

# RADIO COMMUNICATIONS TEST SETS 2955A and 2955R

Part no. 52955-910L (2955A)  
52955-911J (2955A without GPIB)  
52955-321U (2955R)  
52955-326F (2955A French)  
52955-327G (2955A Spanish)  
52955-328V (2955R French)  
52955-329S (2955R Spanish)

The following amendments are incorporated in this manual :

Amendment No.	Date
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**Note...**

Chapter numbers 1 to 3 and 4-1 were reserved for the Operating Manual. However, this has now been renumbered to have Chapters 1 to 6. The Chapters in the Service Manual will be renumbered 1 to 7 in a later printing.

## ASSOCIATED PUBLICATIONS

					<b>Part no.</b>
Operating Manual	...	...	...	...	46881-952B
Programming Manual	...	...	...	...	46881-953K

## PREFACE

### WARNINGS, CAUTIONS AND NOTES

These terms have specific meanings in this manual.




**WARNINGS** contain information to prevent personal injury.

**CAUTIONS** contain information to prevent damage to the equipment.

**Notes** contain important general information.

### HAZARD SYMBOLS

The meaning of hazard symbols appearing on the equipment is as follows:

Symbol	Type of hazard	Reference in manual
	Static sensitive device	Page (v)
	Dangerous voltages present	Page (iv)
	Supply voltage	Page (iv)

### MANUAL AMENDMENT STATUS

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.

## SERVICING PRECAUTIONS

This product has been designed and tested in accordance with IEC Publication 348 - 'Safety Requirements for Electronic Measuring Apparatus'. To keep it in a safe condition and avoid risk of injury, the precautions detailed in the WARNINGS below should be observed. To avoid damage to the equipment the precautions detailed in the CAUTIONS should also be observed.

### WARNING – ELECTRICAL HAZARDS

**AC supply voltage.** This equipment conforms with IEC Safety Class 1, meaning that it is provided with a protective earthing lead. To maintain this protection the mains supply lead must always be connected to the source of supply via a socket with an earthing contact. Make sure that the earth protection is not interrupted if the supply is connected through an extension lead or an autotransformer.

Before fitting a non-soldered plug to the mains lead cut off the tinned end of the wires, otherwise cold flowing of the solder could cause intermittent contact.

**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.

**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.

Make sure that only fuses of the correct rating and type are used for replacement. Do not use mended fuses or short-circuited fuse holders.

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

**Removal of covers.** Disconnect the supply before removing the covers so as to avoid the risk of exposing high voltage parts. If any internal adjustment or servicing has to be carried out with the supply on, it must only be performed by a skilled person who is aware of the hazard involved.

Remember that capacitors inside the equipment, including any supply filter capacitors, may still be charged after disconnection of the supply. Those connected to high voltage points should be discharged before carrying out work inside the equipment.

Note also that the 12 kV EHT 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 EHT 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 CRT itself must also be removed by shorting the anode connection to earth.

### WARNING – OTHER HAZARDS

Parts of this equipment are made from metal pressings, therefore it should be handled with due care to avoid the risk of cuts or scratches.

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

**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.

## CAUTION – STATIC SENSITIVE COMPONENTS

Components identified with the symbol  $\Delta$  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.

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**TECHNICAL DESCRIPTION**  
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## 2955A 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 RF input to display and end with the processor and power supply. Boards are grouped according to function and arranged in alphabetical order. The block diagram is shown in Fig. 4-1.

## 2955A CIRCUIT SUMMARY

2. The RF IN/OUT sockets are protected against overload and may be configured for simplex or duplex operation. Signal output from the RF signal generator may be modulated by either the AF generator or by an input from the EXT MOD INPUT socket. The AF 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 RF signal input is taken to the RF counter, the RF power meter and the modulation meter. An output is taken from the meter at the 110 kHz IF 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 RF 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. Outputs from the filters are fed to the DE-MOD OUT socket and audio amplifier for monitoring purposes, and to the AF 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.

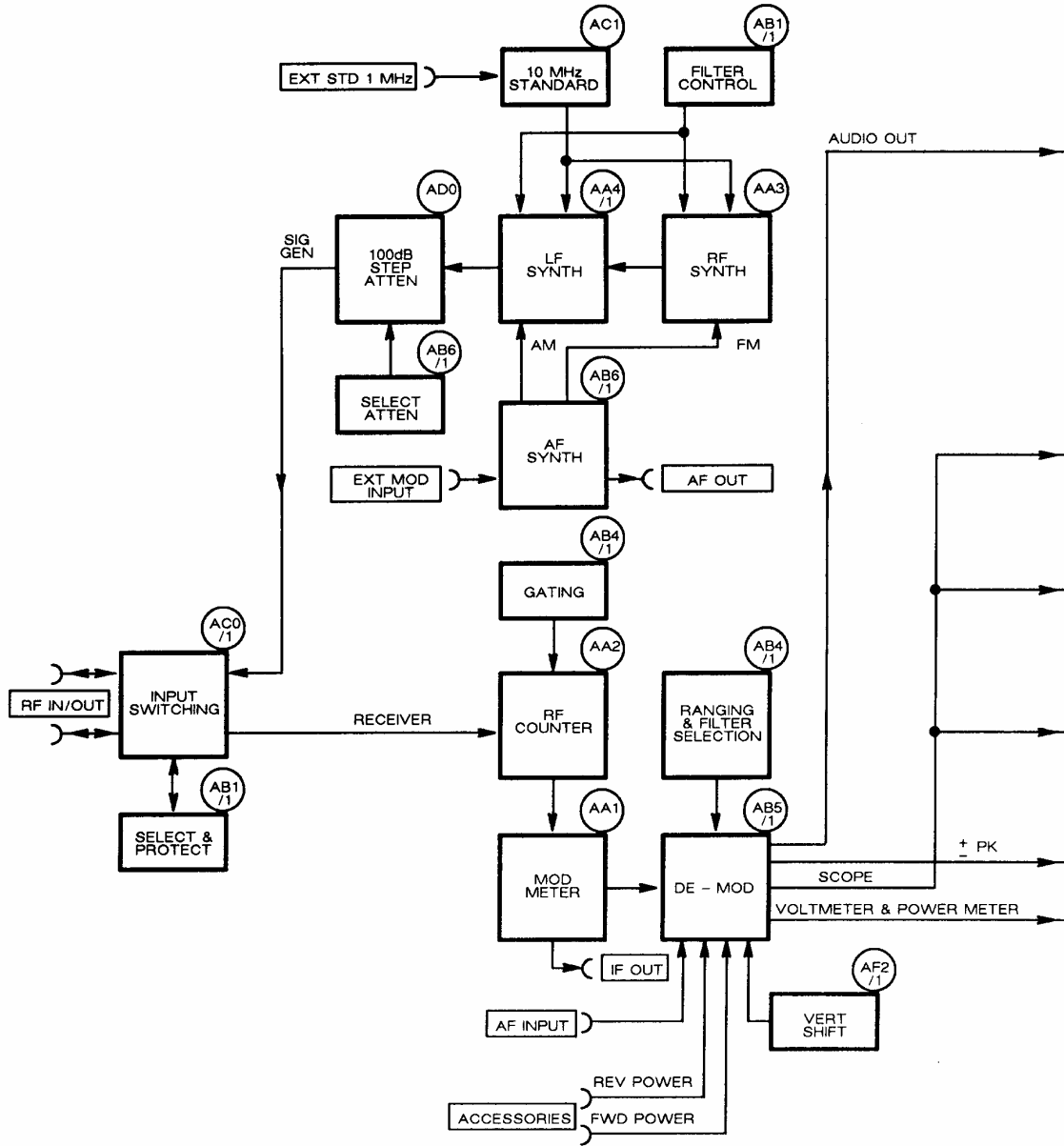
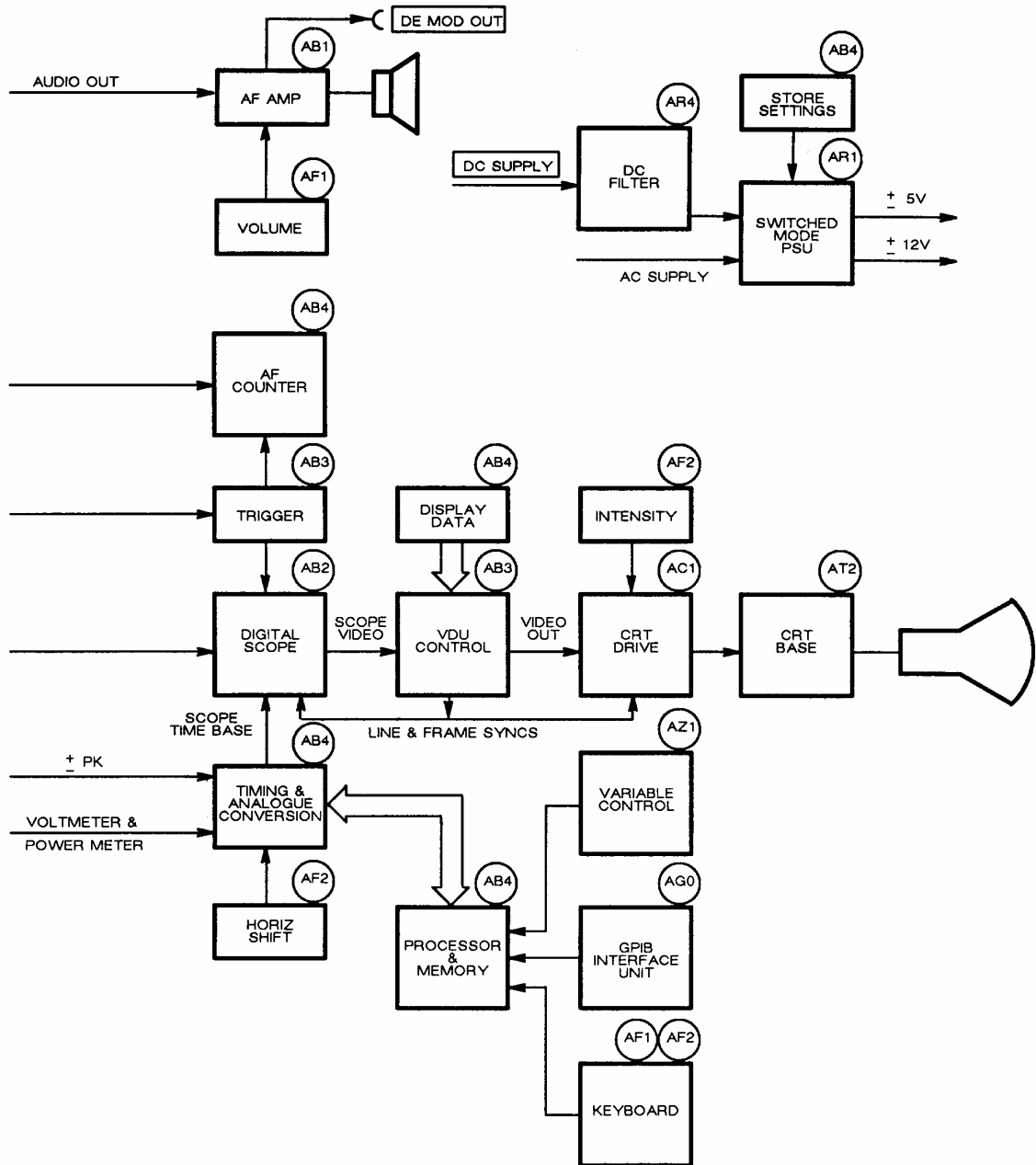


Fig. 4-1 Block diagram of the 2955A

TECHNICAL DESCRIPTION



**RF INPUT/OUTPUT AND RF COUNTER**

3. The RF inputs and outputs are connected to the RF IN/OUT BNC and N-type sockets (see Fig. 4-2). For the BNC socket, the input is sampled on AC2 and if excessive power is detected on AB1/1 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 AB1/1 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 AB1/1. This warning overrides the VOLUME CONTROL on AF2/1. 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.

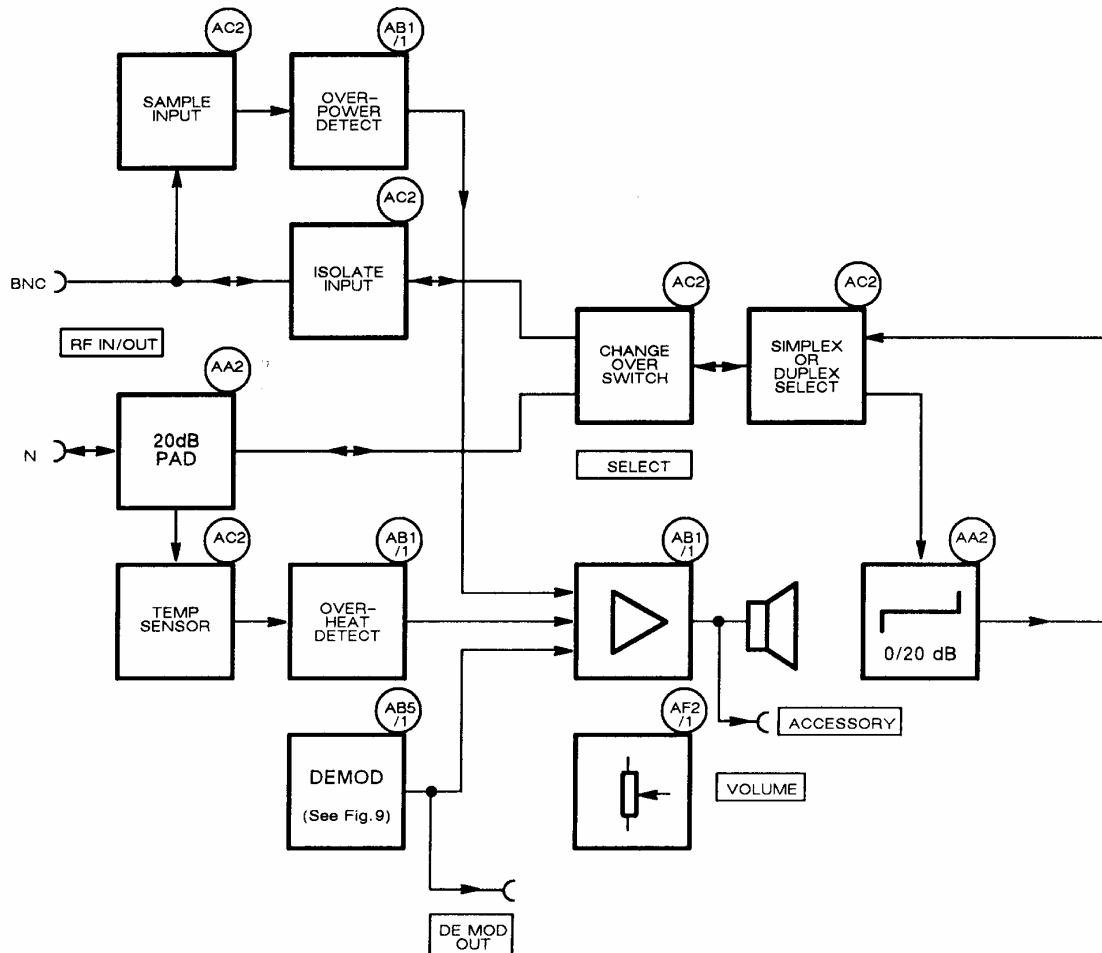
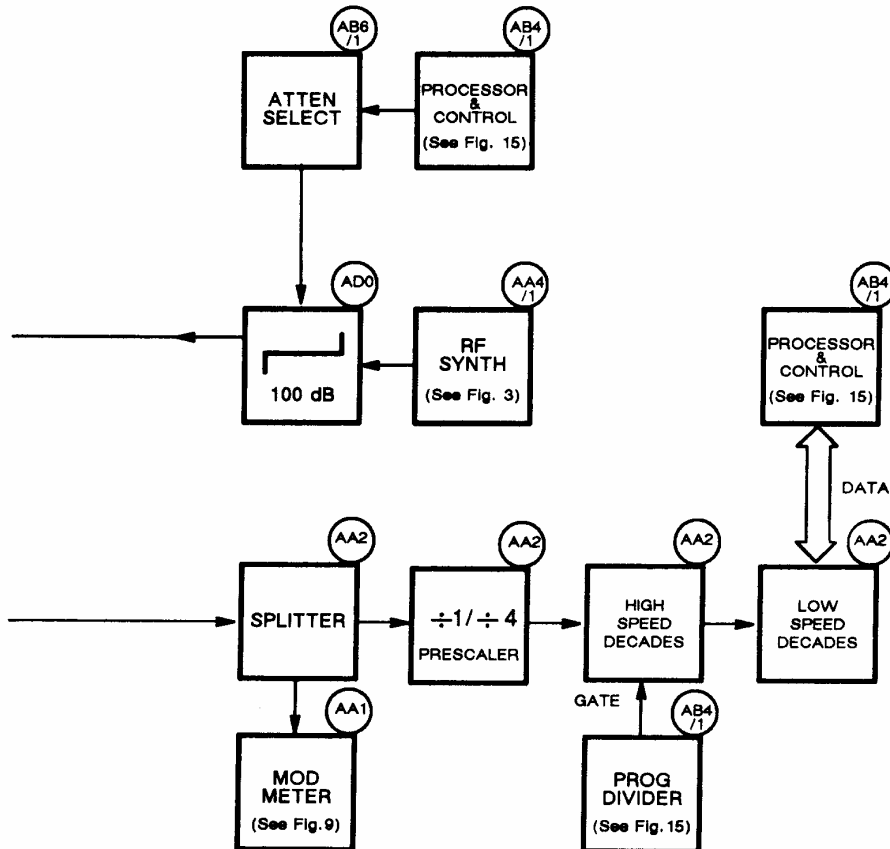


Fig. 4-2 Block diagram of RF input/output & RF counter (showing main functions of boards)

Signal generator output from the RF synthesizer is via a 10 dB attenuator on AA4/1 and then via a 100 dB attenuator which is switched in 20 dB steps by drivers on AB6/1. Signal input is fed from a splitter to the modulation meter on AA1 and to the RF 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 AB4/1. The resulting frequency measurement is fed out on the data bus to processor board AB4/1.



## BOARD AA2 – RF COUNTER

Circuit diagram : Chap. 7, Fig. 7-5.

4. The RF counter is a standard gated counter which has a  $\div 4$  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 RF switch is connected by the SIGNAL INPUT line to a 20 dB 50  $\Omega$  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  $\Omega$  splitter formed by R6,R7 and R8 has a 6 dB loss in all directions and splits the input between the RF 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  $\div 10$  counter IC7 either directly or via  $\div 4$  prescaler IC6. The routing for this is switched by TR2 driven from the  $\div 4/\div 1$  line at TTL 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 ECL  $\div 10$  BCD counter with a gate facility on INH-pin 16 and TTL compatible outputs. The gating signal of either 100 ms or 400 ms duration originates in the programmable counter on AB4/1 and is applied on the GATE INPUT line to TR3. TR3 with IC8 level shift the signal from TTL to ECL for the following counter. IC7 pins 2,7,8 and 10 are state lines and pin 11 is the carry, i.e.  $\div 10$  output. The output from pin 11 is inverted by TR4 to ensure correct polarity for IC5 which is a TTL  $\div 10$  BCD counter. The state lines are from pins 8,9,11 and 12. Pin 12 is the  $\div 2$  output to the next set of dividers formed by IC4. The signal at TP2 is thus either SIGNAL INPUT freq.  $\div 80$  or SIGNAL INPUT freq.  $\div 20$  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 BCD 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 AB1/1 – MOTHERBOARD

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

10. Motherboard AB1/1 contains five 32-way 2-sided edge connectors to provide inter-connection between the various parts of the instrument. The five hold the main logic boards AB2 to AB6/1. Additionally, the board contains the RF tray drivers, keyboard interface, loudspeaker amplifier, DTMF decoder, DCS filter 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 FET TR7. TR7 bias is controlled by the volume control on AF2/1 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 RF power (approximately 1.0 W) being applied to the front panel BNC 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 AB4/1 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 RF power, the decreased resistance (12 k $\Omega$  at 100°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 BNC 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 AF1/1 or AF2/1, 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.

## DTMF decoder

16. The DTMF (Dual Tone Multi Frequency) decoder, IC19, is driven from the demodulated audio from AA5/1. It contains all necessary low and high band filtering and frequency detection circuitry. Upon receipt of a valid DTMF code, IC19 interrupts the processor which in turn clocks the DTMF code out of the chip via the data bus. Crystal X1 is used as the frequency reference for the decoder, and C19 and R39 determine the response time.

## DCS filter

17. IC20 is a 4th order low-pass filter with a bandwidth of 190 Hz. It is used to remove all noise and audio signals from the received demod. signal before it is fed to the DCS (Digitally-Coded-Squelch) decoder on AB4/1.

## BOARD AC2 – INPUT SWITCHING

Circuit diagram : Chap. 7, Fig. 7-25.

18. The input switching unit has four major functions to perform. Firstly, it contains a dummy load/attenuator for dissipating a transmitter's RF 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

19. 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 AB1/1 is on the OVER TEMP OUT line. At a nominal 80°C  $R_{th} = 22 \text{ k}\Omega$  upon which a warning is sounded and a notice is flashed on the screen.

### Switching

20. Relay RLA is capable of breaking up to 100 W of RF power. This is used as the BNC 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 4-1.

TABLE 4-1 SOCKET SELECTION LOGIC – AC2

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

21. 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**

22. R4 and R5 form a 10:1 divider chain across the BNC 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 AB1/1 to raise the alarm and remove the drive on the DUPLEX-ISOLATE (L) line to RLA. RLA disconnects the BNC input thus protecting the instrument.

**RF AND LF SYNTHESIZERS**

23. The RF synthesizer on AA3 uses three switched oscillators to provide a basic frequency range of 165 to 530 MHz (see Fig. 4-3). 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 AB6/1

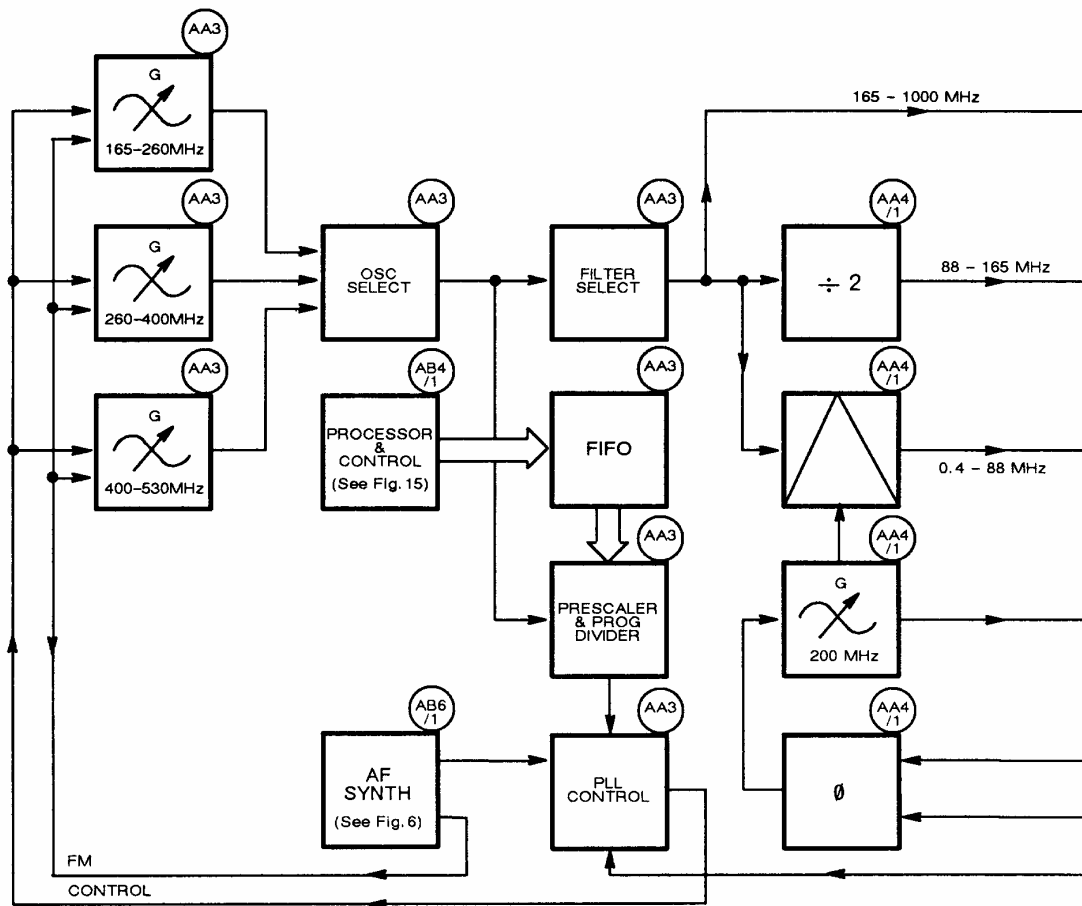
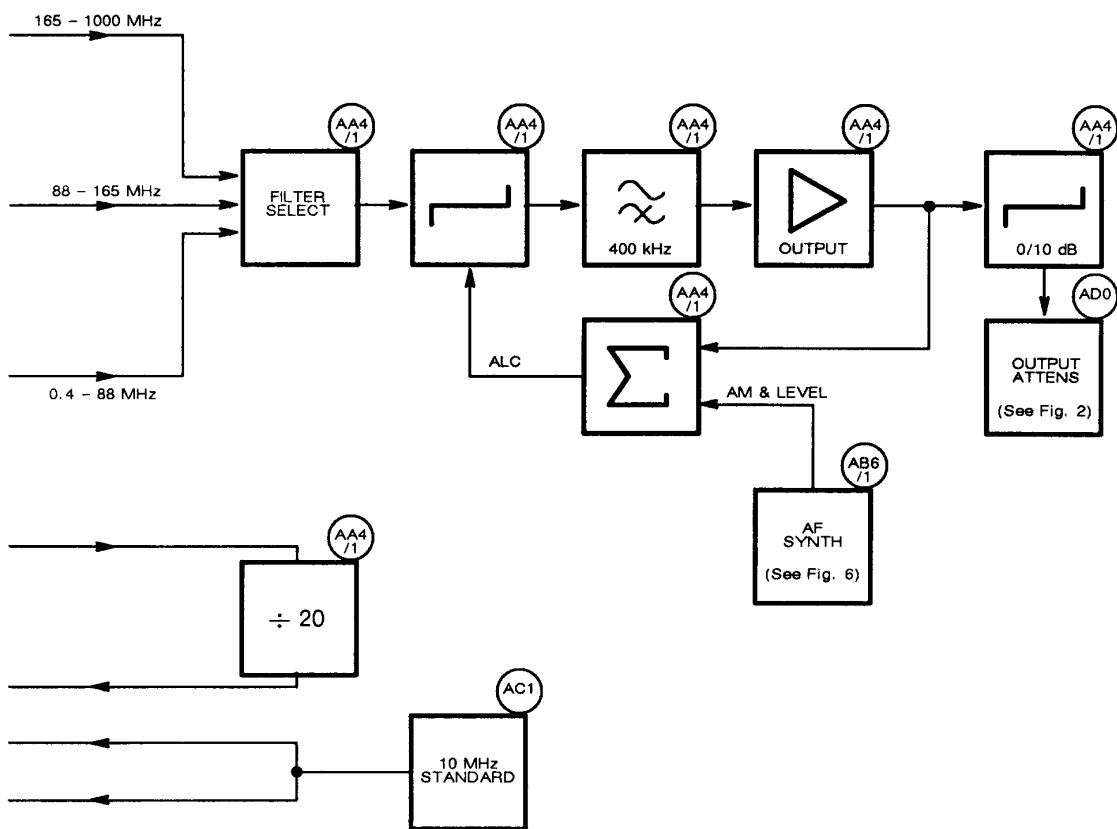


Fig. 4-3 Block diagram of RF and LF synthesizers (showing main functions of boards)

are fed back to the oscillators. LF synthesizer board AA4/1 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 RF oscillators, is phase locked to the 10 MHz standard from AC1. Switched band-pass filters pass the selected frequency through an attenuator controlled by ALC to a 400 kHz low-pass filter. A proportion of the signal from the output amplifier is fed back on the ALC loop together with amplitude modulation and level control signals from AB6/1. A switched 10 dB attenuator passes the signal on to the 100 dB output attenuator.



## BOARD AA3 – RF SYNTHESIZER AND OSCILLATOR

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

24. 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)

25. 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 AB6/1 to cope with the FM 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)

26. Oscillator and filter selection lines OSC CONTROL and FILTER CONTROL are connected to four open collector PNP transistors on board AB1/1 which are driven from TTL. Table 4-2 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 AA4/1.

### Filters (Sheet 1)

27. 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 LP 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 LP filter to oscillator 3. The 265 MHz LP filter is permanently enabled and connected to oscillator 1. The filters select the oscillators' fundamental frequencies for output.

TABLE 4-2 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 AA4/1

**530 to 630 MHz:** Both FILTER CONTROL lines are high which switch TR3 and TR7 on. TR3 switches D11 on to select the 520 MHz HP filter while TR7 switches D14 and D15 on to enable the 630 MHz LP filter. Oscillator 2 is switched on and the filter selects the second harmonic for output.

**630 to 1000 MHz:** FILTER CONTROL input PLA6 is low while PLA7 is high. TR3 is switched on which connects the 520 MHz HP filter to oscillator 2. Also TR7 is switched off which allows TR8 to switch on to connect the 820 MHz LP filter to the same oscillator. TR9 switches on to connect the 800 MHz HP 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 4-3 which shows the transistor switching, while the diode switching is given in Table 4-4. The output from the filters is fed to RF synthesizer board AA4/1 via 18 dB gain amplifier IC4.

TABLE 4-3 FILTER SELECTION - AA3

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

TABLE 4-4 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	D18	D19	D20	D21	D24	D25	D26	D27	D28	D29	D30	
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)**

29. To remove any modulation introduced on the ±12 V supply lines, the oscillators and the CMOS 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 LP filter as they enter the shielded enclosure.



## Divider chain (Sheet 2)

30. The  $\div N$  divider chain consists of five ICs. IC108 and IC112 are  $\div 10/11$  ECL prescalers which enable the divider chain to work over a 165 to 530 MHz range no matter what frequency is selected. IC111, also ECL, 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 CMOS to ECL level shift from IC104 to the ECL ICs. TR104 provides a level shift from ECL to CMOS. Diode D111 provides a clamp to avoid hole storage problems.

31. 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 BCD 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.

32. 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. 4-4. 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.

33. 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.

34. 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.

Period	IC101 (Slave) data				IC104 (Master) data			
	A3	A2	A1	A0	A3	A2	A1	A0
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. 4-4 Programmable dividers : Example of typical data input – AA3

### Synthesizer chip (Sheet 2)

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

#### Frequency standard divider

36. 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

37. 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 LED 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

38. 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 AB6/1 where it is picked off before the FM/AM 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 FM 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)

39. 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 AA4/1 – LF SYNTHESIZER AND OUTPUT AMP**

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

40. 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)**

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

- (a) Through a 1000 MHz LP filter for 165-1000 MHz.
- (b) Through a ÷2 stage and 165 MHz LP filter for 88-165 MHz.
- (c) Through a mixer with its 200 MHz fixed LO to produce 0.4 to 88 MHz, then through a 90 MHz LP filter for 0.4-88 MHz.

**Path 1: 165 to 1000 MHz**

42. 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 AB1/1. 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 LP 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 AB1/1, in order to switch off TR8 and thus disable the 200 MHz oscillator. Switching logic is shown in Table 4-5. The selected path directs the signal through the 1000 MHz low-pass filter.

**TABLE 4-5 FREQUENCY SELECTION – AA4/1**

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**

43. 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 LP filter. Diodes D5 and D6 are switched on by TR1 and direct the signal to amplifier IC1 which provides 600 mV RMS at its output pin 5. TR3 switches on and enables IC2 to provide a ÷2 signal, rich in harmonics, to the following LP filter. IC2 output is an ECL compatible 1 V pk-pk 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**

44. 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 LP 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

45. Fig. 4-5 and Table 4-6 summarize the methods of frequency generation using boards AA3 and AA4/1 to provide the ten frequency ranges.

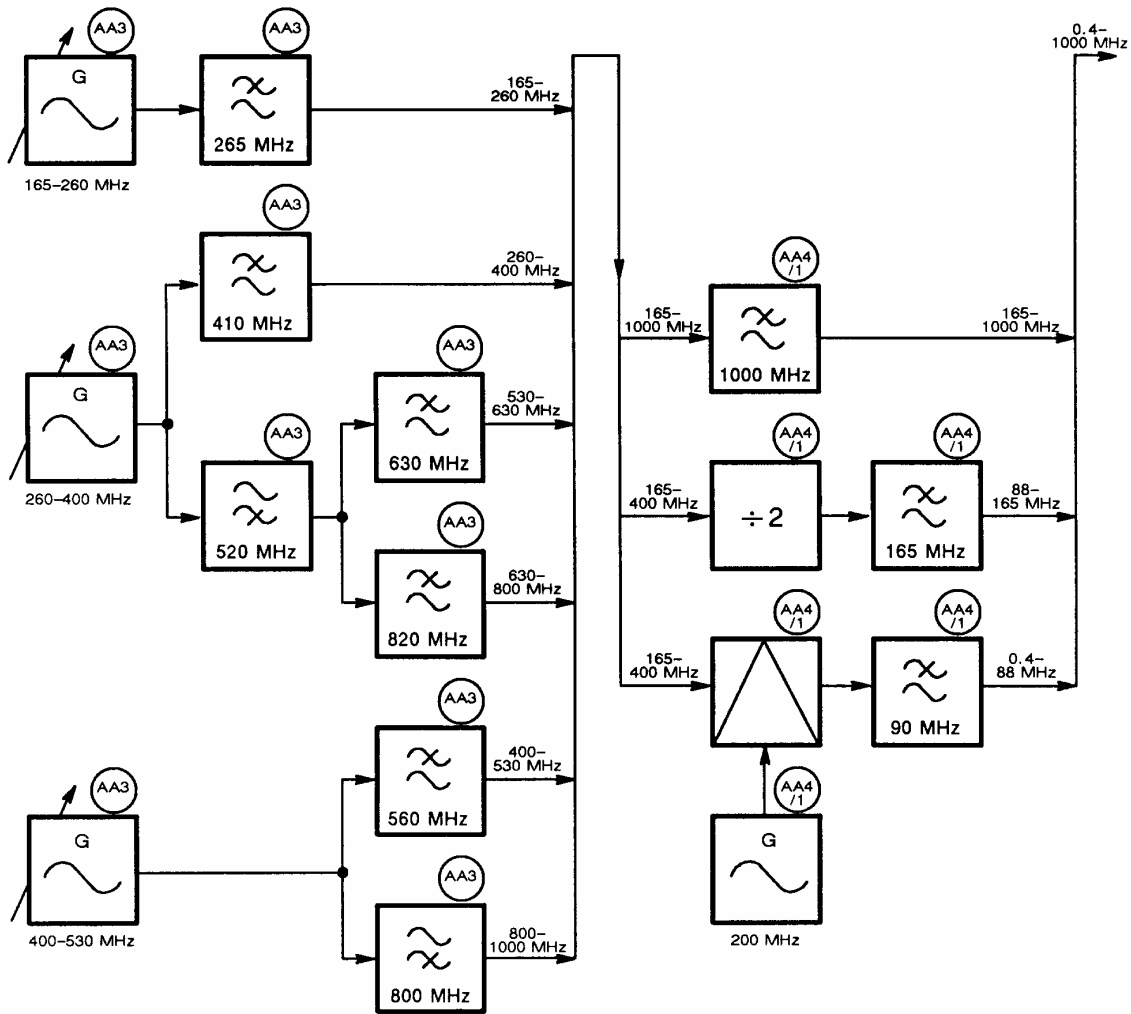


Fig. 4-5 RF synthesizer frequency generation summary  
(switching omitted for the sake of clarity) - AA3, AA4/1

TABLE 4-6 FREQUENCY GENERATION SUMMARY - AA3 AND AA4/1

Board AA3			Board AA4/1		
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)**

46. 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)

47. The signal from the oscillator to the phase locking loop is taken from the collector of TR5 to pin 8 of IC10, an ECL in, TTL 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  $\pm 0.7$  MHz and the hold-in range is  $\pm 5$  MHz.

### Attenuator and ALC (Sheet 2)

48. The pin diode attenuator is formed by D7, D8, D9 and D11. This provides the electronic RF attenuation for the fine attenuator, amplitude modulation and RF 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 AB6/1, and consist of a 'set RF level' DC voltage plus audio modulation. This signal is fed to comparator IC3 via attenuator R22, R23 and compared with a DC or a DC plus a low frequency AC signal proportional to the peak RF 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 DC voltage inserted to check the control range of the attenuator.

49. The feedback path for the RF 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, R39 and C32 provide loop time constants to ensure stability.

### Output amplifier and attenuators (Sheet 2)

50. After the diode attenuator, a 400 kHz high-pass filter ensures that for 250 kHz and below the RF amplifier gain is reduced below unity. This is in order to prevent oscillations due to feedback around the ALC 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 28 dB gain and a higher power output capability. Because the ALC loop reduces the output impedance to approximately  $1 \Omega$ , a  $50 \Omega$  resistor, R46 is provided to give the correct output impedance.

51. 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 RF relay switched on the 0/10 dB line by TTL 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

52. AF synthesizer board AB6/1 generates 2 independent frequencies in the range 10 Hz to 20 kHz and also contains a dedicated square wave generator for digital signalling (see Fig. 4-6). Each synthesizer is based upon a custom designed gate array configured as a bit rate multiplier whose output is an 8 bit address that feeds a PROM lookup table. The PROM contains data that, when fed through a D-A converter, represents a step-approximation to a sine wave. This is then fed to a filter to remove high order harmonics. The output from the filter supplies the reference for a multiplying D-A converter which is used for signal level control. The outputs from both synthesizers are combined and fed via a power amplifier to the AF GEN OUTPUT socket.

53. The outputs from both synthesizers are additionally routed to the modulation control circuits, together with the output of a low frequency square wave generator. A combination of D-A converters and switched gain amplifiers provides the necessary FM and AM level controls to AA3 and AA4/1.

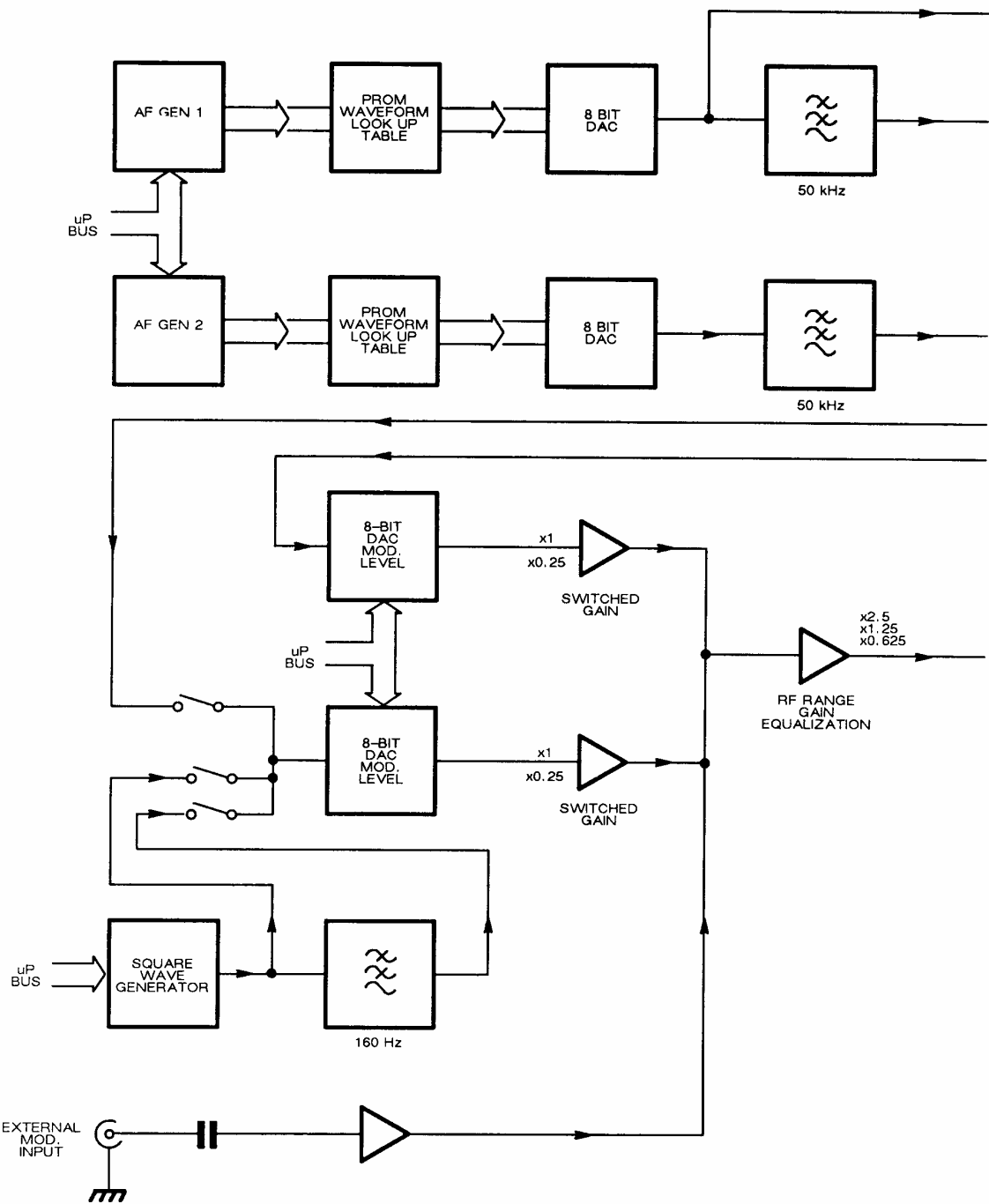
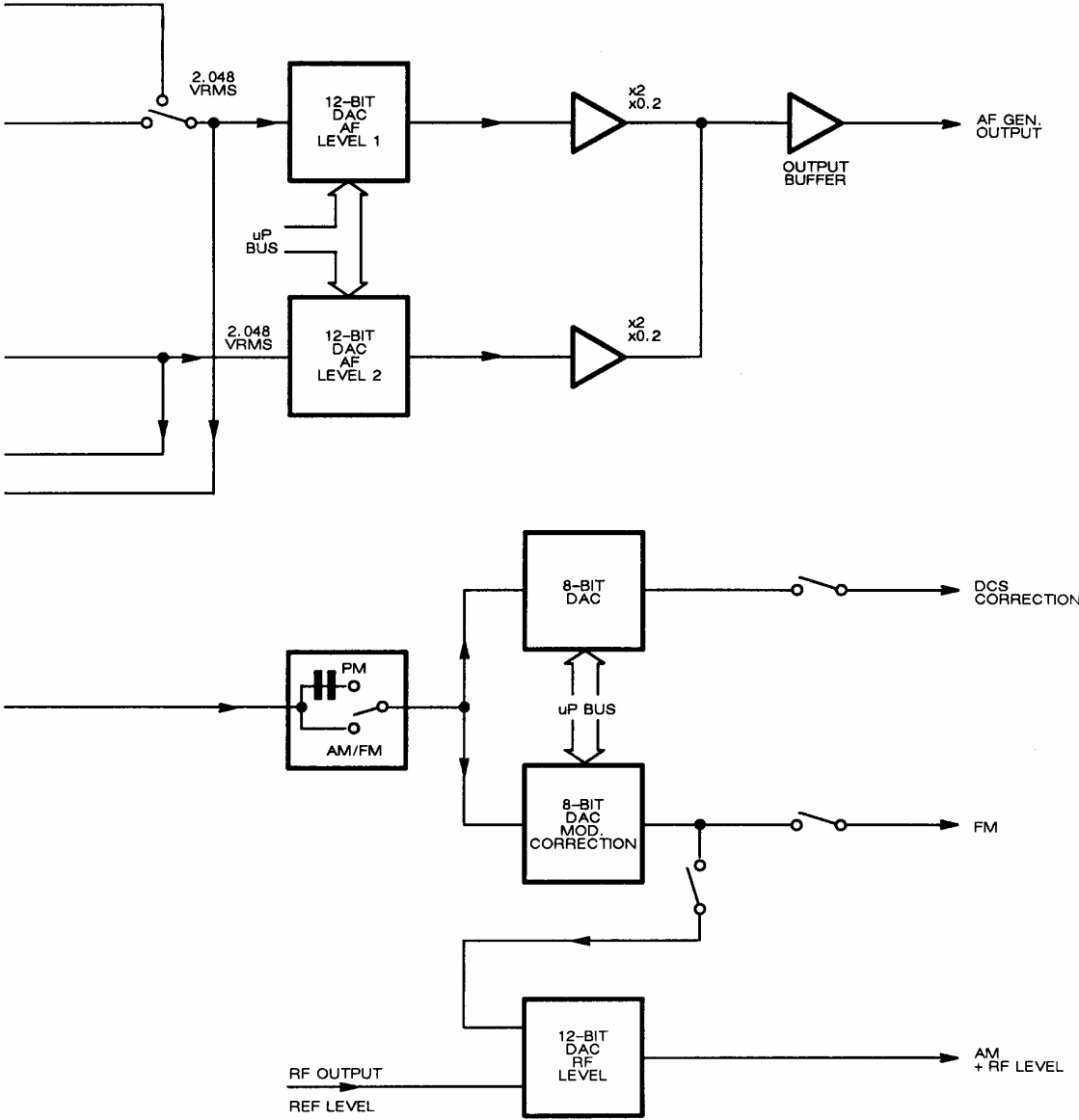


Fig. 4-6 Block diagram of AF synthesizer and modulation control

TECHNICAL DESCRIPTION



## BOARD AB6/1 – AF SYNTHESIZER

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

54. The purpose of AB6/1 is to provide the AF signals for both external and internal use as well as providing modulation correction, RF generator level setting and RF attenuator control.

55. The signals generated on the board are 2 variable frequencies in the range 20 Hz to 20 kHz (sine wave, square wave, triangle and sawtooth) and a low frequency square wave. These supply the AF GEN OUTPUT socket as well as being used to modulate the internal RF signal generator. The variable frequency generators can be changed in frequency very rapidly which enables the generation of DTMF and sequential tones.

### AF Generator logic array (Sheet 1)

56. Both AF generators are functionally similar, and are based on a custom-designed CMOS logic array (IC2 and IC3). The internal architecture of these devices is complex and can only be easily described in very simplistic manner – see Fig. 4-7. Under control of the microprocessor, a binary number is loaded into the phase increment register. This number is added into the accumulator at a rate determined by the clock input. The output from the accumulator is therefore a binary number that is constantly incrementing by a programmed amount. This number is used as an address to the waveform PROMs IC4 and IC5. These are used as look-up tables and contain data that represents the step-wise approximation to the desired waveform. The 8-bit wide data from IC4 and IC5 is converted into an analogue voltage by the D-A converters IC6 and 7.

57. The output of each generator at TP2 and TP4 is a stepped approximation to the desired waveform shape. The number of steps depends on the desired frequency and the clock frequency. The larger the phase increment programmed into IC2, the sooner the accumulator will overflow and “start again” from zero, generating a lower number of steps and a higher output frequency.

58. The waveform PROMs IC4 and IC5 are large enough to contain four separate waveforms – sine, square, triangle and ramp. These are selected by lines A10 and A11, as the highest two address bits.

### Output filters (Sheets 1 & 2)

59. The raw output of each generator is fed to an identical 3rd order low-pass filter which removes the high order harmonics generated by the step approximation (IC8b, IC9b). Audio generator 1 has the facility for bypassing this filter in order to maintain the integrity of waveforms other than sinusoidal. This is achieved by the analogue switch IC34.

60. Outputs from both AF generators are fed to two halves of the dual 12-bit DAC IC10, which is used to set the AF level. The two signals are combined in the power amplifier stage IC12, which drives the AF GEN output socket. IC12 has two gain settings, x2 and x0.2. This provides output level switching of 0 to 409.6 mV at 0.1 mV resolution, and also at 1 mV resolution. D11 and D12 protect IC12 against large reverse voltages being fed into the AF GEN OUTPUT socket.

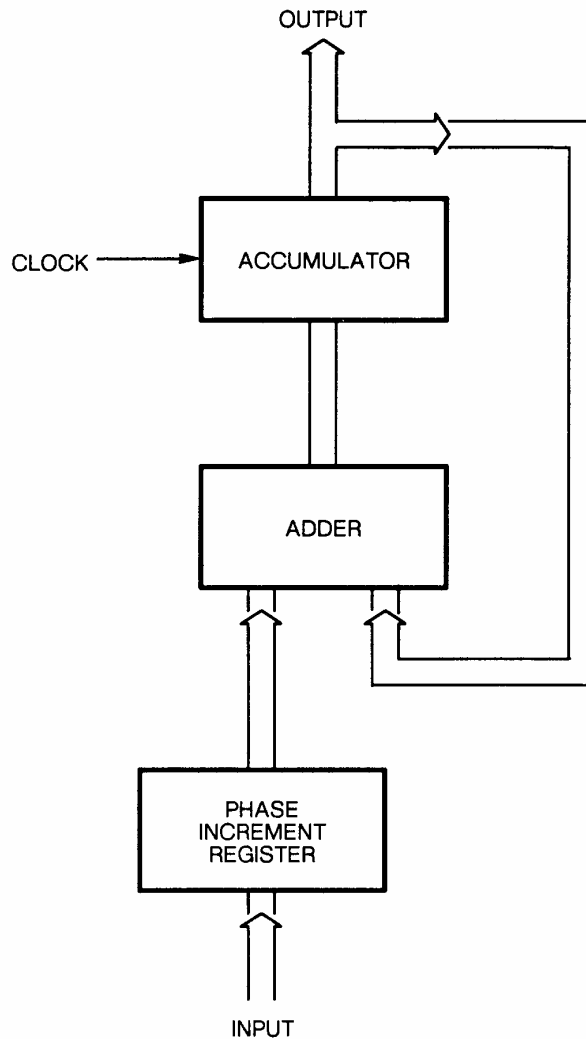


Fig. 4-7 Simplified functional diagram of audio generator logic array

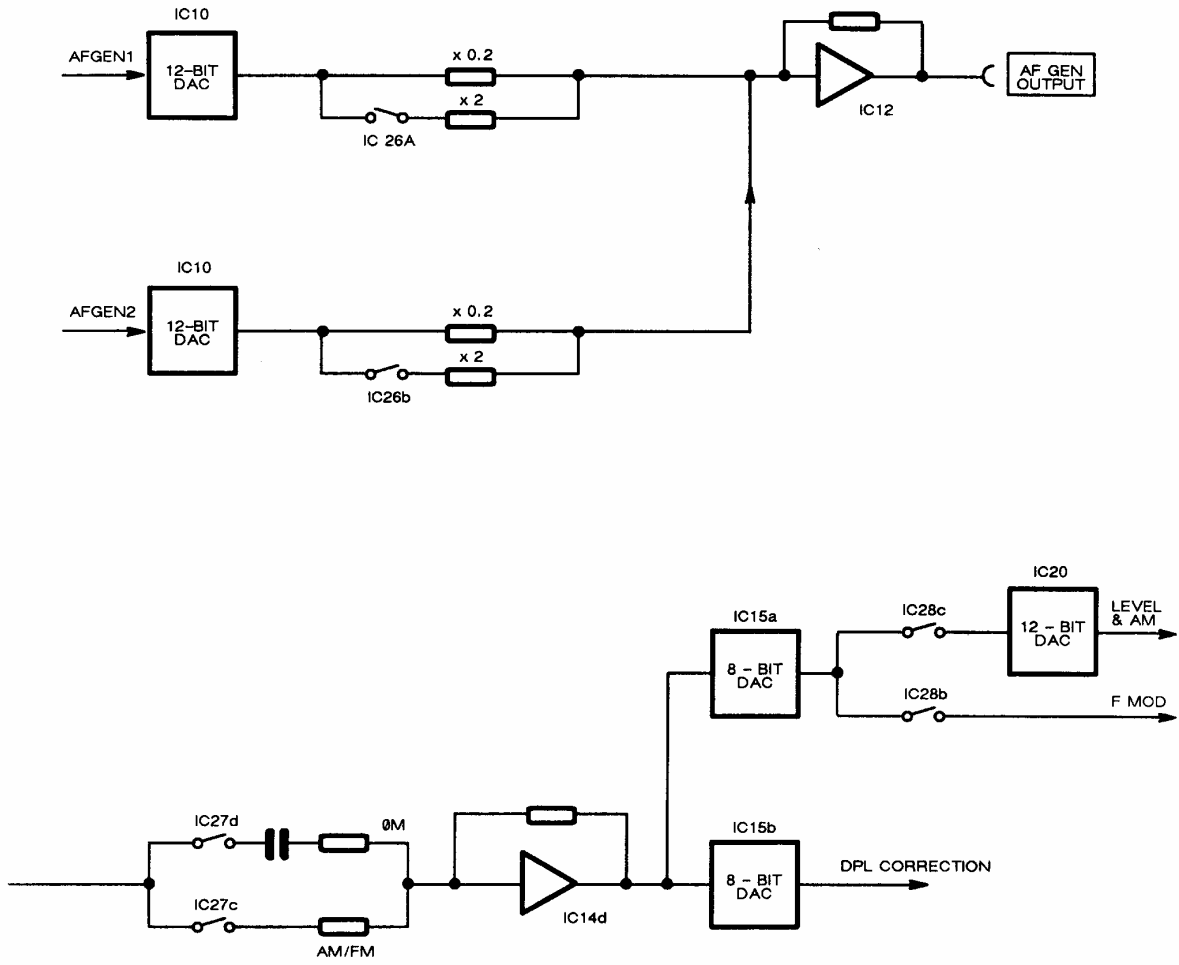
### Modulation control (Sheet 1)

61. Modulation signals can be from AF GENERator 1 and either AF generator 2 or the POCSAG generator, as selected by IC28(d) and IC29(a),(b). They are applied as inputs to the dual DAC IC13, which provides fine level control (see Fig. 4-8). Both outputs are then combined with an external modulation signal in IC14(c). This stage has six gain settings, dependent on the modulation selected and on which oscillator (RF) is selected. IC26(c) and (d) provide a 4:1 gain change which provides for full scale modulation settings of 6.25 kHz and 25 kHz (or 25% and 100%). This is necessary in order to maintain setting accuracy at low levels. IC27(a) and (b) are connected to give gain ratios of 1:2:4. These are selected depending on which RF range is selected. IC14(d) provides phase modulation conversion via the pre-emphasis circuit C15,R30,R33.



Fig. 4-8 Level control switching - AB611

TECHNICAL DESCRIPTION



62. At this point the level is further scaled to compensate for the modulation tracing inaccuracies of the RF synthesizer. To do this the microprocessor determines the set frequency for FM or the level for AM and then looks up a table of correction factors. These correction factors are then placed in the modulation scaling DAC IC15. For FM the level is now correct and it is passed on the FM MOD line to the RF tray. For AM the signal is passed onto the level setting section.

63. To enable the RF synthesizer to be frequency modulated at low frequencies, e.g. for POCSAG, a correction signal is generated by the other half of IC15. This DAC is set to the frequency of the RF synthesizer divided by 2.5 MHz, and is used in inverting mode, i.e. at low RFs the correction factor is small. The signal is fed to the RF tray on the DPL CORRECTION line.

### **RF level setting (Sheet 2)**

64. The RF generator's output level is voltage controlled from AB6/1. A 12-bit multiplying DAC, IC20, together with a stable voltage source supplies this control voltage. Any amplitude modulation required is summed with the control voltage so that it is automatically scaled with the level. The reference voltage generated by Zener diode D9 and set by R20 is summed with the AM by IC16c. The composite signal is then scaled by 12-bit DAC IC20. Note that the lowest 4 bits on lines D0 to D3 are first latched into IC18. Output to the RF tray is on the LEVEL AND AM line.

### **Microprocessor interface (Sheet 1)**

65. Two 3 to 8 line decoders, ICs 23 and 24, 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 IC37, for the same reason. This also has the benefit of reducing off-board loading.

### **Switching and Attenuator control (SKT1) (Sheet 1)**

66. IC30 is used to latch the attenuator and control line information from the microprocessor. The two input switching control lines for IP SELECT and DUPLEX are buffered by TR7,TR8 which are simple open collector drivers with catch diodes D7,D8. The high current requirements of the attenuator solenoids necessitate the use of an additional buffer - IC31. The attenuator drive signal consists of a software generated pulse approx. 20 ms long on the desired control line. Monostable IC38 holds the drive transistors off when the software is not running e.g. at power up.

### **POCSAG Data Generator (Sheet 2)**

67. IC39, IC29 and IC25(a) comprise a square wave generator used for generating the low frequency data for POCSAG and other systems. At the beginning and end of each pulse train the generator is set to the off state with both ICV29(c) and IC29(d) open. Thus the mean modulation voltage is zero and the RF generator will not de-tune.



## MODULATION METER

68. The modulation meter function is implemented by board AA1 (see Fig. 4-9). 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 and 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 and 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 DC is then used to control the VCO. Depending upon the frequency of the input as measured by the RF counter, the processor on AB4/1 selects either the HI line or the LO line to provide the reference for the sampling gate mixer. The resulting 110 kHz IF is fed via a 500 kHz low-pass filter to a 40 dB amplifier. Finally, the signal is sent to AB5/1 for demodulation as well as to the rear panel IF OUT socket.

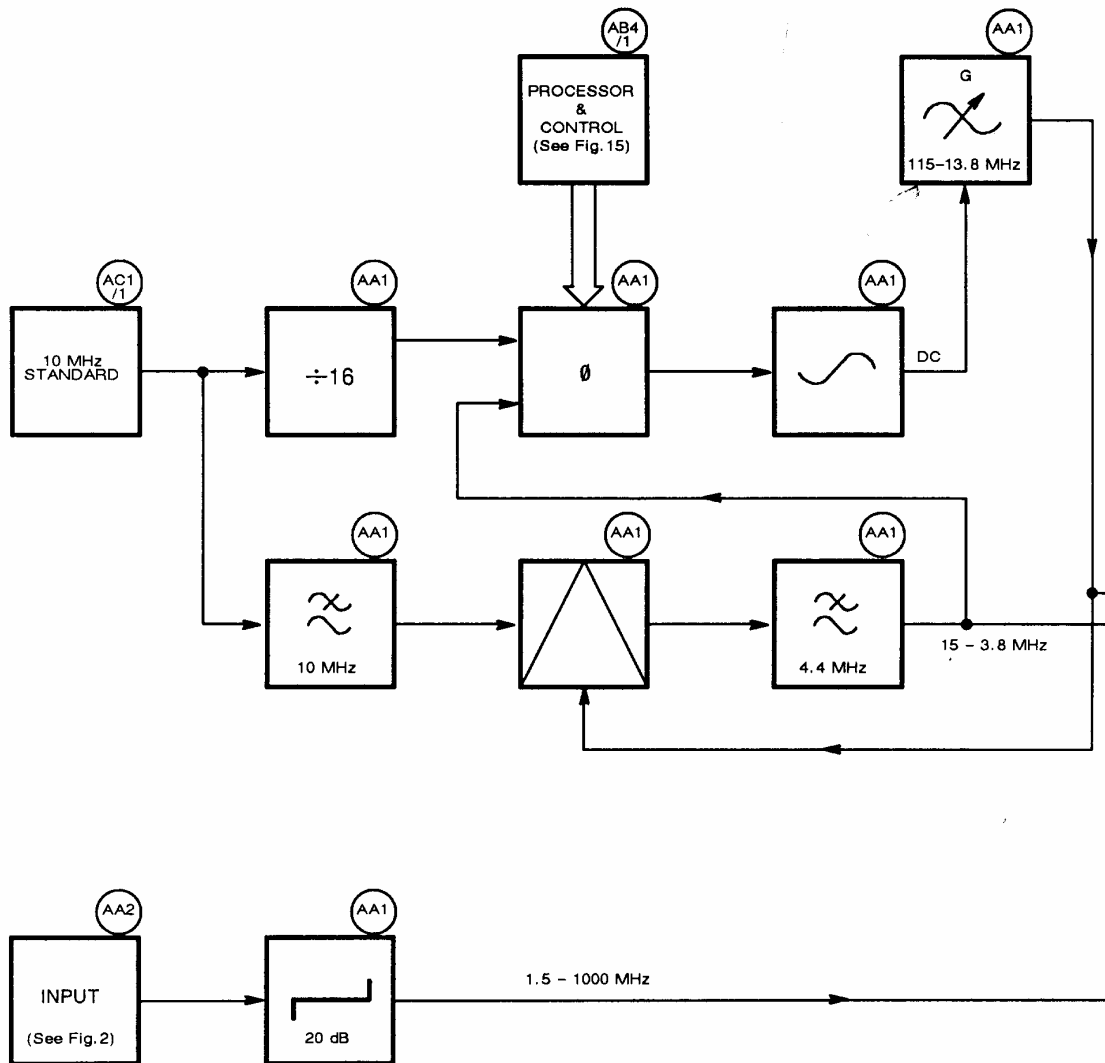
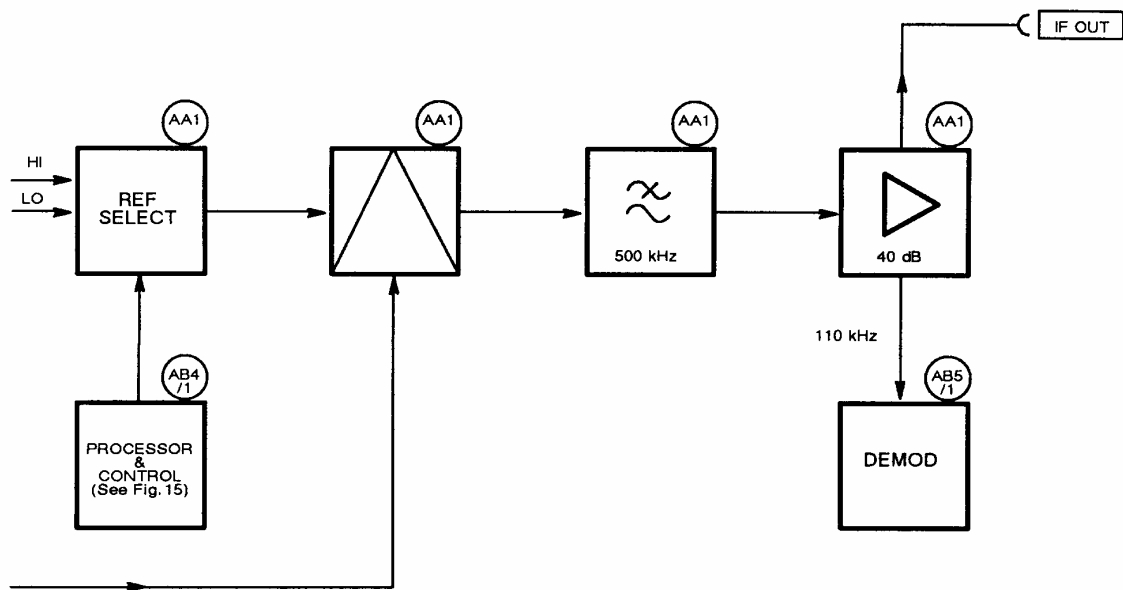


Fig. 4-9 Block diagram of modulation meter (showing main functions of boards)

TECHNICAL DESCRIPTION



## BOARD AA1 – RF MODULATION METER

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

69. AA1 is the RF section of the modulation meter. It consists basically of a synthesized oscillator and a sampling gate mixer followed by IF amplification and filtering.

### Oscillator and PLL (Sheet 1)

70. 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.

71. Oscillator output goes to the squaring amplifier consisting of TR5 and TR6 which produces a TTL 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 TTL 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  $\div 16$  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 PLL filter IC4 which removes the phase comparator frequency of 265 Hz and provides a DC control voltage to varactors D1 to D4 and hence completes the loop.

### Mixer and output (Sheet 2)

72. 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.

73. Sampling gate output is at the IF of 110 kHz and at a level equal to the RF 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 AB5/1. 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

74. The input from the modulation meter on AA1 is sent by AB5/1 on two parallel paths (see Fig. 4-10). One, the AM path is via a 40 dB attenuator, an AGC controlled amplifier and a band-pass filter to an AM detector. The second, FM path is via a high-pass filter to the FM discriminator. Both paths feed through 15 kHz low-pass filters, with de-emphasis applied on the FM path for  $\Phi M$ . The modulation selector connects the three inputs to the voltmeter input selector. This also connects to the optional RF directional power head at the ACCESSORIES socket and to the AF INPUT socket for AF or a modulated DC 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 AB1/1. For voltmeter measurements, the signal is connected to an A-D converter either directly or via a SINAD filter. The RF 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 AF input for feeding to the AF counter on AB4/1 and to the oscilloscope on AB2/2.

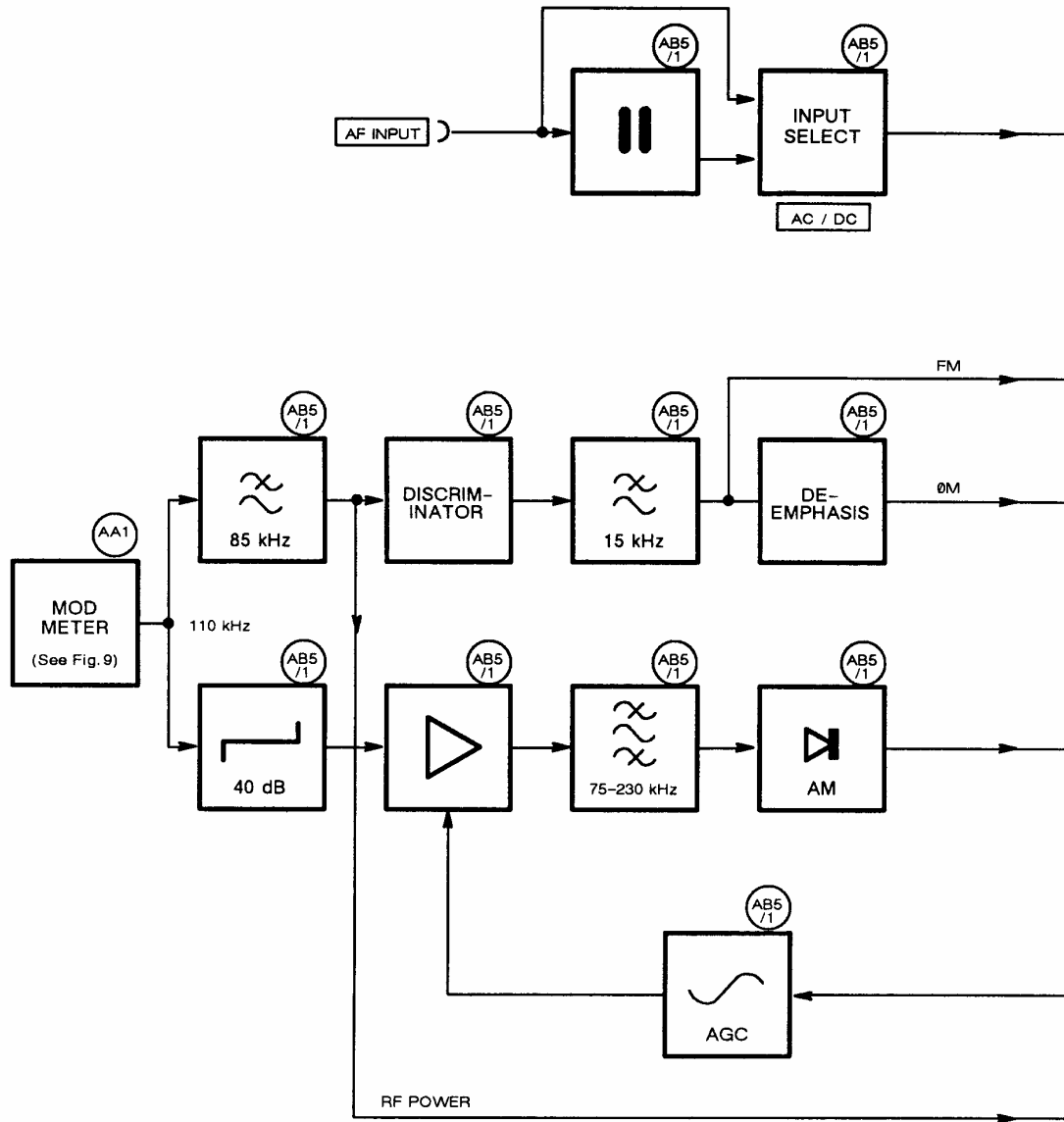
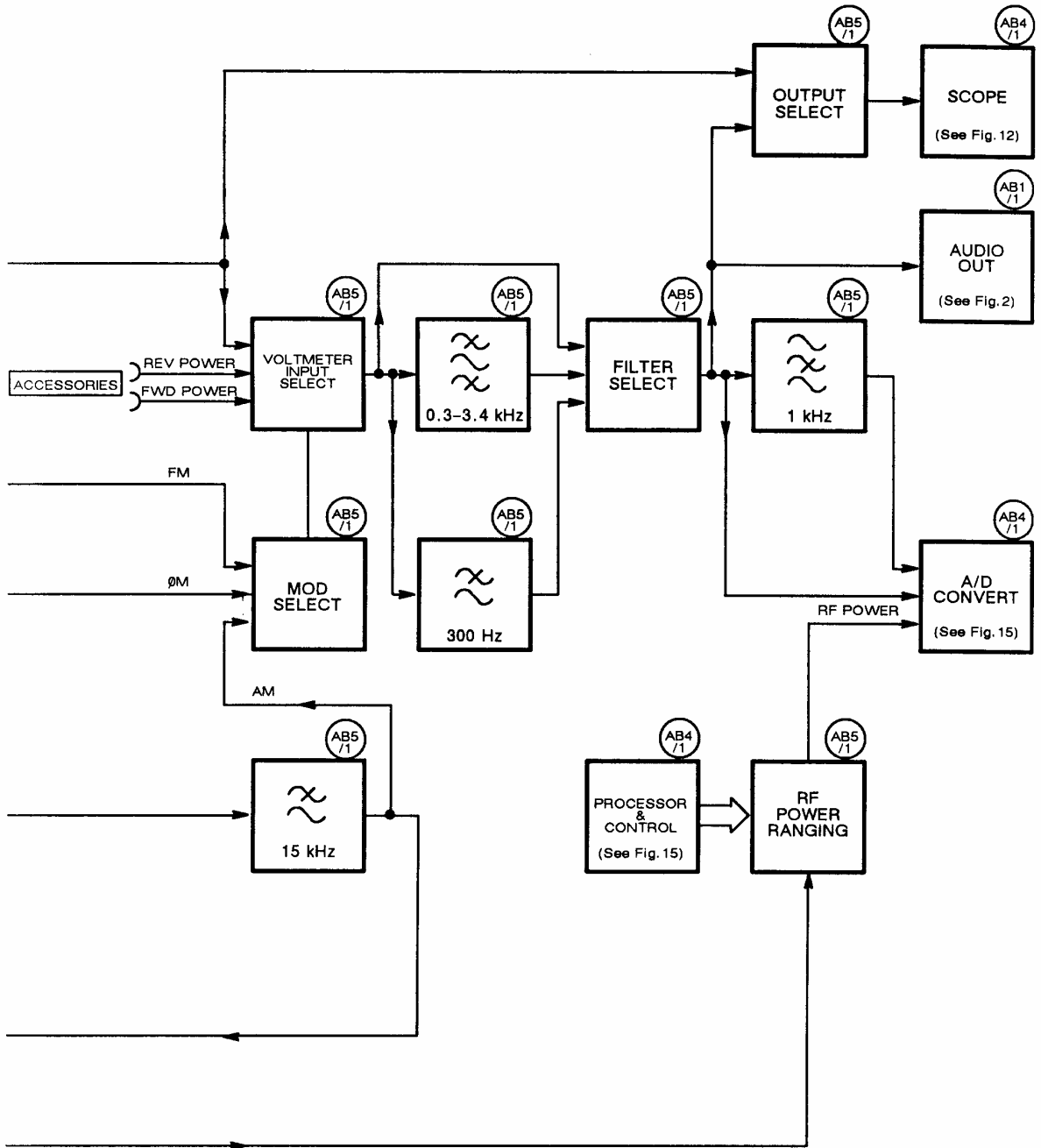


Fig. 4-10 Block diagram of demodulator, voltmeter and power meter (showing main functions of boards)

TECHNICAL DESCRIPTION



## BOARD AB5/1 – DEMODULATION AND SCOPE

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

75. AB5/1 contains all the demodulation circuits and ranging for AM, FM and  $\Phi$ M, all amplitude ranging for the voltmeter, oscilloscope and RF power meter, as well as several audio filters. The board performs the following two main functions:-

- (a) Demodulation of the IF (including voltage ranging) from AA1.
- (b) Measurement of all AF/DC voltages, including the demodulated AF from (a) above.

### IF demodulation (Sheet 1)

76. After the 110 kHz IF comes onto the board from AA1 on the IF IN line it follows two paths, one for FM/ $\Phi$ M and one for AM.

77. The FM/ $\Phi$ M path first passes through an 85 kHz high-pass filter to remove low frequencies (especially 15.625 kHz from the CRT drive) and then it splits into two paths. One path goes to the RF power meter ranging amplifier (sheet 2), the other continues to comparator IC102 which acts as a limiter, the output of which is at TTL 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 IF 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 IF). The signal is now a demodulated FM plus a DC level corresponding to the IF. To remove the latter, the signal is AC coupled to the next stage, IC104b, which enables the output level to be set using R129. For  $\Phi$ M the signal is fed to IC105 which applies 750  $\mu$ s de-emphasis, for FM this IC is by-passed.

78. The AM path is first attenuated 40 dB by R135, R136 so that the following AGC section works with little distortion. At this point the DC bias is set by R138. AGC is accomplished using a dual-gate MOS FET 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 AM detector IC107 and then to a 15 kHz low-pass filter which is configured similarly to the one used for FM. Output is now a demodulated AM plus a DC level corresponding to the mean carrier level. At this point the signal takes two paths. One path is to integrator IC108b which provides a DC which is fed back to dual-gate FET TR101 as the AGC control signal. Reference AGC level is set by R172. The second path is AC coupled to IC108 which enables the AM output level to be set using R168.

79. One of the 3 switch sections of IC317 selects the required demodulated AM, FM or  $\Phi$ M for connection via the DEMOD line to the output filters). The 4th section injects a 5 V square wave (switched by the microprocessor) to generate the RF overpower warning signal.



### Ranging and filters (Sheet 3)

80. The AF input on the AF IN line can be either DC or, via C200, AC coupled into the instrument. RLA performs this task. The 1 M $\Omega$  input impedance is determined by R201 and IC200 which is configured as an inverting amplifier. IC200 gain can be set to  $\pm 2$ , or to  $\pm 20$  when switch IC319d is closed. From IC200 the output takes two paths, one to the oscilloscope and one to the voltmeter.

81. 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 AF 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 AM, switch IC316d is closed, for FM and  $\Phi$ 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.

82. For the voltmeter path, in addition to the AF 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 1 when switch IC312d is closed, or 10 when the switch is open. For calibration purposes the voltmeter gain is set by IC203b using R231. At this point switches IC312a and IC318a respectively determine whether the AF input or the input on the DEMOD line continues along the voltmeter path. IC318 functions as a two pole 4-way switch, see Fig. 4-11. In the first 3 positions it passes the signal (1) directly to the scope and voltmeter or (2) through the 300 Hz to 3.4 kHz band-pass to the scope and voltmeter. In the 4th position, EXTERNAL filter mode, it routes the demod. signal directly to the scope and DEMOD OUT socket, and the AF input to voltmeter. It is then possible to insert an external filter in the demod. voltmeter path.

83. The selected AF 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 RF power ranging circuit. Output on the VOLTMETER line is to the A-D converter on AB4/1. A second, switched output is available which goes on the  $\pm$ PK line to peak detectors on AB4/1 for measuring modulation levels.

Switching (Sheet 2)

84. All switching, gain settings and signal routing 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 TTL levels on the control lines while their outputs switch between the +12 V and -12 V rails.

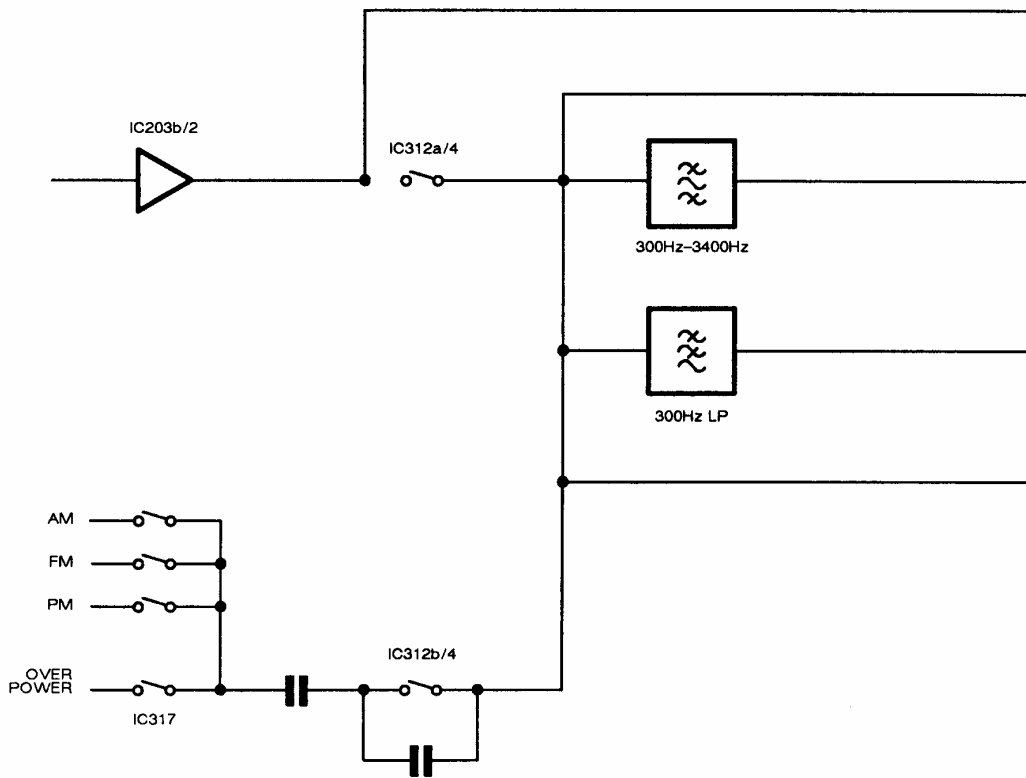
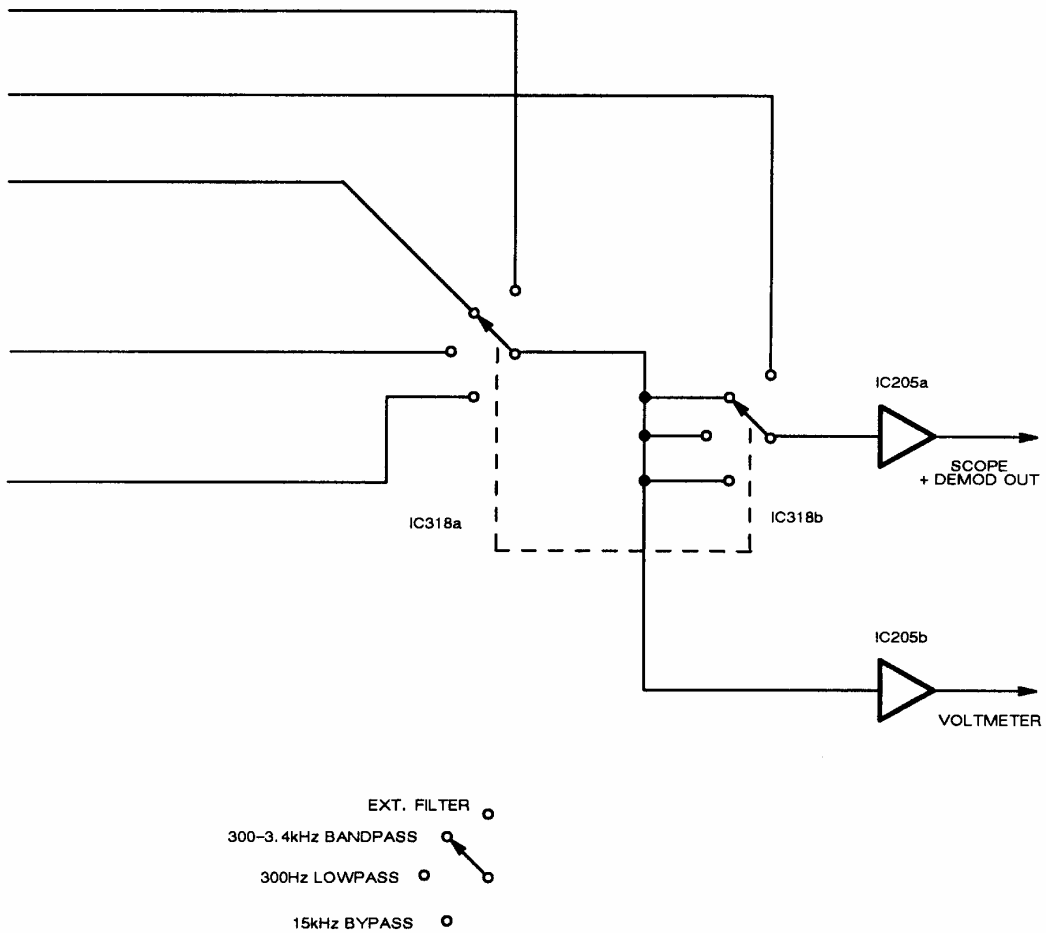


Fig. 4-11 Signal switching - AB5/1

TECHNICAL DESCRIPTION

85. An output from the 85 kHz high-pass filter IC100 (sheet 1) is fed to IC101a to provide the RF 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**

86. The input from AB5/1 to the oscilloscope is ranged and summed with the vertical shift control on AF2/1 (see Fig. 4-12). A 50 kHz low-pass filter feeds out to both the scope trigger on AB3/2 and the A-D converter on AB2/2. The selected single or repetitive trigger from AB4/1 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 VDU board AB3/2. 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 AB3/2.

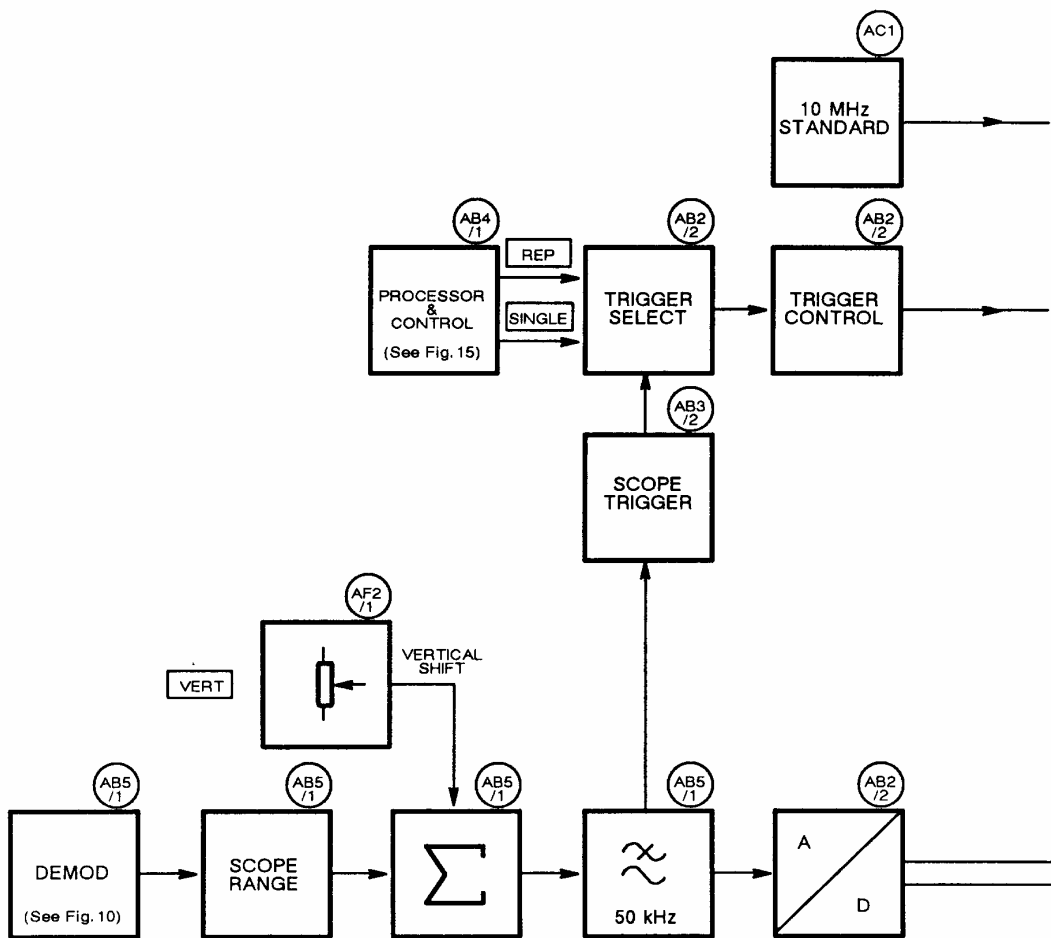
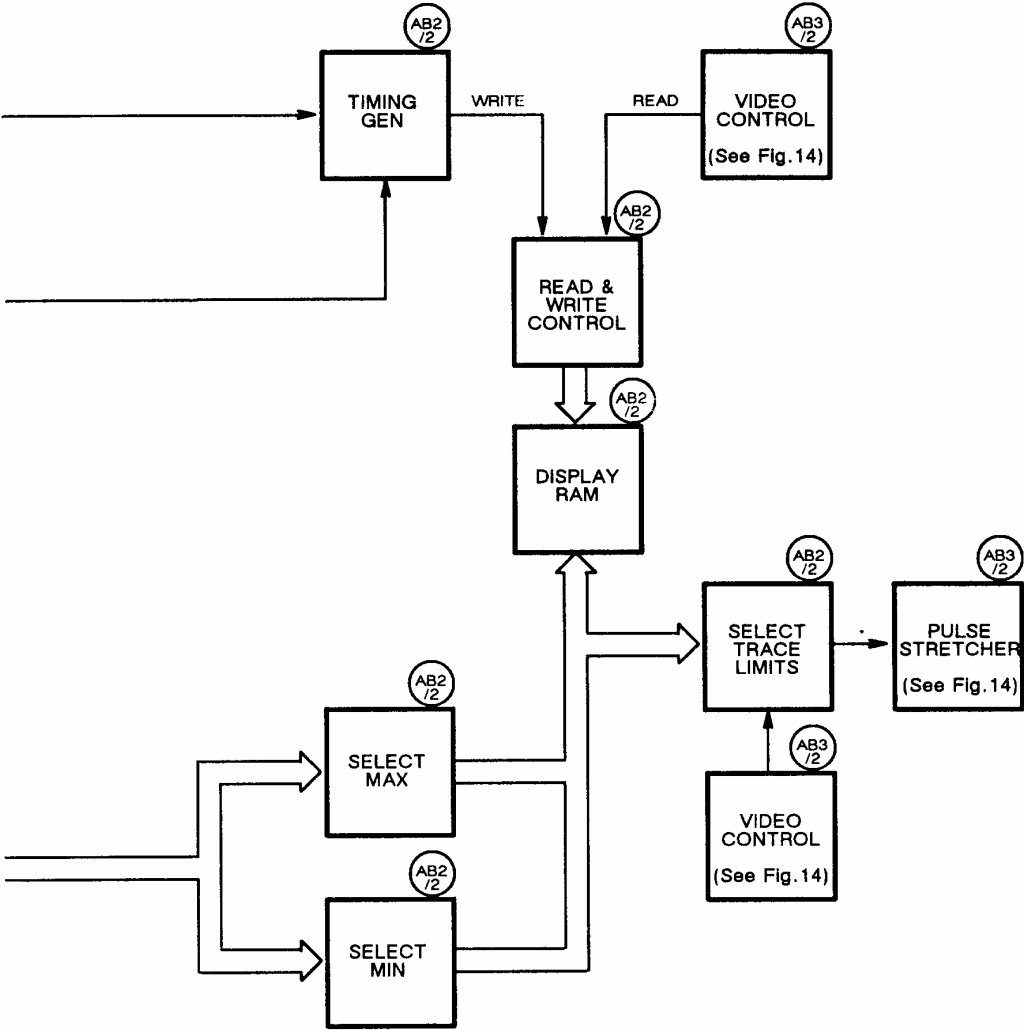


Fig. 4-12 Block diagram of oscilloscope (showing main functions of boards)



## BOARD AB2/2 – DIGITAL SCOPE

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

87. Digital scope board AB2/2 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  $\mu$ s 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 AC signal thus giving the appearance of DC. 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  $\mu$ s 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)

88. 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 AB4/1. 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.

89. 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. 4-13 shows the manner in which values are stored and the lines are drawn on the screen to reproduce the waveform.

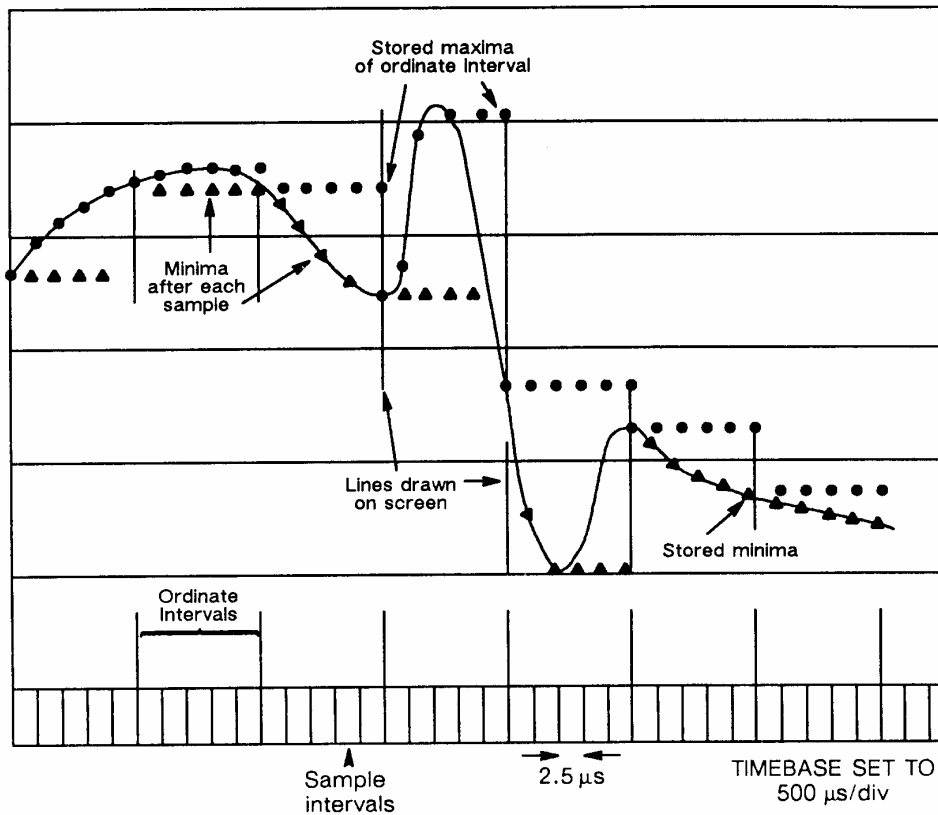


Fig. 4-13 Oscilloscope display generator process - AB2/2

### Trigger control (Sheet 1)

90. 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 AB3/2. 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)

91. 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.

92. 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)

93. The oscilloscope 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 AB4/1. The generation of the pulse from AB4/1, 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)

94. 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 oscil-



oscope 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  $\mu$ s 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.

95. 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.

96. 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

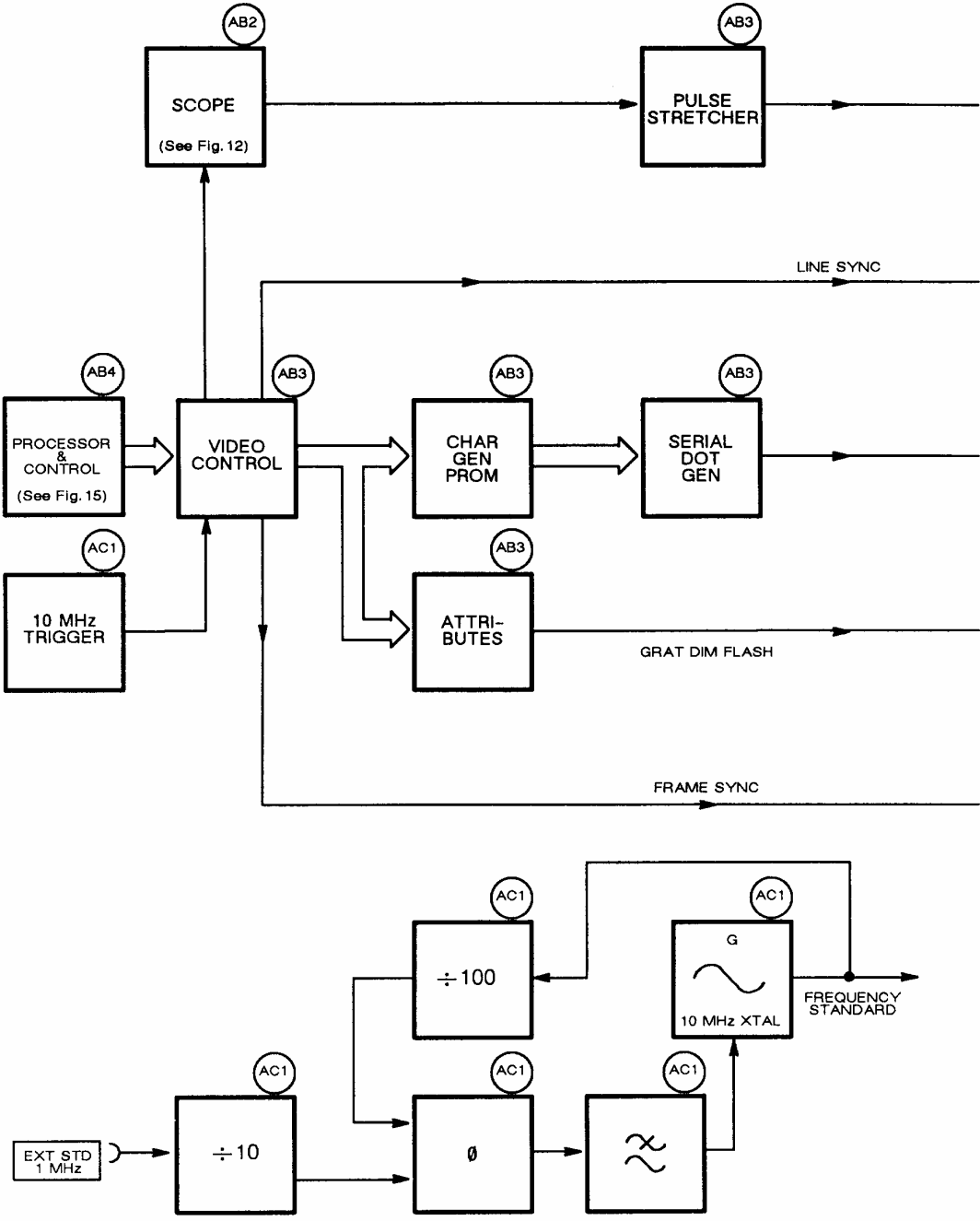
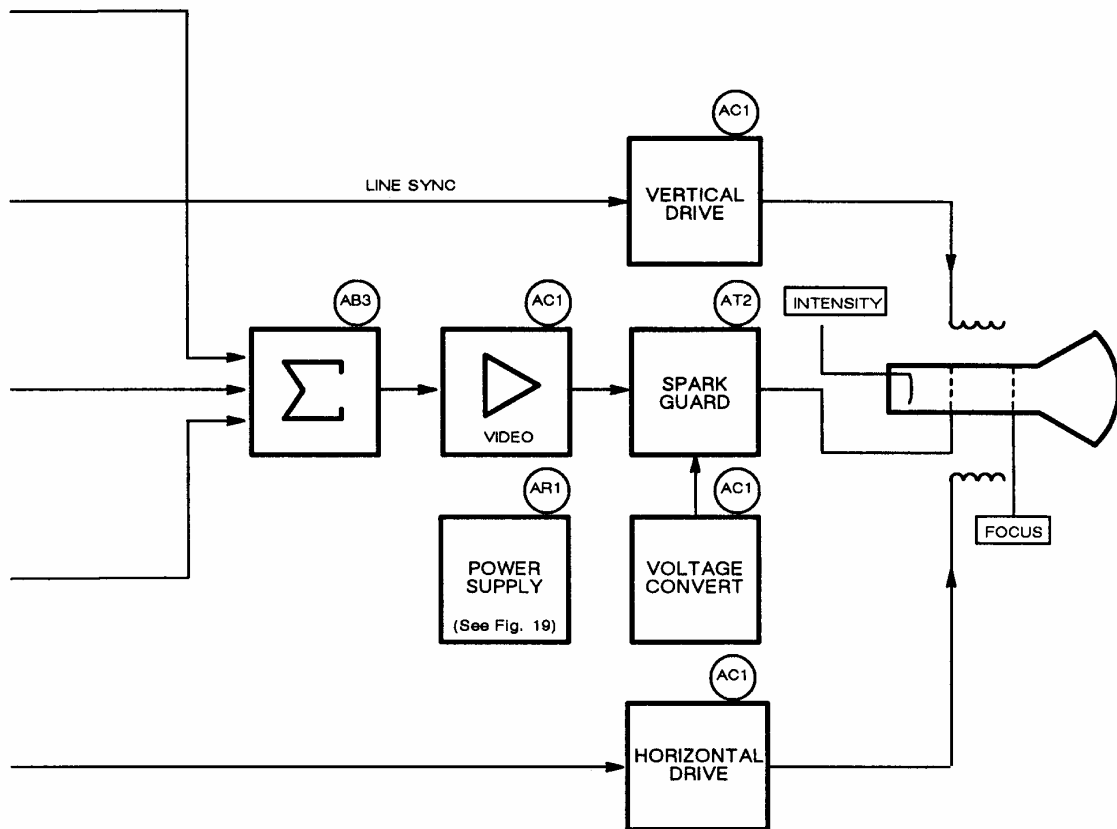


Fig. 4-14 Block diagram of video control and freq. standard (showing main functions of boards)



97. The video control circuit on AB3/2 (see Fig. 4-14) accesses the character generator PROM for read operations to update the display. It also enables the processor on AB4/1 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 AB2/2 which provide the oscilloscope trace are stretched on AB3/2 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 AB3/2 respectively control the vertical and horizontal drives for the CRT. Power from AR1/1 is converted to the high voltages necessary for both the board and for the CRT. For the latter purpose, the voltages are connected to CRT base board AT2 which provides flashover protection.

98. 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.

## BOARD AB3/2 – VDU BOARD

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

99. This board contains the display unit timing and character generation circuits. Additionally, it provides the timing for digital oscilloscope board AB2/2 and supplies the line sync and frame sync signals for CRT drive board AC1. The trigger output is used by both the oscilloscope and the audio frequency counter.

### Rows counter (Sheet 1)

100. 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 micro-processor. At the end of the count, the line sync pulse is generated which is fed out to CRT drive board AC1 and processor board AB4/1. 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 AB2/2 to allow the display counters to load.

### Columns counter (Sheet 1)

101. 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 and $\mu$ p interface (Sheet 1)

102. The  $\mu$ p 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.

103. 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)

104. 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)

105. 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)

106. 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 CRT 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)

107. 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

108. 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**

109. 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**

110. 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 so as to provide the SCOPE CLK signal while the trace is passing through the graticule area. The clock drives the counters on AB2/2 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)**

111. The signal on the SCOPE INPUT line from demodulation and scope board AB5/1 is AC 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 TTL levels. This TRIGGER output supplies the oscilloscope trigger for AB2/2 as well as being used for period measurement by the audio counter on AB4/1.

## BOARD AC1 – CRT DRIVE

Circuit diagram : Chap. 7, Fig. 7-24.

112. The display board AC1 and associated board AT2 provide the drive voltages to display the information generated by digital scope board AB2/2 and VDU board AB3/2. Electromagnetic scanning is used to generate a 320 vertical line raster every 19 ms on a 19 cm CRT with video modulation applied to the grid. AT2 is the flashover protection board.

### Frame output

113. 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 AB3/2. 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 DC blocking capacitor C8 to the horizontal deflection coils.

114. 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 DC 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 HF transients generated during flyback. The supply rail is heavily decoupled by R36, C2 and C3 to prevent frame rate interference.

### Line output

115. 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 CRT 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 CRT 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

116. Five supplementary supplies are generated by T1 to provide higher voltages for the video amplifier and the CRT 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 CRT via the red EHT lead and anode cap.

117. 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.

118. +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.

119. 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.

## Video amplifier

120. Current on the VIDEO IN line from AB3/2 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

121. The PLL 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 DC 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. 4-25.

122. Board AT2 supports the CRT 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 CRT the final anode capacitance is rapidly discharged through one of the CRT 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 CRT coating, preventing large currents from flowing through the CRT circuitry.

**PROCESSOR, CONTROL AND AUDIO COUNTER**

123. The microprocessor on AB4/1 uses an 8-bit data bus which is multiplexed with an 8-bit address bus to provide a 16-bit address (see Fig. 15). Besides controlling the major functions of the instrument, it responds to interrupts from the GPIB and the keyboard AF1/1, AF2/1 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 AR1/1 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

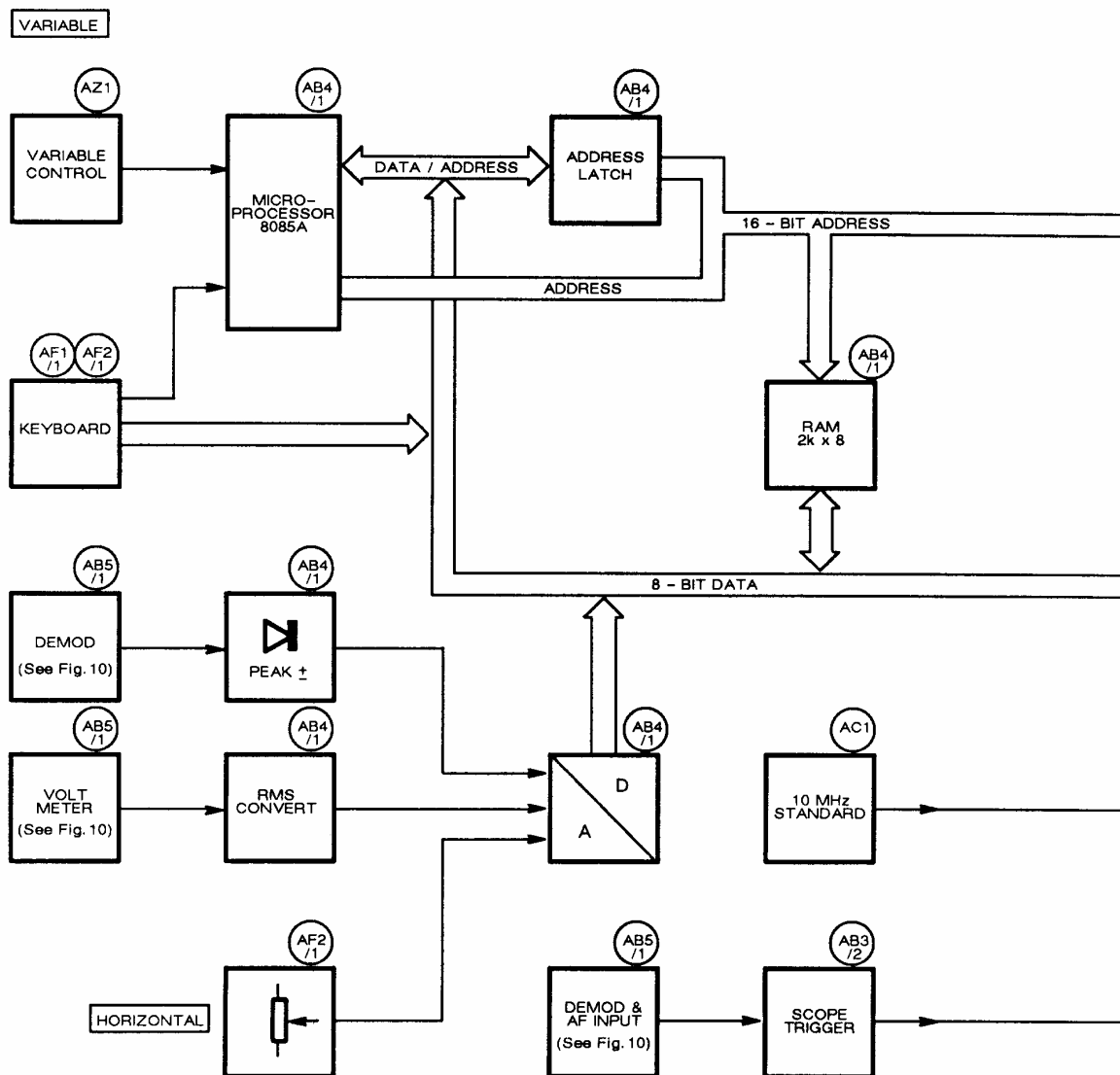
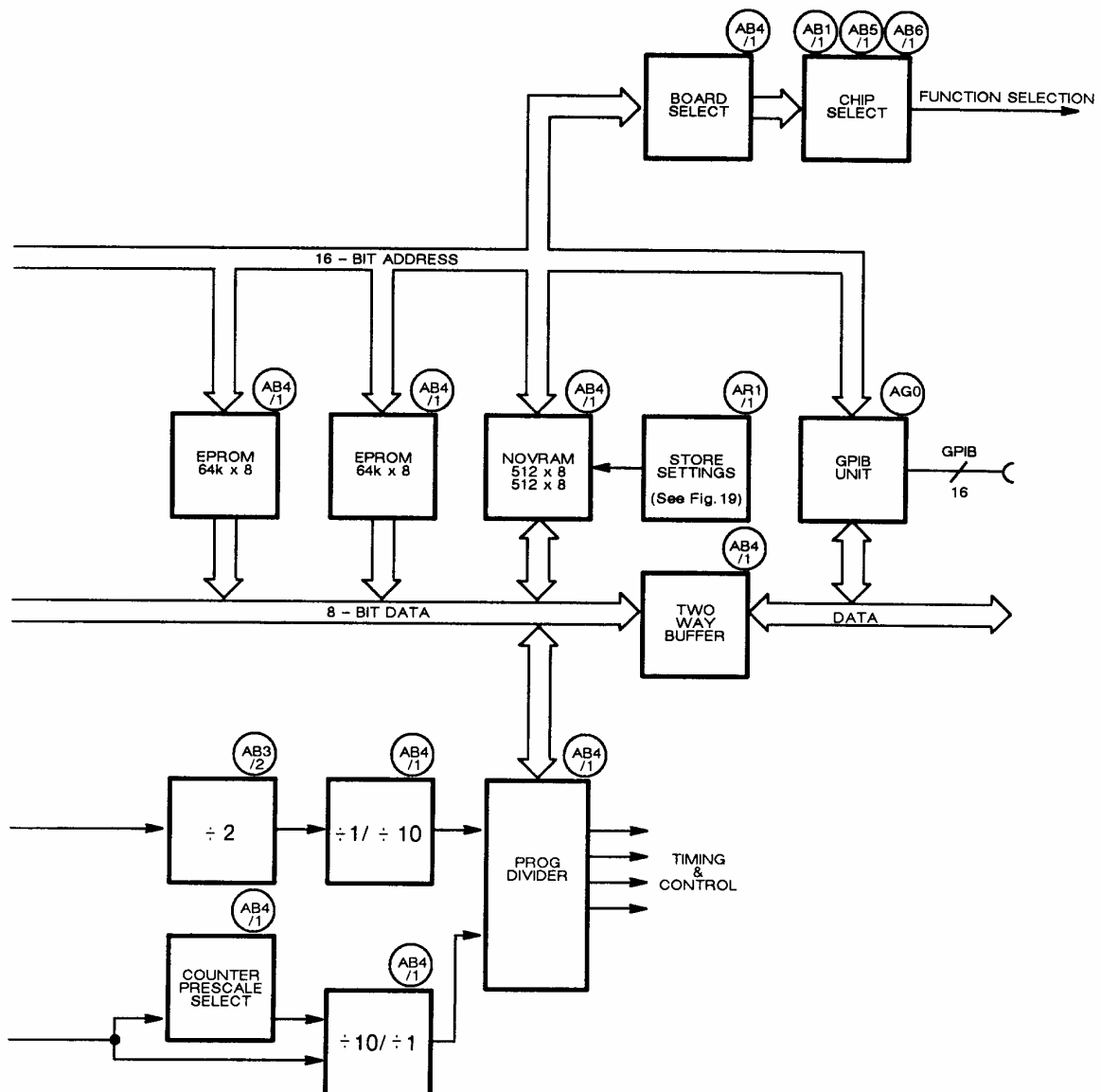


Fig. 4-15 Block diagram of processor, control and audio counter (showing main functions of boards)

converter for measurements of the voltmeter, power meter and demodulation inputs from AB5/1. 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.

124. The frequency to be measured by the AF counter is connected from board AB5/1 to the scope trigger on AB3/2. It is then applied to a frequency comparator on AB4/1 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 AB4/1 – MICROPROCESSOR

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

125. Board AB4/1 contains the microprocessor, memory, A-D converter and programmable divider as well as the audio counter circuit (see Fig. 4-16).

### Microprocessor (Sheet 1)

126. 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. X1 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.

127. 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 IC33 pin 12 show the speed of rotation. Serial Output Data (SOD) controls the gating of IC33 to determine whether the pulses or the TONES TIMER input causes a processor interrupt.

128. 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. RST 6.5 interrupts are generated by positive-edge triggered D-type bistable IC29b. When a keypress is detected on AB1/1, the pin 1 clock input is taken high causing an interrupt. RST 7.5 is fed from switch IC27, whose inputs are from the tones timer, DTMF decoder or DCS filter. 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).

### A-D conversion (Sheet 2)

129. 8-bit A-D converter IC3 operates by successive approximation. It is clocked at 250 kHz by the output from divider IC37 (sheet 3). To minimize noise, the voltage reference for the V REF+ and V REF- inputs is supplied from the on-board regulator D6. 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 eight 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. IN4 is converted to the DCS filter, IN5,6,7 are for additional future facilities. Precision peak/trough detector IC30, supplied from the MOD +/- PEAK line, provides the PEAK and TROUGH voltages which are used for two of the bargraph displays. IC32 converts the voltage on the VOLTMETER line to RMS 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 IC17c and d with a chip select signal from decoder IC18 (sheet 1). Output is in tristate form to the data bus.

