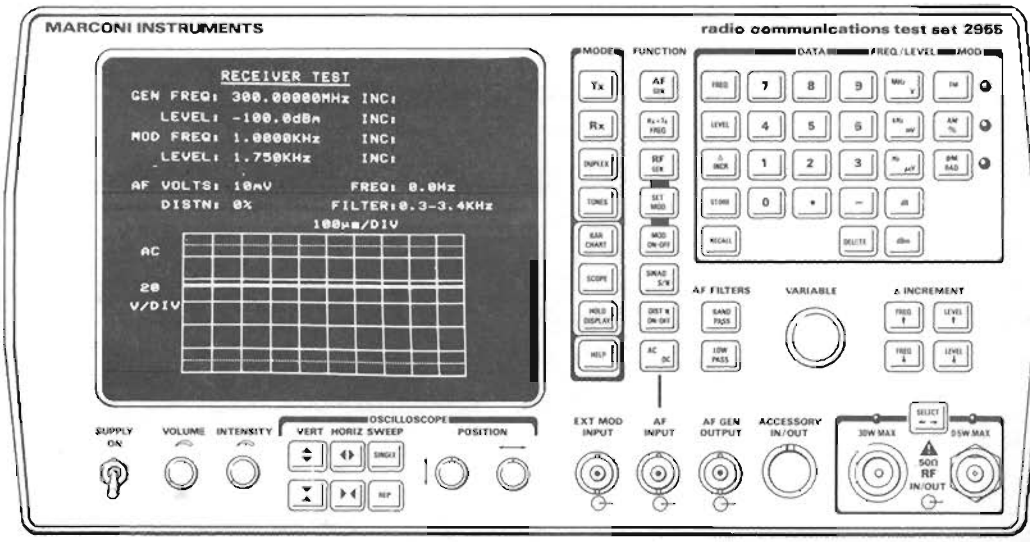
WALT

Marconi
Instruments

2955

RADIO COMMUNICATIONS TEST SET



Service Manual

Radio Communications Test Set 2955

Part nos. 52955-900A
52955-301W
52955-307C
52955-312B

AMENDMENT RECORD

The following amendments are incorporated in this manual:

Amendment no.	Date	Issued at serial nos. prefixed
Am. 1	Mar. 86	119507
Am. 2	Aug. 86	132003
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Am. 4	Apr. 87	132007
Am. 5	Nov. 87	132063
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CONTENTS

PRELIMINARIES

CHAPTERS

(Chapters 1 to 4-2:) These chapters are contained in a separate operating manual - H 52955-900A, Vol. 1.

HAZARD WARNING SYMBOLS

The following symbols appear on the equipment:

Symbol	Type of hazard	Reference
⚠	Static sensitive device	Page (v)
⚠	Dangerous voltages present	Page (iii)
⚠	Supply voltage	Page (iii)

Note ...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am. 1, Am. 2 etc.). New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus > .... < to show the extent of the change. When a chapter is reissued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

NOTES AND CAUTIONS

ELECTRICAL SAFETY PRECAUTIONS

This equipment is protected in accordance with IEC Safety Class 1. It has been designed and tested according to IEC Publication 348, 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

Removal of covers

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be discharged; to discharge mains filter capacitors, if fitted, short together the L (live) and N (neutral) pins of the mains plug.

Note also that the 12 kV e.h.t. circuit for the cathode ray tube retains its charge for a considerable time after switch off. Therefore before any handling is carried out in the vicinity of the cathode ray tube or e.h.t. unit it is essential that the supply is disconnected from the instrument and the final anode lead is shorted to the chassis several times immediately after unplugging. The residual charge on the c.r.t. itself must also be removed by shorting the anode connection to earth.

Mains plug

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous. Before fitting a non-soldered plug to the mains lead, cut off the tinned ends of the mains lead. Otherwise cold flowing of the solder could cause intermittent connections.

Primary fuses

Note that there is a supply fuse in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

CAUTION : STATIC SENSITIVE COMPONENTS

Components identified with the symbol ⚠ on the circuit diagrams and/or parts lists are static sensitive devices. The presence of such devices is also indicated in the equipment by orange disks, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disk or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or replaced the following anti-static equipment must be used.

A work bench with an earthed conductive surface.

Metallic tools earthed either permanently or by repeated discharges.

A low-voltage earthed soldering iron.

An earthed wrist strap and a conductive earthed seat cover for the operator, whose outer clothing must not be of man-made fibre.

(3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

(4) If using a freezer aerosol in fault finding, take care not to spray programmable ICs as this may affect their contents.

WARNING : HANDLING HAZARDS

This equipment is formed from metal pressings and although every endeavour has been made to remove sharp points and edges care should be taken, particularly when servicing the equipment, to avoid minor cuts.

Cathode ray tube: When exposing or handling the cathode ray tube care must be taken to prevent implosion and possible scattering of glass fragments. Handling should only be carried out by experienced personnel and the use of safety mask and gloves is recommended. A defective tube should be disposed of in a safe manner by an authorized waste contractor.

WARNING : TOXIC HAZARD

Many of the electronic components used in this equipment employ resins and other chemicals which give off toxic fumes on incineration. Appropriate precautions should be taken in the disposal of these items.

Chapter 4-2

TECHNICAL DESCRIPTION

CONTENTS

continued ...

CONTENTS (continued)

INTRODUCTION

1. The following description should be read in conjunction with the appropriate diagrams in this chapter and with the circuit diagrams in Chap. 7. Descriptions follow the signal path order of r.f. input to display and end with the processor and power supply. Boards are grouped according to function and arranged in alphabetical order.

CIRCUIT SUMMARY

2. The block schematic for Radio Communications Test Set 2955 is shown in Fig. 1. This summarizes the main functions of the instrument. The RF IN/OUT sockets are protected against overload and may be configured for simplex or duplex operation. Signal output from the r.f. signal generator may be modulated by either the a.f. generator or by an input from the EXT MOD INPUT socket. The a.f. generator also feeds to the AF GEN OUTPUT socket. Both generators are phase locked to the frequency standard which may be either internal or from an external standard connected to the EXT STD 1 MHz socket. The r.f. signal input is taken to the r.f. counter, the r.f. power meter and the modulation meter. An output is taken from the meter at the 110 kHz i.f. and fed to the IF OUT socket. Input to the voltmeter section is selected from the demodulated signal, from the AF INPUT socket or from the optional r.f. directional power head connected to the ACCESSORIES socket. Switched filters follow which may be externally selected as well as internally switched to provide the distortion, signal/noise and SINAD functions. Analogue signals from the voltmeter and power meter are converted to digital form for measurement by the processor. From the filters outputs are fed to the DE-MOD OUT socket and audio amplifier for monitoring purposes, and to the a.f. counter and oscilloscope for display. Most of the functions of the instrument, including the display, are controlled by the microprocessor which besides responding to the front panel controls, regulates peripheral input/output via the GPIB.

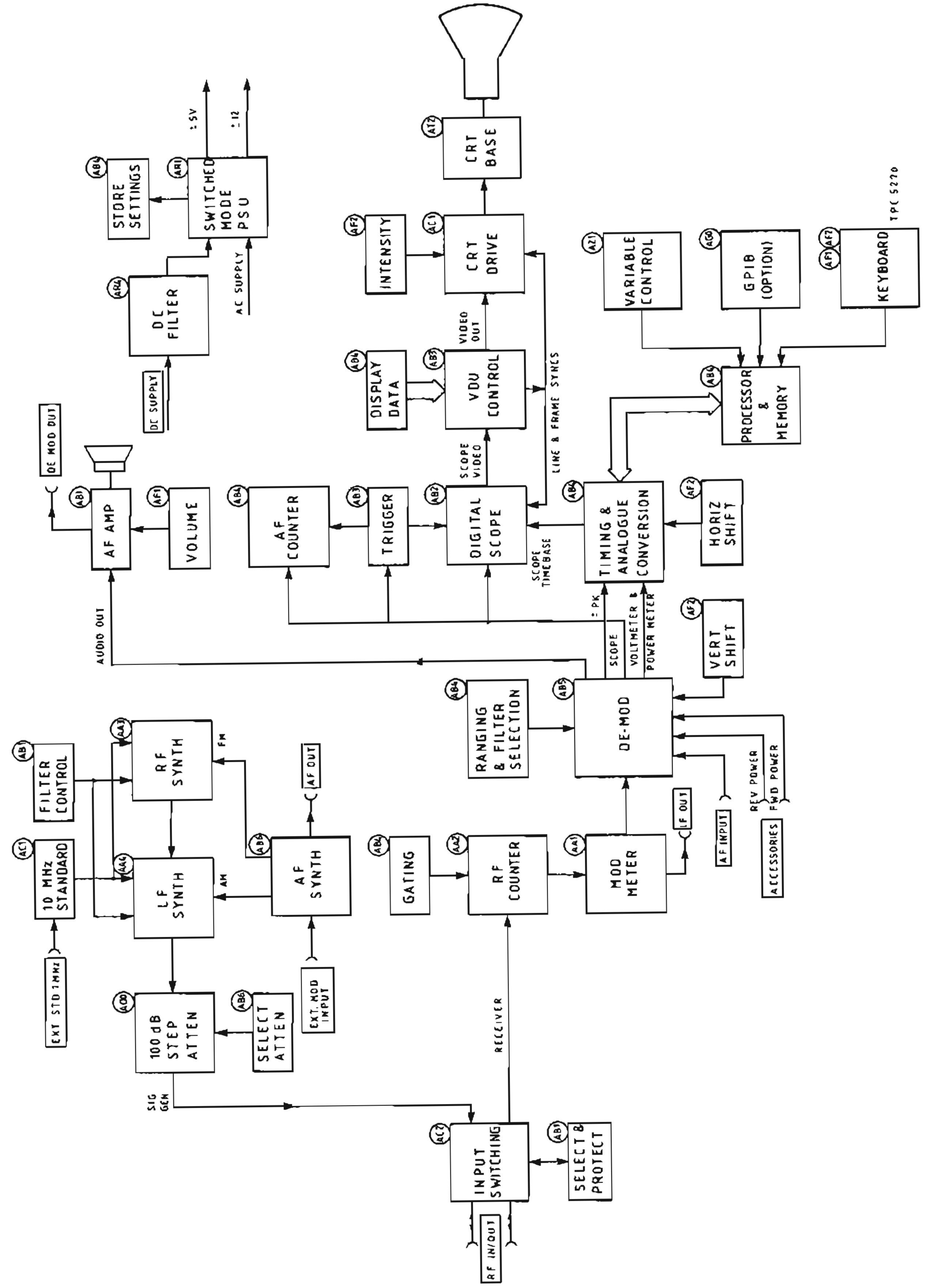


Fig. 1 Block schematic of 2955 showing main functions of boards

RF INPUT/OUTPUT & RF COUNTER

3. The r.f. inputs and outputs are connected to the RF IN/OUT b.n.c. and N-type sockets (see Fig. 2). For the b.n.c. socket, the input is sampled on AC2 and if excessive power is detected on AB1 the input is isolated by AC2 in order to protect the signal generator. No such protection is required for the N-type socket since it is directly connected to a 20 dB pad. Excessive power at this socket results in overheating which is sensed on AC2 causing the detector on AB1 to inform the processor which flashes a warning notice on the screen. For excessive power at either input, an audible warning is generated from the audio amplifier on AB1. This warning overrides the VOLUME CONTROL on AF2. A change-over switch on AC2 responds to the SELECT key for simplex operation and defines the signal paths for 1 port and 2 port duplex operation. Signal generator output from the r.f. synthesizer is via a 10 dB attenuator on AA4 and then via a 100 dB attenuator which is switched in 20 dB steps by drivers on AB6. Signal input is fed from a splitter to the modulation meter on AA1 and to the r.f. counter on AA2. The signal to the counter is fed via a 20 dB pad to a prescaler which is switched in for frequencies above 200 MHz. The counter is gated, depending upon frequency range, by the divider on AB4. The resulting frequency measurement is fed out on the data bus to processor board AB4.

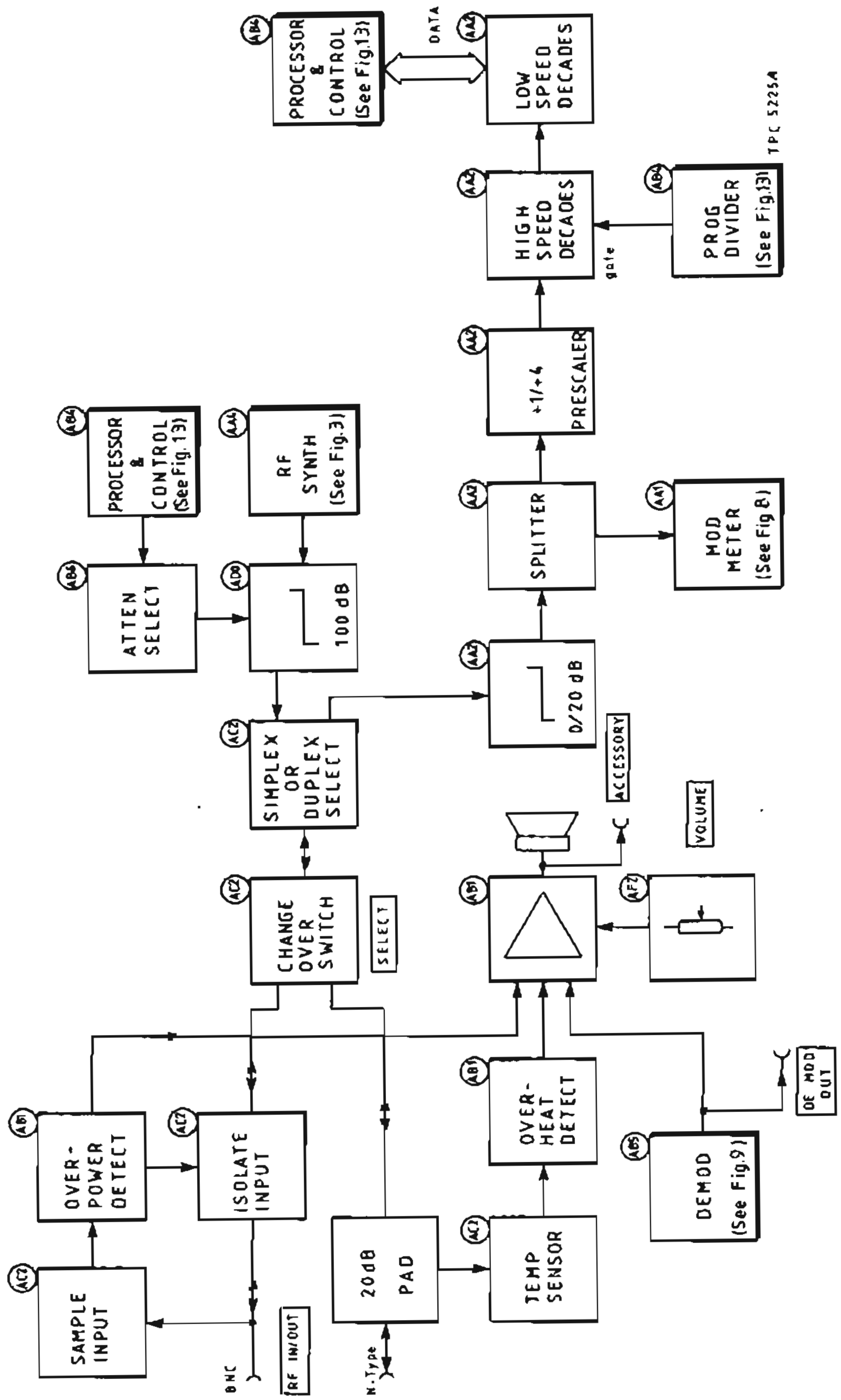


Fig. 2 Block diagram of input/output & r.f. counter (showing main functions of boards)

BOARD AA2 - RF COUNTER

Circuit diagram : Chap. 7, Fig. 5

4. The r.f. counter is a standard gated counter which has a ÷4 prescaler switched in at frequencies above 200 MHz. Normally, resolution is to 10 Hz : below 200 MHz the gate time is 100 ms, above 200 MHz the gate time is increased to 400 ms to compensate for prescaler insertion. When 1 Hz resolution is selected for frequencies below 200 MHz, the gate time is commensurately increased from 100 ms to 1 s. But when the frequency exceeds 200 MHz, the counter reverts to a 400 ms gate time and a 10 Hz resolution.

5. Prescaler switching and gate timing are controlled by the processor which notes the frequency, checks that there are three successive counts which are the same, and then sets up the counter chain accordingly.

20 dB pad

6. The signal from the front panel r.f. switch is connected by the SIGNAL INPUT line to a 20 dB 50 Ω pad formed by R3,R4 and R5. This is switched in by the processor when it detects that the power input has increased to a level where the sampling gate on AA1 is approaching a non-linear condition. The pad also attenuates the input to the counter and avoids overdriving the input amplifiers. It is switched by RLA controlled by the 20 db IN/OUT line to TR1. When the line is taken low, TR1 is switched on and the pad is inserted in the signal path. The following 50 Ω splitter formed by R6,R7 and R8 has a 6 dB loss in all directions and splits the input between the r.f. counter and the sampling gate on AA1.

Input amplifiers

7. Amplifiers IC1 and IC2 provide 10 dB per stage gain which restores signal level lost in the splitter and matching circuit as well as providing an overall gain for the signal input to IC3. IC3 is both a limiting amplifier and a Schmitt trigger. It has positive feedback from output pin 3 to input pin 10 to ensure Schmitt operation at low frequencies (below 100 MHz). This is necessary to drive the following dividers with the correct slew rate, at higher frequencies sine wave operation is acceptable and the high gain is not required. D6 across the amplifier input acts as a peak detector, with C12 and R13 in parallel with IC3's internal impedance as its time constant. This keeps the amplifier from self-biasing under high signal level conditions at high frequencies.

Prescaler and counters

8. From IC3 the signal is routed to the ÷10 counter IC7 either directly or via ÷4 prescaler IC6. The routeing for this is switched by TR2 driven from the ÷4/÷1 line at t.t.l. levels. A low level switches on the prescaler, a high level by-passes IC6 via diodes D2 and D5. The first two counter decades are provided by IC7 and IC5. IC7 is an e.c.l. ÷10 b.c.d. counter with a gate facility on INH-pin 16 and t.t.l. compatible outputs. The gating signal of either 100 ms or 400 ms duration originates in the programmable counter on AB4 and is applied on the GATE INPUT line to TR3. TR3 with IC8 level shift the signal from t.t.l. to e.c.l. for the following counter. IC7 pins 2,7,8 and 10 are state lines and pin 11 is the carry, i.e. ÷10 output. The output from pin 11 is inverted by TR4 to ensure correct polarity for IC5 which is a t.t.l. ÷10 b.c.d. counter. The state lines are from pins 8,9,11 and 12. Pin 12 is the ÷2 output to the next set of dividers formed by IC4. The signal at TP2

is thus either fin ÷80 or fin ÷20 depending upon prescaler setting.

9. The state lines from both IC7 and IC5 are taken to IC4 which is a 7-element counter. This IC has internal registers which store all 7 of the internal b.c.d. states plus those of the external counters IC7 and IC5. The resulting data is read when enabled by a low on the EN COUNTER line to pin 20. When the internal registers are addressed by the processor on pins 14 to 17 the data is read from the tri-state outputs on pins 1 to 4. Note that the data bus is not exclusive to the counter but is shared with the synthesizer in the modulation meter. Overflow information is provided by an internal latch which, when addressed, makes available an overflow flag. At the end of the counting period a further address clears all the internal counters to zero and outputs a reset high pulse from pin 19. This resets the external counters IC5 and IC7.

BOARD AB1 - MOTHERBOARD

Circuit diagram : Chap. 7, Figs. 10 & 11

10. Motherboard AB1 contains five 32-way 2-sided edge connectors to provide interconnection between the various parts of the instrument. The five hold the main logic boards AB2 to AB6. Additionally, the board contains the r.f. tray drivers, keyboard interface, loudspeaker amplifier and part of the overpower and overheat protection circuitry.

Audio amplifier (Sheet 1)

11. Audio power amplifier IC13 supplies the internal loudspeaker as well as earphones or loudspeaker externally connected to the front panel ACCESSORY socket. The gain of IC13, and hence the volume, is controlled by the channel resistance of f.e.t. TR7. TR7 bias is controlled by the volume control on AF2 which is connected to PLG, contact 3. To avoid parasitic oscillations IC13 is heavily decoupled and has a low-pass filter formed by R29 and C11 on its output.

RF power overload (Sheet 1)

12. In the event of excessive r.f. power (approximately 1.0 W) being applied to the front panel b.n.c. socket, diode detectors on AC2 cause a large differential voltage to be applied to the OVERPOWER- and OVERPOWER+ lines on the motherboard. These are connected to pins 5 and 6 of Schmitt trigger IC6. On the occurrence of an overload, IC6 takes pin 2 IC5a and pin 4 IC5b logically low. This causes NAND gate IC5a pin 3 to go high, switching or holding relay driver TR1 off. This takes the DX RELAY line low to AC2 causing it to disconnect the input. NAND-gate IC5b pin 6 going high informs the processor on AB4 that excessive power is being applied as well as, via IC5d, overriding the volume control for maximum audible warning.

13. Detection of excessive power being applied to the N-type socket is provided by IC6a. This is a Schmitt trigger whose non-inverting input is connected to the junction of a potential divider formed by R13 and, via the OVERHEAT line, the thermistor on board AC2. At normal temperatures, most of the voltage from the +5 V rail is dropped across the thermistor and IC6 pin 3 is held logically high. But when the thermistor detects that the 20 dB pad is overheating, due to the application of excessive r.f. power, the decreased resistance (12 kΩ at 100^{0}C) is sufficient to trigger the Schmitt. This causes NAND-gates IC5b and IC5d to respectively inform the processor and override the volume control as for b.n.c. socket protection but leave the DX RELAY line unaffected.

RF tray selection logic (Sheet 2)

14. When its pin 4 is taken low, IC11 decodes address lines A0 to A2 to clock selection logic from the bus into positive-edge triggered bistables IC8,9,14 and 15. The decoder additionally provides a low enable signal for data input buffer IC12. Data output buffer IC7 is enabled by latch IC9 COUNTER EN line going high. TR2,3,4 and 5 are open collector drivers for oscillator and filter selection on board AA3.

Keyboard interface (Sheet 2)

15. The keyboard interface consists of IC2,3 and 4 and detects when a keypress is being made and enables the key to be identified as follows. All of the COLUMNS inputs to buffer IC4 are held high by pull-up resistor R1. Additionally, these inputs are gated by NAND-gate IC3 whose output is thus normally low. Latch IC2 outputs on the ROWS lines are also normally held low. When a key is pressed on AF1 or AF2, it connects one of the ROWS lines to one of the COLUMNS lines taking it low. The low is then detected by IC3 whose output goes high and causes a processor interrupt. The processor then reads the contents of IC4 to determine in which column the keypress is being made. To determine the row, the processor sets the outputs of IC2 high in turn until the previously low line returns high. The output of IC2 causing this response then corresponds to the row in which the keypress is being made, and the key is identified.

BOARD AC2 - INPUT SWITCHING

Circuit diagram : Chap. 7, Fig. 26

16. The input switching unit has four major functions to perform. Firstly, it contains a dummy load/attenuator for dissipating a transmitter's r.f. power. Secondly, it has a changeover system enabling either front panel socket to be selected. Thirdly, it contains a splitter to allow the N-type socket to be used in full duplex single port mode. Lastly, it contains detectors for input overload conditions and a disconnection circuit to protect the rest of the instrument.

20 dB power attenuator

17. 20 dB power board R4 is a thin film, tantalum nitride on alumina, T-pad. It is fixed to a nickel-plated copper carrier. This in turn is bolted into a substantial milled box and then to the case metalwork. This allows efficient cooling of the load and is assisted by the air flow over the box by the fan. A small glass bead thermistor, R1, is placed in a hole in the copper carrier and monitors the temperature. Output to AB1 is on the OVER TEMP OUT line. At a nominal 80^{0}C Rth = 22 kΩ upon which a warning is sounded and a notice is flashed on the screen.

Switching

18. Relay RLA is capable of breaking up to 100 W of r.f. power. This is used as the b.n.c. input overload disconnection relay. It is also used to switch in part of the duplex splitter pad. The remainder of the duplex splitter is switched in by RLC. Switching logic for socket selection is shown in Table 1.

TABLE 1 SOCKET SELECTION LOGIC - AC2

Function	RLA Duplex (H) Isolate (L)	RLB Input Select	RLC DUPLEX (H) NORMAL (L)	Operation
1 port duplex	L	X	H	BNC disconnected, N-type to Sig. gen. & RX.
2 port duplex & simplex	H	L	L	BNC to Sig. gen. N-type to RX.
Simplex	H	H	L	BNC to RX, N-type to Sig. gen.

H = +5 V; L = 0 V X = Don't care

19. The duplex splitter is a simple 6 dB three-part pad formed by R1,2,3. This enables the signal generator and the receiver section to be connected to the N-type socket simultaneously. RLB performs a simple changeover action, allowing either front panel socket to be connected to the receiver or the signal generator.

Overload detection

20. R4 and R5 form a 10:1 divider chain across the b.n.c. input. This tapped-off signal is detected by D1 to D4 and limited by D5. Above a threshold of 0.7 V the differential voltage between the + and - outputs is sufficient to cause AB1 to raise the alarm and remove the drive on the DUPLEX-ISOLATE (L) line to RLA. RLA disconnects the b.n.c. input thus protecting the instrument.

RF AND LF SYNTHESIZERS

21. The r.f. synthesizer on AA3 uses three switched oscillators to provide a basic frequency range of 165 to 530 MHz (see Fig. 3). From these all other signal generator frequencies are derived. Band defining filters select either the harmonic or fundamental frequencies and extend the range from 165 to 1000 MHz. Oscillator output is also taken to a prescaler and programmable divider for frequency setting and then to a control chip for phase locking purposes. The control signal and frequency modulation from AB6 are fed back to the oscillators. LF synthesizer board AA4 uses a divider to extend the range from 165 to 88 MHz and a mixer to reach from 88 to 0.4 MHz. The mixer reference is supplied by a 200 MHz oscillator which, like the r.f. oscillators, is phase locked to the 10 MHz standard from AC1. Switched band- pass filters pass the selected frequency through an attenuator controlled by a.l.c. to a 400 kHz low-pass filter. A proportion of the signal from the output amplifier is fed back on the a.l.c. loop together with amplitude modulation and level control signals from AB6. A switched 10 dB attenuator passes the signal on to the 100 dB output attenuator.

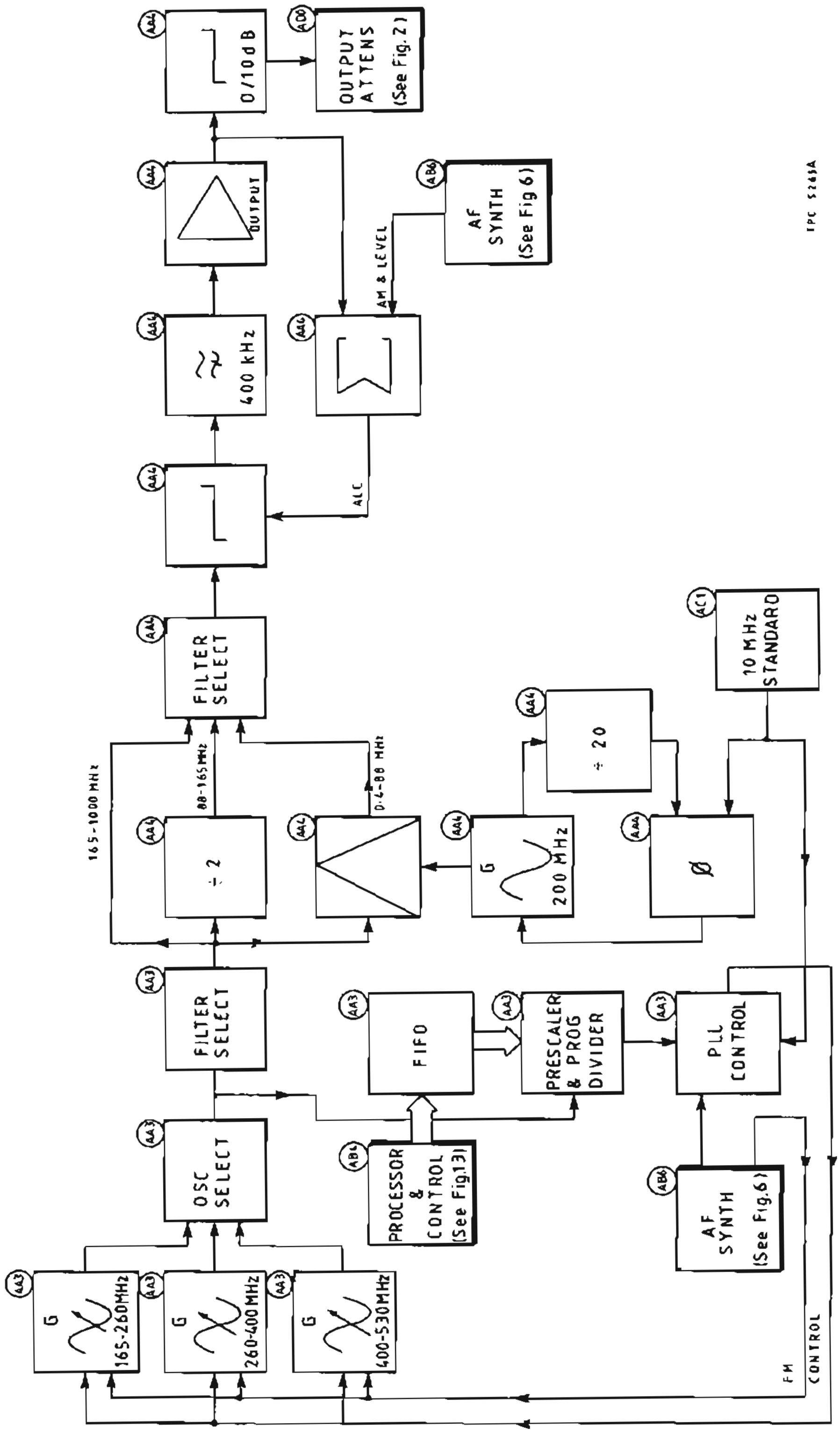


Fig. 3 Block diagram of r.f. and l.f. synthesizers (showing main functions of boards).

BOARD AA3 - RF SYNTHESIZER AND OSCILLATOR

Circuit diagram : Chap. 7, Figs. 6 & 7

22. This board contains the switched oscillators and filters used for frequency selection in the range 165 to 1000 MHz. It also contains the dividers and phase comparators which enable the selected frequency to be phase locked to the 10 MHz frequency standard.

Oscillators (Sheet 1)

23. There are three oscillators on the board based on TR1, TR5 and TR12. They are configured as Colpitts oscillators using split capacitors for feedback and have printed inductors. Oscillator frequency ranges are 165 to 260 MHz (oscillator 1), 260 to 400 MHz (oscillator 2) and 400 to 530 MHz (oscillator 3). Only one oscillator is operational at a time, the power being switched on and off via their emitter resistors as required. When either of the OSC CONTROL lines is taken low, TR2 or TR6 switch off to disconnect the -9 V supply. When either oscillator 1 or 2 is working i.e. TR2 or TR6 is switched on, oscillator 3 is disabled by diodes D3 or D10 which switch TR13 off. Frequency modulation of the oscillators is provided by the FREQ MOD INPUT line. This signal is preset in amplitude on AB6 to cope with the f.m. tracking of the oscillators, and is applied via attenuator networks R1,R2 for TR1, R15,R16 for TR5 and R46,R47 for TR12. Error voltages from the loop amplifier (sheet 2) are applied via R3 to varactor diodes D1,D2 (oscillator 1), D4 (oscillator 2) or D22 (oscillator 3). The oscillators are run hard to obtain the required second and third harmonics. To select the required output frequency, the oscillators feed into a network of switched low-pass and high-pass filters. For phase locking purposes, an output is taken, via an attenuator, from the emitter of each oscillator to amplifier IC1. IC1 output feeds to programmable dividers (sheet 2).

Oscillator and filter selection logic (Sheet 1)

24. Oscillator and filter selection lines OSC CONTROL and FILTER CONTROL are connected to four open collector p.n.p. transistors on board AB1 which are driven from t.t.l. Table 2 shows the switching logic level corresponding to the user-selected frequency. Note that on this board frequencies are generated from 165 to 1000 MHz; the remaining frequencies, those from 165 down to 0.4 MHz, are derived on board AA4.

Filters (Sheet 1)

25. Logic on the FILTER CONTROL lines operates transistor switches which control switching diodes that define the required signal paths through the filters. The actual path selected depends upon whichever oscillator is switched on. The filters are differently configured for three frequency ranges as follows:-

165 to 530 MHz: The two FILTER CONTROL lines are low which switch both TR3 and TR7 off. TR3 off allows pull-up resistor R23 to switch TR4 on which connects the 410 MHz l.p. filter to oscillator 2. TR4 also switches D8 and D9 on which respectively switch TR8 and TR9 off. With TR9 off, pull-up resistor R78 switches TR11 on to connect the 560 MHz l.p. filter to oscillator 3. The 265 MHz l.p. filter is permanently enabled and connected to oscillator 1. The filters select the oscillators' fundamental frequencies for output.

TABLE 2 OSCILLATOR AND FILTER SELECTION LOGIC - AA3

Selected freq. (MHz)	Oscillator control		Selected oscillator (MHz)	Filter control	
	PLA4	PLA5		PLA6	PLA7
0.4 - 60*	H	L	165 - 260	L	L
60 - 88*	L	H	260 - 400	L	L
88 - 130*	H	L	165 - 260	L	L
130 - 165*	L	H	260 - 400	L	L
165 - 260	H	L	165 - 260	L	L
260 - 400	L	H	260 - 400	L	L
400 - 530	L	L	400 - 530	L	L
530 - 630	L	H	260 - 400	H	H
630 - 800	L	H	260 - 400	L	H
800 - 1000	L	L	400 - 530	L	H

*These frequencies are derived on board AA4

<u>530 to 630 MHz</u>: Both FILTER CONTROL lines are high which switch TR3 and TR7 on. TR3 switches D11 on to select the 520 MHz h.p. filter while TR7 switches D14 and D15 on to enable the 630 MHz l.p. filter. Oscillator 2 is switched on and the filter selects the second harmonic for output.

<u>630 to 1000 MHz</u>: FILTER CONTROL input PLA6 is low while PLA7 is high. TR3 is switched on which connects the 520 MHz h.p. filter to oscillator 2. Also TR7 is switched off which allows TR8 to switch on to connect the 820 MHz l.p. filter to the same oscillator. TR9 switches on to connect the 800 MHz h.p. filter to oscillator 3 while also switching TR11 off. The latter action allows pull-up resistor R63 to switch on D17 which connects a tuning stub into circuit to cut down sub-harmonics in the 800 to 1000 MHz range. The filters select the second harmonic outputs from both oscillators.

26. Filter selection is summarized in Table 3 which shows the transistor switching, while the diode switching is given in Table 4. The output from the filters is fed to r.f. synthesizer board AA4 via 18 dB gain amplifier IC4.

TABLE 3 FILTER SELECTION - AA3

Output frequency (MHz)	Filter control		Transistor switches						Filters enabled (MHz)
	PLA6	PLA7	TR3	TR4	TR7	TR8	TR9	TR11	
165 - 530	L	L	OFF	ON	OFF	OFF	OFF	ON	265 LP 410 LP 560 LP
530 - 630	H	H	ON	OFF	ON	OFF	ON	OFF	265 LP 630 LP 520 HP 800 HP
630 - 1000	L	H	ON	OFF	OFF	ON	OFF	OFF	265 LP 820 LP 520 HP 800 HP

TABLE 4 DIODE SWITCHING - AA3

Filter control		Diode switches											
PLA6	PLA7	D5	D6	D7	D8	D9	D11	D12	D13	D14	D15	D16	D17
L	L	X	✓	✓	✓	✓	X	X	✓	X	X	X	X
H	H	✓	X	X	X	X	✓	✓	X	✓	✓	✓	✓
L	H	✓	X	X	X	X	✓	X	✓	X	X	X	✓
PLA6	PLA7	18	19	20	21	24	25	26	27	28	29	30	
L	L	X	✓	✓	X	X	✓	✓	X	X	✓	✓	
H	H	X	✓	X	X	✓	X	X	✓	✓	X	X	
L	H	✓	X	X	✓	✓	X	X	✓	✓	X	X	

✓ = On; X = Off

Regulators (Sheet 2)

27. To remove any modulation introduced on the ±12 V supply lines, the oscillators and the c.m.o.s. sections of the following divider chain have their own ±9 V regulators IC2 and IC3. To this end also, all control lines are taken through a π l.p. filter as they enter the shielded enclosure.

Divider chain (Sheet 2)

28. The ÷N divider chain consists of five ICs. IC108 and IC112 are ÷10/11 e.c.l. prescalers which enable the divider chain to work over a 165 to 530 MHz range no matter what frequency is selected. IC111, also e.c.l., is an interfacing dual master/slave bistable which gives adequate switching times for driving divider sidestep (increasing the division ratio by 1). It also retimes the sidestepping instruction from master programmable divider IC104. TR102,TR103 and TR105 provide a c.m.o.s. to e.c.l. level shift from IC104 to the e.c.l. ICs. TR104 provides a level shift from e.c.l. to c.m.o.s. Diode D111 provides a clamp to avoid hole storage problems.

29. Programmable dividers IC104 and IC101 form a master/slave relationship with IC101 being the slave. IC104 also provides all the timing pulses for prescalers IC108 and IC112. The dividers are programmed by a series of b.c.d. nibbles, applied on the A0 to A3 inputs, which are automatically scanned and loaded into the correct internal latches. Additional programming data is applied on the B0 to B3 inputs. The timing pulses for data input are generated to the dividers' PC (Program Clock) inputs by synthesizer IC106. The programming process is controlled by the PE (Programme Enable) input. The input for division to each divider is on the IN input, from the prescalers to the master and from the master's OFS output to the slave. OFB1 and OFB2 outputs from the master carry feedback signals to the prescalers, OFB1 to the prescaler (IC112) with the highest frequency. OSY provides a synchronizing signal for the feedback. Slave output OFB3 is connected back to the master on input SI to provide the borrow. Master to slave connection OFB1 to RI is necessary for the master/slave configuration. The two outputs for phase locking are OFF from the master and OFS from the slave, both of which go to IC106. The FIFOs (First In-First Out memories), IC102 and IC105, are the buffer between the processor commands and the divider loading sequence.

30. The programming data on the board D0 to D3 lines is clocked into the FIFOs in the order IC105 then IC102 by SHIFT IN from the processor, after which the data ripples through the FIFOs on its own (no clock). Then an enable pulse on the PROGRAM ENABLE line is sent to the PE inputs of the dividers. Clock pulses from IC106 provide the SHIFT OUT signal for the FIFOs as well as being used on the PC inputs to synchronously clock the data into the correct internal registers. There are 7 clock periods, D0 to D6. A typical data input sequence is shown in Fig. 4. On master divider IC104, fixed data must be sent during periods D0 to D6 in order to set certain internal division ratios. On IC101, the data supplied during D2 to D6 is also fixed as it sets the internal registers of the slave as required. At initialization, an extra set of data is required to ensure correct data during the D6 clock period.

31. During the D0 to D6 periods, the appropriate D0 to D6 outputs on both ICs are taken low in turn. Output D6 on the master, D2 and D6 on the slave are connected via diodes D101 to D108 to the divider's B0 to B3 inputs. These inputs, normally held high by pull-up resistors are selectively pulled low during the appropriate D2 and D6 periods to provide additional programming.

32. There are two outputs from the dividers used to phase lock the loop, both of which go to controller IC106. The 5 kHz fast output signal from the master's OFF output, which has jitter, is connected to IC106 by the FAST PHASE LOCK line. This allows fast frequency locking. The 50 Hz slow output signal from the slave's OFS output is jitter free and is connected to IC106 by the SLOW PHASE LOCK line. This is used for fine phase control at a slower speed. These outputs consist of a train of negative-going pulses.

	IC101 (Slave) data				IC104 (Master) data			
	A3	A2	A1	A0	A3	A2	A1	A0
Period								
INIT	L	H	L	H	H	H	H	L
D0	X	X	X	X	H	H	H	H
D1	X	X	X	X	X	X	X	X
D2	L	H	L	L	X	X	X	X
D3	H	H	H	H	X	X	X	X
D4	H	H	H	H	X	X	X	X
D5	H	H	H	H	X	X	X	X
D6	L	H	L	H	H	H	H	L

L = True; X = Data

Fig. 4 Programmable dividers : Example of typical data input - AA3

Synthesizer chip (Sheet 2)

33. IC106, the synthesizer IC, contains the frequency standard divider, two phase comparators - one analogue, one digital, and a modulator.

Frequency standard divider

34. The internal reference divider consists of a reference oscillator, a prescaler and a binary divider. Input to the reference oscillator is supplied by the 10 MHz INPUT line from the frequency standard to the IN pin. The prescaler is programmed to divide by 20 by inputs D0 to D1 being held high by pull-up resistor R115. Inputs A2 and A4 are similarly held high, while the others are held low by being connected to earth, so as to program the binary divider to divide by 20. Total division is thus 2000 which converts the 10 MHz input to 5 kHz which is supplied to the OUT pin. This supplies the clock for the programmable dividers as well as, fed back to the R input, providing the internal reference for the phase comparators.

Phase comparators

35. The two phase comparators operate at 5 kHz from the FAST PHASE LOCK input and 50 Hz from the SLOW PHASE LOCK input. This allows a fast lock using the 5 kHz phase comparator and a narrowband lock using the 50 Hz comparator. The slow phase comparator is built around a sample and hold circuit. A negative-going transition at the input causes hold capacitor C104 to be discharged after which a positive-going ramp is produced. A negative-going transition from clock OUT to the dividers, at the R input, terminates the ramp. C104 holds the voltage that the ramp has attained. An internal sampling switch transfers the voltage to C103 after which the voltage is available at output PC1. The fast phase comparator produces positive or negative-going pulses with variable width depending on the phase relationship between the V and R inputs. Output on PC2 is a linear function of the phase difference. The

fast phase comparator is disabled when the slow comparator approaches lock. An out of lock indication is provided by l.e.d. D106 driven by TR101 from the D/L output. Outputs from the phase comparators on PC1 and PC2 are summed together in IC107. The gain of the slow phase comparator is much higher than that of the fast comparator and the loop bandwidth is much narrower. This is reflected in the large difference in value between R114 and R113.

Modulation

36. Frequency modulation of the synthesizer follows two paths. The first is straight modulation of the oscillator varactor diodes as already discussed. The second path is to extend the low frequency modulation response using the phase modulation capability of IC106. This modulating signal is preset in amplitude to 1/N (where N is the division ratio of the dividers) on AB6 where it is picked off before the f.m./a.m. tracking DAC. The signal on the LF FREQ MOD INPUT is integrated in IC109 and the gain of the two paths equalized by adjusting R138 (this gives a flat f.m. response down to 1 Hz). The integrated signal is then fed to the MOD input of the IC106 phase modulator. This uses external capacitor C105 which is connected to the TCB input. A negative transition at the V input causes C105 to produce a positive-going linear ramp. When the ramp reaches a value almost equal to the MOD input voltage, the ramp terminates, C105 discharges, and a start signal to the ramp at C104 is produced. In this way a linear phase modulation is produced.

Loop amplifier (Sheet 2)

37. IC107 is the main loop amplifier and R114, C109, C111, R125 and C113 are the main loop time constants together with R3 and C5 (sheet 1). The phase comparator outputs from IC106 are summed together by IC107 and compared with 4.5 V provided by the potential divider formed by R119 and R117. From pin 6 the control voltage passes via PLD to the oscillator varactors (sheet 1).

BOARD AA4 - LF SYNTHESIZER AND OUTPUT AMP

Circuit diagram: Chap. 7, Figs. 8 & 9

38. The primary function of this board is to down-convert the 165 to 400 MHz inputs from AA3 in order to supply the range of frequencies from 0.4 to 165 MHz. The board also provides part of the level control system.

Signal paths (Sheet 1)

39. There are three paths for the signal from AA3. These are:-

(a) Through a 1000 MHz l.p. filter for 165-1000 MHz.

(b) Through a 2 stage and 165 MHz l.p. filter for 88-165 MHz.

(c) Through a mixer with its 200 MHz fixed l.o. to produce 0.4 to 88 MHz, then through a 90 MHz l.p. filter for 0.4-88 MHz.

Path 1: 165 to 1000 MHz

40. This path consists basically of a switch-selected 1000 MHz low-pass filter. The switching diodes selecting the path are D3 and D4 which are turned on via R6 by TR2. TR2, forming a bistable with TR1, is switched on by a low logic level on the LF RANGE 1 line from AB1. When TR2 switches on, it applies a high to TR1 and TR3 which then switch off. TR1, via R27 and R29, causes the outputs from the 90 MHz and 165 MHz l.p. filters to be blocked by diodes D12,D14 and D15. And with TR3 switched off, divider IC2 is disabled. LF RANGE 2 is also taken low from AB1, in order to switch off TR8 and thus disable the 200 MHz oscillator. Switching logic is shown in Table 5. The selected path directs the signal through the 1000 MHz low-pass filter.

TABLE 5 FREQUENCY SELECTION - AA4

Frequency range	PLB contacts		Transistor switches				Diode switches									
	4	5	TR1	TR2	TR3	TR8	D1	D2	D3	D4	D5	D6	D12	D13	D14	D15
165-1000MHz	L	L	OFF	ON	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	ON	OFF
88-165MHz	H	L	ON	OFF	ON	OFF	ON	ON	OFF	OFF	ON	ON	ON	ON	OFF	OFF
0.4-88MHz	H	H	ON	OFF	OFF	ON	ON	ON	OFF	OFF	ON	ON	ON	OFF	OFF	ON

Path 2: 88 to 165 MHz

41. For this path, LF RANGE 1 is taken high and LF RANGE 2 is taken low. The former signal switches off TR2 while the latter reverse biases D3 and D4 and forward biases clamp diodes D1 and D2. This removes the signal path through the 1000 MHz l.p. filter. Diodes D5 and D6 are switched on by TR1 and direct the signal to amplifier IC1 which provides 600 mV r.m.s. at its output pin 5. TR3 switches on and enables IC2 to provide a ÷2 signal, rich in harmonics, to the following l.p. filter. IC2 output is an e.c.l.

compatible 1 V p-p square wave. When TR1 switches on it also switches D12 on and D14 off, while D15 is held off by TR3; this forms the output path. TR8 is held off and the 200 MHz oscillator is disabled as for path 1. Output from the 165 MHz low-pass filter is -15 dBm.

Path 3: 0.4 to 88 MHz

42. For this path both LF RANGE lines are high which switch TR2 and TR3 off and TR8 on. Additionally, TR1 switches on via R6 to the -12 V rail so that D12 is on and D14 is off as for path 2. Also divider IC2 is disabled and D15 is switched on by TR3. The signal path thus formed is through amplifier IC1 to pin 7 of mixer IC6, and out from the 90 MHz l.p. filter. With LF RANGE 2 high, TR8 and TR6 switch on to supply power to switch on 200 MHz oscillator TR5. TR5 output feeds to pin 2 of mixer IC6. The input levels to the mixer are +6 dBm into pin 7 and -13 dBm into pin 1. From this it is clear that the variable frequency input acts as the local oscillator and the 200 MHz fixed oscillator input acts as the level determining signal. Thus the output is unaffected by any variation in local oscillator drive. The frequencies at IC6 pin 7 are 200.4 to 288 MHz so that the selected difference frequency of 0.4 to 88 MHz provides the output from the filter.

Synthesizer summary

43. Fig. 5 and Table 6 summarize the methods of frequency generation using boards AA3 and AA4 to provide the ten frequency ranges.

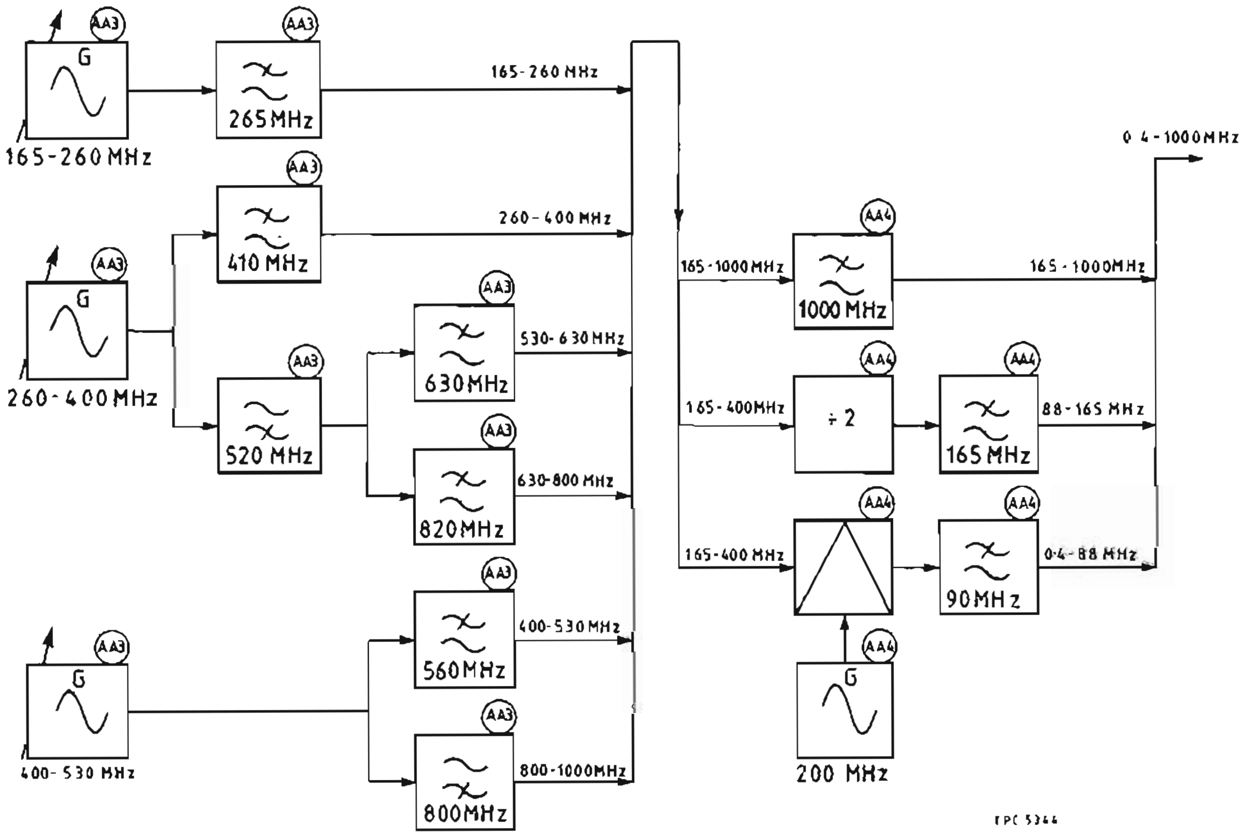


Fig. 5 RF synthesizer frequency generation summary (switching omitted for the sake of clarity) - AA3, AA4

TABLE 6 FREQUENCY GENERATION SUMMARY - AA3 AND AA4

	Board AA3		Board AA4		
Range (MHz)	Oscillator (MHz)	Filter (MHz)	200 MHz oscillator	Divide by 2	Filter (MHz)
0.4 - 60	165 - 260	265 LP	ON	OFF	90 LP
60 - 88	260 - 400	265 LP	ON	OFF	90 LP
88 - 130	165 - 260	265 LP	OFF	ON	165 LP
130 - 165	260 - 400	410 LP	OFF	ON	165 LP
165 - 260	165 - 260	265 LP	OFF	OFF	1000 LP
260 - 400	260 - 400	410 LP	OFF	OFF	1000 LP
400 - 530	400 - 530	560 LP	OFF	OFF	1000 LP
530 - 630	260 - 400	520 HP 630 LP	OFF	OFF	1000 LP
630 - 800	260 - 400	520 HP 820 LP	OFF	OFF	1000 LP
800 - 1000	400 - 530	800 HP	OFF	OFF	1000 LP

Fixed oscillator (Sheet 1)

44. The 200 MHz oscillator is a modified Colpitts which is similar to the oscillators on AA3. The frequency is determined by L18,C73,C74,C75,C79 and the two varactor diodes D19 and D21. Preset C79 is used to set the frequency of the oscillator when unlocked, to ensure locking over the whole temperature range of the instrument. The oscillator is switched on by a high logic level on the LF RANGE 2 line. Output from the oscillator is taken from the emitter of TR5 to obtain the best harmonics then through the filter network R48,R59, L17 and C65. The filter makes the harmonics >35 dB down. TR4 is used as an impedance translator to avoid loading tuned circuit L17 and C65. R35,R36 and R37 improve the matching of the mixer port while C51 and C54 remove very high order signals feeding back into the oscillator from the mixer.

Phase comparator (Sheet 1)

45. The signal from the oscillator to the phase locking loop is taken from the collector of TR5 to pin 8 of IC10, an e.c.l. in, t.t.l. out, divider. Output is then fed through EXclusive-OR gate IC9 to improve the edge speed, and then taken to IC11b. This IC is a bistable which is configured to divide by 2 and produces a square wave signal to pin 9 of phase comparator IC9. The comparison signal for the phase comparator is the internal 10 MHz standard divided by 2 in IC11a. The two signals are compared for phase by EXclusive -OR gate IC9 and the resultant passed through the loop filter to varactor diodes D19 and D21. Loop filter components are R47,R62,C77 with R64,C83,C84, C85. Capture range of the loop is ±0.7 MHz and the hold-in range is ±5 MHz.

Attenuator and a.l.c. (Sheet 2)

46. The pin diode attenuator is formed by D7,D8,D9 and D11. This provides the electronic r.f. attenuation for the fine attenuator, amplitude modulation and r.f. output levelling functions. Input level to the diodes is -15 dBm. Control voltages for the pin attenuator on the AM AND LEVEL INPUT line are provided by a level correction DAC on AB6, and consist of a 'set r.f. level' d.c. voltage plus audio modulation. This signal is fed to comparator IC3 via attenuator R22,R23 and compared with a d.c. or a d.c. plus a low frequency a.c. signal proportional to the peak r.f. output level. The output voltage from IC3 controls the pin diode attenuator through R8. At PLC a link is provided to enable the loop to be broken and a d.c. voltage inserted to check the control range of the attenuator.

47. The feedback path for the r.f. output level from IC8 is via R44 to detector diode D17. This feeds to unity gain amplifier IC7 which has D16, matched with D17, in its feedback loop. The diode corrects for temperature drift and provides an impedance transfer - high in, low out. C50,R30 and C32 provide loop time constants to ensure stability.

Output amplifier and attenuators (Sheet 2)

48. After the diode attenuator, a 400 kHz high-pass filter ensures that for 250 kHz and below the r.f. amplifier gain is reduced below unity. This is in order to prevent oscillations due to feedback around the a.l.c. loop. Amplifiers IC4 and IC5 follow which are thick film hybrids with a frequency response of 200 kHz to 1000 MHz and each giving 12 dB of gain. Output amplifier IC8 is similar to ICs 4 and 5 but with 23 dB gain and a higher power output capability. Because the a.l.c. loop reduces the output impedance to approximately 1 Ω, a 50 Ω resistor, R46 is provided to give the correct output impedance.

49. The bulk of the switched attenuators comprises four pads, a 10 dB pad on this board, and a 20 dB and two 40 dB pads connected externally. IC8 output feeds to the 10 dB pad formed by R54 to R56 which are non-inductive metal film resistors to ensure adequate frequency response. RLA is an r.f. relay switched on the 0/10 dB line by t.t.l. levels which are converted to the relay requirements by TR7. A low logic level switches in the attenuator. The selected output frequency is taken on the 0.4 - 1000 MHz line to the external attenuators.

AF SYNTHESIZER

50. AF synthesizer board AB6 generates a fixed 1 kHz as well as frequencies in the range 20 Hz to 20 kHz (see Fig. 6). For the variable frequency range, a 6.5536 MHz oscillator phase locked to the 10 MHz standard on AC1 supplies the frequency reference for a bit rate multiplier which generates the required frequency. The dividers which follow set the resolution to 0.1 or 1 Hz according to range. A switched capacitor filter converts the square waves from the divider into sine waves for supplying switched low-pass filters which track the fundamental frequency. Output from the filters supplies the reference for a multiplying D-A converter. A second DAC is similarly supplied with a reference which is at 1 kHz derived from the 10 MHz standard. The processor on AB4 controls DAC operation to implement signal level ranging. Two selectors follow. One selects the 1 kHz and/or a variable frequency for the AF GEN OUTPUT socket. The other selects the 1 kHz, a signal from the EXT MOD INPUT socket or a variable frequency, singly or in combination, for signal generator modulation. Both selectors feed to switched gain amplifiers which provide further scaling. One of the amplifiers supplies the reference for the modulation section DAC. This provides frequency modulation for r.f. synthesizer AA3 as well as, via another DAC, amplitude modulation and level control signals to l.f. synthesizer AA4.

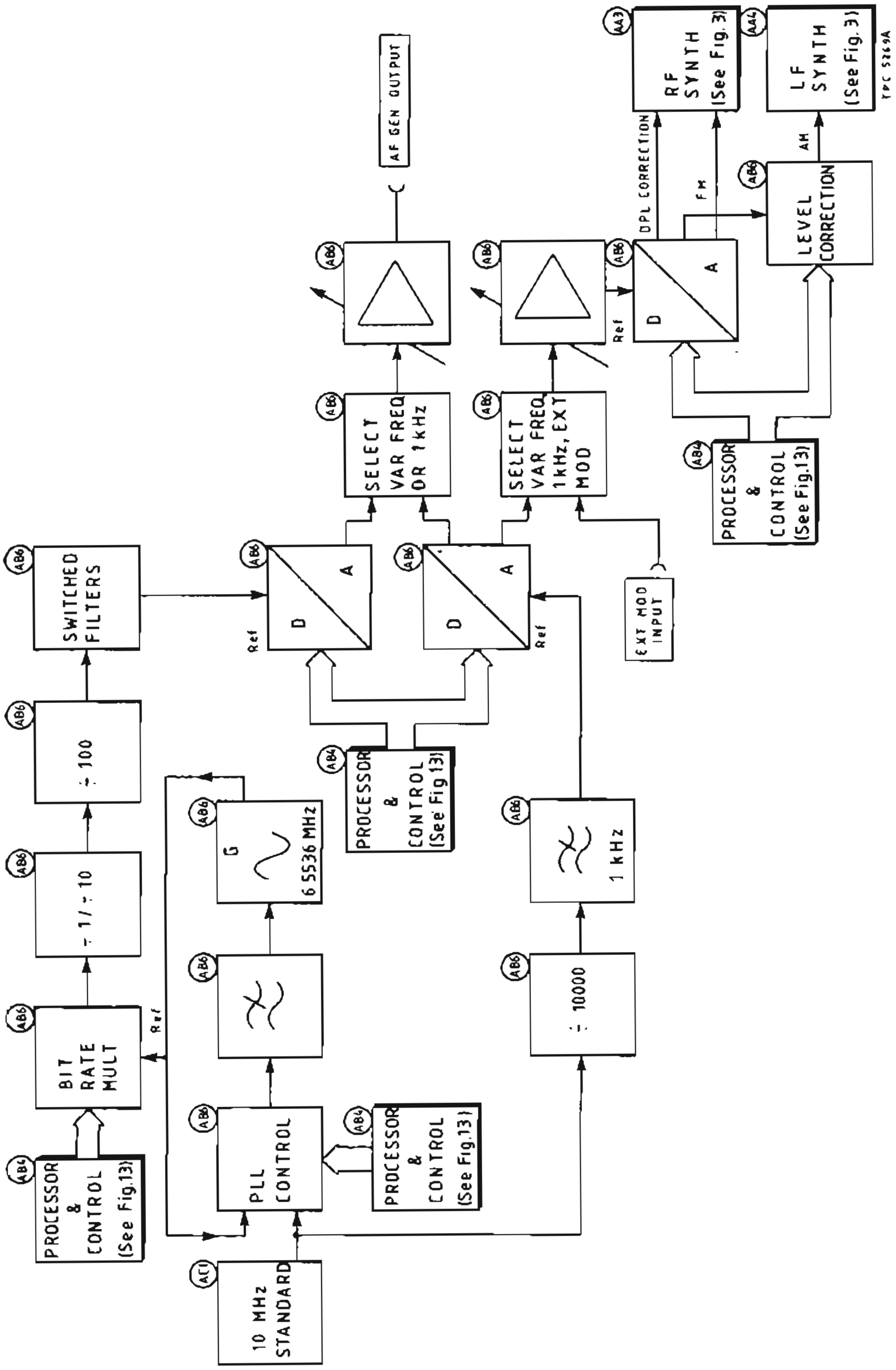


Fig. 6 Block diagram of a.f. synthesizer (showing main functions of boards)

BOARD AB6 - AF SYNTHESIZER

Circuit diagram : Chap. 7, Figs. 22,23 & 24

51. The purpose of AB6 is to provide the a.f. signals for both external and internal use as well as providing modulation correction, r.f. generator level setting and r.f. attenuator control.

52. The signals generated on the board are a variable frequency in the range 20 Hz to 20 kHz and a low distortion 1 kHz signal. These supply the AF GEN OUTPUT socket as well as being used to modulate the internal r.f. signal generator. The variable frequency generator can be changed in frequency very rapidly which enables it to generate sequential tones.

6.5536 MHz phase locked loop (Sheet 1)

53. For the bit rate multiplier section of the synthesizer to generate frequencies in the required 0.1 Hz steps, it is necessary to supply it with a frequency reference of 6.5536 MHz, or 2^{16} x 100 Hz. This is derived from the 10 MHz internal standard by a phase locked loop (p.l.l.) to ensure accurate audio frequencies. Loop control is by IC13 which contains all the necesssary circuitry except for the voltage controlled oscillator and low-pass filter. The v.c.o. is formed by TR1 and TR2 working as a simple LC oscillator, the frequency of which is controlled by the voltage across varactor diode D1. R63,64,65 and C22,23 form the low-pass filter used to maintain the closed loop stability.

54. When IC13 is addressed on pins 8 to 10, the internal dividers are programmed by the data on pins 2,1,18 and 17 and strobed in by IC14 (CS7L) toggling pin 11. Since the address and data lines only need to be active at switch-on they are able to share the bit rate multiplier control lines. The 10 MHz standard input to pin 6 is internally divided to give a comparator frequency of 3.2 kHz. Input from the v.c.o. to pin 3 is divided by 2048 before phase comparison so that when phase locked the v.c.o. frequency is 2048 x 3200 Hz (i.e. 6.5536 MHz). The phase detector output on pin 12 provides the loop error signal which enables D1 to perform frequency correction of the v.c.o.

Bit rate multiplier (Sheet 1)

55. The bit rate multiplier is essentially a 16-bit binary accumulator and consists of a 16-bit full adder, ICs 3,4,5,6 and a 16-bit D-type latch, ICs 7,8. There are two inputs to the adder, one is connected to latch IC1,2 (CS0L,CS1L) supplying the frequency information and a second is connected to the latched output of the adder. The latches being D-type will, when clocked by the v.c.o., latch in the sum of their own output and the frequency information present at the other inputs to the adder. The result of this is that the contents of this accumulator are incremented by the number present at its input on every clock pulse.

56. The most significant bit of the accumulator, taken to divider IC9, (sheet 2), toggles at 1/65536th (2^{-16}) of the clock rate times the number present at the input. For example, if the number n is 100 then the frequency generated is:-

$$\frac{\text{Clock frequency}}{2^{16}} \times n \text{ (Hz)}$$

$$= \frac{6.5536 \times 10^{6}}{65536} \times 100 = \underline{10 \text{ kHz}}$$

From the above it can be seen that the frequencies that can be synthesized are from 100 Hz (when n = 1) to 3.2768 MHz (when $n = 2^{15}$ - set by the 16 data lines and allowing for the toggling action of the latches) in 100 Hz steps. Note that unlike other bit rate multipliers this form maintains a more equal mark to space ratio.

Divider chain (Sheet 2)

57. The a.f. generator generates frequencies in the range 20 Hz to 20 kHz. Since these frequencies are derived from the 100 Hz to 3.2768 MHz input from the bit rate multiplier the input frequency f in must be divided down. This division is also desirable for two additional reasons. Firstly, it helps to reduce the jitter created in the bit rate multiplier. Secondly, the switched capacitor filter, which follows the divider stage, requires clock frequencies at 50 or 100 times its input frequency.

58. The divider chain consists of a switched ÷10 stage IC9 followed by a ÷100 stage IC12a,b (IC12a also has a ÷2 output). Thus the divided output to IC18 pin 4 is either f in/100 or f in /1000 to give frequency ranges of either 1 Hz to 32.768 kHz in 1 Hz steps or 0.1 Hz to 3.2768 kHz in 0.1 Hz steps respectively.

59. Gates forming IC10 and IC11 are used to select the required clock and logic inputs to switched capacitor filter IC18. Regarding the frequency of the input to IC18 pin 4 as fo, then the signal at IC12 pin 1 is at fo x 100 and the ÷2 output from IC12 pin 3 is at fo x 50. Selection logic from latch IC14 routes these frequencies to the CLK inputs of IC18 as required while also taking pin 12 high or low to respectively indicate that x50 or x100 has been selected. Table 7 shows the selection logic.

TABLE 7 DIVISION SELECTION LOGIC - AB6

LATCH IC14		SWITCHED CAPACITOR FILTER IC18			Frequency range	Step size
Pin 2	Pin 5	CLK(pins 10,11)	50/100(pin 12)	INV(pin 4)		
L	L	f in ÷2	H (50)	f in ÷100	10-20 kHz	1 Hz
L	H	f in	L (100)	f in ÷100	3.2768-10 kHz	1 Hz
H	L	f in ÷20	H (50)	f in ÷1000	NOT USED	-
H	H	f in ÷10	L (100)	f in ÷1000	20Hz-3.2768 kHz	0.1 Hz

F IN - PIN 8 IC9

Switched capacitor filter (Sheet 2)

60. It is next necessary to convert the square wave from the divider chain into a sinusoid of 2% distortion or better. This is done using a switched capacitor 4-pole low-pass filter tracking the fundamental frequency.

61. As the applied signal is a good square wave only the odd harmonics are present. The worst, i.e. the third, is at -14 dB and is rejected by a further 20 dB or more to achieve less than 2% distortion.

62. A problem with switched capacitor filters is that the clocking frequency tends to modulate the signal. Therefore, simple post filtering is used to reduce it to acceptable levels.

63. Switched capacitor filter IC18 is configured as two cascaded 2-pole low-pass filters. The maximum clock frequency for the device is 1 MHz, hence for the range 10 kHz to 20 kHz the x50 clock option is used. This results in more clocking noise on the signal and a slightly different gain. The gain change is adjusted for later on in the scaling section. Post filtering is done by switching in C37,C38,C39,C40 (sheet 3) to form a simple low-pass RC filter in conjunction with R8 and C21. The frequencies at which they are switched in are 100 Hz, 300 Hz, 1 kHz and 3 kHz. Below 30 Hz all are switched in in parallel. Capacitor selection is by latch IC17 operating quad latch IC21.

64. The filtered a.f. signal is buffered by IC19a (sheet 3) and also scaled to 2.55 V using R10 to R13. For the 10 kHz to 20 kHz range the separate gain setting is achieved by a low logic level on the 50/100 (L) line closing switch IC22a.

<u>1 kHz generator and filter</u> (Sheet 2)

65. In addition to the variable frequency generator it is necessary to generate an independant 1 kHz signal of less than 1% distortion. To do this the 10 MHz internal reference is divided down by two ÷100 sections, IC29 and IC30, to produce 1 kHz. Then the signal is passed through three cascaded 2-pole low-pass filters, IC20a, IC20b and IC19b. This gives a typical harmonic rejection of 50 dB or better. The output level is scaled by adjusting the gain of the last stage (IC19b) using R48.

<u>Level controls</u> (Sheet 3)

66. The 2.55 V signals from the generators are then scaled using 8-bit multiplying DACs (Digital-to-Analogue Converters) ICs 26 and 27. These provide 0 to 2.55 V r.m.s. in 10 mV steps. Dual DAC IC26 is used for the 1 kHz generator as it is permanently connected to both the front panel AF GEN OUTPUT socket and the modulation section. Only one DAC, IC27, is used for the variable frequency generator since it can be assigned to either the socket or to the modulation section.

67. The signals are further ranged using switched gain amplifiers IC36 and IC20c to give x1, x0.25 and x0.1 at the front panel AF GEN OUTPUT socket and x1 and 0.25 into the modulation section (see Fig. 7).

68. Output amplifier IC36 is a high current device with a low output impedance of less than 5 Ω and is capable of supplying 300 mA. Modulation section amplifier IC20c also has the external modulation summed in at its input (see Fig. 3). This signal is buffered and scaled by IC37a to give a 1 MΩ input impedance and a sensitivity of 1 kHz peak f.m. deviation per 100 mV.

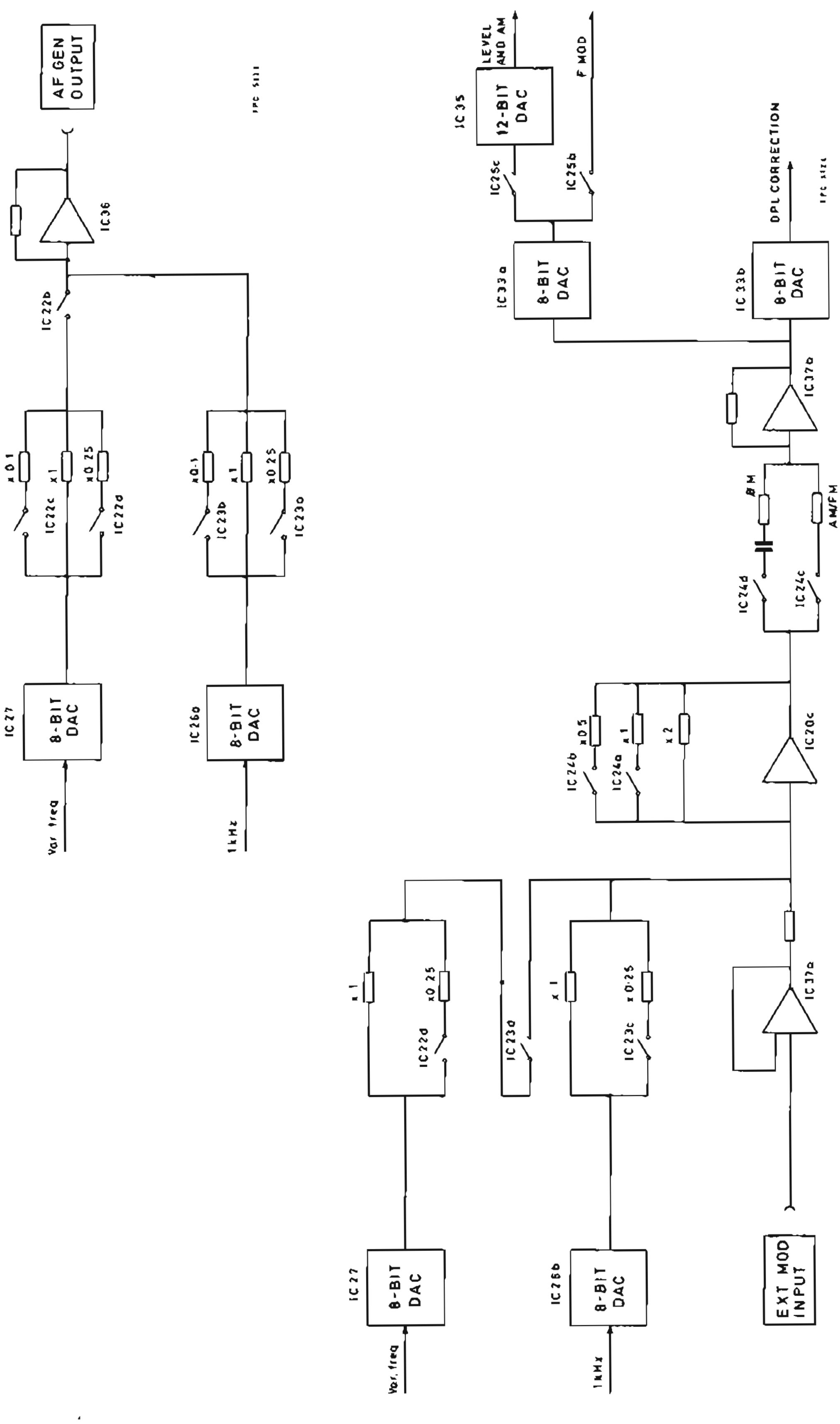


Fig. 7 Level control switching - AB6

Modulation correction (Sheet 3)

69. The signals passing to the modulation section can be scaled by x0.5, x1 or x2 using amplifier IC37b (see Fig. 3). This takes account of the r.f. synthesizer signal being multiplied up or divided down from its basic frequency. Also at this stage a capacitor, C62, can be switched in to form a differentiator to allow easy phase modulation.

70. At this point the level is further scaled to compensate for the modulation tracking inaccuracies of the r.f. synthesizer. To do this the microprocessor determines the set frequency for f.m. or the level for a.m. and then looks up a table of correction factors. These correction factors are then placed in the modulation scaling DAC IC33a. For f.m. the level is now correct and it is passed on the FM MOD line to the r.f. tray. For a.m. the signal is passed onto the level setting section.

71. To enable the r.f. synthesizer to be frequency modulated at low frequencies, e.g. for DPL (Digital Private Line), a correction signal is generated by another DAC IC33b. This DAC is set to the frequency of the r.f. synthesizer divided by 2.5 MHz, and is used in inverting mode, i.e. at low r.f's the correction signal is large and for high r.f's the correction signal is small. The signal is fed to the r.f. tray on the DPL CORRECTION line.

RF level setting (Sheet 3)

72. The r.f. generator's output level is voltage controlled from AB6. A 12-bit multiplying DAC, IC35, together with a stable voltage source supply this control voltage. Any amplitude modulation required is summed with the control voltage so that is is automatically scaled with the level. The reference voltage generated by Zener diode D11 and set by R32 is summed with the a.m. by IC38a. The composite signal is then scaled by 12-bit DAC IC35. Note that the lowest 4 bits on lines D0 to D3 are first latched into IC34. Output to the r.f. tray is on the LEVEL AND AM line.

Microprocessor interface (Sheet 1)

73. Two 3 to 8 line decoders, ICs 15 and 16, are provided to decode the on-board addresses and hence the chip selects. These are gated with board select BS(L) to reduce induced microprocessor noise. The data lines onto the board are also gated, via buffer IC32, for the same reason. This also has the benefit of reducing off-board loading.

Switching and attenuator control (Sheet 2)

74. IC14 is used to latch the input switching and attenuator control line information from the microprocessor. The two input switching control lines for IP SELECT and DUPLEX are buffered by TR12,TR13 which are simple open-collector drivers with switching diodes D8,D9. The three control lines for the 20 dB, 40 dB, 40 dB attenuators are buffered by TRs 3 to 11, 14 to 16, which provide normal and complementary open-collector outputs. This is because the attenuators have latching push-pull actuators. Hardware is used to achieve the complementary outputs rather than software so as to avoid a contention in the push-pull actuators during the power-on period i.e. before the processor takes control.

MODULATION METER

75. The modulation meter function is implemented by board AA1 (see Fig. 8). Signal input in the range 1.5 to 1000 MHz from AA2 is connected via a 20 dB pad to a mixer. An additional 20 dB attenuator on AA2 may be switched into circuit to prevent overloading the mixer. The mixer reference input is selected from one of two frequencies. One frequency is obtained directly from an 11.5 to 13.8 MHz oscillator, the other is derived by mixing the oscillator output with the 10 MHz standard from AC1. The difference frequency of 1.5 to 3.8 MHz takes two paths. One goes to the main mixer, the other is compared for phase with a divided input from the frequency standard. Comparison is done by a synthesizer chip operating under processor control. The resulting d.c. is then used to control the v.c.o. Depending upon the frequency of the input as measured by the r.f. counter, the processor on AB4 selects either the HI line or the LO line to provide the reference for the sampling gate mixer. The resulting 110 kHz i.f. is fed via a 500 kHz low-pass filter to a 40 dB amplifier. Finally, the signal is sent to AB5 for demodulation as well as to the rear panel IF OUT socket.

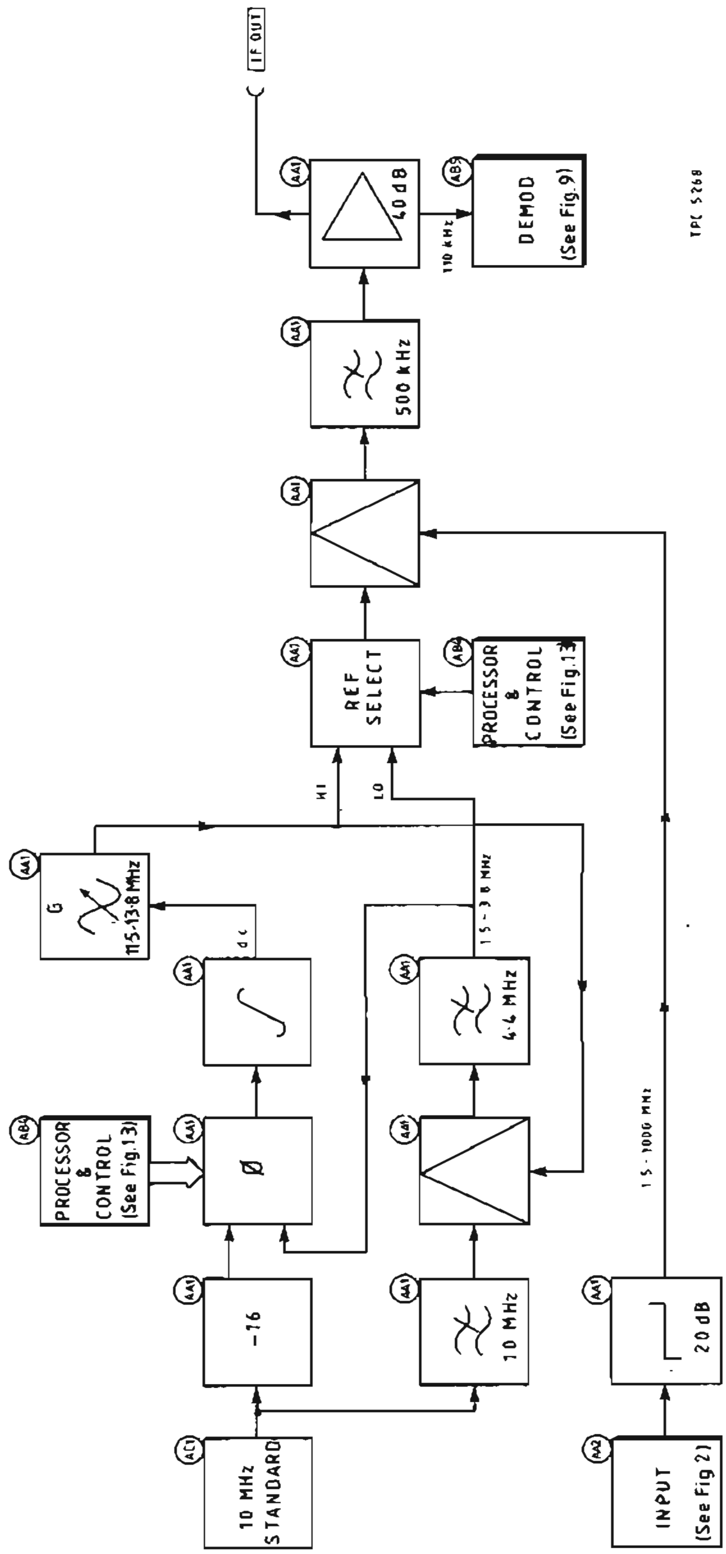


Fig. 8 Block diagram of modulation meter (showing main functions of boards)

BOARD AA1 - RF MODULATION METER

Circuit diagram : Chap. 7. Figs. 3 & 4

76. AA1 is the r.f. section of the modulation meter. It consists basically of a synthesized oscillator and a sampling gate mixer followed by i.f. amplification and filtering.

Oscillator and p.l.l. (Sheet 1)

77. Oscillator TR4 is voltage controllable in the range 11.5 to 13.8 MHz and is phase-locked to the instrument's 10 MHz crystal oscillator. Voltage control of frequency is via varactors D1 to D4. The oscillator is powered from an on-board regulated -9 V supplied by IC5 which is heavily decoupled to minimize power supply noise. To prevent pick-up and to reduce microphony, the oscillator is shielded in a casting.

78. Oscillator output goes to the squaring amplifier consisting of TR5 and TR6 which produces a t.t.l. compatible output which follows two paths. One path goes to quad 2-input NAND-gate IC6 (sheet 2), configured as a single pole changeover switch. The other path is to double-balanced mixer IC2. The second input to the mixer is derived from the 10 MHz crystal oscillator plus 10 MHz filter to give only the fundamental frequency. Mixer output is in the required range of 1.5 to 3.8 MHz, but with unwanted mixer products (notably the fundamental input frequencies at 10 MHz and 11.5 to 13.8 MHz), which are removed by the 4.4 MHz low-pass filter. Output then passes to squaring amplifier TR2,TR3 which gives a t.t.l. compatible output which follows two paths. One path goes to IC6 (sheet 2) as the second input to the logic changeover switch. The other path provides the frequency to which the circuit phase locks and this is fed to pin 3 of synthesizer chip IC3. The reference frequency for IC3 is derived from the 10 MHz crystal oscillator via ÷16 IC1. The synthesizer chip contains microprocessor-programmed reference and oscillator dividers and a phase comparator. The differential output from the phase comparator is fed to p.l.l. filter IC4 which removes the phase comparator frequency of 265 Hz and provides a d.c. control voltage to varactors D1 to D4 and hence completes the loop.

Mixer and output (Sheet 2)

79. When the LO/HI signal from PLA contact 9 is taken high, the 1.5 to 3.8 MHz input from TR3 is gated through IC6a and IC6b. When the signal is taken low, the 11.5 to 13.8 MHz input from TR6 is gated through IC6c to IC6b. The selected signal drives Schmitt trigger TR7 and TR8 which then drives sampling gate mixer diodes D7 and D8 via balun T1 and capacitors C55 and C56. When the higher frequency input is selected, the low HI/LO signal switches on TR14 and temperature compensation for the diodes is applied by thermistor R86 and the network in the emitters of TR7 and TR8. Note that for most modulation meter frequencies, the high frequency input is selected, the low range being used only for continuity of frequency coverage. The modulation meter input, on the RF INPUT line, is applied via a 20 dB pad to the sampling gate mixer.

80. Sampling gate output is at the i.f. of 110 kHz and at a level equal to the r.f. input to the sampling gate diodes. The output is buffered by TR9 and TR11 and then filtered by a 500 kHz low-pass filter which removes unwanted signals (such as sampling gate drive frequencies). Next the signal is amplified using TR12,TR13 by 40 dB and fed on the IF OUTPUT line for demodulation by board AB5. A second, buffered output is provided by TR15 and this is fed on the MONITOR OUTPUT line to the rear panel IF OUTPUT socket.

DEMODULATOR, VOLTMETER AND POWER METER

81. The input from the modulation meter on AA1 is sent by AB5 on two parallel paths (see Fig. 9). One, the a.m. path is via a 40 dB attenuator, an a.g.c. controlled amplifier and a band-pass filter to an a.m. detector. The second, f.m. path is via a high-pass filter to the f.m. discriminator. Both paths feed through 15 kHz low-pass filters, with de-emphasis applied on the f.m. path for ϕ.m. The modulation selector connects the three inputs to the voltmeter input selector. This also connects to the optional r.f. directional power head at the ACCESSORIES socket and to the AF INPUT socket for a.f. or a modulated d.c. as selected by the AC/DC key. Switched filters implement the 15 kHz and 300 Hz low-pass and 0.3 to 3.4 kHz high-pass filtering. Output for monitoring purposes is taken to the audio amplifier on AB1. For voltmeter measurements, the signal is connected to an A-D converter either directly or via a SINAD filter. The r.f. power ranging circuit, operating under processor control, is also connected to the ADC. The output selector connects either the output from the filters or the a.f. input for feeding to the a.f. counter on AB4 and to the oscilloscope on AB2.

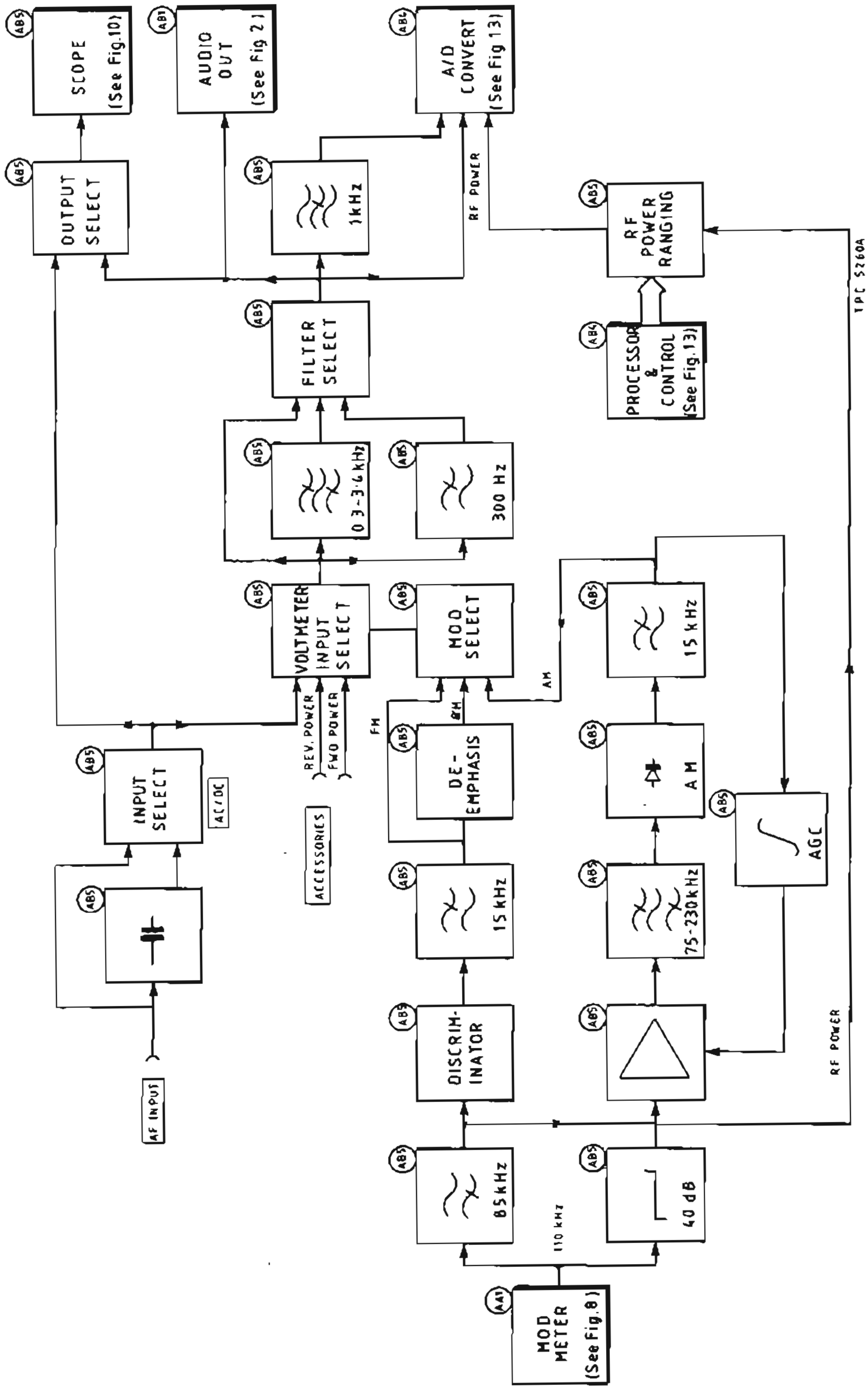


Fig. 9 Block diagram of demodulator, voltmeter and power meter (showing main functions of boards)

BOARD AB5 - DEMODULATION AND SCOPE

Circuit diagram : Chap. 7, Figs. 19,20 & 21

82. AB5 contains all the demodulation circuits and ranging for a.m., f.m. and ϕ.m., all amplitude ranging for the voltmeter, oscilloscope and r.f. power meter, as well as several audio filters. The board performs the following two main functions:-

(a) Demodulation of the i.f. (including voltage ranging) from AA1.

(b) Measurement of all a.f./d.c. voltages, including the demodulated a.f. from (a) above.

IF demodulation (Sheet 1)

83. After the 110 kHz i.f. comes onto the board from AA1 on the IF IN line it follows two paths, one for f.m./ϕ.m. and one for a.m.

84. The f.m./ϕ.m. path first passes through an 85 kHz high-pass filter to remove low frequencies (especially 15.625 kHz from the c.r.t. drive) and then it splits into two paths. One path goes to the r.f. power meter ranging amplifier (sheet 2), the other continues to comparator IC102 which acts as a limiter, the output of which is at t.t.l. levels. Output passes to a pulse type discriminator, monostable IC103, which produces pulses of a fixed width but with a varying mark/space ratio due to the modulation of the i.f. Discriminator output passes to 15 kHz low-pass filter IC104 which has a gain of 4. This is followed by a unity-gain 30 kHz filter which attenuates frequencies above 15 kHz (especially the 110 kHz i.f.). The signal is now a demodulated f.m. plus a d.c. level corresponding to the i.f. To remove the latter, the signal is a.c. coupled to the next stage, IC104b, which enables the output level to be set using R129. For ϕ.m. the signal is fed to IC105 which applies 750 µs de-emphasis, for f.m. this IC is by-passed.

85. The a.m. path is first attenuated 40 dB by R135, R136 so that the following a.g.c. section works with little distortion. At this point the d.c. bias is set by R138. AGC is accomplished using a dual-gate m.o.s. f.e.t. TR101. TR102 which follows, amplifies the signal by about 50 before feeding it to band-pass filter IC106. The filter consists of a 75 kHz high-pass filter with a gain of 10 followed by a 230 kHz low-pass filter, and substantially reduces the noise bandwidth. The signal passes into a.m. detector IC107 and then to a 15 kHz low-pass filter which is configured similarly to the one used for f.m. Output is now a demodulated a.m. plus a d.c. level corresponding to the mean carrier level. At this point the signal takes two paths. One path is to integrator IC108b which provides a d.c. which is fed back to dual-gate f.e.t. TR101 as the a.g.c. control signal. Reference a.g.c. level is set by R172. The second path is a.c. coupled to IC108 which enables the a.m. output level to be set using R168.

86. One of the 3 switch sections of IC317 selects the required demodulated a.m., f.m. or ϕ.m. for connection via the DEMOD line to the output filters (sheet 3)

Ranging and filters (Sheet 3)

87. The a.f. input on the AF IN line can be either d.c. or, via C200, a.c. coupled into the instrument. RLA performs this task. The 1 MΩ input

impedance is determined by R201 and IC200 which is configured as an inverting amplifier. IC200 gain can be set to ÷2, or to ÷20 when switch IC319d is closed. From IC200 the output takes two paths, one to the oscilloscope and one to the voltmeter.

88. The oscilloscope path consists of a chain of amplifiers. IC201 gain can be set to 10, or to 1 with switch IC312c closed. IC203a enables the gain to be set, using R209, for calibration. Two switches follow which select either the a.f. input (IC316b) or an input from the voltmeter (IC316c). The voltmeter input is from voltage follower IC205 which feeds into a switchable potential divider to enable the level to be adjusted according to modulation. For a.m., switch IC316d is closed, for f.m. and ϕ.M., the switch is open. Switched gain amplifiers IC204a and IC204d provide ranging for the oscilloscope. The final stage, IC204c, sums the VERT SHIFT input from the front panel control via voltage follower IC205b, with the oscilloscope ranging levels via a CR filter. The filter has a roll-off at 50 kHz to prevent aliasing.

89. For the voltmeter path, in addition to the a.f. input, a forward or reverse power input can be selected by the switch sections of IC319. The signal on the AF IN, FWD POWER or REV POWER line is fed to amplifier IC202 which has a gain of 10 when switch IC312d is closed, or 1 when the switch is open. For calibration purposes the voltmeter gain is set by IC203b using R231. At this point switches IC312a and IC312b respectively determine whether the a.f. input or the input on the DEMOD line continues along the voltmeter path. For either input the signal may be passed through a low-pass or a band-pass filter. When switch IC318c is closed and IC318a is open, a 300 Hz low-pass filter, IC302a and IC302b, is selected. When switch IC318b is closed and IC318a is open, a 300-3400 Hz band-pass filter, IC300, is selected. To by-pass both filters, switch IC318a is closed and IC318b is open. For display, the demodulated signals are fed by voltage follower IC205 to the oscilloscope. When switch IC318d is closed, R235 connected to the +5 V rail is used to produce audio tones under software control for the audible r.f. power warning. All the above signals are fed by IC205 to the loudspeaker via the audio amplifier on motherboard AB1.

90. The selected a.f. or DEMOD is connected by the switch sections of IC318a to IC204b which provides the ranging for the voltmeter. Here the signal takes one of two paths determined by the switch sections of IC313, either through a SINAD filter or via a by-pass line. The filter is a 1 kHz notch filter with a gain of 10. A third section of IC313 is used to select an input on the RF POWER line from the r.f. power ranging circuit (sheet 2). Output on the VOLTMETER line is to the A-D converter on AB4. A second, switched output is available which goes on the ±PK line to peak detectors on AB4 for measuring modulation levels.

<u>Switching</u> (Sheet 2)

91. All switching, gain settings and signal routeing are performed under processor control. Three octal latches, IC304 to IC306, control the operation of analogue switches IC312 to IC319, as well as maintaining the switch positions once set. All of the switches use t.t.l. levels on the control lines while their outputs switch between the +12 V and -12 V rails.

92. An output from the 85 kHz high-pass filter IC100 (sheet 1) is fed to IC101a to provide the r.f. power signal. Amplifier gain is set by R106. RF power ranging is supplied by switched gain amplifier IC101b. The required

stage gain is selected by the switches forming IC322. These are controlled by IC311 via level shifters IC321. Output on the RF POWER line is switched to the required destination by IC313 (sheet 3).

OSCILLOSCOPE

93. The input from AB5 to the oscilloscope is ranged and summed with the vertical shift control on AF2 (see Fig. 10). A 50 kHz low-pass filter feeds out to both the scope trigger on AB3 and the A-D converter on AB2. The selected single or repetitive trigger from AB4 is selected and used to gate in the AC1 10 MHz standard providing the clock for the write address counters. For the read address counters the clock is provided by v.d.u. board AB3. These addresses are used to access the display RAM. The data held in RAM is from the max. and min. data selectors from which the vertical trace is selected at the line rate for output to the pulse stretcher on AB3.

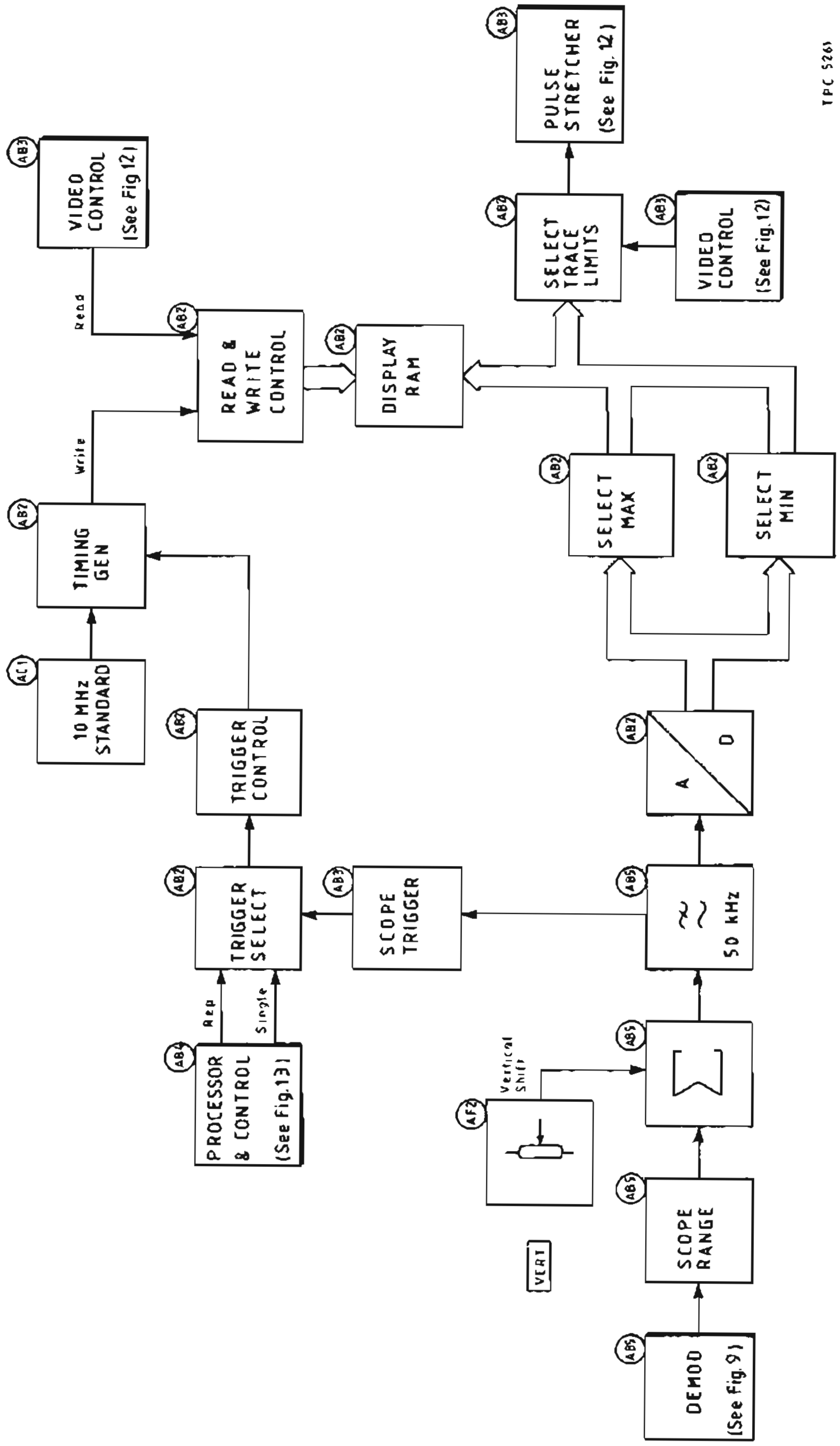


Fig. 10 Block diagram of oscilloscope (showing main functions of boards)

BOARD AB2 - DIGITAL SCOPE

Circuit diagram : Chap. 7, Figs. 12 & 13

94. Digital scope board AB2 converts the analogue waveform into 400 8-bit digital samples which are stored in RAM. The samples are stored for the purpose of updating the screen, which also gives the oscilloscope an indefinite storage capacity. Samples of the analogue signal are taken every 2.5 µs by an A-D converter. This rate is much higher than the ordinate (displayed line) rate since otherwise the display could sample and show e.g. only the troughs of an a.c. signal thus giving the appearance of d.c. The sample values that are stored at the ordinates are the maximum and minimum values which have occurred since the previous ordinate. This ensures that positive and negative spikes will always be captured, provided that they are longer than 2.5 µs in duration, regardless of timebase setting. Lines on the screen at the ordinates are drawn between whichever is the greater of the current and the next stored maximum and whichever is the least of the current and the next stored minimum. The oscilloscope raster is interlaced so that each ordinate only need be refreshed every 40 ms. The method of drawing used eliminates possible flicker by ensuring that lines are never drawn singly even if they correspond to large spikes.

Waveform conversion (Sheet 1)

95. The signal on the SCOPE IN line is connected to A-D converter IC1 which uses a +5 V rail generated by IC49. This voltage may be adjusted slightly by R14 so that the calibration of the oscilloscope corresponds to the calibration of the A-D converter on AB4. IC1 A-D output is latched in IC2 and applied to two 8-bit comparators IC3,IC5 and IC4,IC6. The 'maximum' comparator IC3,IC5 compares the current sample latched in IC2 with the previous maximum stored in IC7. If the current sample value is greater than the stored one, it opens gate IC13b to a clock signal generated when both QD outputs from IC26 go high. The data is then transferred from IC2 to IC7 to become the new maximum data value. If however, the current sample is smaller than the stored one, it is the minimum latch IC8 which is clocked and the current data byte becomes the new minimum data value. Sampling continues until the two latches hold the maximum (peak) and minimum (trough) values found during one ordinate period.

96. The maximum and minimum latch outputs from IC7 and IC8 connect to the A and B inputs respectively of the data selector formed by IC10 and IC11. When enabled by pin 15 being taken low by the SCOPE TIMEBASE signal, the data selector connects the inputs to the data bus. Since SCOPE TIMEBASE occurs at the ordinate rate (which is variable and depends upon timebase setting), only the peak and trough values found during the preceding ordinate period are passed on. When IC26b QB goes low the peak value is output and when it returns high the trough value is output. These data are sent into two consecutive locations in display memory IC12, and write address counters IC18a and IC17 are incremented. IC7 and IC8 are both reloaded at this time with the current sample latched from IC2, ready for comparison with the next sample. Fig. 11 shows the manner in which values are stored and the lines are drawn on the screen to reproduce the waveform.

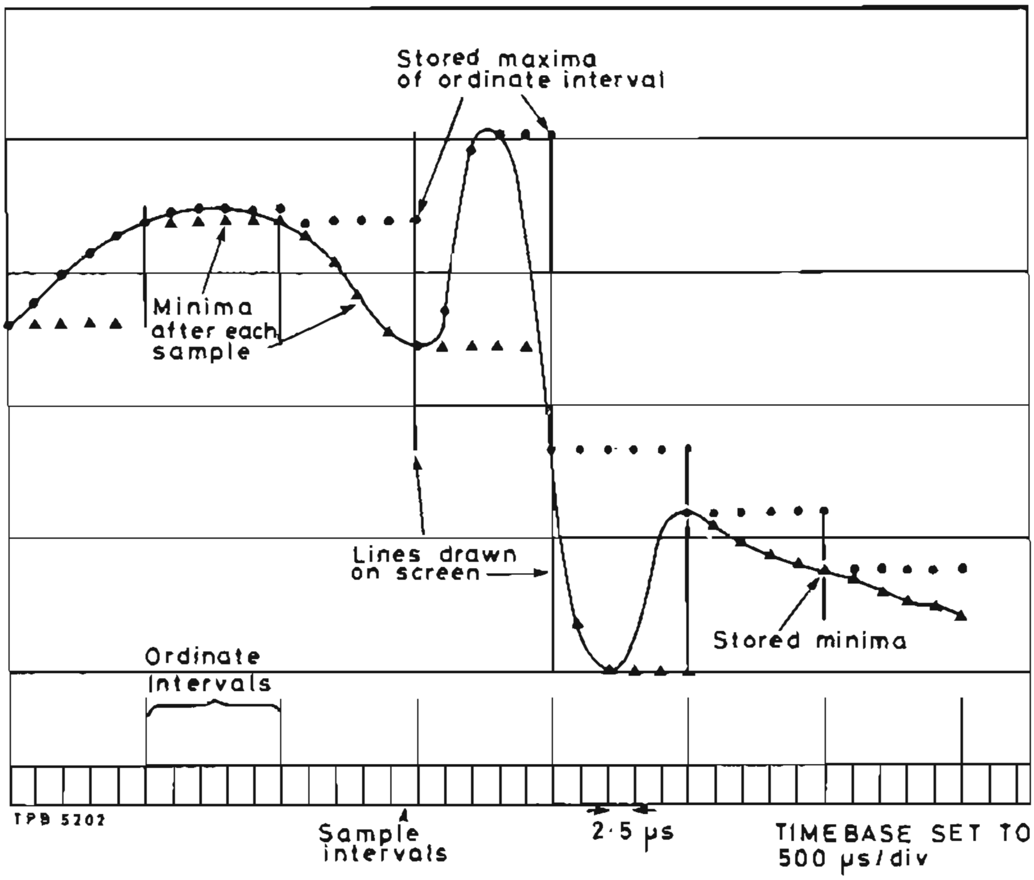


Fig. 11 Oscilloscope display generator process - AB2

<u>Trigger control</u> (Sheet 1)

97. The data conversion and storing process described above is turned on and off by the trigger control. This is done synchronously with the incoming waveform so that the latter may be displayed stationary as follows: When the write address counters IC18a and IC17 reach their highest count, i.e. display memory IC12 is full, IC17 pin 8 goes high to set latch IC23a. This takes the clear lines to counters IC17 and IC18a high, preventing any further writes to memory. IC23a is reset to re-enable memory writes when a negative edge is received on the TRIGGER line from AB3. This signal is a squared version of the waveform to be displayed which ensures that the waveform is shown without jitter on the screen because the first location in memory is always at the same point on the waveform. When TRIGGER signals are present, oscillator IC31, which has a period of 225 ms, is continuously reset. The negative edges of its output thus occur coincident with the negative edges of the TRIGGER, and clock IC23a on pin 3 as though they were the trigger. When no audio signal is present of sufficient amplitude to generate a TRIGGER pulse, IC31 free-runs which, via IC34b, continuously resets latch IC23a as if a triggering waveform had been present thereby causing the oscilloscope to free run.

Single sweep (Sheet 1)

98. When the SINGLE SWEEP button is pressed, the SS/RST (single sweep/reset) line is pulsed low for a reset which, via IC24c, sets IC23a pin 5 high. This has four effects. Firstly, it enables IC27d pin 11 to go low when LOAD DISPLAY COUNTERS goes high. This action closes gate IC27a to the 10 MHz clock and thus halts the timing generator. The generator halts with LOAD DISPLAY COUNTERS held high so that the screen refresh is allowed whenever required. Secondly, it clears the Write Address Counters. Note at this point, that the occurrence of the reset pulse thus has the same effect as the Write Address Counters overflowing, and terminates the current sweep to save the user waiting in slow timebase settings. Thirdly, the R-S latch formed by cross-coupled NAND gates IC27b and IC27c is also set and thereby causes gate IC34b to close and block any trigger output from oscillator IC31. Fourthly, latch IC23b is reset and opens gate IC34d ready for the next TRIGGER pulse.

99. When the next TRIGGER pulse occurs it clocks D-latch IC23a output pin 5 low. This immediately reopens gate IC27a to the 10 MHz clock for the timing generator, which restarts operation. IC23a pin 5 going low also sets IC23b which closes gate IC34d to any further TRIGGER pulses. At the conclusion of the single sweep, the Write Address Counters overflow, which sets IC23a output high again to close IC27a to the 10 MHz clock. With both trigger sources gated off by IC34c and IC34d, operation is halted and the display is frozen. Operation is restarted by the SINGLE SWEEP button being pressed again, which repeats the operation described above, or by the REP SWEEP button being pressed instead. The latter action resets the R-S latch which reopens gate IC34b to continuous trigger pulses from IC31.

Oscilloscope memory (Sheet 1)

100. The oscillosope memory section comprises read and write address counters, data selectors and the sample store held in RAM used for updating the display. Read and write operations are totally asynchronous. Write address counters IC17a, IC17b and IC18a are clocked by the timing generator section and cleared by the trigger control section. Read address counters IC19a, IC19b and IC18b are clocked by the 2XLS input at twice the line sync. rate while the clear is controlled by the cross-coupled R-S latch formed by IC24a and IC24b. The frame sync signal sets this latch which clears the address counters then holds them disabled for a variable period ended by a pulse from the programmable counter on AB4. The generation of the pulse from AB4, and hence the delay before reading a waveform sample, is determined by the setting of the horizontal position control which thus sets the starting point of the waveform to be displayed. Selectors IC14, IC15 and IC16 select RAM IC12 read addresses when select pin 1 is high, and write addresses when pin 1 is low. The enable inputs OE (Output Enable) and WE (Write Enable) to pins 20 and 21 respectively are controlled by the timing generator and prevent read/write conflicts.

Display counters (Sheet 2)

101. Four pairs of display counters, formed from ICs 35 to 42, take the stored values from the RAM and convert them into pulses which cause an oscilloscope trace to be displayed. The four values held are the current maximum and minimum and the next stored maximum and minimum trace values. Loading of the counters is controlled by decoder IC48a. Since the raster is vertically scanned from top to bottom and the oscilloscope occupies the lower half of the screen, the counters are loaded during the first half of the sweep, and this

is achieved by the ENABLE line to IC48a. IC48a then decodes the pulses on the 12.8 μs and Line Sync lines which takes the Y0 to Y3 lines low in turn to load the counters in four sequential bytes from the RAM.

102. The display counters feed into four D-type latches, formed from ICs 45 and 46, whose outputs are gated by the four NAND-gates forming IC47. The purpose of this part of the circuit is to determine which of the two maxima from the counters is the larger and which of the minima is the smaller. These two parameters then define the start and finish of the vertical trace drawn on the screen.

103. To commence the operating sequence, the latches are reset causing SCOPE VIDEO to be taken high. The display counters are then clocked by SCOPE CLK until either IC35,36 or IC37,38 - containing the two maxima - overflows denoting the maximum of the two values. This clocks a high logic level from either IC46a or IC46b which takes SCOPE VIDEO low to begin the screen trace. SCOPE VIDEO remains low until the last counter overflows, denoting the minimum value, which returns SCOPE VIDEO high and the trace is ended.

VIDEO CONTROL AND FREQ STANDARD

104. The video control circuit on AB3 (see Fig. 12) accesses the character generator PROM for read operations to update the display. It also enables the processor on AB4 to access the PROM for write operations to change the display. The PROM holds one screenful of information and this is sent out in serial form from the dot generator. The PROM also selects the attribute to accompany each generated character. Pulses from AB2 which provide the oscilloscope trace are stretched on AB3 then summed with the character and attribute data. The result is fed to the video amplifier on AC1 for display. On this board, line sync and frame sync signals from AB3 respectively control the vertical and horizontal drives for the c.r.t. Power from AR1 is converted to the high voltages necessary for both the board and for the c.r.t. For the latter purpose, the voltages are connected to c.r.t. base board AT2 which provides flashover protection.

105. The 10 MHz crystal oscillator on AC1 provides the internal frequency standard. It operates in a phase locked loop to enable a 1 MHz input from the EXT STD socket to supply the standard when required. For phase comparison, both standards are divided down to 100 kHz.

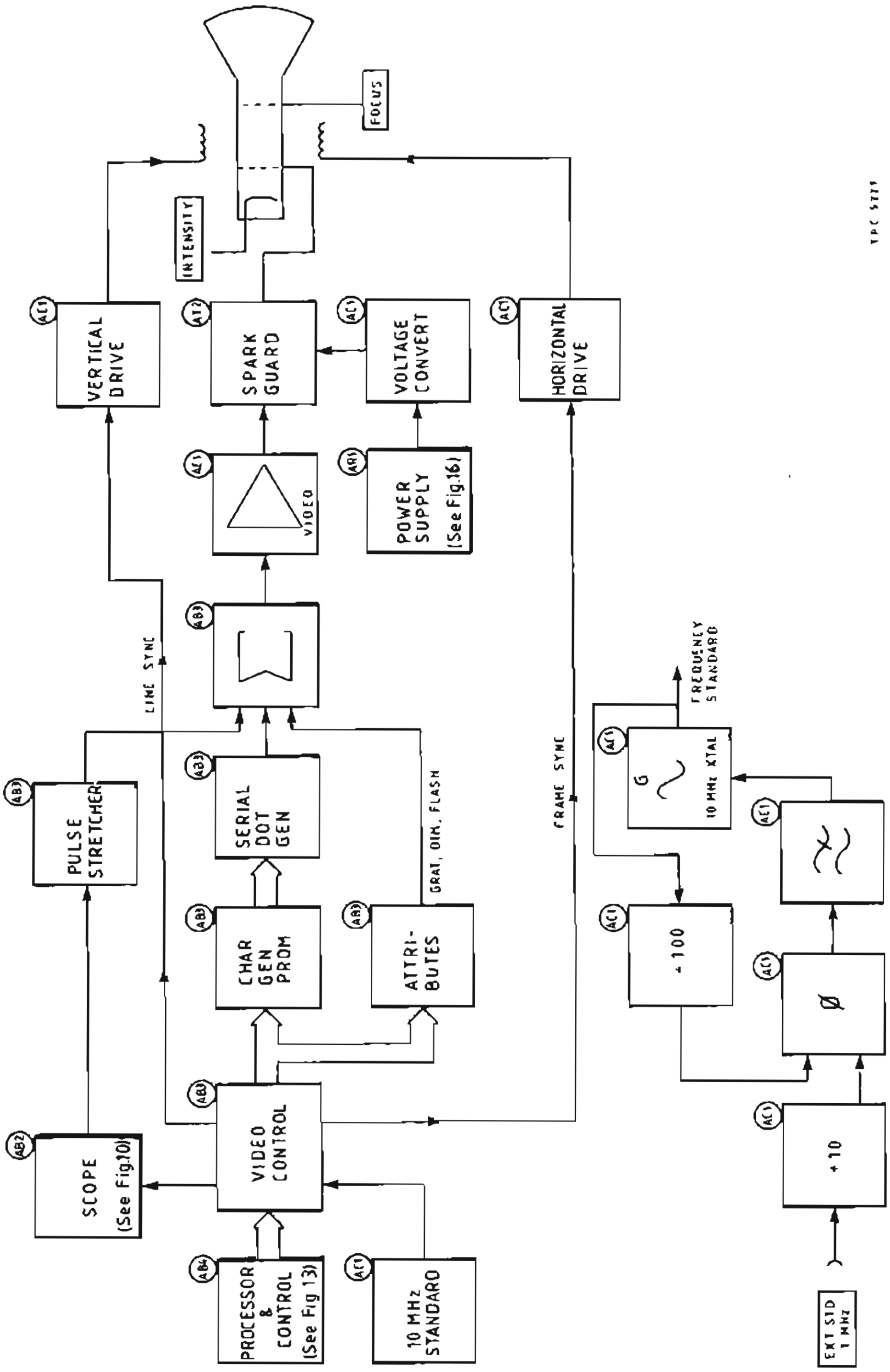


Fig. 12 Block diagram of video control and freq. standard (showing main functions of boards)

BOARD AB3 - VDU BOARD

Circuit diagram : Chap. 7, Figs. 14 & 15

106. This board contains the display unit timing and character generation circuits. Additionally, it provides the timing for digital oscilloscope board AB2 and supplies the line sync and frame sync signals for c.r.t. drive board AC1. The trigger output is used by both the oscilloscope and the audio frequency counter.

Rows counter (Sheet 1)

107. The rows counter is formed by IC16a, IC17a and IC17b. The counter's main purpose is to control the timing of the generation of the dots (pixels) forming each vertical line (ordinate) of the display. To do this it supplies the lower 5 bits of the page memory read address as well as providing enable signals for the page memory and character generator. It also controls the parallel to serial data conversion operation. The counter is clocked by the 10 MHz CLK signal and supplies, after division by two, the 5 MHz CLK from which is derived the internal operating frequency of the microprocessor. At the end of the count, the line sync pulse is generated which is fed out to c.r.t. drive board AC1 and processor board AB4. The signal is also inverted by IC22c and used to set latch IC14a output high to open gate IC26c. Then when LOAD DISPLAY COUNTERS is asserted high, a low ENABLE signal is sent to AB2 to allow the display counters to load.

Columns counter (Sheet 1)

108. The columns counter is formed by IC18a and IC18b. The counter's main function is to control the timing of the generation of the vertical ordinates forming each frame of the screen display. To do this it supplies the higher 6 bits of the page memory read address as well as providing the frame sync signal. For normal operation, selector IC29 selects its A inputs from the columns counter to provide the FRAME SYNC and counter reset signals. But when the oscilloscope function is required, IC29 alternately selects its A and B inputs. The columns counter then supplies FRAME SYNC signals that are shifted by half an ordinate period so as to provide an interlaced frame for double density plotting of the digitized waveform.

Page memory & μp interface (Sheet 1)

109. The μp interface consisting of the three latches IC45,46 and 47 is used for writing to page memory IC34. The latches are loaded in three separate bytes during the vertical scan period. When line sync occurs, signalling the start of the flyback period, the memory is loaded. OE (Output Enable) to the interface and WE (Write Enable) to the memory are both taken low and data from IC45 is stored in the location specified by the address from IC46 and IC47. The address is formed by 11 bits in order to access the 1280 bytes providing one screenful (40 x 32 characters) of information.

110. To read from the page memory, the outputs from rows counter IC16a, IC17 and from columns counter IC18 are used to form the memory address. The address is fed to the bus by tristate drivers IC27, IC37 when enabled by line sync not being asserted. Then the 8-bit data from the memory provides the most significant bits of the address for character generator IC33 as well as being decoded to provide the FLASH, GRATICULE and DIM attributes. The character generator is addressed 32 times during the scan period to form the vertical trace.

Character generator (Sheet 1)

111. Character generator IC33 is a PROM whose 8 most significant address bits are provided by the page memory and used to select the required character of the 256 stored as the instrument's character set. The 3 least significant address bits are provided by character scan counter IC16b. This counter is clocked at the line scan rate and counts up from 0 to 7 to address in turn each of the 8 vertical lines of the selected 8 x 7 character. Gates IC19c, 19d and 20b detect when the count reaches 7 upon which the counter is reset to zero. During the scan period, the selected vertical line of the 32 characters to be displayed is fed in parallel bytes to converter IC36.

Parallel to serial conversion (Sheet 1)

112. Shift register IC36 converts the parallel input data from the character generator into a serial output on the VIDEO line. New character data from IC33 is loaded into IC36 when its LD (load) input is taken low. To supply the required signal, all of the outputs from binary counter IC16a are NANDed in IC25, together with inverted line sync and modified frame sync signals. The latter inputs prevent loading during either of the flyback periods. IC36 is clocked by the 5 MHz CLK line so that each pixel (picture element) forming a character occupies 200 ns. Each bit of data clocked out serially onto the VIDEO line has its logic set to indicate whether the pixel it represents is to be lit or unlit when displayed. The sequence of a load and 8 clock signals is repeated for each of the 32 characters during the vertical scan period.

Video output (Sheet 1)

113. Normally, i.e. when no attributes are asserted, the serial video output from IC36 is routed via IC39c and IC38c and then in parallel to IC43c and IC49d. The latter gates feed to resistive combiners R17 and R18 which are current summers for the video amplifier on c.r.t. drive board AC1. This output, on the VIDEO OUT line, provides three levels of intensity; off, bright and dim. The off condition is where the outputs from IC43c and IC49d are both high, the dim condition is where one output is high and the other is low, and the bright condition is where both outputs are low.

Attributes (Sheet 1)

114. Besides being fed to the character generator the most significant bits of the character address are decoded by ICs 38b, 32b and 38a to determine whether an attribute is to accompany the video signal. The attributes are FLASH, GRATICULE and DIM, all of which are asserted low.

Flash

115. When flash is asserted, the low is clocked out from bistable IC40b by the inverted load signal for IC36. The low logic level closes gate IC39c to the video output so that the signal can only pass through IC39d which is controlled by flash rate generator IC28. This binary counter is clocked by the modified frame sync signal at 52.4 Hz and results in the gate being opened for 0.3 s and closed for 0.6 s to give the required approx. 1 Hz flash rate.

Dim

116. When the barcharts are selected for display, DIM is asserted low. This signal via IC32d provides a high data input for bistable IC42a. Also at this time, SCOPE VIDEO is inactive since the oscilloscope function is disabled when the alternative barchart function has been selected. Output from the pulse stretcher formed by IC23c and IC23d is thus low forcing IC39 pin 3 to go high. Then when IC42a is clocked by the inverted load signal for IC36, pin 4 of IC39 is also taken high. This takes pin 13 of IC49 low causing a high to be applied to the R17 summing arm of the VIDEO OUT line. The accompanying barchart character through the R18 summing arm is therefore at reduced intensity when displayed.

