# Errata

**Title & Document Type:** **3722A Noise Generator Operating and Service Manual**

**Manual Part Number:** **03722-95002**

**Revision Date:** **March 1971**

## 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.

## HP References in this Manual

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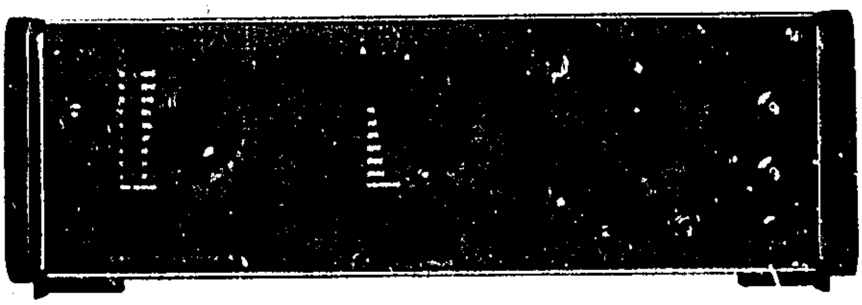
OPERATING AND SERVICE MANUAL

# NOISE GENERATOR
## 3722A



HEWLETT hp PACKARD

HP 3722A

HEWLETT hp PACKARD

## CERTIFICATION

*The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.*

## WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

# MODEL 3722A
# NOISE GENERATOR

**SERIALS PREFIXED: U801**

For instruments with prefixes other than U801, refer to Appendix A and/or the Manual Change sheet.



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## MANUAL CONTENT

This manual is supplied to help you make best use of your instrument. The manual includes 8 sections of information as follows:

**Section I** is an introduction to the instrument. Electrical and mechanical specifications are given.

**Section II** covers inspection, power and signal connexions, packing and shipping.

**Section III** outlines operating procedures.

**Section IV** discusses technical details of circuit operation.

**Section V** provides performance check, trouble-shooting, and adjustment procedures.

**Section VI** lists replaceable parts.

**Section VII** gives information on conversion to Option 01.

**Section VIII** contains circuit diagrams, component locations and individual parts lists extracted from Section VI.

**Appendix A** gives backdating and updating information.

## HOW TO ORDER

To order an Operating and Service Manual, contact your nearest Hewlett-Packard Sales and Service Office. Give complete model, name, and serial number. The serial plate is on the rear panel (see Paragraph 1-10 for serial number system). Comments on this manual are welcome at any Sales and Service Office.

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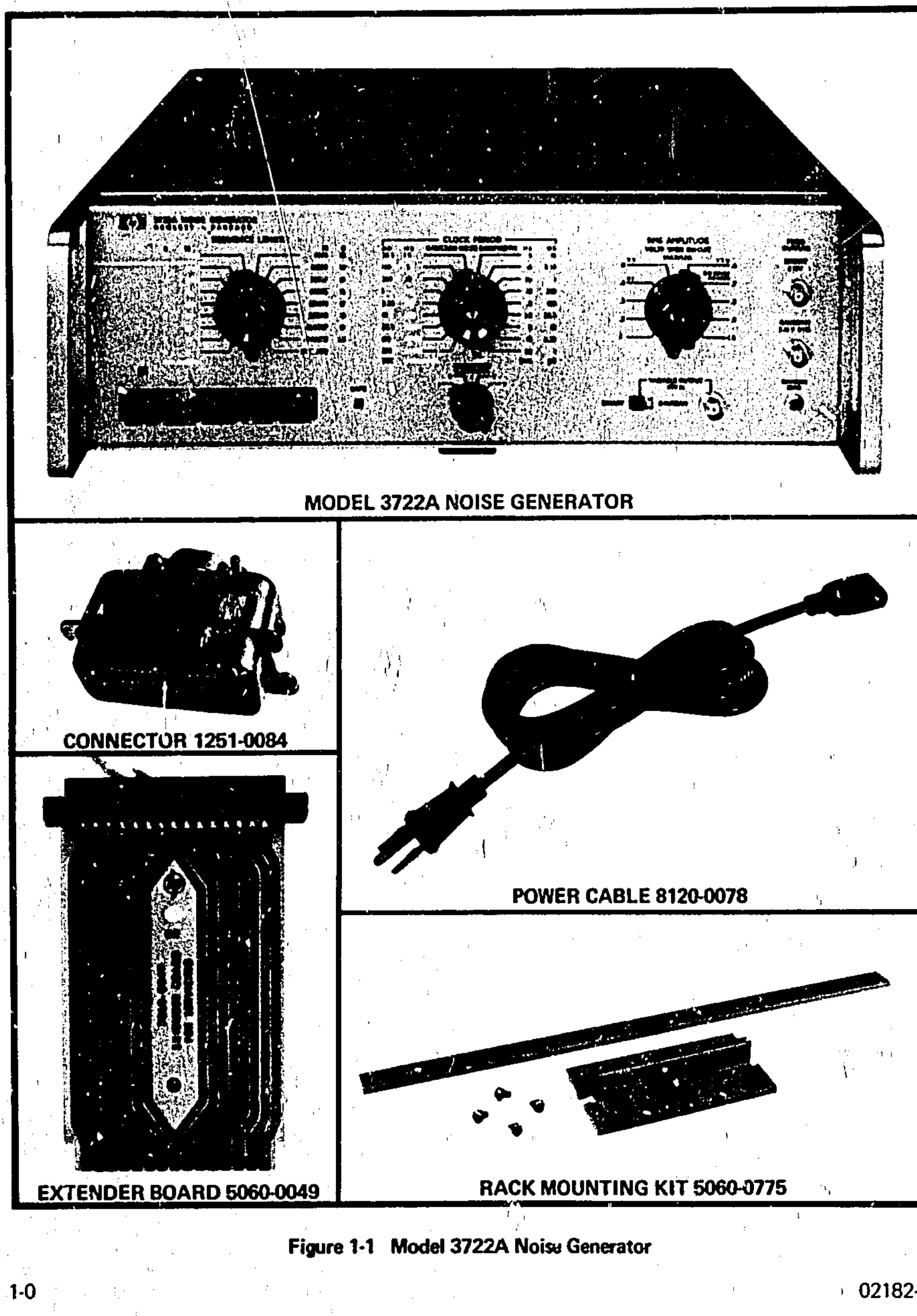



**Figure 1-1 Model 3722A Noise Generator**

# SECTION I
# INTRODUCTION

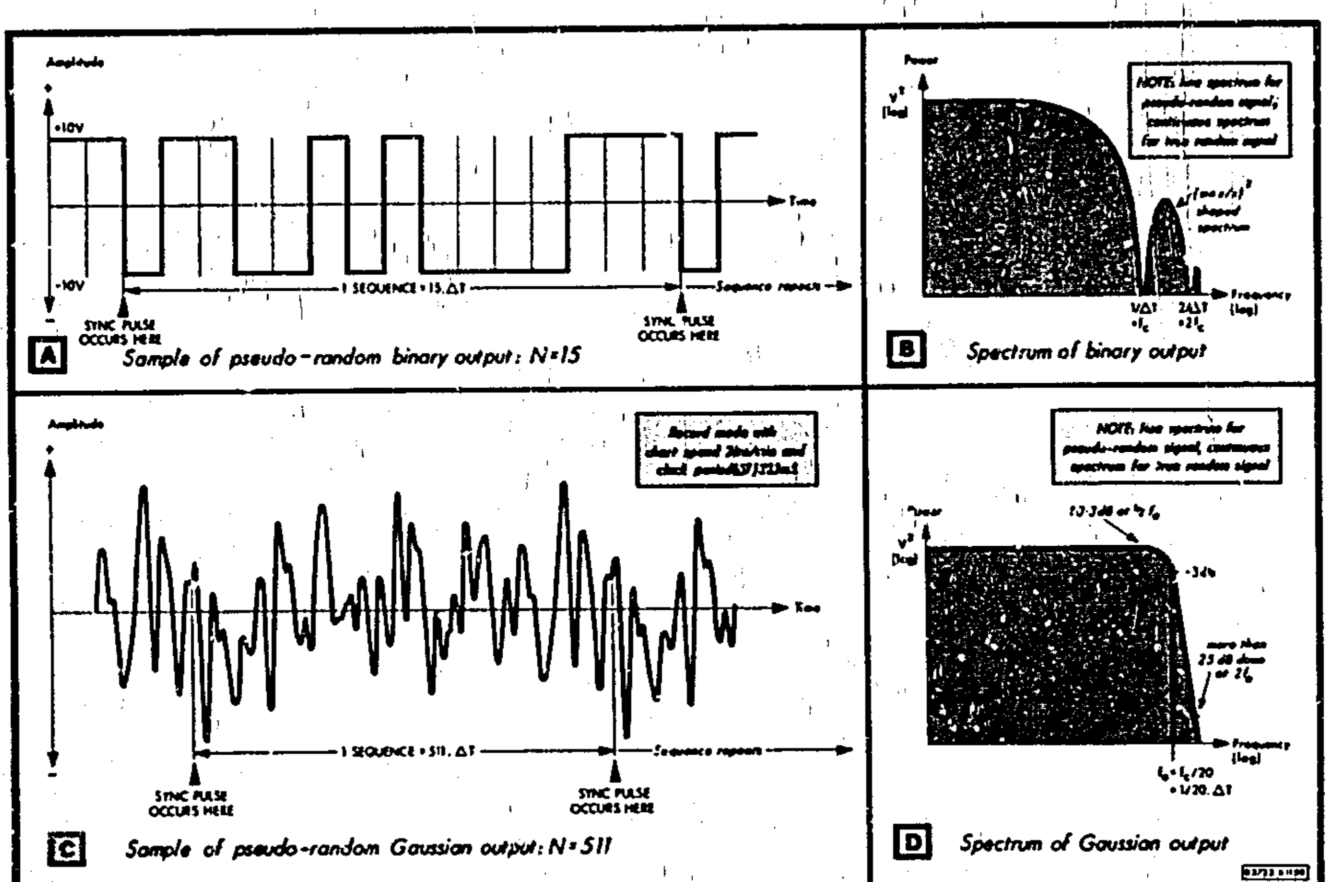
## 1-1 DESCRIPTION

1-2 The Hewlett-Packard *Model 3722A* is a low-frequency broadband noise generator designed primarily for use in control systems evaluation and applications requiring the simulation of random disturbances. Parameters of the *hp 3722A* noise outputs are stable, well-defined and variable over a wide range.

1-3 The *hp 3722A* provides two types of random noise output - a two-level (binary) signal and a continuous analog waveform of approximately Gaussian amplitude distribution. In addition, the *hp 3722A* generates pseudo-random versions of the binary and Gaussian signals: in this mode, the signals are repeated noise patterns, or 'sequences' of known content and duration.

1-4 The spectrum of the binary output is of $(\sin x/x)^2$ form, and that of the Gaussian output is approximately rectangular. Frequency of the first null in the binary spectrum is selectable from 0.003 Hz to 1 MHz (CLOCK PERIOD from 333 seconds to 1µS), and the bandwidth (at -3 dB point) of the Gaussian noise is selectable from 0.00015 Hz to 50 kHz.

1-5 In the random mode the outputs have continuous spectra extending down to dc. In the pseudo-random mode the outputs have line spectra, the harmonic spacing being established by the combination of CLOCK PERIOD ($\Delta T$) and SEQUENCE LENGTH (N) settings. The product of $\Delta T$ and N gives the duration of the pseudo-random noise pattern, and its reciprocal is the lowest frequency in the spectrum. Outputs from the *hp 3722A* are




A Sample of pseudo-random binary output: N=15

B Spectrum of binary output

C Sample of pseudo-random Gaussian output: N=511

D Spectrum of Gaussian output

**Figure 1 - 2 Examples of binary & Gaussian outputs**

# SPECIFICATIONS

## BINARY OUTPUT
**(FIXED AMPLITUDE)**

**AMPLITUDE**

± 10V ± 1% when clock period $\geqslant$ 333μS, ± 3% when 333μS > clock period > 1μS, ± 5% when clock period = 1μS.

**OUTPUT IMPEDANCE**

< 5Ω if clock period $\geqslant$ 333μS, < 10Ω if clock period $\leqslant$ 100μS

**LOAD IMPEDANCE**

1kΩ minimum

**RISE TIME**

< 100nS

**POWER DENSITY**

(clock period x 200) volt$^2$/Hz, at low frequency end of spectrum

**POWER SPECTRUM**

$(\sin x/x)^2$ form: first null occurs at clock frequency and -3dB point occurs at 0.45 x clock frequency

## GAUSSIAN OUTPUT
**(FIXED AMPLITUDE)**

**AMPLITUDE**

3.16V rms ± 2% when bandwidth $\geqslant$ 0.15Hz, +6% -2% if bandwidth $\leqslant$ 0.05Hz: this specification is valid only when sequence length $\geqslant$ 1,023

**OUTPUT IMPEDANCE**

< 1Ω

**LOAD IMPEDANCE**

600Ω minimum

**ZERO DRIFT**

< 5mV change in zero level in any 10°C range from 0° to +55°C

**POWER DENSITY**

Approximately equal to (clock period x 200) volt$^2$/Hz, at low frequency end of spectrum

**POWER SPECTRUM**

Rectangular, low pass: nominal upper frequency $f_0$ (-3dB point) equal to 1/20th of clock frequency. Spectrum is flat within ± 0.3dB up to 1/2 $f_0$, and more than 25dB down at 2 $f_0$

**CREST FACTOR**

Ratio of peak to rms amplitude: up to 3.75 dependent on sequence length

**PROBABILITY DENSITY FUNCTION**

See error curves, Figure 3-9

## VARIABLE OUTPUT
**(BINARY OR GAUSSIAN)**

**AMPLITUDE (OPEN CIRCUIT)**

**BINARY**

4 ranges: ± 1V, ± 3V, ± 3.16V and ± 10V, with ten steps in each range, from x 0.1 to x 1.0

**GAUSSIAN**

3 ranges: 1V rms, 3V rms and 3.16V rms, with ten steps in each range, from x 0.1 to x 1.0

**CALIBRATION ACCURACY**

Better than ± 2.5%, plus tolerance on binary or Gaussian output, as selected

**OUTPUT IMPEDANCE**

600Ω ± 1%, plus impedance of binary or Gaussian output, as selected

# SPECIFICATIONS

## MAIN CONTROLS

### SEQUENCE LENGTH SWITCH

First 17 positions select different pseudo-random sequence lengths: final position selects random mode of operation (INFINITE sequence length). Sequence length (N) is number of clock periods in sequence: possible values of N are 15, 31, 63, 127, 255, 511, 1023, 2047, 4095, 8191, 16383, 32767, 65535, 131071, 262143, 524287, 1048575. $N = 2^n - 1$; where n is in the range 4 to 20 inclusive.

### CLOCK PERIOD SWITCH

Selects 18 frequencies from internal clock:

| Clock period | Clock frequency | Gaussian noise bandwidth |
|---|---|---|
| 333 sec | 0.003Hz | 0.00015Hz |
| 100 sec | 0.01Hz | 0.0005Hz |
| 33.3 sec | 0.03Hz | 0.0015Hz |
| 10 sec | 0.1Hz | 0.005Hz |
| ↓ | ↓ | ↓ |
| 3.33µS | 300kHz | 15kHz |
| 1µS | 1MHz | 50kHz |

## INTERNAL CLOCK

### CRYSTAL FREQUENCY

3MHz nominal

### FREQUENCY STABILITY

Better than ± 25ppm over ambient temperature range 0° to +55°C

### OUTPUT

+1V to +12.5V rectangular wave, period as selected by CLOCK PERIOD switch. Maximum current at 1V level, 10mA

## EXTERNAL CLOCK

### INPUT FREQUENCY

1MHz maximum, for stated specifications. Usable BINARY output (pseudo-random only) with external clock frequencies up to 1.5MHz

### INPUT LEVEL

Negative-going signal from +5V to +3V initiates clock pulse. Maximum input ± 20V

### INPUT IMPEDANCE

1kΩ nominal

## SECONDARY OUTPUTS

### SYNC

Negative-going pulse (+12V to +1.5V) occurring once per pseudo-random sequence; duration of pulse equal to selected clock period. Maximum current at 1.5V level, 10mA

### GATE

Gate signal indicates start and completion of selected number of pseudo-random sequences (1, 2, 4 or 8, selected by front panel control). Two outputs are provided:-

(1) Logic signal: output normally +12.5V, falls to +1V at start of gate interval and returns to +12.5V at end of interval. Maximum current at 1V level, 10mA

# SPECIFICATIONS

(2) Relay changeover contacts: gate relay switching is synchronous with logic signal

Maximum current controlled by relay: 500mA (cont.)

Maximum voltage across relay contacts: 100V

Maximum load controlled by relay: 3W (cont.)

### BINARY RELAY

Relay changeover contacts operate in sync with binary output signal (available only when clock period ≥ 100mS). Relay specification as for gate relay, above

## REMOTE CONTROL

### CONTROL INPUTS

Remote control inputs for RUN, HOLD, RESET and GATE RESET functions are connected to 36-way receptacle on rear panel
Command signal (each input): dc voltage between +1.5V and zero volts
No-command condition: open-circuit input, or dc voltage between +5.5V and +12.5V.
Input impedance: 5kΩ nominal (RUN, HOLD, RESET)
1.5kΩ nominal (GATE RESET)

### SEQUENCE LENGTH INDICATION

18 pins plus one common pin on the 36-way receptacle are used for remote signalling of selected sequence length (contact closure between common pin and any one of the 18 pins)

## GENERAL

### CONSTRUCTION

Standard 19 in. rack-width module, with tilt stand

### AMBIENT TEMPERATURE RANGE

$0^{\circ}$ to $+55^{\circ}C$

### POWER REQUIREMENT

115 or 230V ± 10%, 50 to 1000Hz, 70W

### WEIGHT

Net 10.5kg (23 lb), shipping 13.5kg (30 lb)

### ACCESSORIES FURNISHED

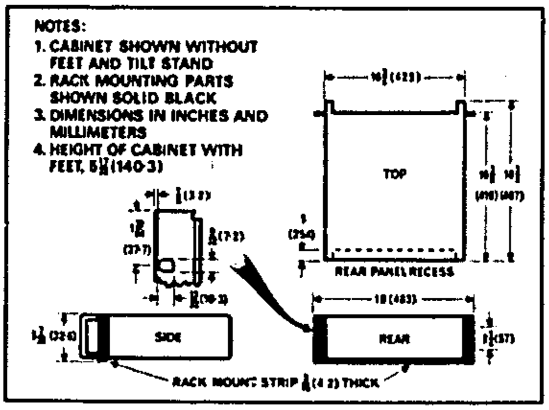
Detachable power cord, rack mounting kit, circuit extender board, 36-way male cable plug, operating and service manual.

## OPTION 01

### ZERO MOMENT OPTION

Shifts relative position of sync pulse and pseudo-random binary sequence such that first time moment of sequence, taken with respect to sync pulse, is zero (sequence shift mechanism is operative only when selected sequence length is ≤ 1023): option 01 also provides facility for inverting binary output signal

## DIMENSIONS



available at fixed amplitudes of ±10V (binary) and 3.16V rms (Gaussian), and a precision RMS AMPLITUDE control provides a variable output ranging from 0.1V up to the level of the fixed outputs. When operating in the pseudo-random mode, the *hp 3722A* provides timing signals (sync and gate pulses) for the control of external measurements.

**1-6 OPTION 01**

1-7 Time averages taken over one period of a pseudo-random sequence are normally independent of the point in time at which the averaging starts. However, when the test signal is contaminated by background disturbances, such as steady drifts, the result of the averaging measurement can be in error. In such cases, the magnitude and sign of the error depend critically on the starting point of the averaging process. In Option 01 models, the starting point (identified by the sync pulse) is optimised for each of the seven shortest sequences (15, 31, 63, 127, 255, 511 and 1023).

1-8 A standard instrument may be converted into an Option 01 version simply by the removal of a wire link and the insertion of a circuit board (the sequence advance assembly) into a pre-wired socket on the main chassis. The conversion procedure is described in Section VII.

**1-9 INSTRUMENT IDENTIFICATION**

1-10 An identification plate on the rear panel of the instrument carries a two-section, eight-digit serial number. The first three digits form the serial prefix number and the last five digits refer to a specific instrument. If the serial prefix on your instrument is not as given on the title page of this manual, there are differences between the manual and your instrument: these differences are described, together with manual errata, in the yellow change sheet included with the manual. For the latest information on the instrument, contact your nearest Hewlett-Packard field office. In any communication with the Company, specify model number and complete serial number.

# SECTION II
# INSTALLATION

## 2-1 INTRODUCTION

2-2 This section contains information on unpacking, inspection, storage, shipment and installation.

## 2-3 UNPACKING AND INSPECTION

2-4 If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dent, broken knobs, etc). If the instrument is damaged or fails to meet specifications (Performance check, Section V), notify the carrier and the nearest Hewlett-Packard field office immediately (field offices are listed at the back of this manual). Retain the shipping carton and the padding material for the carrier's inspection. The field office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

## 2-5 STORAGE AND SHIPMENT

2-6 PACKAGING. Use the original shipping carton and packing material, if available. Your Hewlett-Packard field office will provide information and recommendations on materials to be used if the original packing material has been discarded, or is not re-usable.

Materials used should include:

(1) A double-walled carton (350 lb/sq. in. bursting test).

(2) Heavy paper, polythene or sheets of cardboard to protect all instrument surfaces. Use extra material around projecting parts.

(3) At least 4 in. thickness of tightly-packed shock-absorbing material surrounding the instrument.

Close the carton securely with durable shipping tape. If the instrument is to be shipped to a Hewlett-Packard field office, attach a tag showing owner and address, model number, serial number, trouble symptoms and/or repairs required.

2-7 ENVIRONMENT. Conditions during storage and shipment should be limited as follows:

(1) Maximum altitude 20,000 feet

(2) Minimum temperature -40°F (-40°C)

(3) Maximum temperature +167°F (+75°C)

## 2-8 POWER CONNEXION

2-9 LINE VOLTAGE. The *3722A* will operate from either 115V or 230V (± 10%) power lines. A slide switch on the rear panel permits rapid selection of the appropriate line transformer tappings. Insert a screwdriver into the switch slot and slide the switch to expose the appropriate number (115 or 230). For fuse ratings, see Table 2-1.

**CAUTION**

**Before connecting the instrument to the power supply, check that the slide switch is in the correct position.**

**Table 2-1 115/230V conversion**

| | | |
|---|---|---|
| Line voltage | 115V | 230V |
| Slide switch | 115 | 230 |
| Fuse | 2 ampere slow-blow *hp 2110-0006* | 1 ampere slow-blow *hp 2110-0007* |

2-10 POWER CABLE. The *3722A* is equipped with a detachable 3-wire power cable. Proceed as follows for installation:

(1) Plug the flat connector on the power cable into the 3-pin jack on the rear panel of the instrument.

(2) Connect the power cable plug (2-blade with round grounding pin) to a 3-wire power outlet. Exposed metal parts of the instrument are grounded through the round pin on the plug. If the plug does not fit your power outlet, either use a 3-blade to 2-blade adapter (*hp 1251-0048*) or cut off the plug and fit one to suit your requirements. If the instrument is powered, via an adapter, from a 2-contact outlet, the green pigtail on the adapter should be grounded.

2-11 Power cable connexions are as follows:

| | |
|---|---|
| Black wire | LIVE (hot) |
| White wire | NEUTRAL |
| Green wire | GROUND (safety) |

## 2-12 SIGNAL CONNEXIONS.

2-13 All signal inputs and outputs, excepting those concerned with remote control, are via BNC female connectors. Connexions to the 36-way remote control receptacle are shown in Section III.

## 2-14 BENCH USE

2-15 As shipped from the factory, the *3722A* is ready for bench use. The cabinet is fitted with a foldaway tilt stand which allows the instrument to be inclined for more convenient viewing of the control panel. Plastic feet on the cabinet provide positive location for the *3722A* when stacked with other *hp* full-width modular instruments.

2-16 A control panel cover with carrying handle, *hp 5060-0827*, is available for the *3722A*. The cover, which provides protection in transit, fits between the handles at the front of the instrument, and is held in place by two push-button latches.

## 2-17 RACK INSTALLATION

2-18 A rack mounting kit, *hp 5060-0775*, is supplied with the instrument. For location of the rack mounting parts, refer to Figure 2-1. The assembly procedure is as follows:

(1) Spring the tilt stand free from the feet at the front of the instrument.

(2) Remove the feet (press the release button, slide foot towards the centre of the instrument, and lift clear).

(3) Remove the adhesive-backed corrugated trim strips from the side frames.

(4) Attach the two rack-mount flanges to the side frames (larger corner-notch in the flanges towards the bottom of the instrument).

(5) Attach the wedge shaped grey plastic filler strip to the bottom edge of the front panel (thicker edge of the strip towards the front of the instrument).

**CAUTION**

**Ambient temperature in the rack should not exceed +55°C. Ensure that the position of the instrument in the rack permits air circulation to the intakes on the sides of the instrument, and that nearby instruments do not discharge hot air near the intakes.**

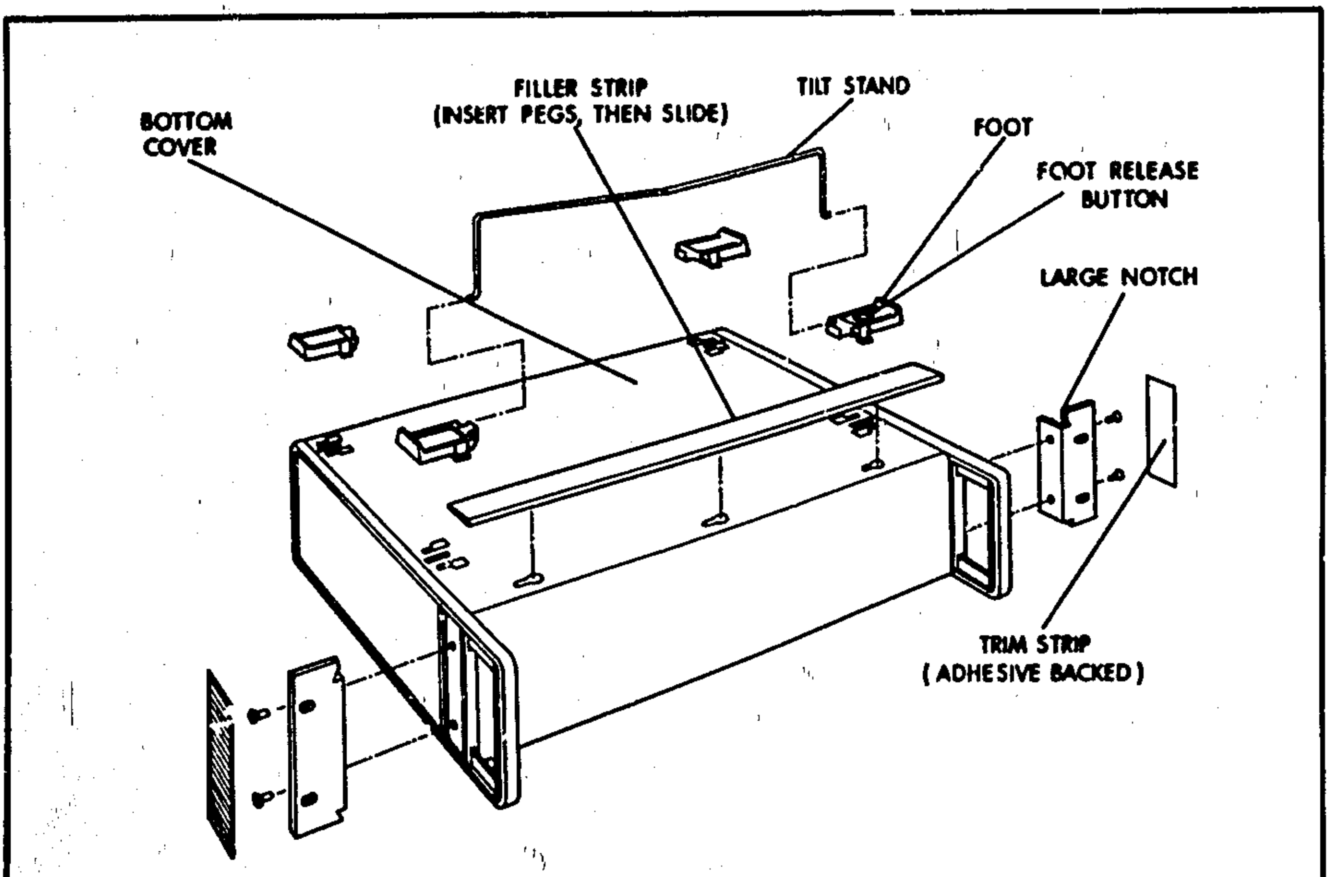



**Figure 2-1 Assembly of rack mounting parts**

# SECTION III
# OPERATION

## 3-1 INTRODUCTION

3-2 Switch-on instructions, together with a summary of the push-button control functions, are given in paragraphs 3-3 to 3-7. Paragraphs 3-8 to 3-37 describe in detail the BINARY and GAUSSIAN outputs from the *hp 3722A*, and the effect upon them of the CLOCK PERIOD and SEQUENCE LENGTH controls. Some description of the noise generation mechanism is included, as this is essential user information. Details of timing outputs from the *hp 3722A* are given in paragraphs 3-38 to 3-41, and a summary of all controls and outputs is given in the text related to Figure 3-18.

## 3-3 SWITCH-ON PROCEDURE

3-4 Essential steps are as follows:-

(1) Check line voltage selector on rear panel: set as appropriate (115 or 230). Connect supply.

(2) Set CLOCK switch on rear panel to INT (or EXT if an external clock is to be used to time *3722A*: for specifications of external clock, refer to Figure 3-13).

(3) Set CONTROL selector on rear panel to LOCAL.

(4) Complete, if required the rapid functional check detailed in Table 3-1.

## 3-5 PUSH-BUTTON CONTROLS

3-6 HOLD and RESET. Either of these push-buttons, when operated, stops the supply of shift pulses to the shift register (paragraph 3-9), and thus inhibits both noise outputs (binary and Gaussian) from the *3722A*. The HOLD button allows the generator to be stopped at any point in a pseudo-random sequence; when the instrument is re-started, by operation of the RUN button, noise generation is resumed from the point in the sequence at which it ceased. The RESET button performs two functions – it stops the supply of shift pulses *and* drives the shift register to a pre-determined state. Both HOLD and RESET operations are illustrated in Figure 3-1.

3-7 GATE RESET. When operated, the GATE RESET control primes a store circuit which, on the following sync pulse, initiates a gate signal. The gate interval depends on (1) the selected duration of pseudo-random sequence, and (2) the setting of the 'SEQUENCES PER GATE INTERVAL' control on the front panel: the latter control can be set for 1, 2, 4 or 8 sequences. Thus with a sequence length of 15 and clock period of 1 second (sequence duration = 15 seconds), the gate signal lasts for 15, 30, 60 or 120 seconds, depending upon the setting of the control. The gate signal falls from +12.5V to zero at the start of the gate interval, and returns to +12.5V at the end. A relay contact version of the gate signal is also provided.

## 3-8 BINARY OUTPUT

3-9 GENERAL. The binary output is generated by a shift register which is triggered at regular intervals by shift pulses derived from a crystal-controlled clock. A change in the output level (from binary '1' to binary '0', or vice-versa) can occur only when the shift register receives a shift pulse: in the interval between shift pulses, the output remains at a constant level.

3-10 The binary signal is available, at fixed amplitude, from the BINARY connector on front and rear panels. Amplitude of the 'fixed' output is nominally ± 10V. Note that a binary signal of ± 10V has an rms amplitude of 10V. Logic definitions used in this section are:

| | |
|---|---|
| Binary '1' | -10V |
| Binary '0' | +10V |

Important characteristics of the binary output are as follows:

| | |
|---|---|
| Output impedance | < 10Ω |
| Load impedance | 1kΩ minimum |
| Rise time | < 100nS |

3-11 The binary signal is available, from a 600Ω impedance source, at the VARIABLE OUTPUT connectors on front and rear panels. The red RMS AMPLITUDE control selects one of four multiplier ranges, and the black control selects one of ten intermediate steps from x 0.1 to x 1.0. Multiplier ranges are:

± 10V, ± 3.16V (= $\pm\sqrt{10}$V), ± 3V and ± 1V.

NOTE These are *open-circuit* amplitudes (i.e. if the VARIABLE OUTPUT is connected to a 600Ω load, the voltage across the load is half that indicated by the RMS AMPLITUDE controls).

3-12 A relay-contact version of the binary signal is available (rear panel BINARY RELAY binding posts) when the selected clock period is 100mS or greater.

3-13 PSEUDO-RANDOM MODE. In the pseudo-random mode, the shift register generates repeated sequences (or patterns) of binary ones and zeros, the form and length of the sequence being established by feedback connexion to the first stage of the register. Feedback selection is made by the SEQUENCE LENGTH switch.

3-14 Pseudo-random, 'maximum length' type, binary sequences (p.r.b.s.) generated by the *hp 3722A* are described in terms of the number of clock periods (or bits) they contain, this being a function of the number of shift register stages involved in generation of the sequence (a maximum of 20 stages is connected into the feedback loop which establishes the length of sequence). The length of a sequence = N bits = $2^n-1$, where n is the number of stages in the feedback system. Thus with

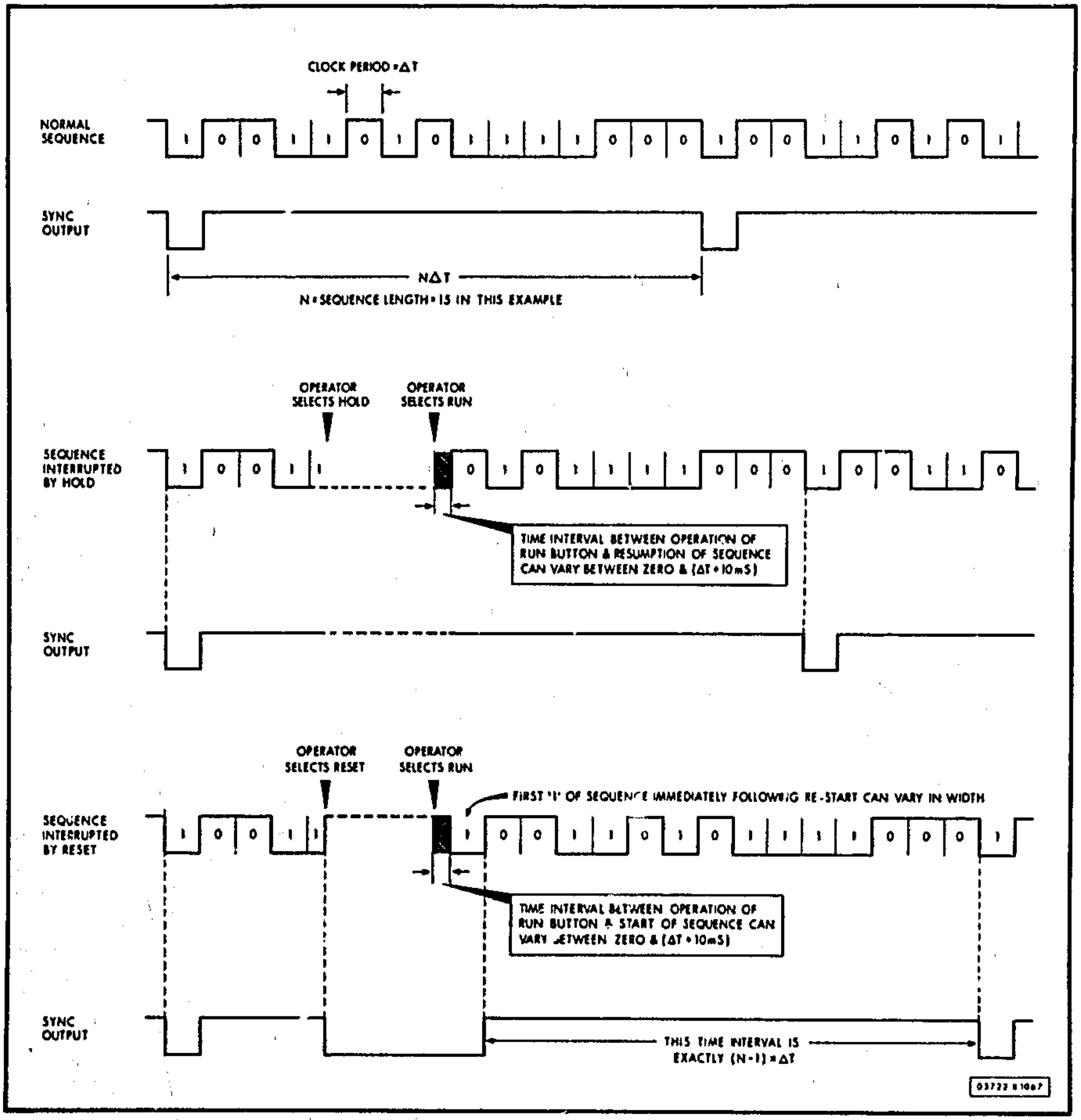



**Figure 3-1 Interruption of sequence by HOLD and RESET**

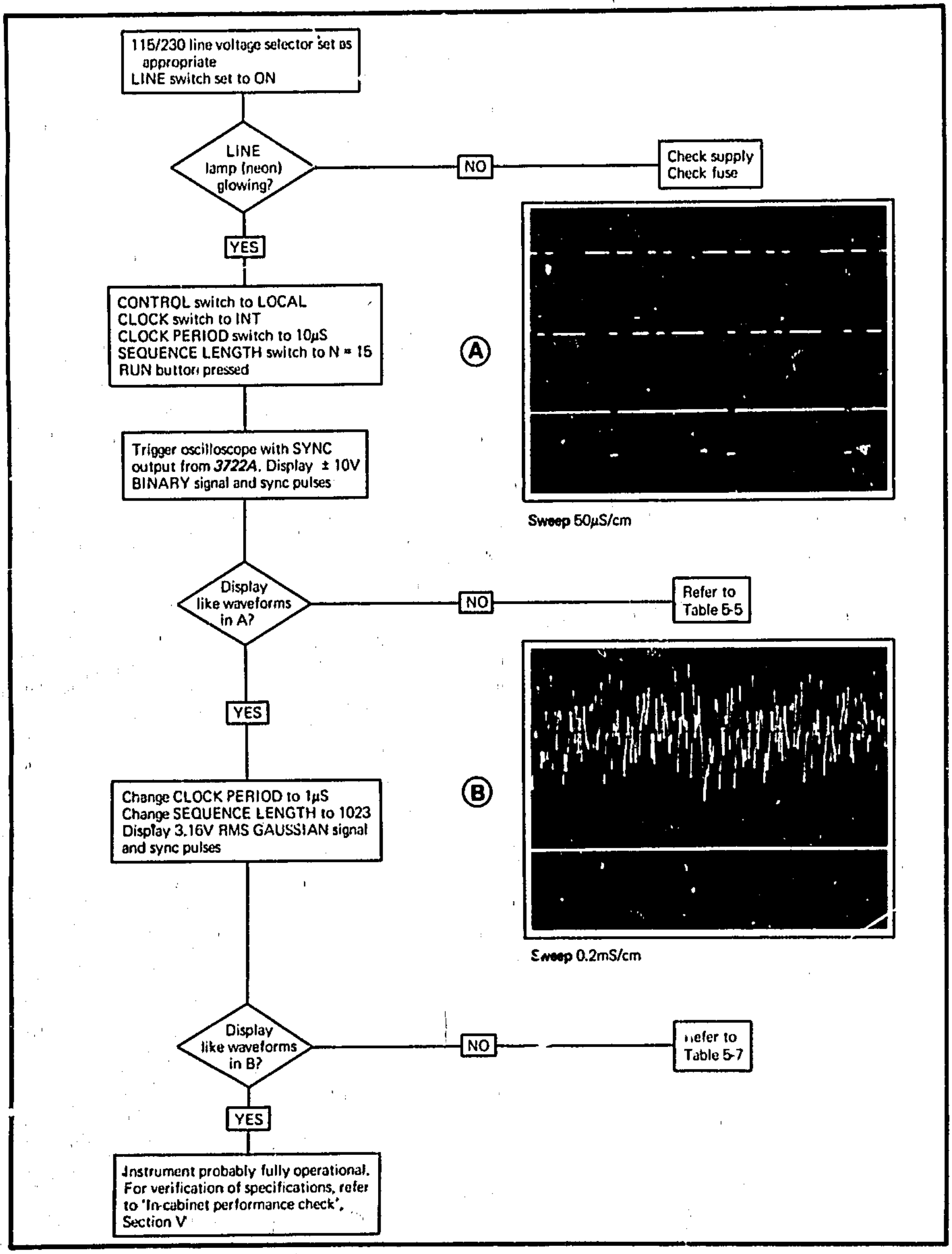



**Table 3-1 Rapid functional check**

4 'active' stages, the sequence length is $2^4-1$ = 15 bits. The SEQUENCE LENGTH switch selects values of n from 4 to 20 inclusive: these, together with the corresponding values of N, are marked on the front panel.

3-15 For a particular number of active stages (i.e. for a particular value of n) there are many possible sequences, all of the same maximum length, N = $2^n-1$, but of different form. In applications where binary noise is used as the test signal, the actual form of the sequence (i.e. the pattern of ones and zeros) is generally of little concern. For each length of sequence generated by the *hp 3722A*, however, a particular form has been chosen to give a good distribution of amplitude in the Gaussian Signal – which is derived from the shift register outputs by a digital to analog conversion process. This optimisation of sequence form applies only to sequences of length 255 periods (n = 8) and greater (with the shorter sequences, it is not possible to obtain a Gaussian-type distribution of amplitude).

3-16 The period (T) of a pseudo-random sequence is equal to the product of N and $\Delta T$, where $\Delta T$ is the clock period. $\Delta T$ is set by the CLOCK PERIOD switch and is selectable, in 18 steps, from 1$\mu$S to 333 seconds.

3-17 An example of a pseudo-random binary sequence is given in Figure 3-2. This shows the actual waveform at the BINARY connector of the *hp 3722A*, with the SEQUENCE LENGTH switch set to N = 15.

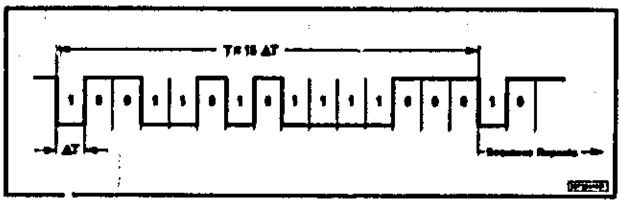


**Figure 3 - 2 15-bit p.r.b.s. generated by *3722A***

3-18 A pseudo-random binary sequence has a line power spectrum (Figure 3-3), the envelope of which is of the mathematically defined $(\sin x/x)^2$ form. The fundamental frequency (i.e. the lowest frequency component in the spectrum) is 1/T = $1/N\Delta T$, = $f_c/N$. All other components in the spectrum are harmonics of 1/T (i.e. integral multiples of 1/T, giving frequencies of 2/T, 3/T, 4/T, etc).

3-19 If, with constant $\Delta T$, N is increased, the frequency of the fundamental (and the spacing of the harmonics) is reduced, causing the number of harmonic components per spectrum lobe to increase. Since the total power of the binary output remains

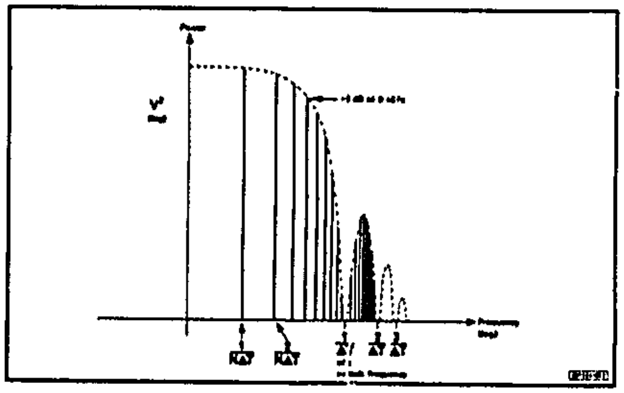


**Figure 3 - 3 Power spectrum of p.r.b.s.**

the same (the waveform still switches between the same amplitude levels), the magnitude of the harmonics is proportionately reduced. If, say, N is doubled, there will be twice the number of components in the spectrum, and the power contributed by each component will be halved. Variations in N therefore do not affect power density, i.e. power per unit bandwidth.

3-20 The envelope of the p.r.b.s. line spectrum is given by the expression:

$$G(f_k) = 2a^2 \left(\frac{N+1}{N^2}\right)\left(\frac{\sin\frac{\pi k}{N}}{\frac{\pi k}{N}}\right)^2$$

Where: $G(f_k)$ is the power, in (volts)$^2$, contributed by the k th harmonic
'a' is the rms amplitude (half peak-to-peak voltage) of the binary signal
'N' is the sequence length

3-21 POWER DENSITY. Calculation of the power contributed by each harmonic is illustrated by the following example, when N = 1023 and $\Delta T$ = 1$\mu$S. For the power contributed by the fundamental, let k = 1 in the above expression.

$$G(f_1) = 2a^2 \left(\frac{N+1}{N^2}\right)\left(\frac{\sin\frac{\pi}{N}}{\frac{\pi}{N}}\right)^2$$

Since N is large, $(N+1)/N^2$ is approximately 1/N, and the squared term is approximately unity. The amplitude, 'a', of the binary signal is 10V.

Therefore, $G(f_1) \simeq \frac{200}{N} = \frac{200}{1023} = 0.195V^2$

Since there are no power contributions at frequencies between the discrete lines of the spectrum, the power in each line (at the low frequency end of the spectrum) must also be equal to $0.195V^2$.

The line spacing is equal to $1/N\Delta T$ Hz.

Therefore, power density = power per unit bandwidth

$$= \frac{200}{N} N\Delta T$$
$$= 200\ \Delta T$$
$$= 200 \times 10^{-6}$$
$$= 0.0002\ V^2/Hz$$

3-22 From the above, it can be seen that power density is directly proportional to clock period, as illustrated by Figure 3-5. The number of lines in the first lobe depends only on N. Reducing the clock frequency $f_c$ (= $1/\Delta T$) squeezes these lines into a narrower bandwidth. Hence, the power per unit bandwidth increases.

**NOTE** The amplitude of individual lines is independent of clock frequency.

3-23 By adjusting the clock period, the power density of the BINARY output can be varied from a minimum of 0.0002 $V^2/Hz$ (clock period $1\mu S$) to a maximum of 67,000 $V^2/Hz$ (clock period 333 sec).

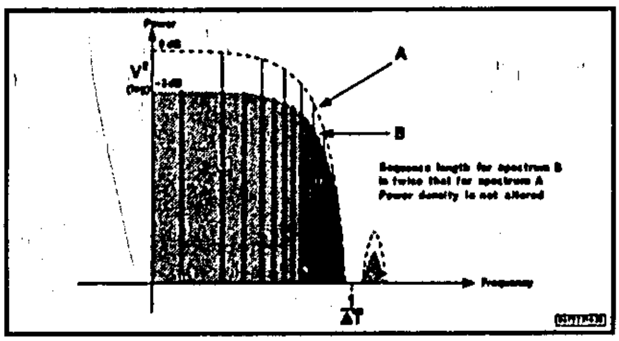



**Figure 3 - 4 Effect of varying sequence length**

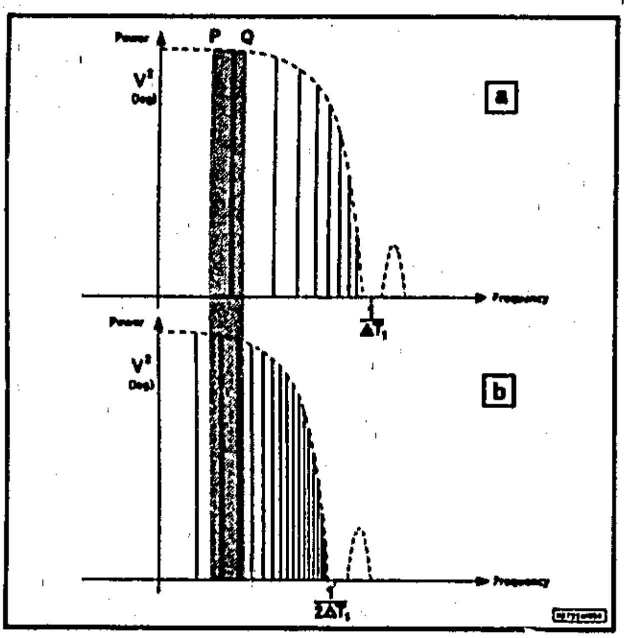



**Figure 3 - 5 Effect of varying clock frequency**

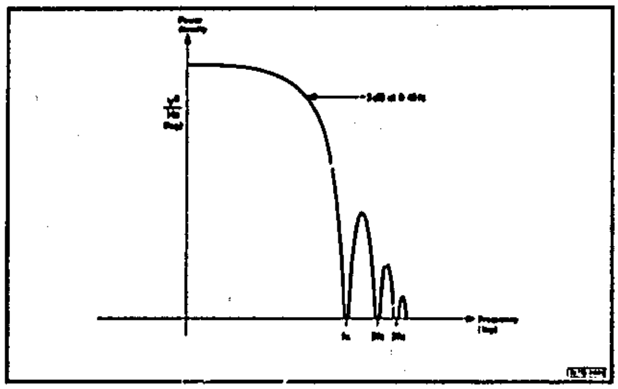


**Figure 3 - 6 Continuous spectrum of random binary output**

3-24 RANDOM MODE. When the SEQUENCE LENGTH switch is set to INFINITE, the shift register feedback loop is disconnected, and the first stage of the register is controlled by a noise source giving a truly random output. Triggering of the shift register remains under the control of the clock. Just before each shift pulse, the random signal is sampled by a level detector which decides, on arrival of the shift pulse, whether a '1' or '0' is to be placed in the first stage of the register. Since the random signal is non-periodic, there is no repeated pattern in the resulting series of ones and zeros from the register (i.e. N is infinite). In this 'random' mode, the spectrum (Figure 3-6) of the binary output is continuous (it contains no discrete harmonics) and is the same shape as the envelope of the p.r.b.s. line spectrum. Power density of the random output, at the low frequency end of the spectrum, is the same as for the p.r.b.s., i.e. $(200\ \Delta T)V^2/Hz$.

**3-25 GAUSSIAN OUTPUT**

3-26 GENERAL. The two-level binary signal from the shift register is converted, by low-pass filtering, into a continuous analog waveform having an approximately Gaussian probability density function (p.d.f.). Low-pass filtering and spectrum shaping is performed by a digital filter working in con-

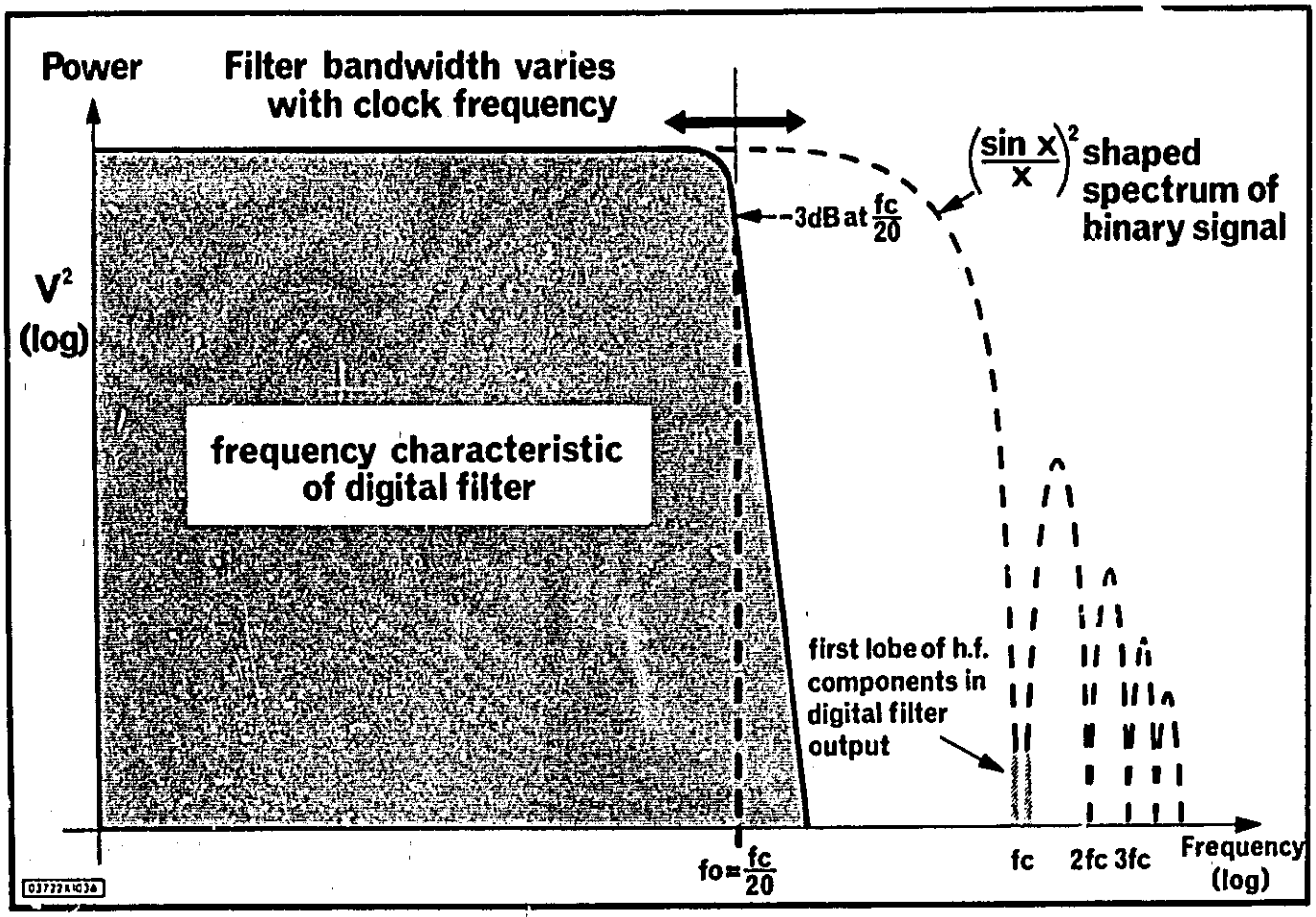



**Figure 3 - 7 Conversion of binary noise to Gaussian noise by low-pass filtering**

junction with the shift register. High frequency components arising from the digital filtering process are removed by a second order analog smoothing filter.

3-27 SPECTRUM. The frequency response of the digital filter (which alone determines the shape of the Gaussian noise spectrum) approaches the 'ideal' rectangular shape, as shown in Figure 3-7.

Important features of the Gaussian noise spectrum are:

(1) The cut-off frequency is directly proportional to clock frequency ($f_c$), and is therefore selectable (18 settings with internal clock, infinitely variable with external clock). Nominal bandwidth (to half-power frequency, $f_o$) of the Gaussian output is $f_c/20$: e.g. with clock frequency 1MHz (CLOCK PERIOD 1μS), the GAUSSIAN NOISE BANDWIDTH is 50kHz.

(2) The rectangular shape of the spectrum does not deteriorate as the clock frequency is reduced (the spectrum is flat within ± 0.3dB at $1/2f_o$). Precise shaping of spectrum is achieved even with the lowest cut-off frequencies (lowest $f_o$ with internal clock is 0.00015Hz).

3-28 In the pseudo-random mode, the output from the GAUSSIAN connector is a series of identical patterns of Gaussian type noise. The pseudo-random Gaussian output has a line power spectrum, the envelope of which is shown – by the thick continuous line – in Figure 3-7. Harmonic frequencies are the same as those for pseudo-random binary sequences, given in Table 3-1. In the random mode, the spectrum of the Gaussian output is continuous, and is the same shape as the envelope of the pseudo-random line spectrum.

3-29 Total power of the Gaussian output remains constant regardless of SEQUENCE LENGTH and CLOCK PERIOD (i.e. Gaussian noise bandwidth) settings. Variations in sequence length and clock period have the same effect on the Gaussian noise spectrum as that described above for the p.r.b.s. spectrum. Summarising:

(1) If sequence length N is doubled, the number of harmonic components in the spectrum is doubled, and the power contributed by each component is halved. Variations in N do not affect power density.

(2) If clock period $\Delta T$ is doubled, the spacing of the harmonic components is halved, doubling the number of lines in a given bandwidth and thus doubling the power density. Variations in $\Delta T$ do not affect the power contributed by the harmonic components.

3-30 POWER DENSITY MEASUREMENT. The power density of the Gaussian signal (measured at the output connector) is approximately $(200\Delta T)V^2/Hz$, at the low frequency end of the spectrum. The exact figure, under any operating conditions, can be checked as follows:-

(1) Press the RESET button on the *3722A*: this resets the shift register to the 'all zeros' state, and gives a stable dc voltage at the GAUSSIAN output connector.

(2) Measure the voltage at the GAUSSIAN output connector or, if required, at some other point in the system to which the *3722A* is connected.

(3) Power per unit bandwidth = power density, in $V^2/Hz$
= $2\Delta T$ x (measured voltage)$^2$.

3-31 In some applications it is permissible to assume that the GAUSSIAN output has a truly rectangular spectrum.

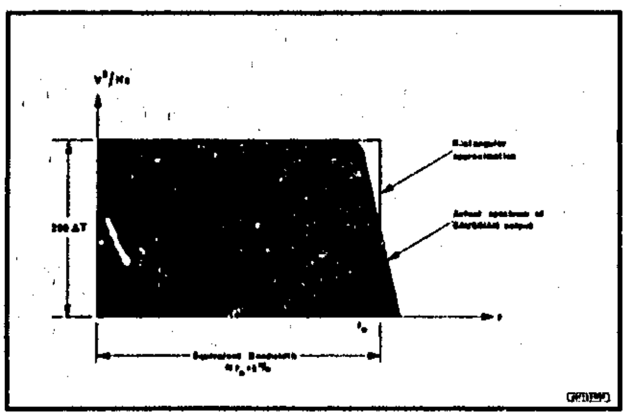


**Figure 3 - 8 Equivalent rectangular spectrum**

If the spectrum is assumed to be rectangular, the following relationship must be satisfied:

Total power = equivalent bandwidth x power density.

Equivalent bandwidth normally exceeds stated GAUSSIAN NOISE BANDWIDTH ($f_0$) by approximately 5%.

3-32 OUTPUT CHARACTERISTICS. The Gaussian noise signal is available, at constant rms amplitude, from the GAUSSIAN connectors on front and rear panels. Amplitude of the 'fixed' output is nominally 3.16V rms. Important features of the Gaussian output are as follows:

| | |
|---|---|
| Output impedance | < 1Ω |
| Load impedance | 600Ω minimum |
| Crest factor (= ratio of peak to rms amplitude) | Up to 3.75, depending on sequence length. |

3-33 The Gaussian signal is available, from a 600Ω impedance source, at the VARIABLE OUTPUT connectors on front and rear panels. The red RMS AMPLITUDE control selects one of three multiplier ranges, and the black control selects one of ten intermediate steps from x 0.1 to x 1.0. Multiplier ranges are:

3.16V rms (= $\sqrt{10}$V), 3V rms and 1V rms.

3.16V rms is obtained at both the third and fourth (fully cw) positions of the red control.

NOTE These are *open-circuit* amplitudes (i.e. if the VARIABLE OUTPUT is connected to a 600Ω load, the voltage across the load is half that indicated by the RMS AMPLITUDE controls).

3-34 PROBABILITY DENSITY FUNCTION. Figure 3-9 shows that the probability density function (p.d.f.) of the Gaussian output, when derived from the longer sequences, is a close approximation to the normal curve. Also shown in Figure 3-9 are error plots for the p.d.f.'s of first and second derivatives of the Gaussian signal obtained with N = 32767: these p.d.f.'s also show unusually small departures from the normal curve. Freedom from discontinuities in the signal, even after two differentiations, is achieved by second order analog filtering of the Gaussian output: this feature applies to all Gaussian noise bandwidths above 0.05Hz.

3-35 In the pseudo-random mode, measurements of p.d.f. are taken over one complete period ($T = N\Delta T$), or an integral number of periods, of the noise. An important feature of pseudo-random noise is the complete absence of statistical fluctuations. All sequences generated with the same settings of SEQUENCE LENGTH and CLOCK PERIOD switches are identical, and all must therefore have the same p.d.f.

3-36 For sequence lengths below N = 8191; the p.d.f. shows significant departures from the normal curve. Two typical examples of this are shown in Figure 3-10.

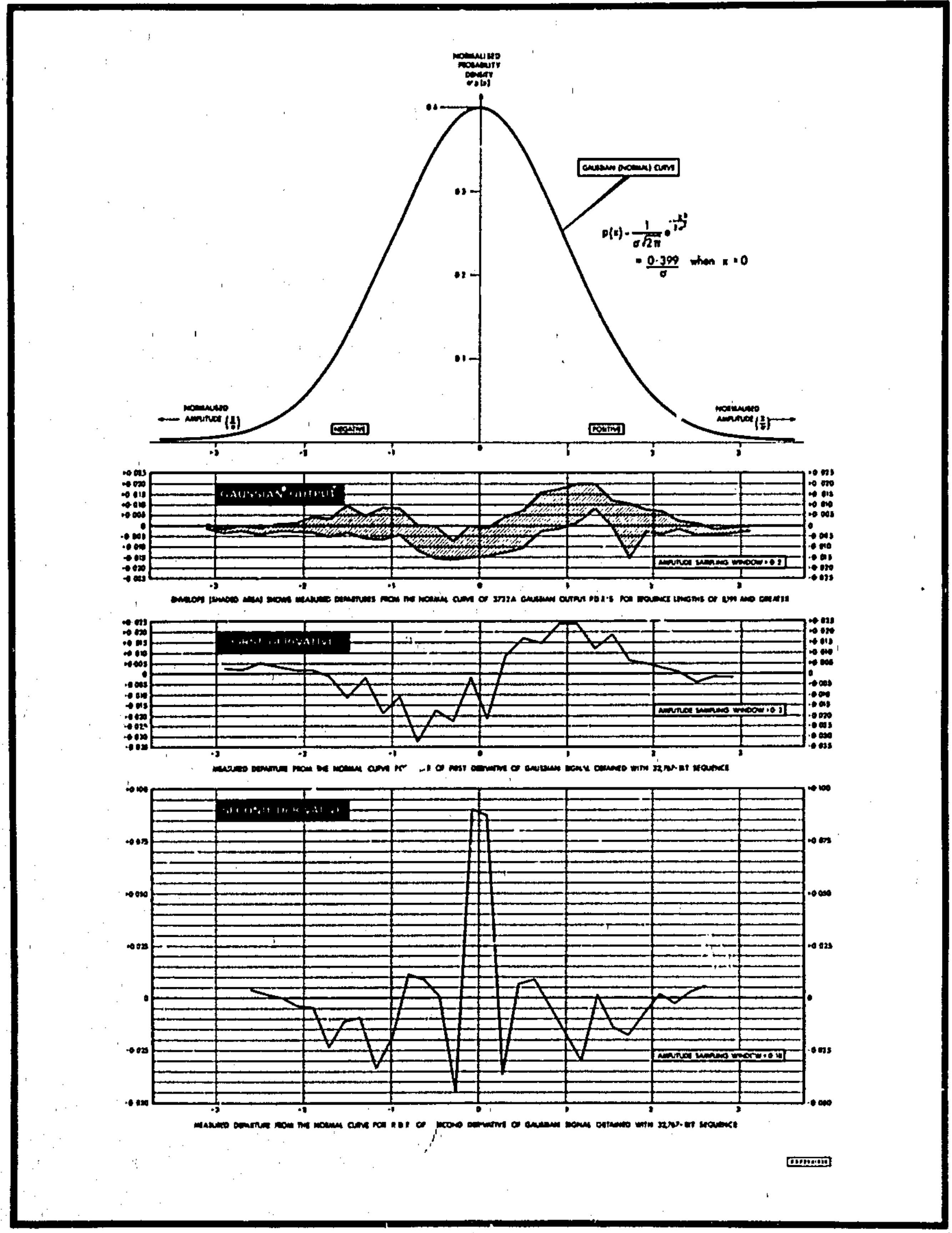



**Figure 3 - 9 Probability density functions of Gaussian signal and its derivatives**

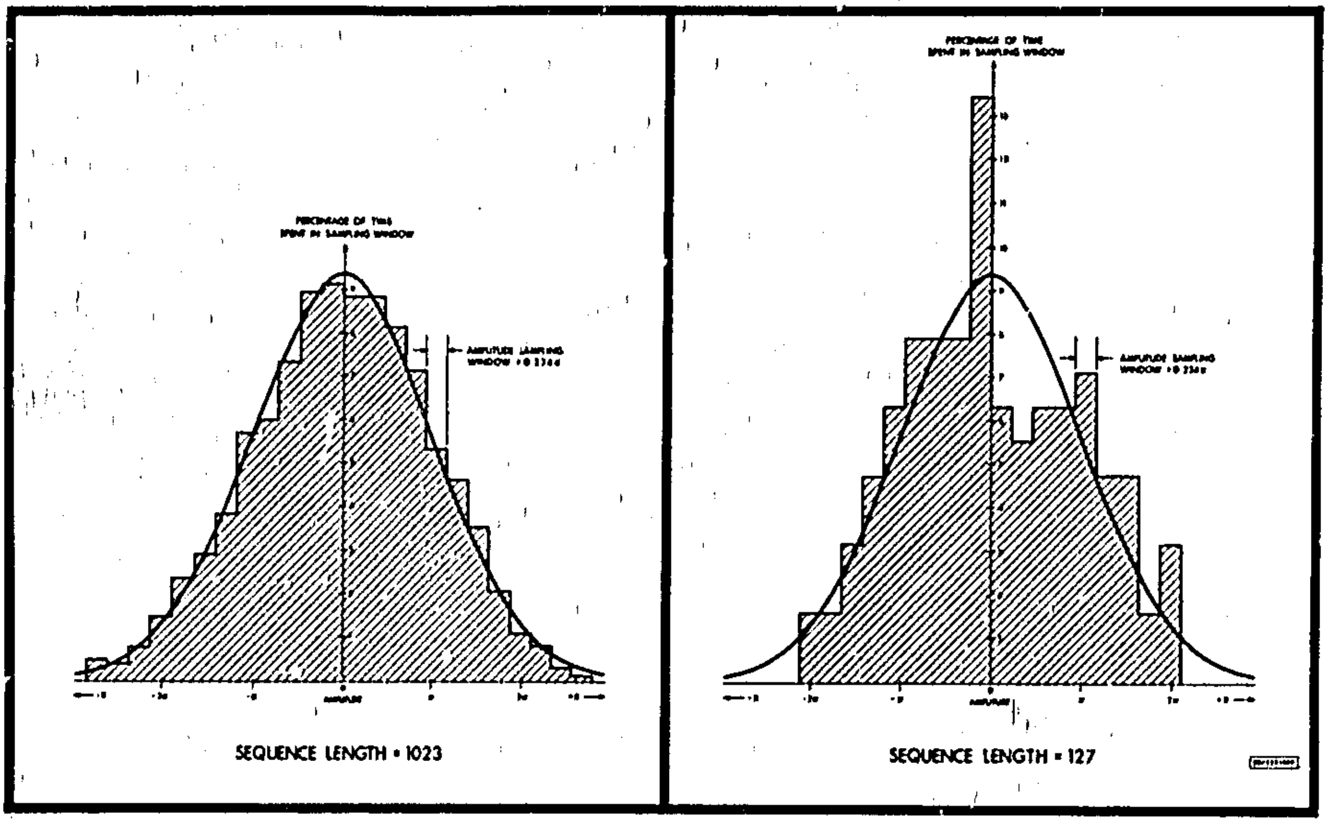



**Figure 3 - 10 Ampiitude histograms of short sequence Gaussian signals**

3-37 FILTER CHARACTERISTICS. Frequency characteristics of the digital filter and analog filter are shown in Figures 3-11 and 3-12 respectively. These will be found particularly useful for the prediction of spectrum shape when the *hp 3722A* is driven by an external clock. The two filters are in cascade and the effect of both must be considered in any calculations of spectrum shape. In this connexion, two important points are:

(1) The half-power frequency of the digital filter varies directly with the clock frequency, even when the clock signal is derived from an external source.

(2) The corner frequency of the analog filter is selected by the CLOCK PERIOD switch (i.e. it is independent of clock frequency if an external clock is used).

**3-38 TIMING SIGNALS**

3-39 CLOCK. When the instrument is controlled by internal clock (clock switch on rear panel set to INT), a timing signal at the internal clock frequency (18 settings, 0.003Hz to 1MHz) is available at the CLOCK connector.

3-40 SYNC. At a particular point in each pseudo-random sequence, the instrument generates a sync pulse which can be used to synchronise external processing or display equipment. In Option 01 versions of the instrument, the point in the sequence at which the sync pulse occurs is optimised (for the seven shortest sequences, N = 15 to N = 1023) such that the first time moment of the p.r.b.s., with respect to the sync pulse, is zero. Details of this Option are given in Section VII.

3-41 GATE. The gate facility is used for the synchronous control of external measuring processes – in particular, when the process is required to last for a selected number of sequences (1, 2, 4 or 8). Duration of the gate is set by the 4-position SEQUENCES PER GATE INTERVAL switch on the front panel. Operation of the GATE RESET push-button initiates the gate signal, which starts on the following sync pulse and ends on the sync pulse marking completion of the selected number of sequences.

The gate signal is available at the GATE connector and GATE RELAY binding posts on the rear panel.

NOTE The gate mechanism is a one-shot device: only one gate signal is generated per operation of the GATE RESET button.

Shows the frequency of the fundamental (first harmonic) given by combinations of 1μS and 3.33μS clock periods with all possible sequence lengths from 15 to 1048575. For fundamental frequencies given by clock periods other than 1μS and 3.33μS, multiply the listed frequency by the appropriate power of 10.

**Example A**
Find the fundamental frequency given by clock period 1mS and sequence length 1023.

Listed frequency for clock period 1μS and sequence length 1023 = 977.517Hz.
1mS = 1μS x $10^3$, so the fundamental frequency with 1mS clock period is one thousandth of that listed = 977.517 x $10^{-3}$ = 0.977517Hz

**Example B**
Find the fundamental frequency given by clock period 333μS and sequence length 8191.

Listed frequency for clock period 3.33μS and sequence length 8191 = 36.6256Hz.
333μS = 3.33μS x $10^2$, so the fundamental frequency with 333μS clock period is one hundredth of that listed = 36.6256 x $10^{-2}$ = 0.366256Hz.

| SEQUENCE LENGTH (N) | CLOCK PERIOD | |
|---|---|---|
| | 1μS | 3.33μS |
| 15 | 66.6667kHz | 20.0000kHz |
| 31 | 32.2581kHz | 9.67742kHz |
| 63 | 15.8730kHz | 4.76190kHz |
| 127 | 7.87402kHz | 2.36220kHz |
| 255 | 3.92157kHz | 1.17647kHz |
| 511 | 1.95695kHz | 587.084Hz |
| 1023 | 977.517Hz | 293.255Hz |
| 2047 | 488.520Hz | 146.556Hz |
| 4095 | 244.200Hz | 73.2601Hz |
| 8191 | 122.085Hz | 36.6256Hz |
| 16383 | 61.0389Hz | 18.3117Hz |
| 32767 | 30.5185Hz | 9.15555Hz |
| 65535 | 15.2590Hz | 4.57771Hz |
| 131071 | 7.62945Hz | 2.28884Hz |
| 262143 | 3.81471Hz | 1.14441Hz |
| 524287 | 1.90735Hz | 0.572206Hz |
| 1048575 | 0.953675Hz | 0.286103Hz |

**Table 3 - 2 List of fundamental frequencies**

**Table 3 - 3 Parameters of binary noise spectrum**

| Clock period ΔT | Clock frequency fc = 1/ΔT | 1/2 power frequency* (Nom. spectrum width) = -3dB point |
|---|---|---|
| 1μS | 1MHz | 450kHz |
| 3.33μS | 300kHz | 135kHz |
| 10μS | 100kHz | 45kHz |
| 33.3μS | 30kHz | 13.5kHz |
| 100μS | 10kHz | 4.5kHz |
| 333μS | 3kHz | 1.35kHz |
| 1mS | 1kHz | 0.45kHz |
| 3.33mS | 300Hz | 0.135kHz |
| 10mS | 100Hz | 45Hz |
| 33.3mS | 30Hz | 13.5Hz |
| 100mS | 10Hz | 4.5Hz |
| 333mS | 3Hz | 1.35Hz |
| 1 sec | 1Hz | 0.45Hz |
| 3.33 sec | 0.3Hz | 0.135Hz |
| 10 sec | 0.1Hz | 0.045Hz |
| 33.3 sec | 0.03Hz | 0.0135Hz |
| 100 sec | 0.01Hz | 0.0045Hz |
| 333 sec | 0.003Hz | 0.00135Hz |

* Other spectrum widths obtainable with external clock.

**Table 3 - 4**

Shows number of harmonic components between dc and -3dB frequency in the spectrum of pseudo-random binary noise.

| Sequence length | Number of harmonics |
|---|---|
| 15 | 6 |
| 31 | 13 |
| 63 | 28 |
| 127 | 57 |
| 255 | 114 |
| 511 | 229 |
| 1023 | 460 |
| 2047 | 921 |
| 4095 | 1,842 |
| 8191 | 3,685 |
| 16383 | 7,372 |
| 32767 | 14,745 |
| 65535 | 29,490 |
| 131071 | 58,981 |
| 262143 | 117,964 |
| 524287 | 235,929 |
| 1048575 | 471,858 |

**Table 3 - 5**

Approximate crest factor of GAUSSIAN output obtained with sequence lengths of 8191 and greater.

| Sequence length | Crest factor |
|---|---|
| 8191 | 3.20 |
| 16383 | 3.35 |
| 32767 | 3.70 |
| 65535 | 3.75 |
| 131071 | 3.80 |
| 262143 | 3.85 |
| 524287 | 3.85 |
| 1048575 | 3.85 |

**Table 3 - 6 Parameters of Gaussian noise spectrum**

| Clock period ΔT | Clock frequency fc = 1/ΔT | 1/2 power frequency* (Nom. spectrum width) = −3dB point | ± 0.3dB frequency in Gaussian spectrum |
|---|---|---|---|
| 1μS | 1MHz | 50kHz | 25kHz |
| 3.33μS | 300kHz | 15kHz | 7.5kHz |
| 10μS | 100kHz | 5kHz | 2.5kHz |
| 33.3μS | 30kHz | 1.5kHz | 0.75kHz |
| 100μS | 10kHz | 0.5kHz | 0.25kHz |
| 333μS | 3kHz | 0.15kHz | 75Hz |
| 1mS | 1kHz | 50Hz | 25Hz |
| 3.33mS | 300Hz | 15Hz | 7.5Hz |
| 10mS | 100Hz | 5Hz | 2.5Hz |
| 33.3mS | 30Hz | 1.5Hz | 0.75Hz |
| 100mS | 10Hz | 0.5Hz | 0.25Hz |
| 333mS | 3Hz | 0.15Hz | 0.075Hz |
| 1 sec | 1Hz | 0.05Hz | 0.025Hz |
| 3.33 sec | 0.3Hz | 0.015Hz | 0.0075Hz |
| 10 sec | 0.1Hz | 0.005Hz | 0.0025Hz |
| 33.3 sec | 0.03Hz | 0.0015Hz | 0.00075Hz |
| 100 sec | 0.01Hz | 0.0005Hz | 0.00025Hz |
| 333 sec | 0.003Hz | 0.00015Hz | 0.000075Hz |

*Other spectrum widths obtainable with external clock

**Table 3 - 7**

Shows number of harmonic components between dc and −3dB frequency in the spectrum of pseudo-random Gaussian noise.

| Sequence length | Number of harmonics | Sequence length | Number of harmonics |
|---|---|---|---|
| | | 4095 | 204 |
| 15 | – | 8191 | 409 |
| 31 | 1 | 16383 | 819 |
| 63 | 3 | 32767 | 1,638 |
| 127 | 6 | 65535 | 3,276 |
| 255 | 12 | 131071 | 6,553 |
| 511 | 25 | 262143 | 13,107 |
| 1023 | 51 | 524287 | 26,214 |
| 2047 | 102 | 1048575 | 52,428 |

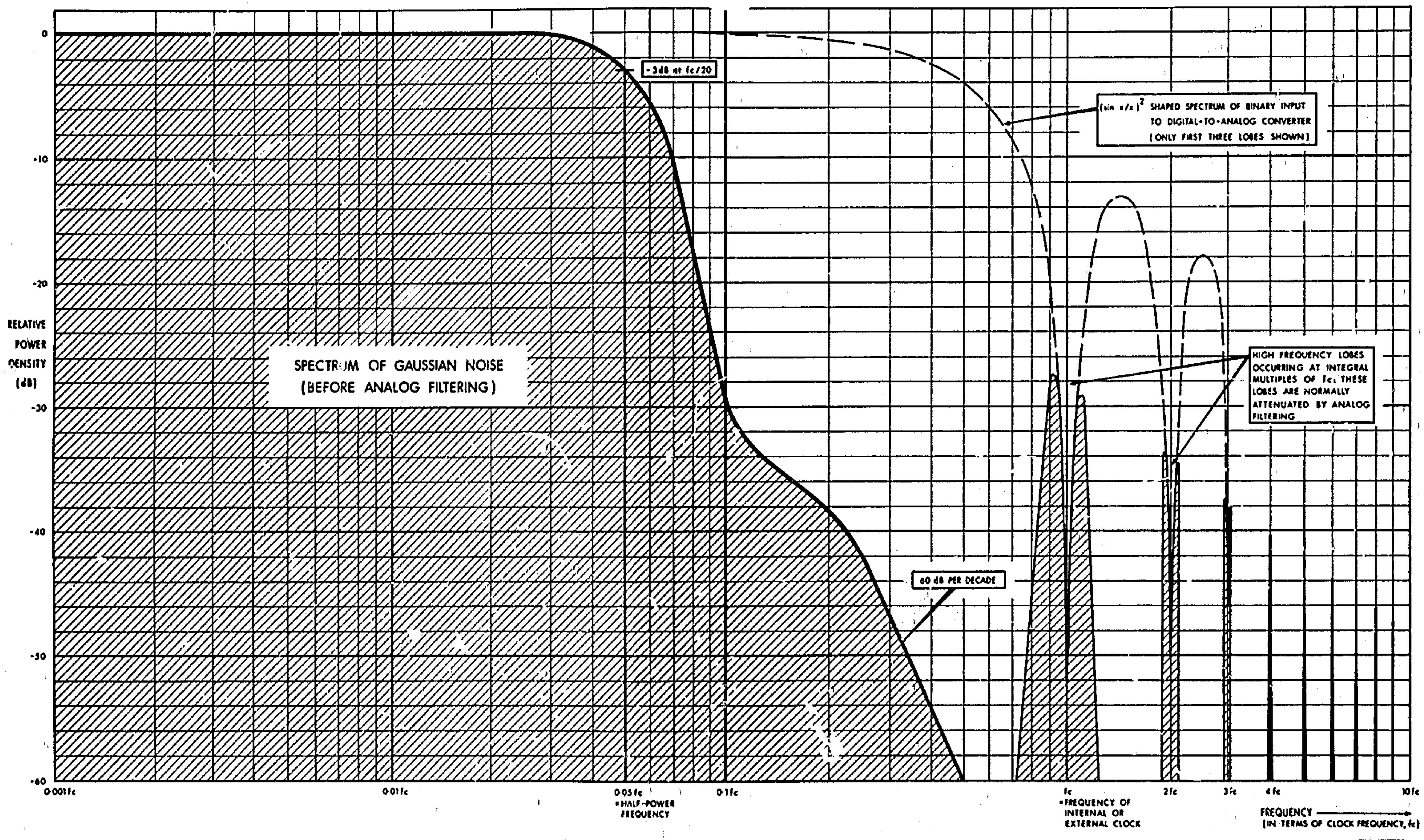



**Figure 3 - 11 Frequency characteristic of digital filter**

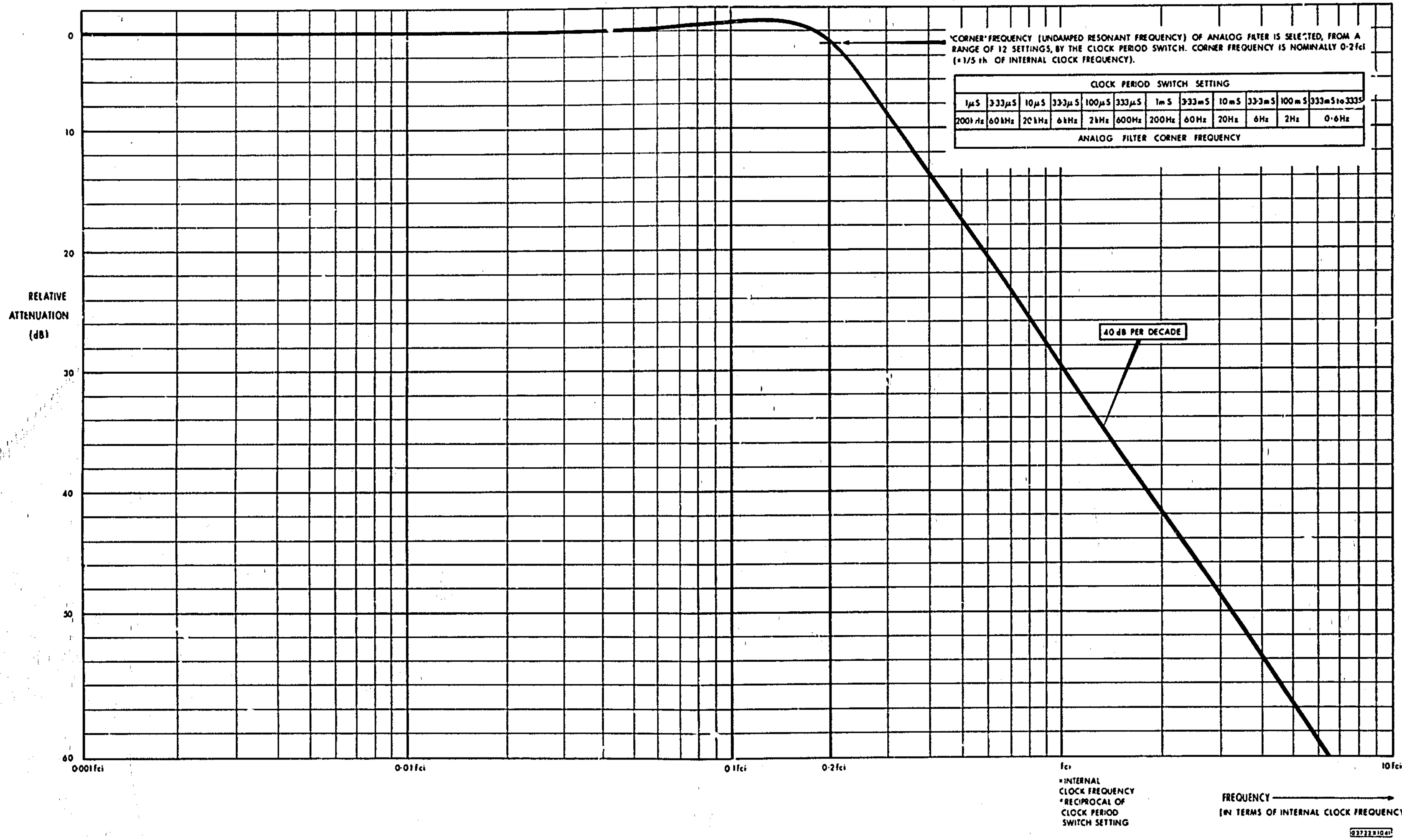
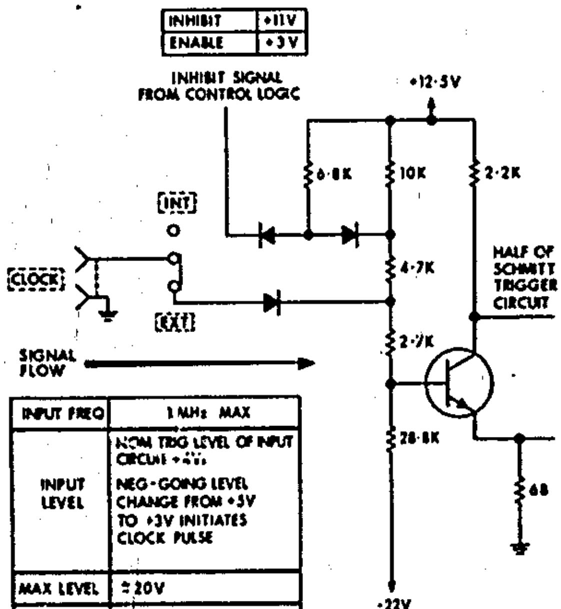
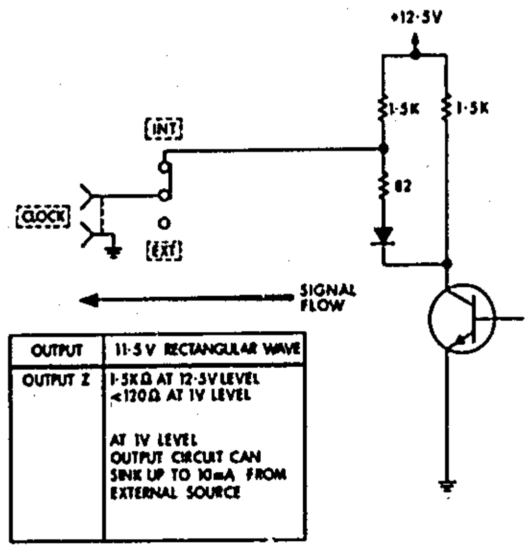



**Figure 3 - 12 Frequency characteristic of analog filter**



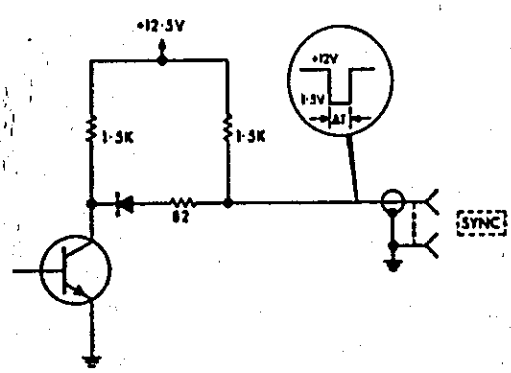

| INPUT FREQ | 1MHz MAX |
|---|---|
| INPUT LEVEL | NOM TRIG LEVEL OF INPUT CIRCUIT +4V. NEG-GOING LEVEL CHANGE FROM +5V TO +3V INITIATES CLOCK PULSE |
| MAX LEVEL | ±20V |
| INPUT Z | 1MΩ NOM |

Figure 3 - 13 CLOCK input circuit



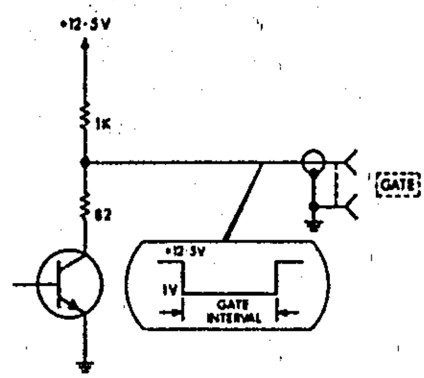

| OUTPUT | 11·5 V RECTANGULAR WAVE |
|---|---|
| OUTPUT Z | 1·5KΩ AT 12·5V LEVEL <120Ω AT 1V LEVEL<br>AT 1V LEVEL OUTPUT CIRCUIT CAN SINK UP TO 10mA FROM EXTERNAL SOURCE |

Figure 3 - 14 CLOCK output circuit




| OUTPUT | NEG-GOING 10·5V PULSE |
|---|---|
| OUTPUT Z | 1·5KΩ AT +12V LEVEL < 120Ω AT 1·5V LEVEL<br>AT 1·5V LEVEL, OUTPUT CIRCUIT CAN SINK UP TO 10mA FROM EXTERNAL SOURCE |

Figure 3 - 15 SYNC output circuit




| OUTPUT | NEG-GOING 11·5V PULSE |
|---|---|
| OUTPUT Z | 1KΩ AT +12·5V LEVEL, <100Ω AT 1V LEVEL<br>AT 1V LEVEL, OUTPUT CIRCUIT CAN SINK UP TO 10mA FROM EXTERNAL SOURCE |

Figure 3 - 16 GATE output circuit

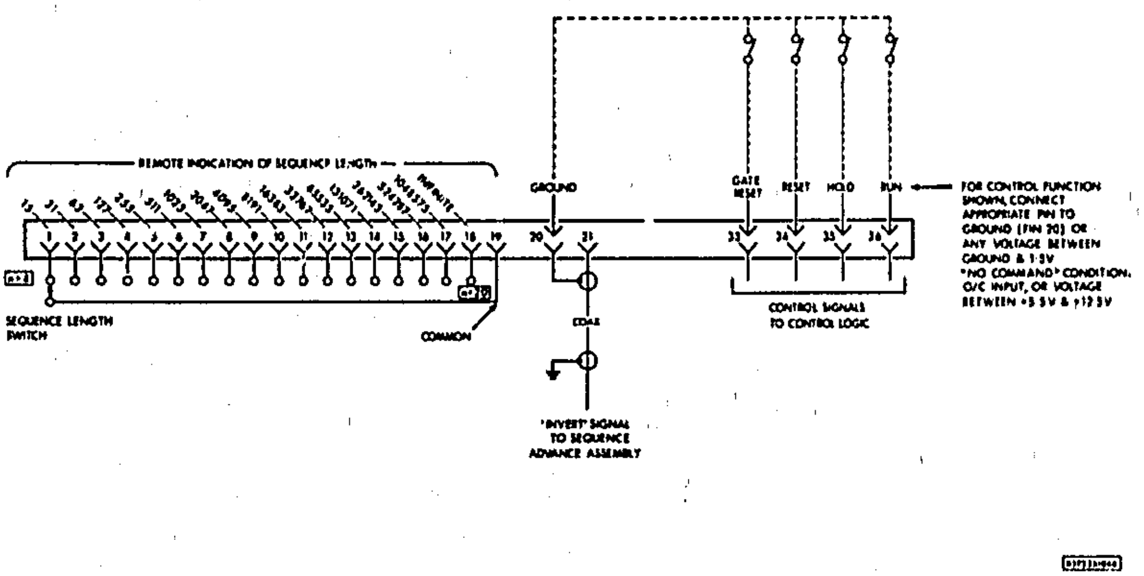



**Figure 3 - 17 36-way receptacle on rear panel**

*Key to Figure 3-18*

**FRONT PANEL CONTROLS**

**(1)** LINE ON-OFF control. Latching push-button. When operated, the indicator lamp glows.

**(2)** RUN control. Push-button, push-pull coupled to the HOLD and RESET buttons. For the *hp 3722A* to generate outputs, the RUN button must be 'in' (this allows the shift register to operate).

**(3)** HOLD control. Push-button which, when operated, stops the shift register and thus holds the outputs at a steady dc level.

**(4)** BINARY (fixed output) connector. Two-level signal taken from one stage of the shift register. Signal amplitude is ±10V, impedance less than 10Ω (because signal amplitude is constant, total output power is constant, regardless of CLOCK PERIOD and SEQUENCE LENGTH settings).

**(5)** GAUSSIAN (fixed output) connector. Smoothed multi-level signal derived from shift register outputs. Signal amplitude is 3.16V rms (regardless of GAUSSIAN NOISE BANDWIDTH setting), and impedance is less than 1Ω.

**(6)** GAUSSIAN ZERO control. Preset potentiometer for adjusting the mean dc level of the Gaussian signal. Range of adjustment is approximately ±50mV.

**(7)** VARIABLE OUTPUT connector. Variable amplitude output of either binary or Gaussian signals (selection by slide switch (8)). Output impedance 600Ω: amplitude controlled by concentric switches (9).

**(8)** VARIABLE OUTPUT selector. Slide switch connects either the ±10V binary or the 3.16V rms Gaussian signal via the amplitude controls to the VARIABLE OUTPUT connector.

**(9)** RMS AMPLITUDE controls. The red control selects one of four 'full scale' multiplier ranges, and the black control selects one of ten intermediate steps from x0.1, to x1.0. The red control selects the same full scale rms values for both Gaussian and binary outputs on the three lower ranges (1V, 3V and 3.16V), but only the binary signal is available at the 10V level: the x10 position of the red control selects ±10V binary and 3.16V rms Gaussian.

NOTE A 10V rms binary signal swings between levels of ±10V. The RMS AMPLTIUDE control is calibrated in volts, open circuit.

**(10)** CLOCK PERIOD control. 18-way selector determines the timebase frequency, and thus controls the stepping rate of the shift register. The CLOCK PERIOD is selectable from 1μS to 333 SEC (outer engravings). Note that the period is directly related to GAUSSIAN NOISE BANDWIDTH, which is selectable from 50kHz to .00015Hz (inner engravings).

**(11)** SEQUENCE LENGTH control. 18-way selector which, by altering the shift register feedback arrangements, determines the number of bits (clock periods) in the pseudo-random sequences. Outer engravings (n) indicate the number of register stages involved in sequence generation, and the inner engravings ($N = 2^n - 1$) state the actual number of bits in the sequence. N is selectable from 15 to 1048575, corresponding to values of n from 4 to 20.

**(12)** SEQUENCES PER GATE INTERVAL control. 4-way selector determines the duration of the gate signal in terms of a number of sequences (1, 2, 4 or 8).

**(13)** GATE lamp. Normally out, but lights during a gate interval.

**(14)** GATE RESET control. Push-button which initiates a gate signal.

**(15)** RESET control. Push-button which, when operated, stops the shift register (as does the HOLD control) and resets it (together with some other circuits) to a pre-determined state.

**REAR PANEL CONTROLS**

**(16)** BINARY (fixed output) connector. Connected in parallel with (4).

**(17)** GAUSSIAN (fixed output) connector. Connected in parallel with (5).

**(18)** VARIABLE OUTPUT connector. Connected in parallel with (7).

**(19)** BINARY RELAY terminals. Changeover relay mimics the binary signal (at connectors (4) and (16)) when the clock period is 100 mS and greater.

**(20)** RELAY DISABLE control. Slide switch: inhibits the binary relay, when set to OFF, so prolonging the life of the relay contacts.

**(21)** CLOCK INT/EXT control. Slide switch: selects the source of timing pulses for the shift register. When the switch is set to INT, the *hp 3722A* is controlled by its internal clock (period from 1μS to 333 sec), the output from which is available at the CLOCK connector (22). When the switch is set to EXT the internal clock is disconnected and the *hp 3722A* is timed by an external device (frequency up to 1MHz) coupled to the CLOCK connector. Figures 3-13 and 3-14 show clock input and output circuits.

**(22)** CLOCK connector. Dual-purpose: output for internal clock or input from external clock. Internal clock output is a rectangular wave between zero and +12.5V.

**(23)** SYNC connector. Negative-going pulse (+12.5V to zero) occuring once per pseudo-random sequence (Figure 3-15). This output is used to synchronise external processing or display equipment (oscilloscope, for example).

**(24)** GATE connector. Gate signal output: falls from +12.5V to zero at start of gate interval, and returns to +12.5V at end (Figure 3-16).

**(25)** GATE RELAY terminals. Changeover relay mimics signal at GATE connector.

**(26)** CONTROL selector. Slide switch: when set to REMOTE disables the RUN, HOLD, RESET and GATE RESET controls on the front panel. These functions can then be remotely controlled via the 36-way CONTROL receptacle (27).

**(27)** CONTROL receptacle. 4 pins of this 36-way receptacle are used for remote control of the RUN, HOLD, RESET and GATE RESET functions. Control is achieved by grounding the appropriate pin (Figure 3-17). 18 pins, plus one common pin, are used for remote signalling of the sequence length selected on the *hp 3722A* front panel. Each pin (Figure 3-17) is related to a particular position of the SEQUENCE LENGTH switch and, when the switch is set to that position, is connected to the common pin (the remaining 17 pins in the group are open-circuit). One pin of the 36-way receptacle is used for the 'invert' input to the sequence shift mechanism (Option 01 models only).

**(28)** POWER receptacle. The *hp 3722A* is powered by 115 or 230V, 50 to 1000Hz ac supply. Power consumption is 70W.

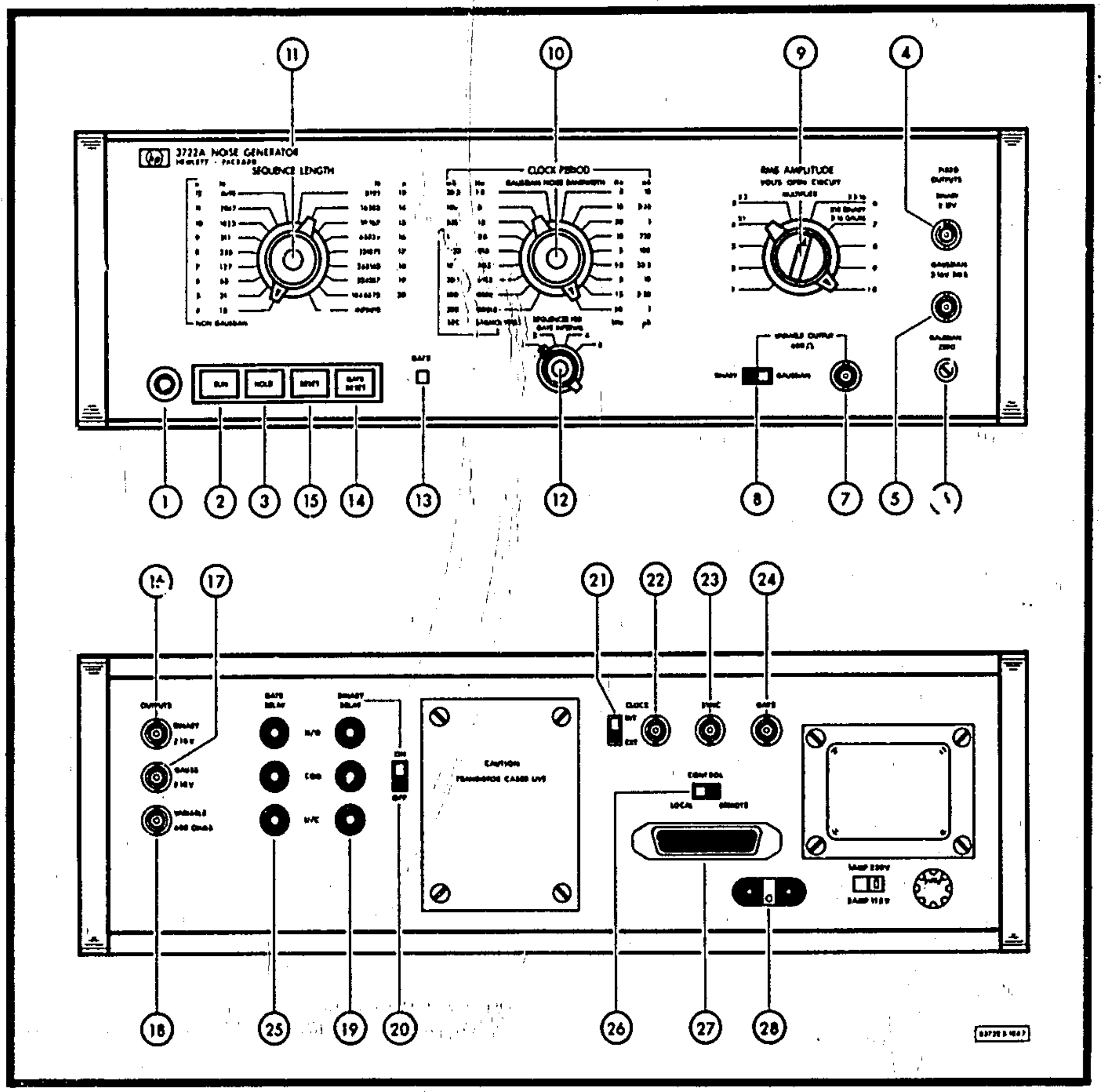


**Figure 3 - 18 Front and rear panels of *hp 3722A***

# SECTION IV
# PRINCIPLES OF OPERATION

## 4-1 INTRODUCTION

4-2 This section contains a brief description of the *3722A* system, to block diagram level, and describes in detail the circuits of individual assemblies. A summary of Hewlett-Packard logic terminology is given at the end of the section. Block diagram and schematics of the printed circuit assemblies are contained in Section VIII.

## 4-3 SYSTEM DESCRIPTION

4-4 Illustrations relevant to this description are:

| | |
|---|---|
| Block diagram | Figure 8-5 |
| Location of assemblies | Figure 8-2 |
| Location of chassis mounted components | Figure 8-3 |
| Location of components on front and rear panels | Figure 8-4 |

Acquaintance with the '1' and '0' notation of signal levels is assumed (see Paragraph 4-91).

4-5 TIMEBASE (CLOCK) GROUP. The internal timebase of the *3722A* comprises a 3MHz crystal-controlled oscillator, a divide-by-three circuit and a chain of nine standard decade dividers (of the type used in Hewlett-Packard electronic counters). Operation of the divide-by-three circuit is basically similar to that of the decade dividers – it is a standard 'count of four' circuit modified, by feedback, such that the number of pulses counted per complete cycle is reduced to three. The timebase is so arranged that, as the CLOCK PERIOD switch S1 is rotated, 3MHz and 1MHz signals (from the oscillator and divide-by-three respectively) are applied alternately to the divider chain. A second wafer of the switch selects tappings in the chain to give a range of output frequencies from 1MHz to 0.003Hz (period, $\Delta T$, from $1\mu S$ to 333 seconds). The selected clock output is applied, via the INT/EXT switch S13, to the shift pulse generator, which supplies a train of trigger pulses (one per cycle of the clock) to the shift register. With S13 set to EXT, the shift pulse generator is driven by an external timing signal applied to the CLOCK connector.

4-6 CONTROL LOGIC. Principal functions of the control logic are the enabling and disabling of the shift pulse generator. When the HOLD button is operated, the control logic produces an inhibiting signal which stops the shift pulse generator, and hence the shift register. No further shift pulses are generated until the inhibit is removed, by operation of the RUN button. When the RESET button is operated, the control logic generates a similar inhibit signal and, in addition, applies a reset pulse to the shift register. Again, the instrument re-starts only when the RUN button is operated. The third function (GATE RESET) of the control logic is described in Paragraph 4-42.

4-7 Each of the four 'push-button' functions can be remotely controlled by a signal (contact closure to ground, or suitable voltage applied) on the appropriate pin of the 36-way CONTROL receptacle on the rear panel (details in Figure 3-17).

4-8 SHIFT REGISTER. The shift register is a chain of 32 flip-flops (stages) four of which are contained in each shift register assembly. These flip-flops, which are of a type commonly encountered in digital computers and data processing systems, must not be confused with the more familiar divide-by-two flip-flop used in the decade divider assemblies (A4, etc): the shift register flip-flop is not a divider, it is an information store. Each stage of the shift register can store one 'bit' of information ('1' or '0'), i.e. it can be in one or other of two stable states (Paragraph 4-60). The flip-flop is said to contain '1' if in the set state, and '0' if reset. The length of time that a bit of information remains in a stage is equal to the time interval between two successive clock, or shift, pulses: for this reason, each shift register stage can be thought of as a delay line in which the time delay between input and output is equal to the clock period.

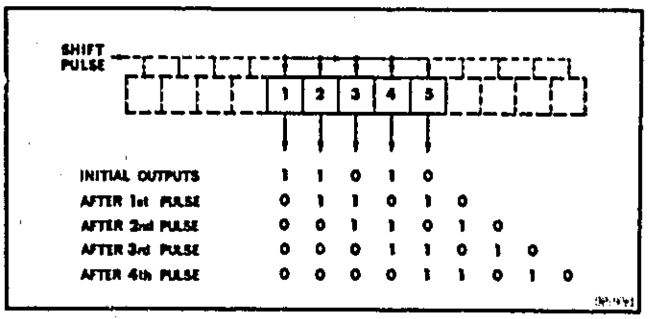
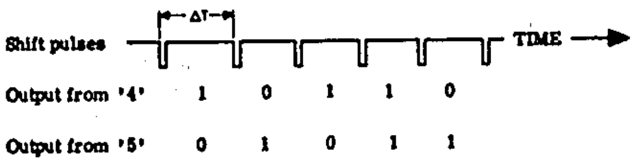



**Figure 4-1 Typical sequence of shift register outputs**

4-9 The shift register stages are connected in cascade so that, on receipt of shift pulses, the information they contain is stepped progressively along the chain (in this case, 'information' means the pattern of ones and zeros in the register). This is illustrated by Figure 4-1, in which five stages of the shift register are shown initially to give — quite arbitrarily — the output pattern 11010. All preceding stages are assumed to be in the reset state (giving '0' outputs).

4-10 The state into which a given stage is switched by a shift pulse depends on the state of the preceding stage, before the shift pulse arrives. Information ('0' of '1') contained in one stage is thus transferred, by the shift pulse, to the next stage. This has the effect of stepping the entire pattern of ones and zeros progressively along the chain — as though on a conveyor belt. Note that the sequence of ones and zeros observed at the output from one stage is a delayed replica of that from the preceding stage. The delay between the two adjacent sequences is equal to one period (ΔT) of the clock:




4-11 SEQUENCE GENERATION. In the *3722A*, the shift register operates in a closed loop condition, and the input to the first stage is supplied via a feedback path from later stages of the shift register. Under these conditions, the closed loop system generates a repeated series of identical sequences — known as 'maximum-length' or 'pseudo-random' binary sequences (p.r.b.s.). Figure 4-2 shows a simple form of p.r.b.s. generator. In this example, only the first four of the 32 register stages are actually involved in generation of the sequence.

