10	1	1901-0040	DIO SI .05A 30V
A5	CR12	1	1901-0040	DIO SI .05A 30V
A5	CR13	1	1901-0040	DIO SI .05A 30V
A5	CR26	1	1901-0040	DIO SI .05A 30V
A5	CR27	1	1901-0040	DIO SI .05A 30V
A5	CR28	1	1901-0040	DIO SI .05A 30V
A5	CR29	1	1901-0040	DIO SI .05A 30V
A5	CR30	1	1901-0040	DIO SI .05A 30V
A5	CR31	1	1901-0040	DIO SI .05A 30V
A5	CR32	1	1901-0040	DIO SI .05A 30V
A5	CR33	1	1901-0040	DIO SI .05A 30V
A5	CR34	1	1901-0040	DIO SI .05A 30V
A5	CR36	1	1901-0040	DIO SI .05A 30V
A5	CR37	1	1901-0040	DIO SI .05A 30V
A5	MP1	0	1205-0011	HT-SINK XSTR
A5	MP3	0	1205-0011	HT-SINK XSTR
A5	MP6	0	1205-0011	HT-SINK XSTR
A5	MP8	0	1205-0011	HT-SINK XSTR
A5	MP26	0	1205-0011	HT-SINK XSTR
A5	MP27	0	1205-0011	HT-SINK XSTR
A5	MP28	0	1205-0011	HT-SINK XSTR
A5	MP29	0	1205-0011	HT-SINK XSTR

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A5	Q1	3	1853-0045	XSTR 2N4036 SI
A5	Q3	2	1854-0448	XSTR SI NPN
A5	Q6	3	1853-0045	XSTR 2N4036 SI
A5	Q8	2	1854-0448	XSTR SI NPN
A5	Q9	2	1853-0036	XSTR SI 2N3906
A5	Q10	2	1853-0036	XSTR SI 2N3906
A5	Q12	2	1853-0036	XSTR SI 2N3906
A5	Q14	2	1853-0036	XSTR SI 2N3906
A5	Q15	2	1853-0036	XSTR SI 2N3906
A5	Q17	2	1853-0036	XSTR SI 2N3906
A5	Q19	3	1853-0045	XSTR 2N4036 SI
A5	Q20	3	1853-0045	XSTR 2N4036 SI
A5	Q21	2	1853-0036	XSTR SI 2N3906
A5	Q22	1	1854-0215	XSTR SI 2N3904
A5	Q26	3	1853-0045	XSTR 2N4036 SI
A5	Q27	3	1853-0045	XSTR 2N4036 SI
A5	Q28	3	1853-0045	XSTR 2N4036 SI
A5	Q29	3	1853-0045	XSTR 2N4036 SI
A5	Q30	7	1854-0039	XSTR 2N3053 SI
A5	Q31	7	1854-0039	XSTR 2N3053 SI
A5	Q32	1	1853-0051	XSTR SI 4037
A5	Q33	1	1854-0215	XSTR SI 2N3904
A5	Q34	1	1854-0215	XSTR SI 2N3904
A5	Q35	1	1853-0051	XSTR SI 4037
A5	Q36	1	1853-0051	XSTR SI 4037
A5	Q37	2	1853-0036	XSTR SI 2N3906
A5	Q38	2	1853-0036	XSTR SI 2N3906
A5	Q39	1	1854-0215	XSTR SI 2N3904
A5	Q40	1	1854-0215	XSTR SI 2N3904
A5	Q41	1	1854-0215	XSTR SI 2N3904
A5	Q42	1	1854-0215	XSTR SI 2N3904
A5	Q43	1	1854-0215	XSTR SI 2N3904
A5	Q44	1	1854-0215	XSTR SI 2N3904
A5	Q45	1	1854-0215	XSTR SI 2N3904
A5	Q46	1	1854-0215	XSTR SI 2N3904
A5	Q47	1	1854-0215	XSTR SI 2N3904
A5	Q48	2	1853-0036	XSTR SI 2N3906
A5	Q49	1	1854-0215	XSTR SI 2N3904
A5	Q50	1	1854-0215	XSTR SI 2N3904
A5	Q51	2	1853-0036	XSTR SI 2N3906
A5	Q52	2	1853-0036	XSTR SI 2N3906
A5	Q53	2	1853-0036	XSTR SI 2N3906
A5	Q54	2	1853-0036	XSTR SI 2N3906
A5	Q55	1	1854-0215	XSTR SI 2N3904
A5	Q56	2	1853-0036	XSTR SI 2N3906
A5	Q57	2	1853-0036	XSTR SI 2N3906
A5	Q58	1	1854-0215	XSTR SI 2N3904
A5	R5	4	0757-0281	R-F 2.74K1%
A5	R6	9	0757-0442	R-F 10K1% .125W
A5	R7	9	0757-0442	R-F 10K1% .125W
A5	R8	2	0698-4477	R-F 10.5K1%
A5	R9	2	0698-4477	R-F 10.5K1%
A5	R10	0	0698-0085	R-F 2.61K1%
A5	R11	2	0698-3495	R-F 866 1% .125W
A5	R13	8	0757-0384	R-F 20 1% .125W
A5	R14	8	0757-0384	R-F 20 1% .125W
A5	R15	0	0698-0085	R-F 2.61K1%
A5	R17	2	0698-3495	R-F 866 1% .125W
A5	R18	1	0757-0452	R-F 27.4K1%
A5	R19	9	0757-0442	R-F 10K1% .125W
A5	R20	9	0757-0442	R-F 10K1% .125W
A5	R21	9	0757-0442	R-F 10K1% .125W

Table 6–3. Replaceable Parts (cont'd)

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A5	R22	9	0757-0442	R-F 10K1% .125W
A5	R23	9	0757-0442	R-F 10K1% .125W
A5	R24	9	0757-0442	R-F 10K1% .125W
A5	R25	9	0757-0442	R-F 10K1% .125W
A5	R26	2	0698-4477	R-F 10.5K1%
A5	R27	2	0698-4477	R-F 10.5K1%
A5	R28	2	0698-3495	R-F 866 1% .125W
A5	R29	0	0698-0085	R-F 2.61K1%
A5	R31	8	0757-0384	R-F 20 1% .125W
A5	R32	8	0757-0384	R-F 20 1% .125W
A5	R33	2	0698-3495	R-F 866 1% .125W
A5	R35	0	0698-0085	R-F 2.61K1%
A5	R51	7	0757-0317	R-F 1.33K1%
A5	R52	7	0757-0317	R-F 1.33K1%
A5	R53	0	0757-0419	R-F 681 1% .125W
A5	R54	2	0698-3437	R-F 133 1% .125W
A5	R55	1	0757-0402	R-F 110 1% .125W
A5	R56	2	0757-0403	R-F 121 1% .125W
A5	R57	3	0757-0420	R-F 750 1% .125W
A5	R58	1	0757-0452	R-F 27.4K1%
A5	R59	1	0757-0452	R-F 27.4K1%
A5	R60	6	0757-0978	R-F 95.3K1%
A5	R61	1	0757-0452	R-F 27.4K1%
A5	R62	6	0757-0449	R-F 20K1% .125W
A5	R63	1	0757-0452	R-F 27.4K1%
A5	R65	9	0757-0442	R-F 10K1% .125W
A5	R66	9	0757-0442	R-F 10K1% .125W
A5	R67	9	0757-0442	R-F 10K1% .125W
A5	R68	4	0698-3455	R-F 261K1% .125W
A5	R69	6	0757-0465	R-F 100K1% .125W
A5	R70	6	0757-0449	R-F 20K1% .125W
A5	R71	3	0757-0470	R-F 162K 1% .125
A5	R72	3	0757-0454	R-F 33.2K1%.125W
A5	R73	6	0757-0449	R-F 20K1% .125W
A5	R74	7	0698-0082	R-F 464 1% .125W
A5	R75	7	0698-0082	R-F 464 1% .125W
A5	R76	7	0698-0082	R-F 464 1% .125W
A5	R77	2	0757-0346	R-F 10 1% .125W
A5	R78	2	0757-0346	R-F 10 1% .125W
A5	R79	2	0757-0346	R-F 10 1% .125W
A5	R80	7	2100-3352	R-VAR 1K .5W
A5	R81	7	2100-3352	R-VAR 1K .5W
A5	R82	6	0757-0283	R-F 2K1% .125W F
A5	R83	6	0757-0283	R-F 2K1% .125W F
A5	R84	8	0698-3558	R-F 4.02K1%
A5	R85	7	0698-0082	R-F 464 1% .125W
A5	R86	7	0698-0082	R-F 464 1% .125W
A5	R87	1	0698-3155	R-F 4.64K 1%.125
A5	R88	7	0698-3226	R-F 6.49K1%
A5	R89	8	0757-0433	R-F 3.32K1%
A5	R90	7	0757-0200	R-F 5.62K1%
A5	R91	1	0698-4442	R-F 4.42K1%
A5	R92	6	0757-0449	R-F 20K1% .125W
A5	R93	6	0757-0449	R-F 20K1% .125W
A5	R94	3	0757-0280	R-F 1K1% .125W F
A5	R96	8	0757-0417	R-F 562 1% .125W
A5	R97	8	0757-0417	R-F 562 1% .125W
A5	R102	3	0698-4428	R-F 1.69K1%
A5	R103	3	0698-4428	R-F 1.69K1%
A5	R104	6	0757-0449	R-F 20K1% .125W
A5	R105	6	0757-0449	R-F 20K1% .125W
A5	R106	8	0757-0417	R-F 562 1% .125W
A5	R107	8	0757-0417	R-F 562 1% .125W
A5	R108	2	0757-0346	R-F 10 1% .125W
A5	R109	2	0757-0346	R-F 10 1% .125W
A5	R110	0	0698-4433	R-F 2.26K1%
A5	R111	0	0698-4433	R-F 2.26K1%
A5	R112	2	0757-0346	R-F 10 1% .125W
A5	R113	2	0757-0346	R-F 10 1% .125W
A5	R114	3	0757-0280	R-F 1K1% .125W F
A5	R115	1	2100-3273	R-VAR 2K 10%
A5	R116	0	0757-0419	R-F 681 1% .125W
A5	R117	8	0698-3152	R-F 3.48K 1%
A5	R118	8	0698-3152	R-F 3.48K 1%
A5	R120	2	0757-0346	R-F 10 1% .125W
A5	R121	2	0757-0346	R-F 10 1% .125W
A5	R122	9	0757-0442	R-F 10K1% .125W
A5	R123	9	0757-0442	R-F 10K1% .125W
A5	R124	2	0698-4469	R-F 1.15K1%
A5	R125	9	0757-0442	R-F 10K1% .125W
A5	R126	5	0683-6245	R-F 620K5% .25W
A5	R130	1	0698-3444	R-F 316 1% .125W
A5	R131	9	0757-0418	R-F 619 1% .125W
A5	R132	3	0757-0438	R-F 5.11K1%
A5	R133	1	0698-3444	R-F 316 1% .125W
A5	R134	4	0757-0398	R-F 75 1% .125W
A5	R135	9	0698-4367	R-F 20.5 1%
A5	R136	6	2100-3351	R-TRMR 500 10%
A5	R137	6	0757-0407	R-F 200 1% .125W
A5	R138	9	0757-0442	R-F 10K1% .125W
A5	R139	4	0757-0405	R-F 162 1% .125W
A5	R140	9	0757-0442	R-F 10K1% .125W
A5	R141	1	0698-3262	R-F 40.2 1%
A5	*R142	4	0757-0281	R-F 2.74K1%
A5	R143	0	0757-0419	R-F 681 1% .125W
A5	R144	1	0757-0452	R-F 27.4K1%
A5	R145	9	0698-0084	R-F 2,15K 1%.125
A5	R146	0	0698-4483	R-F 18.7K1%.125W
A5	R147	7	2100-3352	R-VAR 1K .5W
A5	R148	7	2100-3352	R-VAR 1K .5W
A5	R149	2	0698-3156	R-F 14.7K1%
A5	R150	7	0757-0416	R-F 511 1% .125W
A5	R151	0	0757-0394	R-F 51.1 1%
A5	R152	9	0757-0442	R-F 10K1% .125W
A5	R153	7	0757-0416	R-F 511 1% .125W
A5	R154	6	0757-0069	R-F 121 1% .25W
A5	R155	8	0698-3558	R-F 4.02K1%
A5	R156	8	0698-3558	R-F 4.02K1%
A5	R157	6	0757-0407	R-F 200 1% .125W
A5	R158	0	0757-0401	R-F 100 1% .125W
A5	R159	9	0757-0442	R-F 10K1% .125W
A5	R160	8	0757-0433	R-F 3.32K1%
A5	R161	8	2100-3353	R-VAR 20K .5W
A5	R162	2	2100-3274	R-VAR 10K 10%
A5	R163	9	0757-0442	R-F 10K1% .125W
A5	R164	6	0757-0712	R-F 90.9 1% .25W
A5	R165	9	0757-0997	R-F 39.2 1% 1/2W
A5	R166	9	0757-0442	R-F 10K1% .125W
A5	R167	9	0757-0442	R-F 10K1% .125W
A5	R168	5	0757-0290	R-F 6.19K1%
A5	R169	5	0757-0290	R-F 6.19K1%
A5	R170	5	0757-0290	R-F 6.19K1%
A5	R171	1	2100-3207	R-VAR 5K 10%
A5	R172	1	2100-3207	R-VAR 5K 10%
A5	R173	3	0698-4486	R-F 24.9K1%
A5	R174	3	0698-4486	R-F 24.9K1%
A5	R175	3	0757-0438	R-F 5.11K1%
A5	R176	9	0757-0442	R-F 10K1% .125W
A5	R177	6	0757-0407	R-F 200 1% .125W
A5	R178	9	0757-0442	R-F 10K1% .125W
A5	R179	6	0757-0407	R-F 200 1% .125W

Table 6–3. Replaceable Parts (cont'd)