130. To start the IC3 conversion process, a low from IC18 pin 12 opens the gates of IC19 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 4-7) 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 4-7 A-D INPUT SELECTION LOGIC - AB4/1

Address			Selected analogue input
C	B	A	
L	L	L	IN0 - Peak
L	L	H	IN1 - Trough
L	H	L	IN2 - RMS volts
L	H	H	IN3 - Horiz shift
H	L	L	IN4 - DCS filter
H	L	H	IN5
H	H	L	IN6 Not connected
H	H	H	IN7

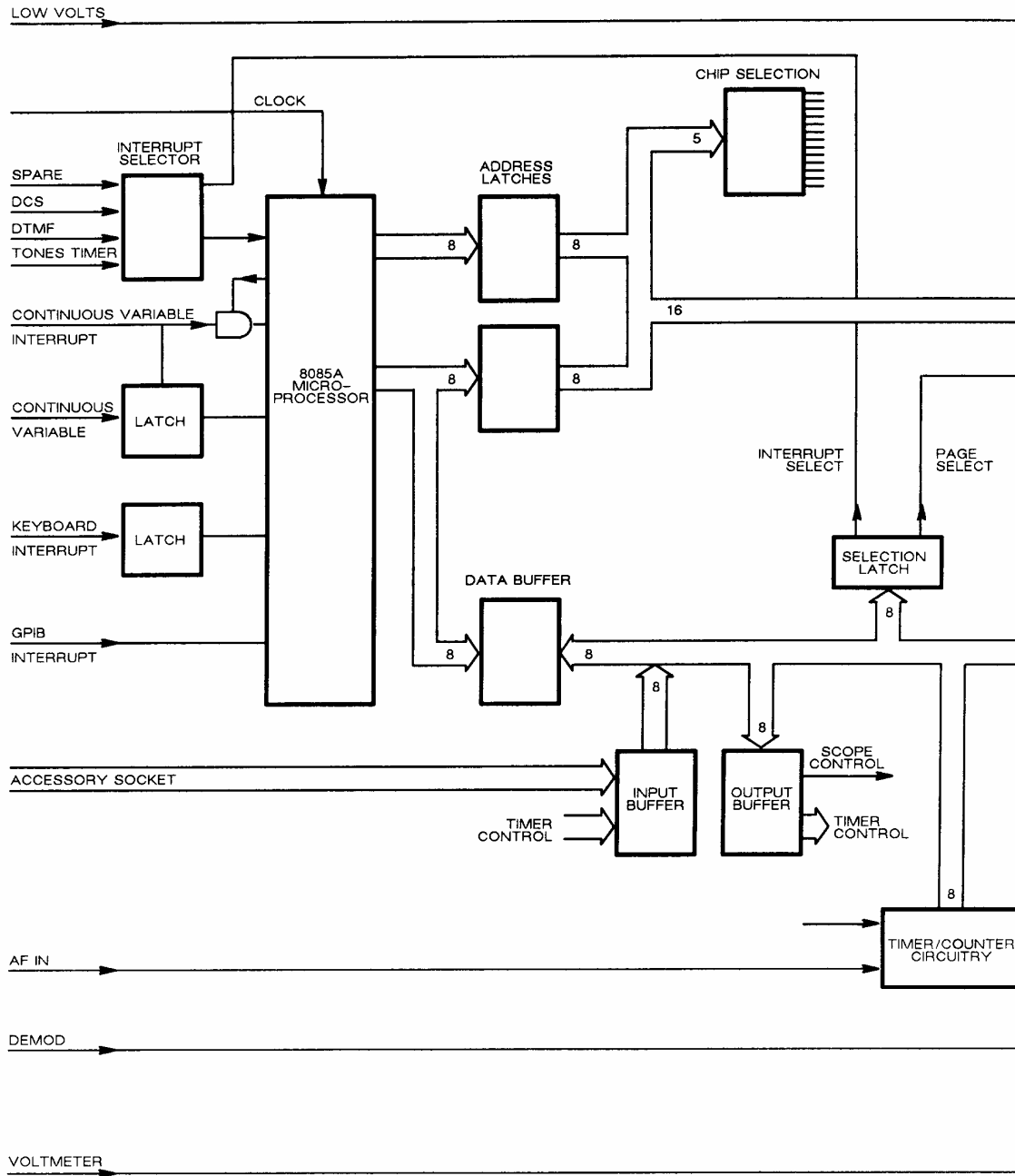
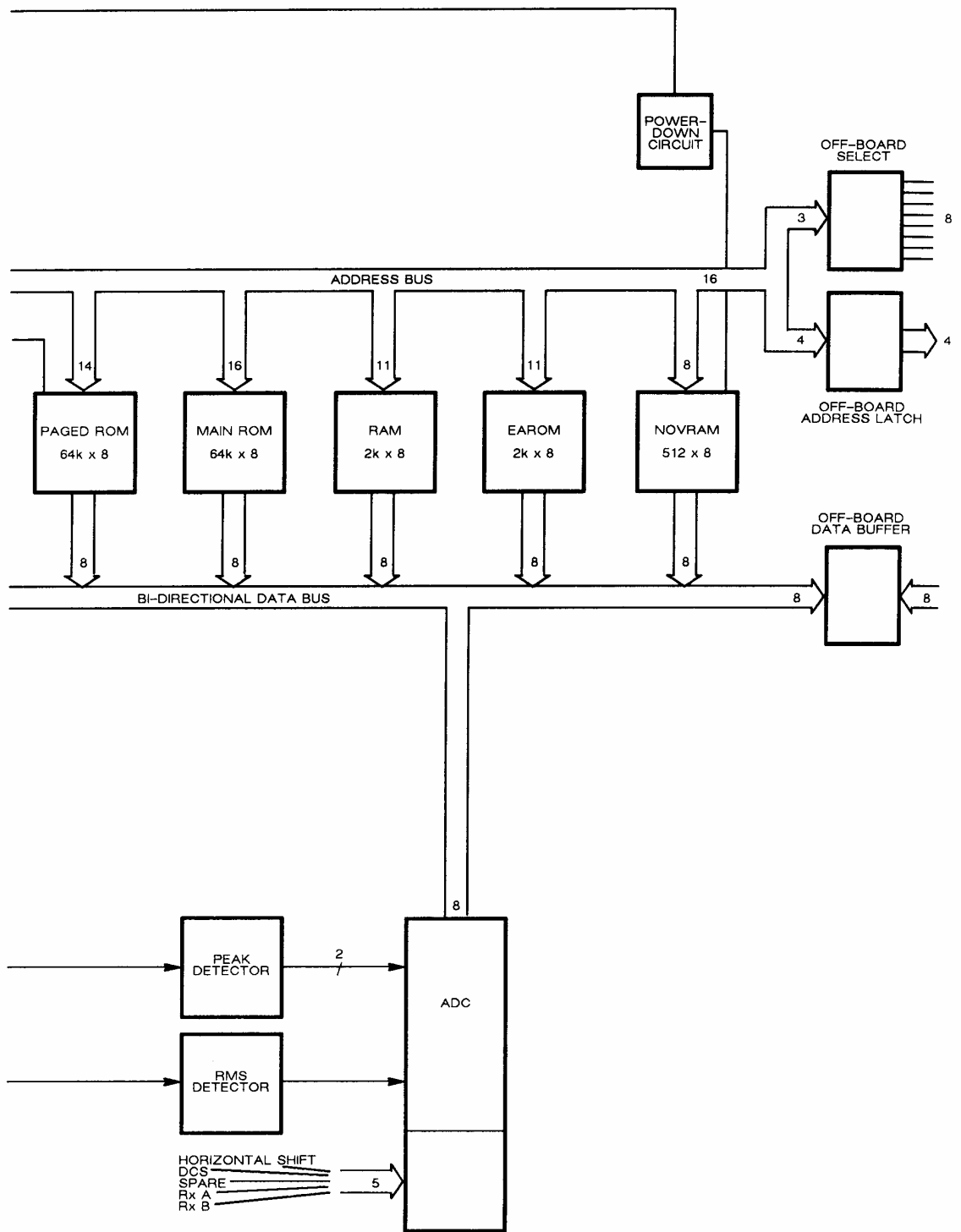


Fig. 4-16 Block diagram of Microprocessor board AB4/1

TECHNICAL DESCRIPTION



### Programmable divider (Sheet 3)

131. 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

132. 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 4 (sheet 1), is used as one of the two sources for the RST 7.5 processor interrupt signal.

#### Counter 2

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

#### Counter 3

134. 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

135. 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 2).

#### Counter 5

136. Provides a variable oscilloscope timebase by dividing a 2.5  $\mu$ s period clock which is fed to IC4 pin 29. The timebase obtained is output from pin 37 on the SCOPE TIMEBASE line.

### Audio counter and prescaler (Sheet 3)

137. The AF 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.



138. 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 1)

139. The main operating system is contained in EPROMs IC9 and IC10 which provide a total of 128 kbytes of memory. As the total addressable area of the  $\mu$ P is only 64k (16 address lines,  $2^{16} = 65,536$ ) half of the total memory space is "paged", i.e. two memory areas sit at the same address, but only one is selected at any one time. This is achieved by a complex chip select scheme, IC5 and IC12.

140. IC13 is a 2 kbyte 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.

141. IC16 is a 2 kbyte 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.

142. IC14 is 512 byte NOVRAM (Non-Volatile RAM) which holds the current front panel settings, all the set-up information contained in the 'change parameters' menus. It functions in a similar way to a normal RAM but with an additional EEPROM in the same package. With the  $\overline{\text{NE}}$  (non-volatile enable) line high, the device functions as a normal RAM. With  $\overline{\text{NE}}$  low, read and write operations relate to the EEPROM part of the chip.

143. The NOVRAM IC14 is controlled by data selector IC31. In normal operation,  $\overline{\text{NE}}$  is high which holds TR4 off and thus the local supply to IC14 and IC31 is maintained via D7 from the common 5 V rail. At power down, the low volts driver on AR1/1 goes open collector and the LOW VOLTS line is pulled high by R37. IC31 pin 1 goes high, which sends  $\overline{\text{NE}}$  low. This turns off TR4 and turns on the 5 V regulator comprising TR3, R38 and D9. IC14 is then supplied 5 V via the +12 V rail. This provides an extra 60 ms in which a store cycle can be completed.

### Data direction control (Sheet 2)

144. 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 IC18 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.

### Selection signals (Sheet 3)

145. BS3 for board AB5/1 provides the RMS TIME TRIGGER signal to IC36 (sheet 2). Since a board select signal to AB5/1 usually involves a voltmeter range change, IC36 is triggered to produce a low delay pulse to IC26. The delay allows time for the RMS converter output to settle (sheet 1).

## **BOARD AF1/1 – MAIN KEYBOARD**

Circuit diagram : Chap. 7, Fig. 7-26.

146. 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 AB1/1, and the rows are received back onto AB1/1 (for details of the keyboard operation see board AB1/1 description).

147. LEDs D1 to D5 are used to indicate modulation and input socket selection and are driven by IC1. They are controlled from AB1/1 using 5 column lines shared with the keyboard. In operation, AB1/1 first takes the appropriate column line high to IC1 then turns the selected LED on by strobing the CLK line.

**BOARD AF2/1 – SCOPE KEYBOARD**

Circuit diagram : Chap. 7, Fig. 7-27.

148. 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 CRT and thus the brightness of the raster. VOLUME control R2 output is connected to AB1/1, 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 AB1/1. R3 controls the time delay introduced by counter number 4 on AB4/1, while R4 varies the bias of the scope ranging IC on AB5/1. The six push-buttons are connected into the same matrix as main keyboard AF1/1. For details of the keyboard operation see board AB1/1 description.

## BOARD AZ1 – OPTICAL ENCODER

Circuit diagram : Chap. 7, Fig. 7-27.

149. 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 AB4/1. Power is supplied from AB1/1 on contacts 1 and 3 to LEDs 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 AB4/1 to determine the direction and rate of movement of the control.

## Unit AG0 – GPIB

Circuit diagram : Chap. 7, Fig. 7-29.

150. 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.

151. 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.

152. 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 DIO1 to DIO5 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 DIO6 and DIO7 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.

153. 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 AB1/1 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.

154. 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

155. 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. 4-17).

**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.

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).

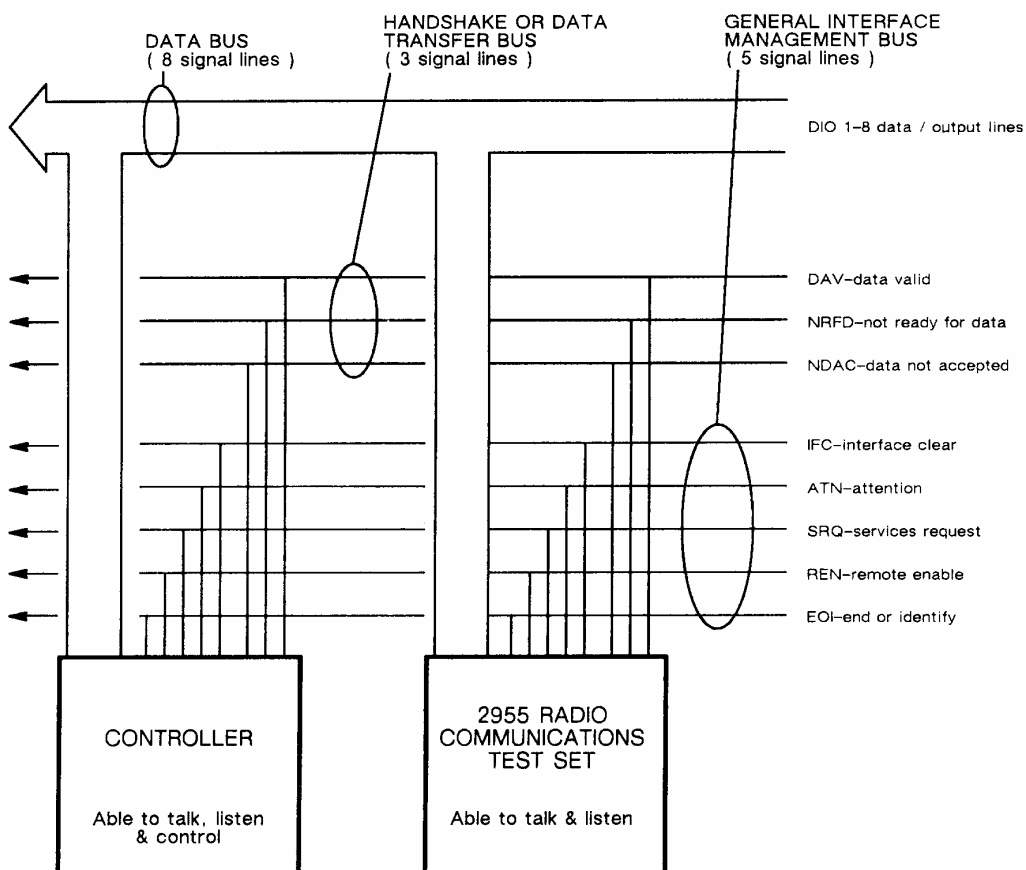


Fig. 4-17 General Purpose Interface Bus (GPIB) structure

**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

156. 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

157. 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. 4-18.

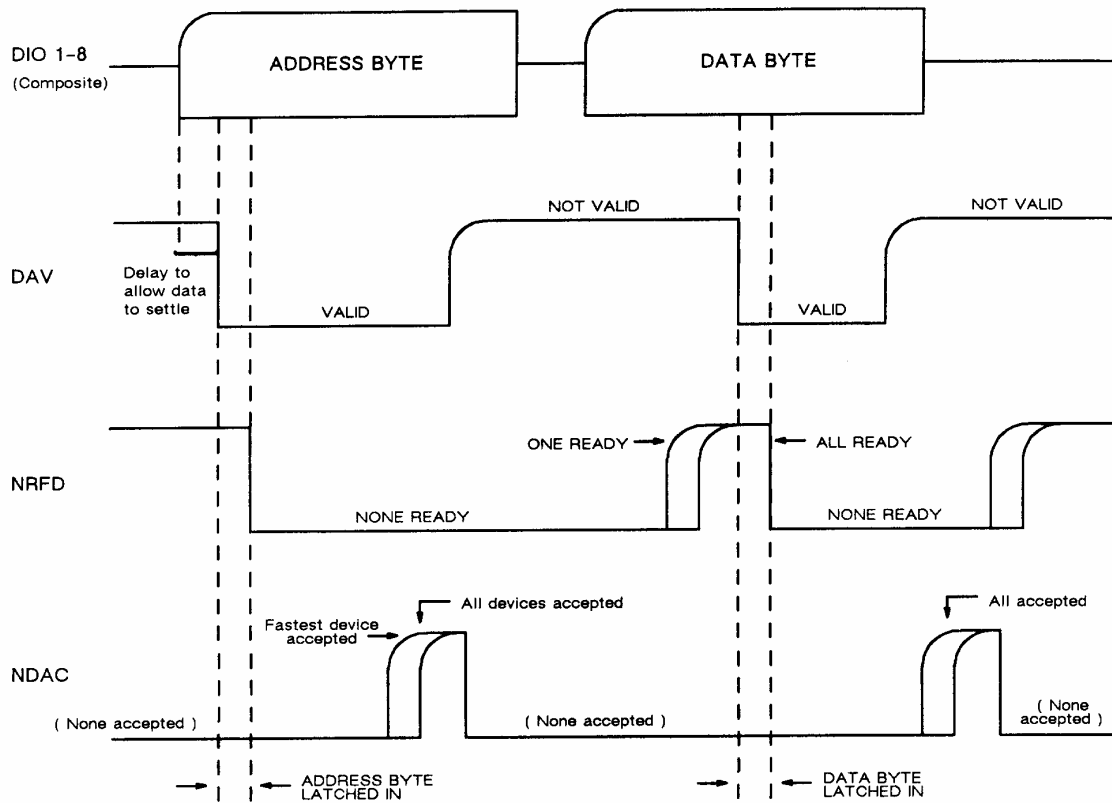


Fig. 4-18 Handshake procedure

### Service request and status byte

158. 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.

159. 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

160. Power supply board AR1/1 selects its input from either the AC mains after rectification or from an external DC via filter board AR4 (see Fig. 4-19). If both AC and DC are connected the AC is selected to supply the power, if AC power fails the DC is automatically selected. Selection is not made if the DC 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 AB4/1 in the event of a power failure. The resulting DC outputs are  $\pm 5$  V and  $\pm 12$  V with the +12 V line supplying a controlled drive for the fan.

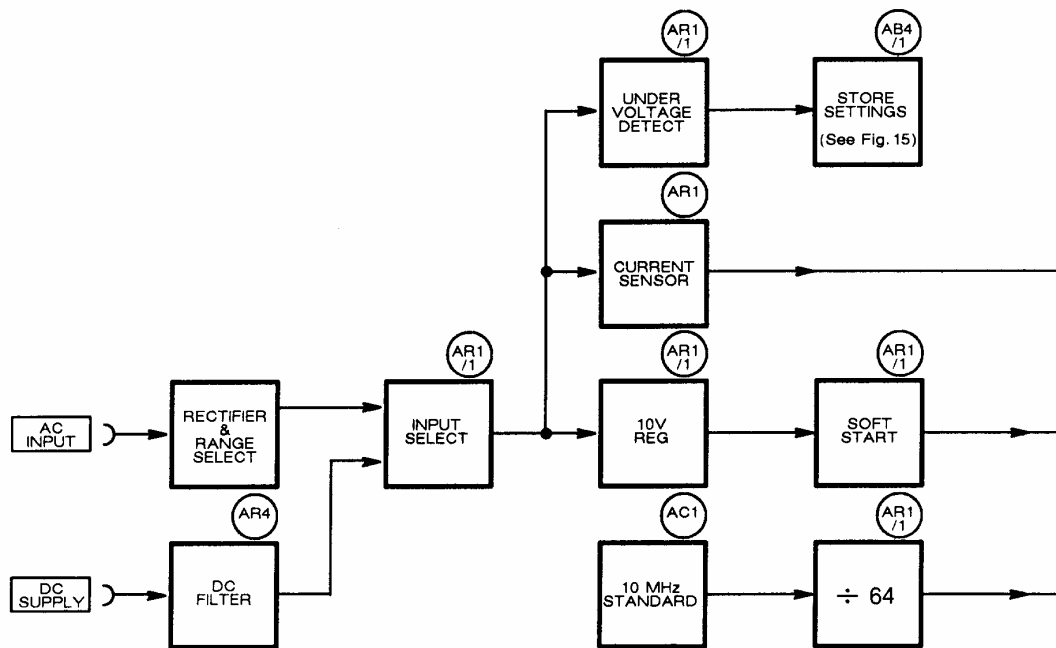
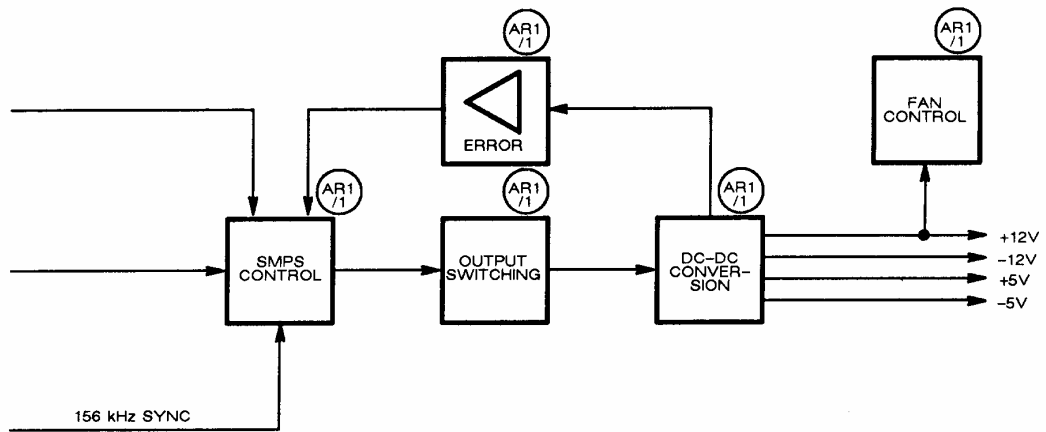


Fig. 4-19 Block diagram of power supply  
(showing main functions of boards)

TECHNICAL DESCRIPTION



## BOARD AR1/1 – POWER SUPPLY

Circuit diagram : Chap. 7, Fig. 4-28.

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

### Input power selection

162. When the instrument is turned on with only external DC 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 DC is applied with the incorrect polarity. If a DC 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 PSU. If AC 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

163. 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 DC 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 PNP 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 DC input falls below 10.8 V, the voltage drop across the series regulator element TR5 drops below the  $V_{be}$  of TR1 (this is preset by R46) which turns off. A signal is thereby sent via opto-isolator IC4 to the processor board AB1/1 on the LOW VOLTS line, so that the front panel settings can be saved in anticipation of a complete failure of the DC supply.

### Controller

164. 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 PSU is locked to the crystal oscillator. Thus interference frequencies generated by the PSU are predictable. C10 and R19 provide a soft start facility which limits the line surge current at switch-on.

### Output stage

165. 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

166. 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

167. 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

168. 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 PSU is overloaded by more than 20% the voltage on IC1 pin 16 will equal that on pin 15, and the PSU will shut-down until it is producing approximately 120% of its nominal output of 44 W.

### Fan drive

169. 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. 4-25.

170. 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.

## 2955R INTRODUCTION

171. The 2955R is identical to the 2955A except that the 2955R also contains a sensitive receiver and appropriate switches. The block diagram of the 2955R is shown in Fig. 4-20. This shows how the sensitive receiver and its switches connect with the 2955A circuits.

## 2955R CIRCUIT SUMMARY

172. The circuits of the sensitive receiver are carried on printed circuit boards RX11 and RX12. These are housed in a separate vertical tray which is mounted adjacent to the input switch and attenuator assemblies.

173. When TRANSMITTER MONITOR mode is selected, the input signal from the RF IN/OUT connectors is routed through bypass switch assembly RX3 to the sensitive receiver. To provide the local oscillator during this mode of operation, the output from the RF signal generator is routed through attenuator and switch assembly RX2 and local oscillator driver board RX12 to the mixer in the sensitive receiver.

174. The incoming signal is converted to an IF of 21.4 MHz. When the local oscillator frequency is set above 21.4 MHz, reception can be obtained at two frequencies which are separated by twice the IF. In order to prevent interference from an unwanted signal, the local oscillator can be set so that the unwanted frequency is either above or below the wanted signal. To do this, the RF IMAGE is set as UPPER or LOWER as described in the Operating Manual.

175. The receiver IF output is levelled by the use of an AGC loop. The magnitude of the AGC control voltage is proportional to the signal strength and provides the level which is shown on the display.

176. To extend the receiver's dynamic range, a 0/10 dB attenuator and a 0/32 dB amplifier are included. Three different gains are available - with the 0/10dB attenuator at 0 and the 0/32 dB amplifier at +32 dB (range 0), with both the 0/10 dB attenuator and the 0/32 dB amplifier at 0 (range 1) and with the 0/10 dB attenuator at -10 dB and the 0/32 dB amplifier at 0 (range 2). On reception of a signal within the operating range, the gain is automatically set appropriately. An internal calibration routine improves the accuracy of the displayed measurement.

177. Two IF filter bandwidths can be set as described in the Operating Manual. In addition to improved selectivity, the narrower filter gives enhanced sensitivity.

TECHNICAL DESCRIPTION

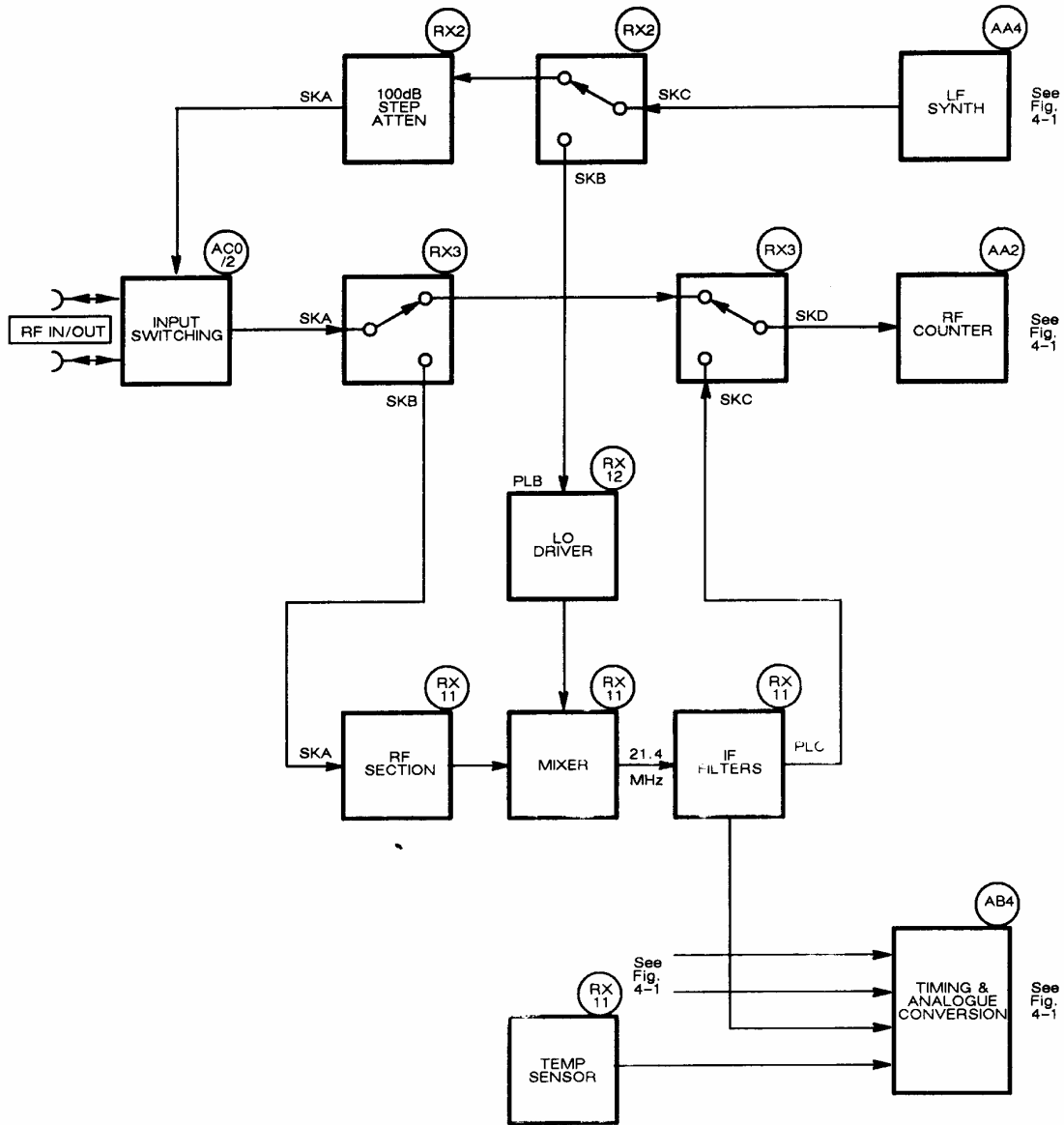


Fig. 4-20 Block diagram of the 2955R



## BOARD RX11 – SENSITIVE RECEIVER

Circuit diagram: Chap. 7, Fig. 7-30.4.

### Summary

178. This board receives the signal from the RF IN/OUT connector on the front panel. After amplification, the input signal is mixed with the output from the RF signal generator to produce an IF of 21.4 MHz. This output is levelled by means of an AGC loop and the control line is used to indicate signal strength.

179. To extend the receiver operating range, there are two gain blocks – a 0/10 dB RF attenuator and a 0/32 dB IF amplifier. Control circuits select, as required, IF bandwidth, 0/10 dB attenuator, 0/32 dB amplifier and local-oscillator notch filter.

### RF section

180. The RF input signal is routed to 0/10 dB attenuator R1, R2 and R3 which is controlled by contacts RLA. The output from the attenuator is fed through 20 dB amplifiers IC1 and IC2 to double balanced mixer IC3. The local oscillator drive for the mixer is fed from the local oscillator driver board RX12. To improve performance of the mixer, its IF port is terminated by 3 dB attenuator R6, R7 and R8. This is followed by 100 MHz LP filter L5, C7, C8 and C9 to remove unwanted frequencies.

### IF filters

181. The IF signal is fed through transformer T1 to the base of amplifier TR1 which recovers the voltage loss of IC3. Then, two identical transformers are used as a wide-band filter. These are buffered from each other by 20 dB amplifier TR2. Adjustment of the resonant circuits is made on preset capacitors C15, C18, C27 and C31. The output from the second transformer is fed through emitter-follower TR3 to give a low output impedance to one of two routes.

182. When wide-band filter has been selected, contacts RLC and RLB are open so that the signal is routed through diodes D1 and D2 to the input of amplifier IC5. These diodes are forward biased to prevent signal break-through around crystal filter IC4. The low-pass filter C39, L11 and C41 improves the out-of-band rejection of the wide-band filter.

183. When narrow-band has been selected, RLC and RLB are closed so that the signal is routed through transformer T2 to IC4 with D1 and D2 reverse biased. T2 converts the driving impedance to give a correct termination for IC4. The output from IC4 is fed through emitter-follower TR4 to give a low output impedance.

### 0/32 dB IF amplifier

184. The signal from RLB is fed to the junction of diodes D3 and D4. For 0 dB, diodes D4 and D6 are forward biased and diodes D3 and D5 are reverse biased. Thus, signals are directly routed to resistor R43. For 32 dB, D3 and D5 are forward biased and D4 and D6 are reverse biased. Then, the signal is fed through amplifier IC5 to R43.

## AGC loop

185. The signal across R43 is applied to gain-controlled amplifier IC6 which is followed by further amplifiers IC7 and IC8. The IF output is fed to the bypass switch assembly RX3 and to peak-detector D7. Compensation for any temperature drift in the characteristics of D7 is provided by diode D8 which is in the circuit of buffer IC9a, D7 and D8 being a matched pair. The detected signal is then fed through 50 Hz low-pass filter IC9b, loop filter IC9a and current-driver IC9c. The action of the loop, over the operating range of the sensitive receiver, is to maintain a reference voltage of 6.2 V into IC9a in order to produce a constant IF output of 0 dBm at IC8.

186. A separate output from the control line is provided by buffer IC10d. This output is used to display received signal strength.

## Temperature sensor

187. To compensate for any drift characteristic of receiver gain, the temperature within the Rx tray is monitored. The output from temperature sensor IC11 is fed through amplifier IC10c to give a suitable level for the calibration routine in order to maintain the accuracy of the signal strength measurements.

## Control logic

188. For the 0/10 dB attenuator, 0 V on connector PLA contact 1 lowers the base voltage of transistor TR6 causing it to conduct and energize relay RLA. This switches the attenuator into its 0 dB position.

189. For the IF filter bandwidth, 0 V on PLA contact 9 lowers the base voltage of transistor TR7 causing it to conduct and energize relays RLB and RLC thus switching the IF signal through the filter. The high voltage to the inputs of amplifiers IC10a and IC10b causes the output to reverse bias diodes D1 and D2 thus isolating the filter.

190. For the 0/32 dB amplifier, 0 V on PLA contact 13 to the input of IC10b causes the output to go high. This causes diodes D3 and D5 to be forward biased (thus switching the IF signal through the amplifier) and diodes D4 and D6 to be reverse biased (thus isolating the bypass route around the amplifier).

191. Relays in the attenuator and switch assembly RX2 are connected to PLA contacts 15 and 16 so that they are energized by a positive voltage pulse when the base and the emitter of transistors TR10 and TR8 and the base of transistors TR11 and TR9 are taken for a short time to 0 V from PLA contacts 10 and 11.

192. Relays in the bypass switch assembly RX3 are connected to PLC contacts 1 and 2 so that they are energized by a positive voltage pulse when the base and the emitter of transistors TR14 and TR12 and the base of transistors TR15 and TR13 are taken for a short time to 0 V from PLA contacts 3 and 7.

193. For the notch filter, a relay on the local oscillator driver board RX12 is connected to PLC contact 6 so that it is energized by a positive voltage pulse when the base of transistor TR5 is taken for a short time to 0 V from PLA contact 5.

## **BOARD RX12 – LOCAL OSCILLATOR DRIVER**

Circuit diagram: Chap. 7, Fig. 7-31.

194. When the sensitive receiver is selected, the RF generator output is fed into this board. Amplifier IC1 is used to give the correct level for the mixer on RX11. The signal to IC1 is fed direct or through a notch filter C1 to C5 and L1 to L4 (which are variable to enable the filter response to be optimized). The filter is tuned to the IF and is connected by relay RLA when the input frequency is above the IF. This filter prevents noise which is generated in the RF generator system around 21.4 MHz leaking across the mixer into the IF system.

## **ATTENUATOR AND SWITCH ASSEMBLY RX2**

195. This consists of four sections. Three sections give 40, 40 and 20 dB attenuation for the normal RF generator output to the RF IN/OUT connectors. The relays which connect the pads have centre-tapped windings. One end is pulse-driven to switch in and the other end to switch out. All sections have a latching action and remain indefinitely in one state until pulsed to the other. The fourth section is used to route the RF generator output through RX12 to the mixer on RX11 or to the attenuator sections.

## **BYPASS SWITCH ASSEMBLY RX3**

196. This consists of two change-over switch sections which are identical to that in RX2. One section is used to route the signal from the RF IN/OUT sockets to the input of RX11 or to the modulation meter input on AA2. The other section is used to route the IF output from RX11 to the modulation meter input on AA2.

**TECHNICAL DESCRIPTION**

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**Chapter 5-0**  
**MAINTENANCE**  
**Contents**

**Para.**

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3	Safety Precautions
4	Recommended test equipment
5	Access to boards and components
5	Removal of case
6	Removal of internal covers
14	Access to boards and units
15	Access to test points
16	Access to front panel
17	Access to rear panel
18	RF tray
19	CRT removal
20	Switching assembly AC0/1 or AC0/2
23	2955A Attenuator assembly
24	2955R Attenuator and switch assembly RX2 and Bypass switch assembly RX3
25	Shaft encoder removal
26	Board removal
27	2955R receiver tray assembly RX1
28	Entering calibration data
28	Transmitter and receiver testing modes
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## INTRODUCTION

1. This chapter provides servicing support information for the two 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.

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 and 5-2 is shown in Table 5-0-1. 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 AB2/2 to AB6/1.

**CRT drive shield**

8. A clear plastic safety shield is fitted over CRT 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 CRT base board AT2 to prevent accidental contact with the board which carries high voltages. First remove the CRT 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 CRT drive shield and the CRT 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 RF 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 AA4/1 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 RF 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, AB1/1 to AB6/1 and AC1, all of which are accessible from above the instrument. AB2/2 to AB6/1 plug into the motherboard AB1/1. Boards AA1 to AA4/1 are contained in the RF tray accessed from below the instrument. Power supply board AR1 is accessible from the rear. Unfastening the rear panel gives access to AR4. Keyboards AF1/1 and AF2/1 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 CRT base.

**Access to test points**

15. To obtain access to board components and test points, boards AB2/2 to AB6/1 may be removed and reconnected to the instrument via the extender board which is available as an optional accessory (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 AB1/1 as well as to the bottom rear of the front panel, the RF 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 AB1/1,PLF. Unplug and fully open out the tray.

### CRT removal

19. To remove the CRT it is first necessary to remove the CRT drive shield, CRT 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 EHT lead at the tube end by gently levering off the grey anode cap.



**Switching assembly AC0/1 or AC0/2**

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 AD0 (2955A) or RX2 (2955R).
- (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 mother-board AB1/1.
- (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.

**2955A Attenuator assembly AD0**

23. Remove attenuator assembly AD0 from the instrument to gain access to part of AB1/1. Proceed as follows:-

- (1) Unscrew and remove the pipe connecting to switching assembly AC0/1. Unscrew the connector to the RF 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) When reassembling, take particular care not to overtighten the pipe connectors.

**2955R Attenuator and switch assembly RX2 and Bypass switch assembly RX3**

24. These are attached by means of screws to a side mounting plate which is attached by means of screws to the side of the instrument. Proceed as follows:-

- (1) Unscrew the SMA connectors and remove the pipes.
- (2) Remove the screws on RX2 and lift it out.
- (3) Remove the screws on the side mounting plate and lift it (with RX3) out.
- (4) Remove the screws on RX3.
- (5) To detach the ribbon cables, remove the lids.
- (6) When reassembling, take particular care not to overtighten the pipe connectors.

## Shaft encoder removal

25. Remove the VARIABLE control knob. Open the front panel (see above) to gain access to keyboard AF1/1. Remove the nut holding the encoder shaft to the board and remove the unit.

## Board removal

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

**Boards AA1,AA2,AA3 and AA4/1:** Compress and remove the spring connectors joining AA3 to AA4/1. Unscrew hexagonal pillars and screws as necessary to remove the board.

**Boards AB2/2,AB3/2,AB4/1,AB5 and AB6/1:** 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 CRT 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 AF1/1:** Open the front panel to gain access. Remove the VARIABLE knob and the six screws holding the board in place.

**Board AF2/1:** 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.

**2955R receiver tray assembly RX1**

27. When looking from the front of the instrument with the top outer cover removed, the receiver tray assembly RX1 is located to the right of the plug-in board compartment. Access for fault-finding and adjustments is obtained as follows:-

- (1) Remove the three screws (one at the top front and two at the top rear) which secure RX1 to the plug-in board compartment.
- (2) On the bypass switch assembly RX3, disconnect the pipe from SKB (the second connector from the front). At the RX1 end, this is to the front lower connector SKA (RF in).
- (3) On RX1, disconnect the cable from connector PLC (IF out). At the RX3 end, this is to SKC (the third connector from the front).
- (4) On RX1, there are two pegs which locate into retaining holes in the mother-board. Gently lift RX1 upwards by about 2 cm to release it.
- (5) With care, lift the front end of RX1 just far enough to perform operations (6) and (7).
- (6) On RX1, disconnect the upper pipe from connector PLB (LO in) but leave it connected at the attenuator and switch assembly RX2.
- (7) On RX1, disconnect and remove the lower pipe from connector SKA (RF in).
- (8) Place some protection on top of the plug-in board compartment and then gently manipulate RX1 upwards and lay it flat on the plug-in board compartment. Take care not to damage the feed-throughs.
- (9) Lift RX1, twist it clockwise and upside down and again lay it flat on the plug-in board compartment but now with the lid on top. To make this easier, you may prefer to remove temporarily the ribbon cable to PL2.
- (10) Remove the lid of RX1 for access to the boards RX11 and RX12.
- (11) When replacing the lid and the connector pipes, secure them tightly as RF leakage could affect the sensitivity.

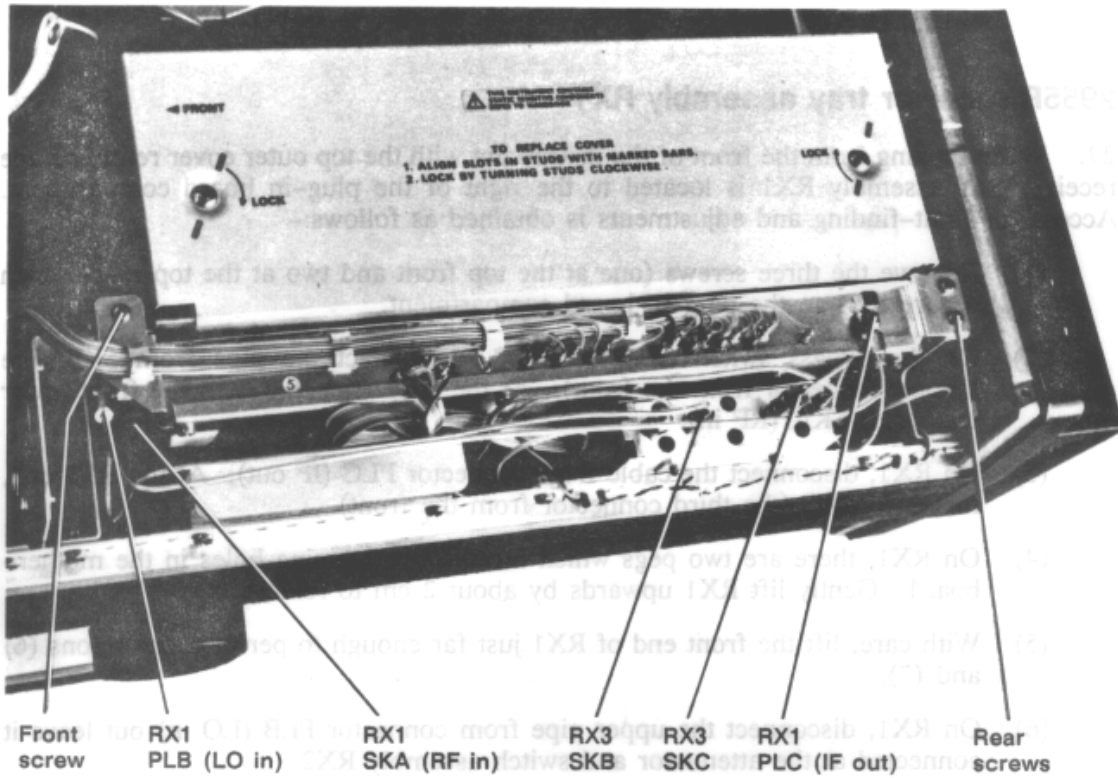


Fig. 5-0-1 Receiver tray assembly RX1 in normal position

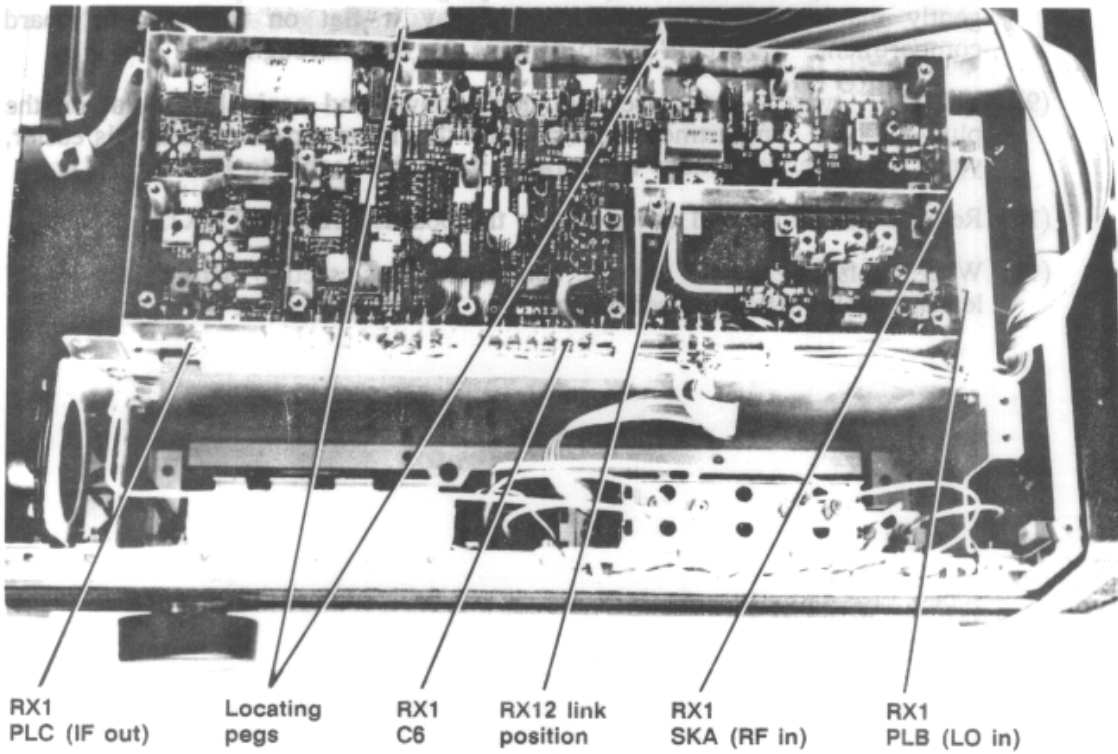


Fig. 5-0-2 Receiver tray assembly RX1 with lid removed

## ENTERING CALIBRATION DATA

### Note...

This facility should not be used except as described in Chap. 5-2 or under the supervision of a Marconi Instruments representative. The effect of changing data is not immediate and is only seen after returning to one of the normal operating modes.

### Transmitter and receiver testing modes

28. To enter data, proceed as follows:-

- (1) Press the TX TEST or RX TEST key and check that the TRANSMITTER TEST or RECEIVER TEST display appears.
- (2) Unlock the facility by pressing in turn the HELP key, the CHANGE PARAMETERS soft key, the AC DC key, the VERT  $\blacklozenge$  key, the FREQ  $\downarrow$  key and the REP SWEEP key. The CALIBRATION DATA display appears.
- (3) Press the SET ADDRESS soft key. ADDRESS appears in reverse video until an address is entered.
- (4) Enter the address using the DATA keypad or increase or decrease the existing address by using the  $\Delta$  INCREMENT FREQ (tens digit) and LEVEL (units digit) keys. The existing data at the selected address appears under READ.
- (5) Enter new data using the DATA keypad. It appears under WRITE. To enter this data, press the ENTER DATA soft key. It then appears under READ.

### Transmitter monitor mode (2955R only)

29. See in Chap. 5-3 for the use of the TEMPERATURE ADC, SIGNAL STRENGTH ADC and RANGE readings. Proceed as follows:-

- (1) Press the TX MON ON-OFF key and check that the TRANSMITTER MONITOR display appears.
- (2) Unlock the facility by pressing in turn the HELP key, the TX MON ON-OFF key, AC DC key, the VERT  $\blacklozenge$  key, the FREQ  $\downarrow$  key and the REP SWEEP key. The CALIBRATION MODE display appears.
- (3) To disable the automatic ranging for the RF input level, press the HOLD RANGE soft key.
- (4) To enter the calibration procedure STAGE 1, press the CALIBRATE soft key.

**TABLE 5-0-1 TEST EQUIPMENT FOR PERFORMANCE CHECKS AND CALIBRATION**

Where more than one example is given for a particular type of equipment, the performance tests are written around the first example. However, the checks can be carried out using the second examples given with very little or no change in the following test procedures.

Description	Minimum specification	Example
Spectrum Analyzer	Frequency range: 0.4 – 1000 MHz	Marconi TF 2370 + TK 2373 or Marconi 2383
Power Meter & Sensors	Frequency range: 0.4 – 1000 MHz Power measurement range: -65 to +20 dB Accuracy: better than 0.15 dB	Marconi 6960A, 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 or HP 8903B Audio Analyzer
Frequency Counter	Frequency range: 0.4 – 1000 MHz 1 MHz Std. O/P	Marconi 2435 or Marconi 2440
Synthesized LF Generator	20 Hz – 20 kHz sine and square level 0 to 2 V RMS 1 MHz Std. O/P	HP 3325A or B
DVM	20 Hz – 20 kHz, 0.02% accuracy RMS DC measurement down to 1 mV	Datron 1065A or Solartron 7150+
Counter/Timer	50 Hz – 15 kHz, accuracy better than 0.005 Hz	Marconi 2438 or Philips 6654C
Audio Analyzer	Sinad measurement psophometric filter	HP 8903A or B
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 $\Omega$ 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 $\pm 5$ 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 or Farnell L12/10C
50 W termination	50 $\Omega$ $\pm 1\%$ 1/2 W	Suhner

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**PERFORMANCE TESTING**  
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## 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 RF 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 AF level DC offset, AF level gain, and demodulated FM and AM gain.

### Frequency range & accuracy specification

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

DC to 50 kHz (3 Hz on AC)  $\pm 5\%$  accuracy  
 FM deviation  $\pm 10\%$  accuracy  
 AM depth  $\pm 10\%$  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% DC	Rotek 3950
Signal Generator	100 MHz, AM/FM Level 7 dBm	Marconi 2019A
Modulation meter	AM/FM 100 MHz Accuracy >3%	Marconi 2305
Power splitter	6 dB, 100 MHz	HP 11667A

### Checking AF level DC offset

10. Proceed as follows:-

- (1) On the UUT select RX and SCOPE, DC 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 AF level gain

11. Proceed as follows:-

- (1) Set the UUT to RX, SCOPE, DC 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. 5-1-1.

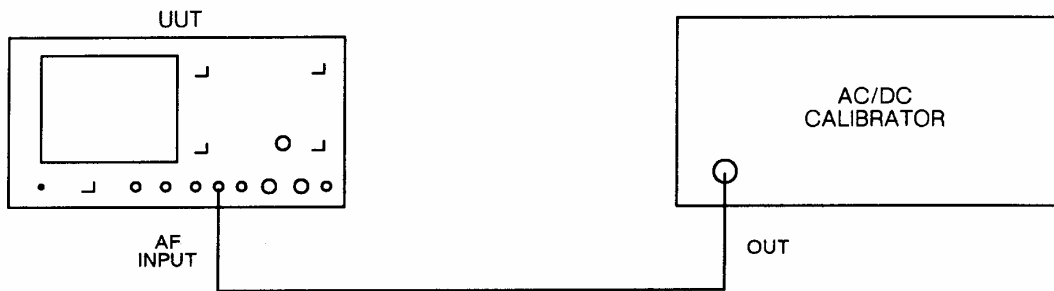


Fig. 5-1-1 Test equipment connections for oscilloscope AF level gain performance checks

- (4) Set the oscilloscope to 2 V/div. Set the calibrator to output DC 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 5-1-1.

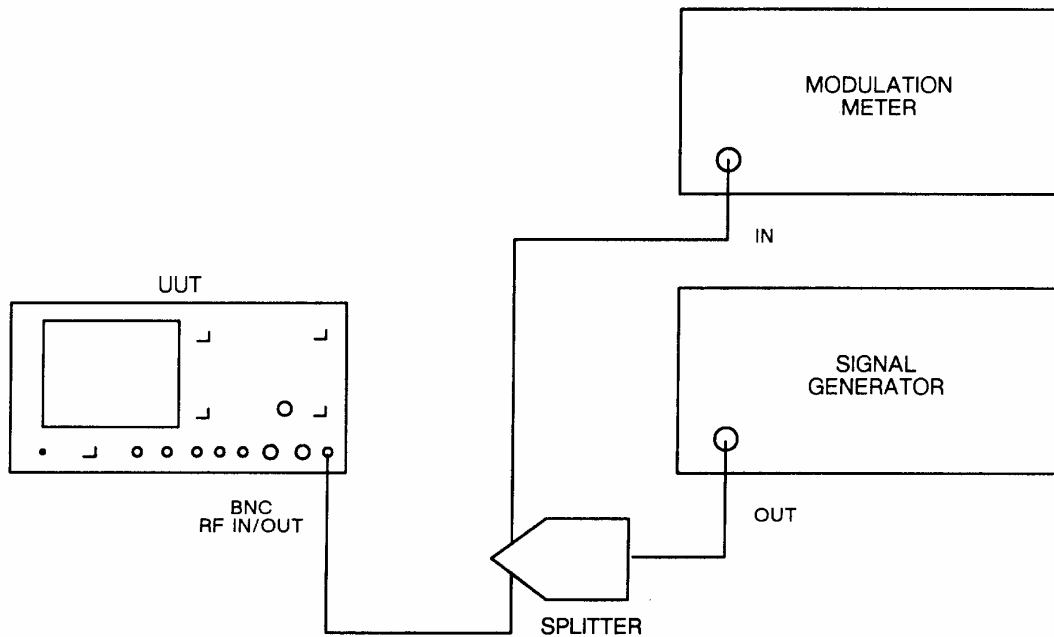
TABLE 5-1-1 AF LEVEL GAIN - OSCILLOSCOPE

Scope range	Nominal DC 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 FM gain

12. Proceed as follows :-

- (1) Connect the equipment as shown in Fig. 5-1-2.
- (2) Set the UUT to TX, FM, SCOPE, 0.3 - 3.4 kHz BAND PASS filter, BNC input socket.



*Fig. 5-1-2 Test equipment connections for oscilloscope demodulated FM gain performance checks*

- (3) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, FM, 1 kHz internal modulation rate.
- (4) Set the modulation meter to monitor FM,  $(p-p)/2$ , in a 0.3 - 3.4 kHz bandwidth.
- (5) Set the UUT oscilloscope range to  $\pm 30$  kHz deviation. Adjust the signal generator FM deviation until the FM 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 5-1-2.

TABLE 5-1-2 DEMODULATED FM GAIN - OSCILLOSCOPE

Scope range ± deviation	FM deviation on scope	Modulation meter limit
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

### Checking demodulated AM gain

13. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-2.
- (2) Set the UUT to TX, AM, SCOPE, 0.3 - 3.4 kHz BAND PASS filter, BNC input socket.
- (3) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, AM, 1 kHz internal modulation rate.
- (4) Set the modulation meter to monitor AM, (p-p)/2, in a 0.3 - 3.4 kHz bandwidth.
- (5) Set the UUT 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 5-1-3.

TABLE 5-1-3 DEMODULATED AM GAIN - OSCILLOSCOPE

Scope range (% AM/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, AM and FM monitor accuracy, AM and FM bar chart and scope, and input sensitivity.

### Demodulation distortion specification

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

At 30% AM and 1 kHz mod. freq. (in a 0.3 – 3.4 kHz bandwidth).

<2% : 21 MHz carrier and above.

<5% : Up to 21 MHz and above.

<1.5% 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, FM & AM	2019A
Distortion meter	0.2% distortion accuracy at 1 kHz.	TF 2331A or HP 8903B

### 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. 5-1-3.

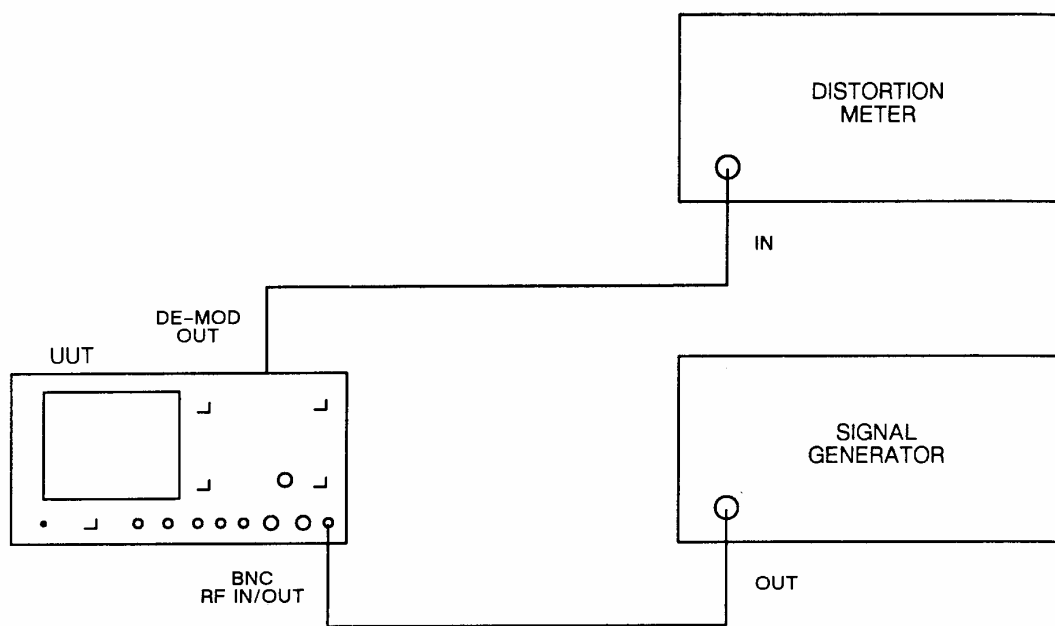


Fig. 5-1-3 Test equipment connections for modulation meter demodulation distortion performance checks

- (2) Set the UUT to TX, AM, 0.3 – 3.4 kHz BAND PASS filter, BNC input socket.
- (3) Set the signal generator to carrier frequency 100 MHz, level 0 dBm, 30% AM, 1 kHz internal modulation rate.
- (4) Tune in the distortion meter and check that the distortion indicated is <2%.
- (5) Set the signal generator to 12 MHz. Tune in the distortion meter and check that the distortion indicated is <5%.
- (6) Change the UUT modulation to FM.
- (7) Change the signal generator modulation to 5 kHz FM, modulation rate 1 kHz, carrier frequency 100 MHz.
- (8) Tune in the distortion meter and check that the distortion indicated is <1.5%.

### AM monitor accuracy specification

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

- ±5% 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, AM 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 RMS level.	HP 3325A or B
Power splitter	6 dB splitter. 50 Ω, 1.5-400 MHz.	HP 11667A

### Checking AM monitor accuracy

20. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-4.

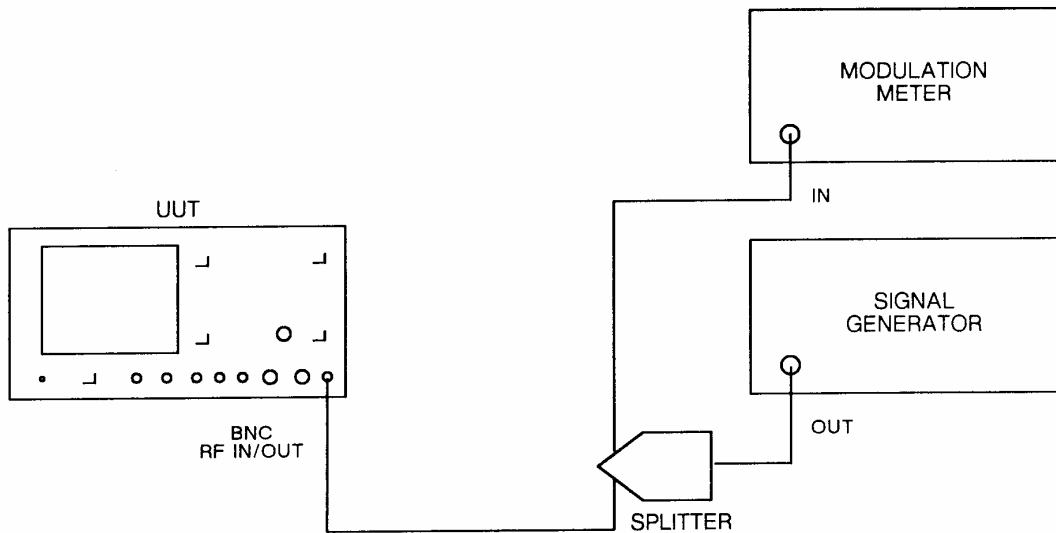


Fig. 5-1-4 Test equipment connections for modulation meter AM & FM monitor accuracy performance checks



- (2) Set the UUT to TX, AM, 0.3 – 3.4 kHz BAND PASS filter, BNC input socket.
- (3) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, 80% AM, 1 kHz internal modulation rate.
- (4) Set the modulation meter to monitor AM in a 0.3 – 3.4 kHz bandwidth.
- (5) Check that the AM level indicated on the UUT display is within  $\pm 5\%$  of reading  $\pm 1$  digit of modulation depth indicated on the modulation meter. Check that the AM bar chart indicates the AM being applied.
- (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.
- (8) Connect an LF generator to the signal generator as shown in Fig. 5-1-5.

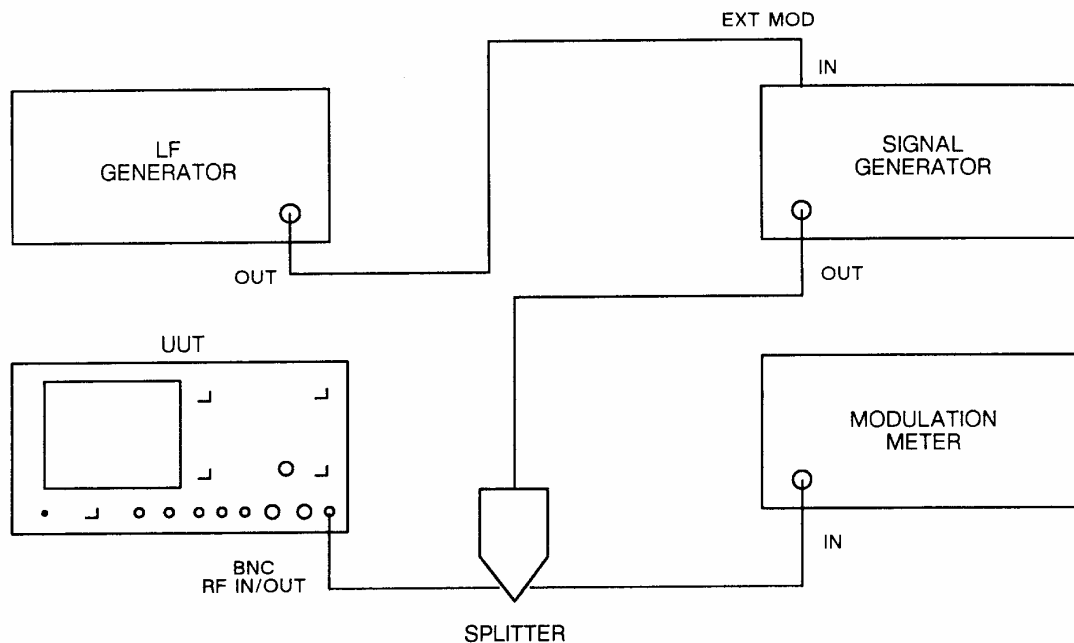


Fig. 5-1-5 Test equipment connections for modulation meter AM & FM

- (9) Set the UUT to TX, AM, 15 kHz LOW PASS filter, BNC input socket.
- (10) Set the signal generator to carrier frequency 100 MHz, level 7 dBm, 80% external AM at a 10 kHz modulation rate (from the LF generator).
- (11) Set the modulation meter to monitor AM in a 30 Hz to 50 kHz bandwidth.
- (12) Set the synthesized LF generator to give a 10 kHz sine wave. Adjust the level to suit the external modulation input of the signal generator.
- (13) Check that the AM level indicated on the UUT display is within  $\pm 8.5\%$  of reading  $\pm 1$  digit of modulation depth indicated on the modulation meter.
- (14) Repeat the above for modulation rates between 50 Hz and 10 kHz. Ensure that the correct filters are selected on both the UUT and the modulation meter according to the modulation rate being used.

**FM monitor accuracy specification**

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

- ±5% ±1 digit at 1 kHz.
- ±6.5% ±1 over range 50 Hz-10 kHz.

**FM monitor accuracy test gear**

22. 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 RMS level.	HP 3325A or B
Power splitter	6 dB splitter. 50 Ω, 1.5-1000 MHz	HP 11667A

**Checking FM monitor accuracy**

23. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-5.
- (2) Set the UUT to TX, FM, 0.3 – 3.4 kHz BAND PASS filter, distortion/SINAD/SN off, BNC input socket.
- (3) Set the signal generator to carrier frequency 500 MHz, level 13 dBm, 25 kHz FM, 1 kHz internal modulation rate.
- (4) Set the modulation meter to monitor FM in a 0.3 to 3.4 kHz bandwidth.
- (5) Check that the FM level indicated on the UUT display is within ±5% of reading ±1 digit of modulation deviation indicated on the modulation meter. Check that the FM bar chart indicates the FM being applied.
- (6) Repeat the above for random carrier frequencies from 1.5 to 1000 MHz and random deviation between 0 and 25 kHz.
- (7) Set the UUT to TX, FM, 15 kHz LOW PASS filter, BNC input socket.
- (8) Set the signal generator to carrier frequency 500 MHz, level 13 dBm, 25 kHz external FM at 10 kHz modulation (from the LF generator).

## PERFORMANCE TESTING

- (9) Set the modulation meter to monitor FM in a 30 Hz to 50 kHz bandwidth.
- (10) Set the synthesized LF generator to give a 10 kHz sinewave. Adjust the level to suit the external modulation input of the signal generator.
- (11) Check that the modulation level indicated on the UUT display is within  $\pm 6.5\%$  of the modulation indicated on the modulation meter. Ensure that the correct filters are selected on both the UUT and the modulation meter according to the modulation rate being used.

**Input sensitivity specification**

24. 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**

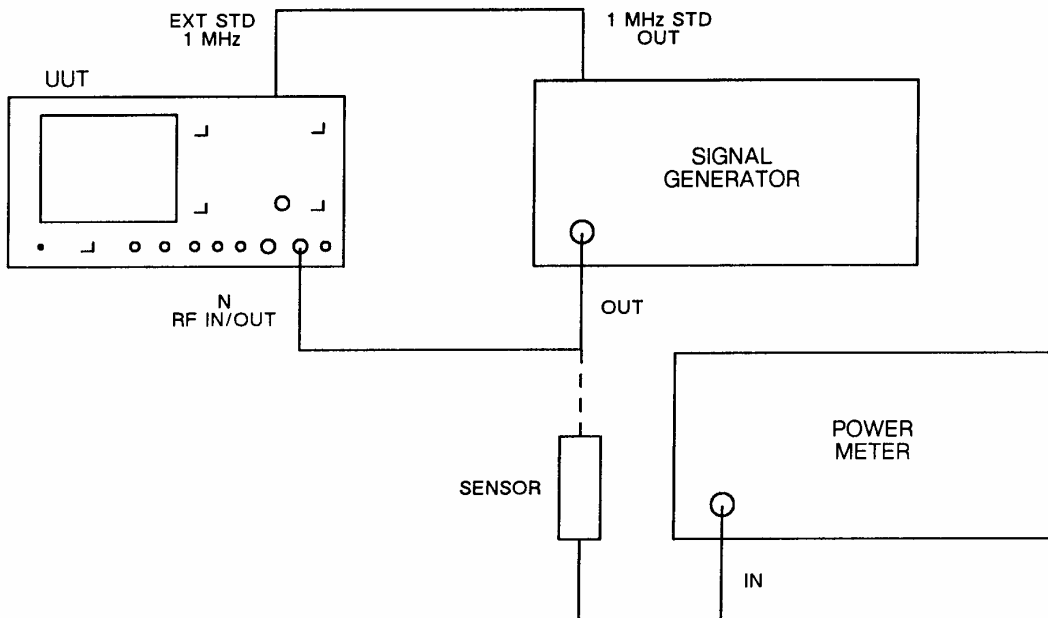
25. The following test gear is required to check the above specification:-

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

**Checking input sensitivity**

26. Proceed as follows:-

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



*Fig. 5-1-6 Test equipment connections for modulation meter input sensitivity performance checks*

## PERFORMANCE TESTING

- (2) Set the signal generator to carrier frequency 400 MHz, modulation 10 kHz FM, modulation rate 1 kHz.
- (3) Connect the power meter to the signal generator output and adjust the RF level to give 5 mW indication on the power meter.
- (4) Connect the signal generator to the UUT N-type input socket and check that the UUT modulation meter reads 10 kHz FM deviation.
- (5) Set the UUT to one port duplex mode and repeat the above checks with the signal generator output set to 20 mW.

## VOLTMETER PERFORMANCE CHECKS

27. The voltmeter performance checks comprise DC and AF level meter accuracy, and AF level meter frequency response.

### DC and AF level meter accuracy specification

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

$$\pm 3\% \text{ of reading } \pm 3 \text{ mV } \pm 1 \text{ digit}$$

### Level meter accuracy test gear

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

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

### Checking DC and AF level meter accuracy

30. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-7.



*Fig. 5-1-7 Test equipment connections for voltmeter DC & AF level accuracy performance checks*

- (2) Set the UUT to audio test, distortion off, 50 kHz LOW PASS filter, DC coupled.
- (3) Set the calibrator to give 1.000 V DC
- (4) Check that the reading on the AF voltmeter indicates the voltage set on the calibrator  $\pm 3\%$  of reading  $\pm 3 \text{ mV } \pm 1 \text{ digit}$ .

## PERFORMANCE TESTING

- (5) Repeat for random DC levels up to 100 V.
- (6) Check the operation of the bar chart and oscilloscope.
- (7) Set the UUT to AC coupled.
- (8) Set the calibrator to give 1.000 V AC at 1 kHz.
- (9) Check that the reading on the AF voltmeter indicates the voltage set on the calibrator  $\pm 3\%$  of reading  $\pm 3$  mV  $\pm 1$  digit.
- (10) Repeat at 1 kHz for random levels up to 100 V.

**AF level meter frequency response specification**

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

$$\pm 3\% \text{ of reading } \pm 3 \text{ mV } \pm 1 \text{ digit}$$

**AF level meter frequency response test gear**

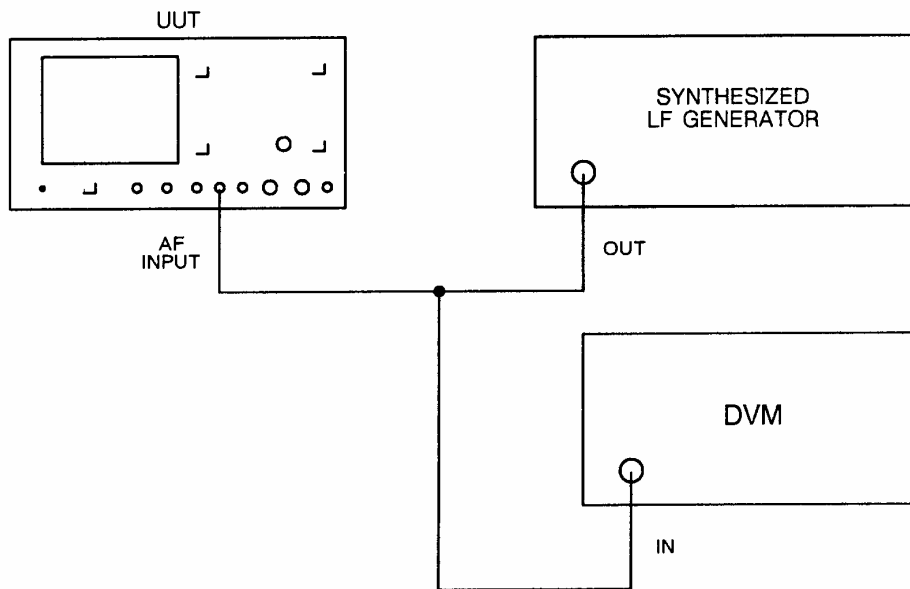
32. The following test gear is required to check the above specification:-LF synthesizer

Description	Minimum spec.	Example
LF synthesizer	50 Hz – 20 kHz. Level 2 V RMS	HP 3325A or B R & S SPN
RMS DVM	50 Hz–20 kHz. Accuracy better than 0.02%.	Datron 1065A
50 Ω termination	50 Ω ±1%, 1/2 W.	Suhner

**Checking AF level meter frequency response**

33. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-8.



*Fig. 5-1-8 Test equipment connections for voltmeter frequency response performance checks*

- (2) Set the UUT to audio test, distortion off, 50 kHz LOW PASS filter, AC coupled.



## PERFORMANCE TESTING

- (4) Set the DVM to monitor AC, RMS.
- (5) Check that the reading on the AF voltmeter is within  $\pm 3\%$  of reading  $\pm 3$  mV  $\pm 1$  digit of reading indicated on the DVM.
- (6) Repeat the above for LF generator frequencies between 50 Hz and 20 kHz.

### RF FREQUENCY METER PERFORMANCE CHECKS

34. The RF frequency meter performance checks comprise accuracy and input sensitivity.

#### Accuracy specification

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

Accuracy: As internal standard  $\pm 1$  digit

#### Accuracy test gear

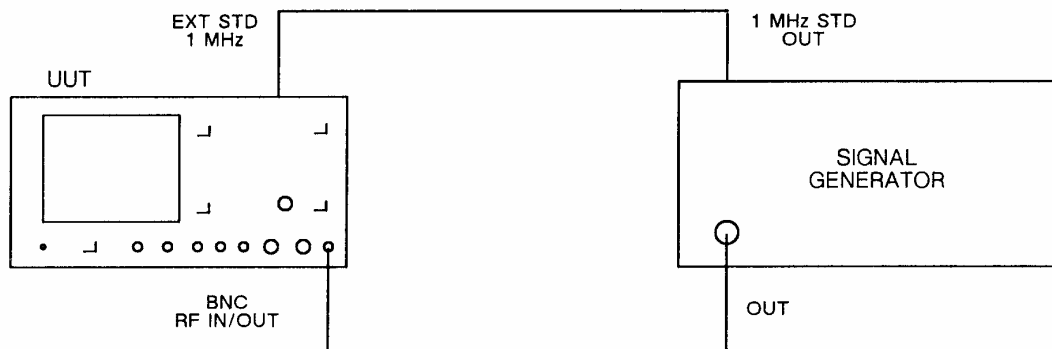
36. The following test gear is required to check the above specification:-

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

#### Checking accuracy

37. Note that the following method checks the RF 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. 5-1-9.



*Fig. 5-1-9 Test equipment connections for RF frequency meter accuracy performance checks*

- (2) Set the UUT to TX, BNC input socket.
- (3) Set the signal generator to carrier frequency 1000 MHz, level 7 dBm, modulation off.

**PERFORMANCE TESTING**

- (4) Check that the UUT indicates the signal generator frequency  $\pm 1$  digit.
- (5) Repeat the above for frequencies between 1.5 and 1000 MHz.

### Input sensitivity specification

38. 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

39. 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, FM	Marconi 2019A
Power meter & sensor	1.5-1000 MHz. -30 to +20 dBm.	Marconi 6960A + Sensor 6912

### Checking input sensitivity

40. Proceed as follows:-

- (1) Set the UUT to TX, N-type input socket.
- (2) Set the signal generator to carrier frequency 100 MHz, modulation off.

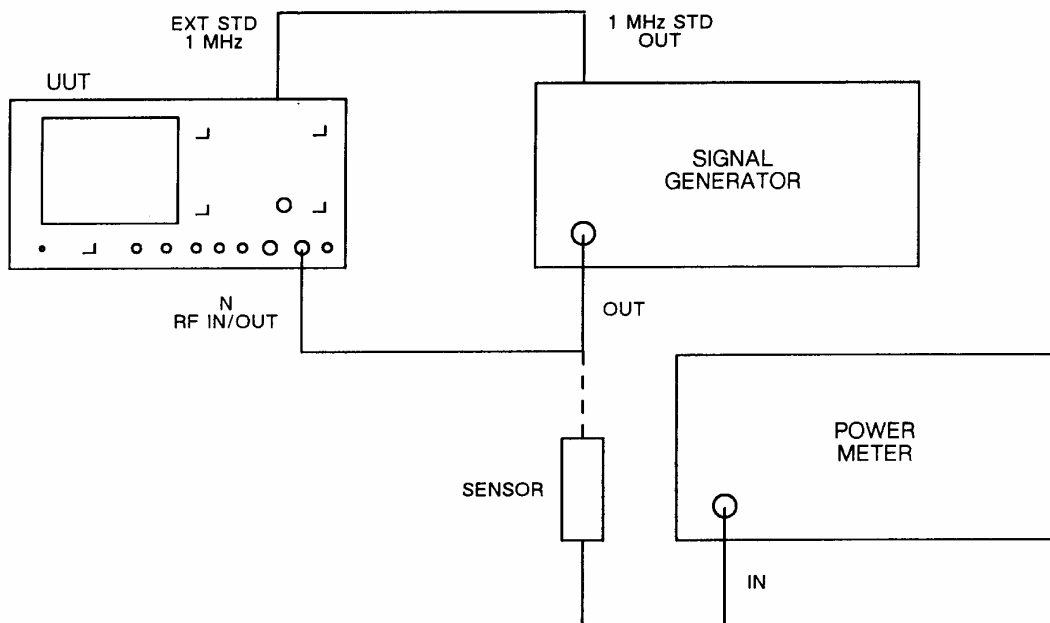


Fig. 5-1-10 Test equipment connections for RF frequency meter input sensitivity performance checks

- (3) Connect the power meter to the signal generator output (see Fig. 5-1-10) and adjust the RF level to give 5 mW indication on the power meter.
- (4) Connect the signal generator to the UUT N-type input socket (see Fig. 5-1-2). Check that the UUT frequency meter is locked and stable and indicates the frequency set on the signal generator  $\pm 10$  Hz.
- (5) Repeat the above for frequencies from 1.5 to 1000 MHz.

## AF FREQUENCY METER PERFORMANCE CHECKS

41. The AF frequency meter performance checks comprise frequency accuracy and sensitivity.

### Frequency accuracy and sensitivity specification

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

Frequency range:	20 Hz – 20 kHz
Frequency accuracy:	As internal standard $\pm 1$ digit $\pm 0.1$ Hz/0.02%. Sensitivity 50 mV

### Frequency accuracy and sensitivity test gear

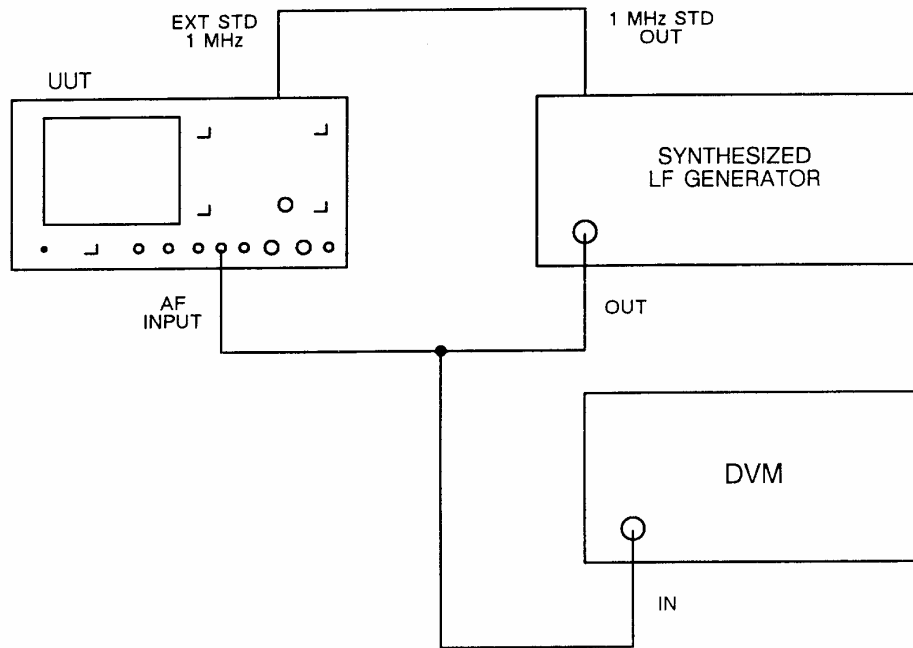
43. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
LF synthesizer	20 Hz–20 kHz. 1 MHz standard output.	HP 3325A or B
50 $\Omega$ termination	50 $\Omega$ , 1/2 W.	Suhner
DVM	0.5% accuracy.	Datron 1065A

### Checking frequency accuracy and sensitivity

44. Note that the following method checks the AF 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. 5-1-11.
- (2) Set the UUT to audio test, distortion off, 50 kHz LOW PASS filter, AC coupled.
- (3) Set the synthesized LF generator to give a 20 kHz sinewave at 50 mV RMS.
- (4) Set the DVM to read AC and RMS.
- (5) Adjust the LF synthesizer output level until the DVM indicates 50 mV.
- (6) Check that the frequency meter on the UUT indicates the frequency set on the synthesizer  $\pm 1$  digit  $\pm 0.1$  Hz/0.02%.
- (7) Repeat the above for random LF synthesizer frequencies between 20 Hz and 20 kHz.



*Fig. 5-1-11 Test equipment connections for AF frequency meter accuracy and sensitivity performance checks*

### AF GENERATOR PERFORMANCE CHECKS

45. The AF generator performance checks comprise output level accuracy, distortion, frequency accuracy, DC offset, residual noise, and waveform shapes. These checks are for testing AF GEN 1. Testing of the second AF generator can be carried out in the same way but with GEN 1 off and GEN 2 on.

#### Output level accuracy specification

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

Level range : 0.1 mV-4.095 V RMS (sine and square)  
0.1 mV-4.095 V (triangle)

Level accuracy :  $\pm 5\%$   $\pm 1$  step, 50 Hz-15 kHz.

#### Output level accuracy test gear

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

Description	Minimum spec.	Example
RMS voltmeter	AC voltage 50 Hz-15 kHz. Accuracy better than 0.5% of reading, 50 mV-4.095 VRMS.	Datron 1065A

#### Checking output level accuracy

48. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-12.

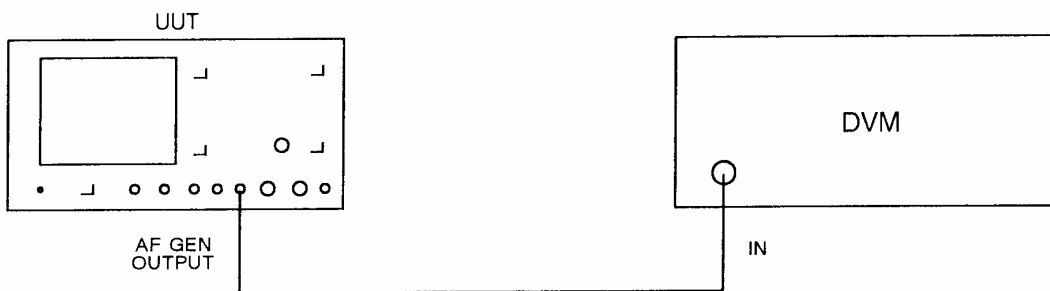


Fig. 5-1-12 Test equipment connections for AF generator output level accuracy performance checks

- (2) Set the UUT to audio test mode by pressing RX, AF GEN. Ensure that GEN 1 is switched on and GEN 2 is off and that the waveform shape selected is sine wave. (This can be confirmed/altered in the audio setup under tones.) Set GEN 1 frequency 1 kHz, level 1 V.



- (3) Check that the voltmeter reads the AF generator level set on the UUT  $\pm 5\% \pm 1$  count.
- (4) Repeat for random AF generator frequencies and levels. Note if checking very low levels the limitations of the DVM being used should be taken into account.

**Distortion specification**

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

Less than 1% up to 15 kHz.  
 Less than 0.5% at 1 kHz.

**Distortion test gear**

50. 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**

51. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-13.



*Fig. 5-1-13 Test equipment connections for AF generator distortion performance checks*

- (2) Set the UUT to audio test mode by pressing RX, AF GEN. Ensure GEN 1 is on, GEN 2 is off and that the waveform is sine wave. (This can be confirmed/alterd in the audio setup under tones.) Set GEN 1 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 UUT AF generator frequency to 1 kHz.
- (6) Tune in the distortion meter and check that the distortion indicated is less than 0.5%.

### AF generator frequency accuracy specification

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

$\pm 0.01$  Hz from 10 Hz to 100 Hz.  
 $\pm 0.1$  Hz from 100 Hz to 20 kHz.

### Frequency accuracy test gear

53. 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

54. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-14.



*Fig. 5-1-14 Test equipment connections for AF generator frequency accuracy performance checks*

- (2) Set the UUT to audio test mode by pressing RX, AF GEN. Ensure GEN 1 is on, GEN 2 is off and that the waveform is sine wave. (This can be confirmed/altered in the audio setup under tones.) Set GEN 1 frequency to 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  $\pm 0.1$  Hz).
- (5) Repeat the above for random frequencies between 100 kHz and 20 kHz checking on the counter/timer that the frequency selected is within  $\pm 0.1$  Hz.
- (6) Repeat for random frequencies between 10 Hz and 100 Hz checking on the counter/timer that the frequency selected is within  $\pm 0.01$  Hz.

**AF generator DC offset, residual noise and waveform check**

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

- Residual noise less than 0.1 mV RMS in psophometric band
- DC offset less than 100 mV DC sine wave, triangle and square wave.

**DC offset, residual noise and spurious signals test gear**

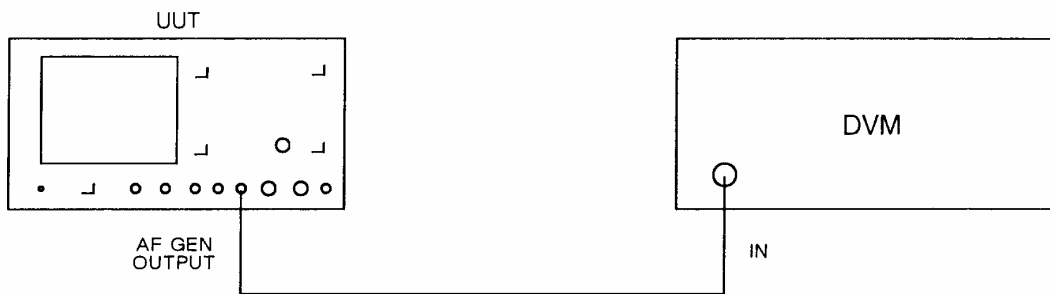
56. The following test gear is required to check the above specification:-

Description	Minimum spec.	Example
DVM	DC measurement down to 1 mV.	Marconi 2610
Audio analyzer	SINAD measurement, psophometric filter.	HP 8903A or B
Oscilloscope	Frequency 20 kHz	Tektronix 2235

**Checking DC offset**

57. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-15.
- (2) Set the UUT to audio test mode by pressing RX, AF GEN. Ensure GEN 1 is on, GEN 2 is off and that the waveform is sine wave. (This can be confirmed/altered in the audio setup under tones.) Set GEN 1 frequency to 50 Hz, level 0 mV.
- (3) Set the DVM to measure DC level.
- (4) Check that the DC level indicated on the DVM is less than 100 mV DC.
- (5) Repeat the above for random frequencies between 50 Hz and 15 kHz.



*Fig. 5-1-15 Test equipment connections for AF generator DC offset performance checks*

### Checking residual noise

58. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-16.



*Fig 5-16 Test equipment connections for AF generator residual noise spurious signals performance checks*

- (2) Set the UUT to audio test mode by pressing RX, AF GEN. Ensure GEN 1 is on, GEN 2 is off and that the waveform is sine wave. (This can be confirmed/alterd in the audio setup under tones.) Set GEN 1 frequency to 50 Hz, level 0 mV.
- (3) Set the audio analyzer to AC level, psophometric band-pass filter on. All other filters off.
- (4) Check that the AC level indicated on the audio analyser is less than 0.2 mV RMS.
- (5) Repeat the above for random frequencies between 50 Hz and 15 kHz.

### Checking waveform shapes

59. Proceed as follows:-

- (1) Connect the oscilloscope to the UUT AF GEN OUTPUT socket.
- (2) Set the oscilloscope controls to DC coupled, 0.5 V/DIV, 0.2  $\mu$ s/DIV time-base.
- (3) Set the UUT to AF audio control mode by pressing RX, AF GEN, TONES, audio setup.
- (4) Set GEN 1 frequency to 1 kHz, level 1 V, shape square. Ensure that GEN 2 is switched off.
- (5) Check on the oscilloscope for a square wave equal about ground of 4 divisions.
- (6) Set GEN 1 shape to triangle and check on the oscilloscope for a triangle waveform equal about ground of 4 divisions.
- (7) Set GEN 1 shape to saw and check on the oscilloscope for a sawtooth wave equal about ground of 4 divisions.

#### Note...

The above check can be carried out using the UUT oscilloscope but will give slight degradation of the shapes.

**DTMF ENCODER/DECODER CHECK**

60. The DTMF encoder/decoder can be checked by carrying out a back-to-back test.

Proceed as follows:-

- (1) Connect the UUT AF GEN OUTPUT socket to the AF INPUT socket.
- (2) Select the audio DTMF generator and receiver display by pressing the following keys from switch on: RX, AF GEN, TONES, DTMF.

1	2	3	4	5	6	7	8	9	0	*	#	A	B	C	D
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

- (4) Clear the receive data window.
- (5) Turn the UUT volume control up slightly and press the SEND key. The tones should now be heard via the loudspeaker and should also appear decoded in the receive data window.

## DISTORTION/SINAD METER PERFORMANCE CHECKS

61. The distortion/SINAD meter performance check comprises distortion measurement accuracy.

### Distortion measurement accuracy specification

62. This section checks that the instrument performs to the following specifications:-

Distortion measurement accuracy:  $\pm 5\%$  of reading  $>0.5\%$  distortion.  
SINAD:  $\pm 1$  dB.

### Distortion measurement accuracy test gear

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

Description	Minimum spec.	Example
Distortion meter	0.2% distortion at 1 kHz.	Marconi 2331A

### Checking distortion accuracy

64. Proceed as follows:-

- (1) Connect the UUT AF GEN OUTPUT socket to the UUT AF INPUT socket.
- (2) Set the UUT to audio test mode. Select distortion and 50 kHz LP filter. Set AF GEN 1 to give a sine wave of frequency 1 kHz at a level of 1 V. Set AF GEN 2 to give a sine wave of frequency 3.5 kHz at a level of 206 mV.
- (3) Adjust the level of AF GEN 2 until the UUT distortion meter reads exactly 20.0%.
- (4) Remove the AF GEN OUTPUT from the AF INPUT and connect the AF GEN OUTPUT to the distortion meter.
- (5) Remove the distortion meter to 1 kHz and check that the distortion indicated is between 18.5 and 21.5%.

## RF POWER METER PERFORMANCE CHECKS

65. The RF power meter performance check comprises accuracy.

### Accuracy specification

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

Accuracy :  $\pm 10\% \pm 1$  count up to 500 MHz  
 $\pm 15\% \pm 1$  count up to 960 MHz  
 $\pm 20\% \pm 1$  count up to 1000 MHz

### Measurement accuracy test gear

67. The following test gear is required to check to 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, RF level 13 dBm.	Marconi 2019A
RF amplifier	1.5–1000 MHz. Min: 3 W 40 dB gain	Marconi TF 2177
Directional coupler	1.5–1000 MHz, 20 dB coupling.	HP 778D (100–1000 MHz) + Mini Circuits ZFDC20-3 (1.5–100 MHz) with female N connectors
Power meter & Sensor	1.5–1000 MHz, $\pm 0.15$ dB accuracy, -30 dBm to +20 dBm.	Marconi 6960A, 6912, sensor

### Checking measurement accuracy

68. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-17, using the high frequency coupler. But note that the power source must be calibrated at the frequencies to be checked.
- (2) Set the UUT 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 UUT indicates 2 W  $\pm 10\% \pm 1$  digit.
- (5) Set the power source to give 220 mW.
- (6) Check that the UUT indicates 220 mW  $\pm 10\% \pm 1$  digit.



- (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 UUT indicates the power sent  $\pm 15\% \pm 1$  digit.
- (9) Repeat for random frequencies between 960 and 1000 MHz and check that the UUT indicates the power sent  $\pm 20\% \pm 1$  digit.
- (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 UUT indicates the power sent  $\pm 10\% \pm 1$  digit.
- (12) Set the UUT to one port duplex mode and repeat the above checks.

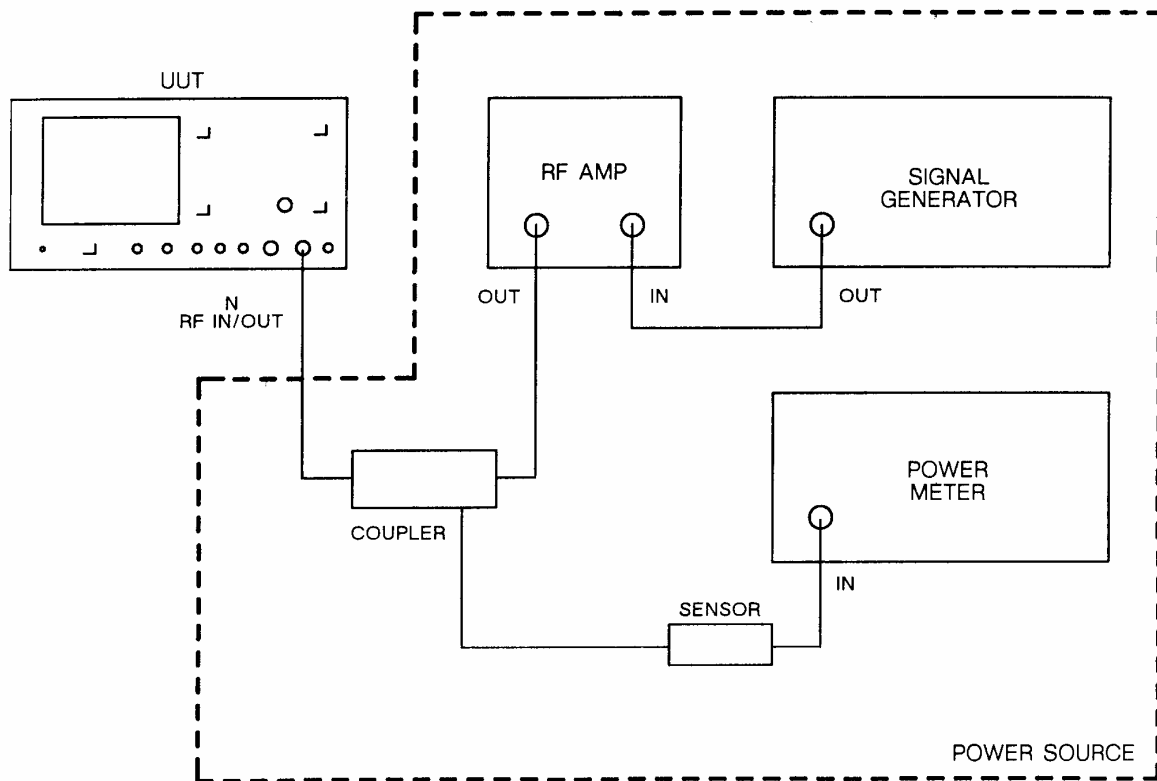


Fig. 5-1-17 Test equipment connections for RF power meter measurement accuracy performance checks

**Note...**

The power source must be a calibrated system with an overall uncertainty not greater than 2% up to 500 MHz and 3% up to 1000 MHz.

## SELCALL PERFORMANCE CHECKS

69. The Selcall performance checks comprise tones operation.

### Tones operation test gear

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

### Checking Selcall tones

71. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-18.

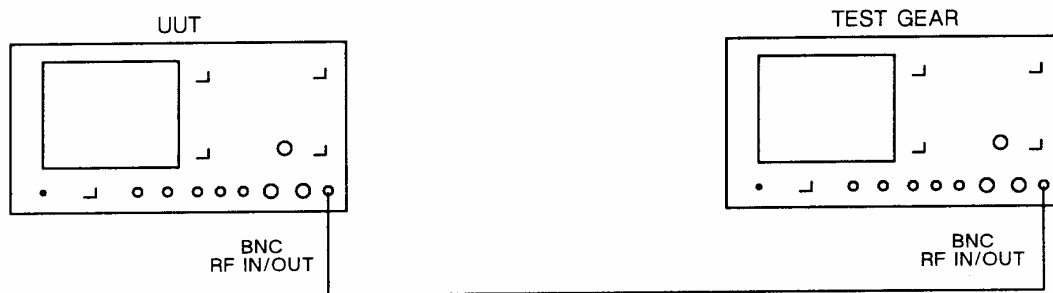


Fig. 5-1-18 Test equipment connections for Selcall tones performance checks

- (2) Set the UUT to RX, carrier frequency 100 MHz, level 0 dBm, modulation off, BNC output socket.
- (3) On the UUT press TONES and select sequential then CCIR.
- (4) Set the 2955A test gear to TX, BNC input socket. Press TONES and select sequential then CCIR.
- (5) On the UUT 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 2955A test gear with 0% error.
- (7) Repeat the above with the instrument settings reversed, and check that the UUT receives the tones correctly.

### RF GENERATOR PERFORMANCE CHECKS

72. The RF generator performance checks comprise: output level, RF accuracy, AM & FM internal accuracy, AM & FM distortion, external AM & FM, RF leakage, FM on CW, and carrier harmonics, sub-harmonics and spurious signals.

#### Output specification

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

$$\pm 2 \text{ dB for levels above } -127 \text{ dBm}$$

#### Output level test gear

74. 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 $\pm 0.15$ dB.	Marconi 6960 + Sensors 6920 & 6912
Spectrum analyzer	Frequency 100 MHz, ability to reduce noise floor below -96 dBm.	Marconi TF 2370

#### Checking output level

75. 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 using the 6920 sensor.

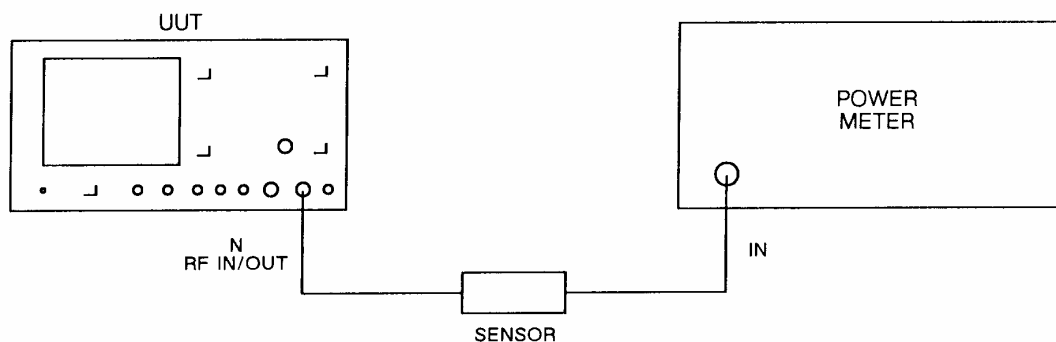


Fig. 5-1-19 Test equipment connections for RF generator output level performance checks

PERFORMANCE TESTING

- (2) Set the UUT to RX, RF GEN, carrier frequency 300 MHz, level -20.5 dBm, INC 1 dB, MOD OFF, N-type output socket.
- (3) Check that the power meter reads -20.5 dBm  $\pm$ 2 dB.
- (4) Decrement the UUT in 1 dB steps using the increment level down keys to -25.5 dBm and check on the power meter that each step is within  $\pm$ 2 dB of the level selected.
- (5) Check that the power meter reads within  $\pm$ 2 dB at the levels and frequencies given in the following table:-

UUT gen freq	UUT level	Reason
300 MHz	-26 dBm	Checks internal 10 dB pad
300 MHz	-36 dBm	Checks 20 dB pad in attenuator
300 MHz	-56 dBm	Checks 1st 40 dB pad in attenuator
1000 MHz	-25 dBm	Checks flatness across frequency band
10 MHz	-25 dBm	

- (6) Replace the 6920 head with the 6912 head and check the level at the following points is within  $\pm$ 2 dB.

UUT gen freq	UUT level
400 kHz	-15 dBm
20 MHz	-15 dBm
100 MHz	-15 dBm
300 MHz	-15.5 dBm
300 MHz	-16.5 dBm
300 MHz	-17.5 dBm
300 MHz	-18.5 dBm
300 MHz	-19.5 dBm
500 MHz	-15 dBm
1000 MHz	-15 dBm

- (7) Connect the spectrum analyzer to the UUT BNC RF OUTPUT socket.
- (8) Set the UUT to give an RF GEN frequency to 100 MHz and level -96 dBm from the BNC socket. Check on the spectrum analyzer for a level of -96 dBm. It will not be possible to check to  $\pm$ 2 dBm but will indicate the last 40 dB of the attenuator is switching in correctly.

### RF generator frequency accuracy specification

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

Accuracy: As internal standard

### RF generator frequency accuracy test gear

77. 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 RF frequency generator accuracy

78. 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. 5-1-20.

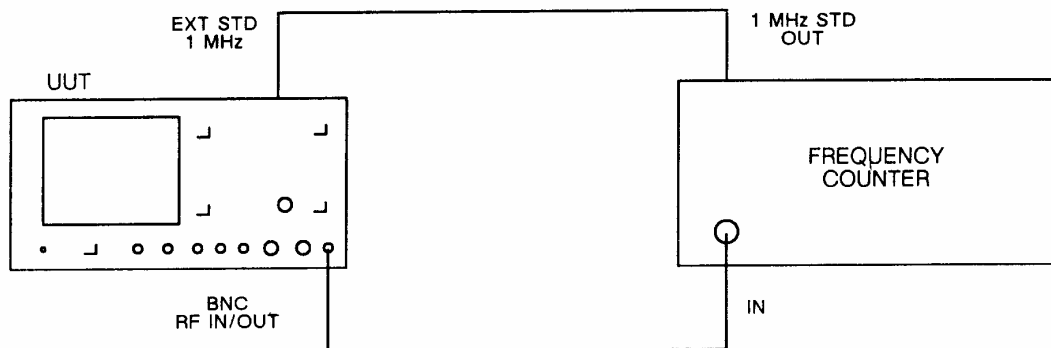


Fig. 5-1-20 Test equipment connections for RF generator RF accuracy performance checks

- (2) Set the UUT to RX, RF GEN, carrier frequency 1000 MHz, level 0 dBm, modulation off, BNC output socket.
- (3) Check that the counter displays the frequency set on the UUT  $\pm 20$  Hz.
- (4) Repeat the above for random frequencies between 0.4 and 1000 MHz.

**AM internal accuracy specification**

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

- ±7% ±1 digit at 1 kHz.
- ±10% of setting ±1 digit from 50 Hz to 5 kHz only and 0 to 70% AM only.
- ±15% of setting ±1 digit from 50 Hz to 15 kHz and 0 to 85% AM

**AM internal accuracy test gear**

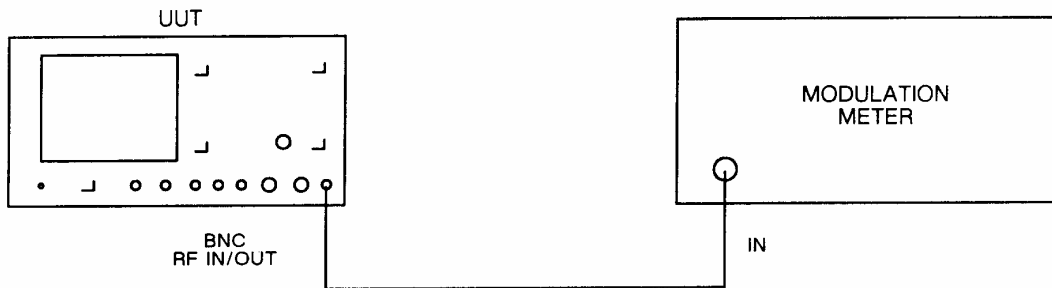
80. The following test gear is required to check the above specification:-

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

**Checking internal AM accuracy**

81. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-21.



*Fig. 5-1-21 Test equipment connections for RF generator AM & FM internal accuracy performance checks*

- (2) Set the UUT to RX, RF GEN, carrier frequency 100 MHz, BNC output socket, level 0 dBm, amplitude modulation frequency 1 kHz sine wave, modulation level 85%, distortion/ SINAD/SN off, BNC output socket.
- (3) Set the modulation meter to monitor AM with 0.3-3.4 kHz band-pass filter selected.
- (4) Check that the AM indicated on the modulation meter is within ±7% ±1 digit.
- (5) Repeat the above at random levels of modulation between 0 and 85%, at random carrier frequencies between 1.5 and 400 MHz, and at random RF levels.

## PERFORMANCE TESTING

- (6) Repeat with random modulation frequencies between 50 Hz and 5 kHz and modulation levels between 0 and 70%, while checking that the modulation meter reading is within  $\pm 10\%$  of setting  $\pm 1$  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 50 kHz and 15 kHz and modulation levels between 0 and 85%, while checking that the modulation meter reading is within  $\pm 15\%$  of setting  $\pm 1$  digit. Ensure that the correct filters are selected on the modulation meter according to the modulation rate being used.

**FM internal accuracy specification**

82. 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**

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

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

**Checking FM internal accuracy**

84. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-22.
- (2) Set the UUT to RX, RF GEN, carrier frequency 100 MHz, BNC output socket, level 0 dBm, FM frequency 1 kHz sine wave, modulation level 25 kHz, distortion/SINAD/SN off.
- (3) Set the modulation meter to monitor FM with 0.3-3.4 kHz band-pass filter selected.
- (4) Check that the FM deviation indicated on the modulation meter is within  $\pm 7\%$   $\pm 10$  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  $\pm 10\%$ . Ensure that the correct filters are selected on the modulation meter according to the modulation rate being used.



**AM and FM distortion specification**

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

- AM: <2% distortion at 1 kHz with 30% AM 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 FM distortion test gear**

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

Description	Minimum spec.	Example
Modulation meter	AM & FM 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 AM & FM distortion**

87. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-22.

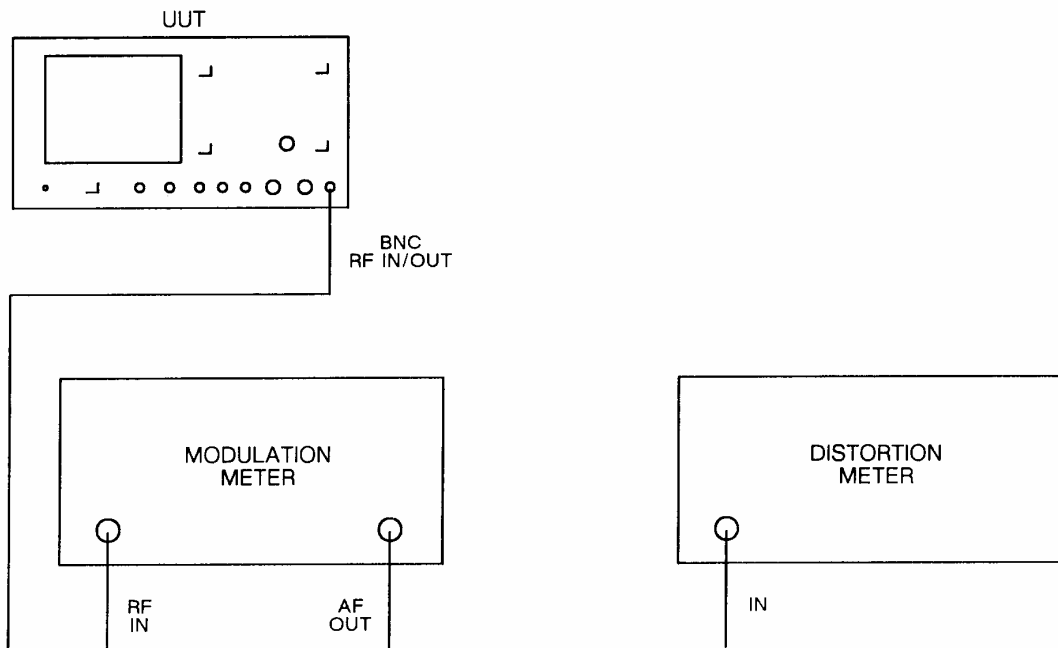


Fig. 5-1-22 Test equipment connections for RF generator AM & FM distortion performance checks

## PERFORMANCE TESTING

- (2) Set the UUT to RX, RF GEN, carrier frequency 100 MHz, BNC output socket, level 0 dBm, AM frequency 1 kHz sine wave, modulation depth 30%, distortion/SINAD/SN off.
- (3) Set the modulation meter to monitor AM with 0.3–3.4 kHz bandwidth filter selected.
- (4) Tune in the distortion meter and check that the reading is less than 2%.
- (5) Change the UUT modulation to 1 kHz FM sine wave with deviation 5 kHz.
- (6) Set the modulation meter to monitor FM 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 AM & FM specification**

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

- AM sensitivity: 0.76 V p-p for 30% AM, ±10%, ±1% AM
- FM sensitivity: 0.5 V p-p for 10 kHz deviation, ±10%.

**External AM & FM test gear**

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

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

**Checking external AM & FM**

90. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-23.

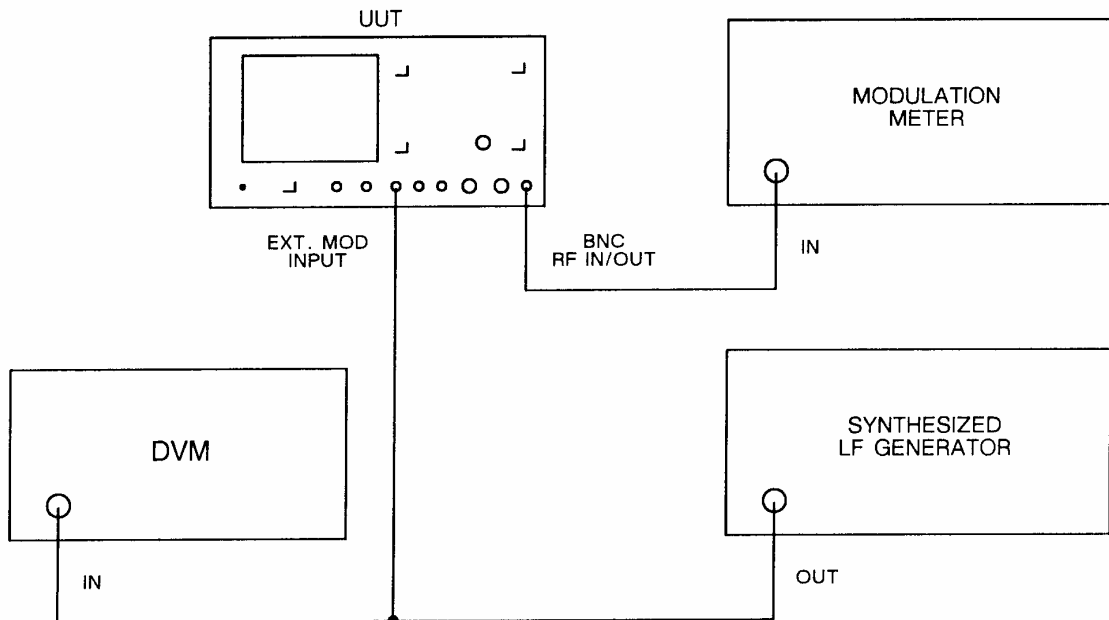


Fig. 5-1-23 Test equipment connections for RF generator external AM & FM performance checks

## PERFORMANCE TESTING

- (2) Set the UUT to RX, RF GEN, carrier frequency 100 MHz, BNC output socket, level 0.0 dBm, AM frequency 1 kHz, modulation depth 0%, distortion/SINAD/SN off.
- (3) Set the synthesized LF generator to give a 1 kHz sinewave output and adjust the level to give an RMS reading on the DVM of 268.7 mV (0.76 V pk-pk).
- (4) Set the modulation meter to monitor AM and select the 0.3–3.4 kHz band-pass filter.
- (5) Check that the modulation meter displays 30% modulation  $\pm 10\% \pm 1\%$  AM.
- (6) Set the UUT to FM modulation level 0 kHz.
- (7) Set the synthesized LF generator to give a 1 kHz sine wave output and adjust the level to give an RMS reading on the DVM of 176.8 mV (0.5 V pk-pk).
- (8) Set the modulation meter to monitor FM with the 0.3–3.4 kHz band-pass filter selected.
- (9) Check that the modulation meter displays 5 kHz deviation  $\pm 10\%$ .
- (10) 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**

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

<0.5  $\mu$ V PD generated in a 50  $\Omega$  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  $\Omega$  sealed load.