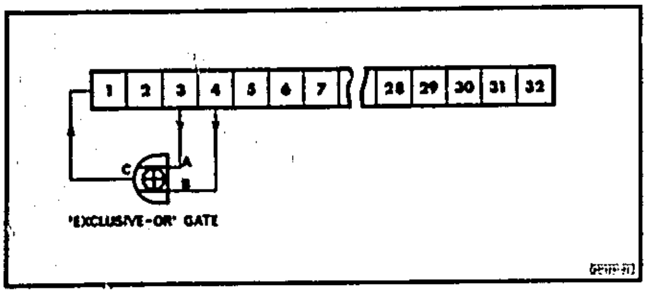



**Figure 4 - 2 15-bit p.r.b.s. generator**

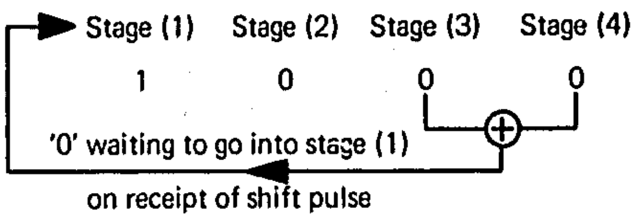
4-12 Here, feedback to the first stage is taken from stages 3 and 4, the outputs from which are processed in an exclusive OR gate (otherwise known as: modulo-two adder, half-adder, non-equivalence or anti-coincidence gate). This gate, which gives a '1' output only when its two inputs are dissimilar, is described by Table 4-1.

**Table 4 - 1 Truth table for modulo-two adder**

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | C |
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

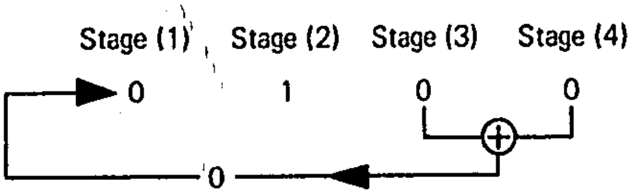
4-13 The sequence generated by the four-stage arrangement of Figure 4-2 can easily be derived. For the purpose of illustration, the initial contents of the first four stages are taken, arbitrarily, to be as follows:

**Before 1st shift pulse**



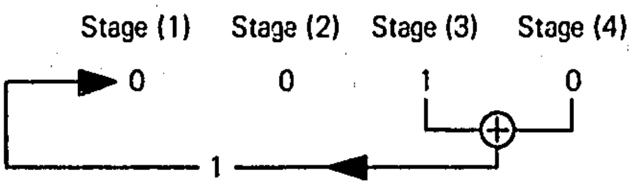

The modulo-two sum of the outputs from the last two stages is '0' (this can be written $0 \oplus 0=0$). At the first shift pulse, the '1' in the first stage is transferred to the second, and is replaced by the '0' in the feedback line. This gives the pattern:

**After 1st pulse**



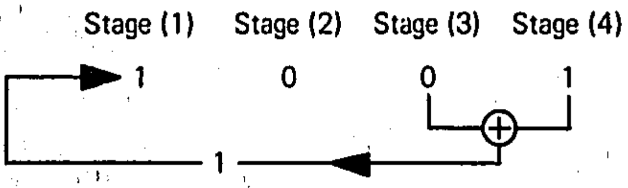

Again, the modulo-two summation yields '0'. The next pattern is therefore:

**After 2nd pulse**



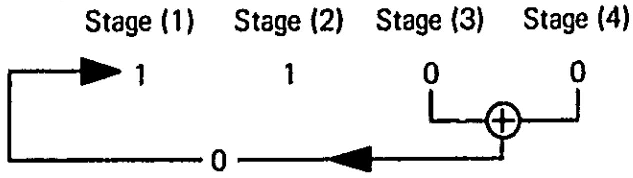

With this pattern, the outputs from the third and fourth stages are dissimilar – so the modulo-two sum is '1'. The '1' thus placed in the feedback line enters the first stage on arrival of the next shift pulse:

**After 3rd pulse**



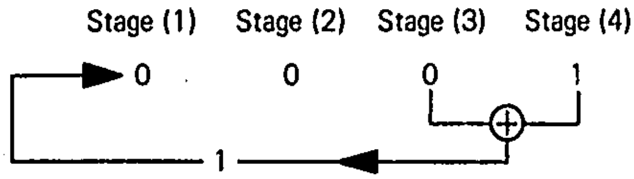

This pattern again places a '1' in the feedback line. So the result after the next shift pulse is:

**After 4th pulse**




The remainder of the sequence can be worked out in a similar manner. After the 14th pulse, the register pattern is:

**After 14th pulse**




4-14 The fifteenth pulse restores the register to the initial state (1000), and thereafter the sequence repeats. The complete 15-bit sequence is summarised in Table 4-2.

**Table 4 - 2 15-bit pseudo-random sequence**

| TIME → | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shift pulses | Initial | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | 9th | 10th | 11th | 12th | 13th | 14th | 15th |
| Stage (1) | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| Stage (2) | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| Stage (3) | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| Stage (4) | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |

Note that, with the exception of 0000, the register generates the maximum number of '1' and '0' combinations possible with four stages. The all-zero condition cannot arise (if it were to occur, all stages of the shift register would remain in the '0' state, and the output would thereafter be an infinite sequence of zeros).

4-15 The above table shows that the pattern appearing at the output from the first stage is exactly the same as that from the second, the third and the fourth (and so on throughout the 32 stages of the register). Note that there is a delay of one clock period between the pattern from one stage and the pattern from the next. The digit sequence from any of the 32 stages is:

........| 1 0 0 1 1 0 1 0 1 1 1 1 0 0 0 |........

TIME →

Figure 4-3 shows this sequence translated into a two-level, or 'binary' waveform ('1' is represented by the relatively negative level).

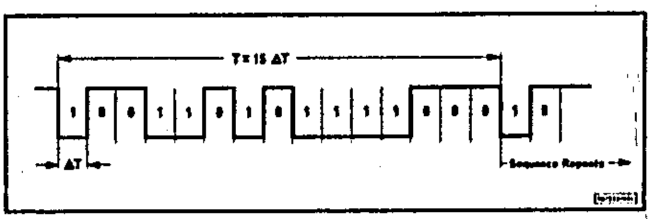



**Figure 4 - 3 15-bit binary waveform**

This in fact is the waveform obtained at the BINARY connector with the SEQUENCE LENGTH switch S2 set to 15 (compare with the oscilloscope photograph 'A', Table 3-1).

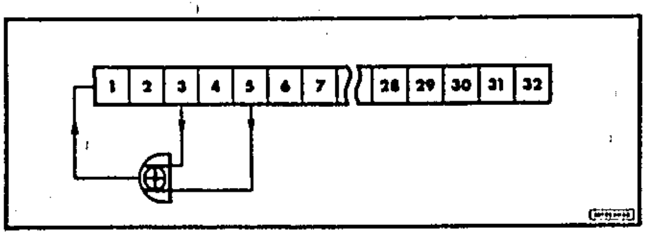



**Figure 4 - 4 31-bit p.r.b.s. generator**

4-16 The next setting (31) of the SEQUENCE LENGTH switch selects, for modulo-two addition, the outputs from stages 3 and 5, as shown in Figure 4-4.

With five stages the maximum number of '1' and '0' combinations is 32 but, as before, the all-zero condition cannot occur. The resulting p.r.b.s. is therefore 31 bits long.

4-17 The 'active' length of the shift register (i.e. that part involved in sequence generation) is selectable, from 4 to 20, by the SEQUENCE LENGTH switch. Feedback is always taken from the last of the active stages, and from one or more of the preceding stages. For the 127-bit sequence in the *3722A*, for example, feedback is taken from stage 7 (7 is the 'n' number engraved on the front panel) and also from stages 3, 4, 5. Where more than two outputs are modulo-two added, extra exclusive OR gates are used, as in Figure 4-5.

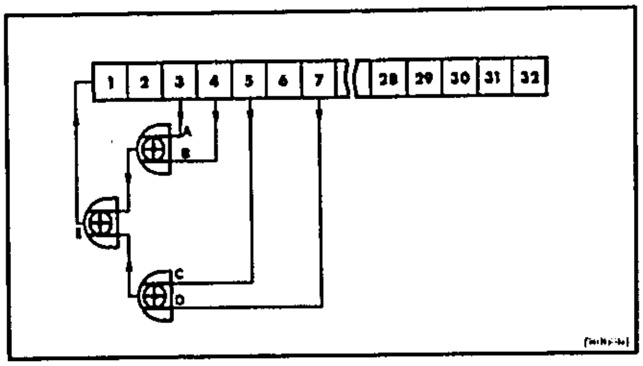



**Figure 4 - 5 127-bit p.r.b.s. generator**

The group of gates shown in Figure 4-5 gives a '1' output only when there is an odd number of '1' inputs. The overall truth table for the group is given in Table 4-3.

4-18 Note that the number of bits, N, in pseudo-random sequences generated by the *3722A* is always one less than the maximum number of '1' and '0' combinations possible with the selected length of register. Thus if n is the number of active stages, $N=2^n-1$. For a particular active length of shift register, there are many possible feedback combinations giving sequences of the same length but of different form. The *3722A* provides only one feedback arrangement for each active length of register. If required, the feedback arrangements – and hence the form of the sequences – can be modified by re-wiring the SEQUENCE LENGTH switch. This should be undertaken with care, as the GAUSSIAN output amplitude distribution can be seriously affected by changes in the form of binary sequence from the shift register.

**Table 4 - 3 Truth table for three modulo-two adders**

| INPUTS | | | | OUTPUT |
|---|---|---|---|---|
| A | B | C | D | E |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 |

4-19 SYNC PULSE. At a particular point in each pseudo-random sequence, the *3722A* generates a sync pulse, which is used to time external processing and display equipment (for example, an oscilloscope triggered by the sync pulse gives a stationary display of the *3722A* output waveforms). The sync pulse is generated by a gate which seeks the all-zero condition in the active stages of the shift register, excluding the first stage. Thus for the 15-bit sequence, the sync pulse occurs when the first four stages contain the pattern:

| (1) | (2) | (3) | (4) |
|---|---|---|---|
| 1 | 0 | 0 | 0 |

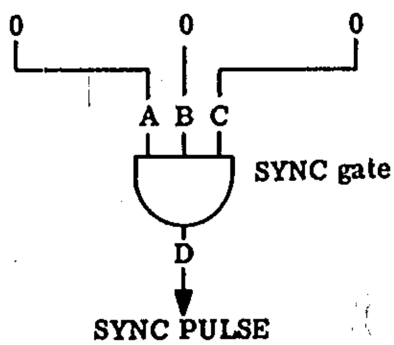



**Table 4 - 4 Truth table for sync gate**

| INPUTS | | | OUTPUT |
|---|---|---|---|
| A | B | C | D |
| 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 |
| 0 | 0 | 0 | 0 |

← SYNC pulse condition

4-20 Note that this is an AND gate for '0' levels: this may seem unusual, but it should be remembered that the assignment of signal level to logic notation is quite arbitrary, and varies from point to point through the system.

4-21 Clearly, the duration of the sync pulse is equal to the interval between shift pulses, and hence equal to the selected clock period (at the next shift pulse, the shift register output pattern changes – no longer satisfying the AND function). The number of inputs to the sync gate is controlled by the SEQUENCE LENGTH switch, and is always one less than the number (n) of active shift register stages.

4-22 RESET and AUTO-START. When the RESET button is operated, all stages of the register are driven into the '0' state by a signal from the control logic: the register remains in the all-zero state until the RUN button is operated (restoring the supply of shift pulses). Since the all-zero condition never arises in the normal course of events, action must be taken to get the shift register under way following reset – and possibly after switch-on (with the shorter sequences in particular, there is the possibility that all active stages could go into the '0' state when power is applied). This difficulty is overcome by the gating arrangement shown in Figure 4-6. If all stages in the feedback system are in the '0' condition, then the output from the sync gate will be '0' (the 'sync' condition): this, coupled with the '0' from the first stage, gives '0' output from the auto-start gate. The logic inverter, which supplies one input of the exclusive OR gate, turns this '0' into a '1' level. The other input of the gate is supplied by the feedback line which, if all stages are in the '0' condition, must be at the '0' level. Since its two inputs are dissimilar, the exclusive OR gate gives a '1' output – which ensures that the first stage of the register will go into the '1' state when the first shift pulse is received.

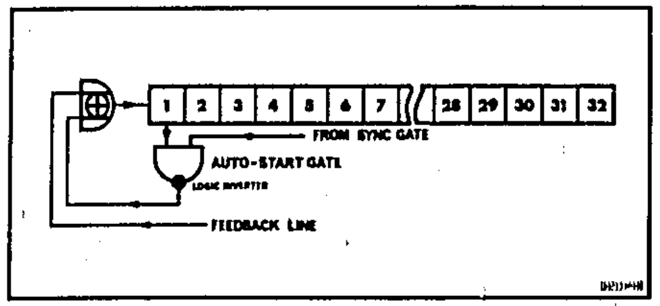



**Figure 4 - 6 Auto-start logic**

4-23 BINARY OUTPUT. In the standard version of the *3722A* (without Option 01), the output from the first stage of the shift register is taken directly to the output switch circuit. This produces an accurately defined ± 10V version of the signal from the first stage. The signal from the output switch is taken to the BINARY (fixed output) connector, the amplitude control (600Ω VARIABLE OUTPUT) and a relay driver circuit, the output from which controls the BINARY RELAY.

4-24 ZERO MOMENT OPTION (OPTION 01). In some applications of binary noise signals it is desirable that the sync pulse should occur at a pre-determined point in the pseudo-random sequence other than the all-zero (with '1' in first stage) condition of the register.

4-25 When Option 01 is included, the position of the sync pulse is shifted with respect to the sequence for each of the seven shortest sequences (n=15 to 1023). The necessary shift in relative position is achieved by generating the sync pulse at the same point as before, and by delaying the actual BINARY output sequence, with respect to the pulse, by a pre-set amount (which is specially selected for each sequence).

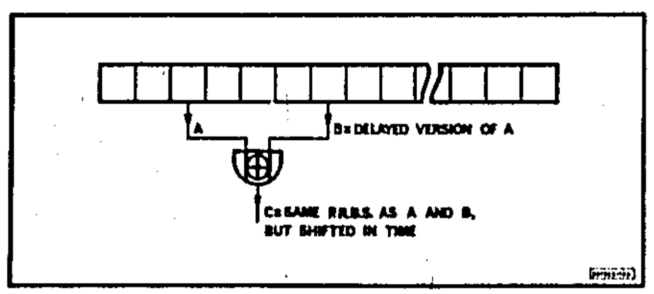



**Figure 4 - 7 Sequence shift by combining outputs**

4-26 As shown in Paragraph 4-10, the sequence of ones and zeros produced by one stage of the register appears, delayed by one clock period, at the output from the next. The shift register itself thus generates 32 differently delayed versions of the same sequence. As a result, relative timing of sync pulse and BINARY output sequence could be adjusted by up to 32 clock periods, simply by taking the output (i.e. the output switch drive) from the appropriate stage. The optimum shift for the longer sequences, however, is greater than 32 bits. To achieve greater delays, use is made of the 'shift and add' property of pseudo-random sequences: this means that a sequence added (modulo-two) to a delayed version of itself produces yet another delayed version of the original sequence, as in Figure 4-7.

4-27 The pairs of shift register outputs from which the binary signal is derived are selected by the SEQUENCE LENGTH switch.

4-28 RANDOM OPERATION OF SHIFT REGISTER. With the SEQUENCE LENGTH switch set to infinite, the feedback system is disconnected, and the first stage of the register is controlled by a semiconductor noise source giving a truly random output signal. Just before each shift pulse, the random signal is sampled by a level detector which decides, on arrival of the shift pulse, whether a '1' or a '0' is to be placed in the first stage of the register. Since the random signal is non-periodic, there is no repeated pattern in the resulting series of ones and zeros from the register.

4-29 GAUSSIAN NOISE. In the *3722A*, the Gaussian multi-level noise signal is generated by low-pass filtering the binary output from the shift register. Examples of this are shown in Figure 4-8, where a pseudo-random binary signal is applied in turn to three low-pass RC filters, of diminishing cut-off frequency. The first filter, having a time constant equal to approximately one third of the clock frequency (period 3.3μS, frequency 300kHz), distorts the edges of the waveform but leaves a still recognisable pattern. The third filter, however, has a much longer time constant and gives a multi-level output very similar in appearance to the Gaussian-type waveform from the *3722A* (oscilloscope photograph 'B' Table 3-1): not only does this filter convert from two-level to multi-level, it also modifies the frequency spectrum of the signal, as shown in Figure 4-9.

4-30 The filter in the *3722A* is a digital device which is not subject to the same limitations as the conventional low-pass filter (in particular, the *3722A* filter is required to yield a rectangular spectrum of selectable cut-off frequency down to 0.00015Hz – not practicable with conventional devices).





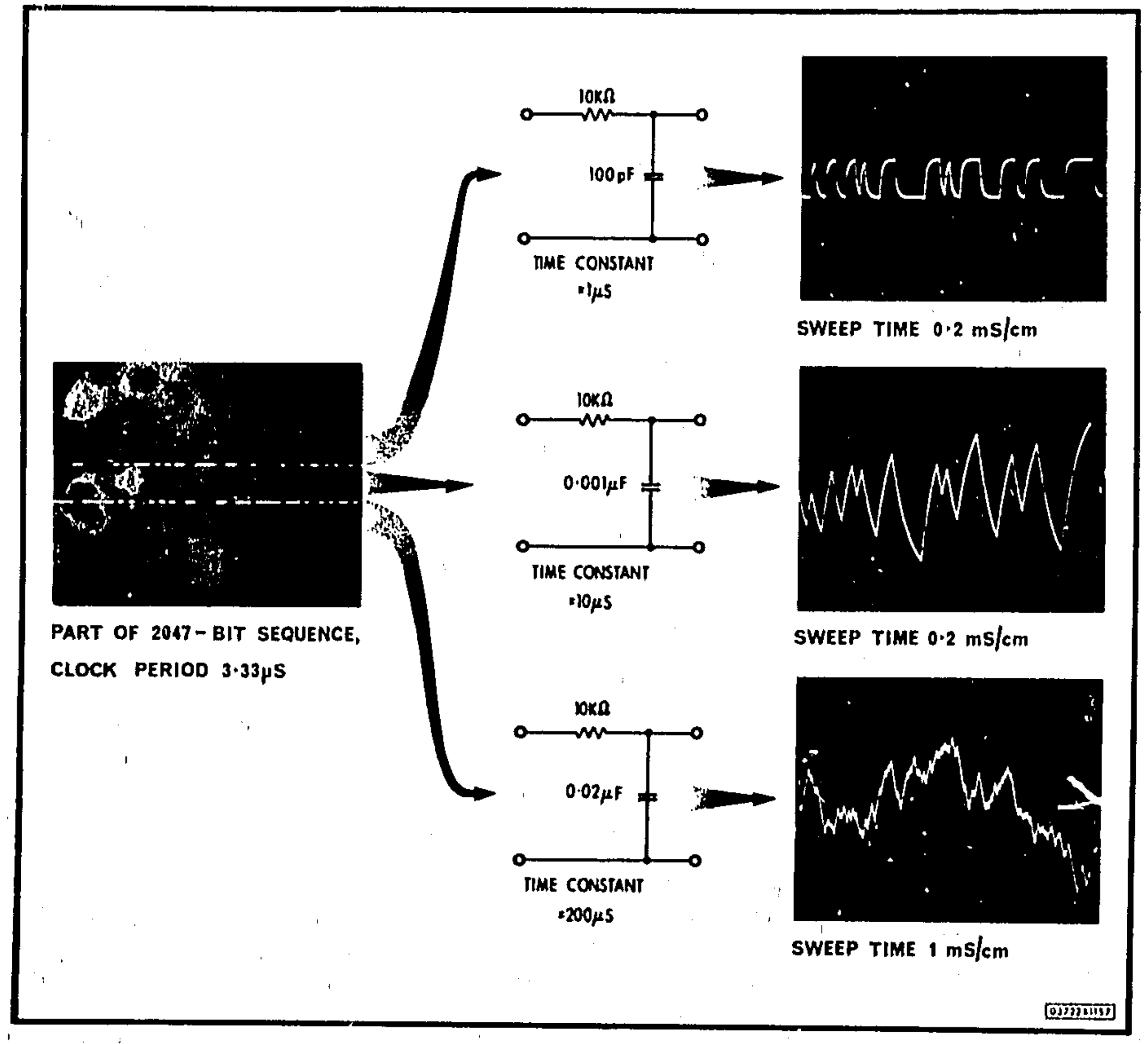



**Figure 4 - 8 Low-pass filtering of p.r.b.s.**

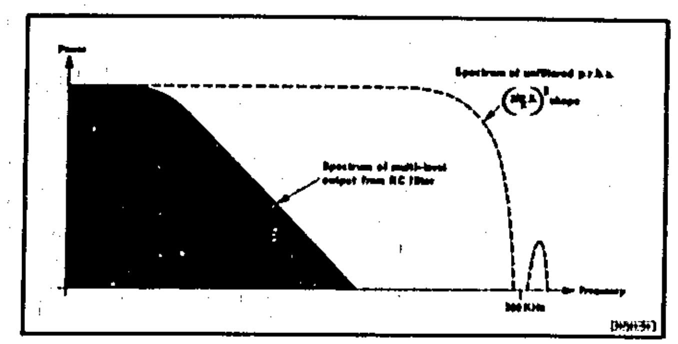


**Figure 4 - 9 Spectrum shaping by simple low-pass filtering**

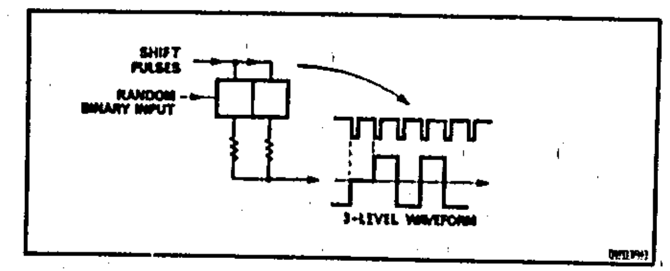



**Figure 4 - 10 Two-stage 'digital to analog' converter**

4-31 Consider first a simple method of digitally converting a binary signal into a multi-level waveform. In Figure 4-10, two stages of a shift register are coupled to resistors of similar value, and the circuit is so arranged that the current flowing through each resistor depends upon the state ('0' or '1') of its associated stage. If, say, a stage in the '1' state causes its load resistor to pass one unit of current, then the possible combinations with two stages are:-

(1) No current (both stages in '0' state).

(2) One unit of current (either stage in '1' state).

(3) Two units of current (both stages in '1' state).

Hence the signal at the summing point can at any given time have one of three values, depending on the combination of digits in the two stages. Figure 4-10 shows the sort of three-level signal which could be produced by a two-stage device, assuming arbitrary changes in digital pattern. Note that, in normal shift register fashion, the pattern changes only when a shift pulse is received. Clearly, with a larger number of 'bits' contributing to the output, the number of possible signal levels is increased. The device therefore acts as a filter in that it derives a multi-level waveform from a two-level signal, as does the low-pass filter described above.

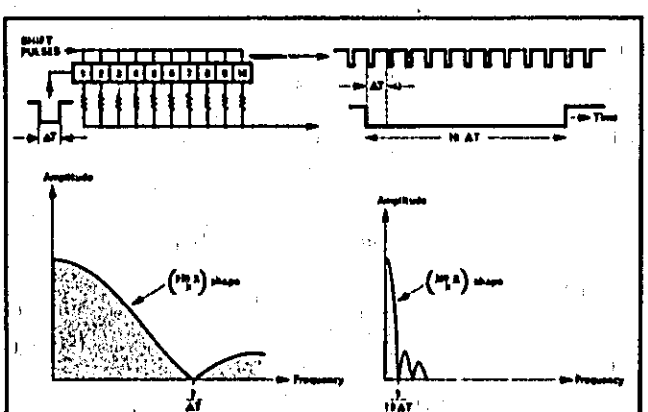


**Figure 4 - 11 10-stage shift register acts as low-pass filter**

4-32 Now consider the other aspect — frequency response. Figure 4-11 shows a single pulse (i.e. a '1' input), of width $\Delta T$, applied to a 10-stage shift register driving 10 identical loads. Since the resistors are of the same value, there is no change in level at the summing point as the '1' passes from one stage to the next: the output is therefore a stretched rectangular pulse. If the shift pulses are at intervals of $\Delta T$, then the width of the output pulse will be $10\Delta T$: the shift register thus behaves exactly like a low-pass filter — narrow pulse in, wide pulse out. A train of pulses of width $\Delta T$ has a (sin x/x) shaped spectrum with the first null occurring at the frequency $1/\Delta T$. Clearly, for a train of stretched pulses as in Figure 4-11, the frequency of the first null is $1/10\Delta T$: in other words, the bandwidth of the signal has been reduced by the factor 10.

4-33 It follows that the shift register with equal load resistors acts as a low-pass filter having a (sin x/x) shaped characteristic. In the *3722A*, however, the requirement is for a Gaussian signal having a *rectangular* spectrum: in other words, the shift register device must be modified in such a way that it behaves as an ideal filter.

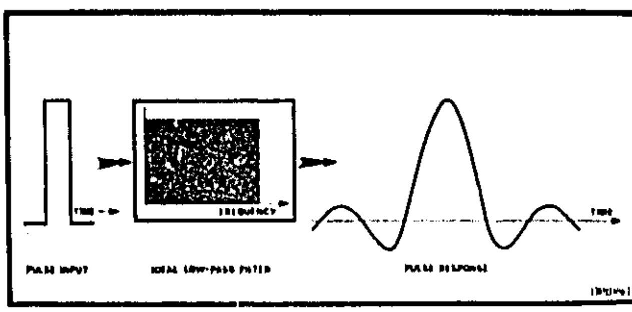


**Figure 4 - 12 Pulse response of ideal low-pass filter**

4-34 An ideal filter, when excited by a pulse input, gives an output (in the TIME domain) of (sin x/x) form (Figure 4-12). If, therefore, the shift register can be arranged to give a (sin x/x) shaped time waveform for each '1' pulse applied to the input, then it must be acting as an ideal filter, with rectangular frequency response. This is achieved by choosing resistor values such that the current contribution to the summing point is graded, from one end of the shift register to the other, to follow the (sin x/x) curve as closely as possible (Figure 4-13).

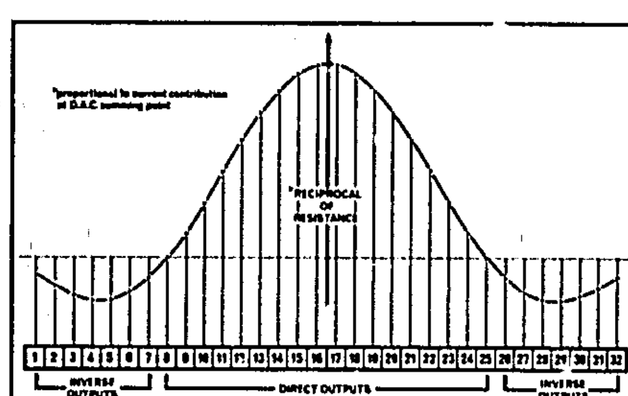


**Figure 4 - 13 Weighting resistors chosen to give sin x/x waveform**

4-35 As shown in Figure 4-13, the (sin x/x) curve is incomplete, and stops short at a point in the second lobe on either side of the centre line: this is because of practical limitations on the size of shift register. Note that the contribution to the signal made by the first and last groups of seven resistors is required to be of the opposite polarity to that made by resistors in the central group. This is arranged by supplying all resistors in the central group with 'reset' outputs from the shift register, and supplying those in the outer groups with 'set' outputs (Paragraph 4-60). It follows that a '1' starting at one end of the register and being conveyed to the other, by a series of shift pulses, will generate the waveform shown in Figure 4-14: this is similar to the waveform produced by the digital filter when in the test condition. With the SEQUENCE LENGTH switch S2 set to INFINITE and the chassis-mounted switch S15 set to TEST, a single pulse recirculates in the shift register, and a waveform like that shown in Figure 4-14 can be observed at the digital filter summing point (refer to Section VIII, Digital Filter Service Note).

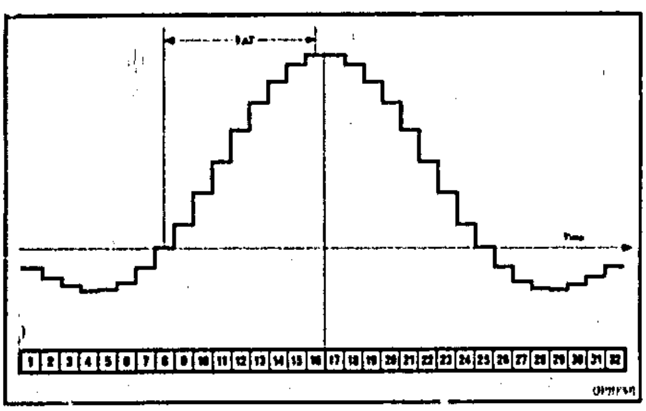



**Figure 4 - 14 Time waveform generated by recirculating '1'**

4-36 The digital filter in the *3722A* has the almost rectangular frequency characteristic shown in Figure 4-15. Owing to the limited size of shift register, which results in truncation of the (sin x/x) curve, the corner of the frequency characteristic is not perfectly square. The high frequency components in the Gaussian output spectrum are caused by *abrupt* changes in output level as pulses pass down the register, and are removed by analog filtering (Paragraph 4-40).

4-37 The unique feature of this digital filter is that the cut-off frequency *automatically keeps in step with clock frequency:* even at the lowest clock frequencies, the filter always has a flat response

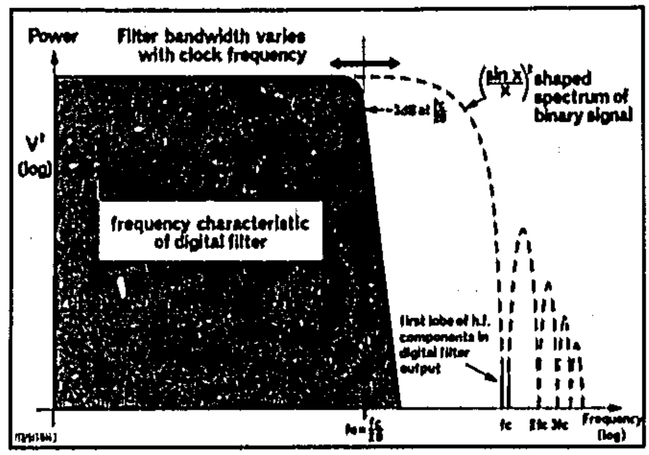



**Figure 4 - 15 Spectrum of Gaussian noise output**

and sharp cut-off. The direct relationship between clock frequency and cut-off frequency follows from the relationship between the (sin x/x) time function and the corresponding frequency function. This relationship is shown in Figure 4-16: if the clock frequency is *increased* then $\tau$ decreases, and the cut-off frequency $\pi/\tau$ *increases.*

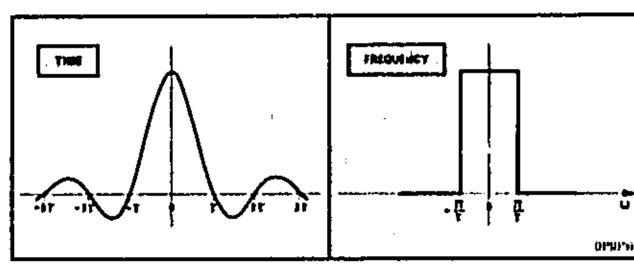



**Figure 4 - 16 Sin x/x shaped waveform & corresponding frequency function**

4-38 The digital filter in the *3722A* is designed such that the half-power frequency of the Gaussian noise spectrum occurs at 1/20th of the clock frequency. With a clock period of 1$\mu$S, for example, the relative power at 50kHz is -3dB.

4-39 The output from the digital filter is a multi-level signal having an approximately Gaussian distribution of amplitude (Figure 4-17): it is distinguished from a conventionally low-pass filtered signal only by abrupt steps between levels (these give rise to the high frequency components mentioned above). The amplitude p.d.f. of the multi-level signal is not significantly affected by the values of weighting resistor assigned to the various stages. The Gaussian nature of the p.d.f. arises mainly from the apparent randomness of the changing pattern of ones and zeros in the shift register — the p.d.f. becomes more

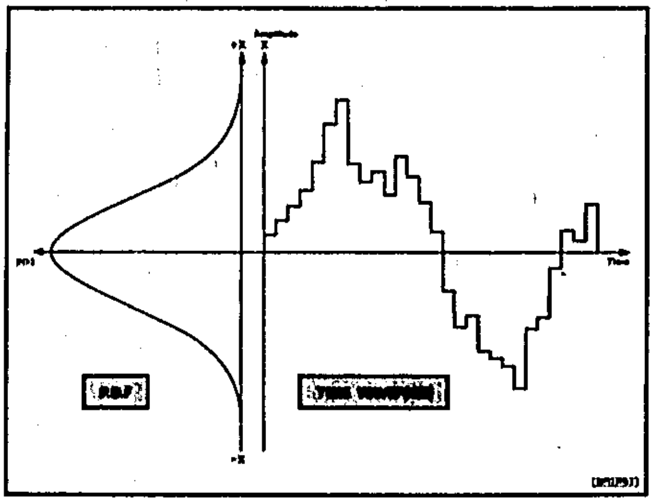


**Figure 4 - 17 Gaussian multi-level output from digital filter**

nearly Gaussian as the sequence length, and hence the 'randomness', is increased (Section III, Figures 3-9 and 3-10).

4-40 ANALOG FILTERING. In analog computing applications, time derivatives (i.e. differentiated versions) of signals occur frequently and, whenever a signal has sharp edges, there is the danger that derivatives could cause overload. In the case of a stepped waveform, with its very fast transit times, even the first time derivative would be a series of very large amplitude spikes. For this reason, a second order analog filter is included in the *3722A* to remove sharp edges from the digital filter output waveform. As a result, neither the first nor the second time derivatives of the waveform yield sharp spikes. The p.d.f. for both derivatives is reasonably Gaussian (Section III, Figure 3-9).

4-41 The analog filter cut-off frequency is selected by the CLOCK PERIOD SWITCH S1, and is nominally 1/5th of the clock frequency (that is, four times the half-power frequency of the digital filter output). This feature is included for all clock period selections of interest to analog computer users, that is, noise bandwidths from 50kHz to 0.15Hz. At frequencies of 0.05Hz and below, the analog filter cut-off remains at the same frequency as for the 0.15Hz setting.

4-42 GATE SYSTEM. The gate system comprises a four-stage binary counter and a selector switch, S4, which sets the number of sequences (1, 2, 4 or 8) in the gate interval. When the GATE RESET button is operated, (i.e. pressed and released), the counter is primed to accept sync pulses. The first of these sets a store in the gate output circuit and thus marks the start of the gate interval. The sync pulses cause the counter to change state as follows:-

| | Stage (1) | Stage (2) | Stage (3) | Stage (4) |
|---|---|---|---|---|
| Initial contents | 0 | 0 | 0 | 0 |
| After 1st pulse | 1 | 0 | 0 | 0 |
| After 2nd pulse | 0 | 1 | 0 | 0 |
| After 3rd pulse | 1 | 1 | 0 | 0 |
| After 4th pulse | 0 | 0 | 1 | 0 |
| After 5th pulse | 1 | 0 | 1 | 0 |
| After 6th pulse | 0 | 1 | 1 | 0 |
| After 7th pulse | 1 | 1 | 1 | 0 |
| After 8th pulse | 0 | 0 | 0 | 1 |
| 'Sequences per gate interval' | 1 | 2 | 4 | 8 |

Selector Switch

'End of Gate' signal

Here the selector switch is shown set to '4 SEQUENCES PER GATE INTERVAL. The '0' signal appearing on the wiper at the end of the fourth sequence resets the store in the output circuit and so marks the end of the gate interval. At the same time, the '0' signal on the wiper inhibits the counter and thus prevents the acceptance of further sync pulses. The inhibit is removed only when the GATE RESET button is again operated (hence there is only one gate signal per operation of the button).

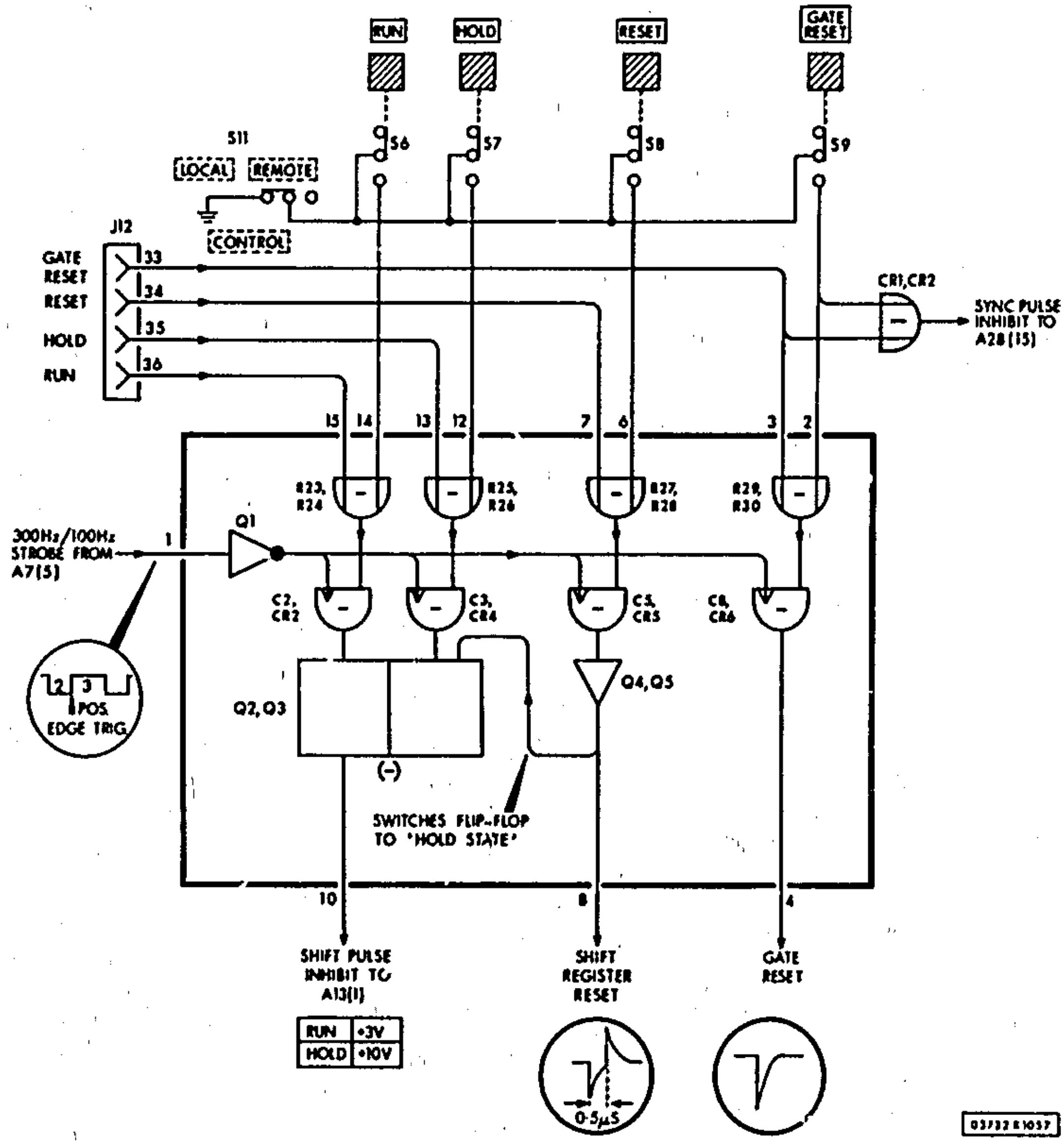



**Figure 4 - 18 Control logic assembly A1: logic diagram**

**4-43 CIRCUIT DESCRIPTION**

4-44 CONTROL LOGIC ASSEMBLY A1. The control logic assembly A1 (Figures 4-18 and 8-7) receives inputs from either the push-buttons on the front panel or the 36-way CONTROL receptacle on the rear panel. Only one of these sources of control signals may be used at any one time, and the CONTROL selector S11 (rear panel) must be set as appropriate – LOCAL for push-button control or REMOTE for control signals via the 36-way receptacle (typically, the instrument is remote controlled by grounding the appropriate pin of the CONTROL receptacle). The four function circuits in A1 are basically similar, each comprising an OR-gate (A1R23+A1R24) and an ac coupled AND-gate (A1C2+A1CR2) similar to those in the shift register assembly (Paragraph 4-61). The OR-gate, when one of its inputs is grounded (via push-button or CONTROL receptacle), primes the AND-gate to pass the next negative-going signal from inverter A1Q1 (which receives a synchronising signal from the decade divider chain). The reset outputs (pins 4 and 8) are negative-going pulses of short duration: the gate reset is taken directly from AND-gate A1C8+A1CR6, but the shift register reset, which is more heavily loaded, is amplified by A1Q4+A1Q5.

4-45 The run/hold mechanism includes a memory element, flip-flop A1Q2+A1Q3. On receipt of a RUN signal, OR-gate A1R23+A1R24 primes the dc input of AND-gate A1C2+A1CR2. On the next falling edge of the synchronising signal from A1Q1, the gate passes a negative-going pulse which switches the flip-flop into the 'run' state (output at pin 10 falls from +10V to +3V). The flip-flop remains in this state until reset by *either* HOLD or RESET signals.

4-46 3MHz CRYSTAL OSCILLATOR ASSEMBLY A2. The oscillator assembly (Figure 8-8) is a two-section circuit comprising a 3MHz crystal-controlled oscillator A2Q1 and a Schmitt trigger A2Q2+A2Q3, which produces a squared version of the 3MHz signal suitable for application to either the divide-by-three assembly, A3, or decade divider A4. Capacitor A2C3 allows frequency adjustment of approximately 0.03%, this being sufficient to accommodate the known tolerance on 'as cut' crystal frequency, and thus allow two or more *3722A* noise generators to be operated at the same frequency.

4-47 DIVIDE-BY-THREE ASSEMBLY A3. The divide-by-three assembly (Figures 4-19 and 8-10) derives a 1MHz signal from the 3MHz oscillator output. The assembly comprises a conventional flip-flop (stage B) and a binary stage (stage A) similar to the typical decade divider stage shown in Figure 4-20. A binary stage is a special flip-flop with commoned inputs arranged so that, on receipt of a train of input pulses, it switches alternately from one state to the other. The circuit of Figure 4-20 is a 'positive true' device, that is, only positive-going input signals have any effect. A positive-going pulse passed by the input capacitor turns off the conducting transistor which, via the cross-coupling components, turns off the other transistor. The following pulse at the input restores the device to its original state, thus completing the cycle of operation. Since one complete cycle requires two input pulses, the binary stage can be said to divide by two.

4-48 The binary stage, A, in the divide-by-three assembly is a modification of the standard arrangement – the left-hand input is supplied via a 'control valve' (OR-gate A3CR1+A3CR2), which is turned on only when the feedback signal from stage B is at the low level (-22V). In the waveforms of Figure 4-19, stages A and B are assumed initially to be in the same state – outputs $\overline{A}$ and $\overline{B}$ at the high level (zero volts). The first rising edge of the input signal from A3Q1 is applied to both sides of stage A – direct to the right-hand side, and via A3CR1+A3CR2 to the left. Since the right-hand output, $\overline{A}$, was already at the high level, the right-hand input has no effect: the left-hand input, however, causes the device to flip to its other stable state – output $\overline{A}$ low. The second rising edge of the input signal restores the binary to its original state, where $\overline{A}$ is at the high level (note that this time the signal is effective at the right-hand input). The rising edge at $\overline{A}$ flips stage B, causing the feedback line to switch to the high (zero volt) level: the zero-volt feedback level clamps the output from OR-gate A3CR1+A3CR2, preventing the transmission of pulses via C1, and thus inhibiting the left-hand input of the binary. Since output $\overline{A}$ is already at the high level, the right-hand input of the binary is also ineffective. The third rising edge of the input signal therefore does not affect the binary, but instead flips stage B: when B flips, the feedback level falls to -22V, removing the inhibit and thus allowing the cycle of operations to repeat.

4-49 DECADE DIVIDER ASSEMBLIES A4 THROUGH A12. Each decade divider assembly divides by 10 the frequency of its input signal. In the *3722A*, nine decade divider assemblies are connected in cascade, and their outputs are tapped by the CLOCK PERIOD switch to provide a selection of frequencies to drive the shift pulse generator.

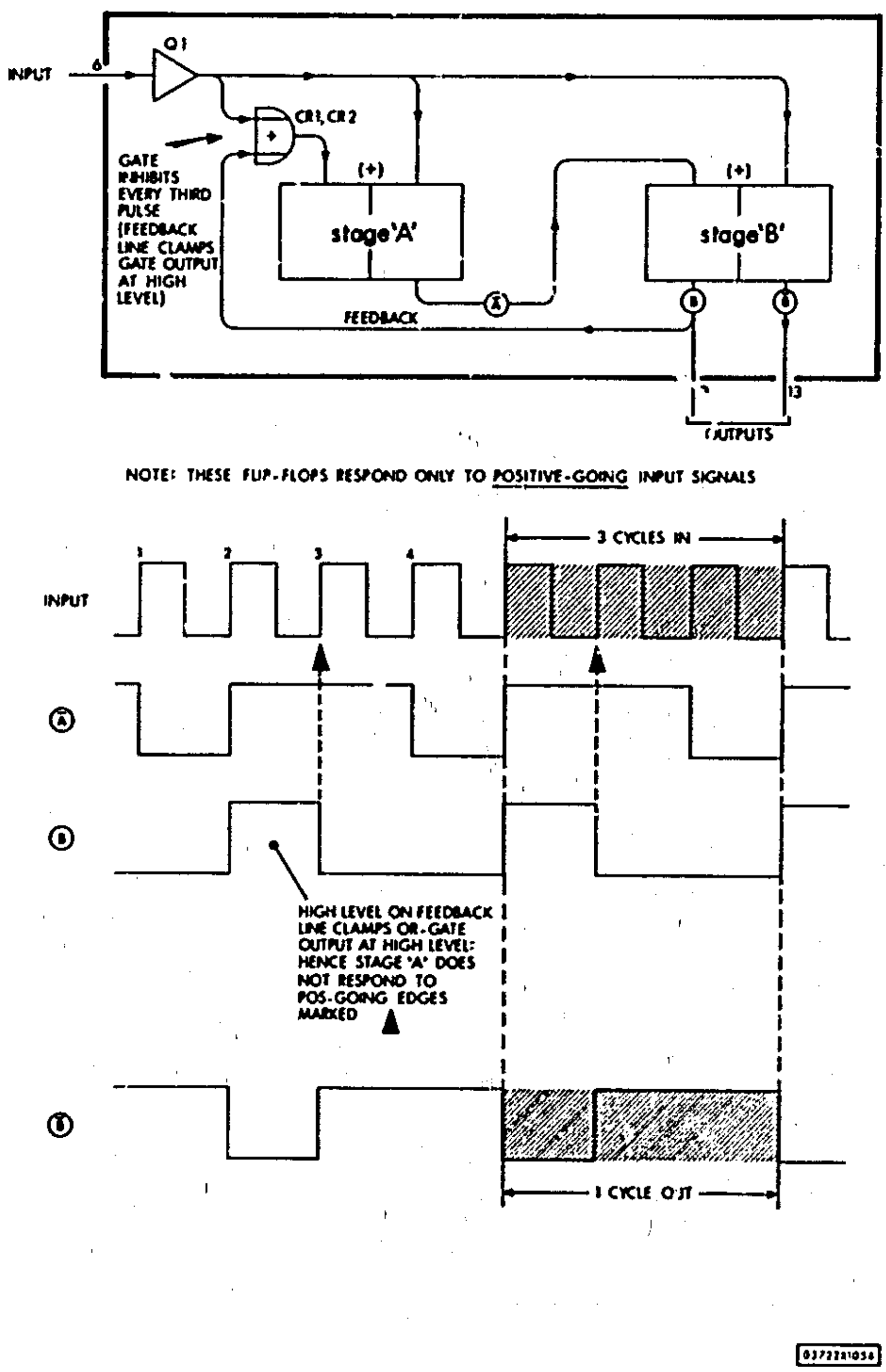



Figure 4 - 19 Divide-by-three assembly A3: logic diagram

4-50 Each decade divider assembly (Figures 4-21, 8-12 and 8-14) comprises three binary stages A, B, D (Figure 4-20) and a conventional flip-flop, C.

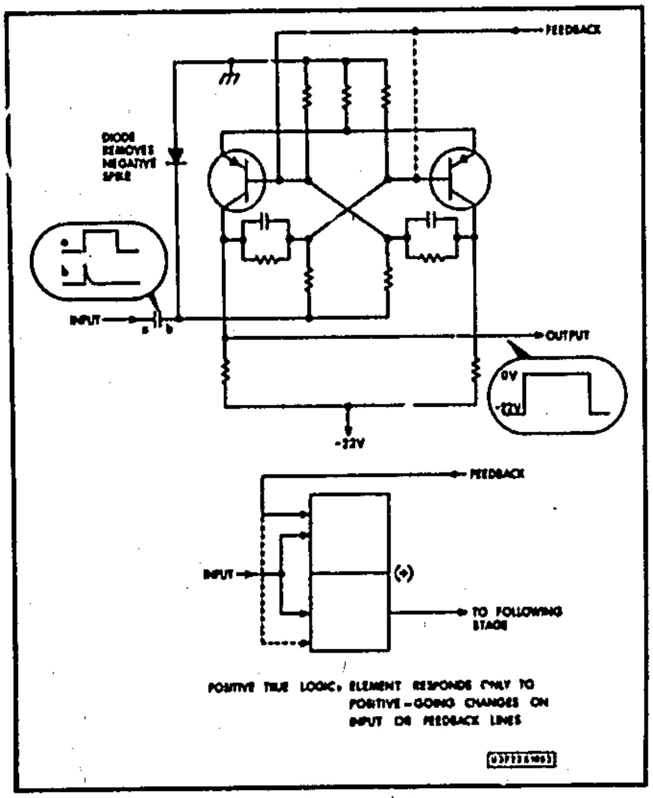



**Figure 4 - 20 Schematic of binary stage**

4-51 A normal cascade arrangement of four two-state circuits acts, overall, as a divide by 16 device – each stage operating at half the frequency of the preceding stage. By selective feedback, however, the four stages can be modified to divide by ten, that is, ten cycles in for one cycle out. The arrangement used in the decade dividers is shown in Figure 4-21. Note the provision of clipping diodes between stages, and also on the feedback line: these diodes allow the transmission of positive pulses only.

4-52 OPERATION OF DIVIDER. One complete cycle of decade divider operation is illustrated by the waveforms in Figure 4-21. All stages are assumed initially to be in the same state – outputs A, B, D and C all at the low level (-22V). On receipt of the first positive pulse derived from the input signal, stage A flips, causing output A to switch to the high level (zero volts). Differentiation of A gives a positive pulse (A') which flips stage B: output B in turn flips stage D, and so on. This 'chain reaction' is virtually instantaneous, ending with all stages in the alternate state – outputs A, B, D and C all at high level.

4-53 Events in the remainder of decade divider cycle are summarised below. Pulse numbers refer to positive-going edges of the input signal, Figure 4-21.

**2nd pulse**
A switches low: negative-going transition, therefore stage B is not affected.

**3rd pulse**
A switches high. Positive pulse at A' switches B low. No other effect.

**4th pulse**
A switches low. No other effect.

**5th pulse**
A switches high. Positive pulse at A' switches B high. Positive pulse at B' switches D low and $\overline{C}$ high (as $\overline{C}$ rises to high level, C falls to low level). Positive pulse ($\overline{C}$') on feedback line restores B to low level and D to high level.

**6th pulse**
A switches low. No other effect.

**7th pulse**
A switches high. Positive pulse at A' switches B high. Positive pulse at B' switches D low.

**8th pulse**
A switches low. No other effect.

**9th pulse**
A switches high. Positive pulse at A' switches B low. No other effect.

**10th pulse**
A switches low. No other effect.

**11th pulse**
A switches high. Positive pulse at A' switches B high. Positive pulse at B' switches D high, and positive pulse at D' switches C high.

The sequence then repeats: the decade divider output, C, is at one tenth the frequency of the input.

4-54 Both high-speed (A4, A5) and low-speed (A6 through A12) decade dividers use similar logic configurations, but differ in circuit detail. The high-speed assemblies include several refinements designed to increase the switching rate of the binaries: very fast switching is achieved by the use of

(1) High frequency transistors.

(2) Low time constants in the interstage coupling networks.

(3) Steering diodes, which determine the path taken by pulses applied to the binaries.

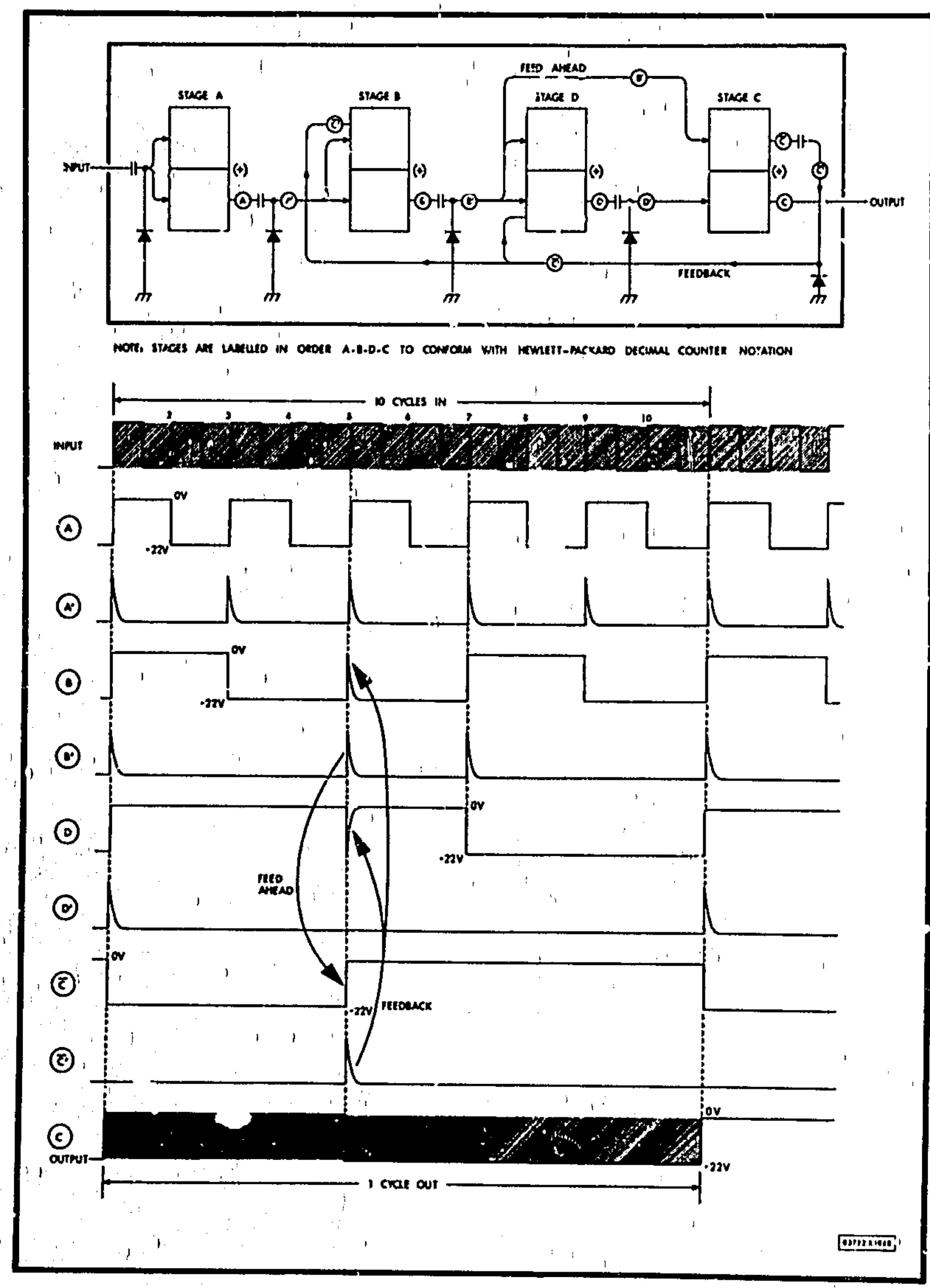



Figure 4 - 21 Decade divider assemblies A4-A12

4-55 SHIFT PULSE GENERATOR ASSEMBLY A13. Principal functions of the shift pulse generator (Figure 8-16) are:

(1) Generation of shift pulses from either internal or external clock signals.

(2) Shaping and amplifying the internal clock signal (from the decade divide chain) for retransmission as a timing signal for use with external equipment.

Assembly A13 comprises a Schmitt trigger A13Q1+A13Q2, three stages of amplification A13Q3+A13Q4+A13Q5, and a pulse generator circuit A13Q6+A13T1.

4-56 Quiescent conditions in the Schmitt circuit are: A13Q1 cut off and A13Q2 conducting. A positive-going edge applied to A13Q1 base very rapidly switches the Schmitt into its other state, where A13Q1 conducts and A13Q2 is cut off. Quiescent conditions are restored – again almost instantaneously – by the next negative-going edge. The circuit thus acts as a shaper capable of converting almost any type of input signal (e.g. sinusoidal or triangular from an external generator) into a rectangular waveform. After amplification in A13Q3 and A13Q4, the Schmitt output is taken, as a timing signal, to the random noise sampler A30, and also to the CLOCK connector (when S13 is set to INT). A13R19+A13R20+A13CR5 protect A13Q4 against damage arising from signals applied accidentally to the CLOCK connector. There is no inversion between the input (A13 pin 3 or pin 4) and the main output at A13(7) – positive-going input gives positive-going output.

4-57 In quiescent conditions, A13Q5, the drive amplifier, is turned off. A13Q6 conducts, and a

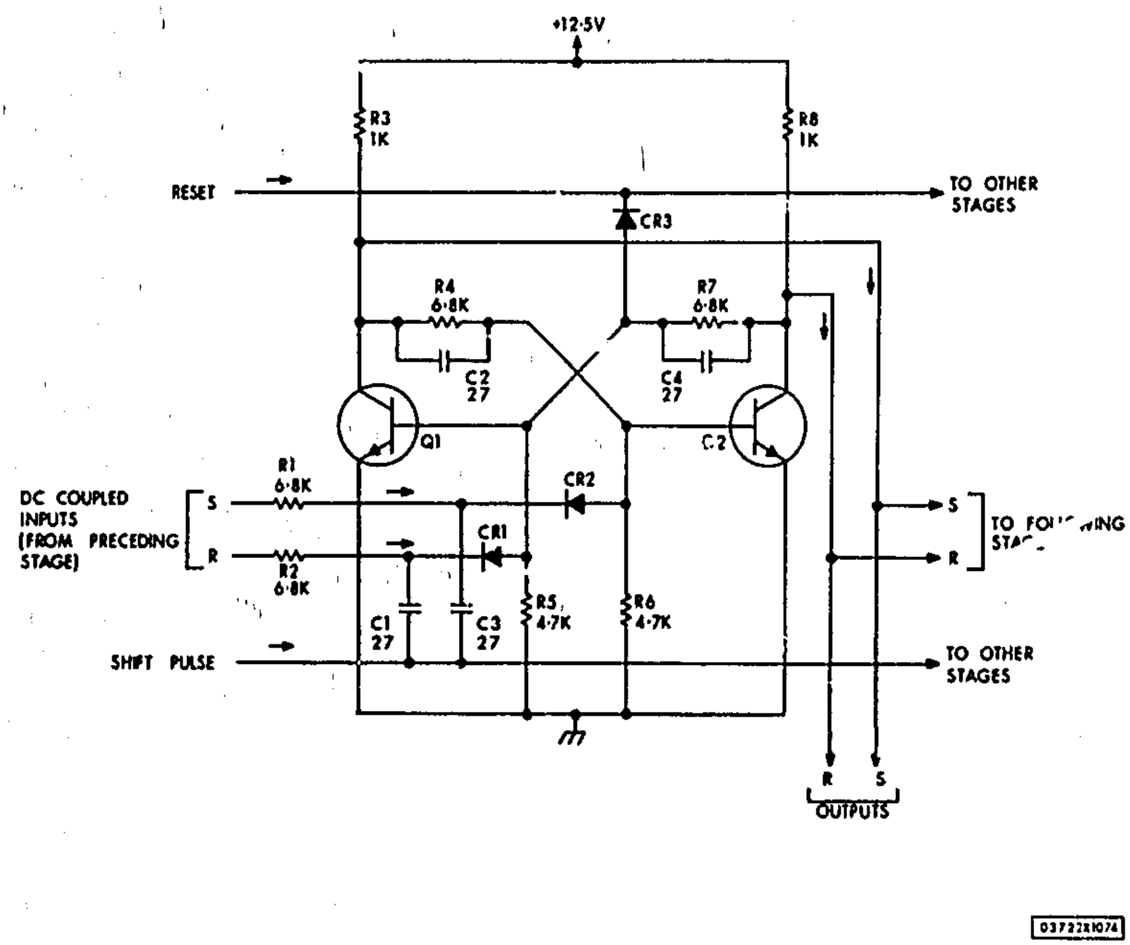



Figure 4 - 22 Schematic of shift register stage

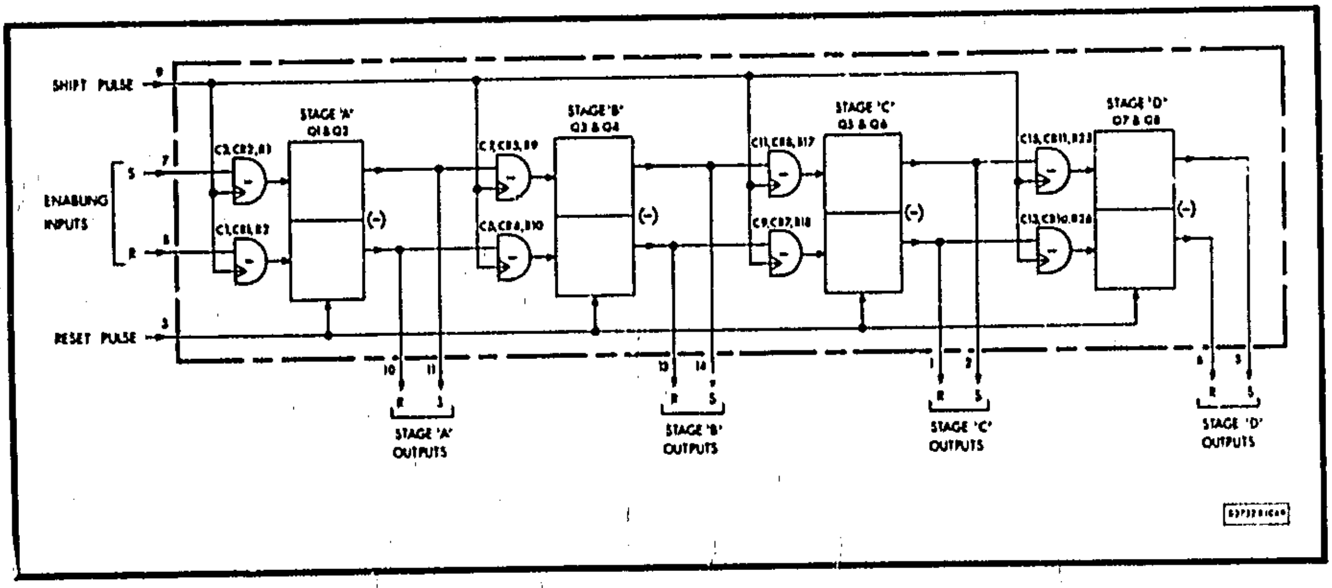



**Figure 4 - 23 Shift register assembly A14 etc**

standing current defined by the supply voltage and A13R25 flows through the primary winding of A13T1. When A13Q5 is switched on (coincident with a negative-going edge on A13Q1 base), the rapid rise in collector voltage transmits a positive-going pulse via A13C5 to the base of A13Q5: this pulse momentarily turns on A13Q5, which in turn cuts off A13Q6. Cutting off A13Q6 is in effect breaking the series circuit A13T1+A13R25 between +12.5V and ground: this results in a high initial rate of current decay in A13T1 primary, and hence a large induced voltage tending to maintain the current. This action yields a positive-going pulse of approximately 50V amplitude across the primary of A13T1, and a negative-going 10V pulse is induced in the secondary. Duration of the shift pulse at A13(9) is approximately 100nS. The shift pulse, which is applied simultaneously to all stages of the shift register, is used also to generate inhibit signals (A13 pins 13 and 14) which disable the auto-start logic during the instant of change in the register.

4-58 The shift pulse generator is under the control of the RUN/HOLD mechanism in the control logic assembly (Paragraph 4-45). When the control logic is in the HOLD condition, the dc level at A13(1) is approximately +10V and A13CR1 is biased off. A13CR2 conducts, and the resulting voltage on A13Q1 base is held positive with respect to the emitter voltage. The transistor is thus held in the conducting condition and cannot respond to the input signal. When the control logic is switched into the RUN condition, the level at A13(1) falls to approximately +3V, this time biasing off A13CR2: the base of A13Q1 then assumes the relatively negative voltage set by the potential divider between the +12.5V and -22V supply rails. In the absence of an input signal, therefore, A13Q1 is cut off.

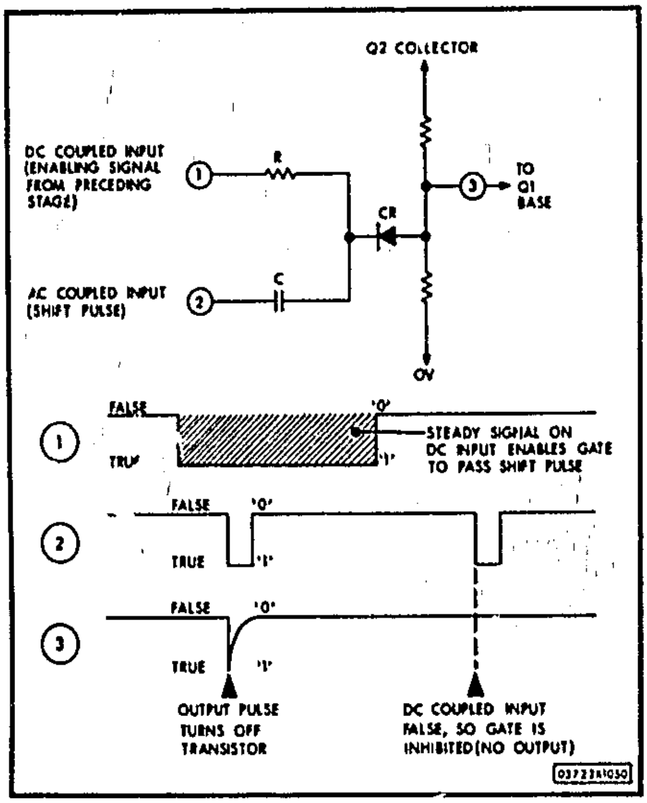



**Figure 4 - 24 Shift register AND gate**

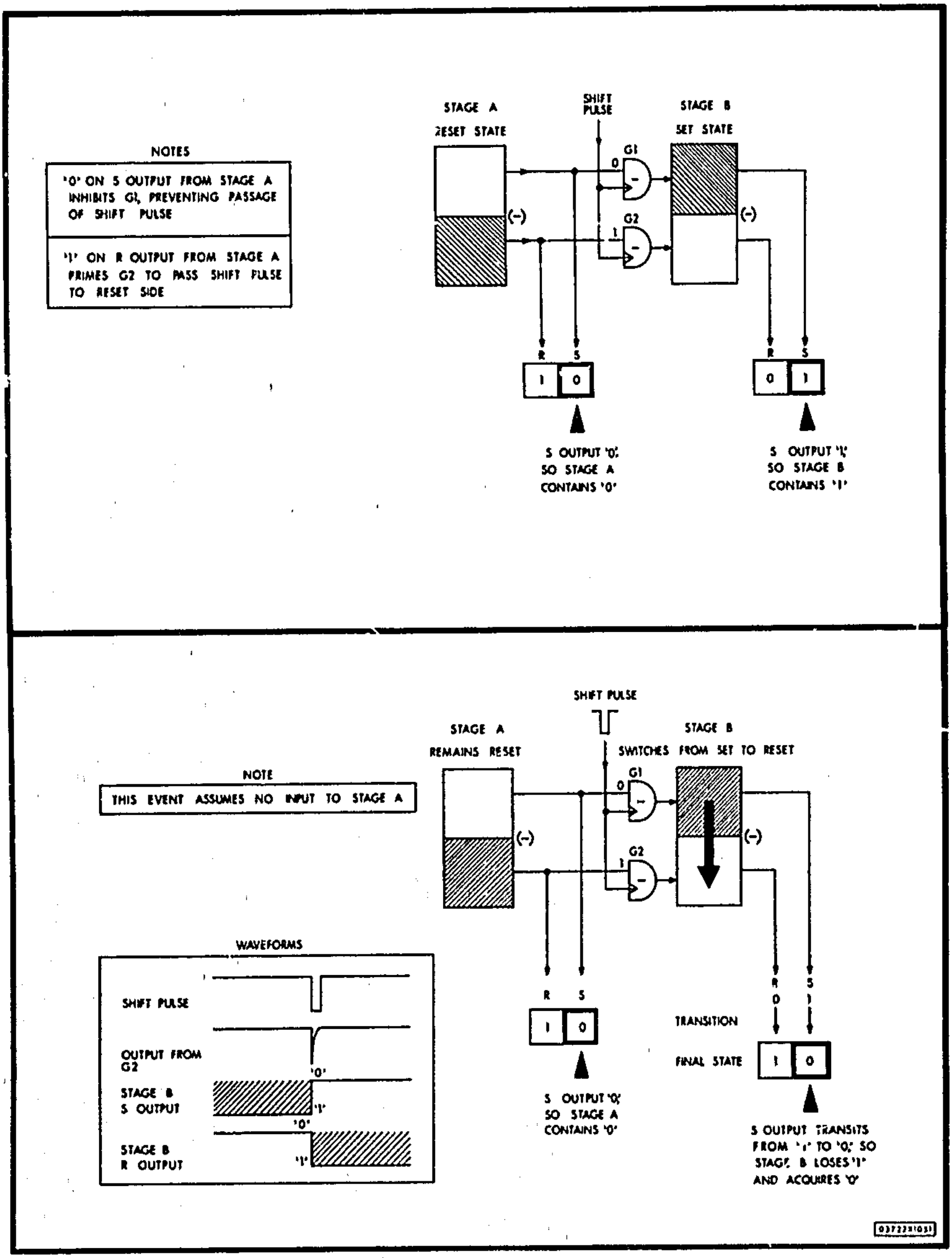



**Figure 4 - 25 Operation of shift register**

4-59 SHIFT REGISTER ASSEMBLY A14 ETC. Each shift register assembly (Figure 8-18) comprises four flip-flops of the type shown in Figure 4-22. The logic of a complete assembly is given in Figure 4-23.

4-60 Logic signal levels in the shift register are nominally +12V and zero volts. The shift register logic is *negative true*; the 'true' condition is represented by zero volts. Each flip-flop gives two outputs, known as 'S' and 'R': when the flip-flop is in the set state (i.e. when it contains '1'), output S is true and output R is false. Output conditions are reversed when the flip-flop is in the reset state:-

| State of flip-flop | Output S | Output R |
|---|---|---|
| SET | True ('1') | False ('0') |
| RESET | False ('0') | True ('1') |

4-61 The two outputs from each stage are connected, via AND gates, to the corresponding inputs of the next. Information is transferred from one stage to another only on receipt of a shift pulse, a negative-going signal applied simultaneously to the ac coupled inputs of all AND gates in the shift register. Each AND gate comprises a resistor, diode and capacitor arrangement as shown in Figure 4-24. Note that the AND gate allows the shift pulse to pass through only when it is enabled by zero volts (true) on the dc coupled input. In this condition, the junction of R and CR is held at approximately zero volts, and the shift pulse passes via CR as a negative-going spike superimposed on the junction voltage. If, on the other hand, the dc coupled input is at the false (+12V) level when the shift pulse arrives, the junction voltage is high and the pulse does not cause CR to conduct – hence no output from the gate. Operation of the complete shift register mechanism is illustrated by Figure 4-25, in which the '0' held by one stage is shown to be transferred, by the shift pulse, to the next.

4-62 DIGITAL FILTER ASSEMBLY A15 ETC. The complete digital filter comprises four similar assemblies, A15, A18, A21 and A24 (Figure 8-20 to 8-26). Overall function of the filter group is described in Paragraphs 4-31 to 4-39.

4-63 Basis of the filter assemblies is the clamp circuit shown in Figure 4-26. The clamp circuits are identical in every respect other than the value of the weighting resistor, R5 – from one end of the filter to the other, the 'weights' follow the approximate (sin x/x) curve of Figure 4-13. One end of the weighting resistor is taken to the collector junction

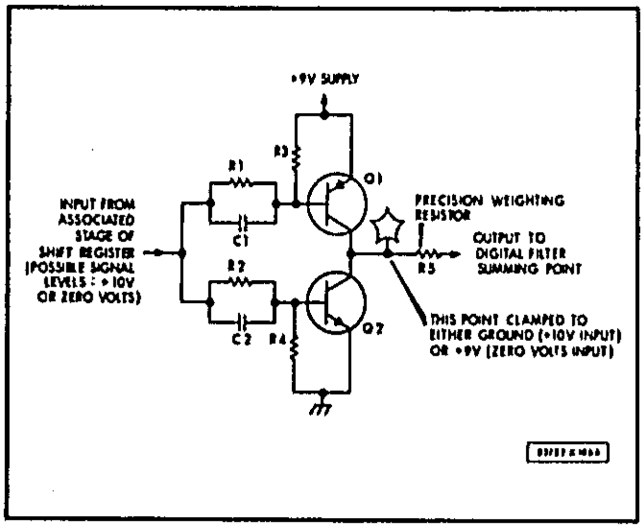



**Figure 4 - 26 Digital filter clamp circuit**

in the clamp circuit, and the other to the filter busbar, or summing point, which feeds the GAUSSIAN output amplifier system. With the exception of stages 8 and 25, each stage of the shift register is associated with one particular clamp circuit. Stages 8 and 25 do not drive clamp circuits, and therefore make no contribution to the filter output (this is equivalent to assigning zero weighting to the two stages, which correspond to the zero crossing points on the curve of Figure 4-13).

4-64 Depending upon the state of the associated shift register stage, the collector junction in the clamp circuit is held at either ground or +9V. At a given time, therefore, the current contribution made by a particular stage to the digital filter output depends on:-

(1) The state ('set' or 'reset') of the stage.

(2) The weight assigned to the stage.

(3) The voltage at the filter summing point (this in turn is dependent upon the contributions made by all other stages).

4-65 FEEDBACK LOGIC ASSEMBLY A27. The feedback logic assembly (Figures 4-27 and 8-28) contains three identical modulo-two adders of the type described in Paragraph 4-09. The overall truth table for the assembly is given in Table 4-3.

4-66 AUTO-START ASSEMBLY A28. Principal functions of the auto-start assembly (Figures 4-28 and 8-30) are:-

(1) Prevention of shift register failure arising from the 'all zero' condition (after switch-on or RESET).

(2) Provision of push-pull inputs for the first stage of the shift register: A28Q2 provides an inverted version of the direct output at A28(7).

(3) Amplification of the sync signal: amplifying stages are A28Q1 and A28Q3.

4-67 If all stages of the shift register are in the '0' state, both the 'all-zeros' signal from the sync gate and the output from the first stage of the register must be at the '0' level. Since there is no inversion (overall) in A28Q1 and A28Q3, it follows that the two active inputs to OR-gate A28CR3+A28CR4 will also be '0'. Inversion by A28Q4 gives a '1' input to the modulo-two adder A28Q5+A28Q6+A28Q7, the other input of which is supplied by the feedback logic. With all stages of the register in the '0' state, this feedback signal must also be '0'. The modulo-two adder thus receives dissimilar inputs and, in consequence, supplies a '1' signal to the first stage of the shift register.

4-68 OR-gate A28CR3+A28CR4 is inhibited, for the duration of each shift pulse, by the signal at A28(5): this signal clamps the output from A28Q4 at the '0' level, and thus prevents a spurious logic decision at the instant of change in the register. The sync signal path is similarly inhibited for the duration of the shift pulse. In addition, the sync signal is inhibited for the length of time that the GATE RESET button is held in, or a remote control gate reset input is applied: this inhibit is achieved by grounding A28(15) via either CR1 or CR2.

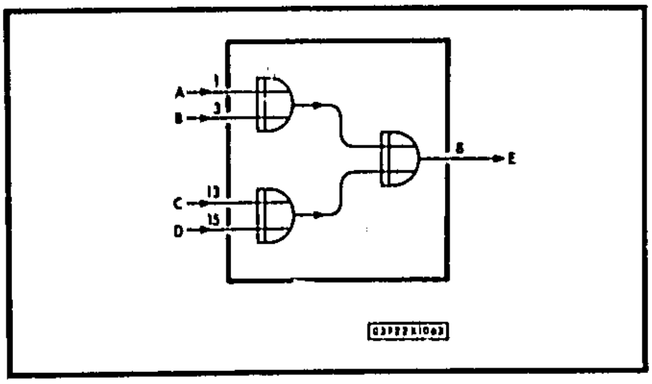



**Figure 4 - 27 Feedback logic assembly A27**

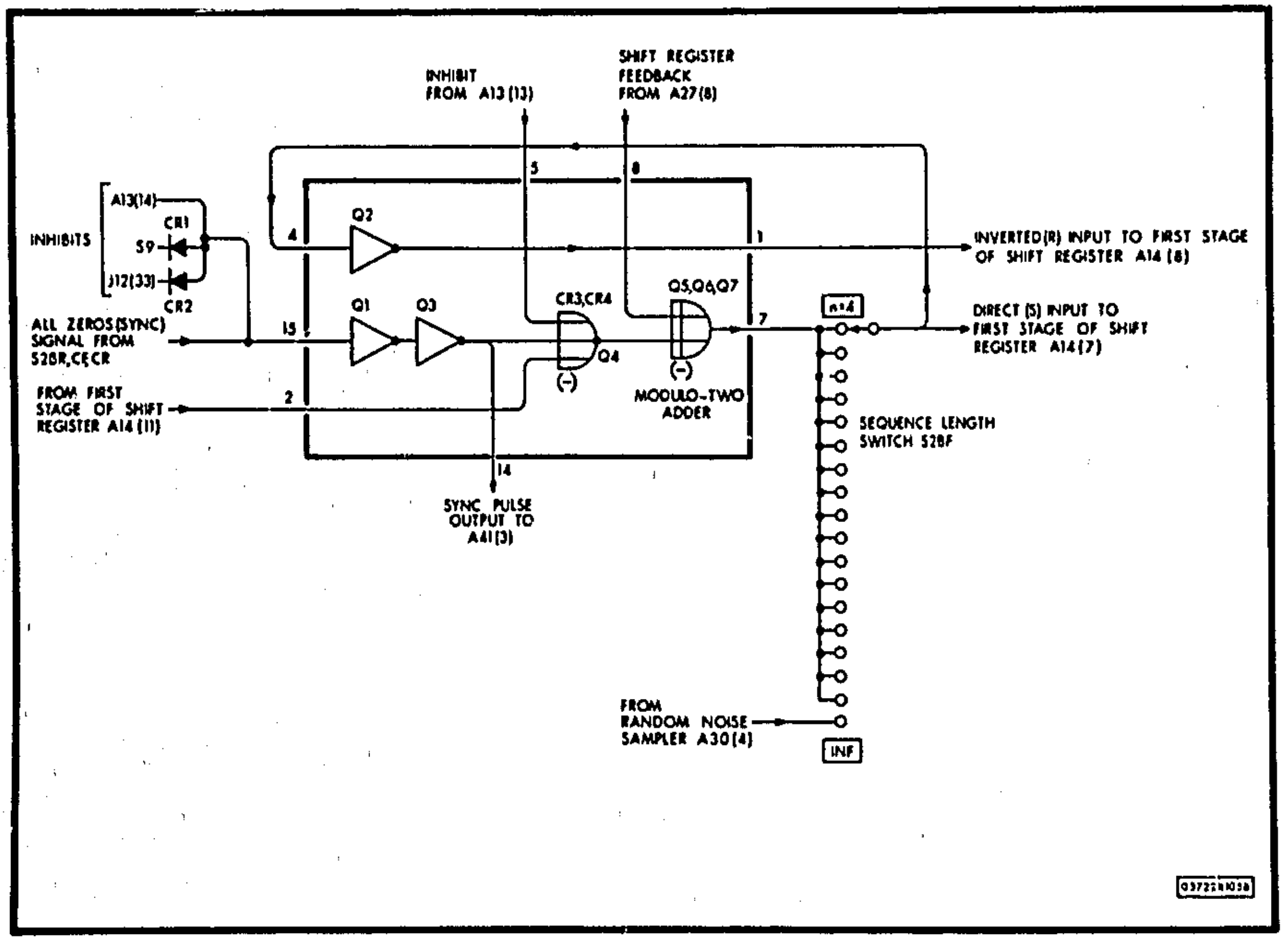



**Figure 4 - 28 Auto-start logic assembly A28**

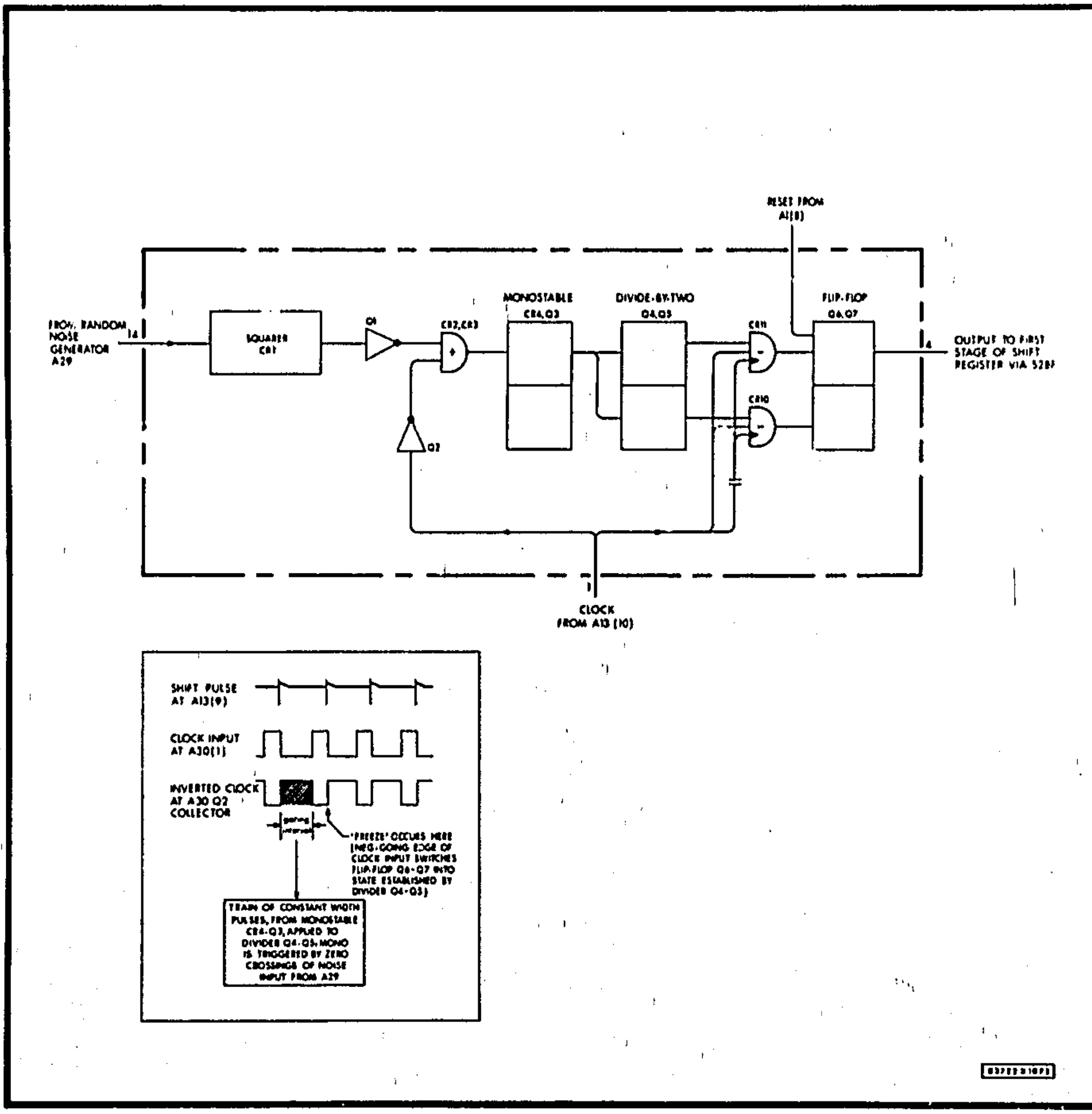



**Figure 4 - 29 Random noise sampler assembly A30**

4-69 RANDOM NOISE GENERATOR ASSEMBLY A29. The random noise generator assembly (Figure 8-32) uses as a noise source a transistor (A29Q1) biased in the base-emitter breakdown condition. The output from Q1 is amplified by A29Q2+A29Q6. The output from the assembly is white noise of approximately 10MHz bandwidth and 5V peak-to-peak amplitude.

4-70 RANDOM NOISE SAMPLER ASSEMBLY A30. When the SEQUENCE LENGTH switch is set to INFINITE, the feedback logic (A27) is disconnected and the input to the first stage of the shift register is provided by the random noise sampler assembly (Figures 4-29 and 8-34). The principal function of this assembly is to decide, before arrival of each shift pulse, whether a '0' or a '1' is to be supplied to the register.

4-71 The requirement is for one sampling per clock period and, with clock frequencies as high as 1MHz, this allows only a very short time in which the sampling decision can be made. In the worst case (1MHz clock), the time available for sampling is approximately 600nS (that being the longer of the two events in the clock cycle). To avoid any significant correlation between the results of successive samplings, a reasonable number of zero crossings of the noise input (from A29) must occur during the 600nS: the average number of zero crossings per second is related to bandwidth which, to guarantee non-correlation, must in this case be around 10MHz.

4-72 Noise from A29 is squared by tunnel diode A30CR1, and the result is gated with the inverted clock waveform from A30Q2. The gating interval starts immediately after the shift pulse, and ends at the next positive-going transition of the clock signal at A30(1). The gate output drives monostable A30CR4+A30Q3, which generates constant-width pulses (approximately 100nS): the number of pulses generated in a particular gating interval depends on the number of zero crossings, in that interval, of the noise input.

4-73 Pulses from the monostable alternately set and reset the divide-by-two flip-flop A30Q4+A30Q5. Since the clock interval (for a given setting of the CLOCK PERIOD switch) remains constant, the state in which the flip-flop remains at the end of the gating interval depends entirely on the number — odd or even — of pulses received from the monostable (with a 10MHz bandwidth noise input, the probability of either state is almost exactly 1/2). If the divide-by-two flip-flop were connected directly to the shift register, there would be the possibility of assymmetrical loading on the flip-flop owing to stray capacitance, etc: this could give rise to a predominance of 'ones' or 'zeros' in the BINARY output, that is, there would no longer be a probability of 1/2. To prevent such one-way bias the divide-by-two circuit is buffered locally by an extra shift register stage A30Q6+A30Q7, the mechanism of which is similar to that of a normal shift register

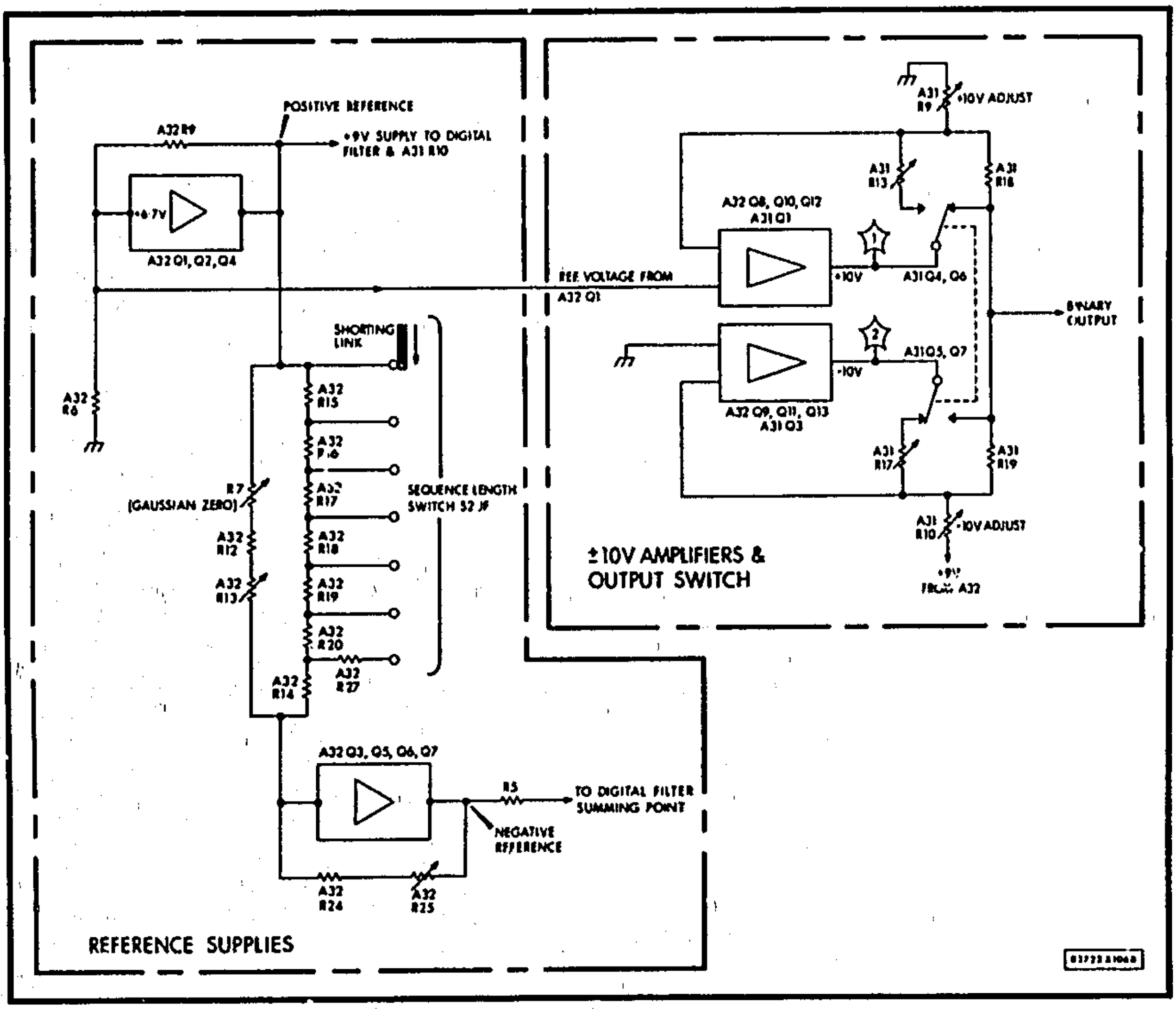



**Figure 4 - 30 Output switch and reference power supply assemblies A31, A32**

stage (Paragraph 4-61). The state into which the extra stage is 'frozen' depends on the state assumed by the divide-by-two circuit at the end of the gate interval. Note that the extra stage is strobed by the negative-going edge of the clock signal, that is, at the same time as the shift pulse is applied to the shift register.

4-74 When the chassis-mounted switch S15 is set to NORMAL, there is the possibility that noise picked up by the switch and interconnecting wires could be fed back into the sampler assembly. To prevent the possible biasing effects of this noise, the divide-by-two stage is effectively disconnected from all external circuits during the gating interval. The voltage at the junction of resistors A30R24+A30R25 is determined by the clock input at A30(1) which, during the gating interval, is at zero volts: in consequence, diodes A30CR6+A30CR9 are biased off, and the circuit cannot be affected by noise on pins A30(8) and A30(9). When S15 is set to TEST, the 'extra' stage A30Q6+A30Q7 converts the shift register from the normal open-ended arrangement into a closed loop, which generates the recirculating '1' used for checking the digital filter. The loop is completed as follows:

Shift register stage 32
↓
Switch S15, set to TEST
↓
Extra stage A30Q6+A30Q7
↓
SEQUENCE LENGTH switch, set to INFINITE
↓
Shift register stage 1

The '1' is placed in the closed loop simply by arranging for the extra stage to be reset to the '1' state, not '0' – as are all stages of the register.

4-75 OUTPUT SWITCH & REFERENCE POWER SUPPLY ASSEMBLIES A31, A32. The reference power supply assembly A32 (Figures 4-30 and 8-37) provides a stabilised +9V supply for the digital filter, and a negative reference to which the digital filter summing point is connected via R5. A32 also contains part of the +10V and -10V operational amplifiers associated with the output switch. A32Q1 is a stable voltage source supplying amplifier A32Q2+A32Q4, the output from which (nominally +9V) is determined by A32R9/A32R6. The negative reference voltage is provided by amplifier A32Q3+A32Q5+A32Q6+A32Q7, and is determined by the ratio of A32R24+A32R25 to the parallel network R7+A32R12+A32R13+A32R14...A32R20. The resistance of the parallel network (and hence the negative reference voltage) is variable, and depends on the setting of the SEQUENCE LENGTH switch – as the switch is turned clockwise (from n=4), the resistance is progressively reduced by a shorting link (S2JF). The resulting shift in reference voltage compensates for dc bias in the GAUSSIAN output, arising from a predominance of 'ones' in the shorter binary sequences (the difference between the numbers of 'ones' and 'zeros' is not significant in sequences longer than N=1023: hence no further correction).

4-76 The +10V level is provided by operational amplifier A32Q8+A32Q10+A32Q12+A31Q1, the output from which is determined by A31R18/A31R8+A31R9. A31R9 allows adjustment of the +10V level. Principal components of the switching mechanism are the inverter A31Q2 (not shown in Figure 4-30) and switching transistors A31Q4, A31Q5, A31Q6, A31Q7. When the input at A31(7) switches to the low level (zero volts), A31Q2 conducts and switches on A31Q6, thus connecting the BINARY output A31(6) to the +10V rail. When A31Q6 switches off (at the next transition of the input signal), A31Q7 switches on, connecting the output to the -10V rail (established by A31R19/A31R10+A31R11 in conjunction with amplifier A32Q9+A32Q11+A32Q13+A31Q3). When A31Q6 switches off, the feedback loop via A31R18 is broken, and the +10V amplifier would saturate if no alternative feedback path were provided (if saturation were to occur, the amplifier recovery time would be unacceptably long, and high frequency operation of the output switch would be unsatisfactory). The alternative feedback path is via A31R13, which is switched into circuit by A31Q5 at the instant A31Q6 ceases to conduct. A31R13 is adjusted so that the voltage at test point 1 remains constant when the transition occurs. This mechanism, which ensures that conditions in the amplifier remain undisturbed, makes possible very rapid switching between output levels, with very little distortion of waveform (transition time less than 100nS). The -10V amplifier is similarly protected by A31R17, which is switched in by A31Q5.

4-77 ANALOG FILTER & OUTPUT AMPLIFIER ASSEMBLIES A33 THROUGH A37. The GAUSSIAN output is amplified by assemblies A35, A36 and A37 (Figure 8-44), the frequency response of which is tailored by negative feedback via components in A33 and A34 (Figure 8-40). Figure 4-31 shows a simplified version of the complete system, comprising an operational amplifier A, and a feedback network R1, R2, R3, C1 and C2. The dc and low frequency gain of the system is determined by the ratio R1/R2, and the frequency response – which is determined by the values of *all* feedback components – has the form shown in Figure 4-32. The response is flat to a frequency, $1/2f_0$, and rises by 10% at $4f_0$ ($f_0$ is selected by the CLOCK PERIOD switch, and is the frequency indicated on the front panel of the instrument).

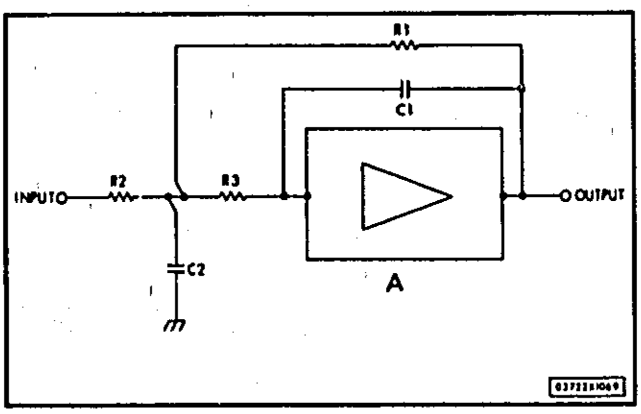



**Figure 4 - 31 Block diagram of complete amplifier system**

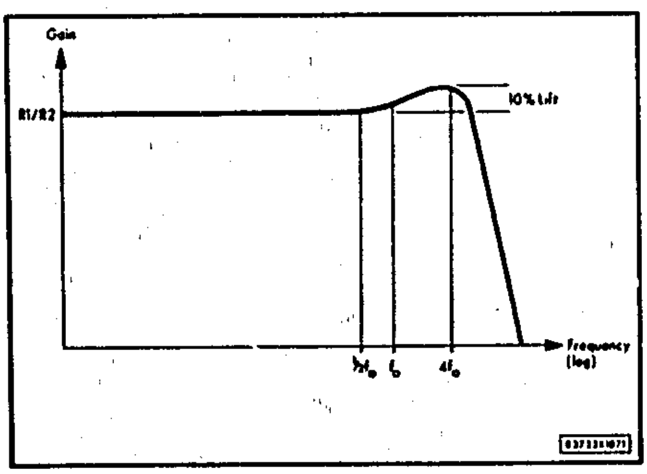



**Figure 4 - 32 Frequency response of amplifier system**

4-78 The output amplifier is required to have wideband capability and very low dc drift. This is achieved by a combination of chopper amplifier (for good dc and low frequency performance) and differential amplifier (designed for wideband performance). The amplifier block 'A' of Figure 4-31 can therefore be considered as two separate amplifiers X and Y, as shown in Figure 4-33. The input signal is applied to the differential amplifier Y via two paths – the chopper amplifier X, and the high-quality capacitor C. This capacitor prevents the base current of the differential amplifier input transistor (A35Q7) flowing in the feedback resistors, and thus causing current drift. The voltage drift of Y is reduced by the gain of X, when referred to input of A.

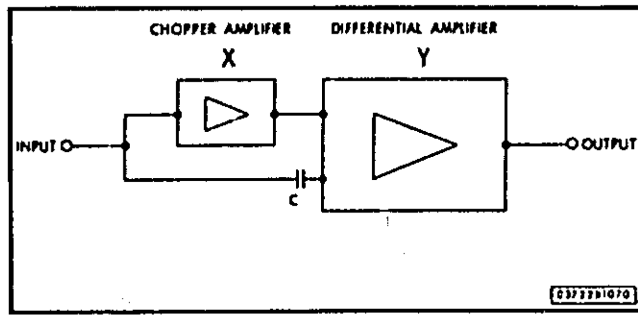
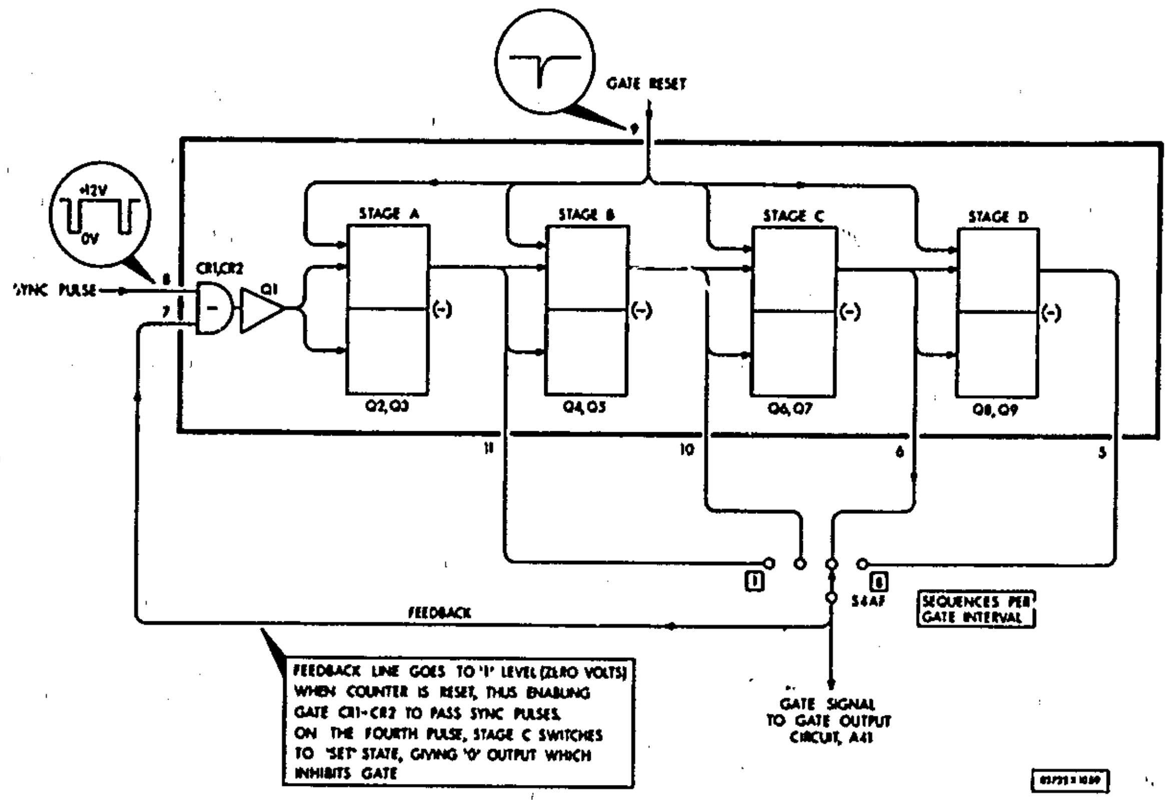



**Figure 4 - 33 Arrangement of chopper and differential amplifiers**

4-79 The chopper amplifier comprises the multivibrator A35Q2+A35Q5, modulator (FET) A35Q1, ac amplifier A35Q3+A35Q4 and demodulator A35Q6. The capacitor-coupled input to differential amplifier A35Q8+A35Q9 is buffered by emitter follower A35Q7. The signal on A35Q8 collector drives A36Q1 which, in conjunction with A37Q1, gives a gain of 10. A37Q1 is coupled via emitter follower A37Q2 to the output driver A37Q6. Q4 and Q5, the output transistors, are connected as complementary emitter followers, in which the quiescent current conditions are defined by A37CR1, A37CR2 and A37R11, A37R12. Resistance-capacitance networks (e.g. A36R1+A36C1) shape the frequency response characteristics of the amplifier to match the feedback network characteristics, these being dependent on CLOCK PERIOD switch setting.

4-80 ATTENUATOR ASSEMBLY A38. The attenuator assembly (Figure 8-46) provides a selectable-amplitude output of either BINARY or GAUSSIAN signals, as selected by slide switch S10 on the front panel. The assembly comprises two rotary switches, mounted in line and controlled by the dual concentric RMS AMPLITUDE knobs on the front panel. The red (inner) knob controls the rear section of the switch assembly, and selects one of four multiplier ranges; x1, x3, x3.16 and x10 (for the GAUSSIAN output, only *three* multipliers are available, namely x1, x3 and x3.16: at both the x3.16 and x10 settings of the red control, the output amplitude is 3.16V rms). Intermediate steps in output amplitude, from x0.1 to x1.0, are provided by the front section of the switch assembly, which is controlled by the black (outer) knob.

4-81 SEQUENCE COUNTER ASSEMBLY A39. The sequence counter assembly (Figures 4-34 and 8-48), which is part of the gate system, is a four-stage binary counter with an input inhibiting mechanism controlled by the GATE INTERVAL switch, S4. The binary stages in A39, while similar



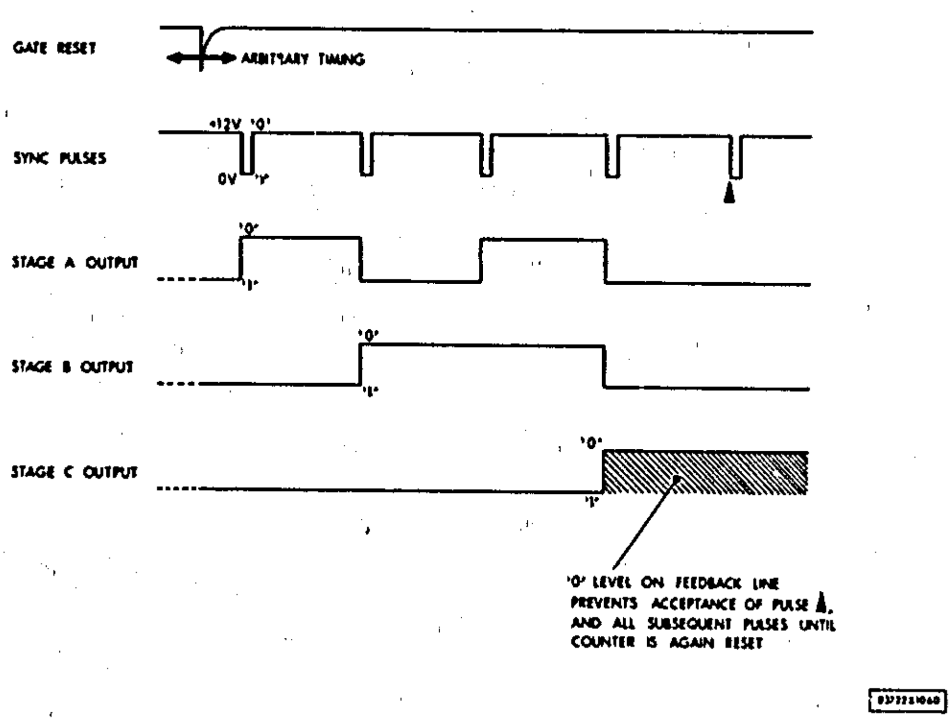




**Figure 4 - 34 Sequence counter assembly A39**

in principle to those in the decade dividers, are negative-edge triggered. When the GATE RESET button is operated, the negative-going signal at A39(9) resets the four binaries to give zero-volt ('1') outputs at A39(11), A39(10), etc. The resulting '1' level on the wiper of S4AF primes AND-gate A39CR1+A39CR2 to accept the next sync pulse from A41. This pulse sets stage A only:

| | A | B | C | D |
|---|---|---|---|---|
| Initial contents (reset) | 1 | 1 | 1 | 1 |
| After 1st sync pulse | 0 | 1 | 1 | 1 |

The second sync pulse resets stage A, and the resulting negative-going edge at the output from A sets stage B:

| | A | B | C | D |
|---|---|---|---|---|
| After 2nd sync pulse | 1 | 0 | 1 | 1 |

The third sync pulse sets stage A, but has no further effect:

| | A | B | C | D |
|---|---|---|---|---|
| After 3rd sync pulse | 0 | 0 | 1 | 1 |

This process continues, with stage A being alternately set and reset by input pulses, and each of the other stages operating at half the frequency of its preceding stage. Paragraph 4-42 shows the complete count-of-eight sequence.