Graticule

117. When D-latch IC42b is clocked with graticule asserted low, it has three effects. Firstly, IC42 pin 8 is taken high which opens gate IC49a to the 10 MHz standard sȯ as to provide the SCOPE CLK signal while the trace is passing through the graticule area. The clock drives the counters on AB2 which count up until they overflow so as to define the start and finish of the trace drawn vertically on the screen as described earlier. Secondly, IC42 pin 8 going high is NANDed by IC32c with the inverted graticule signal so as to provide a low data input to D-latch IC40a. Then, when the latch is clocked, IC39 pin 1 is taken high which opens the gate to the digitized SCOPE VIDEO signal. This signal is inverted by IC39a and fed to both summing arms so that the VIDEO OUT signal causes the waveform to be displayed at maximum intensity. When only the graticule is to be displayed, the absence of the waveform on the SCOPE VIDEO line takes IC39 pin 2 low so that IC49 pin 11 goes high causing the graticule characters to be dimmed whenever they are shown. Thirdly, the low from IC42 pin 9 is clocked out from D-latch IC42a in inverted form to open gate IC32a. This enables the ODD/EVEN FIELD signal to pass through to IC29 which is generating the FRAME SYNC signal. IC28a divides the modified frame sync signal by two to provide the ODD/EVEN FIELD signal which causes data selector IC29 to alternately select different synchronizing inputs thus causing the frame scan to be interlaced. This enables the analogue waveform to be displayed at twice the normal resolution.

Scope trigger (Sheet 2)

118. The signal on the SCOPE INPUT line from demodulation and scope board AB5 is a.c. coupled then clipped by D4, D5 before being applied to IC48a. IC48a and D1,D2 form a peak/trough detector whose outputs are smoothed by C3,C4 and summed in R7,R8 to determine the average signal level. This is connected to the inverting input of comparator IC48b whose other input is connected to the undetected output of IC48a. IC48b is a Schmitt trigger whose hysteresis is set by R10/R6. The following Schmitt trigger IC48c increases the speed of the edges of the signal. D3 level shifts the signal so that the output from buffer IC44b is at t.t.l. levels. This TRIGGER output supplies the oscilloscope trigger for AB2 as well as being used for period measurement by the audio counter on AB4.

BOARD AC1 - CRT DRIVE

Circuit diagram : Chap. 7, Fig. 25

119. The display board AC1 and associated board AT2 provide the drive voltages to display the information generated by digital scope board AB2 and v.d.u. board AB3. Electromagnetic scanning is used to generate a 320 vertical line raster every 19 ms on a 19 cm c.r.t. with video modulation applied to the grid. AT2 is the flashover protection board.

Frame output

120. Frame output is provided by IC1. The oscillator free-running frequency is determined by R1 and C4. A linear voltage ramp is produced on timing capacitor C4 whose slope, i.e. the nominal frame rate in the absence of synchronizing pulses, is determined by the current flowing through timing resistor R1. The oscillator is synchronized by pulses at 52.7 Hz on the FIELD SYNC line from AB3. The height of the generated ramp is determined by the current flowing through R2 and R3. The shape of the ramp is modified by the IC1 internal buffer connected between pins 12 and 1 and by the external linearity components R4,R5,R6, C5 and C6. R6 provides the frame linearity control. Finally, the modified ramp is fed from the IC1 power amplifier via d.c. blocking capacitor C8 to the horizontal deflection coils.

121. The electron beam in the tube is scanned by changing the flux in the scan coils. Since flux is proportional to current, the current in the frame scan coils is monitored by R12 to enable IC1 to compensate for the inductance of the scan coils and temperature variations. For this purpose, the current ramp in the coils is connected to IC1 pin 10, the inverting input of the preamplifier, and compared with the internal voltage ramp. Any necessary correction is applied to the power amplifier. R13,R9 and R11 determine the quiescent operating point of the power amplifier by modifying the d.c. bias on IC1 pin 10. D1 and C1 rectify and store a voltage, approximately twice that of the +12 V rail, which is used by the power amplifier to produce a rapid flyback at the conclusion of the ramp. C7,C9 and R14 damp the h.f. transients generated during flyback. The supply rail is heavily decoupled by R36, C2 and C3 to prevent frame rate interference.

Line output

122. The tube is scanned vertically, starting from the top left-hand corner. Pulses at 15.625 kHz are applied on the LINE SYNC line to IC2a which provides a delay, preset by R21, so that the raster may be centred vertically on the tube face. Monostable IC2b produces pulses which, from pin 5, switch on line output transistor TR3 or, from pin 12, switch on TR4 to remove excess charge from the base of TR3. TR3 drives the line deflection coils in parallel with the primary of T1. When TR3 is on, a current ramp flows from C16 through L1 to the vertical deflection coils causing the c.r.t. beam to scan vertically across the screen. The shape of the ramp is determined by the rate at which the stored voltage on C16 changes. C16 is the 'S' correction capacitor and helps in obtaining a linear raster by reducing scanning velocity towards the edges of the screen. The linearity and width control L1 comprises a saturable inductor and permanent magnet. Saturation point, and thus the linearity, is adjustable by altering the orientation of the magnet. The inductance of L1, and hence the current through the scan coils, is adjustable to obtain the desired raster height. When TR3 is turned off, the c.r.t. beam is rapidly deflected back to the top of the screen and the stored energy in T1 is transferred to boost capacitor C18. C17 tunes the primary of T1 to the

third harmonic of the line scan to improve efficiency. The line output supply is decoupled with L3,L4, C30 and C31.

Supplementary supplies

123. Five supplementary supplies are generated by T1 to provide higher voltages for the video amplifier and the c.r.t. supply lines. The final anode and anode 2 supply of +12 kV comes from an overwinding on the transformer which has an integral rectifier moulded into the assembly. This output is taken directly to the c.r.t. via the red e.h.t. lead and anode cap.

124. D9 provides a +475 V supply for anode 1 and anode 3 (focus) bias, and conducts during line flyback. A +50 V rail is generated during flyback by D5 and smoothed by C22. This supplies the video amplifier.

125. +50 V is applied from C22 via D7 to add to the 100 V from C21 when D8 conducts during the active line period. The +150 V so provided is smoothed by C23 and applied via the front panel INTENSITY control to the tube cathode.

126. A boost rail of +24 V is generated by an overwinding connected to pin 10 of T1 and is smoothed by C18. This supplies +22 V to board AA3 via R34 and D13.

127. Deleted.

Video amplifier

128. Current on the VIDEO IN line from AB3 is applied to the video amplifier, formed by TR1 and TR2, which has a gain of 15. The amplifier inverts and amplifies the signal to 38 V p-p with black level (beam cut-off) corresponding to +5 V.

Phase locked loop

129. The p.l.l. enables the internal 10 MHz standard to be phase locked to an external 1 MHz standard connected to the rear panel EXT STD socket. The external signal is applied by buffer TR5,TR6, divided down to 100 kHz by IC4 then fed to IC3 pin 2. Output from 10 MHz crystal oscillator OS1 is fed back and divided down to 100 kHz by IC5 and applied to IC3 pin 1 for phase comparison with the external signal. Any resulting error signal is d.c. converted by a low-pass filter and fed to pin 5 of OS1. The error signal is used inside OS1 to control a variable capacitance diode which adjusts the frequency of the crystal until it is in lock. Finally, the oscillator square wave output is buffered by IC3b.

BOARD AT2 - CRT BASE

Circuit diagram : Chap. 7, Fig. 25

130. Board AT2 supports the c.r.t. base socket and has spark gaps punched into it to protect the semiconductors on AC1 in the event of a high voltage flashover. When a flashover occurs within the c.r.t. the final anode capacitance is rapidly discharged through one of the c.r.t. electrodes. The resulting voltage spikes are prevented from damaging the AC1 circuitry by a resistor and a spark gap at each electrode junction. The resistor presents a high impedance path to the spike, while a low impedance path is presented by the spark gap when ionized. Thus the discharge current is routed back to the external c.r.t. coating, preventing large currents from flowing through the c.r.t. circuitry.

PROCESSOR, CONTROL AND AUDIO COUNTER

131. The microprocessor on AB4 uses an 8-bit data bus which is multiplexed with an 8-bit address bus to provide a 16-bit address (see Fig. 12). Besides controlling the major functions of the instrument, it responds to interrupts from the GPIB and the keyboard AF1,AF2 and senses the direction of rotation of the VARIABLE control on AZ1. The memory bank contains RAM for the latest instrument settings, EPROM for the operating system, EEPROM for reference data and NOVRAM for the current setting. Loss of power from AR1 is detected and the current setting is stored in non-volatile memory. Besides addressing the memory, the addresses are decoded to provide board and chip select signals to implement the various functions. The data bus is supplied by an A-D converter for measurements of the voltmeter, power meter and demodulation inputs from AB5. The bus also communicates with a programmable divider which provides many of the timing and control signals for the instrument. Input/ output data is controlled by means of a two-way buffer.

132. The frequency to be measured by the a.f. counter is connected from board AB5 to the scope trigger on AB3. It is then applied to a frequency comparator on AB4 and prescaled if above 1.2 kHz. It is then fed to the programmable divider together with a reference derived from the 10 MHz standard on AC1. The reference is prescaled if the unknown frequency is below 800 Hz.

BOARD AB4 - MICROPROCESSOR

Circuit diagram : Chap. 7, Figs. 16,17 & 18

133. Board AB4 contains the microprocessor, memory, A-D converter and programmable divider as well as the audio counter circuit.

Microprocessor (Sheet 1)

134. Central processor IC1 is an 8-bit Intel 8085A which uses a multiplexed data bus to accommodate the 16-bit address. This is split between the 8-bit address bus and the 8-bit data bus. Output lines A8 to A15 carry the high order memory address. I/O lines D0 to D7 carry the low order memory address during the first clock cycle, and then carry data during the second and third machine state clock cycles. I/O is memory mapped, i.e. the I/O devices are treated as part of the memory. ALE (Address Latch Enable) is used to differentiate between data and address; when it is taken high the contents of the data bus are treated as part of the address and latched in IC2. WR (write) and RD (read) asserted low enable the memory or I/O device selected by the address bus to be written into or read out from respectively. They also indicate that the data bus is available for the data transfer operation. X2 has a 5 MHz input which is divided internally to give the internal operating frequency. RESET IN has a long time constant determined by R3, C12 which ensures that all supply lines are stable when processor operation commences. RST is used to reset the GPIB interface.

135. The Serial Input Data (SID) is from D-type bistable IC29a whose data and clock inputs are supplied from the CONTINUOUS VARIABLE lines. These carry square waves which are phase-shifted $\pm 90^{\circ}$ relative to each other depending on the direction of rotation of the front panel VARIABLE control. The information on these lines is converted by IC29a to a level on pin 5 which is high to SID for clockwise. Pulses to IC27 pin 9 show the speed of rotation. Serial Output Data (SOD) controls the gating of IC27 to determine whether the pulses or the TONES TIMER input causes a processor interrupt.

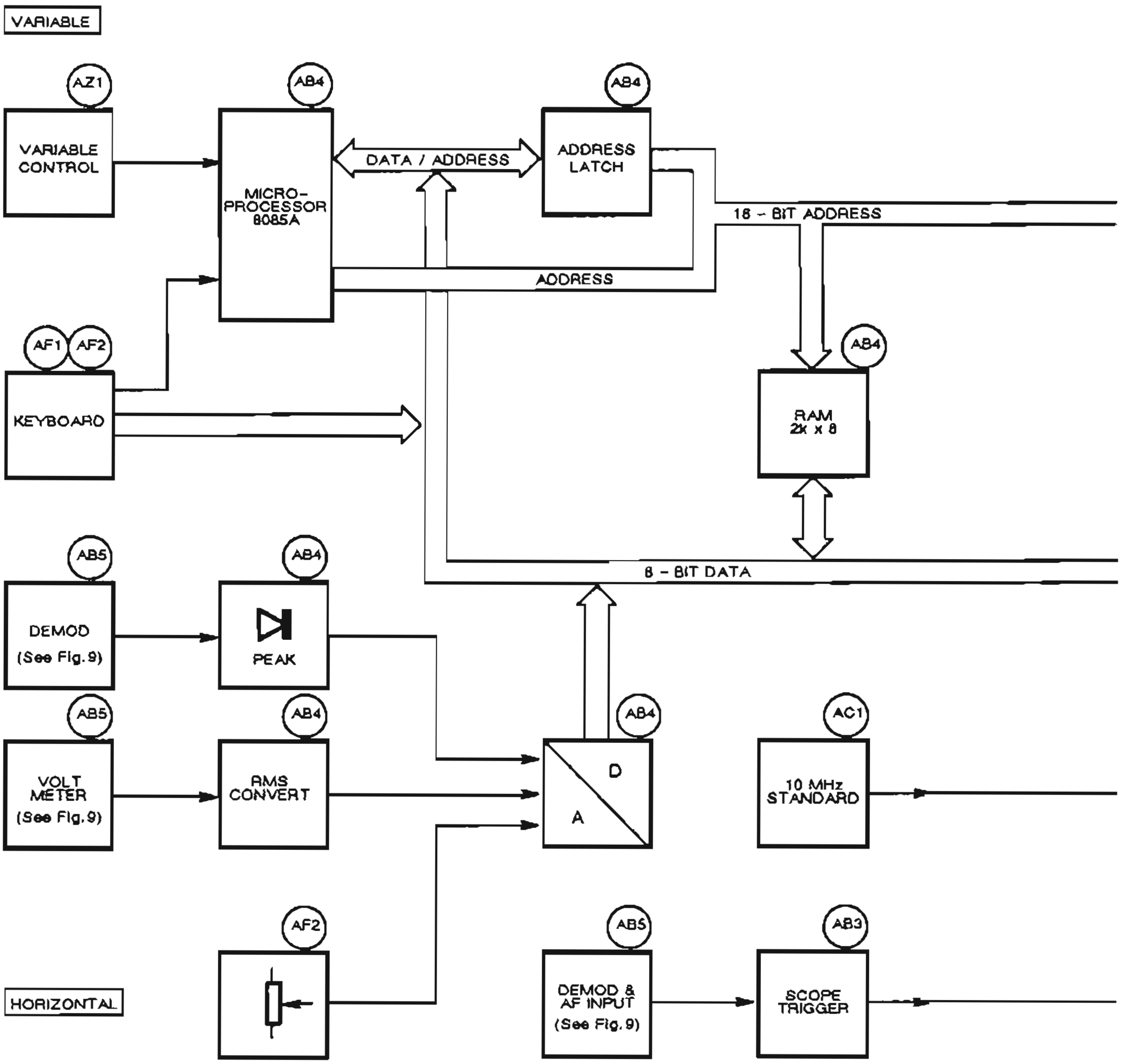
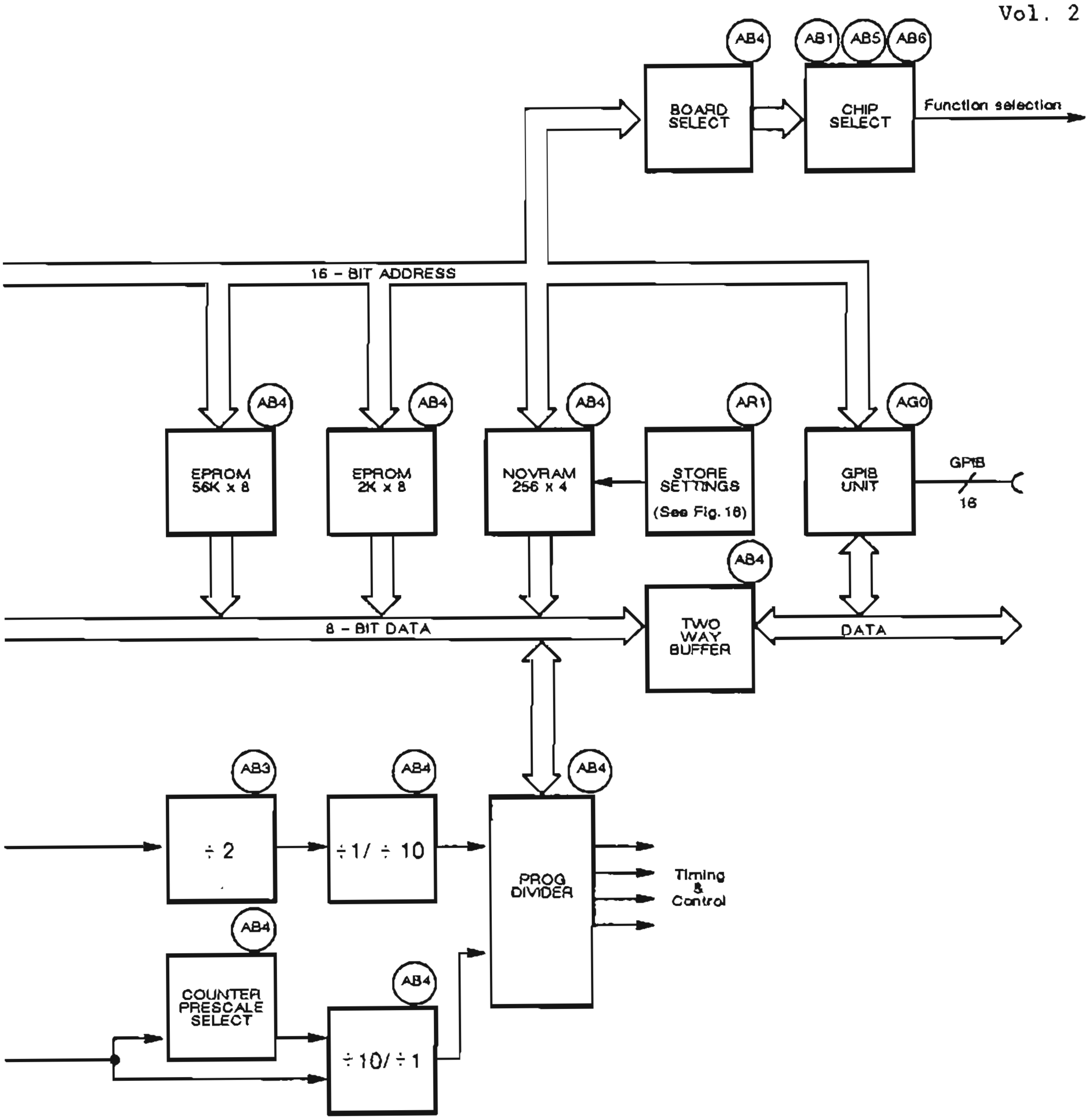


Fig. 13 Block diagram of processor, control and audio counter (showing main functions of boards)

136. The 8085A is configured with 3 edge-triggered interrupt inputs : in ascending priority order these are RST 5.5, RST 6.5 and RST 7.5. RST 5.5 is used for interrupts from the GPIB interface. When the option is not fitted, pull-down resistor R5 disables this input. RST 6.5 interrupts are generated by positive-edge triggered D-type bistable IC37. When a keypress is detected on AB1, the pin 3 clock input is taken high causing an interrupt. Interrupt RST 7.5 is from the VARIABLE control when SOD is high, and from the tones timer when SOD is low. When an interrupt occurs on one of the RST lines, the start address of the service routine is pointed to by the vector stored at the location which is 8 times the RST value, e.g. for RST 7.5 the vector is stored at 3C hexadecimal (60 decimal).



<u>A-D conversion</u> (Sheet 1)

137. 8-bit A-D converter IC3 operates by successive approximation. It is clocked at 250 kHz by the output from divider IC29(b) (sheet 2). To minimize noise, the voltage reference for the V REF+ and V REF- inputs is supplied from the on-board regulator IC35. Zener diode D6 provides protection for IC3 by preventing the V REF+ input from rising higher than 5.6 V in the event of one of the analogue inputs going erroneously high. There are four analogue inputs for conversion. These are PEAK and TROUGH from the modulation meter section applied to IN0 and IN1 respectively, RMS VOLTS from the voltmeter section applied to IN2, and HORIZ SHIFT from the oscilloscope section applied to IN3.

Precision peak/trough detector IC30, supplied from the MOD +/- PEAK line, provides the PEAK and TROUGH voltages which are used for two of the barchart displays. IC32 converts the voltage on the VOLTMETER line to r.m.s. to provide the RMS VOLTS input. The WR(write) and RD(read) signals from the processor respectively supply the START and OE (Output Enable) inputs. These are gated by IC24a and b with a chip select signal from decoder IC18 (sheet 2). Output is in tristate form to the data bus.

138. To start the IC3 conversion process, a low from IC18 pin 12 opens the gates of IC24 ready for the WR pulse from the processor. The rising edge of the pulse to the ALE (Address Latch Enable) input latches in the address on lines A0 to A2. The address is decoded and one of the four analogue inputs is selected (see Table 8) for conversion. The same rising edge is sent to START which commences the voltage sampling process on the selected input and resets its output data latch. When ready to use the digitized output, the processor sends an RD pulse to OE (Output Enable) which changes the output from a high to a low impedance state to enable the data to be read.

TABLE 8 A-D INPUT SELECTION LOGIC - AB4

Address C B A	Selected analogue input
L L L	IN0 - Peak
L L H	IN1 - Trough
L H L	IN2 - RMS volts
L H H	IN3 - Horiz shift

Programmable divider (Sheet 2)

139. IC4 is a complex programmable divider which contains an internal prescaler and five programmable counters. The prescaler is supplied on pin 6 with 1 MHz derived by IC23b from the 5 MHz CLOCK board input. The functions of the five counters are as follows:-

Counter 1

140. Controls the duration of the tones generated by the instrument. The 5 MHz CLOCK input to the board is fed to pin 33 and the output, from pin 3 to IC27 pin 1 (sheet 1), is used as one of the two sources for the RST 7.5 processor interrupt signal.

Counter 2

141. Produces a 40 ms or 400 ms gate pulse for the r.f. counter section. A 1 kHz signal from IC4 pin 7, derived from the prescaler, is gated by IC33a to IC4 pin 32. Output to the counter is on the RF COUNTER GATE line.

Counter 3

142. Measures the period of the unknown audio frequency. The reference frequency is fed in from data selector IC22b to IC4 pin 31, while the frequency to be measured is applied to IC4 pin 36 to gate the reference. The result is read over the data bus by the processor.

Counter 4

143. Provides control for the oscilloscope horizontal shift. It produces a pulse on output pin 38 which is delayed relative to the frame sync input on pin 35. It does this by counting double frequency line sync pulses on the 2XLS line to input pin 30. The number of line sync pulses counted is controlled by the processor according to the digitized value of the horizontal shift obtained from the A-D converter IC3 (sheet 1).

Counter 5

144. Provides a variable oscilloscope timebase by dividing a 2.5 μs period clock which is gated by IC33b to IC4 pin 29. The timebase obtained is output from pin 37 on the SCOPE TIMEBASE line.

Audio counter and prescaler (Sheet 2)

145. The a.f. counter works in period mode. The period to be measured is applied from contact 29b simultaneously to two frequency comparators. These are formed from two timers, IC20a and IC20b, and two D-type latches, IC21a and IC21b. Transistors TR1 and TR2 discharge timing capacitors C28 and C29 at the start of every unknown period. The timers - effectively retriggerable counters - compare the unknown period with their own time constants, and their output states at the end of every period are latched to provide steady levels for input frequency selection. These levels are fed back via low-pass filters R28,C26 and R29,C27 into the timers to provide a small amount of frequency hysteresis to eliminate jitter. Frequency selection is by IC22a and IC22b which select either a prescaled (IC23a,IC23b) or an undivided input.

146. The unknown frequency is a square wave whose falling edge triggers the timers and whose following rising edge clocks the latches. If the period of the unknown frequency is shorter than the timer periods (indicating a high unknown frequency) the latches will take their Q outputs high causing the prescaled inputs to be selected. The faster timer, IC20b, increases the accuracy of measurement of high frequency unknowns : if the unknown is higher than approximately 1.2 kHz, IC21 pin 9 will be high causing IC22a to select unknown divided by 10. The slower timer, IC20a, prevents counter IC4 from overflowing on long periods : if the unknown frequency is lower than approximately 800 Hz the output of the latch, IC21 pin 6, will be high causing data selector IC22b to select 500 kHz from IC23b instead of 5 MHz as the reference for counter IC4.

Memory banks (Sheet 3)

147. The operating system is contained in EPROMs (ultra-violet Erasable Programmable Read Only Memories) IC9 to IC12 which provide a total of 56 K-bytes of memory. These are enabled by IC18 which decodes A14 and A15 of the address bus. A13 is additionally gated by IC34b for IC12 selection.

148. IC13 is a 2 K-byte EEPROM (Electrically Erasable PROM) which contains reference data such as calibration look-up tables and also holds a maximum of 38 instrument settings saved using the STORE key.

149. IC16 is a 2 K-byte RAM (Random Access Memory) in which is stored the latest instrument settings for each of the various modes, DUPLEX, RX etc., as well as holding scratchpad read/write information.

150. IC14 and IC15 are NOVRAMs (Non-Volatile RAMs) which each consist of a RAM and an EAROM (Electrically Alterable ROM). Each memory holds 4 x 256 bits. The RAM holds the current front panel settings, while the settings at switch-on (STORE 0) are held in EAROM. When changing modes, say from DUPLEX to RX, the current DUPLEX settings held in NOVRAM are exchanged with the latest RX settings held in RAM IC16. When IC19 pin 7 (sheet 2) is taken low, IC31 pin 10 goes low to the R inputs which causes the instrument to recall STORE 0 and reset to the settings at switch-on.

151. When R (Recall) is pulsed low, the contents of the EAROM section are transferred to the RAM section with the EAROM contents unaltered. When S (Store) is pulsed low, the contents of the RAM section replace those of the EAROM : this process takes 10 ms. When power is switched off or fails for any reason, the low volts driver on board AR1 goes open collector and the LOW VOLTS line is pulled high by R37. IC31d pin 11 goes low, turning off TR4 and turning on the 5 V regulator comprising TR3, R38 and D9. The NOVRAMs are then supplied with +5 V via the +12 V rail rather than, via D7, from the +5 V rail so that the voltage has farther to fall. This provides IC14 and IC15 with 60 ms of guaranteed supply in which to do a store. The store is started via IC31b which has Schmitt trigger inputs so as to eliminate the possibility of multiple store triggers. IC31a and IC31c, together with the associated timing components, ensure that at switch-on and for sufficiently long afterwards for the supply lines to stabilize, R is held low and S is held high to prevent spurious stores. When the power is going down, extraneous writes to EEPROM IC13 are prevented by IC17d.

<u>Data direction control</u> (Sheet 3)

152. The direction of data flow between the microprocessor data bus and the quiet data bus is controlled by two-way tristate buffer IC7. This is enabled by a low from decoder IC5 to pin 19 IC7. Data direction is determined by the logic state of the RD line to pin 1; for a read operation this line is taken low. The buffer prevents processor activity from spilling over onto the quiet data bus and causing analogue interference.

<u>Selection signals</u> (Sheet 3)

153. IC5 decodes the A11 to A15 address lines. The decoder outputs provide chip selects for EEPROM IC13 and RAM IC16, enable signals for quiet data bus buffer IC7 and decoder IC8, and the latching signal for IC6. Address lines A0 to A3 to the latter are latched to provide the equivalent of a quiet address bus. These address lines in conjunction with the BS (Board Select) lines from IC8 are subsequently decoded for chip selection.

154. BS3 for board AB5 also provides the RMS TIME TRIGGER signal to IC36 (sheet 1). Since a board select signal to AB5 usually involves a voltmeter range change, IC36 is triggered to produce a low delay pulse to IC26. The delay allows time for the r.m.s. converter output to settle (Sheet 1).

BOARD AF1 - MAIN KEYBOARD

Circuit diagram : Chap. 7, Fig. 27

155. The 49 push-buttons on this board control most of the functions of the instrument. They are arranged in a matrix of rows labelled 1 to 8, and columns labelled A to H. The columns are driven from an octal latch on motherboard AB1, and the rows are received back onto AB1 (for details of the keyboard operation see board AB1 description).

156. LEDs D1 to D5 are used to indicate modulation and input socket selection and are driven by IC1. They are controlled from AB1 using 5 column lines shared with the keyboard. In operation, AB1 first takes the appropriate column line high to IC1 then turns the selected l.e.d. on by strobing the CLK line.

BOARD AF2 - SCOPE KEYBOARD

Circuit diagram : Chap. 7, Fig. 28

157. The keyboard contains six push-buttons which control the operation of the oscilloscope, and four potentiometers. INTENSITY potentiometer R1 output is connected to AC1 in order to vary the cathode bias of the c.r.t. and thus the brightness of the raster. VOLUME control R2 output is connected to AB1, where it controls the gain of the audio power amplifier. The outputs of the oscilloscope horizontal and vertical shift controls R3 and R4 are also connected to AB1. R3 controls the time delay introduced by counter number 4 on AB4, while R4 varies the bias of the scope ranging IC on AB5. The six push-buttons are connected into the same matrix as main keyboard AF1. For details of the keyboard operation see board AB1 description.

BOARD AZ1 - OPTICAL ENCODER

Circuit diagram : Chap. 7, Fig. 28

158. This board forms part of the front panel VARIABLE control. The board's function is to indicate the direction of movement of the shaft of the control to the processor on AB4. Power is supplied from AB1 on contacts 1 and 3 to l.e.d's D1 and D2. These are optically coupled, via a pierced disk mounted on the shaft, to photo-detectors X1,X2 connected to contacts 4 and 5. By this means, as the shaft is rotated, quadrature pulses are generated for subsequent decoding on board AB4 to determine the direction and rate of movement of the control.

__Unit AG0 - GPIB__

Circuit diagram : Chap. 7, Fig. 30

159. The function of IC3 is to provide communication between the instrument and the General Purpose Interface Bus (GPIB). The IC is a talker/listener which, in conjunction with transceiver ICs 4,5,6 and 7 and address reader IC2, implements all the necessary GPIB functions for the instrument. It is processor controlled and has capabilities which include data transfer, handshake protocol, talker/listener address recognition, service request and serial poll.

160. Switch bank SW1 is the GPIB address switch which enables the GPIB address to be programmed. Five of the rocker switches set the address in binary format 1,2,4,8,16 for talk and listen modes. The sixth switch is set for talk only mode. The switches configure the address in negative logic: when a switch is open one of the pull-up resistors R1 to R6 holds the input high at logical "0", when a switch is closed the input is connected to earth for logical "1". IC2 is a tristate-gated driver which, when enabled by lines CS and A3 both being taken low, places the switch settings on the D0 to D5 inputs to IC3 for address recognition purposes.

161. Talker/listener IC3 takes care of data transfer as well as decoding control messages. Control messages and addresses are passed on the data bus by means of the handshaking process with ATN asserted by the controller to differentiate them from data. Control messages such as SPE, SPD used for serial poll are decoded and the function carried out. The IC also performs address recognition. During this phase, the data on lines D101 to D105 is compared for equivalence with data on the AD0 to AD4 lines from address reader IC2. When a possible address is recognized and providing certain other conditions are satisfied, the data on lines DI06 and DI07 is decoded to determine whether the instrument is being addressed as a talker or a listener. When designated a talker by the controller, the interface transfers data from the processor by means of a talk handshake to the listeners. It is sent via an internal register to the transceivers which are configured to send. When designated a listener by the controller - and providing Talk Only is not set on SW1 - data is received via the transceivers, which are configured to receive, by means of the listen handshake and stored in an internal data register.

162. IC3 contains 16 read/write registers (8 read, 8 write), 2 for data transfer the rest for interface control, status etc. Address lines A0, A1 and A2 from motherboard AB1 are used to select the required internal read/write register in conjunction with the WR and RD lines. When the A3 line is taken high and the CS line is asserted low, decoders IC1a and IC1b take the CS input low which enables reading to or writing from the selected register. The interrupt request output INT is connected to the RST 5.5 input of the processor and is asserted high for request.

163. Data flow to and from peripherals and controller is via transceivers IC4 to IC7 with the direction of data transfer controlled by the T1/R1 line being taken high for outputs and low for inputs. Additionally, this line is used for the handshake process. For example, a low on the line, after inversion by IC1c, enables the listener signals NRFD and NDAC to be asserted low on the bus while reinversion by IC1d ensures that the complementary DAV talker function is simultaneously disabled. The sole function of T2/R2 is to set the bus management EOI line low for reception or high for transmission.

General purpose interface bus

164. The bus, which is entirely passive, uses 16 signal lines to connect all units of a system in parallel. These lines are functionally sub-divided into data, transfer and interface management buses (see Fig. 14).

Interface management bus: Manages the orderly flow of data across the interface and consists of 5 wires which carry the following signals:-

Interface clear (IFC): Sent by the system controller to clear all interfaces so that they set to an initial condition.

Remote enable (REN): Sent by the controller to enable instruments to be placed under remote control.

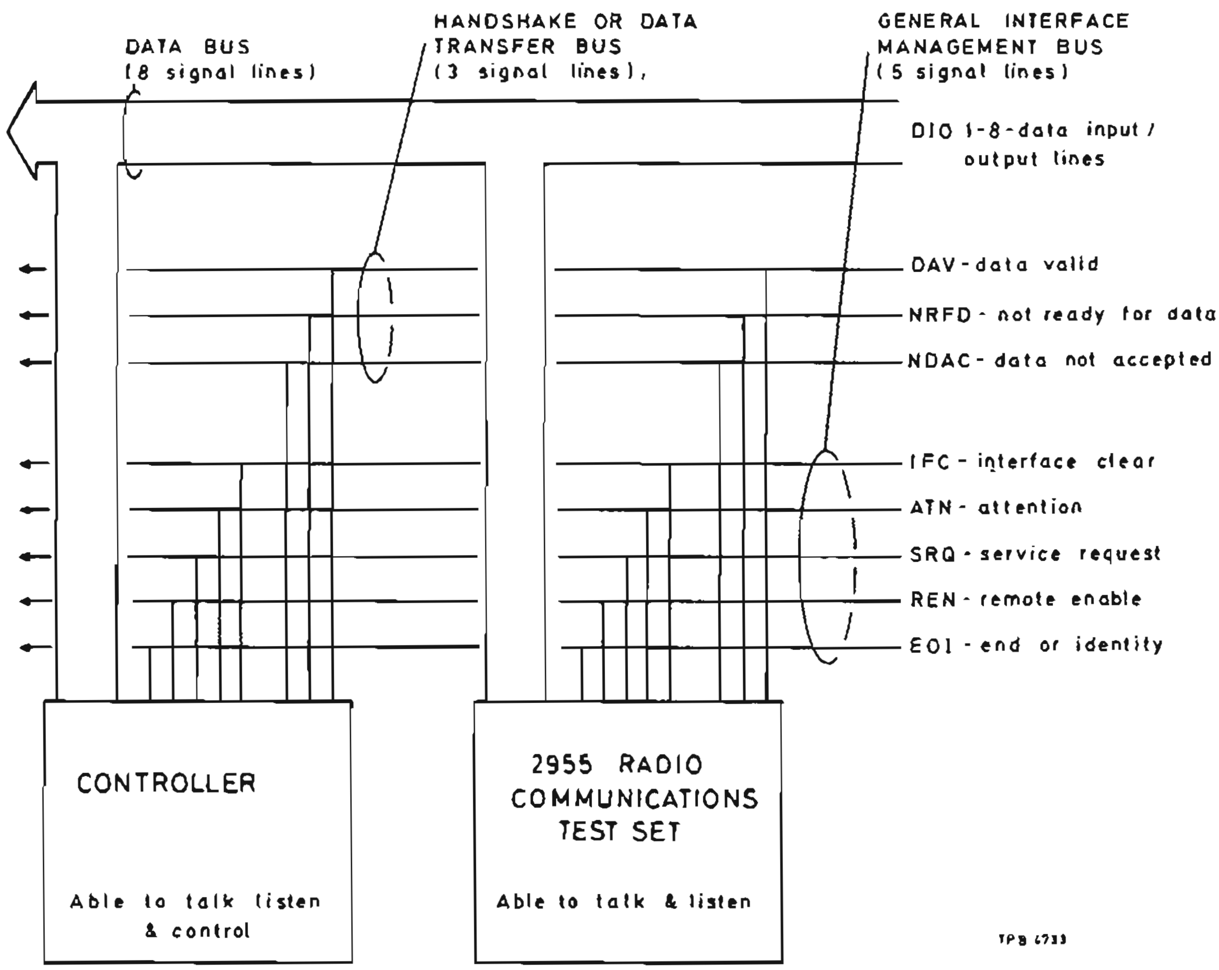


Fig. 14 General Purpose Interface Bus (GPIB) structure

Attention (ATN): Sent by the controller to indicate that an address or command is on the data lines.

End or identity (EOI): An instrument or controller signal sent to indicate the end of a message.

Service request (SRQ): Sent to a controller by an instrument to indicate that it needs service (e.g. has data to pass).

Transfer bus: Co-ordinates the flow of data and comprises 3 lines which are used for the handshaking process, by which a talker or controller synchronizes its readiness to send data with a listener's readiness to receive data. The handshake signals are:-

Not ready for data (NRFD): Asserted (low) by a listener when it is active and not yet ready to receive data. Set high to signal its readiness to receive data.

Data valid (DAV): Asserted by a talker to indicate that the data it has placed on the data bus has settled and may be accepted.

Not data accepted (NDAC): Asserted by a listener when receiving data. Set high as confirmation of receipt of data.

Data bus: Comprises 8 data input/output lines DIO 1 to 8 and is used to transfer the data (commands, addresses and instructions) in bit parallel, byte serial form.

Bus operation

165. A sequence of messages may be commenced by the controller asserting IFC on the management bus to set the interface to its initial condition. The controller then asserts ATN and designates which instruments are to be listeners by sending their listen addresses on the data bus. Similarly, the controller designates the talker (only one instrument may talk at a time) by sending its talk address. Upon the controller removing ATN the talker is free to send data to the listeners by means of the handshake process. The talker concludes the sequence by EOI and this tells the controller to resume control. The controller may now switch the talker and all listeners into the inactive state by sending UNT (untalk) and UNL (unlisten) on the data bus before selecting the next participants.

Handshake

166. The handshake is used whenever data is transferred on the bus. When a signal is asserted the function indicated by the line is carried out, e.g. NRFD is asserted to signify the listener's unreadiness to receive data, and unasserted or removed when ready to receive data. Briefly, a typical handshake is as follows:-

(1) Talker (controller) places a byte on the data bus with DAV initially unasserted to show data is not yet valid.

(2) When all listeners are ready to receive data, NRFD is removed with NDAC at this time asserted.

(3) After a delay to allow data bus to settle, talker asserts DAV to show data is valid and may be accepted.

(4) Data byte is transferred, then listeners assert NRFD. When all listeners have accepted the byte, NDAC is removed to signify receipt.

(5) Talker removes DAV, listeners assert NDAC, and bus reverts to its initial condition ready for next data byte.

The handshake procedure is shown in Fig. 15.

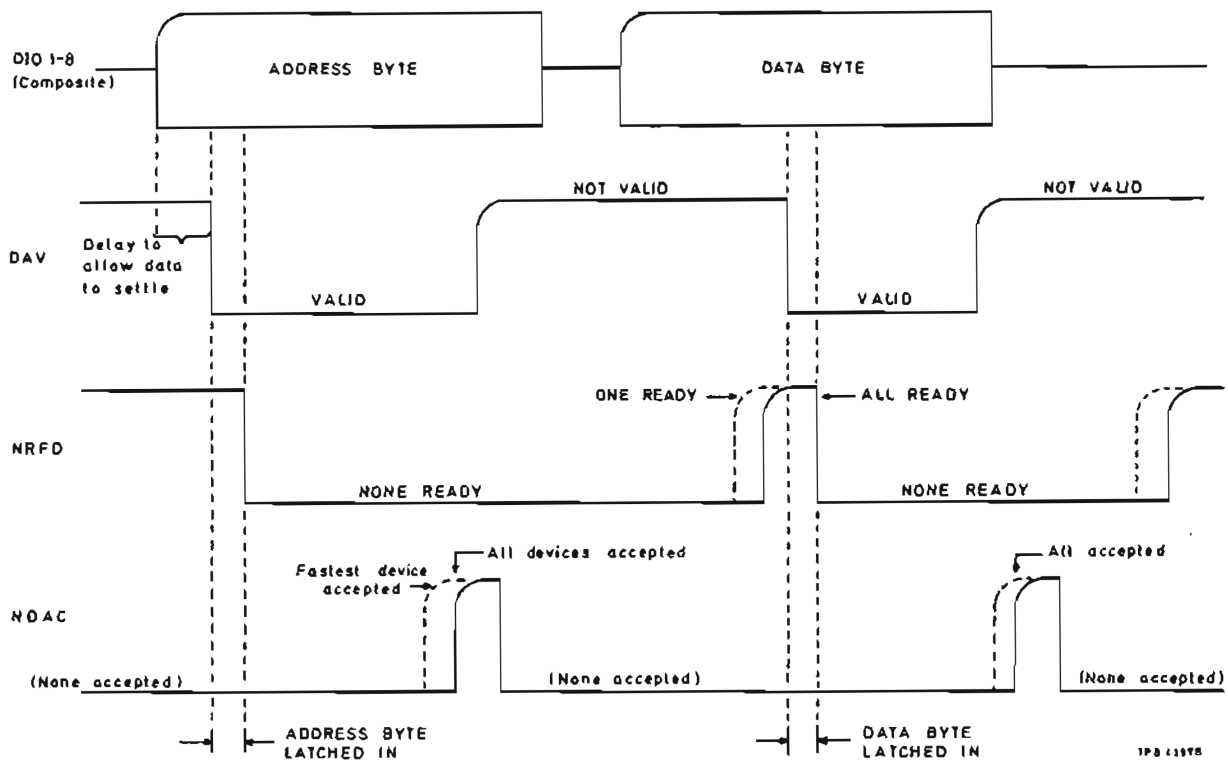


Fig. 15 Handshake procedure

Service request and status byte

167. When the attention of the controller is required i.e. when faulty information is received or at the end of a measurement, the processor causes the interface to send SRQ (service request). Having received SRQ the controller uses serial polling to find out the source of the request (necessary since all devices use the same SRQ line). SPE (serial poll enable) is sent, all devices are unlistened and then sequentially addressed to talk. When the interface receives SPE the processor prepares the status byte.

168. When addressed as a talker, the interface removes SRQ and the processor sends the status byte with bit 6 indicating that the test set was the instrument requesting service. The contents of the remainder of the byte indicate the reason for requesting service. SPD (serial poll disable) ends the sequence.

POWER SUPPLY

169. Power supply board AR1 selects its input from either the a.c. mains after rectification or from an external d.c. via filter board AR3 (see Fig. 16). If both a.c. and d.c. are connected the a.c. is selected to supply the power, if a.c. power fails the d.c. is automatically selected. Selection is not made if the d.c. polarity is incorrect. A 10 V regulator supplies the switched mode power supply controller via a soft start circuit which limits current surge at switch-on. The supply current is monitored so as to shut down the controller for an overload. Controller operating frequency is locked to the 10 MHz standard from AC1. An under-voltage detector enables the front panel settings to be saved by AB4 in the event of a power failure. The resulting d.c. outputs are ±5 V and ±12 V with the +12 V line supplying a controlled drive for the fan.

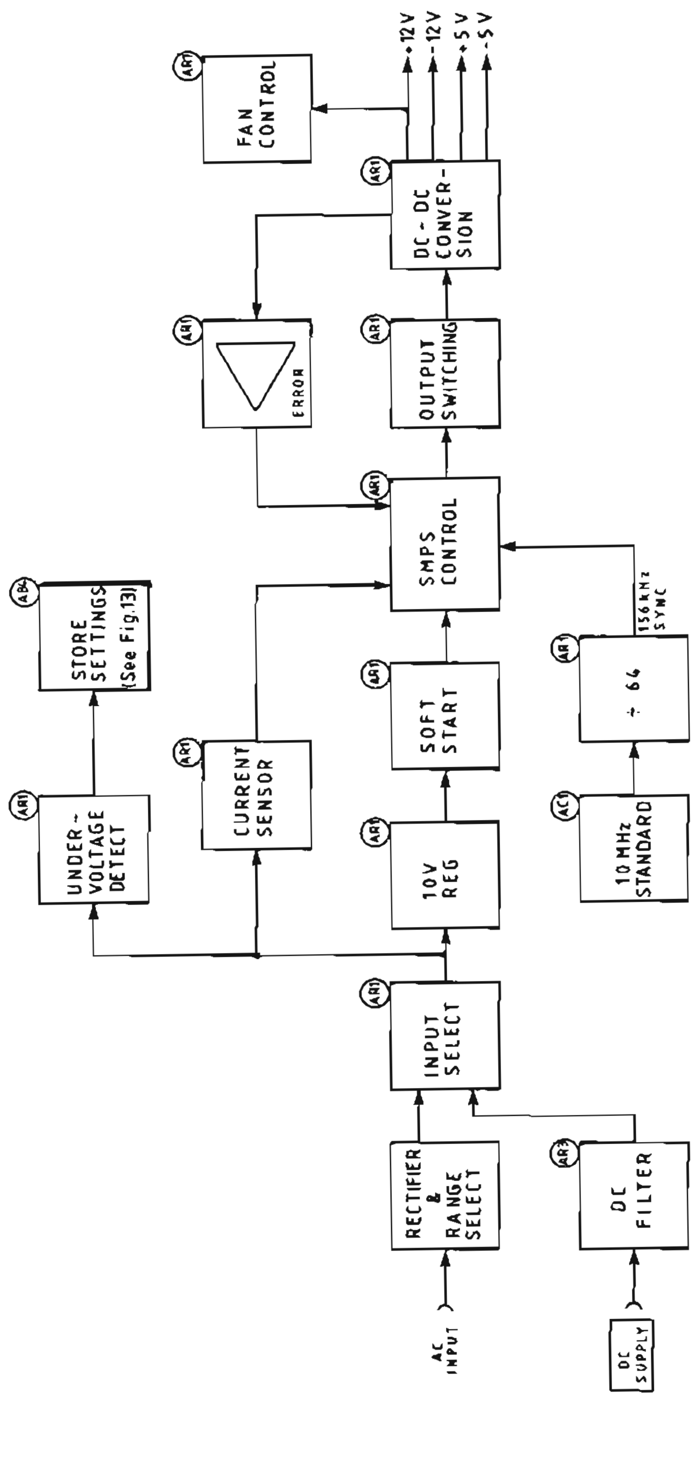


Fig. 16 Block diagram of power supply (showing main functions of boards)

BOARD AR1 - POWER SUPPLY

Circuit diagram : Chap. 7, Fig. 29

170. The power supply unit (p.s.u.) is a switched mode type which operates from either a.c. mains or an external d.c. supply. The rear panel mounted transformer, rectifier and smoothing capacitors reduce the a.c. input to 24 V d.c. before supplying the p.s.u. Outputs from the p.s.u. are on regulated ±12 V and ±5 V lines which are isolated from the d.c. input. If both a.c. mains and d.c. supply are connected, the a.c. supply will provide the power. In the event of a mains power failure, the d.c. supply will be automatically selected without any interruption of the instrument operation.

Input power selection

171. When the instrument is turned on with only external d.c. connected, the current on the ON/OFF SW line through D29 to C29 is sufficient to pull in relay RLA. It is then held in by the current through R48 and R49, and selects the input on the EXT DC line. D28 across RLA solenoid ensures that this selection is not made if the d.c. is applied with the incorrect polarity. If a d.c. input of greater than 34.7 V is applied, Zener diodes D11,D12 conduct thereby switching the relay to the INT DC mains position and so protecting the p.s.u. If a.c. mains is also connected, the rectified input on the INT DC line through R52 switches TR19 on. This causes TR18 to switch off, removing the drive to RLA and power is then supplied on the INT DC line from the rear panel transformer, rectifier and capacitors.

10 V regulator

172. TR2 to TR5 form a series regulator which pre-regulates the supply in order to provide 10 V for controller IC1 and to supply the drive for output switching transistors TR13 and TR16. TR3 and TR4 form a Darlington pair, TR2 amplifies TR3 output to provide the base drive for series pass transistor TR5. Potential divider R12,R46,R8 across the regulator output enables the output voltage to be sampled by the base of TR4. When the d.c. input drops below 8.5 V, the sampled voltage also drops switching TR4 off. TR3 is clamped by Zener diode D1 so that current still passes through this transistor. TR6 is switched off by TR4, which takes the base of p.n.p. TR9 low so that it switches on. This connects the dead time pin of controller IC1 to the reference which switches the controller off. When the d.c. input falls below 10.8 V, the voltage drop across the series regulator element TR5 drops below the Vbe of TR1 (this is preset by R46) which turns off. A signal is thereby sent via opto isolator IC4 to the processor board AB1 on the LOW VOLTS line, so that the front panel settings can be saved in anticipation of a complete failure of the d.c. supply.

Controller

173. C6 and R17 are the timing components which set the internal oscillator of controller IC1 to free run slightly higher than 156 kHz. After the instrument has been switched on and the 10 MHz crystal reference on AC1 has started, the 10 MHZ CLK input is divided by IC2 to 156 kHz, which is applied via isolating transformer T3 to TR7 and TR8. These transistors form a latch which turns on at every cycle of the divided reference, connecting the timing resistor R17 to earth. IC1 mirrors the timing resistor current into C6, which charges to a threshold determined by IC1. IC1 then discharges C6, and the resulting pulse through C5 turns off the latch to await the next cycle of

the divided reference. In this way, the frequency of the p.s.u. is locked to the crystal oscillator. Thus interference frequencies generated by the p.s.u. are predictable. C10 and R19 provide a soft start facility which limits the line surge current at switch-on.

Output stage

174. Controller IC1 provides two non-overlapping complementary square waves, on pins 11 and 8, to the driver transistors TR11,TR12,TR14 and TR15. These transistors provide the drive necessary for the highly capacitive gates of the output field effect transistors TR13 and TR16. The purpose of D7,D8,C25 and D9 is to clamp the drains of TR13 and TR16 to 75 V.

Rectifiers and smoothing

175. The square waves from the secondaries of transformer T1 are first rectified then smoothed by inductive-capacitive filters. Schottky diodes are used for rectifying the +5 V and -5 V rails. The -12 V and -5 V rails have clamp diodes D25 and D24 to prevent overvoltage in the event of a no-load condition.

Error amp

176. The +5 V and +12 V rails are stabilized as a pair. The 'average' voltage obtained from R41 and R42 is compared by IC5 with a reference voltage generated by D31. The resulting error signal is fed via opto-isolator IC3 into the error amplifier of IC1. C15, R39 and C35 are frequency compensation components. C30 and R58 are hum-bucking components.

Current sensor

177. The supply current is monitored by T2 and is added to the supply voltage with R34 and R35 in such a way as to approximate the product of current and voltage. Thus it is possible to monitor supply power. Regardless of the applied external voltage, if the p.s.u. is overloaded by more than 20% the voltage on IC1 pin 16 will equal that on pin 15, and the p.s.u. will shut-down until it is producing approximately 120% of its nominal output of 44 W.

Fan drive

178. This comprises a high power Zener, D26, which conducts while the fan is drawing stall current. When the fan starts running, the current through D26 ceases, and flows instead through R56 and R57.

BOARD AR4 - DC FILTER

Circuit diagram : Chap. 7, Fig. 26

179. This filter prevents noise generated by the switched mode power supply from feeding back to the rear panel DC SUPPLY socket. It is a wide band filter, with the low frequencies suppressed by C1 and the high frequencies suppressed by the two low-pass filters.

Chapter 5-0

MAINTENANCE

CONTENTS

INTRODUCTION

1. This chapter provides servicing support information for the three chapters which follow:

5-1: PERFORMANCE TESTING - Procedures for verifying that the equipment complies with the Performance Data in Chap. 1.

5-2: ADJUSTMENT AND CALIBRATION - tests and adjustments for restoring the equipment to peak performance.

5-3: FAULT DIAGNOSIS - procedures for localizing faults at least to sub-assembly level (normally a printed circuit board), together with information on repair and replacement.

2. In case of difficulties which cannot be resolved with the aid of this manual, please contact our Service Division at the address at the rear of the manual or your nearest Marconi Instruments representative. Always quote the type number and serial number found on the instrument data plate.

SAFETY PRECAUTIONS

3. Although this equipment has been designed and constructed in accordance with international safety standards, it is important that the advice given under NOTES AND CAUTIONS at the front of this manual should be observed in all maintenance procedures to ensure safe working practices.

RECOMMENDED TEST EQUIPMENT

4. The test equipment recommended for use in Chaps. 5-1, 5-2, and 5-3 is shown in Table 1. Alternative equipment may be used provided it complies with the stated minimum specification

ACCESS TO BOARDS AND COMPONENTS

Removal of case

5. The case has two covers. Each cover is secured by four M4 countersunk self-tapping screws which are located at the sides. The covers are slightly sprung. Press at the sides to remove them from the grooves in the side plates. When refitting, ensure that the ventilation holes in the lower cover are at the front and that the covers are fitted into the grooves.

Removal of internal covers

6. The removal of all covers (including shields and screens), to gain access to the boards and components is described below. Replacement of covers is a simple reversal of the given procedures.

Cardframe cover

7. The boards in the cardframe are protected by a cover which is fastened by 2 captive studs. To release the cover, turn the studs approximately a quarter turn anticlockwise until the slots in the stud heads are aligned with the bars marked on the cover. The cover may now be lifted off to expose boards AB2 to AB6.

CRT drive shield

8. A clear plastic safety shield is fitted over c.r.t. drive board AC1 to prevent accidental contact with its components. Remove the topmost of the two nuts and lift off the cover.

CRT base cover

9. A clear plastic cover is fitted over c.r.t. base board AT2 to prevent accidental contact with the board which carries high voltages. First remove the c.r.t. drive shield (see above), then pull off the cover and base as a unit, and finally slide the cover off the board.

CRT screen

10. The earthed metal screen surrounding the cathode ray tube is removed after first removing the c.r.t. drive shield and the c.r.t. base (see above). This gives access to the 2 screws securing the screen to the floor of the instrument. Loosen these screws then slide the screen backwards until the screws enter the apertures, upon which the screen may be lifted off after unplugging PLA on AC1. When replacing, ensure that the washers are immediately under the screwheads.

RF tray

11. The r.f. tray fitted to the underside of the instrument has covers which may be taken off after removing all visible screws. Boards AA1 and AA2 are under the small cover, AA3 and AA4 are under the large. When refitting a cover, ensure that all gaskets are refitted correctly.

Rear cover

12. The rear metal cover may be removed after removing two screws. This exposes the power supply board AR1 with its screen as well as the cooling fan.

Power supply screen

13. To remove the r.f. screen covering power supply board AR1, first take off the rear cover (see above) then remove the 6 screws holding the screen. Ease off the rubber grommet protecting the leads then remove the screen.

Access to boards and units

14. The majority of components are mounted on seven printed circuit boards, AB1 to AB6 and AC1, all of which are accessible from above the instrument. AB2 to AB6 plug into the motherboard AB1. Boards AA1 to AA4 are contained in the r.f. tray accessed from below the instrument. Power supply board AR1 is accessible from the rear. Unfastening the rear panel gives access to AR3. Keyboards AF1 and AF2 are fitted behind the front panel together with AZ1, access to these boards is facilitated by unfastening the front panel. AT2 is connected to the c.r.t. base.

Access to test points

15. To obtain access to board components and test points, boards AB2 to AB6 may be removed and reconnected to the instrument via the extender boards which are available as optional accessories (see Chap. 1, Accessories).

Access to front panel

16. Access to the components and boards behind the front panel is greatly facilitated by its partial removal. Proceed as follows:-

(1) Loosen the nuts on the left-hand side above and below the side frame immediately behind the front panel casting. Remove the cross-head screws in similar positions on the right-hand side. Remove a further screw to enable the loudspeaker assembly to be pulled away.

(2) Loosen the central clip above and behind the front panel, next to the tube, and pull to one side. Loosen the similar clip at the bottom and pull clear.

(3) With the casting remaining in place, pull open the marked panel, hinged at the bottom. Unscrew both cables to the RF IN/OUT sockets for greater access.

(4) When replacing the panel, ensure that the mains lead is not trapped behind the marked panel. Also ensure that when replacing the bezel, the slot is internal and at the top.

Access to rear panel

17. To gain access to the components behind the rear panel, simply remove two screws from each side fitted above and below the side frame. The rear panel may then be pulled away.

RF tray

18. To gain access to the underside of motherboard AB1 as well as to the bottom rear of the front panel, the r.f. tray may be opened out, for which purpose it is hinged. Remove the upper of two screws at the rear and the screw at the front from both sides while supporting the tray. Pull off the Conhex connectors at the front then hinge open slightly to gain access to the ribbon cable to AB1,PLF. Unplug and fully open out the tray.

CRT removal

19. To remove the c.r.t. it is first necessary to remove the c.r.t. drive shield, c.r.t. base unit and metal screen (see above). For convenience, next place the instrument on its face. Remove the yoke assembly. Then, using the pulls, unhook the triangular bandage. This allows the tube to be pulled away complete with rubber housing. Finally, remove the red e.h.t. lead at the tube end by gently levering off the grey anode cap.

Switching assembly ACO

20. To remove this assembly, proceed as follows:-

(1) Remove the four screws which hold the assembly to the right-hand chassis.

(2) Unscrew the SMA connector and remove the rigid pipe which connects to the attenuator assembly ADO.

(3) Remove the SMC connector which is below the SMA connector.

(4) Ease off the ribbon cable which connects to the connector PLM on the motherboard AB1.

(5) Remove the SMA and SMB connectors which connect to the N and BNC RF IN/OUT connector.

21. This assembly should not be dismantled. If a fault is found, the complete assembly should be replaced.

22. When reassembling, follow the above procedure in the reverse order. When replacing the rigid pipe, take particular care not to overtighten the connector.

Attenuator assembly

23. Remove attenuator assembly ADO from the instrument to gain access to part of AB1, and disassemble it to gain access to AT1. Proceed as follows:-

(1) Unscrew and remove the rigid pipe connecting to switching assembly ACO. Unscrew the connector to the r.f. tray lead.

(2) Support the assembly while removing the two screws from the side frame. The assembly may now be removed, still connected by its ribbon cable.

(3) To obtain access to AT1, remove the two screws on the inside of the assembly and slide the cover off.

(4) Unplug the ribbon cable at the AT1 end.

(5) Further disassembly is inadvisable. Any fault found requires the replacement of the complete unit.

(6) When reassembling, take particular care not to overtighten the rigid pipe connectors.

Shaft encoder removal

24. Remove the VARIABLE control knob. Open the front panel (see above) to gain access to keyboard AF1. Remove the nut holding the encoder shaft to the board and remove the unit.

Board removal notes

25. The following notes should be read prior to removal of a board for repair or replacement.

Boards AA1,AA2,AA3 and AA4: Compress and remove the spring connectors joining AA1 to AA2 and AA3 to AA4. Unscrew hexagonal pillars and screws as necessary to remove the board.

Boards AB2,AB3,AB4,AB5 and AB6: These plug-in boards are held in board guides inside the cardframe. To remove a board, pull up the levers fitted to the top of each board to disengage it from its socket, then lift it out. When replacing a board, ensure that it is fitted with the component side facing the centre of the instrument and that the slot in the board engages with the peg in the motherboard socket.

Board AC1: Remove the c.r.t. drive shield. Undo the three nuts on the side frame and lever the board assembly inwards and upwards. Separate the heatsink plate from the board by removing the screws from one side and the nut from the other. When replacing, ensure that the board is fitted in its guide.

Board AF1: Open the front panel to gain access. Remove the VARIABLE knob and the six screws holding the board in place.

Board AF2: Open the front panel to gain access. Remove all four analogue control knobs and the nuts holding two of the shafts to the front panel.

Board AR1: Pull off PLA and PLB. Unscrew the six hexagonal pillars and the central nut on the heatsink, then remove the board.

Board AR4: Open the rear panel to gain access. Remove the two screws holding the board then unsolder leads as necessary to remove the board.

Board AT1: Do not remove this board. In case of a fault, replace the complete attenuator assembly.

Board AT2: To remove, unsolder all leads.

Board AZ1: It is inadvisable to remove this board from the encoder assembly as doing so may damage the lenses. In case of a fault, replace the complete assembly.

TABLE 1 TEST EQUIPMENT FOR PERFORMANCE CHECKS

Description	Minimum specification	Example
Spectrum Analyzer	Frequency range: 0.4 - 1000 MHz	Marconi TF 2370 + TK 2373
Power Meter & Sensors	Frequency range: 0.4 - 1000 MHz Power measurement range: -65 to +20 dB Accuracy: better than 0.15 cB	Marconi 6960 + 6912 & 6920 Sensors
Modulation Meter	AM measurement: 1.5 - 400 MHz FM measurement: 0.5 - 100 MHz AM accuracy: 1% at 1 kHz rate, 2.5% at rates 50 Hz - 15 kHz FM accuracy: 2% D-mod output: 0.3-3.4 kHz weighted filter	Marconi 2305
Distortion Meter	0.2% distortion accuracy	Marconi 2331A
Frequency Counter	Frequency range: 0.4 - 1000 MHz 1 MHz Std. O/P	Marconi 2435
Synthesized LF Generator	20 Hz - 20 kHz sine and square level 0 to 2 V RMS 1 MHz Std. O/P	HP 3325A
DVM	20 Hz - 20 kHz, 0.02% accuracy RMS DC measurement down to 1 mV	Datron 1065A
Counter/Timer	50 Hz - 15 kHz, accuracy better than 0.005 Hz	Marconi 2438
Audio Analyzer	Sinad measurement psophometric filter	HP 8903A
AC/DC Calibrator	DC 0 - 100 V, AC 1 kHz, level accuracy better than 0.05%	Rotek 3950
Signal Generator	Synthesized freq.: 1.5 - 1000 MHz, 1 MHz Std. O/P. RF level: 13 dBm FM: 0 - 25 kHz deviation AM: 0 - 90% Ext. mod. 50 Hz - 10 kHz, Ext. Std. I/P	Marconi 2019A
Power Splitter	6 dB splitter, 50 Ω 1.5 - 400 MHz	HP 11667A
RF Power Source	Overall uncertainty of 2% up to 500 MHz, 3 % up to 1000 MHz	See RF Power Perform. Check
Standard Frequency Source	Frequency accuracy better than ±5 parts in 10^{10}	Rubidium or Caesium ref.
Oscilloscope	100 MHz dual channel	Tektronix 2235
Power Supply	Capable of supplying 55 W at 11 V	Coutant LB1000.2
50 Ω termination	50 Ω ±1% 1/2 W	Suhner

Chapter 5-1

PERFORMANCE TESTING

CONTENTS

GENERAL

1. This section contains information for keeping the instrument in good working order and checking its overall performance. For these purposes this chapter should be read in conjunction with the Technical Description, Chap. 4, and the Circuit Diagrams, Chap. 7.

2. Integrated circuits and semiconductor devices are used throughout this instrument and, although these have inherent long term reliability and mechanical ruggedness, they are susceptible to damage by overloading, reversed polarity and excessive heat or radiation. Avoid hazards such as prolonged soldering, strong r.f. fields or other forms of radiation and the use of insulation testers.

3. In case of difficulties which cannot be resolved with the aid of this book, please contact our Service Division at the address given inside the rear cover, or your nearest Marconi Instruments representative. Always quote the type and serial number found on the data plate at the rear of the instrument.

PERFORMANCE TESTS

4. Test procedures described in this chapter may be simplified and of restricted range compared with the comprehensive factory test facilities which are necessary to demonstrate complete compliance with the specifications.

5. Performance limits quoted are for guidance and should not be taken as guaranteed performance specifications unless they are also quoted in the Performance Data in Chap. 1.

6. When verifying that the instrument meets the stated performance limits, allowance must always be made for the uncertainty of the test equipment used.

OSCILLOSCOPE PERFORMANCE CHECKS

7. The oscilloscope performance checks comprise a.f. level d.c. offset, a.f. level gain, and demodulated f.m. and a.m. gain.

Frequency range & accuracy specification

8. This section checks that the instrument performs to the following specification:-

DC to 50 kHz (3 Hz on a.c.) ±5% accuracy
FM deviation ±10% accuracy
AM depth ±10% accuracy

Frequency range & accuracy test gear

9. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
AC/DC Calibrator	Accuracy 1.5% d.c.	Rotek 3950
Signal Generator	100 MHz, a.m./f.m. Level 7 dBm	Marconi 2019A
Modulation meter	AM/FM 100 MHz Accuracy >3%	Marconi 2305
Power splitter	6 dB, 100 MHz	HP 11667A

Checking a.f. level d.c. offset

10. Proceed as follows:-

MUST BE IN AUDIO TEST MODE TO CHANGE COUPLING.

(1) On the u.u.t. select RX and SCOPE, d.c. coupled. Short out the AF INPUT socket.

(2) Use the oscilloscope vertical POSITION control to bring the trace onto the centre of the graticule.

(3) Scan through the vertical scale ranges and check that the trace does not move more than 1/4 division between ranges.

Checking a.f. level gain

11. Proceed as follows:-

(1) Set the u.u.t. to RX, SCOPE, d.c. coupled, 50 kHz LOW PASS filter, distortion/SINAD/SN off.

(2) Use the vertical POSITION control to move the trace to the bottom dotted graticule line.

(3) Connect the equipment as shown in Fig. 1.

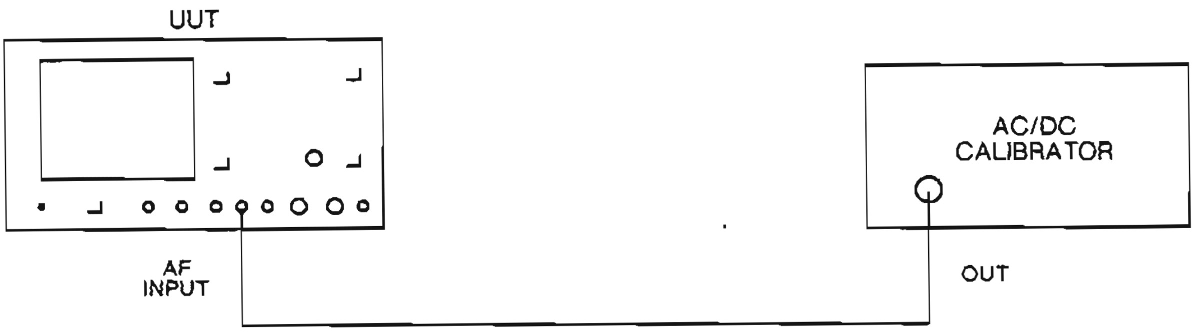


Fig. 1 Test equipment connections for oscilloscope a.f. level gain performance checks

(4) Set the oscilloscope to 2 V/div. Set the calibrator to output + d.c. and adjust the level until the oscilloscope trace appears on the top dotted graticule line. Check that the calibrator output is within 9.5 to 10.5 V.

(5) Repeat step (4) above for the remaining oscilloscope ranges and calibrator limits shown in Table 1.

TABLE 1 AF LEVEL GAIN - OSCILLOSCOPE

Scope range	Nominal d.c. Volts	Calibrator limits
2 V/div	10 V	9.5 - 10.5 V
1 V/div	5 V	4.75 - 5.25 V
500 mV/div	2.5 V	2.375 - 2.625 V
50 mV/div	0.25 V	0.2375 - 0.2625 V

Checking demodulated f.m. gain

12. Proceed as follows :-

(1) Connect the equipment as shown in Fig. 2.

(2) Set the u.u.t. to TX, FM, SCOPE, 0.3 - 3.4 kHz BAND PASS filter, b.n.c. input socket.

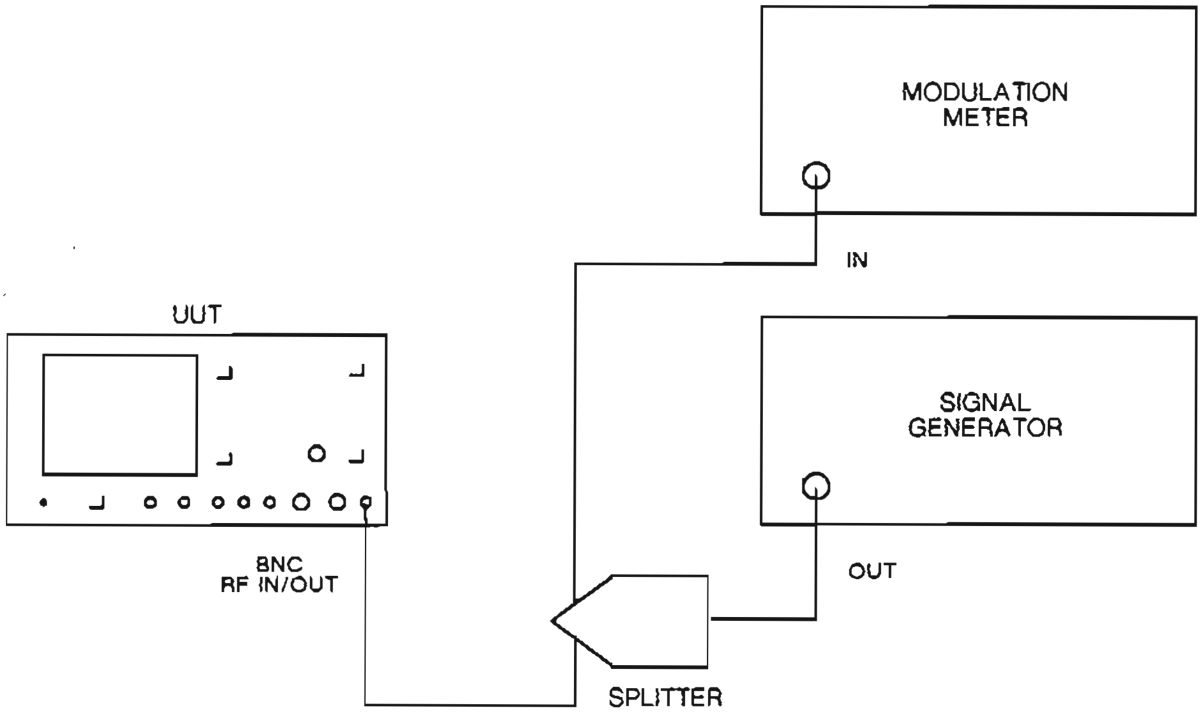


Fig. 2 Test equipment connections for oscilloscope demodulated f.m. gain performance checks.

(3) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, f.m., 1 kHz internal modulation rate.

(4) Set the modulation meter to monitor f.m., (p-p)/2, in a 0.3 - 3.4 kHz bandwidth.

(5) Set the u.u.t. oscilloscope range to ±30 kHz deviation. Adjust the signal generator f.m. deviation until the f.m. deviation on the oscilloscope is shown as 20 kHz. Check on the modulation meter that the deviation limits are within 18.0 to 22.0 kHz.

(6) Repeat step (5) above for the remaining oscilloscope ranges and deviation limits shown in Table 2.

TABLE 2 DEMODULATED FM GAIN - OSCILLOSCOPE

Scope range ± deviation	FM deviation on scope	Modulation meter limits
30 kHz	20 kHz	18.0 - 22 .0 kHz
15 kHz	10 kHz	9.0 - 11.0 kHz
6 kHz	4 kHz	3.6 - 4.4 kHz
3 kHz	2 kHz	1.8 - 2.2 kHz
1.5 kHz	1 kHz	0.9 - 1.1 kHz

<u>Checking demodulated a.m. gain</u>

13. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 2.

(2) Set the u.u.t. to TX, AM, SCOPE, 0.3 - 3.4 kHz BAND PASS filter, b.n.c. input socket.

(3) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, a.m., 1 kHz internal modulation rate.

(4) Set the modulation meter to monitor a.m., (p-p)/2, in a 0.3 - 3.4 kHz bandwidth.

(5) Set the u.u.t. oscilloscope range to 20%/div. Adjust the signal generator depth until the waveform on the oscilloscope is shown as 80%. Check on the modulation meter that the depth limits are within 72 to 88%.

(6) Repeat step (5) above for the remaining oscilloscope ranges and modulation depths shown in Table 3.

TABLE 3 DEMODULATED AM GAIN - OSCILLOSCOPE

Scope range (% a.m./div)	AM depth on scope	Modulation meter limits
20	80%	72 - 88%
10	40%	36 - 44%
5	20%	18 - 22%

MODULATION METER PERFORMANCE CHECKS

14. The modulation meter performance checks comprise demodulation distortion, a.m. and f.m. monitor accuracy, a.m. and f.m. bar chart and scope, and input sensitivity.

Demodulation distortion specification

15. This section checks that the instrument performs to the following specification:-

<2% distortion at 30% a.m. and 1 kHz mod. freq. (in a 0.3 - 3.4 kHz bandwidth). <2% distortion at 5 kHz deviation and 1 kHz mod freq. (in a 0.3 - 3.4 kHz bandwidth).

Demodulation distortion test gear

16. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Signal generator	1.5 - 1000 MHz, f.m. & a.m.	2019A
Distortion meter	0.2% distortion accuracy at 1 kHz.	TF2331A

Checking demodulation distortion

17. Proceed as follows but note that the distortion of the modulated signal being applied will affect the de- mod distortion and therefore should not be more than 0.5%:-

(1) Connect the equipment as shown in Fig. 3.

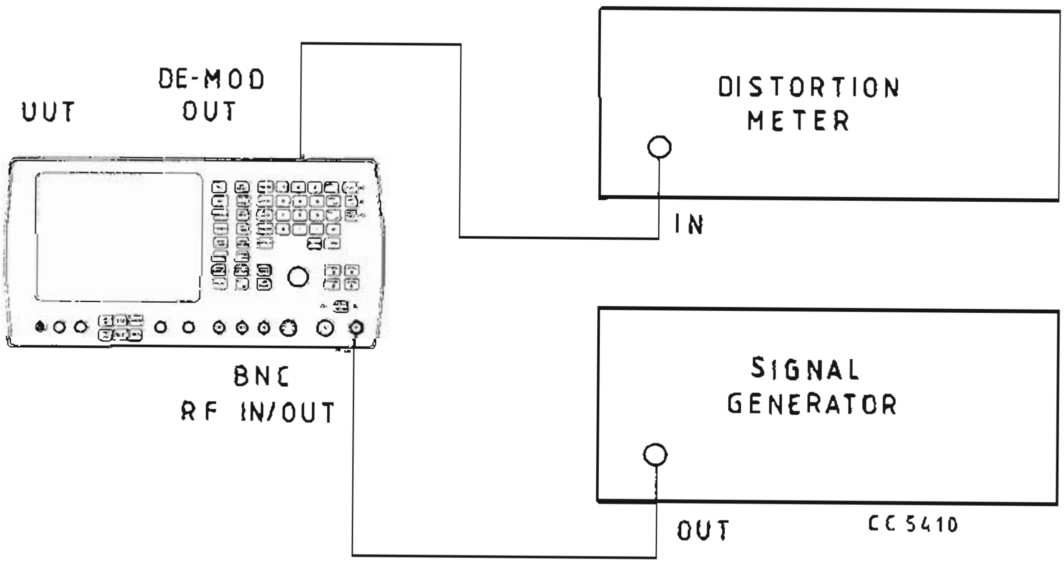


Fig. 3 Test equipment connections for modulation meter demodulation distortion performance checks

(2) Set the u.u.t. to TX, AM, 0.3 - 3.4 kHz BAND PASS filter, b.n.c. input socket.

(3) Set the signal generator to carrier frequency 100 MHz, level 0 dBm, 30% a.m., 1 kHz internal modulation rate.

(4) Tune in the distortion meter and check that the distorion indicated is <2%.

(5) Change the u.u.t. modulation to f.m.

(6) Change the signal generator modulation to 5 kHz f.m., modulation rate 1 kHz.

(7) Tune in the distortion meter and check that the distortion indicated is <2%.

AM monitor accuracy specification

18. This section checks that the instrument performs to the following specification:-

±6% of reading ±1 digit at 1 kHz. ±8.5% of reading ±1 digit (50 Hz-10 kHz).

AM monitor accuracy test gear

19. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Signal generator	1.4-400 MHz, a.m. capability ext. mod. 50 Hz-10 kHz, 0-90%. RF level 13 dBm.	Marconi 2019A
Modulation meter	1.5-400 MHz. AM accuracy 1%.	Marconi 2305
LF synthesizer	50 Hz-10 kHz. 1 V r.m.s. level.	HP 3325A
Power splitter	6 dB splitter. 50 Ω, 1.5-400 MHz.	HP 11667A

Checking a.m. monitor accuracy

20. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 4.

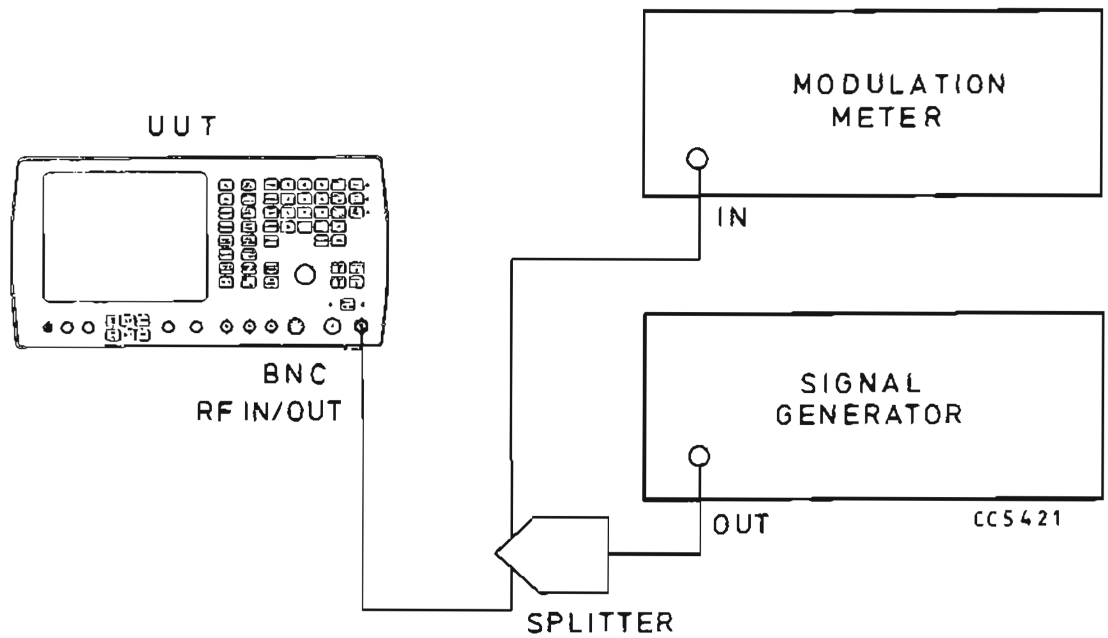


Fig. 4 Test equipment connections for modulation meter a.m. & f.m. monitor accuracy performance checks

(2) Set the u.u.t. to TX, AM, 0.3 - 3.4 kHz BAND PASS filter, b.n.c. input socket.

(3) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, 80% a.m., 1 kHz internal modulation rate.

(4) Set the modulation meter to monitor a.m. in a 0.3 - 3.4 kHz bandwidth.

(5) Check that the a.m. level indicated on the u.u.t. display is within ±6% of reading ±1 digit of modulation depth indicated on the modulation meter.

(6) Repeat the above for modulation depths from 0 to 90% and carrier frequencies between 1.5 and 100 MHz.

(7) Repeat for modulation depths from 0 to 80% and carrier frequencies between 1.5 and 400 MHz.

Checking operation of a.m. bar chart and scope

21. Proceed as follows:=-

(1) Connect the equipment as shown in Fig. 5.

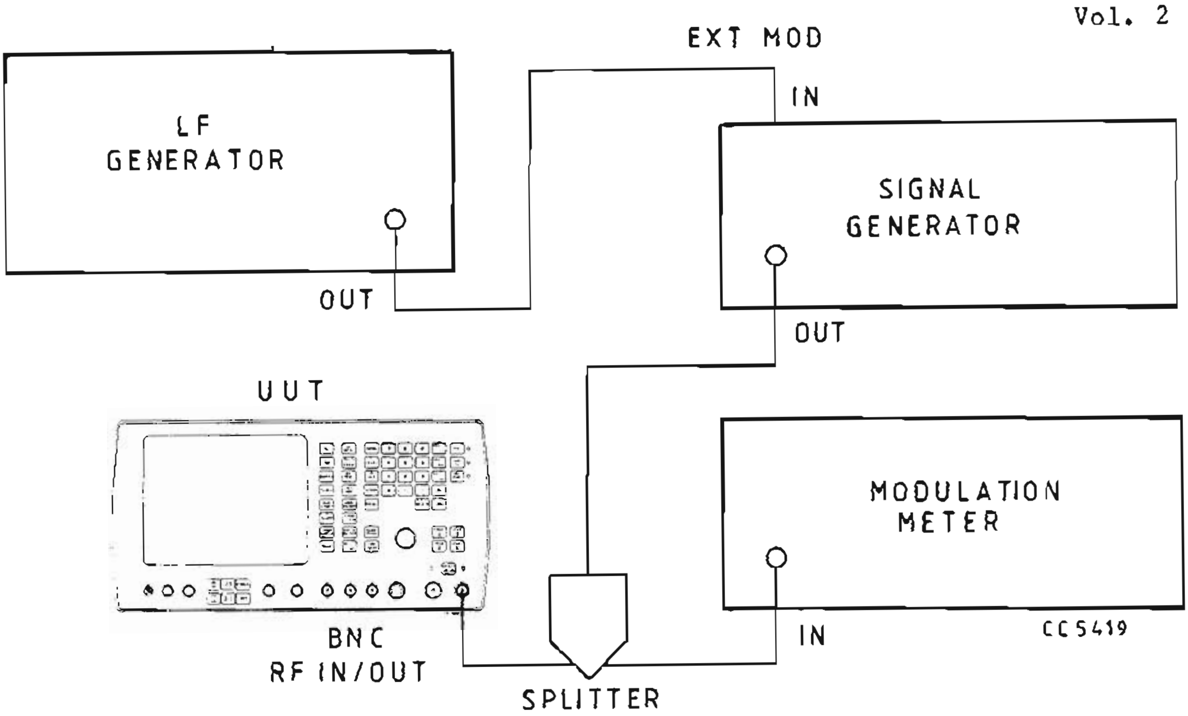


Fig. 5 Test equipment connections for modulation meter a.m. & f.m. bar chart and scope performance checks

(2) Set the u.u.t. to TX, AM, 15 kHz LOW PASS filter, b.n.c. input socket. DIST'N ON/OFF TO OFF (or low freq. AM [illegible])

(3) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, 80% external a.m. at a 10 kHz modulation rate (from the l.f. generator).

(4) Set the modulation meter to monitor a.m. in a 30 Hz to 50 kHz bandwidth.

(5) Set the synthesized l.f. generator to give a 10 kHz sinewave. Adjust the level to suit the external modulation input of the signal generator.

(6) Check that the a.m. level indicated on the u.u.t. display is within ±8.5% of reading ±1 digit of modulation depth indicated on the modulation meter.

(7) Repeat the above for modulation rates between 50 Hz and 10 kHz. Ensure that the correct filters are selected on both the u.u.t. and the modulation meter according to the modulation rate being used.

FM monitor accuracy specification

22. This section checks that the instrument performs to the following specification:-

±6% ±1 digit at 1 kHz.
±8.5% over range 50 Hz-10 kHz.

FM monitor accuracy test gear

23. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Signal generator	1.5-1000 MHz, level 13 dBm. FM 0-25 kHz deviation. FM ext. mod. 50 Hz-10 kHz.	Marconi 2019A
Modulation meter	1.5-1000 MHz. FM accuracy 1%.	Marconi 2305
LF synthesizer	50 Hz-10 kHz. 1 V r.m.s. level.	HP 3325A
Power splitter	6 dB splitter. 50 Ω, 1.5-1000 MHz.	HP 11667A

Checking f.m. monitor accuracy

24. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 4.

(2) Set the u.u.t. to TX, FM, 0.3 - 3.4 kHz BAND PASS filter, distortion/SINAD/SN off, b.n.c. input socket.

(3) Set the signal generator to carrier frequency 500 MHz, level 13 dBm, 25 kHz f.m., 1 kHz internal modulation rate.

(4) Set the modulation meter to monitor f.m. in a 0.3 to 3.4 kHz bandwidth.

r (5) Check that the f.m. level indicated on the u.u.t. display is within ±6% of reading ±1 digit of modulation deviation indicated on the modulation meter.

(6) Repeat the above for random carrier frequencies from 1.5 to 1000 MHz and random deviation between 0 and 25 kHz.

Checking operation of f.m. bar chart and scope

25. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 5.

(2) Set the u.u.t. to TX, FM, 15 kHz LOW PASS filter, b.n.c. input socket.

(3) Set the signal generator to carrier frequency 500 MHz, level 13 dBm, 25 kHz external f.m. at 10 kHz modulation (from the l.f. generator).

(4) Set the modulation meter to monitor f.m. in a 30 Hz to 50 kHz bandwidth.

(5) Set the synthesized l.f. generator to give a 10 kHz sinewave. Adjust the level to suit the external modulation input of the signal generator.

(6) Check that the modulation level indicated on the u.u.t. display is within ±8.5% of the modulation indicated on the modulation meter. Ensure that the correct filters are selected on both the u.u.t. and the modulation meter according to the modulation rate being used.

Input sensitivity specification

26. This section checks that the instrument performs to the following specification:-

N-type socket sensitivity 5 mW. 7 dBm In one port duplex mode, sensitivity is reduced to 20 mW. 13 dBm

Input sensitivity test gear

27. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Signal generator	Synthesized freq. 1.5-1000 MHz. 1 MHz standard output. Level 13 dBm, f.m.	Marconi 2019A
Power meter & sensor	1.5-1000 MHz. -30 to +20 dBm.	Marconi 6960 + Sensor 6912

Checking input sensitivity

28. Proceed as follows:-

(1) Set the u.u.t. to TX, FM, 0.3 - 3.4 kHz BAND PASS filter, N-type input socket.

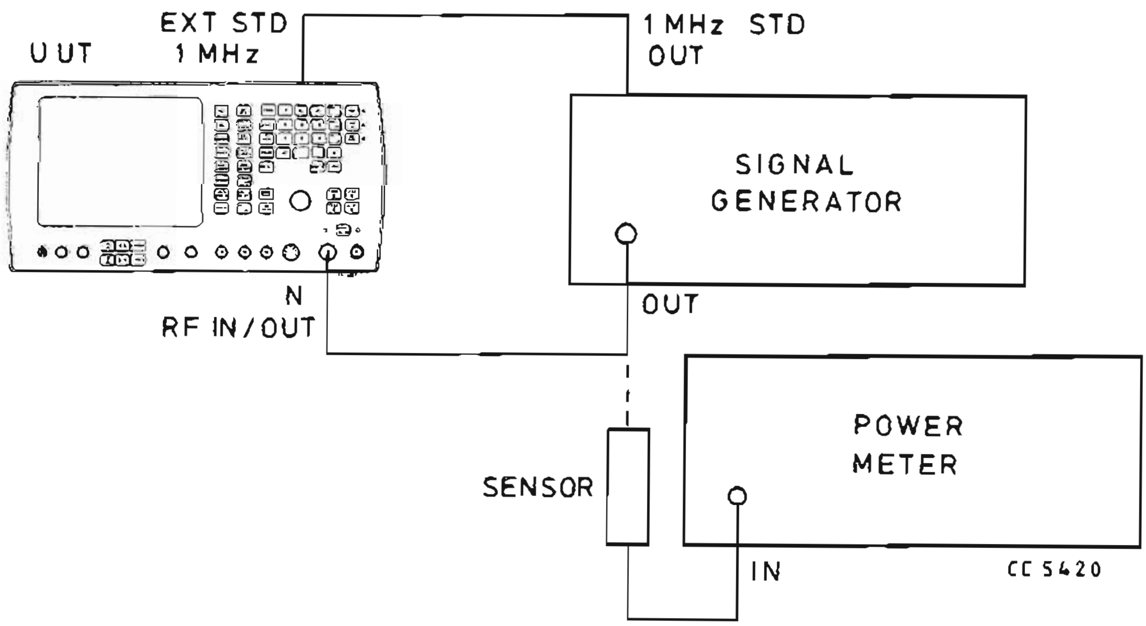


Fig. 6 Test equipment connections for modulation meter input sensitivity performance checks.

(2) Set the signal generator to carrier frequency 400 MHz, modulation 10 kHz f.m., modulation rate 1 kHz.

(3) Connect the power meter to the signal generator output (see Fig. 6) and adjust the r.f. level to give 5 mW indication on the power meter.

(4) Connect the signal generator to the u.u.t. N-type input socket (see Fig. 4) and check that the u.u.t. modulation meter reads 10 kHz f.m. deviation.

(5) Set the u.u.t. to one port duplex mode and repeat the above checks with the signal generator output set to 20 mW.

VOLTMETER PERFORMANCE CHECKS

29. The voltmeter performance checks comprise d.c. and a.f. level meter accuracy, and a.f. level meter frequency response.

DC and a.f. level meter accuracy specification

30. This section checks that the instrument performs to the following specification:-

±3% of reading ±3 mV ±1 digit

Level meter accuracy test gear

31. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
AC/DC calibrator	DC 0-100 V, a.c. 1 kHz. Level accuracy better than 0.05%.	Rotek 3950

Checking d.c. and a.f. level meter accuracy

32. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 7.

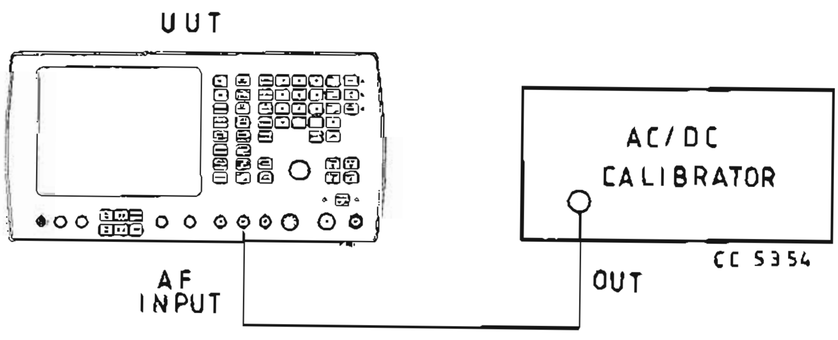


Fig. 7 Test equipment connections for voltmeter d.c. & a.f. level accuracy performance checks

(2) Set the u.u.t. to audio test, distortion off, 50 kHz LOW PASS filter, d.c. coupled.

(3) Set the calibrator to give 1.000 V d.c.

(4) Check that the reading on the a.f. voltmeter indicates the voltage set on the calibrator ±3% of reading ±3 mV ±1 digit.

(5) Repeat for random d.c. levels up to 100 V.

(6) Check the operation of the bar chart and oscilloscope.

(7) Set the u.u.t. to a.c. coupled.

(8) Set the calibrator to give 1.000 V a.c. at 1 kHz.

(9) Check that the reading on the a.f. voltmeter indicates the voltage set on the calibrator ±3% of reading ±3 mV ±1 digit.

(10) Repeat at 1 kHz for random levels up to 100 V.

AF level meter frequency response specification

33. This section checks that the instrument performs to the following specification:-

±3% of reading ±3 mV ±1 digit

AF level meter frequency response test gear

34. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
LF synthesizer	50 Hz-20 kHz. Level 2 V r.m.s.	HP 3325A R & S SPN
RMS d.v.m.	50 Hz-20 kHz. Accuracy better than 0.02%.	Datron 1065A
50 Ω termination	50 Ω ±1%, 1/2 W.	Suhner

Checking a.f. level meter frequency response

35. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 8.

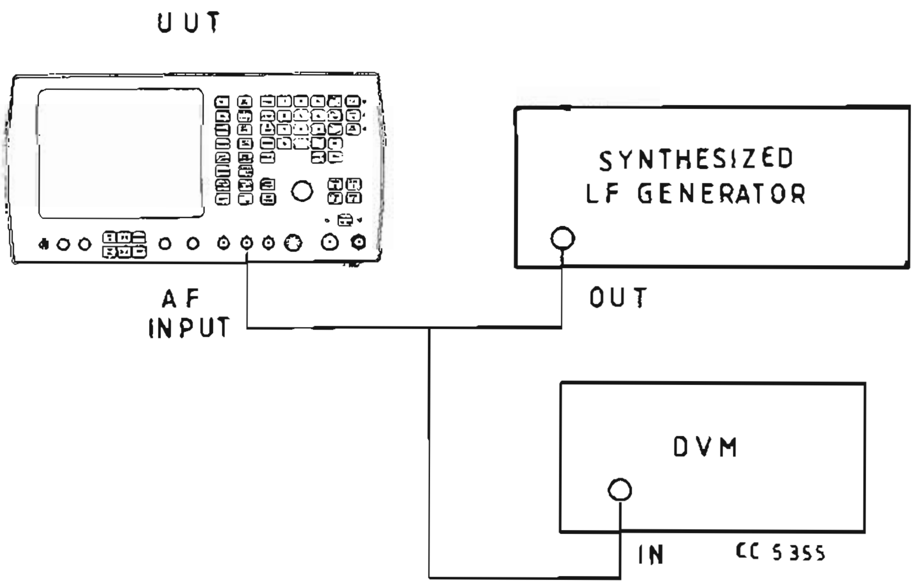


Fig. 8 Test equipment connections for voltmeter frequency response performance checks

(2) Set the u.u.t. to audio test, distortion off, 50 kHz LOW PASS filter, a.c. coupled.

(3) Set the synthesized l.f. generator to give a 1 kHz sinewave at 1 V r.m.s. into 50 Ω.

(4) Set the d.v.m. to monitor a.c., r.m.s.

(5) Check that the reading on the a.f. voltmeter is within ±3% of reading ±3 mV ±1 digit of reading indicated on the d.v.m.

(6) Repeat the above for l.f. generator frequencies between 50 Hz and 20 kHz.

RF FREQUENCY METER PERFORMANCE CHECKS

36. The r.f. frequency meter performance checks comprise accuracy and input sensitivity.

Accuracy specification

37. This section checks that the instrument performs to the following specification:-

Accuracy: As internal standard ±1 digit

Accuracy test gear

38. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Signal generator	Synthesized freq. 1.5-1000 MHz. 1 MHz standard output.	Marconi 2019A

Checking accuracy

39. Note that the following method checks the r.f. frequency meter (internal counters/dividers) is working correctly. However, overall accuracy depends upon the correct setting of the internal 10 MHz standard (see under 'Adjustments' in the board checks for AC1). Proceed as follows:-

(1) Connect the equipment as shown in Fig. 9.

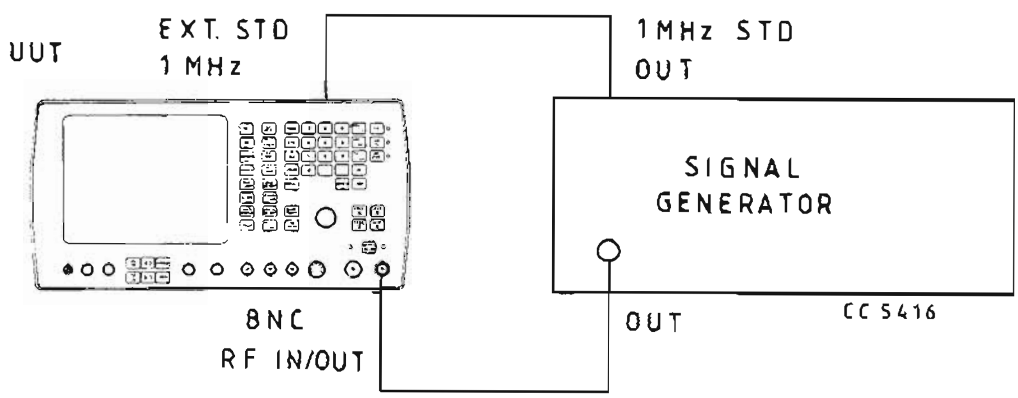


Fig. 9 Test equipment connections for r.f. frequency meter accuracy performance checks

(2) Set the u.u.t. to TX, b.n.c. input socket.

(3) Set the signal generator to carrier frequency 1000 MHz, level 7 dBm, modulation off.

(4) Check that the u.u.t. indicates the signal generator frequency ±1 count.

(5) Repeat the above for frequencies between 1.5 and 1000 MHz.

Input sensitivity specification

40. This section checks that the instrument performs to the following specification:-

N-type socket sensitivity 5 mW. In one port duplex mode, sensitivity is reduced to 20 mW.

Input sensitivity test gear

41. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Signal generator	Synthesized freq. 1.5-1000 MHz. 1 MHz standard output. Level 13 dBm, f.m.	Marconi 2019A
Power meter & sensor	1.5-1000 MHz. -30 to +20 dBm.	Marconi 6960 + Sensor 6912

Checking input sensitivity

42. Proceed as follows:-

(1) Set the u.u.t. to TX, N-type input socket.

(2) Set the signal generator to carrier frequency 100 MHz, modulation off.

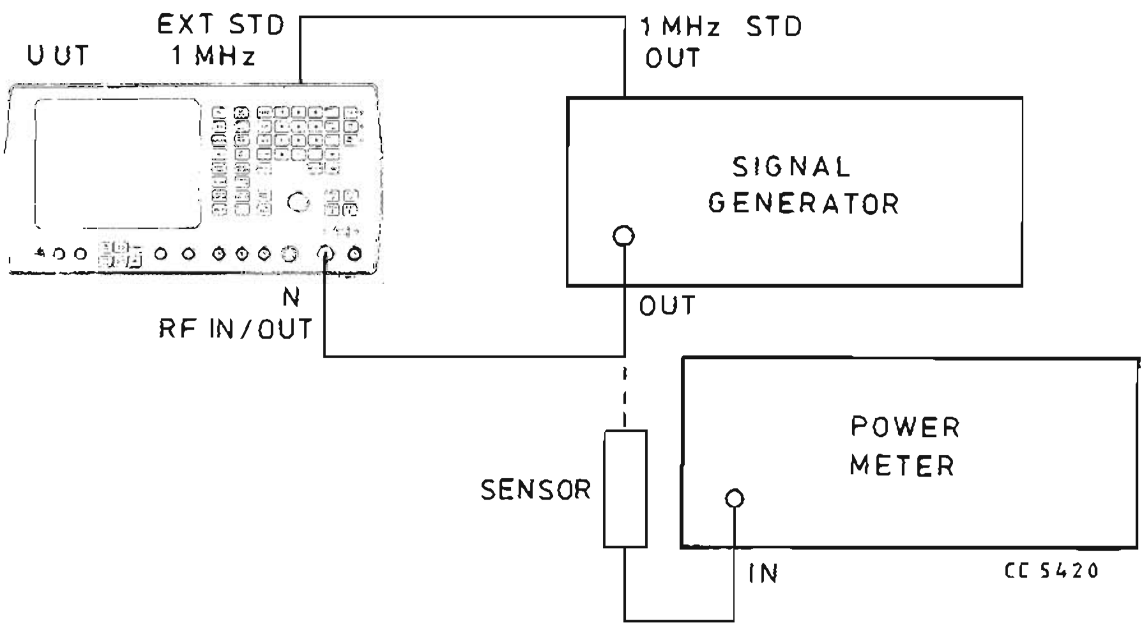


Fig. 10 Test equipment connections for r.f. frequency meter input sensitivity performance checks

(3) Connect the power meter to the signal generator output (see Fig. 10) and adjust the r.f. level to give 5 mW indication on the power meter.

(4) Connect the signal generator to the u.u.t. N-type input socket (see Fig. 2). Check that the u.u.t. frequency meter is locked and stable and indicates the frequency set on the signal generator ±10 Hz.

(5) Repeat the above for frequencies from 1.5 to 1000 MHz.

AF FREQUENCY METER PERFORMANCE CHECKS

43. The a.f. frequency meter performance checks comprise frequency accuracy and sensitivity.

Frequency accuracy and sensitivity specification

44. This section checks that the instrument performs to the following specification:-

As internal standard ±1 digit ±0.1 Hz/0.02%. Sensitivity 50 mV.

Frequency accuracy and sensitivity test gear

45. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
LF synthesizer	20 Hz-20 kHz. 1 MHz standard output.	HP 3325A
50 Ω termination	50 Ω, 1/2 W.	Suhner
DVM	0.5% accuracy.	Datron 1065A

Checking frequency accuracy and sensitivity

46. Note that the following method checks the a.f. frequency meter is working correctly. However, overall accuracy depends upon the correct setting of the internal 10 MHz standard (see under 'Adjustments' in the board checks for AC1. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 11.

(2) Set the u.u.t. to audio test, distortion off, 50 kHz LOW PASS filter, a.c. coupled.

(3) Set the synthesized l.f. generator to give a 20 kHz sinewave at 50 mV r.m.s.

(4) Set the d.v.m. to read a.c. and r.m.s.

(5) Adjust the l.f. synthesizer output level until the d.v.m. indicates 50 mV.

(6) Check that the frequency meter on the u.u.t. indicates the frequency set on the synthesizer ±1 digit ±0.1 Hz/0.02%.

(7) Repeat the above for random l.f. synthesizer frequencies between 20 Hz and 20 kHz.

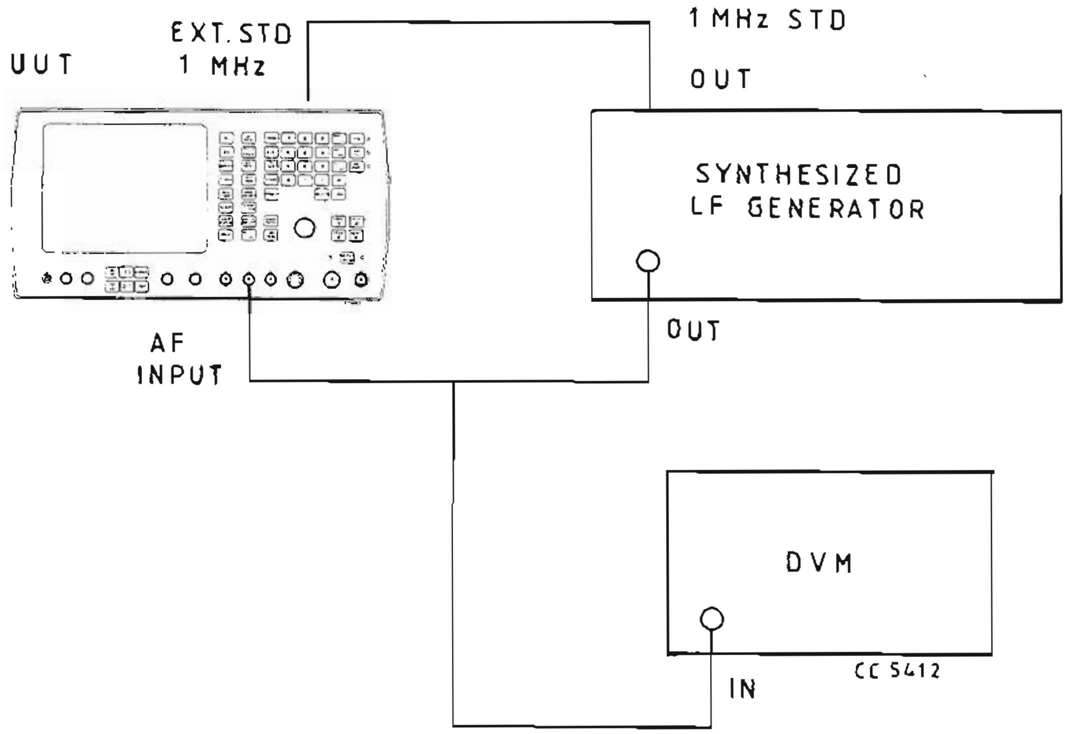


Fig. 11 Test equipment connections for a.f. frequency meter accuracy and sensitivity performance checks

AF GENERATOR PERFORMANCE CHECKS

47. The a.f. generator performance checks comprise output level accuracy, distortion, frequency accuracy, d.c. offset, residual noise, and spurious signals.

Output level accuracy specification

48. This section checks that the instrument performs to the following specification:-

Range :	1 mV-2.55 V up to 5 kHz. 1 mV-2 V up to 15 kHz.
Accuracy:	±5% ±1 count, 50 Hz-15 kHz.

Output level accuracy test gear

49. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
RMS voltmeter	AC voltage 20 Hz-20 kHz. Accuracy better than 0.5% of reading, 50 mV-2.55 V.	Datron 1065A

Checking output level accuracy

50. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 12.

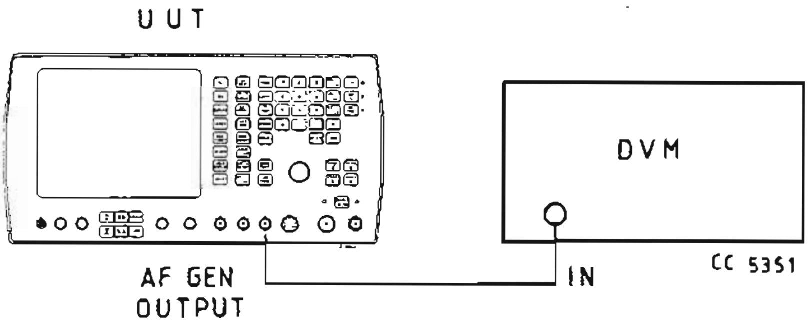


Fig. 12 Test equipment connections for a.f. generator output level accuracy performance checks

(2) Set the u.u.t. to AF GEN, frequency 1 kHz, level 1.00 V.

(3) Check that the voltmeter reads the a.f. generator level set on the u.u.t. ±5% ±1 count.

(4) Repeat for random a.f. generator frequencies and levels.

Distortion specification

51. This section checks that the instrument performs to the following specification:-

Less than 2% up to 15 kHz. Less than 1% for the 1 kHz fixed source.

Distortion test gear

52. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Distortion meter	Frequency range 50 Hz-15 kHz. Better than 0.2% distortion.	Marconi TF 2331A

Checking distortion

53. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 13.

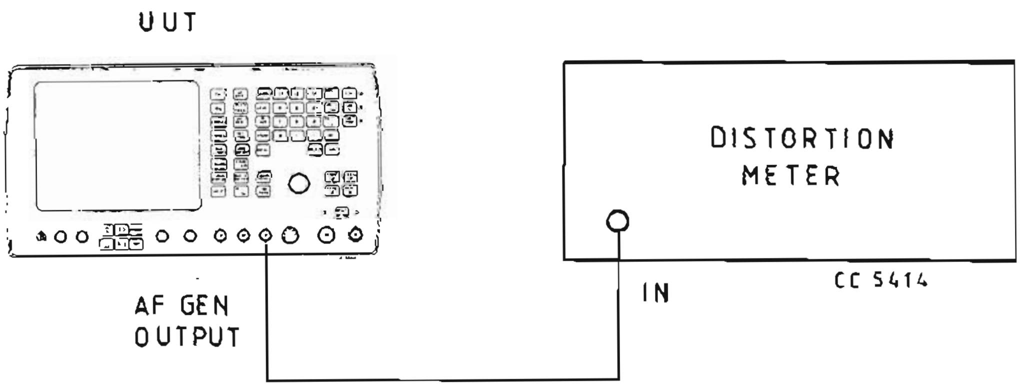


Fig. 13 Test equipment connections for a.f. generator distortion performance checks

(2) Set the u.u.t. to AF GEN, frequency 5 kHz, level 2 V.

(3) Tune in the distortion meter and check that the distortion indicated is less than 2%.

(4) Repeat for random levels and frequencies between 50 Hz and 15 kHz.

(5) Change the u.u.t. a.f. generator frequency to 1 kHz.

(6) Tune in the distortion meter and check that the distortion indicated is less than 1%.

AF generator frequency accuracy specification

54. This section checks that the instrument performs to the following specification:-

±0.01 Hz from 50 Hz to 3.25 kHz.
±0.1 Hz from 3.25 kHz to 15 kHz.

Frequency accuracy test gear

55. The following test gear is required to check to the above specification:-

Description	Minimum spec.	Example
Frequency counter/timer	50 Hz-15 kHz, Accuracy better than 0.1 Hz.	Marconi 2438

Checking frequency accuracy

56. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 14.

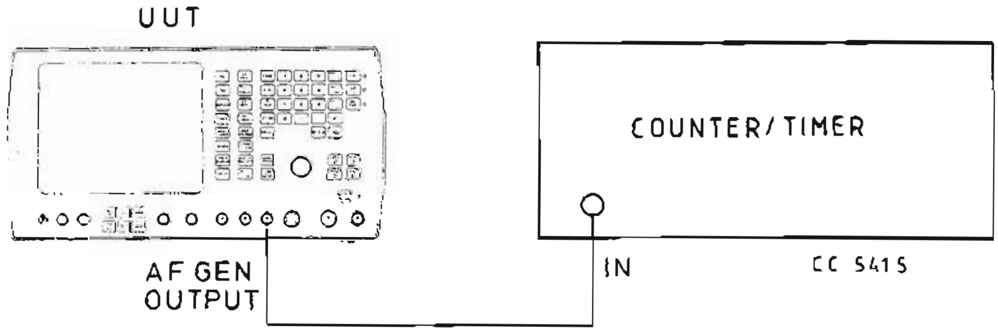


Fig. 14 Test equipment connections for a.f. generator frequency accuracy performance checks

(2) Set the u.u.t. to AF GEN, frequency 15 kHz, level 1 V.

(3) Set the counter/timer to read period (to gain the required resolution).

(4) Check that the counter/timer reads between 66666.2 and 66667.1 ns (15 kHz ±0.1 Hz).

(5) Repeat the above for random frequencies between 3.25 kHz and 15 kHz checking on the counter/timer that the frequency selected is within ±0.1 Hz.

(6) Repeat for random frequencies between 50 Hz and 3.25 kHz checking on the counter/timer that the frequency selected is within ±0.01 Hz.

AF generator d.c. offset, residual noise, and spurious signals

57. This section checks that the instrument performs to the following specification:-

> Spurious less than -26dBc (at 9370 Hz ±20 Hz only).
> Residual noise less than 0.2 mV r.m.s. in psophometric band (less than 0.4 mV at exactly 1 kHz).
> DC offset less than 100 mV d.c.

DC offset, residual noise and spurious signals test gear

58. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
DVM	DC measurement down to 1 mV.	Marconi 2610
Audio analyzer	SINAD measurement, psophometric filter.	HP 8903A

Checking d.c. offset

59. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 15.

(2) Set the u.u.t. to AF GEN, frequency 50 Hz, level 0 mV.

(3) Set the d.v.m. to measure d.c. level.

(4) Check that the d.c. level indicated on the d.v.m. is less than 100 mV d.c.

(5) Repeat the above for random frequencies between 50 Hz and 15 kHz.

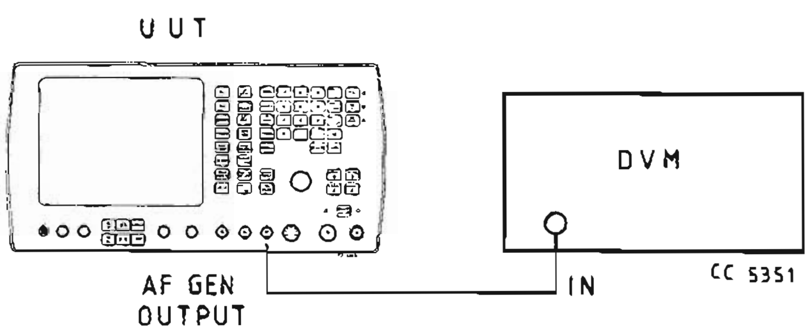


Fig. 15 Test equipment connections for a.f. generator d.c. offset performance checks

Checking residual noise

60. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 16.

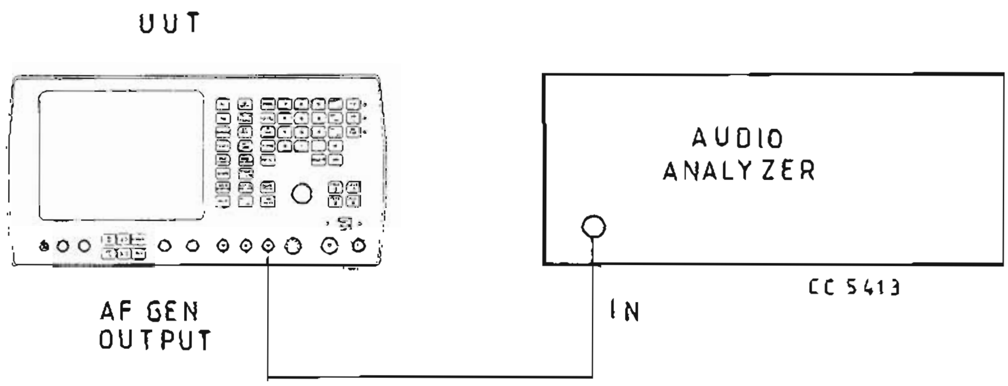


Fig 16 Test equipment connections for a.f. generator residual noise spurious signals performance checks

(2) Set the u.u.t. to AF GEN, frequency 50 Hz, level 0 mV.

(3) Set the audio analyser to a.c. level, psophometric band-pass filter on. All other filters off.

(4) Check that the a.c. level indicated on the audio analyser is less than 0.2 mV r.m.s.

(5) Repeat the above for random frequencies between 50 Hz and 15 kHz.

(6) Repeat for exactly 1 kHz and check that residual noise is less than 0.4 mV r.m.s.

Checking spurious signals

61. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 16.

(2) Set the u.u.t. to AF GEN, frequency 9370 Hz, level 2 V.

(3) Set the audio analyser to 9370 Hz, SINAD, 30 kHz low-pass filter. All other filters off.

(4) Check that the audio analyser reads greater than 27 dB.

DISTORTION/SINAD METER PERFORMANCE CHECKS

62. The distortion/SINAD meter performance check comprises distortion accuracy.

Distortion accuracy specification

63. This section checks that the instrument performs to the following specification:-

Distortion: ±5% of reading ±0.5% distortion. SINAD: ±1 dB.

Distortion accuracy test gear

64. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
LF synthesizer	3.5 kHz sinewave, level 0-1 V r.m.s.	HP 3325A
Distortion meter	0.2% distortion at 1 kHz.	Marconi 2331A
Power splitter	6 dB, d.c. to 50 kHz.	HP 11667A

Checking distortion accuracy

65. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 17.

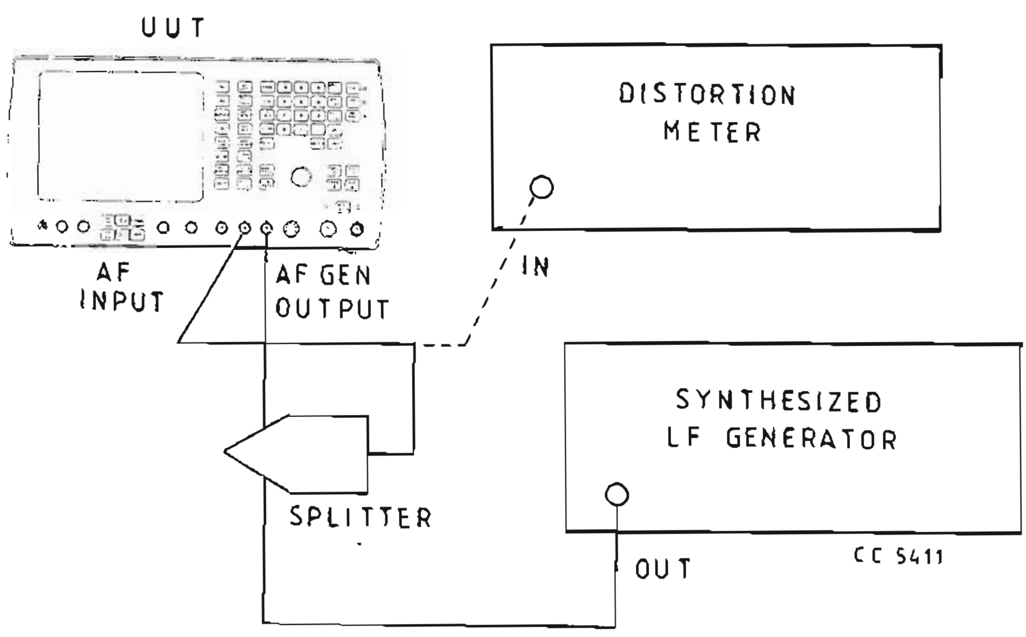


Fig. 17 Test equipment connections for distortion/SINAD meter distortion accuracy performance checks

(2) Set the u.u.t. to RX, distortion on, 50 kHz LOW PASS filter.

(3) Set the synthesized l.f. generator to give a 3.5 kHz sinewave.

(4) Adjust the synthesizer output level until the distortion meter on the u.u.t. indicates 20% distortion.

(5) Remove the splitter from the u.u.t. AF INPUT socket, and connect it to the distortion meter input.

(6) Tune the distortion meter to 1 kHz and check that the distortion displayed is between 18.5 and 21.5%.

(7) Reconnect the splitter to the u.u.t. AF INPUT socket.

(8) Adjust the synthesizer output level until the distortion meter on the u.u.t. indicates 10% distortion.

(9) Select SINAD and the 50 kHz LOW PASS filter on the u.u.t.

(10) Check that the SINAD reading on the u.u.t. is 20 dB ±1 dB.

RF POWER METER PERFORMANCE CHECKS

66. The r.f. power meter performance check comprises accuracy.

Accuracy specification

67. This section checks that the instrument performs to the following specification:-

Accuracy:	±10% ±1 count up to 500 MHz ±15% ±1 count up to 960 MHz ±20% ±1 count up to 1000 MHz

Measurement accuracy test gear

68. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Calibrated power source (as below)	Overall uncertainty of 2% up to 500 MHz 3% up to 1000 MHz.	
Signal generator	1.5-1000 MHz, r.f. level 13 dBm.	Marconi 2019A
RF amplifier	1.5-1000 MHz.	Marconi TF2177
Directional coupler	1.5-1000 MHz, 20 dB coupling.	HP 778D (100-1000 MHz) + Mini Circuits ZFDC203 (1.5-100 MHz)
Power meter & Sensor	1.5-1000 MHz, ±0.15 dB accuracy, -30 dBm to +20 dBm.	Marconi 6960, 69012, 6920, sensors

Checking measurement accuracy

69. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 18, using the high frequency coupler. But note that the power source must be calibrated at the frequencies to be checked.

(2) Set the u.u.t. to TX, N-type input socket.

(3) Set the power source to give an output of 2 W at 100 MHz.

(4) Check that the u.u.t. indicates 2 W ±10% ±1 count.

(5) Set the power source to give 220 mW.

(6) Check that the u.u.t. indicates 220 mW ±10% ±1 count.

(7) Repeat the above for random frequencies between 100 and 500 MHz.

(8) Repeat for random frequencies between 500 and 960 MHz and check that the u.u.t. indicates the power sent ±15% ±1 count.

(9) Repeat for random frequencies between 960 and 1000 MHz and check that the u.u.t. indicates the power sent ±20% ±1 count.

(10) Replace the high frequency directional coupler (HP 778D) with the low frequency coupler.

(11) Repeat the above checks for random frequencies between 1.5 and 100 MHz and check that the u.u.t. indicates the power sent ±10% ±1 count.

(12) Set the u.u.t. to one port duplex mode and repeat the above checks.

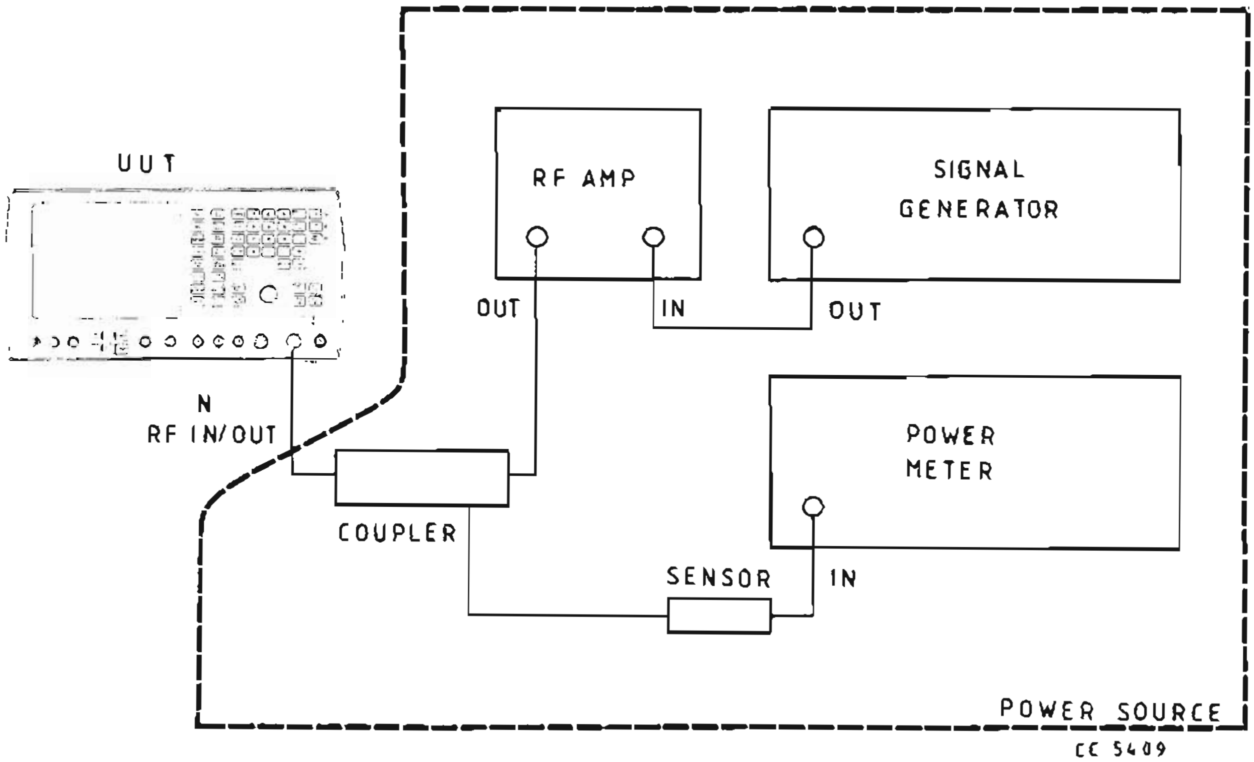


Fig. 18 Test equipment connections for r.f. power meter measurement accuracy performance checks

SELCALL PERFORMANCE CHECKS

70. The Selcall performance checks comprise tones operation.

Tones operation test gear

71. The only test gear required is a second fully operational 2955.

Checking Selcall tones

72. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 19.