**RF leakage test gear**

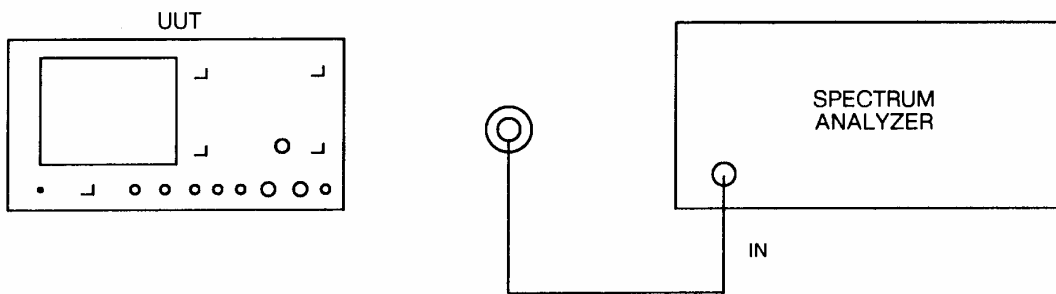
92. The following test gear is required to check the above specification:-

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

**Checking RF leakage**

93. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-24, with the 50  $\Omega$  load connected to the BNC output socket.



*Fig. 5-1-24 Test equipment connections for RF generator RF leakage performance checks*

- (2) Set the UUT to RX, RF GEN, carrier frequency 500 MHz, level -20 dBm, BNC output socket.
- (3) Set the spectrum analyzer to monitor 500 MHz.
- (4) Hold the loop 25 mm away from the UUT case and check that the level picked up on the spectrum analyzer is less than 0.5  $\mu$ V PD.

**FM on CW specification**

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

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

**FM on CW test gear**

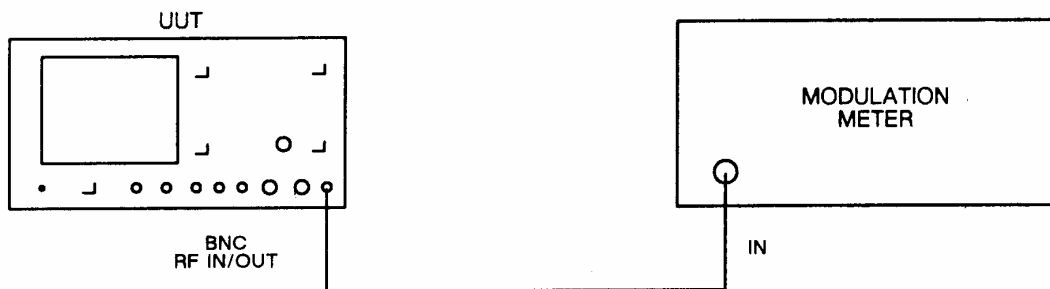
95. The following test gear is required to check the above specification:-

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

**Checking FM on CW**

96. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-25.



*Fig. 5-1-25 Test equipment connections for RF generator FM on CW performance checks*

- (2) Set the UUT to RX, RF GEN, carrier frequency 520 MHz, BNC output socket, level 0 dBm, modulation off.
- (3) Set the modulation meter to monitor FM, 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 UUT 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**

97. 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**

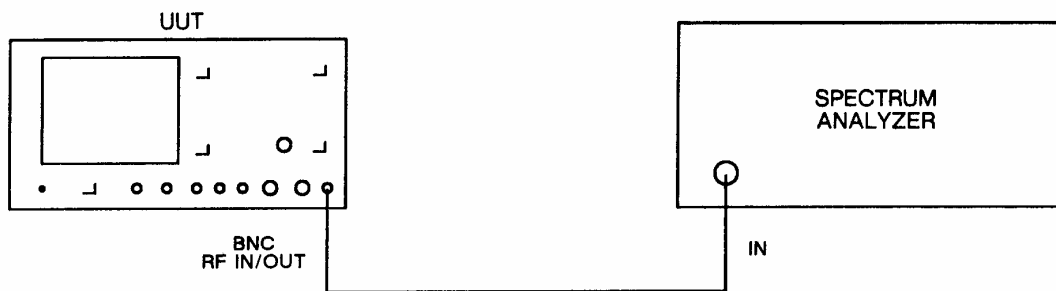
98. The following test gear is required to check the above specification:-

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

**Checking harmonics**

99. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-26.



*Fig. 5-1-26 Test equipment connections for RF generator harmonics, sub-harmonics & spurious signals performance checks*

- (2) Set the UUT to RX, RF GEN, carrier frequency 1.5 MHz, BNC output socket, level 0 dBm, modulation off.
- (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

100. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-26.
- (2) Set the UUT to RX, RF GEN, carrier frequency 530 MHz, BNC output socket, level 0 dBm, modulation off.
- (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 RF generator frequencies between 530 and 1000 MHz.

### Checking spurious signals

101. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-1-26.
- (2) Set the UUT to RX, RF GEN, carrier frequency 88 MHz, BNC output socket level 0 dBm, modulation off.
- (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.



### 2955R SENSITIVE RECEIVER

102. The sensitive receiver performance checks comprise sensitivity and level accuracy.

#### Sensitivity specification

103. This section checks that the receiver performs to the following specification:-

2  $\mu$ V for 10 dB SINAD in 12 kHz bandwidth  
 from 1 MHz to 1000 MHz for 3.5 kHz  
 deviation in a psophometric bandwidth.

#### Sensitivity test gear

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

Description	Minimum spec.	Example
Signal generator	$\pm 2$ dB RF level accuracy at 2 $\mu$ V for carrier frequency 1 to 1000 MHz; ability to provide 3.5 kHz deviation at 1 kHz rate	2019A
SINAD meter	10 dB SINAD measurement in a psophometric bandwidth at accuracy $\pm 1$ dB	HP 8903B & CCITT filter

#### Checking sensitivity

105. Proceed as follows:-

- (1) Connect the signal generator RF output to the RF IN/OUT BNC socket. Connect the SINAD meter input to the DE-MOD OUT socket. See Fig. 5-1-27.

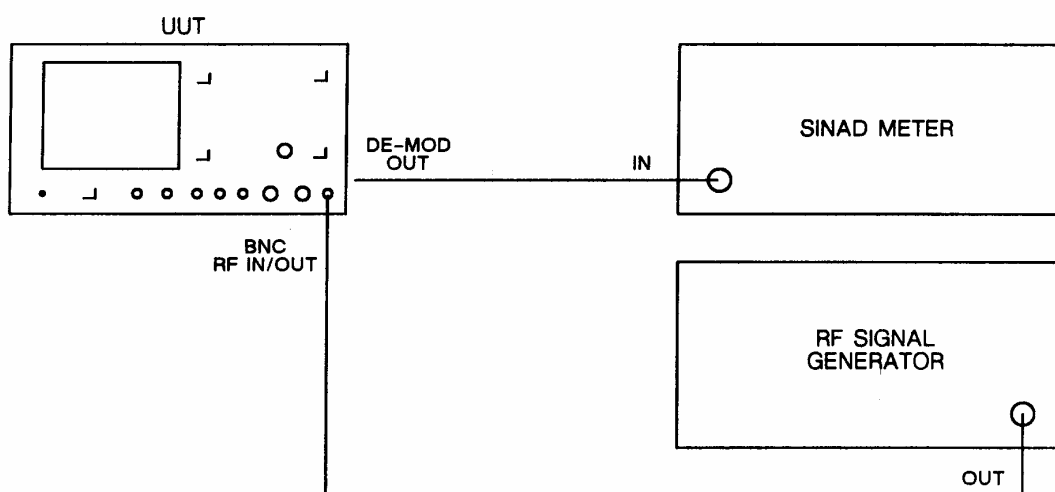


Fig. 5-1-27 Test equipment connections for 2955R sensitive receiver sensitivity check

- (2) Set the 2955R to TRANSMITTER MONITOR mode, the IF FILTER to 12 kHz, the TX FREQUENCY to 10.02 MHz and the RF IN/OUT to the BNC socket.
- (3) Set the signal generator to give a carrier of 10.02 MHz at a level of 2  $\mu$ V PD and 3.5 kHz FM deviation at 1 kHz rate.
- (4) Set the SINAD meter to read in a psophometric bandwidth.
- (5) Check that the SINAD meter reads >10 dB.
- (6) Repeat at 100.02, 200.02, 300.02, 400.02, 500.02, 600.02, 700.02, 800.02, 900.02 and 999.02 MHz. For each frequency, change the TX FREQUENCY and the signal generator frequency.

**Level accuracy specification**

106. This section checks that the receiver performs to the following specification:-

Typically  $\pm 6$  dB at 100 MHz with reference to -60 dBm over the range -87 to -24 dBm (10  $\mu$ V to 14 mV) at the BNC socket or -67 to -4 dBm (100  $\mu$ V to 140 mV) at the N socket.

**Level accuracy test gear**

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

Description	Minimum spec.	Example
Signal generator	$\pm 2$ dB RF level accuracy over range -4 to -87 dBm at 100 MHz	2019A

**Checking level accuracy**

108. Proceed as follows:-

- (1) Connect the signal generator RF output to the RF IN/OUT BNC socket. See Fig. 5-1-28.



Fig. 5-1-28 Test equipment connections for 2955R level accuracy check

## PERFORMANCE TESTING

- (2) Set the 2955R to TRANSMITTER MONITOR mode, the IF FILTER to 12 kHz, the TX FREQUENCY to 100 MHz and the RF IN/OUT to the BNC socket.
- (3) Set the signal generator to give a carrier of 100 MHz at a level of -60 dBm. On the 2955R, press the dBm key for a STRENGTH reading in dBm. Check that the STRENGTH reading is -60 dBm  $\pm$ 10 dB.
- (4) Press the dB key twice to give a STRENGTH reading of 0 dBR. Set the signal generator to the following levels and check that the readings are within  $\pm$ 10 dB of the correct reading:-

<b>Signal generator level</b>	<b>Correct reading</b>
-24 dBm	+36 dBR
-34 dBm	+26 dBR
-44 dBm	+16 dBR
-54 dBm	+6 dBR
-64 dBm	-4 dBR
-74 dBm	-14 dBR
-84 dBm	-24 dBR
-87 dBm	-27 dBR

**PERFORMANCE TESTING**

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## Chapter 5-2

# ADJUSTMENT AND CALIBRATION

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Para.	
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6	Mixer 10 MHz rejection
7	Phase detector balance
AA3	RF synthesizer
8	Low frequency external FM
AA4/1	LF synthesizer and output AMP
9	200 MHz oscillator
10	AB2/2 digital scope
11	AB5/1 demodulation and scope
12	Voltmeter and scope ranging
13	Voltmeter gain
14	filter
15	Notch width
16	AM monitor
17	FM and $\Phi$ M monitor
18	Scope path gain
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26	10 MHz standard
27	Frame height
28	Frame linearity
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34	2955R Sensitive receiver
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## ADJUSTMENT AND CALIBRATION

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## 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 5-2-1 ADJUSTMENT GUIDE - PLUG-IN BOARDS

Adjustment	Para.	Board	Component
A-D converter calibration FM and FM monitor	10	AB2/2	R14
RF power meter calibration	19	AB5/1	R106
FM and FM monitor	17	AB5/1	R129
AM monitor	16	AB5/1	R138
AM monitor	16	AB5/1	R168
AM monitor	16	AB5/1	R172
Scope path gain	18	AB5/1	R209
Voltmeter and scope ranging	12	AB5/1	R213
Voltmeter and scope ranging	12	AB5/1	R230
Voltmeter and scope ranging	12	AB5/1	R339
Voltmeter gain	13	AB5/1	R231
Voltmeter and scope ranging	12	AB5/1	R243
Voltmeter and scope ranging	12	AB5/1	R244
Band-pass filter	14	AB5/1	R305
Notch width	15	AB5/1	R314
AF generator output level	20	AB6/1	R1
RF output level calibration	22	AB6/1	R20

**Note ...**

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

TABLE 5-2-2 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 FM	8	AA3	R138
200 MHz oscillator	9	AA4/1	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 5-2-1 and 5-2-2, which are intended for use with Fig. 5-2-1, summarize the various instrument adjustment points. Table 5-2-5 shows those for the plug-in boards held in the card-frame while Table 5-2-6 shows the remaining, generally less accessible, ones. Fig. 5-2-1 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 RF 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 5-2-1.



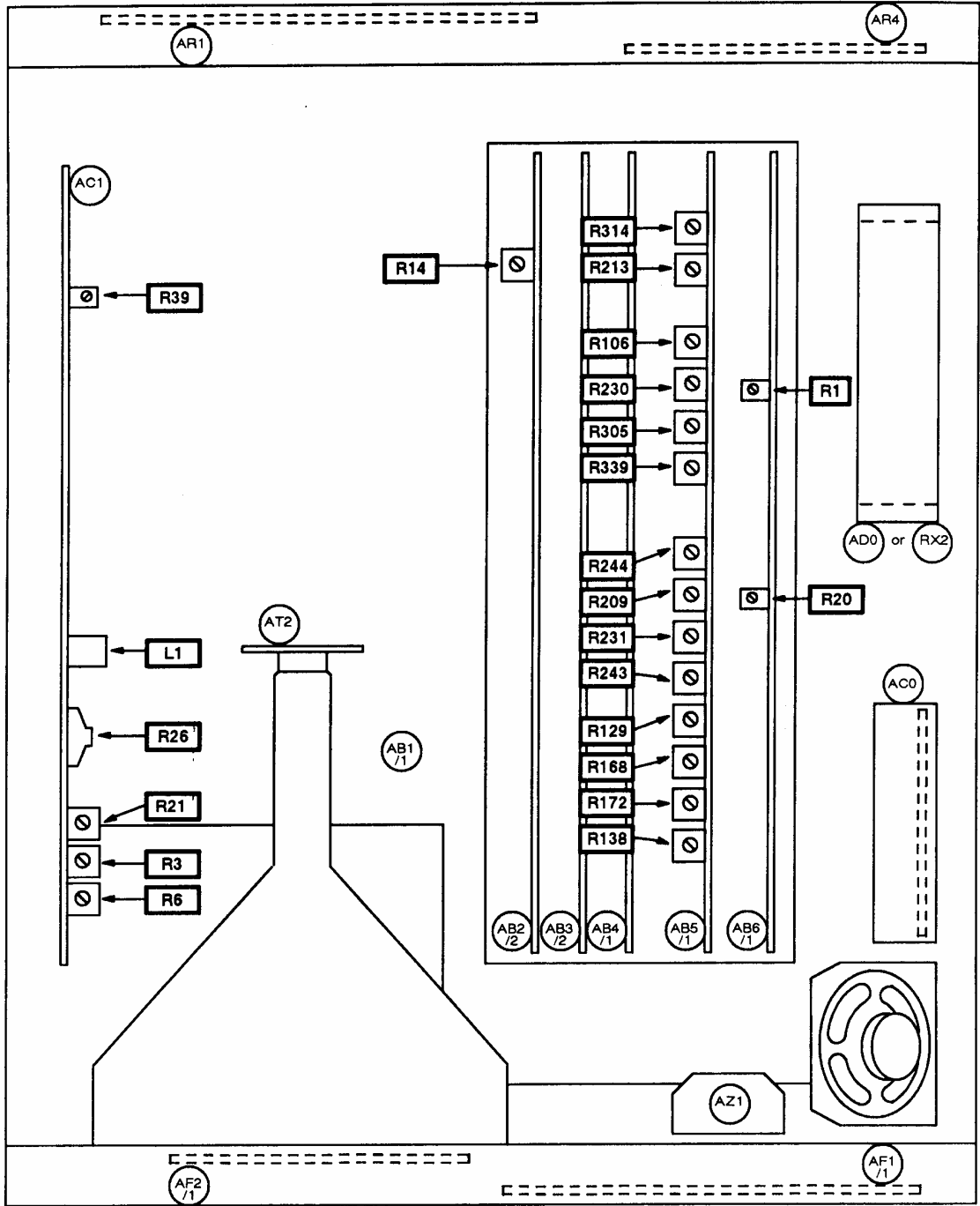


Fig. 5-2-1 Adjustment points accessible from above the instrument

## 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 IF output when the low frequency oscillator is being used. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-2.
- (2) Set the UUT to transmitter test (TX), BNC input socket.
- (3) Set the signal generator to a carrier frequency of 55.6 MHz, RF 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).

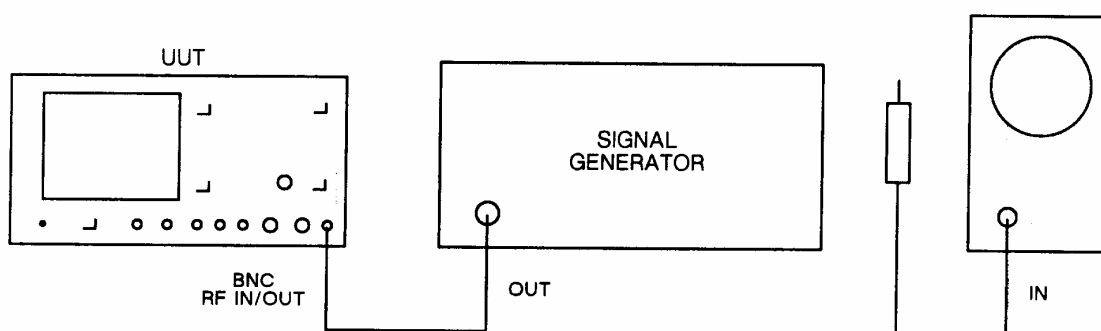


Fig. 5-2-2 Test equipment connections for adjusting R11 and R27 on AA1

### 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. 5-2-2.
- (2) Set the UUT to transmitter test (TX), BNC input socket.
- (3) Set the signal generator to a carrier frequency of 300 MHz, RF 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 LF generator, oscilloscope.

### Low frequency external FM

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

- (1) Connect the equipment as shown in Fig. 5-2-3.
- (2) Set the UUT to receiver test (RX), BNC output socket. Set the signal generator to 300 MHz, level 0 dBm, 0 kHz FM.
- (3) Set the synthesized LF generator to give a 10 Hz square wave of 1 V pk-pk.
- (4) Set the modulation meter to monitor FM. (If the Marconi Modulation Meter 2305 is used, select the 10 Hz - 300 kHz filter and set the LF 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.

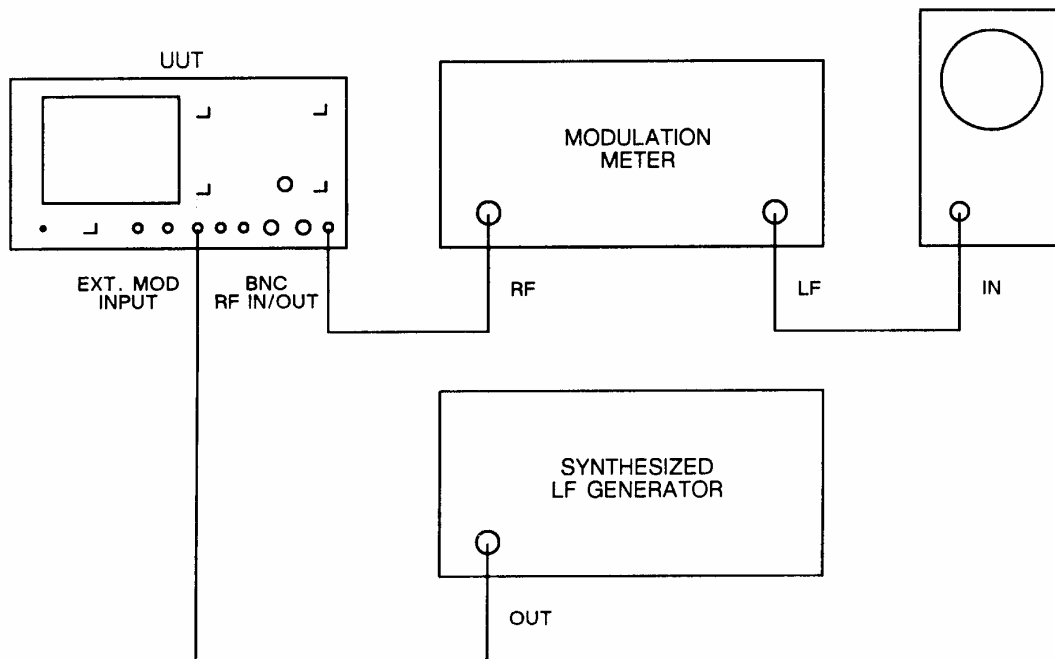


Fig. 5-2-3 Test equipment connections for adjusting R138 on AA3

**AA4/1 – LF SYNTHESIZER AND OUTPUT AMP**

Test equipment : Frequency counter DVM.

**200 MHz oscillator**

9. This adjustment sets up the PLL capture range of the 200 MHz oscillator. Incorrect adjustment of C79 may result in the signal generator frequency not locking between 0.4 and 88 MHz. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-4.

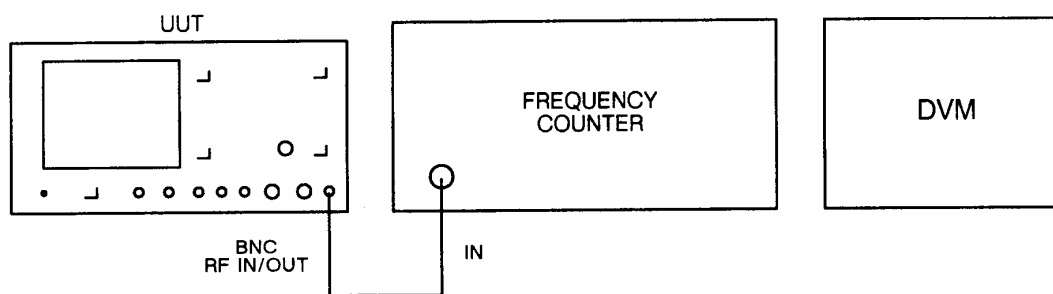


Fig. 5-2-4 Test equipment connections for adjusting C79 on AA4/1

- (2) Turn C79 to one end (plates either fully open or fully closed).
- (3) Set the UUT to receiver test, BNC output socket. Set the UUT signal generator to 50 MHz, RF 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 M $\Omega$ ) DVM set to DC, 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 DVM of 30 mV less than the previously noted voltage.
- (8) Select a UUT signal generator frequency of 100 MHz and check that the counter reads 100 MHz.
- (9) Reset the UUT signal generator frequency to 50 MHz and again check on the counter that it re-locks to 50 MHz.

**AB2/2 – DIGITAL SCOPE**

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

**AB5/1 DEMODULATION AND SCOPE**

Test equipment: AC/DC calibrator, synthesized LF generator, signal generator, modulation meter, oscilloscope, DVM, power source.

11. The following adjustments affect the calibration of the oscilloscope, voltmeter, AF generator, AM/FM/ΦM 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 AF 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 UUT to RX, AF 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 DVM set to DC. Adjust R243 to give a reading on the DVM as close to 0 mV DC as possible. Remove the DVM.
- (5) Select SCOPE and set the UUT oscilloscope to 20V/DIV, DC 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) Set the UUT to audio test and select the 50 kHz low-pass filter and DC coupling.
- (9) Monitor TP5 on AB5/1 with a DVM set to measure DC volts. Adjust R230 for a minimum reading ( $\pm 1$  mV).
- (10) Monitor AB5/1 edge connector pin 31b with the DVM. Adjust R339 for a minimum reading ( $\pm 1$  mV DC).
- (11) Remove the earthing link.

### Voltmeter gain

13. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-5.
- (2) Set the calibrator to give 5.000 V DC.
- (3) Set the UUT to RX, distortion/SINAD/SN off, DC coupled, 50 kHz low-pass filter.
- (4) Adjust R231 until an AF level of 5.00 V DC is displayed.

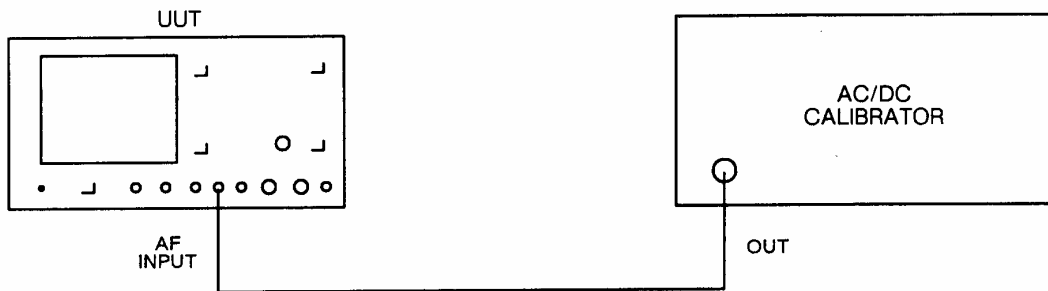


Fig. 5-2-5 Test equipment connections for adjusting R231 on AB5/I

### Band-pass filter

14. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-6.
- (2) Set the synthesized LF generator to give a 1 kHz sinewave at a level of 1 V RMS.
- (3) Set the UUT to RX, distortion/SINAD/SN off, AC coupled, 50 kHz low-pass filter.
- (4) Note the reading on the UUT AF voltmeter.
- (5) Select the band-pass filter on the UUT. Now adjust R305 to obtain the same AF voltmeter reading on the UUT display as was indicated with the 50 kHz low-pass filter selected.



Fig. 5-2-6 Test equipment connections for adjusting R305 and R314 on AB5/I

**Notch width**

15. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-6.
- (2) Set the synthesized LF generator to give a 1.007 kHz sinewave at a level of 1 V RMS.
- (3) Set the UUT to RX, AF generator, 0.3 – 3.4 kHz band-pass filter, AC coupled, distortion on.
- (4) Adjust R314 for the minimum possible distortion reading on the UUT display.

**AM monitor**

16. Proceed as follows:-

- (1) Connect the signal generator to the UUT as shown in Fig. 5-2-7.
- (2) Set the signal generator to carrier frequency 100 MHz, modulation off, RF level 0 dBm.
- (3) Set the UUT to TX, monitoring AM, 0.3 – 3.4 kHz band-pass filter, BNC 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 RF level to 0 dBm and adjust R172 for 1 V pk-pk on the oscilloscope. Remove the oscilloscope probe from TP1.
- (7) Set the signal generator to carrier 100 MHz, AM 50%, modulation 1 kHz, RF level 0 dBm.
- (8) Set the modulation meter to measure AM, (pk-pk)/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 AM depth reading.
- (10) Connect the signal generator output to the UUT BNC input socket and adjust R168 to give the same AM reading on the UUT as was displayed on the modulation meter.

**FM and  $\Phi$ M monitor**

17. Proceed as follows:-

- (1) Connect the signal generator to the modulation meter as shown in Fig. 5-2-7.
- (2) Set the signal generator to carrier frequency 100 MHz, FM deviation 5 kHz, modulation rate 1 kHz, RF level 0 dBm.

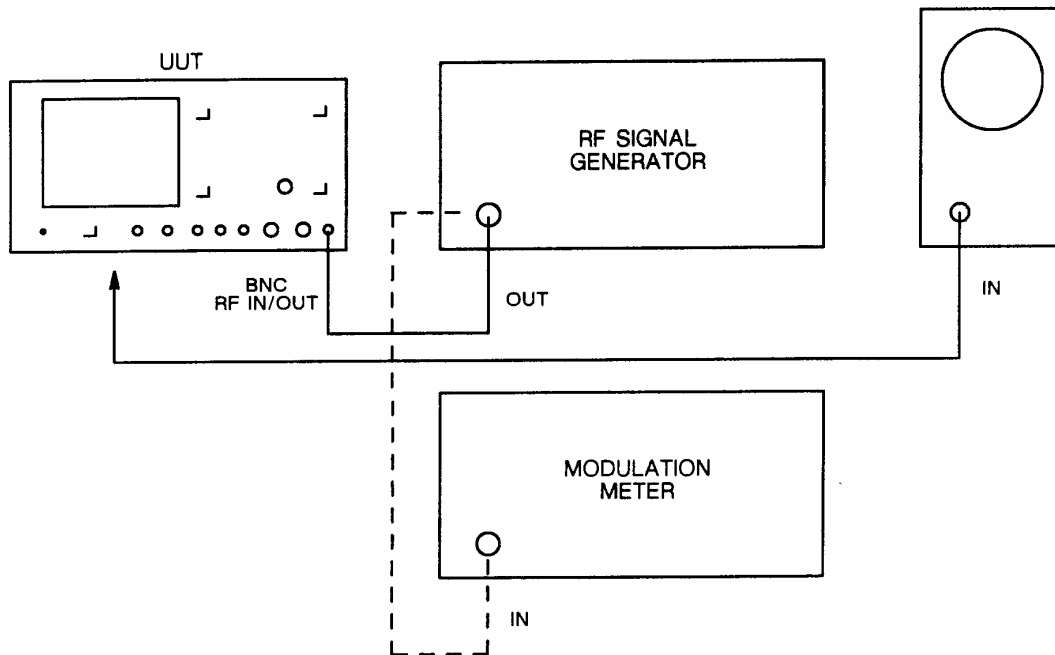


Fig. 5-2-7 Test equipment connections for adjusting R138,R172,R168,R129 on AB5/1

- (3) Set the modulation meter to measure FM with the 0.3 – 3.4 kHz band-pass filter selected.
- (4) Adjust the signal generator FM deviation level to give a reading of 5.00 kHz deviation on the modulation meter.
- (5) Set the UUT to TX, monitoring FM, 0.3 – 3.4 kHz band-pass filter, BNC input.
- (6) Connect the signal generator to the UUT BNC input and adjust R129 for a 5.00 kHz indication on the 2955A display.
- (7) Select SCOPE on the UUT and +6/-6 FM oscilloscope range. Adjust R14 on board AB2/2 to indicate  $\pm 5$  kHz FM on the UUT oscilloscope.

### Scope path gain

18. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-8.
- (2) Set the synthesized LF generator to give a 1 kHz sinewave and adjust the level for an indication of 0.707 V RMS on the DVM.
- (3) Adjust R209 for a 2 V pk-pk (4 divisions) indication on the UUT oscilloscope.



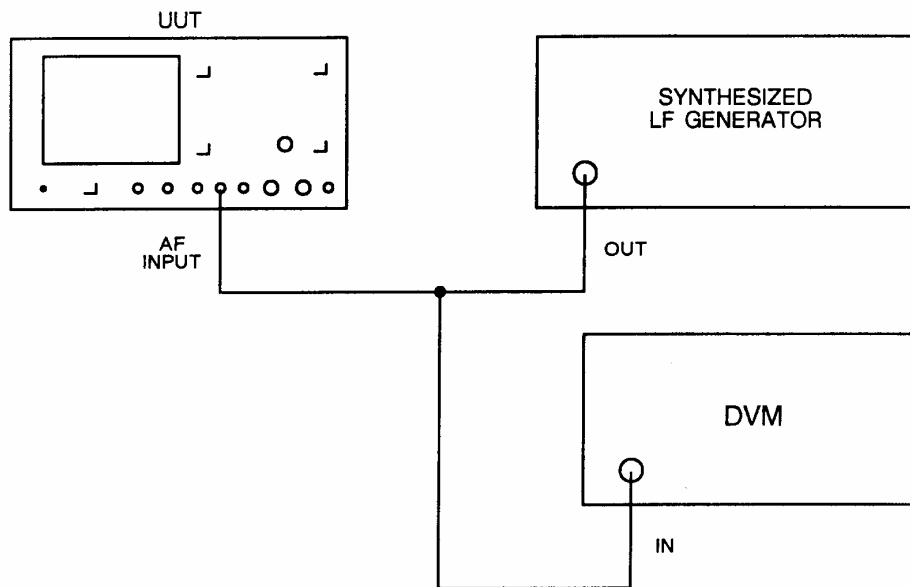


Fig. 5-2-8 Test equipment connections for adjusting R209 on AB5/1

### RF power meter calibration & software correction

19. Calibration of the RF 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  $\pm 2\%$  up to 500 MHz and  $\pm 3\%$  up to 1.1 GHz. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-9, where the power source is a calibrated one formed from the equipment shown in Chap. 5-1, Fig. 5-1-17.



Fig. 5-2-9 Test equipment connections for adjusting R106 on AB5/1

- (2) Set the UUT 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 UUT display. Repeat for the frequencies shown in Table 5-2-3a noting the power reading on the UUT for each frequency.

## ADJUSTMENT AND CALIBRATION

- (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 2955A 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 5-2-3a to 5-2-3e. 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 5-2-3a (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 5-2-3b (20 dB pad on AA2 in, high oscillator band on AA1 selected).
- (9) Set the UUT 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 5-2-3c.
- (10) Set the UUT to TX, with the power source at 2 W. Carry out the software correction for the frequencies and addresses given in Table 5-2-3d (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 5-2-3e (20 dB pad on AA2 out, low oscillator band on AA1 selected).

**TABLE 5-2-3a RF POWER METER SOFTWARE CORRECTION  
(20 dB OUT, HIGH OSC.)**

<b>Address of correction figure</b>	<b>Frequency</b>	<b>Address of correction figure</b>	<b>Frequency</b>
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		

ADJUSTMENT AND CALIBRATION

**TABLE 5-2-3b 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 5-2-3c RF POWER METER SOFTWARE CORRECTION  
(ONE PORT DUPLEX)**

Address of correction figure	Frequency	Address of correction figure	Frequency
63167	11.5 MHz	63178	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	1020 MHz

**TABLE 5-2-3d 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 5-2-3e 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	

**AB6/1 – AF SYNTHESIZER**

Test equipment: DVM, power meter, modulation meter.

**AF generator output level**

20. To adjust the AF generator output level proceed as follows:-
- (1) Connect the equipment as shown in Fig. 5-2-10.
  - (2) Set the UUT to audio test mode.
  - (3) Set the UUT AF GEN 1 frequency to 1 kHz sine wave, level 1 V. Ensure that AF GEN 2 is switched off.
  - (4) Set the DVM to measure AC.
  - (5) Adjust R1 (for adjustment locations see Fig. 5-2-1) for a DVM reading of 1 V  $\pm$ 0.005 V.



*Fig. 5-2-10 Test equipment connections for adjusting R1 on AB6/1*

**RF output level calibration**

21. Calibration of the RF generator signal levels is carried out using R20 and software correction for the electronic fine attenuator.

**Note...**

If the RF output level is adjusted, the RF generator AM and FM must be recalibrated.

22. In most instances of recalibration it is likely that the RF level will only require optimising using R20, 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. 5-2-11 via the 6912 sensor.
- (2) Set the UUT to RX, RF generator frequency 300 MHz, level -15.5 dBm, increment 1 dB, modulation off, N-type socket.

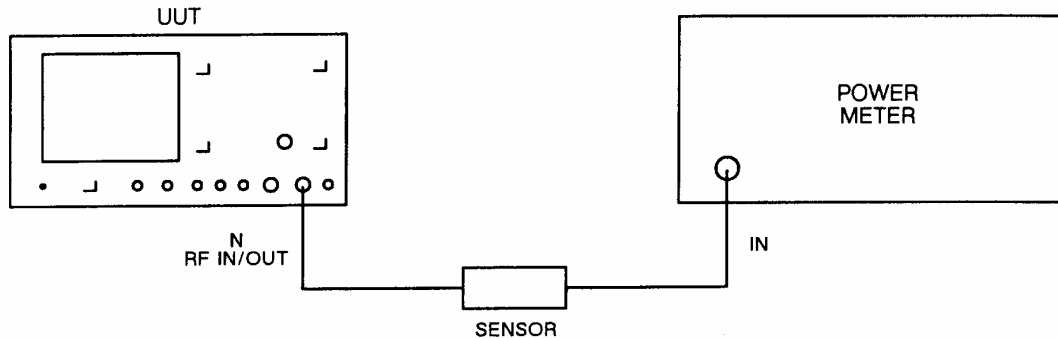


Fig. 5-2-11 Test equipment connections for adjusting R20 on AB6/I

- (3) Adjust R20 for an indication on the power meter of  $-15.5$  dBm.
- (4) Using the decrement key, decrement in 1 dB steps to  $-25.5$  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 CALIBRATION DATA facility as described in Chap. 5-0.
- (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) Re-enter receiver test and adjust R20 for an indication on the power meter of  $-15.5$  dBm.
- (5) Decrement the RF 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 RF level does not change until after returning to the receiver test mode.

(7) Repeat step (6) above for the levels and addresses shown in Table 5-12.

**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.

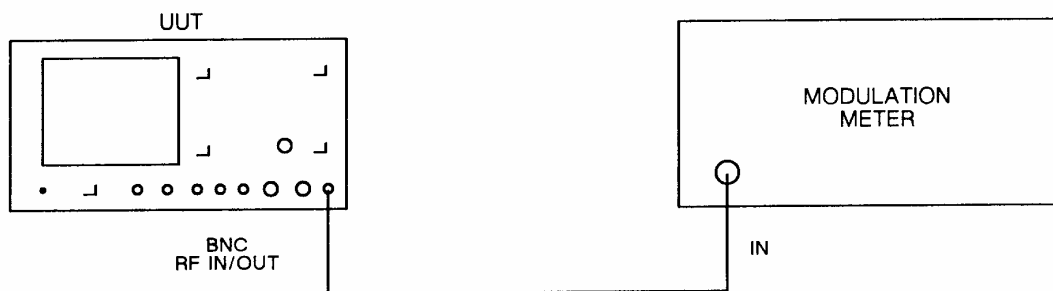
**TABLE 5-2-4 RF OUTPUT LEVEL SOFTWARE CORRECTION**

Address of correction figure	RF level	Address of correction figure	RF level
63244	-15.5 dBm	63250	-21.5 dBm
63245	-16.5 dBm	63251	-22.5 dBm
63246	-17.5 dBm	63252	-23.5 dBm
63247	-18.5 dBm	63253	-24.5 dBm
63248	-19.5 dBm	63254	-25.5 dBm
63249	-20.5 dBm		

**Signal generator AM calibration & software correction**

24. Proceed as follows but note that AM calibration should not be carried out until after the RF level calibration has been set up as this affects the AM :-

- (1) Connect the equipment as shown in Fig. 5-2-12.
- (2) Set the UUT to RX, RF generator frequency 125 MHz, RF level 5 dBm, modulation frequency 1 kHz, modulation level depth 70%, BNC socket, distortion/SINAD/SN off.
- (3) Set the modulation meter to AM, (pk-pk)/2, 0.3 - 3.4 kHz band-pass filter selected.
- (4) Note the modulation depth indicated on the modulation meter.
- (5) Enter the CALIBRATION DATA facility as described in Chap. 5-0.



*Fig. 5-2-12 Test equipment connections for AM and FM calibration*



ADJUSTMENT AND 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 AM slope by subtracting the initial measured depth from the depth now displayed. Using this AM slope figure, calculate the correction figure required to give 70% depth by the following formula :-  

$$\frac{(70 - \text{Mod depth now displayed})}{(\text{AM slope fig.})} + \text{current correction data fig.}$$
- (9) Enter address 63255 and enter the new calculated data correction figure. Return to RX mode. Modulation depth now displayed should be within 70% ±5.9% AM. To optimise accuracy, repeat this step using the formula above.
- (10) AM accuracy at level 5 dBm should now be correct. Repeat the above procedure for addresses and corresponding levels as shown in Table 5-2-5 up to address 63264, level -4 dBm.
- (11) The AM correction figures for -5 dBm and -5.9 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 UUT RF level to -4 dBm and set an increment level of 0.1 dB. Using the level increment down key, step down in 0.1 dB steps until -5 dBm is reached.

TABLE 5-2-5 SIGNAL GENERATOR AM SOFTWARE CORRECTION

Address of correction figure	RF level	Address of correction figure	RF level
63255	5 dBm	63261	-1 dBm
63256	4 dBm	63262	-2 dBm
63257	3 dBm	63263	-3 dBm
63258	2 dBm	63264	-4 dBm
63259	1 dBm	63265	-5 dBm
63260	0 dBm	63266	-5.9 dBm

- (13) The AM correction for -5 dBm can now be carried out as normal. When this is complete, decrement in 0.1 dB steps until -5.9 dBm is reached and carry out the AM correction procedure for this level.

Note...

If by accident the level is stepped past -5.9 dBm, for instance -6 dBm, the 10 dB pad will be switched in and cannot be switched out by simply incrementing one step to -5.9 dBm. If this happens, return the RF level to -4 dBm and decrement -5.9 in 0.1 dB steps back to -5.9 dBm.

**Signal generator FM calibration & software correction**

25. Proceed as follows:-

- (1) Connect the equipment as shown in Fig. 5-2-12.
- (2) Set the UUT to RX, RF generator frequency 165 MHz, RF level 0 dBm, modulation frequency 1 kHz sine wave, deviation 10 kHz, BNC output socket selected.
- (3) Set the modulation meter to FM, (pk-pk)/2, 0.3 – 3.4 kHz b.p. filter selected.
- (4) Note the deviation measured on the modulation meter.
- (5) Enter the CALIBRATION DATA facility as described in Chap. 5-0.
- (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) Enter the CALIBRATION DATA facility as described in Chap. 5-0.
- (10) Enter address 63257 and enter the new calculated data correction figure. Return to RX mode. Deviation now displayed should be within 10 kHz  $\pm 7\%$ . To optimise the accuracy, repeat this step using the formula above.
- (11) FM accuracy at 165 MHz should now be correct. Repeat the above procedure for all the addresses and corresponding frequencies shown in Table 5-2-6. This lists the 131 software correction points covering the 3 main oscillators.

TABLE 5-2-6 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 RF generator, two AF generators and the AF and RF 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. 5-2-13, but ensure that the external reference standard has an accuracy better than  $\pm 5$  parts in  $10^{10}$ .

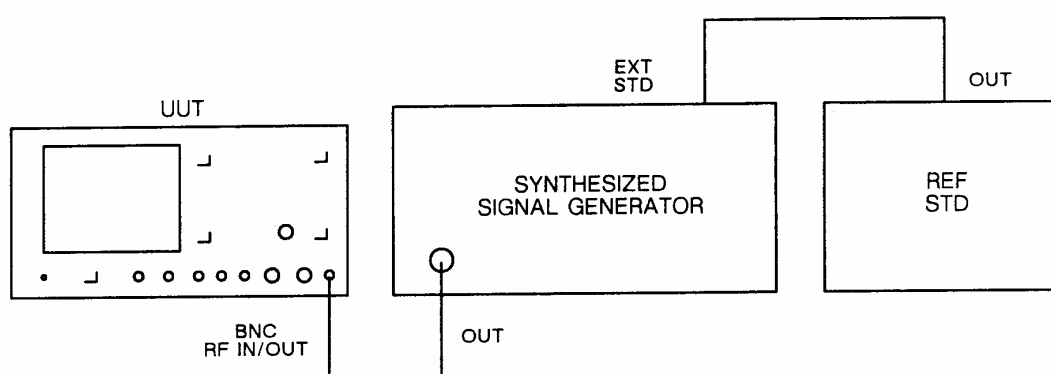


Fig. 5-2-13 Test equipment connections for adjusting R39 on AC1

- (2) Set the synthesized signal generator to external standard, carrier frequency 1000 MHz, modulation off, RF level 0 dBm.
- (3) Set the UUT to TX, BNC input socket selected.
- (4) Adjust R39 for a transmitter frequency indication on the UUT display of 1000 MHz  $\pm 1$  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.

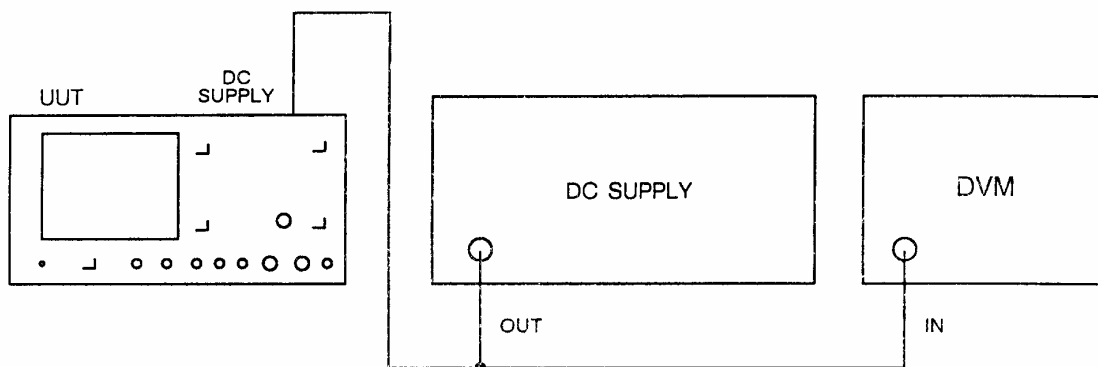
**AR1 – POWER SUPPLY**

Test equipment: DC supply, DVM.

**Low level volts**

32. Proceed as follows:-

- (1) Disconnect the AC mains supply lead from the UUT AC SUPPLY socket.
- (2) Connect the DVM and a DC supply capable of supplying 55 W at 16 V to the UUT rear panel DC SUPPLY socket as shown in Fig. 5-1-14.



*Fig. 5-2-14 Test equipment connections for adjusting R46 on AR1*

- (3) Switch the UUT on and adjust the DC supply until the DVM reads 10.8 V.
- (4) Remove the DVM and connect it between tag 8 (orange lead) and earth.
- (5) Adjust R46 for a DVM 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 DVM between tag 4 and earth.
- (2) Adjust R47 for 5.05 V at tag 4.

**2955R SENSITIVE RECEIVER.**

34. Any problem which is experienced with the receiver performance is more likely to be due to component failure than to maladjustment of presets once these have been set at the factory. Because many of the presets are interactive, initial action should be to determine, as far as possible, that component failure is not the cause of the fault symptom before any adjustments are made.

35. The procedures for the receiver tray assume that all other areas of the 2955R are performing correctly. Before making any adjustments to the hardware or the software, ensure that the 2955R has been on for not less than 30 minutes.

36. Adjustments should be made in the following order:-

Circuit	Board	Components
LO driver notch filter	RX12	L1, L2, L3, L4
20 dB IF 180 kHz band-pass amplifier	RX11	C15, C18, C27, C31
AGC and 38 dB amplifiers	RX11	R87, L16, L19, R59

37. After these hardware adjustments, software calibration can be undertaken.

**LO driver 21.4 MHz notch filter**

Test equipment: Spectrum analyzer (with tracking generator), active probe, lead with an SMC socket (female) and with a connector to the spectrum analyzer (tracking generator output).

38. Proceed as follows:-

- (1) Remove the interconnecting link between RX12 and RX11.
- (2) Connect the tracking generator output to the LO input of RX12 at the SMC plug PLB. Using the active probe, connect the spectrum analyzer RF input to the signal output of RX12 at the interconnecting link position. See Fig. 5-2-15. Earth the probe on the wall of the tray or on the adjacent pad.
- (3) On the 2955R, set the MODE to TRANSMITTER MONITOR. Check that the TX FREQUENCY is 300 MHz (to ensure that the notch filter is in circuit).
- (4) On the spectrum analyzer, set the centre frequency to 21.4 MHz, span to 2 MHz/division, reference level to 0 dBm, span to 10 dB/division, resolution bandwidth to 100 kHz and tracking generator on.
- (5) Use L1, L2, L3 and L4 as necessary to tune the notch filter as shown in Fig. 5-2-16. L1 and L4 (pink) affect the notch depth, L2 (green) affects the LF slope and L3 (yellow) affects the HF slope.
- (6) When the filter has been set, replace the interconnecting link between RX12 and RX11.

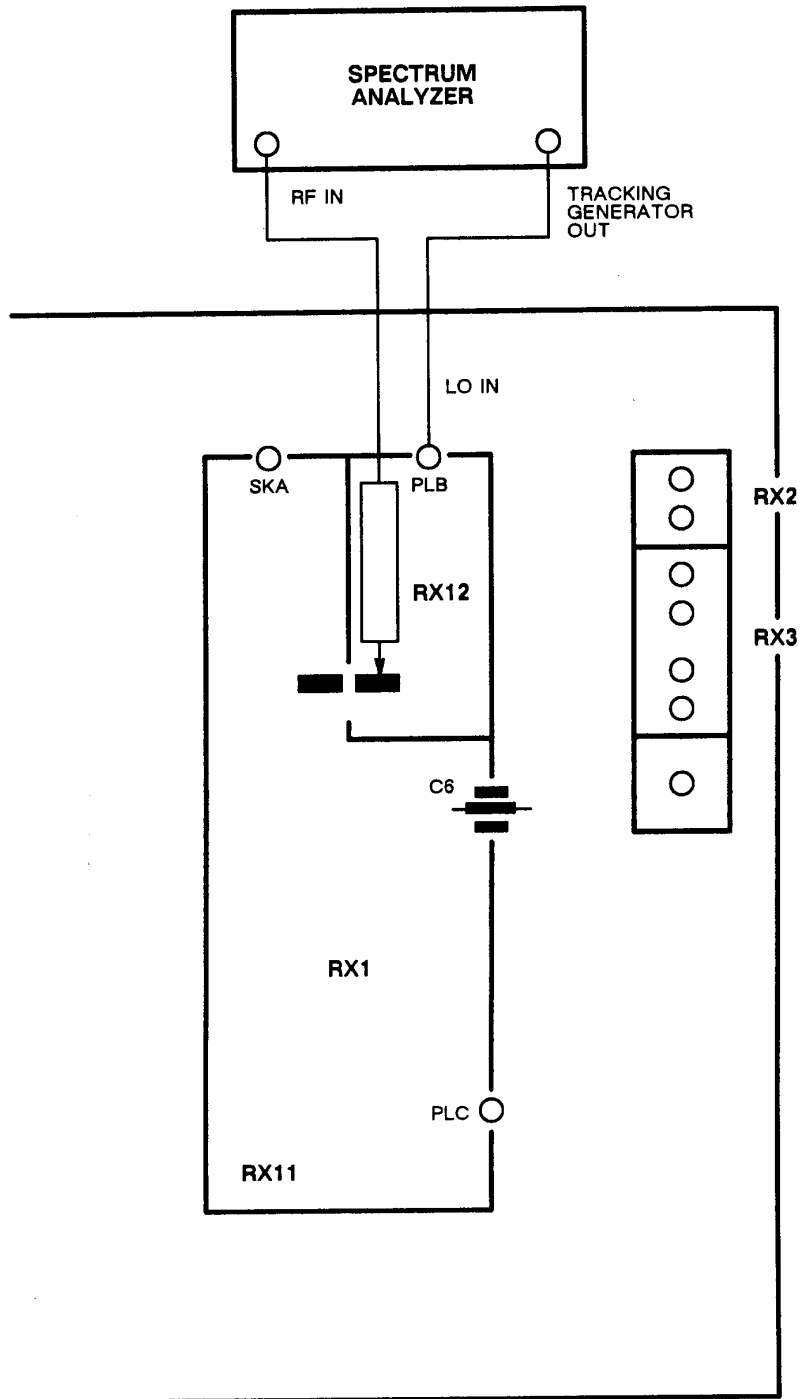


Fig. 5-2-15 Connections for adjustment of 21.4 MHz LO notch filter

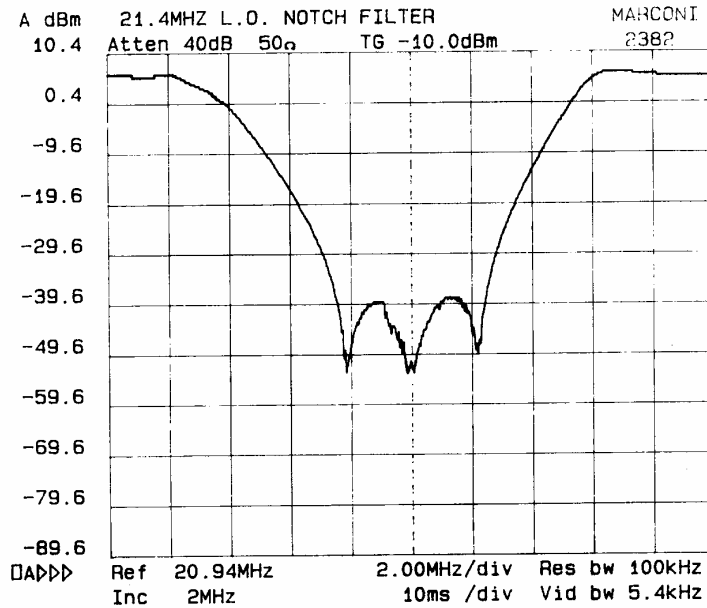


Fig. 5-2-16 Response of 21.4 MHz LO notch filter

### 20 dB IF 180 kHz band-pass amplifier

Test equipment: Spectrum analyzer (with tracking generator), RF signal generator, 50 dB attenuator pad, leads A, B and C to RX1 - lead A with an SMC plug (male) and an SMC socket (female), lead B with an SMC socket (female) and with a connector to the spectrum analyzer (tracking generator output), lead C with two SMA plugs (male), lead from the RF signal generator to the RF IN/OUT BNC socket, lead from the spectrum analyzer (tracking generator output) to the attenuator (if necessary), lead from the attenuator to the RF IN/OUT BNC socket.

**Note...**

When checking the response of the IF filter, ensure that the receiver tray lid is fully secured as this affects the response.

39. Before adjusting any of the presets, check the response as follows:-
  - (1) On the 2955R, set the MODE to TRANSMITTER MONITOR, the TX FREQUENCY to 71.4 MHz, the RF IMAGE to LOWER, the IF FILTER to 180 kHz and the RF IN/OUT to the BNC socket.
  - (2) Using lead A, connect its SMC plug to the free end of the pipe to SKB on RX2 and connect its SMC socket to PLB on RX1. See Fig. 5-2-17.
  - (3) Using lead B, connect its SMC socket to PLC on RX1 and connect its other end to the spectrum analyzer (RF input).
  - (4) Using lead C, connect one SMA plug to SKB on RX3 and connect the other SMA plug to SKA on RX1.



ADJUSTMENT AND CALIBRATION

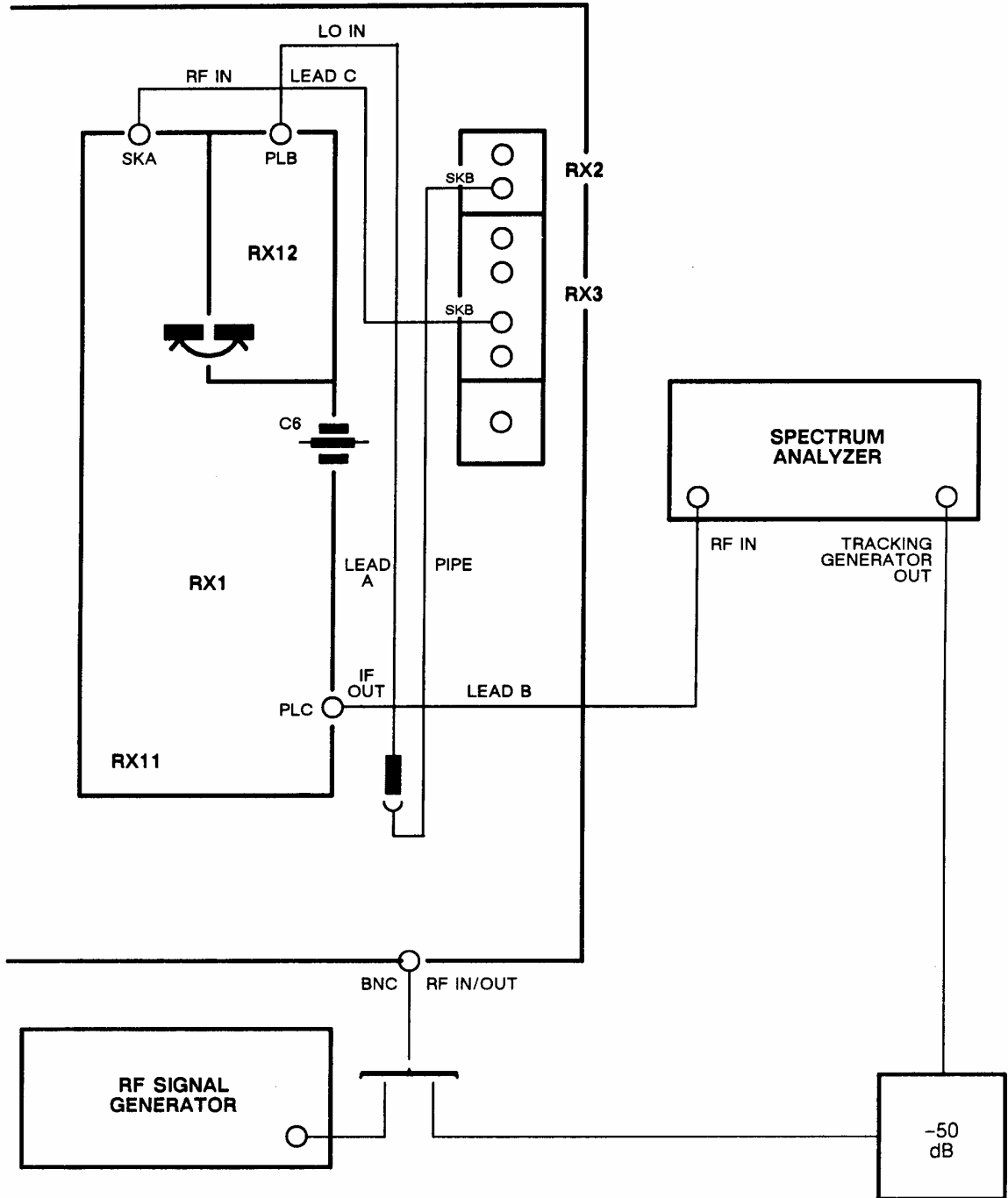


Fig. 5-2-17 Connections for checking 20 dB IF 180 kHz band-pass amplifier

ADJUSTMENT AND CALIBRATION

- (5) Connect the signal generator output to the RF IN/OUT BNC socket.
- (6) Set the signal generator to 71.4 MHz and -20 dBm.
- (7) Select the CALIBRATION MODE display by pressing in turn the HELP, TX MON ON-OFF, AC DC, VERT  $\blacklozenge$ , FREQ  $\downarrow$  and REP SWEEP keys.
- (8) On the display, check that RANGE 2 is indicated. Press the HOLD RANGE key. 2 then appears in reverse video.
- (9) Disconnect the signal generator.
- (10) Connect the tracking generator output through the 50 dB attenuator to the RF IN/OUT BNC socket.
- (11) Set the spectrum analyzer to 21.4 MHz, span to 50 kHz/division, reference level to -8 dBm, span to 1 dB/division, resolution bandwidth to 3 kHz, video bandwidth to 43 Hz and tracking generator on.
- (12) Check that the response is as shown in Fig. 5-2-18 and that the 3 dB points give a bandwidth of  $180 \pm 40$  kHz.
- (13) Reset the spectrum analyzer to 200 kHz/division and 10 dB/division.
- (14) Check that the rejection at 1 MHz offset is  $>38$  dB.

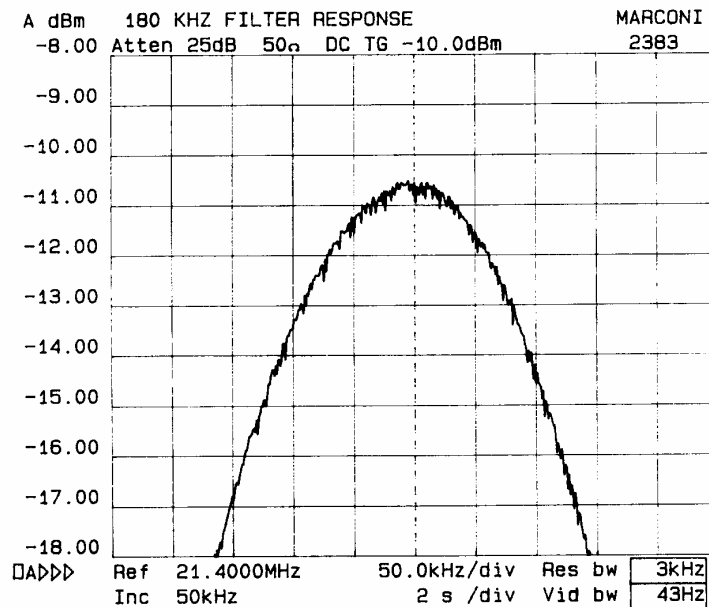


Fig. 5-2-18 Response of 20 dB IF 180 kHz band-pass amplifier (lid secured)

**Note...**

When adjusting the response, the receiver tray lid has to be removed. This affects the response by shifting the centre frequency downwards by approximately 50 kHz. The ideal response is as shown in Fig. 5-2-18. With the lid removed, the response is as shown in Fig. 5-2-19.

40. To adjust the response, proceed as in para. 39 and use C15, C18, C27 and C31 as necessary tune the filters as shown in Fig. 5-2-19. The 3 dB points should give a bandwidth of  $180 \pm 40$  kHz. After adjusting the response, replace the receiver tray lid and check that the response is now as shown in Fig. 5-2-18.

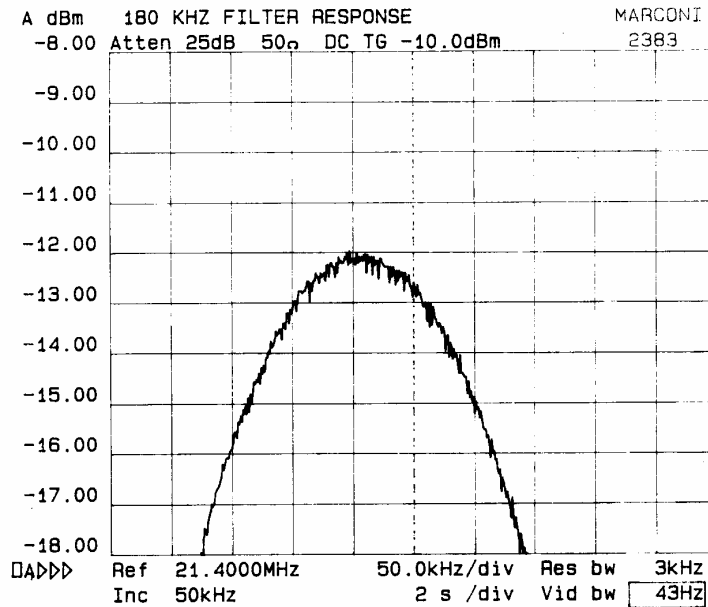


Fig. 5-2-19 Response of 20 dB IF 180 kHz band-pass amplifier (lid removed)

**AGC and 38 dB amplifiers**

Test equipment: Spectrum analyzer, RF signal generator, digital voltmeter, DVM probe, leads A, B and D to RX1 – lead A with an SMC plug (male) and an SMC socket (female), lead B with an SMC socket (female) and with a connector to the spectrum analyzer (tracking generator output), lead D with an SMA plug (male) and with a connector to the RF signal generator (RF out).

41. Proceed as follows:-

- (1) Using lead A, connect its SMC plug to the free end of the pipe to SKB on RX2 and connect its SMC socket to PLB on RX1. See Fig. 5-2-20.
- (2) Using lead B, connect its SMC socket to PLC on RX1 and connect its other end to the spectrum analyzer (RF input).
- (3) Using lead D, connect its SMA plug to SKA on RX1 and connect its other end to the RF signal generator (RF out).
- (4) Connect the DVM to C6 on RX1. C6 is connected to PLA pin 14 on RX11 (yellow wire). Earth the probe on the wall of the tray.

ADJUSTMENT AND CALIBRATION

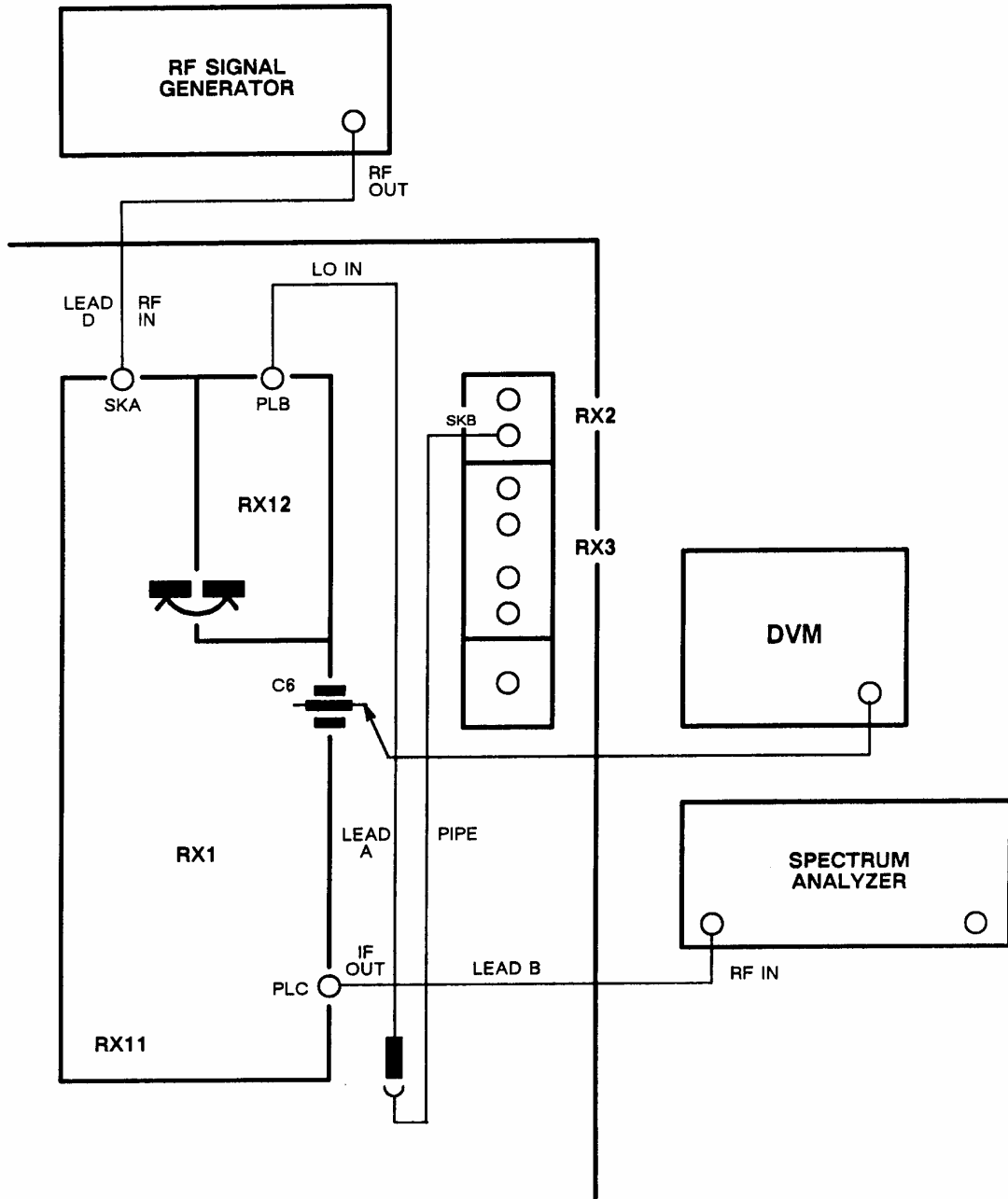


Fig. 5-2-20 Connections for AGC and 38 dB amplifiers

- (5) Set the signal generator to a carrier frequency of 321.4 MHz and a level of -55 dBm.
- (6) On the 2955R, set the MODE to TRANSMITTER MONITOR, the TX FREQUENCY to 321.4 MHz, and the IF FILTER to 12 kHz.
- (7) Use the DVM (on DC) to check the AGC output (with respect to ground) at RX1 C6. On RX11, adjust R87, L16 and L19 for a maximum level. The level should be 3.2 to 4.5 V. If the level is less than 3.2 V, adjust R59 to reduce the IF output level. On the spectrum analyzer, check that the IF output level is not less than -2 dBm. If this is not possible, change the SIC resistor R63 to 300 k $\Omega$ .
- (8) On the spectrum analyzer, check the IF output level. Adjust R59 to give 0 dBm  $\pm$ 1 dB.

### Signal strength meter (internal software)

Test equipment: RF signal generator, lead with BNC male and N male connectors.

42. There are calibration factors for frequency and for level in the instrument's non-volatile memory (EAROM). This procedure consists of twenty stages in which these factors are corrected as necessary. To ensure accuracy, all inner and outer covers should be fitted. Remember to allow a warm-up of 30 minutes.

43. This procedure should take approximately 10 minutes. Instructions appear on the display to set frequencies and levels (PD) on the signal generator and to enter calibration data. An incorrect entry could result in the message TOO MANY ITERATIONS appearing. If this appears or if an error is suspected, abort the procedure and start again. Proceed as follows:-

- (1) Set the signal generator to a carrier frequency of 300.01 MHz and an RF level of 800  $\mu$ V PD.
- (2) Connect the signal generator output to the RF IN/OUT BNC socket.
- (3) In the TRANSMITTER MONITOR mode, select the CALIBRATION MODE display by pressing in turn the HELP, TX MON ON-OFF, AC DC, VERT  $\blacklozenge$ , FREQ  $\downarrow$  and REP SWEEP keys.
- (4) Press the CALIBRATE soft key. The STAGE 1 display appears. The appropriate instructions are given in the lower part of the display. See Table 5-2-7. IN STAGE 1, to ensure that the temperature is stable, check that the TEMPERATURE ADC does not change.
- (5) For each subsequent stage, press the CONTINUE soft key. When it is necessary to enter calibration data, the title of the ENTER soft key flashes. Enter new data using the DATA keypad. This data appears alongside the instruction. Press the ENTER soft key which changes to CONTINUE. In STAGE 2, the required data is 3.5. In STAGE 11, the required data is -0.162.
- (6) After stage 20 or to abort at any time, press the EXIT soft key.

TABLE 5-2-7 SIGNAL STRENGTH METER CALIBRATION

STAGE	Typical SIGNAL STRENGTH ADC	RANGE	Instruction
1	046	0	ENSURE TEMPERATURE IS STABLE THEN CONTINUE
2	046	0	ENTER LIFT FACTOR LO LIFT:- (LO output is 0 dBm at 100 kHz and entered dBm at 1000 MHz, normally 3.5)
3	046	0	CONNECT SIG GEN TO BNC AND SET FREQ TO 300.01 MHz
4	170	1	ADJUST LEVEL TO GET RANGE 1 AND STRENGTH $170 \pm 2$
5	170	1	NOW ENTER SIG GEN LEVEL LEVEL:-
6	104	1	NOW SET SIG GEN LEVEL TO 'stage 5 entered level $\div 8$ ' WAIT FOR READING TO SETTLE
7	242	1	NOW SET SIG GEN LEVEL TO 'stage 5 entered level $\times 20$ ' WAIT FOR READING TO SETTLE
8	180	0	NOW SET SIG GEN LEVEL TO 'stage 5 entered level $\div 40$ ' WAIT FOR READING TO SETTLE
9	222	2	NOW SET SIG GEN LEVEL TO 'stage 5 entered level $\times 30$ ' WAIT FOR READING TO SETTLE
10	222	2	POKING CALIBRATION DATA . . . . COMPLETE
11	222	2	ENTER TEMP CAL FACTOR TEMP FACTOR:- (Normally -0.162)
12	130	1	NOW SET SIG GEN FREQ TO 100 kHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE
13	134	1	NOW SET SIG GEN FREQ TO 300 kHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE
14	135	1	NOW SET SIG GEN FREQ TO 1.01 MHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE
15	135	1	NOW SET SIG GEN FREQ TO 3.01 MHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE
16	136	1	NOW SET SIG GEN FREQ TO 10.01 MHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE
17	132	1	NOW SET SIG GEN FREQ TO 30.01 MHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE

continued...

TABLE 5-2-7 SIGNAL STRENGTH METER CALIBRATION (contd.)

STAGE	Typical SIGNAL STRENGTH ADC	RANGE	Instruction
18	134	1	NOW SET SIG GEN FREQ TO 100.01 MHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE
19	132	1	NOW SET SIG GEN FREQ TO 300.01 MHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE
20	132	1	NOW SET SIG GEN FREQ TO 999.99 MHz AND LEVEL TO 300 $\mu$ V WAIT FOR READING TO SETTLE

**ADJUSTMENT AND CALIBRATION**

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**Chapter 5-3**  
**FAULT DIAGNOSIS**  
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24	AR4 - DC filter
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26	RX11 - Receiver board
26	0/10 dB attenuator
28	20 dB RF amplifier and LO input
29	Mixer
30	20 dB IF 180 kHz band-pass amplifier
31	12 kHz band-pass filter
33	0/32 dB amplifier
35	AGC amplifier
36	38 dB amplifier
38	Temperature sensor
39	Bypass switch driver
40	Local oscillator switch driver
41	Output buffer
42	LO driver 21.4 MHz notch filter switch driver
43	RX12 - Local oscillator driver board
43	21.4 MHz notch filter
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**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.

**FUSE REPLACEMENT**

5. Three cartridge-type fuses are located on the rear panel. For fuse ratings, see under 'Power requirements' in the Operating Manual.

**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  $\Omega$  range on the AVO 8 or the SEI Selectest Super 50.

**BOARD TESTING**

7. 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. 7-3 and 7-4.

8. Proceed as follows:-

### Preliminary

- (1) Connect the signal generator set to 13.6 MHz, 0 dBm (224 mV RMS) to the BNC RF IN/OUT socket. Select TX mode to set the frequency to 13.6 MHz.

### Checking regulators

- (2) Check that the -9 V output from IC5 pin 1 and the +5 V output from IC7 pin 3 are within  $\pm 0.5$  V of the stated voltage.

### Checking PLL

- (3) Connect the oscilloscope to the 10 MHz input at PLB and check for 10 MHz at TTL levels. Transfer to TR1 emitter and check for a 10 MHz sinewave at 200 mV pk-pk. This checks the 10 MHz filter.
- (4) Check the junction of C6/C7/L2 for a sinewave of 3.71 MHz at 1.5 V pk-pk. This checks the mixer operation.
- (5) Check the junction of L3/C9/R17 for a 3.71 MHz pure sinewave of 0.75 V pk-pk. This checks the operation of the 4.4 MHz LP filter. If the amplitude is low, the mixer will have to be adjusted (see 'Mixer 10 MHz rejection' below) before proceeding.
- (6) Connect to TR3 collector (can) and check for a 0 to 5 V squarewave. This checks the squaring amplifier.
- (7) Connect the oscilloscope (or counter) to IC1 pin 12 and check that its frequency is  $\frac{1}{16}$ th that on pin 1 (10 MHz). This checks the frequency divider.
- (8) 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.

- (9) Transfer the oscilloscope to the junction of R41/C28/R42. Set the frequency to 11.4 MHz and check that the DC level is +2 V. Set the frequency to 13.6 MHz and check that the level changes to -7 V. This checks the PLL filter formed by IC4.
- (10) Reset the frequency to 13.6 MHz. Connect to TR6 collector (can) and check for a square wave of 3.6 V pk-pk at 13.71 MHz. This checks the VCO and squaring amplifier.

### Setting up mixer

- (11) Set the signal generator to 55.6 MHz and select AUTO TUNE on the 2955A. Connect the oscilloscope to the IF OUTPUT at PLC. Adjust R11 for minimum distortion (i.e. cleanest sinewave).

### Checking 20 dB pad

- (12) Reset the signal generator to 13.6 MHz. Check the RF INPUT at the junction of R57/R58 for 316 mV pk-pk. Transfer to the junction of R57/R59 and check for 31 mV pk-pk.

### Checking selection logic

- (13) 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 TTL levels.
- (14) Transfer to TR14 collector and check for 0 V.
- (15) Set the frequency 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 TTL levels.
- (16) Transfer to TR14 collector and check for -9 V.

### Checking mixer and output

- (17) Reset the frequency to 13.6 MHz. Connect the oscilloscope to TR8 collector and check for a good square wave from the Schmitt trigger.
- (18) 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 LP filter.
- (19) Check the IF OUTPUT at PLC and the MONITOR OUTPUT at PLE for a 110 kHz sinewave at 2.8 V pk-pk. This checks the operation of the VCO amplifier and the IF monitor respectively.

## AA2 – RF COUNTER

Test equipment : Signal generator, oscilloscope.

Circuit diagram: Chap. 7, Fig. 7-5.

9. Proceed as follows:-

### Preliminary

- (1) Connect the signal generator set to 10 MHz, 0 dBm (224 mV RMS) to the BNC RF IN/OUT socket. Select TX mode to set the frequency to 10 MHz.

### Checking signal input path

- (2) Connect the oscilloscope to the SIGNAL INPUT at R6 and display the sine wave. Increase the signal generator output level to 11 dBm and check that the displayed level drops by 9 dB. This checks the 20 dB pad and switching.
- (3) 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.
- (4) Check the junction of C16/R17/C17 for a square wave of 1 V pk-pk. This checks the Schmitt trigger.
- (5) Check IC7 pin 14 for 10 MHz at ECL levels. Change the signal generator frequency to 210 MHz and check for  $f_{in}/4$ . This checks the operation of the prescaler and bypass switching.

### BCD counters

- (6) 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).
- (7) Check IC5 pin 14 for  $f_{in}/10$  at TTL levels. Change the signal generator frequency to 210 MHz and check for  $f_{in}/40$ . This checks the level shifter and first BCD counter.
- (8) Check TP2 for  $f_{in}/80$ . Change the signal generator frequency to 10 MHz and check for  $f_{in}/20$ . This checks the second BCD counter.

### 7-element counter

- (9) 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.
- (10) Transfer to TP1 and check for a square wave of 3.8  $\mu$ s period. Change the signal generator frequency to 10 MHz and check that the square wave changes to a 20  $\mu$ s period.
- (11) 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. 7-6 and 7-7.

10. Proceed as follows:-

### Checking regulators

- (1) Check that the -9 V line at TP4 and the +9 V line at TP5 are within  $\pm 0.5$  V of the stated voltage.

### Checking oscillator switching

- (2) Select RX mode and set the frequency to 500 MHz. Check that the AA0/1 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.
- (3) 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.
- (4) 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

- (5) 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.
- (6) Set the 2955A 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

- (7) Set the frequency to 200 MHz. Check that the AA0/1 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.
- (8) 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.
- (9) 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

- (10) Connect the spectrum analyser to the output from C96.
- (11) Set the frequency to 165 MHz. Check that the pass band is flat within  $\pm 5$  dB up to 259 MHz. Check that all harmonics are at least 36 dB down. This checks the 265 MHz LP filter.
- (12) Change the frequency to 260 MHz. Check that the pass band is flat within  $\pm 5$  dB up to 399 MHz. Check that all harmonics are at least 32 dB down. This checks the 410 MHz LP filter.
- (13) Change the frequency to 400 MHz. Check that the pass band is flat within  $\pm 5$  dB up to 529 MHz. Check that all harmonics are at least 30 dB down. This checks the 560 MHz LP filter.
- (14) Change the frequency to 530 MHz. Check that the pass band flatness from 520 to 629 MHz is within  $\pm 6$  dB. Check that all harmonics and sub-harmonics are at least 34 dB down. This checks the 520 MHz HP and 630 MHz LP filters.
- (15) Change the frequency to 630 MHz. Check that the pass band flatness from 630 to 799 MHz is within  $\pm 6$  dB. Check that all harmonics and sub-harmonics are at least 34 dB down. This checks the 520 MHz HP and 820 MHz LP filters.
- (16) Change the frequency to 800 MHz. Check that the pass band flatness from 800 to 1000 MHz is within  $\pm 6$  dB. Check that all harmonics are at least 15 dB down and that all sub-harmonics are at least 32 dB down.

### Checking output amplifier

- (17) Remove the coupler between boards AA3 and AA4/1. 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

- (18) Set the 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.
- (19) Set the 2955A to 165, 259, 260, 399, 400, 529 MHz in turn and check at TP3 for these frequencies divided by 100.
- (20) Check TP3 for oscillator frequency divided by 100 (i.e. 1.65 to 5.3 MHz) at CMOS levels.
- (21) Check TP1 for 40 to 60 Hz negative-going pulses. Transfer to TP2 and check for 4 to 6 kHz square waves.

### Checking FIFOs

- (22) Check for a positive 1.4 ms program enable pulse from IC103 pin 10.
- (23) 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.
- (24) Set the 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 LF mod amplifier

- (25) The LF mod. amplifier is checked and, if necessary, adjusted using the method given in 'Low frequency external FM' below.

### Checking phase locking

- (26) Check IC106 pin 22 for a 10 MHz input, and pin 26 for a 5 kHz output. This checks the internal divider.
- (27) Set the frequency to 200 MHz and check that LED D106 is unlit. Increment the frequency to 210 MHz while observing the LED. Check that the LED flashes then goes out again. This checks phase lock operation with the 165 to 260 MHz oscillator.
- (28) 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

- (29) Check for +22 V on IC107 pin 7.
- (30) Set the 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.



## AA4/1 – LF SYNTHESIZER AND OUTPUT AMP

Test equipment : Oscilloscope, frequency counter, spectrum analyzer.

Circuit diagram: Chap. 7, Figs. 7-8 and 7-9.

11. Proceed as follows:-

### Checking switching

- (1) Select RX mode and set the frequency to 50 MHz and check that the AA0/1 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 (TTL levels). This checks the 0.4 to 88 MHz range.
- (2) 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.
- (3) 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

- (4) Connect the counter to IC11 pin 5 and check that its frequency is  $\frac{1}{2}$  that of the 10 MHz on pin 3. Connect to IC10 pin 4 and check that its frequency is  $\frac{1}{20}$  that of the 200 MHz on pin 8. Transfer to IC11 pin 9 and check that its frequency is  $\frac{1}{2}$  that of the 10 MHz on pin 11.

### Checking 200 MHz oscillator

- (5) Set the frequency to 20 MHz and check that TR6 is switched on (-12 V on the collector).
- (6) 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

- (7) 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

- (8) 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

- (9) Change the frequency to 100 MHz. Connect the counter to IC2 pin 6 and check that its frequency is  $\frac{1}{2}$  that of the 200 MHz on pin 1.

### Checking filter operation

- (10) Set the frequency to 1000 MHz and the output level to +5 dBm. Check that the ALC 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.
- (11) Change the frequency to 164 MHz and check that the ALC voltage on TP2 from 88 to 164 MHz is within 0 to 3 V. Check that all harmonics are at least 30 dB down.
- (12) Change the frequency to 87 MHz and check that the ALC voltage on TP2 from 0.4 to 87 MHz is within 0 to 3 V. Check that all harmonics and spurious are at least 25 dB down.

### Checking ALC operation

- (13) Check TP2 for an ALC voltage ranging from +0.25 to +3 V (normally, well below +2 V over all ranges with +5 dBm/-15 dBm selected).

### Checking output amplifier and attenuator

- (14) Set the to 10 MHz and -45 dBm.
- (15) Check that the level at IC8 pin 9 (1.2 V pk-pk) is 30 to 40 times the measurement at the junction of C3/R5/D7 and 100 times the measurement at the junction of R9/D11.
- (16) Check that the level at the junction of R46/C66 is  $\frac{1}{2}$  that at IC8 pin 9.
- (17) Check that the level at the board output is  $\frac{1}{3}$  that at the junction of R46/C66 (i.e. 10 dB lower).
- (18) Select -35 dBm and check that the output level is 3.3 times greater (i.e. 10 dB higher).

## AB1/1 – MOTHERBOARD

Test equipment : Oscilloscope, power source, signal generator.

Circuit diagram: Chap. 7, Figs. 7-10 and 7-11.

12. Proceed as follows:-

### Checking audio amplifier

- (1) Select RX mode and press AF GEN to enter AUDIO TEST. Set the AF 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

- (2) Turn the VOLUME control to minimum. Connect a 12 k $\Omega$  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

- (3) 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

- (4) Bistable IC14 – and selector IC11 – operation may be checked as follows:-

#### LF RANGE logic

- (5) Set the frequency to 50 MHz and check that the AA0 LF RANGE inputs at feedthrough capacitors C37 and C36 are both high (TTL 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

- (6) With the frequency at 200 MHz, check that the AA0/1 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

- (7) Set the frequency to 500 MHz and check that the AA0/1 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

- (8) Bistable IC15 – and selector IC11 – operation may be checked as follows:-

#### D0–D3 data

- (9) Continuously change the frequency using the VARIABLE control while checking for 'random' data (negative-going pulses) on the AA0/1 D0 to D3 outputs at feedthrough capacitors C49,C51,C52,C53.

#### Shift In clocking

- (10) Continuously change the frequency using the VARIABLE control while checking for a train of seven +9 V pulses, each of 75  $\mu$ s duration on the AA0/1 SI(1) input at feedthrough capacitor C54. Check that this train is followed by a similar pulse train on the AA0/1 SI(2) output at C56.

#### ENABLE pulse

- (11) Continuously change the frequency using the VARIABLE control while checking for a +9 V 450  $\mu$ s pulse on the AA0/1 SYNTH ENABLE output at feedthrough capacitor C55.

#### 0–10 dB selection

- (12) Set the level to –36 dBm and check that the AA0/1 0–10 dB output at feedthrough capacitor C35 is high. Change the level to –46 dBm and check that C35 is low.

### Checking bistable IC9 operation

- (13) Bistable IC9 – and selector IC11 – operation may be checked as follows:-

#### SYNTH EN pulse

- (14) 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 AA0/1 SYNTH ENABLE output at feedthrough capacitor C6.

#### HIGH/LOW logic

- (15) Set the frequency to 13.6 MHz and check that the AA0/1 HIGH/LOW output at feedthrough capacitor C1 is low. Change frequency to 14 MHz and check that C1 is high.

#### PRESCALER logic

- (16) Connect the signal generator set to 10 MHz, +5 dBm to the BNC RF IN/OUT socket. Select TX mode. Check that the AA0/1 –4/–1 output at feedthrough capacitor C14 is high. Change the generator frequency to 300 MHz and check that C14 is low.

#### 20 dB logic

- (17) With the signal generator at 0 dBm, check that the AA0/1 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

- (18) Check on the AA0/1 ENABLE COUNTER output at feedthrough capacitor C15 for a low 5 ms pulse followed by a high period of fixed duration.
- (19) 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.
- (20) 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

- (21) 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 negative-going 40  $\mu$ s pulses. This checks the operation of ICs 1 to 4.

### Checking DTMF decoder

- (22) Access the DTMF screen via 'AUDIO TEST' and 'TONES' menus. Connect the AF GEN OUT socket to the AF IN socket. Load up a number sequence and check it is received correctly. During reception IC19 pins 10 and 15 should change, and the received sequence should be audible from the loudspeaker.

## AB2/2 – DIGITAL SCOPE

Test equipment : Oscilloscope.

Circuit diagram: Chap. 7, Figs. 7-12 and 7-13.

13. Proceed as follows:-

### Checking trigger pulse generation

- (1) Select RX mode and press the AF GEN and SCOPE keys. Set the AF generator to 20 Hz and connect the AF GEN OUTPUT socket to the AF INPUT socket. Press the REP SWEEP key.
- (2) Connect the oscilloscope to IC34 pin 13 and check for a 20 Hz square wave. This checks IC48b.
- (3) 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.
- (4) 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.
- (5) 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.
- (6) 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.
- (7) 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.
- (8) Check that IC27 pin 12 and IC27 pin 3 are both high. This checks that the timing generator has halted.
- (9) 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

- (10) The voltage reference for the A-D converter is checked and, if necessary adjusted, using the method given in 'A-D converter calibration' below.
- (11) Check TP1 for a 0.5  $\mu$ s positive pulse at a 400 kHz rate.
- (12) Vary the vertical shift while checking that the output from latch IC2 changes (TTL levels).

### Checking timing generator

- (13) Check the operation of the timing generator by reference to the timing diagram shown in Fig. 5-3-1.

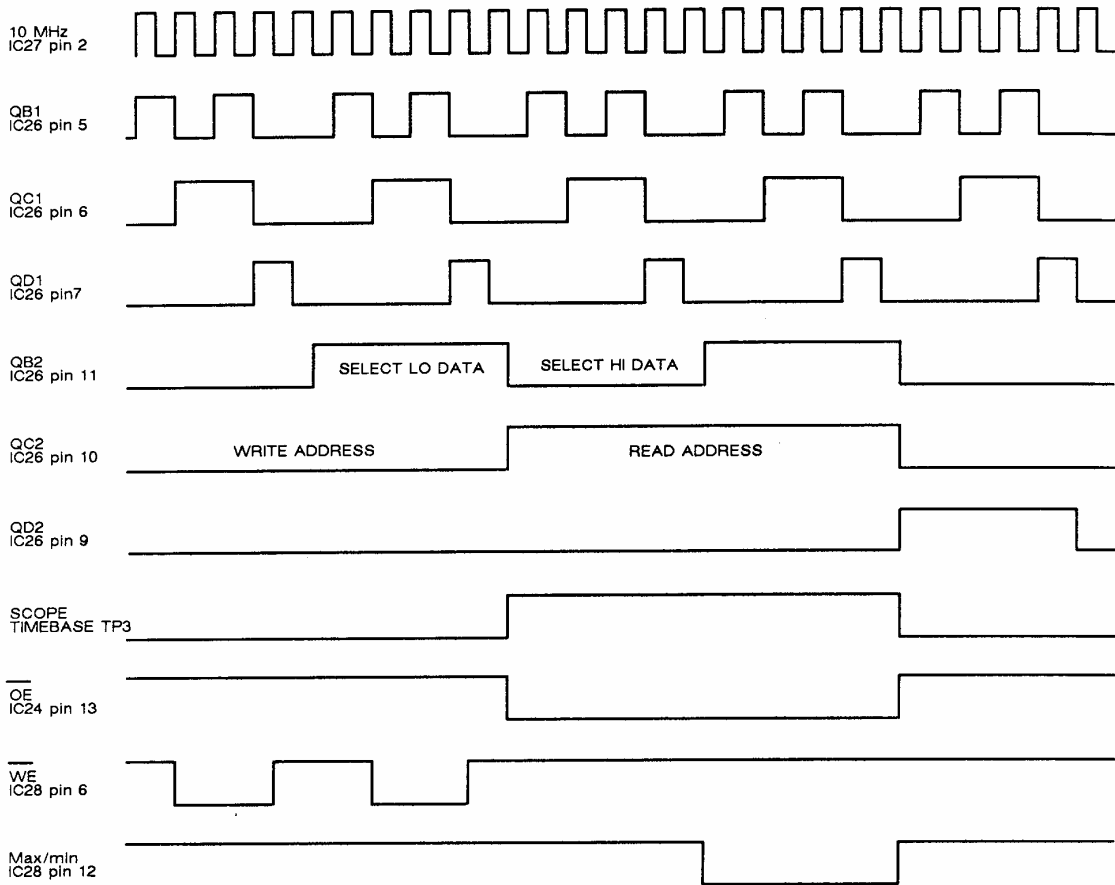


Fig. 5-3-1 Timing generator timing waveform diagram for board AB2/2

### Checking read address reset

- (14) 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

- (15) With an input connected to the AF INPUT socket, check the operation of decoder IC48a by reference to the timing diagram shown in Fig. 5-3-2.
- (16) Set the input to 10 kHz and select a slow timebase. 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  $\mu$ s.

(17) Vary the amplitude of the input and check that the duration of the low period increases and decreases with amplitude.

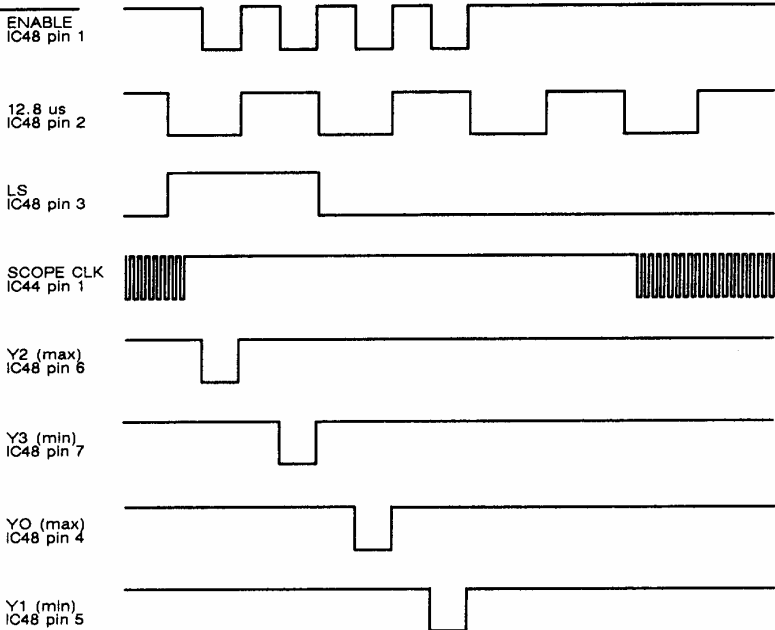


Fig. 5-3-2 Display counters timing waveform diagram for board AB2/2



## AB3/2 – VDU BOARD

Test equipment : Oscilloscope.

Circuit diagram: Chap. 7, Figs. 7-14 and 7-15.

14. Proceed as follows:-

- (1) Select RX mode and press the AF GEN and SCOPE keys. Set the AF generator to 1 kHz and connect the AF GEN OUTPUT socket to the AF INPUT socket. Press the REP SWEEP key.

### Checking rows counters

- (2) Check the operation of the rows counters and associated circuits by reference to the timing diagram shown in Fig. 5-3-3.

### Checking columns counters

- (3) Check the operation of the columns counters and associated circuits by reference to the timing diagram shown in Fig. 5-3-4.

### Checking frame sync

- (4) Connect the oscilloscope to TP2 FRAME SYNC. With SCOPE selected, check for a 450  $\mu$ s positive pulse in a frame sync period of 18.95 ms.
- (5) Press the BAR CHART key and check that the period increases by 32  $\mu$ s.
- (6) 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

- (7) Check on the SCOPE CLK line at IC49 pin 3 for a 26  $\mu$ s train of 10 MHz pulses in a period of 64  $\mu$ s.

### Checking scope trigger

- (8) 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 TTL square waves.

FAULT DIAGNOSIS

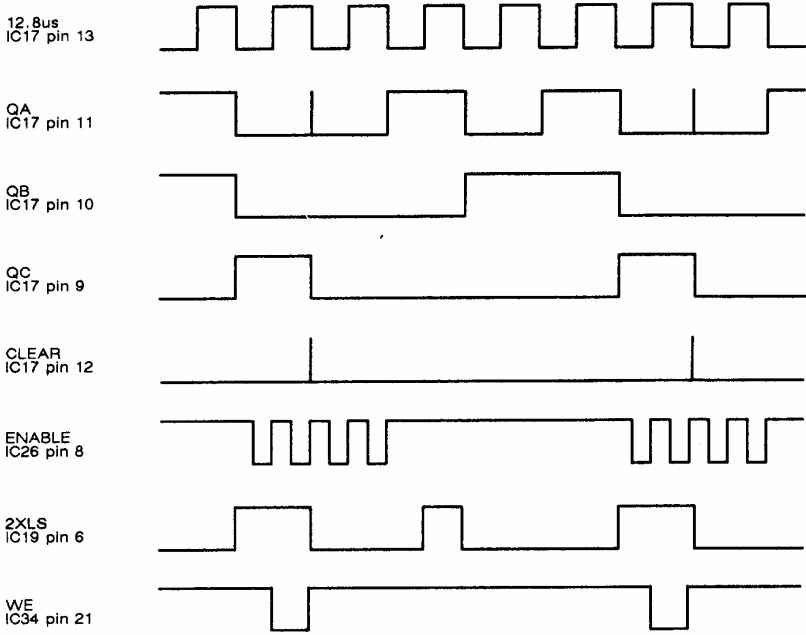


Fig. 5-3-3 Rows counters timing waveform diagram for AB3/2

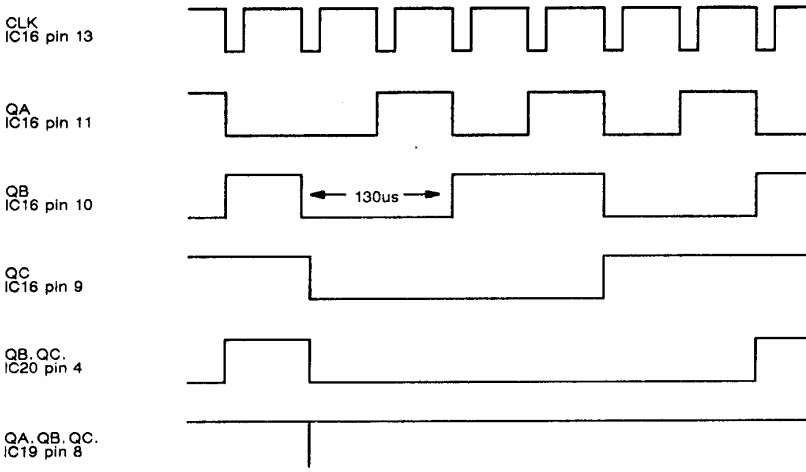


Fig. 5-3-4 Columns counters timing waveform diagram for AB3/2

## BOARD AB4/1 – Microprocessor

Test equipment: Oscilloscope, signal generator, frequency counter.

Circuit diagram: Chap. 7, Figs. 7-16, 7-17 and 7-18.

15. Proceed as follows:-

### Checking VARIABLE operation

- (1) 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.
- (2) Check that IC1 pin 5 (SID) is high when the VARIABLE control is turned clockwise, and low when it is turned anti-clockwise. This checks IC29.
- (3) Check that IC1 pin 4 (SOD) is high and that square waves are present on IC1 pin 6 when the VARIABLE control is turned.
- (4) Press the TONES key then select CONTINUOUS from the RX SEQUENTIAL TONE menu. Check that IC1 pin 4 is low and that IC1 pin 6 does not respond to movement of the VARIABLE control.

### Checking keyboard interrupt

- (5) 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 negative-going 40  $\mu$ s pulses.
- (6) 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

- (7) Select RX then press the AF GEN and SCOPE keys. Set the AF generator to 1 kHz and connect the AF GEN OUTPUT socket to the AF INPUT socket.
- (8) Connect an oscilloscope to IC3 pin 12 and check for a V REF of +5.0 V. This checks regulator IC35.
- (9) Check IC37 pin 11 for a 500 kHz squarewave. Transfer to IC3 pin 10 and check for a 250 kHz clock.
- (10) Connect the oscilloscope to IC18 pin 4 and display the negative-going write and read pulses of 50  $\mu$ s separation on channel one.
- (11) Connect the oscilloscope channel two to OE IC3 pin 9. Check for a positive pulse coincident with the write (first) pulse on channel one.
- (12) Transfer to ALE IC3 pin 22 and check for a positive pulse coincident with the read (second) pulse on channel one.

- (13) 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 RMS converter IC32.
- (14) Connect the signal generator modulated by 5 kHz FM to the N-type input socket. Select TX and the N-type socket.
- (15) 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.
- (16) Check that when the horizontal POSITION control is adjusted, the voltage on the HORIZ SHIFT input to IC3 pin 1 alters accordingly.

### Checking bistable IC19

- (17) Press the front panel keys and check each time for a 13  $\mu$ s negative-going pulse on the KEYBOARD LATCH RESET line to IC19 pin 15.
- (18) Reselect SCOPE. Press the SINGLE SWEEP key and check for an 8  $\mu$ s negative-going pulse on the SS/RST line at IC19 pin 9. Press the REP SWEEP key and check for a similar pulse on IC19 pin 12.
- (19) Connect the oscilloscope to IC19 pin 6. Switch off then back on while checking for a negative-going pulse (note that this may be difficult to detect) on pin 7.
- (20) The remaining outputs are checked under the programmable divider heading.

### Checking RMS converter timer

- (21) Check on the RMS TIME TRIGGER input at IC36 pin 3 for negative-going 0.6  $\mu$ s pulses (the number and periods depending upon the mode selected). Transfer to IC36 pin 6 and check for the generation of 65 ms negative-going pulses.

### Checking audio counter

- (22) Select BAR CHART. With 1 kHz connected to the AF INPUT socket, check for a 1 kHz squarewave at IC24 pin 13.
- (23) Decrease frequency and check that at about 800 Hz, IC21 pin 9 goes low and that fin 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.
- (24) Increase frequency until at about 1 kHz, IC21 pin 9 goes high. Check that fin/10 is present on IC22 pin 6 and that IC21 pin 5 is still high.
- (25) 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

- (26) Select TX and connect a signal generator to the RF INPUT socket.
- (27) Check at TP15 for a 100  $\mu$ s period square wave.
- (28) Transfer to the RF COUNTER GATE output at IC4 pin 2 and check for a positive 6 ms pulse followed by a low period.
- (29) 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).
- (30) 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

- (31) Select RX mode and press the AF GEN and SCOPE keys. Set the AF generator to 100 Hz and connect the AF GEN OUTPUT socket to the AF INPUT socket. Press the REP SWEEP key.
- (32) Check that IC19 pin 5 is held high.
- (33) Alternately press the BAR CHART and SCOPE keys. Check for a 500  $\mu$ s negative-going pulse each time the SCOPE key is pressed.
- (34) Check for similar pulses whenever the HORIZ keys are pressed.
- (35) Transfer to IC34 pin 29 and check for a burst of 1  $\mu$ s positive pulses in a 2.5  $\mu$ s period.
- (36) Select the fastest timebase (100  $\mu$ s) and check that the duration of the burst is 1.25 ms.
- (37) 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.
- (38) Transfer to the SCOPE TIMEBASE output at IC4 pin 37. Select the fastest timebase (100  $\mu$ s) and check that pin 37 is held low.
- (39) Select a 1 ms timebase and check for a 2.5  $\mu$ s negative-going pulse in a 25  $\mu$ s period.
- (40) Check that the period increases linearly with timebase setting, e.g. with a 10 ms oscilloscope timebase selected, a negative-going 2.5  $\mu$ s pulse appears in a 250  $\mu$ s period.

### Tones timer

- (41) Select RX mode and press TONES. Select CCIR from the TONES STANDARD menu and enter a tone number.
- (42) Select TONE BURST and check on IC4 pin 3 for a negative-going 0.1 ms pulse in a 100 ms period.

- (43) 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.
- (44) Repeat the preceding step for EEA (or EIA) and check that the period has changed to 40 ms (or 33ms).

**Delay generation**

- (45) Select SCOPE and check on the 2XLS input line at IC4 pin 30 for clock pulses of varying width occurring every 32  $\mu$ s.
- (46) Check on the FS input at IC4 pin 35 for a 450  $\mu$ s pulse in a period of 18.95  $\mu$ s.
- (47) Transfer to the DELAY output at IC4 pin 38 and trigger from IC4 pin 35. Set the horizontal POSITION control fully anti-clockwise 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**

- (48) Check that TP4 is low. Check that TR4 is on (0 V at the collector).
- (49) Repeatedly switch off to simulate LOW VOLTS, then back on. Check that immediately after switching off, TR4 switches off (+5.6 V on the collector) and that TR3 switches on.

**Checking decoder IC8**

- (50) Select RX. Repeatedly change the signal generator frequency using the VARIABLE control, and check each time for negative-going double pulses on AB1/1 SKC 10b. Check that pulse duration is 0.6  $\mu$ s and separation is 13  $\mu$ s.
- (51) Select TX. Repeatedly change the AF generator frequency using the VARIABLE control, and check each time for negative-going triple pulses on AB1/1 SKC 13a. Check that pulse duration is 0.6  $\mu$ s and separations are 56  $\mu$ s and 24  $\mu$ s.
- (52) Check for negative-going triple pulses on AB1/1 SKC 1b. Check that pulse duration is 0.6  $\mu$ s and separations are 6.8  $\mu$ s and 6.4  $\mu$ s.
- (53) Check for single 0.6  $\mu$ s pulses on AB1/1 SKC 13b.
- (54) Check for single 0.6  $\mu$ s pulses on PLJ 3b.

**Notes...**

- (1) For maintenance purposes, the memory map for the instrument is given in Fig. 5-3-5.
- (2) When replacing EPROMs, note that they are marked A and B and are inserted in the sockets for IC10 and IC9 respectively.