4-82 At some point in the count sequence, the feedback signal (on the wiper of S4AF) will be switched to the '0' level (+12V): this inhibits AND-gate A39CR1+A39CR2, thus preventing the acceptance of further sync pulses until the counter is again reset. The point at which the inhibit is applied depends on the setting of the switch, that is, 1, 2, 4 or 8 SEQUENCES PER GATE INTERVAL. With the switch set as shown in Figure 4-33, the feedback signal goes to the '0' level after the fourth sync pulse:

| | A | B | C | D |
|---|---|---|---|---|
| After 4th sync pulse | 1 | 1 | 0 | 1 |

4-83 GATE & SYNC OUTPUT ASSEMBLY A41. The gate and sync output assembly (Figures 4-35 and 8-51) performs the following main functions:

(1) Amplification of the sync signal.

(2) Amplification of the binary relay drive signal.

(3) Generation of the gate signal.

The sync signal is amplified and inverted by A41Q1, which feeds both the sequence counter A39 and the SYNC output connector J10. A41Q1 also supplies a strobe signal to the ac coupled gates associated with the gate latch circuit A41Q3+A41Q4. A41Q7, the binary relay driver, is supplied with a binary signal taken from the first stage of the shift register (or from assembly A40 in the Option 01 version) via a buffer diode A31CR1 in the output switch assembly (A31CR1 prevents loading of the shift register stage).

4-84 Operation of the gate latch circuit is illustrated by the waveforms of Figure 4-35. The flip-flop is assumed to be initially in the reset ('gate off') state. When the GATE RESET button is operated, the sequence counter is reset (Paragraph 4-81), and the resulting zero volt signal on the wiper of S4AF primes AND-gate A41C3+A41CR6 to pass the next sync pulse (a negative-going signal) from A41Q1: this pulse sets the flip-flop to give a high output (+12V, waveform 4) and hence a low output (zero volts) at the GATE connector J11. This transition marks the start of the gate interval.

4-85 After counting the demanded number of sync pulses (Figure 4-35 shows the case where the gate switch S4 is set to '4'), the sequence counter is inhibited and the resulting high level (+12V) signal on the wiper of S4AF switches inverter A41Q2 to give a zero volt output: this primes AND-gate A41C2+A41CR4 to pass the *next* sync pulse from A41Q1. On receipt of this pulse, the flip-flop is reset and the GATE signal at J11 switches to the high level, thus marking the end of the gate interval. Amplifier/inverter A41Q6 drives both the GATE lamp (front panel) and gate relay in A42. Note the provision of a gate reset input to flip-flop A41Q3+A41Q4. Under normal circumstances this is not required, as the flip-flop is automatically reset at the end of the gate cycle: it is significant only if the gate is cancelled – by operation of the GATE RESET button – during the actual gate interval.

4-86 RELAY ASSEMBLY A42. The relay assembly (Figure 8-51) contains two similar changeover-type reed relays. The changeover contacts are brought out to two sets of terminal posts on the rear panel. A42K1, the binary relay, is de-energised when the main BINARY output is at +10V, and energised when the BINARY output is at -10V. A42K2, the gate relay, is normally de-energised, and is energised only during a gate interval.

4-87 RECTIFIER ASSEMBLY A43. For circuit details, refer to Figure 8-56. The ac supply, of line voltage 115V or 230V, is connected through fuse

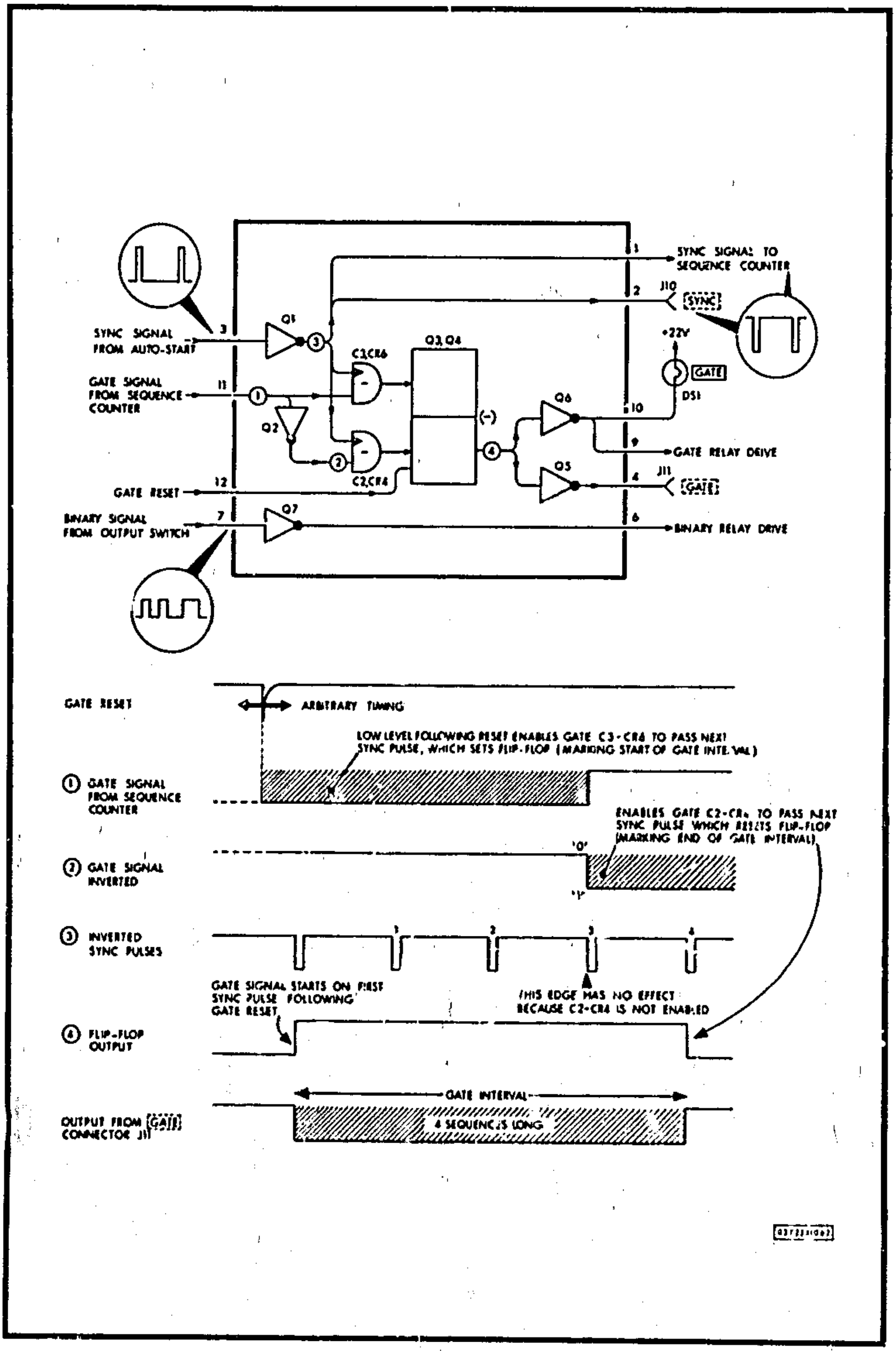



**Figure 4 - 35 Gate and sync output assembly A41**

F1 and LINE switch S5 to the primary of transformer T1, which supplies the three rectifier bridges is assembly A43. For 115V operation, the primary windings of T1 are connected in parallel, and for 230V operation, the windings are in series: the appropriate primary connections are selected by the 115/230 slide switch, S16, on the rear panel. Assembly A43 provides three unstabilised dc supplies — one of approximately 20V and two of approximately 30V.

4-88 POWER SUPPLY STABILISER ASSEMBLY A44. This assembly (Figure 8-56), in conjunction with chassis mounted components Q1, Q2, Q3, etc, stabilises the three dc outputs from A43. The three circuits are similar, and only the +12.5V group is described here.

4-89 The output from bridge rectifier A43CR5-A43CR8 is smoothed by L3+C3, and is stabilised by the circuit comprising control amplifier A44Q4, emitter follower A44Q3, and emitter follower Q2. Q2 is the regulator which controls the current drawn by those circuits supplied from the +12.5V line. Voltage variations on this line are sensed by A44Q4, the output from which is buffered by A44Q3 and supplied as a control signal to Q2. If, for example, the output voltage tends towards +13V, A44Q4 base becomes more positive: the resulting negative-going voltage shift at A44Q4 collector is passed by A44Q3 to the base of Q2, which passes less current and thus restores the load voltage to +12.5V. The output voltage is adjustable by potentiometer A44R9, which sets the bias voltage on A44Q4 base.

## 4-90 SUMMARY OF LOGIC TERMINOLOGY

4-91 LOGIC SIGNAL LEVELS. In a digital system, information is conveyed by signals which can have only two possible levels. In logic notation, these levels are designated '1' and '0'. The '1' level is generally taken to mean yes, enable, true: hence, '0' means no, disable, false. When relating logic to hardware, the '1' and '0' levels must be carefully defined — in a particular part of a system, the '1' could be represented by the more positive of the two signal levels but equally, in another part of the system, it could be represented by the more negative. With the *hp* notation, the symbol for each logic element is assigned (+) or (-) to indicate which of the two signal levels the element recognises as 'true'.

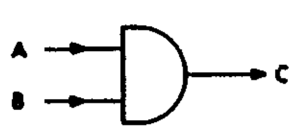
4-92 TRUTH TABLE. Using the '1' and '0' notation, a truth table completely describes the function of a logic element. For example, AND gate having inputs A, B and an output C, is described in the following way:

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | C |
| 0 | 0 | 0 |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 1 | 1 |

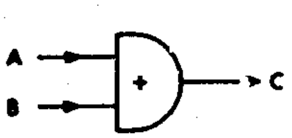
Gate gives a 'true' output only when both A *and* B are true.

4-93 SYMBOLS

4-94 AND GATE. The symbol for a two-input AND gate is:




The truth table for this gate is given in Paragraph 4-3 above. If the gate is 'positive true', the symbol contains (+):




The (+) implies that when (and only when) both A and B are at the relatively *positive* level, the output C will also be at the relatively positive level. If, for example, the two possible signal levels are +12V and zero volts, the truth table could be re-written:

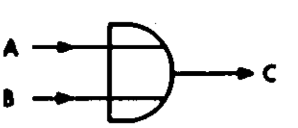
zero volts ≡ '0' false

+12V ≡ '1' true

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | C |
| 0V | 0V | 0V |
| +12V | 0V | 0V |
| 0V | +12V | 0V |
| +12V | +12V | +12V |

An AND gate may have more than two inputs: for a multiple-input AND gate to give a true output, *all* inputs must be true.

4-95 OR GATE. The symbol for a two-input OR gate is:

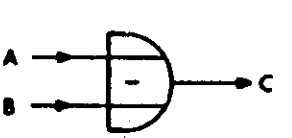



The truth table for this gate is:

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | C |
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 1 |

True output when A *or* B (or both) are true.

Again, the signal level chosen to represent the true state is indicated by (+) or (-) within the logic symbol. The following example shows a negative true OR gate, together with truth table in terms of +12V and zero volt signal levels:



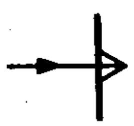
+12V ≡ '0' (false)
zero volts ≡ '1' (true)

(i.e. relatively negative voltage represents '1')

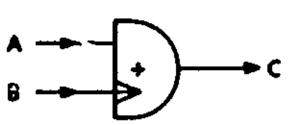
| INPUTS | | OUTPUT |
|---|---|---|
| A | B | C |
| +12V | +12V | +12V |
| 0V | +12V | 0V |
| +12V | 0V | 0V |
| 0V | 0V | 0V |

An OR gate may have more than two inputs: a multiple-input OR gate gives a true output if *one,* or more, of the inputs is true.

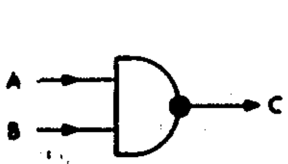
4-96 AC COUPLING. AC coupling is indicated by an arrow:



AC coupling is commonly used in logic elements to which a timing, or strobe, signal is applied. Only ***abrupt*** level changes at the ac coupled input affect the element. The ***direction*** of level change is also important: a positive true gate, for example, responds only to abrupt positive-going signals at the ac coupled input (changes in the opposite direction have no significant effect).




4-97 INVERSION. The symbol for logic inversion is a large dot at the output of the element in which inversion takes place:

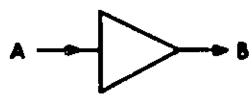



This is simply a conventional AND gate (Paragraph 4-94) followed by an inverter which changes true to false ('1' to '0') and vice versa. The truth table for AND gate plus inverter is:

| INPUTS | | OUTPUT |
|---|---|---|
| A | B | C |
| 0 | 0 | 1 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

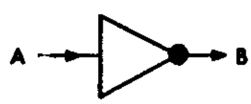
False output only when both inputs true (NAND function).

4-98 AMPLIFIERS. The symbol for an amplifier is:




| A | B |
|---|---|
| 1 | 1 |
| 0 | 0 |

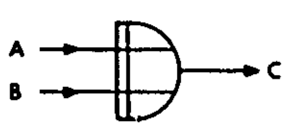
This symbol could be used to represent, say, an emitter follower. An equally common type of buffer stage is the inverting amplifier, represented by:




| A | B |
|---|---|
| 1 | 0 |
| 0 | 1 |

Logic inversion between A and B.

4-99 MODULO-TWO ADDER. A modulo-two adder gives a true output only when its two inputs are *dissimilar:*



| INPUTS | | OUTPUT |
|---|---|---|
| A | B | C |
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

Modulo-two adders in the *hp 3722A* are composed of a number of conventional logic elements (OR gates and inverters) arranged to have the overall logic function described by the above truth table. Other terms for the modulo-two adder are:

- Exclusive OR-gate
- Half adder
- Non-equivalence element
- Anti-coincidence element

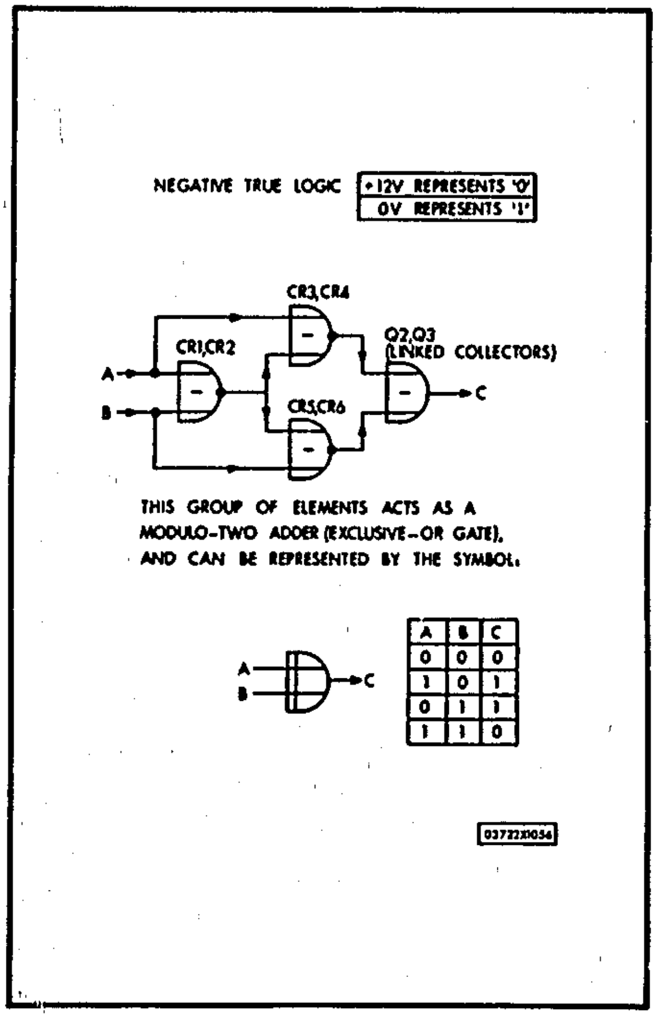



**Figure 4 - 36 Logic of modulo-two adder**

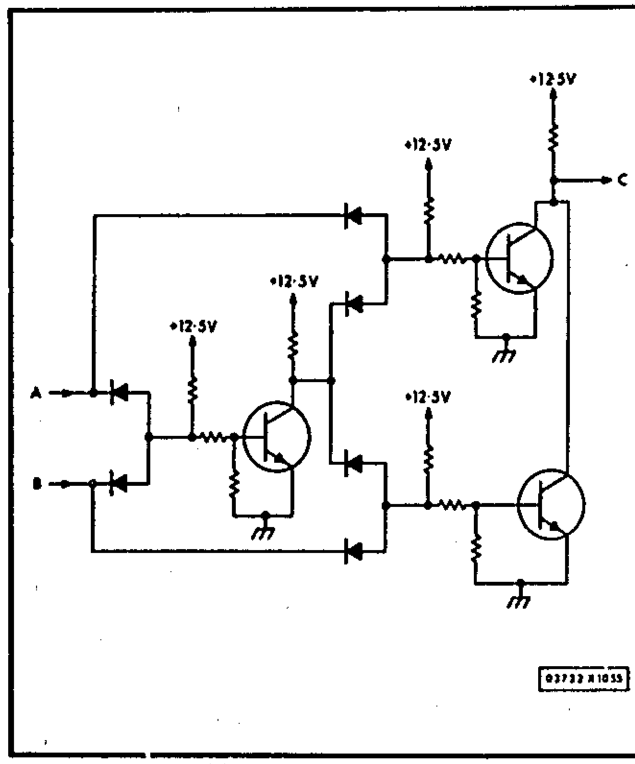
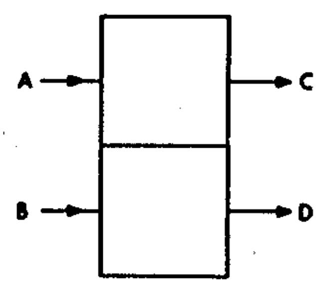



**Figure 4 - 37 Typical circuit of modulo-two adder**

4-100 FLIP-FLOP. The flip-flop is represented by the symbol:




This device has two stable states:

- 'SET' C true, D false
- 'RESET' D true, C false

The flip-flop can change state only on receipt of a true signal applied to the appropriate input: for example, a flip-flop in the reset state is switched to the set state by a true signal on input A. The signal level defined as true for a particular flip-flop is defined by (+) or (-) near the flip-flop symbol:

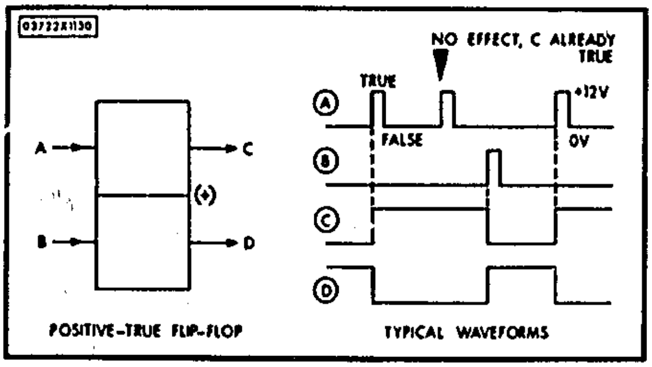



**Figure 4 - 38 Logic of flip-flop**

Note that the signal level definition applies to both inputs and outputs. In logic symbol terms, a true output is given by the 'side' *last to receive a true input signal.* The relationship between logic symbol and schematic of a typical flip-flop is illustrated in Figure 4-39.

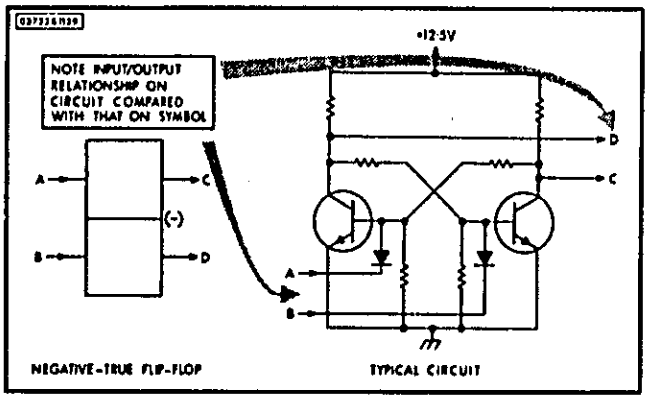



**Figure 4 - 39 Relationship of flip-flop logic and practical circuit**

# SECTION V
# MAINTENANCE

## 5-1 TEST EQUIPMENT

5-2 Recommended test equipment for trouble-shooting and performance checking is listed in Table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the stated characteristics.

## 5-3 ASSEMBLY CONNEXION IDENTIFICATION

5-4 Throughout the manual, connexions to printed circuit assemblies are referred to in abbreviated form. For example, the connexion to pin 15 of assembly A6 is written A6(15).

## 5-5 INSTRUMENT COVER REMOVAL

5-6 TOP & BOTTOM COVERS. Unscrew and remove the four crosshead screws at front and rear of cover. Slide cover towards rear of instrument. There is no need to remove the feet from the bottom cover.

5-7 SIDE COVERS. Unscrew and remove the two crosshead screws securing each cover.

**CAUTION**

**115/230 Vac supply wires are exposed when any of the instrument covers is removed**

## 5-8 PRINTED CIRCUIT COMPONENT REPLACEMENT

5-9 Component lead holes in the *Model 3722A* circuit boards have plated walls to ensure good electrical contact between conductors on opposite sides of the board. To prevent damage to this plating and to the replacement component, apply heat sparingly and work carefully. The following replacement procedure is recommended:

(a) Remove the defective component by first cutting it free from its connecting leads, and then melting solder to remove the bits of wire from the holes.

(b) Melt solder in the component lead holes. Use a clean, dry soldering iron to remove excess solder. Clean holes with a toothpick or wooden splinter: do NOT use a metal tool for cleaning, as this may damage the through-hole plating.

(c) After bending the leads of the replacement component to the correct shape, insert them into the appropriate lead holes in the board. Using heat and solder sparingly, solder the leads in place. Heat may be applied to either side of the board. A heat sink (longnose pliers, commercial heat-sink tweezers, etc.) should be used when replacing transistors and diodes, in order to prevent conduction of excessive heat from the soldering iron to the component.

(d) Through-hole plating breaks are indicated by lifting of the round conductor pads on either side of the board. To repair breaks, press the conductor pads against the board and solder the replacement component lead to the conductor pad on both sides of the board.

**NOTE** Special care must be taken when servicing the following assemblies:-

A29 Random noise generator

A35 Output amplifier (1)

A36 Output amplifier (2)

Component lead holes on these assemblies, although through-plated, have pads on only one side of the board. These pads are more susceptible to lifting off than the normal double-sided type.

**Table 5 - 1 Recommended maintenance test equipment**

| Instrument | Brief specifications | Recommendation |
|---|---|---|
| Oscilloscope | 20MHz bandwidth, dual trace, external trigger facility, preferably with 10cm vertical deflexion. | *hp 140A +*<br>*hp 1420A +*<br>*hp 1402A* |
| Wave Analyzer | DC to 50kHz range, preferably with 'restored frequency' output for accurate frequency indication using electronic counter. | *hp 302A* |
| DC Null Voltmeter | ± 10mV full scale. | *hp 419A* |
| Digital Recorder | Must be interfaced for operation with DVM. | *hp 562A* |
| Signal Generator | Sine wave output, continuously variable from 1MHz to 1.5MHz, variable amplitude (at least 10V peak-to-peak). | *hp 606A* |
| Voltage-to-Frequency Converter | Pulse train output, $10^5$ pulses per second for 1Vdc input. | *hp 2212A* |
| Function Generator | 500Hz square wave, output impedance 600Ω. | *hp 3300A* |
| RMS Voltmeter | True rms responding, accuracy within ± 1% of full scale over frequency range 50Hz to 1MHz. | *hp 3400A* |
| Digital Voltmeter | DC and AC measurement capability, accuracy ± 0.001V: preferably with auto-ranging facility and digital recorder outlet. | *hp 3440A +*<br>*hp 3445A* |
| Electronic Counter | At least 2MHz capability, with 7 digit (minimum) display: must have period averaging facility. | *hp 5245L*<br>(no plug-in required) |

**Table 5 - 2 List of assemblies in *hp 3722A***

| Assembly No. | Title | *hp* Part No. |
|---|---|---|
| A1 | Control logic assembly | 03722-713 |
| A2 | Crystal oscillator assembly | 03722-715 |
| A3 | Divide by three assembly | 03722-705 |
| A4, A5 | High speed decade divider assembly | 03722-725 |
| A6 - A12 | Low speed decade divider assembly | 5212A-65C |
| A13 | Shift pulse generator assembly | 03722-703 |
| A14 | Shift register assembly | 03722-704 |
| A15 | Digital filter assembly (1) | 03722-706 |
| A16 | Shift register assembly | 03722-704 |
| A17 | Shift register assembly | 03722-704 |
| A18 | Digital filter assembly (2) | 03722-721 |
| A19 | Shift register assembly | 03722-704 |
| A20 | Shift register assembly | 03722-704 |
| A21 | Digital filter assembly (3) | 03722-723 |
| A22 | Shift register assembly | 03722-704 |
| A23 | Shift register assembly | 03722-704 |
| A24 | Digital filter assembly (4) | 03722-724 |
| A25 | Shift register assembly | 03722-704 |
| A26 | Not assigned | |
| A27 | Feedback logic assembly | 03722-701 |
| A28 | Auto-start logic assembly | 03722-702 |
| A29 | Random noise generator assembly | 03722-716 |
| A30 | Random noise sampler assembly | 03722-709 |
| A31 | Output switch assembly | 03722-720 |
| A32 | Reference power supply assembly | 03722-719 |
| A33 | Analog filter assembly (1) | 03722-712 |
| A34 | Analog filter assembly (2) | 03722-718 |
| A35 | Output amplifier assembly (1) | 03722-708 |
| A36 | Output amplifier assembly (2) | 03722-730 |
| A37 | Output amplifier assembly (3) | 03722-707 |
| A38 | Attenuator assembly | 03722-728 |
| A39 | Sequence counter assembly | 03722-710 |
| A40 | Sequence advance assembly (Option 01) | 03722-739 |
| A41 | Gate and sync output assembly | 03722-714 |
| A42 | Relay assembly | 03722-722 |
| A43 | Rectifier assembly | 03722-717 |
| A44 | Power supply stabiliser assembly | 03722-711 |
| S1 | Clock period switch assembly | 03722-738 |
| S2 | Sequence length switch assembly | 03722-734 |

## BINARY OUTPUT (fixed amplitude)

**AMPLITUDE**

**Specification states** ± 10V (± 1% when clock period ⩾ 333μS,
± 3% when 333μS > clock period > 1μS,
± 5% when clock period = 1μS).

**Comment**

Amplitude of the binary output is not easily measurable at frequencies greater than can be accommodated by a digital voltmeter (DVM). Typically, digital voltmeters can reliably sample discrete voltage levels when the rate of switching between levels does not exceed, say, 2 or 3 per second. In this performance check, the digital voltmeter is used to verify the binary output amplitude at all clock frequencies less than and including 1Hz (clock periods of 1 sec and greater). The amplitude at frequencies greater than 1Hz is checked by the visual comparison technique described below.

**Procedure for low frequency measurement**

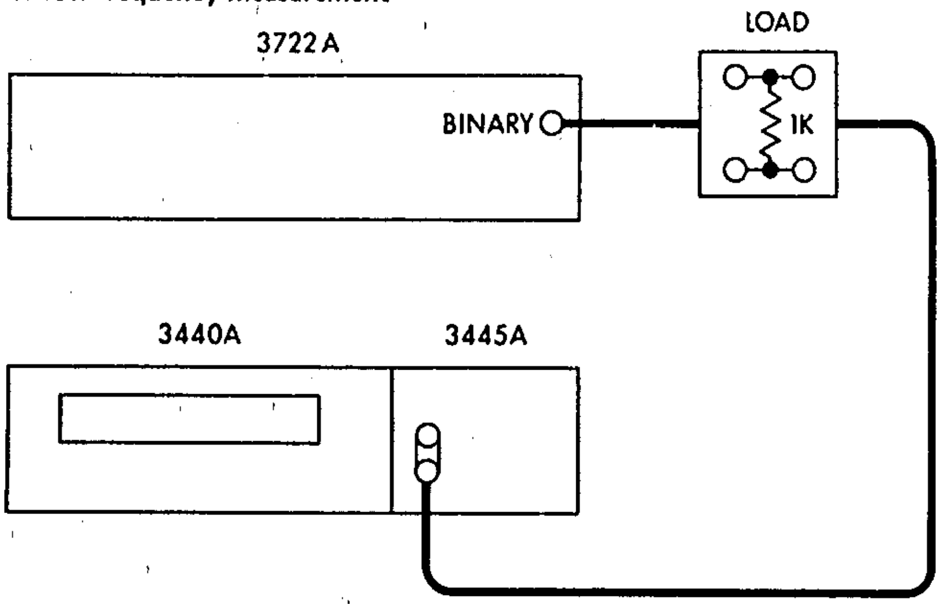



**Figure 5-1**

1) As shown in Figure 5-1, connect the *3722A* BINARY output to a *3440A* DVM via a 1kΩ load (1kΩ is the minimum load impedance for this output).
2) Set the *3445A* range unit to AUTO DC.
3) Set the *3722A* controls as follows:

    CONTROL selector to LOCAL
    CLOCK selector to INT
    SEQUENCE LENGTH switch to N = 15
    CLOCK PERIOD switch to 1 SEC

**Table 5-3 In-cabinet performance check**

## BINARY OUTPUT (fixed amplitude)

4) Press the RESET button. This should drive the binary output to the positive level, giving a DVM reading of +10V ± 0.1V.

5) Press the RUN button. The DVM reading should alternate (though not at regular intervals) between +10V and −10V, thus indicating that a binary sequence is in progress. Press the HOLD button at the appropriate time to stop the sequence when the binary output is at the negative level. The DVM reading should be −10V ± 0.1V.

**Procedure for measurement at frequencies greater than 1Hz**

**NOTE** The visual comparison technique is valid only if the binary waveform is reasonably rectangular. Check this using the set-up of Figure 5-2. On the oscilloscope, select EXT-VE trigger, sweep time 1μS/cm and vertical sensitivity 5V/cm. Set the *3722A* CLOCK PERIOD switch to 1μS, press RUN button and, with the oscilloscope triggered by sync pulses from the *3722A*, display the 15-bit sequence (SEQUENCE LENGTH switch set to N = 15). The waveform should be essentially rectangular, and the dwell at upper and lower levels should be reasonably flat.

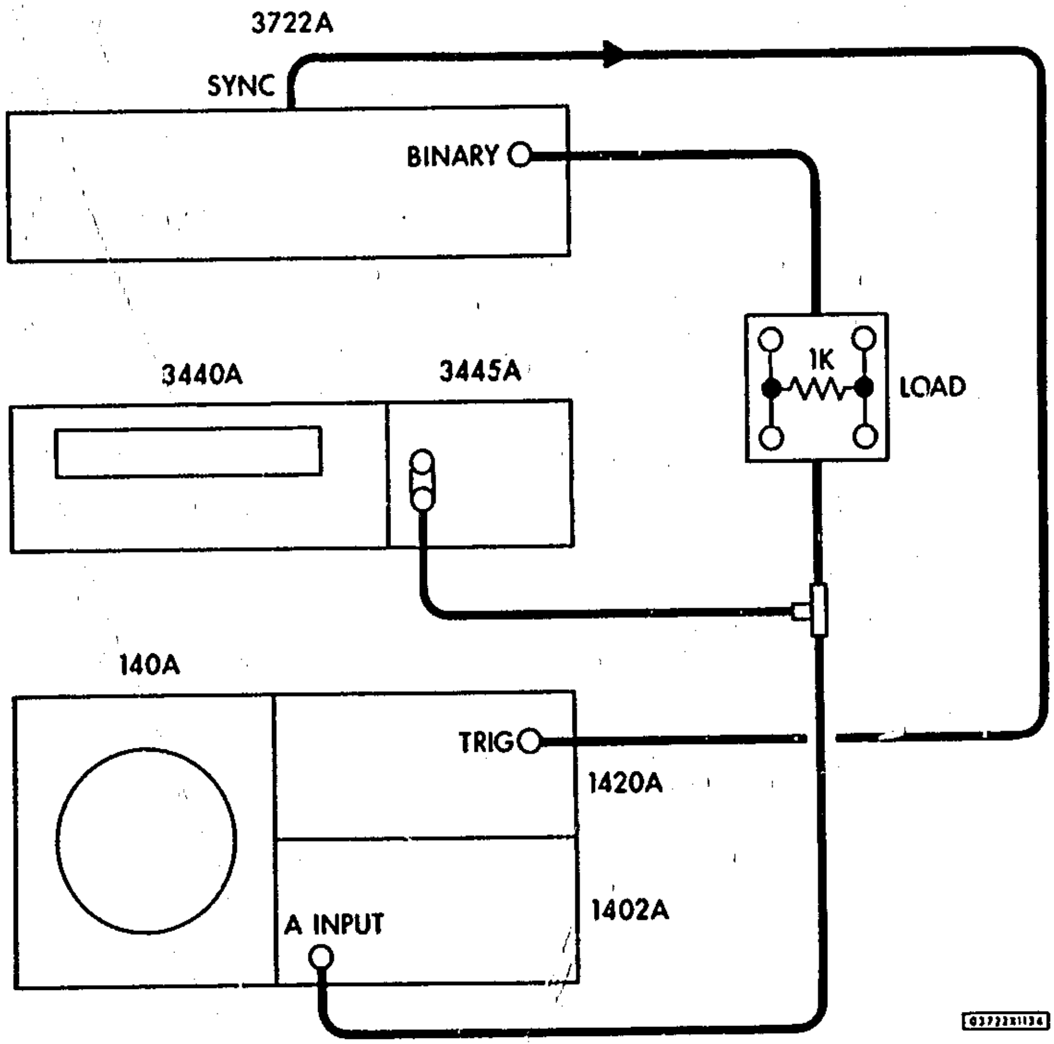



Figure 5-2

Table 5-3 In-cabinet performance check (continued)

## BINARY OUTPUT (fixed amplitude)

1) Set the oscilloscope vertical sensitivity to 2V/cm, dc coupled (note that this sensitivity is suitable only if the oscilloscope has a vertical display of at least 10cm, as on the *140A*).
2) Set the sweep time to 5µS/cm and select FREE RUN triggering.
3) Set the *3722A* CLOCK PERIOD switch to 1 SEC.
4) Press the RUN button. The display should switch between ± 10V levels. Adjust the oscilloscope sensitivity to place the two horizontal traces exactly 10cm apart (or the maximum separation possible with the particular oscilloscope in use).
5) Set the CLOCK PERIOD switch to 333mS and check that the two horizontal traces remain at the same separation.
6) Repeat the observation for all other CLOCK PERIOD switch settings. There should be no detectable change in trace separation for clock periods down to, and including, 333µS Some reduction in separation may be observed as the clock period is reduced beyond 333µS. This reduction should not exceed 4% overall (2% shift each trace) for periods between 100µS and 3.33µS inclusive, and 8% overall at the 1µS setting.

   This *3722A*/DVM/oscilloscope set-up is used in the next test.

### OUTPUT IMPEDANCE

Specification states < 5Ω if clock period ≥ 333µS,
< 10Ω if clock period ≤ 100µS.

**Procedure**

1) With the set-up described above, free-run the scope and observe the horizontal traces produced by the binary output with clock period 1µS. Detach the 1kΩ load from the BINARY connector. Adjust the oscilloscope sensitivity to place the traces exactly 10cm apart.
2) Couple the load to the BINARY connector and check that the separation does not decrease by more than 1%, implying an output impedance of less than 10Ω (this is the 'worst case' test for the range of clock periods 100µS to 1µS).
3) The output impedance for the range of clock periods 333µS upwards is verified by a dc level check. Press the RESET button and measure the +10V level with and without the 1kΩ load. The level change should not exceed 0.05V = 0.5%, implying an output impedance of less than 5Ω. The *3722A* remains connected to the oscilloscope for the next test.

### RISE TIME

Specification states < 100nS

**Procedure**

Trigger the oscilloscope from the *3722A* SYNC signal (select EXT-VE trigger). with sweep time 50nS/cm (0.5µS/cm with x10 multiplier) and clock period 1µS, measure the rise time between 10% and 90% amplitude levels of the binary waveform. Rise time should not exceed 100nS.

**Table 5-3 In-cabinet performance check (continued)**

## BINARY OUTPUT (fixed amplitude)

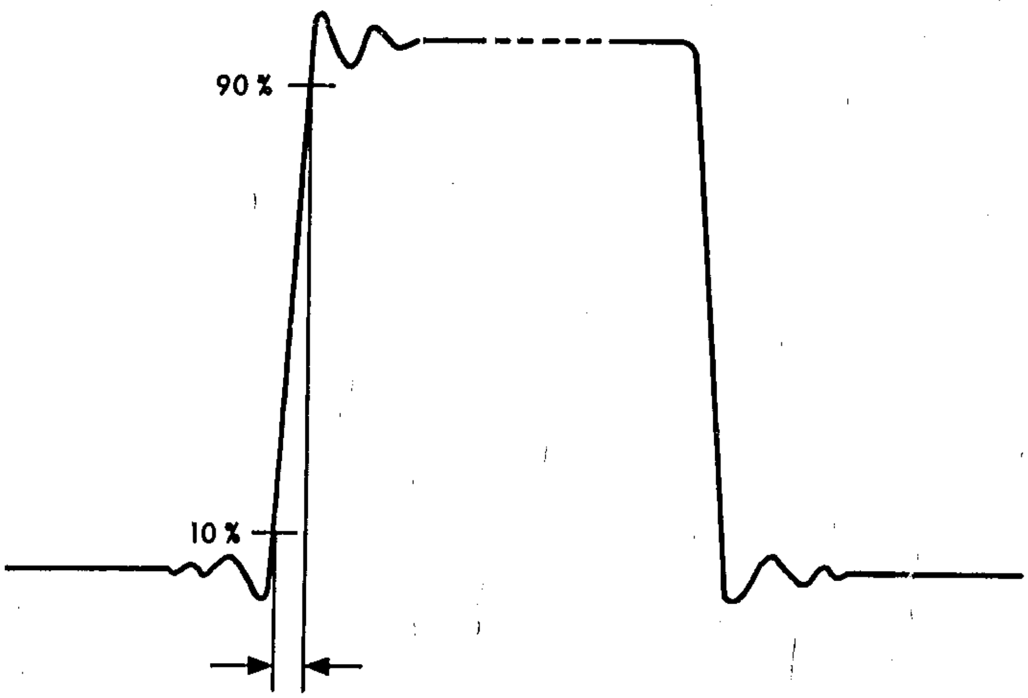



Figure 5-3

**POWER DENSITY**

**Specification states** (clock period x 200) volts²/Hz, at low frequency end of spectrum.

**Comment**

This is true if the rms amplitude of the binary signal is as specified above. Power density is approximately 2 x (rms amplitude of binary signal)$^2$: hence 2 x $10^2$ = 200 volts²/Hz. Note that the rms amplitude of a binary signal is equal to half the peak-to-peak amplitude.

**POWER SPECTRUM**

**Specification states** (sin x/x)$^2$ form: first null occurs at clock frequency and –3dB point occurs at 0.45 x clock frequency.

**Comment**

One of the fundamental properties of a binary signal is its (sin x/x)$^2$ shaped spectrum. This does not need to be verified as part of the performance check. If required, the spectrum shape can be demonstrated using the test set-up described below for the Gaussian power spectrum check.

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

**AMPLITUDE**

**Specification states** 3.16V rms ± 2% when bandwidth ⩾ 0.15Hz,
+6% −2% if bandwidth ⩽ 0.05Hz
(this specification is valid only when the sequence length ⩾ 1023).

**Comment**

In the basic performance check, two techniques are used to verify rms amplitude of the Gaussian output: these are (1) direct *measurement* using an rms voltmeter, this being possible only at the higher clock frequencies, and (2) sampling (with a DVM) the various voltage levels generated in a complete sequence, followed by *calculation* of rms amplitude. This second method is limited by the sampling rate of the DVM and, typically, is not suitable for clock frequencies greater than 1Hz. There is no straightforward technique of measuring the rms amplitude in the middle frequency range (333mS ⩾ clock period ⩾ 333µS), but for most purposes it can be assumed that, if the amplitude is within specifications at the upper and lower frequencies, then the middle frequency performance is satisfactory. On occasion, however, it is essential to measure the amplitude of the mid-band frequencies, and for this purpose, a method using a voltage-to-frequency converter and an electronic counter is described below.

**Procedure for high frequency measurement**

1) As shown in Figure 5-4, connect the *3722A* GAUSSIAN output to a *3400A* rms voltmeter via a 600Ω load (600Ω is the minimum load impedance for this output): the load is not significant in the amplitude check, but is used later to determine output impedance.

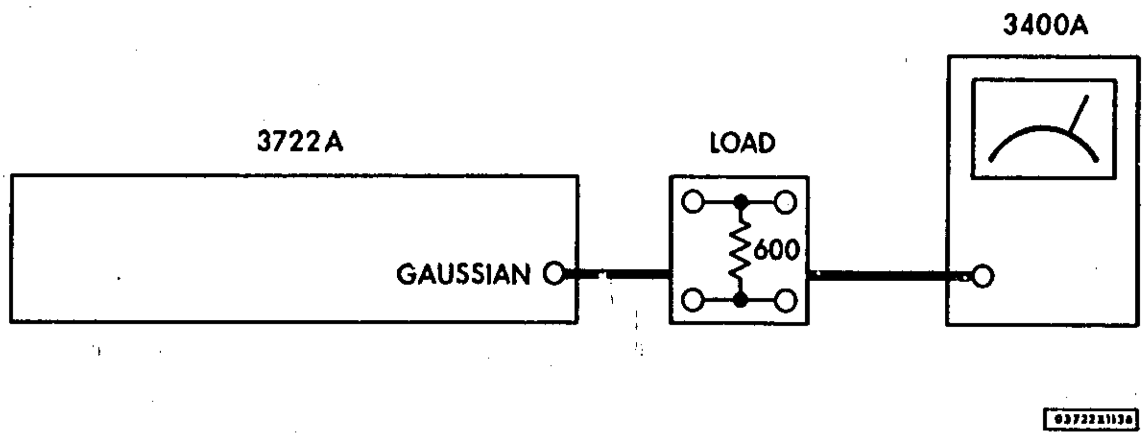



**Figure 5-4**

2) Set the *3722A* controls as follows:-

SEQUENCE LENGTH switch to 1023

CLOCK PERIOD switch to 100µS (bandwidth 0.5kHz).

3) Measure the rms amplitude: this should be 3.16V rms ± 2%.

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

4) Repeat the measurement at each of the higher clock frequencies, (i.e. shorter clock periods, 33.3µS, 10µS, 3.33µS, 1µS): at each setting, the rms amplitude should be 3.16V rms ± 2%.

This *3722A/3400A* set-up, plus a DVM is used for form factor and output impedance measurement.

**Procedure for low frequency measurement**

In this test, the Gaussian output is sampled at regular intervals by a DVM controlled by the *3722A* clock. The DVM samples the Gaussian output each time a positive-going transition occurs in the clock output, i.e. once in each clock period (Figure 5-5).

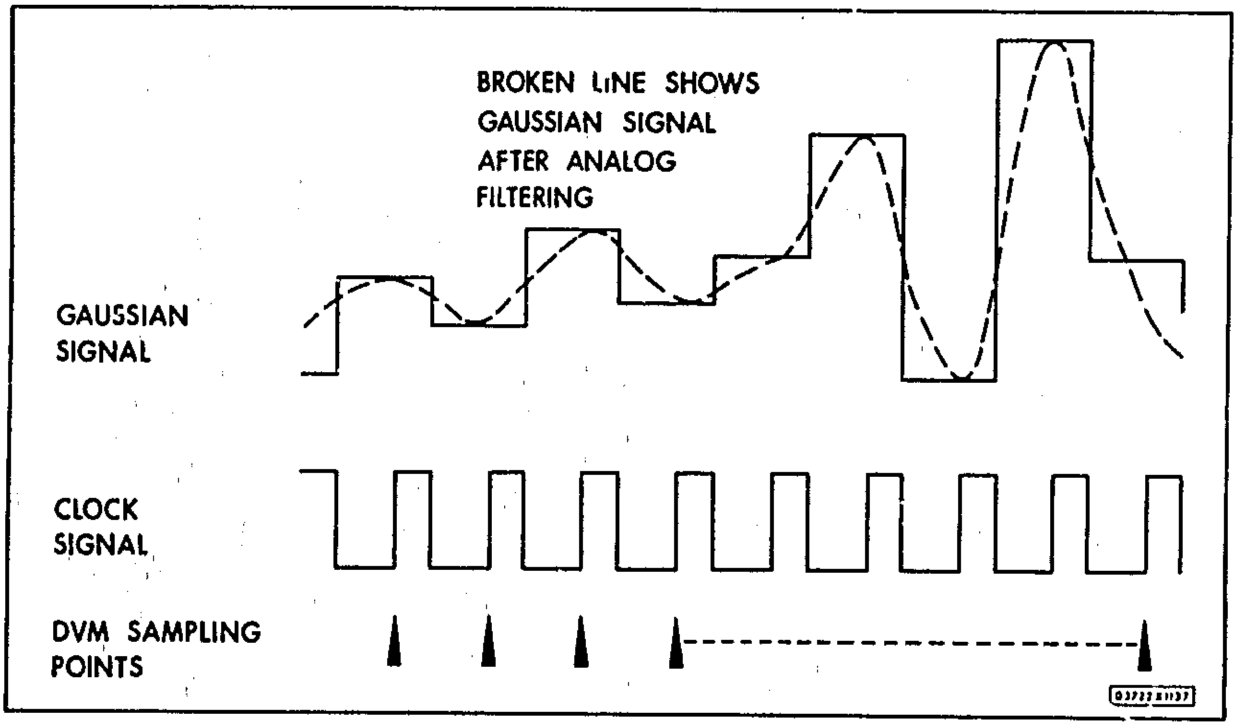



**Figure 5-5**

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

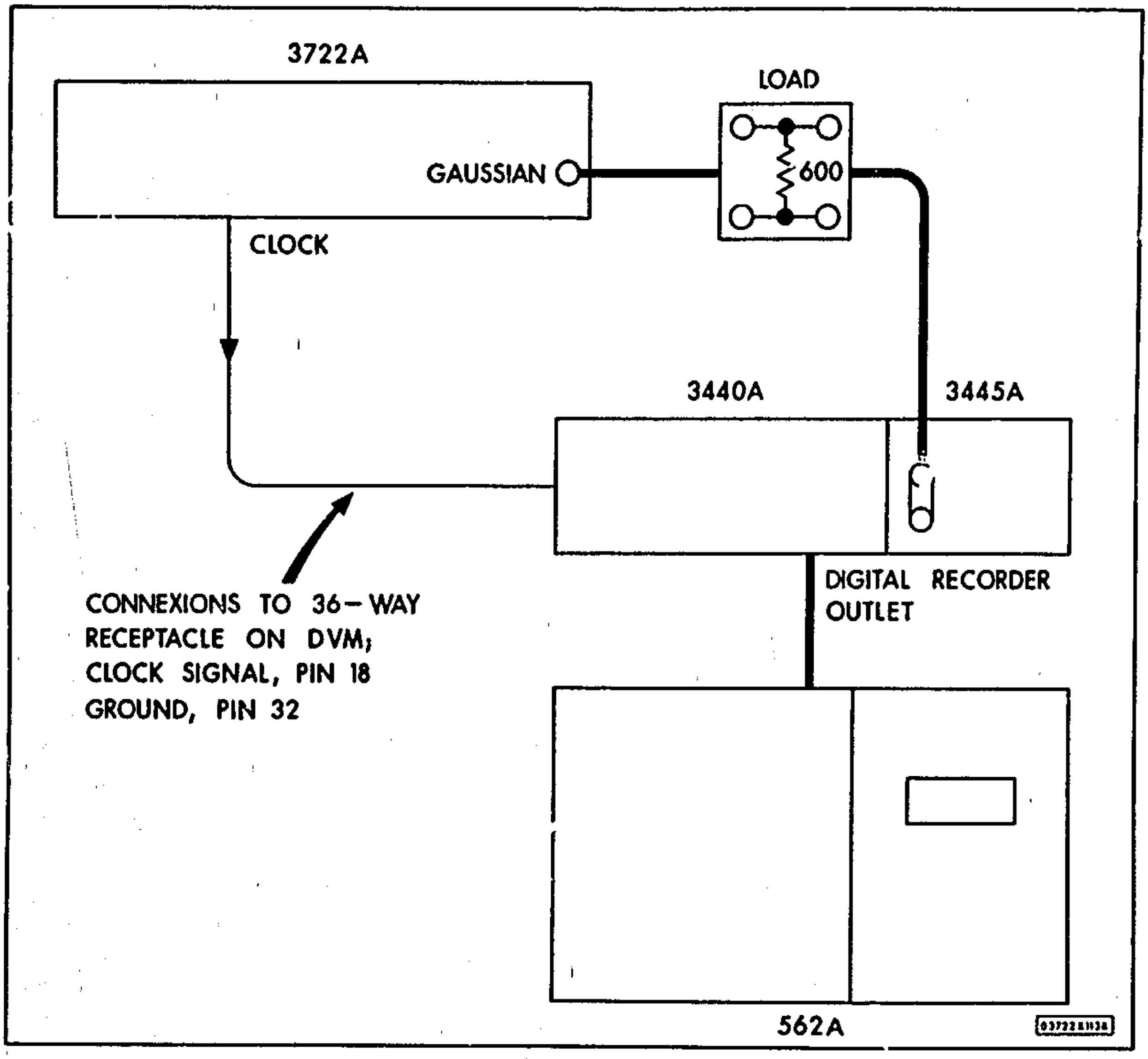



**Figure 5-6**

**NOTE** In factory tests of the *3722A*, the digital recorder shown in Figure 5-6 is replaced by a Hewlett-Packard *2116A* digital computer fitted with an interface which allows direct acquisition and storage of data from the *3440A*. On completion of data acquisition, the calculation of rms amplitude is performed by the computer.

Since mathematical operations on the 1023 samples required for this test are very time-consuming, some form of automatic processor is strongly recommended.

1) Switch on the *562A*, but do not switch on the RECORD toggle.

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

2) Set the *3722A* controls as follows:-

SEQUENCE LENGTH switch to 1023

CLOCK PERIOD switch to 1 SEC.

3) On the *3440A* set the SAMPLE RATE control fully cw to HOLD. Set the range unit to AUTO DC.
Check that the displayed number changes at regular 1 second intervals.

4) On the *562A*, switch on the RECORD toggle. Make a note of the first five or so samples. Allow the recorder to print out 1023 samples (as verified, firstly, by timing with a watch, and secondly, by comparing the print-out at the appropriate time with the record of the first five samples - there should be a ± 1 digit similarity between the first five and those starting the next complete sequence).

5) Calculate the square of each sample, add together all the squares, divide by 1023 and take the square root of the result. Thus if $(a_j)$ is the amplitude of the j th sample, then:-

$$\text{rms amplitude} = \sqrt{\frac{(a_1)^2 + (a_2)^2 + (a_3)^2 + \quad (a_j)^2 + \ldots + (a_{1023})^2}{1023}}$$

The calculated amplitude should be 3.16V rms +6% −2%.

NOTE The above procedure can be used for all clock periods in the range 1 second to 333 seconds.

**Procedure for mid-band frequency measurement**

This procedure is in two parts:-

**(a)** Measurement of form factor of the 1023-bit Gaussian signal. This measurement is made at a clock frequency which allows simultaneous readings of both rms amplitude (with *3400A*) and mean rectified amplitude (with *3440A*).

**(b)** Measurement of the mean rectified amplitude of the 1023-bit Gaussian signal. Mean rectified amplitude of the signal is given by integration over a known period (at least 1023 x clock period in use) of the output from a voltage-to-frequency converter driven by the Gaussian signal. Division of the result by the integration time gives the mean rectified amplitude, which is multiplied by the form factor to give rms amplitude.

**(a) Form Factor**

1) As shown in Figure 5-7, connect the *3722A* GAUSSIAN output via a tee-piece to the *3400A* rms voltmeter and a *3440A* digital voltmeter.

2) Set the *3722A* controls as follows:-

SEQUENCE LENGTH switch to 1023

CLOCK PERIOD switch to 100μS.

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

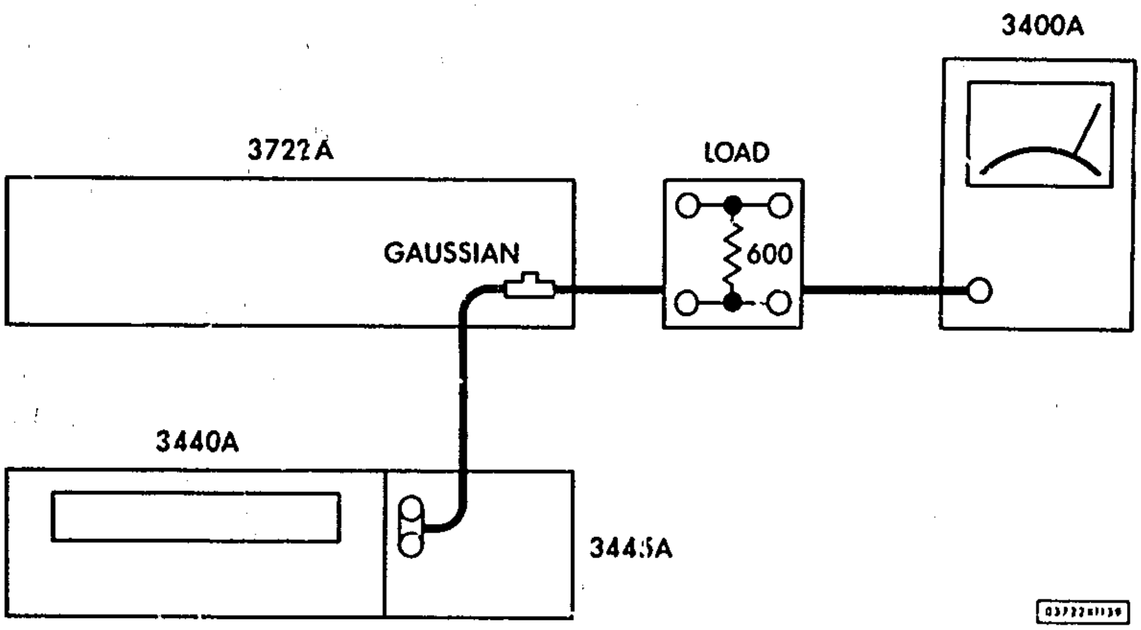



Figure 5-7

3) With the *3445A* range unit set to AUTO AC, note the reading on the *3440A* DVM. This reading, which should be in the region of 2.8V, is divided by 1.11 for conversion to mean rectified amplitude. (Since the *3440A* reads rms amplitude of a *sine wave* input, the indicated amplitude is converted to mean rectified amplitude when divided by the form factor of a sine wave). Mean rectified amplitude = 2.8/1.11.

4) Form factor is the ratio of rms amplitude to mean rectified amplitude, and for this Gaussian signal is approximately equal to 3.16 x 1.11/2.8 ≏1.24.

(b) **Mean rectified amplitude measurement**

1) As shown in Figure 5-8, connect the GAUSSIAN output from the *3722A* via a 600Ω load and a *precision* 10: 1 attenuator to a *2212A* voltage-to-frequency converter (VFC). The accuracy of absolute measurements made by this process depends on attenuator precision and the setting-up of the *2212A* VFC.

2) Couple the SYNC output from the *3722A* to the DC input of a *5245L* counter. Couple the output from the *2212A* to the EXT connector of the *5245L*.

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

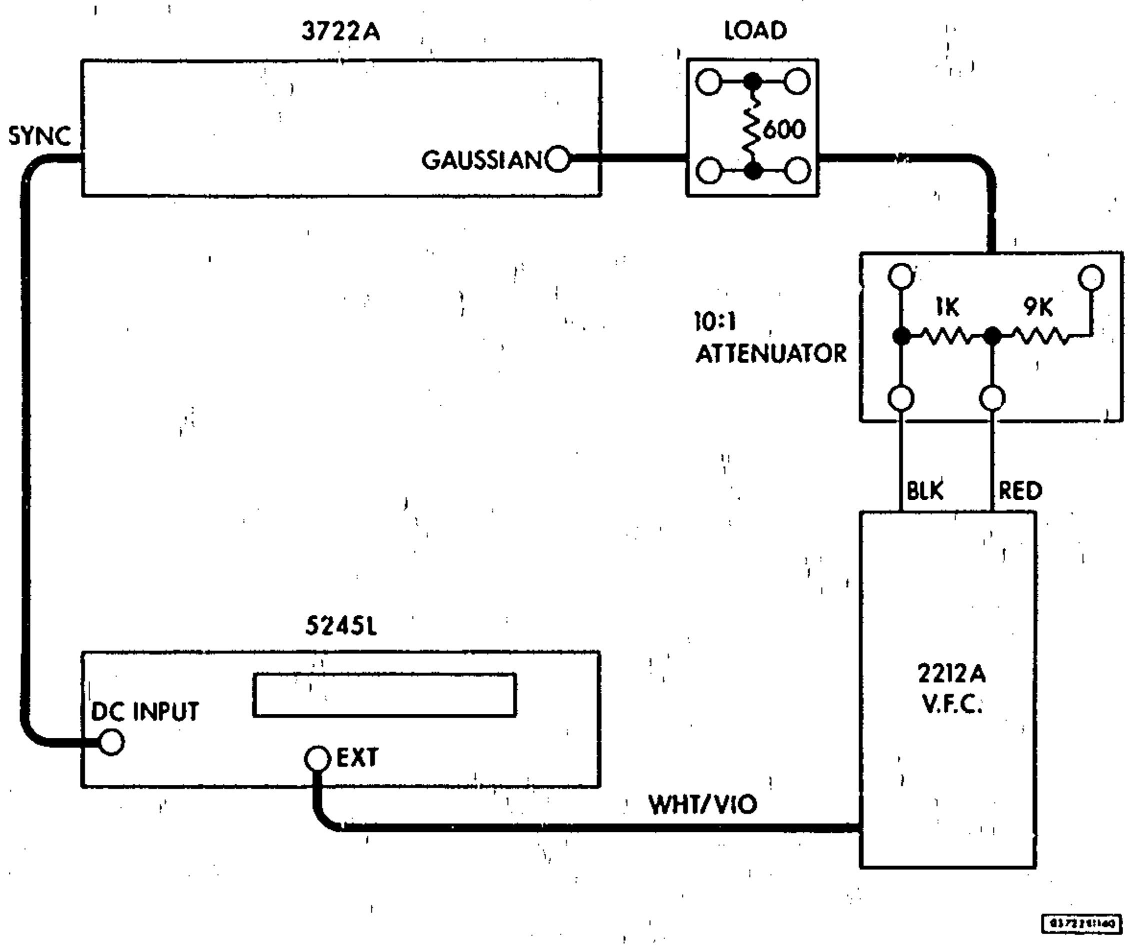



**Figure 5-8**

3) Set the *5245L* controls as follows:-

SENSITIVITY switch to 1 VOLT RMS
TIMEBASE switch to EXT
FUNCTION switch to '1' PERIOD AVERAGE.

In this condition, the *5245L* counts the number of pulses generated by the *2212A* in the interval between sync pulses.

4) Set the *3722A* SEQUENCE LENGTH control to 1023 and the CLOCK PERIOD switch to the required position in the range 333μS to 333mS inclusive.

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

5) Press the *5245L* RESET button. On the next sync pulse from the *3722A*, the *5245L* GATE lamp should light, indicating that the count is in progress. The GATE lamp should be extinguished on the following sync pulse, which stops the count. Repeat the measurement and take the average of several pulse counts.

Calculation: With a steady input of 1Vdc, the *2212A* generates $10^5$ pulses/sec. The reading obtained with the *5245L* is the total of pulses from the *2212A* during the interval (clock period x 1023). The average input to the *2212A* is therefore equal to:-

$$\frac{\text{pulse count}}{10^5 \times 1023 \times \text{clock period}}$$

Since the *2212A* is fed via a 10: 1 attenuator, the mean rectified amplitude of the *3722A* output is equal to:-

$$\frac{10 \times \text{pulse count}}{10^5 \times 1023 \times \text{clock period}}$$

Typically, with a clock period of 10mS the pulse count could be 260865. This gives a mean rectified amplitude of 2.55V and an rms amplitude (based on 1.24 form factor) of 3.16V.

**OUTPUT IMPEDANCE**

Specification states < 1Ω

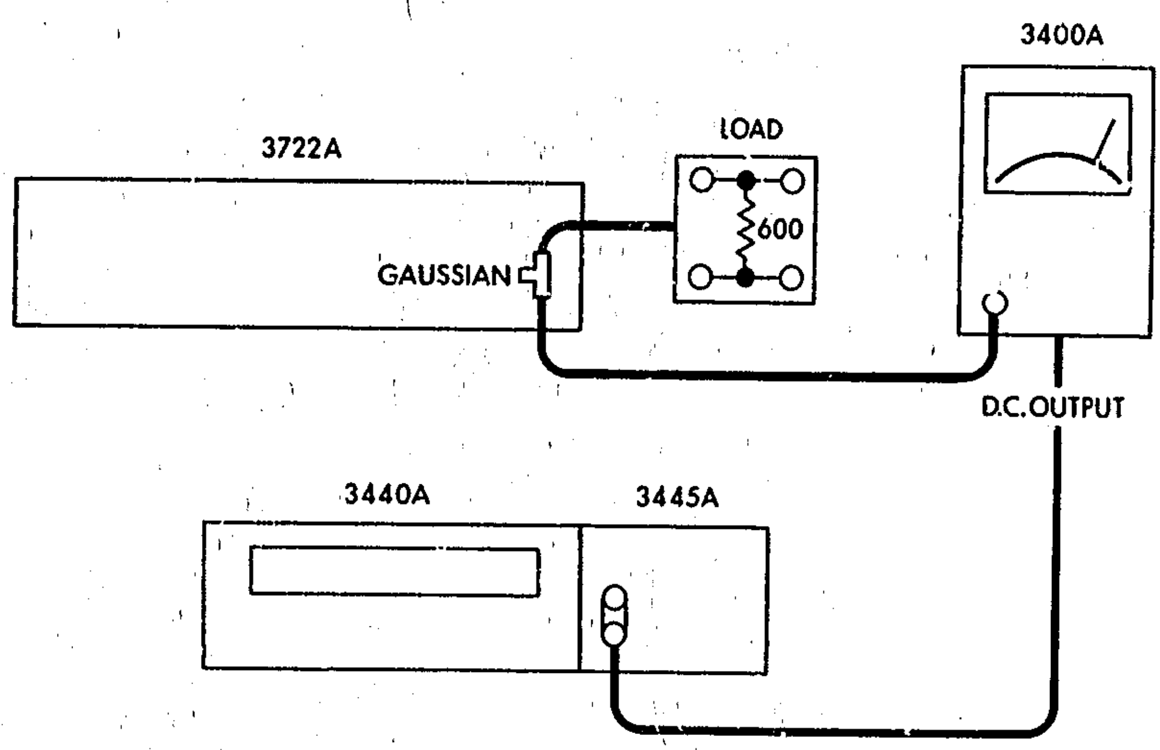



Figure 5-9

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

**Procedure**

1) As shown in Figure 5-9, connect the *3722A* GAUSSIAN output directly to *3400A* rms voltmeter. In order that a load may be applied, fit a BNC tee-piece to the GAUSSIAN output connector. The DC OUTPUT from the *3400A* is connected to a *3440A* DVM.

2) Set the *3722A* controls as follows:-

   SEQUENCE LENGTH switch to 1023

   CLOCK PERIOD switch to 1μS.

3) With the DVM set to AUTO DC, measure the output from the rms voltmeter with *no load* connected to the GAUSSIAN output.

4) Connect the 600Ω load and note the change in DVM reading.

Calculation

$$\text{Output impedance} = \frac{\text{change in voltage}}{\text{change in current}}$$

The full-scale reading on the DVM will be approximately 1V, this being equivalent to the rms voltmeter full scale reading of approximately 3.2V. Typically, the change in DVM reading, when the 600Ω load is applied, will be 1mV - which is equivalent to $3.2 \times 10^{-3}$ V. The change in current when the load is applied is approximately 3.16/600A.

Therefore, output impedance =

$$\frac{3.2 \times 10^{-3} \times 600}{3.16} \simeq 0.6\Omega$$

**ZERO DRIFT**

**Specification states** < 5mV change in zero level in any 10°C range from 0° to +55°C.

**Procedure**

Figure 5-10 shows the arrangement for this check.

1) With the input of the *419A* null voltmeter open-circuit, set the meter zero on the most sensitive range: then set the RANGE switch to 10 VOLTS.

2) Set the *3722A* controls as follows:

   SEQUENCE LENGTH to 2047

   CLOCK PERIOD to 10μS.

   Allow the *3722A* to operate for at least one hour in a controlled environment, at a selected ambient temperature (say 20°C) in the range 0° to +55°C.

3) Connect the *419A* to the GAUSSIAN output of the *3722A*. Adjust the GAUSSIAN zero potentiometer to give null reading on the *419A*.

4) Progressively increase the *419A* sensitivity, adjusting the zero level at each setting of the RANGE switch. Make final adjustments on the 10 MILLIVOLT range. Note the reading.

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

5) Increase the ambient temperature by at least 10°C and allow at least one hour for the *3722A* zero level to stabilise. Note the new reading on the *419A* and calculate zero drift.

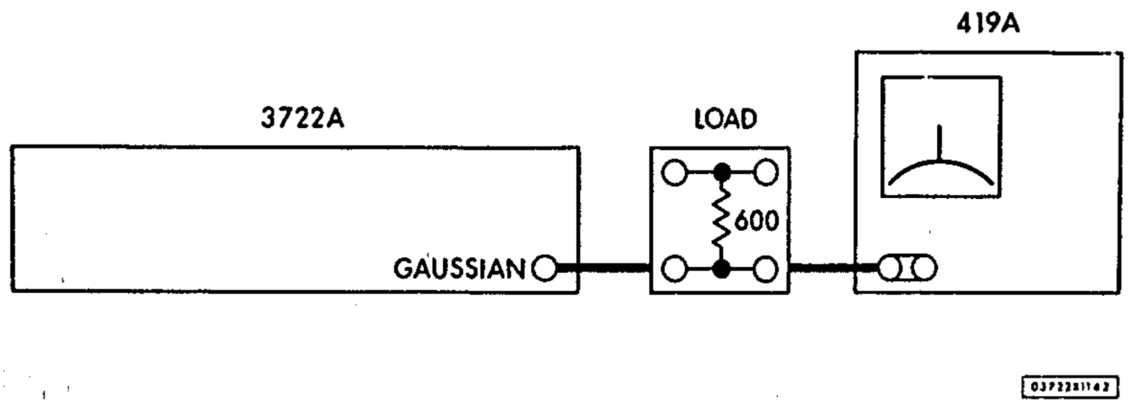



**Figure 5-10**

**POWER DENSITY**

**Specification states** Approximately equal to (clock period x 200) volts²/Hz, at low frequency end of spectrum.

**Procedure**

1) Connect the *3722A* GAUSSIAN output to a DVM, as shown in Figure 5-7.
2) Press the RESET button on the *3722A* and note the DVM reading: this should be approximately 10Vdc.
Power density = 2 x clock period x (measured voltage)².

**POWER SPECTRUM**

**Specification states** Rectangular, low pass: nominal upper frequency $f_0$ (-3dB point) equal to 1/20th of clock frequency. Spectrum is flat within ± 0.3dB up to $1/2f_0$, and more than 25dB down at $2f_0$.

**Comment**

Using conventional techniques, the spectrum can easily be verified for all clock frequencies greater than, and including, 3kHz (i.e. Gaussian noise bandwidth > 150Hz). There is no straightforward technique of checking the spectrum in the mid-band frequency range 50Hz $\geq f_0 \geq$ 0.15Hz. The technique used in the factory for checking the ultra low frequency spectra, where $f_0 <$ 0.05Hz, involves:-

1) Measurement, with a DVM sampling under control of the *3722A* clock, of the various voltage levels generated in a complete sequence (this applies to the pseudo-random mode only). In practice, this data acquisition is performed by the computer used subsequently to calculate the spectrum (compare with rms amplitude measurement described above).

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

2) Computation from the above of the auto-correlation function of the Gaussian output. The Fourier transform of this function yields the amplitude of the harmonics in the spectrum (note that a pseudo-random signal has a line power spectrum).

**Procedure for high frequency check**

1) As shown in Figure 5-11, connect the GAUSSIAN output from the *3722A* to a *302A* wave analyser. The *302A* output is monitored in both frequency (by *5245L*) and amplitude by (*3440A*). A recorder, model *562A*, may be used to print-out DVM readings if required.

2) Set the *302A* controls as follows:

REFERENCE ADJUST fully cw
SCALE VALUE to RELATIVE
MAX INPUT VOLTAGE to 10V
RANGE window to 300mV
MODE SELECTOR to NORMAL

3) Set the *5245L* controls as follows:

SENSITIVITY to 1 VOLT RMS
TIMEBASE to 0.1S
FUNCTION to FREQUENCY

4) Set the *3445A* range unit in the DVM to AUTO AC.

5) Set the *3722A* controls as follows:

SEQUENCE LENGTH to 511
CLOCK PERIOD to 1μS

These settings give a nominal bandwidth ($f_O$) of 50kHz and harmonics at intervals of 1.957kHz.

6) Starting from zero, wind the *302A* FREQUENCY dial to around 1.9kHz and, with the FINE control, slowly adjust the dial until the meter shows a reading. Set the MODE SELECTOR to AFC. Allow the wave analyser to lock in and set the REFERENCE ADJUST control to give a meter reading of exactly 0dB. This is the reference against which all other harmonics will be compared: the meter indication provides a useful double-check in conjunction with DVM reading.

7) Print-out the DVM reading.

8) Tune the *302A* to the next harmonic (2.914kHz) and again print the DVM reading.

9) Repeat the tune/print operation for each of the harmonics up to 50kHz.

**Calculation** The DVM reads the rms amplitude of the restored frequency output from the wave analyser. If the voltage reading for the fundamental is x volts rms, and that for a particular harmonic is y volts rms, then the power (in dB) of the harmonic, relative to the fundamental, is:

$$20 \log_{10} \frac{x}{y}$$

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

Use this to calculate the relative power of the harmonic nearest to $1/2f_O$ (=25kHz) and harmonic nearest to $f_O$ (=50kHz). The relative powers should be ± 0.3dB at $1/2f_O$ and −3dB at $f_O$.

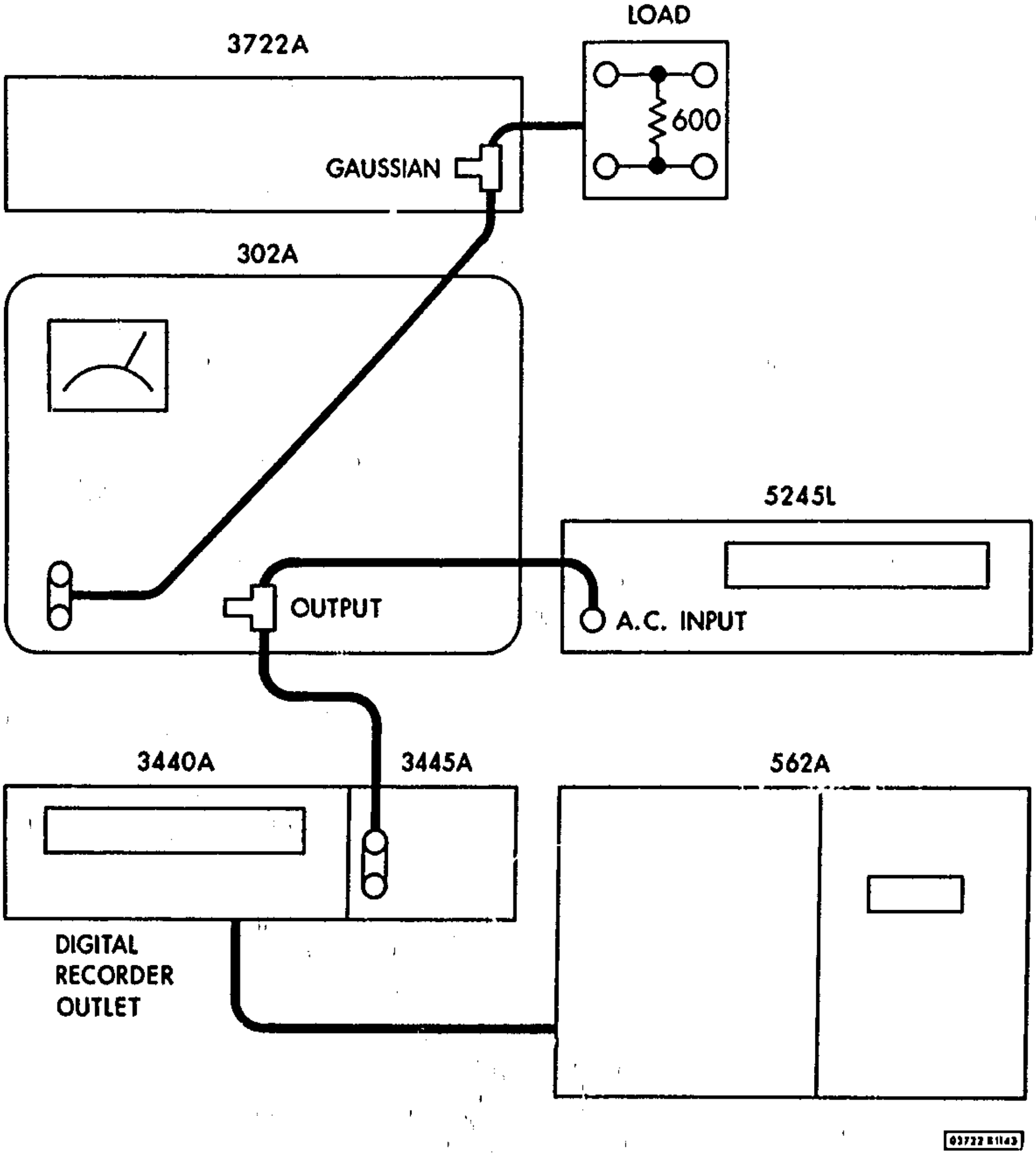



Figure 5-11

Table 5-3 In-cabinet performance check (continued)

## GAUSSIAN OUTPUT (fixed amplitude)

10) Set the *3722A* controls as follows:

SEQUENCE LENGTH to 511

CLOCK PERIOD to 3.33μS.

These settings give a nominal bandwidth ($f_o$) of 15kHz and harmonics at intervals of 587.1Hz.

11) Print-out the voltage readings obtained at each harmonic frequency. Calculate the relative power at $1/2f_o$ and $f_o$ (i.e. 7.5kHz and 15kHz).

12) Check the relative power at $2f_o$ (i.e. 30kHz). This should be more than 25dB down, relative to the fundamental.

13) Check the GAUSSIAN output spectrum at the other clock period settings listed below:

| Clock period | Sequence length | $f_o$ | Fundamental |
|---|---|---|---|
| 10μS | 511 | 5kHz | 195.7 Hz |
| 33.3μS | 511 | 1.5kHz | 58.71Hz |
| 100μS | 511 | 500Hz | 19.57Hz |
| 333μS | 255 | 150Hz | 11.8 Hz |

**CREST FACTOR**

**Specification states** Up to 3.75, dependent on sequence length.

**Procedure**

1) With an oscilloscope having accurately calibrated Y sensitivity, display the Gaussian output from the *3722A*.

2) Set the *3722A* controls as follows:

SEQUENCE LENGTH to 1048575

CLOCK PERIOD to 1μS.

3) Without timebase, observe the vertical deflexion caused by Gaussian signal. Note particularly the peaks attained by the signal. Crest factor is the ratio of peak to rms amplitude, i.e. observed peak excursion (approximately 12V) divided by 3.16. The peak amplitude (and hence crest factor) will be observed to diminish as the sequence length is reduced.

**PROBABILITY DENSITY FUNCTION**

Measured deviations (from the Gaussian curve) of the *3722A* output probability density functions are shown in Section III, Figure 3-9.

**Comment**

It is not necessary, as part of the in-cabinet performance check, to verify the probability density function (p.d.f.) of the Gaussian output. The p.d.f. varies with sequence length but, if the shift register, feedback mechanism and output amplifier are functioning correctly, then deviations in

**Table 5-3 In-cabinet performance check (continued)**

## GAUSSIAN OUTPUT (fixed amplitude)

p.d.f. should not exceed those shown in Figure 3-9: both shift register and feedback are completely checked in the 'SEQUENCE LENGTH' test below. If verific.·tion of p.d.f. is required, the Gaussian output can be sampled by DVM and a histogram plotted of the voltage levels generated in a complete sequence (sampling method as for rms amplitude measurement described above).

## VARIABLE OUTPUT (binary or Gaussian)

A rapid functional check of the RMS AMPLITUDE control can be made with the *3722A* inoperative, i.e. with RESET or HOLD buttons depressed.

Procedure

1) Connect the *3722A* BINARY fixed output to a DVM as shown in Figure 5-1, but without the 1kΩ load.
2) Press the RESET button and note the DVM reading, which should be approximately +10V.
3) Transfer the DVM input cable to the *3722A* VARIABLE OUTPUT connector.
4) Set the red (inner) amplitude control to x 10, and the black (outer) control to 1.0. The DVM reading should be as before, within ± 2.5%.
5) Check each setting of the red and black controls in turn. The calibration accuracy at each setting should be ± 2.5% with respect to the voltage at the fixed output.

## MAIN CONTROLS

**SEQUENCE LENGTH**

Procedure

1) Connect the *3722A* to a *5245L* counter as shown in Figure 5-12.
2) Set the *5245L* controls as follows:

   INPUT SENSITIVITY to 1 VOLT RMS
   TIME BASE to EXT
   FUNCTION to '1' PERIOD AVERAGE

   In this condition, the *5245L* counts the number of clock periods between sync pulses from the *3722A*.

**Table 5-3 In-cabinet performance check (continued)**

## MAIN CONTROLS

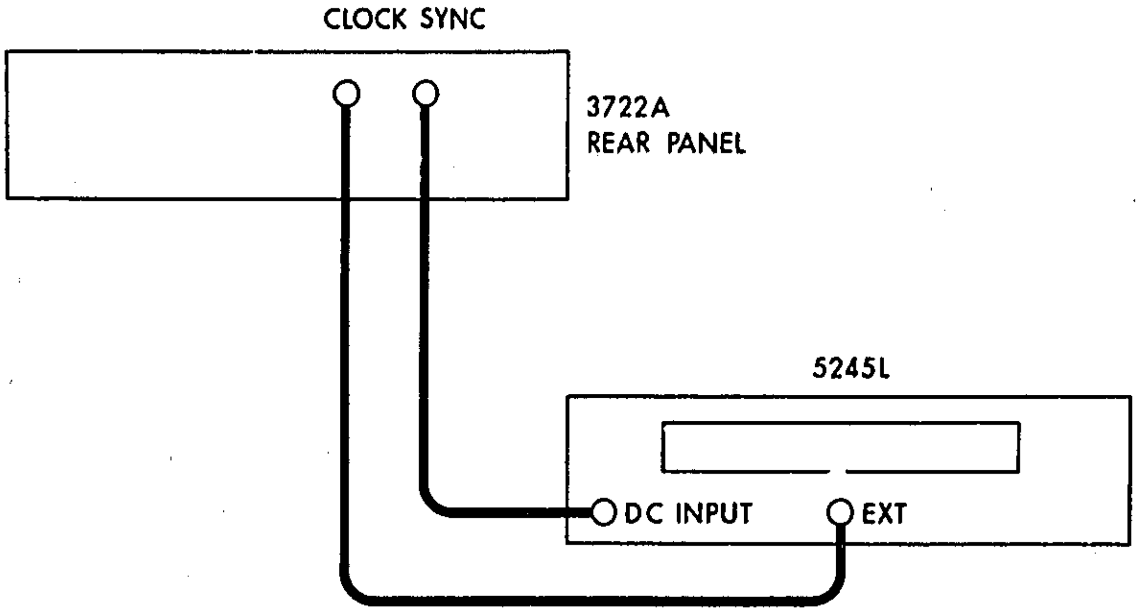



**Figure 5-12**

3) Set the *3722A* SEQUENCE LENGTH switch to each of the 'pseudo-random' positions in turn (N=15 to N=1048575). The count should correspond exactly with the front panel sequence length engravings.
4) As described in Figure 5-13, check the first n bits of each pseudo-random sequence.

**Table 5-3 In-cabinet performance check (continued)**

## MAIN CONTROLS

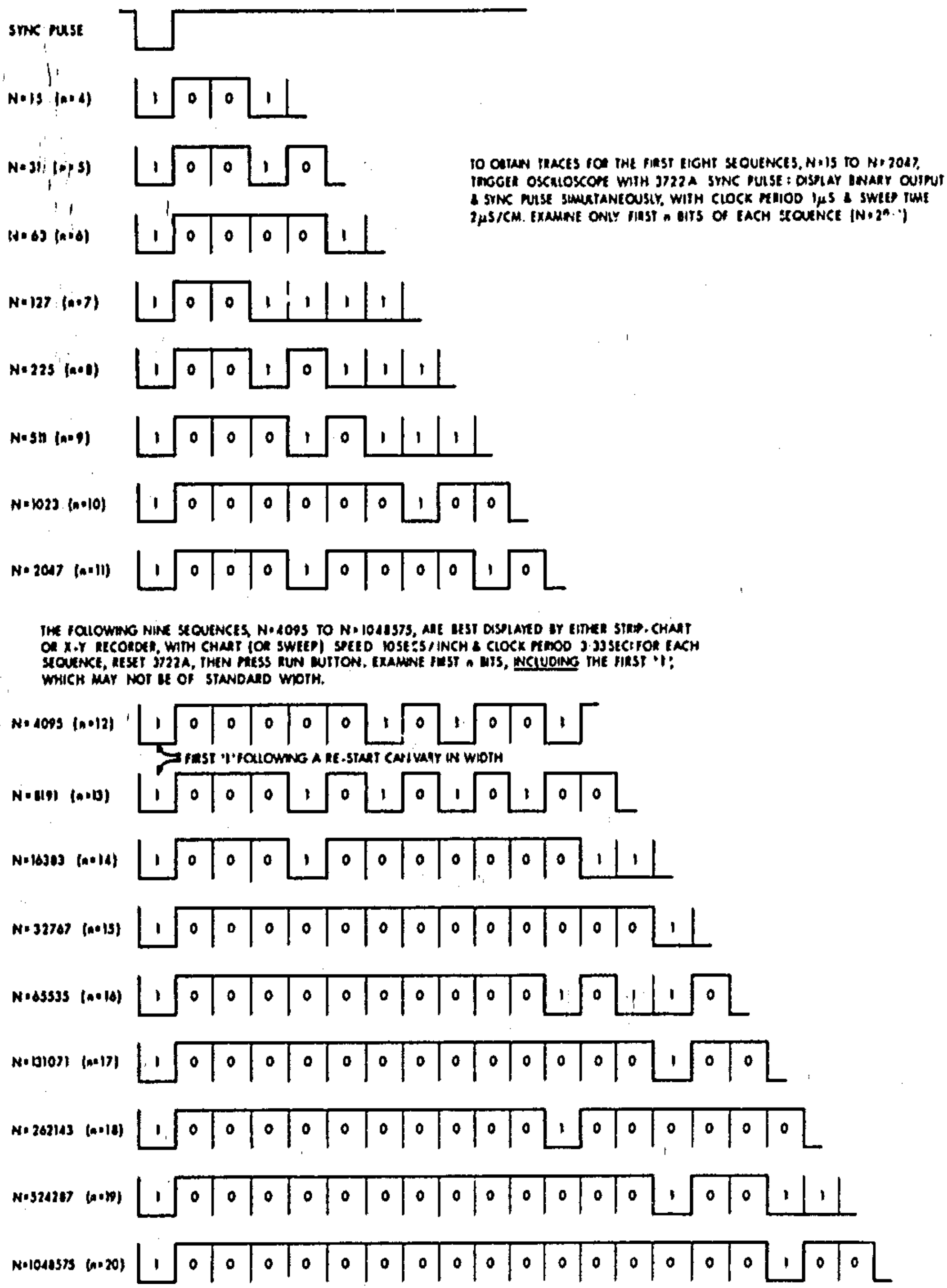



**Figure 5-13**

03722X1063

**Table 5-3 In-cabinet performance check (continued)**

## MAIN CONTROLS

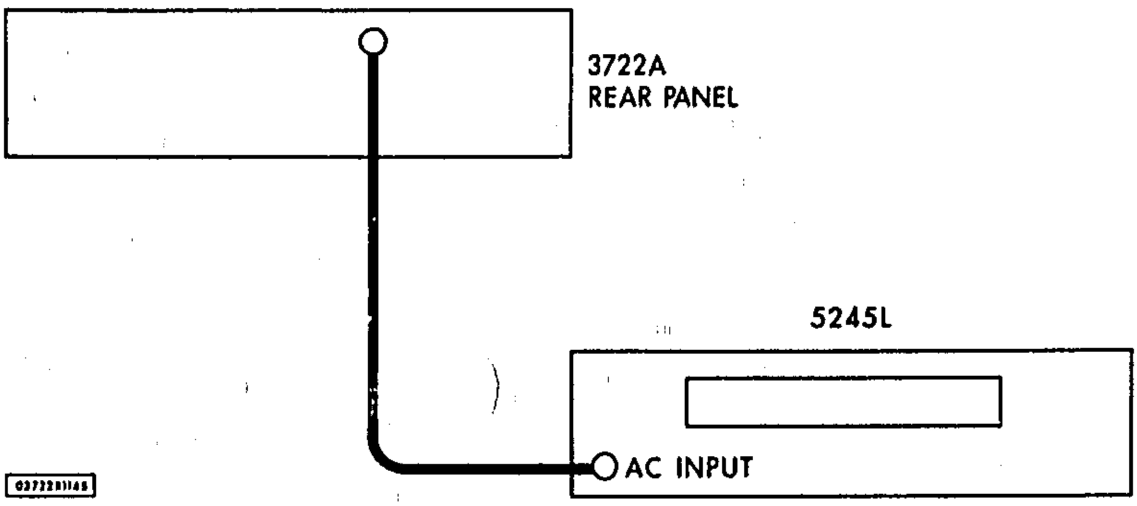



Figure 5-14

### CLOCK PERIOD

**Procedure**

1) Connect the *3722A* to a *5245L* counter as shown in Figure 5-14.
2) Set the *5245L* INPUT SENSITIVITY to 1 VOLT RMS.
3) Check the *3722A* clock period using the settings of *5245L* TIMEBASE and FUNCTION switches listed on the next page.

**Table 5-3 In-cabinet performance check (continued)**

## MAIN CONTROLS

| *3722A* CLOCK PERIOD | *5245L* TIMEBASE | *5245L* FUNCTION | *5245L* READOUT |
|---|---|---|---|
| 1μS | 10mS | FREQUENCY | 1000kHz |
| 3.33μS | 0.1μS | 100 Per'd Av'ge | 3.333μS |
| 10μS | 0.1μS | 10 | 10.00μS |
| 33.3μS | 0.1μS | 10 | 33.33μS |
| 100μS | 0.1μS | 1 | 100.0μS |
| 333μS | 0.1μS | 1 | 333.3μS |
| 1mS | 1μS | 1 | 1000μS |
| 3.33mS | 1μS | 1 | 3333μS |
| 10mS | 10μS | 1 | 10.00mS |
| 33.3mS | 10μS | 1 | 33.33mS |
| 100mS | 0.1mS | 1 | 100.0mS |
| 333mS | 0.1mS | 1 | 333.3mS |
| 1 sec | 1mS | 1 | 1000mS |
| 3.33 sec | 1mS | 1 | 3333mS |
| 10 sec | 10mS | 1 | 10.00 sec |
| 33.3 sec | 10mS | 1 | 33.33 sec |
| 100 sec | 0.1 sec | 1 | 100.0 sec |
| 333 sec | 0.1 sec | 1 | 333.3 sec |

4) With CLOCK PERIOD switch set to 100μS, display on an oscilloscope (sweep time 20μS/cm) the clock output from the *3722A*. The waveform should be rectangular, and should switch between +1V and +12.5V

## EXTERNAL CLOCK

**Procedure**

Check CAUTION note, Figure 5-15

1) With the arrangement shown in Figure 5-15, display the output from the *606A* set to approximately 1MHz. Adjust the *606A* output attenuator to give a 10V peak-to-peak signal.

2) Set the SEQUENCE LENGTH switch to 15 and observe the pseudo-random BINARY output from the *3722A*. From left to right on the display, the binary waveform should read: 100110101111000, where '1' is the more negative level.

**Table 5-3 In-cabinet performance check (continued)**

## EXTERNAL CLOCK

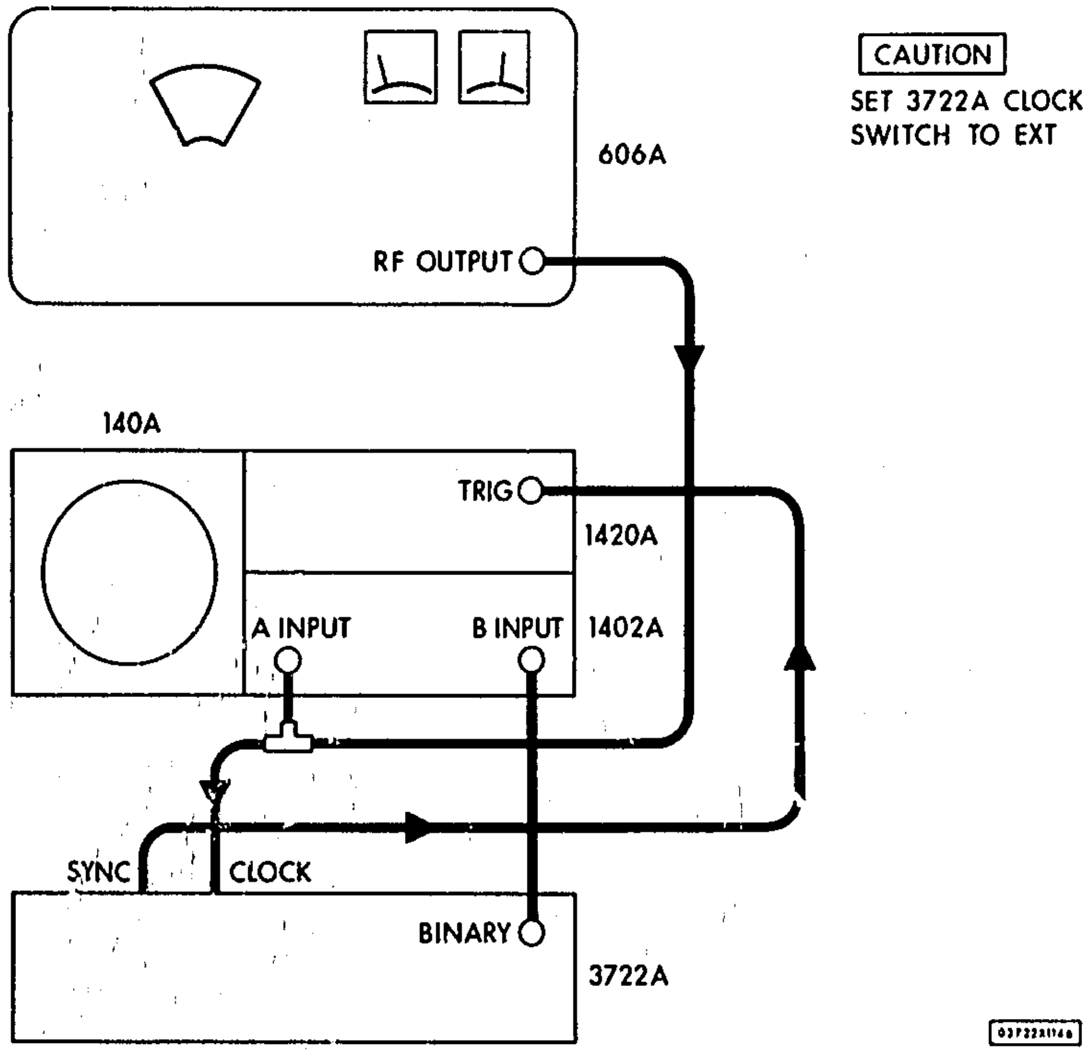



Figure 5-15

3) Increase the *606A* signal frequency to 1.5MHz, checking that the output remains at 10V peak-to-peak. The pseudo-random binary output from the *3722A* should not alter in form (i.e. the sequence of ones and zeros should remain as above).

4) Return the *3722A* CLOCK switch to INT.

**Table 5-3 In-cabinet performance check (continued)**

## SECONDARY OUTPUTS

### SYNC

**Procedure**

1) Set the *3722A* controls as follows:
   SEQUENCE LENGTH to 15
   CLOCK PERIOD to 100µS.
2) With oscilloscope sweep time 20µS/cm, display the SYNC output from the *3722A*. The sync pulse should be negative-going, of 100µS duration, and extend from approximately +1.5V to +12V.

### GATE

**Procedure**

1) Set the *3722A* controls as follows:
   SEQUENCE LENGTH to 15
   CLOCK PERIOD to 1 SEC
   SEQUENCES PER GATE INTERVAL to '1'
2) Connect a multimeter, set for resistance measurement, to the N/O and COM terminals of the *3722A* GATE RELAY.
3) With sweep time 2 sec/cm, display the signal from the *3722A* GATE connector (BNC).
4) Press the GATE RESET button. On the next sync pulse, the display should switch from +12.5V to +1V, and the GATE lamp should light. At the same time, the meter reading should change from open-circuit to short-circuit. After 15 seconds, initial conditions should be restored.
5) Repeat the test with the SEQUENCES PER GATE INTERVAL switch set to 2, 4 and 8, in turn.

### BINARY RELAY

**Procedure**

1) Set the *3722A* controls as follows:
   SEQUENCE LENGTH to 15
   CLOCK PERIOD to 1 SEC.
2) Connect a multimeter, set for resistance measurement, to the N/O and COM terminals of the *3722A* BINARY RELAY.
3) Switch ON the BINARY RELAY.
4) With sweep time 2 sec/cm, display the *3722A* BINARY output on an oscilloscope. The meter reading should alternate between open-circuit and short-circuit in synchronism with the level switching on the display.

**Table 5-3 In-cabinet performance check (continued)**

## REMOTE CONTROL

**Procedure**

1) Set the *3722A* controls as follows:
   SEQUENCE LENGTH to 15.
   CLOCK PERIOD to 100mS.
2) Press the RUN button, then set the LOCAL/REMOTE switch to REMOTE.
3) With oscilloscope sweep time 5μS/cm, display the BINARY output from the *3722A*.
4) Connect pin 34 (RESET) of the CONTROL receptacle (on the *3722A* rear panel) briefly to ground. The display should immediately switch to, and remain at, the positive level (+10V).
5) Connect pin 36 (RUN) of the receptacle briefly to ground. The display should again alternate between ± 10V levels.
6) Connect pin 35 (HOLD) of the receptacle briefly to ground. The display should immediately hold at one or other of the two levels.
7) Repeat step (5). Connect pin 33 (GATE RESET) of the receptacle briefly to ground. On the next sync pulse, the GATE lamp should light. On completion of the gate interval (1.5 seconds), the lamp should be extinguished.

## SEQUENCE LENGTH INDICATION

**Procedure**

1) Set the SEQUENCE LENGTH switch to 15.
2) Connect a multimeter, set for resistance measurement, between pins 19 (common) and 1 of the CONTROL receptacle. The meter should indicate zero resistance.
3) Set the SEQUENCE LENGTH switch to 31.
4) Connect the multimeter between pins 19 and 2 of the receptacle. The meter should again indicate zero resistance.
5) Repeat the check at the remaining settings of the SEQUENCE LENGTH switch, at each setting connecting the multimeter between pin 19 and the appropriate pin of the CONTROL receptacle.

   See following table for list of settings.

**Table 5-3 In-cabinet performance check (continued)**

## SEQUENCE LENGTH INDICATION

| SEQUENCE LENGTH | PIN NUMBER |
|---|---|
| 15 | 1 |
| 31 | 2 |
| 63 | 3 |
| 127 | 4 |
| 255 | 5 |
| 511 | 6 |
| 1023 | 7 |
| 2047 | 8 |
| 4095 | 9 |
| 8191 | 10 |
| 16383 | 11 |
| 32767 | 12 |
| 65535 | 13 |
| 131071 | 14 |
| 262143 | 15 |
| 524287 | 16 |
| 1048575 | 17 |
| INFINITE | 18 |

**Table 5-3 In-cabinet performance check (continued)**

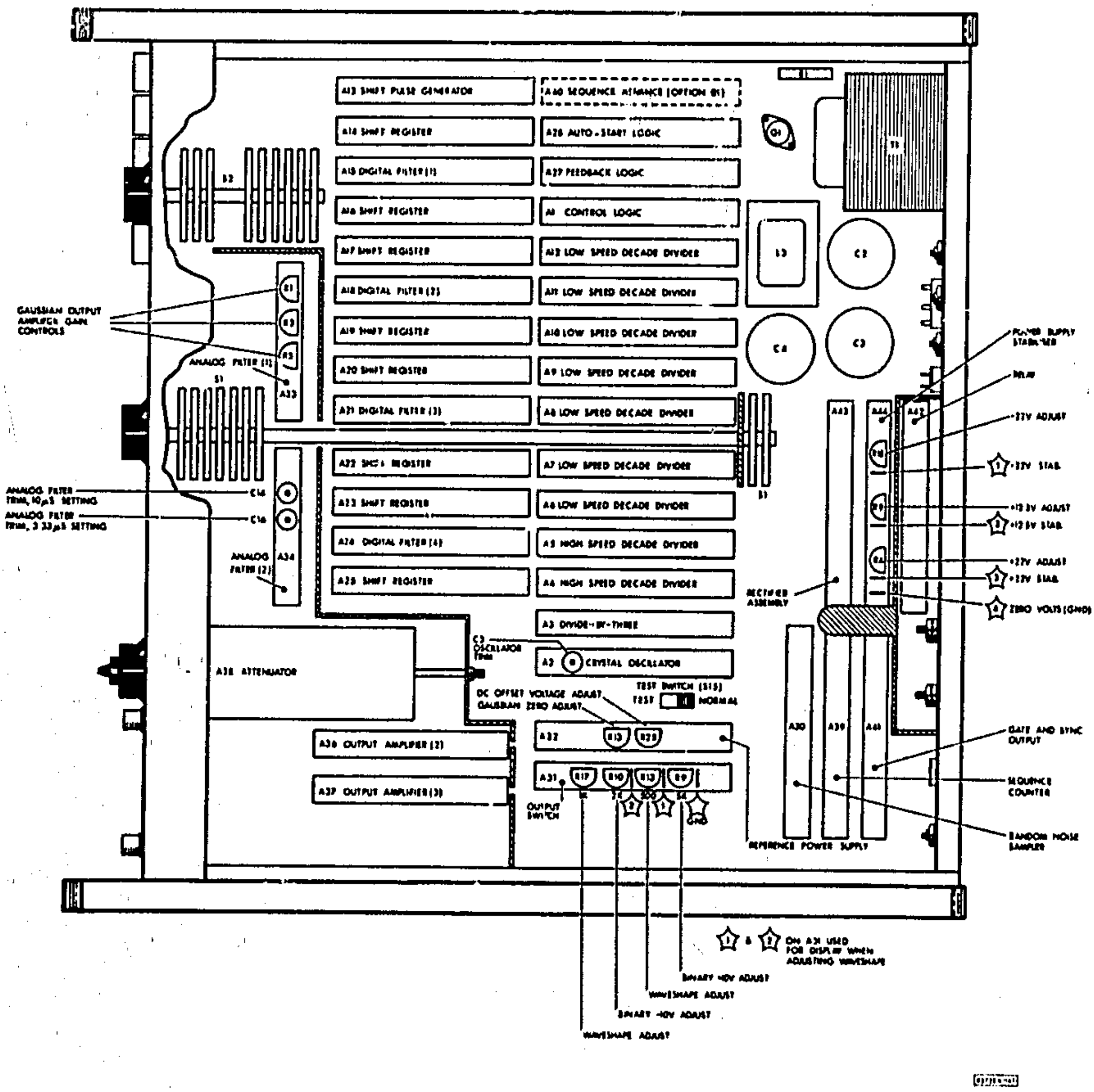


Figure 5-16 Location of assemblies and main test points

Table 5-3 In-cabinet performance check (continued)

Figure 5-16 shows the location of all test points and trimmers.

**Stabilised power supplies**

**+22V supply**

Monitor the voltage at test point 3 on A44. This should be +22V ± 100mV. If necessary, adjust A44R4.

**+12.5V supply**

Monitor the voltage at test point 2 on A44. This should be +12.5V ± 100mV. If necessary, adjust A44R9.

**-22V supply**

Monitor the voltage at test point 1 on A44. This should be -22V ± 100mV. If necessary, adjust A44R15.

**Crystal oscillator**

(1) Set the *3722A* controls as follows:

CLOCK PERIOD to 1$\mu$S

CLOCK switch (rear panel) to INT

CONTROL switch (rear panel) to LOCAL.

(2) Operate the RUN button.

(3) Using an electronic counter, measure the frequency of the CLOCK output (BNC connector, rear panel). Adjust the clock frequency to 1MHz using A2C3.

**Binary output amplitude**

(1) Set the *3722A* controls as follows:

SEQUENCE LENGTH to 15

CLOCK PERIOD to 3.33 sec

(2) Connect the DVM to the BINARY output (fixed).

(3) Operate the *3722A* RESET button. The DVM should read +10V ± 20mV. If necessary, adjust A31R9.

(4) Operate the *3722A* RUN button and, as soon as the DVM shows a negative voltage, operate the HOLD button. The DVM should read -10V ± 20mV. If necessary, adjust A31R10.

NOTE Adjustments to A31R9 and A31R10 must be followed by waveshape adjustment (below).

**Binary waveshape**

(1) Set the *3722A* controls as follows:

SEQUENCE LENGTH to 15

CLOCK PERIOD to 1mS

(2) Operate the RUN button.

(3) Set the oscilloscope controls as follows:

| | |
|---|---|
| INPUT | AC coupled |
| SENSITIVITY | 0.05V/CM |
| TRIGGER | EXT from *3722A* SYNC |
| SWEEP TIME | 1mS/CM |

(4) Using a 10:1 divider probe, display the waveform at test point 1 on A31. Adjust A31R13 for minimum signal.

(5) Using the same probe, display the waveform at test point 2 on A31. Adjust A31R17 for minimum signal.

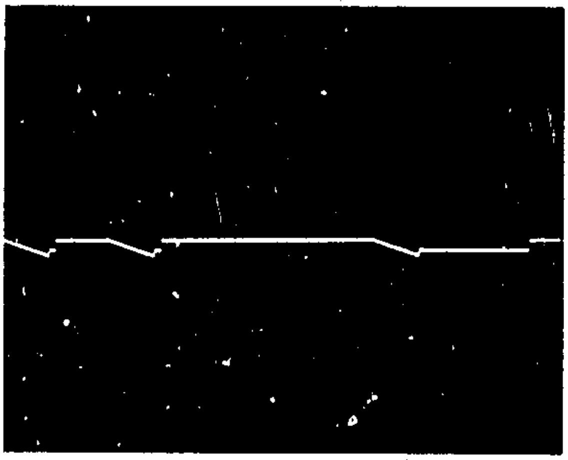


**Figure 5 - 17 Typical near-correct adjustment of A31R13**

**Analog filter trim**

This procedure requires the use of a generator providing a 500Hz square wave at 600$\Omega$ output impedance: *hp* function generator, model *3300A*, is recommended.

(1) Remove assemblies A15, A18, A21, A24 and A32.

(2) Set the CLOCK PERIOD switch to 3.33$\mu$S and operate the HOLD button.

(3) Connect the CHANNEL A output from the *3300A* between socket XA15 pin 4 and ground.

**Table 5-4 Adjustment procedures**

(4) Set the *3300A* controls as follows:

| | |
|---|---|
| FREQUENCY | 5 |
| RANGE | x 100 |
| CHANNEL A | SQUARE |
| CHANNEL B | SQUARE |

(5) Connect an oscilloscope to the GAUSSIAN (fixed) output.

(6) Set the oscilloscope controls as follows:

| | |
|---|---|
| SENSITIVITY | 0.2V/CM |
| TRIGGER | EXT (from channel B of *3300A*) |
| SWEEP TIME | 2mS/CM |

(7) Adjust the *3300A* channel A amplitude for 5cm display (excluding overshoot), then set sweep time to 2μS/CM and observe leading edge of waveform. Amplitude of the overshoot should be between 0.45 and 0.55cm (9 to 11% overshoot): if necessary, adjust A34C16 to achieve this.

(8) Repeat with CLOCK PERIOD switch set to 10μS. Again, the overshoot on the 5cm waveform should be 0.45 to 0.55cm: if necessary, adjust A34C14 to achieve this.