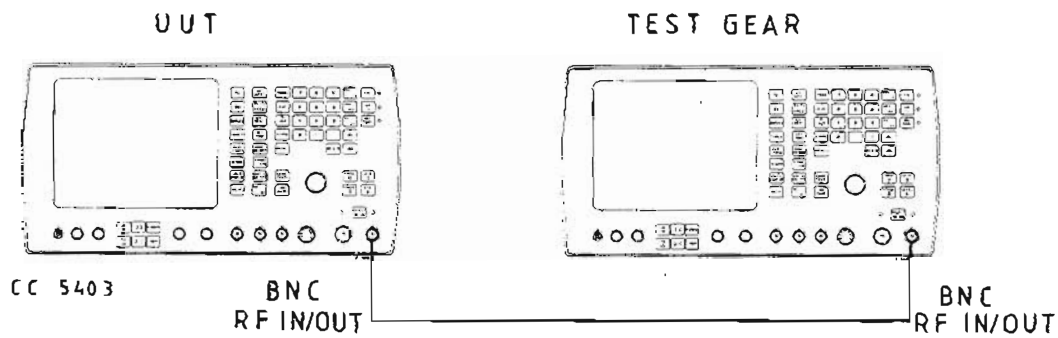


Fig. 19 Test equipment connections for Selcall tones performance checks

(2) Set the u.u.t. to RX, carrier frequency 100 MHz, level 0 dBm, modulation off, b.n.c. output socket.

(3) On the u.u.t. press TONES and select CCIR.

(4) Set the 2955 test gear to TX, b.n.c. input socket. Press TONES and select CCIR.

(5) On the u.u.t. enter tone numbers 1 to 10 using the data keys. Press the tone burst key.

(6) Check that the transmitted tones 1 to 10 appear on the 2955 test gear with 0% error.

(7) Repeat the above with the instrument settings reversed, and check that the u.u.t. receives the tones correctly.

RF GENERATOR PERFORMANCE CHECKS

73. The r.f. generator performance checks comprise: output level, r.f. accuracy, a.m. & f.m. internal accuracy, a.m. & f.m. distortion, external a.m. & f.m., r.f. leakage, f.m. on c.w., and carrier harmonics, sub-harmonics and spurious signals.

Output specification

74. This section checks that the instrument performs to the following specification:-

±2 dB for levels above -127 dBm

Output level test gear

75. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Power meter & sensors	0.4-1000 MHz, -65 to 0dBm, accuracy better than ±0.15 dB.	Marconi 6960 + Sensors 6920 & 6912

Checking output level

76. Proceed as follows, but note that checking low levels (less than -60 dBm) requires the use of specialised attenuator measurement equipment:-

(1) Connect the equipment as shown in Fig. 20, using the 6920 power sensor.

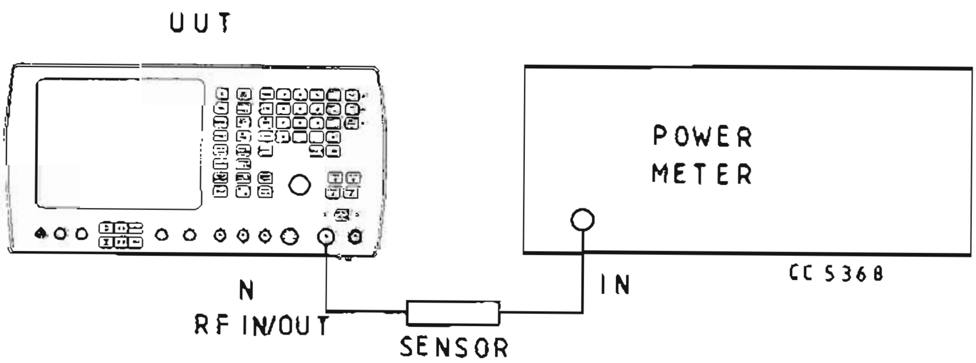


Fig. 20 Test equipment connections for r.f. generator output level performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 300 MHz, level -20 dBm, increments 1 dB, modulation off, N-type output socket.

(3) Check that the level indicated on the power meter agrees with the level set on the u.u.t. ±2 dB.

(4) Decrement the u.u.t. in 1 dB steps to -60 dBm and check that each step is within +/- 2 dB of the level set.

(5) Repeat the above checks for random frequencies between 10 MHz and 1000 MHz.

(6) Replace the power sensor with the 6912.

(7) Repeat the above checks for random frequencies between 0.4 and 10 MHz.

RF accuracy specification

77. This section checks that the instrument performs to the following specification:-

Accuracy: As internal standard

RF accuracy test gear

78. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Frequency counter	0.4-1000 MHz, 1 MHz standard output	Marconi 2435

Checking r.f. accuracy

79. Note that the following method checks that the frequency synthesizer is working correctly. However, overall accuracy depends upon the correct setting of the internal 10 MHz standard (see under 'Adjustments' in the board checks for AC1). Proceed as follows:-

(1) Connect the equipment as shown in Fig. 21.

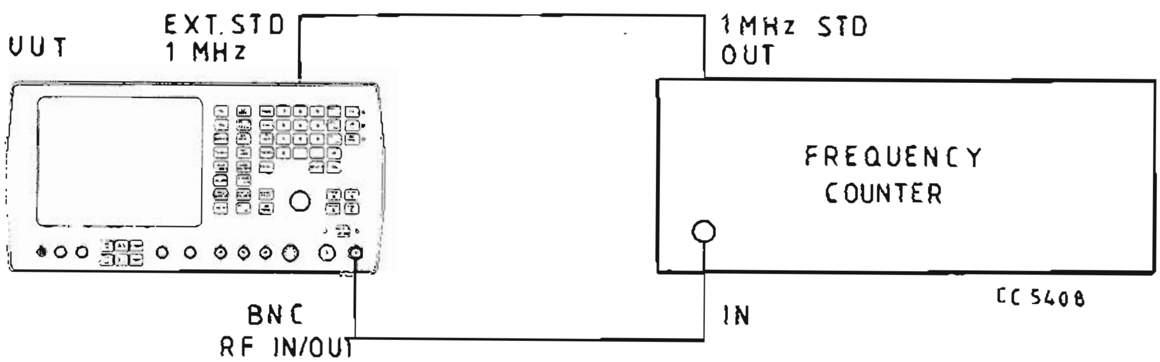


Fig. 21 Test equipment connections for r.f. generator r.f. accuracy performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 1000 MHz, level 0 dBm, modulation off, b.n.c. output socket.

(3) Check that the counter displays the frequency set on the u.u.t. ±20 Hz.

(4) Repeat the above for random frequencies between 0.4 and 1000 MHz.

AM internal accuracy specification

80. This section checks that the instrument performs to the following specification:-

±7% ±1 digit at 1 kHz. ±10% of reading ±1 digit from 50 Hz to 5 kHz only and 0 to 60% a.m. only. ±15% of reading ±1 digit from 50 Hz to 15 kHz and 0 to 70% a.m.

AM internal accuracy test gear

81. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Modulation meter	AM measurement 0.5-1000 MHz, accuracy 1% at 1 kHz rate, 2.5% at rates 50Hz-15 kHz.	Marconi 2305

Checking internal a.m. accuracy

82. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 22.

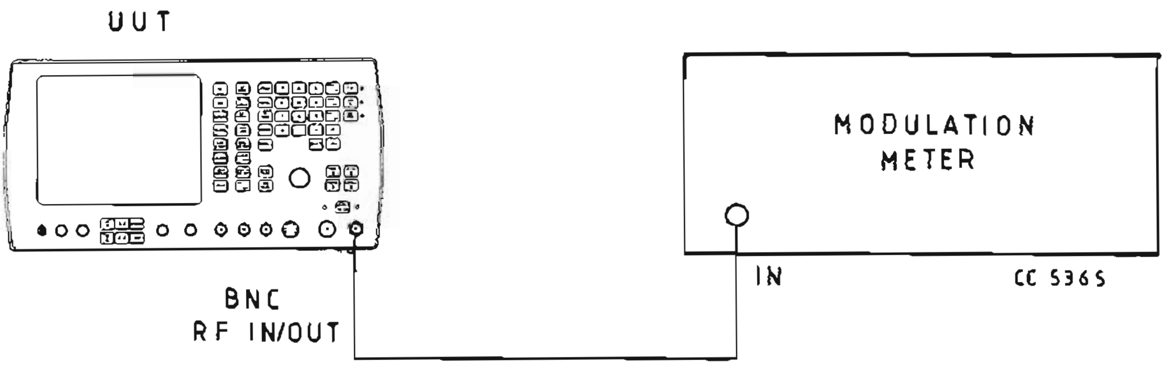


Fig. 22 Test equipment connections for r.f. generator a.m. & f.m. internal accuracy performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 100 MHz, level 0 dBm, amplitude modulation frequency 1 kHz, modulation level 70%, distortion/SINAD/SN off, b.n.c. output socket.

(3) Set the modulation meter to monitor a.m. with 0.3-3.4 kHz band-pass filter selected.

(4) Check that the a.m. indicated on the modulation meter is within ±7% ±1 digit.

(5) Repeat the above at random levels of modulation between 0 and 70%, at random carrier frequencies between 1.5 and 400 MHz, and at random r.f. levels.

(6) Repeat with random modulation frequencies between 50 Hz and 5 kHz and modulation levels between 0 and 60%, while checking that the modulation meter reading is within ±10% of reading ±1 digit. Ensure that the correct filters are selected on the modulation meter according to the modulation rate being used.

(7) Repeat with random modulation frequencies between 5,0 kHz and 15 kHz and modulation levels between 0 and 70%, while checking that the modulation meter reading is within ±15% of reading ±1 digit. Ensure that the correct filters are selected on the modulation meter according to the modulation rate being used.

FM internal accuracy specification

83. This section checks that the instrument performs to the following specification:-

±7% ±10 Hz (at 1 kHz)
±10% (50 Hz to 15 kHz)

FM internal accuracy test gear

84. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Modulation meter f.m.	0.5-1000 MHz, accuracy 2%.	Marconi 2305

Checking f.m. internal accuracy

85. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 22.

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 100 MHz, level 0 dBm, f.m. frequency 1 kHz, modulation level 25 kHz, distortion/SINAD/SN off, b.n.c. output socket.

(3) Set the modulation meter to monitor f.m. with 0.3-3.4 kHz band-pass filter selected.

(4) Check that the f.m. deviation indicated on the modulation meter is within ±7% ±10 Hz.

(5) Repeat the above at random deviations between 0 and 25 kHz, and random carrier frequencies between 0.5 and 1000 MHz.

(6) Repeat for modulation rates between 50 Hz and 15 kHz and check that the modulation meter deviation reading is within ±10%. Ensure that the correct filters are selected on the modulation meter according to the modulation rate being used.

AM and f.m distortion specification

86. This section checks that the instrument performs to the following specification:-

AM:	<2% distortion at 1 kHz with 30% a.m. in a 0.3-3.4 kHz bandwidth.
FM:	<1% distortion at 1 kHz with 5 kHz deviation in a 0.3-3.4 kHz bandwidth.

AM and f.m. distortion test gear

87. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Modulation meter	AM & f.m. modulation, demodulated output.	Marconi 2305*
Distortion meter	Accuracy better than 0.3% at 1 kHz.	Marconi 2331A

* If the modulation meter has the distortion option fitted, the distortion meter is not required.

Checking a.m. & f.m. distortion

88. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 23.

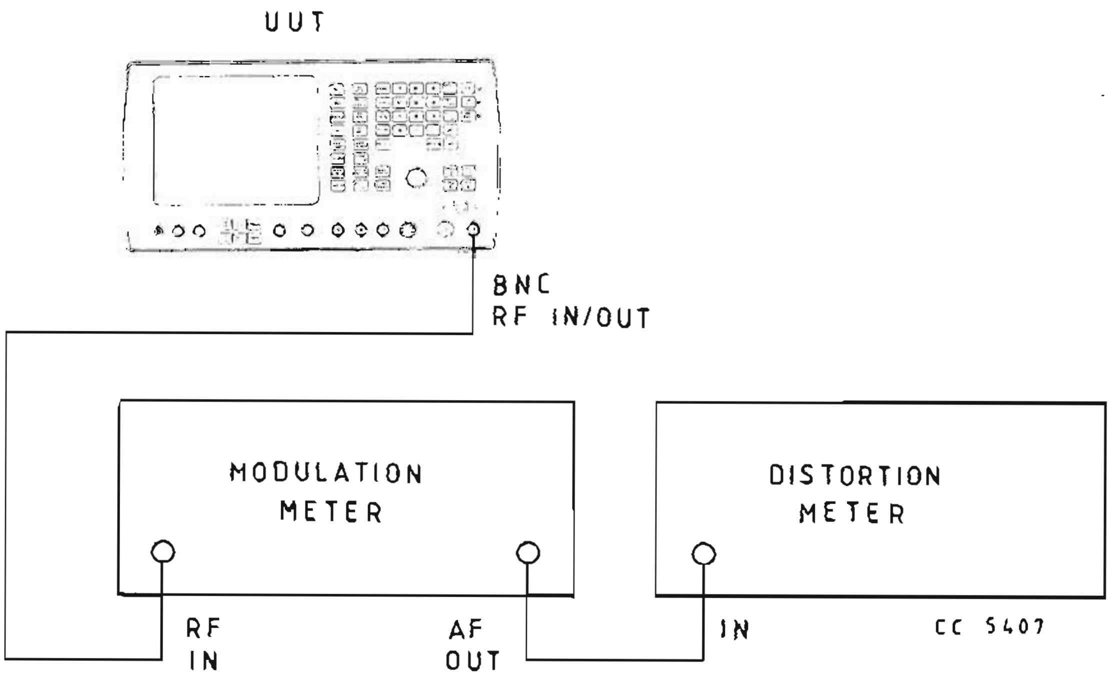


Fig. 23 Test equipment connections for r.f. generator a.m. & f.m. distortion performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 100 MHz, level 0 dBm, a.m. frequency 1 kHz, modulation depth 30%, distortion/SINAD/SN off, b.n.c. output socket.

(3) Set the modulation meter to monitor a.m. with 0.3-3.4 kHz band-width filter selected.

(4) Tune in the distortion meter and check that the reading is less than 2%.

(5) Change the u.u.t. modulation to 1 kHz f.m. with deviation 5 kHz.

(6) Set the modulation meter to monitor f.m. with 0.3-3.4 kHz band-width filter selected.

(7) Tune in the distortion meter and check that the reading is less than 1%.

External a.m. & f.m. specification

89. This section checks that the instrument performs to the following specification:-

AM sensitivity:	2 V p-p for 40% a.m., ±10% of reading ±1% a.m.
FM sensitivity:	2 V p-p for 10 kHz deviation, ±10% of reading.

External a.m. & f.m. test gear

90. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Modulation meter	1% a.m. accuracy at 1 kHz, 2.5% at rate 50 Hz-15 kHz, f.m. accuracy 2%.	Marconi 2305
LF synthesizer	50 Hz-15 kHz range	HP 3325A
DVM	0.5% accuracy	Datron 1065A

Checking external a.m. & f.m.

91. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 24.

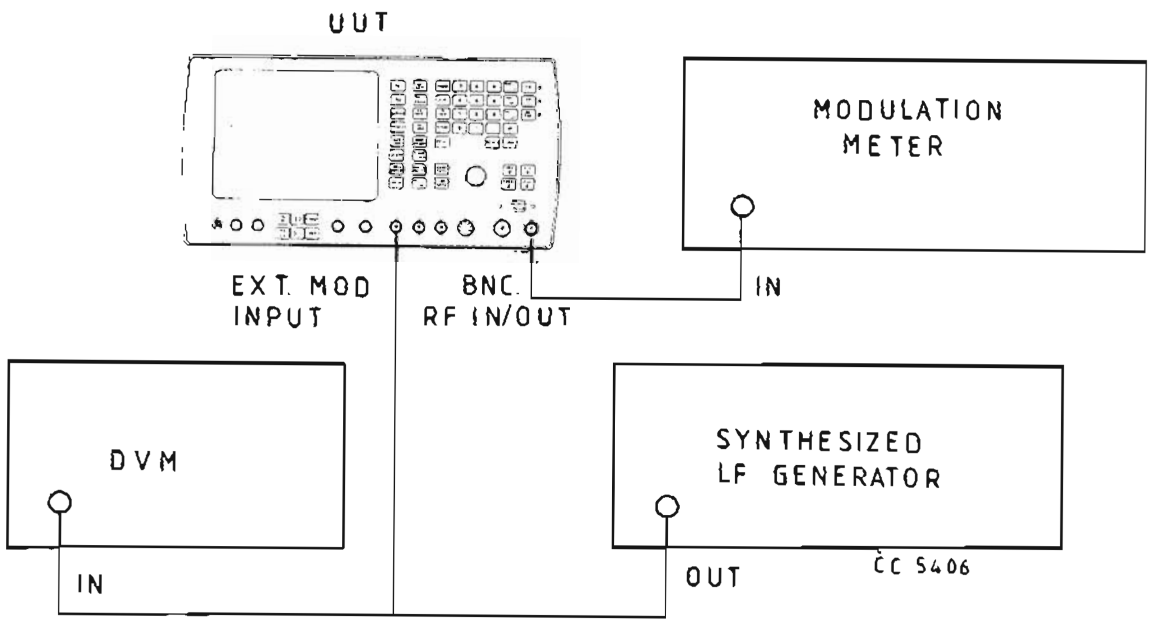


Fig. 24 Test equipment connections for r.f. generator external a.m. & f.m. performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 100 MHz, level 0.0 dBm, a.m. frequency 1 kHz, modulation depth 0%, distortion/SINAD/SN off, b.n.c. output socket.

(3) Set the synthesized l.f. generator to give a 1 kHz sinewave output and adjust the level to give an r.m.s. reading on the d.v.m. of 0.707.

(4) Set the modulation meter to monitor a.m. and select the 0.3-3.4 kHz band-pass filter.

(5) Check that the modulation meter displays 40% modulation +/- 10% of reading +/- 1% a.m.

(6) Set the u.u.t. to f.m. modulation level 0 kHz.

(7) Set the modulation meter to monitor f.m. with the 0.3-3.4 kHz band-pass filter selected.

(8) Check that the modulation meter displays 10 kHz deviation ±10% of reading.

(9) Repeat the above checks for external modulation frequencies between 50 Hz and 15 kHz. Ensure that the correct filters are selected on the modulation meter according to the modulation rate being used.

RF leakage specification

92. This section checks that the instrument performs to the following specification:-

<0.5 µV p.d. generated in a 50 Ω load by a 2-turn 25 mm loop as near as 25 mm to the case of the instrument with the output set to less than −20 dBm and the output terminated in a 50 Ω sealed load.

RF leakage test gear

93. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Spectrum analyser	0.4-1000 MHz	Marconi TF 2370 + TF 2373.
50 Ω sealed load	—	—
2-turn 25 mm loop	—	—

Checking r.f. leakage

94. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 25, with the 50 Ω load connected to the b.n.c. output socket.

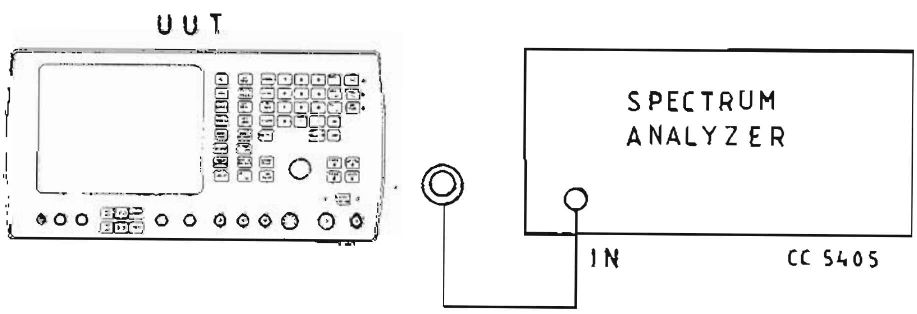


Fig. 25 Test equipment connections for r.f. generator r.f. leakage performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 500 MHz, level −20 dBm, b.n.c. output socket.

(3) Set the spectrum analyzer to monitor 500 MHz.

(4) Hold the loop 25 mm away from the u.u.t. case and check that the level picked up on the spectrum analyzer is less than 0.5 µV p.d.

FM on c.w. specification

95. This section checks that the instrument performs to the following specification:-

<30 Hz up to 520 MHz (0.3 - 3.4 kHz weighted r.m.s.).
<60 Hz up to 1000 MHz (0.3 - 3.4 kHz weighted r.m.s.).

FM on c.w. test gear

96. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Modulation meter	FM noise average, 0-1000 MHz, 0.3-3.4 kHz weighted filter.	Marconi 2305

Checking f.m. on c.w.

97. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 26.

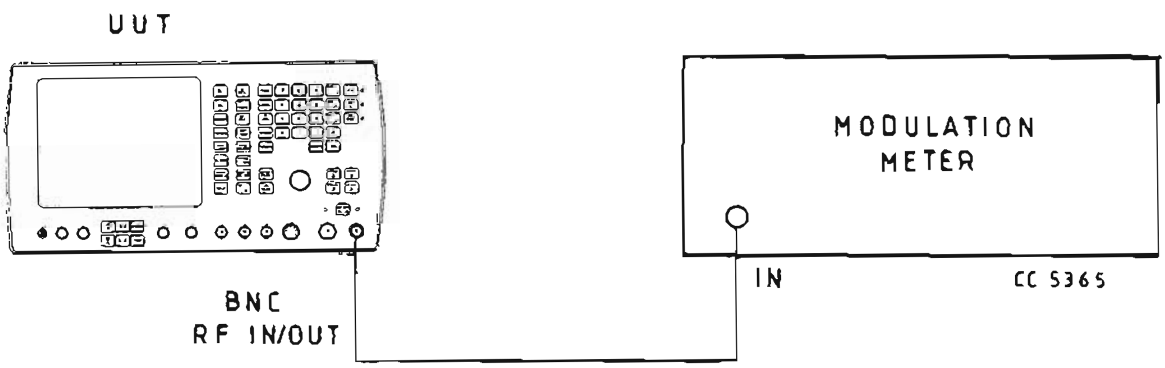


Fig. 26 Test equipment connections for r.f. generator f.m. on c.w. performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 520 MHz, level 0 dBm, modulation off, b.n.c. output socket.

(3) Set the modulation meter to monitor f.m., with noise average and 0.3-3.4 kHz band-pass filter selected.

(4) Check that the modulation meter indicates less than 30 Hz.

(5) Repeat the above for random frequencies below 520 MHz.

(6) Change the u.u.t. frequency to 1000 MHz and check that the modulation meter reads less than 60 Hz.

(7) Repeat the above for random frequencies between 520 and 1000 MHz.

Carrier harmonics, sub-harmonics & spurious signals specification

98. This section checks that the instrument performs to the following specification:-

Harmonics:	Harmonics are in band 0.4-1000 MHz only. Less than -20 dBc up to 1.5 MHz. Less than -25 dBc 1.5-250 MHz. Less than -20 dBc 250-1000 MHz.
Sub-harmonics:	None up to 530 MHz. Less than -25 dBc to 1000 MHz.
Spurious signals:	Carrier up to 88 MHz. Less than -45 dBc below 110 MHz Less than -35 dBc above 110 MHz. Carrier up to 1000 MHz. Less than -60 dBc.

Harmonics, sub-harmonics & spurious signals test gear

99. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
Spectrum analyzer	0.4-1000 MHz.	Marconi 2370 + 2373

Checking harmonics

100. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 27.

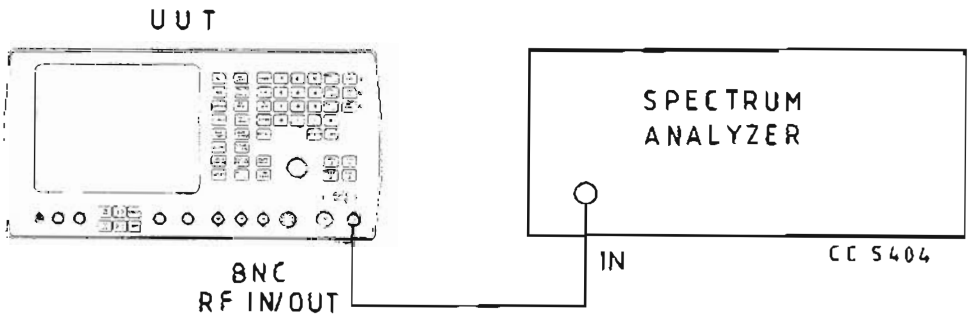


Fig. 27 Test equipment connections for r.f. generator harmonics, sub-harmonics & spurious signals performance checks

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 1.5 MHz, level 0 dBm, b.n.c. output socket.

(3) Adjust the spectrum analyzer controls to reference the 1.5 MHz fundamental on the top graticule line.

(4) Check that the harmonics are less than -20 dBc.

(5) Repeat the above at random frequencies between 0.4 and 1.5 MHz.

(6) Repeat at random frequencies between 1.5 and 250 MHz, checking that the harmonics are less than -25 dBc.

(7) Repeat at random frequencies between 250 and 1000 MHz, checking that the harmonics are less than -20 dBc.

Checking sub-harmonics

101. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 27.

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 530 MHz, level 0 dBm, b.n.c. output socket.

(3) Adjust the spectrum analyzer to reference the 530 MHz fundamental on the top graticule line.

(4) Check that all sub-harmonics are less than -25 dBc.

(5) Repeat the above for r.f. generator frequncies between 530 and 1000 MHz.

Checking spurious signals

102. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 27.

(2) Set the u.u.t. to RX, RF GEN, carrier frequency 88 MHz, level 0.0 dBm, b.n.c. output socket.

(3) Adjust the spectrum analyzer controls to reference the 88 MHz fundamental on the top graticule line.

(4) Check that all spurious signals below 110 MHz are less than -45 dBc and all spurious signals above 110 MHz are less than -35 dBc.

(5) Repeat for random carrier frequencies between 0.4 and 88 MHz.

(6) Repeat for random carrier frequencies between 88 and 1000 MHz checking that all spurious signals are less than -60 dBc.

Chapter 5-2

ADJUSTMENT AND CALIBRATION

CONTENTS

INTRODUCTION

1. This chapter describes adjustments which will restore the Test Set to its peak operating condition. Test equipment recommended for this purpose is listed in Chap. 5-0 and summarized for each test board procedure. Before carrying out any adjustment procedures refer to Chap. 5-0 for safety considerations and access instructions.

2. Adjustable procedures are described for each board and are listed in board alpha-numeric order. When it is known that re-adjustment is needed on just one or two boards it is normally sufficient to confine activities to those boards alone.

3. Adjustment and factory selected components are indicated on the circuit diagrams and their location is shown on the layout diagrams opposite the circuit diagrams.

TABLE 1 ADJUSTMENT GUIDE - PLUG-IN BOARDS

Adjustment	Para.	Board	Component
A-D converter calibration FM and ΦM monitor }	10	AB2	R14
RF power meter calibration	19	AB5	R106
FM and ΦM monitor	17	AB5	R129
AM monitor	16	AB5	R138
AM monitor	16	AB5	R168
AM monitor	16	AB5	R172
Scope path gain	18	AB5	R209
Voltmeter and scope ranging	12	AB5	R213
Voltmeter and scope ranging	12	AB5	R230
Voltmeter gain	13	AB5	R231
Voltmeter and scope ranging	12	AB5	R243
Voltmeter and scope ranging	12	AB5	R244
Band-pass filter	14	AB5	R305
Notch width	15	AB5	R314
AF generator output level	20	AB6	R11
AF generator output level	20	AB6	R12
AF generator output level	20	AB6	R48
RF output level calibration	22	AB6	R32

Note ...

Refer to relevant procedures detailed under board headings before attempting any adjustment.

TABLE 2 ADJUSTMENT GUIDE - NON-PLUG-IN BOARDS

ADJUSTMENT	Para.	BOARD	COMPONENT
Mixer 10 MHz rejection	6	AA1	R11
Phase detector balance	7	AA1	R27
Low frequency external f.m.	8	AA3	R138
200 MHz oscillator	9	AA4	C79
Linearity and width	30	AC1	L1
Frame height	27	AC1	R3
Frame linearity	28	AC1	R6
Vertical shift	29	AC1	R21
Focus	31	AC1	R26
10 MHz standard	26	AC1	R39
Low level volts	32	AR1	R46
+5 V supply line	33	AR1	R47

Note ...

Refer to relevant procedures detailed under board headings before attempting any adjustment.

4. The board tests always assume that all other sections of the instrument are working correctly. Also, for each test of a component or group of components, it is assumed that all other components on the board are working correctly. This approach enables a fault finding procedure to be continued down to component level, and also enables a quick functional check to be made following the replacement of a component or board. For these tests, the only equipment normally required is an oscilloscope.

5. Tables 1 and 2, which are intended for use with Fig. 1, summarize the various instrument adjustment points. Table 5 shows those for the plug-in boards held in the card-frame while Table 6 shows the remaining, generally less accessible, ones. Fig. 28 is a simplified plan view of the instrument and shows the adjustment points that are accessible from above the instrument while also showing the locations of all boards except those in the r.f. tray. Note however, that in the majority of cases adjustment should only be necessary following component replacement. Adjustments may be made in accordance with the details given under the appropriate board headings, using the equipment specified in Table 1.

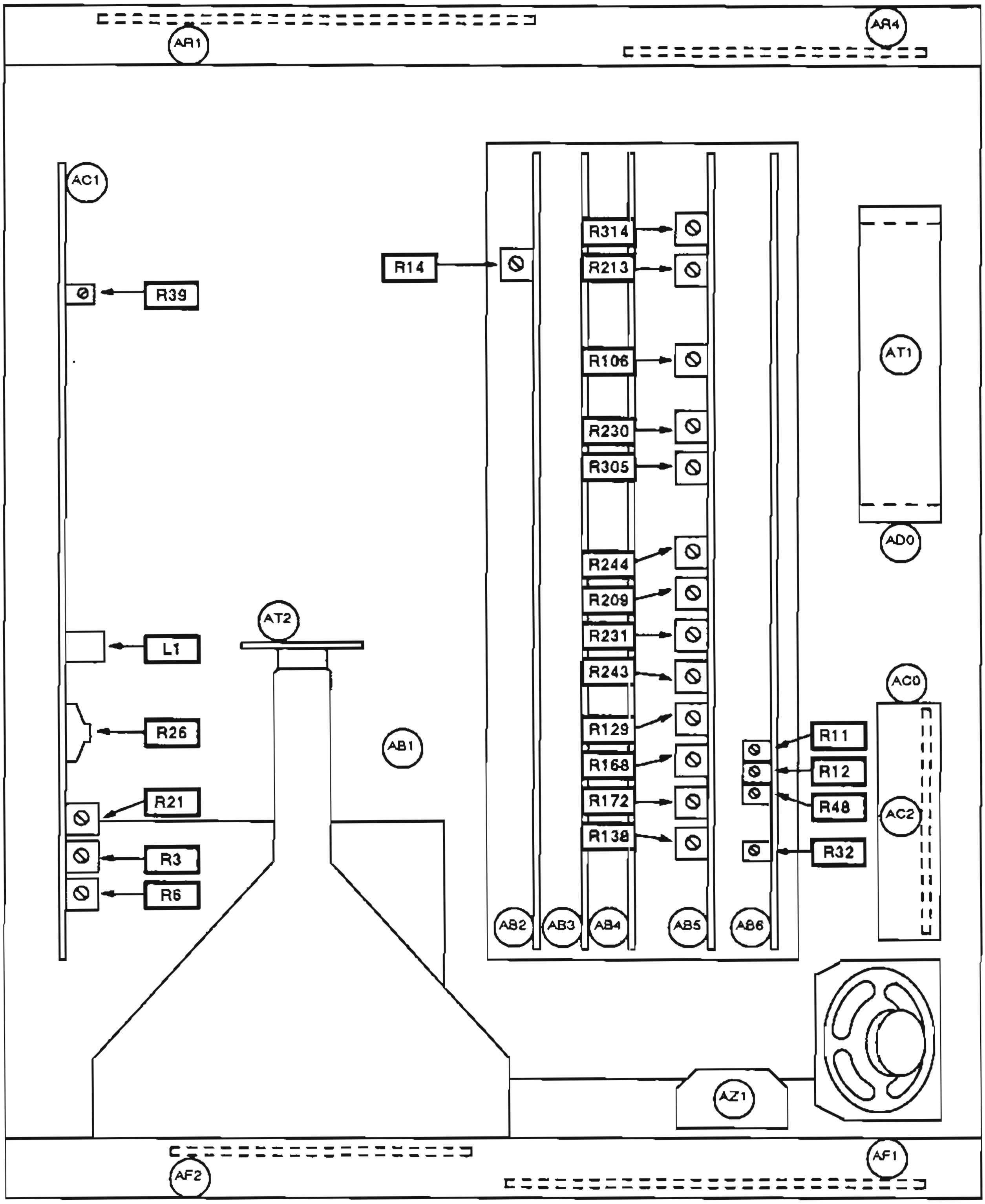


Fig. 1 Adjustment points accessible from above the instrument

AA1 - RF MODULATION METER

Test equipment : Signal generator, oscilloscope.

Mixer 10 MHz rejection

6. This adjustment sets up maximum rejection of the 10 MHz fundamental at the output of mixer IC2. It provides a clean i.f. output when the low frequency oscillator is being used. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 2.

(2) Set the u.u.t. to transmitter test, b.n.c. input socket.

(3) Set the signal generator to a carrier frequency of 55.6 MHz, r.f. level 0 dBm, modulation off.

(4) Connect the oscilloscope probe to the IF OUTPUT at PLC. Adjust R11 for minimum distortion (i.e. cleanest sinewave).

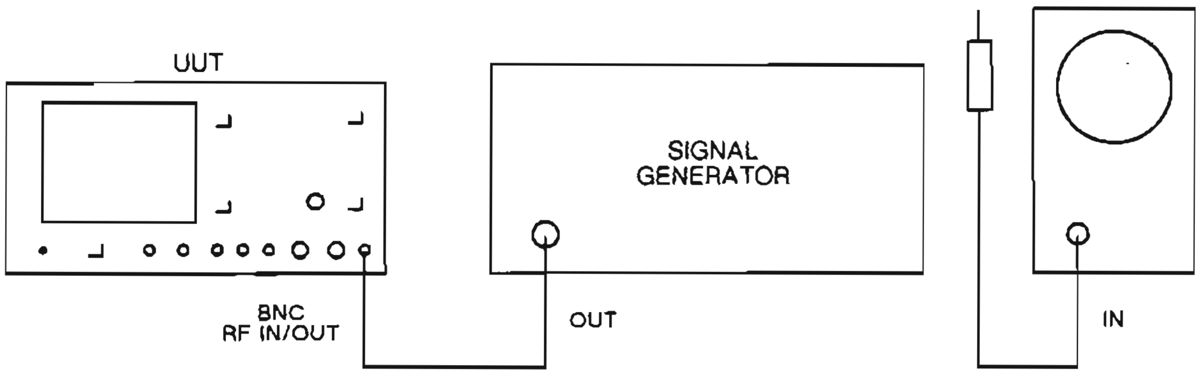


Fig. 2 Test equipment connections for adjusting R11 and R27 on AA1

Phase detector balance

7. This adjustment removes the 265 Hz spikes produced by synthesizer chip IC3. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 2.

(2) Set the u.u.t. to transmitter test, b.n.c. input socket.

(3) Set the signal generator to a carrier frequency of 300 MHz, r.f. level 13 dBm, modulation off.

(4) Monitor TP1 on the oscilloscope and adjust R27 to reduce the height of the pulse spikes to a minimum. The spikes should be less than 150 mV in either the positive or negative direction.

AA3 - RF SYNTHESIZER

Test equipment : Modulation meter, synthesized l.f. generator, oscilloscope.

Low frequency external f.m.

8. This adjustment sets up the modulation input to synthesizer chip IC106 to prevent the p.l.l. from restricting any low frequency f.m. from being applied. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 3.

(2) Set the u.u.t. to receiver test, b.n.c. output socket. Set the signal generator to 300 MHz, level 0 dBm, 0 kHz f.m.

(3) Set the synthesized l.f. generator to give a 10 Hz square wave of 1 V p-p.

(4) Set the modulation meter to monitor f.m. (If the Marconi Modulation Meter 2305 is used, select the 10 Hz - 300 kHz filter and set the l.f. control to the white mark.)

(5) The oscilloscope should display a fuzzy 10 Hz 'square wave' which will have some sag. If there is more than 40% sag, adjust R138 until the top and bottom of the waveform are reasonably straight and smooth.

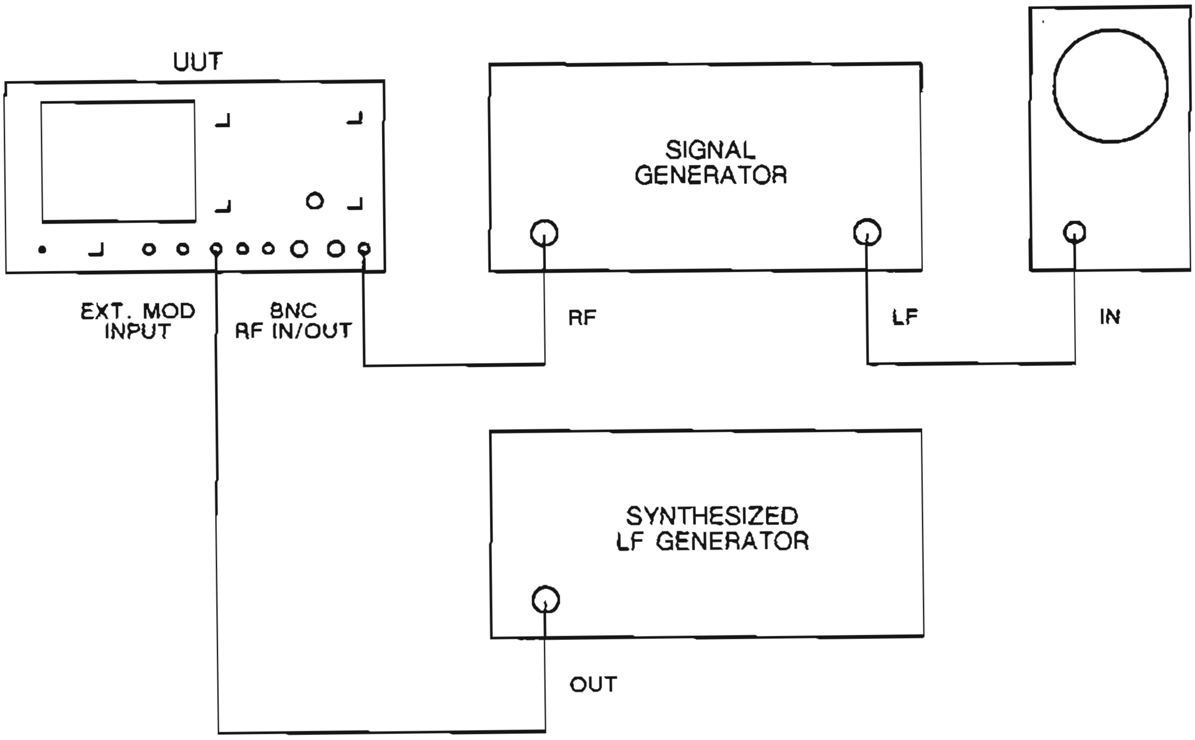


Fig. 3 Test equipment connections for adjusting R138 on AA3

AA4 - LF SYNTHESIZER AND OUTPUT AMP

Test equipment : Frequency counter d.v.m.

200 MHz oscillator

9. This adjustment sets up the p.l.l. capture range of the 200 MHz oscillator. Incorrect adjustment of C79 may result in the 2955 Signal Generator frequency not locking between 0.4 and 88 MHz. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 4.

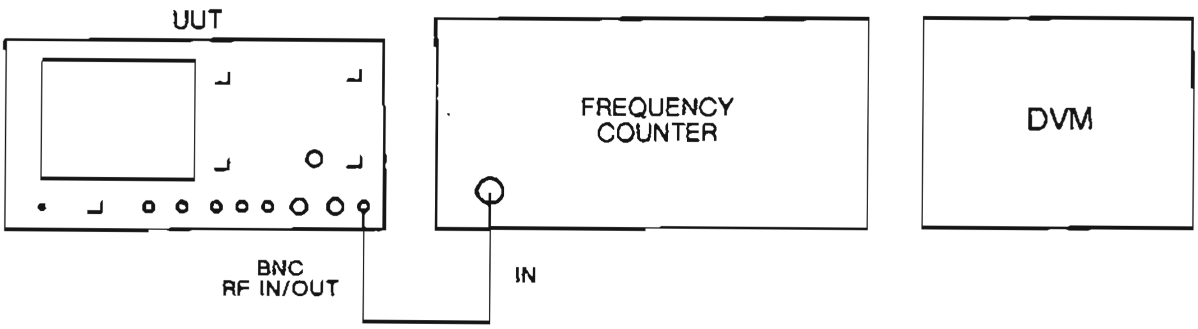


Fig. 4 Test equipment connections for adjusting C79 on AA4

(2) Turn C79 to one end (plates either fully open or fully closed).

(3) Set the u.u.t. to receiver test, b.n.c. output socket. Set the 2955 signal generator to 50 MHz, r.f. level 0 dBm, modulation off.

(4) Monitor the output with the frequency counter. If locked to 50 MHz, remove and reconnect PLA until the frequency remains unlocked with PLA connected.

(5) Using a high impedance (>1 MΩ) d.v.m. set to d.c., note the voltage at the junction of R47,R64 w.r.t. earth.

(6) Slowly adjust C79 until the counter shows that the frequency is locked to 50 MHz.

(7) Finally, adjust C79 to give a reading on the d.v.m. of 30 mV less than the previously noted voltage.

(8) Select a 2955 signal generator frequency of 100 MHz and check that the counter reads 100 MHz.

(9) Reset the 2955 signal generator frequency to 50 MHz and again check on the counter that it re-locks to 50 MHz.

AB2 - DIGITAL SCOPE

10. For adjustemnt of R14, see para. 17 (7).

AB5 DEMODULATION AND SCOPE

Test equipment: AC/DC calibrator, synthesized l.f. generator, signal generator, modulation meter, oscilloscope, d.v.m., power source.

11. The following adjustments affect the calibration of the 2955's oscilloscope, voltmeter, a.f. generator, a.m./f.m./ϕ.m. monitors, distortion/SINAD meter and filters.

Note...

Many of the adjustments interact with each other so the following adjustments should be carried out in the sequence given below.

Voltmeter and scope ranging

12. Proceed as follows:-

(1) To minimise noise pick-up during the adjustment of R243, earth the a.f. input to IC200 on pin 2 as close to the IC as is practical.

(2) Set R243, R244 and R213 to their mid-positions.

(3) Set the u.u.t. to RX, a.f. generator frequency 1 kHz and level 0 mV. Select distortion/SINAD/SN off, 50 kHz low-pass filter.

(4) Monitor IC200 output on pin 6 with the d.v.m. set to d.c. Adjust R243 to give a reading on the d.v.m. as close to 0 mV d.c. as possible. Remove the d.v.m.

(5) Select SCOPE and set the 2955 oscilloscope to 20V/DIV, d.c. coupled. Using the oscilloscope vertical position control, set the trace to the centre graticule line.

(6) Change to 10mV/DIV and adjust R244 to bring the trace onto the centre line. Change to 100mV/DIV and adjust R213 to bring the trace once again onto the centre line.

(7) Repeat the adjustments in the preceding step until the trace remains stationary on the centre line through all the scope ranges.

(8) Reset the oscilloscope to 20V/DIV and adjust R230 for an a.f. volts indication on the 2955 display of 0 mV. Remove the earthing link from the a.f. input.

Voltmeter gain

13. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 5.

(2) Set the calibrator to give 5.000 V d.c.

(3) Set the u.u.t.to RX, distortion/SINAD/SN off, d.c. coupled, low-pass filter.

(4) Adjust R231 until the 2955 displays an a.f. level of 5.00 V d.c.

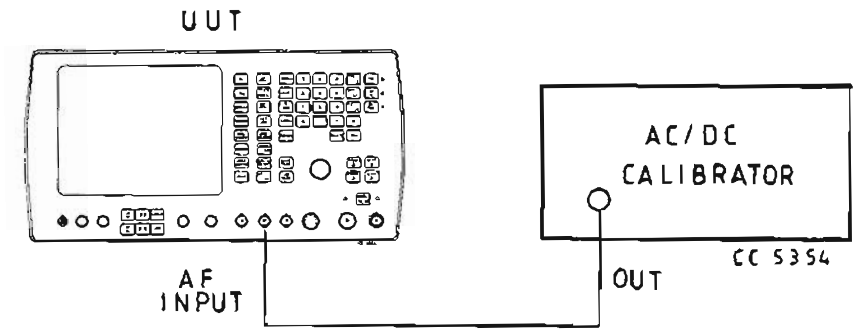


Fig. 5 Test equipment connections for adjusting R231 on AB5

Band-pass filter

14. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 6.

(2) Set the synthesized l.f. generator to give a 1 kHz sinewave at a level of 1 V r.m.s.

(3) Set the u.u.t. to RX, distortion/SINAD/SN off, a.c. coupled, 50 kHz low-pass filter.

(4) Note the reading on the 2955 a.f. voltmeter.

(5) Select the band-pass filter on the u.u.t. Now adjust R305 to obtain the same a.f. voltmeter reading on the 2955 display as was indicated with the 50 kHz low-pass filter selected.

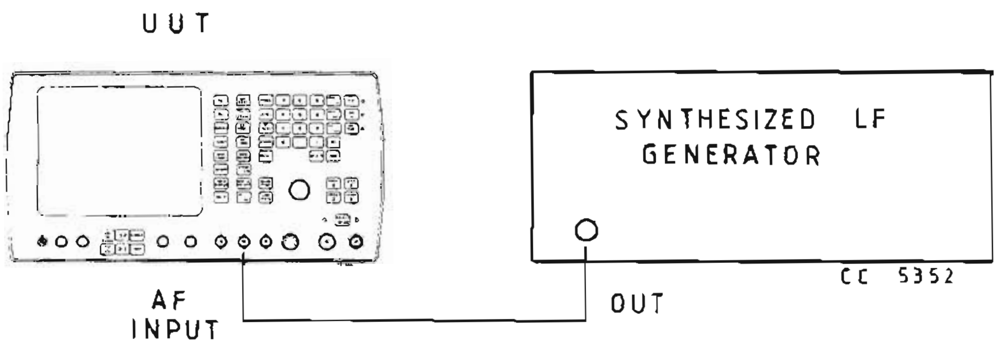


Fig. 6 Test equipment connections for adjusting R305 and R314 on AB5

Notch width

15. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 6.

(2) Set the synthesized l.f. generator to give a 1.007 kHz sinewave at a level of 1 V r.m.s.

(3) Set the u.u.t. to RX, a.f. generator, 0.3 - 3.4 kHz band-pass filter, a.c. coupled, distortion on.

(4) Adjust R314 for the minimum possible distortion reading on the 2955 display.

AM monitor

16. Proceed as follows:-

(1) Connect the signal generator to the u.u.t. as shown in Fig. 7.

(2) Set the signal generator to carrier frequency 100 MHz, modulation off, r.f. level 0 dBm.

(3) Set the u.u.t. to TX, monitoring a.m., 0.3 - 3.4 kHz band-pass filter, b.n.c. input.

(4) Set R172 to mid-position. Monitor TP1 via the probe on the oscilloscope.

(5) Reduce the signal generator output slowly until the trace on the oscilloscope starts to reduce. Now adjust R138 to peak the trace, i.e. maximum amplitude on TP1.

(6) Increase the signal generator r.f. level to 0 dBm and adjust R172 for 1 V p-p on the oscilloscope. Remove the oscilloscope probe from TP1.

(7) Set the signal generator to carrier 100 MHz, a.m. 50%, modulation 1 kHz, r.f. level 0 dBm.

(8) Set the modulation meter to measure a.m., (p-p)/2 with the 0.3 - 3.4 kHz band-pass filter selected.

(9) Connect the signal generator output to the modulation meter input and note the a.m. depth reading.

(10) Connect the signal generator output to the u.u.t. b.n.c. input socket and adjust R168 to give the same a.m. reading on the 2955 as was displayed on the modulation meter.

FM and ϕ.m. monitor

17. Proceed as follows:-

(1) Connect the signal generator to the modulation meter as shown in Fig. 7.

(2) Set the signal generator to carrier frequency 100 MHz, f.m. deviation 5 kHz, modulation rate 1 kHz, r.f. level 0 dBm.

(3) Set the modulation meter to measure f.m. with the 0.3 - 3.4 kHz band-pass filter selected.

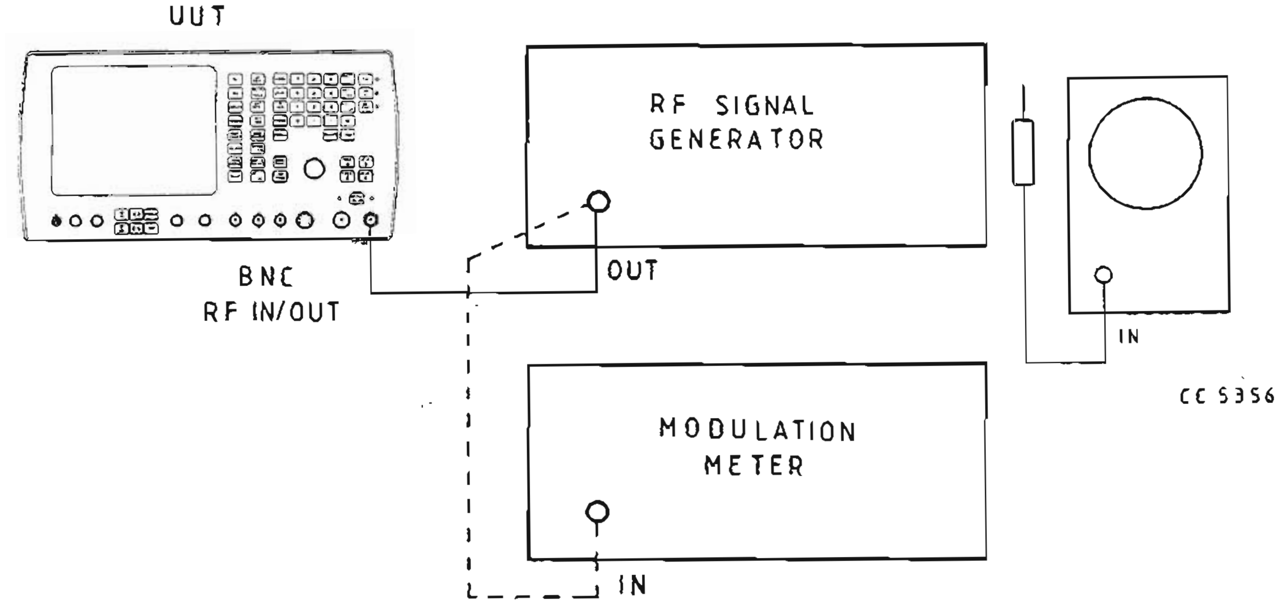


Fig. 7 Test equipment connections for adjusting R138,R172,R168,R129 on AB5

(4) Adjust the signal generator f.m. deviation level to give a reading of 5.00 kHz deviation on the modulation meter.

(5) Set the u.u.t. to TX, monitoring f.m., 0.3 - 3.4 kHz band-pass filter, b.n.c. input.

(6) Connect the signal generator to the u.u.t. b.n.c. input and adjust R129 for a 5.00 kHz indication on the 2955 display.

(7) Select SCOPE on the u.u.t. and +6/-6 f.m. oscilloscope range. Adjust R14 on board AB2 to indicate ±5 kHz f.m. on the 2955 oscilloscope.

Scope path gain

18. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 8.

(2) Set the synthesized l.f. generator to give a 1 kHz sinewave and adjust the level for an indication of 0.707 V r.m.s. on the d.v.m.

(3) Adjust R209 for a 2 V p-p (4 divisions) indication on the 2955 oscilloscope.

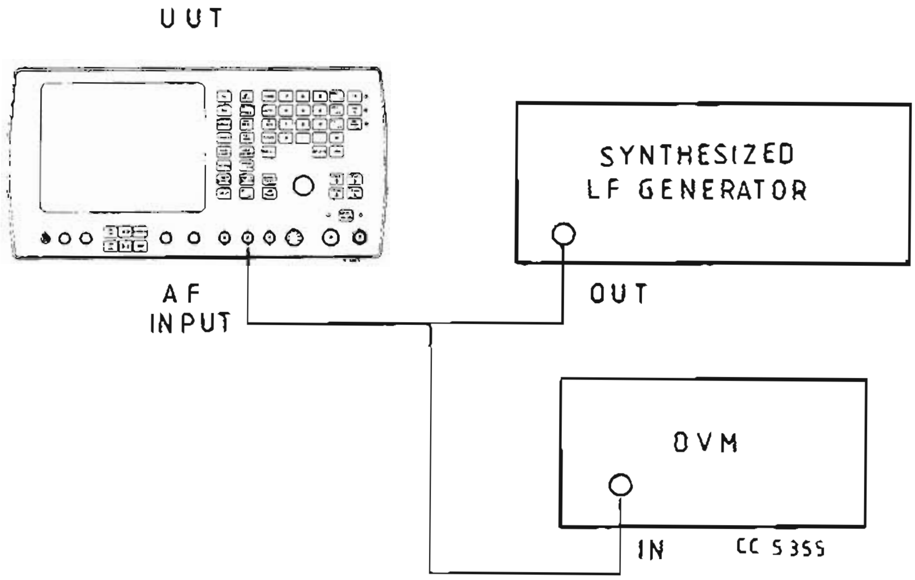


Fig. 8 Test equipment connections for adjusting R209 on AB5

RF power meter calibration & software correction

19. Calibration of the 2955 r.f. power meter requires the use of an accurate power source capable of supplying at least 2 W from 1 MHz to 1.1 GHz with an accuracy of ±2% up to 500 MHz and ±3% up to 1.1 GHz. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 9, where the power source is a calibrated one formed from the equipment shown in Chap. 5-1, Fig. 18.

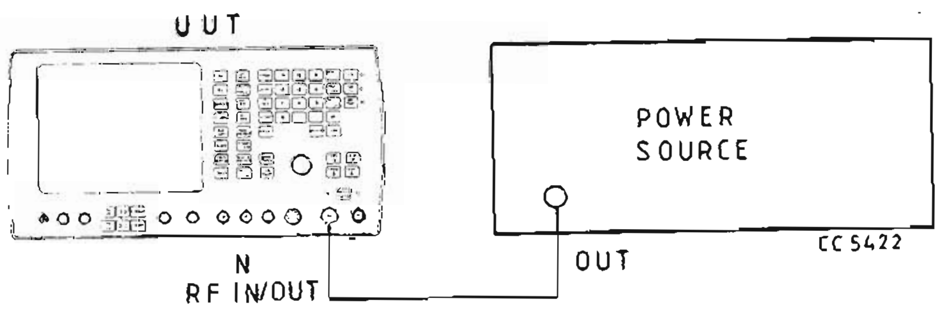


Fig. 9 Test equipment connections for adjusting R106 on AB5

(2) Set the u.u.t. to TX, N-type input socket.

(3) Set the power source to give 220 mW at 100 MHz.

(4) Note the power reading on the 2955 display. Repeat for the frequencies shown in Table 3a noting the power reading on the 2955 for each frequency.

(5) If the power readings are all low or all high, it will only be necessary to adjust R106 to optimize.

(6) If the readings are randomly high and low, the software corrections will require altering. To do this, enter the new data using the 2955 unlocking and data insertion procedure. Since different circuits are switched in internally for different levels and frequencies there are several sets of corresponding correction points. These corrections should be carried out at the frequencies and levels given in Tables 3a to 3e. This will ensure that the correct circuits are switched in.

(7) Set the power source to give 220 mW. Carry out the software correction for the frequencies and addresses given in Table 3a (20 dB pad on AA2 out, high oscillator band on AA1 selected).

(8) Set the power source to give 2 W. Carry out the software correction for the frequencies and addresses given in Table 3b (20 dB pad on AA2 in, high oscillator band on AA1 selected).

(9) Set the u.u.t. to one port duplex mode, with the power source at 2 W. Carry out the software correction for the frequencies and addresses given in Table 3c.

(10) Set the u.u.t. to TX, with the power source at 2 W. Carry out the software correction for the frequencies and addresses given in Table 3d (20 dB pad on AA2 in, low oscillator band on AA1 selected).

(11) Set the power source to give 220 mW, then carry out the software correction for the frequencies and addresses given in Table 3e (20 dB pad on AA2 out, low oscillator band on AA1 selected).

HELP, CHANGE PARAMETER, (HELP, ⇕, FREQ ↓, REP)*

PRESSING THESE KEYS TO GET INTO SOFTWARE CALIBRATION MENU.

TO CHANGE VALUES IN MEMORY, SELECT 'ENTER ADDRESS' AND ENTER SELECTED ADDRESS VALUE IN THAT ADDRESS (- FROM 000 TO 255 ie -128 TO +128

* FOR 2955B USE (AC/DC, ⇕, FREQ ⇩, REP.). IN CALIBRATION MENU SET/LEAVE EAROM PAGE AS "0". THE ADDRESSES FOR POWER METER CAL SEEM TO BE THE SAME AS ~~FOR~~ THE 2955.

TABLE 3a RF POWER METER SOFTWARE CORRECTION (20 dB OUT, HIGH OSC.)

Address of correction figure	Frequency	Address of correction figure	Frequency
63445	11.5 MHz	63468	830 MHz
63446	50 MHz	63469	840 MHz
63447	100 MHz	63470	850 MHz
63448	150 MHz	63471	860 MHz
63449	200 MHz	63472	870 MHz
63450	250 MHz	63473	880 MHz
63451	300 MHz	63474	890 MHz
63452	350 MHz	63475	900 MHz
63453	400 MHz	63476	910 MHz
63454	450 MHz	63477	920 MHz
63455	500 MHz	63478	930 MHz
63456	550 MHz	63479	940 MHz
63457	600 MHz	63480	950 MHz
63458	650 MHz	63481	960 MHz
63459	670 MHz	63482	970 MHz
63460	690 MHz	63483	980 MHz
63461	710 MHz	63484	990 MHz
63462	730 MHz	63485	1000 MHz
63463	750 MHz	63486	1010 MHz
63464	770 MHz	63487	1020 MHz
63465	790 MHz		
63466	810 MHz		
63467	820 MHz		

TABLE 3b RF POWER METER SOFTWARE CORRECTION (20 dB IN, HIGH OSC.)

Address of correction figure	Frequency	Address of correction figure	Frequency
63402	11.5 MHz	63424	820 MHz
63403	50 MHz	63425	830 MHz
63404	100 MHz	63426	840 MHz
63405	150 MHz	63427	850 MHz
63406	200 MHz	63428	860 MHz
63407	250 MHz	63429	870 MHz
63408	300 MHz	63430	880 MHz
63409	350 MHz	63431	890 MHz
63410	400 MHz	63432	900 MHz
63411	450 MHz	63433	910 MHz
63412	500 MHz	63434	920 MHz
63413	550 MHz	63435	930 MHz
63414	600 MHz	63436	940 MHz
63415	650 MHz	63437	950 MHz
63416	670 MHz	63438	960 MHz
63417	690 MHz	63439	970 MHz
63418	710 MHz	63440	980 MHz
63419	730 MHz	63441	990 MHz
63420	750 MHz	63442	1000 MHz
63421	770 MHz	63443	1010 MHz
63422	790 MHz	63444	1020 MHz
63423	810 MHz		

TABLE 3c RF POWER METER SOFTWARE CORRECTION (ONE PORT DUPLEX)

Address of correction figure	Frequency	Address of correction figure	Frequency
63167	11.5 MHz	63178	~~500~~ 550 MHz
63168	50 MHz	63179	600 MHz
63169	100 MHz	63180	650 MHz
63170	150 MHz	63181	700 MHz
63171	200 MHz	63182	750 MHz
63172	250 MHz	63183	800 MHz
63173	300 MHz	63184	850 MHz
63174	350 MHz	63185	900 MHz
63175	400 MHz	63186	950 MHz
63176	450 MHz	63187	1000 MHz
63177	500 MHz	63188	1050 MHz

TABLE 3d RF POWER METER SOFTWARE CORRECTION (20 dB IN, LOW OSC.)

Address of correction figure	Frequency	
63132	1.5 MHz	These corrections interpolate as grouped, e.g. the corrections for 1.5, 2.15 and 2.98 MHz all affect each other and should be adjusted until the power reading is correct at all 3 frequencies.
63133	2.15 MHz	
63134	2.98 MHz	
63135	3.01 MHz	
63136	4.5 MHz	
63137	6.08 MHz	
63138	6.12 MHz	
63139	9.18 MHz	
63140	9.22 MHz	
63141	13.8 MHz	
63142	56.9 MHz	

TABLE 3e RF POWER METER SOFTWARE CORRECTION (20 dB OUT, LOW OSC.)

Address of correction figure	Frequency	
63146	1.5 MHz	These corrections interpolate as grouped, e.g. the corrections for 1.5, 2.15 and 2.98 MHz all affect each other and should be adjusted until the power reading is correct at all 3 frequencies.
63147	2.15 MHz	
63148	2.98 MHz	
63149	3.01 MHz	
63150	4.5 MHz	
63151	6.08 MHz	
63152	6.12 MHz	
63153	9.18 MHz	
63154	9.22 MHz	
63155	13.8 MHz	
63156	56.9 MHz	

AB6 - AF SYNTHESISER

Test equipment: DVM, power meter, modulation meter.

AF generator output level

ADJUSTMENT LOCATION CHAP. 5-2 P. 5

20. To adjust the a.f. generator output level proceed as follows:-

(1) Connect the equipment as shown in Fig. 10.

(2) Set the u.u.t. to receiver test.

(3) Set the 2955 a.f. generator frequency to 1 kHz, level 1 V.

(4) Set the d.v.m. to measure a.c.

(5) Adjust R48 (for adjustment locations see Fig. 28) for a d.v.m. reading of 1 V ±0.005 V.

(6) Change the a.f. generator frequency to 1001 Hz and adjust R11 for a d.v.m. reading of 1 V ±0.005 V.

(7) Change the a.f. generator frequency to 11 kHz and adjust R12 for a d.v.m. reading of 1 V ±0.005 V.

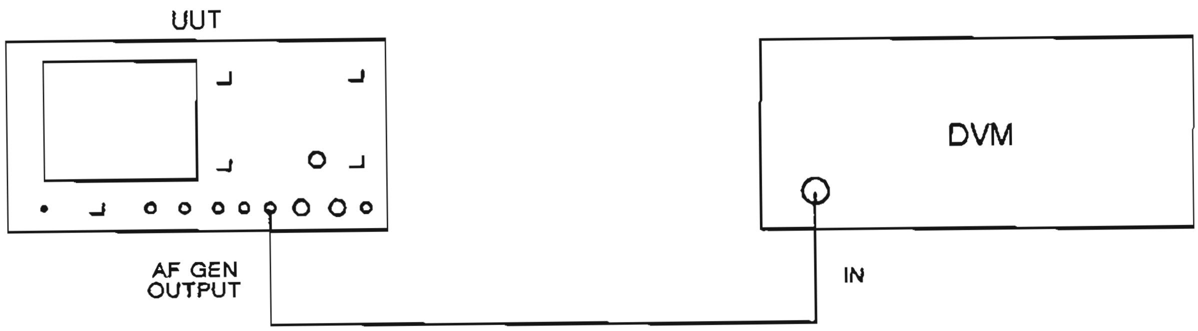


Fig. 10 Test equipment connections for adjusting R48,R11,R12 on AB6

RF output level calibration

21. Calibration of the r.f. generator signal levels is carried out using R32 and software correction for the electronic fine attenuator.

Note...

If the r.f. output level is adjusted, the r.f. generator a.m. and f.m. must be recalibrated.

22. In most instances of recalibration it is likely that the r.f. level will only require optimising using R32, i.e. the entire range of the electronic attenuator is slightly high or slightly low. This will be determined by proceeding as follows:-

(1) Connect the equipment shown in Fig. 11 via a high-sensitivity head (-20 to -65 dBm).

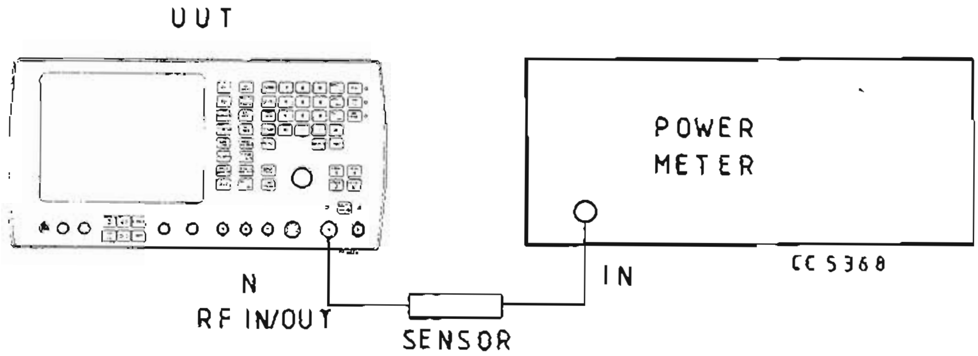


Fig. 11 Test equipment connections for adjusting R32 on AB6

(2) Set the u.u.t. to RX, r.f. generator frequency 300 MHz, level -20.5 dBm, increment 1 dB, modulation off, N-type socket.

(3) Adjust R32 for an indication on the power meter of -20.5 dBm.

(4) Using the decrement key, decrement in 1 dB steps to -30.5 dBm while checking each step level on the power meter.

(5) If these levels are correct, the software correction for the fine attenuator need not be carried out.

(6) If these levels are incorrect, the electronic fine attenuator will have to be recalibrated as given below.

Recalibration of electronic fine attenuator

23. Proceed as follows:-

(1) Enter the data menu using the 2955 unlocking and data insertion procedure.

(2) Enter address 63232, then enter a data correction figure of 005 into this address.

(3) Next enter address 63244 and enter a nominal correction figure of 000. Press the increment level key once to obtain the next memory address (63245) and again enter a nominal figure of 000. Continue this process entering a nominal figure of 000 up to and including address 63254.

(4) Reenter receiver test and adjust R32 for an indication on the power meter of -20.5 dBm.

(5) Decrement the 2955 r.f. output by 1 dB, using the decrement level key, to -21.5 dBm and note the reading on the power meter.

(6) If the output level is incorrect, enter the data menu and correct the data. Data corrections may be made in the range 000 to 254, and a data correction of 1 gives an approximate change in level of 0.01 dB. Note that after altering any correction data figures, the r.f. level will not change until the 2955 is returned to receiver test mode.

(7) Repeat step (6) above for the levels and addresses shown in Table 12.

Note...

It is vital to step down in 1 dB steps using the decrement level key and not by selecting the level desired using the white data entry keys. This is to ensure that none of the bulk attenuator pads are switched in and that the fine attenuator is calibrated over its entire range.

TABLE 4 RF OUTPUT LEVEL SOFTWARE CORRECTION

Address of correction figure	RF level	Address of correction figure	RF level
63244	-20.5 dBm	63250	-26.5 dBm
63245	-21.5 dBm	63251	-27.5 dBm
63246	-22.5 dBm	63252	-28.5 dBm
63247	-23.5 dBm	63253	-29.5 dBm
63248	-24.5 dBm	63254	-30.5 dBm
63249	-25.5 dBm		

Signal generator a.m. calibration & software correction

24. Proceed as follows but note that a.m. calibration should not be carried out until after the r.f. level calibration has been set up as this affects the a.m. :-

(1) Connect the equipment as shown in Fig. 12.

(2) Set the u.u.t. to RX, r.f. generator frequency 125 MHz, r.f. level 0dBm, modulation frequency 1 kHz, modulation level depth 60%, b.n.c. socket, distortion/SINAD/SN off.

(3) Set the modulation meter to a.m., (p-p)/2, 0.3 - 3.4 kHz b.p. filter selected.

(4) Note the modulation depth indicated on the modulation meter.

(5) Enter the data menu using the 2955 unlocking and data insertion procedure.

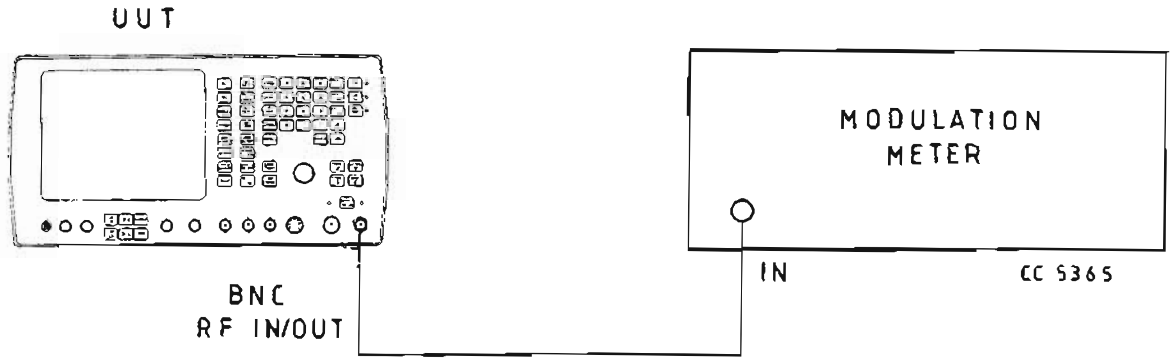


Fig. 12 Test equipment connections for a.m. and f.m. calibration

(6) Enter address 63255 and then increase the displayed 'read' figure by 1. Ensure that the new figure has been transferred to the 'read' display.

(7) Note the data correction figure entered, then return to RX mode and note the new modulation depth displayed on the modulation meter.

(8) Now calculate the a.m. slope by subtracting the initial measured depth from the depth now displayed. Using this a.m. slope figure, calculate the correction figure required to give 60% depth by the following formula :-

$$\frac{(60 - \text{Mod depth now displayed})}{(\text{AM slope fig.})} + \text{current correction data fig.}$$

(9) Unlock the 2955 again. Enter address 63255 and enter the new calculated data correction figure. Return to TX mode. Modulation depth now displayed should be within 60% ±5.2% a.m. To optimise accuracy, repeat this step using the formula above.

(10) AM accuracy at level 0 dBm should now be correct. Repeat the above procedure for addresses and corresponding levels as shown in Table 13 up to address 63264, level -9dBm.

(11) The a.m. correction figures for -10 dBm and -10.9 dBm are entered in the same way as above except care must be taken to prevent the internal 10 dB pad of the attenuator from being automatically switched in.

(12) To prevent automatic attenuator selection, set the 2955 r.f. level to -9 dBm and set an increment level of 0.1 dB. Using the level decrement key, step down in 0.1 dB steps until -10 dBm is reached.

TABLE 5 SIGNAL GENERATOR AM SOFTWARE CORRECTION

Address of correction figure	RF level	Address of correction figure	RF level
63255	0 dBm	63261	-6 dBm
63256	-1 dBm	63262	-7 dBm
63257	-2 dBm	63263	-8 dBm
63258	-3 dBm	63264	-9 dBm
63259	-4 dBm	63265	-10 dBm
63260	-5 dBm	63266	-10.9 dBm

13) The a.m. correction for -10 dBm can now be carried out as normal. When this is complete, decrement in 0.1 dB steps until -10.9 dBm is reached and carry out the a.m. correction procedure for this level.

CAUTION ...

If by accident the level is stepped past -10.9 dbm, for instance -11.0 dBm, the 10 dB pad will be switched in and cannot be switched out by simply incrementing one step to -10.9 dBm. If this happens, return the r.f. level to -9 dBm and decrement in 0.1 dB steps back to -10.9 dBm.

Signal generator f.m. calibration & software correction

25. Proceed as follows:-

(1) Connect the equipment as shown in Fig. 12.

(2) Set the u.u.t. to RX, r.f. generator frequency 165 MHz, r.f. level 0 dBm, modulation frequency 1 kHz, deviation 10 kHz, b.n.c. output socket selected.

(3) Set the modulation meter to f.m., (p-p)/2, 0.3 - 3.4 kHz b.p. filter selected.

(4) Note the deviation measured on the modulation meter.

(5) Enter the data menu using the 2955 unlocking and data insertion procedure.

(6) Enter address 63267 and then increase the displayed 'read' figure by 1. Ensure that the new figure has been transferred to the 'read' display.

(7) Note the data correction figure, then return to RX mode and note the new deviation measured on the modulation meter.

(8) Now calculate the tracking slope by subtracting the initial measured deviation from the deviation now displayed . Using this tracking slope figure, calculate the correction figure required to give 10 kHz deviation by the following formula:-

$$\frac{(10 - \text{deviation now displayed})}{(\text{Tracking slope fig.})} + \text{current correction data fig.}$$

(9) Unlock the 2955 again. Enter address 63257 and enter the new calculated data correction figure. Return to RX mode. Deviation now displayed should be within 10 kHz ±7%. To optimise the accuracy, repeat this step using the formula above.

(10) FM accuracy at 165 MHz should now be correct. Repeat the above procedure for all the addresses and corresponding frequencies shown in Table 10. This lists the 131 software correction points covering the 3 main oscillators.

TABLE 6 SIGNAL GENERATOR FM SOFTWARE CORRECTION

OSC. 1		OSC. 2		OSC. 3	
Address	Freq.	Address	Freq.	Address	Freq.
63267	165	63306	260	63354	400
63268	167.5	63307	263	63355	403
63269	170	63308	266	63356	406
63270	172.5	63309	269	63357	409
63271	175	63310	272	63358	412
63272	177.5	63311	275	63359	415
63273	180	63312	278	63360	418
63274	182.5	63313	281	63361	421
63275	185	63314	284	63362	424
63276	187.5	63315	287	63363	427
63277	190	63316	290	63364	430
63278	192.5	63317	293	63365	433
63279	195	63318	296	63366	436
63280	197.5	63319	299	63367	439
63281	200	63320	302	63368	442
63282	202.5	63321	305	63369	445
63383	205	63322	308	63370	448
63284	207.5	63323	311	63371	451
63285	210	63324	314	63372	454
63286	212.5	63325	317	63373	457
63287	215	63326	320	63374	460
63288	217.5	63327	323	63375	463
63289	220	63328	326	63376	466
63290	222.5	63329	329	63377	469
63291	225	63330	332	63378	472
63292	227.5	63331	335	63379	475
63293	230	63332	338	63380	478
63294	232.5	63333	341	63381	481
63295	235	63334	344	63382	484
63296	237.5	63335	347	63383	487
63297	240	63336	350	63384	490
63298	242.5	63337	353	63385	493
63299	245	63338	356	63386	496
63300	247.5	63339	359	63387	499
63301	250	63340	362	63388	502
63302	252.5	63341	365	63389	505
63303	255	63342	368	63390	508
63304	257.5	63343	371	63391	511
63305	259.9999	63344	374	63392	514
		63345	377	63393	517
		63346	380	63394	520
		63347	383	63395	523
		63348	386	63396	526
		63349	389	63397	529
		63350	392		
		63351	395		
		63352	398		
		63353	399.9999		

AC1 - CRT DRIVE

Test equipment: Synthesized signal generator, reference standard.

10 MHz standard

26. This adjustment governs the frequency accuracy of the 2955 r.f. generator, 1 kHz fixed source, and the a.f. and r.f. frequency counters. Note that the adjustment should not be carried out until the instrument has been switched on for at least 20 minutes. Then proceed as follows:-

(1) Connect the equipment as shown in Fig. 13, but ensure that the external reference standard has an accuracy better than ±5 parts in 10^{10}.

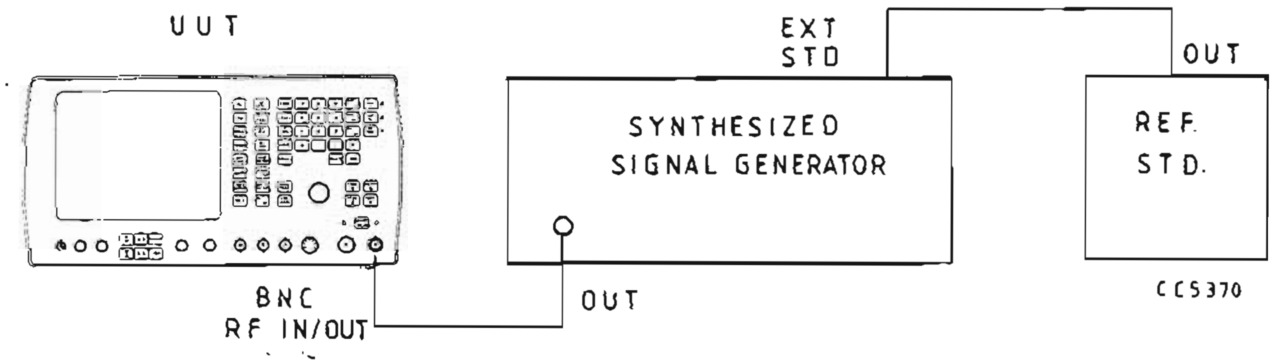


Fig. 13 Test equipment connections for adjusting R39 on AC1

(2) Set the synthesized signal generator to external standard, carrier frequency 1000 MHz, modulation off, r.f. level 0 dBm.

(3) Set the u.u.t. to TX, b.n.c. input socket selected.

(4) Adjust R39 for a transmitter frequency indication on the u.u.t. display of 1000 MHz ±1 count.

Frame height

27. To obtain full horizontal cover of the tube face, adjust HEIGHT preset R3.

Frame linearity

28. To obtain a linear display across the tube face, adjust LINEARITY preset R6.

Vertical shift

29. To position the display centrally on the tube face, adjust VERT SHIFT preset R21.

Linearity and width

30. To obtain full vertical cover of the tube face, adjust LIN AND WIDTH preset L1.

Focus

31. To obtain sharp focus of the display, adjust FOCUS control R26.

AR1 - POWER SUPPLY

Test equipment: DC supply, d.v.m.

Low level volts

32. Proceed as follows:-

(1) Disconnect the a.c. mains supply lead from the u.u.t. AC SUPPLY socket.

(2) Connect the d.v.m. and a d.c. supply capable of supplying 55 W at 16 V to the u.u.t. rear panel DC SUPPLY socket (see Fig. 14).

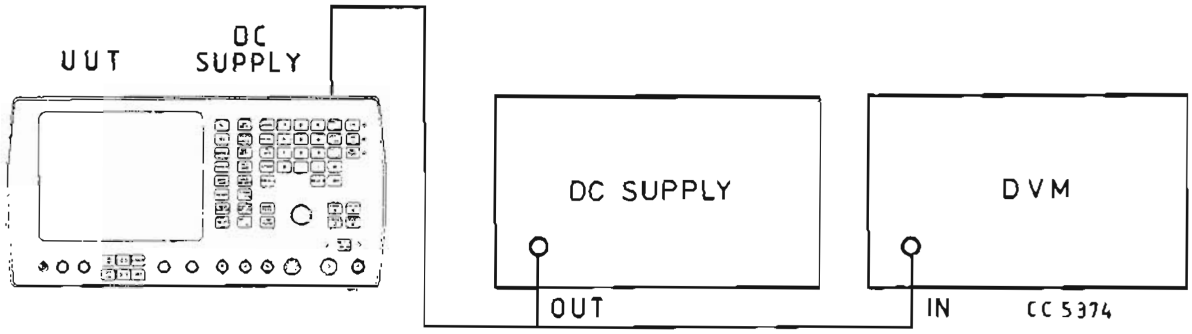


Fig. 14 Test equipment connections for adjusting R46 on AR1

(3) Switch the u.u.t. on and adjust the d.c. supply until the d.v.m. reads 10.8 V.

(4) Remove the d.v.m. and connect it between tag 8 (orange lead) and earth.

(5) Adjust R46 for a d.v.m. reading of 1.8 V, but note that due to the nature of this adjustment the voltage will be unstable.

+5 V supply

33. Proceed as follows:-

(1) Connect the d.v.m. between tag 4 and earth.

(2) Adjust R47 for 5.05 V at tag 4.

Chapter 5-3

FAULT DIAGNOSIS

CONTENTS

GENERAL PROCEDURE

1. The following fault finding sections are intended as a guide to localising the problem to one component or a small group of components.

2. If the adapter is suspected of not working correctly it should be separated from the 2955 and tests carried out on the 2955 to ensure it is not faulty. Where possible connect a known good 2955 to the adapter and establish whether the fault lies in the adapter or the original 2955.

3. Only after it has been verified that the adapter definitely contains the malfunction should checks be carried out to find the fault.

4. It should not be automatically assumed that a complex electronic fault has occurred. In portable equipment in particular connections and plugs may have worked loose. Accordingly conduct an exhaustive visual examination of the adapter for loose plugs, loose connections, bent pins, splayed sockets and many sign of overheating. If the adapter is not working correctly but it is difficult to ascertain the exact area where the problem lies go through the performance checks in Chapter 5; this will help point to the area where the malfunction exists.

FUSE REPLACEMENT

5. Three cartridge-type fuses are located on the rear panel. These are all time lag. The two mains supply fuses are 500 mA for 210 to 240 V and 1 A for 105 to 120 V. The d.c. supply fuse is 6.3 A. Switch off the power supply when replacing a fuse.

TRANSISTOR AND DIODE CHECKING

6. Transistors may be checked by measuring the electrode voltages and/or by measuring the resistance between electrodes by means of a multimeter. So that the meter voltage does not damage the transistors or diodes use the lowest voltage and the maximum source resistance available, e.g. the x10 Ω range on the AVO 8 or the SEI Selectest Super 50.

FAULT FINDING

7. The fault finding tables which appear at the end of the chapter provide a systematic procedure for localizing faults to board level or to comparatively small groups of components. After using the procedure, the fault may be traced to component level using the board checks detailed under 'Board Testing'.

BOARD TESTING

8. The board tests which follow may be used for fault finding to component level as well as being used to ensure correct board operation following repair or replacement. When testing at board level, note that the various tests are carried out sequentially. This often means that test equipment and instrument settings for the second and subsequent tests in a sequence are dependent upon those used for the first test in the sequence.

AA1 - RF MODULATION METER

Test equipment : Signal generator, oscilloscope, frequency counter

Circuit diagram: Chap. 7, Figs. 3 and 4

Preliminary

9. Connect the signal generator set to 13.6 MHz, 0 dBm (224 mV r.m.s.) to the b.n.c. RF IN/OUT socket. Select TX mode to set the 2955 frequency to 13.6 MHz.

Checking regulators

10. Check that the -9 V output from IC5 pin 1 and the +5 V output from IC7 pin 3 are within ±0.5 V of the stated voltage.

Checking p.l.l.

11. Connect the oscilloscope to the 10 MHz input at PLB and check for 10 MHz at t.t.l. levels. Transfer to TR1 emitter and check for a 10 MHz sinewave at 200 mV p-p. This checks the 10 MHz filter.

12. Check the junction of C6/C7/L2 for a sinewave of 3.71 MHz at 1.5 V p-p. This checks the mixer operation.

13. Check the junction of L3/C9/R17 for a 3.71 MHz pure sinewave of 0.75 V p-p. This checks the operation of the 4.4 MHz l.p. filter. If the amplitude is low, the mixer will have to be adjusted (see 'Mixer 10 MHz rejection' below) before proceeding.

14. Connect to TR3 collector (can) and check for a 0 to 5 V squarewave. This checks the squaring amplifier.

15. Connect the oscilloscope (or counter) to IC1 pin 12 and check that its frequency is 1/16th that on pin 1 (10 MHz). This checks the frequency divider.

16. Connect the oscilloscope, set to 1 ms per division, to TP1 and check for one of three conditions:-

(a) In lock and operating correctly: Small 'pips' of either polarity at a frequency of 265 Hz will be seen.

(b) In lock but not operating correctly: Pulses (typically 1.75 V) at 265 Hz will be seen. The balance will have to be adjusted (see 'Phase detector balance' below) before proceeding.

(c) Out of lock: A 180 mV pulse train of either polarity with varying mark/space ratio will be seen.

The above checks the phase locking operation.

17. Transfer the oscilloscope to the junction of R41/C28/R42. Set the 2955 to 11.4 MHz and check that the d.c. level is +2 V. Set the 2955 to 13.6 MHz and check that the level changes to -7 V. This checks the p.l.l. filter formed by IC4.

18. Reset the 2955 to 13.6 MHz. Connect to TR6 collector (can) and check for a square wave of 3.6 V p-p at 13.71 MHz. This checks the v.c.o. and squaring amplifier.

Setting up mixer

19. Set the signal generator to 55.6 MHz and select AUTO TUNE on the 2955. Connect the oscilloscope to the IF OUTPUT at PLC. Adjust R11 for minimum distortion (i.e. cleanest sinewave).

Checking 20 dB pad

20. Reset the signal generator to 13.6 MHz. Check the RF INPUT at the junction of R57/R58 for 316 mV p-p. Transfer to the junction of R57/R59 and check for 31 mV p-p.

Checking selection logic

21. Check IC6 pin 2 is low and IC6 pins 4 and 10 are both high. Check IC6 pin 6 for a 13.71 MHz signal at t.t.l. levels.

22. Transfer to TR14 collector and check for 0 V.

23. Set the 2955 to 14 MHz. Check IC6 pin 2 is high, IC6 pin 10 is low and IC6 pin 5 is high. Check IC6 pin 6 for a 3.71 MHz signal at t.t.l. levels.

24. Transfer to TR14 collector and check for -9 V.

Checking mixer and output

25. Reset the 2955 to 13.6 MHz. Connect the oscilloscope to TR8 collector and check for a good square wave from the Schmitt trigger.

26. Check at the junction of L12/C62/R77 for a pure 110 kHz sine wave at the same level as that at the junction of R57/R59. This checks the operation of the sampling gate mixer, buffer and l.p. filter.

27. Check the IF OUTPUT at PLC and the MONITOR OUTPUT at PLE for a 110 kHz sinewave at 2.8 V p-p. This checks the operation of the i.f. amplifier and the i.f. monitor respectively.

AA2 - RF COUNTER

Test equipment : Signal generator, oscilloscope.

Circuit diagram: Chap. 7, Fig. 5

Premiliminary

28. Connect the signal generator set to 10 MHz, 0 dBm (224 mV r.m.s.) to the b.n.c. RF IN/OUT socket. Select TX mode to set the 2955 to 10 MHz.

Checking signal input path

29. Connect the oscilloscope to the SIGNAL INPUT at R6 and display the sinewave. Increase the signal generator output level to 11 dBm and check that the displayed level drops by 9 dBm. This checks the 20 dB pad and switching.

30. Set the signal generator to -10 dBm. Check that the signal on IC2 pin 5 is six times the amplitude of the signal on IC1 pin 1. This checks the operation of the 16 dB amplifier.

31. Check the junction of C16/R17/C17 for a square wave of 1 V p-p. This checks the Schmitt trigger.

32. Check IC7 pin 14 for 10 MHz at e.c.l. levels. Change the signal generator frequency to 210 MHz and check for fin/4. This checks the operation of the prescaler and bypass switching.

BCD counters

33. Check IC7 pin 16 for low 400 ms gating periods. Change the signal generator frequency to 10 MHz and check that the gating periods have changed to 100 ms (10 Hz resolution selected).

34. Check IC5 pin 14 for fin/10 at t.t.l. levels. Change the signal generator frequency to 210 MHz and check for fin/40. This checks the level shifter and first b.c.d. counter.

35. Check TP2 for fin/80. Change the signal generator frequency to 10 MHz and check for fin/20. This checks the second b.c.d. counter.

7-element counter

36. Check IC4 pin 19 for high reset pulses occurring every 120 ms. Change the signal generator frequency to 210 MHz and check that the pulses occur every 400 ms.

37. Transfer to TP1 and check for a squarewave of 3.8 us period. Change the signal generator frequency to 10 MHz and check that the squarewave changes to a 20 us period.

38. Vary the frequency of the signal generator and check for 'random' data on IC4 pins 1 to 4. This checks the data sent to the processor.

AA3 - RF SYNTHESIZER AND OSCILLATOR

Test equipment : Oscilloscope, power source, frequency counter, spectrum analyzer.

Circuit diagram: Chap. 7, Figs. 6 and 7

Checking regulators

39. Check that the -9 V line at TP4 and the +9 V line at TP5 are within ±0.5 V of the stated voltage.

Checking oscillator switching

40. Set the 2955 to RX mode at 500 MHz. Check that the AA0 OSC SELECT inputs at feedthrough capacitors C43 and C44 are both low (-9 V). Check at their collectors that TR13 is on (-8.5 V) and TR2 and TR6 are both off (0 V). Change frequency to 900 MHz and check that the levels are unaltered. This checks the oscillator selection for the 165 to 530 MHz frequency range.

41. Change frequency to 300 MHz. Check that C43 is low (-9 V), C44 is high (0 V), TR6 is on and TR2 and TR13 are both off. Change frequency to 600, 700, 150 and 70 MHz and check in turn that the levels are unaltered. This checks the oscillator selection for the 530 to 630 MHz frequency range.

42. Change frequency to 200 MHz. Check that C43 is high (0 V), C44 is low (-9 V), TR2 is on and TR6 and TR13 are both off. Change frequency to 100 then 50 MHz and check in turn that the levels are unaltered. This checks the oscillator selection for the 630 to 1000 MHz frequency range.

Checking oscillator tuning

43. Disconnect PLD. Connect the power source, initially set to 3 V, to R3 input. Connect the counter to TP3 to measure oscillator frequency divided by 100.

44. Set the 2955 frequency in turn to 200, 300 and 500 MHz, each time varying the power source voltage between 3 and 18 V while checking that each oscillator operates over its full frequency range. Replace PLD.

Checking filter switching

45. Set the 2955 frequency to 200 MHz. Check that the AA0 FILT CONTROL inputs at feedthrough capacitors C45 and C46 are both low. Check at their collectors that TR4,TR11 are both on (-12 V) and that TR3,TR7,TR8,TR9 are all off. This checks the filter switching for the 165 to 530 MHz range.

46. Change frequency to 550 MHz. Check that C45 and C46 are both high. Check that TR3, TR7 ,TR9 are all on and that TR4,TR8,TR11 are all off. This checks the filter switching for the 530 to 630 MHz range.

47. Change frequency to 650 MHz. Check that C45 is low and C46 is high. Check that TR3,TR8,TR9 are both on and that TR4,TR7,TR11 are all off. This checks the filter switching for the 630 to 1000 MHz range.

Checking filter operation

48. Connect the spectrum analyser to the output from C96.

49. Set the 2955 frequency to 165 MHz. Check that the pass band is flat within ±5 dB up to 259 MHz. Check that all harmonics are at least 36 dB down. This checks the 265 MHz l.p. filter.

50. Change the frequency to 260 MHz. Check that the pass band is flat within ±5 dB up to 399 MHz. Check that all harmonics are at least 32 dB down. This checks the 410 MHz l.p. filter.

51. Change the frequency to 400 MHz. Check that the pass band is flat within ±5 dB up to 529 MHz. Check that all harmonics are at least 30 dB down. This checks the 560 MHz l.p. filter.

52. Change the frequency to 530 MHz. Check that the pass band flatness from 520 to 629 MHz is within ±6 dB. Check that all harmonics and sub- harmonics are at least 34 dB down. This checks the 520 MHz h.p. and 630 MHz l.p. filters.

53. Change the frequency to 630 MHz. Check that the pass band flatness from 630 to 799 MHz is within ±6 dB. Check that all harmonics and sub- harmonics are at least 34 dB down. This checks the 520 MHz h.p. and 820 MHz l.p. filters.

54. Change the frequency to 800 MHz. Check that the pass band flatness from 800 to 1000 MHz is within ±6 dB. Check that all harmonics are at least 15 dB down and that all subharmonics are at least 32 dB down.

Checking output amplifier

55. Remove the coupler between boards AA3 and AA4. Using a spectrum analyzer and signal injector, check that IC4 output is -15 to -8 dBm over all frequency ranges (including doubled ranges) of the oscillators. Replace the coupler.

Checking divider amplifier and divider chain

56. Set the 2955 frequency to 165 MHz. Check, using the spectrum analyzer, that the gain of the amplifier from the junction of R14/C6 to IC112 pin 12 is greater than 14 dB.

57. Set the 2955 to 165, 259, 260, 399, 400, 529 MHz in turn and check at TP3 for these frequencies divided by 100.

58. Check TP3 for oscillator frequency divided by 100 (i.e. 1.65 to 5.3 MHz) at c.m.o.s. levels.

59. Check TP1 for 40 to 60 Hz negative-going pulses. Transfer to TP2 and check for 4 to 6 kHz square waves.

Checking FIFOs

60. Check for a positive 1.4 ms program enable pulse from IC103 pin 10.

61. Connect the oscilloscope to SHIFT OUT from IC103 pin 4. Check for a train of pulses occurring each time the frequency is changed. The train consists of 7 pulses each of 0.1 ms duration occurring in 1.4 ms.

62. Set the 2955 frequency to 300 MHz. Check that IC104 pin 4 is low and pins 1,2,3 are all high. Transfer to IC101 and check that pins 1 and 3 are low and pins 2 and 4 are high.

Checking l.f. mod amplifier

63. The l.f. mod. amplifier is checked and, if necessary, adjusted using the method given in 'Low frequency external f.m.' below.

Checking phase locking

64. Check IC106 pin 22 for a 10 MHz input, and pin 26 for a 5 kHz output. This checks the internal divider.

65. Set the frequency to 200 MHz and check that l.e.d. D106 is unlit. Increment the frequency to 210 MHz while observing the l.e.d. Check that the l.e.d. flashes then goes out again. This checks phase lock operation with the 165 to 260 MHz oscillator.

66. Repeat the above test at 320 and 330 MHz to check the 260 to 400 MHz oscillator, and at 490 and 500 MHz to check the 400 to 530 MHz oscillator.

Checking loop amplifier

67. Check for +22 V on IC107 pin 7.

68. Set the 2955 frequency to 165 MHz and check at IC107 pin 6 for 3 V. Change frequency to 259 MHz and check that the level has changed to 17 V.

AA4 - LF SYNTHESIZER AND OUTPUT AMP

Test equipment : Oscilloscope, frequency counter, spectrum analyzer.

Circuit diagram: Chap. 7, Figs 8 and 9

Checking switching

69. Set the 2955 to RX mode at 50 MHz and check that the AA0 LF RANGE inputs at feedthrough capacitors C37 and C36 are both high. Check that TR1,TR8 are both on and that TR2,TR3 are both off (t.t.l. levels). This checks the 0.4 to 88 MHz range.

70. Change frequency to 100 MHz. Check that C37 is high and C36 is low. Check that TR1,TR3 are both on and that TR2,TR8 are both off. This checks the 88 to 165 MHz range.

71. Change frequency to 200 MHz. Check that C37 and C36 are both low. Check that TR2 is on and that TR1,TR3,TR8 are all off. This checks the 165 to 1000 MHz range.

Checking phase comparator dividers

72. Connect the counter to IC11 pin 5 and check that its frequency is 1/2 that of the 10 MHz on pin 3. Connect to IC10 pin 4 and check that its frequency is 1/20 that of the 200 MHz on pin 8. Transfer to IC11 pin 9 and check that its frequency is 1/2 that of the 10 MHz on pin 11.

Checking 200 MHz oscillator

73. Set the 2955 frequency to 20 MHz and check that TR6 is switched on (-12 V on the collector).

74. Connect the counter to the junction of C57/R37 and check for 200 MHz. If the frequency does not lock the oscillator will require adjustment (see '200 MHz oscillator setting' below) before proceeding.

Checking mixer

75. Check that the input on pin 2 of mixer IC6 is at -13 dBm. Transfer to the mixer side of C33 and check for +6 dBm.

Checking 18 dB amplifier

76. Connect the spectrum analyzer to the junction of R7/C7/D6 and set a reference level. Transfer to the mixer side of C33 and check for an 18 dB gain.

Checking divider operation

77. Change the 2955 frequency to 100 MHz. Connect the counter to IC2 pin 6 and check that its frequency is 1/2 that of the 200 MHz on pin 1.

Checking filter operation

78. Set the 2955 frequency to 1000 MHz and the output level to 0 dBm. Check that the a.l.c. voltage on TP2 from 165 to 1000 MHz is within 0 to 3 V. Check that all harmonics are at least 20 dB down and all subharmonics are at least 30 dB down.

79. Change the frequency to 164 MHz and check that the a.l.c voltage on TP2 from 88 to 164 MHz is within 0 to 3 V. Check that all harmonics are at least 30 dB down.

80. Change the frequency to 87 MHz and check that the a.l.c. voltage on TP2 from 0.4 to 87 MHz is within 0 to 3 V. Check that all harmonics and spurii are at least 25 dB down.

Checking a.l.c. operation

81. Check TP2 for an a.l.c. voltage ranging from +0.25 to +3 V (normally, well below +2 V over all ranges with 0 dBm/-20 dBm selected).

Checking output amplifier and attenuator

82. Set the 2955 to 10 MHz and -50 dBm.

83. Check that the level at IC8 pin 8 (1.2 V p-p) is 16 to 20 times the measurement at the junction of C3/R5/D7 and 50 times the measurement at the junction of R9/D11.

84. Check that the level at the junction of R46/C66 is 1/2 that at IC8 pin 8.

85. Check that the level at the board output is 1/3 that at the junction of R46/C66 (i.e. 10 dB lower).

86. Select -40 dBm and check that the output level is 3.3 times greater (i.e. 10 dB higher).

AB1 - MOTHERBOARD

Test equipment : Oscilloscope, power source, signal generator.

Circuit diagram: Chap. 7, Figs. 10 and 11

Checking audio amplifier

87. Set the 2955 to RX mode and press AF GEN to enter AUDIO TEST. Set the 2955 a.f. generator output level to 1 V. Connect the AF GEN OUTPUT socket to the AF INPUT socket and check for an audible output. This checks the operation of TR7 and IC13 as well as the loudspeaker.

Checking overheat logic

88. Turn the VOLUME control to minimum. Connect a 12 kΩ resistor between earth and PLM contact 2 in order to simulate an overheat condition. Check that IC5 pin 5 goes low and that IC5 pins 6 and 11 are both taken high. (The screen should flash followed after a delay by an audible warning.) This checks Schmitt trigger IC6a.

Checking overpower logic

89. Connect the power source set to -1 V to PLM contact 4. Check that IC5 pins 3 and 6 go low and that PLM contact 9 goes high. Repeat the checks with a +1 V input to PLM contact 8. This checks Schmitt trigger IC6b.

Checking bistable IC14 operation

90. Bistable IC14 - and selector IC11 - operation may be checked as follows:-

LF RANGE logic

91. Set the 2955 to 50 MHz and check that the AA0 LF RANGE inputs at feed-through capacitors C37 and C36 are both high (t.t.l. levels). Change frequency to 100 MHz and check that C37 is high and C36 is low. Change frequency to 200 MHz and check that C37 and C36 are both low.

FILTER logic

92. With the frequency at 200 MHz, check that the AA0 FILT CONTROL inputs at feedthrough capacitors C45 and C46 are both low. Change frequency to 550 MHz and check that C45 and C46 are both high. Change frequency to 650 MHz and check that C45 is low and C46 is high.

OSC SEL logic

93. Set the frequency to 500 MHz and check that the AA0 OSC SELECT inputs at feedthrough capacitors C43 and C44 are both low. Change frequency to 300 MHz and check that C43 is low and C44 is high. Change frequency to 200 MHz and check that C43 is high and C44 is low.

Checking bistable IC15 operation

94. Bistable IC15 - and selecter IC11 - operation may be checked as follows:-

D0-D3 data

95. Continuously change the frequency of the 2955 using the VARIABLE control while checking for 'random' data (negatively-going pulses) on the AA0 D0 to D3 outputs at feedthrough capacitors C49,C51,C52,C53.

Shift In clocking

96. Continuously change the frequency using the VARIABLE control while checking for a train of seven +9 V pulses, each of 75 μs duration on the AA0 SI(1) input at feedthrough capacitor C54. Check that this train is followed by a similar pulse train on the AA0 SI(2) output at C56.

ENABLE pulse

97. Continuously change the frequency using the VARIABLE control while checking for a +9 V 450 μs pulse on the AA0 SYNTH ENABLE output at feedthrough capacitor C55.

0-10 dB selection

98. Set the 2955 level to -41 dBm and check that the AA0 0-10 dB output at feedthrough capacitor C35 is high. Change the level to -51 dBm and check that C35 is low.

Checking bistable IC9 operation

99. Bistable IC9 - and selector IC11 - operation may be checked as follows:-

SYNTH EN pulse

100. Switch the frequency between 11.4 and 13.6 MHz each time checking for four 0.1 ms +9 V pulses at 2 ms separation on the AA0 SYNTH ENABLE output at feedthrough capacitor C6.

HIGH/LOW logic

101. Set the frequency to 13.6 MHz and check that the AA0 HIGH/LOW output at feedthrough capacitor C1 is low. Change frequency to 14 MHz and check that C1 is high.

PRESCALER logic

102. Connect the signal generator set to 10 MHz, 0 dBm to the b.n.c. RF IN/OUT socket. Set the 2955 to TX mode. Check that the AA0 -4/-1 output at feed-through capacitor C14 is high. Change the generator frequency to 300 MHz and check that C14 is low.

20 dB logic

103. With the signal generator at 0 dBm, check that the AA0 20 dB IN/OUT output at feedthrough capacitor C13 is high. Increase the signal generator output to greater than +13 dBm and check that C13 is low.

COUNTER EN pulse

104. Check on the AA0 ENABLE COUNTER output at feedthrough capacitor C15 for a low 5 ms pulse followed by a high period of fixed duration.

105. With 10 Hz counter resolution selected, set the frequency to 210 MHz and check that the high period is 400 ms. Change frequency to 10 MHz and check that the period has changed to 100 ms.

106. Press HELP then CHANGE PARAMETERS and set the RF COUNTER RESOLUTION to 1 Hz. Check that the high period is now 1 s.

Checking keyboard interrupt

107. Check at SKC 1a for a low logic level. Press the front panel keys in turn and check each time that the level goes high, with the initial 40 ms consisting of negatively-going 40 μs pulses. This checks the operation of ICs 1 to 4.

AB2 - DIGITAL SCOPE

Test equipment : Oscilloscope.

Circuit diagram: Chap. 7, Figs. 12 and 13.

Checking trigger pulse generation

108. Select RX mode and press the AF GEN and SCOPE keys. Set the 2955 a.f. generator to 20 Hz and connect the AF GEN OUTPUT socket to the AF INPUT socket. Press the REP SWEEP key.

109. Connect the oscilloscope to IC34 pin 13 and check for a 20 Hz square wave. This checks IC48b.

110. Connect the oscilloscope second channel to IC34 pin 5 to display the output from IC31. Check that the falling edges of both signals are coincident. This checks that IC31 is being reset.

111. Remove the input to the AF INPUT socket and check that the output from IC31 has changed to a 225 ms period squarewave. This checks the IC31 auto-trigger function. Replace the input to the RF INPUT socket.

112. Check that IC27 pin 8 is high and that the trigger waveform is present on IC34 pin 6 and IC23 pin 3. This checks the repetitive sweep gating.

113. Press the SINGLE SWEEP key and check that IC34 pin 4 is low and IC34 pin 6 is high. This checks the single sweep gating.

114. Remove the input to the AF INPUT socket. Press SINGLE SWEEP and check that IC48 pin 10, IC23 pin 8 and IC23 pin 5 are all high. This checks the reset operation.

115. Check that IC27 pin 12 and IC27 pin 3 are both high. This checks that the timing generator has halted.

116. Check that the write address outputs from IC17 and IC18 are all low. This checks that the write address counters have correctly reset. Replace the input to the AF INPUT socket and press REP SWEEP.

Checking A-D converter

117. The voltage reference for the A-D converter is checked and, if necessary adjusted, using the method given in 'A-D converter calibration' below.

118. Check TP1 for a 0.5 μs positive pulse at a 400 kHz rate.

119. Vary the vertical shift while checking that the output from latch IC2 changes (t.t.l. levels).

Checking timing generator

120. Check the operation of the timing generator by reference to the timing diagram shown in Fig. 32.

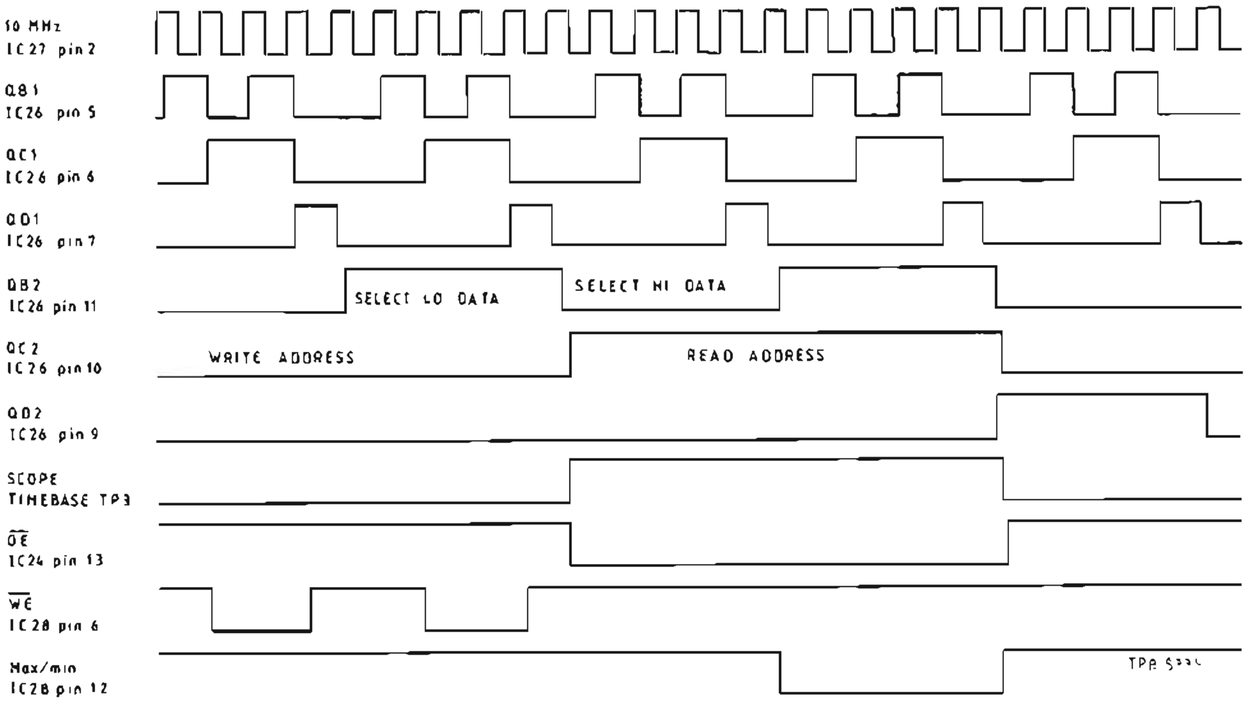


Fig. 1 Timing generator timing waveform diagram for board AB2

Checking read address reset

121. Set the horizontal POSITION control fully anticlockwise. Trigger from IC24 pin 6 and check for a high reset pulse on IC24 pin 1. Adjust the POSITION control and check that the width of the reset pulse decreases from the left.

Checking display counters

122. With an input connected to the AF INPUT socket, check the operation of decoder IC48a by reference to the timing diagram shown in Fig. 2

123. Set the input to 10 kHz and select a slow timebase on the 2955 oscilloscope. Trigger an oscilloscope from the falling edge of the Y1 pulse on IC48 pin 5 and display the SCOPE VIDEO signal on TP6. Check that the signal starts high, goes low and then returns high, all within the line scan period of 64 µs.

124. Vary the amplitude of the input and check that the duration of the low period increases and decreases with amplitude.

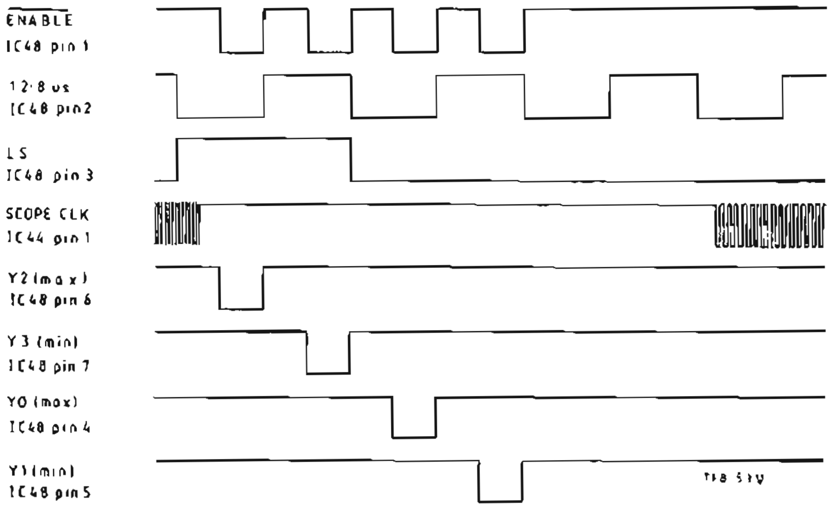


Fig. 2 Display counters timing waveform diagram for board AB2

AB3 - VDU BOARD

Test equipment : Oscilloscope

Circuit diagram: Chap. 7, Figs. 14 and 15

125. Select RX mode and press the AF GEN and SCOPE keys. Set the 2955 a.f. generator to 1 kHz and connect the AF GEN OUTPUT socket to the AF INPUT socket. Press the REP SWEEP key.

Checking rows counters

126. Check the operation of the rows counters and associated circuits by reference to the timing diagram shown in Fig. 34.

Checking columns counters

127. Check the operation of the columns counters and associated circuits by reference to the timing diagram shown in Fig. 35.

Checking frame sync

128. Connect the oscilloscope to TP2 FRAME SYNC. With SCOPE selected, check for a 450 μs positive pulse in a frame sync period of 18.95 ms.

129. Press the BAR CHART key and check that the period increases by 32 μs.

130. Check that IC29 pin 1 is held high. Press SCOPE and check that pin 1 is alternately high and low for successive frame sync periods.

Checking scope clock

131. Check on the SCOPE CLK line at IC49 pin 3 for a 26 μs train of 10 MHz pulses in a period of 64 μs.

Checking scope trigger

132. Connect the AF GEN OUTPUT socket to the AF INPUT socket and set the oscilloscope horizontal scale to 100 mV/div. With a 1 kHz input, check on the TRIGGER line at TP1 for 1 kHz t.t.l. square waves.

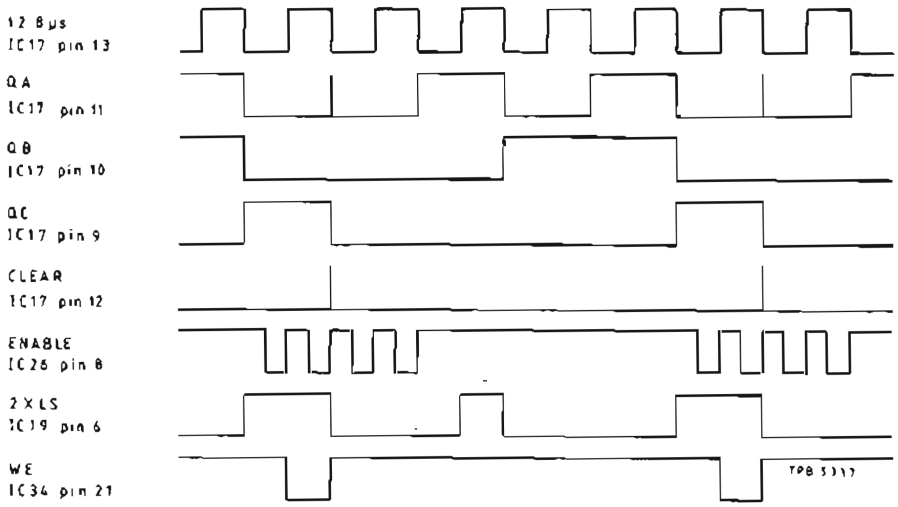


Fig. 3 Rows counters timing waveform diagram for AB3

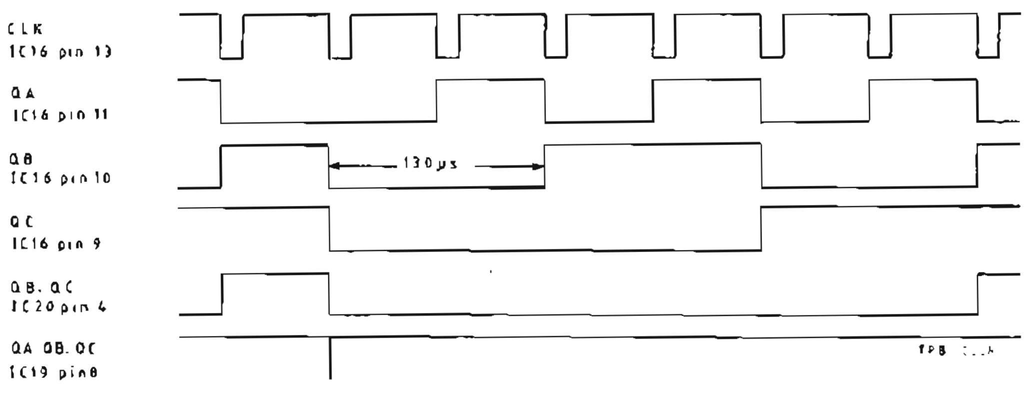


Fig. 4 Columns counters timing waveform diagram for AB3

BOARD AB4 - Microprocessor

Test equipment: Oscilloscope, signal generator, frequency counter.

Circuit diagram: Chap. 7, Figs. 16,17 and 18

Checking VARIABLE operation

133. Ensure that the TONES mode is not selected. Adjust the VARIABLE control while checking on TP6 and TP7 for square waves whose frequency increases as the rate of spin is increased. This checks board AZ1 operation.

134. Check that IC1 pin 5 (SID) is high when the VARIABLE control is turned clockwise, and low when it is turned anticlockwise. This checks IC29.

135. Check that IC1 pin 4 (SOD) is high and that square waves are present on IC1 pin 7 when the VARIABLE control is turned.

136. Press the TONES key then select CONTINUOUS from the RX SEQUENTIAL TONE menu. Check that IC1 pin 4 is low and that IC1 pin 7 does not respond to movement of the VARIABLE control.

Checking keyboard interrupt

137. Select RX. Check at TP8 for a low logic level. Press the front panel keys in turn and check each time that the level goes high, with the initial 40 ms consisting of negatively-going 40 μs pulses.

138. Transfer to IC1 pin 8. Press the front panel keys in turn and check for a high pulse that returns low when IC37 pin 1 goes low.

Checking A-D converter

139. Select RX then press the AF GEN and SCOPE keys. Set the 2955 a.f. generator to 1 kHz and connect the AF GEN OUTPUT socket to the AF INPUT socket.

140. Connect an oscilloscope to IC3 pin 12 and check for a V REF of +5.0 V. This checks regulator IC35.

141. Check IC29 pin 11 for a 500 kHz squarewave. Transfer to IC3 pin 10 and check for a 250 kHz clock.

142. Connect the oscilloscope to IC24 pin 5 and display the negatively-going write and read pulses of 50 μs separation on channel one.

143. Connect the oscilloscope channel two to OE IC3 pin 9. Check for a positive pulse coincident with the write (first) pulse on channel one.

144. Transfer to ALE IC3 pin 22 and check for a positive pulse coincident with the read (second) pulse on channel one.

145. Connect the oscilloscope to the VOLTMETER input at IC32 pin 4 and display the signal. Transfer to the RMS VOLTS input to IC3 pin 28 and check that the signal level is 0.707 of its former level. This checks the operation of r.m.s. converter IC32.

146. Connect the signal generator modulated by 5 kHz f.m. to the N-type input socket. Select TX and the N-type socket.

147. Check for positive-going 'humps' on the PEAK line to IC3 pin 26 and the TROUGH line to IC3 pin 27. This checks the operation of peak/trough detector IC30.

148. Check that when the 2955 oscilloscope horizontal POSITION control is adjusted, the voltage on the HORIZ SHIFT input to IC3 pin 1 alters accordingly.

Checking bistable IC19

149. Press the front panel keys and check each time for a 13 μs negatively-going pulse on the KEYBOARD LATCH RESET line to IC19 pin 15.

150. Reselect SCOPE. Press the SINGLE SWEEP key and check for an 8 μs negatively-going pulse on the SS/RST line at IC19 pin 10. Press the REP SWEEP key and check for a similar pulse on IC19 pin 12.

151. Connect the oscilloscope to IC19 pin 7. Switch off then back on while checking for a negatively-going pulse (note that this may be difficult to detect) on pin 7.

152. The remaining outputs are checked under the programmable divider heading.

Checking r.m.s. converter timer

153. Check on the RMS TIME TRIGGER input at IC36 pin 3 for negatively-going 0.6 μs pulses (the number and periods depending upon the mode selected). Transfer to IC36 pin 6 and check for the generation of 65 ms negatively-going pulses.

Checking audio counter

154. Select BAR CHART. With 1 kHz connected to the AF INPUT socket, check for a 1 kHz squarewave at IC24 pin 13.

155. Decrease frequency and check that at about 800 Hz, IC21 pin 9 goes low and that f in is present on IC22 pin 6. Check that IC21 pin 5 is high and that a 5 MHz squarewave is present on IC22 pin 8.

156. Increase frequency until at about 1 kHz, IC21 pin 9 goes high. Check that f in/10 is present on IC22 pin 6 and that IC21 pin 5 is still high.

157. Decrease frequency until at about 250 Hz, IC21 pin 5 goes low and that a 500 kHz squarewave is present at IC22 pin 8.

Checking programmable divider

RF counter gating

158. Select TX and connect a signal generator to the RF INPUT socket.

159. Check at TP9 for a 100 μs period squarewave.

160. Transfer to the RF COUNTER GATE output at IC4 pin 2 and check for a positive 6 ms pulse followed by a low period.

161. Set the signal generator in turn to 210 MHz and 10 MHz and check that the low period is respectively 400 ms and 100 ms (10 Hz resolution selected).

162. Press HELP then CHANGE PARAMETERS and set the RF COUNTER RESOLUTION to 1 Hz. Check that the gating period has changed to 1 s. Disconnect the signal generator.

Oscilloscope timebase

163. Select RX mode and press the AF GEN and SCOPE keys. Set the 2955 a.f. generator to 100 Hz and connect the AF GEN OUTPUT socket to the AF INPUT socket. Press the REP SWEEP key.

164. Check that IC33 pin 4 is held high.

165. Alternately press the BAR CHART and SCOPE keys. Check for a 500 μs negatively-going pulse each time the SCOPE key is pressed.

166. Check for similar pulses whenever the HORIZ keys are pressed.

167. Transfer to IC33 pin 5 and check for a burst of 1 μs positive pulses in a 2.5 μs period.

168. Select the fastest 2955 oscilloscope timebase (100 μs) and check that the duration of the burst is 1.25 ms.

169. Check that the duration of the burst increases linearly with timebase setting, e.g. with a 1 ms oscilloscope time base selected, the burst occupies 12.5 ms.