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A5	R180	2	0698-3156	R-F 14.7K1%
A5	R181	1	0757-0428	R-F 1.62K 1%
A5	R182	9	0757-0278	R-F 1.78K1%
A5	R183	8	0698-3558	R-F 4.02K1%
A5	R184	9	0757-0442	R-F 10K1% .125W
A5	R185	6	0757-0407	R-F 200 1% .125W
A5	R186	9	0757-0442	R-F 10K1% .125W
A5	R187	9	0757-0442	R-F 10K1% .125W
A5	R188	3	0757-0438	R-F 5.11K1%
A5	R189	6	0757-0407	R-F 200 1% .125W
A5	R190	6	0757-0465	R-F 100K1% .125W
A5	R191	6	0757-0465	R-F 100K1% .125W
A5	R192	9	0757-1094	R-F 1.47K1%
A5	R193	3	0698-3446	R-F 383 1% .125W
A5	R194	0	0698-3435	R-F 38.3 1%
A5	R195	9	0757-0418	R-F 619 1% .125W
A5	R196	9	0757-0442	R-F 10K1% .125W
A5	R197	3	0757-0438	R-F 5.11K1%
A5	R198	8	0698-0083	R-F 1.96K1%
A5	R199	9	0757-0442	R-F 10K1% .125W
A5	R200	8	0757-0441	R-F 8.25K1%
A5	R201	3	0757-0438	R-F 5.11K1%
A5	R202	8	0698-0083	R-F 1.96K1%
A5	R203	9	0757-0442	R-F 10K1% .125W
A5	R204	0	0698-3435	R-F 38.3 1%
A5	R205	3	0698-3446	R-F 383 1% .125W
A5	R206	9	0757-1094	R-F 1.47K1%
A5	R207	0	0757-0500	R-F 30.1 1% .25W
A5	R208	7	0698-3440	R-F 196 1% .125W
A5	R209	0	0757-0394	R-F 51.1 1%
A5	R210	2	2100-3349	R-VAR 100 -+10%
A5	R211	3	0698-3438	R-F 147 1% .125W
A5	R212	3	0698-3438	R-F 147 1% .125W
A5	R213	2	2100-3274	R-VAR 10K 10%
A5	R214	6	0757-0283	R-F 2K1% .125W F
A5	R215	1	0757-0452	R-F 27.4K1%
A5	R216	1	0757-0452	R-F 27.4K1%
A5	R217	0	2100-3355	R-VAR 100K
A5	R218	9	0757-0723	R-F 365 1% .25W
A5	R220	0	0757-0394	R-F 51.1 1%
A5	R221	9	0757-0723	R-F 365 1% .25W
A5	R222	2	0757-0388	R-F 30.1 1%
A5	R223	8	0698-3152	R-F 3.48K 1%
A5	R224	0	0757-0401	R-F 100 1% .125W
A5	R225	0	0757-0401	R-F 100 1% .125W
A5	R230	2	2100-3274	R-VAR 10K 10%
A5	R231	8	0698-3152	R-F 3.48K 1%
A5	U1	7	1826-0111	IC-DUAL OP AMPL
A5	U2	7	1826-0111	IC-DUAL OP AMPL
A5	U3	7	1826-0111	IC-DUAL OP AMPL
A5	U4	7	1826-0111	IC-DUAL OP AMPL
A5	U5	7	1826-0111	IC-DUAL OP AMPL
A5	U6	7	1826-0111	IC-DUAL OP AMPL
A5	U7	7	1826-0111	IC-DUAL OP AMPL
A5	U8	7	1826-0111	IC-DUAL OP AMPL
A5	U9	7	1826-0111	IC-DUAL OP AMPL
A5	U10	7	1826-0111	IC-DUAL OP AMPL
A5	VR3	3	1902-3268	DIO 26.1V 5% .4W
A5	VR24	6	1902-0184	DIO 16.2V 5% .4W
A5	VR25	7	1902-3139	DIO ZNR 8.25V 5%
A5	VR35	3	1902-0579	DIO 5.11V 5% 1W
A5	W7	5	5081-1957	CBL RB 14C 191MM
A5	W8	4	5081-1956	CBL RB 16C 165MM
A5	X4	6	1200-0588	SOCKET IC 16cont

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A6			08082-61601	CBL AY-XFMR
A6	J1	5	08082-26506	BD PC
A6	T1	4	5080-0984	XFMR-POWER
A6	X1	6	1251-0333	CONN PC 20CONT
A8			08082-66508	BD AY AMP BUFFER
A8	C1	4	0160-3470	C-F .01UF 50V
A8	C2	5	0180-1746	C-F 15UF 20V TA
A8	C3	4	0160-3470	C-F .01UF 50V
A8	C4	5	0180-1746	C-F 15UF 20V TA
A8	C5	4	0160-3470	C-F .01UF 50V
A8	C6	4	0160-3470	C-F .01UF 50V
A8	C7	4	0160-3470	C-F .01UF 50V
A8	C9	4	0160-3470	C-F .01UF 50V
A8	C10	4	0160-3470	C-F .01UF 50V
A8	C11	4	0160-3470	C-F .01UF 50V
A8	CR1	7	1901-0533	DIO HOT CARR
A8	CR2	7	1901-0533	DIO HOT CARR
A8	CR3	7	1901-0533	DIO HOT CARR
A8	CR4	7	1901-0533	DIO HOT CARR
A8	MP1	2	1260-0364	CONNECTOR LEAD
A8	R1	8	0698-5174	R-F 200 5% .125W
A8	R2	4	0698-4411	R-F 140 1% .125W
A8	R3	5	0757-0274	R-F 1.21K1%
A8	R4	3	0757-0280	R-F 1K1% .125W F
A8	R11	3	0757-0280	R-F 1K1% .125W F
A8	R12	5	0757-0274	R-F 1.21K1%
A8	R15	4	0698-4411	R-F 140 1% .125W
A8	R16	5	2100-3350	R-VAR 200 10%
A8	R17	2	2100-3349	R-VAR 100 -+10%
A8	R19	0	0698-5176	R-F 510 5% .125W
A8	R20	8	0698-5174	R-F 200 5% .125W
A8	R21	6	0698-5180	R-F 2K5% .125W
A8	R22	6	0698-5180	R-F 2K5% .125W
A8	R23	4	0757-0273	R-F 3.01K1%
A8	R24	4	0757-0273	R-F 3.01K1%
A8	R25	5	0698-3381	R-F 150 5% .125W
A8	R26	5	0698-3381	R-F 150 5% .125W
A8	R13	1	0757-0387	R-F 27.4 1%
A8	R14	1	0757-0387	R-F 27.4 1%
A8	U1	4	5081-3027	IC

A5(x4) 5040-9316 Lock clip 16pol

Table 6–3. Replaceable Parts (cont'd)

REFERENCE DESIGNATOR		CD	H-P PART NUMBER	DESCRIPTION
A9			08082-66509	BD AY ATTENUATOR
A9	CR1	1	1901-0040	DIO SI .05A 30V
A9	CR2	1	1901-0040	DIO SI .05A 30V
A9	CR3	1	1901-0040	DIO SI .05A 30V
A9	CR4	1	1901-0040	DIO SI .05A 30V
A9	CR5	1	1901-0040	DIO SI .05A 30V
A9	CR6	1	1901-0040	DIO SI .05A 30V
A9	CR7	1	1901-0040	DIO SI .05A 30V
A9	CR8	1	1901-0040	DIO SI .05A 30V
A9	CR9	1	1901-0040	DIO SI .05A 30V
A9	CR10	1	1901-0040	DIO SI .05A 30V
A9	CR11	1	1901-0040	DIO SI .05A 30V
A9	CR12	1	1901-0040	DIO SI .05A 30V
A9	CR13	1	1901-0040	DIO SI .05A 30V
A9	CR14	1	1901-0040	DIO SI .05A 30V
A9	J1	1	1250-0835	JACK RECEP STRAI
A9	J2	1	1250-0835	JACK RECEP STRAI
A9	K1	1	0490-1034	RELAY 12V .5A
A9	K2	1	0490-1034	RELAY 12V .5A
A9	K3	1	0490-1034	RELAY 12V .5A
A9	K4	1	0490-1034	RELAY 12V .5A
A9	L1	0	9100-0346	COIL FXD
A9	L2	0	9100-0346	COIL FXD
A9	L3	0	9100-0346	COIL FXD
A9	L4	0	9100-0346	COIL FXD
A9	L5	5	5081-1973	INDUCTANCE 3BEAD
A9	L6	5	5081-1973	INDUCTANCE 3BEAD
A9	L7	8	9140-0118	COIL-CHOKE 500UH
A9	L8	8	9140-0118	COIL-CHOKE 500UH
A9	R1	7	0757-0284	R-F 150 1% .125W
A9	R2	7	0757-0284	R-F 150 1% .125W
A9	R3	7	0757-0284	R-F 150 1% .125W
A9	R4	7	0757-0284	R-F 150 1% .125W
A9	R5	1	0698-4377	R-F 37.4 1%
A9	R6	1	0698-4377	R-F 37.4 1%
A9	R7	7	0698-4406	R-F 115 1% .125W
A9	R8	7	0698-4406	R-F 115 1% .125W
A9	R9	7	0698-4406	R-F 115 1% .125W
A9	R10	7	0698-4406	R-F 115 1% .125W
A9	R11	8	0757-0706	R-F 51.1 1% .25W
A9	R12	8	0757-0706	R-F 51.1 1% .25W
A9	R13	4	0757-0398	R-F 75 1% .125W
A9	R14	4	0757-0398	R-F 75 1% .125W
A9	R15	8	0757-0384	R-F 20 1% .125W
A9	R16	8	0757-0384	R-F 20 1% .125W
A9	R17	8	0757-0384	R-F 20 1% .125W
A9	R18	8	0757-0384	R-F 20 1% .125W
A9	R19	8	0757-0433	R-F 3.32K1%
A9	R20	8	0757-0433	R-F 3.32K1%
A9	R21	8	0757-0433	R-F 3.32K1%
A9	R22	8	0757-0433	R-F 3.32K1%
A9	R23	1	0757-0337	R-F 432 1% .25W
A9	R24	1	0757-0337	R-F 432 1% .25W
A9	R25	1	0757-0337	R-F 432 1% .25W
A9	R26	1	0757-0337	R-F 432 1% .25W
A9	W9	7	5081-1959	CBL RB 16C 210MM

Table 6–4. Schematic Diagram Notes

Front panel nomenclature

Rear panel nomenclature

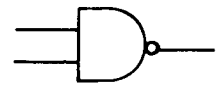
Primary signal path

Feedback

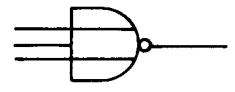
Ground

P/O — Part of

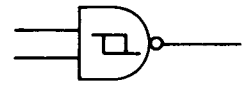
Factory selected



2-Input NAND gate

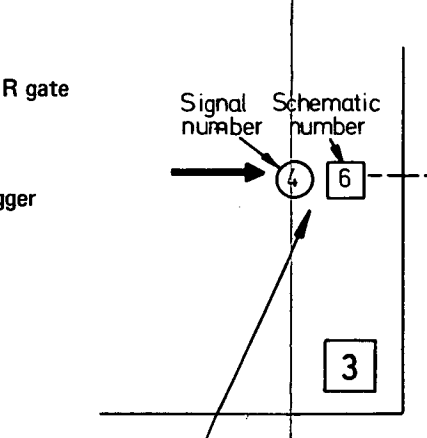


3-Input NOR gate



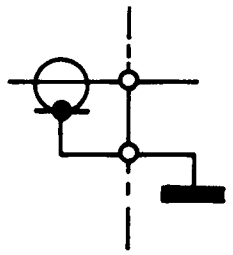
Schmitt trigger

Connections between Schematics:

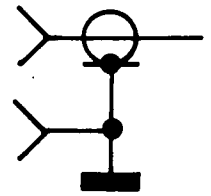


These references on a signal leaving a schematic diagram indicate the signal destination. The circle contains the signal number and the square contains the number of the schematic to which that signal goes.

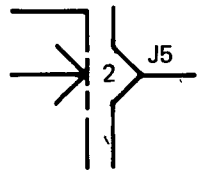
These references on a signal entering a schematic diagram indicate the signal origin. The circle contains the signal number and the square contains the number of the schematic on which that signal originates



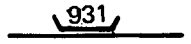
Coaxial Connector
Bolt down cable bush



Coaxial Connector
bulkhead mounted.

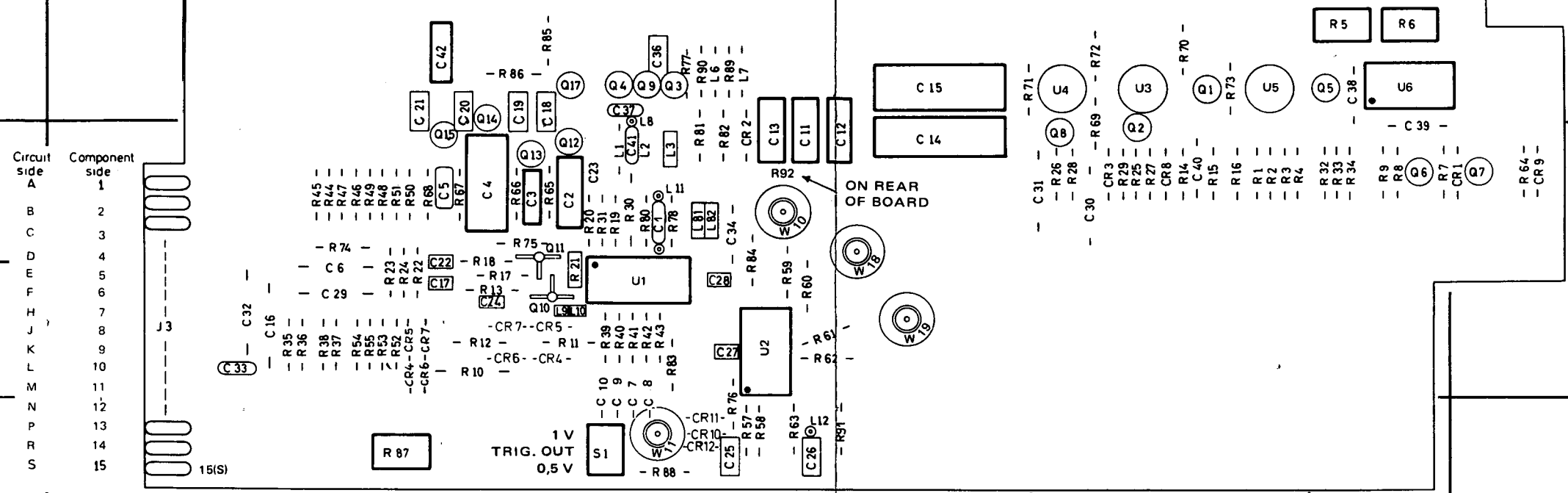


Printed circuit board edge connector and socket (X5) with pin number (2).



Indicates wire colour using resistor colour code.