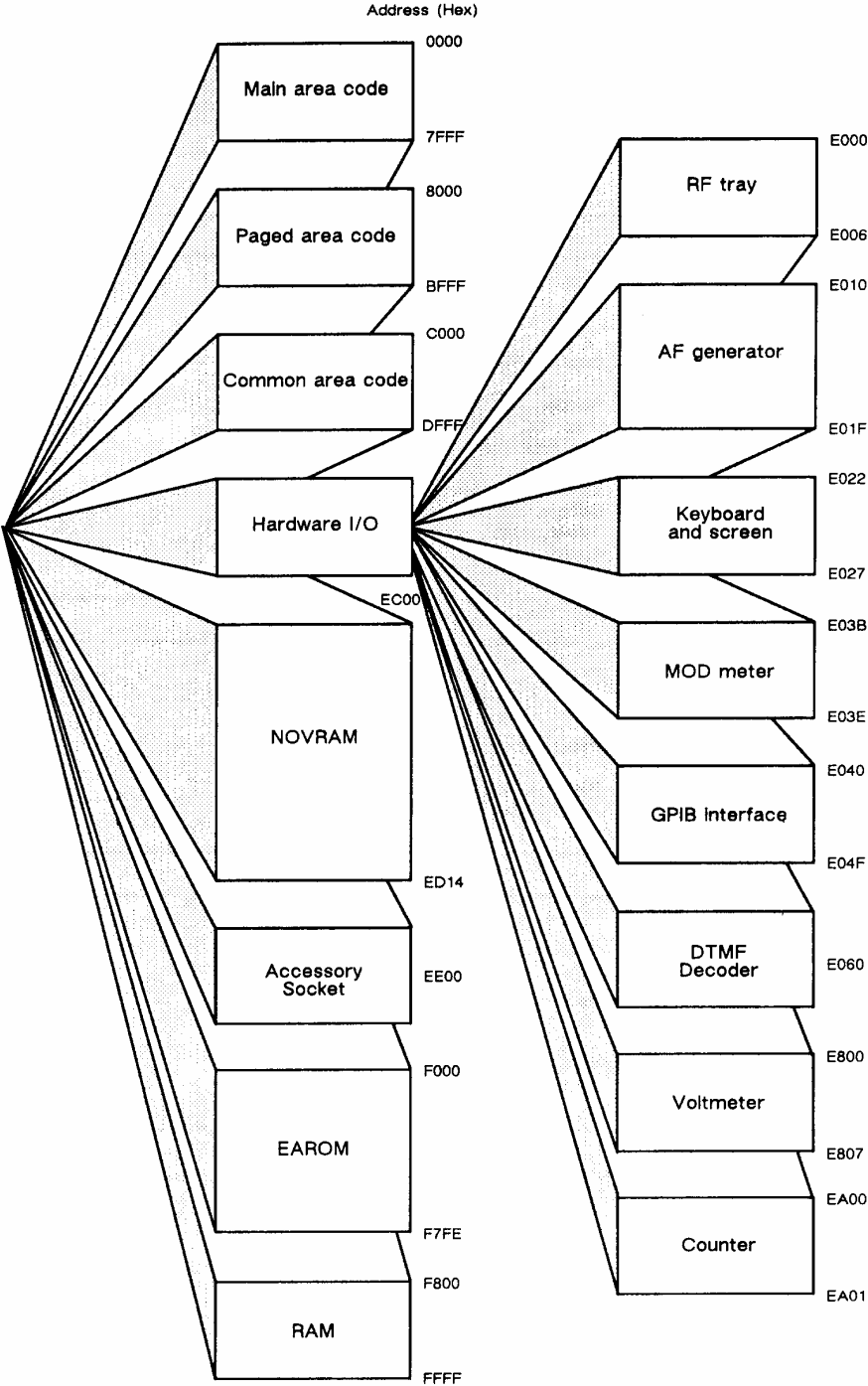


Fig. 5-3-5 2955A Memory map

## FAULT DIAGNOSIS

### Memory Map

Address (HEX)	Address (DEC)	Description
0000 - 7FFF	00064 - 32767	Main area code
8000 - BFFF	32768 - 49151	Paged area code
C000 - DFFF	49152 - 57343	Common area code
E000 - EBFF	57344 - 60415	Hardware I/O
EC00 - EDFF	60416 - 60927	NOVRAM
EE00	60928	Accessory socket
F000 - F7FF	61440 - 63487	EAROM
F800 - FFFF	63488 - 65535	RAM

### Main area code

Address (HEX)	Address (DEC)	Description
0000	0000	Hardware RESET vector
0010	0016	Jump table error vector
0024	0036	VARIABLE interrupt vector
002C	0044	GPiB interrupt vector
0034	0052	Keyboard interrupt vector
0038	0056	Software RESET vector
003C	0060	Tones, DTMF and data interrupt vector
0040 - 7FFF	0064 - 32767	Code

### Paged area code

Address (HEX)	Address (DEC)	Description
8000 - BEFF	32768 - 48895	Pages 0,1,2,3 or 4
BF00 - BFFF	48896 - 49151	Jump table for calls to paged areas

### Common area code

Address (HEX)	Address (DEC)	Description
C000 - C7FF	49152 - 51199	Jump table for calls to main area
C800 - CFFF	51200 - 53247	Numbers, terminators and messages
D000 - DFFF	53248 - 57343	Text strings

### Hardware I/O

Address (HEX)	Address (DEC)	Description
E000 - E006	57344 - 57350	RF tray
E010 - E01F	57360 - 57375	AF generator
E022 - E027	57378 - 57383	Keyboard and screen
E038 - E03E	57403 - 57406	MOD meter
E040 - E04F	57408 - 57423	GPiB interface
E060	57440	DTMF decoder
E800 - E807	59392 - 59399	Voltmeter
EA00 - EA01	59904 - 59905	Counter



FAULT DIAGNOSIS

NOVRAM				
-----				
Address (HEX)	Address (DEC)	Label (Length)	Description	
EC00 - EC04	60416 - 60420	RFFREQ (5)	RF GEN frequency	
EC05 - EC0B	60421 - 60427	RFLEVL (7)	RF GEN level and increment	
EC0C - EC0F	60428 - 60431	AFFRQ1 (4)	AF GEN1 frequency	
EC10 - EC13	60432 - 60435	AFFRQ2 (4)	AF GEN2 frequency	
EC14 - EC17	60436 - 60439	AFLEV1 (4)	AF1 level	
EC18 - EC1B	60440 - 60443	AFLEV2 (4)	AF2 level	
EC1C - EC1F	60444 - 60447	MDLEV1 (4)	MOD1 level	
EC20 - EC23	60448 - 60451	MDLEV2 (4)	MOD2 level	
EC24 - EC27	60452 - 60455	LINC (4)	Level increment	
EC28 - EC2C	60456 - 60460	FINC (5)	Frequency increment	
EC2D	60461	TRAMON	TX MON flag - 0 = normal, 1 = TX MON	
EC2E	60462	IFFILT	TX MON IF filter - 0 = 12 kHz, 4 = 180 kHz	
EC2F	60463	TXUNIT	TX MON STRENGTH units - 0 = $\mu$ V, 1 = dB $\mu$ V, 2 = dBm, 3 = dBR	
EC30	60464		Un-used	
EC31 - EC32	60465 - 60466	TNESTD (2)	Address of current tone standard	
EC33	60467	LEVINC (1)	Level increment type	
EC34	60468	FRQINC (1)	Frequency increment type	
EC35	60469	SEL (1)	RF input socket	
EC36	60470	ACDC (1)	AF input coupling	
EC37	60471	BARSCP (1)	Barchart/Scope	
EC38	60472	DISTR1 (1)	Distortion type	
EC39	60473	SCSSWP (1)	Scope single sweep/repeat	
EC3A	60474	SCTIM (1)	Scope timebase pointer	
EC3B	60475	SCVRAM (1)	Scope AM vertical gain pointer	
EC3C	60476	SCVRFM (1)	Scope FM vertical gain pointer	
EC3D	60477	SCVRPM (1)	Scope PM vertical gain pointer	
EC3E	60478	GENSEL (1)	AF generator selection	
EC3F	60479	GENST1 (1)	Generator type selection	
EC40	60480	GENST2 (1)	Generator attribute selection	
EC41	60481	AFON (1)	AF generator on/off	
EC42	60482	AFSTAT (1)	AF generator status	
EC43	60483	MODON (1)	Modulation on/off	
EC44	60484	CWON (1)	RF generator on/off	
EC45	60485	LVLLOK (1)	AF or MOD levels locked	
EC46	60486	MODE (1)	Main instrument mode	
EC47	60487	MODMDE (1)	Receiver MOD type	
EC48	60488	TXMODM (1)	Transmitter MOD type	
EC49	60489	NEWMOD (1)	New MOD type	
EC4A	60490	MDTUNE (1)	MOD meter tuning auto/manual	
EC4B	60491	FILTER (1)	AF filter type	
EC4C	60492	DBVFLG (1)	AF level dBV flag	
EC4D	60493	DBRFLG (1)	MOD level dBR flag	
EC4E	60494	BARHLD (1)	Barchart auto-range/hold-range	
EC4F	60495	BARNUM (1)	Current barchart selected for update	
EC50	60496	BARSEL (1)	Current barchart selected by user	
EC51	60497	TONEXT (1)	Tone number for extended tone	
EC52	60498	RFIMIJ (1)	TX MONITOR RF image lower/upper	
EC53	60499	BAND (1)	TX MONITOR frequency band	
EC54	60500	SMODE (1)	Instrument sub-mode	
EC55 - EC88	60501 - 60600	TNEDAT (100)	Sequential tones send data buffer	
ECB9 - ECBC	60601 - 60604	MDFRQS (4)	DCS MOD frequency (bit-rate)	
ECBD - ECC0	60605 - 60608	MDLVLS (4)	DCS MOD level	
ECC1	60609	GENPOL (1)	DCS generator polarity	
ECC2	60610	DECPOL (1)	DCS decoder polarity	
ECC3 - ECC4	60611 - 60612	SKOUNT (2)	DCS Decoder sample counter	
ECC5	60613	INDCS (1)	DCS showing/not-showing	
ECC6 - ECC9	60614 - 60617	AFLEVD (4)	DTMF AF level	
ECCA	60618	AFSTAD (1)	DTMF AF generator status	
ECCB - ECCE	60619 - 60622	MDLVLD (4)	DTMF MOD level	
ECCF	60623	MODMDD (1)	DTMF MOD type	
ECD0 - ECEB	60624 - 60651	SDBUFF (28)	DTMF send data buffer	
ECEC	60652	STOTAL (1)	DTMF send data buffer counter	
ECED	60653	RTOTAL (1)	DTMF receive data buffer counter	
ECEE - ECF2	60654 - 60658	RFFRQP (5)	POCSAG RF frequency	
ECF3 - ECF9	60659 - 60665	RFLVLP (7)	POCSAG RF level	
ECFA - ECFD	60666 - 60669	MDFRQP (4)	POCSAG MOD frequency (bit-rate)	
ECFE - ED01	60670 - 60673	MDLVLP (4)	POCSAG MOD level (deviation)	
ED02 - ED05	60674 - 60677	POXRIC (4)	POCSAG RIC in binary integer format	
ED06 - ED09	60678 - 60681	ERMASK (4)	POCSAG error mask	

FAULT DIAGNOSIS

NOVRAM (contd.)				
ED0A	60682	ADNUM	(1)	POCSAG address number
ED0B	60683	MESNUM	(1)	POCSAG message number
ED0C - ED0F	60684 - 60687	DCSWRD	(4)	DCS codeword
ED10 - ED14	60688 - 60692	TXFREQ	(5)	TX MOD meter frequency

EARAM				
-----				
Address (HEX)	Address (DEC)	Label	(Length)	Description
F000 - F5AF	61440 - 62895	NVSTR	(1456)	26 non-volatile stores, each of 56 bytes
F5B0 - F64B	62896 - 63051			Un-used
F64C - F64F	63052 - 63055	TXDIFF	(4)	TX MONITOR iteration difference
F650	63056	TXITER	(1)	Number of iterations for last TX MONITOR cal
F651	63057	OPTION	(1)	TX MONITOR available flag
F652 - F653	63058 - 63059	TX100K	(2)	9 TX MONITOR strength calibration factors
F654 - F655	63060 - 63061	TX300K	(2)	for frequency
F656 - F657	63062 - 63063	TX1M	(2)	
F658 - F659	63064 - 63065	TX3M	(2)	
F65A - F65B	63066 - 63067	TX10M	(2)	
F65C - F65D	63068 - 63069	TX30M	(2)	
F65E - F65F	63070 - 63071	TX100M	(2)	
F660 - F661	63072 - 63073	TX300M	(2)	
F662 - F663	63074 - 63075	TX1G	(2)	
F664 - F667	63076 - 63079	FAC1	(4)	7 TX MONITOR strength calibration factors
F668 - F66B	63080 - 63083	FAC2	(4)	for level
F66C - F66F	63084 - 63087	FAC3	(4)	
F670 - F673	63088 - 63091	FAC4	(4)	
F674 - F677	63092 - 63095	FAC5	(4)	
F678 - F67B	63096 - 63099	FAC6	(4)	
F67C - F67F	63100 - 63103	FAC7	(4)	
F680	63104	TMPFAC	(1)	TX MONITOR calibration temperature
F681 - F684	63105 - 63108	CWFAC	(4)	3 DIRECTIONAL POWER METER calibration
F685 - F688	63109 - 63112	PEPFAC	(4)	factors
F689 - F68C	63113 - 63116	PEPSQR	(4)	
F68D	63117			Un-used
F68E - F691	63118 - 63121	DEFMDL	(4)	Default MOD level
F692	63122	DEFHTP	(1)	Default MOD type
F693 - F696	63123 - 63126	RFLVOF	(4)	RF level offset
F697 - F69B	63127 - 63131	TNEEXT	(5)	Extended tone length
F69C - F6B7	63132 - 63159	RFCOR3	(28)	Low frequency band RF POWER correction
F6B8	63160	PDEM	(1)	Power reading PD/EMF
F6B9	63161	RFRES	(1)	RF counter resolution
F6BA	63162	SNADEF	(1)	Default reading
F6BB	63163	NALLOW	(1)	STORE function enable/disable
F6BC - F6BE	63164 - 63166	FCOD	(3)	SELF TEST fail codes
F6BF - F6D4	63167 - 63188	RFCOR2	(22)	6dB DUPLEX RF POWER correction
F6D5	63189			Un-used
F6D6 - F6D7	63190 - 63191	DTMFTN	(2)	Duration of DTMF tone
F6D8 - F6D9	63192 - 63193	DTMFGP	(2)	Duration of DTMF gap
F6DA	63194	DEFFIL	(1)	Default AF filter
F6DB	63195	POMODE	(1)	GPIB MODE normal/2955 emulation
F6DC - F6DE	63196 - 63198			Un-used
F6DF	63199	UKUSFL	(1)	Tone standard UK/USA
F6E0 - F6FF	63200 - 63231	TONSTD	(32)	User defined tones
F700 - F70B	63232 - 63243	BULKY	(12)	Bulk attenuator correction
F70C - F716	63244 - 63254	LAWCOR	(11)	RF level fine correction
F717 - F722	63255 - 63266	AMLAW	(12)	AM correction to RF level
F723 - F749	63267 - 63305	OS1LAW	(39)	FM correction to VCO1 frequency
F74A - F779	63306 - 63353	OS2LAW	(48)	FM correction to VCO2 frequency
F77A - F7A6	63354 - 63398	OS3LAW	(45)	FM correction to VCO3 frequency
F7A7	63399	TRMLOK	(1)	TX/RX MOD meter frequency lock
F7A8	63400	AF20DB	(1)	AF 20dB attenuator flag
F7A9	63401	OHM600	(1)	600 ohm adaptor flag
F7AA - F7FE	63402 - 63486	RFCOR	(85)	High frequency band RF POWER correction

## FAULT DIAGNOSIS

### RAM

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Address (HEX)	Address (DEC)	Description
F800 - F83F	63488 - 63551	TX TEST mode store
F840 - F87F	63552 - 63615	RX TEST mode store
F880 - F8BF	63616 - 63679	AF TEST mode store
F8C0 - F8FF	63680 - 63743	DX TEST mode store
F900 - FBFF	63744 - 64511	Common area variables
FC00 - FCFF	64512 - 64767	Main area variables
FD00 - FD7F	64768 - 64895	Keyboard buffer
FD80 - FDFF	64896 - 65023	GPIB input buffer
FE00 - FE7F	65024 - 65151	GPIB output buffer
FE80 - FF3F	65152 - 65343	Paged area variables
FF40 - FF7F	65344 - 65407	TX MONITOR mode store
FF80 - FFFF	65408 - 65535	Stack

### RF tray

-----

Address (HEX)	Address (DEC)	Label	Description
E000	57344	AA30	RF generator frequency
E001	57345	AA31	MOD meter RF path
E002	57346	RECVER	Sensitive receiver RF path
E004	57348	AA14	MAB44 address register
E005	57349	AA15	MAB44 data register
E006	57350	AA16	MAB44 control register

### AF generator

-----

Address (HEX)	Address (DEC)	Label	Description
E010	57360	AFGEN1	AF GEN1 frequency
E011	57361	AFGEN2	AF GEN2 frequency
E012	57362	AFLTCH	AF GEN address latch and wave shape
E013	57363	AMLEVH	AM modulation level bits 4-11
E014	57364	AMLEVL	AM modulation level bits 0-3
E015	57365	AFDPL	AF and DCS control switching
E016	57366	MODCON	Modulation control switching
E017	57367	IPATEN	RF input and attenuator relay control
E018	57368	MDDAC1	MOD1 level DAC
E019	57369	MDDAC2	MOD2 level DAC
E01A	57370	LTAMFM	Modulation level correction DAC
E01B	57371	LVAMFM	DCS correction DAC
E01C	57372	AFDAC1	AF1 level DAC (lower 8 bits)
E01D	57373	AFDAC2	(upper 4 bits)
E01E	57374	AFDAC3	AF2 level DAC (lower 8 bits)
E01F	57375	AFDAC4	(upper 4 bits)

### Keyboard and screen

-----

Address (HEX)	Address (DEC)	Label	Description
E022	57378	ROWS	Keyboard rows read
E023	57379	COLS,SETKEY	Keyboard columns write
E024	57380	LEDL	Front panel LEDs
E025	57381	CHAR	Screen data
E026	57382	ADDRLO	Screen column address
E027	57383	ADDRHI	Screen row address

## FAULT DIAGNOSIS

MOD meter -----			
Address (HEX)	Address (DEC)	Label	Description
E03B	57403	IC35EN	Demod and AF path
E03D	57405	IC34EN	Demod and AF path
E03E	57406	IC33EN	Demod and AF path

GPIB interface -----			
Address (HEX)	Address (DEC)	Label	Description
E040 - E047	57408 - 57415	ADDRSW	Address switch
E048	57416	DATAIO	Data I/O register
E049	57417	INTST1	Interrupt status byte 1
E04A	57418	INTST2	Interrupt status byte 2
E04B	57419	SPOLDT	Serial poll register
E04C	57420	ADDRMD	Address mode register
E04D	57421	AUXIMD	Auxiliary mode register
E04E	57422	ADDREG	Address register
E04F	57423	EOSREG	End Of String register

Voltmeter -----			
Address (HEX)	Address (DEC)	Label	Description
E800	59392	ADE800	+v peak detector
E801	59393	ADE801	-v peak detector
E802	59394	ADE802	RMS detector
E803	59395	ADE803	Scope horizontal shift
E804	59396	ADE804	DCS decoder input
E805	59397	ADE805	PM indicator
E806	59398	ADE806	Sensitive receiver signal strength
E807	59399	ADE807	Sensitive receiver temperature

Counter -----			
Address (HEX)	Address (DEC)	Label	Description
EA00	59904	AB1200	Divider data register
EA01	59905	AB1201	Divider command register

## AB5/1 – DEMODULATION & SCOPE

Test equipment : Oscilloscope, signal generator, AF generator.

Circuit diagram: Chap. 7, Figs. 7-19, 7-20 and 7-21.

16. Proceed as follows:-

### Preliminary

- (1) Set the signal generator to carrier frequency 100 MHz, FM deviation 25.5 kHz, modulation rate 1 kHz, RF level 0 dBm.
- (2) Select TX mode, modulation FM, BNC socket selected. Select manual tune (to prevent tracking the signal generator).

### Checking 85 kHz HP filter

- (3) Switch the signal generator modulation off. Check at IC100 pin 6 for a 110 kHz sine wave.
- (4) 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

- (5) Connect the oscilloscope to IC102 pin 7 and check for 110 kHz at TTL levels. This checks the limiting operation.
- (6) Set the modulation to AM and check that IC102 pin 7 goes high. This checks the operation of switch TR100.

### Checking discriminator

- (7) Reset the modulation to FM. Check IC103 pin 6 for 3.4  $\mu$ s pulses.
- (8) 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 LP filter

- (9) 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

- (10) Set the signal generator modulating frequency to 1 kHz. Check at TP2 for a 1 kHz sinewave at 10 V pk-pk  $\pm$ 20%. If not, the FM and  $\phi$ M level may need adjusting (see 'Adjustments' below).

### Checking de-emphasis

- (11) Set the signal generator modulation to 5 kHz deviation. Connect the oscilloscope to IC105 pin 6 and check for 4 V pk-pk at a 1 kHz rate, for 2 V pk-pk at a 2 kHz rate, and 8 V pk-pk at a 500 Hz rate.

### Checking 40 dB attenuator

- (12) Connect the oscilloscope, AC coupled, to the junction of C124/R141/R142 and check that the 110 kHz signal level is  $\frac{1}{100}$  of that on the IF IN line at contact 2a.

### Checking amplifier TR102

- (13) 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 AGC

- (14) With the signal generator modulation off, check TP1 for a 110 kHz sinewave at 1 V pk-pk. If not, the AM monitor will have to be adjusted (see 'Adjustments' below) before proceeding.

### Checking band-pass filter

- (15) With the signal generator modulation off, turn down the RF level until the AGC 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 AM output

- (16) Set the signal generator to 64% AM. Connect to TP3 and check for 5 V pk-pk  $\pm 20\%$ . If not, the AM monitor will need adjustment (see 'Adjustments' below) before proceeding.

### Checking switching

- (17) The switching operation for the whole board may be checked using the information given in Tables 5-12a to 5-12e.

### Checking amplifier chain

- (18) 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 5-13 and 5-14. To check the oscilloscope path, select SCOPE and refer to Table 5-3-2. To check the voltmeter path, select BAR CHART and refer to Table 5-3-3. For the lower voltage levels, use an AF generator set to 1 kHz. For the higher voltage levels, it may be necessary to use a DC source (but remember to convert the input values from pk-pk to RMS).
- (19) If the levels are incorrect, it will be necessary to adjust the voltmeter and scope ranging (see 'Adjustment' below) before proceeding.

### Checking vertical shift

- (20) Vary the oscilloscope vertical shift control and check that the DC level at the junction of R221/C204/R222 varies commensurately.

TABLE 5-3-1a CHECKING SWITCHING OPERATION - AB5/1

Operation	To implement	Decoder IC309 pins			Latch IC306 pins		IC311 pin	Switches closed
		4	5	6	7	9		
Select AM	Press TX, AM	L	H	H	-	-	-	IC316 14,15 : IC317 2,3
Select $\Phi$ M	Press TX, $\Phi$ M	H	L	H	-	-	H	IC317 6,7
Select FM	Press TX, FM	H	H	L	-	-	H	IC317 10,11
Select 15 kHz LP filter	Press TX, LOW PASS (15 kHz)	-	-	-	-	H	L	IC318 7,9 : IC318 12,10
Select 0.3 - 3.4 kHz BP filter	Press TX, BAND PASS	-	-	-	-	H	H	IC318 8,9 : IC318 11,10
Select 300 Hz LP filter	Press TX, LOW PASS (300 Hz)	-	-	-	-	L	H	IC318 6,9 : IC318 13,10
Select external filter	Press TX, EXTERNAL	-	-	-	-	L	L	IC318 5,9 : IC318 14,10
RF power warning	Connect 2 W max. to BNC socket	H	H	H	-	-	L*	IC317 14,15 (after delay)

\* Switching

TABLE 5-3-1b CHECKING SWITCHING OPERATION - AB5/1

Operation	To implement	Decoder IC309 pins										Switches closed	
		4	5	6	7	12	11	10	9				
Select AF 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	-	-	-	-	L	H	H	-	-	-	-	IC322 1,4
RF power ranging x2	Vary input to BNC socket by $\pm 10$ dBm	-	-	-	-	H	L	H	-	-	-	-	IC322 8,5
RF power ranging x5		-	-	-	-	H	H	L	-	-	-	-	IC322 9,12

\* Switching



TABLE 5-3-1c CHECKING SWITCHING OPERATION - AB5/1

Operation	To implement	Decoder IC309 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		-	-	-	-	L	H	H	H	H	H	H	IC314 2,3
Voltmeter/demod. ranging x2	Press TX, DIST'N off, FM Vary deviation from 1 kHz to 15 kHz	-	-	-	-	H	L	L	H	H	H	H	IC314 6,7
Voltmeter/demod. ranging x5		-	-	-	-	H	H	L	L	H	H	H	IC314 10,11
Voltmeter/demod. ranging x10		-	-	-	-	H	H	H	L	H	H	L	IC314 14,15

\* Switching

TABLE 5-3-1d CHECKING SWITCHING OPERATION - AB5/1

Operation	To implement	Decoder IC309 pins										Switches closed	
		4	5	6	7	12	11	10	9				
Scope ranging x1	Press TX, SCOPE. Select 30 kHz FM	L	H	H	H	-	-	-	-	-	-	-	IC315 2,3
Scope ranging x2	Press TX, SCOPE. Select 15 kHz FM	H	L	H	H	-	-	-	-	-	-	-	IC315 6,7
Scope ranging x5	Press TX, SCOPE. Select 6 kHz FM	H	H	L	H	-	-	-	-	-	-	-	IC315 10,11
Scope ranging x10	Press TX, SCOPE. Select 3 kHz FM	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 5-3-1e CHECKING SWITCHING OPERATION - AB5/1

Operation	To implement	Decoder IC309 pins									Switches closed
		4	5	6	7	12	11	10	9		
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 DC	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 (POCSAG and DCS)	Press TX	-	-	-	-	-	-	L	-	-	IC312 6,7 closed
External AF to scope x1	Press RX, SCOPE, 20 V/div.	-	-	-	-	-	-	-	L	-	IC312 10,11 closed
External AF to scope x10	Press RX, SCOPE, 50 mV/div.	-	-	-	-	-	-	-	-	H	IC312 10,11 open
AF/FWD/REV to volt-meter x1	Press BARCHART, DIST'N off, DC. 7 V DC to AF INPUT	-	-	-	-	-	-	-	-	L	IC31214,15 closed
AF/FWD/REV to volt-meter x10	Press BARCHART, DIST'N off, DC. 3 V DC to AF INPUT	-	-	-	-	-	-	-	-	-	IC312 14,15 open

\*Switching

TABLE 5-3-2 AB5/1 OSCILLOSCOPE SIGNAL LEVELS - RX MODE

AF in (pk-pk)	/div	IC304 pin 5	IC200 gain	Level	IC304 pin 16	IC201 gain	Level	IC304 pin 8	IC204a gain	Level	IC305 pins 15 12	IC20 gain	Scope
-	100V	L	÷20	-	L	x1	-	L	x1	-	L	x1	-
-	50V	L	÷20	-	L	x1	-	L	x1	-	L	x2	-
80V	20V	L	÷20	4V	L	x1	4V	L	x1	4V x k	H	x5	20V x k
40V	10V	L	÷20	2V	L	x1	2V	L	x1	2V x k	H	x10	20V x k
20V	5V	L	÷20	1V	L	x1	1V	H	x10	10V x k	L	x2	20V x k
8V	2V	L	÷20	400mV	L	x1	400mV	H	x10	4V x k	H	x5	20V x k
4V	1V	L	÷20	200mV	L	x1	200mV	H	x10	2V x k	H	x10	20V x k
2V	500mV	H	÷2	1V	L	x1	1V	H	x10	10V x k	L	x2	20V x k
800mV	200mV	H	÷2	400mV	L	x1	400mV	H	x10	4V x k	H	x5	20V x k
400mV	100mV	H	÷2	200mV	L	x1	200mV	H	x10	2V x k	H	x10	20V x k
200mV	50mV	H	÷2	100mV	H	x10	1V	H	x10	10V x k	L	x2	20V x k
80mV	20mV	H	÷2	40mV	H	x10	400mV	H	x10	4V x k	H	x5	20V x k
40mV	10mV	H	÷2	20mV	H	x10	200mV	H	x10	2V x k	H	x10	20V x k

Where k is the ratio of IC203a OUT/IN (approx. 0.17)

TABLE 5-3-3 AB5/1 VOLTMETER SIGNAL LEVELS - RX MODE

AF in (RMS)	Range	Resolution	IC304 pin 5	IC201 gain	Level	IC304 pin 19	IC202 gain	Level	IC305 pins 9 6	IC204b gain	Volt-meter
100V	64 - 128V	500mV	L	-20	5V	L	x1	5V	L L	x1	5V x k
50V	25.6 - 64V	250mV	L	-20	2.5V	L	x1	2.5V	L H	x2	5V x k
20V	12.8 - 25.6V	100mV	L	-20	1V	L	x1	1V	H L	x5	5V x k
10V	6.4 - 12.8V	50mV	L	-20	500mV	L	x1	500mV	H H	x10	5V x k
5V	2.56 - 6.4V	25mV	L	-20	250mV	H	x10	2.5V	L H	x2	5V x k
2V	1.28 - 2.56V	10mV	L	-20	100mV	H	x10	1V	H L	x5	5V x k
1V	0.64 - 1.28V	5mV	L	-20	50mV	H	x10	500mV	H H	x10	5V x k
500mV	256 - 640mV	2.5mV	H	-2	250mV	H	x10	2.5V	L H	x2	5V x k
200mV	128 - 256mV	1mV	H	-2	100mV	H	x10	1V	H L	x5	5V x k
100mV	- 128mV	0.5mV	H	-2	50mV	H	x10	500mV	H H	x10	5V x k

Where k is the ratio of IC203b OUT/IN (approx. 1.0)

### Checking the 50 kHz LP filter

- (21) Select RX and connect the AF generator set to 10 kHz to the AF INPUT socket. Connect the oscilloscope to the SCOPE line at contact 32b.
- (22) Check that the response is flat to 20 kHz and that obvious roll-off occurs at 50 kHz.

### Checking 0.3 – 3.4 kHz BP filter

- (23) Select BAND PASS and connect the oscilloscope to the rear panel DE-MOD OUT socket.
- (24) Adjust the AF 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.
- (25) 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 LP filter

- (26) Press LOW-PASS to obtain the 300 Hz LP filter.
- (27) Adjust the AF generator upwards from 100 Hz and check that the signal is 3 dB down at 300 Hz.

### Checking SINAD filter

- (28) Select DIST'N on. Set the AF 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  $\frac{1}{10}$  of the level at IC204 pin 7. If not, the notch width will have to be adjusted (see 'Adjustment' below).

## BOARD AB6/1 – AF GENERATORS

Test equipment : Oscilloscope, frequency counter.

Circuit diagram: Chap. 7, Figs. 7-22 and 7-23.

17. Proceed as follows:-

### Checking audio generators

- (1) Set frequency to 1 kHz, sinewave. Monitor TP2 with an oscilloscope. A 1 kHz sine wave of 6 V pk-pk (approx.) should be present. Change frequency to 20 kHz. The step approximations should be clearly visible, with no steps missing. TP3 should be a smoothed version of the same signal.
- (2) Repeat (1) for AF GEN 2, but at TP4 and 5.
- (3) LP filter check. Set both generators to 20 kHz, square wave. Compare the signals at TP3 and TP5. TP3 should be a 5 V pk-pk square wave, and TP5 should be a filtered equivalent.

### Checking gain setting

- (4) Set AF GEN 1 to 1 kHz, 100 mV, sine wave. TP6 should be a 1.5 V pk-pk sine wave. AF GEN out should be 100 mV RMS (280 mV pk-pk). Change AF GEN 1 level to 1 V and check AF GEN out is 1 V RMS (2.8 V pk-pk).
- (5) Turn AF GEN 1 off and AF GEN 2 on and repeat (4), but with TP7.

### Checking mod level setting

- (6) In Rx test mode, set RF GEN frequency 150 MHz, mod level 25 kHz. Monitor TP12. Note the voltage (approximately 6 V pk-pk). Change the RF GEN frequency to 300 MHz. The voltage should halve. Change the RF GEN frequency to 600 MHz, the voltage should halve again.
- (7) Turn mod 1 off, mod 2 on, and repeat (6).

### Checking phase mod

- (8) Monitor TP13. Set mod frequency 1 kHz level 25 kHz. Change mod frequency to 2 kHz, the signal amplitude should not change. Change mod level to 5 rad, the signal amplitude should fall by 50%.

### Checking FM tracking correction

- (9) Set mod frequency 1 kHz, level 25 kHz. Monitor TP15. Changing the RF GEN frequency from 90 to 150 MHz should vary the mod amplitude by 10-30%.

### AM/FM setting

- (10) Monitor TP16. Check that with FM selected, the signal is a constant voltage that should vary with adjustment of R20. Check that with AM selected the mod appears at TP16, and that IC28(b) is open.

### POCSAG Generator

- (11) Enter the POCSAG screen. Monitor TP15. Pressing the send key should produce a burst of data (approximately 1.6 V pk-pk) centred about zero.

## AC1 – CRT DRIVE

Test equipment: Oscilloscope, signal generator.

Circuit diagram: Chap. 7, Fig. 7-25.

18. Proceed as follows:-

### Checking internal standard

- (1) 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

- (2) Check at IC5 pin 4 for 10 MHz at TTL levels. Transfer to IC5 pin 3 and check for 1 MHz, then to pin 13 and check for 100 kHz.

### Checking external input

- (3) Connect a 1 MHz signal in the range 100 mV to 3 V RMS to the rear panel EXT STD 1 MHz socket.
- (4) Check at IC4 pin 1 for 1 MHz at TTL levels. This checks TR5 and TR6.
- (5) Check at IC4 pin 12 for 100 kHz. This checks the divider operation.

### Checking phase detector operation

- (6) Vary the frequency of the external signal and check for a varying mark/space ratio at IC3 pin 3.
- (7) Transfer to the junction of R43/C34/R42 and check for a varying DC voltage as the frequency of the external signal is varied.

### Checking video amplifier

- (8) Check tag 9 for a 38 V pk-pk signal. Check that the lower level (beam cut-off) is at +5 V. This checks the operation of TR1, TR2.

### Checking frame output

- (9) Check on IC1 pin 9 for a ramp at a rate of 52.7 Hz.
- (10) Check that the display has full horizontal cover of the tube face. If not, adjustment is necessary (see 'Frame height' below).
- (11) Check that the characters on the display are linear across the tube face. If not, adjustment is necessary (see 'Frame linearity' below).
- (12) Check IC1 pin 10 for a DC bias of 2.3 V.
- (13) Check at IC1 pin 4 for a waveform of 25 V amplitude at the frame rate.



### Checking line output

- (14) Check that the display is centrally positioned on the tube. If not, adjustment is necessary (see 'Vertical shift' below).
- (15) Check that TR4 and TR3 switch on and off (but note the 300 V on TR3 collector) at the line sync rate.
- (16) 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

- (17) Check for +475 V at the junction of D9/C26.
- (18) Check for +50 V at TR2 collector (can).
- (19) Check for +150 V at PLB 1.
- (20) Check tag 8 for +22 V.

### Checking INTENSITY control

- (21) 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).
- (22) 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. 7-26.

19. Proceed as follows:-

### Checking overheat

- (1) Select TX and the N-type socket. Connect the oscilloscope to OVER TEMP OUT AC0 tag 1.
- (2) With no RF input, i.e. at ambient temperature, check that the voltage on AC0 tag 1 is between 4 and 5 V.
- (3) 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.
- (4) Connect a 12 k $\Omega$  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

- (5) Select the BNC socket and connect the power source set to a low level to the socket.
- (6) Check for a high logic level on DUPLEX-ISOLATE A0 tag 2.
- (7) 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.
- (8) 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

- (9) With TX selected, check that INPUT SELECT on A0 tag 3 is at a high logic level.
- (10) Select two port duplex and check that A0 tag 3 has gone low.

### Checking duplex/normal

- (11) With two port duplex selected, check that DUPLEX/NORMAL on A0 tag 6 is at a low logic level.
- (12) Select one port duplex and check that A0 tag 6 has gone high.

## AF1/1 – MAIN KEYBOARD

Test equipment: Oscilloscope.

Circuit diagram: Chap. 7, Fig. 7-26.

20. Proceed as follows:-

### Checking key operation

- (1) Check that the COLUMNS lines leading to PLA 7,11,16,19,18,13,14,15 are all high.
- (2) Check that the ROWS lines leading to PLA 12,20,17,9,6,10,2,3,4 are all low.
- (3) 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

- (4) Press SELECT until IC1 pin 5 goes high. Check that BNC socket LED D1 is lit.
- (5) Press SELECT once. Check that IC1 pin 7 goes high and that N-type socket LED D2 is lit.
- (6) Select RX and set a modulating frequency.
- (7) Set an AM depth level. Check that IC1 pin 12 goes high and that LED D4 is lit.
- (8) Set an FM deviation level. Check that IC1 pin 15 goes high and that LED D5 is lit.
- (9) Set a  $\Phi$ M deviation level. Check that IC1 pin 10 is goes and that LED D3 is lit.

## **AF2/1 – SCOPE KEYBOARD**

Test equipment: Oscilloscope.

Circuit diagram: Chap.7, Fig. 7-27.

21. Proceed as follows:-

### **Checking key operation**

- (1) Check that the COLUMNS lines leading to tags 4,6,8 are all high.
- (2) Check that the ROWS lines leading to tags 7 and 9 are both low.
- (3) 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**

- (4) 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. 7-29.

22. Proceed as follows:-

### **Checking power supply**

- (1) Check AB1/1 PLC contact 20 for +5 V.

### **Checking clock signal**

- (2) Check AB1/1 PLC contact 19 for a 5 MHz square wave at TTL levels.

## AR1/1 – POWER SUPPLY

Test equipment: Oscilloscope.

Circuit diagram: Chap. 7, Fig. 7-28.

23. Proceed as follows:-

### Checking input relay

- (1) Connect a DC 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.)
- (2) Connect AC mains to the rear panel AC SUPPLY socket. Check that TR19 switches on, TR18 switches off and RLA contacts 7 and 6 are connected.
- (3) Remove the AC supply. Check that RLA contacts 5 and 6 are reconnected.

### Checking 10 V regulator

- (4) Check at IC1 pin 12 for 10 V. If not, the regulator setting will require adjustment (see 'Low level volts' below).

### Checking low volts

- (5) Decrease the DC supply voltage and check that at 10.7 V (at 6 A) TR1 switches on. Check that tag 8 is logically high.

### Checking dividers

- (6). Check IC2 pin 6 for 10 MHz divided by 16.
- (7) Check IC2 pin 10 for 10 MHz divided by 64.
- (8) Check that TR8 is pulsed on and off at the divided reference (156 kHz) rate.

### Checking controller

- (9) Decrease the DC 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.
- (10) Check that the controller has switched off by checking that pins 8 and 11 are both high.
- (11) Restore the DC supply. Check IC1 pins 8 and 11 for complementary pulses.
- (12) Vary the DC supply voltage and check for a varying mark/space ratio on IC1 pins 8 and 11.

### Checking output

- (13) 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. 7-25.

### **Checking filter**

24. With no external DC supply connected, check that all unwanted signals (mainly at 50 Hz) on tags 3 and 4 are much reduced on tags 1 and 2.

## **AZ1 – OPTICAL ENCODER**

Test equipment: Oscilloscope.

Circuit diagram: Chap. 7, Fig. 7-28.

25. Proceed as follows:-

### **Checking encoder**

- (1) Connect one oscilloscope channel to AB1/1 PLX contact 2 and the other to contact 4.
- (2) Rotate the front panel VARIABLE control while checking for quadrature pulses on the oscilloscope display.
- (3) Check that the pulse rate increases with the control turning rate, and that the phase changes when the movement is reversed.

## RX11 – RECEIVER BOARD

Test equipment: RF signal generator, DC voltmeter, spectrum analyzer, active probe, oscilloscope.

Circuit diagram: Chap. 7, Fig. 7-34.

### 0/10 dB attenuator

26. This is switched by RLA to 0 for signal levels below typically 4 mV (BNC socket) or 40 mV (N socket) and to -10 dB for signal levels above these. Proceed as follows:-

- (1) On the 2955R, set the MODE to TRANSMITTER MONITOR, the TX FREQUENCY to 50 MHz, the modulation as appropriate and the RF IN/OUT to the BNC socket.
- (2) Connect the signal generator to the RF IN/OUT BNC socket. Set the frequency to 50 MHz and the level to 1 mV.
- (3) Use the active probe to connect the spectrum analyzer to IC1 pin 1. Check that the level is approximately -47 dBm.
- (4) Set the signal generator to -10 dBm. Check that the level at IC1 pin 1 is -20 dBm.
- (5) If the levels in (3) and (4) are incorrect, check for the levels in para. 27.

27. The switching of this attenuator is controlled by the microprocessor in accordance with the RF level output. Check the following DC levels for 0 dB (RANGE 0 and 1) and -10 dB (RANGE 2):-

Position	0 dB	-10 dB
R74 input side	0	+5 V
Junction of D11 and TR6 collector	+5 V	0

### 20 dB RF amplifier and LO input

28. IC1 and IC2 give approximately 12 dB and 8 dB gain respectively. Proceed as follows:-

- (1) Connect the signal generator between RX3 and the board RF input. Set the frequency to 50 MHz and the level to -55 dBm.
- (2) Tune the spectrum analyzer to 50 MHz and connect the active probe in turn to IC1 pin 3 and IC3 pin 3. Check that the levels are approximately -43 dBm and -35 dBm respectively.
- (3) Check that the DC voltages at IC1 pin 3 and IC2 pin 3 are approximately 5.0 V and 5.3 V respectively.
- (4) Connect the active probe between RX12 and the board LO input. Check for the presence of the LO signal at approximately +8 dBm.

- (5) Use the spectrum analyser to check that the LO frequency is as follows:-

RF IMAGE setting	LO frequency
UPPER	71.4 MHz
LOWER	28.6 MHz

### Mixer

29. The IF is 21.4 MHz. The mixer conversion loss is typically 7 dB. Check the conversion loss as follows:-

- (1) Tune the spectrum analyzer to 21.4 MHz and connect the active probe to the junction of C7, C8, L5, R7 and R8.
- (2) Assuming that the 0/10 dB attenuator is at 0, check that the IF level at the junction is approximately 10 dB (20 - 7 - 3) above the input level.

### 20 dB IF 180 kHz band-pass amplifier

30. Check the response as follows:-

- (1) Connect the tracking generator of the spectrum analyzer to the RF IN/OUT BNC socket. Set the level to -60 dBm.
- (2) On RX11, remove the link on PLB.
- (3) On the 2955R, set the TX FREQUENCY to 21.4 MHz.
- (4) Tune the spectrum analyzer to 21.4 MHz and set the span to 1 MHz/division. Connect the active probe to TP1.
- (5) On the spectrum analyzer, check that the response is as follows:-

Bandwidth	Frequency
3 dB	180 kHz $\pm$ 40 kHz
60 dB	2 MHz approximately

- (6) The response is affected by the lid being removed, especially the centre frequency. If there is any doubt about the correct shape, proceed as described in Chap. 5-2 para. 39.

### 12 kHz band-pass filter

31. Check the response as follows:-

- (1) On the TRANSMITTER MONITOR display, set the IF FILTER to 12 kHz.
- (2) Tune the spectrum analyzer to 21.4 MHz and set the span to 5 kHz/division. Connect the active probe to the junction of C46, D3, D4 and R38.
- (3) On the spectrum analyzer, check that the response is as follows:-

Bandwidth	Frequency
3 dB	12kHz +6/-2 kHz
60 dB	80 kHz approximately



32. This filter is switched by RLB and RLC. When the filter is not in circuit, the pin diode switch D1 and D2 form an alternative signal path. Check the following DC levels:-

Position	12 kHz	180 kHz
IC10 pin 1	-12 V	+8 V
R76 input side	0 V	+5 V

### 0/32 dB amplifier

33. This is switched to +32 dB for signal levels below typically 150  $\mu$ V and to 0 for signal levels above this level. Proceed as follows:-

- (1) Connect the signal generator to the RF IN/OUT BNC socket. Set the signal generator frequency and the TX FREQUENCY on the 2955R to the same figure. Set the signal generator level to 50  $\mu$ V.
- (2) Select the CALIBRATION MODE display by pressing in turn the HELP, TX MON ON-OFF, AC DC, VERT  $\blacklozenge$ , FREQ  $\downarrow$  and REP SWEEP keys.
- (3) On the display, check that RANGE 0 is indicated.
- (4) Increase the signal level until the SIGNAL STRENGTH ADC reading is 231. At this point, check that the RANGE changes to 1 and that the SIGNAL STRENGTH ADC reading is approximately 135. If not, further examination is necessary.
- (5) If the ADC readings are suspect, monitor the gain change by using an active probe connected to TP2.

34. Check the following DC levels for 0 dB (RANGE 1 and 2) and +32 dB (RANGE 0):-

Position	0 dB	+32 dB
IC5 pin 3	+8 V	+8 V
IC10 pin 7	-12 V	+8 V

### AGC amplifier

35. The IF output has to be terminated in approximately 50  $\Omega$ . Otherwise, the AGC loop may oscillate. The amplifier gain is dependent on the current drive from IC9 pin 8. This relies on a peak detector to measure the amplifier output level, an AGC buffer to linearize the peak detector output, a loop filter and a voltage to current converter. The link formed by PLB can be removed to facilitate fault finding in the AGC loop.

### 38 dB amplifier

36. IC7 and IC8 give approximately 32 dB and 12 dB gain to give a gain of 38 dB +6/-0 dB. Check the following DC levels:-

Position	DC level
IC7 pin 3	+8 V
IC8 pin 3	+5 V

37. Select the CALIBRATION MODE display as previously described and check the following typical DC levels:-

SIGNAL STRENGTH ADC reading	IC10 pin 14	IC9 pin 1
230	+4.69 V	-4.69 V
200	+4.05 V	-4.05 V
150	+3.05 V	-3.05 V
125	+2.51 V	-2.51 V
110	+2.23 V	-2.23 V

### Temperature sensor

38. The output of the temperature sensor is from 0 to 5 V by 65.095 mV/°C with 0 mV at 0°C. This is fed to the ADC on AB4/1. Select the CALIBRATION MODE display, as previously described, to check the TEMPERATURE ADC reading.

### Bypass switch driver

39. When TRANSMITTER MONITOR mode is selected, the input signal from the RF IN/OUT connectors is routed through RX3 to the sensitive receiver. The relays in RX3 require a pulse of typically 20 ms duration. On the oscilloscope, check this at TR15 collector and TR13 collector.

### Local oscillator switch driver

40. When TRANSMITTER MONITOR mode is selected, the output signal from the signal generator is routed through RX2 and RX12 to the mixer in the sensitive receiver. The relays in RX2 require a pulse of typically 20 ms duration. On the oscilloscope, check this at TR11 collector and TR9 collector.

### Output buffer

41. The AGC voltage is buffered by IC10d and this voltage is fed to the ADC on AB4/1 to indicate the RF level using an algorithm which incorporates the 0/10 dB attenuator setting, the 0/32 dB amplifier setting, temperature data and calibration data to correct for frequency and level variations. Select the CALIBRATION MODE display, as previously described, to check the SIGNAL STRENGTH ADC reading.

### LO driver 21.4 MHz notch filter switch driver

42. At the frequencies given in para. 42, check the following DC levels for the RX12 filter in circuit and out of circuit:-

Position	Filter	
	In	Out
R72 input side	0	+5 V
Junction of D10 and TR5 collector	+5 V	0

**RX12 – LOCAL OSCILLATOR DRIVER BOARD**

Test equipment: Spectrum analyzer, active probe, oscilloscope.

Circuit diagram: Chap. 7, Fig. 7-35.

**21.4 MHz notch filter**

43. This is switched by RLA when the TX FREQUENCY is set as follows:-

TX FREQUENCY	RF IMAGE	
	LOWER	UPPER
0.1 to 10 MHz	Not available	Out
10 to 21.8 MHz	Not available	In
21.8 to 34.8 MHz	In	In
34.8 to 52.8 MHz	Out	In
52.8 to 978.6	In	In
978.6 to 1000 MHz	In	Not available

44. Check the response as follows:-

- (1) On the 2955R, set the MODE to TRANSMITTER MONITOR and the TX FREQUENCY to greater than 52.8 MHz.
- (2) Connect the tracking generator of the spectrum analyzer between RX2 and the board RF input.
- (3) Set the spectrum analyzer to 21.4 MHz centre frequency and 1 MHz/division.
- (4) Connect the active probe to the junction of RLA pin 1 and C6. Check that the response is as shown in Fig. 5-2-16.
- (5) If the spectrum analyzer display is almost flat, then it is likely that the filter is not in circuit. See para. 42 to check the switch driver.
- (6) If necessary, adjust the filter response by resetting L1, L2, L3 and L4.
- (7) Set the TX FREQUENCY to less than 10 MHz. Check that the response is flat.

**8 dB amplifier**

45. Check the gain of IC1. If the gain is not approximately 8 dB, check that the voltage on IC1 pin 3 is  $5.5 \pm 0.5$  V.

**FAULT DIAGNOSIS**

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## Chapter 6

# REPLACEABLE PARTS

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## INTRODUCTION

1. Each sub-assembly or printed circuit board in this instrument has been allocated a unit identification, e.g. A0/1, AA2, AB1/1 etc. The complete component reference carries its unit number as a prefix e.g. AB1/1 C3 (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
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 6-1.

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.

**ELECTRICAL COMPONENTS****Unit A0/1 - 2955A Overall assembly**

7. When ordering, prefix circuit reference with A0/1.

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	52955-910L	U2632	52955-910L
C1	CAP ELEC 4700U 40V 10%+	26426-093	K8996	071 17472
C2	CAP ELEC 4700U 40V 10%+	26426-093	K8996	071 17472
C3	CAP ELEC 220V 63V 20% AX	26415-820		
C4	CAP PC 470N 100V 10%	26582-679		
D1	DI BRIDGE BY260 200V 12A	28359-190	K8996	BY260 200
FS1	FUSE T/LAG 0.80A 20X5	23411-065	U0154	L2080
FS2	FUSE T/LAG 0.80A 20X5	23411-065	U0154	L2080
FS3	FUSE T/LAG 6.3A 20X5	23411-065	K0647	5502 OR TDC123
	H/W FUSE HOLDER PANEL 20X5 (1 OF 3)	23416-192	U0928	F396 1 OR F455/S
LS1	LOUDSPEAKER ROUND 75R 2.25"	23646-105	S4248	6A1 70
R4	RES MF 22R .25W 2% 100PPM	24773-321	K8996	MR25
R29	RES MF 390R .25W 2% 100PPM	24773-263	K8996	MR25
S1	SW TOG 4CO MIN ON-ON	23462-266	U3515	U41 SHZQ1
	SW PART TOG LEVER CAP BLACK	23462-881	S3323	CPO1
	COVER MAINS SW 4 POLE	37561-105		
S2	SW SLIDE 2CO PANEL MTG	23467-161	U3627	46206 LE
SKB	CON-RF BNC-FEM 50 BKHD	23443-442	K1072	GE35152YBN
SKC	CON CIRC FEM 7 FXD DIN	23424-353	U1479	DIN CONN 7WAY
T1	TRANSFORMER MAINS.	44990-903	U2632	44490-903
	FAN ASSEMBLY	23535-128	U3613	FBP-08A12H
X3	FERRITE BEADS (4)	23635-845	K7584	FX 4025
X4	FERRITE BEADS (4)	23635-845	K7584	FX 4025
	VALVE CRT 190F31 E7-91 7"90DE	28235-617	U4794	190FB31
	CONNECTOR ASSY (TYPE N)	43130-165	U2632	43130-165



## REPLACEABLE PARTS

## Unit A0/1 - 2955A Overall assembly (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
CONNECTOR ASSY BNC	43130-166	U2632	43130-166
CABLE CO-AX ASSY, AF INPUT AB1/1 PLR	43130-167	U2632	43130-167
CABLE CO-AX S/R ASSY, AAO/1 PLC AC2	43130-168	U2632	43130-168
CABLE CO AX ASSY, AAO/1 PLB AB1/1	43130-169	U2632	43130-169
CABLE CO-AX ASSY, AF GEN AB1/1 PLK	43130-170	U2632	43130-170
CABLE RIBBON ASSY, AF2/1 AB1/1 PLG	43130-183	U2632	43130-183
CABLE CO-AX ASSY, AC2 ATTEN	43130-193	U2632	43130-193
CABLE CO-AX ASSY, AAO/1 AB1/1	43130-447	U2632	43130-447
CABLE CO-AX ASSY, AAO/1 PLD AB1/1	43130-199	U2632	43130-199
CABLE CO-AX S/R ASSY AAO/1 ATTEN	43137-533	U2632	43137-533
CABLE CO-AX ASSY, AAO/1 PLB-AC1	43130-201	U2632	43130-201
CABLE CO-AX ASSY, AB1/1 PLT-AR1/1	43130-202	U2632	43130-202
CABLE CO-AX ASSY, EXT STD-AC1	43130-203	U2632	43130-203
E PROM 2716 (AB3-IC33)	44533-153	U2632	TBX12
MAGNET TBX12 6MM CRT CORRECTOR	28238-157	U3008	28238-157
E PROM, SET, 2. (FOR AB4, IC9/B & IC10A)	44533-247	U2632	44533-247
EE PROM X2816A (AB4-IC13)	44533-362	U2632	44533-362
E PROM (FOR AB6, IC4 & IC5)	44533-351	U2632	44533-351
CABLE CO-AX ASSY, IF OUT	43130-227	U2632	43130-227

REPLACEABLE PARTS

Unit AA0/1 – RF tray

8. When ordering, prefix circuit reference with AA0/1.

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
C1 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C2 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C3 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C4 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C5 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C6 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C7 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C8 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C9 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C11 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C13 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C14 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C15 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C17 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C18 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C19 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C20 CAP CER 50P 300V 10%	26333-229	K8445	FT73 29 K3000
C21 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C22 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C23 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C24 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C25 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C26 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C27 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C28 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C29 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C30 CAP CER 50P 300V 10%	26333-229	K8445	FT73
C31 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C32 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C33 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C34 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C35 CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C36 CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C37 CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C38 CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C39 CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C40 CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C41 CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C42 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C43 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C44 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C45 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C46 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C47 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000

REPLACEABLE PARTS

Unit AA0/1 - RF tray (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C48	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C49	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C50	CAP CER 56P 500V 20%	26373-855	K8445	
C51	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C52	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C53	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C54	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C55	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C56	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C57	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C60	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C61	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C62	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C63	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
L1	IND CHOKE GEN	23642-551		
L2	IND CHOKE GEN	44190-036	U2632	44190-036
L3	IND CHOKE GEN	44190-036	U2632	44190-036
L4	IND CHOKE GEN	44190-036	U2632	44190-036
L5	IND CHOKE GEN	44190-036	U2632	44190-036
L6	IND CHOKE GEN	44190-036	U2632	44190-036
L7	IND CHOKE GEN	44190-036	U2632	44190-036
L8	IND CHOKE GEN	44190-036	U2632	44190-036
L9	IND CHOKE GEN	44190-036	U2632	44190-036
L11	IND CHOKE GEN	44190-036	U2632	44190-036
L12	IND CHOKE GEN	44190-036	U2632	44190-036
L13	IND CHOKE GEN	44190-036	U2632	44190-036
L14	IND CHOKE GEN	44190-036	U2632	44190-036
L15	IND CHOKE GEN	44190-036	U2632	44190-036
L16	IND CHOKE GEN	44190-036	U2632	44190-036
L17	IND CHOKE GEN	44190-036	U2632	44190-036
L18	IND CHOKE GEN	44190-036	U2632	44190-036
L19	IND CHOKE 3.3UH 10% LAQ	23642-552	K0467	406 8 274 69 016
L20	IND CHOKE 3.3UH 10% LAQ	23642-552	K0467	406 8 274 69 016
L21	IND CHOKE 3.3UH 10% LAQ	23642-552	K0467	406 8 274 69 016
L23	IND CHOKE GEN	44190-036	U2632	44190-036
PLA	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLB	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLD	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLE	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLF	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLG	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLH	CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
R1	RES MF 150R .125W 2% 100PPM	24772-053	U1395	MFR3
R2	RES MF 270R .125W 100PPM	24772-059	U1395	MFR3
R3	RES MF 470R .125W 2% 100PPM	24772-065	U1395	MFR3

REPLACEABLE PARTS

Unit AA0/1 - RF tray (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
COUPLER ASSY RF	41700-379	U2632	41700-379
CABLE.RIBBON.ASSY, AA3 PLB-AAO/1	43130-182	U2632	43130-182
CABLE.RIBBON.ASSY, AA1 PLA-AAO/1	43130-184	U2632	43130-184
CABLE.RIBBON.ASSY, AA2 PLA-AAO/1	43130-186	U2632	43130-186
CABLE.RIBBON.ASSY, AA0/1-AB1/1 PLA	43130-187	U2632	43130-187
CABLE.RIBBON.ASSY, AA0/1-AB1/1 PLF	43130-188	U2632	43130-188
CABLE.CO-AX.ASSY, AA1 PLB-AAO/1 PLA	43130-194	U2632	43130-194
CABLE.CO-AX.ASSY, AA3 PLC-AAO/1 PLG	43130-195	U2632	43130-195
CABLE.CO-AX.ASSY, AA4 PLA-AAO/1 PLG	43130-196	U2632	43130-196

REPLACEABLE PARTS

Unit AA1 – RF modulation meter

9. When ordering, prefix circuit reference with AA1.

	Complete unit	44828-878	U2632	44828-878
C1	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C2	CAP CER 150P 63V 2%	26343-479	K8996	2222 682
C3	CAP CER 100P 63V 2%	26343-477	K8996	2222 682
C4	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C5	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C6	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C7	CAP CER 47P 63V 2%	26343-473	K8996	2222 682
C8	CAP CER 68P 63V 2%	26343-475	K8996	2222 682
C9	CAP CER 47P 63V 5%	26343-473	K8996	2222 682
C10	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C11	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C12	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C13	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C14	CAP TANT 10U 35V 20%	26486-225	K4701	199D
C15	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C16	CAP CER 680P 63V 10%	26383-583	K8996	630-18-681
C17	CAP CER 680P 63V 10%	26383-583	K8996	630-18-681
C18	CAP PETP 22N 63V 10%	26582-431	K1945	R68 D C 2202 AAK
C19	CAP PETP 1U0 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C21	CAP PETP 1U0 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C22	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C23	CAP PETP 1U0 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C24	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C25	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C26	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C27	CAP PETP 150N 100V 10%	26582-212	K8300	PMT2R OR PMC2R
C28	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C29	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C31	CAP CER 15P 63V 5%	26343-467	K8996	2222 682
C32	CAP PS 100P 63V 2%	26538-557	K4642	EXFS RP 1
C33	CAP PS 100P 63V 2%	26538-557	K4642	EXFS RP 1
C34	CAP CER 1N8 63V 10%	26383-586	K8996	630-18-182
C35	CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C36	CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C37	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C38	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C39	CAP CER 4N7 63V 10%	26383-591	K8996	630-18-472
C40	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C41	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C42	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C43	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C44	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C45	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C46	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C47	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK

REPLACEABLE PARTS

Unit AA1 - RF modulation meter (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
C48 CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C49 CAP PETP 470N 63V 10%	26582-427	K1945	R68 D C 4703 AAK
C51 CAP CER 22N 18V 20%	26383-007	U4011	ECK F1H223ZV
C52 CAP TANT 4U7 35V 20%	26486-219	U3613	SH
C53 CAP CER 10N 25V 20%	26383-008	K1439	SDPN RF0605
C54 CAP CER 47P 63V 2%	26343-473	K8996	2222 682
C55 CAP CER 3P3 63V .5PF	26343-459	K8996	2222 682
C56 CAP CER 3P3 63V .5PF	26343-459	K8996	2222 682
C57 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C58 CAP CER 270P 63V 2%	26343-482	K8996	2222 682
C61 CAP CER 680P 63V 10%	26383-583	K8996	630-18-681
C62 CAP CER 560P 63V 10%	26383-581	K8996	630-18
C63 CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C64 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C65 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C66 CAP PETP 470N 63V 10%	26582-427	K1945	R68 D C 4703 AAK
C67 CAP CER 22N 18V 20%	26383-007	U4011	ECK F1H223ZV
C68 CAP PETP 470N 63V 10%	26582-427	K1945	R68 D C 4703 AAK
C69 CAP CER 22N 18V 20%	26383-007	U4011	ECK F1H223ZV
C70 CAP CER 2P7 63V .5PF	26343-458	K8996	2222 682
C71 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
D1 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D2 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D3 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D4 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D5 DI ZEN BZX79C9V1 9.1V 5%	28371-757	K8996	BZX79 C9V1
D6 DI ZEN BZX79C5V1 5.1V 5%	28371-401	K8996	BZX79 C5V1
D7 DI H/CARR BAR19 4V !	28349-020	K6791	BAR19
D8 DI H/CARR BAR19 4V !	28349-020	K6791	BAR19
D9 DI H/CARR BAT29 5V !	28349-014	K6791	BAT 29 OR BAR 35
IC1 ICD CTR 74LS93 4BIT BIN 2,8,16	28464-117	K5519	SN74LS93N
IC2 ICA MOD/DMOD MC1496N BAL DIL14	28461-924	K6659	UA796PC
IC3 ICA PLL MC145145 4BIT BUS I/P !	28461-937	K5519	MC 145145P OR L
IC4 ICA AMP TLO74CN QUAD FET I/P	28461-349	K5519	TLO74CN
IC5 ICA VREG- 79L05AC 5V .1A TO92	28461-736	K5519	MC79L05AC
IC6 ICD NAND 74S00N QUAD 2INP	28466-331	K1196	ZN74S00E
IC7 ICA VREG+ 78L05AC 5V OA1 TO92	28461-734	K0461	UA78L05AC
L1 IND CHOKE 1.0UH 10% LAQ	23642-549	U4038	SC10 13
L2 IND CHOKE 47UH 10% LAQ	23642-559	U4038	SC10 33
L3 IND CHOKE 47UH 10% LAQ	23642-559	U4038	SC10 33
L4 IND CHOKE 1.0UH 5%	23642-464	U4251	3640 21
L5 IND CHOKE 1.0UH 5%	23642-464	U4251	3640 21
L6 IND CHOKE 100UH 10% LAQ	23642-561	U4038	SC10 37
L7 IND CHOKE 150UH 10% LAQ	23642-562	U4038	SC10 39
L8 IND CHOKE 33UH 10% LAQ	23642-558	U4038	SC10 31
L9 IND CHOKE 220UH 10% LAQ	23642-563	K0467	406 8 274 71 008
L11 IND CHOKE 150UH 10% LAQ	23642-562	U4038	SC10 39
L12 IND CHOKE 470UH 10% LAQ	23642-565	U4038	SC10 45

REPLACEABLE PARTS

Unit AA1 - RF modulation meter (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLC	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLD	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLE	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
R1	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R2	RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R3	RES MF 3K3 .25W 2% 100PPM	24773-285	K8996	MR25
R4	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R5	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R6	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R7	RES MF 3K3 .25W 2% 100PPM	24773-285	K8996	MR25
R8	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R9	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R11	RV CERM 50K LIN .5W 10%	25711-643	U0914	E2A
R12	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R13	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R14	RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R15	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R16	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R17	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R18	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R19	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R21	RES MF 560R .25W 2% 100PPM	24773-267	K8996	MR25
R22	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R23	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R24	RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R25	RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R26	RES MF 9K1 .25W 2% 100PPM	24773-296	K8996	MR25
R27	RV CERM 2K0 LIN .5W 10%	25711-639	U0914	E2A
R28	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R29	RES MF 390K .25W 2% 100PPM	24773-335	U2453	LR1 OR PR1
R30	RES MF 33R .25W 2% 100PPM	24773-237	K8996	MR25
R31	RES MF 75K .25W 2% 100PPM	24773-318	K8996	MR25
R32	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R33	RES MF 5K1 .25W 2% 100PPM	24773-290	K8996	MR25
R34	RES MF 5K6 .25W 2% 100PPM	24773-291	K8996	MR25
R35	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R36	RES MF 5K1 .25W 2% 100PPM	24773-290	K8996	MR25
R37	RES MF 5K6 .25W 2% 100PPM	24773-291	K8996	MR25
R38	RES MF 56R .25W 2% 100PPM	24773-243	K8996	MR25
R39	RES MF 56R .25W 2% 100PPM	24773-243	K8996	MR25
R40	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R41	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R42	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R43	RES MF 820K .25W 2% 100PPM	24773-344	U2453	LR1 OR PR1
R44	RES MF 300K .25W 2% 100PPM	24773-332	K8996	MR25
R45	RES MF 2K0 .25W 2% 100PPM	24773-280	K8996	MR25
R46	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R47	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25

## REPLACEABLE PARTS

## Unit AA1 - RF modulation meter (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R48	RES MF 560R .25W 2% 100PPM	24773-267	K8996	MR25
R49	RES MF 360R .25W 2% 100PPM	24773-282	K8996	MR25
R50	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R51	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R52	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R53	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R54	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R55	RES MF 560R .25W 2% 100PPM	24773-267	K8996	MR25
R56	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R57	RES MF 360R .25W 1% 100PPM	24762-639	K8479	H8N
R58	RES MF 61R1 .25W 1% 100PPM	24762-571	K8479	H8N
R59	RES MF 61R1 .25W 1% 100PPM	24762-571	K8479	H8N
R60	RES MF 3K9 .25W 2% 100PPM	24773-287	K8996	MR25
R61	RES CC 680R .125W 5%	24331-984	U0914	BB6815
R62	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R63	RES CC 560R .125W 5%	24331-965	U0914	BB5615
R64	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R65	RES CC 22R .125W 5%	24331-988	U0914	BB2205
R66	RES CC 220R .125W 5%	24331-976	U0914	BB2215
R67	RES CC 680R .125W 5%	24331-984	U0914	BB6815
R68	RES CC 22R .125W 5%	24331-988	U0914	BB2205
R69	RES CC 22R .125W 5%	24331-988	U0914	BB2205
R71	RES MF 50R0 .25W 1% 100PPM	24762-558	K8479	H8N
R72	RES MF 22K0 .125W 2%	24772-105	U0914	BB2235
R73	RES MF 22K0 .125W 2%	24772-105	U0914	BB2235
R74	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R75	RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R76	RES MF 620R .25W 2% 100PPM	24773-268	K8996	MR25
R77	RES MF 8K2 .25W 2% 100PPM	24773-295	K8996	MR25
R78	RES MF 3K0 .25W 2% 100PPM	24773-284	K8996	MR25
R79	RES MF 62R .125W 2% 100PPM	24772-044	U1395	MFR3
R81	RES MF 5K6 .25W 2% 100PPM	24773-291	K8996	MR25
R82	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R84	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R85	RES MF 160R .25W 2% 100PPM	24773-254	K8996	MR25
R86	RV THERM 4K 2% BEAD 2DC402	25685-244	15454	2DC402
R87	RES MF 3K0 .25W 2% 100PPM	24773-284	K8996	MR25
R88	RES MF 15K .25W 2% 100PPM	24773-301	K8996	MR25
R89	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R90	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R91	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R92	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R93	RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R94	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R95	RV THERM 50R NTC	26598-248		
R96	RES MF 15R .125W 2% 100PPM	24772-048	U1395	MFR3



REPLACEABLE PARTS

Unit AA1 – RF modulation meter (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
TR1	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR2	TR PSI MPSLO8 12V 700M - SW	28431-767	K5519	MPSLO8ORMPS4258
TR3	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR4	TR NJF J310 25V - 24MA	28459-028	K5519	J310
TR5	TR PSI BC308B 20V 130M - GEN	28433-455	K8300	BC252B
TR6	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR7	TR NSI BFY90 15V 1G - AMP	28452-157	K8996	BFY90
TR8	TR NSI BFY90 15V 1G - AMP	28452-157	K8996	BFY90
TR9	TR NJF J310 25V - 24MA	28459-028	K5519	J310
TR11	TR NSI BC109B&C 20V 150M - GEN	28452-77K	K8996	BC109B OR C
TR12	TR NSI BC109B&C 20V 150M - GEN	28452-777	K8996	BC109B OR C
TR13	TR PSI BC308B 20V 130M - GEN	28433-455	K8300	BC252B
TR14	TR PSI BC308B 20V 130M - GEN	28433-455	K8300	BC252B
TR15	TR NSI BC237A 45V 150M - GEN	28455-421	K1196	ZTX107AL
T1	MIN BALUN	43590-141	U2632	43590-141

REPLACEABLE PARTS

Unit AA2 - RF counter

10. When ordering, prefix circuit reference with AA2.

	Complete unit	44828-879	U2632	44828-879
C1	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C2	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C3	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C4	CAP CER 1P8 63V .5PF	26343-456	K8996	2222 682
C5	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C6	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C7	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C8	CAP CER 1P8 63V .25P	26343-456	K8996	2222 682
C9	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C10	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C11	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C12	CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C13	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C14	CAP CER 22N 18V 20%	26383-007	U4011	ECK F1H223ZV
C15	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C16	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C17	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C18	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C19	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C20	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C21	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C22	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C23	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C24	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C25	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C26	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C27	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C28	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C29	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C30	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C31	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C32	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C33	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C34	CAP CER 2N2 63V 10%	26383-587	K8996	630-18-222
D1	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D2	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D3	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D4	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D5	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D6	DI H/CARR BAT29 5V	28349-014	K6791	BAT 29 OR BAR 35
IC1	MOD HYB OM345 VHF/UHF AMP SIL	28461-351	K8996	OM345
IC2	MOD HYB OM345 VHF/UHF AMP SIL	28461-351	K8996	OM345
IC3	ICA AMP SL952 1GHZ LIMITING	28461-364	K0467	SL952
IC4	ICD CTR 844 10 DECADE CUSTOM	28464-021	K4567	MA844
IC5	ICD CTR 74LS90 4BIT DEC 2,5,10	28464-014	K5519	SN74LS90N
IC6	ICD DIV SP8610B /4 1GHZ	28464-024	K0467	SP8610B
IC7	ICD DIV SP8637B /10 DIL16	28464-027	K0467	SP8637B
IC8	ICD NOR 10102 QUAD 2INP	28466-219	K5519	MC10102 (P OR L)

## REPLACEABLE PARTS

## Unit AA2 - RF counter (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
R1	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R2	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R3	RES MF 61R1 .25W 1% 100PPM	24762-571	K8479	H8N
R4	RES MF 247R .25W 1% 100PPM	24762-631	K8479	H8N
R5	RES MF 61R1 .25W 1% 100PPM	24762-571	K8479	H8N
R6	RES MF 2R2 .25W 2% 100PPM	24773-209	U1395	RC55
R7	RES MF 50R0 .25W 1% 100PPM	24762-558	K8479	H8N
R8	RES MF 53R3 .25W 1% 100PPM	24762-557	K8479	H8N
R9	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R10	RES CC 33R .125W 5%	24331-978	U0914	BB3305
R11	RES CC 33R .125W 5%	24331-978	UU0914	BB3305
R12	RES CC 120R .125W 5%	24331-998	U0914	BB1215
R13	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R14*	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R15	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R16	RES CC 680R .125W 5%	24331-984	U0914	BB6815
R17	RES MF 680R .25W 2% 100PPM	24773-269	K8996	MR25
R18	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R19*	RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R20	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R21	RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R22	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R23	RES MF 680R .25W 2% 100PPM	24773-269	K8996	MR25
R24	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R25	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R26	RES MF 680R .25W 2% 100PPM	24773-269	K8996	MR25
R27	RES MF 56K .25W 2% 100PPM	24773-315	K8996	MR25
R28	RES MF 1K2 .25W 2% 100PPM	24773-275	K8996	MR25
R29	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R30	RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R32	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R33	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R34	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R35	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R36	RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R37	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R38	RES CC 180R .125W 5%	24331-961	U0914	BB1815
RLA	RELAY MAG 2CO 5V 62R	23486-101	U0611	172-5
TR1	TR PSI BCY70 40V 250M - GEN	28434-857	K6659	BCY70
TR2	TR PSI BCY70 40V 250M - GEN	28434-857	K6659	BCY70
TR3	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR4	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
X2	CABLE ASSY SMC/OE, AAO PLC-AA2	43130-192	U2632	43130-192

REPLACEABLE PARTS

Unit AA3 – RF synthesizer and oscillator

11. When ordering, prefix circuit reference with AA3.

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
Complete unit	44828-880	U2632	44828-880
C1 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C2 CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C3 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C4 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C5 CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C6 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C7 CAP CER 27P 63V 2%	26343-470	K8996	2222 682
C8 CAP CER 18P 63V 2%	26343-468	K8996	2222 682
C9 CAP CER 47N 50V 10% MONOL	26343-560	U2109	SR15 5C 473 KAA
C11 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C12 CAP CER 27P 63V 5%	26343-470	K8996	2222 682
C13 CAP CER 15P 63V 5%	26343-467	K8996	2222 682
C14 CAP CER 8P2 63V .5PF	26343-464	K8996	2222 682
C15 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C16 CAP CER 4P7 63V .5PF	26343-461	K8996	2222 682
C17 CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C18 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C19 CAP CER 8P2 63V .5PF	26343-464	K8996	2222 682
C21 CAP CER 10P 63V .5PF	26343-465	K8996	2222 682
C22 CAP CER 15P 63V 5%	26343-467	K8996	2222 682
C23 CAP CER 15P 63V 5%	26343-467	K8996	2222 682
C24 CAP CER 12P 63V 5%	26343-466	K8996	2222 682
C25 CAP CER 10P 63V .5PF	26343-465	K8996	2222 682
C26 CAP CER 100P 63V 2%	26343-477	K8996	2222 682
C27 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C28 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C29 CAP CER 8P2 63V .5PF	26343-464	K8996	2222 682
C31 CAP CER 4P7 63V .5PF	26343-461	K8996	2222 682
C32 CAP CER 8P2 63V .5PF	26343-464	K8996	2222 682
C33 CAP CER 2P7 63V .5PF	26343-458	K8996	2222 682
C34 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C35 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C36 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C37 CAP CER 15P 50V 5%	26386-766		0805 1K JAW TR
C38 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C39 CAP CER 12P 63V 5%	26343-466	K8996	2222 682
C40 CAP CER 8P2 50V .25PF	26386-954		0805 5K CAW TR
C41 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C42 CAP CER 15P 50V 5%	26386-766		0805 1K JAW TR
C43 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C44 CAP CER 100P 63V 2%	26343-477	K8996	2222 682
C45 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C46 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C47 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C48 CAP CER 2P7 63V .5PF	26343-458	K8996	2222 682

## REPLACEABLE PARTS

## Unit AA3 - RF synthesizer and oscillator (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
C49 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C50 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C51 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C52 CAP CER 8P2 63V .5PF	26343-464	K8996	2222 682
C53 CAP CER 3P3 63V .5PF	26343-459	K8996	2222 682
C54 CAP CER 8P2 63V .5PF	26343-464	K8996	2222 682
C55 CAP CER 2.2P 63V .5PF	26343-457	K8996	2222 682
C56 CAP CER 10P 63V .5PF	26343-465	K8996	2222 682
C57 CAP CER 12P 63V 5%	26343-466	K8996	2222 682
C58 CAP CER 12P 63V 5%	26343-466	K8996	2222 682
C59 CAP CER 2.2P 63V .5PF	26343-457	K8996	2222 682
C60 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C61 CAP CER 3P3 63V .5PF	26343-459	K8996	2222 682
C62 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C63 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C64 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C65 CAP CER 12P 50V 5%	26386-956	-	0805 1K JAW TR
C66 CAP CER 100P 63V 2%	26343-477	K8996	2222 682
C67 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C68 CAP CER 10P 50V .25PF	26386-955	-	0805 1K CAW TR
C69 CAP CER 10P 50V .25PF	26386-955	-	0805 1K CAW TR
C71 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C72 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C73 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C74 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C75 CAP CER 12P 63V 5%	26343-466	K8996	2222 682
C76 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C77 CAP CER 6P8 63V .5PF	26343-463	K8996	2222 682
C78 CAP CER 8P2 63V .5PF	26343-464	K8996	2222 682
C79 CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C80 CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C81 CAP CER 27P 63V 5%	26343-470	K8996	2222 682
C82 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C83 CAP ELEC 22U 25V 20%	26421-114	U4011	K22/25
C84 CAP CER 4P7 63V .5PF	26343-461	K8996	2222 682
C85 CAP CER 2P2 63V .5PF	26343-457	K8996	2222 682
C86 CAP CER 3P3 63V .5PF	26343-459	K8996	2222 682
C87 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C88 CAP CER 10P 63V .5PF	26343-465	K8996	2222 682
C89 CAP CER 15P 63V 5%	26343-467	K8996	2222 682
C90 CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C91 CAP CER 15P 63V 5%	26343-467	K8996	2222 682
C92 CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C93 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C94 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C95 CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C96 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C97 CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C98 CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C101 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102

REPLACEABLE PARTS

Unit AA3 – RF synthesizer and oscillator (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
C102 CAP ELEC 47U 16V 20%	26421-017	U2475	LRVB 47/16M
C103 CAP PETP 22N 63V 10%	26582-431	K1945	R68 D C 2202 AAK
C104 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C105 CAP PETP 22N 63V 10%	26582-431	K1945	R68 D C 2202 AAK
C106 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C107 CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C108 CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C109 CAP PETP 1UO 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C111 CAP PETP 1UO 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C112 CAP ELEC 47U 63V 20%+	26421-121	U4011	CEB4763
C113 CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C114 CAP ELEC 100U 6.3V 20%	26421-118	U4011	K100/6.3
C115 CAP PETP 1UO 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C116 CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C117 CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C118 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C119 CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C121 CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C122 CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C123 CAP CER 4P7 63V .5PF	26343-461	K8996	2222 682
C124 CAP CER 4P7 63V .5PF	26343-461	K8996	2222 682
D1 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D2 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D3 DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D4 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D5 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D6 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D7 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D8 DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D9 DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D10 DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D11 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D12 DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D13 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D14 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D15 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D16 DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D17 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D18 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D19 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D20 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D21 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D22 DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D23 DI ZEN BZX79C6V2 6.2V 5%	28371-481	K8996	BZX79 C6V2
D24 DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D25 to D33 DI SIL BA482 35V JUNC	28335-675	K8996	BA482

## REPLACEABLE PARTS

## Unit AA3 – RF synthesizer and oscillator (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
D101	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D102	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D103	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D104	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D105	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D106	LAMP LED CQY40L 3V RED	28624-104	K6617	CQY40L+CLIP+RING
D107	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D108	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D109	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D111	DI H/CARR BAT42 30V FAST	28349-013	K6791	BAT 42
D112	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D113	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D114	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D115	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D116	DI REC 1N4004 400V	28357-028	K6659	1N4004
IC1	MOD HYB OM350 40-860MHZ AMP	28461-371	K7584	OM350
IC2	ICA VREG- 79L05AC 5V .1A TO92	28461-736	K5519	MC79L05AC
IC3	ICA VREG+ LM317LZ ADJ .1A	28461-741	K7093	LM317LZ [PLASTIC]
IC4	MOD HYB OM350 40-860MHZ AMP	28461-371	K7584	OM350
IC101	ICD DIV HEF4751 UNIVERSAL	28469-433	K8996	HEF451VP [PLASTIC]
IC102	ICD SH-REG 40105 16X4BIT FIFO	28467-531	K4122	HCF40105BE OR BF
IC103	ICD NOR 4001 QUAD 2INP	28466-207	K6659	4001BPC
IC104	ICD DIV HEF4751 UNIVERSAL	28469-433	K8996	HEF451VP [PLASTIC]
IC105	ICD SH-REG 40105 16X4BIT FIFO	28467-531	K4122	HCF40105BE OR BF
IC106	ICD MISC HEF4750 FREQ SYNTH	28469-432	K8996	HEF4750VD [CRAMIC]
IC107	ICA AMP TLO71CP FET I/P DIL8	28461-347	K5519	TLO71CP
IC108	ICD DIV SP8647B/10,11 TTL O/P	28464-015	K0467	SP8647B
IC109	ICA AMP TLO71CP FET I/P DIL8	28461-347	K5519	TLO71CP
IC111	ICD FF-D MC10131L	28462-605	K5519	MC10131 (L OR P)
IC112	ICD DIV SP8685B /10,11 500MHZ	28464-026	K0467	SP8685B
L1	IND CHOKE 4.7UH 10% LAQ	23642-553	U4038	SC10 21
L2	IND RF 10UH	44290-805	U2632	44290-805W
L6	IND RF 10UH	44290-805	U2632	44290-805W
L14	IND RF 10UH	44290-805	U2632	44290-805W
L17	IND RF 10UH	44290-805	U2632	44290-805W
L28	IND CHOKE 4.7UH 10% LAQ	23642-553	U4038	SC10 21
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLC	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLD	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLZ	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
R1	RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R2	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R3	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R4	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R5	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R6	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R7	RES CC 4R7 .125W 5%	24331-985	U0914	BB47G5
R8	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R9	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R11	RES CC 47R .125W 5%	24331-975	U0914	BB4705

## REPLACEABLE PARTS

## Unit AA3 – RF synthesizer and oscillator (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R12	RES CC 180R .125W 5%	24331-961	U0914	BB1815
R13	RES MF 1K5 .25W 2% 100PPM	24773-277	K8996	MR25
R14	RES CC 33R .125W 5%	24331-978	U0914	BB3305
R15	RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R16	RES MF 39R .25W 2% 100PPM	24773-239	K8996	MR25
R17	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R18	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R19	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R21	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R22	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R23	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R24	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R25	RES CC 120R .125W 5%	24331-998	U0914	BB1215
R26	RES CC 68R .125W 5%	24331-957	U0914	BB68G5
R27	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R28	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R29	RES MF 39K .25W 2% 100PPM	24773-311	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R32	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R33	RES CC 270R .125W 5%	24331-992	U0914	BB2715
R34	RES MF 1K2 .25W 2% 100PPM	24773-275	K8996	MR25
R35	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R36	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R37	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R38	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R39	RES CC 33R .125W 5%	24331-978	U0914	BB3305
R40	RES MF 18K .25W 2% 100PPM	24773-303	K8996	MR25
R41	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R42	RES CC 100R .125W 5%	24331-997	U0914	BB1015
R43	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R44	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R45	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R46	RES MF 39K .25W 2% 100PPM	24773-311	K8996	MR25
R47	RES MF 56R .25W 2% 100PPM	24773-243	K8996	MR25
R48	RES MF 18K .25W 2% 100PPM	24773-303	K8996	MR25
R49	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R51	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R52	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R53	RES MF 18K .25W 2% 100PPM	24773-303	K8996	MR25
R54	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R55	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R56	RES CC 100R .125W 5%	24331-997	U0914	BB1015
R57	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R58	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R59	RES MF 39K .25W 2% 100PPM	24773-311	K8996	MR25
R61	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R62	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R63	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R64	RES MF 8K2 .25W 2% 100PPM	24773-295	K8996	MR25
R65	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25



## REPLACEABLE PARTS

## Unit AA3 – RF synthesizer and oscillator (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R66	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R67	RES CC 120R .125W 5%	24331-998	U0914	BB1215
R68	RES CC 10R .125W 5%	24331-974	U0914	BB1005
R69	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R71	RES CC 150R .125W 5%	24331-990	U0914	BB1515
R72	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R73	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R74	RES CC 33R .125W 5%	24331-978	U0914	BB3305
R75	RES CC 270R .125W 5%	24331-992	U0914	BB2715
R76	RES MF 1K2 .25W 2% 100PPM	24773-275	K8996	MR25
R77	RES MF 560R .25W 2% 100PPM	24773-267	K8996	MR25
R78	RES CC 4K7 .125W 5%	24331-970	U0914	BB4725
R79	RES CC 2K2 .125W 5%	24331-983	U0914	BB2225
R81	RES CC 4K7 .125W 5%	24331-970	U0914	BB4725
R82	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R83	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R84	RES CC 100R .125W 5%	24331-997	U0914	BB1015
R85	RES CC 2K2 .125W 5%	24331-983	U0914	BB2225
R86	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R87	RES MF 360R .25W 2% 100PPM	24773-262	K8996	MR25
R88	RES MF 3K3 .25W 2% 100PPM	24773-285	K8996	MR25
R89	RES CC 560R .125W 5%	24331-965	U0914	BB5615
R101	RN BUS 2K7 2% 1W 50V	24681-668	K5743	4610X-101
R102	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R103	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R104	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R105	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R106	RES MF 33K .25W 2% 100PPM	24773-309	K8996	MR25
R107	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R108	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R109	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R110	RES MF 1R2 .25W 2% 100PPM	24773-203	U1395	RC55
R111	RES MF 18K .25W 2% 100PPM	24773-303	K8996	MR25
R112	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R113	RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
R114	RES MG 2M2 .25W 5%	24321-877	K8996	VR25
R115	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R116	RES MF 20K .25W 2% 100PPM	24773-304	K8996	MR25
R117	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R118	RES MF 1K8 .25W 2% 100PPM	24773-279	K8996	MR25
R119	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R120	RES MF 1M 1/4W 2% 100PPM	24773-346	U2453	LR1 OR PR1
R121	RES MF 36R .25W 2% 100PPM	24773-238	K8996	MR25
R122	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R123	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R124	RES MF 36R .25W 2% 100PPM	24773-238	K8996	MR25
R125	RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R126	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R127	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R128	RES MF 620R .25W 2% 100PPM	24773-268	K8996	MR25

REPLACEABLE PARTS

Unit AA3 – RF synthesizer and oscillator (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R129	RES MF 620R .25W 2% 100PPM	24773-268	K8996	MR25
R130	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R131	RES MF 560R .25W 2% 100PPM	24773-267	K8996	MR25
R132	RES MF 560K .25W 2% 100PPM	24773-340	U2453	LR1 OR PR1
R133	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R134	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R135	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R136	RES MF 33K .25W 2% 100PPM	24773-309	K8996	MR25
R137	RES MF 1K5 .25W 2% 100PPM	24773-277	K8996	MR25
R138	RV CERM 200K LIN .5W 10%	25711-645	K8479	E2A
R139	RES MF 22R .25W 2% 100PPM	24773-233	K8996	MR25
R140	RES MF 680R .25W 2% 100PPM	24773-269	K8996	MR25
R141	RES CC 470R .125W 5%	24331-964	U0914	BB4715
R142	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R143	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R144	RES MF 4K7 1/4W 2% 100PPM	24773-289	K8996	MR25
R145	RES MF 4K7 1/4W 2% 100PPM	24773-289	K8996	MR25
R146	RES MF 470K .125W 2% 100PPM	24772-137	U1395	MFR3
R147	RES MF 10K .125W 2% 100PPM	24772-097	U0142	CMF51
R148	RES MF 20K .25W 2% 100PPM	24773-304	K8996	MR25
SK1	CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
SK2	CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
TR1	TR NSI BFR90 15V 5G - AMP	28452-167	K8996	BFR90 OR /02
TR2	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR3	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR4	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR5	TR NSI BFR90 15V 5G - AMP	28452-167	K8996	BFR90 OR /02
TR6	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR7	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR8	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR9	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR11	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR12	TR NSI BFR90 15V 5G - AMP	28452-167	K8996	BFR90 OR /02
TR13	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR101	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR102	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR103	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR104	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR105	TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A

## Unit AA4/1 - LF synthesizer and output amplifier

12. When ordering, prefix circuit reference with AA4/1.

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
	Complete unit	44829-613	U2632	44829-613
C1	CAP CER 2P7 63V .5PF	26343-484	K7584	2222 678 09278
C2	CAP CER 1P8 63V .5PF	26343-490	K7584	2222 678 09188
C3	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C4	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C5	CAP CER 22N 18V 20%	26383-007	U4011	ECK F1H223ZV
C6	CAP CER 1P8 63V .5PF	26343-498	K7584	2222 678 1-189
C7	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C8	CAP CER 1N2 63V 10%	26383-592	K8996	630-18-122
C9	CAP CER 3N9 63V 10%	26383-590	K8996	630-18-392
C10	CAP CER 10P 63V 5%	26343-492	K7584	2222 678
C11	CAP PETP 150N 100V 10%	26582-437	K1945	R68 D C 1503 AAK
C12	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C13	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C14	CAP CER 2P2 63V .25PF	26343-491	K7584	2222 678 09228
C15	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C16	CAP CER 12P 63V 5%	26343-497	K7584	2222 688 10129
C17	CAP CER 6P8 63V .5PF	26343-487	K7584	2222 678 09688
C18	CAP CER 22P 63V 5%	26343-489	K7584	2222 678 34229
C19	CAP CER 10P 63V .5PF	26343-492	K7584	2222 678
C20	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C21	CAP CER 8P2 63V .5PF	26343-488	K7584	2222 678 09828
C22	CAP CER 3N9 63V 10%	26383-590	K8996	630-18-392
C23	CAP CER 1N5 63V 10%	26383-593	K8996	630-18-152
C24	CAP CER 3N9 63V 10%	26383-590	K8996	630-18-392
C25	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C26	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C27	CAP CER 12P 63V 5%	26343-497	K7584	2222 678 10129
C28	CAP CER 10P 63V .5PF	26343-492	K7584	2222 678
C29	CAP CER 8P2 63V .5PF	26343-488	K7584	2222 678 09828
C31	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C32	CAP CER 2N7 63V 10%	26383-588	K7584	630-51-272
C33	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C34	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C35	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C36	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C37	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C38	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C39	CAP CER 12P 63V 2%	26343-497	K7584	2222 678 10129
C40	CAP CER 47P 63V 2%	26343-433	K7584	2222 678 34479
C41	CAP CER 56P 63V 2%	26343-444	K7584	2222 678 34569
C42	CAP CER 39P 63V 2%	26343-430	K7584	2222 678 34399
C43	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C44	CAP CER 33P 63V 2%	26343-494	K7584	2222 678 34399
C45	CAP CER 56P 63V 2%	26343-444	K7584	2222 678 34569
C46	CAP CER 56P 63V 2%	26343-444	K7584	2222 678 34569

REPLACEABLE PARTS

Unit AA4/1 - LF synthesizer and output amplifier (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C47	CAP CER 33P 63V 2%	26343-494	K7584	2222 678 34339
C48	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C50	CAP CER 82P 63V 2%	26343-432	K8996	2222 678 34151
C52	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C53	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C54	CAP CER 4P7 63V .5PF	26343-485	K8996	2222 678 09478
C55	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C56	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C57	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C58	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C59	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C60	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C61	CAP CER 10N 25V 20%	26386-759	K7584	1210 2B 223 K9BB
C62	CAP CER 220P 63V 2%	26343-436	K7584	2222 678 58271
C63	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C64	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C65	CAP CER 12P 63V 2%	26343-497	K7584	2222 678 10129
C66	CAP CER 10N 25V 20%	26386-759	K7584	1210 2B 223 K9BB
C67	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C68	CAP CER 560P 63V 10%	26383-581	K8996	630-18
C69	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C70	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C71	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C72	CAP CER 100N 30V 20%	26582-429	K1945	R69 DC 103 AAK
C73	CAP CER 22P 63V 2%	26343-489	K7584	2222 678 34299
C74	CAP CER 22P 63V 2%	26343-489	K7584	2222 678 34299
C75	CAP CER 15P 63V 2%	26343-937	K8996	2222 678 10159
C76	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C77	CAP PETP 470N 63V 10%	26582-427	K1945	R68 D C 4703 AAK
C79	CAP-VAR PLAS 15P 2P TRIM	26878-402	U2120	105 3901 015
C80	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C81	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C82	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C83	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C84	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C85	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C86	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C87	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C88	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C90	CAP CER 15P 63V .5PF	26343-493	K8996	2222 678 10159
C91	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C92	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C93	CAP CETR 22P 63V 2%	26343-489	K7584	2222 678 34299
C94	CAP CER 47N 50V 10% MON	26343-560	U2109	SR15 5C 473 KAA
C95	CAP CER 47N 50V 10% MON	26343-560	U2109	SR15 5C 473 KAA
D1	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D2	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D3	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D4	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D5	DI SIL BA482 35V JUNC	28335-675	K8996	BA482

REPLACEABLE PARTS

Unit AA4/1 – LF synthesizer and output amplifier (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
D6	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D7	DI PIN 5082-3379 50V	28383-997	K3464	HP5082 3379
D8	DI PIN 5082-3379 50V	28383-997	K3464	HP5082 3379
D9	DI PIN 5082-3379 50V	28383-997	K3464	HP5082 3379
D11	DI PIN 5082-3379 50V	28383-997	K3464	HP5082 3379
D12	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D13	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D14	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D15	DI SIL BA482 35V JUNC	28335-675	K8996	BA482
D16	DI H/CARR HP5082-2826 1V SETS	28349-011	K3464	HP5082 2826
D17	DI H/CARR HP5082-2826	28349-011	K3464	HP5082 2826
D18	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D19	DI V/CAP BB809 3V 29PF	28381-132	K8996	BB809
D22	DI ZEN BZX79C5V1 5.1V 5%	28371-401	K8996	BZX79 C5V1
D23	DI RECT BAV99 70V DOUBLE	28383-903	K8996	BAV99
D24	DI ZEN BZX79C5V1 5.1V 5%	28371-401	K8996	BZX79 C5V1
IC1	MOD HYB OM350 40-860MHZ AMP	28461-371	K7584	OM350
IC2	ICD DIV SP8604BCM/2 300MHZ	28462-022	K0467	SP8604BCM
IC3	ICA AMP NE531N J FET DIL8	28461-317	U3418	RC4531[TE OR DN]
IC4	MOD HYB OM345 VHF/UHF AMP SIL	28461-351	K8996	OM345
IC5	MOD HYB OM345 VHF/UHF AMP SIL	28461-351	K8996	OM345
IC6	MOD RF SBL-1 DOUBLE BAL MIXER	28531-002	15542	SBL-1
IC7	ICA AMP TLO71CP FET I/P DIL8	28461-347	K5519	TLO71CP
IC8	ICA HYB OM370L	28461-406	K7584	OM370L
IC9	ICD XOR 74LS86 QUAD 2INP	28466-406	K5519	SN74LS86N
IC10	ICD DIV SP8789B '20/21 225MHZ	28464-034	K0467	SP 8789DP
IC11	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
L5	IND CHOKE 22UH 10% LAQ	23642-557	U4038	SC10 29
L6	IND CHOKE 22UH 10% LAQ	23642-557	U4038	SC10 29
L7	IND CHOKE 1.0UH 10% LAQ	23642-549	U4038	SC10 13
L15	IND CHOKE 470UH 10% SCREENED	23642-333	U4251	553 3635 33
L16	IND CHOKE 3.3UH 10% LAQ	23642-552	K0467	406 8 274 69 016
L19	IND CHOKE 33UH 10% LAQ	44190-036	U2632	44190-036
L20	IND CHOKE 33UH 10% LAQ	23642-558	U4038	SC10 31
L21	IND CHOKE 40UH 10% LAQ	44190-036	U2632	44190-036
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
R1	RES CC 120R .125W 5%	24331-998	U0914	BB1215
R2	RES MF 12K .25W 2% 100PPM	24773-299	K8996	MR25
R3	RES MF 12K .25W 2% 100PPM	24773-299	K8996	MR25
R4	RES CC 120R .125W 5%	24331-998	U0914	BB1215
R5	RES CC 220R .125W 5%	24331-976	U0914	BB2215
R6	RES MF 560R .25W 2% 100PPM	24773-267	K8996	MR25
R7	RES MF 2K4 .25W 2% 100PPM	24773-282	K8996	MR25
R8	RES MF 220R .125W 2% 100PPM	24772-057	U0142	CMF51
R9	RES CC 220R .125W 5%	24331-976	U0914	BB2215
R11	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25

REPLACEABLE PARTS

Unit AA4/1 - LF synthesizer and output amplifier (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R12	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R13	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R14	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R15	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R16	RES MF 1K5 .25W 2% 100PPM	24773-277	K8996	MR25
R17	RES CC 120R .125W 5%	24331-998	U0914	BB1215
R18	RES MF 120R .25W 2% 100PPM	24773-251	K8996	MR25
R19	RES CC 82R .125W 5%	24331-996	U0914	BB8205
R21	RES CC 68R .125W 5%	24331-979	U0914	BB6805
R22	RES MF 1K0 .125W 2% 100PPM	24772-073	U0142	CMF51
R23	RES MF 2K4 .125W 2% 100PPM	24772-027	U0142	CMF51
R24	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R25	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R26	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R27	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R28	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R29	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R31	RES CC 150R .125W 5%	24331-990	U0914	BB1515
R30	RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R32	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R33	RES MF 12K .25W 2% 100PPM	24773-299	K8996	MR25
R34	RES MF 120R .25W 5%	24773-251	K8996	MR25
R35	RES CC 150R .125W 5%	24331-990	U0914	BB1515
R36*	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R37	RES CC 33R .125W 5%	24331-978	U0914	BB3305
R38	RES MF 470K .125W 2% 100PPM	24772-137	K7584	MR16 OR MRS16T
R39	RES MF 6K8 .25W 2%	24773-293	K8996	MR25
R40	RES CC 1K0 .125W 5%	24331-967	U0914	BB1025
R41	RES CC 680R .125W 5%	24331-984	U0914	BB6815
R42	RES MF 470K .125W 2% 100PPM	24772-137	K7584	MR16 OR MRS16T
R43	RES CC 1K8 .125W 5%	24331-947	U0914	BB1825
R44	RES CC 100R .125W 5%	24331-947	U0914	BB1825
R45	RES CC 47R .125W 5%	24331-975	U0914	BB4705
R46	RES MF 50R0 .25W 1% 100PPM	24762-558	K8479	H8N
R47	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R48	RES CC 470R .125W 5%	24331-964	U0914	BB4715
R50	RES MF 22R .25W 2% 100PPM	24773-233	K8996	MR25
R51	RES CC 1K8 .125W 5%	24331-947	U0914	BB1825
R52	RES CC 10R .125W 5%	24331-974	U0914	BB1005
R53	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R54	RES MF 96R3 .25W 1% 100PPM	24762-582	K8479	H8N
R55	RES MF 71R2 .25W 1% 100PPM	24762-572	K8479	H8N
R56	RES MF 96R3 .25W 1% 100PPM	24762-582	K8479	H8N
R57	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R58	RES MF 2K2 .125W 2% 100PPM	24772-081	U0142	CMF51

## REPLACEABLE PARTS

## Unit AA4/1 - LF synthesizer and output amplifier (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R59	RES CC 390R .125W 5%	24331-963	U0914	BB3915
R60	RES CC 680R .125W 5%	24331-984	U0914	BB6815
R61	RES MF 3K3 .25W 2% 100PPM	24773-285	K8996	MR25
R62	RES MF 270R .25W 2% 100PPM	24773-259	K8996	MR25
R63	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R64	RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
R70	RES MF 1K5 .25W 2% 100PPM	24773-277	K8996	MR25
R71	RES MF 150K .25W 2% 100PPM	24773-325	K8996	MR25
R74	RES MF 4K7 1/4W 2% 100PPM	24773-289	K8996	MR25
R75	RES MF 4K7 1/4W 2% 100PPM	24773-289	K8996	MR25
RLA	RELAY MAG 2CO 5V 62R	23486-101	U0611	172-5
SK1	CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
TR1	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR2	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR3	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR4	TR NSI BFR90 15V 5G - AMP	28452-167	K8996	BFR90 OR /02
TR5	TR NSI BFR90 15V 5G - AMP	28452-167	K8996	BFR90 OR /02
TR6	TR NSI BC209C 20V 150M - GEN	28452-771	K1196	ZTX109CL (NLC)
TR7	TR PSI BCY72 25V 200M - GEN	28433-487	K8300	BCY72
TR8	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
X10	CABLE ASSY SMA/OE, AA4-ATTEN	43130-192	U2632	43130-192

REPLACEABLE PARTS

Unit AB1/1 – Mother board

13. When ordering, prefix circuit reference with AB1/1.

	Complete unit	44829-523	U2632	44829-523
C3	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C4	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C5	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C6	CAP ELEC 470U 6V 20%+	26421-126	U4011	CEB4706
C8	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C9	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C10	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C11	CAP PETP 100N 63V 10%	26382-429	K1945	R68 D C 1003 AAK
C12	CAP ELEC 470U 16V 20%+	26421-127	U4011	CEB47016
C13	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C14	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C15	CAP PETP 100N 100V 10%	26582-211	K8300	PMT2R OR PMC2R
C16	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C17	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C18	CASP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C19	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C20	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C21	CAP CER 470P 63V 10%	26383-582	K8996	630-18-471
C22	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C23	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C24	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C25	CAP CER 2N2 63V 10%	26383-587	K8996	630-18-222
C26	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
D1	DI ZEN BZX79C5V1 5.1V 5%	28371-401	K8996	BZX79 C5V1
D2	DI ZEN BZX79C5V1 5.1V 5%	28371-401	K8996	BZX79 C5V1
D3	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D4	DI ZEN BZX79C4V7 4.7V 5%	28371-371	K8996	BZX79 C4V7
IC1	ICD DEC/DMX 74LS138 3-8	28465-027	K5519	SN74LS138N
IC2	ICD FF-D 74LS273 OCT +EDG TR	28462-615	K5519	SN74LS273N
IC3	ICD NAND 74LS30 8INP	28466-348	K5519	SN74LS30N
IC4	ICD BUFF 74LS244 OCT 3ST	28469-182	K5519	SN74LS244N
IC5	ICD NAND 74LS03 QUAD 2INP O/C	28466-346	K5519	SN74LS03N
IC6	ICA AMP TL072CP DUAL FET I/P	28461-348	K5519	TL072CP
IC7	ICD BUFF 74LS126A QUAD 3ST	28469-101	K5519	SN74LS126AN
IC8	ICD FF-D 74LS273 OCT +EDG TR	28462-615	K5519	SN74LS273N
IC9	ICD FF-D 74LS174 HEX +EDG TR	28462-612	K6659	74LS174PC
IC11	ICD DEC/DMX 74LS138 3-8	28465-027	K5519	SN74LS138N
IC12	ICD BUFF 74LS125A QUAD 3ST	28469-184	K0461	SN74LS125AN
IC13	ICA AMP LM380 AUDIO 2.5W DIL14	28461-372	K7093	LM380N
IC14	ICD FF-D 74LS377 OCT CKEN +E T	28462-619	K6659	74LS377PC
IC15	ICD FF-D 74LS377 OCT CKEN +E T	28462-619	K6659	74LS377PC
IC16	ICD BUFF 7416 HEX O/C INV 15V	28469-112	K0461	SN7416N
IC17	ICD BUFF 7416 HEX O/C INV 15V	28469-112	K0461	SN7416N
IC18	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC19	ICA MISC MT8870BE DTMF RX !	28461-962	K0467	MV 8870DP
IC20	ICA AMP TL072CP DUAL FET I/P	28461-348	K5519	TL072CP
IC21	ICD FF-D 74LS273 OCT +EDG TR	28462-615	K5519	SN74LS273N
IC22	ICD CTR 74LS90 4BIT DEC 2,5,10	28464-014	K5519	SN74LS90N



## REPLACEABLE PARTS

## Unit AB1/1 - Mother board (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
PLA TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLAA TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLAB TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLB CON-RF SMB-MALE 50 PCB STR	23444-334	K1072	GE65207BN
PLC TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLD CON PART MIN WAFER 9P 3008	23435-913	U1613	10-16-1091
PLE CON PART MIN WAFER 9P 3008	23435-913	U1613	10-16-1091
PLF TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLG TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLH TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLJ TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLK TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLM TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLP TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLR CON-RF SMB-MALE 50 PCB STR	23444-334	K1072	GE65207BN
PLS TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLT CON-RF SMB-MALE 50 PCB STR	23444-334	K1072	GE65207BN
PLU TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLW TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLX TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLY TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLZ TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
R1 RES NET 1K0 1W 2% 9SIP	24681-654	U0914	671210 1K0J
R2 RES MF 1K0 .25W 2%	24773-273	K8996	MR25
R3 RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R4 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R5 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R6 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R7 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R8 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R9 RES MF 470K .25W 2% 100PPM	24773-337	U2453	LR1 OR PR1
R11 RES MG 10M .25W 5%	24321-885	K8996	VR25
R12 RES MF 5K6 .25W 2% 100PPM	24773-291	K8996	MR25
R13 RES MF 18K .25W 2% 100PPM	24773-303	K8996	MR25
R14 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R15 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R16 RES MF 220K .25W 2% 100PPM	24773-329	K8996	MR25
R17 RES MF 5K6 .25W 2% 100PPM	24773-291	K8996	MR25
R18 RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R19 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R20 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R21 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R22 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R24 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R25 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R26 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R27 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R28 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25

REPLACEABLE PARTS

Unit AB1/1 – Mother board (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R29	RES MF 2R7 .25W 2% 100PPM	24773-211	U1395	RC55
R30	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R32	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R33	RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R34	RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R35	RES MF 470K .25W 2% 100PPM	24773-337	U2453	LR1 OR PR1
R36	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R37	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R38	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R39	RES MF 300K .25W 2% 100PPM	24773-332	K8996	MR25
R40	RES MF 300K .25W 2% 100PPM	24773-332	K8996	MR25
R41	RES MF 680K .25W 2% 100PPM	24773-342	U2453	LR1 OR PR1
R42	RES MF 270K .25W 2% 100PPM	24773-331	K8996	MR25
R43	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R44	RES MF 220K .25W 2% 100PPM	24773-329	K8996	MR25
R45	RES MF 180K .25W 2% 100PPM	24773-327	K8996	MR25
R46	RES MF 680R .25W 2% 100PPM	24773-289	K8996	MR25
R47	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R48	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R49	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
SKA	CON EDGE FEM 32 FXD .15" 2S K7	23435-827	K0574	T5M55740QQ32
SKB	CON EDGE FEM 32 FXD .15" 2S K7	23435-827	K0574	T5M55740QQ32
SKC	CON EDGE FEM 32 FXD .15" 2S K7	23435-827	K0574	T5M55740QQ32
SKD	CON EDGE FEM 32 FXD .15" 2S K7	23435-827	K0574	T5M55740QQ32
SKE	CON EDGE FEM 32 FXD .15" 2S K7	23435-827	K0574	T5M55740QQ32
TR1	TR PSI 2N2905A 60V 200M – GEN	28435-868	K6617	2N2905A
TR2	TR PSI BC307A 45V 130M – GEN	28435-227	K6360	BC307A
TR3	TR PSI BC307A 45V 130M – GEN	28435-227	K6360	BC307A
TR4	TR PSI BC307A 45V 130M – GEN	28435-227	K6360	BC307A
TR5	TR PSI BC307A 45V 130M – GEN	28435-227	K6360	BC307A
TR7	TR NMF VN10KM 60V 5R0 – VMOS !	28459-046	U5008	VN 10 KM
X1	XTAL 3.579545M P30P 140R –UM1	28312-112		
X19	CABLE ASSY.RIBBON, AB1/1 PLN-ATTEN	43130-185	U2632	43130-185

## Unit AB2/2 – Digital scope

14. When ordering, prefix circuit reference with AB2/2.

	Complete unit	44829-635	U2632	44829-635
C1	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C2	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C3	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C4	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C5	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C6	CAP ELEC 1U0 50V 20%	26421-106	U4011	K1.0/50
C7	CAP ELEC 1U0 50V 20%	26421-106	U4011	K1.0/50
C8	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C9	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C10	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C11	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C12	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C13	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C14	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C15	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C16	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C17	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C18	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C19	CAP CER 100P 500V 5%	26343-068	K7584	2222 652 58101
D1	DI H/CARR BAT42 30V FAST	28349-013	K6791	BAT 42
D2	DI H/CARR BAT42 30V FAST	28349-013	K6791	BAT 42
IC1	ICA ADC ADC0820 8BIT 2US	28461-935	K7093	ADC0820CCN
IC2	ICD FF-D 74LS273 OCT +EDG TR	28462-615	K5519	SN74LS273N
IC3	ICD COMP 74LS85 4BIT	28469-371	K5519	SN74LS85N
IC4	ICD COMP 74LS85 4BIT	28469-371	K5519	SN74LS85N
IC5	ICD COMP 74LS85 4BIT	28469-371	K5519	SN74LS85N
IC6	ICD COMP 74LS85 4BIT	28469-371	K5519	SN74LS85N
IC7	ICD FF-D 74LS273 OCT +EDG TR	28462-615	K5519	SN74LS273N
IC8	ICD FF-D 74LS273 OCT +EDG TR	28462-615	K5519	SN74LS273N
IC10	ICD MUX 74LS257 QUAD 2INP 3ST	28469-712	K5519	SN74LS257N
IC11	ICD MUX 74LS257 QUAD 2INP 3ST	28469-712	K5519	SN74LS257N
IC12	ICM RAM HM6116P-4 2KX8 200NS	28469-307	U4794	UPD446D-2 OR C-2
IC13	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC14	ICD MUX 74LS158 QUAD 2INP INV	28469-720	K0461	SN74LS158N
IC15	ICD MUX 74LS158 QUAD 2INP INV	28469-720	K0461	SN74LS158N
IC16	ICD MUX 74LS158 QUAD 2INP INV	28469-720	K0461	SN74LS158N
IC17	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130	K5519	SN74LS393N
IC18	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130	K5519	SN74LS393N
IC19	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130	K5519	SN74LS393N
IC21	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC23	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC24	ICD NOR 74LS02 QUAD 2INP	28466-214	K5519	SN74LS02N
IC25	ICD INV 74LS04 HEX	28469-171	K5519	SN74LS04N
IC26	ICD CTR 74LS390 DUAL 4BIT DEC	28464-127	K5519	SN74LS390N
IC27	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC28	ICD NAND 74LS10 TRIP 3INP	28466-351	K5519	SN74LS10N

## REPLACEABLE PARTS

## Unit AB2/2 - Digital scope (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
IC31	ICD MONO 555 TIMER	28468-304	K5519	MC1455P1
IC34	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC35	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC36	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC37	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC38	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC39	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC40	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC41	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC43	ICD CTR 74LS197 4BIT BIN PRE	28464-116	K5519	SN74LS197N
IC44	ICD INV 74LS04 HEX	28469-171	K5519	SN74LS04N
IC45	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC46	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC47	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC48	ICD DEC/DMX 74LS139 DUAL 2-4	28465-029	K5519	SN74LS139N
IC49	ICA VREG+ LM317LZ PROG OAI	28461-741	K7093	LM317LZ [PLAS.]
R1	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R2	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R3	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R4	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R5	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R6	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R7	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R8	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R9	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R10	RES MF 150K .25W 2% 100PPM	24773-325	K8996	MR25
R11	RES MF 390R .25W 2% 100PPM	24773-263	K8996	MR25
R12	RES MF 1K8 .25W 2% 100PPM	24773-279	K8996	MR25
R13	RES MF 3K9 .25W 2% 100PPM	24773-287	K8996	MR25
R14	RV CERM 2KOR LIN .5W 10% VERT	25711-609	K8479	E4A

## Unit AB3/2 – VDU board

15. When ordering, prefix circuit reference with AB3/2.

	Complete unit	44829-636	U2632	44829-636
C1	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C3	CAP ELEC 470N 50V 20%	26421-104	U4011	K. 47/50
C4	CAP ELEC 470N 50V 20%	26421-104	U4011	K. 47/50
C5	CAP ELEC 470N 50V 20%	26421-104	U4011	K. 47/50
C6	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C7	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C8	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C9	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C10	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C11	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C12	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C13	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C15	CAP TANT 1U0 35V 20%	26486-209	U3613	SH
C16	CAP CER 270P 63V 2%	26343-436	K7584	2222 678 58271
C17	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C18	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C19	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C20	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C21	CAP CER 22P 63V 2%	26343-489	K7584	2222 678 34229
C22	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C23	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
D1	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D2	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D3	DI ZEN BZX79C5V6 5.6V 5%	28371-417	K8996	BZX79 C5V6
D4	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D5	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
IC14	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC16	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130	K5519	SN74LS393N
IC17	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130	K5519	SN74LS393N
IC18	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130	K5519	SN74LS393N
IC19	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC20	ICD AND 4081 QUAD 2INP	28466-009	K6659	4081BPC
IC22	ICD INV 74LS04 HEX	28469-171	K5519	SN74LS04N
IC23	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC24	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC25	ICD NAND 74LS30 8INP	28466-348	K5519	SN74LS30N
IC26	ICD NAND 74LS10 TRIP 3INP	28466-351	K5519	SN74LS10N
IC27	ICD BUFF 74LS365A HEX 3ST	28469-194	K0461	SN74LS365AN
IC28	ICD CTR 74LS393 DUAL 4BIT BIN	28464-130	K5519	SN74LS393N
IC29	ICD MUX 74LS157 QUAD 2INP	28469-707	K5519	SN74LS157N
IC30	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC32	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC34	ICM RAM HM6116P-4 2KX8 20ONS	28469-307	U4794	UPD446D-2 OR C-2
IC36	ICD SH-REG 74LS165 8BIT PISO	28467-530	K0461	SN74LS165AN
IC37	ICD BUFF 74LS365A HEX 3ST	28469-194	K0461	SN74LS365AN
IC38	ICD NAND 74LS10 TRIP 3INP	28466-351	K5519	SN74LS10N

## REPLACEABLE PARTS

## Unit AB3/2 - VDU board (contd.)

Circuit Ref.	Description	Mil Part No.	Mfr. Code	Mfr. Part No.
IC39	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
IC40	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC42	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC43	ICD XOR 74LS86 QUAD 2INP	28466-406	K5519	SN74LS86N
IC44	ICD INV 74LS04 HEX	28469-171	K5519	SN74LS04N
IC45	ICD FF-D 74LS374 OCT +E TR 3ST	28462-618	K5519	SN74LS374N
IC46	ICD FF-D 74LS374 OCT +E TR 3ST	28462-618	K5519	SN74LS374N
IC47	ICD FF-D 74LS374 OCT +E TR 3ST	28462-618	K5519	SN74LS374N
IC48	ICA AMP TL074CN QUAD FET I/P	28461-349	K5519	TL074CN
IC49	ICD NAND 74LS00 QUAD 2INP	28466-345	K5519	SN74LS00N
L1	IND CHOKE 2U2 10%	23642-551	K0467	406 8 274 69 014
R1	RES MF 470K .25W 2% 100PPM	24773-337	U2453	LR1 OR PR1
R2	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R3	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R6	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R7	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R8	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R9	RES MF 220K .25W 2% 100PPM	24773-329	K8996	MR25
R10	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R11	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R13	RES MF 1M0 .25W 2% 100PPM	24773-346	U2453	LR1 OR PR1
R14	RES MF 1M0 .25W 2% 100PPM	24773-346	U2453	LR1 OR PR1
R16	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R17	RES MF 8K2 .25W 2% 100PPM	24773-295	K8996	MR25
R18	RES MF 1K2 .25W 2% 100PPM	24773-275	K8996	MR25
R24	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R25	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R26	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R27	RES MF 150R 1/4W 2% 100PPM	24773-253	K8996	MR25
SK1	S/C-ACC SKT DIL24 LOW PROFILE	28488-044	U2685	1824-AG-111D

REPLACEABLE PARTS

Unit AB4/1 – Microprocessor

16. When ordering, prefix circuit reference with AB4/1.

	Complete unit	44829-524	U2632	44829-524
C1	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C2	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C3	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C4	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C5	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C6	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C7	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C8	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C9	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C10	CAP CER 4N7 63V 10%	26383-591	K8996	630-18-472
C12	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C13	CAP ELEC 22U 25V 20%+	26415-805	U4011	CEA 22/25
C14	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C15	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C16	CAP ELEC 22U 40V 20%+	26415-805	U4011	CEA 22/25
C17	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C18	CAP PETP 470N 63V 10%	26582-427	K1945	R68 D C 4703 AAK
C22	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C23	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C24	CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C25	CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C26	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C27	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C28	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C29	CAP PC 10N0 250V 2%	26582-297	K8283	A2B 1004D
C30	CAP ELEC 470N 50V 20%	26421-104	U4011	K.47/50
C31	CAP PETP 1U0 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C33	CAP ELEC 1U0 50V 20%	26421-106	U4011	K1.0/50
C34	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C35	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C36	CAP ELEC 4U7 35V SUBMIN	26421-108	U4011	K4.7/35
C40	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C41	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C42	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C43	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C44	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C45	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C46	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C47	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C48	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C49	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C50	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C51	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C52	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C53	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C54	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C55	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C56	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA

## REPLACEABLE PARTS

## Unit AB4/1 - Microprocessor (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C57	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C58	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C59	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C60	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C61	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C62	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C63	CAP PETP 10N 63V 10%	26582-426	K1945	R68 DC 1001 AAK
C64	CAP PETP 10N 63V 10%	26582-426	K1945	R68 DC 1001 AAK
D1	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D2	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D3	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D4	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D5	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D6	ICA VREF ZNREF050 5V 1% TO18	28461-759	K1196	ZNREF050C1
D7	DI RECT 11DQ04 40V SCHOTTKY	28355-170	U5008	11DQ04
D8	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D9	DI ZEN BZX79C5V6 5.6V 5%	28371-417	K8996	BZX79 C5V6
D11	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D12	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D13	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D14	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D15	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D16	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D17	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
IC1	ICM MP P8085A 8BIT NMOS !	28469-396	K7664	MSL8085AP
IC2	ICD FF-D 74LS374 OCT +E TR 3ST	28462-618	K5519	SN74LS734N
IC3	ICA ADC 0809 8BIT 8CHAN MUX !	28461-945	K7093	ADC0809CCN
IC4	ICM MP-SUP AM9513A TIM'G CTLR !	28469-416	U1458	AM9513APC
IC5	ICD PAL EP310 DC-2	28469-491	U2632	EP310 DC-2
IC6	ICD FF-D 74LS175 QUAD +EDG TR	28462-614	K5519	SN74LS175N
IC7	ICD BUFF 74LS245 OCT TXRX	28469-188	K5519	SN74LS245N
IC8	ICD DEC/DMX 74LS138 3-8	28465-027	K5519	SN74LS138N
IC11	ICD FF-D 74LS374 OCT +E TR 3ST	28462-618	K5519	SN74LS374N
IC12	ICD FF-D 74LS273 OCT =EDG TR	28462-615	K5519	SN74LS273N
IC14	ICM RAM X2004P 512X8 BIT 28DIL !	28467-079	60395	X2004P OR X2004D
IC15	ICM BUFF 74LS245 OCT TXTX !	28469-188	K5519	SN74LS245N
IC16	ICM RAM HM6116P-4 2KX8 20ONS !	28469-307	U4794	UPD446D-2 OR C-2
IC17	ICD OR 74LS32 QUAD 2INP	28466-108	K5519	SN74LS32N
IC18	ICD DEC/DMX 74LS139 DUAL 2-4	28465-029	K5519	SN74LS139N
IC19	ICD FF-D 74LS273 OCT +EDG TR	28462-615	K5519	SN74LS273N
IC20	ICD MONO 556 DUAL TIMER	28468-312	K5519	MC3456P OR L
IC21	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC22	ICD AND/OR 74LS51 DUAL 2-3INP	28466-454	K6659	74LS51PC
IC23	ICD CTR 74LS390 DUAL 4BIT DEC	28464-127	K5519	SN74LS390N
IC24	ICD INV 74LS14 HEX SCHM	28469-176	K5519	SN74LS14N
IC25	ICD INV 74HCT14 HEX	28469-009	K7584	PC74HCT14P
IC26	ICD BUFF 74LS244 OCT 3ST	28469-182	K5519	SN74LS244N
IC27	ICD MUX 74LS151 8 INP	28469-715	K5519	SN74LS151N
IC28	ICD NAND 74LS00 QUAD 2 INP	28466-345	K5519	SN74LS00N



## REPLACEABLE PARTS

## Unit AB4/1 – Microprocessor (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
IC29	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
IC30	ICA AMP TLO72CP DUAL FET I/P	28461-348	K5519	TLO72CP
IC31	ICD MUX 74HC157 QUAD 2 INP	28469-729	K5519	MC74HC157N
IC32	ICA MISC AD536A RMS AC/DC CONV	28461-939	K7284	AD536AJH
IC33	ICD NAND 74LS00 QUAD 2 INP	28466-345	K5519	SN74LS00N
IC34	ICD NOR 74LS02 QUAD 2 INP	28466-214	K5519	SN74LS02N
IC36	ICD MONO 74LS122 RETR	28468-310	K5519	SN74LS122N
IC37	ICD FF-D 74LS74 DUAL +EDG TR	28462-611	K5519	SN74LS74AN
R1	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R3	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R5	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R6	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R7	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R8	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R9	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R10	RES MF 22K 1/8W 2% 100PPM	24772-105	U0142	CMF51
R11	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R12	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R13	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R14	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R15	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R16	RES MF 47R .25W 2% 100PPM	24773-241	K8996	MR25
R17	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R18	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R19	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R20	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R25	RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R26	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R28	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R29	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R30	RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
R31	RES MF 62K .25W 2% 100PPM	24773-316	K8996	MR25
R32	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R33	RES MF 150K .25W 2% 100PPM	24773-325	K8996	MR25
R34	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R35	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R36	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R37	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R38	RES MF 1K5 .25W 2% 100PPM	24773-277	K8996	MR25
R39	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R42	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R44	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R45	RES MF 300R .125W 2%	24772-060	U0142	CMF51
R46	RES MF 10K .125W 2%	24772-097	U0142	SMF51
R47	RES MF 300R .125W 2%	24772-060	U0142	CMF51
R48	RES MF 10K .125W 2%	24772-097	U0142	SMF51
R50	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R51	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25

REPLACEABLE PARTS

Unit AB4/1 – Microprocessor (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R52	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R53	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R54	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R55	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R56	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R57	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R58	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
R59	RES MF 470R 1/4W 2% 100PPM	24773-265	K8996	MR25
SK1	S/C-ACC SKT DIL28 LOW PROFILE	28488-045	U2685	1828-AG-111D
SK2	S/C-ACC SKT DIL28 LOW PROFILE	28488-045	U2685	1828-AG-111D
SK3	S/C-ACC SKT DIL20 LOW PROFILE	28488-034	U2685	1828-AG-111D
SK5	S/C-ACC SKT DIL24 LOW PROFILE	28488-044	U2685	1824-AG-111D
SK6	S/C-ACC SKT DIL40 LOW PROFILE	28488-046	U2685	1840-AG-111D
SK7	CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
SK8	CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
TR1	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR2	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR3	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL
TR4	TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZTX108BL

## Unit AB5/2 - Demodulation and scope

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
17.	When ordering, prefix circuit reference with AB5/2.			
	Complete unit	44829-770	U2632	44829-770
C102	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C103	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C104	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C105	CAP CER 120P 63V 2%	26343-438	K8996	2222 678 3
C106	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C107	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C108	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C109	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C110	CAP PETP 47N 63V 10%	26582-428	K1945	R68 D C 4702 AAK
C111	CAP CER 15P 63V 5%	26343-493	K8996	2222 682
C112	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C113	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C114	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C115	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C116	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C117	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C118	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C119	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C121	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C122	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C123	CAP PS 4N7 63V 1%	26538-918	K4642	EXFS/HR 4700/1%
C124	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C125	CAP CER 220P 63V 2%	26343-435	K7584	2222 678 58221
C126	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C127	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C128	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C129	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C130	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C131	CAP CER 560P 63V 10%	26383-581	K8996	630-18
C132	CAP CER 1N2 63V 10%	26383-592	K8996	630-18-122
C133	CAP ELEC 22U 25V 20%	26421-114	U4011	K22/25
C134	CAP ELEC 22U 25V 20%	26421-114	U4011	K22/25
C135	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C136	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C137	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C138	CAP CER 15P 63V 5%	26343-493	K8996	2222 678 10159
C139	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C140	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C141	CAP CER 330P 63V 2%	26343-447	K7584	2222 678 58331
C142	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C143	CAP CER 100P 63V 2%	26343-437	K8996	2222 678 34101
C144	CAP PETP 1U 50V 10%	26582-432	K1945	R68 C C 1004 AAK
C145	CAP PETP 330N 63V 10%	26582-408	K8283	M2B33101B
C146	CAP PETP 330N 63V 10%	26582-408	K8283	M2B33101B
C147	CAP CER 56P 63V 2%	26343-444	K7584	2222 678 34569

## REPLACEABLE PARTS

## Unit AB5/2 - Demodulation and scope (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C148	CAP CER 47P 63V 2%	26343-433	K8996	2222 678 34479
C200	CAP PETP 100N 250V 10%	26582-208	K8283	A1 B1013 B
C201	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C202	CAP CER 220P 63V 2%	26343-435	K7584	2222 678 58221
C203	CAP CER 1P8 63V .25PF	26343-490	K8996	2222 678 09188
C204	CAP CER 15P 63V 2%	26343-493	K8996	2222 678 10159
C205	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C206	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C207	CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C208	CAP PETP 220N 63V 10%	26538-430	K1945	R68 D C 2203 AAK
C300	CAP PS 22N0 63V 1%	26538-932	K1191	710 2200PF1%
C301	CAP PS 22N0 63V 1%	26538-932	K1191	710 2200PF1%
C302	CAP PS 22N0 63V 1%	26538-932	K1191	710 2200PF1%
C303	CAP PS 22N0 63V 1%	26538-932	K1191	710 2200PF1%
C304	CAP PS 22N0 63V 1%	26538-932	K1191	710 2200PF1%
C305	CAP PS 22N0 63V 1%	26538-932	K1191	710 2200PF1%
C306	CAP PS 10N0 63V 1%	26343-926	K8996	2222 443 4 1003
C307	CAP CER 220P 63V 2%	26343-435	K7584	222 678 58221
C308	CAP PS 10N0 63V 1%	26538-926	K8996	2222 443 4 1003
C309	CAP PS 2N7 63V 1%	26538-912	K8996	2222 443 8 2702
C310	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C311	CAP PS 4N7 63V 1%	26538-918	K4642	EXFS/HR 4700/1%
C312	CAP PS 4N7 63V 1%	26538-918	K4642	EXFS/HR 4700/1%
C313	CAP PS 4N7 63V 1%	26538-918	K4642	EXFS/HR 4700/1%
C314	CAP PS 4N7 63V 1%	26538-918	K4642	EXFS/HR 4700/1%
C315	CAP PC 100N 100V 2%	26582-299	K8283	A2B 1015D
C316	CAP PS 2N2 63V 1%	26538-910	K4642	EXFS/HR 2200/1%
C317	CAP PC 100N 100V 2%	26582-299	K8283	A2B 1015D
C318	CAP PS 22N 63V 1%	26538-932	K1191	710 2200PF1%
C319	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C320	CAP PETP 1U 50V 10%	26582-432	K1945	R68 D C 1003 AAK
C321	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C322	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C323	CAP ELEC 220U 16V 20%+	26421-124	U4011	CEB22016
C324	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C325	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C326	CAP CER 10N 25V 20%	26383-006	K1439	SDPN RF0605
C327	CAP CER 82P 63V 2%	26343-431	K8996	22222 678 34829
D100	DI ZEN BZX79C4V7 4.7V 5%	28371-371	K8996	BZX79 C4V7
D101	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D102	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D103	DI ZEN BZX79C4V7 4.7V 5%	28371-371	K8996	BZX79 C4V7
D200	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D300	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
IC100	ICA AMP TL071CP FET I/P DIL8	28461-347	K5519	TL071CP
IC101	ICA AMP TL072CP DUAL FET I/P	28461-348	K5519	TL072CP
IC102	ICA COMP LM311	28461-695	K5519	LM311N
IC103	ICD MONO 74121	28468-402	K8996	FJK101
IC104	ICA AMP TL074CN QUAD FET I/P	28461-349	K5519	TL074CN

REPLACEABLE PARTS

Unit AB5/2 – Demodulation and scope (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
IC105	ICA AMP TLO71CP FET I/P DIL8	28461-347	K5519	TLO71CP
IC106	ICA AMP AD712JN	28461-407		
IC107	ICA AMP TLO71CP FET I/P DIL8	28461-347	K5519	TLO71CP
IC108	ICA AMP TLO74CN QUAD FET I/P	28461-349	K5519	TLO74CN
IC200	ICA AMP TLO71CP FET I/P DIL8	28461-347	K5519	TLO71CP
IC201	ICA AMP TLO71CP FET I/P DIL8	28461-347	K5519	TLO71CP
IC202	ICA AMP OP27GP	28461-368	K5519	OP-27GDE
IC203	ICA AMP TLO72BCP FET I/P DIL8	28461-377	K0461	TLO72 BCP
IC204	ICA AMP TLO74BCN FET I/P DIL14	28461-378	K0461	TLO74 BCN
IC205	ICA AMP TLO72CP DUAL FET I/P	28461-348	K5519	TLO72CP
IC300	ICA AMP TLO74CN QUAD FET I/P	28461-349	K5519	TLO74CN
IC301	ICA AMP TLO74CN QUAD FET I/P	28461-349	K5519	TLO74CN
IC302	ICA AMP TLO72CP DUAL FET I/P	28461-348	K5519	TLO72CP
IC303	ICD BUFF 74LS244 OCT 3ST	28469-182	K5519	SN74LS244N
IC304	ICD FF-D 74LS377 OCT CKEN +E T	28462-619	K6659	74LS377PC
IC305	ICD FF-D 74LS377 OCT CKEN +E T	28462-619	K6659	74LS377PC
IC306	ICD FF-D 74LS377 OCT CKEN +E T	28462-619	K6659	74LS377PC
IC307	ICD DEC/DMX 74LS139 DUAL 2-4	28465-029	K5519	SN74LS139N
IC308	ICD DEC/DMX 74LS139 DUAL 2-4	28465-029	K5519	SN74LS139N
IC309	ICD DEC/DMX 74LS139 DUAL 2-4	28465-029	K5519	SN74LS139N
IC311	ICD DEC/DMX 74LS139 DUAL 2-4	28465-029	K5519	SN74LS139N
IC312	ICA SW DG211CJ QUAD CMOS !	28461-936	K7068	DG211CJ
IC313	ICA SW DG211CJ QUAD CMOS !	28461-936	K7068	DG211CJ
IC314	ICA SW DG211CJ QUAD CMOS !	28461-936	K7068	DG211CJ
IC315	ICA SW DG211CJ QUAD CMOS !	28461-936	K7068	DG211CJ
IC316	ICA SW DG211CJ QUAD CMOS !	28461-936	K7068	DG211CJ
IC317	ICA SW DG211CJ QUAD CMOS !	28461-936	K7068	DG211CJ
IC318	ICA SW DG529 41/P LATCH 18DIL !	28461-979	K7068	DG529CJ
IC319	ICA SW DG211CJ QUAD CMOS !	28461-936	K7068	DG211CJ
IC321	ICA AMP TLO74CN QUAD FET I/P	28461-349	K5519	TLO74CN
IC322	ICA SW SD5002 QUAD DMOS !	28469-717	K7068	SD5002N OR I
L101	IND CHOKE 1000UH 10% LAQ	23642-567	U4038	SC10 49
L300	IND CHOKE 33UH 10% LAQ	23642-558	U4038	SC10 31
L301	IND CHOKE 33UH 10% LAQ	23642-558	U4038	SC10 31
R102	RES MF 15K .25W 2% 100PPM	24773-301	K8996	MR25
R103	RES MF 82K .25W 2% 100PPM	24773-319	K8996	MR25
R104	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R105	RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R106	RV CERM 50K0 LIN .5W 10%	25711-612	U0914	E4A
R107	RES MF 4K99 .25W 0.5% 50PPM	24753-364	K8479	H8
R108	RES MF 3K0 .25W 0.5% 50PPM	24753-475	K8479	H8
R109	RES MF 2K .25W 0.5% 50PPM	24753-626	K8479	H8
R111	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R112	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R113	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R114	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R115	RES MF 39K .25W 2% 100PPM	24773-311	K8996	MR25
R116	RES MF 240R .25W 2% 100PPM	24773-258	K8996	MR25
R117	RES MF 54K6 .25W 0.5% 50PPM	24753-582	K8479	H8

REPLACEABLE PARTS

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
<b>Unit AB5/2 – Demodulation and scope (contd.)</b>			
R118 RES MF 110K .25W 0.5% 50PPM	24753-347	K8479	H8
R119 RES MF 78K7 .25W 0.5% 50PPM	24753-375	K8479	H8
R120 RES MF 470R .125W 2% 100PPM	24772-065	U0142	CMF51
R121 RES MF 24K3 .25W 0.5% 50PPM	24753-618	K8479	H8
R122 RES MF 48K7 .25W .5% 50PPM	24753-351	K8479	H8
R123 RES MF 28K0 .25W 0.5% 50PPM	24753-370	K8479	H8
R124 RES MF 9K1 .25W 2% 100PPM	24773-296	K8996	MR25
R125 RES MF 9K1 .25W 2% 100PPM	24773-296	K8996	MR25
R126 RES MF 33K .25W 2% 100PPM	24773-309	K8996	MR25
R127 RES MF 470K .25W 2% 100PPM	24773-337	U2453	LR1 OR PR1
R128 RES MF 8K2 .25W 2% 100PPM	24773-295	K8996	MR25
R129 RV CERM 10K LIN .5W 10%	25711-603	K8479	E4A
R131 RES MF 36K .25W 2% 100PPM	24773-310	K8996	MR25
R132 RES MF 160K .25W 2% 100PPM	24773-326	K8996	MR25
R133 RES MF 1K00 .25W 0.5% 50PPM	24753-624	K8479	H8
R134 RES MF 8K66 .25W 0.5% 50PPM	24753-377	K8479	H8
R135 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R136 RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R137 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R138 RV CERM 100K LIN .5W 10%	25711-613	K8479	E4A
R139 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R141 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R142 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R143 RES MF 33K .25W 2% 100PPM	24773-309	K8996	MR25
R144 RES MF 39K .25W 2% 100PPM	24773-311	K8996	MR25
R145 RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R146 RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R147 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R148 RES MF 1K8 .25W 2% 100PPM	24773-279	K8996	MR25
R149 RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R150 RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R151 RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R152 RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R153 RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R154 RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R155 RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R156 RES MF 5K1 .25W 2% 100PPM	24773-290	K8996	MR25
R157 RES MF 54K6 .25W 0.5% 50PPM	24753-582	K8479	H8
R158 RES MF 110K .25W 0.5% 50PPM	24753-347	K8479	H8
R159 RES MF 78K7 .25W 0.5% 50PPM	24753-375	K8479	H8
R160 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R161 RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R162 RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R163 RES MF 24K3 .25W 0.5% 50PPM	24753-618	K8479	H8
R164 RES MF 48K7 .25W .5% 50PPM	24753-351	K8479	H8
R165 RES MF 28K0 .25W 0.5% 50PPM	24753-370	K8479	H8
R166 RES MF 470K .25W 2% 100PPM	24773-337	U2453	LR1 OR PR1
R167 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R168 RV CERM 5K0 LIN .5W 10%	25711-610	K8479	E4A
R169 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25

REPLACEABLE PARTS

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
<b>Unit AB5/2 – Demodulation and scope (contd.)</b>			
R171 RES MF 39K .25W 2% 100PPM	24773-311	K8996	MR25
R172 RV CERM 10K LIN .5W 10%	25711-603	K8479	E4A
R173 RES MF 220K .25W 2% 100PPM	24773-329	K8996	MR25
R174 RES MF 220K .25W 2% 100PPM	24773-329	K8996	MR25
R175 RES MF 4K7 1/4W 2% 100PPM	24773-289	K8996	MR25
R176 RES MF 150K 1/4W 2% 100PPM	24773-325	K8996	MR25
R177 RES MF 56K 1/4W 2% 100PPM	24773-315	K8996	MR25
R200 RES MF 3K3 .25W 2% 100PPM	24773-285	K8996	MR25
R201 RES MF 1M0 .25W .5% 50PPM	24753-337	K8479	H8
R202 RES MF 470K .25W 2% 100PPM	24773-337	U2453	LR1 OR PR1
R203 RES MF 54K6 .25W 0.5% 50PPM	24753-582	K8479	H8
R204 RES MF 499K .25W 0.5% 50PPM	24753-363	K8479	H8
R205 RES MF 40K2 .25W .5% 50PPM	24753-355	K8479	H8
R206 RES MF 4K32 .25W 0.5% 50PPM	24753-640	K8479	H8
R207 RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R208 RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R209 RV CERM 2KOR LIN .5W 10%	25711-609	K8479	E4A
R210 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R211 RES MF 40K2 .25W .5% 50PPM	24753-355	K8479	H8
R212 RES MF 4K0 .25W 0.5% 50PPM	24753-482	K8479	H8
R213 RV CERM 100K LIN .5W 10%	25711-613	K8479	E4A
R214 RES MF 220K .25W 2% 100PPM	24773-329	K8996	MR25
R215 RES MF 330R .25W 2% 100PPM	24773-261	K8996	MR25
R216 RES MF 4K99 .25W 0.5% 50PPM	24753-364	K8479	H8
R217 RES MF 3K0 .25W 0.5% 50PPM	24753-475	K8479	H8
R218 RES MF 1K00 .25W 0.5% 50PPM	24753-624	K8479	H8
R219 RES MF 1K00 .25W 0.5% 50PPM	24753-624	K8479	H8
R220 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R221 RES MF 200K .25W 2% 100PPM	24773-328	K8996	MR25
R222 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R223 RES MF 91K .25W 2% 100PPM	24773-320	K8996	MR25
R224 RES MF 11K .25W 2% 100PPM	24773-298	K8996	MR25
R225 RES MF 20K .25W 2% 100PPM	24773-304	K8996	MR25
R226 RES MF 40K2 .25W .5% 50PPM	24753-355	K8479	H8
R227 RES MF 4K32 .25W 0.5% 50PPM	24753-640	K8479	H8
R228 RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R229 RES MF 15K .25W 2% 100PPM	24773-301	K8996	MR25
R231 RV CERM 10K LI .5W 10%	25711-603	K8479	E4A
R232 RES MF 18K72 .25W 0.5% 50PPM	24753-539	K8479	H8
R233 RES MF 1K87 .25W 0.5% 50PPM	24753-642	K8479	H8
R234 RES MF 10K .25W 0.5% 50PPM	24753-628	K8479	H8
R235 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R236 RES MF 4K99 .25W 0.5% 50PPM	24753-364	K8479	H8
R237 RES MF 3K0 .25W 0.5% 50PPM	24753-475	K8479	H8
R238 RES MF 1K00 .25W 0.5% 50PPM	24753-624	K8479	H8
R239 RES MF 1K00 .25W 0.5% 50PPM	24753-624	K8479	H8
R241 RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25
R242 RES MF 10R .25W 2% 100PPM	24773-225	K8996	MR25

REPLACEABLE PARTS

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
<b>Unit AB5/2 – Demodulation and scope (contd.)</b>			
R243 RV CERM 100K LIN .5W 10%	25711-613	K8479	E4A
R244 RV CERM 100K LIN .5W 10%	25711-613	K8479	E4A
R245 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R300 RES MF 3K57 .25W 0.5% 50PPM	24753-479	K8479	H8
R301 RES MF 150K0 .25W 0.5% 50PPM	24753-542	K8479	H8
R302 RES MF 8K45 .25W 0.5% 50PPM	24753-376	K8479	H8
R303 RES MF 29K4 .25W 0.5% 50PPM	24753-371	K8479	H8
R304 RES MF 30K8 .25W 0.5% 50PPM	24753-580	K8479	H8
R305 RV CERM 5K0 LIN .5W 10%	25711-610	K8479	E4A
R306 RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R307 RES MF 35K7 .25W 0.5% 50PPM	24753-372	K8479	H8
R308 RES MF 12K7 .25W 0.5% 50PPM	24753-367	K8479	H8
R309 RES MF 12K7 .25W 0.5% 50PPM	24753-367	K8479	H8
R310 RES MF 6K92 .25W 0.5% 50PPM	24753-570	K8479	H8
R311 RES MF 15K0 .25W 0.5% 50PPM	24753-538	K8479	H8
R312 RES MF 59K0 .25W 0.25% 25PPM	24732-261	K8479	H8
R313 RES MF 5K23 .25W 0.25% 25PPM	24732-262	K8479	H8
R314 RV CERM 20K LIN .5W 10%	25711-611	W0914	E4A
R315 RES MF 226K .25W 0.25% 25PPM	24732-200	K8479	H8
R316 RES MF 19K6 .25W 0.25% 25PPM	24732-265	K8479	H8
R317 RES MF 39K2 .25W 0.25% 25PPM	24732-264	K8479	H8
R318 RES MF 61K9 .25W 0.5% 50PPM	24753-583	K8479	H8
R319 RES MF 59K0 .25W 0.25% 25PPM	24732-261	K8479	H8
R320 RV CERM 20K LIN .5W 10%	25711-611	U0914	E4A
R321 RES MF 5K23 .25W 0.25% 25PPM	24732-262	K8479	H8
R322 RES MF 232K .25W 0.25% 25PPM	24732-263	K7584	MR25 OR MPR24
R323 RES MF 19K6 .25W 0.25% 25PPM	24732-265	K8479	H8
R324 RES MF 39K2 .25W 0.25% 25PPM	24732-264	K8479	H8
R325 RES MF 90K9 .25W 0.5% 50PPM	24753-378	K8479	H8
R326 RES MF 34K0 .25W 0.5% 50PPM	24753-362	K8479	H8
R327 RES MF 34K0 .25W 0.5% 50PPM	24753-362	K8479	H8
R328 RES MF 40K2 .25W .5% 50PPM	24753-355	K8479	H8
R329 RES MF 12K7 .25W 0.5% 50PPM	24753-367	K8479	H8
R331 RES MF 12K7 .25W 0.5% 50PPM	24753-367	K8479	H8
R332 RES MF 23K2 .25W 0.5% 50PPM	24753-369	K8479	H8
R334 RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R335 RES MF 750R .25W 2% 100PPM	24773-270	K8996	MR25
R336 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R337 RES MF 470R .125W 2% 100PPM	24772-065	U0142	CMF51
R338 RES MF 470R .125W 2% 100PPM	24772-065	U0142	CMF51
R339 RV 10K LIN 0.5W 10% VERT	25711-603	K8479	E4A
R340 RES MG 10M 1/4W 5%	24321-885	K8996	VR25



REPLACEABLE PARTS

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
<b>Unit AB5/2 – Demodulation and scope (contd.)</b>			
RLA RELAY REED 1NO 5V 500R DIL SCR	23486-525	K7144	97 1 A 5/83D
SKA CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
TR100 TR NSI BC209C 20V 150M – GEN	28452-771	1196	ZTX109CL (NLC)
TR101 TR NMF 40673 20V 400M DG !	28459-010	88285	40673
TR102 TR NSI BC109B&C 20V 150M – GEN	28452-777	K8996	BC109B OR C

REPLACEABLE PARTS

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
<b>Unit AB6/1 – AF synthesizer</b>			
18. When ordering, prefix circuit reference with AB6/1.			
Complete unit	44829-526	U2632	44829-526
C1 CAP CER 100U 35V 20%+	26421-122	U4011	CEB10035
C2 CAP CER 15P 63V 2%	26343-445	K7584	2222 678 52159
C3 CAP CER 470P 63V 10%	26383-582	K1439	K8996 630-18-471
C4 CAP PS IN2 63V 1%	26538-904	K4642	EXFS/HR 1200/1%
C5 CAP CER 68P 63V 2%	26343-434	K7584	2222 678 34689
C6 CAP CER 15P 63V 2%	26343-445	K1439	SDPN RF0605
C7 CAP CER 470P 63V 10%	26383-582	K1439	K8996 630-18-471
C8 CAP CAP PS IN2 63V 1%	26538-904	K1439	SDPN RF0605
C9 CAP CER 68P 63V 2%	26343-434	K4701	199D
C10 CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C11 CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C12 CAP PETP 100N 100V 10%	26582-211	K8300	PMT2R OR PMC2R
C13 CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C14 CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C15 CAP PS 4N7 63V 1%	26538-918	K4642	EXFS/HR 4700/1%
C16 CAP PS 15N0 63V 1%	26538-930	K8996	2222 443 4 1503
C17 CAP PS 8N2 63V 1%	26538-924	K4642	EXFS/HR 8200/1%
C18 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C19 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C20 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C21 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C22 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C23 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C24 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C25 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C26 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C27 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C29 CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C30 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C31 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C32 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C33 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C34 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C35 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C36 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C37 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C38 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C39 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C40 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C41 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C42 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C43 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C44 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C45 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C46 CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA

## REPLACEABLE PARTS

## Unit AB6/1 - AF synthesizer (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C47	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C48	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C49	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C50	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C51	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C52	CAP CER 10N 50V 20%	26346-120	U2109	MA10 5C103 MAA
C53	CAP ELEC 33U 25V 20%	26421-115	U4011	K33/25
C54	CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C55	CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C56	CAP ELEC 100U 35V 20%+	26421-122	U4011	CEB10035
C57	CAP CER 120P 63V 2%	26343-438	K8996	2222 678 3
C58	CAP CER 33P 63V 2%	26343-494	K7584	2222 678 34339
C59	CAP CER 15P 63V 2%	26343-445	K7584	2222 678 52159
C60	CAP CER 15P 63V 2%	26343-445	K7584	2222 678 52159
C61	CAP CER 33P 63V 2%	26343-494	K7584	2222 678 34339
C62	CAP CER 33P 63V 2%	26343-494	K7584	2222 678 34339
C63	CAP CER 15P 63V 2%	26343-445	K7584	2222 678 52159
C64	CAP CER 15P 63V 2%	26343-445	K7584	2222 678 52159
C65	CAP PETP 220N 63V 10%	26582-430	K1945	R68 D C 2203 AAK
C66	CAP CER 100P 63V 2%	26343-437	K8995	2222 678 34101
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
D1	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D2	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D3	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D4	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D5	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D6	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D7	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D8	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D9	DI ZEN 1N825/A 6.2V 5%	28371-494	k8996	1N825 OR A
D10	DI ZEN 1N825/A 6.2V 5%	28371-494	k8996	1N825 OR A
D11	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D12	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D13	DI ZEN 1N825/A 6.2V 5%	28371-494	k8996	1N825 OR A
D14	DI ZEN 1N825/A 6.2V 5%	28371-494	k8996	1N825 OR A
IC1	ICD FF-D 74HC273 OCT +EDG TR	28462-627	K5519	MC74HC273N
IC2	ICD LA L5A0586 (CUSTOM) 68PLCC	44528-001		
IC3	ICD LA L5A0586 (CUSTOM) 68PLCC	44528-001		
IC6	ICA DAC AD7524JN 8BIT	28469-400	K7284	AD7524JN OR AD
IC7	ICA DAC AD7524JN 8BIT	28469-400	K7284	AD7524JN OR AD
IC8	ICA AMP NE5532 DUAL LN DIL8	28461-363	K0461	NE5532N
IC9	ICA AMP NE5532 DUAL LN DIL8	28461-363	K0461	NE5532N
IC10	ICA DAC AD7537 12BITS 24DIL	28461-977	K7284	AD7537JN
IC11	ICA AMP TL074CN QUAD FET I/P	28461-349	K5519	TL074CN

REPLACEABLE PARTS

Unit AB6/1 - AF synthesizer (contd.)

Circuit Ref.	Description	MI No.	Part No.	Mfr. Code	Mfr. Part No.
IC12	ICA AMP 2030 AUDIO 14W T0220		28461-495	K4122	TDA 2030 H
IC13	ICA DAC AD7528JN DUAL 8BIT !		28469-428	K7284	AD7528JN
IC14	ICA AMP TL074CN QUAD FET I/P		28461-349	K5519	TL074CN
IC15	ICA DACAD7528JN DUAL 8BIT !		28469-428	K7284	AD7528JN
IC16	ICD AMP TL074CN QUAD FET I/P		28461-349	K5519	TL074CN
IC17	ICD FF-D 74LS273 OCT +EDG TR !		28462-627	K5519	MC74HC273N
IC18	ICD FF-D 74LS273 OCT +EDG TR !		28462-627	K5519	MC74HC273N
IC19	ICD FF-D 74LS273 OCT +EDG TR !		28462-627	K5519	MC74HC273N
IC20	ICA DAC 7545 12BIT MULT BUFF !		28469-436	K7284	AD7545JN OR KN
IC22	ICA NAND 74HC00 QUAD 2 INP !		28466-365	K5519	MC74HC00N
IC23	ICD/DMX 74HC138 3-8 !		28465-040	K5519	MC74HC138N
IC24	ICA/DMX 74HC138 3-8 !		28465-040	88285	CD74HC138E
IC25	ICA AMP TL074CN QUAD FET I/P		28461-349	K5519	TL074CN
IC26	ICA SW DG411 SPST (CMOS) 16DIL		28461-978	K7068	DG411DJ
IC27	ICA SW DG411 SPST (CMOS) 16DIL		28461-978	K7068	DG411DJ
IC28	ICA SW DG411 SPST (CMOS) 16DIL		28461-978	K7068	DG411DJ
IC29	ICA SW DG411 SPST (CMOS) 16DIL		28461-978	K7068	DG411DJ
IC30	ICD FF-D 74HC273 OCT +EDG TR !		28462-627	K5519	MC74HC273N
IC31	ICD BUFF 74HC244 OCT 3ST !		28469-128	K5519	MC74HC273N
IC34	ICA SW DG411 SPST (CMOS) 16DIL		28461-978	K7068	DG411DJ
IC35	ICD INV 74HC14 HEX SCHMITT !		28469-119	K5519	MC74HC14N
IC36	ICD FF-D 74LS175 QUAD +EDG TR		28462-614	K5519	SN74LS175N
IC37	ICD LATCH 74HCT573 OCT ET 3S !		28462-422	K7584	PC74HCT573P
IC38	ICD MONO 74HC123 DUAL RETR		28468-315	K7093	MM74HC123AN
IC38	ICD MONO 74HC123 DUAL RETR !		28468-315	K7093	MM74HC123AN
IC39	ICD FF-D 74HC74 +EDG TRIG !		28462-622	K5519	MC74HC74N
IC40	ICA OP AMP TLO71CP SINGLE		28461-347	K5519	TLO71CP
L1	IND CHOKE 2H2 10% LAQ		23642-551	K0467	406 8 274 69 014
L2	IND CHOKE 10UH 10% LAQ		23642-555	U4038	SC10 25
L3	IND CHOKE 2H2 10% LAQ		23642-551	0467	406 8 274 69 014
L4	IND CHOKE - 2.5 TURNS		23642-909	K8996	4312 020 36700
R1	RV CERM 10K LIN .3W 10%		25748-507	K5743	3006P
R2	RES MF 620R .25W 2% 100PPM		24773-268	K8996	MR25
R3	RES MF 10K0 .25W 1% 50PPM		24723-405	K8479	H8
R4	RES MF 10K0 .25W 1% 50PPM		24723-405	K8479	H8
R5	RES MF 10K0 .25W 1% 50PPM		24723-405	K8479	H8
R6	RES MF 10K0 .25W 1% 50PPM		24723-405	K8479	H8
R7	RES MF 10K0 .25W 1% 50PPM		24723-405	K8479	H8
R8	RES MF 10K0 .25W 1% 50PPM		24723-405	K8479	H8
R9	RES MF 1K09 .25W 1% 50PPM		24723-215	U0142	EE-0,10-1K09-B-C2
R10	RES MF 10K .25W 1% 100PPM		24723-405	K8479	H8
R11	RES MF 1K09 .25W 0.15 100PPM		24723-215	U0142	EE-0,10-1K09-B-C2
R12	RES MF 10K .25W 0.1% 100PPM		24723-405	K8479	H8
R14	RES MF 40K .25W 0.5% 50PPM		24723-375	K7584	MR25 OR MPR24
R15	RES MF 13K3 .25W 0.5% 50PPM		24753-359	K8479	H8
R16	RES MF 2K .25W .2% 50PPM		24773-280	K8996	MR25

## Unit AB6/1 – AF synthesizer (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R17	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R18	RES MF 10K .25W .2% 50PPM	24773-297	K8996	MR25
R19	RES MF 10K .25W .2% 50PPM	24773-297	K8996	MR25
R20	RV CERM 10K LIN .3W 10%	25748-507	K5743	3006P
R21	RES MF 750R .25W .2% 50PPM	24773-270	K8996	MR25
R22	RES MF 13K3 .25W 0.5% 50PPM	24753-359	K8479	H8
R23	RES MF 40K .25W 0.1% 50PPM	24723-375	K7584	MR25 OR MPR24
R24	RES MF 10K0 .125W 2% 50PPM	24772-097	U0142	CMF51
R25	RES MF 1M0 .125W 2% 100PPM	24772-141	U0142	CMF51
R26	RES MF 3K6 .25W 2% 50PPM	24773-286	K8996	MR25
R27	RES MF 6K65 .25W 0.5% 50PPM	24753-374	K8479	H8
R28	RES MF 20K0 .25W 0.5% 50PPM	24753-663	K8479	H8
R29	RES MF 20K0 .25W 0.5% 100PPM	24753-663	K8479	H8
R30	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R31	RES MF 34K .25W 5% 100PPM	24753-362	K8479	H8
R32	RES MF 33K .25W .55 100PPM	24753-309	K8996	MR25
R33	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R34	RES MF 15K .25W 2% 100PPM	24773-301	K8996	MR25
R35	RES MF 15K .25W 2% 100PPM	24773-301	K8996	MR25
R36	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R37	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R38	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R39	RES RN ISOL 330R 2% 16DIL	24681-513	U4736	761 3
R41	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R42	RES MF 390K .25W 2% 100PPM	24773-335	U2453	LR1 OR PR1
R43	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R44	RES MF 13K .25W 2% 100PPM	24773-300	K8996	MR25
R45	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R46	RES MF 470R .25W 2% 100PPM	24773-265	K8996	MR25
R47	RES MF 33K .25W 2% 100PPM	24773-309Z	K8996	MR25
TR1	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA
TR2	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA
TR3	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA
TR4	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA
TR5	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA
TR6	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA
TR7	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA
TR8	TR PSI ZTX 750ST 45V 100M 1W	28435-225	K1196	ZTXSTOA

## Unit AC0/1 and Unit AC0/2 – Input switching assembly

19. This assembly should not be dismantled.

2955A Complete unit	44990-901	U2632	44990-901
2955R Complete unit	44990-998	U2632	44990-998

REPLACEABLE PARTS

Unit AC1 - CRT Drive

20. When ordering, prefix circuit reference with AC1.

	Complete unit	44828-890	U2632	44828-890
C1	CAP ELEC 100U 25V 20%+	26415-813	K8996	031 37101
C2	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C3	CAP ELEC 4700U 25V 10%+	26422-323	K8996	2222 050 56472
C4	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C5	CAP PETP 150N 100V 10%	26582-212	K8300	PMT2R OR PMC2R
C6	CAP PETP 68N 100V 10%	26582-224	K8300	PMT2R OR PMC2R
C7	CAP CER 33P 63V 5%	26343-471	K8996	2222 682
C8	CAP ELEC 2200U 16V 20%+	26421-132	K8996	035 55222
C9	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C10	CAP ELEC 4U7 63V 20%+	26415-801	U4011	CEA 4R7/63
C11	CAP ALUM 3U3 50V 20%	26421-109	U4011	CEA 3.3/50
C12	CAP PS 10N0 63V 1%	26538-926	K8996	2222 443 4 1003
C13	CAP PS 10N0 63V 1%	26538-926	K8996	2222 443 4 1003
C15	CAP PETP 22N 400V 10%	26582-234	K8283	A1 B2204B
C16	CAP PETP 1U5 100V 10%	26582-219	K8283	A1B 152 02B
C17	CAP PP 12N 630V 10% 2.5K/US	26582-490	K6791	PS618 12N10%630V
C18	CAP ELEC 100U 50V 20%+	26421-123	K8996	035 90019
C19	CAP ELEC 1000U 35V 20%+	26421-130	K8996	035 90006
C20	CAP PETP 220N 100V 10%	26582-226	K8300	PMT2R OR PMC2R
C21	CAP PETP 47N 250V 10%	26582-206	K8283	A1 B4703B
C22	CAP ELEC 4U7 63V 20%+	26415-801	U4011	CEA 4R7/63
C23	CAP PETP 47N 250V 10%	26582-206	K8283	A1 B4703B
C25	CAP PETP 47N 250V 10%	26582-206	K8283	A1 B4703B
C26	CAP PC 22N 630V 10%	26531-114	K1365	FKC3
C27	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C28	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C30	CAP ELEC 470U 16V 20%+	26421-127	U4011	CEB47016
C31	CAP ELEC 470U 16V 20%+	26421-127	U4011	CEB47016
C32	CAP ELEC 470U 6V 20%+	26421-126	U4011	CEB4706
C33	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C34	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C35	CAP ELEC 2U2 50V 20%	26421-009	U2475	LRVB 2.2/50M
C36	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C37	CAP ELEC 470U 6V 20%+	26421-126	U4011	CEB4706
C38	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C39	CAP CER 68P 63V 2% PLATE	26343-475	K8996	2222 682
C40	CAP PETP 100N 63V 10% RAD MIN	26582-429	K1945	R68 D C 2203 AAK
C41	CAP PETP 100N 63V 10% RAD MIN	26582-429	K1945	R68 D C 2203 AAK
D1	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D2	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D3	DI RECT BYW95C 600V FAST	28358-726	K8996	BYW95C
D4	DI RECT BA159 1000V	28359-103	K8300	BA159
D5	DI RECT BA159 1000V	28359-103	K8300	BA159
D7	DI RECT BA159 1000V	28359-103	K8300	BA159
D8	DI RECT BA159 1000V	28359-103	K8300	BA159
D9	DI RECT BA159 1000V	28359-103	K8300	BA159
D11	DI RECT MR854 400V 3A	28357-016	K5519	MR854
D12	DI ZEN 1N825/A 6.2V 5%	28371-494	K8996	1N825 OR A

## REPLACEABLE PARTS

## Unit AC1 - CRT Drive (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
D13	DI ZEN BZX79C22 22V 5%	28373-067	K8996	BZX79 C22
D14	DI ZEN BZX79C5V6 5.6V 5%	28371-417	K8996	BZX79 C5V6
D15	DI SIL IN4148 75V JUNC	28336-676	K8996	IN4148
D16	DI RECT BA159 1000V	28359-103	K8300	BA159
IC1	MOD CRT-SUP TDA1170S FLD DRIVE	28231-408	K4701	ULN2270Q
IC2	ICD MONO 74LS221 DUAL	28468-404	K5519	SN74LS221N
IC3	ICD XOR 74LS86 QUAD 2INP	28466-406	K5519	SN74LS86N
IC4	ICD CTR 74LS90 4BIT DEC 2,5,10	28464-014	K5519	SN74LS90N
IC5	ICD CTR 74LS390 DUAL 4BIT DEC	28464-127	K5519	SN74LS390N
L1	COIL ASSY.L1	44290-920	U2632	44290-920R
L3	IND CHOKE - 2.5TURNS	23642-909	K8996	4312 020 36700
L4	IND CHOKE - 2.5TURNS	23642-909	K8996	4312 020 36700
L5	IND CHOKE 33U 10%	23642-558		
L6	IND CHOKE 1U 10%	23642-549		
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLB	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLC	CON-RF SMB-MALE 50 PCB STR	23444-334	K1072	GE65207BN
R1	RES MF 270K .25W 2% 100PPM	24773-331	K8996	MR25
R2	RES MF 180K .25W 2% 100PPM	24773-327	K8996	MR25
R3	RV CERM 100K LIN .5W 10%	25711-613	K8479	E4A
R4	RES MF 270K .25W 2% 100PPM	24773-331	K8996	MR25
R5	RES MF 39K .25W 2% 100PPM	24773-311	K8996	MR25
R6	RV CERM 50K0 LIN .5W 10%	25711-612	U0914	E4A
R7	RES MF 470K .25W 2% 100PPM	24773-337	U2453	LR1 OR PR1
R8	RES MF 220K .25W 2% 100PPM	24773-329	K8996	MR25
R9	RES MF 56K .25W 2% 100PPM	24773-315	K8996	MR25
R11	RES MF 68K .25W 2% 100PPM	24773-317	K8996	MR25
R12	RES MF 1R0 .25W 2% 100PPM	24773-201	U1395	RC55
R13	RES MF 56K .25W 2% 100PPM	24773-315	K8996	MR25
R14	RES MF 3R3 .25W 2% 100PPM	24773-213	U1395	RC55
R15	RES MF 22R .25W 2% 100PPM	24773-233	K8996	MR25
R16	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R17	RES MF 15K .25W 2% 100PPM	24773-301	K8996	MR25
R18	RES MF 68R .25W 2% 100PPM	24773-245	K8996	MR25
R19	RES MF 3K3 .25W 2% 100PPM	24773-285	K8996	MR25
R20	RES MF 5K6 .25W 2% 100PPM	24773-291	K8996	MR25
R21	RV CERM 5K0 LI .5W 10%	25711-610	K8479	E4A
R22	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R23	RES MF 100R .25W 2% 100PPM	24773-249	K8996	MR25
R24	RES MF 120R .25W 2% 100PPM	24773-251	K8996	MR25
R25	RES MF 1M0 .25W 2% 100PPM	24773-346	U2453	LR1 OR PR1
R26	RV CARB 1M0 LIN .25W 20%	25611-193	K2510	MPWT STYLE D
R27	RES MG 1M8 .25W 5%	24321-876	K8996	VR25
R28	RES MF 1M0 .25W 2% 100PPM	24773-346	U2453	LR1 OR PR1
R31	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R33*	RES MF 62K .25W 2% 100PPM	24773-316	K8996	MR25
R34	RES MF 560R .25W 2% 100PPM	24773-267	K8996	MR25

REPLACEABLE PARTS

Unit AC1 - CRT Drive (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
R36 RES MF 4R7 .25W 2% 100PPM	24773-217	U1395	RC55
R37 RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
R38 RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R39 RV CERM 100K LIN .3W 10%	25748-510	K5743	3006P
R40 RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
R41 RES MF 240R .25W 2% 100PPM	24773-258	K8996	MR25
R42 RES MF 18K .25W 2% 100PPM	24773-303	K8996	MR25
R43 RES MF 6K8 .25W 2% 100PPM	24773-293	K8996	MR25
R44 RES MF 12K .25W 2% 100PPM	24773-299	K8996	MR25
R45 RES MF 15K .25W 2% 100PPM	24773-301	K8996	MR25
R46 RES MF 1K2 .25W 2% 100PPM	24773-275	K8996	MR25
R47 RES MF 390R .25W 2% 100PPM	24773-283	K8996	MR25
R48 RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R49 RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R50 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R52 RES MF 5K1 .25W 2% 100PPM	24773-290	K8996	MR25
R53 RES MF 22R .25W 2% 100PPM	24773-233	K8996	MR25
R54 RES MF 150R .25W 2% 100PPM	24773-253	K8996	MR25
R55 RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R56 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R57 RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
TR1 TR NSI 2N2483 60V 30M - LN AMP	28455-787	K8996	2N2483
TR2 TR NSI 2N2483 60V 30M - LN AMP	28455-787	K8996	2N2483
TR3 TR NSI BU806 400V - - DAR PWR	28458-690	K8996	BU806
TR4 TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR5 TR NSI 2N2369 15V 500M - SW	28452-197	K5519	2N2369 OR A
TR6 TR PSI BC308B 20V 130M - GEN	28433-455	K8300	BC252B
TR7 TR NSI BC208B 20V 150M - GEN	28452-781	K1196	ZT108BL
T1 MOD CRT-SUP TBT6 LINE O/P XFMR	28231-402	A2984	10.0213/15
CABLE ASSY, AB1/1 PLD - AC1	43130-524	U2632	43130-524B
FUSE T/LAG 1.6A SIZE 0	23411-810	U0154	L2238.1.6A
H/W FUSEHOLDER INLINE SIZE 0	23418-320	K2504	238-356
OCXO OSCILLATOR UNIT	44990-377	U2632	44990-377

Unit AD0 and Unit RX2 - Attenuator assembly (100 dB)

21. This assembly should not be dismantled.

2955A Complete unit	44429-039	U2632	44429-039
2955R Complete unit	44429-037	U2632	44429-037



## Unit AF1/1 – Main keyboard

22. When ordering, prefix circuit reference with AF1/1.

	Complete unit (excluding keys)	44829-597	U2632	44829-597
D1	LAMP LED HLMP1401 2.4V YELLOW	28624-137	K3464	HLMP1401
D2	LAMP LED HLMP1401 2.4V YELLOW	28624-137	K3464	HLMP1401
D3	LAMP LED HLMP1401 2.4V YELLOW	28624-137	K3464	HLMP1401
D4	LAMP LED HLMP1401 2.4V YELLOW	28624-137	K3464	HLMP1401
D5	LAMP LED HLMP1401 2.4V YELLOW	28624-137	K3464	HLMP1401
IC1	ICD FF-D 74LS174 HEX +EDG TR	28462-612	K6659	74LS174PC
R1	RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
R2	RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
R3	RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
R4	RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
R5	RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
SA1	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SA2	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SA3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SA4	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SA5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SA6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SA7	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SA8	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB1	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB2	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB4	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB7	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SB8	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SC1	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SC3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SC4	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SC5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SC6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SC7	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SC8	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD1	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD2	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD4	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD7	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SD8	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SE1	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SE2	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SE3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SE5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SE6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP

REPLACEABLE PARTS

Unit AF1/1 – Main keyboard (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
SF1	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SF2	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SF3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SF4	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SF5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SF6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SF7	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SF8	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SG2	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SG3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SG4	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SG5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SG6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SH3	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SH4	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SH5	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SH6	SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
	KEY CAP BLUE "Tx TEST"	37591-391R	U2632	37591-391
	KEY CAP BLUE "Rx TEST"	37591-392	U2632	37591-392
	KEY CAP BLUE "DUPLEX TEST"	37591-393	U2632	37591-393
	KEY CAP BLUE "TONES"	37590-912	U2632	37590-912
	KEY CAP BLUE (BLANK)	37590-689	U2632	37590-689
	KEY CAP BLUE "SCOPE/BAR"	37591-395	U2632	37591-395
	KEY CAP BLUE "HOLD DISPLAY"	37590-914	U2632	37590-914
	KEY CAP GREEN "AF GEN"	37590-891	U2632	37590-891
	KEY CAP GREEN "RX=TX FREQ"	37590-890	U2632	37590-890
	KEY CAP GREEN "RF GEN"	37590-892	U2632	37590-892
	KEY CAP GREEN "SET MOD"	37590-893	U2632	37590-893
	KEY CAP GREEN "ON-OFF"	37591-396	U2632	37591-396
	KEY CAP GREEN "SINAD S/N"	37590-895	U2632	37590-895
	KEY CAP GREEN "DIST'N ON OFF"	37590-896	U2632	37590-896
	KEY CAP ORANGE "FREQ"	37590-897	U2632	37590-897
	KEY CAP ORANGE "LEVEL"	37590-898	U2632	37590-898
	KEY CAP ORANGE "DELTA INCR"	37590-899	U2632	37590-899
	SW-CAP RECT ORANGE "STORE"	37590-710	U2632	37590-710
	SW-CAP RECT ORANGE "RECALL"	37590-709	U2632	37590-709
	KEY CAP ORANGE "FM"	37590-900	U2632	37590-900
	KEY CAP ORANGE "ΦM RAD"	37590-901	U2632	37590-901
	KEY CAP ORANGE "MHz/V"	37590-902	U2632	37590-902
	KEY CAP ORANGE "kHz/mV"	37590-903	U2632	37590-903
	KEY CAP ORANGE "Hz/uV"	37590-904	U2632	37590-904
	KEY CAP ORANGE "dB"	37590-905	U2632	37590-905
	KEY CAP ORANGE "dBm"	37590-906	U2632	37590-906
	KEY CAP ORANGE "AM %"	37590-907	U2632	37590-907
	KEY CAP WHITE "0"	37590-887	U2632	37590-887
	KEY CAP WHITE "1"	37590-886	U2632	37590-886
	KEY CAP WHITE "2"	37590-885	U2632	37590-885

REPLACEABLE PARTS

Unit AF1/1 – Main keyboard (contd.)

Circuit Description Ref.	Ml Part No.	Mfr. Code	Mfr. Part No.
KEY CAP WHITE "3"	37590-884	U2632	37590-884
KEY CAP WHITE "4"	37590-883	U2632	37590-883
KEY CAP WHITE "5"	37590-882	U2632	37590-882
KEY CAP WHITE "6"	37590-878	U2632	37590-878
KEY CAP WHITE "7"	37590-880	U2632	37590-880
KEY CAP WHITE "8"	37590-879	U2632	37590-879
KEY CAP WHITE "9"	37590-878	U2632	37590-878
KEY CAP WHITE "-"	37590-889	U2632	37590-889
KEY CAP DK BROWN "FREQ" (UP)	37590-863	U2632	37590-863
KEY CAP DK BROWN "FREQ" (DOWN)	37590-864	U2632	37590-864
KEY CAP DK BROWN "BAND PASS"	37590-871	U2632	37590-871
SW-CAP RECT BROWN "HELP"	37590-711	U2632	37590-711
KEY CAP DK BROWN "SELECT L-R"	37590-862	U2632	37590-862
KEY CAP DK BROWN "LEVEL" (UP)	37590-866	U2632	37590-866
KEY CAP DK BROWN "LEVEL" (DOWN)	37590-865	U2632	37590-865
KEY CAP DK BROWN "LOW PASS"	37590-872	U2632	37590-872
KEY CAP DK BROWN "AC/DC"	37590-873	U2632	37590-873
KEY CAP WHITE ". "	37590-888	U2632	37590-888
KEY CAP WHITE "DELETE"	37590-877	U2632	37590-877
CABLE ASSY. RIBBON.	43130-189	U2632	43130-189

Unit AF2/1 – Scope keyboard

Circuit Description Ref.	Ml Part No.	Mfr. Code	Mfr. Part No.
23. When ordering, prefix circuit reference with AF2/1.			
Complete unit (excluding keys)	44829-642	U2632	44829-642
R1 RV PLAS 50K LIN 0.25W 20%	25761-005	K5743	82C1AE28 B18
R2 RV PLAS 50K LIN 0.25W 20%	25761-005	K5743	82C1AE28 B18
R3 RV PLAS 50K LIN 0.25W 20%	25761-005	K5743	82C1AE28 B18
R4 RV PLAS 50K LIN 0.25W 20%	25761-005	K5743	82C1AE28 B18
SG4 SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SG5 SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SG8 SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SH4 SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SH5 SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
SH8 SW PUSH 1P1W MOM LIPA D6	23465-301	K8214	Y41 A 00280 FP
KEY CAP DK BROWN "SINGLE"	37590-875	U2632	37590-875
KEY CAP DK BROWN "REP"	37590-876	U2632	37590-876
KEY CAP DK BROWN "DECR VERT"	37590-868	U2632	37590-868
KEY CAP DK BROWN "INCR VERT"	37590-870	U2632	37590-870
KEY CAP DK BROWN "DECR HORIZ"	37590-869	U2632	37590-869
KEY CAP DK BROWN "INCR HORIZ"	37590-867	U2632	37590-867

REPLACEABLE PARTS

**Unit AG0 – GPIB unit**

24. When ordering, prefix circuit reference with AG0.

Complete unit	44990-845	U2632	44990-845
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**Unit AG1 – GPIB interface circuit**

25. When ordering, prefix circuit reference with AG1.

Complete unit	44828-639	U2632	44828-639
C1 CAP TANT 4.7UF 35V 20% BEAD	26486-219	U3613	SH
C2 CAP CER 0.047UF 25V 20% DISC	26383-017	U4011	ECK F1H473ZV
IC1 ICD NAND 74LS00 QUAD 21NP	28466-345	K5519	SN74LS00N
IC2 ICD BUFF 74LS365	28469-194	K0461	SN74LS365AN
IC3 ICD MF SUP 8291A GPIB TALK/LIST !	28467-014	U1425	D8291A OR P8291A
IC4 IDC BUFF 3448 QUAD GPIB TXRX 3S	28469-190	U1458	MC3448AP OR AL
IC5 IDC BUFF 3448 QUAD GPIB TXRX 3S	28469-190	U1458	MC3448AP OR AL
IC6 IDC BUFF 3448 QUAD GPIB TXRX 3S	28469-190	U1458	MC3448AP OR AL
IC7 IDC BUFF 3448 QUAD GPIB TXRX 3S	28469-190	U1458	MC3448AP OR AL
R1 RES MF 47K .25W 2% 100POVPM	24773-313	K8996	MR25
R2 RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
R3 RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
R4 RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
R5 RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
R6 RES MF 47K .25W 2% 100PPM	24773-313	K8996	MR25
SA SW1 DIL 6SW – GPIB ADDRESS	23465-897	K4265	PIP GLP
CABLE ASSEMBLY (connects to Motherboard AB1/1)	43129-825	U2632	43129-825

REPLACEABLE PARTS

Unit AR1/1 – Power supply

26. When ordering, prefix circuit reference with AR1/1.

	Complete unit	44829-645	U2632	44829-645
C4	CAP CER 470P 63V 10%	26383-582	K8996	630-18-471
C5	CAP CER 470P 63V 10%	26383-582	K8996	630-18-471
C6	CAP CER 1N0 63V 10%	26383-585	K8996	630-18-102
C7	CAP ELEC 47U 63V 20%+	26421-121	U4011	CEB4763
C8	CAP ELEC 1000U 35V 20%+	26421-130	K8996	035 90006
C9	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C10	CAP ELEC 3U3 50V 20%	26421-109	U4011	K3.3/50
C11	CAP ELEC 3U3 50V 20%	26421-109	U4011	K3.3/50
C12	CAP CER 47N 25V 20%	26383-017	U4011	ECK F1H473ZV
C13	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C14	CAP CER 820P 63V 10%	26383-584	K8996	630-18-821
C15	CAP ELEC 100U 6.3V 20%	26421-118	U4011	K100/6.3
C16	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C17	CAP ELEC 1000U 35V 20%+	26421-130	K8996	035 90006
C18	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C19	CAP ELEC 1000U 35V 20%+	26421-130	K8996	035 90006
C21	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C22	CAP ELEC 1000U 35V 20%+	26421-130	K8996	035 90006
C23	CAP CER 100N 30V 20%	26383-031	U4011	ECK F1H104ZV
C24	CAP ELEC 2200U 16V 20%+	26421-132	K8996	035 55222
C25	CAP PETP 100N 100V 10%	26582-211	K8300	PMT2R OR PMC2R
C27	CAP ELEC 470U 16V 20%+	26421-127	U4011	CEB47016
C28	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C29	CAP ELEC 470U 25V 20%+	26421-129	K8996	035 56471
C30	CAP ELEC 10U 35V 20%	26421-112	U4011	K10/35
C35	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C36	CAP PETP 100N 100V 10%	26582-211	K8300	PMT2R OR PMC2R
C37	CAP CER 2N2 63V 10%	26383-587	K8996	630-18-102
C38	CAP PETP 10N 63V 10%	26582-426	K1945	R68 D C 1002 AAK
C39	CAP PETP 100N 100V 10%	26582-211	K8300	PMT2R OR PMC2R
C40	CAP PETP 100N 63V 10%	26582-429	K1945	R68 D C 1003 AAK
C41	CAP ELEC 47U 63V 20%+ PCB	26421-121	U4011	CEB4763
D1	DI ZEN BZX79C4V7 4.7V 5%	28371-371	K8996	BZX79 C4V7
D3	DI ZEN BZX79C5V6 5.6V 5%	28371-417	K8996	BZX79 C5V6
D4	DI ZEN BZX79C5V6 5.6V 5%	28371-417	K8996	BZX79 C5V6
D5	DI ZEN BZX79C5V6 5.6V 5%	28371-417	K8996	BZX79 C5V6
D6	DI ZEN BZX79C5V6 5.6V 5%	28371-417	K8996	BZX79 C5V6
D7	DI SIL BAY72 100V JUNC	28337-126	K6659	BAY72
D8	DI SIL BAY72 100V JUNC	28337-126	K6659	BAY72
D9	DI ZEN BZV85 75V 5% 1W	28377-143	K8300	ZPY75
D11	DI ZEN BZX79C18 18V 5%	28372-584	K8996	BZX79 C18
D12	DI ZEN BZX79C16 16V 5%	28372-472	K8996	BZX79 C16
D13	DI H/CARR BAT42 30V FAST	28349-013	K6791	BAT 42
D14	DI RECT BYV28-100 100V FAST	28356-019	K8996	BYV28 200
D15	DI RECT BYV28-100 100V FAST	28356-019	K8996	BYV28 200
D16	DI RECT BYV28-100 100V FAST	28356-019	K8996	BYV28 200
D17	DI RECT BYV28-100 100V FAST	28356-019	K8996	BYV28 200

## REPLACEABLE PARTS

## Unit AR1/1 - Power supply (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
D18	DI RECT 2OCTQ45 45V DUA SCH	28355-165	U5008	2OCTQ45
D21	DI RECT 11DQ06 60V SCHOTTKY	28355-172	U5008	11 DQ 06
D22	DI RECT 11DQ06 60V SCHOTTKY	28355-172	U5008	11 DQ 06
D23	DI ZEN 1N5365B 36V 5% 5W	28374-120	K5519	1N5365B
D24	DI ZEN BZX79C6V2 6.2V 5%	28371-481	K8996	BZX79 C6V2
D25	DI ZEN BZX79C15 15V 5%	28372-309	K8996	BZX79 C15
D26	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D27	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D28	DI SIL 1N4148 75V JUNC	28336-676	K8996	1N4148
D29	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D30	DI H/CARR BAT29 5V !	28349-014	K6791	BAT 29 OR BAR 35
D31	DI ZEN 1N825/A 6.2V 5%	28371-494	K8996	1N825 OR A
D32	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
D33	DI RECT 1N4004 400V	28357-028	K8996	1N4004
D34	DI H/CARR BAT42 30V FAST !	28349-013	K6791	BAT 42
IC1	ICA VREG TL494 PWM CTLR DIL16	28461-739	K0461	TL494CN OR J
IC2	ICD CTR 74LS393 DUAL 4BIT BIN	28464-162	K0461	SN74LS393N
IC3	MOD OPTO CNY17 ISOL 7K5V PK	28625-008	K6997	CNY17-2Z
IC4	MOD OPTO CNY17 ISOL 7K5V PK	28625-008	K6997	CNY17-2Z
IC5	ICA AMP TL071CP FET I/P DIL8	28461-347	K5519	TL071CP
IC6	ICA VREG 78L05AC 5V .1A T092	28461-734	K0461	UA78L05AC
L1	INDUCTOR ASSY (L1)	44291-015	U2632	44290-898
L3	INDUCTOR ASSY (L3)	44290-899	U2632	44290-899
L5	INDUCTOR ASSY (L5)	44291-016	U2632	44290-900
L7	INDUCTOR ASSY (L7)	44290-901	U2632	44290-901
L9	INDUCTOR ASSY	44290-957	U2632	44290-957
PLA	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLB	CON PART MIN WAFER 6P 3008	23435-911	U1613	10-16-1061
PLC	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
PLD	TERM C/PIN 0.64SQX6 S/E REEL	23435-188	U2338	75401 001
R1	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R2	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R3	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R4	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R5	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R6	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R7	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R8	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R9	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R11	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R12	RES MF 56K .25W 2% 100PPM	24773-315	K8996	MR25
R14	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R16	RES MF 120K .25W 2% 100PPM	24773-323	K8996	MR25
R17	RES MF 3K6 .25W 2% 100PPM	24773-286	K8996	MR25
R18	RES MF 27K .25W 2% 100PPM	24773-307	K8996	MR25
R19	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R20	RES MF 20K .25W 2% 100PPM	24773-304	K8996	MR25
R21	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R22	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R23	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25

REPLACEABLE PARTS

Unit AR1/1 - Power supply (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R24	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R25	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R26	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R27	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R28	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R29	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R31	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R33	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R34	RES MF 1K0 .25W 2% 100PPM	24773-273	K8996	MR25
R35	RES MF 20K .25W 2% 100PPM	24773-304	K8996	MR25
R36	RES MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
R37	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R38	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R39	RES MF 3K9 .25W 2% 100PPM	24773-287	K8996	MR25
R41	RES MF 9K1 .25W 2% 100PPM	24773-296	K8996	MR25
R42	RES MF 9K1 .25W 2% 100PPM	24773-296	K8996	MR25
R43	RES MF 2K7 .25W 2% 100PPM	24773-283	K8996	MR25
R44	RES MF 1K2 .25W 2% 100PPM	24773-275	K8996	MR25
R45	RES MF 22K .25W 2% 100PPM	24773-305	K8996	MR25
R46	RV CERM 5K0 LIN .5W 10%	25711-640	U0914	E2A
R47	RV CERM 2K0 LIN .5W 10%	25711-639	U0914	E2A
R48	RES MO 1K0 .5W 2% 250PPM	24573-073	K4184	TR5 OR TRM5ORNK5
R49	RES MO 1K0 .5W 2% 250PPM	24573-073	K4184	TR5 OR TRM5ORNK5
R51	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R52	RES MF 100K .25W 2% 100PPM	24773-321	K8996	MR25
R57	RES MF 12R .25W 2% 250PPM	24773-277		
R58	RES MF 130K .25W 2% 100PPM	24773-324	K8996	MR25
R60	RES MF 30K .25W 2% 100PPM	24773-308	K8996	MR25
R61	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R62	RES MF 4K7 .25W 2% 100PPM	24773-289	K8996	MR25
R64	RES MF 820R .25W 2% 100PPM	24773-271	K8996	MR25
R65	RES MF 10K .25W 2% 100PPM	24773-297	K8996	MR25
R66	RES MF 2K2 .25W 2% 100PPM	24773-281	K8996	MR25
R67	RV CER 5K0 LIN .25W 10% 12T	25748-585	K5743	3266W-1-502
RLA	RELAY MAG 1C0 12V 270R	23486-157	K7495	G2L 113 PV
SKC	CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
SKD	CON JUMP FEM 2 1 ROW	23435-990	U2338	65474 001
TR1	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR2	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR3	TR NSI BC237A 45V 150M - GEN	28455-421	K1196	ZTX107AL
TR4	TR NSI BC237A 45V 150M - GEN	28455-421	K1196	ZTX107AL
TR5	TR PSI 2N2905A 60V 200M - GEN	28435-868	K6617	2N2905A
TR6	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR7	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR8	TR NSI BC237A 45V 150M - GEN	28455-421	K1196	ZTX107AL
TR9	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A
TR11	TR PSI BC307A 45V 130M - GEN	28435-227	K6360	BC307A

REPLACEABLE PARTS

**Unit AR1/1 – Power supply (contd.)**

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
TR12	TR NSI 2N2369 15V 500M – SW	28452-197	K5519	2N2369 OR A
TR13	TR NMF 540 100V OR085 27A PWR !	28459-069	U5008	IRF 540
TR14	TR PSI BC307A 45V 130M – GEN	28435-227	K6360	BC307A
TR15	TR NSI 2N2369 15V 500M – SW	28452-197	K5519	2N2369 OR A
TR16	TR NMF 540 100V OR085 27A PWR !	28459-069	U5008	IRF 540
TR18	TR NSI BC237A 45V 150M – GEN	28455-421	K1196	ZTX107AL
TR19	TR NSI BC237A 45V 150M – GEN	28455-421	K1196	ZTX107AL
T1	TRANSFORMER ASSY. (T1)	43590-149	U2632	43590-149W
T2	TRANSFORMER. CURR. SENS. (T2)	43590-150	U2632	43590-150V
T3	TRANSFORMER. CLOCK ISOL TG(T3)	43590-151	U2632	43590-151S

**Unit AR4 – DC filter**

27. When ordering, prefix circuit reference with AR4.

	Complete unit	44829-508	U2632	44829-508
C1	CAP PETP 6U8 63V 10%	26582-424	K8283	M2B68201B
C2	CAP PETP 2U2 63V 10%	26582-418	K8283	A1B22201B
C3	CAP PETP 2U2 63V 10%	26582-418	K8283	A1B22201B
C4	CAP PETP 2U2 63V 10%	26582-418	K8283	A1B22201B
C5	CAP PETP 2U2 63V 10%	26582-418	K8283	A1B22201B
L1	INDUCTOR ASSY.	44290-958	U2632	44290-958
L2	INDUCTOR ASSY.	44290-958	U2632	44290-958
X1	FERRITE BEADS (4)	23635-845	K7584	FX 4025
X2	FERRITE BEADS (4)	23635-845	K7584	FX 4025

**Unit AT2 – CRT base**

28. When ordering, prefix circuit reference with AT2.

	Complete unit	44828-520	U2632	44828-520
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**Unit AZ1 - Encoder assembly**

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
29. When ordering, prefix circuit reference with AZ1.			
Complete unit	44990-492	U2632	44990-492
D1 LAMP LED OP240SLA 1.3V IR	28624-126	U1718	OP240SLA
D2 LAMP LED OP240SLA 1.3V IR	28624-126	U1718	OP240SLA
R1 MF 220R .25W 2% 100PPM	24773-257	K8996	MR25
X1 MOD OPTO SDP8600 SCHM DET	28625-004	00001	VTIC7210 OR 7110
X2 MOD OPTO SDP8600 SCHM DET	28625-004	00001	VTIC7210 OR 7110

**Unit A0/2 - 2955R Overall assembly**

30. When ordering, prefix circuit reference with A0/2.			
Complete unit	52955-321	U2632	52955-321
C1 CAP ELEC 4700U 40V 10%+	26426-093	K8996	071 17472
C2 CAP ELEC 4700U 40V 10%+	26426-093	K8996	071 17472
C3 CAP ELEC 220V 63V 20% AX	26415-820		
C4 CAP PC 470N 100V 10%	26582-679		
D1 DI BRIDGE BY260 200V 12A	28359-190	K8996	BY260 200
FS1 FUSE T/LAG 0.50A 20X5	23411-056	U0154	L2080
FS2 FUSE T/LAG 0.50A 20X5	23411-056	U0154	L2080
FS3 FUSE T/LAG 6.3A 20X5	23411-065	K0647	5502 OR TDC123
H/W FUSE HOLDER PANEL 20X5 (1 OF 3)	23416-192	U0928	F396 1 OR F455/S
LS1 LOUDSPEAKER ROUND 75R 2.25"	23646-105	S4248	6A1 70
R4 RES MF 22R .25W 2% 100PPM	24773-321	K8996	MR25
R29 RES MF 390R .25W 2% 100PPM	24773-263	K8996	MR25
S1 SW TOG 4CO MIN ON-ON	23462-266	U3515	U41 SHZQ1
SW PART TOG LEVER CAP BLACK	23462-881	S3323	CPO1
COVER MAINS SW 4 POLE	37561-105		
S2 SW SLIDE 2CO PANEL MTG	23467-161	U3627	46206 LE
SKB CON-RF BNC-FEM 50 BKHD	23443-442	K1072	GE35152YBN
SKC CON CIRC FEM 7 FXD DIN	23424-353	U1479	DIN CONN 7WAY
T1 TRANSFORMER MAINS.	44990-903	U2632	44490-903
FAN ASSEMBLY	23535-128	U3613	FBP-08A12H
X3 FERRITE BEADS (4)	23635-845	K7584	FX 4025
X4 FERRITE BEADS (4)	23635-845	K7584	FX 4025
VALVE CRT 190F31 E7-91 7"90DE	28235-617	U4794	190FB31
CONNECTOR ASSY (TYPE N)	43130-165	U2632	43130-165
CONNECTOR ASSY BNC	43130-166	U2632	43130-166
CABLE CO-AX ASSY, AF INPUT AB1/1 PLR	43130-167	U2632	43130-167
CABLE CO AX ASSY, AAO/1 PLB AB1/1	43130-169	U2632	43130-169
CABLE CO-AX ASSY, AF GEN AB1/1 PLK	43130-170	U2632	43130-170

## REPLACEABLE PARTS

## Unit A0/2 – 2955R Overall assembly (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
CABLE RIBBON ASSY, AF2/1 AB1/1 PLG	43130-183	U2632	43130-183
CABLE CO-AX ASSY, AAO/1 AB1/1	43130-447	U2632	43130-447
CABLE CO-AX ASSY, AAO/1 PLD AB1/1	43130-199	U2632	43130-199
CABLE CO-AX ASSY, AAO/1 PLB-AC1	43130-201	U2632	43130-201
CABLE CO-AX ASSY, AB1/1 PLT-AR1/1	43130-202	U2632	43130-202
CABLE CO-AX ASSY, EXT STD-AC1	43130-203	U2632	43130-203
CABLE CO-AX SEMI-RIGID, RX2 TO AAO/1	43137-534	U2632	43137-534
CABLE CO-AX SEMI-RIGID, RX2 TO RX1	43137-535	U2632	43137-535
CABLE CO-AX SEMI-RIGID, RX3 TO AAO/1	43137-536	U2632	43137-536
CABLE CO-AX, RX3 TO RX1	43137-537	U2632	43137-537
CABLE CO-AX SEMI-RIGID, RX3 TO RX1	43137-538	U2632	43137-538
CABLE CO-AX SEMI-RIGID, RX3 TO ACO/2	43137-539	U2632	43137-539
CABLE CO-AX SEMI-RIGID, RX2 TO ACO/2	43137-540	U2632	43137-540
E PROM 2716 (AB3-IC33)	44533-153	U2632	TBX12
MAGNET TBX12 6MM CRT CORRECTOR	28238-157	U3008	28238-157
E PROM, SET, 2. (FOR AB4, IC9/B & IC10A)	44533-247	U2632	44533-247
EE PROM X2816A (AB4-IC13)	44533-362	U2632	44533-362
E PROM (FOR AB6, IC4 & IC5)	44533-351	U2632	44533-351
CABLE CO-AX ASSY, IF OUT	43130-227	U2632	43130-227

## Unit AA0/2 – RF tray

31. When ordering, prefix circuit reference with AA0/1.

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
C1 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C2 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C3 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C4 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C5 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C6 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C7 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C8 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C9 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C11 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C13 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C14 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C15 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C17 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C18 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C19 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C20 CAP CER 50P 300V 10%	26333-229	K8445	FT73 29 K3000
C21 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C22 CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000

REPLACEABLE PARTS

Unit AA0/2 - RF tray (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C23	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C24	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C25	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C26	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C27	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C28	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C29	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C30	CAP CER 50P 300V 10%	26333-229	K8445	FT73
C31	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C32	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C33	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C34	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C35	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C36	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C37	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C38	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C39	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C40	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C41	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C42	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C43	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C44	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C45	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C46	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C47	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C48	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C49	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C50	CAP CER 56P 500V 20%	26373-855	K8445	
C51	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C52	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C53	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C54	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C55	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C56	CAP CER 1N0 300V 20%+	26373-733	K8445	FT73 29 K3000
C57	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C60	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C61	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C62	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
C63	CAP FILTERCON 1N5 350V -0%	26397-205	K8300	TPS003A
L1	IND CHOKE GEN	23642-551		
L2	IND CHOKE GEN	44190-036	U2632	44190-036
L3	IND CHOKE GEN	44190-036	U2632	44190-036
L4	IND CHOKE GEN	44190-036	U2632	44190-036
L5	IND CHOKE GEN	44190-036	U2632	44190-036
L6	IND CHOKE GEN	44190-036	U2632	44190-036
L7	IND CHOKE GEN	44190-036	U2632	44190-036
L8	IND CHOKE GEN	44190-036	U2632	44190-036
L9	IND CHOKE GEN	44190-036	U2632	44190-036
L11	IND CHOKE GEN	44190-036	U2632	44190-036

REPLACEABLE PARTS

Unit AA0/2 - RF tray (contd.)

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
L12 IND CHOKE GEN	44190-036	U2632	44190-036
L13 IND CHOKE GEN	44190-036	U2632	44190-036
L14 IND CHOKE GEN	44190-036	U2632	44190-036
L15 IND CHOKE GEN	44190-036	U2632	44190-036
L16 IND CHOKE GEN	44190-036	U2632	44190-036
L17 IND CHOKE GEN	44190-036	U2632	44190-036
L18 IND CHOKE GEN	44190-036	U2632	44190-036
L19 IND CHOKE 3.3UH 10% LAQ	23642-552	K0467	406 8 274 69 016
L20 IND CHOKE 3.3UH 10% LAQ	23642-552	K0467	406 8 274 69 016
L21 IND CHOKE 3.3UH 10% LAQ	23642-552	K0467	406 8 274 69 016
L23 IND CHOKE GEN	44190-036	U2632	44190-036
PLA CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLB CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLD CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLE CON-RF SMB-MALE 50 BKHD SOLEER	23444-331	K1072	GE65218BNMBN
PLF CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLG CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
PLH CON-RF SMB-MALE 50 BKHD SOLDER	23444-331	K1072	GE65218BNMBN
R1 RES MF 150R .125W 2% 100PPM	24772-053	U1395	MFR3
R2 RES MF 270R .125W 100PPM	24772-059	U1395	MFR3
R3 RES MF 470R .125W 2% 100PPM	24772-065	U1395	MFR3
COUPLER ASSY RF	41700-379	U2632	41700-379
CABLE.RIBBON.ASSY, AA3 PLB-AAO/1	43130-182	U2632	43130-182
CABLE.RIBBON.ASSY, AA1 PLA-AAO/1	43130-184	U2632	43130-184
CABLE.RIBBON.ASSY, AA2 PLA-AAO/1	43130-186	U2632	43130-186
CABLE.RIBBON.ASSY, AAO/1-AB1/1 PLA	43130-187	U2632	43130-187
CABLE.RIBBON.ASSY, AAO/1-AB1/1 PLF	43130-188	U2632	43130-188
CABLE.CO-AX.ASSY, AA1 PLB-AAO/1 PLA	43130-194	U2632	43130-194
CABLE.CO-AX.ASSY, AA3 PLC-AAO/1 PLG	43130-195	U2632	43130-195
CABLE.CO-AX.ASSY, AA4 PLA-AAO/1 PLG	43130-196	U2632	43130-196

Unit RX1 - Rx tray

32. When ordering, prefix circuit reference with RX1.

Complete unit	44990/879		
C1 FILTER RFI-SUPPRESSION 1.5nF (min) 350V DC	26397/205	K8300	TPS003A
C2 FILTER RFI-SUPPRESSION 1.5nF (min) 350V DC	26397/205	K8300	TPS003A
C3 FILTER RFI-SUPPRESSION 1.5nF (min) 350V DC	26397/205	K8300	TPS003A
C4 CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C5 CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C6 CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000

REPLACEABLE PARTS

C7	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C8	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C9	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C10	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C11	FILTER RFI-SUPPRESSION 1,5nF (min) 350V DC	26397/205	K8300	TPS003A
C12	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C13	FILTER RFI-SUPPRESSION 22nF (min) 100V DC 10A	23642/921	No code	51-750-302
C14	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C15	FILTER RFI-SUPPRESSION 1.5nF (min) 350V DC	26397/205	K8300	TPS003A
C16	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT73 29 K3000
C17	FILTER RFI-SUPPRESSION 1.5nF (min) 350V DC	26397/205	K8300	TPS003A
C18	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT 73 29 K 3000
C19	CAPACITOR FIXED CERAMIC 1nF -20/+80% 300V	26373/733	K8445	FT 73 29 K 3000

Unit RX11 – Sensitive receiver

Circuit Description Ref.	MI Part No.	Mfr. Code	Mfr. Part No.
33. When ordering, prefix circuit reference with RX11.			
Complete unit	44829/561		
C1 CAPACITOR FIXED CERAMIC 100nF ±10% 50V X7R MULTILAYER, SURFACE-MOUNTED, SIZE 1210, (TAPED).	26386/887	U2109	12105C104KA3TR
C2 CAPACITOR FIXED CERAMIC 50V X7R 100nF ±10% MULTILAYER, SURFACE- MOUNTED, SIZE 1210, (TAPED).	26386/887	U2109	12105C104KA3TR
C3 CAPACITOR FIXED ALUMINIUM 33µF ±20% 25V ELECTROLYTIC, RADIAL, 5mm PWP, (TAPED).	26421/115	U4011	K33/25
C4 CAPACITOR FIXED CERAMIC 100nF ±10% 50V X7R MULTILAYER, SURFACE-MOUNTED, SIZE 1210, (TAPED).	26386/887	U2109	12105C104KA3TR
C5 CAPACITOR FIXED CERAMIC 100nF ±10% 50V X7R MULTILAYER, SURFACE-MOUNTED, SIZE 1210, (TAPED).	26386/887	U2109	12105C104KA3TR
C6 CAPACITOR FIXED CERAMIC 100nF ±10% 50V X7R MULTILAYER, SURFACE-MOUNTED, SIZE 1210, (TAPED).	26386/887	U2109	12105C104KA3TR
C7 CAPACITOR FIXED CERAMIC 27pF ±2% 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/499	K8996	2222 678 34279

## REPLACEABLE PARTS

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C8	CAPACITOR FIXED CERAMIC 1.8pF $\pm 0.25$ pF 63V NPO SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/490	K7584	2222 678 09188
C9	CAPACITOR FIXED CERAMIC 27pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/499	K8996	2222 678 34279
C10	CAPACITOR FIXED CERAMIC 220pF $\pm 2\%$ 63V N750 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/435	K7584	2222 678 58221
C11	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C12	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C13	CAPACITOR FIXED CERAMIC 82pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/431	K8996	2222 678 34829
C14	CAPACITOR FIXED CERAMIC 22pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/489	K8996	2222 678 34829
C15	CAPACITOR VARIABLE CERAMIC 3.5pF to 10pF 100V NPO VERTICAL-PCB MOUNT 5mm DIA. 3.5mm LONG	26847/098	K1439	5 S TRICO 302504 104
C16	CAPACITOR FIXED CERAMIC 1.2pF $\pm 0.5$ pF 50V 30 ppm/DEG.C, MULTILAYER, SURFACE-MOUNTED, SIZE 0805,	26343/754	U2109	08055A1R2DA3TR
C17	CAPACITOR FIXED CERAMIC 100pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/437	K8996	2222 678 34101
C18	CAPACITOR VARIABLE CERAMIC 3.5pF to 10pF 100V NPO VERTICAL-PCB MOUNT, 5mm DIA, 3.5mm LONG, 302504 104	26847/098	K1439	5 S TRICO
C19	CAPACITOR FIXED CERAMIC 18pF $\pm 2\%$ 63V NPO SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/498	K7584	2222 678 10189
C20	CAPACITOR FIXED CERAMIC 680pF $\pm 5\%$ 50V 30 ppm/DEG.C, MULTILAYER, SURFACE-MOUNTED, SIZE 0805, JAT 00J	26343/788	U2109	0805 5A 681
C21	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C22	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C25	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C26	CAPACITOR FIXED CERAMIC 82pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/431	K8996	2222 678 34829
C27	CAPACITOR VARIABLE CERAMIC 3.5pF to 10pF 100V NPO VERTICAL-PCB MOUNT, 5mm DIA, 3.5mm LONG, 302504 104	26847/098	K1439	5 S TRICO

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C28	CAPACITOR FIXED CERAMIC 22pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/489	K8996	2222 678 34829
C29	CAPACITOR FIXED CERAMIC 1.2pF $\pm 0.5\text{pF}$ 50V 30 ppm/DEG.C, MULTI-LAYER, SURFACE-MOUNTED, SIZE 0805,	26343/754	U2109	08055A1R2DA3TR
C30	CAPACITOR FIXED CERAMIC 100pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/437	K8996	2222 678 34101
C31	CAPACITOR VARIABLE CERAMIC 3.5pF to 10pF 100V NPO VERTICAL-PCB MOUNT, 5mm DIA, 3.5mm LONG, 302504 104	26847/098	K1439	5 S TRICO
C32	CAPACITOR FIXED CERAMIC 18pF $\pm 2\%$ 63V NPO SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/498	K7584	2222 678 10189
C33	CAPACITOR FIXED CERAMIC 680pF $\pm 5\%$ 50V 30 ppm/DEG.C, MULTILAYER, SURFACE-MOUNTED, SIZE 0805,	26343/788	U2109	08055A681JAT00J
C34	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C35	CAPACITOR FIXED CERAMIC 1.8pF $\pm 0.25\text{pF}$ 63V NPO SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/490	K7584	2222 678 09188
C36	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C37	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C38	CAPACITOR FIXED CERAMIC 10pF $\pm 2\%$ 63V NPO SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/492	K7584	2222 678
C39	CAPACITOR FIXED CERAMIC 150pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/432	K8996	2222 678 34151
C40	CAPACITOR FIXED CERAMIC 8.2pF $\pm 0.25\text{pF}$ 63V NPO SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/488	K7584	2222 678 09828
C41	CAPACITOR FIXED CERAMIC 150pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/432	K8996	2222 678 34151
C42	CAPACITOR FIXED CERAMIC 1.8pF $\pm 0.25\text{pF}$ 63V NPO SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/490	K7584	2222 678 09188
C43	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C44	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C45	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102

## REPLACEABLE PARTS

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C46	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C47	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C48	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C49	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C50	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C51	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C52	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C53	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C54	CAPACITOR FIXED CERAMIC 15OpF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/432	K8996	2222 678 34151
C55	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C56	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C57	CAPACITOR FIXED CERAMIC 330pF $\pm 2\%$ 63V N750 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/447	K7584	2222 678 58331
C58	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C59	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C60	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C61	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C62	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C63	CAPACITOR FIXED CERAMIC 330pF $\pm 2\%$ 63V N750 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/447	K7584	2222 678 58331



## REPLACEABLE PARTS

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C64	CAPACITOR FIXED CERAMIC 1nF $\pm 10\%$ 63V Y5S SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26383/585	K8996	630-18-102
C65	CAPACITOR FIXED POLYESTER 1uF $\pm 10\%$ 50V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/432	K1945	R68 CC 1004 AAK
C66	CAPACITOR FIXED CERAMIC 150pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/432	K8996	2222 678 34151
C67	CAPACITOR FIXED POLYESTER 1uF $\pm 10\%$ 50V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/432	K1945	R68 CC 1004 AAK
C68	CAPACITOR FIXED POLYESTER 470nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/427	K1945	R68 DC 4703 AAK
C69	CAPACITOR FIXED POLYESTER 470nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/427	K1945	R68 DC 4703 AAK
C70	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C71	CAPACITOR FIXED POLYESTER 47nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/428	K1945	R68 DC 4702 AAK
C72	CAPACITOR FIXED POLYESTER 47nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/428	K1945	R68 DC 4702 AAK
C73	CAPACITOR FIXED POLYESTER 47nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/428	K1945	R68 DC 4702 AAK
C74	CAPACITOR FIXED POLYESTER 47nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/428	K1945	R68 DC 4702 AAK
C75	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C76	CAPACITOR FIXED POLYESTER 47nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/428	K1945	R68 DC 4702 AAK
C77	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C78	CAPACITOR FIXED POLYESTER 10nF $\pm 10\%$ 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
C79	CAPACITOR FIXED ALUMINIUM 33uF $\pm 20\%$ 25V ELECTROLYTIC, RADIAL, 5mm PWP, (TAPED).	26421/115	U4011	K33/25
C80	CAPACITOR FIXED ALUMINIUM 220uF $\pm 20\%$ 16V ELECTROLYTIC, RADIAL, 5mm PWP, (LOOSE).	26421/124	U4011	CEB 22016
C81	CAPACITOR FIXED ALUMINIUM 33uF $\pm 20\%$ 25V ELECTROLYTIC, RADIAL, 5mm PWP, (TAPED).	26421/115	U4011	K33/25

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
D1	DIODE PIN 5082-3379... 250mW 50V VHF-UHF ATTENUATOR, AXIAL:-OUTLINE-15. - (TAPED)	28383/997	K3464	HP5082 3379
D2	DIODE PIN 5082-3379... 250mW 50V VHF-UHF ATTENUATOR, AXIAL:-OUTLINE-15. - (TAPED)	28383/997	K3464	HP5082 3379
D3	DIODE GENERAL-PURPOSE BA-482... 35V 100mA 1.2Vf @ 100mA AXIAL:- DO-34. - (TAPED)	28335/675	K8996	BA482
D4	DIODE PIN 5082-3379... 250mW 50V VHF-UHF ATTENUATOR, AXIAL:- OUTLINE-15. - (TAPED)	28383/997	K3464	HP5082 3379
D5	DIODE GENERAL-PURPOSE BA-482... 35V 100mA 1.2Vf @ 100mA AXIAL:- DO-34. - (TAPED)	28335/675	K8996	BA482
D6	DIODE PIN 5082-3379... 250mW 50V VHF-UHF ATTENUATOR, AXIAL:- OUTLINE-15. - (TAPED)	28383/997	K3464	HP5082 3379
D7	DIODES MATCHED PAIR	44529/057	U2632	44529-057
D8	DIODES MATCHED PAIR	44529/057	U2632	44529-057
D9	DIODE ZENER 1N825... 250mW 6.2V 5% 50mA 20ppm/DEG.C, AXIAL:- DO-35. - (TAPED)	28371/494	K8996	1N825 OR A
D10	DIODE GENERAL-PURPOSE 1N4148... 75V 110mA 1Vf @ 10mA, AXIAL:- DO-35. -(TAPED)	28336/676	K8996	1N4148D1
D11	DIODE GENERAL-PURPOSE 1N4148... 75V 110mA 1Vf @ 10mA, AXIAL:- DO-35. - (TAPED)	28336/676	K8996	1N4148
D12	DIODE GENERAL-PURPOSE 1N4148... 75V 110mA 1Vf @ 10mA, AXIAL:- DO-35. - (TAPED)	28336/676	K8996	1N4148
D13	DIODE RECTIFIER 1N4004... 400V 1A 1.1Vf @ 1A. AXIAL:- SOD-81. - (TAPED)	28357/028	K8996	1N4004
D14	DIODE RECTIFIER 1N4004... 400V 1A 1.1Vf @ 1A. AXIAL:- SOD-81. - (TAPED)	28357/028	K8996	1N4004
D15	DIODE RECTIFIER 1N4004... 400V 1A 1.1Vf @ 1A. AXIAL:- SOD-81. - (TAPED)	28357/028	K8996	1N4004
D16	DIODE RECTIFIER 1N4004... 400V 1A 1.1Vf @ 1A. AXIAL:- SOD-81. - (TAPED)	28357/028	K8996	1N4004
IC1	IC ANALOGUE MICROWAVE-AMPLIFIER MSA-0385... CASCADABLE BIPOLAR, 4.0GHz, MONOLITHIC, 4 PIN,	28461/415	15542	MSA-0385
IC2	IC ANALOGUE MICROWAVE-AMPLIFIER MSA-0485... CASCADABLE BIPOLAR, 3.6GHz, MONOLITHIC, 4 PIN,	28461/410	15542	MAR-4
IC5	IC ANALOGUE MICROWAVE-AMPLIFIER MSA-0885... CASCADABLE BIPOLAR, 6.0GHz, MONOLITHIC, 4 PIN,	28461/414	15542	MAR-8
IC6	IC ANALOGUE WIDEBAND-AMPLIFIER MC1350P... SINGLE, 12V WITH AGC CONTROL, 8 PIN, DUAL-IN-LINE.	28461/408	K5519	MC1350P

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
IC7	IC ANALOGUE MICROWAVE-AMPLIFIER MSA-0885... CASCADABLE BIPOLAR, 6.0GHZ, MONOLITHIC, 4 PIN,	28461/414	15542	MAR-8
IC8	IC ANALOGUE MICROWAVE-AMPLIFIER MSA-0385... CASCADABLE BIPOLAR, 4.0GHZ, MONOLITHIC, 4 PIN,	28461/415	15542	MSA-0385
IC9	IC ANALOGUE OPERATIONAL AMP. TLO74BCN... QUAD, JFET-INPUT, LINEAR, 14 PIN, DUAL-IN-LINE.	28461/378	K0461	TLO74 BCN
IC10	IC ANALOGUE OPERATIONAL AMP. TLO74CN... QUAD, JFET-INPUT, LINEAR, 14 PIN, DUAL-IN-LINE.	28461/349	K0461	TLO74CN
IC11	IC ANALOGUE TEMPERATURE-SENSOR LM35DZ... 30V $\pm 1.5$ DEG.C VOLTAGE PROPORTIONAL, MONOLITHIC, 3	28461/980	K7093	LM35DZ
L1	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	K4038	SC10 29
L2	CHOKE ASSEMBLY	44291/009	U2632	44291-099
L3	INDUCTOR FIXED 220uH $\pm 10\%$ LACQUERED, MINIATURE, 110mA 17R (MAX), 45 Q @ 0.79 MHz, 4.2 MHz SRF MIN,	23642/563	K0467	406 8 274 71 008
L4	CHOKE ASSEMBLY	44291/009	U2632	44291-009
L5	COIL R.F. 0.08uH	34901/046		
L6	503nH TAPPED INDUCTOR	44291/006	U2632	44291-006
L7	503nH INDUCTOR	44291/007	U2632	44291-007
L8	503nH TAPPED INDUCTOR	44291/006	U2632	44291-006
L9	503nH INDUCTOR	44291/007	U2632	44291-007
L10	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L11	INDUCTOR VARIABLE 0.38uH - (nom) - PCB-MOUNTED (LOOSE)	23642/932	U3065	E528DN-100070
L12	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L13	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L14	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L15	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L16	INDUCTOR VARIABLE 0.17uH - (nom) - PCB-MOUNTED (LOOSE)	23642/933	U3065	E528DN-100066
L17	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L18	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29

REPLACEABLE PARTS

Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
L19	INDUCTOR VARIABLE 0.17uH - (nom) - PCB-MOUNTED (LOOSE)	23642/933	U3065	E528DN-100066
L20	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L21	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
L22	INDUCTOR FIXED 22uH $\pm 10\%$ LACQUERED, MINIATURE, 260mA 3R (MAX), 55 Q @ 2.5 MHz, 25 MHz SRF MIN,	23642/557	U4038	SC10 29
PLA	TERMINAL CONNECTOR-PIN 0.64mm SQUARE, 5.97mm HIGH, PCB-MOUNTING, SINGLE-ENDED, REELED.	23435/188	U2338	75401 001
RLA	RELAY MAGNETIC, DOUBLE-POLE CHANGEOVER. 5V (COIL), 62R - PCB MOUNTING, HERMETIC SEAL, WIDE B/W	23486/101	U0611	172-5
RLB	RELAY REED, SINGLE-POLE N/O. 5V (COIL), 230R - PCB MOUNTING, CO-AXIAL.	23486/513	U2541	CR 2204 5 32
RLC	RELAY REED, SINGLE-POLE N/O. 5V (COIL), 230R - PCB MOUNTING, CO-AXIAL.	23486/513	U2541	CR 2204 5 32
R1	RESISTOR FIXED METAL-GLAZE 95R3 $\pm 1\%$ 250mW 200V 100 ppm/DEG.C, SURFACE-MOUNTED: 1210 - (TAPED) T1 (100PPM)	24321/602	U0142	CRCW 1210 95R3 F
R2	RESISTOR FIXED METAL-GLAZE 71R5 $\pm 1\%$ 250mW 200V100 ppm/DEG.C, SURFACE-MOUNTED: 1210 - (TAPED) T1 (100PPM)	24321/603	U0142	CRCW 1210 71R5 F
R3	RESISTOR FIXED METAL-GLAZE 95R3 $\pm 1\%$ 250mW 200V100 ppm/DEG.C, SURFACE-MOUNTED: 1210 - (TAPED) T1 (100PPM)	24321/602	U0142	CRCW 1210 95R3 F
R4	RESISTOR FIXED METAL-OXIDE 200R $\pm 2\%$ 500mW 350V 250 ppm/DEG.C, AXIAL: - (TAPED)	24573/056	K7584	MR30 (NLC)
R5	RESISTOR FIXED METAL-OXIDE 120R $\pm 2\%$ 500mW 350V 250 ppm/DEG.C, AXIAL: - (TAPED)	24573/051	K4184	TR5 OR TRM50RNK5
R6	RESISTOR FIXED METAL-GLAZE 294R $\pm 1\%$ 125mW 200V 100 ppm/DEG.C, SURFACE-MOUNTED: 1206 - (TAPED) T1 (100PPM)	24321/600	U0142	CRCW 1206 2940 F
R7	RESISTOR FIXED METAL-GLAZE 17R8 $\pm 1\%$ 125mW 200V 100 ppm/DEG.C, SURFACE-MOUNTED: 1206 - (TAPED) T1 (100PPM)	24321/601	U0142	CRCW 1206 17R8 F
R8	RESISTOR FIXED METAL-GLAZE 294R $\pm 1\%$ 125mW 200V 100 ppm/DEG.C, SURFACE-MOUNTED: 1206 - (TAPED) T1 (100PPM)	24321/600	U0142	CRCW 1206 2940 F
R9	RESISTOR FIXED METAL-FILM 330R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/061	U0142	CMF51
R10	RESISTOR FIXED METAL-FILM 3K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/084	U0142	CMF51

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R11	RESISTOR FIXED METAL-FILM 1K3 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/076	U0142	CMF51
R12	RESISTOR FIXED METAL-FILM 10R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/025	U0142	CMF51
R13	RESISTOR FIXED METAL-FILM 62R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/044	U0142	CMF51
R14	RESISTOR FIXED METAL-FILM 82R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/047	U0142	CMF51
R15	RESISTOR FIXED METAL-FILM 18R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/031	U0142	CMF51
R16	RESISTOR FIXED METAL-FILM 1K8 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/079	U0142	CMF51
R17	RESISTOR FIXED METAL-FILM 680R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/069	U0142	CMF51
R18	RESISTOR FIXED METAL-FILM 47R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/041	U0142	CMF51
R19	RESISTOR FIXED METAL-FILM 51R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/042	U0142	CMF51
R20	RESISTOR FIXED METAL-FILM 51R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/042	U0142	CMF51
R21	RESISTOR FIXED METAL-FILM 68R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/045	U0142	CMF51
R22	RESISTOR FIXED METAL-FILM 2K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/080	U0142	CMF51
R23	RESISTOR FIXED METAL-FILM 1K2 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/075	U0142	CMF51
R24	RESISTOR FIXED METAL-FILM 47R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/041	U0142	CMF51
R25	RESISTOR FIXED METAL-FILM 56R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/043	U0142	CMF51
R26	RESISTOR FIXED METAL-FILM 75R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/046	U0142	CMF51
R27	RESISTOR FIXED METAL-FILM 47R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL: - (TAPED)	24772/041	U0142	CMF51
R28	RESISTOR FIXED METAL-FILM 75R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/046	U0142	CMF51

## REPLACEABLE PARTS

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R29	RESISTOR FIXED METAL-FILM 510R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/066	U0142	CMF51
R30	RESISTOR FIXED METAL-FILM 270R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/059	U0142	CMF51
R31	RESISTOR FIXED METAL-FILM 510R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/066	U0142	CMF51
R32	RESISTOR FIXED METAL-FILM 47R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/041	U0142	CMF51
R33	RESISTOR FIXED METAL-FILM 220R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/057	U0142	CMF51
R34	RESISTOR FIXED METAL-FILM 1K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/073	U0142	CMF51
R35	RESISTOR FIXED METAL-FILM 100R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/049	U0142	CMF51
R36	RESISTOR FIXED METAL-FILM 43R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/040	U0142	CMF51
R37	RESISTOR FIXED METAL-FILM 510R $\pm 2\%$ 25mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/066	U0142	CMF51
R38	RESISTOR FIXED METAL-FILM 100R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/049	U0142	CMF51
R39	RESISTOR FIXED METAL-FILM 1K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/073	U0142	CMF51
R40	RESISTOR FIXED METAL-FILM 390R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/063	U0142	CMF51
R41	RESISTOR FIXED METAL-OXIDE 120R $\pm 2\%$ 500mW 350V 250 ppm/DEG.C, AXIAL:- (TAPED)	24573/051	U0142	CMF51
R42	RESISTOR FIXED METAL-FILM 1K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/073	U0142	CMF51
R43	RESISTOR FIXED METAL-FILM 100R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/049	U0142	CMF51
R44	RESISTOR FIXED METAL-FILM 300R $\pm 0.1\%$ 250mW 200V 25 ppm/DEG.C, AXIAL:- (TAPED)	24723/397	K8479	H8
R45	RESISTOR FIXED METAL-FILM 200R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/056	U0142	CMF51
R46	RESISTOR FIXED METAL-OXIDE 120R $\pm 2\%$ 500mW 350V 250 ppm/DEG.C, AXIAL:- (TAPED)	24573/051	K4184	TR5 OR TRM5ORNK5

## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R47	RESISTOR FIXED METAL-OXIDE 150R $\pm 2\%$ 500mW 350V 250 ppm/DEG.C, AXIAL:- (TAPED)	24573/053	K4184	TR5 OR TRM50RNK5
R48	RESISTOR FIXED METAL-FILM 51R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/042	U0142	CMF51
R49	RESISTOR FIXED METAL-FILM 180R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/055	U0142	CMF51
R50	RESISTOR FIXED METAL-FILM 680R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/069	U0142	CMF51
R51	RESISTOR FIXED METAL-FILM 470K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/137	U0142	CMF51
R52	RESISTOR FIXED METAL-FILM 470K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/137	U0142	CMF51
R53	RESISTOR FIXED METAL-FILM 4K7 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/089	U0142	CMF51
R54	RESISTOR FIXED METAL-FILM 4K7 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/089	U0142	CMF51
R55	RESISTOR FIXED METAL-FILM 47K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/113	U0142	CMF51
R56	RESISTOR FIXED METAL-FILM 47K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/113	U0142	CMF51
R57	RESISTOR FIXED METAL-FILM 470K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/137	U0142	CMF51
R58	RESISTOR FIXED METAL-FILM 820R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/071	U0142	CMF51
R59	RESISTOR VARIABLE CERMET LINEAR, 2K 10% 500mW 200V 150 ppm/DEG.C, SINGLE-TURN, HORIZONTAL-PCB,	25711/639	U0914	E2A
R60	RESISTOR FIXED METAL-FILM 2K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/080	U0142	CMF51
R61	RESISTOR FIXED METAL-FILM 320K $\pm 0.1\%$ 250mW 200V 50 ppm/DEG.C, AXIAL:- (TAPED)	24723/404	K8479	H8
R62	RESISTOR FIXED METAL-FILM 10K $\pm 0.1\%$ 250mW 200V 15 ppm/DEG.C, AXIAL:- (TAPED)	24723/373	K8479	H8
R63	RESISTOR FIXED METAL-FILM 300K $\pm 0.5\%$ 250mW 50 ppm/DEG.C, AXIAL:- (TAPED)	24753/213	K8479	H8
R64	RESISTOR FIXED METAL-FILM 10K $\pm 0.1\%$ 250mW 200V 15 ppm/DEG.C, AXIAL:- (TAPED)	24723/373	K8479	H8

## REPLACEABLE PARTS

## Unit RX11 - Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R65	RESISTOR FIXED METAL-FILM 1K $\pm 0.1\%$ 250mW 200V 15 ppm/DEG.C, AXIAL:- (TAPED)	24723/306	K8479	H8
R66	RESISTOR FIXED METAL-FILM 10K $\pm 0.1\%$ 250mW 200V 15 ppm/DEG.C, AXIAL:- (TAPED)	24723/373	K8479	H8
R67	RESISTOR FIXED METAL-FILM 10K $\pm 0.1\%$ 250mW 200V 15 ppm/DEG.C, AXIAL:- (TAPED)	24723/373	K8479	H8
R68	RESISTOR FIXED METAL-FILM 300R $\pm 0.1\%$ 250mW 200V 25 ppm/DEG.C, AXIAL:- (TAPED)	24723/397	K8479	H8
R69	RESISTOR FIXED METAL-FILM 10K $\pm 0.1\%$ 250mW 200V 15 ppm/DEG.C, AXIAL:- (TAPED)	24723/373	K8479	H8
R70	RESISTOR FIXED METAL-FILM 59K $\pm 0.25\%$ 250mW 200V 25 ppm/DEG.C, AXIAL:- (TAPED)	24732/261	K8479	H8
R71	RESISTOR FIXED METAL-FILM 300R $\pm 0.1\%$ 250mW 200V 25 ppm/DEG.C, AXIAL:- (TAPED)	24723/397	K8479	H8
R72	RESISTOR FIXED METAL-FILM 1K 2% 125mW 50V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/073	U0142	CMF51
R73	RESISTOR FIXED METAL-FILM 2K2 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/081	U0142	CMF51
R74	RESISTOR FIXED METAL-FILM 1K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/073	U0142	CMF51
R75	RESISTOR FIXED METAL-FILM 2K2 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/081	U0142	CMF51
R76	RESISTOR FIXED METAL-FILM 1K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/073	U0142	CMF51
R77	RESISTOR FIXED METAL-FILM 2K2 $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/081	U0142	CMF51
R78	RESISTOR FIXED METAL-FILM 27K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/107	U0142	CMF51
R79	RESISTOR FIXED METAL-FILM 12K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/099	U0142	CMF51
R80	RESISTOR FIXED METAL-FILM 470K $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/137	U0142	CMF51
R81	RESISTOR FIXED METAL-FILM 270R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/059	U0142	CMF51
R82	RESISTOR FIXED METAL-FILM 240R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/058	U0142	CMF51



## Unit RX11 – Sensitive receiver (contd.)

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
R83	RESISTOR FIXED METAL-FILM 240R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/058	U0142	CMF51
R84	RESISTOR FIXED METAL-FILM 120R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/051	U0142	CMF51
R85	RESISTOR FIXED METAL-FILM 120R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/051	U0142	CMF51
R86	RESISTOR FIXED METAL-FILM 10R $\pm 2\%$ 125mW 150V 100 ppm/DEG.C, AXIAL:- (TAPED)	24772/025	U0142	CMF51
R87	RESISTOR VARIABLE CERMET LINEAR, 1K 10% 500mW 200V 150 ppm/DEG.C, SINGLE-TURN, HORIZONTAL-PCB,	25711/638	U0914	E2A
SKB	CONNECTOR JUMPER SHORTING-LINK, 2 WAY, SOCKET, FEMALE, 3A - FREE-MOUNTING, ON 0.64mm PINS, 9.6mm	23435/990	U2338	65474 001
T1	IMPEDANCE TRANSFORMER	44291/008	U2632	44291-008
T2	IMPEDANCE TRANSFORMER	44291/008	U2632	44291-008
TER B	ERMINAL CONNECTOR-PIN 0.64mm SQUARE, 5.97mm HIGH, PCB-MOUNTING, SINGLE-ENDED, REELED.	23435/188	U2338	75401 001
TER C	TERMINAL CONNECTOR-PIN 0.64mm SQUARE, 5.97mm HIGH, PCB-MOUNTING, SINGLE-ENDED, REELED.	23435/188	U2338	75401 001
TP1	TERMINAL CONNECTOR-PIN 0.64mm SQUARE, 5.97mm HIGH, PCB-MOUNTING, SINGLE-ENDED, REELED.	23435/188	U2338	75401 001
TP2	TERMINAL CONNECTOR-PIN 0.64mm SQUARE, 5.97mm HIGH, PCB-MOUNTING, SINGLE-ENDED, REELED.	23435/188	U2338	75401 001
TR1	TRANSISTOR NPN BIPOLAR BFR91A.... SOT-37. 12V 6GHz 300mW 35mA 40hFE @ 30mA.	28451/694	K8996	BFR91A
TR2	TRANSISTOR NPN BIPOLAR BFR96S.... SOT-37. 15V 5GHz 700mW 100mA 25hFE @ 70mA.	28452/172	K8996	BFR96S
TR3	TRANSISTOR NPN BIPOLAR BFR96S.... SOT-37. 15V 5GHz 700mW 100mA 25hFE @ 70mA.	28452/172	K8996	BFR96S
TR4	TRANSISTOR NPN BIPOLAR 2N2369.... TO-18. 15V 500MHz(min) 360mW 500mA 40hFE @ 10mA, SWITCHING.	28452/197	K5519	2N2369 OR A
TR5	TRANSISTOR PNP BIPOLAR MPS6534.... TO-92. 40V 250MHz 625mW 600mA 90hFE @ 100mA.	28434/827	K5519	MPS634M

REPLACEABLE PARTS

**Unit RX11 – Sensitive receiver (contd.)**

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
TR6	TRANSISTOR PNP BIPOLAR MPS6534.... TO-92. 40V 250MHz 625mW 600mA 90hFE @ 100mA.	28434/827	K5519	MPS634M
TR7	TRANSISTOR PNP BIPOLAR BC308B.... TO-18. 20V 130MHz 200mW 100mA 200hFE @ 2mA, TAPED (COLLECTOR	28433/455	K8300	BC252B
TR8	TRANSISTOR PNP BIPOLAR BC308B.... TO-18. 20V 130MHz 200mW 100mA 200hFE @ 2mA, TAPED (COLLECTOR	28433/455	K8300	BC252B
TR9	TRANSISTOR PNP BIPOLAR ZTX750.... TO-92. 45V 100MHz 1W 2A 100hFE @ 500mA, (LOOSE)	28435/226	K1196	ZTX750K
TR10	TRANSISTOR PNP BIPOLAR BC308B.... TO-18. 20V 130MHz 200mW 100mA 200hFE @ 2mA, TAPED (COLLECTOR	28433/455	K8300	BC252B
TR11	TRANSISTOR PNP BIPOLAR ZTX750.... TO-92. 45V 100MHz 1W 2A 100hFE @ 500mA, (LOOSE)	28435/226	K1196	ZTX750K
TR12	TRANSISTOR PNP BIPOLAR BC308B.... TO-18. 20V 130MHz 200mW 100mA 200hFE @ 2mA, TAPED (COLLECTOR	28433/455	K8300	BC252B
TR13	TRANSISTOR PNP BIPOLAR ZTX750.... TO-92. 45V 100MHz 1W 2A 100hFE @ 500mA, (LOOSE)	28435/226	K1196	ZTX750K
TR14	TRANSISTOR PNP BIPOLAR BC308B.... TO-18. 20V 130MHz 200mW 100mA 200hFE @ 2mA, TAPED (COLLECTOR	28433/455	K8300	BC252B
TR15	TRANSISTOR PNP BIPOLAR ZTX750.... TO-92. 45V 100MHz 1W 2A 100hFE @ 500mA, (LOOSE)	28435/226	K1196	ZTX750K

**Unit RX12 – Local oscillator driver**

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
34.	When ordering, prefix circuit reference with RX12.  Complete unit	44829/594	U2632	44829-594
C1	CAPACITOR FIXED CERAMIC 150pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/432	K8996	2222 678 34151
C2	CAPACITOR FIXED CERAMIC 180pF $\pm 2\%$ 63V N750 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/446	K7584	2222 678 58181
C3	CAPACITOR FIXED CERAMIC 330pF $\pm 2\%$ 63V N750 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/447	K7584	2222 678 58331
C4	CAPACITOR FIXED CERAMIC 150pF $\pm 2\%$ 63V N150 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/432	K8996	2222 678 34151
C5	CAPACITOR FIXED CERAMIC 220pF $\pm 2\%$ 63V N750 SINGLELAYER, RADIAL, 2.5mm PWP, (TAPED).	26343/435	K7584	2222 678 58221

**Unit RX12 – Local oscillator driver (contd.)**

Circuit Ref.	Description	MI Part No.	Mfr. Code	Mfr. Part No.
C6	CAPACITOR FIXED CERAMIC 39nF $\pm$ 20% 50V X7R MULTILAYER, SURFACE-MOUNTED, SIZE 1210, 00J	26386/756	U2109	1210 5C 393 MAT
C7	CAPACITOR FIXED ALUMINIUM 33uF $\pm$ 20% 25V ELECTROLYTIC, RADIAL, 5mm PWP, (TAPED).	26421/115	U4011	K33/25
C8	CAPACITOR FIXED CERAMIC 39nF $\pm$ 20% 50V X7R MULTILAYER, SURFACE-MOUNTED, SIZE 1210, 00J	26386/756	U2109	1210 5C 393 MAT
C9	CAPACITOR FIXED CERAMIC 39nF $\pm$ 20% 50V X7R MULTILAYER, SURFACE-MOUNTED, SIZE 1210, 00J	26386/756	U2109	1210 5C 393 MAT
C10	CAPACITOR FIXED POLYESTER 10nF $\pm$ 10% 63V 330 ppm/DEG.C, RADIAL, 5mm PWP, (TAPED).	26582/426	K1945	R68 DC 1002 AAK
L1	INDUCTOR VARIABLE 0.38uH - (nom) - PCB-MOUNTED (LOOSE)	23642/932	U3065	E528DN-100070
L2	INDUCTOR VARIABLE 0.17uH - (nom) - PCB-MOUNTED (LOOSE)	23642/933	U3065	E528DN-100066
L3	INDUCTOR VARIABLE 0.13uH - (nom) - PCB-MOUNTED (LOOSE)	23642/931	U3065	E528DN-100065
L4	INDUCTOR VARIABLE 0.38uH - (nom) - PCB-MOUNTED (LOOSE)	23642/932	U3065	E528DN-100070
L5	CHOKE ASSEMBLY	44291/009	U2632	44291-009
L6	INDUCTOR FIXED 220uH $\pm$ 10% LACQUERED, MINIATURE, 110mA 17R (MAX), 45 Q @ 0.79 MHz, 4.2 MHz SRF MIN,	23642/563	K0467	406 8 274 71 008
PLA	TERMINAL CONNECTOR-PIN 0.64mm SQUARE, 5.97mm HIGH, PCB-MOUNTING, SINGLE-ENDED, REELED.	23435/188	U2338	M 75401 001
R1	RESISTOR FIXED METAL-OXIDE 120R $\pm$ 2% 500mW 350V 250 ppm/DEG.C, AXIAL: - (TAPED)	24573/051	K4184	TR5 OR TRM50RNK5
RLA	RELAY MAGNETIC, DOUBLE-POLE CHANGEOVER. 5V (COIL), 62R - PCB MOUNTING, HERMETIC SEAL, WIDE BANDWIDTH.	23486/101	U0611	172-5

**Unit RX3 – Bypass switch assembly**

35. This assembly should not be dismantled.

Complete unit	44429-038	U2632	44429-038
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## MISCELLANEOUS MECHANICAL PARTS

Item No.	Description	Part Number
36.	Order without prefix. Item numbers as shown in Fig. 6-1.	
1	Top cover	35903-805
2	Board frame cover	35906-437
3	Board guide (1 of 12)	22324-001
4	AT2 protective cover	37590-841
5	CRT magnetic shield Gasket moulding	35904-561 37590-988
6	CRT strap assembly	41700-687
7	VARIABLE control knob Cap, stone grey	41149-060 37590-281
8	CRT bezel	37590-916
9	Lower cover	35904-460
10	Front panel, marked	35906-486
11	CRT window CRT screen, mesh	37490-707 31519-125
12	VOLUME, INTENSITY or POSITION control knob (1 of 4) Cap, stone grey (1 of 4)	41149-073 37590-242
13	Foot (1 of 4) Stud, nylon (1 of 4)	37590-681 37590-223
14	Handle, moulded	41700-380
15	RF tray cover (small)	41690-406
16	Boss (1 of 2) Index ring (1 of 2) Cover (1 of 2) Screw, pan M5 x 16 (1 of 2) Compression spring (1 of 2) Sleeve (1 of 2)	35890-080 34900-902 37590-883 21837-565 31119-085 31718-228
17	Side rail (1 of 2)	34900-872
18	RF tray cover (large)	41690-408
19	AC1 safety shield	37490-749
20	Rear cover Grommet, blind (1 of 2) Air filter (1 of 3)	41690-407 23188-242 37490-718
21	Rear stand (1 of 2)	37590-915
22	Rear panel Voltage selector locking plate	35904-457 35904-422
23	Nut, sheet metal (1 of 8)	35901-352

REPLACEABLE PARTS

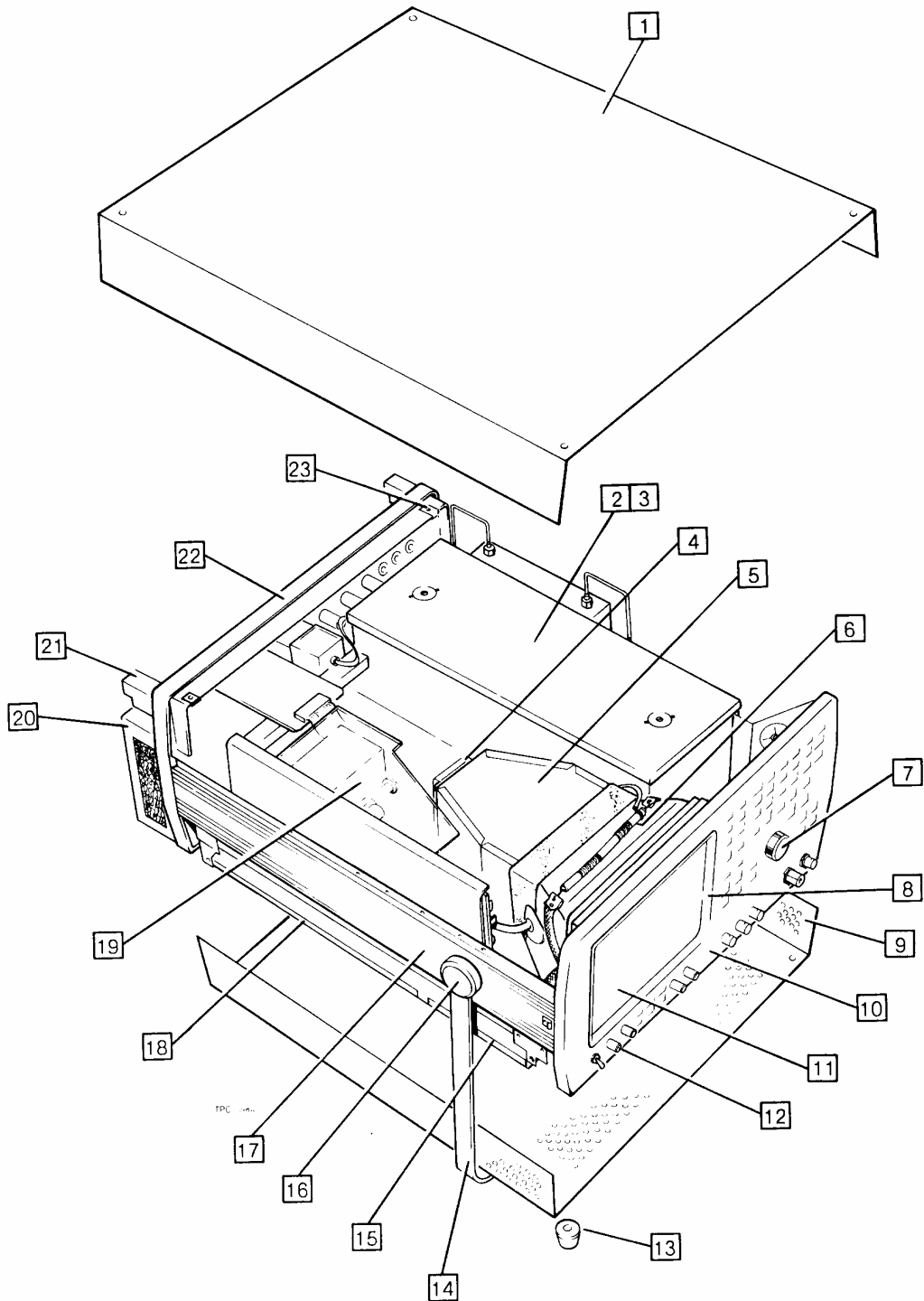


Fig. 6-1 Miscellaneous mechanical parts

**TABLE 6-1 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
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

REPLACEABLE PARTS

NATO Mfr. Code	Manufacturer's Address
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
K636	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
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

REPLACEABLE PARTS

NATO Mfr.  
Code

Manufacturer's Address

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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 ORY

U1613 MOLEX ELECTRONICS LTD, MOLEX HOUSE, FARNHAM ROAD, BORDEN, HANTS,  
GU35 ONU

U1718 TRW CONNECTORS LTD, SHIREOAKS ROAD, WORKSOP, NOTTS, S80 3HA

U2120 DAU COMPONENTS, 70-74 BARNHAM ROAD, BARNHAM, WEST SUSSEX, PO22 OES

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

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 OTU

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

**Para.**

- 1 Circuit notes
- 1 Component values
- 2 Symbols
- 3 PCB layouts

Fig.	Part no.	Page Comp. layout	Cct.
1	AO/1 : 2955A Overall assembly	-	3/4
2	AA0/1 : 2955A RF tray	-	5
3	AA1 : RF modulation meter (oscillator and PLL)	44828-878	6 7/8
4	AA1 : RF modulation meter (mixer)	"	-
5	AA2 : RF counter	44828-879	10 11
6	AA3 : RF synthesizer (oscillator & filters)	44828-880	12 13/14
7	AA3 : RF synthesizer (dividers)	"	-
8	AA4/1 : Low frequency synthesizer and output amp. (mixer)	44829-613	16 17/18
9	AA4/1 : Low frequency synthesizer and output amp. (output)	"	-
10	AB1/1 : Motherboard (audio amp. and overload protection)	44829-523	20 21/22
11	AB1/1 : Motherboard (keyboard interface)	"	-
12	AB2/2 : Digital scope (A-D and timing)	44829-635	24 25/26
13	AB2/2 : Digital scope (output)	"	-
14	AB3/2 : VDU board (character generator)	44829-636	28 29/30
15	AB3/2 : VDU board (scope trigger)	"	-
16	AB4/1 : Microprocessor (processor & memory)	44829-524	32 33/34
17	AB4/1 : Microprocessor (A-D conversion)	"	-
18	AB4/1 : Microprocessor (programmable divider)	"	-
19	AB5/2 : Demodulation and scope (IF demodulation)	44829-770	38 39/40
20	AB5/2 : Demodulation and scope (switching)	"	-
21	AB5/2 : Demodulation and scope (ranging and filters)	"	-
22	AB6/1 : AF generators 1 & 2 (dividers)	44829-526	44 45/46
23	AB6/1 : AF generators (D-A conversion)	"	-
24	AC1 : CRT drive	44828-890	48 49
	AT2 : CRT base	44828-520	48 49
25	AC2 : Input switching	44828-876	50 51
	AR4 : DC filter	44829-508	50 51
26	AF1/1 : Main keyboard	44829-597	52 53
27	AF2/1 : Scope keyboard	44829-642	54 55
	AZ1 : Optical encoder	44828-523	54 55
28	AR1/1 : Power supply	44829-645	56 57
29	AG0 : GPIB unit	44990-845	58 59/60

Fig.	Part no.	Page		
		Comp. layout	Cct.	
30	A0/2 : 2955R Overall assembly	52955-321	-	61/62
31	AA0/2 : 2955R RF tray	-	-	63/64
32	RX2 : 2955R Attenuator and switch assembly and RX3 : 2955R Bypass switch assembly	-	-	65/66
33	RX1 : 2955R RX tray interconnections	44990-879	-	67
34	RX11 : 2955R Sensitive receiver	44829-561	68	69
35	RX12 : 2955R Local oscillator driver	44829-594	70	71/72







## CIRCUIT NOTES

### Component values

- Resistors : R = ohms, k = kilohms, M = megohms.  
Capacitors :  $\mu$  = microfarads, n = nanofarads, p = picofarads.  
Inductors :  $\mu$  = microhenries, m = millihenries.  
SIC = value selected during test, nominal value shown.  
= static sensitive component.

