The performance figures quoted are subject to normal manufacturing and service tolerances

The right is reserved to alter the equipment described in this manual in the light of future technical development.

WARNING

The Power Amplifier PWB uses semiconductors containing Beryllium Oxide. If inhaled, dust from this oxide can be toxic.

No danger can arise from normal handling but no attempt should be made to tamper with these devices.

They should not be discarded with industrial or domestic waste.

A full list of these devices is given in the Parts List.

VHF/UHF FM MOBILE RADIOTELEPHONE SERIES FM1000

SERVICE MANUAL
Issue 1 April 1988

Printed in England

TP253

AMENDMENT LIST

Changes made to the equipment described in this publication are published as amendments which are dated and consecutively numbered.

Reprints will incorporate all the amendments to date and an entry to this effect will be recorded on the amendment list below. Each page affected by amendment action will bear the amendment number as a suffix to the reference number, eg TP123/4 indicates that the page has been corrected by amendment number 4.

Should it become necessary to raise the issue of a publication, the amendment numbering will recommence with No 1.

Amend't No	Date	Initials	Remarks
1	Nov 1988		incorporated on reprint
2	June 1989		incorporated on reprint
3	Sept 1989		incorporated on reprint

ERRORS AND OMISSIONS

The usefulness of this publication depends upon its accuracy. Whilst every endeavour has been made to minimise errors, some may exist. It is therefore requested that any errors or omissions noted be advised as follows:-

Please quote:

a) Title of publication
b) TP Ref No and issue No
c) Last amendment No received
d) Page and/or Fig No in error

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SECTION 1
GENERAL INFORMATION

SUMMARY OF DATA

General

Operation	Single or two frequency simplex.
Modulation	Phase (F3E).
Frequency Bands	E0 68 - 88MHz B0 132 - 156MHz A9 146 - 174MHz K1 174 - 208MHz K2 192 - 225MHz TM 400 - 440MHz T4 425 - 450MHz U0 440 - 470MHz W1 470 - 500MHz W4 500 - 520MHz
Channel Spacing	12,5kHz (type S), 20kHz (type R) or 25kHz (type V)
No of Channels	Up to 100
Power Supply	12V (nominal) DC vehicle battery, negative earth.
Antenna Impedance	50Ω
Maximum Current	Transmit: <7,0A Receive: <1,2A Standby: <700mA
Switching Bandwidth	Complete frequency band on receive and transmit.
Temperature Range	Operation: -30°C to +60°C ambient. Storage: -40°C to +85°C ambient.
Crystal Stability	Standard: ±5,0ppm Option: ±2,0ppm
Cabinet Radiation	To CEPT or relevant national specification.
Weatherproofing	Water and dust resistant to IEC529.

Dimensions	**Local Mount**	**Remote Mount**
Transceiver with cradle:	Height: 39mm + 17mm "chin" Width: 185mm Depth: 210mm (transceiver requires at least 260mm depth to clear rear connectors and cables).	39mm 185mm 210mm
Junction Box:	60mm x 53mm x 27mm (less cables & connector)	
Display Console:	143mm x 57mm x 30mm	
Loudspeaker (standard):	135mm width, 105mm height, 63mm depth, excluding bracket.	

Weight	Transceiver Unit:	1,6kg
	Console:	0,16kg
	Loudspeaker (Standard):	0,6kg
	(Compact):	0,19kg
Construction and Finish	Die-cast aluminium frame and pressed aluminium (sheet) covers. Textured paint finish.	

Transmitter

Power Output Range	1 to 30W: 68MHz - 88MHz, 132MHz - 174MHz 1 to 25W: 174MHz - 225MHz 1 to 6W: 400MHz - 520MHz (Low Power) 1 to 25W: 400MHz - 520MHz (High Power)
Standard Power levels	1W, 6W, 10W, 15W, 25W, 30W (output power software programmable per channel).
Spurious and Harmonics	<0,2µW between 0 - 1GHz.
Hum and Noise	To CEPT or relevant national specification.
Modulation Response	6dB/octave (+1dB/-3dB) pre-emphasis characteristic between 300Hz and 3000Hz (2550Hz 12,5kHz systems). Response may be altered to comply with local regulatory requirements.
Modulation Distortion	Less than 2% (at 60% peak system deviation with 1kHz modulation)

Receiver

Reference Sensitivity	12dB SINAD for 0,31µ230V (PD) signal input modulated by 1kHz tone at 60% peak system deviation.
Intermediate Frequencies	21,4MHz and 455kHz
Adjacent Channel Selectivity	Greater than 70dB.
Audio Output	3W RMS minimum into 3Ω load at less than 5% distortion. (1,5W as measured in accordance with CEPT TR24.01 Annex II recommendations). Receiver audio output is reduced to 0,5W RMS (±0,2W) when using the 50 metre Control Cable Kit."
Audio Response	6dB/octave (+1dB/-3dB) de-emphasis characteristic between 300Hz and 3kHz.

Tone-Signalling

Address Code Form (SELCALL)	Between 4 and 17 sequential tones.	
Tone Frequency Range	SELCALL:	810 - 2800Hz (see Table 1.1 for specific frequencies).
	CTCSS:	67,0 - 250,3Hz (see Table 1.3 for specific frequencies).
	FREE TONE:	563Hz, 600Hz, 638Hz, 679Hz, 723Hz, 770Hz, 820Hz, 873Hz (Decode only).
Link Establishment Time (LET)	10ms - 2,55s (in 10ms increments)	
Inter-FreeTone Period	0 - 25,5 seconds (in 100ms increments).	

TABLE 1.1 - SELCALL TONE FREQUENCIES (All frequencies in Hz)

FUNCTION	CODING CHARACTER	SYSTEM TONE FREQUENCIES							
		Philips ST-500							
		CCIR/EEA Type 1	ZVEI Type 2	DZVEI Type 3	CCIR Type 4	EEA Type 5	ZVEI Type 6	DZVEI Type 7	ZVEI2 Type 8
"0" TONE	0	1981	2400	2200	1981	1981	2400	2200	2400
"1" TONE	1	1124	1060	970	1124	1124	1060	970	1060
"2" TONE	2	1197	1160	1060	1197	1197	1160	1060	1160
"3" TONE	3	1275	1270	1160	1275	1275	1270	1160	1270
"4" TONE	4	1358	1400	1270	1358	1358	1400	1270	1400
"5" TONE	5	1446	1530	1400	1446	1446	1530	1400	1530
"6" TONE	6	1540	1670	1530	1540	1540	1670	1530	1670
"7" TONE	7	1640	1830	1670	1640	1640	1830	1670	1830
"8" TONE	8	1747	2000	1830	1747	1747	2000	1830	2000
"9" TONE	9	1860	2200	2000	1860	1860	2200	2000	2200
GROUP TONE	A	1055	970	825	2400	1055	2800	2600	886
EXTENDED TONE	B	—	—	—	930	930	810	—	—
ALARM TONE	C	2400	2800	2600	2247	2247	970	886	810
SELECTABLE TONE	D	—	—	—	991	991	886	810	—
REPEAT TONE	E	2110	2600	2400	2110	2110	2600	2400	970

Note: ***The number of tones sent will normally be dictated by the system the equipment is to be used with.***

Not all combinations of frequency bands, options etc are available for every market area.

TABLE 1.2 - TONE LENGTH AND CALL DURATION

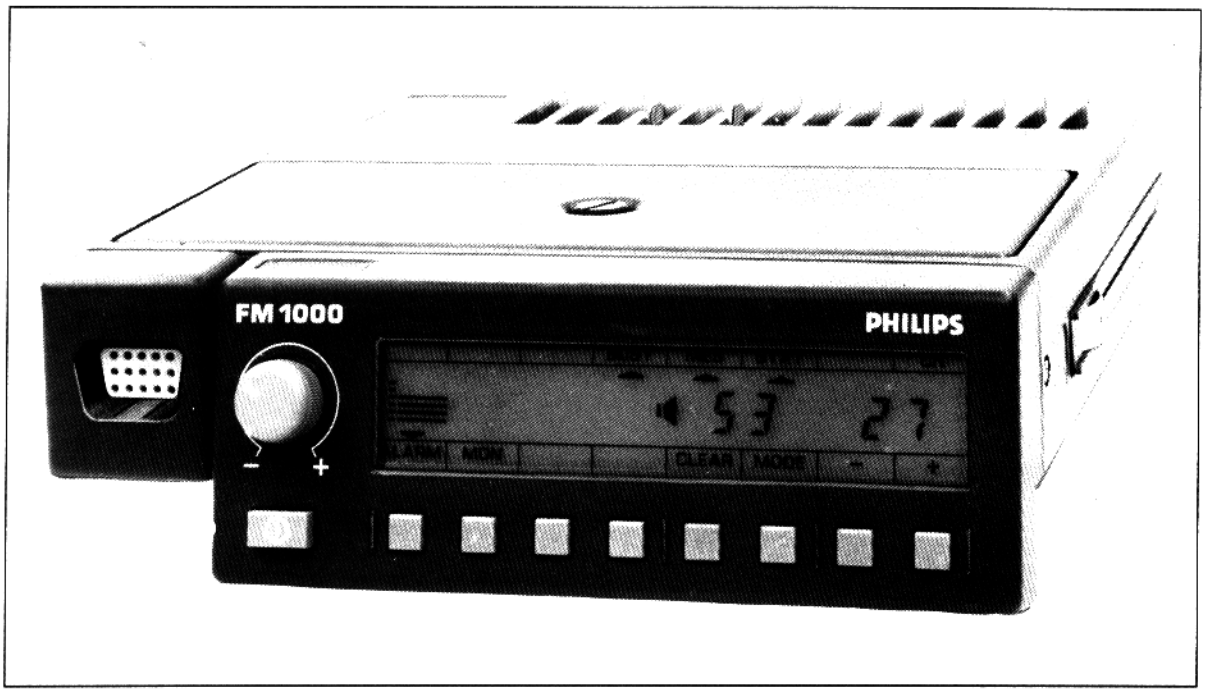
SIGNALLING SYSTEM	TONE LENGTH
CCIR (Philips ST-500)	100ms
EEA (Philips ST-500)	40ms
ZVEI (Philips ST-500)	70ms
DZVEI (Philips ST-500)	70ms
CCIR (Tone Type 4)	100ms
EEA (Tone Type 5)	40ms
ZVEI (Tone Type 6)	70ms
DZVEI (Tone Type 7)	70ms
ZVEI2 (Tone Type 8)	70ms

TABLE 1.3 - CTCSS TONE FREQUENCIES

No	Freq	No	Freq	No	Freq	No	Freq	No	Freq	No	Freq
1	67,0	8	88,5	15	110,9	22	141,3	29	179,9	36	233,6
2	71,9	9	91,5	16	114,8	23	146,2	30	186,2	37	241,8
3	74,4	10	94,8	17	118,8	24	151,4	31	192,8	38	250,3
4	77,0	11	97,4	18	123,0	25	156,7	32	203,5		
5	79,7	12	100,0	19	127,3	26	162,2	33	210,7		
6	82,5	13	103,5	20	131,8	27	167,9	34	218,1		
7	85,4	14	107,2	21	136,5	28	173,8	35	225,7		

TABLE 1.4 - DTMF FREQUENCIES (DTMF microphone only)

Tone Frequency Pairing		High Frequency Group (Hz)		
		1209	1336	1477
Low Frequency Group (Hz)	697	1	2	3
	770	4	5	6
	852	7	8	9
	941	*	0	#



INTRODUCTION

The FM1000 series of transceivers is a range of frequency-synthesised transmitter-receiver units for use in vehicle, transportable or desk-top applications.

Two microprocessors control all transceiver functions, including volume level, synthesiser, and tone signalling status, the information for which is stored within an EEPROM (Electrically Erasable Programmmable Read Only Memory). Data within the EEPROM may be altered, subject to programmer "authority", by an external data programmer. A third microprocessor is used in a "Display" console. Clear visual indication of user action and equipment status is provided by a Liquid Crystal Display (LCD) console unit.

Both continuous (CTCSS) and sequential (SELCALL) tone-signalling systems are incorporated into the transceiver as standard features. "Free Tone" tone bursts, employed in E31-type systems, can be decoded. A carrier level detector provides signal strength information for voting purposes, improved squelch performance etc, while a transmission timer may be programmed to conserve airtime, particularly during periods of maximum radio traffic.

The equipment employs an advanced frequency synthesiser circuit which permits multiple-channel operation from a single master crystal. Transmit- receive switching is achieved by the use of a solid-state antenna switch. Direct frequency modulation of the transmitter synthesiser circuits is employed permitting a wide frequency response enabling the transmission of low-speed data.

The transmitter can generate up to 30W (VHF) or 25W (UHF) into a 50Ω load. Power output is preset to a specific level by software and is maintained over wide variations in temperature and supply voltage. Under fault conditions, power is reduced progressively to protect the transmitter output devices.

The equipment is powered from a nominal 12V DC negative ground vehicle electrical system, the complete installation comprising of a compact transmitter/receiver, console, external loudspeaker, fist microphone and associated fixings. The console may be attached either to the transceiver front for local operation, or connected as a remote unit, should space be at a premium, allowing the transceiver unit to be stowed under a seat, in the trunk of a vehicle or any other convenient location.

Transceiver Type FM1100 is the Analogue version of the FM1000 range and is described fully within this publication. Where other FM1000 variants differ from the FM1100 transceiver, these will be detailed in supplementary publications.

ASSOCIATED PRODUCTS

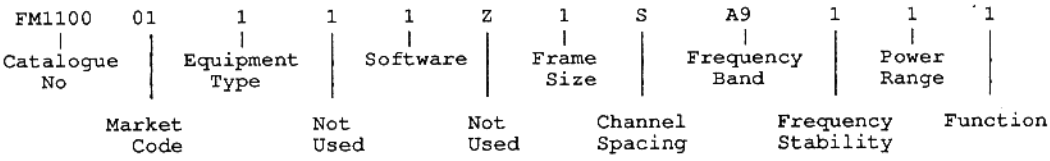
FM1000 Series Products

(1)	FM1100 Analogue Transceiver FM1200 FFSK Transceiver	(Publication Ref TP253A)
(2)	Display Console Keypad Console	(Publication Ref TP251)
(3)	Junction Box with 1 metre remote cable Junction Box with 5 metres remote cable	
(4)	Microphone, standard Microphone, DTMF	
(5)	Loudspeaker, standard Loudspeaker, compact	
(6)	Cradle, standard mounting Cradle, Cassette mounting	
(7)	Hands-Free Kit	(Publication Ref TP865)
(8)	50 metre Control Cable Kit	unsuitable for use with the Basic Console and/or DTMF/Keypad microphone.

Programmers/Diagnostic Tools		**User Manual Reference No**
(1) Comprehensive Data Programmer		TP860
(2) Portable Data Programmer		TP862
(3) Field Service Aid	(Engineering Mode) (Portable Data Prog Mode)	TP863 TP862

EQUIPMENT VARIATIONS

The sub-assemblies fitted to the transceiver will vary according to the role in which it is used. The complement of sub-assemblies for any particular equipment is indicated by an ordering code number marked on the equipment caseback. A typical order code number is given below, together with a list of codes which are not self-explanatory.



Market Code

01 Standard production
02 France
03 Germany
06 Denmark
07 Sweden
10 Norway
11 Switzerland
13 Holland
14 Italy
18 Spain
25 Austria
27 Belgium
31 Portugal

Equipment Type

1 Analogue Transciever Type FM1100
2 FFSK Transceiver Type FM1200*

Software

0 Less Software (EPROM & EEPROM)
1 Display Console, Std EEPROM
2 Display Console, Enhanced EEPROM
3 Basic Console, Standard EEPROM

Frame Size

1 Standard Frame
2 Extended Frame (required for Keypad Console and MODEM Interface)

Channel Spacing

S 12,5kHz
R 20kHz
V 25kHz

* Refer to Publication Ref TP253A

Frequency Band

E0	68- 88MHz
B0	132-156MHz
A9	146-174MHz
K1	174-208MHz
K2	192-225MHz
TM	400-440MHz
T4	425-450MHz
U0	440-470MHz
W1	470-500MHz
W4	500-520MHz

Frequency Stability

1 ±5ppm
2 ±2ppm

Power Range

1 Standard VHF (1-25/30W)
2 Standard UHF (6-25W)
3 Low Power UHF (1-6W)

Function

0 Less Control/Signalling PWB
1 CTCSS + Sequential Tone signalling
2 Sequential Tone signalling only
3 CTCSS only
4 Less signalling

GLOSSARY

ALARM

The FM1000's alarm facility allows it to transmit a special tone sequence which takes priority on a system controller's display to indicate that some unexpected or emergency condition has occured.

ALERT CALL

Audible indication of being "called". Different tone cadences are generated within the equipment to alert the user to specific conditions (eg individual call, group call, channel busy).

ANSWERBACK TO ID

See Transpond.

ANSWERBACK TO REMOTE RESET

See Auto-acknowledge

AUTO-ACKNOWLEDGE

A pre-determined encode sequence transmitted as a result of a Remote Reset sequence.

BUSY INDICATOR

An indicator that signifies that a carrier is present, without a valid CTCSS tone.

CCIR

CCIR is the sequential tone signalling system recommended by the Comité Consultatif International de Radio.

CDP

See Comprehensive Data Programmer.

COMPREHENSIVE DATA PROGRAMMER

The Comprehensive Data Programmer is one of two editing devices which assist in the customisation of FM1000 radios and is based on a Philips P3102 computer (or any similar PC-XT compatible). The other editing device is the Portable Data Programmer (see below). The main functions of the CDP are to read in configurations either from standard configurations stored on hard disk or from an FM1000 itself, to examine or modify configurations, and to output the configurations back to the hard disk or FM1000.

CTCSS

Continuous Tone Controlled Squelch System. A continuous tone (lower than the audio range of the receiver) is modulated onto the carrier as well as other signalling or voice traffic. Only receivers which have been instructed to recognise the same CTCSS tone will be able to receive the voice transmissions, since the squelch of receivers looking for different CTCSS tones will prevent the audio from being heard. This provides a simple method of sending messages to selected receivers only and allows several different networks to use the same frequencies. CTCSS is also known as Tone Lock or Tone Squelch.

DZVEI

Depressed DZVEI, a modified form of ZVEI, with lower signalling frequencies.

EEA

EEA is the sequential tone signalling system recommended by the Electronic Engineering Association, and is the preferred system within the UK.

GROUP CALL

A group call is a transmission destined for a group of radio receivers. This enables a system controller, for example, to transmit a single message to many mobiles simultaneously.

IDENTITY

An identity is the name given to each sequence of tones which is used in sequential tone signalling. Encode identities are the tone sequences which are transmitted when a particular condition occurs such as when the alarm button is pressed. The decode identities are the sequences against which incoming tone sequences are compared. When an incoming tone sequence matches one of the decode identities then the corresponding function is invoked.

LET

See Link Establishment Time.

LINK ESTABLISHMENT TIME

The Link Establishment Time is the time for which the carrier is transmitted before any signalling tones or audio are transmitted. This is to allow the base station receiver a short time to detect that carrier is present and to ready itself for the incoming message.

LOCKOUT

A facility which combines Receiver Lockout and Transmit Inhibit facilities.

MESSAGE

A set of digits received in addition to an idenitity which can be used to convey a pre- determined message.

PDP

See Portable Data Programmer.

PORTABLE DATA PROGRAMMER

The portable data programmer (PDP) is a portable device which provides a subset of the functionality of the CDP. The PDP can upload parameters from, or download parameter sets to, an FM1000 in the same way that a CDP can. Its authority is limited, however, so there are some parameters that the PDP will not be able to alter which the CDP can.

RECEIVER LOCKOUT

A facility which prevents the user from enabling the loudspeaker until the receiver has been "called".

REMOTE RESET

The remote reset facility allows cancellation of all previously initiated functions when a pre-defined tone sequence is received from a control or base-station.

SCANNING

Scanning is a facility which allows the FM1000 to continuously monitor a selected group of channels. The FM1000 switches between the channels in the nominated scan group in cyclic sequence, stopping when the search condition (eg a free channel, the strongest signal) is satisfied.

SQUELCH

Squelch is a system used to prevent weak, unintelligable signals and random noise from being heard by a radio operator while still allowing intelligable signals to be received normally. This is accomplished by the use of a variable threshold below which any received signals are ignored. Only signals whose strength is above the squelch level cause the audio circuits of the FM1000 to be enabled, with the result that only satisfactory signals are received.

3rd TONE RESET

The remote cancellation of all previously initiated functions on the receipt of the first three tones of a valid identity.

TIMED RESET

Partial cancellation of previously initiated functions (eg "CALL" indicator remains lit) if the user fails to reply within a pre- determined period.

TRANSMITTER INHIBIT

A facility which prevents the user from transmitting (other than alarms) while the channel is "Busy".

TRANSMITTER LOCKOUT

A facility which prevents the user from transmitting (other than alarms) until the user has been "called" either as an individual or as part of a group of users.

TRANSPOND

A facility whereby a predetermined encode sequence is automatically transmitted as a result of the user being called.

VALIDATION

The operation of the FM1000 is controlled by many parameters which can have complex dependencies on each other. For instance, all the defined transmit and receive frequencies must be within the frequency band specified. Parameter sets in which there are inconsistencies between two or more parameters cannot be downloaded into an FM1000 or PDP since they could produce undesirable effects. The CDP provides a validation function which determines whether the configuration currently being processed is valid or not.

VOTING

During normal scanning, the scan stops when a channel is encountered which fulfills the condition that is being looked for (such as being occupied). Voting is a feature used during scanning when there is more than one channel which satisfies the required conditions. It involves examining all the channels which satisfy the required conditions, and then selecting the channel with the highest signal strength.

ZVEI

ZVEI is the sequential tone signalling system recommended by the Zentral-Verband der Electrotechnische Industrie.

SECTION 2
INSTALLATION

Note: For full installation details refer to Installation Instructions (Publication Ref No TP858).

UNPACKING

Unpack the container(s) and check the contents against the list given below:-

Description	**Remarks**
Radio (FM1000 series radio)	
Console	Basic, Standard (Display) or Keypad
Microphone	Standard or DTMF
Microphone Installation Kit	Bagged Items*
Loudspeaker Assembly	Standard or Small
Control Cable	Standard or 50 metre
Graphics Panel	supplied either separately or fitted to Console; -see heading.
Equipment Data Sheet	See following page.

Where an installation kit has been ordered, this should be packed in a separate container as follows:-

Installation Kit 1	comprising:- Cradle Installation Kit, Standard* Common Installation Items (Bagged)*
or	
Installation Kit 2	comprising:- Cradle Installation Kit, Cassette* Common Installation Items (Bagged)*
or	
Installation Kit 3	comprising:- Cradle Installation Kit, Standard* Common Installation Items (Bagged)* Remote Installation Items (Bagged)* Junction Box c/w 1 metre cable
or	
Installation Kit 4	comprising:- Cradle Installation Kit, Standard* Common Installation Items (Bagged)* Remote Installation Items (Bagged)* Junction Box c/w 5 metres cable

* Refer to pages inside back cover for piece part listing.

Note: The manufacturers, or their authorized agents, must be notified by letter within ten days of receipt of equipment, if any damage or shortages are found.

The following items will also be required:-

Antenna plus feeder cable — This may have been ordered from the manufacturers or dealer at the same time as the radio.

Connectors to suit vehicle battery terminal (+ve), chassis earthing point and auxilary terminal of ignition switch.

Grommets, where drilling of bulk-heads, for cables, is necessary.

EQUIPMENT DATA SHEET

PHILIPS RADIO COMMUNICATION SYSTEMS Ltd Cambridge England

TYPE	FM1000	NO	8/0908-A44950
NC	0156LABWJ9VA9092B		
AC	01000000145200000		
NAME	ACME TRADING CO LTD		
PROG	JDG	DATE	87-07-12

E1-231-103B#22057AB74A0* E2-232- E3-233-22B820A#2626
241-18422746135462113 242- 243-111111111222
E4-234-33FF2BAC3*23*23 E5-235-22C4BA34*01003572 E6-236-
244-241414242311411 245-13571136246341511 246
E7-237- E8-238-
247- 248-

D1-201-103B#382*27FA681 D2-202-103572*24FA681 D3-203-2834BB29A1
211-1334116473546273 212-13342473542673 213-2181128341
D4-204-214C3980*20FA681 D5-205- D6-206-99AB92*2
214-1334116473546273 215- 216-21242123
D7-207-839*1BB292#19 D8-208-
217-1224724163547 218-

S1-121- 02 03 04 05 06 07 08 09 10 11 12
S2-122 12 13 14 15 16 17 18 19 30 31 32
S3-123- 50 51 52 255 255 255 255 255 255 255 255
S4-124-255 255 255 255 255 255 255 255 255 255 255
S5-125- 55 54 57 255 255 255 60 255 53 255 61
S6-126-255 255 255 255 255 255 255 255 255 255 255

120-1 127-040 130-1 131-1 132-050 140-20 141-8 142-1
143-029A4B*6#37719813 144-2 145-0 146-2 147-11C94
148-2 221-32 222-27 223-255 224-20 255-255 226-32 227-27 228-255
261-007 262-102 263-012 264-006 265-000 266-018 267-255 268-004 270-2
271-0 272-0 273-1 274-3 275-6 276-8 280-10 281-001 282-2
283-2 284-0 285-0 286-12 287-1 301-020 302-200 303-040 304-20
305-09 306-0 307-0 310-1 311-1 312-0 313-0 320-0 321-1
322-1 333-4 334-2 335-0 336-1 391-01 392-05 393-255 394-0
395-25 396-28 397-255 500-09 501-10 502-45 503-26 513-255 514-255
515-255 516-255 551-17 552-36 553-37 554-42 555-31 556-255 557-27
558-255 559-25 560-35 561-30 562-26 563-255 564-255 565-0 566-29
901-09 902-10 904-0 905-12011 909-1262 990-44
991-003417 992-4 993-0 994-1 995=-1 996-4

CH	RX FREQ	REF	TX FREQ	REF	MPO	PWR	SQL	DEC	ENC	SIG	VSG	CSE	LCK
	101	111	102	112	103	104	105	106	107	108	109	110	115
00	440.00000	1	440.01250	0	1	6	5	1	1	0	1	2	1
01	440.02500	0	440.03750	1	0	6	5	8	6	1	4	0	0
02	440.05000	0	440.06250	0	0	5	5	0	9	1	0	4	0
03	440.07500	0	440.08750	1	0	2	2	0	13	0	1	3	0
04	440.10000	0	440.11250	1	0	2	1	3	27	0	0	0	0
06	450.00000	1	450.00650	1	0	1	2	0	0	0	1	1	1
07	440.00000	1	440.01250	0	0	6	5	23	22	1	0	4	0
08	440.02500	0	440.03750	1	1	6	5	21	22	1	0	4	0
09	440.05000	0	440.06250	0	0	5	5	16	6	1	0	4	0
35	460.03000	0	460.05000	0	0	4	0	27	38	0	0	0	0

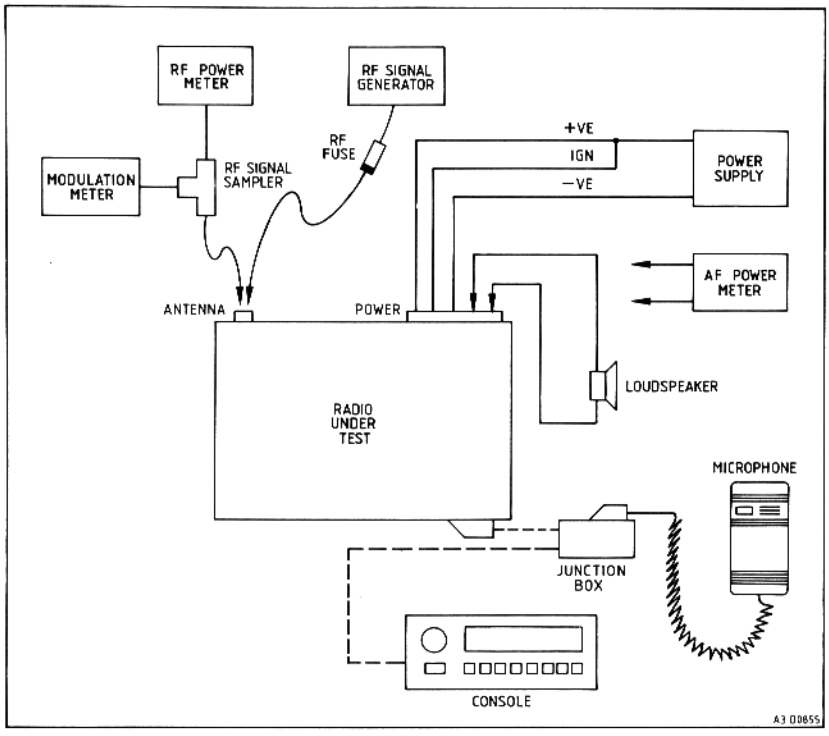
!!IMPORTANT!!

An individual data sheet, listing all transmitter and receiver frequencies including signalling information, is supplied with every radio. The owner of the radio is ***strongly urged*** to retain this sheet, in the event of the equipment having to be repaired or allocated new channels, identities etc. It is not possible for the manufacturers or the dealer to replace copies of lost or mislaid data sheets.

SERVICEABILITY CHECK

Note: (a) The following check is intended only as a means of rapidly checking equipment serviceability. It does not replace or preclude any of the tests and adjustments quoted in Section 4.

(b) A list of suitable test equipment is given in Section 4.



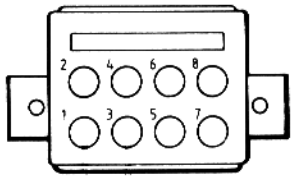
Test Circuit for Serviceability Check

1. Connect radio and test equipment as shown in the diagram. Connect the radio to the power supply using the Battery Lead Assembly (Item 5 in the Installation diagrams). Make the loudspeaker connection to the radio by inserting the loudspeaker connecting pins into recesses (marked 1 & 3) of the housing of the Battery Lead Assembly (see below). Push the pins in only as far as is required to make electrical connection. Do not push the pins in so far that they lock inside the housing, as they need to be removed prior to installation.

1. Loudspeaker (Live)	5. Remote Alarm
2. Battery (+)	6. External Alert
3. Loudspeaker (Ground)	7. Battery (-)
4. 0V	8. Ignition

NOTE: Observe loudspeaker polarity when connecting test equipment (eg AF power meter) to the radio.

CONNECTOR REAR VIEW



If it is known that the radio is to be used in a remote installation, the loudspeaker may be connected via the Junction Box.

2. Connect the Junction Box and Console as shown; do not connect the microphone at this stage. If the Console is already fitted to the radio (ie for Local Control), omit the Junction Box from the installation.

3. Connect the RF signal generator to the antenna socket. Modulate the RF signal generator with 1kHz tone at 60% peak system deviation and tune to receiver channel frequency at an output level of 1µV PD.

4. Set the power supply voltage to 13,2V DC (nominal) and switch on.

5. Press the radio ON/OFF button. Check that the display back-light is on and, after a short delay, characters appear on the display.

6. Select the required channel, increase the volume control setting and check that the audio tone is heard in the loudspeaker.

7. Switch off the radio. Disconnect the loudspeaker and connect the AF Power Meter in its place. If connecting via Battery Lead Assembly, connect meter live terminal to pin 1 and meter ground to pin 3. If connecting via Junction Box, connect meter live terminal to the brown lead and meter ground (screen) to the blue lead.

8. Switch on the radio. With the RF signal generator settings quoted in paragraph (3), check that an audio power reading of 3W is obtainable by adjusting the volume control.

9. Disconnect the RF signal generator and AF Power Meter.

10. Connect RF power meter and modulation meter, via a 'T' Attenuator, to the antenna socket; connect a fist microphone to the socket of the Junction Box (Remote Control) or directly to the radio (Local Control).

11. Depress the microphone press-to-talk switch and check that transmit flag ■ appears on the display. If the radio has been programmed for transmit lockout, it will be necessary to feed the appropriate CTCSS or SELCALL signal to the radio beforehand. Check that the power output is to specification.

12. Speak in a normal conversational manner across the face of the microphone and check that modulation is registered on the meter, but does not exceed peak system deviation level quoted below:-

12,5kHz (S)	±2,5kHz
20kHz (R)	±4,0kHz
25/30kHz (V)	±5,0kHz

Allow for meter "kick" on sudden speech peaks. Release the press-to-talk switch.

If peak system deviation is consistently exceeded, re-adjust modulation as detailed in Section 4, or return the radio to your dealer.

FREQUENCY TRIMMING

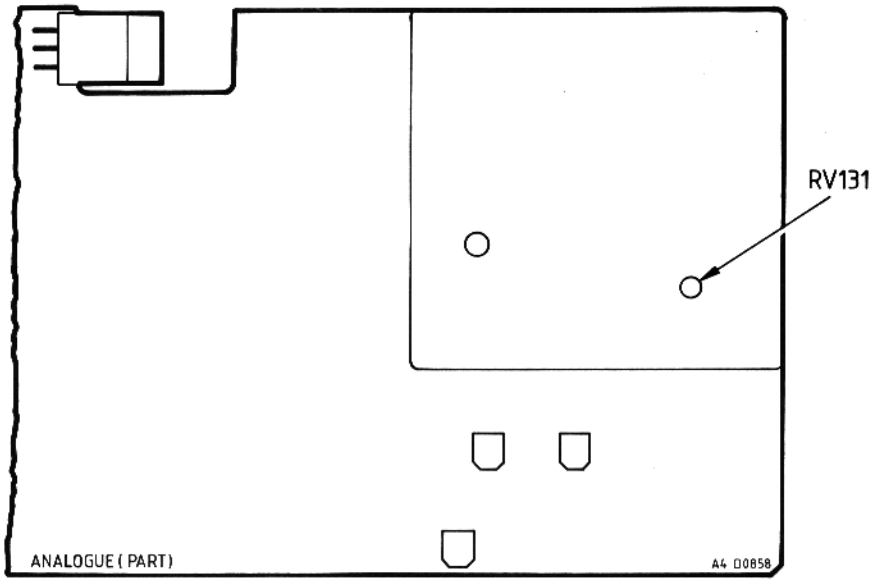
The reference oscillator in all FM1000 series radios is preset before leaving the factory and should not require further adjustment. An oscillator that has drifted out-of-calibration may be the cause of distorted reception and, in extreme cases only, no reception at all.

If it is suspected that the reference oscillator is out-of-calibration, it may be reset as detailed in the Service Manual. A frequency counter that is known to be accurate is required. If in doubt, return the radio to your dealer.

Note that in synthesised equipments such as the FM1000 series radio, all receive and transmit channel frequencies are derived from one crystal-controlled reference oscillator. It is not possible to 'net' channels on an individual basis, and therefore, it is imperative in radio systems incorporating such equipments that base station transmitters and receivers are tuned exactly to their allocated frequencies.

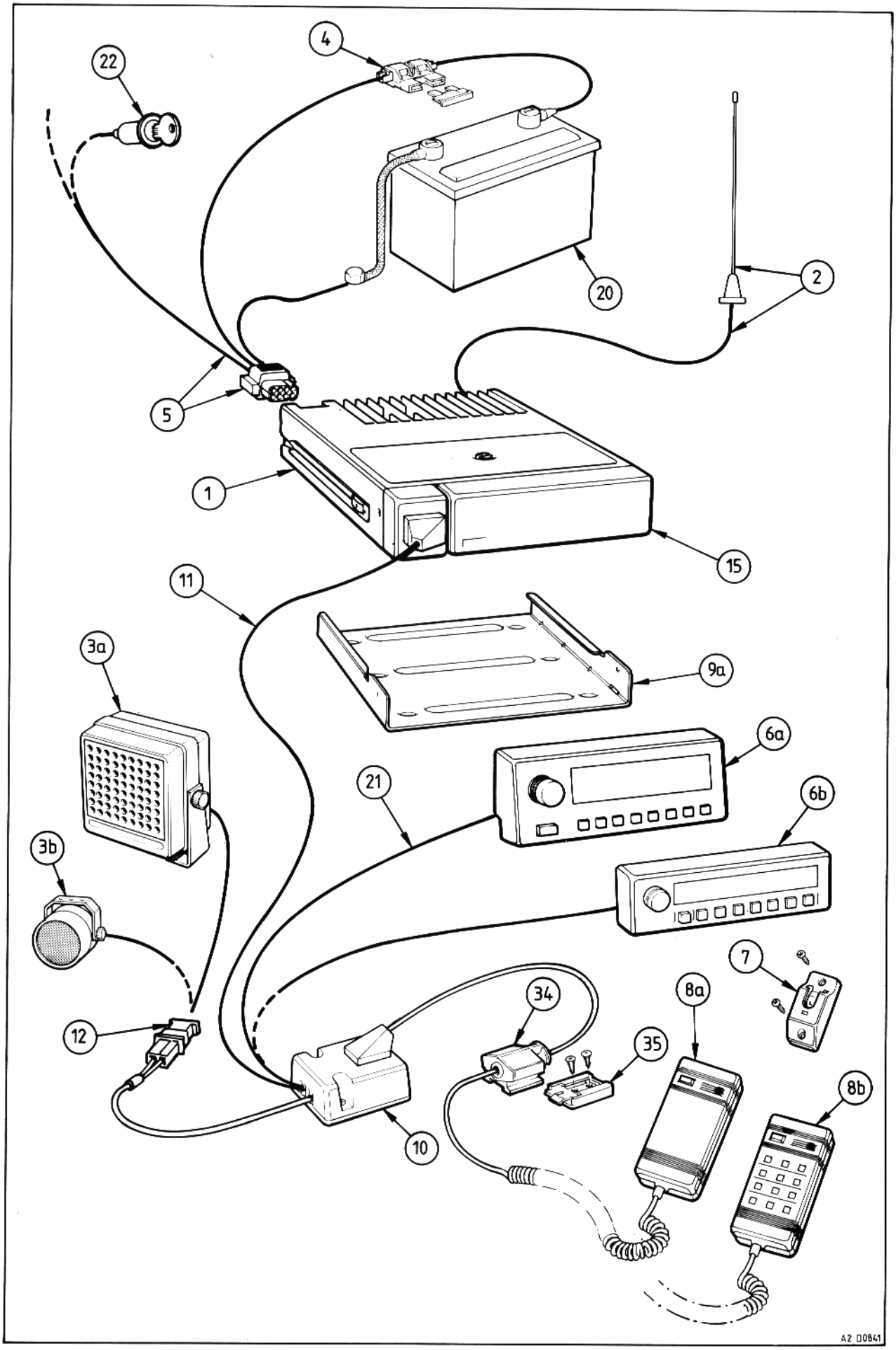
Note: The frequency counter used for frequency trimming must be known to be in calibration or have recently been checked against a reliable frequency standard. Always allow a frequency counter to warm-up prior to use.

1. Connect loudspeaker and microphone to the radio.
2. Connect the power supply to the radio, ensuring that the positive lead is fused and that supply polarity is correct (negative ground). Adjust the power supply to 13,2V DC.
3. Connect RF power meter and set to the appropriate range (50W for high power radios). Connect a frequency counter to the meter via a 20dB attenuator.
4. Remove the large cover from the radio.
5. Switch on the radio and allow a five-minute warming-up period to elapse.

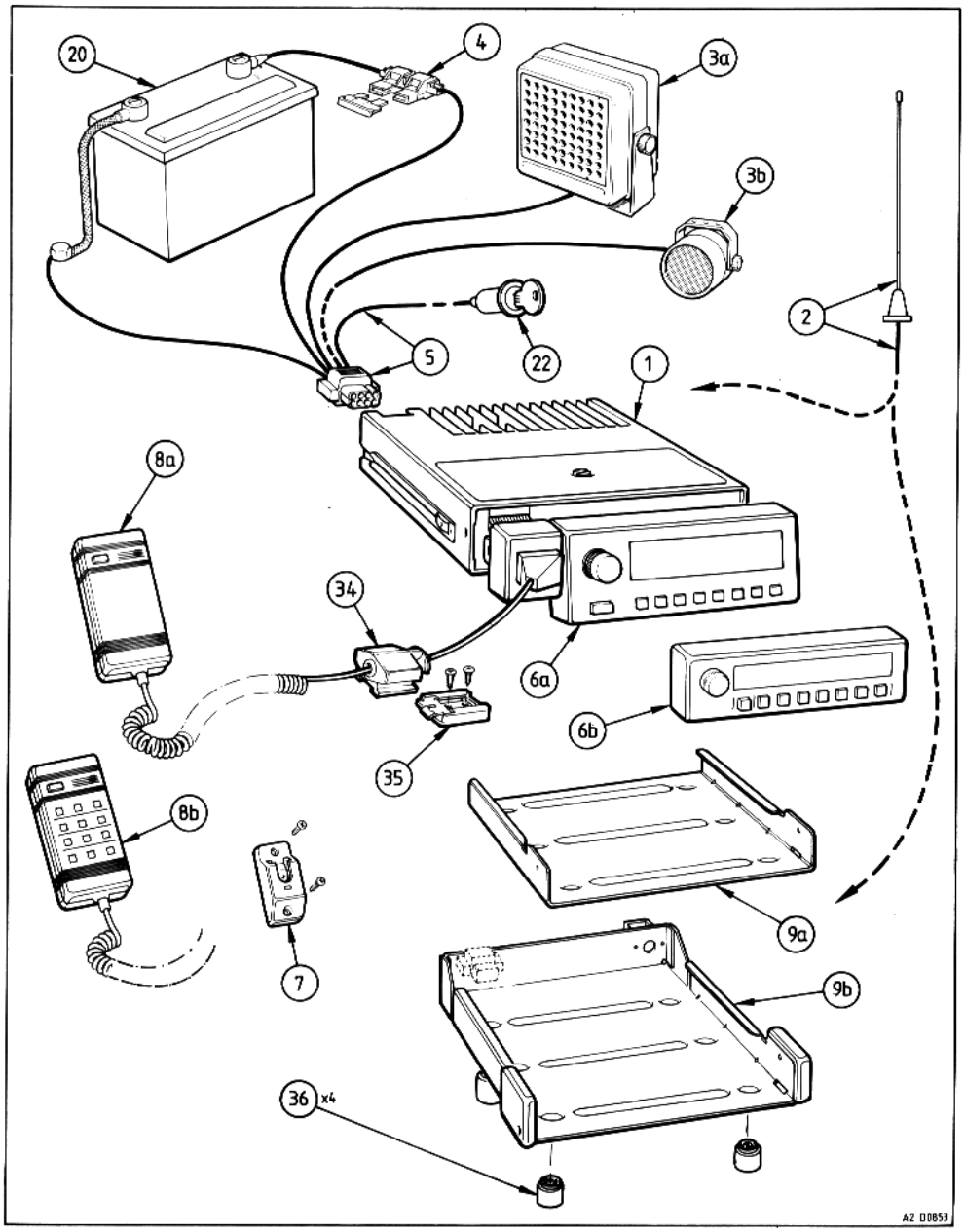


Location of RV131

6. Operate the press-to-talk switch and adjust RV131 on the Analogue PWB to set the frequency counter to the EXACT frequency of the selected channel.
7. Switch off radio, disconnect test equipment and refit cover to radio.



Basic Installation Diagram for Remote Control



Basic Installation Diagram for Local Control

The item reference numbers apply to the installation procedures only:

(1)	Radio	(15)	Fascia (for Remote Control)
(2)	Antenna and Feeder Cable	(16)	Console Plate
(3a)	Loudspeaker, standard	(17)	9-way Connector
(3b)	Loudspeaker, small	(18)	Magnet
(4)	Fuseholder	(19)	Key (Cradle release)
(5)	Battery Lead Assembly	(20)	Vehicle Battery
(6a)	Standard (4-6 digit) Console	(21)	Console Cable (9-way)
(6b)	Basic Console	(22)	Vehicle Ignition Switch
(7)	Rest (Mic Installation Kit)	(23)	Volume Control Knob
(8a)	Microphone, standard	(24)	Front Panel, Console
(8b)	Microphone, DTMF	(25)	Rear Panel & PWB, Console
(9a)	Cradle, standard mount	(26)	Graphics Panel
(9b)	Cradle, Cassette mount	(27)	Bezel
(10)	Junction Box	(28)	Scotchlok Connector
(11)	Control Cable, 1, 5 or 50m	(34)	Strain Relief Clamp
(12)	Mate n' Lock Housing	(35)	Clamp Support
(13)	Bracket, Console	(36)	Spacer, Cradle (4 off)
(14)	Cradle, Console		

Note: The 50-metre control cable is unsuitable for use with Basic Consoles, DTMF and Keypad microphones.

INSTALLATION

Preliminaries

WARNING

The installation should be carried out in accordance with local PTT and Health & Safety regulations. UK vehicular installations should conform to *Code of Practice MPT1362* published by the Department of Trade & Industry.

CAUTION

FM1000 series radios are suitable for 12V negative earth operation only. If your vehicle is positive earth, or is of a different nominal voltage, please consult your dealer.

Notes: ***Consult the vehicle manufacturer's handbook to establish whether it is practical to disconnect to the battery without disturbing electronic devices such as central locking mechanisms, engine management computers, security-coded radio-cassette units (ICE) etc.***

"Pozidriv screws are used in this equipment. Only the correct size of "Pozidriv" screwdriver, should be used to tighten or loosen these screws (No 1 is suitable for screws up to metric size M3; No 2 for screws larger then this). The use of any other size of screwdriver type can result in severe damage to the screwhead.

Tools Required

Circle cutter, holesaw or socket punch
Drills (see sizes below)
Power Drill
Soldering Iron
Screwdrivers - "Pozidriv" No 1
Allen Key, M3 (2,5mm A/F)
Medium size pliers
Wire Cutters

Drill Sizes:

Drill for No 6 self-tapping screws	- 2,8mm
Drill for No 10 self-tapping screws	- 3,4mm

The Graphics Panel

The Graphics Panel (26) is a strip of clear film which fits over, and provides a text overlay for, the indicators on the Console display. There are several variants of this panel, to cater for all versions of the FM1000 range, and one should be supplied to suit the configuration of your radio.

			BUSY	MES	STAT		CH 04
S2	MON	ALERT		CLEAR	MODE	−	+

Typical Graphics Panel for Standard Console

				BUSY			
POWER	MON		ALARM		CH1	CH2	CH3

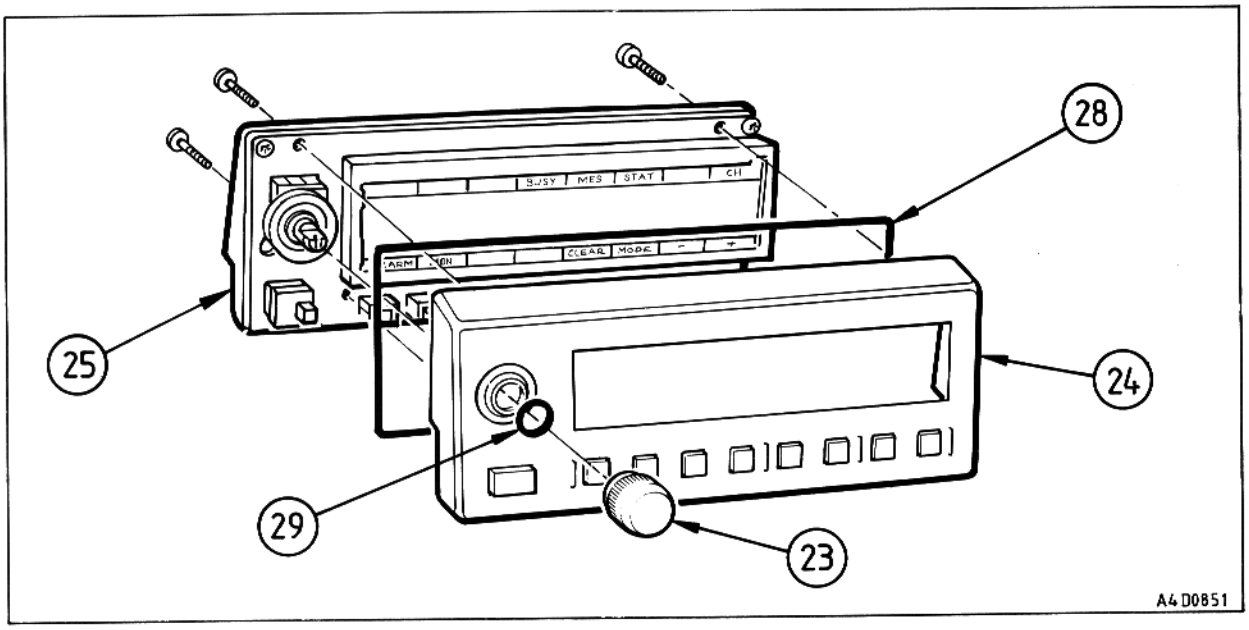
Typical Graphics Panel for Basic Console

If the Graphics Panel is not fitted to the Console display on delivery of your radio, or the incorrect version is fitted, then carry out the procedure detailed on the following pages.

Note: On fitting, ensure that the Graphics Panel is free from dust paricles, grease marks etc as these can spoil the appearance of the display when it is backlit.

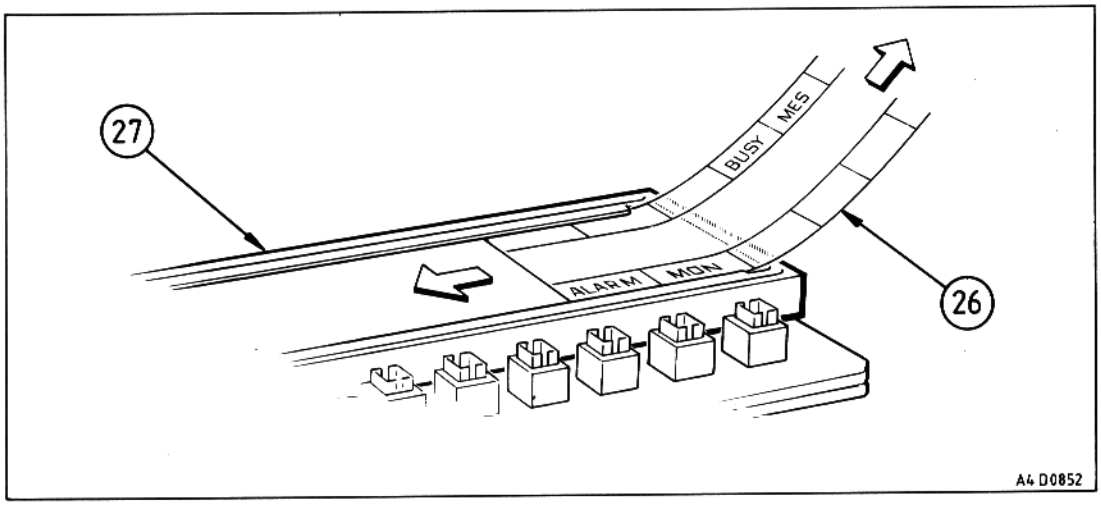
Standard (Display) and Keypad Consoles

1. Remove the four 2,2 psm screws holding the Console rear plate (25) to the front panel (24), and pull the volume control knob (23) away from its spindle.



2. Pull the front panel away from the rear plate and PWB assembly.

3. If a Graphics Panel (26) is already in place over the display and it is not the required version, slide it to the right and out from the cut-out in the Bezel (27). If removal is proving to be difficult, slip a penknife blade (or similar flat blade) under the panel to lift it away from the display and to provide extra grip. Be careful not to scratch the liquid crystal display.



4. Fit the new Graphics Panel by locating the left-hand edge under the side runners at the right-hand side of the Bezel (27), and sliding it across the face of the display. Ensure that the panel is located centrally within the "frame " of the Bezel.

5. Refit the Console front panel to the rear plate/PWB assembly and secure with the four 2,2 psm screws. Push the volume control knob back onto the volume control spindle.

Basic Consoles

Refer to FM1000 series Installation Instructions (Publication Ref TP858).

Cradle and Antenna

CAUTION

Always fit a new antenna when installing the FM1000 radio. Even if the vehicle already has an antenna used with a previous radiotelephone installation, there is no guarantee that it will be serviceable for the life of the new radio, or have been cut to match the working frequencies of the new radio.

1. Choose a safe and sensible location for the radio (1) and cradle (9), ensuring that the installation:-

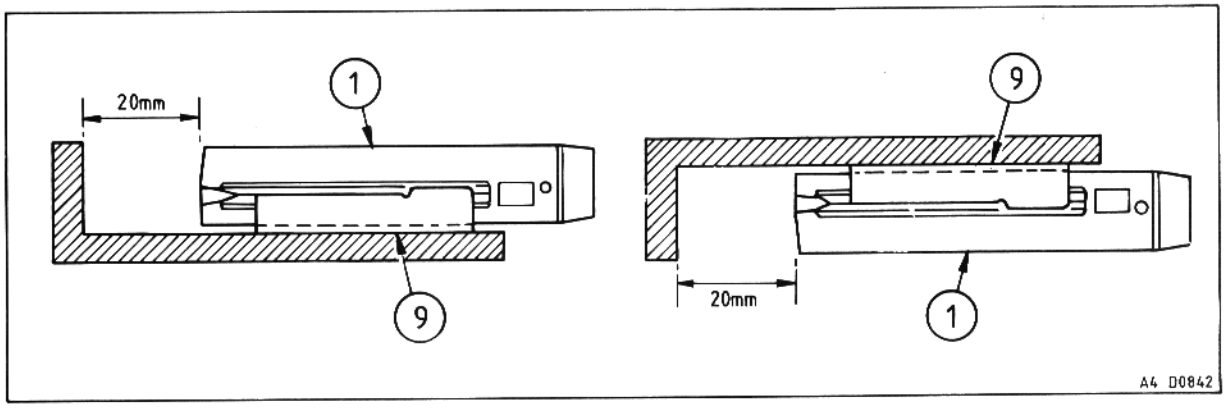
   is easy to operate when seat belts are worn.

   does not inconvenience driver or passengers when seated, entering or alighting vehicle.

   will not injure vehicle occupants under impact conditions.

   does not interrupt flow from heater or air-conditioning vents.

   Avoid mounting in small enclosed spaces (eg glove lockers), especially if the unit is to be used frequently or for long periods in the transmit condition. To prevent excessive self-heating, the unit should have an unobstructed airflow space of at least 20mm from the rear and the side with the (finned) heatsink.

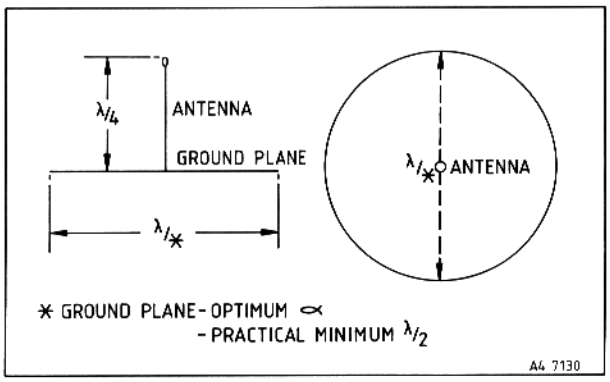


2. Using the cradle as a template, mark and drill four No 10 holes (3,4mm dia). Secure cradle with the four No 10 x 13mm screws from the Common Installation Items.

3. Mount the antenna and feeder (2) according to the manufacturers fixing instructions.

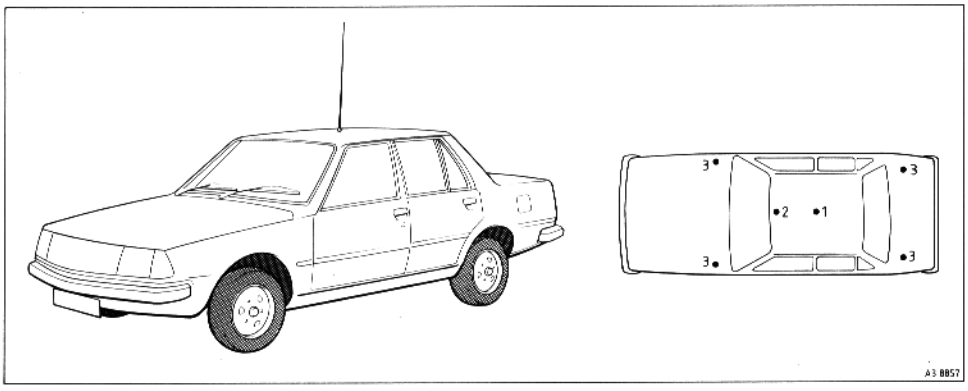
   To prevent interference with any other electrical systems in the vehicle (eg electronic ignition, anti-lock brakes etc) the radiotelephone and antenna should be mounted as far as away as possible from these units and their associated cables. Reference should be made to the vehicle manufacturers handbook for the location of these items.

When the antenna is to be fitted to a glassfibre (GRP) or other non-metallic body, a ground-plane is required for optimum efficiency. This ground-plane should consist of strips of aluminium foil or similar conducting material fitted to the inside surface at the selected antenna location, and should be a minimum of $\lambda/2$ diameter.

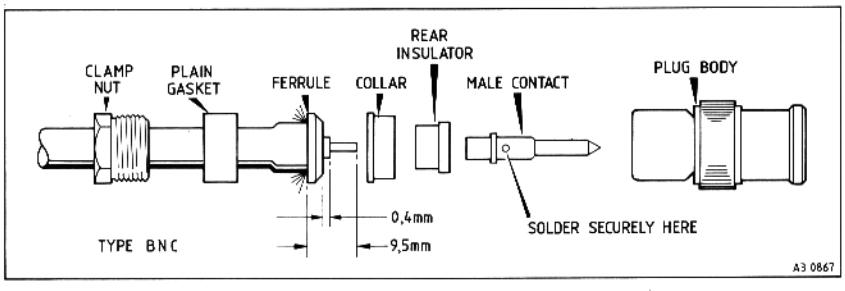


Ensure that all sections of the groundplane are securely connected electrically, and that they will remain so under vibration.

For best all round performance of the radio, the antenna should be mounted on the centre of the vehicle roof. Alternative positions give degraded performance, the numerals on the diagram below giving the order of preference.

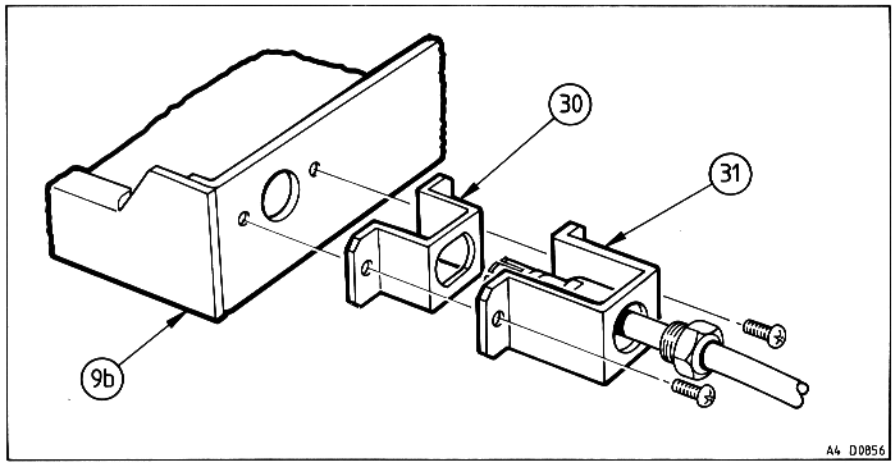


5a. *Standard Mount Cradle (9a) only:*
Connect the feeder plug as shown below. Ensure that the clamp nut is tight enough to provide both a good fit and good retention.



5b. *Cassette Mount Cradle (9b) only:*
Connect the feeder plug, ensuring that on completion, Outer Support Bracket (31) is located between the Clamp nut and plug body. Locate Inner Support Bracket (30) over the front of the plug body, with the flats of the bracket aperture locating against the "shoulders" of the plug body.

Secure the cable/plug/brackets assembly to the rear of the cradle (9b) using the two M2,5 x 5mm screws supplied with the cradle. Finally, check that the clamp nut is tight enough to provide good retention.



6. With the Connector of the Battery Lead Assembly (5) resting in its intended final position (it may be advantageous to have the radio in position too), route the wires of the Battery Lead Assembly to the vehicle battery.

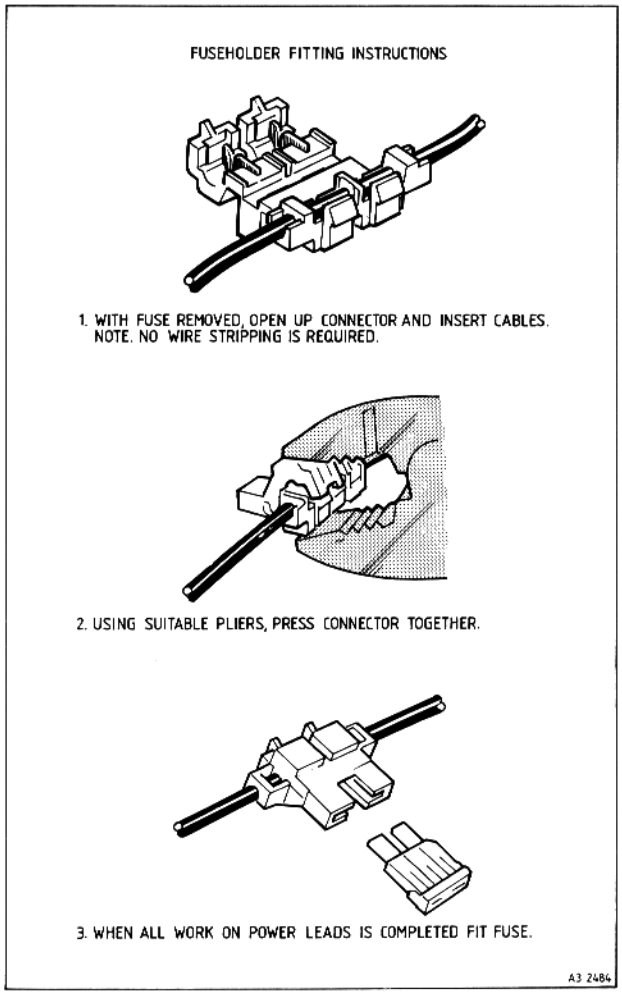
   Cables should be routed away from areas of extreme heat and possible battery acid leakage. Wherever possible, existing holes in the vehicle bulkhead should be used. If metalwork has to be drilled, ensure that holes are fitted with grommets.

7. Connect the plain black wire (-ve) to a point on the chassis as close to the battery as possible. Trim wire to length and connect to the chassis using a suitable ring connector.

8. Trim the black wire with red tracer (+ve) so that it is long enough to reach the positive terminal of the battery. Do not connect wire at this stage.

9. Lay the black/red wire out in its proposed position, with its free end close to the positive terminal of the vehicle battery. Determine a suitable position for the fuseholder (4) as close as possible to the battery and cut the wire at that point. Connect the fuseholder to the two cut ends of the wire as shown in the diagram.

   DO NOT fit the fuse at this stage.



10. Connect the black/red wire to the positive terminal of the vehicle battery, using a suitable ring connector.

11a Ignition-Switched Radio

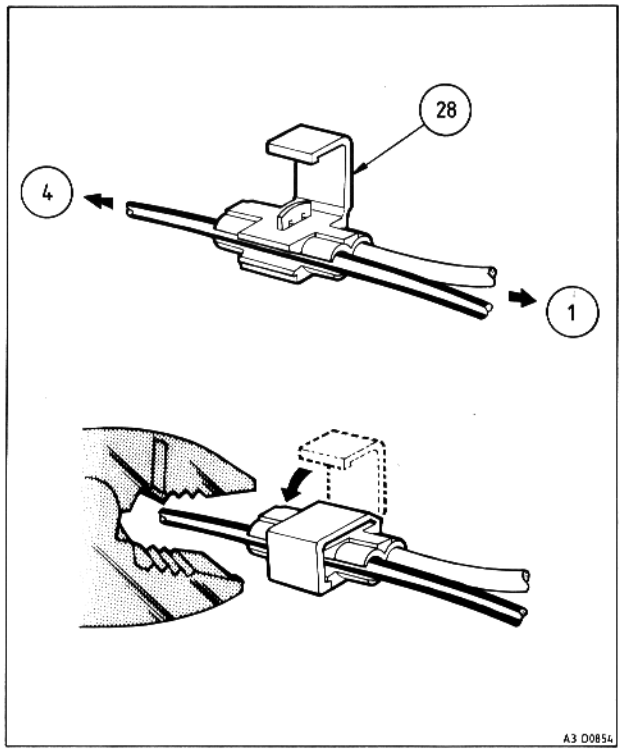
If ON/OFF switching via the vehicle ignition switch is required, connect the white (ignition) lead to the auxiliary terminal of the vehicle's ignition switch, using a suitable connector and trimming any excess wire first to maintain a tidy installation.

11b Standard-Switched Radio

If ON/OFF Switching via the vehicle ignition is not required, the white (ignition) lead must be connected to the black/red lead (+ve), using the Scotchlok connector (28) from the Common Installation Items. No wire-stripping is required for this operation.

Determine a suitable connection point on the black/red lead (between the radio and fuseholder) DO NOT connect the white lead between the fuseholder and vehicle battery.

Trim the white lead to the length required to reach the connection point. Insert the white wire into the inner (blanked off) channel of the Scotchlok connector. Slide the connector over the black/red wire at the point where the connection is to be made. Close the connector using pliers as shown in the diagram.



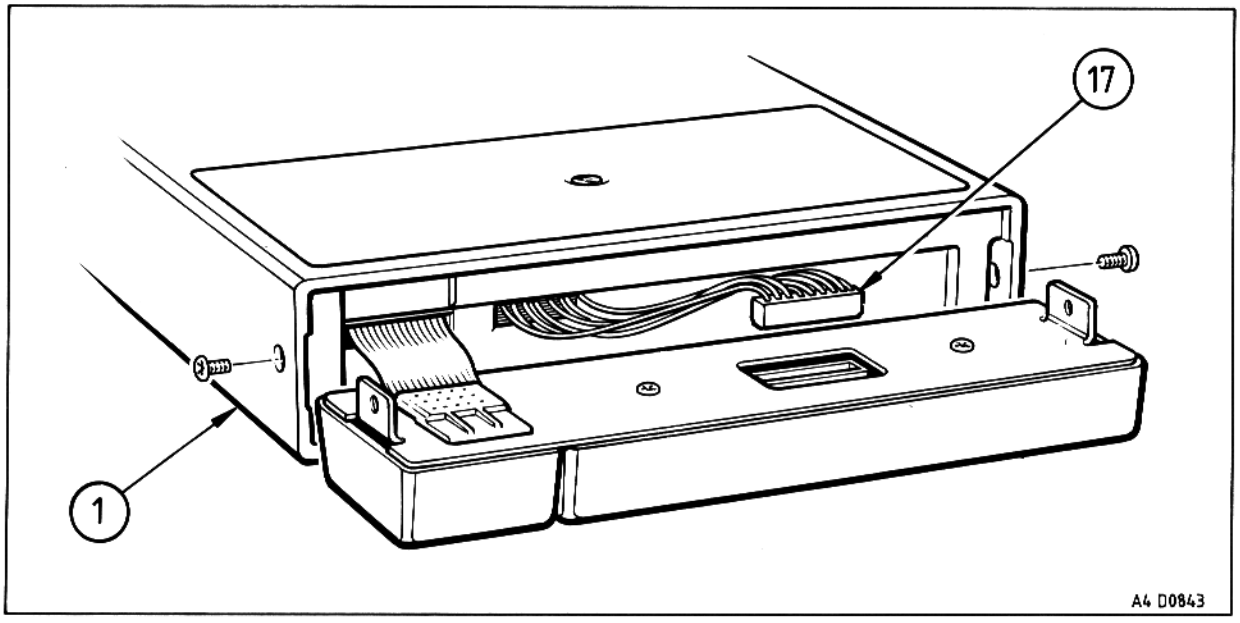
12. If the Battery Lead Assembly (5) has been connected to the cradle (cassette type) or to the radio at any time during this procedure, disconnect it in order to facilitate the remainder of this installation procedure.

13. Proceed to "Local Control" or "Remote Control", whichever is applicable to the installation you require.

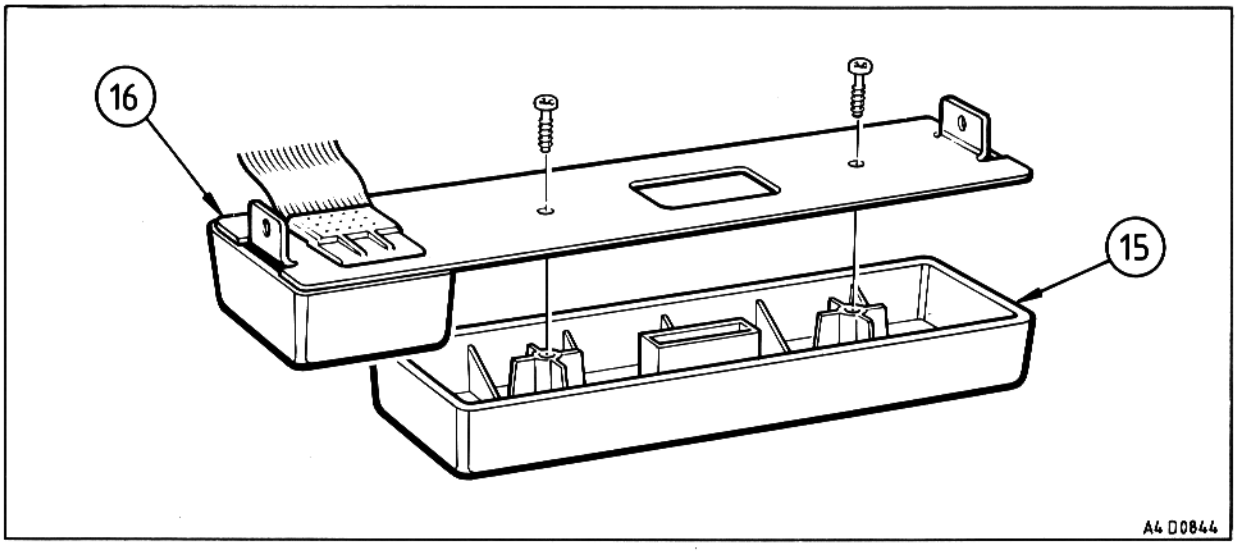
Local Control

When the radio is depatched from the factory, it is fitted with the Fascia (15) for Remote control. It is necessary, therefore, to attach the Console (6) to the unit for Local control.

1. Remove the two screws from the sides of the radio (1) as shown below. Prise the Front Panel Assembly away from the radio.



2. Without causing damage to the ribbon cable, remove the two screws from the Console Plate (16). Remove Fascia (15) from the Console Plate.



3. Remove the two M2,5 x 5mm screws from the rear of the Console (6). Offer Console up to the Console Plate and secure with the two M2,5 x 5mm screws previously removed from the rear of the Console. Mate the 9-way connector (17) with the corresponding connector on the rear of the Console.

4. Locate new Front Panel assembly, with Console, onto the front of the radio. Ensure that when the radio is installed in its cradle, the Console will not be upside-down (otherwise rotate Console 180°). Secure with the screws removed in paragraph (1).