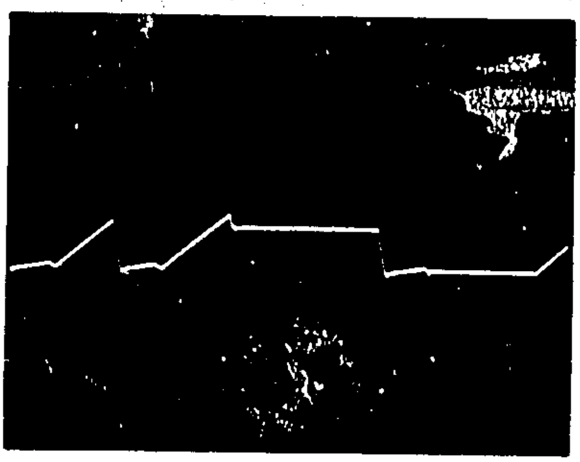


**Figure 5 - 18 Extreme maladjustment of A31R17**

**Gaussian offset & zero adjustments**

(1) Connect a dc null voltmeter, model *419A*, to the GAUSSIAN (fixed) output. Set the voltmeter RANGE switch to 300mV. Depress the VM button.

(2) Set the *3722A* controls as follows:

SEQUENCE LENGTH to 2047
CLOCK PERIOD to 10μS

(3) Set the GAUSSIAN ZERO control (front panel) to the mid-position (note the meter reading at the fully cw and ccw settings, then set the control to give a meter reading midway between the two). Set both A32R13 and A32R25 to their mid-positions.

(4) Adjust A32R13 (10kΩ) to give null reading on the meter.

(5) Set the SEQUENCE LENGTH switch to 15 and note the change in meter reading. If the meter reading changes by more than 3mV, the dc offset voltage must be adjusted using A32R25 (1kΩ). The procedure for this is as follows:

(a) Make a *very small* adjustment to A32R25, remembering the direction of rotation.

(b) Change the sequence length to 2047 and zero the meter using A32R13.

(c) Return to sequence length 15 and note the change in meter reading. If this is greater than the change observed before, A32R25 was rotated in the wrong direction. Rectify this and repeat step (b). Once the correct direction of A32R25 rotation has been established, the procedure is repeated until the change in meter reading on switching from sequence length 2047 to 15 is less than 3mV.

(6) Make final adjustments to the GAUSSIAN ZERO control.

**Table 5-4 Adjustment procedures (continued)**

**Gaussian output amplifier gain**

(1) Set the *3722A* controls as follows:

SEQUENCE LENGTH to 2047

CLOCK PERIOD to 33.3μS

(2) Connect the rms voltmeter, model *3400A*, to the GAUSSIAN (fixed) output. The meter reading should be 3.16V rms (full scale on the 3V range): if necessary, adjust A33R1.

(3) Remove the rms voltmeter and connect in its place a DVM.

(4) Set the CLOCK PERIOD switch to 333μS and operate the RESET button. The DVM reading should be 9.96V ± 20mV.

(5) Set the CLOCK PERIOD switch to 1mS. The DVM reading should remain the same: if necessary, adjust A33R3 to achieve this.

(6) Set the CLOCK PERIOD switch to 3.33mS. Again, the DVM reading should be as before: if necessary, adjust A33R5 to achieve this.

**Table 5-4 Adjustment procedures (continued)**

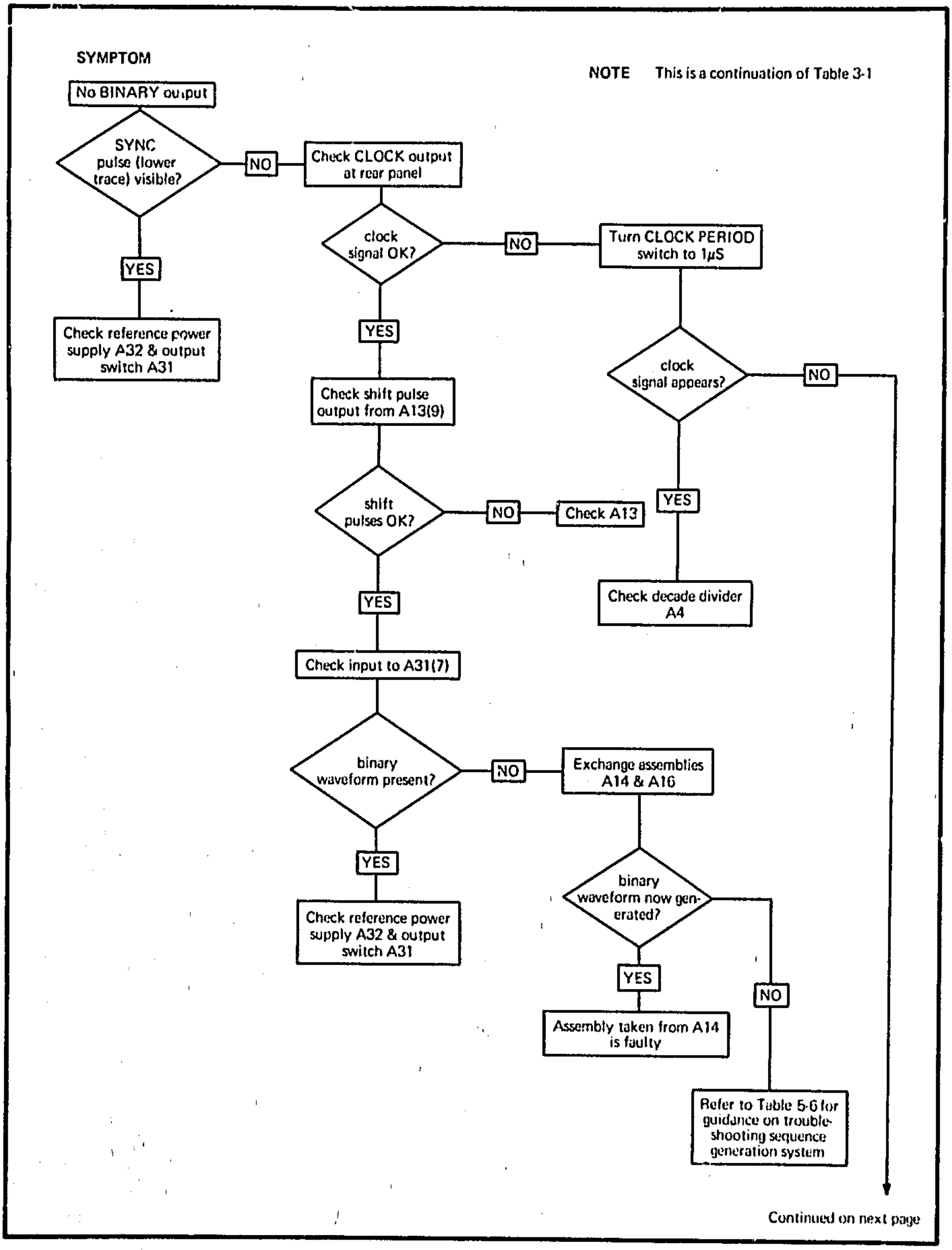



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Table 5 - 5 Troubleshooting BINARY system

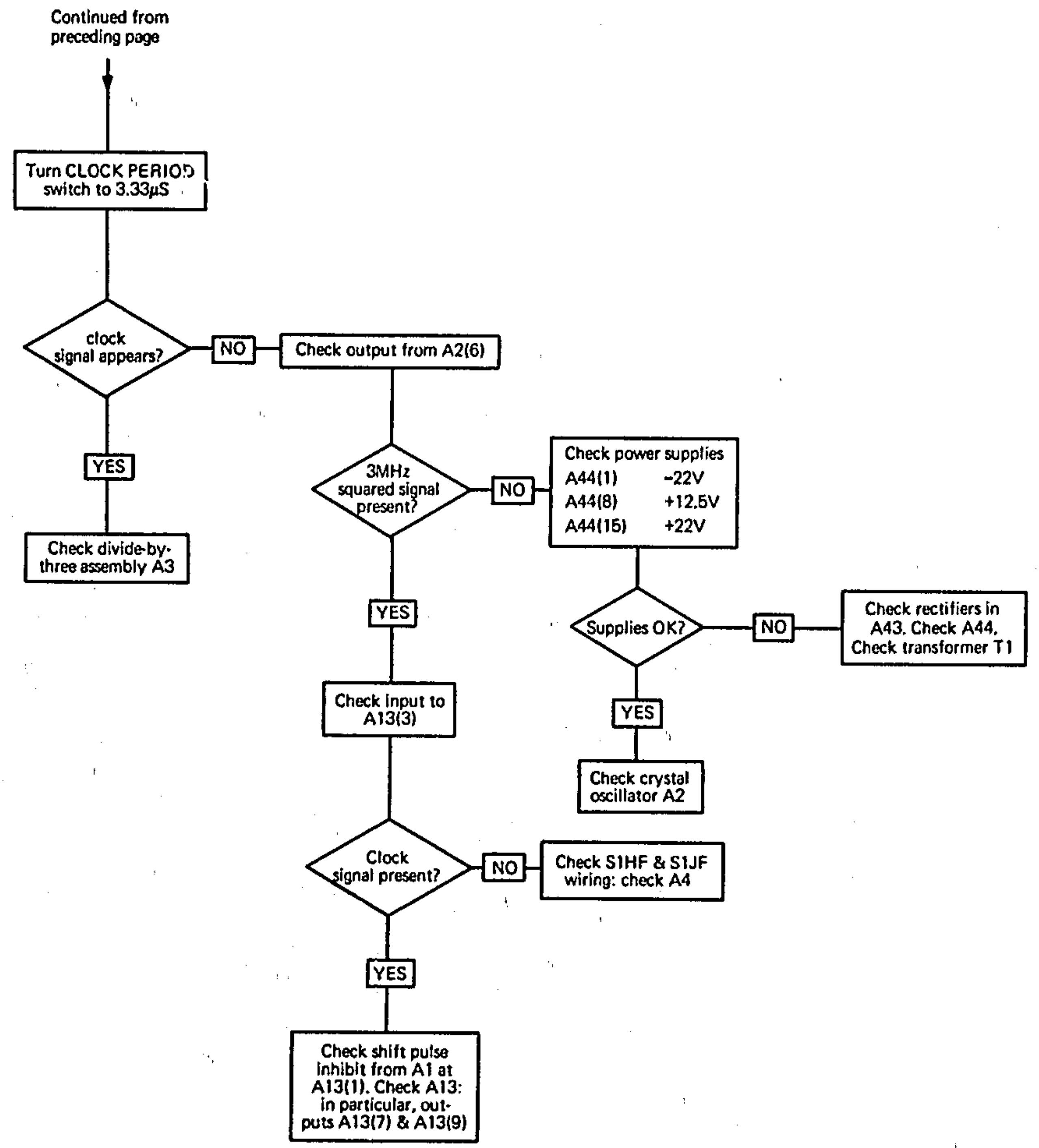



**Table 5 - 5 (continued)**

**SYMPTOM** No sequence generated (that is, no binary waveform present at A31(7)).

**LOCATION OF FAULT** If the system fails to generate a sequence even at the lowest (N=15) setting of the SEQUENCE LENGTH switch, the fault must lie in the loop:-

A14 ---▶ SEQUENCE LENGTH switch S2, wafers DF & EF ---▶ A27 ---▶ A28 ---▶ S2BF

Check shift register assembly A14 by replacement with any of the other shift register assemblies (see Table 5-5).

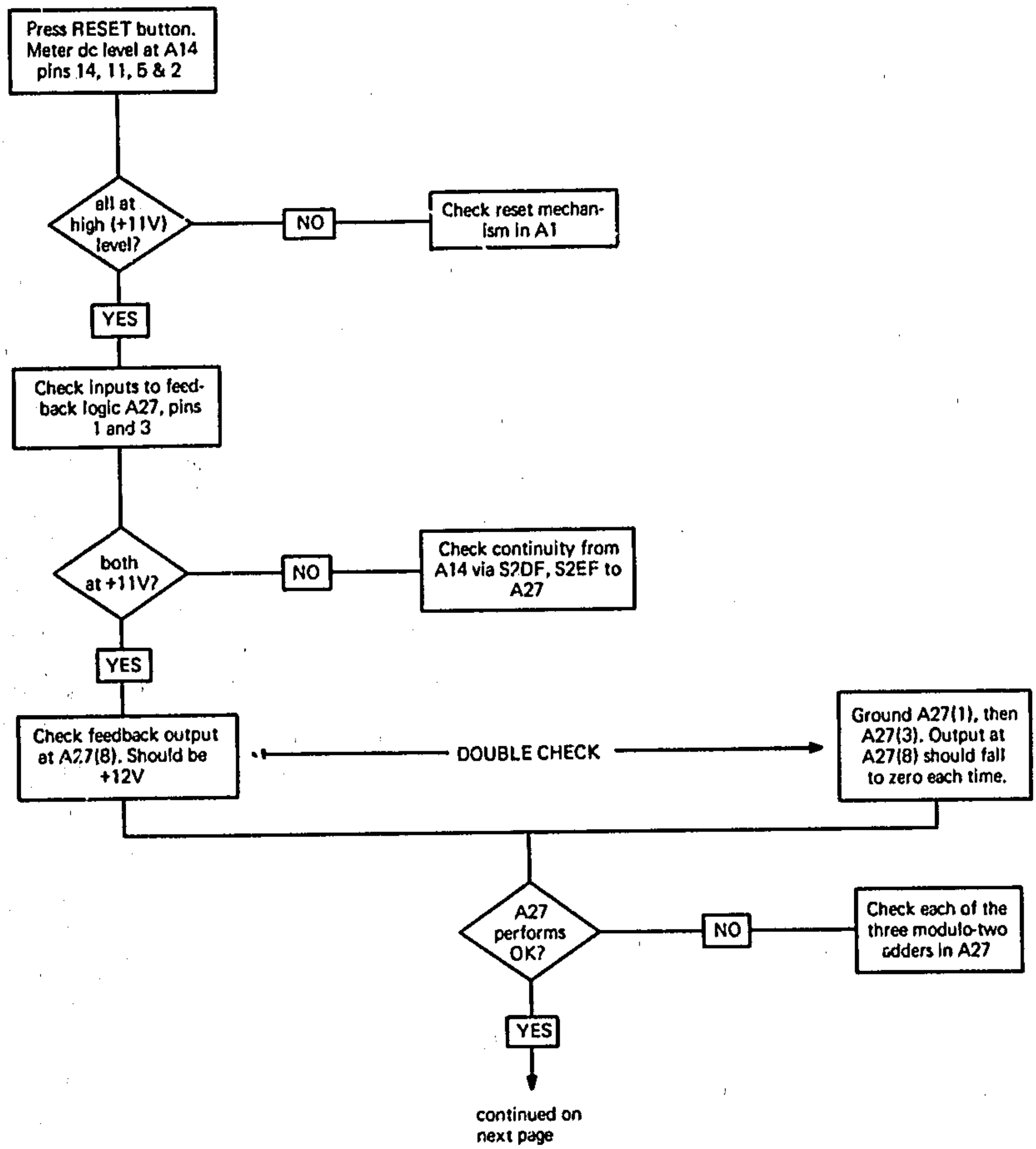



**Table 5 - 6 Troubleshooting sequence generation system**

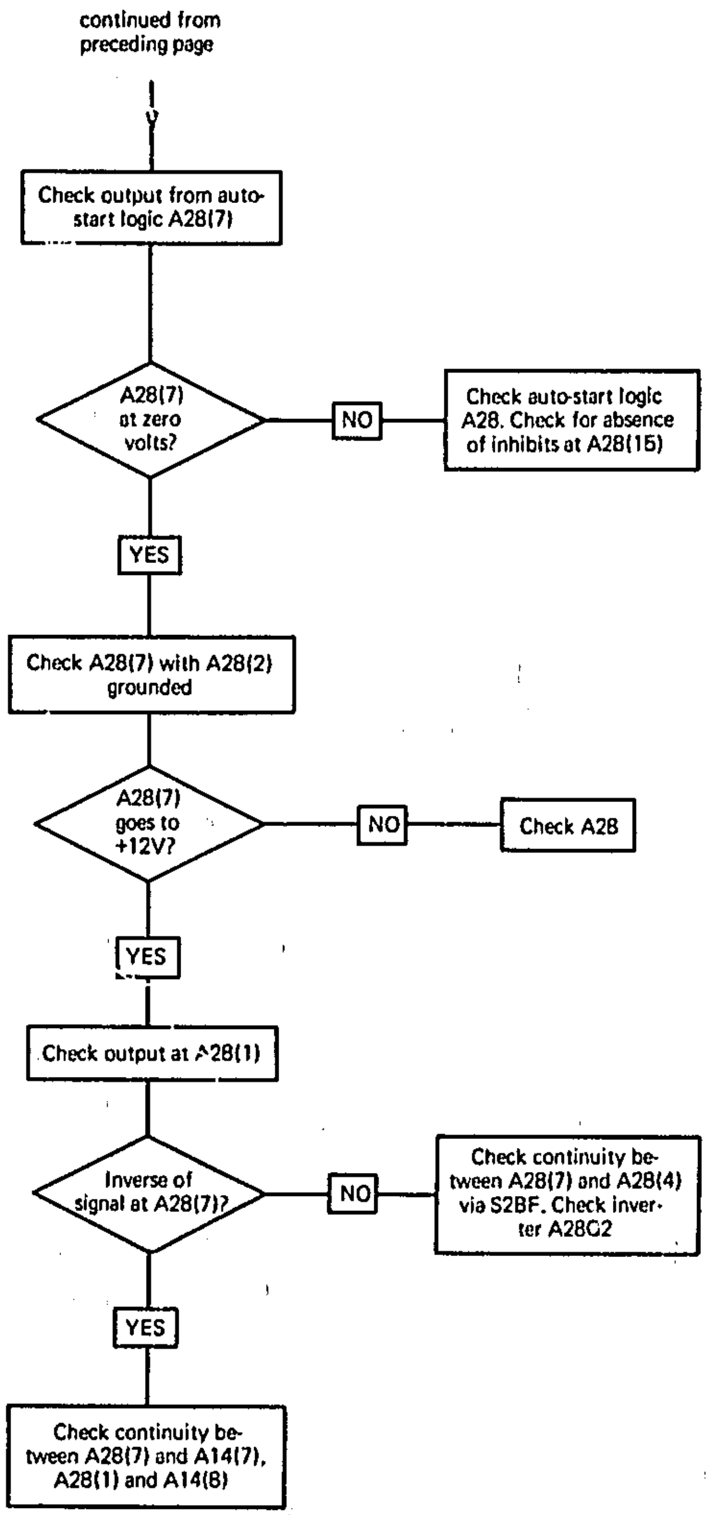



**Table 5 - 6 (continued)**

**SYMPTOM** No GAUSSIAN output, but BINARY output OK (continuation of Table 3-1).

**LOCATION OF FAULT** Digital filter or output amplifiers.

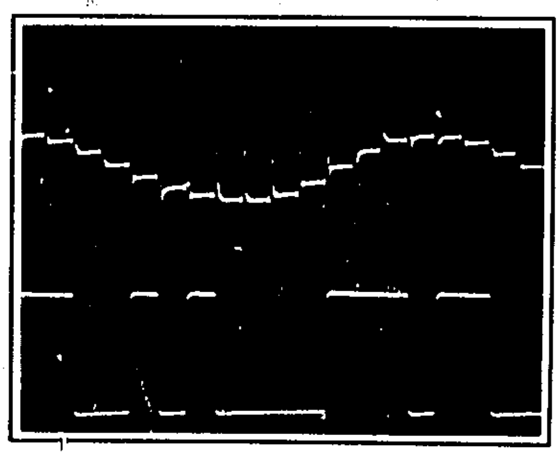
There is also the possibility that the shift register chain could be broken (only the first 10 stages are used to generate the 1023-bit sequence). Eliminate this first by displaying the waveform on A25(5), this being the output from the final stage of the shift register. The waveform should be a binary sequence of similar form to that observed at the BINARY output connector. If there is no signal at A25(5), work back from the end of the shift register until the break in the chain is found.

Set SEQUENCE LENGTH switch to N=15, and CLOCK PERIOD switch to 1µS. With high Y sensitivity (at least 0.5V/cm) display signal on digital filter summing point, A22(4). Trigger oscilloscope from SYNC output.

multi-level signal displayed?

NO → Check +9V supply to digital filter assemblies at pin A24(15). Check digital filter test waveform, as described in Table 5-8.

YES → Check output amplifier assemblies A35, A36 & A37: also analog filters A33 & A34. Refer to Table 8-2 for details.



**Upper trace** waveform at A22(4), 0.5V/cm
**Lower trace** BINARY output, 10V/cm
**Sweep** 2µS/cm

**Table 5 - 7 Troubleshooting GAUSSIAN system**

**COMMENT**

The sh ... e GAUSSIAN output spectrum depends almost entirely on the frequency characteristic c ... filter. The filter characteristic is very easily checked by the recirculating '1' test, which ... ter to generate a repeated sequence of (sin x/x) type waveforms – a train of waveform ... ing, in effect, the impulse response of the filter. The impulse response *completely de...es* the frequency characteristic of the filter.

Observation of the output from the filter, when in the recirculating '1' condition, thus reveals any trouble spots likely to affect the output spectrum. The voltage levels (i.e. the steps) in the filter output are defined by precision resistors, and are unlikely to vary by other than small amounts. A really significant failure – for example, a non-functioning resistor clamp circuit – is shown up by an obvious departure from the correct voltage level. Some difference in voltage levels between the 'up slope' and 'down slope' of the (sin x/x) type waveform may be observed. This difference, which is not normally significant, is owing to the load imposed on the digital filter by the output amplifiers and analog filters: these contain reactive components, the effect of which is particularly apparent in the range of CLOCK PERIOD settings 1μS to 333μS. In other words, it is not possible (at high frequencies) to obtain an undistorted display of the test waveform without disconnecting the amplifiers and analog filters.

TO DISPLAY THE TEST WAVEFORM WITHOUT DISTORTION, detach the white/black wire from A22(4). The voltage levels on the up and down slope should then be identical, even at the shorter CLOCK PERIOD settings.

**Procedure to obtain display**

(1) Set the chassis-mounted test switch to TEST.

(2) Set the SEQUENCE LENGTH switch to INFINITE.

(3) Display the BINARY output from the *3722A* on the B channel of an oscilloscope, with Y sensitivity 20V/cm.

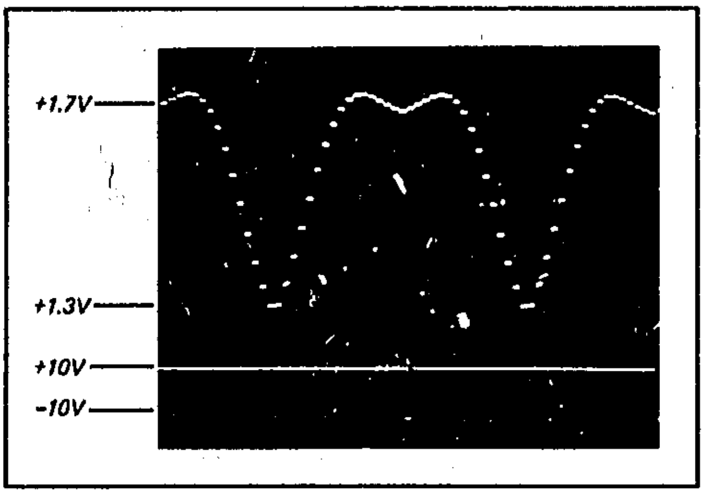
(4) Display the signal at the digital filter summing point A22(4) on the A channel of the oscilloscope, with Y sensitivity 0.1V/cm, ac coupled.

(5) Set the CLOCK PERIOD switch to 10μS.

(6) Set the oscilloscope sweep rate to 50μS/cm.

(7) Press the RESET button, then the RUN button.

(8) Trigger the oscilloscope from the B channel input.




**Upper trace** pattern generated by recirculating '1'
**Lower trace** BINARY output

**Table 5 - 8 Digital filter functional check**

# SECTION VI

# REPLACEABLE PARTS

## 6-1 INTRODUCTION

6-2 This section contains information for ordering replacement parts. Table 6-1 (Reference Designation Index) lists parts in alpha-numerical order of their reference designators and gives the following information for each part:

a. Hewlett-Packard stock number.

b. Description (abbreviations given in list below).

c. Any applicable notes.

6-3 Table 6-2 (Replaceable Parts) lists parts in numerical order of their Hewlett-Packard stock numbers and provides the following information:

a. Description of each part (abbreviations given in list below).

b. Total quantities of each part used in the instrument (refer to TQ column).

6-4 Table 6-3 (Commercial Equivalents) lists in Hewlett-Packard stock number order all transistors and diodes used in 3722A and gives for each the following information:

a. Jedec equivalent (if any).

b. Manufacturer and manufacturer's part number.

## 6-5 ORDERING INFORMATION

6-6 To order a replacement part, address the order or enquiry to your local Hewlett-Packard field office (see lists at rear of manual for addresses).

6-7 Specify the following information for each part:

a. Model and full serial number of instrument.

b. Hewlett-Packard stock number.

c. Circuit reference designator.

d. Description.

6-8 To order a part not listed in the tables, give a complete description of the part including its function and location in the instrument.

## REFERENCE DESIGNATORS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | = assembly | K | = relay | T | = transformer |
| C | = capacitor | L | = inductor | W | = cable |
| CR | = diode | MP | = miscellaneous part (mechanical) | X | = socket |
| DS | = device signalling (lamp) | Q | = transistor | XA | = printed-circuit assembly connector |
| F | = fuse | R | = resistor | XF | = fuse holder |
| J | = jack | S | = switch | Y | = crystal |

## ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| A | = amperes | LIN | = linear taper | TA | = tantalum |
| AL | = aluminium | LOG | = logarithmic taper | | |
| ASSY | = assembly | | | U (μ) | = micro ($10^{-6}$) |
| | | m | = milli ($10^{-3}$) | | |
| CCW | = counter clockwise | MEG | = mega ($10^6$) | V | = volts |
| CER | = ceramic | MHz | = mega cycles/second | VAR | = variable |
| COAX | = coaxial | *METALAC | = metallized lacquer | VDCW | = dc working volts |
| COMP | = composition | MET FLM | = metal film | | |
| CW | = clockwise | MET OX | = metallic oxide | W | = watts |
| | | MY | = mylar | W/ | = with |
| ELECT | = electrolytic | | | WW | = wirewound |
| EXT | = external | n | = nano ($10^{-9}$) | | |
| | | N/C | = normally closed | | |
| F | = farads | NE | = neon | | |
| FET | = field effect transistor | N/O | = normally open | | |
| FXD | = fixed | NSR | = not separately replaceable | | |
| GE | = germanium | PC | = printed circuit | | |
| GND | = ground | P | = pico ($10^{-12}$) | | |
| | | PIV | = peak inverse voltage | | |
| H | = henries | POLY | = polystyrene | | |
| INT | = internal | PPM | = parts per million | | |
| | | RMS | = root-mean-square | | |
| K | = kilo ($10^3$) | | | | |
| kHz | = kilo cycles/second | SI | = silicon | | |

## COLOUR ABBREVIATIONS

| | |
|---|---|
| BLK | black |
| BRN | brown |
| RED | red |
| ORG | orange |
| YEL | yellow |
| GRN | green |
| BLU | blue |
| VIO | violet |
| GRY | grey |
| WHT | white |

*U.K. Trade Name

Table 6-1. Reference Designation Index

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A1 | 03722-713 | ASSY: CONTROL LOGIC | |
| | 03722-313 | BOARD: BLANK PC (NSR) | |
| A1C1 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A1C2 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW | |
| A1C3 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW | |
| A1C4 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW | |
| A1C5 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW | |
| A1C6 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | |
| A1C7 | 0160-0300 | C: FXD MY 2700PF 10% 200VDCW | |
| A1C8 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW | |
| A1CR1 | 1901-0040 | DIODE: SI | |
| A1CR2 | 1901-0040 | DIODE: SI | |
| A1CR3 | 1901-0040 | DIODE: SI | |
| A1CR4 | 1901-0040 | DIODE: SI | |
| A1CR5 | 1901-0040 | DIODE: SI | |
| A1CR6 | 1901-0040 | DIODE: SI | |
| A1Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A1Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A1Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A1Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A1Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A1R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A1R2 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A1R3 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A1R4 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A1R5 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A1R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A1R7 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A1R8 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A1R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A1R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A1R11 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A1R12 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A1R13 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A1R14 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | |
| A1R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A1R16 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A1R17 | 0758-0015 | R: FXD MET OX 220 OHM 5% 1/2W | |
| A1R18 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W | |
| A1R19 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A1R20 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A1R21 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A1R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A1R23 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A1R24 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A1R25 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A1R26 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A1R27 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A1R28 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A1R29 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A1R30 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A2 | 03722-715 | ASSY: CRYSTAL OSCILLATOR | |
| | 03722-315 | BOARD: BLANK PC (NSR) | |
| A2C1 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW | |
| A2C2 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW | |
| A2C3 | 0121-0105 | C: VAR CER 9-35PF | |
| A2C4 | 0160-2197 | C: FXD MICA 10PF 5% 300VDCW | |
| A2C5 | 0150-0086 | C: FXD CER 4700PF 20% 500VDCW | |
| A2C6 | 0160-2208 | C: FXD MICA 330PF 5% 300VDCW | |
| A2C7 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW | |
| A2C8 | 0160-0179 | C: FXD MICA 33PF 5% 300VDCW | |
| A2C9 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | |
| A2C10 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | |
| A2CR1 | 1901-0040 | DIODE: SI | |
| A2L1 | 9100-1633 | L: FXD COIL 68UH 5% | |
| A2MP1 | 0380-0509 | BEAD: GLASS | |
| A2MP2 | 0380-0509 | BEAD: GLASS | |
| A2Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A2Q2 | 1853-0034 | TRANSISTOR: SI PNP | |
| A2Q3 | 1853-0034 | TRANSISTOR: SI PNP | |
| A2R1 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A2R2 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A2R3 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W | |
| A2R4 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W | |
| A2R5 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A2R6 | 0758-0017 | R: FXD MET OX 1.5K OHM 5% 1/2W | |
| A2R7 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A2T1 | 9100-0619 | TRANSFORMER: CRYSTAL OSCILLATOR | |
| A2Y1 | 0410-0601 | CRYSTAL: QUARTZ 3MHz | |
| A3 | 03722-705 | ASSY: DIVIDE-BY-THREE | |
| | 03722-305 | BOARD: BLANK PC (NSR) | |
| A3C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A3C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A3C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A3C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A3C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A3C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A3C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A3C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A3CR1 | 1901-0040 | DIODE: SI | |
| A3CR2 | 1901-0040 | DIODE: SI | |
| A3CR3 | 1901-0040 | DIODE: SI | |
| A3CR4 | 1901-0040 | DIODE: SI | |
| A3CR5 | 1901-0040 | DIODE: SI | |
| A3CR6 | 1901-0040 | DIODE: SI | |
| A3CR7 | 1901-0040 | DIODE: SI | |
| A3CR8 | 1901-0040 | DIODE: SI | |
| A3CR9 | 1901-0040 | DIODE: SI | |
| A3CR10 | 1901-0040 | DIODE: SI | |
| A3Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A3Q2 | 1853-0034 | TRANSISTOR: SI PNP | |
| A3Q3 | 1853-0034 | TRANSISTOR: SI PNP | |
| A3Q4 | 1853-0034 | TRANSISTOR: SI PNP | |
| A3Q5 | 1853-0034 | TRANSISTOR: SI PNP | |
| A3R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A3R2 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W | |
| A3R3 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A3R4 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W | |
| A3R5 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | |
| A3R6 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A3R7 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A3R8 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | |
| A3R9 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W | |
| A3R10 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W | |
| A3R11 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | |
| A3R12 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A3R13 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A3R14 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | |
| A3R15 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W | |
| A4 | 03722-725<br>03722-325 | ASSY: HIGH-SPEED DECADE DIVIDER<br>BOARD: BLANK PC(NSR) | |
| A4C1 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW | |
| A4C2 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW | |
| A4C3 | 0140-0191 | C: FXD MICA 56PF 5% 300VDCW | |
| A4C4 | 0140-0191 | C: FXD MICA 56PF 5% 300VDCW | |
| A4C5 | 0150-0122 | C: FXD CER 2000PF 20% 500VDCW | |
| A4C6 | 0140-0191 | C: FXD MICA 56PF 5% 300VDCW | |
| A4C7 | 0160-0181 | C: FXD MICA 30PF 5% 300VDCW | |
| A4C8 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A4C9 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A4C10 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A4C11 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW | |
| A4C12 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW | |
| A4C13 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW | |
| A4C14 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW | |
| A4C15 | 0140-0176 | C: FXD MICA 100PF 2% 300VDCW | |
| A4C16 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW | |
| A4CR1 | 1901-0040 | DIODE: SI | |
| A4CR2 | 1901-0040 | DIODE: SI | |
| A4CR3 | 1901-0040 | DIODE: SI | |
| A4CR4 | 1901-0040 | DIODE: SI | |
| A4CR5 | 1901-0040 | DIODE: SI | |
| A4CR6 | 1901-0040 | DIODE: SI | |
| A4CR7 | 1901-0040 | DIODE: SI | |
| A4CR8 | 1901-0040 | DIODE: SI | |
| A4CR9 | 1901-0040 | DIODE: SI | |
| A4CR10 | 1901-0040 | DIODE: SI | |
| A4CR11 | 1901-0040 | DIODE: SI | |
| A4Q1 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4Q2 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4Q3 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4Q4 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4Q5 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4Q6 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4Q7 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4Q8 | 1853-0034 | TRANSISTOR: SI PNP | |
| A4R1 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | |
| A4R2 | 0758-0024 | R: FXD MET FLM 100 OHM 5% 1/2W | |
| A4R3 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W | |
| A4R4 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A4R5 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R6 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A4R7 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W | |
| A4R8 | 0698-4232 | R: FXD MET OX 110 OHM 5% 1/4W | |
| A4R9 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R10 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A4R11 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W | |
| A4R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R13 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A4R14 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W | |
| A4R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A4R16 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W | |
| A4R17 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A4R18 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R19 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A4R20 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A4R21 | 0698-4232 | R: FXD MET OX 110 OHM 5% 1/4W | |
| A4R22 | 0698-4288 | R: FXD MET OX 27K OHM 5% 1/4W | |
| A4R23 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A4R24 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W | |
| A4R25 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R26 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A4R27 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W | |
| A4R28 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A4R29 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W | |
| A4R30 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W | |
| A4R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R32 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | |
| A4R33 | 0698-5707 | R: FXD MET OX 47 OHM 5% 1/4W | |
| A4R34 | 0698-4232 | R: FXD MET OX 110 OHM 5% 1/4W | |
| A4R35 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R36 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | |
| A4R37 | 0698-3799 | R: FXD MET OX 22 OHM 5% 1/4W | |
| A4R38 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R39 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W | |
| A4R40 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W | |
| A4R41 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A4R42 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W | |
| A4R43 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A4R44 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R45 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | |
| A4R46 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R47 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W | |
| A4R48 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A4R49 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A4R50 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W | |
| A4R51 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W | |
| A4R52 | 0698-4265 | R: FXD MET OX 3.0K OHM 5% 1/4W | |
| A4R53 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W | |
| A5 | | SAME AS A4: USE PREFIX A5 | |
| A6 | 5212A-65C | ASSY: LOW-SPEED DECADE DIVIDER | |
| | 5212A-65C-1 | BOARD: BLANK PC (NSR) | |
| A6C1 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW | |
| A6C2 | 0140-0194 | C: FXD MICA 110PF 5% 300VDCW | |
| A6C3 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW | |
| A6C4 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW | |
| A6C5 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW | |
| A6C6 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW | |
| A6C7 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW | |
| A6C8 | 0140-0199 | C: FXD MICA 240PF 5% 300VDCW | |
| A6C9 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW | |
| A6C10 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A6C11 | 0140-0194 | C: FXD MICA 110PF 5% 300VDCW | |
| A6C12 | 0140-0198 | C: FXD MICA 200PF 5% 300VDCW | |
| A6C13 | 0140-0198 | C: FXD MICA 200PF 5% 300VDCW | |
| A6C14 | 0140-0200 | C: FXD MICA 390PF 5% 300VDCW | |
| A6CR1 | 1910-0016 | DIODE: GE | |
| A6CR2 | 1910-0016 | DIODE: GE | |
| A6CR3 | 1910-0016 | DIODE: GE | |
| A6CR4 | 1910-0016 | DIODE: GE | |
| A6CR5 | 1910-0016 | DIODE: GE | |
| A6Q1 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6Q2 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6Q3 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6Q4 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6Q5 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6Q6 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6Q7 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6Q8 | 1850-0062 | TRANSISTOR: GE PNP | |
| A6R1 | 0683-3915 | R: FXD COMP 390 OHM 5% 1/4W | |
| A6R2 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R3 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R4 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R5 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W | |
| A6R6 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R7 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W | |
| A6R8 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R9 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R10 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R11 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W | |
| A6R12 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R13 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R14 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R15 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R16 | 0683-8225 | R: FXD COMP 8.2K OHM 5% 1/4W | |
| A6R17 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R18 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W | |
| A6R19 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R20 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R21 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R22 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W | |
| A6R23 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R24 | 0383-6835 | R: FXD COMP 68K OHM 5% 1/4W | |
| A6R25 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R26 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R27 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R28 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W | |
| A6R29 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R30 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A6P31 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R32 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R33 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R34 | 0683-8225 | R: FXD COMP 8.2K OHM 5% 1/4W | |
| A6R35 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R36 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R37 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R38 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R39 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W | |
| A6R40 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R41 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W | |
| A6R42 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | |
| A6R43 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | |
| A6R44 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A6R45 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W | |
| A6R46 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | |
| A7 | | SAME AS A6: USE PREFIX A7 | |
| A8 | | SAME AS A6: USE PREFIX A8 | |
| A9 | | SAME AS A3: USE PREFIX A9 | |
| A10 | | SAME AS A6: USE PREFIX A10 | |
| A11 | | SAME AS A6: USE PREFIX A11 | |
| A12 | | SAME AS A6: USE PREFIX A12 | |
| A13 | 03722-703 | ASSY: SHIFT PULSE GENERATOR | |
| | 03722-303 | BOARD: BLANK PC (NSR) | |
| A13C1 | 0160-0137 | C: FXD CER 0.33UF 20% 25VDCW | |
| A13C2 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | |
| A13C3 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | |
| A13C4 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | |
| A13C5 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW | |
| A13C6 | 0160-2009 | C: FXD MICA 820PF 5% 300VDCW | |
| A13C7 | 0160-2208 | C: FXD MICA 330PF 5% 300VDCW | |
| A13CR1 | 1901-0040 | DIODE: SI | |
| A13CR2 | 1901-0040 | DIODE: SI | |
| A13CR3 | 1901-0040 | DIODE: SI | |
| A13CR4 | 1901-0040 | DIODE: SI | |
| A13CR5 | 1910-0034 | DIODE: GE | |
| A13CR6 | 1910-0034 | DIODE: GE | |
| A13CR7 | 1901-0040 | DIODE: SI | |
| A13CR8 | 1901-0040 | DIODE: SI | |
| A13CR9 | 1901-0040 | DIODE: SI | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A13Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A13Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A13Q3 | 1853-0034 | TRANSISTOR: SI PNP | |
| A13Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A13Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A13Q6 | 1854-0215 | TRANSISTOR: SI NPN | |
| A13R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A13R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A13R3 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A13R4 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A13R5 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A13R6 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | |
| A13R7 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A13R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A13R9 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W | |
| A13R10 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A13R11 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A13R12 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A13R13 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A13R14 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A13R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A13R16 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A13R17 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A13R18 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A13R19 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A13R20 | 0758-0026 | R: FXD MET FLM 82 OHM 5% 1/2W | |
| A13R21 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A13R22 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W | |
| A13R23 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A13R24 | | NOT ASSIGNED | |
| A13R25 | 0761-0026 | R: FXD MET OX 220 OHM 5% 1W | |
| A13R26 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A13R27 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A13T1 | 9100-0620 | TRANSFORMER: SHIFT PULSE GENERATOR | |
| A14 | 03722-704 | ASSY: SHIFT REGISTER | |
| | 03722-304 | BOARD: BLANK PC(NSR) | |
| A14C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A14C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A14CR1 | 1901-0040 | DIODE: SI | |
| A14CR2 | 1901-0040 | DIODE: SI | |
| A14CR3 | 1901-0040 | DIODE: SI | |
| A14CR4 | 1901-0040 | DIODE: SI | |
| A14CR5 | 1901-0040 | DIODE: SI | |
| A14CR6 | 1901-0040 | DIODE: SI | |
| A14CR7 | 1901-0040 | DIODE: SI | |
| A14CR8 | 1901-0040 | DIODE: SI | |
| A14CR9 | 1901-0040 | DIODE: SI | |
| A14CR10 | 1901-0040 | DIODE: SI | |
| A14CR11 | 1901-0040 | DIODE: SI | |
| A14CR12 | 1901-0040 | DIODE: SI | |
| A14Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14Q7 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A14R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R3 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A14R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R5 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R6 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R7 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R8 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A14R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R10 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R11 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A14R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R13 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R14 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R16 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A14R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R19 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A14R20 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A14R21 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R22 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R23 | 0698-42[illegible] | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R24 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A14R25 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R26 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R27 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A14R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R29 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R30 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A14R31 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A14R32 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A15 | 03722-706 | ASSY: DIGITAL-TO-ANALOG CONVERTER (1) | |
| | 03722-306 | BOARD: BLANK PC (NSR) | |
| A15C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A15Q1 | 1853-0015 | TRANSISTOR: SI PNP | |
| A15Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A15Q3 | 1853-0015 | TRANSISTOR: SI PNP | |
| A15Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A15Q5 | 1853-0015 | TRANSISTOR: SI PNP | |
| A15Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A15Q7 | 1853-0015 | TRANSISTOR: SI PNP | |
| A15Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A15Q9 | 1853-0015 | TRANSISTOR: SI PNP | |
| A15Q10 | 1854-0605 | TRANSISTOR: SI NPN | |
| A15Q11 | 1853-0015 | TRANSISTOR: SI PNP | |
| A15Q12 | 1854-0605 | TRANSISTOR: SI NPN | |
| A15Q13 | 1853-0015 | TRANSISTOR: SI PNP | |
| A15Q14 | 1854-0605 | TRANSISTOR: SI NPN | |
| A15R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R2 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R5 | 0757-0484 | R: FXD MET FLM 619K OHM 1% 1/8W 100 PPM | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | Part No. | Description * | Note |
|---|---|---|---|
| A15R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R10 | 0698-5797 | R: FXD MET FLM 296K OHM 1% 1/8W 150 PPM | |
| A15R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R15 | 0698-5796 | R: FXD MET FLM 186K OHM 1% 1/8W 150 PPM | |
| A15R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R20 | 0698-5795 | R: FXD MET FLM 138K OHM 1% 1/8W 100 PPM | |
| A15R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R25 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM | |
| A15R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R30 | 0757-0468 | R: FXD MET FLM 130K OHM 1% 1/8W 100 PPM | |
| A15R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A15R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A15R35 | 0757-0472 | R: FXD MET FLM 200K OHM 1% 1/8W 100 PPM | |
| A15TP1 | 0360-0124 | TERMINAL PIN | |
| A15TP2 | 0360-0124 | TERMINAL PIN | |
| A15TP3 | 0360-0124 | TERMINAL PIN | |
| A15TP4 | 0360-0124 | TERMINAL PIN | |
| A15TP5 | 0360-0124 | TERMINAL PIN | |
| A15TP6 | 0360-0124 | TERMINAL PIN | |
| A15TP7 | 0360-0124 | TERMINAL PIN | |
| A16 | | SAME AS A14: USE PREFIX A16 | |
| A17 | | SAME AS A14: USE PREFIX A17 | |
| A18 | 03722-721 | ASSY: DIGITAL-TO-ANALOG CONVERTER (2) | |
| | 03722-321 | BOARD: BLANK PC (NSR) | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A18C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A18Q1 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18Q3 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18Q5 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18Q7 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18Q9 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q10 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18Q11 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q12 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18Q13 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q14 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18Q15 | 1853-0015 | TRANSISTOR: SI PNP | |
| A18Q16 | 1854-0605 | TRANSISTOR: SI NPN | |
| A18R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R2 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R5 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM | |
| A18R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R10 | 0698-5794 | R: FXD MET FLM 52.6K OHM 1/2% 1/8W 50 PPM | |
| A18R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R15 | 0698-5793 | R: FXD MET FLM 31.1K OHM 1/2% 1/8W 50 PPM | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A18R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R20 | 0698-5792 | R: FXD MET FLM 21.3K OHM 1/2% 1/8W 50 PPM | |
| A18R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R25 | 0698-5791 | R: FXD MET FLM 16K OHM 1/2% 1/8W 50 PPM | |
| A18R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R30 | 0698-5790 | R: FXD MET FLM 12.95K OHM 1/2% 1/8W 50 PPM | |
| A18R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R35 | 0698-5789 | R: FXD MET FLM 11.1K OHM 1/2% 1/8W 50 PPM | |
| A18R36 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R37 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A18R38 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R39 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A18R40 | 0698-5788 | R: FXD MET FLM 10K OHM 1/2% 1/8W 50 PPM | |
| A18TP1 | 0360-0124 | TERMINAL PIN | |
| A18TP2 | 0360-0124 | TERMINAL PIN | |
| A18TP3 | 0360-0124 | TERMINAL PIN | |
| A18TP4 | 0360-0124 | TERMINAL PIN | |
| A18TP5 | 0360-0124 | TERMINAL PIN | |
| A18TP6 | 0360-0124 | TERMINAL PIN | |
| A18TP7 | 0360-0124 | TERMINAL PIN | |
| A18TP8 | 0360-0124 | TERMINAL PIN | |
| A19 | | SAME AS A14: USE PREFIX A19 | |
| A20 | | SAME AS A14: USE PREFIX A20 | |
| A21 | 03722-723 | ASSY: DIGITAL-TO-ANALOG CONVERTER (3) | |
| | 03722-323 | BOARD: BLANK PC (NSR) | |
| A21C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A21C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A21Q1 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21Q3 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21Q5 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21Q7 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21Q9 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q10 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21Q11 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q12 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21Q13 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q14 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21Q15 | 1853-0015 | TRANSISTOR: SI PNP | |
| A21Q16 | 1854-0605 | TRANSISTOR: SI NPN | |
| A21R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R2 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R5 | 0698-5788 | R: FXD MET FLM 10K OHM 1/2% 1/8W 50 PPM | |
| A21R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R10 | 0698-5789 | R: FXD MET FLM 11.1K OHM 1/2% 1/8W 50 PPM | |
| A21R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R15 | 0698-5790 | R: FXD MET FLM 12.95K OHM 1/2% 1/8W 50 PPM | |
| A21R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R20 | 0698-5791 | R: FXD MET FLM 16K OHM 1/2% 1/8W 50 PPM | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A21R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R25 | 0698-5792 | R: FXD MET FLM 21.3K OHM 1/2% 1/8W 50 PPM | |
| A21R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R30 | 0698-5793 | R: FXD MET FLM 31.1K OHM 1/2% 1/8W 50 PPM | |
| A21R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R35 | 0698-5794 | R: FXD MET FLM 52.6K OHM 1/2% 1/8W 50 PPM | |
| A21R36 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R37 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A21R38 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R39 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A21R40 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM | |
| A21TP1 | 0360-0124 | TERMINAL PIN | |
| A21TP2 | 0360-0124 | TERMINAL PIN | |
| A21TP3 | 0360-0124 | TERMINAL PIN | |
| A21TP4 | 0360-0124 | TERMINAL PIN | |
| A21TP5 | 0360-0124 | TERMINAL PIN | |
| A21TP6 | 0360-0124 | TERMINAL PIN | |
| A21TP7 | 0360-0124 | TERMINAL PIN | |
| A21TP8 | 0360-0124 | TERMINAL PIN | |
| A22 | | SAME AS A14: USE PREFIX A22 | |
| A23 | | SAME AS A14: USE PREFIX A23 | |
| A24 | 03722-724 | ASSY: DIGITAL-TO-ANALOG CONVERTER (4) | |
| | 03722-324 | BOARD: BLANK PC (NSR) | |
| A24C1 | | NOT ASSIGNED | |
| A24C2 | | NOT ASSIGNED | |
| A24C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A24C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A24Q1 | | NOT ASSIGNED | |
| A24Q2 | | NOT ASSIGNED | |
| A24Q3 | 1853-0015 | TRANSISTOR: SI PNP | |
| A24Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A24Q5 | 1853-0015 | TRANSISTOR: SI PNP | |
| A24Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A24Q7 | 1853-0015 | TRANSISTOR: SI PNP | |
| A24Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A24Q9 | 1853-0015 | TRANSISTOR: SI PNP | |
| A24Q10 | 1854-0605 | TRANSISTOR: SI NPN | |
| A24Q11 | 1853-0015 | TRANSISTOR: SI PNP | |
| A24Q12 | 1854-0605 | TRANSISTOR: SI NPN | |
| A24Q13 | 1853-0015 | TRANSISTOR: SI PNP | |
| A24Q14 | 1854-0605 | TRANSISTOR: SI NPN | |
| A24Q15 | 1853-0015 | TRANSISTOR: SI PNP | |
| A24Q16 | 1854-0605 | TRANSISTOR: SI NPN | |
| A24R1 | | NOT ASSIGNED | |
| A24R2 | | NOT ASSIGNED | |
| A24R3 | | NOT ASSIGNED | |
| A24R4 | | NOT ASSIGNED | |
| A24R5 | | NOT ASSIGNED | |
| A24R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R10 | 0757-0472 | R: FXD MET FLM 200K OHM 1% 1/8W 100 PPM | |
| A24R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R15 | 0757-0468 | R: FXD MET FLM 130K OHM 1% 1/8W 100 PPM | |
| A24R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R20 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM | |
| A24R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R25 | 0698-5795 | R: FXD MET FLM 138K OHM 1% 1/8W 100 PPM | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A24R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R30 | 0698-5796 | R: FXD MET FLM 186K OHM 1% 1/8W 150 PPM | |
| A24R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R35 | 0698-5797 | R: FXD MET FLM 296K OHM 1% 1/8W 150 PPM | |
| A24R36 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R37 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A24R38 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R39 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A24R40 | 0757-0484 | R: FXD MET FLM 619K OHM 1% 1/8W 100 PPM | |
| A24TP1 | | NOT ASSIGNED | |
| A24TP2 | 0360-0124 | TERMINAL PIN | |
| A24TP3 | 0360-0124 | TERMINAL PIN | |
| A24TP4 | 0360-0124 | TERMINAL PIN | |
| A24TP5 | 0360-0124 | TERMINAL PIN | |
| A24TP6 | 0360-0124 | TERMINAL PIN | |
| A24TP7 | 0360-0124 | TERMINAL PIN | |
| A24TP8 | 0360-0124 | TERMINAL PIN | |
| A25 | | SAME AS A14: USE PREFIX A25 | |
| A26 | | NOT ASSIGNED | |
| A27 | 03722-701 | ASSY: FEEDBACK LOGIC | |
| | 03722-301 | BOARD: BLANK PC (NSR) | |
| A27C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A27CR1 | 1901-0040 | DIODE: SI | |
| A27CR2 | 1901-0040 | DIODE: SI | |
| A27CR3 | 1901-0040 | DIODE: SI | |
| A27CR4 | 1901-0040 | DIODE: SI | |
| A27CR5 | 1901-0040 | DIODE: SI | |
| A27CR6 | 1901-0040 | DIODE: SI | |
| A27CR7 | 1901-0040 | DIODE: SI | |
| A27CR8 | 1901-0040 | DIODE: SI | |
| A27CR9 | 1901-0040 | DIODE: SI | |
| A27CR10 | 1901-0040 | DIODE: SI | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A27CR11 | 1901-0040 | DIODE: SI | |
| A27CR12 | 1901-0040 | DIODE: SI | |
| A27CR13 | 1901-0040 | DIODE: SI | |
| A27CR14 | 1901-0040 | DIODE: SI | |
| A27CR15 | 1901-0040 | DIODE: SI | |
| A27CR16 | 1901-0040 | DIODE: SI | |
| A27CR17 | 1901-0040 | DIODE: SI | |
| A27CR18 | 1901-0040 | DIODE: SI | |
| A27Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q7 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27Q9 | 1854-0605 | TRANSISTOR: SI NPN | |
| A27R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R5 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R6 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R7 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A27R8 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A27R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R10 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R11 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R16 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R17 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R18 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R19 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R20 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R21 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A27R22 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A27R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R25 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R26 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A27R27 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A27R30 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | Part No. | Description * | Note |
|---|---|---|---|
| A27R31 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R32 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A27R33 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A28 | 03722-702 | ASSY: AUTO-START LOGIC | |
| | 03722-302 | BOARD: BLANK PC(NSR) | |
| A28C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A28CR1 | 1901-0040 | DIODE: SI | |
| A28CR2 | 1901-0040 | DIODE: SI | |
| A28CR3 | 1901-0040 | DIODE: SI | |
| A28CR4 | 1901-0040 | DIODE: SI | |
| A28CR5 | 1901-0040 | DIODE: SI | |
| A28CR6 | 1901-0040 | DIODE: SI | |
| A28CR7 | 1901-0040 | DIODE: SI | |
| A28CR8 | 1901-0040 | DIODE: SI | |
| A28CR9 | 1901-0040 | DIODE: SI | |
| A28CR10 | 1901-0040 | DIODE: SI | |
| A28Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A28Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A28Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A28Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A28Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A28Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A28Q7 | 1854-0605 | TRANSISTOR: SI NPN | |
| A28R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R4 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A28R5 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R6 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A28R7 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A28R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R10 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A28R11 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A28R12 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A28R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R15 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A28R16 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A28R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R19 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A28R20 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A28R21 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R22 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A28R25 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A28R26 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A28R27 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A29 | 03722-716 | ASSY: RANDOM NOISE GENERATOR | |
| | 03722-316 | BOARD: BLANK PC (NSR) | |
| A29C1 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW | |
| A29C2 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW | |
| A29C3 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW | |
| A29C4 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW | |
| A29C5 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW | |
| A29MP1 | 0340-0038 | PIN | |
| A29MP2 | 0340-0038 | PIN | |
| A29MP3 | 0340-0038 | PIN | |
| A29MP4 | 0340-0038 | PIN | |
| A29MP5 | 0340-0039 | INSULATOR | |
| A29MP6 | 0340-0039 | INSULATOR | |
| A29MP7 | 0340-0039 | INSULATOR | |
| A29MP8 | 0340-0039 | INSULATOR | |
| A29MP9 | 03722-122 | SCREEN | |
| A29Q1 | 1853-0015 | TRANSISTOR: SI PNP | |
| A29Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A29Q3 | 1854-0071 | TRANSISTOR: SI NPN | |
| A29Q4 | 1853-0015 | TRANSISTOR: SI PNP | |
| A29Q5 | 1853-0036 | TRANSISTOR: SI PNP | |
| A29Q6 | 1854-0071 | TRANSISTOR: SI NPN | |
| A29R1 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A29R2 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A29R3 | 0698-4243 | R: FXD MET OX 330 OHM 5% 1/4W | |
| A29R4 | 0698-4267 | R: FXD MET OX 3.6K OHM 5% 1/4W | |
| A29R5 | 0698-5701 | R: FXD MET OX 27 OHM 5% 1/4W | |
| A29R6 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W | |
| A29R7 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W | |
| A29R8 | 0698-5707 | R: FXD MET OX 47 OHM 5% 1/4W | |
| A29R9 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | |
| A29R10 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A29R11 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A29R12 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | Part No. | Description * | Note |
|---|---|---|---|
| A30 | 03722-709 | ASSY: RANDOM NOISE SAMPLER | |
| | 03722-309 | BOARD: BLANK PC (NSR) | |
| A30C1 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW | |
| A30C2 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW | |
| A30C3 | 0150-0093 | C: FXD CER 0.01UF 100VDCW | |
| A30C4 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW | |
| A30C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C7 | 0160-2208 | C: FXD MICA 330PF 5% 300VDCW | |
| A30C8 | 0150-0093 | C: FXD CER 0.01UF 100VDCW | |
| A30C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A30CR1 | 1912-0002 | DIODE: TUNNEL | |
| A30CR2 | 1901-0040 | DIODE: SI | |
| A30CR3 | 1901-0040 | DIODE: SI | |
| A30CR4 | 1912-0002 | DIODE: TUNNEL | |
| A30CR5 | 1901-0040 | DIODE: SI | |
| A30CR6 | 1901-0040 | DIODE: SI | |
| A30CR7 | 1910-0034 | DIODE: GE | |
| A30CR8 | 1910-0034 | DIODE: GE | |
| A30CR9 | 1901-0040 | DIODE: SI | |
| A30CR10 | 1901-0040 | DIODE: SI | |
| A30CR11 | 1901-0040 | DIODE: SI | |
| A30CR12 | 1901-0040 | DIODE: SI | |
| A30CR13 | 1901-0040 | DIODE: SI | |
| A30L1 | 9140-0114 | COIL: FXD 10UH | |
| A30L2 | 9140-0112 | COIL: FXD 4.7UH | |
| A30Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A30Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A30Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A30Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A30Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A30Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A30Q7 | 1854-0605 | TRANSISTOR: SI NPN | |
| A30R1 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R2 | 0758-0086 | R: FXD MET OX 100 OHM 5% 1/4W | |
| A30R3 | 0758-0086 | R: FXD MET OX 100 OHM 5% 1/4W | |
| A30R4 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W | |
| A30R5 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A30R6 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R7 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A30R8 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A30R9 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R11 | 0698-4246 | R: FXD MET OX 470 OHM 5% 1/4W | |
| A30R12 | 0698-4234 | R: FXD MET OX 130 OHM 5% 1/4W | |
| A30R13 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W | |
| A30R14 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R16 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A30R17 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W | |
| A30R18 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W | |
| A30R19 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A30R20 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A30R21 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A30R22 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R23 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A30R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A30R25 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A30R26 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A30R27 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A30R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A30R29 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A30R30 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A30R31 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A30R32 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A31 | 03722-720 | ASSY: OUTPUT SWITCH | |
| | 03722-320 | BOARD: BLANK PC (NSR) | |
| A31C1 | 0180-0376 | C: FXD TA 0.47UF 10% 35VDCW | |
| A31C2 | 0180-0059 | C: FXD AL 10UF -10%+100% 25VDCW | |
| A31C3 | 0180-0376 | C: FXD TA 0.47UF 10% 35VDCW | |
| A31C4 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A31C5 | 0180-0376 | C: FXD TA 0.47UF 10% 35VDCW | |
| A31C6 | 0180-0059 | C: FXD AL 10UF -10%+100% 25VDCW | |
| A31CR1 | 1901-0040 | DIODE: SI | |
| A31CR2 | 1901-0040 | DIODE: SI | |
| A31Q1 | 1853-0036 | TRANSISTOR: SI PNP | |
| A31Q2 | 1853-0036 | TRANSISTOR: SI PNP | |
| A31Q3 | 1854-0071 | TRANSISTOR: SI NPN | |
| A31Q4 | 1853-0015 | TRANSISTOR: SI PNP | |
| A31Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A31Q6 | 1854-0215 | TRANSISTOR: SI NPN | |
| A31Q7 | 1853-0036 | TRANSISTOR: SI PNP | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A31R1 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A31R2 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A31R3 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A31R4 | 0764-0016 | R: FXD MET FLM 1.0K OHM 5% 2W | |
| A31R5 | 0760-0022 | R: FXD MET FLM 330 OHM 2% 1W | |
| A31R6 | 0760-0022 | R: FXD MET FLM 330 OHM 2% 1W | |
| A31R7 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A31R8 | 0698-6033 | R: FXD MET FLM 7.5K OHM 1% 1/4W 50 PPM | |
| A31R9 | 2100-1760 | R: VAR WW LIN 5.0K OHM 10% 1/2W | |
| A31R10 | 2100-1759 | R: VAR WW LIN 2.0K OHM 10% 1/2W | |
| A31R11 | 0698-6033 | R: FXD MET FLM 7.5K OHM 1% 1/4W 50 PPM | |
| A31R12 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A31R13 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W | |
| A31R14 | 0757-0914 | R: FXD MET FLM 390 OHM 2% 1/8W | |
| A31R15 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W | |
| A31R16 | 0757-0436 | R: FXD MET FLM 4.32K OHM 1% 1/8W 100 PPM | |
| A31R17 | 2100-1758 | R: VAR WW LIN 1.0K OHM 10% 1/2W | |
| A31R18 | 0698-3763 | R: FXD MET FLM 3.92K OHM 1% 1/4W 50 PPM | |
| A31R19 | 0698-6034 | R: FXD MET FLM 9K OHM 1% 1/4W 50 PPM | |
| A31R20 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A31TP1 | 0360-0124 | TERMINAL PIN | |
| A31TP2 | 0360-0124 | TERMINAL PIN | |
| A31TP3 | 0360-0124 | TERMINAL PIN | |
| A32 | 03722-719 | ASSY: REFERENCE POWER SUPPLY | |
| | 03722-319 | BOARD: BLANK PC (NSR) | |
| A32C1 | 0180-0374 | C: FXD TA 10UF 10% 20VDCW | |
| A32C2 | 0160-0161 | C: FXD MY 0.01UF | |
| A32C3 | 0180-0374 | C: FXD TA 10UF 10% 20VDCW | |
| A32C4 | 0160-0297 | C: FXD MY 1200PF 10% 200VDCW | |
| A32C5 | 0160-0297 | C: FXD MY 1200PF 10% 200VDCW | |
| A32CR1 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW | |
| A32CR2 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW | |
| A32CR3 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW | |
| A32CR4 | 1901-0040 | DIODE: SI | |
| A32CR5 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW | |
| A32CR6 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW | |
| A32CR7 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW | |
| A32MP1 | 0380-0509 | BEAD: GLASS | |
| A32MP2 | 0380-0509 | BEAD: GLASS | |
| A32MP3 | 0380-0509 | BEAD: GLASS | |
| A32MP4 | 0380-0509 | BEAD: GLASS | |
| A32Q1 | 1820-0001 | TRANSISTOR: SI NPN (AMPLIFIER REFERENCE) | |
| A32Q2 | 1854-0071 | TRANSISTOR: SI NPN | |
| A32Q3 | 1853-0607 | TRANSISTOR: SI PNP (MATCHED WITH Q5) | |
| A32Q4 | 1853-0036 | TRANSISTOR: SI PNP | |
| A32Q5 | 1853-0607 | TRANSISTOR: SI PNP (MATCHED WITH Q3) | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A32Q6 | 1853-0036 | TRANSISTOR: SI PNP | |
| A32Q7 | 1853-0036 | TRANSISTOR: SI PNP | |
| A32Q8 | 1854-0071 | TRANSISTOR: SI NPN | |
| A32Q9 | 1853-0015 | TRANSISTOR: SI PNP | |
| A32Q10 | 1854-0071 | TRANSISTOR: SI NPN | |
| A32Q11 | 1853-0015 | TRANSISTOR: SI PNP | |
| A32Q12 | 1854-0071 | TRANSISTOR: SI NPN | |
| A32Q13 | 1853-0015 | TRANSISTOR: SI PNP | |
| A32R1 | 0698-4256 | R: FXD MET OX 1.2K OHM 5% 1/4W | |
| A32R2 | 0698-4256 | R: FXD MET OX 1.2K OHM 5% 1/4W | |
| A32R3 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W | |
| A32R4 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W | |
| A32R5 | 0698-4256 | R: FXD MET OX 1.2K OHM 5% 1/4W | |
| A32R6 | 0698-3768 | R: FXD MET FLM 12K OHM 1% 1/4W | |
| A32R7 | 0698-4300 | R: FXD MET OX 82K OHM 5% 1/4W | |
| A32R8 | 0698-4245 | R: FXD MET OX 390 OHM 5% 1/4W | |
| A32R9 | 0698-3763 | R: FXD MET FLM 3920 OHM 1% 1/4W | |
| A32R10 | 0698-4292 | R: FXD MET OX 39K OHM 5% 1/4W | |
| A32R11 | 0698-4300 | R: FXD MET OX 82K OHM 5% 1/4W | |
| A32R12 | 0698-5793 | R: FXD MET FLM 31.1K OHM [illegible]% 1/8W 50 PPM | |
| A32R13 | 2100-0989 | R: VAR WW LIN 10K OHM 5% 1W | |
| A32R14 | 0811-0601 | R: FXD WW 8K OHM 1% 1/2W 5 PPM | |
| A32R15 | 0698-3779 | R: FXD MET OX 305 OHM 1% 1/4W | |
| A32R16 | 0698-3778 | R: FXD MET OX 138 OHM 1% 1/4W | |
| A32R17 | 0698-3777 | R: FXD MET OX 65 OHM 1% 1/4W | |
| A32R18 | 0698-3776 | R: FXD MET OX 32 OHM 2% 1/4W | |
| A32R19 | 0698-3775 | R: FXD MET OX 16 OHM 2% 1/4W | |
| A32R20 | 0698-3775 | R: FXD MET OX 16 OHM 2% 1/4W | |
| A32R21 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A32R22 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A32R23 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A32R24 | 0811-0602 | R: FXD WW 9K OHM 1% 1/2W 5PPM | |
| A32R25 | 2100-0941 | R: VAR WW LIN 1.0K OHM 5% 1W | |
| A32R26 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | |
| A32R27 | 0698-3775 | R: FXD MET OX 16 OHM 2% 1/4W | |
| A32R28 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A32R29 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W | |
| A32R30 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W | |
| A32R31 | 0698-4292 | R: FXD MET OX 39K OHM 5% 1/4W | |
| A32R32 | 0698-4292 | R: FXD MET OX 39K OHM 5% 1/4W | |
| A33 | 03722-712 | ASSY: ANALOG FILTER (1) | |
| | 03722-312 | BOARD: BLANK PC (NSR) | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊛ Part No. | Description * | Note |
|---|---|---|---|
| A33C1 | 0160-0615 | C: FXD METALAC 10UF 10% 63VDCW | |
| A33C2 | 0160-0615 | C: FXD METALAC 10UF 10% 63VDCW | |
| A33C3 | | C: FXD METALAC SELECTED ON TEST | |
| A33C4 | 0160-0646 | C: FXD POLY 0.022UF 1% 63VDCW | |
| A33C5 | 0160-0647 | C: FXD POLY 6200PF 1% 500VDCW | |
| A33R1 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W | |
| A33R2 | 0698-3468 | R: FXD MET FLM 1.07K OHM 1% 1/4W 50PPM | |
| A33R3 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W | |
| A33R4 | 0698-3468 | R: FXD MET FLM 1.07K OHM 1% 1/4W 50PPM | |
| A33R5 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W | |
| A33R6 | 0698-3468 | R: FXD MET FLM 1.07K OHM 1% 1/4W 50PPM | |
| A33R7 | 0698-3770 | R: FXD MET FLM 23.1K OHM 1% 1/4W 50PPM | |
| A33R8 | 0698-3765 | R: FXD MET FLM 6.53K OHM 1% 1/4W 50PPM | |
| A33R9 | 0698-3759 | R: FXD MET FLM 1.81K OHM 1% 1/4W 50PPM | |
| A33R10 | 0698-3773 | R: FXD MET FLM 141.6K OHM 1% 1/4W 50PPM | |
| A33R11 | 0698-3772 | R: FXD MET FLM 42.48K OHM 1% 1/4W 50PPM | |
| A33R12 | 0698-3769 | R: FXD MET FLM 14.16K OHM 1% 1/4W 50PPM | |
| A33R13 | 0698-3771 | R: FXD MET FLM 23.6K OHM 1% 1/4W 50PPM | |
| A33R14 | 0698-3766 | R: FXD MET FLM 7.08K OHM 1% 1/4W 50PPM | |
| A33R15 | 0698-3761 | R: FXD MET FLM 2.36K OHM 1% 1/4W 50PPM | |
| A34 | 03722-718 | ASSY: ANALOG FILTER (2) | |
| | 03722-318 | BOARD: BLANK PC (NSR) | |
| A34C1 | | C: FXD MY SELECTED ON TEST | |
| A34C2 | 0160-0620 | C: FXD METALAC 2UF 10% 63VDCW | |
| A34C3 | 0160-0648 | C: FXD POLY 0.16UF 1% 63VDCW | |
| A34C4 | 0160-0649 | C: FXD POLY 0.051UF 1% 63VDCW | |
| A34C5 | 0160-0650 | C: FXD POLY 0.062UF 1% 63VDCW | |
| A34C6 | 0160-0651 | C: FXD POLY 2200PF 1% 500VDCW | |
| A34C7 | 0160-2598 | C: FXD MICA 620PF 2% 300VDCW | |
| A34C8 | 0160-0655 | C: FXD METALAC 1UF 5% 63VDCW | |
| A34C9 | 0170-0019 | C: FXD MY 0.1UF 5% 200VDCW | |
| A34C10 | 0160-0633 | C: FXD POLY 0.01UF 1% 63VDCW | |
| A34C11 | 0160-0652 | C: FXD POLY 3000PF 1% 500VDCW | |
| A34C12 | 0160-0653 | C: FXD POLY 1000PF 1% 500VDCW | |
| A34C13 | 0140-0206 | C: FXD MICA 270PF 5% 500VDCW | |
| A34C14 | 0121-0105 | C: VAR CER 9-35PF | |
| A34C15 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A34C16 | 0121-0105 | C: VAR CER 9-35PF | |
| A35 | 03722-708 | ASSY: OUTPUT AMPLIFIER (1) | |
| | 03722-303 | BOARD: BLANK PC (NSR) | |
| A35C1 | 0160-0163 | C: FXD MY 0.033UF 10% | |
| A35C2 | 0160-0619 | C: FXD METALAC 1UF 10% 63VDCW | |
| A35C3 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | |
| A35C4 | 0160-0157 | C: FXD MY 0.0047UF 10% 200VDCW | |
| A35C5 | 0160-0128 | C: FXD CER 2.2UF 20% 25VDCW | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A35C6 | | NOT ASSIGNED | |
| A35C7 | 0180-1714 | C: FXD TA 330UF 10% 6VDCW | |
| A35C8 | 0180-0059 | C: FXD AL 30UF -10%+100% 25VDCW | |
| A35C9 | 0160-0157 | C: FXD MY 0.0047UF 10% 200VDCW | |
| A35C10 | 0160-0619 | C: FXD METALAC 1UF 10% 63VDCW | |
| A35C11 | 0160-0615 | C: FXD METALAC 10UF 10% 63VDCW | |
| A35C12 | 0180-1714 | C: FXD TA 330UF 10% 6VDCW | |
| A35C13 | 0160-2198 | C: FXD MICA 20PF 5% 300VDCW | |
| A35C14 | 0150-0096 | C: FXD CER 0.05UF 100VDCW | |
| A35C15 | 0160-0137 | C: FXD CER 0.33UF 20% 25VDCW | |
| A35C16 | 0160-0128 | C: FXD CER 2.2UF 20% 25VDCW | |
| A35C17 | 0160-0128 | C: FXD CER 2.2UF 20% 25VDCW | |
| A35CR1 | 1901-0040 | DIODE: SI | |
| A35CR2 | 1901-0040 | DIODE: SI | |
| A35CR3 | 1901-0040 | DIODE: SI | |
| A35CR4 | 1901-0040 | DIODE: SI | |
| A35CR5 | 1901-0040 | DIODE: SI | |
| A35CR6 | 1901-0040 | DIODE: SI | |
| A35MP1 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP2 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP3 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP4 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP5 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP6 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP7 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP8 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP9 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP10 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP11 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP12 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE | |
| A35MP13 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS | |
| A35MP14 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS | |
| A35MP15 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS | |
| A35MP16 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS | |
| A35MP17 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS | |
| A35MP18 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS | |
| A35Q1 | 1855-0603 | TRANSISTOR: SI FET | |
| A35Q2 | 1854-0071 | TRANSISTOR: SI NPN | |
| A35Q3 | 1854-0071 | TRANSISTOR: SI NPN | |
| A35Q4 | 1854-0071 | TRANSISTOR: SI NPN | |
| A35Q5 | 1854-0071 | TRANSISTOR: SI NPN | |
| A35Q6 | 1854-0071 | TRANSISTOR: SI NPN | |
| A35Q7 | 1854-0071 | TRANSISTOR: SI NPN | |
| A35Q8 | 1854-0071 | TRANSISTOR: SI NPN | |
| A35Q9 | 1854-0071 | TRANSISTOR: SI NPN | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | Part No. | Description * | Note |
|---|---|---|---|
| A35R1 | 0698-4290 | R: FXD MET OX 33K OHM 5% 1/4W | |
| A35R2 | 0698-4290 | R: FXD MET OX 33K OHM 5% 1/4W | |
| A35R3 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R4 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R5 | 0683-2255 | R: FXD COMP 2.2 MEG OHM 5% 1/4W | |
| A35R6 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A35R7 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W | |
| A35R8 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W | |
| A35R9 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R10 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | |
| A35R11 | 0683-1055 | R: FXD COMP 1 MEG OHM 5% 1/4W | |
| A35R12 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | |
| A35R13 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W | |
| A35R14 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R15 | 0683-1055 | R: FXD COMP 1 MEG OHM 5% 1/4W | |
| A35R16 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W | |
| A35R17 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W | |
| A35R18 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R19 | | R: FXD MET OX SELECTED ON TEST | |
| A35R20 | 0683-3345 | R: FXD COMP 330K OHM 5% 1/4W | |
| A35R21 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A35R22 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R23 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R24 | 0683-4755 | R: FXD COMP 4.7 MEG OHM 5% 1/4W | |
| A35R25 | 0757-0473 | R: FXD MET FLM 221K OHM 1% 1/8W | |
| A35R26 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A35R27 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A35R28 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | |
| A35R29 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A35R30 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A35W1 | 03722-772 | CABLE: COAX (CODED RED/GRY) | |
| A36 | 03722-730 | ASSY: OUTPUT AMPLIFIER (2) | |
| | 03722-330 | BOARD: BLANK PC (NSR) | |
| A36C1 | 0160-0163 | C: FXD MY 0.033UF 10% | |
| A36C2 | 0160-0157 | C: FXD MY 4700PF 10% | |
| A36C3 | 0160-2225 | C: FXD MICA 2000PF 5% 300VDCW | |
| A36C4 | 0160-0297 | C: FXD MY 1200PF 10% 200VDCW | |
| A36C5 | 0160-0153 | C: FXD MY 1000PF 10% | |
| A36C6 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW | |
| A36C7 | 0180-1846 | C: FXD TA 2.2UF 10% 35VDCW | |
| A36Q1 | 1853-0012 | TRANSISTOR: SI PNP | |
| A36R1 | 0683-0685 | R: FXD COMP 6.8 OHM 5% 1/4W | |
| A36R2 | 0698-4252 | R: FXD MET OX 820 OHM 5% 1/4W | |
| A36R3 | 0698-4252 | R: FXD MET OX 820 OHM 5% 1/4W | |
| A36R4 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W | |
| A36R5 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⓗ Part No. | Description * | Note |
|---|---|---|---|
| A36R6 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W | |
| A36R7 | 0698-5701 | R: FXD MET OX 27 OHM 5% 1/4W | |
| A36R8 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W | |
| A37 | 03722-707 | ASSY: OUTPUT AMPLIFIER (3) | |
| | 03722-307 | BOARD: BLANK PC (NSR) | |
| A37C1 | 0170-0066 | C: FXD MY 0.027UF 10% 200VDCW | |
| A37C2 | 0160-0161 | C: FXD MY 0.01UF 10% | |
| A37C3 | 0160-0301 | C: FXD MY 0.012UF 10% 200VDCW | |
| A37C4 | 0160-0157 | C: FXD MY 0.0047UF 10% 200VDCW | |
| A37C5 | 0140-0179 | C: FXD MICA 1000PF 5% 300VDCW | |
| A37C6 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW | |
| A37C7 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW | |
| A37C8 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW | |
| A37C9 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW | |
| A37C10 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW | |
| A37CR1 | 1901-0040 | DIODE: SI | |
| A37CR2 | 1901-0040 | DIODE: SI | |
| A37CR3 | 1902-0126 | DIODE: BREAKDOWN 2.31V 400mW | |
| A37L1 | 9100-1653 | L: FXD COIL 910UH 5% | |
| A37L2 | 9100-1653 | L: FXD COIL 910UH 5% | |
| A37Q1 | 1853-0012 | TRANSISTOR: SI PNP | |
| A37Q2 | 1854-0039 | TRANSISTOR: SI NPN | |
| A37R1 | 0683-1205 | R: FXD COMP 12 OHM 5% 1/4W | |
| A37R2 | 0683-1205 | R: FXD COMP 12 OHM 5% 1/4W | |
| A37R3 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W | |
| A37R4 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W | |
| A37R5 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W | |
| A37R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A37R7 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A37R8 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A37R9 | 0764-0016 | R: FXD MET OX 1.0K OHM 5% 2W | |
| A37R10 | 0760-0024 | R: FXD MET OX 100 OHM 5% 1W | |
| A37R11 | 0758-0606 | R: FXD MET OX 22 OHM 5% 1/2W | |
| A37R12 | 0758-0606 | R: FXD MET OX 22 OHM 5% 1/2W | |
| A37R13 | 0760-0024 | R: FXD MET OX 100 OHM 5% 1W | |
| A37R14 | 0760-0024 | R: FXD MET OX 100 OHM 5% 1W | |
| A37R15 | 0698-3624 | R: FXD MET OX 150 OHM 5% 2W | |
| A37R16 | 0698-3774 | R: FXD MET FLM 600 OHM 0.25% 1/4W | |
| A37R17 | 0698-3624 | R: FXD MET OX 150 OHM 5% 2W | |
| A38 | 03722-728 | ASSY: ATTENUATOR (COMPLETE WITH OUTER SCREEN & ALL COMPONENTS PREFIXED A38 BELOW ) | |
| | 03722-109 | ATTENUATOR: OUTER SCREEN (SEE CHASSIS MOUNTED COMPONENTS MP41) | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A38R1 | 0698-3760 | R: FXD MET FLM 1900 OHM 1/4% 1/4W 50 PPM | |
| A38R2 | 0698-3754 | R: FXD MET FLM 877 OHM 1/4% 1/4W 50 PPM | |
| A38R3 | 0698-3780 | R: FXD MET OX 32.2 OHM 1% 1/2W 250 PPM | |
| A38R4 | 0698-3758 | R: FXD MET FLM 1300 OHM 1/4% 1/4W 50 PPM | |
| A38R5 | 0698-4204 | R: FXD MET FLM 11.75K OHM 1% 1/4W 100 PPM | |
| A38R6 | 0698-3754 | R: FXD MET FLM 877 OHM 1/4% 1/4W 50 PPM | |
| A38R7 | 0757-1021 | R: FXD MET FLM 66.5 OHM 1% 1/4W 100 PPM | |
| A38R8 | 0698-5798 | R: FXD MET FLM 257 OHM 1/2% 1/4W 100 PPM | |
| A38R9 | 0698-3774 | R: FXD MET FLM 600 OHM 1/4% 1/4W 50 PPM | |
| A38R10 | 0698-3369 | R: FXD MET FLM 1.4K OHM 1/4% 1/4W 100 PPM | |
| A38R11 | 0698-3764 | R: FXD MET FLM 5400 OHM 1/4% 1/4W 50 PPM | |
| A38R12 | 0757-0715 | R: FXD MET FLM 150 OHM 1% 1/4W 100 PPM | |
| A38R13 | 0757-1035 | R: FXD MET FLM 400 OHM 1/2% 1/4W 100 PPM | |
| A38R14 | 0698-3755 | R: FXD MET FLM 900 OHM 1/2% 1/4W 100 PPM | |
| A38R15 | 0698-3762 | R: FXD MET FLM 2400 OHM 1/2% 1/4W 50 PPM | |
| A38R16 | 0757-1023 | R: FXD MET FLM 6.04K OHM 1% 1/4W 100 PPM | |
| A38R17 | 0757-0339 | R: FXD MET FLM 3.01K OHM 1% 1/4W 100 PPM | |
| A38R18 | 0757-0739 | R: FXD MET FLM 2.0K OHM 1% 1/4W 100 PPM | |
| A38R19 | 0698-5584 | R: FXD MET FLM 1.5K OHM 1/2% 1/4W 100 PPM | |
| A38R20 | 0698-3757 | R: FXD MET FLM 1200 OHM 1% 1/4W 100 PPM | |
| A38R21 | 0698-3145 | R: FXD MET FLM 1.0K OHM 1/4% 1/4W 9 PPM | |
| A38R22 | 0698-3753 | R: FXD MET FLM 857 OHM 1/4% 1/4W 50 PPM | |
| A38R23 | 0698-3752 | R: FXD MET FLM 750 OHM 1/4% 1/4W 50 PPM | |
| A38R24 | 0698-5800 | R: FXD MET FLM 667 OHM 1/4% 1/4W 50 PPM | |
| A38S1 | 3100-0621 | SWITCH (NSR: USE COMPLETE ASSEMBLY) | |
| A38W1 | 03722-760 | CABLE: COAX (CODED BRN/WHT) | |
| A38W2 | 03722-761 | CABLE: COAX (CODED RED/BLK) | |
| A38W3 | 03722-762 | CABLE: COAX (CODED RED/BRN) | |
| A38W4 | 03722-763 | CABLE: COAX (CODED RED/RED) | |
| A39 | 03722-710 | ASSY: SEQUENCE COUNTER | |
| | 03722-310 | BOARD: BLANK PC (NSR) | |
| A39C1 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A39C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A39C4 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39C5 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39C6 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39C7 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39C8 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39C9 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39C10 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | |
| A39CR1 | 1901-0040 | DIODE: SI | |
| A39CR2 | 1901-0040 | DIODE: SI | |
| A39CR3 | 1901-0040 | DIODE: SI | |
| A39CR4 | 1901-0040 | DIODE: SI | |
| A39CR5 | 1901-0040 | DIODE: SI | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A39CR6 | 1901-0040 | DIODE: SI | |
| A39CR7 | 1901-0040 | DIODE: SI | |
| A39CR8 | 1901-0040 | DIODE: SI | |
| A39CR9 | 1901-0040 | DIODE: SI | |
| A39CR10 | 1901-0040 | DIODE: SI | |
| A39CR11 | 1901-0040 | DIODE: SI | |
| A39CR12 | 1901-0040 | DIODE: SI | |
| A39CR13 | 1901-0040 | DIODE: SI | |
| A39CR14 | 1901-0040 | DIODE: SI | |
| A39Q1 | 1853-0015 | TRANSISTOR: SI PNP | |
| A39Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39Q7 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39Q9 | 1854-0605 | TRANSISTOR: SI NPN | |
| A39R1 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | |
| A39R2 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | |
| A39R3 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R5 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R7 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R8 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R11 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R13 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R15 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R16 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R18 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R20 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R21 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R22 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R23 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R24 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R25 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R26 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R27 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R29 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R30 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊛ Part No. | Description * | Note |
|---|---|---|---|
| A39R31 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R32 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A39R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A39R34 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A39R35 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40 | 03722-739 | ASSY: SEQUENCE ADVANCE (fitted in Option 01 Models only – see Section VII) | |
| | 03722-339 | BOARD: BLANK PC (NSR) | |
| A40C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A40CR1 | 1901-0040 | DIODE: SI | |
| A40CR2 | 1901-0040 | DIODE: SI | |
| A40CR3 | 1901-0040 | DIODE: SI | |
| A40CR4 | 1901-0040 | DIODE: SI | |
| A40CR5 | 1901-0040 | DIODE: SI | |
| A40CR6 | 1901-0040 | DIODE: SI | |
| A40CR7 | 1901-0040 | DIODE: SI | |
| A40CR8 | 1901-0040 | DIODE: SI | |
| A40CR9 | 1901-0040 | DIODE: SI | |
| A40CR10 | 1901-0040 | DIODE: SI | |
| A40CR11 | 1901-0040 | DIODE: SI | |
| A40CR12 | 1901-0040 | DIODE: SI | |
| A40CR13 | 1901-0040 | DIODE: SI | |
| A40CR14 | 1901-0040 | DIODE: SI | |
| A40CR15 | 1901-0040 | DIODE: SI | |
| A40CR16 | 1901-0040 | DIODE: SI | |
| A40Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q6 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q7 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q8 | 1854-0605 | TRANSISTOR: SI NPN | |
| A40Q9 | 1854-0605 | TRANSISTOR: SI NPN | |

OPTION 01 MODELS ONLY

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A40R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R3 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A40R4 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A40R5 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R7 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R9 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A40R10 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A40R11 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A40R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R14 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A40R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A40R16 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R20 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A40R21 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A40R22 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A40R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R25 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A40R26 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A40R27 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R28 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A40R29 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A40R30 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R31 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A40R32 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A40R33 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A40R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41 | 03722-714 | ASSY: GATE AND SYNC OUTPUT | |
| | 03722-314 | BOARD: BLANK PC (NSR) | |
| A41C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A41C2 | 0160-2150 | C: FXD MICA 33PF 5% 300VDCW | |
| A41C3 | 0160-2150 | C: FXD MICA 33PF 5% 300VDCW | |
| A41C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | |
| A41CR1 | 1901-0040 | DIODE: SI | |
| A41CR2 | 1910-0034 | DIODE: GE | |
| A41CR3 | 1901-0040 | DIODE: SI | |
| A41CR4 | 1901-0040 | DIODE: SI | |
| A41CR5 | 1901-0040 | DIODE: SI | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A41CR6 | 1901-0040 | DIODE: SI | |
| A41CR7 | 1901-0040 | DIODE: SI | |
| A41CR8 | 1901-0025 | DIODE: SI | |
| A41CR9 | 1901-0025 | DIODE: SI | |
| A41Q1 | 1854-0605 | TRANSISTOR: SI NPN | |
| A41Q2 | 1854-0605 | TRANSISTOR: SI NPN | |
| A41Q3 | 1854-0605 | TRANSISTOR: SI NPN | |
| A41Q4 | 1854-0605 | TRANSISTOR: SI NPN | |
| A41Q5 | 1854-0605 | TRANSISTOR: SI NPN | |
| A41Q6 | 1854-0071 | TRANSISTOR: SI NPN | |
| A41Q7 | 1854-0071 | TRANSISTOR: SI NPN | |
| A41R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41R3 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A41R4 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A41R5 | 0758-0026 | R: FXD MET FLM 82 OHM 5% 1/2W | |
| A41R6 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A41R7 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41R9 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A41R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A41R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A41R12 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A41R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41R14 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A41R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41R16 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A41R17 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A41R18 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A41R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | |
| A41R20 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A41R21 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A41R22 | 0758-0026 | R: FXD MET FLM 82 OHM 5% 1/2W | |
| A41R23 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | |
| A41R24 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | |
| A41R25 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A41R26 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A41R27 | 0758-0029 | R: FXD MET FLM 470 OHM 5% 1/2W | |
| A41R28 | 0758-0029 | R: FXD MET FLM 470 OHM 5% 1/2W | |
| A41R29 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | |
| A41R30 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | |
| A41R31 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | |
| A41R32 | 0758-0029 | R: FXD MET FLM 470 OHM 5% 1/4W | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊛ Part No. | Description * | Note |
|---|---|---|---|
| A42 | 03722-722 | ASSY: RELAY | |
| | 03722-322 | BOARD: BLANK PC (NSR) | |
| A42K1 | 9161-0013 | RELAY: COIL | |
| A42K2 | 9161-0013 | RELAY: COIL | |
| A42K1A | 0490-0604 | RELAY: REED | |
| A42K2A | 0490-0604 | RELAY: REED | |
| A42MP1 | 0340-0039 | FEEDTHROUGH: TEFLON | |
| A42MP2 | 0340-0039 | FEEDTHROUGH: TEFLON | |
| A42MP3 | 0340-0039 | FEEDTHROUGH: TEFLON | |
| A42MP4 | 0340-0039 | FEEDTHROUGH: TEFLON | |
| A42MP5 | 0340-0039 | FEEDTHROUGH: TEFLON | |
| A42MP6 | 0340-0039 | FEEDTHROUGH: TEFLON | |
| A42MP7 | 0340-0059 | TERMINAL POST: BRASS | |
| A42MP8 | 0340-0059 | TERMINAL POST: BRASS | |
| A42MP9 | 0340-0059 | TERMINAL POST: BRASS | |
| A42MP10 | 0340-0059 | TERMINAL POST: BRASS | |
| A42MP11 | 0340-0059 | TERMINAL POST: BRASS | |
| A42MP12 | 0340-0059 | TERMINAL POST: BRASS | |
| A43 | 03722-717 | ASSY: RECTIFIER | |
| | 03722-317 | BOARD: BLANK PC (NSR) | |
| A43C1 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW | |
| A43C2 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW | |
| A43C3 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW | |
| A43CR1 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR2 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR3 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR4 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR5 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR6 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR7 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR8 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR9 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR10 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR11 | 1901-0045 | DIODE: SI 100PIV 0.75A | |
| A43CR12 | 1901-0045 | DIODE: SI 100PIV 0.75A | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊕ Part No. | Description * | Note |
|---|---|---|---|
| A44 | 03722-711 | ASSY: POWER SUPPLY STABILISER | |
| | 03722-311 | BOARD: BLANK PC (NSR) | |
| A44C1 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW | |
| A44C2 | 0180-0141 | C: FXD AL 50UF -10%+75% 50VDCW | |
| A44C3 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW | |
| A44C4 | 0180-0141 | C: FXD AL 50UF -10%+75% 50VDCW | |
| A44C5 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW | |
| A44C6 | 0180-0141 | C: FXD AL 50UF -10%+75% 50VDCW | |
| A44CR1 | 1902-0017 | DIODE: BREAKDOWN 6.81V 400mW | |
| A44CR2 | 1902-0017 | DIODE: BREAKDOWN 6.81V 400mW | |
| A44CR3 | 1902-3234 | DIODE: BREAKDOWN 19.6V 400mW | |
| A44CR4 | 1902-0017 | DIODE: BREAKDOWN 6.81V 400mW | |
| A44Q1 | 1853-0001 | TRANSISTOR: SI PNP | |
| A44Q2 | 1853-0001 | TRANSISTOR: SI PNP | |
| A44Q3 | 1854-0003 | TRANSISTOR: SI NPN | |
| A44Q4 | 1854-0003 | TRANSISTOR: SI NPN | |
| A44Q5 | 1854-0003 | TRANSISTOR: SI NPN | |
| A44Q6 | 1854-0003 | TRANSISTOR: SI NPN | |
| A44R1 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A44R2 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W | |
| A44R3 | 0698-4245 | R: FXD MET OX 390 OHM 5% 1/4W | |
| A44R4 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W | |
| A44R5 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A44R6 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A44R7 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W | |
| A44R8 | 0698-4241 | R: FXD MET OX 270 OHM 5% 1/4W | |
| A44R9 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W | |
| A44R10 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A44R11 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | |
| A44R12 | 0698-4246 | R: FXD MET OX 470 OHM 5% 1/4W | |
| A44R13 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W | |
| A44R14 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | |
| A44R15 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W | |
| A44R16 | 0698-4245 | R: FXD MET OX 390 OHM 5% 1/4W | |
| A44R17 | 0698-4233 | R: FXD MET OX 120 OHM 5% 1/4W | |
| A44R18 | 0698-3799 | R: FXD MET OX 22 OHM 5% 1/4W | |
| A44R19 | 0698-5707 | R: FXD MET OX 47 OHM 5% 1/4W | |
| A44TP1 | 0360-0124 | TERMINAL PIN | |
| A44TP2 | 0360-0124 | TERMINAL PIN | |
| A44TP3 | 0360-0124 | TERMINAL PIN | |
| A44TP4 | 0360-0124 | TERMINAL PIN | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ℗ Part No. | Description * | Note |
|---|---|---|---|
| CHASSIS MOUNTED COMPONENTS | | | |
| C1 | 0160-0664 | C: FXD CER 2x0.001UF -0% +100% 1000VDCW | |
| C2 | 0180-0129 | C: FXD ELECT 975UF 40VDCW | |
| | 1520-0001 | MOUNTING BASE (C2) | |
| C3 | 0180-0129 | C: FXD ELECT 975UF 40VDCW | |
| C4 | 0180-0129 | C: FXD ELECT 975UF 40VDCW | |
| | 1520-0001 | MOUNTING BASE (C4) | |
| CR1 | 1901-0040 | DIODE: SI | |
| CR2 | 1910-0034 | DIODE: GE | |
| DS1 | 2140-0602 | LAMP: FILAMENT (GATE) | |
| | 5040-0234 | LAMP HOLDER (DS1) | |
| | 5040-0235 | RETAINER (DS1) | |
| DS2 | 1450-0106 | LAMP: NEON, COMPLETE WITH LENS (PART OF LINE SWITCH S5) | |
| F1 | 2110-0006 | FUSE: CARTRIDGE SLOW-BLOW 2A 125V (FOR 115V OPERATION) | |
| | 2110-0007 | FUSE: CARTRIDGE SLOW-BLOW 1A 250V (FOR 230V OPERATION) | |
| J1 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (BINARY OUTPUT: FRONT PANEL) | |
| J2 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (GAUSSIAN OUTPUT: FRONT PANEL) | |
| J3 | 1250-0118 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (VARIABLE OUTPUT: FRONT PANEL) | |
| J4 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (BINARY OUTPUT: REAR PANEL) | |
| J5 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (GAUSSIAN OUTPUT: REAR PANEL) | |
| J6 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (VARIABLE OUTPUT: REAR PANEL) | |
| J7 | | GROUP OF 3 BINDING POSTS (GATE RELAY): EACH POST COMPRISES 3 ITEMS AS LISTED BELOW:- | |
| | 5060-0635 | BINDING POST ASSY (BLK) | |
| | 0340-0099 | INSULATOR | |
| | 0340-0100 | INSULATOR: BINDING POST | |
| J8 | | GROUP OF 3 BINDING POSTS (BINARY RELAY): COMPONENTS AS LISTED FOR J7 | |
| J9 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (CLOCK: REAR PANEL) | |
| J10 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (SYNC: REAR PANEL) | |
| J11 | 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING (GATE: REAR PANEL) | |
| J12 | 1251-0085 | CONNECTOR: 36-CONTACT FEMALE RECEPTACLE (CONTROL: REAR PANEL) PART OF SEQUENCE LENGTH SWITCH HARNESS 03722-736 | |
| | 1251-0084 | CONNECTOR: 36-CONTACT MALE CABLE PLUG (MATES WITH J12) | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | Part No. | Description * | Note |
|---|---|---|---|
| L1 | 9140-0136 | INDUCTOR: 22UH | |
| L2 | 9140-0136 | INDUCTOR: 22UH | |
| L3 | 9110-0051 | INDUCTOR: 40MH | |
| | 7100-0333 | COVER (L3) | |
| MP1 | 5060-0732 | FRAME ASSEMBLY | |
| MP2 | 03722-101 | FRONT PANEL | |
| MP3 | 03722-123 | DUMMY FRONT PANEL | |
| MP4 | 5000-0738 | SIDE COVER (REAR) | |
| MP5 | 5000-0739 | SIDE COVER (FRONT) | |
| MP6 | 03722-118 | TOP COVER | |
| MP7 | 03722-119 | BOTTOM COVER | |
| MP8 | 5060-0222 | SIDE HANDLE ASSEMBLY | |
| MP9 | 5060-0766 | HANDLE ASSEMBLY RETAINER | |
| MP10 | 5060-0767 | FOOT ASSEMBLY | |
| MP11 | 1490-0030 | TILT STAND | |
| MP12 | 5000-0051 | TRIM STRIP (SIDE) | |
| MP13 | 03722-104 | REAR PANEL | |
| MP14 | 00140-24701 | PANEL TRIM (TOP) | |
| MP15 | 00140-24702 | PANEL TRIM (BOTTOM) | |
| MP16 | 03722-105 | CLIP | |
| MP17 | 7120-1254 | LOGO | |
| MP18 | 5060-0775 | RACK MOUNTING KIT | |
| MP19 | 0340-0039 | INSULATOR (ACCEPTS MP20 OR MP21) | |
| MP20 | 0340-0038 | FEEDTHROUGH PIN (Q4, Q5, Q6) | |
| MP21 | 0340-0058 | MOUNTING POST (R1, R2, R3) | |
| MP22 | 0360-0117 | TERMINAL BOARD (MOUNTS L1 & L2) | |
| MP23 | 0370-0035 | KNOB: 1 DIA 1/4 SHAFT W/ARROW BLK (S1) | |
| MP24 | 0370-0035 | KNOB: 1 DIA 1/4 SHAFT W/ARROW BLK (S2) | |
| MP25 | 0370-0037 | KNOB: 1 DIA 17/64 SHAFT W/ARROW BLK (RMS AMPLITUDE) | |
| MP26 | 0370-0027 | KNOB: 3/4 DIA 1/8 SHAFT W/ARROW RED (RMS AMPLITUDE) | |
| MP27 | 0370-0104 | KNOB: 5/8 DIA 1/4 SHAFT W/ARROW BLK (S4) | |
| MP28 | 0370-0118 | KNOB: PUSH-BUTTON (FITS S6, S7, S8 & S9) | |
| MP29 | 5000-0316 | LABEL: RUN (S6) | |
| MP30 | 5000-3363 | LABEL: RESET (S8) | |
| MP31 | 5000-3365 | LABEL: HOLD (S7) | |
| MP32 | 5000-3366 | LABEL: GATE RESET (S9) | |
| MP33 | | NOT ASSIGNED | |
| MP34 | 5060-0049 | ASSY: EXTENDER BOARD 15-CONTACT 4.6 LONG | |
| MP35 | 03722-735 | HARNESS: MAIN | |
| MP36 | 03722-740 | HARNESS: LINE, REAR PANEL & PUSH-BUTTON | |
| MP37 | 03722-741 | HARNESS: CLOCK PERIOD SWITCH (REAR) | |
| MP38 | 03722-106 | RELAY SCREEN | |
| MP39 | 03722-107 | CLOCK PERIOD SWITCH SCREEN | |
| MP40 | 03722-108 | ATTENUATOR SUPPORT BRACKET | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊛ Part No. | Description * | Note |
|---|---|---|---|
| MP41 | 03722-109 | ATTENUATOR SCREEN | |
| MP42 | 03722-110 | SWITCH MOUNT (CLOCK PERIOD SWITCH: REAR SECTION) | |
| MP43 | 03722-111 | TRANSISTOR COVER (REAR PANEL) | |
| MP44 | 03722-112 | RETAINER (A39, A41, A43 & A44) | |
| MP45 | 03722-113 | HEAT SINK PLATE (Q4, Q5, Q6) | |
| MP46 | 03722-120 | RETAINER (U-CHANNEL: FULL WIDTH) | |
| MP47 | 03722-121 | BRACKET (MOUNTED ON MP40: SUPPORTS MP46) | |
| MP48 | 03722-361 | CARD SUPPORT: 2 SLOTS 1.43 LONG | |
| MP49 | 03722-362 | CARD SUPPORT: 3 SLOTS 1.96 LONG | |
| MP50 | 03722-363 | CARD SUPPORT: 10 SLOTS 4.15 LONG | |
| MP51 | 03722-364 | CARD SUPPORT: 18 SLOTS 6.34 LONG | |
| MP52 | 03722-366 | CARD SUPPORT: 1 SLOT 0.8 LONG | |
| MP53 | 03722-368 | CARD SUPPORT: 2 SLOTS 1.43 LONG | |
| MP54 | 03722-367 | PILLAR (SUPPORT MP44) | |
| Q1 | 1853-0052 | TRANSISTOR: SI PNP | |
| | 0340-0162 | INSULATING WASHER (Q1) | |
| | 1200-0168 | MOUNTING BASE (Q1) | |
| Q2 | 1854-0063 | TRANSISTOR: SI NPN | |
| | 1200-0043 | INSULATING WASHER (Q2) | |
| | 1200-0041 | MOUNTING BASE (Q2) | |
| Q3 | 1854-0072 | TRANSISTOR: SI NPN | |
| | 0340-0162 | INSULATING WASHER (Q3) | |
| | 1200-0168 | MOUNTING BASE (Q3) | |
| Q4 | 1854-0039 | TRANSISTOR: SI NPN | |
| | 1205-0050 | HEAT SINK (Q4) | |
| Q5 | 1853-0012 | TRANSISTOR: SI PNP | |
| | 1205-0050 | HEAT SINK (Q5) | |
| Q6 | 1854-0039 | TRANSISTOR: SI NPN | |
| | 1205-0050 | HEAT SINK (Q6) | |
| R1 | 0812-0033 | R: FXD WW 7 OHM 3% 5W | |
| R2 | 0812-0046 | R: FXD WW 2 OHM 5% 5W | |
| R3 | 0812-0033 | R: FXD WW 7 OHM 3% 5W | |
| R4 | 0683-3335 | R: FXD CARBON 33K OHM 5%1/4W | |
| R5 | 0698-6402 | R: FXD MET FLM 3.01K OHM 1% 1/4W 50PPM | |
| R6 | | NOT ASSIGNED | |
| R7 | 2100-0626 | R: VAR WW LIN 1.0K OHM 10% 1/2W (GAUSSIAN ZERO) | |
| | 1410-0112 | HEX STANDOFF BUSH (R7) | |
| | 5020-0446 | HEX NUT (R7) | |
| R8 | 0758-0086 | R: FXD MET OX 100 OHM 5% 1/4W | |
| S1 | 03722-738 | ASSY: CLOCK PERIOD SWITCH (INCLUDES JUMPER LEADS & FRONT CABLE HARNESS) | |
| | 3100-2412 | SWITCH (MECHANISM ONLY) | |
| | 03722-732 | CLOCK PERIOD CABLE HARNESS (FRONT) | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ℗ Part No. | Description * | Note |
|---|---|---|---|
| S2 | 03722-734 | ASSY: SEQUENCE LENGTH SWITCH (INCLUDES DIODES, JUMPER LEADS, LINKS, SPREADER, HARNESS & CONTROL RECEPTACLE J12) | |
| | 03722-746 | ASSY: SEQUENCE LENGTH SWITCH (AS ABOVE BUT WITHOUT HARNESS & CONTROL RECEPTACLE) | |
| | 3100-0619 | SWITCH (MECHANISM ONLY) | |
| | 03722-365 | SPREADER (JUMPER LEADS) | |
| | 03722-736 | HARNESS (INCLUDES CONTROL RECEPTACLE J12) | |
| S2CR1 | 1901-0040 | DIODE: SI | |
| S2CR2 | 1901-0040 | DIODE: SI | |
| S2CR3 | 1901-0040 | DIODE: SI | |
| S2CR4 | 1901-0040 | DIODE: SI | |
| S2CR5 | 1901-0040 | DIODE: SI | |
| S2CR6 | 1901-0040 | DIODE: SI | |
| S2CR7 | 1901-0040 | DIODE: SI | |
| S2CR8 | 1901-0040 | DIODE: SI | |
| S2CR9 | 1901-0040 | DIODE: SI | |
| S2CR10 | 1901-0040 | DIODE: SI | |
| S2CR11 | 1901-0040 | DIODE: SI | |
| S2CR12 | 1901-0040 | DIODE: SI | |
| S2CR13 | 1901-0040 | DIODE: SI | |
| S2CR14 | 1901-0040 | DIODE: SI | |
| S2CR15 | 1901-0040 | DIODE: SI | |
| S2CR16 | 1901-0040 | DIODE: SI | |
| S2CR17 | 1901-0040 | DIODE: SI | |
| S2CR18 | 1901-0040 | DIODE: SI | |
| S2CR19 | 1901-0040 | DIODE: SI | |
| S3 | | NOT ASSIGNED | |
| S4 | 3100-0618 | SWITCH (SEQUENCES PER GATE INTERVAL) | |
| S6 to S9 | 03722-370 | ASSY: 4 PUSH-BUTTON SWITCHES (RUN, HOLD, RESET & GATE RESET) | |
| S10 | 3101-0032 | SWITCH: SLIDE (BINARY/GAUSSIAN) | |
| S11 | 3101-0069 | SWITCH: SLIDE (CONTROL LOCAL/REMOTE) | |
| S12 | 3101-0069 | SWITCH: SLIDE (RELAY DISABLE) | |
| S13 | 3101-0011 | SWITCH: SLIDE (CLOCK) | |
| S14 | | NOT ASSIGNED | |
| S15 | 3101-0011 | SWITCH: SLIDE (DIGITAL FILTER TEST) | |
| S16 | 3101-0033 | SWITCH: SLIDE (LINE VOLTAGE SELECTOR) | |
| T1 | 9100-0624 | TRANSFORMER | |
| W1 | 8120-0078 | CABLE: POWER | |
| XA1 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA2 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA3 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA4 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA5 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| S5 | 3101-0100 | SWITCH: PUSH-BUTTON (LINE) COMPLETE WITH LAMP & LENS ASSY DS2 | |