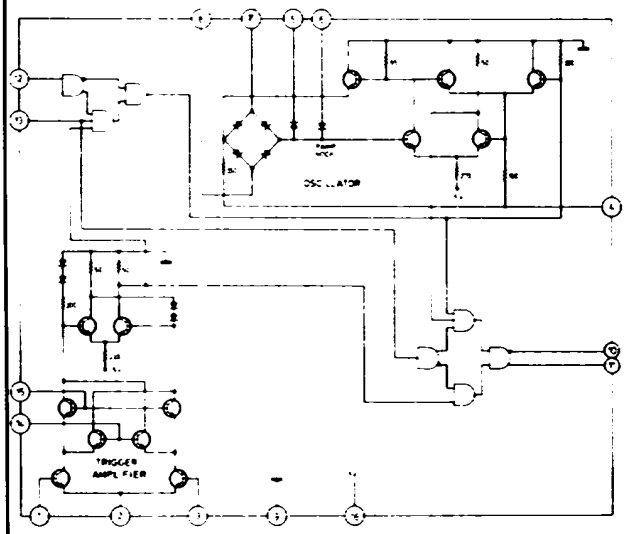
A3 BOARD ASSEMBLY REP. RATE 08082–66503

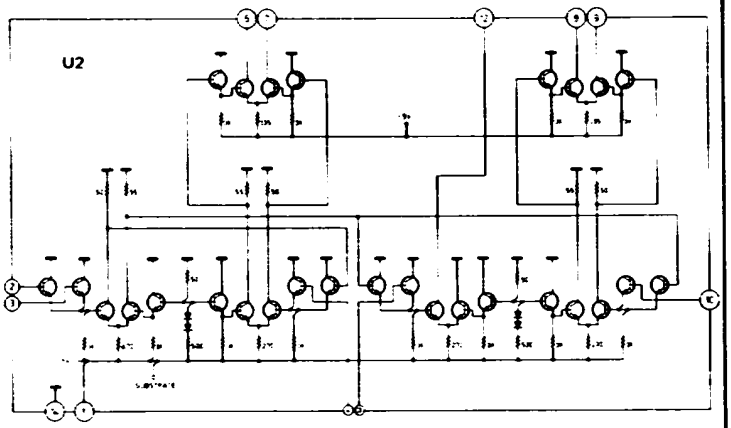


● Indicates pin 1

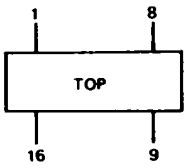
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C2	E-3	C27	F-4													R78	F-3
C3	E-3	C28	F-4	CR6	E-4	Q1	J-2	R5	K-2	R21	D-2	R39	F-4	R59	G-4	R80	F-3
C4	E-3	C29	D-4	CR7	E-4	Q2	I-3	R6	K-2	R21	E-4	R40	F-4	R60	G-4	R81	F-3
C5	D-3	C30	I-3	CR8	I-3	Q3	F-2	R7	K-3	R22	D-4	R41	F-4	R61	G-4	R82	F-3
C6	D-4	C31	I-3	CR9	L-3	Q4	F-2	R8	K-3	R23	D-4	R42	F-4	R62	G-5	R82	G-5
C7	F-3	C32	C-4	CR10	F-5	Q5	K-2	R9	K-3	R24	D-4	R43	F-4	R63	G-5	R83	F-3
C9	F-4	C33	C-4	CR11	F-5	Q6	K-3	R10	E-4	R25	I-3	R44	D-3	R64	L-3	R84	G-4
C10	F-4	C34	F-3	CR12	F-5	Q7	L-3	R11	E-4	R26	I-3	R45	C-3	R65	E-3	R85	E-2
C11	G-3	C36	F-2	L2	F-3	Q8	I-3	R12	E-4	R27	I-3	R46	D-3	R66	E-3	R86	E-2
C12	G-3	C37	F-2	L3	F-3	Q9	F-2	R13	E-4	R28	I-3	R47	D-3	R67	D-3	R87	D-5
C13	G-3	C38	K-2	L6	F-2	Q10	E-4	R14	J-3	R29	I-3	R48	D-3	R68	D-3	R88	F-5
C14	H-3	C39	K-2	L7	F-2	Q11	E-3	R15	J-3	R30	F-3	R49	D-3	R69	I-3	R90	F-2
C15	H-2	C40	J-3	L8	F-3	Q12	E-3	R16	J-3	R31	F-3	R50	D-3	R70	J-2	R92	G-3
C16	C-4	C41	F-3	L9	E-4	Q12	E-3	R17	E-4	R32	K-3	R51	D-3	R71	I-2	S1	F-5
C17	D-4	C42	D-2	L10	E-4	Q14	E-2	R18	E-2	R33	K-3	R52	D-4	R72	I-2	U1	F-4
C22	D-4	CR1	L-3	L11	F-3	Q17	E-2	R18	E-4	R34	K-3	R53	D-4	R73	J-2	U3	I-2
C23	E-3	CR2	G-3	L12	G-5	R1	J-3	R19	E-2	R35	C-4	R54	D-4	R74	D-3	U4	I-2
C24	E-4	CR3	I-3	L81	F-3	R2	J-3	R19	F-3	R36	C-4	R55	D-4	R75	E-3	U6	K-2
C25	F-5	CR4	E-4	L82	F-3	R3	J-3	R20	E-2	R37	D-4	R57	F-5	R76	F-5	W10	G-3
C26	G-5	CR5	E-4	J3	B-4	R4	J-3	R20	E-3	R38	D-4	R58	G-5	R77	F-2	W19	H-4

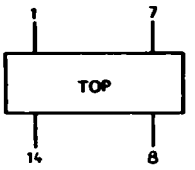
U1, U2



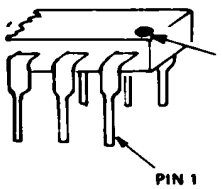


NOTE
1. PINS ARE NUMBERED AS FOLLOWS:

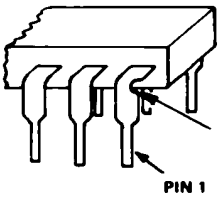




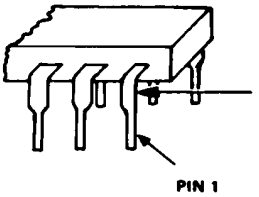
2. PIN 1 IS IDENTIFIED IN ONE OF THE FOLLOWING WAYS:



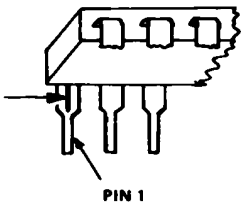
MARK ON CASE



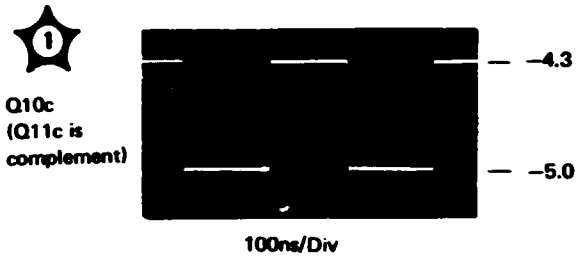
CUT-AWAY

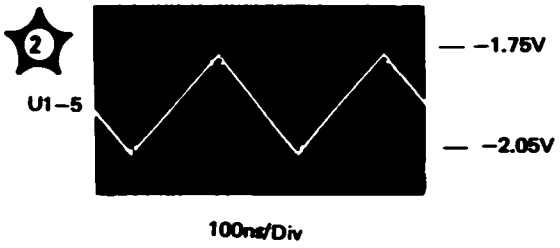


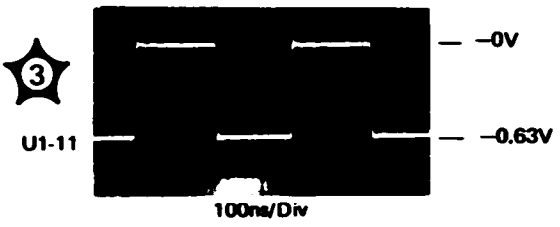
CUT-OUT

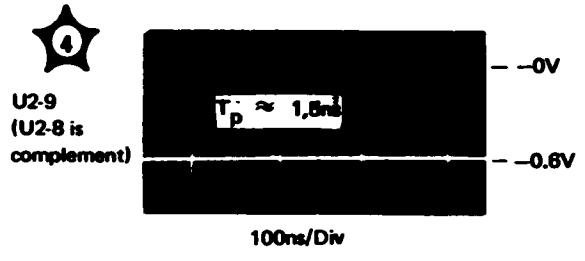


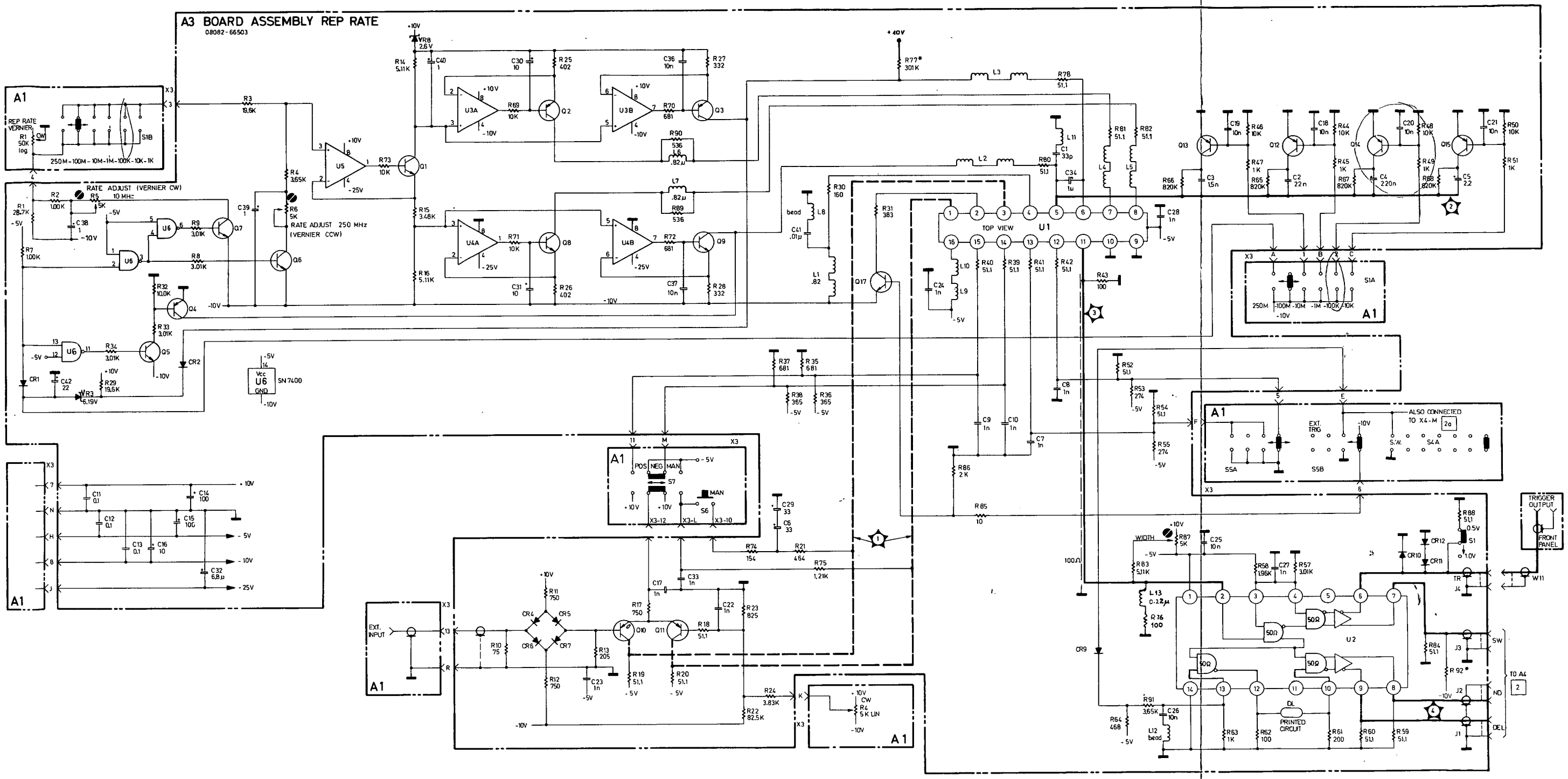
SCRATCH


1
Q10c
(Q11c is
complement)
–4.3
–5.0
100ns/Div


2
U1–5
–1.75V
–2.05V
100ns/Div


3
U1-11
–0V
–0.63V
100ns/Div

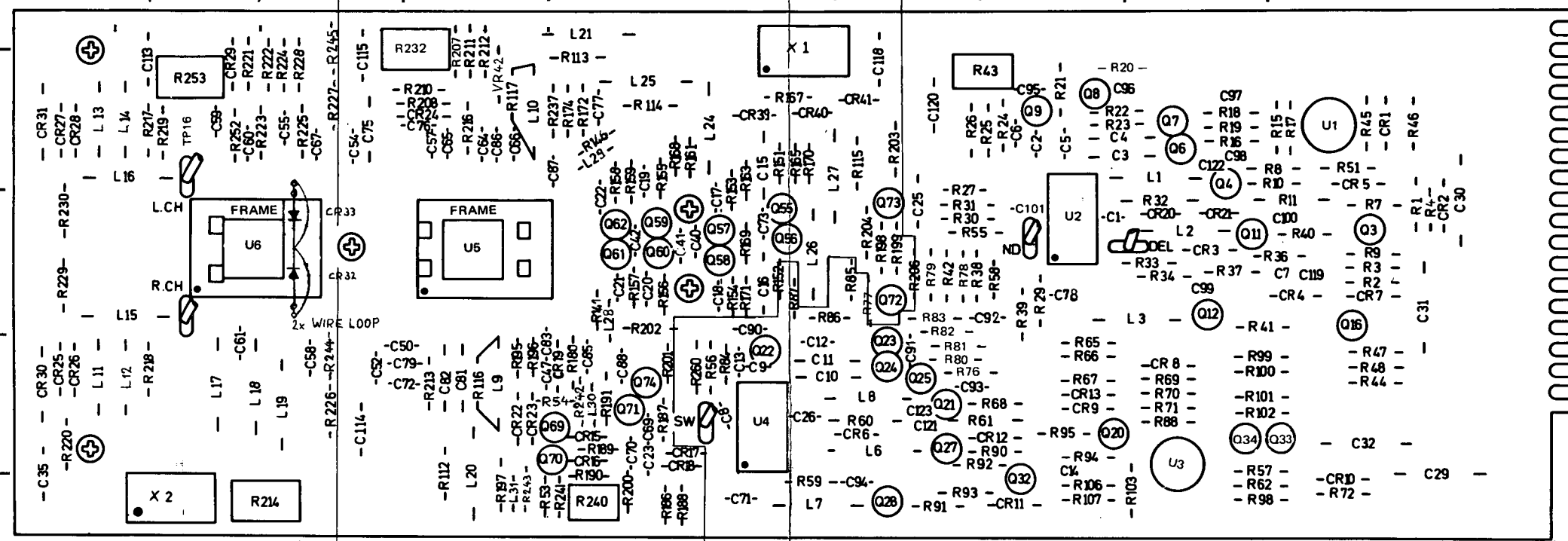

4
U2-9
(U2-8 is
complement)
–0V
–0.6V
100ns/Div



1

REPETITION RATE GENERATOR—BOARD A3

Board A4 — Output Board Layout



● Indicates pin 1

See Service Sheet 2c

See Service Sheet 2a

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	I-3											CR32,33	D3
C2	I-2	C21	F-3	C59	C-2	C81	E-4	C113	C-2	CR11	I-5	CR31	B-2
C3	I-2	C22	F-3	C60	C-2	C82	E-4	C114	D-4	CR12	I-4	CR39	G-2
C4	I-2	C23	F-4	C60	C-4	C83	F-4	C115	D-2	CR13	I-4	CR40	G-2
C5	I-2	C25	H-3	C61	C-4	C85	F-4	C118	H-2	CR15	F-4	CR41	H-2
C6	I-2	C26	G-4	C64	E-2	C86	E-2	C119	K-3	CR16	F-4	L1	J-2
C7	K-3	C29	L-4	C65	E-2	C87	F-2	C120	H-2	CR17	F-4	L2	J-3
C8	G-4	C30	L-3	C30	L-3	C88	F-4	C121	H-4	CR18	F-4	L3	J-3
C9	G-4	C32	K-4	C31	L-3	C90	G-3	C122	J-2	CR19	F-4	L6	H-4
C10	C-4	C35	B-5		D-2	C91	I-3	C123	H-4	CR20	J-3	L7	G-4
C11	C-4	C40	G-3	C69	F-4	C92	H-4	CR1	K-2	CR21	J-3	L8	H-4
C12	G-4	C41	F-3	C70	F-4	C93	H-4	CR2	L-3	CR22	E-4	L9	E-4
C13	G-4	C42	F-3	C71	G-4	C94	H-5	CR3	J-3	CR23	E-4	L10	E-2
C14	I-5	C47	F-4	C72	E-4	C95	I-2	CR4	K-3	CR24	E-2	L15	C-3
C15	G-2	C50	E-4	C72	I-3	C96	J-2	CR5	K-2	CR25	B-4	L16	C-2
C16	G-3	C52	D-4	C73	G-3	C97	I-2	CR6	H-4	CR26	B-4	L17	C-4
C17	G-3	C54	D-2	C75	D-2	C98	I-2	CR7	K-3	CR27	B-2	L18	C-4
C18	G-3	C55	D-2	C76	E-2	C99	J-3	CR8	J-4	CR28	B-2	L19	D-4
C19	F-2	C57	E-2	C77	F-2	C100	K-3	CR9	I-4	CR29	C-2	L20	E-5
C20	F-3	C58	D-4	C79	E-4	C101	I-3	CR10	K-5	CR30	B-4	L21	F-2