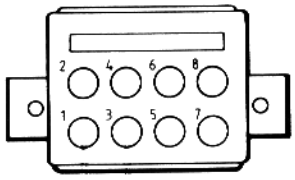
5. Determine a suitable position for the loudspeaker (3), paying due regard to the length of cable supplied for connecting to the socket of the Battery Lead Assembly(5). Using the loudspeaker bracket as a template, mark and drill two 3,4mm diameter holes. Secure loudspeaker with two No 10 self-tapping screws from the bagged items.

6. Push the two pins on the Loudspeaker (3) lead into pins 1 & 3 of the Battery Lead Connector as shown below. Note that the loudspeaker is not a polarity conscious item.

1. Loudspeaker (Live)	5. Remote Alarm
2. Battery (+)	6. External Alert
3. Loudspeaker (Ground)	7. Battery (-)
4. 0V	8. Ignition

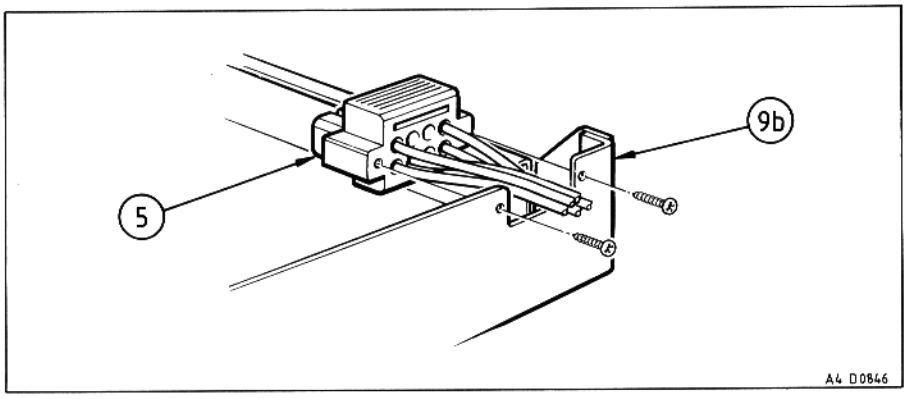
NOTE: Observe loudspeaker polarity when connecting test equipment (eg AF power meter) to the radio.

CONNECTOR
REAR VIEW

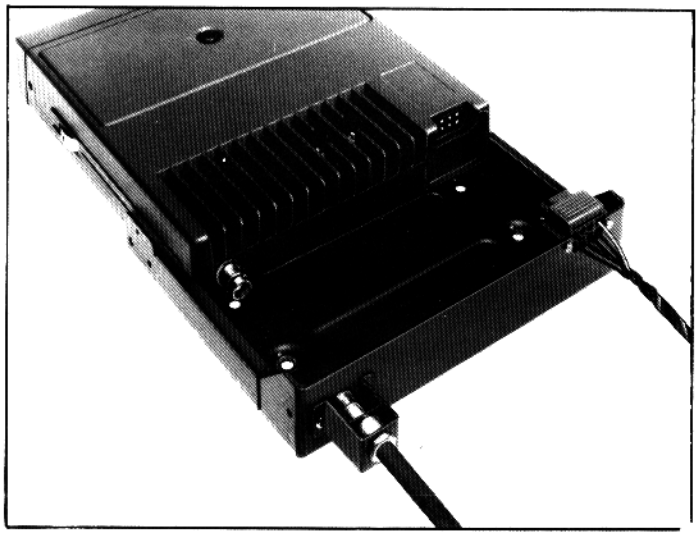


7a. *Standard Mount Cradle only:*
Mate Battery Lead Assembly (5) to rear connector on radio (1).

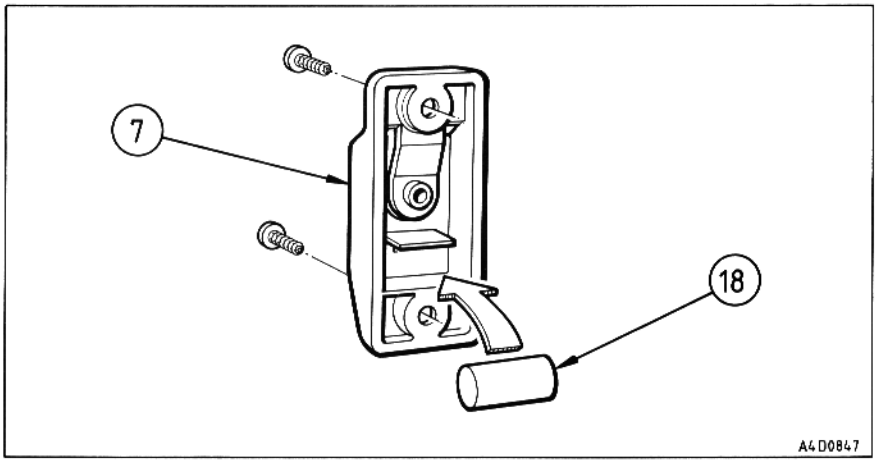
7b. *Cassette Mounting Cradle only:-*
Secure the Battery Lead Assembly (5) to the rear of the cradle (9b) using two 2,5 X 10mm self-tapping screws from the bagged items.



8. Slide transceiver into cradle. Ensure that on the Cassette Mount version the power and antenna connectors on the radio mate fully with the corresonding connectors on the cradle.



9. Connect the microphone (8) to the socket on the radio front panel. Determine a suitable position for the Microphone and Rest (7). Using the Rest as a template, mark and drill two 2,8mm diameter holes. Secure with two No 6 self-tapping screws from the Microphone Installation Kit. If your radio is programmed for "Hookswitch" operation, the Rest is fitted with a small magnet (18); ensure that the magnet is housed correctly inside Rest.



The microphone cable must be clamped to prevent interference with the vehicle gear lever or other controls, using the Strain Relief Clamp (34) and Clamp Support (35) from the Microphone Installation Kit. Using the Clamp Support as a template, mark and drill two 2,8mm diameter holes where the Clamp is to be fitted. Secure the Clamp Support with two No 6 self-tapping screws from the Microphone Installation Kit. Fold the Strain Relief Clamp over the microphone cable at a suitable anchor point and slide the Clamp into the Clamp Support.

It should be noted that the Cable Clamps from the Standard and Keypad Microphone Installation Kits are different sizes, to take into account the difference in cable diameters.

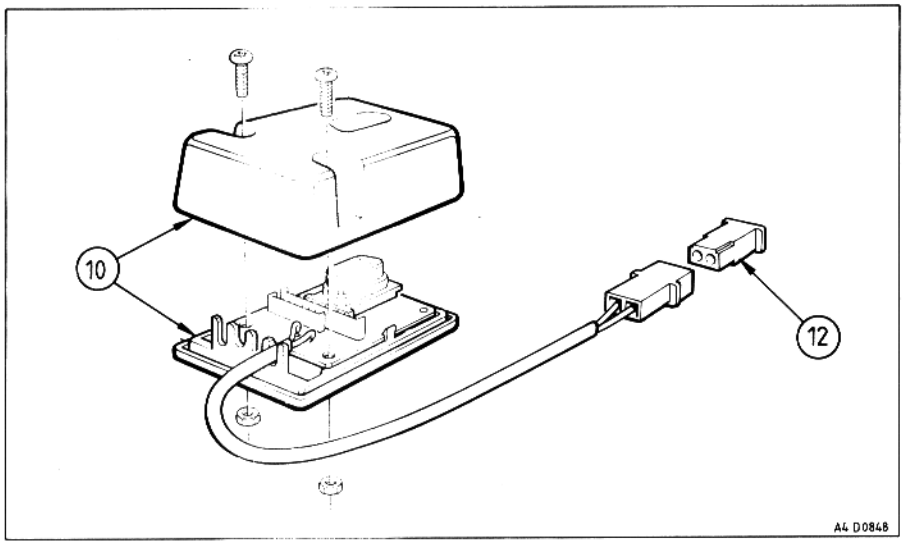
6. Re-check installation, particularly with regard to wiring. If Remote Alarm and/or External Alert is required, proceed to the relevant headed section(s). Otherwise proceed to 'Final Check'.

Remote Control

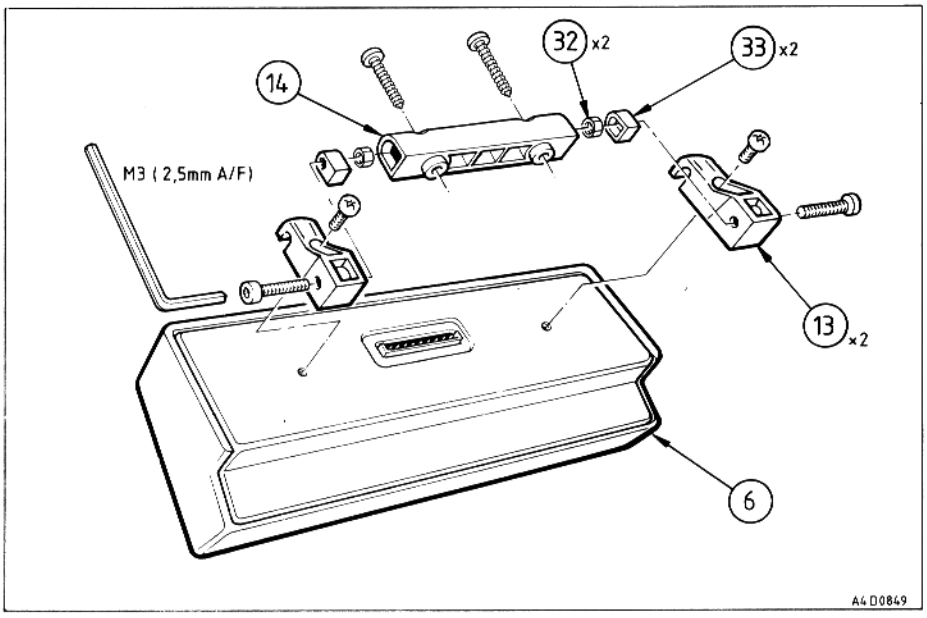
Note: It is recommended that all cables and accessories are 'laid out' prior to final installation in order to determine practicable locations for the Junction Box, Console, etc.

1. Connect the end of the Control Cable (11) with the 15-way data plug into the corresponding socket of the radio. Feed the control cable from the radio (1) to where the Junction Box (10) is to be situated. Use vehicle carpets, headlining, trim etc to best advantage to conceal the cable wherever possible. If it is necessary to drill a hole in any bulkhead, always fit a grommet before feeding the cable through.

2. Remove the top half of the Junction Box (10) by unscrewing the two securing screws. Connect the free end of the Control Cable into the corresponding (large) connector inside the Junction Box.



3. Choose a suitable position for the Console (6) and Cradle (14), paying due regard to the length of cable supplied for connection to the Junction Box. Using the Console Cradle (14) as a template, mark and drill two 2,8mm diameter holes. Secure cradle with two No 6 x 19mm self-tapping screws from the bagged items.



The cradle should have a threaded bush assembly, comprising bush (33) and nut (32), fitted at each end. Fit the nut inside the bush recess, and repeat for the second pair. Insert the two bush assemblies into the opposing ends of the cradle (14) as shown.

4. Connect one end of the 9-way control cable (21) into the connector on the Console rear panel. Remove one of the two screws from the Console backplate, and use it to secure one of the Cradle Brackets (13) to the backplate. Repeat the operation for the second bracket and screw, this time gripping the control cable between the backplate and the cut-out in the bracket.

5. Locate the Console brackets over the ends of the Cradle, and secure with the two M3 socket head screws from the bagged items.

6. Connect the cable from the Console into the corresponding (small) connector inside the Junction Box.

7. Choose a suitable position for the loudspeaker (3), paying due regard to the length of cable supplied for connecting to the flying lead of the Junction Box. Using the loudspeaker bracket as a template, mark and drill two 3,4mm diameter holes. Secure loudspeaker with two No 10 self-tapping screws from the bagged items.

8. Pull the Mate n'Lock housing (12) away from the flying lead on the Junction Box. Push the two pins of the loudspeaker lead into the back of the housing until they are fully home. Reconnect the two halves of the Mate n' lock connector.

9. Re-assemble the Junction Box (this is exactly the reverse of disassembly). Peel off the backing strip from the Junction Box base to reveal the self-adhesive pad. Place the Junction Box into the mounting position required and press down to allow the pad to stick firmly onto the surface.

   Alternatively, the Box may be secured using two No 6 x 25mm taptite screws supplied with the Junction Box. Note that the screws also hold the two halves of the Junction Box together, as the same holes are required for this purpose. The Junction Box may be used as a drilling template.

10. Connect the microphone (8) to the socket on the Junction Box. Determine a suitable position for the Microphone and Rest (7). Using the Rest as a template, mark and drill two 2,8mm diameter holes. Secure with two No 6 self-tapping screws from the Microphone Installation Kit. Ensure that the small magnet (18) is housed correctly inside the Microphone Rest.

    The microphone cable must be clamped to prevent interference with the vehicle gear lever or other controls, using the Strain Relief Clamp and Clamp Support from the Microphone Installation Kit. Using the Clamp Support as a template, mark and drill two 2,8mm diameter holes where the Strain Relief Clamp is to be fitted. Secure the Clamp Support with two No 6 self-tapping screws from the Microphone Installation Kit. Fold the Strain Relief Clamp over the microphone cable at a suitable anchor point and slide the Clamp into the Clamp Support.

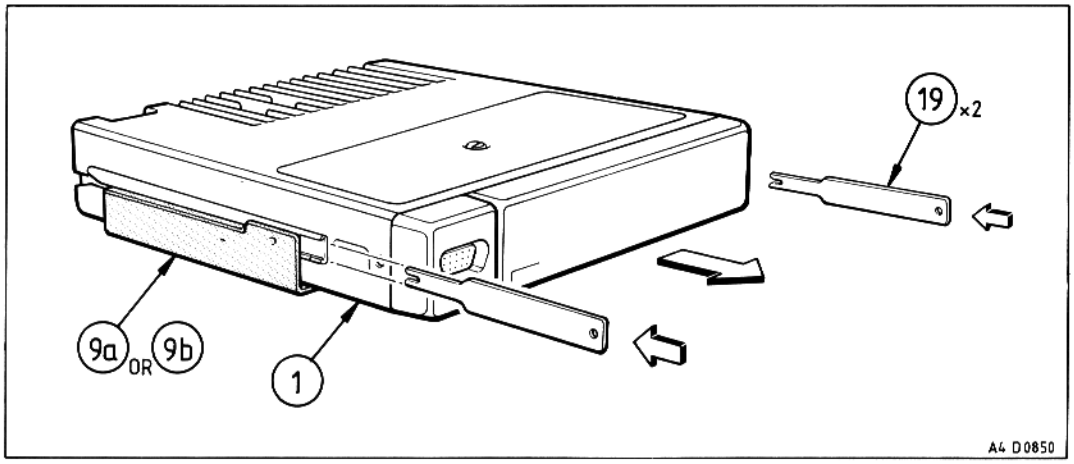
    It should be noted that the Cable Clamps from the Standard and Keypad Microphone Installation Kits are different sizes, to take into account the difference in cable diameters.

11. Mate the Battery Lead Assembly (5) with the rear connector on the radio (1).

12. Slide the radio into the cradle.

Removal of Radio

Keys (19) should be inserted on both sides of the radio as shown below, in order to release it from the cradle.

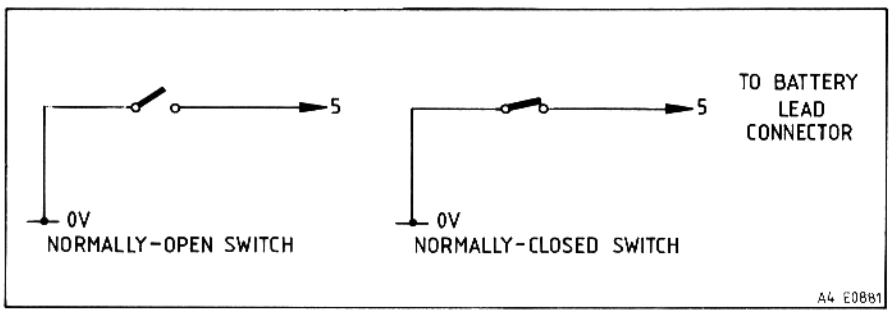


ALARMS AND ALERTS

Note: Unless Remote Alarm and External Alert facilities are programmed into your FM1000, the circuits detailed below will not function.

Remote Alarm

Normally, the Alarm function is provided by a button on the Console, but a switch external to the console may be connected to the radio for a remote alarm facility. This switch should be connected between pin 5 of the Battery Lead Connector (5) and vehicle ground.



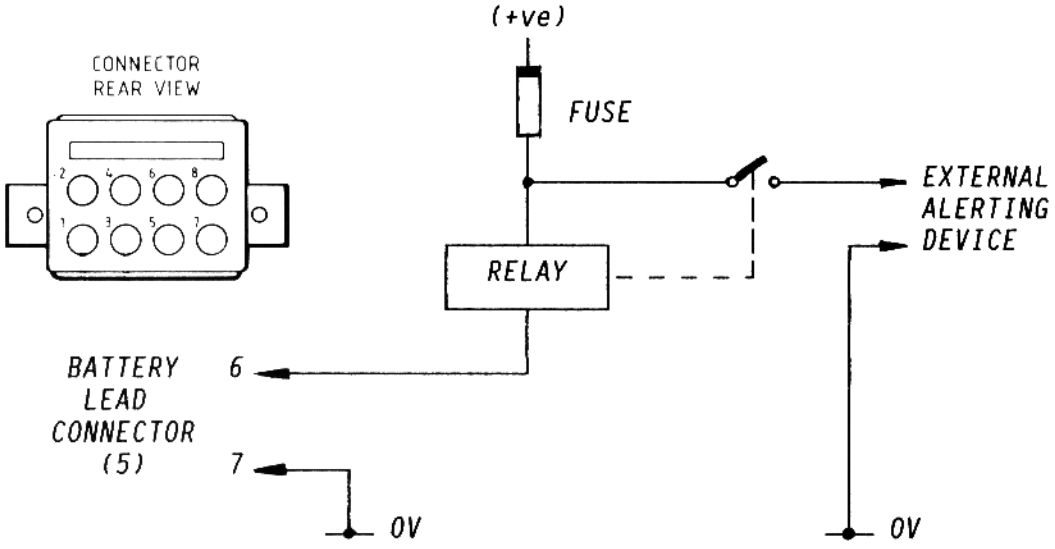
The switch may be either a normally-open or a normally-closed switch, as the alarm is triggered by a 'change of state' at pin 5.

Solder or crimp the lead from the switch with one of the contacts from the Common Installation (Bagged) items, before fitting to the Battery Lead Connector (5).

External Alert

If an alerting device external to the radio is required (eg horn, siren), this may be connected to the radio via a relay. The relay is then connected between pin 6 of the Battery Lead Connector (5) and battery positive (+).

Note: The maximum current and voltage ratings for the FM1000 external alert output are 100mA and +30V DC respectively. Any device (including relays) or power supplies which may cause these limits to be exceeded, should NOT be connected directly to this output.



Solder or crimp the lead from the relay with one of the contacts from the Common Installation (Bagged) items, before fitting to the Battery Lead Connector (5).

Always protect the alerting circuit with a fuse compatible with the combined current ratings of the alert device and relay.

Pin 6 of the Battery Lead Connector will go 'low' (ie <1,5V) when the External Alert is enabled.

CAUTION
Under NO circumstances should the External Alert and Remote Alarm outputs be grounded simultaneously, even if power is not being applied to the radio.

FINAL CHECK

Re-check installation, particularly with regard to wiring, and then fit the fuse into the fuseholder. Switch on radio and carry out checks detailed below.

Note: Only key the transmitter on long enough to carry out the measurement or check specified.

Voltage Standing-Wave Ratio (VSWR) Measurement

1. Use the cutting chart (supplied with the antenna) to determine the length corresponding to the frequency mid-way between highest and lowest transmit channel frequencies. Cut antenna rod to length.

2. Connect Reflectometer in line with antenna cable. Switch on radio, key on transmitter, and check VSWR reading on the Reflectometer. Keep ALL vehicle doors closed during measurements.

   If the VSWR reading is worse (ie numerically higher) than 1.5:1, then re-check all connections between antenna, antenna feeder and radio. Check that the antenna rod is not touching any part of the vehicle bodywork or other objects.

3. If the VSWR reading is satisfactory, disconnect Reflectometer and re-connect radio directly to the socket on the antenna feeder. Carry out 'Air Check'.

   Note: If you are unable to achieve a satisfactory VSWR reading, consult your dealer or local Philips Service Depot.

Air Check

1. With the vehicle stationary and the engine running at fast idle, carry out a two-way air check between the radio and another station. Check that neither alternator whine nor ignition noise is present on received signals. Confirm with the station contacted that no similar interference is present on your transmission.

2. Repeat the checks detailed in paragraph (1) with the vehicle in motion (in the interests of road safety, the radio should be operated by a passenger).

   Note: If any interference is experienced from the alternator or ignition circuits, consult a qualified auto-electrician for remedial action. If interference from engine management computer/systems is experienced, then contact the vehicle manufacturer or main dealer.

3. Carry out 'RF Compatibility Checks', if necessary.

RF Compatibility Checks

The following checks should be carried out if the vehicle is equipped with electronic anti-skid, ignition or engine management systems.

Note: (a) The transmitter should be keyed only for the time required to make an observation.

(b) An assistant will be required for the following checks.

1. With the vehicle stationary and the engine running at fast idle, key the transmitter. Check that the brake lights do not illuminate and that the engine continues to run normally.

2. Operate the brake pedal, key the transmitter and check that the brake lights do not extinguish.

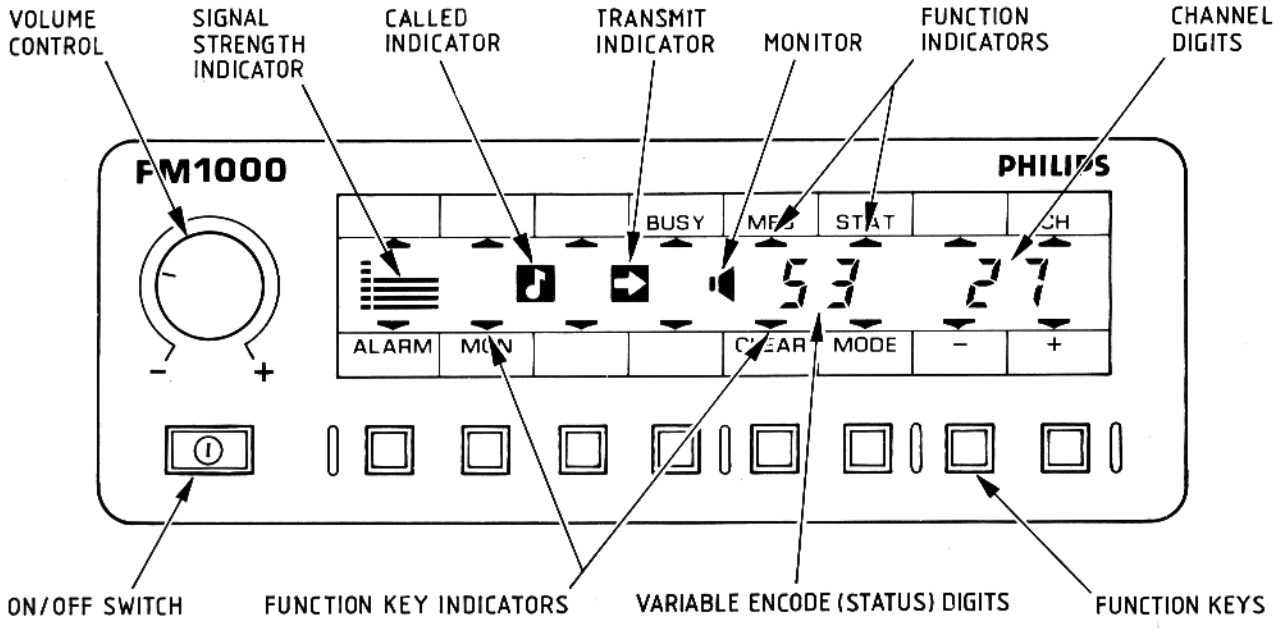
3. Put the vehicle into motion at approximately 15-25km/hr (10-15mph), key the transmitter and operate the brake pedal simultaneously. Check that the braking action is normal and that the engine does not surge or cut out.

> **CAUTION**
>
> In the event of an apparent malfunction in the braking and/or ignition systems during the above checks, the radio installation should be rendered inoperative and the vehicle manufacturer should be contacted before any further use is made of the radio installation.

Conclusion

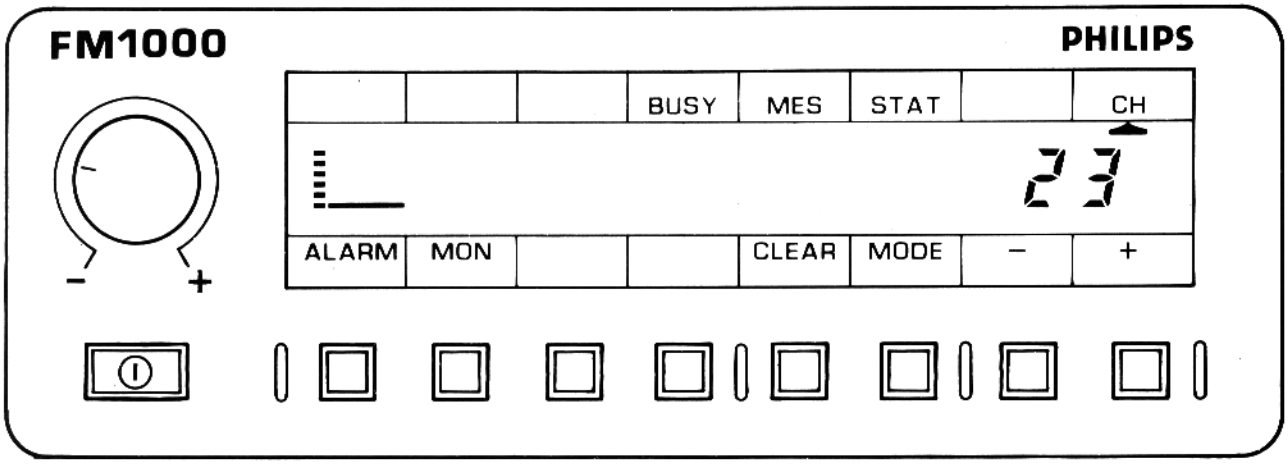
Complete any Customer Approval procedures before handing over the vehicle and installation (UK installers should refer to MPT1362).

The Control Console has 8 function/facility keys, an On/Off key, a 6 digit display, 16 programmable indicators, 4 function-specific indicators and a rotary volume control knob.



Switch ON/OFF 

To switch on, press the ON/OFF button. The radio will perform a self-test during which all characters on the display are visible. The radio may display an Identity Schedule Code (a two digit code to indicate which software package is programmed in the radio). After three seconds it will revert to its normal switch-on state, displaying the channel number and satus digits if they are programmed.



When switching on, the channel and status digits will be programmed to one of the following options:

- The digits displayed when the equipment was last switched off.
- Fixed preset digits.

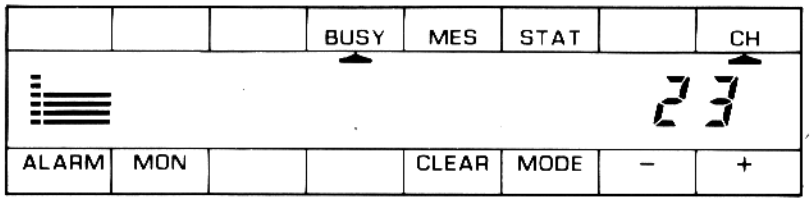
To switch off, press the ON/OFF button again. The equipment may be wired for ON/OFF switching via the vehicle ignition. The radio will then be automatically switched off when the ignition key is out or in the off position.

Busy Indicator BUSY

The indicator is on whenever the channel is busy.

Additional options available with the Busy indicator are:

- Busy alert tone ▬ ▬ ▬ (sounds if you attempt to transmit when the Busy indicator is on)
- Transmit Inhibit (prohibits you from transmitting whenever the Busy indicator is on)



Signal Strength Indicator

The strength indicator shows the signal strength of any received signal. It has four levels as shown below.

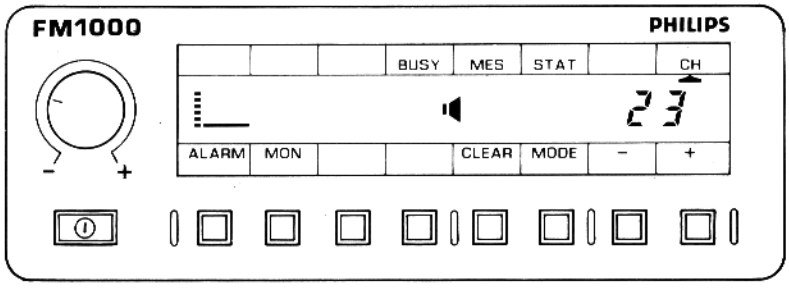
No signal *Low* *Medium* *High*

Monitor [MON]

The Monitor button and indicator will be programmed to one of the following options:-

- Receiver squelch defeat ON/OFF
- Signalling defeat/signalling reset
- Signalling reset only

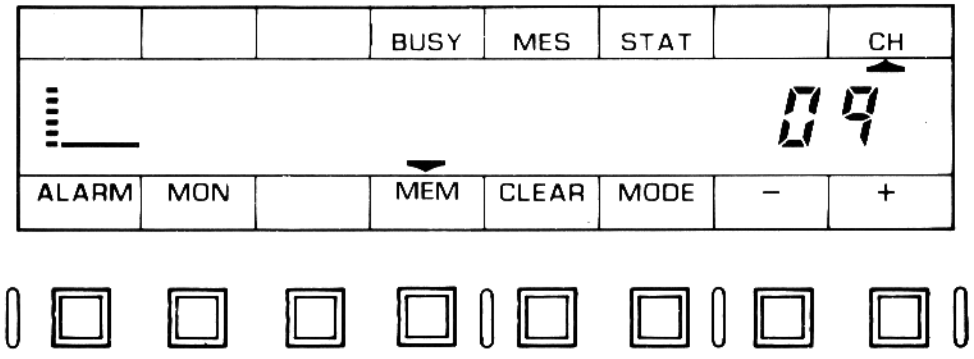
Each of these options enable you to listen to all calls on the channel whenever the Monitor indicator (◀) is on. The Monitor button has an additional function when signalling is fitted. It can then be used to cancel the called alert and flashing indicator.



Memory Function (User Defined Channel) [MEM]

The User Defined Channel button toggles the channel setting between the working channel and the User Defined channel. When the [MEM] button is pressed the channel is changed to the User Defined Channel and an indicator is displayed. Pressing the [MEM] button again causes the radio to revert to the working channel.

To initialise the User Defined Channel, select to become the User Defined Channel using the editing controls, then hold down the [MEM] button for three seconds. After three seconds a beep indicates that the button can be released.



Alert Tones

	TYPE OF ALERT		FREQUENCY Hz	TONE DURATION IN MILLISECONDS 100 200 300 400 500 600 700 800 900 1000 1100 1200
1	INVALID KEY	GENERATED WHEN OPERATOR PRESSES AN INVALID KEY	240	
2	MEMORY ERROR	GENERATED WHEN AN ERROR IS DETECTED IN NON-VOLATILE MEMORY	240	CONTINUES FOR 5 SECS.
3	CONSOLE FAULT	GENERATED WHEN EQUIPMENT IS SWITCHED ON WITHOUT CORRECT CONSOLE CONNECTED	240	CONTINUES INDEFINITELY
4	SYNTHESISER LOCK	GENERATED WHEN SYNTHESISER IS OUT OF LOCK	240	TONE PATTERN REPEATS
5	CHANNEL BUSY	GENERATED WHEN OPERATING PTT AND CHANNEL IS BUSY	2000	TONE PATTERN REPEATS
6	CALL ALERT	GENERATED WHEN AN INDIVI-DUAL CALL IS RECEIVED	780	TONE PATTERN REPEATS FOR 4 SECS.
7	GROUP CALL ALERT	GENERATED WHEN A GROUP CALL IS RECEIVED	1470	
8	REMOTE RESET	GENERATED WHEN A REMOTE RESET IS RECEIVED	1470	

Note: ***These instructions refer to those functions which are common to all FM1100 radios with Standard Consoles. For detailed instructions on options relevant to your radio, refer to the appropriate User Guides:***

FM1100 Radio, Standard Console	***(Publication Ref TP1913)***
FM1100 Radio, Basic Console	***(Publication Ref TP1942)***
FM1100 Radio, Keypad Console	***(Publication Ref TP1955)***

SECTION 3
TECHNICAL DESCRIPTION

CIRCUIT SUMMARY

Introduction

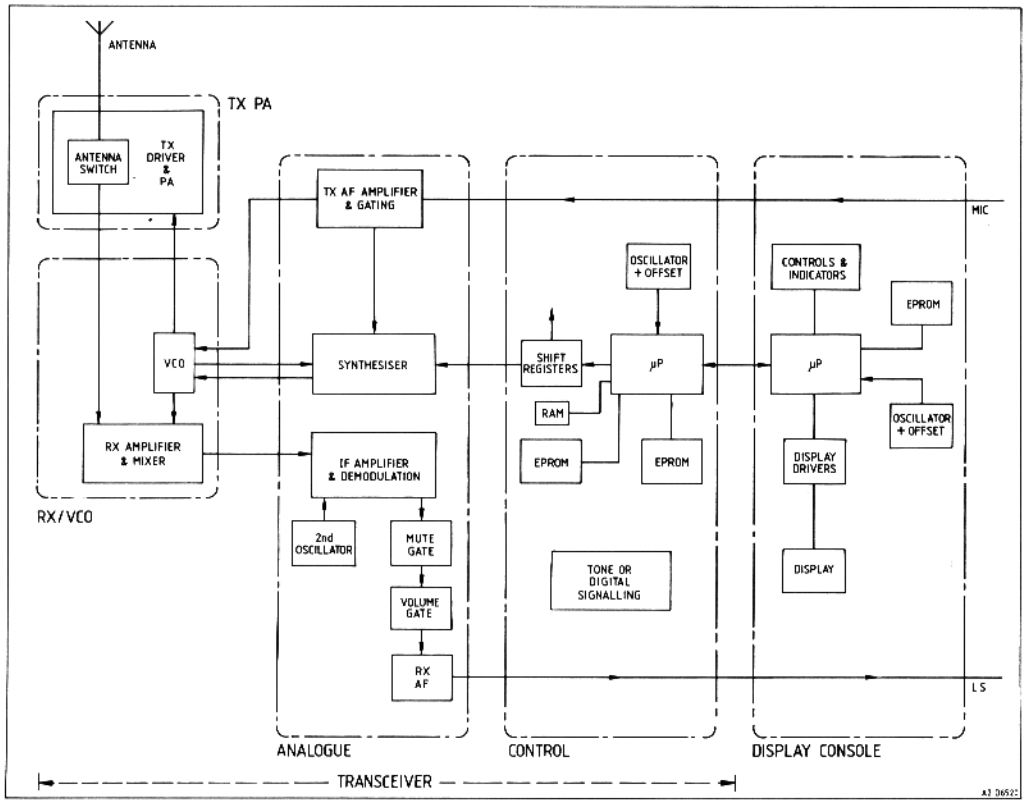


Fig 3.1 Basic Transceiver Block Diagram

The transceiver consists principally of five PWB assemblies as follows:-

Tx PA — comprising antenna switch, Tx driver & PA.

Rx/Tx RF — comprising RF Amplifier (UHF bands only), electronically-tuned RF filter, 1st Mixer, Rx/Tx VCO (VHF) or separate Rx and Tx VCOs (UHF), and RF tracking circuits.

ANALOGUE — comprising:-

- Synthesiser:- Reference Oscillator, Comparator and Dividers, Pre-Scaler, synthesiser IC, Loop Filter.
- Transmitter:- Audio amplifier, limiter, filters and gating. Power Control circuits.

	Receiver:-	1st & 2nd IFs, 2nd oscillator & mixer, Rx demodulation circuits including squelch gate. Digital AF volume control. AF Amplifier, filters and gating.
CONTROL	comprising main transceiver microprocessor with clock oscillator, EPROM, EEPROM, RAM, Shift Registers, timers, 30V generator and tone signalling circuits.	
DISPLAY CONSOLE	comprising (slave) microprocessor, EPROM, address latch, front panel controls and indicators, liquid crystal display and associated display drivers.	

Microprocessors

Virtually all transceiver functions are controlled by a microprocessor which receives and issues control signals to and from peripheral devices. System operation is defined by a set of instructions stored in an EPROM. In order to maintain a compact transceiver layout avoiding additional and cumbersome wiring, the interface between processor and peripheral devices is of the serial data type; shift registers are employed to convert serial data to parallel data when required.

The processor derives a clock signal from an external oscillator. The output frequency of the oscillator can be offset by software should a harmonic from it fall within any of the programmed receiver channels. This offset is not significantly great to affect the operation of the microprocessor.

The microprocessor selects programmed channels, switches the VCO range and causes the channel number to be displayed. The same data is used to provide an automatic increment or decrement to the nearest programmed channel whenever the channel change function is operated.

Channel changing is prompted by user action on the transceiver console. The microprocessor addresses and monitors channel information stored in EEPROM. This information is sent via shift registers to the synthesiser where it sets the division ratio of the dividers.

A second (slave) microprocessor is employed within the transceiver for generation of tone-signalling, receiving instructions from, and sending status information to, the master processor. A third microprocessor is used in the 4-Digit console as an interface between the master processor and console front panel.

A connection to the transceiver's external message bus can be made via the front panel socket to allow alterations to customizable data stored within the EEPROM. Such alterations must be valid configurations and are subject to programmer authority.

Synthesiser

The synthesiser is of Phase-Lock Loop (PLL) type, employing a reference oscillator, voltage controlled oscillator (VCO) and comparator. The VCO feeds a sample of its output via a prescaler and dividers to a comparator. Here the sample output is compared against a reference source, and outputs an error voltage to re-adjust the VCO if it is out-of-lock.

A loop filter attenuates high frequency noise and is the main element that determines the dynamic characteristics of the phase locked loop (PLL). AF modulation is applied to both the VCO and the reference oscillator to reduce audio frequency components at the phase comparator output and to provide a low modulation frequency response.

The synthesiser output is used to provide the receiver local oscillator frequency in the receive mode and the modulated carrier source for the transmitter. Both signals are passed through buffer stages and are normally at final frequency.

Transmitter

Audio signals from the transceiver microphone input are amplified and fed via a pre-emphasis circuit to the limiter. The limiter ensures that system deviation is not exceeded despite wide variations in microphone output level. From the limiter the signal is fed via a low-pass filter with a 3kHz cut-off to the Reference Oscillator and VCO Loop Filter. A separate audio input is provided on the Transmitter audio amplifier for in-band tone-signalling. This input by-passes the part of the microphone amplifier stage switched off for the duration of the tone encode period, thereby ensuring that speech does not interfere with the tone information.This does not apply to DTMF tones which are generated from within a keypad microphone.

Output from the VCO, at final carrier frequency, is applied via a buffer-amplifier before application to the PA. The transmitter PA circuit is of broad-band design, its gain controlled by a feedback power control circuit. Any one of six power levels may be specified on a per-channel basis. Transmitter power is adjustable between 1W and either 25W or 30W, dependant on frequency band.

Power Amplifier RF output is fed to the antenna switch, where the signal is directed by diode switches to the antenna filter and antenna socket. The antenna filter comprises a low-pass filter to reduce harmonic radiation.

The transceiver may be programmed to disable the transmitter at a pre-determined period after key-on. The timer is reset by releasing the PTT switch.

Receiver

Signals from the antenna socket are directed by diode switches in the antenna switch to the input of the electronically-tuned filter which provides a high degree of selectivity against unwanted signals. Use of varicap diodes allow the pass-band of the filter to be tuned to any part of the frequency band. UHF band versions have an amplifier to boost the filtered output. The amplified and/or filtered RF signals and VCO output from the synthesiser are combined in a mixer stage to produce a 21,4MHz intermediate frequency.

In the receive mode, the synthesiser circuits are programmed to produce an output from the receiver VCO at the following frequency:-

EO Band: $f_o = f_c + 21,4MHz$

All other Bands: $f_o = f_c - 21,4MHz$

where f_o = oscillator injection frequency and
f_c = channel centre frequency.

The mixer output is fed via suitable matching to the 1st IF Crystal Filter on the Analogue PWB, which provides selectivity against adjacent channel interference. The filtered 21,4MHz signal is amplified and fed to a 2nd mixer stage, together with a crystalled controlled second oscillator to produce a 2nd IF signal of 455kHz. Crystal frequencies for the 2nd oscillator are 20,945MHz (standard) and 21,855MHz (alternative). The 455kHz signal is amplified and then demodulated to provide a low-level audio output. This is fed via a digital attenuator controlled by the processor which provides stepped volume level control, before application to the receiver audio amplifier. A squelch circuit, driven by the noise output of the demodulator, is used to inhibit receiver noise reaching the loudspeaker when a carrier signal is absent. Squelch threshold level is controlled by software.

An RSSI (received signal strength indicator) can be used for receiver voting or trunked radio applications, in addition to driving the signal strength indicator on the console display.

CONTROL PWB

Microprocessor

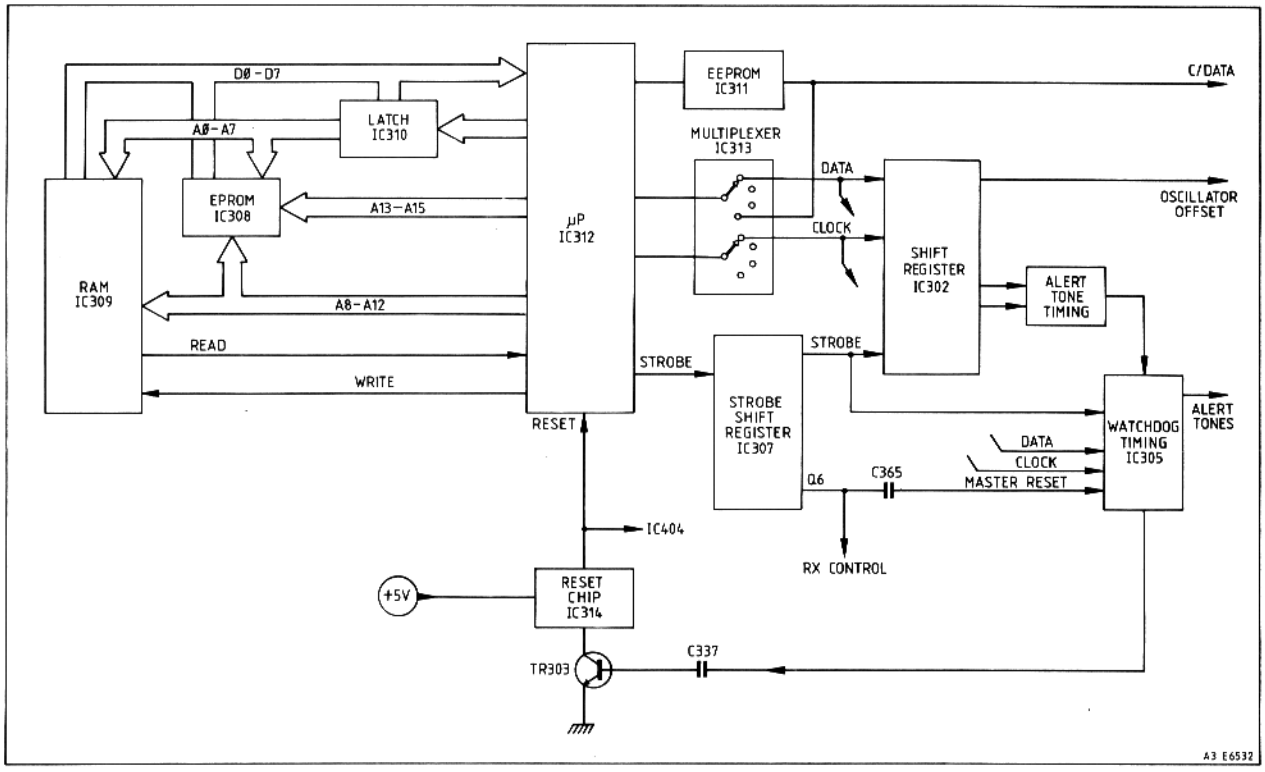


Fig 3.2 Microprocessor Block Diagram

The power-up process, which includes the microprocessor "self-check" routine, takes about four seconds. Operation of the transceiver controls will be ignored by the microprocessor during this period.

Microprocessor IC312 receives and issues control information to and from peripheral devices. System operation is defined by a set of instructions stored in EPROM IC308 or RAM IC309. These instructions are read by the microprocessor by first addressing either the EPROM or RAM via the 8-bit latch IC310 and then taking PSEN 'low'. Instructions are read and processed at a speed defined by the microprocessor crystal oscillator frequency and on-board oscillator-dividers. The microprocessor cycles through a loop interrogating peripheral devices until a message is received.

EEPROM IC311 is a serial device and is thus slow to exchange and update data. Therefore at switch-on, microprocessor IC312 loads EEPROM (IC311) data into RAM IC309, which, although having a volatile memory, is a parallel device capable of faster data transfer. At switch-off, the microprocessor interrogates the RAM for any changes made to stored data (channel number selection, volume control setting etc) and writes any modifications to the EEPROM. If significant changes have been made, there is a noticeable delay before the microprocessor issues instructions to remove power from the transceiver.

Data stored within the 512 byte EEPROM is typically as follows:

Transmit and receive frequencies for channels 0 - 9

Encode and Decode Identities 1 - 4

Last channel number used

Last volume control setting

Frequencies for channels 10 - 99 and Encode/Decode identities 5 - 8 are stored in EPROM IC308. The microprocessor reads EPROM/RAM channel frequency data and whether clock offset is required for the current channel or not. If offset is required, the microprocessor instructs shift register IC302 to put a 'low' on Q1 (pin 4) which is then applied to TR307 base via bridge R356/R357. This switches off TR307 which in turn switches on TR306, effectively putting C334 in parallel with C333 and pulling XL301 down in frequency onto its calibrated frequency (12MHz). Offset is implemented on a channel by channel basis, whenever the receiver channel is within ±50kHz of a 0,5MHz multiple. The frequency offset is sufficient to move any oscillator harmonics away from a programmed receiver channel, but insufficient to disrupt the operation or timing of the microprocessor.

Multiplexer IC313 allows IC312 to read and write data to and from various peripheral devices in a number of modes. They are:-

(i) Internal Message Bus - Serial TxData and RxData to SELCALL microprocessor IC404

(ii) Internal Expansion Bus - Clock and Data lines to Shift Registers on Analogue PWB.

(iii) External Message Bus - TxData and RxData to external devices, eg console, PDP, CDP, microcomputer etc. *(Intel 8051 Mode 2)*

(iv) External Expansion Bus - Read/write to shift registers external to Analogue PWB, DTMF/keypad microphone. *(Intel 8051 Mode 0)*

The microprocessor writes, via multiplexer IC313, to Shift Registers IC302, IC307 and IC503. Data is distributed as follows:-

Shift Register IC302

Q1 Microprocessor crystal oscillator frequency offset*
Q4 Relay Start*
Q5 Alert Tone frequency*
Q6 CTCSS Detector output gate (see "CTCSS Signalling")
Q7 Alert Tone Output gate*
Q8 Alert Tone frequency*

* See "Power-Up and Alert Tone Generation"

Shift Register IC307

Q1 Strobe for Shift Register IC302
Q2 Strobe for Shift Register IC503
Q4 Load Switch Input Register IC303
Q5 Synthesiser Control (Analogue PWB)
Q6 Rx Control Data (Volume Control and audio gates)ǂ
Q7 Tx Power Level Controlǂ
Q8 Tx Control (VCO Tx/Rx and audio gates)*

ǂ Analogue PWB

Data is read into the microprocessor from the following input registers:-

A to D Converter IC301

A0 Tune Volts
A1 +13,6V voltage sense.
A2 Tx Temperature (via Analogue PWB, from TH1 mounted on heatsink)
Q3 Noise Level (squelch output from IC207, Analogue PWB)
Q4 RSSI (from IC201 pin 11, Analogue PWB)
Q5 Power Level (from Power Control circuit, Analogue PWB)
Q6 Volume
Q7 Hook/Facility Switch

Switch Input Register IC303

D0 ON/OFF Switch.
D2 PTT Switch.
D3 Remote Alarm (External connection to radio)
D5 Synthesiser in/out lock.
D7 CTCSS Valid (see "CTCSS Signalling")

Power-Up and Alert Tone Generation

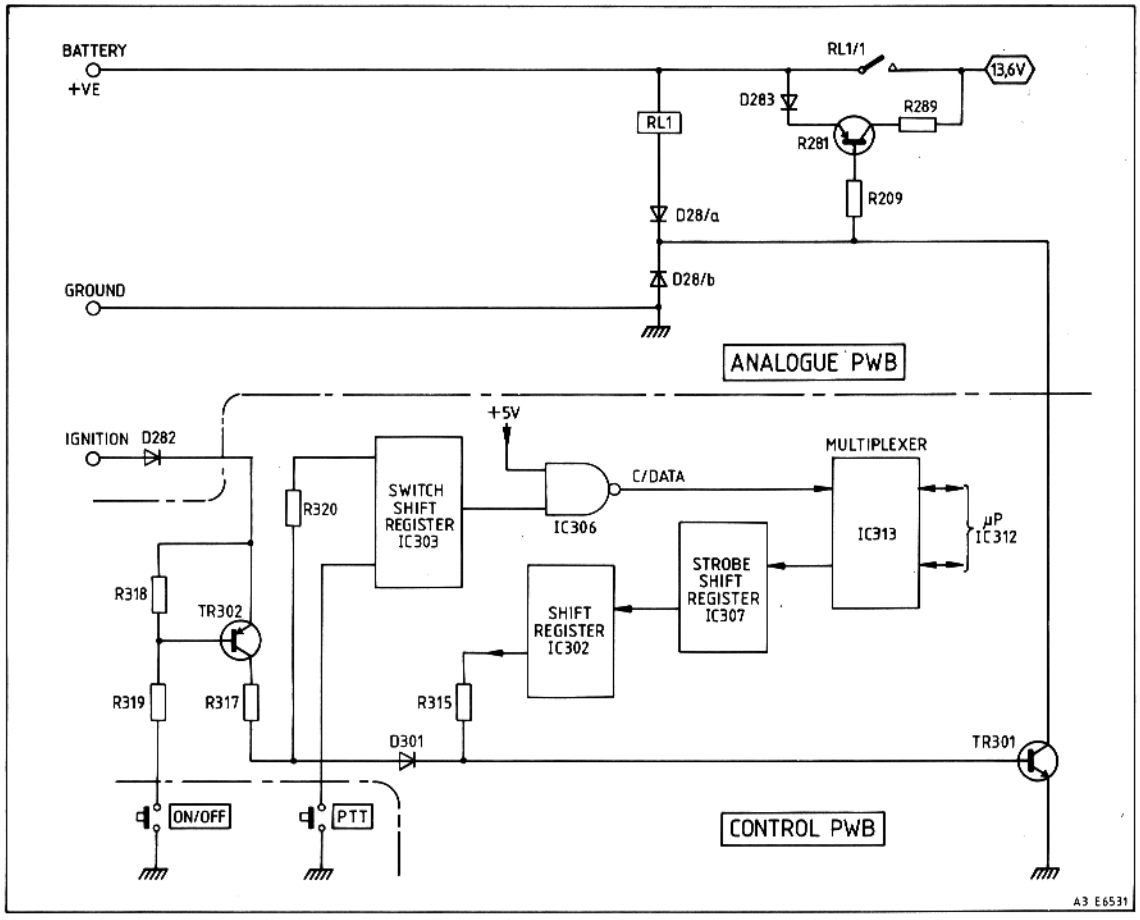


Fig 3.3 Power-Up Block Diagram

Reset chip IC314 generates a reset pulse for the microprocessor which is output at pin 6. A reset is generated at power-up, whenever the +5V line drops below a threshold level, and whenever the Watchdog/Timer IC305 outputs a reset signal.

The Watchdog/Timer IC monitors activity on the receiver control line (IC307 pin 13) and if a pre-defined period of inactivity is observed, assumes that IC312 has locked-up and outputs a reset signal via TR303 to IC314 pin 2. Alert Tone generation is performed by IC305. Tone frequencies are determined by resistors switched in and out of the IC305 feedback circuit by isolation gates IC304a,b, and tone duration determined by gate IC304c. The gates are switched by Shift Register IC302, acting on data sent by microprocessor IC312.

When the ignition input line to the transceiver is pulled up to +12V, the voltage is applied to TR302 emitter. When the ON/OFF switch is set by the user to ON (switch closed), a 'low' is applied to TR302 base. This action switches on both TR302 and TR301 (via D301) to energise the Start Relay situated on the Analogue PWB. The 'high' on TR302 collector is also applied to Switch Input Register IC303, at pin 11, which is transferred as data, via IC306c, to microprocessor IC312. Once the microprocessor has acknowledged user action to switch on the unit, it instructs Shift Register IC302 to output a 'high' at pin 7 (Q4) to maintain the 'on' condition of TR302. Once this is done, the radio may only be switched off when the microprocessor sets Q4 to 'low', normally after the input to IC303 has gone 'low'. The microprocessor waits for the EEPROM to be updated by changes in RAM data before sending switch-off data.

30V Generation

The Tuning Law circuits and Loop Filter require +30V DC to provide sufficient voltage swing for complete frequency band coverage. This is generated on the Control PWB by oscillator IC318. Output at pin 6 is rectified by D310 and smoothed by C348, R373 and C349. A sample of the output, produced by R371, RV301 and R372, is applied to pin 1 of IC318 as feedback to provide a degree of adjustment of the output level.

Sequential Tone Signalling (SELCALL)

SELCALL functions are controlled by microprocessor IC404 which relies on master processor IC312 for its clock signal, which defines processing speed, and instructions from the console. Tone signalling data is stored in EPROM IC405, which is accessed via 8-bit latch IC406.

On decode, unsquelched and unfiltered receiver audio is applied to high-pass filter IC401b,c, which provides a low frequency cut-off at 500Hz, and is then fed to low-pass filter IC401a,d, which provides high frequency cut-off at 2800Hz. The signal is then applied to limiter IC402 which squares the audio to 5V logic, suitable for IC404. This is applied, via buffer IC403d, to the Interrupt input of microprocessor IC404 at pin 15.

The microprocessor reads the decode identity(ies) by measuring the falling-edge of incoming waveforms. Each tone is decode and passed to IC312 for sequence matching. It polls the interrupt line to IC312 and waits for a status request message at pin 14 (INT0). Depending on programming, reception of a valid decode sequence (ie a Group call or Unit Decode Identity) may stimulate the following:-

(a) The CALL Indicator to appear on the console display.

(b) Steady or intermittent Alert Tone.

(c) The receiver audio gate to open.

(d) An external output (eg ALARM).

(e) Transpond.

(f) A Paging call on a Paging channel.

In the encode mode, microprocessor IC404 generates the required tone sequence on port 1 (pins 7, 8, 9), as a series of square waves which are summed together by Digital-to-Analogue converter (DAC) IC403a,b,c, and IC402. The product is a 5-stepped squared waveform, which is applied to low-pass filter amplifier IC402c which rounds off the signal to produce an acceptable sine-waveform. The signal then passes via preset level potentiometer RV401 and then applied (together with any CTCSS signal) to summing amplifier IC502b. IC502b output is then presented to the transmitter audio input via SKB7.

Depending on programming, the microprocessor may initiate an encode sequence in response to the following:-

(a) The transceiver being switched-on.

(b) Key input from the console, or PTT pressed or released.

(c) Remote Reset or Transpond signal from the receiver.

(d) An external input (eg ALARM).

(e) The microphone going either on-hook or off-hook.

Where the transceiver is used in an E31-type telephone switching system, the microprocessor may also be used to decode "Freetone" tone bursts.

CTCSS Signalling

Unfiltered and unsquelched audio is fed via SKB11 to pins 22 & 23 of IC501, a CTCSS Encoder/Decoder device.

The operating frequency of IC501 is derived from an on-chip oscillator, the accuracy of which is controlled by ceramic resonator CER501, and various multipliers and filters which are tuned by capacitor elements switched by logic levels applied to data inputs DΦ-D5. Frequency data is sent from microprocessor IC312 via Strobe Shift Register IC307 and converted to parallel data by Shift Register IC503 for application to DΦ-D5.

The sub-audio signal is applied to an on-chip band-pass filter to reject unwanted adjacent CTCSS tones. The filtered CTCSS signal is then passed to a limiter where it is converted to logic levels and is fed to a digital period detector which measures each logic pulse; the outputs from the detector are used to set or reset the Detector Output latch. The Detector Output goes "high" when the correct CTCSS tone is detected; the output is presented to pin 16 of IC501 where it is fed via integration network R507, C507, D501, R506, before application to the comparator input at pin 14. Here it is compared with a reference voltage at IC501 pin 12 (set by R501, R502). An input voltage higher than the reference level will switch the comparator output (pin 13) low. Resistor R503, connected between the comparator output and reference input, introduces a level of hysteresis to prevent "jitter" at squelch threshold levels.

On the successful detection of the correct CTCSS tone, the tone detector output ("low") at pin 13 will be applied to Switch Input Register IC303 and converted to data for microprocessor IC303. The microprocessor then instructs the Shift Register IC302 to output a "high" at pin 13 (Q6) to enable audio gate IC304d, and allow audio to be returned to the receiver audio stages via SKB7.

If a CTCSS tone is required when the transceiver is keyed to transmit, microprocessor IC312 instructs Shift Register IC503 to output a 'high' at Q7 (pin 12) in order to power-up IC501 encoder. CTCSS encode frequency data (which can differ from decode frequency data) from the microprocessor is latched into IC501 data inputs DΦ-D5 by IC503. The on-chip oscillator and multipliers generate a low-distortion sub-audio sinewave signal at pin 17.

The CTCSS encode signal is then fed, via isolation gate IC504c and low-pass filter R517, C513, to the set level control RV501. The output is then applied to summing amplifier IC502b before application to the transmitter audio input via SKB7.

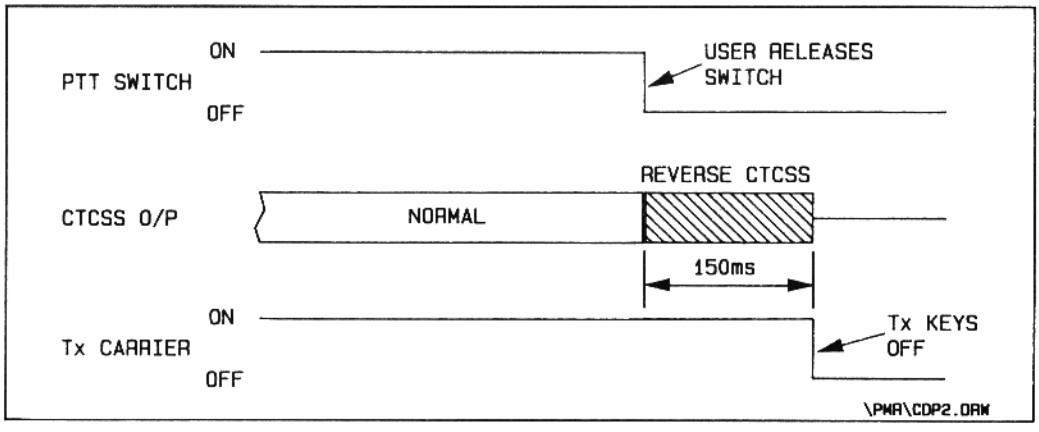


Fig 3.4 Example of Reverse Tone Burst Timing

When CTCSS Reverse Tone Burst is programmed, microprocessor IC312 instructs Shift Register IC503 to output a 'low' at Q8 (pin 11), which closes isolation gate IC504c,b, and opens gate IC504d. This re-directs the CTCSS signal through phase-shift amplifier IC502a. Typical phase shift is 126° at 120Hz.

CTCSS FREQUENCY TRUTH TABLE

TONE No	FREQ (Hz)	IC501 DATA BUS D5	D4	D3	D2	D1	DΦ
01	67,0	1	1	1	1	1	1
02	71,9	0	1	1	1	1	1
03	74,4	1	1	1	1	1	0
04	77,0	0	0	1	1	1	1
05	79,7	1	1	1	1	0	1
06	82,5	0	1	1	1	1	0
07	85,4	1	1	1	1	0	0
08	88,5	0	0	1	1	1	0
09	91,5	1	1	1	0	1	1
10	94,8	0	1	1	1	0	1
11	97,4	1	1	1	0	1	0
12	100,0	0	0	1	1	0	1
13	103,5	0	1	1	1	0	0
14	107,2	0	0	1	1	0	0
15	110,9	0	1	1	0	1	1
16	114,8	0	0	1	0	1	1
17	118,8	0	1	1	0	1	0
18	123,0	0	0	1	0	1	0
19	127,3	0	1	1	0	0	1
20	131,8	0	0	1	0	0	1
21	136,5	0	1	1	0	0	0
22	141,3	0	0	1	0	0	0
23	146,2	0	1	0	1	1	1
24	151,4	0	0	0	1	1	1
25	156,7	0	1	0	1	1	0
26	162,2	0	0	0	1	1	0
27	167,9	0	1	0	1	0	1
28	173,8	0	0	0	1	0	1
29	179,9	0	1	0	1	0	0
30	186,2	0	0	0	1	0	0
31	192,8	0	1	0	0	1	1
32	203,5	0	0	0	0	1	1
33	210,7	0	1	0	0	1	0
34	218,1	0	0	0	0	1	0
35	225,7	0	1	0	0	0	1
36	233,6	0	0	0	0	0	1
37	241,8	0	1	0	0	0	0
38	250,3	0	0	0	0	0	0

Synthesiser

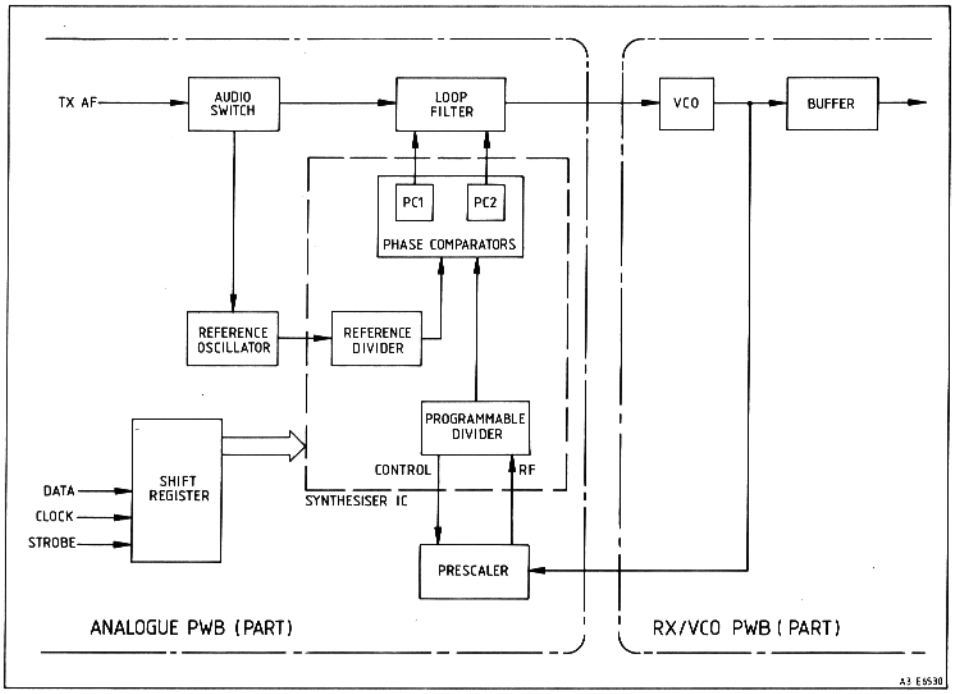


Fig 3.5 Synthesiser Block Diagram

The synthesiser is of a single-loop type with a VCO operating at either the transmitter channel frequency or receiver local oscillator frequency depending on whether the transciever is transmtting or receiving. All the transmitter and receiver frequencies are controlled by a single high stability crystal-controlled reference oscillator. On transmit, audio is applied to both the VCO (via the loop filter) and the reference oscillator, to prevent cancellation of the modulation by the phase comparator.

The reference oscillator TR132, is a Colpitts oscillator, with crystal XL131 running in series resonance mode. TR131 completes the feedback loop. Normally a crystal frequency of 8,4MHz is used, but where the receiver frequency (on any channel) is within ±50kHz of a multiple of the reference crystal frequency, alternative frequencies of 7,2MHz, 7,8MHz or 9,0MHz are used. To minimise long term drift, the crystal is pre-aged. A multi-turn potentiometer, RV131, is used to trim the reference frequency, and hence the transmit and receive frequencies, to the required values. Oscillator output is applied to IC104 pin 8.

Status of the Q outputs from Shift Register IC105 control the division ratio of IC104 reference divider. The reference frequency input to the phase comparators (the output from the reference divider) is either 5kHz (for 20kHz or 30kHz channel spacing) or 6,25kHz (for 12,5kHz or 25kHz channel spacing).

The phase comparators require two input signals, one from the reference divider and the other from the VCO programmmable divider. The programmmable divider, together with Prescaler IC102 enables the VCO output frequency to be changed in steps equal to the equipment channel spacing. There are two phase comparators, PC1 and PC2, and both compare the phase of the two divider outputs.

Phase comparator PC1 is a high gain sample-and-hold comparator which gives good noise performance but is slow to acquire lock. Phase comparator PC2 is a low gain digital comparator which is able to acquire lock rapidly but is noisy. IC101 circuitry is arranged so that phase comparator PC2 rapidly brings the loop into the linear range of PC1 and then goes tri-state. In this way, the loop is able to acquire lock rapidly whilst maintaining the good noise performance of PC1.

The loop filter is a conventional low-pass filter using operational amplifier IC103b. The filtered output is available as the control voltage for the VCO (VHF) or VCOs (UHF) at PLF3 (TUNE VOLTS). In order to produce the necessary control voltage range, IC103 operates from the 30V supply generated on the Control PWB. A buffer, IC103a, provides a TUNE VOLTS output suitable for the Control PWB microprocessor, at PLA12.

An out-of-lock signal ('low') is presented at IC104 pin 3 until phase comparator PC2 goes tri-state. This is applied to the switch input shift register ICxxx, as control data for microprocessor ICxxx, and to TRxxx, LEDxxx as a visual indication of lock for fault finding purposes.

Two types of prescaler are used, depending on frequency band; VHF band equipments use a prescaler with an 80/81 division ratio, while UHF band equipments use a prescaler with a 128/129 division ratio. The prescaler is of the two modulus type and its division ratio is controlled at pin 8 by synthesiser IC102. A sample of VCO output is applied via PLE1 to the prescaler at pin 5 (pin 2 on UHF prescalers). The prescaler output is divided down (within IC102) to the same frequency as the reference oscillator frequency; the required division ratio equalling the prescaler output frequency divided by the phase comparator reference frequency (6,25kHz or 5kHz).

Transmitter Switching

Transmit/receive switching data from the Control PWB is sent to Shift Register IC2 and is output at pin 11 (Q8) as a 'high' level for transmit and 'low' for receive. A 'high' will switch on TR3 and hence TR2 (via D2) and TR1. Transistor TR2 switches +10V DC to the Tx pre-amplifier stages via PLC1 and TR1 switches current to the antenna pin-diode switches via PLC7. Double-diode D1a,b controls the voltage drop on TR1 base and hence limits the current to the pin-diodes.

At switch-on, TR4, TR3 hold the radio in the receive mode momentarily, in order to allow all device gates to set to their correct 'state'. This 'hold' time is determined by the time constant of R27, C17.

Transmitter Power Control

Power Level Data from the Control PWB is output from Shift Register IC2 between gates Q1 to Q7 and is applied to the D to A converter comprising resistor array RN1 and operational amplifier IC1d. Output from IC1d is fed to buffer TR8, calibration potentiometer RV1 and operational amplifier IC1c, before application as a reference level for comparator IC1a at pin 3. Temperature compensation is added by IC1c, R22, D6, as the Schottky diodes in the power detector circuits do not have a linear response.

To prevent spurious power-settings, R16, C10 provide smoothing for the reference level.

Output from the Tx PA Schottky diode detectors (Tx Detector Output) at PLC3 is buffered by IC1b before application to the second comparator input at IC1a pin 2. IC1a output is applied to TR5-7 and to the Control PWB input register via PLB6. Transistors TR7, TR6, TR5 form a DC amplifier which produces a DC output suitable to drive the TX PA driver devices. Potentiometer RV2 limits the maximum control output voltage available. Diode D5 provides temperature compensation for TR7, and D7 holds TR7 emitter voltage "up" when the amplifier stages are in limiting.

Bias for the Schottky diodes is provided by R24, R25, and is presented to the Tx PA via PLC2.

Logic levels required from IC2 output gates for specified transmitter power levels are given at the end of Section 4.

Transmitter Audio

Signals from the microphone are applied via the Control PWB to PLA4 and fed to operational amplifier IC55a. Amplifier gain is adjusted by RV53 to compensate for variations in microphone sensitivity. Further amplification is provided by IC55b. The audio signal is then applied to IC55c which adds a 6dB/octave pre-emphasis characteristic and limiting to the signal. The output is applied to a 2nd order Chebishev (Tchebishev) filter, which has a very sharp cut-off profile. Audio is then output to IC53a,b, a 4th order Butterworth filter, which in combination with IC55c, produces a flat in-band response with a good high frequency roll-off characteristic.

Signalling tones are applied to the AF stages via IC52a, which is controlled by pin 13 (Q6) of Shift Register IC54. As these signals are on a low impedance line, their connection to resistive bridge R67, R64, attenuates speech output and thus prevents over-modulation during tone transmission.

When in-band tones (eg SELCALL) are being transmitted, IC54 pin 12 (Q7) goes 'low', disabling transmission gate IC52b, inhibiting microphone audio from the remainder of the audio stages and thus preventing speech corrupting out-going tone information. When speech is allowed to pass the transmission gate, IC55d output is attenuated by R70, R69, before application to IC53a.

The combined audio sources are then filtered by IC53a, b & c. Where group delay is a critical factor (eg digital signalling in FM1200 variants) signals are applied to IC53c via transmission gate IC52d. Modulation level is adjusted by RV52.

Audio is then passed to IC51a, a buffer amplifier whose output is applied to the VCO modulator and IC51b which provides a buffered output for the reference oscillator. Potentiometer RV51 provides modulation balance, by adjusting the audio level to the reference oscillator.

Receiver IF and AF

FL301 is a six-pole crystal filter which provides a high degree of selectivity against unwanted adjacent channel signals. Output from FL301 is then fed via pre-amplifier TR201 to the input of IF Amplifier/Demodulator IC201. Diodes D201a,b limit the signal to prevent overloading IC201 input.

IC201 provides further amplification of the 21,4MHz signal before application to the internal 2nd mixer, where the signal is converted to 455kHz. The second mixer oscillator is external, comprising TR202, XL201 running at 21,855MHz (standard) or 20,945MHz (alternative) and is applied to IC201 at pin 19. The product is then fed through external 455kHz ceramic filter FL202 and then returned to IC201 which provides 2nd IF amplification and demodulation. A quadrature detector is employed in IC201, and is tuned by external quadrature coil L202. There is also a RSSI output on IC201 at pin 11.