* See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

| Reference Designation | ⊛ Part No. | Description * | Note |
|---|---|---|---|
| XA6 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA7 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA8 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA9 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA10 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA11 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA12 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA13 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA14 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA15 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA16 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA17 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA18 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA19 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA20 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA21 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA22 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA23 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA24 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA25 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA26 | | NOT ASSIGNED | |
| XA27 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA28 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA29 | | NOT ASSIGNED | |
| XA30 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA31 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA32 | 1251-0159 | CONNECTOR: PC 30-CONTACT | |
| XA33 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA34 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA35 | | NOT ASSIGNED | |
| XA36 | 1251-0213 | CONNECTOR: PC 15-CONTACT | |
| XA37 | 1251-0159 | CONNECTOR: PC 30-CONTACT | |
| XA38 | | NOT ASSIGNED | |
| XA39 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA40 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA41 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA42 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA43 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XA44 | 1251-0135 | CONNECTOR: PC 15-CONTACT | |
| XF1 | 1400-0084 | FUSE HOLDER (EXTRACTOR TYPE) | |
| <u>PACKAGING MATERIAL</u> | | | |
| | 9211-0249 | CARTON | |
| | 9223-0040 | CORNER POST (4 REQUIRED) | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts

| ⓗ Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 0121-0105 | C: VAR CER 9-35PF | | 3 | |
| 0140-0176 | C: FXD MICA 100PF 2% 300VDCW | | 2 | |
| 0140-0179 | C: FXD MICA 1000PF 5% 300VDCW | | 1 | |
| 0140-0191 | C: FXD MICA 56PF 5% 300VDCW | | 6 | |
| 0140-0192 | C: FXD MICA 68PF 5% 300VDCW | | 15 | |
| 0140-0193 | C: FXD MICA 82PF 5% 300VDCW | | 10 | |
| 0140-0194 | C: FXD MICA 110PF 5% 300VDCW | | 14 | |
| 0140-0195 | C: FXD MICA 130PF 5% 300VDCW | | 32 | |
| 0140-0196 | C: FXD MICA 150PF 5% 300VDCW | | 22 | |
| 0140-0198 | C: FXD MICA 200PF 5% 300VDCW | | 14 | |
| 0140-0199 | C: FXD MICA 240PF 5% 300VDCW | | 7 | |
| 0140-0200 | C: FXD MICA 390PF 5% 300VDCW | | 7 | |
| 0140-0204 | C: FXD MICA 47PF 5% 500VDCW | | 7 | |
| 0140-0206 | C: FXD MICA 270PF 5% 500VDCW | | 1 | |
| 0150-0086 | C: FXD CER 4700PF 20% 500VDCW | | 1 | |
| 0150-0093 | C: FXD CER 0.01UF -20%+80% 100VDCW | | 2 | |
| 0150-0096 | C: FXD CER 0.05UF 100VDCW | | 1 | |
| 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW | | 12 | |
| 0150-0122 | C: FXD CER 2000PF 20% 500VDCW | | 2 | |
| 0160-0128 | C: FXD CER 2.2UF 20% 25VDCW | | 3 | |
| 0160-0134 | C: FXD MICA 220PF 5% 300VDCW | | 3 | |
| 0160-0137 | C: FXD CER 0.33UF 20% 25VDCW | | 2 | |
| 0160-0153 | C: FXD MY 1000PF 10% 200VDCW | | 1 | |
| 0160-0157 | C: FXD MY 4700PF 10% 200VDCW | | 4 | |
| 0160-0161 | C: FXD MY 0.01UF 10% 200VDCW | | 2 | |
| 0160-0163 | C: FXD MY 0.033UF 10% 200VDCW | | 2 | |
| 0160-0179 | C: FXD MICA 33PF 5% 300VDCW | | 1 | |
| 0160-0181 | C: FXD MICA 30PF 5% 300VDCW | | 2 | |
| 0160-0297 | C: FXD MY 1200PF 10% 200VDCW | | 3 | |
| 0160-0300 | C: FXD MY 2700PF 10% 200VDCW | | 1 | |
| 0160-0301 | C: FXD MY 0.012UF 10% 200VDCW | | 1 | |
| 0160-0615 | C: FXD METALAC 10UF 10% 63VDCW | | 3 | |
| 0160-0619 | C: FXD METALAC 1UF 10% 63VDCW | | 2 | |
| 0160-0620 | C: FXD METALAC 2UF 10% 63VDCW | | 1 | |
| 0160-0633 | C: FXD POLY 0.01UF 1% 63VDCW | | 1 | |
| 0160-0646 | C: FXD POLY 0.022UF 1% 63VDCW | | 1 | |
| 0160-0647 | C: FXD POLY 6200PF 1% 500VDCW | | 1 | |
| 0160-0648 | C: FXD POLY 0.16UF 1% 63VDCW | | 1 | |
| 0160-0649 | C: FXD POLY 0.051UF 1% 63VDCW | | 1 | |
| 0160-0650 | C: FXD POLY 0.062UF 1% 63VDCW | | 1 | |
| 0160-0651 | C: FXD POLY 2200PF 1% 500VDCW | | 1 | |
| 0160-0652 | C: FXD POLY 3000PF 1% 500VDCW | | 1 | |
| 0160-0653 | C: FXD POLY 1000PF 1% 500VDCW | | 1 | |
| 0160-0655 | C: FXD METALAC 1UF 5% 63VDCW | | 1 | |
| 0160-0664 | C: FXD CER 2x0.001UF -0% +100% | | 1 | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 0160-2009 | C: FXD MICA 820PF 5% 300VDCW | | 1 | |
| 0160-2150 | C: FXD MICA 33PF 5% 300VDCW | | 2 | |
| 0160-2197 | C: FXD MICA 10PF 5% 300VDCW | | 1 | |
| 0160-2198 | C: FXD MICA 20PF 5% 300VDCW | | 1 | |
| 0160-2204 | C: FXD MICA 100PF 5% 300VDCW | | 6 | |
| 0160-2208 | C: FXD MICA 330PF 5% 300VDCW | | 3 | |
| 0160-2225 | C: FXD MICA 2000PF 5% 300VDCW | | 1 | |
| 0160-2306 | C: FXD MICA 27PF 5% 300VDCW | | 226 | |
| 0160-2598 | C: FXD MICA 620PF 2% 300VDCW | | 1 | |
| 0170-0019 | C: FXD MY 0.1UF 5% 200VDCW | | 1 | |
| 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW | | 6 | |
| 0170-0066 | C: FXD MY 0.027UF 10% 200VDCW | | 1 | |
| 0180-0059 | C: FXD AL 10UF -10%+100% 25VDCW | | 3 | |
| 0180-0129 | C: FXD AL 975UF -10%+50% 40VDCW | | 3 | |
| 0180-0141 | C: FXD AL 50UF -10%+75% 50VDCW | | 3 | |
| 0180-0291 | C: FXD TA 1.0UF 35VDCW | | 10 | |
| 0180-0374 | C: FXD TA 10UF 10% 20VDCW | | 2 | |
| 0180-0376 | C: FXD TA 0.47UF 10% 35VDCW | | 3 | |
| 0180-1714 | C: FXD TA 330UF 10% 6VDCW | | 2 | |
| 0180-1846 | C: FXD TA 2.2UF 10% 35VDCW | | 1 | |
| 0340-0038 | PIN | | 13 | |
| 0340-0039 | INSULATOR | | 25 | |
| 0340-0058 | MOUNTING POST | | 6 | |
| 0340-0059 | TERMINAL POST: BRASS | | 6 | |
| 0340-0060 | TERMINAL: CLOVER LEAF PTFE | | 12 | |
| 0340-0099 | INSULATOR: BINDING POST | | 6 | |
| 0340-0100 | INSULATOR: BINDING POST | | 6 | |
| 0340-0162 | INSULATING WASHER | | 2 | |
| 0360-0065 | TERMINAL: SUBMINIATURE BRASS | | 6 | |
| 0360-0117 | TERMINAL BOARD | | 2 | |
| 0360-0124 | TERMINAL PIN | | 38 | |
| 0370-0027 | KNOB: 3/4 DIA | | 1 | |
| 0370-0035 | KNOB: 1 DIA | | 2 | |
| 0370-0037 | KNOB: 1 DIA | | 1 | |
| 0370-0104 | KNOB: 5/8 DIA | | 1 | |
| 0370-0118 | KNOB: PUSH BUTTON | | 4 | |
| 0380-05[illegible]9 | BEAD: GLASS | | 6 | |
| 0410-[illegible]01 | CRYSTAL: QUARTZ 3MHz | | 1 | |
| 0490-0604 | RELAY: REED | | 2 | |
| 0683-0685 | R: FXD COMP 6.8 OHM 5% 1/4W | | 1 | |
| 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W | | 42 | |
| 0683-1055 | R: FXD COMP 1 MEG OHM 5% 1/4W | | 2 | |
| 0683-1205 | R: FXD COMP 12 OHM 5% 1/4W | | 2 | |
| 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W | | 28 | |
| 0683-2255 | R: FXD COMP 2.2 MEG OHM 5% 1/4W | | 1 | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 0683-3335 | R: FXD CARBON 33K OHM 5%1/4W | | 1 | |
| 0683-3345 | R: FXD COMP 330K OHM 5% 1/4W | | 1 | |
| 0683-3915 | R: FXD COMP 390 OHM 5% 1/4W | | 7 | |
| 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W | | 56 | |
| 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W | | 112 | |
| 0683-4755 | R: FXD COMP 4.7 MEG OHM 5% 1/4W | | 1 | |
| 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W | | 56 | |
| 0683-6835 | R: FXD COMP 68K OHM 5% 1/4W | | 7 | |
| 0683-8225 | R: FXD COMP 8.2K OHM 5% 1/4W | | 14 | |
| 0698-3145 | R: FXD MET FLM 1.0K OHM 1/4% 1/4W | | 1 | |
| 0698-3369 | R: FXD MET FLM 1.4K OHM 1/4% 1/4W 100 PPM | | 1 | |
| 0698-3468 | R: FXD MET FLM 1.07K OHM 1% 1/4W 50 PPM | | 3 | |
| 0698-3624 | R: FXD MET OX 150 OHM 5% 2W | | 2 | |
| 0698-3752 | R: FXD MET FLM 750 OHM 1/4% 1/4W 50 PPM | | 1 | |
| 0698-3753 | R: FXD MET FLM 857 OHM 1/4% 1/4W 50 PPM | | 1 | |
| 0698-3754 | R: FXD MET FLM 877 OHM 1/4% 1/4W 50 PPM | | 2 | |
| 0698-3755 | R: FXD MET FLM 900 OHM 1/2% 1/4W 100 PPM | | 1 | |
| 0698-3757 | R: FXD MET FLM 1.2K OHM 1% 1/4W 100 PPM | | 1 | |
| 0698-3758 | R: FXD MET FLM 1.3K OHM 1/4% 1/4W 50 PPM | | 1 | |
| 0698-3759 | R: FXD MET FLM 1.81K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3760 | R: FXD MET FLM 1.9K OHM 1/4% 1/4W 50 PPM | | 1 | |
| 0698-3761 | R: FXD MET FLM 2.36K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3762 | R: FXD MET FLM 2.4K OHM 1/2% 1/4W 50 PPM | | 1 | |
| 0698-3763 | R: FXD MET FLM 3.92K OHM 1% 1/4W 50 PPM | | 2 | |
| 0698-3764 | R: FXD MET FLM 5.4K OHM 1/4% 1/4W 50 PPM | | 1 | |
| 0698-3765 | R: FXD MET FLM 6.53K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3766 | R: FXD MET FLM 7.08K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3768 | R: FXD MET FLM 12K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3769 | R: FXD MET FLM 14.16K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3770 | R: FXD MET FLM 23.1K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3771 | R: FXD MET FLM 23.6K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3772 | R: FXD MET FLM 42.48K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3773 | R: FXD MET FLM 141.6K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-3774 | R: FXD MET FLM 600 OHM 1/4% 1/4W 50 PPM | | 2 | |
| 0698-3775 | R: FXD MET OX 16 OHM 2% 1/4W | | 3 | |
| 0698-3776 | R: FXD MET OX 32 OHM 2% 1/4W | | 1 | |
| 0698-3777 | R: FXD MET OX 65 OHM 1% 1/4W | | 1 | |
| 0698-3778 | R: FXD MET OX 138 OHM 1% 1/4W | | 1 | |
| 0698-3779 | R: FXD MET OX 305 OHM 1% 1/4W | | 1 | |
| 0698-3780 | R: FXD MET OX 32.2 OHM 1% 1/2W | | 1 | |
| 0698-3799 | R: FXD MET OX 22 OHM 5% 1/4W | | 3 | |
| 0698-4204 | R: FXD MET FLM 11.75K OHM 1% 1/4W 100 PPM | | | |
| 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W | | 8 | |
| 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W | | 6 | |
| 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W | | 5 | |
| 0698-4232 | R: FXD MET OX 110 OHM 5% 1/4W | | 6 | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts (Cont'd)

| ℗ Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 0698-4233 | R: FXD MET OX 120 OHM 5% 1/4W | | 1 | |
| 0698-4234 | R: FXD MET OX 130 OHM 5% 1/4W | | 1 | |
| 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W | | 10 | |
| 0698-4241 | R: FXD MET OX 270 OHM 5% 1/4W | | 1 | |
| 0698-4243 | R: FXD MET OX 330 OHM 5% 1/4W | | 1 | |
| 0698-4245 | R: FXD MET OX 390 OHM 5% 1/4W | | 3 | |
| 0698-4246 | R: FXD MET OX 470 OHM 5% 1/4W | | 2 | |
| 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W | | 4 | |
| 0698-4252 | R: FXD MET OX 820 OHM 5% 1/4W | | 2 | |
| 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W | | 106 | |
| 0698-4256 | R: FXD MET OX 1.2K OHM 5% 1/4W | | 3 | |
| 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W | | 8 | |
| 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W | | 19 | |
| 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W | | 11 | |
| 0698-4265 | R: FXD MET OX 3.0K OHM 5% 1/4W | | 2 | |
| 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W | | 42 | |
| 0698-4267 | R: FXD MET OX 3.6K OHM 5% 1/4W | | 1 | |
| 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W | | 6 | |
| 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W | | 96 | |
| 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W | | 258 | |
| 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W | | 25 | |
| 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W | | 9 | |
| 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W | | 7 | |
| 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W | | 88 | |
| 0698-4288 | R: FXD MET OX 27K OHM 5% 1/4W | | 2 | |
| 0698-4290 | R: FXD MET OX 33K OHM 5% 1/4W | | 2 | |
| 0698-4292 | R: FXD MET OX 39K OHM 5% 1/4W | | 3 | |
| 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W | | 5 | |
| 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W | | 5 | |
| 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W | | 8 | |
| 0698-4300 | R: FXD MET OX 82K OHM 5% 1/4W | | 2 | |
| 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W | | 8 | |
| 0698-5584 | R: FXD MET FLM 1.5K OHM 1/2% 1/4W 100 PPM | | 1 | |
| 0698-5701 | R: FXD MET OX 27 OHM 5% 1/4W | | 2 | |
| 0698-5707 | R: FXD MET OX 47 OHM 5% 1/4W | | 4 | |
| 0698-5788 | R: FXD MET FLM 10K OHM 1/2% 1/8W 50 PPM | | 2 | |
| 0698-5789 | R: FXD MET FLM 11.1K OHM 1/2% 1/8W 50 PPM | | 2 | |
| 0698-5790 | R: FXD MET FLM 12.95K OHM 1/2% 1/8W 50 PPM | | 2 | |
| 0698-5791 | R: FXD MET FLM 16K OHM 1/2% 1/8W 50 PPM | | 2 | |
| 0698-5792 | R: FXD MET FLM 21.3K OHM 1/2% 1/8W 50 PPM | | 2 | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts (Cont'd)

| Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 0698-5793 | R: FXD MET FLM 31.1K OHM 1/2% 1/8W 50 PPM | | 3 | |
| 0698-5794 | R: FXD MET FLM 52.6K OHM 1/2% 1/8W 50 PPM | | 2 | |
| 0698-5795 | R: FXD MET FLM 138K OHM 1% 1/8W 100 PPM | | 2 | |
| 0698-5796 | R: FXD MET FLM 186K OHM 1% 1/8W 150 PPM | | 2 | |
| 0698-5797 | R: FXD MET FLM 296K OHM 1% 1/8W 150 PPM | | 2 | |
| 0698-5798 | R: FXD MET FLM 257 OHM 1/2% 1/4W 100 PPM | | 1 | |
| 0698-5800 | R: FXD MET FLM 667 OHM 1/4% 1/4W 50 PPM | | 1 | |
| 0698-6033 | R: FXD MET FLM 7.5K OHM 1% 1/4W 50 PPM | | 2 | |
| 0698-6034 | R: FXD MET FLM 9K OHM 1% 1/4W 50 PPM | | 1 | |
| 0698-6402 | R: FXD MET FLM 3.01K OHM 1% 1/4W 50 PPM | | 1 | |
| 0757-0339 | R: FXD MET FLM 3.01K OHM 1% 1/4W 100 PPM | | 1 | |
| 0757-0436 | R: FXD MET FLM 4.32K OHM 1% 1/8W 100 PPM | | 1 | |
| 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM | | 4 | |
| 0757-0468 | R: FXD MET FLM 130K OHM 1% 1/8W 100 PPM | | 2 | |
| 0757-0472 | R: FXD MET FLM 200K OHM 1% 1/8W 100 PPM | | 2 | |
| 0757-0473 | R: FXD MET FLM 221K OHM 1% 1/8W 100 PPM | | 1 | |
| 0757-0484 | R: FXD MET FLM 619K OHM 1% 1/8W 100 PPM | | 2 | |
| 0757-0715 | R: FXD MET FLM 150 OHM 1% 1/4W 100 PPM | | 1 | |
| 0757-0739 | R: FXD MET FLM 2.0K OHM 1% 1/4W 100 PPM | | 1 | |
| 0757-0914 | R: FXD MET FLM 390 OHM 2% 1/8W 100 PPM | | 1 | |
| 0757-1021 | R: FXD MET FLM 66.5 OHM 1% 1/4W 100 PPM | | 1 | |
| 0757-1023 | R: FXD MET FLM 6.04K OHM 1% 1/4W 100 PPM | | 1 | |
| 0757-1035 | R: FXD MET FLM 400 OHM 1/2% 1/4W 100 PPM | | 1 | |
| 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W | | 8 | |
| 0758-0015 | R: FXD MET OX 220 OHM 5% 1/2W | | 1 | |
| 0758-0017 | R: FXD MET FLM 1.5K OHM 5% 1/2W | | 1 | |
| 0758-0024 | R: FXD MET FLM 100 OHM 5% 1/2W | | 2 | |
| 0758-0026 | R: FXD MET OX 82 OHM 5% 1/2W | | 3 | |
| 0758-0029 | R: FXD MET OX 470 OHM 5% 1/2W | | 3 | |
| 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W | | 8 | |
| 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W | | 6 | |
| 0758-0086 | R: FXD MET OX 100 OHM 5% 1/4W | | 3 | |
| 0758-0606 | R: FXD MET OX 22 OHM 5% 1/2W | | 2 | |
| 0760-0022 | R: FXD MET FLM 330 OHM 2% 1W | | 2 | |
| 0760-0024 | R: FXD MET OX 100 OHM 5% 1W | | 3 | |
| 0761-0026 | R: FXD MET OX 220 OHM 5% 1W | | 1 | |
| 0764-0016 | R: FXD MET OX 1.0K OHM 5% 2W | | 2 | |
| 0811-0601 | R: FXD WW 8K OHM 1% 1/2W 5 PPM | | 1 | |
| 0811-0602 | R: FXD WW 9K OHM 1% 1/2W 5 PPM | | 1 | |
| 0812-0033 | R: FXD WW 7 OHM 3% 5W | | 2 | |
| 0812-0046 | R: FXD WW 2 OHM 5% 5W | | 1 | |
| 1200-0041 | TRANSISTOR MOUNTING TO3 | | 1 | |
| 1200-0043 | TRANSISTOR INSULATING WASHER TO3 | | 1 | |
| 1200-0168 | TRANSISTOR MOUNTING TO66 | | 2 | |
| 1205-0050 | TRANSISTOR HOLDERS | | 3 | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 1250-0083 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING | | 8 | |
| 1250-0118 | CONNECTOR: BNC FEMALE BULKHEAD MOUNTING | | 1 | |
| 1251-0084 | CONNECTOR: 36-CONTACT MALE CABLE PLUG | | 1 | |
| 1251-0085 | CONNECTOR: 36-CONTACT FEMALE RECEPTACLE | | 1 | |
| 1251-0135 | CONNECTOR: PC 15 CONTACTS | | 37 | |
| 1251-0159 | CONNECTOR: PC 30 CONTACTS | | 2 | |
| 1251-0213 | CONNECTOR: PC 15 CONTACTS | | 1 | |
| ▶1400-0084 | FUSE HOLDER EXTRACTOR POST TYPE | | 1 | |
| 1490-0030 | STAND-TILT | | 1 | |
| 1510-0009 | BINDING POST | | 6 | |
| 1520-0001 | MOUNTING BASE | | 2 | |
| 1820-0001 | AMPLIFIER: REF NPN SI | | 1 | |
| 1850-0062 | TRANSISTOR: GE | | 56 | |
| 1853-0001 | TRANSISTOR: SI PNP | | 2 | |
| 1853-0012 | TRANSISTOR: SI PNP | | 3 | |
| 1853-0034 | TRANSISTOR: SI PNP | | 23 | |
| 1853-0036 | TRANSISTOR: SI PNP | | 7 | |
| 1853-0052 | TRANSISTOR: SI PNP | | 1 | |
| 1853-0607 | TRANSISTOR: SI PNP MATCHED PAIR | | 1 | |
| 1854-0003 | TRANSISTOR: SI NPN | | 4 | |
| 1854-0039 | TRANSISTOR: SI NPN | | 3 | |
| 1854-0063 | TRANSISTOR: SI NPN | | 1 | |
| 1854-0071 | TRANSISTOR: SI NPN | | 17 | |
| 1854-0072 | TRANSISTOR: SI NPN | | 1 | |
| 1854-0215 | TRANSISTOR: SI NPN | | 2 | |
| 1854-0605 | TRANSISTOR: SI NPN | | 143 | |
| 1855-0603 | TRANSISTOR: SI FET | | 1 | |
| 1901-0025 | DIODE: SI | | 2 | |
| 1901-0040 | DIODE: SI | | 235 | |
| 1901-0045 | DIODE: SI | | 12 | |
| 1902-0017 | DIODE: BREAKDOWN 6.81V 400MW | | 3 | |
| 1902-0041 | DIODE: BREAKDOWN 5.11V 400MW | | 6 | |
| 1902-0126 | DIODE: BREAKDOWN 2.61V 400MW | | 1 | |
| 1902-3234 | DIODE: BREAKDOWN 19.6V 5% 400MW | | 1 | |
| 1910-0016 | DIODE: GE | | 35 | |
| 1910-0034 | DIODE: GE | | 6 | |
| 1912-0002 | DIODE: TUNNEL | | 2 | |
| 2100-0626 | R: VAR WW LIN 1K OHM 10% 1/2W | | 1 | |
| 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/4W | | 7 | |
| 2100-1758 | R: VAR WW LIN 1.0K OHM 10% 1/2W | | 1 | |
| 2100-1759 | R: VAR WW LIN 2.0K OHM 10% 1/2W | | 1 | |
| 2100-1760 | R: VAR WW LIN 5.0K OHM 10% 1/2W | | 1 | |
| 2100-0941 | R: VAR WW LIN 1.0K OHM 5% 1W | | 1 | |
| 2100-0989 | R: VAR WW LIN 10K OHM 5% 1W | | 1 | |
| 2110-0006 | FUSE: CARTRIDGE SLOW-BLOW 2A 125V | | 1 | |
| ▶1853-0015 | TRANSISTOR: SI PNP | | 37 | |
| ▶1450-0106 | LAMP & RED LENS ASSY | | 1 | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 2110-0007 | FUSE: CARTRIDGE SLOW-BLOW 1A 250V | | 1 | |
| 2140-0022 | LAMP: NEON | | 1 | |
| 2140-0602 | LAMP: FILAMENT | | 1 | |
| 3100-0618 | SWITCH (SEQUENCES PER GATE INTERVAL) | | 1 | |
| 3101-0011 | SWITCH: SLIDE | | 2 | |
| 3101-0032 | SWITCH: SLIDE | | 1 | |
| 3101-0033 | SWITCH: SLIDE | | 1 | |
| 3101-0069 | SWITCH: SLIDE | | 2 | |
| 3101-0100 | SWITCH: PUSH-BUTTON (INCLUDES LAMP & LENS ASSY 1450-0106) | | 1 | |
| 5000-0051 | PLATE: FLUTED AL | | 2 | |
| 5000-0316 | LABEL: RUN | | 1 | |
| 5000-0738 | SIDE COVER (REAR) | | 2 | |
| 5000-0739 | SIDE COVER (FRONT) | | 2 | |
| 5000-3363 | LABEL: RESET | | 1 | |
| 5000-3365 | LABEL: HOLD | | 1 | |
| 5000-3366 | LABEL: GATE RESET | | 1 | |
| 5020-0446 | HEX NUT | | 1 | |
| 5040-0234 | LAMP HOLDER | | 1 | |
| 5040-0235 | RETAINER | | 1 | |
| 5060-0049 | EXTENDER BOARD | | 1 | |
| 5060-0222 | SIDE HANDLE ASSY | | 2 | |
| 5060-0732 | FRAME ASSY | | 1 | |
| 5060-0766 | HANDLE ASSY RETAINER | | 2 | |
| 5060-0767 | FOOT ASSY | | 5 | |
| 5060-0775 | RACK MOUNTING KIT | | 1 | |
| 7100-0333 | COVER | | 1 | |
| 7120-0607 | PLATE SERIAL | | 1 | |
| 7120-1254 | LOGO | | 1 | |
| 8120-0078 | CABLE: POWER | | 1 | |
| 9100-0619 | TRANSFORMER: CRYSTAL OSCILLATOR | | 1 | |
| 9100-0620 | TRANSFORMER: SHIFT PULSE GENERATOR | | 1 | |
| 9100-0624 | TRANSFORMER | | 1 | |
| 9100-1633 | L: FXD COIL 68UH 5% | | 1 | |
| 9100-1653 | L: FXD COIL 910UH 5% | | 2 | |
| 9100-0051 | INDUCTOR 40MH | | 1 | |
| 9140-0112 | COIL: FXD 4.7UH 10% | | 1 | |
| 9140-0114 | COIL: FXD 10UH 10% | | 1 | |
| 9140-0136 | INDUCTOR: 22UH | | 2 | |
| 9161-0013 | RELAY: COIL | | 2 | |
| 9211-0249 | CARTON | | 1 | |
| 9223-0040 | POST | | 4 | |
| 00140-24701 | SUPPORT: PANEL TOP | | 1 | |
| 00140-24702 | SUPPORT: PANEL BOTTOM | | 1 | |
| 03722-101 | FRONT PANEL | | 1 | |
| 03722-103 | DECK MAIN | | 1 | |

* See list of abbreviations in introduction to this section

Table 6-2 Replaceable Parts (Cont'd)

| Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 03722-104 | REAR PANEL | | 1 | |
| 03722-105 | CLIP | | 2 | |
| 03722-106 | SCREEN: RELAY | | 1 | |
| 03722-107 | SCREEN: SWITCH | | 1 | |
| 03722-108 | BRACKET: SUPPORT | | 1 | |
| 03722-109 | SCREEN: ATTENUATOR | | 1 | |
| 03722-110 | SWITCH: MOUNT | | 1 | |
| 03722-111 | SHIELD | | 1 | |
| 03722-112 | CARD RETAINER | | 1 | |
| 03722-113 | HEAT SINK | | 1 | |
| 03722-114 | STIFFENER | | 1 | |
| 03722-118 | COVER TOP | | 1 | |
| 03722-119 | COVER BOTTOM | | 1 | |
| 03722-120 | CARD RETAINER | | 2 | |
| 03722-121 | BRACKET | | 1 | |
| 03722-122 | SHIELD | | 1 | |
| ▶03722-361 | CARD SUPPORT | | 1 | |
| 03722-362 | CARD SUPPORT | | 1 | |
| 03722-363 | CARD SUPPORT | | 1 | |
| 03722-364 | CARD SUPPORT | | 1 | |
| 03722-366 | CARD SUPPORT | | 1 | |
| 03722-367 | PILLAR | | 1 | |
| 03722-368 | CARD SUPPORT | | 1 | |
| ▶03722-701 | ASSY: FEEDBACK LOGIC | | 1 | |
| 03722-702 | ASSY: AUTO-START LOGIC | | 1 | |
| 03722-703 | ASSY: SHIFT PULSE GENERATOR | | 1 | |
| 03722-704 | ASSY: SHIFT REGISTER | | 8 | |
| 03722-705 | ASSY: DIVIDE-BY-THREE | | 1 | |
| 03722-706 | ASSY: DIGITAL-TO-ANALOG CONVERTER (1) | | 1 | |
| 03722-707 | ASSY: OUTPUT AMPLIFIER (3) | | 1 | |
| 03722-708 | ASSY: OUTPUT AMPLIFIER (1) | | 1 | |
| 03722-709 | ASSY: RANDOM NOISE SAMPLER | | 1 | |
| 03722-710 | ASSY: SEQUENCE COUNTER | | 1 | |
| 03722-711 | ASSY: POWER SUPPLY STABILISER | | 1 | |
| 03722-712 | ASSY: ANALOG FILTER (1) | | 1 | |
| 03722-713 | ASSY: CONTROL LOGIC | | 1 | |
| 03722-714 | ASSY: GATE AND SYNC OUTPUT | | 1 | |
| 03722-715 | ASSY: CRYSTAL OSCILLATOR | | 1 | |
| 03722-716 | ASSY: RANDOM NOISE GENERATOR | | 1 | |
| 03722-717 | ASSY: RECTIFIER | | 1 | |
| 03722-718 | ASSY: ANALOG FILTER (2) | | 1 | |
| 03722-719 | ASSY: REFERENCE POWER SUPPLY | | 1 | |
| 03722-720 | ASSY: OUTPUT SWITCH | | 1 | |
| 03722-721 | ASSY: DIGITAL-TO-ANALOG CONVERTER (2) | | 1 | |
| 03722-722 | ASSY: RELAY | | 1 | |
| ▶03722-370 | ASSY: PUSH-BUTTON SWITCH | | 1 | |
| ▶03722-123 | DUMMY FRONT PANEL | | 1 | |

* See list of abbreviations in introduct' to this section

Table 6-2 Replaceable Parts (Cont'd)

| ⓗ Stock No. | Description * | | TQ | |
|---|---|---|---|---|
| 03722-723 | ASSY: DIGITAL-TO-ANALOG CONVERTER (3) | | 1 | |
| 03722-724 | ASSY: DIGITAL-TO-ANALOG CONVERTER (4) | | 1 | |
| 03722-725 | ASSY: HIGH SPEED DECADE DIVIDER | | 2 | |
| 03722-728 | ASSY: ATTENUATOR SWITCH | | 1 | |
| 03722-730 | ASSY: OUTPUT AMPLIFIER (2) | | 1 | |
| 03722-732 | CLOCK PERIOD CABLE HARNESS (FRONT) | | 1 | |
| 03722-734 | ASSY: SEQUENCE LENGTH SWITCH | | 1 | |
| 03722-735 | CABLE HARNESS MAIN | | 1 | |
| 03722-738 | CLOCK PERIOD SWITCH ASSEMBLY | | 1 | |
| 03722-740 | REAR PANEL AND PUSH BUTTON HARNESS | | 1 | |
| 03722-741 | CLOCK PERIOD CABLE HARNESS (REAR) | | 1 | |
| 03722-746 | ASSY: SEQUENCE LENGTH SWITCH | | 1 | |
| 03722-760 | COAXIAL CABLE (BRN/WHT) | | 1 | |
| 03702-761 | COAXIAL CABLE (RED/BLK) | | 1 | |
| 03722-762 | COAXIAL CABLE (RED/BRN) | | 1 | |
| 03722-763 | COAXIAL CABLE (RED/RED) | | 1 | |
| 03722-772 | COAXIAL CABLE (RED/GRY) | | 1 | |
| 03722-901 | MANUAL | | 1 | |
| 5212A-65C | ASSY: LOW SPEED DECADE DIVIDER | | 7 | |

* See list of abbreviations in introduction to this section

Table 6-3 Commercial Equivalents - Transistors and Diodes

| ℗ Part No. | JEDEC Equivalent | Manufacturer |
|---|---|---|
| 1820-0001 | -------- | General Electric 4JX19A519<br>Motorola SCA-11 |
| 1850-0062 | -------- | RCA 34146<br>Texas GA287 |
| 1853-0001 | Similar to 2N1132 | Fairchild S3251<br>Texas SM10168<br>Transitron ST8047 |
| 1853-0012 | 2N2904A | Motorola 2N2904A<br>Texas 2N2904A |
| 1853-0015 | 2N3640 | Motorola MPS3640-5 |
| 1853-0034 | -------- | Fairchild S18864<br>Motorola SM3197<br>Texas SM9477 |
| 1853-0036 | 2N3906 | Motorola 2N3906-5 |
| 1853-0052 | 2N3740 | Motorola 2N3740 |
| 1853-0607 | -------- | ------------ |
| 1854-0003 | Similar to 2N1714 | Fairchild S7088<br>Motorola SS2199<br>PSI PT1844<br>Raytheon RT5299 |
| 1854-0039 | 2N3053 | Motorola 2N3053<br>RCA 2N3053<br>Transitron 2N3053 |
| 1854-0063 | 2N3055 | Motorola 2N3055<br>RCA 2N3055 |
| 1854-0071 | -------- | Texas SK1124 |
| 1854-0072 | 2N3054 | RCA 2N3054 |
| 1854-0215 | 2N3904 | Motorola 2N3904-5 |
| 1854-0605 | -------- | Motorola MPS2714 |
| 1855-0603 | 2N3819 | Texas 2N3819 |
| 1901-0025 | -------- | Continental CD12298<br>Fairchild FD2387<br>General Electric SS410<br>Raytheon RD9028<br>Sylvania D3072<br>Transitron SG817 |

Table 6-3 Commercial Equivalents - Transistors and Diodes (Cont'd)

| ⊕ Part No. | JEDEC Equivalent | Manufacturer |
|---|---|---|
| 1901-0040 | -------- | Continental CD6319<br>Fairchild FDG1088<br>I.T.T. S541<br>Transitron SG5050<br>Texas PG512 |
| 1901-0045 | -------- | Motorola SR1358-7 |
| 1902-0017 | -------- | Continental CD35657<br>Motorola SZ10939-133 |
| 1902-0041 | -------- | Continental CD35622<br>Motorola SZ10939-98 |
| 1902-0126 | -------- | Continental CD35538<br>Motorola SZ10939-14 |
| 1902-3234 | -------- | Continental CD35790<br>Motorola SZ10939-266 |
| 1910-0016 | -------- | General Instruments GD150<br>I.T.T. G718<br>Sylvania D2361<br>Transitron S3185G |
| 1910-0034 | -------- | Hughes HD1840<br>I.T.T. G724<br>Sylvania D6670 |
| 1912-0002 | -------- | General Electric 1N3716 special |

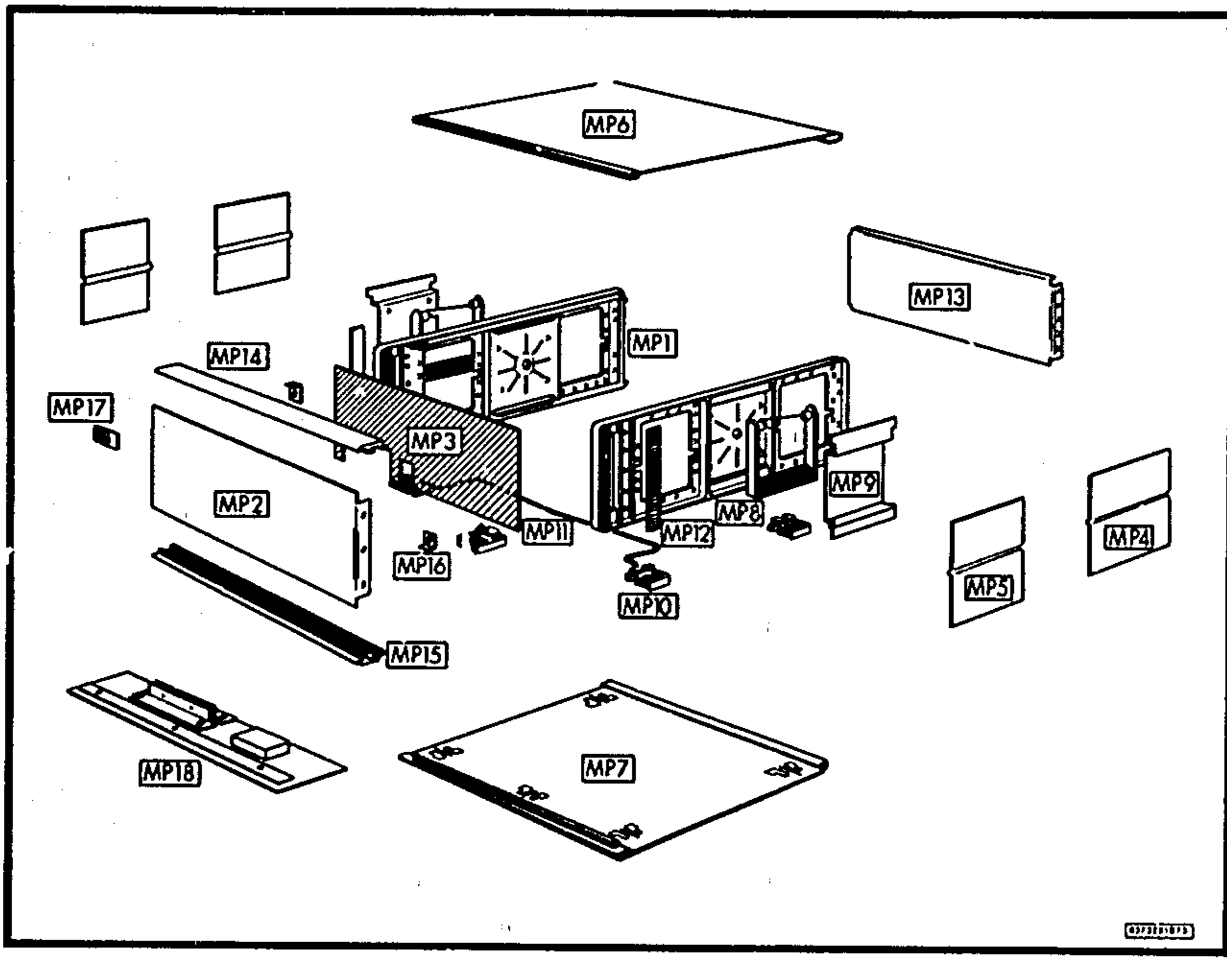



Figure 6 - 1 Location of cabinet components

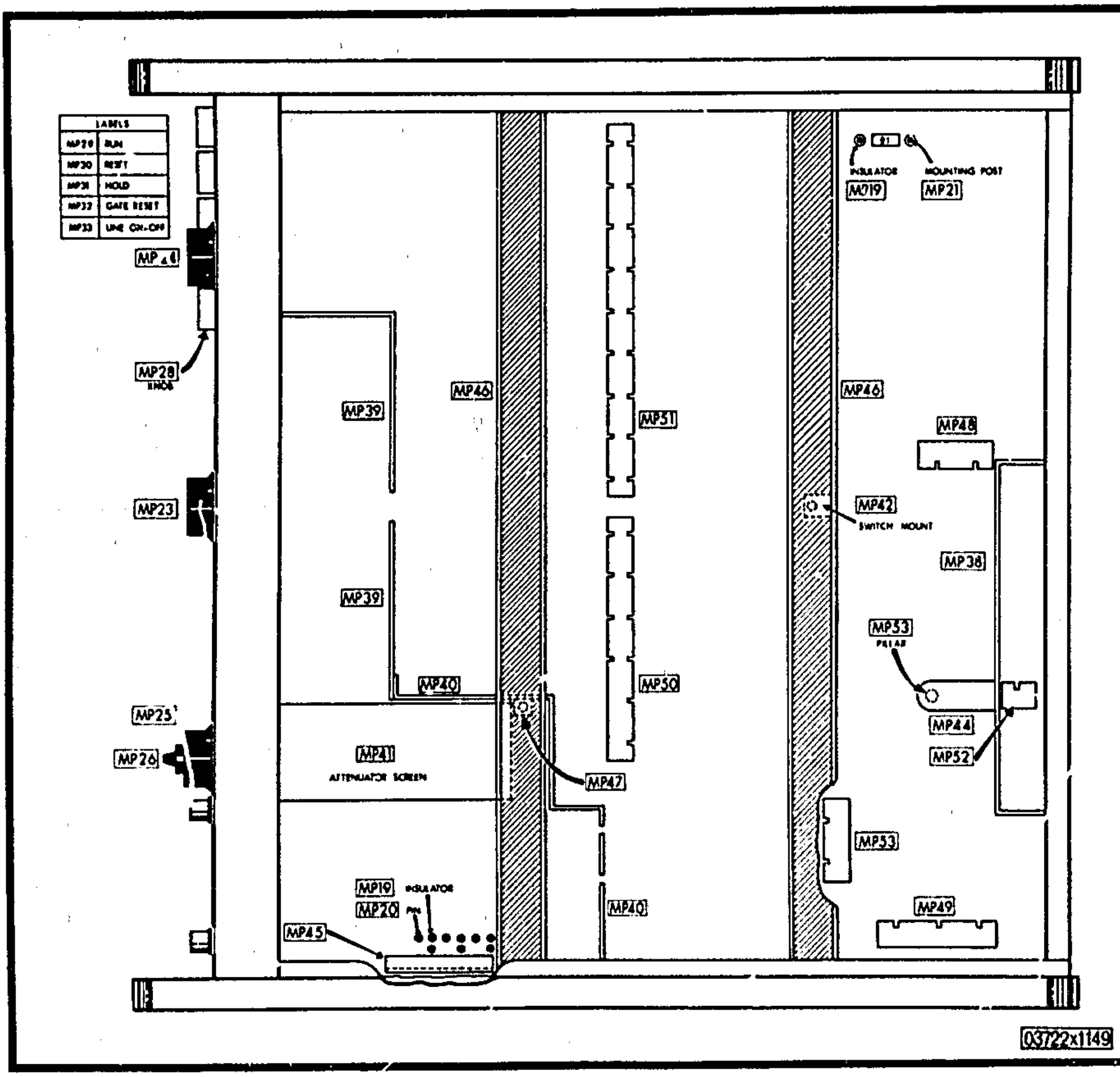



Figure 6 - 2 Location of mechanical parts

# SECTION VII
# OPTION 01

*Sequence shift for zero time moment*

## 7-1 INTRODUCTION

7-2 Time averages taken over one period of a pseudo-random sequence are normally independent of the point in time at which the averaging starts. However, when the test signal is contaminated by background disturbances such as steady drift – as occurs in many practical systems – the result of the averaging measurement can be in error. In such cases, the magnitude and sign of the error depend critically on the starting point of the averaging process. In Option 01 versions of the *hp 3722A*, an optimum starting point (identified by the sync pulse) has been chosen for each of the seven shortest sequences (N = 15 to N = 1023). This optimisation is such that the first time moment of the pseudo-random binary sequence, with respect to the sync pulse, is zero.

## 7-3 SEQUENCE ADVANCE ASSEMBLY A40

7-4 Logic diagram and typical waveforms are given in Figure 7-1. For circuit details, refer to Figure 7-4. General information on the technique of sequence shifting used in the *hp 3722A* is given in Paragraphs 4-24 to 4-27.

7-5 The two main inputs to the assembly, at A40(14) and A40(15), are a selected pair of binary signals from the shift register: selection is performed by wafers S2HF and S2JR of the SEQUENCE LENGTH switch. A40Q1+Q2+Q3 generate the modulo-two sum of the input pair, and supply the result to a second modulo-two adder, A40Q4+Q5+Q6. The other input of the second adder is taken from the CONTROL receptacle on the rear panel: when pin 21 of this receptacle is open-circuit (the normal condition), the binary waveform from the first modulo-two adder passes without modification through the second. If pin 21 is grounded, however, the second adder receives in effect a permanent '1' input which *inverts the binary waveform.* A40Q8 +Q9 is a conventional flip-flop of the type used in the shift register (Paragraphs 4-59 to 4-61). The output from the flip-flop is a delayed, inverted version of that from the second modulo-two adder.

7-6 Pairs of shift register outputs selected by the SEQUENCE LENGTH switch are as follows (refer to block diagram, Figure 8-5):-

| SEQUENCE LENGTH switch setting | Shift register outputs |
|---|---|
| N= 15 | 2 and 8 |
| N= 31 | 5 and 11 |
| N= 63 | 5 and 2 |
| N= 127 | 26 and 2 |
| N= 255 | 30 and 11 |
| N= 511 | 10 and 26 |
| N=1023 | 3 and 8 |

## 7-7 CONVERSION TO OPTION 01

7-8 To convert a standard *hp 3722A* instrument into an Option 01 version, proceed as follows:-

(1) Remove the wire link between pins 1 and 4 of socket XA40.

(2) Insert into socket XA40 a Sequence Advance Assembly, *hp* part number *03722-739.*

(3) Check operation of the converted instrument as detailed in Figure 7-2.

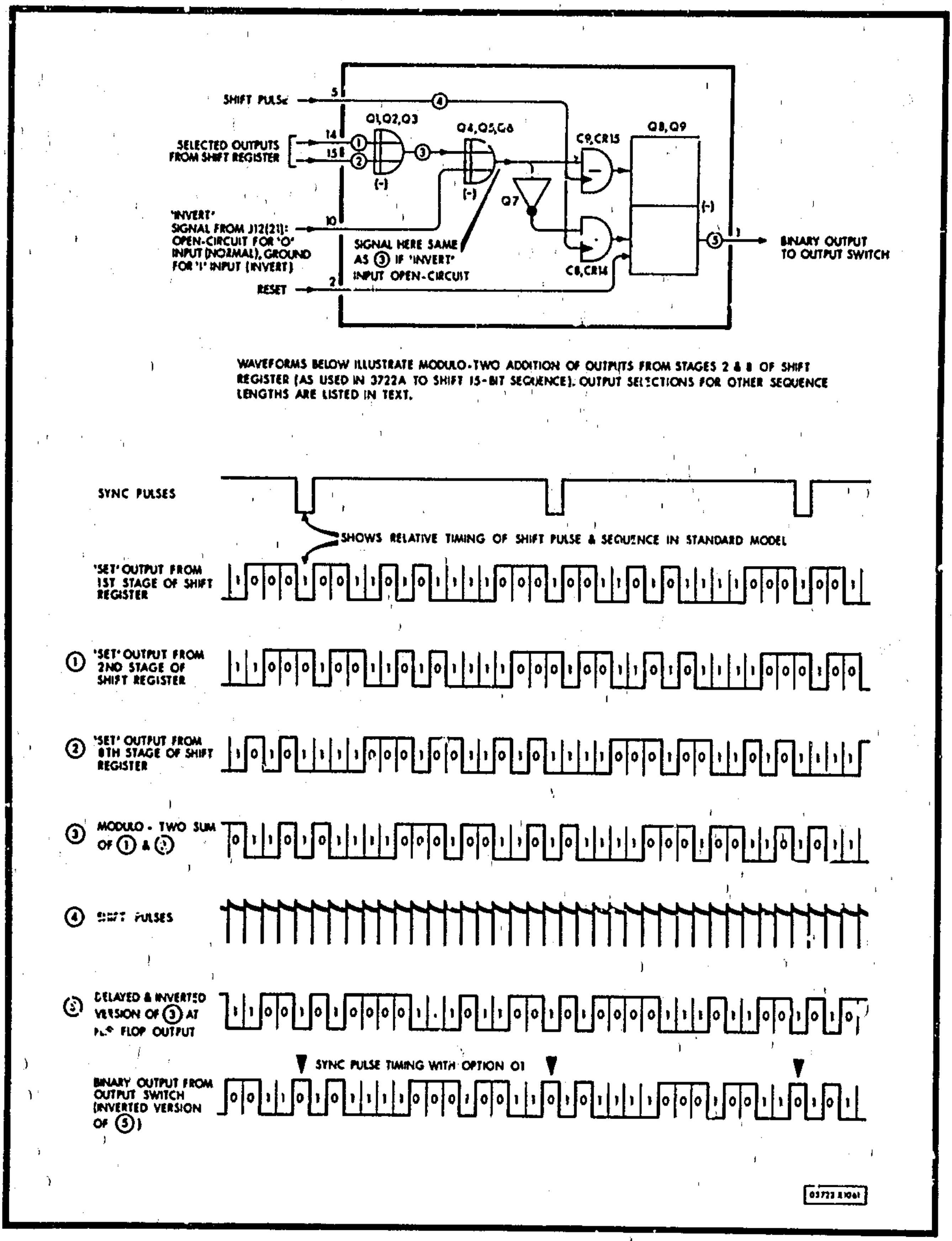
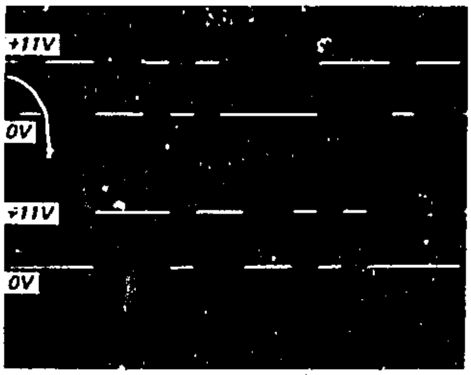
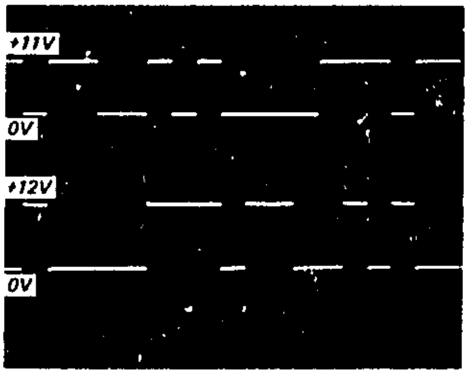


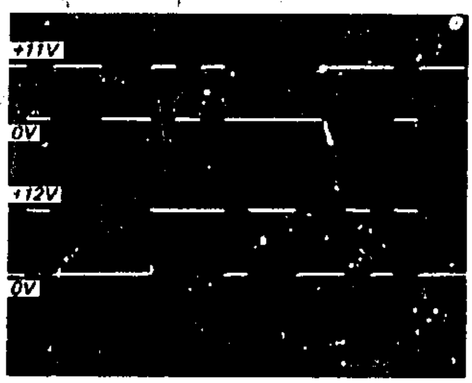

Figure 7 - 1 Generation of shifted sequence



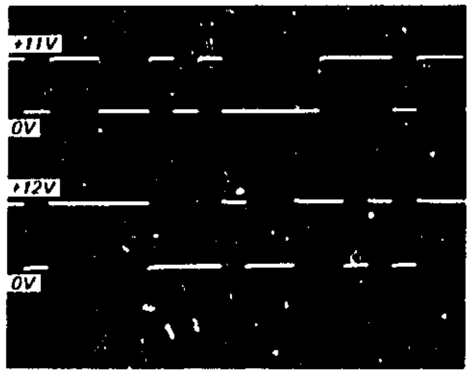

**Upper trace** input to A40(14), 10V/cm
**Lower trace** input to A40(15), 10V/cm
**Clock period** 10$\mu$S **N** = 15
**Sweep** 20$\mu$S/cm
**Trigger** from *3722A* SYNC



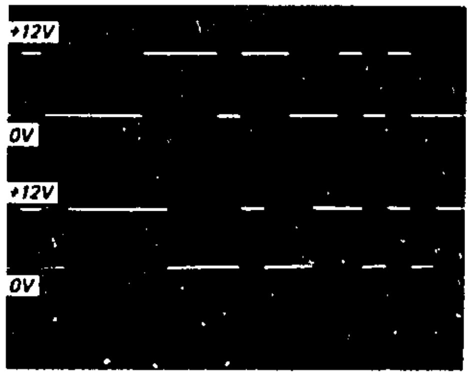

**Upper trace** input to A40(14), 10V/cm
**Lower trace** A40Q2 & A40Q3 collectors, 10V/cm
**Clock period** 10$\mu$S **N** = 15
**Sweep** 20$\mu$S/cm
**Trigger** from *3722A* SYNC




**Upper trace** input to A40(14), 10V/cm
**Lower trace** A40Q5 & A40Q6 collectors, 10V/cm, with input A40(10) open-circuit. In this condition there is no inversion – so the waveforms are exactly as before.
**Clock period** 10$\mu$S **N** = 15
**Sweep** 20$\mu$S/cm
**Trigger** from *3722A* SYNC




**Upper trace** input to A40(14), 10V/cm
**Lower trace** A40Q5 & A40Q6 collectors, 10V/cm, with A40(10) grounded. (A40(10) is brought out to J12(21) on the rear panel). Note inversion of lower trace compared with preceding waveforms.
**Clock period** 10$\mu$S **N** = 15
**Sweep** 20$\mu$S/cm
**Trigger** from *3722A* SYNC




**Upper trace** A40Q5 & A40Q6 collectors, 10V/cm, with A40(10) open-circuit
**Lower trace** A40Q9C (output from sequence advance assembly), 10V/cm
**Clock period** 10$\mu$S **N** = 15
**Sweep** 20$\mu$S/cm
**Trigger** from *3722A* SYNC

TO OBTAIN TRACES FOR THE FIRST EIGHT SEQUENCES, N = 15 TO N = 2047, TRIGGER OSCILLOSCOPE WITH 3722A SYNC PULSE: DISPLAY BINARY OUTPUT & SYNC PULSE SIMULTANEOUSLY, WITH CLOCK PERIOD 1$\mu$S & SWEEP TIME 2$\mu$S/CM. EXAMINE ONLY FIRST n BITS OF EACH SEQUENCE ($N = 2^n - 1$)

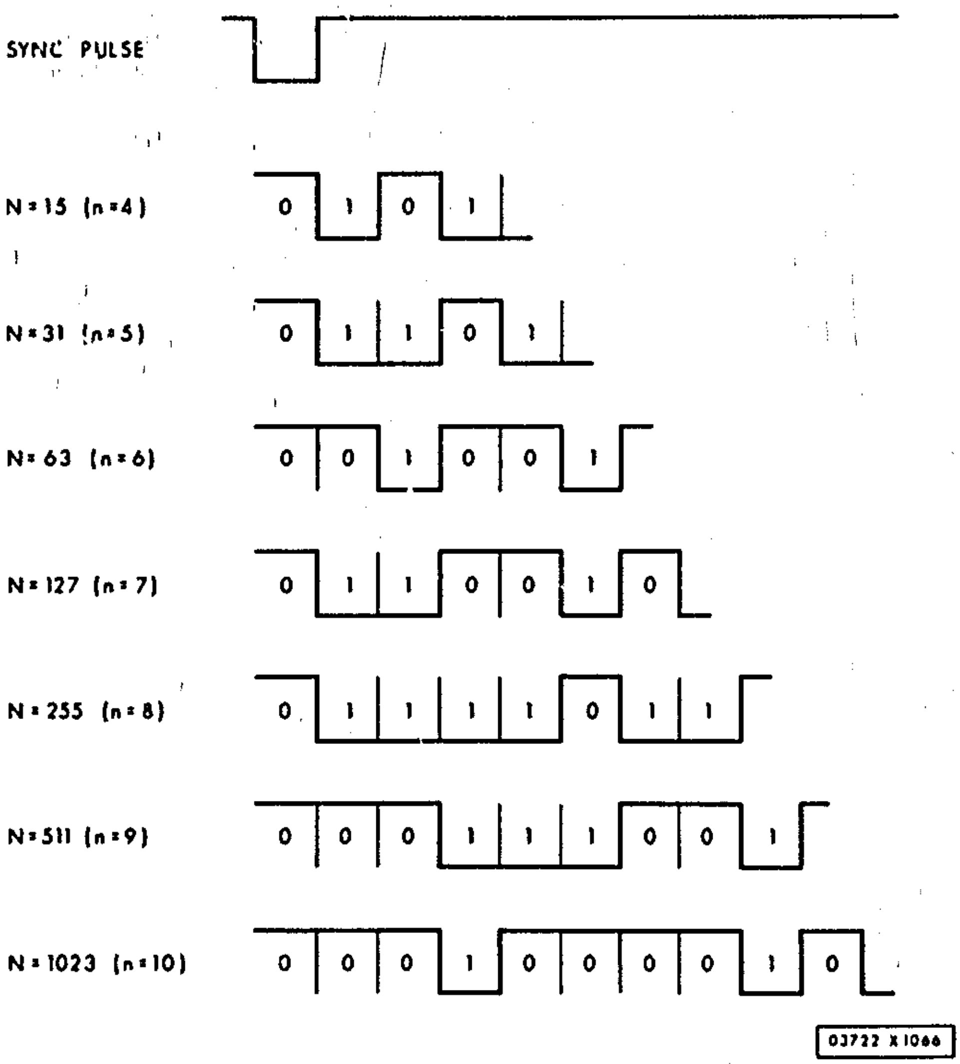



**Figure 7 - 2 Sequence shift check**

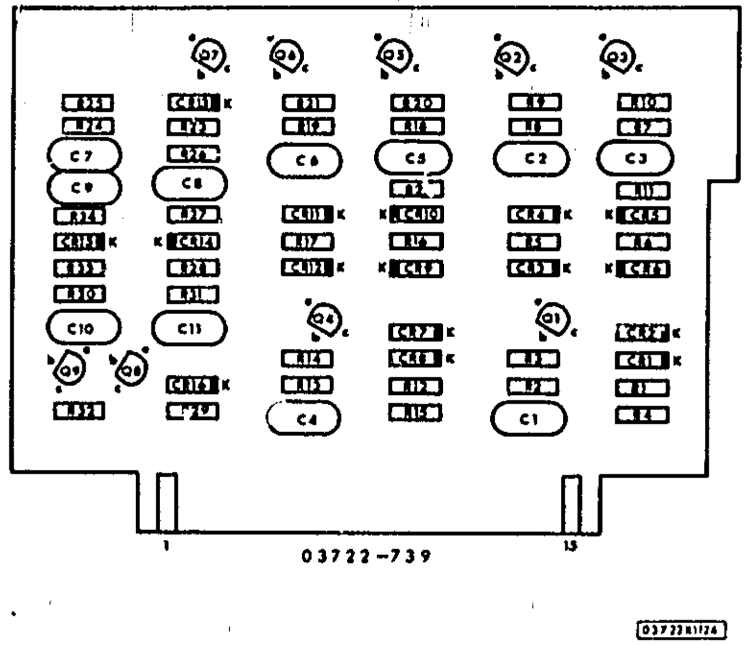



Figure 7 - 3 Sequence advance assembly A40, component location

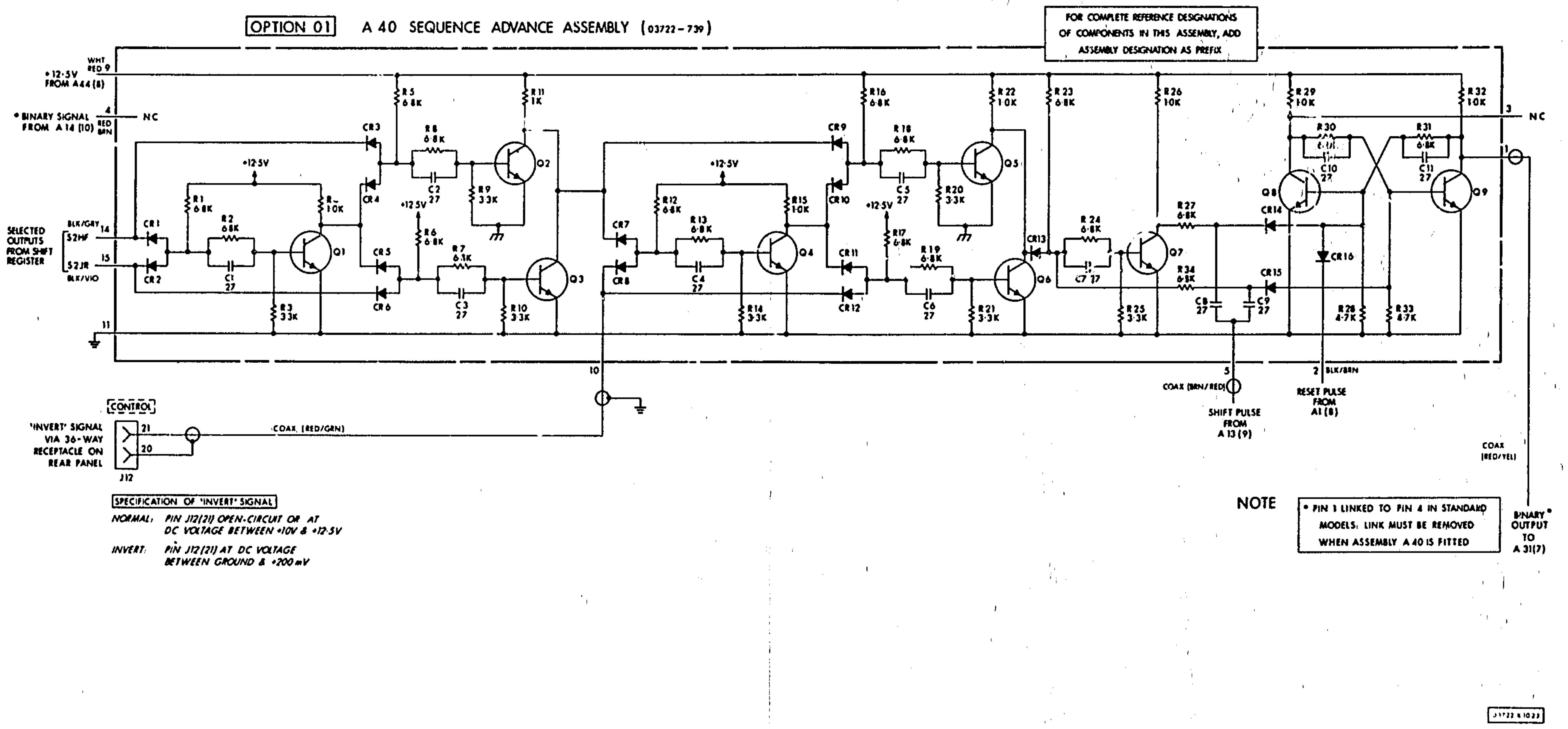



Figure 7 - 4 Sequence advance assembly A40, schematic

| | | |
|---|---|---|
| A40 | 03722-739 | ASSY: SEQUENCE ADVANCE |
| | 03722-339 | BOARD: BLANK PC (NSR) |
| A40C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A40CR1 | 1901-0040 | DIODE: SI |
| A40CR2 | 1901-0040 | DIODE: SI |
| A40CR3 | 1901-0040 | DIODE: SI |
| A40CR4 | 1901-0040 | DIODE: SI |
| A40CR5 | 1901-0040 | DIODE: SI |
| A40CR6 | 1901-0040 | DIODE: SI |
| A40CR7 | 1901-0040 | DIODE: SI |
| A40CR8 | 1901-0040 | DIODE: SI |
| A40CR9 | 1901-0040 | DIODE: SI |
| A40CR10 | 1901-0040 | DIODE: SI |
| A40CR11 | 1901-0040 | DIODE: SI |
| A40CR12 | 1901-0040 | DIODE: SI |
| A40CR13 | 1901-0040 | DIODE: SI |
| A40CR14 | 1901-0040 | DIODE: SI |
| A40CR15 | 1901-0040 | DIODE: SI |
| A40CR16 | 1901-0040 | DIODE: SI |
| A40Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q7 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A40Q9 | 1854-0605 | TRANSISTOR: SI NPN |

| | | |
|---|---|---|
| A40R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R3 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A40R4 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A40R5 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R7 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R9 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A40R10 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A40R11 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A40R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R14 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A40R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A40R16 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R20 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A40R21 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A40R22 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A40R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R25 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A40R26 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A40R27 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R28 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A40R29 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A40R30 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R31 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A40R32 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A40R33 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A40R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |

# SECTION VIII
# SCHEMATICS, COMPONENT LOCATION DIAGRAMS, WAVEFORMS & SERVICE NOTES

## 8-1 INTRODUCTION

8-2 This section contains all circuit diagrams and component location diagrams, in assembly number order. Where necessary, oscilloscope waveforms and explanatory notes are included. Detailed trouble-shooting information is given for the following assemblies:

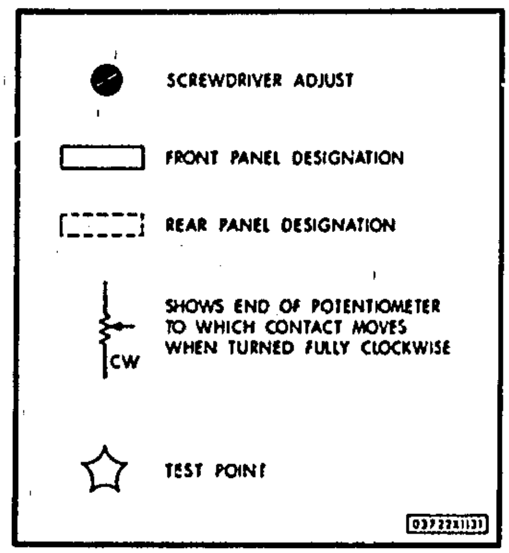
Digital filters A15, A18, A21 and A24

Random noise system A29 and A30

Analog filters A33 and A34

Output amplifiers A35, A36 and A37

On the reverse of each circuit diagram is component list extracted from Table 6-1.



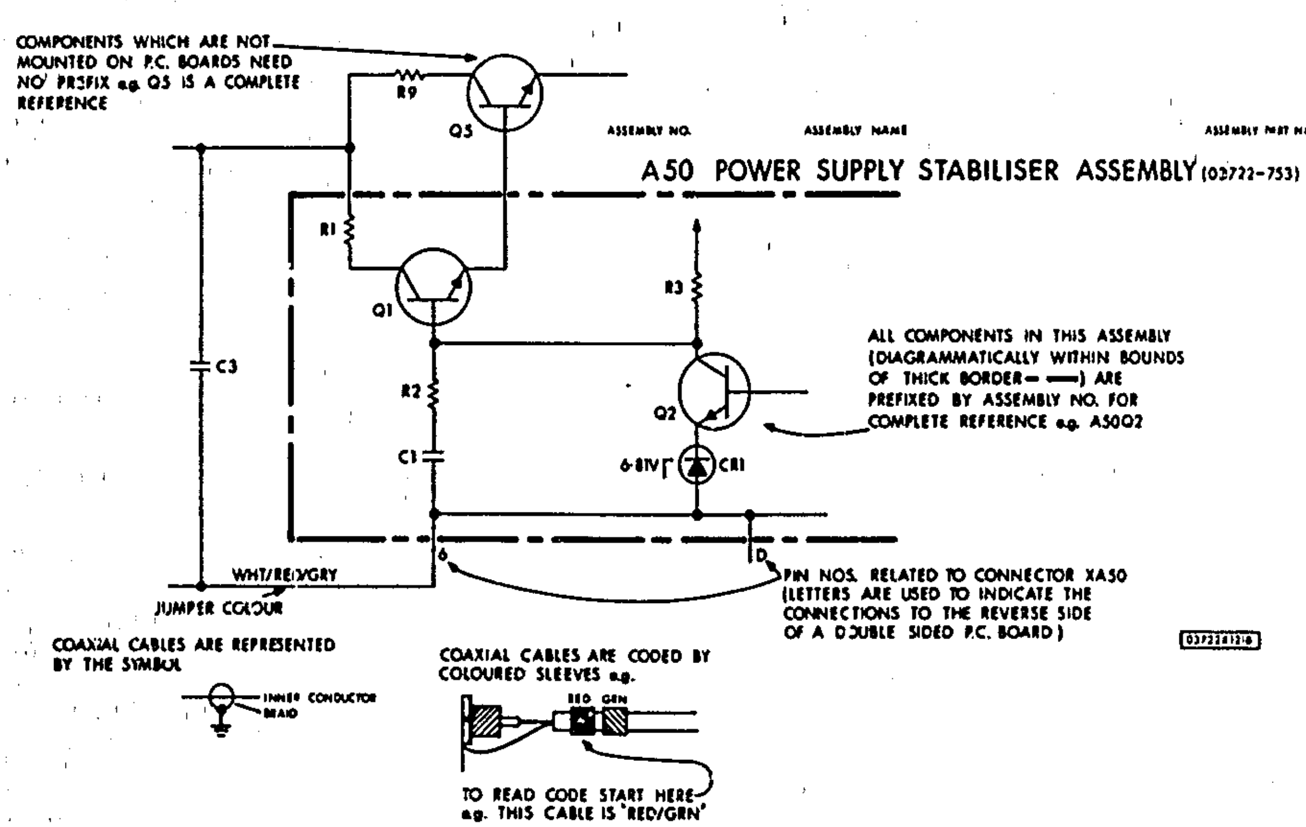




**Figure 8 - 1 Guide to schematics**

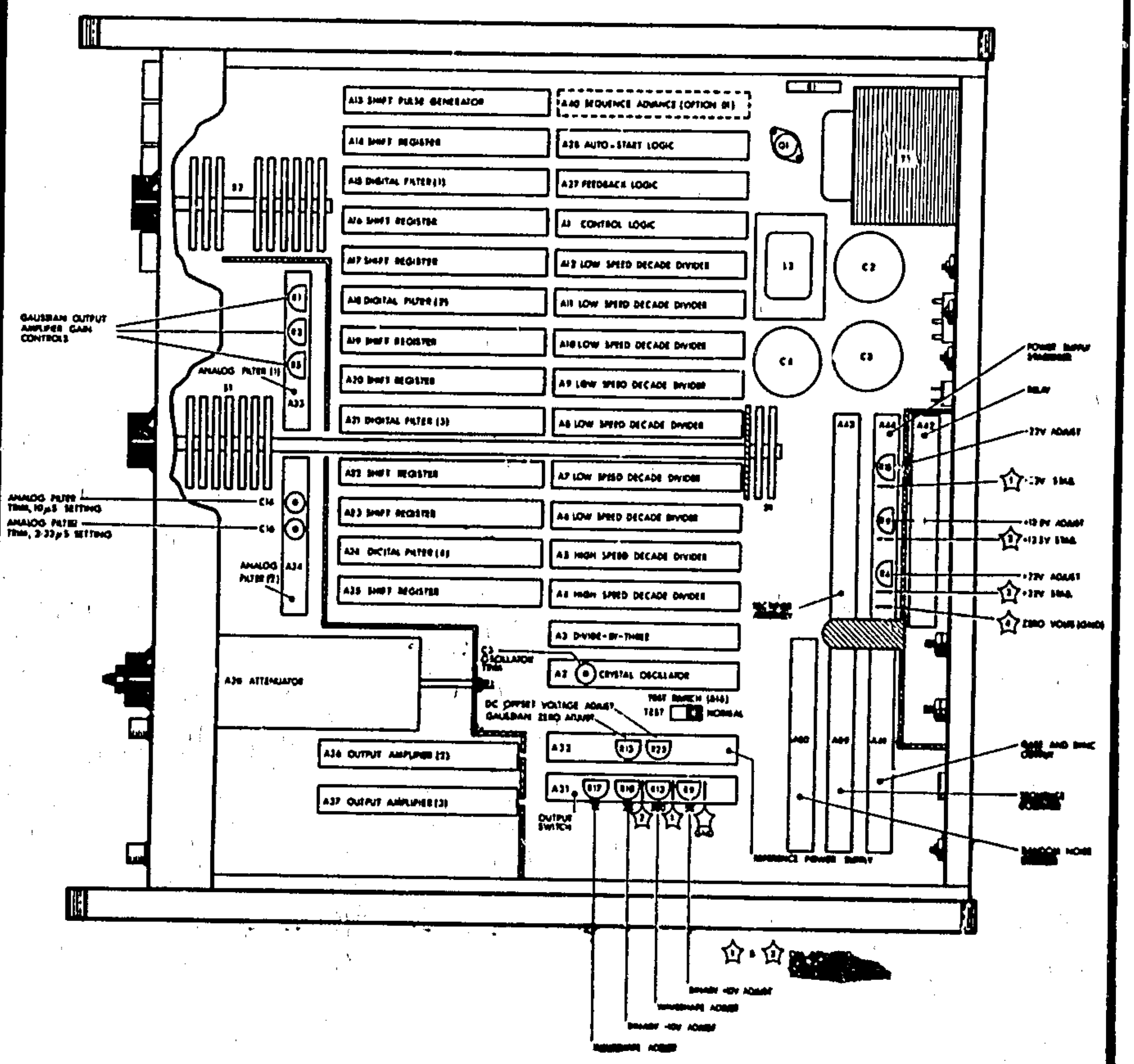



Figure 8 - 2 Location of assemblies

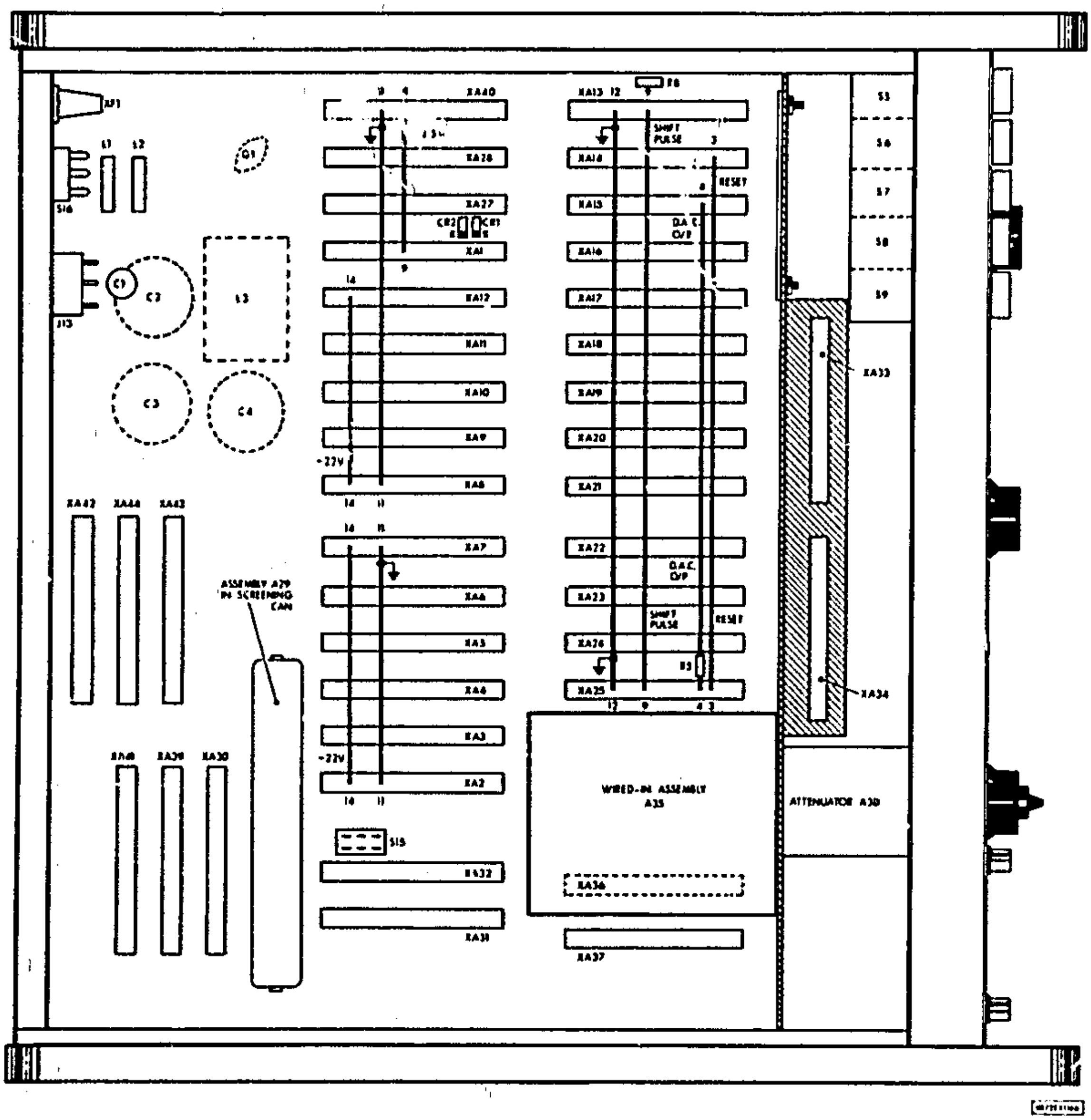



Figure 8 - 3 Location of chassis mounted components

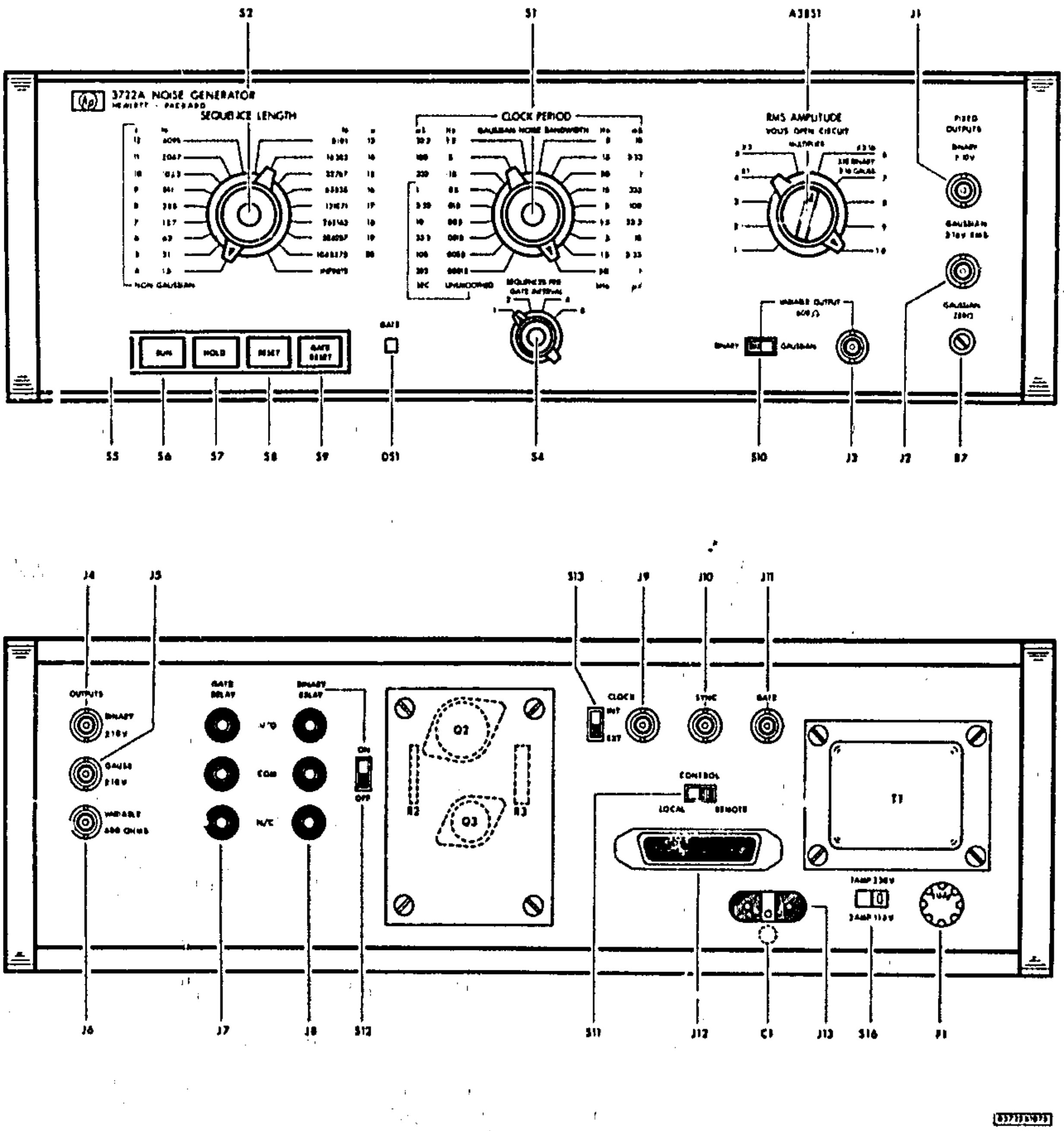
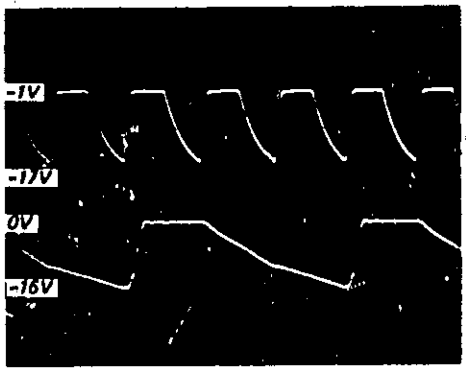
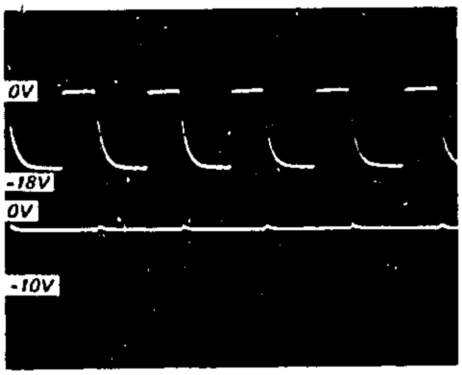


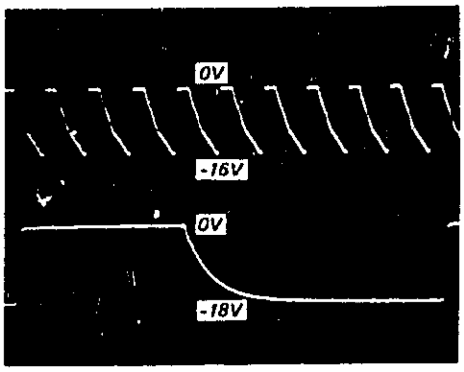

**Figure 8 - 4 Location of components on front & rear panels**



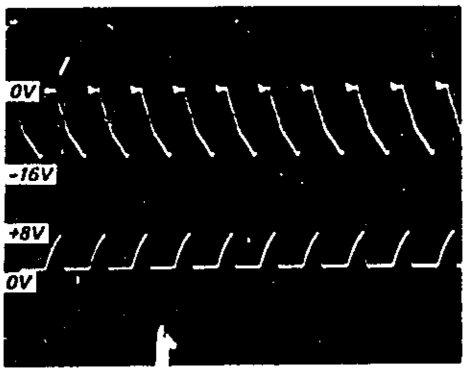

**Upper trace** crystal oscillator output A2(6), 10V/cm
**Lower trace** ÷3 output A3(9), 10V/cm
**Clock period** 1$\mu$S **Sweep** 0.2$\mu$S/cm
**Trigger** internal



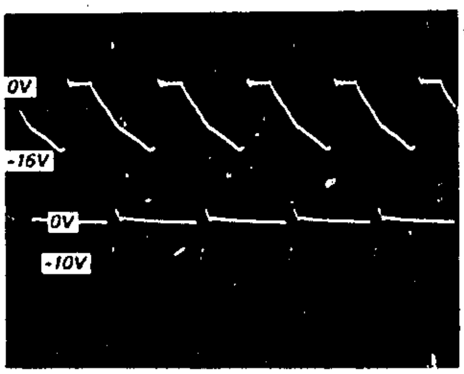

**Upper trace** clock input to shift pulse generator A13(3), 10V/cm
**Lower trace** shift pulse A13(9), 10V/cm
**Clock period** 10$\mu$S **Sweep** 5$\mu$S/cm
**Trigger** internal



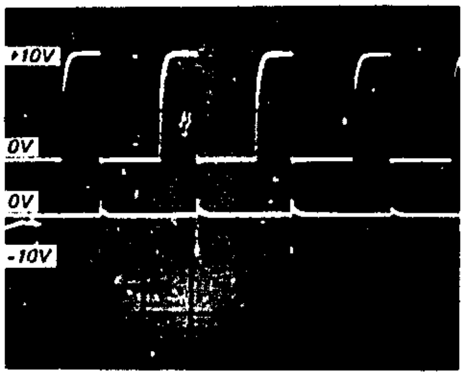

**Upper trace** ÷3 output A3(9), 10V/cm
**Lower trace** ÷10 output A4(13), 10V/cm
**Clock period** 1$\mu$S **Sweep** 1$\mu$S/cm
**Trigger** internal



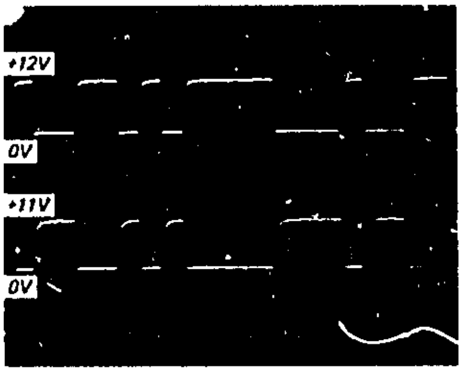

**Upper trace** clock input to A13(3), 10V/cm
**Lower trace** clock output at A13(7), 10V/cm
**Clock period** 1$\mu$S **Sweep** 1$\mu$S/cm
**Trigger** internal



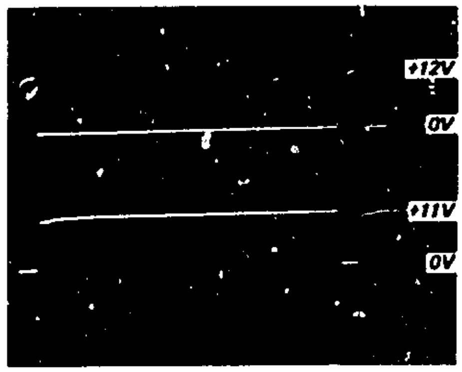

**Upper trace** clock input to shift pulse generator A13(3), 10V/cm
**Lower trace** shift pulse A13(9), 10V/cm
**Clock period** 1$\mu$S **Sweep** 0.5$\mu$S/cm
**Trigger** internal



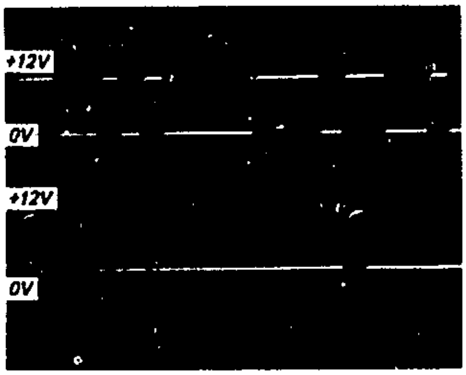

**Upper trace** clock input to random noise sampler A30(1), 5V/cm
**Lower trace** shift pulse at A13(9), 10V/cm
**Clock period** 10$\mu$S **Sweep** 5$\mu$S/cm
**Trigger** from *3722A* CLOCK



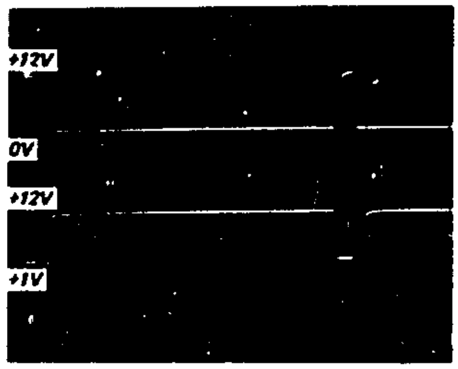

**Upper trace** shift register output A14(10), 10V/cm
**Lower trace** shift register output A14(11), 10V/cm
**Clock period** 1$\mu$S **N** = 15 **Sweep** 2$\mu$S/cm
**Trigger** from *3722A* SYNC



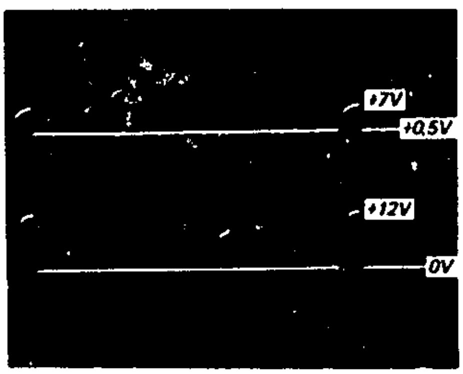

**Upper trace** sync pulse from A28(14) to A41(3), 10V/cm
**Lower trace** sync pulse from A41(1) to sequence counter, 10V/cm
**Clock period** 1$\mu$S **N** = 15 **Sweep** 2$\mu$S/cm
**Trigger** from *3722A* SYNC



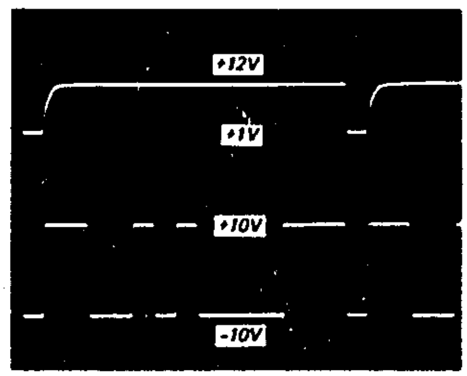

**Upper trace** feedback signal from A27(8), 10V/cm
**Lower trace** sync pulse from A28(14), 10V/cm
**Clock period** 1$\mu$S **N** = 15 **Sweep** 2$\mu$S/cm
**Trigger** from *3722A* SYNC




**Upper trace** sync pulse at A41(3), 10V/cm
**Lower trace** SYNC output from A41(2), 10V/cm
**Clock period** 1$\mu$S **N** = 15 **Sweep** 2$\mu$S/cm
**Trigger** from *3722A* SYNC



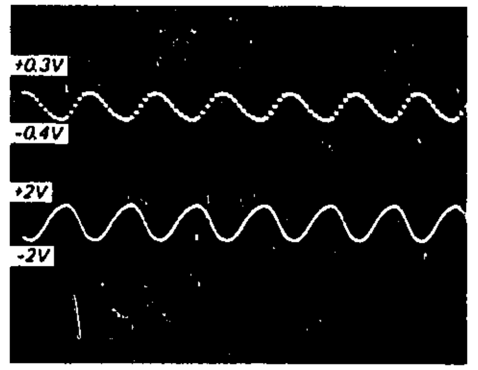

**Upper trace** 'all zeros' signal to A28(15), 10V/cm
**Lower trace** sync pulse from A28(14), 10V/cm
**Clock period** 1$\mu$S **N** = 15 **Sweep** 2$\mu$S/cm
**Trigger** from *3722A* SYNC



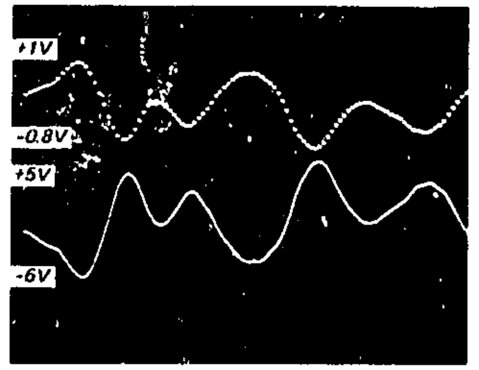

**Upper trace** SYNC pulse at A41(2), 10V/cm
**Lower trace** BINARY output at A31(6), 10V/cm
**Clock period** 1$\mu$S N=15 **Sweep** 2$\mu$S/cm
**Trigger** from *3722A* SYNC

**All photographs**

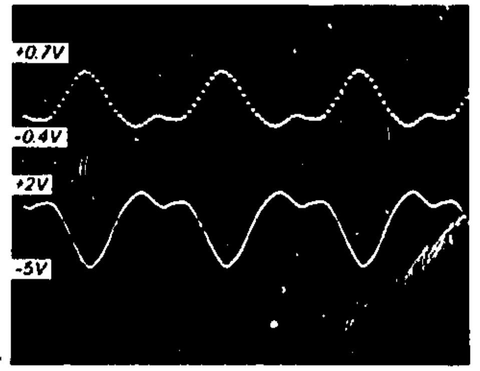
**Upper trace** digital filter output at A22(4) 1V/cm
**Lower trace** GAUSSIAN output at J2, 5V/cm
**Clock period** 1$\mu$S **Sweep** 10$\mu$S/cm
**Trigger** from *3722A* SYNC



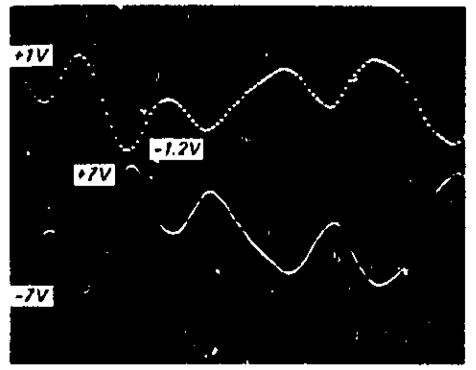

N = 15



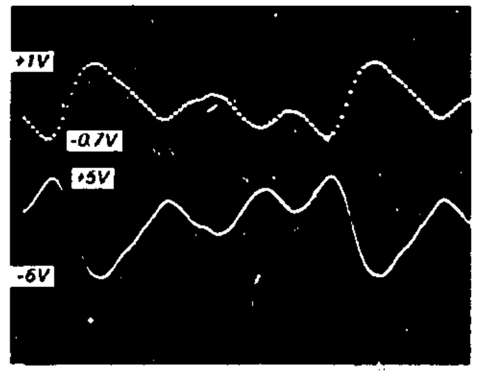

N = 127



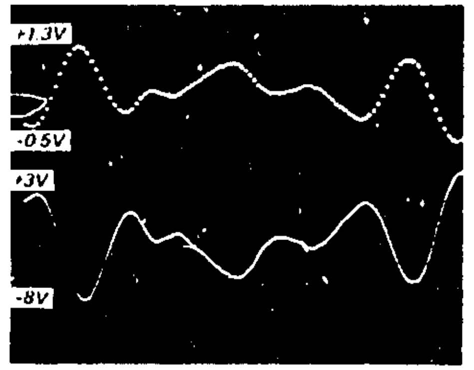

N = 31




N = 255




N = 63




N = 511

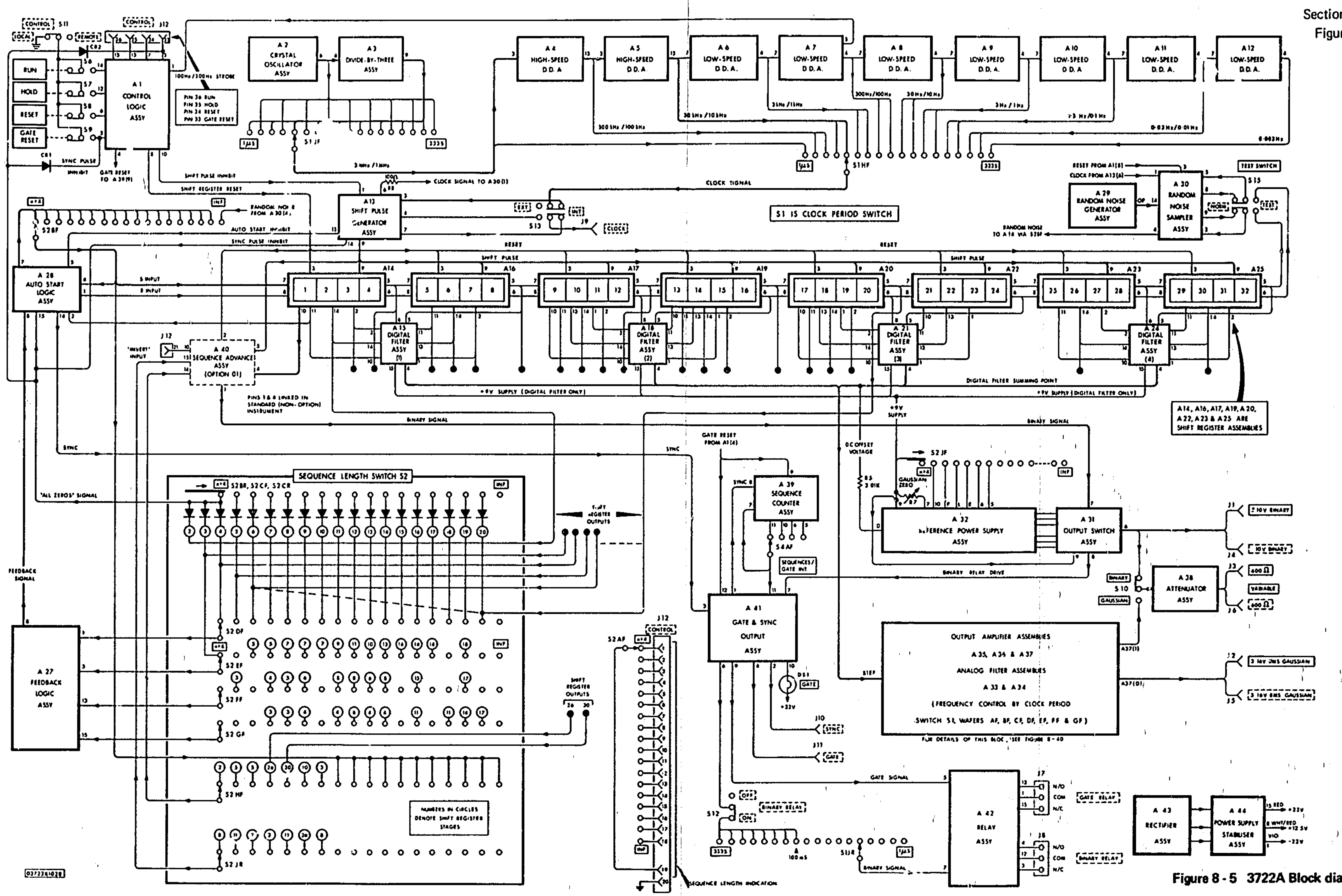



**Figure 8 - 5 3722A Block diagram**

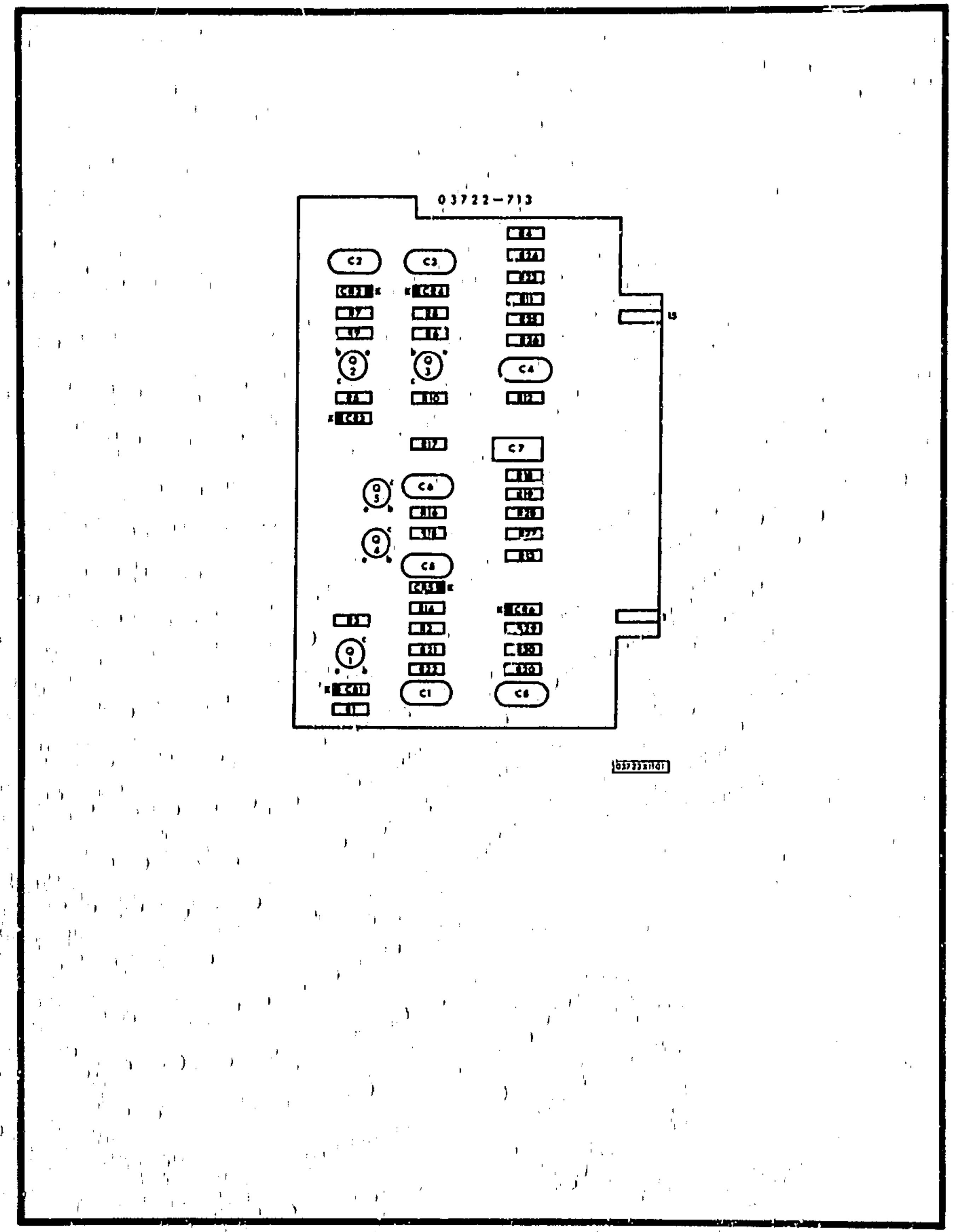



Figure 8 - 6 Control logic assembly A1, component location

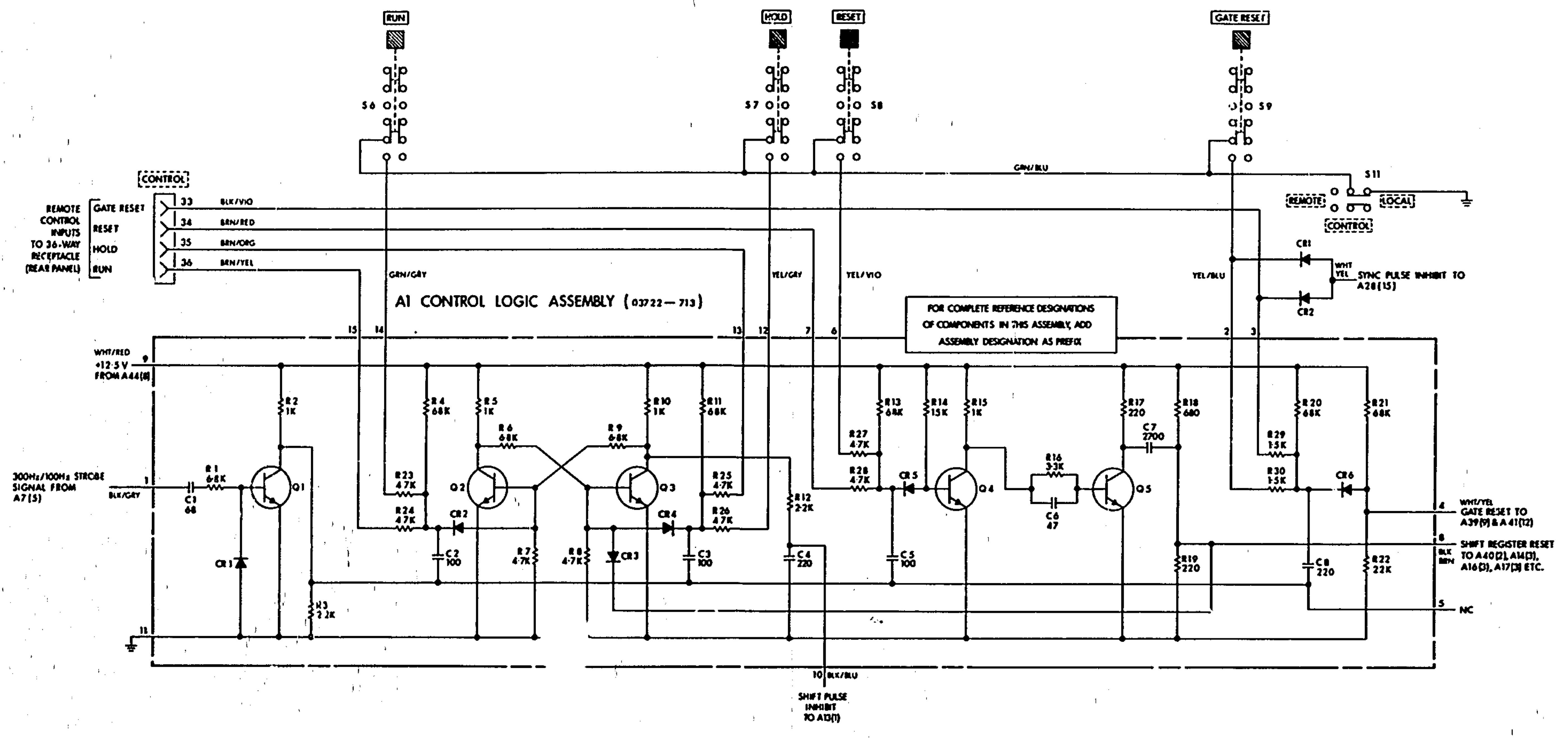
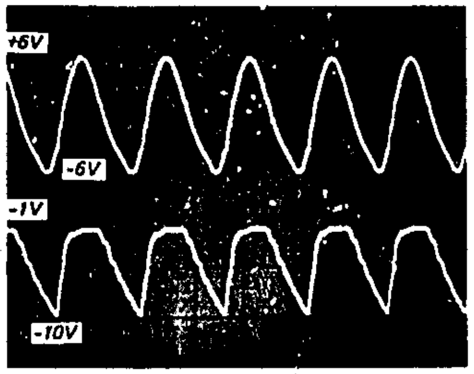


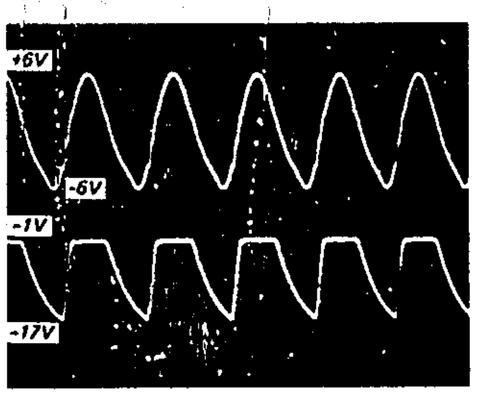

Figure 8 - 7 Control logic assembly A1, schematic

| | | |
|---|---|---|
| A1 | 03722-713 | ASSY: CONTROL LOGIC |
| | 03722-313 | BOARD: BLANK PC (NSR) |
| A1C1 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A1C2 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A1C3 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A1C4 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW |
| A1C5 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A1C6 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A1C7 | 0160-0300 | C: FXD MY 2700PF 10% 200VDCW |
| A1C8 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW |
| A1CR1 | 1901-0040 | DIODE: SI |
| A1CR2 | 1901-0040 | DIODE: SI |
| A1CR3 | 1901-0040 | DIODE: SI |
| A1CR4 | 1901-0040 | DIODE: SI |
| A1CR5 | 1901-0040 | DIODE: SI |
| A1CR6 | 1901-0040 | DIODE: SI |
| A1Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A1Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A1Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A1Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A1Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A1R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A1R2 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A1R3 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A1R4 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A1R5 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A1R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A1R7 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R8 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A1R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A1R11 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A1R12 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A1R13 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A1R14 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W |
| A1R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A1R16 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A1R17 | 0758-0015 | R: FXD MET OX 220 OHM 5% 1/2W |
| A1R18 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W |
| A1R19 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A1R20 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A1R21 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A1R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A1R23 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R24 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R25 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R26 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R27 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R28 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A1R29 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |
| A1R30 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |