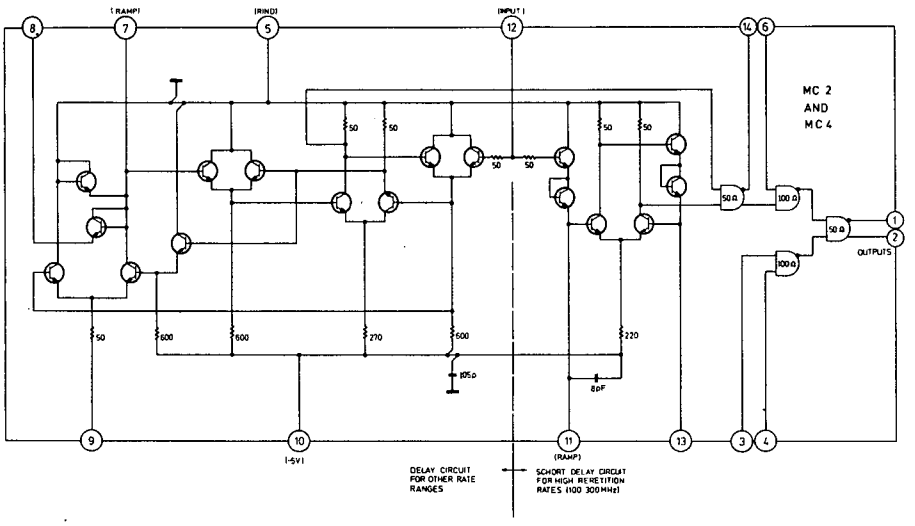
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
L22	F-3	Q24	H-4	Q73	H-2	R21	I-2						
L23	F-2	Q25	H-4	Q74	F-4	R22	I-2	R41	K-3	R66	I-4	R90	I-4
L24	G-2	Q27	H-4	R1	L-3	R23	I-2	R43	I-2	R68	I-4	R91	H-5
L25	F-2	Q28	H-5	R2	K-3	R24	I-2	R44	K-4	R69	J-4	R92	I-4
L26	G-3	Q32	I-5	R2	C-2	R25	I-2	R45	K-2	R70	J-4	R93	H-5
L27	G-2	Q33	K-4	R2	C-4	R26	H-2	R46	K-2	R71	J-4	R94	I-4
J1	G-2	Q34	J-4	R8	K-2	R27	H-3	R47	K-4	R72	K-5	R95	I-4
J2	C-5	Q54	F-4	R9	K-3	R29	I-3	R48	K-4	R76	H-4	R98	J-5
Q3	K-3	Q55	G-3	R10	K-2	R11	B-4	R51	K-2	R78	H-3	R100	J-4
Q4	J-2	Q56	G-3	R11	K-2	R31	H-3	R53	F-5	R79	H-3	R101	J-4
Q6	J-2	Q57	G-3	R12	K-3	R32	J-3	R54	F-4	R80	H-4	R102	J-4
Q7	J-2	Q58	G-3	R13	B-2	R33	J-2	R55	H-3	R81	H-4	R103	J-4
Q8	I-2	Q59	F-3	R14	C-2	R34	J-2	R56	G-4	R82	H-3	R106	I-5
Q9	I-2	Q60	F-3	R15	K-2	R36	K-3	R57	J-4	R83	H-3	R107	I-5
Q11	I-2	Q61	F-3	R16	J-2	R37	J-2	R58	I-3	R84	G-4	R112	E-5
Q12	I-2	Q62	F-3	R17	K-2	R38	H-3	R60	H-4	R85	H-3	R113	F-2
Q16	I-2	Q69	D-4	R18	F-4	R38	L-3	R61	I-4	R86	G-3	R114	F-2
Q20	I-4	Q70	D-4	R19	J-2	R39	I-3	R62	J-5	R87	G-3	R115	H-2
Q21	I-4	Q71	E-4	R20	J-2	R40	K-3	R65	I-4	R88	J-4	R116	E-4

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
R117	E-2	R188	F-5	R211	E-2	R245	D-2						
R141	F-2	R189	F-4	R212	E-2	R252	C-2						
R146	F-3	R190	F-5	R213	E-4	R253	C-2						
R151	G-2	R191	F-4	R216	E-2	R260	G-4						
R153	G-2	R195	E-4	R218	C-4	U-2	I-3						
R154	G-3	R196	E-4	R219	C-2	U-3	J-4						
R158	F-2	R197	E-5	R221	C-2	U-4	G-4						
R159	F-2	R198	H-3	R222	D-2	U-5	E-3						
R161	F-2	R199	H-3	R223	D-2	U-6	C-3						
R165	G-2	R200	F-5	R224	D-2	U6	C-3						
R168	F-2	R201	F-4	R225	D-2								
R169	G-3	R202	F-3	R226	D-4								
R170	G-2	R203	H-2	R227	D-2								
R171	G-3	R204	H-3	R228	B-3								
R180	E-2	R205	H-3	R229	E-3								
R187	F-3	R206	H-3	R230	E-2								
R188	F-4	R207	E-2	R232	E-2								
R189	F-4	R209	E-2	R237	F-2								
R190	F-5	R210	E-2	R241	F-5								

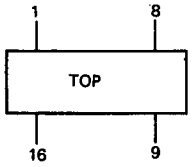
R4 L-3

R244 D4

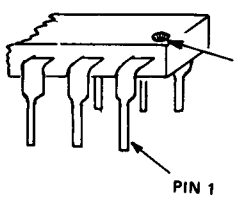
U2, U4



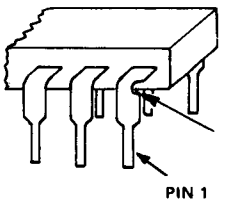
NOTE
1. PINS ARE NUMBERED AS FOLLOWS:



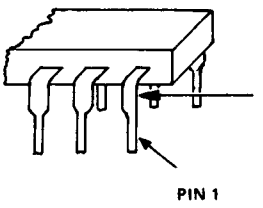
2. PIN 1 IS IDENTIFIED IN ONE OF THE FOLLOWING WAYS:



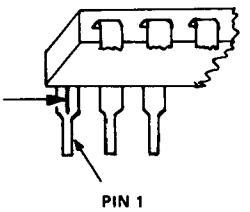
MARK ON CASE



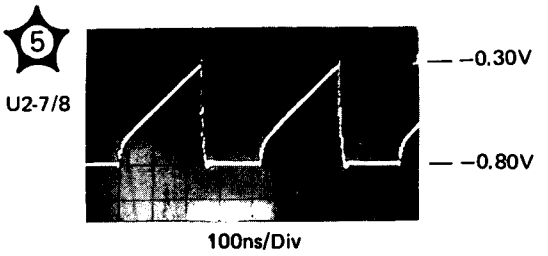
CUT-OUT

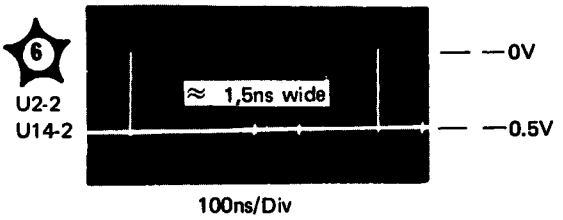


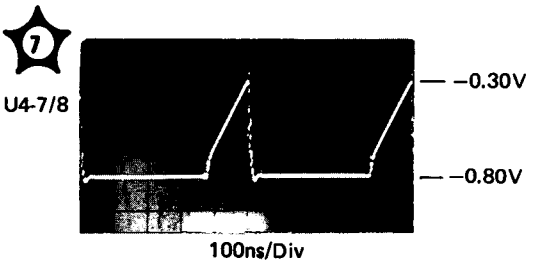
CUT-AWAY

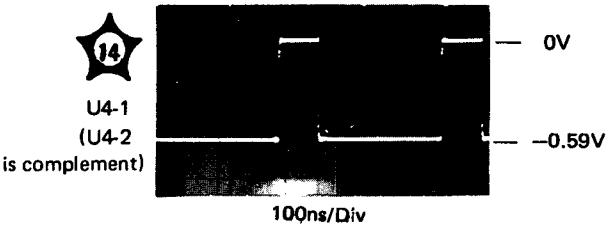


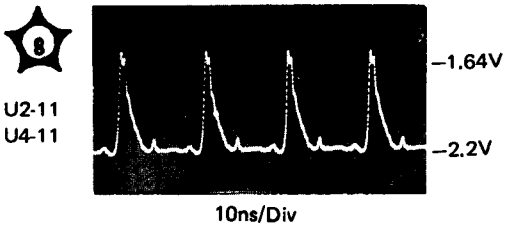
SCRATCH

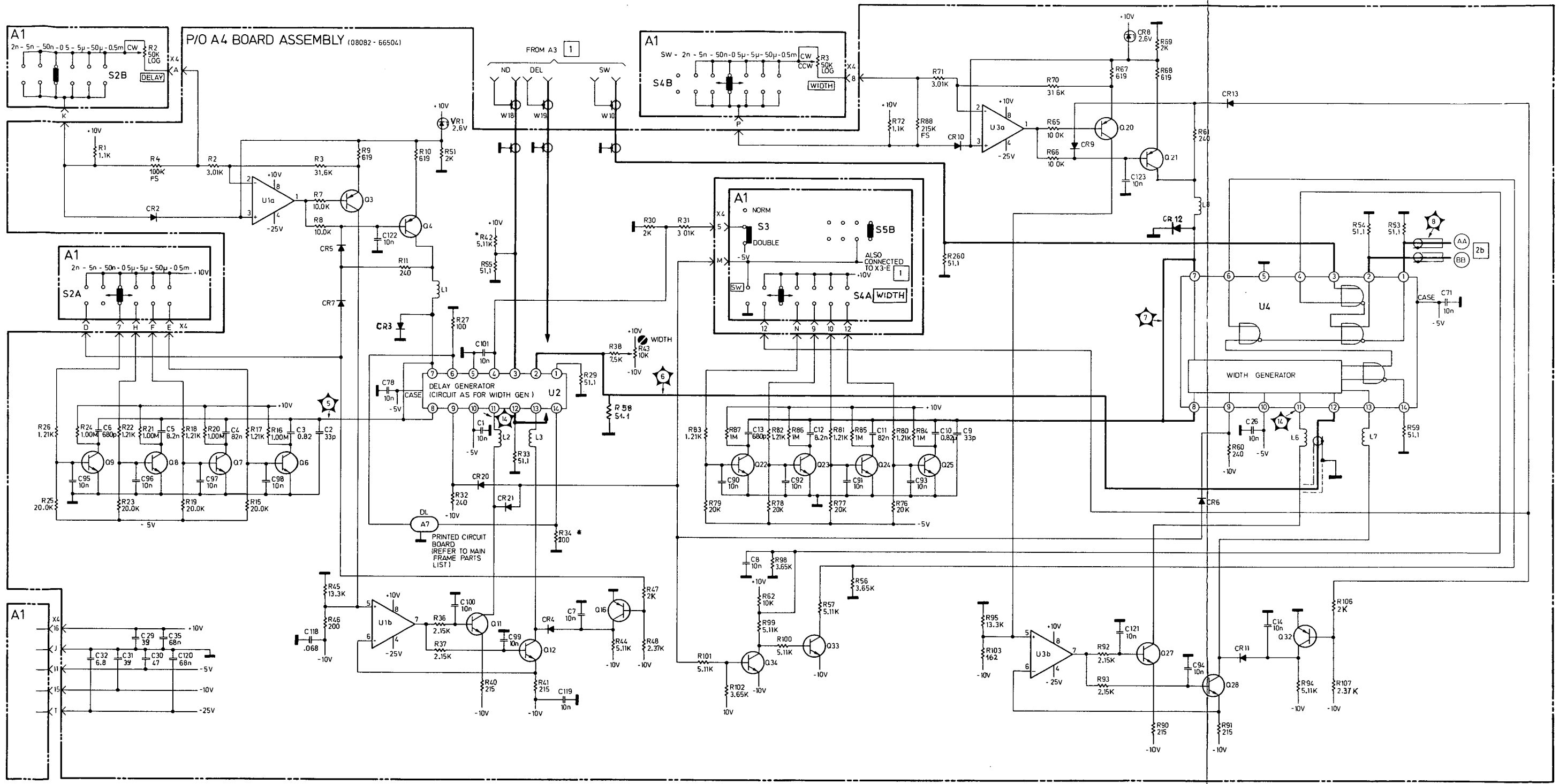

5
U2-7/8
–0.30V
–0.80V
100ns/Div


6
U2-2
U14-2
≈ 1,5ns wide
0V
–0.5V
100ns/Div


7
U4-7/8
–0.30V
–0.80V
100ns/Div


14
U4-1
(U4-2
is complement)
0V
–0.59V
100ns/Div

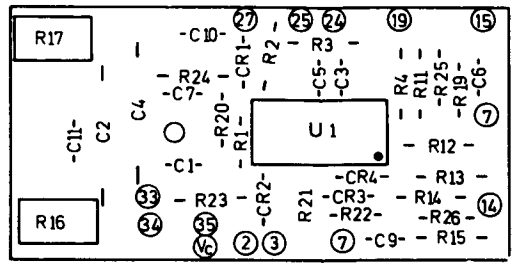

8
U2-11
U4-11
–1.64V
–2.2V
10ns/Div



2a

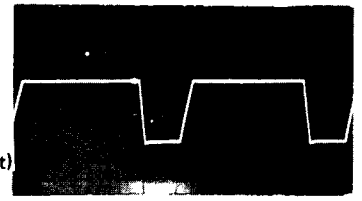
DELAY AND WIDTH GENERATORS– PART OF BOARD A4