Demodulated audio output from IC201 pin 4 is then applied to IC202b, a low-pass filter with a 120kHz cut-off which removes any 455kHz signal component and harmonics. The audio signal then is fed through limiter IC202c which removes high impulse noise before application to isolation gate IC204b, which, when a 'high' is applied to pin 5, breaks the signal path to pin 2 of IC203a should tone-signalling control of the receiver be required. Audio for the tone-signalling circuits (incorporated on the Control PWB) is taken from the junction of R225, R223. Audio is returned from the tone-signalling circuits (subject to signalling control status) via R268, C224. Buffer IC203a sets the HF response of the audio signal by introducing a 6dB/octave de-emphasis characteristic. Audio is then applied to the external isolation gates IC204d and IC204e, which, if required, breaks the direct signal path to IC203d, allowing audio to be re-directed, or processed, by an external stage via the external options connector PLJ.

A high-pass filter, IC203d, shapes the LF audio characteristic by providing a 300Hz roll-off, and after passing through the receiver mute gate IC204a, is applied to the low-pass filter IC203c, which provides a 3kHz cut-off.

Control of the audio gain level is provided by a four-stage electronic volume control comprising transistors TR203-TR206 which switch resistive attenuators in or out, according to voltages to their bases by shift register IC205. A preset (master) volume control is provided by RV203, TR207.

Final amplification is carried out by power amplifier IC206; its output is presented at PLB10 where it is directed via the Control PWB to connectors at the front and rear of the transceiver.

A portion of the output from IC202b pin 7 is applied to noise squelch circuits IC202a, IC202d, IC207. IC202a is a high-pass filter with a 35kHz cut-off and IC202d a high-gain amplifier which is controlled by thermister TH201. The filtered and amplified noise output is then directed through the active rectifier stage IC207a, D203a, D203b to the active smoothing stage IC207b,c,d. Overall gain is adjusted by preset RV204 and the output is applied to PLB1.

TRANSMITTER POWER AMPLIFIERS

All frequency band versions of the PWB are of untuned broadband circuit design. All buffer stage input and output impedances are close to 50Ω to improve broadband performance. Connections between pre-amplifier, driver and power amplifier devices are made via multiple-section matching networks and printed circuit microstrips.

Transmitter PA AT29027 (E0 Band)

Drive from the Rx/VCO PWB is applied via PLD3 at a level of 0dBm to buffer amplifiers TR705, TR704, which receive their DC supply from the Tx Switched +10V line. The signal is then amplified by pre-amplifier TR703, driver TR702 and power amplifier TR701. TR703 and TR702 receive their DC supply from the Tx Power Level Control line, and hence transmitter power is ultimately determined by the voltage level applied to their collectors. PA transistor TR701 is powered from the +13,6V line.

The signal, at final carrier power, is applied via low-pass filter C706, L703, C705, C704, L702, C703, C702, L701 and C701, to the antenna socket.

Schottky diodes D703a,b are connected to each end of L707, which produces a nominal 90° phase shift across its terminals at mid-band frequencies. Thus, even in VSWR mis-match conditions, if a null is detected at one end of L707, a peak should be detected at the other end. Outputs from the diodes are summed and hence the detector output level is determined by the diode providing the higher DC level. Bias for the Schottky diodes is supplied at PLB5 (from the Analogue PWB).

On receive, signals from the antenna are fed through the three-stage antenna low-pass filter to the pin-diode antenna switch. The Antenna Switch Control line (PLB1) will be 'low' on receive, switching off D701 and D702, and hence directing received signals to the RF input on the Rx VCO Assembly via PLA1.

Transmitter PA AT29025/- (A9, B0, Bands)

Drive from the Rx/VCO PWB is applied via PLD3 at a level of 0dBm to buffer amplifiers TR904, TR903 and preamplifier TR902, which receive their DC supply from the Tx Switched +10V line. The signal is then amplified by driver TR901 and power amplifier TR900. TR901 receives its DC supply from the Tx Power Level Control line, and hence transmitter power is ultimately determined by the voltage level applied to its collector. PA transistor TR900 is powered from the +13,6V line.

The signal, at final carrier power, is applied via low-pass filter C906, L902, C905, L901, C903, L900 and C901, to the antenna socket.

Schottky diodes D902a,b are connected to each end of L906, which produces a nominal 90° phase shift across its terminals at mid-band frequencies. Thus, even in VSWR mis-match conditions, if a null is detected at one end of L901, a peak should be detected at the other end. Outputs from the diodes are summed and hence the detector output level is determined by the diode providing the higher DC level. Bias for the Schottky diodes is supplied at PLB5 (from the Analogue PWB).

On receive, signals from the antenna are fed through the three-stage antenna low-pass filter to the pin-diode antenna switch. The Antenna Switch Control line (PLB1) will be 'low' on receive, switching off D900 and D901, and hence directing received signals to the RF input on the Rx VCO Assembly via PLA1.

Transmitter PA AT29026/- (K1, K2 Bands)

Drive from the Rx/VCO PWB is applied via PLD3 at a level of 0dBm to buffer amplifiers TR1004 and TR1003 which receive their DC supply from the Tx Switched +10V line. The signal is then passed to pre-amplifier TR1002, driver TR1001 and power amplifier TR1000. TR1002 and TR1001 receive their DC supply from the Tx Power Level Control line, and hence transmitter power is ultimately determined by the voltage level applied to their collectors. PA transistor TR1000 is powered from the +13,6V line.

The signal, at final carrier power, is applied via low-pass filter C1006, C1005, L1002, C1004, L1001, C1003, C1002, L1000 and C1000, to the antenna socket.

Schottky diodes D1002a,b are connected to each end of L1005, which produces a nominal 90° phase shift across its terminals at mid-band frequencies. Thus, even in VSWR mis-match conditions, if a null is detected at one end of L1001, a peak should be detected at the other end. Outputs from the diodes are summed and hence the detector output level is determined by the diode providing the higher DC level. Bias for the Schottky diodes is supplied at PLB5 (from the Analogue PWB).

On receive, signals from the antenna are fed through the three-stage antenna low-pass filter to the pin-diode antenna switch. The Antenna Switch Control line (PLB1) will be 'low' on receive, switching off D1000 and D1001, and hence directing received signals to the RF input on the Rx VCO Assembly via PLA1.

Transmitter PA AT29028/- (UHF Bands)

Drive from the Rx/VCO PWB is applied via PLD3 at a level of +8dBm to buffer amplifiers TR1205 and TR1204 which receive their DC supply from the Tx Switched +10V line. The signal is then passed to pre-amplifier TR1203, driver TR1202 and power amplifier TR1201. TR1203 receives its DC supply from the Tx Power Level Control line, and hence transmitter power is ultimately determined by the voltage level applied to its collector. Driver TR1202 and power amplifier TR1201 are powered from the +13,6V line.

On 6 watt versions of the PWB, power amplifier TR2101 is omitted and link LK1201 added to carry the signal to the antenna filter. The matching networks for TR2101 are also omitted to maintain 50Ω impedance at TR2102 output.

The signal, at final carrier power, is applied via low-pass filter C1207, C1206, L1203, C1205, L1202, C1204, C1203, L1201, C1202 and C1201, to the antenna socket.

Schottky diodes D1203a,b are connected to each end of L1206, which produces a nominal 90° phase shift across its terminals at mid-band frequencies. Thus, even in VSWR mis-match conditions, if a null is detected at one end of L1206, a peak should be detected at the other end. Outputs from the diodes are summed and hence the detector output level is determined by the diode providing the higher DC level. Bias for the Schottky diodes is supplied at PLB5 (from the Analogue PWB).

On receive, signals from the antenna are fed through the three-stage antenna low-pass filter to the pin-diode antenna switch. The Antenna Switch Control line (PLB1) will be 'low' on receive, switching off D1201 and D1202, and hence directing received signals to the RF input on the Rx VCO Assembly via PLA1.

Provision for resistive attenuation is made on the Tx PA PWB for when de-sensitizing of the receiver is required; however in most applications this feature is not required and the resistors are omitted.

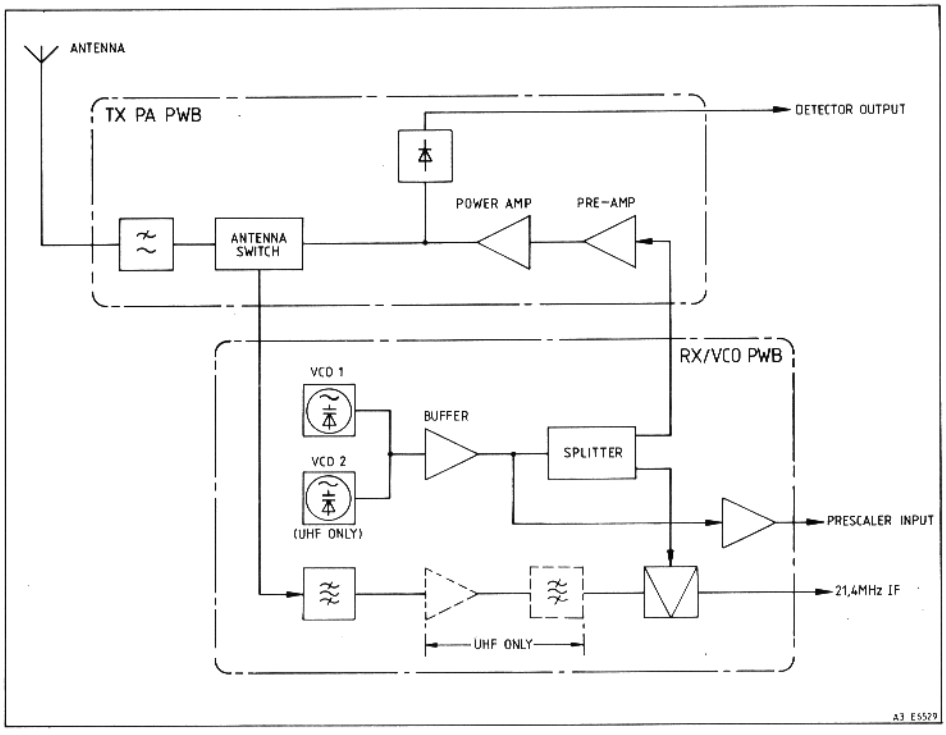


Fig 3.6 Transceiver Front End Block Diagram

Rx VCO ASSEMBLY AT29029/- (E0 Band)

Signals for the receiver from the PA antenna switch are applied to L602. Provision for resistive attenuation is made on the Rx VCO Assembly where de-sensitizing of the receiver is required; however in most applications this feature is not required and the resistors are omitted. The required selectivity is provided by a 4-pole electronically-tuneable filter comprising varicap diodes D600 - D618 and associated components; the varicap diodes are arranged in a back-to-back format to minimise distortion of the tuned signal. As the varicap diodes must be finely-matched to provide accurate tracking over the entire frequency band, four unused and similarly-matched varicap diodes are provided on the PWB assembly for spares, obviating replacement of all varicap diodes in the event of the failure of one.

The filtered signals are then applied to g1 of dual-gate MOSFET TR601. Local oscillator output, at 21,4MHz above receiver carrier frequency, is applied to g2 of TR601 and the product is output at its drain. Resistor R609, inductor LV601 and capacitors C601, C604 provide suitable matching for the 21,4MHz crystal filter on the Analogue PWB.

Oscillator output is taken from TR653 source and is fed via C662 to buffer TR654, a dual-gate MOSFET, whose output, provides oscillator output via C668 to amplifier TR657. A Wilkinson Splitter, formed by C673, L657, C674, and L658, C675, splits power from TR657 collector equally to each end of R674. Signal level at the injection coil L605 is typically +8dBm, which is suitable for application to the 1st mixer TR601. However, the transmitter power amplifier requires a level of 0dBm, and thus the signal from L658 is attenuated by R675, R676, R677.

A sample signal from TR854 drain is provided for the Prescaler via C664, TR656, and is presented at PLA4.

The Voltage Translation circuit comprises IC601 and is powered by the 30V line from PLA13. The latter part of IC601 controls the set-point and slope for the tuning law; RV601 alters the slope. Typical tuning voltage range is 8-20V. When the transceiver is transmitting, TR602 is switched on by the VCO Tx/Rx control line, pulling the translation output down to 0V, and hence de-tuning the receiver band-pass filter.

Rx VCO ASSEMBLY AT29029/- (A, B, K Bands)

Signals for the receiver from the PA antenna switch are applied to L802. Provision for resistive attenuation is made on the Rx VCO Assembly where de-sensitizing of the receiver is required; however in most applications this feature is not required and the resistors are omitted. The required selectivity is provided by a 4-pole electronically-tuneable filter comprising varicap diodes D800 - D815 and associated components; the varicap diodes are arranged in a back-to-back format to minimise distortion of the tuned signal. As the varicap diodes must be finely-matched to provide accurate tracking over the entire frequency band, four unused and similarly-matched varicap diodes are provided on the PWB assembly for spares, obviating replacement of all sixteen diodes in the event of the failure of one.

The filtered signals are then applied to g1 of dual-gate MOSFET TR800. Local oscillator output, at 21,4MHz below receiver carrier frequency, is applied to g2 of TR800 and the product is output at its drain. Inductors LV801, L806 and capacitors C811, C814 provide suitable matching for the 21,4MHz crystal filter on the Analogue PWB.

VCO frequency coverage is determined manually by CV858 and electronically by varicap diodes D851, D852. Modulation compensation is provided by D853. To maintain frequency stability, a ripple-free power supply must be provided for the VCO, and the supply line from the Analogue PWB is smoothed further by capacitance multiplier network C860, R857, TR853.

The VCO Tx/Rx line (PLA6) is 'low' for receive, thus switching on TR850, switching off TR851 and D850. This effectively adds the inductance of L851 in series with L852, pulling JFET oscillator TR852 down in frequency, so that the local oscillator can track 21,4MHz below the receiver carrier frequency. When the transceiver is keyed to transmit, the VCO Tx/Rx line is 'high', switching on D850 which decouples L851 via C851, so that L852 is the only resonant inductance.

Oscillator output is taken from TR852 source and is fed via C862 to buffer TR854, a dual-gate MOSFET, whose output, provides oscillator output via C868 to amplifier TR856. A Wilkinson Splitter, formed by C874, L857, C875, and L858, C876, splits power from TR856 collector equally to each end of R874. Signal level at the injection coil L801 is typically +8dBm, which is suitable for application to the 1st mixer TR800. However, the transmitter power amplifier requires a level of 0dBm, and thus the signal from L858 is attenuated by R875, R877, R876.

A sample signal from TR854 drain is provided for the Prescaler via C865, TR855, and is presented at PLA4.

The Voltage Translation circuit comprises IC800 and is powered by the 30V line from PLA13. The latter part of IC800 controls the set-point and slope for the tuning law; RV801 alters the slope, RV802 sets the level. Typical tuning voltage range is 8-20V. When the transceiver is transmitting, TR801 is switched on by the VCO Tx/Rx control line, pulling the translation output down to 0V, and hence de-tuning the receiver band-pass filter.

Rx VCO ASSEMBLY AT29031/- (UHF Bands)

Signals for the receiver from the PA antenna switch are applied to L1101. The required selectivity is provided by a 2-pole electronically- tuneable filter comprising varicap diodes D1102 - D1109 and associated components; the varicap diodes are arranged in a back-to-back format to minimise distortion of the tuned signal. The signals are then amplified by TR1101, a gallium-arsenide dual-gate MESFET, before application to a 4-pole tuneable filter comprising D1110 - D1125. Again the diodes are arranged in a back-to-back format. As the varicap diodes must be finely-matched to provide accurate tracking over the entire frequency band, four unused and similarly-matched varicap diodes are provided on the PWB assembly for spares, obviating replacement of all varicap diodes in the event of the failure of one.

The filtered signals are then applied to g1 of dual-gate MOSFET TR1102. Local oscillator output, at 21,4MHz below receiver carrier frequency, is applied to g2 of TR1102 and the product is output at its drain. Inductor LV1101, and capacitors C1146, C1147 provide suitable matching for the 21,4MHz crystal filter on the Analogue PWB.

Frequency coverage of the JFET receiver VCO (TR1151) is determined manually by CV1108 and electronically by varicap diode D1151, which resonate with a shortened 1/4 wave transmission line. The oscillator tracks 21,4MHz below the receiver channel frequency. Output is taken from the oscillator feedback circuit, at the junction of C1158, C1159 and is applied to g1 of buffer TR1153, a dual-gate MOSFET.

JFET TR1154 is the transmitter VCO, the frequency coverage of which is determined manually by CV1109 and electronically by D1153, and a shortened 1/4 wave transmission line; modulation compensation is provided by D853. Output is taken from the oscillator feedback circuit, at the junction of C1173, C1174 and is applied to g1 of buffer TR1156.

The VCO Tx/Rx line (PLA6) is 'low' for receive, thus switching on TR1152, via TR1155, switching on the receiver VCO. When the transceiver is keyed to transmit, the VCO Tx/Rx line is 'high', switching on TR1155 and hence the transmitter VCO. To maintain frequency stability, a ripple-free power supply must be provided for the VCO, and the supply line from the Analogue PWB is smoothed further by capacitance multiplier network C1183, R1175, TR1158.

Output from the two VCO buffers are combined and applied via C1177 to amplifier TR1159. A Wilkinson Splitter, formed by C1189, L1161, C1190, and L1162, C1191, splits power from TR1159 collector equally to each end of R1181. Signal level at the injection coil L1108 is typically +8dBm, which is suitable for application to the 1st mixer TR1102 and the UHF Transmitter power amplifier input.

A sample signal from TR1157 drain is provided for the Prescaler and is presented at PLA4 via C1181.

The Voltage Translation circuit comprises IC1101 and is powered by the 30V line from PLA13. The latter part of IC1101 controls the set-point and slope for the tuning law; RV1101 alters the slope, RV1102 sets the level. Typical tuning voltage range is 8-20V.

DISPLAY CONSOLE

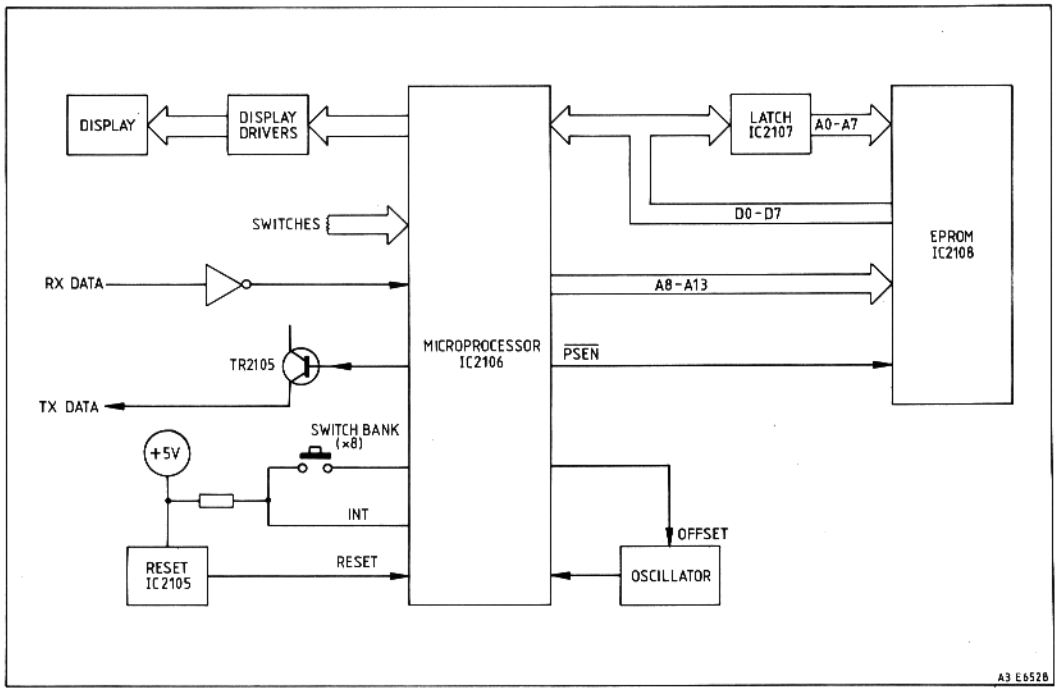


Fig 3.7 Console Block Diagram

Microprocessor IC2106 receives and issues control information to and from peripheral devices. System operation is defined by a set of instructions stored in EPROM IC2108. These instructions are read by the microprocessor by first addressing the EPROM via the 8-bit latch IC2107 and then taking PSEN 'low'. Instructions are read and processed at a speed defined by the microprocessor crystal oscillator frequency and on-board oscillator-dividers. The microprocessor cycles through a loop until an 'interrupt' signal is received.

The microprocessor is reset at pin 10 by Reset chip IC2105 whenever the +5V regulated line drops below an acceptable level. The Console PWB has its own +5V regulator IC2104, which receives power from the transceiver 13,6V line at PLA1.

Two interrupt inputs to the microprocessor, INT0 and INT1, are held at +5V by R2105 and R2104 respectively. When a display button key is depressed, a 'low' is applied to the relevant input to inform the microprocessor to look for key switch action. Switches SW2102-SW2105 put an interrupt on IC2106 pin 14 (INT0) and switches SW2106-SW2109 put an interrupt on IC2106 pin 15 (INT1).

The microprocessor receives data from the transceiver which informs it as to whether clock offset is required for the current channel or not. If offset is required, the microprocessor puts a 'low' on TR2103 base via bridge R2116/R2115. This switches off TR2103 which in turn switches on TR2102, effectively putting C2117 in parallel with C2116 and pulling XL2117 down onto its calibration frequency. The frequency offset is not sufficient to disrupt the operation or timing of the microprocessor (see 'Control PWB').

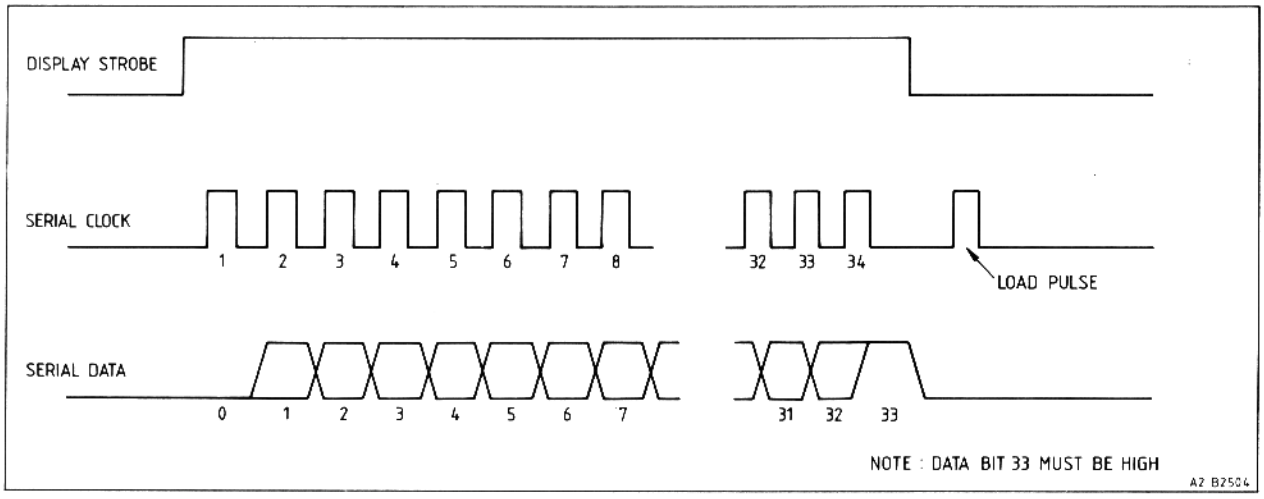


Fig 3.8 Display Driver Timing Diagram

For correct operation, LCD2101 requires a square-wave of approximately 50Hz which is applied to the LCD common backplane, with individual display segments driven in phase to switch them off, or out of phase to switch them on.

Two display drivers IC2101 and IC2102 are employed: these have a three line serial bus structure enabling serial data transfer from IC2106. Both have on-board oscillators; only that in IC2102 is used to drive the LCD backplane, the oscillator in IC2101 is disabled by grounding pin 3.

When the microprocessor makes the DISPLAY STROBE line high, data from the microprocessor is clocked into the driver by SERIAL CLOCK pulses, also provided by the microprocessor. Data is locked into the driver when the DISPLAY STROBE is low. At the 35th clock pulse the data is transferred to the LCD; LCD segments are switched on as a result of corresponding 'high' serial data bits. As data is locked into the driver, the display is updated only when display information needs to be changed, ie as a result of pressing a console button.

The display backlight is switched on and off by the microprocessor via IC2103a,b,c, and TR2104.

Basic Console

The Basic Console comprises principally of IC2006, a parallel-output shift register with a second shift register (IC2004) connected to its serial output. Serial data, clock and strobe lines to the Basic Console are buffered by IC2005. The Data line is normally held high by R2017.

A 2 byte serial message from the Control PWB is transmitted to the Basic Console along the data line and is clocked into the Shift Registers IC2006 and IC2004 respectively. The first serial byte resides in IC2004 and the second in IC2006. If the bit to appear at O7 of IC2006 (pin 12) is set high when the first strobe input to the Basic Console is pulsed high, O7 output will be latched high. (Normally the output is low due to the resistor R2105 pulling the tri-state output down.) This action pulses the strobe input of IC2004, causing the byte residing there to be latched to outputs O0 to O7. Parallel outputs O0 to O6 drive LED indicators via NAND gates IC2002, IC2003. Output O7 drives LED2001 via TR2001.

Input shift register IC2007 may be activated by a strobe from IC2006. The serial input of IC2007 (pin 10) is connected to 0V. While IC2007 remains unstrobed, the inversion and tri-state output of IC2003 result in no data being impressed on the data line when IC2007 receives clock pulses. However, a 'low' on IC2007 pin 1 will prompt it to load parallel data from the console switches into its shift register. This occurs when IC2006 is strobed by a pulse on the strobe line and the byte held in its shift register results in a low level at O6. If, at this moment, any of the switches SW2002 to SW2008 are closed, the serial output byte shifted out of IC2007 (by the next eight clock pulses) will contain low levels at the relevant switch positions. IC2007 serial output is OR'ed to the data line by a section of NAND gate IC2003. The data line can then be read by the Control PWB.

Power on indication is provided by LP2001 switched in parallel with the ON/OFF line by a section of SW2001. A regulated 5V supply is provided by IC2001. Potentiometer RV2001 is the voltage control for the loudspeaker volume.

Standard Microphone AT29036

An electret microphone insert with integral FET amplifier is used, and receives a nominal 4,7V power supply produced by zener diode D1501, derived from the transceiver's nominal +13,6V supply (via R1501). Microphone output is presented at PLA5.

Hookswitch SW1503 is a reed switch which closes when it is in the proximity of a magnetic field, normally when the microphone is located within the microphone rest ("On Hook"). Facility switch SW1502 may be used instead of one of the Console keys, subject to transceiver programming.

SECTION 4
SERVICING

PRECAUTIONARY NOTES AND GENERAL INFORMATION

WARNING

The Power Amplifier PWB uses semiconductors containing Berryllium Oxide. If inhaled, dust from this oxide can be toxic. No danger can arise from normal handling but no attempt should be made to tamper with these devices.

They should not be discarded with industrial or domestic waste.

A full list of these devices is given in the Parts List.

CAUTION

Metal Oxide Semiconductors are used in this equipment, therefore the following precautions should be strictly observed, otherwise the devices may become damaged.

(a) Device leads should always be in contact with a conductive material to avoid the build-up of static charges.

(b) Soldering iron tips, tools and metal parts of test equipment used during servicing must be grounded.

(c) To avoid transient voltage spikes, devices must not be inserted into, nor removed from, circuits with power applied.

(d) Signals must NOT be applied to integrated circuits in the absence of power supplies to the devices.

(e) Use conductive foam on work surfaces.

Servicing Philosophy

The FM1000 series equipment is designed for repair down to component level but experience of Surface Mounted Devices (SMDs) is required. It is recommended that the first line of repair is to exchange or replace complete PWB assemblies having first located the general area of the fault with a basic complement of test equipment. Component level servicing may require sophisticated test equipment, and is best carried out at a centralised repair workshop. In particular, the Rx/VCO PWB is factory adjusted and should not require re-alignment during normal servicing.

Routine Frequency Adjustments

Although the pre-aged reference oscillator quartz crystal used in this equipment is extremely accurate and reliable, it is important to realise that crystals "age" slightly and require re-adjustment periodically. Therefore, the FREQUENCY TRIMMING PROCEDURE in Section 2 needs to be carried out as a matter of routine at least once a year. The need for this adjustment is not affected by whether or not the equipment is in use; it occurs even during careful storage and is greatest when the crystal is new.

As the reference oscillator frequency ultimately determines all transmit and receive frequencies, great care must be taken in setting it to an accurate frequency standard.

Fault Finding - Integrated Circuits (ICs)

In the event of an apparent failure of an IC, all external components should be checked to prove the serviceability, or otherwise, of the IC before replacing it.

It is essential that these checks be carried out, otherwise the original cause of the failure could still be present and damage the replacement item.

Transmitter Loading

Although protection circuits ensure that the transceiver operates safely over a wide range of loading conditions, it is not advisable to operate the transmitter without a load connected to the antenna socket. During transmitter servicing, the RF Power Meter provides a suitable termination.

Printed Wire Boards (PWBs)

Particular care should be taken not to bend a PWB when removing, replacing, or working on it, as this may cause hairline breaks in the printed tracks, and such breaks are difficult to locate. DO NOT connect test leads to a printed track.

Replacement of wire-ended components

When replacing wire ended-components, ensure that the wires do not protrude more than 1mm beyond the track surface. Failure to do this may result in short circuiting the component to another track or print wire board.

Surface Mounted Devices (SMDs)

This equipment utilises a large number of SMD components. Soldering of these sub-miniature components should be carried out at the lowest practicable temperature, preferably using a thermistatically-controlled soldering iron providing a bit temperature of 250°C. If these components are removed for any reason they MUST NOT be re-used, but replaced by new items. Due to the small size and lack of identification on these components, the replacement item should be fitted as soon as it is removed from the packet or container. Removal of ICs may cause printed wire tracks to lift, so avoid if possible (see "Fault Finding - Integrated Circuits" above). Inspect all new solder joints and clean away any foreign material.

Soldering

Soldering operations should be kept to a minimum. Ensure that the equipment is switched off before commencing any soldering operation.

The amount of solder used, and the dwell time of the soldering iron should be kept to the minimum required for practical purposes. Avoid excessive heat by using heat shunts, and always check that the holes in the PWB are clear of solder before fitting a component.

Wherever possible, use a low voltage DC soldering iron with an earthed bit. When soldering wire ends in plated-through holes of PWBs, ensure that solder flows through the hole to emerge on the other side of the board.

Module and Board Pins - Cleaning

Contamination from grease or dust should be removed by the application of contact cleaning fluid only (such as RS Components Ltd, -Cat No 554/175). Under NO circumstances should any abrasive or corrosive cleaning agent be used. Do not use cleaning fluid on Liquid Crystal Displays.

Elastomeric Connectors (Zebra Strips)

"Zebra Strips" are used in Display consoles. These are stratified interconnectors, made up of alternate layers of conductive and non-conductive silicon, and are used to carry signals from the PWB to the Liquid Crystal Display (LCD). It is important that the strips are located correctly between the LCD and printed conductor. If any strip should become damaged or contaminated, it should be replaced with a new item.

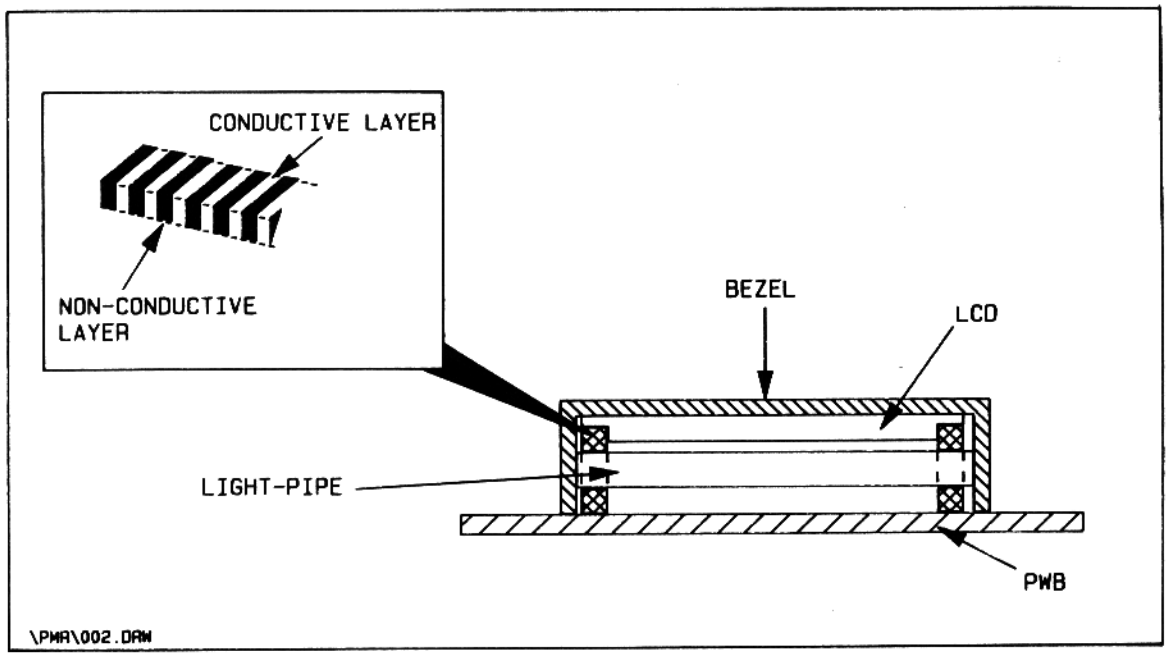


Fig 4.1 Location of Zebra Strips

"Pozidriv" Screws

"Pozidriv" screws are used in this equipment. Only the correct size of "Pozidriv" screwdriver should be used to release or tighten these screws (No 1 is suitable for screws up to metric size M3; No 2 for screws larger than this). The use of any other screwdriver type can result in severe damage to the screwhead.

Component Code Allocation

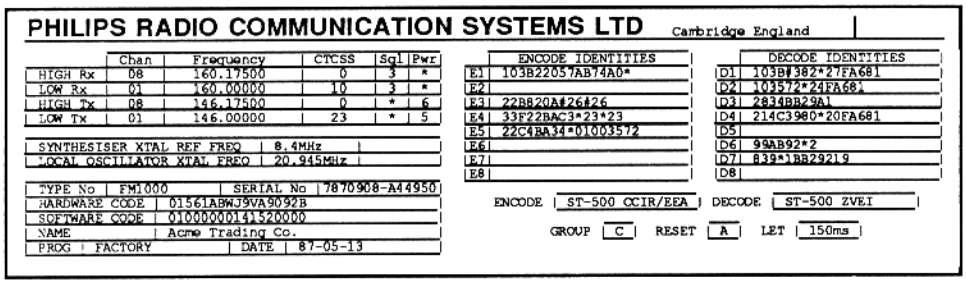
The components on each PWB are allocated a unique range of coding numbers. Where a particular PWB has more than one major circuit function, the code numbering is sub-divided into sub-ranges. Code allocations are as follows:-

Cct Ref	Printed Wire Board	Sub-ranges	
001-300	Analogue	001-050	Tx Power Control
		051-100	Tx Audio
		101-130	Synthesiser
		131-160	Reference Oscillator
		161-200	Decoupling PWB
		201-280	Rx IF & AF
		281-300	Level Shift & others
301-600	Control	301-400	Transceiver Control
		401-500	Sequential Signalling
		501-550	CTCSS Signalling
		551-600	reserved
601-700	E Band Rx	601-650	Rx Front End
		651-700	VCO
701-800	E Band Tx		
801-899	A, B, K Bands Rx	801-850	Rx Front End
		851-900	VCO
900-999	A, B Bands Tx		
1000-1100	K Band Tx		
1101-1200	UHF Rx Front End	1101-1150	Rx Front End
		1151-1200	VCO
1501-1600	Microphone	1501-1520	Standard
		1521-1540	Keypad
		1541-1550	DTMF
		1551-1600	reserved
1601-2100	reserved		
2101-2200	Console		

EQUIPMENT DATA SHEET/LABEL

An individual data sheet, listing all transmitter and receiver frequencies including signalling information, is supplied with each transceiver (see Section 2).

A summary of equipment configuration (Data Sheet details) is recorded on a label attached to the underside of one of the equipment covers.



PHILIPS RADIO COMMUNICATION SYSTEMS LTD Cambridge England

	Chan	Frequency	CTCSS	Sql	Pwr
HIGH Rx	D8	160.17500	0	3	*
LOW Rx	01	160.00000	10	3	*
HIGH Tx	D8	146.17500	0	*	6
LOW Tx	01	146.00000	23	*	5

SYNTHESISER XTAL REF FREQ	8.4MHz
LOCAL OSCILLATOR XTAL FREQ	20.945MHz

TYPE No	FM1000	SERIAL No	7870908-A44950
HARDWARE CODE	01561ABWJ9VA9092B		
SOFTWARE CODE	010000001415200000		
NAME	Acme Trading Co.		
PROG	FACTORY	DATE	87-05-13

	ENCODE IDENTITIES
E1	103B22057AB74A0*
E2	
E3	22BB20A#26#26
E4	33F22BAC3*23*23
E5	22C4BA34*01003572
E6	
E7	
E8	

	DECODE IDENTITIES
D1	103B#382*27FA681
D2	103572*24FA681
D3	2834BB29A1
D4	214C3980*20FA681
D5	
D6	99AB92*2
D7	839*1BB29219
D8	

ENCODE ST-500 CCIR/EEA DECODE ST-500 ZVEI

GROUP C RESET A LET 150ms

Fig 4.2 Equipment Label

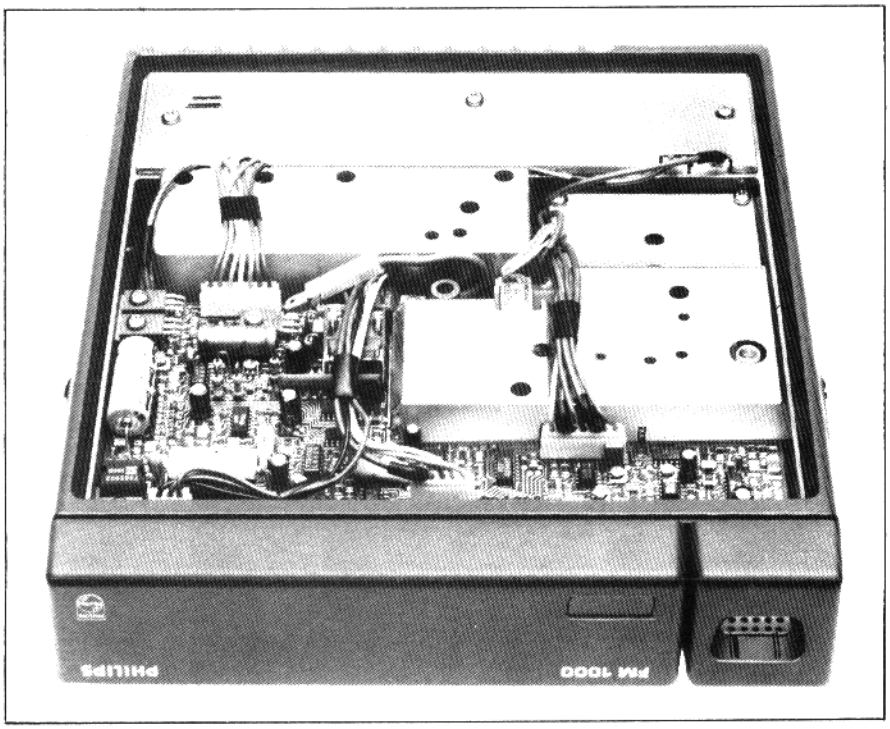


Fig 4.3 Internal View of Transceiver

The transceiver chassis consists of a die-cast aluminium frame onto which the PWBs, external connectors and fascia are mounted. Two pressed aluminium sheet lids (located top and bottom) complete the equipment enclosure and each are retained by a centrally-located pan-headed screw which threads into a bush on the chassis.

Each PWB carries mainly surface-mounted devices (SMDs) and a few discrete components. RF sensitive circuits are screened by aluminium covers which are plated to allow soldered connections to the PWB earthplane. Connections between PWBs are by short jumper leads which plug directly into the boards via small strip connectors. PWBs are secured to threaded lugs on the chassis by screws.

A plate, attached by two screws to the chassis, carries the data socket and fascia. The 15-way data socket, together with ribbon cable for the transceiver, is retained by a plastic moulding which is secured to the plate to form part of the front panel. When remote control of the transceiver is required, a plastic blanking fascia is secured to the plate by two M2,5 screws. When local control of the transceiver is required, a display console is mounted in place of the fascia.

The display console comprises a die-cast aluminium panel onto which a single PWB is mounted by two M2,5 screws. Components are soldered to both sides of the PWB and comprise mainly of SMDs and discrete components such as switch buttons, volume control potentiometer, ICs and 9-way strip connector. The Liqiud Crystal Display (LCD) is retained by a bezel which is attached to the PWB by lugs; electrical connection to the PWB is made by two elastomeric connectors (zebra strips). The PWB/Backplate assembly is secured to a plastic front panel by four self-tapping screws. The front panel has cut-outs for the button switches and LCD window, while the backplate has a cutout for the 9-way connector.

DISASSEMBLY

Access to Printed Wire Boards (PWBs)

Access to the Analogue, Decoupling, Tx PA and Rx VCO PWBs is gained by removing the larger of the two lids, after unscrewing the relevant retaining screw. Access to the Control PWB is by releasing the screw retaining the smaller of the two lids. On re-assembly, the notch in the large lid should be lined up with the corner nearest to the antenna socket.

Note: It is imperative that the correct lids are used for re-assembly, as equipment serial number and configuration details are carried on these.

Analogue PWB

Remove the three screws which hold the PWB to the frame, and the five screws which secure power transistors to the frame. Disconnect the positive lead (thick red wire) from the spade connector on the PWB edge and then carefully pull the PWB away from the chassis, ensuring that connecting pins to the Control PWB are not damaged on removal.

On re-assembly, carefully re-align the PWB so that the underside pins align with their corresponding sockets on the Control PWB. In some circumstances it may be easier to remove the Control PWB and refit once the Analogue PWB is correctly located. Ensure that the insulator is correctly positioned on the double-heatsink for transistors TR1, TR5.

Rx VCO PWB

Disconnect interconnecting leads to the PWB. Remove the four outer screws on the VCO screening can and the two screws at the opposite end of the PWB, then carefully lift out the PWB assembly. The screen/heatsink underneath the VCO may be removed by undoing a single screw inside the VCO can (located centrally), taking care not to lose the rubber retaining washer. As two screening cans are secured to the PWB by numerous lugs, it is recommended that VCO/Rx front end-associated faults should be proved beyond reasonable doubt before removal of either can. If any of the screening can lugs become damaged, or the plating becomes cracked or blistered, a new can MUST BE FITTED.

Re-assembly is a reversal of disassembly, but ensure that wires from the power connector do not become trapped under the PWB, and that they emerge from the cut-out on the side of the PWB.

Note: Unless your workshop is suitably equipped for the re-alignment of this PWB, it is recommended that it is exchanged for a replacement assembly.

Tx PA PWB

Disconnect interconnecting leads to the PWB. Remove the three screws securing the screening can to the PWB, remove the can, and then unsolder the connection from the PWB to the antenna socket. Release the screw and three pillars securing the PWB to the chassis frame. Remove the two PA transistor retaining nuts (situated on the finned chassis exterior) and pull the PWB out.

Re-assembly is the reverse of disassembly, but check that there is a sufficient coating of heatsink compound on the seatings for the PA transistors. Finally, ensure the spring contacts are compressed between the frame and antenna filter screen.

Control PWB

Disconnect interconnecting leads to the PWB. Remove the 15-way ribbon connector from the PWB. Remove the four screws which hold the PWB to the chassis and the screw which retains the power transistor to the frame. Lift out the PWB, taking care not to damage the connecting pins from the Analogue PWB. Complete removal necessitates disconnection of the 9-way connector on the PWB underside.

Re-assembly is the reverse of dis-assembly, but ensure that the 9-way connector is refitted to the PWB underside and that the PWB sockets mate up with the connecting pins from the Analogue PWB.

Decoupling PWB and Power Connector

Remove the Tx PA and Rx VCO PWBs as previously described. Release the Decoupling PWB retaining screw (situated underneath the Tx PA). Remove the two screws securing the power connector to the chassis rear, and then pull the connector out from its recess. The Decoupling PWB forms the rear part of the power connector.

Re-assembly is the reverse of disassembly, but ensure that the power connector leads do not become trapped between the Rx VCO PWB and the threaded lugs on the chassis frame. Check also that the wires emerge from the cut-out on the side of the Rx VCO PWB.

Thermistor

The thermistor is located underneath the Rx VCO PWB and is secured to a chassis lug by a spring clip.

Antenna Socket

Unsolder the wire connection to the Tx PA PWB, then unscrew the socket from the transceiver frame using a 10mm A/F spanner.

Display Console

Remove the console from the transceiver or cradle, depending on installation (see Section 2). Unscrew the four self-tapping screws securing the backplate (25) to the front panel (24). Remove the volume control knob (23) and pull the front panel away from the backplate. To remove the PWB, undo the screw securing the PWB to the backplate at top right, and undo the screw securing the regulator heatsink to the backplate at bottom left.

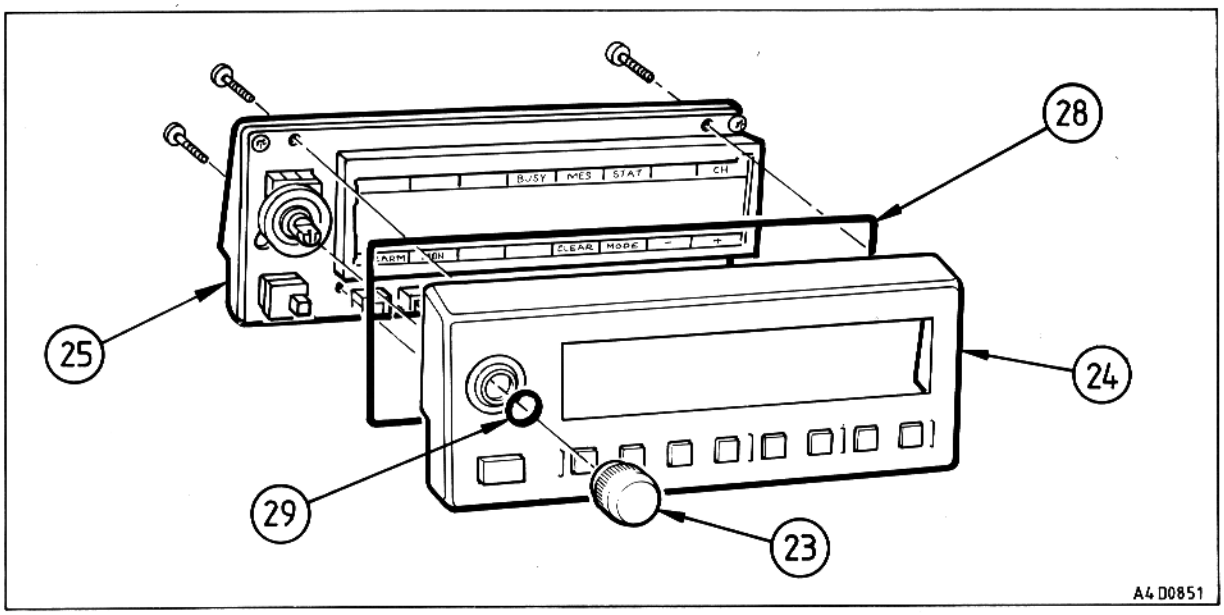


Fig 4.4 Display Console Assembly

Re-assembly is the reverse of disassembly, but ensure that the small rubber 'O'-Ring (29) is not dislodged by the volume control spindle when fitting the front panel over the PWB/Backplate assembly. Finally, ensure that gasket (28) is seated correctly round the backplate, pushing it home with a fingernail if necessary.

To remove the Graphics Panel, refer to Section 2.

To remove the LCD, bend the eight bezel lugs so that they line up with the slots on the PWB. Pull the bezel away from the PWB and then remove the plastic spacers from inside the bezel. The LCD and zebra strips may be removed once the light-pipe has been prised away from the bezel.

Basic Console

Remove the console from the transceiver or cradle, depending on installation. Unscrew the two self-tapping screws securing the backplate (121) to the front panel (126). Remove the volume control knob (124) and pull the front panel off its spindle. To remove the PWB, undo the two M2,5 screws securing it to the backplate. Access to components is gained by removing two screws which secure the reflector support (129) to the PWB.

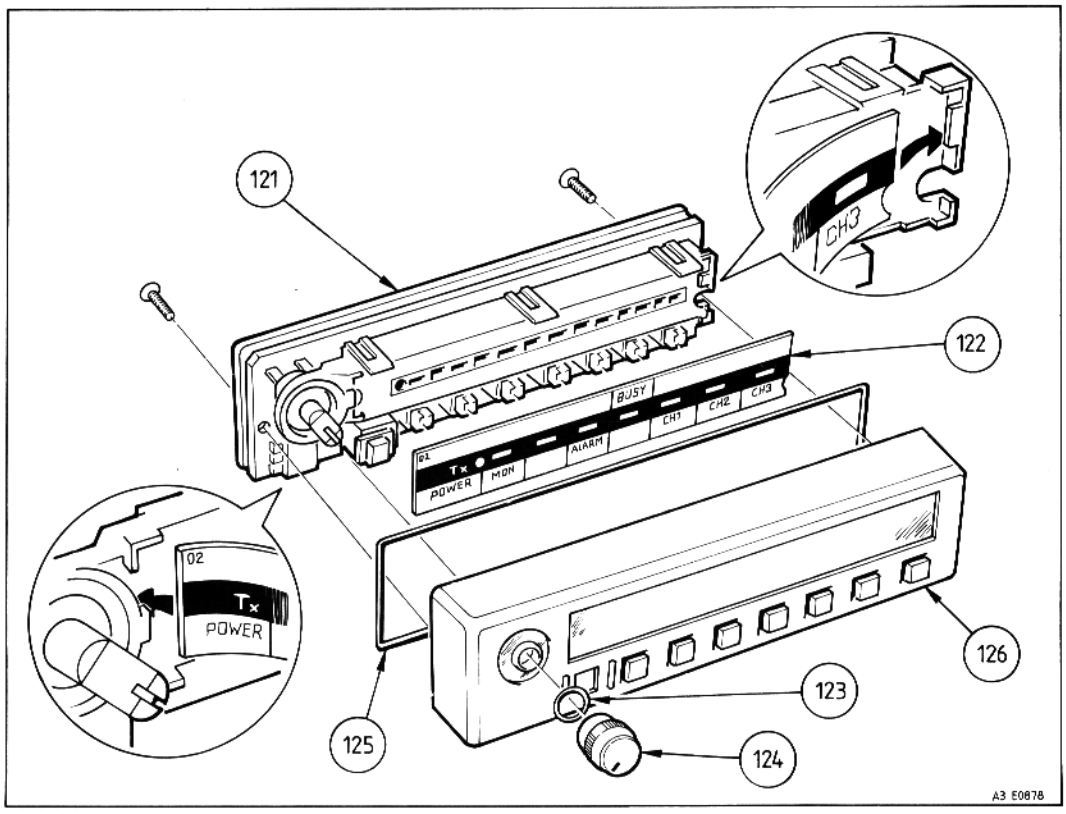


Fig 4.4A Basic Console Assembly

Re-assembly is the reverse of disassembly, but ensure that the small rubber 'O'-Ring (123) is not dislodged by the volume control spindle when fitting the front panel over the PWB/Backplate assembly. Finally, ensure that the gasket (125) is seated correctly round the backplate.

The Graphics Panel is tucked under two lugs at opposing ends of the light-pipe.

CHANGE OF CHANNEL FREQUENCIES

Note: The following checks should be carried out when changing the transceiver channel frequencies to ensure that birdies (internally generated spurii) are not present on any programmed channel.

On change of equipment channel frequencies, it may be necessary to change the reference oscillator and 2nd oscillator crystals (in addition to the EPROM). Receiver channels near harmonics of 12MHz may require Microprocessor Offset to be enabled (see Appendix A).

Transmitter and receiver re-alignment should not be necessary.

CRYSTAL INFORMATION

Receiver 2nd oscillator

Standard Frequency	20,945MHz (Part No 4313 320 90021)
Alternative Frequency	21,855MHz (Part No 4313 320 90031)
Specification:	E312
Temperature Range:	-30°C to +60°C
Freq/Temp Tolerance:	±15ppm (+25°C ref)

The alternative crystal frequency is only used when the receiver carrier frequency lies within the following bands:-

83,680 - 83,880MHz	418,800 - 419,000MHz
146,575 - 146,775MHz	439,745 - 439,945MHz
167,460 - 167,660MHz	460,690 - 460,890MHz
188,505 - 188,705MHz	481,635 - 481,905MHz
209,350 - 209,550MHz	502,580 - 502,780MHz

The Comprehensive Data Programmer (CDP) calculates the required crystal frequency during the FM1000 validation routine and issues a message indicating which crystal is required.

Approved Suppliers: Toyocom, ITT (UK), Hy-Q.

Synthesiser Reference Oscillator

	Freq/Temp Tolerance (+25°C Ref)	
	±5ppm	**±2ppm**
Standard (8,4MHz):	3513 505 01461	3513 500 00601
Alternative (7,2MHz):	3513 505 01441	3513 500 00581
Alternative (7,8MHz):	3513 505 01451	3513 500 00591
Alternative (9,0MHz):	3513 505 01471	3513 500 00611
Specification:	P325	
Temperature Range:	-10°C to +70°C	-30°C to +70°C

The CDP calculates the required crystal frequency during the FM1000 validation routine and issues a message indicating which crystal is required.

Any subsequent changes or additions made to receiver channel frequencies must be checked for birdies (harmonics of reference oscillator). If any birdies are present, a new reference oscillator frequency must be calculated (for zero or minimum number of birdies) starting with 8,4MHz as the preferred option and then working through the alternatives specified. Once the most suitable reference oscillator has been determined and fitted, ALL receiver channels must be re-checked for birdies.

Approved Suppliers for ±5ppm crystals: Toyocom, ITT (UK), Hy-Q.

High stability (±2ppm) Reference Oscillator modules are available direct from Philips RCS.

TEST EQUIPMENT

CAUTION

It is possible for the radio to transmit short tone bursts (eg Switch-On Identity) when it is apparently in receive mode. Therefore, it is imperative to protect the RF signal generator output with a suitable trip or RF fuse. The Combined Test Set quoted below is fitted with a suitable protection device.

The following is a list of test equipment recommended for functional tests, setting up and fault location. Equivalent types may be used where those recommended are not available, provided that corrections are made for any differences in characteristics.

Item	Parameters	Suitable Type
DC Power Supply	10-16V, 10A	Kingshill 18VC10
RF Signal Generator	68-520MHz	Combined Test Set Marconi TF2955
Frequency Counter	68-520MHz	
AF Signal Generator	67,0-2800Hz	
Modulation Meter	68-520MHz	
RF Power Meter	50W, 50Ω	
AF Power Meter	3W, 3Ω	
Distortion Analyzer	True RMS reading	
FM1000 Field Service Aid or Portable Data Programmer		
SELCALL Test Set	ZVEI, DZVEI, EEA, CCIR + CTCSS tones	Part No SH10052‡
RF Signal Sampler	20dB min attenuation	Bird 4275-020
Control Head	Standard Console	Part No 3513 505 00721
FM1000 Test Interface		Part No SH10089 (see text)
Set of Trimming Tools		Part No AT00007

‡ ***When Sequential Tone systems other than Philips ST-500 are required, or when CTCSS + SELCALL is required, a Schlumberger 4922 is recommended.***

Test Set SH10052 may be used for ST-500 + CTCSS, but a second AF signal generator (eg Kron-Hite 4100) and summing network will be required.

ALIGNMENT PROCEDURE

Notes: 1. Transmitter Alignment MUST be carried out before aligning the receiver.

2. The majority of alignment is carried out at PWB level before fitting to the transceiver, and should not need to be repeated during equipment alignment. Hence such alignment stages have been omitted from the following procedures.

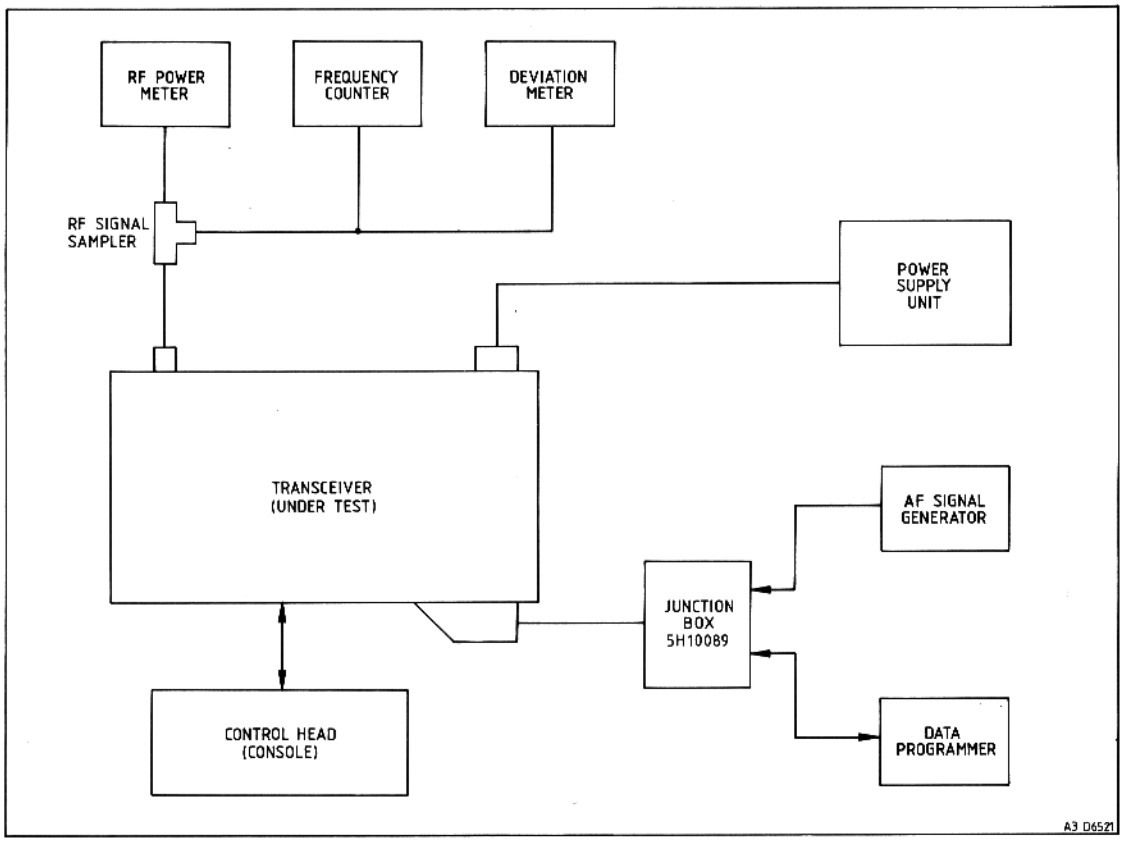


Fig 4.5 Synthesiser and Transmitter Test Connections

Note: Before commencing alignment, remove the 5-way Power Connector (PLB) from the Tx PA module before applying DC Power to the equipment.

Synthesiser

	TUNE	*ACTION*
1.	RV301	Adjust to give 30V ±0,2V at PLF 7 on the Analogue PWB.

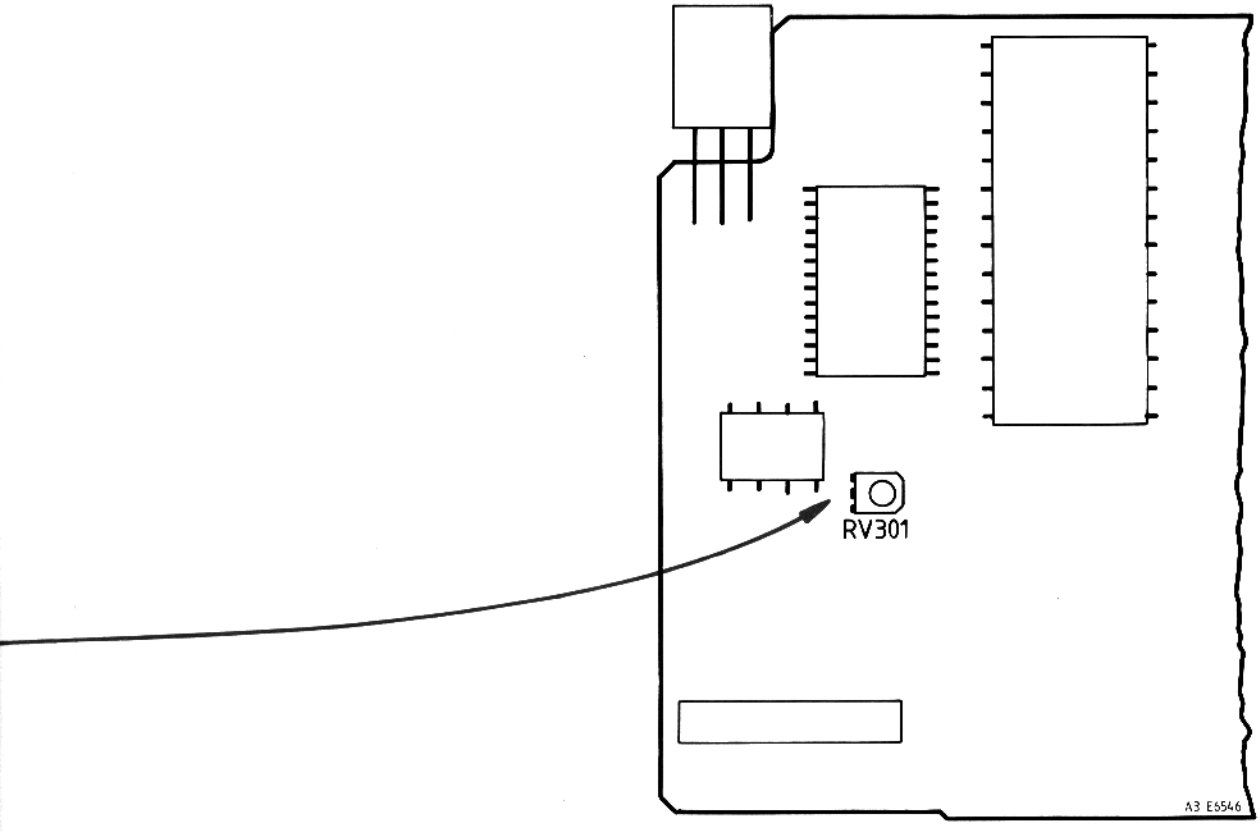

RV301
A3 E5546

Table 4.1

Frequency Band/Calibration Frequency								
E0	B0	A9	K1	K2	U0	TM	T4	WM
76MHz	144MHz	160MHz	176MHz	208MHz	455MHz	420MHz	437MHz	495MHz

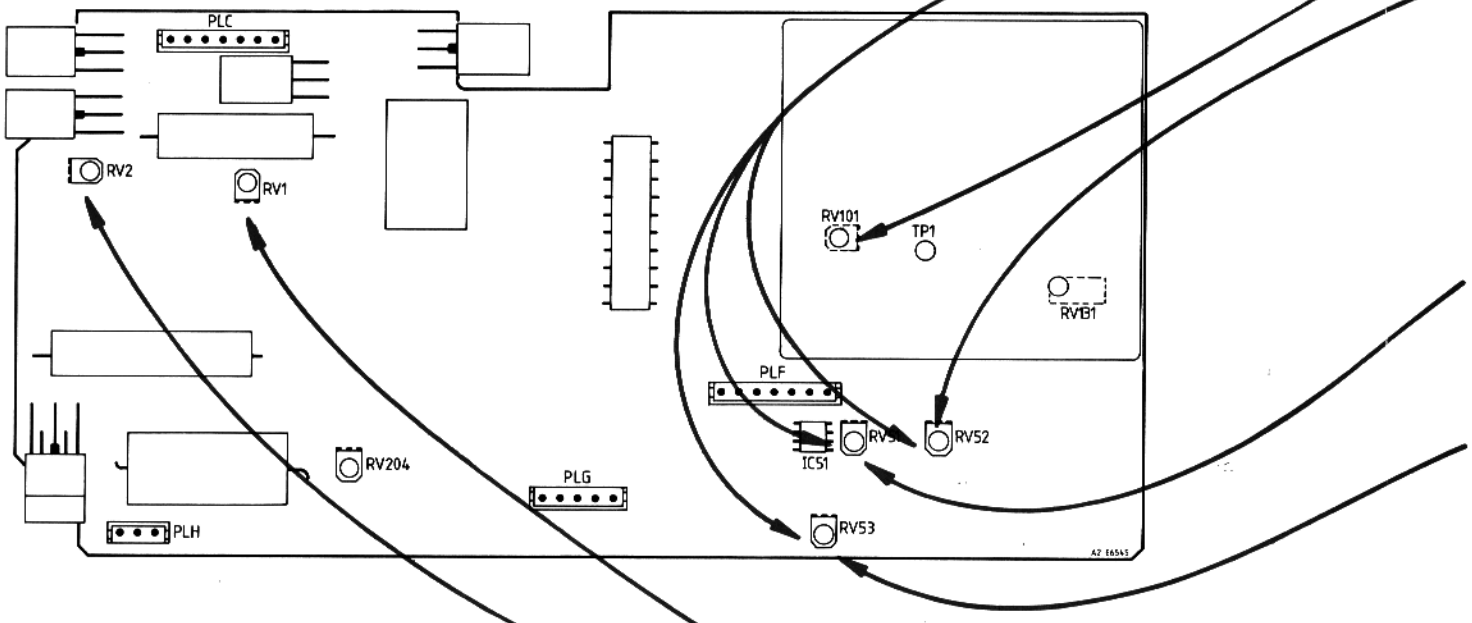


Fig 4.7 Modulation and Transmitter Alignment Diagram

Table 4.2

Code	Function
RV1	Set Power
RV2	Limit Volts
RV51	Modulation Balance
RV52	Peak Deviation
RV53	Microphone Gain
RV101	Phase Comparator Gain

Modulat

TUNI

1.

2. RV5
RV53

3. RV1C

4. RV52

5. RV51

6.

7. RV53

8.

Transmit

Note

TUNE

1.

2. RV2

3.

4. RV1

Modulation

	TUNE	*ACTION*
1.		Using the PDP, set the transmitter to the appropriate calibration frequency in Table 4.1 (left). Use a non-customized channel (eg "#102.00") if possible.
2.	RV51, RV52 RV53	Set fully anticlockwise. Tune AF signal generator to 1kHz and adjust output level to produce a peak deviation level of ±3kHz (±100Hz).
3.	RV101	Adjust to produce 60mV peak-to-peak at TP1.
4.	RV52	With the AF signal generator set to 1kHz at an output level of 30mV RMS, adjust (peak deviation) to 90% peak system deviation as shown below:-

Channel Spacing	Deviation Level
25kHz (V)	±4,0kHz
20kHz (R)	±3,25kHz
12,5kHz (S)	±2,0kHz

5.	RV51	Adjust (mod balance) to give minimum ripple voltage at TP1.
6.		Repeat steps (6) and (7) until interaction between adjustments ceases.
7.	RV53	With AF signal generator level reduced to 3mV RMS, adjust to give 60% peak system deviation.
8.		Using the portable data programmer, erase the test frequency, or lock it out.

Transmitter Power Control

Note: Key the transmitter for the minimum time required to make the relevant reading or adjustment.

	TUNE	*ACTION*
1.		Refit 5-way connector PLB to the Tx PA. Using the PDP, set the transmitter to the maximum power level (#104.2 for Low Power UHF, #104.5 for K1/K2, #104.6 for all others) and calibration frequency for the equipment frequency band (see Table 4.3).
2.	RV2	Adjust to give the "limit volts" reading (as shown in Table 4.3) at PLC pin 6.
3.		Set transmitter power to 25W (#104.5), or 6W (#104.2) for low power UHF versions.
4.	RV1	Adjust RV1 for 25W (6W for low-power UHF) reading on the power meter.

TUNE	ACTION
5.	Using the PDP, reset the transmitter power parameter to that required by the user. Key on the transmitter and check that the correct power output is achieved (to within ±1,5dB).
6.	Using the portable data programmer, erase the calibration frequency, or lock it out.

Table 4.3

Frequency Band	Calibration Frequency	Calibration Power 0,5W	Limit Volts 0,1V
E0 68 - 88MHz	76MHz	25W	10V
B0 132 - 156MHz	138MHz	25W	11V
A9 146 - 174MHz	153MHz	25W	11V
K1 174 - 208MHz	183MHz	25W	11V
K2 192 - 225MHz	200MHz	25W	11V
TM 425 - 450MHz Low Power	410MHz	6W	9V
TM 425 - 450MHz High Power	410MHz	25W	9V
T4 425 - 450MHz Low Power	430MHz	6W	9V
T4 425 - 450MHz High Power	430MHz	25W	9V
U0 440 - 470MHz Low Power	450MHz	6W	9V
U0 440 - 470MHz High Power	450MHz	25W	9V
WM 470 - 520MHz Low Power	490MHz	6W	9V
WM 470 - 520MHz High Power	490MHz	25W	9V

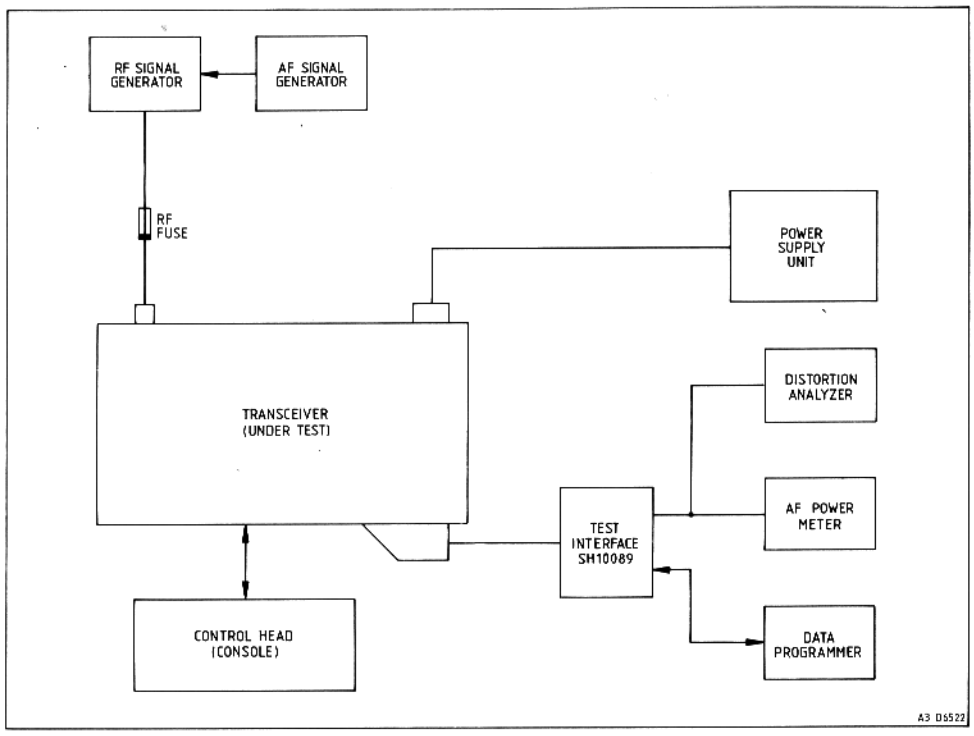


Fig 4.8 Receiver Test Connections

	TUNE	ACTION
1.		Adjust the RF signal generator output to give 12dB SINAD.
2.	RV204	Adjust to give a reading of 4,0V DC (±0,1V) at PLB pin 1.