170. Transfer to the SCOPE TIMEBASE output at IC4 pin 37. Select the fastest 2955 oscilloscope timebase (100 μs) and check that pin 37 is held low.

171. Select a 1 ms timebase and check for a 2.5 μs negatively-going pulse in a 25 μs period.

172. Check that the period increases linearly with timebase setting, e.g. with a 10 ms oscilloscope timebase selected, a negatively-going 2.5 μs pulse appears in a 250 μs period.

Tones timer

173. Select RX mode and press TONES. Select CCIR from the TONES STANDARD menu and enter a tone number.

174. Select TONE BURST and check on IC4 pin 3 for a negatively-going 0.1 ms pulse in a 100 ms period.

175. Press RETURN and select the ZVEI tones standard. Select TONE BURST and check on IC4 pin 3 that the period has changed to 70 ms.

176. Repeat the preceding step for EEA (or EIA) and check that the period has changed to 40 ms (or 33ms).

Delay generation

177. Select SCOPE and check on the 2XLS input line at IC4 pin 30 for clock pulses of varying width occurring every 32 µs.

178. Check on the FS input at IC4 pin 35 for a 450 µs pulse in a period of 18.95 µs.

179. Transfer to the DELAY output at IC4 pin 38 and trigger from IC4 pin 35. Set the horizontal POSITION control fully anticlockwise and check for a positive pulse occurring after a delay of 1.5 ms. Turn the POSITION control fully clockwise and check that the delay has increased to 3.5 ms.

Checking power down operation

180. Check that TP4 is low, IC31 pins 11 and 4 are high and IC25 pin 2 is low. Check that TR4 is on (0V at the collector).

181. Repeatedly switch off to simulate LOW VOLTS, then back on. Check that immediately after switching off, IC31 pins 11 and 4 both go low and IC25 pin 2 goes high. Check that TR4 switches off (+5.6 V on the collector) and that TR3 switches on.

182. Check that when switching back on, IC31 pin 10 is initially low then returns high.

Checking decoder IC8

183. Select RX. Repeatedly change the 2955 signal generator frequency using the VARIABLE control, and check each time for negatively-going double pulses on AB1 SKC 10b. Check that pulse duration is 0.6 µs and separation is 13 µs.

184. Select TX. Repeatedly change the 2955 a.f. generator frequency using the VARIABLE control, and check each time for negatively-going triple pulses on AB1 SKC 13a. Check that pulse duration is 0.6 µs and separations are 56 µs and 24 µs.

185. Check for negatively-going triple pulses on AB1 SKC 1b. Check that pulse duration is 0.6 µs and separations are 6.8 µs and 6.4 µs.

186. Check for single 0.6 µs pulses on AB1 SKC 13b.

187. Check for single 0.6 µs pulses on PLJ 3b.

Memory

Memory map

188. For maintenance purposes, the memory map for the instrument is given in Fig. 36.

Replacing EPROMs

189. When replacing EPROMs, note that they are marked A to D and are inserted in the sockets for IC9 to IC12 respectively.

2955 MEMORY MAP

ADDRESS (HEX)	ADDRESS (DECIMAL)	DESCRIPTION
0 - DFFF	0 - 57343	PROGRAM CODE AREA
E000 - E7FF	57344 - 59391	OFF BOARD (AB4) I/
E800 - EFFF	59392 - 61439	ON BOARD (AB4) I/O
F000 - F7FF	61440 - 63487	EAROM, CAL & STORE
F800 - FFFF	63488 - 65535	RAM, VARIABLES, ST

HEX)	ADDRESS (DECIMAL)	LABEL (SIZE)		DESCRIPTION
	57344	AA30	(1)	RF FREQ GEN REG
	57345	AA31	(1)	MODMETER TUNE,PADS ETC.
	57348	AA14	(1)	MA844 ADDRESS REG
	57349	AA15	(1)	MA844 DATA REG
	57350	AA16	(1)	MA844 CONTROL REG
	57360	AB60	(2)	AF GEN FREQ (2 BYTE)
	57362	AB62	(1)	AF GEN LEVEL DAC
	57363	AB63	(1)	1 kHz MOD LEVEL DAC
	57364	AB64	(1)	1 kHz AF LEVEL DAC
	57365	AB65	(1)	LPF & SWITCHING
	57366	AB66	(1)	ROUTING & SWITCHING
	57367	AB67	(1)	I/P SWITCHING,ATTEN,ETC.
	57368	AB68	(1)	MOD TRACKING DAC
	57369	AB69	(1)	IF COR'N (OPL) DAC
	57370	AB6A	(1)	MOD O/P SWITCHING & LEVEL DAC
	57371	AB6B	(1)	RF LEVEL 10dB DAC,12 BIT
	57378	ROWS	(1)	KEYBOARD ROWS READ
	57379	COLS,SETKEY	(1)	KEYBOARD COLUMNS WRITE
	57380	LEDL	(1)	FRONT PANEL LEDS
	57381	CHAR	(1)	CHARACTER TO SCREEN
	57382	ADDRLO	(1)	SCREEN ADDRESS ROW
	57383	ADDRHI	(1)	SCREEN ADDRESS COLUMN
	57403	IC33EN	(1)	RANGE AND SIGNAL SWITCHING
	57405	IC34EN	(1)	RANGE AND SIGNAL SWITCHING
	57406	IC35EN	(1)	RANGE AND SIGNAL SWITCHING
047	57408 57415	ADDRSN	(1)	GPIB ADDRESS SWITCH (READ)
	57416	DATAIN	(1)	GPIB DATA I/O REG
	57417	INTST1	(1)	GPIB 'INTERRUPT STATUS' REG
	57418	INTST2	(1)	GPIB 'INTERRUPT STATUS' REG
	57419	SPOLMD	(1)	GPIB 'SERIAL POLL MODE' REG
	57420	ADDRMD	(1)	GPIB 'ADDRESSED MODE' REG
	57421	AUXMDR	(1)	'AUXILARY MODE' REG
	57422	ADDREG	(1)	GPIB 'ADDRESS' REGISTER
	57423	EOSREG	(1)	GPIB 'END OF STRING' REGISTER

ADDRESS (DECIMAL)	LABEL (SIZE)		DESCRIPTION
60416 - 60420	RFFREQ	(5)	RF GEN FREQ DATA BCD PACKED
60421 - 60427	RFLEVEL	(7)	RF GEN LEVEL DATA UNITS,INC
60428 - 60431	AFFREQ	(4)	AF GEN FREQ DATA SPFP
60432 - 60435	AFLEVEL	(4)	AF GEN LEVEL DATA SPFP
60436 - 60439	MODLEVEL	(4)	MOD GEN LEVEL DATA SPFP
60440 - 60443	LINC	(4)	GENERAL LEVEL INC REG
60444	LEVELINC	(1)	LEVEL INC TYPE FLAG
60445 - 60449	FINC	(5)	GENERAL FREQ INC REG
60450	FREQINC	(1)	FREQ INC TYPE FLAG
60451	ACDC	(1)	AF INPUT COUPLING FLAG
60452	BARSCP	(1)	BARCHART SCOPE FLAG
60453	DISTORT	(1)	DISTORTION FLAG
60454	SEL	(1)	RF INPUT SELECT FLAG
60455	SINAD	(1)	SINAD S N FLAG
60456	SOTIM	(1)	SCOPE TIMEBASE POINTER
60457	SCVRTAM	(1)	AM SCOPE VERT GAIN
60458	SCVRTFM	(1)	FM SCOPE VERT GAIN
60459	SCVRTPM	(1)	PM SCOPE VERT GAIN
60460	GENSET1	(1)	1st LEVEL KEY FLAG
60461	GENSET2	(1)	2nd LEVEL KEY FLAG
60462	MODOF	(1)	MOD ON/OFF FLAG
60463	MODEQONEK	(1)	1 kHz MOD FREQ FLAG
60464	ONEKFILT	(1)	1 kHz NOTCH FILTER FLAG
60465	MODE	(1)	TX,RX,AF,DX MODES FLAG
60466	MODMDE	(1)	AM,PM,FM,MOD TYPE FLAG
60467	RESVB1	(1)	UNUSED •
60468	RESVB2	(1)	UNUSED •
60469	SINSIN	(1)	UNUSED •
60470	TXFREQSET	(1)	MANUAL MOD METER TUNING ETC
60471	SUBAUDIO FLAG	(1)	SUB AUDIBLE TONE ACTIVE FLAG
60472	TWOTONES	(1)	TWO SIMULTANEOUS TONES ACTIVE
60473	SCSWEEP	(1)	SCOPE SINGLE SWEEP FLAG
60474	FILTER	(1)	AF INPUT FILTER FLAG
60475 - 60478	SAMLEVEL	(4)	SUB AUDIBLE TONE MOD LEVEL
60479	RESVB4	(1)	UNUSED •

TPC 5273A

Shadow register addresses

190. Certain hardware ports have shared functions, i.e. some bits control one function and the others control a totally un-related function; this is efficient use of hardware. However, the software must be arranged so that one function does not affect another. This is achieved by use of shadow registers. When a subroutine wishes to change bits on a port it first reads the contents of the associated shadow register. The relevant bits are ANDed or Ored and the new information sent to the port. This new information is also copied back to the shadow register for future operations.

191. To assist debugging and servicing, these shadow registers are located at the beginning of the program variable area (see Table 1) and will not change their locations.

TABLE 1 SHADOW REGISTER ADDRESSES - AB4

Address		Name	Function
Hex	Decimal		
F900	63744	STORE	Keyboard hardware
F901	63745	STOREK	Keyboard hardware
F902	63746	DATAA	IC33EN
F903	63747	DATAB	IC34EN
F904	63748	DATAC	IC35EN
F905	63749	AB67S	AB6 I/O switching
F906	63750	AA16S	MA844 control resistor
F907	63751	AA31S	RF frequency control
F908	63752	AB40S	Accessory socket and utilities
F909	63753	AB62S	AF gen. level DAC
F90A	63754	AB63S	1 kHz MOD level DAC
F90B	63755	AB64S	1 kHz AF level DAC
F90C	63756	AB65S	Low-pass filter and routeing
F90D	63757	AB66S	Routeing and switching
F90E	63758	AB6AS	Modulation output switching and r.f. level
F90F	63759	APPK	A/D reading for +ve peak
F910	63760	APPPTR	A/D +ve peak range pointer
F911	63761	AMPK	A/D reading for -ve peak
F912	63762	ARF	A/D reading for r.f. power
F913	63763	ARFPTR	A/D r.f. power range pointer
F914	63764	ADAFV	A/D reading for a.f. volts
F915	63765	AAFPTR	A/D AF volts range pointer
F916	63766	ADO	A/D reading for TX dist. notch out
F917	63767	ADOPTR	A/D TX dist. notch out range pointer
F918	63768	ADIS	A/D reading for TX dist. notch in
F919	63769	ADIPTR	A/D TX dist. notch in range pointer
F91A	63770	ADSINI	A/D reading with notch in
F91B	63771	ASNPTR	A/D reading with notch in range pointer
F91C	63772	ADMODF	A/D reading for modulation off
F91D	63773	AMFPTR	A/D reading for modulation off pointer
F91E	63774	ADCHG	A/D reading for range change flag

AB5 - DEMODULATION & SCOPE

Test equipment : Oscilloscope, signal generator, a.f. generator.

Circuit diagram: Chap. 7, Figs. 19, 20 and 21.

Preliminary

192. Set the signal generator to carrier frequency 100 MHz, f.m. deviation 25.5 kHz, modulation rate 1 kHz, r.f. level 0 dBm.

193. Set the 2955 to TX, modulation f.m., b.n.c. socket selected. Select manual tune (to prevent the 2955 from tracking the signal generator).

Checking 85 kHz h.p. filter

194. Switch the signal generator modulation off. Check at IC100 pin 6 for a 110 kHz sinewave.

195. Tune the signal generator higher in frequency and check that after plus 30 kHz roll-off occurs. Retune the signal generator to 100 MHz.

Checking limiter

196. Connect the oscilloscope to IC102 pin 7 and check for 110 kHz at t.t.l. levels. This checks the limiting operation.

197. Set the 2955 to modulation a.m. and check that IC102 pin 7 goes high. This checks the operation of switch TR100.

Checking discriminator

198. Reset the 2955 to modulation f.m. Check IC103 pin 6 for 3.4 μs pulses.

199. Vary the signal generator carrier frequency in 10 kHz steps around 100 MHz and check that the mark/space ratio changes accordingly.

Checking 15 kHz l.p. filter

200. Connect the oscilloscope to TP2. Switch the signal generator modulation on and adjust the frequency while checking for roll-off after 10 kHz. Check that at 15 kHz the level has decreased by half (i.e. 6 dB down).

Checking amplifier IC104b

201. Set the signal generator modulating frequency to 1 kHz. Check at TP2 for a 1 kHz sinewave at 10 V p-p +-20%. If not, the f.m. and ϕ.m. level may need adjusting (see 'Adjustments' below).

Checking de-emphasis

202. Set the signal generator modulation to 5 kHz deviation. Connect the oscilloscope to IC105 pin 6 and check for 4 V p-p at a 1 kHz rate, for 2 V p-p at a 2 kHz rate, and 8 V p-p at a 500 Hz rate.

Checking 40 dB attenuator

203. Connect the oscilloscope, a.c. coupled, to the junction of C124/R141/R142 and check that the 110 kHz signal level is 1/100 of that on the IF IN line at contact 2a.

Checking amplifier TR102

204. Check that the 110 kHz signal at the junction of C127/C128/C129/R149 is 50 times greater than that at the junction of C126/R146/R147.

Checking a.g.c.

205. With the signal generator modulation off, check TP1 for a 110 kHz sinewave at 1 V p-p. If not, the a.m. monitor will have to be adjusted (see 'Adjustments' below) before proceeding.

Checking band-pass filter

206. With the signal generator modulation off, turn down the r.f. level until the a.g.c. has no effect. Adjust the signal generator carrier frequency upwards from 100 MHz and check that roll-off occurs at plus 50 kHz. Tune downwards from 100 MHz and check that roll-off occurs at minus 80 kHz.

Checking a.m. output

207. Set the signal generator to 64% a.m. Connect to TP3 and check for 5 V p-p ±20%. If not, the a.m. monitor will need adjustment (see 'Adjustments' below) before proceeding.

Checking switching

208. The switching operation for the whole board may be checked using the information given in Tables 8a to 8e.

Checking amplifier chain

209. The amplifier chain may be checked by connecting a signal source to the AF INPUT socket with RX mode selected, then checking the levels by reference to Tables 3 and 4 . To check the oscilloscope path, select SCOPE and refer to Table 3. To check the voltmeter path, select BAR CHART and refer to Table 10. For the lower voltage levels, use an a.f. generator set to 1 kHz. For the higher voltage levels, it may be necessary to use a d.c. source (but remember to convert the input values given in Table 9 from p-p to r.m.s.).

210. If the levels are incorrect, it will be necessary to adjust the voltmeter and scope ranging (see 'Adjustment' below) before proceeding.

Checking vertical shift

211. Vary the oscilloscope vertical shift control and check that the d.c. level at the junction of R221/C204/R222 varies commensurately.

Checking 50 kHz l.p. filter

212. Select RX and connect the a.f. generator set to 10 kHz to the AF INPUT socket. Connect the oscilloscope to the SCOPE line at contact 32b.

TABLE 2 CHECKING SWITCHING OPERATION - AB5

Operation	To implement	Decoder IC309 pins								Switches closed
		4	5	6	7	12	11	10	9	
Select a.m.	Press TX, AM	L	H	H	-	-	-	-	-	IC316 4,15 : IC317 2,3
Select ϕ.m.	Press TX, ϕM	H	L	H	-	-	-	-	-	IC317 6,7
Select f.m.	Press TX, FM	H	H	L	-	-	-	-	-	IC317 10,11
Select 15 kHz l.p. filter	Press TX, LOW PASS (15 kHz)	-	-	-	-	L	H	H	H	IC318 2,3
Select 0.3 - 3.4 kHz b.p. filter	Press TX, BAND PASS	-	-	-	-	H	L	H	H	IC318 6,7
Select 300 Hz l.p. filter	Press TX, LOW PASS (300 Hz)	-	-	-	-	H	H	L	H	IC318 10,11
RF power warning	Connect 2 W max. to b.n.c. socket	-	-	-	-	H	H	H	L*	IC318 14,15 (after delay)

* Switching

TABLE 2b CHECKING SWITCHING OPERATION - AB5

Operation	To implement	Decoder IC311 pins								Switches closed
		4	5	6	7	12	11	10	9	
Select a.f. input socket	Press RX	L	H	H	-	-	-	-	-	IC319 2,3
Select reverse power	Connect ACCESSORY socket pin 6 to 0 V	H	L*	H	-	-	-	-	-	IC319 6,7
Select forward power	Connect ACCESSORY socket pin 6 to 0 V	H	H	L*	-	-	-	-	-	IC319 10, 11
RF power ranging x1	Press TX Vary input to b.n.c. socket by ±10 dBm	-	-	-	-	L	H	H	-	IC322 1,4
RF power ranging x2		-	-	-	-	H	L	H	-	IC322 8,5
RF power ranging x5		-	-	-	-	H	H	L	-	IC322 9,12

*Switching

TABLE 2 c CHECKING SWITCHING OPERATION - AB5

Operation	To implement	Decoder IC307 pins								Switches closed
		4	5	6	7	12	11	10	9	
SINAD filter out	Press RX, DIST´N off	L	H	H	-	-	-	-	-	IC313 2,3
SINAD filter in	Press RX, DIST´N on	H	L*	H	-	-	-	-	-	IC313 6,7
RF power (absorptive)	Press TX	H	H	L*	-	-	-	-	-	IC313 10,11
Voltmeter/demod. ranging x1	Press TX, DIST´N off, FM Vary deviation from 1 kHz to 15 kHz (applies to all four voltmeter/demod. rows)	-	-	-	-	L	H	H	H	IC314 2,3
Voltmeter/demod. ranging x2		-	-	-	-	H	L	H	H	IC314 6,7
Voltmeter/demod. ranging x5		-	-	-	-	H	H	L	H	IC314 10,11
Voltmeter/demod. ranging x10		-	-	-	-	H	H	H	L	IC314 14,15

* Switching

TABLE 2d CHECKING SWITCHING OPERATION - AB5

Operation	To implement	Decoder IC308 pins								Switches closed
		4	5	6	7	12	11	10	9	
Scope ranging x1	Press TX, SCOPE. Select 30 kHz f.m.	L	H	H	H	-	-	-	-	IC315 2,3
Scope ranging x2	Press TX, SCOPE. Select 15 kHz f.m.	H	L	H	H	-	-	-	-	IC315 6,7
Scope ranging x5	Press TX, SCOPE. Select 6 kHz f.m.	H	H	L	H	-	-	-	-	IC315 10,11
Scope ranging x10	Press TX, SCOPE. Select 3 kHz f.m.	H	H	H	L	-	-	-	-	IC315 14,15
AF to scope	Press RX.	-	-	-	-	-	L	H	-	IC316 6,7
Demod. to scope	Press TX.	-	-	-	-	-	H	L	-	IC316 10,11

TABLE 2e CHECKING SWITCHING OPERATION - AB5

Operation	To implement	Decoder IC304 pins								Switches closed
		2	5	6	9	12	15	16	19	
Peak detector in	Press TX	L*	-	-	-	-	-	-	-	IC313 14,15 closed
AF/scope ÷ 20	Press RX, SCOPE, 20 V/div.	-	L	-	-	-	-	-	-	IC319 14,15 closed
AF/scope ÷ 2	Press RX, SCOPE, 500 mV/div.	-	H	-	-	-	-	-	-	IC319 14,15 open
Select d.c.	Press RX, DIST˜N off, DC	-	-	L	-	-	-	-	-	RLA closed
Scope ranging x1	Press RX, SCOPE, 20 V/div.	-	-	-	L	-	-	-	-	IC316 2,3 closed
Scope ranging x10	Press RX, SCOPE, 5 V/div.	-	-	-	H	-	-	-	-	IC316, 2,3 open
AF/FWD/REV to filters	Press RX	-	-	-	-	L	-	-	-	IC312 2,3 closed
Demod. to filters	Press TX	-	-	-	-	-	L	-	-	IC312 6,7 closed
External a.f. to scope x1	Press RX, SCOPE, 20 V/div.	-	-	-	-	-	-	L	-	IC312 10,11 closed
External a.f. to scope x10	Press RX, SCOPE, 50 mV/div.	-	-	-	-	-	-	H	-	IC312 10,11 open
AF/FWD/REV to voltmeter x1	Press BARCHART, DIST˜N off, DC. 7 V d.c. to AF INPUT	-	-	-	-	-	-	-	L	IC312 14,15 closed
AF/FWD/REV to voltmeter x10	Press BARCHART, DIST˜N off, DC. 3 V d.c. to AF INPUT	-	-	-	-	-	-	-	H	IC312 14,15 open

*Switching

TABLE 3 AB5 OSCILLOSCOPE SIGNAL LEVELS - RX MODE

AF IN (P-P)	/DIV	IC304 Pin 5	IC200 Gain	LEVEL	IC304 Pin 16	IC201 Gain	LEVEL	IC304 Pin 8	IC204a Gain	LEVEL	IC305 15	pins 12	IC204d Gain	SCOPE
-	100 V	L	÷20	-	L	x1	-	L	x1	-	L	L	x1	-
-	50 V	L	÷20	-	L	x1	-	L	x1	-	L	H	x2	-
80 V	20 V	L	÷20	4 V	L	x1	4 V	L	x1	4 V x k	H	L	x5	20 V x k
40 V	10 V	L	÷20	2 V	L	x1	2 V	L	x1	2 V x k	H	H	x10	20 V x k
20 V	5 V	L	÷20	1 V	L	x1	1 V	H	x10	10 V x k	L	H	x2	20 V x k
8 V	2 V	L	÷20	400 mV	L	x1	400 mV	H	x10	4 V x k	H	L	x5	20 V x k
4 V	1 V	L	÷20	200 mV	L	x1	200 mV	H	x10	2 V x k	H	H	x10	20 V x k
2 V	500 mV	H	÷2	1 V	L	x1	1 V	H	x10	10 V x k	L	H	x2	20 V x k
800 mV	200 mV	H	÷2	400 mV	L	x1	400 mV	H	x10	4 V x k	H	L	x5	20 V x k
400 mV	100 mV	H	÷2	200 mV	L	x1	200 mV	H	x10	2 V x k	H	H	x10	20 V x k
200 mV	50 mV	H	÷2	100 mV	H	x10	1 V	H	x10	10 V x k	L	H	x2	20 V x k
80 mV	20 mV	H	÷2	40 mV	H	x10	400 mV	H	x10	4 V x k	H	L	x5	20 V x k
40 mV	10 mV	H	÷2	20 mV	H	x10	200 mV	H	x10	2 V x k	H	H	x10	20 V x k

Where k is the ratio of IC203a OUT/IN (approx. 0.17)

TABLE 4 AB5 VOLTMETER SIGNAL LEVELS - RX MODE

AF In (r.m.s.)	Range	Resolution	IC304 pin 5	IC200 gain	Level	IC304 pin 19	IC202 gain	Level	IC305 pins 9	IC305 pins 6	IC204b gain	Voltmeter
100 V	64 - 128 V	500 mV	L	÷20	5 V	L	x1	5 V	L	L	x1	5 V x k
50 V	25.6 - 64 V	250 mV	L	÷20	2.5 V	L	x1	2.5 V	L	H	x2	5 V x k
20 V	12.8 - 25.6 V	100 mV	L	÷20	1 V	L	x1	1 V	H	L	x5	5 V x k
10 V	6.4 - 12.8 V	50 mV	L	÷20	500 mV	L	x1	500 mV	H	H	x10	5 V x k
5 V	2.56 - 6.4 V	25 mV	L	÷20	250 mV	H	x10	2.5 V	L	H	x2	5 V x k
2 V	1.28 - 2.56 V	10 mV	L	÷20	100 mV	H	x10	1 V	H	L	x5	5 V x k
1 V	0.64 - 1.28 V	5 mV	L	÷20	50 mV	H	x10	500 mV	H	H	x10	5 V x k
500 mV	256 - 640 mV	2.5 mV	H	÷2	250 mV	H	x10	2.5 V	L	H	x2	5 V x k
200 mV	128 - 256 mV	1 mV	H	÷2	100 mV	H	x10	1 V	H	L	x5	5 V x k
100 mV	- 128 mV	0.5 mV	H	÷2	50 mV	H	x10	500 mV	H	H	x10	5 V x k

Where k is the ratio of IC203b OUT/IN (approx. 1.0)

213. Check that the response is flat to 20 kHz and that obvious roll-off occurs at 50 kHz.

Checking 0.3 - 3.4 kHz b.p. filter

214. Select BAND PASS and connect the oscilloscope to the rear panel DE-MOD OUT socket.

215. Adjust the a.f generator frequency upwards from 1 kHz and check that the signal is 3 dB down at 3.4 kHz. Tune downwards and check that the signal is 3 dB down at 300 Hz.

216. Switch between the band-pass and 50 kHz low-pass filters. If the signal levels are different, then the band-pass filter will have to be adjusted (see 'Adjustment' below) before proceeding.

Checking 300 Hz l.p. filter

217. Press LOW-PASS to obtain the 300 Hz l.p. filter.

218. Adjust the a.f. generator upwards from 100 Hz and check that the signal is 3 dB down at 300 Hz.

Checking SINAD filter

219. Select DIST'N on. Set the a.f. generator output to 1 kHz at 100 mV. Check at 1 kHz minus 8 Hz and 1 kHz plus 8 Hz that the level at IC301 pin 14 is less than 1/10 of the level at IC204 pin 7. If not, the notch width will have to be adjusted (see 'Adjustment' below).

BOARD AB6 - AF SYNTHESIZER

Test equipment : Oscilloscope, frequency counter.

Circuit diagram: Chap.7, Figs. 22, 23 and 24.

Checking v.c.o.

220. Select TX. Check at the junction of D1/C24/R55 for 0.5 to 4.5 V d.c. Connect a counter to IC13 pin 13 and check for 6.5536 MHz.

Checking bit rate multiplier

221. Set the 2955 a.f. generator to 3.2768 kHz and check TP1 for 3.2768 MHz. Change frequency to 20 Hz and check TP1 for 20 kHz.

Checking range selection

222. Set the a.f. generator to 15 kHz. Check that IC14 pins 2 and 5 are both low, and that IC11 pins 2 and 4 are both high. Check IC18 pin 4 for 15 kHz and pin 10 for 750 kHz. This checks the 10 to 20 kHz range.

223. Change frequency to 5 kHz. Check that IC14 pin 2 is low and pin 5 is high. Check IC18 pin 4 for 5 kHz and pin 10 for 500 kHz. This checks the 3.2768 to 10 kHz range.

224. Change frequency to 2 kHz. Check that IC14 pins 2 and 5 are both high. Check IC18 pin 4 for 2 kHz and pin 10 for 200 kHz. This checks the 20 to 3.2768 kHz range.

Checking switched capacitor filter

225. Check at TP6 for a pure sinewave at 3.5 V p-p.

Checking 1 kHz dividers and filters

226. Check IC30 pin 13 for a 1 kHz squarewave. This checks the divider operation.

227. Transfer to TP5 and check for a pure sinewave of 7 V p-p. If not, the level will have to be adjusted (see 'AF generator output level' below).

Checking latch IC14 and drivers

228. The latch outputs on IC14 pins 2 and 5 are checked under the range selection and v.c.o. headings.

229. Press DUPLEX. Select 1 port duplex by pressing the SELECT key until the b.n.c. socket is selected. Check that whenever this socket is selected, the DUPLEX line from TR13 collector goes high.

230. Select RX. Press SELECT and check that whenever the b.n.c. socket is selected, the IP SELECT line from TR12 collector goes high.

231. With RX selected, set the signal generator r.f. output level to -20 dBm. Check for 0 V on the 20 dB OUT line at contact 22a, the 40 dB OUT line at contact 23a and the 40 dB OUT line at contact 21a.

232. Check for +5 V on the 20 dB IN line at contact 22b, the 40 dB IN line at contact 23b and the 40 dB IN line at contact 21b.

233. Set the r.f. output level to -140 dBm using a single step decrement. Check for 0 V on the 20 dB IN line at contact 22b, the 40 dB IN line at contact 23b and the 40 dB IN line at contact 21b.

234. Check for +5 V on the 20 dB OUT line at contact 22a, the 40 dB OUT line at contact 23a and the 40 dB OUT line at contact 21a.

Checking switched l.p. filters

235. Tune the 2955 a.f. generator down to 3 kHz. Check that between 3 kHz and 1 kHz switch IC21d is closed.

236. Continue tuning down and check that between 1 kHz and 300 Hz switch IC21c is closed, between 300 Hz and 100 Hz switch IC21b is closed, and between 100 Hz and 30 Hz switch IC21a is closed.

237. Check that below 30 Hz all sections of switch IC21 are closed.

Checking a.f. amplifier IC19

238. Set the 2955 a.f. generator to 5 kHz and check for 7 V p-p on IC27 pin 15. If not, the level will have to be adjusted (see 'AF generator output level' below).

239. Change frequency to 15 kHz and check for 7 V p-p on IC27 pin 15. If not, the level will have to be adjusted (see 'AF generator output level' below).

Checking variable frequency DAC

240. Connect to IC27 pin 16 and display the level as a reference. Adjust the level using the VARIABLE control and check that the level changes in steps of 10 mV. This checks IC27 and IC19d.

Checking variable frequency range switching

241. Switch between RX and TX and check that when TX is selected, switch IC22b closes.

242. With TX selected, set the output level to 2 V and check at the AF GEN OUTPUT socket for 2 V. This checks the x1 scaling and output amplifier IC36.

243. Set the output level in turn to 500 mV and 200 mV and check that IC22 sections c and d respectively close. This checks the x0.25 and x0.1 scaling.

Checking 1 kHz DAC

244. With TX selected, set the 2955 a.f. generator to 1 kHz. Adjust the level using the VARIABLE control and check for 10 mV steps on TP8. This checks IC26 and IC19c.

245. Select RX and set the modulating frequency to 1 kHz. Adjust the level using the VARIABLE control and check for 10 mV steps on TP9. This checks IC26 and IC20d.

Checking 1 kHz range switching

246. Switch between RX and TX and check that when TX is selected, switch IC23d closes.

247. Select TX. Set the output level in turn to 500 mV and 200 mV and check that IC23 sections a and b respectively close. This checks the x0.25 and x0.1 scaling.

248. Select RX and modulation f.m. Check that for 0 Hz deviation IC23c is open , and that for 25 kHz deviation IC23c is closed. This checks the x1 and x0.25 scaling.

Checking external modulation

249. Select TX and connect the AF GEN OUTPUT socket to the EXT MOD INPUT socket.

250. Set the a.f. generator output to 1 V p-p and check on IC37a pin 1 that the level is unchanged. This checks the buffer operation.

251. Transfer to TP1 and check that the level is about 3 times greater. This checks amplifier IC20c operation. Remove the socket connector.

Checking gain switching

252. Select RX and set the modulation to f.m.

253. Set the 2955 signal frequency to 300 MHz and check that switch IC24a is closed and IC24b is open. This checks the x1 scaling.

254. Change frequency to 600 MHz and check that switch IC24b is closed and IC24a is open. This checks the x0.5 scaling.

255. Change frequency to 100 MHz and check that switches IC24a and IC24b are both open. This checks the x2 scaling.

256. Change modulation to phase modulation and check that switch IC24d is closed.

Checking modulation selection

257. Switch between a.m. and f.m. Check that when f.m. is selected, switches IC25a and IC25b are closed. Check that when a.m. is selected, switch IC25c is closed.

Checking r.f. output level

258. Switch the modulation off and set the 2955 signal generator output level to −20 dBm. Check at the N-type socket for −20 dBm. If not, follow the procedure given under 'RF output level calibration'.

Checking modulation level

259. Select f.m. Adjust the r.f. level using the VARIABLE control while checking that the d.c. at contact 31a varies accordingly over a range of 10 dB.

260. Select a.m. and set the modulation level to 30%. Check contact 31a for d.c. with an a.c. component.

AC1 - CRT DRIVE

Test equipment: Oscilloscope, signal generator.

Circuit diagram: Chap. 7, Fig. 25.

Checking internal standard

261. The frequency of the internal 10 MHz crystal oscillator may be checked and, if necessary, adjusted using the procedure given in '10 MHz standard' below.

Checking divider operation

262. Check at IC5 pin 4 for 10 MHz at t.t.l. levels. Transfer to IC5 pin 3 and check for 1 MHz, then to pin 13 and check for 100 kHz.

Checking external input

263. Connect a 1 MHz signal in the range 100 mV to 3 V r.m.s. to the rear panel EXT STD 1 MHz socket.

264. Check at IC4 pin 1 for 1 MHz at t.t.l. levels. This checks TR5 and TR6.

265. Check at IC4 pin 12 for 100 kHz. This checks the divider operation.

Checking phase detector operation

266. Vary the frequency of the external signal and check for a varying mark/space ratio at IC3 pin 3.

267. Transfer to the junction of R43/C34/R42 and check for a varying d.c. voltage as the frequency of the external signal is varied.

Checking video amplifier

268. Check tag 9 for a 38 V p-p signal. Check that the lower level (beam cut-off) is at +5 V. This checks the operation of TR1,TR2.

Checking frame output

269. Check on IC1 pin 9 for a ramp at a rate of 52.7 Hz.

270. Check that the display has full horizontal cover of the tube face. If not, adjustment is necessary (see 'Frame height' below).

271. Check that the characters on the display are linear across the tube face. If not, adjustment is necessary (see 'Frame linearity' below).

272. Check IC1 pin 10 for a d.c. bias of 2.3 V.

273. Check at IC1 pin 4 for a waveform of 25 V amplitude at the frame rate.

Checking line output

274. Check that the display is centrally positioned on the tube. If not, adjustment is necessary (see 'Vertical shift' below).

275. Check that TR4 and TR3 switch on and off (but note the 300 V on TR3 collector) at the line sync rate.

276. Check that the display has full vertical cover of the tube face. If not, adjustment is necessary (see 'Linearity and width' below).

Checking supplementary supplies

277. Check for +475 V at the junction of D9/C26.

278. Check for +50 V at TR2 collector (can).

279. Check for +150 V at PLB 1.

280. Check tag 8 for +22 V.

Checking INTENSITY control

281. Check at tag 14 that the voltage varies between 125 and 80 V (nominal) as the front panel INTENSITY control is varied across its range. Check for a full range of intensities (note that the lower voltage provides the high intensity).

282. Check that the display is in sharp focus. If not, adjustment is necessary (see 'Focus' below).

AC2 - INPUT SWITCHING

Test equipment: Oscilloscope, power source

Circuit diagram: Chap.7, Fig. 26.

Checking overheat

283. Select TX and the N-type socket. Connect the oscilloscope to OVER TEMP OUT AC0 tag 1.

284. With no r.f. input, i.e. at ambient temperature, check that the voltage on AC0 tag 1 is btween 4 and 5 V.

285. Connect the power source set to 30 W to the N-type socket. Check that the voltage on AC0 tag 1 falls to no lower than 2.5 V.

286. Connect a 12 kΩ resistor between AC0 tag 1 and earth and check that the screen flashes, followed after a delay by the audible warning.

Checking overload detection and isolation

287. Select the b.n.c. socket and connect the power source set to a low level to the socket.

288. Check for a high logic level on DUPLEX-ISOLATE A0 tag 2.

289. Increase the input voltage negatively, and check that when A0 tag 4 is at +1 V, the screen flashes followed after a delay by an audible warning. Check that A0 tag 2 goes to a low logic level to operate the relay to disconnect the input.

290. Increase the input voltage positively, and check that when A0 tag 5 is at -1 V, the screen flashes and the warning sounds as before.

Checking input selection

291. With TX selected, check that INPUT SELECT on A0 tag 3 is at a high logic level.

292. Select two port duplex and check that A0 tag 3 has gone low.

Checking duplex/normal

293. With two port duplex selected, check that DUPLEX/NORMAL on A0 tag 6 is at a low logic level.

294. Select one port duplex and check that A0 tag 6 has gone high.

AF1 - MAIN KEYBOARD

Test equipment: Oscilloscope.

Circuit diagram: Chap. 7, Fig. 11.

Checking key operation

295. Check that the COLUMNS lines leading to PLA 7,11,16,19,18,13,14,15 are all high.

296. Check that the ROWS lines leading to PLA 12,20,17,9,6,10,2,3,4 are all low.

297. Press and hold the keys in turn while checking for corresponding low logic levels on the COLUMNS lines (refer to the circuit diagram to correlate keys with lines). For example, pressing and holding the RX key will cause PLA 11 to go low.

Checking latch operation

298. Press SELECT until IC1 pin 5 goes high. Check that b.n.c. socket l.e.d. D1 is lit.

299. Press SELECT once. Check that IC1 pin 7 goes high and that N-type socket l.e.d. D2 is lit.

300. Select RX and set a modulating frequency.

301. Set an a.m. depth level. Check that IC1 pin 12 goes high and that l.e.d. D4 is lit.

302. Set an f.m. deviation level. Check that IC1 pin 15 goes high and that l.e.d. D5 is lit.

303. Set a ϕ.m. deviation level. Check that IC1 pin 10 is goes and that l.e.d. D3 is lit.

AF2 - SCOPE KEYBOARD

Test equipment: Oscilloscope.

Circuit diagram: Chap.7, Fig. 28.

Checking key operation

304. Check that the COLUMNS lines leading to tags 4,6,8 are all high.

305. Check that the ROWS lines leading to tags 7 and 9 are both low.

306. Press and hold the keys in turn while checking for corresponding low logic levels on the COLUMNS lines (refer to the circuit diagram to correlate keys with lines). For example, pressing and holding the RX key will cause tag 4 to go low.

Checking analogue controls

307. Connect the oscilloscope in turn to the wipers of the VOLUME and POSITION controls R2,R3,R4 and check for 0 to +5 V as the controls are adjusted over their full ranges.

AG1 - GPIB INTERFACE

Test equipment: Oscilloscope

Circuit diagram: Chap. 7, Fig. 30

Checking power supply

308. Check AB1 PLC contact 20 for +5 V.

Checking clock signal

309. Check AB1 PLC contact 19 for a 5 MHz square wave at t.t.l. levels.

AR1 - POWER SUPPLY

Test equipment: Oscilloscope,

Circuit diagram: Chap. 7, Fig. 29.

Checking input relay

310. Connect a d.c. supply of 12 - 15 V at 6 - 5 A to the rear panel DC SUPPLY socket. Check that TR18 is switched on (0 V at collector) and that RLA contacts 5 and 6 are connected. (Check at this time, that the fan is operating.)

311. Connect a.c. mains to the rear panel AC SUPPLY socket. Check that TR19 switches on, TR18 switches off and RLA contacts 7 and 6 are connected.

312. Remove the a.c. supply. Check that RLA contacts 5 and 6 are reconnected.

Checking 10 V regulator

313. Check at IC1 pin 12 for 10 V. If not, the regulator setting will require adjustment (see 'Low level volts' below).

Checking low volts

314. Decrease the d.c. supply voltage and check that at 10.7 V (at 6 A) TR1 switches on. Check that tag 8 is logically high.

Checking dividers

315. Check IC2 pin 6 for 10 MHz divided by 16.

316. Check IC2 pin 10 for 10 MHz divided by 64.

317. Check that TR8 is pulsed on and off at the divided reference (156 kHz) rate.

Checking controller

318. Decrease the d.c. supply voltage still further and check that at about 8.5 V on IC1 pin 12, TR4 and TR6 both switch off and TR9 switches on.

319. Check that the controller has switched off by checking that pins 8 and 11 are both high.

320. Restore the d.c. supply. Check IC1 pins 8 and 11 for complementary pulses.

321. Vary the d.c. supply voltage and check for a varying mark/space ratio on IC1 pins 8 and 11.

Checking output

322. Check tag 6 for +12 V and tag 4 for +5.05 V. If not, the error amplifier will need adjustment (see '+5 V supply' below).

AR4 - DC FILTER

Test equipment: Oscilloscope

Circuit diagram: Chap 7, Fig. 26

Checking filter

323. With no external d.c. supply connected, check that all unwanted signals (mainly at 50 Hz) on tags 3 and 4 are much reduced on tags 1 and 2.

A21 - OPTICAL ENCODER

Test equipment: Oscilloscope

Circuit diagram: Chap. 7, Fig. 28

Checking encoder

324. Connect one oscilloscope channel to A81 PLX contact 2 and the other to contact 4.

325. Rotate the front panel VARIABLE control while checking for quadrature pulses on the oscilloscope display.

326. Check that the pulse rate increases with the control turning rate, and that the phase changes when the movement is reversed.

Chapter 6

REPLACEABLE PARTS

CONTENTS

INTRODUCTION

1. Each sub-assembly or printed circuit board in this instrument has been allocated a unit identification, e.g. A0, AA2, AB1 etc. The complete component reference carries its unit number as a prefix e.g. AB1C3 (capacitor C3 on the mother board) but, for convenience in the text and on circuit diagrams, the prefix is not used. However, when ordering replacements or in correspondence, quote the complete component reference.

ABBREVIATIONS

2. The components are listed in alphanumerical order of the complete circuit reference and the following abbreviations are used:

ADC	analogue-digital converter
CAP	capacitor
CARR	carrier
CARB	carbon
CC	carbon composition
CDE CNV	code converter
CER	ceramic
CERM	cermet
CF	carbon film
COAX	coaxial
CON	connector
DAC	digital-analogue converter
DEC/DMX	decoder/demultiplexer
DECOD	decoder
DIL	dual in-line
DIV	divider
DRIV	driver
ELEC	electrolytic
ENCOD	encoder
FEM	female
FF	flip-flop (bistable)
FILTERCON	filtering capacitor
CER	germanium
GP	general purpose
ICA	integrated circuit, analogue
ICD	integrated circuit, digital
IND	inductor
INV	inverter
LD/T	lead through
MF	metal film
MG	metal glaze
MISC	miscellaneous
MO	metal oxide
MP	microprocessor
MP SUPP	microprocessor support
MUX	multiplexer
NET	network
PLAS	plastic
PLL	phase-locked loop
Q/ACT	quick acting
RECT	rectifier
RES	resistor
RV	resistor, variable
RX	receiver
SEC	secondary
SH REG	shift register
SIL	silicon
SW	switch
T/LAG	time lag
TANT	tantalum
TOG	toggle
TR NJF	n-JFET
TR NSI	NPN silicon transistor

TR PSI	PNP silicon transistor
TX	transmitter
VAR	variable
VREG	voltage regulator
WW	wirewound
!	static sensitive component

COMPONENT VALUES

3. One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons:

(a) Components indicated by a * have their values selected during test to achieve particular performance limits.

(b) Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the instrument is maintained.

(c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

When there is a difference between the component fitted and the one listed, always use as a replacement the same type and value as found in the instrument.

MANUFACTURERS' PART NUMBERS

4. To assist you in obtaining replacements, components are listed with both a Marconi Instruments (MI) part number and a manufacturer's part number. The manufacturer can be identified by the 5-character Mfr. code which is cross-referenced to the manufacturer's name and address in Table 1.

5. Mfr. codes with four digits and a prefix letter are NSCM codes (Nato Supply Codes for Manufacturers). Those with five digits are FSCM codes (Federal Supply Codes for Manufacturers) which are assigned to North American suppliers.

ORDERING

6. When ordering replacements, address the order to our Service Division (address inside rear cover) or nearest agent and specify the following for each component required:-

(1) Type* and serial number of instrument.

(2) Complete circuit reference.

(3) Description.

(4) Marconi Instruments part number.

*As given on the serial number label at the rear of the instrument; if this is superseded by a model number label, quote the model number instead of the type number.

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

ELECTRICAL COMPONENTS

Unit A0 - Main assembly

7. When ordering, prefix circuit reference with A0

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	52955-900A	U2632	52955-900A
C1	CAP ELEC 4700U 40V 10%+	26426-093M	K8996	071 17472
C2	CAP ELEC 4700U 40V 10%+	26426-093M	K8996	071 17472
C3	CAP ELEC 220V 63V 20% AX	26415-820J		
C4	CAP PC 470N 100V 10%	26582-679X		
D1	DI BRIDGE BY260 200V 12A	28359-190S	K8996	BY260 200
FS1	FUSE T/LAG 0.50A 20X5	23411-056X	U0154	L2080
FS2	FUSE T/LAG 0.50A 20X5	23411-056X	U0154	L2080
FS3	FUSE T/LAG 6.3A 20X5	23411-065A	K0647	5502 OR TDC123
	H/W FUSE HOLDER PANEL 20X5 (1 OF 3)	23416-192R	U0928	F396 1 OR F455/S
LS1	LOUDSPEAKER ROUND 75R 2.25"	23646-105A	S4248	6A1 70
R29	RES MF 390R .25W 2% 100PPM	24773-263P	K8996	MR25
S1	SW TOG 4CO MIN ON-ON	23462-266S	U3515	U41 SHZQ1
	SW PART TOG LEVER CAP BLACK	23462-881F	S3323	CP01
	COVER MAINS SW 4 POLE	37561-105P		
S2	SW SLIDE 2CO PANEL MTG	23467-161W	U3627	46206 LE
SKB	CON-RF BNC-FEM 50 BKHD	23443-442B	K1072	GE35152YBN
SKC	CON CIRC FEM 7 FXD DIN	23424-353P	U1479	DIN CONN 7WAY
T1	TRANSFORMER MAINS.	43490-087V	U2632	43490-087V
	FAN AX 12V DC BRUSHLESS 80MM	23535-128K	U3613	FBP-08A12H
X3	FERRITE BEADS (4)	23635-845E		
X4	FERRITE BEADS (4)	23635-845E		
	VALVE CRT 190F31 E7-91 7"90DE	28235-617C	U4794	190FB31
	CONNECTOR ASSY (TYPE N)	43130-165S	U2632	43130-165S
	CONNECTOR ASSY BNC	43130-166W	U2632	43130-166W
	CABLE CO-AX ASSY, AF INPUT AB1 PLR	43130-167D	U2632	43130-167D
	CABLE CO-AX S/R ASSY, AA0 PLC AC2	43130-168T	U2632	43130-168T
	CABLE CO AX ASSY, AA0 PLB AB1	43130-169P	U2632	43130-169P
	CABLE CO-AX ASSY, AF GEN AB1 PLK	43130-170D	U2632	43130-170D
	CABLE RIBBON ASSY, AF2 AB1 PLG	43130-183Z	U2632	43130-183Z
	CABLE CO-AX ASSY, AC2 ATTEN	43130-193J	U2632	43130-193J
	CABLE CO-AX ASSY, AA0 PLA AB1	43130-198W	U2632	43130-198W
	CABLE CO-AX ASSY, AA0 PLD AB1	43130-199D	U2632	43130-199D
	CABLE CO-AX ASSY, AA0 PLG AB1	43130-200F	U2632	43130-200F

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit A0	- Main assembly		(Contd.)	
	CABLE CO-AX ASSY, AA0 PLB-AC1	43130-201G	U2632	43130-201G
	CABLE CO-AX ASSY, AB1 PLT-AR1	43130-202V	U2632	43130-202V
	CABLE CO-AX ASSY, EXT STD-AC1	43130-203S	U2632	43130-203S
	CABLE CO-AX ASSY, AA0 PLF-AB1	43130-225Y	U2632	43130-225Y
	CABLE CO-AX ASSY, AAO PLE-AB1	43130-226N	U2632	43130-226N
	E PROM 2716 (AB3-IC33)	44533-153W	U2632	TBX12
	MAGNET TBX12 6MM CRT CORRECTOR	28238-156X	U3008	28238-156X
	E PROM,SET,4.(FOR AB4,IC9/A, IC10/B,IC11/C,IC12/D)	44533-155T	U2632	44533-155T
	EE PROM X2816A (AB4-IC13)	44533-156P	U2632	44533-156P
	CABLE CO-AX ASSY, IF OUT	43130-227L	U2632	43130-227L

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AA0 - RF tray

8. When ordering, prefix circuit reference with AA0

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44990-486S	U2632	44990-486S
C1	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C2	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C3	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C4	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C5	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C6	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C7	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C8	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C9	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C11	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C13	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C14	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C15	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C16	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C17	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C18	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C19	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C20	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C21	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C22	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C23	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C24	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C25	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C26	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C27	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C28	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C29	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C30	CAP CER 50P 300V 10%	26333-229U	K8445	FT73
C31	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C32	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C33	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C34	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C35	CAP FILTERCON 1N5 350V -0%	26397-205F	K8300	TPS003A
C36	CAP FILTERCON 1N5 350V -0%	26397-205F	K8300	TPS003A
C37	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C38	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C39	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C40	CAP CER 120P 63V 2%	26343-438L	K8996	2222 678 3
C41	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C42	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA0	- RF tray			(Contd.)
C43	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C44	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C45	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C46	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C47	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C48	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C49	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C50	CAP CER 27P 63V 5%	26343-499U	K8996	2222 678 34279
C51	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C52	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C53	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C54	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C55	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C56	CAP CER 1N0 300V 20%+	26373-733K	K8445	FT73 29 K3000
C57	CAP CER 68P 63V 2%	26343-475F	K8996	2222 682
C60	CAP FILTERCON 1N5 350V -0%	26397-205F	K8300	TPS003A
C61	CAP FILTERCON 1N5 350V -0%	26397-205F	K8300	TPS003A
C62	CAP FILTERCON 1N5 350V -0%	26397-205F	K8300	TPS003A
C63	CAP FILTERCON 1N5 350V -0%	26397-205F	K8300	TPS003A
L1	IND CHOKE GEN	44190-036B	U2632	44190-036B
L2	IND CHOKE GEN	44190-036B	U2632	44190-036B
L3	IND CHOKE GEN	44190-036B	U2632	44190-036B
L4	IND CHOKE GEN	44190-036B	U2632	44190-036B
L5	IND CHOKE GEN	44190-036B	U2632	44190-036B
L6	IND CHOKE GEN	44190-036B	U2632	44190-036B
L7	IND CHOKE GEN	44190-036B	U2632	44190-036B
L8	IND CHOKE GEN	44190-036B	U2632	44190-036B
L9	IND CHOKE GEN	44190-036B	U2632	44190-036B
L11	IND CHOKE GEN	44190-036B	U2632	44190-036B
L12	IND CHOKE GEN	44190-036B	U2632	44190-036B
L13	IND CHOKE GEN	44190-036B	U2632	44190-036B
L14	IND CHOKE GEN	44190-036B	U2632	44190-036B
L15	IND CHOKE GEN	44190-036B	U2632	44190-036B
L16	IND CHOKE GEN	44190-036B	U2632	44190-036B
L17	IND CHOKE GEN	44190-036B	U2632	44190-036B
L18	IND CHOKE GEN	44190-036B	U2632	44190-036B
L19	IND CHOKE 3.3UH 10% LAQ	23642-552L	K0467	406 8 274 69 016
L20	IND CHOKE 3.3UH 10% LAQ	23642-552L	K0467	406 8 274 69 016
L21	IND CHOKE 3.3UH 10% LAQ	23642-552L	K0467	406 8 274 69 016

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA0	- RF tray		(Contd.)	
L22	IND CHOKE GEN	44190-036B	U2632	44190-036B
L23	IND CHOKE GEN	44190-036B	U2632	44190-036B
L24	IND CHOKE 3.3UH 10% LAQ	23642-552L	K0467	406 8 274 69 016
PLA	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331H	K1072	GE65218BNMBN
PLB	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331H	K1072	GE65218BNMBN
PLD	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331H	K1072	GE65218BNMBN
PLE	CON-RF SMB-MALE 50 BKHD SOLEER	23444-331H	K1072	GE65218BNMBN
PLF	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331H	K1072	GE65218BNMBN
PLG	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331H	K1072	GE65218BNMBN
PLH	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331H	K1072	GE65218BNMBN
	COUPLER ASSY RF	41700-379P	U2632	41700-379P
	CABLE.RIBBON.ASSY, AA3 PLB-AA0	43130-182A	U2632	43130-182A
	CABLE.RIBBON.ASSY, AA1 PLA-AA0	43130-184H	U2632	43130-184H
	CABLE.RIBBON.ASSY, AA2 PLA-AA0	43130-186U	U2632	43130-186U
	CABLE.RIBBON.ASSY, AA0-AB1 PLA	43130-187Y	U2632	43130-187Y
	CABLE.RIBBON.ASSY, AA0-AB1 PLF	43130-188N	U2632	43130-188N
	CABLE.CO-AX.ASSY, AA1 PLB-AA0 PLA	43130-194F	U2632	43130-194F
	CABLE.CO-AX.ASSY, AA3 PLC-AA0 PLG	43130-195G	U2632	43130-195G
	CABLE.CO-AX.ASSY, AA4 PLA-AA0 PLG	43130-196V	U2632	43130-196V

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AA1 - RF modulation meter

9. When ordering, prefix circuit reference with AA1

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44828-878C	U2632	44828-878C
C1	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C2	CAP CER 150P 63V 2%	26343-479W	K8996	2222 682
C3	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C4	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C5	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C6	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C7	CAP CER 47P 63V 2%	26343-473L	K8996	2222 682
C8	CAP CER 68P 63V 2%	26343-475F	K8996	2222 682
C9	CAP CER 47P 63V 5%	26343-473L	K8996	2222 682
C10	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C11	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C12	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C13	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C14	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C15	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C16	CAP CER 680P 63V 10%	26383-583P	K8996	630-18-681
C17	CAP CER 680P 63V 10%	26383-583P	K8996	630-18-681
C18	CAP PETP 22N 63V 10%	26582-431J	K1945	R68 D C 2202 AAK
C19	CAP PETP 1U0 50V 10%	26582-432F	K1945	R68 C C 1004 AAK
C21	CAP PETP 1U0 50V 10%	26582-432F	K1945	R68 C C 1004 AAK
C22	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C23	CAP PETP 1U0 50V 10%	26582-432F	K1945	R68 C C 1004 AAK
C24	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C25	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C26	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C27	CAP PETP 150N 100V 10%	26582-212K	K8300	PMT2R OR PMC2R
C28	CAP PETP 10N 63V 10%	26582-426N	K1945	R68 D C 1002 AAK
C29	CAP PETP 10N 63V 10%	26582-426N	K1945	R68 D C 1002 AAK
C31	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C32	CAP PS 100P 63V 2%	26538-557S	K4642	EXFS RP 1
C33	CAP PS 100P 63V 2%	26538-557S	K4642	EXFS RP 1
C34	CAP CER 1N8 63V 10%	26383-586C	K8996	630-18-182
C35	CAP ELEC 100U 35V 20%+	26421-122J	U4011	CEB10035
C36	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C37	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C38	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C39	CAP CER 4N7 63V 10%	26383-591B	K8996	630-18-472
C40	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C41	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C42	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA1	- RF modulation meter		(Contd.)		
C43	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C44	CAP ELEC 220U 16V 20%+		26421-124G	U4011	CEB22016
C45	CAP PETP 100N 63V 10%		26582-429F	K1945	R68 D C 1003 AAK
C46	CAP ELEC 220U 16V 20%+		26421-124G	U4011	CEB22016
C47	CAP PETP 100N 63V 10%		26582-429F	K1945	R68 D C 1003 AAK
C48	CAP PETP 220N 63V 10%		26582-430L	K1945	R68 D C 2203 AAK
C49	CAP PETP 470N 63V 10%		26582-427L	K1945	R68 D C 4703 AAK
C51	CAP CER 22N 18V 20%		26383-007R	U4011	ECK F1H223ZV
C52	CAP TANT 4U7 35V 20%		26486-219P	U3613	SH
C53	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C54	CAP CER 47P 63V 2%		26343-473L	K8996	2222 682
C55	CAP CER 3P3 63V .5PF		26343-459K	K8996	2222 682
C56	CAP CER 3P3 63V .5PF		26343-459K	K8996	2222 682
C57	CAP PETP 100N 63V 10%		26582-429F	K1945	R68 D C 1003 AAK
C58	CAP CER 270P 63V 2%		26343-482W	K8996	2222 682
C61	CAP CER 680P 63V 10%		26383-583P	K8996	630-18-681
C62	CAP CER 560P 63V 10%		26383-581D	K8996	630-18
C63	CAP PETP 220N 63V 10%		26582-430L	K1945	R68 D C 2203 AAK
C64	CAP PETP 100N 63V 10%		26582-429F	K1945	R68 D C 1003 AAK
C65	CAP PETP 100N 63V 10%		26582-429F	K1945	R68 D C 1003 AAK
C66	CAP PETP 470N 63V 10%		26582-427L	K1945	R68 D C 4703 AAK
C67	CAP CER 22N 18V 20%		26383-007R	U4011	ECK F1H223ZV
C68	CAP PETP 470N 63V 10%		26582-427L	K1945	R68 D C 4703 AAK
C69	CAP CER 22N 18V 20%		26383-007R	U4011	ECK F1H223ZV
C70	CAP CER 2P7 63V .5PF		26343-458B	K8996	2222 682
C71	CAP CER 6P8 63V .5PF		26343-463A	K8996	2222 682
D1	DI V/CAP BB809 3V 29PF		28381-132G	K8996	BB809
D2	DI V/CAP BB809 3V 29PF		28381-132G	K8996	BB809
D3	DI V/CAP BB809 3V 29PF		28381-132G	K8996	BB809
D4	DI V/CAP BB809 3V 29PF		28381-132G	K8996	BB809
D5	DI ZEN BZX79C9V1 9.1V 5%		28371-757P	K8996	BZX79 C9V1
D6	DI ZEN BZX79C5V1 5.1V 5%		28371-401U	K8996	BZX79 C5V1
D7	DI H/CARR BAR19 4V	!	28349-020G	K6791	BAR19
D8	DI H/CARR BAR19 4V	!	28349-020G	K6791	BAR19
D9	DI H/CARR BAT29 5V	!	28349-014L	K6791	BAT 29 OR BAR 35
IC1	ICD CTR 74LS93 4BIT BIN 2,8,16		28464-117W	K5519	SN74LS93N
IC2	ICA MOD/DMOD MC1496N BAL DIL14		28461-924X	K6659	UA796PC
IC3	ICA PLL MC145145 4BIT BUS I/P	!	28461-937U	K5519	MC 145145P OR L
IC4	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC5	ICA VREG- 79L05AC 5V .1A TO92		28461-736L	K5519	MC79L05AC
IC6	ICD NAND 74S00N QUAD 2INP		28466-331D	K1196	ZN74S00E
IC7	ICA VREG+ 78L05AC 5V 0A1 TO92		28461-734Y	K0461	UA78L05AC

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA1	- RF modulation meter (Contd.)			
L1	IND CHOKE 1.0UH 10% LAQ	23642-549L	U4038	SC10 13
L2	IND CHOKE 47UH 10% LAQ	23642-559D	U4038	SC10 33
L3	IND CHOKE 47UH 10% LAQ	23642-559D	U4038	SC10 33
L4	IND CHOKE 1.0UH 5%	23642-464M	U4251	3640 21
L5	IND CHOKE 1.0UH 5%	23642-464M	U4251	3640 21
L6	IND CHOKE 100UH 10% LAQ	23642-561W	U4038	SC10 37
L7	IND CHOKE 150UH 10% LAQ	23642-562D	U4038	SC10 39
L8	IND CHOKE 33UH 10% LAQ	23642-558W	U4038	SC10 31
L9	IND CHOKE 220UH 10% LAQ	23642-563T	K0467	406 8 274 71 008
L11	IND CHOKE 150UH 10% LAQ	23642-562D	U4038	SC10 39
L12	IND CHOKE 470UH 10% LAQ	23642-565X	U4038	SC10 45
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLC	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLD	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLE	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
R1	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R2	RES MF 820R .25W 2% 100PPM	24773-271B	K8996	MR25
R3	RES MF 3K3 .25W 2% 100PPM	24773-285F	K8996	MR25
R4	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R5	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R6	RES MF 100R .25W 2% 100PPM	24773-249J	K8996	MR25
R7	RES MF 3K3 .25W 2% 100PPM	24773-285F	K8996	MR25
R8	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R9	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R11	RV CERM 50K LIN .5W 10%	25711-643S	U0914	E2A
R12	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R13	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R14	RES MF 6K8 .25W 2% 100PPM	24773-293D	K8996	MR25
R15	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R16	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R17	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R18	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R19	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R21	RES MF 560R .25W 2% 100PPM	24773-267R	K8996	MR25
R22	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R23	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R24	RES MF 27K .25W 2% 100PPM	24773-307K	K8996	MR25
R25	RES MF 27K .25W 2% 100PPM	24773-307K	K8996	MR25
R26	RES MF 9K1 .25W 2% 100PPM	24773-296X	K8996	MR25
R27	RV CERM 2K0 LIN .5W 10%	25711-639V	U0914	E2A

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA1	**- RF modulation meter**	**(Contd.)**		
R28	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R29	RES MF 390K .25W 2% 100PPM	24773-335M	U2453	LR1 OR PR1
R30	RES MF 33R .25W 2% 100PPM	24773-237K	K8996	MR25
R31	RES MF 75K .25W 2% 100PPM	24773-318L	K8996	MR25
R32	RES MF 2K7 .25W 2% 100PPM	24773-283L	K8996	MR25
R33	RES MF 5K1 .25W 2% 100PPM	24773-290V	K8996	MR25
R34	RES MF 5K6 .25W 2% 100PPM	24773-291S	K8996	MR25
R35	RES MF 2K7 .25W 2% 100PPM	24773-283L	K8996	MR25
R36	RES MF 5K1 .25W 2% 100PPM	24773-290V	K8996	MR25
R37	RES MF 5K6 .25W 2% 100PPM	24773-291S	K8996	MR25
R38	RES MF 56R .25W 2% 100PPM	24773-243H	K8996	MR25
R39	RES MF 56R .25W 2% 100PPM	24773-243H	K8996	MR25
R40	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R41	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R42	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R43	RES MF 820K .25W 2% 100PPM	24773-344Z	U2453	LR1 OR PR1
R44	RES MF 300K .25W 2% 100PPM	24773-332T	K8996	MR25
R45	RES MF 2K0 .25W 2% 100PPM	24773-280U	K8996	MR25
R46	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R47	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R48	RES MF 560R .25W 2% 100PPM	24773-267R	K8996	MR25
R49	RES MF 360R .25W 2% 100PPM	24773-262T	K8996	MR25
R50	RES MF 47R .25W 2% 100PPM	24773-241A	K8996	MR25
R51	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R52	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R53	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R54	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R55	RES MF 560R .25W 2% 100PPM	24773-267R	K8996	MR25
R56	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R57	RES MF 360R .25W 1% 100PPM	24762-639Y	K8479	H8N
R58	RES MF 61R1 .25W 1% 100PPM	24762-571U	K8479	H8N
R59	RES MF 61R1 .25W 1% 100PPM	24762-571U	K8479	H8N
R60	RES MF 3K9 .25W 2% 100PPM	24773-287V	K8996	MR25
R61	RES CC 680R .125W 5%	24331-984V	U0914	BB6815
R62	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R63	RES CC 560R .125W 5%	24331-965B	U0914	BB5615
R64	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R65	RES CC 22R .125W 5%	24331-988T	U0914	BB2205
R66	RES CC 220R .125W 5%	24331-976N	U0914	BB2215
R67	RES CC 680R .125W 5%	24331-984V	U0914	BB6815
R68	RES CC 22R .125W 5%	24331-988T	U0914	BB2205
R69	RES CC 22R .125W 5%	24331-988T	U0914	BB2205
R71	RES MF 50R0 .25W 1% 100PPM	24762-558R	K8479	H8N

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA1	- RF modulation meter (Contd.)			
R72	RES CC 22K0 .125W 5%	24331-960P	U0914	BB2235
R73	RES CC 22K0 .125W 5%	24331-960P	U0914	BB2235
R74	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R75	RES MF 6K8 .25W 2% 100PPM	24773-293D	K8996	MR25
R76	RES MF 620R .25W 2% 100PPM	24773-268B	K8996	MR25
R77	RES MF 8K2 .25W 2% 100PPM	24773-295P	K8996	MR25
R78	RES MF 3K0 .25W 2% 100PPM	24773-284J	K8996	MR25
R79	RES MF 62R .125W 2% 100PPM	24772-044R	K7584	MR16 OR MRS16T
R81	RES MF 5K6 .25W 2% 100PPM	24773-291S	K8996	MR25
R82	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R84	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R85	RES MF 160R .25W 2% 100PPM	24773-254G	K8996	MR25
R86	RV THERM 4K 2% BEAD 2DC402	25685-244T	15454	2DC402
R87	RES MF 3K0 .25W 2% 100PPM	24773-284J	K8996	MR25
R88	RES MF 15K .25W 2% 100PPM	24773-301P	K8996	MR25
R89	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R90	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R91	RES MF 47R .25W 2% 100PPM	24773-241A	K8996	MR25
R92	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R93	RES MF 820R .25W 2% 100PPM	24773-271B	K8996	MR25
R94	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R95	RV THERM 50R AT 25C	25685-248C	15454	2DA500F
R96	RES MF 15R .125W 2% 100PPM	24772-029V	K7584	MR16 OR MRS16T
TR1	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
TR2	TR PSI MPSL08 12V 700M - SW	28431-767E	K5519	MPSL08ORMPS4258
TR3	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
TR4	TR NJF J310 25V - 24MA	28459-028E	K5519	J310
TR5	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR6	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
TR7	TR NSI BFY90 15V 1G - AMP	28452-157R	K8996	BFY90
TR8	TR NSI BFY90 15V 1G - AMP	28452-157R	K8996	BFY90
TR9	TR NJF J310 25V - 24MA	28459-028E	K5519	J310
TR11	TR NSI BC109B&C 20V 150M - GEN	28452-777K	K8996	BC109B OR C
TR12	TR NSI BC109B&C 20V 150M - GEN	28452-777K	K8996	BC109B OR C
TR13	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR14	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR15	TR NSI BC237A 45V 150M - GEN	28455-421X	K1196	ZTX107AL
T1	MIN BALUN	43590-141Y	U2632	43590-141Y

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AA2 - RF counter

10. When ordering, prefix circuit reference with AA2

	Complete unit	44828-879R	U2632	44828-879R
C1	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C2	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C3	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C4	CAP CER 1P8 63V .5PF	26343-456C	K8996	2222 682
C5	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C6	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C7	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C8	CAP CER 1P8 63V .25P	26343-456C	K8996	2222 682
C9	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C10	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C11	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C12	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C13	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C14	CAP CER 22N 18V 20%	26383-007R	U4011	ECK F1H223ZV
C15	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C16	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C17	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C18	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C19	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C20	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C21	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C22	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C23	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C24	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C25	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C26	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C27	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C28	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C29	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C30	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C31	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C32	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C33	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C34	CAP CER 2N2 63V 10%	26383-587R	K8996	630-18-222
D1	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D2	DI SIL BA482 35V JUNC	28335-675R	K8996	BA482
D3	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D4	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D5	DI SIL BA482 35V JUNC	28335-675R	K8996	BA482

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA2	- RF counter		(Contd.)		
D6	DI H/CARR BAT29 5V	!	28349-014L	K6791	BAT 29 OR BAR 35
IC1	MOD HYB OM345 VHF/UHF AMP SIL		28461-351Z	K8996	OM345
IC2	MOD HYB OM345 VHF/UHF AMP SIL		28461-351Z	K8996	OM345
IC3	ICA AMP SL952 1GHZ LIMITING		28461-364V	K0467	SL952
IC4	ICD CTR 844 10 DECADE CUSTOM	!	28464-021P	K4567	MA844
IC5	ICD CTR 74LS90 4BIT DEC 2,5,10		28464-014S	K5519	SN74LS90N
IC6	ICD DIV SP8610B /4 1GHZ		28464-024C	K0467	SP8610B
IC7	ICD DIV SP8637B /10 DIL16		28464-027K	K0467	SP8637B
IC8	ICD NOR 10102 QUAD 2INP		28466-219G	K5519	MC10102 (P OR L)
PLA	TERM C/PIN 0.64SQX6 S/E REEL		23435-188V	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL		23435-188V	U2338	75401 001
R1	RES MF 1K0 .25W 2% 100PPM		24773-273A	K8996	MR25
R2	RES MF 2K2 .25W 2% 100PPM		24773-281Y	K8996	MR25
R3	RES MF 61R1 .25W 1% 100PPM		24762-571U	K8479	H8N
R4	RES MF 247R .25W 1% 100PPM		24762-631R	K8479	H8N
R5	RES MF 61R1 .25W 1% 100PPM		24762-571U	K8479	H8N
R6	RES MF 2R2 .25W 2% 100PPM		24773-209E	U1395	RC55
R7	RES MF 50R0 .25W 1% 100PPM		24762-558R	K8479	H8N
R8	RES MF 53R3 .25W 1% 100PPM		24762-557C	K8479	H8N
R9	RES MF 100R .25W 2% 100PPM		24773-249J	K8996	MR25
R10	RES CC 33R .125W 5%		24331-978J	U0914	BB3305
R11	RES CC 33R .125W 5%		24331-978J	U0914	BB3305
R12	RES CC 120R .125W 5%		24331-998K	U0914	BB1215
R13	RES MF 68K .25W 2% 100PPM		24773-317N	K8996	MR25
R14	RES MF 10K .25W 2% 100PPM		24773-297M	K8996	MR25
R15	RES MF 10R .25W 2% 100PPM		24773-225W	K8996	MR25
R16	RES CC 680R .125W 5%		24331-984V	U0914	BB6815
R17	RES MF 680R .25W 2% 100PPM		24773-269K	K8996	MR25
R18	RES MF 2K7 .25W 2% 100PPM		24773-283L	K8996	MR25
R19*	RES MF 6K8 .25W 2% 100PPM		24773-293D	K8996	MR25
R20	RES CC 68R .125W 5%		24331-979F	U0914	BB6805
R21	RES MF 820R .25W 2% 100PPM		24773-271B	K8996	MR25
R22	RES MF 2K2 .25W 2% 100PPM		24773-281Y	K8996	MR25
R23	RES MF 680R .25W 2% 100PPM		24773-269K	K8996	MR25
R24	RES MF 100R .25W 2% 100PPM		24773-249J	K8996	MR25
R25	RES MF 470R .25W 2% 100PPM		24773-265M	K8996	MR25
R26	RES MF 680R .25W 2% 100PPM		24773-269K	K8996	MR25
R27	RES MF 56K .25W 2% 100PPM		24773-315U	K8996	MR25
R28	RES MF 1K2 .25W 2% 100PPM		24773-275H	K8996	MR25
R29	RES MF 470R .25W 2% 100PPM		24773-265M	K8996	MR25
R30	RES MF 820R .25W 2% 100PPM		24773-271B	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA2	- RF counter	(Contd.)		
R31	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R32	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R33	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R34	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R35	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R36	RES MF 820R .25W 2% 100PPM	24773-271B	K8996	MR25
R37	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R38	RES CC 180R .125W 5%	24331-961X	U0914	BB1815
RLA	RELAY MAG 2CO 5V 62R	23486-101F	U0611	172-5
TR1	TR PSI BCY70 40V 250M - GEN	28434-857Z	K6659	BCY70
TR2	TR PSI BCY70 40V 250M - GEN	28434-857Z	K6659	BCY70
TR3	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR4	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
X2	CABLE ASSY SMC/OE, AAO PLC-AA2	43130-192L	U2632	43130-192L

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AA3 - RF synthesizer and oscillator

11. When ordering, prefix circuit reference with AA3

	Complete unit	44828-880M	U2632	44828-880M
C1	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C2	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C3	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C4	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C5	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C6	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C7	CAP CER 27P 63V 2%	26343-470U	K8996	2222 682
C8	CAP CER 18P 63V 2%	26343-468Y	K8996	2222 682
C9	CAP CER 47N 50V 10% MONOL	26343-560M	U2109	SR15 5C 473 KAA
C11	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C12	CAP CER 27P 63V 5%	26343-470U	K8996	2222 682
C13	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C14	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C15	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C16	CAP CER 4P7 63V .5PF	26343-461B	K8996	2222 682
C17	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C18	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C19	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C21	CAP CER 10P 63V .5PF	26343-465H	K8996	2222 682
C22	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C23	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C24	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C25	CAP CER 10P 63V .5PF	26343-465H	K8996	2222 682
C26	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C27	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C28	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C29	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C31	CAP CER 4P7 63V .5PF	26343-461B	K8996	2222 682
C32	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C33	CAP CER 2P7 63V .5PF	26343-458B	K8996	2222 682
C34	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C35	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C36	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C37	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C38	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C39	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C40	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C41	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C42	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C43	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA3	- RF synthesizer and oscillator (Contd.			
C44	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C45	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C46	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C47	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C48	CAP CER 2P7 63V .5PF	26343-458B	K8996	2222 682
C49	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C50	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C51	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C52	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C53	CAP CER 3P3 63V .5PF	26343-459K	K8996	2222 682
C54	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C55	CAP CER 2.2P 63V .5PF	26343-457R	K8996	2222 682
C56	CAP CER 10P 63V .5PF	26343-465H	K8996	2222 682
C57	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C58	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C59	CAP CER 2.2P 63V .5PF	26343-457R	K8996	2222 682
C60	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C61	CAP CER 3P3 63V .5PF	26343-459K	K8996	2222 682
C62	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C63	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C64	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C65	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C66	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C67	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C68	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C69	CAP CER 10P 63V .5PF	26343-465H	K8996	2222 682
C71	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C72	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C73	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C74	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C75	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C76	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C77	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C78	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C79	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C80	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C81	CAP CER 27P 63V 5%	26343-470U	K8996	2222 682
C82	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C83	CAP ELEC 22U 25V 20%	26421-114E	U4011	K22/25
C84	CAP CER 4P7 63V .5PF	26343-461B	K8996	2222 682
C85	CAP CER 2P2 63V .5PF	26343-457R	K8996	2222 682
C86	CAP CER 3P3 63V .5PF	26343-459K	K8996	2222 682
C87	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA3	- RF synthesizer and oscillator (Contd.)			
C88	CAP CER 10P 63V .5PF	26343-465H	K8996	2222 682
C89	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C90	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C91	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C92	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C93	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C94	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C95	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C96	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C97	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C98	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C101	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C102	CAP ELEC 47U 16V 20%	26421-017J	U2475	LRVB 47/16M
C103	CAP PETP 22N 63V 10%	26582-431J	K1945	R68 D C 2202 AAK
C104	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C105	CAP PETP 22N 63V 10%	26582-431J	K1945	R68 D C 2202 AAK
C106	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C107	CAP ELEC 100U 35V 20%+	26421-122J	U4011	CEB10035
C108	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C109	CAP PETP 1U0 50V 10%	26582-432F	K1945	R68 C C 1004 AAK
C111	CAP PETP 1U0 50V 10%	26582-432F	K1945	R68 C C 1004 AAK
C112	CAP ELEC 47U 63V 20%+	26421-121L	U4011	CEB4763
C113	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C114	CAP ELEC 100U 6.3V 20%	26421-118L	U4011	K100/6.3
C115	CAP PETP 1U0 50V 10%	26582-432F	K1945	R68 C C 1004 AAK
C116	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C117	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C118	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C119	CAP ELEC 100U 35V 20%+	26421-122J	U4011	CEB10035
C121	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C122	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C123	CAP CER 4P7 63V .5PF	26343-461B	K8996	2222 682
C124	CAP CER 4P7 63V .5PF	26343-461B	K8996	2222 682
D1	DI V/CAP BB809 3V 29PF	28381-132G	K8996	BB809
D2	DI V/CAP BB809 3V 29PF	28381-132G	K8996	BB809
D3	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D4	DI V/CAP BB809 3V 29PF	28381-132G	K8996	BB809
D5	DI SIL BA482 35V JUNC	28335-675R	K8996	BA482
D6	DI SIL BA482 35V JUNC	28335-675R	K8996	BA482
D7	DI SIL BA482 35V JUNC	28335-675R	K8996	BA482
D8	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D9	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D10	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.

Unit AA3 - RF synthesizer and oscillator (Contd.)

D11	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D12	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D13	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D14	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D15	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D16	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D17	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D18	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D19	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D20	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D21	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D22	DI V/CAP BB809 3V 29PF		28381-132G	K8996	BB809
D23	DI ZEN BZX79C6V2 6.2V 5%		28371-481D	K8996	BZX79 C6V2
D24	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D25 to D33	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D101	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D102	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D103	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D104	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D105	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D106	LAMP LED CQY40L 3V RED		28624-104W	K6617	CQY40L+CLIP+RING
D107	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D108	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D109	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D111	DI H/CARR BAT42 30V FAST	!	28349-013N	K6791	BAT 42
D112	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D113	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D114	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D115	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D116	DI RECT 1N4004 400V		28357-028K	K8996	1N4004
IC1	MOD HYB OM350 40-860MHZ AMP		28461-371T	K7584	OM350
IC2	ICA VREG- 79L05AC 5V .1A TO92		28461-736L	K5519	MC79L05AC
IC3	ICA VREG+ LM317LZ ADJ .1A		28461-741F	K7093	LM317LZ[PLASTIC
IC4	MOD HYB OM350 40-860MHZ AMP		28461-371T	K7584	OM350
IC101	ICD DIV HEF4751 UNIVERSAL	!	28469-433B	K8996	HEF451VP[PLASTIC
IC102	ICD SH-REG 40105 16X4BIT FIFO	!	28467-531R	K4122	HCF40105BE OR BF
IC103	ICD NOR 4001 QUAD 2INP	!	28466-207Z	K6659	4001BPC
IC104	ICD DIV HEF4751 UNIVERSAL	!	28469-433B	K8996	HEF451VP[PLASTIC
IC105	ICD SH-REG 40105 16X4BIT FIFO	!	28467-531R	K4122	HCF40105BE OR BF
IC106	ICD MISC HEF4750 FREQ SYNTH	!	28469-432R	K8996	HEF4750VD[CRAMIC

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA3	- RF synthesizer and oscillator (Contd.)			
IC107	ICA AMP TL071CP FET I/P DIL8	28461-347A	K5519	TL071CP
IC108	ICD DIV SP8647B/10,11 TTL O/P	28464-015W	K0467	SP8647B
IC109	ICA AMP TL071CP FET I/P DIL8	28461-347A	K5519	TL071CP
IC111	ICD FF-D MC10131L	28462-605R	K5519	MC10131 (L OR P)
IC112	ICD DIV SP8685B /10,11 500MHZ	28464-026B	K0467	SP8685B
L1	IND CHOKE 4.7UH 10% LAQ	23642-553J	U4038	SC10 21
L2	IND RF 10UH	44290-805W	U2632	44290-805W
L6	IND RF 10UH	44290-805W	U2632	44290-805W
L14	IND RF 10UH	44290-805W	U2632	44290-805W
L17	IND RF 10UH	44290-805W	U2632	44290-805W
L28	IND CHOKE 4.7UH 10% LAQ	23642-553J	U4038	SC10 21
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLC	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLD	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLZ	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
R1	RES MF 27K .25W 2% 100PPM	24773-307K	K8996	MR25
R2	RES MF 47R .25W 2% 100PPM	24773-241A	K8996	MR25
R3	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R4	RES MF 100R .25W 2% 100PPM	24773-249J	K8996	MR25
R5	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R6	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R7	RES CC 4R7 .125W 5%	24331-985S	U0914	BB47G5
R8	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R9	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R11	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R12	RES CC 180R .125W 5%	24331-961X	U0914	BB1815
R13	RES MF 1K5 .25W 2% 100PPM	24773-277U	K8996	MR25
R14	RES CC 33R .125W 5%	24331-978J	U0914	BB3305
R15	RES MF 27K .25W 2% 100PPM	24773-307K	K8996	MR25
R16	RES MF 39R .25W 2% 100PPM	24773-239Z	K8996	MR25
R17	RES MF 100R .25W 2% 100PPM	24773-249J	K8996	MR25
R18	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R19	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R21	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R22	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R23	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R24	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R25	RES CC 120R .125W 5%	24331-998K	U0914	BB1215
R26	RES CC 6R8 .125W 5%	24331-957P	U0914	BB68G5
R27	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA3	**- RF synthesizer and oscillator**		**(Contd.)**	
R28	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R29	RES MF 39K .25W 2% 100PPM	24773-311A	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R32	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R33	RES CC 270R .125W 5%	24331-992P	U0914	BB2715
R34	RES MF 1K2 .25W 2% 100PPM	24773-275H	K8996	MR25
R35	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R36	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R37	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R38	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R39	RES CC 33R .125W 5%	24331-978J	U0914	BB3305
R40	RES MF 18K .25W 2% 100PPM	24773-303M	K8996	MR25
R41	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R42	RES CC 100R .125W 5%	24331-997B	U0914	BB1015
R43	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R44	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R45	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R46	RES MF 39K .25W 2% 100PPM	24773-311A	K8996	MR25
R47	RES MF 56R .25W 2% 100PPM	24773-243H	K8996	MR25
R48	RES MF 18K .25W 2% 100PPM	24773-303M	K8996	MR25
R49	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R51	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R52	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R53	RES MF 18K .25W 2% 100PPM	24773-303M	K8996	MR25
R54	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R55	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R56	RES CC 100R .125W 5%	24331-997B	U0914	BB1015
R57	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R58	RES MF 100R .25W 2% 100PPM	24773-249J	K8996	MR25
R59	RES MF 39K .25W 2% 100PPM	24773-311A	K8996	MR25
R61	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R62	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R63	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R64	RES MF 8K2 .25W 2% 100PPM	24773-295P	K8996	MR25
R65	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R66	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R67	RES CC 120R .125W 5%	24331-998K	U0914	BB1215
R68	RES CC 10R .125W 5%	24331-974U	U0914	BB1005
R69	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R71	RES CC 150R .125W 5%	24331-990D	U0914	BB1515
R72	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R73	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA3	**- RF synthesizer and oscillator (Contd.)**			
R74	RES CC 33R .125W 5%	24331-978J	U0914	BB3305
R75	RES CC 270R .125W 5%	24331-992P	U0914	BB2715
R76	RES MF 1K2 .25W 2% 100PPM	24773-275H	K8996	MR25
R77	RES MF 560R .25W 2% 100PPM	24773-267R	K8996	MR25
R78	RES CC 4K7 .125W 5%	24331-970A	U0914	BB4725
R79	RES CC 2K2 .125W 5%	24331-983G	U0914	BB2225
R81	RES CC 4K7 .125W 5%	24331-970A	U0914	BB4725
R82	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R83	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R84	RES CC 100R .125W 5%	24331-997B	U0914	BB1015
R85	RES CC 2K2 .125W 5%	24331-983G	U0914	BB2225
R86	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R87	RES MF 360R .25W 2% 100PPM	24773-262T	K8996	MR25
R88	RES MF 3K3 .25W 2% 100PPM	24773-285F	K8996	MR25
R89	RES CC 560R .125W 5%	24331-965B	U0914	BB5615
R101	RN BUS 2K7 5% 10SIP	24681-607W	U0914	910A
R102	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R103	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R104	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R105	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R106	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
R107	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R108	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R109	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R110	RES MF 1R2 .25W 2% 100PPM	24773-203R	U1395	RC55
R111	RES MF 13K .25W 2% 100PPM	24773-300T	K8996	MR25
R112	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R113	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R114	RES MG 1M5 .25W 5%	24321-875N	K8996	VR25
R115	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R116	RES MF 20K .25W 2% 100PPM	24773-304C	K8996	MR25
R117	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R118	RES MF 1K8 .25W 2% 100PPM	24773-279N	K8996	MR25
R119	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R120	RES MF 1M 1/4W 2% 100PPM	24773-346E	U2453	LR1 OR PR1
R121	RES MF 36R .25W 2% 100PPM	24773-238A	K8996	MR25
R122	RES MF 100R .25W 2% 100PPM	24773-249J	K8996	MR25
R123	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R124	RES MF 36R .25W 2% 100PPM	24773-238A	K8996	MR25
R125	RES MF 27K .25W 2% 100PPM	24773-307K	K8996	MR25
R126	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R127	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R128	RES MF 620R .25W 2% 100PPM	24773-268B	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA3	**- RF synthesizer and oscillator (Contd.)**			
R129	RES MF 620R .25W 2% 100PPM	24773-268B	K8996	MR25
R130	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R131	RES MF 560R .25W 2% 100PPM	24773-267R	K8996	MR25
R132	RES MF 560K .25W 2% 100PPM	24773-340R	U2453	LR1 OR PR1
R133	RES MF 47R .25W 2% 100PPM	24773-241A	K8996	MR25
R134	RES MF 47R .25W 2% 100PPM	24773-241A	K8996	MR25
R135	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R136	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
R137	RES MF 1K5 .25W 2% 100PPM	24773-277U	K8996	MR25
R138	RV CERM 200K LIN .5W 10%	25711-645D	K8479	E2A
R139	RES MF 22R .25W 2% 100PPM	24773-233M	K8996	MR25
R140	RES MF 680R .25W 2% 100PPM	24773-269K	K8996	MR25
R141	RES CC 470R .125W 5%	24331-964R	U0914	BB4715
R142	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R143	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R144	RES MF 4K7 1/4W 2% 100PPM	24773-289W	K8996	MR25
R145	RES MF 4K7 1/4W 2% 100PPM	24773-289W	K8996	MR25
R146	RES MF 470K .125W 2% 100PPM	24772-137D		
R147	RES MF 10K .125W 2% 100PPM	24772-097S	U0142	CMF51
R148*	RES MF 20K .25W 2% 100PPM	24773-304C	K8996	MR25
SK1	CON JUMP FEM 2 1 ROW	23435-990X	U2338	65474 001
SK2	CON JUMP FEM 2 1 ROW	23435-990X	U2338	65474 001
TR1	TR NSI BFR90 15V 5G - AMP	28452-167U	K8996	BFR90 OR /02
TR2	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR3	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR4	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR5	TR NSI BFR90 15V 5G - AMP	28452-167U	K8996	BFR90 OR /02
TR6	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR7	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR8	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR9	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR11	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR12	TR NSI BFR90 15V 5G - AMP	28452-167U	K8996	BFR90 OR /02
TR13	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR101	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR102	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
TR103	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
TR104	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
TR105	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A

Apr. 89 (Am. 10)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AA4 - LF synthesizer and output amplifier

12. When ordering, prefix circuit reference with AA4

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44828-881C	U2632	44828-881C
C1	CAP CER 2P7 63V .5PF	26343-458B	K8996	2222 682
C2	CAP CER 1P8 63V .5PF	26343-456C	K8996	2222 682
C3	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C4	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C5	CAP CER 22N 18V 20%	26383-007C	U4011	ECK F1H223ZV
C6	CAP CER 1P8 63V .5PF	26343-456C	K8996	2222 682
C7	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C8	CAP CER 1N2 63V 10%	26383-592K	K8996	630-18-122
C9	CAP CER 3N9 63V 10%	26383-590R	K8996	630-18-392
C10	CAP CER 10P 63V 5%	26343-465H	K8996	2222 682
C11	CAP PETP 150N 100V 10%	26582-212K	K8300	PMT2R OR PMC2R
C12	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C13	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C14	CAP CER 2P2 63V .25PF	26343-457R	K8996	2222 682
C15	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C16	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C17	CAP CER 6P8 63V .5PF	26343-463A	K8996	2222 682
C18	CAP CER 22P 63V 5%	26343-469N	K8996	2222 682
C19	CAP CER 10P 63V .5PF	26343-465H	K8996	2222 682
C20	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C21	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C22	CAP CER 3N9 63V 10%	26383-590R	K8996	630-18-392
C23	CAP CER 1N5 63V 10%	26383-593A	K8996	630-18-152
C24	CAP CER 3N9 63V 10%	26383-590R	K8996	630-18-392
C25	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C26	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C27	CAP CER 12P 63V 5%	26343-466E	K8996	2222 682
C28	CAP CER 10P 63V .5PF	26343-465H	K8996	2222 682
C29	CAP CER 8P2 63V .5PF	26343-464Z	K8996	2222 682
C31	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C32	CAP CER 2N7 63V 10%	26383-588B		
C33	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C34	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C35	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C36	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C37	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C38	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C39	CAP CER 12P 63V 2%	26343-466E	K8996	2222 682
C40	CAP CER 47P 63V 2%	26343-473L	K8996	2222 682
C41	CAP CER 56P 63V 2%	26343-474J	K8996	2222 682

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA4	- LF synthesizer and output amplifier (Contd.)			
C42	CAP CER 39P 63V 2%	26343-472N	K8996	2222 682
C43	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C44	CAP CER 33P 63V 2%	26343-471Y	K8996	2222 682
C45	CAP CER 56P 63V 2%	26343-474J	K8996	2222 682
C46	CAP CER 56P 63V 2%	26343-474J	K8996	2222 682
C47	CAP CER 33P 63V 2%	26343-471Y	K8996	2222 682
C48	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C50	CAP CER 82P 63V 2%	26343-476G	K6617	EDPU
C52	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C53	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C54	CAP CER 4P7 63V .5PF	26343-461B	K8996	2222 682
C55	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C56	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C57	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C58	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C59	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C60	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C61	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C62	CAP CER 220P 63V 2%	26343-481S	K8996	2222 682
C63	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C64	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C65	CAP CER 12P 63V 2%	26343-466E	K8996	2222 682
C66	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C67	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C68	CAP CER 560P 63V 10%	26383-581D	K8996	630-18
C69	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C70	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C71	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C72	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C73	CAP CER 22P 63V 2%	26343-469N	K8996	2222 682
C74	CAP CER 22P 63V 2%	26343-469N	K8996	2222 682
C75	CAP CER 15P 63V 2%	26343-467U	K8996	2222 682
C76	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C77	CAP PETP 470N 63V 10%	26582-427L	K1945	R68 D C 4703 AAK
C79	CAP-VAR PLAS 15P 2P TRIM	26878-402K	U2120	105 3901 015
C80	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C81	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C82	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C83	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C84	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C85	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C86	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.

Unit AA4 - LF synthesizer and output amplifier (Contd.)

C87	CAP CER 1N0 63V 10%		26383-585M	K8996	630-18-102
C88	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C90	CAP CER 15P 63V .5PF		26343-467U	K8996	2222 682
C91	CAP ELEC 33U 25V 20%		26421-115U	U4011	K33/25
C92	CAP CER 1N0 63V 10%		26383-585M	K8996	630-18-102
C93	CAP CETR 22P 63V 2%		26343-469N	K8996	2222 682
C94	CAP CER 47N 50V 10% MON		26343-560M	U2109	SR15 5C 473 KAA
C95	CAP CER 47N 50V 10% MON		26343-560M	U2109	SR15 5C 473 KAA
C96	CAP CER 4N7 63V 10%		26383-591B	K8996	630-18-472
C97	CAP CER 1P8 63V .25PF		26343-490M	K7584	2222 687 09188
D1	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D2	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D3	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D4	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D5	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D6	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D7	DI PIN 5082-3379 50V	!	28383-997T	K3464	HP5082 3379
D8	DI PIN 5082-3379 50V	!	28383-997T	K3464	HP5082 3379
D9	DI PIN 5082-3379 50V	!	28383-997T	K3464	HP5082 3379
D11	DI PIN 5082-3379 50V	!	28383-997T	K3464	HP5082 3379
D12	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D13	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D14	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D15	DI SIL BA482 35V JUNC		28335-675R	K8996	BA482
D16	DI H/CARR HP5082-2826 1V SETS	!	28349-011U	K3464	HP5082 2826
D17	DI H/CARR HP5082-2826	!	28349-011U	K3464	HP5082 2826
D18	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D19	DI V/CAP BB809 3V 29PF		28381-132G	K8996	BB809
D22	DI ZEN BZX79C5V1 5.1V 5%		28371-401U	K8996	BZX79 C5V1
D23	DI RECT BAV99 70V DOUBLE		28383-903X	K8996	BAV99
D24	DI ZEN BZX79C5V1 5.1V 5%		28371-401U	K8996	BZX79 C5V1
IC1	MOD HYB OM350 40-860MHZ AMP		28461-371T	K7584	OM350
IC2	ICD DIV SP8604BCM/2 300MHZ		28462-022R	K0467	SP8604BCM
IC3	ICA AMP NE531N J FET DIL8		28461-586C		
IC4	MOD HYB OM345 VHF/UHF AMP SIL		28461-351Z	K8996	OM345
IC5	MOD HYB OM345 VHF/UHF AMP SIL		28461-351Z	K8996	OM345
IC6	MOD RF SBL-1 DOUBLE BAL MIXER		28531-002A	15542	SBL-1
IC7	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC8	MOD HYB OM360L 400KHZ-1GHZ AMP		28461-370D	K8996	DM360L
IC9	ICD XOR 74LS86 QUAD 2INP		28466-406C	K5519	SN74LS86N
IC10	ICD DIV SP8789B ÷20/21 225MHZ		28464-034E		
IC11	ICD FF-D 74LS74 DUAL +EDG TR		28462-611A	K5519	SN74LS74AN

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA4	- LF synthesizer and output amplifier (Contd.)			
L5	IND CHOKE 22UH 10% LAQ	23642-557S	U4038	SC10 29
L6	IND CHOKE 22UH 10% LAQ	23642-557S	U4038	SC10 29
L7	IND CHOKE 1.0UH 10% LAQ	23642-549L	U4038	SC10 13
L15	IND CHOKE 470UH 10% SCREENED	23642-333B	U4251	553 3635 33
L16	IND CHOKE 3.3UH 10% LAQ	23642-552L	K0467	406 8 274 69 016
L19	IND CHOKE 33UH 10% LAQ	23642-558W	U4038	SC10 31
L20	IND CHOKE 33UH 10% LAQ	23642-558W	U4038	SC10 31
L21	IND CHOKE 40UH 10% LAQ	44190-030B		
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLC	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
R1	RES CC 120R .125W 5%	24331-998K	U0914	BB1215
R2	RES MF 12K .25W 2% 100PPM	24773-299R	K8996	MR25
R3	RES MF 12K .25W 2% 100PPM	24773-299R	K8996	MR25
R4	RES CC 120R .125W 5%	24331-998K	U0914	BB1215
R5	RES CC 220R .125W 5%	24331-976N	U0914	BB2215
R6	RES MF 560R .25W 2% 100PPM	24773-267R	K8996	MR25
R7	RES MF 2K4 .25W 2% 100PPM	24773-282N	K8996	MR25
R8	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R9	RES CC 220R .125W 5%	24331-976N	U0914	BB2215
R11	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R12	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R13	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R14	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R15	RES MF 47R .25W 2% 100PPM	24773-241A	K8996	MR25
R16	RES MF 1K5 .25W 2% 100PPM	24773-277U	K8996	MR25
R17	RES CC 120R .125W 5%	24331-998K	U0914	BB1215
R18	RES MF 120R .25W 2% 100PPM	24773-251L	K8996	MR25
R19	RES CC 82R .125W 5%	24331-996R	U0914	BB8205
R21	RES CC 68R .125W 5%	24331-979F	U0914	BB6805
R22	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R23	RES MF 3K9 .25W 2% 100PPM	24773-287V	K8996	MR25
R24	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R25	RES MF 2K7 .25W 2% 100PPM	24773-283L	K8996	MR25
R26	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R27	RES MF 100R .25W 2% 100PPM	24773-249J	K8996	MR25
R28	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R29	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R30	RES MF 6K8 .25W 2% 100PPM	24773-293D	K8996	MR25
R31	RES CC 150R .125W 5%	24331-990D	U0914	BB1515
R32	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA4	- LF synthesizer and output amplifier (Contd.)			
R33	RES MF 12K .25W 2% 100PPM	24773-299R	K8996	MR25
R34	RES CC 120R .125W 5%	24331-998K	U0914	BB1215
R35	RES CC 150R .125W 5%	24331-990D	U0914	BB1515
*R36	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R37	RES CC 33R .125W 5%	24331-978J	U0914	BB3305
R38	RES MF 470K .25W 2% 100PPM	24773-337R	U2453	LR1 OR PR1
R40	RES CC 1K0 .125W 5%	24331-967A	U0914	BB1025
R41	RES CC 680R .125W 5%	24331-984V	U0914	BB6815
R42	RES MF 470K .25W 2% 100PPM	24773-337R	U2453	LR1 OR PR1
R43	RES CC 1K8 .125W 5%	24331-947F	U0914	BB1825
R44	RES CC 75R .125W 5%	24331-953S	U0914	BB7505
R45	RES CC 47R .125W 5%	24331-975Y	U0914	BB4705
R46	RES MF 50R0 .25W 1% 100PPM	24762-558R	K8479	H8N
R47	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R48	RES CC 470R .125W 5%	24331-964R	U0914	BB4715
R50	RES MF 22R .25W 2% 100PPM	24773-233M	K8996	MR25
R51	RES CC 1K8 .125W 5%	24331-947F	U0914	BB1825
R52	RES CC 10R .125W 5%	24331-974U	U0914	BB1005
R53	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R54	RES MF 96R3 .25W 1% 100PPM	24762-582S	K8479	H8N
R55	RES MF 71R2 .25W 1% 100PPM	24762-572Y	K8479	H8N
R56	RES MF 96R3 .25W 1% 100PPM	24762-582S	K8479	H8N
R57	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R58	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R59	RES CC 390R .125W 5%	24331-963C	U0914	BB3915
R60	RES CC 680R .125W 5%	24331-984V	U0914	BB6815
R61	RES MF 3K3 .25W 2% 100PPM	24773-285F	K8996	MR25
R62	RES MF 270R .25W 2% 100PPM	24773-259T	K8996	MR25
R63	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R64	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R70	RES MF 1K5 .25W 2% 100PPM	24773-277U	K8996	MR25
R71	RES MF 150K 1/4W 2% 100PPM	24773-325V	K8996	MR25
R74	RES MF 4K7 1/4W 2% 100PPM	24773-289W	K8996	MR25
R75	RES MF 4K7 1/4W 2% 100PPM	24773-289W	K8996	MR25
RLA	RELAY MAG 2CO 5V 62R	23486-101F	U0611	172-5
SK1	CON JUMP FEM 2 1 ROW	23435-990X	U2338	65474 001
TR1	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR2	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR3	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR4	TR NSI BFR90 15V 5G - AMP	28452-167U	K8996	BFR90 OR /02
TR5	TR NSI BFR90 15V 5G - AMP	28452-167U	K8996	BFR90 OR /02

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AA4	**- LF synthesizer and output amplifier (Contd.)**			
TR6	TR NSI BC209C 20V 150M - GEN	28452-771P	K1196	ZTX109CL (NLC)
TR7	TR PSI BCY72 25V 200M - GEN	28433-487R	K8300	BCY72
TR8	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
X10	CABLE ASSY SMA/OE, AA4-ATTEN	43130-197S	U2632	43130-197S

Unit AB1 - Mother board

13. When ordering, prefix circuit reference with AB1

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44828-882R	U2632	44828-882R
C3	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C4	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C5	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C6	CAP ELEC 470U 6V 20%+	26421-126S	U4011	CEB4706
C7	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C8	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C9	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C10	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C11	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C12	CAP ELEC 470U 16V 20%+	26421-127W	U4011	CEB47016
C13	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C14	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C15	CAP PETP 100N 100V 10%	26582-211B	K8300	PMT2R OR PMC2R
C16	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C17	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
D1	DI ZEN BZX79C5V1 5.1V 5%	28371-401U	K8996	BZX79 C5V1
D2	DI ZEN BZX79C5V1 5.1V 5%	28371-401U	K8996	BZX79 C5V1
D3	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
IC1	ICD DEC/DMX 74LS138 3-8	28465-027F	K5519	SN74LS138N
IC2	ICD FF-D 74LS273 OCT +EDG TR	28462-615U	K5519	SN74LS273N
IC3	ICD NAND 74LS30 8INP	28466-348Y	K5519	SN74LS30N
IC4	ICD BUFF 74LS244 OCT 3ST	28469-182T	K5519	SN74LS244N
IC5	ICD NAND 74LS03 QUAD 2INP O/C	28466-346E	K5519	SN74LS03N
IC6	ICA AMP TL072CP DUAL FET I/P	28461-348Z	K5519	TL072CP
IC7	ICD BUFF 74LS126A QUAD 3ST	28469-101U	K5519	SN74LS126AN
IC8	ICD FF-D 74LS273 OCT +EDG TR	28462-615U	K5519	SN74LS273N
IC9	ICD FF-D 74LS174 HEX +EDG TR	28462-612Z	K6659	74LS174PC
IC11	ICD DEC/DMX 74LS138 3-8	28465-027F	K5519	SN74LS138N
IC12	ICD BUFF 74LS125A QUAD 3ST	28469-184X	K0461	SN74LS125AN
IC13	ICA AMP LM380 AUDIO 2.5W DIL14	28461-372P	K7093	LM380N
IC14	ICD FF-D 74LS377 OCT CKEN +E T	28462-619J	K6659	74LS377PC

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB1	- Mother board	(Contd.)		
IC15	ICD FF-D 74LS377 OCT CKEN +E T	28462-619J	K6659	74LS377PC
IC16	ICD BUFF 7416 HEX O/C INV 15V	28469-112S	K0461	SN7416N
IC17	ICD BUFF 7416 HEX O/C INV 15V	28469-112S	K0461	SN7416N
IC18	ICD NAND 74LS00 QUAD 2INP	28466-345H	K5519	SN74LS00N
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLB	CON-RF SMB-MALE 50 PCB STR	23444-334Y	K1072	GE65207BN
PLC	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLD	CON PART MIN WAFER 9P 3008	23435-913G	U1613	10-16-1091
PLE	CON PART MIN WAFER 9P 3008	23435-913G	U1613	10-16-1091
PLF	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLG	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLH	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLJ	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLK	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLM	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLP	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLR	CON-RF SMB-MALE 50 PCB STR	23444-334Y	K1072	GE65207BN
PLS	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLT	CON-RF SMB-MALE 50 PCB STR	23444-334Y	K1072	GE65207BN
PLU	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLW	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLX	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLY	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
R1	RES NET 1K0 5% 9SIP	24681-625H	U0914	671210 1K0J
R3	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R9	RES MF 470K .25W 2% 100PPM	24773-337R	U2453	LR1 OR PR1
R11	RES MG 10M .25W 5%	24321-885W	K8996	VR25
R12	RES MF 5K6 .25W 2% 100PPM	24773-291S	K8996	MR25
R13	RES MF 18K .25W 2% 100PPM	24773-303M	K8996	MR25
R14	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R15	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R16	RES MF 220K .25W 2% 100PPM	24773-329T	K8996	MR25
R17	RES MF 5K6 .25W 2% 100PPM	24773-291S	K8996	MR25
R18	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R19	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R20	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R21	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R22	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R24	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R25	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R26	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R27	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R28	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB1	- Mother board	(Contd.)		
R29	RES MF 2R7 .25W 2% 100PPM	24773-211H	U1395	RC55
R30	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R32	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R33	RES MF 6K8 .25W 2% 100PPM	24773-293D	K8996	MR25
R34	RES MF 6K8 .25W 2% 100PPM	24773-293D	K8996	MR25
R35	RES MF 470K .25W 2% 100PPM	24773-337R	U2453	LR1 OR PR1
R36	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
SKA	CON EDGE FEM 32 FXD .15" 2S K7	23435-827A	K0574	T5M55740QQ32
SKB	CON EDGE FEM 32 FXD .15" 2S K7	23435-827A	K0574	T5M55740QQ32
SKC	CON EDGE FEM 32 FXD .15" 2S K7	23435-827A	K0574	T5M55740QQ32
SKD	CON EDGE FEM 32 FXD .15" 2S K7	23435-827A	K0574	T5M55740QQ32
SKE	CON EDGE FEM 32 FXD .15" 2S K7	23435-827A	K0574	T5M55740QQ32
TR1	TR PSI 2N2905A 60V 200M - GEN	28435-868C	K6617	2N2905A
TR2	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR3	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR4	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR5	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR7	TR NMF VN10KM 60V 5R0 - VMOS !	28459-046T	U5008	VN 10 KM
X19	CABLE ASSY.RIBBON, AB1 PLN-ATTEN	43130-185E	U2632	43130-185E

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.