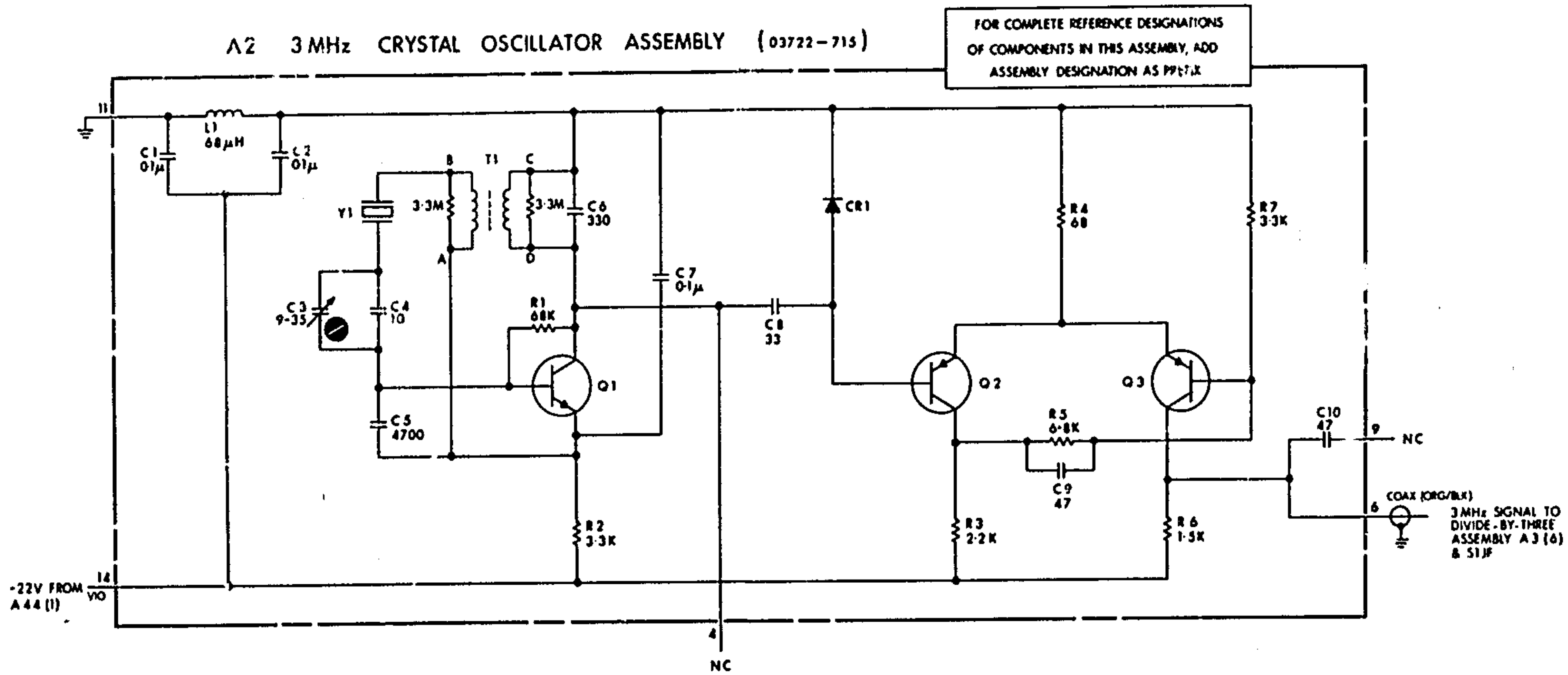
**A2 Test waveforms**




**Upper trace** A2Q1C, 5V/cm
**Lower trace** A2Q3C, 5V/cm
**Clock period** 3.33$\mu$S, 33.3$\mu$S, etc
**Sweep** 0.2$\mu$S/cm
**Trigger** internal




**Upper trace** A2Q1C, 5V/cm
**Lower trace** A2Q3C, 10V/cm
**Clock period** 1$\mu$S, 10$\mu$S, etc
**Sweep** 0.2$\mu$S/cm
**Trigger** internal



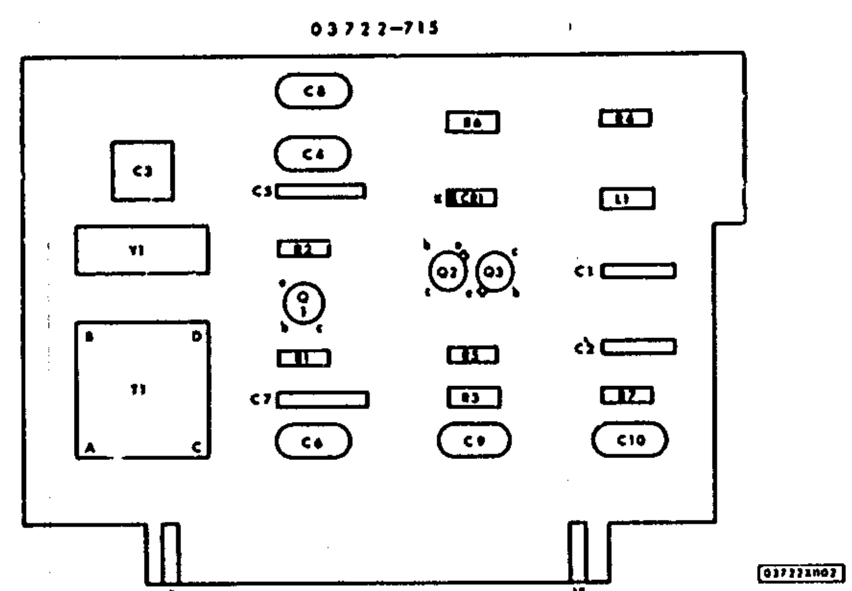




**Figure 8 - 8 Crystal oscillator assembly A2, schematic & component location**

| | | |
|---|---|---|
| A2 | 03722-715 | ASSY: CRYSTAL OSCILLATOR |
| | 03722-315 | BOARD: BLANK PC (NSR) |
| A2C1 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A2C2 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A2C3 | 0121-0105 | C: VAR CER 9-35PF |
| A2C4 | 0160-2197 | C: FXD MICA 10PF 5% 300VDCW |
| A2C5 | 0150-0086 | C: FXD CER 4700PF 20% 500VDCW |
| A2C6 | 0160-2208 | C: FXD MICA 330PF 5% 300VDCW |
| A2C7 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A2C8 | 0160-0179 | C: FXD MICA 33PF 5% 300VDCW |
| A2C9 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A2C10 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A2CR1 | 1901-0040 | DIODE: SI |
| A2L1 | 9100-1633 | L: FXD COIL 68UH 5% |
| A2MP1 | 0380-0509 | BEAD: GLASS |
| A2MP2 | 0380-0509 | BEAD: GLASS |
| A2Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A2Q2 | 1853-0034 | TRANSISTOR: SI PNP |
| A2Q3 | 1853-0034 | TRANSISTOR: SI PNP |
| A2R1 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A2R2 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A2R3 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W |
| A2R4 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W |
| A2R5 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A2R6 | 0758-0017 | R: FXD MET OX 1.5K OHM 5% 1/2W |
| A2R7 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A2T1 | 9100-0619 | TRANSFORMER: CRYSTAL OSCILLATOR |
| A2Y1 | 0410-0301 | CRYSTAL: QUARTZ 3MHz |

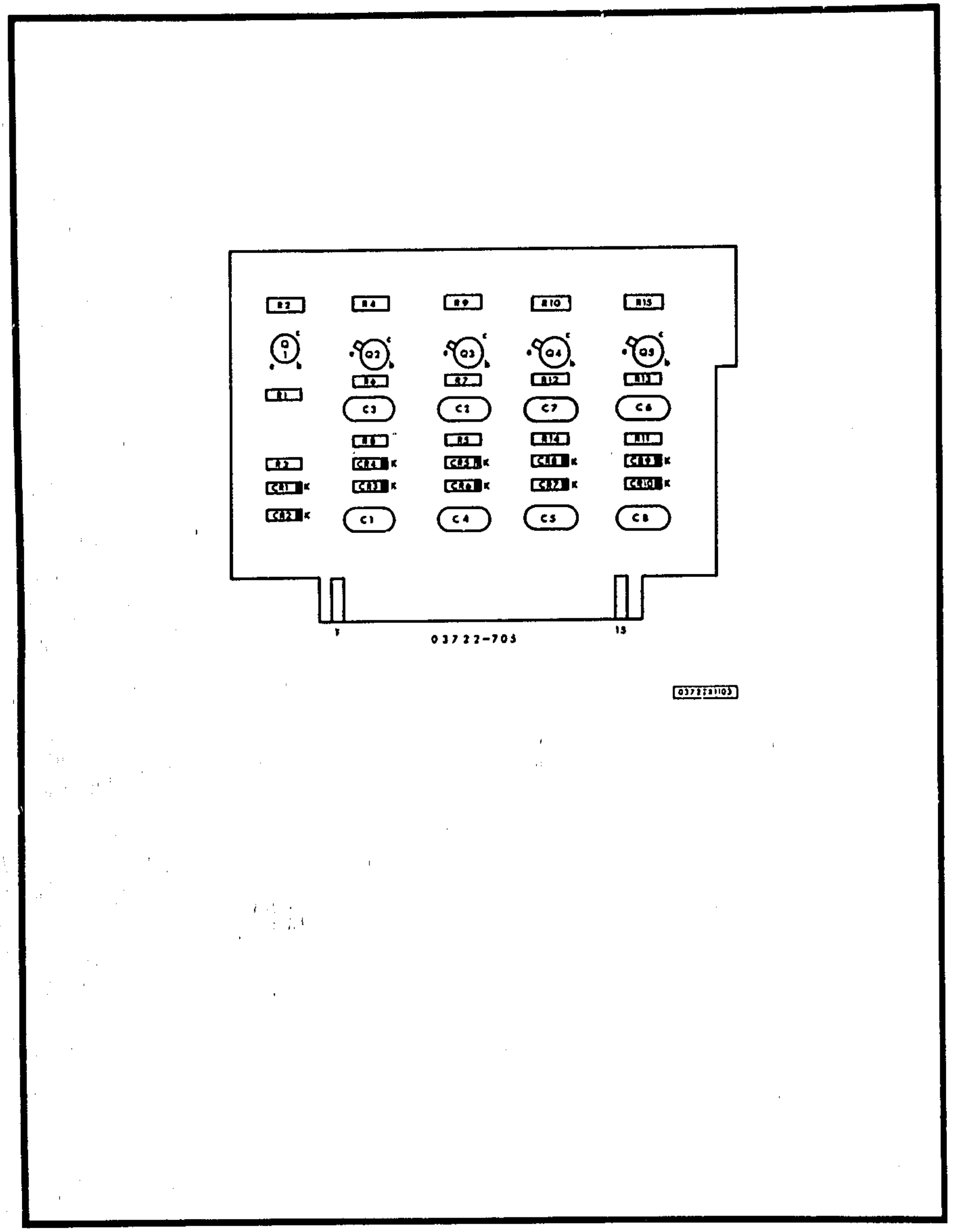



Figure 8 - 9 Divide-by-three assembly A3, component location

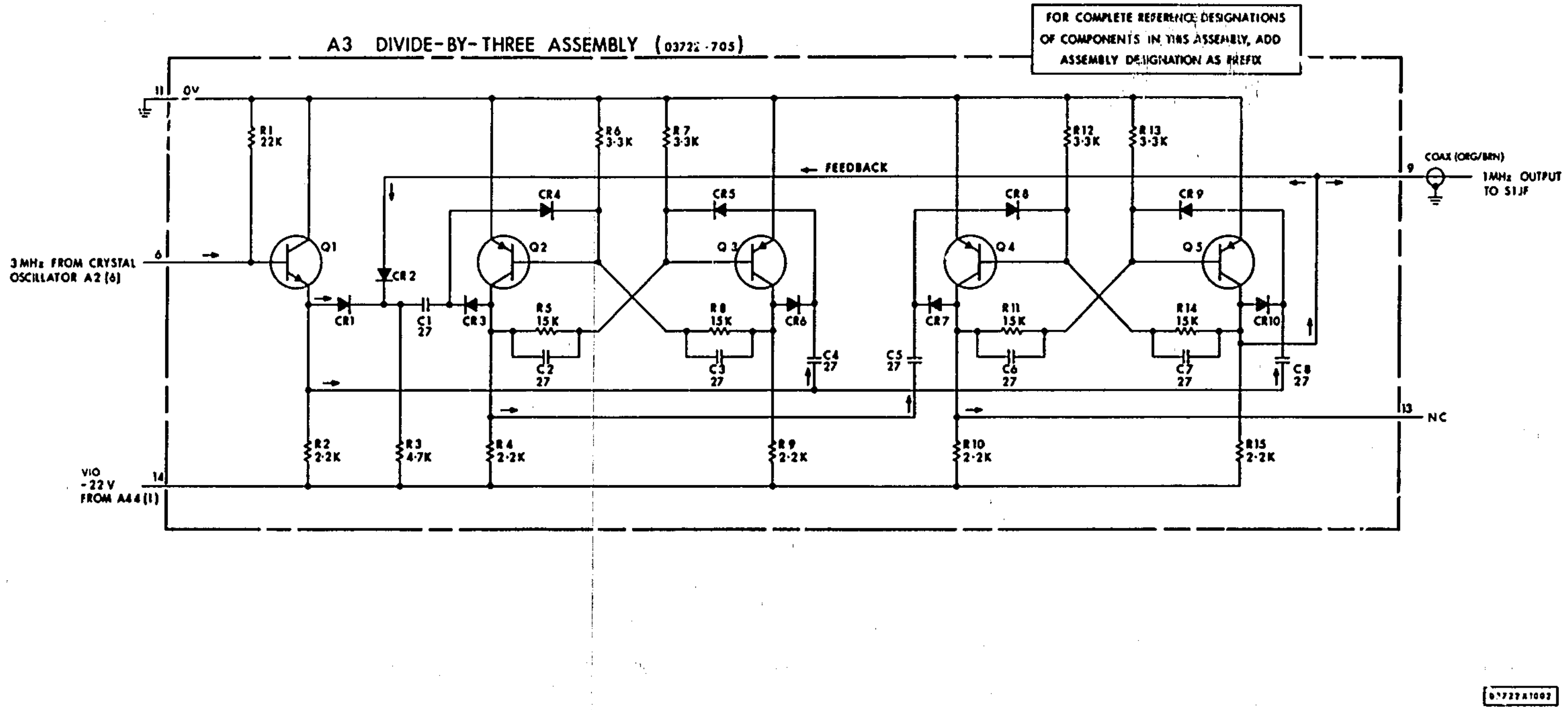



Figure 8 - 10 Divide-by-three assembly A3, schematic

| | | |
|---|---|---|
| A3 | 03722-705 | ASSY: DIVIDE-BY-THREE |
| | 03722-305 | BOARD: BLANK PC(NSR) |
| A3C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A3CR1 | 1901-0040 | DIODE: SI |
| A3CR2 | 1901-0040 | DIODE: SI |
| A3CR3 | 1901-0040 | DIODE: SI |
| A3CR4 | 1901-0040 | DIODE: SI |
| A3CR5 | 1901-0040 | DIODE: SI |
| A3CR6 | 1901-0040 | DIODE: SI |
| A3CR7 | 1901-0040 | DIODE: SI |
| A3CR8 | 1901-0040 | DIODE: SI |
| A3CR9 | 1901-0040 | DIODE: SI |
| A3CR10 | 1901-0040 | DIODE: SI |
| A3Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A3Q2 | 1853-0034 | TRANSISTOR: SI PNP |
| A3Q3 | 1853-0034 | TRANSISTOR: SI PNP |
| A3Q4 | 1853-0034 | TRANSISTOR: SI PNP |
| A3Q5 | 1853-0034 | TRANSISTOR: SI PNP |
| A3R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A3R2 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W |
| A3R3 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A3R4 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W |
| A3R5 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W |
| A3R6 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A3R7 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A3R8 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W |
| A3R9 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W |
| A3R10 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W |
| A3R11 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W |
| A3R12 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A3R13 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A3R14 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W |
| A3R15 | 0758-0044 | R: FXD MET FLM 2.2K OHM 5% 1/2W |

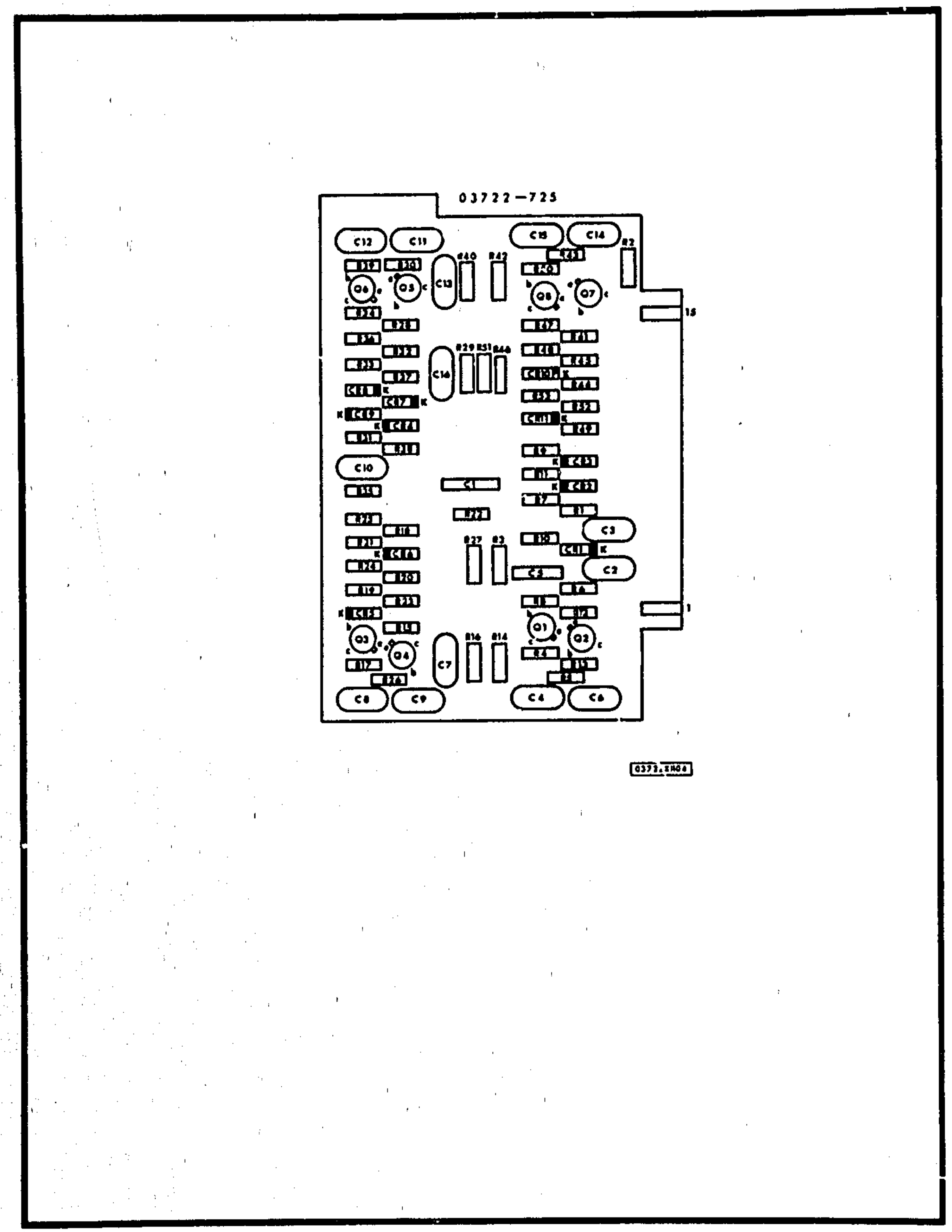



Figure 8 - 11 High speed decade divider assembly A4, A5; component location

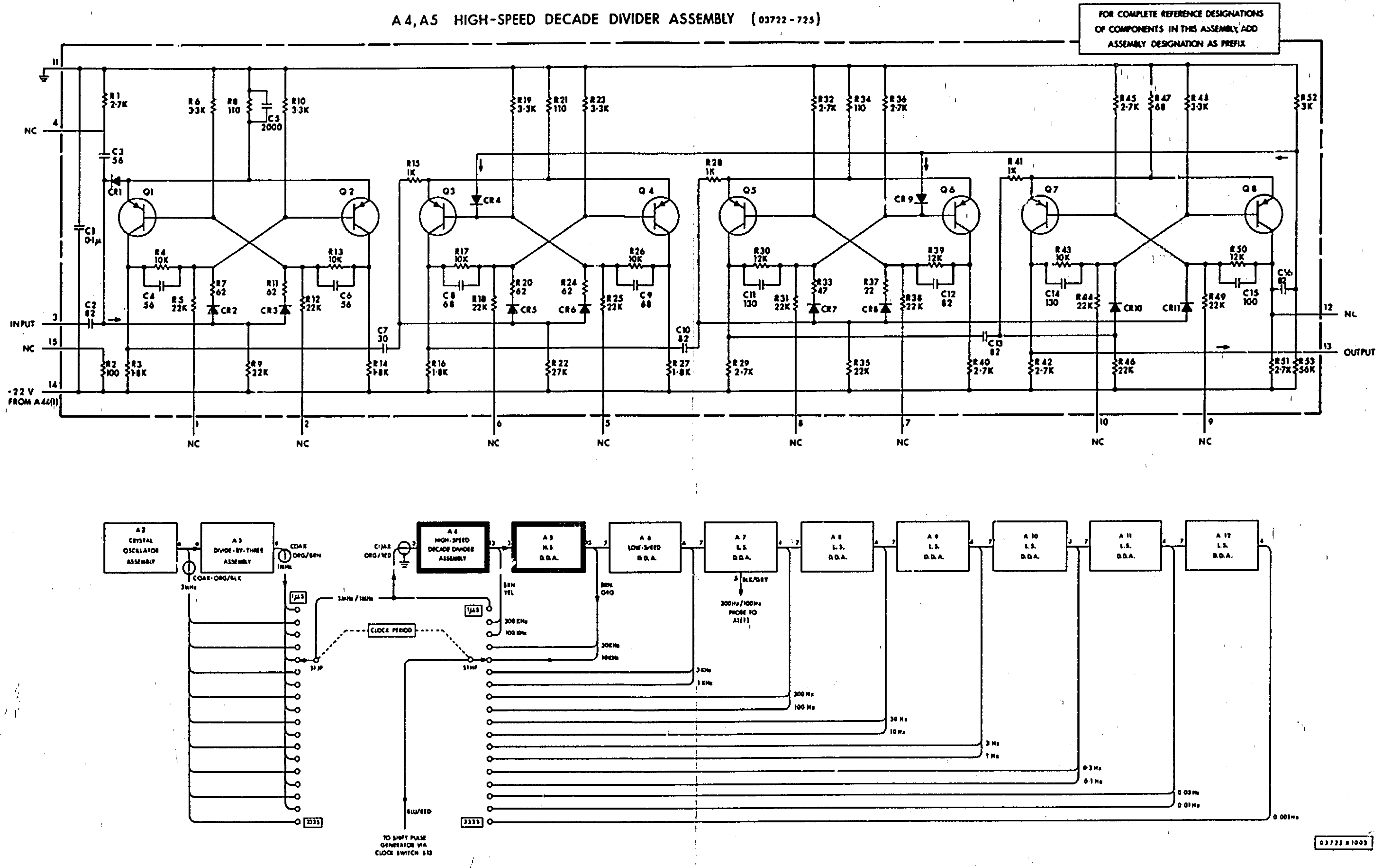



Figure 8 - 12 High speed decade divider assembly A4, A5; schematic

| | | |
|---|---|---|
| A4 | 03722-725 | ASSY: HIGH-SPEED DECADE DIVIDER |
| | 03722-325 | BOARD: BLANK PC (NSR) |
| A4C1 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A4C2 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW |
| A4C3 | 0140-0191 | C: FXD MICA 56PF 5% 300VDCW |
| A4C4 | 0140-0191 | C: FXD MICA 56PF 5% 300VDCW |
| A4C5 | 0150-0122 | C: FXD CER 2000PF 20% 500VDCW |
| A4C6 | 0140-0191 | C: FXD MICA 56PF 5% 300VDCW |
| A4C7 | 0160-0181 | C: FXD MICA 30PF 5% 300VDCW |
| A4C8 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A4C9 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A4C10 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW |
| A4C11 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW |
| A4C12 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW |
| A4C13 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW |
| A4C14 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW |
| A4C15 | 0140-0176 | C: FXD MICA 100PF 2% 300VDCW |
| A4C16 | 0140-0193 | C: FXD MICA 82PF 5% 300VDCW |
| A4CR1 | 1901-0040 | DIODE: SI |
| A4CR2 | 1901-0040 | DIODE: SI |
| A4CR3 | 1901-0040 | DIODE: SI |
| A4CR4 | 1901-0040 | DIODE: SI |
| A4CR5 | 1901-0040 | DIODE: SI |
| A4CR6 | 1901-0040 | DIODE: SI |
| A4CR7 | 1901-0040 | DIODE: SI |
| A4CR8 | 1901-0040 | DIODE: SI |
| A4CR9 | 1901-0040 | DIODE: SI |
| A4CR10 | 1901-0040 | DIODE: SI |
| A4CR11 | 1901-0040 | DIODE: SI |
| A4Q1 | 1853-0034 | TRANSISTOR: SI PNP |
| A4Q2 | 1853-0034 | TRANSISTOR: SI PNP |
| A4Q3 | 1853-0034 | TRANSISTOR: SI PNP |
| A4Q4 | 1853-0034 | TRANSISTOR: SI PNP |
| A4Q5 | 1853-0034 | TRANSISTOR: SI PNP |
| A4Q6 | 1853-0034 | TRANSISTOR: SI PNP |
| A4Q7 | 1853-0034 | TRANSISTOR: SI PNP |
| A4Q8 | 1853-0034 | TRANSISTOR: SI PNP |
| A4R1 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W |
| A4R2 | 0758-0024 | R: FXD MET FLM 100 OHM 5% 1/2W |
| A4R3 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W |
| A4R4 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A4R5 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R6 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A4R7 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W |
| A4R8 | 0698-4232 | R: FXD MET OX 110 OHM 5% 1/4W |
| A4R9 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R10 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A4R11 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W |
| A4R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R13 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A4R14 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W |
| A4R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A4R16 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W |
| A4R17 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A4R18 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R19 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A4R20 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W |
| A4R21 | 0698-4232 | R: FXD MET OX 110 OHM 5% 1/4W |
| A4R22 | 0698-4288 | R: FXD MET OX 27K OHM 5% 1/4W |
| A4R23 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A4R24 | 0698-4226 | R: FXD MET OX 62 OHM 5% 1/4W |
| A4R25 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R26 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A4R27 | 0758-0043 | R: FXD MET FLM 1.8K OHM 5% 1/2W |
| A4R28 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A4R29 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W |
| A4R30 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W |
| A4R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R32 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W |
| A4R33 | 0698-5707 | R: FXD MET OX 47 OHM 5% 1/4W |
| A4R34 | 0698-4232 | R: FXD MET OX 110 OHM 5% 1/4W |
| A4R35 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R36 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W |
| A4R37 | 0698-3799 | R: FXD MET OX 22 OHM 5% 1/4W |
| A4R38 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R39 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W |
| A4R40 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W |
| A4R41 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A4R42 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W |
| A4R43 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A4R44 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R45 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W |
| A4R46 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R47 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W |
| A4R48 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A4R49 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A4R50 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W |
| A4R51 | 0758-0004 | R: FXD MET FLM 2.7K OHM 5% 1/2W |
| A4R52 | 0698-4265 | R: FXD MET OX 3.0K OHM 5% 1/4W |
| A4R53 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W |
| A5 | | SAME AS A4: USE PREFIX A5 |

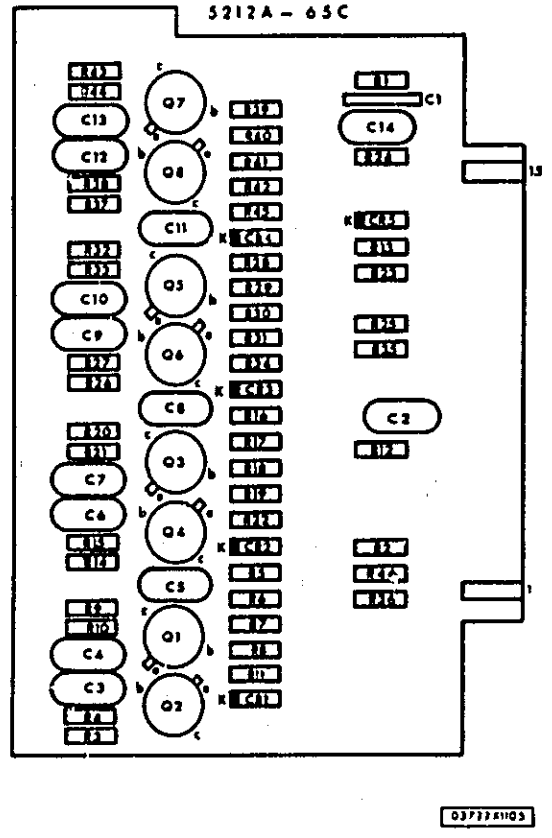



Figure 8 - 13 Low speed decade divider assembly A6 (etc), component location

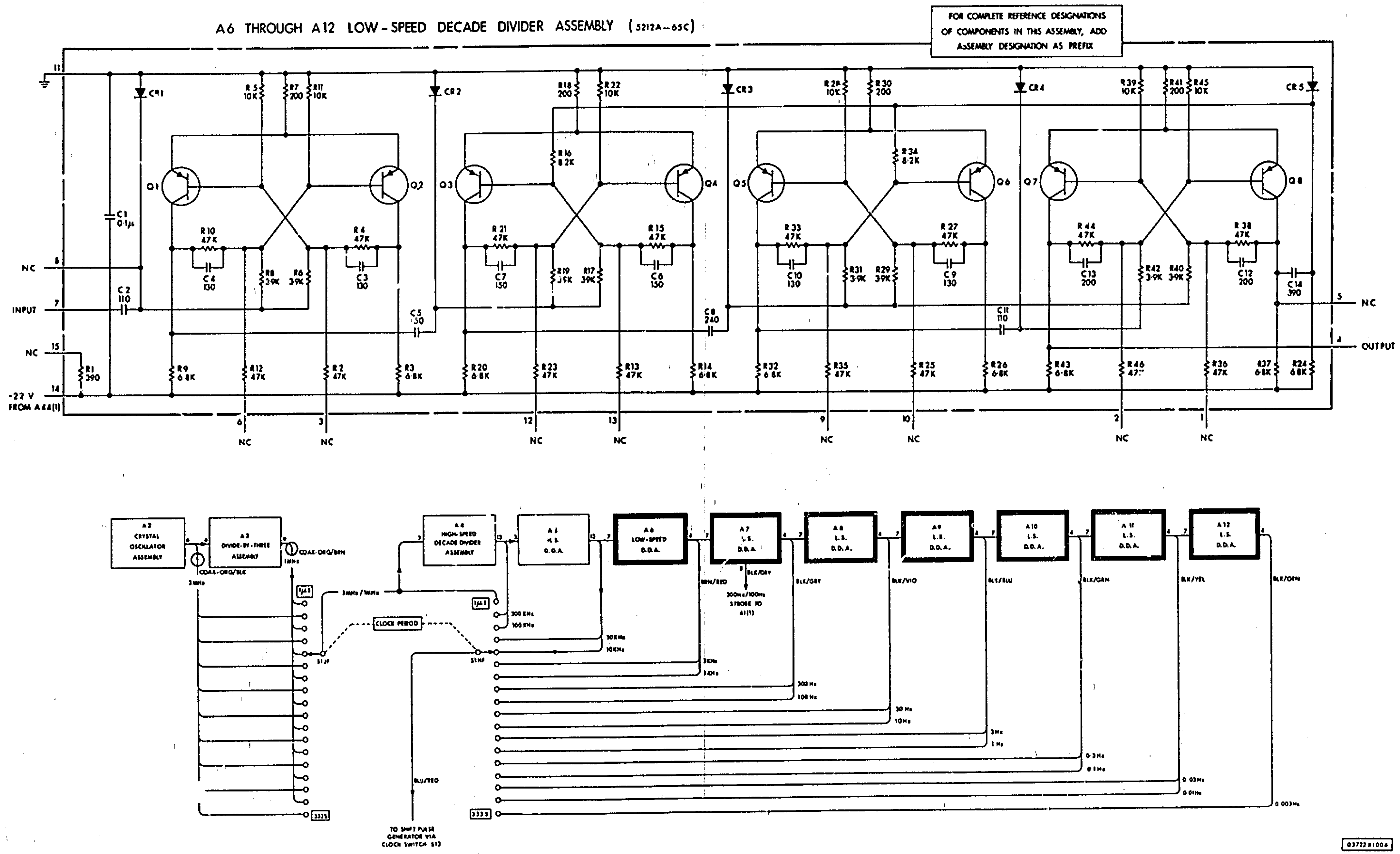
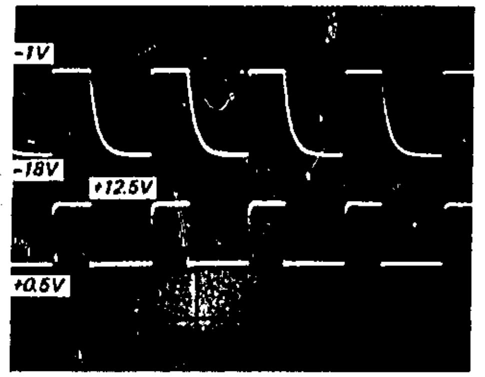
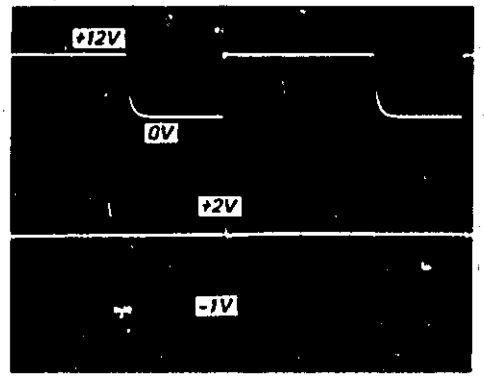



Figure 8 - 14 Low speed decade divider assembly A6 (etc), schematic

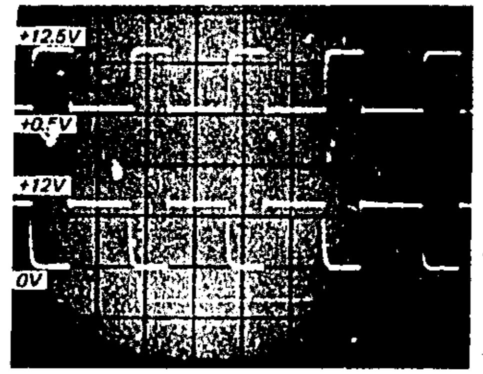
| | | |
|---|---|---|
| A6 | 5212A-65C | ASSY: LOW-SPEED DECADE DIVIDER |
| | 5212A-65C-1 | BOARD: BLANK PC (NSR) |
| A6C1 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A6C2 | 0140-0194 | C: FXD MICA 110PF 5% 300VDCW |
| A6C3 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW |
| A6C4 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW |
| A6C5 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW |
| A6C6 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW |
| A6C7 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW |
| A6C8 | 0140-0199 | C: FXD MICA 240PF 5% 300VDCW |
| A6C9 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW |
| A6C10 | 0140-0195 | C: FXD MICA 130PF 5% 300VDCW |
| A6C11 | 0140-0194 | C: FXD MICA 110PF 5% 300VDCW |
| A6C12 | 0140-0198 | C: FXD MICA 200PF 5% 300VDCW |
| A6C13 | 0140-0198 | C: FXD MICA 200PF 5% 300VDCW |
| A6C14 | 0140-0200 | C: FXD MICA 390PF 5% 300VDCW |
| A6CR1 | 1910-0016 | DIODE: GE |
| A6CR2 | 1910-0016 | DIODE: GE |
| A6CR3 | 1910-0016 | DIODE: GE |
| A6CR4 | 1910-0016 | DIODE: GE |
| A6CR5 | 1910-0016 | DIODE: GE |
| A6Q1 | 1850-0062 | TRANSISTOR: GE PNP |
| A6Q2 | 1850-0062 | TRANSISTOR: GE PNP |
| A6Q3 | 1850-0062 | TRANSISTOR: GE PNP |
| A6Q4 | 1850-0062 | TRANSISTOR: GE PNP |
| A6Q5 | 1850-0062 | TRANSISTOR: GE PNP |
| A6Q6 | 1850-0062 | TRANSISTOR: GE PNP |
| A6Q7 | 1850-0062 | TRANSISTOR: GE PNP |
| A6Q8 | 1850-0062 | TRANSISTOR: GE PNP |
| A6R1 | 0683-3915 | R: FXD COMP 390 OHM 5% 1/4W |
| A6R2 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R3 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R4 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R5 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W |
| A6R6 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R7 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W |
| A6R8 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R9 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R10 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R11 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W |
| A6R12 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R13 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R14 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R15 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R16 | 0683-8225 | R: FXD COMP 8.2K OHM 5% 1/4W |
| A6R17 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R18 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W |
| A6R19 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R20 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R21 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R22 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W |
| A6R23 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R24 | 0683-6835 | R: FXD COMP 68K OHM 5% 1/4W |
| A6R25 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R26 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R27 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R28 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W |
| A6R29 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R30 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W |
| A6R31 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R32 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R33 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R34 | 0683-8225 | R: FXD COMP 8.2K OHM 5% 1/4W |
| A6R35 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R36 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R37 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R38 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R39 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W |
| A6R40 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R41 | 0683-2015 | R: FXD COMP 200 OHM 5% 1/4W |
| A6R42 | 0683-3925 | R: FXD COMP 3.9K OHM 5% 1/4W |
| A6R43 | 0683-6825 | R: FXD COMP 6.8K OHM 5% 1/4W |
| A6R44 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A6R45 | 0683-1035 | R: FXD COMP 10K OHM 5% 1/4W |
| A6R46 | 0683-4735 | R: FXD COMP 47K OHM 5% 1/4W |
| A7 | | SAME AS A6: USE PREFIX A7 |
| A8 | | SAME AS A6: USE PREFIX A8 |
| A9 | | SAME AS A6: USE PREFIX A9 |
| A10 | | SAME AS A6: USE PREFIX A10 |
| A11 | | SAME AS A6: USE PREFIX A11 |
| A12 | | SAME AS A6: USE PREFIX A12 |



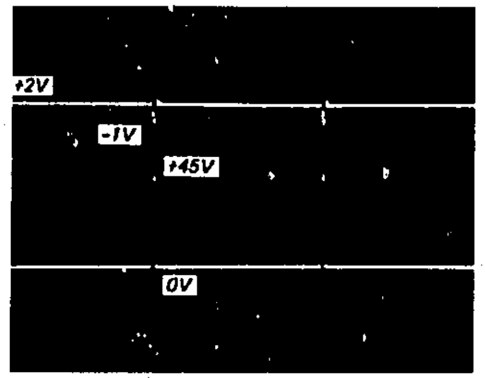
**Upper trace** clock input A13(3), 10V/cm
**Lower trace** Schmitt output A13Q2C, 10V/cm
**Clock period** 10μS **Sweep** 5μS/cm
**Trigger** internal



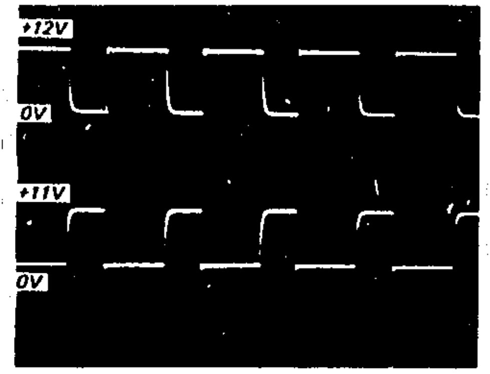
**Upper trace** A13Q3C, 10V/cm
**Lower trace** A13Q5C, 2V/cm
**Clock period** 10μS **Sweep** 2μS/cm
**Trigger** internal



**Upper trace** A13Q2C, 10V/cm
**Lower trace** A13Q3C, 10V/cm
**Clock period** 10μS **Sweep** 5μS/cm
**Trigger** internal



**Upper trace** A13Q5C, 5V/cm
**Lower trace** A13Q6C, 20V/cm
**Clock period** 3.33μS **Sweep** 1μS/cm
**Trigger** internal



**Upper trace** A13Q3C, 10V/cm
**Lower trace** A13Q4C, 10V/cm
**Clock period** 10μS **Sweep** 5μS/cm
**Trigger** internal

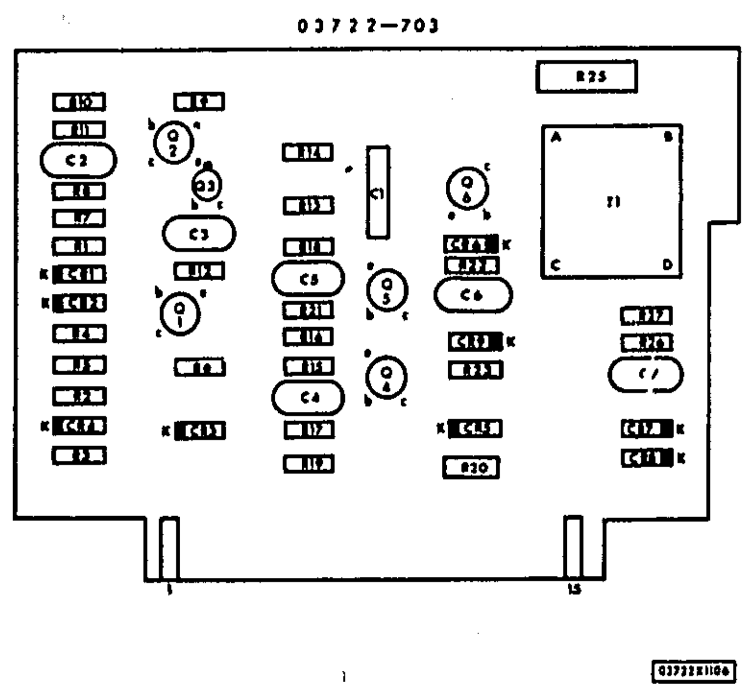



Figure 8 - 15 Shift pulse generator assembly A13, component location

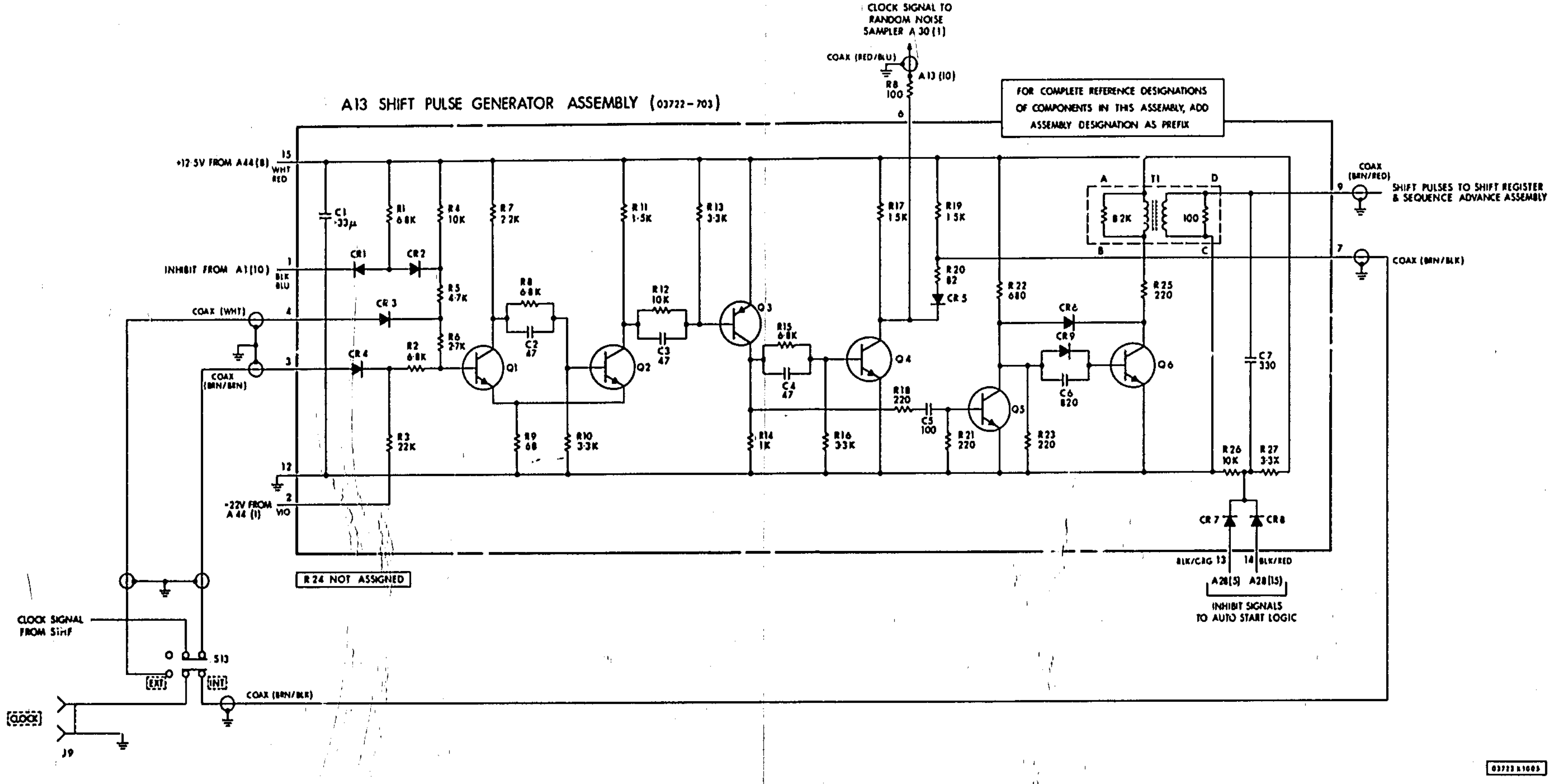



Figure 8 - 16 Shift pulse generator A13, schematic

| | | |
|---|---|---|
| A13 | 03722-703 | ASSY: SHIFT PULSE GENERATOR |
| | 03722-303 | BOARD: BLANK PC (NSR) |
| A13C1 | 0160-0137 | C: FXD CER 0.33UF 20% 25VDCW |
| A13C2 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A13C3 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A13C4 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A13C5 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A13C6 | 0160-2009 | C: FXD MICA 820PF 5% 300VDCW |
| A13C7 | 0160-2208 | C: FXD MICA 330PF 5% 300VDCW |
| A13CR1 | 1901-0040 | DIODE: SI |
| A13CR2 | 1901-0040 | DIODE: SI |
| A13CR3 | 1901-0040 | DIODE: SI |
| A13CR4 | 1901-0040 | DIODE: SI |
| A13CR5 | 1910-0034 | DIODE: GE |
| A13CR6 | 1910-0034 | DIODE: GE |
| A13CR7 | 1901-0040 | DIODE: SI |
| A13CR8 | 1901-0040 | DIODE: SI |
| A13CR9 | 1901-0040 | DIODE: SI |
| A13Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A13Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A13Q3 | 1853-0034 | TRANSISTOR: SI PNP |
| A13Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A13Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A13Q6 | 1854-0215 | TRANSISTOR: SI NPN |
| A13R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A13R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A13R3 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A13R4 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A13R5 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A13R6 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W |
| A13R7 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A13R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A13R9 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W |
| A13R10 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A13R11 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |
| A13R12 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A13R13 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A13R14 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A13R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A13R16 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A13R17 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |
| A13R18 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A13R19 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |
| A13R20 | 0758-0026 | R: FXD MET FLM 82 OHM 5% 1/2W |
| A13R21 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A13R22 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W |
| A13R23 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A13R24 | | NOT ASSIGNED |
| A13R25 | 0761-0026 | R: FXD MET OX 220 OHM 5% 1W |
| A13R26 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A13R27 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A13T1 | 9100-0620 | TRANSFORMER: SHIFT PULSE GENERATOR |

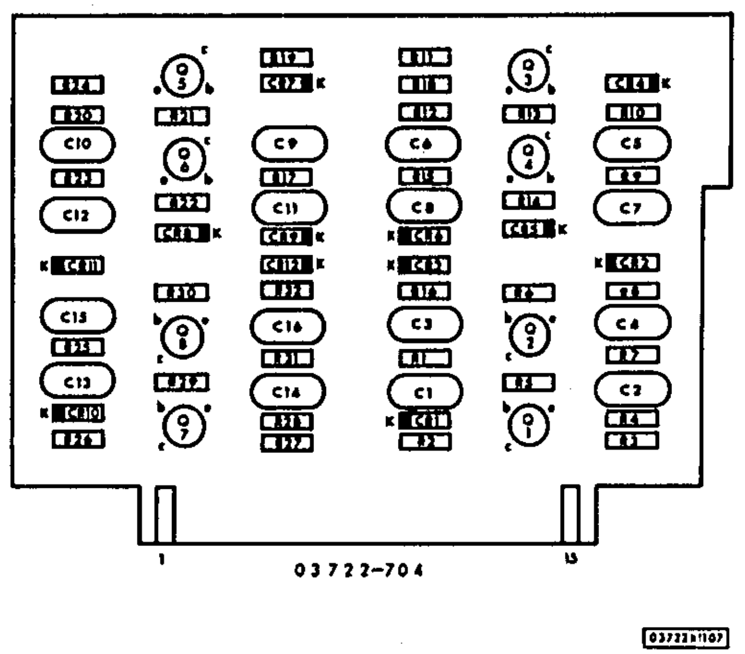



Figure 8 - 17 Shift register assembly A14 (etc), component location

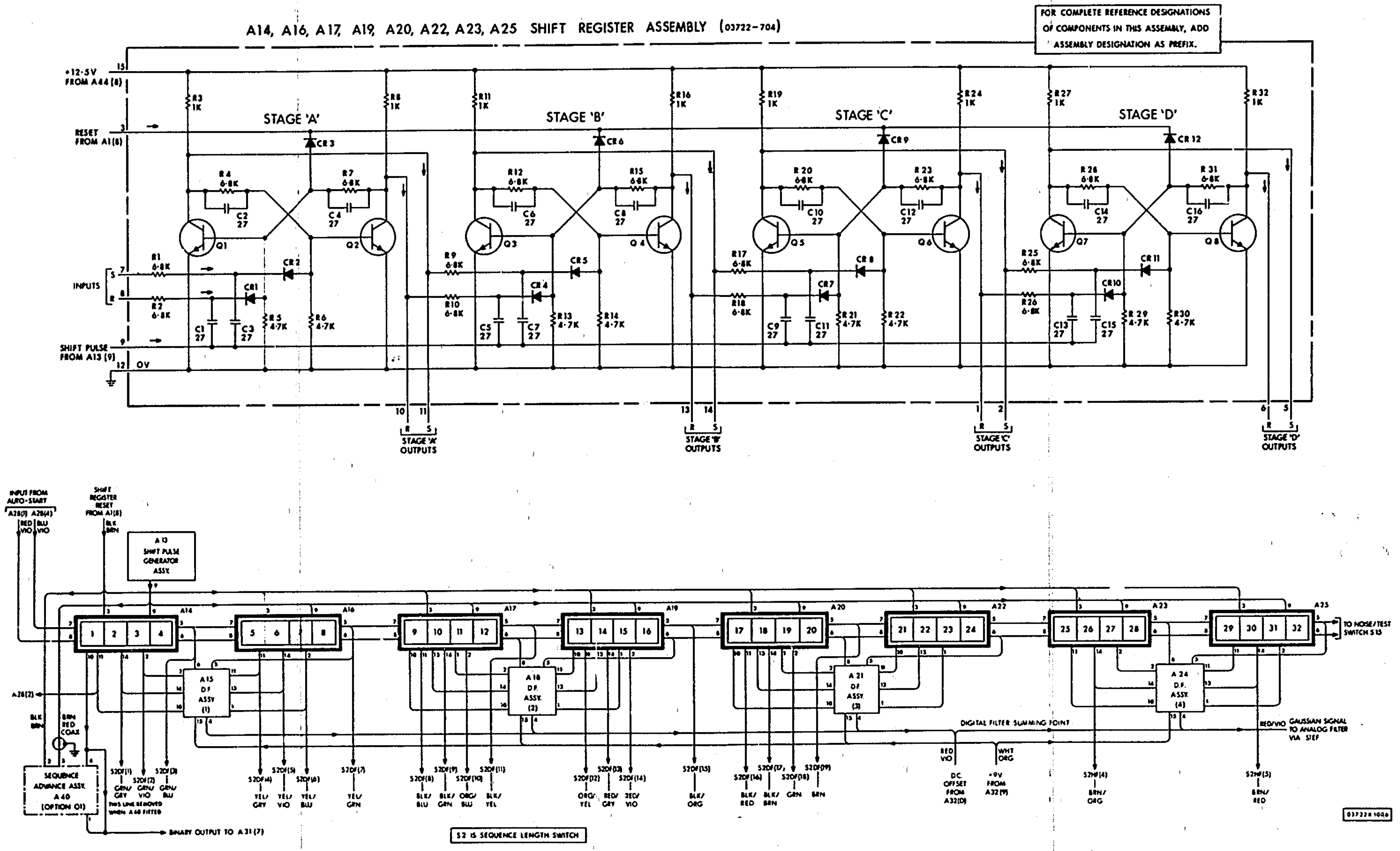



Figure 8 - 18 Shift register assembly A14 (etc), schematic

| | | |
|---|---|---|
| A14 | 03722-704 | ASSY: SHIFT REGISTER |
| | 03722-304 | BOARD: BLANK PC(NSR) |
| A14C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A14CR1 | 1901-0040 | DIODE: SI |
| A14CR2 | 1901-0040 | DIODE: SI |
| A14CR3 | 1901-0040 | DIODE: SI |
| A14CR4 | 1901-0040 | DIODE: SI |
| A14CR5 | 1901-0040 | DIODE: SI |
| A14CR6 | 1901-0040 | DIODE: SI |
| A14CR7 | 1901-0040 | DIODE: SI |
| A14CR8 | 1901-0040 | DIODE: SI |
| A14CR9 | 1901-0040 | DIODE: SI |
| A14CR10 | 1901-0040 | DIODE: SI |
| A14CR11 | 1901-0040 | DIODE: SI |
| A14CR12 | 1901-0040 | DIODE: SI |
| A14Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A14Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A14Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A14Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A14Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A14Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A14Q7 | 1854-0605 | TRANSISTOR: SI NPN |
| A14Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A14R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R3 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A14R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R5 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R6 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R7 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R8 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A14R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R10 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R11 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A14R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R13 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R14 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R16 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A14R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R19 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A14R20 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R21 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R22 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R24 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A14R25 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R26 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R27 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A14R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R29 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R30 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A14R31 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A14R32 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A16 | | SAME AS A14: USE PREFIX A16 |
| A17 | | SAME AS A14: USE PREFIX A17 |
| A22 | | SAME AS A14: USE PREFIX A22 |
| A23 | | SAME AS A14: USE PREFIX A23 |
| A19 | | SAME AS A14: USE PREFIX A19 |
| A20 | | SAME AS A14: USE PREFIX A20 |
| A25 | | SAME AS A14: USE PREFIX A25 |
| A26 | | NOT ASSIGNED |

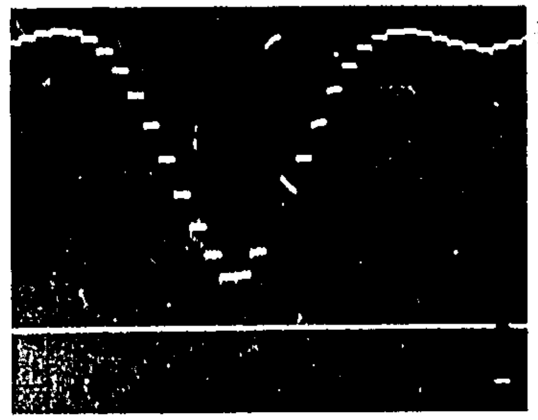
## SERVICE NOTE

*Digital filter check*

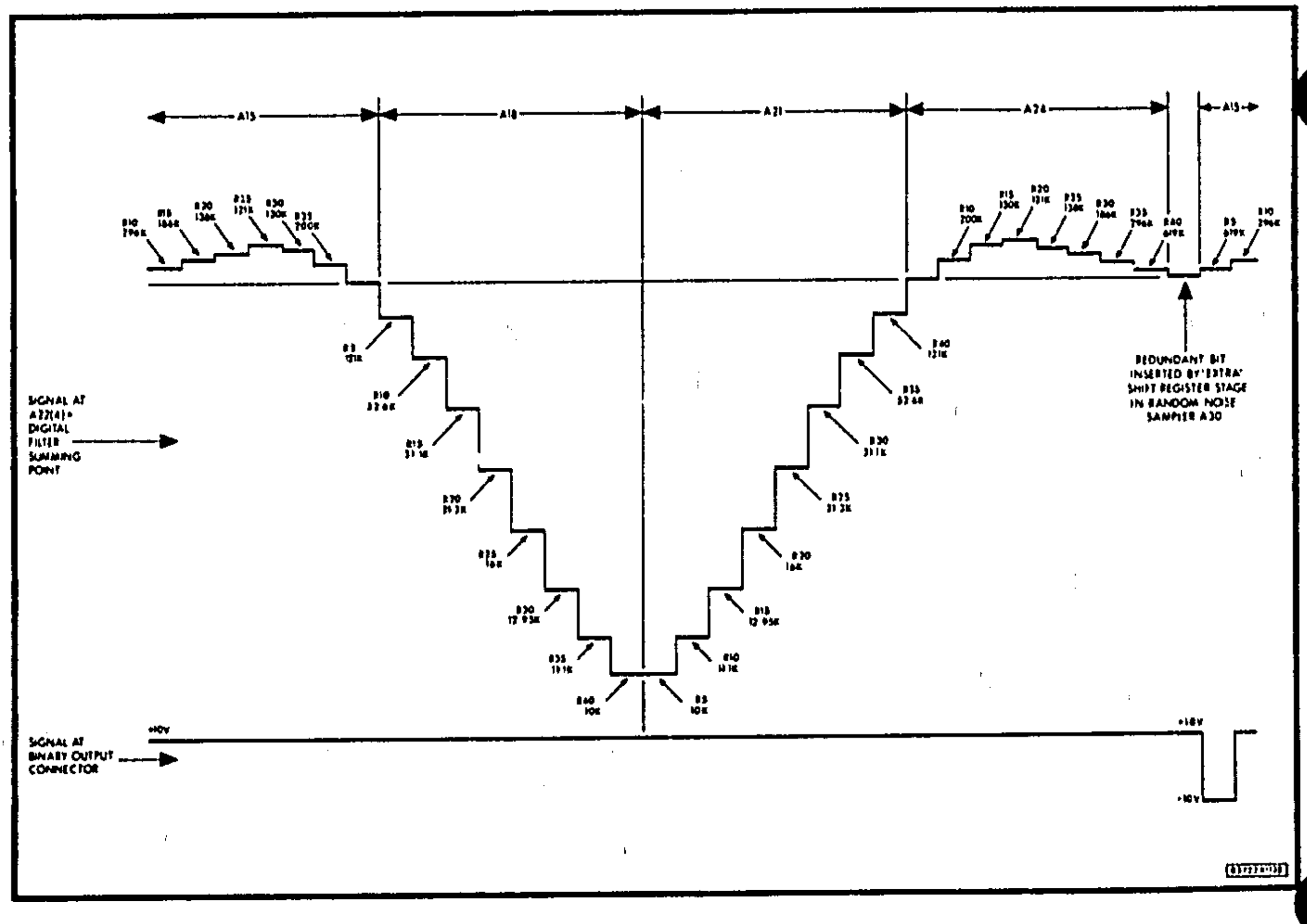
(Applies to A15, A18, A21 & A24)

**Procedure**

Perform the digital filter functional check detailed in Table 5-8. Extreme faults in the filter will be immediately obvious – for example, the photograph right shows the waveform obtained with resistor R15 in A21 open-circuit. Isolate the fault by reference to the annotated waveform on this page. Note that failure of a clamp circuit can cause the same distortion of the test waveform as a resistor fault. Each clamp circuit comprises two transistors situated, physically, near opposite ends of the associated precision resistor – for example, resistor A15R15 located between the transistors of its clamp circuit, A15Q5 + A15Q6.



**Faulty test waveform**



**Digital filter troubleshooting guide**

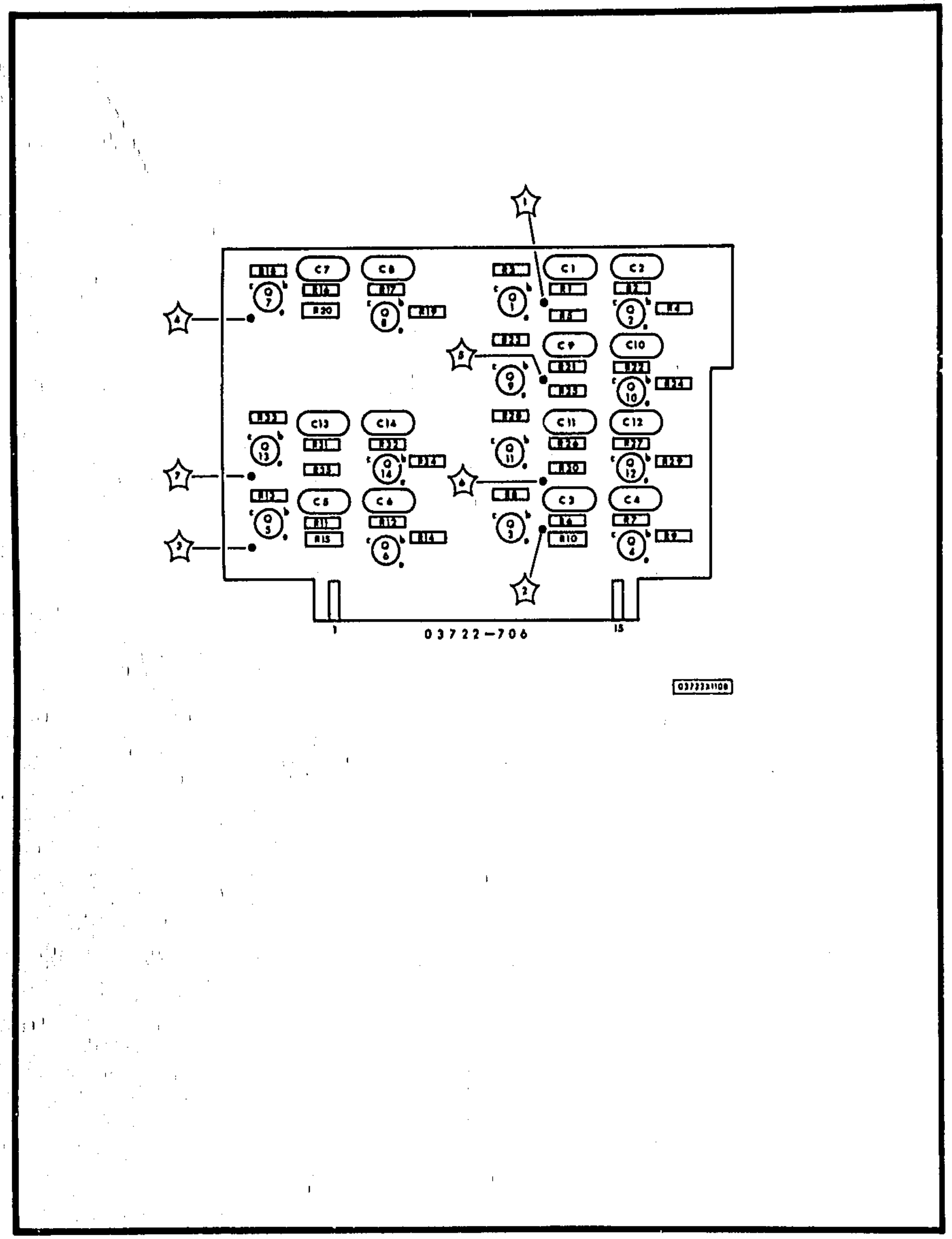



Figure 8 - 19 Digital filter assembly (1) A15, component location

A15 DIGITAL FILTER ASSEMBLY (03722-706)

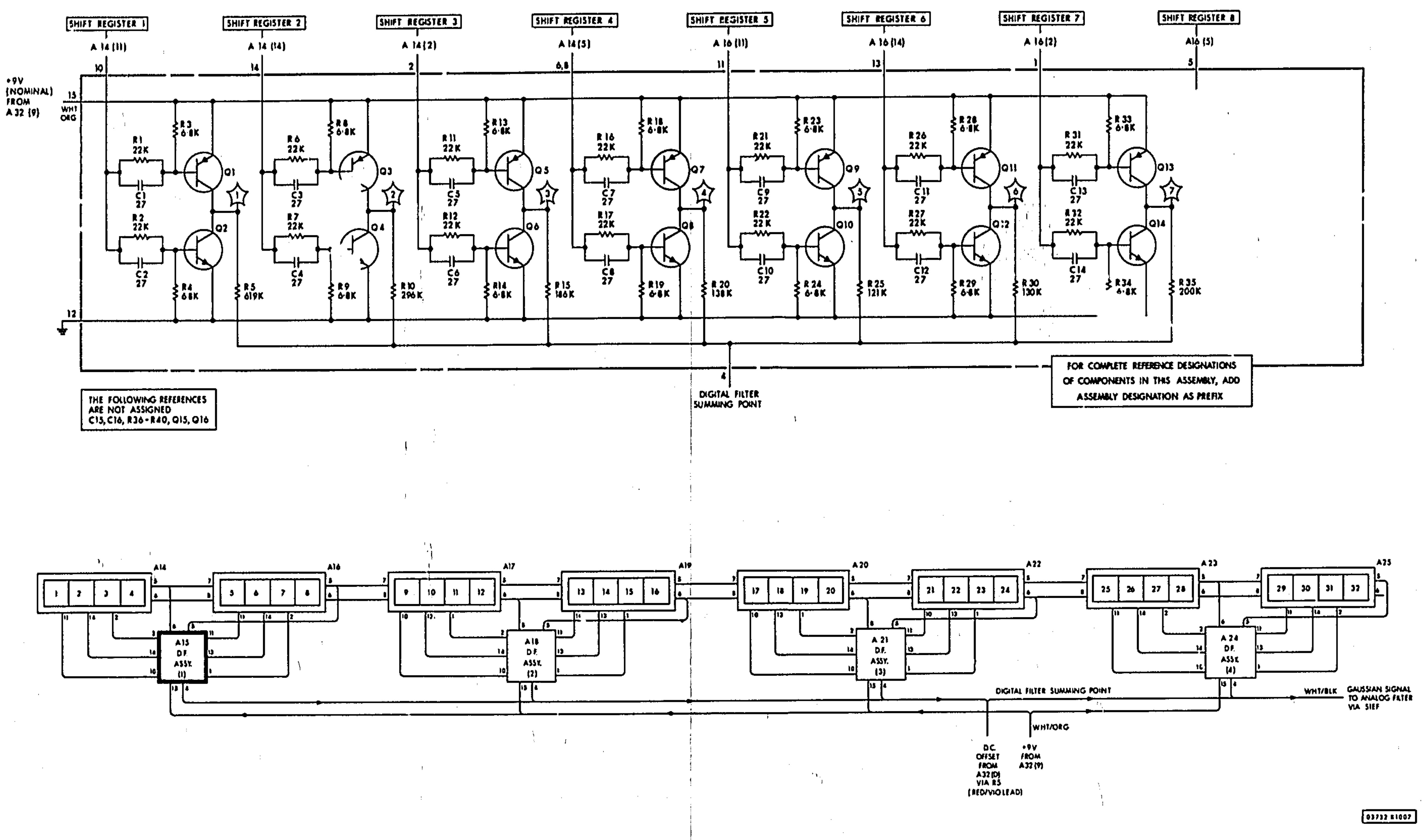



Figure 8 - 20 Digital filter assembly (1) A15, schematic

| | | |
|---|---|---|
| A15 | 03722-706 | ASSY: DIGITAL-TO-ANALOG CONVERTER (1) |
| | 03722-306 | BOARD: BLANK PC (NSR) |
| A15C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A15Q1 | 1853-0015 | TRANSISTOR: SI PNP |
| A15Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A15Q3 | 1853-0015 | TRANSISTOR: SI PNP |
| A15Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A15Q5 | 1853-0015 | TRANSISTOR: SI PNP |
| A15Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A15Q7 | 1853-0015 | TRANSISTOR: SI PNP |
| A15Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A15Q9 | 1853-0015 | TRANSISTOR: SI PNP |
| A15Q10 | 1854-0605 | TRANSISTOR: SI NPN |
| A15Q11 | 1853-0015 | TRANSISTOR: SI PNP |
| A15Q12 | 1854-0605 | TRANSISTOR: SI NPN |
| A15Q13 | 1853-0015 | TRANSISTOR: SI PNP |
| A15Q14 | 1854-0605 | TRANSISTOR: SI NPN |
| A15R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R2 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R5 | 0757-0484 | R: FXD MET FLM 619K OHM 1% 1/8W 100 PPM |
| A15R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R10 | 0698-5797 | R: FXD MET FLM 296K OHM 1% 1/8W 150 PPM |
| A15R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R15 | 0698-5796 | R: FXD MET FLM 186K OHM 1% 1/8W 150 PPM |
| A15R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R20 | 0698-5795 | R: FXD MET FLM 138K OHM 1% 1/8W 100 PPM |
| A15R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R25 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM |
| A15R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R30 | 0757-0468 | R: FXD MET FLM 130K OHM 1% 1/8W 100 PPM |
| A15R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A15R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A15R35 | 0757-0472 | R: FXD MET FLM 200K OHM 1% 1/8W 100 PPM |
| A15TP1 | 0360-0124 | TERMINAL PIN |
| A15TP2 | 0360-0124 | TERMINAL PIN |
| A15TP3 | 0360-0124 | TERMINAL PIN |
| A15TP4 | 0360-0124 | TERMINAL PIN |
| A15TP5 | 0360-0124 | TERMINAL PIN |
| A15TP6 | 0360-0124 | TERMINAL PIN |
| A15TP7 | 0360-0124 | TERMINAL PIN |

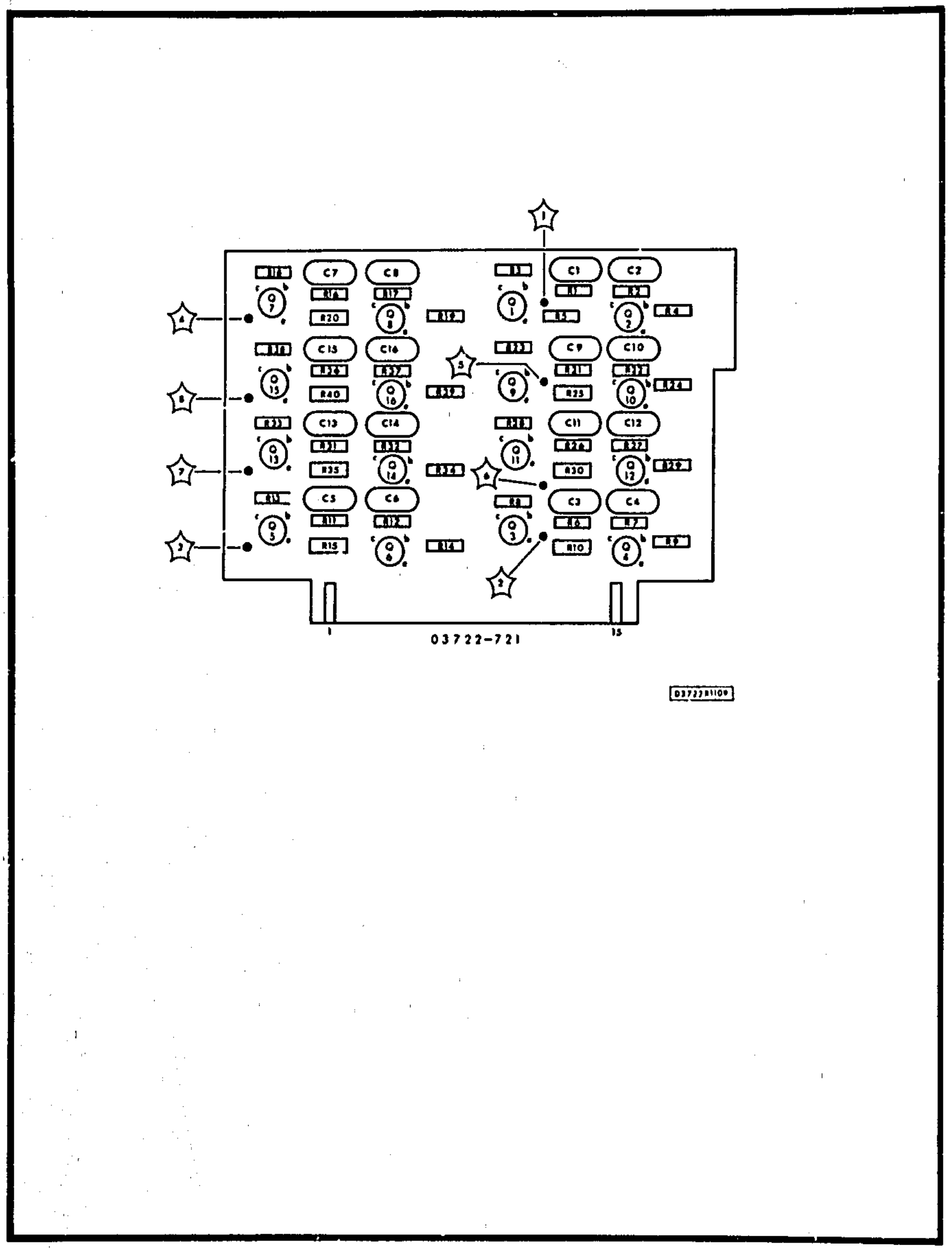



Figure 8 - 21 Digital filter assembly (2) A18, component location

A18 DIGITAL FILTER ASSEMBLY (03722-721)

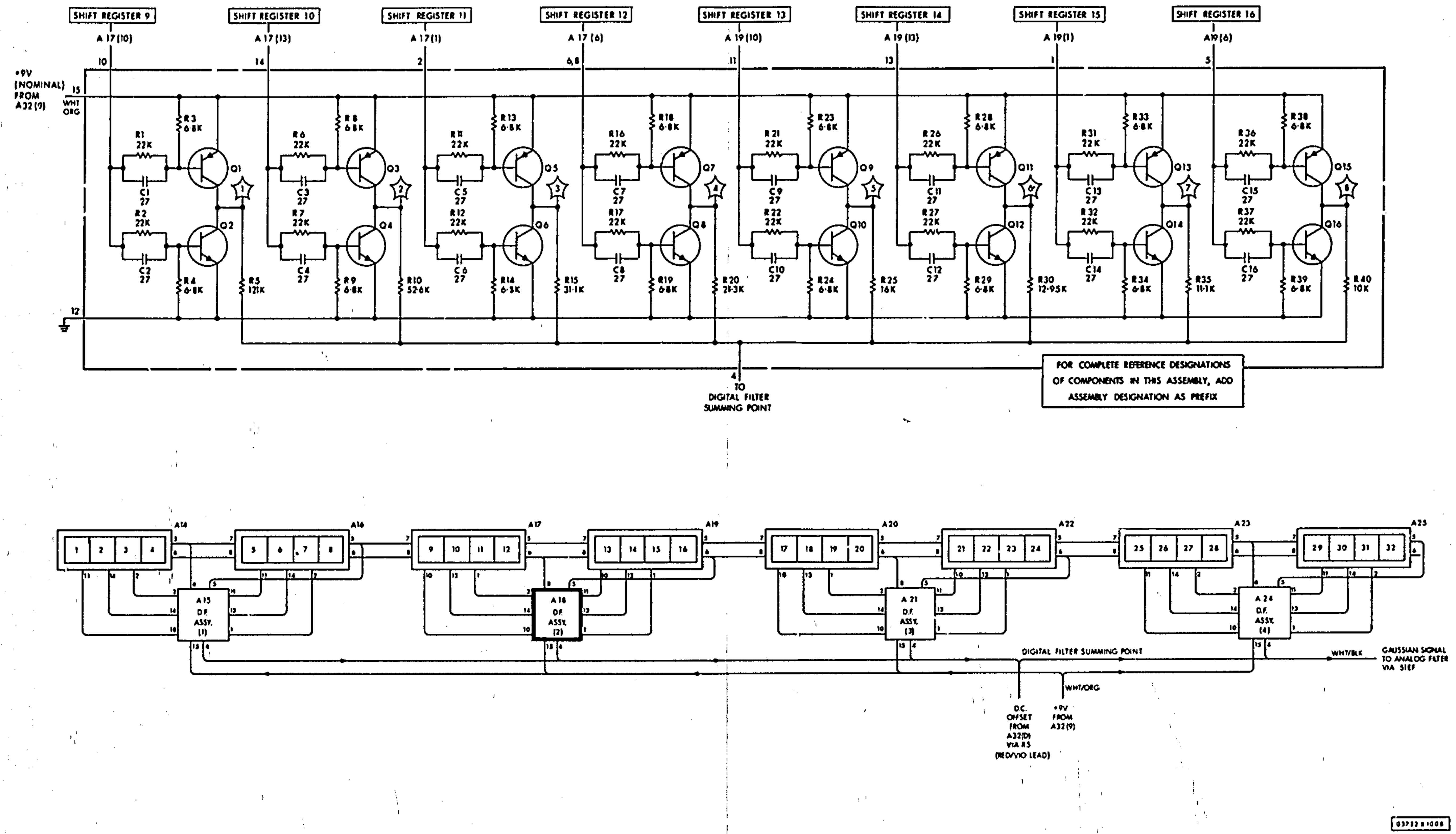



Figure 8 - 22 Digital filter assembly (2) A18, schematic

| | | |
|---|---|---|
| A18 | 03722-721 | ASSY: DIGITAL-TO-ANALOG CONVERTER (2) |
| | 03722-321 | BOARD: BLANK PC (NSR) |
| A18C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A18Q1 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A18Q3 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A18Q5 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A18Q7 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A18Q9 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q10 | 1854-0605 | TRANSISTOR: SI NPN |
| A18Q11 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q12 | 1854-0605 | TRANSISTOR: SI NPN |
| A18Q13 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q14 | 1854-0605 | TRANSISTOR: SI NPN |
| A18Q15 | 1853-0015 | TRANSISTOR: SI PNP |
| A18Q16 | 1854-0605 | TRANSISTOR: SI NPN |
| A18R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R2 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R5 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM |
| A18R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R10 | 0698-5794 | R: FXD MET FLM 52.6K OHM 1/2% 1/8W 50 PPM |
| A18R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R15 | 0698-5793 | R: FXD MET FLM 31.1K OHM 1/2% 1/8W 50 PPM |
| A18R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R20 | 0698-5792 | R: FXD MET FLM 21.3K OHM 1/2% 1/8W 50 PPM |
| A18R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R25 | 0698-5791 | R: FXD MET FLM 16K OHM 1/2% 1/8W 50 PPM |
| A18R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R30 | 0698-5790 | R: FXD MET FLM 12.95K OHM 1/2% 1/8W 50 PPM |
| A18R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R35 | 0698-5789 | R: FXD MET FLM 11.1K OHM 1/2% 1/8W 50 PPM |
| A18R36 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R37 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A18R38 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R39 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A18R40 | 0698-5788 | R: FXD MET FLM 10K OHM 1/2% 1/8W 50 PPM |
| A18TP1 | 0360-0124 | TERMINAL PIN |
| A18TP2 | 0360-0124 | TERMINAL PIN |
| A18TP3 | 0360-0124 | TERMINAL PIN |
| A18TP4 | 0360-0124 | TERMINAL PIN |
| A18TP5 | 0360-0124 | TERMINAL PIN |
| A18TP6 | 0360-0124 | TERMINAL PIN |
| A18TP7 | 0360-0124 | TERMINAL PIN |
| A18TP8 | 0360-0124 | TERMINAL PIN |

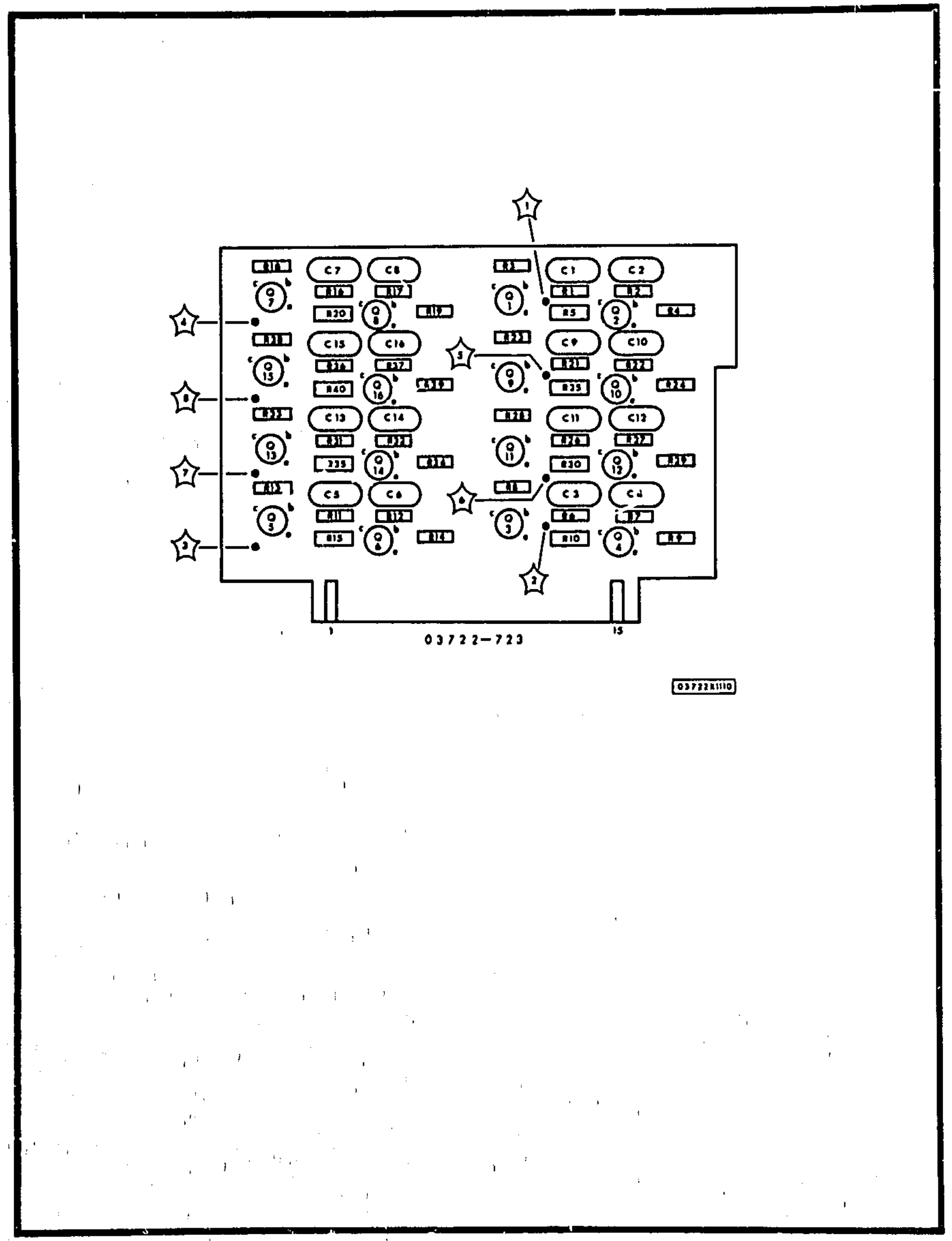



Figure 8 - 23 Digital filter assembly (3) A21, component location

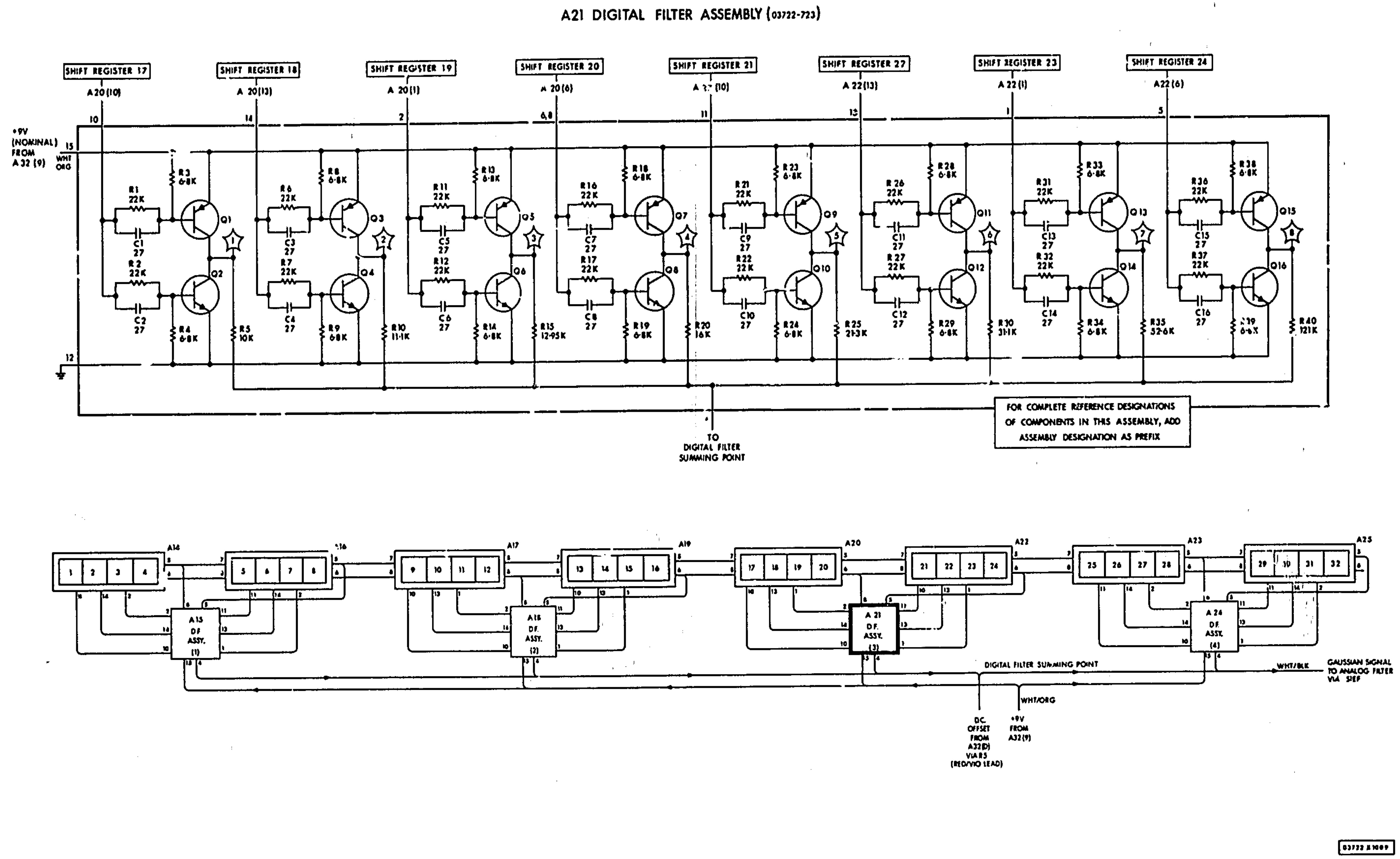



Figure 8 - 24 Digital filter assembly (3) A21, schematic

| | | |
|---|---|---|
| A21 | 03722-723 | ASSY: DIGITAL-TO-ANALOG CONVERTER (3) |
| | 03722-323 | BOARD: BLANK PC (NSR) |
| A21C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDC |
| A21C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDC |
| A21C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDC |
| A21C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A21Q1 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A21Q3 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A21Q5 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A21Q7 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A21Q9 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q10 | 1854-0605 | TRANSISTOR: SI NPN |
| A21Q11 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q12 | 1854-0605 | TRANSISTOR: SI NPN |
| A21Q13 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q14 | 1854-0605 | TRANSISTOR: SI NPN |
| A21Q15 | 1853-0015 | TRANSISTOR: SI PNP |
| A21Q16 | 1854-0605 | TRANSISTOR: SI NPN |
| A21R1 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R2 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R5 | 0698-5788 | R: FXD MET FLM 10K OHM 1/2% 1/8W 50 PPM |
| A21R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R10 | 0698-5789 | R: FXD MET FLM 11.1K OHM 1/2% 1/8W 50 PPM |
| A21R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R15 | 0698-5790 | R: FXD MET FLM 12.95K OHM 1/2% 1/8W 50 PPM |
| A21R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R20 | 0698-5791 | R: FXD MET FLM 16K OHM 1/2% 1/8W 50 PPM |
| A21R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R25 | 0698-5792 | R: FXD MET FLM 21.3K OHM 1/2% 1/8W 50 PPM |
| A21R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R30 | 0698-5793 | R: FXD MET FLM 31.1K OHM 1/2% 1/8W 50 PPM |
| A21R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R35 | 0698-5794 | R: FXD MET FLM 52.6K OHM 1/2% 1/8W 50 PPM |
| A21R36 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R37 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A21R38 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R39 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A21R40 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM |
| A21TP1 | 0360-0124 | TERMINAL PIN |
| A21TP2 | 0360-0124 | TERMINAL PIN |
| A21TP3 | 0360-0124 | TERMINAL PIN |
| A21TP4 | 0360-0124 | TERMINAL PIN |
| A21TP5 | 0360-0124 | TERMINAL PIN |
| A21TP6 | 0360-0124 | TERMINAL PIN |
| A21TP7 | 0360-0124 | TERMINAL PIN |
| A21TP8 | 0360-0124 | TERMINAL PIN |

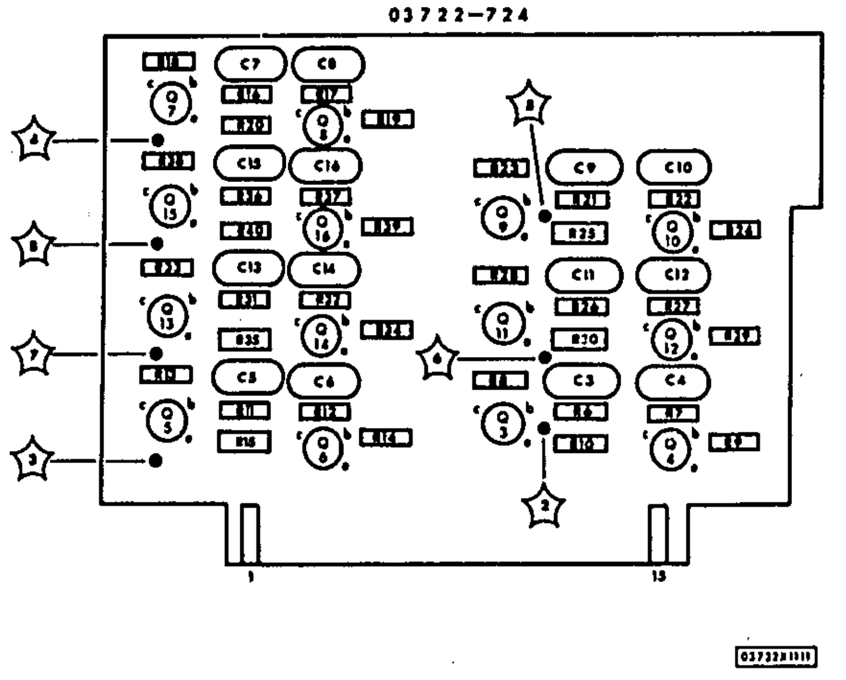



Figure 8 - 25 Digital filter assembly (4) A24, component location

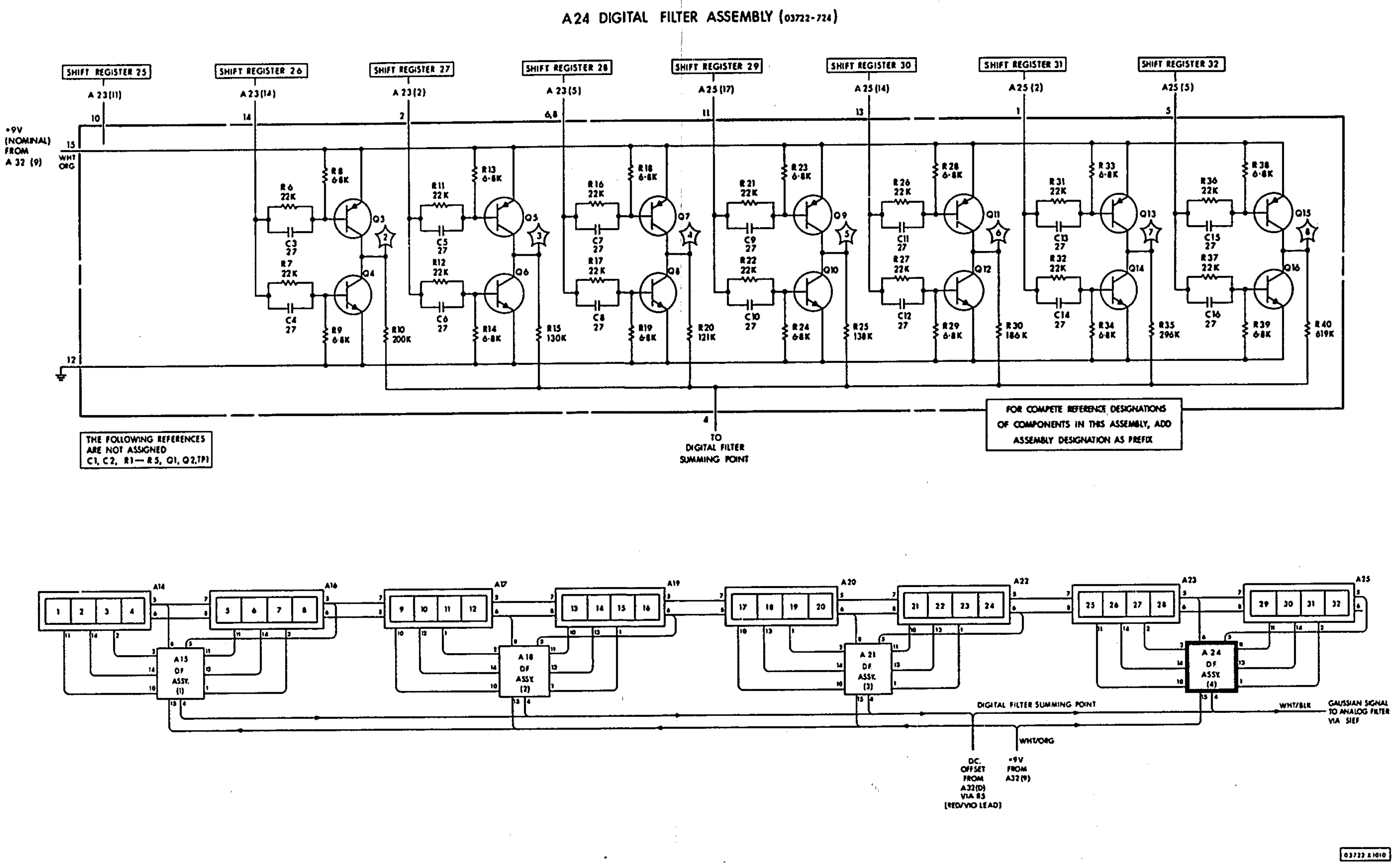



Figure 8 - 26 Digital filter assembly (4) A24, schematic

| | | |
|---|---|---|
| A24 | 03722-724 | ASSY: DIGITAL-TO-ANALOG CONVERTER (4) |
| | 03722-324 | BOARD: BLANK PC (NSR) |
| A24C1 | | NOT ASSIGNED |
| A24C2 | | NOT ASSIGNED |
| A24C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24C16 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A24Q1 | | NOT ASSIGNED |
| A24Q2 | | NOT ASSIGNED |
| A24Q3 | 1853-0015 | TRANSISTOR: SI PNP |
| A24Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A24Q5 | 1853-0015 | TRANSISTOR: SI PNP |
| A24Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A24Q7 | 1853-0015 | TRANSISTOR: SI PNP |
| A24Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A24Q9 | 1853-0015 | TRANSISTOR: SI PNP |
| A24Q10 | 1854-0605 | TRANSISTOR: SI NPN |
| A24Q11 | 1853-0015 | TRANSISTOR: SI PNP |
| A24Q12 | 1854-0605 | TRANSISTOR: SI NPN |
| A24Q13 | 1853-0015 | TRANSISTOR: SI PNP |
| A24Q14 | 1854-0605 | TRANSISTOR: SI NPN |
| A24Q15 | 1853-0015 | TRANSISTOR: SI PNP |
| A24Q16 | 1854-0605 | TRANSISTOR: SI NPN |
| A24R1 | | NOT ASSIGNED |
| A24R2 | | NOT ASSIGNED |
| A24R3 | | NOT ASSIGNED |
| A24R4 | | NOT ASSIGNED |
| A24R5 | | NOT ASSIGNED |
| A24R6 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R7 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R10 | 0757-0472 | R: FXD MET FLM 200K OHM 1% 1/8W 100 PPM |
| A24R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R12 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R15 | 0757-0468 | R: FXD MET FLM 130K OHM 1% 1/8W 100 PPM |
| A24R16 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R17 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R20 | 0757-0467 | R: FXD MET FLM 121K OHM 1% 1/8W 100 PPM |
| A24R21 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R22 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R25 | 0698-5795 | R: FXD MET FLM 138K OHM 1% 1/8W 100 PPM |
| A24R26 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R27 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R30 | 0698-5796 | R: FXD MET FLM 186K OHM 1% 1/8W 150 PPM |
| A24R31 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R32 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R34 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R35 | 0698-5797 | R: FXD MET FLM 296K OHM 1% 1/8W 150 PPM |
| A24R36 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R37 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A24R38 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R39 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A24R40 | 0757-0484 | R: FXD MET FLM 619K OHM 1% 1/8W 100 PPM |
| A24TP1 | | NOT ASSIGNED |
| A24TP2 | 0360-0124 | TERMINAL PIN |
| A24TP3 | 0360-0124 | TERMINAL PIN |
| A24TP4 | 0360-0124 | TERMINAL PIN |
| A24TP5 | 0360-0124 | TERMINAL PIN |
| A24TP6 | 0360-0124 | TERMINAL PIN |
| A24TP7 | 0360-0124 | TERMINAL PIN |
| A24TP8 | 0360-0124 | TERMINAL PIN |

8.18a

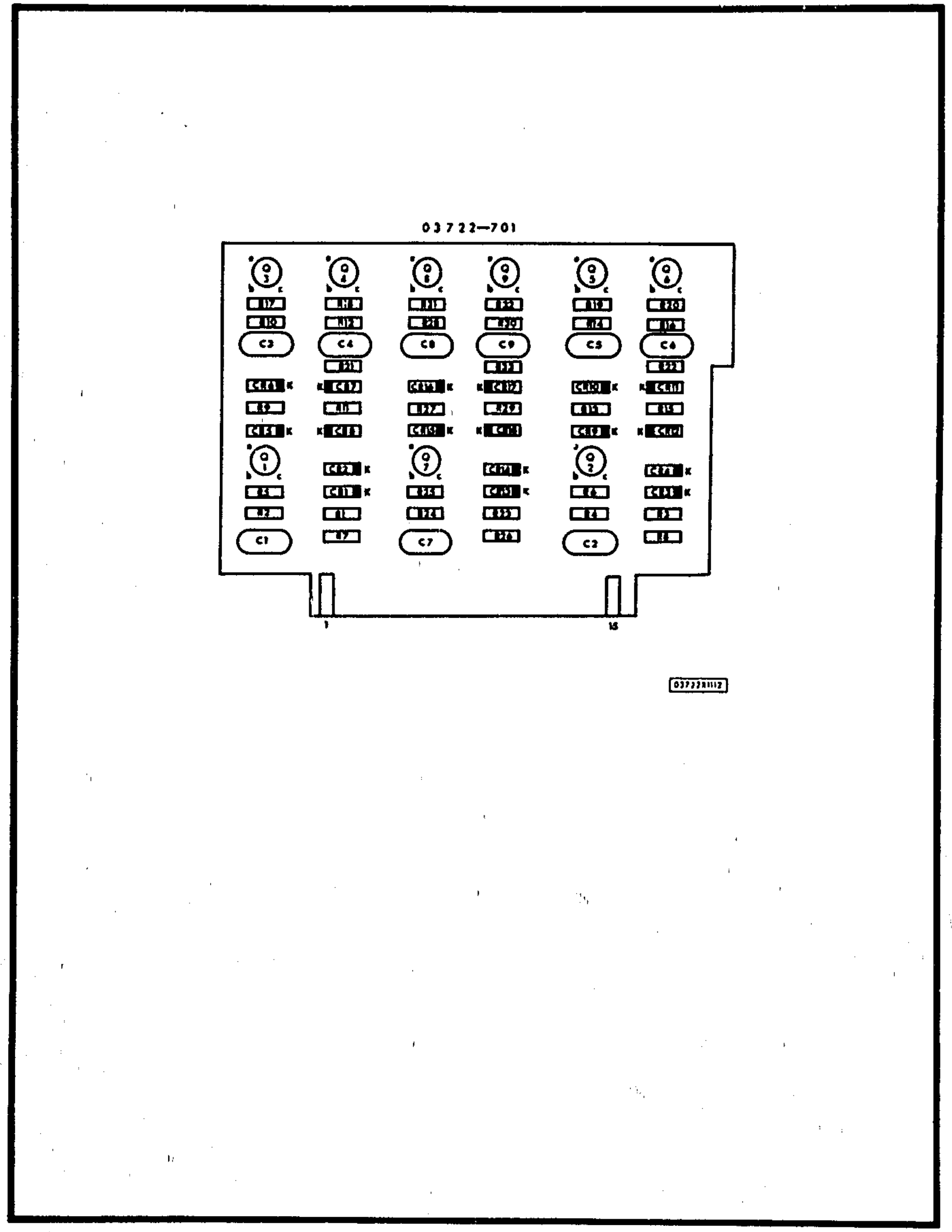



Figure 8 - 27 Feedback logic assembly A27, component location

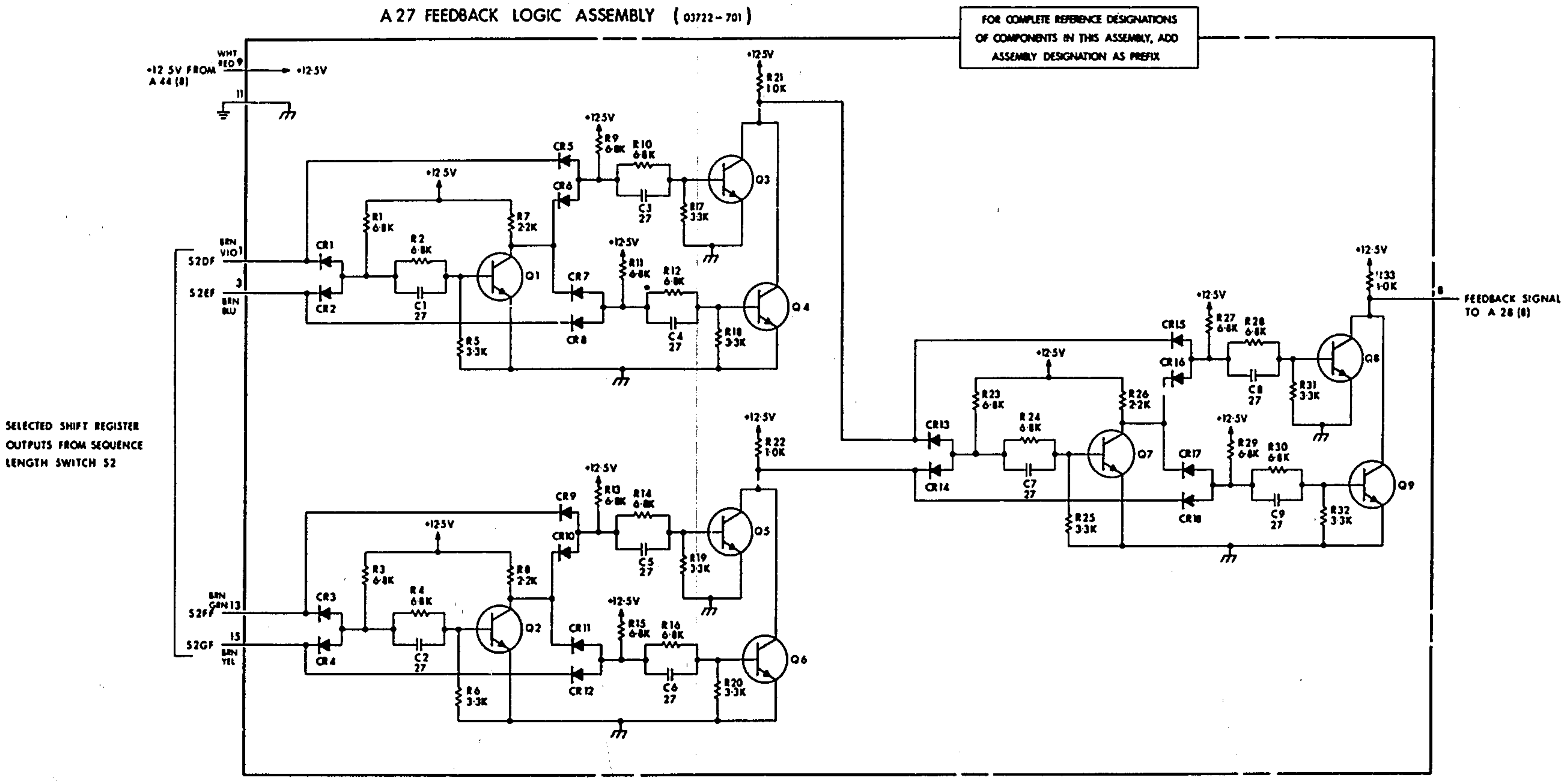



Figure 8 - 28 Feedback logic assembly A27, schematic

| | | |
|---|---|---|
| A27 | 03722-701 | ASSY: FEEDBACK LOGIC |
| | 03722-301 | BOARD: BLANK PC(NSR) |
| A27C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A27CR1 | 1901-0040 | DIODE: SI |
| A27CR2 | 1901-0040 | DIODE: SI |
| A27CR3 | 1901-0040 | DIODE: SI |
| A27CR4 | 1901-0040 | DIODE: SI |
| A27CR5 | 1901-0040 | DIODE: SI |
| A27CR6 | 1901-0040 | DIODE: SI |
| A27CR7 | 1901-0040 | DIODE: SI |
| A27CR8 | 1901-0040 | DIODE: SI |
| A27CR9 | 1901-0040 | DIODE: SI |
| A27CR10 | 1901-0040 | DIODE: SI |
| A27CR11 | 1901-0040 | DIODE: SI |
| A27CR12 | 1901-0040 | DIODE: SI |
| A27CR13 | 1901-0040 | DIODE: SI |
| A27CR14 | 1901-0040 | DIODE: SI |
| A27CR15 | 1901-0040 | DIODE: SI |
| A27CR16 | 1901-0040 | DIODE: SI |
| A27CR17 | 1901-0040 | DIODE: SI |
| A27CR18 | 1901-0040 | DIODE: SI |
| A27Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q7 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A27Q9 | 1854-0605 | TRANSISTOR: SI NPN |
| A27R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R5 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R6 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R7 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A27R8 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A27R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R10 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R11 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R16 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R17 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R18 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R19 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R20 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R21 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A27R22 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A27R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R25 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R26 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A27R27 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R29 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R30 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A27R31 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R32 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A27R33 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |