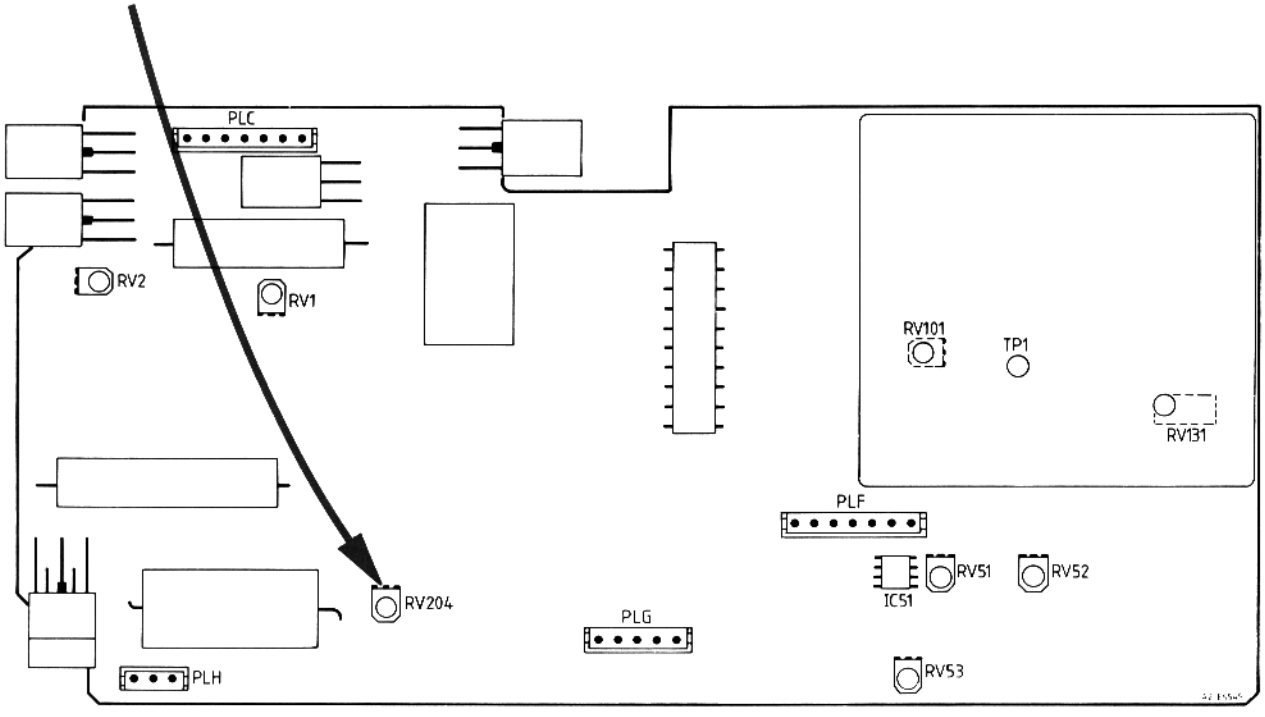


Fig 4.9 Receiver Alignment Diagram

PERFORMANCE CHECKS

Preliminaries

1. Interface between test equipment and transceiver is to be made via the facility connector.

2. Transceiver is to have covers fitted.

Transmitter

1. RF Power

Check that the RF power output on those channels with the lowest, mid and highest frequencies, is as follows:-

	E0,B0,A9	K1,K2	U,T,W, Low Pwr	U,T,W, High Pwr
(a) Nominal RF power @ 13,6V	30W	25W	7W	25W
Maximum current	<7A	<7A	<3,5A	<8A
Minimum current	>4,5A	>4,5A	>2A	>5A
RF Power @ 10,8V	>20W	>15W	>4W	>15W
RF Power @ 15,6V	<35W	<30W	<8W	<30W
(b) RF Power adjustment	1-30W	1-25W	1-7W	2,5-25W
Max power to which equipment should be adjusted	35W	30W	10W	30W
Power variation across frequency band	1dB	1dB	1dB	1dB

2. Peak System Deviation

Adjust AF generator to give 60% peak system deviation at 1kHz. Increase output level by 20dB and check that the following peak system deviation is within the limits specified for the lowest and highest channel frequencies.

Channel Spacing	Deviation Limits
25kHz (V)	±4,0kHz to ±5,0kHz
20kHz (R)	±3,2kHz to ±4,0kHz
12,5kHz (S)	±2,0kHz to ±2,5kHz

3. Microphone Amplifier

Set the AF signal generator output to 1kHz at a level of 3mV RMS and check that between 50%-70% peak system deviation is obtained.

4. Modulation Distortion

Adjust the AF signal generator output to produce 60% peak system deviation at 1kHz and check that the distortion level is not greater than 2%.

5. Frequency Error

Check that the RF carrier frequency is within ±5ppm (standard) or ±2,5ppm (option) of any channel centre frequency.

Receiver

1. Rated Audio Output

With an RF input of 1mV PD, modulated by 1kHz at 60% peak system deviation, check that the AF output is not less than 3W at less than 5% distortion into a 3Ω load.

2. Reference Sensitivity

With an RF input modulated by 1kHz at 60% peak system deviation, adjust the volume control for 1,5W AF output. Adjust the RF level to produce 12dB SINAD and check that the level is less than 0,31µV PD. Note that signal generator calibration is rarely better than ±2dB.

3. Limiting Characteristics

Less than 2dB change in audio output with RF input change from 0,5µ230 PD to 100mV PD.

4. IF Bandwidth (Nose)

Set the RF signal generator output level to +6dB wrt the level required to produce 20dB noise quieting. Tune the RF frequency above and below the centre frequency to obtain 20dB quieting and check that it is obtained with the following frequency adjustments:-

25kHz	(V) sets	greater than ±7,0kHz
20kHz	(R) sets	greater than ±6,0kHz
12,5kHz	(S) sets	greater than ±3,75kHz

5. IF Bandwidth (Skirt)

Set the RF signal generator output level to +90dB wrt 0,5µ230V PD. Check that the quieting level is below 20dB at the appropriate frequency displacements stated below:-

25kHz	(V) sets	less than ±25kHz
20kHz	(R) sets	less than ±20kHz
12,5kHz	(S) sets	less than ±12,5kHz

6. Squelch Threshold, Opening and Closing Level

Adjust the RF signal generator output to level required to give the programmed squelch opening level (9, 12, 15, 18, 21 or 24dB SINAD) and check that the squelch opens. Reduce generator output to that level required to produce 9dB SINAD and check that the squelch closes.

7. Residual Noise

Set the volume control to maximum and with squelch closed, check that the AF millivoltmeter reading is less than 10mV.

8. Audio Sensitivity

Set the volume control to maximum. Set the RF signal generator output level to 1mV PD and modulate with 1kHz tone. Check that the tone deviation level required to produce a AF power reading of 3W is less than 40% peak system deviation.

9. Maximum Current

Check the transceiver current readings with the following test conditions:-

Receiver squelched, no RF signal	less than 700mA
RF input of 1mV PD modulation frequency 1kHz at 60% peak system deviation and volume control set for 3W AF output	less than 1,1A

TEST DATA

Peak System Deviation (PSD)

Channel Spacing		Maximum Deviation	Parameter Value*
12,5kHz	(S)	±2,5kHz	0
20kHz	(R)	±4,0kHz	1
25/30kHz	(V)	±5,0kHz	2

*Parameter #993 on FM1100

Test Frequencies

VHF BANDS

Frequency Bands	E0	B0	A9	K1	K2
Top of Band	88	156	174	208	225
Mid Band	78	144	160	192	208
Calibration	76	138	153	183	200
Bottom of Band	68	132	146	174	192

UHF BANDS

Frequency Bands	High Power				Low Power			
	TM	T4	U0	WM	TM	T4	U0	WM
Top of Band	440	450	470	520	440	450	470	520
Mid Band	420	437	455	495	420	437	455	495
Calibration	430	430	455	490	430	430	455	490
Bottom of Band	400	425	440	470	400	425	440	470

Synthesiser Codes for Test Frequencies

Freq (MHz)	Hex Code	Freq (MHz)	Hex Code
68	3520	225	AFC8
75	3A98	400	4E20
78	3CF0	410	55F0
88	44C0	420	5DC0
132	6720	425	61A8
138	6BD0	431	6658
144	7080	437	6B08
146	7210	440	6D60
153	7788	447	72D8
156	79E0	450	7530
160	7D00	455	7918
174	87F0	470	84D0
183	8EF8	482	8E30
192	9600	495	9858
200	9C40	520	ABE0
208	A280		

Band-Dependant Parameter values

VHF BANDS

Parameter No & Name		Freq Band/Parameter Values				
		E0	B0	A9	K1	K2
992	Frequency Band	0	1	2	3	4
910	HF Tx Power Compensation	141	151	133	137	128
911	Tx Calibration Point 1 (1W)	20	17	19	25	26
912	Tx Calibration Point 2 (6W)	38	37	43	41	50
913	Tx Calibration Point 3 (10W)	51	49	56	62	63
914	Tx Calibration Point 4 (15W)	65	60	67	76	76
915	Tx Calibration Point 5 (25W)	87	89	95	96	99
916	Tx Calibration Point 6 (30W)	98	95	106	0	0

UHF BANDS

Parameter No and Name		Freq Band/Parameter Values							
		High Power				Low Power			
		TM	T4	U0	WM	TM	T4	U0	WM
992	Frequency Band	5	6	7	8	5	6	7	8
910	HF Tx Power Compensation	120	145	135	160	116	122	122	132
911	Tx Calibration Point 1 (1W)	12	13	13	11	21	16	16	19
912	Tx Calibration Point 2 (6W)	43	47	39	44	64	48	48	64
913	Tx Calibration Point 3 (10W)	57	62	53	56	0	0	0	0
914	Tx Calibration Point 4 (15W)	72	77	68	70	0	0	0	0
915	Tx Calibration Point 5 (25W)	100	110	100	100	0	0	0	0
916	Tx Calibration Point 6 (30W)	0	0	0	0	0	0	0	0

Power Calibration Data

Q numbers refer to the output of the Tx Power Control Shift Register (IC2) and use notation Q1 to Q8. Q7 is the most significant, Q1 the least significant. Q8 is the Tx/Rx keying output.

The HF Transmitter Power Compensation, or Correction Factor, is a value between 0 and 255 which is used for high frequency-compensation of the transmitter power control calibration points in the top half of the frequency band in use. Mid range value (ie 128) corresponds to a correction factor of 1,0.

E0 BAND Calibration Frequency 76MHz
(Correction Factor >85MHz :141)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	1	0	0	20
6W	0	1	0	0	1	1	0	38
10W	0	1	1	0	0	1	1	51
15W	1	0	0	0	0	0	1	65
25W	1	1	0	0	0	0	1	97
30W	1	1	0	0	0	1	0	98

B0 BAND Calibration Frequency 138MHz
(Correction Factor >144MHz :154)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	0	0	1	17
6W	0	1	0	0	1	0	1	37
10W	0	1	1	0	0	0	1	49
15W	0	1	1	1	1	0	0	60
25W	1	0	1	1	0	0	1	89
30W	1	0	1	1	1	1	1	95

A9 BAND Calibration Frequency 153MHz
(Correction Factor >160MHz :133)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	0	1	1	19
6W	0	1	0	1	0	1	1	43
10W	0	1	1	1	0	0	0	56
15W	1	0	0	0	0	1	1	67
25W	1	0	1	1	1	1	1	95
30W	1	1	0	1	0	1	0	106

K1 BAND Calibration Frequency 183MHz
(Correction Factor >191MHz :137)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	1	0	0	20
6W	0	1	1	0	0	0	0	48
10W	1	0	0	0	0	0	0	64
15W	1	0	1	0	0	1	0	82
25W	1	1	1	1	0	0	0	120
30W	0	0	0	0	0	0	0	0

K2 BAND Calibration Frequency 200MHz
(Correction Factor >192MHz :128)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	1	0	1	0	26
6W	0	1	1	0	0	1	0	50
10W	0	1	1	1	1	1	1	63
15W	1	0	0	1	1	0	0	76
25W	1	1	0	0	0	1	1	99
30W	0	0	0	0	0	0	0	0

TM BAND (High Power)
Calibration Frequency 410MHz
(Correction Factor >420MHz :120)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	0	1	1	0	0	12
6W	0	1	0	1	0	1	1	43
10W	0	1	1	1	0	0	1	57
15W	1	0	0	1	0	0	0	72
25W	1	1	0	0	1	0	0	100
30W	0	0	0	0	0	0	0	0

TM BAND (Low Power)
Calibration Frequency 410MHz
(Correction Factor >420MHz :116)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	1	0	1	21
6W	1	0	0	0	0	0	0	64

T4 BAND (High Power)
Calibration Frequency 430MHz
(Correction Factor >435MHz :145)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	0	1	1	0	1	13
6W	0	1	0	1	1	1	1	47
10W	0	1	1	1	1	1	0	62
15W	1	0	0	1	1	0	1	77
25W	1	1	0	1	1	1	0	110
30W	0	0	0	0	0	0	0	0

T4 BAND (Low Power)
Calibration Frequency 430MHz
(Correction Factor >435MHz :122)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	0	0	0	16
6W	0	1	1	0	0	0	0	48

U0 BAND (High Power)
Calibration Frequency 455MHz
(Correction Factor >460MHz :135)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	0	1	1	0	1	13
6W	0	1	0	0	1	1	1	39
10W	0	1	1	0	1	0	1	53
15W	1	0	0	0	1	0	0	68
25W	1	1	0	0	1	0	0	100
30W	0	0	0	0	0	0	0	0

U0 BAND (Low Power)
Calibration Frequency 450MHz
(Correction Factor >460MHz :122)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	0	0	0	16
6W	0	1	1	0	0	0	0	48

WM BAND (High Power)
Calibration Frequency 490MHz
(Correction Factor >500MHz :160)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	0	1	0	1	1	11
6W	0	1	0	1	1	0	0	44
10W	0	1	1	1	0	0	0	56
15W	1	0	0	0	1	1	0	70
25W	1	1	0	0	1	0	0	100
30W	0	0	0	0	0	0	0	0

WM BAND (Low Power)
Calibration Frequency 490MHz
(Correction Factor >510MHz:132)

Power Level	Q7	Q6	Q5	Q4	Q3	Q2	Q1	DEC VALUE
1W	0	0	1	0	0	1	1	19
6W	1	0	0	0	0	0	0	64

SQUELCH CALIBRATION PARAMETER VALUES

	NOISE				RSSI			
CALIBR'tn Pt	1	2	3	4	1	2	3	4
PARAMETER No	921	922	923	924	931	932	933	934
E0 Band	77	121	138	160	0	0	0	0
B0 Band	85	121	148	168	79	82	87	92
A9 Band	85	121	148	168	79	82	87	92
K1 Band	85	121	148	168	0	0	0	0
K2 Band	85	121	148	168	0	0	0	0
TM Band	85	121	148	168	0	0	0	0
T4 Band	85	121	148	168	0	0	0	0
U0 Band	85	121	148	168	0	0	0	0
WM Band	85	121	148	168	0	0	0	0

BASIC PORTABLE DATA PROGRAMMER (PDP) USER GUIDE

This guide is intended to help with the procedures described in this Manual; for a more comprehensive description of the operation of the PDP, refer to the FM1000 Portable Data Programmer User Manual (Publication Ref: TP862).

Note: ***Ability to alter certain programmed parameters will depend on the level of protection initiated in the equipment software and the status of the PDP being used.***

Channel specific parameters for channels 0-9 only are normally alterable. It is recommended that test/alignment frequencies are set on channel 00 as this is usually not programmed.

All the Programmable Parameters can be accessed and read by the PDP, but it will not normally be possible to alter values.

To read or alter a Programmable Parameter

1a. Remote control version: Disconnect the Junction Box and Control Lead from the radio. Plug the PDP into the microphone socket on the radio, and apply DC power. The radio will be switched on automatically by the PDP.

1b. Local control version: Switch the set OFF at the console. Plug the PDP into the microphone socket; the radio will be switched on automatically by the PDP.

2. The PDP will display either **OK MEMORY FULL** or **OK MEMORY EMPTY.**

3. Press any number key; the prompt **>_** will be shown.

4. Press the SHIFT key, followed by the **->** key, in order to copy the customer's stored parameters into the non-volatile memory of the PDP. The display will show: **COPYING IN.**

5. Wait until the display shows **OK COPY IN.**

6. Press any NUMBER key; the prompt **>_** will be shown.

7. To read a Channel Parameter, enter the Channel Parameter required (eg 101 for receiver channel frequency). The display will show **>101_**.

8. The cursor underscore "_" indicates that the PDP is waiting for a channel number to be entered. Channel numbers must be entered in two digit form; eg enter channel 1 as "01". The display will now show **>101.01**.

9. Press **[ENTER]** and the channel 1 Rx frequency is displayed in MHz.

10. To change a channel parameter value, carry out paragraphs (7) to (9), to display the stored value. Then use the keys to overwrite with the new value. Press ENTER to program the new value. The display will then revert to the **>_** prompt.

    If an error is made entering the new value, it can be erased by pressing **[SHIFT]** followed by **[DELETE]**.

9) To confirm that the new value is as entered, repeat steps (7) to (9).

Note: If a previously unprogrammed channel is being set up, then Receiver and Transmitter frequencies must be entered.

If an existing programmed channel is being used, then check that the channel specific parameters are set to appropriate values for testing e.g. defeat CTCSS if required.

Conclusion

1. On completion of a test or editing session, confirm that ALL customer parameters have been restored to their correct values by using the COPY OUT function from the values retained in the PDP. Press the **[SHIFT]** key, and then the **<-** key.

2. The PDP will display the message **COPYING OUT**.

3. Wait until the PDP displays the message **n COPY OUT**, where **n** is a numerical indication of the amount of data modified.

4. Disconnect the PDP from the microphone socket. After a short delay the start relay will be heard to switch off. (The delay is to enable the data stored in the FM1000 RAM to be copied to the EEPROM.)

5. Reconnect the microphone or Junction Box to complete the installation.

Note: If during alignment or fault repair it is necessary to remove DC power from the radio while the PDP is connected, always switch off by first unplugging the PDP, in order to store any modified parameters into the EEPROM. Disconnecting the main power supply first may result in data being lost.

TEST INTERFACE SH10089

Test Interface SH10089 is a modified Junction Box which allows connection of test equipment and a handheld programmer to the FM1000 radio. The Interface unit is plugged into the microphone socket of the radio, and then the Portable Data Programmer or Field Service Aid plugged into the unit. The Test Interface circuit includes a pair of shift-registers, to allow testing of the FM1000 external message bus.

The Test Interface is available from dealers, but may be constructed from locally-sourced components, if required.

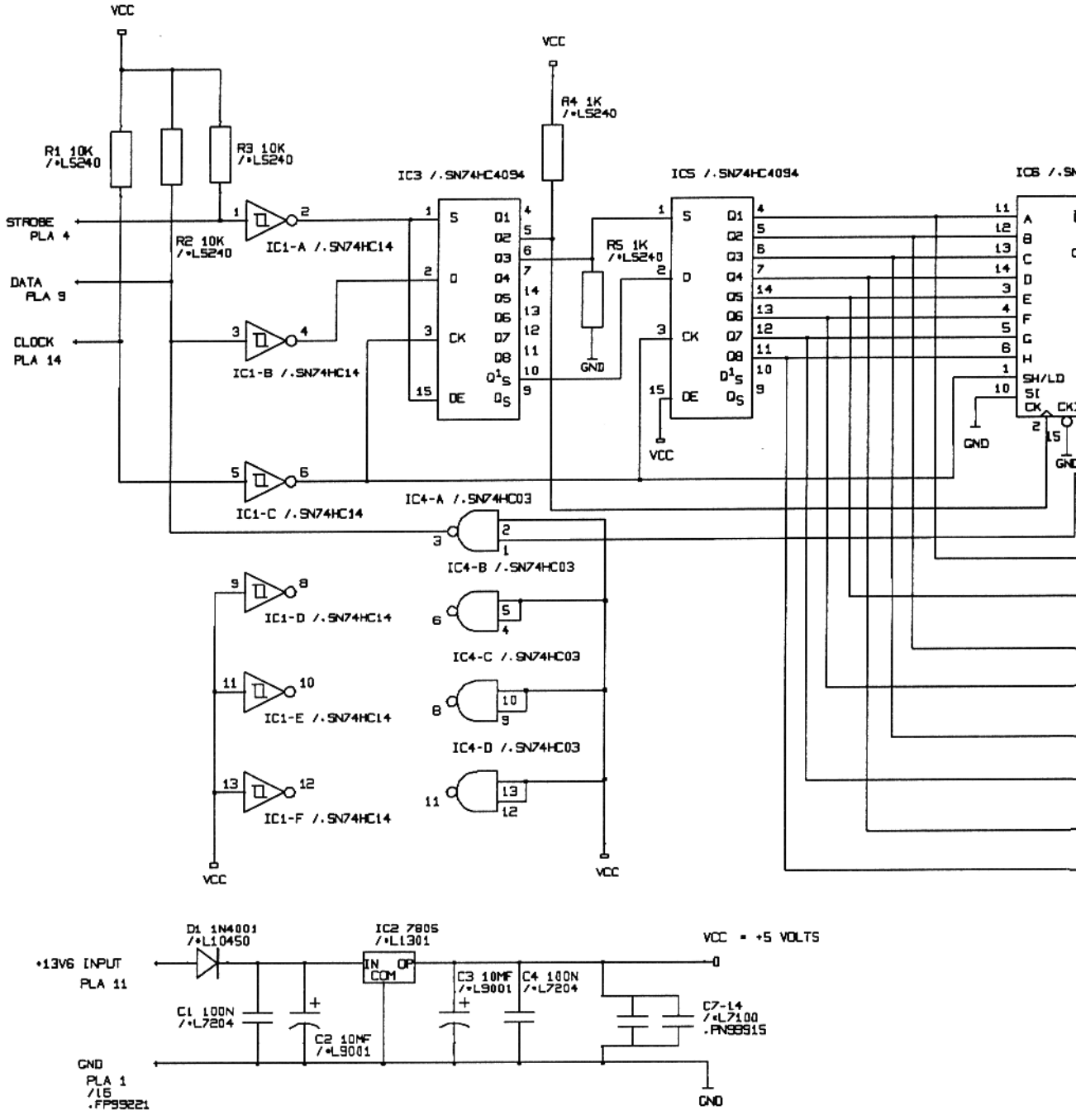
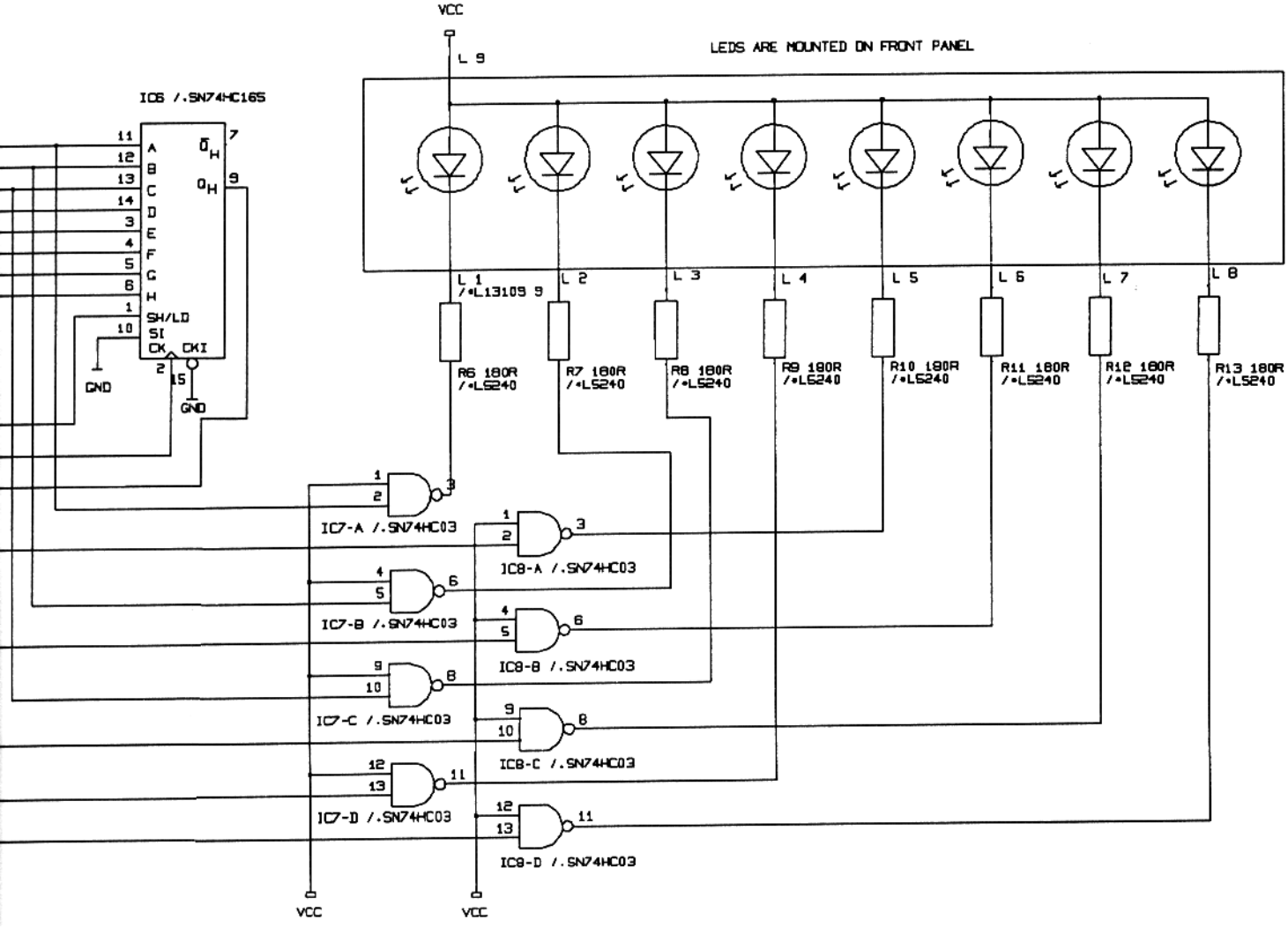


Fig 4.10 SH10089 Circuit Diagram - Test Registers

ɔment and
phone
into the
000

IC SUPPLY RAILS				
IC---	GND	+5V		
IC1	7	14		
IC3	8	16		
IC4	7	14		
IC5	8	16		
IC6	8	16		
IC7	7	14		
IC8	7	14		



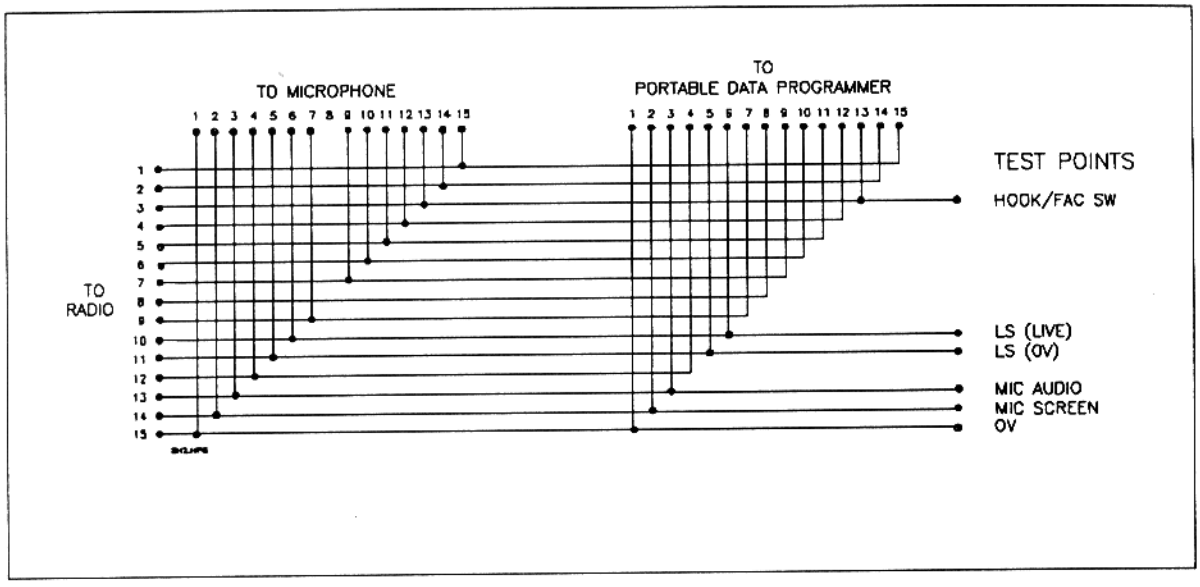


Fig 4.11 SH10089 Circuit Diagram - Interface Connections

SECTION 5
PARTS LIST

NOTATION

In the following Parts List, component values are designated thus:-

CAPACITORS Values are given in micro Farads (µF) unless otherwise stated.

22	= 22 micro Farad	(F x 10^{-6})
22n	= 22 nano Farad	(F x 10^{-9})
22p	= 22 pico Farad	(F x 10^{-12})

Fractional values are shown thus:

2µ2	= 2,2 micro Farad	=	(2,2 x 10^{-6})F
2n2	= 2,2 nano Farad	=	(2,2 x 10^{-9})F
2p2	= 2,2 pico Farad	=	(2,2 x 10^{-12})F

RESISTORS Values are given Ohms unless otherwise stated:

22	= 22 Ohms	
22k	= 22 kilohms	(Ohms x 10^{3})
22M	= 22 Megohms	(Ohms x 10^{6})

Fractional values are shown thus:

2Ω2	= 2,2 ohms		
2k2	= 2,2 kilohms	=	(2,2 x 10^{3}) Ohms
2M2	= 2,2 Megohms	=	(2,2 x 10^{6}) Ohms

ORDERING OF SPARE PARTS

To assist the Spares Department, please quote the following information when ordering parts:-

a) Description and Part Number of the item required.

b) Part No of the assembly it is used on.

c) Type or Catalogue Number (eg FM1100) of the equipment the assembly is used on and, where possible, the equipment code number given on the equipment label.

The right is reserved to fit alternative types of semiconductors with equal or improved performance to those quoted in the Parts List.

ABBREVIATIONS

carbon film	c film	Liquid Crystal Display	LCD
ceramic	cer	pan head	pan
electrically erasable programmable read-only memory	EEPROM	polystyrene	poly
electrolytic	elect	pozidriv	pozi
hexagonal	hex	printed wiring board	PWB
light emitting diode	LED	tantalum	tant
		surface-mounted device	SMD

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VHF/UHF FM MOBILE RADIOTELEPHONE TYPE FM1100

Frequency Bands				Channel Spacing
E0	68 - 88MHz	TM	400 - 440MHz	12,5kHz (type S)
B0	132 - 156MHz	T4	425 - 450MHz	20kHz (type R)
A9	146 - 174MHz	U0	440 - 470MHz	25kHz (type V)
K1	174 - 208MHz	W1	470 - 500MHz	
K2	192 - 225MHz	W4	500 - 520MHz	

INSTALLATION KITS

Note: The item numbers given in the Remarks column refer to items listed in Section 2 of this Service Manual.

KIT 1 (Local Installation)

Cct Ref	Description	Part No	Remarks
—	Cradle Assembly, Standard Mount	3513 504 00001	c/w BNC plug FP99100
—	Installation Kit, Grey, Common Items	3513 504 01951	see headed list

KIT 2 (Local Installation)

Cct Ref	Description	Part No	Remarks
—	Cradle Assembly, Cassette Mount	3513 504 00011	
	comprising:-		
—	Cradle	——	
—	Bracket Support, Inner	——	
—	Bracket Support, Outer	——	
	Plug, BNC, 50, straight	3513 904 50081	
—	Screw, M2,5 x 5mm	2522 178 16037	2/Antenna Support Brackets
—	Screw, FM2,5 x 10mm	3513 993 57024	2/Power Lead-Cradle
—	Installation Kit, Common Items	3513 504 01951	see headed list

KIT 3 (Remote Installation with 1 metre cable)

Cct Ref	Description	Part No	Remarks
—	Cradle Assembly, Standard Mount	3513 504 00001	c/w BNC plug FP99100
—	Installation Kit, Grey, Common Items	3513 504 01801	see headed list
—	Installation Kit, Remote Console	3513 504 00061	see headed list
—	Junction Box Assembly, Grey	3513 504 01761	c/w 1 metre cable

KIT 4 (Remote Installation with 5 metres cable)

Cct Ref	Description	Part No	Remarks
—	Cradle Assembly, Standard Mount	3513 504 00001	
—	Installation Kit, Grey, Common Items	3513 504 01801	see headed list
—	Installation Kit, Remote Console	3513 504 00061	see headed list
—	Junction Box Assembly, Grey	3513 504 01771	c/w 5 metres cable

COMMON INSTALLATION ITEMS (5 metre)

Grey 3513 504 01801 Brown 3513 504 00051

Description	Part No	Remarks
Extractor Key	—	2/Cradle **Item 19**
Fuse, 10A	2422 086 10096	
Fuseholder	2422 088 00185	**Item 4**
Battery Lead Assembly (5 metres)	—	**Item 5**
Socket Contact, 5 off	—	Alarm/Alert connections etc
Scotchlok Connector	—	**Item 28**
Installation Instructions	—	Publications Ref No TP858
Screw, st, S/T, No 10 x 13mm	—	4/Cradle Fixing

COMMON INSTALLATION ITEMS (2 metre)

Grey 3513 504 01951 Brown 3513 504 01861

Description	Part No	Remarks
Extractor Key	—	2/Cradle **Item 19**
Cradle Spacer, 4 off	—	
Fuse, 10A	2422 086 10096	
Fuseholder	2422 088 00185	**Item 4**
Battery Lead Assembly (2 metres)	—	**Item 5**
Socket Contact, 5 off		Alarm/Alert connections etc
Scotchlok Connector		**Item 28**
Installation Instructions		Publications Ref No TP858
Screw, st, S/T, No 10 x 13mm	—	4/Cradle Fixing
Screw, st, S/T, No 10 x 32mm	—	4/Cradle Fixing using Spacers

INSTALLATION ITEMS, REMOTE CONTROL

Grey 3513 504 01741 Brown 3513 504 00061

Description	Remarks
Cable Assembly, 9-way	1/Console-Junction Box **Item 21**
Cradle Assembly	1/Console
comprising:	
Cradle	**Item 14**
Bush, 2 off	**Item 33**
Nut, M3, 2 off	**Item 32**
Cradle Bracket	2/Console **Item 13**
Screw, st, pan, pozi, No 6 x 19mm	2/Cradle Fixing
Screw, st, hex, cap Hd, M3 x 16mm	2/Brackets-Cradle

MICROPHONE INSTALLATION KIT

Standard, Grey	**Part No 3513 504 01791**
Standard, Brown	**Part No 3513 504 00071**
DTMF/Keypad, Grey	**Part No 3513 504 03901**

Description	Remarks
Microphone Rest	
Magnet	1/Microphone Rest
Strain Relief Clamp	
Clamp Support	
Screw, st, pozi, pan No 6 x 13mm	2/Microphone Rest

CHASSIS COMPONENTS

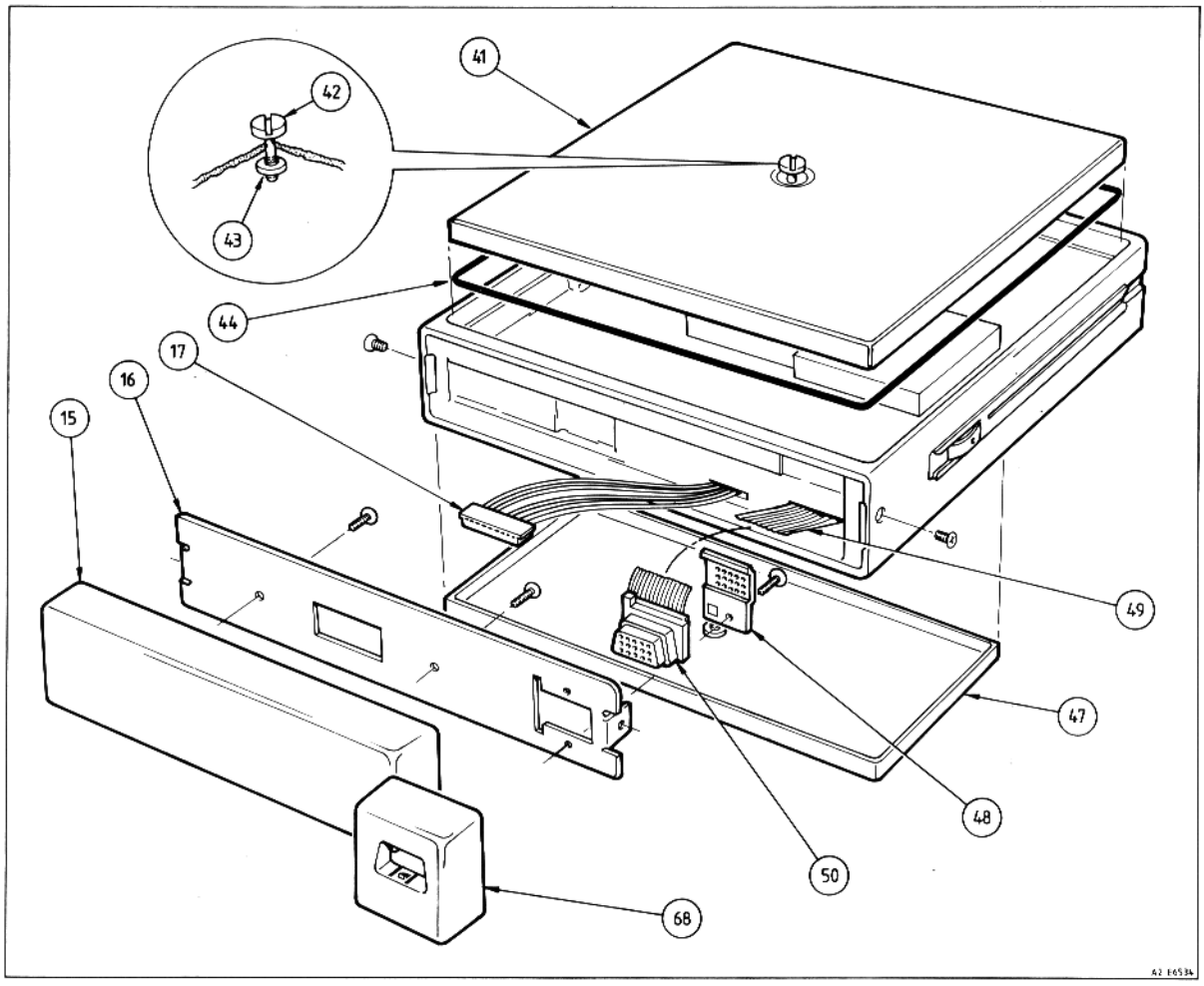


Fig 5.1 Exploded Diagram - Transceiver Chassis

Item No	Description	Part No	Remarks
(15)	Fascia, Remote, Grey Fascia, Remote, Brown	3513 901 90041 3513 901 90011	
(16)	Plate, Console, Grey Plate, Console, Brown	3513 905 30041 3513 905 30011	
(17)	Cable Assy, Interconnect	3513 505 00811	1/Control PWB-Console
(41)	Cover, Frame, Large, Grey Cover, Frame, Large, Brown	3513 901 10071 3513 901 10011	
(42)	Screw, special	3513 905 80001	1/Large Cover, 1/Small Cover
(43)	Washer, Cover	3513 907 30011	1/Screw 3513 905 80001
(44)	Gasket, RFI, 1,8mm dia	4313 322 20001	order per metre
(47)	Cover, Frame, Small, Grey Cover, Frame, Small, Brown	3513 901 10061 3513 901 10001	
(48)	Clamp	3513 900 80001	1/Ribbon cable
(49)	Ribbon Cable	3513 506 00131	1/Data Socket
(50)	Socket, 15-way Data	4313 324 40001	
(68)	Cover, Data Socket, Grey Cover, Data Socket, Brown	3513 901 10051 3513 901 10031	

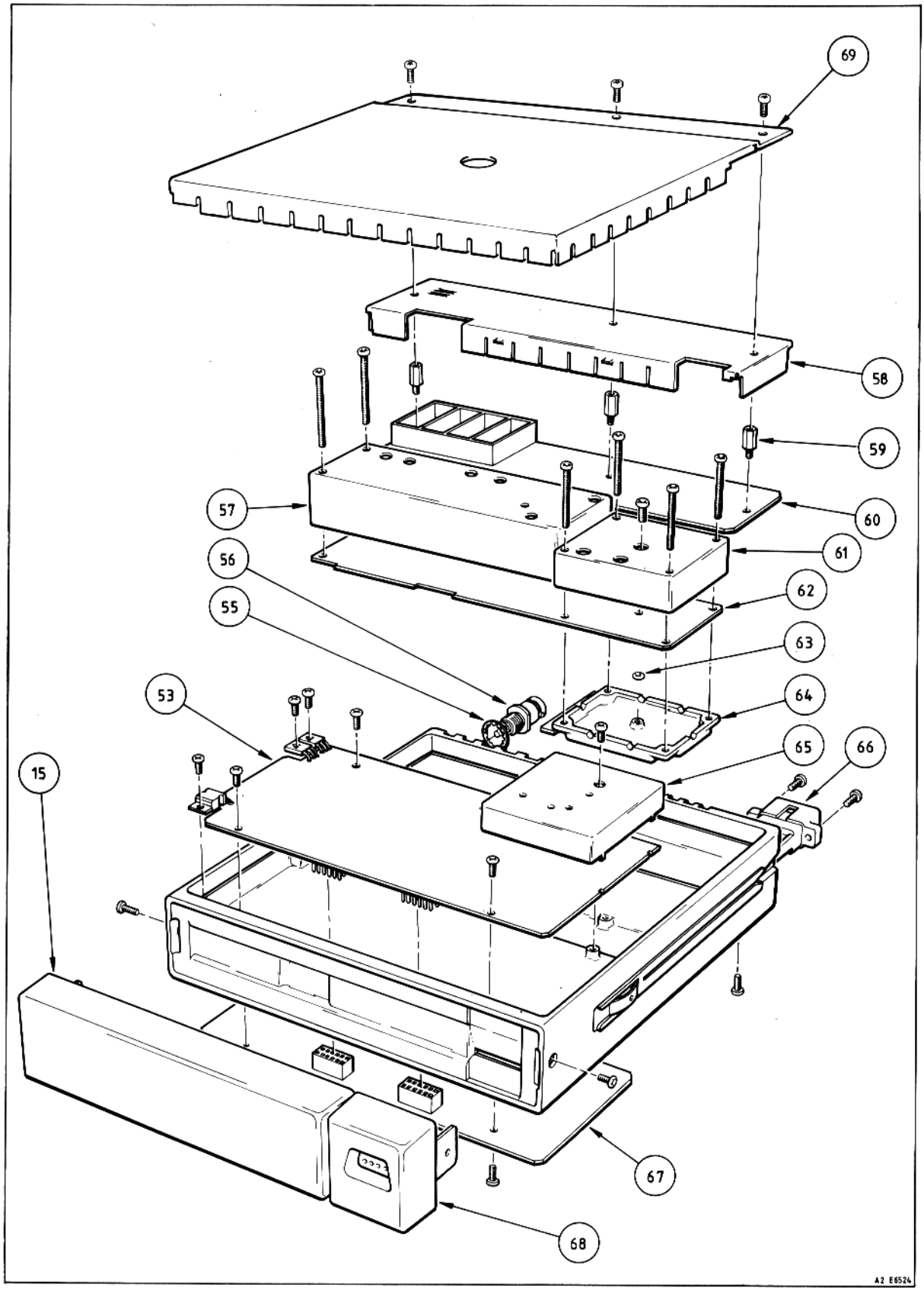


Fig 5.2 Exploded Diagram - Sub-Assemblies

SUB-ASSEMBLIES

Item No	Description	Part No	Remarks
(15)	Fascia, Remote, Grey Fascia, Remote, Brown	3513 901 90041 3513 901 90011	
(53)	Analogue PWB*	——	c/w Item (65)
(54)	not used		
(55)	Washer	3513 907 30021	
(56)	Antenna Socket	4313 324 40011	
(57)	Screening Can, Rx*	——	
(58)	Cover, Screening, PA	3513 901 10021	1/Tx PA
(59)	Pillar, Hexagonal	3513 904 90001	3/Tx PA
(60)	Tx PA PWB*	——	
(61)	Screening Can, VCO	3513 901 30031	
(62)	Rx/VCO PWB*	——	c/w Items (57), (61) & (63)
(63)	"O" Ring	2613 080 39461	
(64)	Casting, VCO Screen	3513 906 20001	
(65)	Screening Can, Synthesiser	3513 901 30061	1/Analogue PWB
(66)	PWB Decoupling	3513 500 00622 3513 500 00822	VHF Bands UHF Bands
(67)	Control PWB*	——	
(68)	Cover, Data Socket, Grey Cover, Data Socket, Brown	3513 901 90041 3513 901 10031	
(69)	Screen	3513 906 20081	

* See headed list

Screws:

st, pan, pozi, M2,5 x 30mm	2522 178 16047	2/Rx VCO PWB (not E0 Band)
st, pan, pozi, M2,5 x 25mm	2522 178 16046	4/VCO screening can
st, pan, pozi, M2,5 x 5mm	2522 178 16037	2/Tx PA PWB (all bands) 2/Rx VCO PWB (E0 Band) 1/VCO Casting-VCO PWB
st, pan, pozi, M2,5 x 8mm	2522 178 16039	1/TR281-Analogue PWB
st, psm, FM2,5 x 25mm	3513 993 57024	2/Remote Fascia 2/Data Socket-Console Plate

VHF Frequency Band variations

Description	Part No	E0	B0	A9	K1	K2
Tx PA Assembly (E0)	3513 500 00081	§				
Tx PA Assembly (B0)	3513 500 00041		§			
Tx PA Assembly (A9)	3513 500 00031			§		
Tx PA Assembly (K1)	3513 500 00061				§	
Tx PA Assembly (K2)	3513 500 00071					§
Rx VCO Assembly (E0)	3513 500 00552	§				
Rx VCO Assembly (B0)	3513 500 00521		§			
Rx VCO Assembly (A9)	3513 500 00511			§		
Rx VCO Assembly (K1)	3513 500 00531				§	
Rx VCO Assembly (K2)	3513 500 00541					§
Cable Assembly (1/Analogue-PA)	3513 505 00211	§				
Cable Assembly (1/Analogue-PA)	3513 505 00201		§	§	§	§
Screw, M2,5 (2/Rx VCO)	2522 178 16037	§				
Screw, M2,5 (2/Rx VCO)	2522 178 16047		§	§	§	§

UHF Frequency Band Variations

Description	Part No	TM	T4	U0	W1	W4
Tx PA, High Power (TM)	3513 500 00102	§				
Tx PA, High Power (T4)	3513 500 00102		§			
Tx PA, High Power (U0)	3513 500 00102			§		
Tx PA, High Power (W1)	3513 500 00952				§	
Tx PA, High Power (W4)	3513 500 00962					§
Tx PA, Low Power (TM, T4, U0)	3513 500 00122	§	§	§		
Tx PA, Low Power (WM)	3513 500 00132				§	§
Rx VCO Assembly (TM)	3513 500 00212	§				
Rx VCO Assembly (T4)	3513 500 00242		§			
Rx VCO Assembly (U0)	3513 500 00222			§		
Rx VCO Assembly (WM)	3513 500 00232				§	§
Cable Assembly (1/Analogue-PA)	3513 505 00201	§	§	§	§	§
Screw, M2,5 (2/Rx VCO)	2522 178 16047	§	§	§	§	§

Channel Spacing variations

FREQUENCY RANGE/STABILITY	12,5kHz (S)	20kHz (R)	25kHz (V)
Analogue PWB VHF 5,0ppm	3513 500 00262	3513 500 00281	3513 500 00302
Analogue PWB VHF 2,0ppm	3513 500 00272	3513 500 00291	3513 500 00312
Analogue PWB UHF 5,0ppm	3513 500 00321	3513 500 00341	3513 500 00361
Analogue PWB UHF 2,0ppm	3513 500 00331	3513 500 00351	3513 500 00371

Tone Signalling Variations

Description	Part No
PWB Control Assembly, SELCALL + CTCSS	3513 500 00391
PWB Control Assembly, SELCALL only	3513 500 00401
PWB Control Assembly, CTCSS only	3513 500 00411

MISCELLANEOUS ITEMS

Cct Ref	Description	Part No	Remarks
—	Display Console Assembly*	——	
—	Microphone Assembly, Standard*	——	
—	Microphone Assembly, Keypad/DTMF*	——	
LS1	Loudspeaker Assembly	3513 505 00041	
—	Cable Assembly	3513 505 00541	1/Rx VCO-Tx PA (E0, TM, T4, U0 & WM Bands)
—	Cable Assembly	3513 505 00191	1/Rx VCO-Tx PA (B0, A9, K1 & K2 Bands)
—	Cable Assembly	3513 505 00211	1/Analogue-Tx PA (E0 Band)
—	Cable Assembly	3513 505 00201	1/Analogue-Tx PA (not E0 Band)
—	Cable Assembly	3513 505 00221	1/Rx VCO-Tx PA (VHF Bands)
—	Cable Assembly	3513 505 00231	1/Rx VCO-Tx PA (UHF Bands)
—	Cable, Control	3513 505 00251	Item 11
—	Crystal/Posistor Assembly (8,4MHz)	3513 505 01461	Standard
—	Crystal/Posistor Assembly (7,2MHz)	3513 505 01441	Alternative
—	Crystal/Posistor Assembly (7,8MHz)	3513 505 01451	Alternative
—	Crystal/Posistor Assembly (9,0MHz)	3513 505 01471	Alternative
—	Nut, PA,	3513 904 10001	2/Power Transistors
—	Earth Clip, Beryllium Cu	3513 900 60011	
—	Earth Strap	3513 904 40011	2/Tx PA (UHF only)
—	Washer, st, M2,5	2522 600 24014	1/TR1, 1/TR5, 1/TR281

*See headed list

STANDARD CONSOLE

Grey **Part No 3513 505 00721**

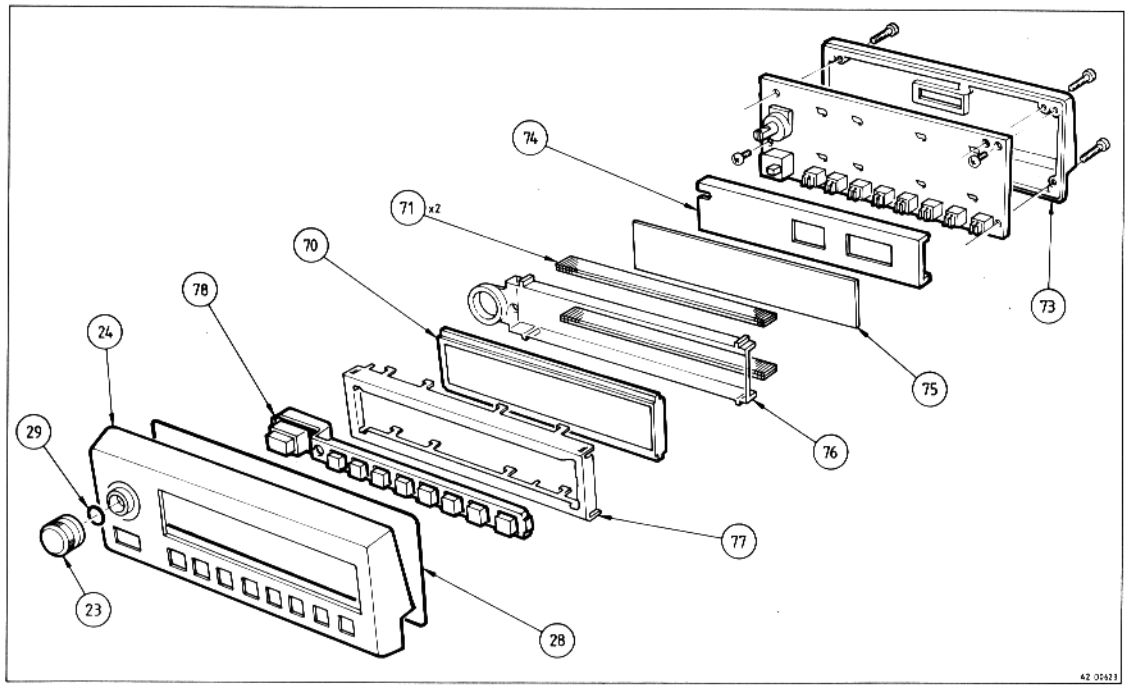


Fig 5.3 Exploded Diagram - Standard (Display) Console

Item	Description	Grey Console	Brown Console
(23)	Knob, Volume	3513 903 00091	3513 903 00001
(24)	Housing, Front, 6-Digit	3513 902 30081	3513 902 30071
(28)	Gasket	3513 902 10011	3513 902 10011
(29)	"O" Ring, Rubber	3513 905 60021	3513 905 60021
(70)	Liquid Crystal Display (LCD2101)	4313 324 90001	4313 324 90001
(71)	Zebra Strip, (2/LCD2101)	3513 900 60041	3513 900 60041
(73)	Back Plate	3513 905 30021	3513 905 30021
(74)	Support, (1/Reflector)	3513 905 80191	3513 905 80191
(75)	Reflector	3513 905 60031	3513 905 60031
(76)	Light-Pipe	3513 902 10021	3513 902 10021
(77)	Bezel	3513 900 20051	3513 900 20051
(78)	Switch Membrane	3513 900 20081	3513 900 20001

ITEMS NOT ILLUSTRATED

Cct Ref	Description	Part No	Remarks
LP2101	Bulb, 60mA, with sleeve	4313 322 80001	
—	Screw, st, pan, pozi, M2,5 x 5mm	2522 175 16037	2/PWB-Back Plate 2/Back Plate-Brackets
—	Screw, st, psm, thr, 2,2 x 10mm	3513 993 57005	4/PWB-Housing

BASIC CONSOLE

Grey **Part No 3513 505 00731**

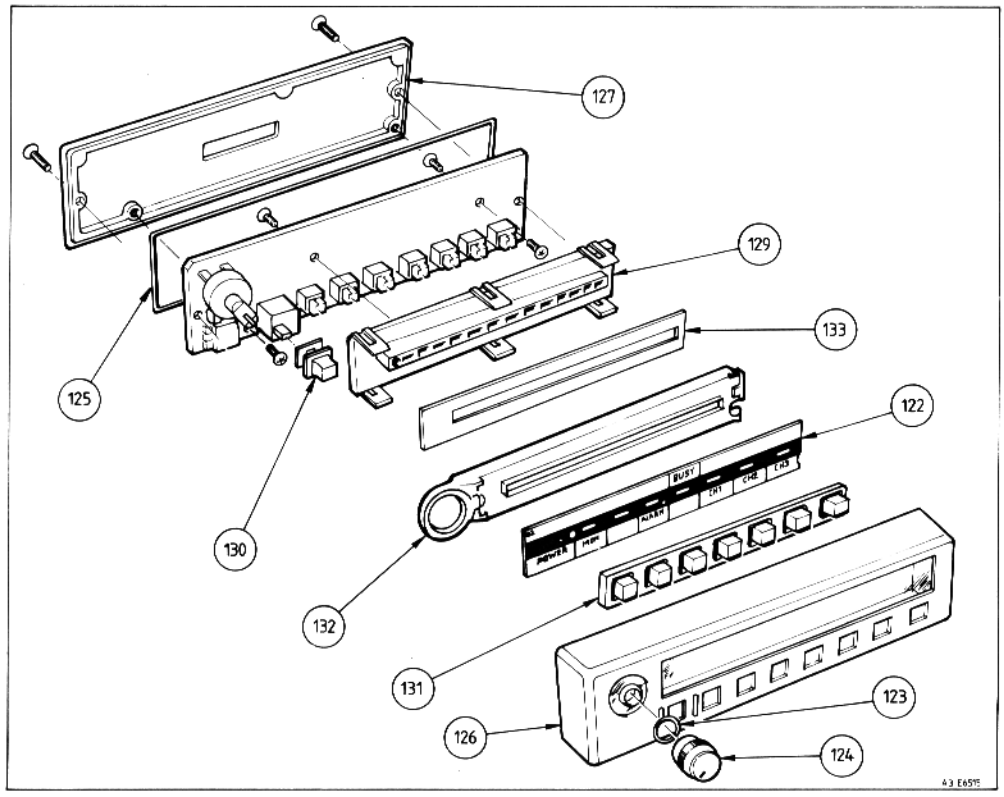


Fig 5.4 Exploded Diagram - Basic Console

Item No	Description	Grey Console	Brown Console
(123)	"O" Ring, Rubber	3513 905 60021	3513 905 60021
(124)	Volume Knob	3513 903 00101	3513 903 00051
(125)	Gasket, Backplate	3513 902 10031	3513 902 10031
(126)	Housing, Front	3513 902 30061	3513 902 30001
(127)	Back Plate	3513 905 30001	3513 905 30001
(129)	Reflector, Support	3513 905 80201	3513 905 80121
(130)	Support Button	3513 905 80131	3513 905 80131
(131)	Button Key Panel	3513 900 20081	3513 900 20001
(132)	Light-Pipe	3513 902 10001	3513 902 10001
(133)	Reflector	3513 905 60041	3513 905 60041

ITEMS NOT ILLUSTRATED

Cct Ref	Description	Part No	Remarks
LP2101	Bulb, 60mA, with sleeve	4313 322 80001	
—	Screw, st, pan, pozi, M2,5 x 5mm	2522 175 16037	2/PWB-Back Plate 2/Back Plate-Brackets
—	Screw, st, FM2,2 x 8mm	3513 993 57004	2/Reflector-Support
—	Screw, st, psm, thr, 2,2 x 10mm	3513 993 57005	4/PWB-Housing

JUNCTION BOX

	Grey	Brown
1 metre cable	3513 504 01761	3513 504 00021
5 metre cable	3513 504 01771	3513 504 00031

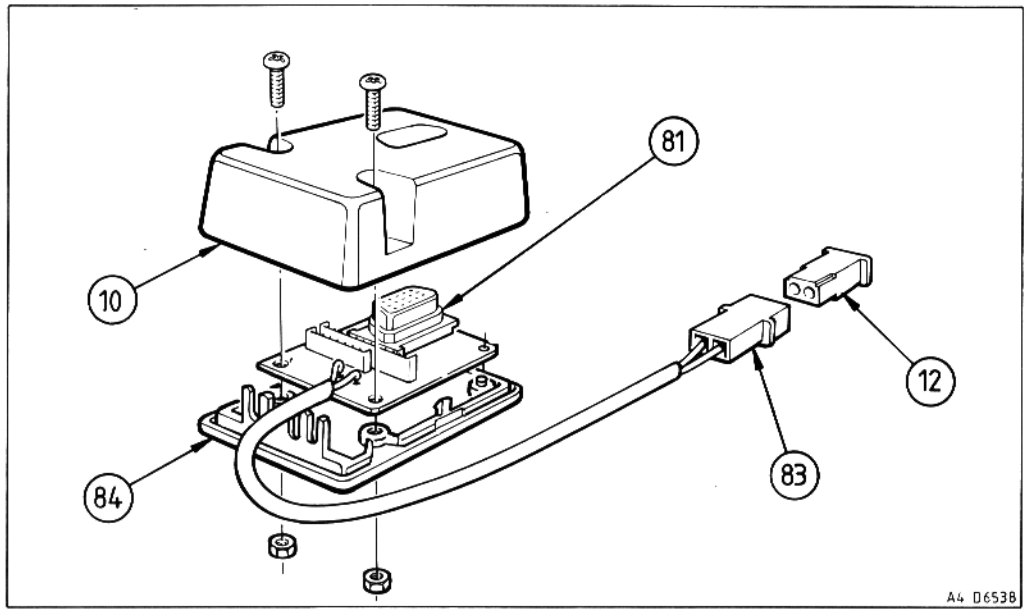


Fig 5.5 Exploded Diagram - Junction Box

Item No	Description	Part No	Remarks
(10)	Top, Junction Box, Grey	3513 902 70011	
	Top, Junction Box, Brown	3513 902 70001	
(81)	Socket, Data, 15-way	4313 324 40001	
(83)	Cable Assembly	3513 505 00181	
	comprising:-		
	Housing, 2-way	2422 025 02898	
	Pin, Contact (Strip), 2 off	2422 034 19189	
(12)	Housing, 2-way	2422 025 02901	1/Loudspeaker
(84)	Base, Junction Box, Grey	3513 900 20061	
	Base, Junction Box, Brown	3513 900 20031	

MISCELLANEOUS ITEMS

Cct Ref	Description	Part No	Remarks
—	Plug Assembly, Data, 15-way, Grey	3513 505 00601	1 metre length
—	Plug Assembly, Data, 15-way, Brown	3513 505 00081	1 metre length
—	Plug Assembly, Data, 15-way, Grey	3513 505 00611	5 metres length
—	Plug Assembly, Data, 15-way, Brown	3513 505 00091	5 metres length
—	Pad, Adhesive	3513 905 10031	
—	Nut, st, hex, M3	2522 401 30008	2/Top-Base
—	Screw, st, pan, pozi, M3 x 8mm	2522 178 16059	2/Top-Base
—	Screw, st, pan, S/T No 6 x 25mm (2 off)	2513 200 06407	(Alternative to fixing by adhesive pad)
—	Seal, Silicon Rubber	3513 905 80111	order per metre

STANDARD MICROPHONE

Grey **Part No 3513 505 00691**
Brown **Part No 3513 505 00121**

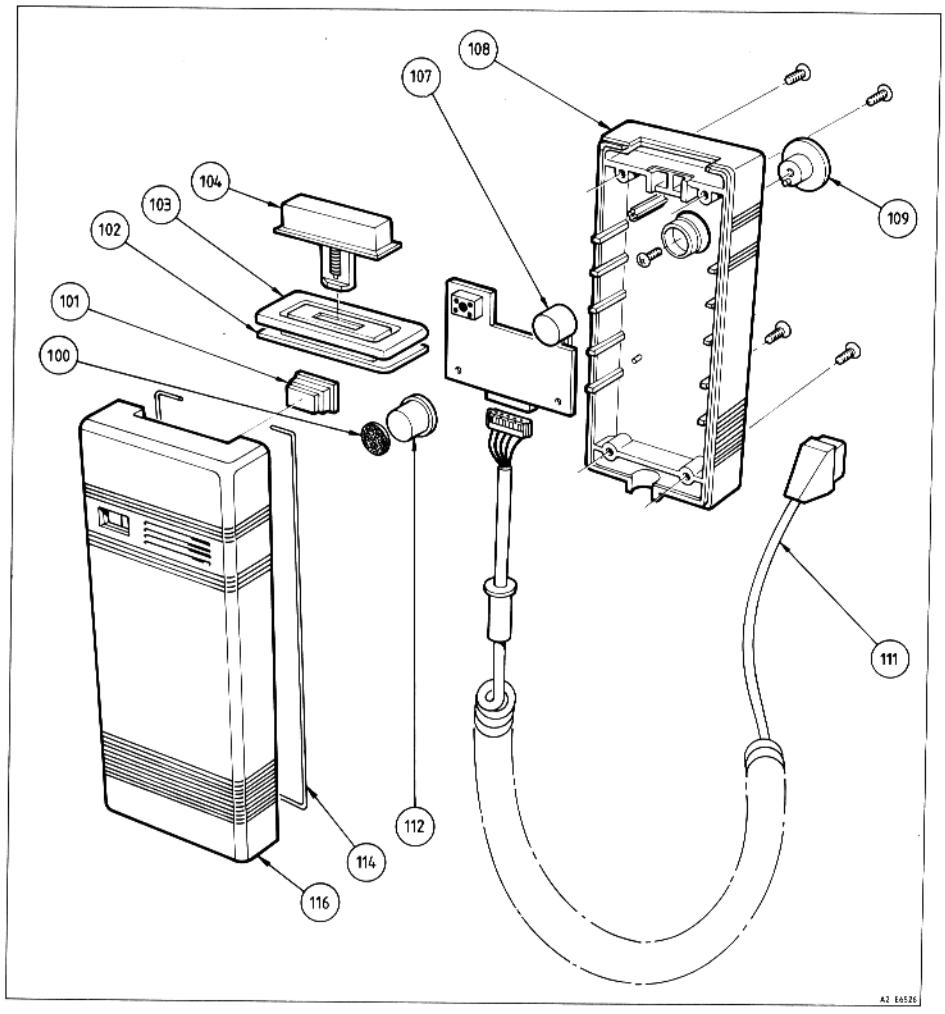


Fig 5.5 Exploded Diagram - Standard Microphone

Item No	Description	Grey	Brown
(100)	Disc, Acoustic	3513 901 50001	3513 901 50001
(101)	Facility Key	3513 903 00071	3513 903 00021
(102)	Seal (1/Pressel)	3513 905 80061	3513 905 80061
(103)	Support Ring (1/Pressel Seal)	3513 905 60011	3513 905 60011
(104)	Pressel (requires Spring 3513 905 80101)	3513 904 50151	3513 904 50161
(107)	Microphone, Electret	4313 322 90001	4313 322 90001
(108)	Case Back	3513 900 90051	3513 900 90031
(109)	Knob, Mic Rest (1/Case Back)	3513 903 00061	3513 903 00041
(111)	Plug Assembly, Data, 5-way	3513 505 00051	3513 505 00571
(112)	Housing, Support (1/electret insert)	3513 902 30031	3513 902 30031
(114)	Silicon Rubber Seal	3513 905 80111	3513 905 80111
(116)	Case Front	3513 900 90041	3513 900 90011

DTMF/KEYPAD MICROPHONE

	Grey	Brown
Keypad	3513 505 00701	3513 505 00131
DTMF	3513 505 00711	3513 505 00141

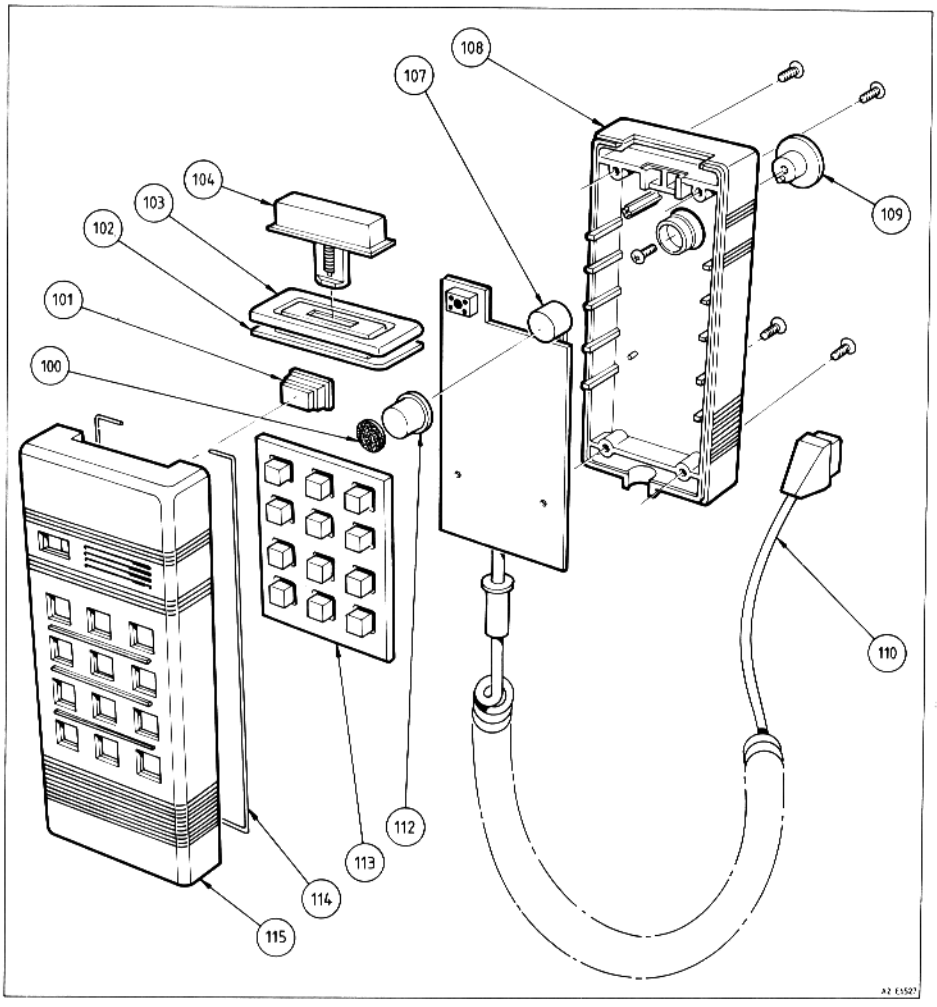
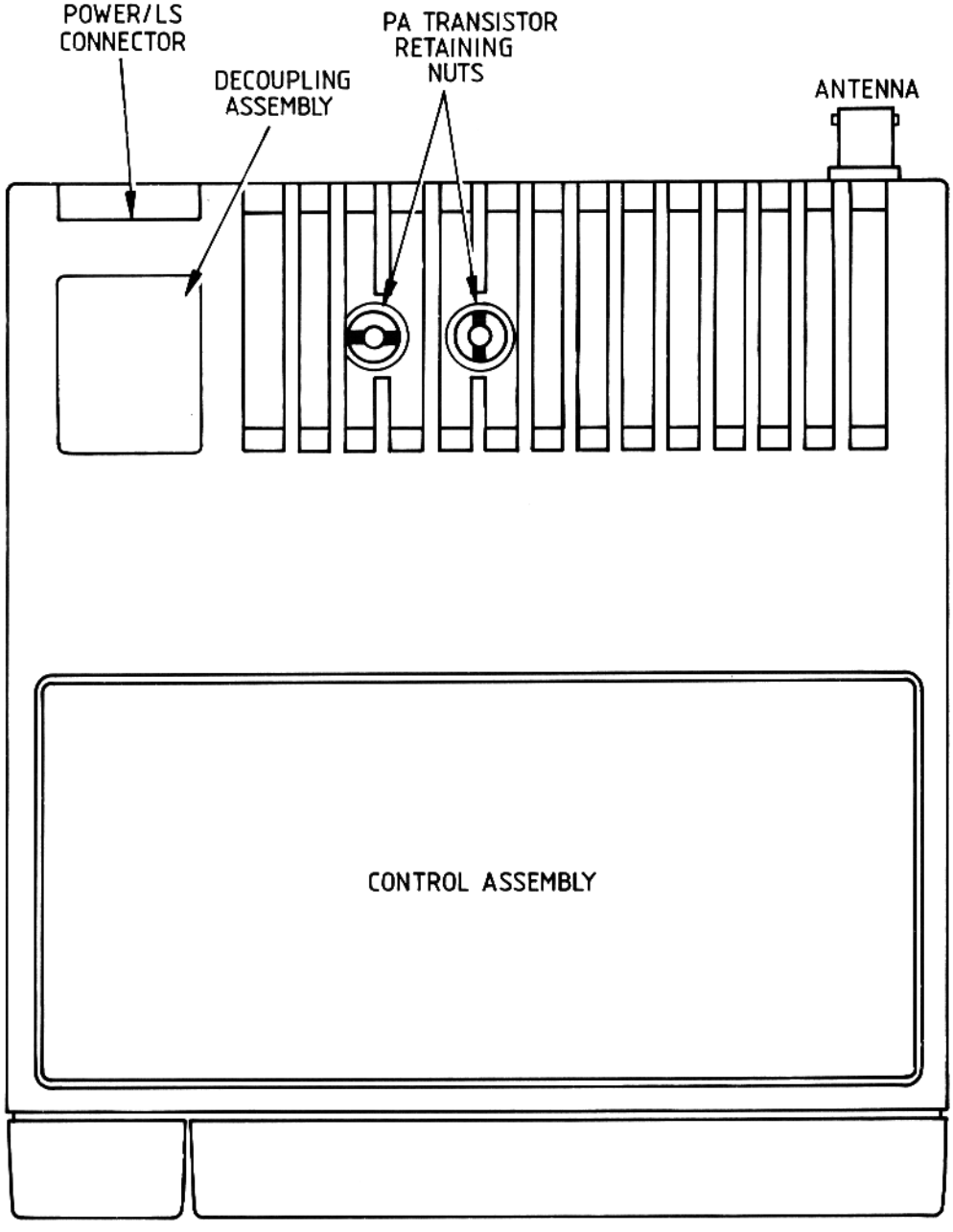