Unit AB2 - Digital scope

14. When ordering, prefix circuit reference with AB2

	Complete unit		44828-883B	U2632	44828-883B
C1	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C2	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C3	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C4	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C5	CAP PETP 10N 63V 10%		26582-426N	K1945	R68 D C 1002 AAK
C6	CAP ELEC 1U0 50V 20%		26421-106B	U4011	K1.0/50
C7	CAP ELEC 1U0 50V 20%		26421-106B	U4011	K1.0/50
C8	CAP PETP 100N 63V 10%		26582-429F	K1945	R68 D C 1003 AAK
C9	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C10	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C11	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C12	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C13	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C14	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C15	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C16	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C17	CAP CER 10N 25V 20%		26383-006C	K1439	SDPN RF0605
C18	CAP PETP 100N 63V 10%		26582-429F	K1945	R68 D C 1003 AAK
C19	CAP CER 100P 5% RAD		26343-068W	K7584	2222 652 58101
D1	DI H/CARR BAT42 30V FAST		28349-013N	K6791	BAT42
D2	DI H/CARR BAT42 30V FAST		28349-013N	K6791	BAT42
IC1	ICA ADC ADC0820 8BIT 2US	!	28461-935H	K7093	ADC0820CCN
IC2	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC3	ICD COMP 74LS85 4BIT		28469-371E	K5519	SN74LS85N
IC4	ICD COMP 74LS85 4BIT		28469-371E	K5519	SN74LS85N
IC5	ICD COMP 74LS85 4BIT		28469-371E	K5519	SN74LS85N
IC6	ICD COMP 74LS85 4BIT		28469-371E	K5519	SN74LS85N
IC7	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC8	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC10	ICD MUX 74LS257 QUAD 2INP 3ST		28469-712A	K5519	SN74LS257N
IC11	ICD MUX 74LS257 QUAD 2INP 3ST		28469-712A	K5519	SN74LS257N
IC12	ICM RAM HM6116P-4 2KX8 200NS	!	28469-307N	U4794	UPD446D-2 OR C-2
IC13	ICD NAND 74LS00 QUAD 2INP		28466-345H	K5519	SN74LS00N
IC14	ICD MUX 74LS158 QUAD 2INP INV		28469-720Y	K0461	SN74LS158N
IC15	ICD MUX 74LS158 QUAD 2INP INV		28469-720Y	K0461	SN74LS158N
IC16	ICD MUX 74LS158 QUAD 2INP INV		28469-720Y	K0461	SN74LS158N
IC17	ICD CTR 74LS393 DUAL 4BIT BIN		28464-130R	K5519	SN74LS393N
IC18	ICD CTR 74LS393 DUAL 4BIT BIN		28464-130R	K5519	SN74LS393N
IC19	ICD CTR 74LS393 DUAL 4BIT BIN		28464-130R	K5519	SN74LS393N

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB2	- Digital scope	(Contd.)		
IC21	ICD FF-D 74LS74 DUAL +EDG TR	28462-611A	K5519	SN74LS74AN
IC23	ICD FF-D 74LS74 DUAL +EDG TR	28462-611A	K5519	SN74LS74AN
IC24	ICD NOR 74LS02 QUAD 2INP	28466-214Y	K5519	SN74LS02N
IC25	ICD INV 74LS04 HEX	28469-171L	K5519	SN74LS04N
IC26	ICD CTR 74LS390 DUAL 4BIT DEC	28464-127R	K5519	SN74LS390N
IC27	ICD NAND 74LS00 QUAD 2INP	28466-345H	K5519	SN74LS00N
IC28	ICD NAND 74LS10 TRIP 3INP	28466-351Y	K5519	SN74LS10N
IC31	ICD MONO 555 TIMER	28468-304P	K5519	MC1455P1
IC34	ICD NAND 74LS00 QUAD 2INP	28466-345H	K5519	SN74LS00N
IC35	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC36	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC37	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC38	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC39	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC40	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC41	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC43	ICD CTR 74LS197 4BIT BIN PRE	28464-116S	K5519	SN74LS197N
IC44	ICD INV 74LS04 HEX	28469-171L	K5519	SN74LS04N
IC45	ICD FF-D 74LS74 DUAL +EDG TR	28462-611A	K5519	SN74LS74AN
IC46	ICD FF-D 74LS74 DUAL +EDG TR	28462-611A	K5519	SN74LS74AN
IC47	ICD NAND 74LS00 QUAD 2INP	28466-345H	K5519	SN74LS00N
IC48	ICD DEC/DMX 74LS139 DUAL 2-4	28465-029V	K5519	SN74LS139N
IC49	ICA VREG+ LM317LZ PROG 0A1	28461-741F	K7093	LM317LZ (PLASTIC
R1	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R2	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R3	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R4	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R5	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R6	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R7	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R8	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R9	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R10	RES MF 150K .25W 2% 100PPM	24773-263P	K8996	MR25
R11	RES MF 390R .25W 2% 100PPM	24773-277U	K8996	MR25
R12	RES MF 1K8 .25W 2% 100PPM	24773-279N	K8996	MR25
R13	RES MF 3K9 .25W 2% 100PPM	24773-287V	K8996	MR25
R14	RV CERM 2K0R LIN .5W 10% VERT	25711-609W	K8479	E4A

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AB3 - VDU board

15. When ordering, prefix circuit reference with AB3

	Complete unit	44828-884K	U2632	44828-884K
C1	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C3	CAP ELEC 470N 50V 20%	26421-104C	U4011	K.47/50
C4	CAP ELEC 470N 50V 20%	26421-104C	U4011	K.47/50
C5	CAP ELEC 470N 50V 20%	26421-104C	U4011	K.47/50
C6	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C7	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C8	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C9	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C10	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C11	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C12	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C13	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C15	CAP TANT 1U0 35V 20%	26486-209F	U3613	SH
C16	CAP CER 270P 63V 2%	26343-482W	K8996	2222 682
C17	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C18	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C19	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C20	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C21	CAP CER 22P 63V 2%	26343-469N	K8996	2222 682
C22	CAP CER 100P 63V 2%	26343-477N	K8996	2222 682
C23	CAP CER 100P 63V 2%	26343-477N	K8996	2222 682
D1	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D2	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D3	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D4	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D5	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
IC14	ICD FF-D 74LS74 DUAL +EDG TR	28462-611A	K5519	SN74LS74AN
IC16	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130R	K5519	SN74LS393N
IC17	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130R	K5519	SN74LS393N
IC18	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130R	K5519	SN74LS393N
IC19	ICD NAND 74LS00 QUAD 2INP	28466-345H	K5519	SN74LS00N
IC20	ICD AND 4081 QUAD 2INP !	28466-009L	K6659	4081BPC
IC22	ICD INV 74LS04 HEX	28469-171L	K5519	SN74LS04N
IC23	ICD NAND 74LS00 QUAD 2INP	28466-345H	K5519	SN74LS00N
IC24	ICD FF-D 74LS74 DUAL +EDG TR	28462-611A	K5519	SN74LS74AN
IC25	ICD NAND 74LS30 8INP	28466-348Y	K5519	SN74LS30N
IC26	ICD NAND 74LS10 TRIP 3INP	28466-351Y	K5519	SN74LS10N
IC27	ICD BUFF 74LS365A HEX 3ST	28469-194Z	K0461	SN74LS365AN
IC28	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130R	K5519	SN74LS393N

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB3	- VDU board		(Contd.)		
IC29	ICD MUX 74LS157 QUAD 2INP		28469-707B	K5519	SN74LS157N
IC30	ICD FF-D 74LS74 DUAL +EDG TR		28462-611A	K5519	SN74LS74AN
IC32	ICD NAND 74LS00 QUAD 2INP		28466-345H	K5519	SN74LS00N
IC34	ICM RAM HM6116P-4 2KX8 200NS	!	28469-307N	U4794	UPD446D-2 OR C-2
IC36	ICD SH-REG 74LS165 8BIT PISO		28467-530C	K0461	SN74LS165AN
IC37	ICD BUFF 74LS365A HEX 3ST		28469-194Z	K0461	SN74LS365AN
IC38	ICD NAND 74LS10 TRIP 3INP		28466-351Y	K5519	SN74LS10N
IC39	ICD NAND 74LS00 QUAD 2INP		28466-345H	K5519	SN74LS00N
IC40	ICD FF-D 74LS74 DUAL +EDG TR		28462-611A	K5519	SN74LS74AN
IC42	ICD FF-D 74LS74 DUAL +EDG TR		28462-611A	K5519	SN74LS74AN
IC43	ICD XOR 74LS86 QUAD 2INP		28466-406C	K5519	SN74LS86N
IC44	ICD INV 74LS04 HEX		28469-171L	K5519	SN74LS04N
IC45	ICD FF-D 74LS374 OCT +E TR 3ST		28462-618L	K5519	SN74LS374N
IC46	ICD FF-D 74LS374 OCT +E TR 3ST		28462-618L	K5519	SN74LS374N
IC47	ICD FF-D 74LS374 OCT +E TR 3ST		28462-618L	K5519	SN74LS374N
IC48	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC49	ICD NAND 74LS00 QUAD 2INP		28466-345H	K5519	SN74LS00N
L1	IND CHOKE 2U2 10%		23642-551N	K0467	406 8 274 69 014
R1	RES MF 470K .25W 2% 100PPM		24773-337R	U2453	LR1 OR PR1
R2	RES MF 10K .25W 2% 100PPM		24773-297M	K8996	MR25
R3	RES MF 10K .25W 2% 100PPM		24773-297M	K8996	MR25
R6	RES MF 10K .25W 2% 100PPM		24773-297M	K8996	MR25
R7	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R8	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R9	RES MF 220K .25W 2% 100PPM		24773-329T	K8996	MR25
R10	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R11	RES MF 4K7 .25W 2% 100PPM		24773-289W	K8996	MR25
R13	RES MF 1M0 .25W 2% 100PPM		24773-346E	U2453	LR1 OR PR1
R14	RES MF 1M0 .25W 2% 100PPM		24773-346E	U2453	LR1 OR PR1
R16	RES MF 1K0 .25W 2% 100PPM		24773-273A	K8996	MR25
R17	RES MF 8K2 .25W 2% 100PPM		24773-295P	K8996	MR25
R18	RES MF 1K2 .25W 2% 100PPM		24773-275H	K8996	MR25
R24	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R25	RES MF 4K7 .25W 2% 100PPM		24773-289W	K8996	MR25
R26	RES MF 10K .25W 2% 100PPM		24773-297M	K8996	MR25
R27	RES MF 150R 1/4W 2% 100PPM		24773-253F	K8996	MR25
SK	S/C-ACC SKT DIL24 LOW PROFILE		28488-044N	U2685	1824-AG-111D

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AB4 - Microprocessor

16. When ordering, prefix circuit reference with AB4

	Complete unit	44828-885A	U2632	44828-885A
C1	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C2	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C3	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C4	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C5	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C6	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C7	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C8	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C12	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C13	CAP ELEC 22U 25V 20%+	26415-805K	U4011	CEA 22/25
C14	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C15	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C16	CAP ELEC 22U 40V 20%+	26415-805K	U4011	CEA 22/25
C17	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C18	CAP PETP 470N 63V 10%	26582-427L	K1945	R68 D C 4703 AAK
C22	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C23	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C24	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C25	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C26	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C27	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C28	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C29	CAP PC 10N0 250V 2%	26582-297D	K8283	A2B 1004D
C30	CAP ELEC 470N 50V 20%	26421-104C	U4011	K.47/50
C31	CAP ELEC 3U3 50V 20%	26421-109Z	U4011	K3.3/50
C32	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C33	CAP ELEC 1U0 50V 20%	26421-106B	U4011	K1.0/50
C34	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C35	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C36	CAP ELEC 4U7 35V SUBMIN	26421-108A	U4011	K4.7/35
D1	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D2	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D3	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D4	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D5	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D6	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D7	DI RECT 11DQ04 40V SCHOTTKY	28355-170U	U5008	11DQ04
D9	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D10	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D11	DI H/CARR BAT42 30V FAST !	28349-013N	K6791	BAT 42

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB4	**- Microprocessor**		**(Contd.)**		
D12	DI H/CARR BAT42 30V FAST	!	28349-013N	K6791	BAT 42
D13	DI H/CARR BAT42 30V FAST	!	28349-013N	K6791	BAT 42
D14	DI H/CARR BAT42 30V FAST	!	28349-013N	K6791	BAT 42
IC1	ICM MP P8085A 8BIT NMOS	!	28469-396K	K7664	MSL8085AP
IC2	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC3	ICA ADC 0809 8BIT 8CHAN MUX	!	28461-945F	K7093	ADC0809CCN
IC4	ICM MP-SUP AM9513A TIM'G CTLR	!	28469-416G	U1458	AM9513APC
IC5	ICD DEC/DMX 74LS138 3-8		28465-027F	K5519	SN74LS138N
IC6	ICD LATCH 74LS75 QUAD		28462-408U	K5519	SN74LS75N
IC7	ICD BUFF 74LS245 OCT TXRX		28469-188B	K5519	SN74LS245N
IC8	ICD DEC/DMX 74LS138 3-8		28465-027F	K5519	SN74LS138N
IC14	ICM RAM X2210D 64X4 NONVOL	!	28469-313F	60395	X2210 D-10
IC15	ICM RAM X2210D 64X4 NONVOL	!	28469-313F	60395	X2210 D-10
IC16	ICM RAM HM6116P-4 2KX8 200NS	!	28469-307N	U4794	UPD446D-2 OR C-2
IC17	ICD OR 74LS32 QUAD 2INP		28466-108U	K5519	SN74LS32N
IC18	ICD DEC/DMX 74LS139 DUAL 2-4		28465-029V	K5519	SN74LS139N
IC19	ICD FF-D 74LS174 HEX +EDG TR		28462-612Z	K6659	74LS174PC
IC20	ICD MONO 556 DUAL TIMER		28468-312B	K5519	MC3456P OR L
IC21	ICD FF-D 74LS74 DUAL +EDG TR		28462-611A	K5519	SN74LS74AN
IC22	ICD AND/OR 74LS51 DUAL 2-3INP		28466-454N	K6659	74LS51PC
IC23	ICD CTR 74LS390 DUAL 4BIT DEC		28464-127R	K5519	SN74LS390N
IC24	ICD NOR 74LS02 QUAD 2INP		28466-214Y	K5519	SN74LS02N
IC25	ICD INV 74LS04 HEX		28469-171L	K5519	SN74LS04N
IC26	ICD BUFF 74LS244 OCT 3ST		28469-182T	K5519	SN74LS244N
IC27	ICD NAND 74LS00 QUAD 2INP		28466-345H	K5519	SN74LS00N
IC29	ICD FF-D 74LS74 DUAL +EDG TR		28462-611A	K5519	SN74LS74AN
IC30	ICA AMP TL072CP DUAL FET I/P		28461-348Z	K5519	TL072CP
IC31	ICD NAND 4093 QUAD 2INP SCH BI	!	28469-203U	K7093	CD4093BCNA
IC32	ICA MISC AD536A RMS AC/DC CONV		28461-939N	K7284	AD536AJH
IC33	ICD NAND 74LS00 QUAD 2INP		28466-345H	K5519	SN74LS00N
IC34	ICD OR 74LS32 QUAD 2INP		28466-108U	K5519	SN74LS32N
IC35	ICA VREG+ 78L05AC 5V OA1 TO92		28461-734Y	K0461	UA78L05AC
IC36	ICD MONO 74LS122 RETR		28468-310C	K5519	SN74LS122N
IC37	ICD FF-D 74LS74 DUAL +EDG TR		28462-611A	K5519	SN74LS74AN
R3	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R5	RES MF 15K .25W 2% 100PPM		24773-301P	K8996	MR25
R6	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R7	RES MF 47R .25W 2% 100PPM		24773-241A	K8996	MR25
R8	RES MF 68K .25W 2% 100PPM		24773-317N	K8996	MR25
R9	RES MF 68K .25W 2% 100PPM		24773-317N	K8996	MR25
R11	RES MF 10R .25W 2% 100PPM		24773-225W	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB4	- Microprocessor (Contd.)			
R12	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R13	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R14	RES MF 2K7 .25W 2% 100PPM	24773-283L	K8996	MR25
R15	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R16	RES MF 47R .25W 2% 100PPM	24773-241A	K8996	MR25
R17	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R18	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R19	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R25	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R26	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R27	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R28	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R29	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R30	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R31	RES MF 62K .25W 2% 100PPM	24773-316Y	K8996	MR25
R32	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R33	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R34	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R35	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R36	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R37	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R38	RES MF 1K5 .25W 2% 100PPM	24773-277U	K8996	MR25
R39	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R40	RES MF 1M0 .25W 2% 100PPM	24773-346E	U2453	LR1 OR PR1
R41	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R42	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R43	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R44	RES MF 470R 1/4W 2% 100PPM	24773-265M	K8996	MR25
SK1	S/C-ACC SKT DIL28 LOW PROFILE	28488-045L	U2685	1828-AG-111D
SK2	S/C-ACC SKT DIL28 LOW PROFILE	28488-045L	U2685	1828-AG-111D
SK3	S/C-ACC SKT DIL28 LOW PROFILE	28488-045L	U2685	1828-AG-111D
SK4	S/C-ACC SKT DIL28 LOW PROFILE	28488-045L	U2685	1828-AG-111D
SK5	S/C-ACC SKT DIL24 LOW PROFILE	28488-044N	U2685	1824-AG-111D
SK6	S/C-ACC SKT DIL40 LOW PROFILE	28488-046J	U2685	1840-AG-111D
SK7	CON JUMP FEM 2 1 ROW	23435-990X	U2338	65474 001
SK8	CON JUMP FEM 2 1 ROW	23435-990X	U2338	65474 001
TR1	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR2	TR PSI BC307A 45V 130M - GEN	28435-227H	K6360	BC307A
TR3	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR4	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AB5 - Demodulation and scope

17. When ordering, prefix circuit reference with AB5

	Complete unit	44828-886Z	U2632	44828-886Z
C102	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C103	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C104	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C105	CAP CER 120P 63V 2%	26343-478S	K8996	2222 682
C106	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C107	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C108	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C109	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C110	CAP PETP 47N 63V 10%	26582-428J	K1945	R68 D C 4702 AAK
C111	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C112	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C113	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C114	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C115	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C116	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C117	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C118	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C119	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C121	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C122	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C123	CAP PS 4N7 63V 1%	26538-918A	K4642	EXFS/HR 4700/1%
C124	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C125	CAP CER 220P 63V 2%	26343-481S	K8996	2222 682
C126	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C127	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C128	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C129	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C130	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C131	CAP CER 560P 63V 10%	26383-581D	K8996	630-18
C132	CAP CER 1N2 63V 10%	26383-592K	K8996	630-18-122
C133	CAP ELEC 22U 25V 20%	26421-114E	U4011	K22/25
C134	CAP ELEC 22U 25V 20%	26421-114E	U4011	K22/25
C135	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C136	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C137	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C138	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C139	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C140	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C141	CAP CER 330P 63V 2%	26343-483D	K6617	EDPU
C142	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB5	- Demodulation and scope	(Contd.)		
C143	CAP CER 100P 63V 2%	26343-477V	K8996	2222 682
C144	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C145	CAP PETP 330N 63V 10%	26582-408X	K8283	M2B33101B
C146	CAP PETP 330N 63V 10%	26582-408X	K8283	M2B33101B
C147	CAP CER 56P 63V 2%	26343-474J	K8996	2222 682
C148	CAP CER 47P 63V 2%	26343-433H	K8996	2222 678 34479
C200	CAP PETP 100N 250V 10%	26582-208B	K8283	A1 B1013 B
C201	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C202	CAP CER 220P 63V 2%	26343-481S	K8996	2222 682
C203	CAP CER 1P8 63V .5PF	26343-456C	K8996	2222 682
C204	CAP CER 15P 63V 5%	26343-467U	K8996	2222 682
C205	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C206	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C207	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C208	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C300	CAP PS 22N0 63V 1%	26538-932J	K1191	710 22000PF1%
C301	CAP PS 22N0 63V 1%	26538-932J	K1191	710 22000PF1%
C302	CAP PS 22N0 63V 1%	26538-932J	K1191	710 22000PF1%
C303	CAP PS 22N0 63V 1%	26538-932J	K1191	710 22000PF1%
C304	CAP PS 22N0 63V 1%	26538-932J	K1191	710 22000PF1%
C305	CAP PS 22N0 63V 1%	26538-932J	K1191	710 22000PF1%
C306	CAP PS 10N0 63V 1%	26538-926Y	K8996	2222 443 4 1003
C307	CAP CER 220P 63V 2%	26343-481S	K8996	2222 682
C308	CAP PS 10N0 63V 1%	26538-926Y	K8996	2222 443 4 1003
C309	CAP PS 2N7 63V 1%	26538-912X	K8996	2222 443 8 2702
C310	CAP PETP 1U0 50V 10%	26582-432F	K1945	R68 C C 1004 AAK
C311	CAP PS 4N7 63V 1%	26538-918A	K4642	EXFS/HR 4700/1%
C312	CAP PS 4N7 63V 1%	26538-918A	K4642	EXFS/HR 4700/1%
C313	CAP PS 4N7 63V 1%	26538-918A	K4642	EXFS/HR 4700/1%
C314	CAP PS 4N7 63V 1%	26538-918A	K4642	EXFS/HR 4700/1%
C315	CAP PC 100N 100V 2%	26582-299P	K8283	A2B 1015D
C316	CAP PS 2N2 63V 1%	26538-910T	K4642	EXFS/HR 2200/1%
C317	CAP PC 100N 100V 2%	26582-299P	K8283	A2B 1015D
C318	CAP PS 22N 63V 1%	26538-932J	K1191	710 22000PF1%
C319	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C321	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C322	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C323	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
C324	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C325	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C326	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C327	CAP CER 82P 63V 2%	26343-476G	K6617	EDPU

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB5	- Demodulation and scope (Contd.)				
D100	DI ZEN BZX79C4V7 4.7V 5%		28371-371F	K8996	BZX79 C4V7
D101	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D102	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D103	DI ZEN BZX79C4V7 4.7V 5%		28371-371F	K8996	BZX79 C4V7
D200	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D300	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
IC100	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC101	ICA AMP TL072CP DUAL FET I/P		28461-348Z	K5519	TL072CP
IC102	ICA COMP UA710CN DIL8		28461-699J	U3418	RC710DN OR NB
IC103	ICD MONO 74121		28468-402S	K8996	FJK101
IC104	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC105	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC106	ICA AMP TL072CP DUAL FET I/P		28461-348Z	K5519	TL072CP
IC107	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC108	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC200	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC201	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC202	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC203	ICA AMP TL072BCP FET I/P DIL8		28461-377B	K0461	TL072 BCP
IC204	ICA AMP TL074BCN FET I/P DIL14		28461-378K	K0461	TL074 BCN
IC205	ICA AMP TL072CP DUAL FET I/P		28461-348Z	K5519	TL072CP
IC300	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC301	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC302	ICA AMP TL072CP DUAL FET I/P		28461-348Z	K5519	TL072CP
IC303	ICD BUFF 74LS244 OCT 3ST		28469-182T	K5519	SN74LS244N
IC304	ICD FF-D 74LS377 OCT CKEN +E T		28462-619J	K6659	74LS377PC
IC305	ICD FF-D 74LS377 OCT CKEN +E T		28462-619J	K6659	74LS377PC
IC306	ICD FF-D 74LS377 OCT CKEN +E T		28462-619J	K6659	74LS377PC
IC307	ICD DEC/DMX 74LS139 DUAL 2-4		28465-029V	K5519	SN74LS139N
IC308	ICD DEC/DMX 74LS139 DUAL 2-4		28465-029V	K5519	SN74LS139N
IC309	ICD DEC/DMX 74LS139 DUAL 2-4		28465-029V	K5519	SN74LS139N
IC311	ICD DEC/DMX 74LS139 DUAL 2-4		28465-029V	K5519	SN74LS139N
IC312	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC313	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC314	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC315	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC316	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC317	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC318	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC319	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC321	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB5	- Demodulation and scope		(Contd.)		
IC322	ICA SW SD5002 QUAD DMOS	!	28469-717Y	K7068	SD5002N OR I
L101	IND CHOKE 1000UH 10% LAQ		23642-567C	U4038	SC10 49
L300	IND CHOKE 33UH 10% LAQ		23642-558W	U4038	SC10 31
L301	IND CHOKE 33UH 10% LAQ		23642-558W	U4038	SC10 31
R102	RES MF 15K .25W 2% 100PPM		24773-301P	K8996	MR25
R103	RES MF 82K .25W 2% 100PPM		24773-319J	K8996	MR25
R104	RES MF 22K .25W 2% 100PPM		24773-305R	K8996	MR25
R105	RES MF 27K .25W 2% 100PPM		24773-307K	K8996	MR25
R106	RV CERM 50K0 LIN .5W 10%		25711-612W	U0914	E4A
R107	RES MF 4K99 .25W 0.5% 50PPM		24753-364W	K8479	H8
R108	RES MF 3K0 .25W 0.5% 50PPM		24753-475C	K8479	H8
R109	RES MF 2K .25W 0.5% 50PPM		24753-626U	K8479	H8
R111	RES MF 2K7 .25W 2% 100PPM		24773-283L	K8996	MR25
R112	RES MF 2K7 .25W 2% 100PPM		24773-283L	K8996	MR25
R113	RES MF 1K0 .25W 2% 100PPM		24773-273A	K8996	MR25
R114	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R115	RES MF 39K .25W 2% 100PPM		24773-311A	K8996	MR25
R116	RES MF 240R .25W 2% 100PPM		24773-258P	K8996	MR25
R117	RES MF 54K6 .25W 0.5% 50PPM		24753-582B	K8479	H8
R118	RES MF 110K .25W 0.5% 50PPM		24753-347H	K8479	H8
R119	RES MF 78K7 .25W 0.5% 50PPM		24753-375B	K8479	H8
R120	RES MF 390R .25W 2% 100PPM		24773-263P	K8996	MR25
R121	RES MF 24K3 .25W 0.5% 50PPM		24753-618K	K8479	H8
R122	RES MF 48K7 .25W .5% 50PPM		24753-351E	K8479	H8
R123	RES MF 28K0 .25W 0.5% 50PPM		24753-370P	K8479	H8
R124	RES MF 9K1 .25W 2% 100PPM		24773-296X	K8996	MR25
R125	RES MF 9K1 .25W 2% 100PPM		24773-296X	K8996	MR25
R126	RES MF 33K .25W 2% 100PPM		24773-309Z	K8996	MR25
R127	RES MF 470K .25W 2% 100PPM		24773-337R	U2453	LR1 OR PR1
R128	RES MF 8K2 .25W 2% 100PPM		24773-295P	K8996	MR25
R129	RV CERM 10K LIN .5W 10%		25711-603L	K8479	E4A
R131	RES MF 36K .25W 2% 100PPM		24773-310K	K8996	MR25
R132	RES MF 160K .25W 2% 100PPM		24773-326S	K8996	MR25
R133	RES MF 1K00 .25W 0.5% 50PPM		24753-624H	K8479	H8
R134	RES MF 8K66 .25W 0.5% 50PPM		24753-377A	K8479	H8
R135	RES MF 10K .25W 2% 100PPM		24773-297M	K8996	MR25
R136	RES MF 100R .25W 2% 100PPM		24773-249J	K8996	MR25
R137	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R138	RV CERM 100K LIN .5W 10%		25711-613D	K8479	E4A
R139	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R141	RES MF 100K .25W 2% 100PPM		24773-321L	K8996	MR25
R142	RES MF 1K0 .25W 2% 100PPM		24773-273A	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB5	- Demodulation and scope (Contd.)			
R143	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
R144	RES MF 39K .25W 2% 100PPM	24773-311A	K8996	MR25
R145	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R146	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R147	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R148	RES MF 1K8 .25W 2% 100PPM	24773-279N	K8996	MR25
R149	RES MF 6K8 .25W 2% 100PPM	24773-293D	K8996	MR25
R150	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R151	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R152	RES MF 820R .25W 2% 100PPM	24773-271B	K8996	MR25
R153	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R154	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R155	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R156	RES MF 5K1 .25W 2% 100PPM	24773-290V	K8996	MR25
R157	RES MF 54K6 .25W 0.5% 50PPM	24753-582B	K8479	H8
R158	RES MF 110K .25W 0.5% 50PPM	24753-347H	K8479	H8
R159	RES MF 78K7 .25W 0.5% 50PPM	24753-375B	K8479	H8
R160	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R161	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R162	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R163	RES MF 24K3 .25W 0.5% 50PPM	24753-618K	K8479	H8
R164	RES MF 48K7 .25W .5% 50PPM	24753-351E	K8479	H8
R165	RES MF 28K0 .25W 0.5% 50PPM	24753-370P	K8479	H8
R166	RES MF 470K .25W 2% 100PPM	24773-337R	U2453	LR1 OR PR1
R167	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R168	RV CERM 5K0 LIN .5W 10%	25711-610V	K8479	E4A
R169	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R171	RES MF 39K .25W 2% 100PPM	24773-311A	K8996	MR25
R172	RV CERM 10K LIN .5W 10%	25711-603L	K8479	E4A
R173	RES MF 220K .25W 2% 100PPM	24773-329T	K8996	MR25
R174	RES MF 220K .25W 2% 100PPM	24773-329T	K8996	MR25
R175	RES MF 4K7 1/4W 2% 100PPM	24773-289W	K8996	MR25
R176	RES MF 150K 1/4W 2% 100PPM	24773-325V	K8996	MR25
R177	RES MF 56K 1/4W 2% 100PPM	24773-315U	K8996	MR25
R200	RES MF 3K3 .25W 2% 100PPM	24773-285F	K8996	MR25
R201	RES MF 1M0 .25W .5% 50PPM	24753-337M	K8479	H8
R202	RES MF 470K .25W 2% 100PPM	24773-337R	U2453	LR1 OR PR1
R203	RES MF 54K6 .25W 0.5% 50PPM	24753-582B	K8479	H8
R204	RES MF 499K .25W 0.5% 50PPM	24753-363S	K8479	H8
R205	RES MF 40K2 .25W .5% 50PPM	24753-355L	K8479	H8
R206	RES MF 4K32 .25W 0.5% 50PPM	24753-640S	K8479	H8
R207	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB5	- Demodulation and scope (Contd.)			
R208	RES MF 2K7 .25W 2% 100PPM	24773-283L	K8996	MR25
R209	RV CERM 2K0R LIN .5W 10%	25711-609W	K8479	E4A
R210	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R211	RES MF 40K2 .25W .5% 50PPM	24753-355L	K8479	H8
R212	RES MF 4K0 .25W 0.5% 50PPM	24753-482A	K8479	H8
R213	RV CERM 100K LIN .5W 10%	25711-613D	K8479	E4A
R214	RES MF 220K .25W 2% 100PPM	24773-329T	K8996	MR25
R215	RES MF 330R .25W 2% 100PPM	24773-261D	K8996	MR25
R216	RES MF 4K99 .25W 0.5% 50PPM	24753-364W	K8479	H8
R217	RES MF 3K0 .25W 0.5% 50PPM	24753-475C	K8479	H8
R218	RES MF 1K00 .25W 0.5% 50PPM	24753-624H	K8479	H8
R219	RES MF 1K00 .25W 0.5% 50PPM	24753-624H	K8479	H8
R220	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R221	RES MF 200K .25W 2% 100PPM	24773-328D	K8996	MR25
R222	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R223	RES MF 91K .25W 2% 100PPM	24773-320N	K8996	MR25
R224	RES MF 11K .25W 2% 100PPM	24773-298C	K8996	MR25
R225	RES MF 20K .25W 2% 100PPM	24773-304C	K8996	MR25
R226	RES MF 40K2 .25W .5% 50PPM	24753-355L	K8479	H8
R227	RES MF 4K32 .25W 0.5% 50PPM	24753-640S	K8479	H8
R228	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R229	RES MF 15K .25W 2% 100PPM	24773-301P	K8996	MR25
R230	RV CERM 100K LIN .5W 10%	25711-613D	K8479	E4A
R231	RV CERM 10K LI .5W 10%	25711-603L	K8479	E4A
R232	RES MF 18K72 .25W 0.5% 50PPM	24753-539P	K8479	H8
R233	RES MF 1K87 .25W 0.5% 50PPM	24753-642D	K8479	H8
R234	RES MF 10K .25W 0.5% 50PPM	24753-628N	K8479	H8
R235	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R236	RES MF 4K99 .25W 0.5% 50PPM	24753-364W	K8479	H8
R237	RES MF 3K0 .25W 0.5% 50PPM	24753-475C	K8479	H8
R238	RES MF 1K00 .25W 0.5% 50PPM	24753-624H	K8479	H8
R239	RES MF 1K00 .25W 0.5% 50PPM	24753-624H	K8479	H8
R241	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R242	RES MF 10R .25W 2% 100PPM	24773-225W	K8996	MR25
R243	RV CERM 100K LIN .5W 10%	25711-613D	K8479	E4A
R244	RV CERM 100K LIN .5W 10%	25711-613D	K8479	E4A
R245	RES MF 100K .125W 2% 100PPM	24772-121Z	U0142	CMF51
R300	RES MF 3K57 .25W 0.5% 50PPM	24753-479A	K8479	H8
R301	RES MF 150K0 .25W 0.5% 50PPM	24753-542P	K8479	H8
R302	RES MF 8K45 .25W 0.5% 50PPM	24753-376K	K8479	H8
R303	RES MF 29K4 .25W 0.5% 50PPM	24753-371X	K8479	H8
R304	RES MF 30K8 .25W 0.5% 50PPM	24753-580C	K8479	H8
R305	RV CERM 5K0 LIN .5W 10%	25711-610V	K8479	E4A

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB5	- Demodulation and scope (Contd.)			
R306	RES MF 27K .25W 2% 100PPM	24773-307K	K8996	MR25
R307	RES MF 35K7 .25W 0.5% 50PPM	24753-372M	K8479	H8
R308	RES MF 12K7 .25W 0.5% 50PPM	24753-367P	K8479	H8
R309	RES MF 12K7 .25W 0.5% 50PPM	24753-367P	K8479	H8
R310	RES MF 6K92 .25W 0.5% 50PPM	24753-570S	K8479	H8
R311	RES MF 15K0 .25W 0.5% 50PPM	24753-538T	K8479	H8
R312	RES MF 59K0 .25W 0.25% 25PPM	24732-261A	K8479	H8
R313	RES MF 5K23 .25W 0.25% 25PPM	24732-262Z	K8479	H8
R314	RV CERM 10K LIN .5W 10%	25711-603L	K8479	E4A
R315	RES MF 232K .25W 0.25% 25PPM	24732-263H	K8479	H8
R316	RES MF 19K6 .25W 0.25% 25PPM	24732-265U	K8479	H8
R317	RES MF 39K2 .25W 0.25% 25PPM	24732-264E	K8479	H8
R318	RES MF 61K9 .25W 0.5% 50PPM	24753-583K	K8479	H8
R319	RES MF 59K0 .25W 0.25% 25PPM	24732-261A	K8479	H8
R320	RES MF 3K0 1/4W 2% 100PPM	24773-284J	K8996	MR25
R321	RES MF 5K23 .25W 0.25% 25PPM	24732-262Z	K8479	H8
R322	RES MF 243K .25W 0.25% 25PPM	24732-266Y	K8479	H8
R323	RES MF 19K6 .25W 0.25% 25PPM	24732-265U	K8479	H8
R324	RES MF 39K2 .25W 0.25% 25PPM	24732-264E	K8479	H8
R325	RES MF 90K9 .25W 0.5% 50PPM	24753-378Z	K8479	H8
R326	RES MF 34K0 .25W 0.5% 50PPM	24753-362V	K8479	H8
R327	RES MF 34K0 .25W 0.5% 50PPM	24753-362V	K8479	H8
R328	RES MF 40K2 .25W .5% 50PPM	24753-355L	K8479	H8
R329	RES MF 12K7 .25W 0.5% 50PPM	24753-367P	K8479	H8
R331	RES MF 12K7 .25W 0.5% 50PPM	24753-367P	K8479	H8
R332	RES MF 23K2 .25W 0.5% 50PPM	24753-369M	K8479	H8
R334	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R335	RES MF 750R .25W 2% 100PPM	24773-270R	K8996	MR25
R336	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R337	RES MF 470R .125W 2% 100PPM	24772-065S	U0142	CMF51
R337	RES MF 470R .125W 2% 100PPM	24772-065S	U0142	CMF51
R339	RV 10K LIN 0.5W 10% VERT	25711-603L	K8479	E4A
R340	RES MG 10M 1/4W 5%	24321-885W	K8996	VR25
RLA	RELAY REED 1NO 5V 500R SCR	23486-436N	K7144	97 1 A 5 1
TR100	TR NSI BC209C 20V 150M - GEN	28452-771P	K1196	ZTX109CL (NLC)
TR101	TR NMF 40673 20V 400M DG !	28459-010V	88285	40673
TR102	TR NSI BC109B&C 20V 150M - GEN	28452-777K	K8996	BC109B OR C

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AB6 - AF synthesizer

18. When ordering, prefix circuit reference with AB6

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44828-887H	U2632	44828-887H
C1	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C2	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C3	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C4	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C5	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C6	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C7	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C8	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C9	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C10	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C11	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C12	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C13	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C14	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C15	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C16	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C17	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C18	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C19	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C20	CAP TANT 47U 6V 20%	26486-232A	K8300	TAG OR TAP
C21	CAP CER 470P 63V 10%	26383-582T	K8996	630-18-471
C22	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C23	CAP PETP 100N 100V 10%	26582-211B	K8300	PMT2R OR PMC2R
C24	CAP CER 470P 63V 10%	26383-582T	K8996	630-18-471
C25	CAP CER 150P 63V 2%	26343-479W	K8996	2222 682
C26	CAP CER 150P 63V 2%	26343-479W	K8996	2222 682
C27	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C28	CAP PETP 10N 400V 10%	26582-232W	K8283	A1 B1004B
C29	CAP PETP 330N 100V 10%	26582-213A	K8283	A1B 331 02B
C30	CAP PETP 10N 400V 10%	26582-232W	K8283	A1 B1004B
C31	CAP PS 680P 63V 2%	26538-630S	K4642	EXFS RP 1
C32	CAP PETP 10N 400V 10%	26582-232W	K8283	A1 B1004B
C33	CAP PS 3N3 63V 1%	26538-914C	K8996	2222 443 8 3302
C34	CAP PETP 10N 400V 10%	26582-232W	K8283	A1 B1004B
C35	CAP PS 1N0 63V 1%	26538-902G	K4642	EXFS/HR 1000/1%
C36	CAP PETP 330N 100V 10%	26582-213A	K8283	A1B 331 02B
C37	CAP PETP 33N 250V 10%	26582-205M	K8283	A1 B3303B
C38	CAP PETP 15N 250V 10%	26582-203P	K8283	A1 B1503B
C39	CAP CER 3N3 63V 10%	26383-589K	K8996	630-18-332
C40	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB6	- AF synthesizer	(Contd.)		
C41	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C42	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C43	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C44	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C45	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C46	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C47	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C48	CAP ELEC 33U 25V 20%	26421-115U	U4011	K33/25
C49	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C51	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C52	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C53	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C54	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C55	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C56	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C57	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C58	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C59	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C60	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C61	CAP PETP 220N 100V 10%	26582-226G	K8300	PMT2R OR PMC2R
C62	CAP PS 4N7 63V 1%	26538-918A	K4642	EXFS/HR 4700/1%
C63	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C64	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C65	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C66	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C67	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C68	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C69	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C70	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C71	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C72	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C73	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C74	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C75	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C76	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C77	CAP PETP 100N 100V 10%	26582-211B	K8300	PMT2R OR PMC2R
C78	CAP TANT 10U 35V 20%	26486-225C	K4701	199D
C79	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C80	CAP CER 10N 25V 20%	26383-006C	K1439	SDPN RF0605
C81	CAP ELEC 220U 16V 20%+	26421-124G	U4011	CEB22016
*C86	CAP CER 4P7 63V .5PF PLATE	26343-485P	K8996	2222 678 09478
C87	CAP CER 33P 63V 2% PLATE	26343-471Y	K8996	2222 678

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB6	- AF synthesizer		(Contd.)		
D1	DI V/CAP BB809 3V 29PF		28381-132G	K8996	BB809
D8	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D9	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D11	DI ZEN 1N825/A 6.2V 5%		28371-494Z	K8996	1N825 OR A
D12	DI RECT 11DQ06 60V SCHOTTKY	!	28355-172N	U5008	11 DQ 06
D13	DI RECT 11DQ06 60V SCHOTTKY	!	28355-172N	U5008	11 DQ 06
IC1	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC2	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC3	ICD ADDER 74LS283 4BIT FULL		28469-397A	K5519	SN74LS283N
IC4	ICD ADDER 74LS283 4BIT FULL		28469-397A	K5519	SN74LS283N
IC5	ICD ADDER 74LS283 4BIT FULL		28469-397A	K5519	SN74LS283N
IC6	ICD ADDER 74LS283 4BIT FULL		28469-397A	K5519	SN74LS283N
IC7	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC8	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC9	ICD CTR 74LS90 4BIT DEC 2,5,10		28464-014S	K5519	SN74LS90N
IC10	ICD BUFF 74LS126 ->28469101		28464-185M	K5519	SN74LS90N
IC11	ICD INV 74LS04 HEX		28469-171L	K5519	SN74LS04N
IC12	ICD CTR 74LS390 DUAL 4BIT DEC		28464-127R	K5519	SN74LS390N
IC13	ICA PLL MC145145 4BIT BUS I/P	!	28461-937U	K5519	MC 145145P OR L
IC14	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC15	ICD DEC/DMX 74LS138 3-8		28465-027F	K5519	SN74LS138N
IC16	ICD DEC/DMX 74LS138 3-8		28465-027F	K5519	SN74LS138N
IC17	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC18	ICA MISC MF10 DUA SW CAP FILTR	!	28461-938Y	K7093	MF10CCN
IC19	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC20	ICA AMP TL074CN QUAD FET I/P		28461-349H	K5519	TL074CN
IC21	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC22	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC23	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC24	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC25	ICA SW DG211CJ QUAD CMOS	!	28461-936E	K7068	DG211CJ
IC26	ICA DAC AD7528JN DUAL 8BIT	!	28469-428C	K7284	AD7528JN
IC27	ICA DAC AD7524JN 8BIT	!	28469-400R	K7284	AD7524JN OR AD
IC28	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC29	ICD CTR 74LS390 DUAL 4BIT DEC		28464-127R	K5519	SN74LS390N
IC30	ICD CTR 74LS390 DUAL 4BIT DEC		28464-127R	K5519	SN74LS390N
IC31	ICD NAND 74LS00 QUAD 2INP		28466-345H	K5519	SN74LS00N
IC32	ICD LATCH 74LS373 OCT 3ST		28462-410E	K5519	SN74LS373N
IC33	ICA DAC AD7528JN DUAL 8BIT	!	28469-428C	K7284	AD7528JN
IC34	ICD FF-D 74LS273 OCT +EDG TR		28462-615U	K5519	SN74LS273N
IC35	ICA DAC 7545 12BIT MULT BUFF	!	28469-436Z	K7284	AD7545JN OR KN

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB6	- AF synthesizer	(Contd.)		
IC36	ICA AMP UA759 HI POWER 741	28461-369P	K6659	UA759M1C
IC37	ICA AMP TL074CN QUAD FET I/P	28461-349H	K5519	TL074CN
IC38	ICA AMP TL072CP DUAL FET I/P	28461-348Z	K5519	TL072CP
L1	IND CHOKE 10UH 10% LAQ	23642-555G	U4038	SC10 25
L2	IND CHOKE 10UH 10% LAQ	23642-555G	U4038	SC10 25
L3	IND CHOKE 22UH 10% LAQ	23642-557S	U4038	SC10 29
L4	IND CHOKE 10UH 10% LAQ	23642-555G	U4038	SC10 25
L5	IND CHOKE 2.2UH 10% LAQ	23642-551N	K0467	406 8 274 69 014
R2	RES MF 15K .25W 2% 100PPM	24773-301P	K8996	MR25
R3	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R4	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R5	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R6	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R7	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R8	RES MF 4K3 .25W 2% 100PPM	24773-288S	K8996	MR25
R9	RES MF 1M0 .25W 2% 100PPM	24773-346E	U2453	LR1 OR PR1
R10	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R11	RV CERM 10K LIN .3W 10%	25748-507X	K5743	3006P
R12	RV CERM 100K LIN .3W 10%	25748-510X	K5743	3006P
R13	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R14	RES MF 11K1 .25W 0.5% 50PPM	24753-366T	K8479	H8
R15	RES MF 66K5 .25W 0.5% 50PPM	24753-373C	K8479	H8
R16	RES MF 100K .25W .5% 50PPM	24753-340M	K8479	H8
R17	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R18	RES MF 100K .25W .5% 50PPM	24753-340M	K8479	H8
R19	RES MF 11K1 .25W 0.5% 50PPM	24753-366T	K8479	H8
R20	RES MF 66K5 .25W 0.5% 50PPM	24753-373C	K8479	H8
R21	RES MF 13K3 .25W .5% 50PPM	24753-359V	K8479	H8
R22	RES MF 40K2 .25W .5% 50PPM	24753-355L	K8479	H8
R23	RES MF 7K06 .25W 0.5% 50PPM	24753-365D	K8479	H8
R24	RES MF 20K0 .25W 0.5% 50PPM	24753-663N	K8479	H8
R25	RES MF 20K0 .25W 0.5% 50PPM	24753-663N	K8479	H8
R26	RES MF 6K65 .25W 0.5% 50PPM	24753-374R	K8479	H8
R27	RES MF 34K0 .25W 0.5% 50PPM	24753-362V	K8479	H8
R28	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
R29	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R30	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R32	RV CERM 10K LIN .3W 10%	25748-507X	K5743	3006P
R33	RES MF 750R .25W 2% 100PPM	24773-270R	K8996	MR25
R34	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R35	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R36	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB6	- AF synthesizer (Contd.)			
R37	RES MF 680R .25W 2% 100PPM	24773-269K	K8996	MR25
R38	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R39	RES MF 62K .25W 2% 100PPM	24773-316Y	K8996	MR25
R40	RES MF 62K .25W 2% 100PPM	24773-316Y	K8996	MR25
R41	RES MF 56K .25W 2% 100PPM	24773-315U	K8996	MR25
R42	RES MF 24K .25W 2% 100PPM	24773-306B	K8996	MR25
R43	RES MF 24K .25W 2% 100PPM	24773-306B	K8996	MR25
R44	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
R45	RES MF 24K .25W 2% 100PPM	24773-306B	K8996	MR25
R46	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
R47	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
R48	RV CERM 20K LI .3W 10%	25748-508M	K5743	3006P
R49	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R50	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R51	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R52	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R53	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R54	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R55	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R56	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R57	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R58	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R59	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R60	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R61	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R62	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R63	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R64	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R65	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R66	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R67	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R69	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R70	RES MF 1M0 .25W 2% 100PPM	24773-346E	U2453	LR1 OR PR1
R71	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R72	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R73	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R74	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R75	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25
R76	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R77	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R78	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25
R79	RES MF 470R .25W 2% 100PPM	24773-265M	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AB6	- AF synthesizer	(Contd.)		
TR1	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR2	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZTX108BL
TR3	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR4	TR NSI BFY51 30V 50M - GEN	28455-827T	K8300	BFY51
TR5	TR NSI BFY51 30V 50M - GEN	28455-827T	K8300	BFY51
TR6	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR7	TR NSI BFY51 30V 50M - GEN	28455-827T	K8300	BFY51
TR8	TR NSI BFY51 30V 50M - GEN	28455-827T	K8300	BFY51
TR9	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR10	TR NSI BFY51 30V 50M - GEN	28455-827T	K8300	BFY51
TR11	TR NSI BFY51 30V 50M - GEN	28455-827T	K8300	BFY51
TR12	TR PSI 2N2905A 60V 200M - GEN	28435-868C	K6617	2N2905A
TR13	TR PSI 2N2905A 60V 200M - GEN	28435-868C	K6617	2N2905A
TR14	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR15	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR16	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B

Unit AC0 - Input switching assembly

19. This assembly should not be dismantled.

	Complete unit	44990-503R	U2632	44990-503R

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AC1 - CRT Drive

20. When ordering, prefix circuit reference with AC1

	Complete unit	44828-890H	U2632	44828-890H
C1	CAP ELEC 100U 25V 20%+	26415-813U	K8996	031 37101
C2	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C3	CAP ELEC 4700U 25V 10%+	26422-323T	K8996	2222 050 56472
C4	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C5	CAP PETP 150N 100V 10%	26582-212K	K8300	PMT2R OR PMC2R
C6	CAP PETP 68N 100V 10%	26582-224J	K8300	PMT2R OR PMC2R
C7	CAP CER 33P 63V 5%	26343-471Y	K8996	2222 682
C8	CAP ELEC 2200U 16V 20%+	26421-132T	K8996	035 55222
C9	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C10	CAP ELEC 4U7 63V 20%+	26415-801M	U4011	CEA 4R7/63
C11	CAP PETP 220N 63V 10%	26582-430L	K1945	R68 D C 2203 AAK
C12	CAP PS 10N0 63V 1%	26538-926Y	K8996	2222 443 4 1003
C13	CAP PS 10N0 63V 1%	26538-926Y	K8996	2222 443 4 1003
C15	CAP PETP 22N 400V 10%	26582-234T	K8283	A1 B2204B
C16	CAP PETP 1U5 100V 10%	26582-219N	K8283	A1B 152 02B
C17	CAP PP 12N 630V 10% 2.5K/US	26582-490E	K6791	PS618 12N10%630V
C18	CAP ELEC 100U 50V 20%+	26421-123F	K8996	035 90019
C19	CAP ELEC 1000U 35V 20%+	26421-130W	K8996	035 90006
C20	CAP PETP 220N 100V 10%	26582-226G	K8300	PMT2R OR PMC2R
C21	CAP PETP 47N 250V 10%	26582-206C	K8283	A1 B4703B
C22	CAP ELEC 4U7 63V 20%+	26415-801M	U4011	CEA 4R7/63
C23	CAP PETP 47N 250V 10%	26582-206C	K8283	A1 B4703B
C25	CAP PETP 47N 250V 10%	26582-206C	K8283	A1 B4703B
C26	CAP PC 22N 630V 10%	26531-114V	K1365	FKC3
C27	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C28	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C30	CAP ELEC 470U 16V 20%+	26421-127W	U4011	CEB47016
C31	CAP ELEC 470U 16V 20%+	26421-127W	U4011	CEB47016
C32	CAP ELEC 470U 6V 20%+	26421-126S	U4011	CEB4706
C33	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C34	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C35	CAP ELEC 2U2 50V 20%	26421-009E	U2475	LRVB 2.2/50M
C36	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C37	CAP ELEC 470U 6V 20%+	26421-126S	U4011	CEB4706
C38	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C39	CAP CER 68P 63V 2% PLATE	26343-475F	K8996	2222 682
C40	CAP PETP 100N 63V 10% RAD MIN	26582-429F	K1945	R68 D C 2203 AAK
C41	CAP PETP 100N 63V 10% RAD MIN	26582-429F	K1945	R68 D C 2203 AAK

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AC1	- CRT Drive (Contd.)			
D1	DI RECT 1N4004 400V	28357-028K	K8996	1N4004
D2	DI SIL 1N4148 75V JUNC	28336-676J	K8996	1N4148
D3	DI RECT BYW95C 600V FAST	28358-726P	K8996	BYW95C
D4	DI RECT BA159 1000V	28359-103B	K8300	BA159
D5	DI RECT BA159 1000V	28359-103B	K8300	BA159
D7	DI RECT BA159 1000V	28359-103B	K8300	BA159
D8	DI RECT BA159 1000V	28359-103B	K8300	BA159
D9	DI RECT BA159 1000V	28359-103B	K8300	BA159
D11	DI RECT MR854 400V 3A	28357-016W	K5519	MR854
D12	DI ZEN 1N825/A 6.2V 5%	28371-494Z	K8996	1N825 OR A
D13	DI ZEN BZX79C22 22V 5%	28373-067V	K8996	BZX79 C22
D14	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D15	DI SIL IN4148 75V JUNC	28336-676J	K8996	IN4148
IC1	MOD CRT-SUP TDA1170S FLD DRIVE	28231-408A	K4701	ULN2270Q
IC2	ICD MONO 74LS221 DUAL	28468-404D	K5519	SN74LS221N
IC3	ICD XOR 74LS86 QUAD 2INP	28466-406C	K5519	SN74LS86N
IC4	ICD CTR 74LS90 4BIT DEC 2,5,10	28464-014S	K5519	SN74LS90N
IC5	ICD CTR 74LS390 DUAL 4BIT DEC	28464-127R	K5519	SN74LS390N
L1	COIL ASSY.L1	44290-920R	U2632	44290-920R
L3	IND CHOKE - 2.5TURNS	23642-909X	K8996	4312 020 36700
L4	IND CHOKE - 2.5TURNS	23642-909X	K8996	4312 020 36700
L5	IND CHOKE 33U 10%	23642-558W		
L6	IND CHOKE 1U 10%	23642-549L		
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188V	U2338	75401 001
PLC	CON-RF SMB-MALE 50 PCB STR	23444-334Y	K1072	GE65207BN
R1	RES MF 270K .25W 2% 100PPM	24773-331D	K8996	MR25
R2	RES MF 180K .25W 2% 100PPM	24773-327W	K8996	MR25
R3	RV CERM 100K LIN .5W 10%	25711-613D	K8479	E4A
R4	RES MF 270K .25W 2% 100PPM	24773-331D	K8996	MR25
R5	RES MF 39K .25W 2% 100PPM	24773-311A	K8996	MR25
R6	RV CERM 50K0 LIN .5W 10%	25711-612W	U0914	E4A
R7	RES MF 470K .25W 2% 100PPM	24773-337R	U2453	LR1 OR PR1
R8	RES MF 220K .25W 2% 100PPM	24773-329T	K8996	MR25
R9	RES MF 56K .25W 2% 100PPM	24773-315U	K8996	MR25
R11	RES MF 68K .25W 2% 100PPM	24773-317N	K8996	MR25
R12	RES MF 1R0 .25W 2% 100PPM	24773-201M	U1395	RC55
R13	RES MF 56K .25W 2% 100PPM	24773-315U	K8996	MR25
R14	RES MF 3R3 .25W 2% 100PPM	24773-213U	U1395	RC55
R15	RES MF 22R .25W 2% 100PPM	24773-233M	K8996	MR25
R16	RES MF 4K7 .25W 2% 100PPM	24773-289W	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AC1	- CRT Drive	(Contd.)		
R17	RES MF 15K .25W 2% 100PPM	24773-301P	K8996	MR25
R18	RES MF 68R .25W 2% 100PPM	24773-245U	K8996	MR25
R19	RES MF 3K3 .25W 2% 100PPM	24773-285F	K8996	MR25
R20	RES MF 5K6 .25W 2% 100PPM	24773-291S	K8996	MR25
R21	RV CERM 5K0 LI .5W 10%	25711-610V	K8479	E4A
R22	RES MF 2K7 .25W 2% 100PPM	24773-283L	K8996	MR25
R23	RES MF 100R .25W 2% 100PPM	24773-249J	K8996	MR25
R24	RES MF 120R .25W 2% 100PPM	24773-251L	K8996	MR25
R25	RES MF 1M0 .25W 2% 100PPM	24773-346E	U2453	LR1 OR PR1
R26	RV CARB 1M0 LIN .25W 20%	25611-193U	K2510	MPWT STYLE D
R27	RES MG 1M8 .25W 5%	24321-876L	K8996	VR25
R28	RES MF 1M0 .25W 2% 100PPM	24773-346E	U2453	LR1 OR PR1
R31	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R33	RES MF 82K .25W 2% 100PPM	24773-319J	K8996	MR25
R34	RES MF 560R .25W 2% 100PPM	24773-267R	K8996	MR25
R36	RES MF 4R7 .25W 2% 100PPM	24773-217J	U1395	RC55
R37	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R38	RES MF 820R .25W 2% 100PPM	24773-271B	K8996	MR25
R39	RV CERM 100K LIN .3W 10%	25748-510X	K5743	3006P
R40	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R41	RES MF 240R .25W 2% 100PPM	24773-258D	K8996	MR25
R42	RES MF 18K .25W 2% 100PPM	24773-303M	K8996	MR25
R43	RES MF 6K8 .25W 2% 100PPM	24773-293D	K8996	MR25
R44	RES MF 12K .25W 2% 100PPM	24773-299R	K8996	MR25
R45	RES MF 15K .25W 2% 100PPM	24773-301P	K8996	MR25
R46	RES MF 1K2 .25W 2% 100PPM	24773-275H	K8996	MR25
R47	RES MF 390R .25W 2% 100PPM	24773-263P	K8996	MR25
R48	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R49	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R50	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R52	RES MF 5K1 .25W 2% 100PPM	24773-290V	K8996	MR25
R53	RES MF 22R .25W 2% 100PPM	24773-233M	K8996	MR25
R54	RES MF 150R .25W 2% 100PPM	24773-253F	K8996	MR25
R55	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R56	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R57	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
TR1	TR NSI 2N2483 60V 30M - LN AMP	28455-787W	K8996	2N2483
TR2	TR NSI 2N2483 60V 30M - LN AMP	28455-787W	K8996	2N2483
TR3	TR NSI BU806 400V - - DAR PWR	28458-690K	K8996	BU806
TR4	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A
TR5	TR NSI 2N2369 15V 500M - SW	28452-197H	K5519	2N2369 OR A

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AC1	- CRT Drive	(Contd.)		
TR6	TR PSI BC308B 20V 130M - GEN	28433-455R	K8300	BC252B
TR7	TR NSI BC208B 20V 150M - GEN	28452-781A	K1196	ZT108BL
T1	MOD CRT-SUP TBT6 LINE O/P XFMR	28231-402X	A2984	10.0213/15
	CABLE ASSY, AB1 PLD - AC1	43130-524B	U2632	43130-524B
	FUSE T/LAG 1.6A SIZE 0	23411-810W		
	H/W FUSEHOLDER INLINE SIZE 0	23416-320V		

Unit AD0 - Attenuator assembly (100 db)

21. When ordering, prefix circuit reference with AD0

Complete unit	44429-034J	U2632	44429-030U

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AF1 - Main keyboard

22. When ordering, prefix circuit reference with AF1

	Complete unit	44828-888E	U2632	44828-888E
D1	LAMP LED LLL37 2.4V YELLOW	28624-106T	K6360	LLL27[YELLOW]
D2	LAMP LED LLL37 2.4V YELLOW	28624-106T	K6360	LLL27{YELLOW]
D3	LAMP LED LLL37 2.4V YELLOW	28624-106T	K6360	LLL27[YELLOW]
D4	LAMP LED LLL37 2.4V YELLOW	28624-106T	K6360	LLL27[YELLOW]
D5	LAMP LED LLL37 2.4V YELLOW	28624-106T	K6360	LLL27[YELLOW]
IC1	ICD FF-D 74LS174 HEX +EDG TR	28462-612Z	K6659	74LS174PC
R1	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R2	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R3	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R4	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R5	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
SA1	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SA2	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SA3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SA4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SA5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SA6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SA7	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SA8	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB1	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB2	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB7	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SB8	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SC1	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SC3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SC4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SC5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SC6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SC7	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SC8	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SD1	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SD2	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SD3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SD4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AF1	- Main keyboard		(Contd.)	
SD5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SD6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SD7	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SD8	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SE1	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SE2	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SE3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SE5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SE6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF1	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF2	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF7	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SF8	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SG2	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SG3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SG4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SG5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SG6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SH3	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SH4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SH5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SH6	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
	KEY CAP BLUE "Tx"	37590-909R	U2632	37590-909R
	KEY CAP BLUE "Rx"	37590-908C	U2632	37590-908C
	KEY CAP BLUE "DUPLEX"	37590-913B	U2632	37590-913B
	KEY CAP BLUE "TONES"	37590-912R	U2632	37590-912R
	KEY CAP BLUE "BAR CHART"	37590-911C	U2632	37590-911C
	KEY CAP BLUE "SCOPE"	37590-910M	U2632	37590-910M
	KEY CAP BLUE "HOLD DISPLAY"	37590-914K	U2632	37590-914K
	KEY CAP GREEN "AF GEN"	37590-891J	U2632	37590-891J
	KEY CAP GREEN "RX-TX FREQ"	37590-890L	U2632	37590-890L
	KEY CAP GREEN "RF GEN"	37590-892F	U2632	37590-892F
	KEY CAP GREEN "SET MOD"	37590-893G	U2632	37590-893G
	KEY CAP GREEN "MOD ON-OFF"	37590-894V	U2632	37590-894V
	KEY CAP GREEN "SINAD"	37590-895S	U2632	37590-895S
	KEY CAP GREEN "DIT'N"	37590-896W	U2632	37590-896W
	KEY CAP ORANGE "FREQ"	37590-897D	U2632	37590-897D

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AF1	- Main keyboard		(Contd.)	
	KEY CAP ORANGE "LEVEL"	37590-898T	U2632	37590-898T
	KEY CAP ORANGE "DELTA INCR"	37590-899P	U2632	37590-899P
	SW-CAP RECT ORANGE "STORE"	37590-710K	U2632	37590-710K
	SW-CAP RECT ORANGE "RECALL"	37590-709Z	U2632	37590-709Z
	KEY CAP ORANGE "FM"	37590-900V	U2632	37590-900V
	KEY CAP ORANGE "PHASE MOD RAD"	37590-901S	U2632	37590-901S
	KEY CAP ORANGE "MHz/V"	37590-902W	U2632	37590-902W
	KEY CAP ORANGE "kHz/mV"	37590-903D	U2632	37590-903D
	KEY CAP ORANGE "Hz/uV"	37590-904T	U2632	37590-904T
	KEY CAP ORANGE "dB"	37590-905P	U2632	37590-905P
	KEY CAP ORANGE "dBm"	37590-906X	U2632	37590-906X
	KEY CAP ORANGE "AM %"	37590-907M	U2632	37590-907M
	KEY CAP WHITE "0"	37590-887L	U2632	37590-887L
	KEY CAP WHITE "1"	37590-886N	U2632	37590-886N
	KEY CAP WHITE "2"	37590-885Y	U2632	37590-885Y
	KEY CAP WHITE "3"	37590-884U	U2632	37590-884U
	KEY CAP WHITE "4"	37590-883E	U2632	37590-883E
	KEY CAP WHITE "5"	37590-882H	U2632	37590-882H
	KEY CAP WHITE "6"	37590-878Z	U2632	37590-878Z
	KEY CAP WHITE "7"	37590-880A	U2632	37590-880A
	KEY CAP WHITE "8"	37590-879H	U2632	37590-879H
	KEY CAP WHITE "-"	37590-889F	U2632	37590-889F
	KEY CAP DK BROWN "FREQ UP"	37590-863S	U2632	37590-863S
	KEY CAP DK BROWN "FREQ DOWN"	37590-864W	U2632	37590-864W
	KEY CAP DK BROWN "BAND PASS"	37590-871X	U2632	37590-871X
	SW-CAP RECT BROWN "HELP"	37590-711A	U2632	37590-711A
	KEY CAP DK BROWN "SELECT L-R"	37590-862V	U2632	37590-862V
	KEY CAP DK BROWN "LEVEL UP"	37590-866T	U2632	37590-866T
	KEY CAP DK BROWN "LEVEL DOWN"	37590-865D	U2632	37590-865D
	KEY CAP DK BROWN "LOW PASS"	37590-872M	U2632	37590-872M
	KEY CAP DK BROWN "AC/DC"	37590-873C	U2632	37590-873C
	KEY CAP WHITE "."	37590-888J	U2632	37590-888J
	KEY CAP WHITE "DELETE"	37590-877A	U2632	37590-877A
	CABLE ASSY.RIBBON.	43130-189L	U2632	43130-189L

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AF2 - Scope keyboard

23. When ordering, prefix circuit reference with AF2

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44828-889U	U2632	44828-889U
R1	RV PLAS 50K LIN 0.25W 20%	25761-005E	K5743	82C1AE28 B18
R2	RV PLAS 50K LIN 0.25W 20%	25761-005E	K5743	82C1AE28 B18
R3	RV PLAS 50K LIN 0.25W 20%	25761-005E	K5743	82C1AE28 B18
R4	RV PLAS 50K LIN 0.25W 20%	25761-005E	K5743	82C1AE28 B18
SG4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SG5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SG8	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SH4	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SH5	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
SH8	SW PUSH 1P1W MOM LIPA D6	23465-301P	K8214	Y41 A 00280 FP
	KEY CAP DK BROWN "SINGLE"	37590-875B	U2632	37590-875B
	KEY CAP DK BROWN "REP"	37590-876K	U2632	37590-876K
	KEY CAP DK BROWN "DECR VERT"	37590-868X	U2632	37590-868X
	KEY CAP DK BROWN "INCR VERT"	37590-870P	U2632	37590-870P
	KEY CAP DK BROWN "DECR HORIZ"	37590-869M	U2632	37590-869M
	KEY CAP DK BROWN "INCR HORIZ"	37590-867P	U2632	37590-867P

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AGO	- GPIB unit			
24. When ordering, prefix circuit reference with AGO				
	Complete unit	54433-002Y	U2632	54433-002Y
Unit AG1	- GPIB interface circuit			
25. When ordering, prefix circuit reference with AG1				
	Complete unit	44828-639C	U2632	44828-639C
C1	CAP TANT 4.7UF 35V 20% BEAD	26486-219P	U3613	SH
C2	CAP CER 0.047UF 25V 20% DISC	26383-017U	U4011	ECK F1H473ZV
IC1	ICD NAND 74LS00 QUAD 21NP	28466-345H	K5519	SN74LS00N
IC2	ICD BUFF 74LS365	28469-194Z	K0461	SN74LS365AN
IC3	ICD MP SUP 8291A GPIB TALK/LIST !	28467-014C	U1425	D8291A OR P8291A
IC4	IDC BUFF 3448 QUAD GPIBTXRX 3S	28469-190R	U1458	MC3448AP OR AL
IC5	IDC BUFF 3448 QUAD GPIBTXRX 3S	28469-190R	U1458	MC3448AP OR AL
IC6	IDC BUFF 3448 QUAD GPIBTXRX 3S	28469-190R	U1458	MC3448AP OR AL
IC7	IDC BUFF 3448 QUAD GPIBTXRX 3S	28469-190R	U1458	MC3448AP OR AL
R1	RES MF 47K .25W 2% 100POvPM	24773-313H	K8996	MR25
R2	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R3	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R4	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R5	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
R6	RES MF 47K .25W 2% 100PPM	24773-313H	K8996	MR25
SA	SW1 DIL 6SW - GPIB ADDRESS	23465-897N	K4265	PIP GLP
	CABLE ASSEMBLY (connects to Motherboard AB1)	43129-825W	U2632	43129-825W

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AR1 - Power supply

26. When ordering, prefix circuit reference with AR1

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44828-891E	U2632	44828-891E
C4	CAP CER 470P 63V 10%	26383-582T	K8996	630-18-471
C5	CAP CER 470P 63V 10%	26383-582T	K8996	630-18-471
C6	CAP CER 1N0 63V 10%	26383-585M	K8996	630-18-102
C7	CAP ELEC 47U 63V 20%+	26421-121L	U4011	CEB4763
C8	CAP ELEC 1000U 35V 20%+	26421-130W	K8996	035 90006
C9	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C10	CAP ELEC 3U3 50V 20%	26421-109Z	U4011	K3.3/50
C11	CAP ELEC 3U3 50V 20%	26421-109Z	U4011	K3.3/50
C12	CAP CER 47N 25V 20%	26383-017U	U4011	ECK F1H473ZV
C13	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C14	CAP CER 820P 63V 10%	26383-584X	K8996	630-18-821
C15	CAP ELEC 100U 6.3V 20%	26421-118L	U4011	K100/6.3
C16	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C17	CAP ELEC 1000U 35V 20%+	26421-130W	K8996	035 90006
C18	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C19	CAP ELEC 1000U 35V 20%+	26421-130W	K8996	035 90006
C21	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C22	CAP ELEC 1000U 35V 20%+	26421-130W	K8996	035 90006
C23	CAP CER 100N 30V 20%	26383-031S	U4011	ECK F1H104ZV
C24	CAP ELEC 1000U 35V 20%+	26421-130W	K8996	035 90006
C25	CAP PETP 100N 100V 10%	26582-211B	K8300	PMT2R OR PMC2R
C27	CAP ELEC 470U 16V 20%+	26421-127W	U4011	CEB47016
C28	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C29	CAP ELEC 470U 25V 20%+	26421-129T	K8996	035 56471
C30	CAP ELEC 10U 35V 20%	26421-112Z	U4011	K10/35
C35	CAP PETP 10N 63V 10%	26582-426N	K1945	R68 D C 1002 AAK
C36	CAP PETP 100N 100V 10%	26582-211B	K8300	PMT2R OR PMC2R
C37	CAP CER 2N2 63V 10%	26383-587R	K8996	630-18-102
C38	CAP PETP 10N 63V 10%	26582-426N	K1945	R68 D C 1002 AAK
C39	CAP PETP 100N 100V 10%	26582-211B	K8300	PMT2R OR PMC2R
C40	CAP PETP 100N 63V 10%	26582-429F	K1945	R68 D C 1003 AAK
C41	CAP ELEC 47U 63V 20%+ PCB	26421-121L	U4011	CEB4763
D1	DI ZEN BZX79C4V7 4.7V 5%	28371-371F	K8996	BZX79 C4V7
D3	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D4	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D5	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D6	DI ZEN BZX79C5V6 5.6V 5%	28371-417X	K8996	BZX79 C5V6
D7	DI SIL BAY72 100V JUNC	28337-126P	K6659	BAY72
D8	DI SIL BAY72 100V JUNC	28337-126P	K6659	BAY72

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AR1	- Power supply		(Contd.)		
D9	DI ZEN BZV85 75V 5% 1W		28377-143J	K8300	ZPY75
D11	DI ZEN BZX79C18 18V 5%		28372-584H	K8996	BZX79 C18
D12	DI ZEN BZX79C16 16V 5%		28372-472M	K8996	BZX79 C16
D13	DI H/CARR BAT42 30V FAST	!	28349-013N	K6791	BAT 42
D14	DI RECT BYV28-100 100V FAST		28356-019N	K8996	BYV28 200
D15	DI RECT BYV28-100 100V FAST		28356-019N	K8996	BYV28 200
D16	DI RECT BYV28-100 100V FAST		28356-019N	K8996	BYV28 200
D17	DI RECT BYV28-100 100V FAST		28356-019N	K8996	BYV28 200
D18	DI RECT 20CTQ45 45V DUA SCH		28355-165H	U5008	20CTQ45
D21	DI RECT 11DQ06 60V SCHOTTKY		28355-172N	U5008	11 DQ 06
D22	DI RECT 11DQ06 60V SCHOTTKY		28355-172N	U5008	11 DQ 06
D23	DI ZEN 1N5365B 36V 5% 5W		28374-120L	K5519	IN5365B
D24	DI ZEN BZX79C6V2 6.2V 5%		28371-481D	K8996	BZX79 C6V2
D25	DI ZEN BZX79C15 15V 5%		28372-309Z	K8996	BZX79 C15
D26	DI RECT 1N4004 400V		28357-028K	K8996	1N4004
D27	DI RECT 1N4004 400V		28357-028K	K8996	1N4004
D28	DI SIL 1N4148 75V JUNC		28336-676J	K8996	1N4148
D29	DI RECT 1N4004 400V		28357-028K	K8996	1N4004
D30	DI H/CARR BAT29 5V	!	28349-014L	K6791	BAT 29 OR BAR 35
D31	DI ZEN 1N825/A 6.2V 5%		28371-494Z	K8996	1N825 OR A
D32	DI H/CARR BAT42 30V FAST	!	28349-013N	K6791	BAT 42
D33	DI RECT 1N4004 400V		28357-028K	K8996	1N4004
D34	DI H/CARR BAT42 30V FAST	!	28349-013N	K6791	BAT 42
IC1	ICA VREG TL494 PWM CTLR DIL16		28461-739G	K0461	TL494CN OR J
IC2	ICD CTR 74LS393 DUAL 4BIT BIN		28464-162R	K5519	SN74LS393N
IC3	MOD OPTO CNY17 ISOL 7K5V PK		28625-008N	K6997	CNY17-2Z
IC4	MOD OPTO CNY17 ISOL 7K5V PK		28625-008N	K6997	CNY17-2Z
IC5	ICA AMP TL071CP FET I/P DIL8		28461-347A	K5519	TL071CP
IC6	ICA VREG 78L05AC 5V .1A T092		28461-734Y		
L1	INDUCTOR ASSY (L1)		44290-898G	U2632	44290-898G
L3	INDUCTOR ASSY (L3)		44290-899V	U2632	44290-899V
L5	INDUCTOR ASSY (L5)		44290-900N	U2632	44290-900N
L7	INDUCTOR ASSY (L7)		44290-901L	U2632	44290-901L
L9	INDUCTOR ASSY		44290-957H		
PLA	TERM C/PIN 0.64SQX6 S/E REEL		23435-188V	U2338	75401 001
PLB	CON PART MIN WAFER 6P 3008		23435-911J	U1613	10-16-1061
PLC	TERM C/PIN 0.64SQX6 S/E REEL		23435-188V	U2338	75401 001
PLD	TERM C/PIN 0.64SQX6 S/E REEL		23435-188V	U2338	75401 001
R1	RES MF 2K2 .25W 2% 100PPM		24773-281Y	K8996	MR25
R2	RES MF 22K .25W 2% 100PPM		24773-305R	K8996	MR25
R3	RES MF 4K7 .25W 2% 100PPM		24773-289W	K8996	MR25

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
Unit AR1	- Power supply	(Contd.)		
R4	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R5	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R6	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R7	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R8	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R9	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R11	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R12	RES MF 56K .25W 2% 100PPM	24773-315U	K8996	MR25
R14	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R16	RES MF 120K .25W 2% 100PPM	24773-323F	K8996	MR25
R17	RES MF 3K6 .25W 2% 100PPM	24773-286G	K8996	MR25
R18	RES MF 27K .25W 2% 100PPM	24773-307K	K8996	MR25
R19	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25
R20	RES MF 20K .25W 2% 100PPM	24773-304C	K8996	MR25
R21	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R22	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R23	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R24	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R25	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R26	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R27	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R28	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R29	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R33	RES MF 22K .25W 2% 100PPM	24773-305R	K8996	MR25
R34	RES MF 1K0 .25W 2% 100PPM	24773-273A	K8996	MR25
R35	RES MF 20K .25W 2% 100PPM	24773-304C	K8996	MR25
R36	RES MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
R37	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R38	RES MF 2K2 .25W 2% 100PPM	24773-281Y	K8996	MR25
R39	RES MF 3K9 .25W 2% 100PPM	24773-287V	K8996	MR25
R41	RES MF 9K1 .25W 2% 100PPM	24773-296X	K8996	MR25
R42	RES MF 9K1 .25W 2% 100PPM	24773-296X	K8996	MR25
R43	RES MF 2K4 .25W 2% 100PPM	24773-282N	K8996	MR25
R44	RES MF 1K2 .25W 2% 100PPM	24773-275H	K8996	MR25
R45	RES MF 20K .25W 2% 100PPM	24773-304C	K8996	MR25
R46	RV CERM 5K0 LIN .5W 10%	25711-640F	U0914	E2A
R47	RV CERM 2K0 LIN .5W 10%	25711-639V	U0914	E2A
R48	RES MO 1K0 .5W 2% 250PPM	24573-073W	K4184	TR5 OR TRM50RNK5
R49	RES MO 1K0 .5W 2% 250PPM	24573-073W	K4184	TR5 OR TRM50RNK5
R51	RES MF 10K .25W 2% 100PPM	24773-297M	K8996	MR25
R52	RES MF 100K .25W 2% 100PPM	24773-321L	K8996	MR25

Circuit Ref.	Description		MI Part No.	Mfr. Code	Mfr. Part No.
Unit AR1	- Power supply		(Contd.)		
R57	RES MF 12R .25W 2% 250PPM		24773-277T		
R58	RES MF 130K .25W 2% 100PPM		24773-324G	K8996	MR25
R60	RES MF 30K .25W 2% 100PPM		24773-308A	K8996	MR25
R61	RES MF 2K2 .25W 2% 100PPM		24773-281Y	K8996	MR25
R62	RES MF 4K7 .25W 2% 100PPM		24773-289W	K8996	MR25
R64	RES MF 820R .25W 2% 100PPM		24773-271B	K8996	MR25
R65	RES MF 10K .25W 2% 100PPM		24773-297M	K8996	MR25
R66	RES MF 2K2 .25W 2% 100PPM		24773-281Y	K8996	MR25
R67	RV CER 5K0 LIN .25W 10% 12T		25748-585H	K5743	3266W-1-502
RLA	RELAY MAG 1CO 12V 270R		23486-157U	K7495	G2L 113 PV
SKC	CON JUMP FEM 2 1 ROW		23435-990X	U2338	65474 001
SKD	CON JUMP FEM 2 1 ROW		23435-990X	U2338	65474 001
TR1	TR PSI BC307A 45V 130M - GEN		28435-227H	K6360	BC307A
TR2	TR PSI BC307A 45V 130M - GEN		28435-227H	K6360	BC307A
TR3	TR NSI BC237A 45V 150M - GEN		28455-421X	K1196	ZTX107AL
TR4	TR NSI BC237A 45V 150M - GEN		28455-421X	K1196	ZTX107AL
TR5	TR PSI 2N2905A 60V 200M - GEN		28435-868C	K6617	2N2905A
TR6	TR PSI BC307A 45V 130M - GEN		28435-227H	K6360	BC307A
TR7	TR PSI BC307A 45V 130M - GEN		28435-227H	K6360	BC307A
TR8	TR NSI BC237A 45V 150M - GEN		28455-421X	K1196	ZTX107AL
TR9	TR PSI BC307A 45V 130M - GEN		28435-227H	K6360	BC307A
TR11	TR PSI BC307A 45V 130M - GEN		28435-227H	K6360	BC307A
TR12	TR NSI 2N2369 15V 500M - SW		28452-197H	K5519	2N2369 OR A
TR13	TR NMF 530 100V 0R18 14A PWR	!	28459-049M	U5008	IRF 530
TR14	TR PSI BC307A 45V 130M - GEN		28435-227H	K6360	BC307A
TR15	TR NSI 2N2369 15V 500M - SW		28452-197H	K5519	2N2369 OR A
TR16	TR NMF 530 100V 0R18 14A PWR	!	28459-049M	U5008	IRF 530
TR18	TR NSI BC237A 45V 150M - GEN		28455-421X	K1196	ZTX107AL
TR19	TR NSI BC237A 45V 150M - GEN		28455-421X	K1196	ZTX107AL
T1	TRANSFORMER ASSY.(T1)		43590-149W	U2632	43590-149W
T2	TRANSFORMER.CURR.SENS.(T2)		43590-150V	U2632	43590-150V
T3	TRANSFORMER.CLOCK ISOL'TG(T3)		43590-151S	U2632	43590-151S

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AR4 - DC filter

27. When ordering, prefix circuit reference with AR4

	Complete unit	44829-508F	U2632	44829-508F
C1	CAP PETP 6U8 63V 10%	26582-424U	K8283	M2B68201B
C2	CAP PETP 2U2 63V 10%	26582-418Z	K8283	A1B22201B
C3	CAP PETP 2U2 63V 10%	26582-418Z	K8283	A1B22201B
C4	CAP PETP 2U2 63V 10%	26582-418Z	K8283	A1B22201B
C5	CAP PETP 2U2 63V 10%	26582-418Z	K8283	A1B22201B
L1	INDUCTOR ASSY.	44290-958E	U2632	44290-958E
L2	INDUCTOR ASSY.	44290-958E	U2632	44290-958E
X1	FERRITE BEADS (4)	23635-845E		
X2	FERRITE BEADS (4)	23635-845E		

Unit AT2 -CRT base

28. When ordering, prefix circuit reference with AT2

	Complete unit	44828-520Y	U2632	44828-520Y

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.

Unit AZ1 - Encoder assembly

29. When ordering, prefix circuit reference with AZ1

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44990-492T	U2632	44990-492T
D1	LAMP LED OP240SLA 1.3V IR	28624-126N	U1718	OP240SLA
D2	LAMP LED OP240SLA 1.3V IR	28624-126N	U1718	OP240SLA
R1	MF 220R .25W 2% 100PPM	24773-257W	K8996	MR25
X1	MOD OPTO SDP8600 SCHM DET	28625-004H	00001	VTIC7210 OR 7110
X2	MOD OPTO SDP8600 SCHM DET	28625-004H	00001	VTIC7210 OR 7110

Unit OS1 - 10 MHz oscillator HS (OCXO)

30. When ordering, prefix circuit reference with OS1

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44990-377J	U2632	44990-377J

Item No.	Description	Part Number

MISCELLANEOUS MECHANICAL PARTS

31. Order without prefix. Item numbers as shown in Fig. 1.

1	Top cover	35903-805H
2	Board frame cover	35904-449N
3	Board guide (1 of 12)	22324-001E
4	AT2 protective cover	37590-841C
5	CRT magnetic shield	35904-561G
	Gasket moulding	37590-988N
6	CRT strap assembly	41700-687T
7	VARIABLE control knob	41149-060S
	Cap, stone grey	37590-281W
8	CRT bezel	37590-916Z
9	Lower cover	35904-460V
10	Front panel, marked	35904-456F
11	CRT window	37490-707T
	CRT screen, mesh	31519-125H
12	VOLUME, INTENSITY or POSITION control knob (1 of 4)	41149-073K
	Cap, stone grey (1 of 4)	37590-242F
13	Foot (1 of 4)	37590-681Y
	Stud, nylon (1 of 4)	37590-223C
14	Handle, moulded	41700-380D
15	RF tray cover (small)	41690-406G
16	Boss (1 of 2)	35890-080M
	Index ring (1 of 2)	34900-902T
	Cover (1 of 2)	37590-683L
	Screw, pan M5 x 16 (1 of 2)	21837-565T
	Compression spring (1 of 2)	31119-085M
	Sleeve (1 of 2)	31718-228L
17	Side rail (1 of 2)	34900-872R
18	RF tray cover (large)	41690-408S
19	AC1 safety shield	37490-749K
20	Rear cover	41690-407V
	Grommet, blind (1 of 2)	23188-242S
	Air filter (1 of 3)	37490-718A
21	Rear stand (1 of 2)	37590-915A
22	Rear panel	35904-457V
	GPIB cover plate	35904-534T
	Voltage selector locking plate	35904-422J
23	Nut, sheet metal (1 of 8)	35901-352Z

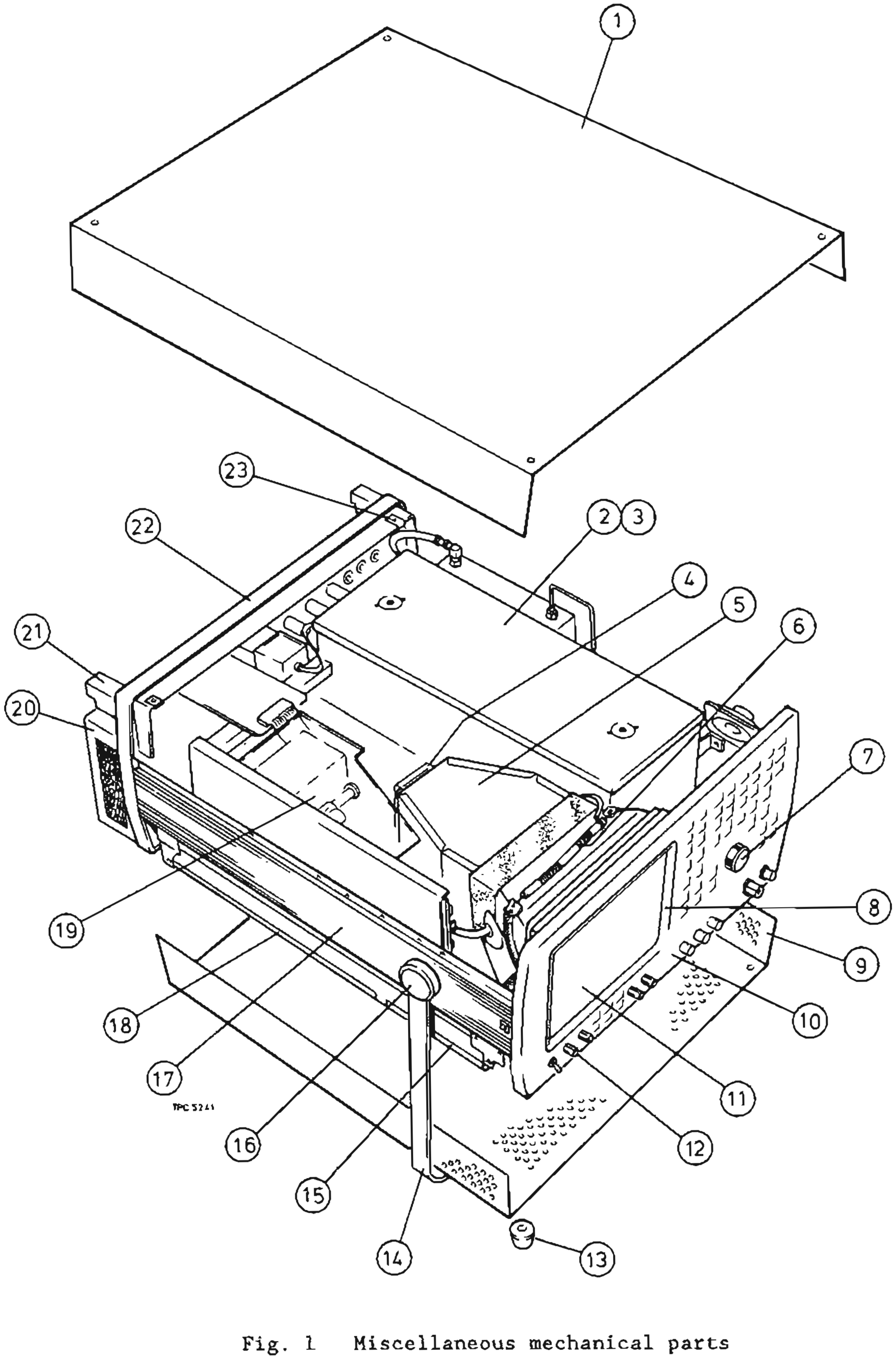


Fig. 1 Miscellaneous mechanical parts

TABLE 1 CROSS REFERENCE - MANUFACTURERS' CODES TO NAMES AND ADDRESSES

NATO Mfr. Code	Manufacturer's Address
00001	VACTEC INC OPTO ELECTRONICS, 10900 PAGE BLVD, ST LOUIS, MO 63132, USA
15454	AMETEK INC RODAN DIV, 2905 BLUE STAR STREET, ANAHEIM, CALIFORNIA, CA92806
15542	MINI-CIRCUITS LABORATORY, DIV SCIENTIFIC COMPONENTS CORP, 2625 E 14TH ST, BROOKLYN, NY11235
55285	BERGQUIST CO INC, THE 5300 EDINA INDUSTRIAL BLVD, MINNEAPOLIS, MN55435 5099
60395	XICOR INC, 851 BUCKEYE CT, MILPITAS, CA95035, AJ3674
88285	RCA CORP, 30 ROCKEFELLER PLAZA, NEW YORK, NY10020
A2984	SAREA ITALY, 20090 SEGRATE (MI), REDECESIA, VIA UMBRIA 10
K0461	TEXAS INSTRUMENTS LTD, MANTON LANE, BEDFORD, MK41 7PA
K0467	PLESSEY SEMICONDUCTORS LTD, CHEYNEY MANOR, SWINDON, WILTS, SN3 2QW
K0574	DOWTY ELECTRONIC INTERCONNECT, FASSETTS ROAD, LOUDWATER, HIGH WYCOMBE, BUCKS, HP10 9UT
K1072	GREENPAR CONNECTORS LTD, PO BOX 15, HARLOW, ESSEX, CM20 2ER
K1191	SUFLEX LTD, NEWPORT RD, RISCA, NEWPORT, GWENT, NP1 6YD
K1196	FERRANTI LTD ELECTRONICS DIVISION, GEM MILL, CHADDERTON, OLDHAM, LANCS, OL9 8NP
K1365	WAYCOM LTD, WOKINGHAM ROAD, BRACKNELL, BERKS, RG12 1ND
K1439	STETTNER (DE) STEATITE ROEDERSTEIN LTD, HAGLEY HOUSE, 83 HAGLEY ROAD, BIRMINGHAM, B16 8QW
K1660	REDPOINT LTD, LYNTON ROAD, CHEYNEY MANOR, SWINDON, SN2 2QN
K1935	JERMYN INDUSTRIES LTD, VESTRY ESTATE, VESTRY ROAD, SEVENOAKS, KENT, TN14 5EU
K1945	ARCOTRONICS (SCOTLAND) LTD, WHITESIDE WORKS, BATHGATE, WEST LOTHIAN, EH48 2RL
K2510	CITEC LTD, CHEYNEY MANOR, SWINDON, WILTS, SN2 2PZ
K3464	HEWLETT-PACKARD LTD, ESKDALE ROAD, WINNERSH TRIANGLE, WOKINGHAM, BERKS, RG11 5DZ
K4122	SGS UNITED KINGDOM LTD, PLANAR HOUSE, WALTON STREET, AYLESBURY, BUCKS, HP21 7QN

NATO Mfr. Code	Manufacturer's Address
K4567	MARCONI ELECTRONIC DEVICES LTD, EAST LANE, WEMBLEY, MIDDX, HA9 7PP
K4642	LCR COMPONENTS, CROSS STREET, TREDEGAR, GWENT, NP2 6HA
K4701	SPRAGUE ELECTRIC (UK) LTD, AIRTECH 2, GENNER ROAD OFF FLEMING WAY, CRAWLEY, WEST SUSSEX, RH10 2YG
K5519	MOTOROLA (UK SALES) LTD, MOTOROLA SEMI-CON PRODUCTS GRP, FAIRFAX HOUSE, 69 BUCKINGHAM STREET, AYLESBURY BUCKS, HP20 2NF
K5743	BOURNS ELECTRONICS LTD, HODFORD HOUSE, 27 HIGH STREET, HOUNSLOW, MIDDLESEX, TW3 1TE
K6360	SIEMENS LTD ELECTRONIC COMPONENTS GROUP, SIEMENS HOUSE, WINDMILL ROAD, SUNBURY ON THAMES, MIDDLESEX, TW16 7HS
K6617	AEG (UK) LTD, 217 BATH ROAD, SLOUGH, BERKS, SL1 4FW
K6659	FAIRCHILD SEMICONDUCTOR LTD, 230 HIGH STREET, POTTERS BAR, HERTS, EN6 5BL
K6791	THOMSON CSF COMPONENTS & MATERIALS LTD, RINGWAY HOUSE, BELL ROAD, DANESHILL, BASINGSTOKE HANTS, RG24 0QG
K6997	GENERAL INSTRUMENT (UK) LTD, COCK LANE, HIGH WYCOMBE, BUCKS, HP13 7DE
K7068	SILICONIX LTD, LLANLLIENWEN CLOSE, MORRISTON, SWANSEA, SA6 6NE
K7093	NATIONAL SEMICONDUCTOR (UK) LTD, 301 HARPUR CENTRE, HORNE LANE, BEDFORD, MK40 1TR
K7284	ANALOG DEVICES LTD, CENTRAL AVENUE, EAST MOLESEY, SURREY, KT8 0SN
K7495	IMO PRECISION CONTROLS LTD, 1000 NORTH CIRCULAR ROAD, STAPLE CORNER, LONDON, NW2 7JP
K7584	PHILIPS ELECTRONIC & ASSOC. INDS. LTD, ARUNDEL GT COURT, 8 ARUNDEL STREET, LONDON, WC2R 3DT
K7664	MITSUBISHI CORPORATION, BOW BELLS HOUSE, BREAD STREET, LONDON, EC4N 9BJ
K8214	LIPA & ISOSTAT (GB) LTD, HERON INDUSTRIAL ESTATE, 8 ROBERT WAY, WICKFORD, ESSEX, SS11 8DD
K8283	ASHCROFT ELECTRONICS LTD, 1 WILKINSON ROAD, CIRENCESTER, GLOS, GL7 1YT
K8300	STANDARD TELEPHONE & CABLES LTD, CHRISTCHURCH WAY, GREENWICH, LONDON, SE10 0AG
K8445	MIDLAND CAPACITORS LTD, 46 CHURCH STREET, COGENHOE, NORTHAMPTON, NN7 1LS

NATO Mfr. Code	Manufacturer's Address
K8479	HOLSWORTHY ELECTRONICS LTD, NORTH ROAD, HOLSWORTHY, DEVON, EX22 6JE
K8996	MULLARD LTD, MULLARD HOUSE, TORRINGTON PLACE, LONDON, WC1E 7HD
S3323	FUJISOKU ELECTRIC CO LTD, TOKIO, JAPAN,
S4248	FOSTER ELECTRIC CO, 512 NIYAZAWA'CHO, AKISHIMA'CITY, TOKIO, JAPAN,
U0142	DALE-ACI COMPONENTS LTD, SOLWAY IND ESTATE, MARYPORT, CUMBRIA, CA15 8NF
U0154	BELLING LEE LTD, INTEC HOUSE, 540 GREAT CAMBRIDGE ROAD, ENFIELD, MIDDLESEX, EN1 3RY
U0611	TELEDYNE RELAYS, HEATHROW HOUSE, BATH ROAD, CRANFORD, MIDDX, TW5 9QQ
U0914	GENERAL HYBRID LTD, BEDE INDUSTRIAL EST, JARROW, TYNE & WEAR, NE32 3EN
U0928	BULGIN AF & CO LTD, BYE-PASS ROAD, BARKING, ESSEX, IG11 0AZ
U1395	WELWYN ELECTRONICS LTD, RESOLUTE ELECTRONICS DIV, BEDLINGTON, NORTHUMBERLAND, NE22 7AA
U1458	ADVANCED MICRO DEVICES (UK) LTD, AMD HOUSE, GOLDSWORTH ROAD, WOKING, SURREY, GU21 1JT
U1479	DELTRON COMPONENTS LTD, BALFOUR HOUSE, 590 UXBRIDGE ROAD, HAYES, MIDDX, UB4 0RY
U1613	MOLEX ELECTRONICS LTD, MOLEX HOUSE, FARNHAM ROAD, BORDEN, HANTS, GU35 0NU
U1718	TRW CONNECTORS LTD, SHIREOAKS ROAD, WORKSOP, NOTTS, S80 3HA
U2120	DAU COMPONENTS, 70-74 BARNHAM ROAD, BARNHAM, WEST SUSSEX, PO22 0ES
U2338	DUPONT (UK) LTD (BERG ELECTRONICS DIV), WEDGEWOOD WAY, STEVENAGE, HERTS, SG1 4QN
U2453	NEOHM, ITALIA HOUSE, PASS STREET, WERNETH, OLDHAM LANCS, OL9 6HZ
U2475	ECC ELECTRONICS (UK) LTD, UNIT 9, BLENHEIM ROAD, HIGH WYCOMBE, BUCKS, HP12 3RT
U2632	MARCONI INSTRUMENTS SERVICE DIVISION, THE AIRPORT, LUTON, BEDS, LU2 9NS
U2685	AUGAT INTERCONNECTION COMPONENTS LTD, SUNRISE PARKWAY, LINFORD WOOD EAST, MILTON KEYNES, BUCKS, MK14 6LF
U3008	RANK BRIMAR LTD, GREENSIDE WAY, MIDDLETON, MANCHESTER, LANCS, M24 1SN

NATO Mfr. Code	Manufacturer's Address
U3418	RAYTHEON SEMICONDUCTOR INTERNATL CO LTD, HARREM HOUSE, OGILVIE ROAD, HIGH WYCOMBE, BUCKS, HP12 3DS
U3515	C & K SWITCHES LTD, CUNLIFFE DRIVE, NORTHFIELD AVENUE, KETTERING, NORTHANTS, NN16 8LF
U3613	MATSUSHITA ELECTRONICS COMPONENTS CO.LTD, NATIONAL PANASONICS (UK) LTD, 300-318 BATH ROAD, SLOUGH, BERKS, SL1 6JB
U3627	CANADIAN INSTRUMENTS & ELECTRONICS LTD, STATION ROAD, ILKESTON, DERBYSHIRE, DE7 5TX
U4011	WIMPEY DUBILIER LTD, CHAUCER TRADING ESTATE, LAUNTON ROAD, BICESTER, OXON, OX6 0TU
U4038	SIGMEX LTD, SIGMA HOUSE, NORTH HEATH LANE, HORSHAM, SUSSEX, RH12 4UZ
U4251	MIDLAND ROSS LTD, GRIMES DIVISION, DUKESBRIDGE CHAMBERS, 1 DUKE STREET, READING BERKS, RG1 4LN
U4794	NEC ELECTRONICS (UK) LTD, SYGNES HOUSE, SUNRISE PARKWAY, MILTON KEYNES, MK14 6NP
U5008	POWER PRODUCTS INTERNATIONAL LTD, COMMERCE WAY, EDENBRIDGE, KENT, TN8 6ED

Chapter 7

SERVICING DIAGRAMS

CONTENTS

CIRCUIT NOTES

Component values

1. Resistors : No suffix = ohms, k = kilohoms, M = megohms.
   Capacitors : No suffix = microfarads, p = picofarads.

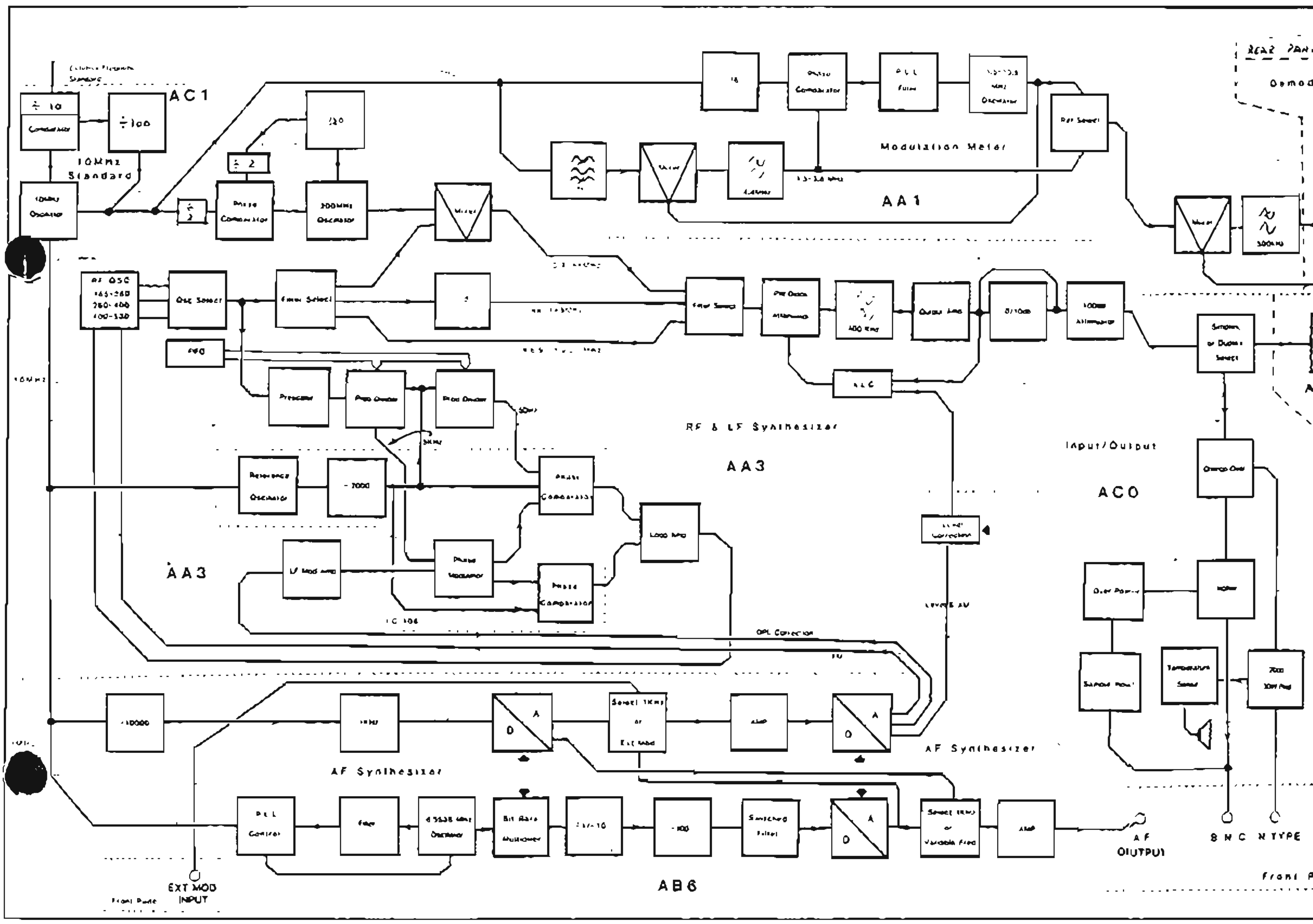
Symbols

2. Symbols are to BS 3939 with the following additions :

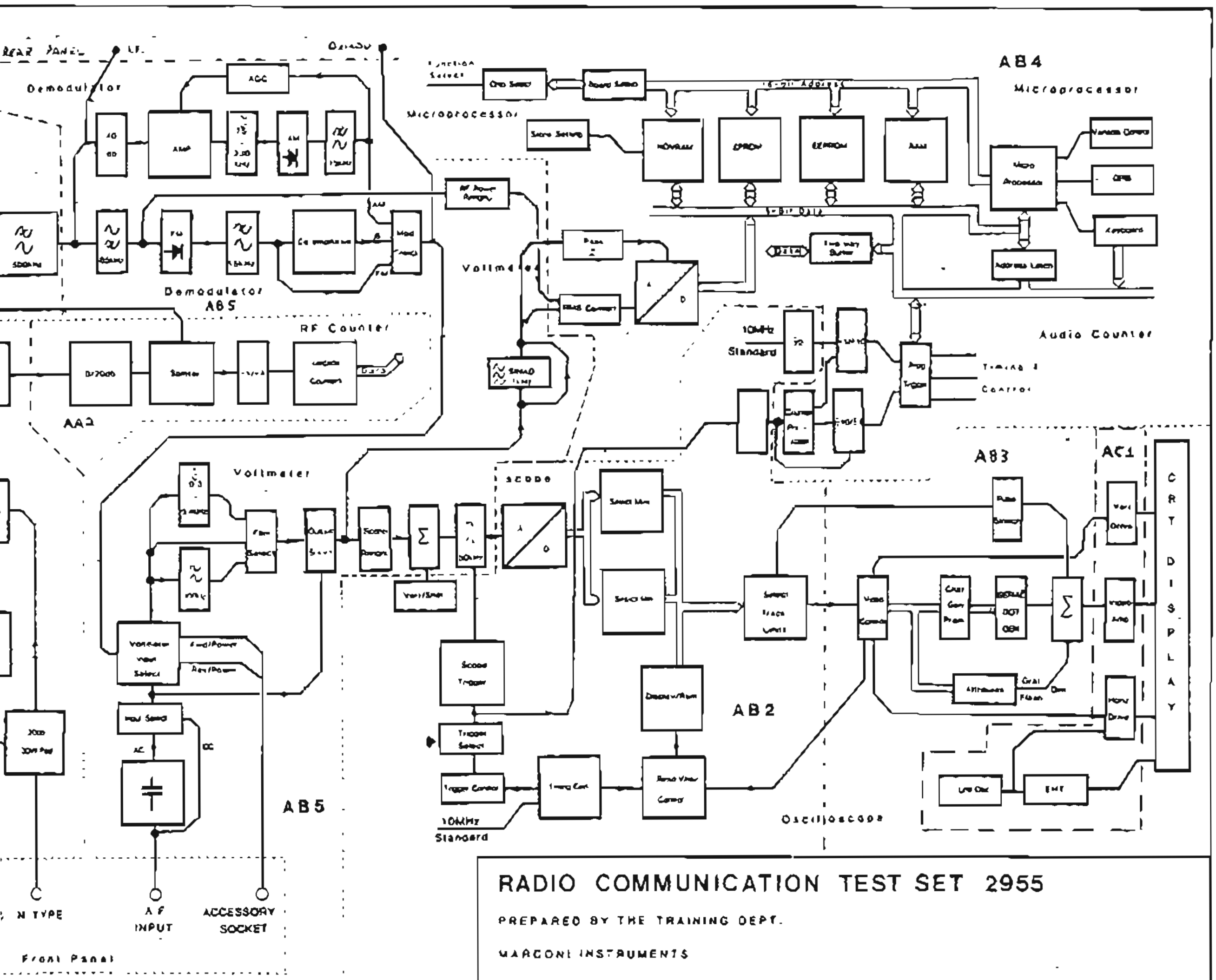
   - Static sensitive component - see Notes and Cautions, p. iv.
   - Tag
   - Test point
   - Edge connector
   - Ferrite bead
   - Unit identification

PCB layouts

3. PCB layouts are shown as viewed from the component side.



AC1
÷ 10
÷100
10MHz Standard
Phase Comparator
200MHz Oscillator
Mixer
Modulation Meter
AA1
RF OSC
165-260
260-400
400-530
Osc Select
Filter Select
Prescaler
Reference Oscillator
÷7000
Phase Comparator
Loop Amp
LF Mod Amp
Phase Modulator
RF & LF Synthesizer
AA3
ALC
Input/Output
ACO
Change Over
Over Power
Temperature Sensor
÷10000
D
A
Select 1KHz or Ext Mod
AMP
AF Synthesizer
PLL Control
Filter
Bit Rate Multiplier
÷100
Switched Filter
AB6
EXT MOD INPUT
AF OUTPUT
BNC
N TYPE

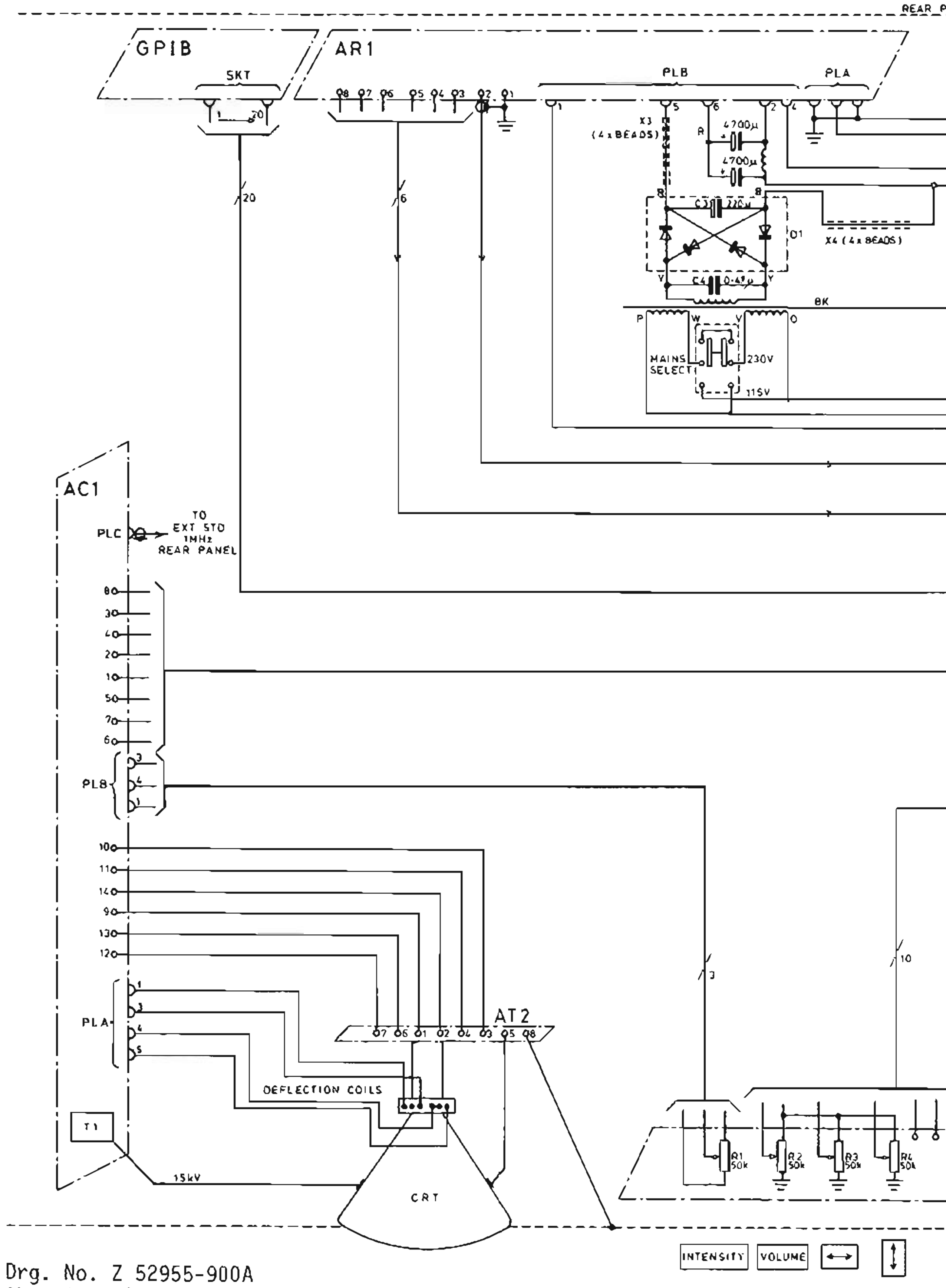


RADIO COMMUNICATION TEST SET 2955

PREPARED BY THE TRAINING DEPT.

MARCONI INSTRUMENTS

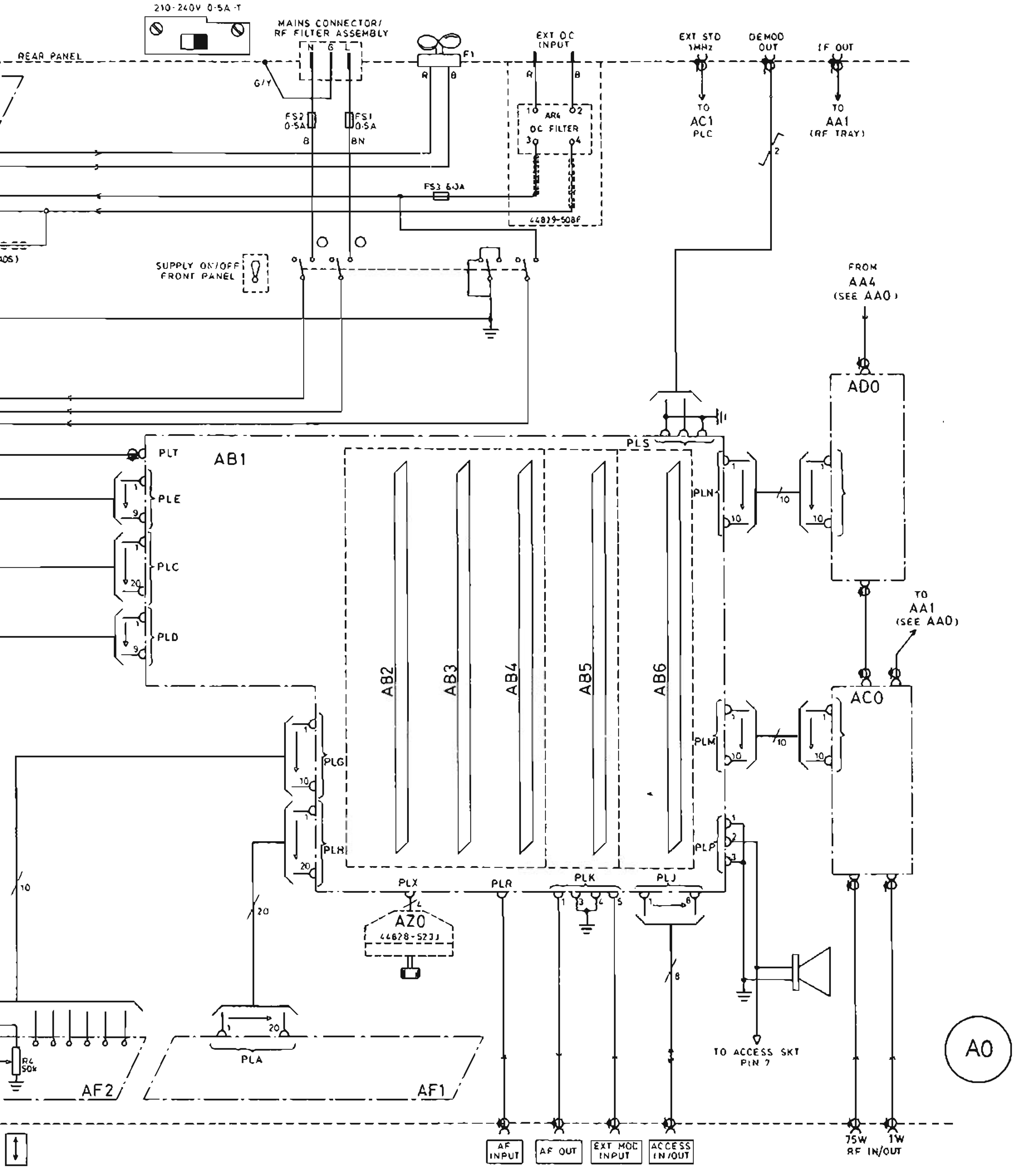
ST ALBANS FJA/1/85. APRIL 1985



Drg. No. Z 52955-900A
Sht. 1 of 2, Iss. 7

Fig. 1

A0 : Overall



FOR RF TRAY AA0 SEE SHEET 2

Overall connection diagram

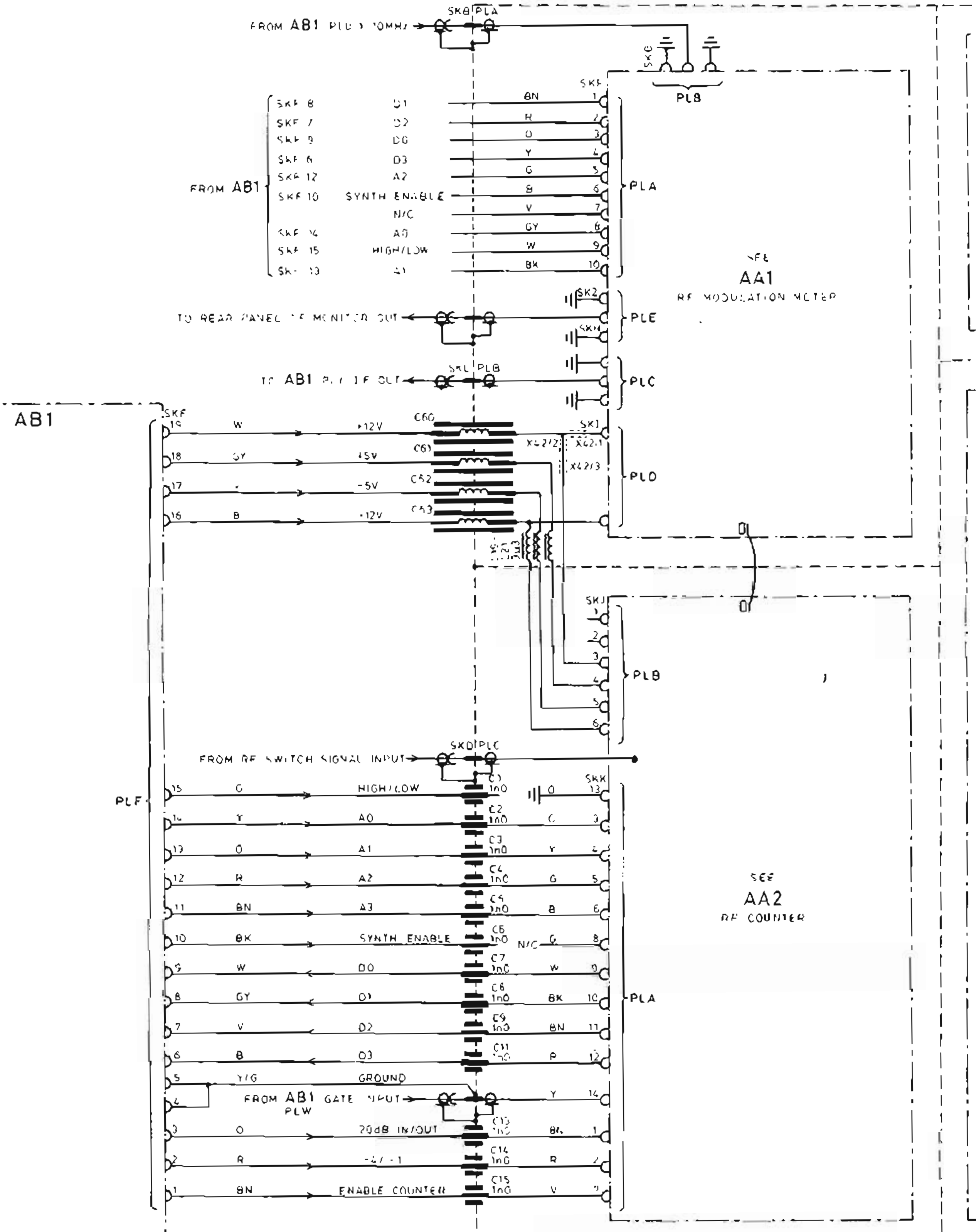
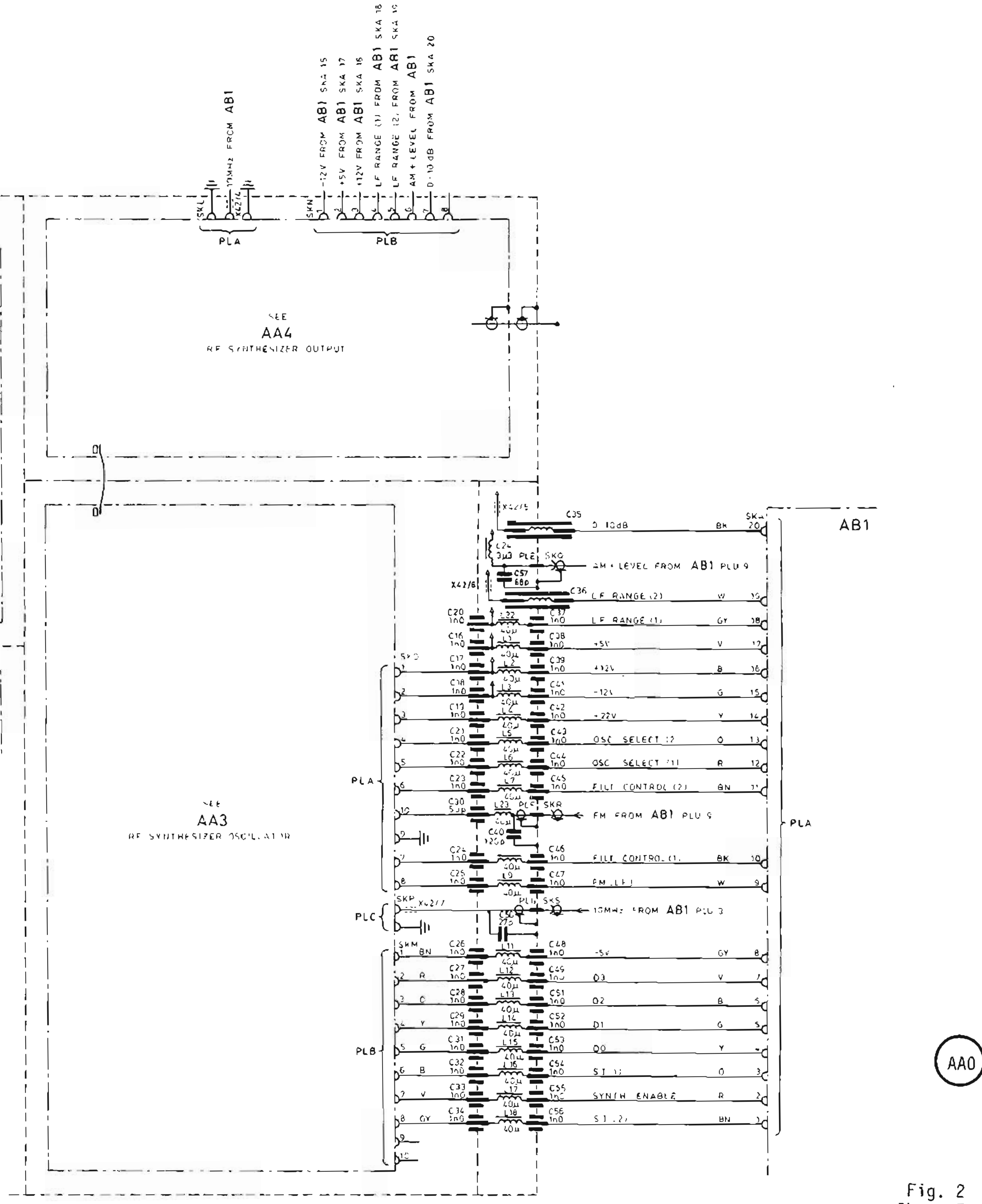


Fig. 2

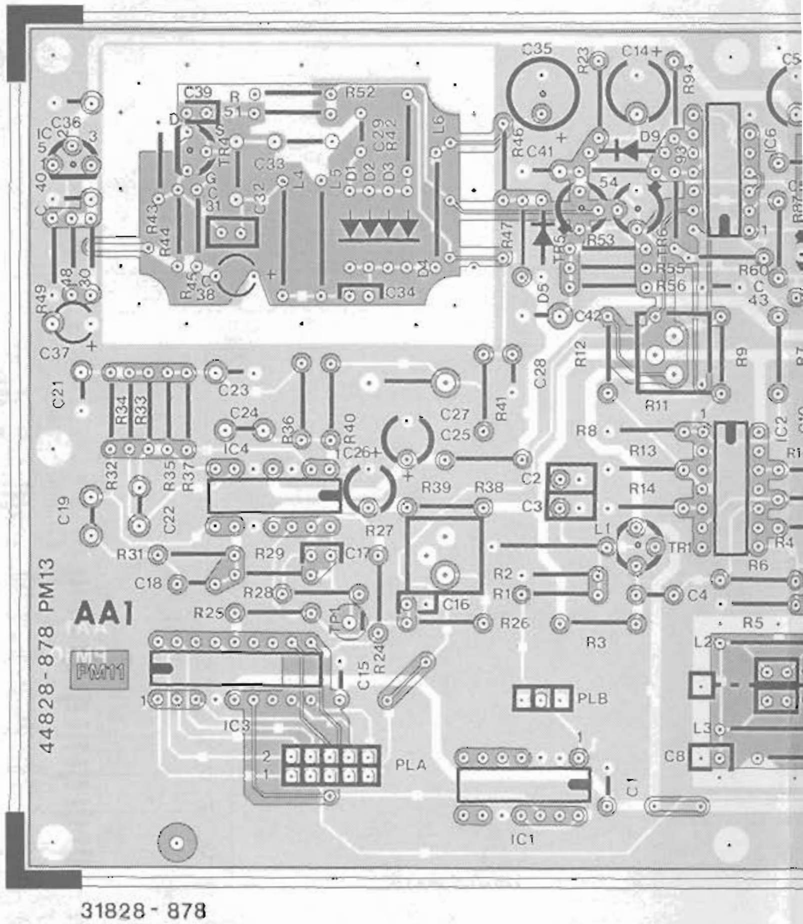
Aug. 86 (Am. 2)

Drg. No. Z 52955-900A
Sh. 2 of 2, Iss. 7

AA0

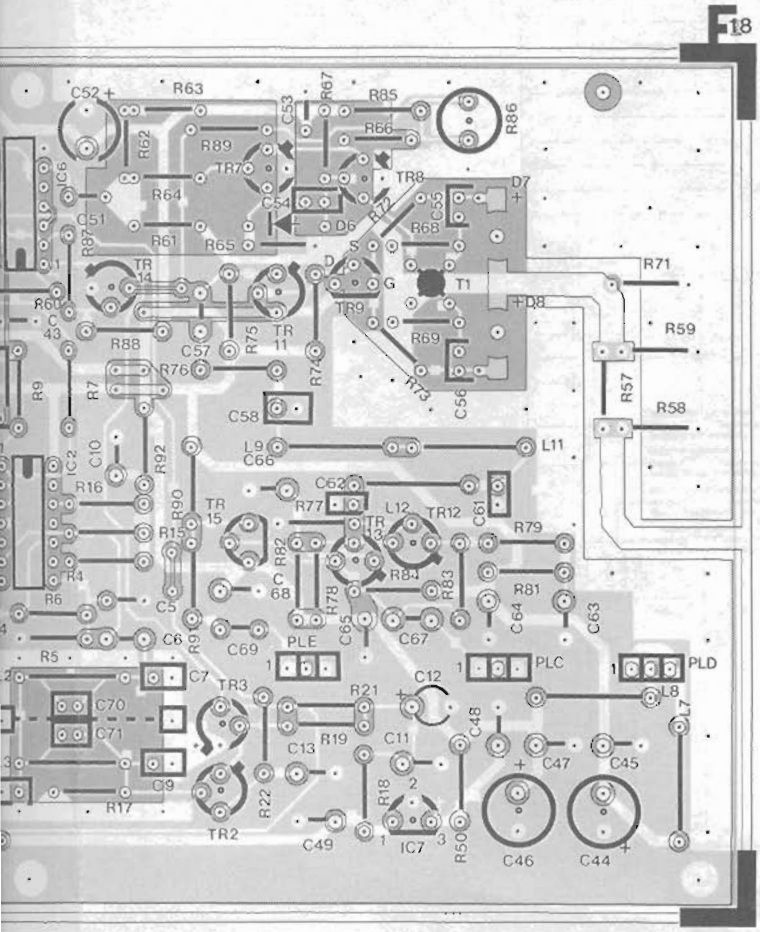

AA4
RF SYNTHESIZER OUTPUT
AA3
RF SYNTHESIZER OSCILLATOR
AB1
PLA
PLB
PLC
AAO

AAO : RF tray



31828 - 878

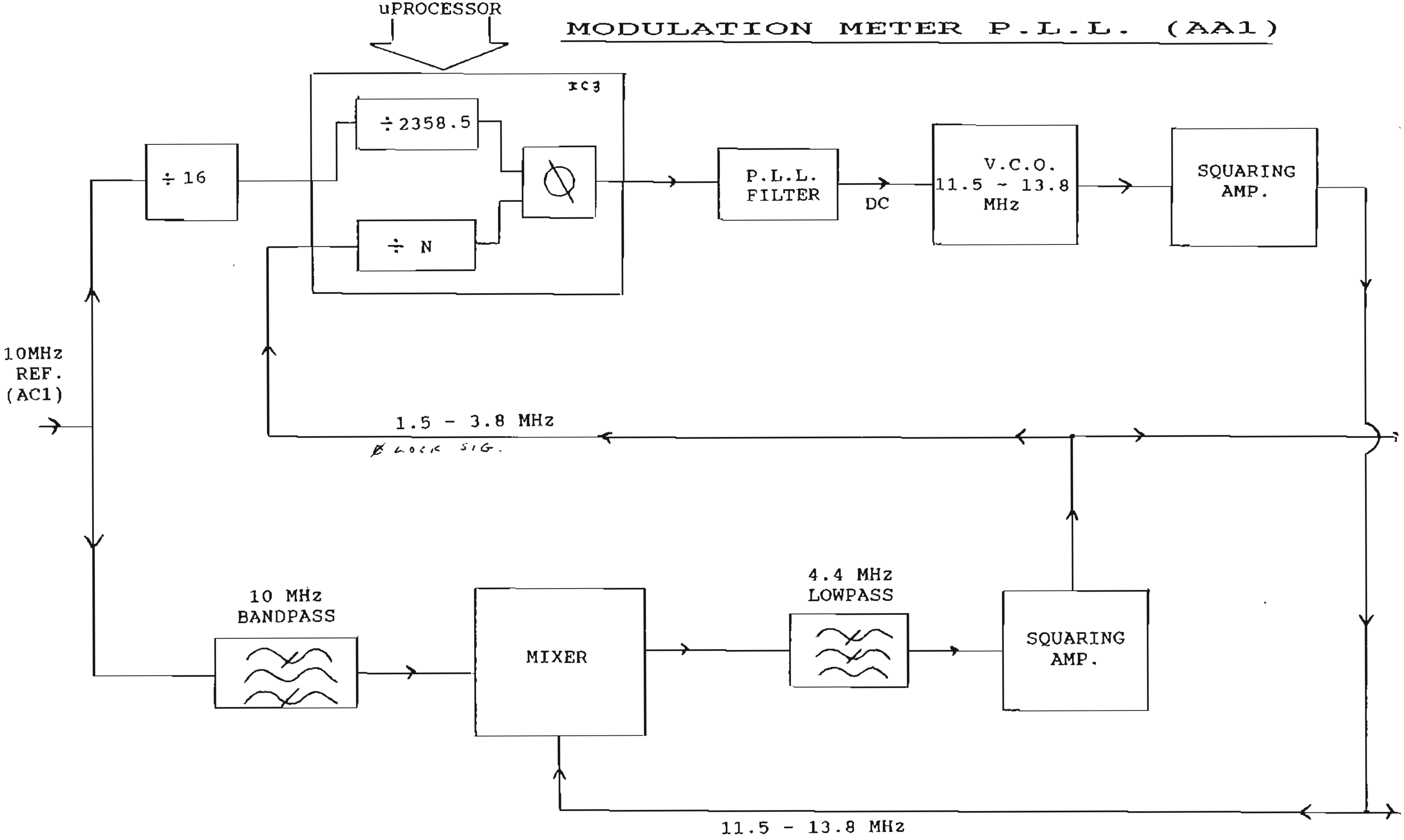
Component lay



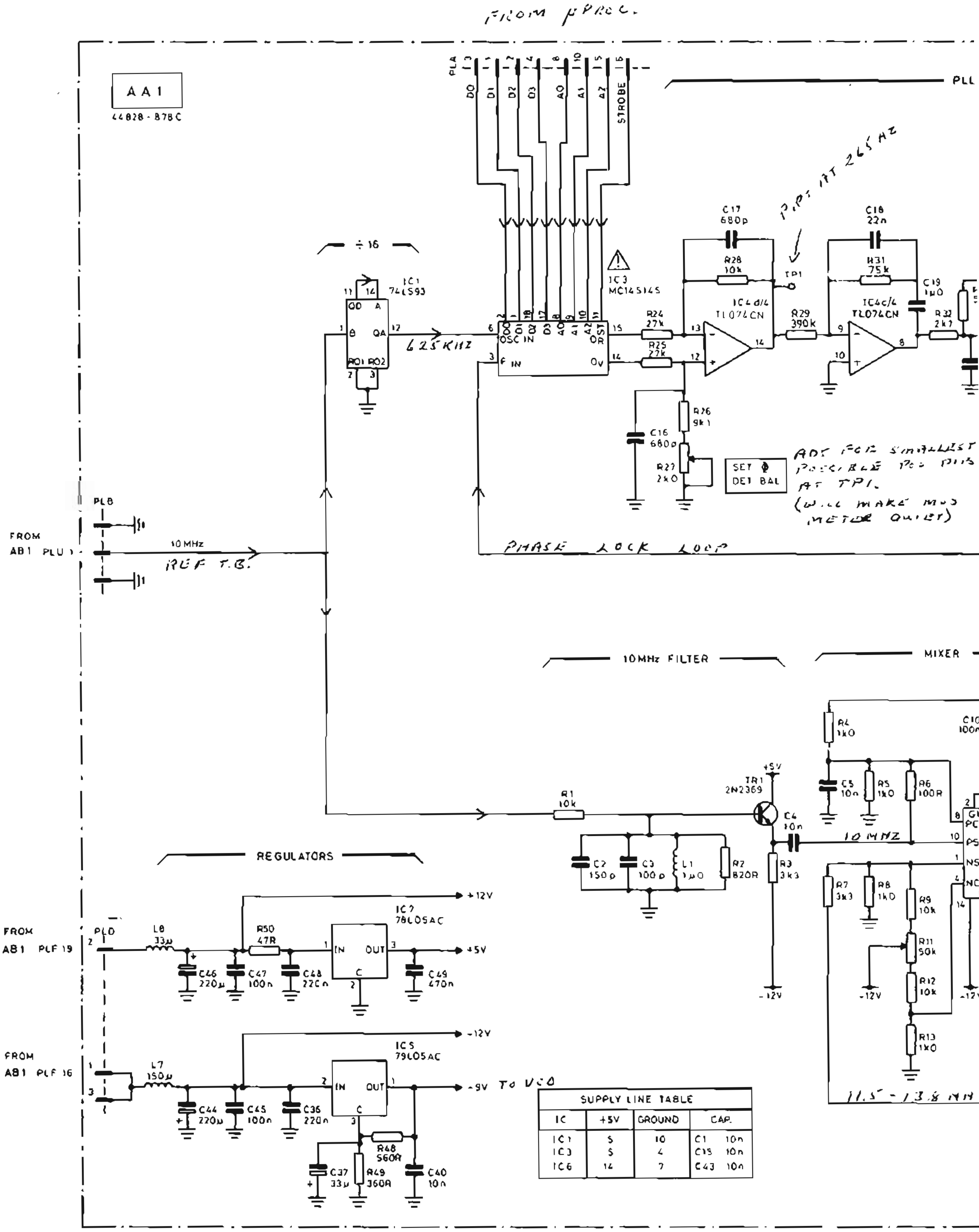
ent layout : AA1

Fig. 3a

MODULATION METER P.L.L. (AA1)



PAGE 7/8



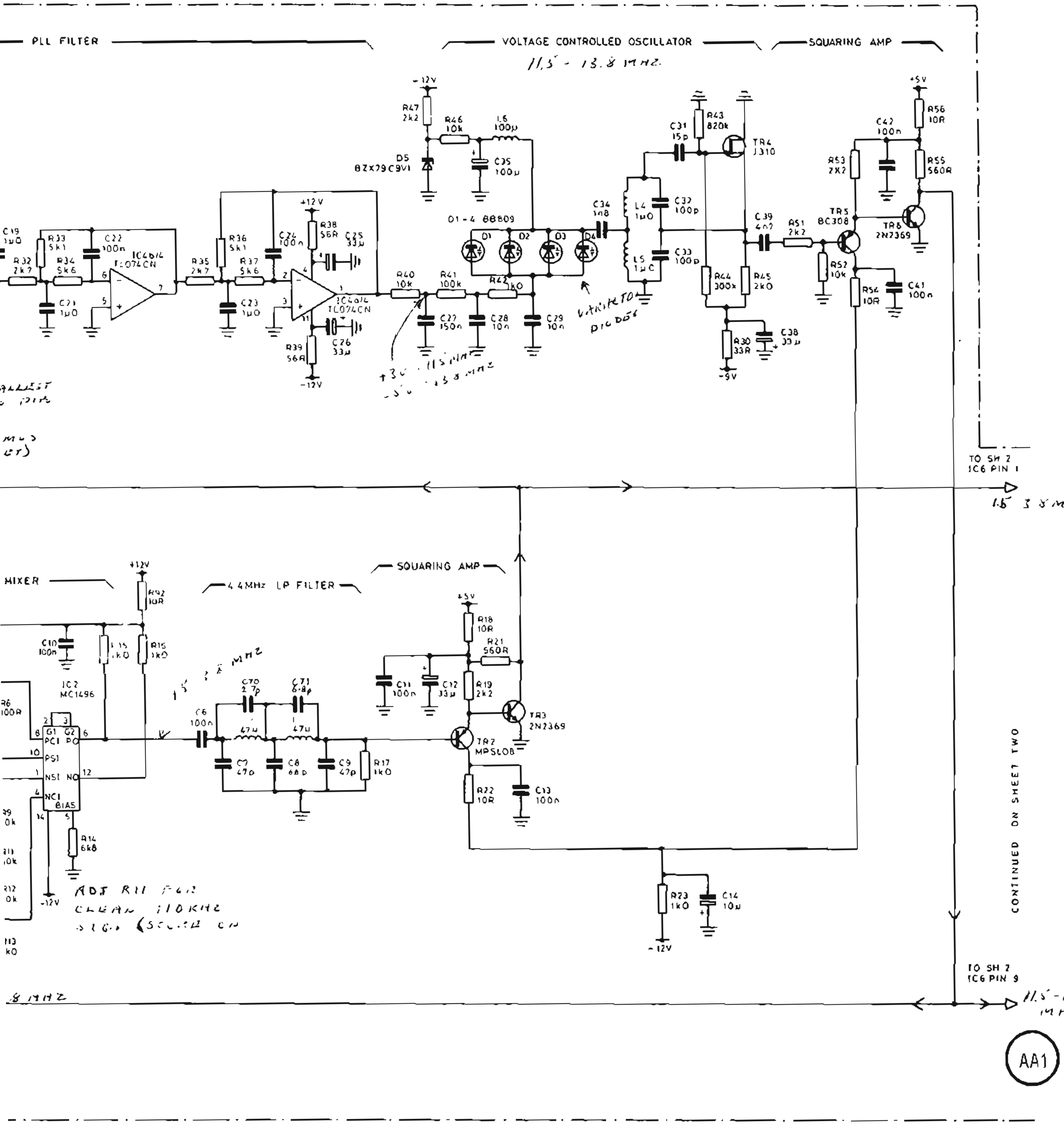
SUPPLY LINE TABLE			
IC	+5V	GROUND	CAP.
IC1	5	10	C1 10n
IC3	5	4	C15 10n
IC6	14	7	C43 10n

Drg. No. Z 44828-878C
Sht. 1 of 2, Iss. 7

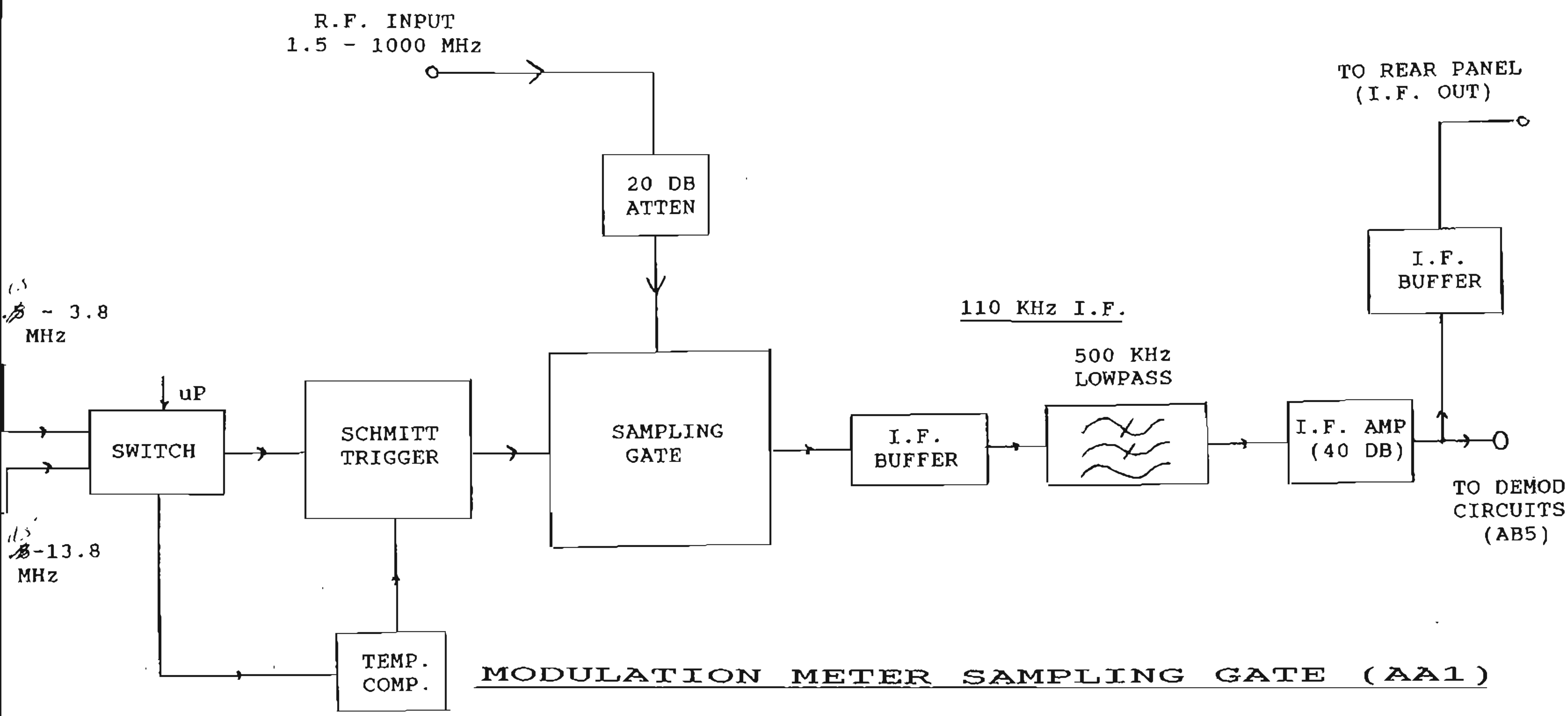
AA1 : RF modulation met

Fig. 3

Nov. 87 (Am. 5)

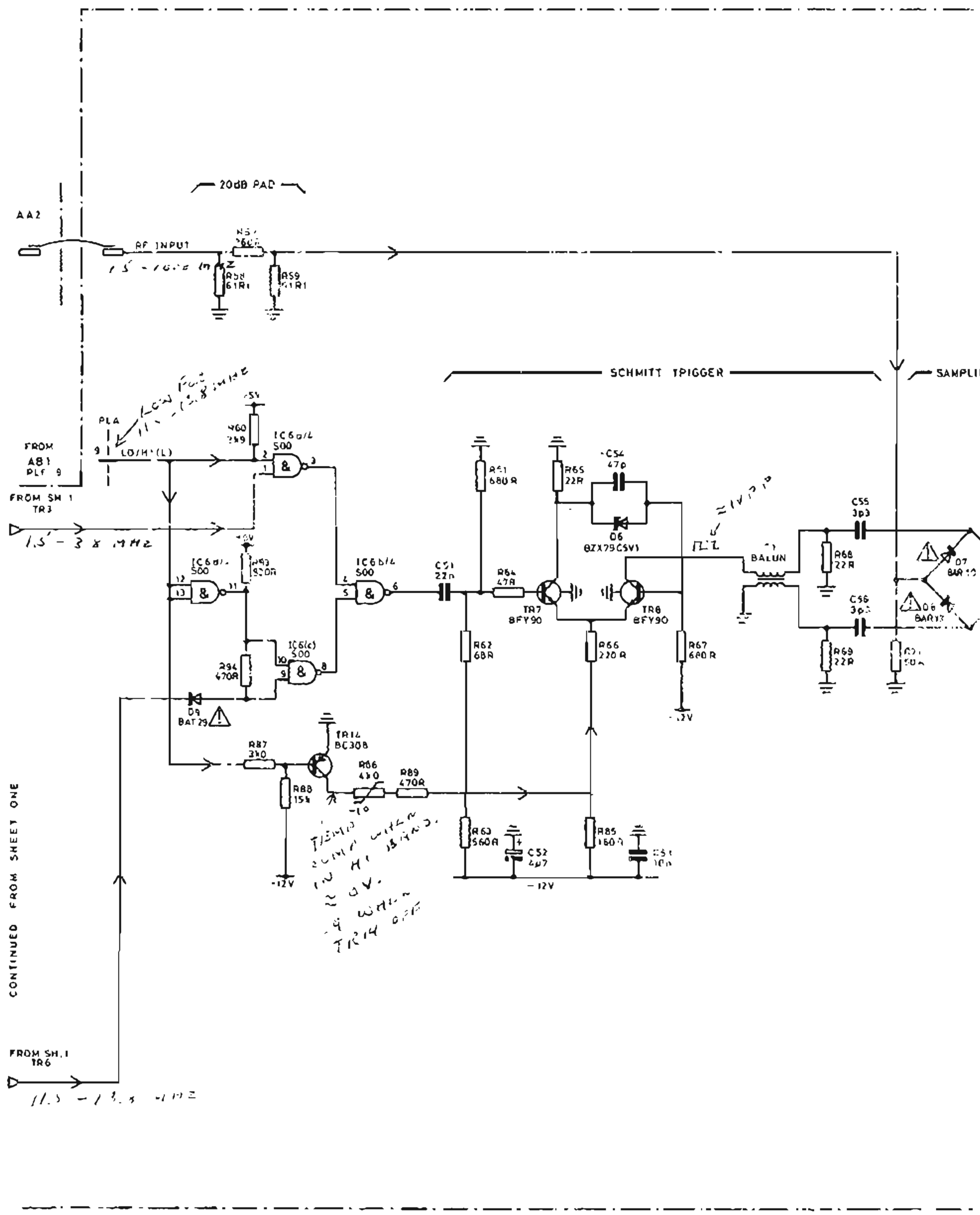


n meter (oscillator and p.l.l.)