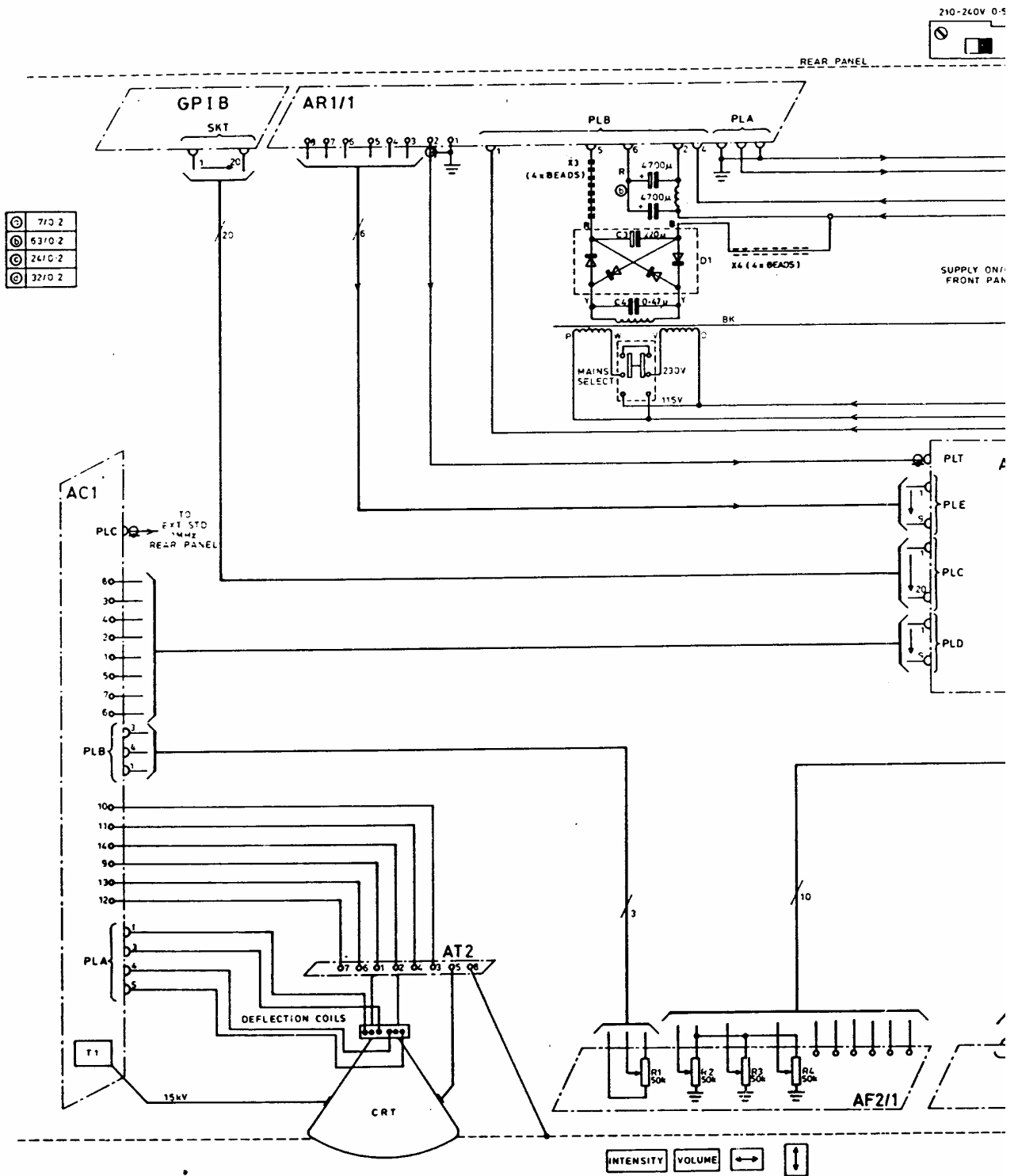
### Symbols

- Symbols are to BDS 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

- PCB layouts are shown as viewed from the component side.

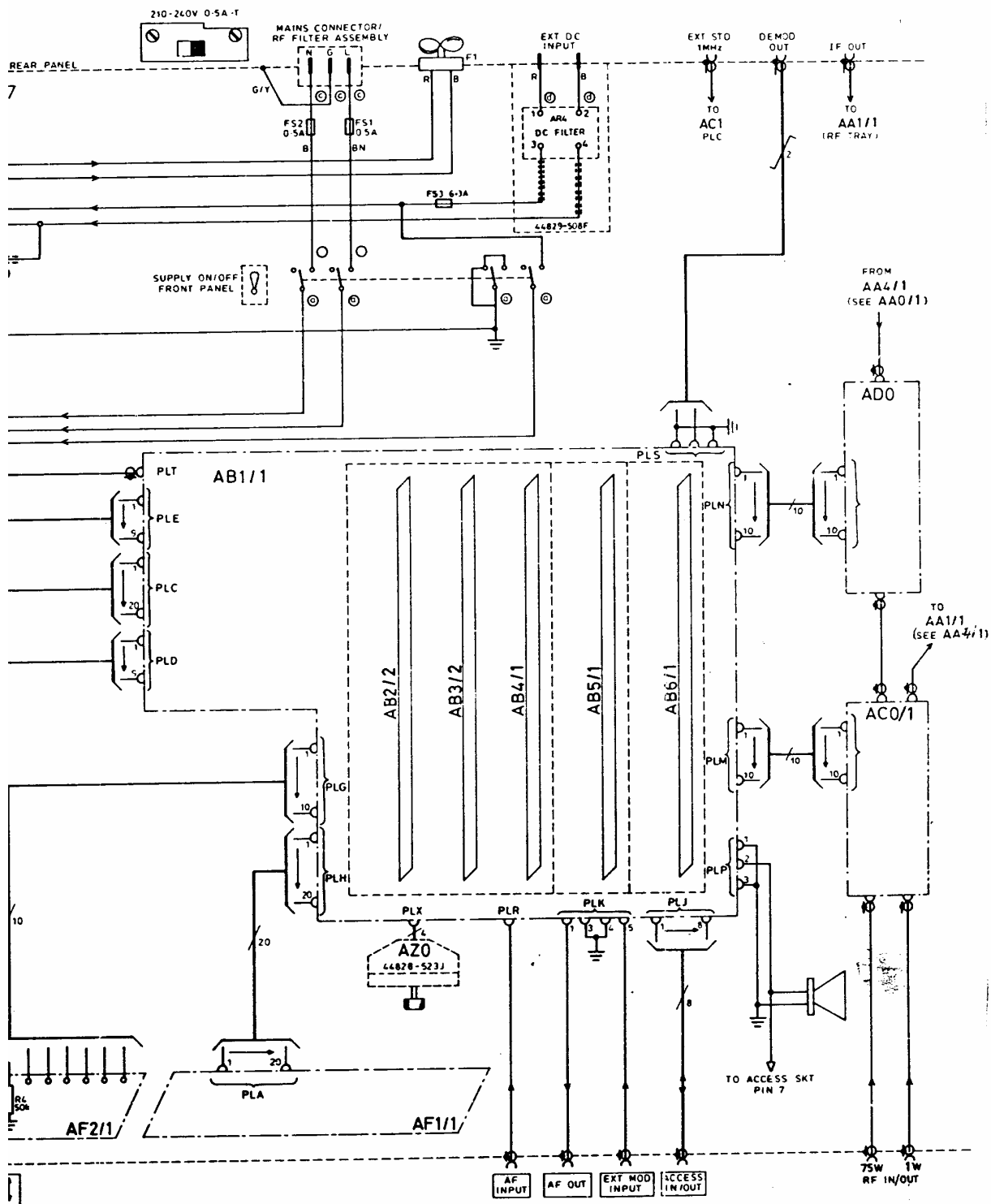


Drg. No. Z 52955-910L  
Sht. 1 of 2, Iss. 1

Fig. 1

Apr. 90 (Am. 1)

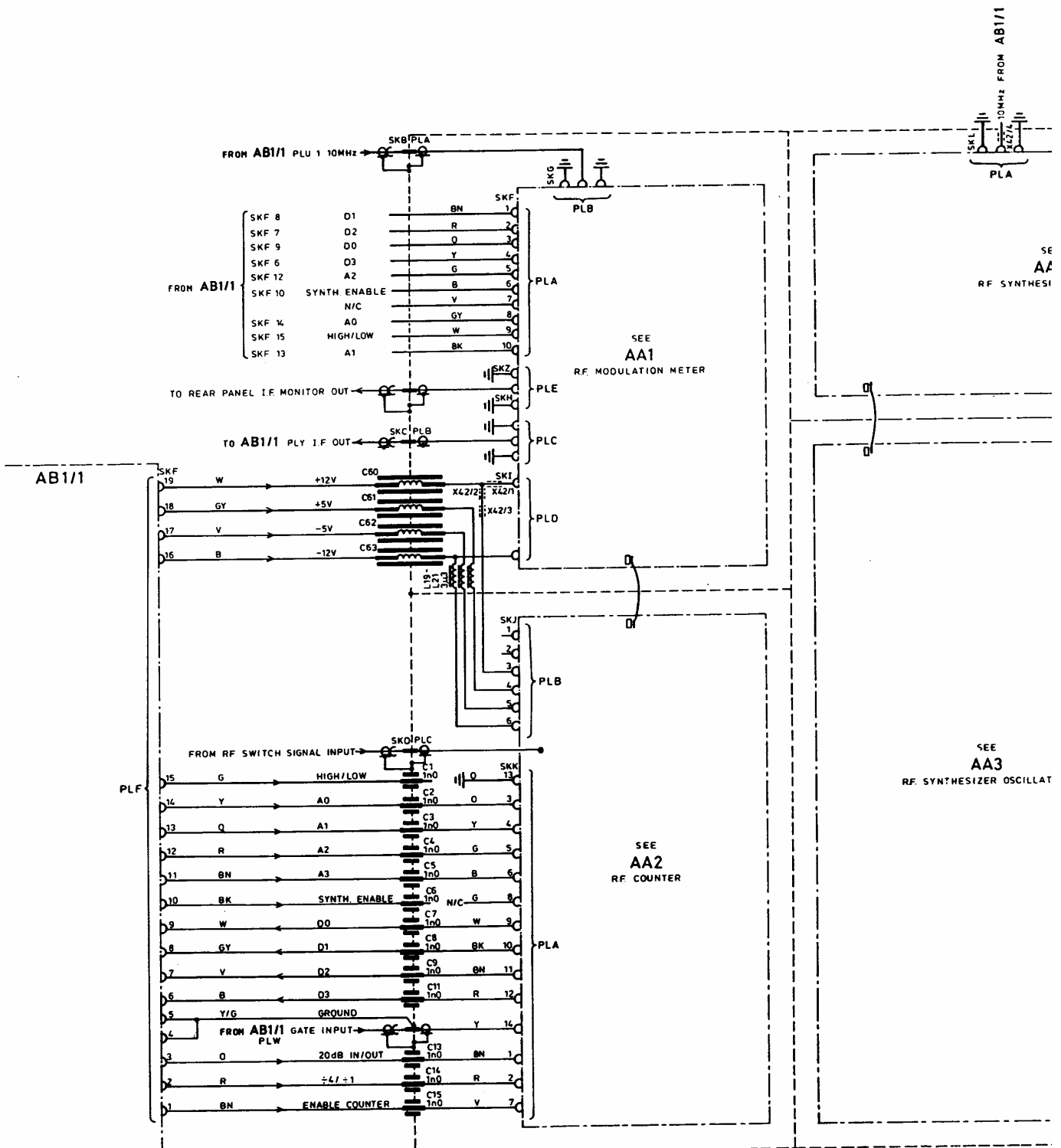
A011 : 2955A Overall assen



A0  
/1

FOR RF TRAY AAO SEE SHEET 2

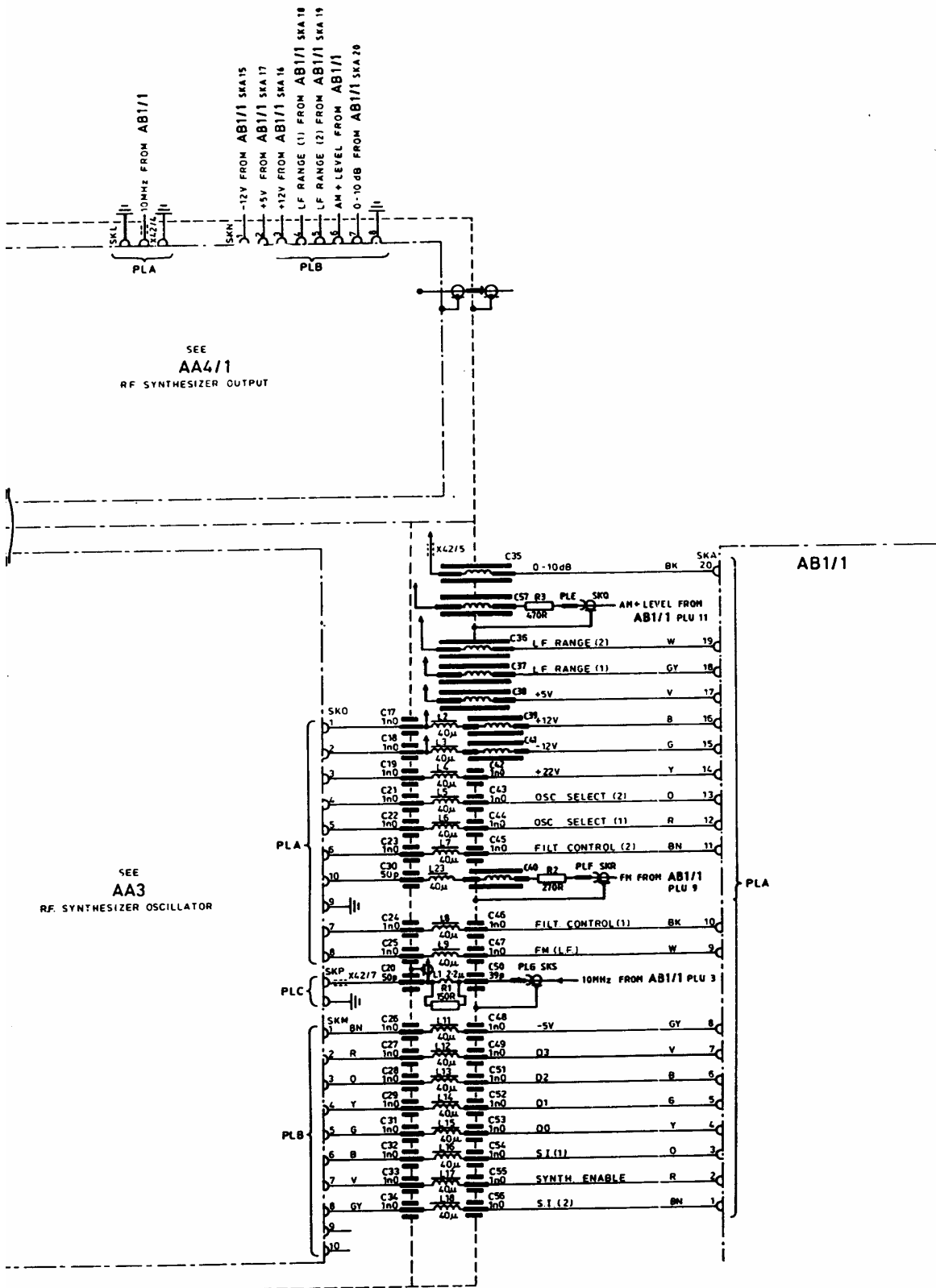
: 2955A Overall assembly



g. 2  
 or. 90 (Am. 1)

Drg. No. Z 52955-910L  
 Sht. 2 of 2, Iss.2

AA0/1 : 2955A RF tray



: 2955A RF tray



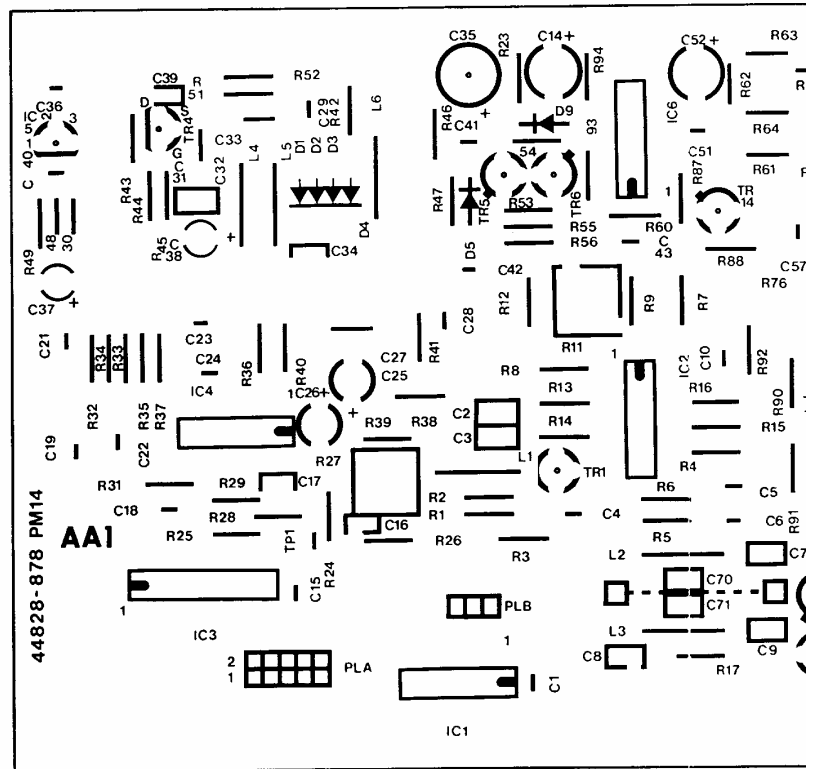
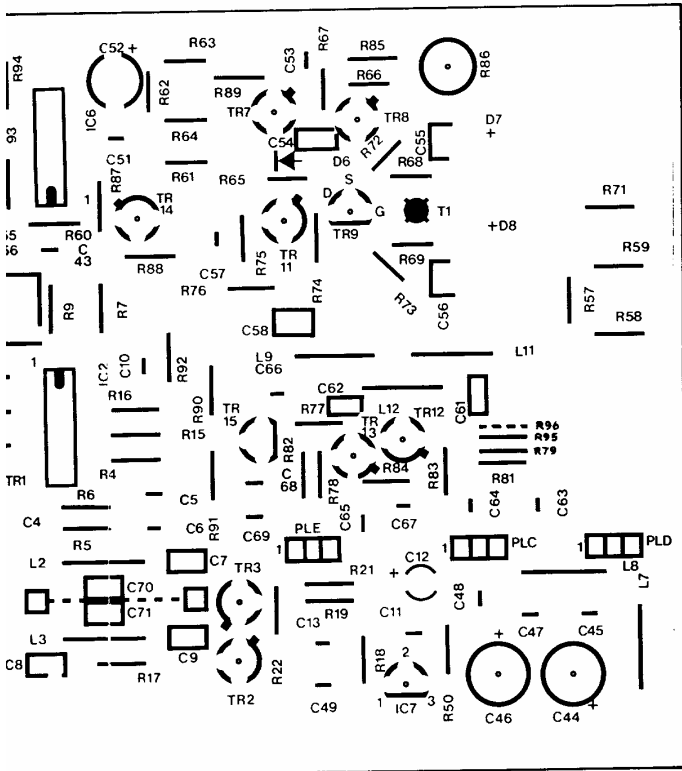


Fig. 3  
 Chap. 7  
 Page 6

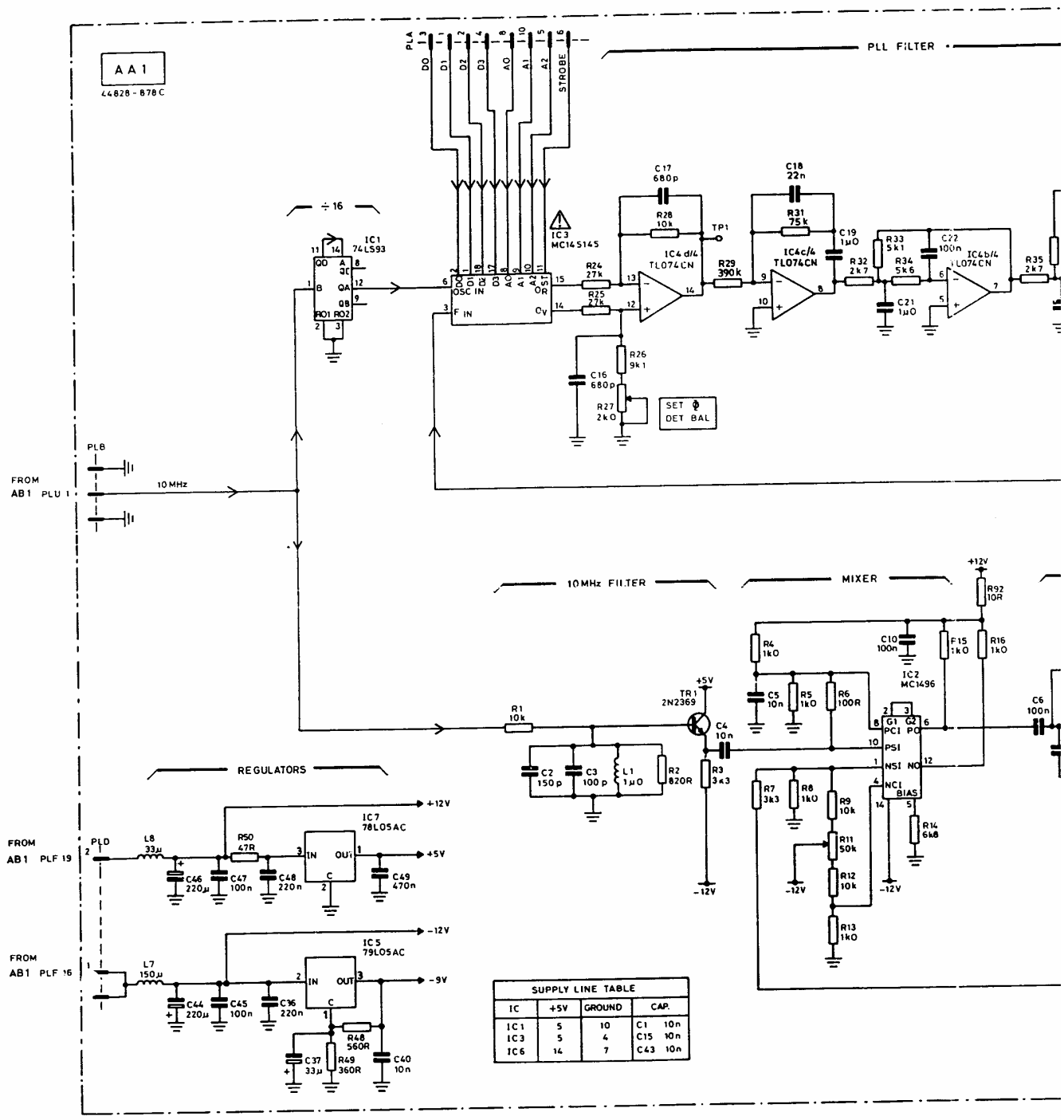
AA1 : Component layout



: Component layout

Fig. 3  
Mar. 89





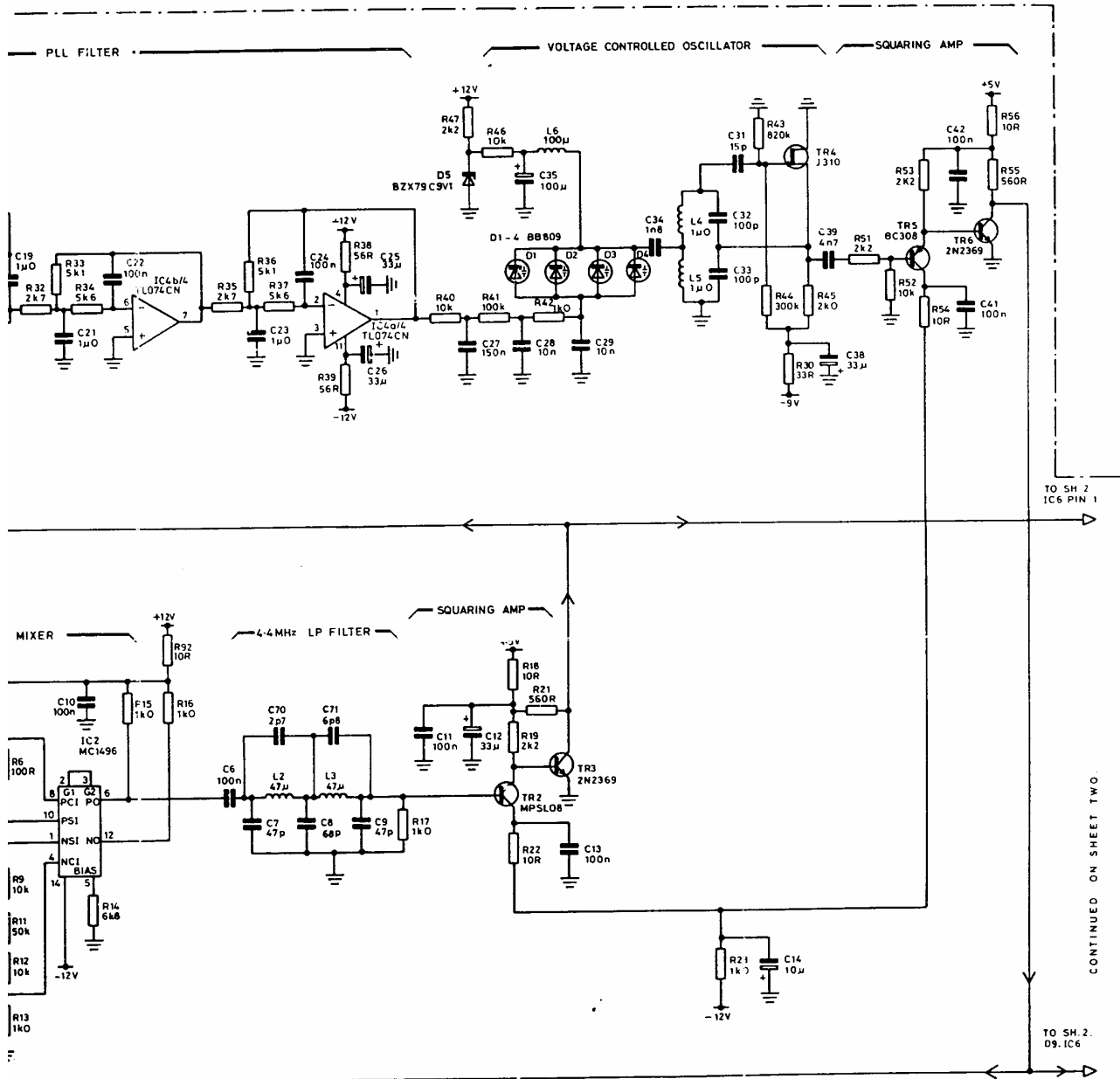
Drg. No. Z 44828-878  
Sht. 1 of 2, Iss. 10

⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

AA1 : RF modulation meter (oscillator)

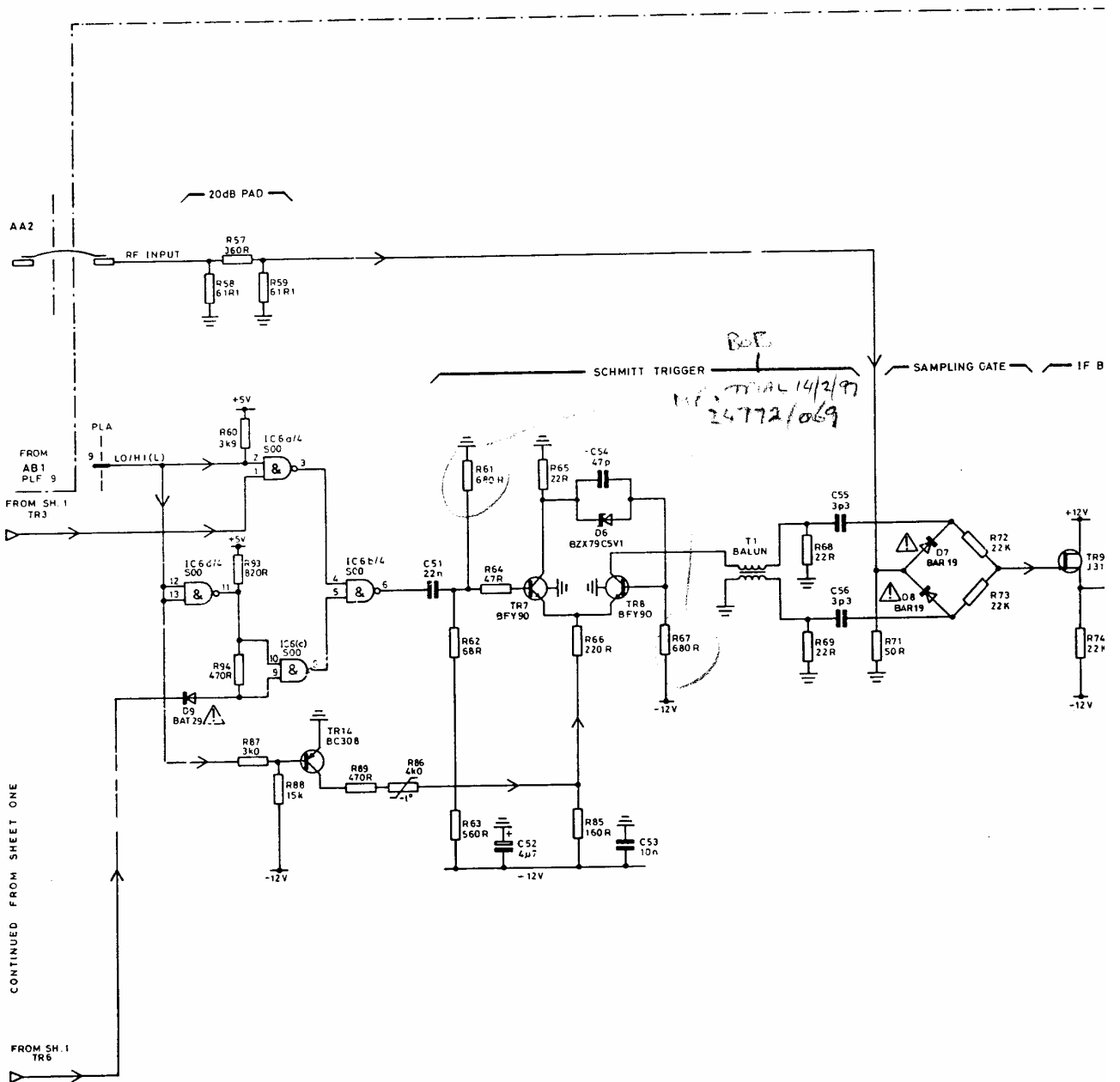
Fig. 3

Sep. 90 (Am. 2)



AA1

modulation meter (oscillator and PLL)



CONTINUED FROM SHEET ONE

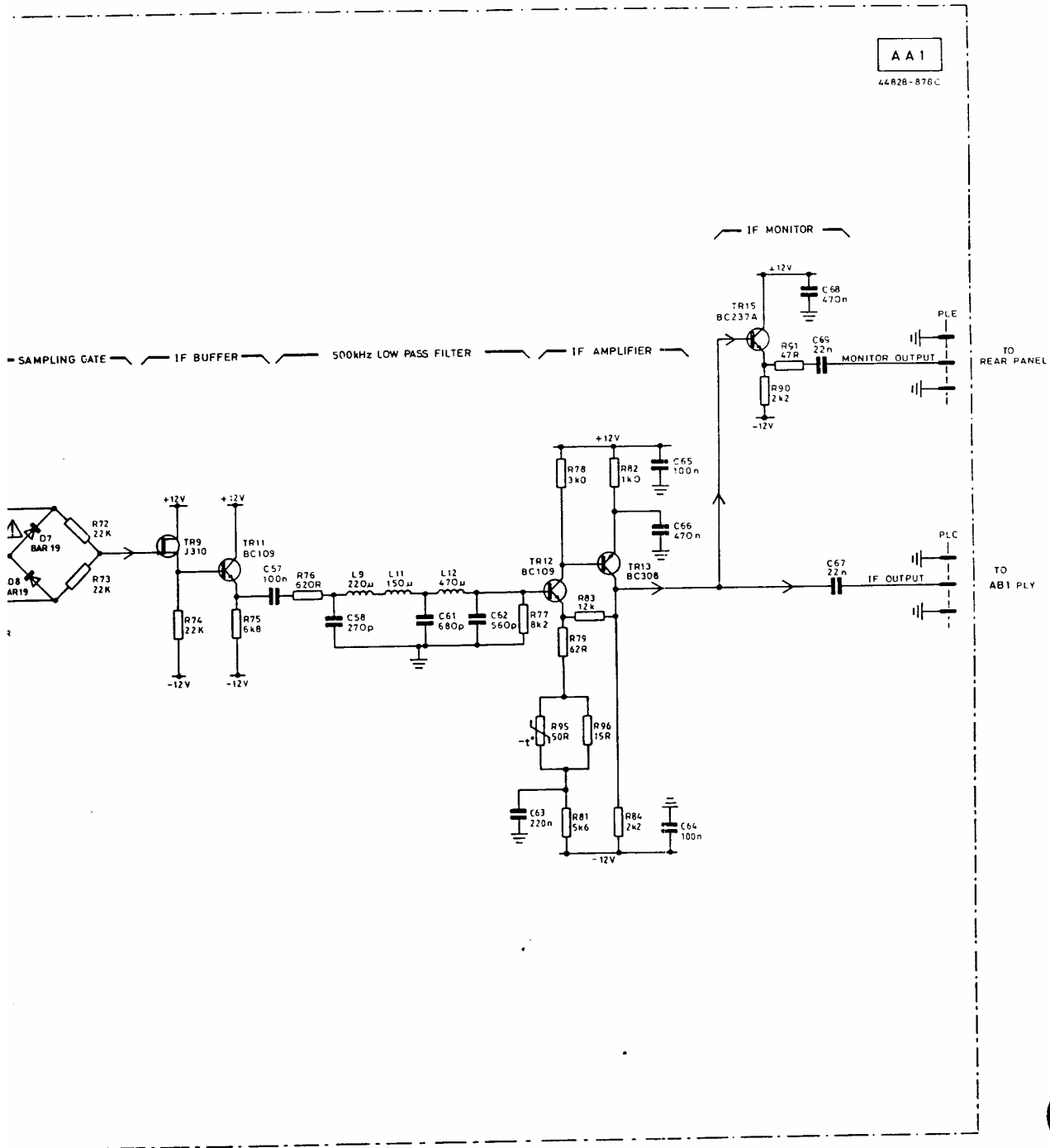
Drg. No. Z 44828-878  
Sht. 2 of 2, Iss. 7

⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

Fig. 4

AA1 : RF modulation meter (m

Apr. 90 (Am. 1)



AA1

modulation meter (mixer)

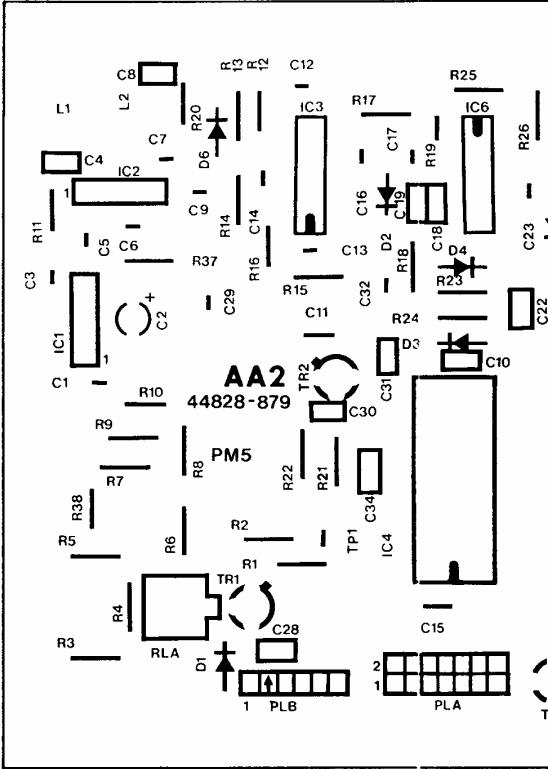


Fig. 5  
 Chap. 7  
 Page 10

AA2 : Component layout

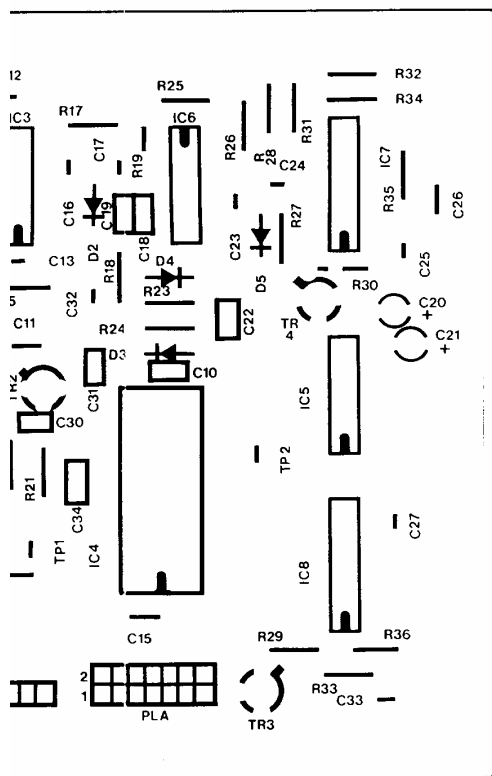
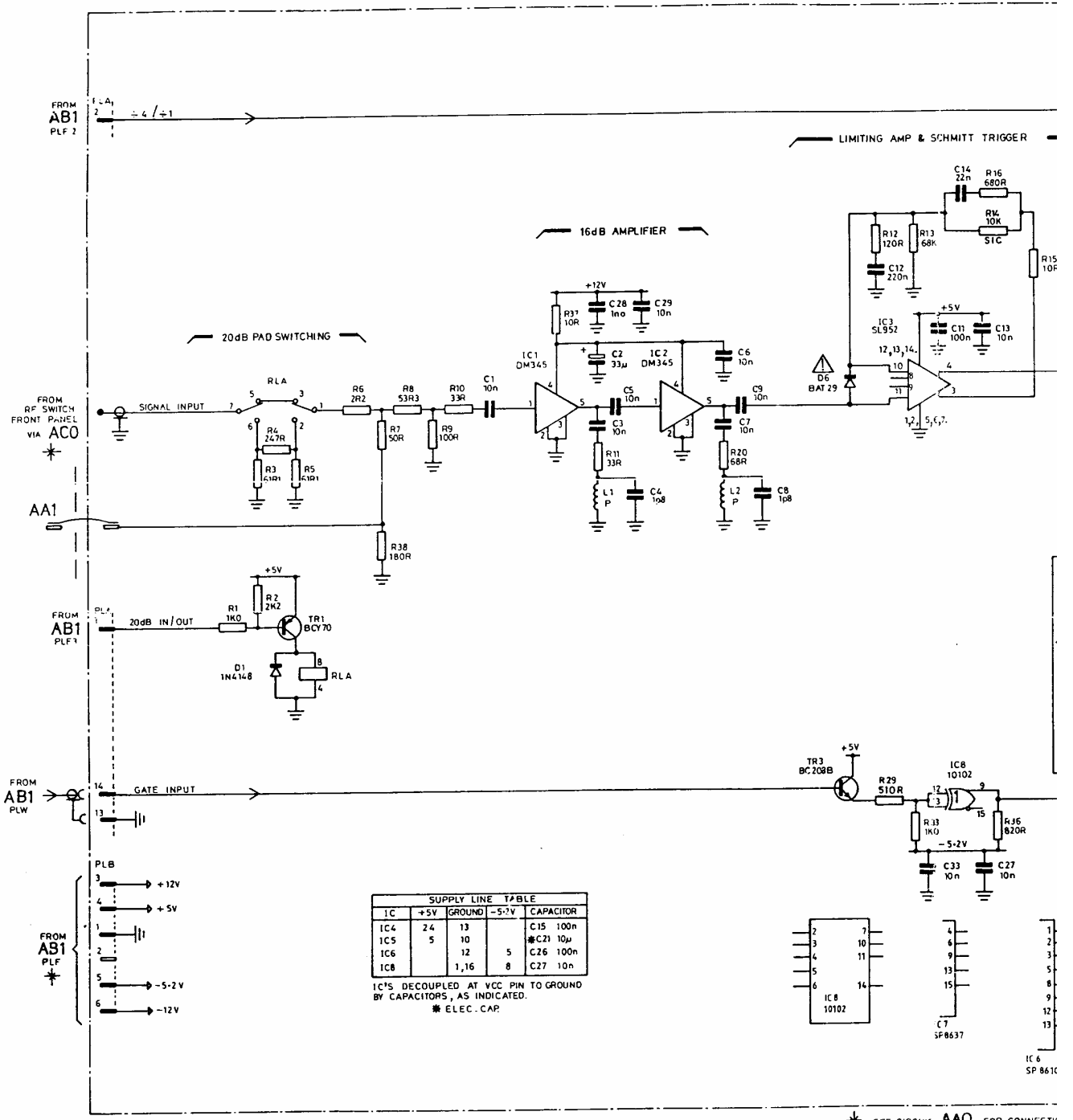


Fig. 5 : Component layout

Fig. 5

Mar. 89



Drg. No. Z 44828-879  
Sht. 1 of 1, Iss. 9

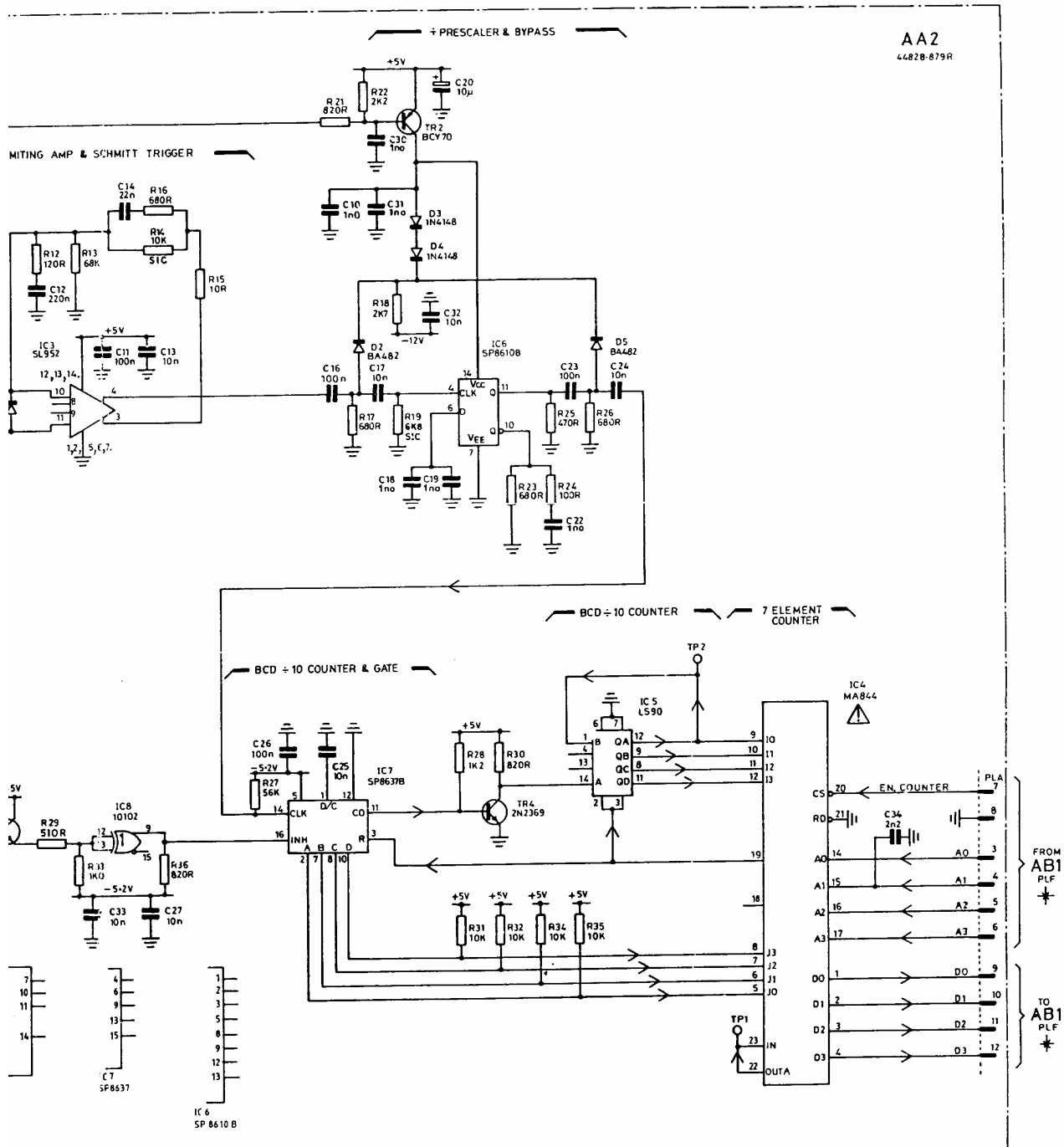
SEE CIRCUIT AAO FOR CONNECT

THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

AA2 : RF counter

Fig. 5

Sep. 90 (Am. 2)



\* SEE CIRCUIT AAO FOR CONNECTIONS DETAILS

AA2

DEVICE.

AA2 : RF counter

Fig. 5  
Chap. 7  
Page 11



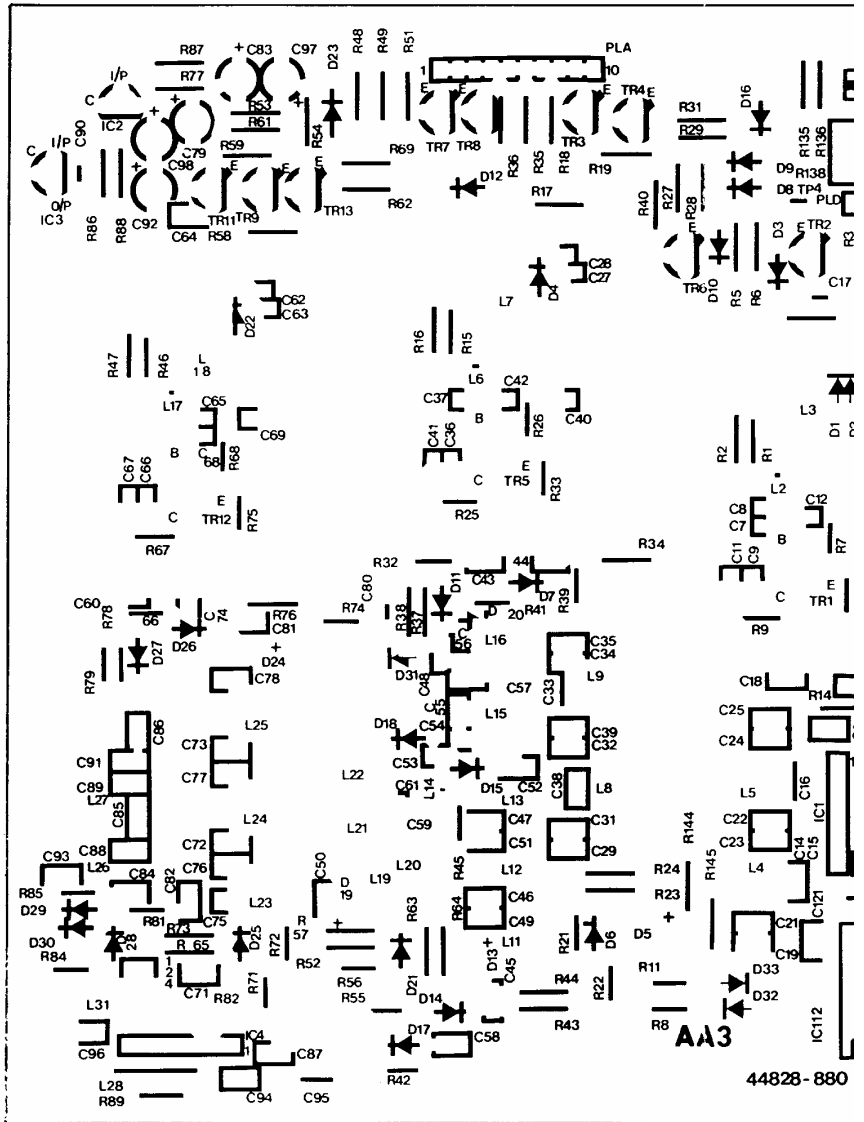
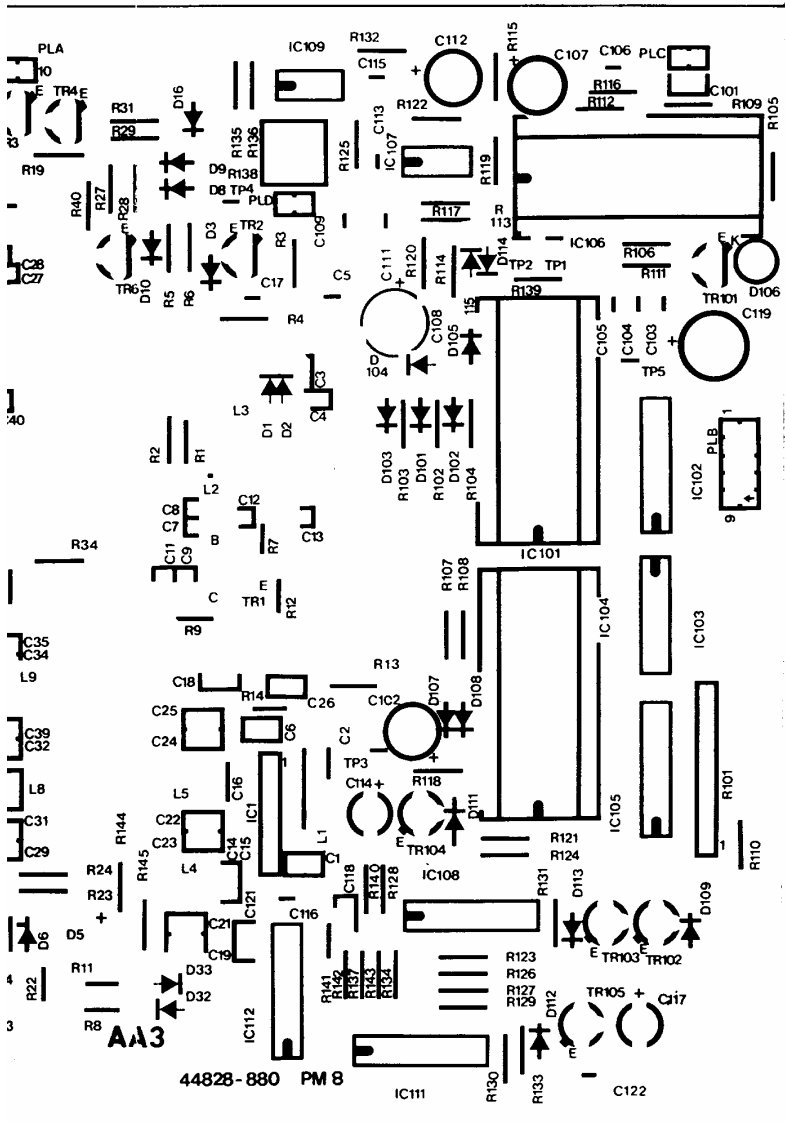


Fig. 6  
 Chap. 7  
 Page 12

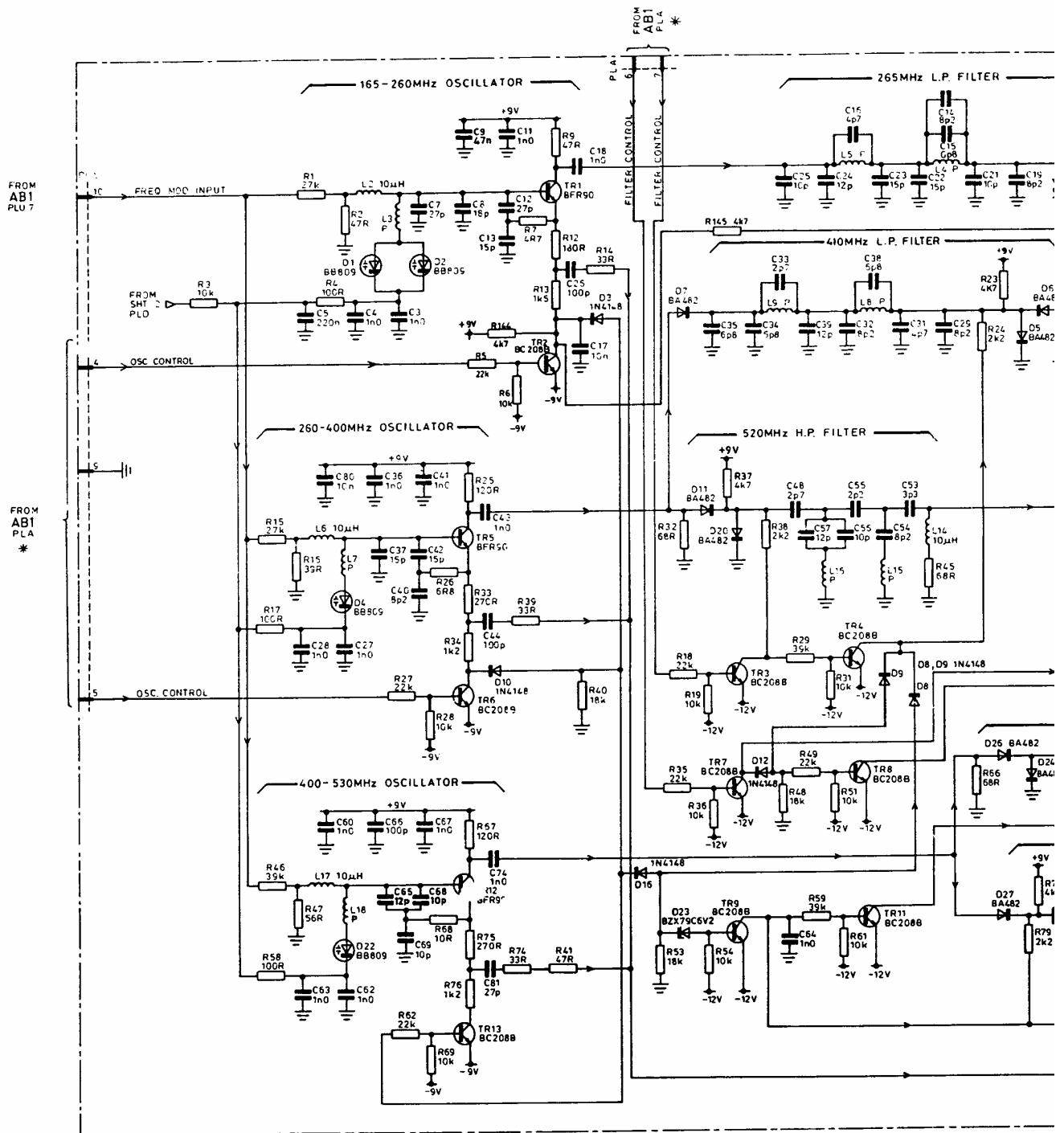
AA3 : Component layout



AA3 : Component layout

Fig. 6

Mar. 89



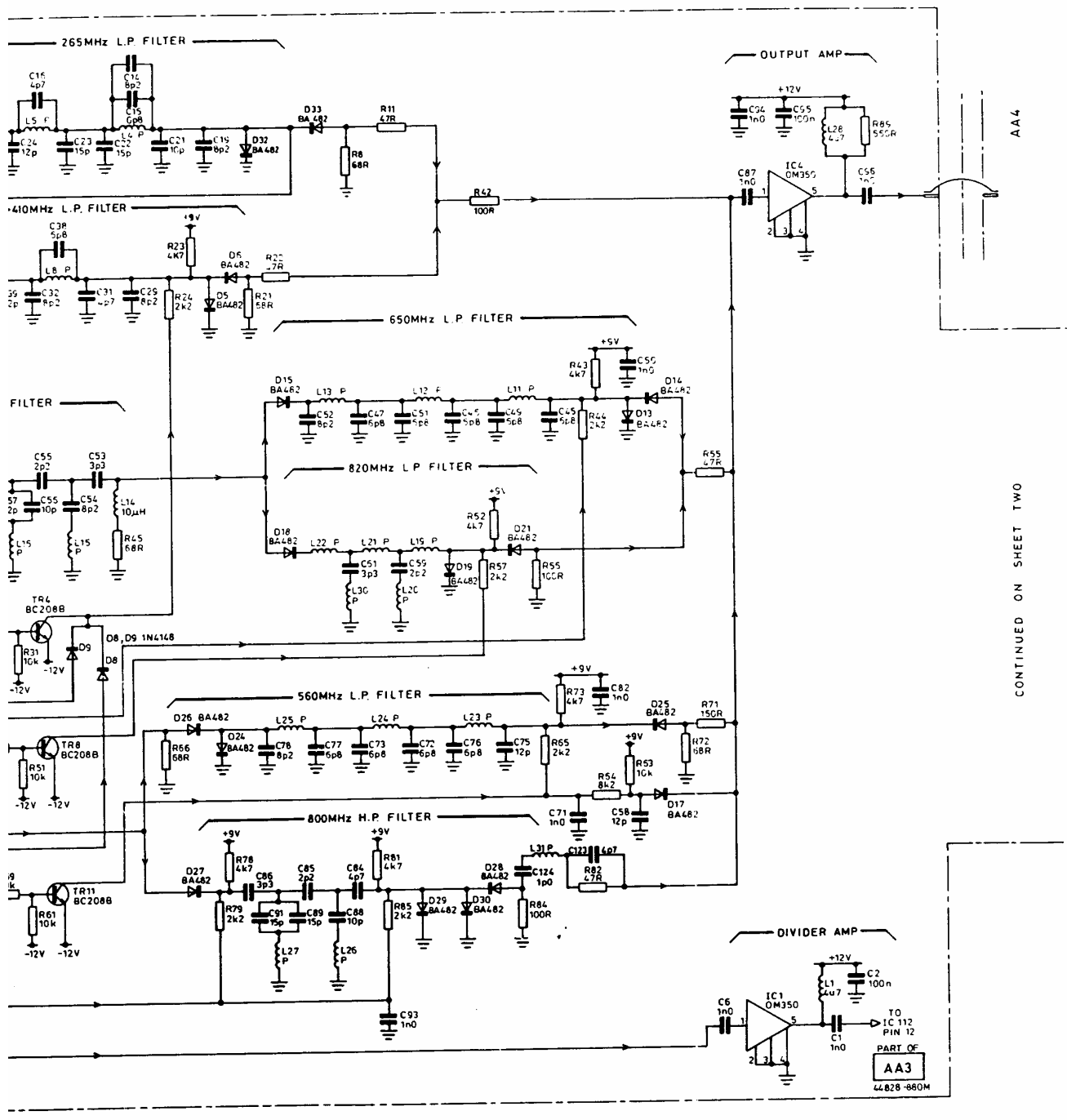
Drg. No. Z 44828-880  
Sht. 1 of 2, Iss. 7

\* SEE CIRCUIT AAO FOR CONNECTIONS DETAILS

Fig. 6

Apr. 90 (Am. 1)

AA3 : RF synthesizer (oscillator &



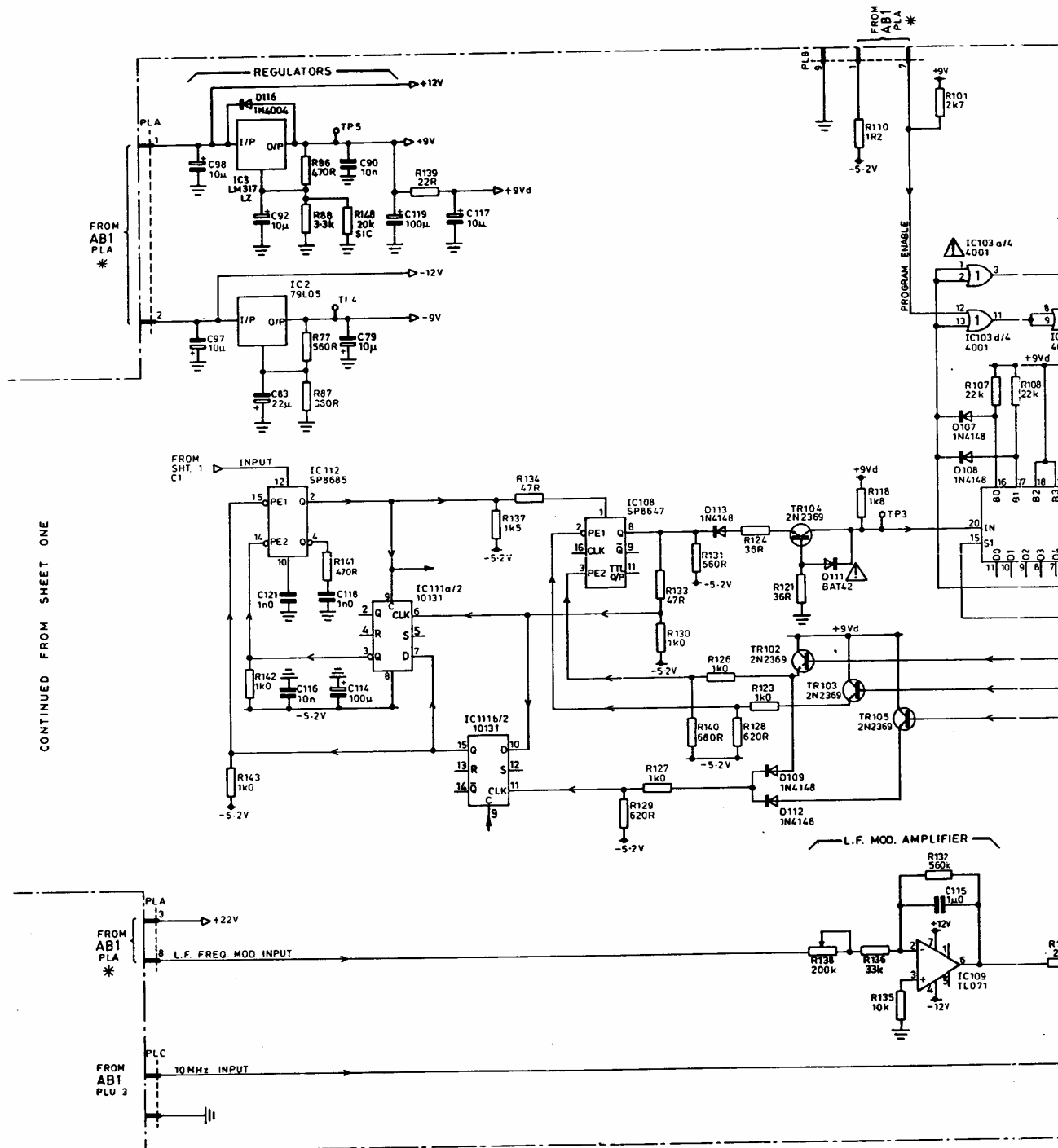
AA4

CONTINUED ON SHEET TWO

PART OF  
AA3  
44828-880M

AA3

Fig. 6 synthesizer (oscillator & filters)



CONTINUED FROM SHEET ONE

SUPPLY LINE TABLE				
IC	+9V	+9Vd	GND	-5-2V
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			1, 16	8
IC 112			16	8

Drg. No. Z 44828-880  
Sht. 2 of 2, Iss. 11

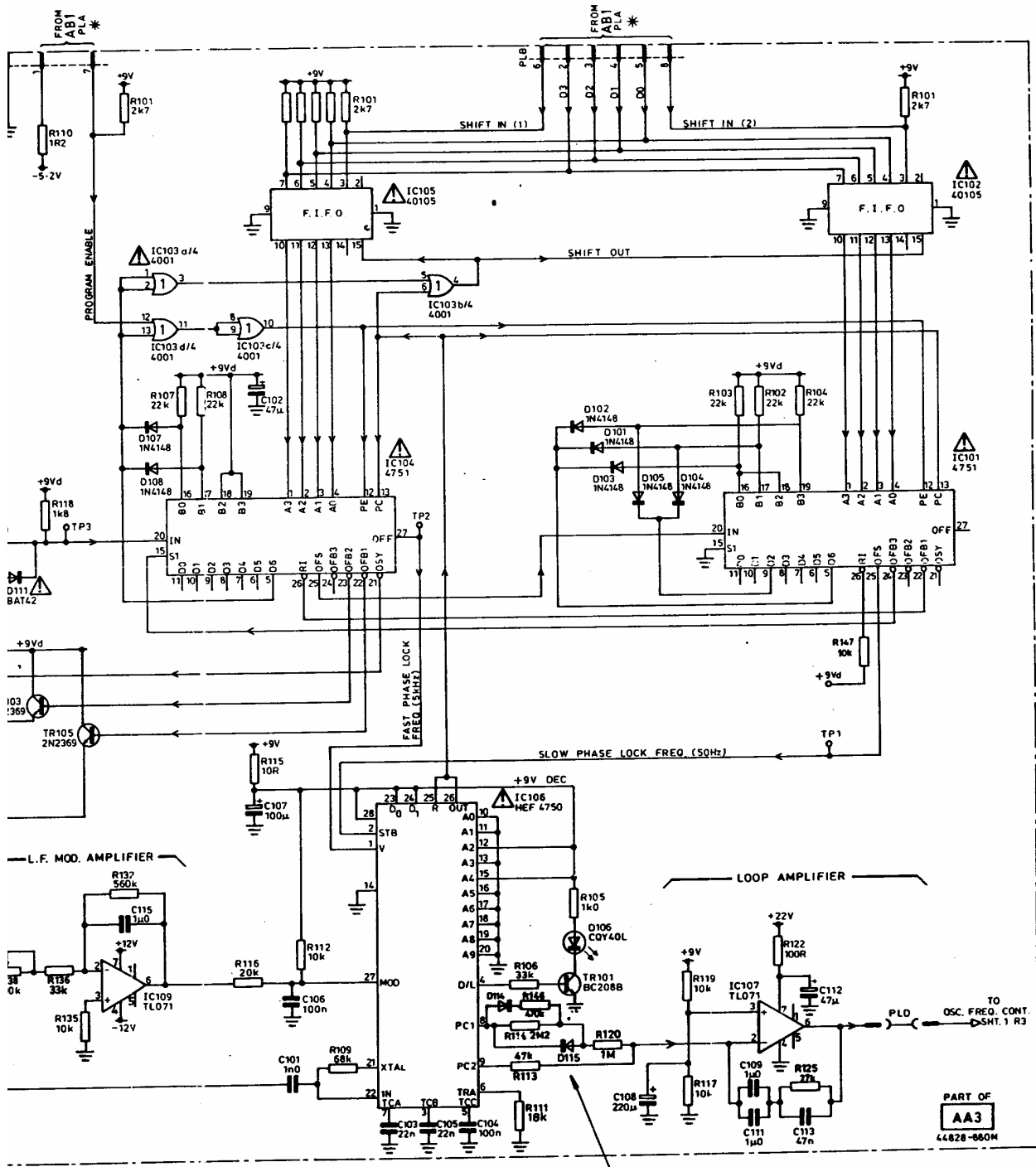
\* SEE CIRCUIT AAO FOR CONNECTION DETAILS

⚠ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

Fig. 7

Sep. 90 (Am. 2)

AA3 : RF synthesizer (divide.



CIRCUIT AA0 FOR CONNECTION DETAILS.

STATIC-SENSITIVE DEVICE.

RF synthesizer (dividers)

AA3

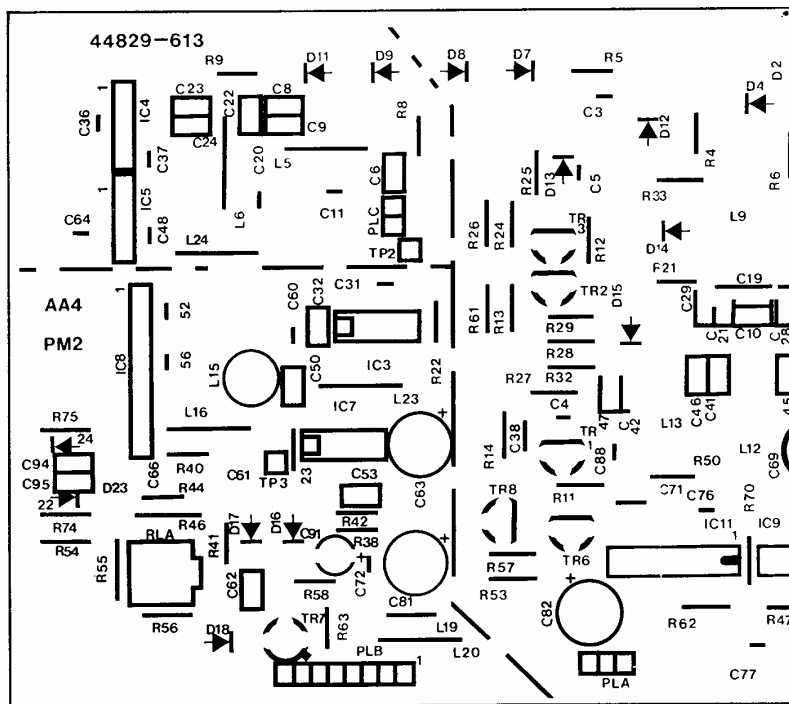
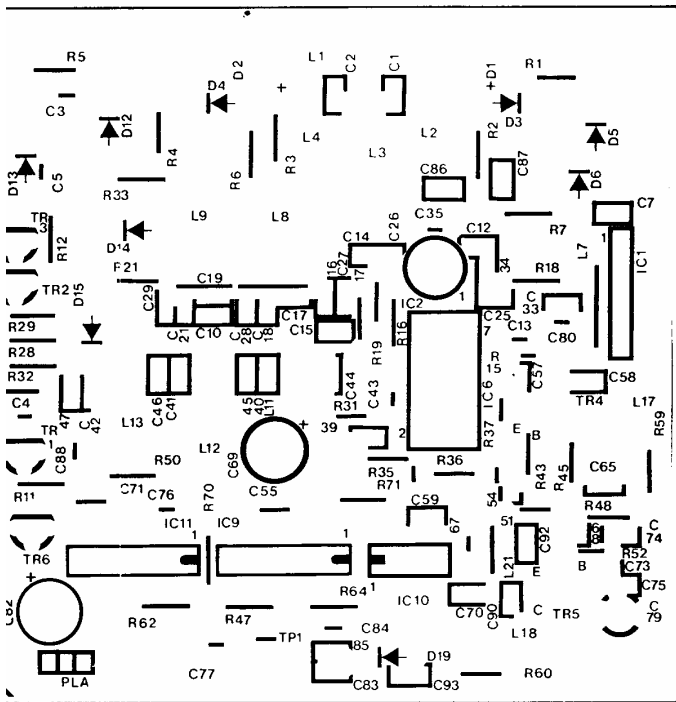


Fig. 8  
Chap. 7  
Page 16

AA4/1 : Component layout

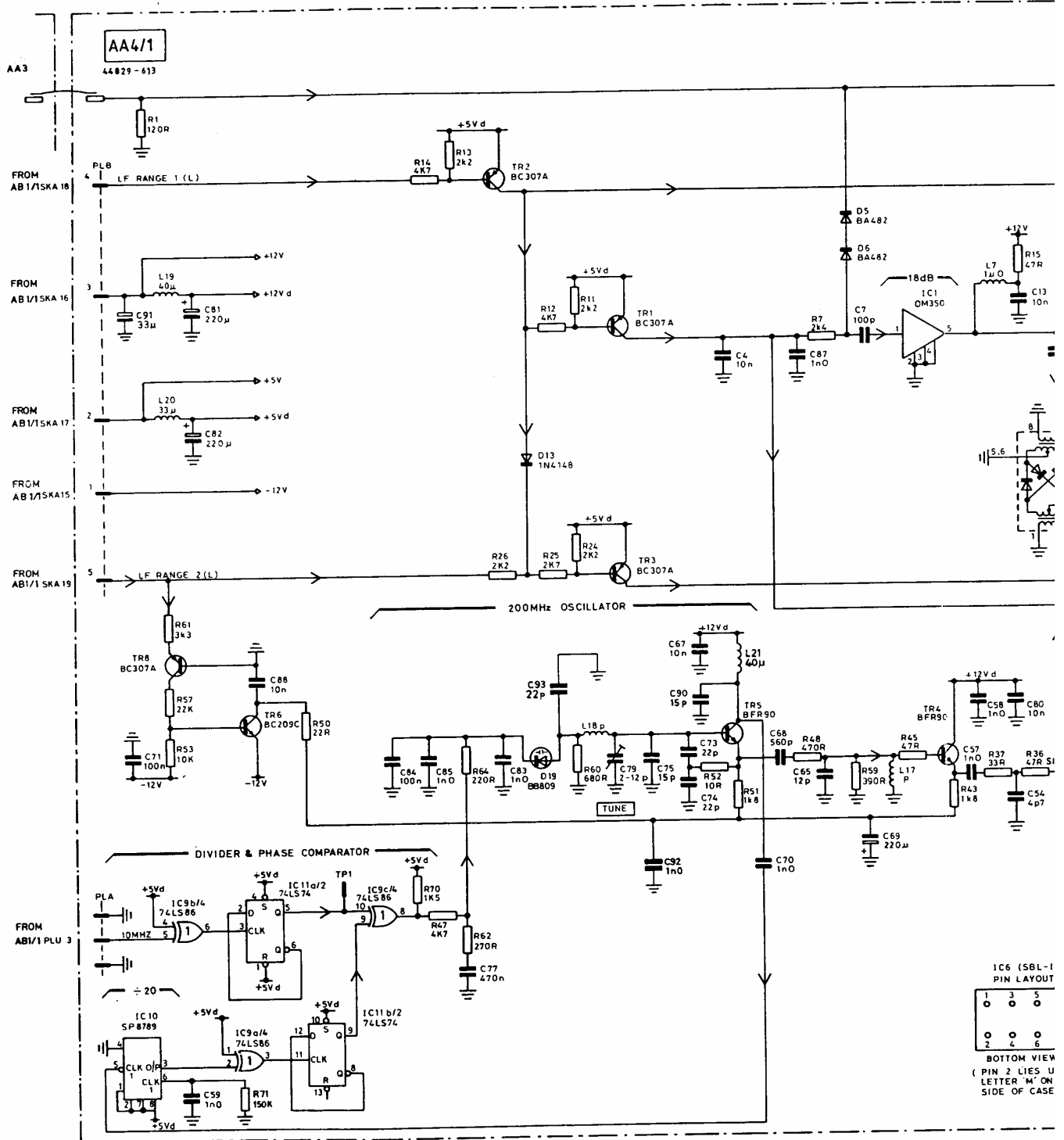


Component layout

Fig. 8

Mar. 89



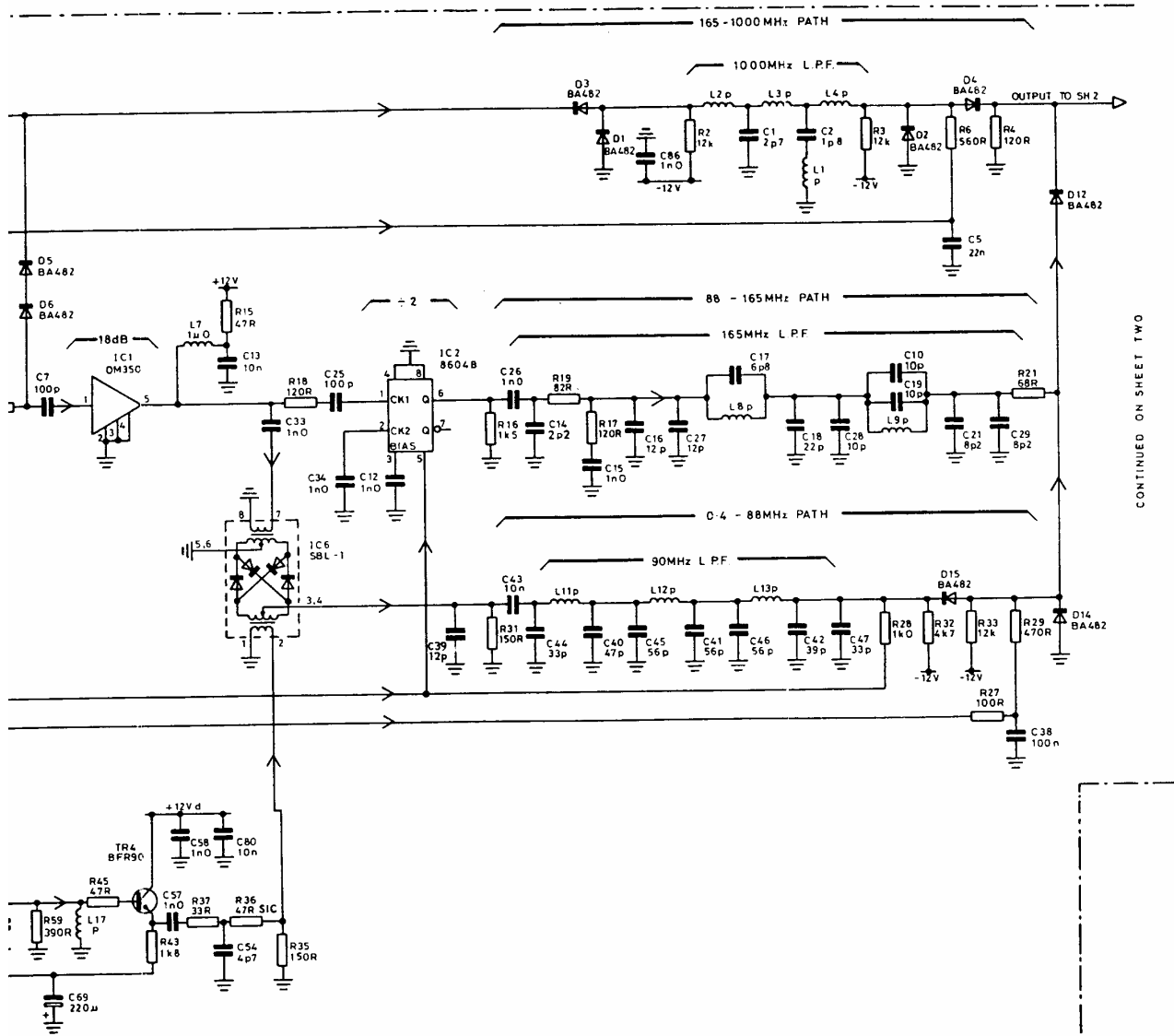


Drg. No. Z 44829-613  
Sht. 1 of 2, Iss. 2

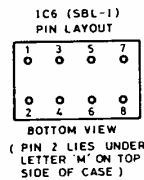
Fig. 8

Mar. 89

AA4/1 : Low frequency synthesizer and outp



CONTINUED ON SHEET TWO



SUPPLY LINE TABLE

IC	+5Vd	GROUND	CAP.
IC 9	14	7	C55 100n
IC 10	7,1,2,8	4	
IC 11	14	7	C76 10n

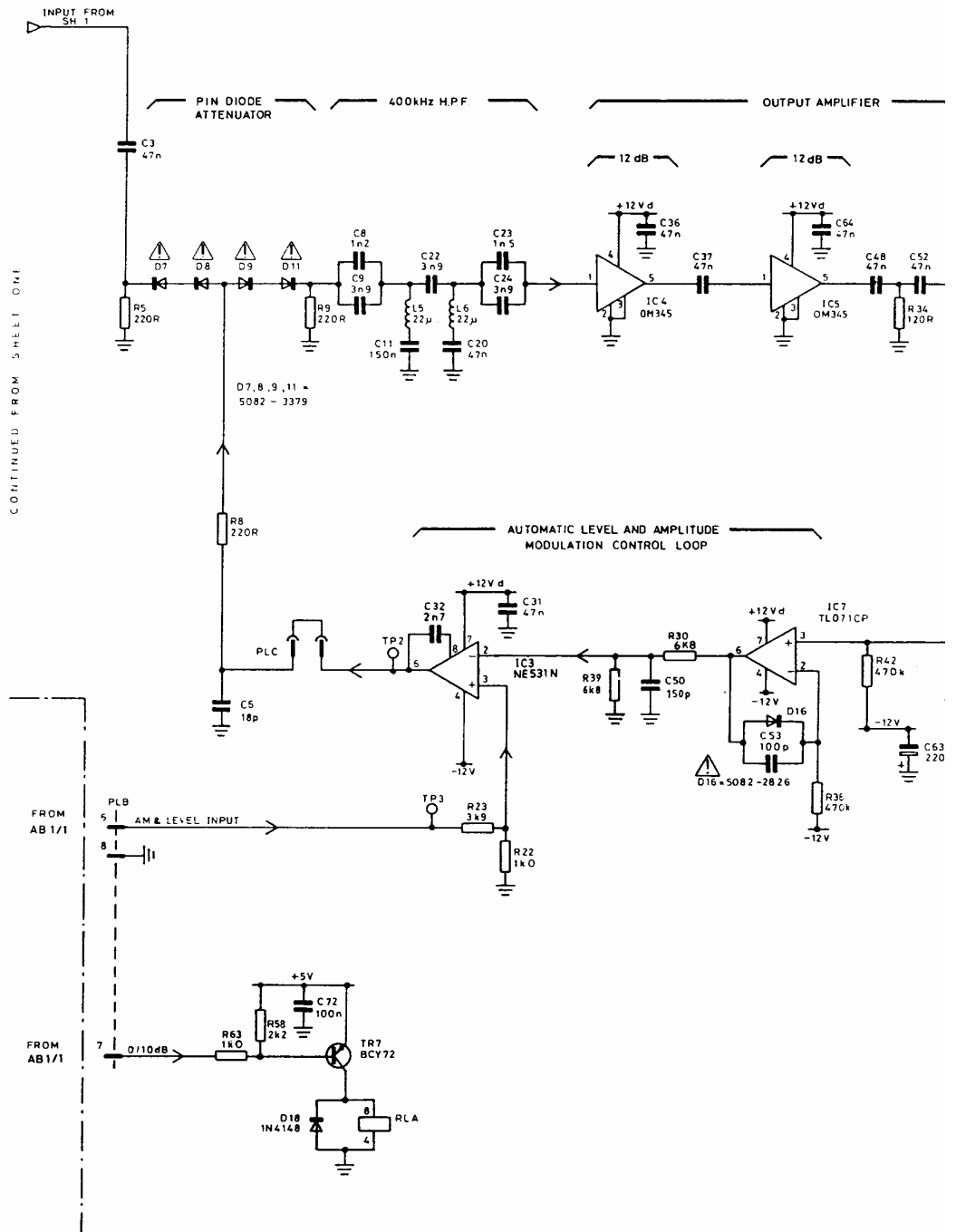
IC'S DECOUPLED AT +5Vd PIN TO GROUND BY CAPACITORS AS INDICATED.