Board A8 – Buffer Amplifier Layout



9

U5-9
(Int. max)
(U5-18 is
complement)

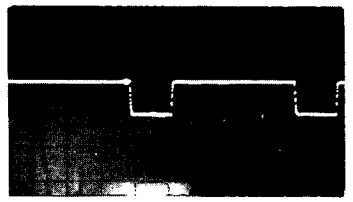


— –13.67V
— –15.56V

100ns/div

10

U5-11

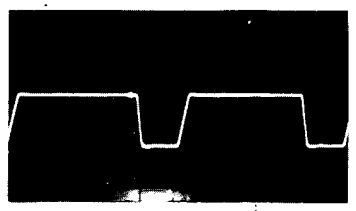


— –19.24
— –19.78

100ns/div

12

U5-14
(U5-15 is
complement)

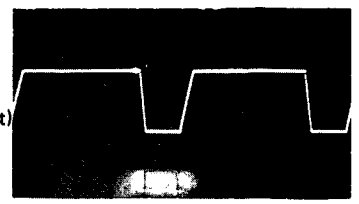


— –8V
— –9.7V

100ns/div

11

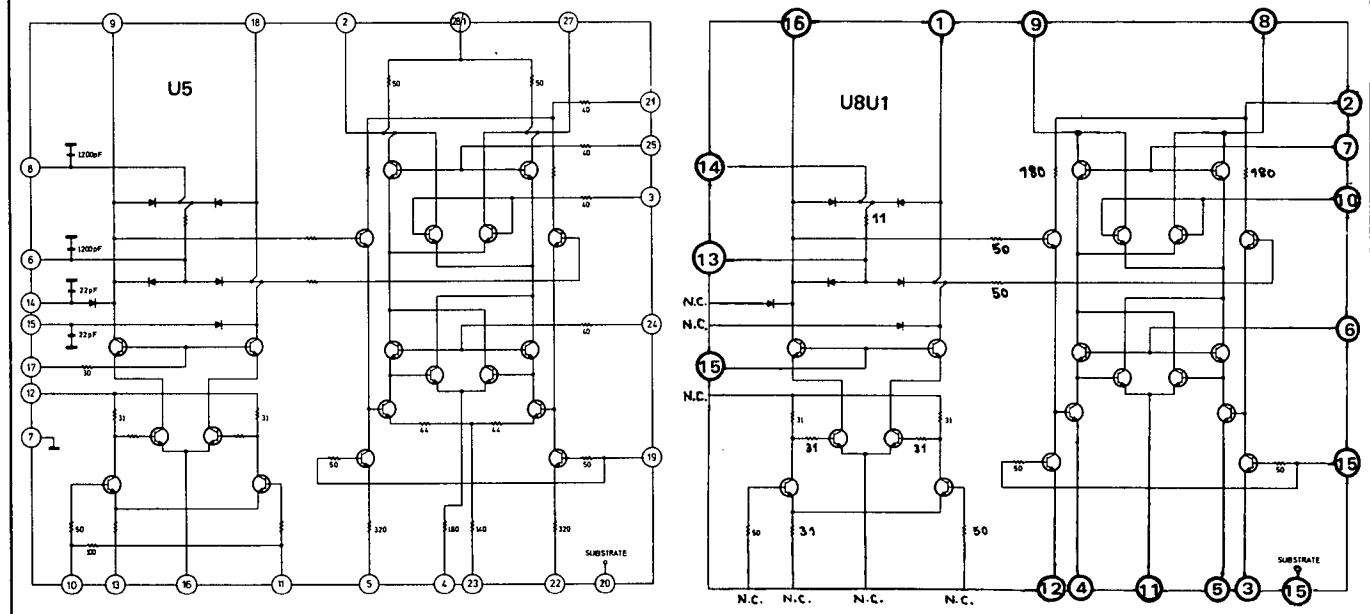
U4-2
(U5-27 is
complement)



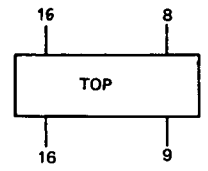
— –12.83V
— –14.72V

100ns/div

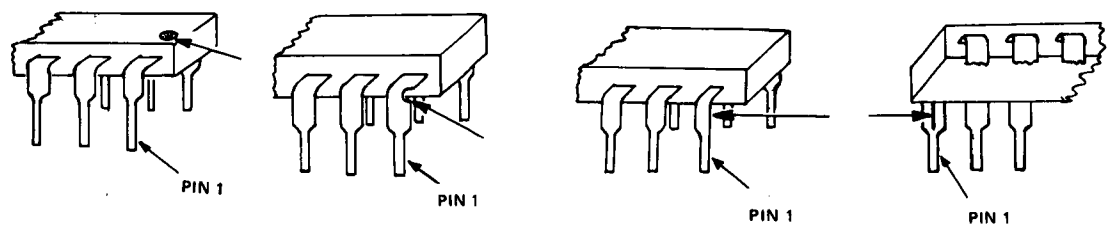
U5, A8U1
When replacing, use thermal compound 6040–0265. For U5 refer also to page 6–24.



NOTE
1. PINS ARE NUMBERED AS FOLLOWS:



2. PIN 1 IS IDENTIFIED IN ONE OF THE FOLLOWING WAYS:



MARK ON CASE | CUT-OUT | CUT-AWAY | SCRATCH

P/O A4 BOARD ASSEMBLY (08082 - 66504)

SLOPE GENERATOR

TRANSITION <5ns BUFFER AMPLIFIER TRANSITION >5ns

SLOPE CAPACITANCE SWITCHING

VOLTAGE- LEVEL SHIFTER

GND + ENABLE CIRCUITS FOR < 5ns TRANSITION TIME

A8 BOARD ASSEMBLY BUFFER 08082-66508

U1 COMPLEMENT SWITCH | 2 STAGE LINEAR AMPLIFIER | IMPEDANCE CONVERTER

TO SLOPE GENERATOR

U5 REFER TO MAIN FRAME PARTS LIST

COMPLEMENT SWITCH | SWITCH 8X0 INPUTS | IMPEDANCE CONVERTER | 2-STAGE LINEAR AMPLIFIER

LEADING EDGE

TRAILING EDGE

AMPLITUDE

BASELINE

SUBSTRATE

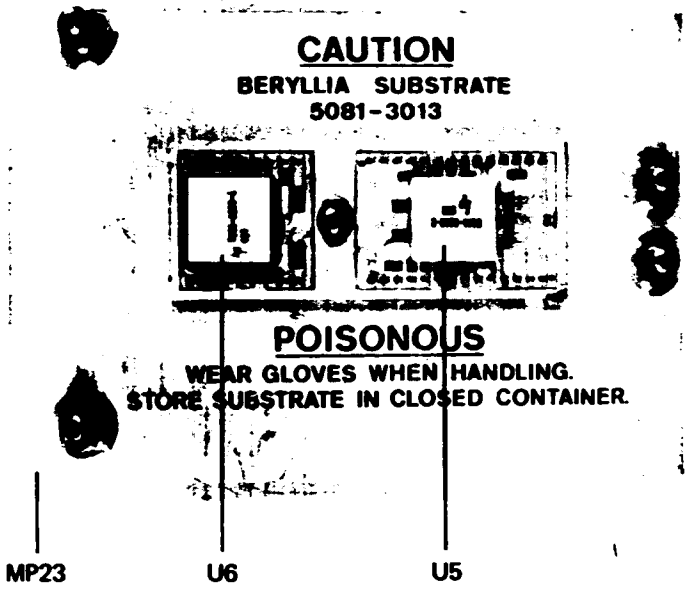
FROM WIDTH CIRCUIT

WIDTH

2b

SLOPE GENERATOR—PART OF BOARD A4 AND BUFFER AMPLIFIER—BOARD A8

U5, U6



CAUTION
Ensure U5, U6 are oriented as shown

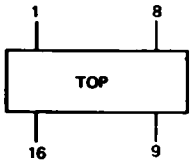
NOTE: Disregard poisonous materials CAUTION on MP23. (Beryllia is non-toxic when solid and in fired ceramic). Risk lies in breathing particles. This is only possible if the substrate is:

1. ground with a very hard abrasive
2. heated to 800°C in damp air

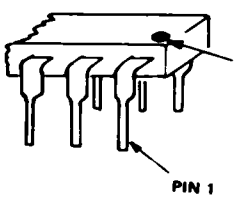
Neither procedure is necessary and both must be avoided.

U6

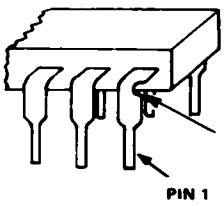
NOTE
1. PINS ARE NUMBERED AS FOLLOWS:



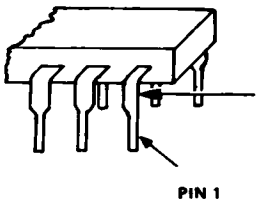
2. PIN 1 IS IDENTIFIED IN ONE OF THE FOLLOWING WAYS:



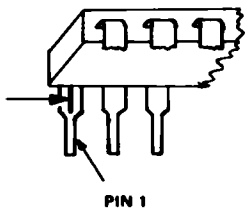
MARK ON CASE



CUT-OUT



CUT-AWAY



SCRATCH

OUTPUT AT FRONT PANEL

A5 EXT DC-OFFSET

3b $I_{DC\,B}$ 25

A9 4 STEP ATT

OUTPUT AT FRONT PANEL

13

A9 4 STEP ATT

A5 EXT DC OFFSET

24 3b $I_{DC\,A}$

POS PULSE DC OFFSET

$I_{pos\,B}$

3b

POS PULSE DC OFFSET

3b $I_{pos\,A}$ A5

X5-N

X4 6

A1

W17

W16

P/O A4
BOARD ASSEMBLY
08082-66504

CR26 CR25

L11 500µ L12 500µ L15

R218 953

R229 2.49K

+10V R220 6.19K

CR30 5.6V

CR31 5.6V

R219 6.19K -25V

CR28 CR27

L13 500µ L14 500µ L16

R217 953

R230 2.49K

3.51 R CH 2.8

3.03 L CH 2.8

5081-3013

50 40 40 40

TP16 -6.3V

VR29 5.62V

R253 100

R252 51.1

C59 10n

R221 464

-10V

5.35 5.35 5.65

.032

X5 X4 18 K

AMPLITUDE VERNIER

IV802 17 0V

Q19 -6.24

A1

L17 6.25

L18 6.00

L19

C61 10n

50

IV801 18 0V

620c -6.01

621 c 5.8

Q19c -5.26

IV40 19

A5

2b

FROM PIN 2 U5

15 15 15 33

100 50 50

C55 10n C58 10n C67 10n

R225 121 R228 127

R226 110 R244 56.2

R227 110 R245 56.2

-25V -25V -25V

CR32 CR33

WIRE LOOP * WIRE LOOP *

U6
REFER TO MAIN FRAME PARTS LIST

SUBSTRATE 13.27

R223 10K

C60 10n

R222 12.1K

R224 10K

-25V

FROM PIN 27 U5 2b

13

Output 5V neg. L. CH

0

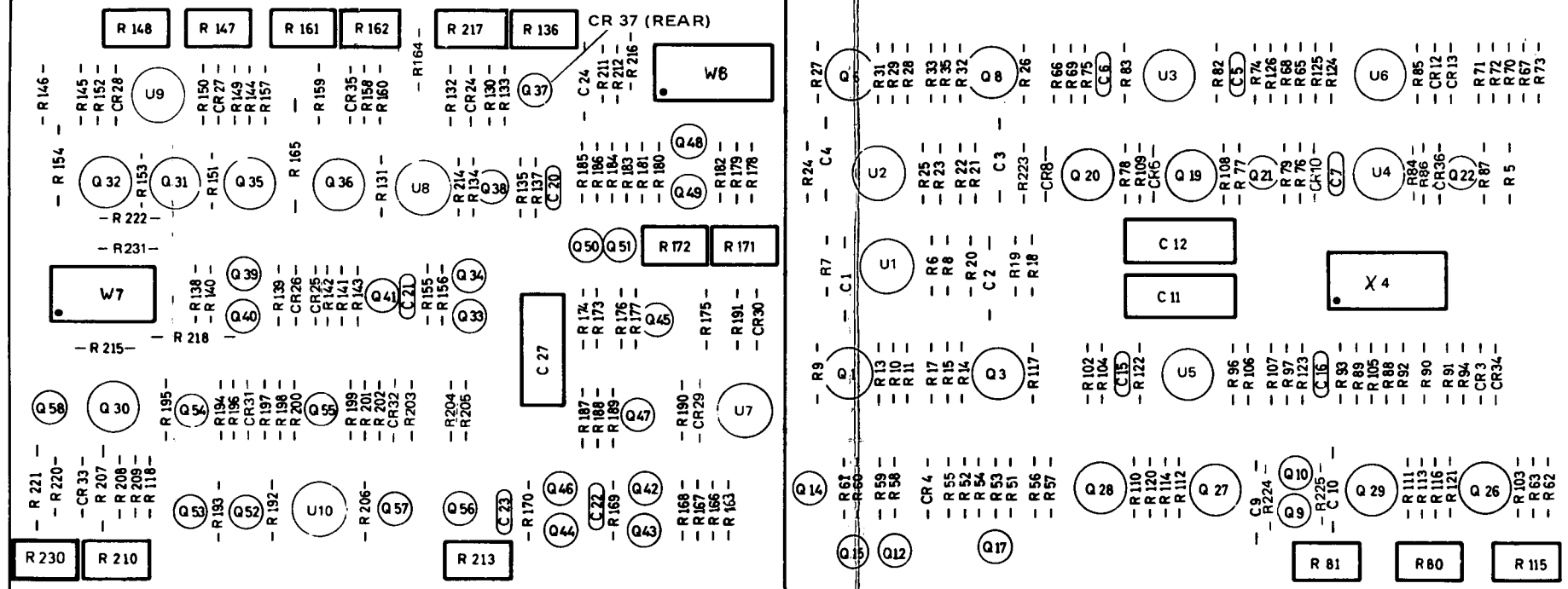
−5V

100ns/div

2c

OUTPUT AMPLIFIER—PART OF BOARD A4

Board A5 – Offset Board Layout

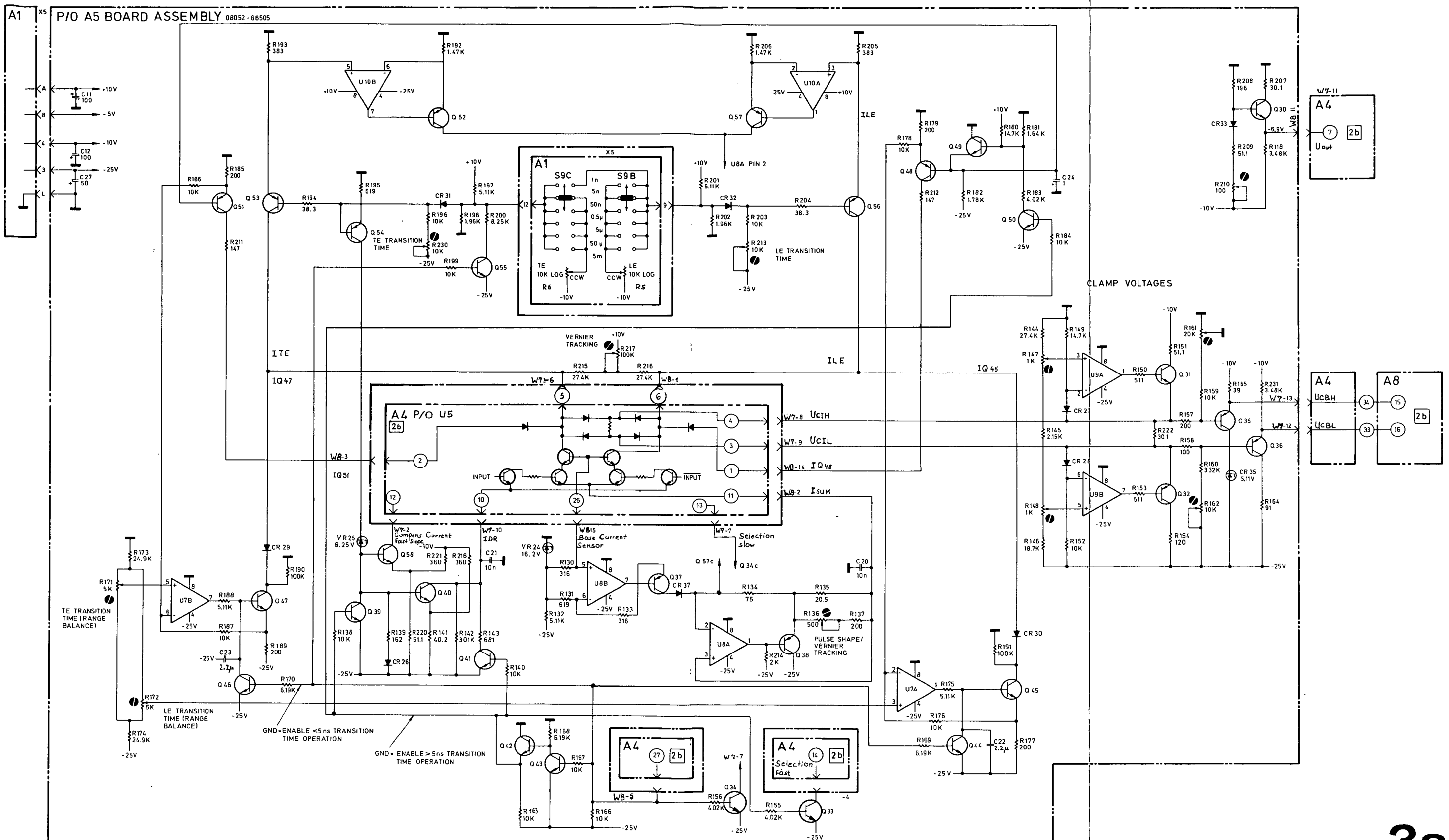


● Indicates pin 1

See Service Sheet 3a

See Service Sheet 3b

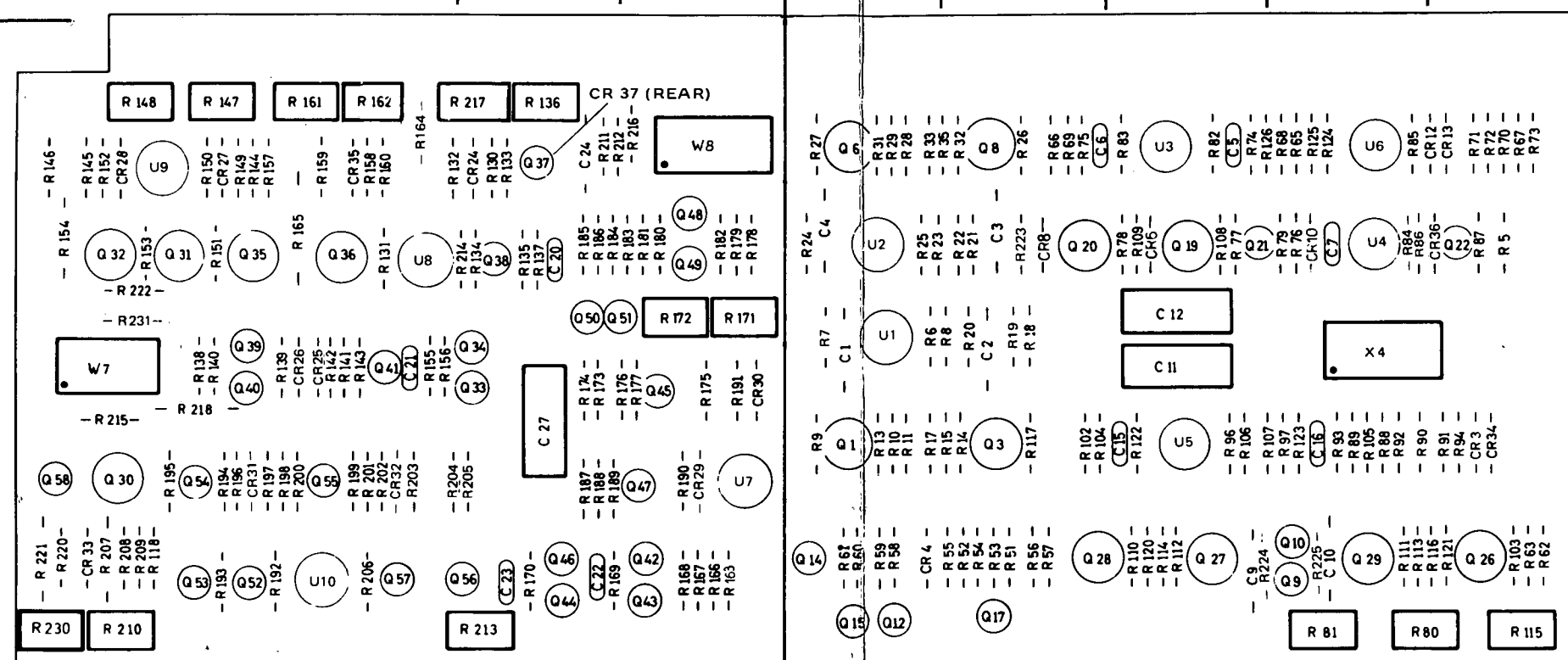
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
				CR 37	F 2													R115	K-5												
C1	G-3	CR3	K-4	CR36	K-3	Q30	B-4	Q49	F-3	R15	G-4	R52	H-5	R72	K-2	R91	K-4	R116	J-5	R139	C-4	R158	D-2	R178	F-3	R197	C-4	R215	B-4	U8	D-3
C2	H-3	CR4	G-5	Q1	G-4	Q31	C-3	Q50	E-3	R17	G-4	R53	H-5	R73	K-2	R92	J-4	R117	H-4	R140	C-4	R159	D-2	R179	F-3	R198	C-4	R216	F-2	U9	C-2
C3	H-3	CR6	I-3	Q3	H-4	Q32	B-3	Q51	E-3	R18	H-3	R54	H-5	R74	I-2	R93	J-4	R118	C-5	R141	D-4	R160	D-2	R180	F-3	R199	D-4	R217	E-2	U10	D-5
C4	G-3	CR8	H-3	Q6	G-2	Q33	E-4	Q52	C-5	R19	H-3	R55	G-5	R75	H-2	R94	K-4	R120	I-5	R142	D-4	R161	D-2	R181	F-3	R200	D-4	R218	C-4		
C5	I-2	CR10	J-3	Q8	H-2	Q34	E-4	Q53	C-5	R20	H-3	R56	H-5	R76	J-3	R96	I-4	R121	K-5	R143	D-4	R162	D-2	R182	F-3	R200	D-4	R220	B-5		
C6	H-2	CR12	J-2	Q9	J-5	Q35	C-3	Q54	C-4	R21	H-3	R57	H-5	R77	I-3	R97	J-4	R122	I-4	R144	C-2	R164	D-2	R183	F-3	R201	D-4	R221	B-5		
C7	J-3	CR13	K-2	Q10	J-5	Q36	D-3	Q55	D-4	R22	H-3	R58	G-5	R78	I-3	R102	H-4	R123	J-4	R145	B-2	R165	D-3	R184	E-3	R202	D-4	R222	C-3		
C9	F-5	CR24	E-2	Q12	G-5	Q37	E-2	Q56	E-5	R23	G-3	R59	G-5	R79	J-3	R103	K-5	R124	J-2	R146	B-2	R166	F-5	R185	E-3	R203	D-4	R223	H-3		
C10	J-5	CR25	D-4	Q14	G-5	Q38	E-3	Q57	D-5	R24	G-3	R60	G-5	R80	J-5	R104	H-4	R125	J-2	R147	C-2	R167	F-5	R186	E-3	R204	D-4	R224	I-5		
C11	I-4	CR26	D-4	Q15	G-5	Q39	C-4	Q58	B-4	R25	G-3	R61	G-5	R81	J-5	R105	J-4	R126	I-2	R148	C-2	R168	F-5	R187	E-4	R205	E-4	R225	J-5		
C12	I-3	CR27	C-2	Q17	H-5	Q40	C-4	R5	K-3	R26	H-2	R62	K-5	R82	I-2	R106	I-4	R130	E-2	R149	C-2	R169	E-5	R188	E-4	R206	D-5	R230	B-5		
C15	I-4	CR28	B-2	Q19	I-3	Q41	D-4	R6	G-3	R27	G-2	R63	K-5	R83	I-2	R107	I-4	R131	D-3	R150	C-2	R170	E-5	R189	E-4	R207	B-5	R231	C-3		
C16	J-4	CR29	F-4	Q20	H-3	Q42	F-5	R7	G-3	R28	G-2	R65	J-2	R84	J-3	R108	I-3	R132	D-2	R151	C-2	R171	F-3	R190	F-4	R208	B-5	U1	G-3		
C20	E-3	CR30	F-4	Q21	I-3	Q43	F-5	R8	G-3	R29	G-2	R66	H-2	R85	J-2	R109	I-3	R133	E-2	R152	B-2	R172	F-3	R191	F-4	R209	C-5	U2	G-3		
C21	D-4	CR31	C-4	Q22	K-3	Q44	E-5	R9	G-4	R31	G-2	R67	K-2	R86	J-3	R110	I-5	R134	E-3	R153	C-3	R173	E-4	R192	C-5	R210	B-5	U3	I-2		
C22	E-5	CR32	D-4	Q26	K-5	Q45	F-4	R10	G-4	R32	H-2	R68	J-2	R87	K-3	R111	J-5	R135	E-3	R154	B-3	R174	E-4	R193	C-5	R211	E-2	U4	J-3		
C23	E-5	CR33	B-5	Q27	I-5	Q46	E-5	R11	G-4	R33	G-2	R69	H-2	R88	J-4	R112	I-5	R136	E-2	R155	D-4	R175	F-4	R194	C-4	R212	E-2	U5	I-4		
C24	E-2	CR34	K-4	Q28	H-5	Q47	F-4	R13	G-4	R35	G-2	R70	K-2	R89	J-4	R113	J-5	R137	E-3	R156	D-4	R176	E-4	R195	C-4	R213	E-5	U6	J-2		
C27	E-4	CR35	D-2	Q29	J-5	Q48	F-3	R14	H-4	R51	H-5	R71	K-2	R90	J-4	R114	I-5	R138	C-4	R157	C-2	R177	F-4	R196	C-4	E214	E-3	U7	F-4		