MODULATION METER SAMPLING GATE (AA1)

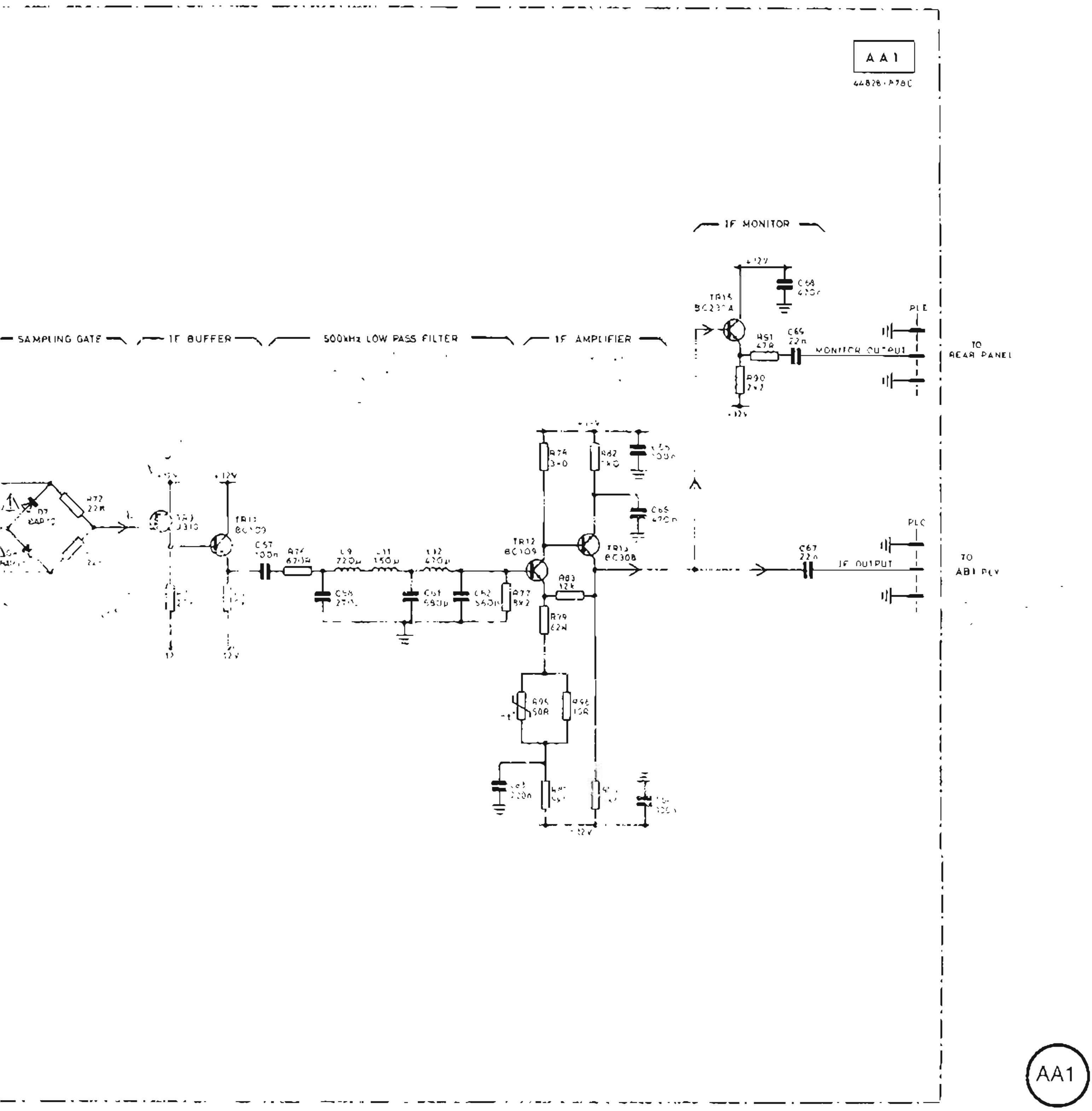
PAGE 9



Drg. No. Z 44828-878C
Sh. 2 of 2, Iss. 6

⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

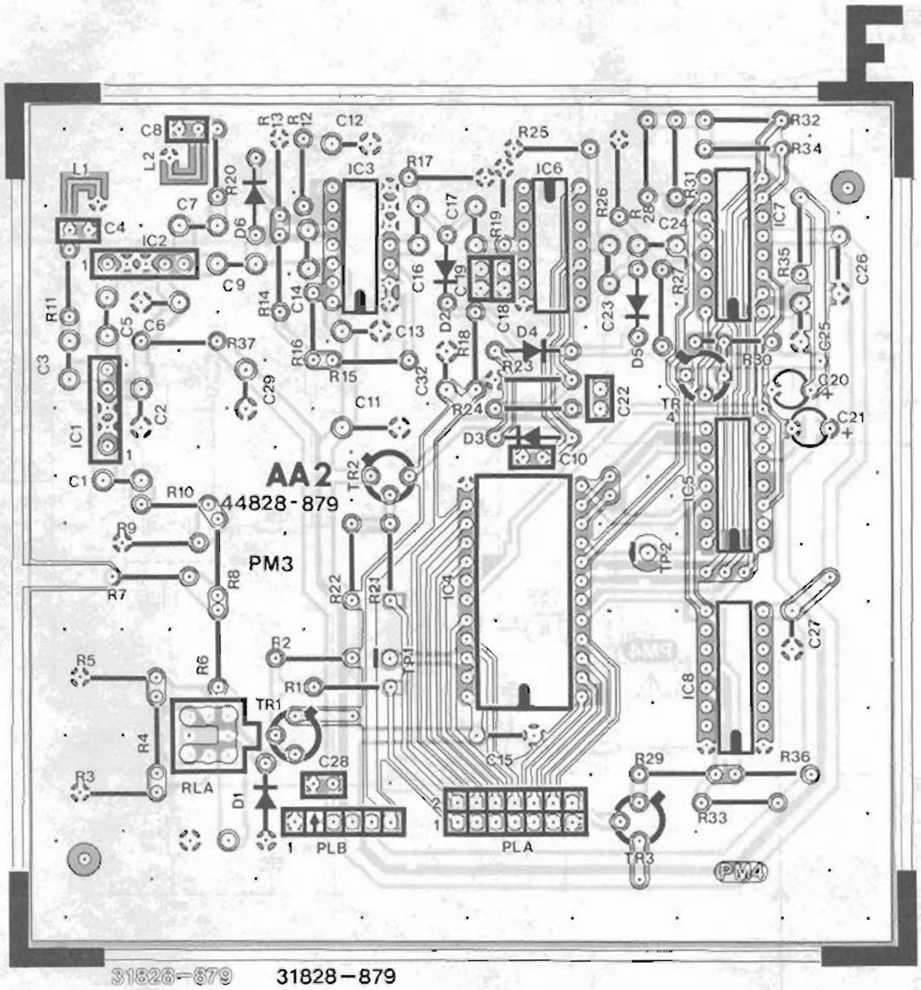
Fig. 4 AA1 : RF modul



RF modulation meter (mixer)

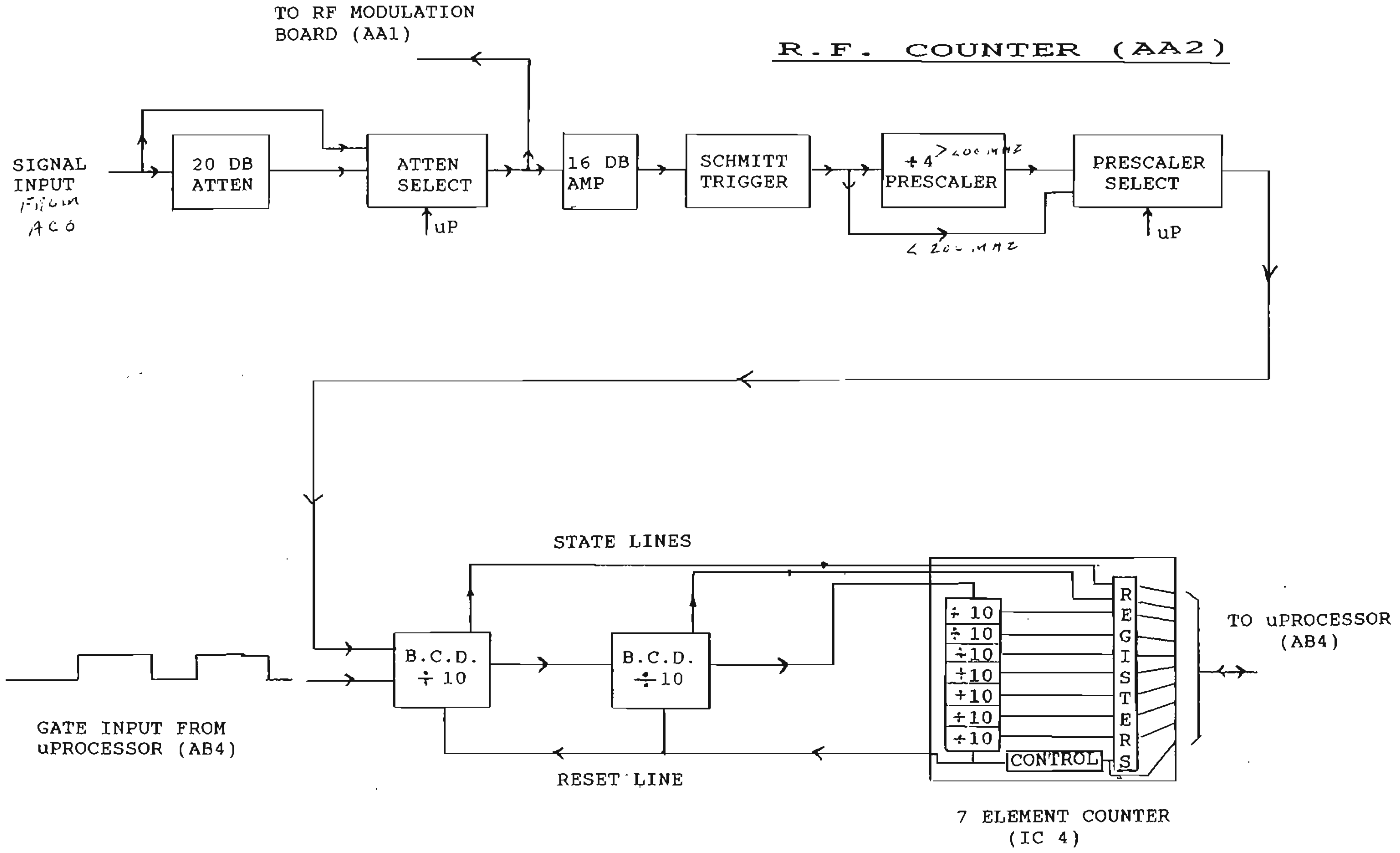
Component

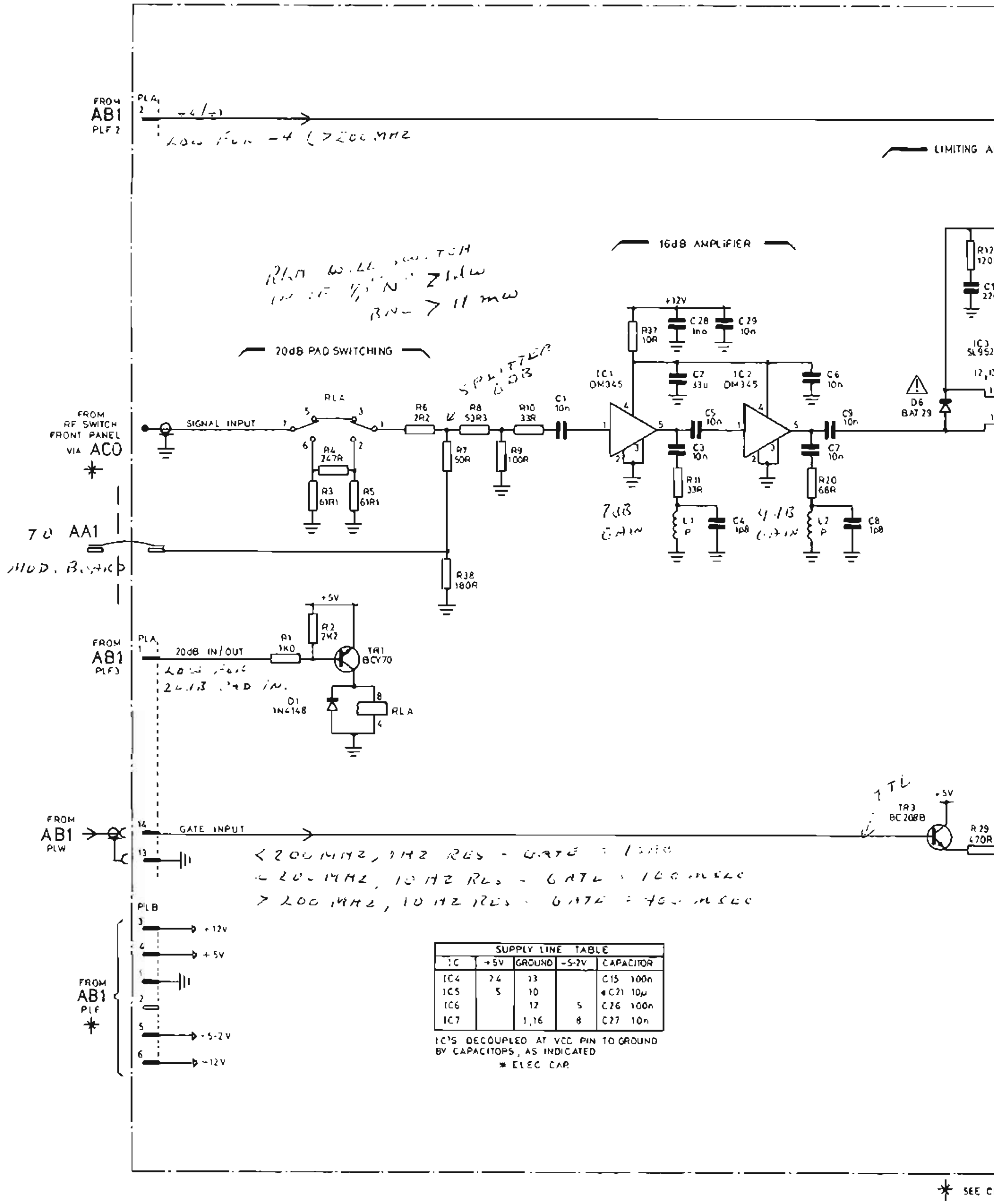
Fig. 5a
Chap. 7
Page 10



ponent layout : AAZ

R.F. COUNTER (AA2)





SUPPLY LINE TABLE				
IC	+5V	GROUND	-5.2V	CAPACITOR
IC4	24	13		C15 100n
IC5	5	10		*C21 10µ
IC6		12	5	C26 100n
IC7		1,16	8	C27 10n

IC'S DECOUPLED AT VCC PIN TO GROUND BY CAPACITORS, AS INDICATED

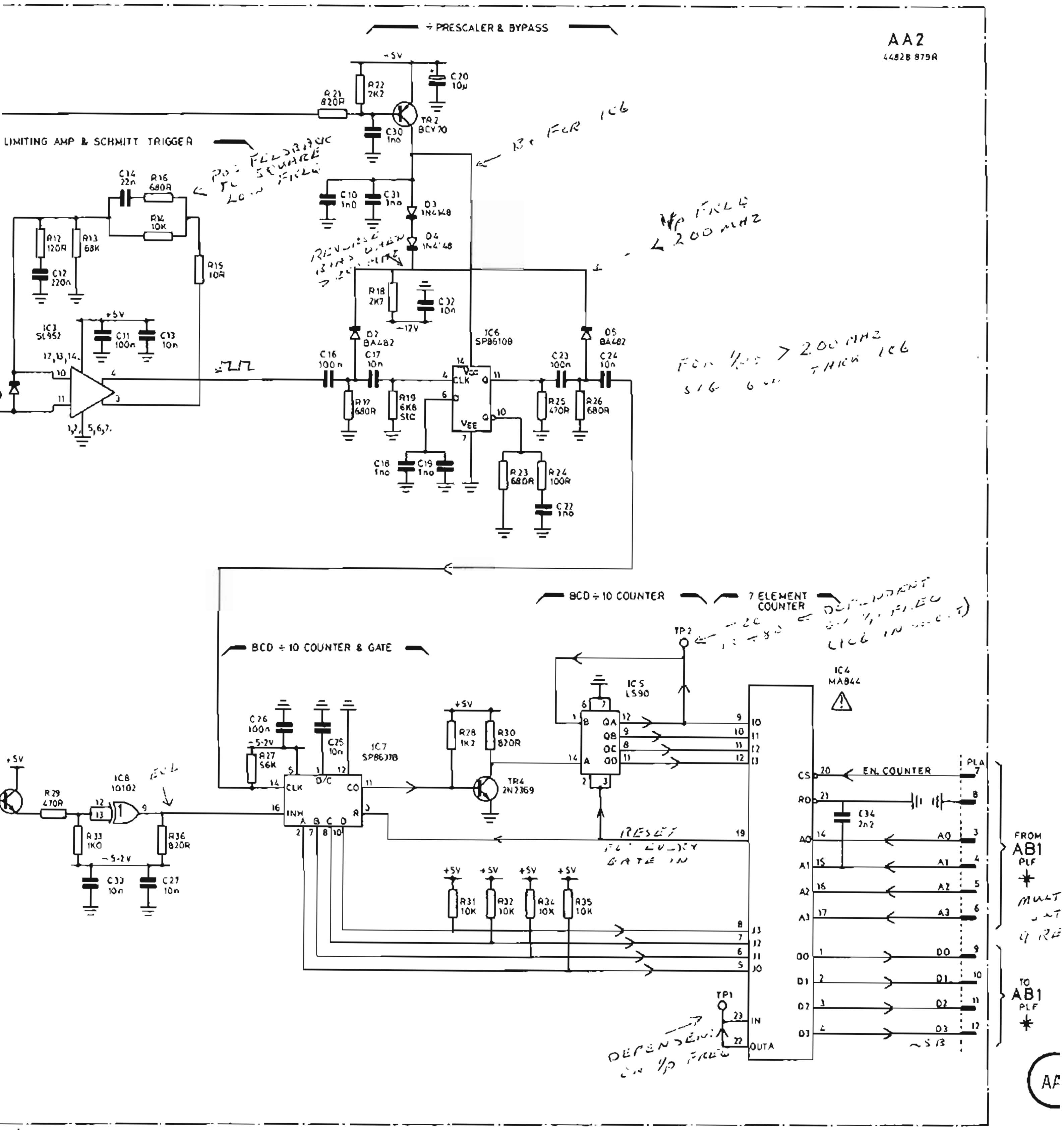
* ELEC CAP

Drg. No. Z 44828-879R
Sh. 1 of 1, Iss. 4

AA2 :

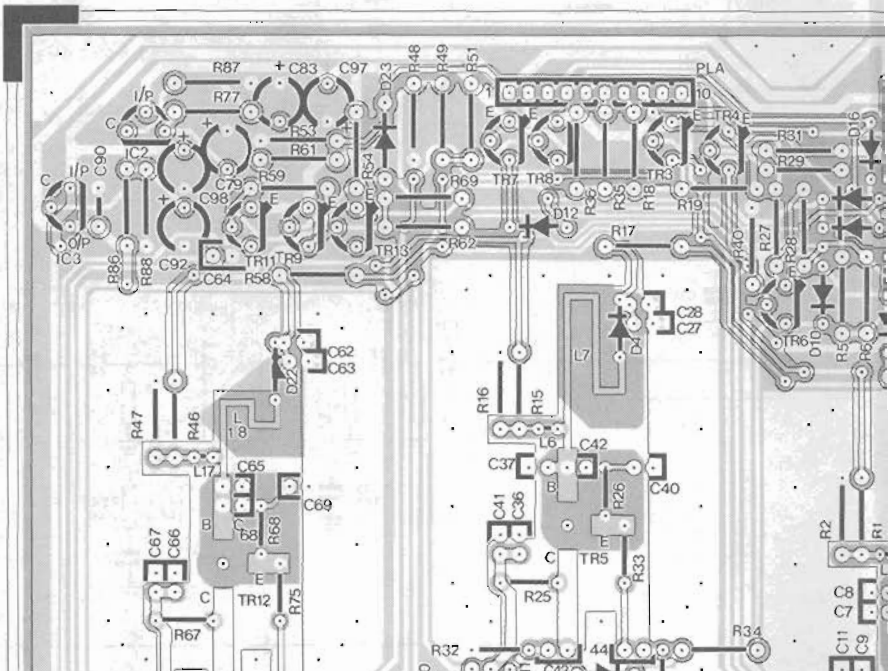
Fig. 5

Jan. 87 (Am. 3)



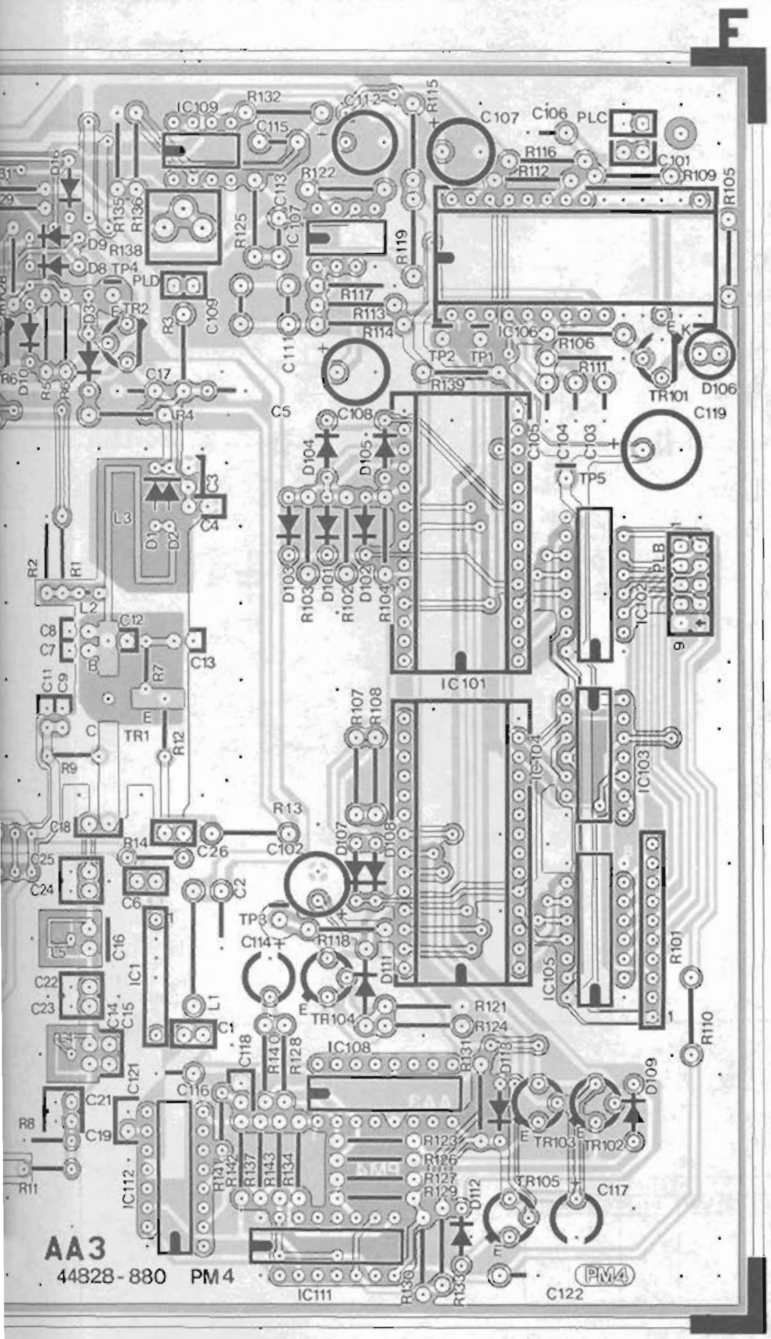
✱ SEE CIRCUIT AAO FOR CONNECTIONS DETAILS

AA2 : RF counter



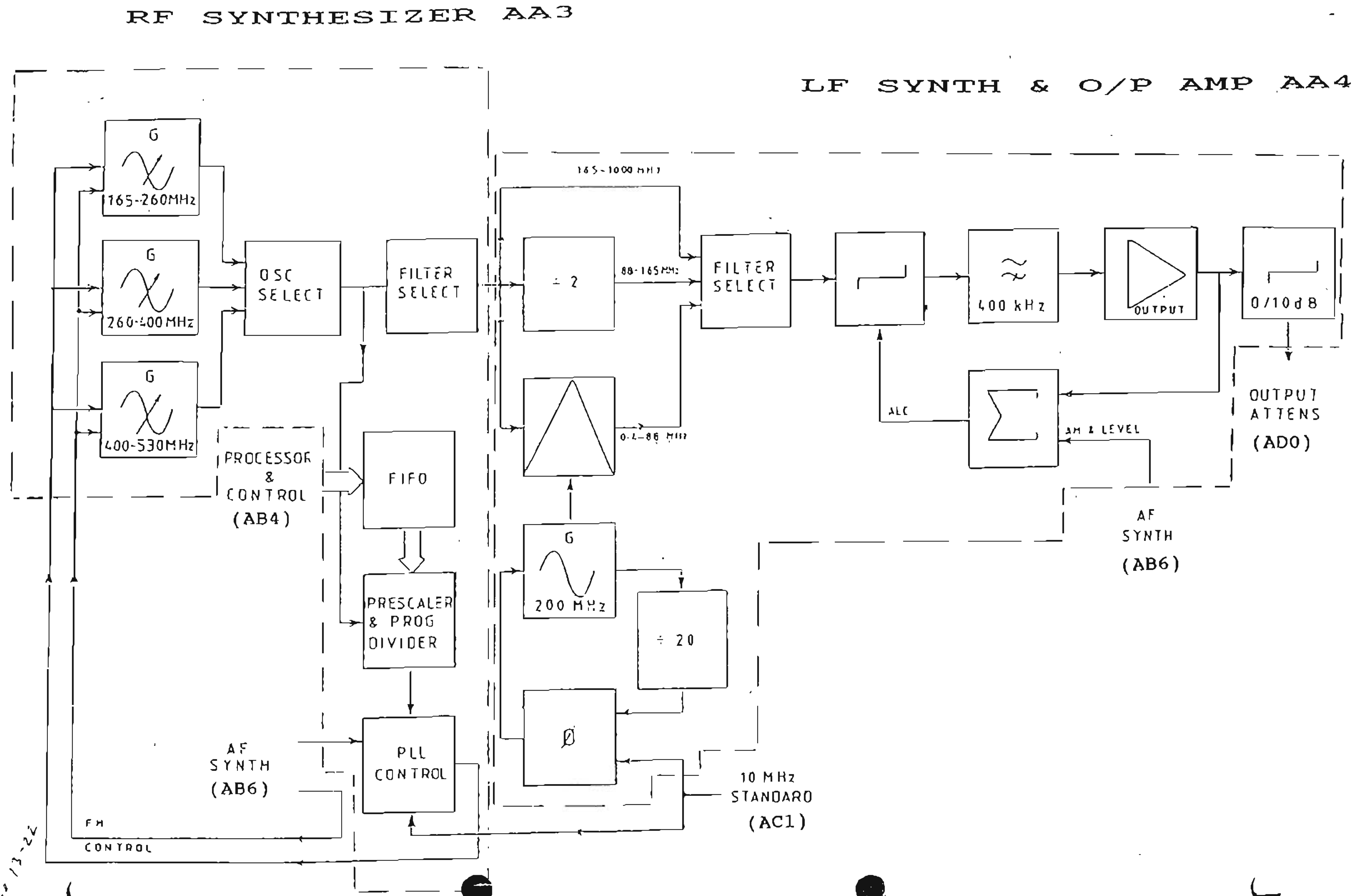
31828-880

Component layout :

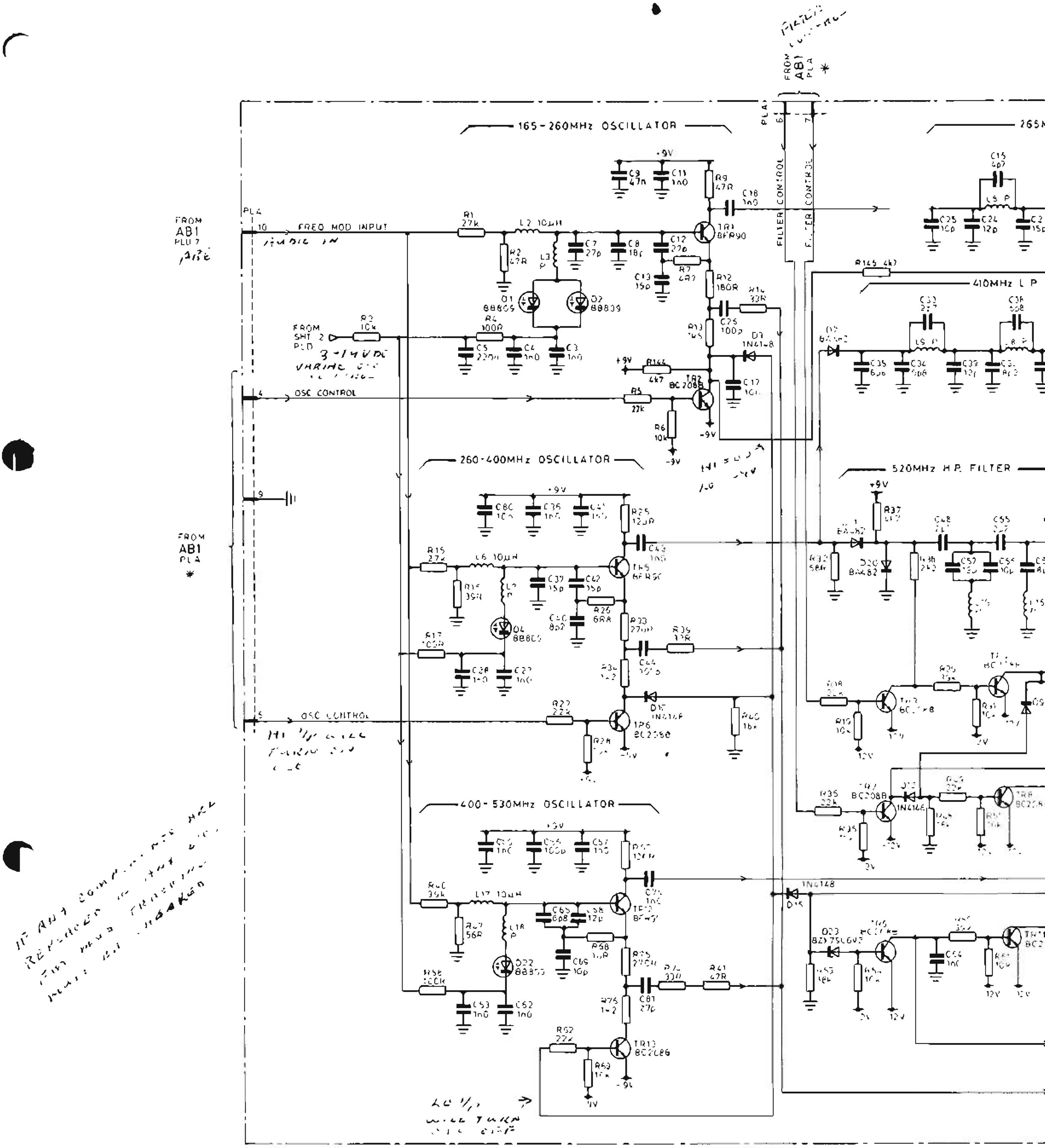


yout : AA3

Fig. 6a


RF SYNTHESIZER AA3
LF SYNTH & O/P AMP AA4
G
165-260MHz
G
260-400MHz
G
400-530MHz
OSC SELECT
FILTER SELECT
PROCESSOR & CONTROL (AB4)
FIFO
PRESCALER & PROG DIVIDER
PLL CONTROL
AF SYNTH (AB6)
FM CONTROL
165-1000 MHz
÷ 2
88-165MHz
0.4-88 MHz
FILTER SELECT
G
200 MHz
÷ 20
Ø
10 MHz STANDARD (AC1)
400 kHz
OUTPUT
0/10dB
OUTPUT ATTENS (AD0)
ALC
AM & LEVEL
AF SYNTH (AB6)

M15



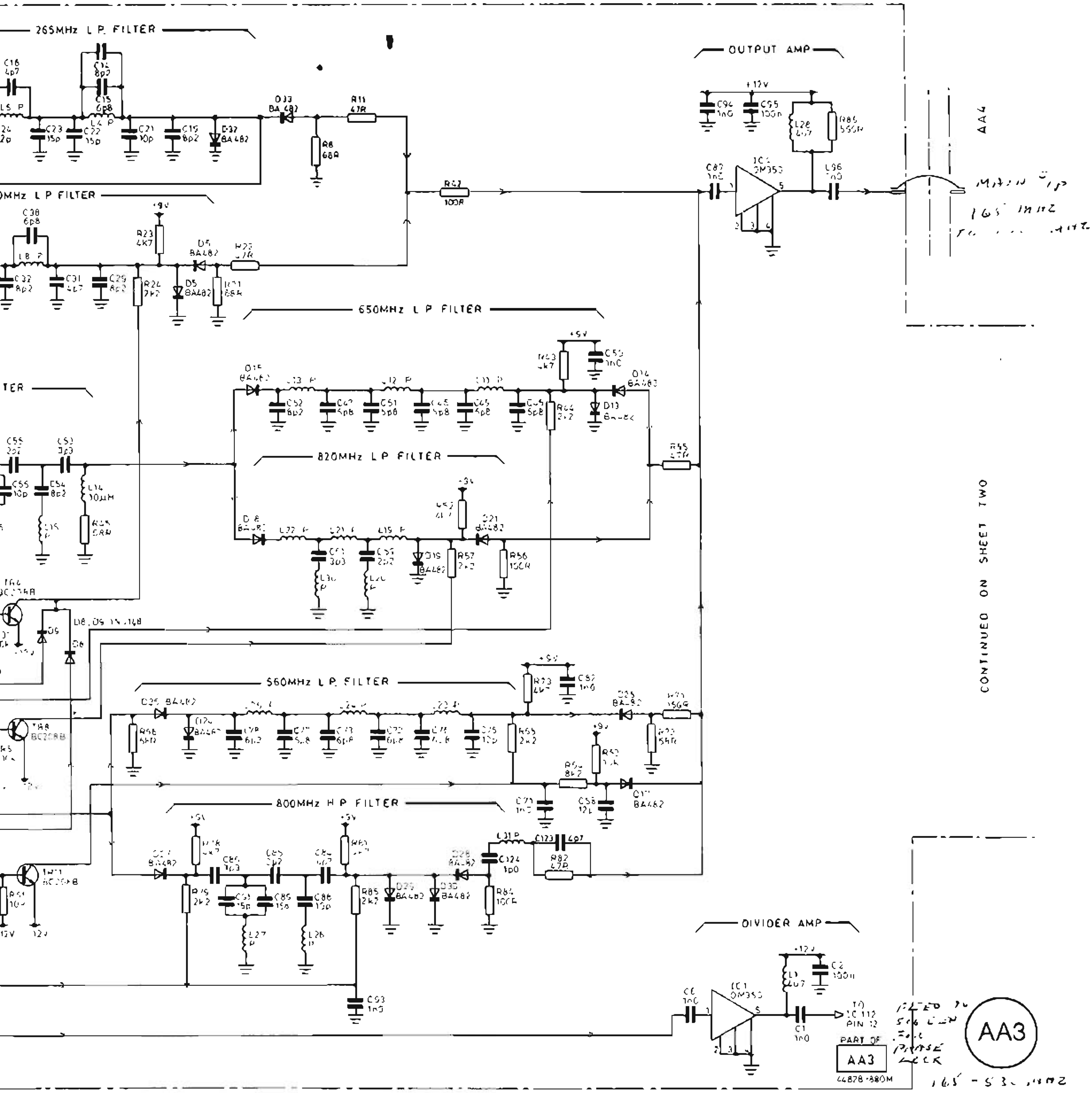
Drg. No. Z 44828-880M
Sht. 1 of 2, Iss. 5

✱ SEE CIRCUIT AAO FOR CONNECTIONS DETAILS

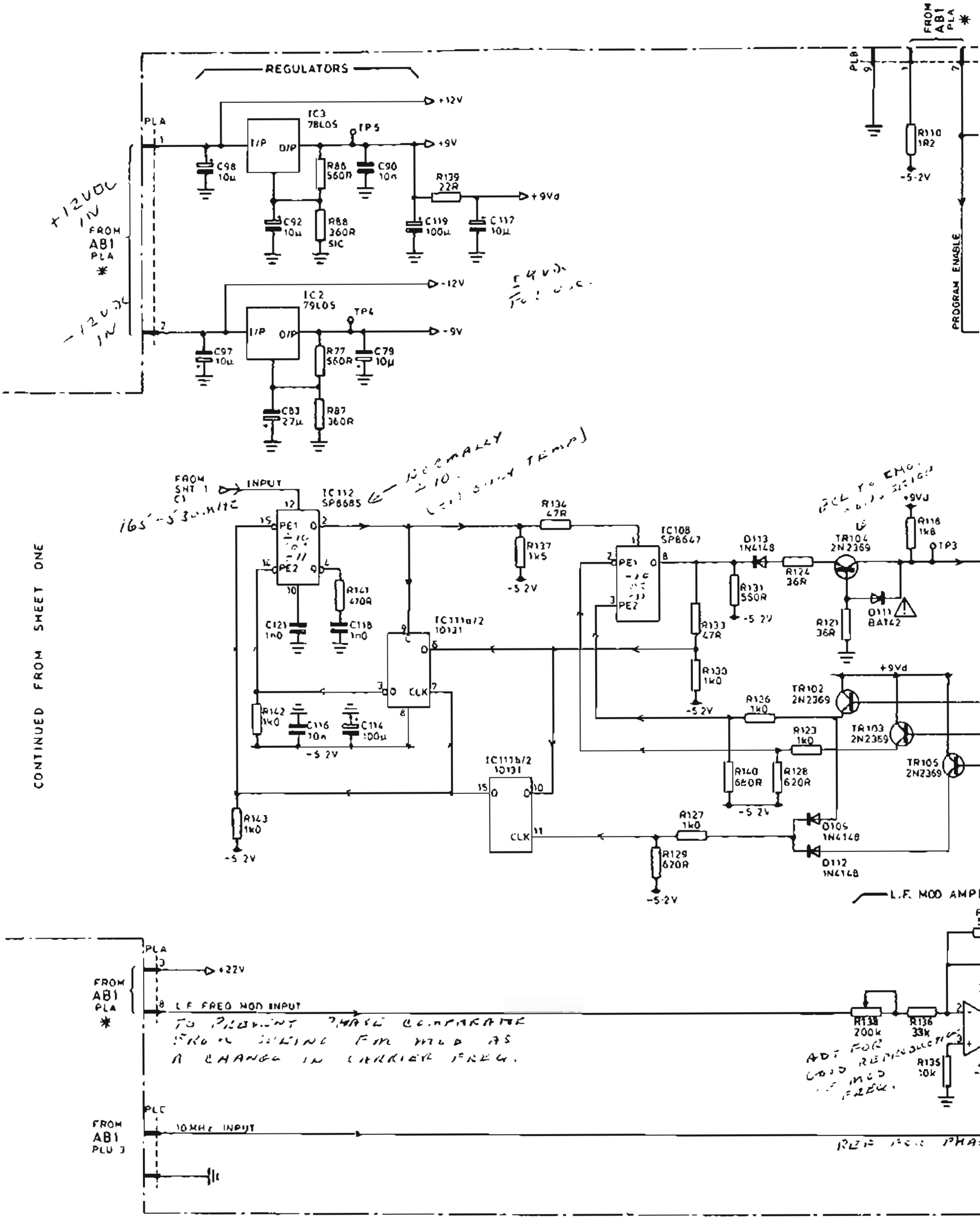
AA3 : RF synthesize

Fig. 6

Nov. 87 (Am. 5)



hesizer & oscillator (filters)



SUPPLY LINE TABLE					
IC	+9V	+9Vd	GND	-5·2V	DEC CAP
IC 101		28	14		
IC 102	16		8		
IC 103	14		7		
IC 104		28	14		
IC 105	16		8		
IC 108			5	12	
IC 111			16	8	
IC 112			16	8	C122, 10n

Drg. No. Z 44828-880M
Sht. 2 of 2, Iss. 9

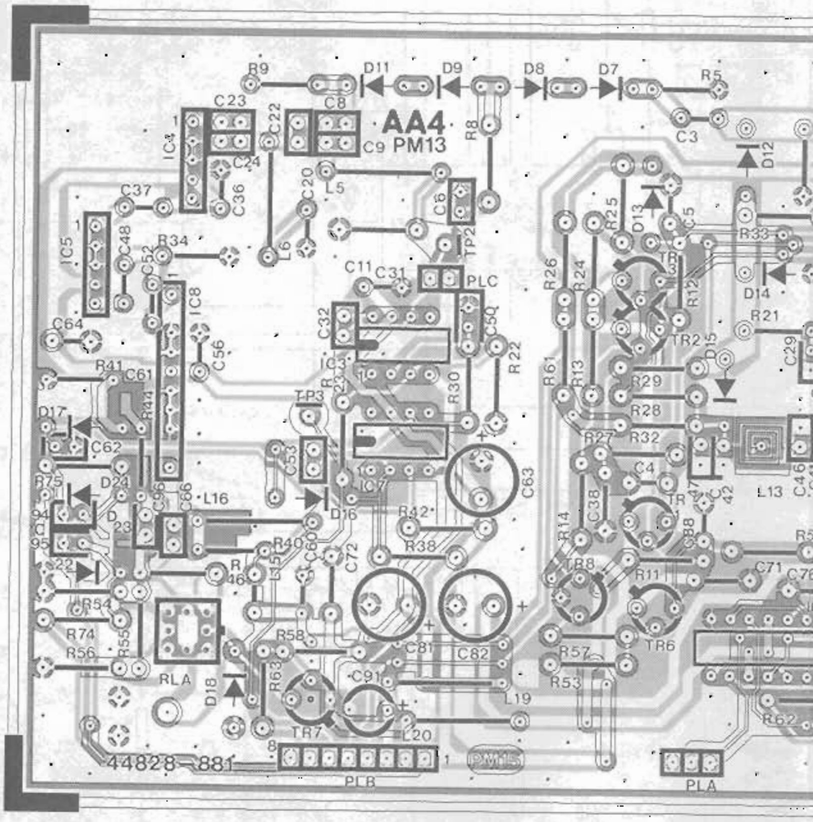
* SEE CIRCUIT AAO FOR

⚠ THIS SYMBOL INDICATES A STATIC-SENSITI

Fig. 7

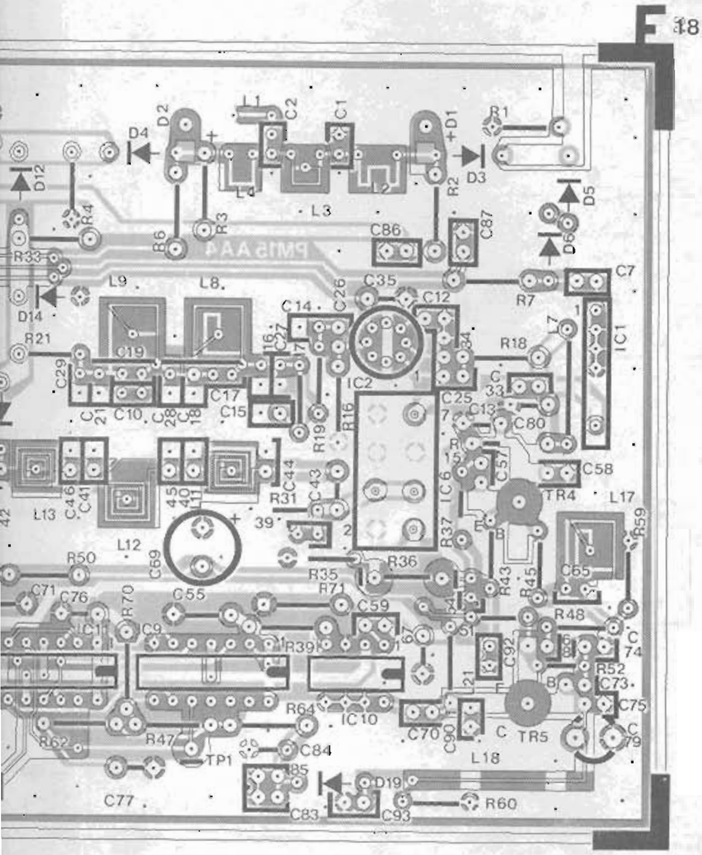
AA3 : RF synthesize

Apr. 89 (Am. 10)



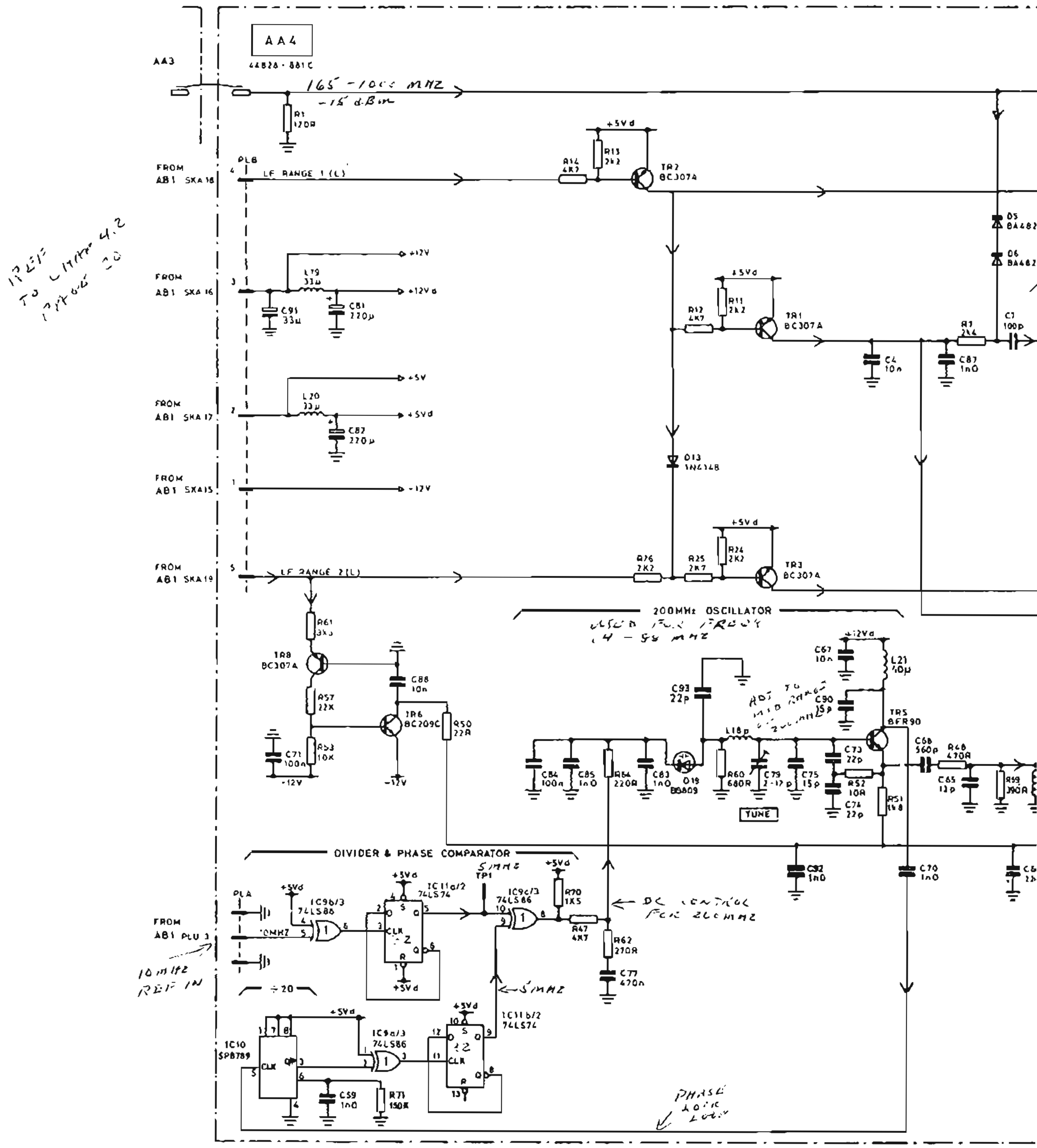
31828-881

Component layout



ayout : AA4

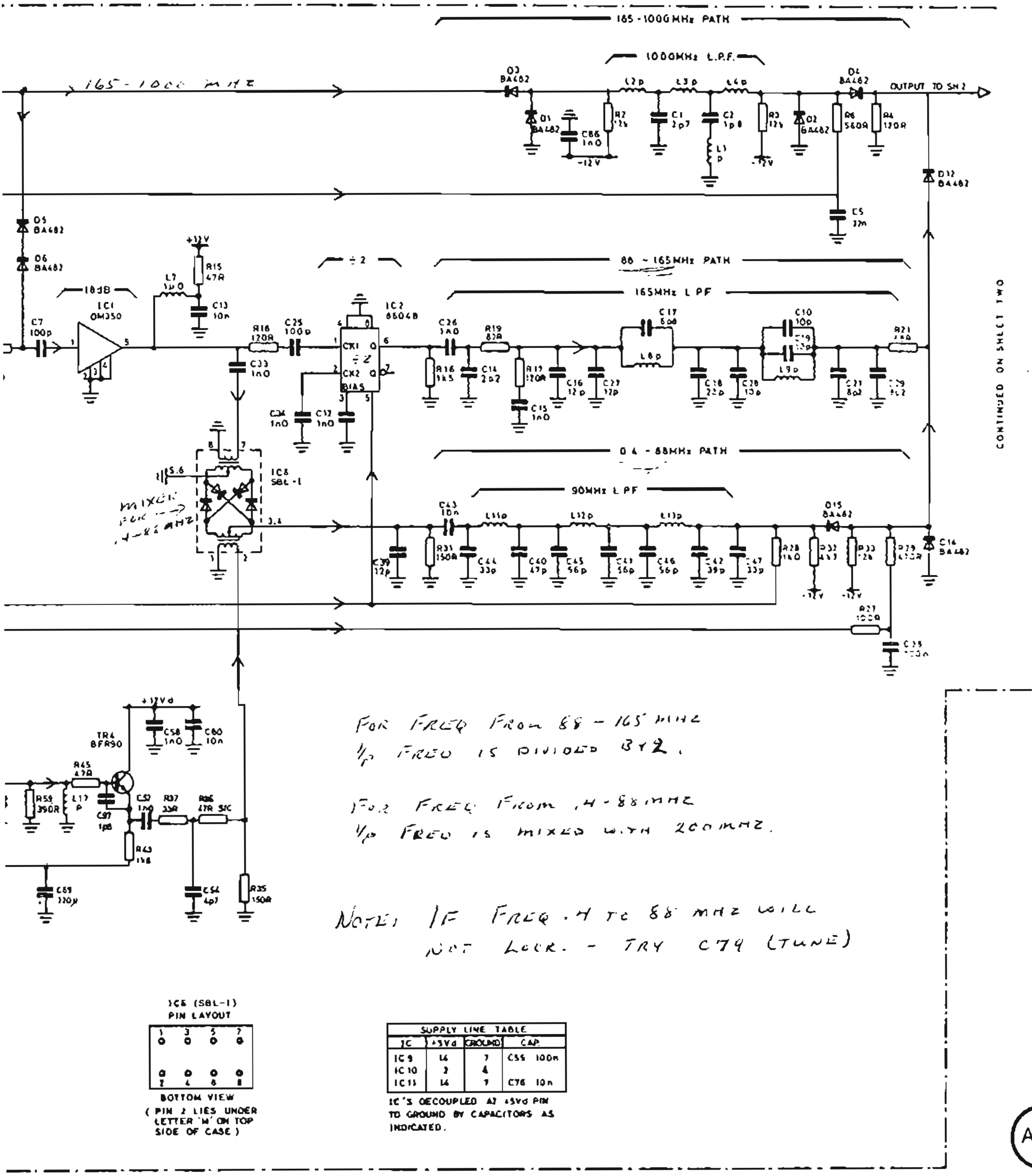
Fig. 8a



Drg. No. Z 44828-881C
Sht. 1 of 2, Iss. 13

Fig. 8

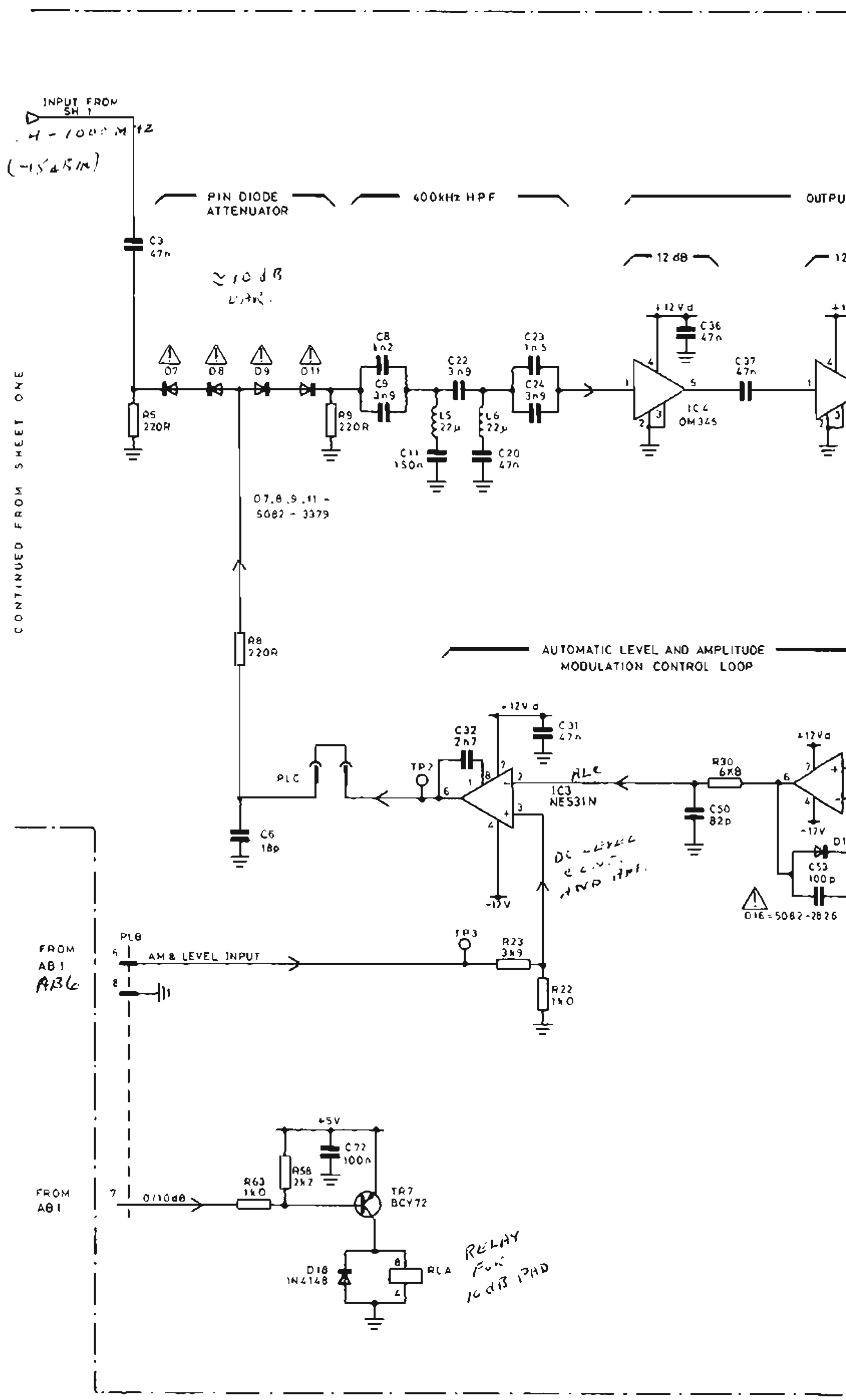
AA4 : Low frequency sy



SUPPLY LINE TABLE

IC	+5Vd	GROUND	CAP
IC 9	14	7	C55 100n
IC 10	2	4	
IC 11	14	7	C76 10n

IC'S DECOUPLED AT +5Vd PIN TO GROUND BY CAPACITORS AS INDICATED.

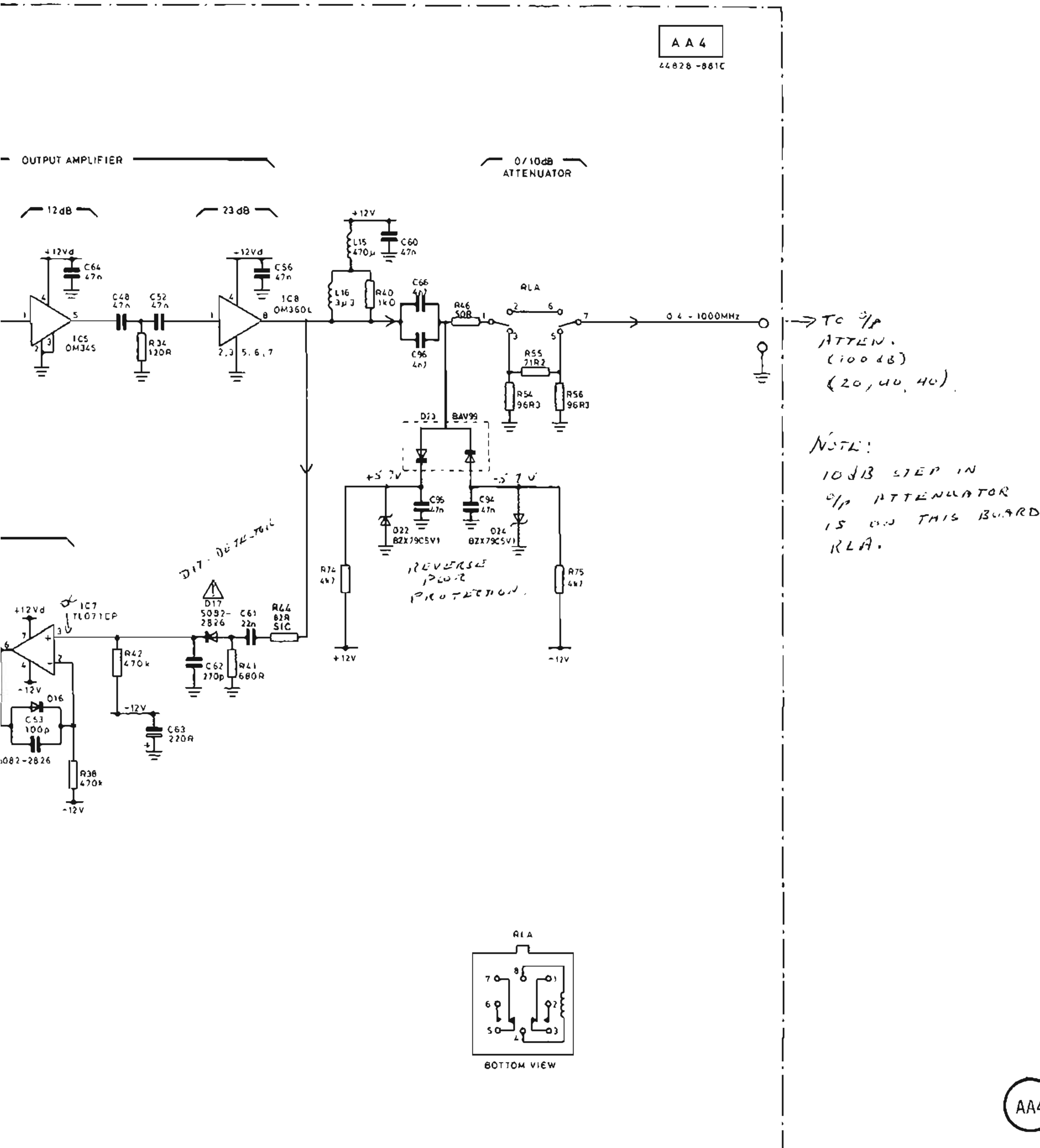


Drg. No. Z 44828-881C
Sht. 2 of 2, Iss. 9

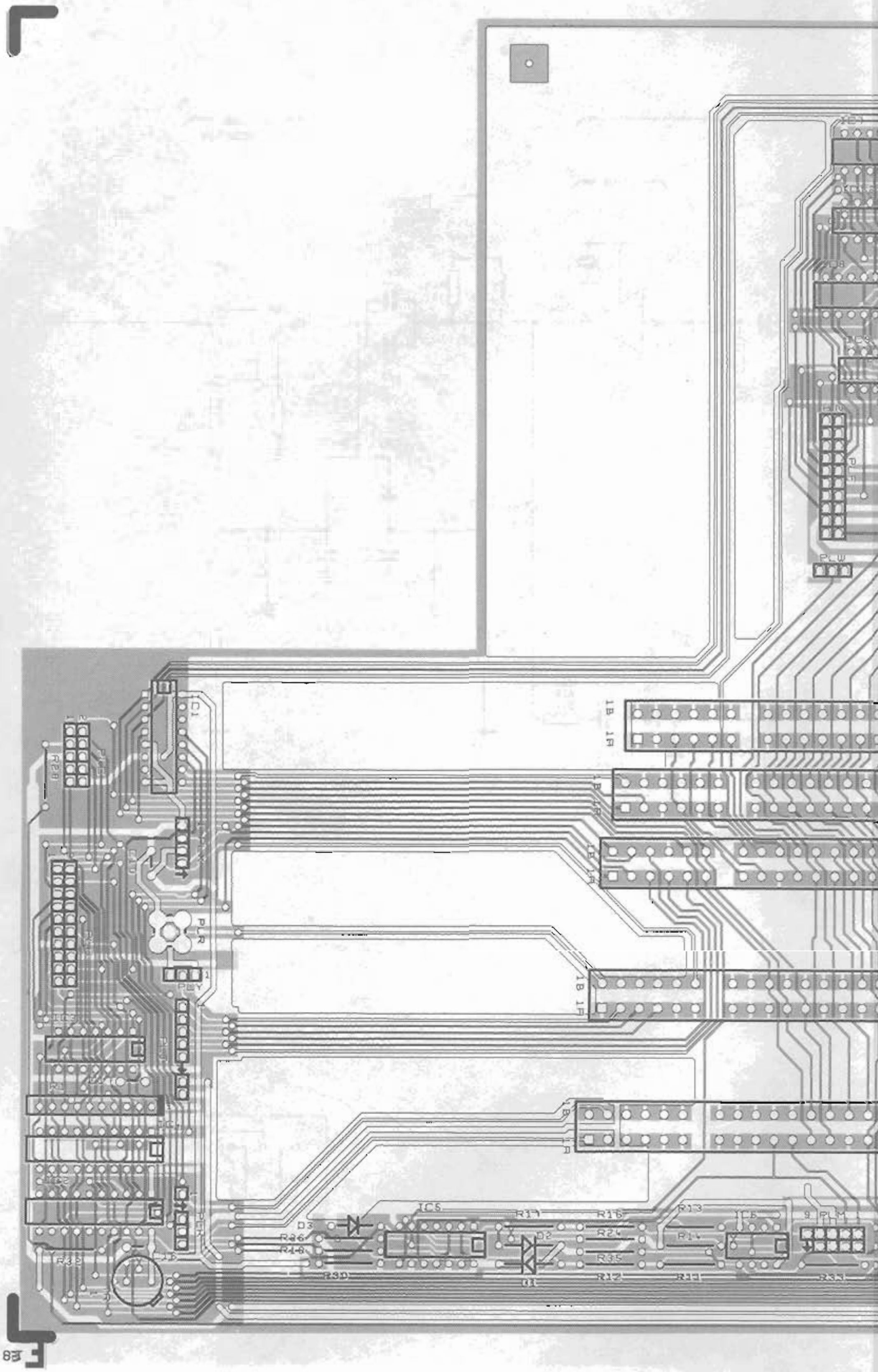
Fig. 9

AA4 : Low frequency synt

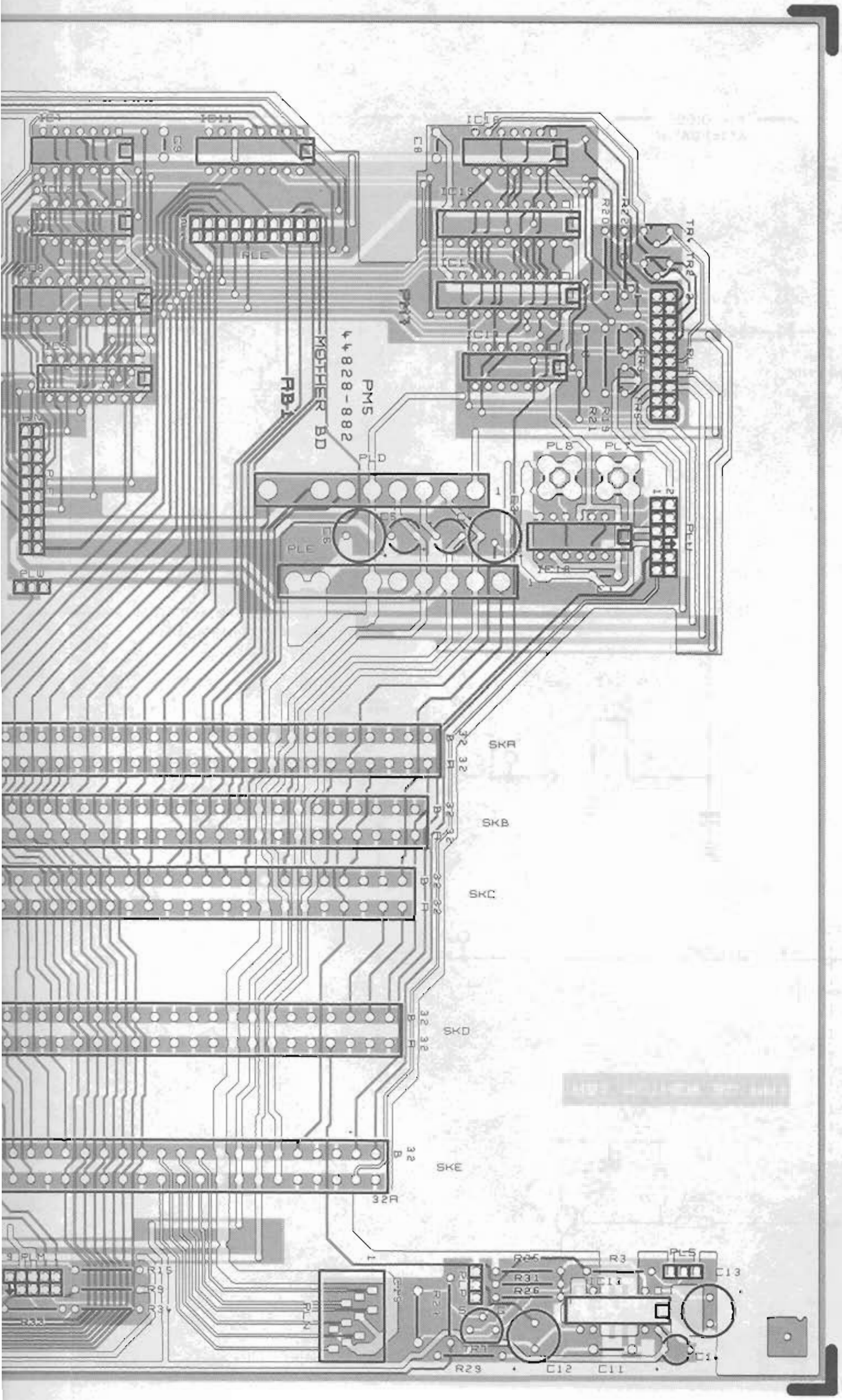
Nov. 87 (Am. 5)



/ synthesizer & output amp. (output)

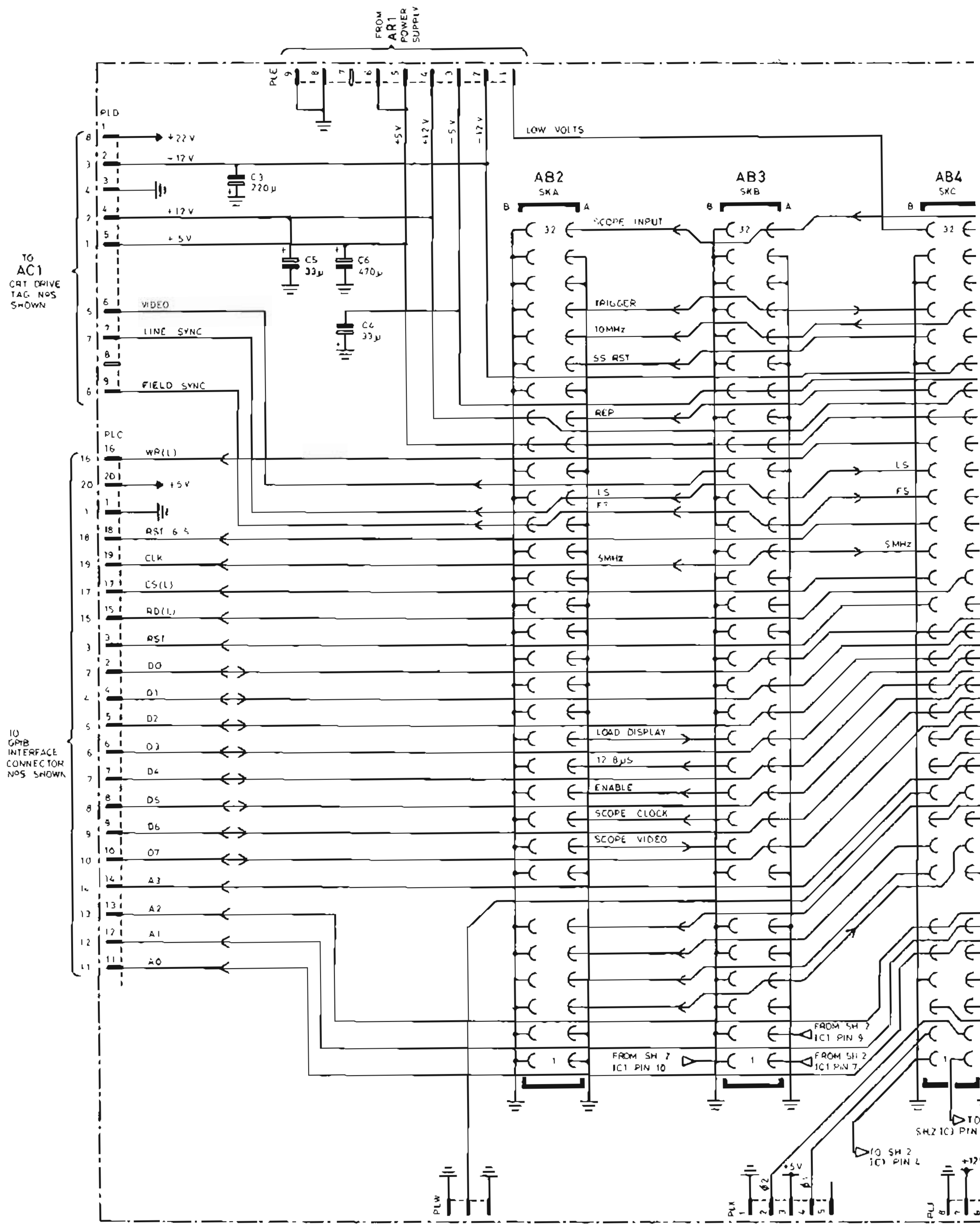


Component layout :



ayout : AB1

Fig. 10a



✱ FOR CONDUCTIVITY DETAILS SEE CIRCUIT A0

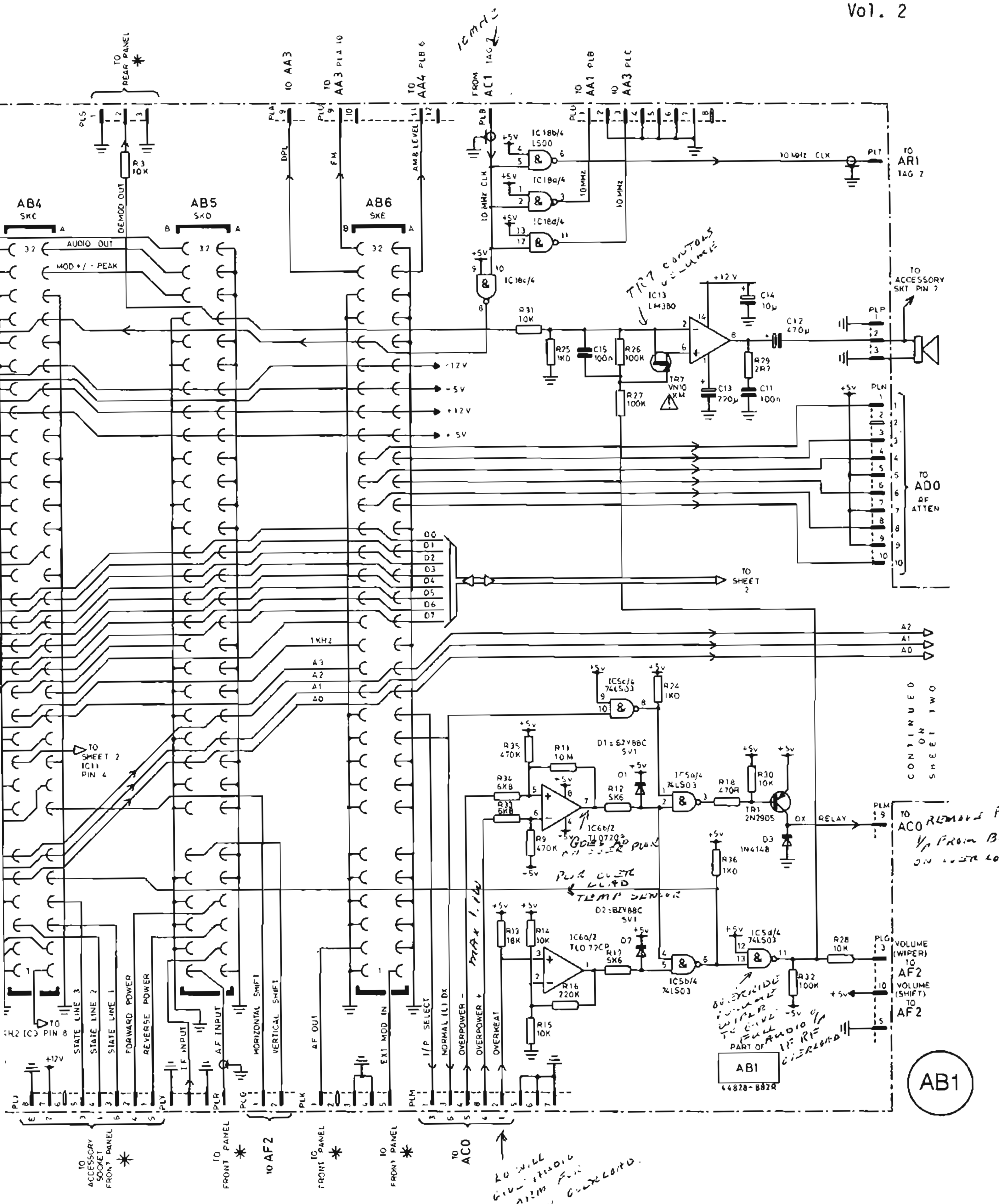
⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

Drg. No. Z 44828-882R
Sh. 1 of 2, Iss. 9

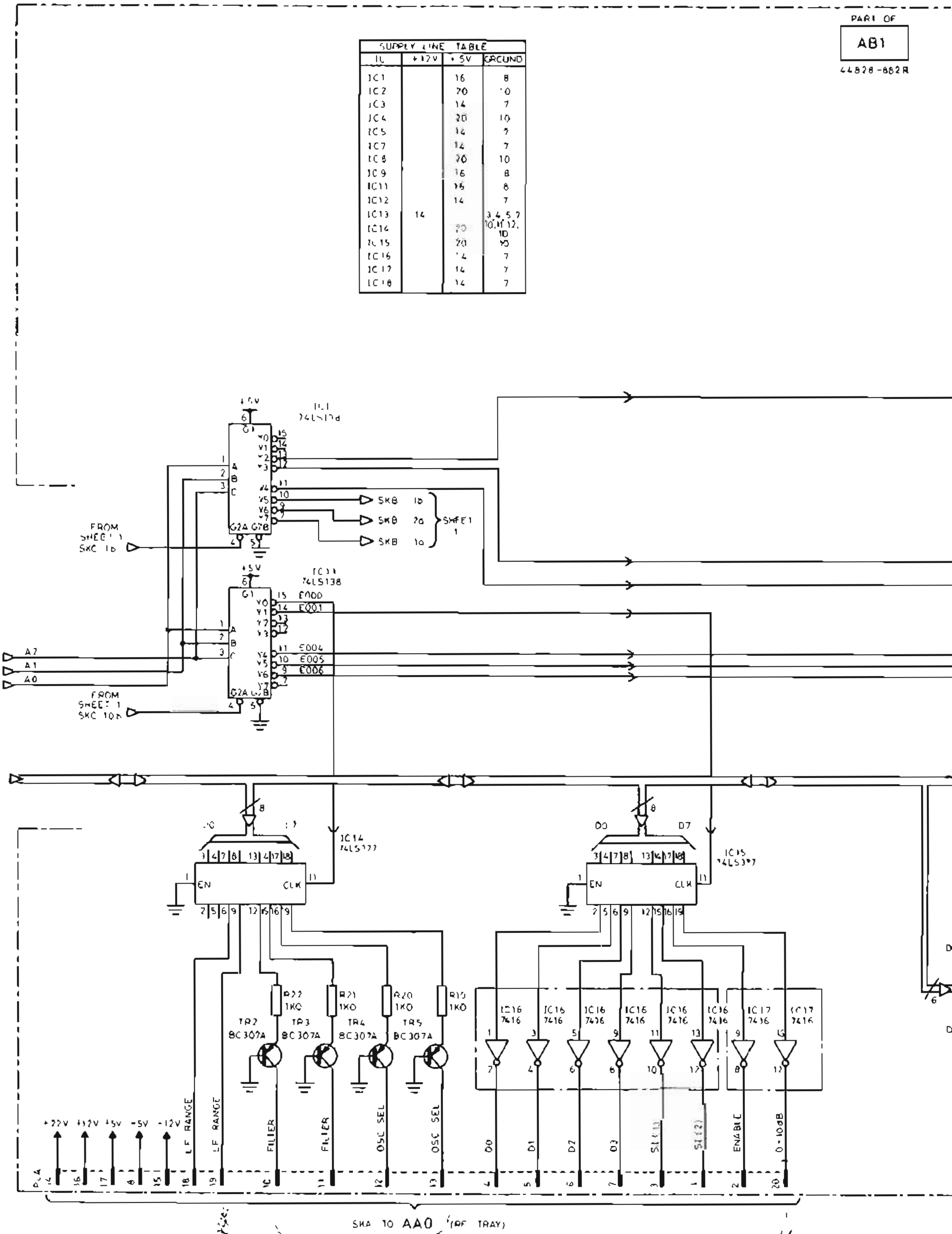
AB1 : Motherboard (a

Fig. 10

Jul. 88 (Am. 9)



ard (audio amp. & overload protection)

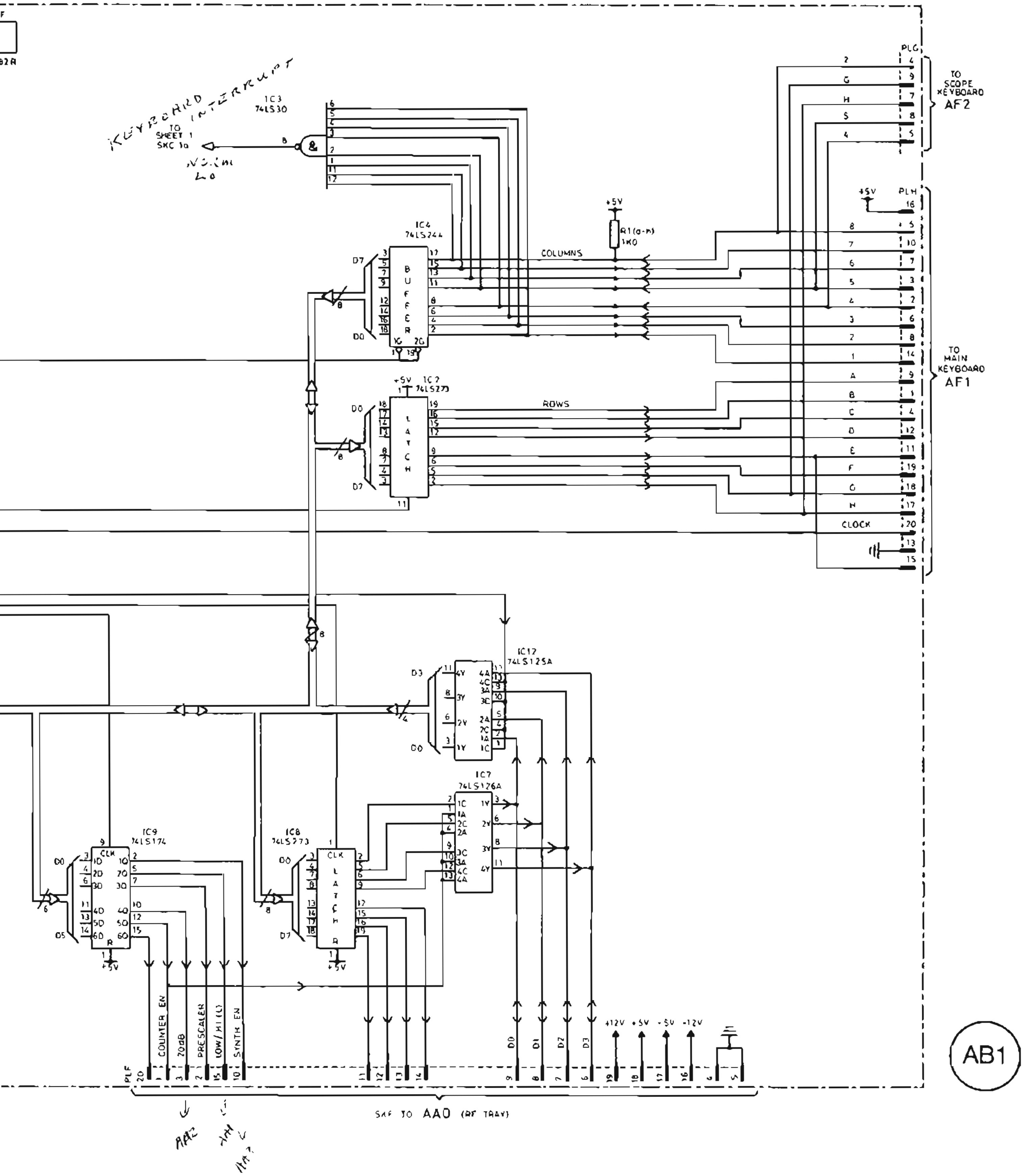


SUPPLY LINE TABLE			
IC	+12V	+5V	GROUND
IC1		16	8
IC2		20	10
IC3		14	7
IC4		20	10
IC5		14	7
IC7		14	7
IC8		20	10
IC9		16	8
IC11		16	8
IC12		14	7
IC13	14		3,4,5,7 10,11,12,
IC14		20	10
IC15		20	10
IC16		14	7
IC17		14	7
IC18		14	7

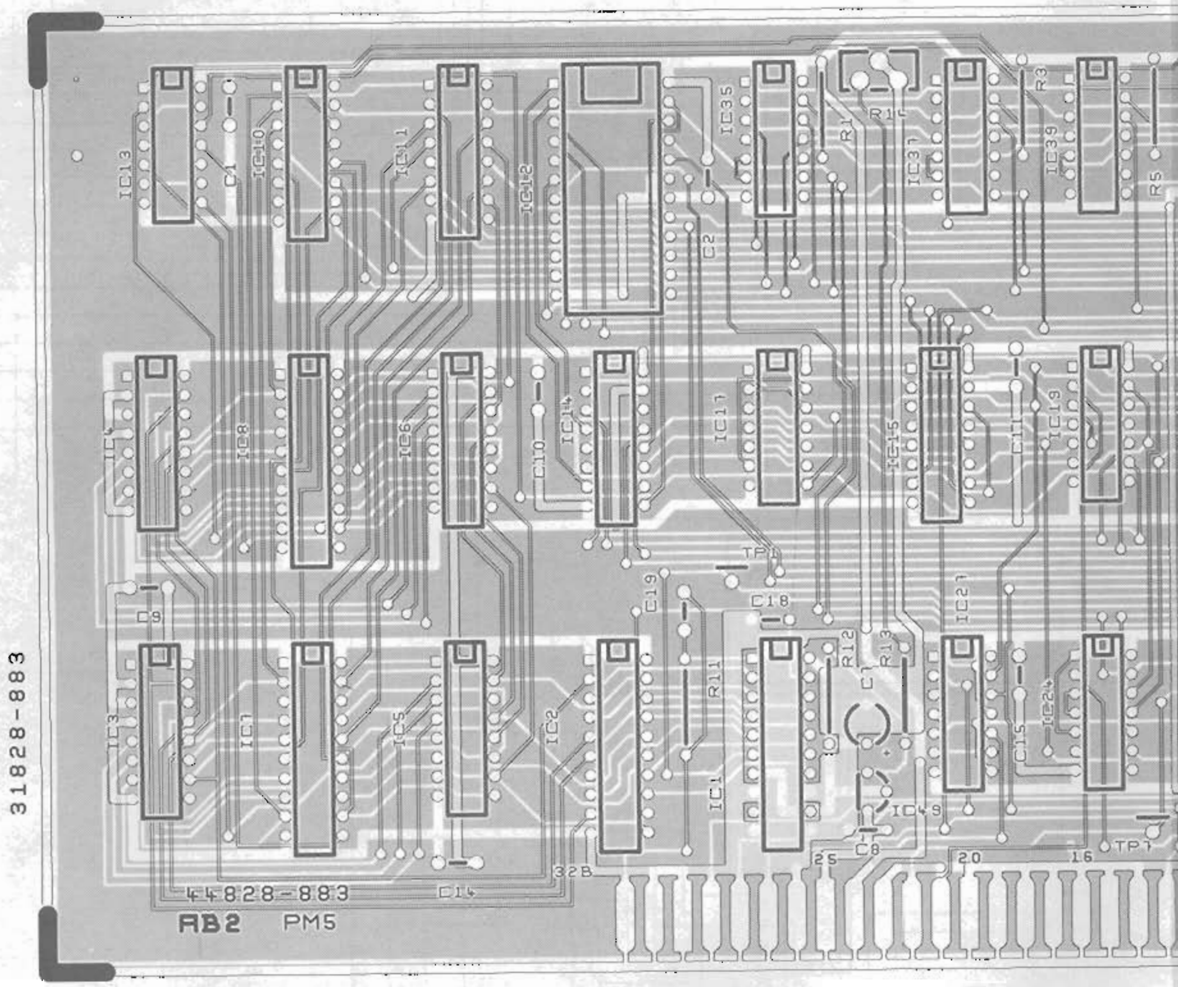
Drg. No. Z 44828-882R
Sh. 2 of 2, Iss. 8

AB1 : Motherboar

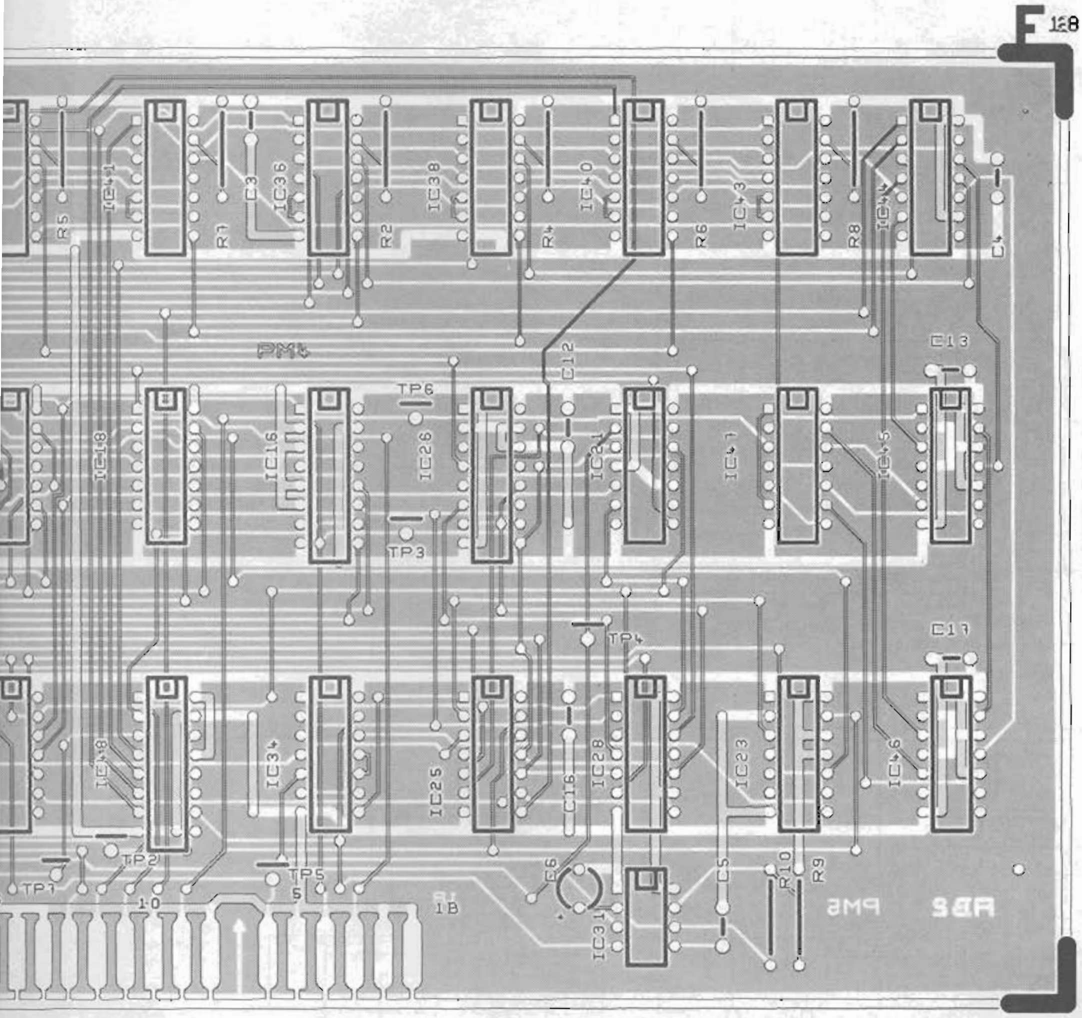
Fig. 11



erboard (keyboard interface)

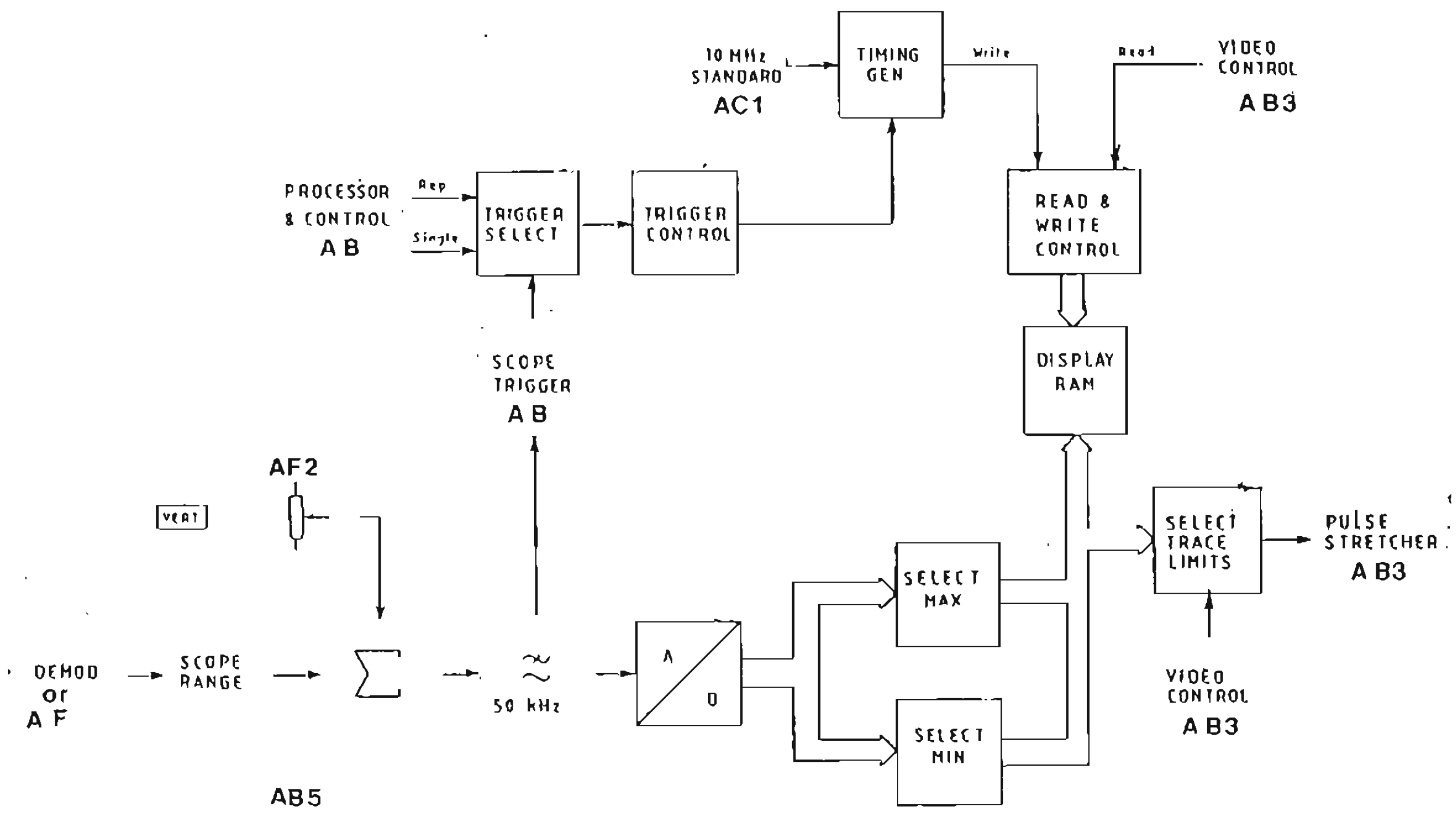


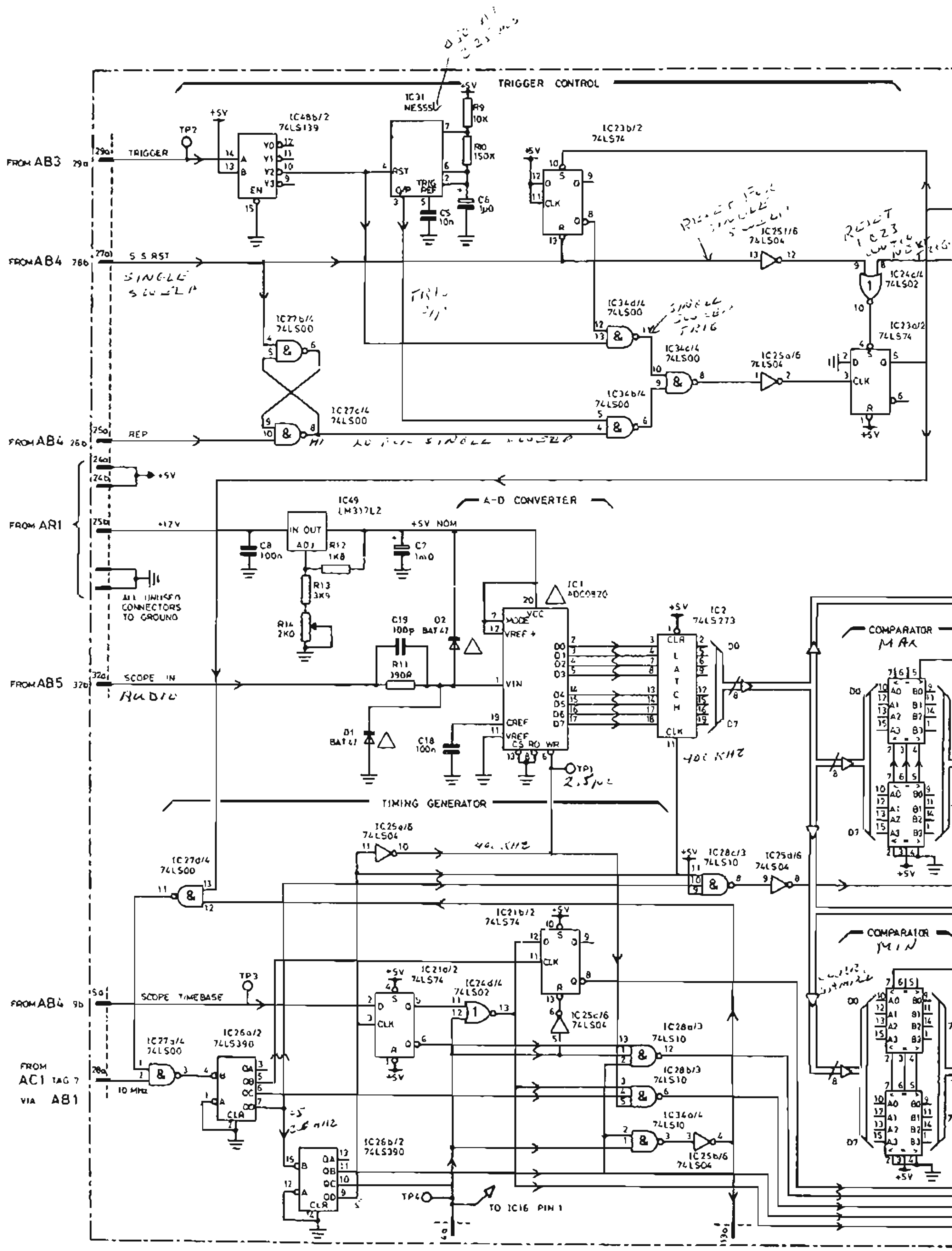
Component layout :


128
PM4
PM5
AB2
TP1
TP2
TP3
TP4
TP5
TP6
IC41
IC36
IC38
IC40
IC43
IC44
IC18
IC16
IC26
IC24
IC47
IC45
IC48
IC34
IC25
IC28
IC23
IC46
IC31
R5
R1
R2
R4
R6
R8
R9
R10
C3
C4
C5
C6
C12
C13
C16
C17
10
5
1B

yout : AB2

DIGITAL SCOPE BOARD (AB2)



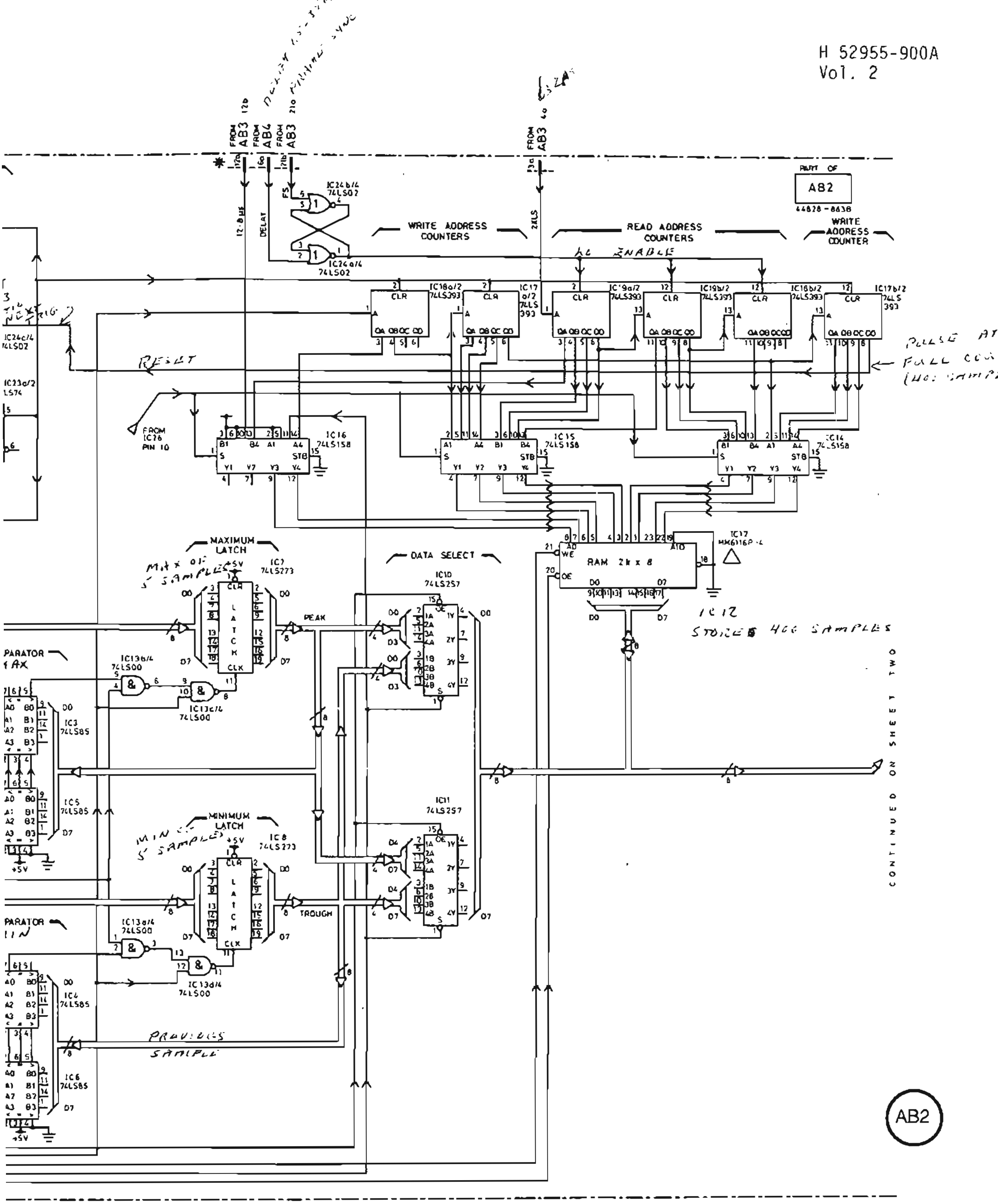


Drg. No. Z 44828-883B
Sht. 1 of 2, Iss. 10

Fig. 12

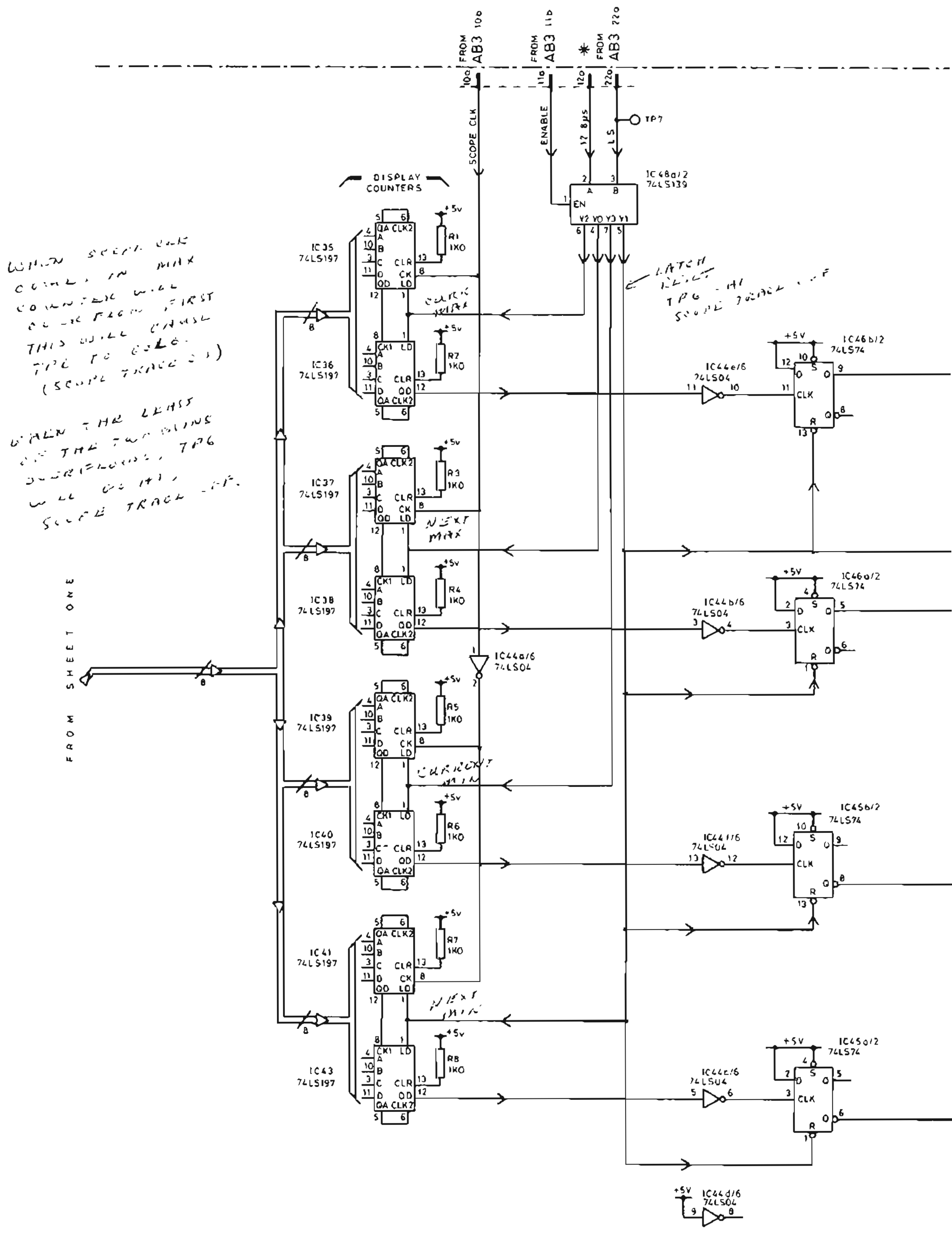
AB2 : Digital sco

Apr. 89 (Am. 10)



△ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

al scope (A-D and timing)



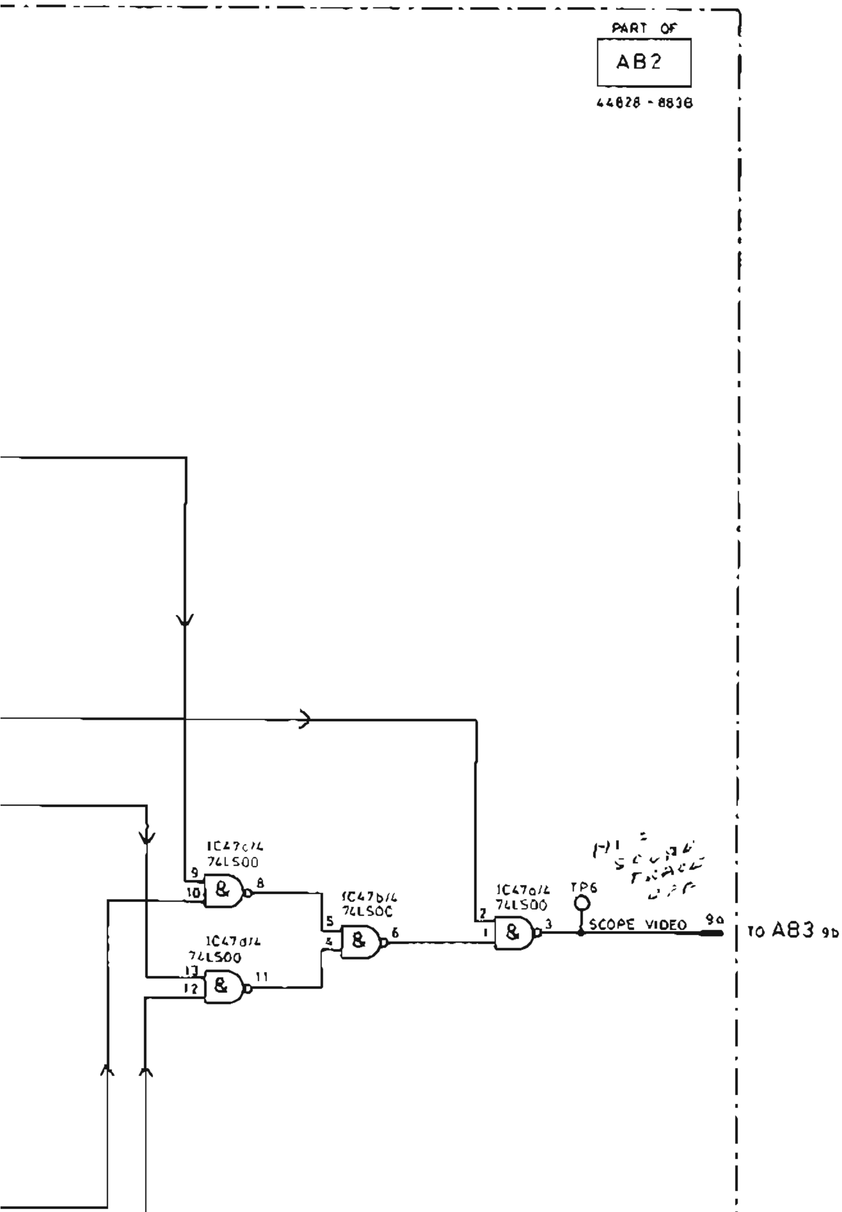
✱ REPEATED ON THIS DIAGRAM FOR CLARITY

Drg. No. Z 44828-883B
Sh. 2 of 2, Iss. 1

Fig. 13

June 85

AB2 : Digit

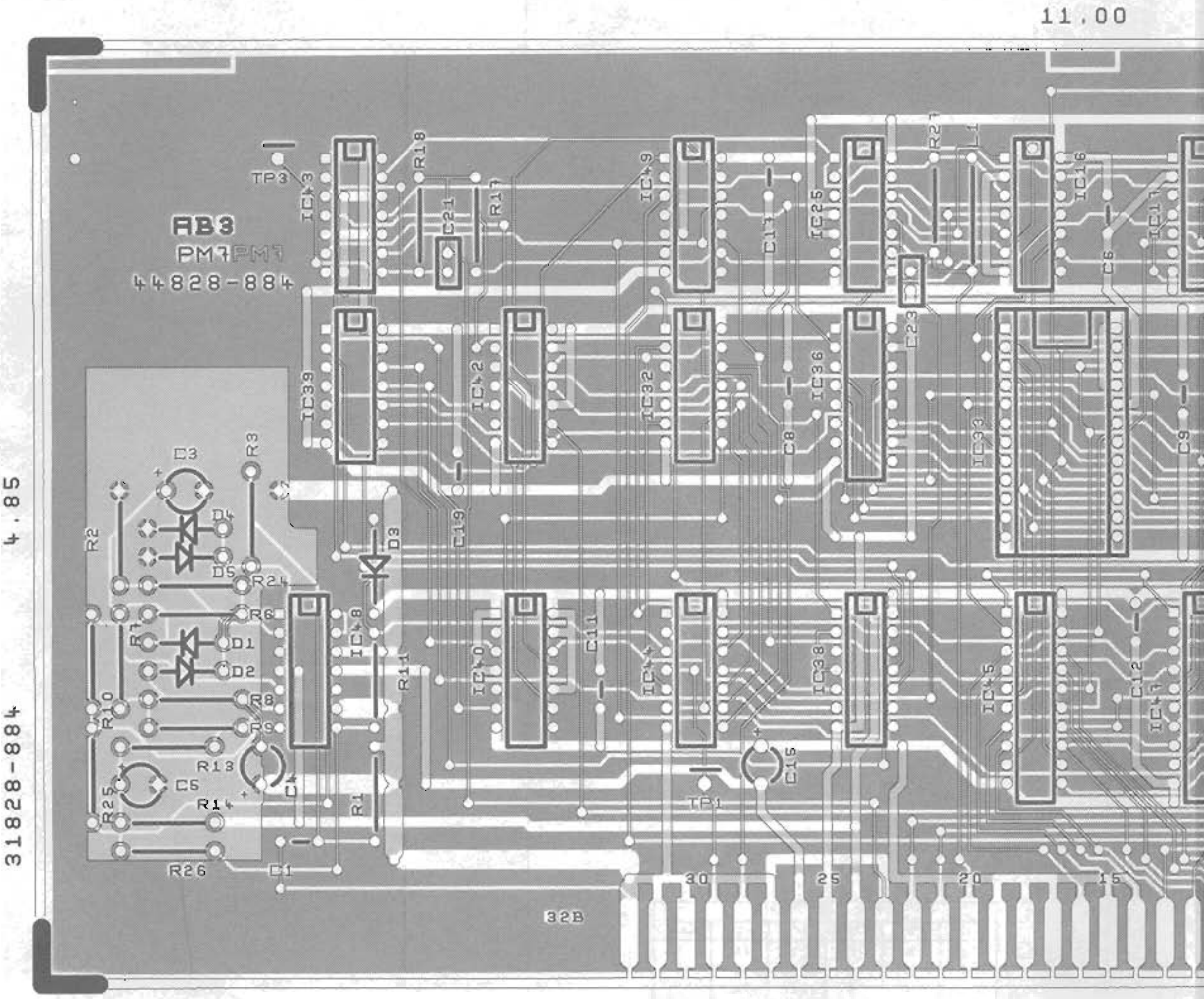


SUPPLY LINE TABLE					
IC	+5v	GROUND	IC	+5v	GROUND
IC2	20	10	IC25	14	7
IC3	16	8	IC26	16	8
IC4	16	8	IC27	14	7
IC5	16	8	IC28	14	7
IC6	16	8	IC31	8	1
IC7	20	10	IC34	14	7
IC8	20	10	IC35	14	7
IC10	16	8	IC36	14	7
IC11	16	8	IC37	14	7
IC12	24	12	IC38	14	7
IC13	14	7	IC39	14	7
IC14	16	8	IC40	14	7
IC15	16	8	IC41	14	7
IC16	16	8	IC43	14	7
IC17	14	7	IC44	14	7
IC18	14	7	IC45	14	7
IC19	14	7	IC46	14	7
IC21	14	7	IC47	14	7
IC23	14	7	IC48	16	8
IC24	14	7			