UNUSED GATE



AA4  
/1

ncy synthesizer and output amp. (mixer)



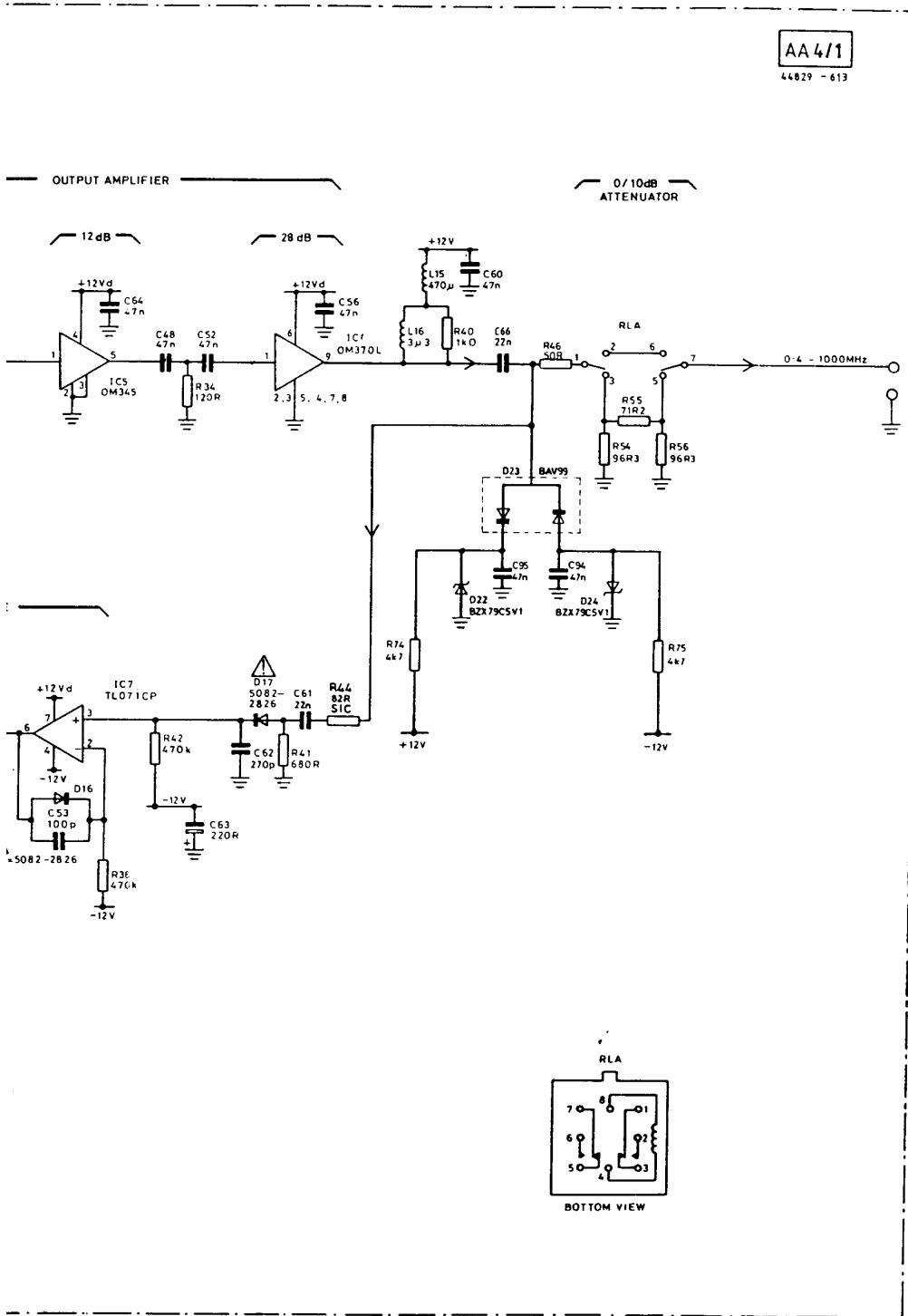
Drg. No. Z 44829-613  
 Sht. 2 of 2, Iss. 1

THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

Fig. 9

AA4/1 : Low frequency synthesizer and output

Mar. 89



NSITIVE DEVICE.

synthesizer and output amp. (output)

AA4  
/1

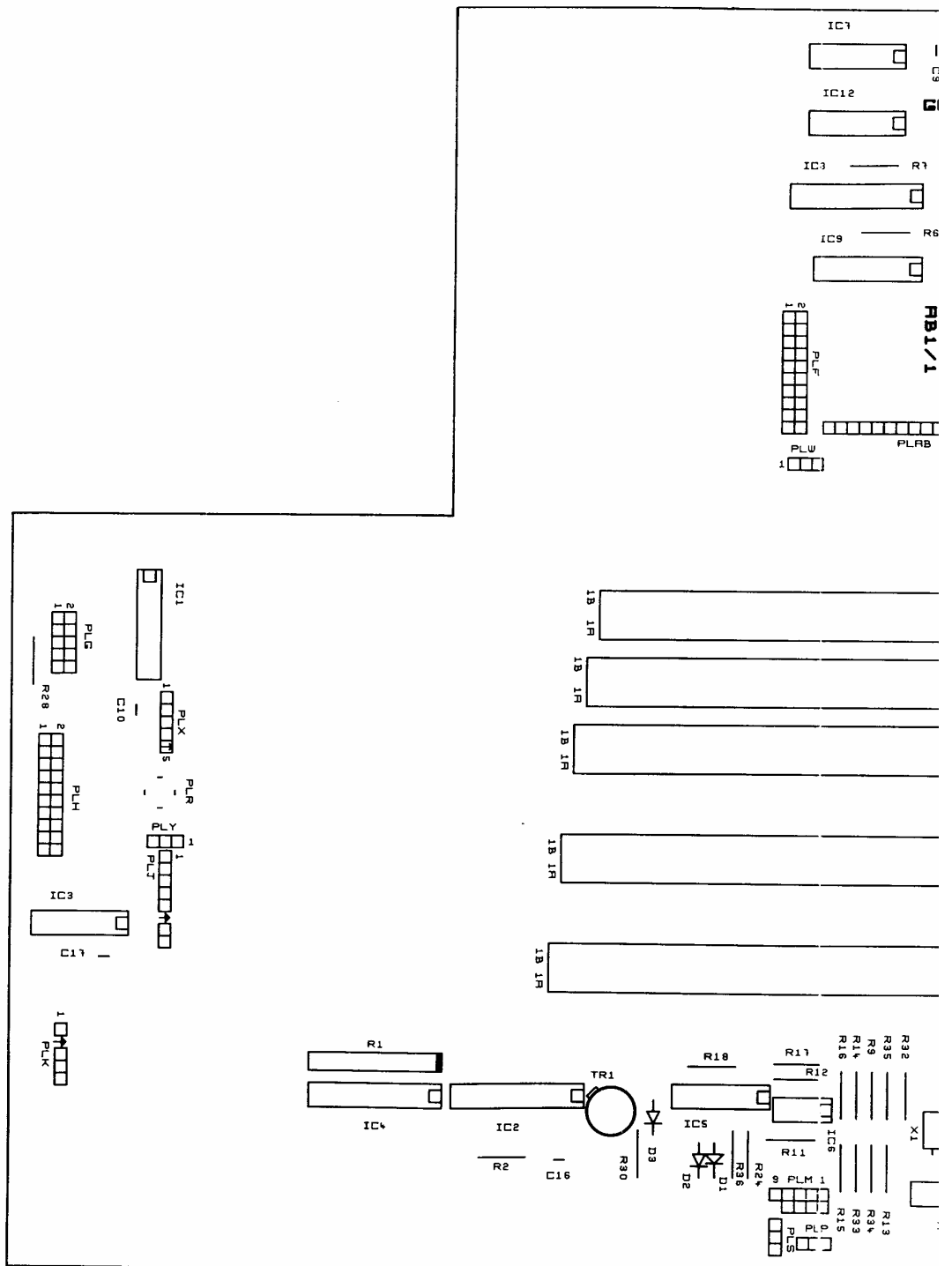
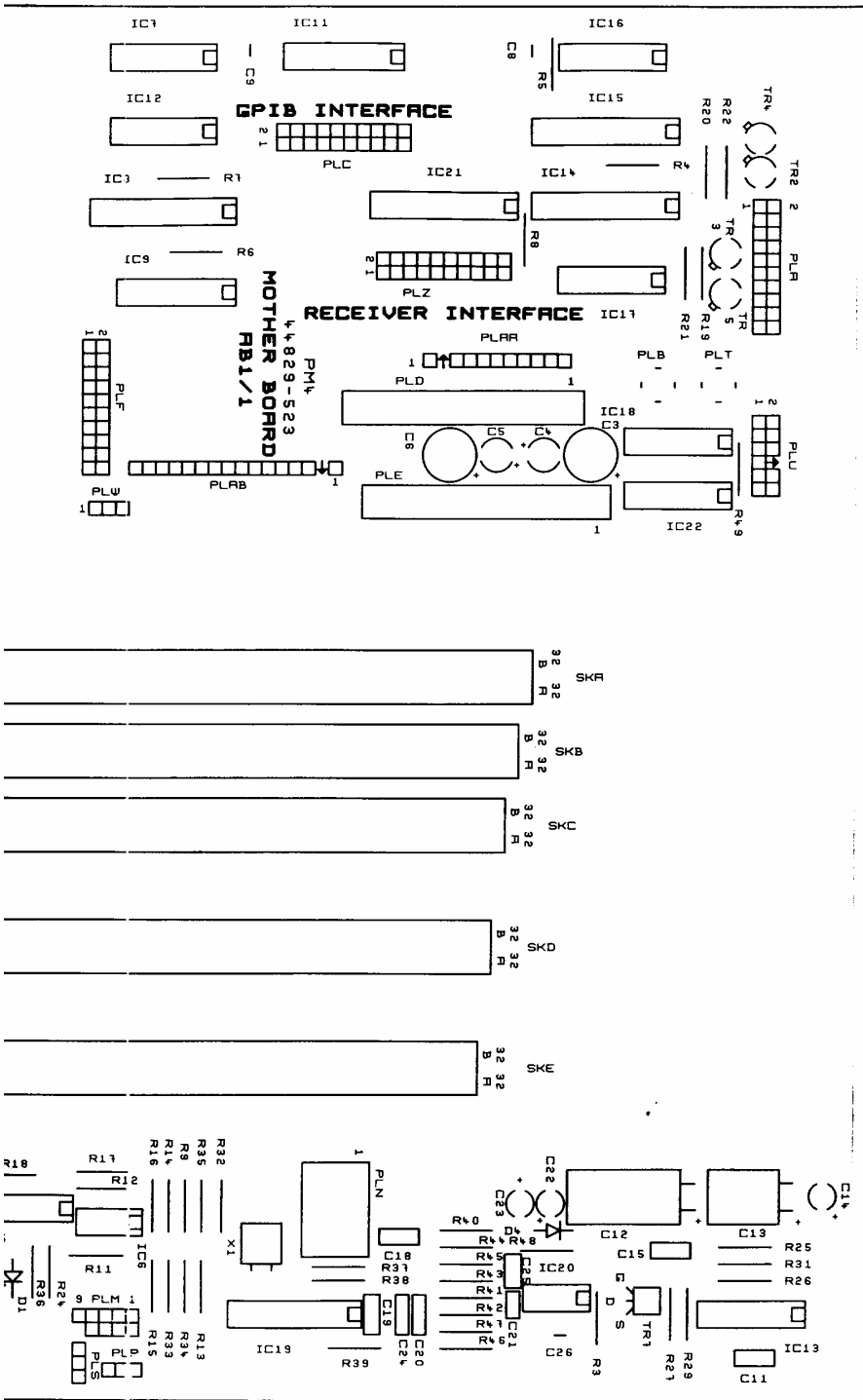


Fig. 10  
 Chap. 7  
 Page 20

ABI/1 : Component layout



11 : Component layout

Fig. 10

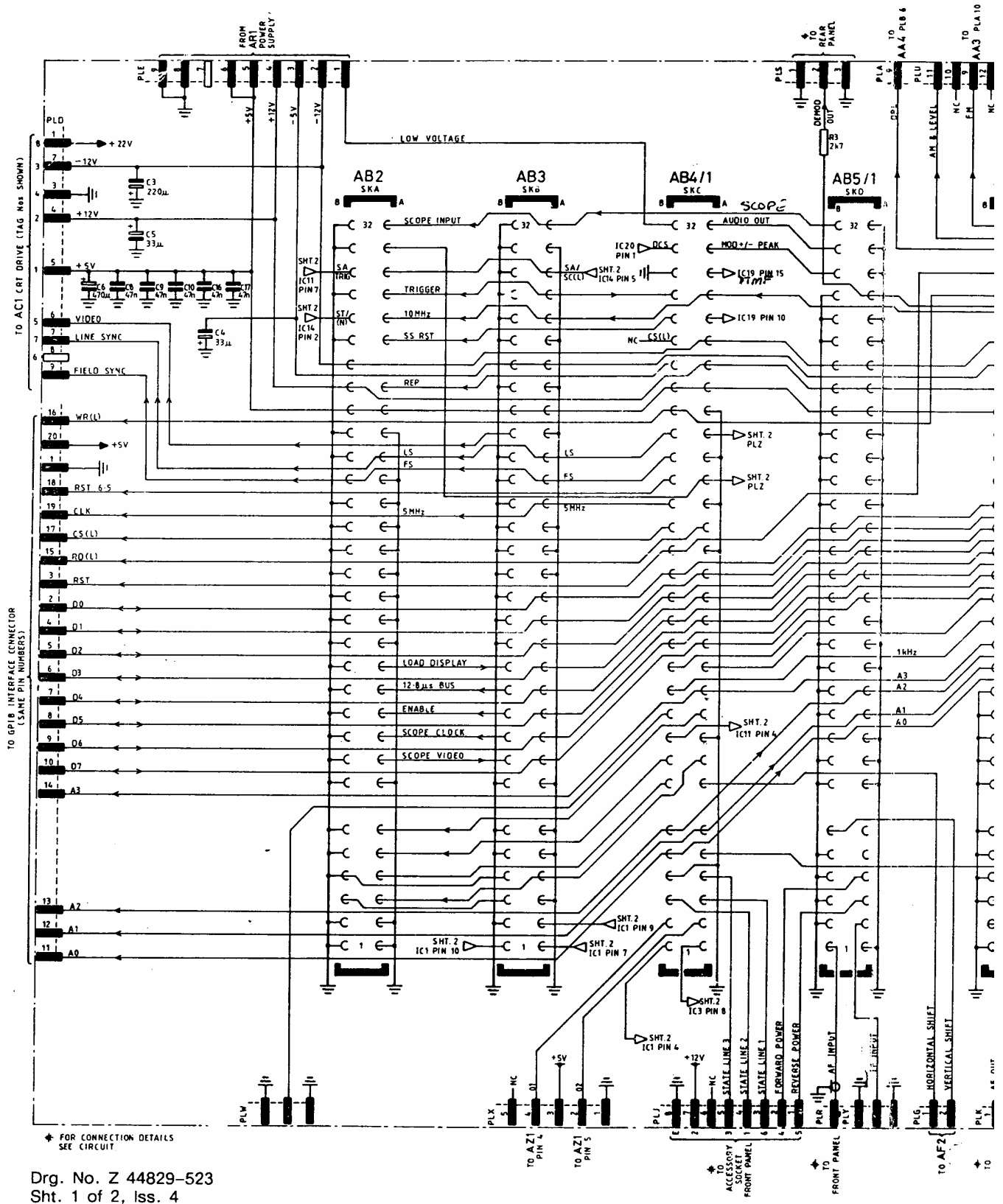
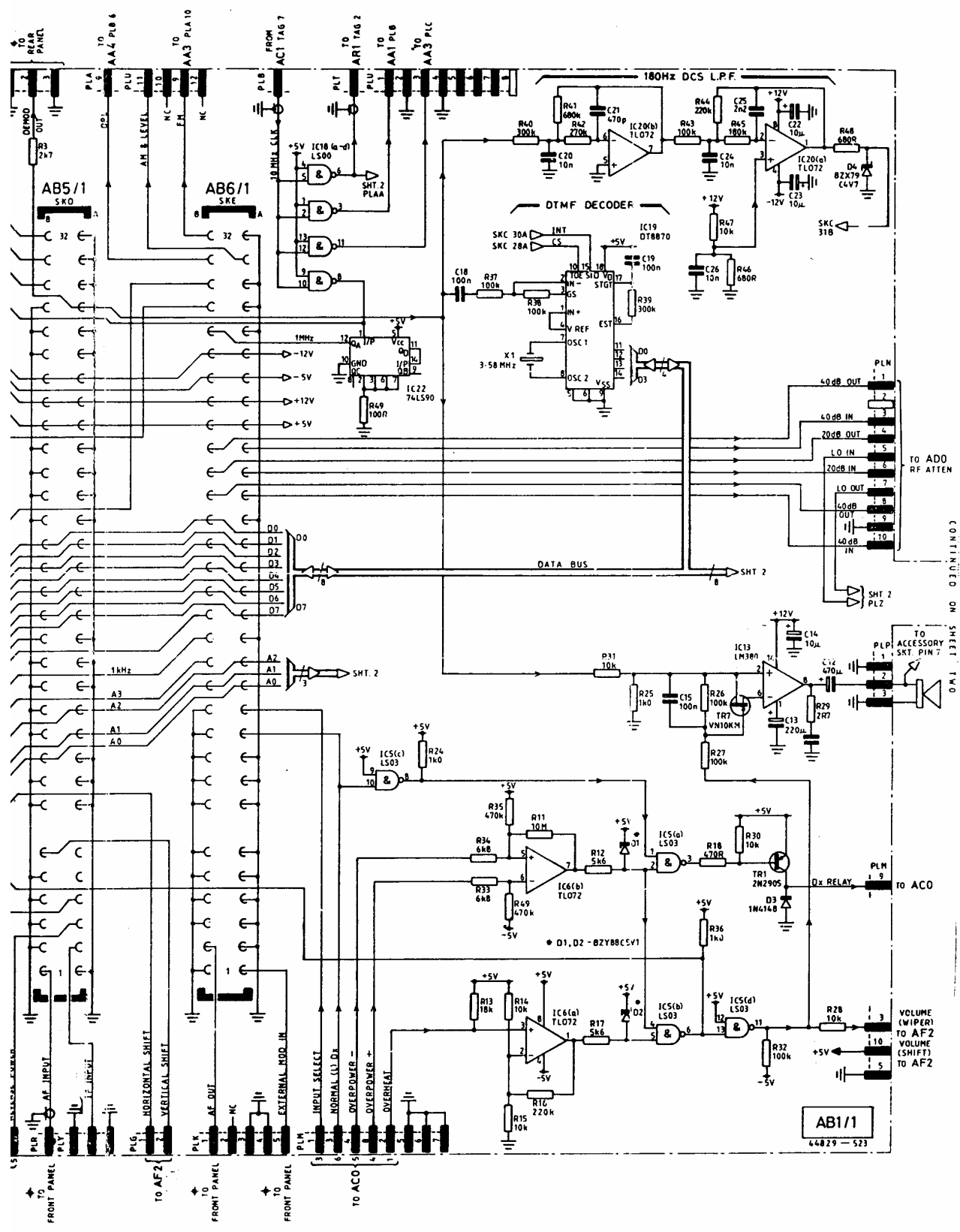


Fig. 10

Sep. 90 (Am. 2)

AB111 : Motherboard (audio amp. and over)



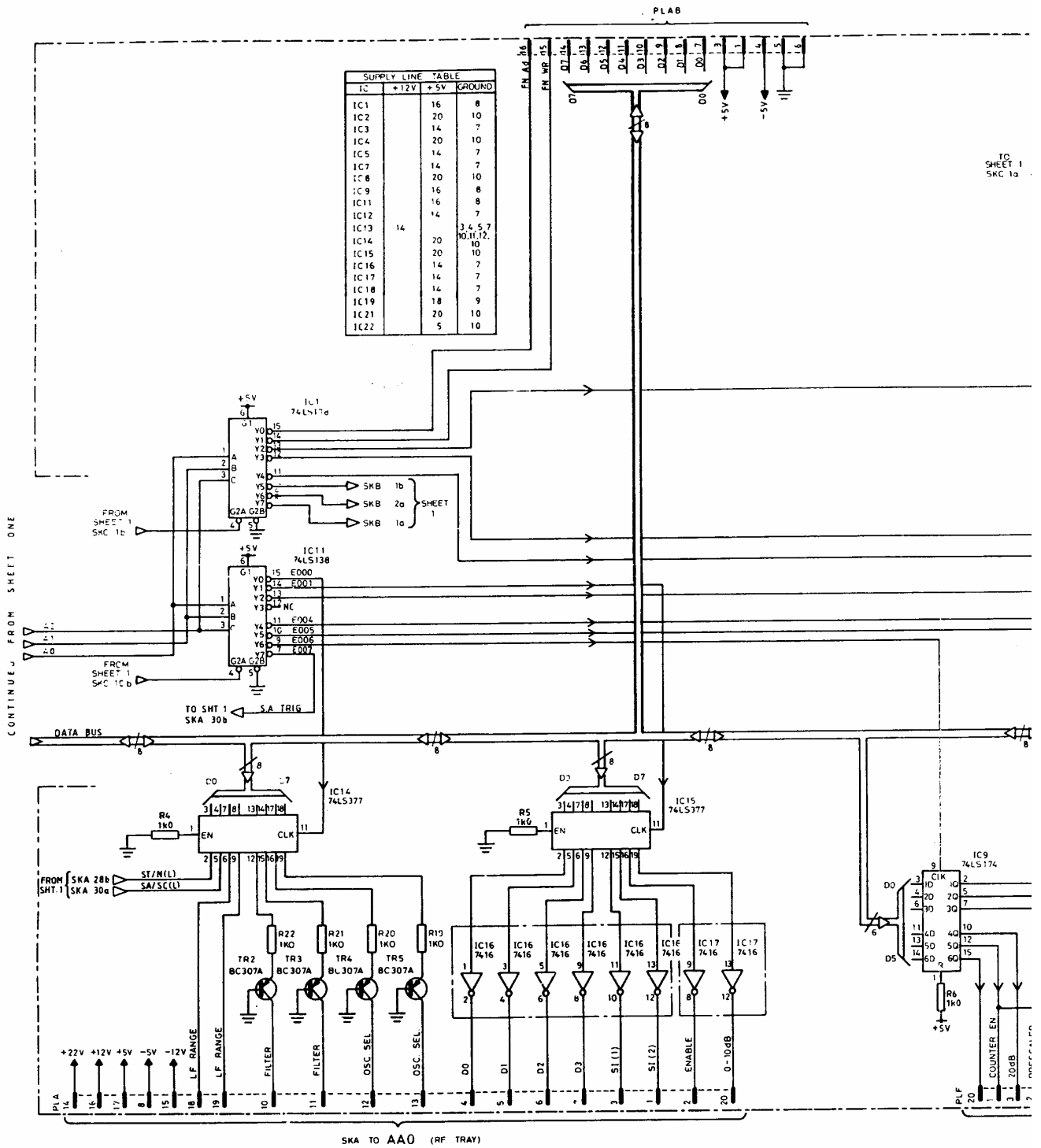
CONTINUED ON SHEET NO. 0310N1100

AB1  
/1

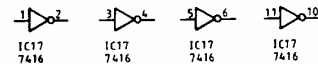
(audio amp. and overload protection)

Fig. 10  
Chap. 7  
Page 21/22





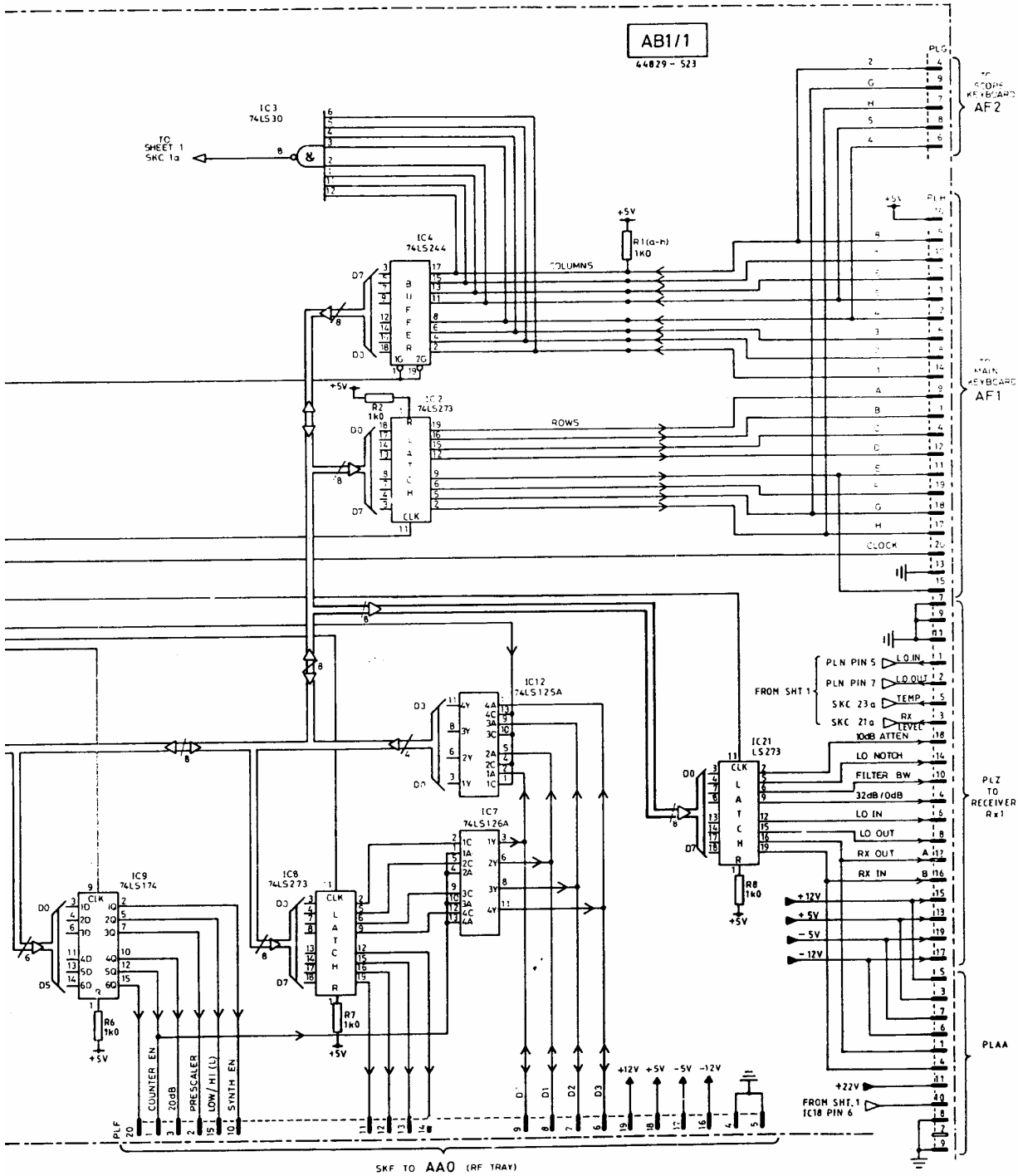
Drg. No. Z 44829-523  
Sht. 2 of 2, Iss. 2



AB111 : Motherboard (keyboard)

Fig. 11

Apr. 90 (Am. 1)



AB1  
/1

erboard (keyboard interface)

Fig. 11  
Chap. 7  
Page 23

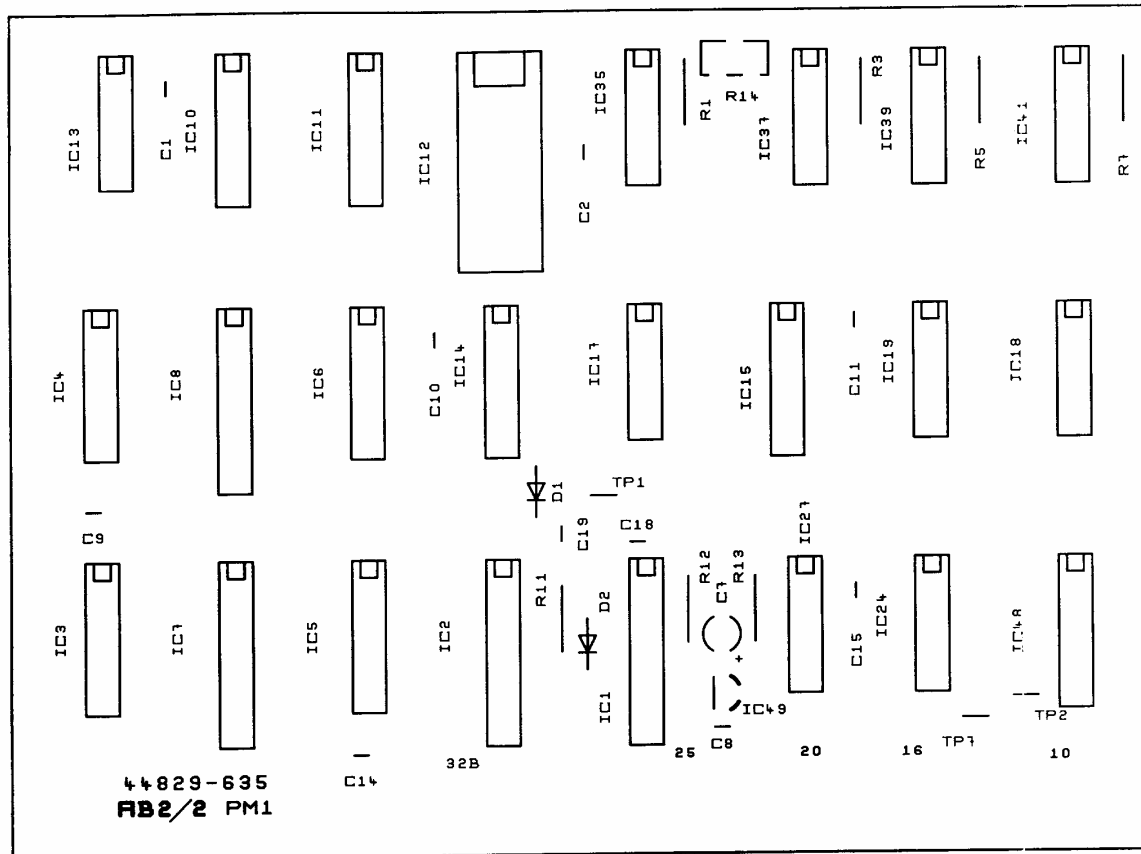


Fig. 12  
Chap. 7  
Page 24

AB2/2 : Component layout

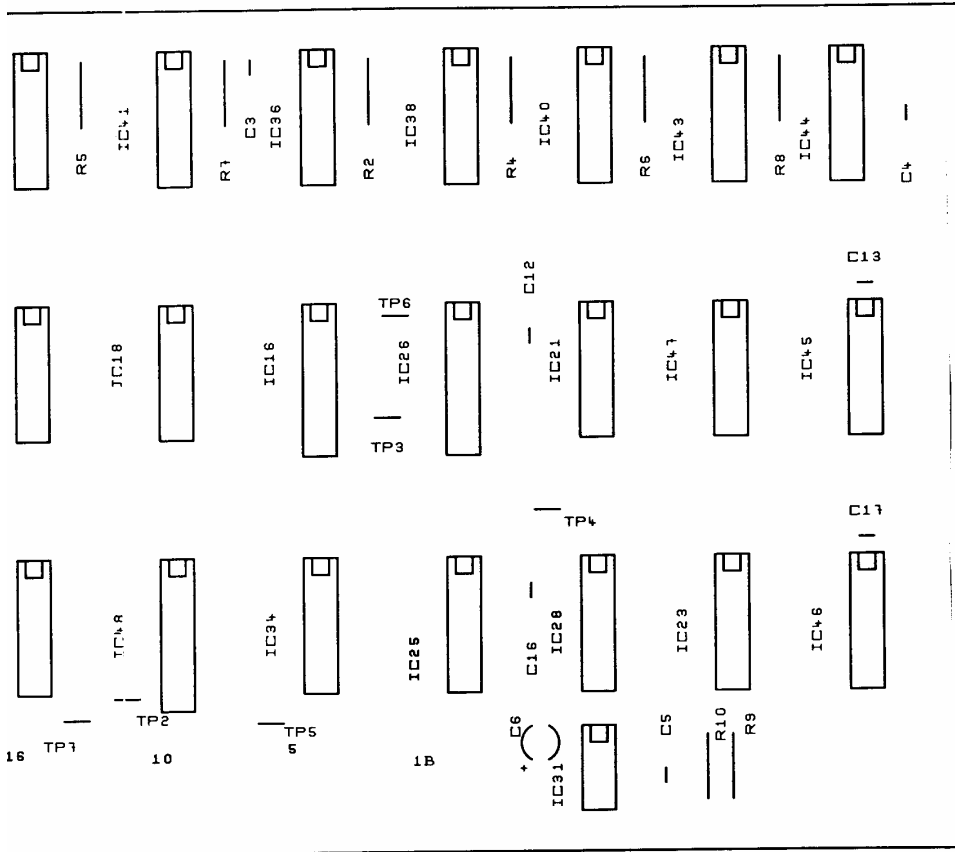


Fig. 12: Component layout

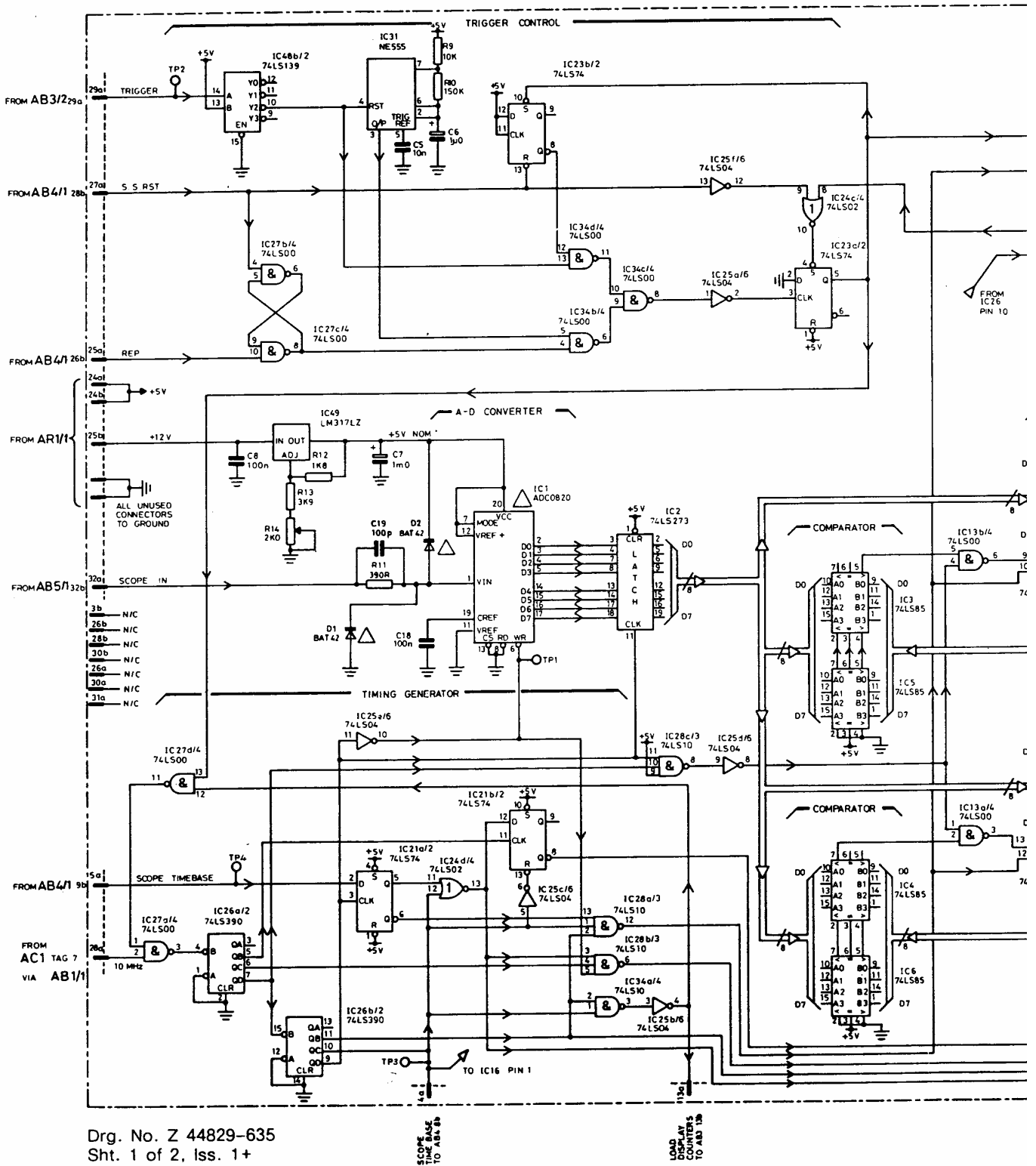
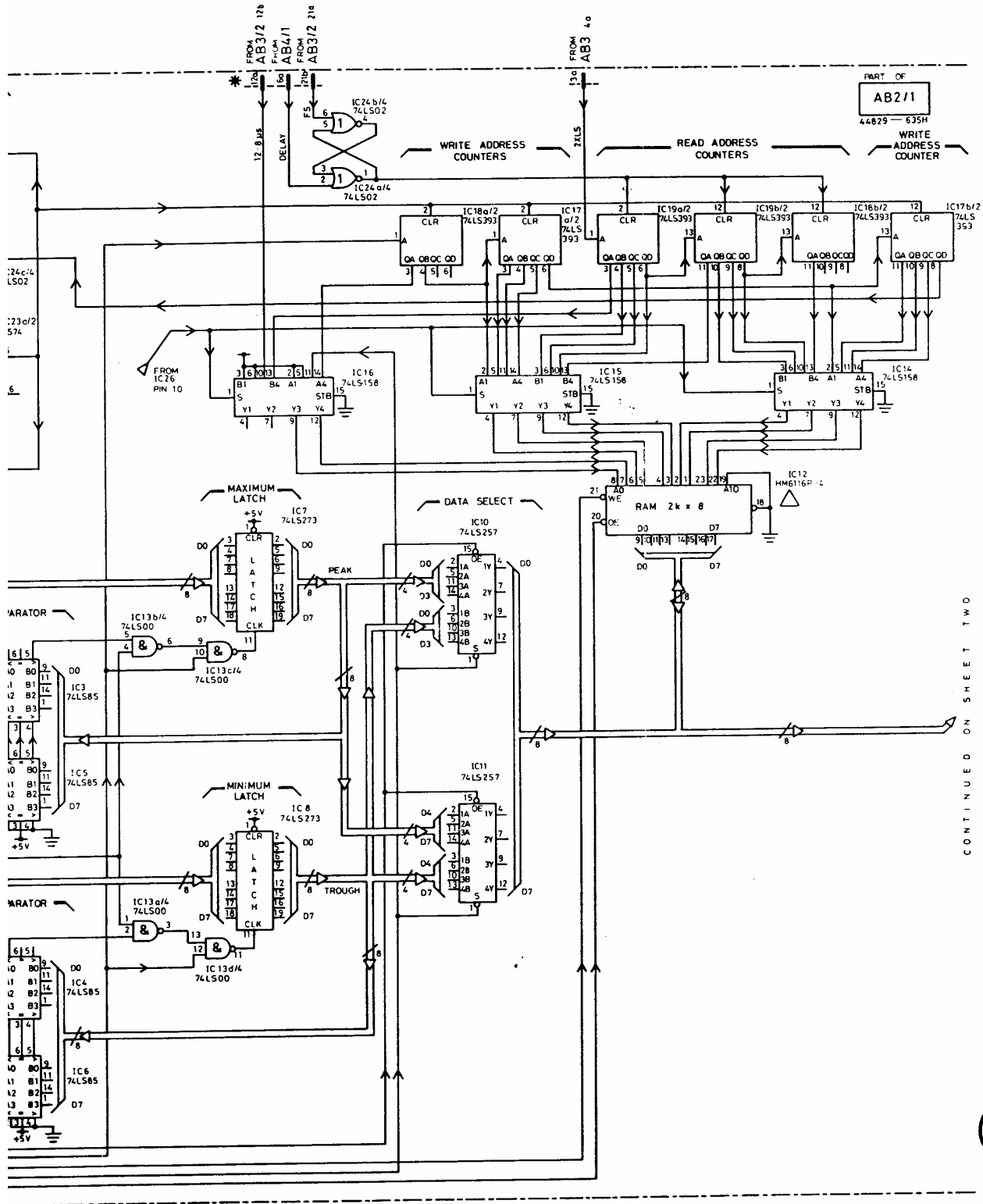


Fig. 12

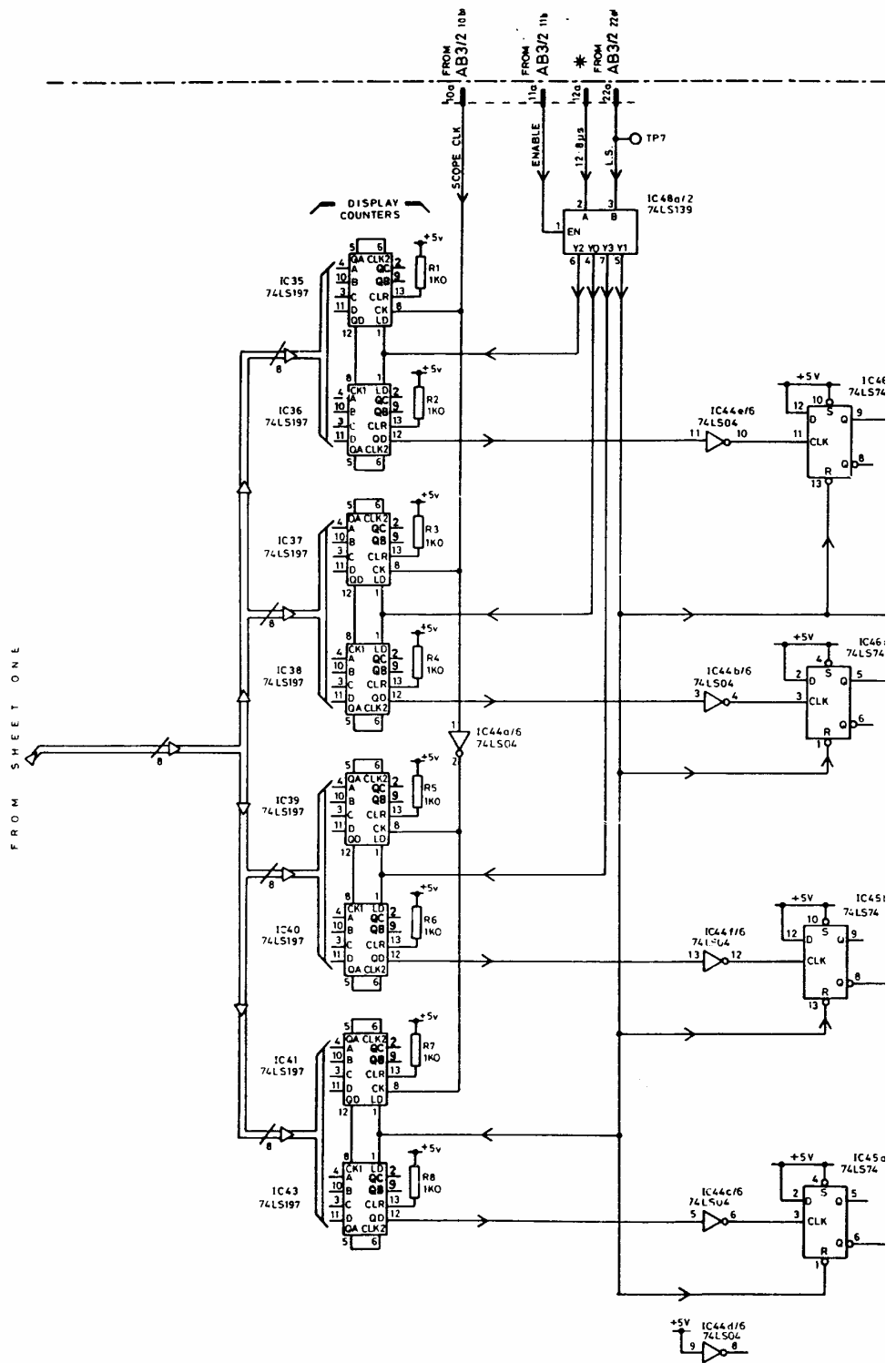
Feb. 90 (Am: 1)

AB2/2 : Digital scope (A-D and)



AB2  
/2

ital scope (A-D and timing)

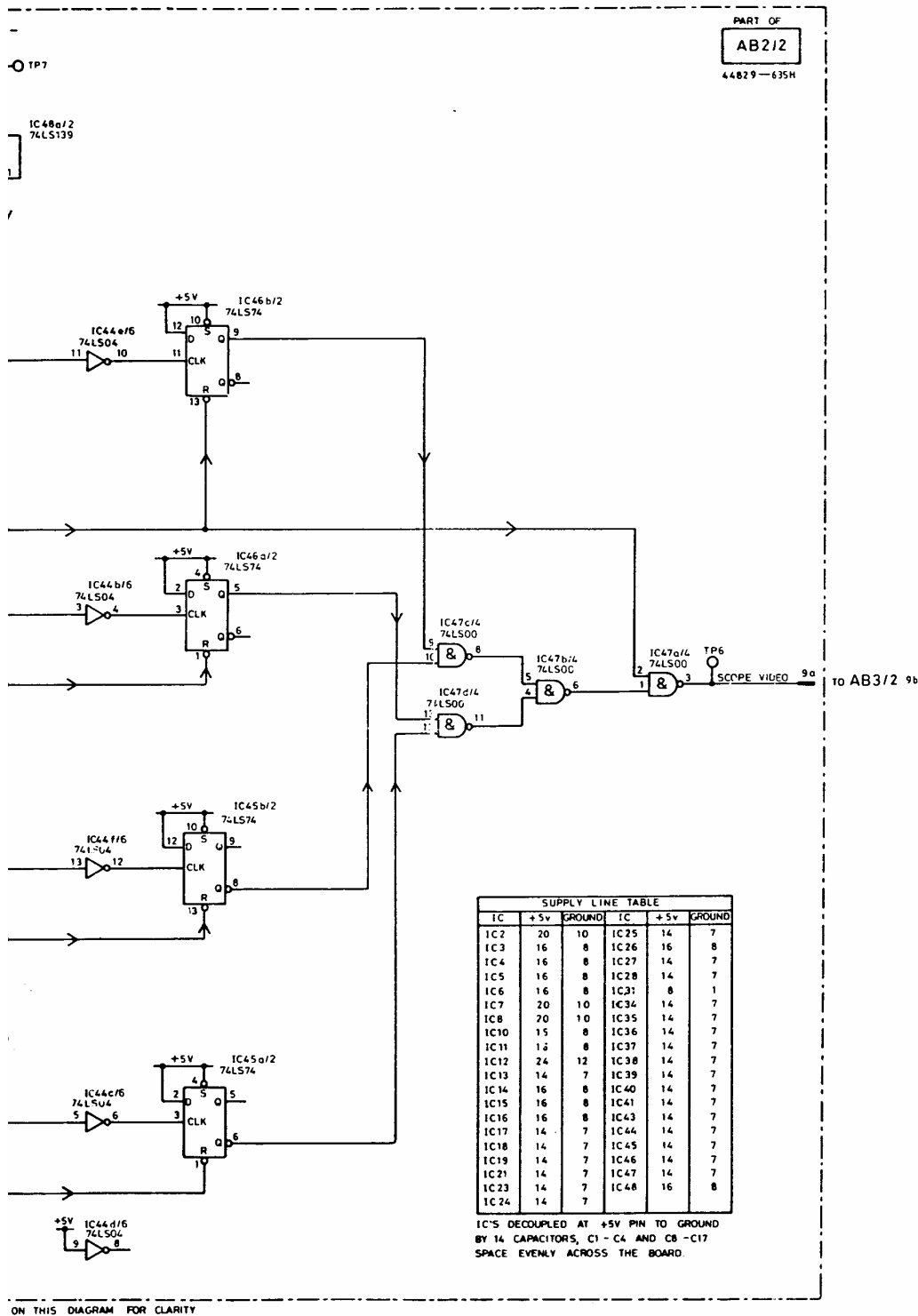


Drg. No. Z 44829-635  
 Sht. 2 of 2, Iss. 2

\* REPEATED ON THIS DIAGRAM FOR CLARITY

Fig. 13  
 Sep. 90 (Am. 2)

AB2/2 : Digital scope (output)



AB2  
/2

: Digital scope (output)

Fig. 13  
Chap. 7  
Page 27



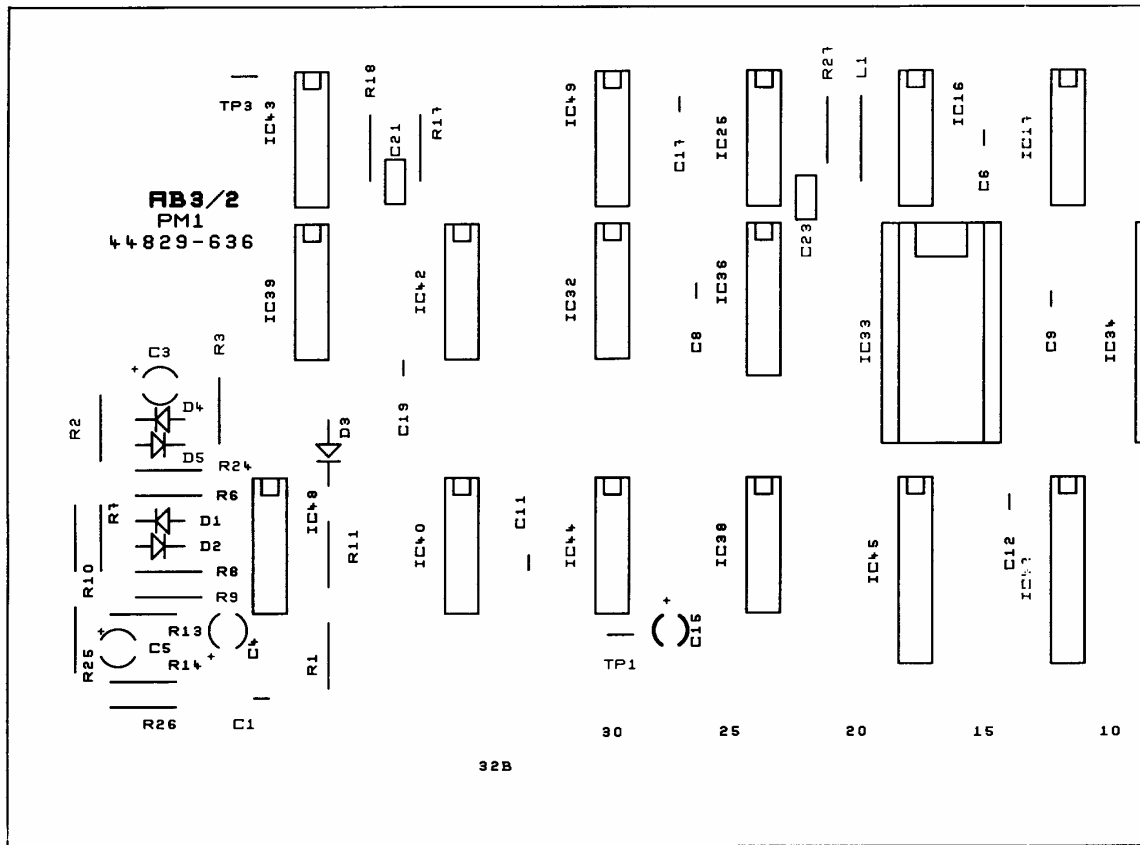
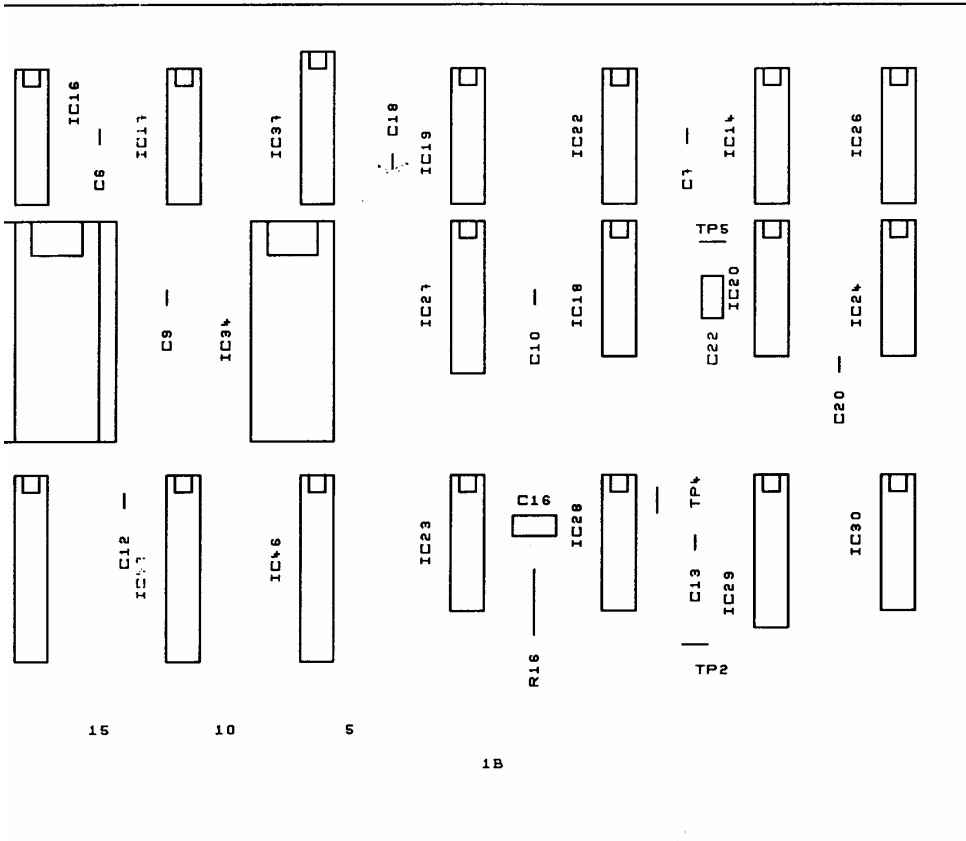


Fig. 14  
Chap. 7  
Page 28

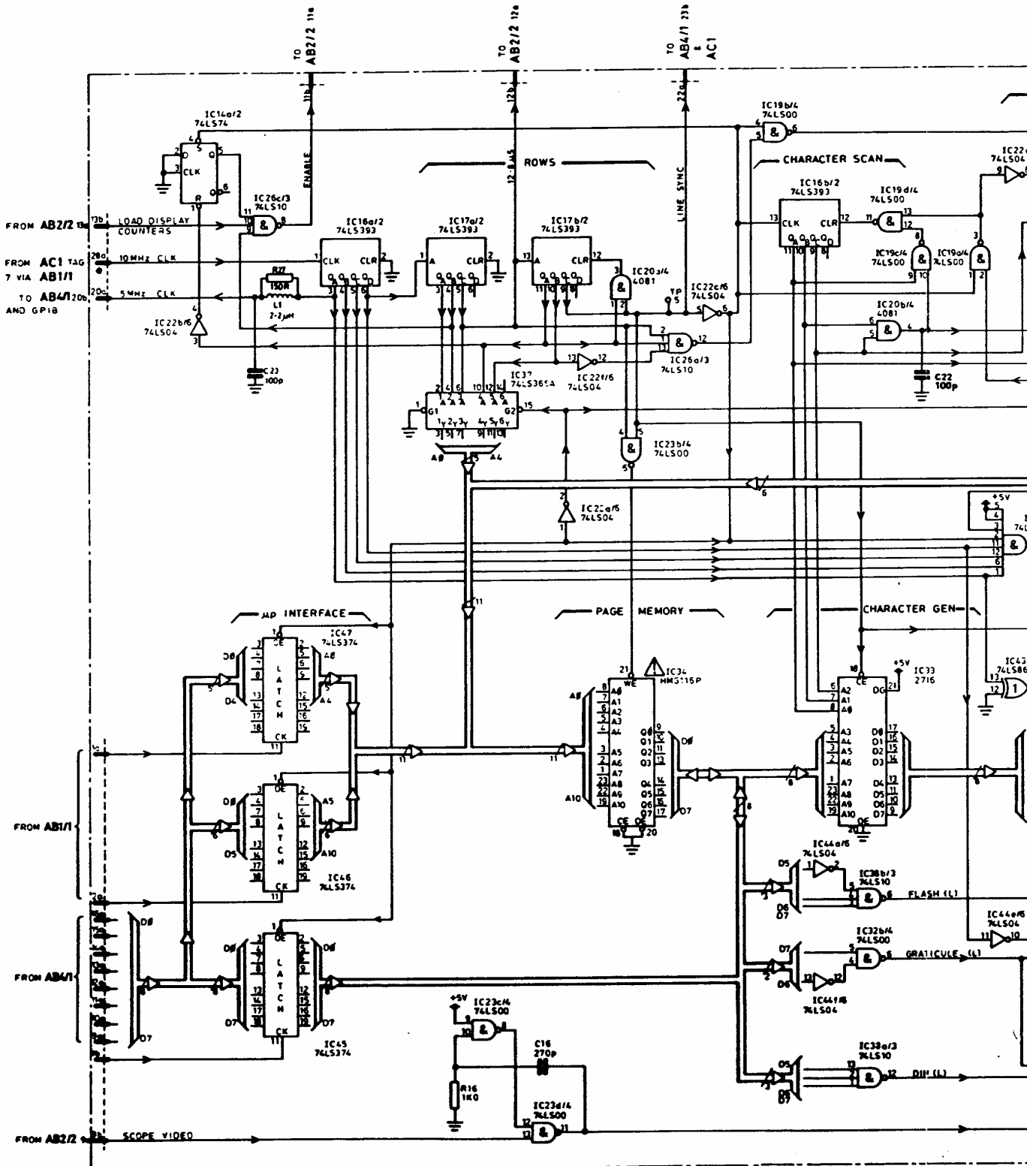
AB3/2 : Component layout



12 : Component layout

Fig. 14

Mar. 89



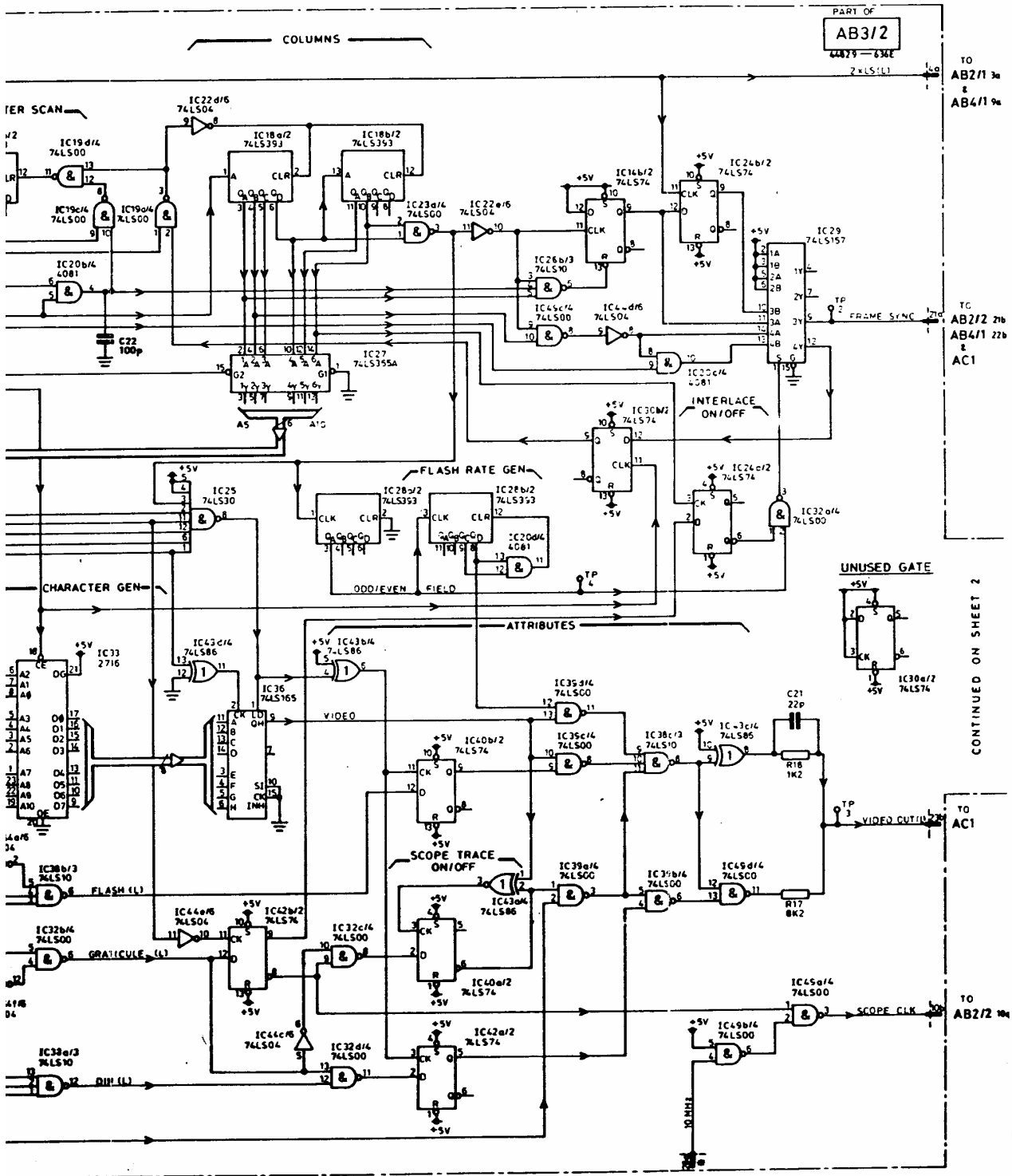
THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

\* REPEATED ON THIS DRAWING FOR CIRCUIT CLARITY.

Drg. No. Z 44829-636  
Sht. 1 of 2, Iss. 2

Fig. 14  
Mar. 89

AB32 : VDU board (character gene

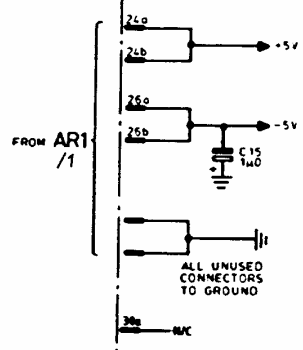
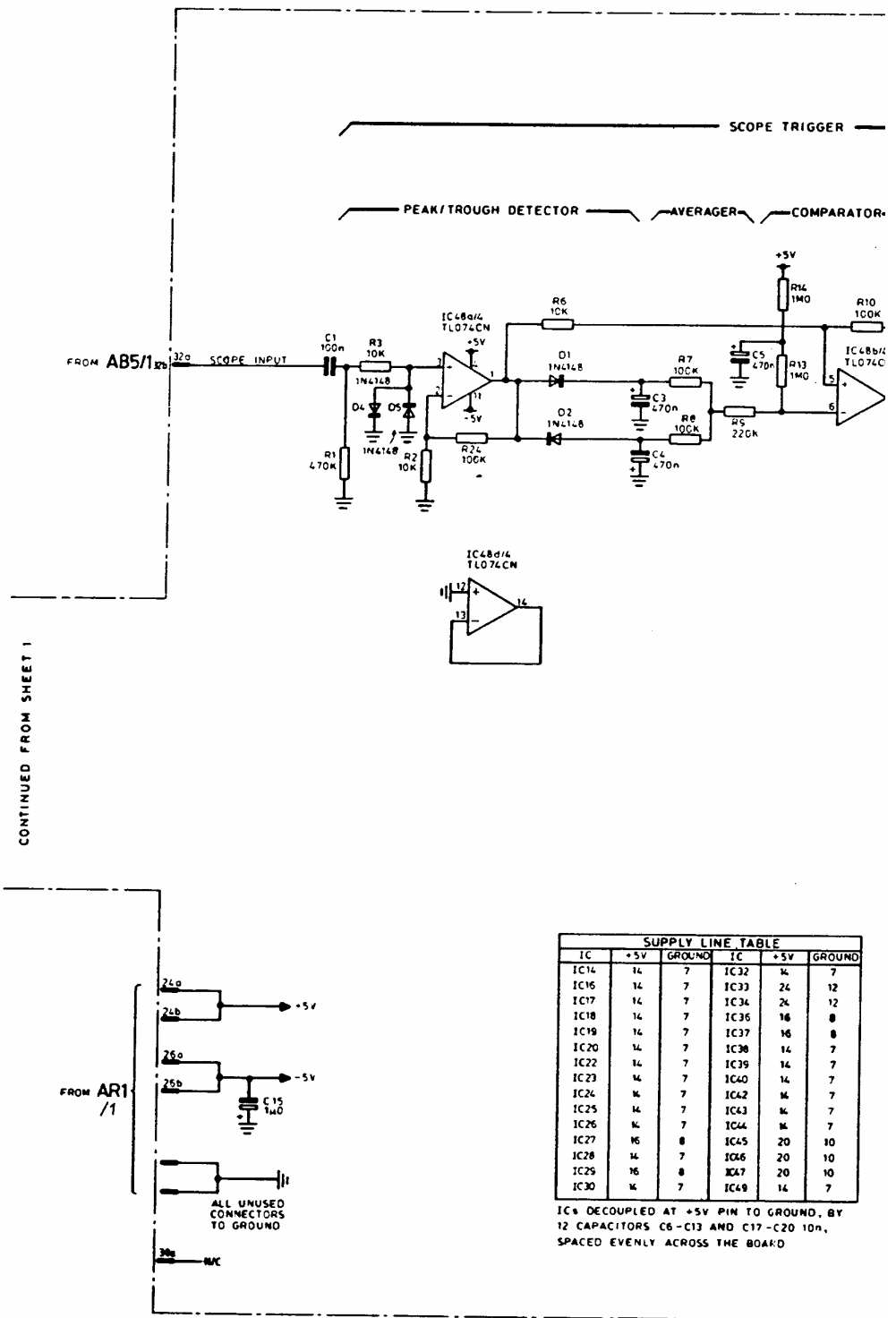


FOR CIRCUIT CLARITY

board (character generator)

Fig. 14  
Chap. 7  
Page 29/30

AB3  
/2



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 44829-636  
Sht. 2 of 2, Iss. 2

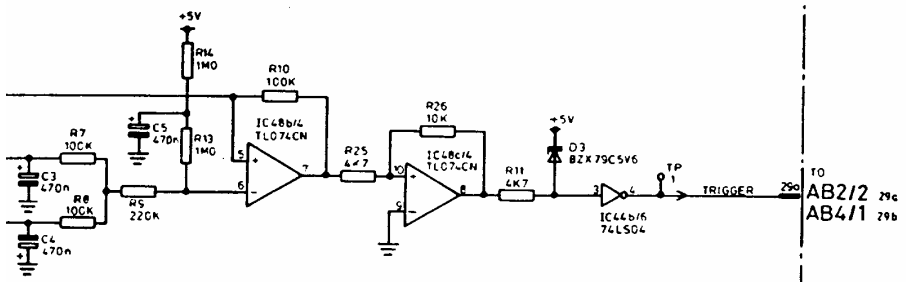
Fig. 15  
Mar. 89

AB312 : VDU board (scope trigger)

PART OF  
**AB3/2**  
44829 - 636E

SCOPE TRIGGER

AVERAGER      COMPARATOR      SCHMITT TRIGGER



SUPPLY LINE TABLE					
+5V	GROUND	IC	+5V	GROUND	
14	7	IC32	14	7	
14	7	IC33	24	12	
14	7	IC34	24	12	
14	7	IC35	16	8	
14	7	IC37	16	8	
14	7	IC38	14	7	
14	7	IC39	14	7	
14	7	IC40	14	7	
14	7	IC42	14	7	
14	7	IC43	14	7	
14	7	IC44	14	7	
16	8	IC45	20	10	
14	7	IC46	20	10	
16	8	IC47	20	10	
14	7	IC49	14	7	

UPLED AT +5V PIN TO GROUND, BY  
TORS C6-C13 AND C17-C20 10n,  
VENLY ACROSS THE BOARD



AB3  
/2

VDU board (scope trigger)

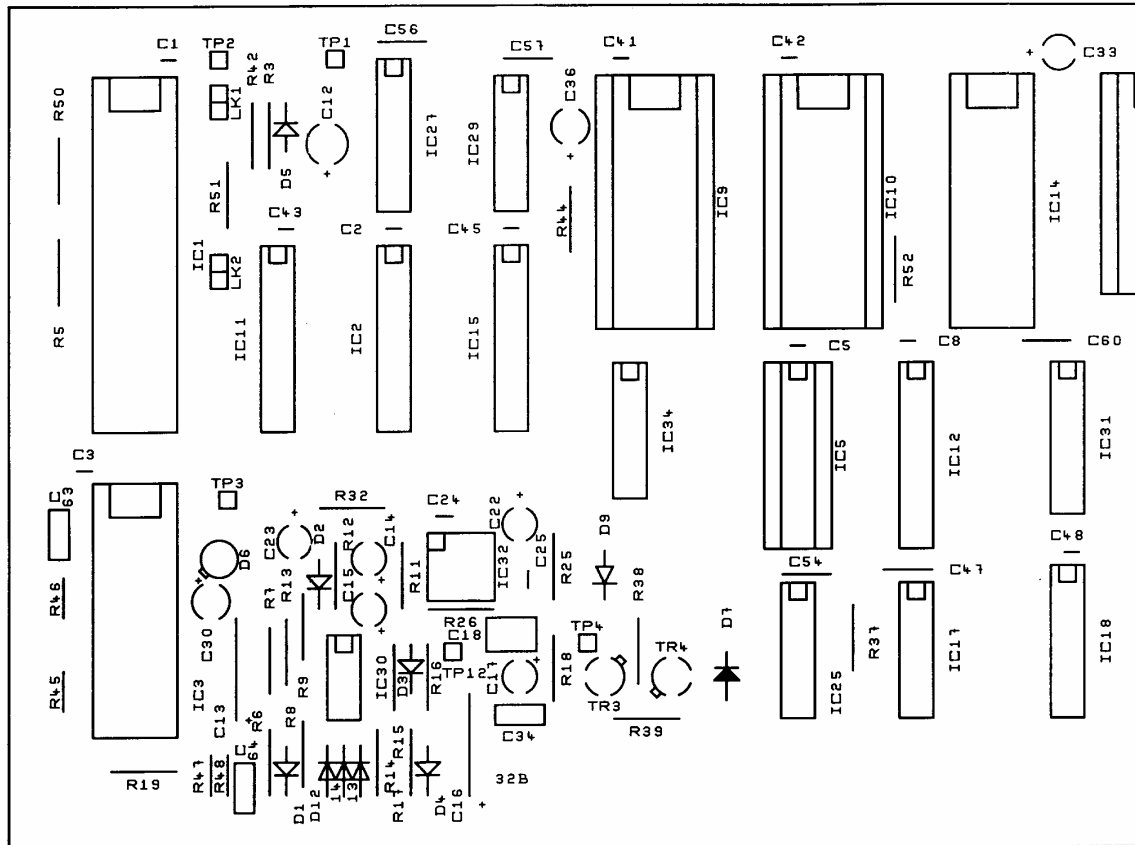
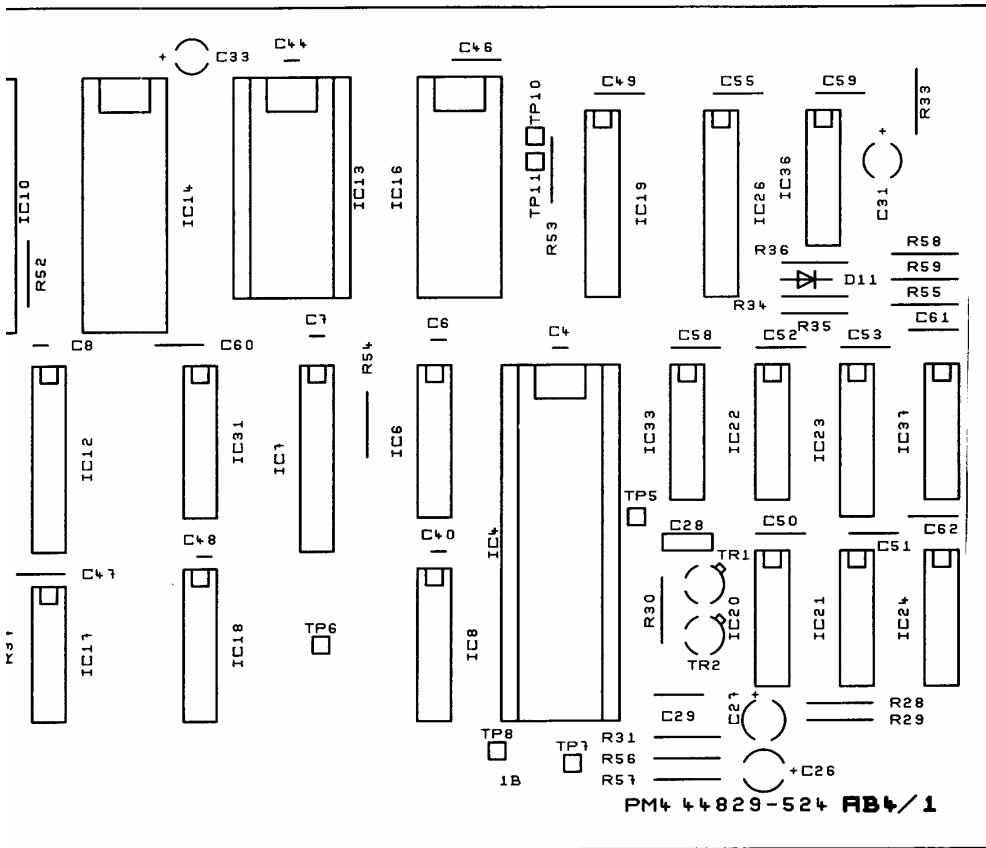


Fig. 16  
 Chap. 7  
 Page 32

AB411 : Component layout

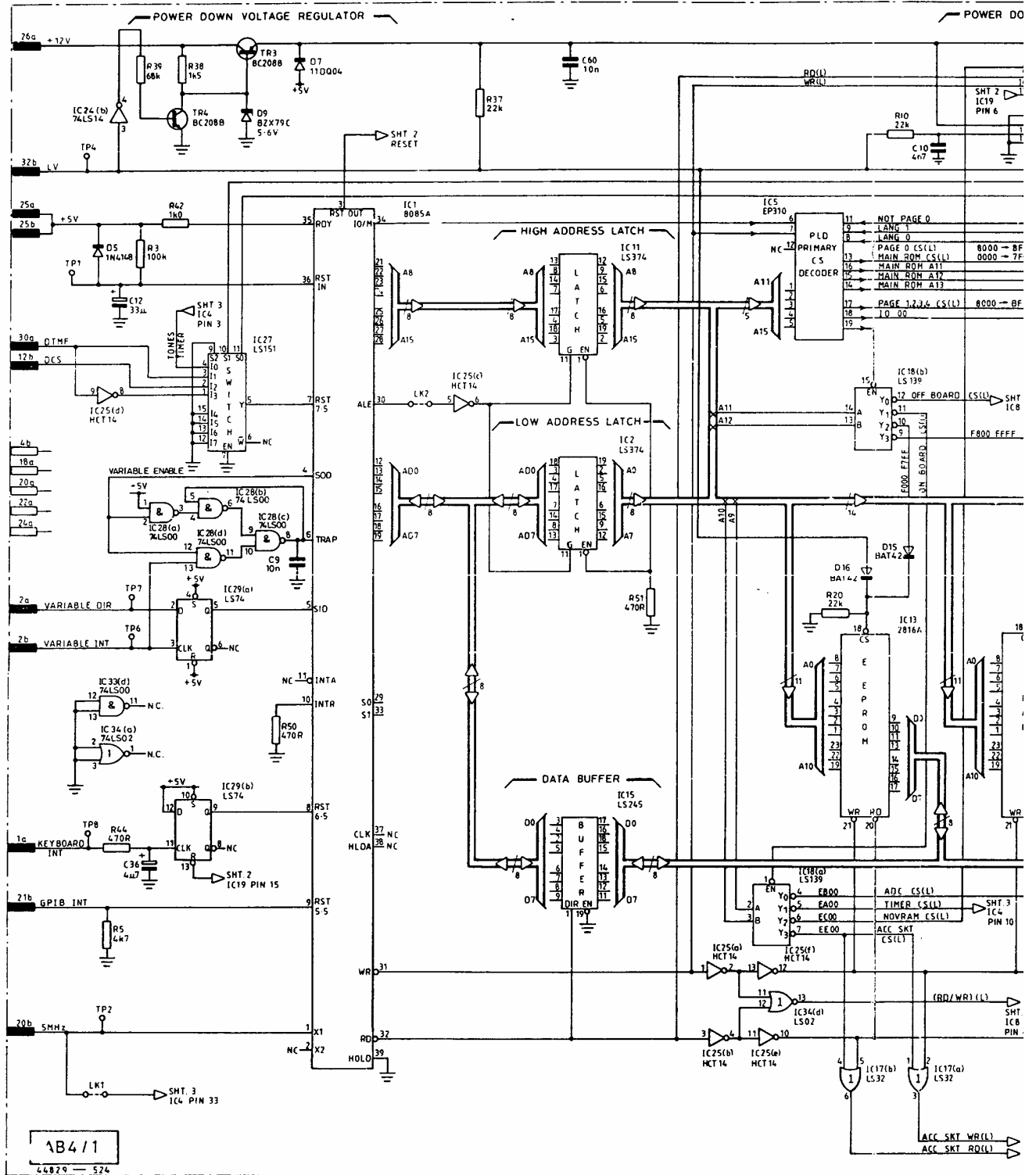


11 : Component layout

Fig. 16

Mar. 89



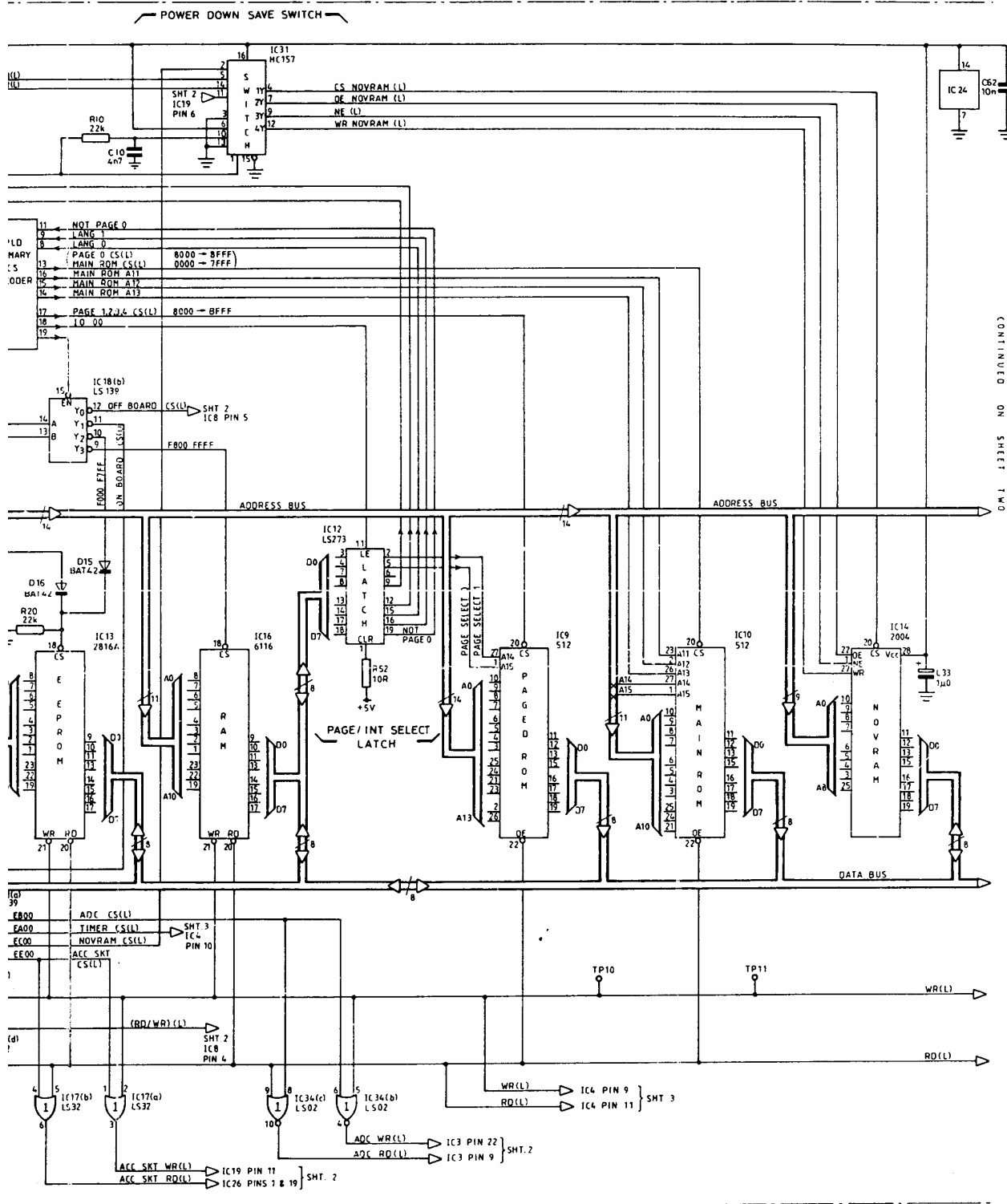


Drq. No. 44829-524  
Sht. 1 of 3, Iss. 6

AB4/1 : Microprocessor (processor)

Fig. 16

Sep. 90 (Am. 2)

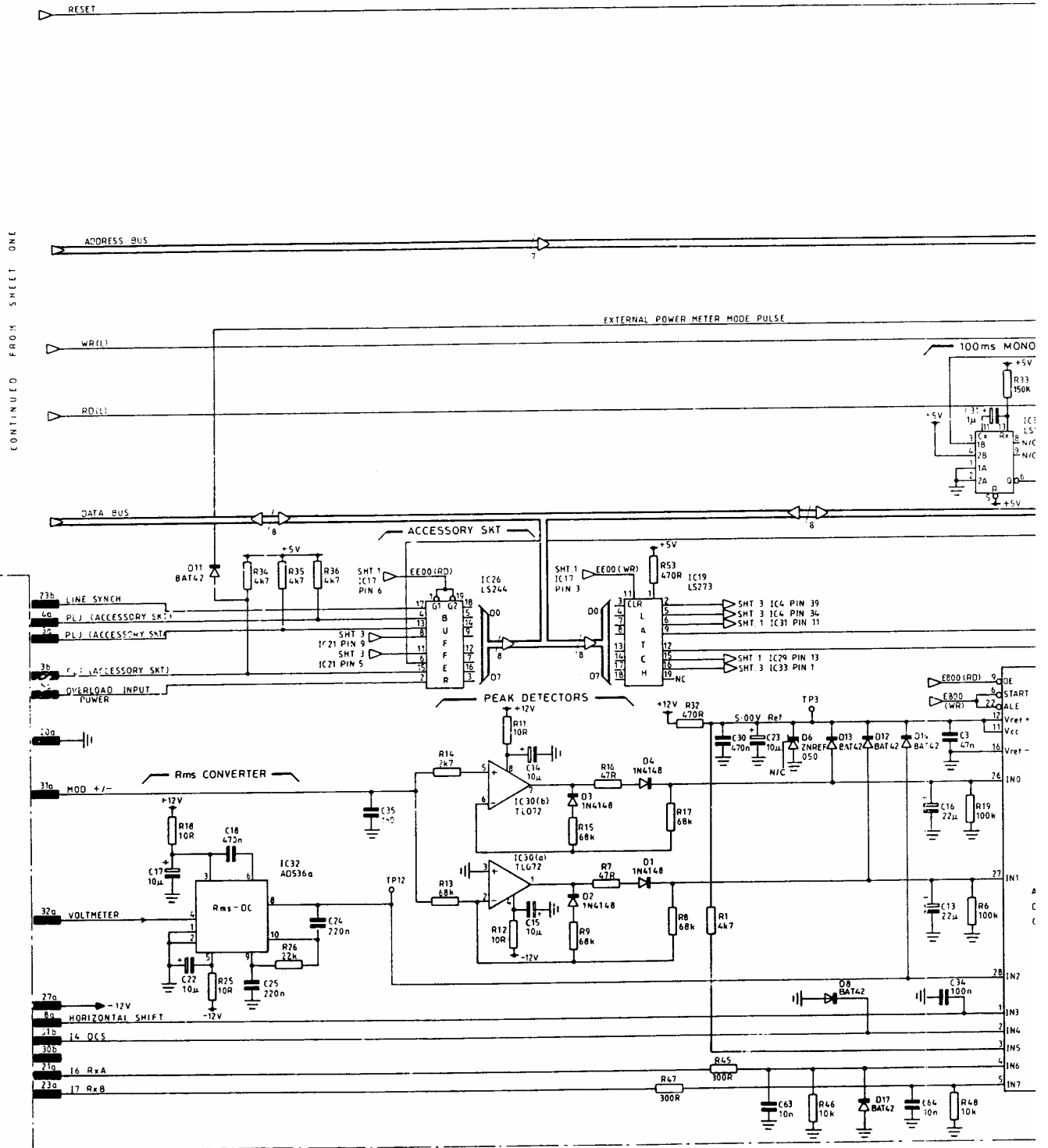


CONTINUED ON SHEET NO. 03111100

AB4  
/1

processor (processor & memory)

Fig. 16  
Chap. 7  
Page 33/34



Drg. No. Z 44829-524  
Sht. 2 of 3, Iss. 6

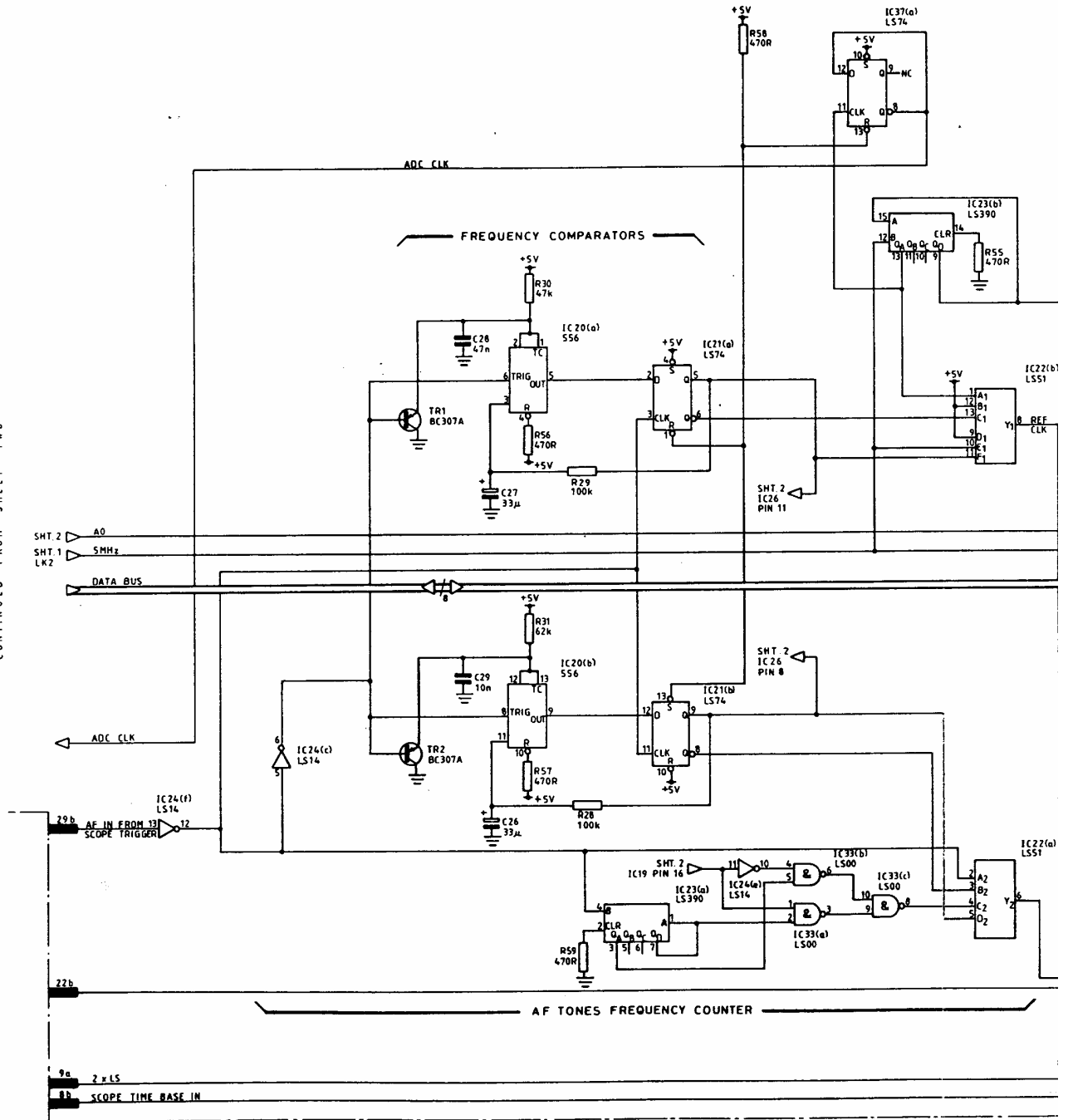
AB4/1 : Microprocessor (A-D con

Fig. 17

Apr. 90 (Am. 1)



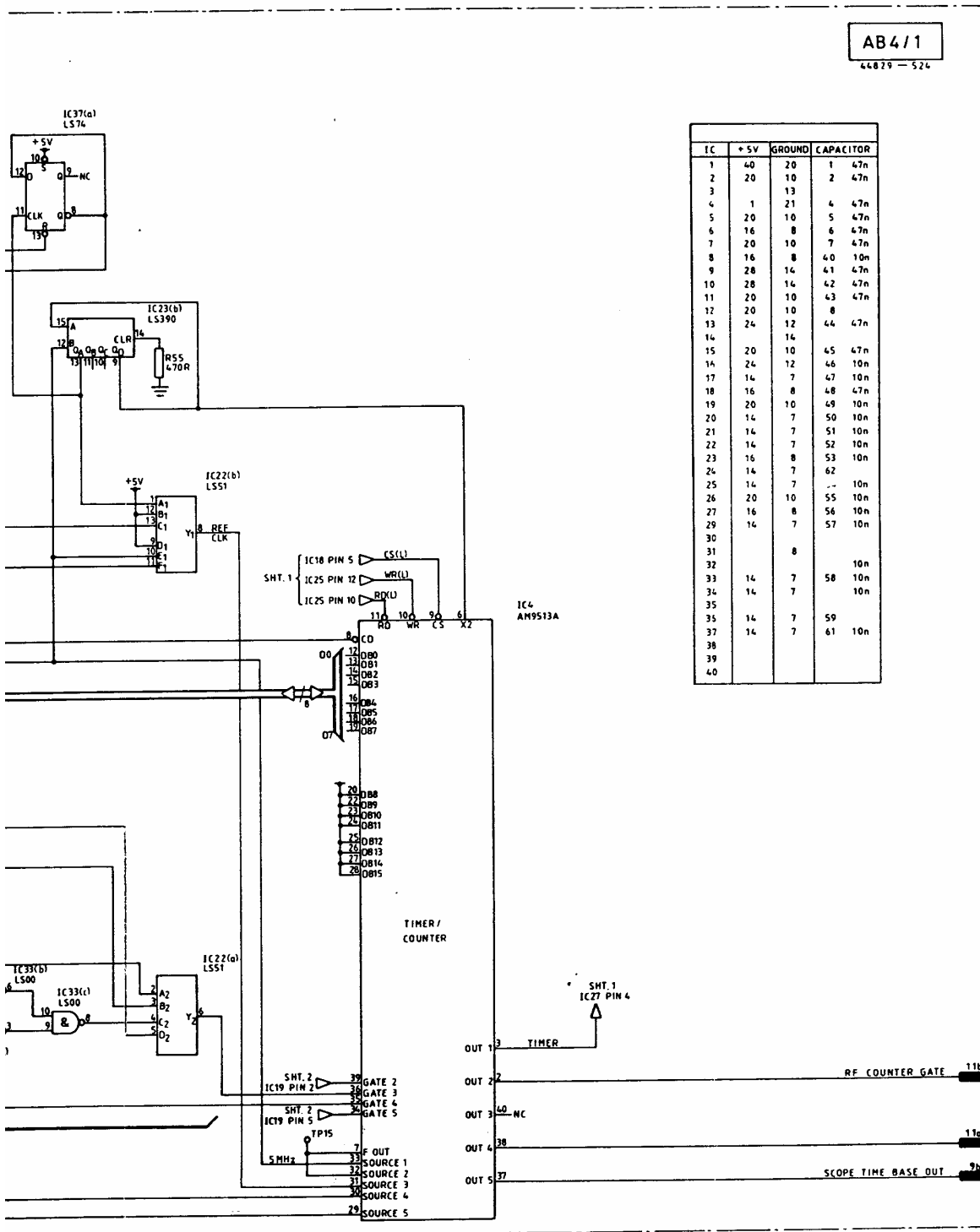
CONTINUED FROM SHEET TWO



Drg. No. Z 44829-524  
Sht. 3 of 3, Iss. 1

Fig. 18  
Mar. 89

AB4/1 : Microprocessor (programmabl



processor (programmable divider)

Fig. 18  
Chap. 7  
Page 37



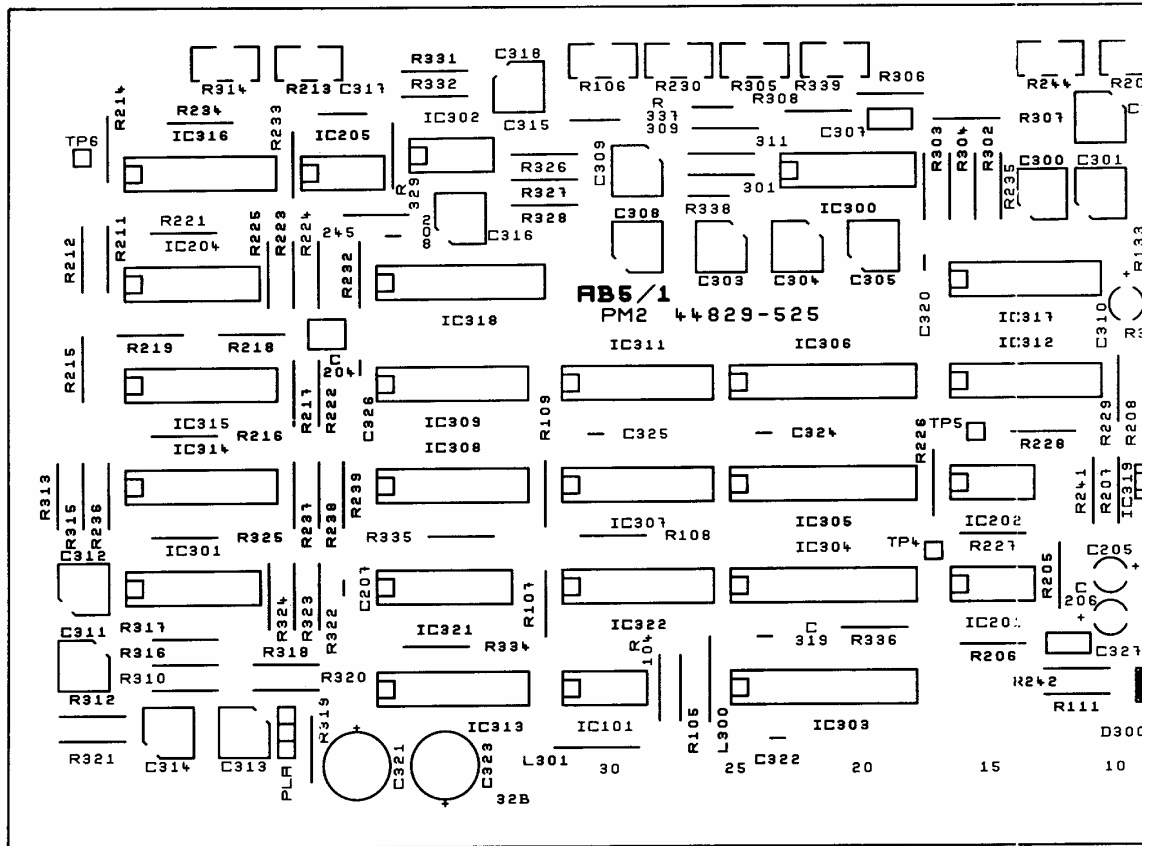


Fig. 19  
 Chap. 7  
 Page 38

AB5/2 : Component layout

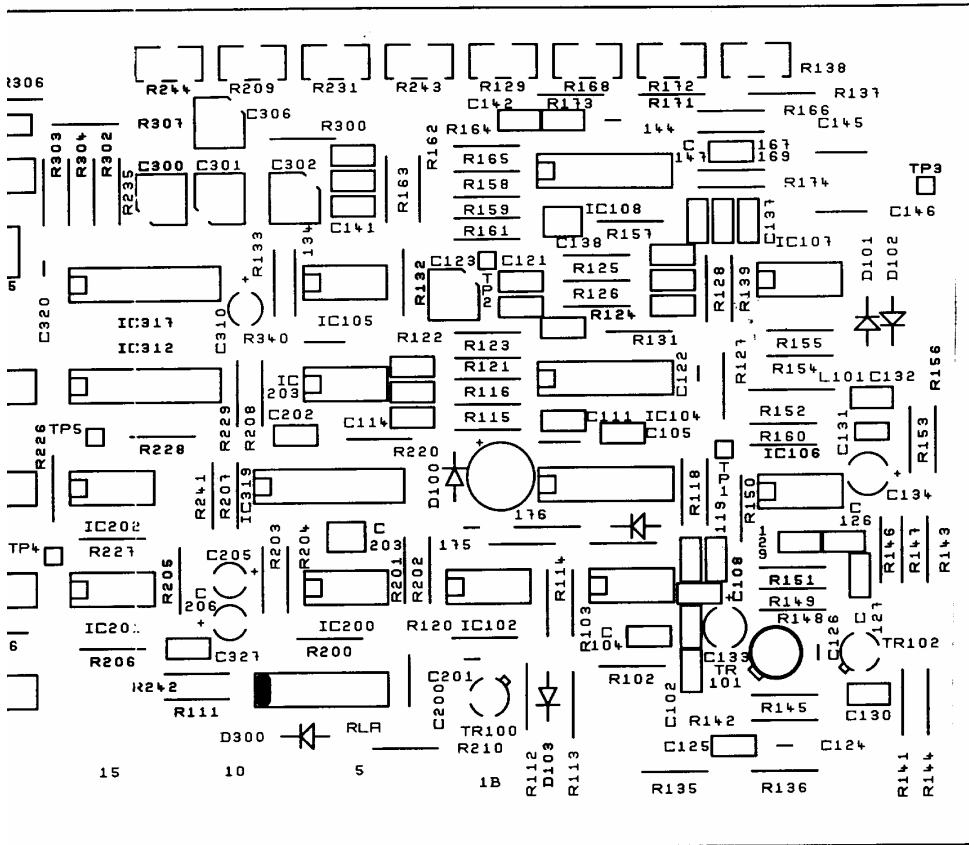
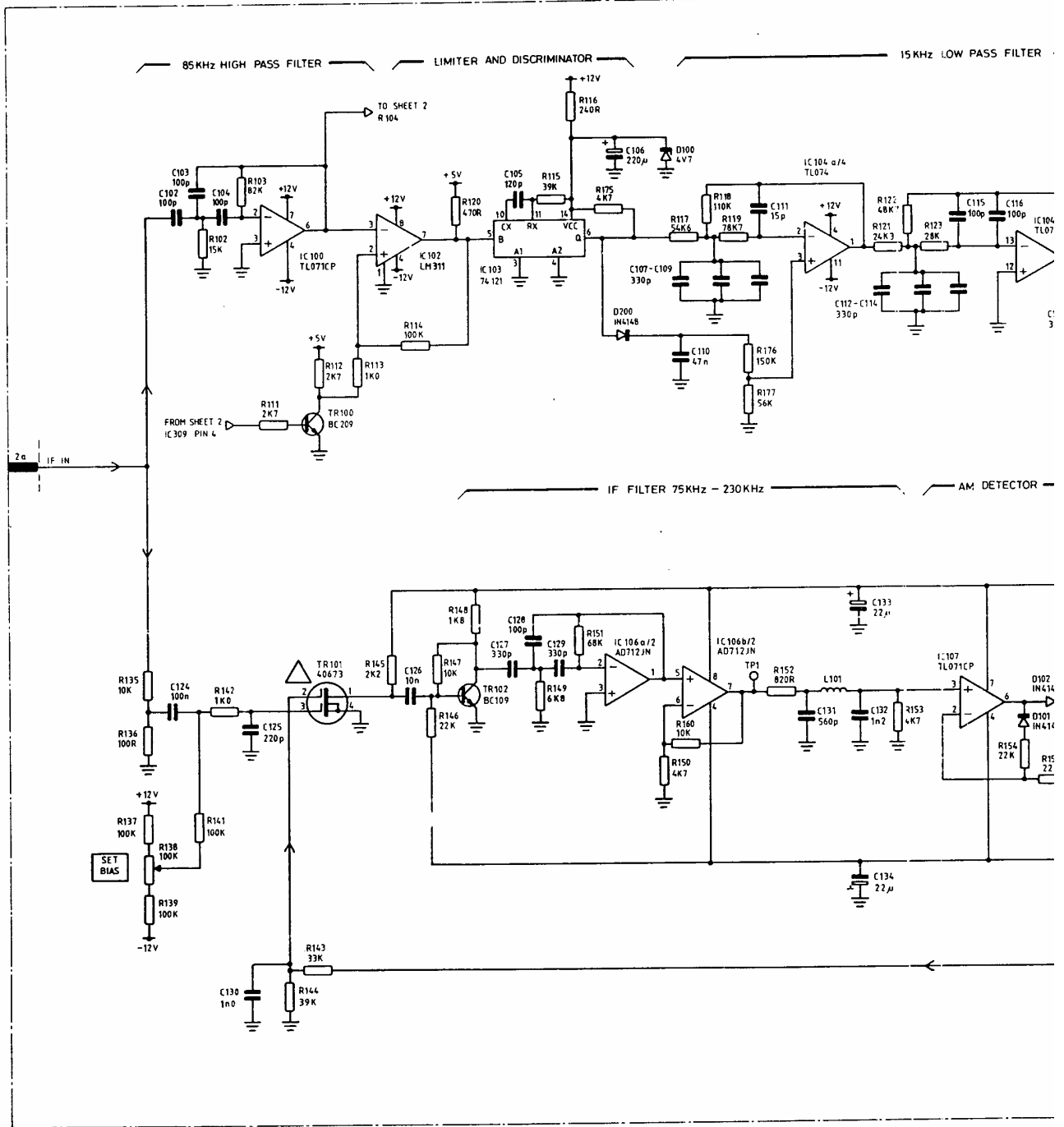


Fig. 2 : Component layout

Fig. 19  
Sep. 90 (Am. 2)





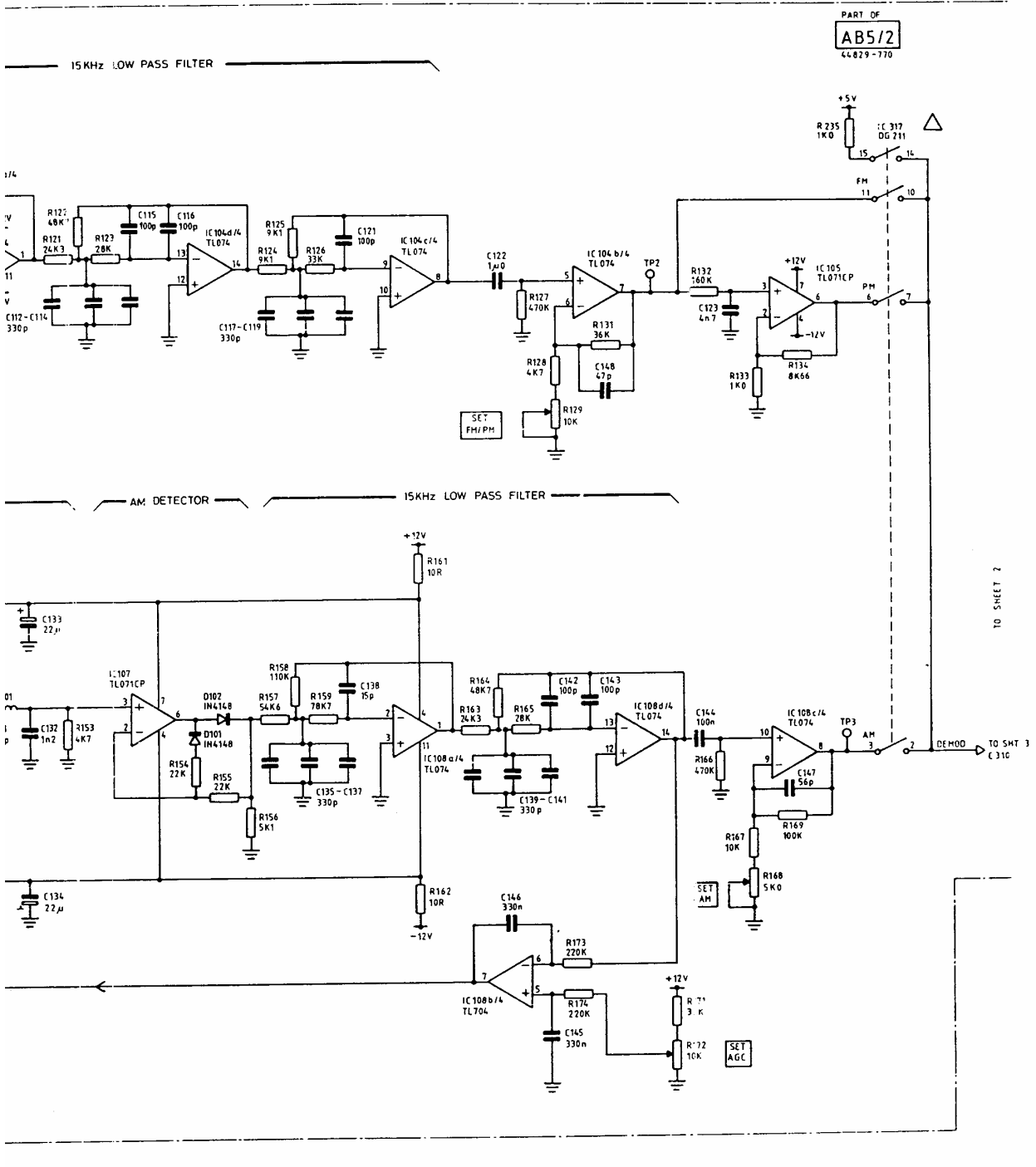
△ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

Drg. No. Z 44829-770  
Sht. 1 of 3, Iss. 1

Fig. 19

Sep. 90 (Am. 2)

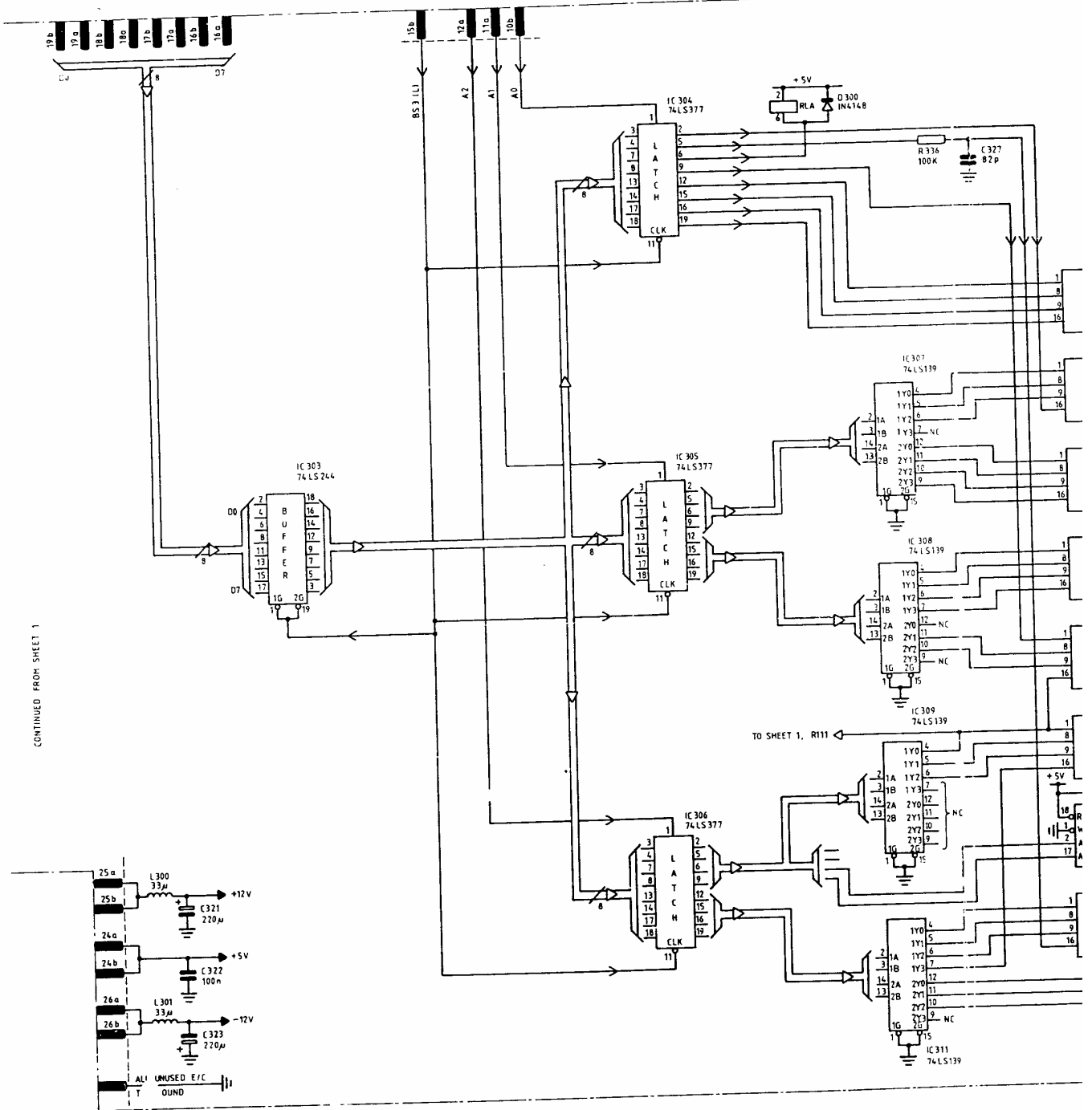
AB512 : Demodulation and scope (IF)



AB5  
/2

ulation and scope (IF demodulation)

Fig. 19  
Chap. 7  
Page 39/40



CONTINUED FROM SHEET 1

△ THIS SYMBOL INDICATES A STATIC - SENSITIVE DEVICE.

Drg. No. Z 44829-770  
Sht. 2 of 3, Iss. 1

AB5/2 : Demodulation and scope (s

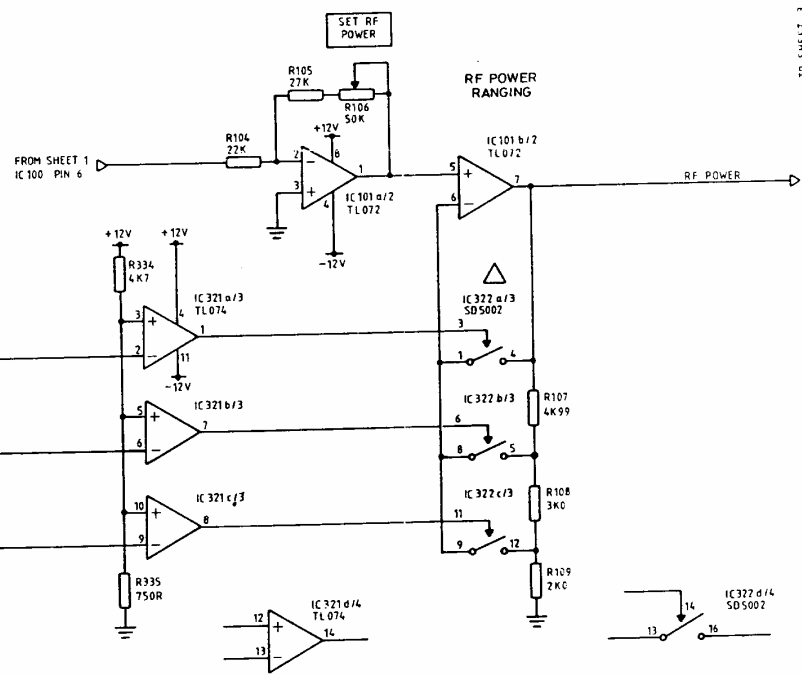
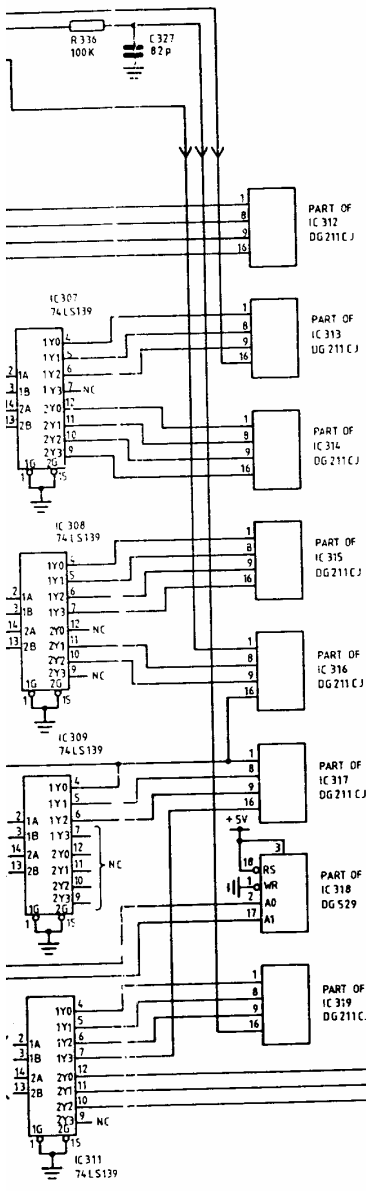
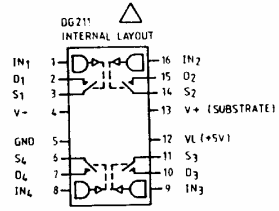
Fig. 20

Sep. 90 (Am. 2)

PART OF  
**AB5/2**  
44829-770

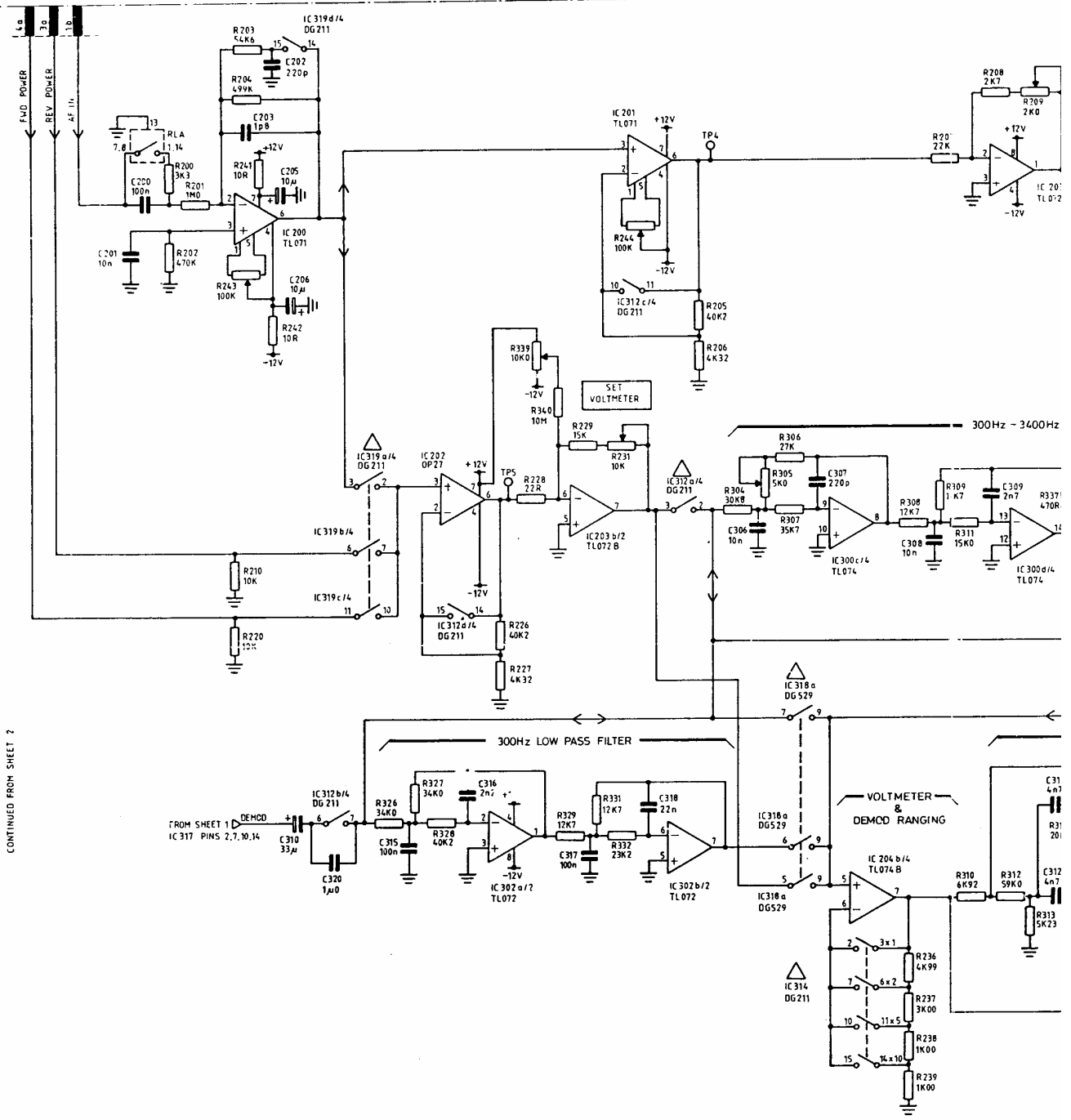
SUPPLY LINE TABLE					
IC	+12V	+5V	GROUND	-12V	CAP
IC 303		20	10		C 315
IC 304		20	10		
IC 305		20	10		C 324
IC 306		20	10		
IC 307		16	8		C 325
IC 308		16	8		
IC 309		16	8		C 326
IC 311		16	8		
IC 312	13	12	5	4	
IC 313	13	12	5	4	
IC 314	13	12	5	4	
IC 315	13	12	5	4	
IC 316	13	12	5	4	
IC 317	13	12	5	4	
IC 318	15	18	16	4	
IC 319	13	12	5	4	

IC's DECOUPLED AT +5V PIN TO GROUND WITH 10n CAPACITOR WHERE INDICATED



TO SHEET 3

**AB5**  
/2



CONTINUED FROM SHEET 2

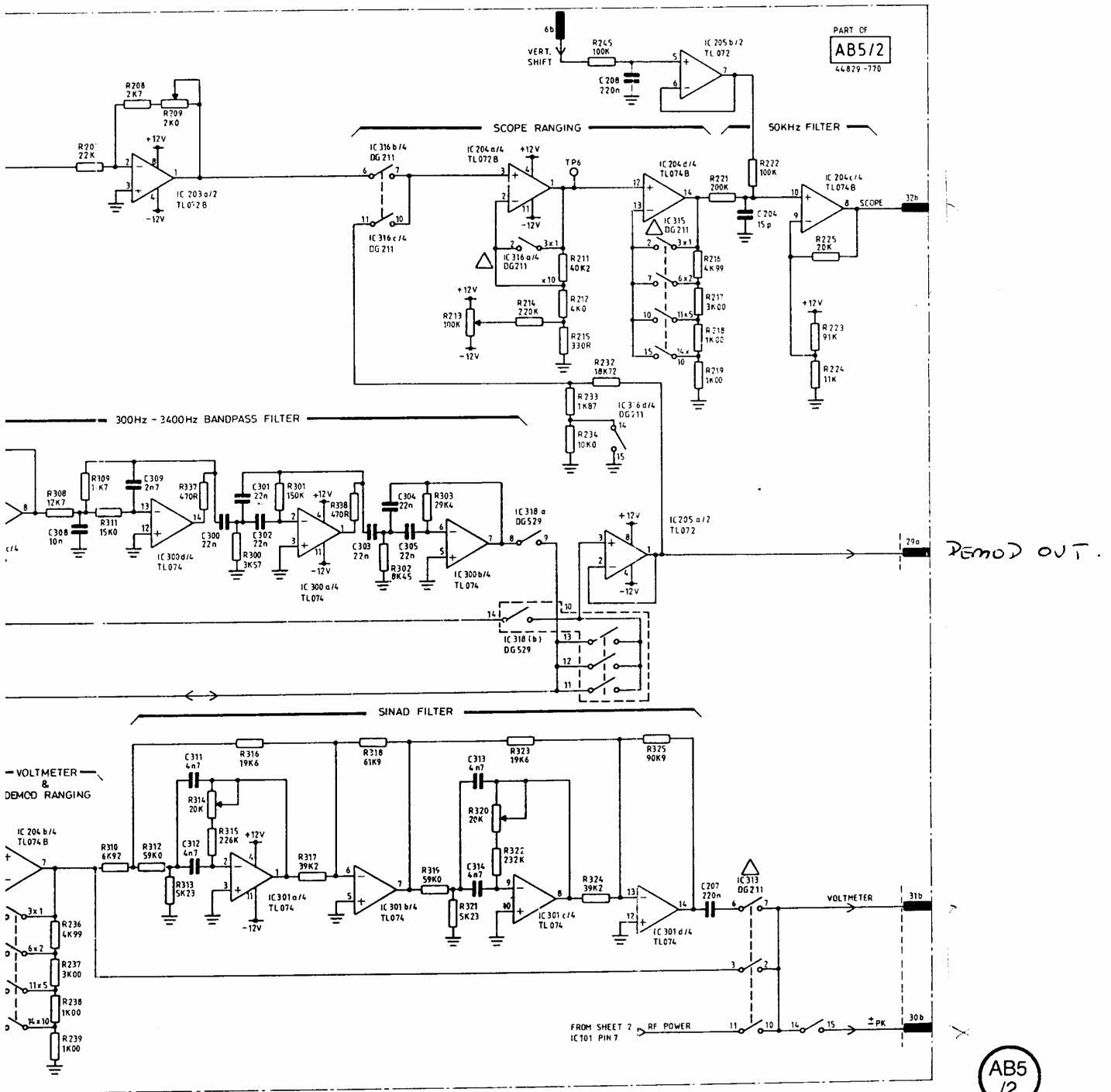
△ THIS SYMBOL INDICATES A STATIC-SENSITIVE DEVICE.