Fig 5.6 Exploded Diagram - DTMF/Keypad Microphone

Item No	Description	Grey	Brown
(100)	Disc, Acoustic	3513 901 50001	3513 901 50001
(101)	Facility Key	3513 903 00071	3513 903 00021
(102)	Seal (1/Pressel)	3513 905 80061	3513 905 80061
(103)	Support Ring (1/Pressel Seal)	3513 905 60011	3513 905 60011
(104)	Pressel (requires Spring 3513 905 80101)	3513 904 50151	3513 904 50161
(107)	Microphone, Electret	4313 322 90001	4313 322 90001
(108)	Case Back	3513 900 90051	3513 900 90031
(109)	Knob, Mic Rest (1/Case Back)	3513 903 00061	3513 903 00041
(110)	Plug Assembly, Data, 10-way	3513 505 00591	3513 505 00071
(112)	Housing, Support (1/electret insert)	3513 902 30031	3513 902 30031
(113)	Keypad Membrane (1/SW1521-SW1532)	3513 903 00081	3513 903 00031
(114)	Silicon Rubber Seal	3513 905 80111	3513 905 80111
(115)	Case Front, Keypad	3513 900 90071	3513 900 90021


POWER/LS
CONNECTOR
DECOUPLING
ASSEMBLY
PA TRANSISTOR
RETAINING
NUTS
ANTENNA
CONTROL ASSEMBLY

FIG

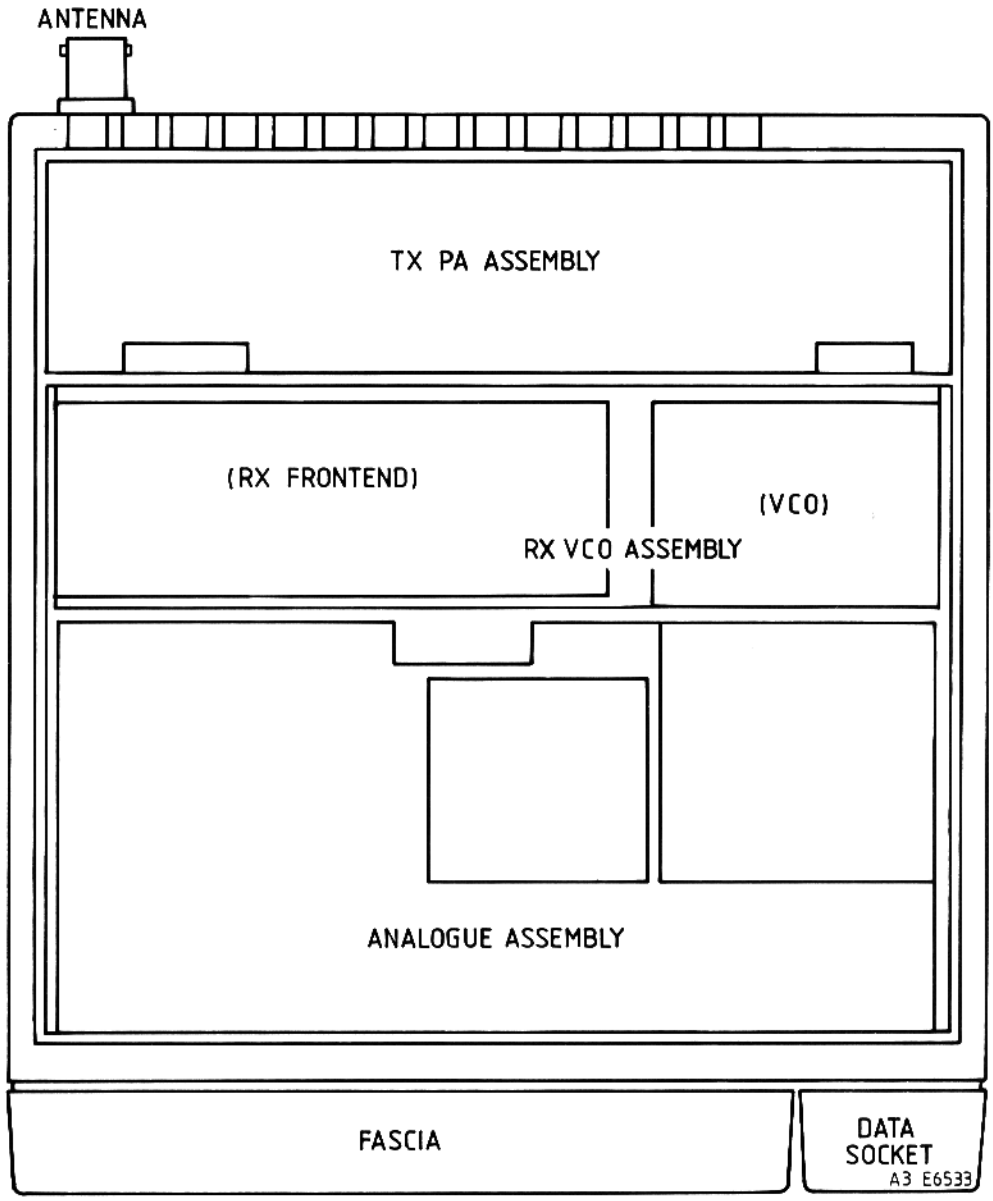


FIG 6.1 TRANSCEIVER LAYOUT DIAGRAM

TP253

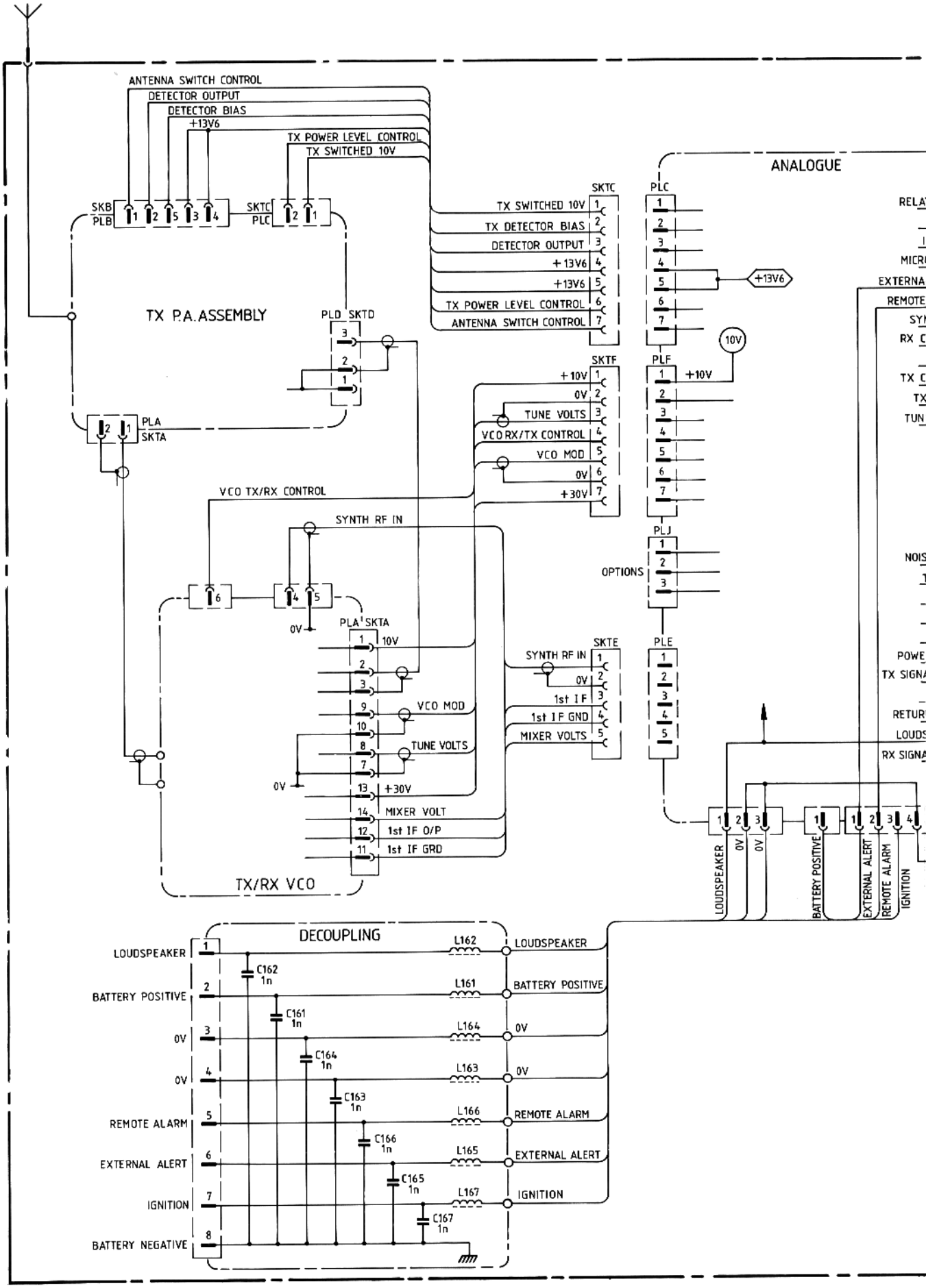
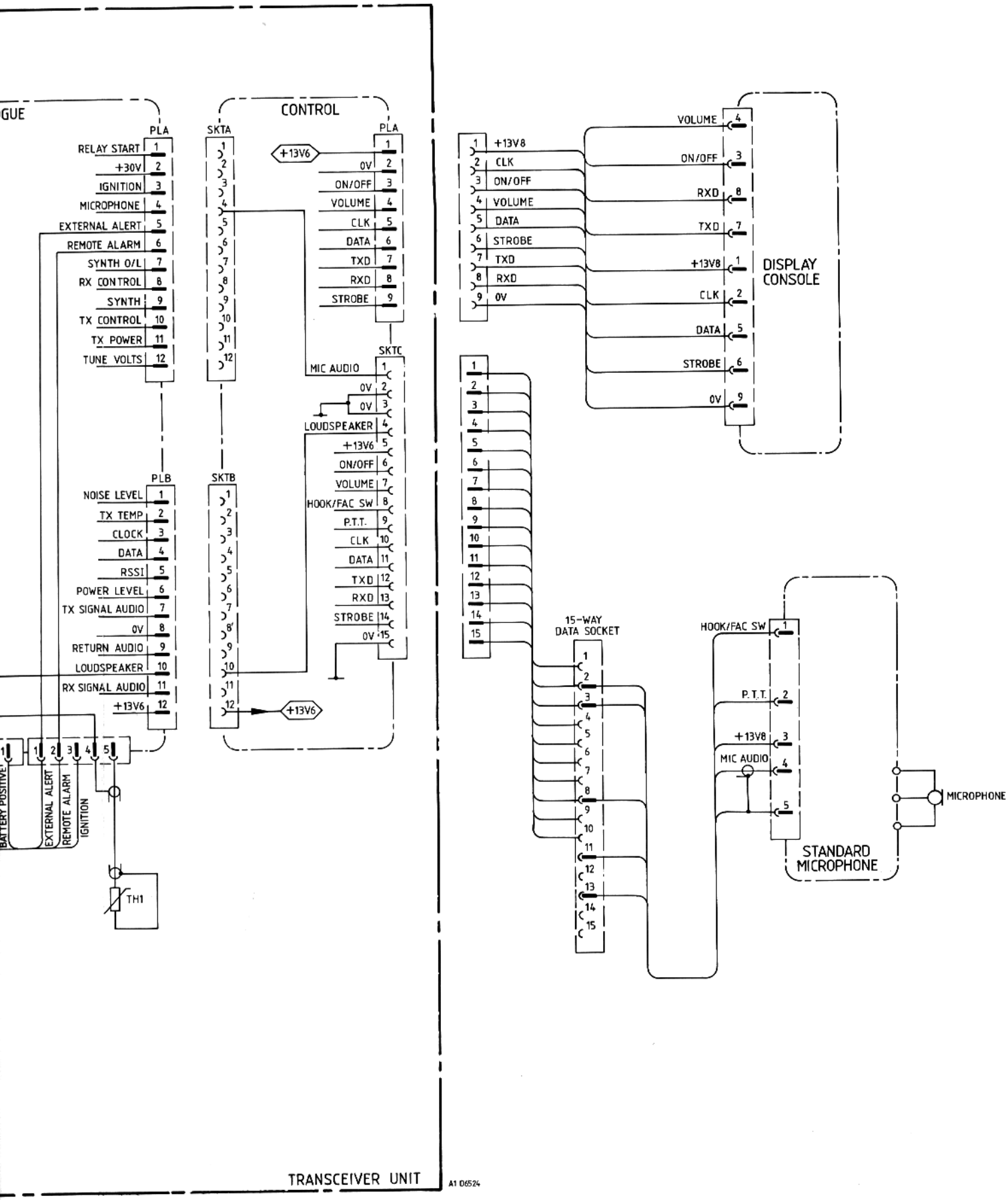


FIG 6.2 TRANSCEIVER INTERCONNECTION DIAGRAM


GUE
PLA
RELAY START 1
+30V 2
IGNITION 3
MICROPHONE 4
EXTERNAL ALERT 5
REMOTE ALARM 6
SYNTH O/L 7
RX CONTROL 8
SYNTH 9
TX CONTROL 10
TX POWER 11
TUNE VOLTS 12
PLB
NOISE LEVEL 1
TX TEMP 2
CLOCK 3
DATA 4
RSSI 5
POWER LEVEL 6
TX SIGNAL AUDIO 7
0V 8
RETURN AUDIO 9
LOUDSPEAKER 10
RX SIGNAL AUDIO 11
+13V6 12
BATTERY POSITIVE
EXTERNAL ALERT
REMOTE ALARM
IGNITION
TH1
CONTROL
SKTA
PLA
+13V6
0V 2
ON/OFF 3
VOLUME 4
CLK 5
DATA 6
TXD 7
RXD 8
STROBE 9
SKTC
MIC AUDIO 1
0V 2
0V 3
LOUDSPEAKER 4
+13V6 5
ON/OFF 6
VOLUME 7
HOOK/FAC SW 8
P.T.T. 9
CLK 10
DATA 11
TXD 12
RXD 13
STROBE 14
0V 15
SKTB
+13V6
TRANSCEIVER UNIT
A1 06524
+13V8 1
CLK 2
ON/OFF 3
VOLUME 4
DATA 5
STROBE 6
TXD 7
RXD 8
0V 9
VOLUME 4
ON/OFF 3
RXD 8
TXD 7
+13V8 1
CLK 2
DATA 5
STROBE 6
0V 9
DISPLAY CONSOLE
15-WAY DATA SOCKET
HOOK/FAC SW 1
P.T.T. 2
+13V8 3
MIC AUDIO 4
5
MICROPHONE
STANDARD MICROPHONE

TION

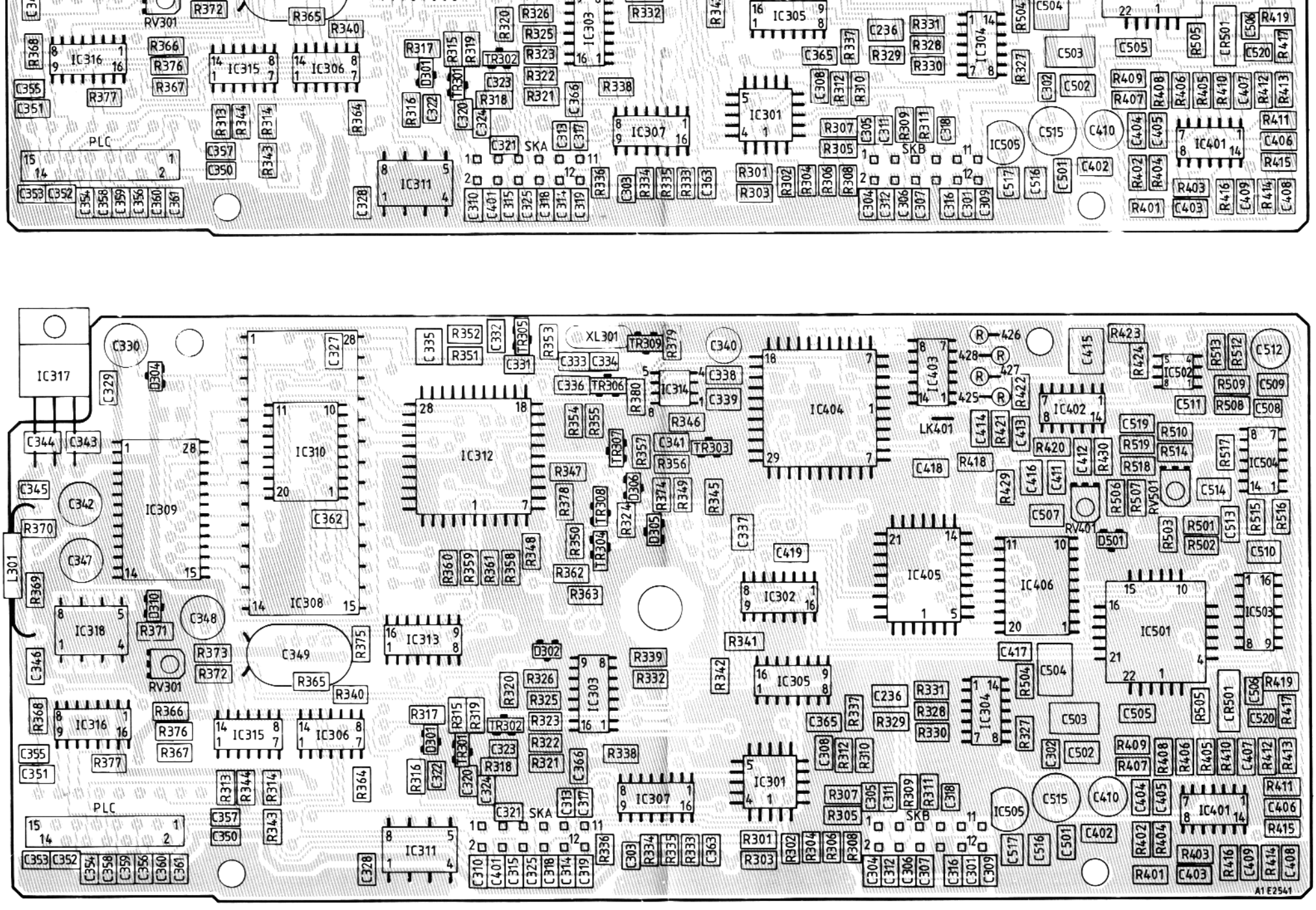
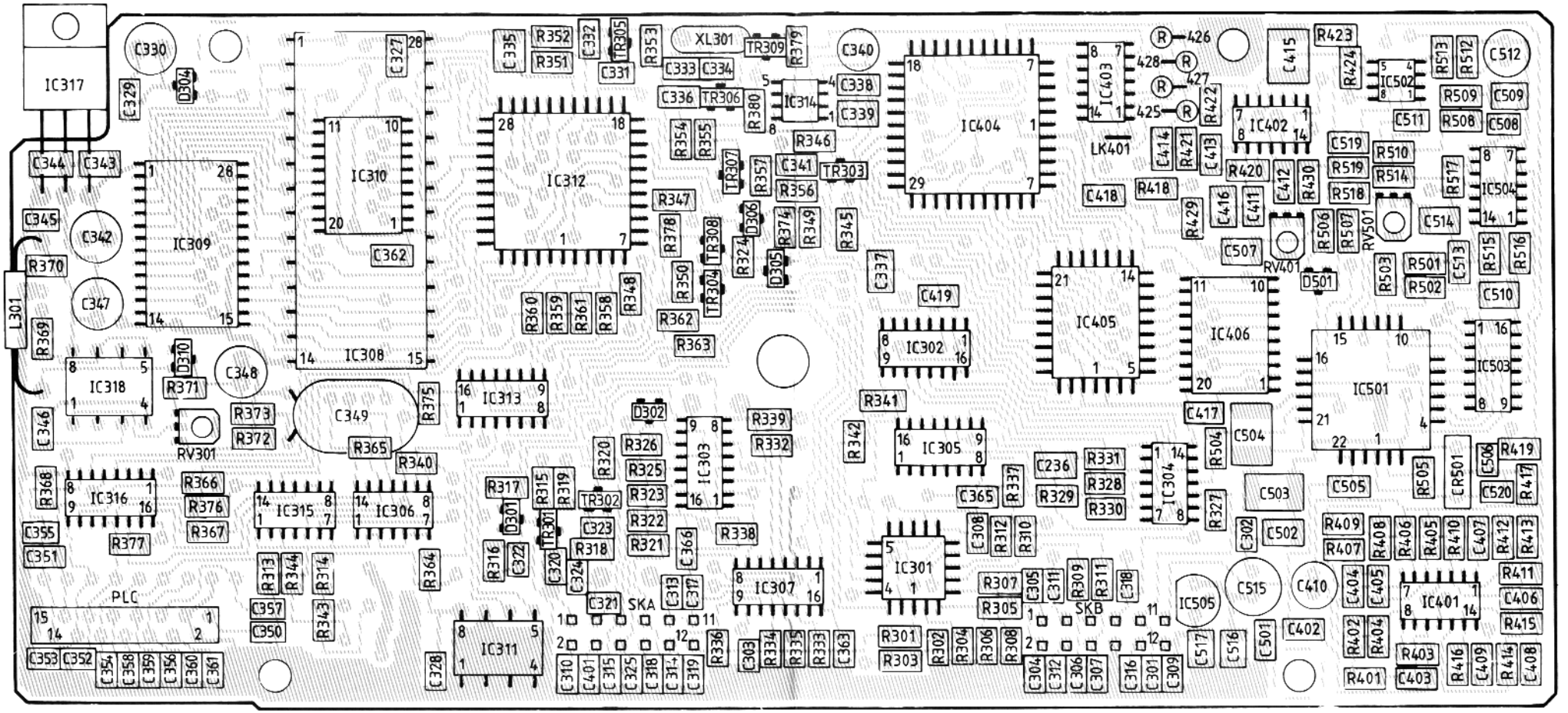
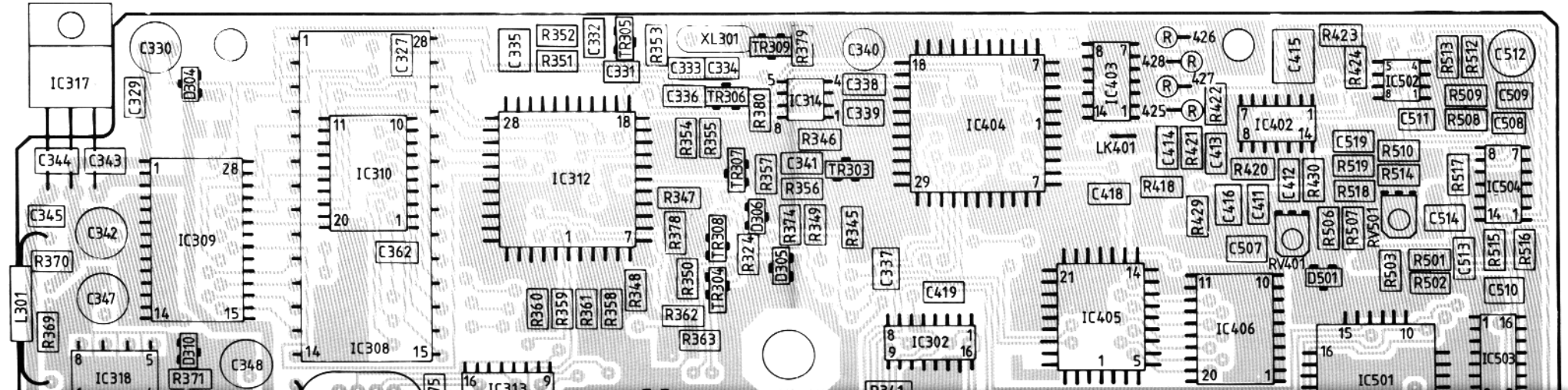
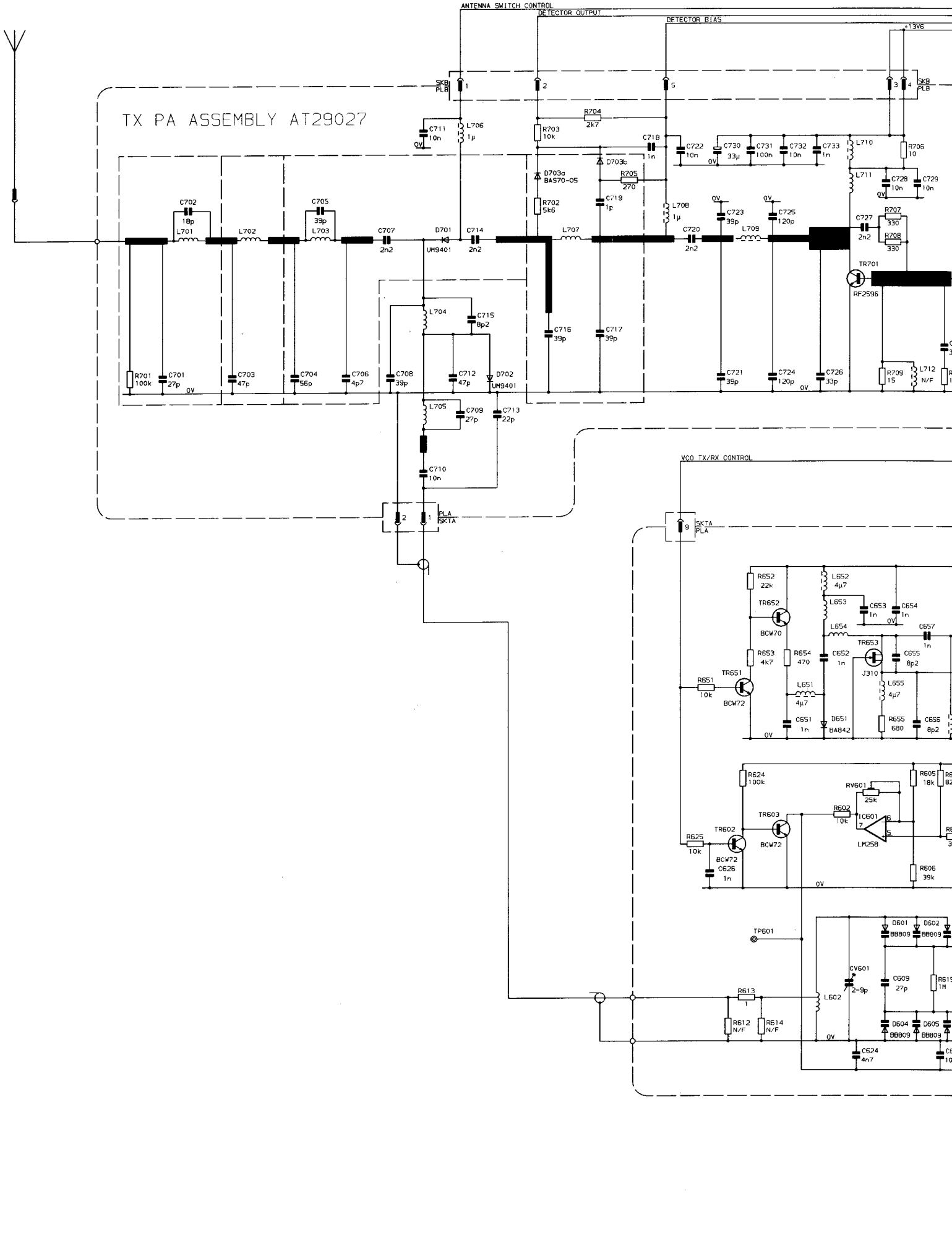


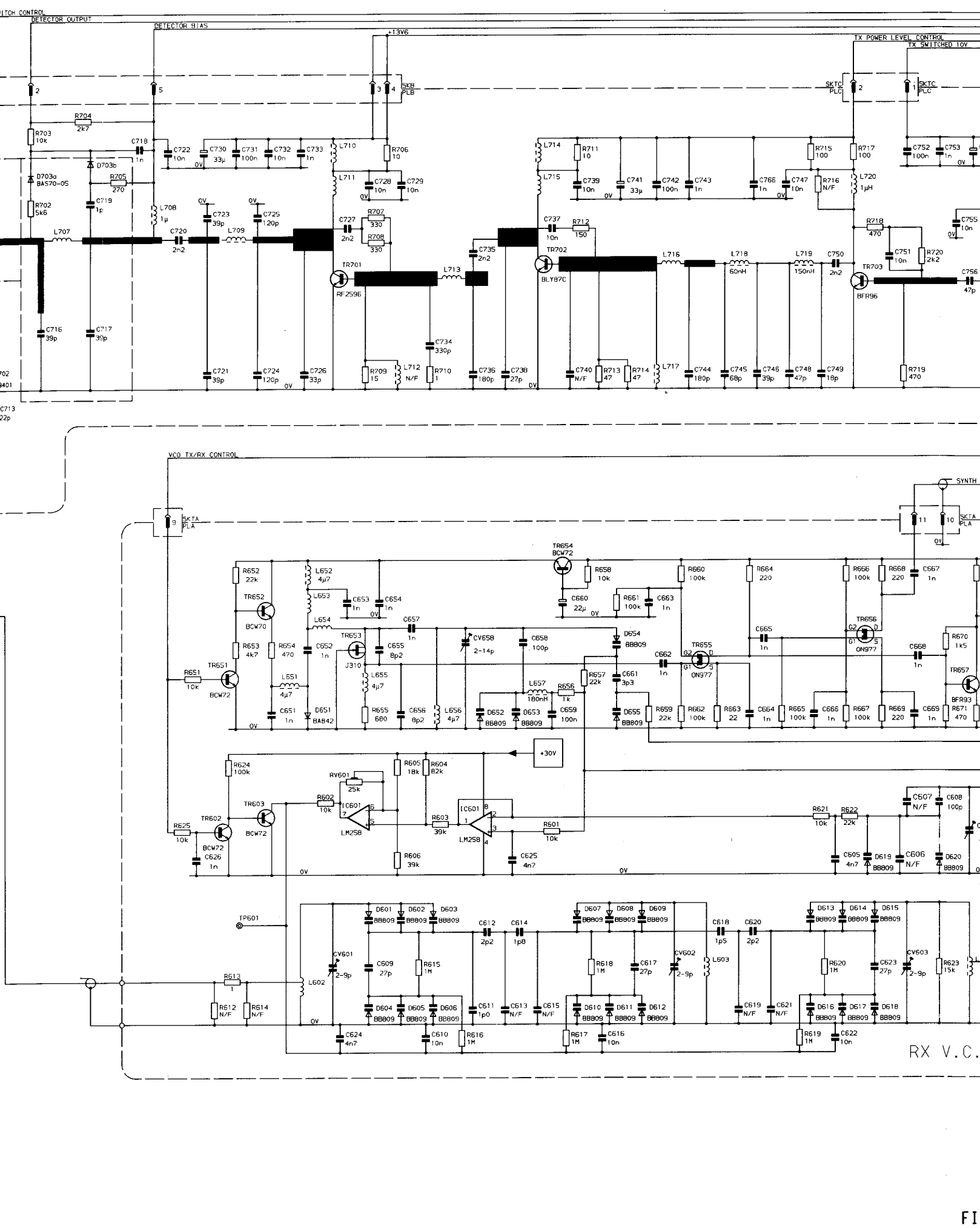
FIG 6.3 CONTROL PWB
COMPONENT LOCATION DIAGRAM


IC317
C330
C329
D304
C344
C343
C345
C342
IC309
R370
C347
L301
R369
IC318
D310
R371
C348
RV301
C346
R373
R372
C349
R375
R365
R340
R368
IC316
R366
R376
R367
R377
C355
C351
IC315
IC306
R313
R344
R374
C357
C350
R343
R364
PLC
C353
C352
C354
C358
C359
C356
C360
C361
C327
IC310
C362
IC308
C335
R352
R351
C332
TR305
R353
C331
XL301
TR309
R379
C333
C334
C336
TR306
R380
IC314
C340
C338
C339
IC312
R354
R355
R346
C341
TR303
TR307
R357
R356
R347
R378
TR308
D306
R374
R349
R345
R324
D305
R350
TR304
R360
R359
R361
R358
R348
R362
R363
C337
IC404
IC403
LK401
R426
R428
R427
R425
R422
C414
R421
C413
C418
R418
R429
C416
C411
C415
R423
R424
IC502
R513
R512
C512
R509
C509
C511
R508
C508
IC402
R420
C412
R430
C519
R519
R518
R510
R514
RV501
R506
R507
C507
RV401
D501
C514
R517
IC504
R515
R516
C513
R503
R501
R502
C510
IC405
IC406
IC302
R419
R417
C520
C508
CR501
R505
C505
C503
C504
R504
C417
R341
R342
IC305
IC304
C236
R331
R328
R330
R329
C365
R337
R327
C302
C502
R409
R407
R408
R406
R405
R410
C407
R412
R413
R411
C406
R415
IC401
R402
R404
R403
R401
C403
R416
C409
R414
C408
C410
C515
IC505
C501
C402
C517
C516
R339
R332
IC303
R326
R325
R323
R322
R321
R320
D302
R317
R315
R319
TR302
D301
TR301
C322
C320
C323
C324
R318
C366
R338
C321
SKA
C313
C317
IC307
R307
R305
C305
C311
R309
R311
C318
SKB
IC301
R301
R303
R302
R304
R306
R308
C304
C312
C306
C307
C316
C301
C309
R336
C303
R334
R335
R333
C363
C310
C401
C315
C325
C318
C314
C319
C328
IC311
R316
R364


IC317
C330
C329
D304
C344
C343
C345
C342
IC309
R370
C347
L301
R369
IC318
D310
R371
C348
C362
IC308
IC310
C327
C335
R352
R351
C332
TR305
R353
C331
XL301
TR309
R379
C333
C334
C336
TR306
R380
IC314
C340
C338
C339
IC312
R354
R355
R346
C341
TR303
TR307
R357
R356
R347
R378
TR308
D306
R374
R349
R345
R324
D305
R350
TR304
R360
R359
R361
R358
R348
R362
R363
C337
IC404
IC403
LK401
R426
R428
R427
R425
R422
C414
R421
C413
C418
R418
R429
C416
C411
C415
R423
R424
IC502
R513
R512
C512
R509
C509
C511
R508
C508
IC402
R420
C412
R430
C519
R519
R518
R510
R514
RV501
R506
R507
C507
RV401
D501
C514
R517
IC504
R515
R516
C513
R503
R501
R502
C510
IC405
IC406
IC302
IC501
IC503

66-88 MHz


ANTENNA SWITCH CONTROL
DETECTOR OUTPUT
DETECTOR BIAS
+13V6
TX PA ASSEMBLY AT29027
SKB PLB
SKTA PLA
VCO TX/RX CONTROL
C711 10n
L706 1µ
R703 10k
R704 2k7
C718 1n
C722 10n
C730 33µ
C731 100n
C732 10n
C733 1n
L710
R706 10
L711
C728 10n
C729 10n
D703a BAS70-05
D703b
R705 270
R702 5k6
C719 1p
L708 1µ
C723 39p
C725 120p
C727 2n2
R707 330
R708 330
TR701 RF2596
C702 18p
L701
L702
C705 39p
L703
C707 2n2
D701 UM9401
C714 2n2
L707
C720 2n2
L709
L704
C715 8p2
C716 39p
C717 39p
R701 100k
C701 27p
C703 47p
C704 56p
C706 4p7
C708 39p
C712 47p
D702 UM9401
C721 39p
C724 120p
C726 33p
R709 15
L712 N/F
L705
C709 27p
C713 22p
C710 10n
PLA SKTA
R652 22k
L652 4µ7
TR652 BCW70
L653
C653 1n
C654 1n
L654
C657 1n
TR653 J310
C655 8p2
R653 4k7
R654 470
C652 1n
TR651 BCW72
R651 10k
L651 4µ7
L655 4µ7
C651 1n
D651 BA842
R655 680
C656 8p2
R624 100k
RV601 25k
R605 18k
R602 10k
IC601 LM258
TR603 BCW72
TR602 BCW72
R625 10k
C626 1n
R606 39k
TP601
D601 BB809
D602 BB809
CV601 2-9p
C609 27p
R613 1
L602
R612 N/F
R614 N/F
D604 BB809
D605 BB809
C624 4n7


DETECTOR OUTPUT
DETECTOR BIAS
+13V6
TX POWER LEVEL CONTROL
TX SWITCHED 10V
SKB PLB
SKTC PLC
TR701 RF2596
TR702 BLY87C
TR703 BFR96
VCO TX/RX CONTROL
SKTA PLA
SYNTH
TR651 BCW72
TR652 BCW70
TR653 J310
TR654 BCW72
TR655 ON977
TR656 ON977
TR657 BFR93
TR602 BCW72
TR603 BCW72
IC601 LM258
+30V
TP601
RX V.C.

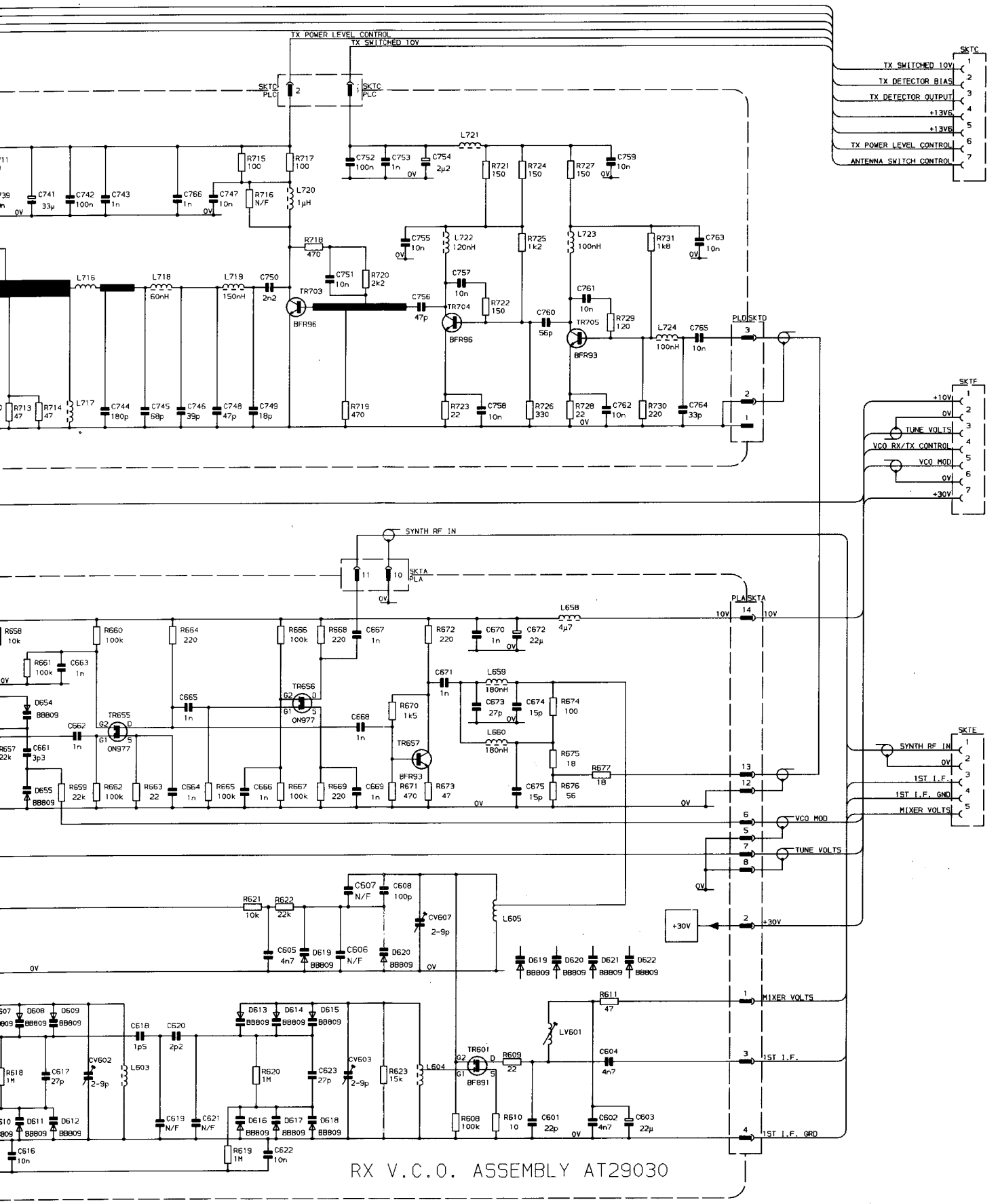
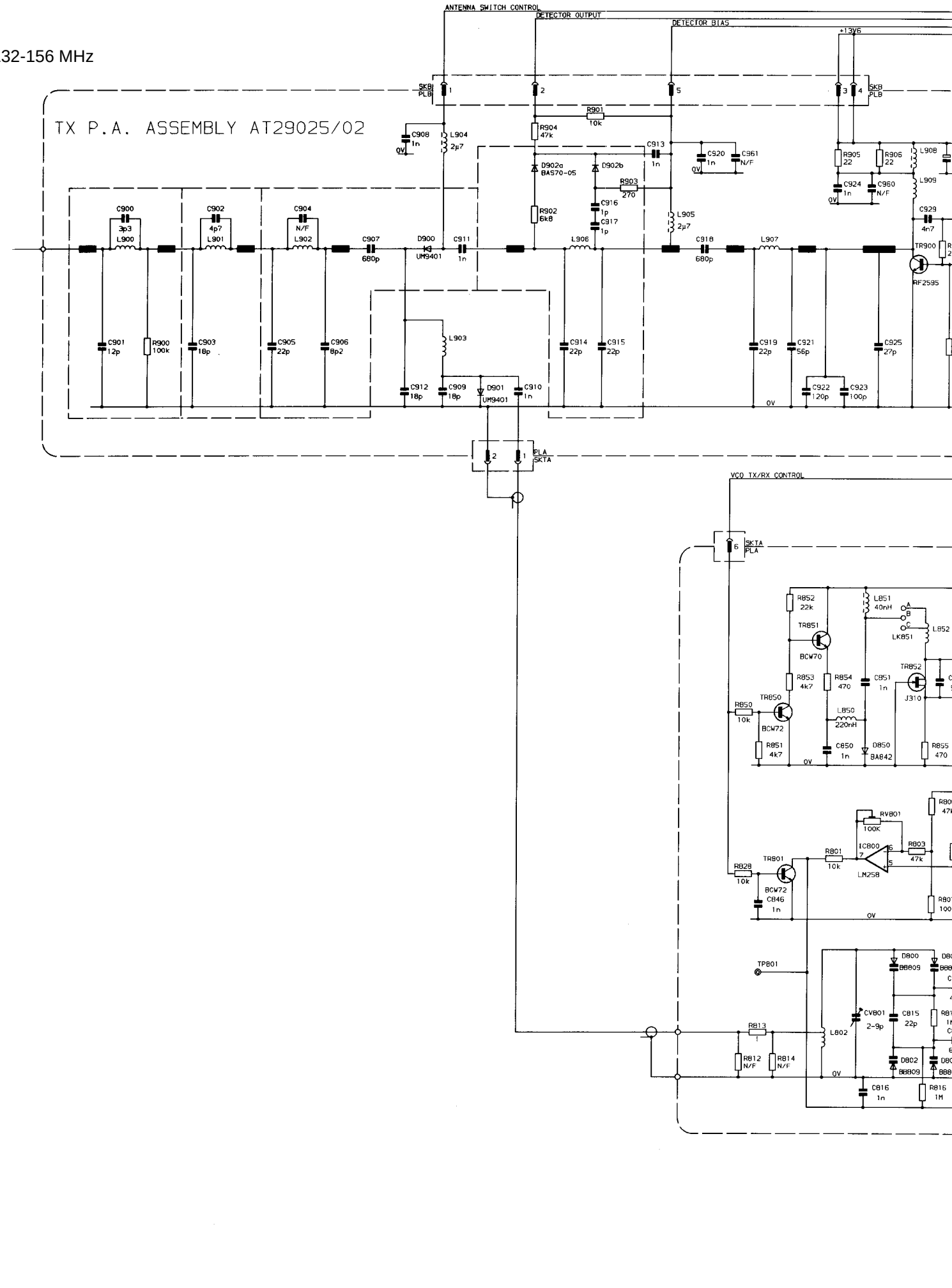
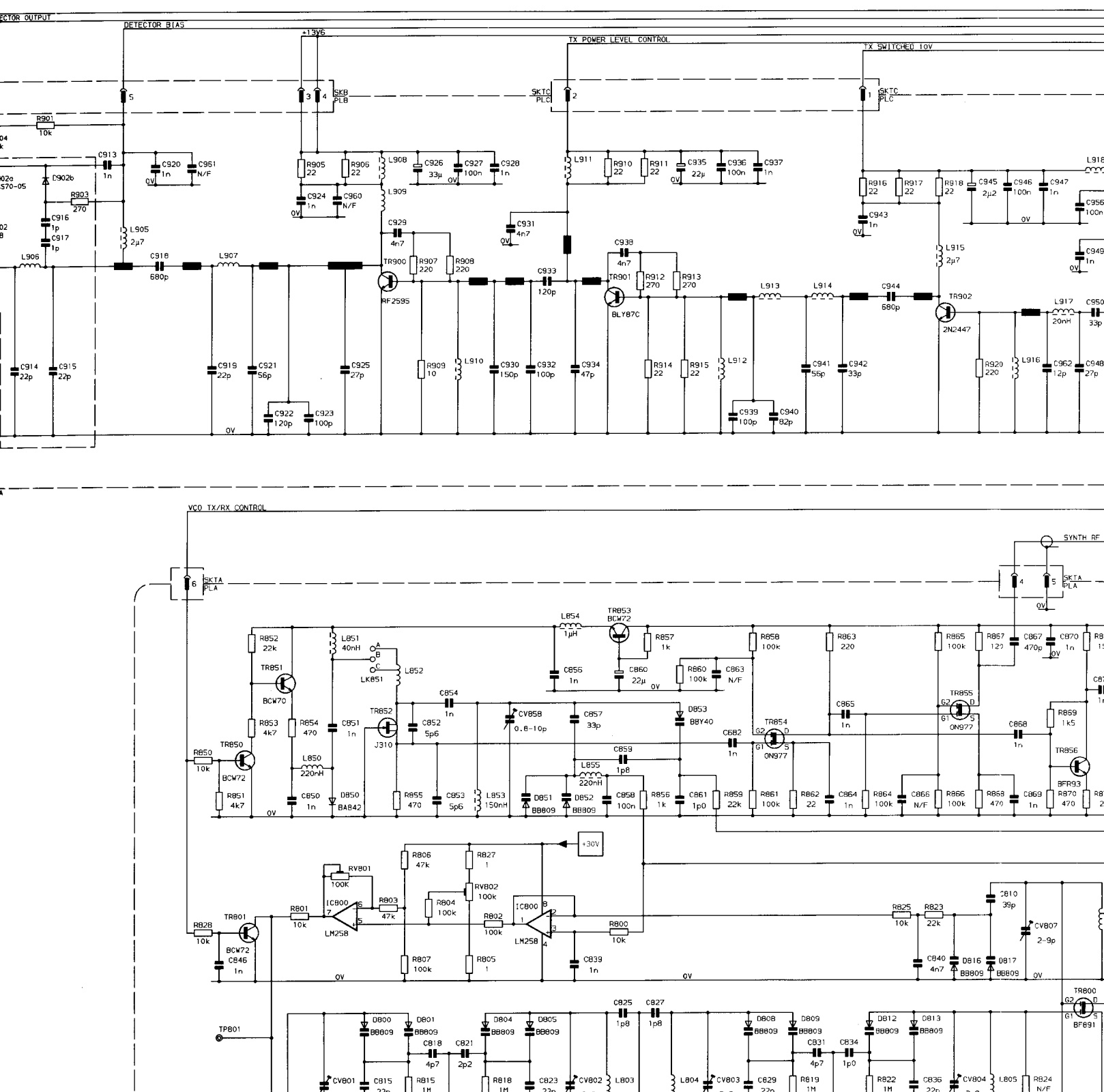


FIG 6.4 RF FRONT END CIRCUIT DIAGRAM
(66-88MHz)

132-156 MHz


TX P.A. ASSEMBLY AT29025/02
ANTENNA SWITCH CONTROL
DETECTOR OUTPUT
DETECTOR BIAS
+13V6
5KB PLB
5KB PLB
PLA 5KTA
VCO TX/RX CONTROL
5KTA PLA
R901 10k
R904 47k
R902 6k8
R903 270
C908 1n
L904 2µ7
D902a BAS70-05
D902b
C913 1n
C920 1n
C961 N/F
L905 2µ7
R905 22
R906 22
L908
L909
C924 1n
C960 N/F
C929 4n7
TR900 RF2595
C900 3p3 L900
C902 4p7 L901
C904 N/F L902
C907 680p
D900 UM9401
C911 1n
L906
C918 680p
L907
C901 12p
R900 100k
C903 18p
C905 22p
C906 8p2
L903
C912 18p
C909 18p
D901 UM9401
C910 1n
C914 22p
C915 22p
C916 1p
C917 1p
C919 22p
C921 56p
C922 120p
C923 100p
C925 27p
0V
R852 22k
TR851 BCW70
L851 40nH
LK851
L852
TR852 J310
C851 1n
R853 4k7
R854 470
TR850 BCW72
R850 10k
L850 220nH
R851 4k7
C850 1n
D850 BA842
R855 470
RV801 100K
IC800 LM258
R803 47k
R801 10k
TR801 BCW72
R828 10k
C846 1n
TP801
D800 BB809
D802 BB809
CV801 2-9p
C815 22p
L802
R813
R812 N/F
R814 N/F
C816 1n
R816 1M


ECTOR OUTPUT
DETECTOR BIAS
+13V6
TX POWER LEVEL CONTROL
TX SWITCHED 10V
SKB PLB
SKTC PLC
R901 10k
C913 1n
C920 1n
C961 N/F
D902b
R903 270
C916 1p
C917 1p
L905 2µ7
L906
C918 680p
L907
R905 22
R906 22
L908
C926 33µ
C927 100n
C928 1n
L909
C924 1n
C960 N/F
C929 4n7
TR900
R907 220
R908 220
RF2595
C931 4n7
C933 120p
L911
R910 22
R911 22
C935 22µ
C936 100n
C937 1n
C938 4n7
TR901
R912 270
R913 270
BLY87C
L913
L914
C944 680p
L915 2µ7
TR902
2N2447
R916 22
R917 22
R918 22
C945 2µ2
C946 100n
C947 1n
C943 1n
L918
C956 100n
C949 1n
L917 20nH
C950 33p
C914 22p
C915 22p
C919 22p
C921 56p
C925 27p
C922 120p
C923 100p
R909 10
L910
C930 150p
C932 100p
C934 47p
R914 22
R915 22
L912
C939 100p
C940 82p
C941 56p
C942 33p
R920 220
L916
C962 12p
C948 27p
0V
VCO TX/RX CONTROL
SYNTH RF
SKTA PLA
R852 22k
L851 40nH
LK851
L852
TR851
BCW70
R853 4k7
R854 470
C851 1n
TR852
J310
C852 5p6
C854 1n
CV858 0.6-10p
C857 33p
L854 1µH
TR853 BCW72
R857 1k
C856 1n
C860 22µ
R858 100k
R860 100k
C863 N/F
R863 220
R865 100k
R867 120
C867 470p
C870 1n
D853 BBY40
C682 1n
TR854 ON977
C865 1n
TR855 ON977
R869 1k5
C868 1n
TR856 BFR93
TR850 BCW72
R850 10k
R851 4k7
L850 220nH
C850 1n
D850 BA842
C859 1p8
L855 220nH
R855 470
C853 5p6
L853 150nH
D851 BB809
D852 BB809
C858 100n
R856 1k
C861 1p0
R859 22k
R861 100k
R862 22
C864 1n
R864 100k
C866 N/F
R866 100k
R868 470
C869 1n
R870 470
+30V
RV801 100k
RV802 100k
R806 47k
R827 1
R803 47k
R804 100k
R802 100k
R805 1
R807 100k
IC800 LM258
R801 10k
R828 10k
TR801 BCW72
C846 1n
R800 10k
C839 1n
R825 10k
R823 22k
C810 39p
CV807 2-9p
C840 4n7
D816 BB809
D817 BB809
TR800 BF891
TP801
R813
L802
R812 N/F
R814 N/F
D800 BB809
D801 BB809
C818 4p7
C821 2p2
CV801 2-9p
C815 22p
R815 1M
C819 6p8
D802 BB809
D803 BB809
C822 1p8
D804 BB809
D805 BB809
R818 1M
C823 22p
D806 BB809
D807 BB809
CV802 2-9p
L803
C825 1p8
C827 1p8
L804
C826 2p2
CV803 2-9p
D808 BB809
D809 BB809
C829 22p
C831 4p7
R819 1M
C832 1p0
D810 BB809
D811 BB809
C828 1n
R820 1M
C824 1n
R817 1M
C816 1n
R816 1M
C834 1p0
C835 2p2
D812 BB809
D813 BB809
R822 1M
C836 22p
D814 BB809
D815 BB809
R821 1M
CV804 2-9p
L805
R824 N/F
R808 100k
RX V.C.O. ASSE

FIG

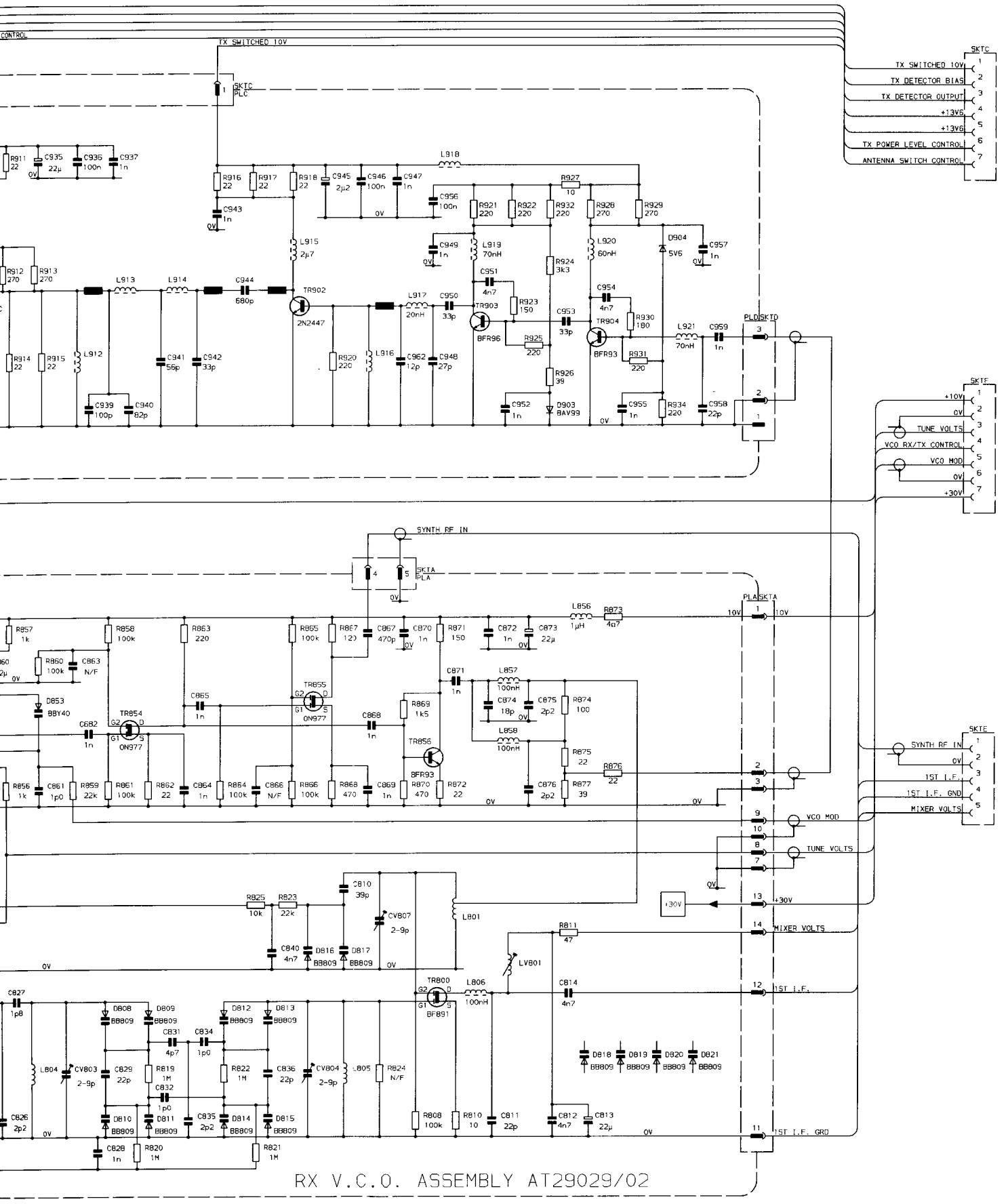
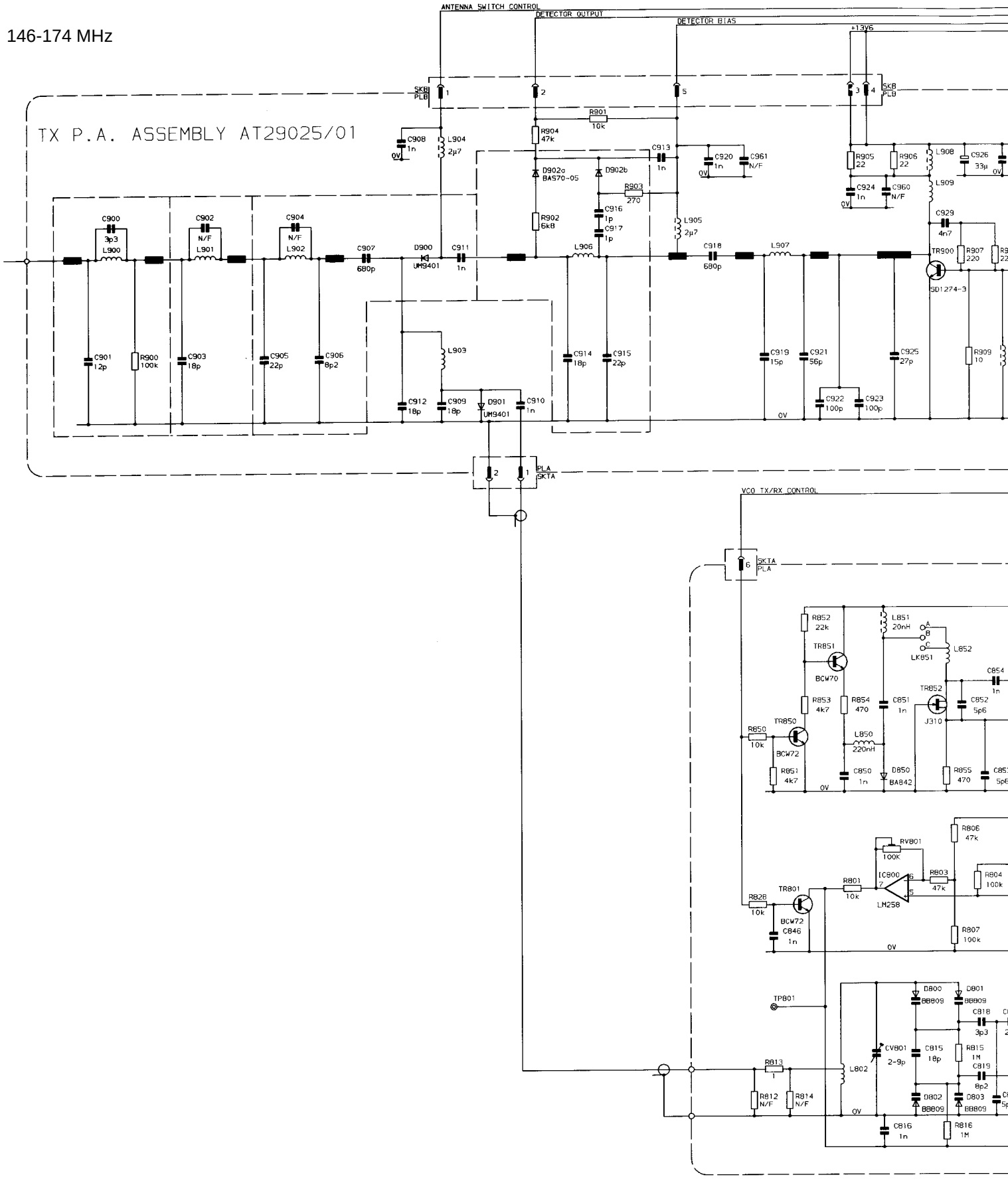
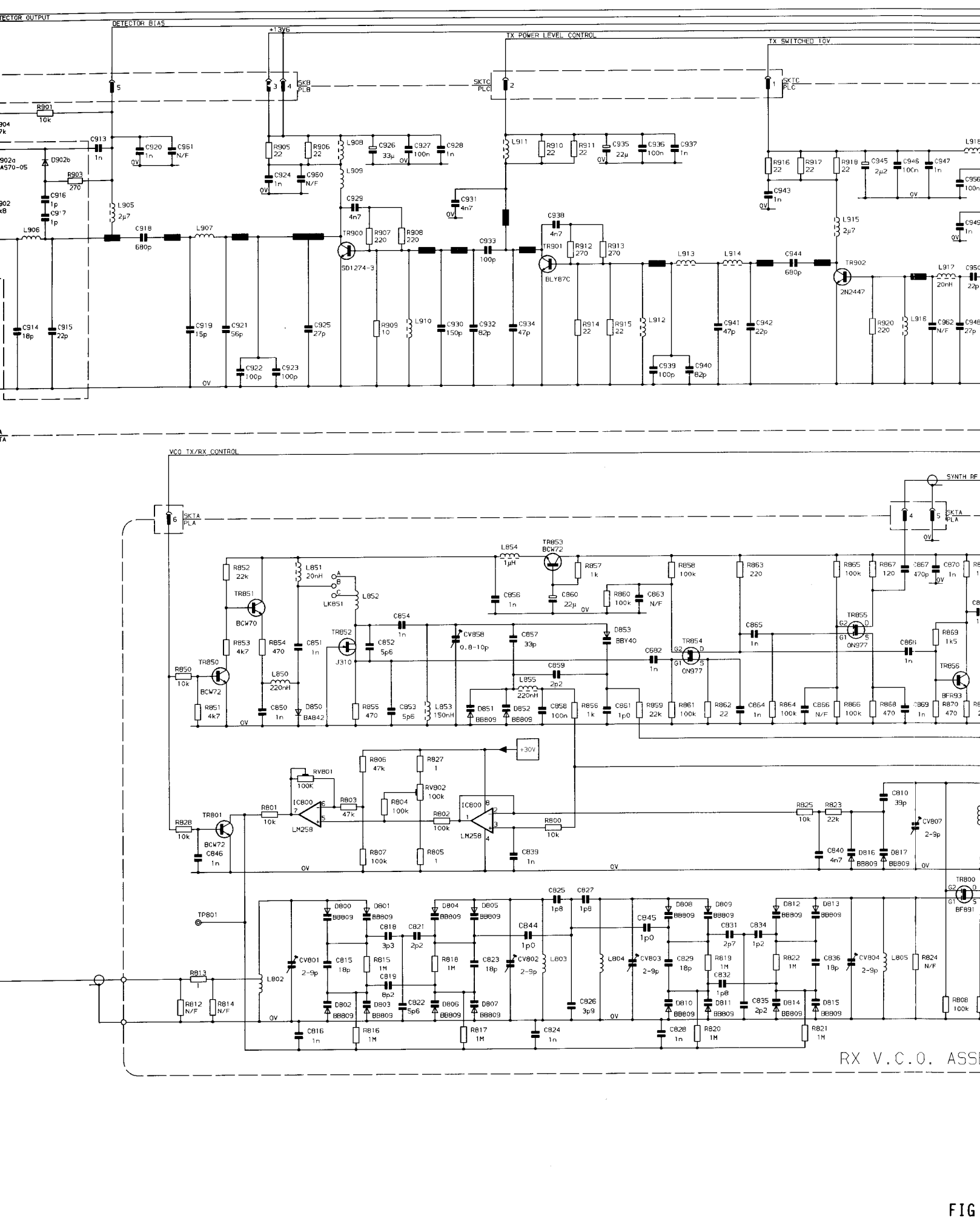


FIG 6.6 RF FRONT END CIRCUIT DIAGRAM
(132-156MHz)

146-174 MHz


TX P.A. ASSEMBLY AT29025/01
ANTENNA SWITCH CONTROL
DETECTOR OUTPUT
DETECTOR BIAS
+13V6
SKB PLB
SKTA PLA
VCO TX/RX CONTROL
C900 3p3 L900
C901 12p
R900 100k
C902 N/F L901
C903 18p
C904 N/F L902
C905 22p
C906 8p2
C907 680p
D900 UM9401
C908 1n
L904 2µ7
C909 18p
D901 UM9401
C910 1n
C911 1n
C912 18p
L903
R901 10k
R902 6k8
R903 270
R904 47k
D902a BAS70-05
D902b
C913 1n
C914 18p
C915 22p
C916 1p
C917 1p
L905 2µ7
L906
C918 680p
L907
C919 15p
C920 1n
C921 56p
C922 100p
C923 100p
C924 1n
C925 27p
C926 33µ
C929 4n7
L908
L909
C960 N/F
C961 N/F
R905 22
R906 22
R907 220
R909 10
TR900 SD1274-3
R850 10k
TR850 BCW72
R851 4k7
C850 1n
D850 BA842
L850 220nH
R852 22k
TR851 BCW70
R853 4k7
R854 470
C851 1n
L851 20nH
LK851
L852
TR852 J310
C852 5p6
C854 1n
R855 470
R806 47k
RV801 100k
IC800 LM258
R803 47k
R804 100k
R807 100k
R801 10k
R828 10k
TR801 BCW72
C846 1n
TP801
D800 BB809
D801 BB809
CV801 2-9p
C815 18p
C818 3p3
R815 1M
C819 8p2
D802 BB809
D803 BB809
L802
R813 1
R812 N/F
R814 N/F
C816 1n
R816 1M
0V



RX V.C.O. ASS

FIG

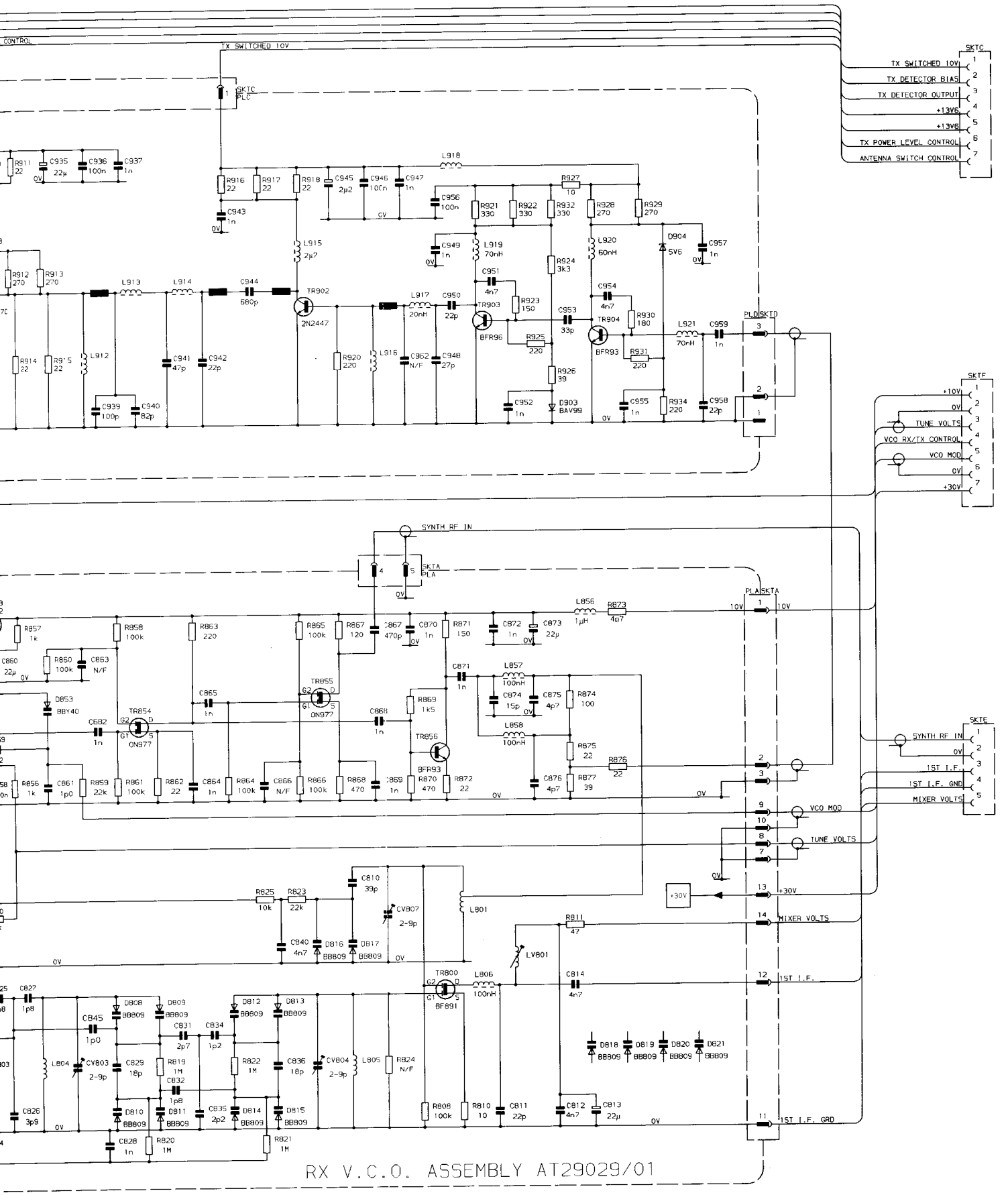
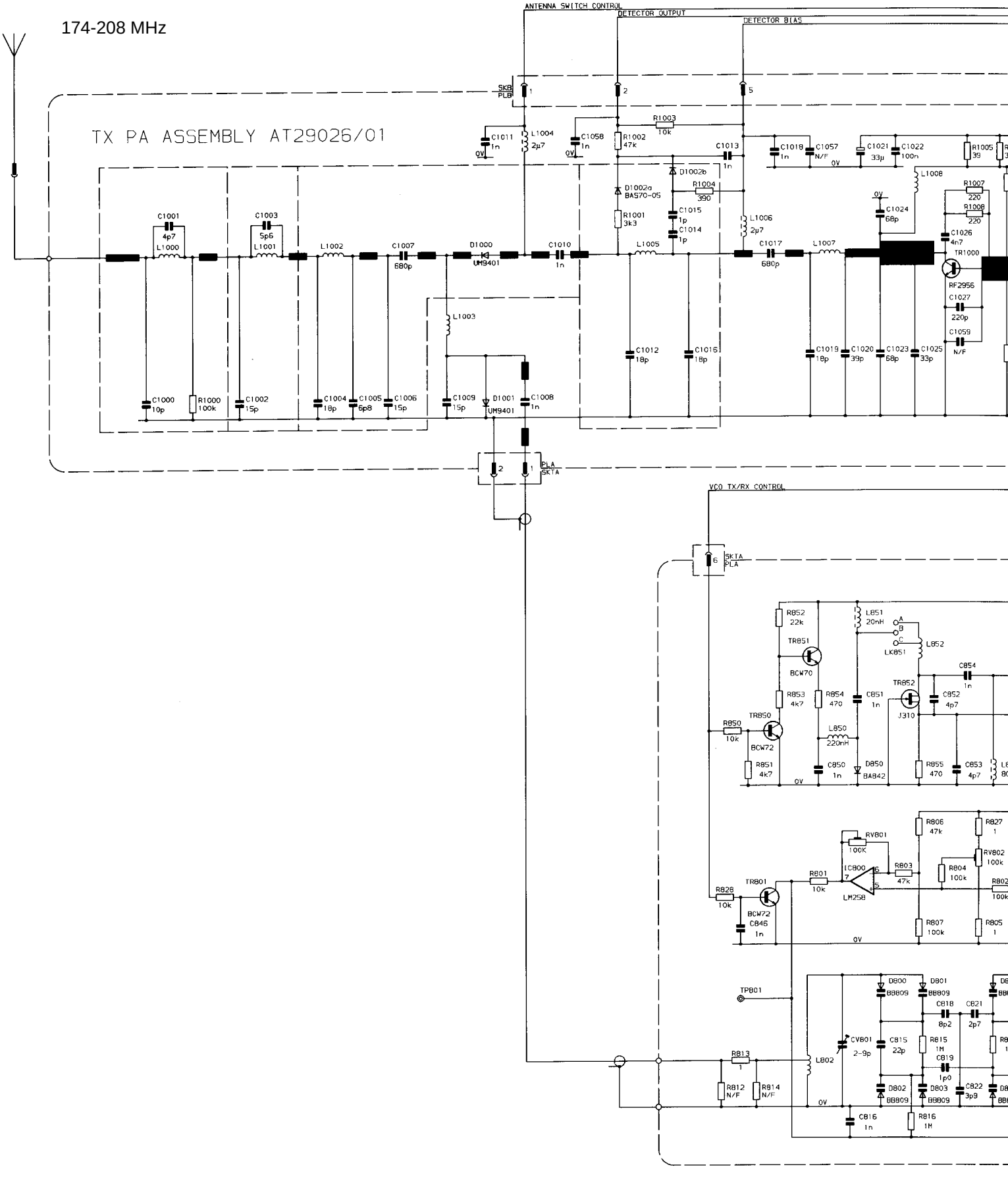
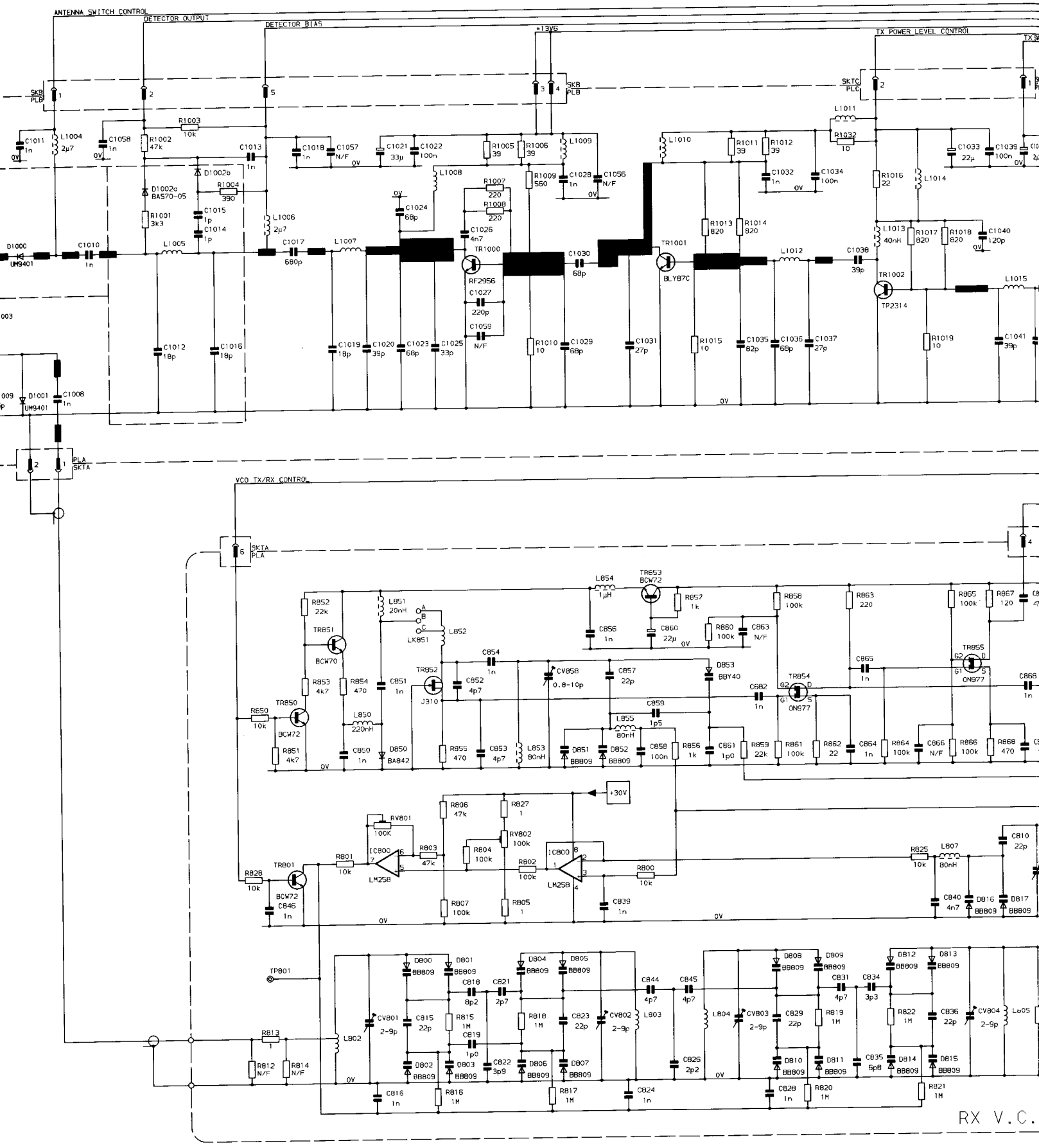


FIG 6.7 RF FRONT END CIRCUIT DIAGRAM
(146-174MHz)

174-208 MHz


TX PA ASSEMBLY AT29026/01
ANTENNA SWITCH CONTROL
DETECTOR OUTPUT
DETECTOR BIAS
SKB
PLB
PLA
SKTA
VCO TX/RX CONTROL
SKTA
PLA
L1000
L1001
L1002
L1003
L1004
L1005
L1006
L1007
L1008
L802
L850
L851
L852
C1000
C1001
C1002
C1003
C1004
C1005
C1006
C1007
C1008
C1009
C1010
C1011
C1012
C1013
C1014
C1015
C1016
C1017
C1018
C1019
C1020
C1021
C1022
C1023
C1024
C1025
C1026
C1027
C1057
C1058
C1059
C815
C816
C818
C819
C821
C822
C845
C846
C850
C851
C852
C853
C854
D1000
D1001
D1002a
D1002b
D800
D801
D802
D803
D850
R1000
R1001
R1002
R1003
R1004
R1005
R1007
R1008
R806
R807
R812
R813
R814
R815
R816
R827
R828
R850
R851
R852
R853
R854
R855
TR1000
TR801
TR850
TR851
TR852
TP801
RV801
RV802
IC800
LK851
BAS70-05
BB809
BCW70
BCW72
J310
LM258
RF2956


ANTENNA SWITCH CONTROL
DETECTOR OUTPUT
DETECTOR BIAS
+13VG
TX POWER LEVEL CONTROL
SKB PLB
SKTC PLC
PLA SKTA
SKTA PLA
VCO TX/RX CONTROL
TP801
RX V.C.