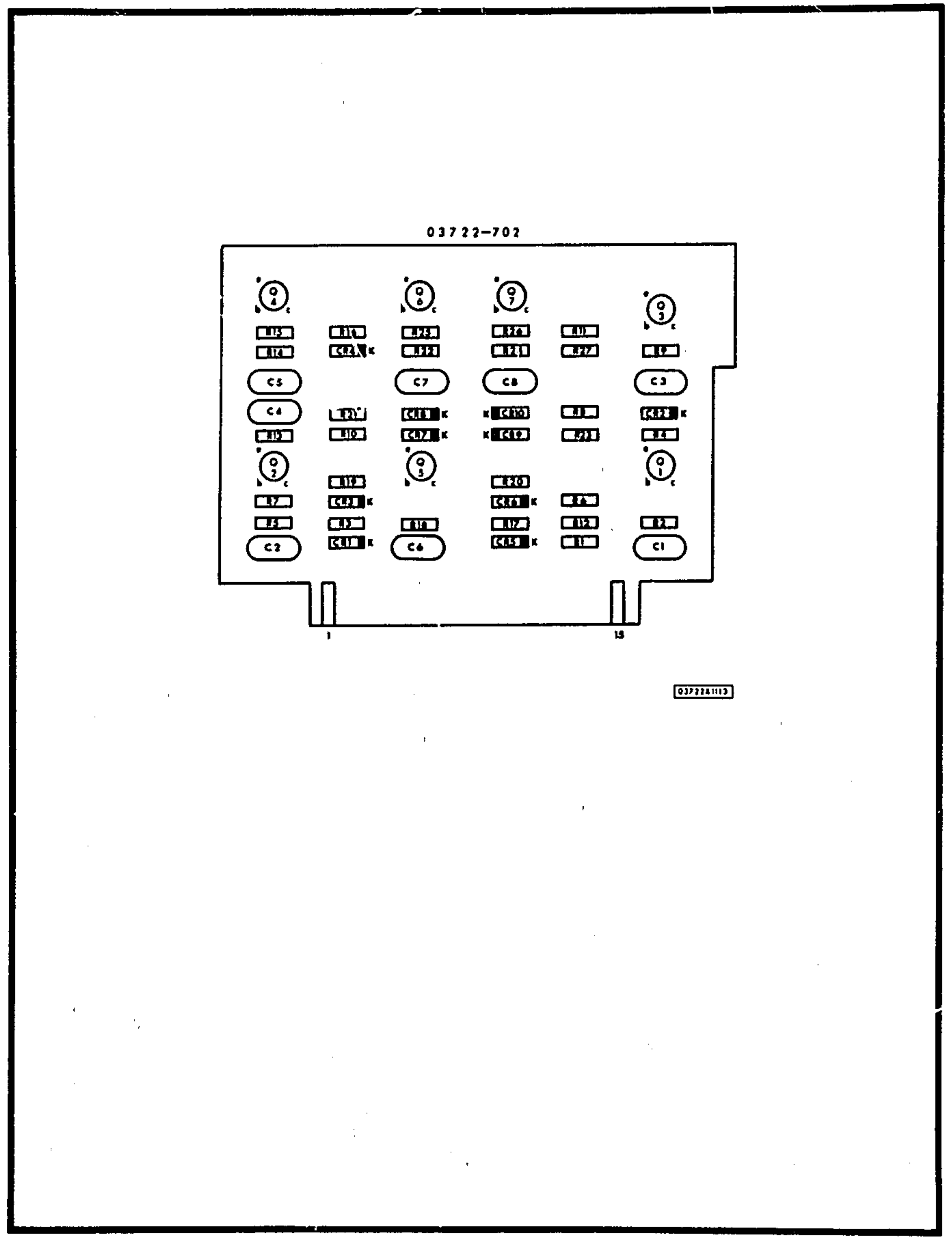


Figure 8 - 29 Auto-start logic assembly A28, component location

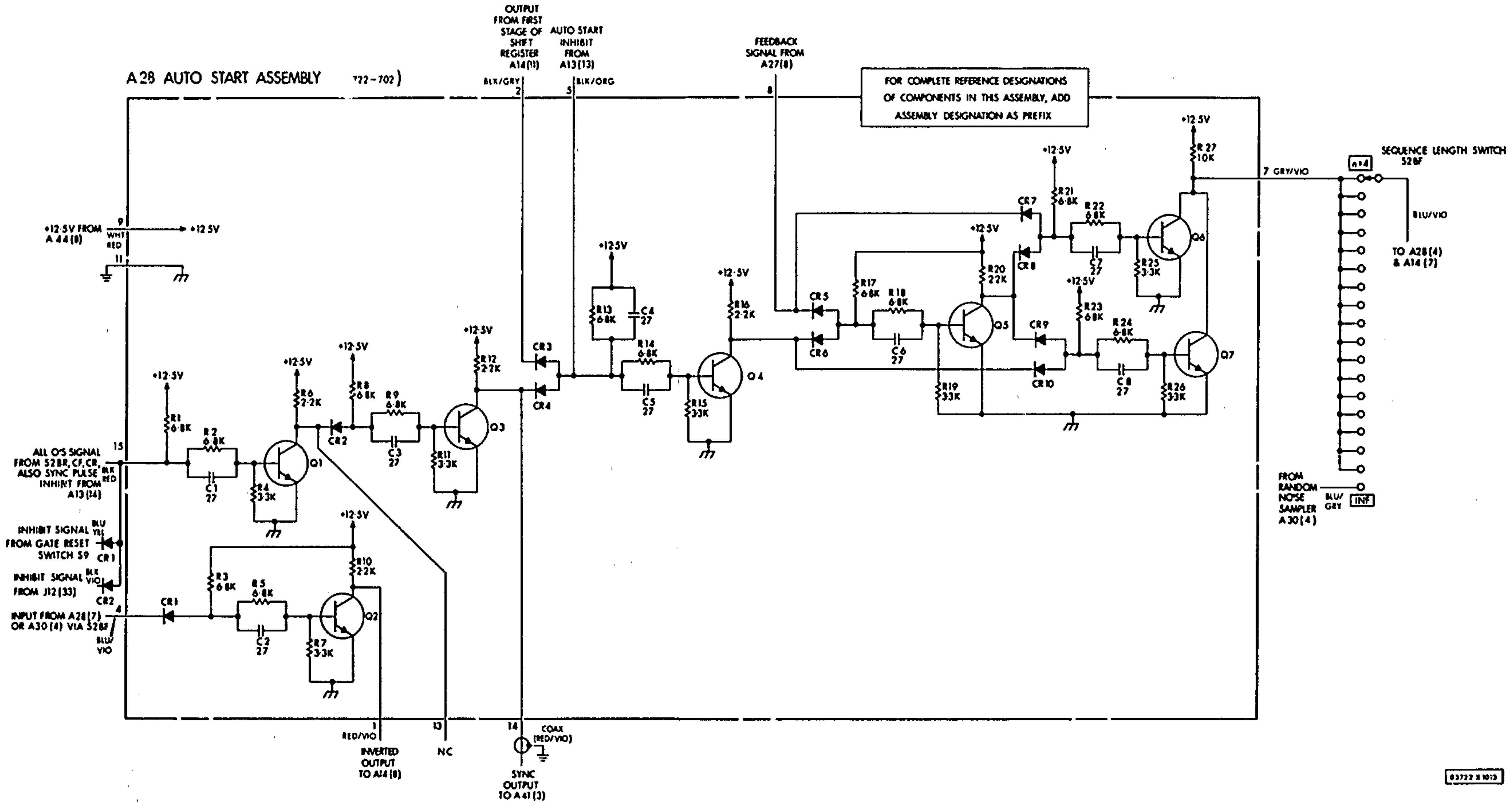


Figure 8 - 30 Auto-start logic assembly A28, schematic

| | | |
|---|---|---|
| A28 | 03722-702 | ASSY: AUTO-START LOGIC |
| | 03722-302 | BOARD: BLANK PC(NSR) |
| A28C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28C7 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28C8 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A28CR1 | 1901-0040 | DIODE: SI |
| A28CR2 | 1901-0040 | DIODE: SI |
| A28CR3 | 1901-0040 | DIODE: SI |
| A28CR4 | 1901-0040 | DIODE: SI |
| A28CR5 | 1901-0040 | DIODE: SI |
| A28CR6 | 1901-0040 | DIODE: SI |
| A28CR7 | 1901-0040 | DIODE: SI |
| A28CR8 | 1901-0040 | DIODE: SI |
| A28CR9 | 1901-0040 | DIODE: SI |
| A28CR10 | 1901-0040 | DIODE: SI |
| A28Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A28Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A28Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A28Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A28Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A28Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A28Q7 | 1854-0605 | TRANSISTOR: SI NPN |
| A28R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R3 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R4 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A28R5 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R6 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A28R7 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A28R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R10 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A28R11 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A28R12 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A28R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R15 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A28R16 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A28R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R18 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R19 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A28R20 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A28R21 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R22 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R23 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A28R25 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A28R26 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A28R27 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |

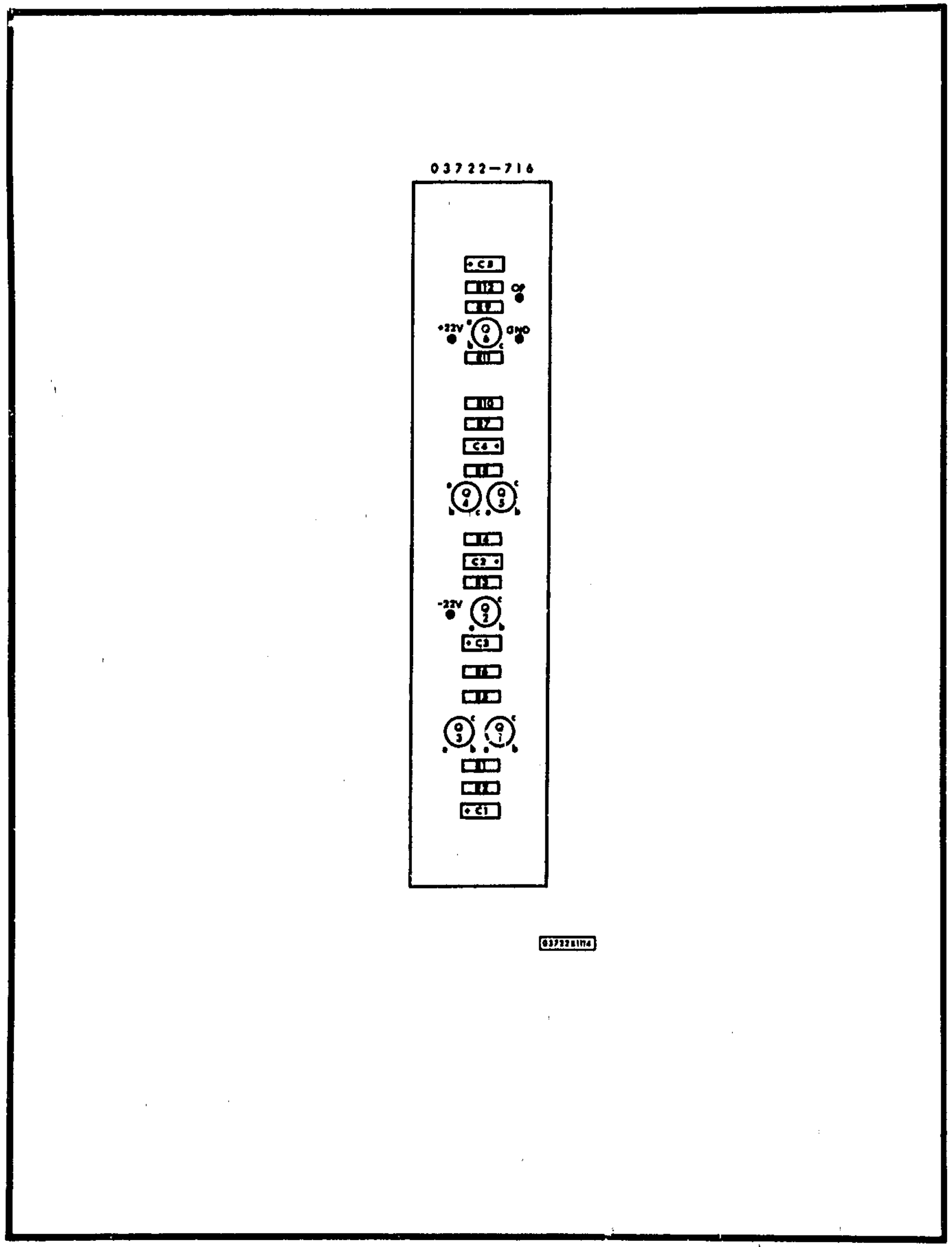



Figure 8 - 31 Random noise generator assembly A29, component location

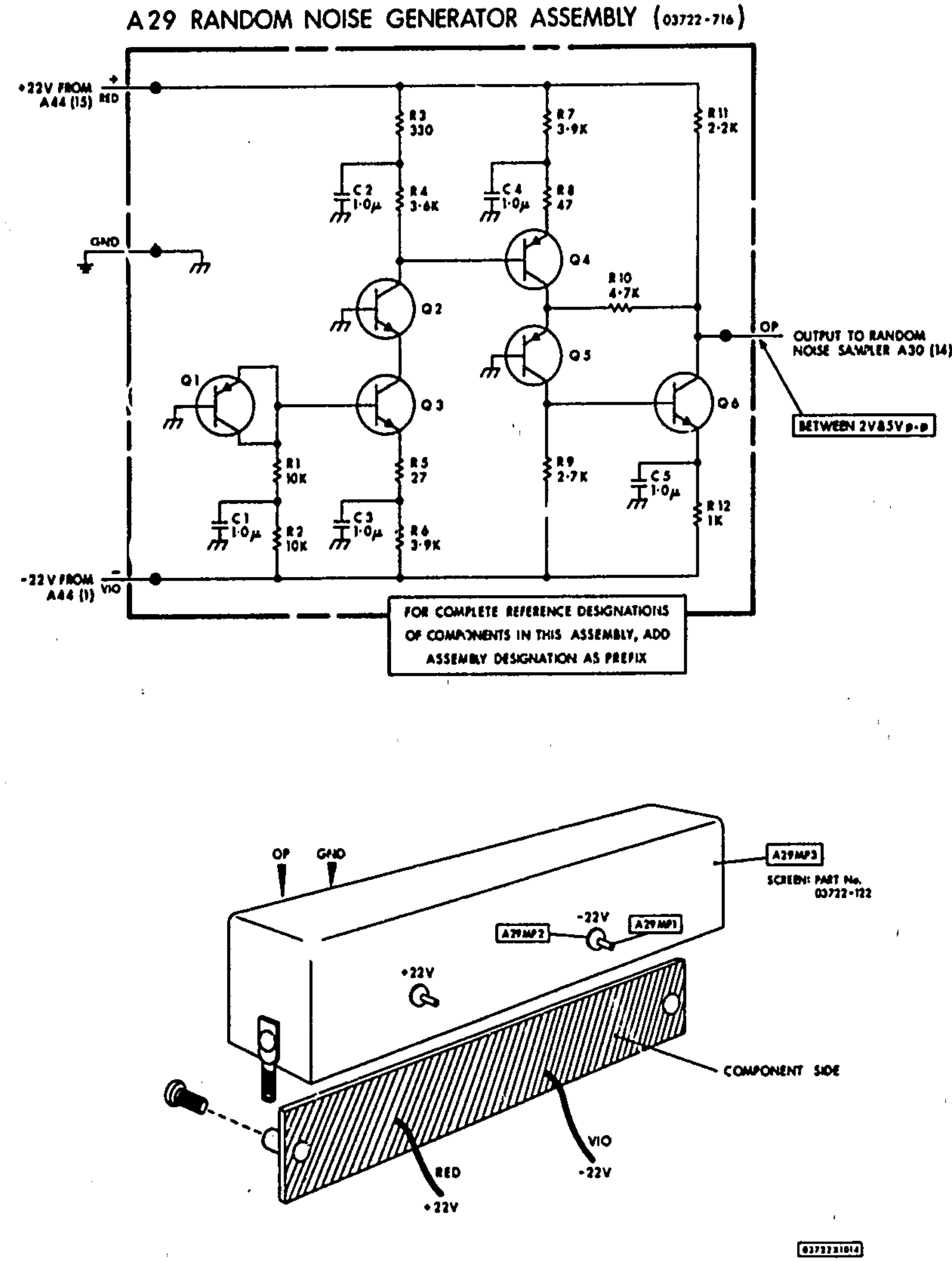



Figure 8 - 32 Random noise generator assembly A29, schematic

| | | |
|---|---|---|
| A29 | 03722-716 | ASSY: RANDOM NOISE GENERATOR |
| | 03722-316 | BOARD: BLANK PC (NSR) |
| A29C1 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW |
| A29C2 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW |
| A29C3 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW |
| A29C4 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW |
| A29C5 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW |
| A29MP1 | 0340-0038 | PIN |
| A29MP2 | 0340-0038 | PIN |
| A29MP3 | 0340-0038 | PIN |
| A29MP4 | 0340-0038 | PIN |
| A29MP5 | 0340-0039 | INSULATOR |
| A29MP6 | 0340-0039 | INSULATOR |
| A29MP7 | 0340-0039 | INSULATOR |
| A29MP8 | 0340-0039 | INSULATOR |
| A29MP9 | 03722-122 | SCREEN |
| A29Q1 | 1853-0015 | TRANSISTOR: SI PNP |
| A29Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A29Q3 | 1854-0071 | TRANSISTOR: SI NPN |
| A29Q4 | 1853-0015 | TRANSISTOR: SI PNP |
| A29Q5 | 1853-0036 | TRANSISTOR: SI PNP |
| A29Q6 | 1854-0071 | TRANSISTOR: SI NPN |
| A29R1 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A29R2 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A29R3 | 0698-4243 | R: FXD MET OX 330 OHM 5% 1/4W |
| A29R4 | 0698-4267 | R: FXD MET OX 3.6K OHM 5% 1/4W |
| A29R5 | 0698-5701 | R: FXD MET OX 27 OHM 5% 1/4W |
| A29R6 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W |
| A29R7 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W |
| A29R8 | 0698-5707 | R: FXD MET OX 47 OHM 5% 1/4W |
| A29R9 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W |
| A29R10 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A29R11 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A29R12 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |

**Table 8 - 1 Random noise system — functional check & troubleshooting procedures**

(1) Set the *3722A* controls as follows:

SEQUENCE LENGTH switch to INFINITE
CLOCK PERIOD switch to $1\mu S$
CLOCK switch (rear panel) to INT
TEST switch (on chassis) to NORMAL
Press RUN button

(2) Connect the *3722A* BINARY output to the DC COUPLED input of an electronic counter, e.g. *hp 5245L.*

(3) Set the counter controls as follows:

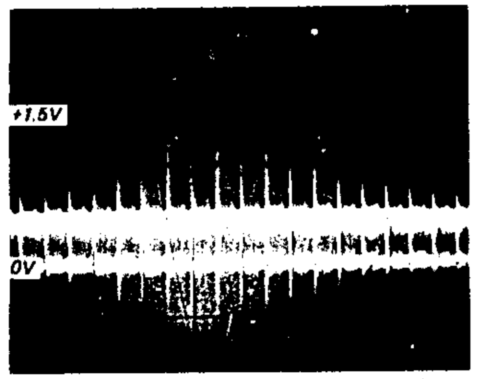
SENSITIVITY switch to 1V
TIMEBASE switch to 1 SEC
FUNCTION switch to FREQUENCY

(4) Check that the counter reads 250kHz ± 5kHz on average of three or four readings. If the count is not correct, check for the presence of noise at the output from A29 (random noise generator). If the noise signal is satisfactory, troubleshoot the random noise sampler, A30, concentrating particularly on the tunnel diode Schmitt and monostable circuits. Disconnect the noise input to A30(14) and substitute a low-amplitude single tone of approximately 10MHz. A suitable signal generator for this purpose is the *hp 606A.* As the input frequency is swept from around 6MHz to 10MHz, check operation of the Schmitt shaper at A30Q1 collector, and check also that the width of the monostable output pulses at A30Q3 collector is reasonably constant. If the pulse duration tends to track the period of the input signal, it may be that the monostable is being forced by an over-large input. Re-check after attenuating the signal generator output to the point where the monostable just triggers regularly.

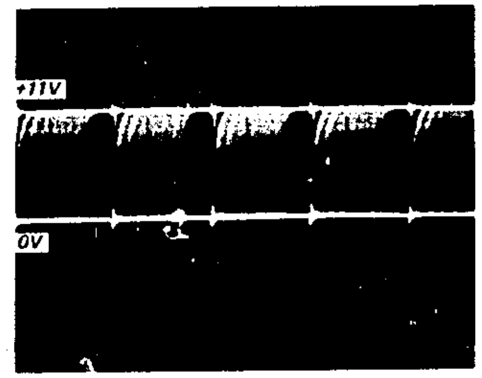
NOTE The monostable operates only when the clock input to the sampler, at A30(1), is at the low (zero volt) level.

**Reason for 250kHz frequency count**

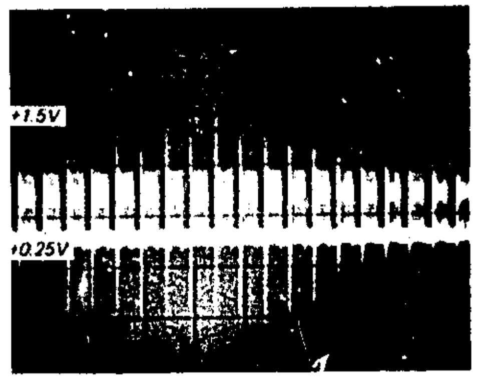
With a true random drive from the noise sampler, there is a 50-50 probability of the output from the first stage of the shift register being at either the high or low levels in any clock period. Hence, the mean crossing rate of the BINARY output — with 1MHz clock — must be 500kHz. Two zero crossings (one positive-going and one negative-going) are equivalent to one cycle of a periodic signal — so the measured frequency of the BINARY output should be approximately 250kHz.



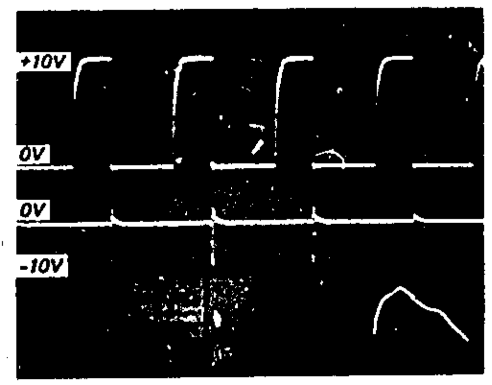

A30CR1 anode, 0.5V/cm
**Clock period** $1\mu S$ **Sweep** $2\mu S/cm$
**Trigger** internal




A30Q4C, 5V/cm
**Clock period** $1\mu S$ **Sweep** $0.5\mu S/cm$
Blurred patches signify free-running divide-by-two stage. At end of gating interval, the divide-by-two stage stops (signified by the clear patches occurring once in each clock period). The divide-by-two stage should show no preference for either high or low levels — hence the even intensity of upper and lower traces.

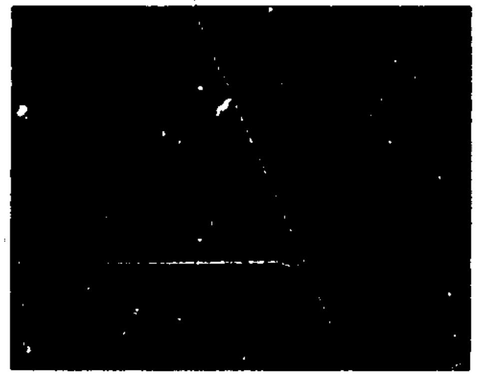



A30CR4 anode, 0.5V/cm
**Clock period** $1\mu S$ **Sweep** $2\mu S/cm$
**Trigger** internal

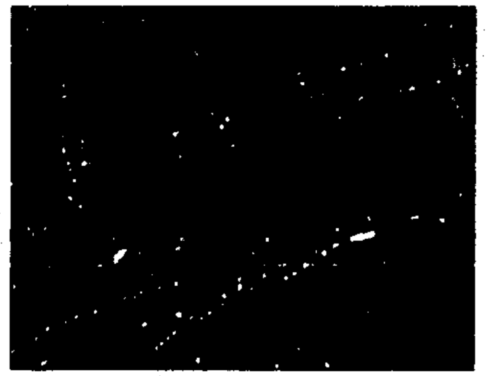



**Upper trace** clock input to random noise sampler A30(1), 5V/cm
**Lower trace** shift pulse at A13(9), 10V/cm
**Clock period** $10\mu S$ **Sweep** $5\mu S/cm$
**Trigger** from *3722A* CLOCK

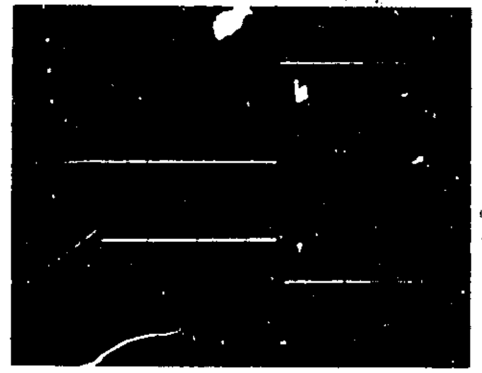
| | | |
|---|---|---|
| A30 | 03722-709 | ASSY: RANDOM NOISE SAMPLER |
| | 03722-309 | BOARD: BLANK PC (NSR) |
| A30C1 | 0140-0196 | C: FXD MICA 150PF 5% 300VDCW |
| A30C2 | 0180-0291 | C: FXD TA 1.0UF 10% 35VDCW |
| A30C3 | 0150-0093 | C: FXD CER 0.01UF 100VDCW |
| A30C4 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A30C5 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C6 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C7 | 0160-2208 | C: FXD MICA 330PF 5% 300VDCW |
| A30C8 | 0150-0093 | C: FXD CER 0.01UF 100VDCW |
| A30C9 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C10 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C11 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C12 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C13 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C14 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30C15 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A30CR1 | 1912-0002 | DIODE: TUNNEL |
| A30CR2 | 1901-0040 | DIODE: SI |
| A30CR3 | 1901-0040 | DIODE: SI |
| A30CR4 | 1912-0002 | DIODE: TUNNEL |
| A30CR5 | 1901-0040 | DIODE: SI |
| A30CR6 | 1901-0040 | DIODE: SI |
| A30CR7 | 1910-0034 | DIODE: GE |
| A30CR8 | 1910-0034 | DIODE: GE |
| A30CR9 | 1901-0040 | DIODE: SI |
| A30CR10 | 1901-0040 | DIODE: SI |
| A30CR11 | 1901-0040 | DIODE: SI |
| A30CR12 | 1901-0040 | DIODE: SI |
| A30CR13 | 1901-0040 | DIODE: SI |
| A30L1 | 9140-0114 | COIL: FXD 10UH |
| A30L2 | 9140-0112 | COIL: FXD 4.7UH |
| A30Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A30Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A30Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A30Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A30Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A30Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A30Q7 | 1854-0605 | TRANSISTOR: SI NPN |
| A30R1 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R2 | 0758-0086 | R: FXD MET OX 100 OHM 5% 1/4W |
| A30R3 | 0758-0086 | R: FXD MET OX 100 OHM 5% 1/4W |
| A30R4 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W |
| A30R5 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A30R6 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R7 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A30R8 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A30R9 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R11 | 0698-4246 | R: FXD MET OX 470 OHM 5% 1/4W |
| A30R12 | 0698-4234 | R: FXD MET OX 130 OHM 5% 1/4W |
| A30R13 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W |
| A30R14 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R16 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A30R17 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W |
| A30R18 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W |
| A30R19 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A30R20 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A30R21 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A30R22 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R23 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A30R24 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A30R25 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A30R26 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A30R27 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A30R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A30R29 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A30R30 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A30R31 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A30R32 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |



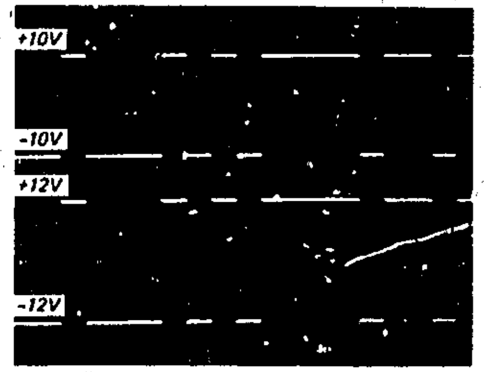
**Upper trace** BINARY output, 10V/cm
**Lower trace** A31TP1, R13 maladjusted, 0.5V/cm
**Clock period** 1mS **N** = 31
**Sweep** 1mS/cm
**Trigger** from *3722A* SYNC



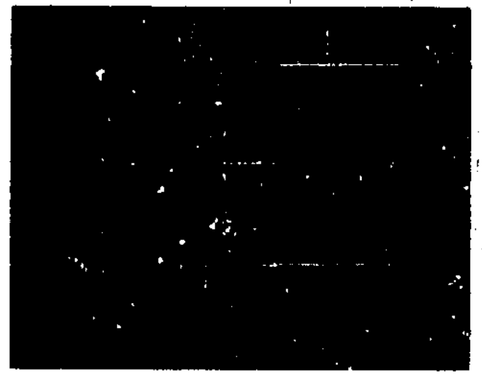
As opposite, but R13 adjusted correctly.



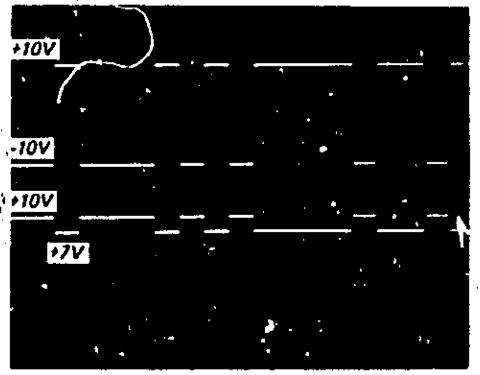
**Upper trace** BINARY output, 10V/cm
**Lower trace** A31TP2, R17 maladjusted, 0.5V/cm
**Clock period** 1mS **N** = 31
**Sweep** 1mS/cm
**Trigger** from *3722A* SYNC



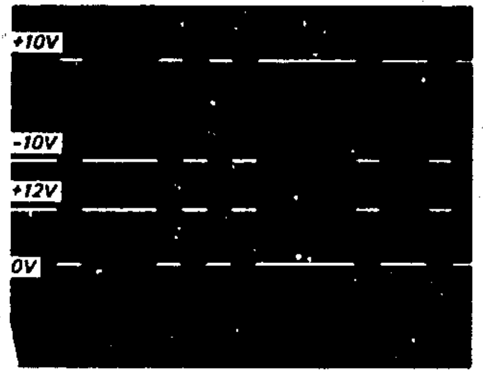

**Upper trace** BINARY output, 10V/cm
**Lower trace** A31Q2C, 10V/cm
**Clock period** 100μS **N** = 31
**Sweep** 0.2mS/cm
**Trigger** from *3722A* SYNC



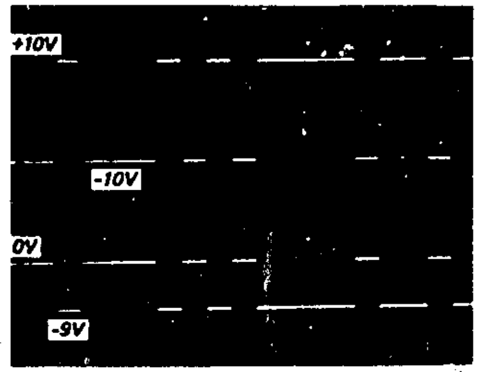
As above, but R17 adjusted correctly.



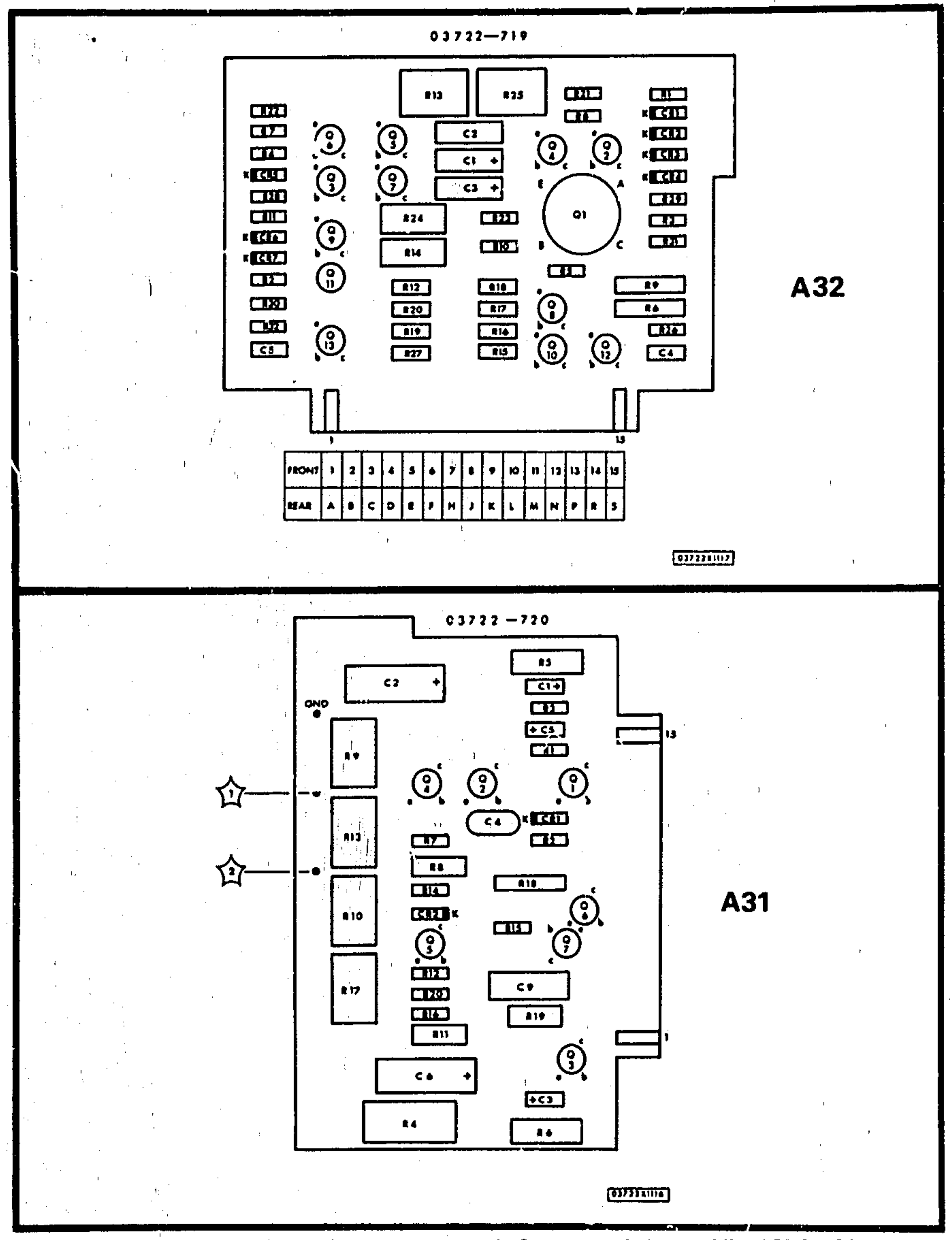

**Upper trace** BINARY output, 10V/cm
**Lower trace** A31Q4C, 10V/cm
**Clock period** 100μS **N** = 31
**Sweep** 0.2mS/cm
**Trigger** from *3722A* SYNC




**Upper trace** BINARY output, 10V/cm
**Lower trace** input at A31(7), 10V/cm
**Clock period** 100μS **N** = 31
**Sweep** 0.2mS/cm
**Trigger** from *3722A* SYNC




**Upper trace** BINARY output, 10V/cm
**Lower trace** A31Q5C, 10V/cm
**Clock period** 100μS **N** = 31
**Sweep** 0.2mS/cm
**Trigger** from *3722A* SYNC




Figures 8 - 35 & 8 - 36 Reference power supply & output switch assemblies A32 & A31, component location

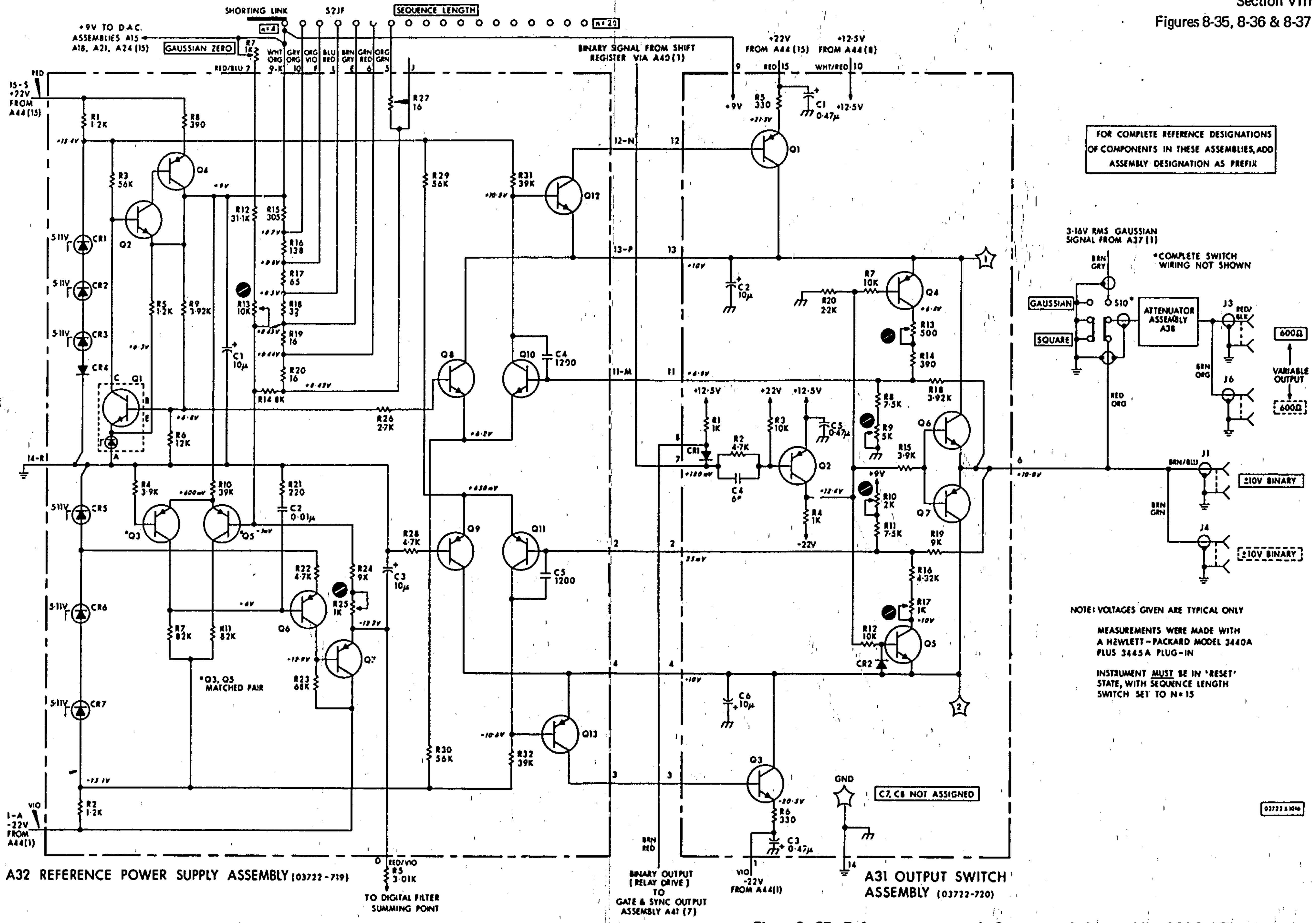
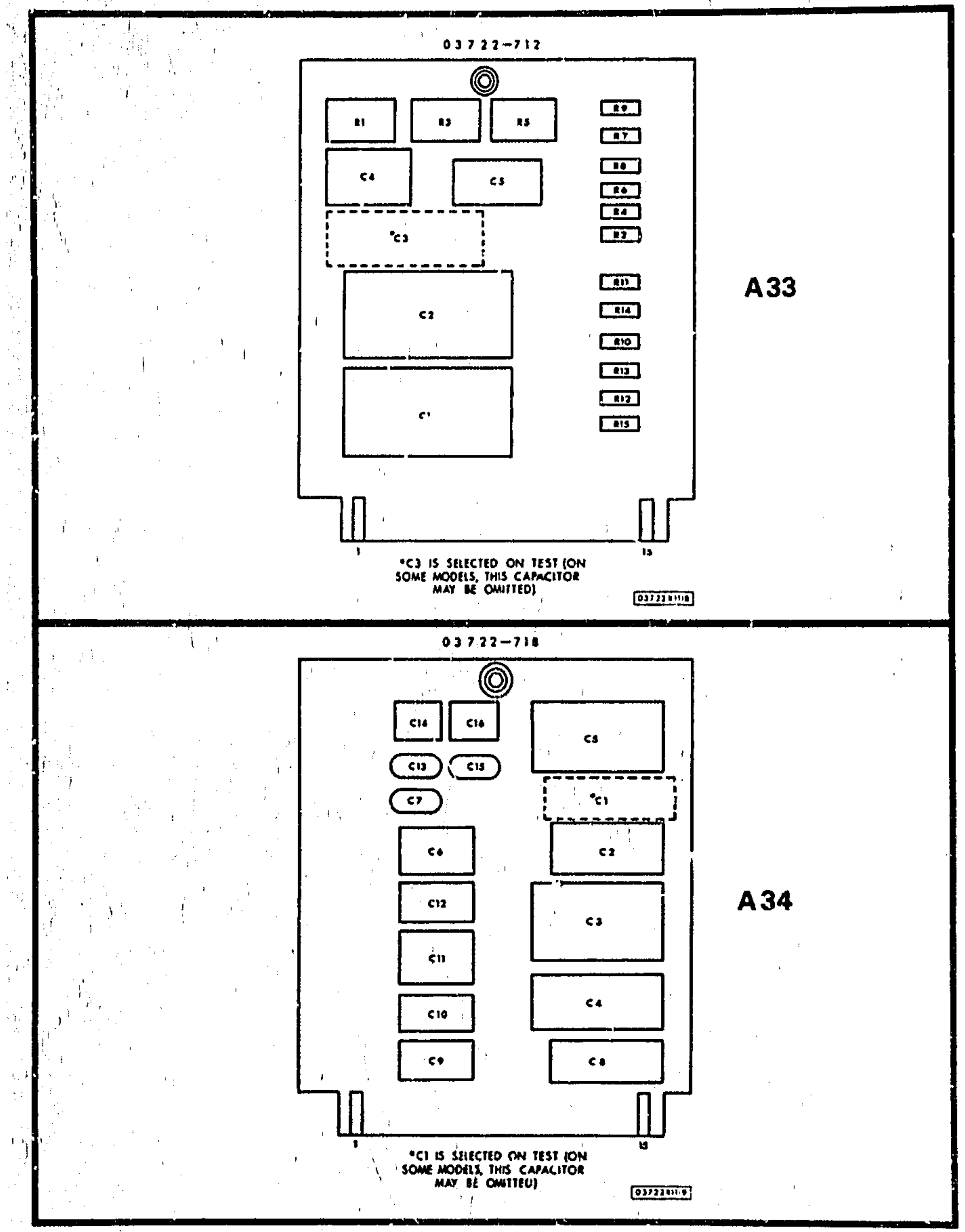



Figure 8 - 37 Reference power supply & output switch assemblies A31 & A32, schematic

| | | |
|---|---|---|
| A31 | 03722-720 | ASSY: OUTPUT SWITCH |
| | 03722-320 | BOARD: BLANK PC (NSR) |
| A31C1 | 0180-0376 | C: FXD TA 0.47UF 10% 35VDCW |
| A31C2 | 0180-0059 | C: FXD AL 10UF -10%+100% 25VDCW |
| A31C3 | 0180-0376 | C: FXD TA 0.47UF 10% 35VDCW |
| A31C4 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A31C5 | 0180-0376 | C: FXD TA 0.47UF 10% 35VDCW |
| A31C6 | 0180-0059 | C: FXD AL 10UF -10%+100% 25VDCW |
| A31CR1 | 1901-0040 | DIODE: SI |
| A31CR2 | 1901-0040 | DIODE: SI |
| A31Q1 | 1853-0036 | TRANSISTOR: SI PNP |
| A31Q2 | 1853-0036 | TRANSISTOR: SI PNP |
| A31Q3 | 1854-0071 | TRANSISTOR: SI NPN |
| A31Q4 | 1853-0015 | TRANSISTOR: SI PNP |
| A31Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A31Q6 | 1854-0215 | TRANSISTOR: SI NPN |
| A31Q7 | 1853-0036 | TRANSISTOR: SI PNP |
| A31R1 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A31R2 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A31R3 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A31R4 | 0764-0016 | R: FXD MET FLM 1.0K OHM 5% 2W |
| A31R5 | 0760-0022 | R: FXD MET FLM 330 OHM 2% 1W |
| A31R6 | 0760-0022 | R: FXD MET FLM 330 OHM 2% 1W |
| A31R7 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A31R8 | 0698-6033 | R: FXD MET FLM 7.5K OHM 1% 1/4W 50 PPM |
| A31R9 | 2100-1760 | R: VAR WW LIN 5.0K OHM 10% 1/2W |
| A31R10 | 2100-1759 | R: VAR WW LIN 2.0K OHM 10% 1/2W |
| A31R11 | 0698-6033 | R: FXD MET FLM 7.5K OHM 1% 1/4W 50 PPM |
| A31R12 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A31R13 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W |
| A31R14 | 0757-0914 | R: FXD MET FLM 390 OHM 2% 1/8W |
| A31R15 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W |
| A31R16 | 0757-0436 | R: FXD MET FLM 4.32K OHM 1% 1/8W 100 PPM |
| A31R17 | 2100-1758 | R: VAR WW LIN 1.0K OHM 10% 1/2W |
| A31R18 | 0698-3763 | R: FXD MET FLM 3.92K OHM 1% 1/4W 50 PPM |
| A31R19 | 0698-6034 | R: FXD MET FLM 9K OHM 1% 1/4W 50 PPM |
| A31R20 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A31TP1 | 0360-0124 | TERMINAL PIN |
| A31TP2 | 0360-0124 | TERMINAL PIN |
| A31TP3 | 0360-0124 | TERMINAL PIN |
| A32 | 03722-719 | ASSY: REFERENCE POWER SUPPLY |
| | 03722-319 | BOARD: BLANK PC (NSR) |
| A32C1 | 0180-0374 | C: FXD TA 10UF 10% 20VDCW |
| A32C2 | 0160-0161 | C: FXD MY 0.01UF |
| A32C3 | 0180-0374 | C: FXD TA 10UF 10% 20VDCW |
| A32C4 | 0160-0297 | C: FXD MY 1200PF 10% 200VDCW |
| A32C5 | 0160-0297 | C: FXD MY 1200PF 10% 200VDCW |
| A32CR1 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW |
| A32CR2 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW |
| A32CR3 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW |
| A32CR4 | 1901-0040 | DIODE: SI |
| A32CR5 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW |
| A32CR6 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW |
| A32CR7 | 1902-0041 | DIODE: BREAKDOWN 5.11V 400mW |
| A32MP1 | 0380-0509 | BEAD: GLASS |
| A32MP2 | 0380-0509 | BEAD: GLASS |
| A32MP3 | 0380-0509 | BEAD: GLASS |
| A32MP4 | 0380-0509 | BEAD: GLASS |
| A32Q1 | 1820-0001 | TRANSISTOR: SI NPN (AMPLIFIER REFERENCE) |
| A32Q2 | 1854-0071 | TRANSISTOR: SI NPN |
| A32Q3 | 1853-0607 | TRANSISTOR: SI PNP (MATCHED WITH Q5) |
| A32Q4 | 1853-0036 | TRANSISTOR: SI PNP |
| A32Q5 | 1853-0607 | TRANSISTOR: SI PNP (MATCHED WITH Q3) |
| A32Q6 | 1853-0036 | TRANSISTOR: SI PNP |
| A32Q7 | 1853-0036 | TRANSISTOR: SI PNP |
| A32Q8 | 1854-0071 | TRANSISTOR: SI NPN |
| A32Q9 | 1853-0015 | TRANSISTOR: SI PNP |
| A32Q10 | 1854-0071 | TRANSISTOR: SI NPN |
| A32Q11 | 1853-0015 | TRANSISTOR: SI PNP |
| A32Q12 | 1854-0071 | TRANSISTOR: SI NPN |
| A32Q13 | 1853-0015 | TRANSISTOR: SI PNP |
| A32R1 | 0698-4256 | R: FXD MET OX 1.2K OHM 5% 1/4W |
| A32R2 | 0698-4256 | R: FXD MET OX 1.2K OHM 5% 1/4W |
| A32R3 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W |
| A32R4 | 0698-4268 | R: FXD MET OX 3.9K OHM 5% 1/4W |
| A32R5 | 0698-4256 | R: FXD MET OX 1.2K OHM 5% 1/4W |
| A32R6 | 0698-3768 | R: FXD MET FLM 12K OHM 1% 1/4W |
| A32R7 | 0698-4300 | R: FXD MET OX 82K OHM 5% 1/4W |
| A32R8 | 0698-4245 | R: FXD MET OX 390 OHM 5% 1/4W |
| A32R9 | 0698-3763 | R: FXD MET FLM 3920 OHM 1% 1/4W |
| A32R10 | 0698-4292 | R: FXD MET OX 39K OHM 5% 1/4W |
| A32R11 | 0698-4300 | R: FXD MET OX 82K OHM 5% 1/4W |
| A32R12 | 0698-5793 | R: FXD MET FLM 31.1K OHM 1/2% 1/8W 50 PPM |
| A32R13 | 2100-0989 | R: VAR WW LIN 10K OHM 5% 1W |
| A32R14 | 0811-0601 | R: FXD WW 8K OHM 1% 1/2W 5 PPM |
| A32R15 | 0698-3779 | R: FXD MET OX 305 OHM 1% 1/4W |
| A32R16 | 0698-3778 | R: FXD MET OX 138 OHM 1% 1/4W |
| A32R17 | 0698-3777 | R: FXD MET OX 65 OHM 1% 1/4W |
| A32R18 | 0698-3776 | R: FXD MET OX 32 OHM 2% 1/4W |
| A32R19 | 0698-3775 | R: FXD MET OX 16 OHM 2% 1/4W |
| A32R20 | 0698-3775 | R: FXD MET OX 16 OHM 2% 1/4W |
| A32R21 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A32R22 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A32R23 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A32R24 | 0811-0602 | R: FXD WW 9K OHM 1% 1/2W 5PPM |
| A32R25 | 2100-0941 | R: VAR WW LIN 1.0K OHM 5% 1W |
| A32R26 | 0698-4264 | R: FXD MET OX 2.7K OHM 5% 1/4W |
| A32R27 | 0698-3775 | R: FXD MET OX 16 OHM 2% 1/4W |
| A32R28 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A32R29 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W |
| A32R30 | 0698-4296 | R: FXD MET OX 56K OHM 5% 1/4W |
| A32R31 | 0698-4292 | R: FXD MET OX 39K OHM 5% 1/4W |
| A32R32 | 0698-4292 | R: FXD MET OX 39K OHM 5% 1/4W |




Figures 8 - 38 & 8 - 39 Analog filter assemblies (1) A33 & (2) A34, component location

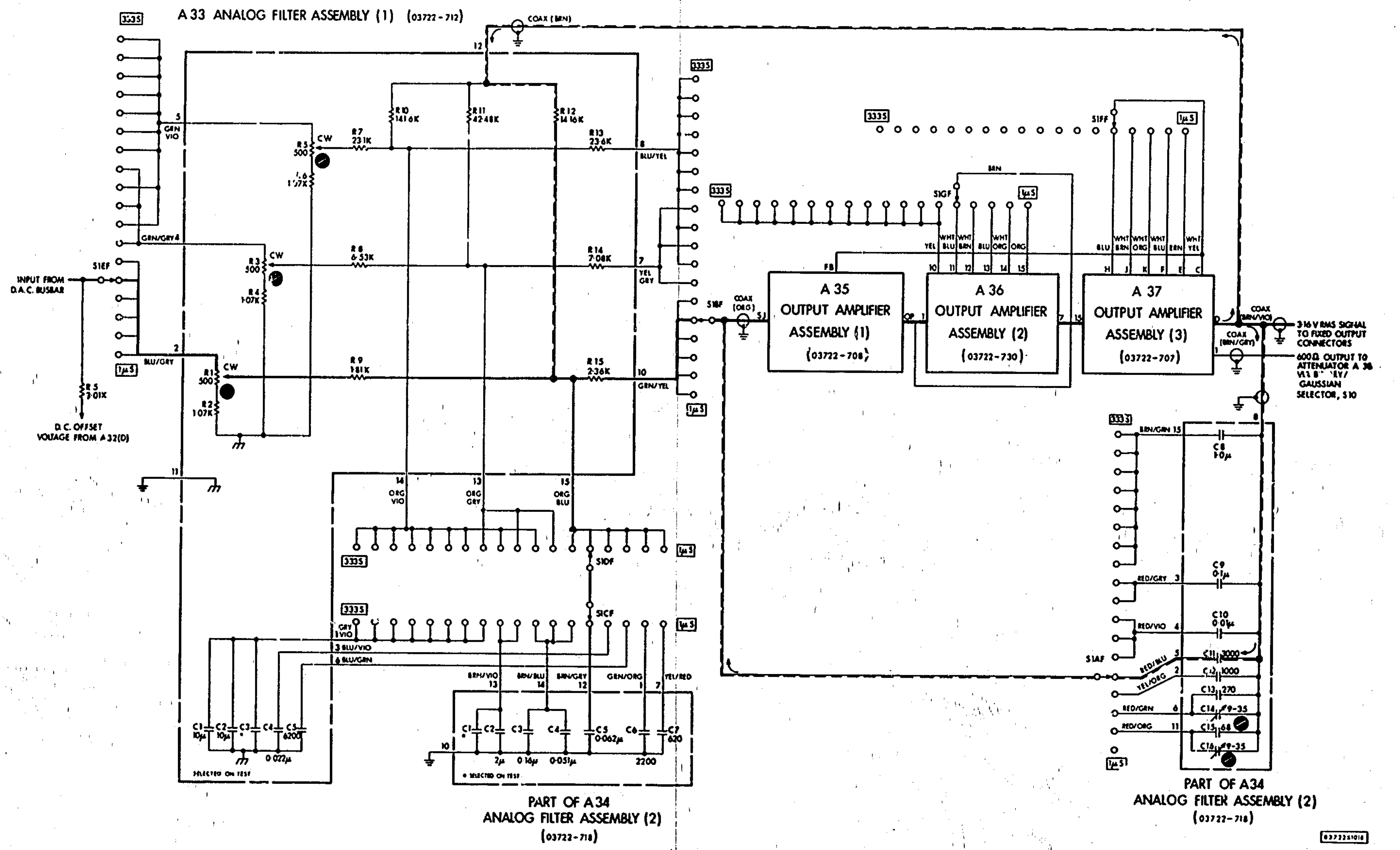



Figure 8 - 40 Analog filter assemblies (1) A33 & (2) A34, schematic

| | | |
|---|---|---|
| A33 | 03722-712 | ASSY: ANALOG FILTER (1) |
| | 03722-312 | BOARD: BLANK PC (NSR) |
| A33C1 | 0160-0615 | C: FXD METALAC 10UF 10% 63VDCW |
| A33C2 | 0160-0615 | C: FXD METALAC 10UF 10% 63VDCW |
| A33C3 | | C: FXD METALAC SELECTED ON TEST |
| A33C4 | 0160-0646 | C: FXD POLY 0.022UF 1% 63VDCW |
| A33C5 | 0160-0647 | C: FXD POLY 6200PF 1% 500VDCW |
| A33R1 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W |
| A33R2 | 0698-3468 | R: FXD MET FLM 1.07K OHM 1% 1/4W 50PPM |
| A33R3 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W |
| A33R4 | 0698-3468 | R: FXD MET FLM 1.07K OHM 1% 1/4W 50PPM |
| A33R5 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W |
| A33R6 | 0698-3468 | R: FXD MET FLM 1.07K OHM 1% 1/4W 50PPM |
| A33R7 | 0698-3770 | R: FXD MET FLM 23.1K OHM 1% 1/4W 50PPM |
| A33R8 | 0698-3765 | R: FXD MET FLM 6.53K OHM 1% 1/4W 50PPM |
| A33R9 | 0698-3759 | R: FXD MET FLM 1.81K OHM 1% 1/4W 50PPM |
| A33R10 | 0698-3773 | R: FXD MET FLM 141.6K OHM 1% 1/4W 50PPM |
| A33R11 | 0698-3772 | R: FXD MET FLM 42.46K OHM 1% 1/4W 50PPM |
| A33R12 | 0698-3769 | R: FXD MET FLM 14.16K OHM 1% 1/4W 50PPM |
| A33R13 | 0698-3771 | R: FXD MET FLM 23.6K OHM 1% 1/4W 50PPM |
| A33R14 | 0698-3766 | R: FXD MET FLM 7.08K OHM 1% 1/4W 50PPM |
| A33R15 | 0698-3761 | R: FXD MET FLM 2.36K OHM 1% 1/4W 50PPM |
| A34 | 03722-718 | ASSY: ANALOG FILTER (2) |
| | 03722-318 | BOARD: BLANK PC (NSR) |
| A34C1 | | C: FXD MY SELECTED ON TEST |
| A34C2 | 0160-0620 | C: FXD METALAC 2UF 10% 63VDCW |
| A34C3 | 0160-0648 | C: FXD POLY 0.16UF 1% 63VDCW |
| A34C4 | 0160-0649 | C: FXD POLY 0.051UF 1% 63VDCW |
| A34C5 | 0160-0650 | C: FXD POLY 0.062UF 1% 63VDCW |
| A34C6 | 0160-0651 | C: FXD POLY 2200PF 1% 500VDCW |
| A34C7 | 0160-2598 | C: FXD MICA 620PF 2% 300VDCW |
| A34C8 | 0160-0655 | C: FXD METALAC 1UF 5% 63VDCW |
| A34C9 | 0170-0019 | C: FXD MY 0.1UF 5% 200VDCW |
| A34C10 | 0160-0633 | C: FXD POLY 0.01UF 1% 63VDCW |
| A34C11 | 0160-0652 | C: FXD POLY 3000PF 1% 500VDCW |
| A34C12 | 0160-0653 | C: FXD POLY 1000PF 1% 500VDCW |
| A34C13 | 0140-0206 | C: FXD MICA 270PF 5% 500VDCW |
| A34C14 | 0121-0105 | C: VAR CER 9-35PF |
| A34C15 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A34C16 | 0121-0105 | C: VAR CER 9-35PF |

## SERVICE NOTE

*Output amplifier (1) A35*

**Checking amplifier input offset and replacement of R19**

After any servicing of amplifier assembly A35, the input offset should be checked as follows:

(1) Connect to the *3722A* GAUSSIAN output a DVM fitted with a high-gain auto range plug-in (e.g. *hp 3440A* + *hp 3445A*).

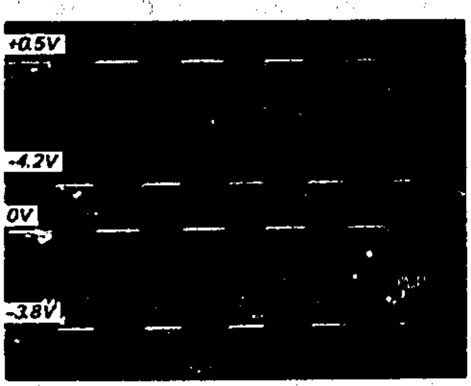
(2) Set the *3722A* CLOCK PERIOD switch to 333μS and operate the HOLD button.

(3) Connect a shorting link between pin 4 of socket XA24 and ground. The DVM reading should be between ± 1mV.

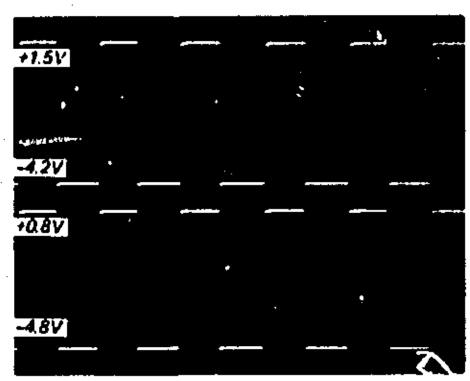
(4) Check that for clock periods 1mS and 3.33mS the DVM reading does not exceed ± 2mV.

If the DVM reading exceeds the stated limits, R19 must be replaced. The value of R19 should be increased if the DVM reading is positive, and vice versa. A range of typical values is given opposite (all resistors are MET OX, 5%, 1/4W).

| Value | *hp* Part No. |
|---|---|
| 1kΩ | 0698-4254 |
| 1.2kΩ | 0698-4256 |
| 1.5kΩ | 0698-4258 |
| 1.8kΩ | 0698-4260 |
| 2kΩ | 0698-4261 |
| 2.2kΩ | 0698-4262 |
| 2.4kΩ | 0698-4263 |
| 2.7kΩ | 0698-4264 |
| 3kΩ | 0698-4265 |
| 3.3kΩ | 0698-4266 |
| 3.6kΩ | 0698-4267 |
| 3.9kΩ | 0698-4268 |
| 4.3kΩ | 0698-4269 |
| 4.7kΩ | 0698-4270 |
| 5.1kΩ | 0698-4271 |




**Upper trace** A35Q2C, 2V/cm
**Lower trace** A35CR1 anode, 2V/cm
**Sweep** 1mS/cm **Trigger** internal




**Upper trace** A35Q5C, 2V/cm
**Lower trace** A35CR5 cathode, 2V/cm
**Sweep** 1mS/cm **Trigger** internal

8-24b

**COMMENT**

One of the problems of fault finding in a feedback system is that a malfunction in one part of the circuit is propagated through the rest of the system. It is therefore necessary to break the loop at some convenient point before attempting to find the source of trouble. However, breaking the feedback loop around a dc amplifier usually gives rise to abnormal circuit conditions, since the feedback also defines quiescent dc conditions. Hence the unorthodox approach necessary when troubleshooting the Gaussian output amplifier system.

**EQUIPMENT REQUIRED**

(1) Oscilloscope with high impedance probes.
(2) High impedance voltmeter ($Z > 10M\Omega$): for example, *hp 3440A* digital voltmeter.
(3) Square wave generator: for example, *hp 3300A*.
(4) Short jumper lead terminated at each end with miniature crocodile clips in insulated sleeves.
(5) A 100kΩ resistor, terminated at one end in a BNC plug (to mate with the GAUSSIAN output connector): the other end of the resistor is soldered to an insulated lead terminated with a crocodile clip.

**SYMPTOM**

Excessive dc offset at output from Gaussian amplifier (i.e. offset observed at GAUSSIAN output connector).

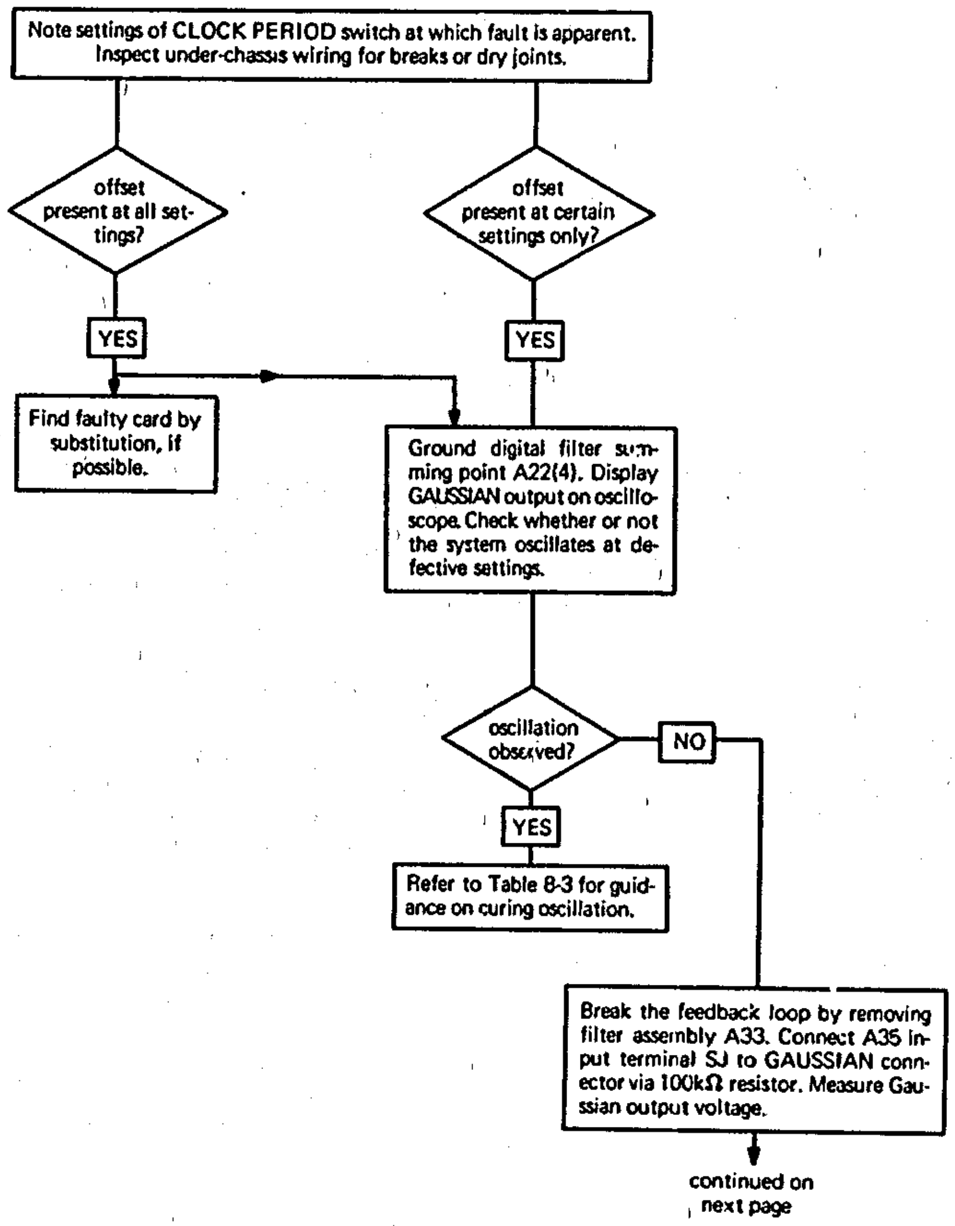



**Table 8-2 Troubleshooting analog filters and Gaussian output amplifiers**

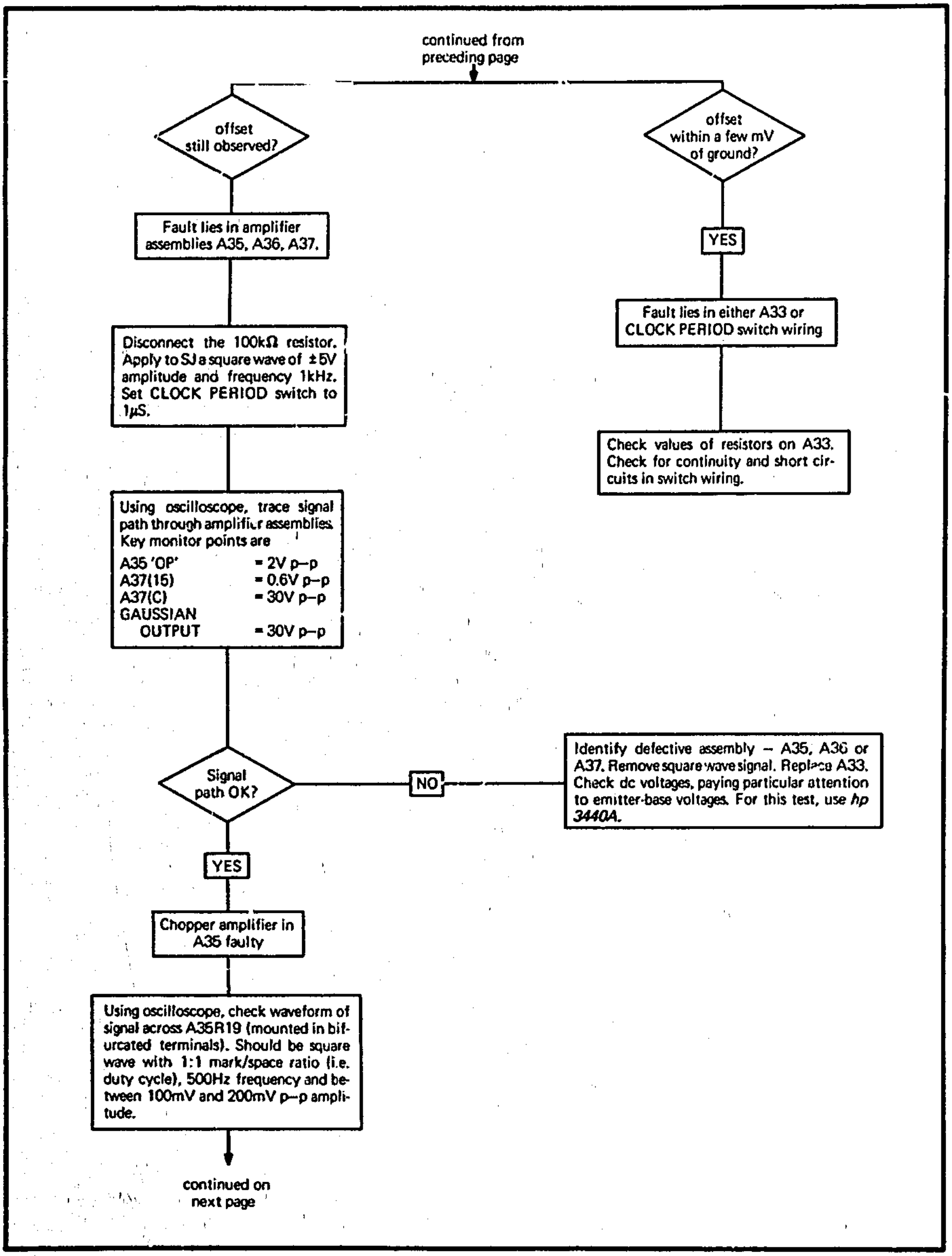



**Table 8-2 (continued)**

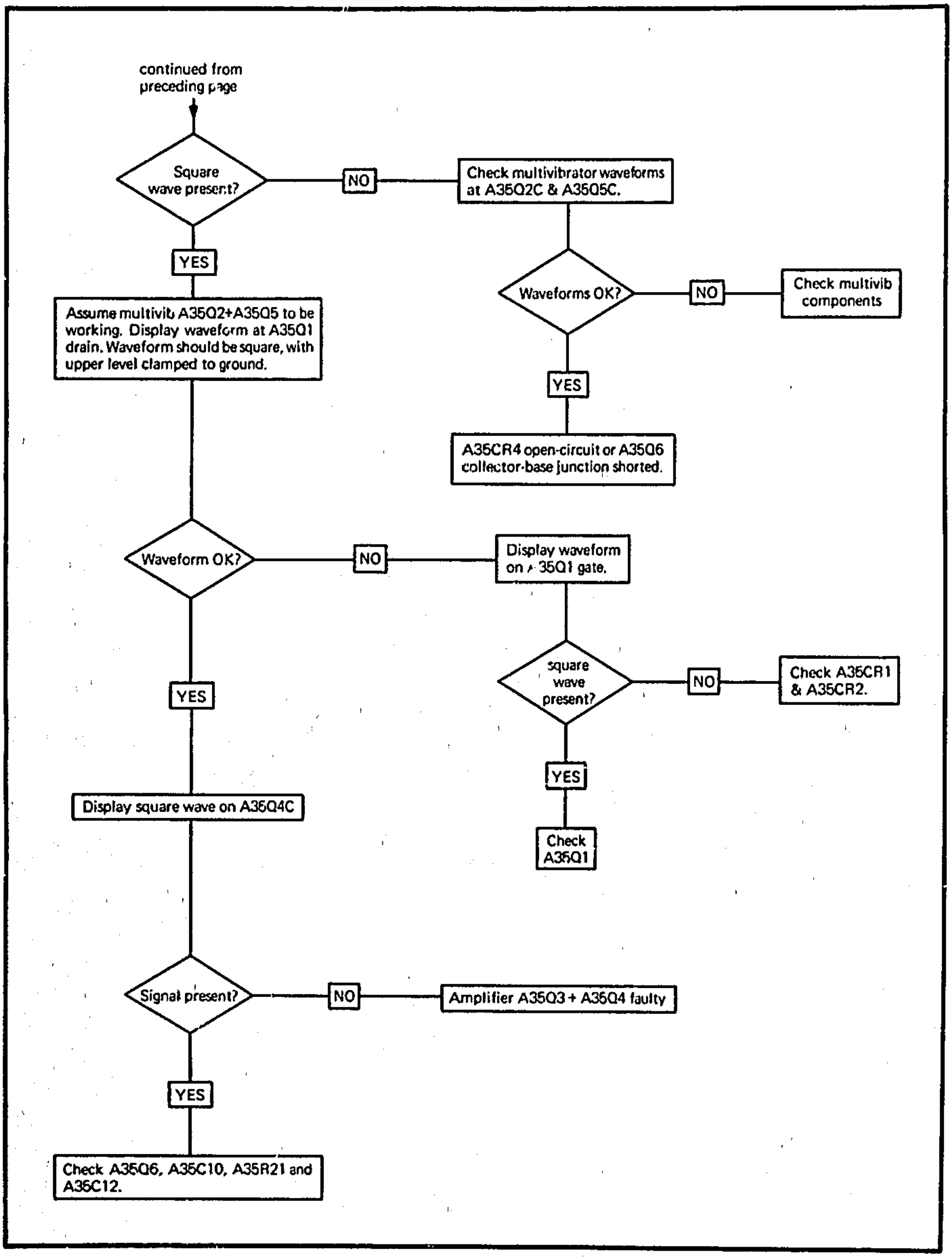



Table 8-2 (continued)

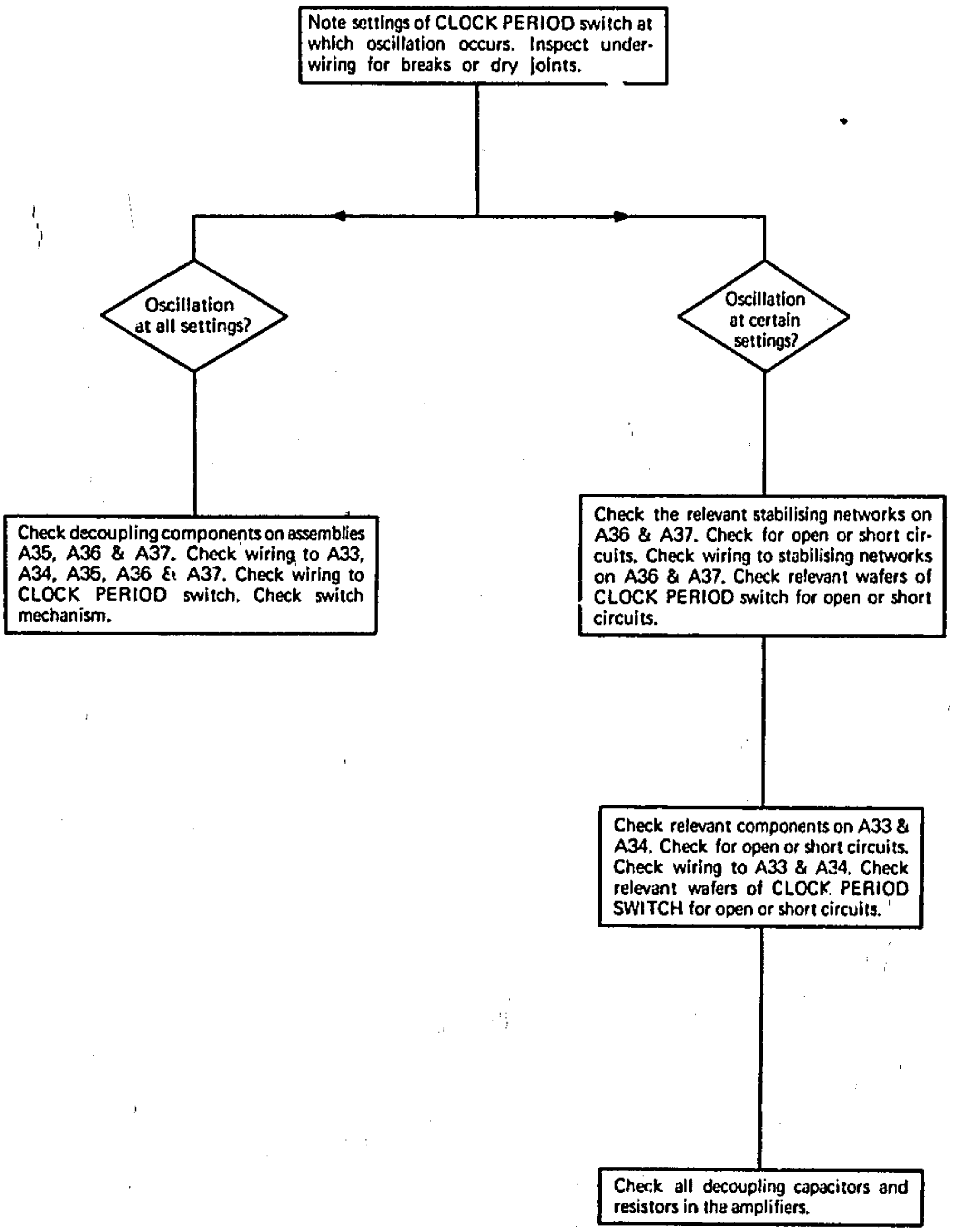
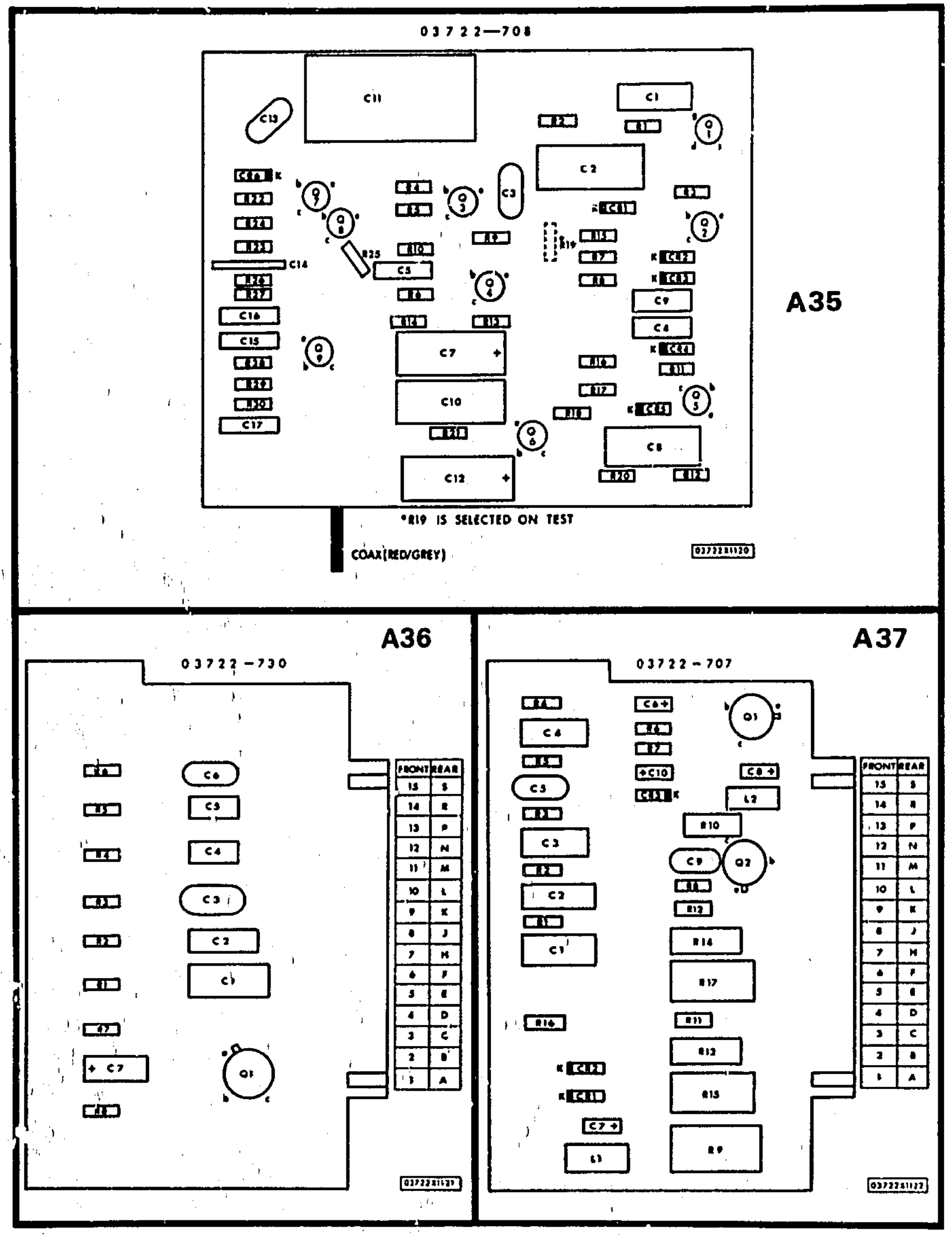
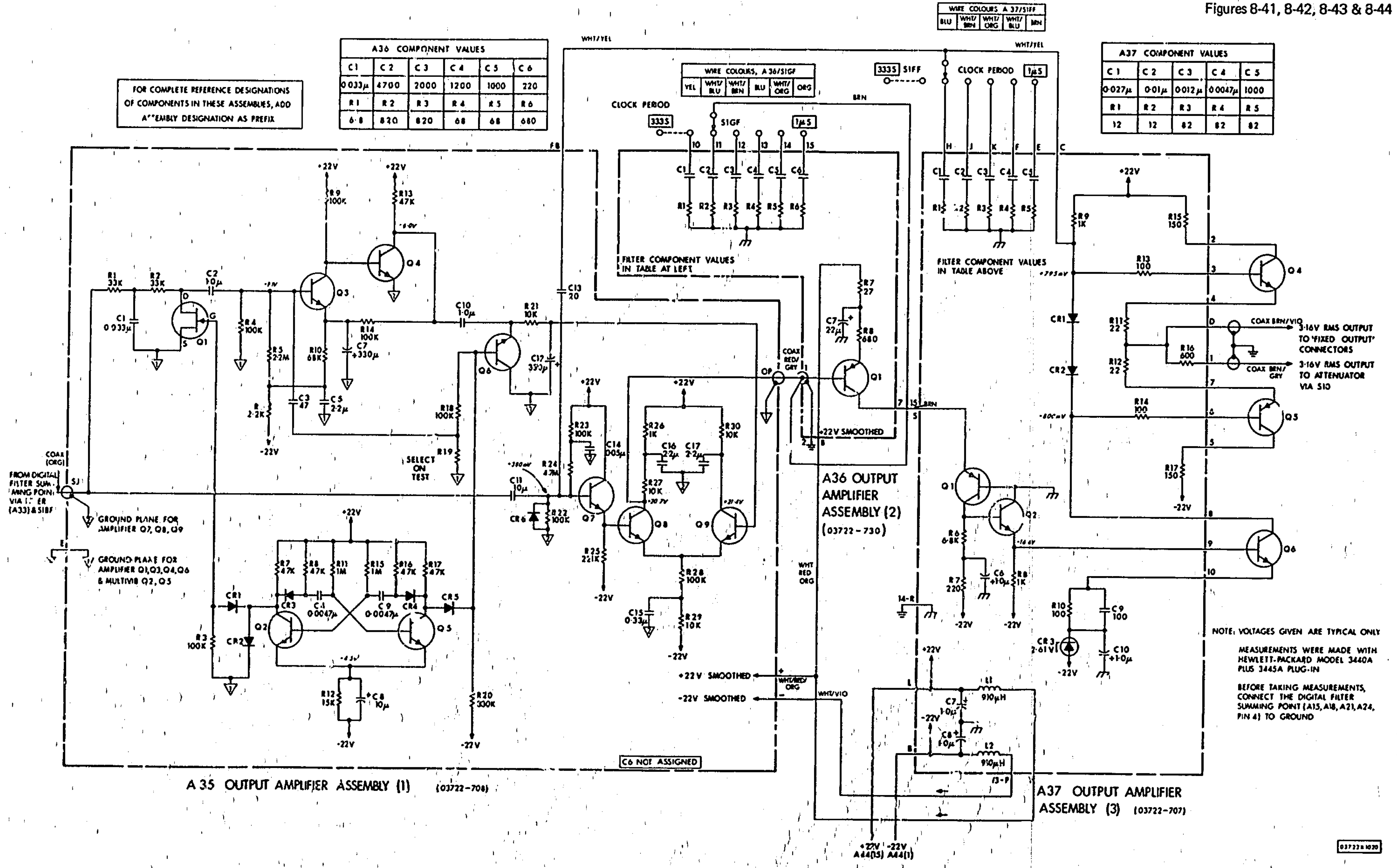



**Table 8-3 Troubleshooting oscillation in Gaussian output amplifiers**




Figures 8 - 41, 8 - 42 & 8 - 43 Output amplifier assemblies (1) A35, (2) A36 & (3) A37 component location




A36 COMPONENT VALUES

| C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|
| 0·033μ | 4700 | 2000 | 1200 | 1000 | 220 |
| R1 | R2 | R3 | R4 | R5 | R6 |
| 6·8 | 820 | 820 | 68 | 68 | 680 |

A37 COMPONENT VALUES

| C1 | C2 | C3 | C4 | C5 |
|---|---|---|---|---|
| 0·027μ | 0·01μ | 0·012μ | 0·0047μ | 1000 |
| R1 | R2 | R3 | R4 | R5 |
| 12 | 12 | 82 | 82 | 82 |

Figure 8 - 44 Output amplifier assemblies (1) A35, (2) A36 & (3) A37, schematic

| | | |
|---|---|---|
| A35 | 03722-708 | ASSY: OUTPUT AMPLIFIER (1) |
| | 03722-308 | BOARD: BLANK PC (NSR) |
| A35C1 | 0160-0163 | C: FXD MY 0.033UF 10% |
| A35C2 | 0160-0619 | C: FXD METALAC 1UF 10% 63VDCW |
| A35C3 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A35C4 | 0160-0157 | C: FXD MY 0.0047UF 10% 200VDCW |
| A35C5 | 0160-0128 | C: FXD CER 2.2UF 20% 25VDCW |
| A35C6 | | NOT ASSIGNED |
| A35C7 | 0180-1714 | C: FXD TA 330UF 10% 6VDCW |
| A35C8 | 0180-0059 | C: FXD AL 30UF -10%+100% 25VDCW |
| A35C9 | 0160-0157 | C: FXD MY 0.0047UF 10% 200VDCW |
| A35C10 | 0160-0619 | C: FXD METALAC 1UF 10% 63VDCW |
| A35C11 | 0160-0615 | C: FXD METALAC 10UF 10% 63VDCW |
| A35C12 | 0180-1714 | C: FXD TA 330UF 10% 6VDCW |
| A35C13 | 0160-2198 | C: FXD MICA 20PF 5% 300VDCW |
| A35C14 | 0150-0096 | C: FXD CER 0.05UF 100VDCW |
| A35C15 | 0160-0137 | C: FXD CER 0.33UF 20% 25VDCW |
| A35C16 | 0160-0128 | C: FXD CER 2.2UF 20% 25VDCW |
| A35C17 | 0160-0128 | C: FXD CER 2.2UF 20% 25VDCW |
| A35CR1 | 1901-0040 | DIODE: SI |
| A35CR2 | 1901-0040 | DIODE: SI |
| A35CR3 | 1901-0040 | DIODE: SI |
| A35CR4 | 1901-0040 | DIODE: SI |
| A35CR5 | 1901-0040 | DIODE: SI |
| A35CR6 | 1901-0040 | DIODE: SI |
| A35MP1 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP2 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP3 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP4 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP5 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP6 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP7 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP8 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP9 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP10 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP11 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP12 | 0340-0060 | TERMINAL: CLOVER LEAF PTFE |
| A35MP13 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS |
| A35MP14 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS |
| A35MP15 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS |
| A35MP16 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS |
| A35MP17 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS |
| A35MP18 | 0360-0065 | TERMINAL: SUBMINIATURE BRASS |
| A35Q1 | 1855-0603 | TRANSISTOR: SI FET |
| A35Q2 | 1854-0071 | TRANSISTOR: SI NPN |
| A35Q3 | 1854-0071 | TRANSISTOR: SI NPN |
| A35Q4 | 1854-0071 | TRANSISTOR: SI NPN |
| A35Q5 | 1854-0071 | TRANSISTOR: SI NPN |
| A35Q6 | 1854-0071 | TRANSISTOR: SI NPN |
| A35Q7 | 1854-0071 | TRANSISTOR: SI NPN |
| A35Q8 | 1854-0071 | TRANSISTOR: SI NPN |
| A35Q9 | 1854-0071 | TRANSISTOR: SI NPN |
| A35R1 | 0698-4290 | R: FXD MET OX 33K OHM 5% 1/4W |
| A35R2 | 0698-4290 | R: FXD MET OX 33K OHM 5% 1/4W |
| A35R3 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R4 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R5 | 0683-2255 | R: FXD COMP 2.2 MEG OHM 5% 1/4W |
| A35R6 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A35R7 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W |
| A35R8 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W |
| A35R9 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R10 | 0698-4298 | R: FXD MET OX 68K OHM 5% 1/4W |
| A35R11 | 0683-1055 | R: FXD COMP 1 MEG OHM 5% 1/4W |
| A35R12 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W |
| A35R13 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W |
| A35R14 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R15 | 0683-1055 | R: FXD COMP 1 MEG OHM 5% 1/4W |
| A35R16 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W |
| A35R17 | 0698-4294 | R: FXD MET OX 47K OHM 5% 1/4W |
| A35R18 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R19 | | R: FXD MET OX SELECTED ON TEST |
| A35R20 | 0683-3345 | R: FXD COMP 330K OHM 5% 1/4W |
| A35R21 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A35R22 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R23 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R24 | 0683-4755 | R: FXD COMP 4.7 MEG OHM 5% 1/4W |
| A35R25 | 0757-0473 | R: FXD MET FLM 221K OHM 1% 1/8W |
| A35R26 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A35R27 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A35R28 | 0698-4302 | R: FXD MET OX 100K OHM 5% 1/4W |
| A35R29 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A35R30 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A35W1 | 03722-772 | CABLE: COAX (CODED RED/GRY) |
| A36 | 03722-730 | ASSY: OUTPUT AMPLIFIER (2) |
| | 03722-330 | BOARD: BLANK PC (NSR) |
| A36C1 | 0160-0163 | C: FXD MY 0.033UF 10% |
| A36C2 | 0160-0157 | C: FXD MY 4700PF 10% |
| A36C3 | 0160-2225 | C: FXD MICA 2000PF 5% 300VDCW |
| A36C4 | 0160-0297 | C: FXD MY 1200PF 10% 200VDCW |
| A36C5 | 0160-0153 | C: FXD MY 1000PF 10% |
| A36C6 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW |
| A36C7 | 0180-1846 | C: FXD TA 2.2UF 10% 35VDCW |
| A36Q1 | 1853-0012 | TRANSISTOR: SI PNP |
| A36R1 | 0683-0685 | R: FXD COMP 6.8 OHM 5% 1/4W |
| A36R2 | 0698-4252 | R: FXD MET OX 820 OHM 5% 1/4W |
| A36R3 | 0698-4252 | R: FXD MET OX 820 OHM 5% 1/4W |
| A36R4 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W |
| A36R5 | 0698-4227 | R: FXD MET OX 68 OHM 5% 1/4W |
| A36R6 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W |
| A36R7 | 0698-5701 | R: FXD MET OX 27 OHM 5% 1/4W |
| A36R8 | 0698-4250 | R: FXD MET OX 680 OHM 5% 1/4W |
| A37 | 03722-707 | ASSY: OUTPUT AMPLIFIER (3) |
| | 03722-307 | BOARD: BLANK PC (NSR) |
| A37C1 | 0170-0066 | C: FXD MY 0.027UF 10% 200VDCW |
| A37C2 | 0160-0161 | C: FXD MY 0.01UF 10% |
| A37C3 | 0160-0301 | C: FXD MY 0.012UF 10% 200VDCW |
| A37C4 | 0160-0157 | C: FXD MY 0.0047UF 10% 200VDCW |
| A37C5 | 0140-0179 | C: FXD MICA 1000PF 5% 300VDCW |
| A37C6 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW |
| A37C7 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW |
| A37C8 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW |
| A37C9 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A37C10 | 0180-0291 | C: FXD TA 1UF 10% 35VDCW |
| A37CR1 | 1901-0040 | DIODE: SI |
| A37CR2 | 1901-0040 | DIODE: SI |
| A37CR3 | 1902-0126 | DIODE: BREAKDOWN 2.61V 400mW |
| A37L1 | 9100-1653 | L: FXD COIL 910UH 5% |
| A37L2 | 9100-1653 | L: FXD COIL 910UH 5% |
| A37Q1 | 1853-0012 | TRANSISTOR: SI PNP |
| A37Q2 | 1854-0039 | TRANSISTOR: SI NPN |
| A37R1 | 0683-1205 | R: FXD COMP 12 OHM 5% 1/4W |
| A37R2 | 0683-1205 | R: FXD COMP 12 OHM 5% 1/4W |
| A37R3 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W |
| A37R4 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W |
| A37R5 | 0698-4230 | R: FXD MET OX 82 OHM 5% 1/4W |
| A37R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A37R7 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A37R8 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A37R9 | 0764-0016 | R: FXD MET OX 1.0K OHM 5% 2W |
| A37R10 | 0760-0024 | R: FXD MET OX 100 OHM 5% 1W |
| A37R11 | 0758-0606 | R: FXD MET OX 22 OHM 5% 1/2W |
| A37R12 | 0758-0606 | R: FXD MET OX 22 OHM 5% 1/2W |
| A37R13 | 0760-0024 | R: FXD MET OX 100 OHM 5% 1W |
| A37R14 | 0760-0024 | R: FXD MET OX 100 OHM 5% 1W |
| A37R15 | 0698-3624 | R: FXD MET OX 150 OHM 5% 2W |
| A37R16 | 0698-3774 | R: FXD MET FLM 600 OHM 0.25% 1/4W |
| A37R17 | 0698-3624 | R: FXD MET OX 150 OHM 5% 2W |

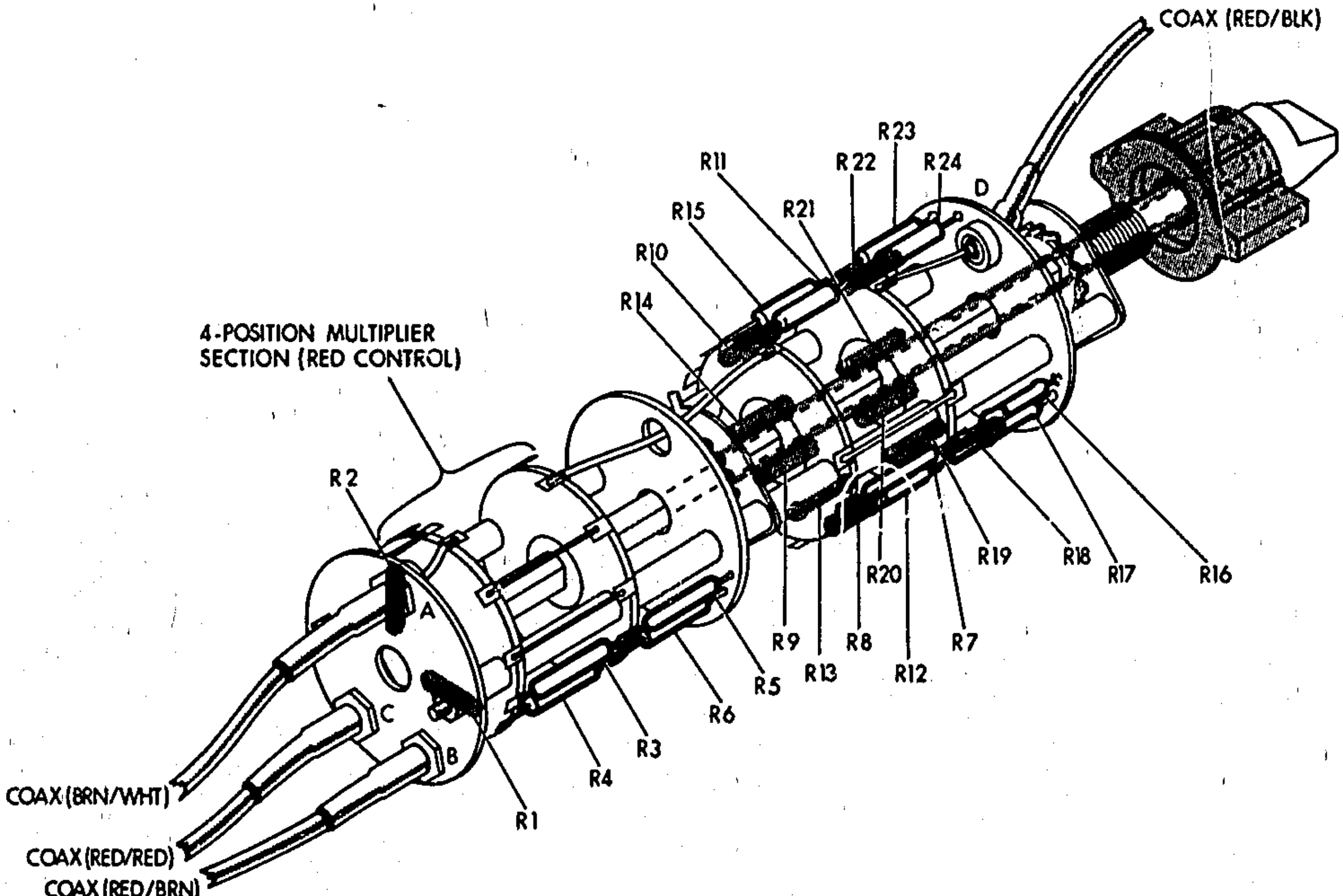



Figure 8-45 Attenuator assembly A38, component location

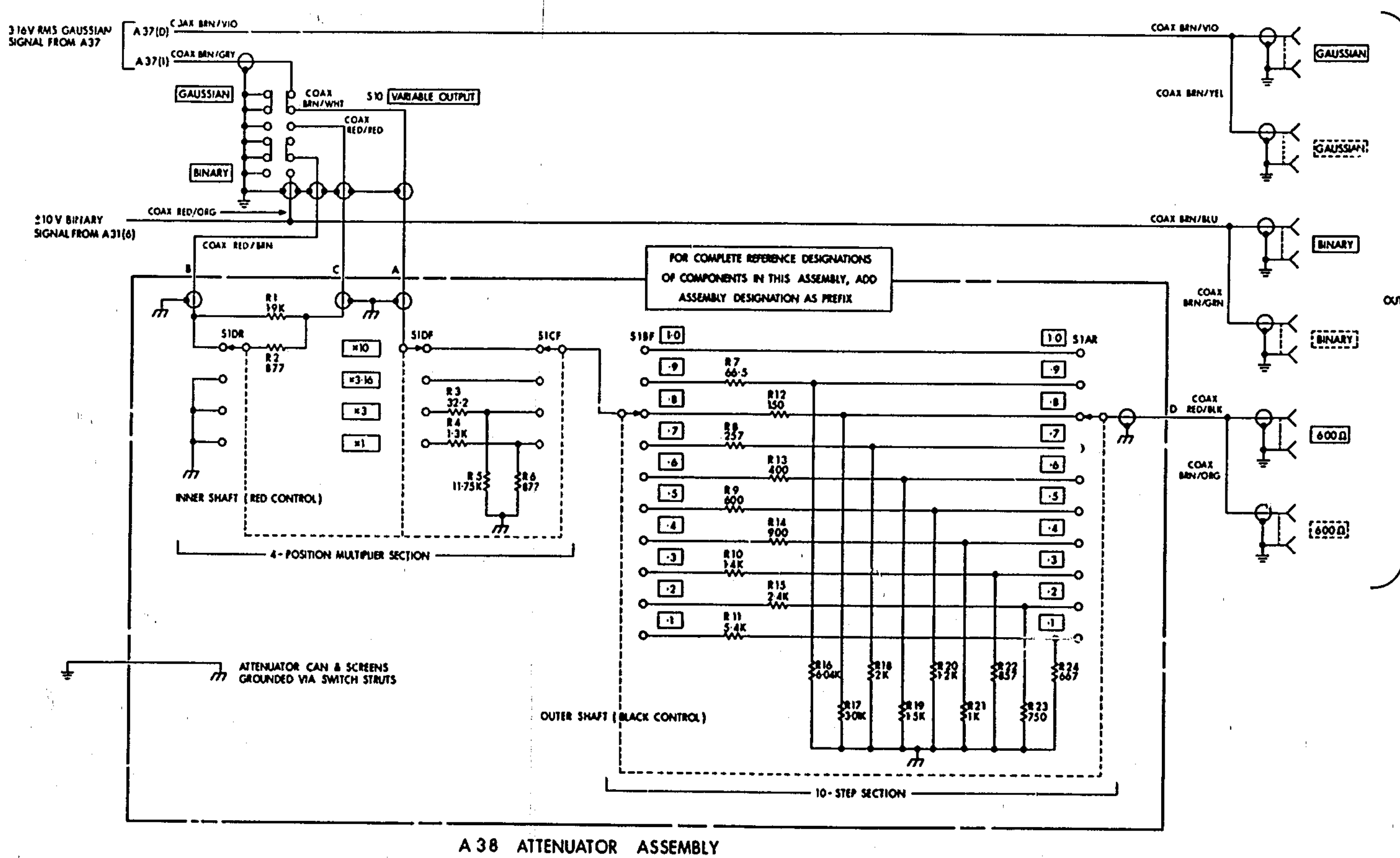



Figure 8-46 Attenuator assembly A38, schematic

| | | |
|---|---|---|
| A38 | 03722-728 | ASSY: ATTENUATOR (COMPLETE WITH OUTER SCREEN & ALL COMPONENTS PREFIXED A38 BELOW ) |
| | 03722-109 | ATTENUATOR: OUTER SCREEN (SEE CHASSIS MOUNTED COMPONENTS MP41) |
| A38R1 | 0698-3760 | R: FXD MET FLM 1900 OHM 1/4% 1/4W 50 PPM |
| A38R2 | 0698-3754 | R: FXD MET FLM 877 OHM 1/4% 1/4W 50 PPM |
| A38R3 | 0698-3780 | R: FXD MET OX 32.2 OHM 1% 1/2W 250 PPM |
| A38R4 | 0698-3758 | R: FXD MET FLM 1300 OHM 1/4% 1/4W 50 PPM |
| A38R5 | 0698-4204 | R: FXD MET FLM 11.75K OHM 1% 1/4W 100 PPM |
| A38R6 | 0698-3754 | R: FXD MET FLM 877 OHM 1/4% 1/4W 50 PPM |
| A38R7 | 0757-1021 | R: FXD MET FLM 66.5 OHM 1% 1/4W 100 PPM |
| A38R8 | 0698-5798 | R: FXD MET FLM 257 OHM 1/2% 1/4W 100 PPM |
| A38R9 | 0698-3774 | R: FXD MET FLM 600 OHM 1/4% 1/4W 50 PPM |
| A38R10 | 0698-3369 | R: FXD MET FLM 1.4K OHM 1/4% 1/4W 100 PPM |
| A38R11 | 0698-3764 | R: FXD MET FLM 5400 OHM 1/4% 1/4W 50 PPM |
| A38R12 | 0757-0715 | R: FXD MET FLM 150 OHM 1% 1/4W 100 PPM |
| A38R13 | 0757-1035 | R: FXD MET FLM 400 OHM 1/2% 1/4W 100 PPM |
| A38R14 | 0698-3755 | R: FXD MET FLM 900 OHM 1/2% 1/4W 100 PPM |
| A38R15 | 0698-3762 | R: FXD MET FLM 2400 OHM 1/2% 1/4W 50 PPM |
| A38R16 | 0757-1023 | R: FXD MET FLM 6.04K OHM 1% 1/4W 100 PPM |
| A38R17 | 0757-0339 | R: FXD MET FLM 3.01K OHM 1% 1/4W 100 PPM |
| A38R18 | 0757-0739 | R: FXD MET FLM 2.0K OHM 1% 1/4W 100 PPM |
| A38R19 | 0698-5584 | R: FXD MET FLM 1.5K OHM 1/2% 1/4W 100 PPM |
| A38R20 | 0698-3757 | R: FXD MET FLM 1200 OHM 1% 1/4W 100 PPM |
| A38R21 | 0698-3145 | R: FXD MET FLM 1.0K OHM 1/4% 1/4W 9 PPM |
| A38R22 | 0698-3753 | R: FXD MET FLM 857 OHM 1/4% 1/4W 50 PPM |
| A38R23 | 0698-3752 | R: FXD MET FLM 750 OHM 1/4% 1/4W 50 PPM |
| A38R24 | 0698-5800 | R: FXD MET FLM 667 OHM 1/4% 1/4W 50 PPM |
| A38S1 | 3100-0621 | SWITCH (NSR: USE COMPLETE ASSEMBLY) |
| A38W1 | 03722-760 | CABLE: COAX (CODED BRN/WHT) |
| A38W2 | 03722-761 | CABLE: COAX (CODED RED/BLK) |
| A38W3 | 03722-762 | CABLE: COAX (CODED RED/BRN) |
| A38W4 | 03722-763 | CABLE: COAX (CODED RED/RED) |