Drg. No. Z 44829-770  
Sht. 3 of 3, Iss. 1

Fig. 21

AB5/2 : Demodulation and scope (rangir)

Sep. 90 (Am. 2)



ion and scope (ranging and filters)

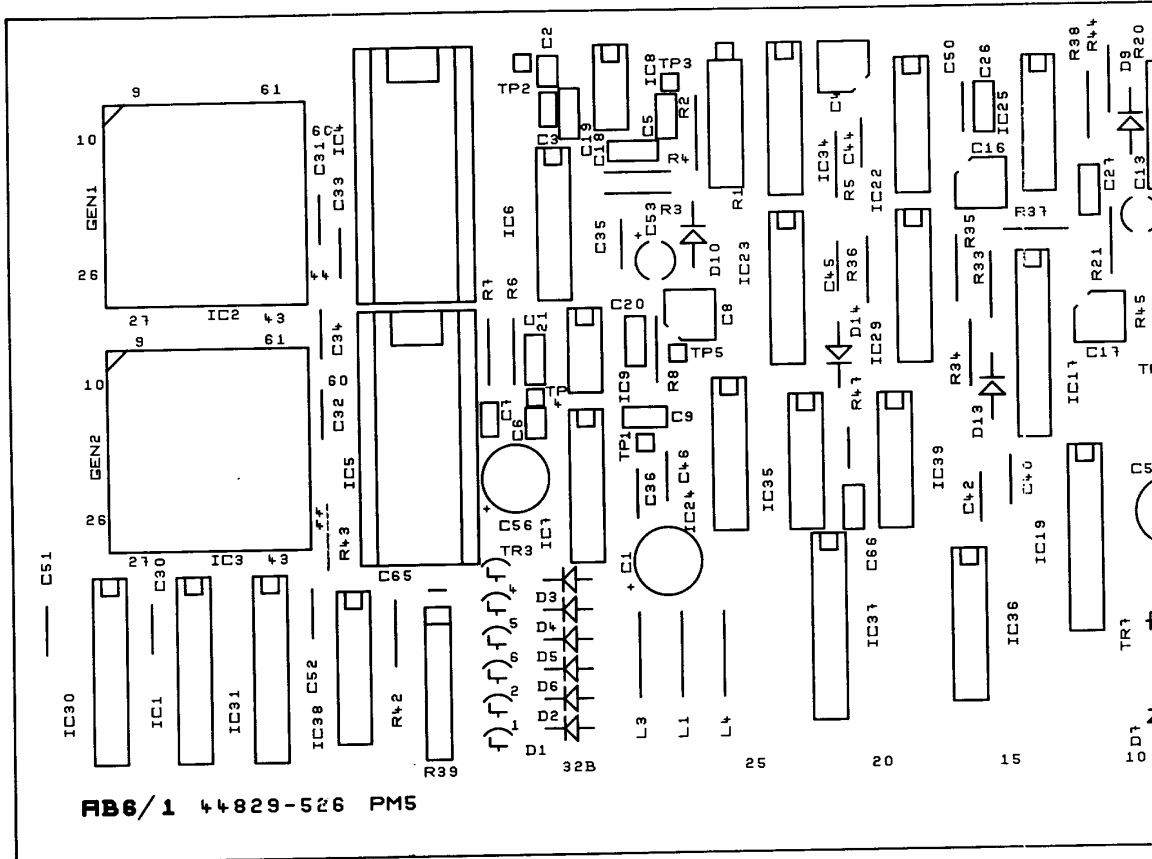
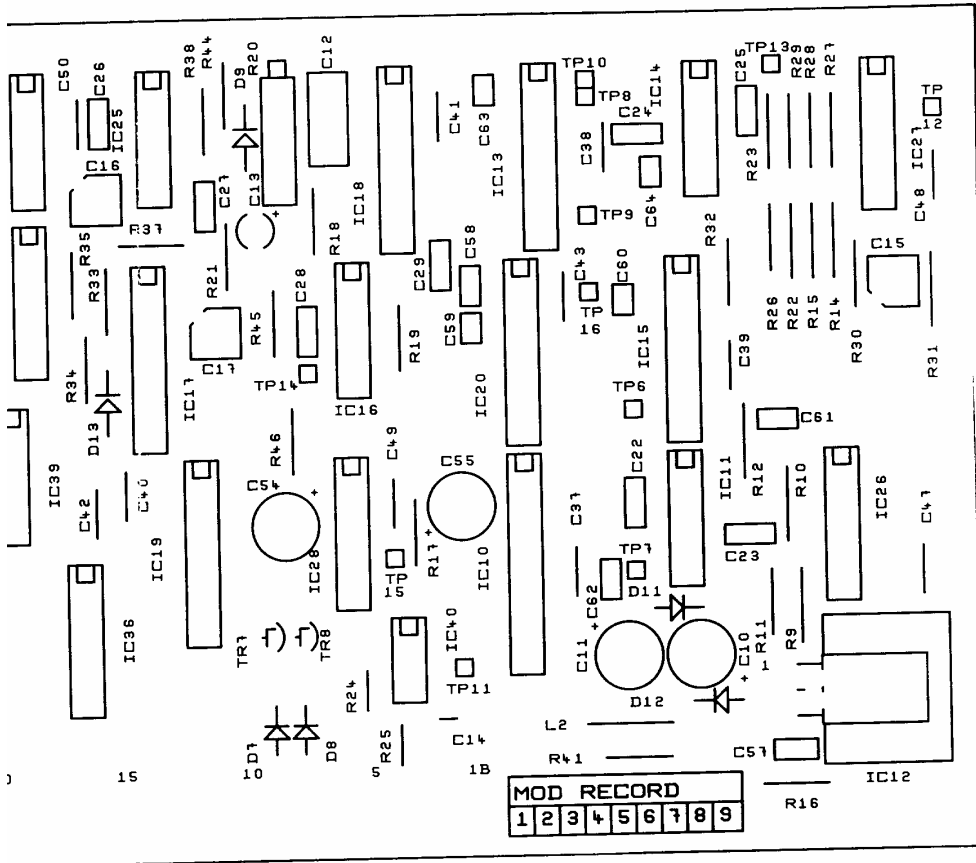


Fig. 22  
 Chap. 7  
 Page 44

AB6/1 : Component layout



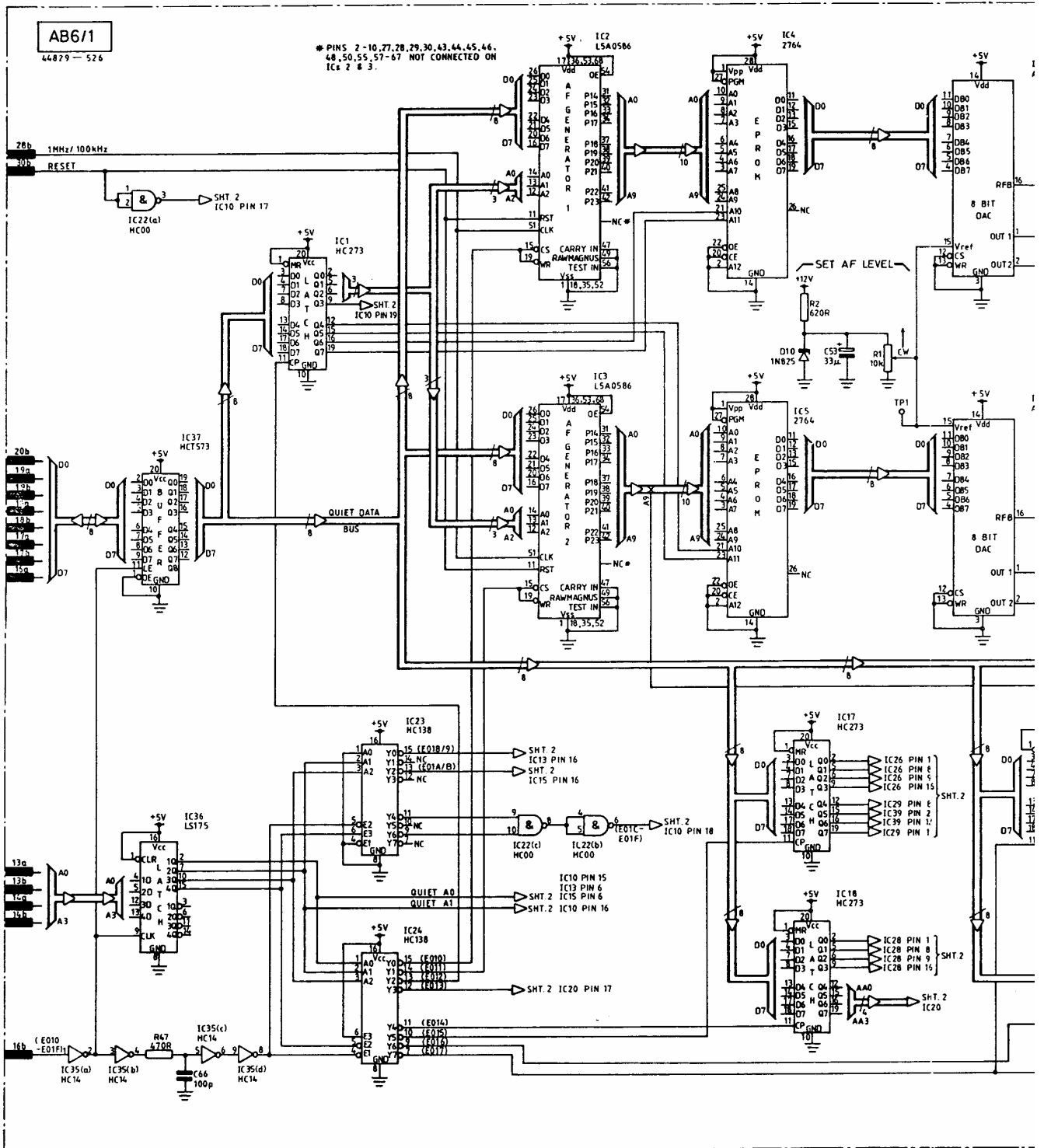
1 : Component layout

Fig. 22

Mar. 89

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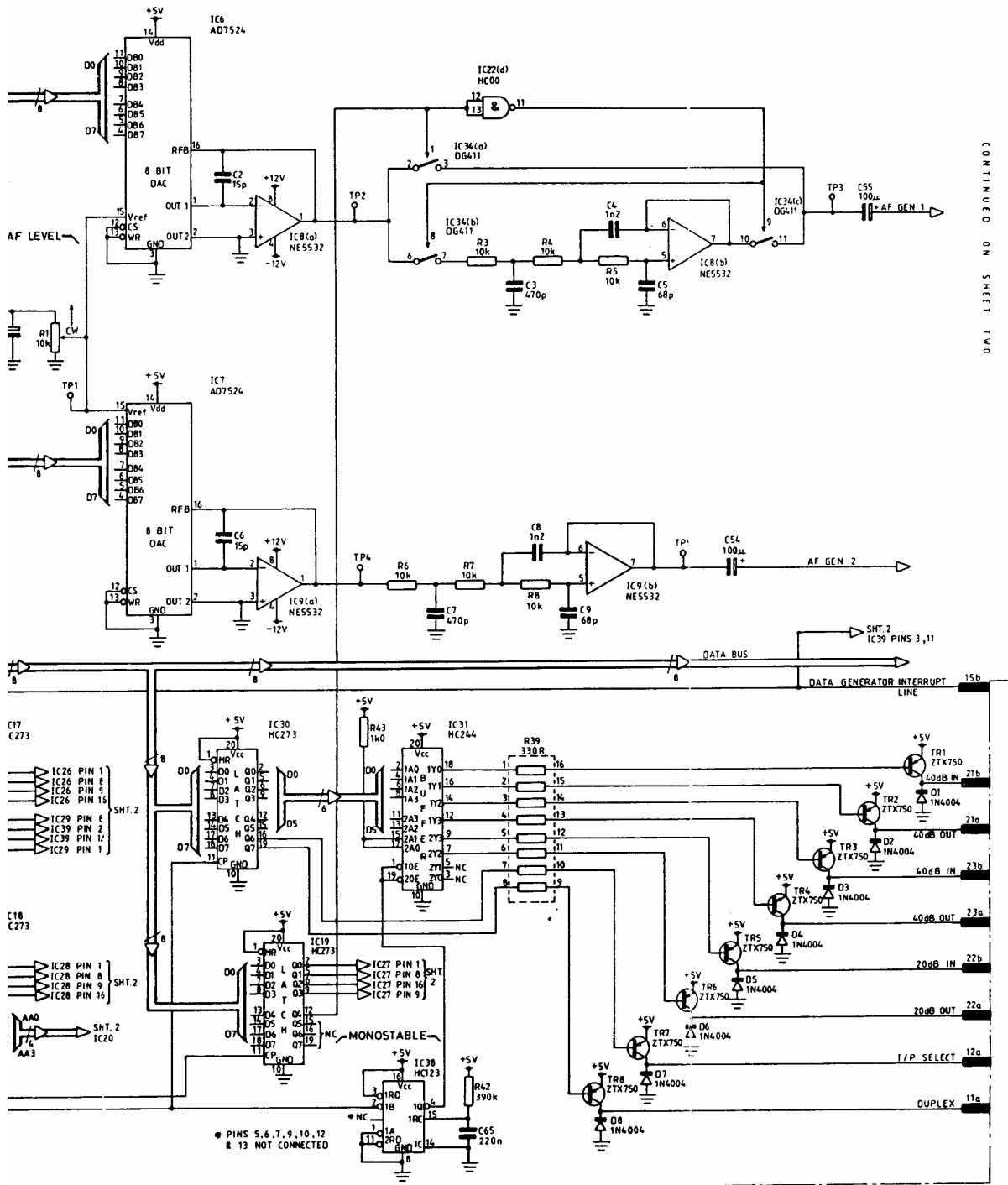


Drg. No. Z 44829-526  
Sht. 1 of 2, Iss. 1

Fig. 22

Mar. 89

AB6/1 : AF generators 1 & 2 (divi

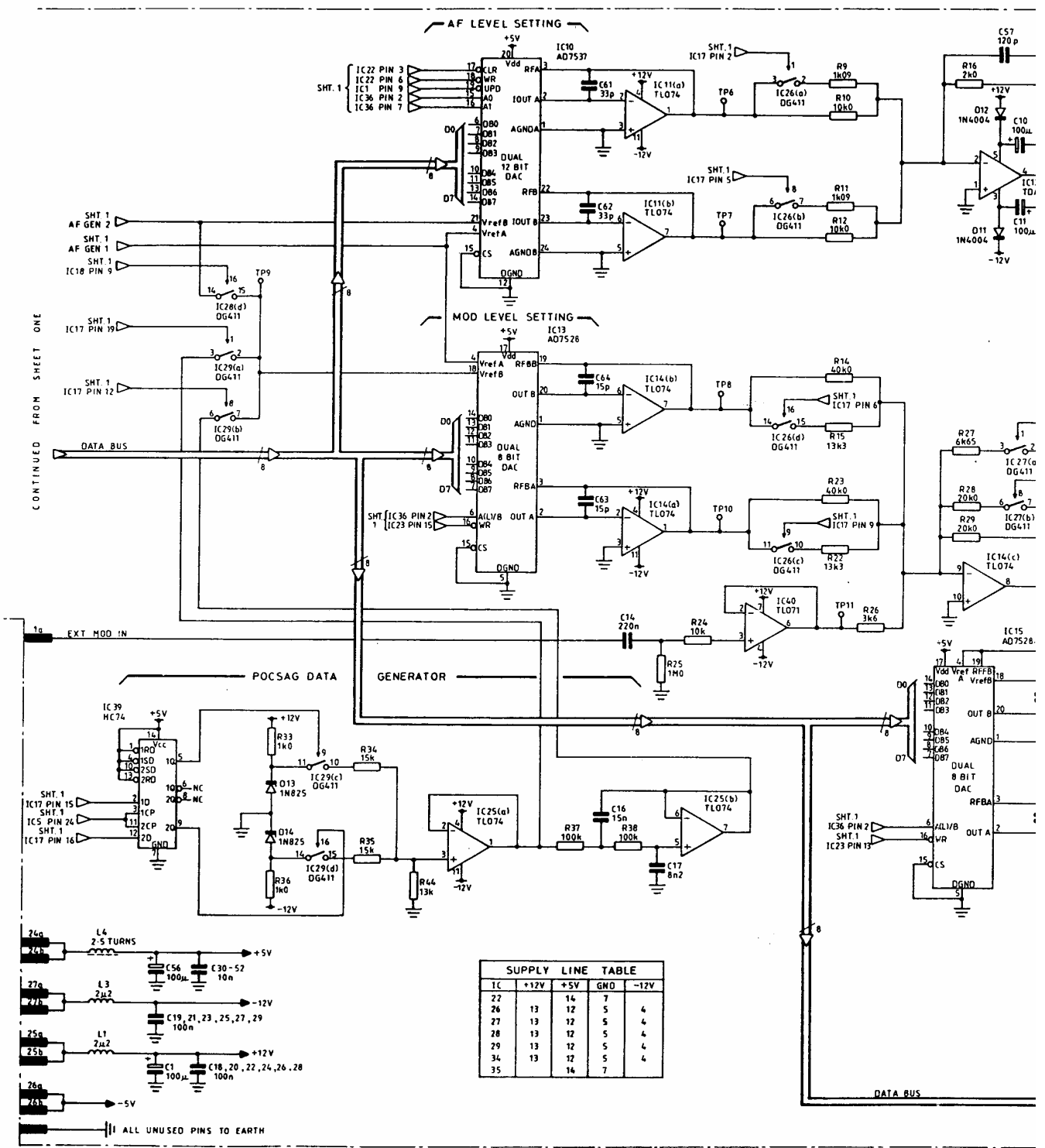


CONTINUED ON SHEET TWO

Generators 1 & 2 (dividers)

Fig. 22  
Chap. 7  
Page 45/46

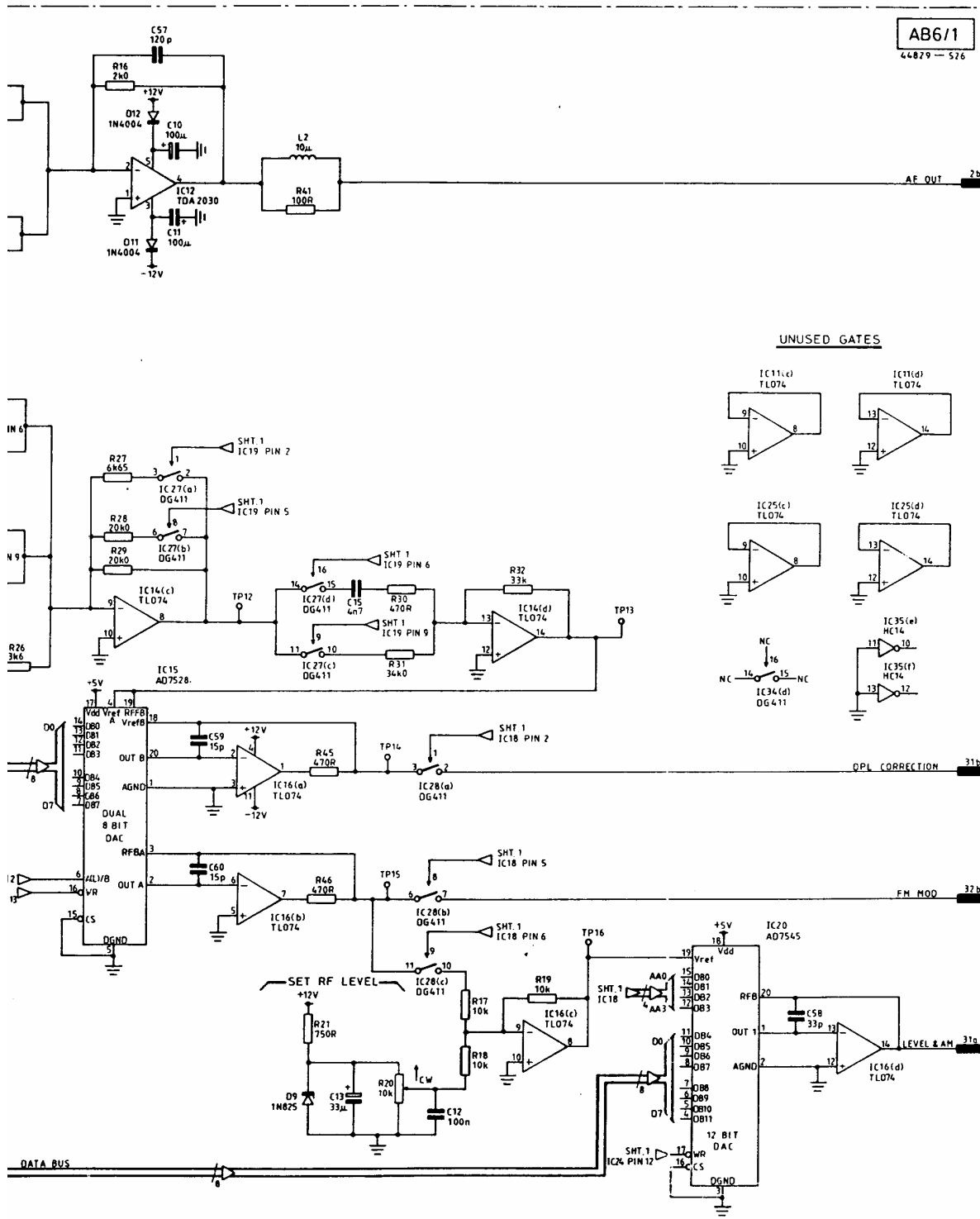




Drg. No. Z 44829-526  
 Sht. 2 of 2, Iss. 1

Fig. 23  
 Mar. 89

AB611 : AF generators 1 & 2 (D-A cc

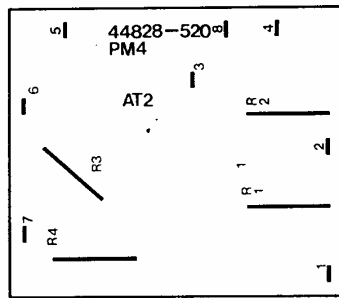
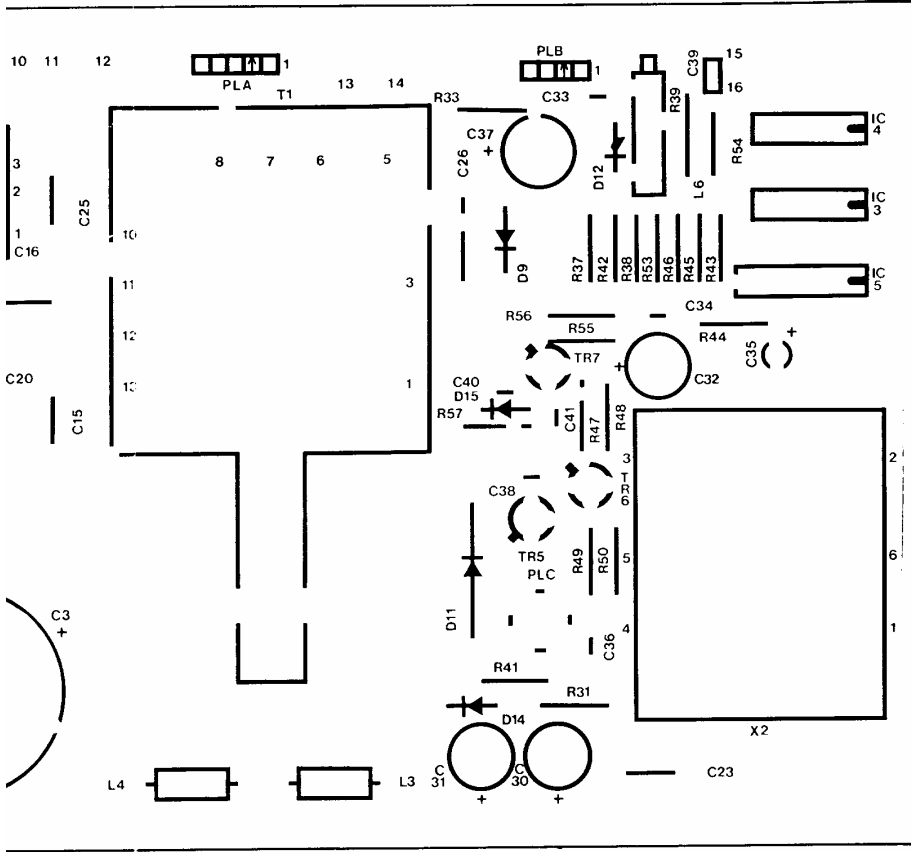


tors 1 & 2 (D-A conversion)

AB6  
/1

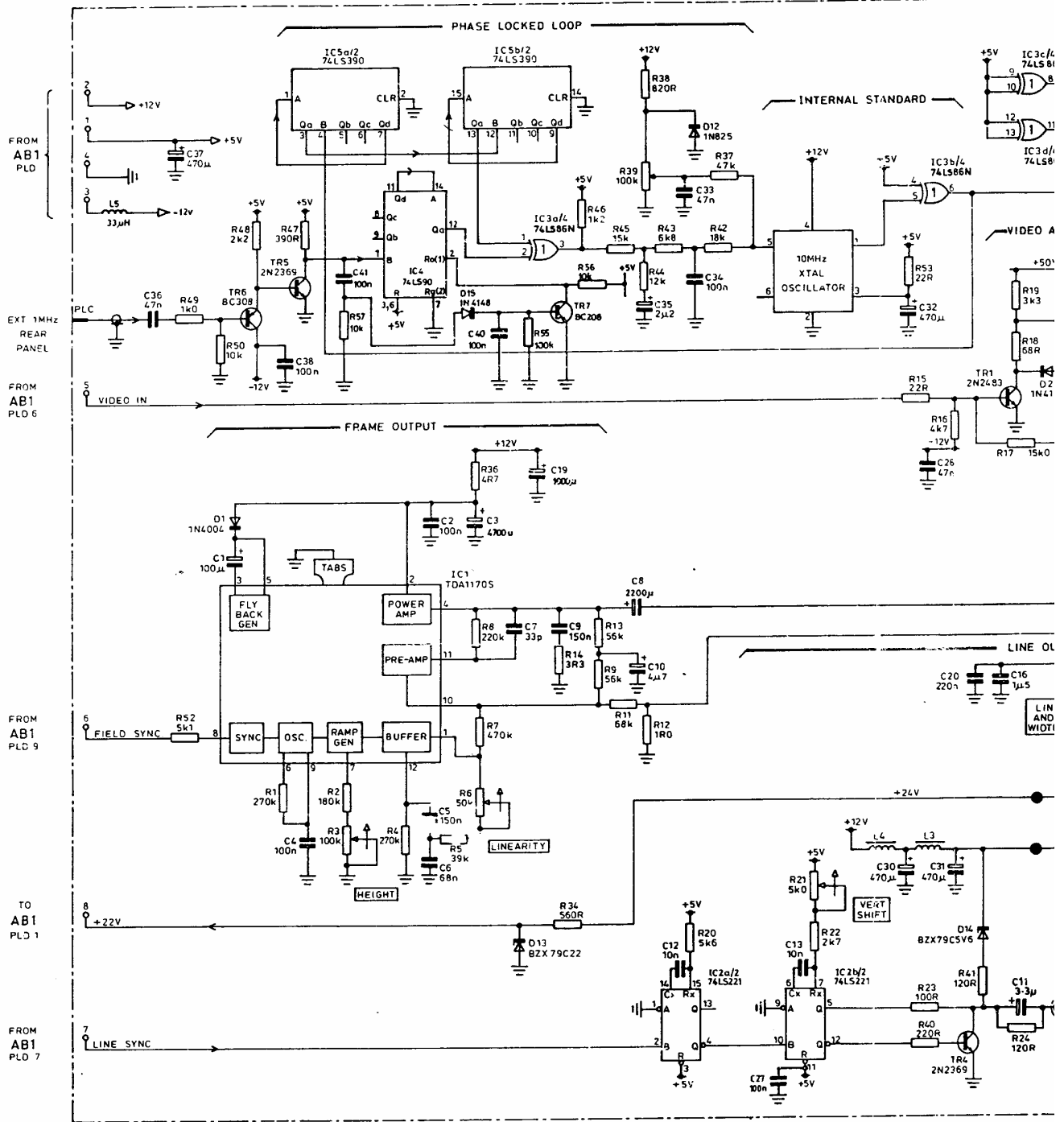
Fig. 23  
Chap. 7  
Page 47





: Component layout  
: Component layout

Fig. 24

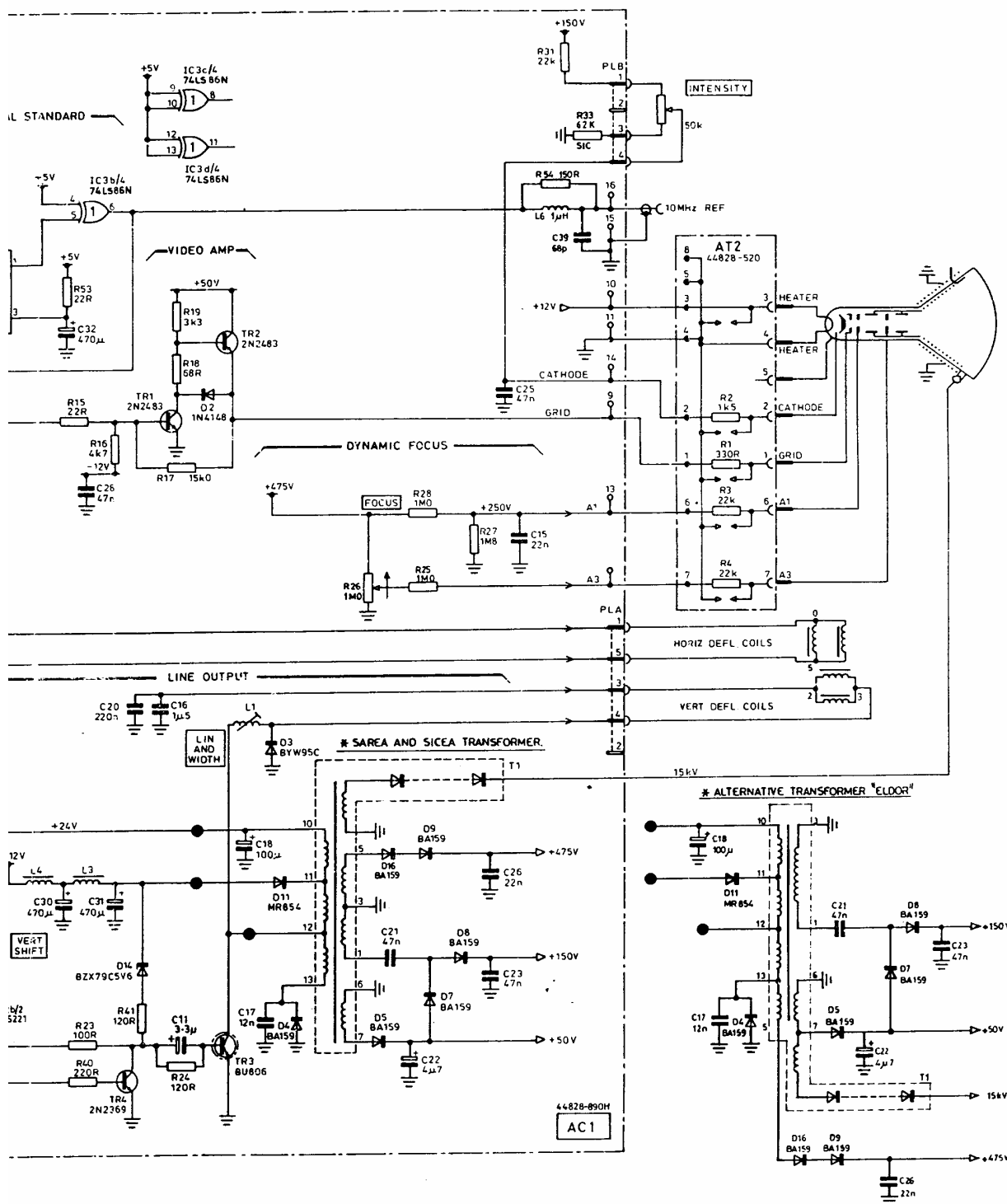


Drg. No. 44828-890  
 Sht. 1 of 1, Iss. 16

IC	+5V	GROUND
IC2	16	8
IC3	14	7
IC4	5	10
IC5	16	8

AC1 : CRT drive  
 AT2 : CRT base

Fig. 24  
 Sep. 90 (Am. 2)



**SUPPLY LINE TABLE**

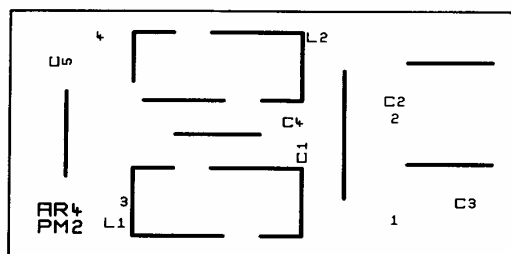
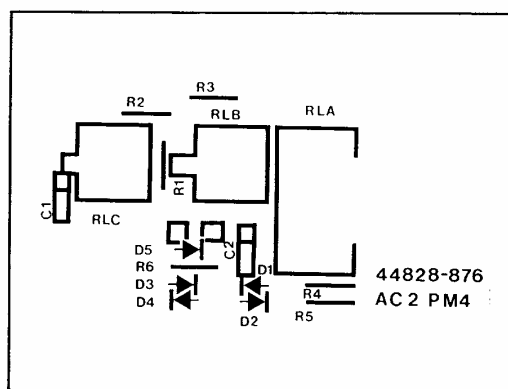
IC	+5V	GROUND
IC2	16	8
IC3	14	7
IC4	5	10
IC5	16	8



RT drive  
T base

Fig. 24  
Chap. 7  
Page 49



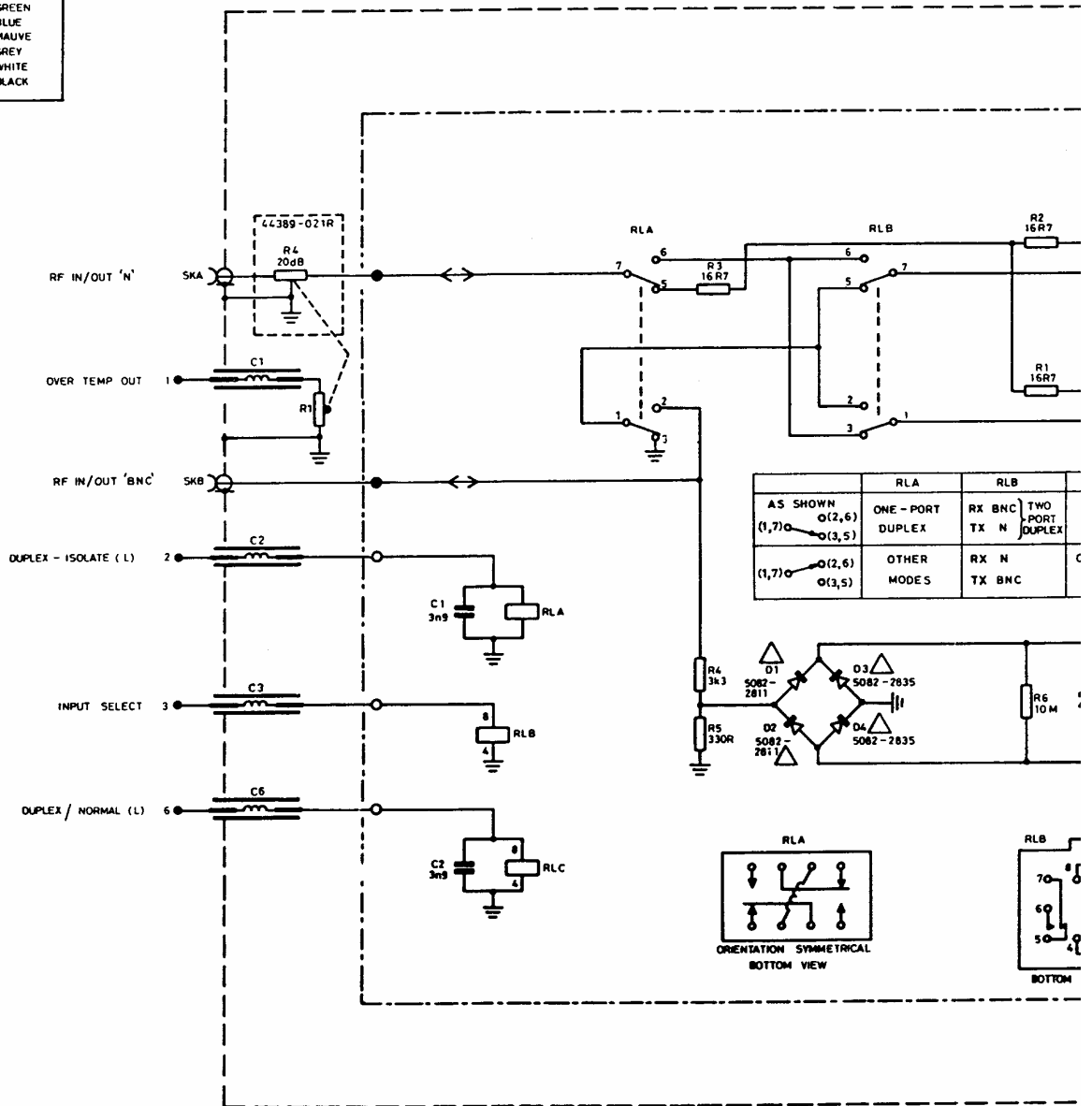


AC2 : Component layout  
AR4 : Component layout

Fig. 25

Mar. 89

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

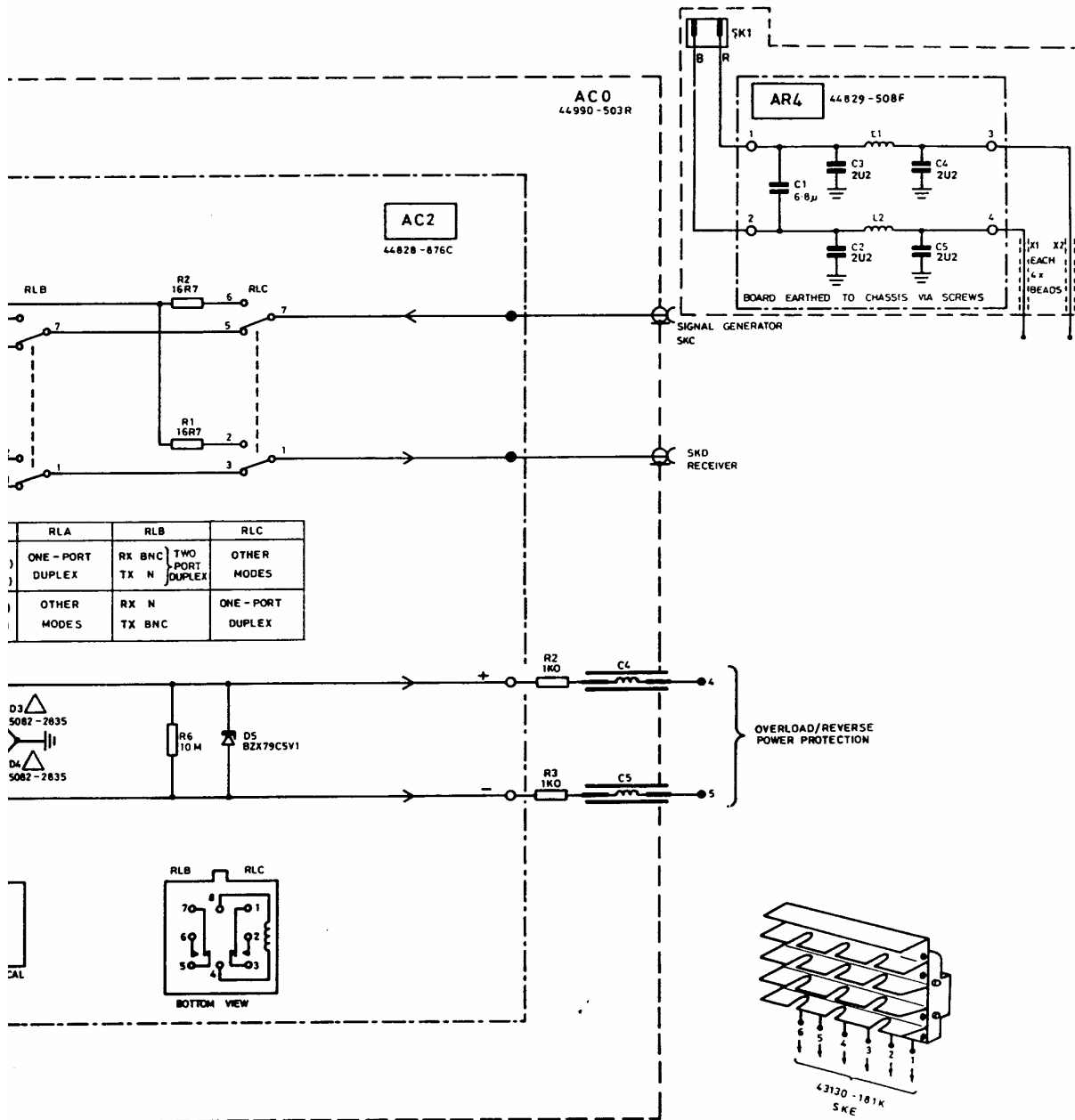


Drg. No. Z 44828-876  
Sht. 1 of 1, Iss. 7

Fig. 25

Apr. 90 (Am. 1)

AC2 : Input switching  
AR4 : DC filter



AC2

AR4

2 : Input switching  
1 : DC filter

Fig. 25  
Chap. 7  
Page 51

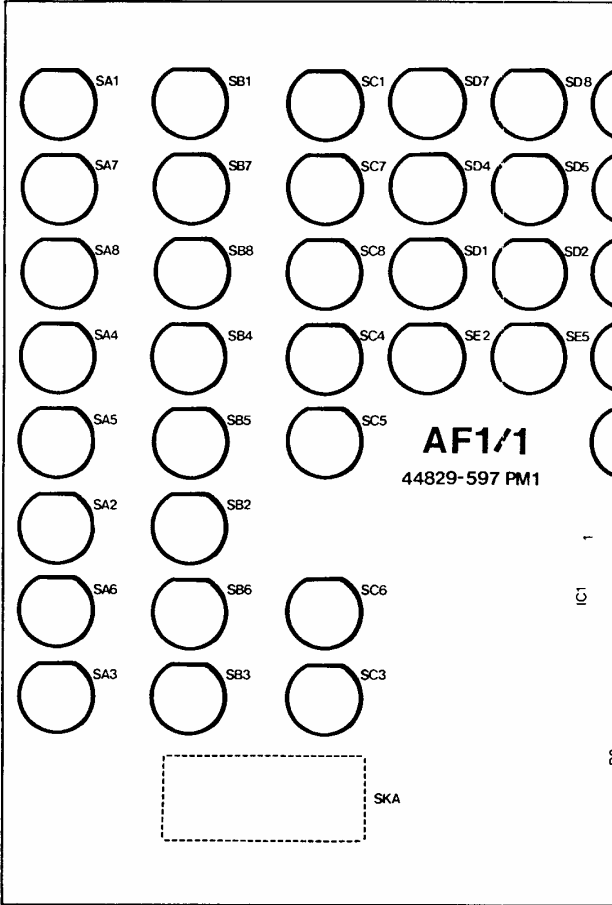
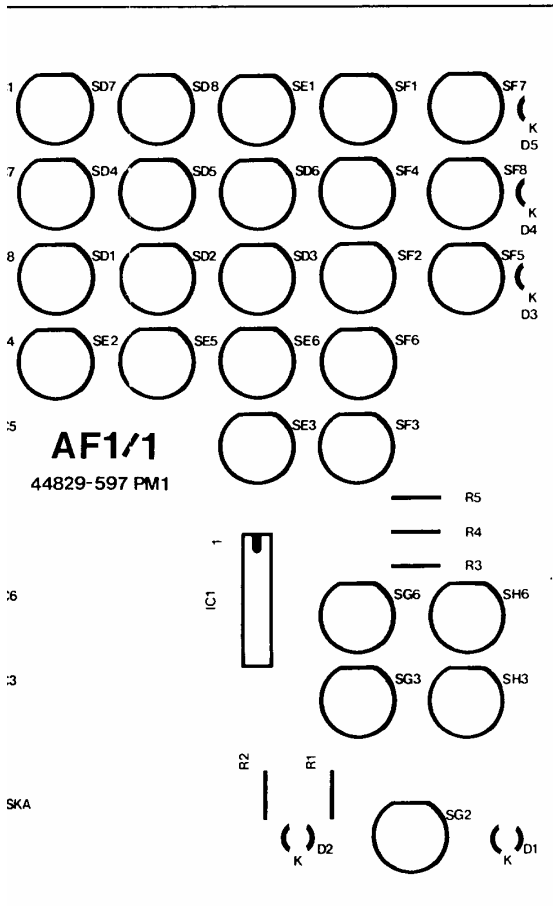


Fig. 26  
 Chap. 7  
 Page 52

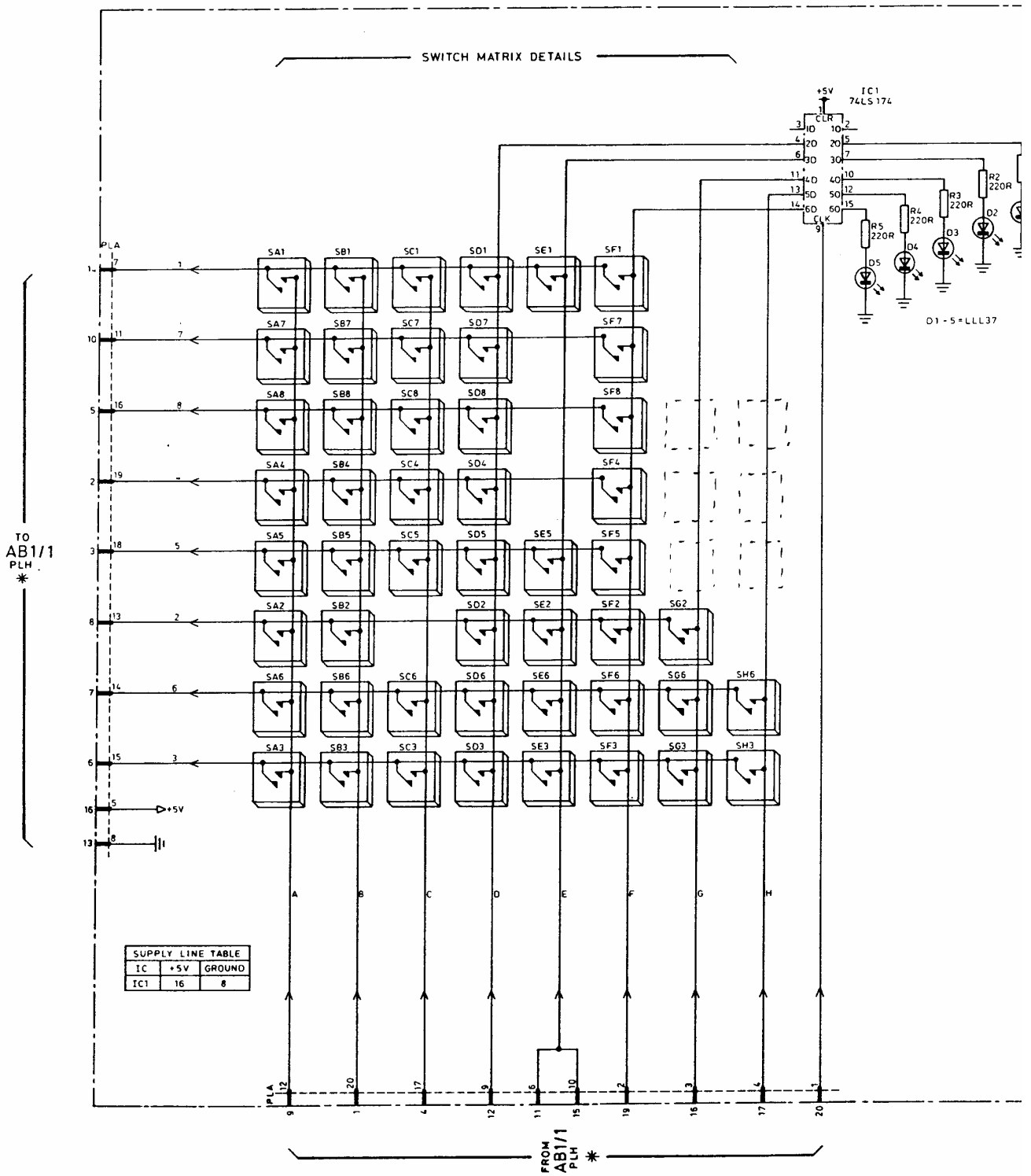
AF1/1 : Component layout



1 : Component layout

Fig. 26

Mar. 89

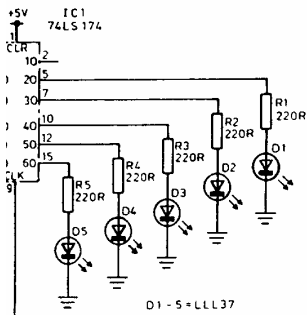


Drg. No. Z 44829-597  
 Sht. 1 of 1, Iss. 1

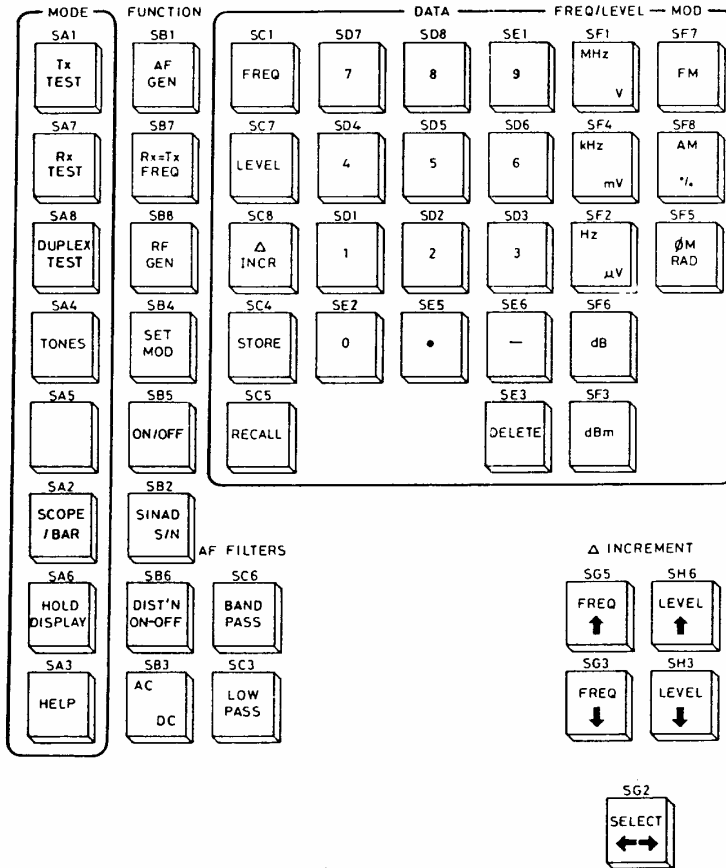
Fig. 26

Mar. 89

AF111 : Main keyboard



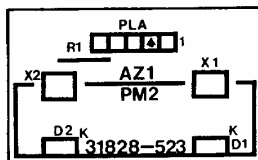
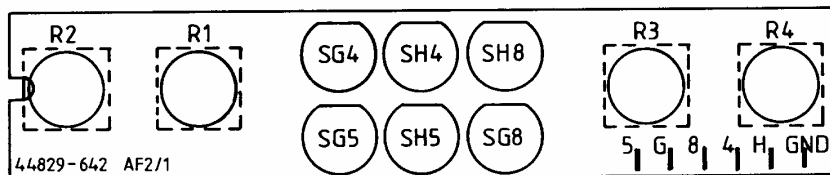
TYPICAL FRONT PANEL KEY POSITIONS  
FOR ENGLISH VERSION



\* SEE CIRCUIT AA0/1 FOR CONNECTION DETAILS.

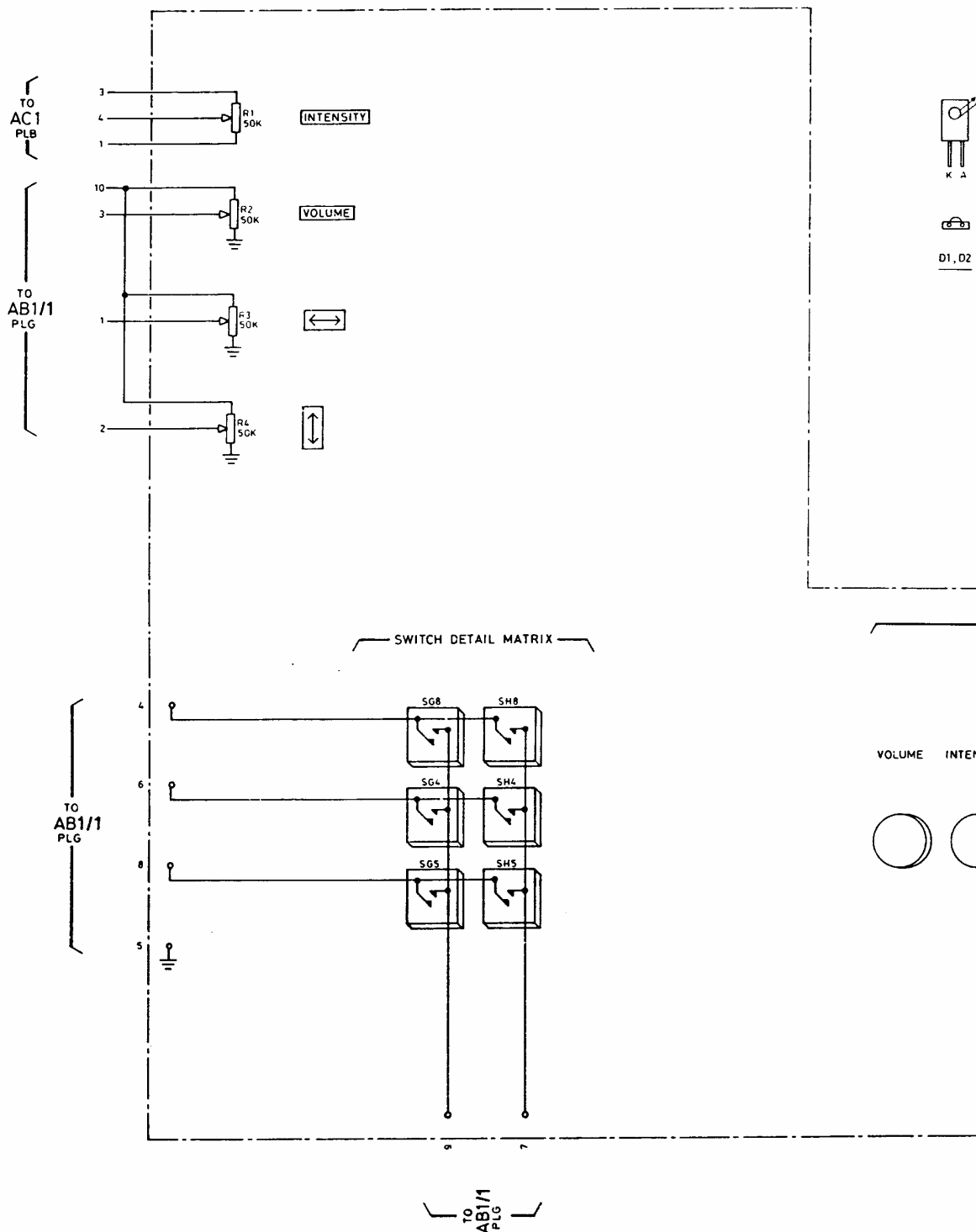
AF1/1

AF1  
/1



AF2/1 : Component layout  
AZ1 : Component layout



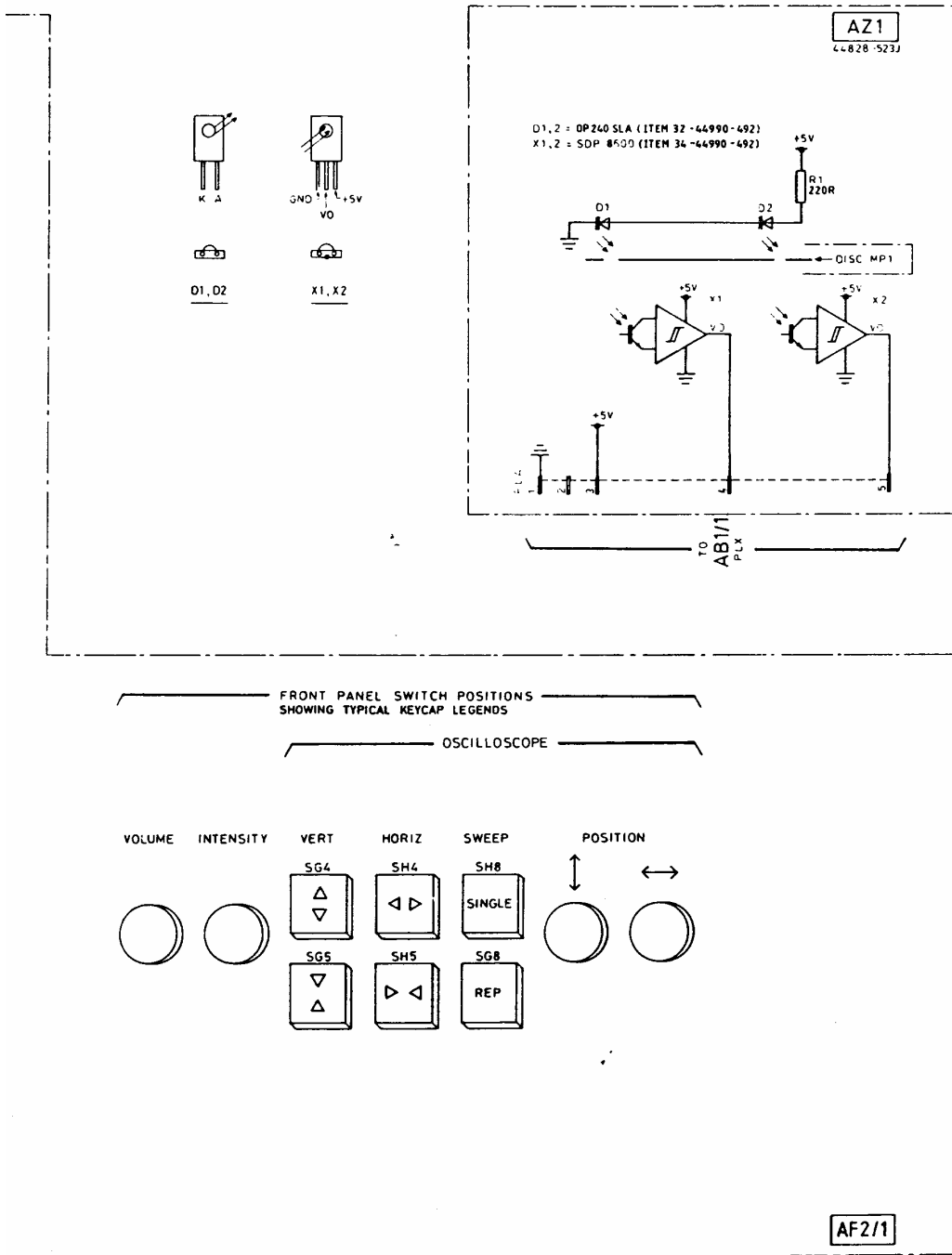


Drg. No. Z 44829-642  
 Sht. 1 of 1, Iss. 2

AF2/1 : Scope keyboard  
 AZ1 : Optical encoder

Fig. 27

Apr. 90 (Am. 1)



AF2  
/1  
AZ1

l : Scope keyboard  
: Optical encoder

Fig.27  
Chap. 7  
page 55

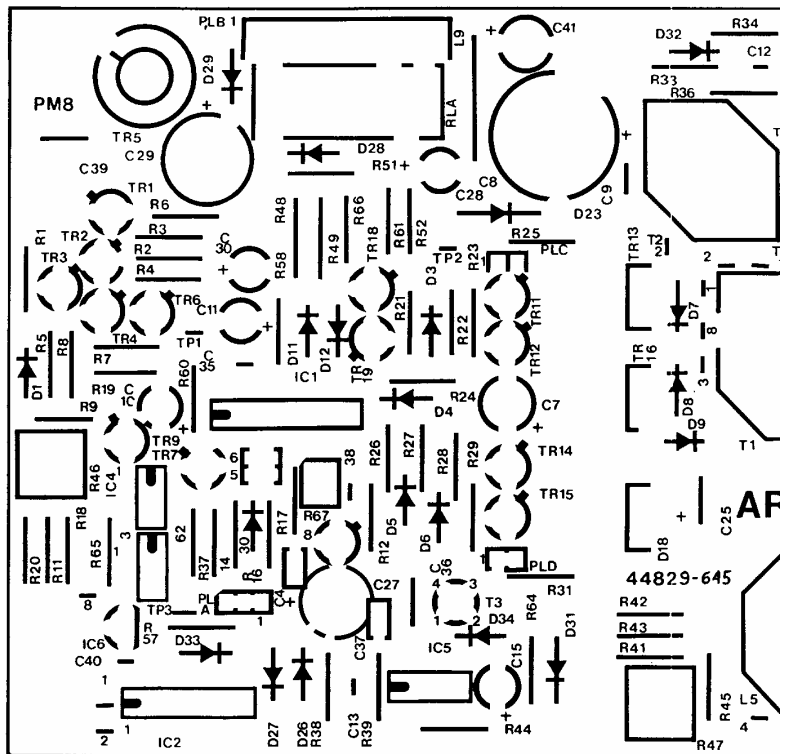
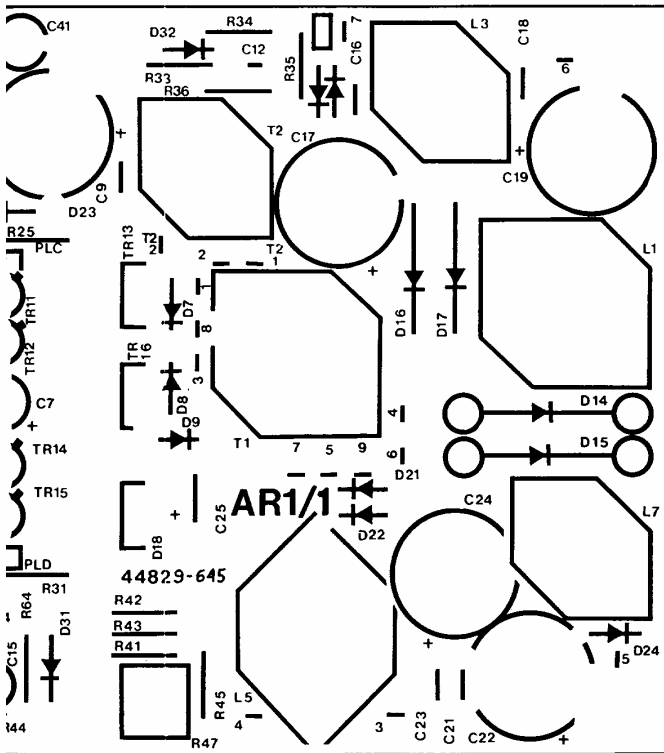


Fig. 28  
 Chap. 7  
 Page 56

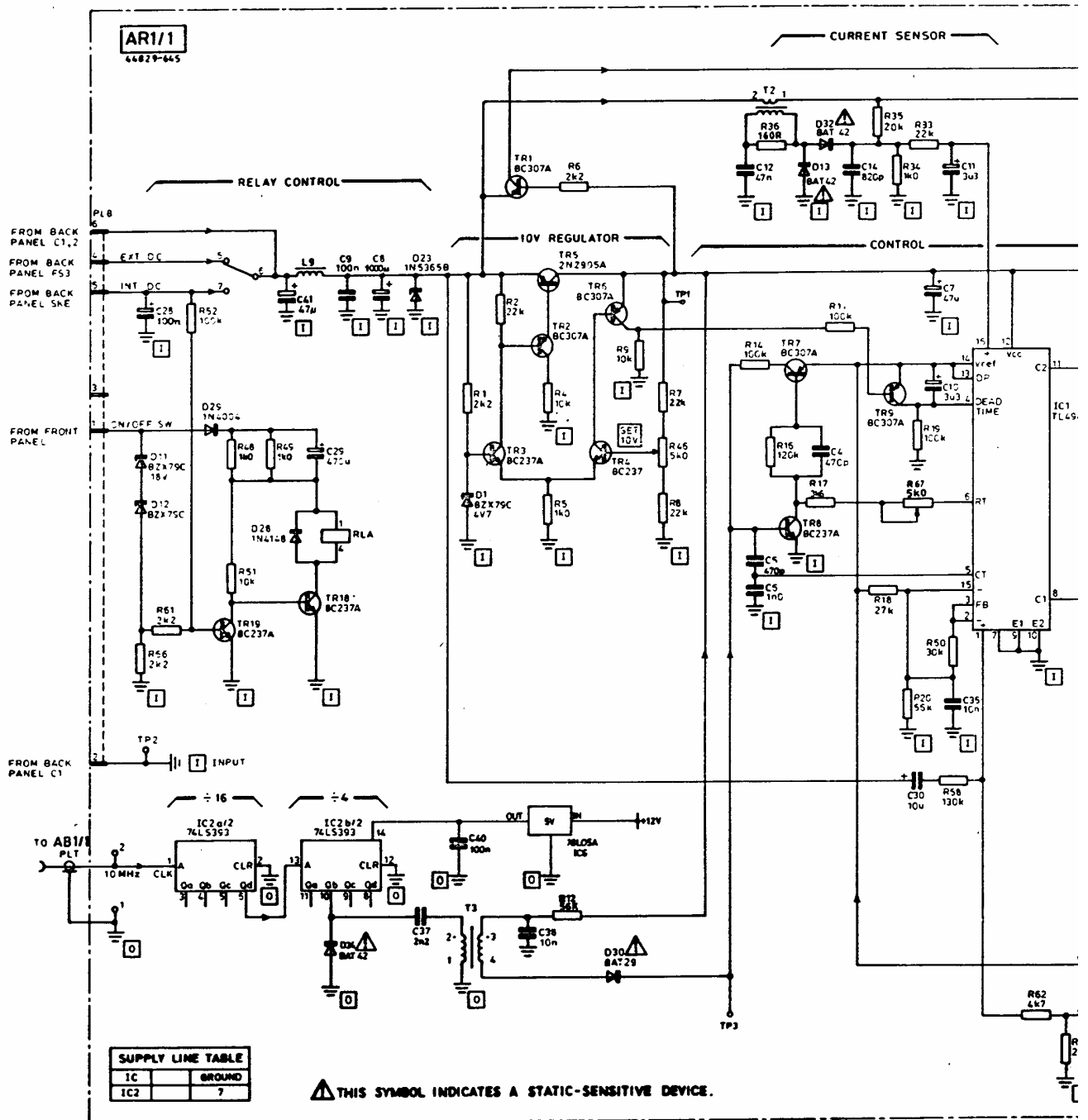
AR111 : Component layout.



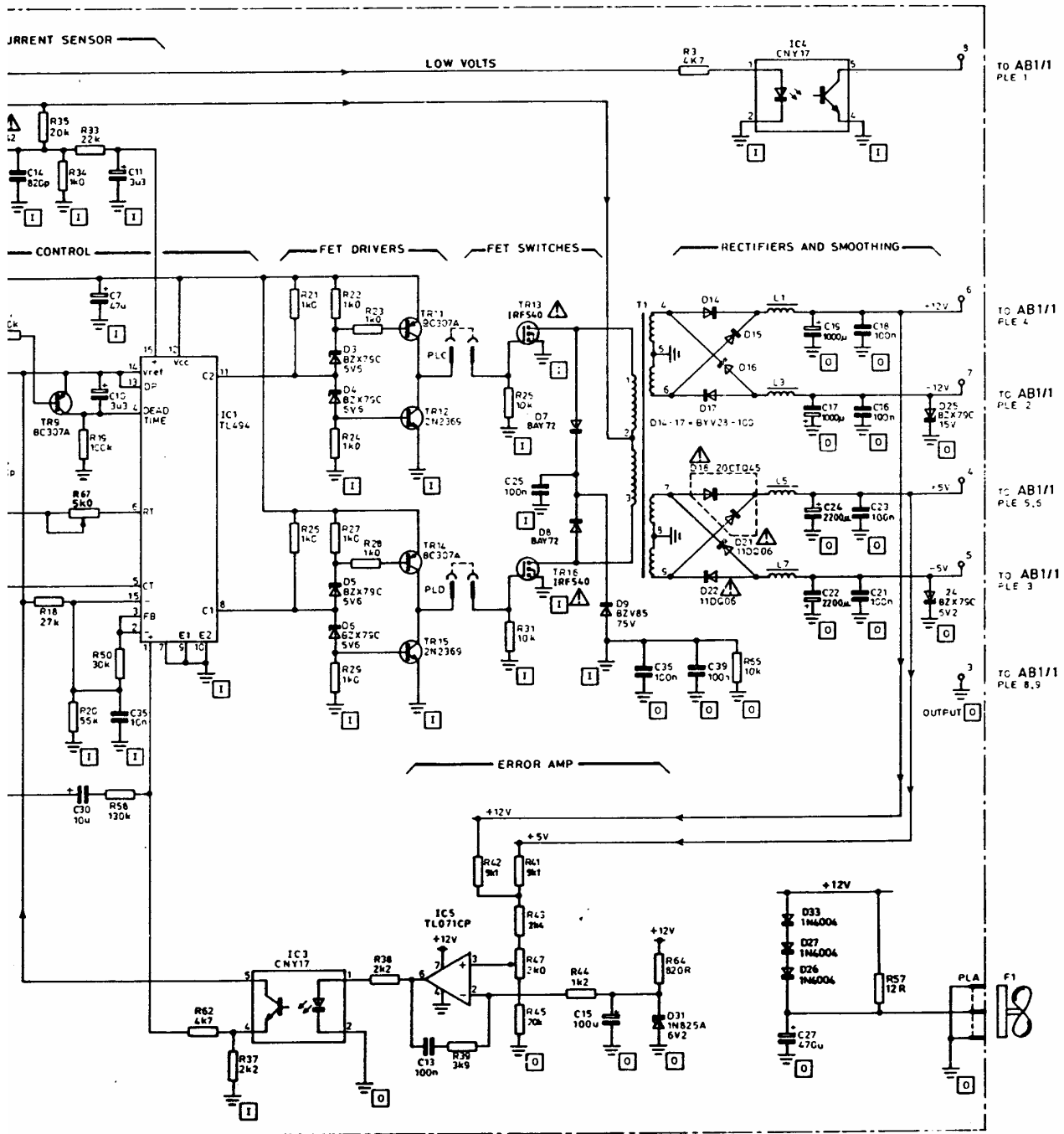
111 : Component layout

Fig. 28

Mar. 89

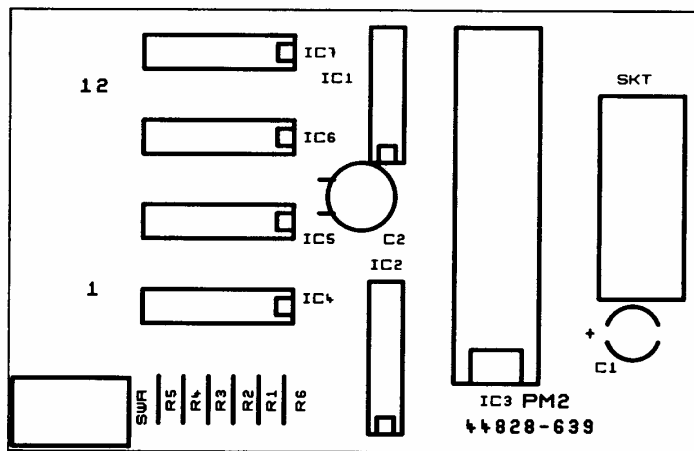


Drg. No. Z 44829-645  
Sht. 1 of 1, Iss. 1



AR1  
/1

AR1/1 : Power supply




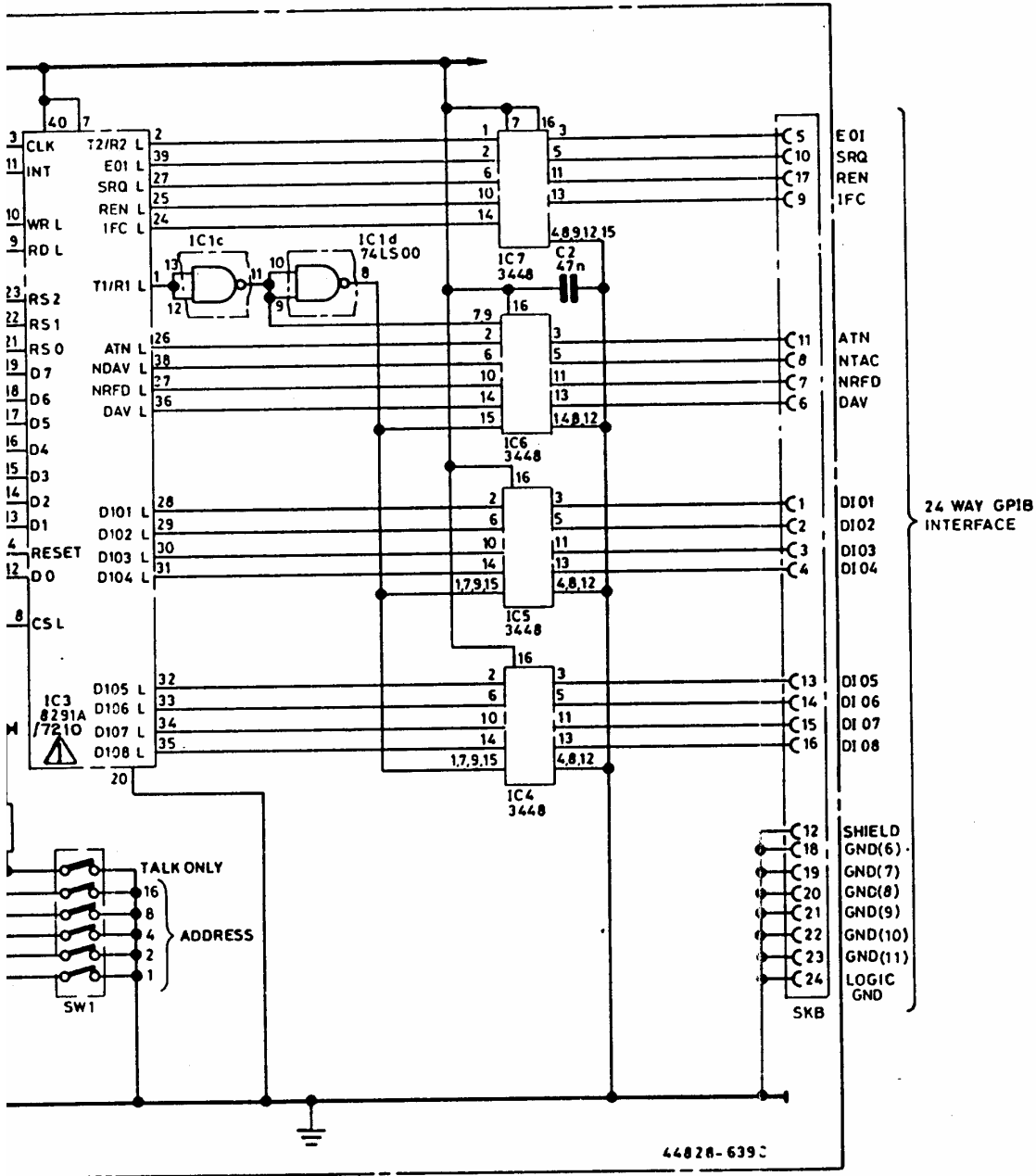
AG1 : Component layout

Fig. 29  
Mar. 89





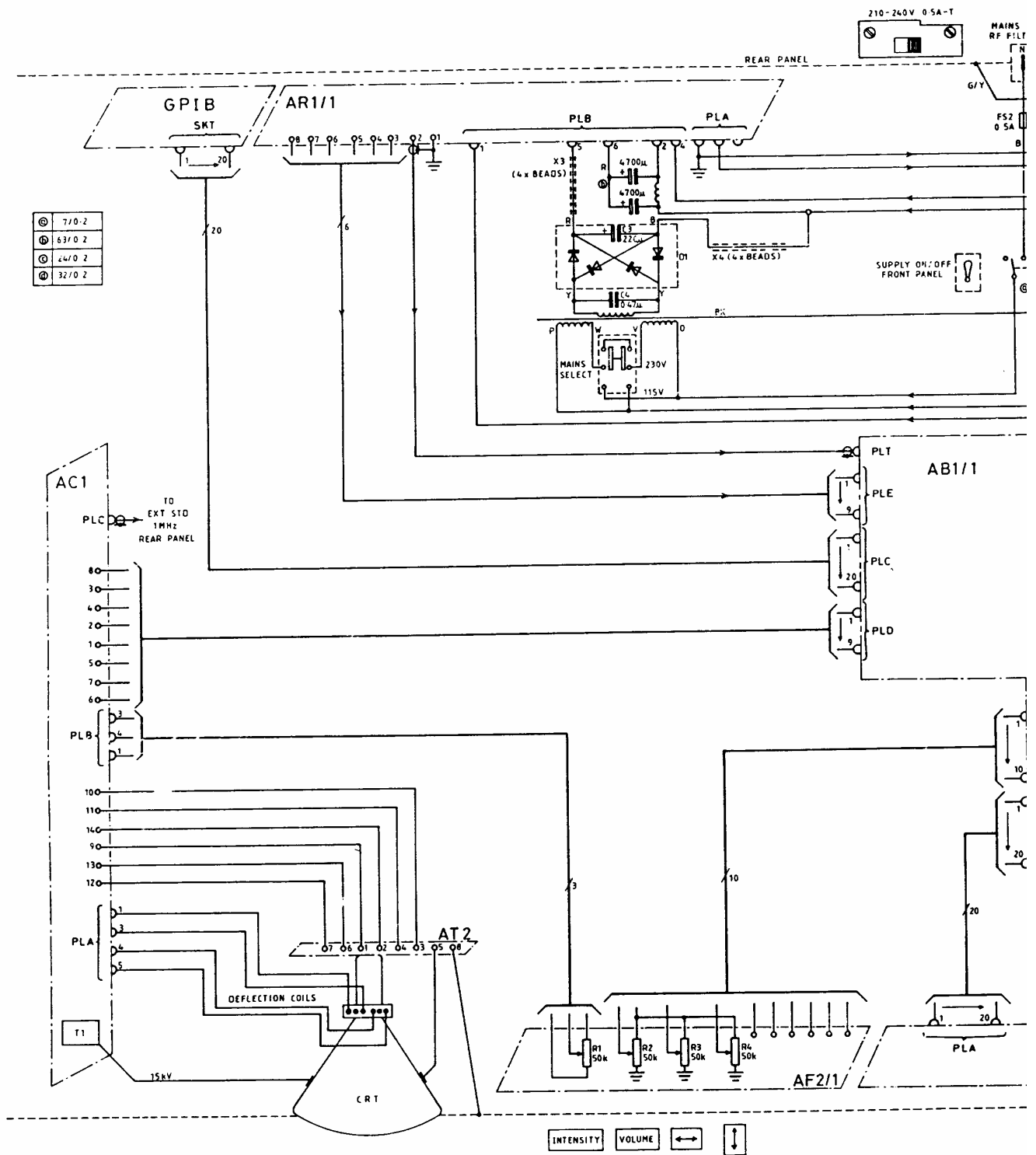
COMPONENT MARKED  IS STATIC SENSITIVE, PRECAUTIONS AS PER MIC 2320  
IC2 ADDRESS = CS L =  $\bar{A}3$   
IC3 ADDRESS = CS L = A3



AGO

GO : GPIB unit

Fig. 29  
Chap. 7  
Page 59/60

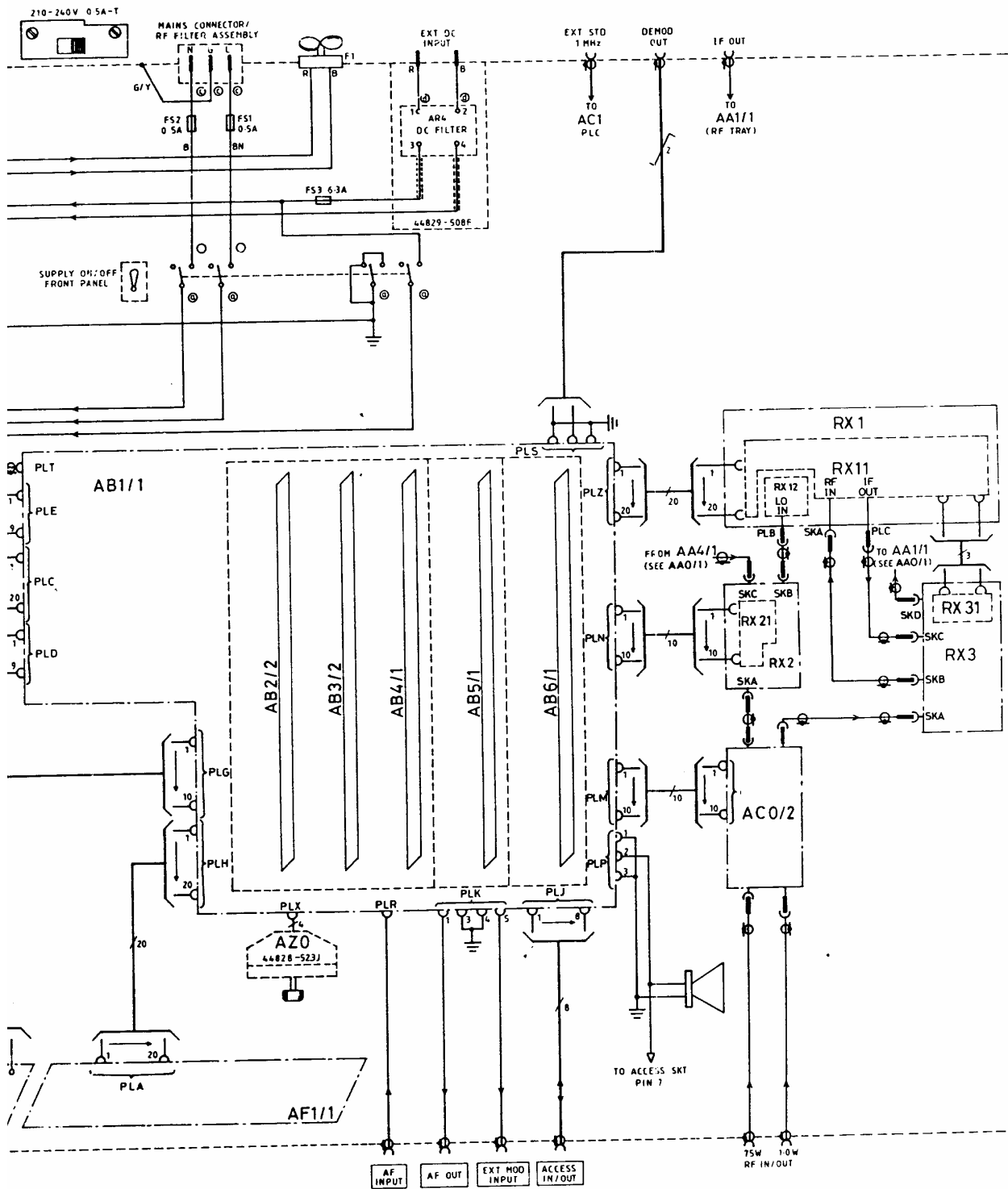


Drg. No. Z 52955-321  
Sht. 1 of 3, Iss. 3

A012 : 2955R Overall asse

Fig. 30

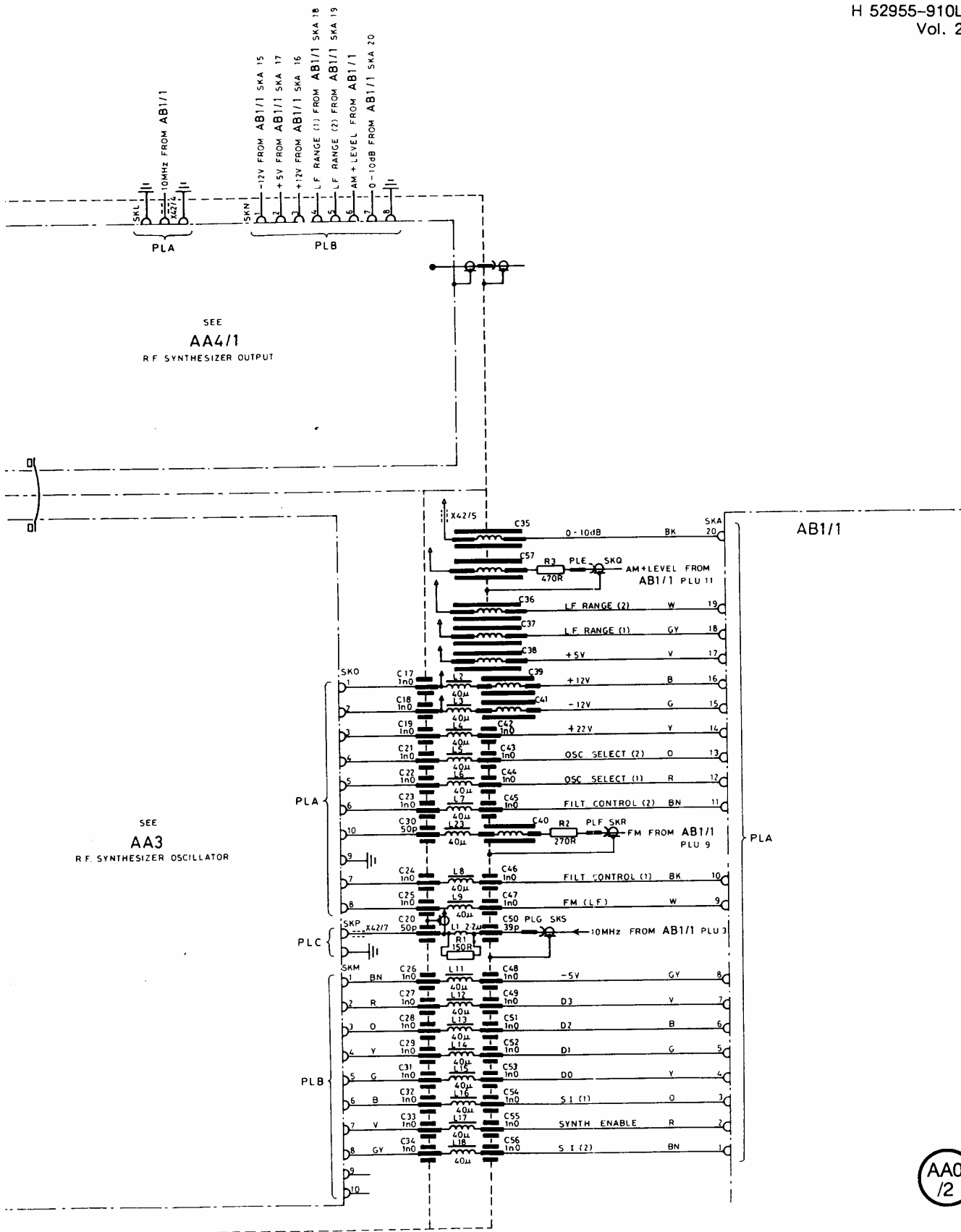
Apr. 90 (Am. 1)



A0  
12

2955R Overall assembly

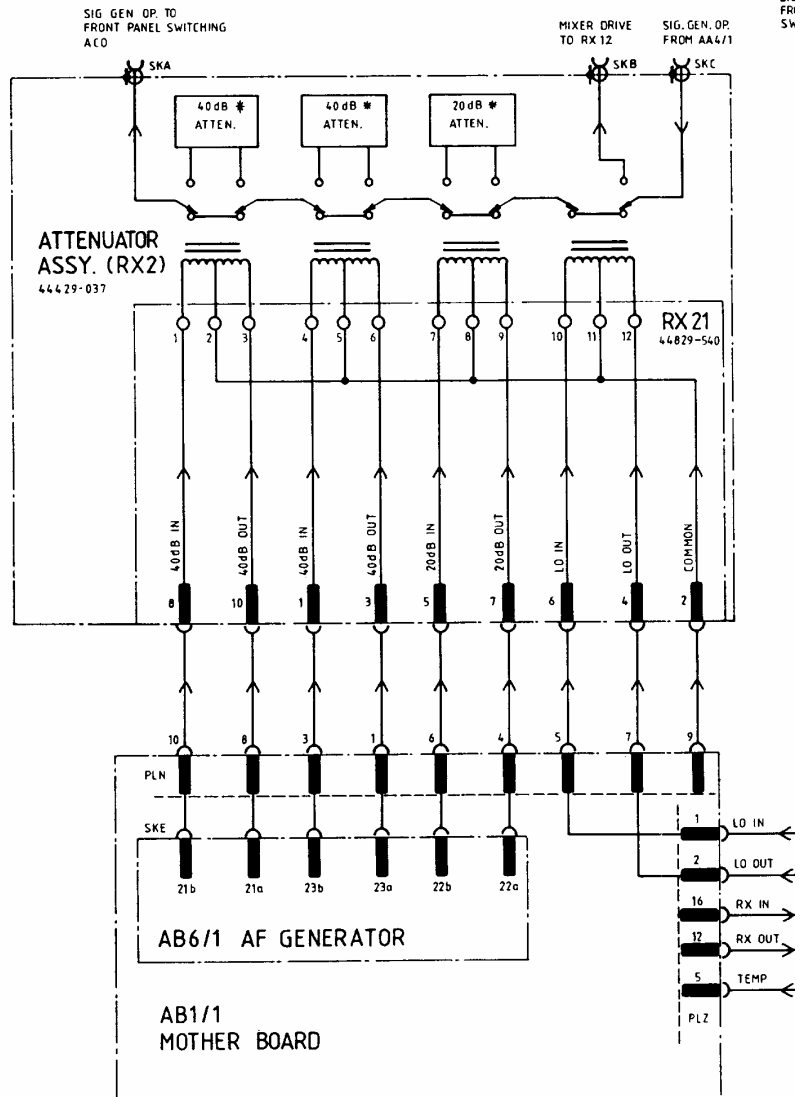




AA0  
/2

1/2 : 2955R RF tray

\* ATTENUATOR PADS  
FORMED BY SUBSTRATE  
BULK RESISTANCE



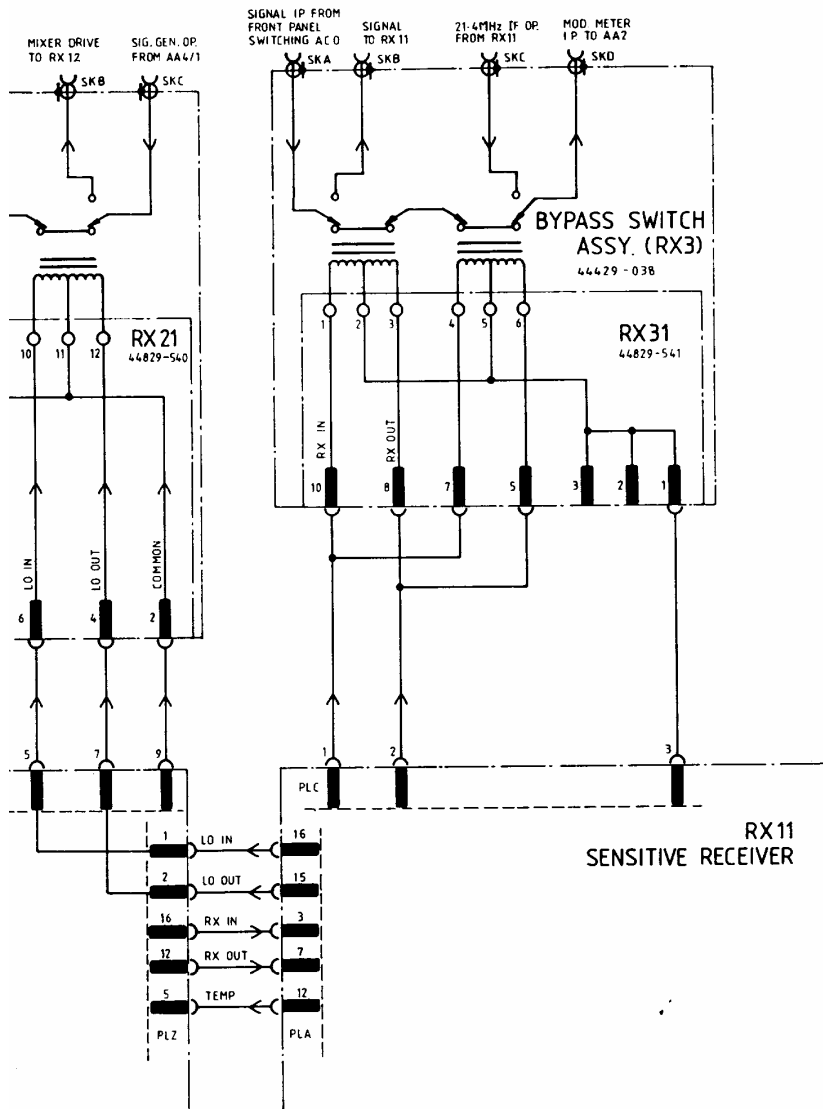
SIC  
FRI  
SW

Drg No. Z 52955-321  
Sht. 3 of 3, Iss. 4

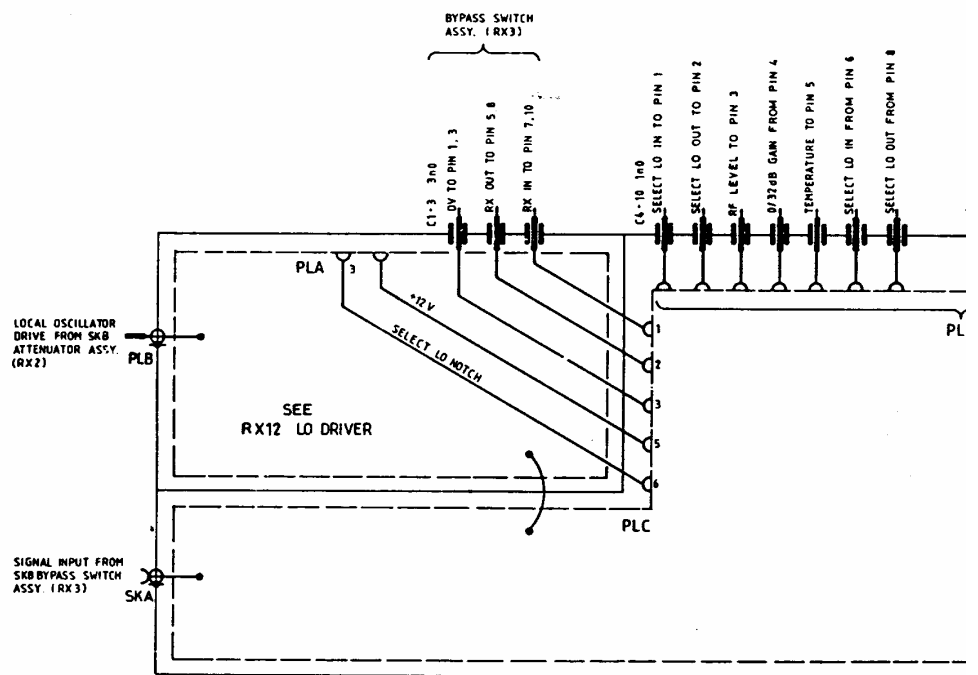
Fig. 32

Apr. 90 (Am. 1)

*RX2 : 2955R Attenuator and sw  
and RX3 : 2955R Bypass switc*



5R Attenuator and switch assembly  
: 2955R Bypass switch assembly

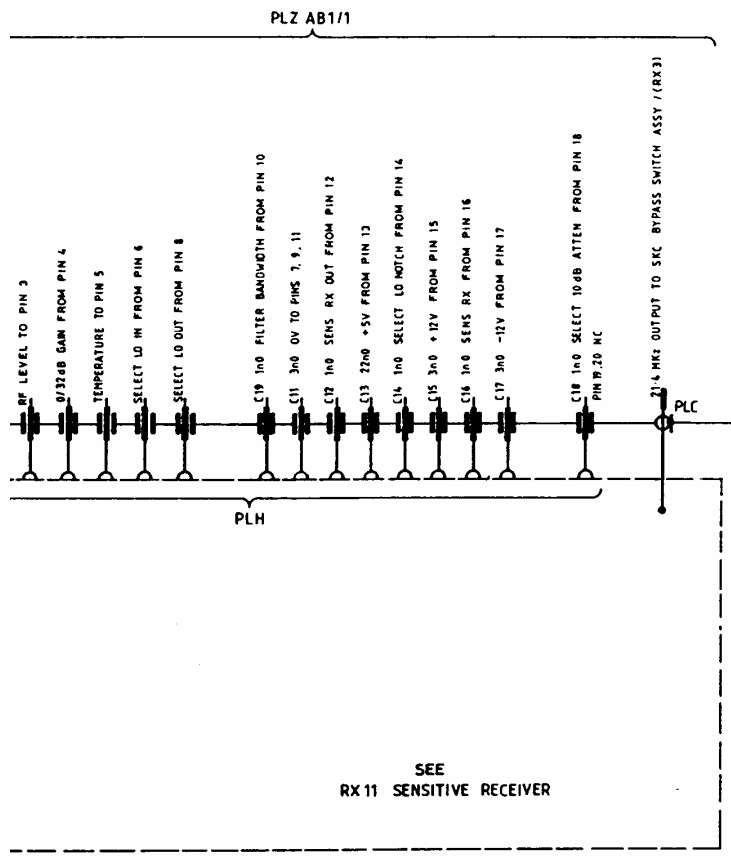


Drg. No. Z 44990-879  
 Sht. 1 of 1, Iss. 3

Fig. 33  
 Apr. 90 (Am. 1)

*RX1 : 2955R Rx tray inter*





RX1

2955R Rx tray interconnections

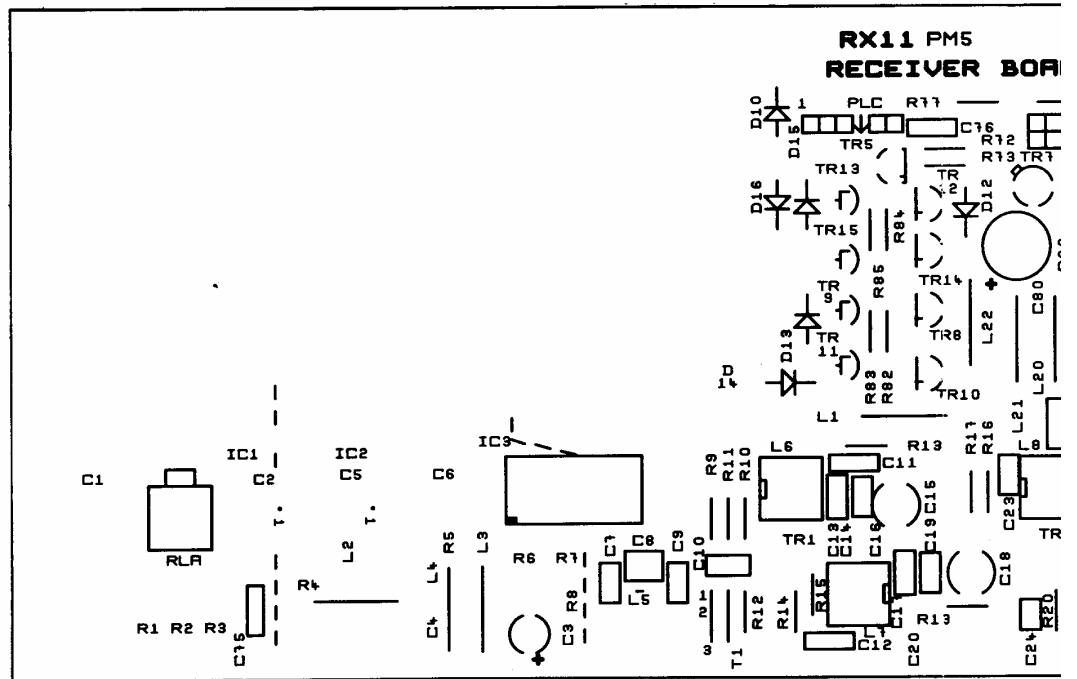
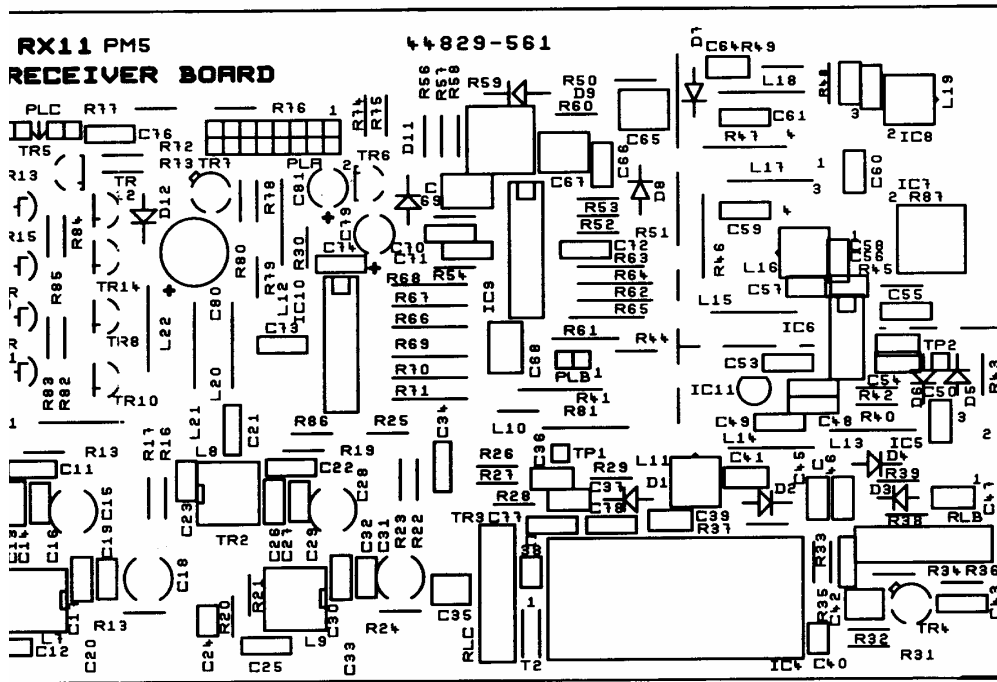


Fig. 34  
 Chap. 7  
 Page 68

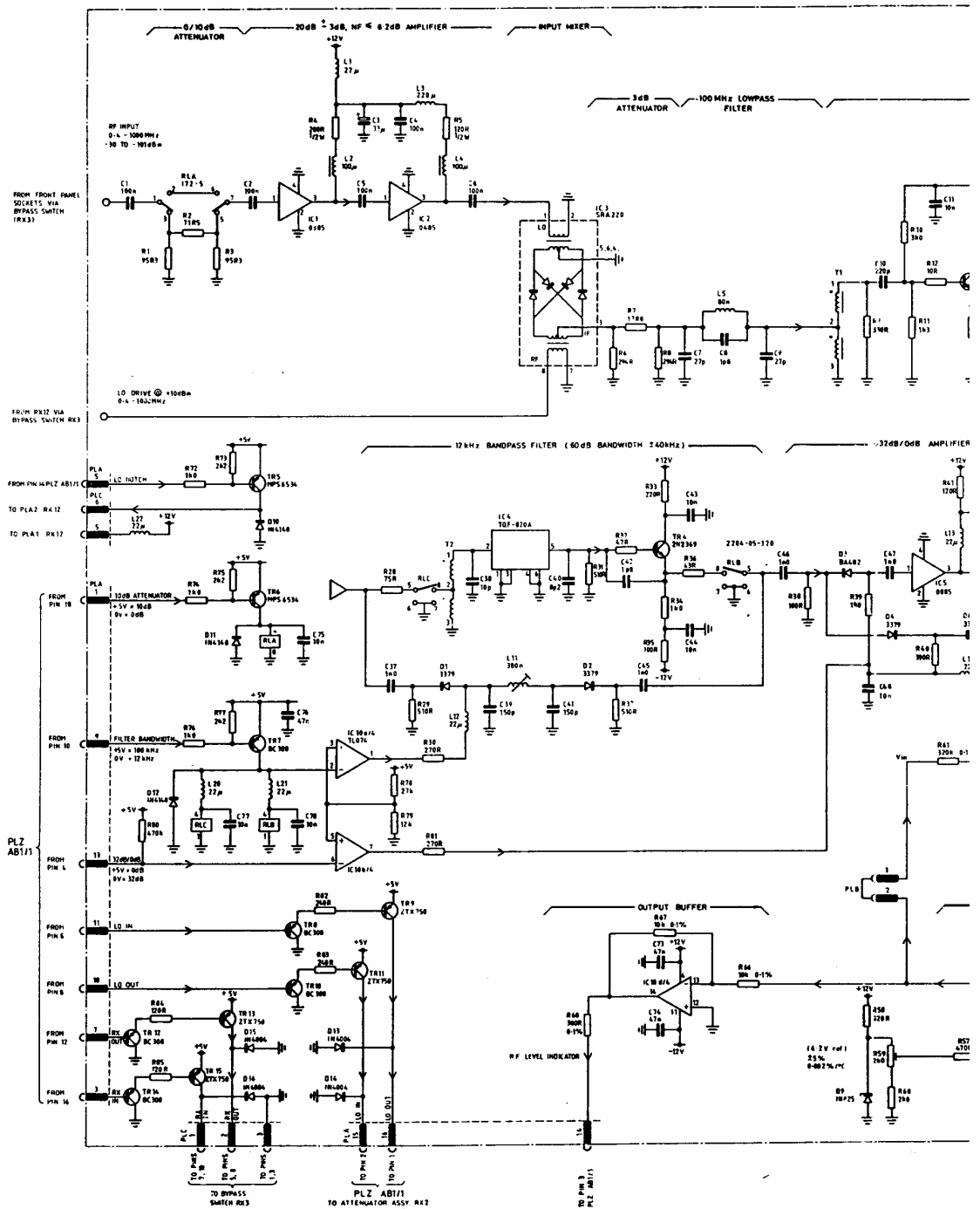
RX11 : Component layout



: Component layout

Fig. 34

Apr. 90 (Am. 1)

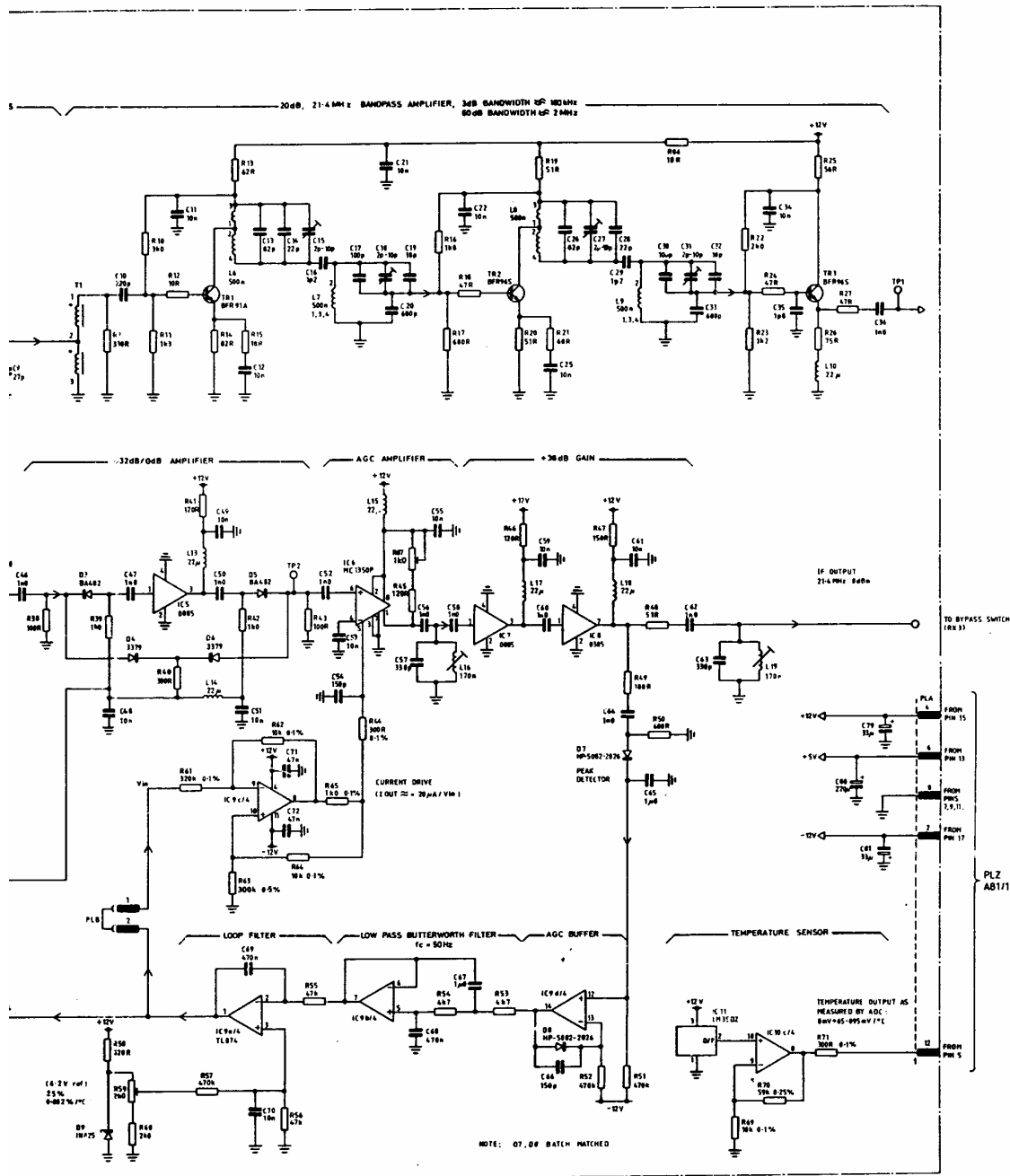


Drg. No. 44829-561  
Sht. 1 of 1, Iss. 10

RX11 : 2955R Sensitive re

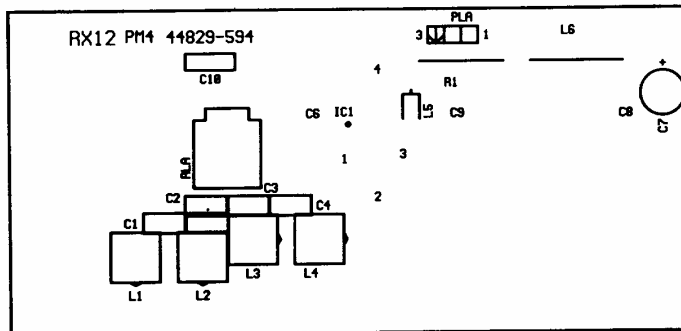
Fig. 34

Sep. 90 (Am. 2)

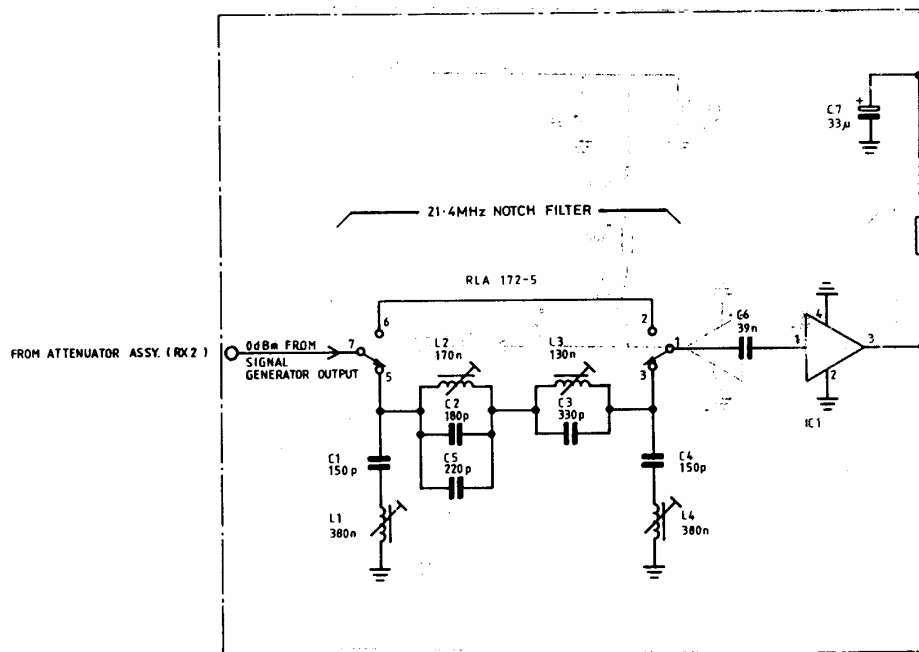


RX11

2955R Sensitive receiver



*RX12 . Component layout*

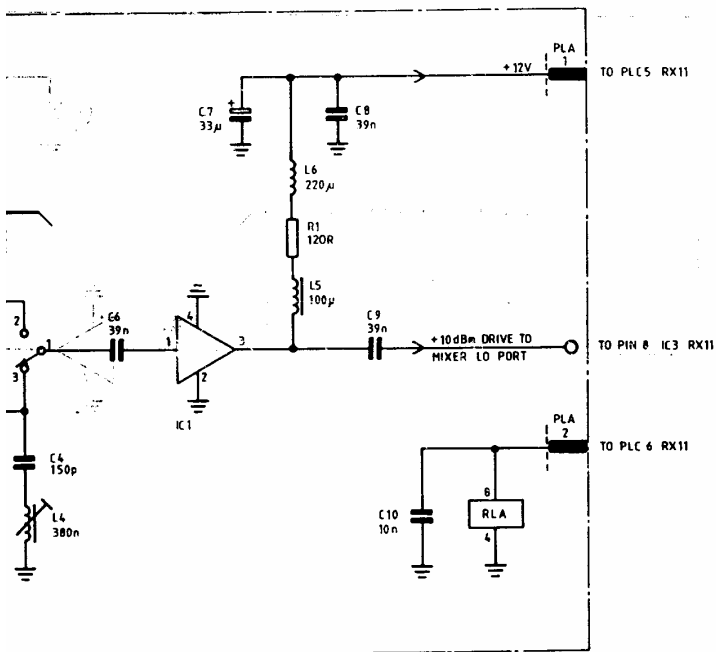


Drg. No. Z 44829-594  
 Sht. 1 of 1, Iss. 4

Fig. 35

Apr. 90 (Am. 1)

*RX12G-2955R LO driver*



RX12 52955R LO driver



Fig. 35  
Chap. 7  
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## MARCONI INSTRUMENTS LIMITED

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