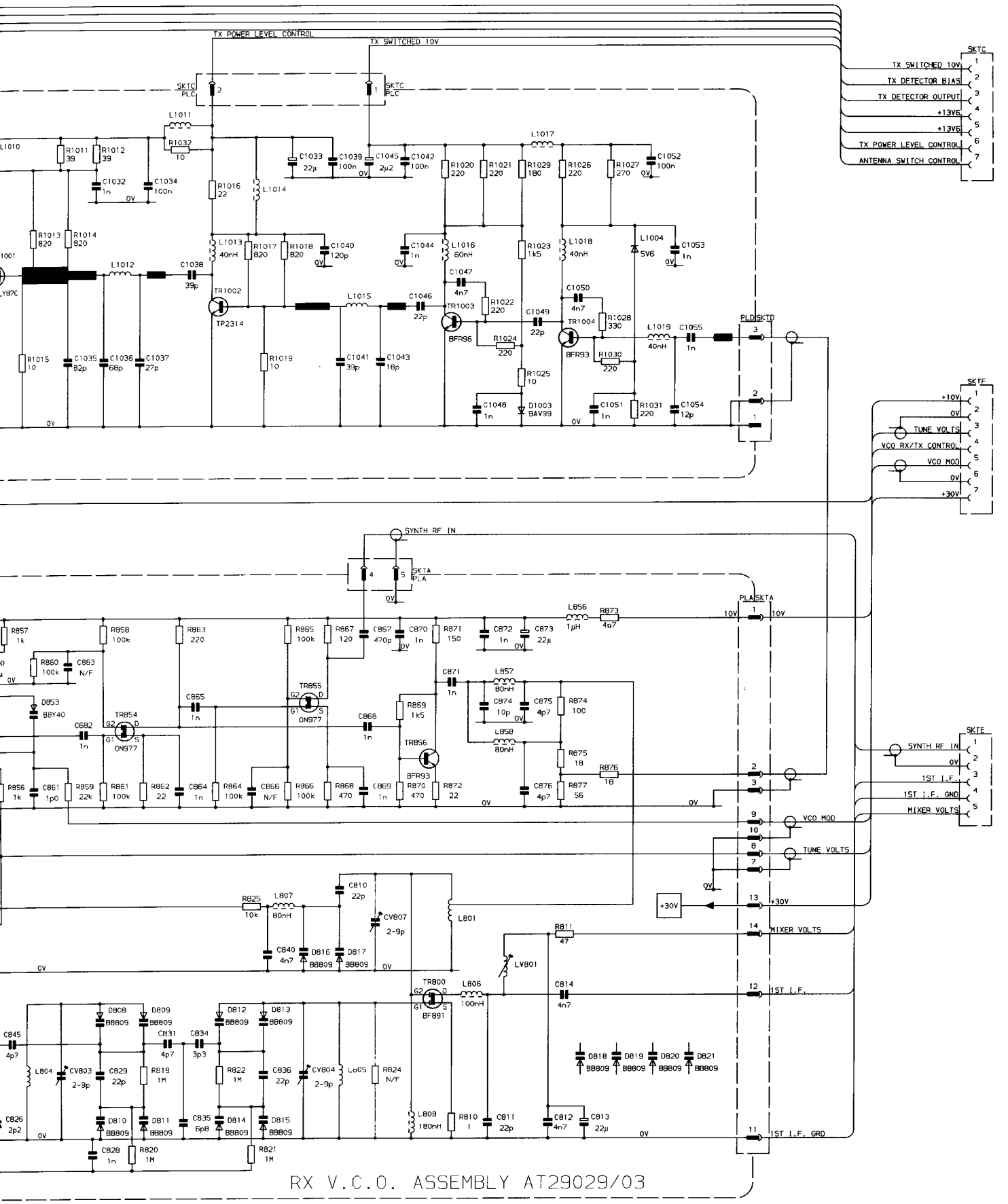
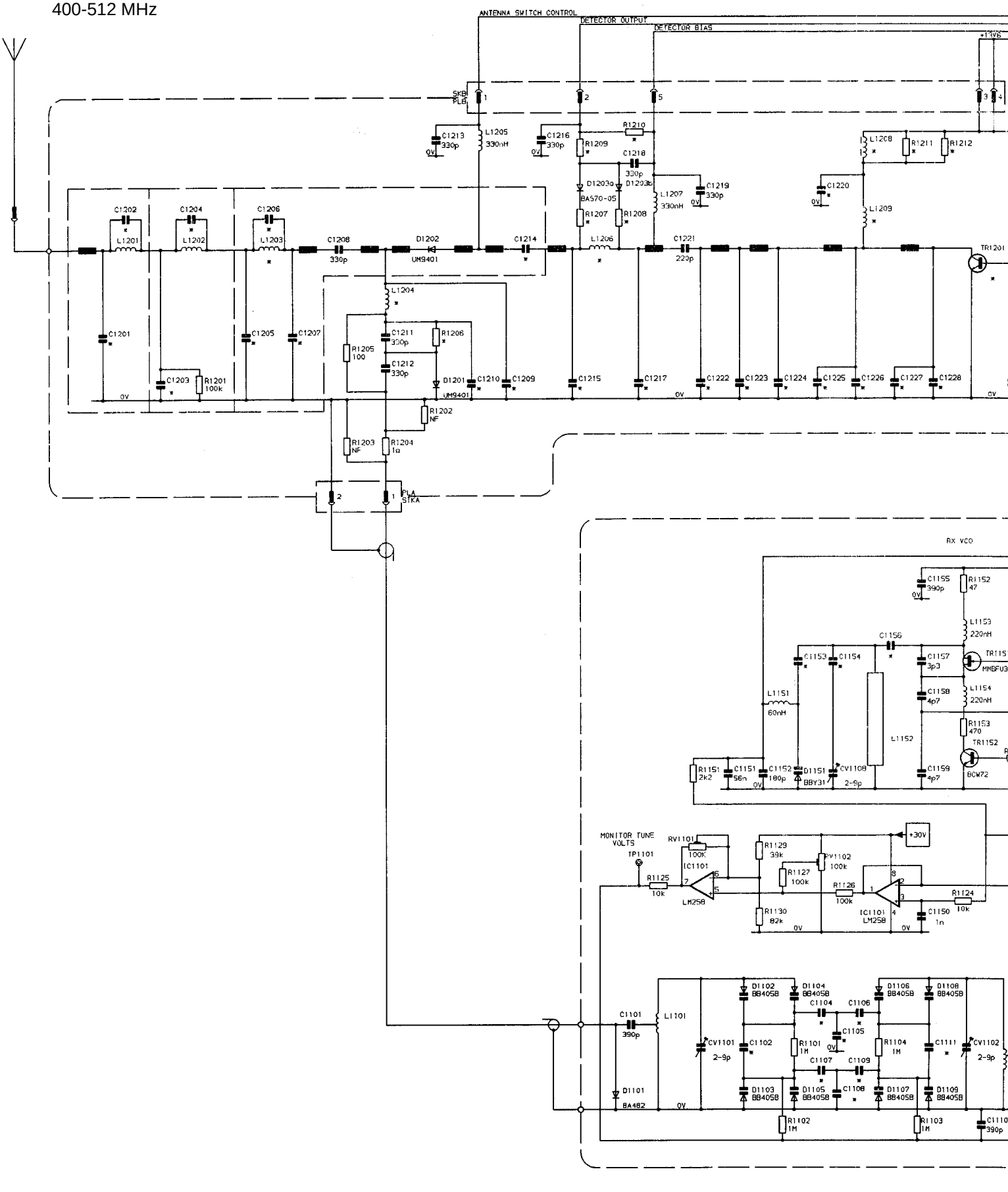
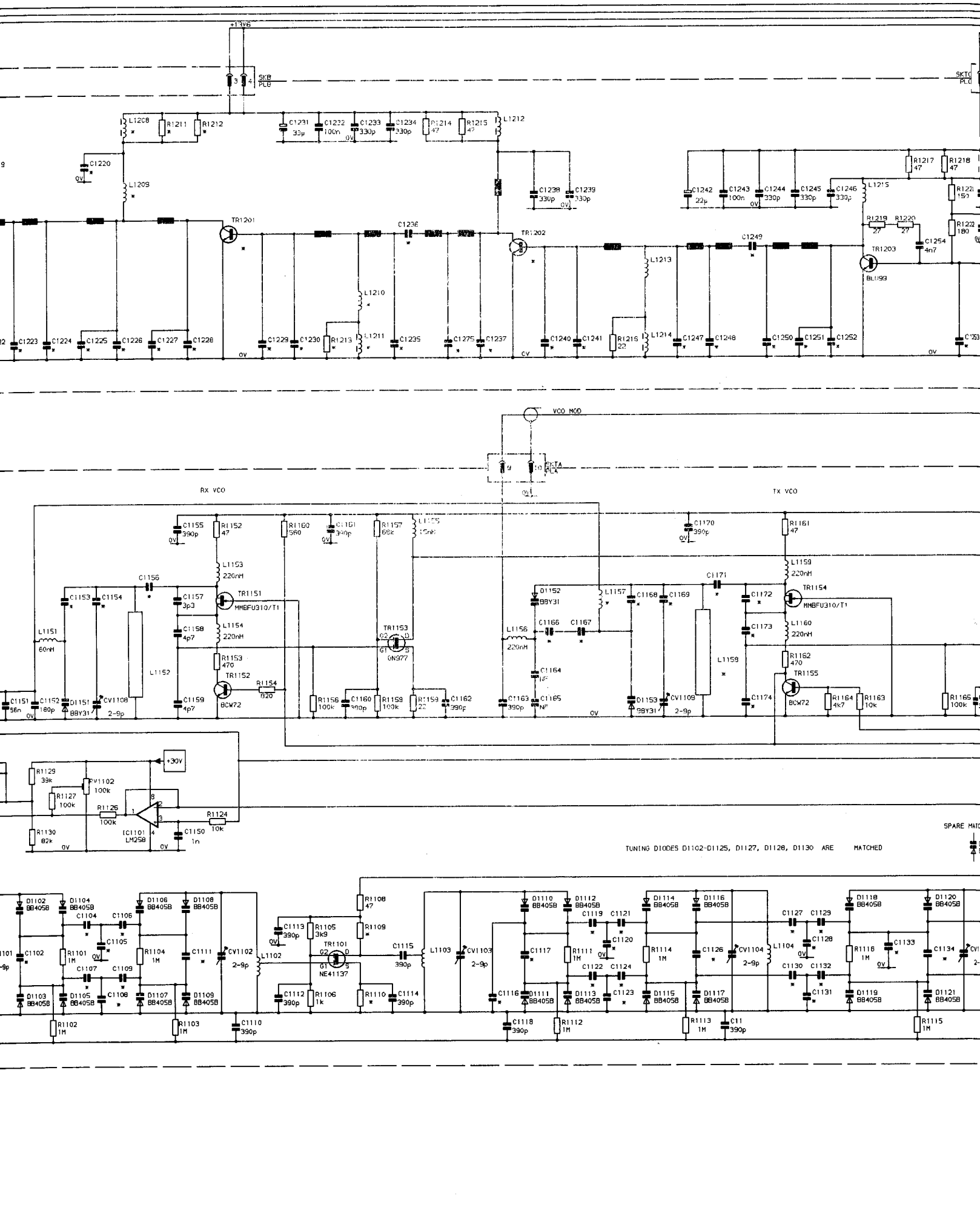


FIG 6.9 RF FRONT END CIRCUIT DIAGRAM
(174-208MHz)

400-512 MHz


ANTENNA SWITCH CONTROL
DETECTOR OUTPUT
DETECTOR BIAS
+13V6
SKB PLB
PLA STKA
RX VCO
MONITOR TUNE VOLTS
+30V
0V
L1205 330nH
L1204
L1201
L1202
L1203
L1206
L1207 330nH
L1208
L1209
L1151 60nH
L1152
L1153 220nH
L1154 220nH
TR1201
TR1151 MMBFU3
TR1152 BCW72
D1202 UM9401
D1201 UM9401
D1203a BA570-05
D1203b
D1101 BA482
D1102 BB405B
D1103 BB405B
D1104 BB405B
D1105 BB405B
D1106 BB405B
D1107 BB405B
D1108 BB405B
D1109 BB405B
D1151 BBY31
IC1101 LM258
RV1101 100K
CV1101 2-9p
CV1102 2-9p
CV1108 2-9p
TP1101
R1201 100k
R1202 NF
R1203 NF
R1204 1Ω
R1205 100
R1206
R1207
R1208
R1209
R1210
R1211
R1212
R1101 1M
R1102 1M
R1103 1M
R1104 1M
R1124 10k
R1125 10k
R1126 100k
R1127 100k
R1129 39k
R1130 82k
R1151 2k2
R1152 47
R1153 470
C1101 390p
C1102
C1104
C1105
C1106
C1107
C1108
C1109
C1110 390p
C1111
C1150 1n
C1151 56n
C1152 180p
C1153
C1154
C1155 390p
C1156
C1157 3p3
C1158 4p7
C1159 4p7
C1201
C1202
C1203
C1204
C1205
C1206
C1207
C1208 330p
C1209
C1210
C1211 330p
C1212 330p
C1213 330p
C1214
C1215
C1216 330p
C1217
C1218 330p
C1219 330p
C1220
C1221 220p
C1222
C1223
C1224
C1225
C1226
C1227
C1228


+13V6
SKB PL8
L1208
R1211
R1212
C1231 33µ
C1232 100n
C1233 330p
C1234 330p
R1214 47
R1215 47
L1212
C1220
L1209
C1238 330p
C1239 330p
R1217 47
R1218 47
C1242 22µ
C1243 100n
C1244 330p
C1245 330p
C1246 330p
L1215
R1219 27
R1220 27
C1254 4n7
TR1203
BLU99
TR1201
TR1202
C1236
C1249
L1213
L1210
L1211
R1213
C1235
C1275
C1237
C1240
C1241
R1216 22
L1214
C1247
C1248
C1250
C1251
C1252
C1223
C1224
C1225
C1226
C1227
C1228
C1229
C1230
0V
VCO MOD
SKTA PL4
Rx VCO
Tx VCO
C1155 390p
R1152 47
R1160 560
C1161 340p
R1157 68k
L1155 15nH
L1153 220nH
C1156
C1153
C1154
C1157 3p3
TR1151 MMBFU310/T1
L1151 60nH
C1158 4p7
L1154 220nH
R1153 470
TR1152 BCW72
R1154 820
L1152
C1151 56n
C1152 180p
D1151 BBY31
CV1108 2-9p
C1159 4p7
R1156 100k
C1160 390p
R1158 100k
R1159 22
C1162 390p
TR1153 ON977
C1170 390p
R1161 47
L1159 220nH
C1171
TR1154 MMBFU310/T1
D1152 BBY31
L1157
C1168
C1169
C1172
L1156 220nH
C1166
C1167
C1173
L1160 220nH
C1164 NF
R1162 470
TR1155 BCW72
C1163 390p
C1165 NF
D1153 BBY31
CV1109 2-9p
L1158
C1174
R1164 4k7
R1163 10k
R1165 100k
+30V
R1129 39k
PV1102 100k
R1127 100k
R1126 100k
R1124 10k
R1130 82k
IC1101 LM258
C1150 1n
SPARE MATC
TUNING DIODES D1102-D1125, D1127, D1128, D1130 ARE MATCHED
D1102 BB405B
D1104 BB405B
D1106 BB405B
D1108 BB405B
C1104
C1106
C1105
C1102
R1101 1M
R1104 1M
C1111
CV1102 2-9p
C1107
C1109
D1103 BB405B
D1105 BB405B
C1108
D1107 BB405B
D1109 BB405B
R1102 1M
R1103 1M
C1110 390p
L1102
C1113 390p
R1105 3k9
TR1101 NE41137
R1108 47
R1109
C1115 390p
C1112 390p
R1106 1k
R1110
C1114 390p
L1103
CV1103 2-9p
D1110 BB405B
D1112 BB405B
C1119
C1121
C1120
C1117
R1111 1M
C1122
C1124
D1111 BB405B
D1113 BB405B
C1123
C1116
C1118 390p
R1112 1M
D1114 BB405B
D1116 BB405B
R1114 1M
C1126
CV1104 2-9p
D1115 BB405B
D1117 BB405B
R1113 1M
C11 390p
C1127
C1129
C1128
L1104
C1130
C1132
C1131
D1118 BB405B
D1120 BB405B
R1116 1M
C1133
C1134
D1119 BB405B
D1121 BB405B
R1115 1M

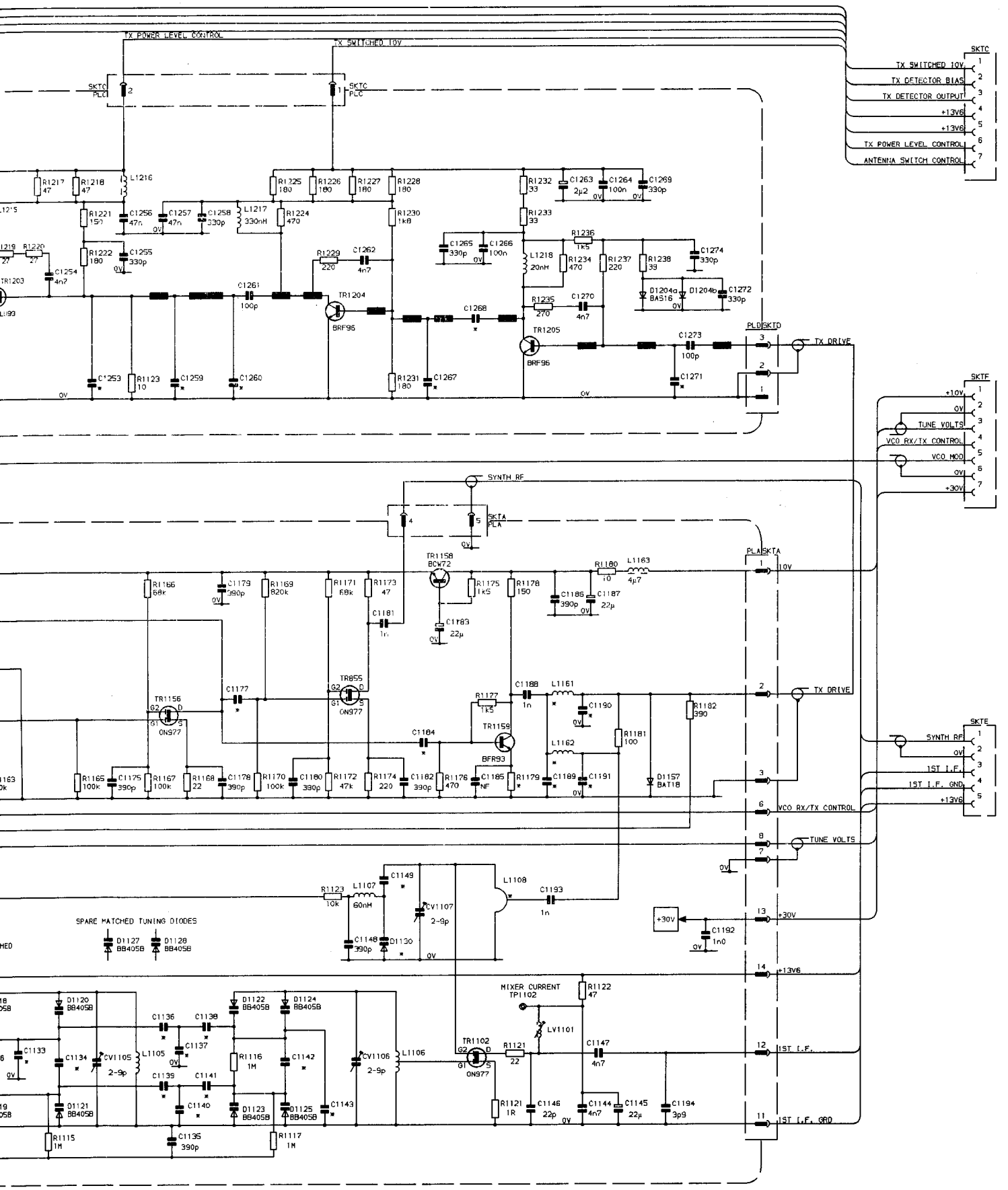
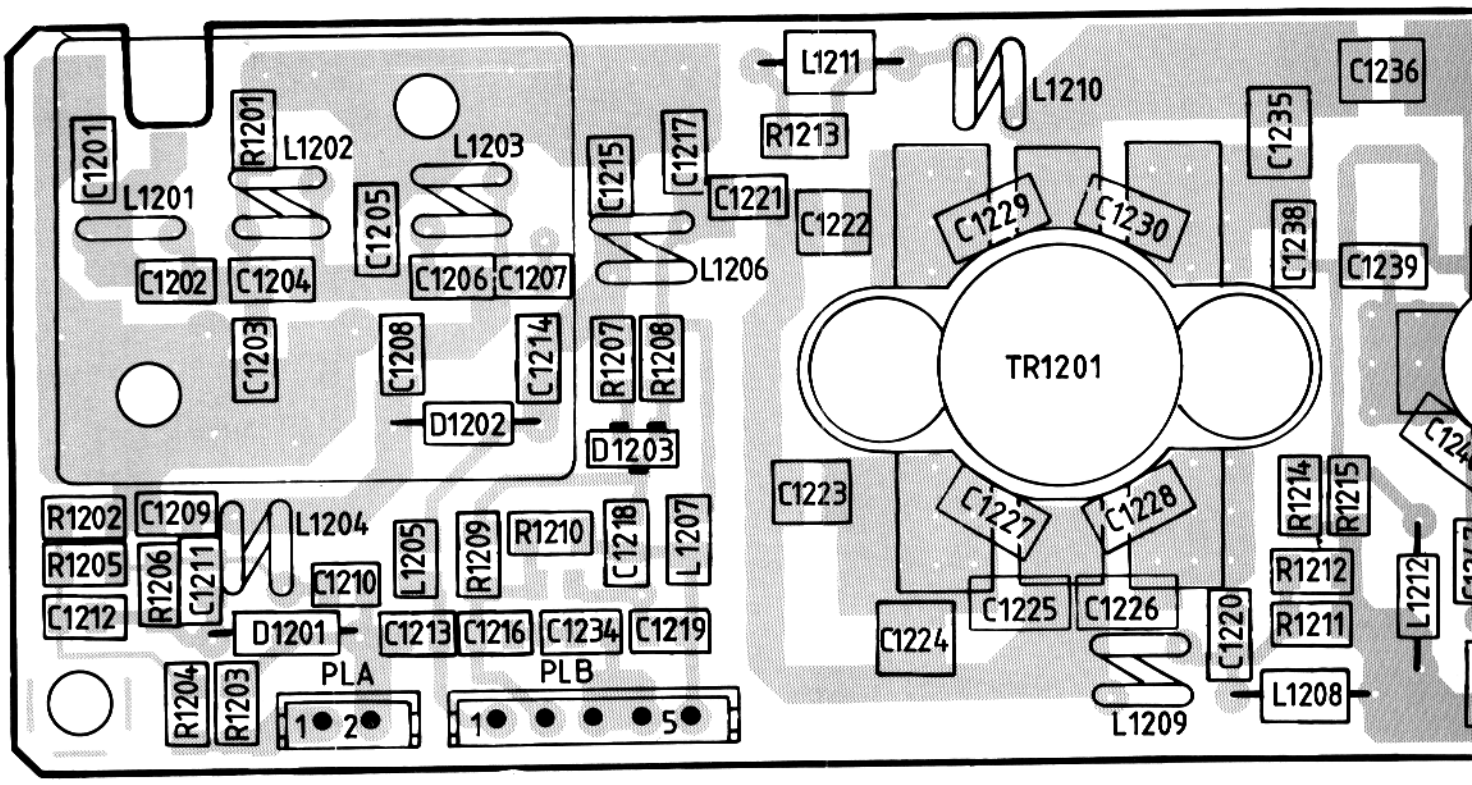
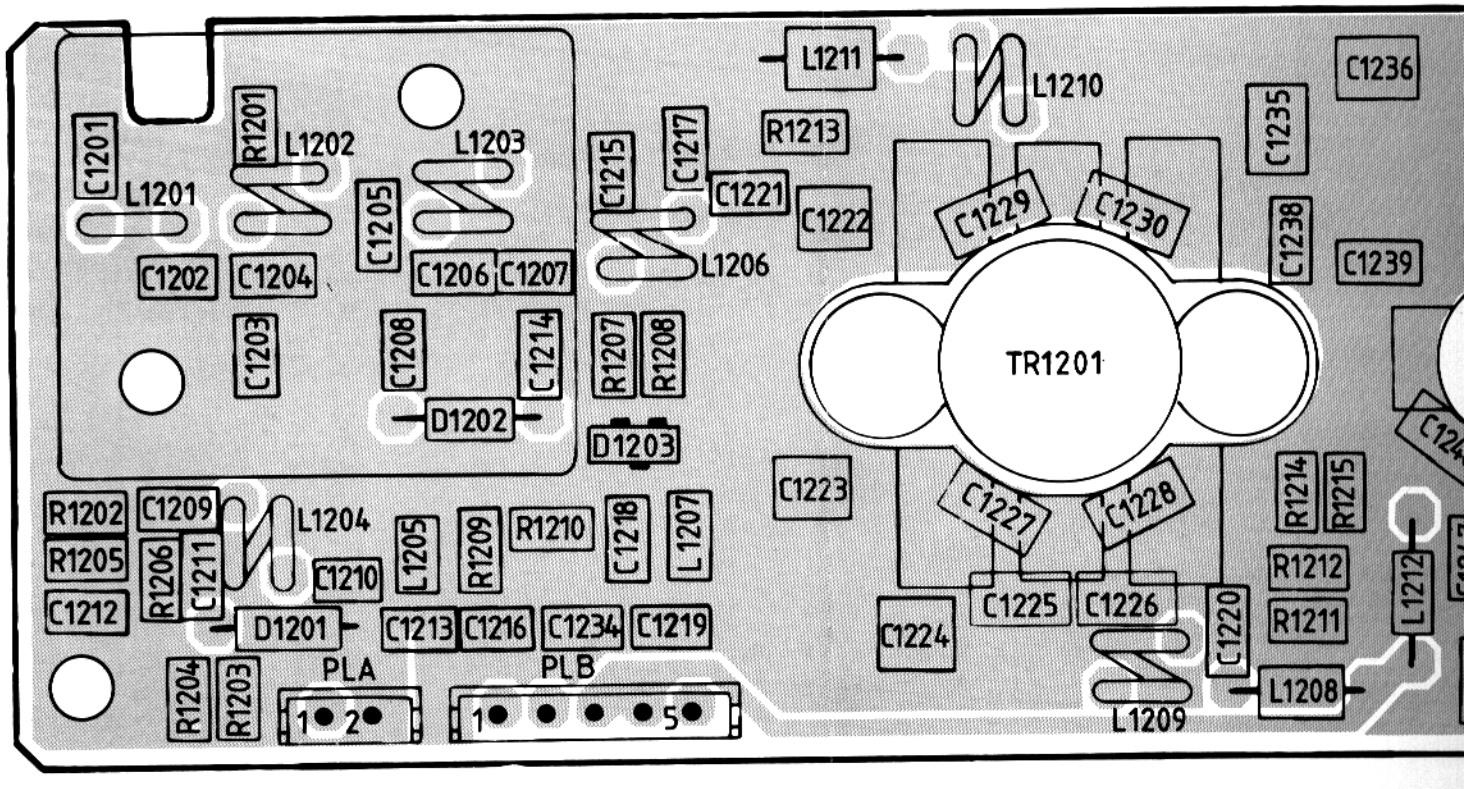
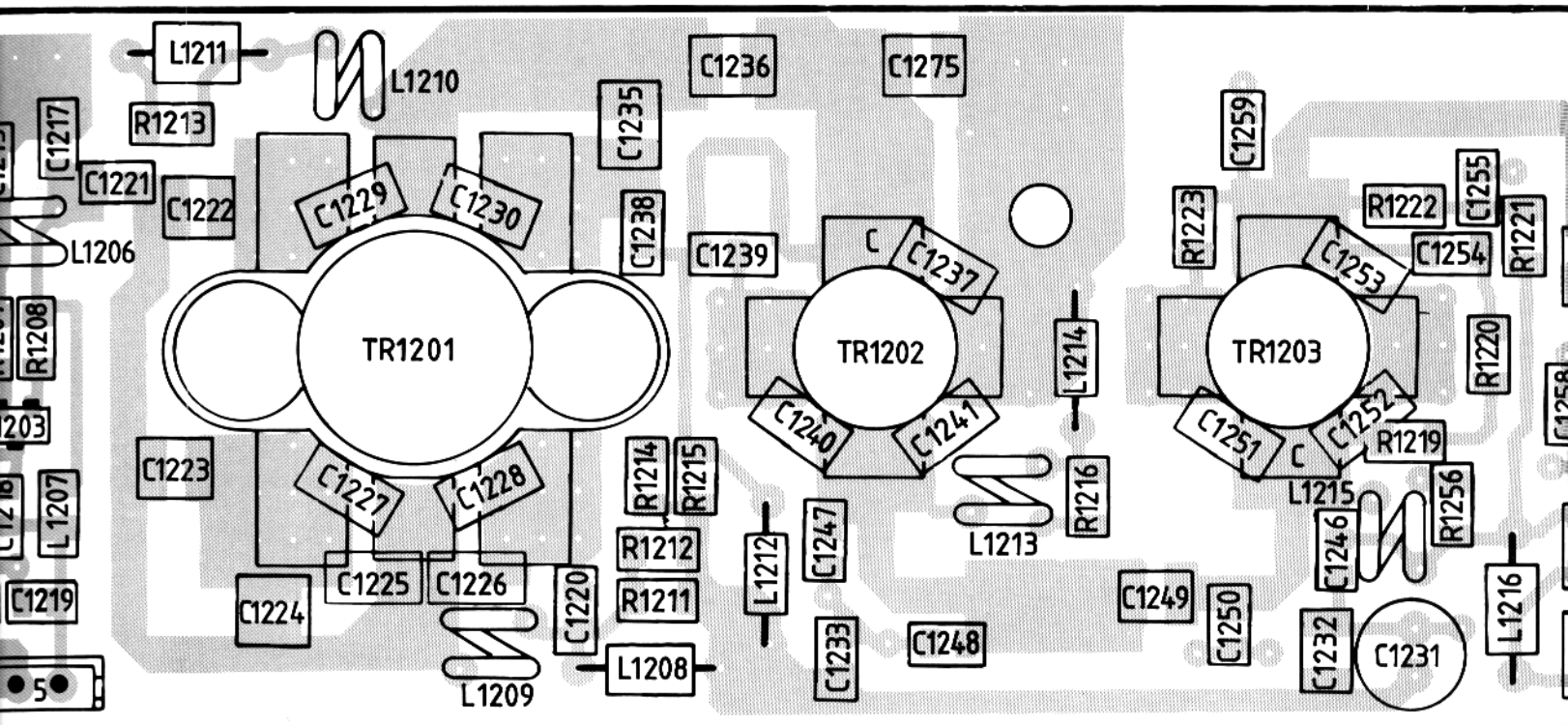


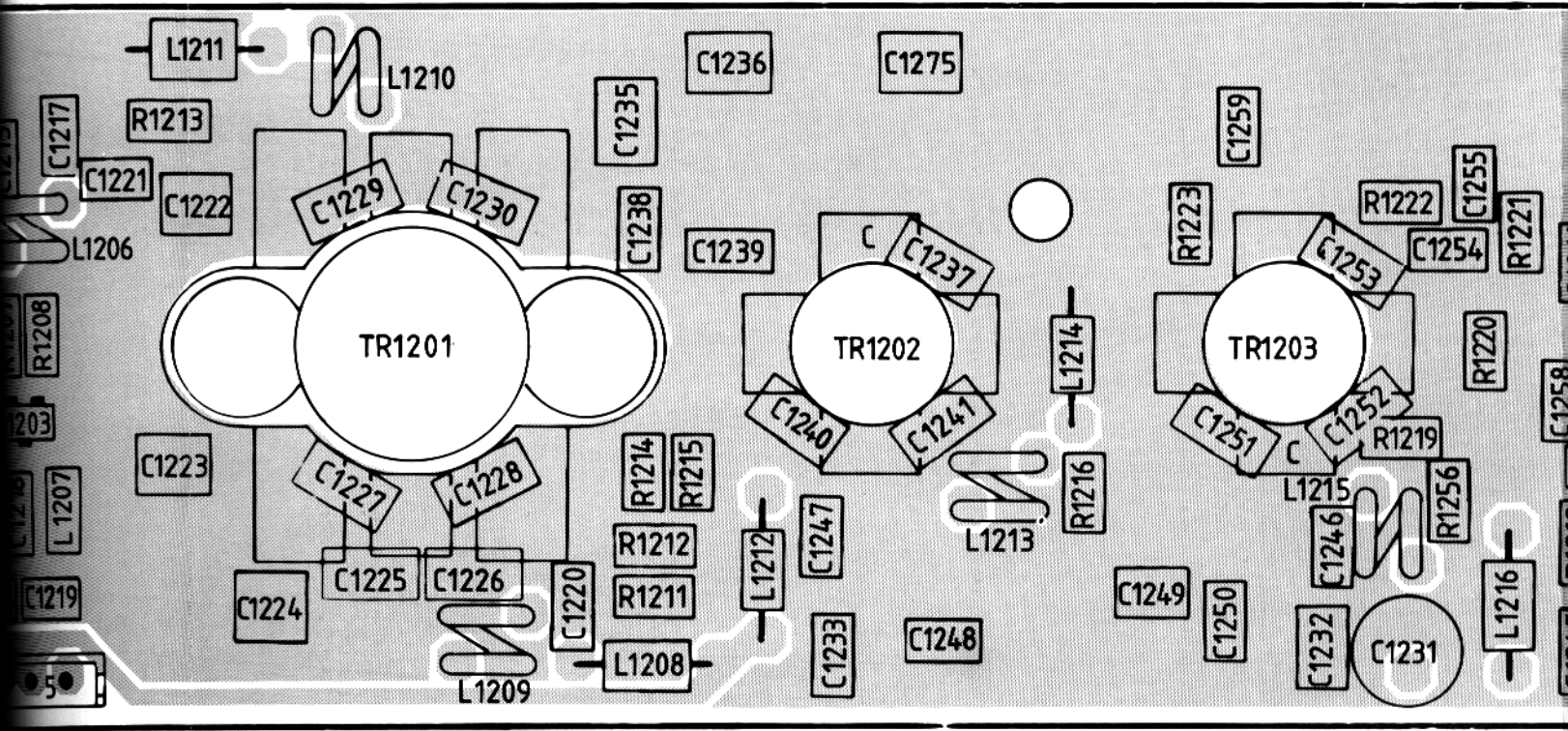
FIG 6.11A RF CIRCUIT DIAGRAM
(400-512MHz)

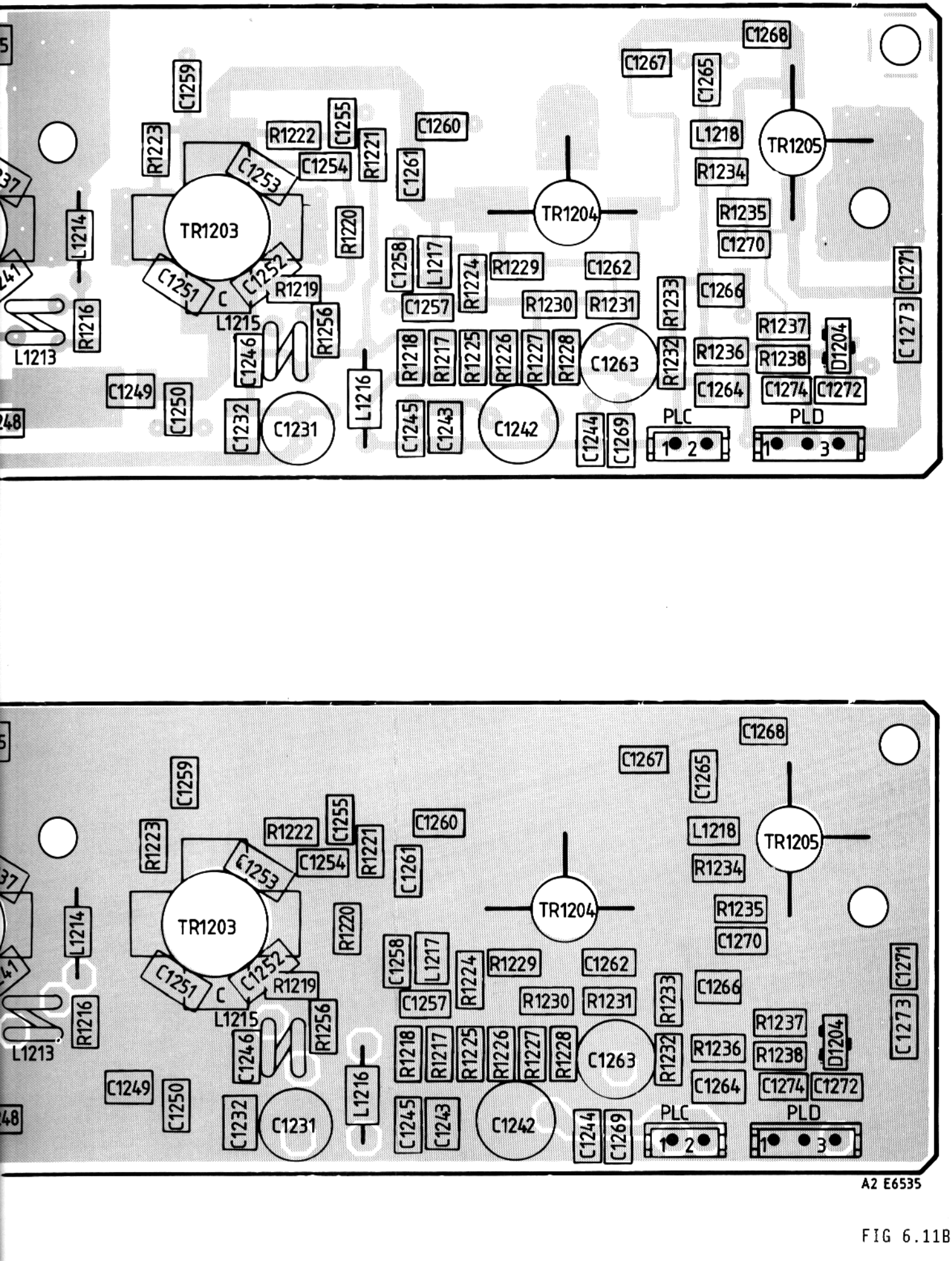
TP253/1


C1201
L1201
R1201
L1202
L1203
C1205
C1202
C1204
C1206
C1207
C1203
C1208
C1214
D1202
C1215
C1217
C1221
C1222
L1206
R1207
R1208
D1203
L1211
L1210
R1213
C1236
C1235
C1229
C1230
C1238
C1239
TR1201
C1223
C1227
C1228
R1214
R1215
R1202
C1209
L1204
R1205
R1206
C1211
C1210
C1205
R1209
R1210
C1218
L 1207
C1212
D1201
C1213
C1216
C1234
C1219
PLA
PLB
R1204
R1203
1 2
1 5
C1224
C1225
C1226
C1220
R1212
R1211
L1212
L1208
L1209


C1201
L1201
R1201
L1202
L1203
C1205
C1202
C1204
C1206
C1207
C1203
C1208
C1214
D1202
C1215
C1217
C1221
C1222
L1206
R1207
R1208
D1203
L1211
L1210
R1213
C1236
C1235
C1229
C1230
C1238
C1239
TR1201
C1223
C1227
C1228
R1214
R1215
R1202
C1209
L1204
R1205
R1206
C1211
C1210
C1205
R1209
R1210
C1218
L 1207
C1212
D1201
C1213
C1216
C1234
C1219
PLA
PLB
R1204
R1203
1 2
1 5
C1224
C1225
C1226
C1220
R1212
R1211
L1212
L1208
L1209

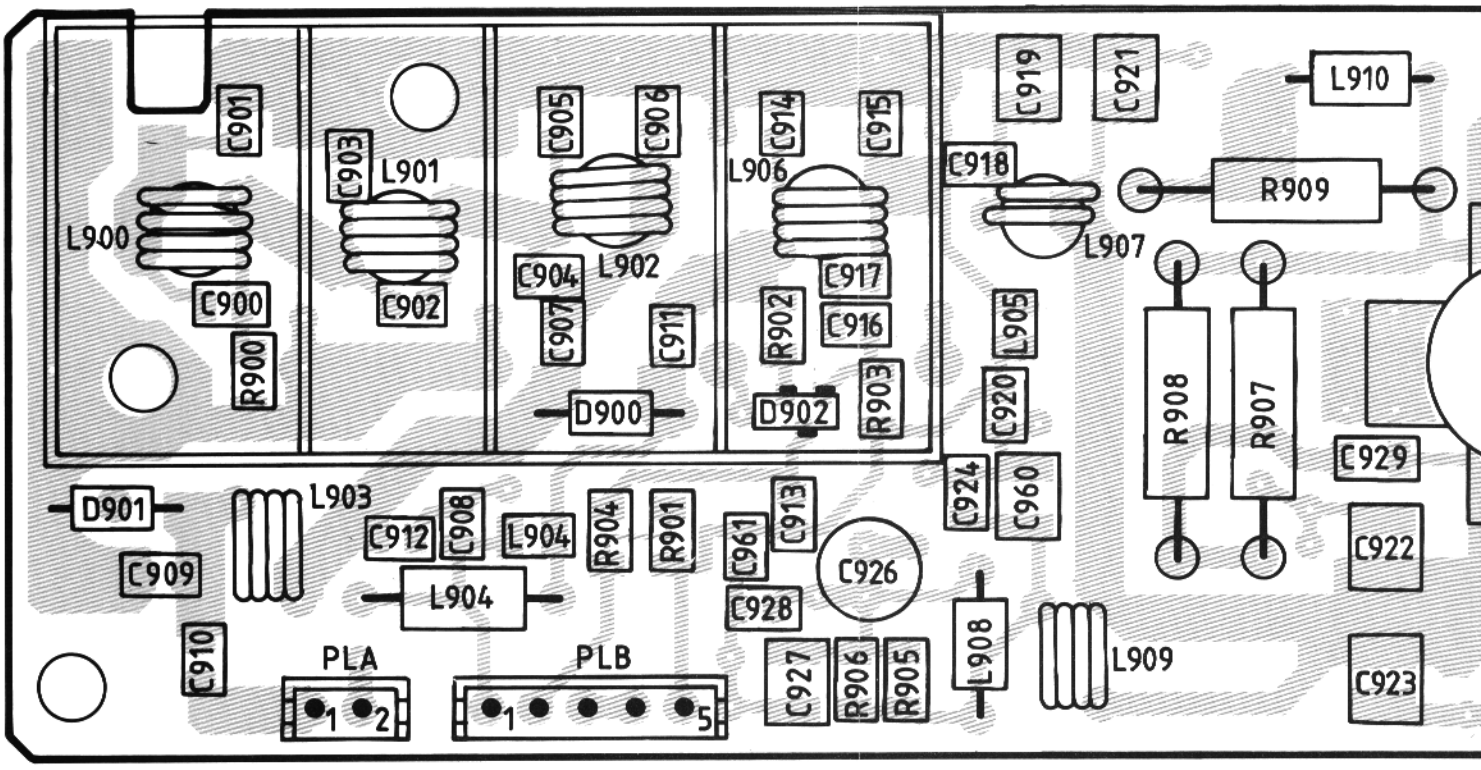

L1211
L1210
R1213
C1217
C1221
C1222
L1206
R1208
C1223
L1207
C1219
C1224
C1225
C1226
C1227
C1228
C1229
C1230
TR1201
C1235
C1238
C1236
C1275
C1239
C1237
TR1202
C1240
C1241
L1214
L1213
R1216
C1247
L1212
C1233
C1248
C1220
L1208
L1209
R1214
R1215
R1212
R1211
C1259
R1223
C1253
TR1203
C1251
C1252
C1254
C1255
R1222
R1221
R1220
R1219
L1215
R1256
C1246
C1249
C1250
C1232
C1231
L1216

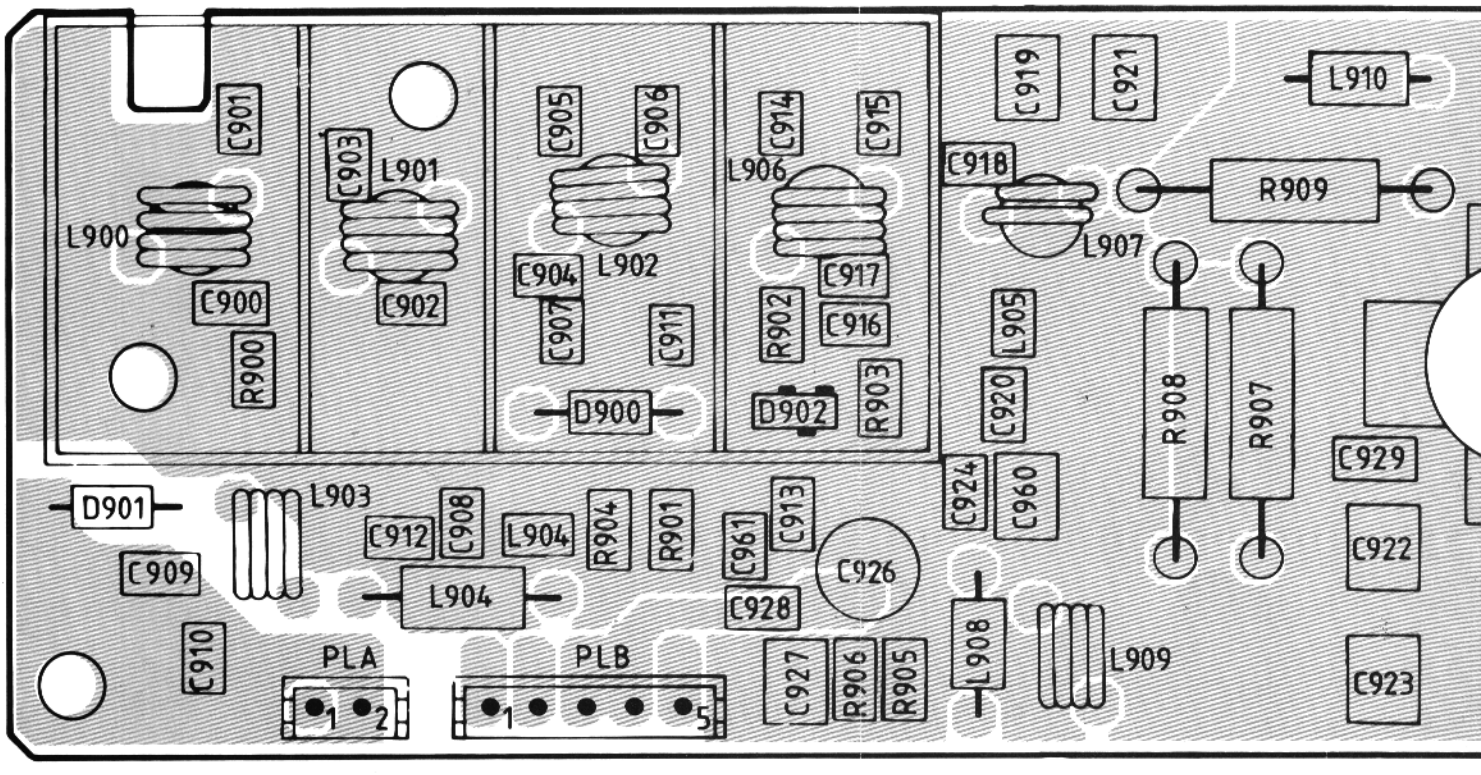

L1211
L1210
R1213
C1217
C1221
C1222
L1206
R1208
C1223
L1207
C1219
C1224
C1225
C1226
C1227
C1228
C1229
C1230
TR1201
C1235
C1238
C1236
C1275
C1239
C1237
TR1202
C1240
C1241
L1214
L1213
R1216
C1247
L1212
C1233
C1248
C1220
L1208
L1209
R1214
R1215
R1212
R1211
C1259
R1223
C1253
TR1203
C1251
C1252
C1254
C1255
R1222
R1221
R1220
R1219
L1215
R1256
C1246
C1249
C1250
C1232
C1231
L1216

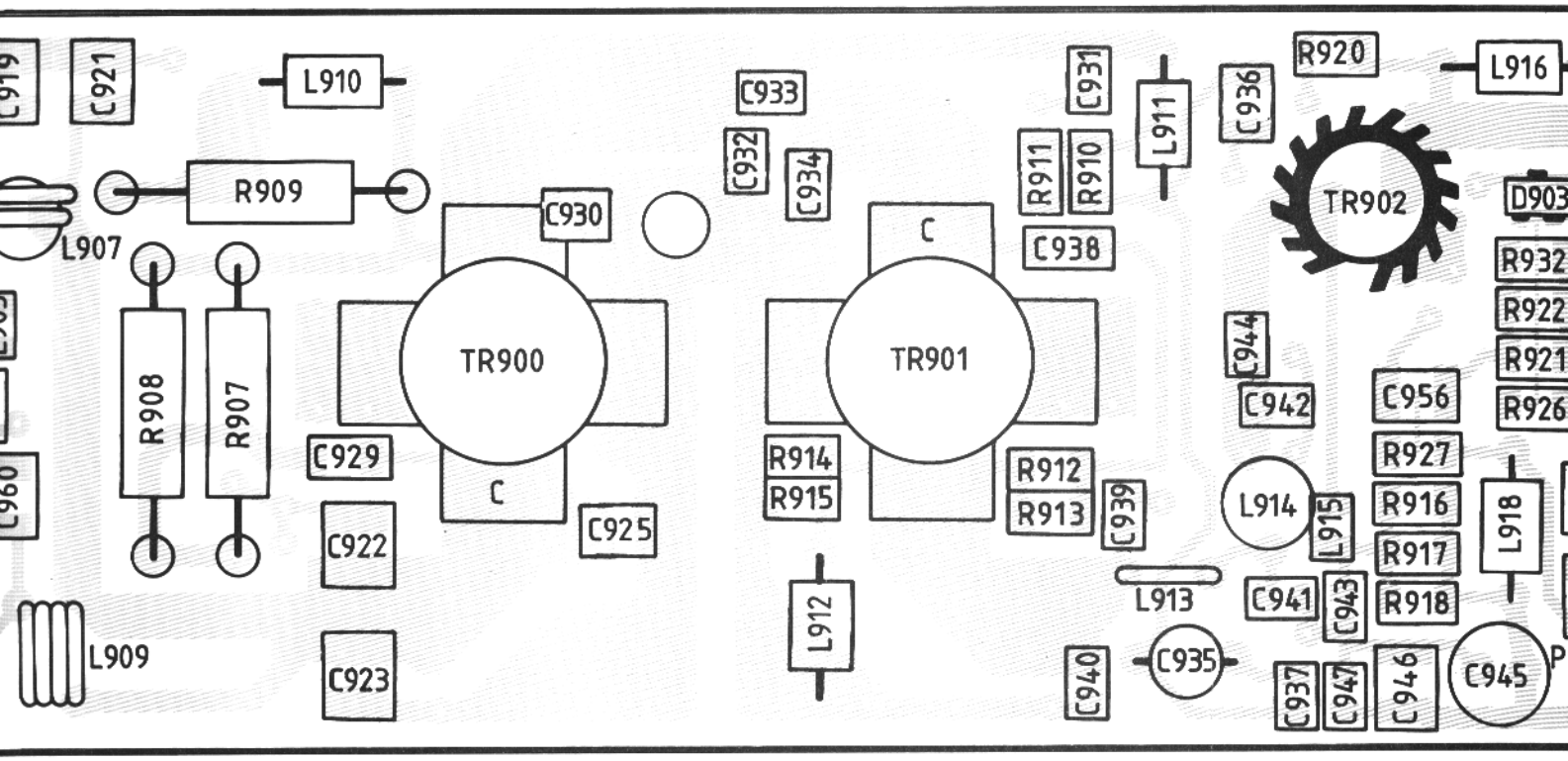


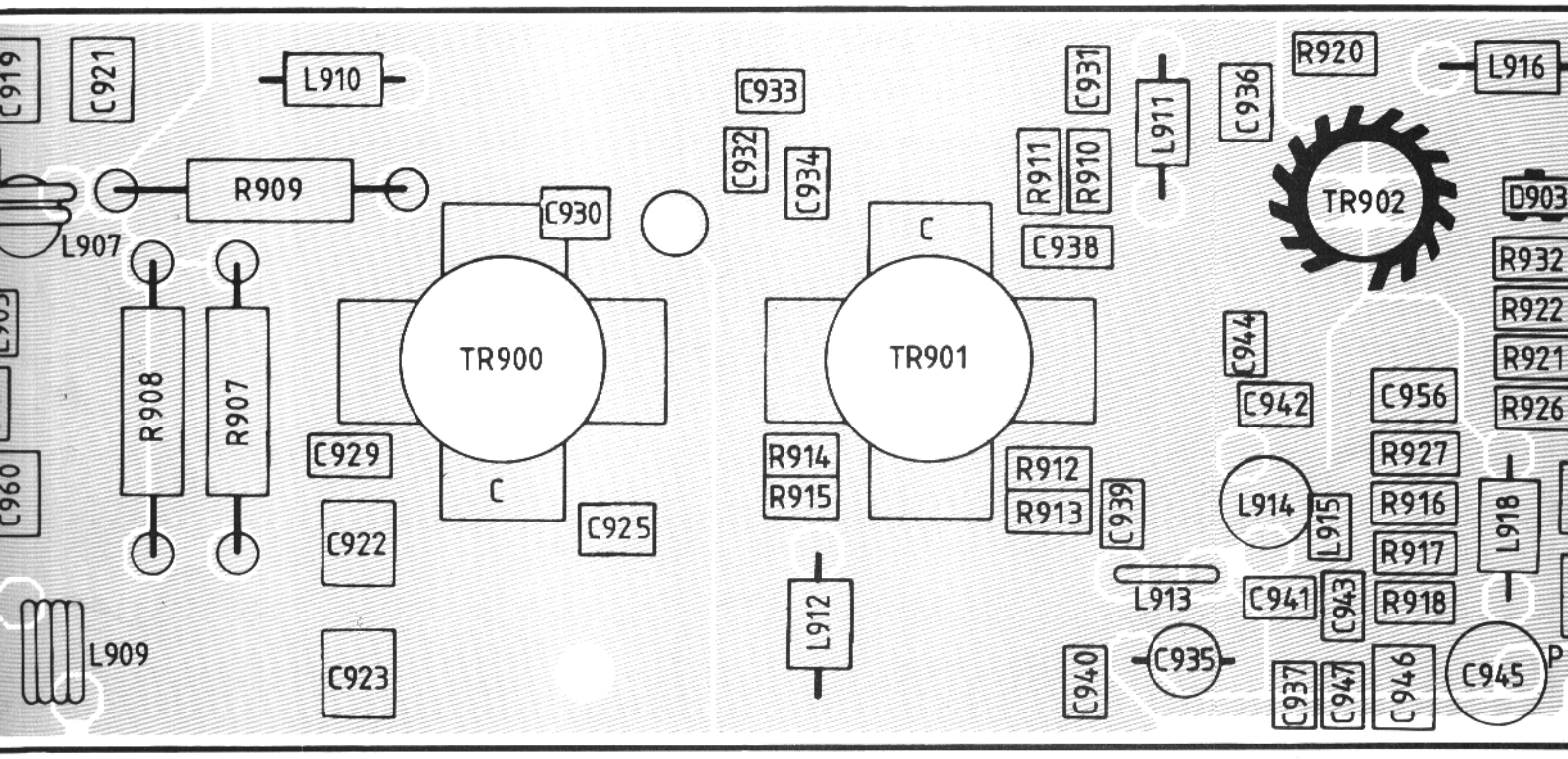
A2 E6535

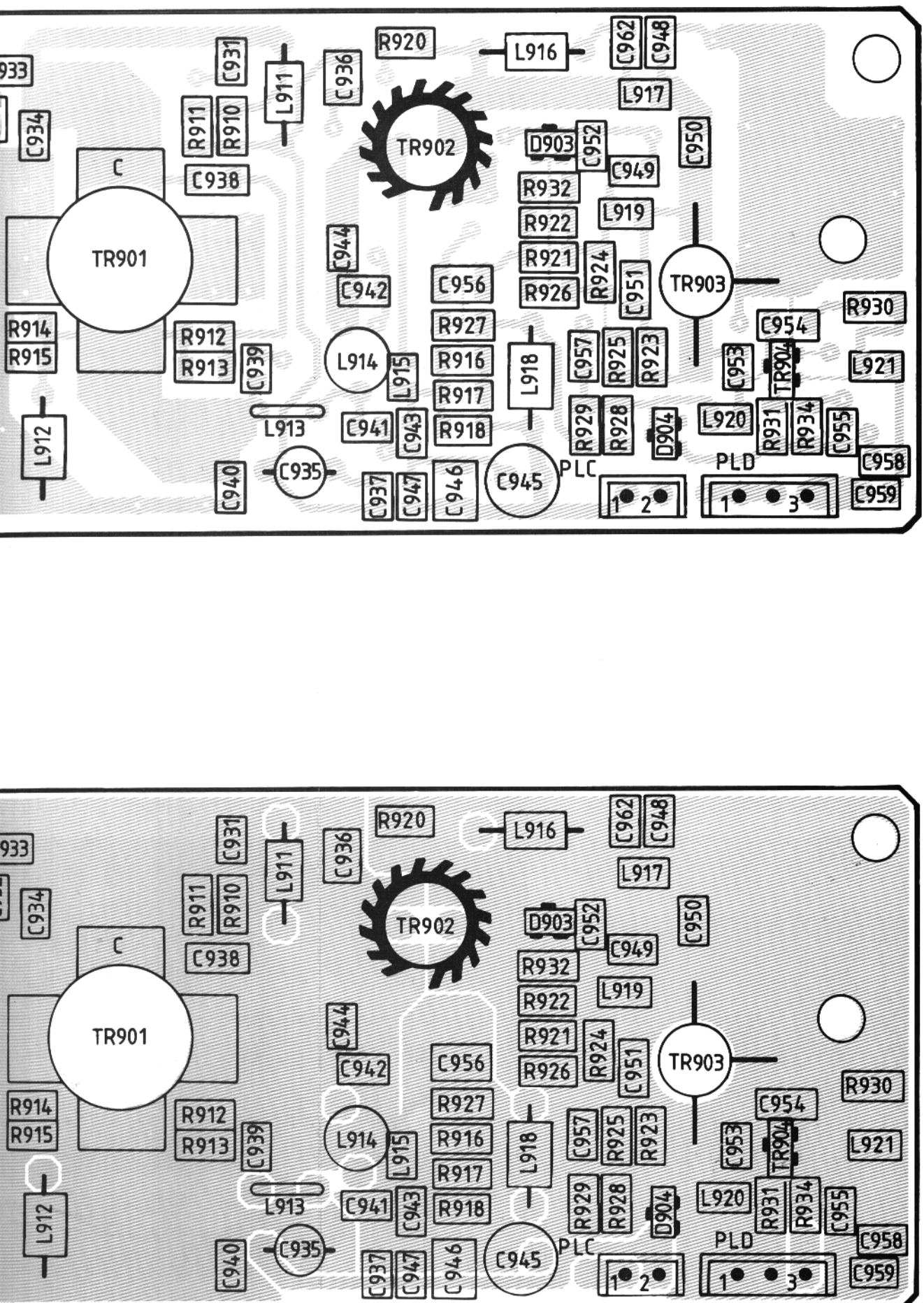
FIG 6.11B TRANSM
LOCATI


C901
C903
L901
C905
C906
C914
C915
C919
C921
L910
L900
C900
C902
C904
L902
L906
C917
C918
R909
R900
C907
C911
R902
C916
L907
L905
D900
D902
R903
C920
R908
R907
D901
L903
C912
C908
L904
R904
R901
C961
C913
C924
C960
C929
C909
L904
C926
C928
C922
C910
PLA
PLB
C927
R906
R905
L908
L909
C923
1
2
1
5


C901
C903
L901
C905
C906
C914
C915
C919
C921
L910
L900
C900
C902
C904
L902
L906
C917
C918
R909
R900
C907
C911
R902
C916
L907
L905
D900
D902
R903
C920
R908
R907
D901
L903
C912
C908
L904
R904
R901
C961
C913
C924
C960
C929
C909
L904
C926
C928
C922
C910
PLA
PLB
C927
R906
R905
L908
L909
C923
1
2
1
5