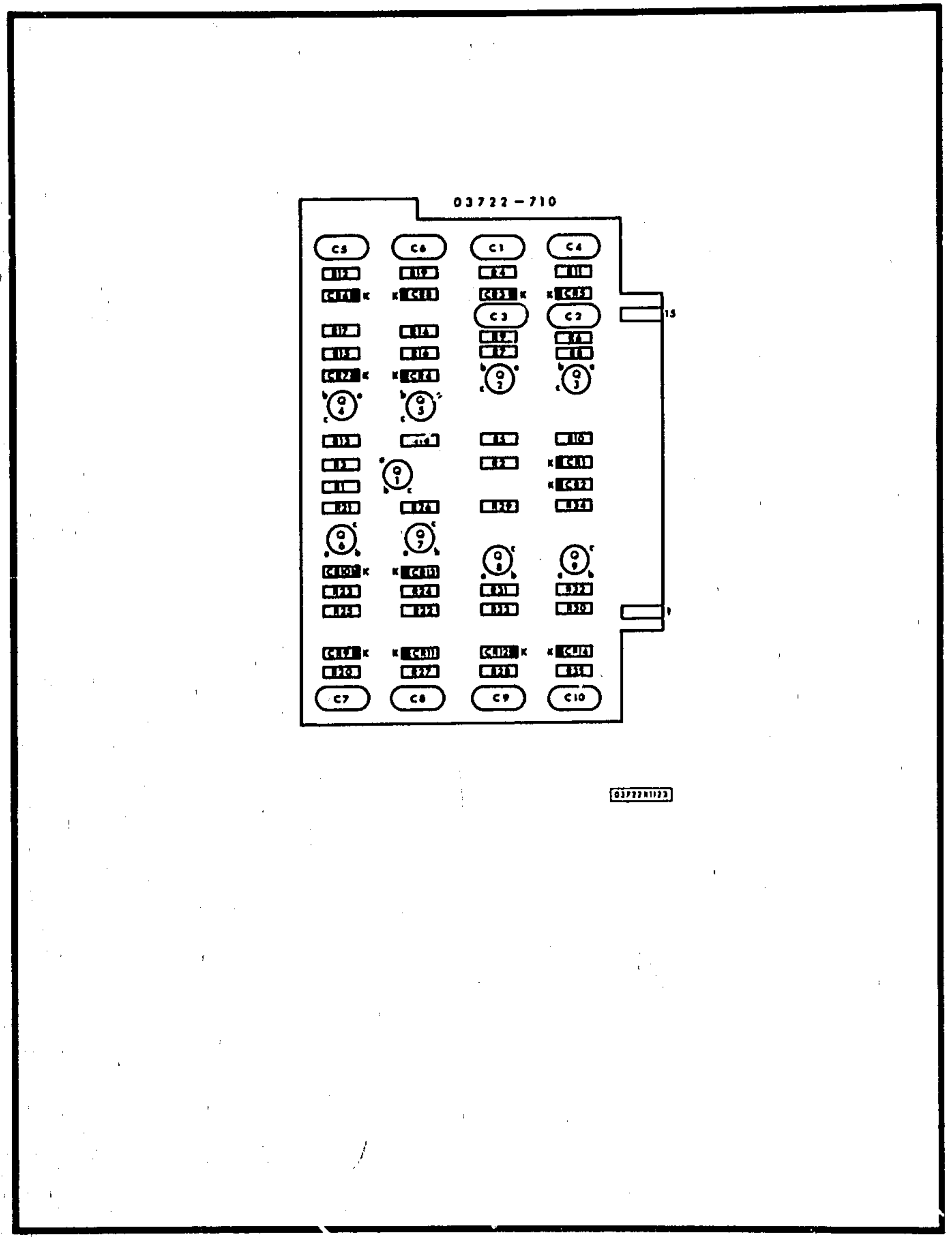



Figure 8 - 47 Sequence counter assembly A39, component location

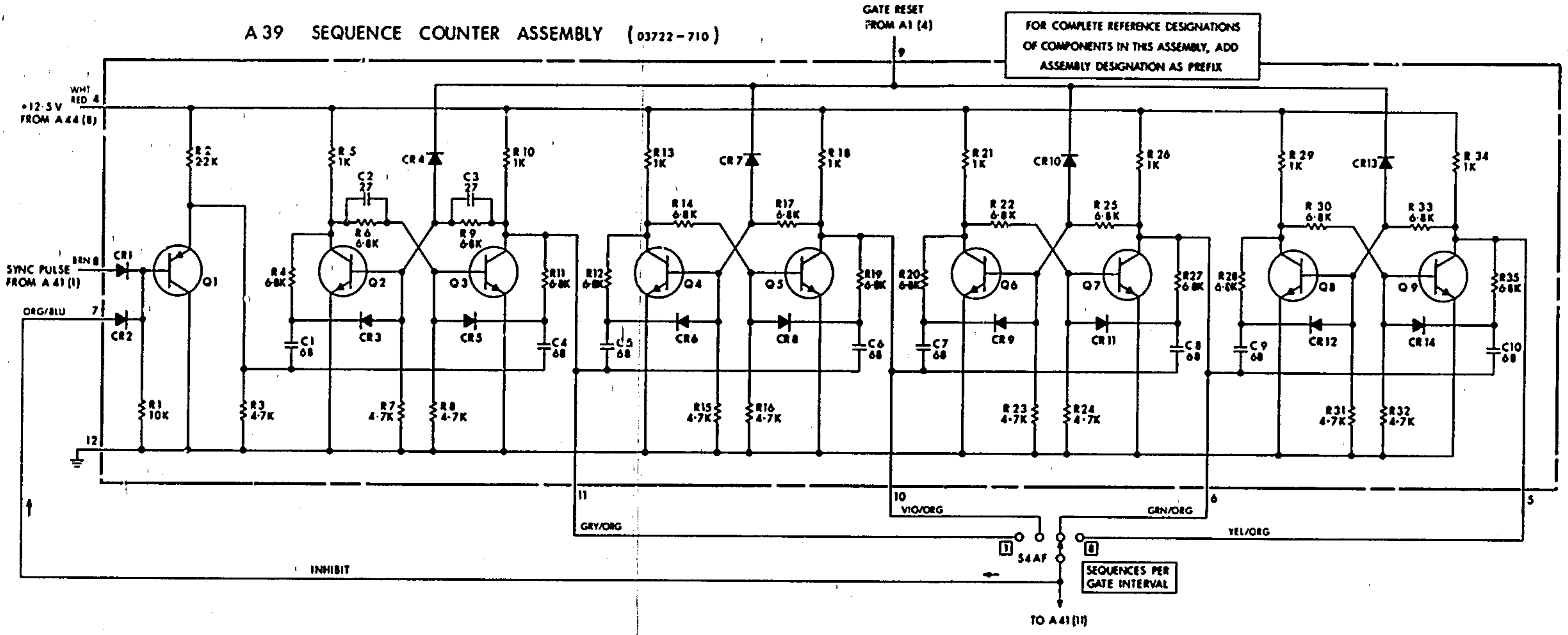
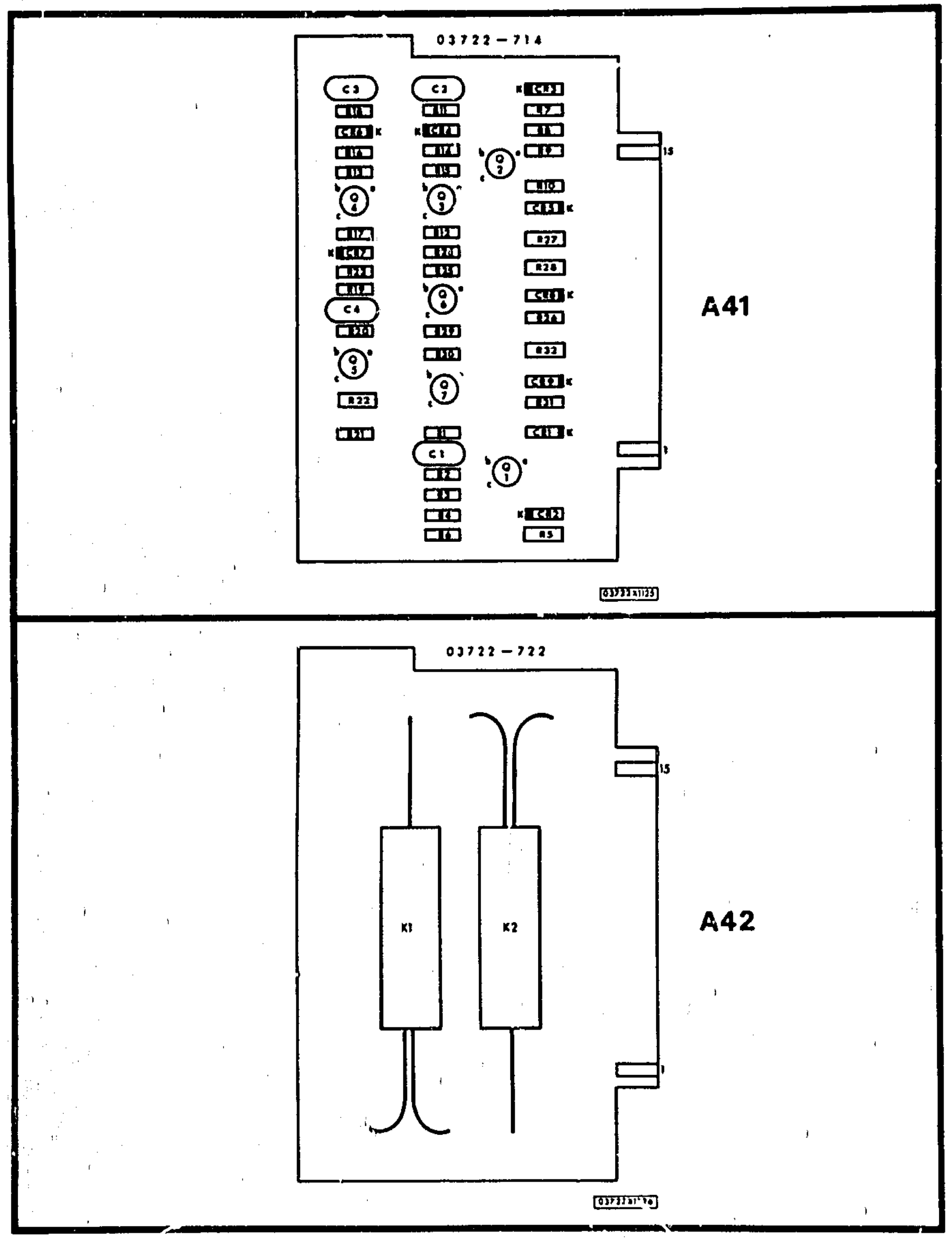



Figure 8 - 48 Sequence counter assembly A39, schematic

| | | |
|---|---|---|
| A39 | 03722-710 | ASSY: SEQUENCE COUNTER |
| | 03722-310 | BOARD: BLANK PC (NSR) |
| A39C1 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39C2 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A39C3 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A39C4 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39C5 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39C6 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39C7 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39C8 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39C9 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39C10 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A39CR1 | 1901-0040 | DIODE: SI |
| A39CR2 | 1901-0040 | DIODE: SI |
| A39CR3 | 1901-0040 | DIODE: SI |
| A39CR4 | 1901-0040 | DIODE: SI |
| A39CR5 | 1901-0040 | DIODE: SI |
| A39CR6 | 1901-0040 | DIODE: SI |
| A39CR7 | 1901-0040 | DIODE: SI |
| A39CR8 | 1901-0040 | DIODE: SI |
| A39CR9 | 1901-0040 | DIODE: SI |
| A39CR10 | 1901-0040 | DIODE: SI |
| A39CR11 | 1901-0040 | DIODE: SI |
| A39CR12 | 1901-0040 | DIODE: SI |
| A39CR13 | 1901-0040 | DIODE: SI |
| A39CR14 | 1901-0040 | DIODE: SI |
| A39Q1 | 1853-0015 | TRANSISTOR: SI PNP |
| A39Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A39Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A39Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A39Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A39Q6 | 1854-0605 | TRANSISTOR: SI NPN |
| A39Q7 | 1854-0605 | TRANSISTOR: SI NPN |
| A39Q8 | 1854-0605 | TRANSISTOR: SI NPN |
| A39Q9 | 1854-0605 | TRANSISTOR: SI NPN |
| A39R1 | 0698-4278 | R: FXD MET OX 10K OHM 5% 1/4W |
| A39R2 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% 1/4W |
| A39R3 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R4 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R5 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R7 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R8 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R11 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R12 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R13 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R14 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R15 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R16 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R17 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R18 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R20 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R21 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R22 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R23 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R24 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R25 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R26 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R27 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R28 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R29 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R30 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R31 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R32 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A39R33 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A39R34 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A39R35 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |




Figures 8 - 49 & 8 - 50 Gate & sync output assembly A41 and relay assembly A42, component location

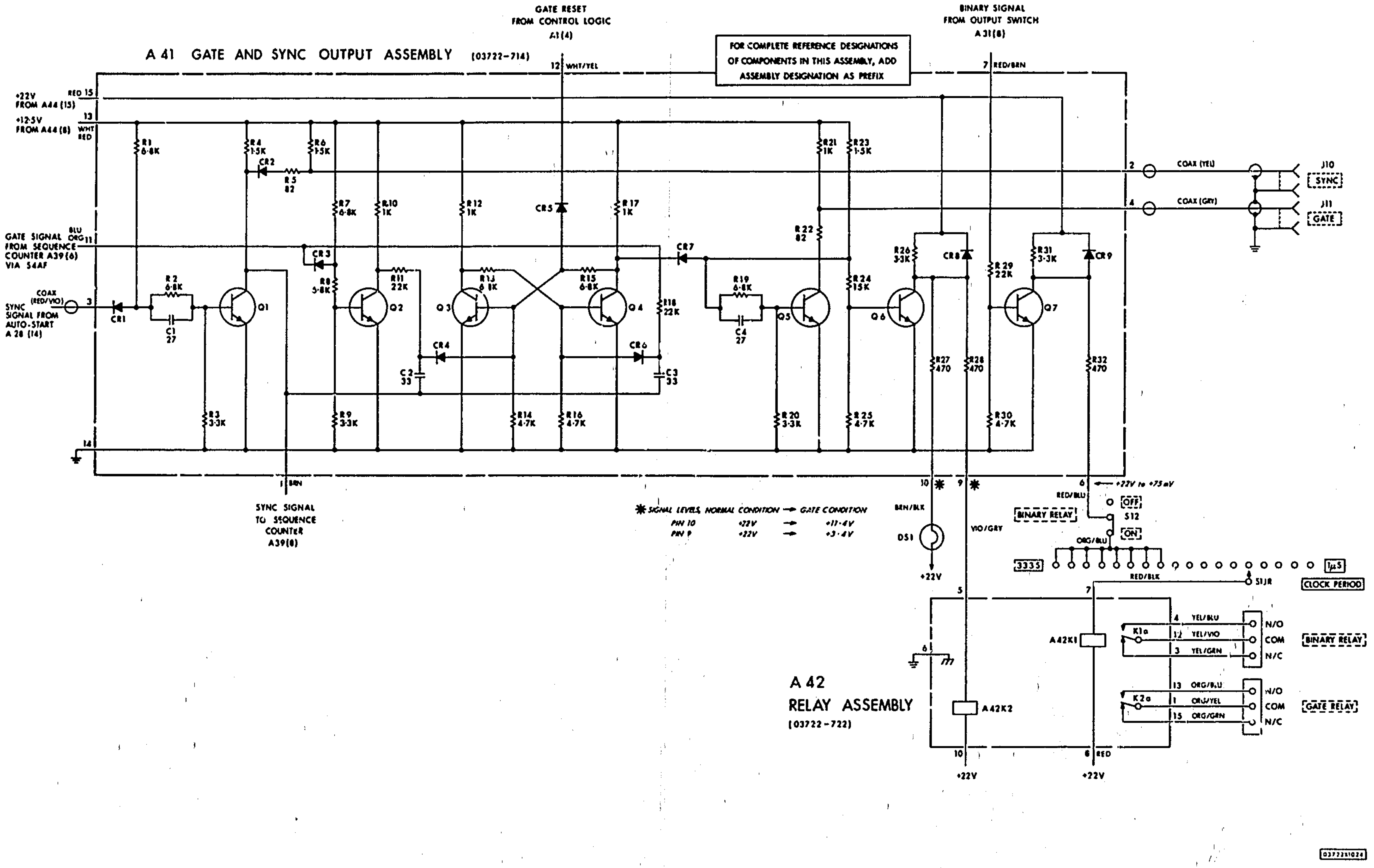



Figure 8 - 51 Gate and sync output assembly A41 & relay assembly A42, schematic

| | | |
|---|---|---|
| A41 | 03722-714 | ASSY: GATE AND SYNC OUTPUT |
| | 03722-314 | BOARD: BLANK PC (NSR) |
| A41C1 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A41C2 | 0160-2150 | C: FXD MICA 33PF 5% 300VDCW |
| A41C3 | 0160-2150 | C: FXD MICA 33PF 5% 300VDCW |
| A41C4 | 0160-2306 | C: FXD MICA 27PF 5% 300VDCW |
| A41CR1 | 1901-0040 | DIODE: SI |
| A41CR2 | 1910-0034 | DIODE: GE |
| A41CR3 | 1901-0040 | DIODE: SI |
| A41CR4 | 1901-0040 | DIODE: SI |
| A41CR5 | 1901-0040 | DIODE: SI |
| A41CR6 | 1901-0040 | DIODE: SI |
| A41CR7 | 1901-0040 | DIODE: SI |
| A41CR8 | 1901-0025 | DIODE: SI |
| A41CR9 | 1901-0025 | DIODE: SI |
| A41Q1 | 1854-0605 | TRANSISTOR: SI NPN |
| A41Q2 | 1854-0605 | TRANSISTOR: SI NPN |
| A41Q3 | 1854-0605 | TRANSISTOR: SI NPN |
| A41Q4 | 1854-0605 | TRANSISTOR: SI NPN |
| A41Q5 | 1854-0605 | TRANSISTOR: SI NPN |
| A41Q6 | 1854-0071 | TRANSISTOR: SI NPN |
| A41Q7 | 1854-0071 | TRANSISTOR: SI NPN |
| A41R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A41R2 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A41R3 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A41R4 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |
| A41R5 | 0758-0026 | R: FXD MET FLM 82 OHM 5% 1/2W |
| A41R6 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |
| A41R7 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A41R8 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A41R9 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A41R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A41R11 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A41R12 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A41R13 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A41R14 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A41R15 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A41R16 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A41R17 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A41R18 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A41R19 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% 1/4W |
| A41R20 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A41R21 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A41R22 | 0758-0026 | R: FXD MET FLM 82 OHM 5% 1/2W |
| A41R23 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% 1/4W |
| A41R24 | 0698-4282 | R: FXD MET OX 15K OHM 5% 1/4W |
| A41R25 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A41R26 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A41R27 | 0758-0029 | R: FXD MET FLM 470 OHM 5% 1/2W |
| A41R28 | 0758-0029 | R: FXD MET FLM 470 OHM 5% 1/2W |
| A41R29 | 0698-4286 | R: FXD MET OX 22K OHM 5% 1/4W |
| A41R30 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% 1/4W |
| A41R31 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% 1/4W |
| A41R32 | 0758-0029 | R: FXD MET FLM 470 OHM 5% 1/4W |

| | | |
|---|---|---|
| A42 | 03722-722 | ASSY: RELAY |
| | 03722-322 | BOARD: BLANK PC (NSR) |
| A42K1 | 9161-0013 | RELAY: COIL |
| A42K2 | 9161-0013 | RELAY: COIL |
| A42K1A | 0490-0604 | RELAY: REED |
| A42K2A | 0490-0604 | RELAY: REED |
| A42MP1 | 0340-0039 | FEEDTHROUGH: TEFLON |
| A42MP2 | 0340-0039 | FEEDTHROUGH: TEFLON |
| A42MP3 | 0340-0039 | FEEDTHROUGH: TEFLON |
| A42MP4 | 0340-0039 | FEEDTHROUGH: TEFLON |
| A42MP5 | 0340-0039 | FEEDTHROUGH: TEFLON |
| A42MP6 | 0340-0039 | FEEDTHROUGH: TEFLON |
| A42MP7 | 0340-0059 | TERMINAL POST: BRASS |
| A42MP8 | 0340-0059 | TERMINAL POST: BRASS |
| A42MP9 | 0340-0059 | TERMINAL POST: BRASS |
| A42MP10 | 0340-0059 | TERMINAL POST: BRASS |
| A42MP11 | 0340-0059 | TERMINAL POST: BRASS |
| A42MP12 | 0340-0059 | TERMINAL POST: BRASS |

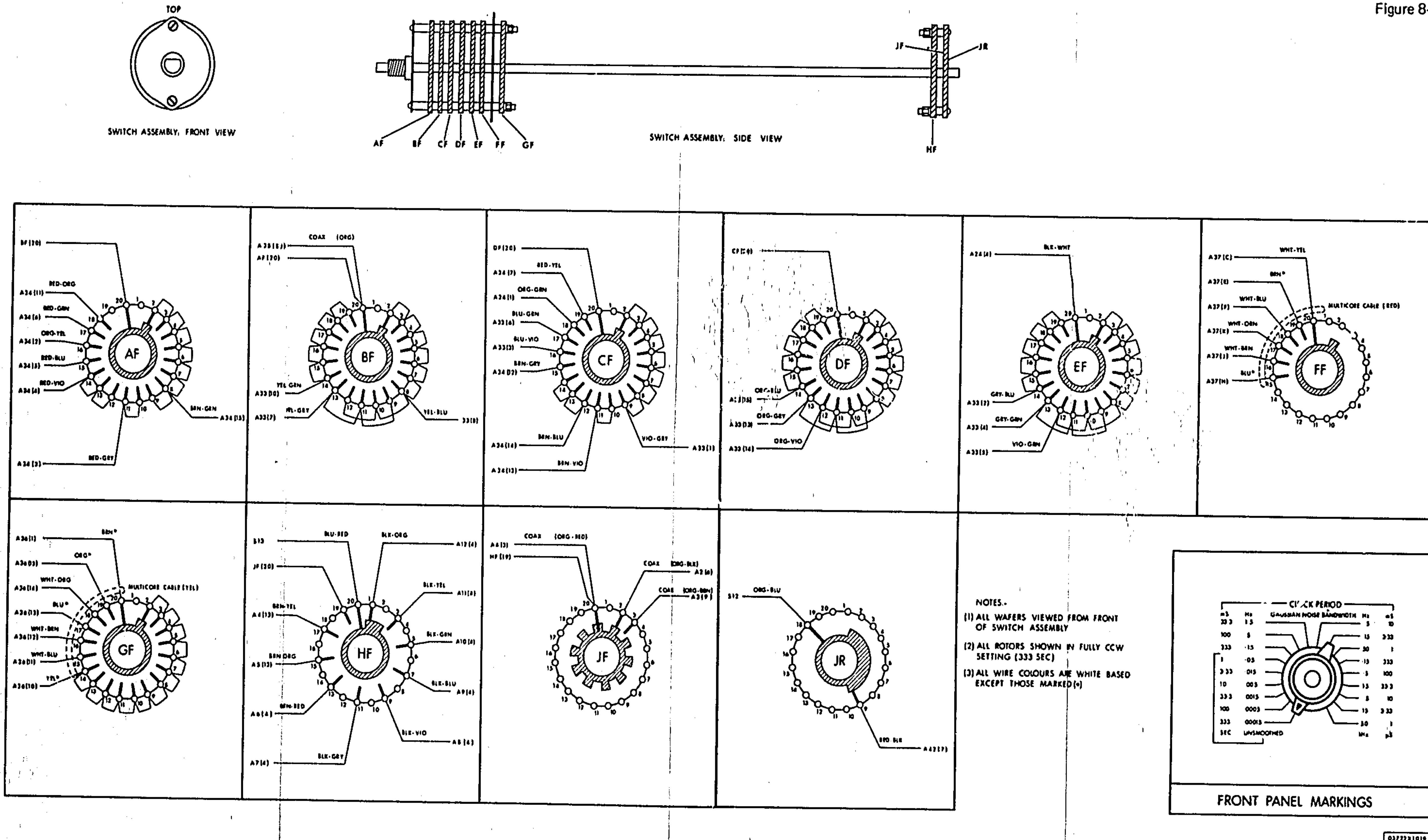
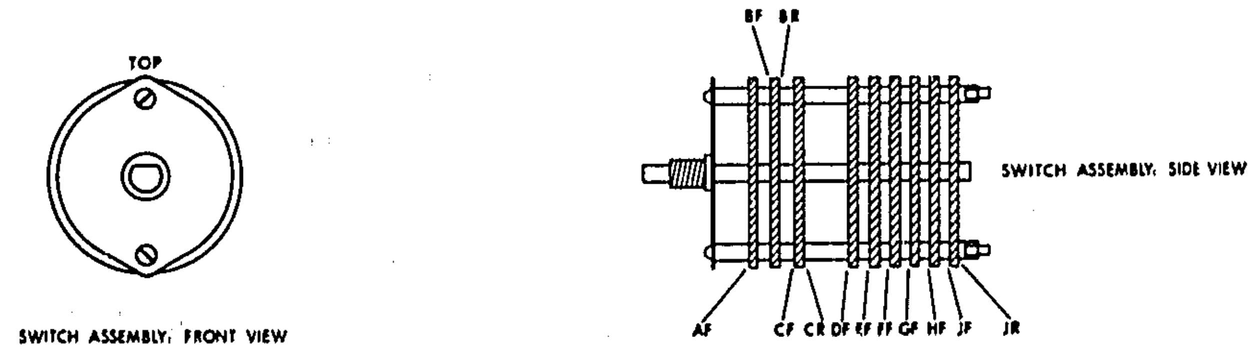
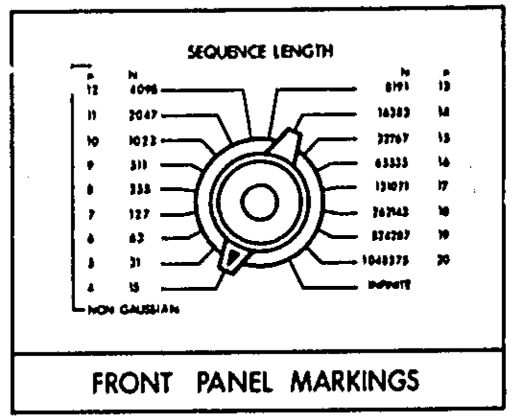



Figure 8 - 52 Clock period switch S1




NOTES:
(1) ALL WAFERS VIEWED FROM FRONT OF SWITCH ASSEMBLY
(2) ALL ROTORS SHOWN IN FULLY CCW SETTING (n=4, N=15)



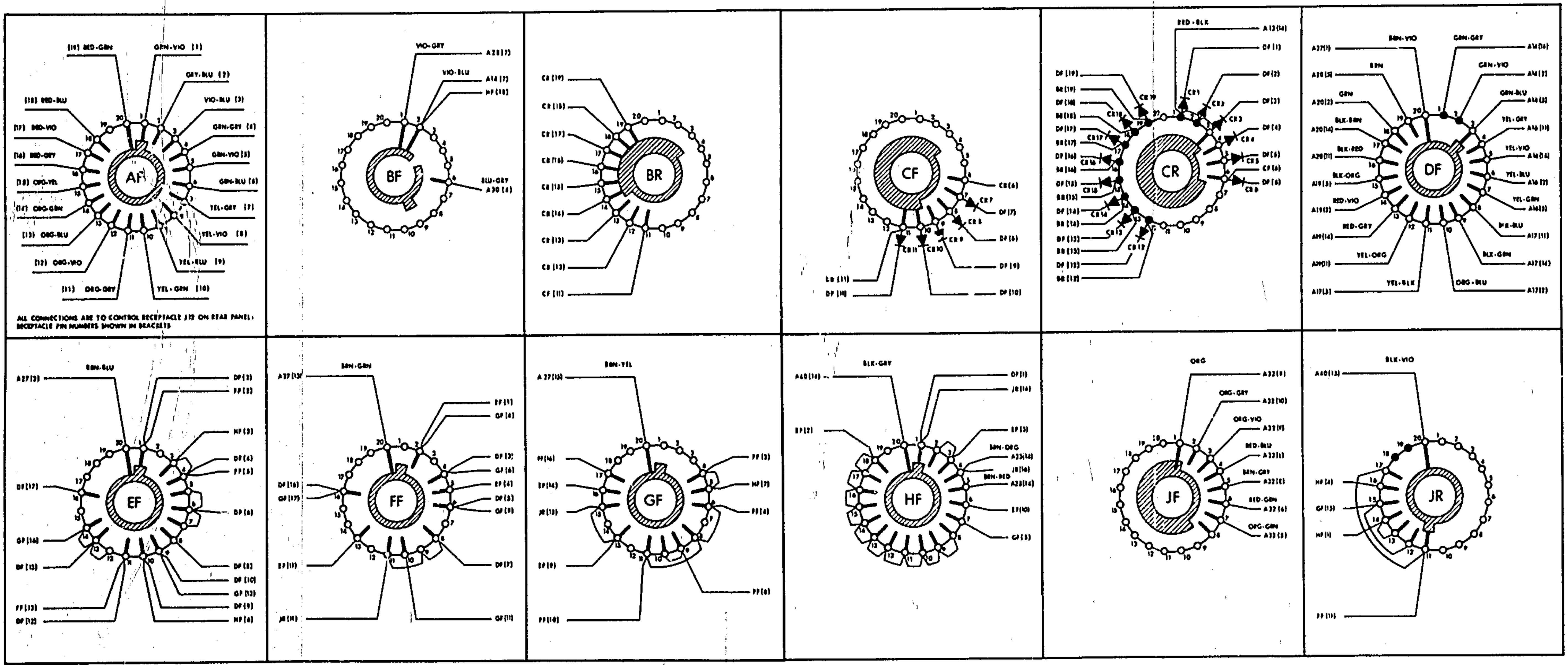
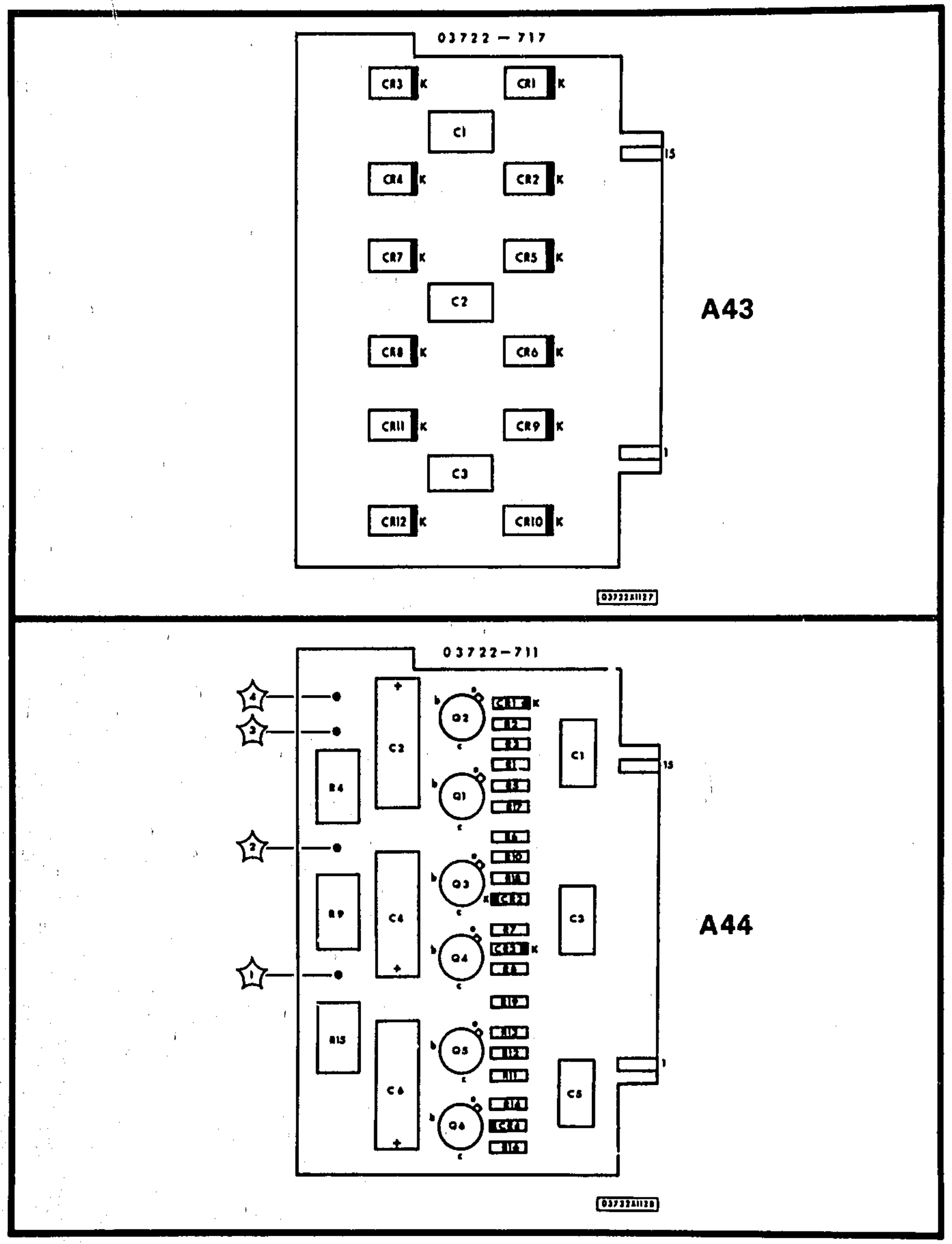
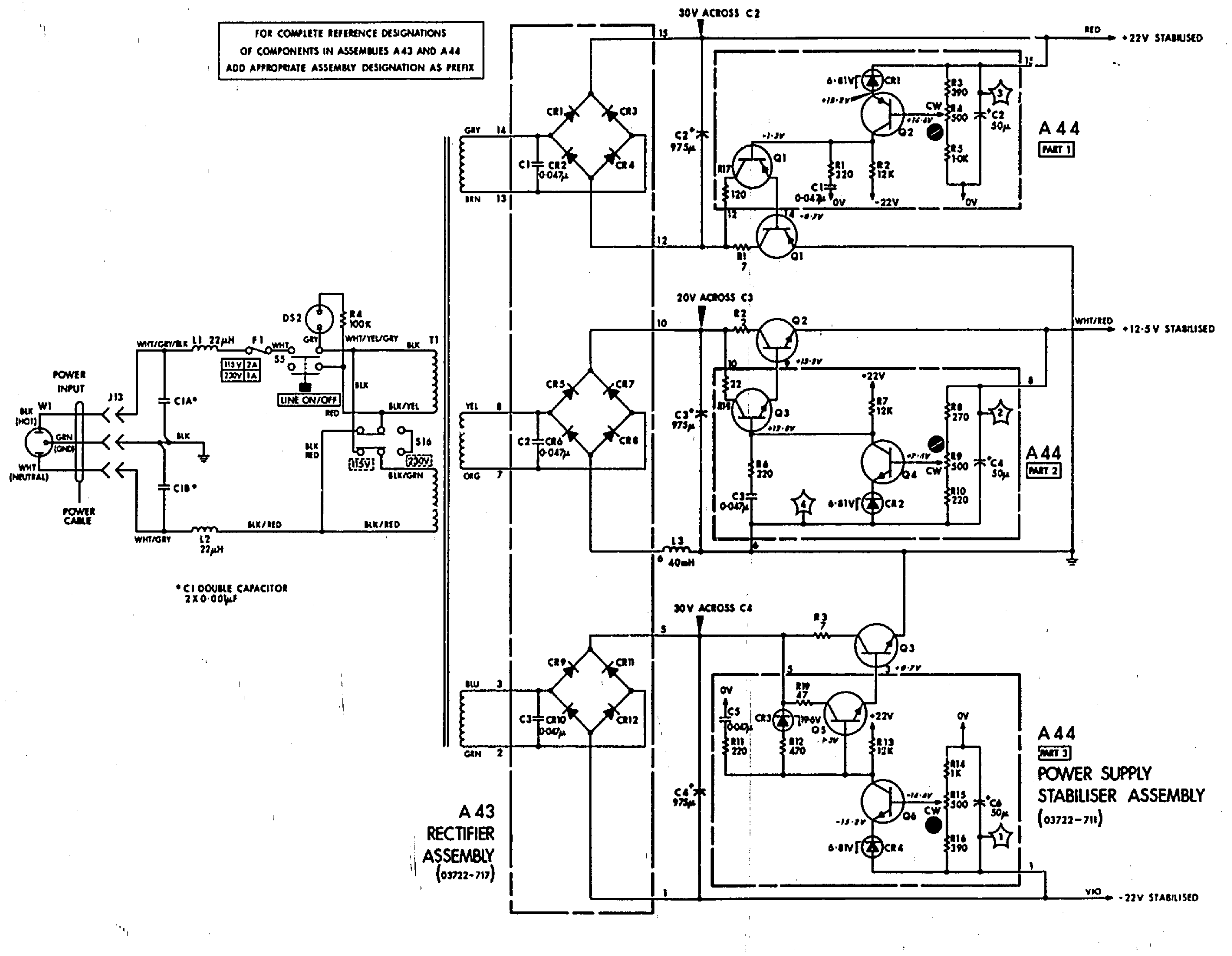




Figure 8 - 53 Sequence length switch S2




Figures 8 - 54 & 8 - 55 Rectifier assembly A43 and power supply stabiliser assembly A44, component location




POWER SUPPLY PIN CONNECTIONS ON ASSEMBLIES

| ASSY | -22V A44(1) | +12·5V A44(8) | +22V A44(15) |
|---|---|---|---|
| A1 | — | 9 | — |
| A2 | 14 | — | — |
| A3 | 14 | — | — |
| A4,5 | 14 | — | — |
| A6-12 | 14 | — | — |
| A13 | 2 | 15 | — |
| A14 | — | 15 | — |
| A15 | — | — | — |
| A16,17 | — | 15 | — |
| A18 | — | — | — |
| A19,20 | — | 15 | — |
| A21 | — | — | — |
| A22,23 | — | 15 | — |
| A24 | — | — | — |
| A25 | — | 15 | — |
| A27 | — | 9 | — |
| A28 | — | 9 | — |
| A29 | -22V | — | +22V |
| A30 | — | 6 | — |
| A31 | 1 | 10 | 15 |
| A32 | 1 | — | 15 |
| A33 | — | — | — |
| A34 | — | — | — |
| A35 | STABILISED SUPPLIES FROM A37 | | |
| A36 | | | |
| A37 | 8 | — | [illegible] |
| A39 | — | 4 | — |
| A40 | — | 9 | — |
| A41 | — | 13 | 15 |
| A42 | — | — | 8&10 |
| | VIO | WHT/RED | RED |

Figure 8 - 56 Rectifier assembly A43 & power supply assembly A44, schematic

| | | |
|---|---|---|
| A43 | 03722-717 | ASSY: RECTIFIER |
| | 03722-317 | BOARD: BLANK PC (NSR) |
| A43C1 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW |
| A43C2 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW |
| A43C3 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW |
| A43CR1 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR2 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR3 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR4 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR5 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR6 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR7 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR8 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR9 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR10 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR11 | 1901-0045 | DIODE: SI 100PIV 0.75A |
| A43CR12 | 1901-0045 | DIODE: SI 100PIV 0.75A |

| | | |
|---|---|---|
| A44 | 03722-711 | ASSY: POWER SUPPLY STABILISER |
| | 03722-311 | BOARD: BLANK PC (NSR) |
| A44C1 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW |
| A44C2 | 0180-0141 | C: FXD AL 50UF -10%+75% 50VDCW |
| A44C3 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW |
| A44C4 | 0180-0141 | C: FXD AL 50UF -10%+75% 50VDCW |
| A44C5 | 0170-0040 | C: FXD MY 0.047UF 10% 200VDCW |
| A44C6 | 0180-0141 | C: FXD AL 50UF -10%+75% 50VDCW |
| A44CR1 | 1902-0017 | DIODE: BREAKDOWN 6.81V 400mW |
| A44CR2 | 1902-0017 | DIODE: BREAKDOWN 6.81V 400mW |
| A44CR3 | 1902-3234 | DIODE: BREAKDOWN 19.6V 400mW |
| A44CR4 | 1902-0017 | DIODE: BREAKDOWN 6.81V 400mW |
| A44Q1 | 1853-0001 | TRANSISTOR: SI PNP |
| A44Q2 | 1853-0001 | TRANSISTOR: SI PNP |
| A44Q3 | 1854-0003 | TRANSISTOR: SI NPN |
| A44Q4 | 1854-0003 | TRANSISTOR: SI NPN |
| A44Q5 | 1854-0003 | TRANSISTOR: SI NPN |
| A44Q6 | 1854-0003 | TRANSISTOR: SI NPN |
| A44R1 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A44R2 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W |
| A44R3 | 0698-4245 | R: FXD MET OX 390 OHM 5% 1/4W |
| A44R4 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W |
| A44R5 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A44R6 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A44R7 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W |
| A44R8 | 0698-4241 | R: FXD MET OX 270 OHM 5% 1/4W |
| A44R9 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W |
| A44R10 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A44R11 | 0698-4239 | R: FXD MET OX 220 OHM 5% 1/4W |
| A44R12 | 0698-4246 | R: FXD MET OX 470 OHM 5% 1/4W |
| A44R13 | 0698-4280 | R: FXD MET OX 12K OHM 5% 1/4W |
| A44R14 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% 1/4W |
| A44R15 | 2100-1757 | R: VAR WW LIN 500 OHM 10% 1/2W |
| A44R16 | 0698-4245 | R: FXD MET OX 390 OHM 5% 1/4W |
| A44R17 | 0698-4233 | R: FXD MET OX 120 OHM 5% 1/4W |
| A44R18 | 0698-3799 | R: FXD MET OX 22 OHM 5% 1/4W |
| A44R19 | 0698-5707 | R: FXD MET OX 47 OHM 5% 1/4W |
| A44TP1 | 0360-0124 | TERMINAL PIN |
| A44TP2 | 0360-0124 | TERMINAL PIN |
| A44TP3 | 0360-0124 | TERMINAL PIN |
| A44TP4 | 0360-0124 | TERMINAL PIN |

# APPENDIX A
# MANUAL CHANGES

This manual applies directly to instruments with Serial Prefix numbers U801. This appendix gives back-dating and updating information which makes the manual applicable to instruments with Serial Prefix numbers below and above U801. Make all alterations in this manual according to the Errata below. Also check the following table for your instrument Serial Prefix and/or Serial Number and make any listed change/s in the manual.

| Serial Prefix and/ or Number | Change |
|---|---|
| U717-00110 and below | 1 thru 3 |
| U717-00156 and below | 2 thru 3 |
| U801-00160 and below | 3 |
| U801-00171 and above | 4 |
| U820-00201 and above | 4 thru 5 |
| U830-00301 and above | 4 thru 6 |
| U850 and above | 4 thru 7 |

| Serial Prefix and/ or Number | Change |
|---|---|
| U850-00452 and above | 4 thru 8 |
| U901 and above | 4 thru 9 |
| U943/U950 and above | 4 thru 10 |
| U968 and above | 4 thru 11 |
| U968-00598 and above | 4 thru 12 |
| U968-00611 and above | 4 thru 13 |

**ERRATA** Page 1-3 Specifications

Change INTERNAL CLOCK OUTPUT to read "approx +1V to approx +12.5V" SECONDARY OUTPUTS SYNC to read "Negative going pulse (approx +12V to approx +1.5V)"

Page 4-17 Paragraph 4-57

Change . . . "When A13Q5 is switched on (coincident . . ." to read "When A13Q3 is switched on (coincident . . ."

Page 4-23 Paragraph 4-76

Change . . . "The alternative feedback path . . . . into circuit by A31Q5" to read . . . "The alternative feedback path . . . . into circuit by A31Q4"

Page 5-24 Table 5-3

Change 4) to read ". . . . The waveform should be rectangular, and should switch between approx +1V and approx +12.5V"

Page 5-33, 5-34 Table 5-5

Replace these two pages with the updated ones at the end of this appendix.

Section VI Replaceable Parts

Change A33C4 to Part No 0160-0634
A4R37 to Part No 0698-6745
A37R16 and A38R9 to Part No 0698-6261
A44R18 to Part No 0698-6745

Delete Part No 03722-746 ASSY: SEQUENCE LENGTH SWITCH (Part of S2)

**CHANGE 1** Section VIII Schematics

Page 8-8 Figure 8-7

Delete From A1(1) BLK/GRY jumper "300Hz/100Hz STROBE SIGNAL FROM A7(5)"
Add To A1(1) Coax RED/WHT "1MHz STROBE SIGNAL FROM A3(13)"

Page 8-10 Figure 8-10

Delete From A3(13) "NC"
Add To A3(13) Coax RED/WHT "1MHz STROBE SIGNAL TO CONTROL LOGIC A1(1)"

Page 8-12 Figure 8-14

Delete From A7(5) BLK/GRY jumper "300Hz/100Hz STROBE TO A1(1)"

**CHANGE 2** Section VI Replaceable Parts
Change DS2 to Part No 2140-0022 LAMP: NEON (Line ON/OFF)
5040-0234 LAMP HOLDER (DS2)
5040-0235 RETAINER (DS2)
MP3 to Part No 03722-102 DUMMY FRONT PANEL
S6 to S9 to S5 to S9 Part No 03722-369 ASSY: 5 PUSH BUTTON SWITCHES
Add MP33 Part No 5000-3394 LABEL: LINE ON/OFF (S5)

**CHANGE 3** Section VIII Schematics
Page 8-23 Figure 8-37
Add To A32(J) a WHT/RED/ORG jumper to SEQUENCE LENGTH switch S2JF(8)
Page 8-34 Figure 8-53
Add To S2JF(8) a WHT/RED/ORG jumper "TO REFERENCE POWER SUPPLY A32(J)"

**CHANGE 4** Section VI Replaceable Parts
Change A32Q9, A32Q11, A32Q13 to Part No 1853-0036 TRANSISTOR: SI PNP

**CHANGE 5** Section VI Replaceable Parts
Change A3C1, C4, C8, A4C7 and A5C7 } to Part No 0160-0182 C: FXD MICA 47PF 5% 300VDCW

**CHANGE 6** Section VI Replaceable Parts
Change R8 to Part No 0698-3473 R: FXD 5620 OHM 1% 1/4W

**CHANGE 7** Section VI Replaceable Parts
Change A44CR2 to Part No 1902-0052 DIODE: BREAKDOWN 6.81V 2% 400mW
A44R8 to Part No 0698-3444 R: FXD FLM 316 OHM 1% 1/8W
A44R9 to Part No 2100-1754 R: VAR WW LIN 50 OHM 10% 1/2W
A44R10 to Part No 0757-0415 R: FXD FLM 475 OHM 1% 1/8W
L3 to Part No 9100-2830 INDUCTOR 40MH

**CHANGE 8** Section VI Replaceable Parts and Section VIII Schematics
Change the following transistors to Part No 1854-0019 TRANSISTOR: SI NPN

| | |
|---|---|
| A1Q1, 2, 3, 4, 5 | A27Q1, 2, 3, 4, 5, 6, 7, 8, 9 |
| A2Q1 | A28Q1, 2, 3, 4, 5, 6, 7 |
| A3Q1 | A29Q2 |
| A13Q1, 2, 4, 5 | A30Q1, 2, 3, 4, 5, 6, 7 |
| A14Q1, 2, 3, 4, 5, 6, 7, 8 | A31Q5 |
| A15Q2, 4, 6, 8, 10, 12, 14 | A39Q2, 3, 4, 5, 6, 7, 8, 9 |
| A18Q2, 4, 6, 8, 10, 12, 14, 16 | A40Q1, 2, 3, 4, 5, 6, 7, 8, 9 |
| A21Q2, 4, 6, 8, 10, 12, 14, 16 | A41Q1, 2, 3, 4, 5 |
| A24Q4, 6, 8, 10, 12, 14, 16 | |

Change C1 to Part No 0160-2657 C: FXD CER 2x0.001UF 1000VDCW
A2C6 to Part No 0140-0149 C: FXD 470PF 5%
A30R3 to Part No 0698-4238 R: FXD FLM 200 OHM 5% 1/4W

**CHANGE 9** Page 6-2, 6-3 Table 6-1 and Page 8-8 Figure 8-7
Replace these pages with the updated ones at the end of this appendix.

**CHANGE 10** Section VI Replaceable Parts and Section VIII Schematics
Change A32Q3, 5 to Part No 5080-3505 TRANSISTOR: SI PNP (MATCHED PAIR)
S5 to Part No 3101-1248 SWITCH: PUSH BUTTON
S16 to Part No 3101-1234 SWITCH: SLIDE
W1 to Part No 8120-1351 CABLE: POWER
Page 8-35 Figure 8-56 Alter the Power Supply input wiring as shown in Figure A-1
Page 1-4 Specifications
Change "POWER REQUIREMENT" to read "115 or 230V ±10% 48 to 440Hz, 70W"

**CHANGE 11** Section VI Replaceable Parts and Section VIII Schematics

Change the following capacitors to Part No 0140-0202 C: FXD MICA 15PF 5% 500VDCW

A15C1 through C14 A21C1 through C16
A18C1 through C16 A24C3 through C16

Add C5 through C8 Part No 0150-0121 C: FXD 0.1UF between pins 12 and 15 of XA15, XA18, XA21 and XA24

**CHANGE 12** Section VI Replaceable Parts and Section VIII Schematics

Change the following capacitors to Part No 0160-2197 C: FXD MICA 10PF 5% 300VDCW

A15C1 through C14 A21C1 through C16
A18C1 through C16 A24C3 through C16

**CHANGE 13** Section VI Replaceable Parts

Change A32R13 to Part No 2100-1761 R: VAR W W LIN 10K OHM 5% 1W
A32R25 to Part No 2100-1758 R: VAR W W LIN 1.0K OHM 5% 1W
C1 to Part No 0160-3561 C: FXD 2x0.001UF 1000VDCW

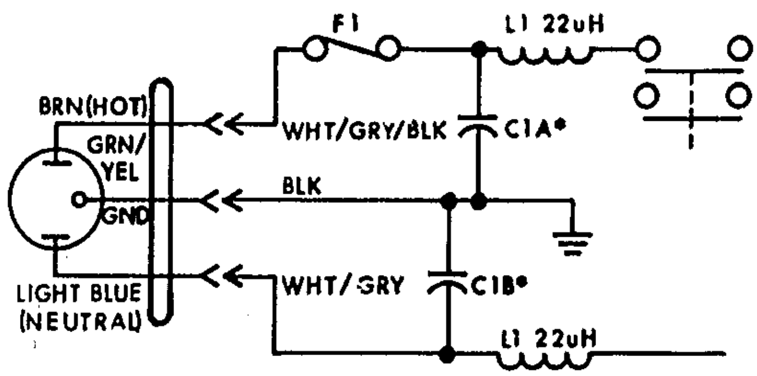



**Figure A-1**

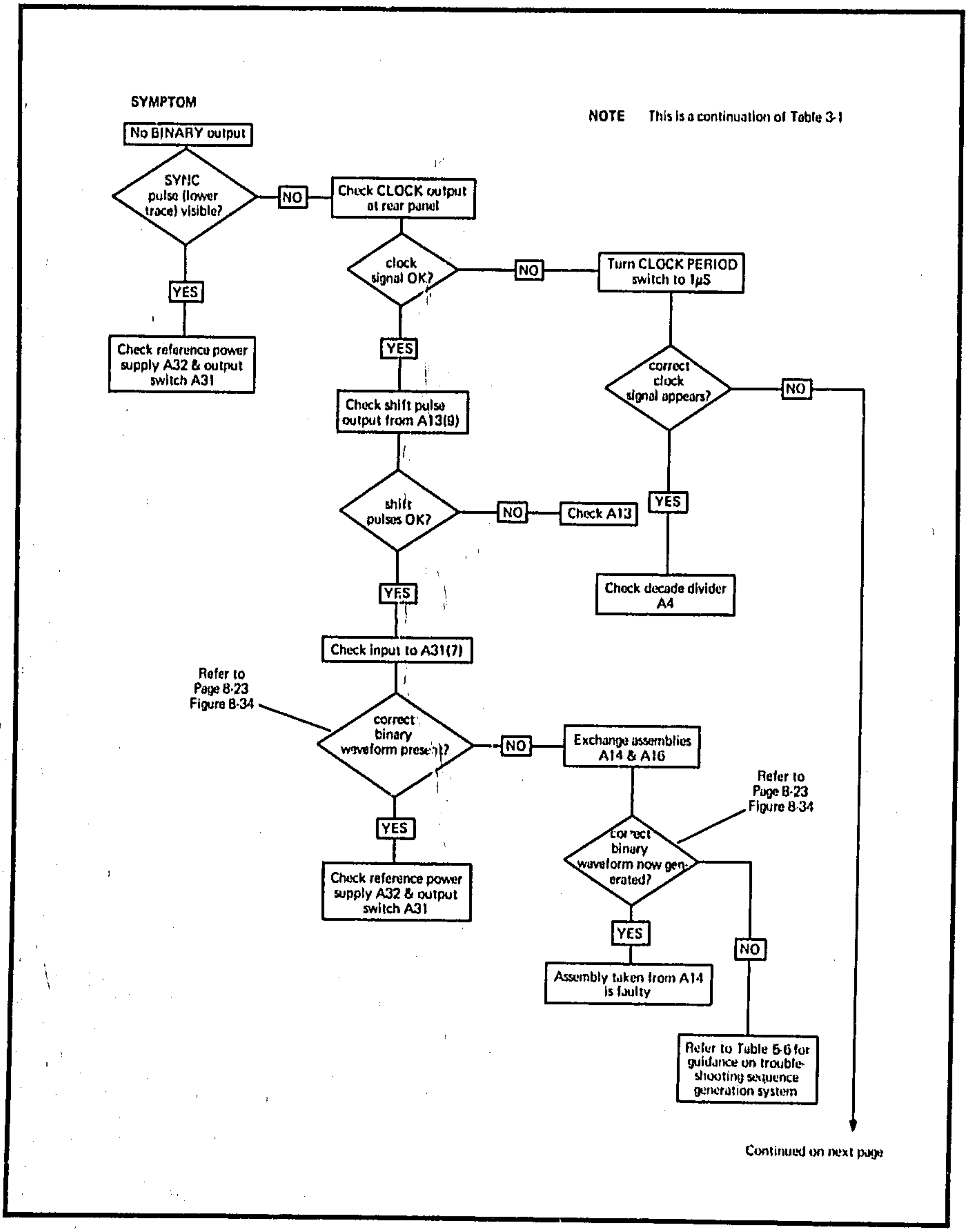



Table 5-5 Troubleshooting BINARY system

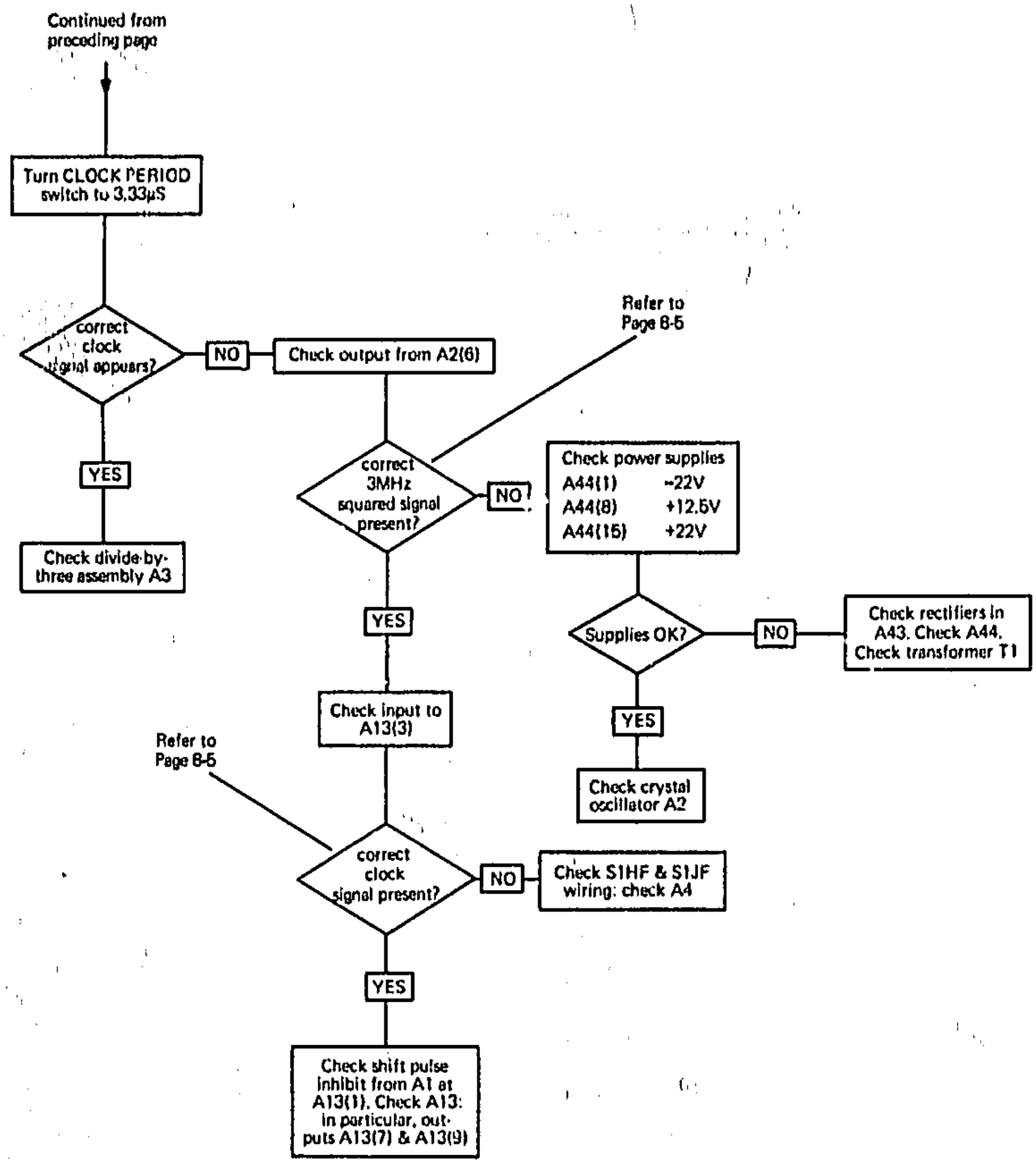



Table 5-5 (continued)

Table 6-1 Reference designation index

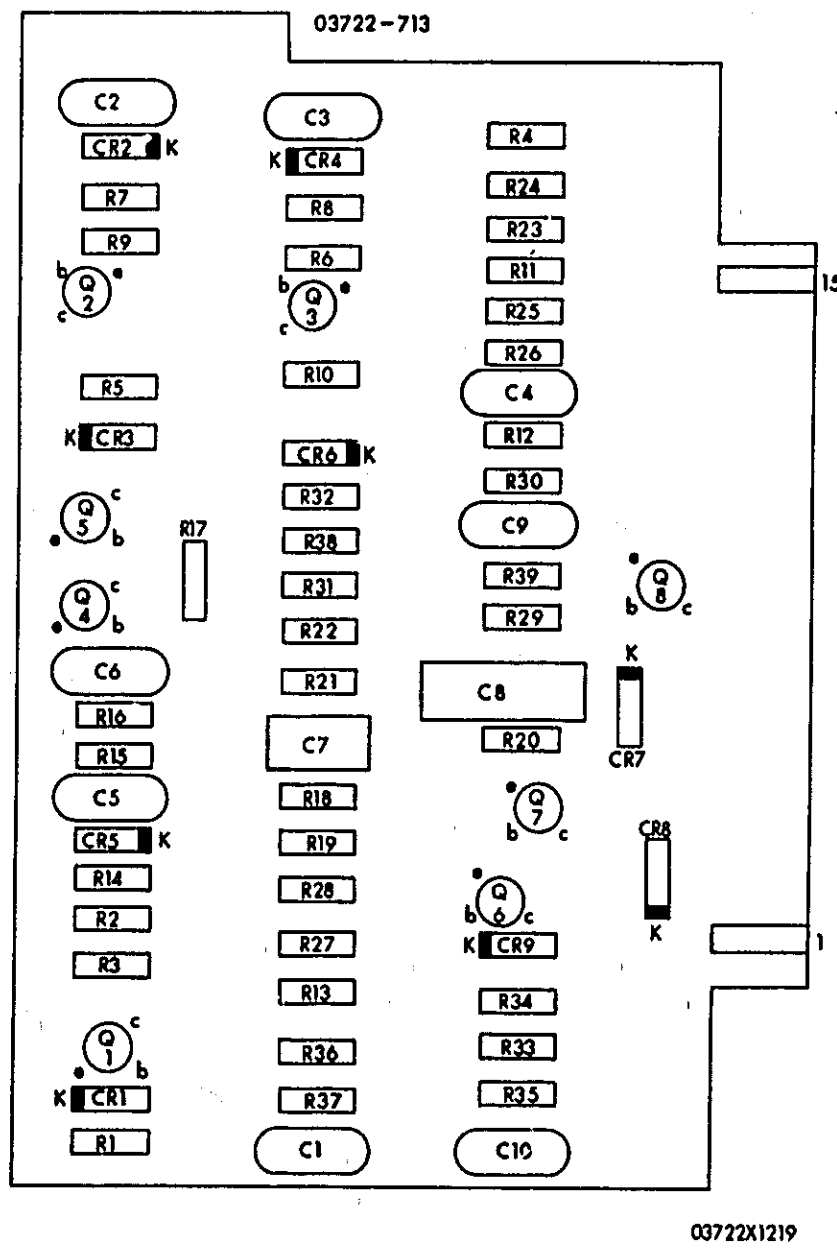
| Reference Designation | *hp* Part No | Description |
|---|---|---|
| A1 | 03722-713 | ASSY: CONTROL LOGIC |
| | 03722-313 | BOARD: BLANK PC (NSR) |
| A1C1 | 0140-0192 | C: FXD MICA 68PF 5% 300VDCW |
| A1C2 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A1C3 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A1C4 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW |
| A1C5 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A1C6 | 0140-0204 | C: FXD MICA 47PF 500VDCW |
| A1C7 | 0160-0300 | C: FXD MY 2700PF 10% 200VDCW |
| A1C8 | 0180-1746 | C: FXD TANT 15UF 20VDCW |
| A1C9 | 0160-2204 | C: FXD MICA 100PF 5% 300VDCW |
| A1C10 | 0160-0134 | C: FXD MICA 220PF 5% 300VDCW |
| A1CR1 | 1901-0040 | DIODE: SI |
| A1CR2 | 1901-0040 | DIODE: SI |
| A1CR3 | 1901-0040 | DIODE: SI |
| A1CR4 | 1901-0040 | DIODE: SI |
| A1CR5 | 1901-0040 | DIODE: SI |
| A1CR6 | 1901-0040 | DIODE: SI |
| A1CR7 | 1910-0034 | DIODE: GE |
| A1CR8 | 1910-0034 | DIODE: GE |
| A1CR9 | 1901-0040 | DIODE: SI |
| A1Q1 | 1854-0019 | TRANSISTOR: SI NPN |
| A1Q2 | 1854-0019 | TRANSISTOR: SI NPN |
| A1Q3 | 1854-0019 | TRANSISTOR: SI NPN |
| A1Q4 | 1854-0019 | TRANSISTOR: SI NPN |
| A1Q5 | 1854-0019 | TRANSISTOR: SI NPN |
| A1Q6 | 1853-0036 | TRANSISTOR: SI PNP |
| A1Q7 | 1853-0036 | TRANSISTOR: SI PNP |
| A1Q8 | 1853-0036 | TRANSISTOR: SI PNP |
| A1R1 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% ¼W |
| A1R2 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% ¼W |
| A1R3 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% ¼W |
| A1R4 | 0698-4298 | R: FXD MET OX 68K OHM 5% ¼W |
| A1R5 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% ¼W |
| A1R6 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% ¼W |
| A1R7 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R8 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R9 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% ¼W |
| A1R10 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% ¼W |
| A1R11 | 0698-4298 | R: FXD MET OX 68K OHM 5% ¼W |
| A1R12 | 0698-4262 | R: FXD MET OX 2.2K OHM 5% ¼W |
| A1R13 | 0698-4298 | R: FXD MET OX 68K OHM 5% ¼W |
| A1R14 | 0698-4282 | R: FXD MET OX 15K OHM 5% ¼W |
| A1R15 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% ¼W |

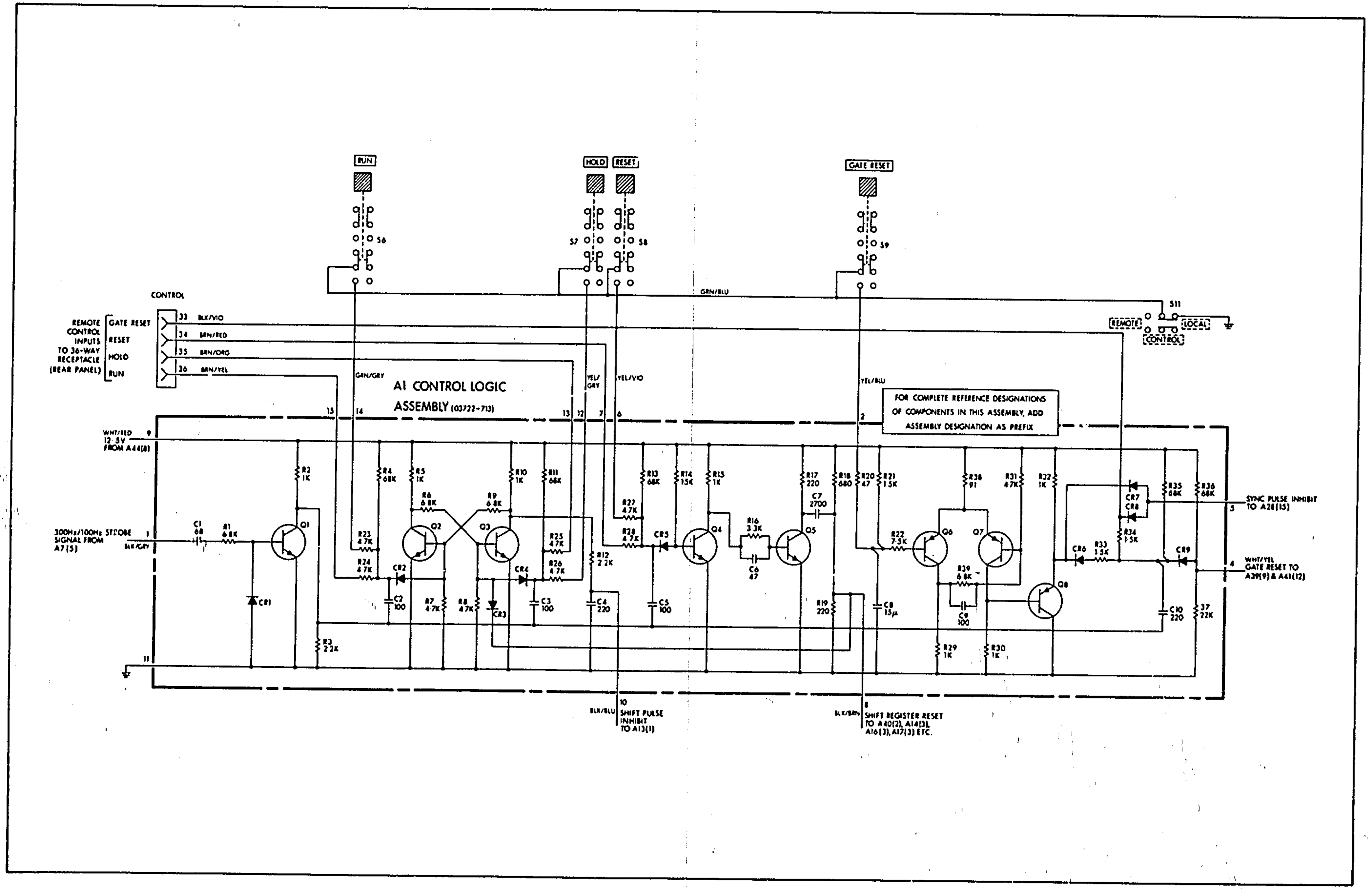
Abbreviations listed in introduction to this section

Table 6-1 Reference designation index (continued)

| Reference Designation | hp Part No | Description |
|---|---|---|
| A1R16 | 0698-4266 | R: FXD MET OX 3.3K OHM 5% ¼W |
| A1R17 | 0758-0015 | R: FXD MET OX 220 OHM 5% ½W |
| A1R17 | 0758-0015 | R: FXD MET OX 220 OHM 5% ½W |
| A1R18 | 0698-4250 | R: FXD MET OX 680 OHM 5% ¼W |
| A1R19 | 0698-4239 | R: FXD MET OX 220 OHM 5% ¼W |
| A1R20 | 0698-5707 | R: FXD MET OX 47 OHM 5% ¼W |
| A1R21 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% ¼W |
| A1R22 | 0698-4275 | R: FXD MET OX 7.5K OHM 5% ¼W |
| A1R23 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R24 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R25 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R26 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R27 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R28 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R29 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% ¼W |
| A1R30 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% ¼W |
| A1R31 | 0698-4270 | R: FXD MET OX 4.7K OHM 5% ¼W |
| A1R32 | 0698-4254 | R: FXD MET OX 1.0K OHM 5% ¼W |
| A1R33 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% ¼W |
| A1R34 | 0698-4258 | R: FXD MET OX 1.5K OHM 5% ¼W |
| A1R35 | 0698-4298 | R: FXD MET OX 68K OHM 5% ¼W |
| A1R36 | 0698-4298 | R: FXD MET OX 68K OHM 5% ¼W |
| A1R37 | 0698-4286 | R: FXD MET OX 22K OHM 5% ¼W |
| A1R38 | 0698-4231 | R: FXD MET OX 91 OHM 5% ¼W |
| A1R39 | 0698-4274 | R: FXD MET OX 6.8K OHM 5% ¼W |
| A2 | 03722-715 | ASSY: CRYSTAL OSCILLATOR |
| | 03722-315 | BOARD: BLANK PC (NSR) |
| A2C1 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A1C2 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A2C3 | 0121-0105 | C: VAR CER 9-35PF |
| A2C4 | 0160-2197 | C: FXD MICA 10PF 5% 300VDCW |
| A2C5 | 0150-0086 | C: FXD CER 4700PF 20% 500VDCW |
| A2C6 | 0140-0149 | C: FXD MICA 470PF 5% 500VDCW |
| A2C7 | 0150-0121 | C: FXD CER 0.1UF -20%+80% 50VDCW |
| A2C8 | 0160-0179 | C: FXD MICA 33PF 5% 300VDCW |
| A2C9 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A2C10 | 0140-0204 | C: FXD MICA 47PF 5% 500VDCW |
| A2CR1 | 1901-0040 | DIODE: SI |
| A2L1 | 9100-1633 | L: FXD COIL 68UH 5% |
| A2MP1 | 0380-0509 | BEAD: GLASS |
| A2MP2 | 0380-0509 | BEAD: GLASS |

Abbreviations listed in introduction to this section


03722-713
03722X1219


RUN
HOLD
RESET
GATE RESET
CONTROL
REMOTE CONTROL INPUTS TO 36-WAY RECEPTACLE (REAR PANEL)
GATE RESET
RESET
HOLD
RUN
REMOTE
LOCAL
CONTROL
A1 CONTROL LOGIC ASSEMBLY (03722-713)
FOR COMPLETE REFERENCE DESIGNATIONS OF COMPONENTS IN THIS ASSEMBLY, ADD ASSEMBLY DESIGNATION AS PREFIX
WHT/RED 12.5V FROM A44(8)
300Hz/100Hz STROBE SIGNAL FROM A7(5)
SYNC PULSE INHIBIT TO A28(15)
WHT/YEL GATE RESET TO A29(9) & A41(12)
SHIFT PULSE INHIBIT TO A13(1)
SHIFT REGISTER RESET TO A40(2), A14(3), A16(3), A17(3) ETC.

# MANUAL CHANGES

— MANUAL IDENTIFICATION —
Model Number: 3722A
Date Printed: March 1971
Part Number: 03722-95002

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:
Make all ERRATA corrections.
Make all appropriate serial number related changes indicated in the tables below.

| Serial Prefix or Number | Make Manual Changes |
|---|---|
| 1101U | 14 |
| 1133U | 14-15 |
| 1133U-00806 | 14-16 |
| 1133U-00821 | 14-17 |
| 1133U-01406 | 14-18 |
| 1133U-01096 | 14-19 |
| 1133U-01106 | 14-20 |
| 1133U-01116 | 14-21 |
| 1133U-01136 | 14-22 |
| 1428U | 14-23 |
| 1428U-01176 | 14-24 |

| Serial Prefix or Number | Make Manual Changes |
|---|---|
| 1428U-01196 | 14-25 |
| 1451U-01206 | 14-26 |
| 1523U | 14-27 |
| 1523U-01286 | 14-28 |
| 1640U | 14-29 |
| 1703U | 14-30 |
| 1722U | 14-31 |
| | |
| | |
| | |
| | |

✱ NEW ITEM

## ERRATA

Page 1-0, Figure 1-1:
Delete Rack Mounting Kit.

Page 1-3, Under Specifications:
In OUTPUT and GATE, change +12.5V to read +12V.
In SYNC, change +1.5V to read +1V.

Page 1-4, Under Accessories Furnished:
Delete Rack Mounting Kit.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of the supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement or the model number and print date from the title page of the manual.

[illegible]



HEWLETT hp PACKARD

ERRATA (Cont'd):

Page 2-2, Paragraph 2-18:
Change to read:- "A Rack Mounting Kit is available to install the instrument in a 19-inch rack. Rack Mounting Kits may be obtained through your nearest Hewlett-Packard Office by ordering HP Part Number 5060-8740".

Page 5-12/13/14:
Change to:
(b) MEAN RECTIFIED AMPLITUDE MEASUREMENT.

1) As shown in Figure 5-8, connect the GAUSSIAN output from the 3722A via a 600Ω load to the digital voltmeter input of a 5328A Universal Counter, Option 020 or 021.

2) Couple the SYNC output from the 3722A to INPUT A of the 5328A.

3) Set the 5328A controls as follows:

FUNCTION to DVM, A→B: this is a "phantom" function, 3 switch positions clockwise from STOP.

DVM to 100V range: DVM Filter OFF (applies to 5328A Option 021 only).

LEVEL A to 0.25V approximately: Check using READ A position on DVM module.

LEVEL B to PRESET.

SLOPE A: +
SLOPE B: -
ATTEN to 1 on both inputs
AC/DC to DC on both inputs
CHECK/Com A/SEP switch to COM A
1MΩ/50Ω switch to 1mΩ

4) Set the 3722A SEQUENCE LENGTH control to 1023 and the CLOCK PERIOD switch to the required position in the range 3.33mS to 333mS inclusive.

5) Press the 5328A RESET button. On the next sync pulse from the 3722A, the 5328A G (Gate) lamp should light, indicating that the voltage integration is in progress. The G lamp should be extinguished by the following SYNC pulse, which stops the integration. Allow several repetitions of the integration to occur and take the average result.

ERRATA (Cont'd):

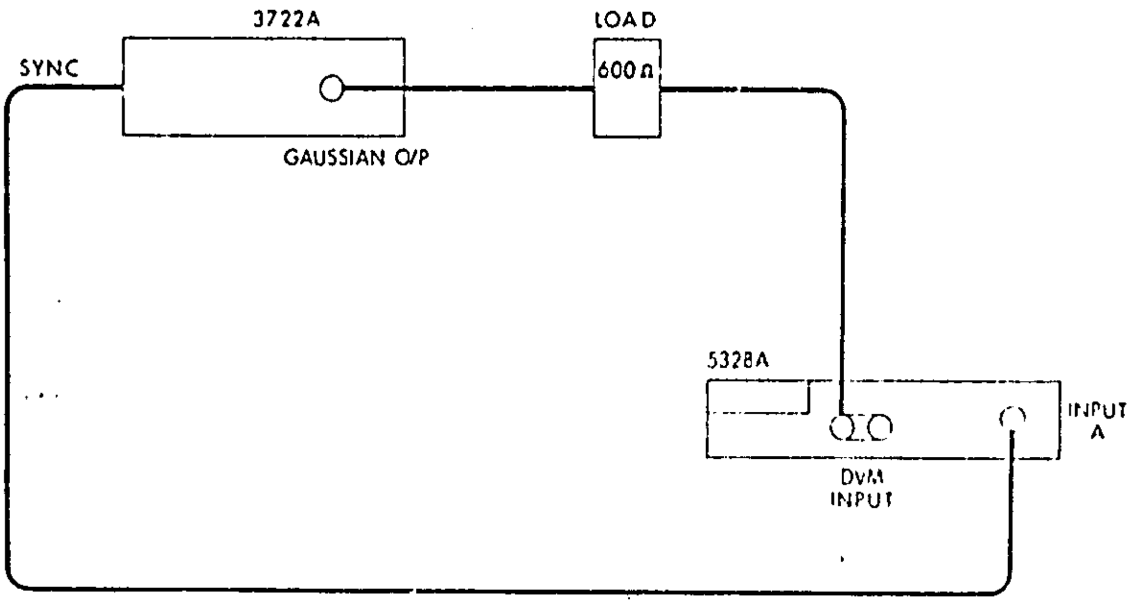
CALCULATION: In the "phantom" position DVM, A→B, the 5328A integrates the voltage at the DVM input over a period determined by the events at Channels A and B. Units of the displayed reading are volt seconds. The sign of the reading has no significance in this test.

The mean rectified amplitude of the 3722A output is equal to:

$$\frac{\text{Voltage Reading}}{1023 \times \text{Clock Period}}$$

Typically, with a clock period of 10mS the voltage reading could be 26.100. This gives a mean rectified amplitude of 2.55V and an rms amplitude (based on a 1.24 form factor) of 3.16V.

Page 5-13:
Change Figure 5-8 to:




Page 5-24, Under "Main Controls":
Change Paragraph 4 to read "+1V and +12V".

ERRATA (Cont'd):

Page 5-26, Under "Sync":
Change Paragraph 2 to read "+1V to +12V".

Page 5-26, Under "Gate":
Change Paragraph 4 to read "+12V to +1V".

Page 6-36, Table 6-1:
Change A44CR1, 4 to 1902-0048 Diode Zener 6.81V 5%.

Page 6-37, Table 6-1:
Add C9 Part Number 0180-0291 C. FXD 1μF.

Page 6-38, Table 6-1:
Delete MP18.

Page 6-41, Table 6-1:
Change XF1 to 2110-0564 Fuse Post.
2110-0565 Fuse Cap.
2110-0569 Fuse Post Nut.

Page 6-47, Table 6-2:
Change 1400-0084 to 2110-0564 Fuse Post.
2110-0565 Fuse Cap.
2110-0569 Fuse Post Cap.

Page 8-8, Figure 8-7:
Add C9 1μF (between Pin 6 of A1 board and earth).

ERRATA (Cont'd):

In Tables 6-1 and 6-2 and on each assembly change the Part Number of the following resistors:-

| | | | |
|---|---|---|---|
| From | 0698-3775 | to | 0757-0382 |
| | 0698-3776 | | 0757-0180 |
| | 0698-3777 | | 0698-4389 |
| | 0698-3778 | | 0698-4410 |
| | 0698-3779 | | 0757-0410 |
| | 0698-3780 | | 0698-5019 |
| | 0698-3799 | | 0698-6745 |
| | 0698-4226 | | 0757-0276 |
| | 0698-4227 | | 0757-0397 |
| | 0698-4230 | | 0757-0399 |
| | 0698-4232 | | 0757-0402 |
| | 0698-4233 | | 0757-0403 |
| | 0698-4234 | | 0698-3437 |
| | 0698-4239 | | 0698-3441 |
| | 0698-4241 | | 0698-3132 |
| | 0698-4243 | | 0698-3444 |
| | 0698-4245 | | 0698-3446 |
| | 0698-4246 | | 0698-0082 |
| | 0698-4250 | | 0757-0419 |
| | 0698-4252 | | 0757-0421 |
| | 0698-4254 | | 0757-0280 |
| | 0698-4256 | | 0757-0274 |
| | 0698-4258 | | 0757-1094 |
| | 0698-4262 | | 0698-0084 |
| | 0698-4264 | | 0698-0085 |
| | 0698-4265 | | 0698-3151 |
| | 0698-4266 | | 0757-0279 |
| | 0698-4267 | | 0698-3152 |
| | 0698-4268 | | 0698-3153 |
| | 0698-4270 | | 0698-3155 |
| | 0698-4274 | | 0757-0439 |
| | 0698-4278 | | 0757-0442 |
| | 0698-4280 | | 0757-0444 |
| | 0698-4282 | | 0698-3156 |
| | 0698-4286 | | 0757-0199 |
| | 0698-4288 | | 0698-3159 |
| | 0698-4290 | | 0698-3160 |
| | 0698-4292 | | 0698-3161 |
| | 0698-4294 | | 0698-3162 |
| | 0698-4296 | | 0757-0459 |
| | 0698-4298 | | 0757-0461 |
| | 0698-4300 | | 0757-0463 |
| | 0698-4302 | | 0757-0465 |
| | 0698-5701 | | 0698-3432 |
| | 0698-5707 | | 0698-3436 |
| | 0758-0015 | | 0698-0088 |
| | 0758-0026 | | 0757-0711 |
| | 0758-0086 | | 0757-0401 |

The following changes are a continuation of those in Appendix A of the Manual.

## CHANGE 14

Section VI, Table 6-1:
Change Chassis Mounted Component C1 to Part Number 0160-3561 C. FXD CER 2 x 0.001uF.
Change A32R13 to Part Number 2100-1761 R. VAR WW Lin 10K ohm 5% 1W.
Change A32R25 to Part Number 2100-1758 R. VAR WW Lin 1.0K 5% 1W.

## CHANGE 15

Section VI, Table 6-1:
Change MP2 03722-101 Front Panel to 03722-133.
Change MP4 5000-0738 Side Cover (rear) to 5000-8709.
Change MP5 5000-0739 Side Cover (front) to 5000-8711.
Change MP6 03722-118 Top Cover to 03722-134.
Change MP7 03722-119 Bottom Cover to 03722-135.
Change MP9 5060-0766 Handle Assembly Retainer to 5060-8737.
Change MP14 00140-24701 Panel Trim (top) to 5020-6850.
Change MP18 5060-0775 Rack Mounting Kit to 5060-8740.
Change MP28 0370-0118 Knob: Push-Button (Fits S6, S7, S8 and S9) to 0370-1400.

## CHANGE 16

Section VI, Table 6-1:
Change Q4 and Q6 to Part Number 1854-0419 Transistor: SI NPN.

## CHANGE 17

Section VI, Table 6-1:
Change MP14 to Part Number 5020-4175 Panel Trim (top)
Change MP15 to Part Number 5020-4176 Panel Trim (bottom).

## CHANGE 18

Table 6-1, Page 6-27:
Change A35Q1 to Part Number 1855-0062 Transistor Si Fet.

## CHANGE 19

Table 6-1:
Change A2R2 to Part Number 0757-0280 R. FXD 1K ohm 1% ⅛W.

CHANGE 20

Table 6-1:
Change A13R25 to Part Number 0698-3620 R. FXD 100 ohm 5% 2W.

CHANGE 21

Pages 6-26/27, Table 6-1:
Change A35C1, 10 to Part Number 0160-3324 C. FXD 1uF 100V.

CHANGE 22

Table 6-1:
Change S5 to Part Number 3101-1395 S.W. PB.
Change A11 1850-0062 XSTR GE PNP to 1853-0217 XSTR SI PNP.
Change A11 1910-0016 Di GE to 1901-0040 Di SI.

CHANGE 23

Page 6-9, Table 6-1:
Change A13R25 to Part Number 0698-3624 R. FXD 150Ω 5% 2W.

Pages 6-22/23, Table 6-1:
Delete A30CR13 Part Number 1901-0040 Di SI.
Add A30R33 Part Number 0757-0420 R. FXD 750Ω 1% ⅛W.

CHANGE 24

Table 6-1:
Change R41 to Part Number 0683-1015 R. FXD 100Ω 5% ¼W.
Change R38, 44 to Part Number 0683-3935 R. FXD 39KΩ 5% ¼W.

CHANGE 25

Page 6-38, Table 6-1:
Add MP60 Part Number 5061-0748 XSTR Socket Assy (for use with Q5).

CHANGE 26

Table 6-1:
Change A6 thru A12: CR1 to CR5 to Part Number 1901-0016 De Ge (Reverses Change 22).
Add A30CR13 Part Number 1901-0040 Di SI (In parallel with A30R33 Ref. Change 23).

## CHANGE 27

Page 6-41, Table 6-1:
Change XFI to Part Number 2110-0464 Fuse Holder
2110-0465 Fuse Cap
2110-0467 Nut Hex

Page 6-47, Table 2:
Delete 1400-0084 Fuse Holder.
Add 2110-0464 Fuse Holder.
2110-0465 Fuse Cap.
2110-0467 Nut Hex.

## CHANGE 28

Delete Change 25.

Page 6-39, Table 6-1:
Change Q5 to Part Number 5080-9061 XSTR ASSY. (This assy is XSTR 1853-0012 with additional leads welded on).

## CHANGE 29

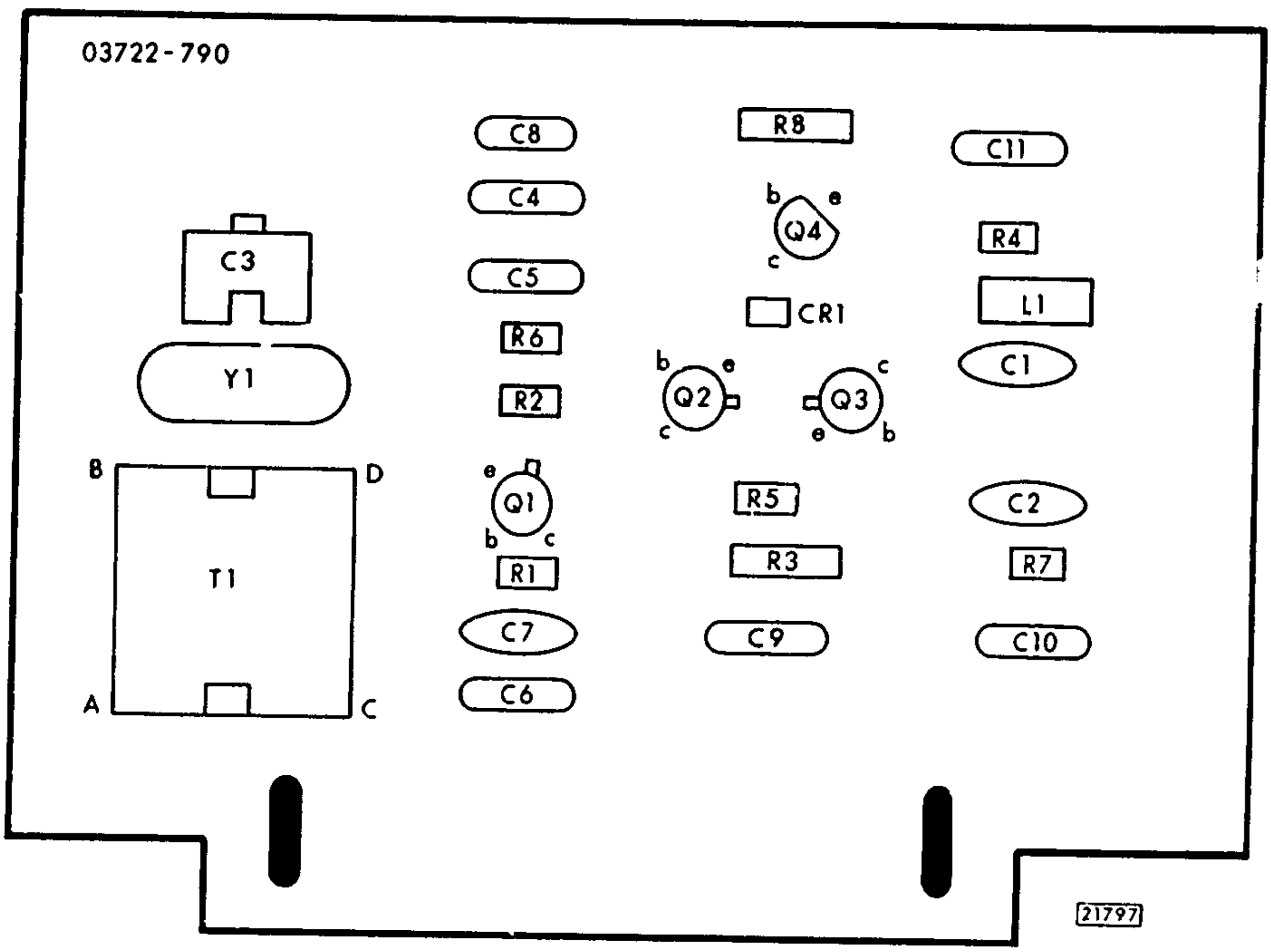
Page 6-3, Table 6-1:
Replace the parts list for the A2 Assembly with the following parts list.

**Table 6-1 Replaceable Parts**

| Ref Desig | HP Part No | Description |
|---|---|---|
| A2 | 03722-[illegible] | ASSY : CRYSTAL OSCILLATOR |
| | 03722-[illegible] | BOARD : BLANK PC (NSR) |
| A2C1 | 0150-0121 | CAPACITOR, FXD 0.1µF 50VDC |
| A2C2 | 0150-0121 | CAPACITOR, FXD 0.1µF 50VDC |
| A2C3 | 0121-0105 | CAPACITOR, VAR 9-35pF |
| A2C4 | 0160-2197 | CAPACITOR, FXD 10pF 300V |
| A2C5 | 0160-0938 | CAPACITOR, FXD 1000pF |
| A2C6 | 0160-2208 | CAPACITOR, FXD 330pF 300V |
| A2C7 | 0150-0121 | CAPACITOR, FXD 0.1µF 50VDC |
| A2C8 | 0160-0179 | CAPACITOR, FXD 33pF 300V |
| A2C9 | 0140-0204 | CAPACITOR, FXD 47pF 500V |
| A2C10 | 0140-0204 | CAPACITOR, FXD 47pF 500V |
| A2C11 | 0140-0210 | CAPACITOR, FXD 270pF 300V |
| A2CR1 | 1901-0040 | DIODE : SI |
| A2L1 | 9100-1633 | INDUCTOR, FXD, COIL 68µH 5% |
| A2Q1 | 1854-0019 | TRANSISTOR : SI NPN |
| A2Q2 | 1853-0034 | TRANSISTOR : SI PNP |
| A2Q3 | 1853-0034 | TRANSISTOR : SI PNP |
| A2Q4 | 1854-0071 | TRANSISTOR : SI NPN |
| A2R1 | 0698-3150 | RESISTOR, FXD 23.7K 1% .25W |
| A2R2 | 0757-0280 | RESISTOR, FXD 1K 1% .125W |
| A2R3 | [illegible]-3599 | RESISTOR, FXD 2.15K 1% .25W |
| A2R4 | 0757-0397 | RESISTOR, FXD 68.1Ω 1% |
| A2R5 | 0757-0439 | RESISTOR, FXD 6.81K 1% |
| A2R6 | 0757-0290 | RESISTOR, FXD 6.19K 1% .125W |
| A2R7 | 0757-0433 | RESISTOR, FXD 1.32K 1% .125W |
| A2R8 | 0757-0463 | RESISTOR, FXD [illegible]K 1% .125W |
| A2T1 | 9100-0619 | TRANSFORMER, CRYSTAL OSCILLATOR |
| A2Y1 | 0410-0601 | CRYSTAL, QUARTZ 3MHz |

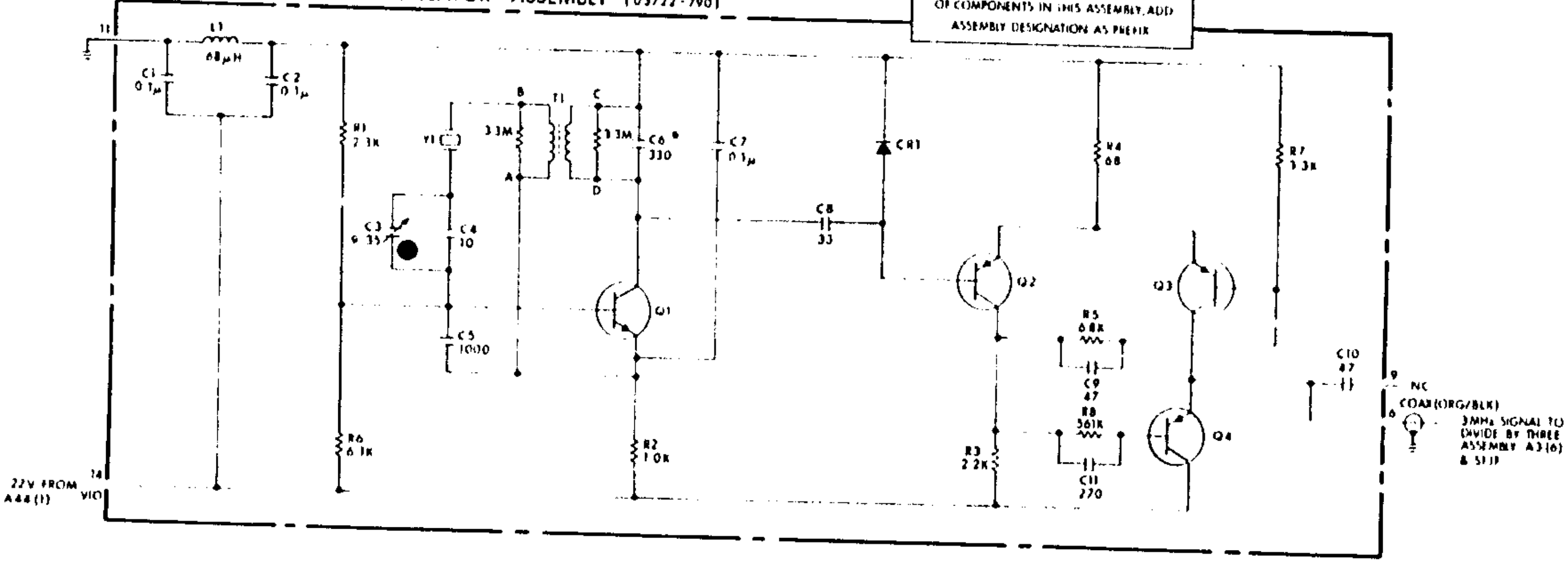
CHANGE 29 (Cont'd):

Page 8-9, Figure 8-8:
Replace Schematic and Layout diagrams with attached diagrams.
Change the parts list on the back of Figure 8-8 to correspond with the replaceable parts list Table 6-1.



## A2 3MHz CRYSTAL OSCILLATOR ASSEMBLY (03722-790)

FOR COMPLETE REFERENCE DESIGNATIONS OF COMPONENTS IN THIS ASSEMBLY, ADD ASSEMBLY DESIGNATION AS PREFIX




* NOTE SELECT ON TEST

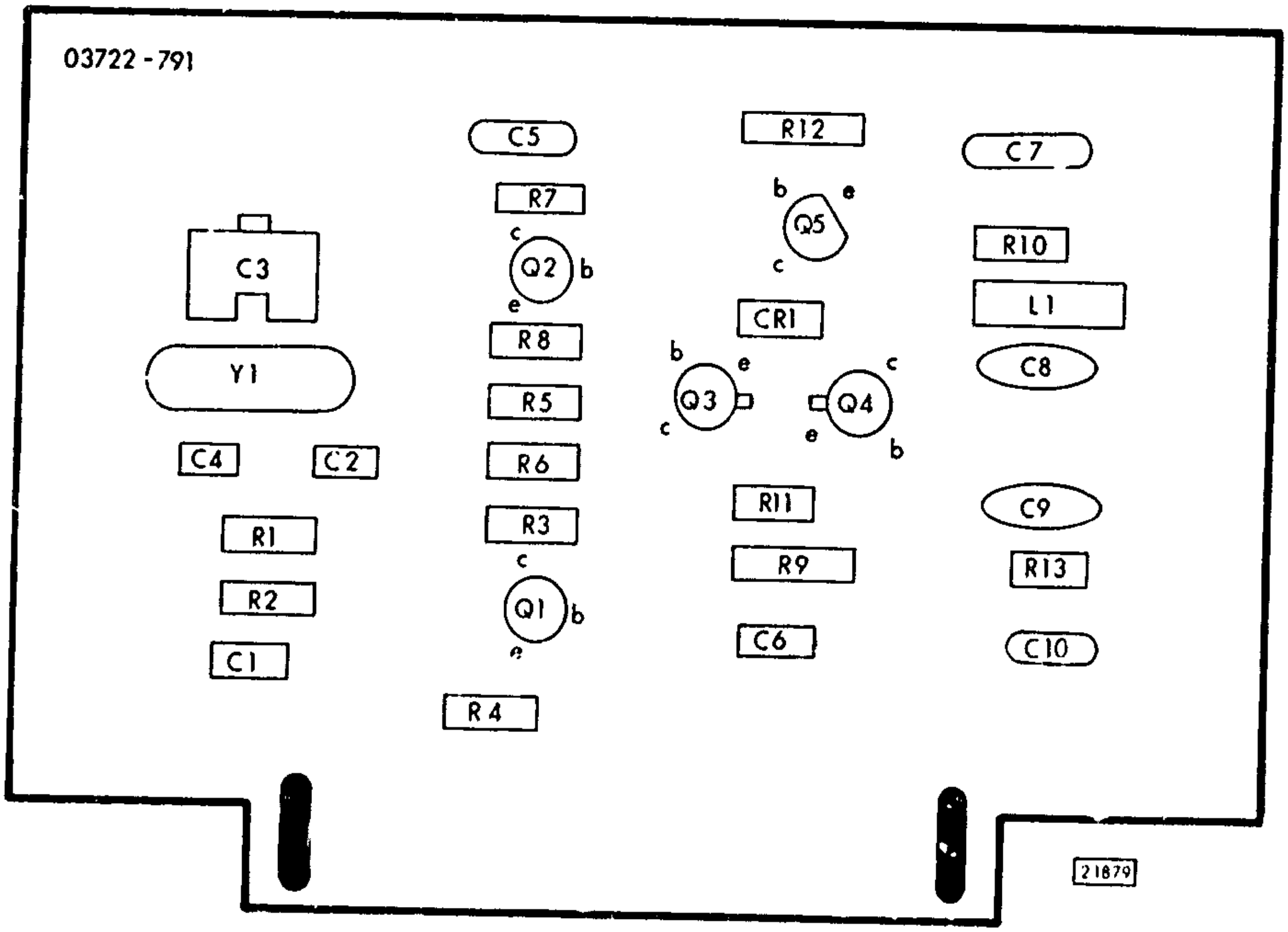
CHANGE 30

Page 6-3, Table 6-1:
Replace the parts list for the A2 Assembly with the following parts list.

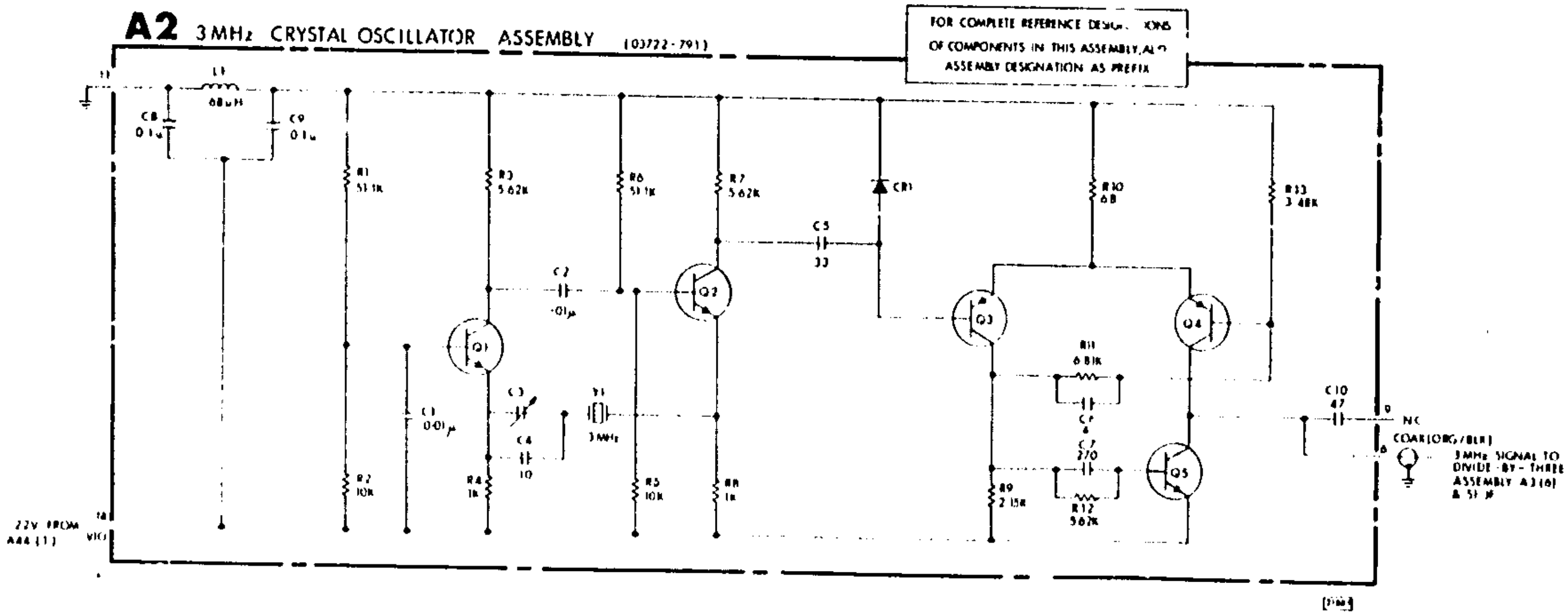
Table 6-1. Replaceable Parts.

| Ref Desig | hp Part No | Description |
|---|---|---|
| C1 | 0160-2055 | CF 0.01nf 100V |
| C2 | 0160-2055 | CF 0.01nf 100V |
| C3 | 0121-0105 | CV 9/35pF |
| C4 | 0160-2197 | CF 10pf 300V |
| C5 | 0160-0179 | CF 33pf 300V |
| C6 | 0160-2307 | CF 47pf 500V |
| C7 | 0140-0210 | CF 270pf 200V |
| C8 | 0150-0121 | CF 0.1nf 50V |
| C9 | 0150-0121 | CF 0.1nf 50V |
| C10 | 0160-2307 | CF 47pf 500V |
| CR1 | 1901-0040 | Dio Swg |
| L1 | 9100-1633 | Coil Fxd 68nH |
| Q1 | 1854-0005 | Tstr Si NPN |
| Q2 | 1854-0005 | Tstr Si NPN |
| Q3 | 1853-0034 | Tstr Si PNP |
| Q4 | 1853-0034 | Tstr Si PNP |
| Q5 | 1854-0019 | Tstr Si NPN |
| R1 | 0757-0458 | RF 51.5k 1% 1/8W |
| R2 | 0757-0442 | RF 10k 1% 1/8W |
| R3 | 0757-0200 | RF 5.62k 1% 1/8W |
| R4 | 0757-0280 | RF 1k 1% 1/8W |
| R5 | 0757-0442 | RF 10k 1% 1/8W |
| R6 | 0757-0458 | RF 51.1k 1% 1/8W |
| R7 | 0757-0200 | RF 5.62k 1% 1/8W |
| R8 | 0757-0280 | RF 1k 1% 1/8W |
| R9 | 0698-3599 | RF 2.15k 1% 1/8W |
| R10 | 0757-0397 | RF 68.1 1% 1/8W |
| R11 | 0757-0439 | RF 6.81k 1% 1/8W |
| R12 | 0757-0483 | RF 562k 1% 1/8W |
| R13 | 0698-3152 | RF 3.48k 1% 1/8W |
| T1 | 0410-0601 | Xtal 3MHz |

Page 8-9, Figure 8-8:
Replace Schematic and Layout diagrams with attached diagrams.
Change the parts list on the back of Figure 8-8 to correspond with the replaceable parts list, Table 6-1.


03722-791
C5
R12
C7
R7
b
e
Q5
c
R10
C3
c
Q2
b
e
CR1
L1
R8
b
e
c
C8
Y1
R5
Q3
Q4
c
e
b
C4
C2
R6
R11
C9
R1
R3
R9
R13
R2
c
Q1
b
e
C6
C10
C1
R4
21879

**A2** 3MHz CRYSTAL OSCILLATOR ASSEMBLY (03722-791)



CHANGE 31

Pages 6-4/6-6, Table 6-1:
Change A5 to read 03722-792 on A4 assy 03722-725.
Change A4C2 to 0160-2306 C. FXD 27pF (material is same for A4 and A5 except for C2).

Page 8-11, Figure 8-12:
Add Part Number 03722-792 (A5).
Add Note 1: C2 is 27pF for A4 (03722-725).
82pF for A5 (03722-792).