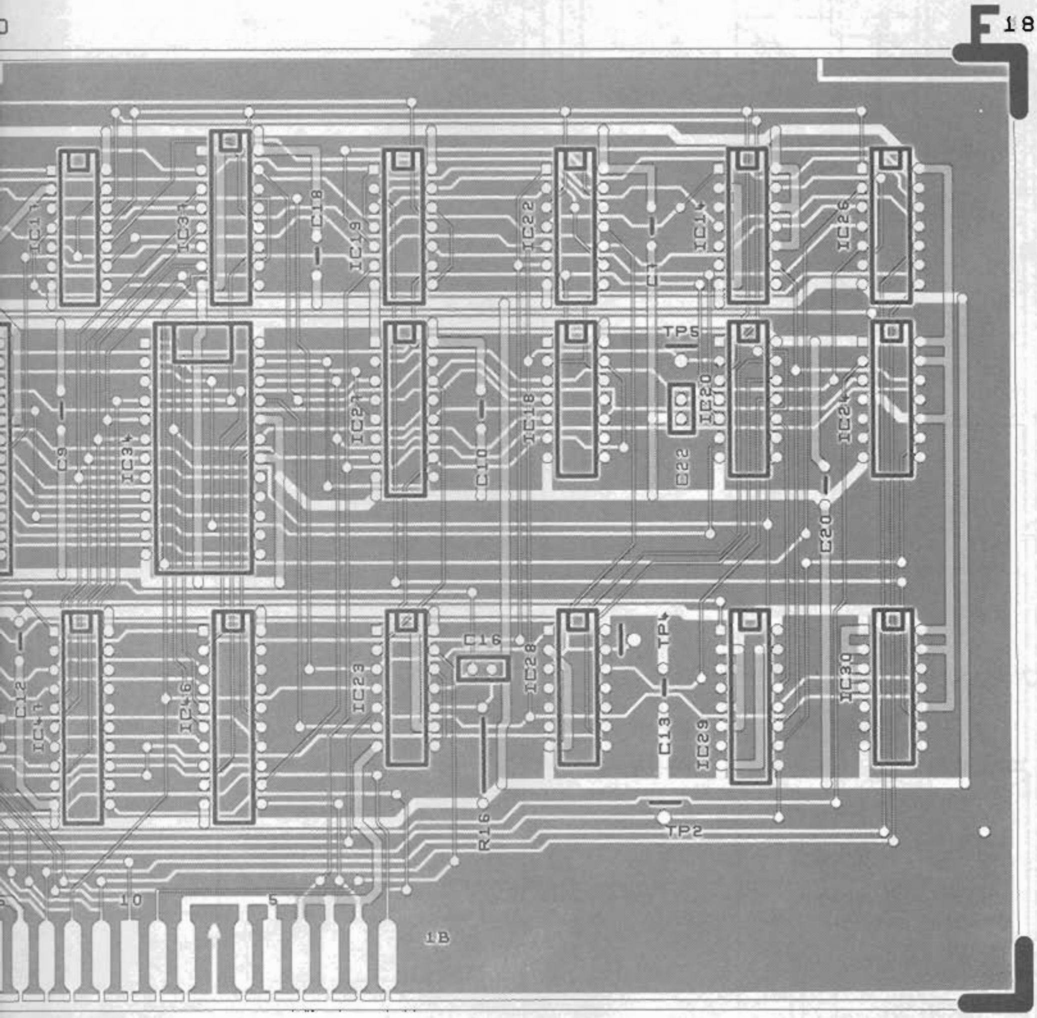
IC'S DECOUPLED AT +5V PIN TO GROUND BY 14 CAPACITORS, C1 - C4 AND C8 - C17 SPACE EVENLY ACROSS THE BOARD

AB2

Digital scope (output)



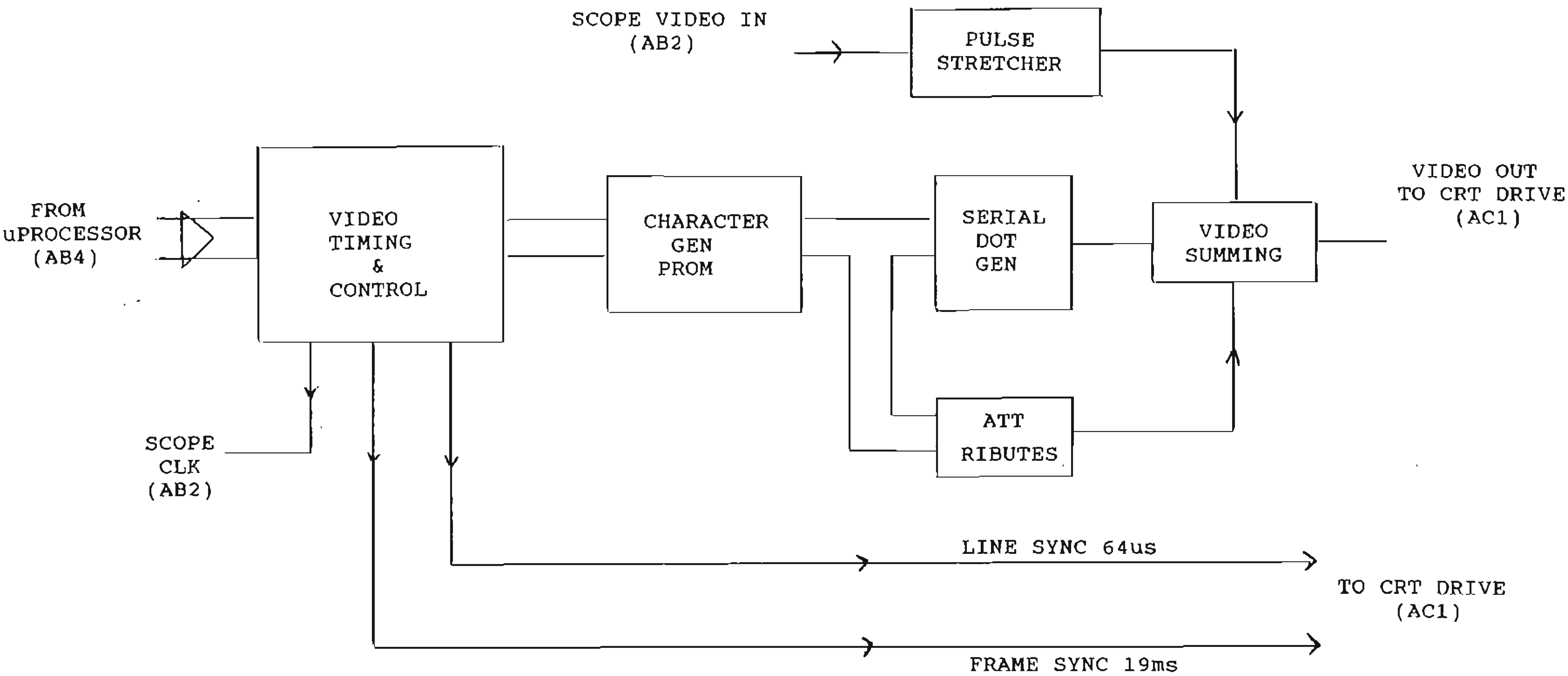
Component layout : A



ut : AB3

Fig. 14a

VDU BOARD (CHARACTER GENERATOR) AB3



Page 24

M13

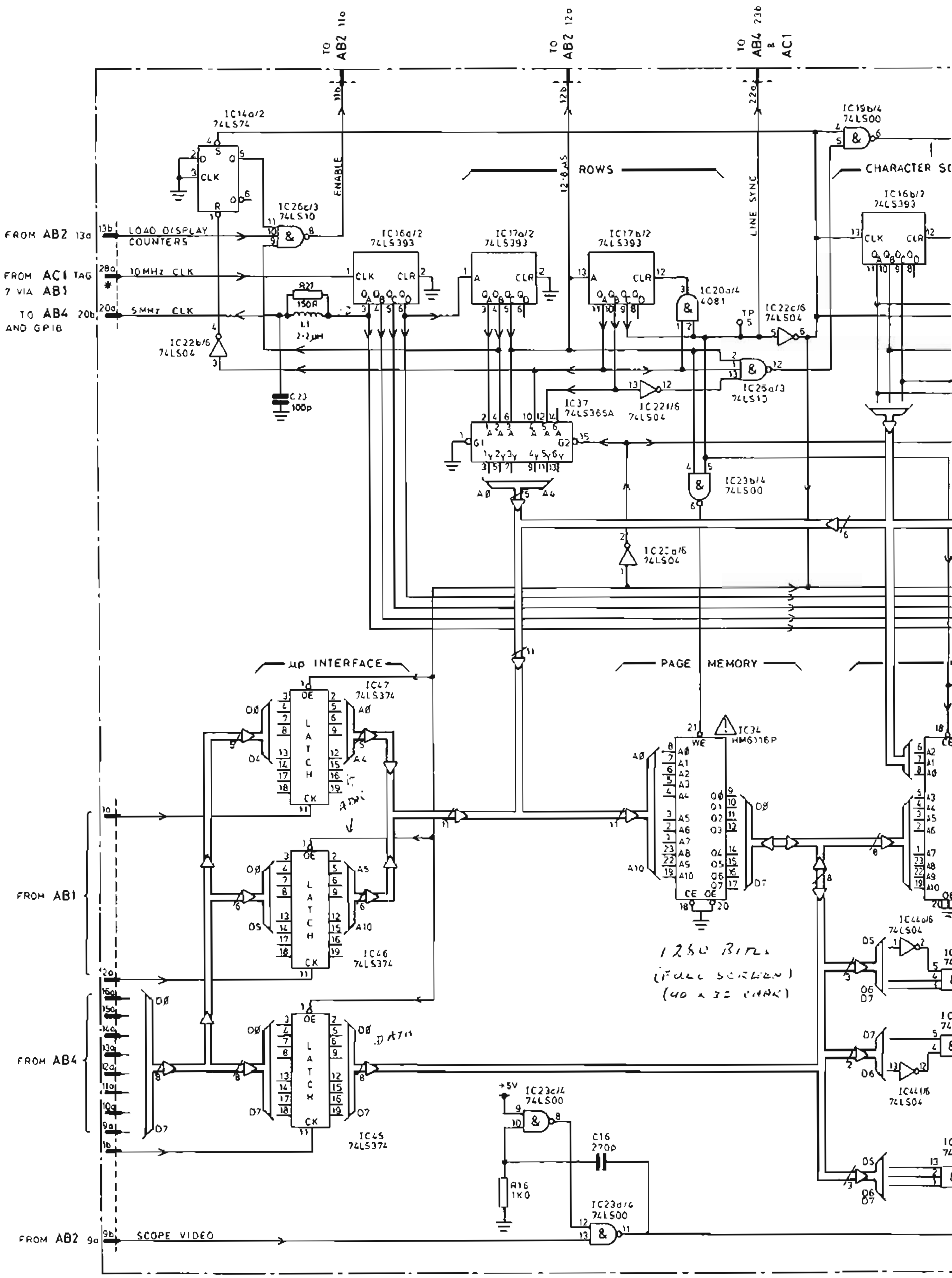
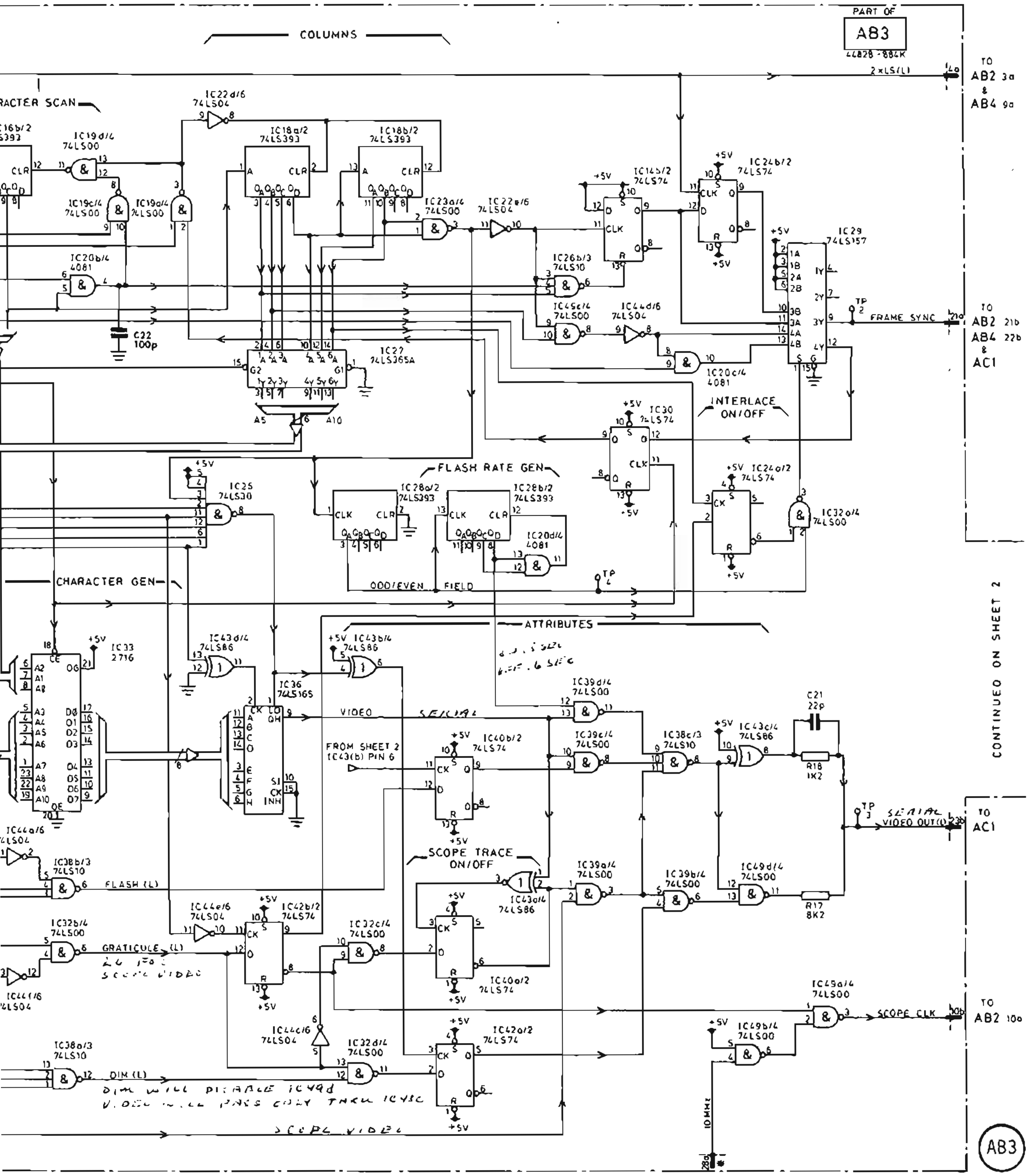


Fig. 14

Drg. No. Z 44828-884K
Sht. 1 of 2, Iss. 8

AB3 : VDU board

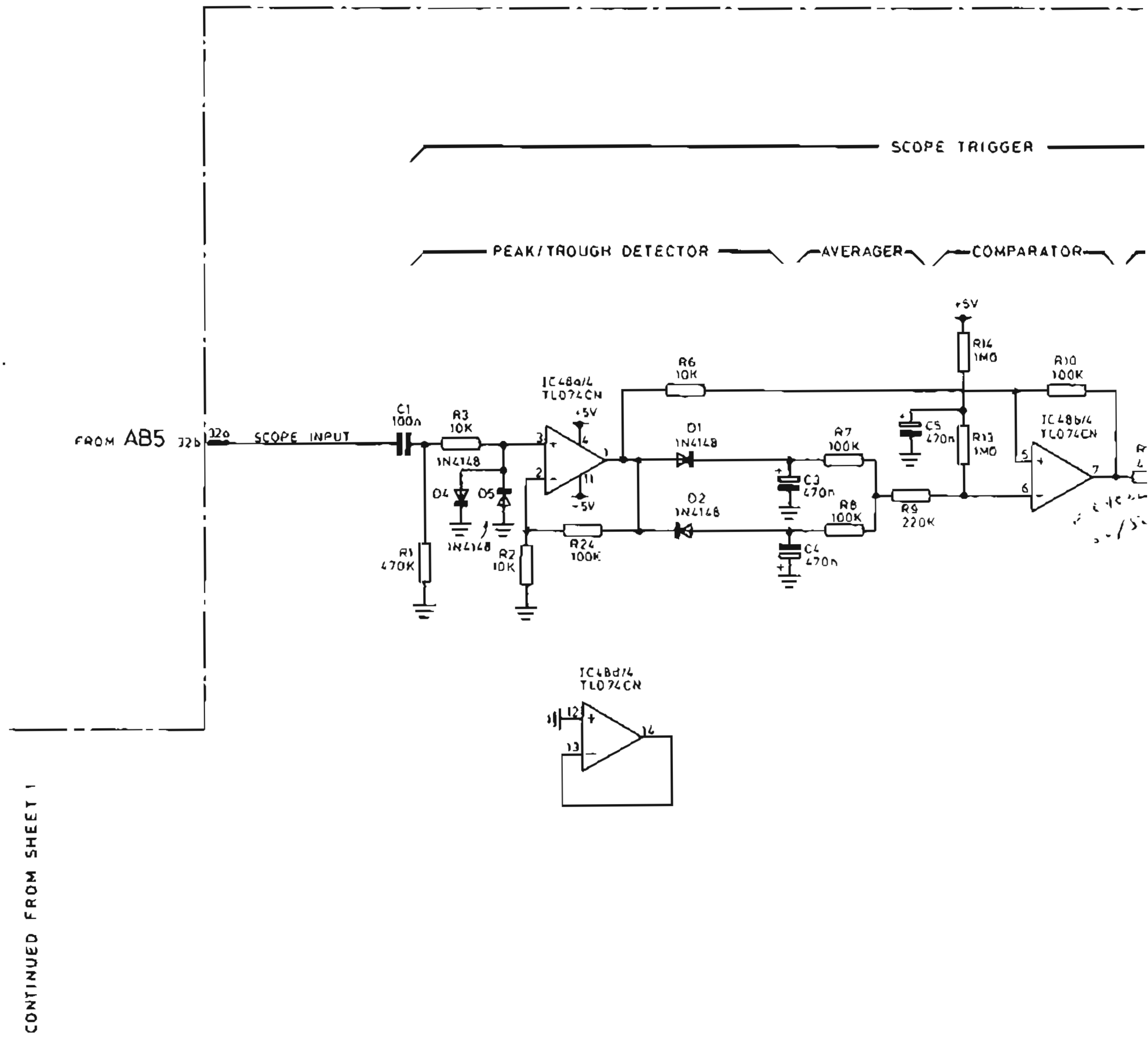
Feb. 88 (Am. 6)

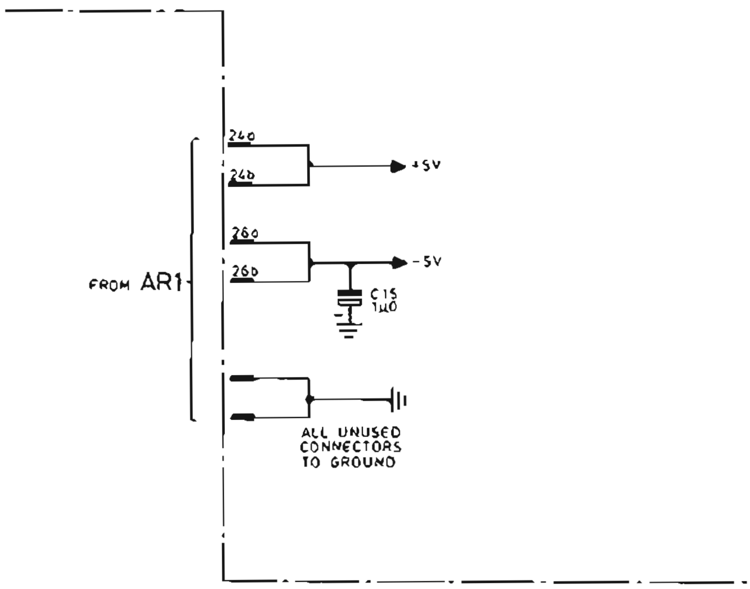


board (character generator)

⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

✱ REPEATED ON THIS DRAWING FOR CIRCUIT CLARITY





SUPPLY LINE TABLE					
IC	+5V	GROUND	IC	+5V	GROUND
IC14	14	7	IC32	14	7
IC16	14	7	IC33	24	12
IC17	14	7	IC34	24	12
IC18	14	7	IC36	16	8
IC19	14	7	IC37	16	8
IC20	14	7	IC38	14	7
IC22	14	7	IC39	14	7
IC23	14	7	IC40	14	7
IC24	14	7	IC42	14	7
IC25	14	7	IC43	14	7
IC26	14	7	IC44	14	7
IC27	16	8	IC45	20	10
IC28	14	7	IC46	20	10
IC29	16	8	IC47	20	10
IC30	14	7	IC49	14	7

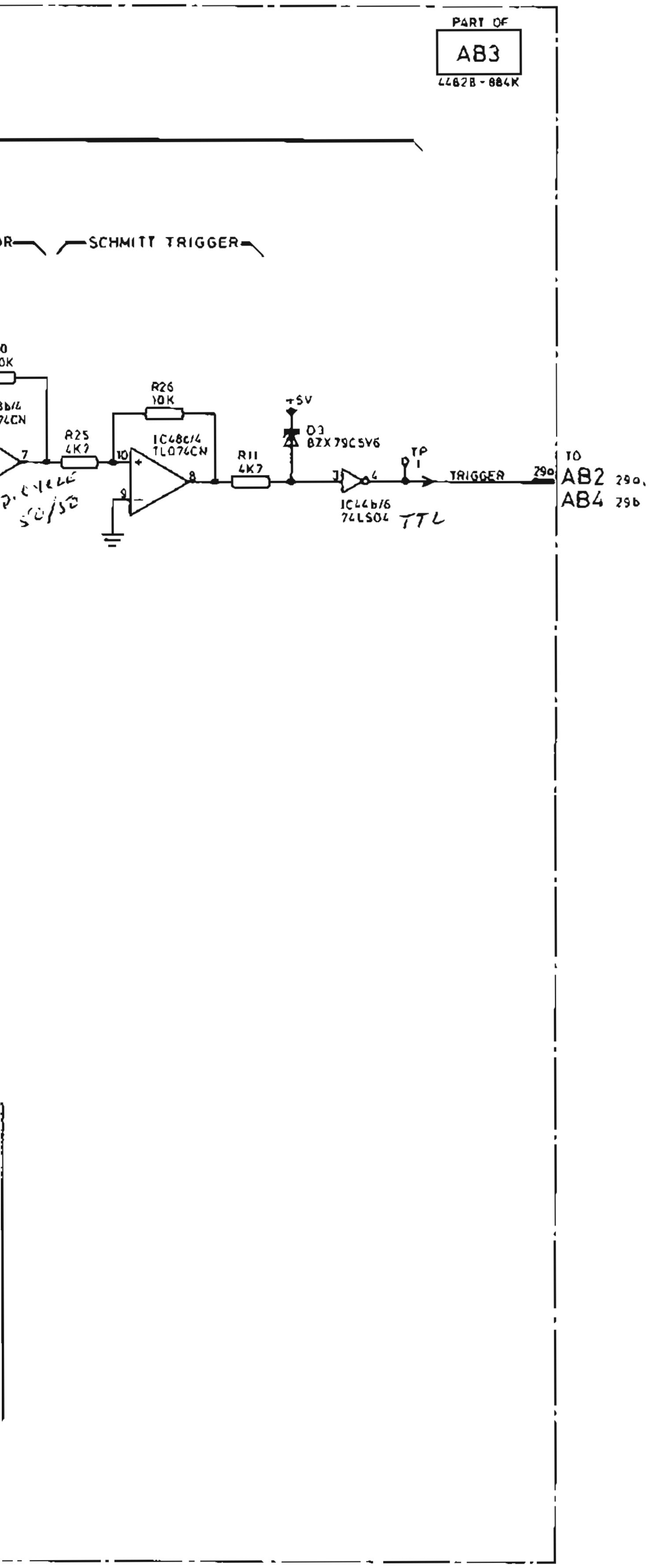
ICs DECOUPLED AT +5V PIN TO GROUND, BY 12 CAPACITORS C6-C13 AND C17-C20 10n, SPACED EVENLY ACROSS THE BOARD

Drg. No. Z 44828-884K
Sh. 2 of 2, Iss. 5

Fig. 15

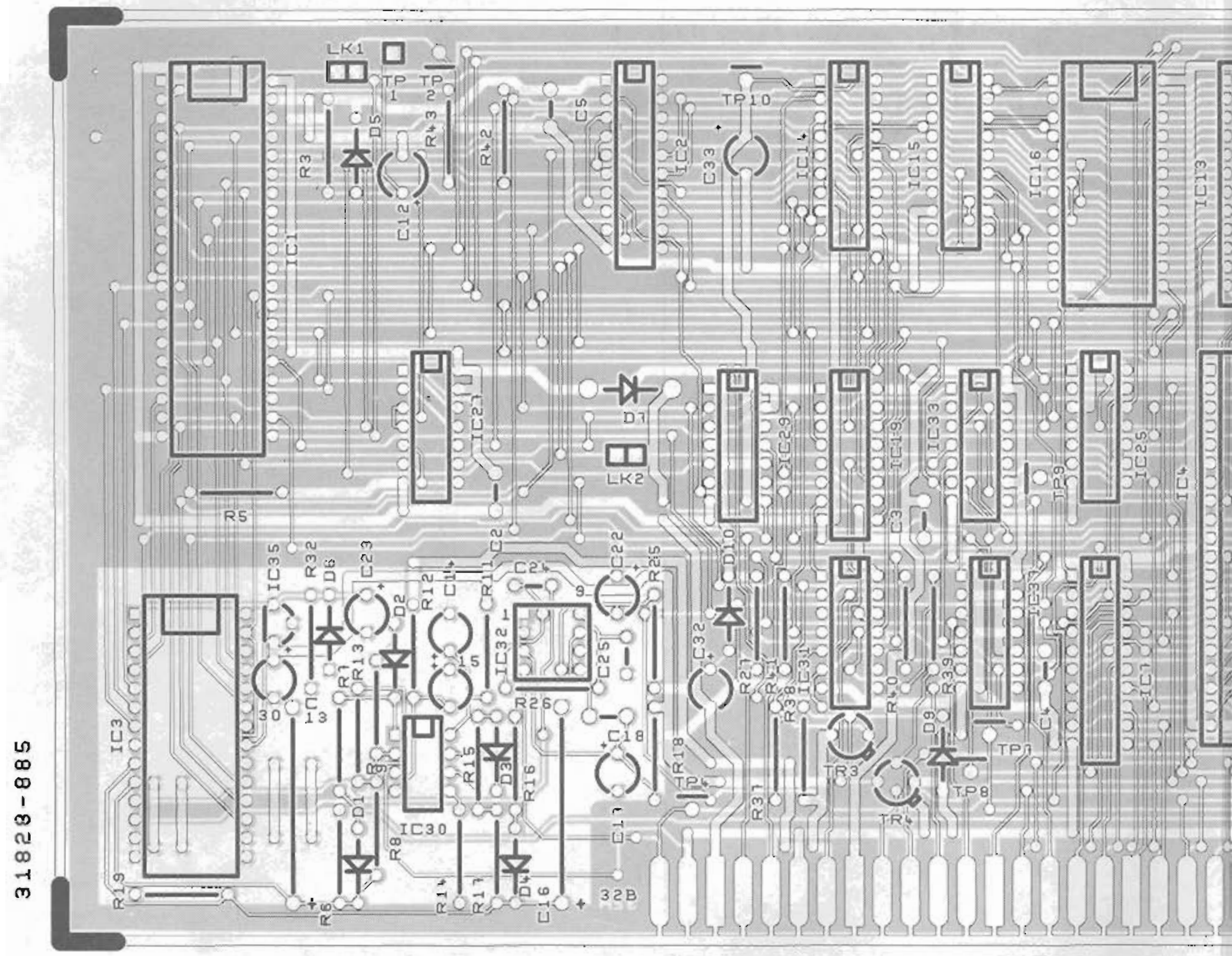
AB3 : VDU board

June 85

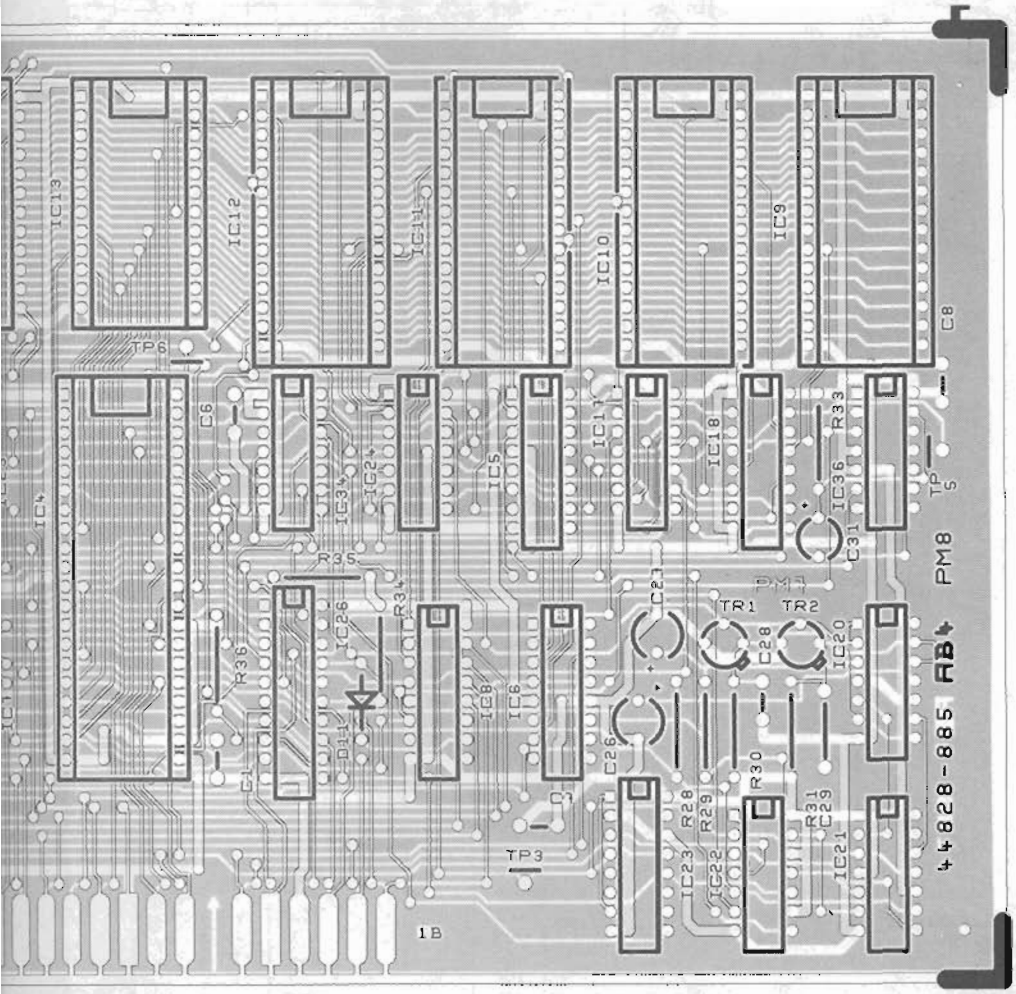


board (scope trigger)

AB3



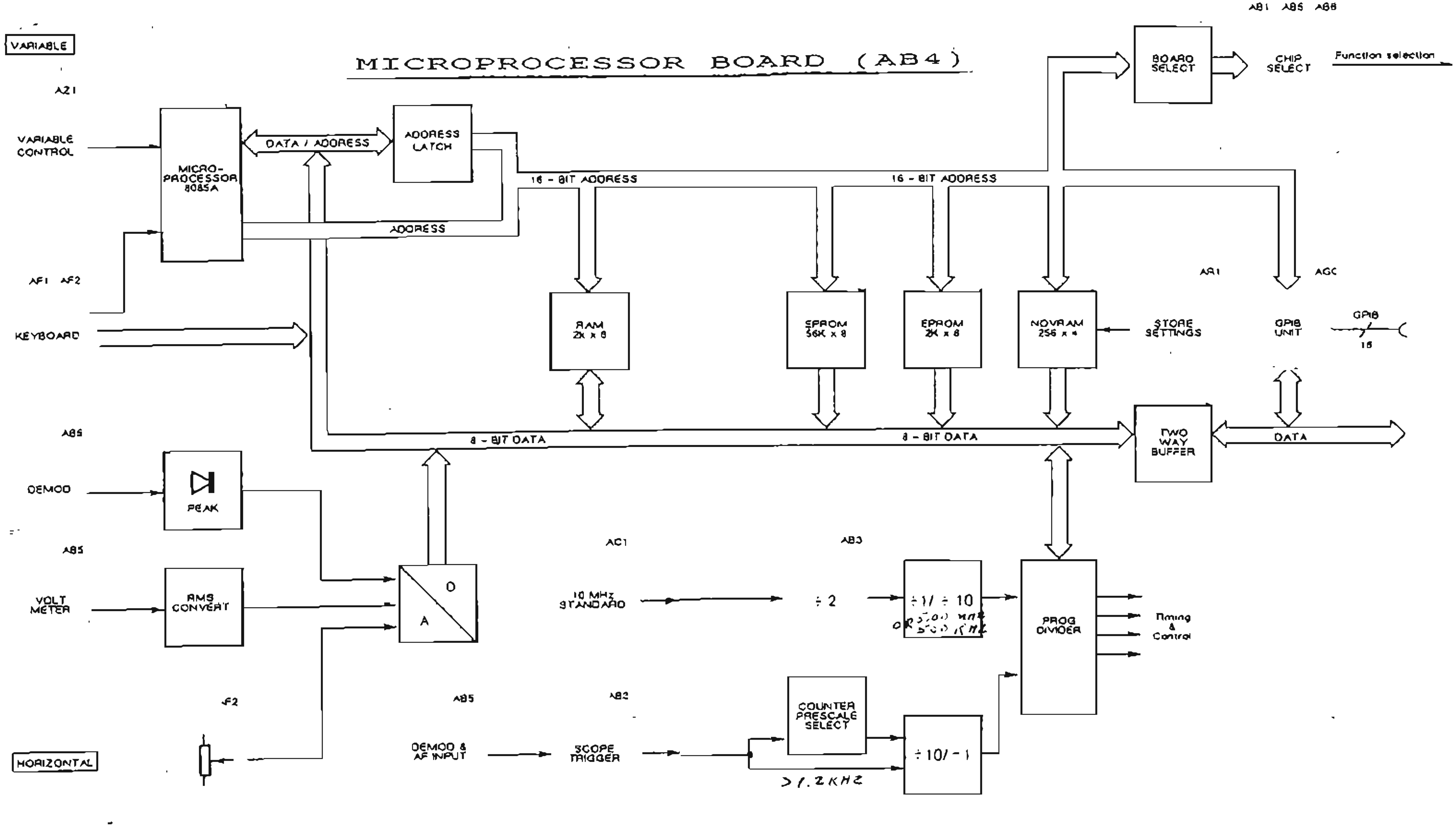
Component layout

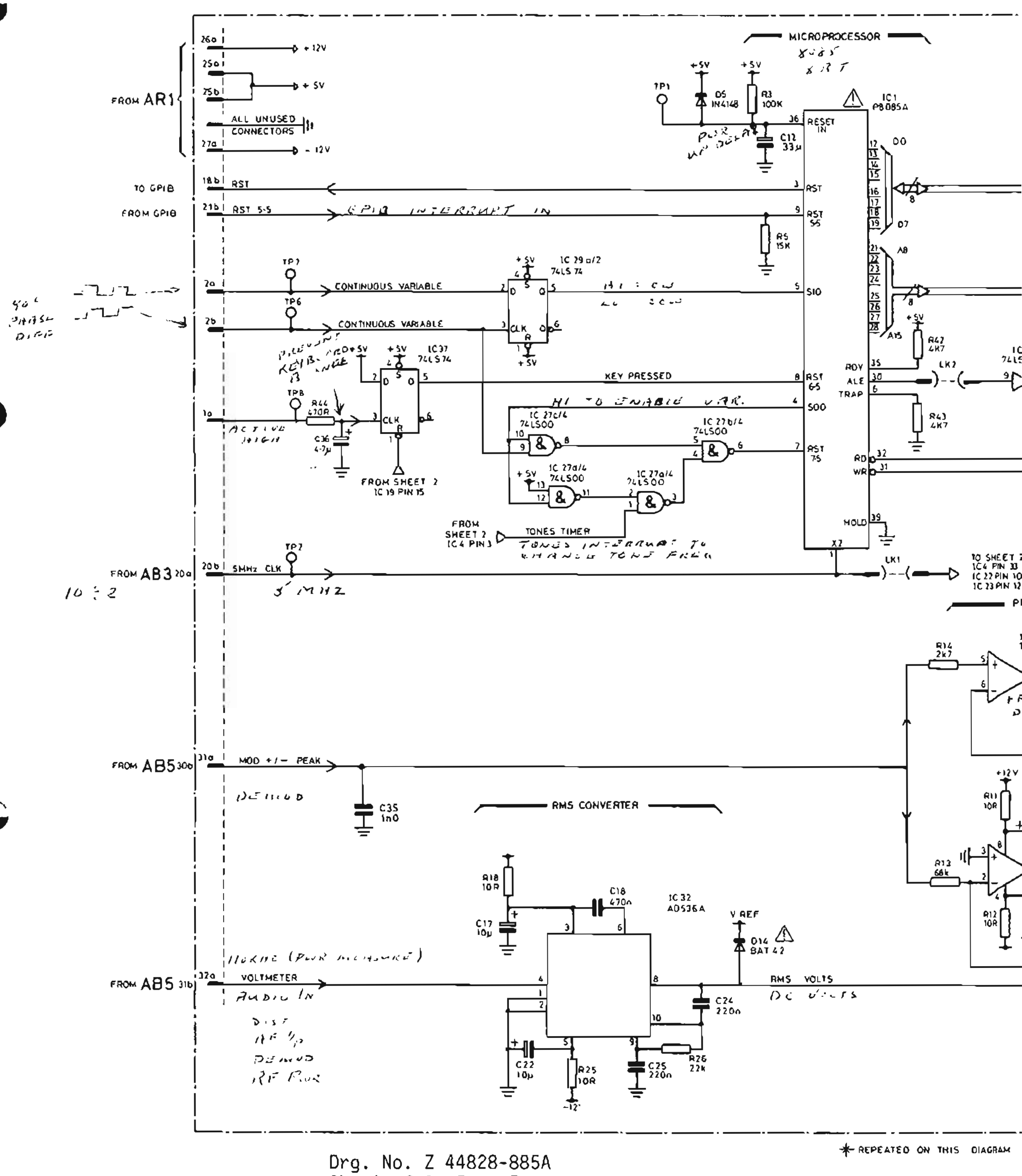


ayout : AB4

Fig. 16a

MICROPROCESSOR BOARD (AB4)



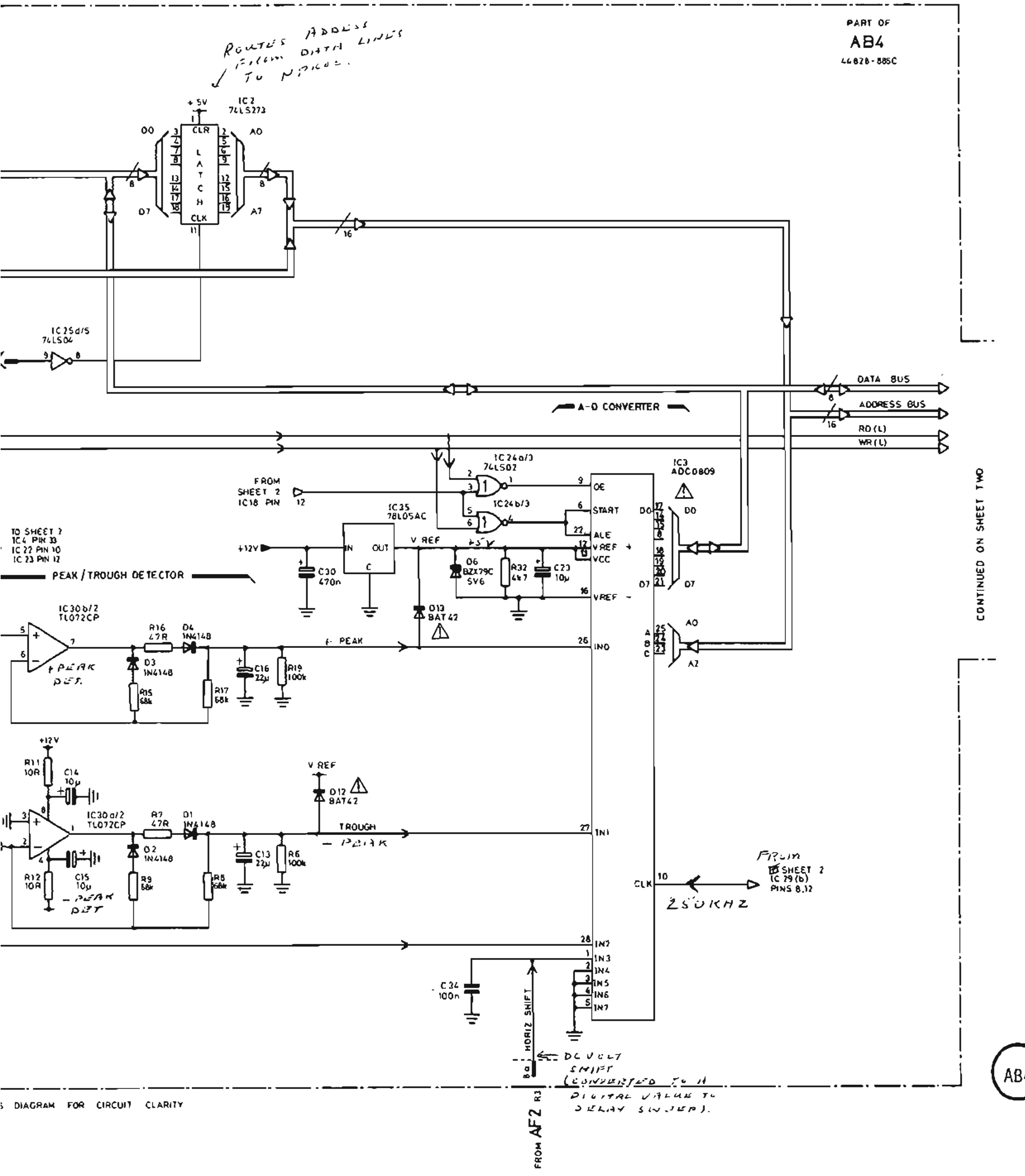


Drg. No. Z 44828-885A
Sh. 1 of 3, Iss. 5

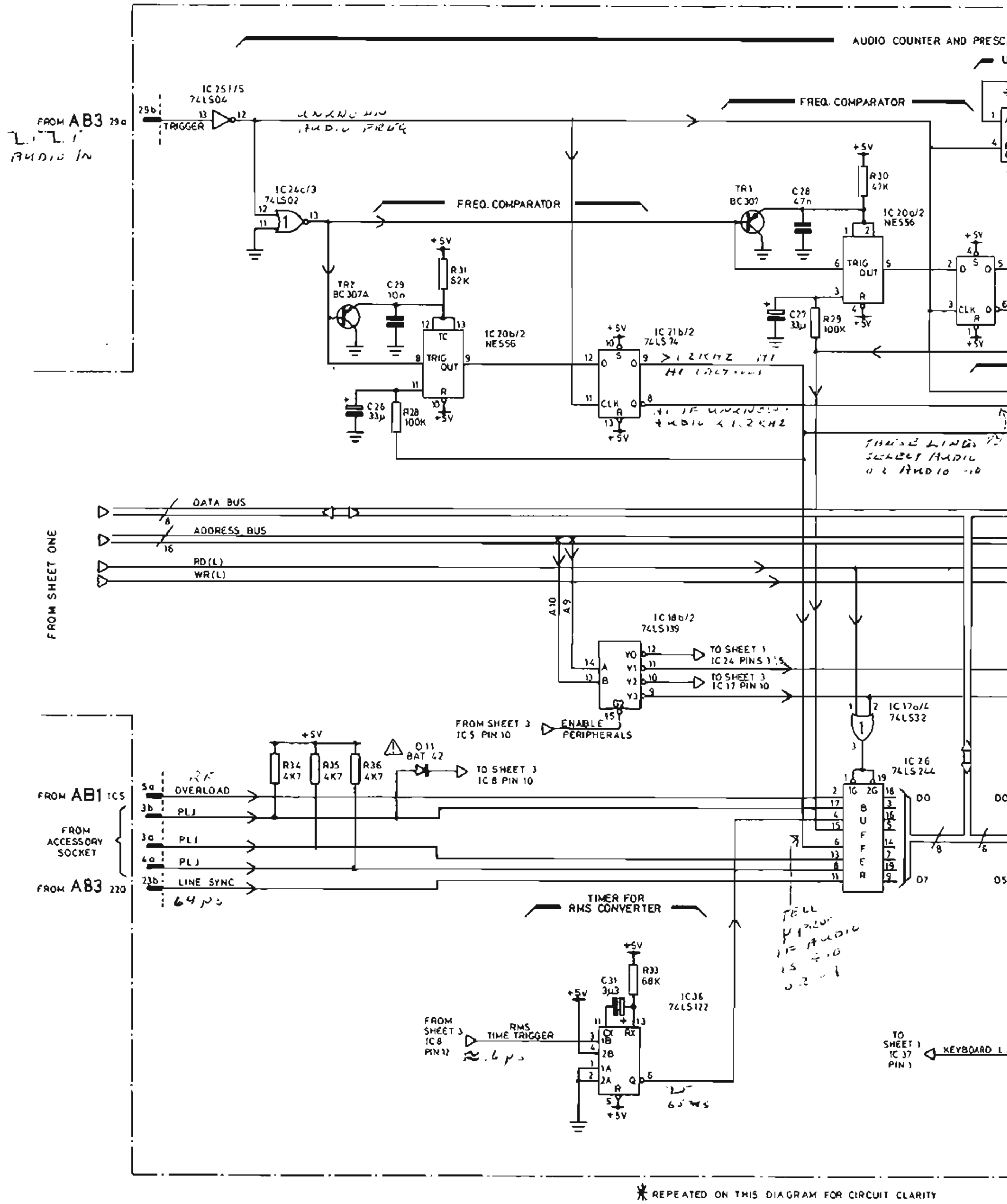
AB4 : Microp

Fig. 16

Aug. 86 (Am. 2)



Microprocessor (processor)

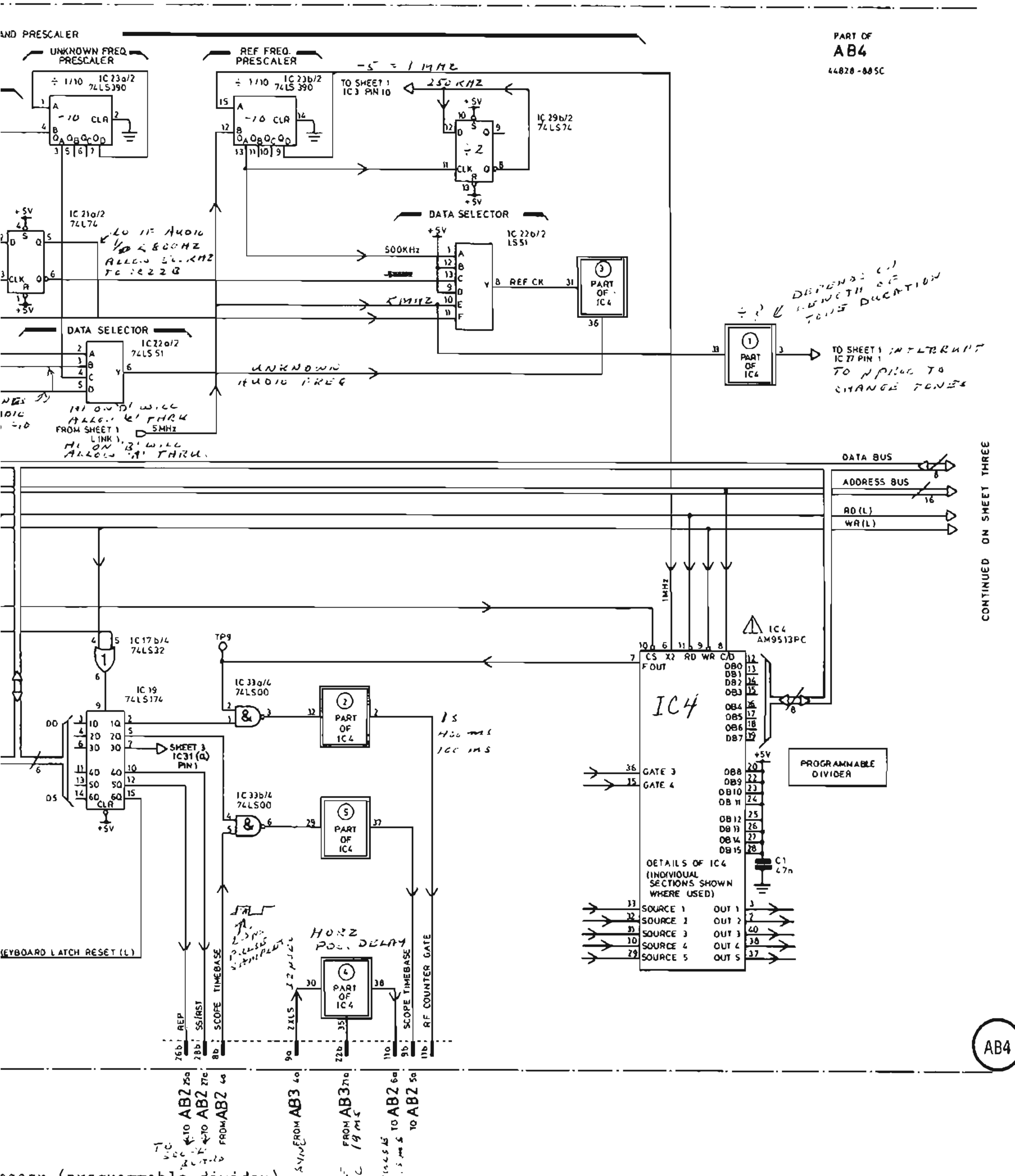


Drg. No. Z 44828-885C
Sh. 2 of 3, Iss. 3

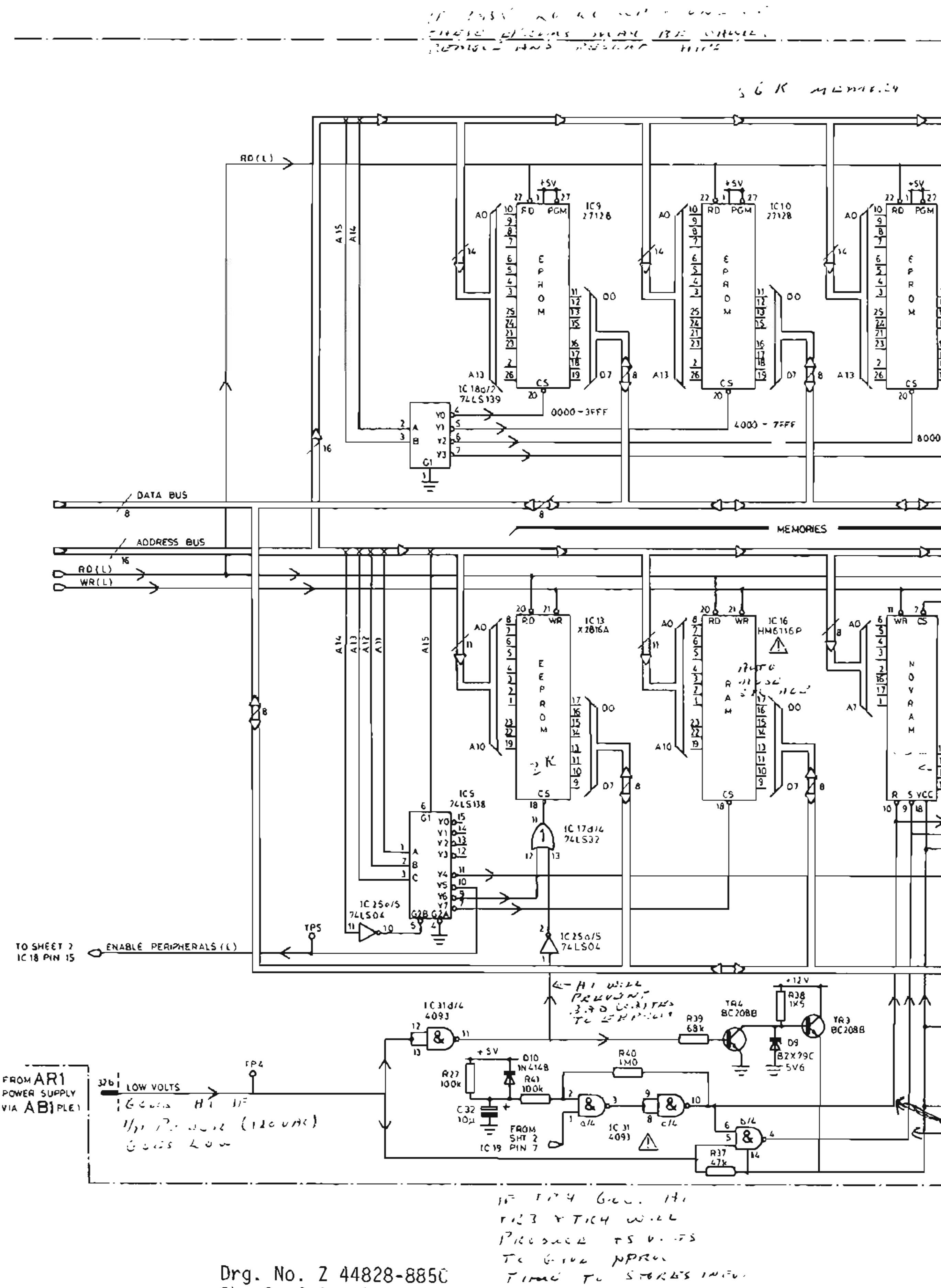
Fig. 17

AB4 : Microprocessor (

Mar. 86 (Am. 1)



essor (programmable divider)

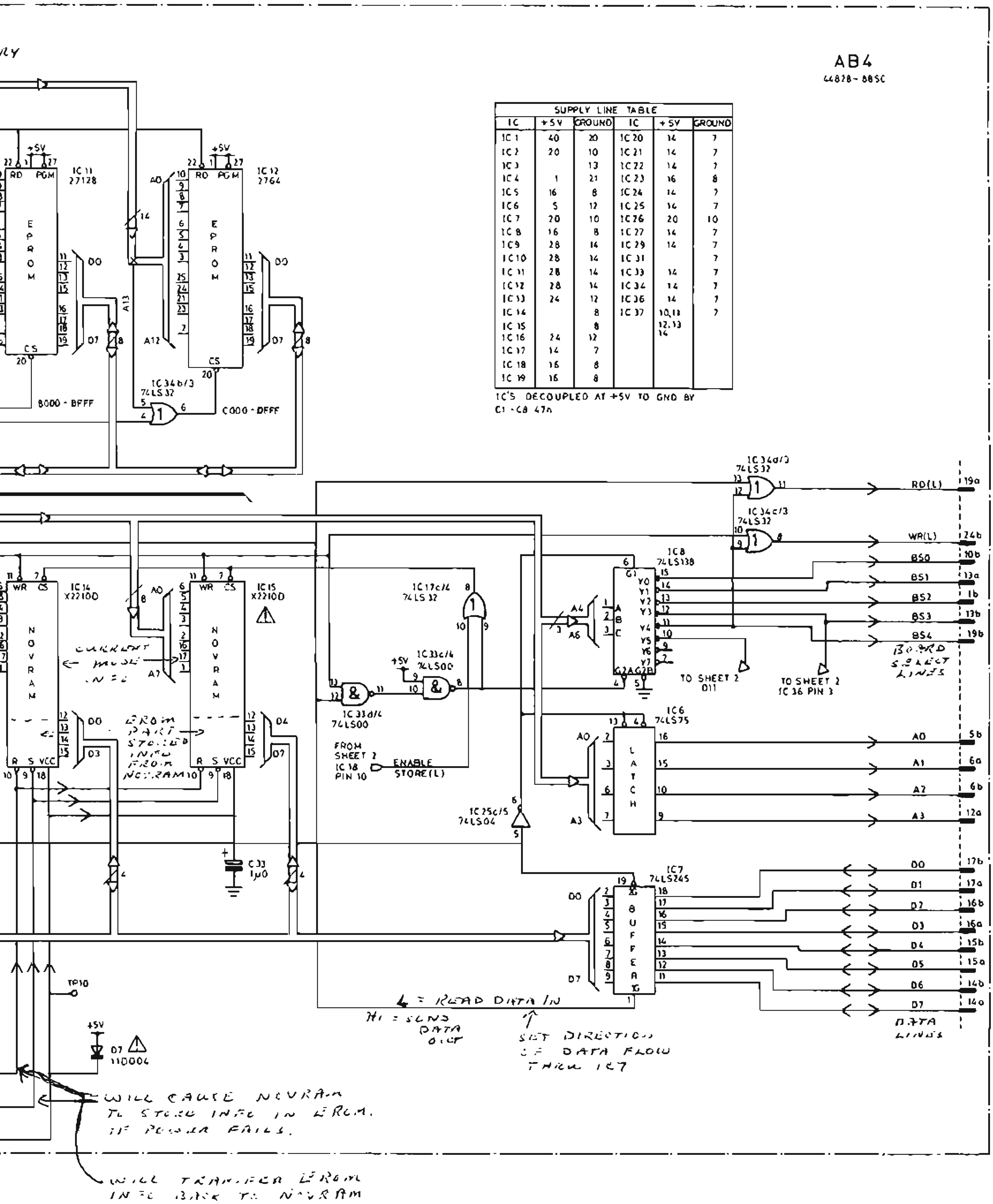


Drg. No. Z 44828-885C
Sh. 3 of 3, Iss. 3

Fig. 18

AB4 : Microp

Mar. 86 (Am. 1)

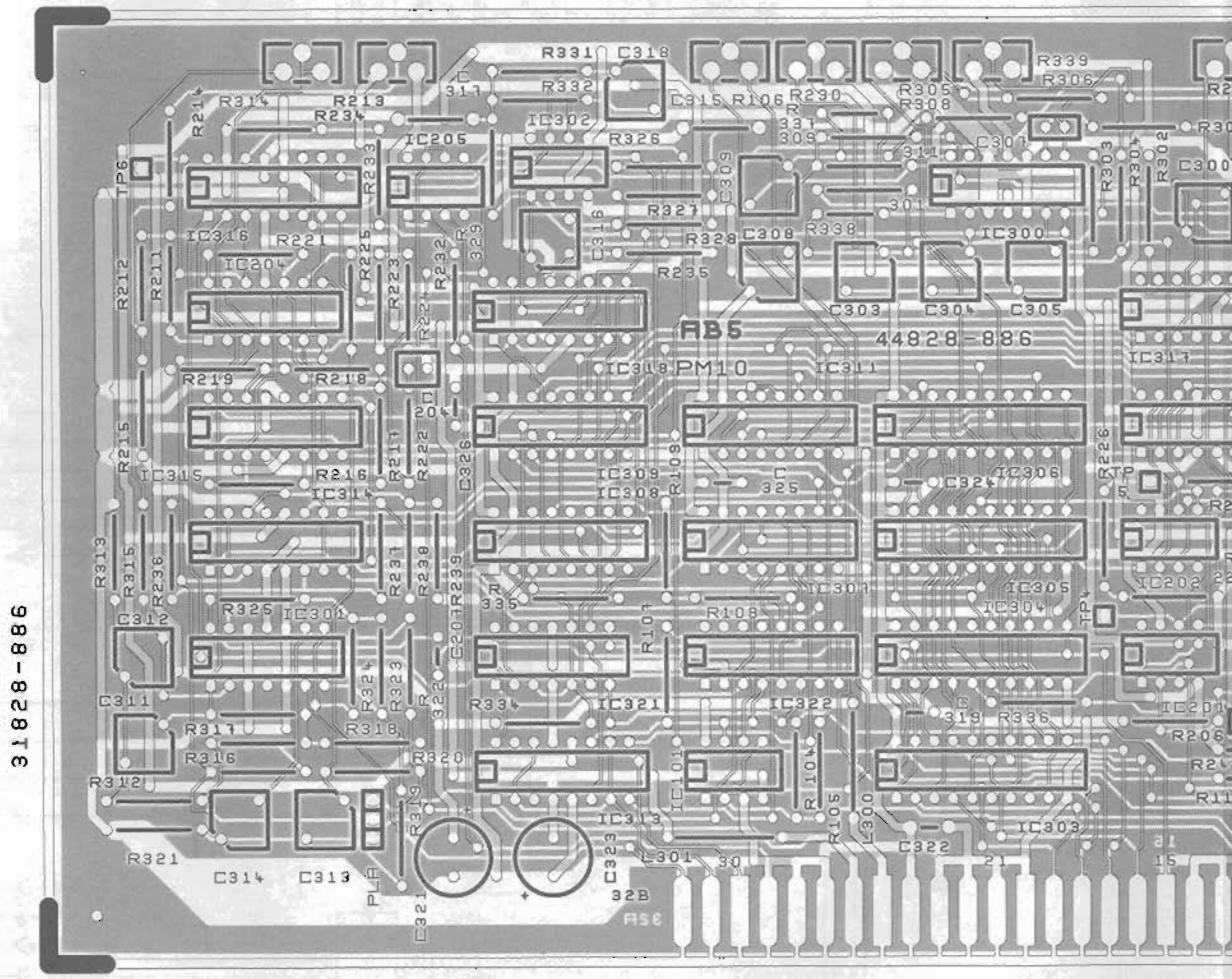


SUPPLY LINE TABLE					
IC	+5V	GROUND	IC	+5V	GROUND
IC 1	40	20	IC 20	14	7
IC 2	20	10	IC 21	14	7
IC 3		13	IC 22	14	7
IC 4	1	21	IC 23	16	8
IC 5	16	8	IC 24	14	7
IC 6	5	12	IC 25	14	7
IC 7	20	10	IC 26	20	10
IC 8	16	8	IC 27	14	7
IC 9	28	14	IC 29	14	7
IC 10	28	14	IC 31		7
IC 11	28	14	IC 33	14	7
IC 12	28	14	IC 34	14	7
IC 13	24	12	IC 36	14	7
IC 14		8	IC 37	10, 11, 12, 13, 14	7
IC 15		8			
IC 16	24	12			
IC 17	14	7			
IC 18	16	8			
IC 19	16	8			

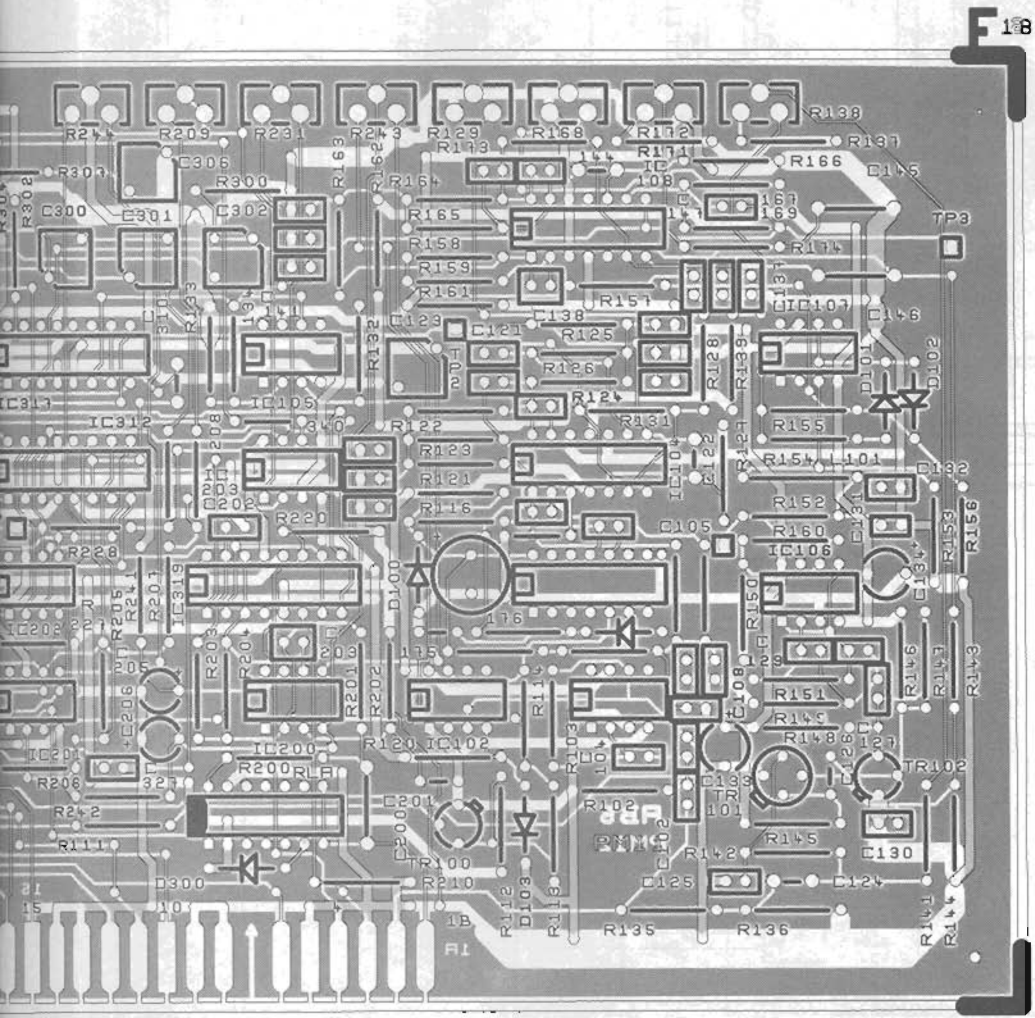
IC'S DECOUPLED AT +5V TO GND BY C1 - C8 47n

AB4

Microprocessor (memory)



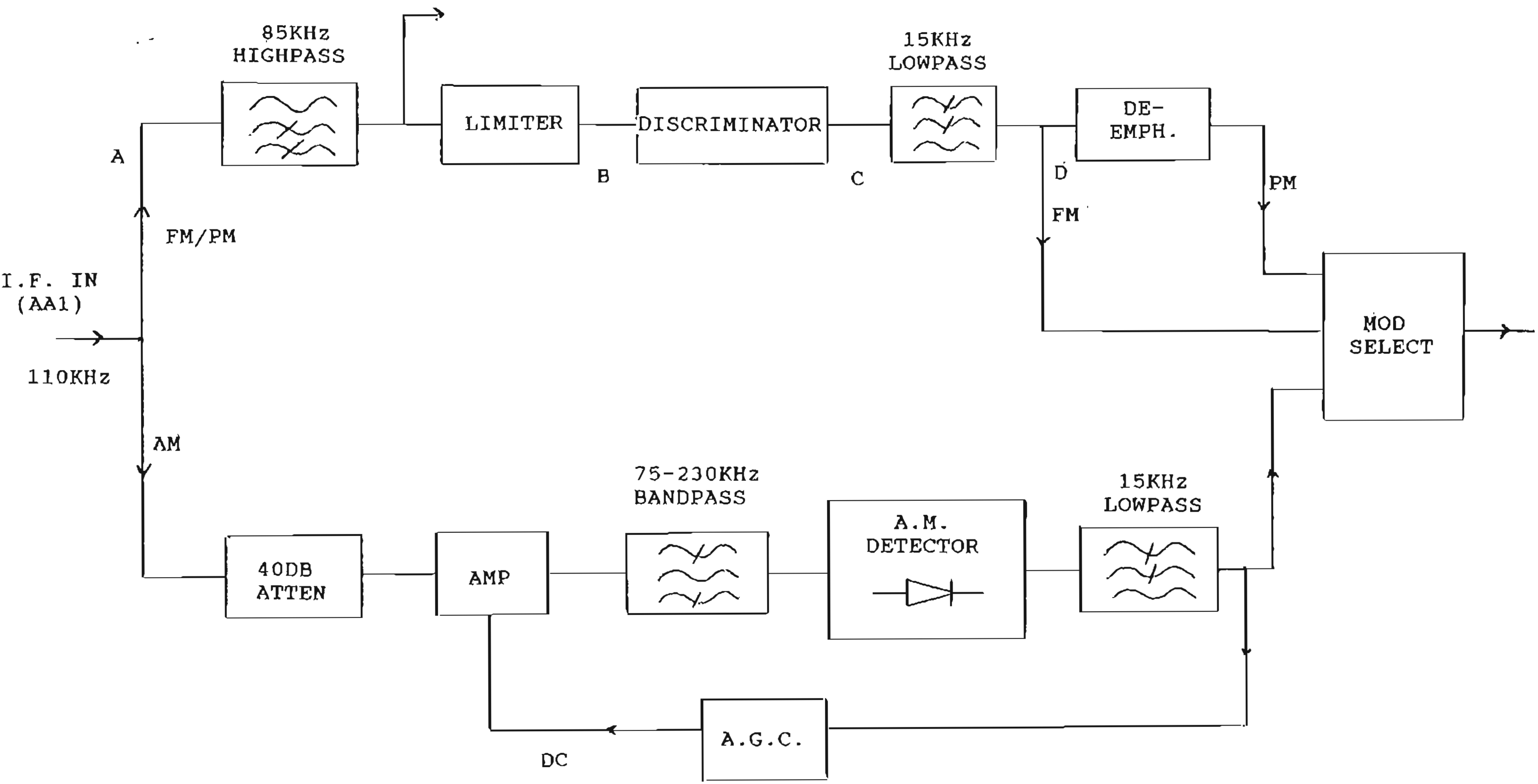
Component layout :

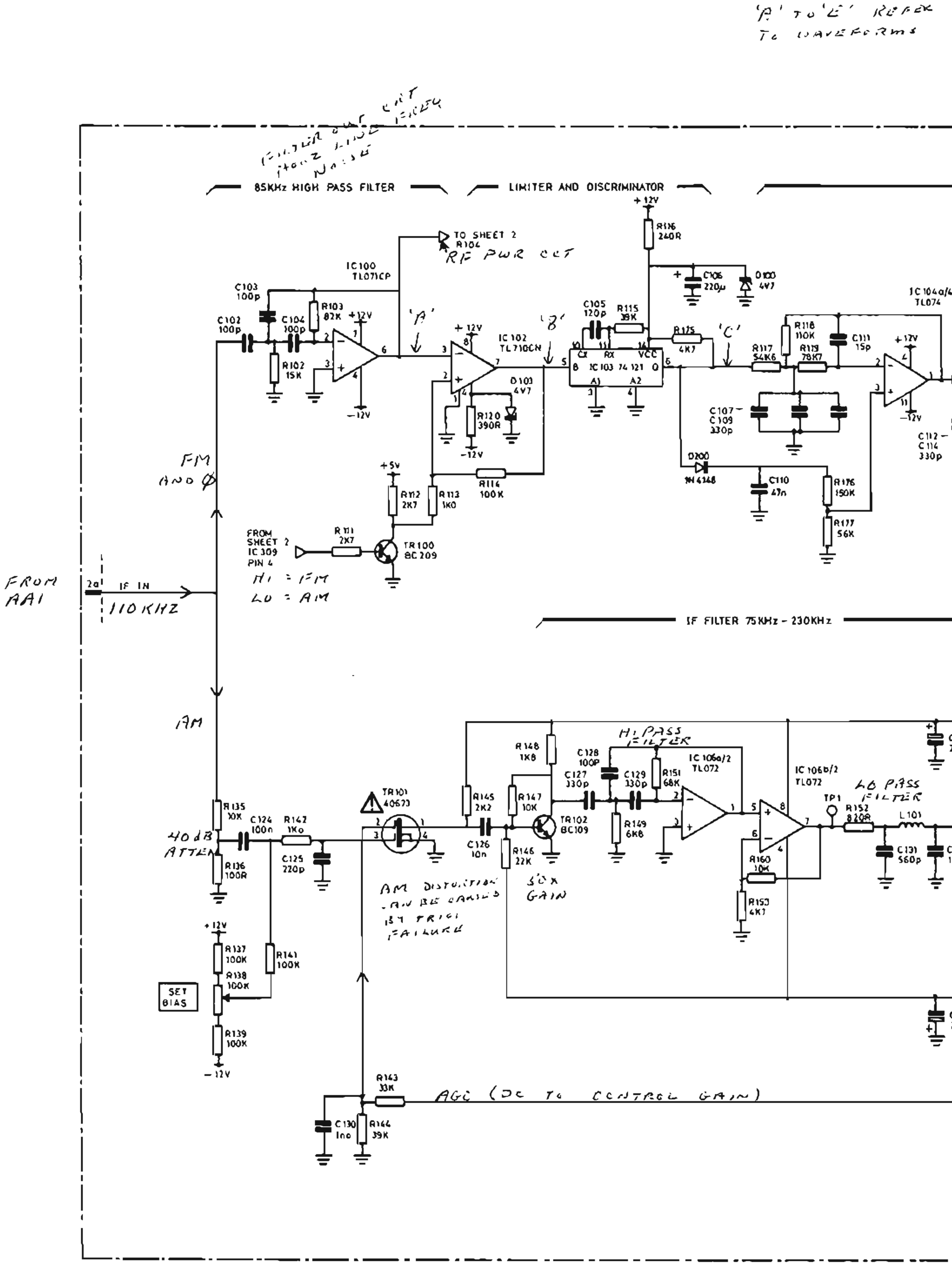


ayout : AB5

Fig. 19a

DEMODULATION & SCOPE (AB5)

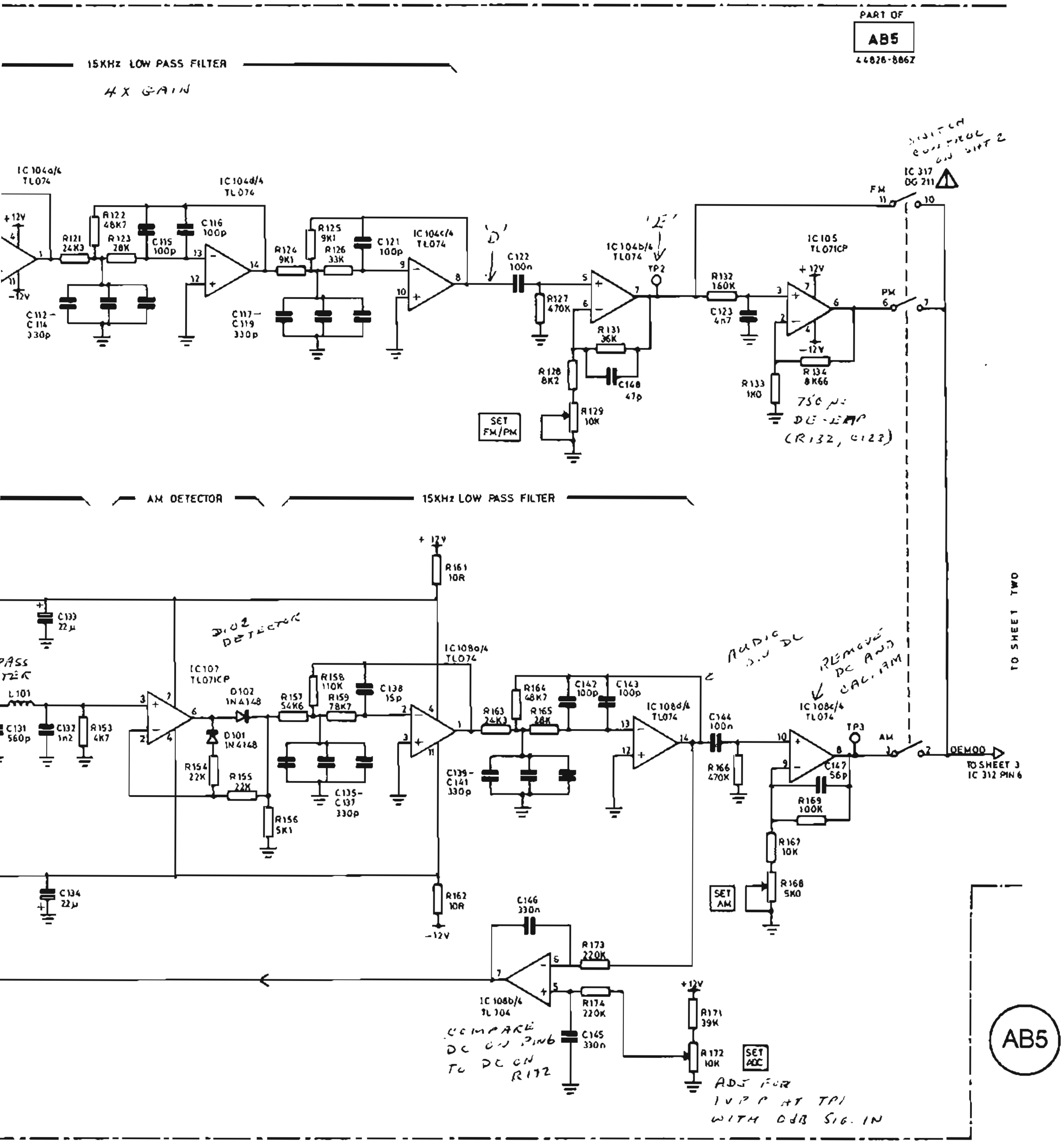




Drg. No. Z 44828-886Z
Sht. 1 of 3, Iss. 9

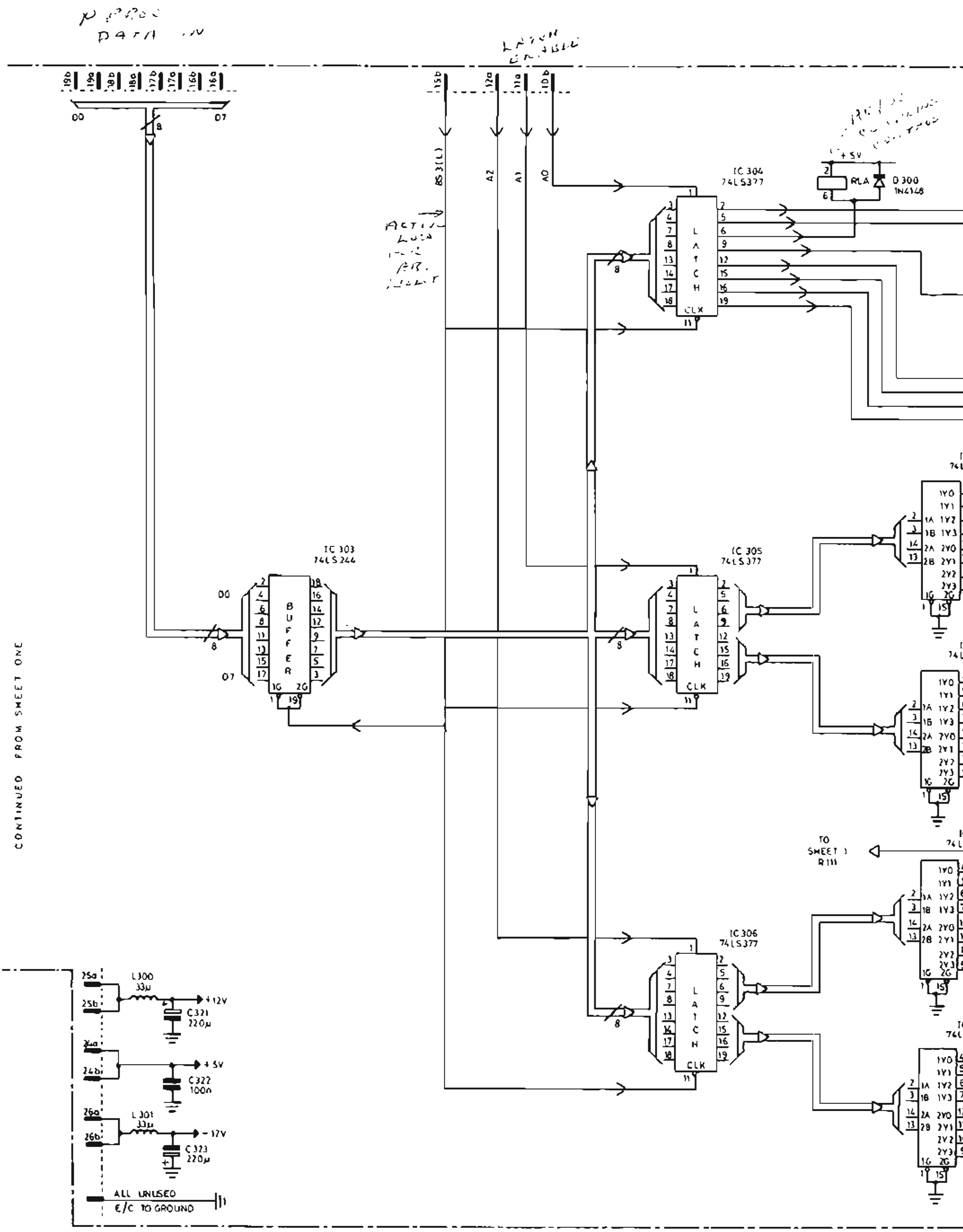
Fig. 19

AB5 : Demodulat



⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

odulation & scope (i.f. demodulation)

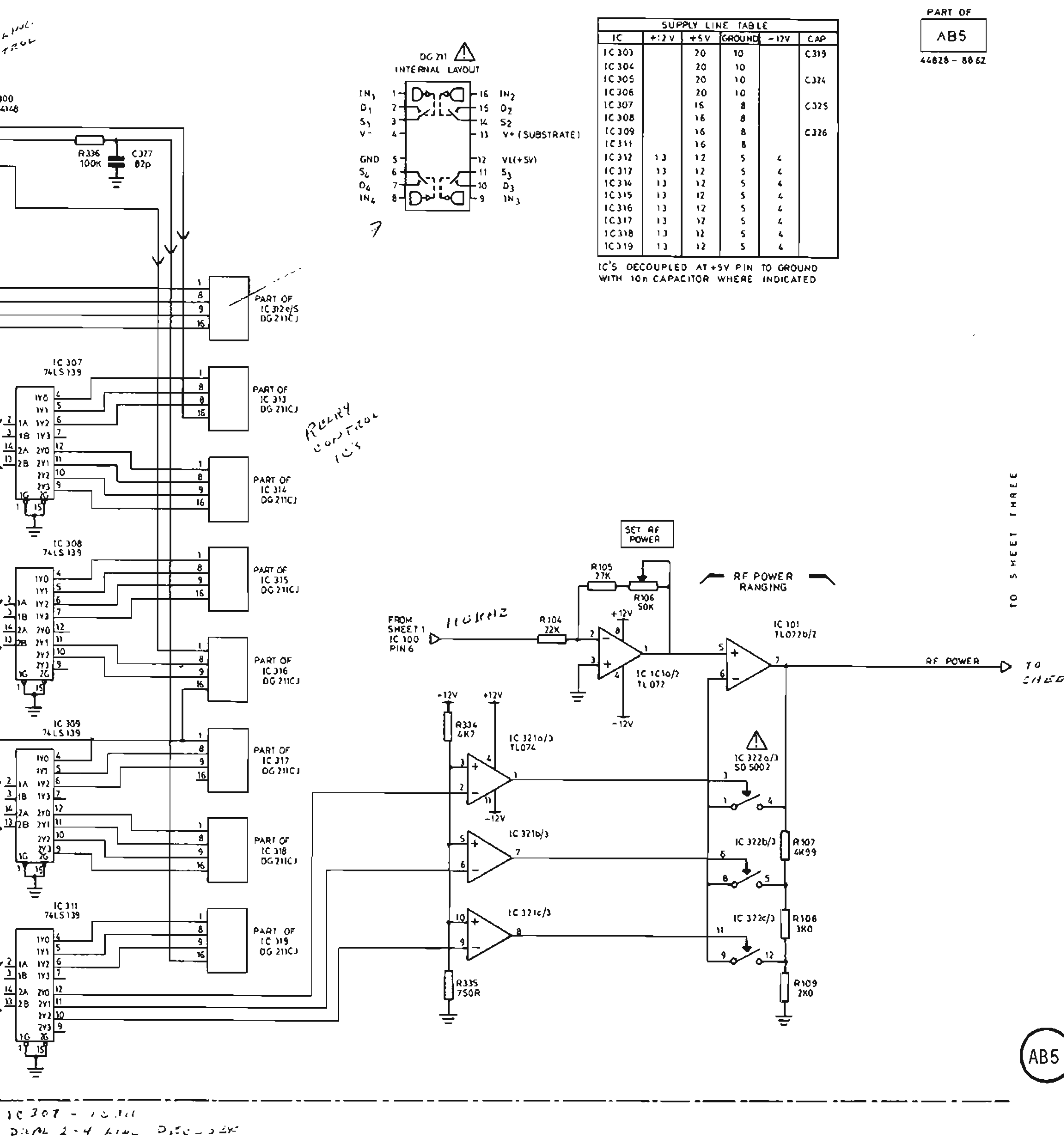


Drg. No. Z 44828-886Z
Sh. 2 of 3, Iss. 4

AB5 : Demodulatic

Fig. 20

Mar. 86 (Am. 1)

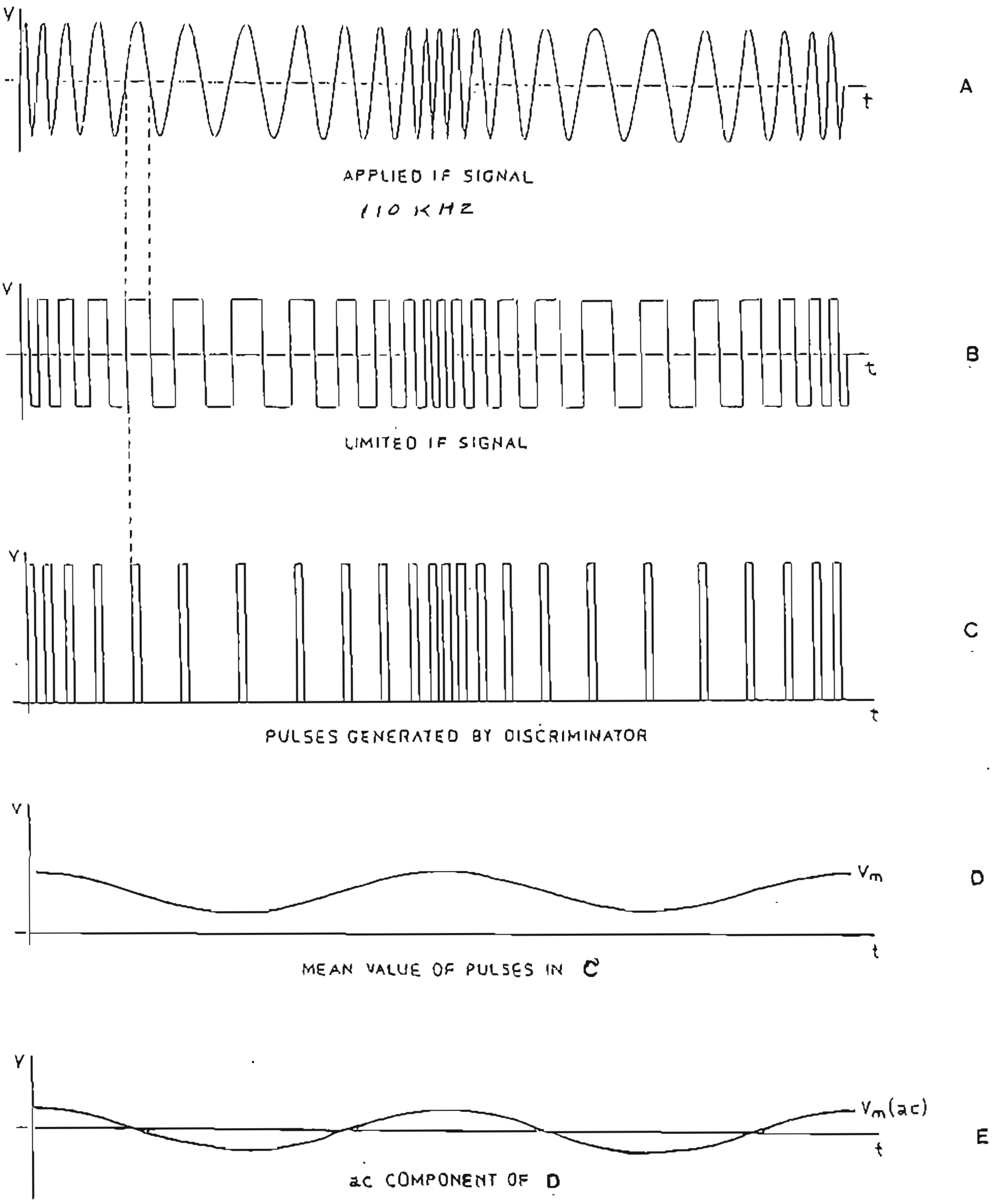


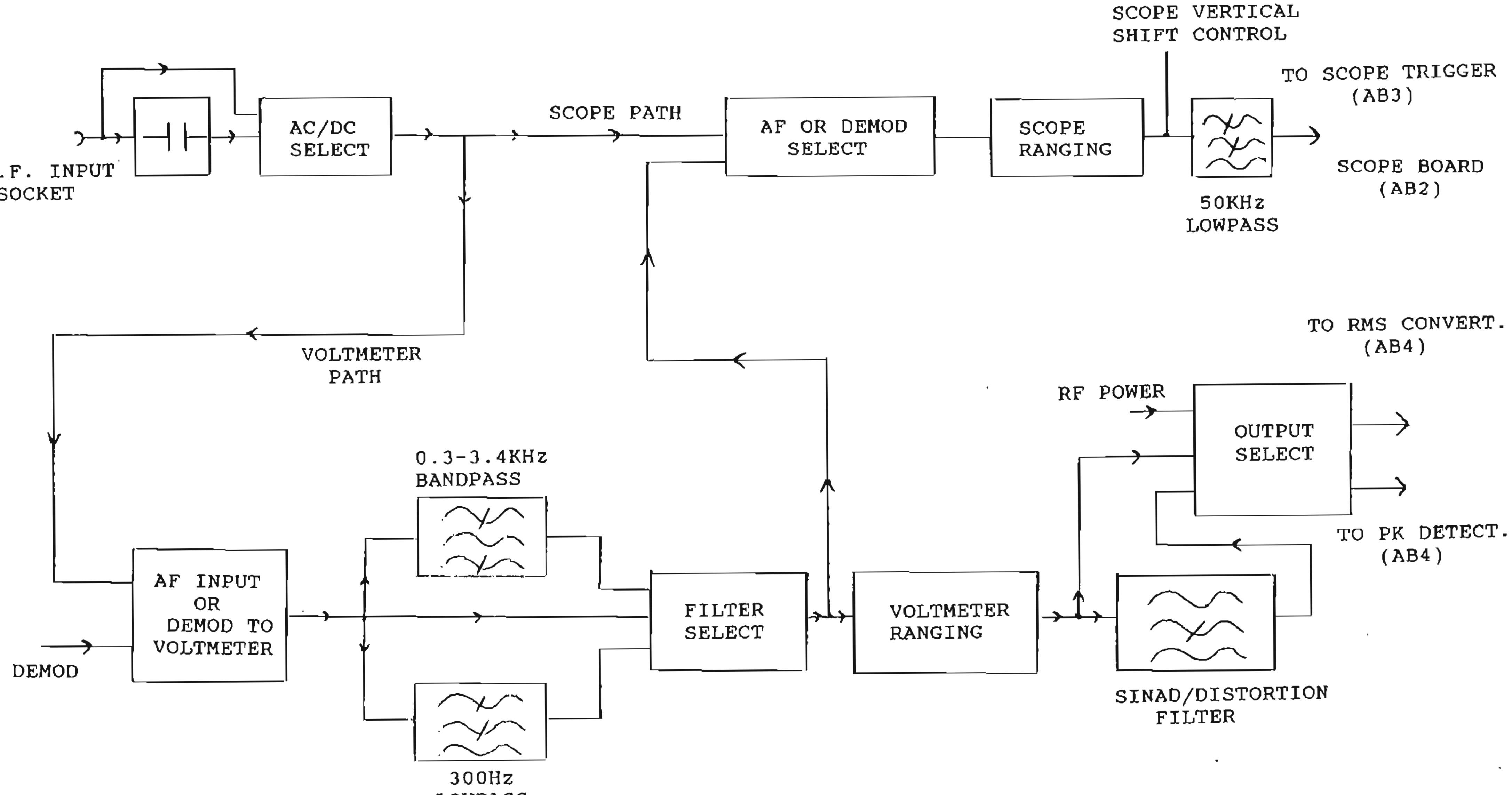
SUPPLY LINE TABLE					
IC	+12V	+5V	GROUND	-12V	CAP
IC 303		20	10		C319
IC 304		20	10		
IC 305		20	10		C324
IC 306		20	10		
IC 307		16	8		C325
IC 308		16	8		
IC 309		16	8		C326
IC 311		16	8		
IC 312	13	12	5	4	
IC 313	13	12	5	4	
IC 314	13	12	5	4	
IC 315	13	12	5	4	
IC 316	13	12	5	4	
IC 317	13	12	5	4	
IC 318	13	12	5	4	
IC 319	13	12	5	4	

IC'S DECOUPLED AT +5V PIN TO GROUND WITH 10n CAPACITOR WHERE INDICATED

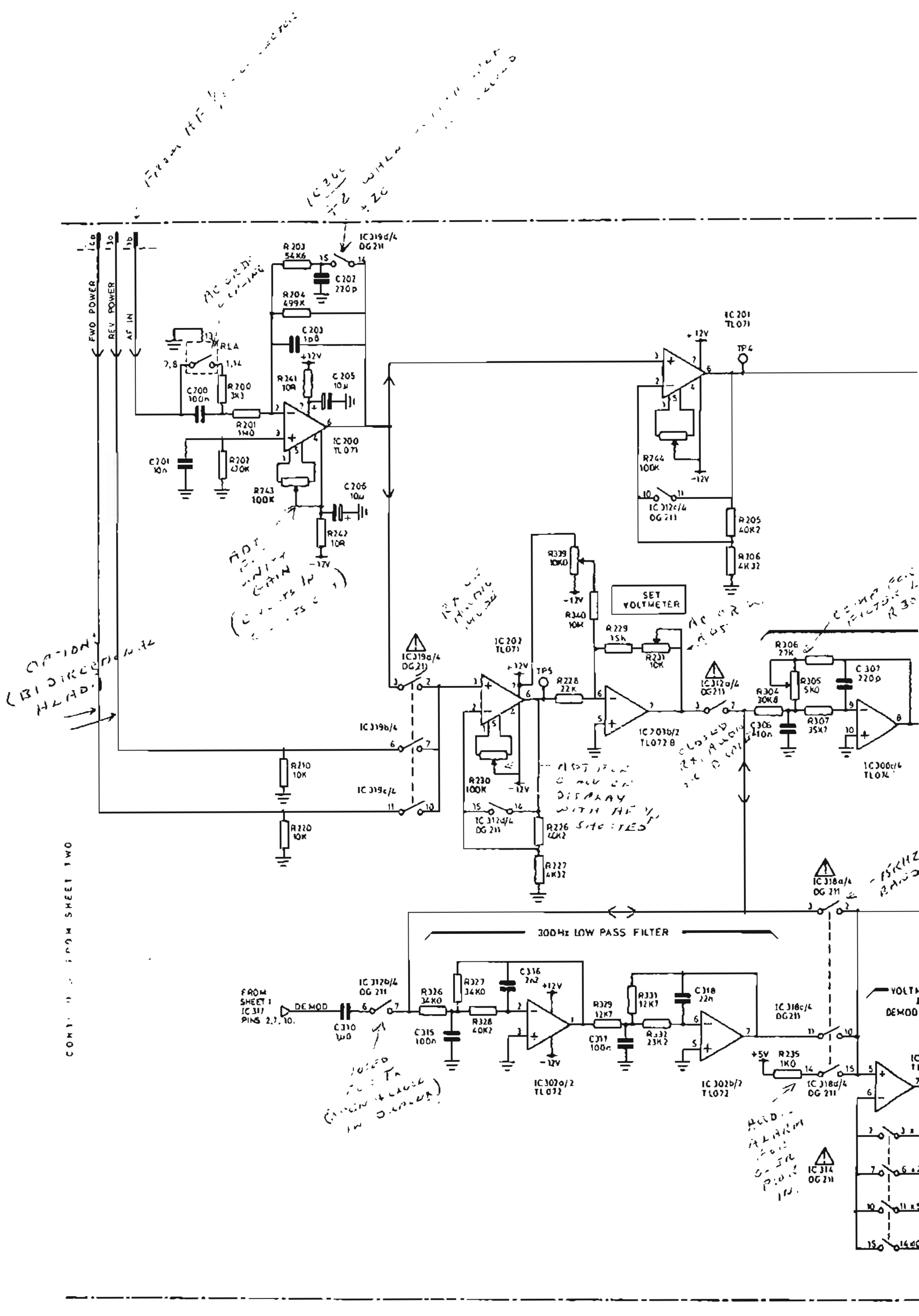
dulation & scope (switching)

FM DEMODULATION (AB5)



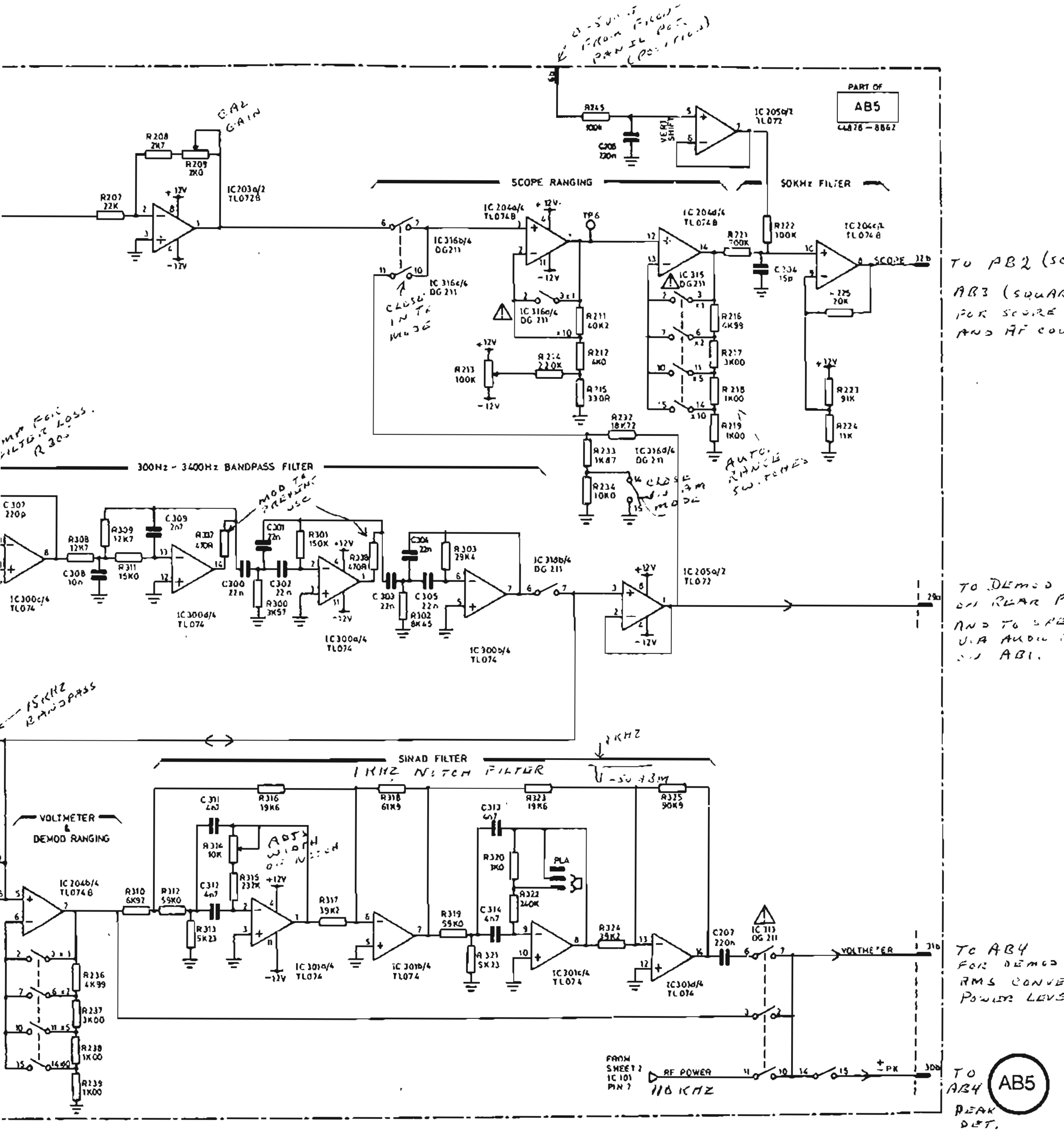


DEMODULATION & SCOPE (AB5)

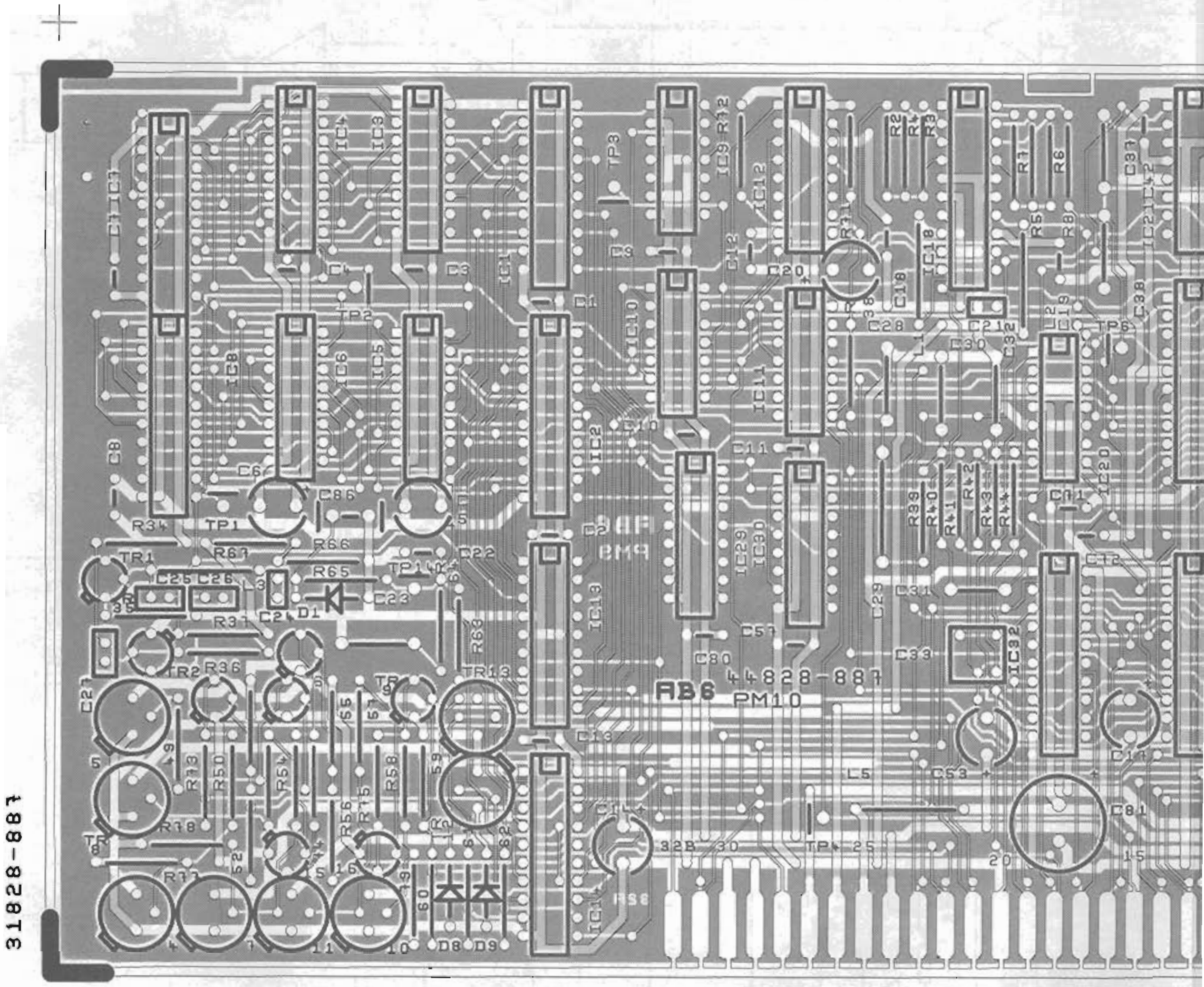


Drg. No. Z 44828-886Z
Sht. 3 of 3, Iss. 10

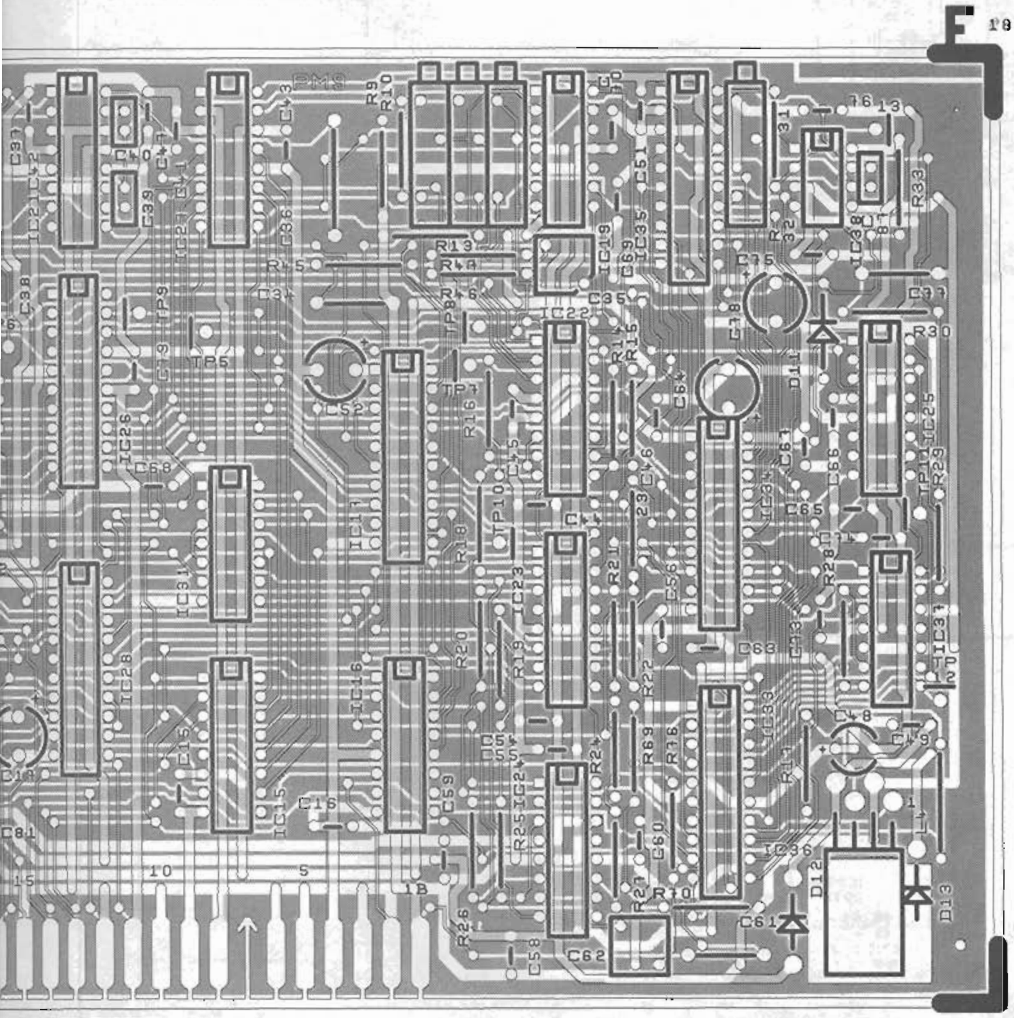
⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.



ation & scope (ranging & filters)

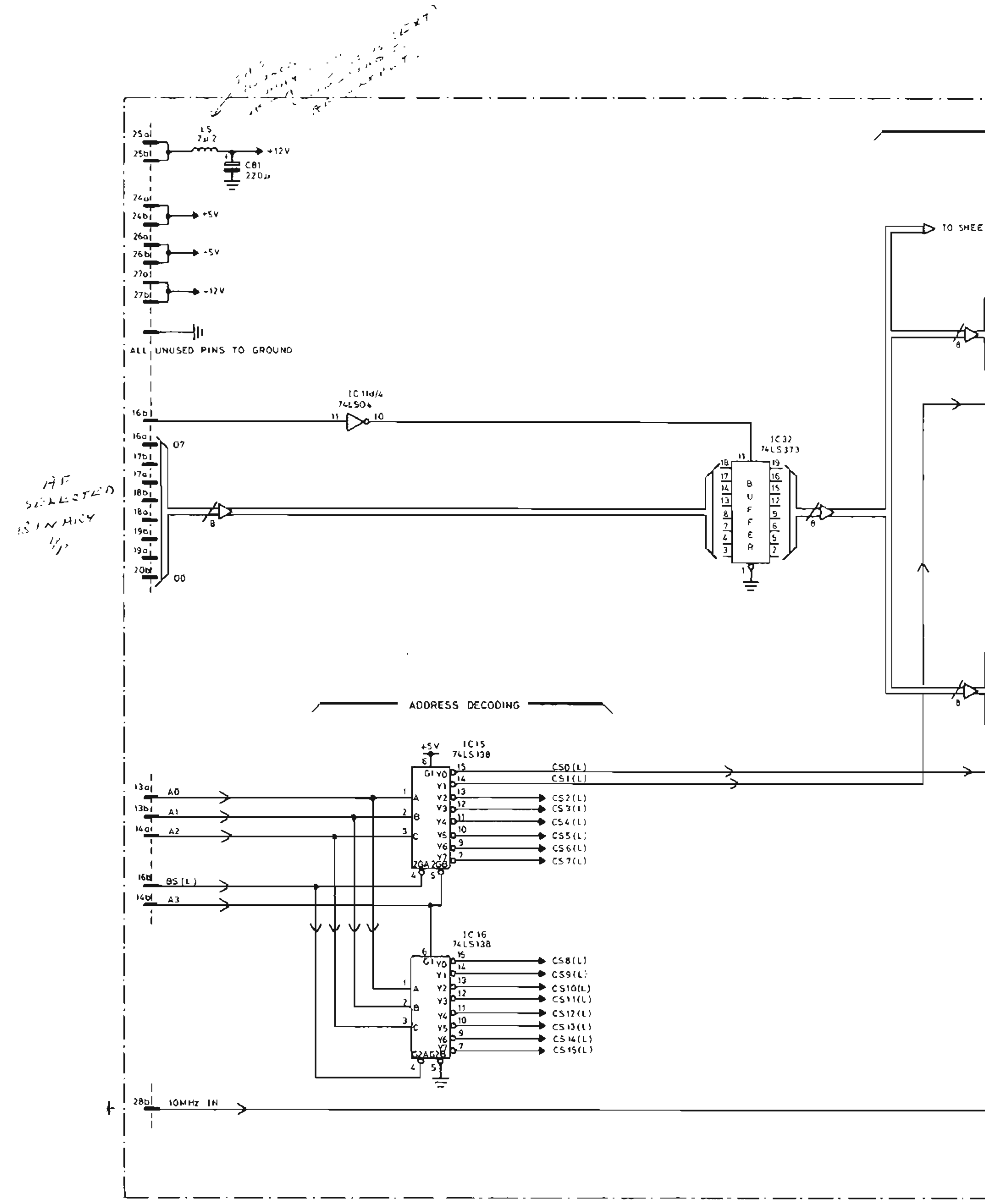


AB6 : Component layo



t layout

Fig. 22a



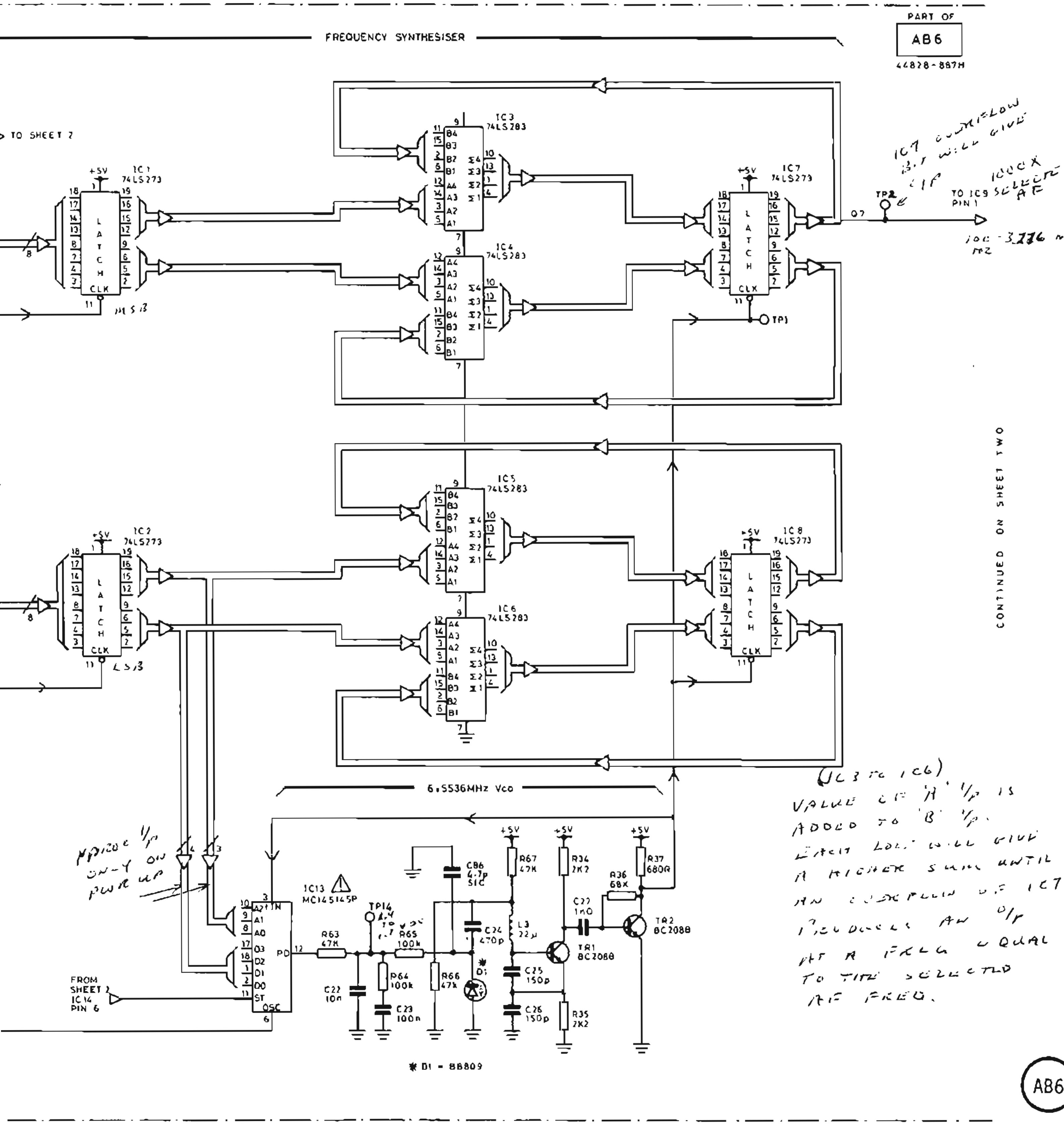
✦ DUPLICATED ON THIS DRAWING FOR CIRCUIT CLARITY

Drg. No. Z 44828-887H
Sh. 1 of 3, Iss. 5

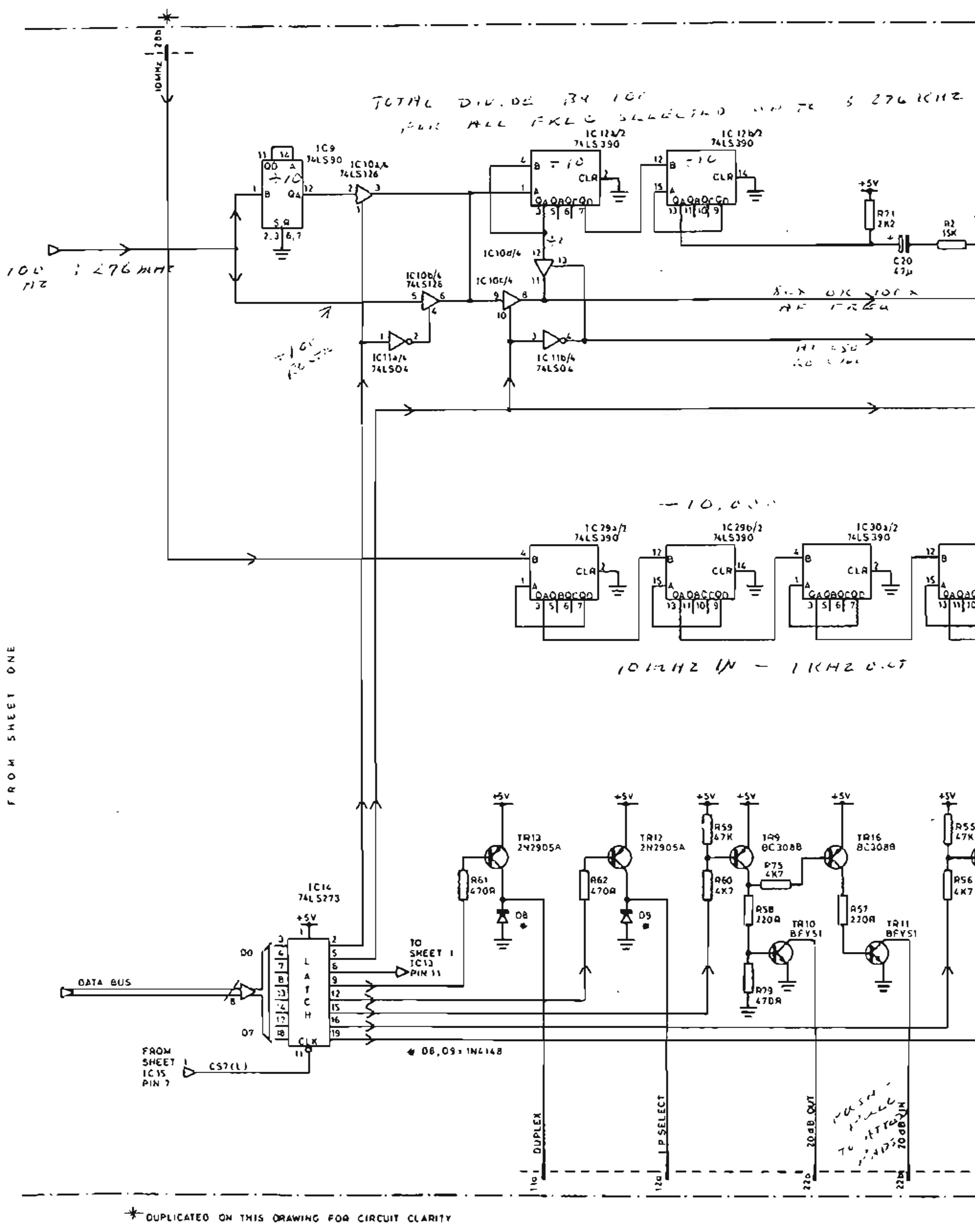
AB6 : AF synthesi

Fig. 22

Aug. 86 (Am. 2)