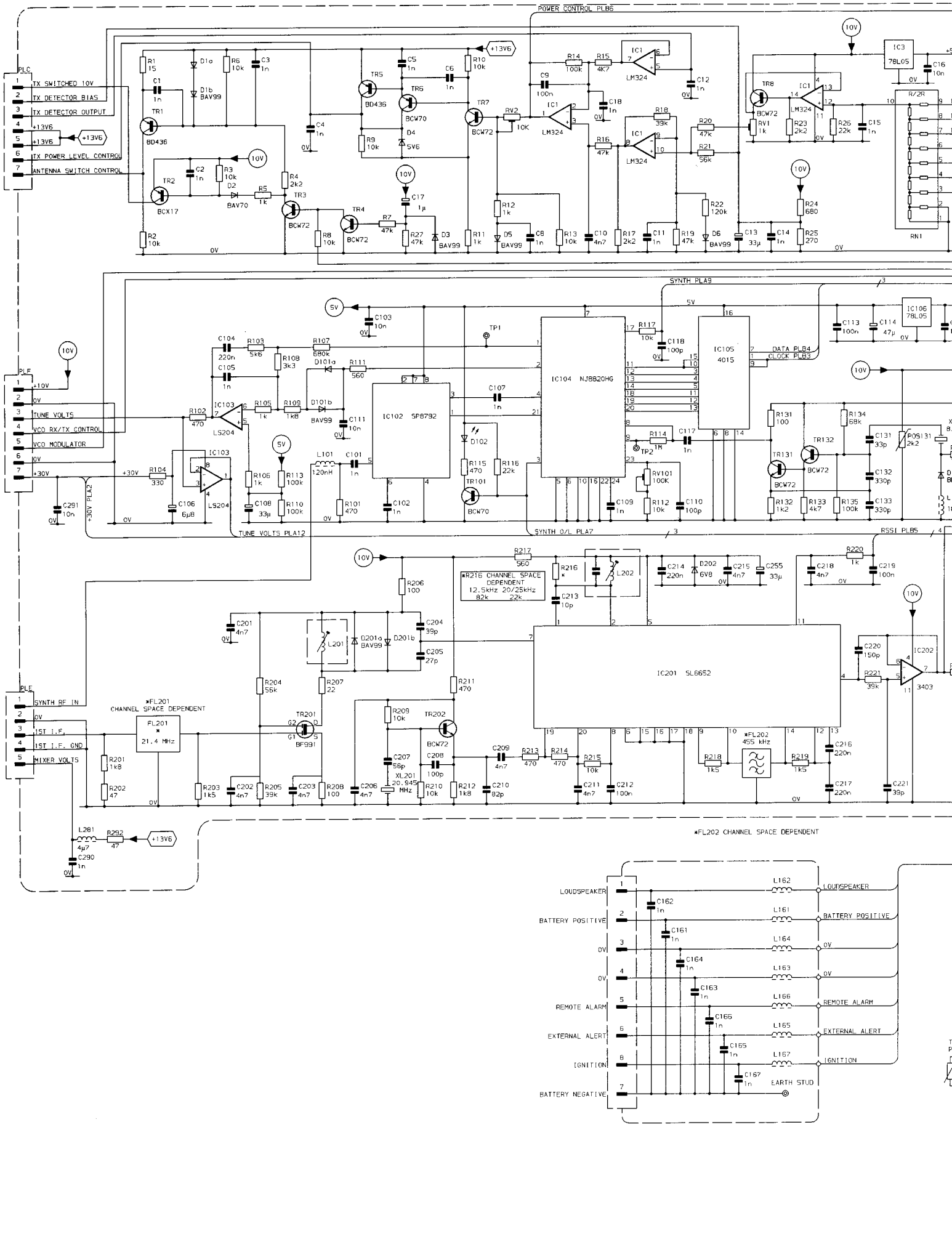

C919
C921
L910
C933
C931
L911
C936
R920
L916
C932
C934
R911
R910
TR902
D903
R909
C930
C938
L907
C
C
R932
R922
R921
R926
TR900
TR901
C944
C942
C956
R927
R908
R907
C929
R914
R915
R912
R913
C939
L914
L915
R916
R917
R918
L918
C960
C922
C925
L913
C941
C943
L909
L912
C935
C945
C923
C940
C937
C947
C946

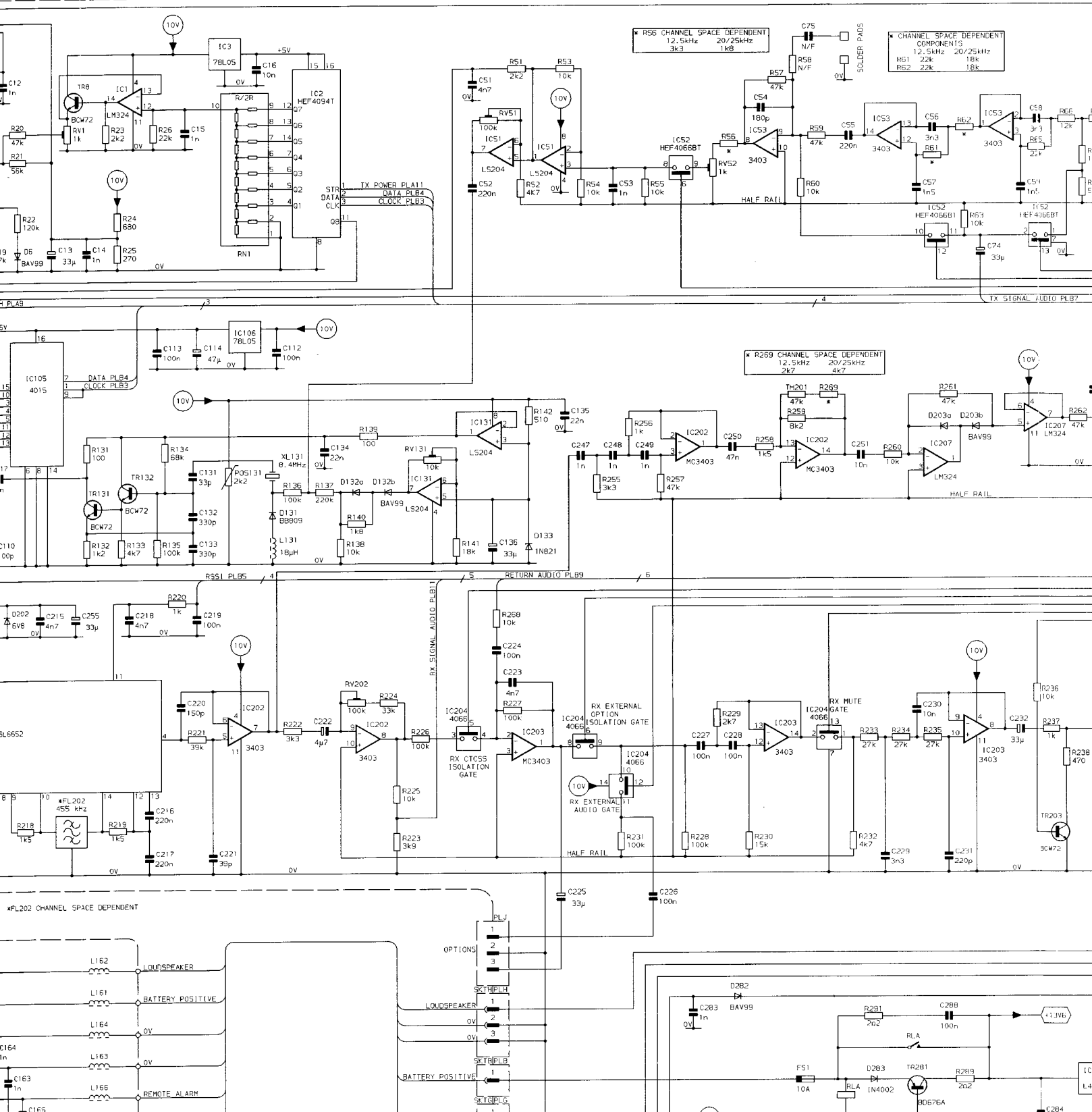

C919
C921
L910
C933
C931
L911
C936
R920
L916
C932
C934
R911
R910
TR902
D903
R909
C930
C938
L907
C
C
R932
R922
R921
R926
TR900
TR901
C944
C942
C956
R927
R908
R907
C929
R914
R915
R912
R913
C939
L914
L915
R916
R917
R918
L918
C960
C922
C925
L913
C941
C943
L909
L912
C935
C945
C923
C940
C937
C947
C946



A2 E6540

FIG 6.8 TRANSMITTER PA CO
LOCATION DI GRAM


POWER CONTROL PLB6
PLC
1 TX SWITCHED 10V
2 TX DETECTOR BIAS
3 TX DETECTOR OUTPUT
4 +13V6
5 +13V6
6 TX POWER LEVEL CONTROL
7 ANTENNA SWITCH CONTROL
SYNTH PLA9
PLE
1 +10V
2 0V
3 TUNE VOLTS
4 VCO RX/TX CONTROL
5 VCO MODULATOR
6 0V
7 +30V
TUNE VOLTS PLA12
SYNTH O/L PLA7
RSSI PLB5
DATA PLB4
CLOCK PLB3
IC104 NJ88820HG
IC102 SP8792
IC105 4015
IC201 SL6652
IC103 LS204
IC106 78L05
IC3 78L05
LM324
BD436
BCW70
BCW72
BCX17
BAV70
BAV99
BF991
3403
R/2R
RN1
*R216 CHANNEL SPACE DEPENDENT
12.5kHz 20/25kHz
82k 22k
*FL201
CHANNEL SPACE DEPENDENT
FL201
*
21.4 MHz
*FL202
455 kHz
XL201
20.945
MHz
*FL202 CHANNEL SPACE DEPENDENT
LOUDSPEAKER
BATTERY POSITIVE
0V
0V
REMOTE ALARM
EXTERNAL ALERT
IGNITION
BATTERY NEGATIVE
EARTH STUD


* R56 CHANNEL SPACE DEPENDENT
12.5kHz 20/25kHz
3k3 1k8
* CHANNEL SPACE DEPENDENT COMPONENTS
12.5kHz 20/25kHz
RG1 22k 18k
RG2 22k 18k
* R269 CHANNEL SPACE DEPENDENT
12.5kHz 20/25kHz
2k7 4k7
*FL202 CHANNEL SPACE DEPENDENT
TX SIGNAL AUDIO PLB7
RSSI PLB5
RETURN AUDIO PLB9
RX SIGNAL AUDIO PLB11
HALF RAIL
RX EXTERNAL OPTION ISOLATION GATE
RX MUTE GATE
RX CTCSS ISOLATION GATE
RX EXTERNAL AUDIO GATE
TX POWER PLA11
DATA PLB4
CLOCK PLB3
LOUDSPEAKER
BATTERY POSITIVE
REMOTE ALARM
EXTERNAL ALERT
IGNITION
EARTH STUD
TH1 FITTED TO P.A. HEATSINK
SOLDER PADS
IC1 LM324
IC2 HEF4094T
IC3 78L05
IC51 LS204
IC52 HEF4066BT
IC53 3403
IC105 4015
IC106 78L05
IC131 LS204
IC202 MC3403
IC203 MC3403
IC204 4066
IC207 LM324
TR8 BCW72
TR131 BCW72
TR132 BCW72
TR203 BC672
TR281 BD676A
D131 BB809
D132a D132b BAV99
D202 6V8
D203a D203b BAV99
D281a BAV70
D281b
D282 BAV99
D283 IN4002
D133 1N821
L131 18µH
L161
L162
L163
L164
L165
L166
L167
XL131 8.4MHz
POS131 2k2
RV1 1k
RV51 100k
RV52 1k
RV131 10k
RV202 100k
RN1 R/2R
FS1 10A
RLA
PL1
SKT8PLH
SKT8PLB
SKT8PLG
OPTIONS
0V
10V
+5V
+13V6

FIG

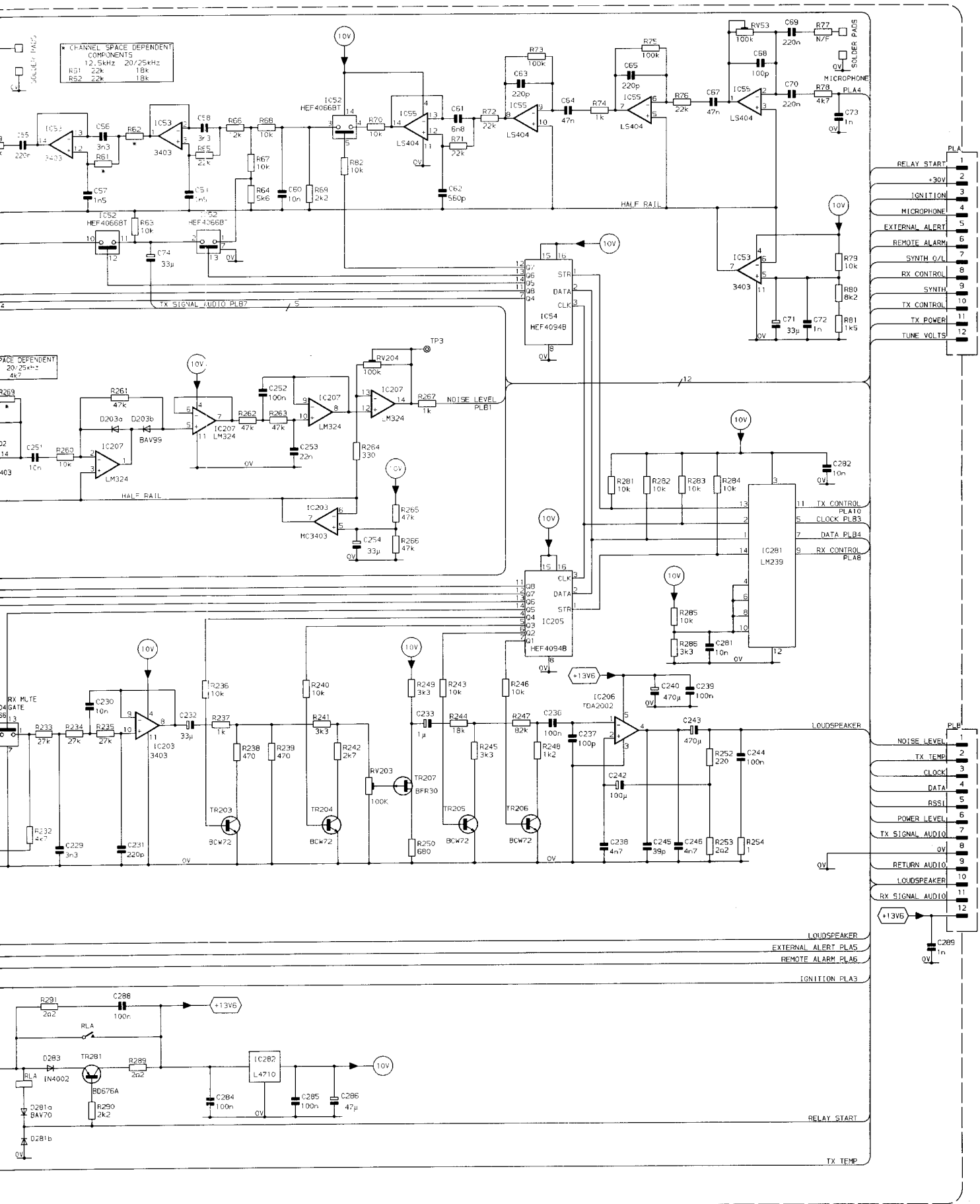
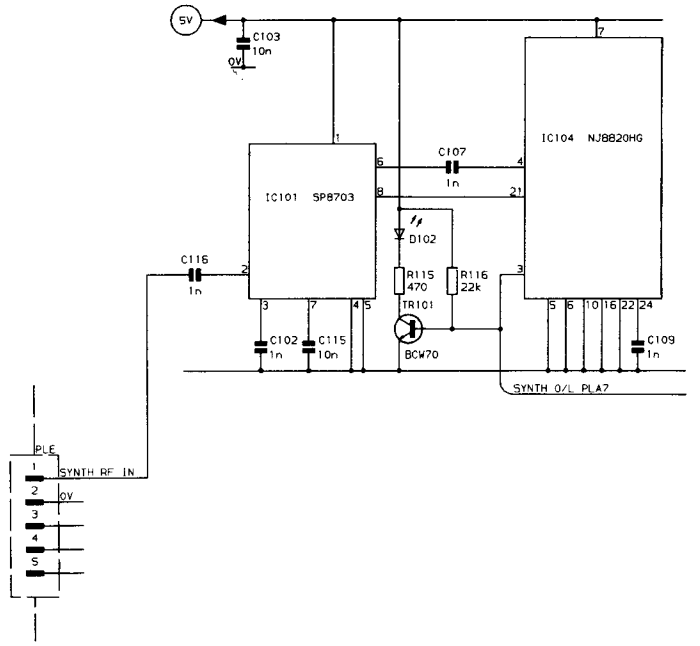
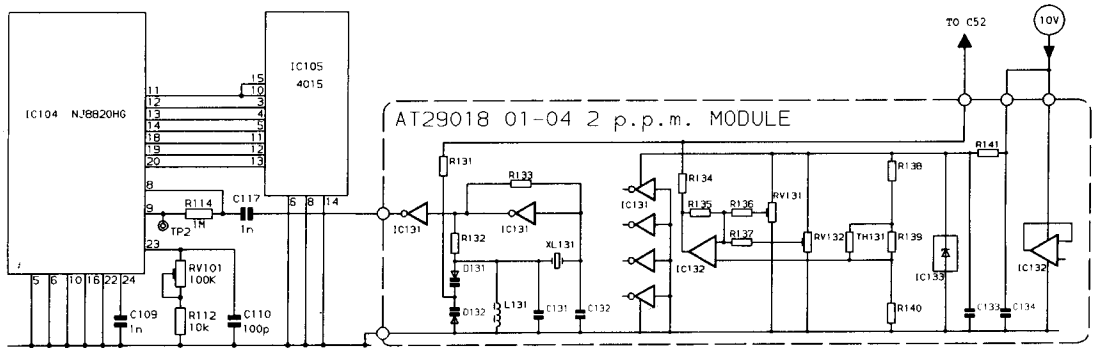


FIG 6.12 ANALOGUE PWB CIRCUIT DIAGRAM

TP253

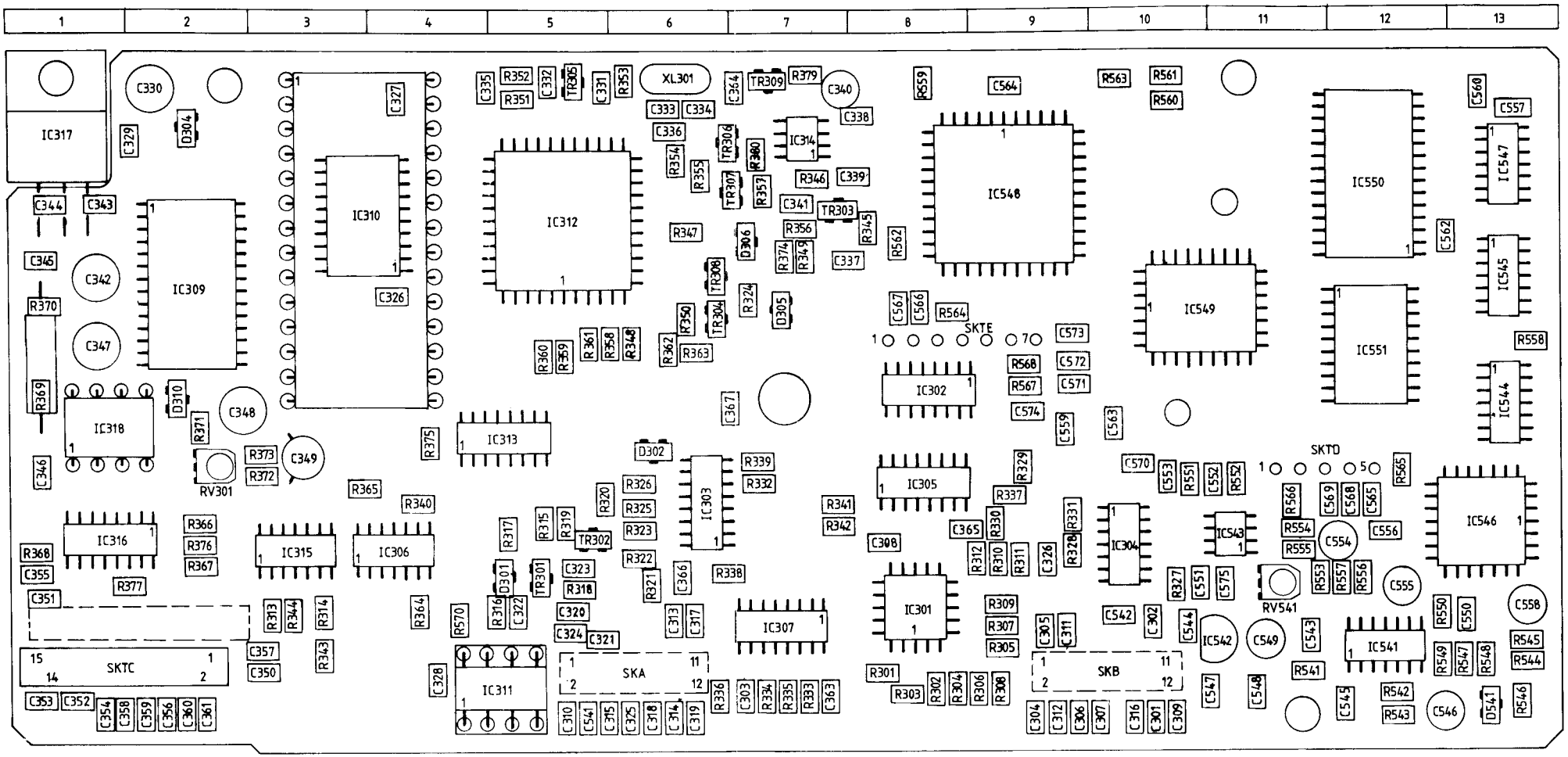


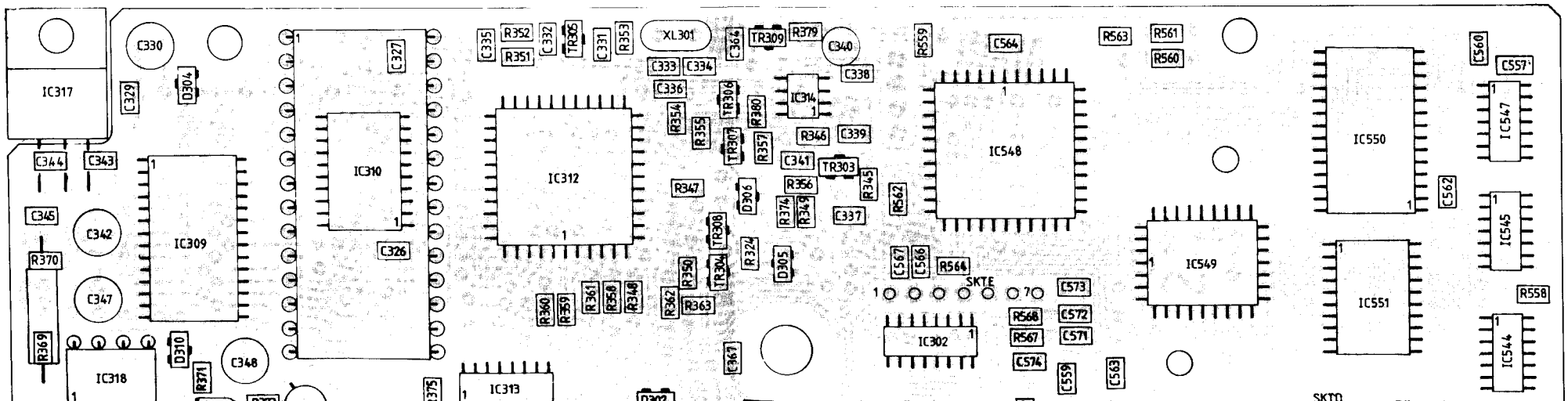
UHF PRESCALER (IC101)

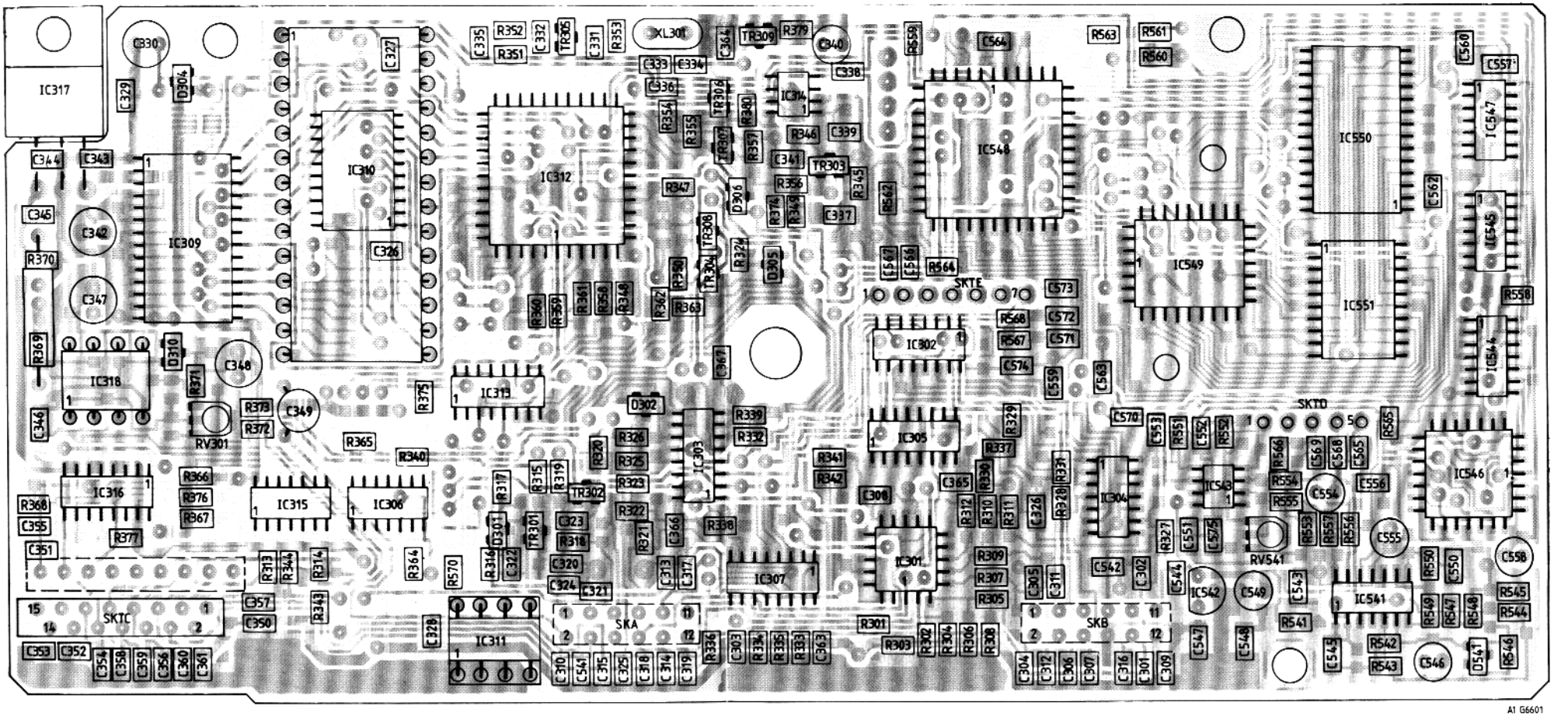


±2ppm REFERENCE OSCILLATOR MODULE

FIG 6.13 ANALOGUE PWB CIRCUIT VARIATIONS

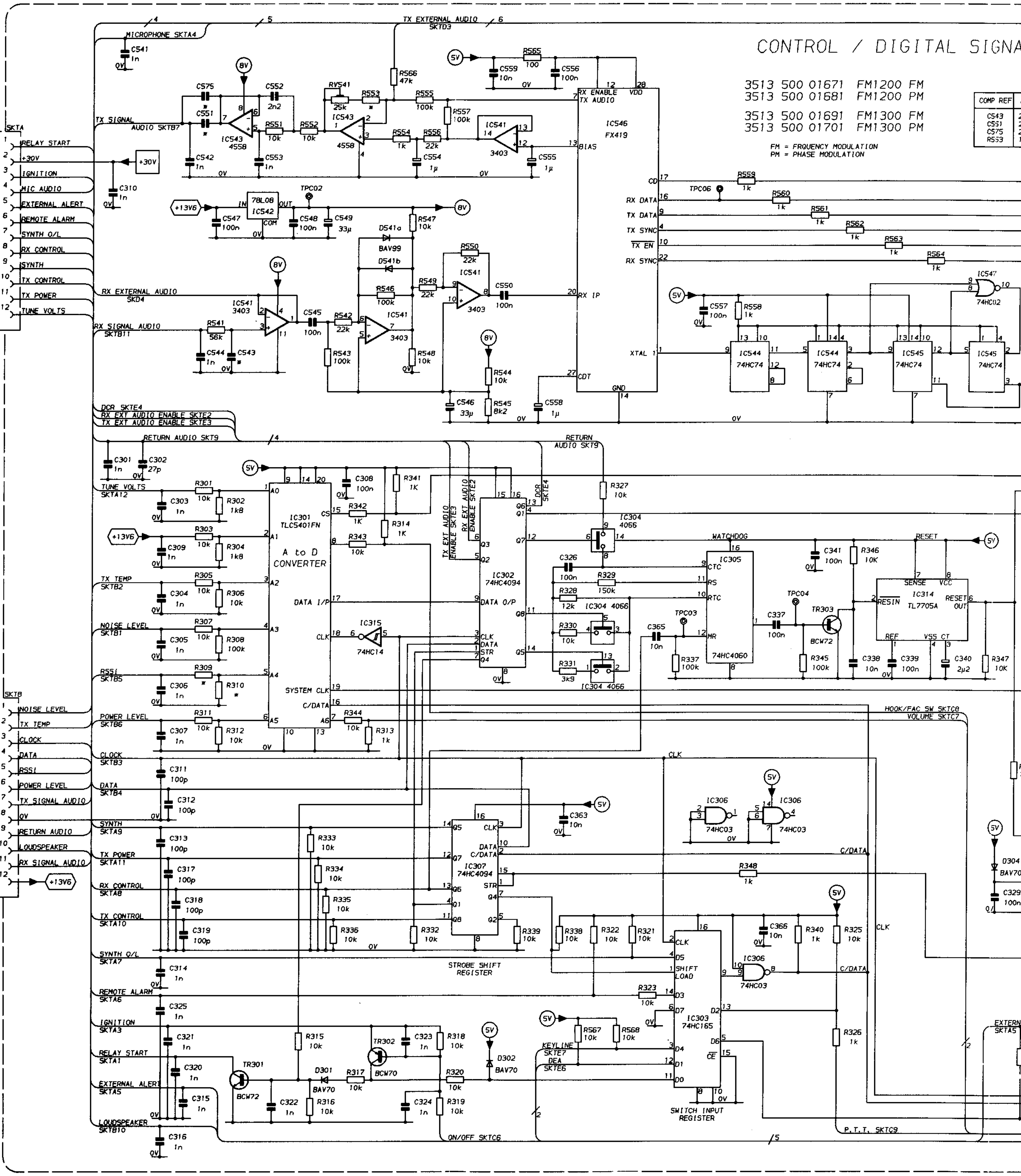

1 2 3 4 5 6 7 8 9 10 11 12 13
A B C D E F
IC317
IC310
IC309
IC312
XL301
IC314
IC548
IC550
IC547
IC545
IC549
IC551
IC544
IC318
IC313
IC302
IC303
IC305
IC304
IC543
IC546
IC316
IC315
IC306
IC307
IC301
IC542
IC541
IC311
RV301
RV541
SKTC
SKA
SKB
SKTE
SKTD


IC317
IC310
IC309
IC312
XL301
IC314
IC548
IC550
IC547
IC545
IC549
IC551
IC544
IC318
IC313
IC302
SKTE
SKTD



A1 G6601

FIG 6.1 CONTROL/DIGITAL SIGNALLING PWB COMPONENT LOCATION DIAGRAM


CONTROL / DIGITAL SIGNA
3513 500 01671 FM1200 FM
3513 500 01681 FM1200 PM
3513 500 01691 FM1300 FM
3513 500 01701 FM1300 PM
FM = FREQUENCY MODULATION
PM = PHASE MODULATION
COMP REF
C543
C551
C575
R553
SKTA
RELAY START
+30V
IGNITION
MIC AUDIO
EXTERNAL ALERT
REMOTE ALARM
SYNTH O/L
RX CONTROL
SYNTH
TX CONTROL
TX POWER
TUNE VOLTS
SKTB
NOISE LEVEL
TX TEMP
CLOCK
DATA
RSSI
POWER LEVEL
TX SIGNAL AUDIO
0V
RETURN AUDIO
LOUDSPEAKER
RX SIGNAL AUDIO
+13V6
MICROPHONE SKTA4
TX EXTERNAL AUDIO SKTD3
TX SIGNAL AUDIO SKTB7
RX EXTERNAL AUDIO SKD4
RX SIGNAL AUDIO SKTB11
IC546 FX419
IC542 78L08
IC301 TLC5401FN
A to D CONVERTER
IC302 74HC4094
IC304 4066
IC305 74HC4060
IC314 TL7705A
IC307 74HC4094
STROBE SHIFT REGISTER
IC303 74HC165
SWITCH INPUT REGISTER
IC306 74HC03
IC544 74HC74
IC545 74HC74
IC547 74HC02
IC541 3403
IC543 4558
IC315 74HC14
WATCHDOG
RESET
HOOK/FAC SW SKTC8
VOLUME SKTC7
ON/OFF SKTC6
P.T.T. SKTC9
KEYLINE SKTE7
DEA SKTE6
DCR SKTE4
RX EXT AUDIO ENABLE SKTE2
TX EXT AUDIO ENABLE SKTE3
RETURN AUDIO SKT9

CONTROL / DIGITAL SIGNALLING ASSEMBLY

3513 500 01671 FM1200 FM
3513 500 01681 FM1200 PM

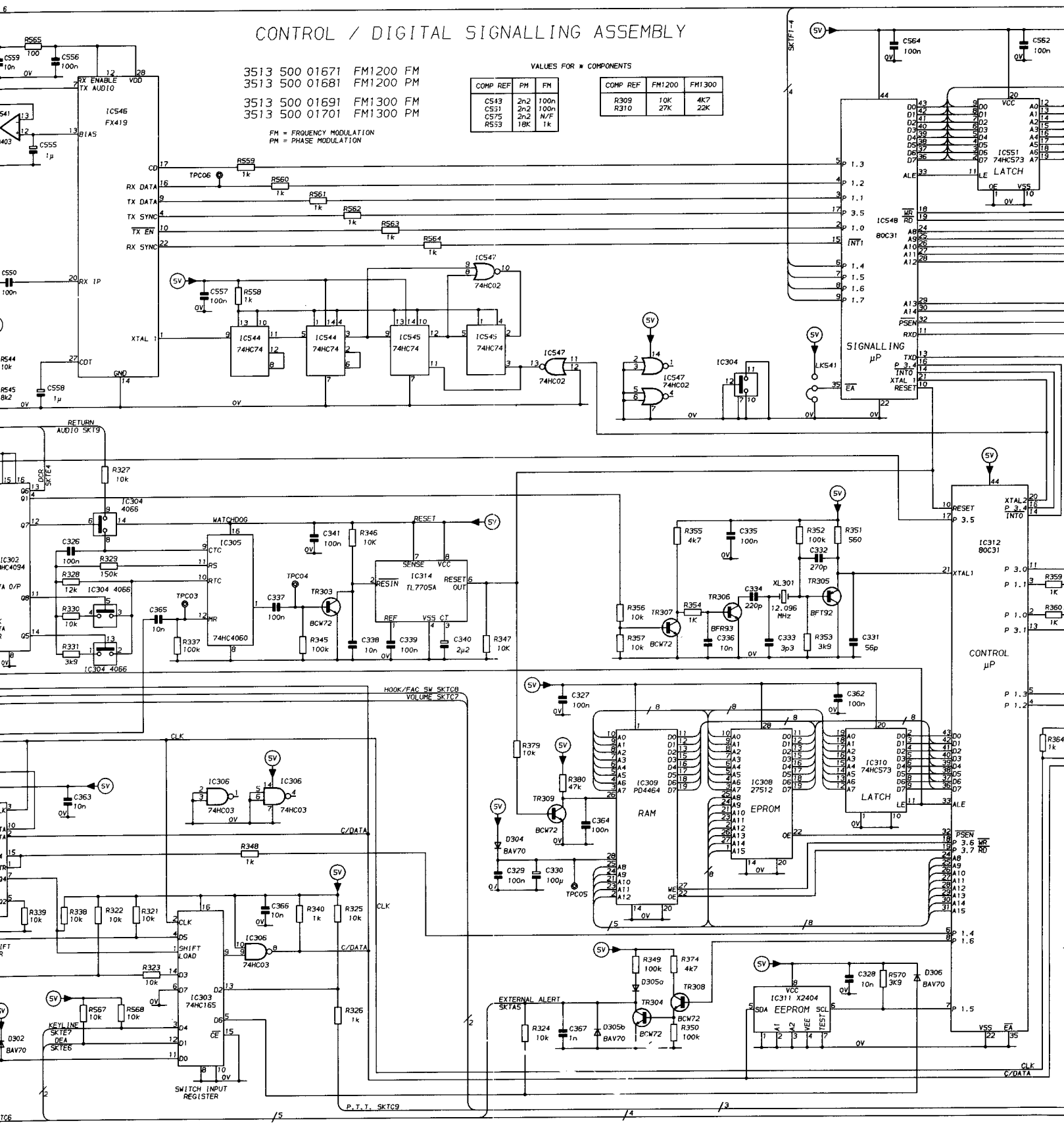
3513 500 01691 FM1300 FM
3513 500 01701 FM1300 PM

FM = FRQUENCY MODULATION
PM = PHASE MODULATION

VALUES FOR * COMPONENTS

COMP REF	PM	FM
C543	2n2	100n
C531	2n2	100n
C575	2n2	N/F
R533	18K	1k

COMP REF	FM1200	FM1300
R309	10K	4K7
R310	27K	22K



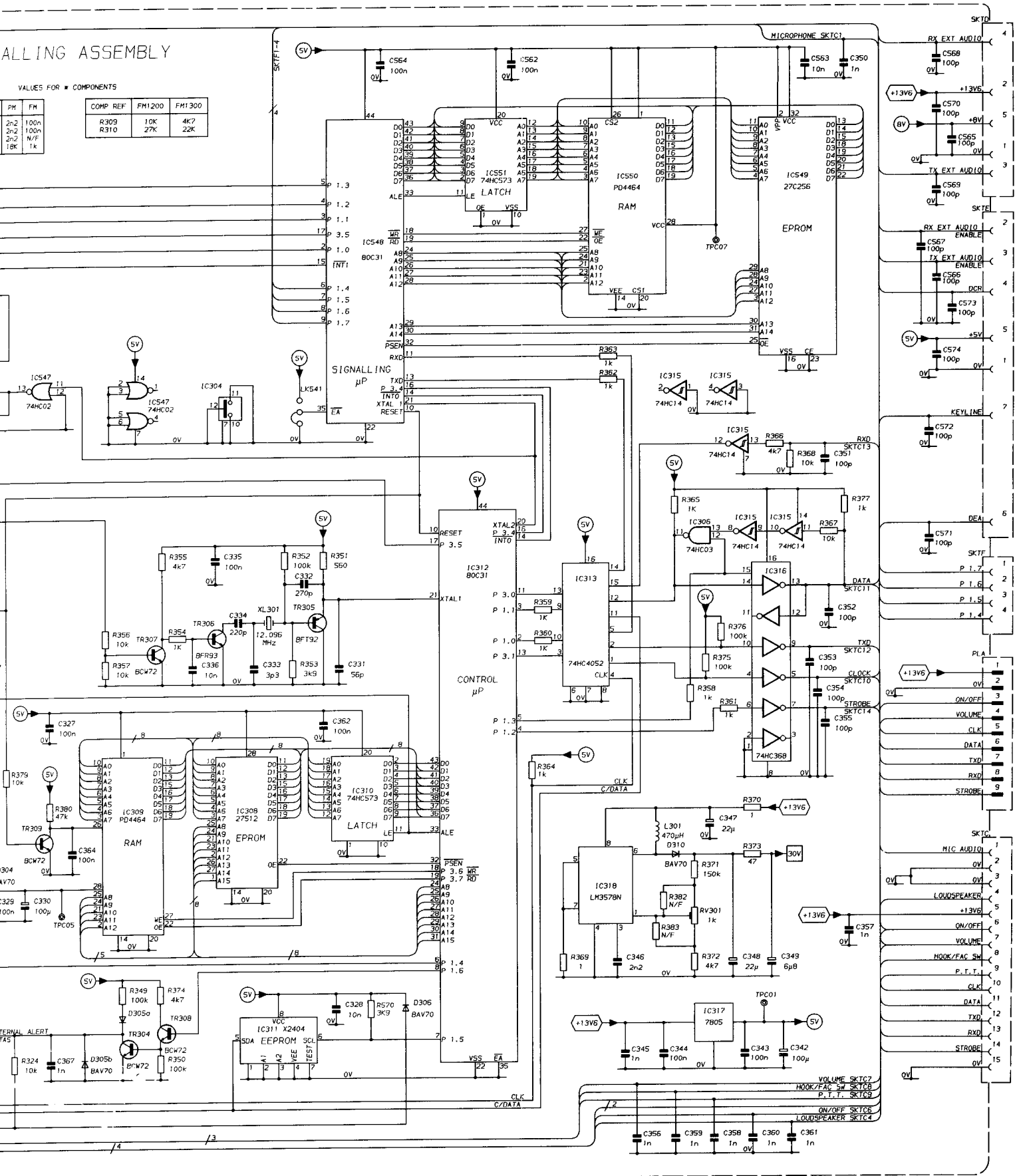
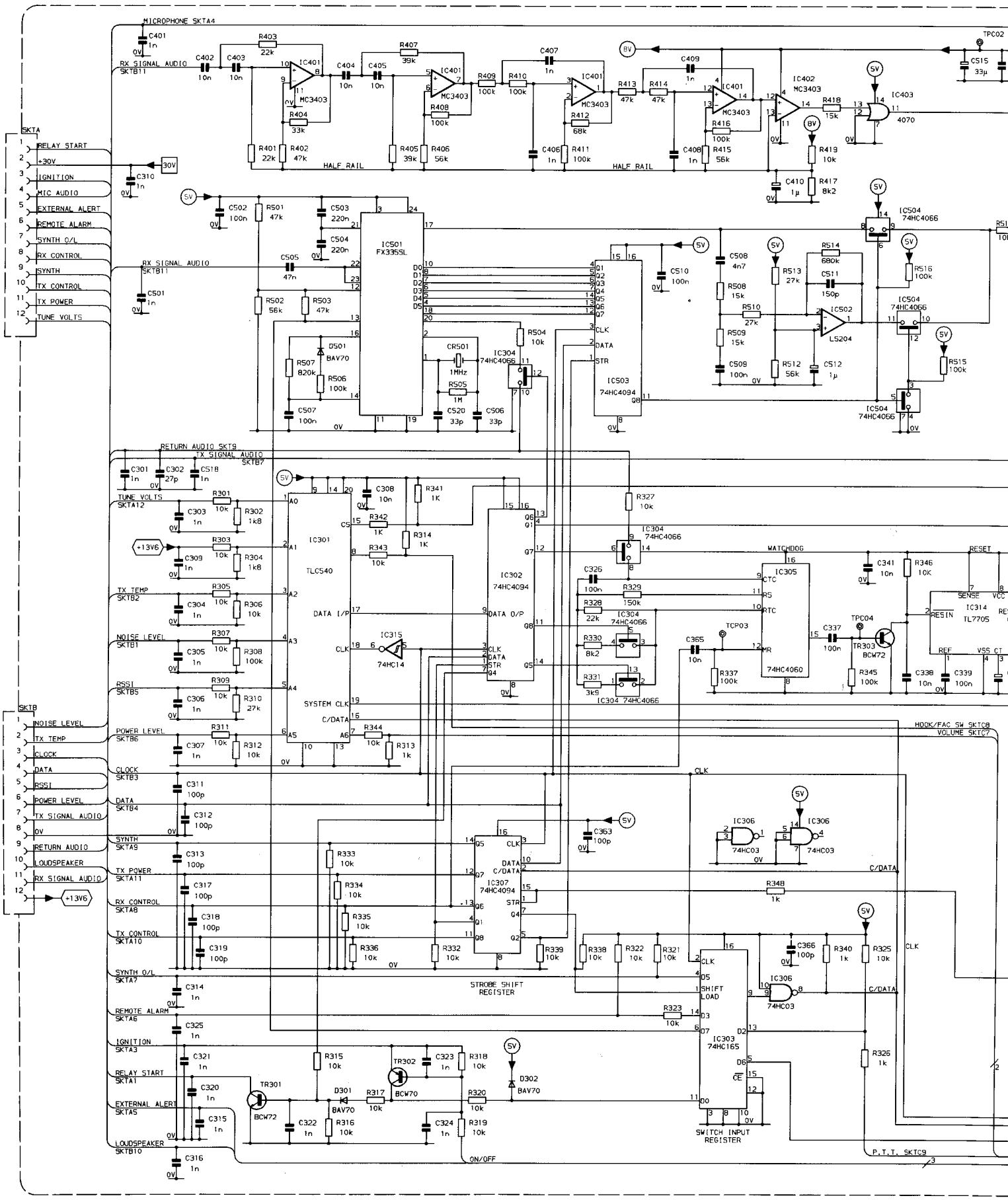
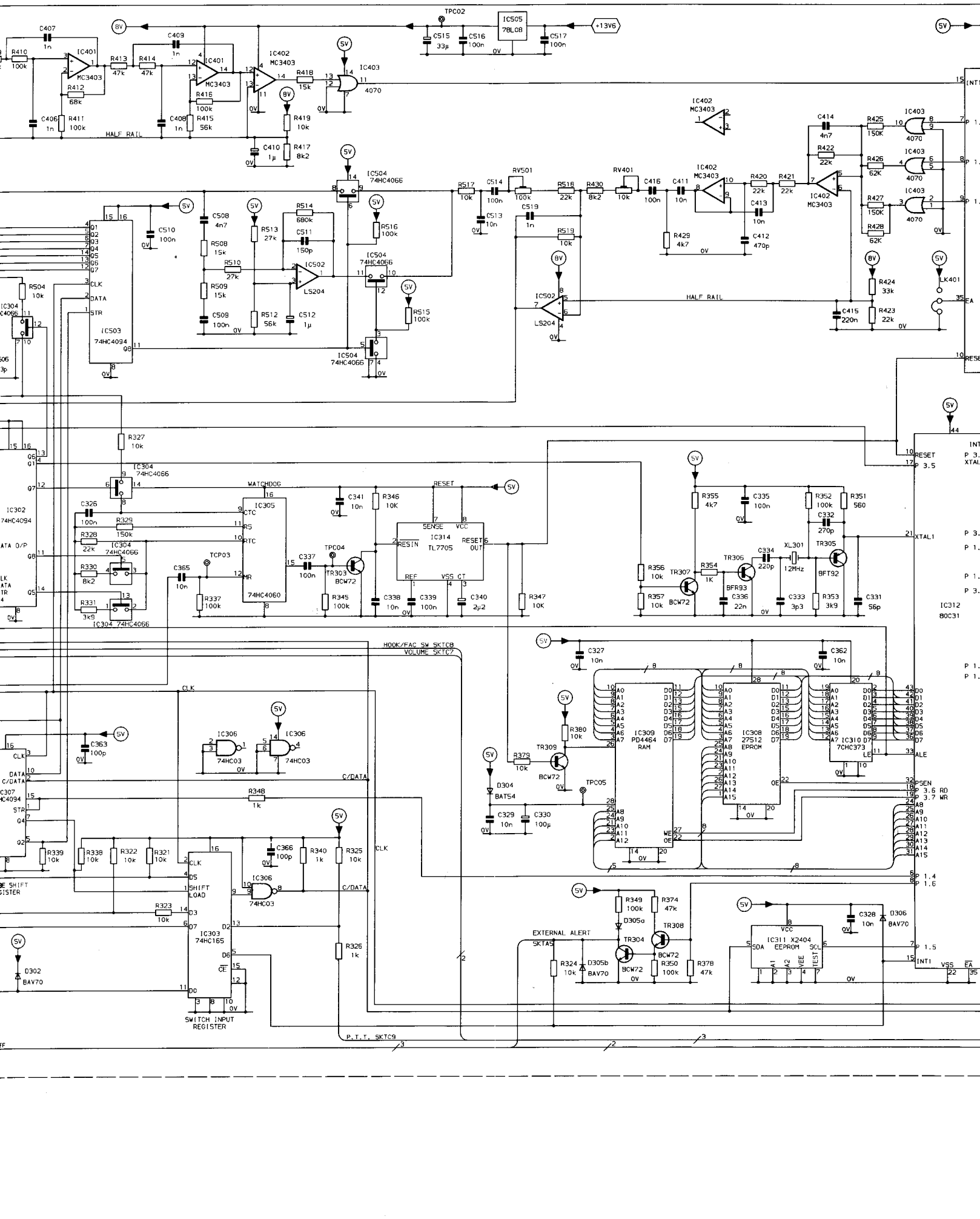


FIG 6.2 CONTROL/DIGITAL SIGNALLING PWB CIRCUIT DIAGRAM

CONTROL PWB


MICROPHONE SKTA4
RX SIGNAL AUDIO SKTB11
HALF RAIL
SKTA
RELAY START
+30V
IGNITION
MIC AUDIO
EXTERNAL ALERT
REMOTE ALARM
SYNTH O/L
RX CONTROL
SYNTH
TX CONTROL
TX POWER
TUNE VOLTS
IC501 FX335SL
IC503 74HC4094
IC504 74HC4066
IC502 LS204
IC402 MC3403
IC403 4070
IC303 74HC165
SWITCH INPUT REGISTER
STROBE SHIFT REGISTER
IC307 74HC4094
IC301 TLC540
IC302 74HC4094
IC304 74HC4066
IC305 74HC4060
IC306 74HC03
IC314 TL7705
WATCHDOG
RESET
HOOK/FAC SW SKTC8
VOLUME SKTC7
RETURN AUDIO SKTC9
TX SIGNAL AUDIO SKTB7
SKTB
NOISE LEVEL
TX TEMP
CLOCK
DATA
RSSI
POWER LEVEL
TX SIGNAL AUDIO
0V
SYNTH
RETURN AUDIO
LOUDSPEAKER
TX POWER
RX SIGNAL AUDIO
+13V6
RX CONTROL
TX CONTROL
SYNTH O/L
REMOTE ALARM
IGNITION
RELAY START
EXTERNAL ALERT
LOUDSPEAKER
ON/OFF
P.T.T. SKTC9


TPC02
IC505
78L08
+13V6
8V
5V
0V
IC401
MC3403
IC402
MC3403
IC403
4070
HALF RAIL
IC504
74HC4066
IC502
LS204
IC503
74HC4094
IC304
74HC4066
IC305
74HC4060
IC314
TL7705
IC309
PD4464
RAM
IC308
27512
EPROM
IC310
74HC373
IC303
74HC165
IC306
74HC03
IC311 X2404
EEPROM
WATCHDOG
RESET
SENSE
VCC
RESIN
REF
VSS
CT
XTAL1
12MHz
TR303
BCW72
TR304
TR305
BFT92
TR306
BFR93
TR307
TR308
TR309
D302
BAV70
D304
BAT54
D305a
D305b
D306
LK401
HOOK/FAC SW SKTC8
VOLUME SKTC7
C/DATA
CLK
EXTERNAL ALERT
SKTA5
P.T.T. SKTC9
SWITCH INPUT
REGISTER
SHIFT
LOAD
SDA
SCL
RESET
XTAL
PSEN
ALE
INT1
VSS
EA

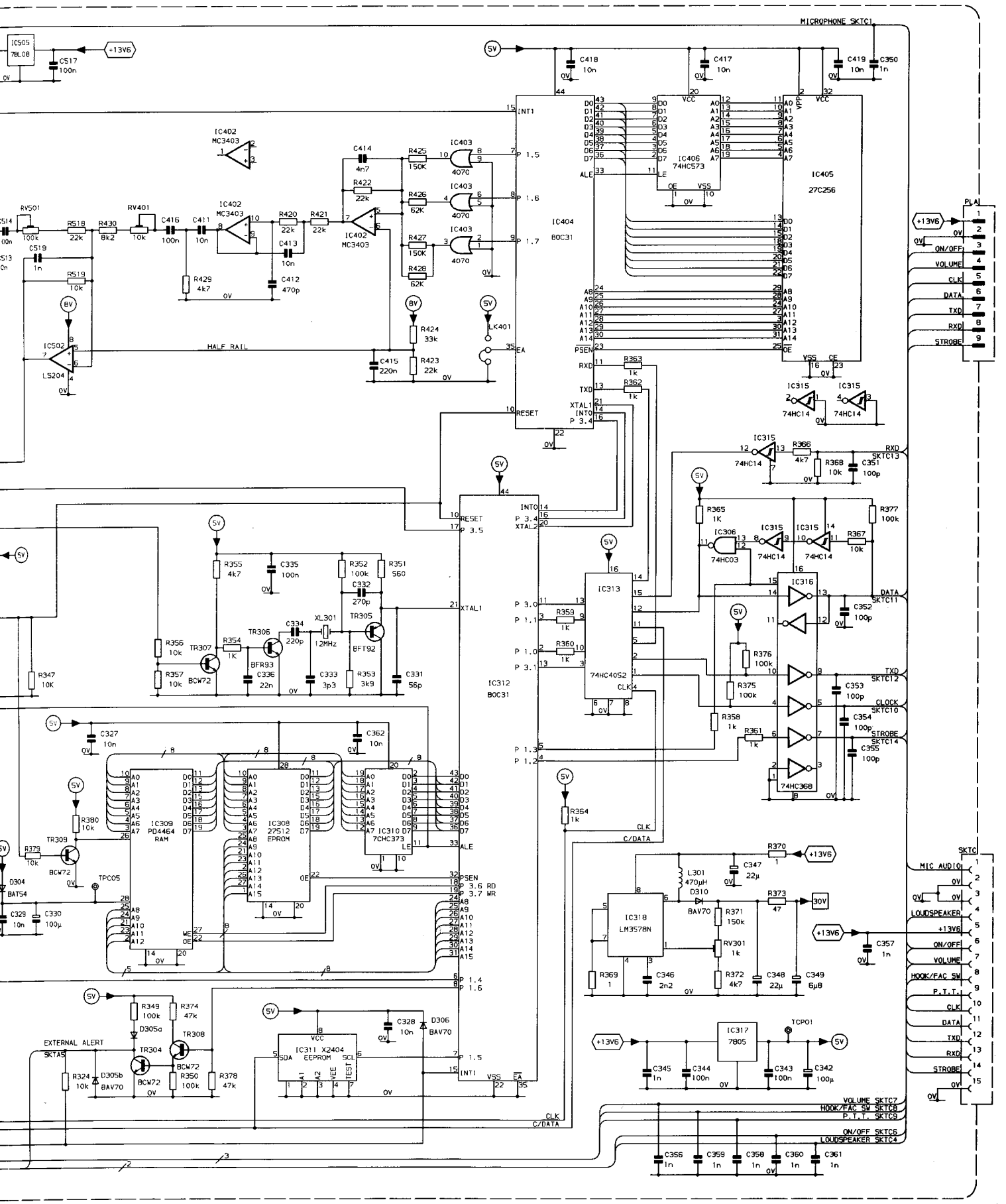
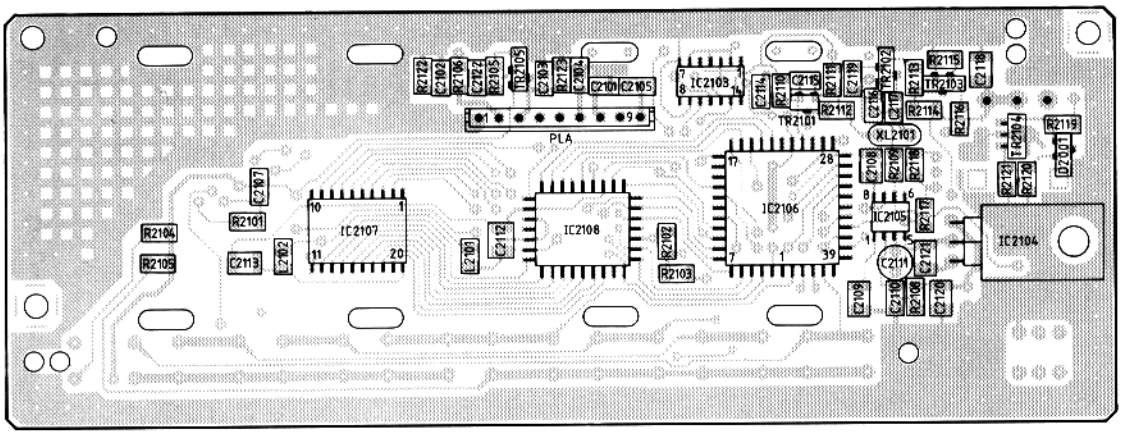
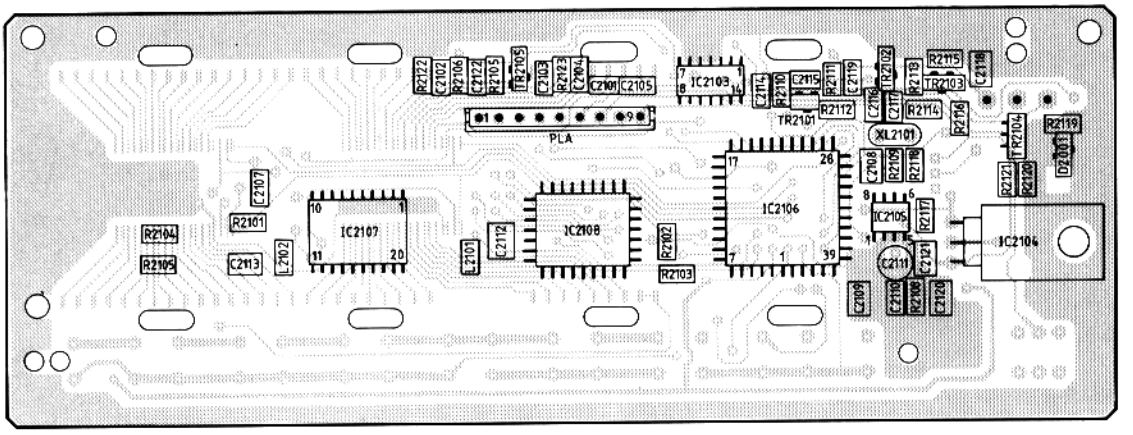
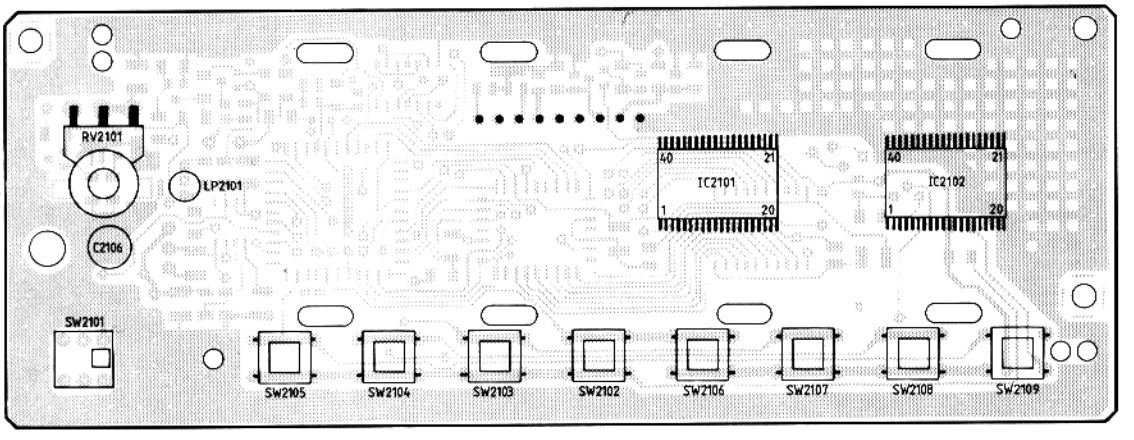


FIG 6.14 CONTROL PWB CIRCUIT DIAGRAM







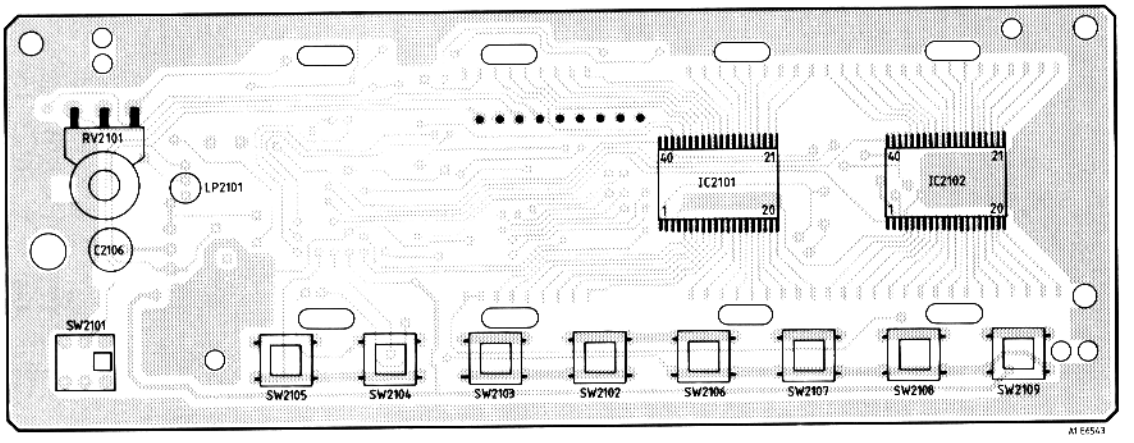
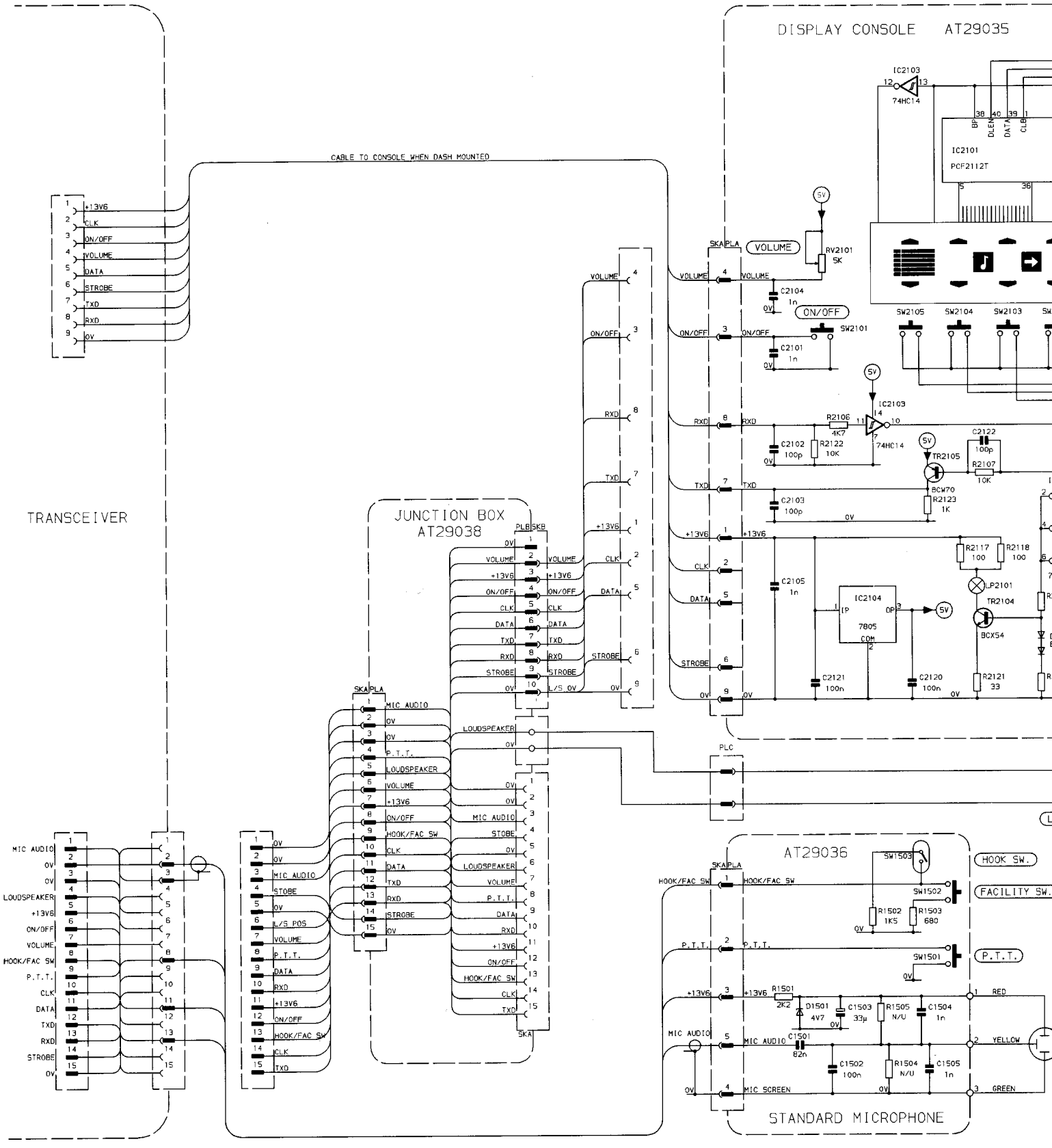
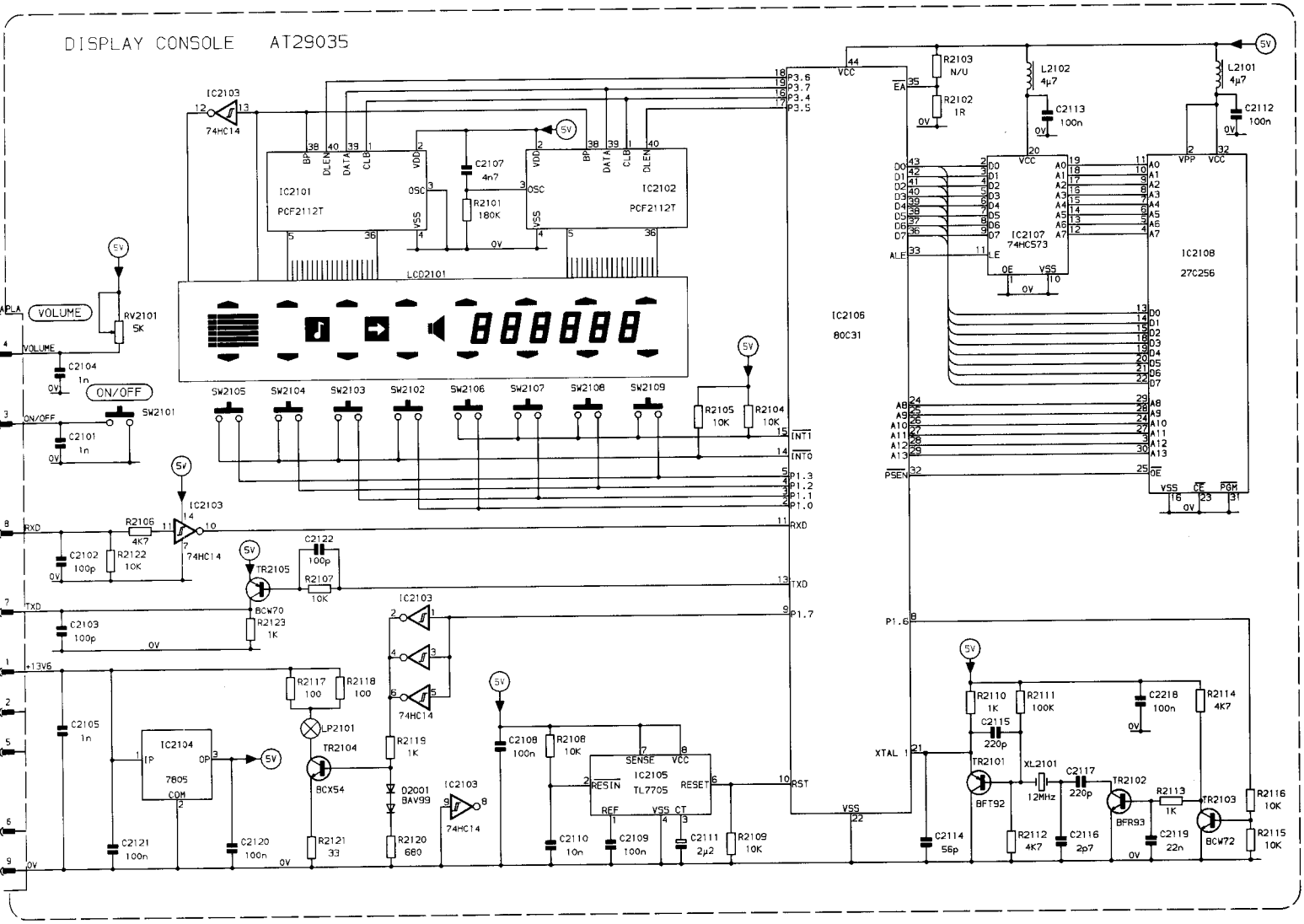


FIG 6.15 DISPLAY CONSOLE
COMPONENT LOCATION DIAGRAM


TRANSCEIVER
CABLE TO CONSOLE WHEN DASH MOUNTED
+13V6
CLK
ON/OFF
VOLUME
DATA
STROBE
TXD
RXD
0V
JUNCTION BOX
AT29038
PLB
SKB
SKA
PLA
MIC AUDIO
P.T.T.
LOUDSPEAKER
HOOK/FAC SW
L/S POS
L/S 0V
DISPLAY CONSOLE AT29035
IC2103
74HC14
IC2101
PCF2112T
RV2101
5K
SW2101
SW2105
SW2104
SW2103
R2106
4K7
R2122
10K
C2102
100p
C2103
100p
C2104
1n
C2101
1n
C2105
1n
TR2105
BCW70
R2123
1K
C2122
100p
R2107
10K
R2117
100
R2118
100
LP2101
TR2104
BCX54
IC2104
7805
R2121
33
C2120
100n
C2121
100n
PLC
AT29036
SW1503
SW1502
SW1501
R1502
1K5
R1503
680
R1501
2K2
D1501
4V7
C1503
33µ
R1505
N/U
C1504
1n
C1501
82n
C1502
100n
R1504
N/U
C1505
1n
HOOK SW.
FACILITY SW.
P.T.T.
STANDARD MICROPHONE
RED
YELLOW
GREEN
MIC SCREEN