3a

SLOPE GENERATOR CURRENT AND VOLTAGE SOURCE–PART OF BOARD A5

Board A5 – Offset Board Layout

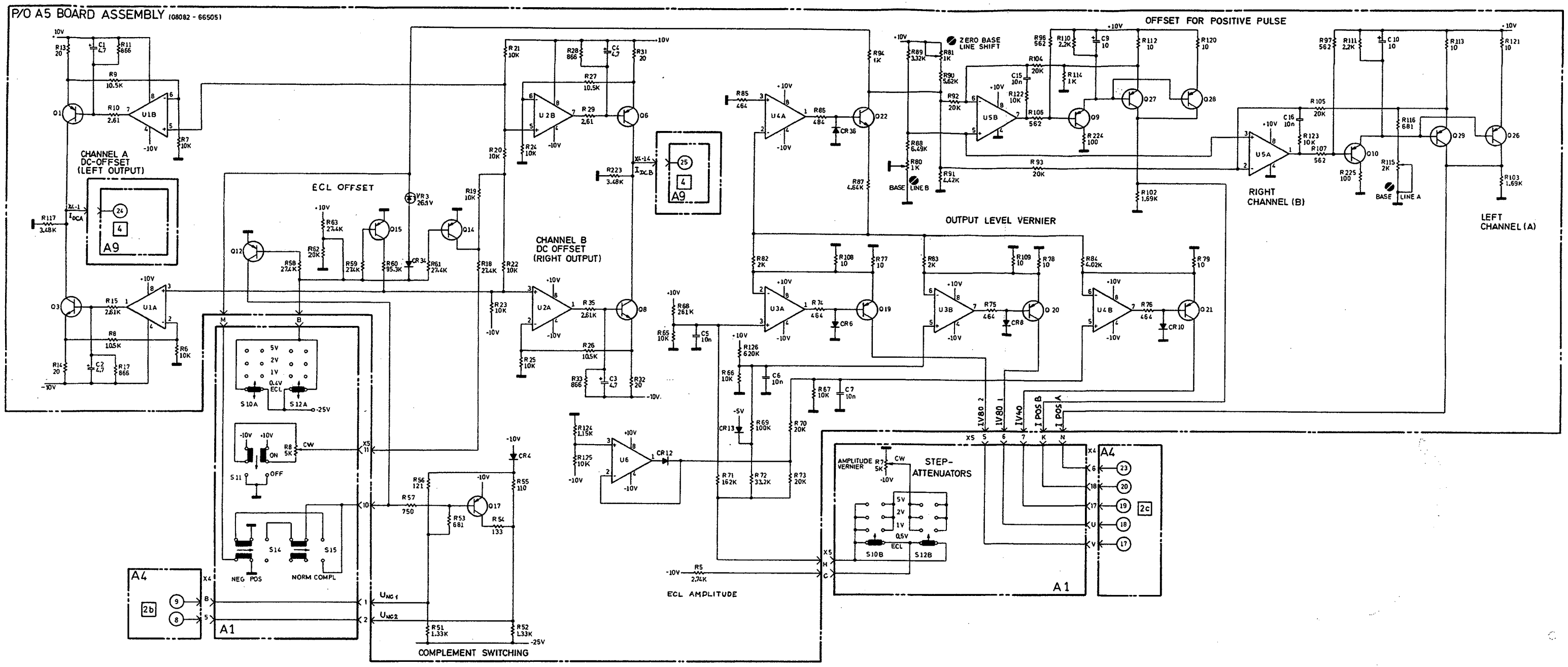


● Indicates pin 1

See Service Sheet 3a

See Service Sheet 3b

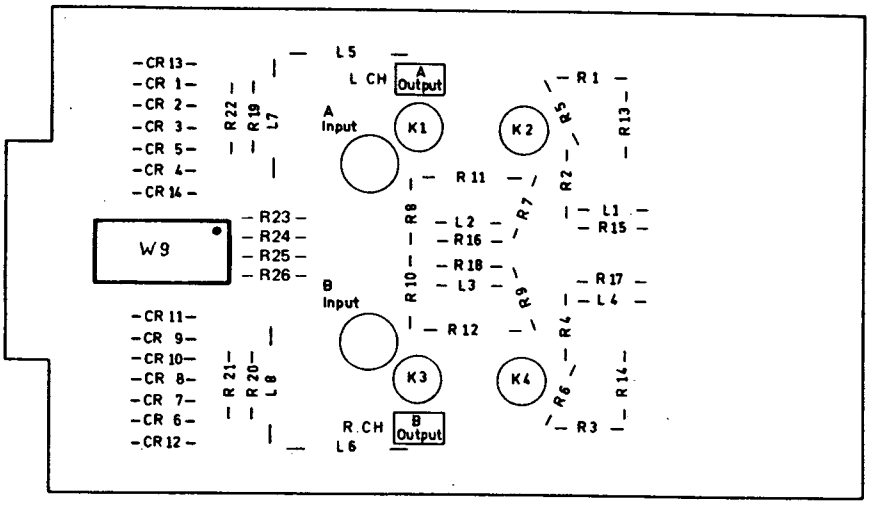
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
				CR 37	F 2													R115	K-5												
C1	G-3	CR3	K-4	CR36	K-3	Q30	B-4	Q49	F-3	R15	G-4	R52	H-5	R72	K-2	R91	K-4	R116	J-5	R139	C-4	R158	D-2	R178	F-3	R197	C-4	R215	B-4	U8	D-3
C2	H-3	CR4	G-5	Q1	G-4	Q31	C-3	Q50	E-3	R17	G-4	R53	H-5	R73	K-2	R92	J-4	R117	H-4	R140	C-4	R159	D-2	R179	F-3	R198	C-4	R216	F-2	U9	C-2
C3	H-3	CR6	I-3	Q3	H-4	Q32	B-3	Q51	E-3	R18	H-3	R54	H-5	R74	I-2	R93	J-4	R118	C-5	R141	D-4	R160	D-2	R180	F-3	R199	D-4	R217	E-2	U10	D-5
C4	G-3	CR8	H-3	Q6	G-2	Q33	E-4	Q52	C-5	R19	H-3	R55	G-5	R75	H-2	R94	K-4	R120	I-5	R142	D-4	R161	D-2	R181	F-3	R200	D-4	R218	C-4		
C5	I-2	CR10	J-3	Q8	H-2	Q34	E-4	Q53	C-5	R20	H-3	R56	H-5	R76	J-3	R96	I-4	R121	K-5	R143	D-4	R162	D-2	R182	F-3	R200	D-4	R220	B-5		
C6	H-2	CR12	J-2	Q9	J-5	Q35	C-3	Q54	C-4	R21	H-3	R57	H-5	R77	I-3	R97	J-4	R122	I-4	R144	C-2	R164	D-2	R183	F-3	R201	D-4	R221	B-5		
C7	J-3	CR13	K-2	Q10	J-5	Q36	D-3	Q55	D-4	R22	H-3	R58	G-5	R78	I-3	R102	H-4	R123	J-4	R145	B-2	R165	D-3	R184	E-3	R202	D-4	R222	C-3		
C9	F-5	CR24	E-2	Q12	G-5	Q37	E-2	Q56	E-5	R23	G-3	R59	G-5	R79	J-3	R103	K-5	R124	J-2	R146	B-2	R166	F-5	R185	E-3	R203	D-4	R223	H-3		
C10	J-5	CR25	D-4	Q14	G-5	Q38	E-3	Q57	D-5	R24	G-3	R60	G-5	R80	J-5	R104	H-4	R125	J-2	R147	C-2	R167	F-5	R186	E-3	R204	D-4	R224	I-5		
C11	I-4	CR26	D-4	Q15	G-5	Q39	C-4	Q58	B-4	R25	G-3	R61	G-5	R81	J-5	R105	J-4	R126	I-2	R148	C-2	R168	F-5	R187	E-4	R205	E-4	R225	J-5		
C12	I-3	CR27	C-2	Q17	H-5	Q40	C-4	R5	K-3	R26	H-2	R62	K-5	R82	I-2	R106	I-4	R130	E-2	R149	C-2	R169	E-5	R188	E-4	R206	D-5	R230	B-5		
C15	I-4	CR28	B-2	Q19	I-3	Q41	D-4	R6	G-3	R27	G-2	R63	K-5	R83	I-2	R107	I-4	R131	D-3	R150	C-2	R170	E-5	R189	E-4	R207	B-5	R231	C-3		
C16	J-4	CR29	F-4	Q20	H-3	Q42	F-5	R7	G-3	R28	G-2	R65	J-2	R84	J-3	R108	I-3	R132	D-2	R151	C-2	R171	F-3	R190	F-4	R208	B-5	U1	G-3		
C20	E-3	CR30	F-4	Q21	I-3	Q43	F-5	R8	G-3	R29	G-2	R66	H-2	R85	J-2	R109	I-3	R133	E-2	R152	B-2	R172	F-3	R191	F-4	R209	C-5	U2	G-3		
C21	D-4	CR31	C-4	Q22	K-3	Q44	E-5	R9	G-4	R31	G-2	R67	K-2	R86	J-3	R110	I-5	R134	E-3	R153	C-3	R173	E-4	R192	C-5	R210	B-5	U3	I-2		
C22	E-5	CR32	D-4	Q26	K-5	Q45	F-4	R10	G-4	R32	H-2	R68	J-2	R87	K-3	R111	J-5	R135	E-3	R154	B-3	R174	E-4	R193	C-5	R211	E-2	U4	J-3		
C23	E-5	CR33	B-5	Q27	I-5	Q46	E-5	R11	G-4	R33	G-2	R69	H-2	R88	J-4	R112	I-5	R136	E-2	R155	D-4	R175	F-4	R194	C-4	R212	E-2	U5	I-4		
C24	E-2	CR34	K-4	Q28	H-5	Q47	F-4	R13	G-4	R35	G-2	R70	K-2	R89	J-4	R113	J-5	R137	E-3	R156	D-4	R176	E-4	R195	C-4	R213	E-5	U6	J-2		
C27	E-4	CR35	D-2	Q29	J-5	Q48	F-3	R14	H-4	R51	H-5	R71	K-2	R90	J-4	R114	I-5	R138	C-4	R157	C-2	R177	F-4	R196	C-4	E214	E-3	U7	F-4		