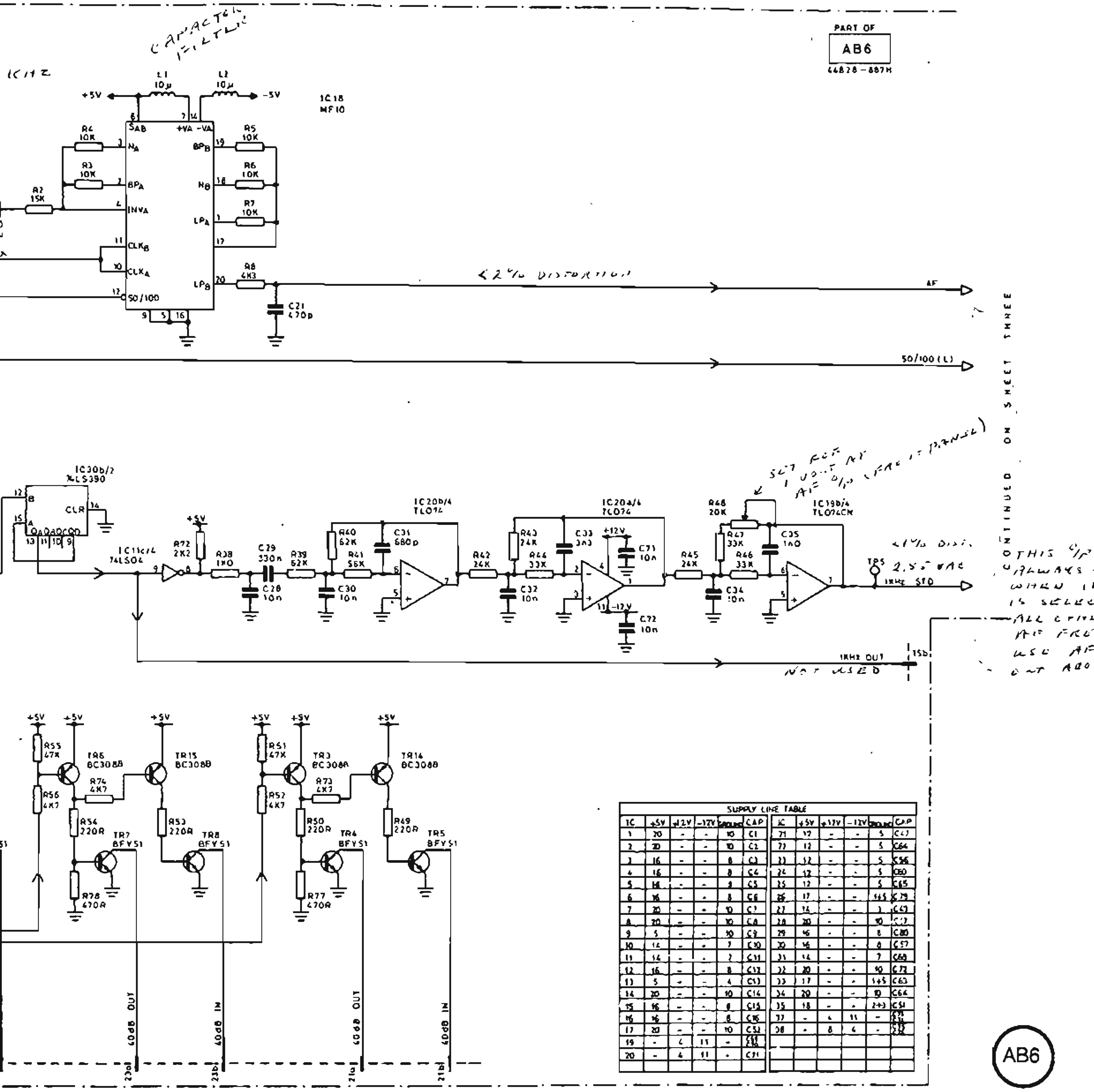
...nthesizer (bit rate multiplier)



Drg. No. Z 44828-887H
Sht. 2 of 3, Iss. 3

Fig. 23

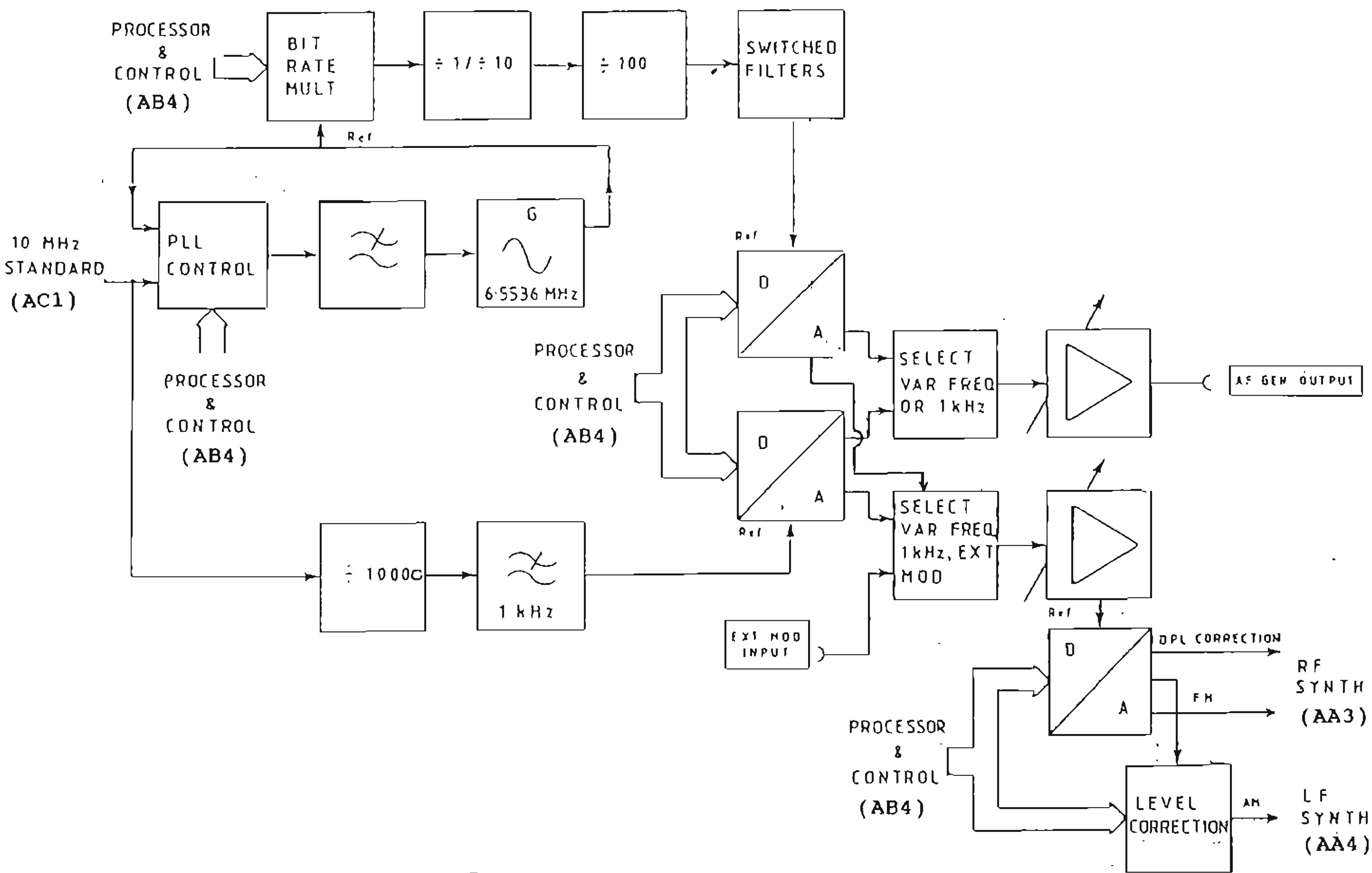
AB6 : AF synthe



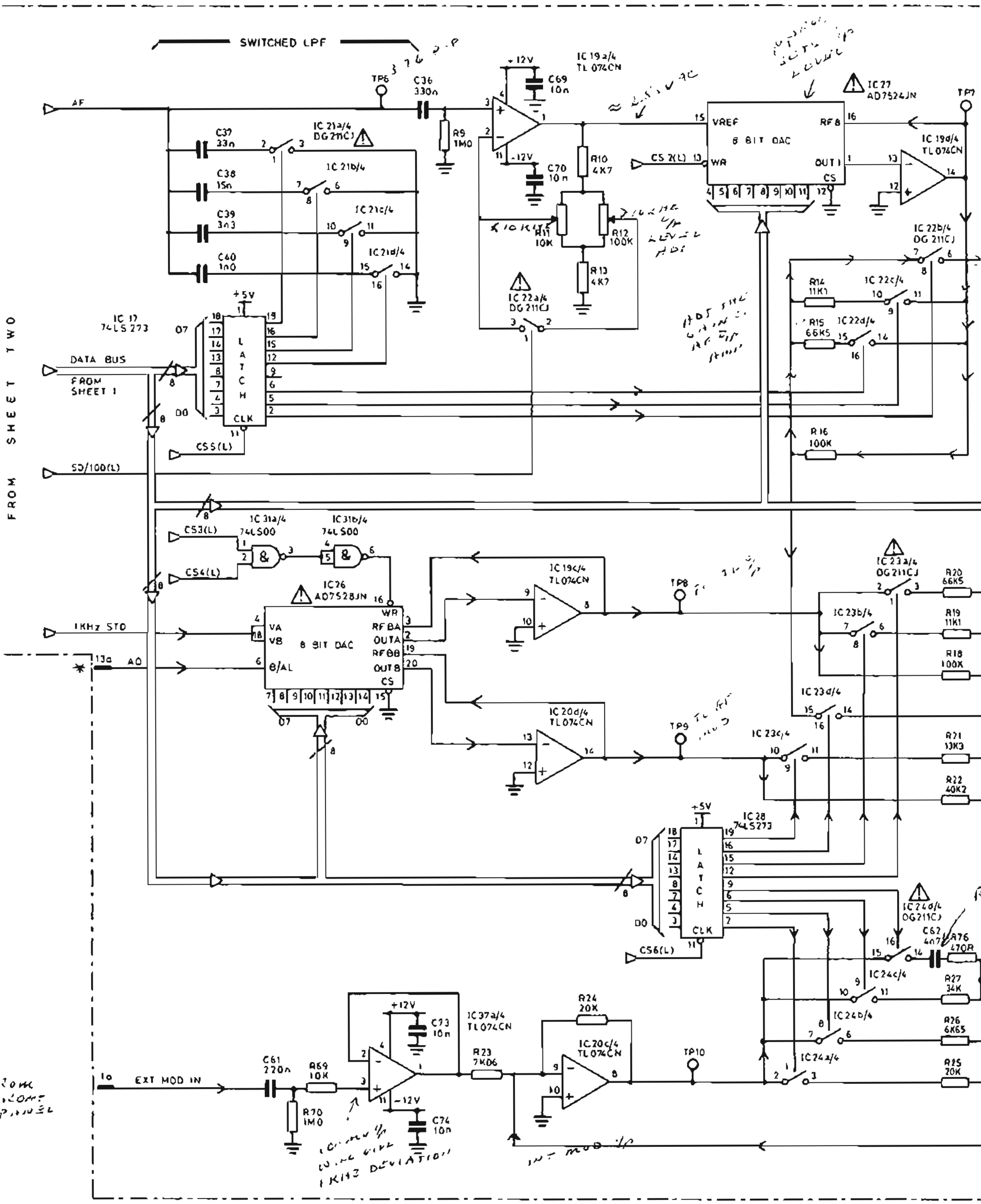
SUPPLY LINE TABLE											
IC	+5V	+12V	-12V	GROUND	CAP	IC	+5V	+12V	-12V	GROUND	CAP
1	20	-	-	10	C1	21	12	-	-	5	C47
2	20	-	-	10	C2	22	12	-	-	5	C64
3	16	-	-	8	C3	23	12	-	-	5	C56
4	16	-	-	8	C4	24	12	-	-	5	C60
5	16	-	-	8	C5	25	12	-	-	5	C65
6	16	-	-	8	C6	26	17	-	-	1+5	C79
7	20	-	-	10	C7	27	14	-	-	3	C67
8	20	-	-	10	C8	28	20	-	-	10	[illegible]
9	5	-	-	10	C9	29	16	-	-	8	C80
10	14	-	-	7	C10	30	16	-	-	8	C57
11	14	-	-	7	C11	31	14	-	-	7	C69
12	16	-	-	8	C12	32	20	-	-	10	C72
13	5	-	-	4	C13	33	17	-	-	1+5	C63
14	20	-	-	10	C14	34	20	-	-	10	C66
15	16	-	-	8	C15	35	18	-	-	2+3	C51
16	16	-	-	8	C16	37	-	4	11	-	[illegible]
17	20	-	-	10	C52	38	-	8	4	-	[illegible]
19	-	4	11	-	[illegible]						
20	-	4	11	-	C71						

synthesizer (filter & dividers)

AF SYNTHESIZER BOARD (AB6)



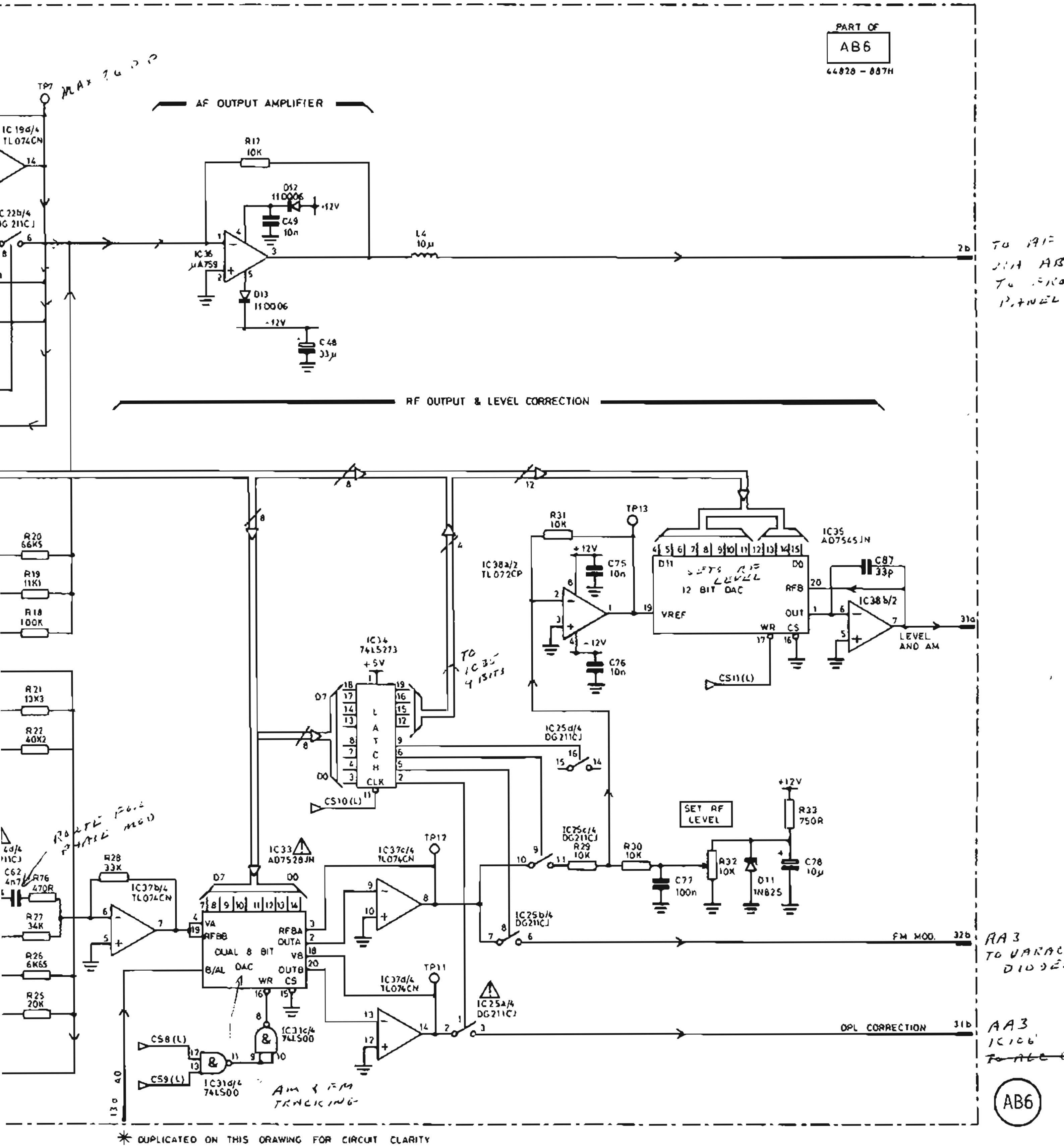
M14



Drg. No. Z 44828-887H
Sht. 3 of 3, Iss. 6

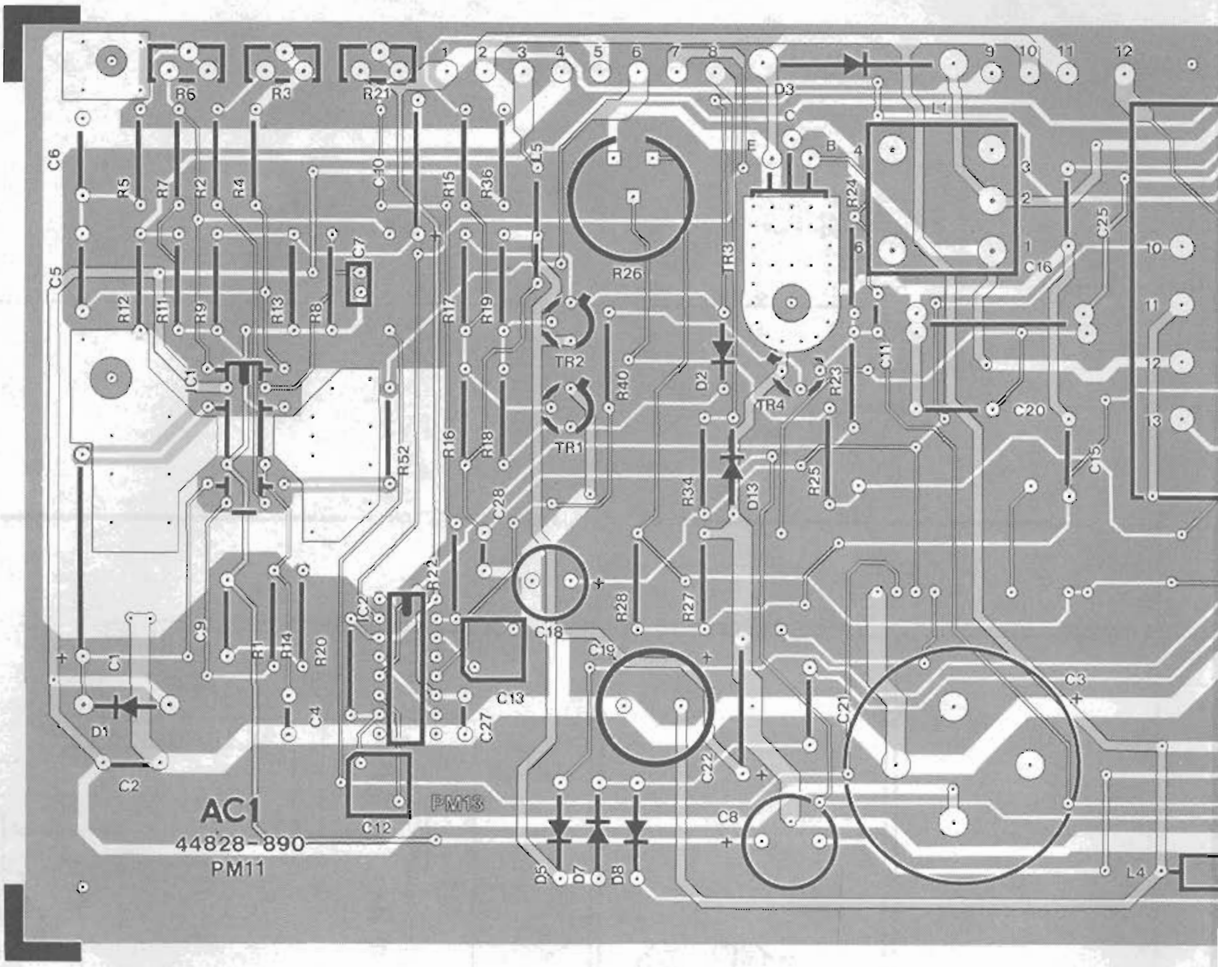
⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

Fig. 24

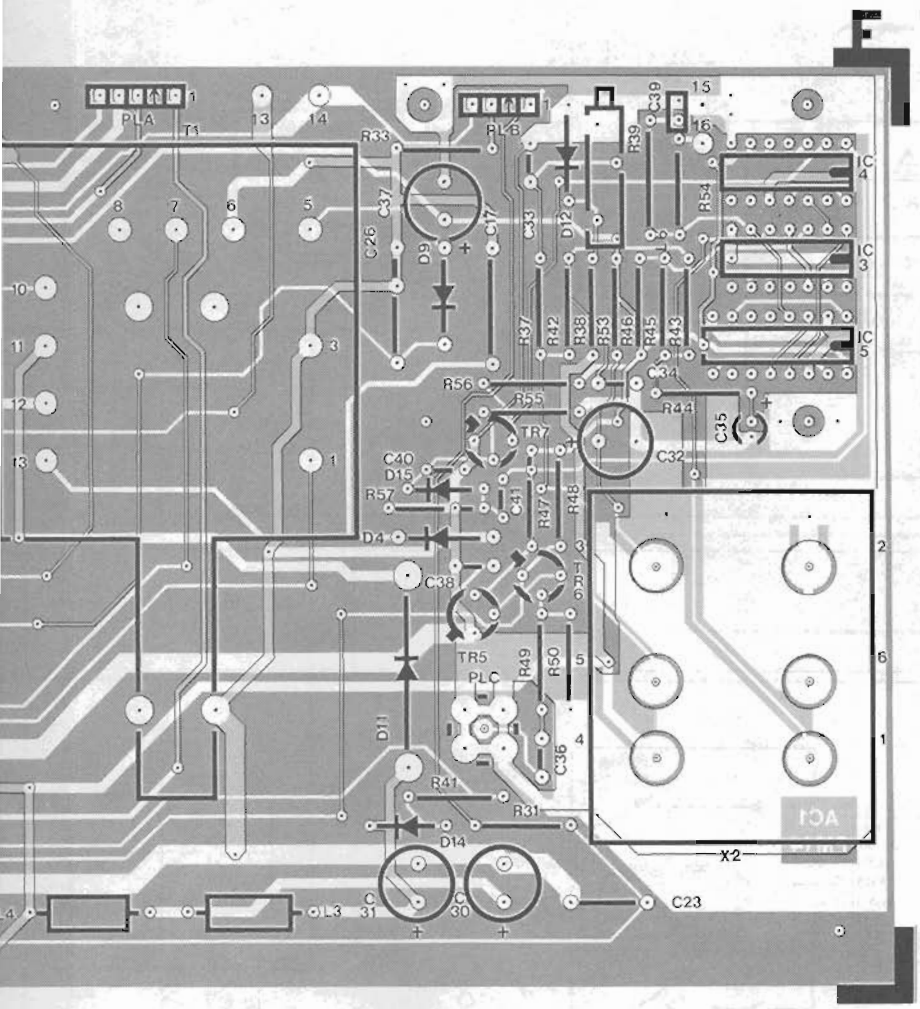


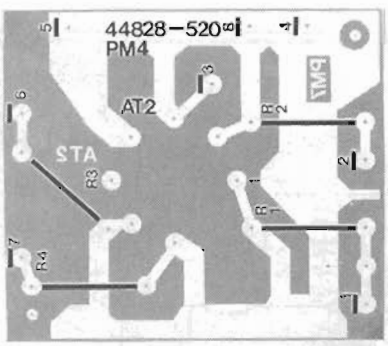
* DUPLICATED ON THIS DRAWING FOR CIRCUIT CLARITY

synthesizer (D-A conversion)



Component layout :



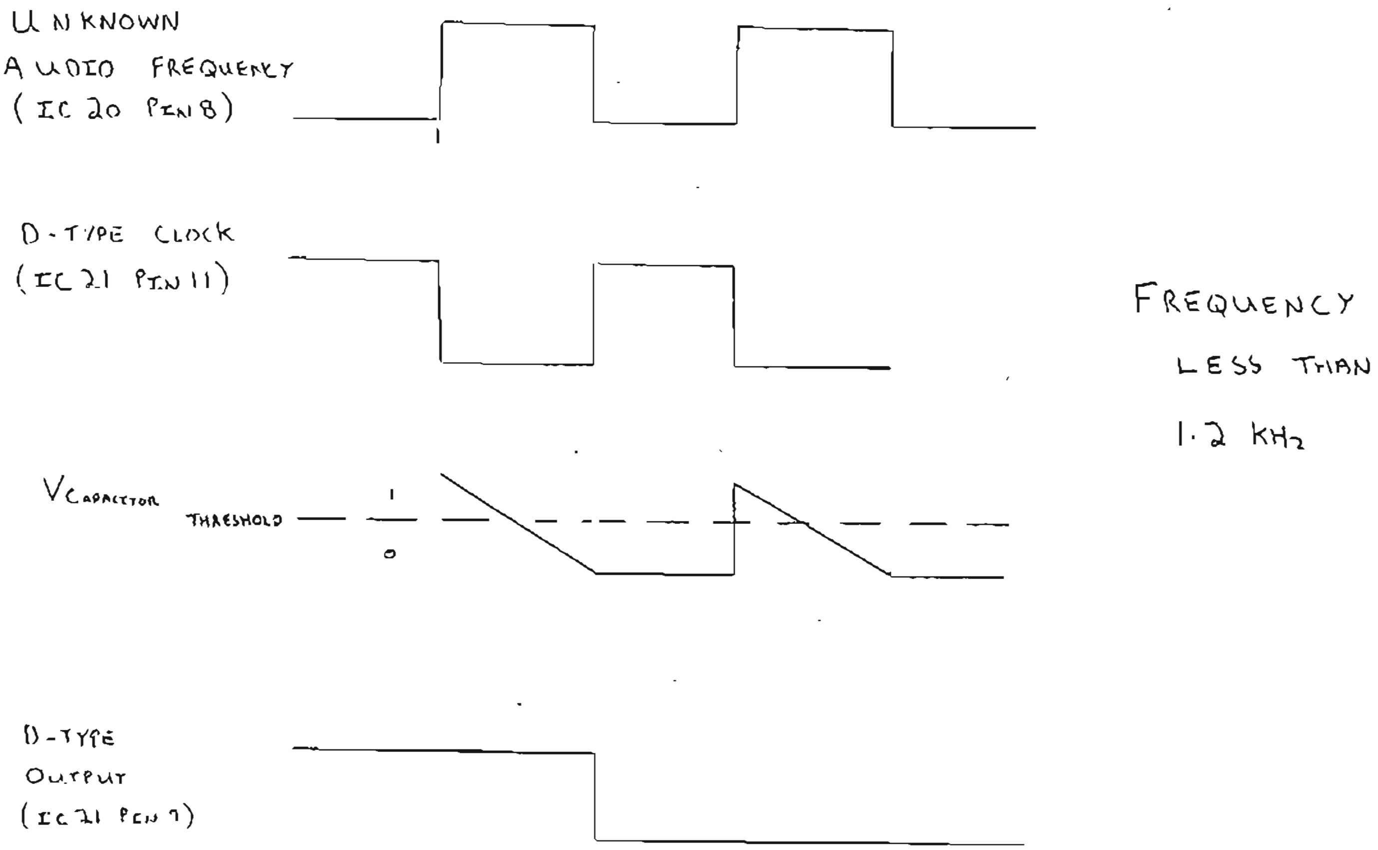


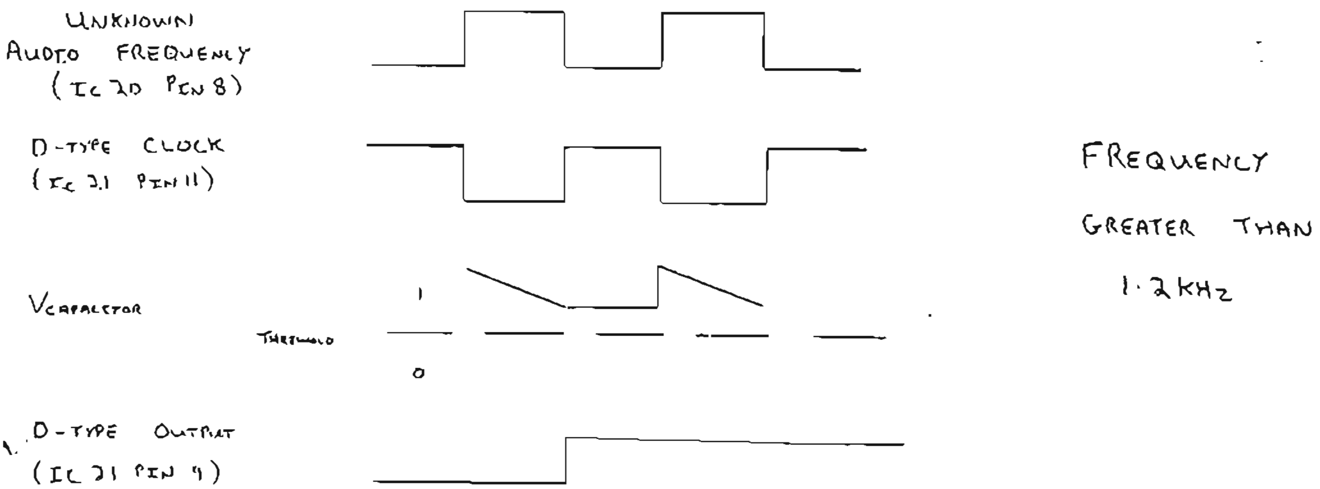
yout : AC1, AT2

Fig. 25a

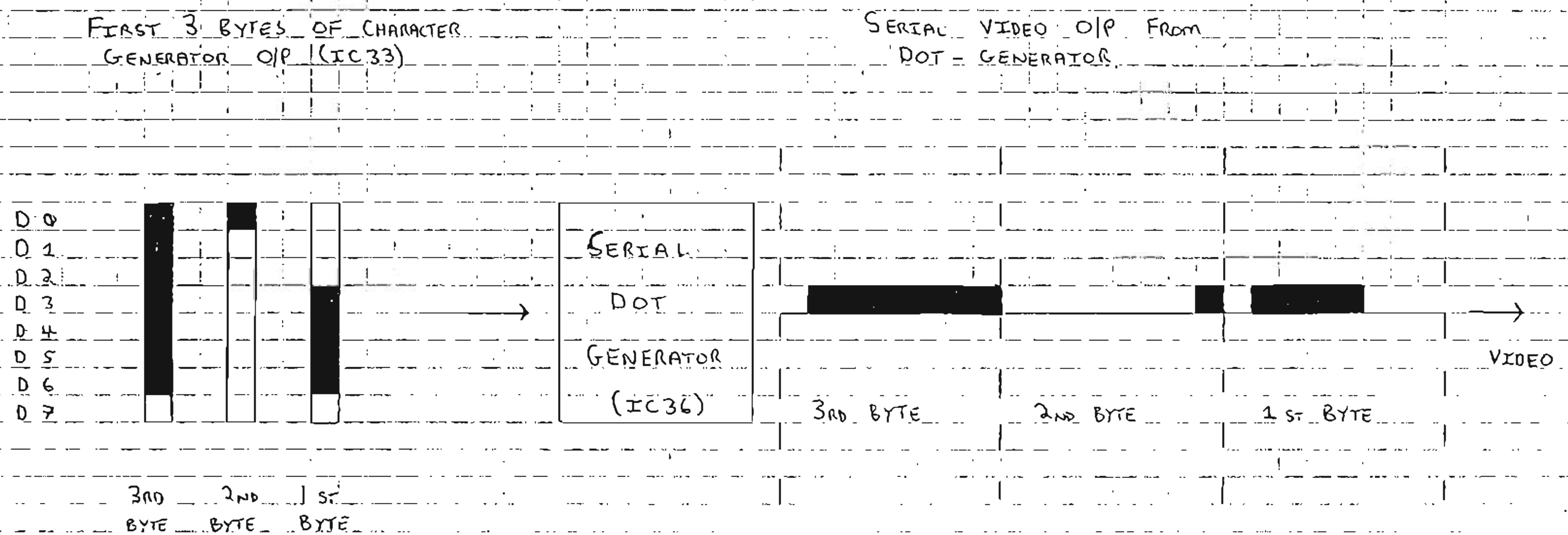
FREQUENCY COMPARATOR OPERATION.

[AUDIO COUNTER ON ABL]

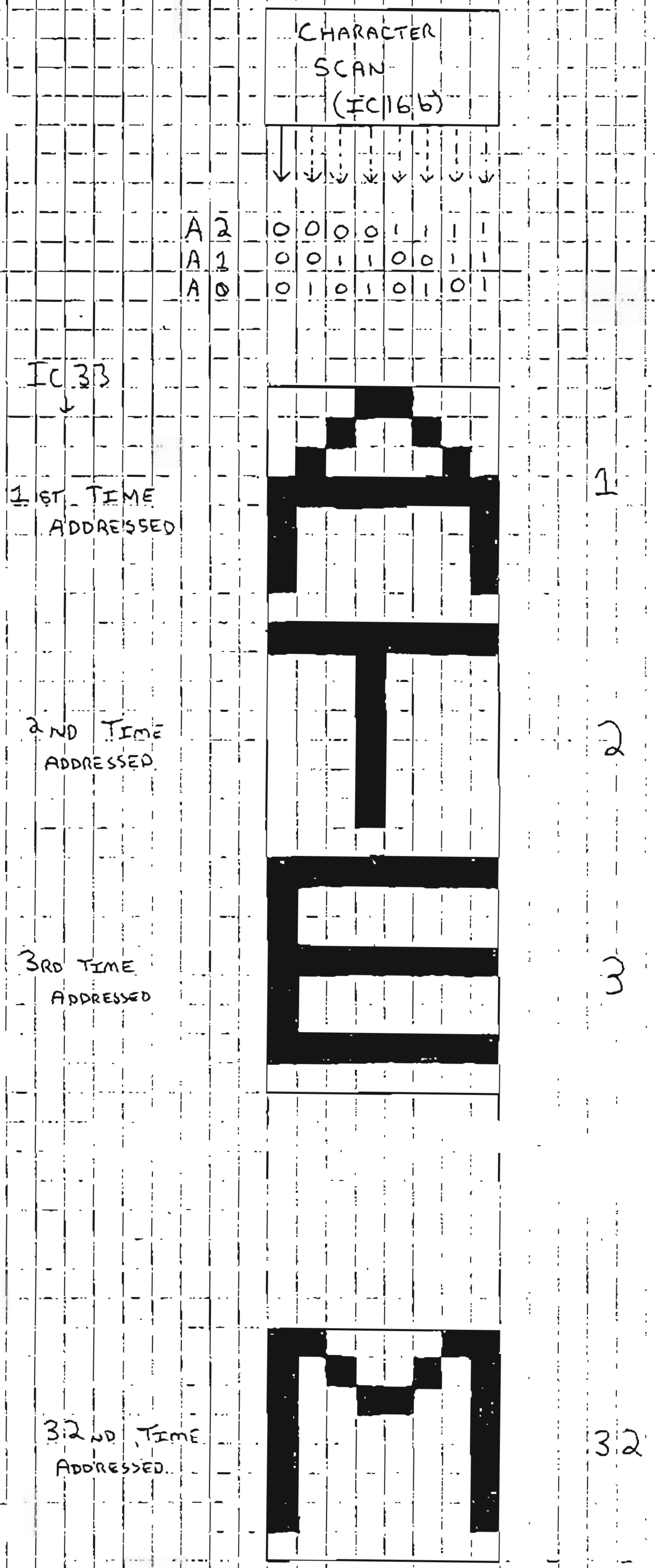


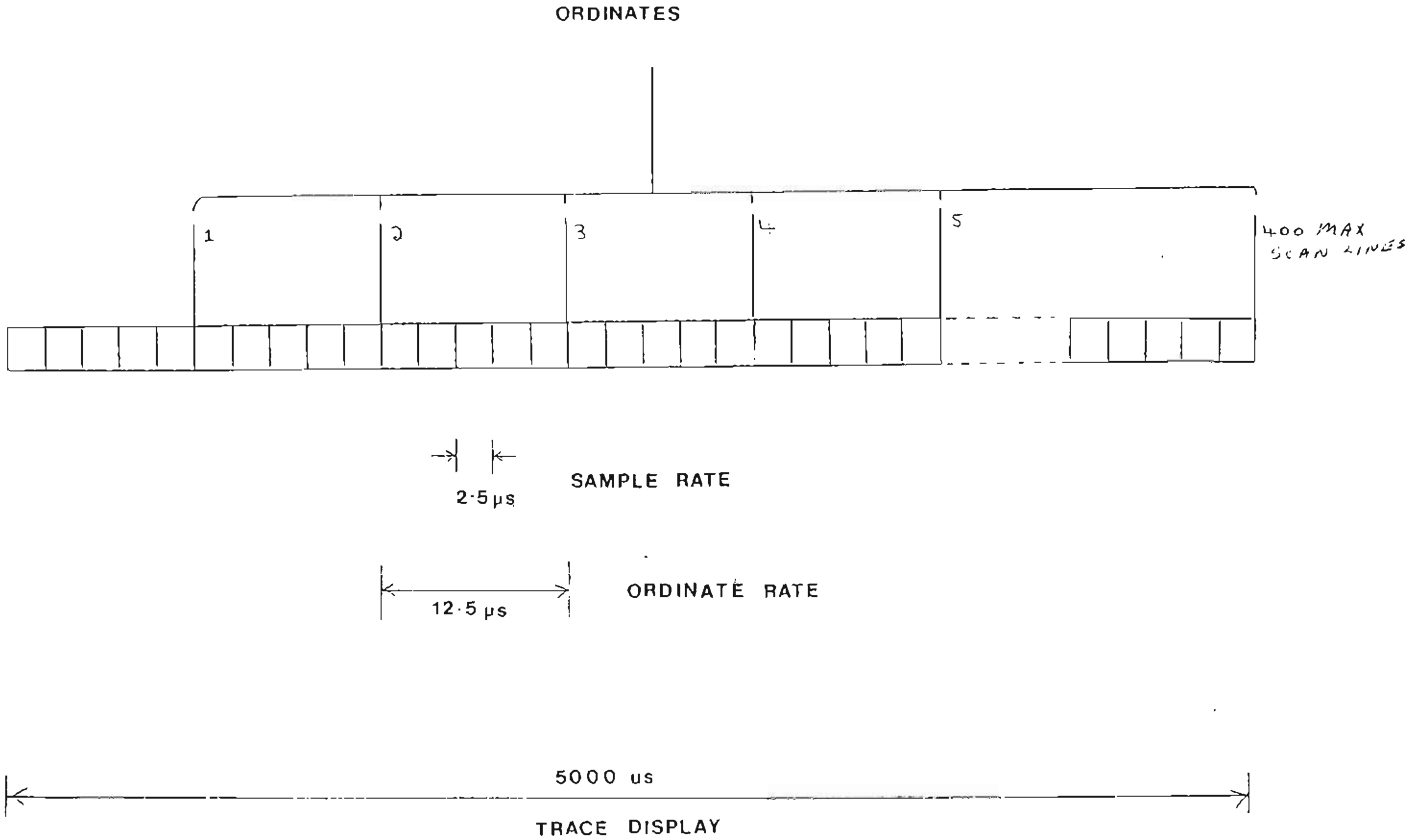


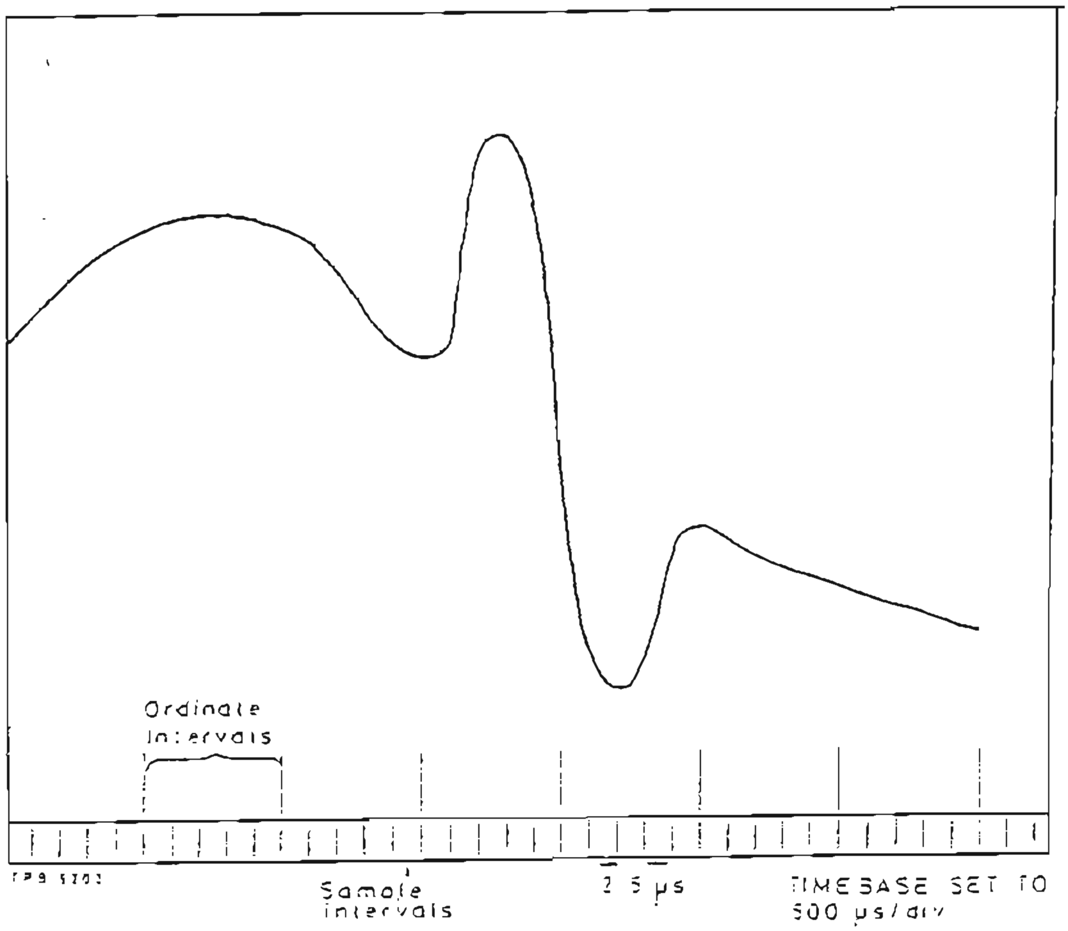
GOES WITH FIG 17 PAGE 35/36


FIRST 3 BYTES OF CHARACTER GENERATOR O/P (IC33)
D0
D1
D2
D3
D4
D5
D6
D7
3RD BYTE
2ND BYTE
1ST BYTE
SERIAL DOT GENERATOR (IC36)
SERIAL VIDEO O/P FROM DOT - GENERATOR
3RD BYTE
2ND BYTE
1 ST BYTE
VIDEO

M16


CHARACTER SCAN (IC16b)
A2 0 0 0 0 1 1 1 1
A1 0 0 1 1 0 0 1 1
A0 0 1 0 1 0 1 0 1
IC33
1ST TIME ADDRESSED
2ND TIME ADDRESSED
3RD TIME ADDRESSED
32ND TIME ADDRESSED
1
2
3
32


ORDINATES
1
2
3
4
5
400 MAX
SCAN LINES
2·5 μs
SAMPLE RATE
12·5 μs
ORDINATE RATE
5000 us
TRACE DISPLAY



THIS DIAGRAM IS ONLY A SMALL PORTION OF THE ENTIRE HORZ SWEEP. (NOT REALLY ON CRT).
IT SHOWS A GLITCH ON A WAVEFORM

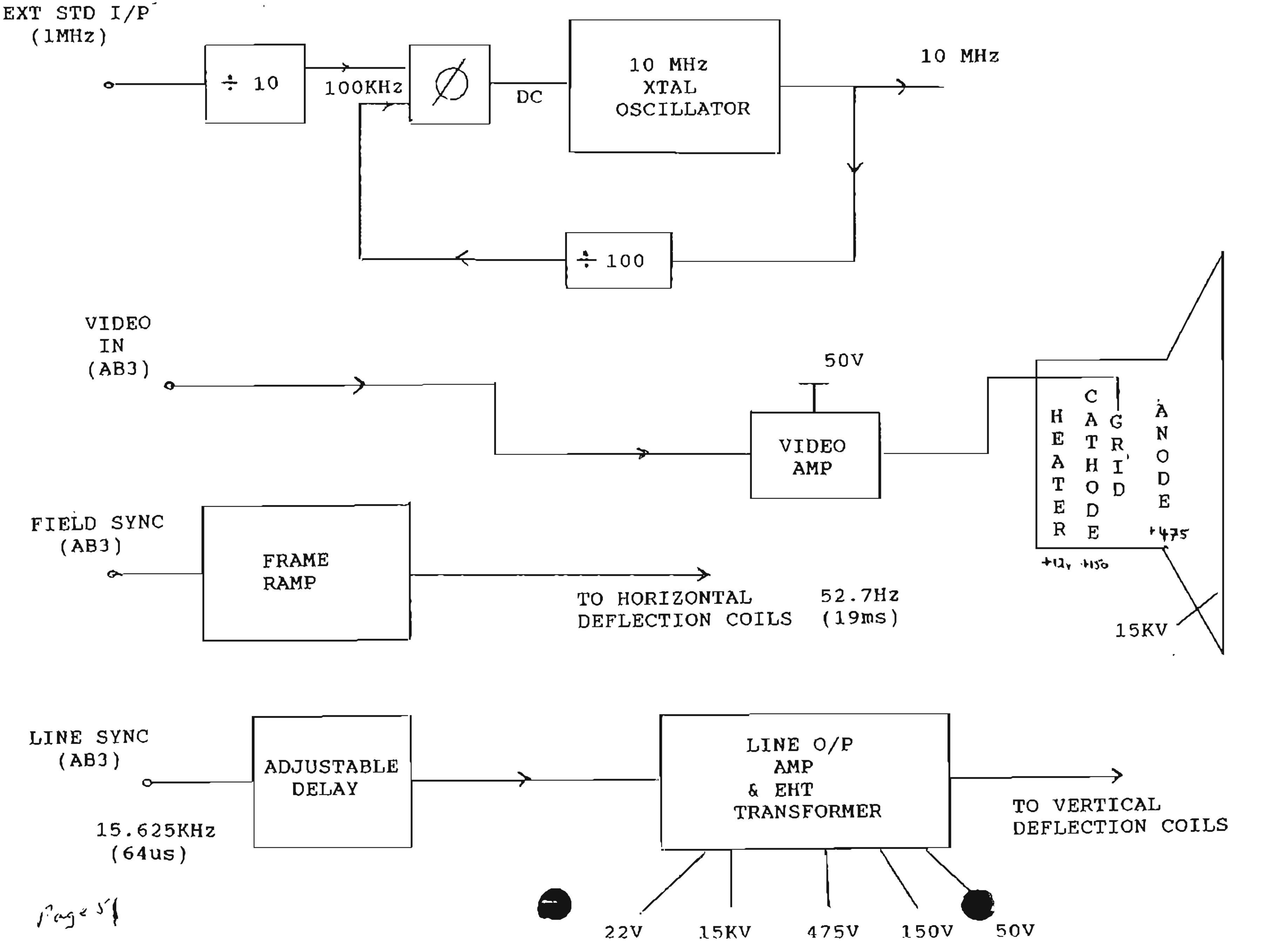
SAMPLES ARE TAKEN EVERY 2 5 µS

1 LINE IS DRAWN ON SCOPE FOR EVERY 5 SAMPLES.
THE MIN AND MAX OF EVERY 10 SAMPLES IS TAKEN TO PRODUCE A LINE ON DISPLAY.

NOTE: DISPLAY IS SCANNED VERTICALLY
MAX OF 400 SCANS.
(DEPENDENT ON TIME/DIV).

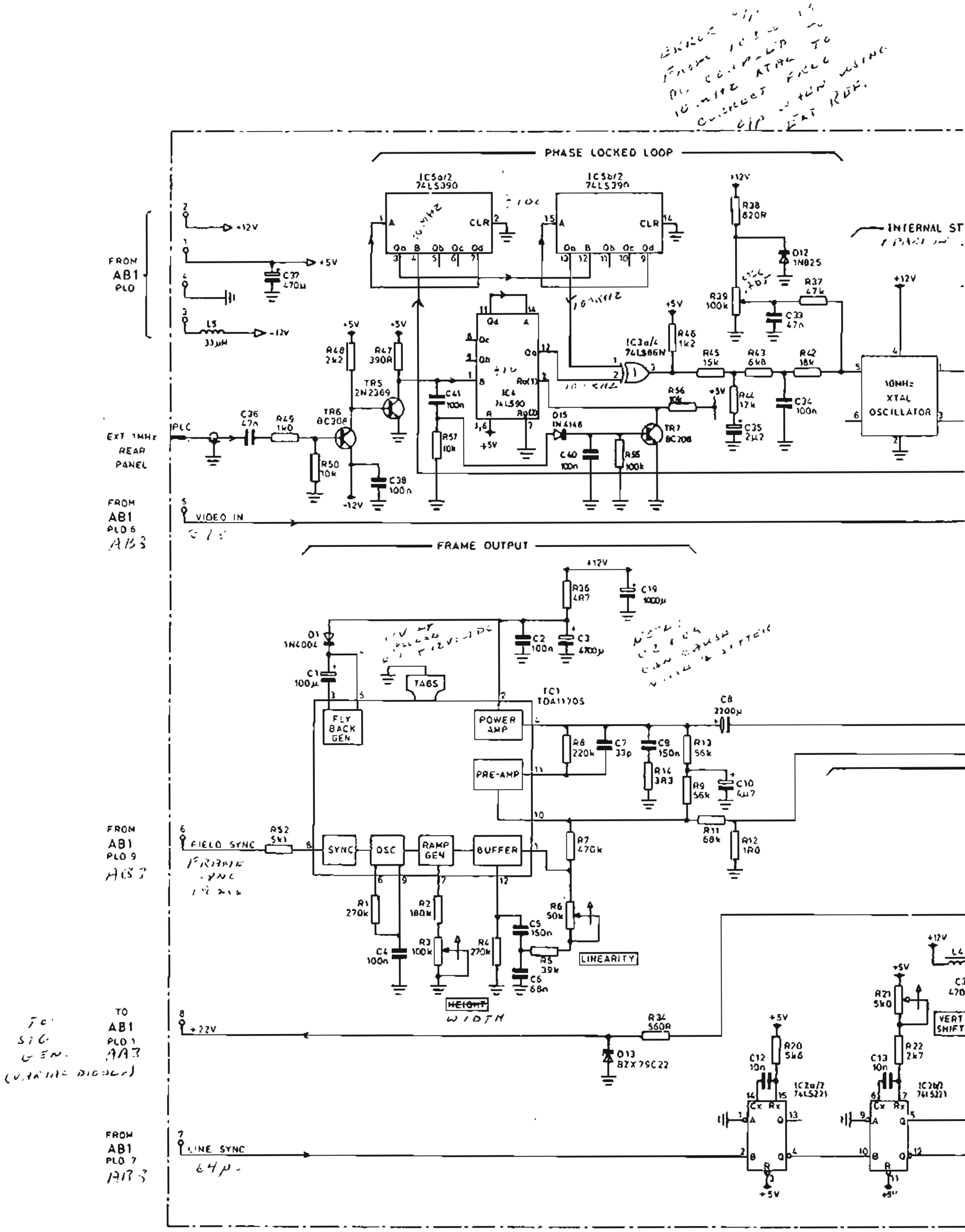
SEE PAGE 42, CHAP 4-2 IN SERVICE MANUAL

CRT DRIVE BOARD AC1



Page 51

M13

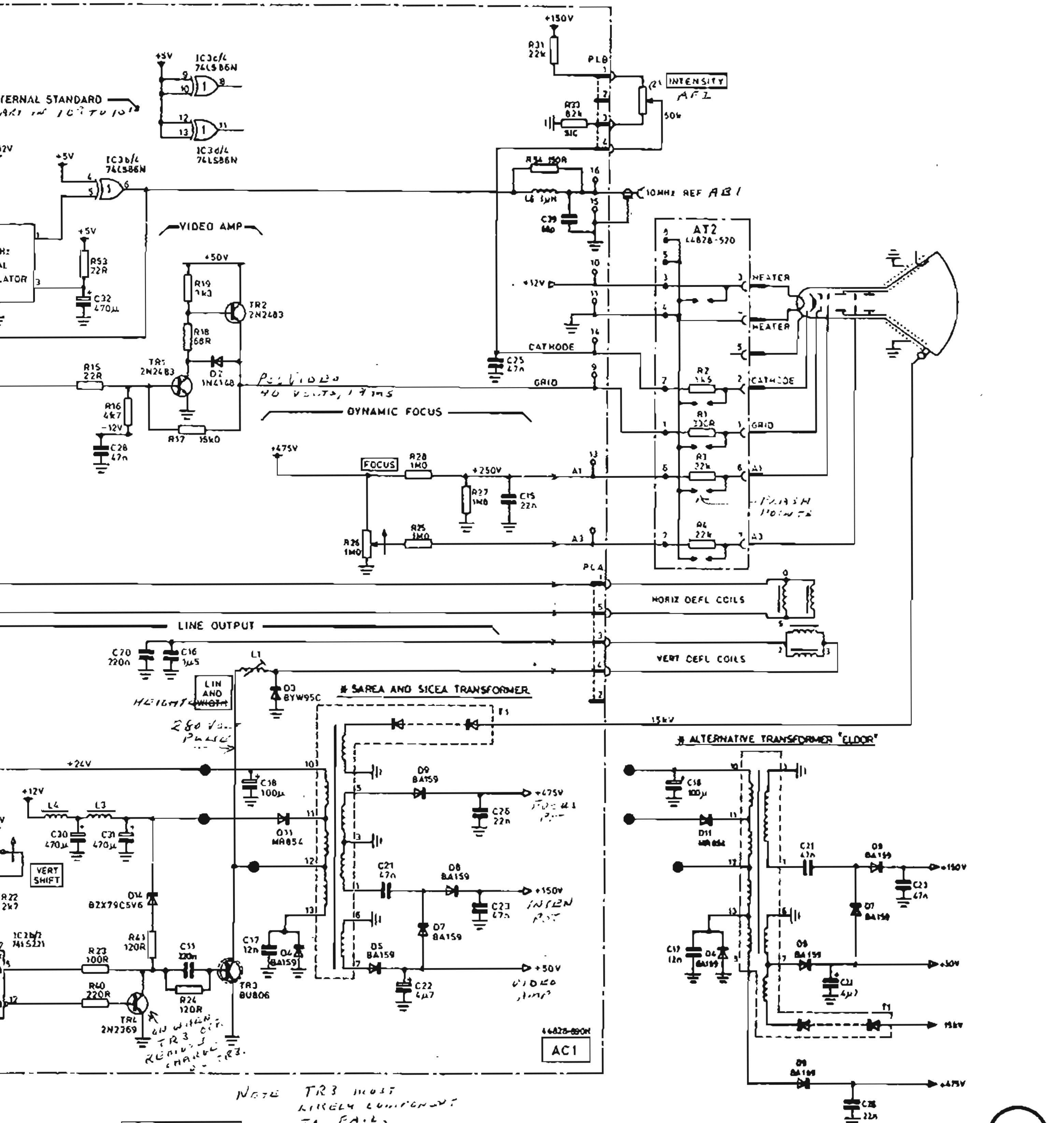


Drg. No. Z 44828-890H
Sht. 1 of 1, Iss. 12

Fig. 25

Apr. 89 (Am. 10)

AC1
AT2



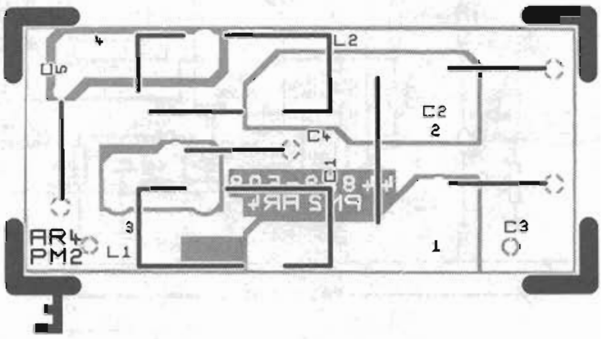
SUPPLY LINE TABLE		
IC	+5V	GROUND
IC2	14	6
IC3	14	7
IC4	5	10
IC5	16	8

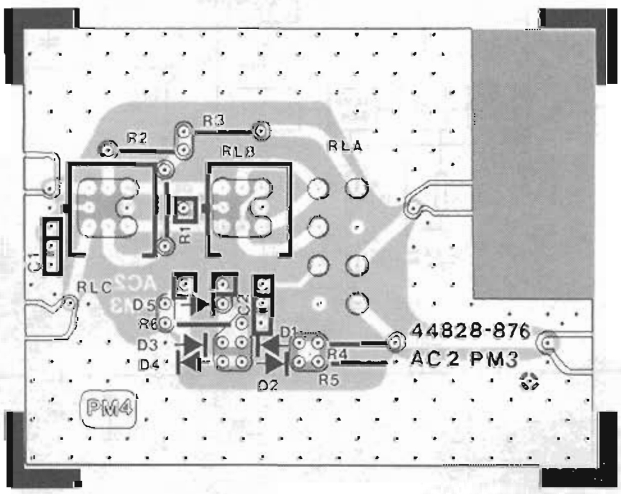
AC1 : CRT drive
AT2 : CRT base

AC1
AT2

Component layout : AC

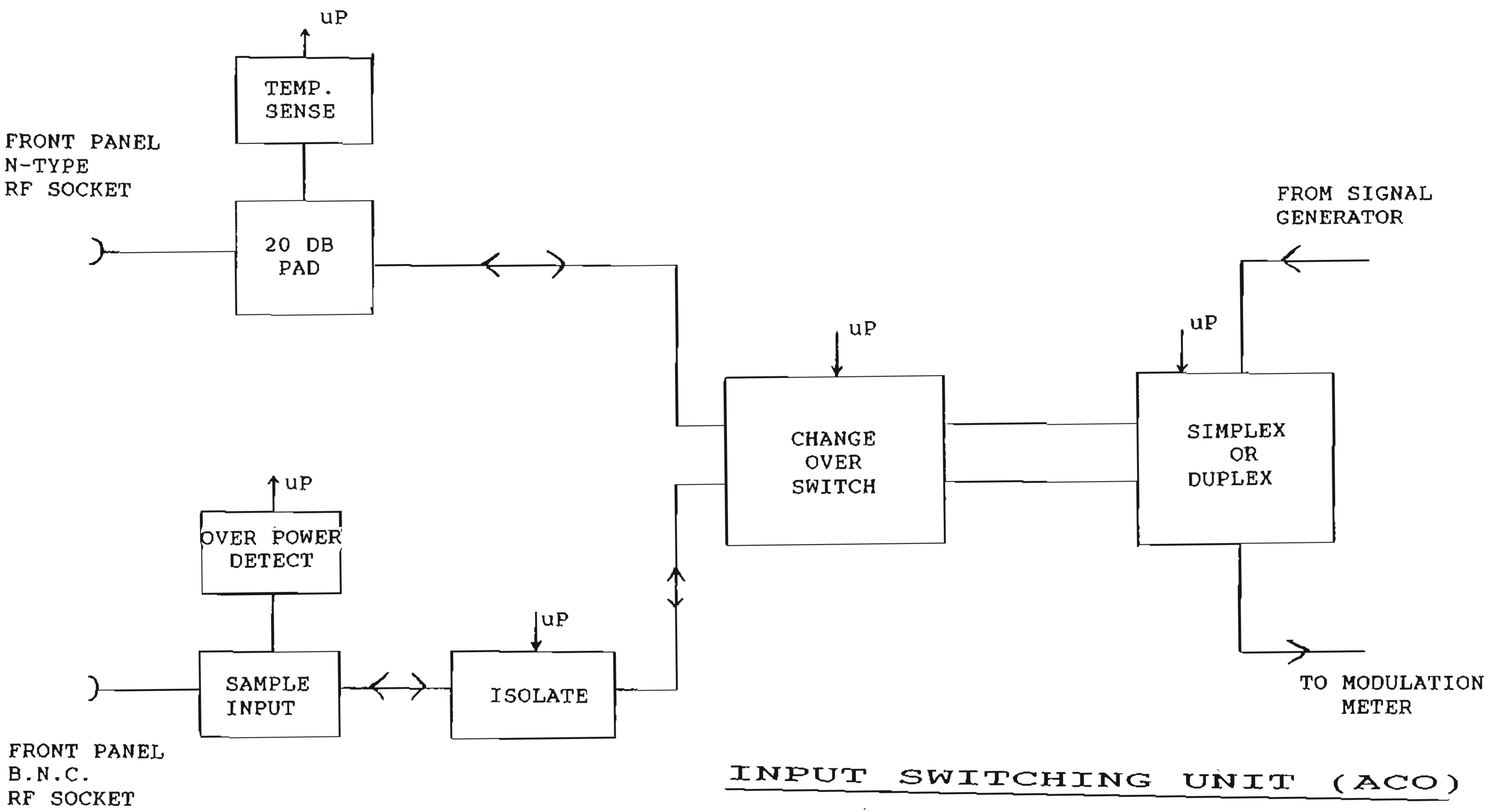
Fig. 26a
Chap. 7
Page 52





ut : AC2, AR4

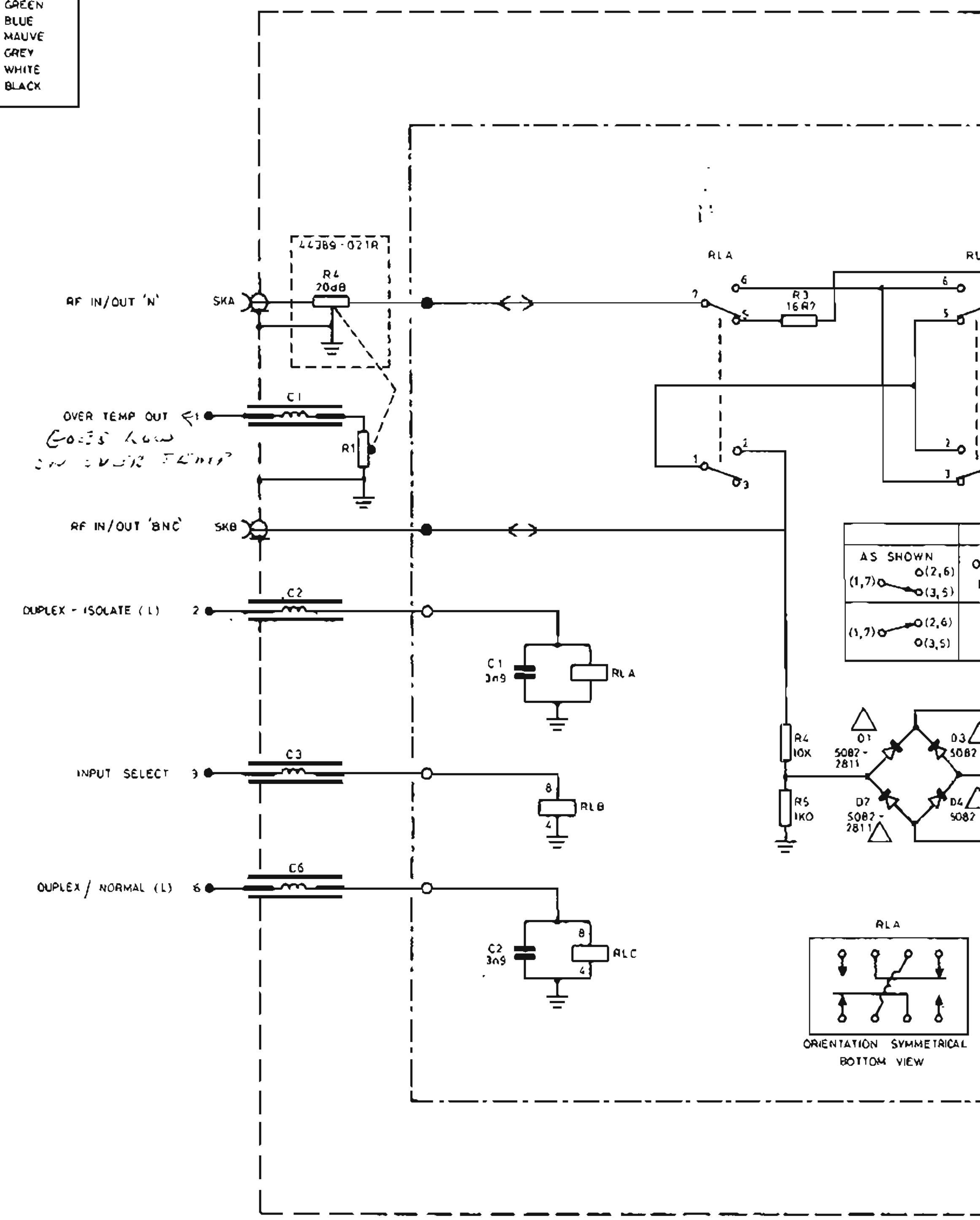
Fig. 26a



INPUT SWITCHING UNIT (ACO)

PAGE 53

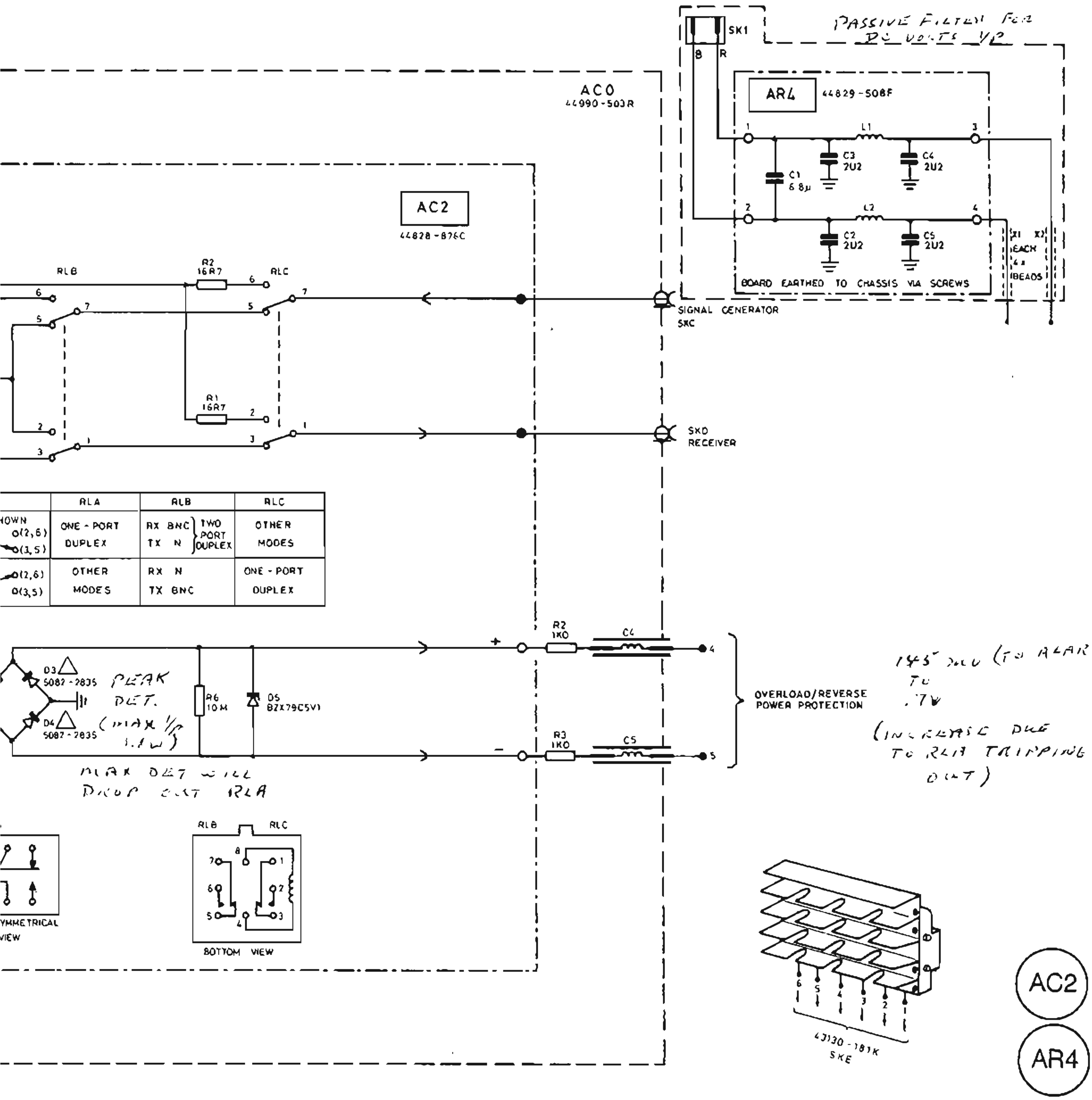
AC2	AB1 PLM	COLOUR
3	1	BROWN
1	2	RED
6	3	ORANGE
5	4	YELLOW
NC	5	GREEN
NC	6	BLUE
NC	7	MAUVE
4	8	GREY
2	9	WHITE
NC	KEY	BLACK



Drg. No. Z 44828-876X
Sh. 1 of 1, Iss. 5

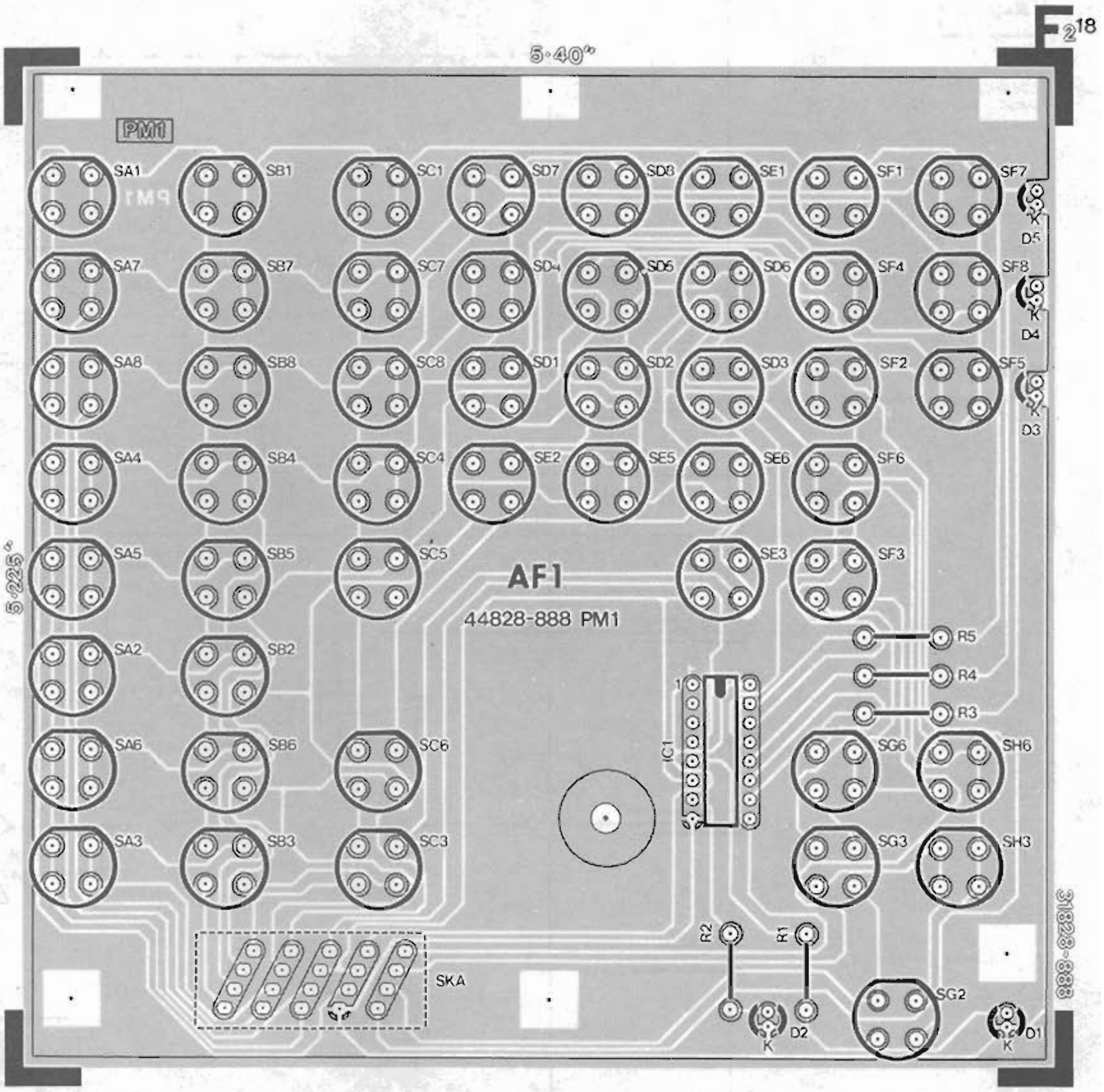
△ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

..B↓, RLC ↓
..B↑, RLC ↓
..B↓ RLC ↑



AC2 : Input switching
AR4 : DC filter

AF1 : Component

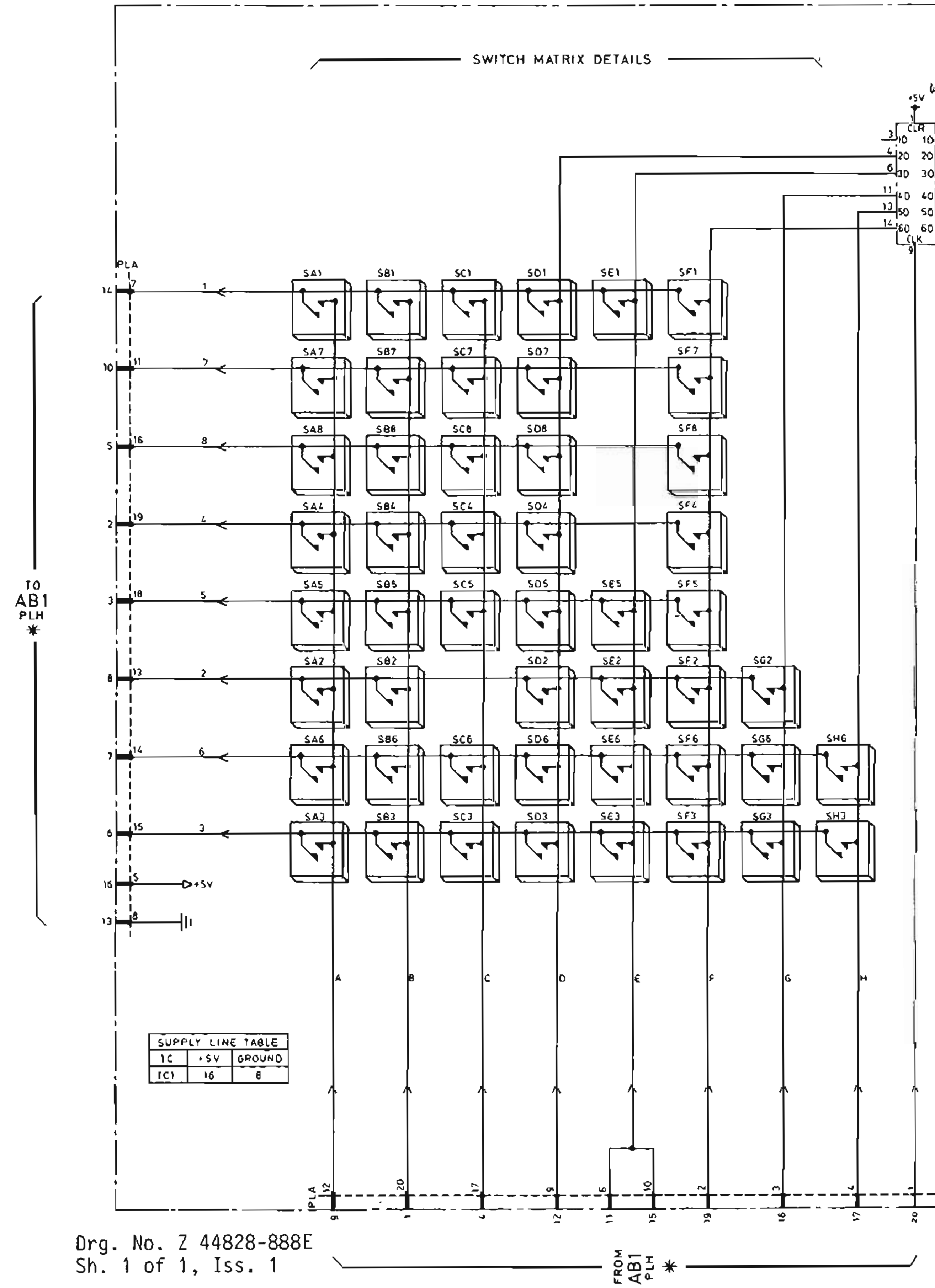


31828-888

...onent layout

Fig. 27a

June 85

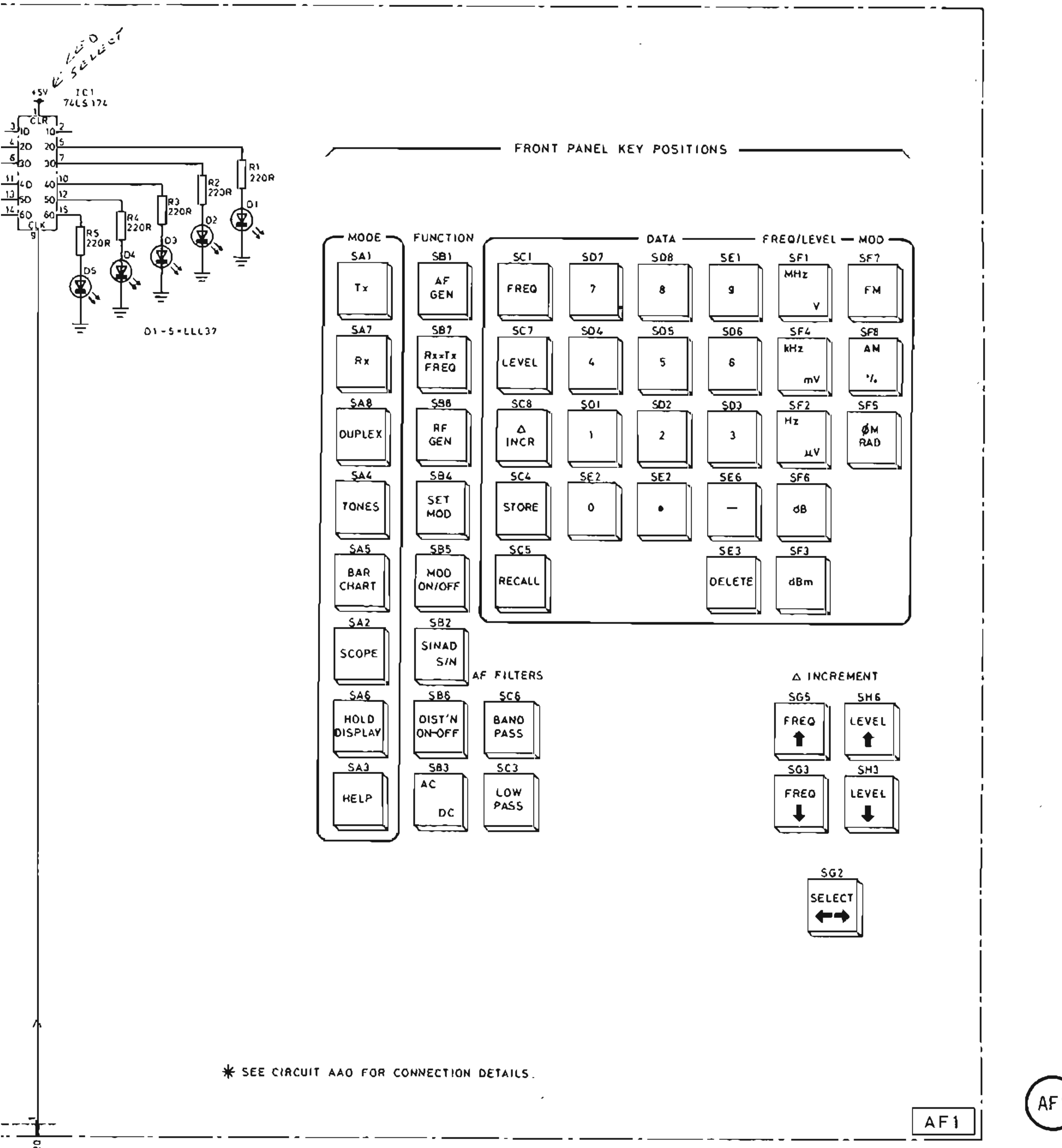


Drg. No. Z 44828-888E
Sh. 1 of 1, Iss. 1

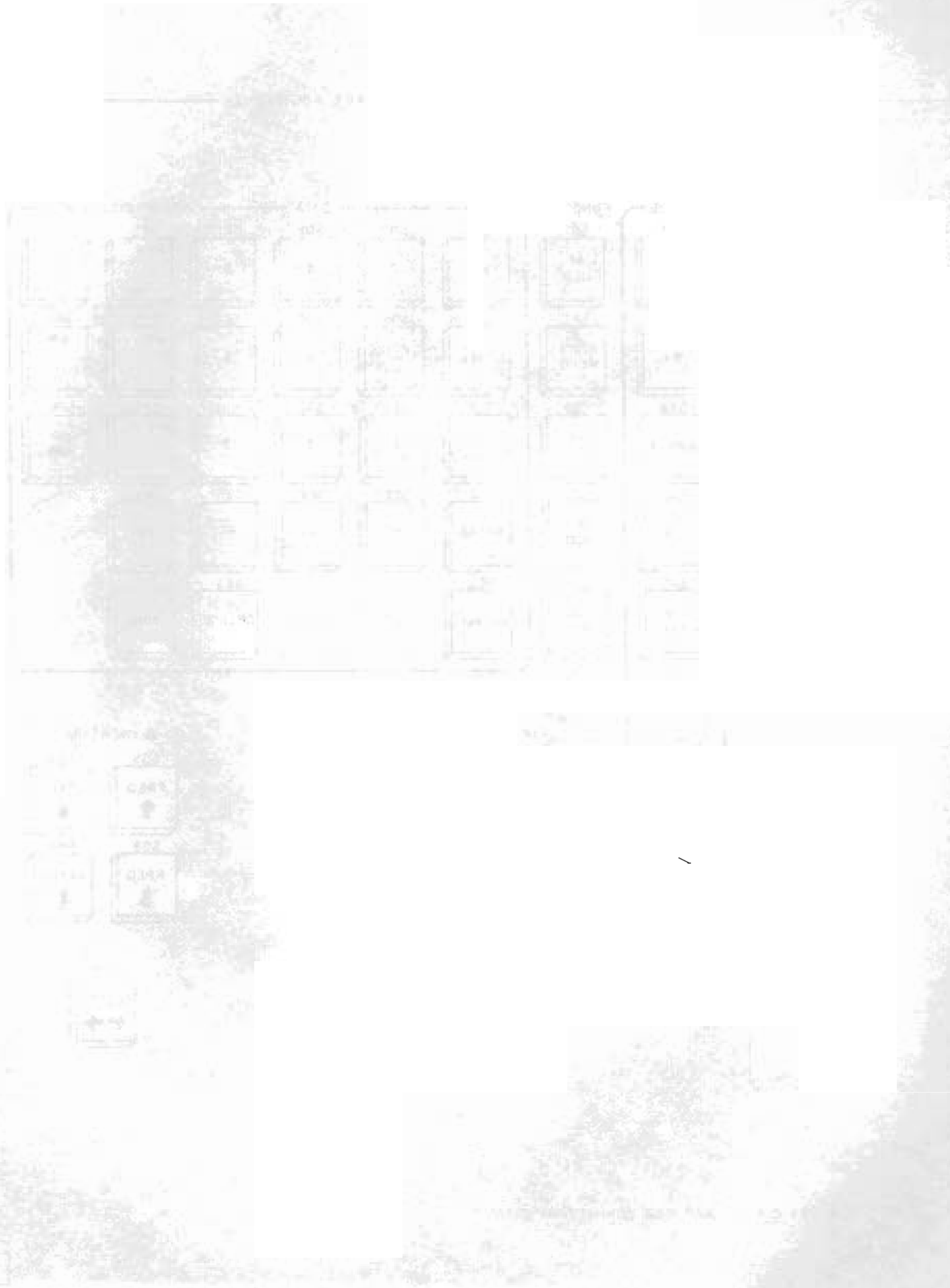
AF1 : M

Fig. 27

June 85

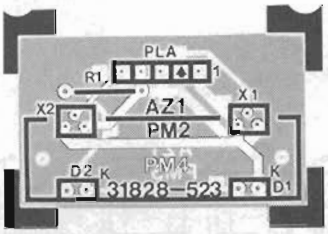


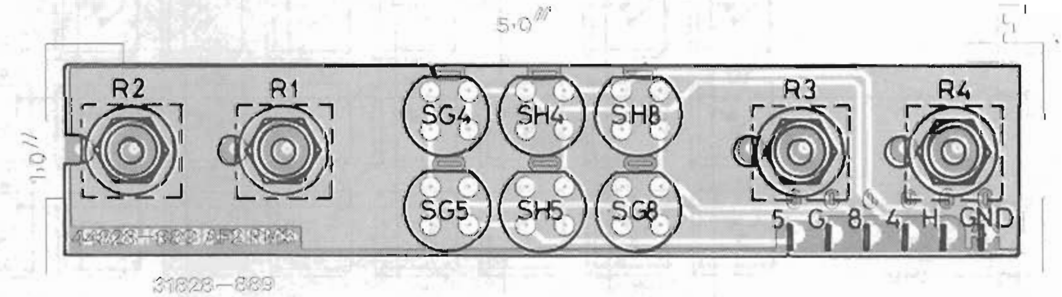
F1 : Main keyboard



Board layout : AF2,

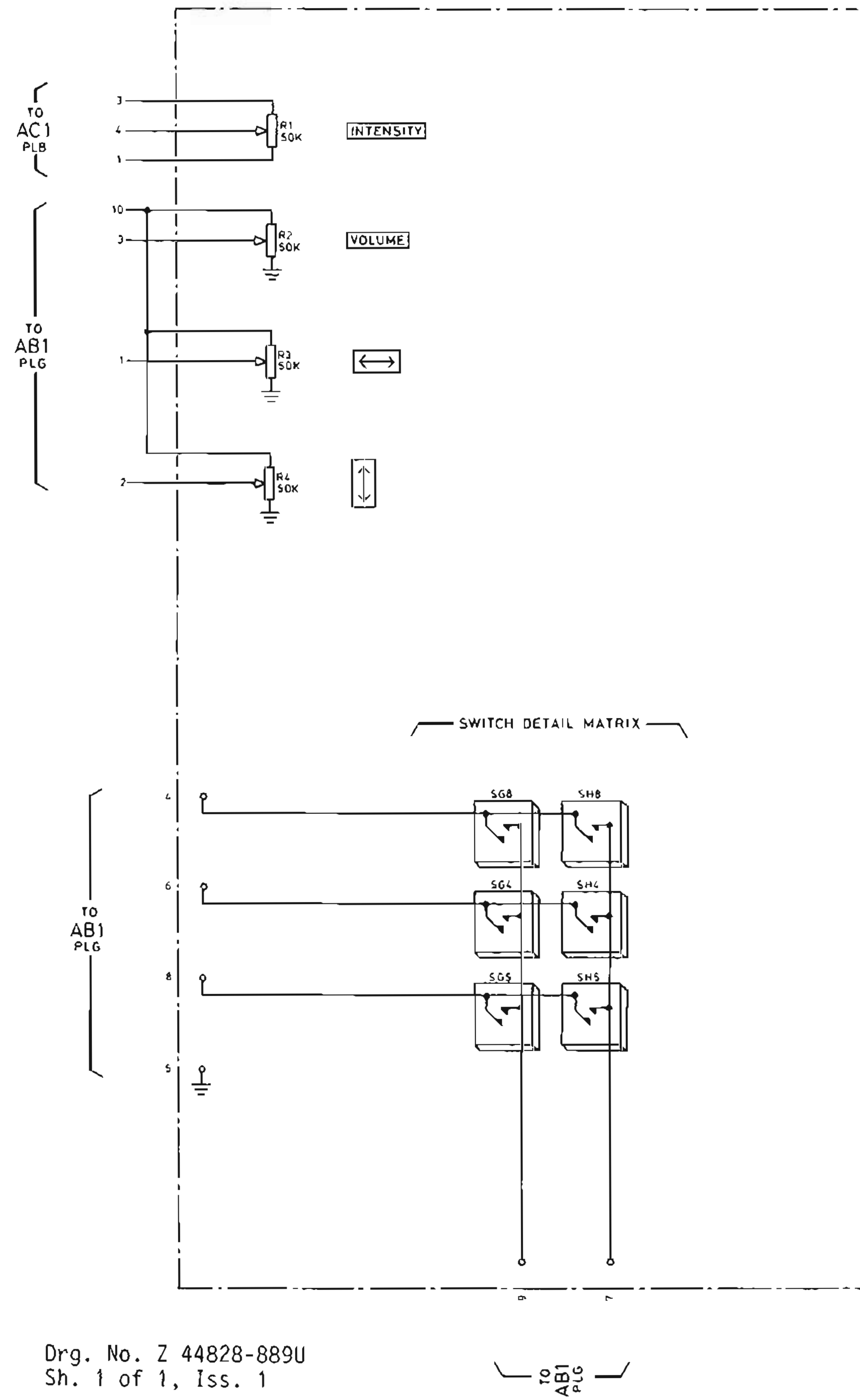
Fig. 28a
Chap. 7
Page 56





: AF2, AZ1

Fig. 28a

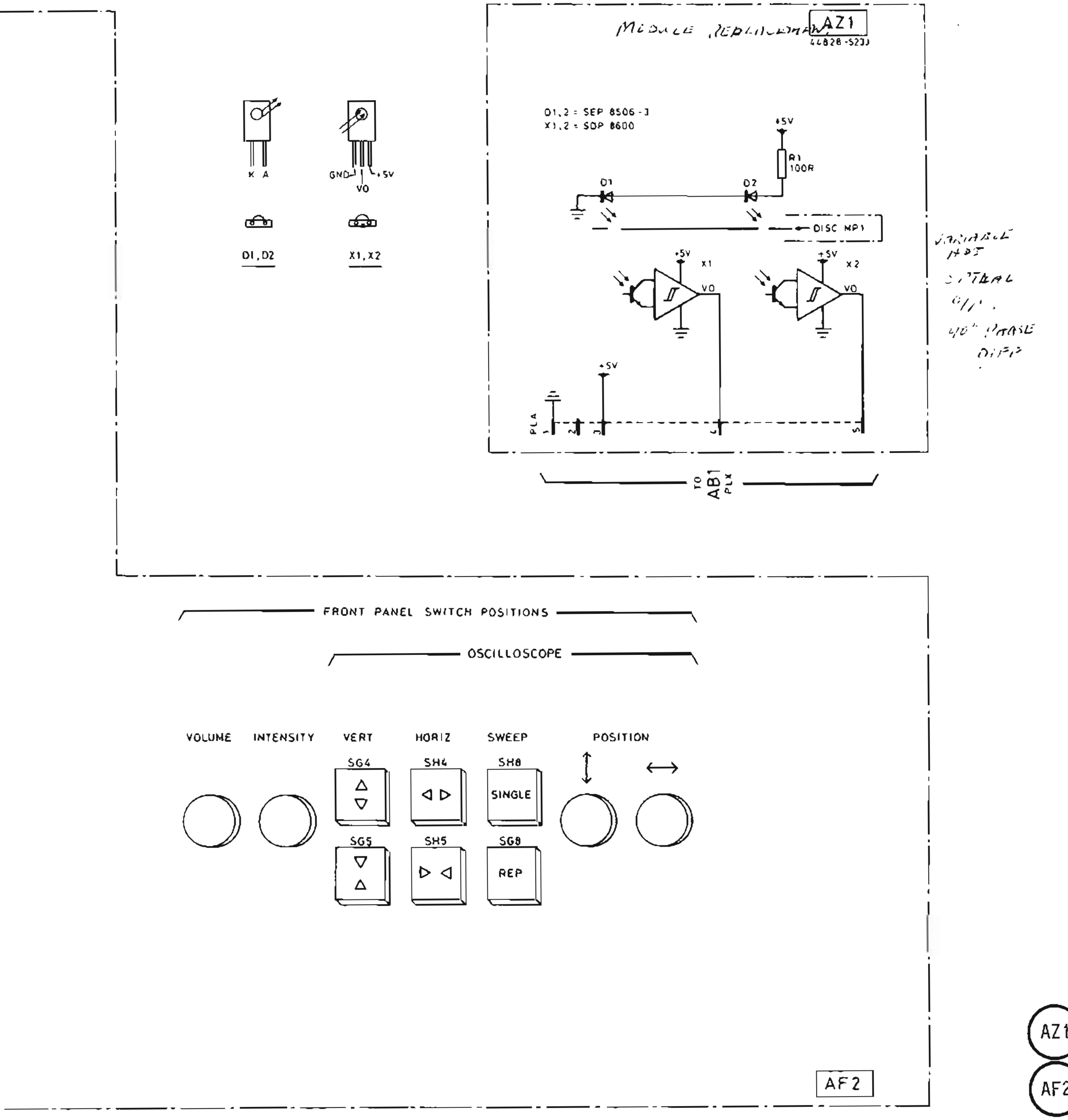


Drg. No. Z 44828-889U
Sh. 1 of 1, Iss. 1

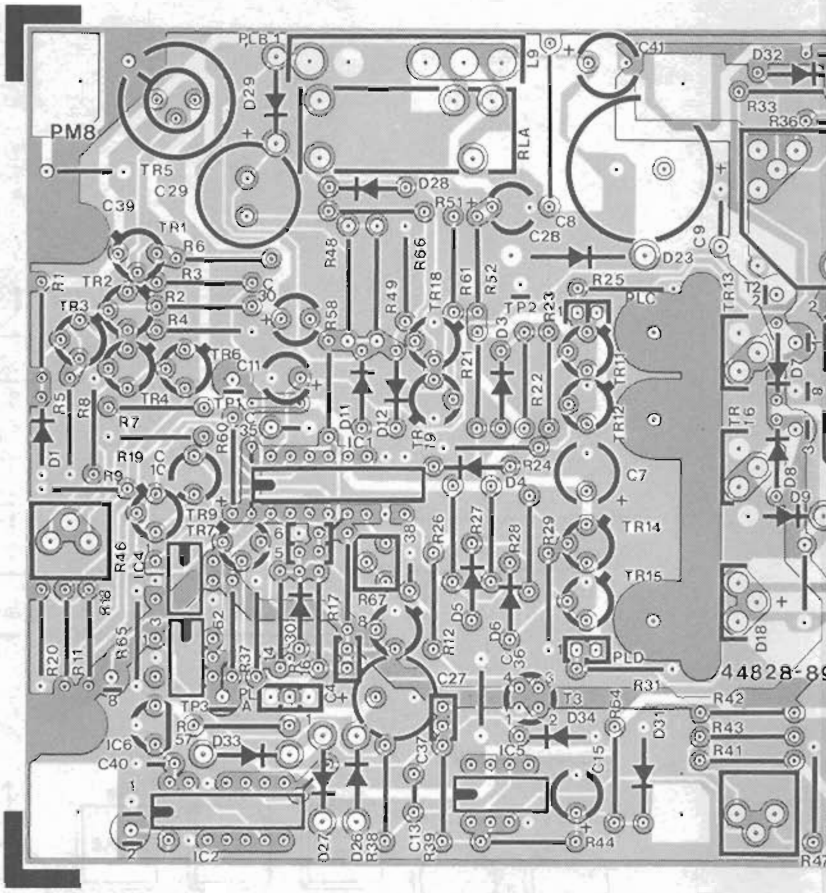
AF2 : Sc
AZ1 : Op

Fig. 28

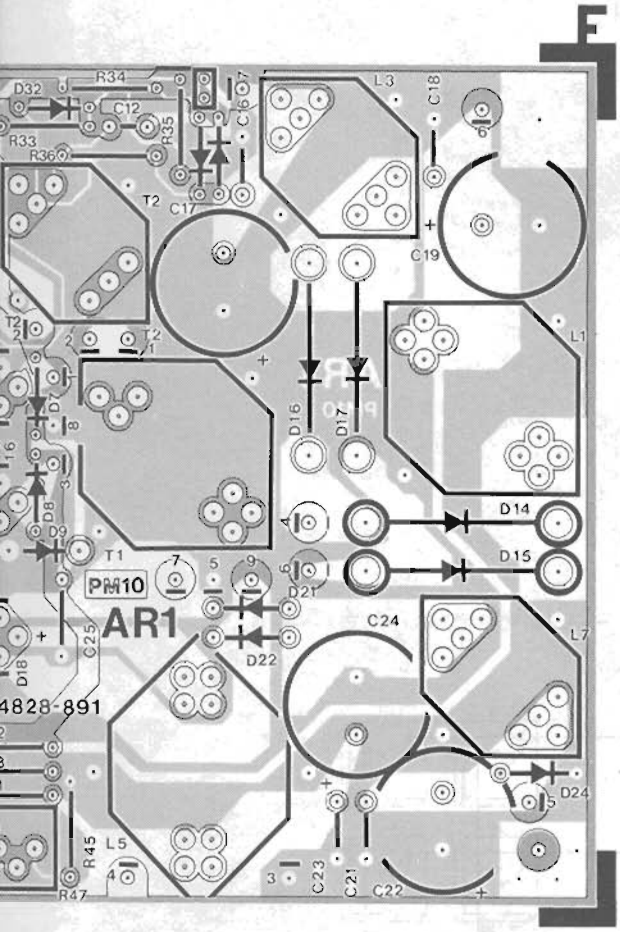
June 85



F2 : Scope keyboard
Z1 : Optical encoder

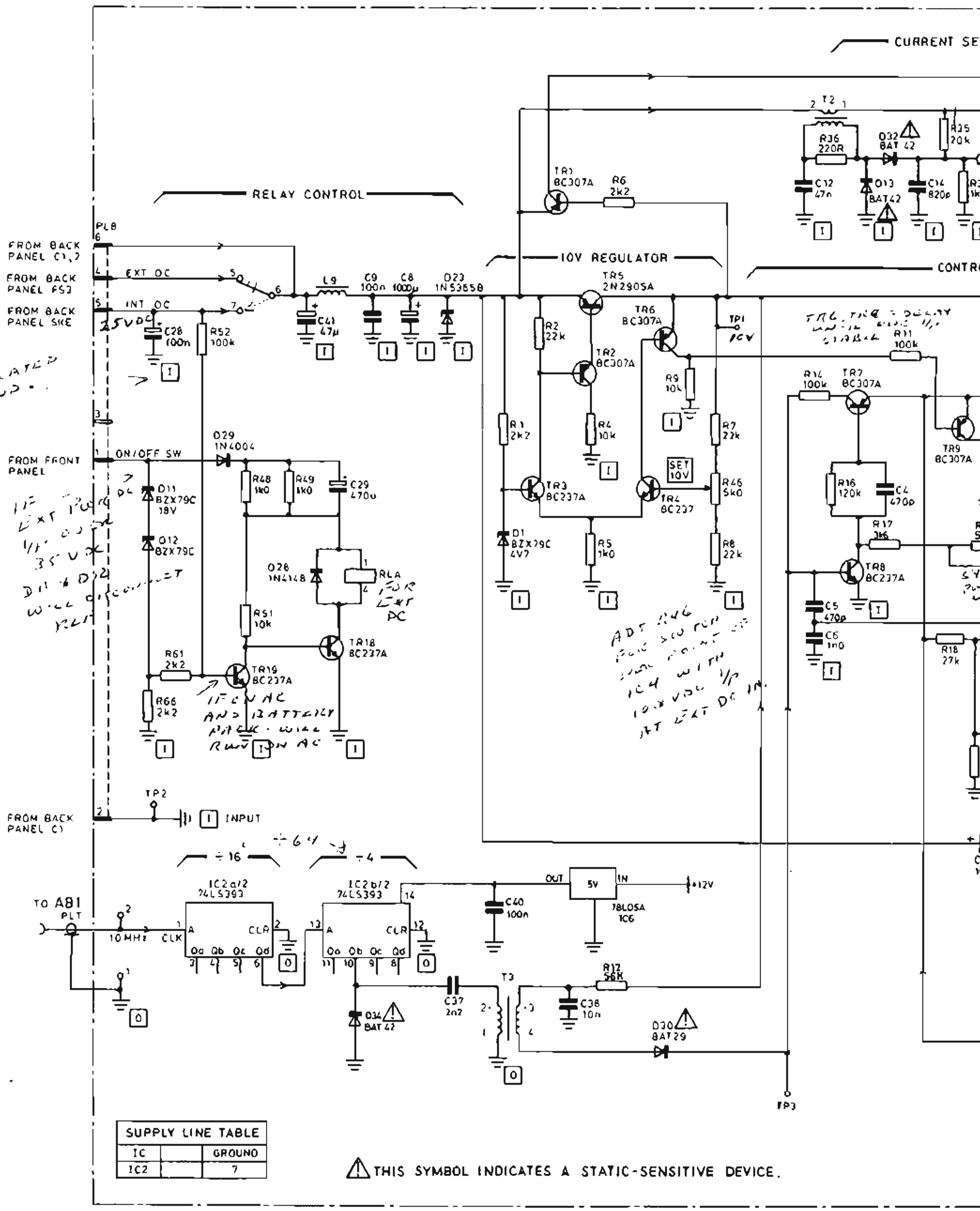


Component layout :



yout : AR1

Fig. 29a

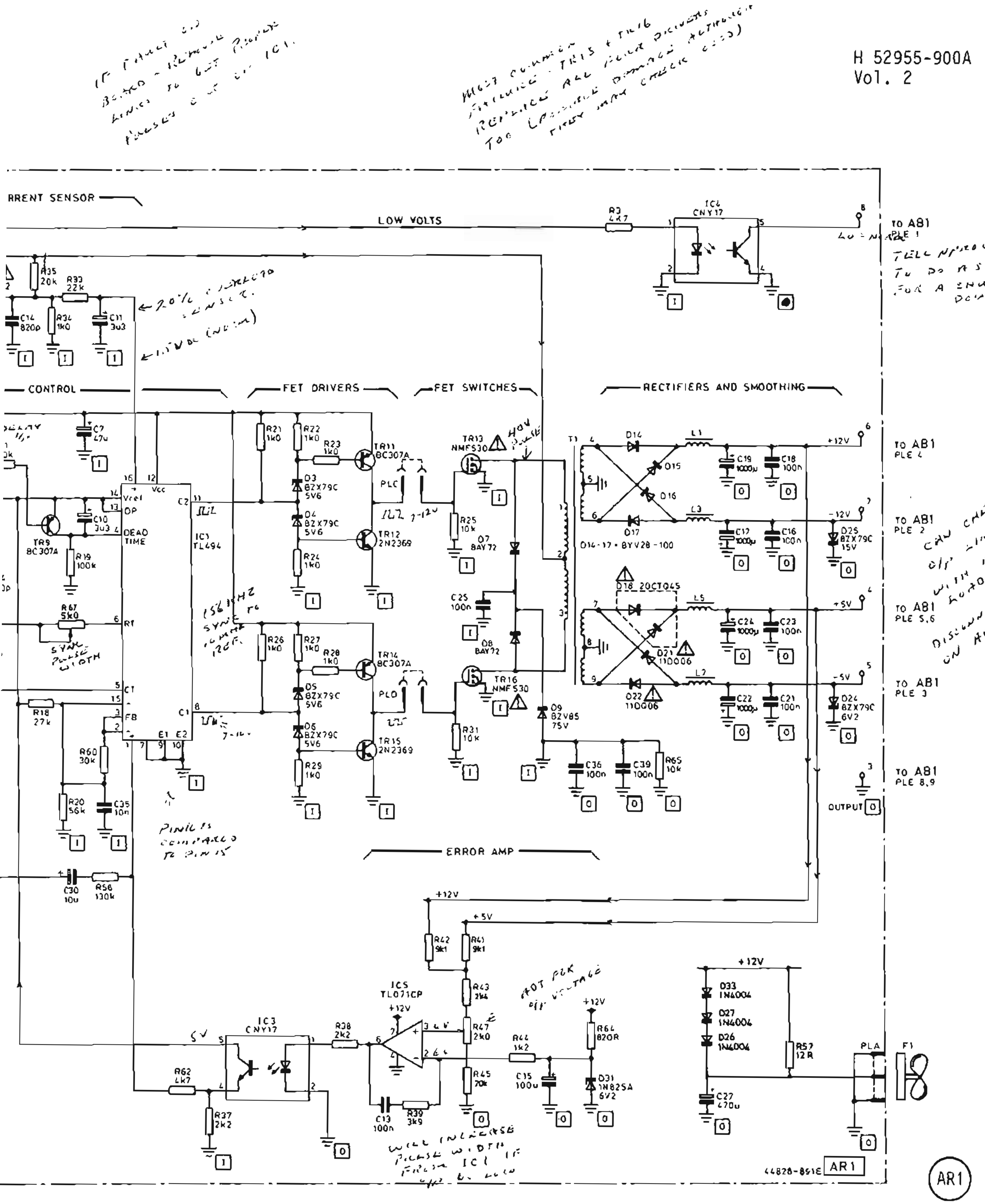


Drg. No. Z 44828-891E
Sht. 1 of 1, Iss. 10

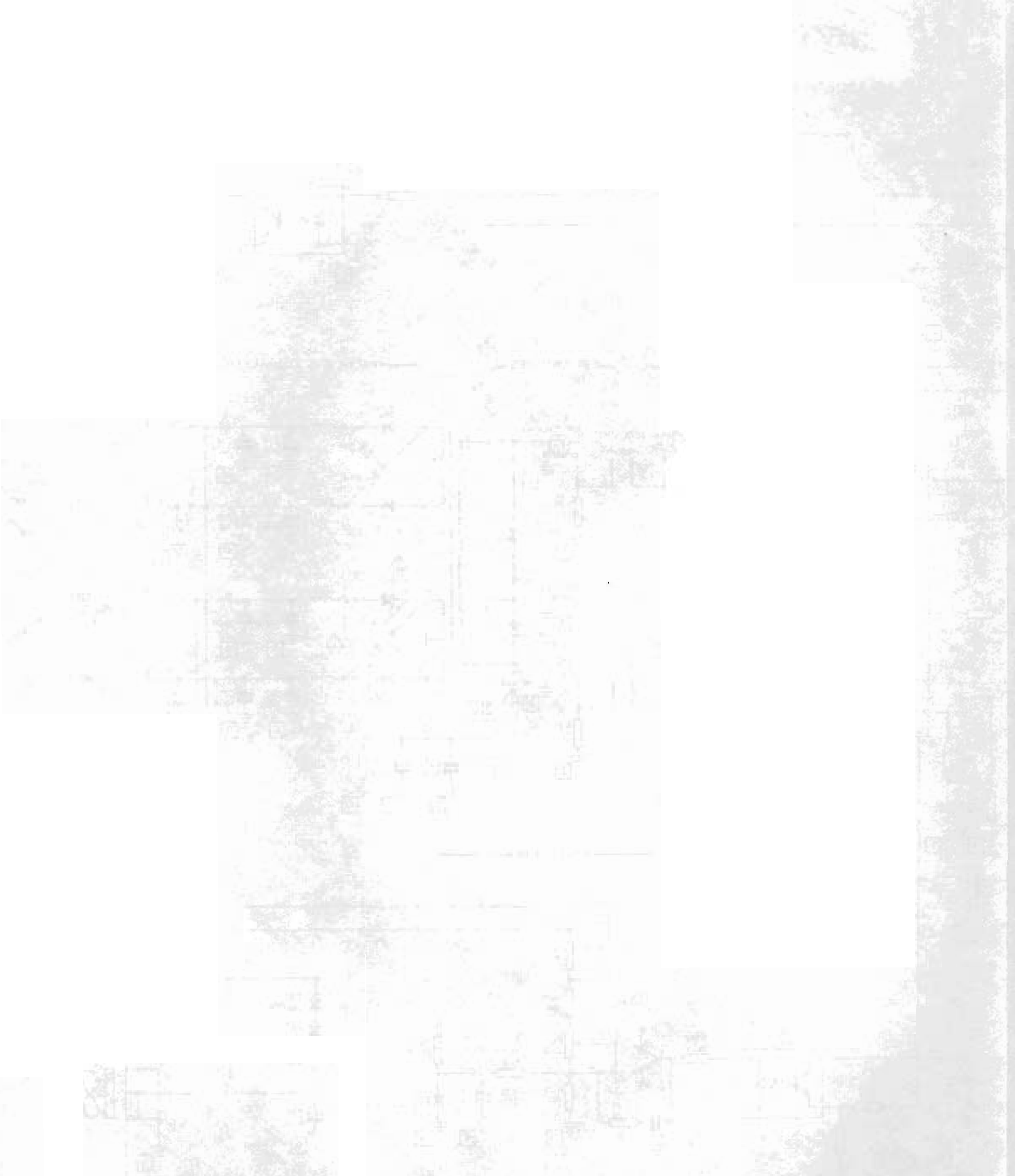
AR1

Fig. 29

Feb. 88 (Am. 6)

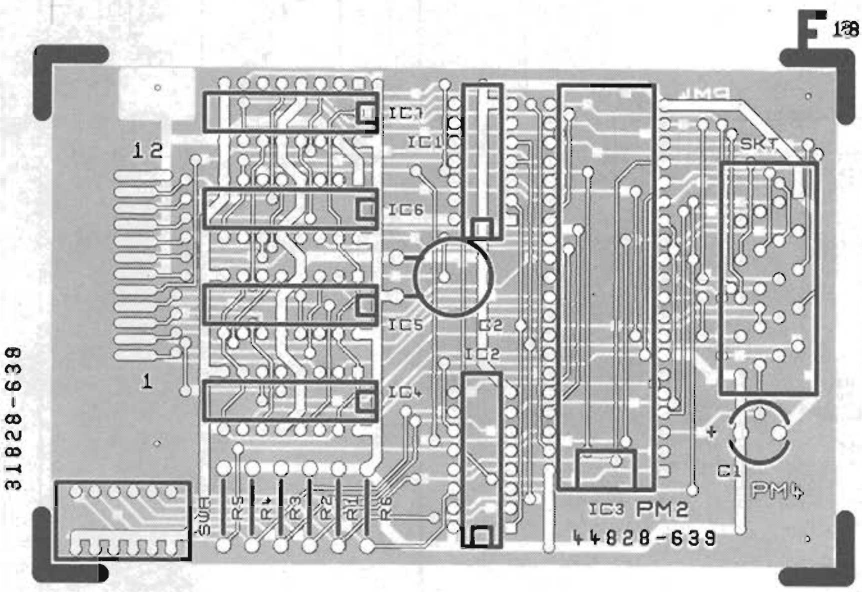


AR1 : Power supply



Component layout

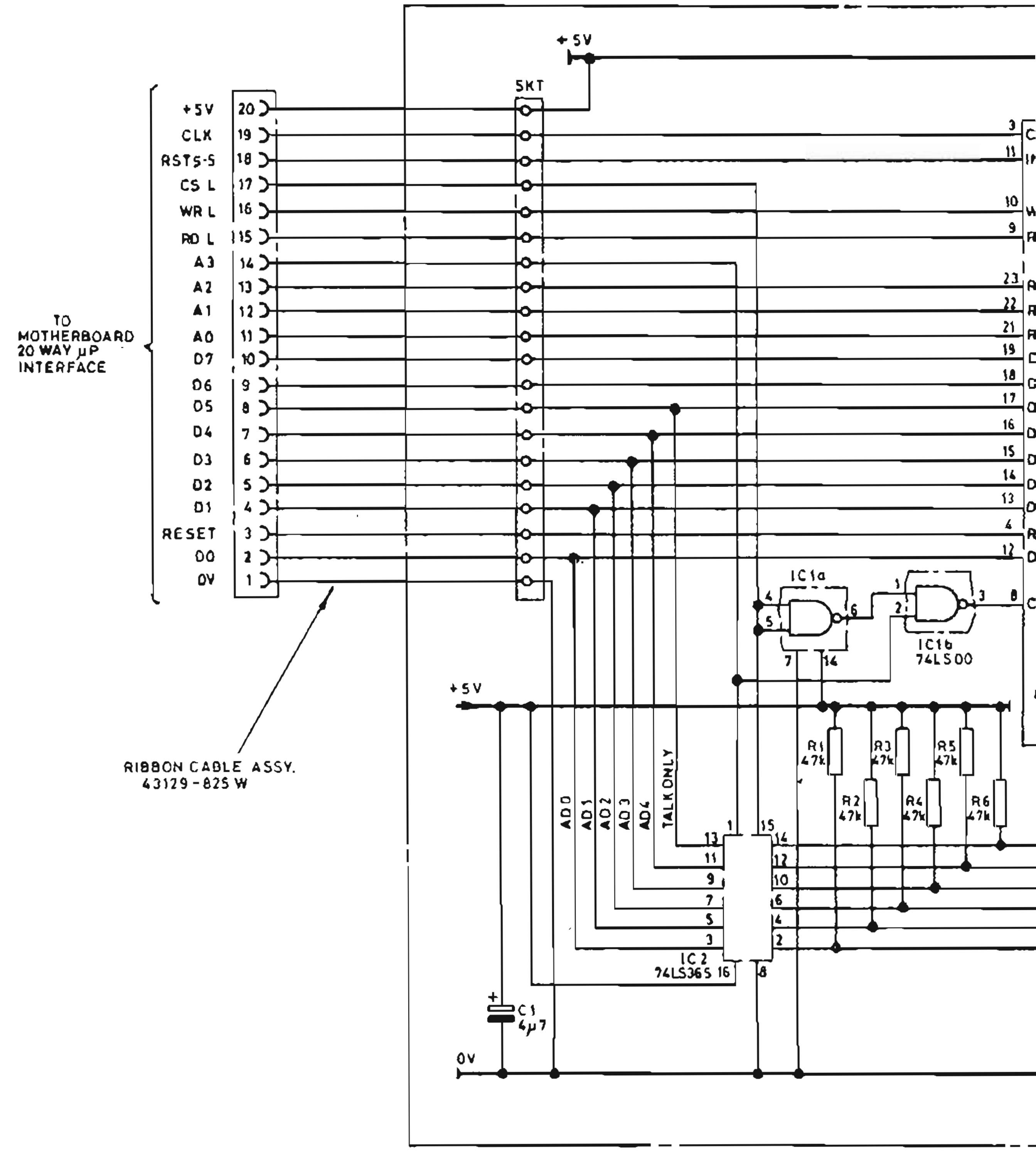
Fig. 30a
Chap. 7



ayout : AG1

Fig. 30a

IF NPROC WILL NOT RUN. DON'T FORGET POSSIBLE FAILURE OF GPIB BOARD. JUST UNPLUG FROM RDI BOARD



Drg. No. Z 54433-002Y
Sh. 1 of 1, Iss. 1

AGO :

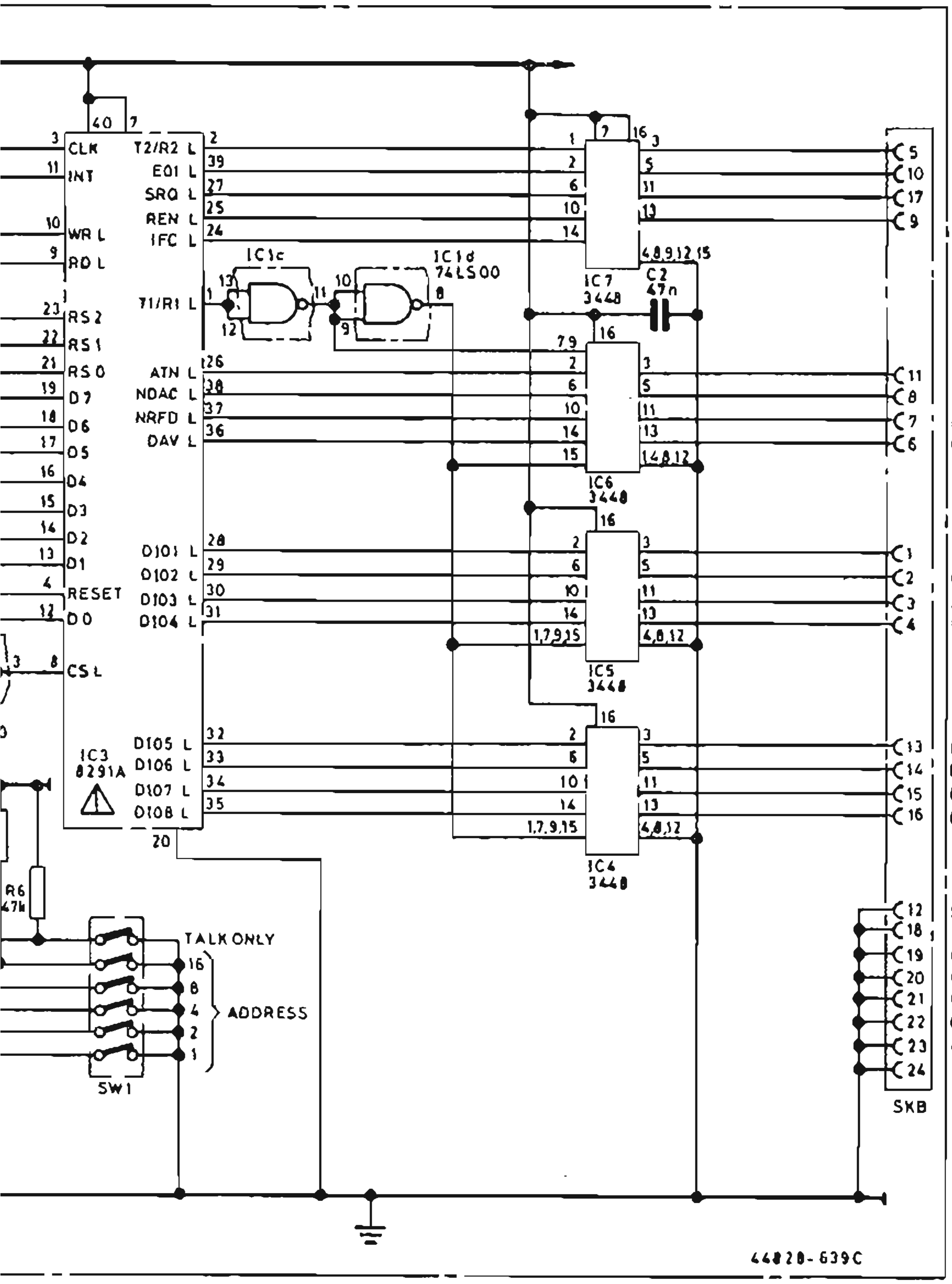
Fig. 30

June 85

COMPONENT MARKED ⚠ IS STATIC SENSITIVE. PRECAUTIONS AS PER MIC 2320

IC2 ADDRESS = CS L = $\overline{A3}$

IC3 ADDRESS = CS L = A3



AGO

AGO : GPIB unit

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3/88