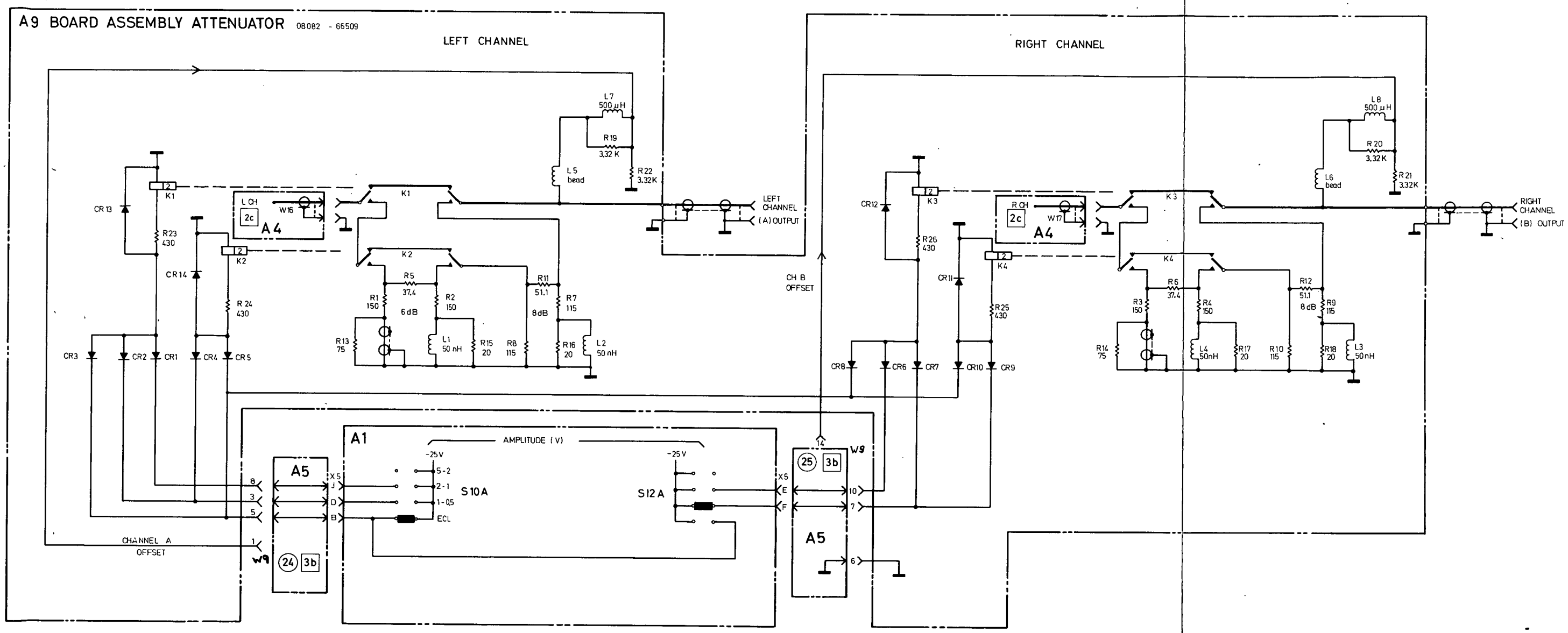
3b

DC OFFSET AND AMPLITUDE VERNIER–PART OF BOARD A5

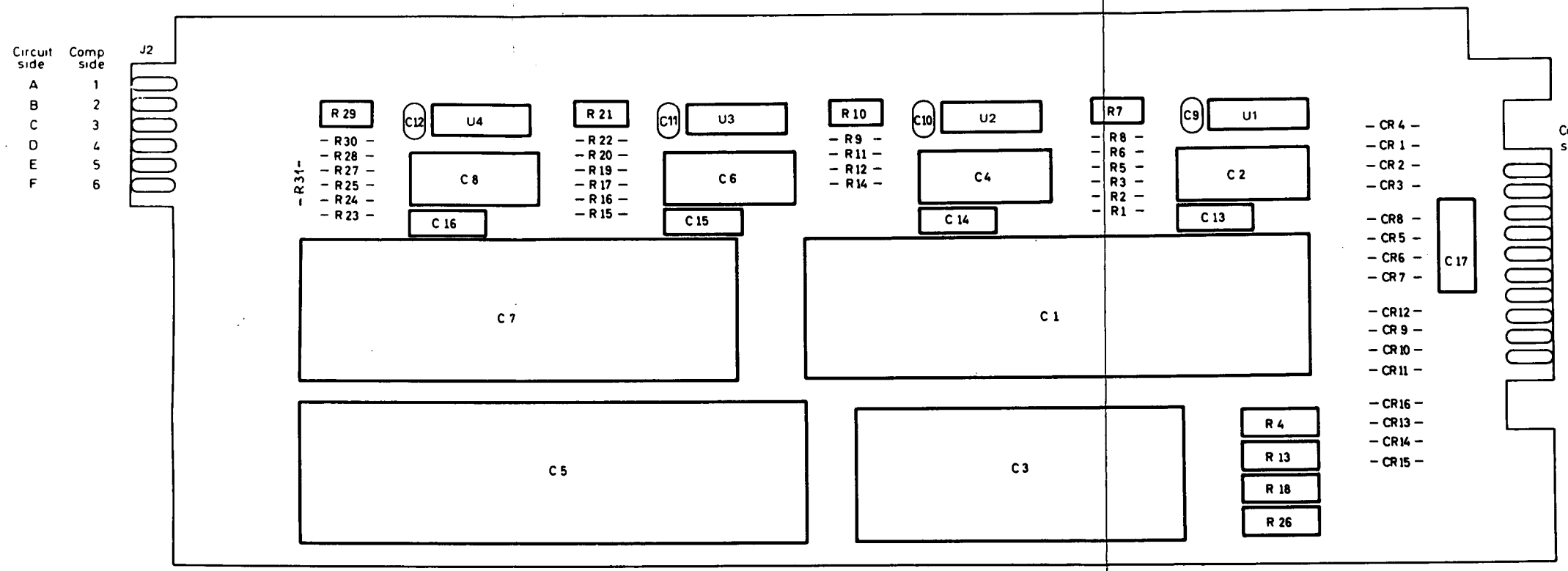
Board A9 – Attenuator Layout

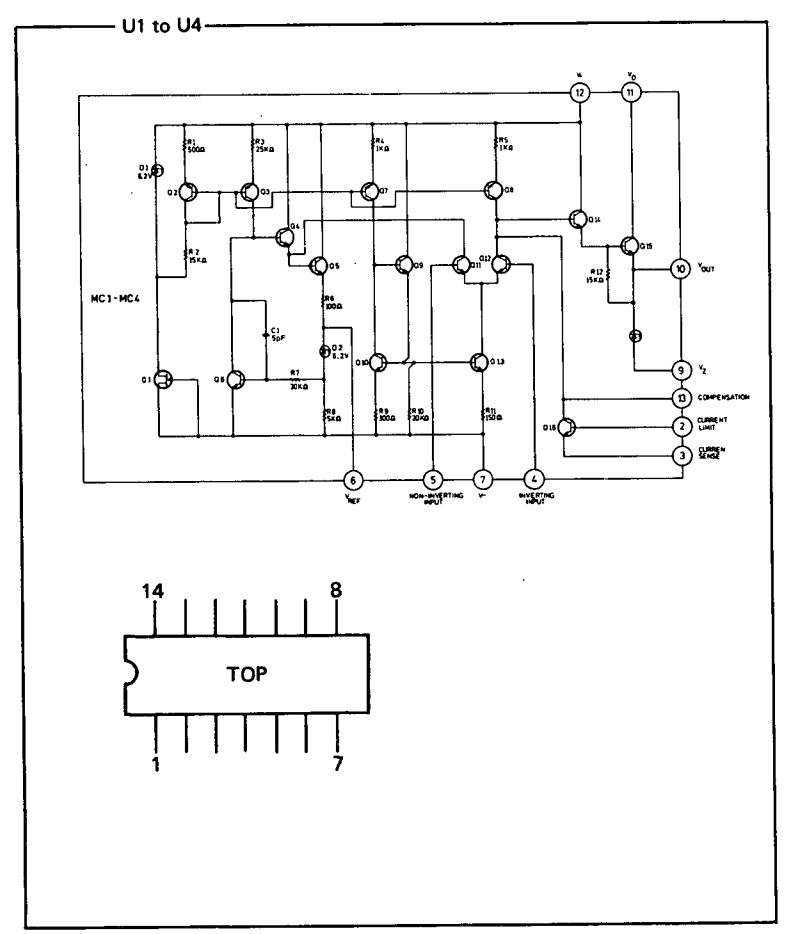


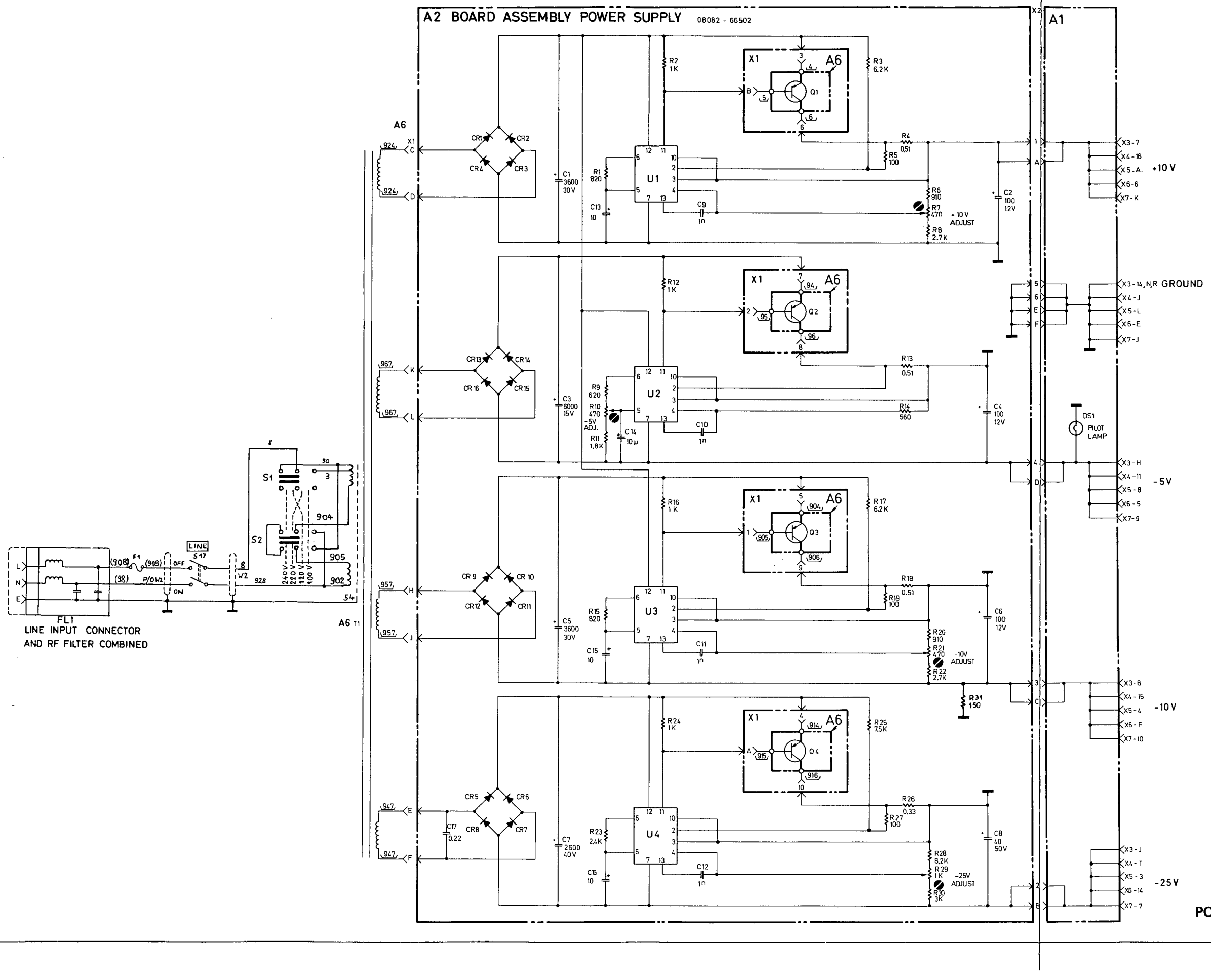
A9 BOARD ASSEMBLY ATTENUATOR 08082 - 66509



Board A2 — Power Supply Layout






A2 BOARD ASSEMBLY POWER SUPPLY 08082 - 66502
A1
A6
FL1
LINE INPUT CONNECTOR
AND RF FILTER COMBINED
LINE
OFF
ON
S1
S2
F1
P/O W2
A6 T1
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
C1 3600 30V
C2 100 12V
C3 6000 15V
C4 100 12V
C5 3600 30V
C6 100 12V
C7 2600 40V
C8 40 50V
C9 1n
C10 1n
C11 1n
C12 1n
C13 10
C14 10µ
C15 10
C16 10
C17 0,22
R1 620
R2 1K
R3 6,2K
R4 0,51
R5 100
R6 910
R7 470
+10 V ADJUST
R8 2,7K
R9 620
R10 470 -5V ADJ.
R11 1,8K
R12 1K
R13 0.51
R14 560
R15 820
R16 1K
R17 6,2K
R18 0.51
R19 100
R20 910
R21 470 -10V ADJUST
R22 2,7K
R23 2,4K
R24 1K
R25 7,5K
R26 0,33
R27 100
R28 8,2K
R29 1K -25V ADJUST
R30 3K
R31 150
U1
U2
U3
U4
Q1
Q2
Q3
Q4
DS1 PILOT LAMP
X3-7
X4-16
X5-A. +10 V
X6-6
X7-K
X3-14,N,R GROUND
X4-J
X5-L
X6-E
X7-J
X3-H
X4-11
X5-8
X6-5
X7-9 -5V
X3-8
X4-15
X5-4
X6-F
X7-10 -10 V
X3-J
X4-T
X5-3
X6-14
X7-7 -25V

7-1 INTRODUCTION

7-2 This section contains backdating information which adapts this manual to instruments with serial numbers lower than that shown on the title page.

7-3 Changes are listed in the serial number order that they occured in the manufacture of the instrument. However, in adapting this manual to an instrument with serial number lower than that shown on the title page, apply the changes in reverse order. That is, begin with the latest change that applies to the serial number in question. Table 7-1 lists the serial numbers to which each change applies. Where changes to components occur, alter the associated schematic and layout diagram as necessary.

Table 7-1 Manual Backdating Changes.

Serial No.	Changes
1410G00145 and lower	1 to 23
1410G00170 and lower	2 to 23
1410G00270 and lower	3 to 23
1410G00300 and lower	4 to 23
1410G00315 and lower	5 to 23
1410G00350 and lower	6 to 23
1410G00390 and lower	7 to 23
1410G00430 and lower	8 to 23
1410G00500 and lower	9 to 23
1635G00515 and lower	10 to 23
1635G00560 and lower	11 to 23
1635G00575 and lower	12 to 23
1635G00775 and lower	13 to 23
1635G00795 and lower	14 to 23
1635G00905 and lower	15 to 23
1635G00925 and lower	16 to 23
1822G01045 and lower	17 to 23
1822G01205 and lower	18 to 23
1822G01230 and lower	19 to 23
1822G01735 and lower	20 to 23
1822G02125 and lower	21 to 23
1822G02275 and lower	22 to 23
1822G02845 and lower	23

CHANGE 1 (1410G00145 and below)

A9 R23, 24, 25, 26 are replaced by a wire link. Amplitude switches S10A, S12A (Schematic 4) are connected to -10 V (instead of -25 V as in later models). A9 K1, 2, 3, 4 are of different type but may be replaced by relay part number 0490-1034 (see A9 parts list) used in later models. The following components are different from those in later models:

A5CR3	1902-0025	DIODE ZNR 10V
A5R58-63	0757-0442	R-F 10K 1%
A5R62	0757-0440	R-F 7.5K 1%

CHANGE 2 (1410G00170 and below)

Change frame parts list to read:

F1	1400-0084	FUSE HOLDER
S6	3101-0124	SW P-BTN SPST

Change A4 parts list to read:

CR17,CR18	1901-0533	DIO HOT CARR.
R204	0757-0283	R-F 2K

CHANGE 3 (1410G00270 and below)

Change frame parts list to read:

F1	2110-0464	BODY FUSE

Delete the following from the frame parts list:

F1	1490-0090	WASHER NEOPRANE
F1	2190-0054	WASHER LOCK
F1	2110-0467	NUT HEX. MET
F1	2110-0465	FUSEHOLDER

CHANGE 4 (1410G00300 and below)

Change A4 parts list to read:

C6	0160-4030	C-F 820 PF
C13	0160-4030	C-F 820 PF
R2	0757-0279	R-F 3.16K
R17	0757-0279	R-F 3.16K

CHANGE 5 (1410G00315 and below)

Change A5 parts list to read:

R88	0698-4471	R-F 7.15K
R90	0698-4444	R-F 4.87K

CHANGE 6 (1410G00350 and below)

Change A5 parts list to read:

R164	0757-0400	R-F 90.9

CHANGE 7 (1410G00390 and below)

Change A5 parts list to read:

CR3	1902-3256	DIO BKDN 23.7V
R94	0757-0273	R-F 3.01K
R142	0757-0273	R-F 3.01K

For these instruments, R142 did not have a factory selected value.

CHANGE 8 (1410G00430 and below)

Delete the following components from the A5 parts list, schematics and component layouts:

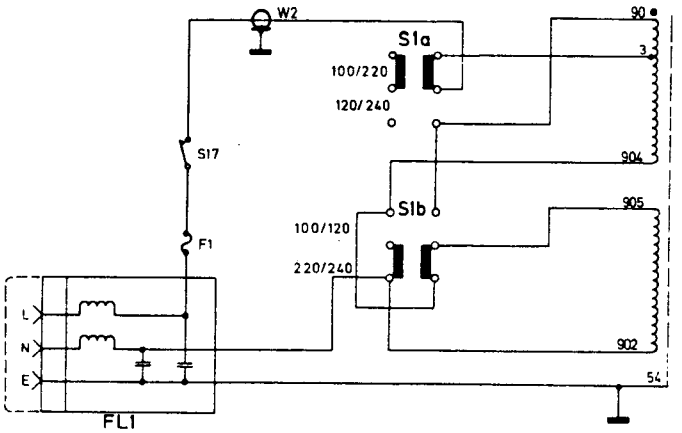
CR23, CR37, R224 and R225

CHANGE 9 (1410G00500 and below)

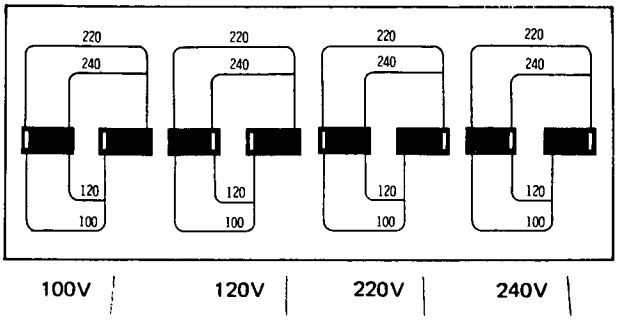
Change frame parts list to read:

MP7	08082-00203	PANEL REAR
S1	3101-1609	SWITCH DPDT DUAL

Page 6-33, change diagram to read:



Page 2-2, replace Figure 2-4 content by:



CHANGE 10 (1635G00515 and below)

Change the A3 parts list to read:

L2-L5	9170-0029	CORE SHIELDING BEAD
L6-L10	9170-0029	CORE SHIELDING BEAD
L15-L19	9170-0029	CORE SHIELDING BEAD
L24,L26	9170-0029	CORE SHIELDING BEAD

Change the A9 parts list to read:

L5,L6	9170-0029	CORE SHIELDING BEAD

CHANGE 11(1635G00560 and below)

Delete the following from the frame parts list:
MP33, MP34, MP35, MP36

CHANGE 12 (1635G00575)

Change the A4 parts list to read:

R47,R106	0757-0283	R-FXD 2K 1% .125W
R241	0698-5180	R-FXD 2K 5% .125W

Delete the following components from the A4 parts list, schematic and component layout:
L30, L31, R242 and R243

CHANGE 13 (1635G00775 and below)

Change A3 parts list to read:

R5,R6,R87	2100-2788	R-VAR 4.7K

CHANGE 14 (1635G00795 and below)

Delete A2 R31 from parts list, schematic and component layout.

Change A5 parts list to read:

R165	0698-5890	R-F 39 OHM

CHANGE 15 (1635G00905 and below)

Change A2 parts list to read:

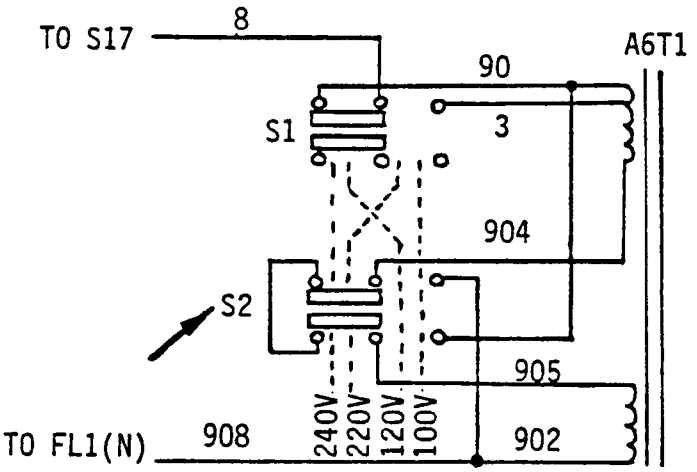
C15	0180-0374	C-F 10 UF 20V

CHANGE 16 (1635G00925 and below)

Change frame parts list to read:

W2	08082-61602	CBL AY PWR SHLD

Change schematic 5 as follows:



CHANGE 17 (1822G01045 and below)

Change frame parts list to read:

MP7	08082-00204	PANEL REAR

Add the following parts to the frame parts list:

FL1	9135-0035	FILTER LINE
S1,S2	3101-2298	SW SLIDE

CHANGE 18 (1822G01205 and below)

Change A4 parts list to read:

C19,C20	5080-1087	CAP SELECT
C17,C18	5080-1088	CAP SELECT

CHANGE 19 (1822G01230 and below)

Change frame parts list to read:

MP4	08015-04103	COVER BOTTOM

CHANGE 20 (1822G01735 and below)

Delete L13 fromthe A3 parts list, schematic and component layout.

Change the A4 parts list to read:

R103	0757-0407	R-F 200
R208	0757-0424	R-F 1.1K

Replace VR42 with R209 on A4 parts list, component layout and schematic.

R209	0757-0428	R-F 1.62K

Change A5 parts list to read:

C22,C23	0160-4209	C-F .01UF

CHANGE 21 (1822G02125 and below)

Change the frame parts list to read:

R1,R2,R3	2100-3081	RESISTOR VAR. 50K 10%

CHANGE 22 (1822G02275 and below)

Change the A4 parts list to read:

R225	0757-0403	R-F 121 1%
R226,R227	0757-0798	R-F 110 1%
R228	0698-4409	R-F 127 1%

Delete R224 and R245 from the A4 parts list, component layout and schematic.

CHANGE 23 (1822G02845 and below)

Change the A4 parts list to read:

J1	1200-0423	SKT IC 16CON
J2	1200-0424	SKT IC 14CON