NOTES

1. CONSOLE AND MICROPHONE SHOWN IN DASH MOUNT CONFIGURATION.
2. LOUDSPEAKER SHOWN IN REMOTE MOUNT CONFIGURATION.

FIG 6.16 DISPLAY CONSOLE & JUNCTION BOX CIRCUIT DIAGRAM

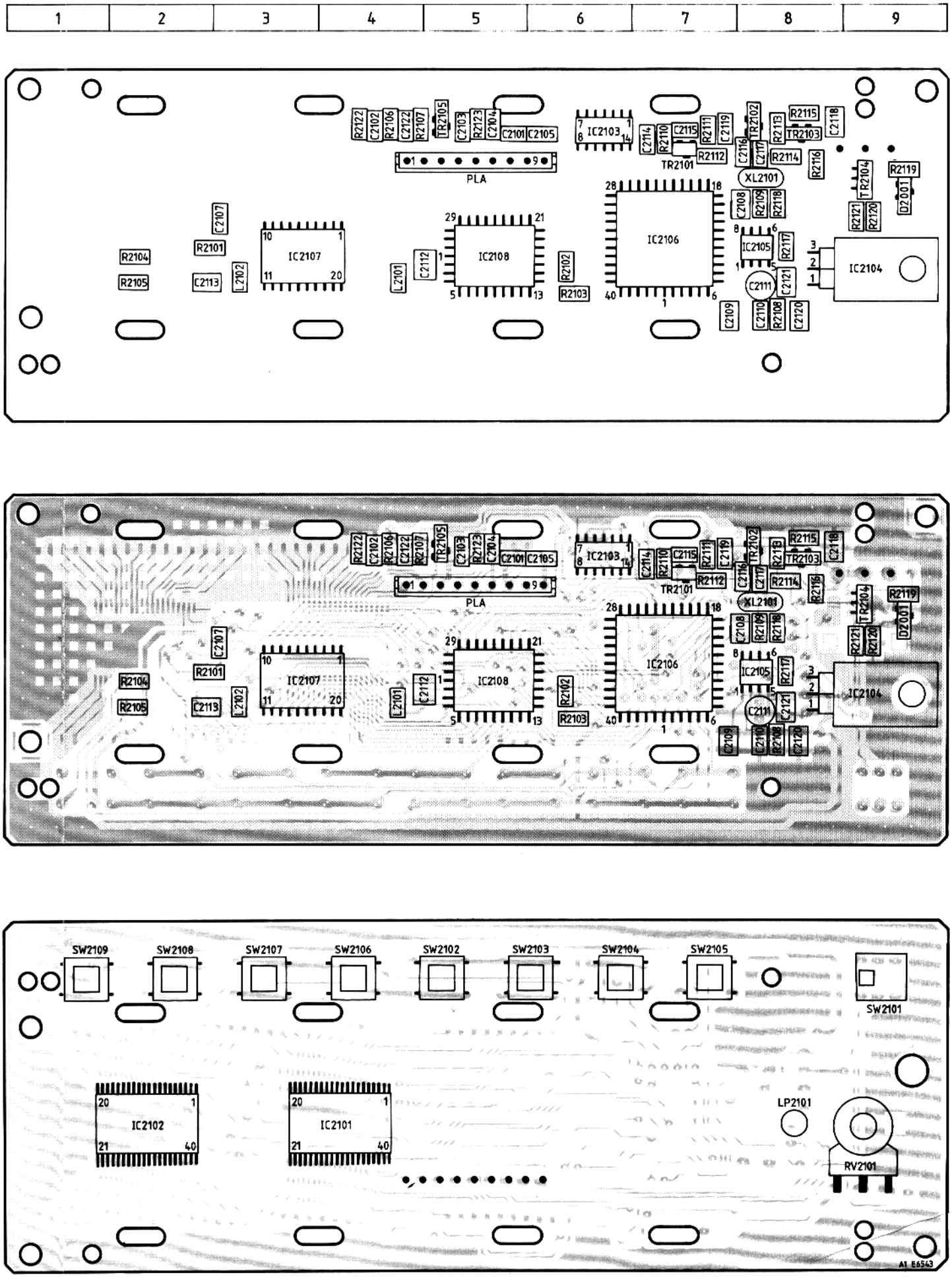
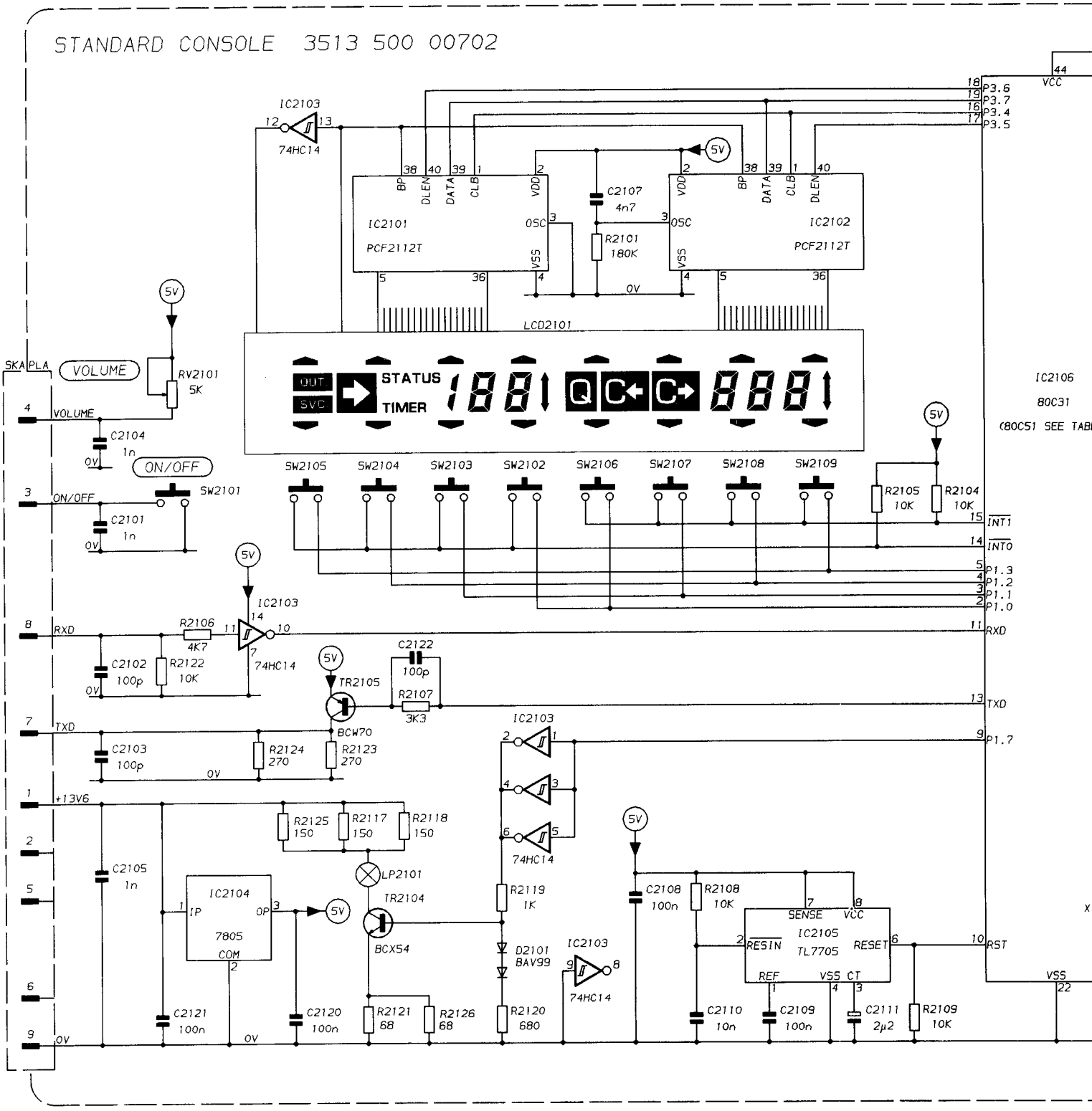


FIG 6.5 FM1200/FM1300 STANDARD CONSOLE COMPONENT LOCATION DIAGRAM

TP253A



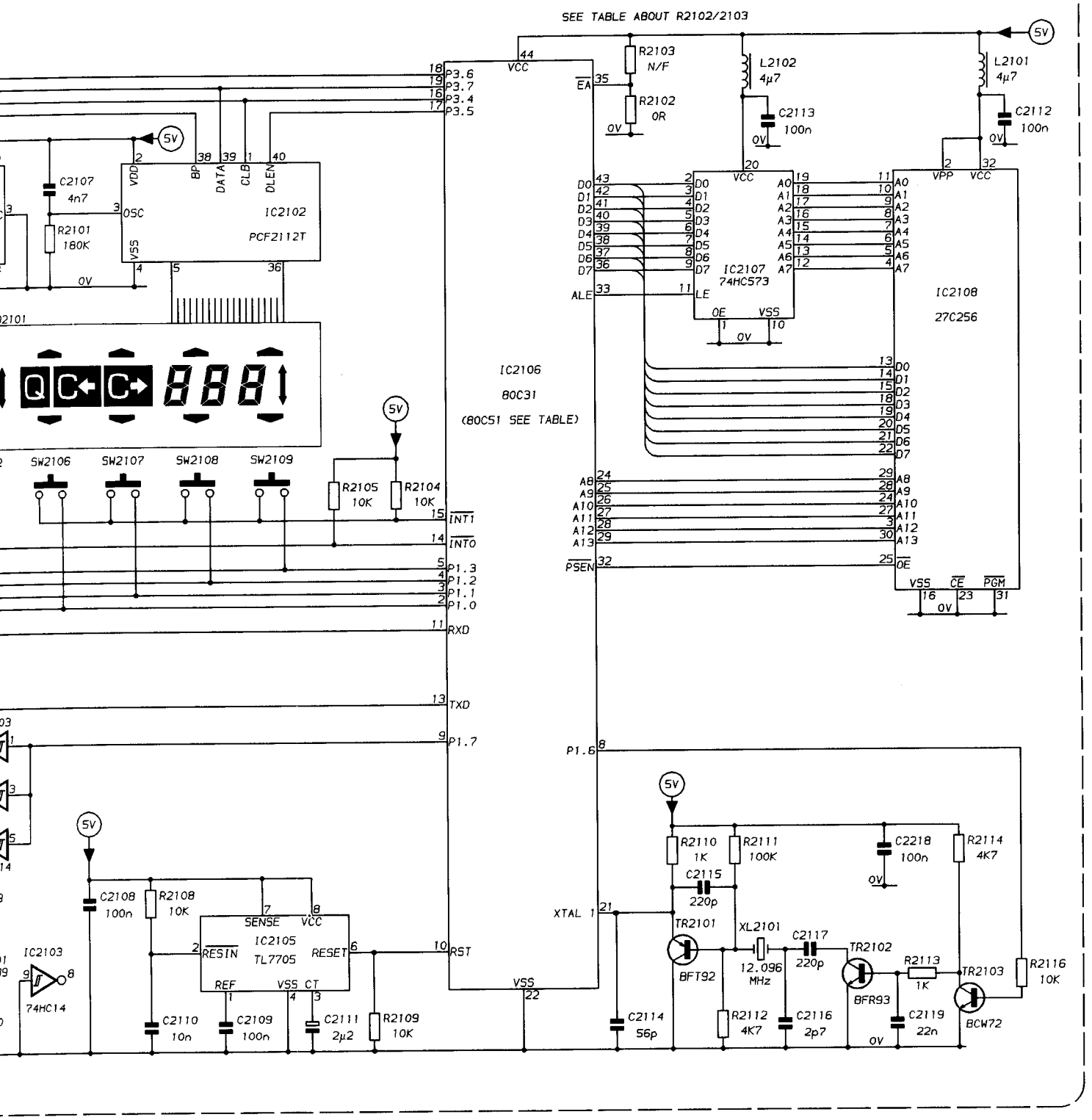
MEMORY ACCESS

IC2106 µP	MEMORY ACCESSED	IC2106 PIN 35	R2102	R2103	IC2107/2108
80C31	EXTERNAL	0V	FITTED	N/F	REQUIRED
80C51	EXTERNAL	0V	FITTED	N/F	REQUIRED
80C51	INTERNAL (MASKED)	5V	N/F	FITTED	NOT REQUIRED (MAY BE FITTED)

NOTES

1. N/F = NOT FITTED

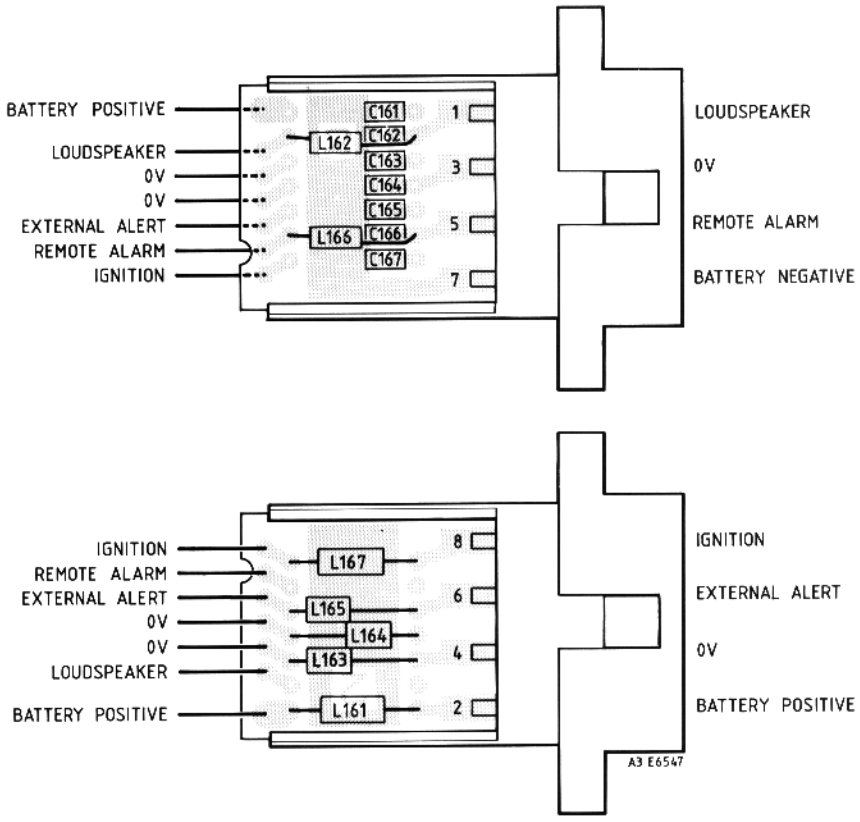
FIG 6.6 FM1200/FM1300 STANDARD CONSOLE CIRCUIT DIAGRAM



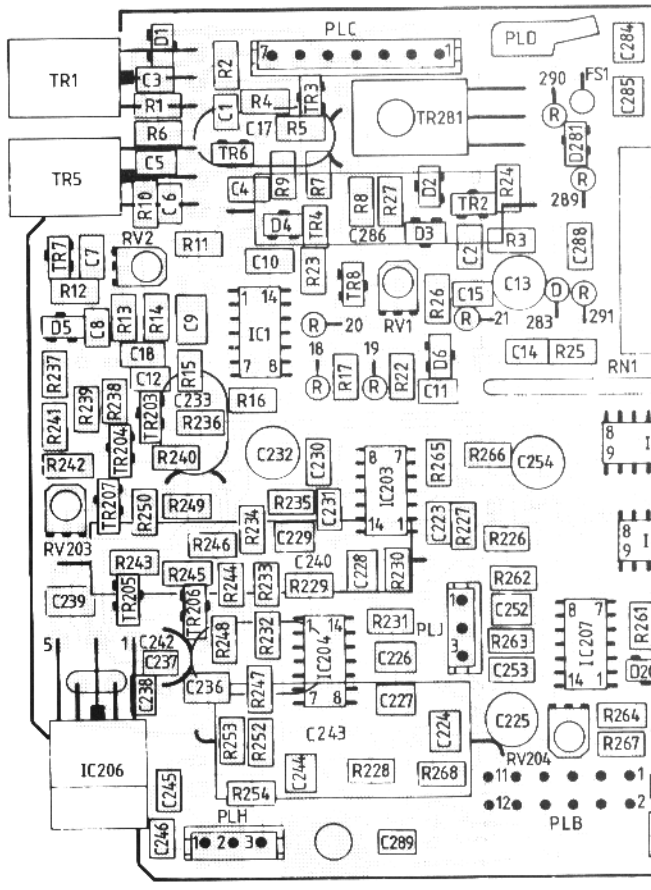
MEMORY ACCESS

IC2106 µP	MEMORY ACCESSED	IC2106 PIN 35	R2102	R2103	IC2107/2108
80C31	EXTERNAL	0V	FITTED	N/F	REQUIRED
80C51	EXTERNAL	0V	FITTED	N/F	REQUIRED
80C51	INTERNAL (MASKED)	5V	N/F	FITTED	NOT REQUIRED (MAY BE FITTED)

0 STANDARD CONSOLE
RAM



DECOUPLING PWB



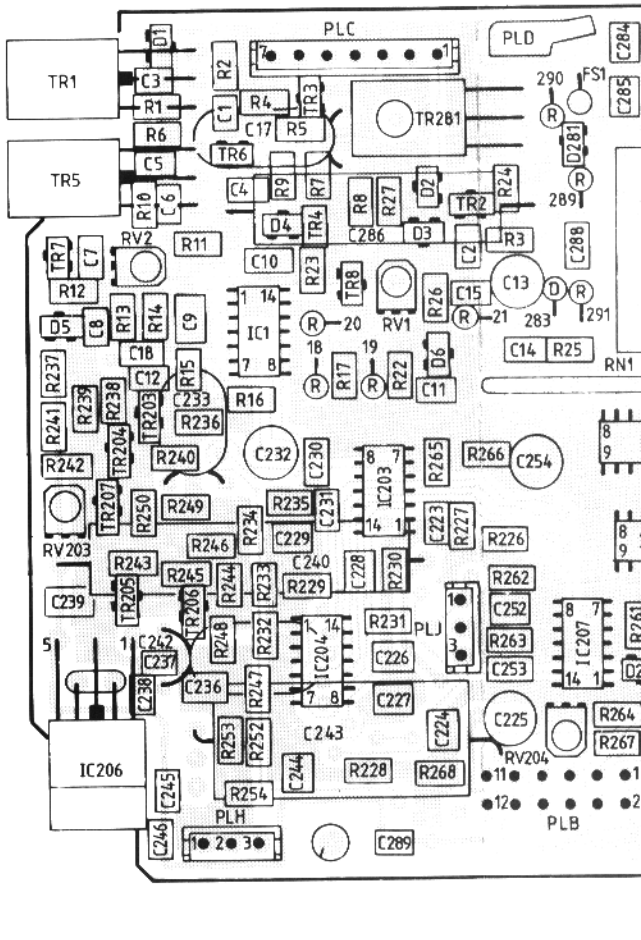
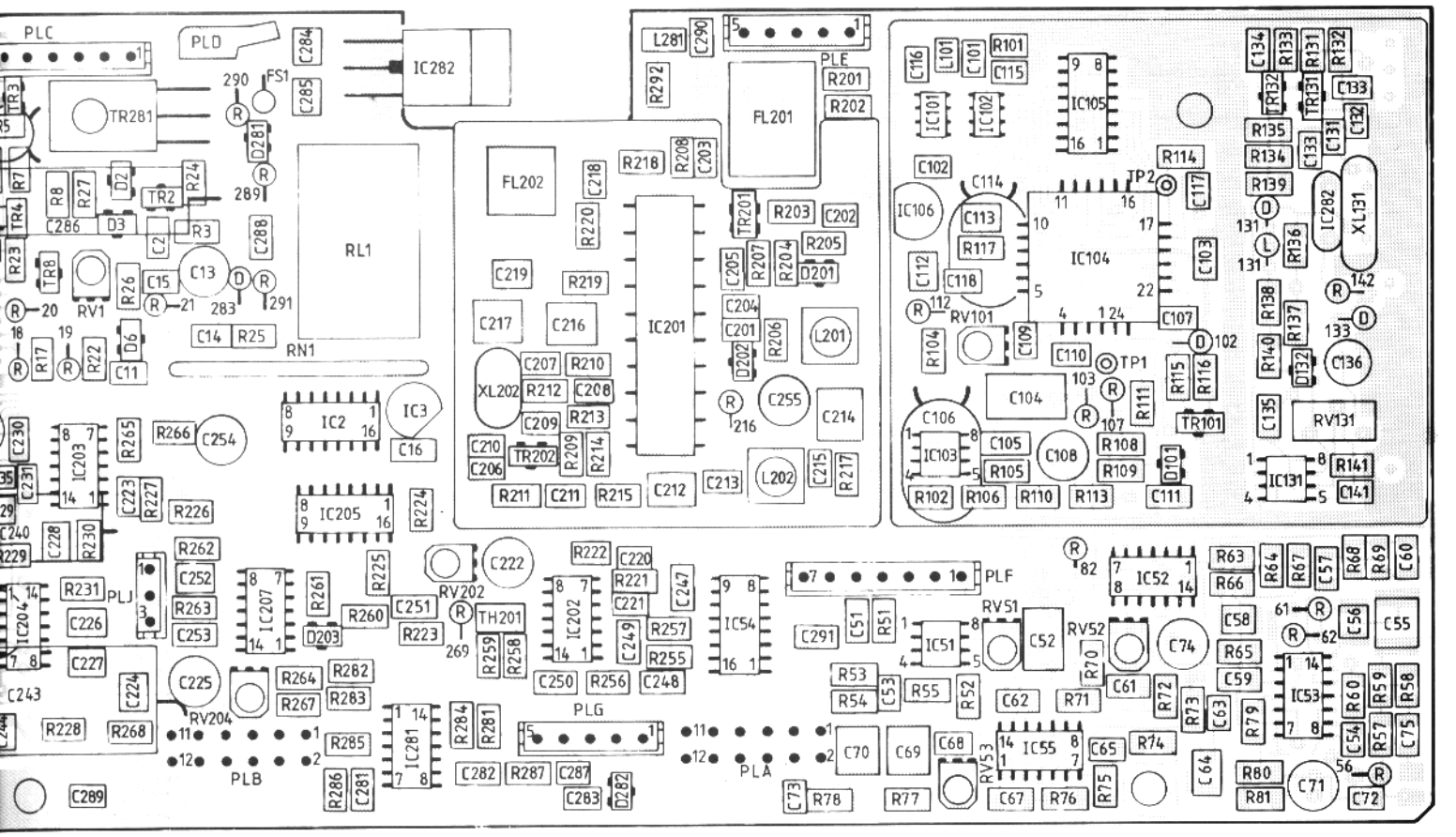
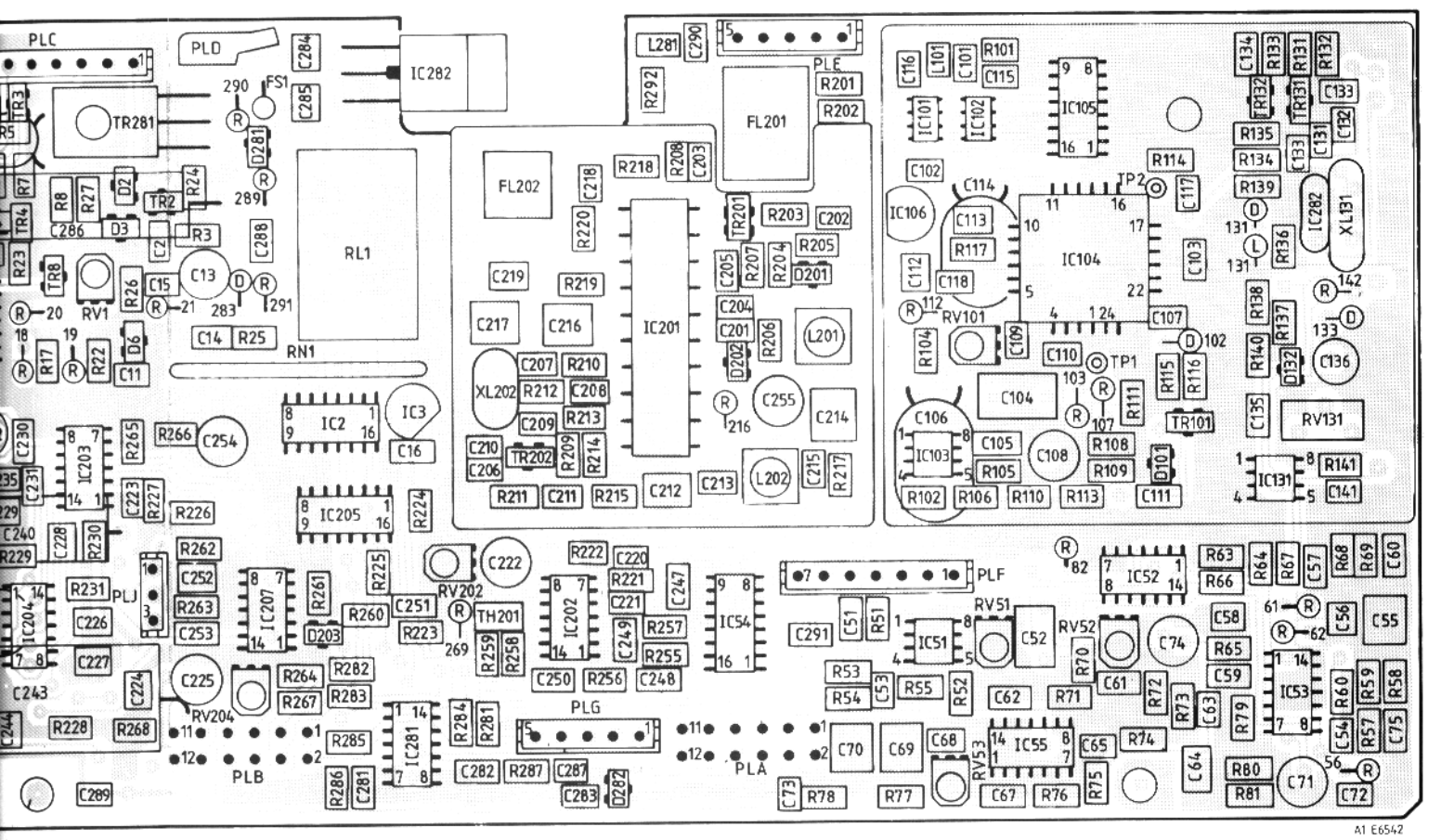


FIG 6.17 ANALOGUE PWB
COMPONENT LOCATION DIAGRAM





A1 E6542

AGRAM

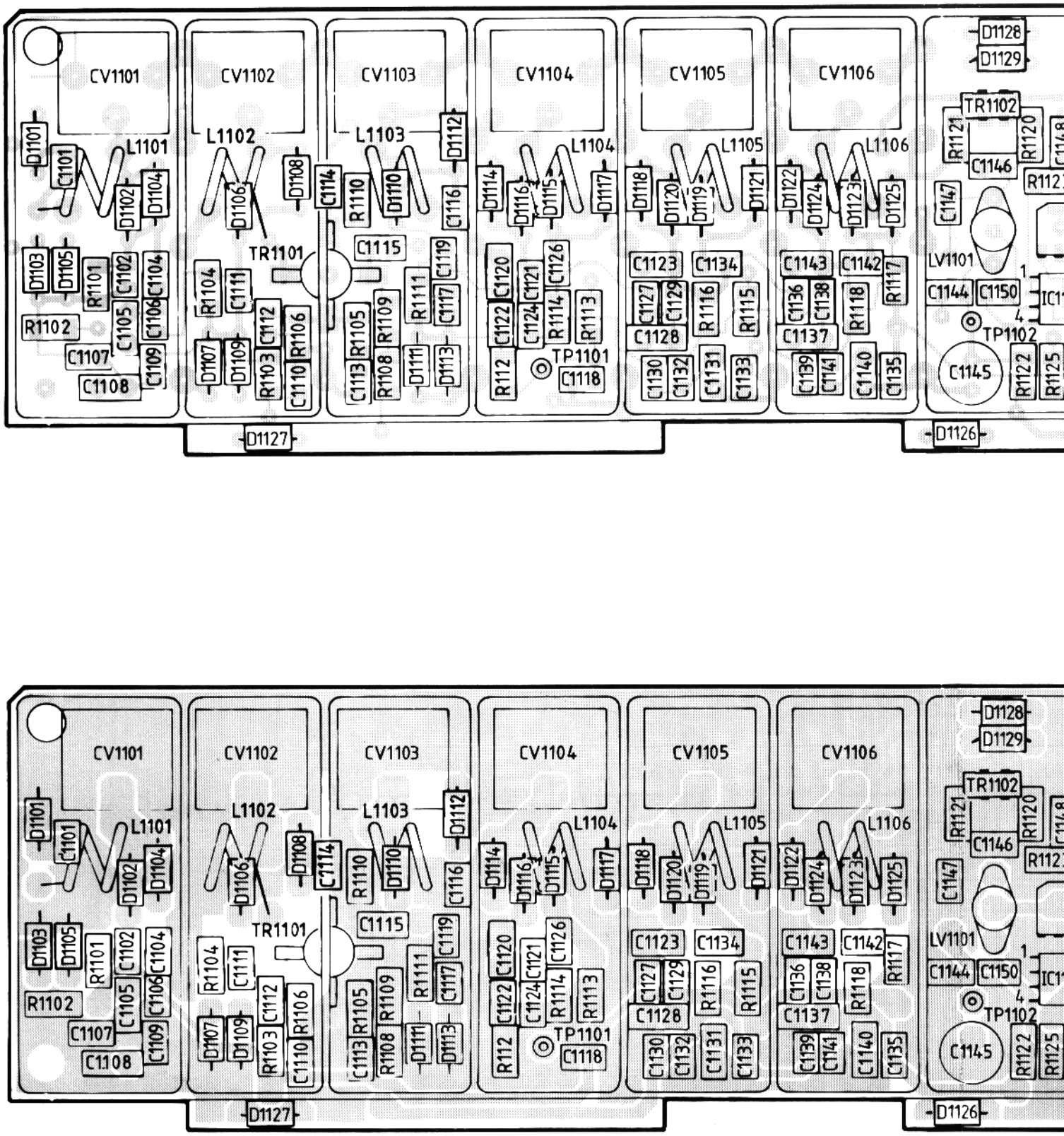


FIG 6.20 Rx VCO COMPONENT LOCATION DIAGRAM (400-512MHz)

CV1106
L1106
D1123
D1125
C1142
R1117
R1118
C1138
C1141
C1140
C1135
D1128
D1129
CV1107
TR1102
R1121
R1120
C1146
C1148
L1108
C1149
R1123
L1107
R1124
D1126
C1147
LV1101
RV1101
RV1102
C1144
C1150
IC1101
R1129
TP1102
C1145
R1122
R1125
R1126
R1127
R1130
D1126
PLA
1
14
TR1155
R1160
C1181
C1179
R1164
TR1152
R1154
R1173
R1174
R1166
R1162
C1173
C1174
R1161
C1170
R1163
R1167
C1172
R1165
L1160
TR1154
L1159
CV1109
R1151
TR1157
R1168
C1182
C1178
C1175
C1165
D1152
C1171
C1169
C1168
R1171
TR1156
C1164
C1166
C1167
L1157
C1187
C1190
R1181
C1180
R1169
R1170
C1177
TR1153
D1153
D1151
C1191
L1156
1172
R
L1155
C1184
C1162
L1161
L1162
C1161
C1185
R1159
C1151
C1152
C1156
L1151
C1153
C1186
C1189
R1179
R1156
C1154
CV1108
C1160
C1188
TR1159
L1154
L1153
L1163
R1180
C1183
R1175
R1178
R1177
R1158
C1157
TR1151
C1158
C1159
C1155
R1152
TR1158
R1176
R1157
R1153
A2 E6548

LOCATION
Hz)

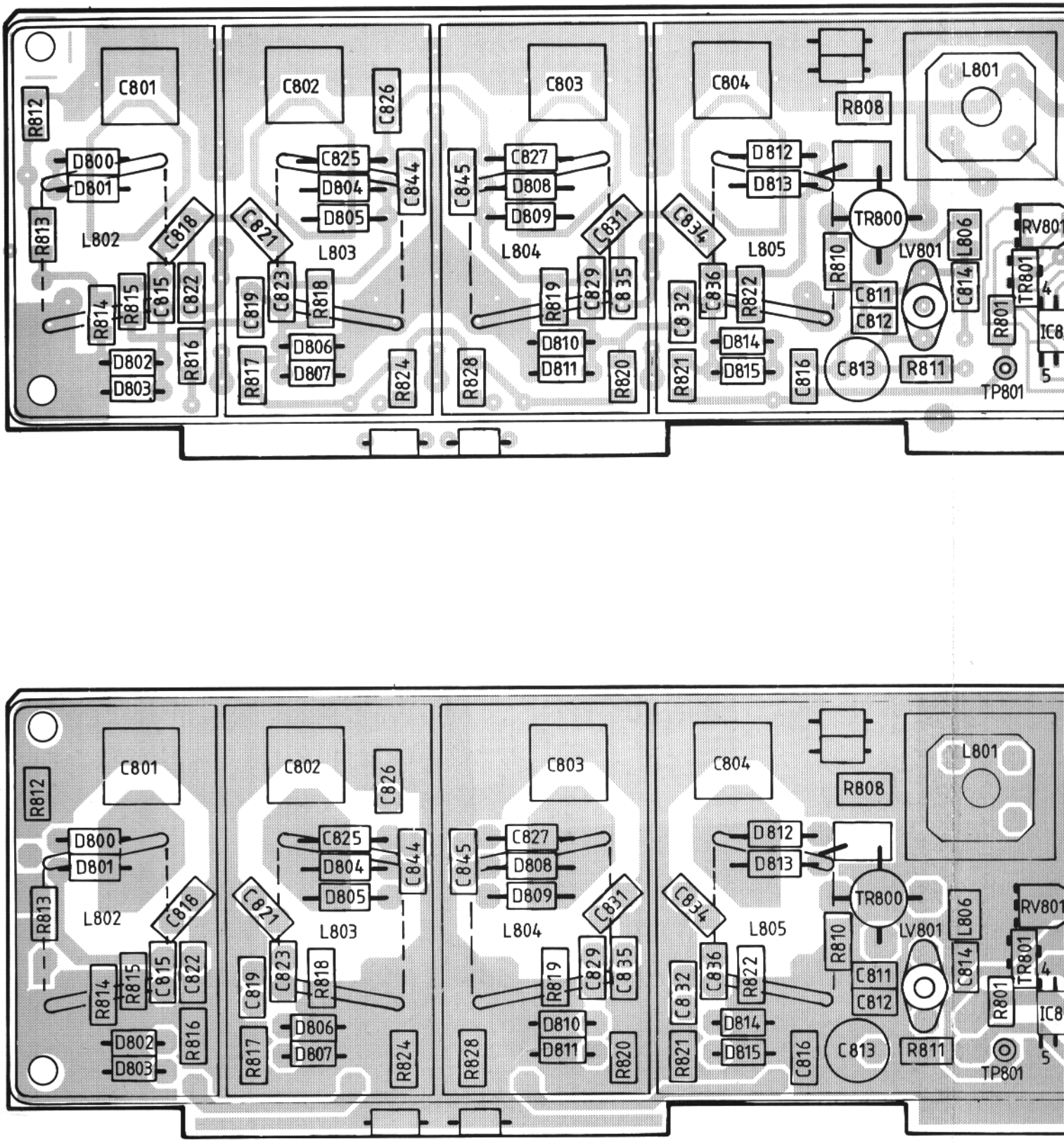
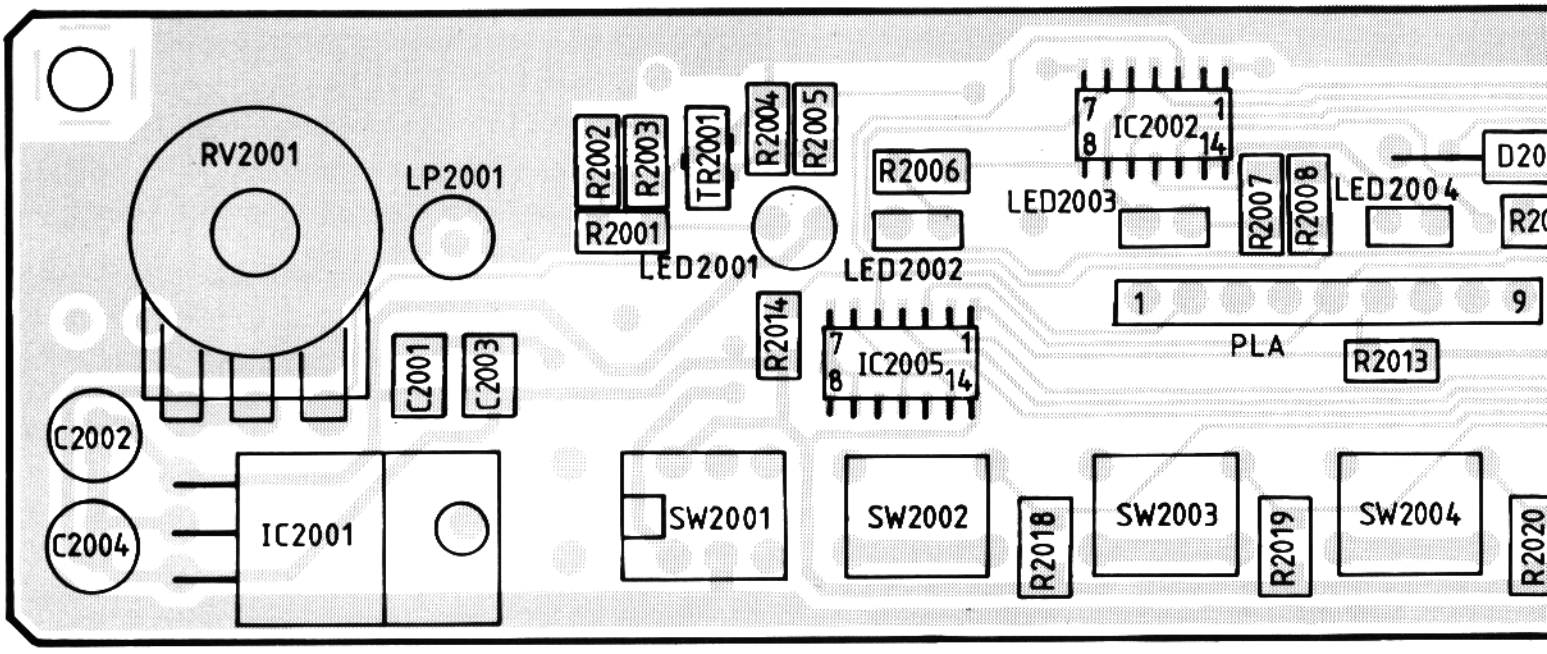


FIG 6.19 Rx VCO COMPONENT LOCATION DIAGRAM (132-225MHz)

L801
C807
R808
C810
R823
C840
R825
TR800
LV801
L806
RV801
D816
D817
R828
R810
C814
TR801
C846
C811
C812
C839
R801
4
1
IC800
R800
R807
C813
R811
TP801
5
8
R802
R804
R803
PLA
1
14
R873
L856
C869
R868
C872
C870
C873
R862
C864
R850
R857
TR853
R851
TR850
R876
R867
R871
TR859
R864
R863
TR854
R852
C867
C865
C860
R853
R877
R875
R858
L854
R874
R866
C866
R865
C868
R860
C863
TR851
C876
L858
C856
C875
L857
C871
R869
TR856
R872
R861
R855
C862
C852
C853
L851
C850
R854
C874
R870
TR852
C851
R856
R859
D853
L853
A
L850
R806
B
D850
R827
RV802
C858
C861
C859
C854
L852
LK852
R805
L855
C857
D852
D851
C858

A2 E6544

225MHz)


RV2001
LP2001
R2002
R2003
R2001
TR2001
R2004
R2005
R2006
LED2001
LED2002
IC2002
LED2003
R2007
R2008
LED2004
D20
R20
R2014
IC2005
1
9
PLA
R2013
C2001
C2003
C2002
C2004
IC2001
SW2001
SW2002
R2018
SW2003
R2019
SW2004
R2020

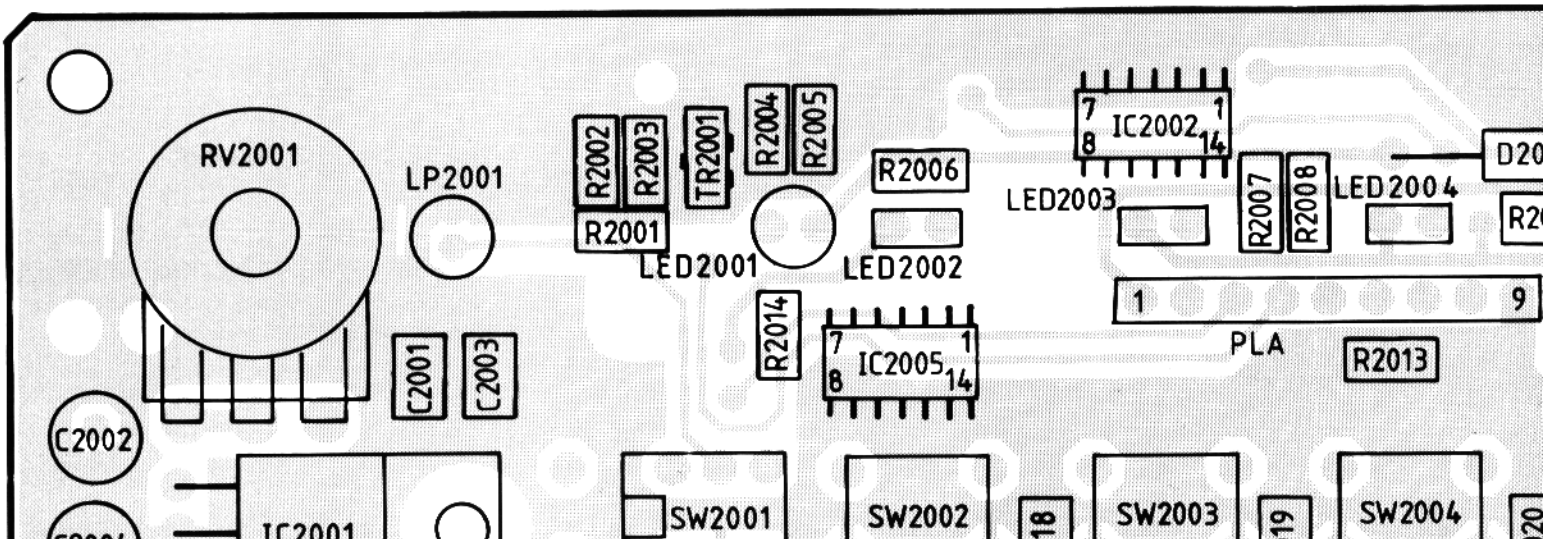
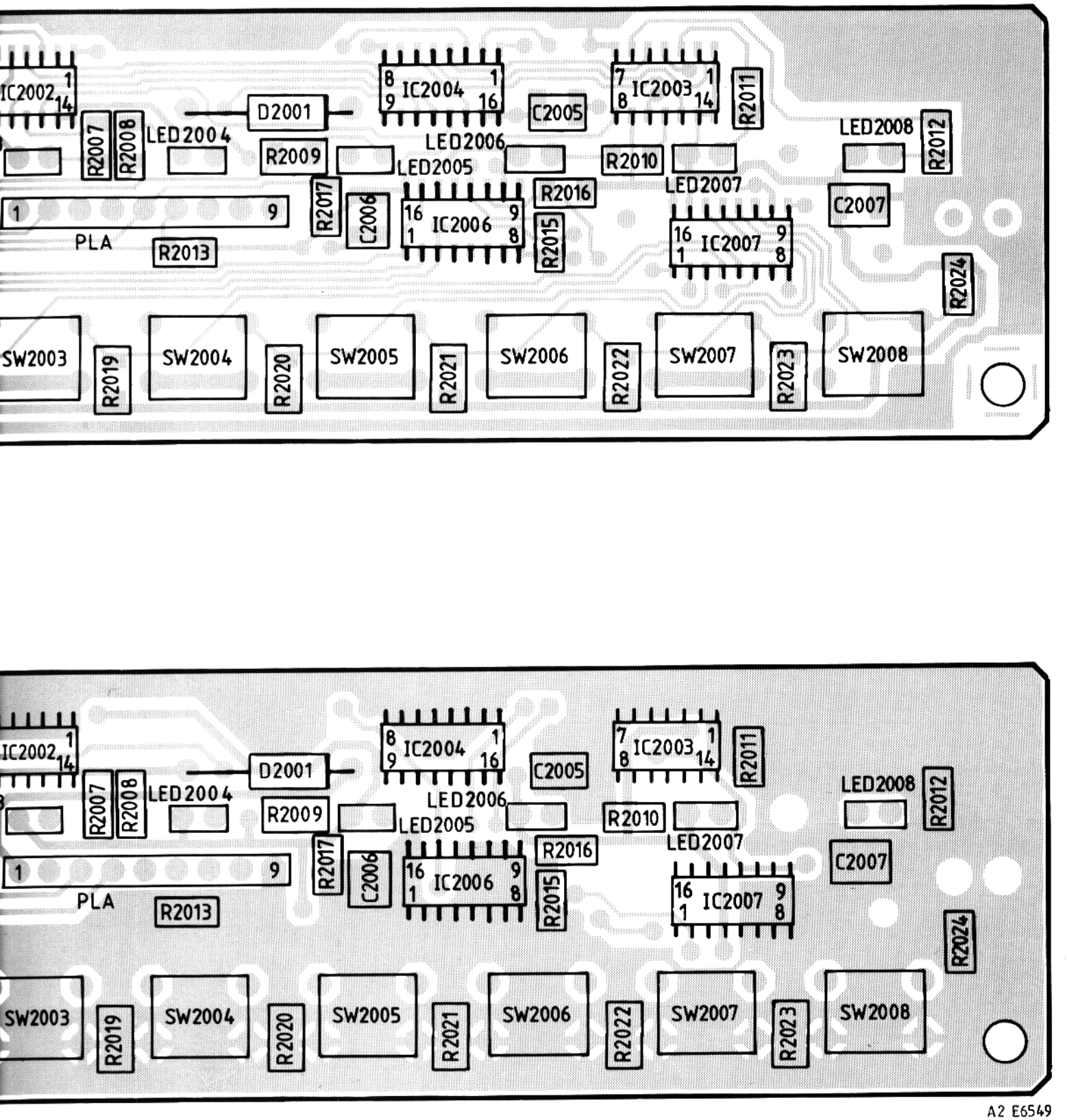

RV2001
LP2001
R2002
R2003
R2001
TR2001
R2004
R2005
R2006
LED2001
LED2002
IC2002
LED2003
R2007
R2008
LED2004
D20
R20
R2014
IC2005
1
9
PLA
R2013
C2001
C2003
C2002
C2004
IC2001
SW2001
SW2002
R2018
SW2003
R2019
SW2004
R2020

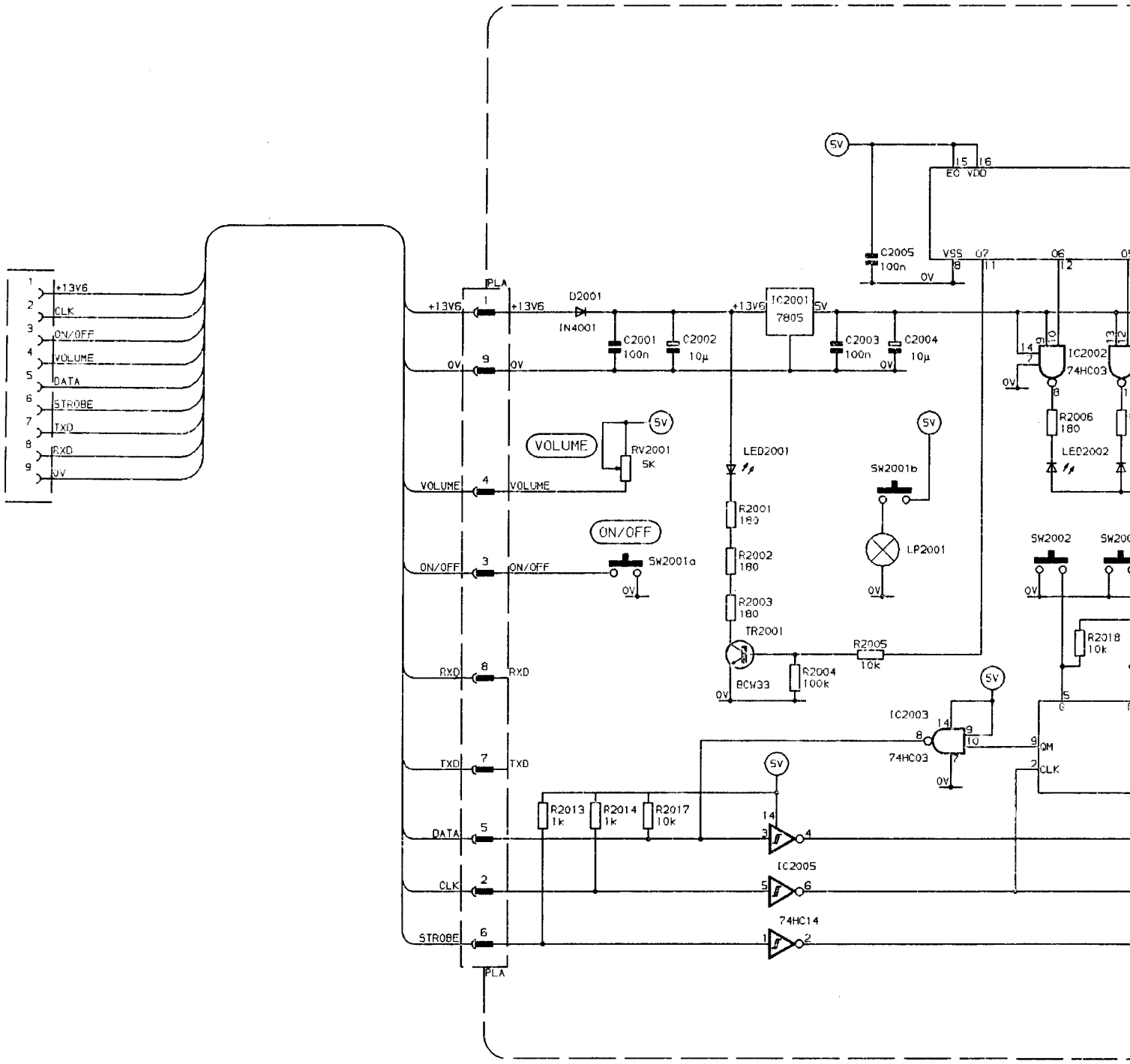
FIG 6.21



A2 E6549

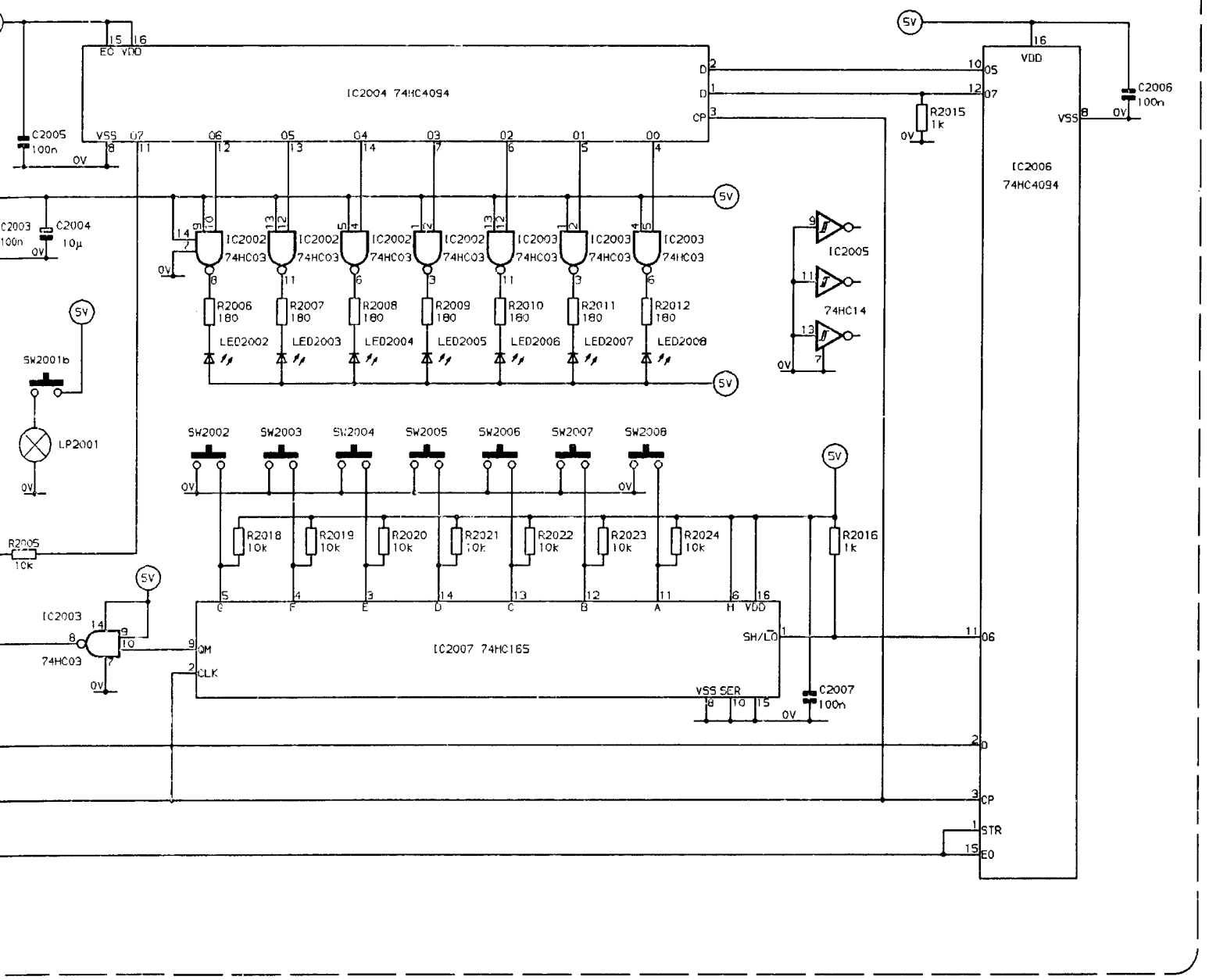
FIG 6.21 BASIC CONSOLE COMPONENT LOCATION DIAGRAM

TP253/1



TP253/1

FIG 6.22 BASIC CONSOLE CIRCUIT DIAGRAM



CONSOLE
T DIAGRAM

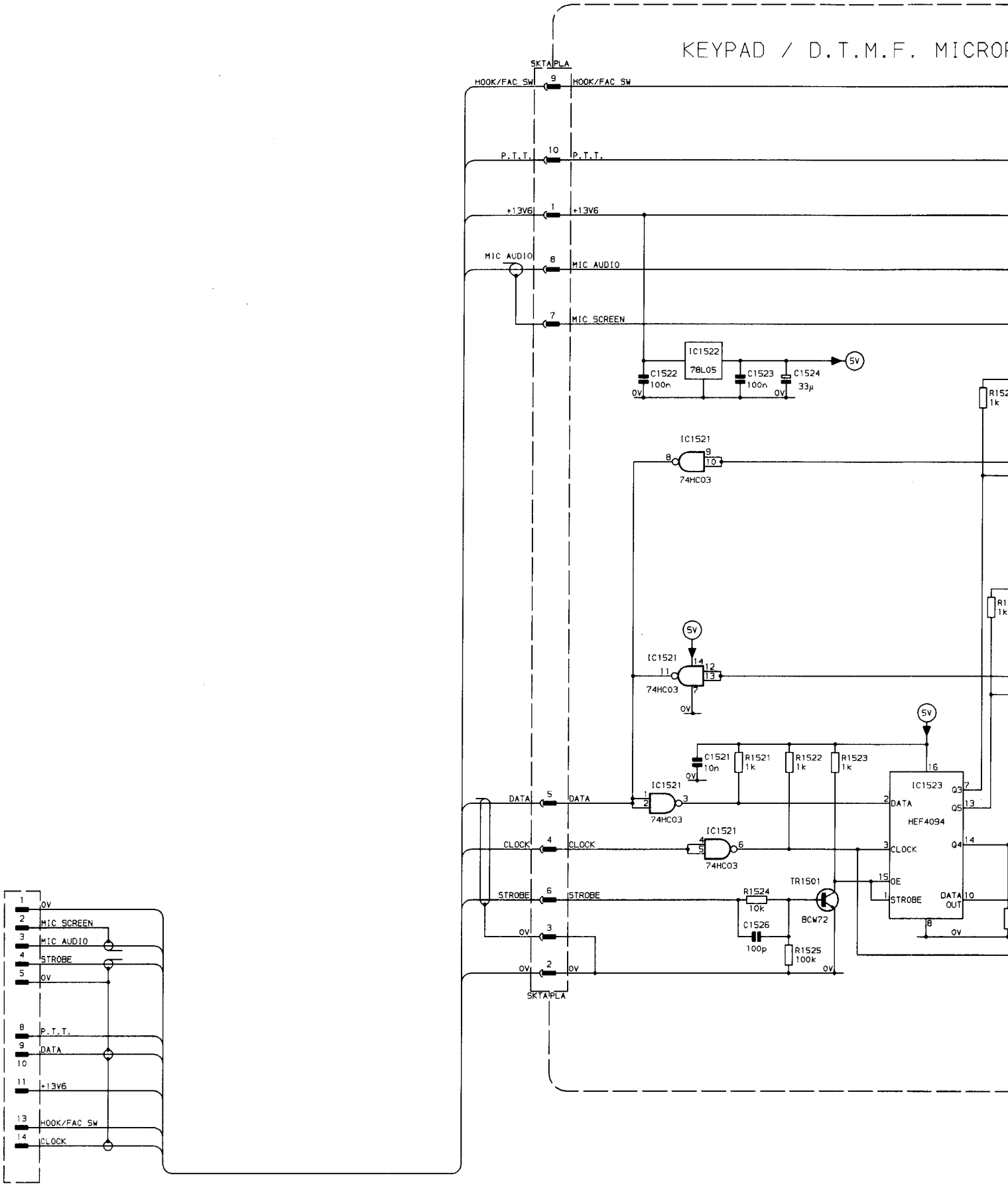
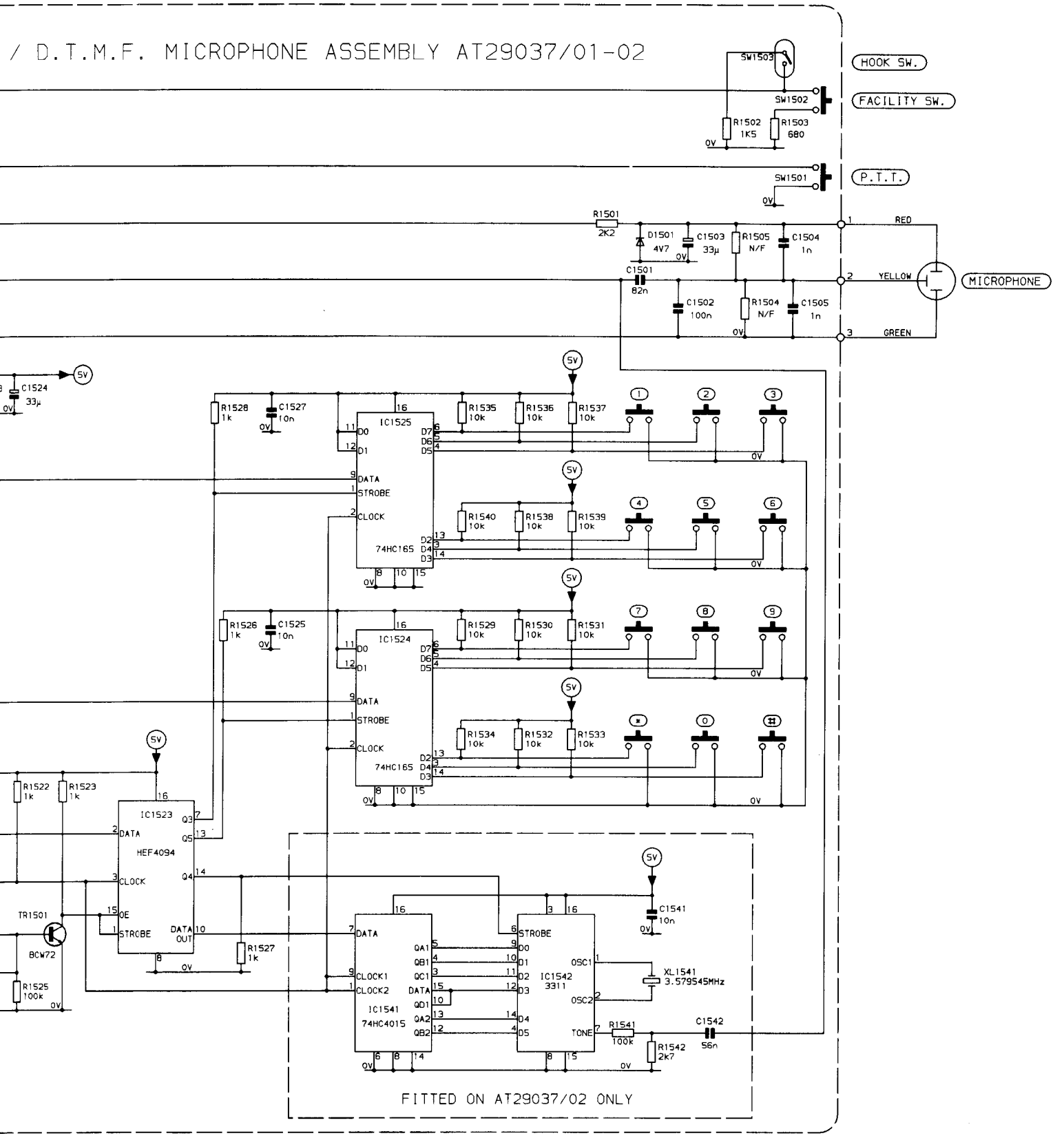


FIG 6.23 DTMF/KEYPAD MICROPHONE CIRCUIT DIAGRAM


/ D.T.M.F. MICROPHONE ASSEMBLY AT29037/01-02
SW1503
HOOK SW.
SW1502
FACILITY SW.
R1502 1K5
R1503 680
0V
SW1501
P.T.T.
R1501 2K2
D1501 4V7
C1503 33µ
R1505 N/F
C1504 1n
C1501 82n
C1502 100n
R1504 N/F
C1505 1n
1 RED
2 YELLOW
3 GREEN
MICROPHONE
5V
C1524 33µ
R1528 1k
C1527 10n
IC1525
R1535 10k
R1536 10k
R1537 10k
DATA
STROBE
CLOCK
74HC165
R1540 10k
R1538 10k
R1539 10k
R1526 1k
C1525 10n
IC1524
R1529 10k
R1530 10k
R1531 10k
R1534 10k
R1532 10k
R1533 10k
R1522 1k
R1523 1k
IC1523
HEF4094
TR1501
BCW72
R1525 100k
R1527 1k
IC1541
74HC4015
IC1542
3311
C1541 10n
XL1541 3.579545MHz
R1541 100k
C1542 56n
R1542 2k7
FITTED ON AT29037/02 ONLY

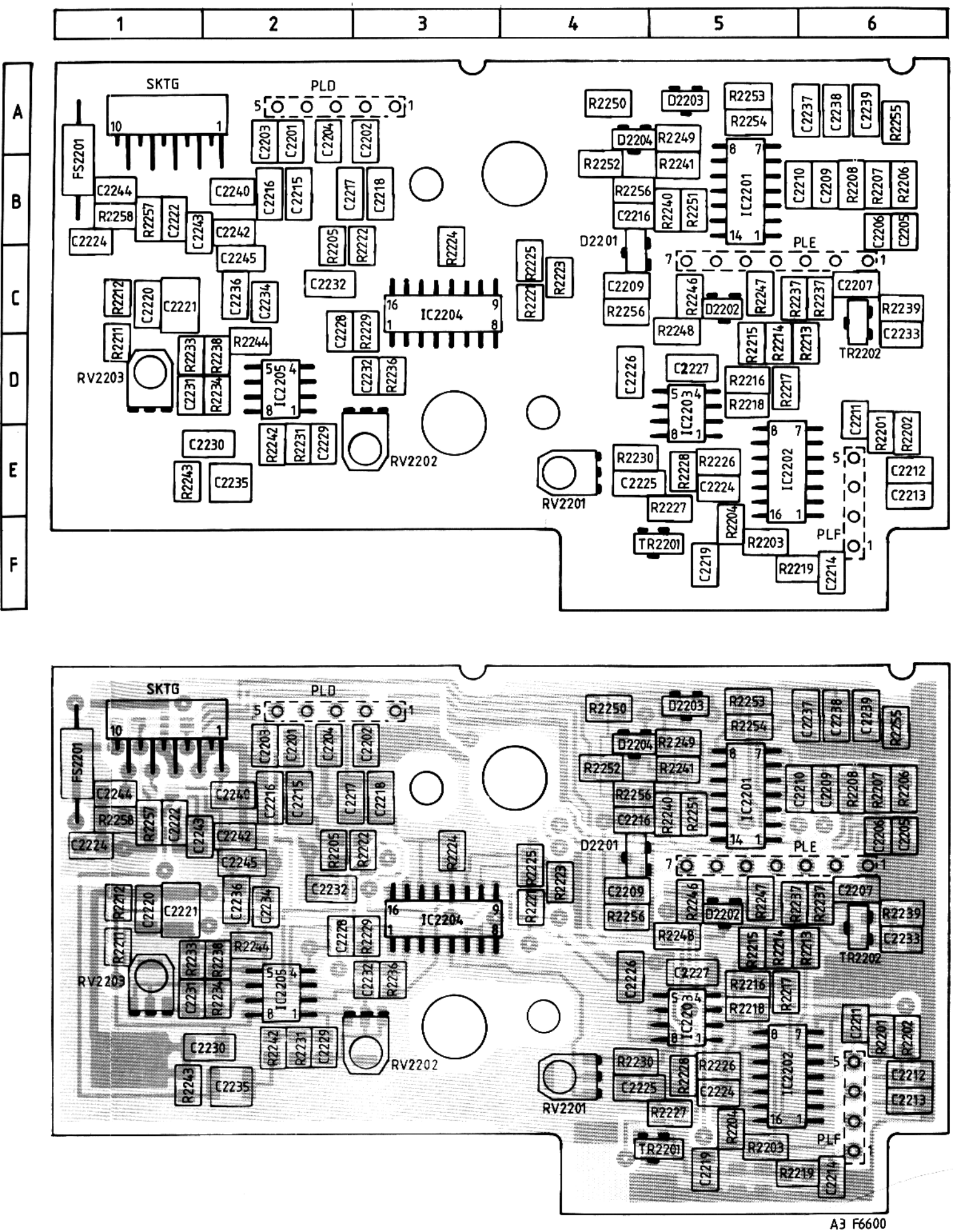
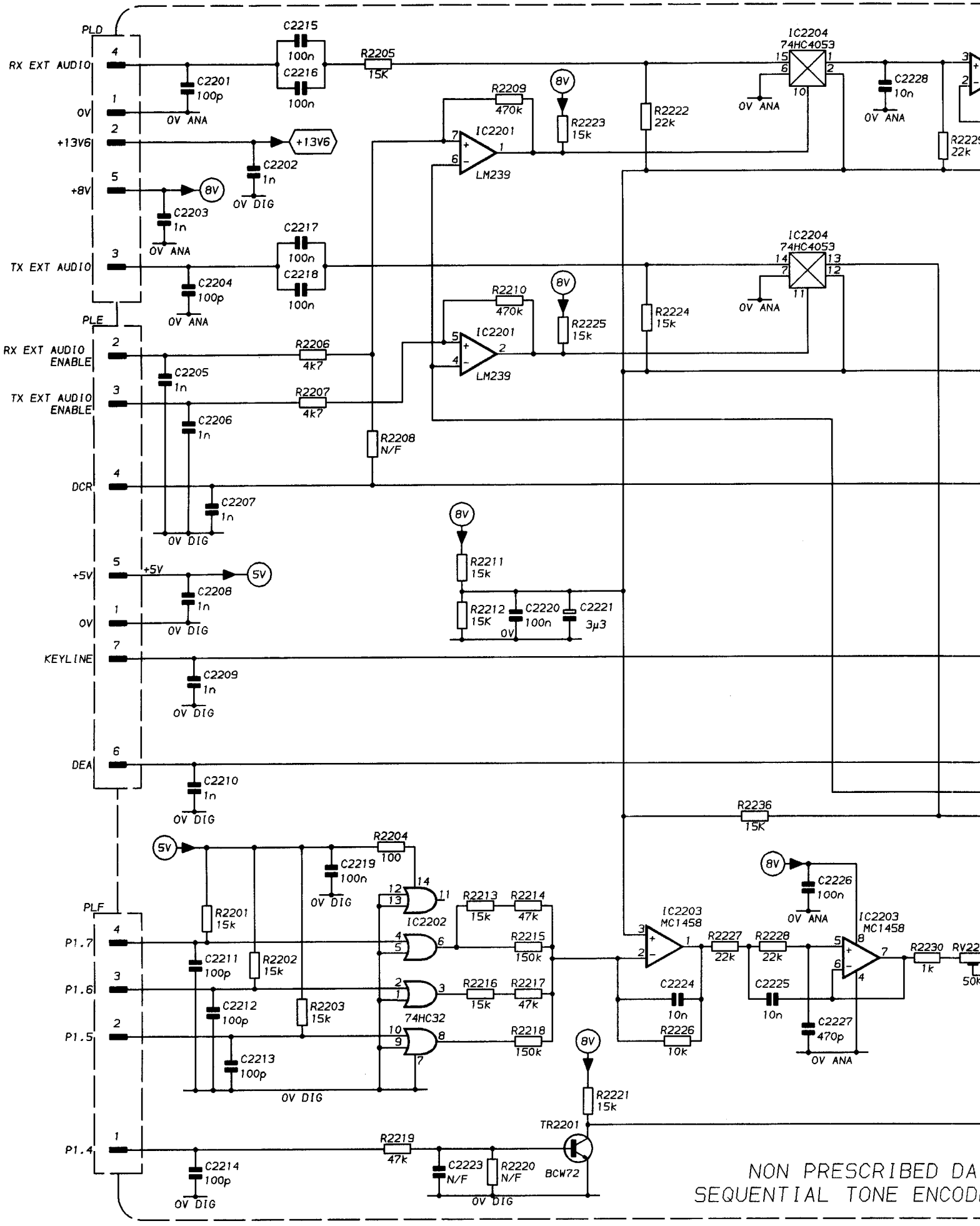


FIG 6.3 NON-PRESCRIBED DATA PWB COMPONENT LOCATION DIAGRAM

TP253A


PLD
RX EXT AUDIO
0V
+13V6
+8V
TX EXT AUDIO
PLE
RX EXT AUDIO ENABLE
TX EXT AUDIO ENABLE
DCR
+5V
0V
KEYLINE
DEA
PLF
P1.7
P1.6
P1.5
P1.4
C2201 100p
C2215 100n
C2216 100n
R2205 15K
C2202 1n
C2203 1n
C2217 100n
C2218 100n
C2204 100p
C2205 1n
C2206 1n
C2207 1n
C2208 1n
C2209 1n
C2210 1n
C2211 100p
C2212 100p
C2213 100p
C2214 100p
R2206 4k7
R2207 4k7
R2208 N/F
R2201 15k
R2202 15k
R2203 15k
R2204 100
C2219 100n
R2209 470k
R2210 470k
R2211 15k
R2212 15K
C2220 100n
C2221 3µ3
R2223 15k
R2225 15k
R2222 22k
R2224 15k
IC2201 LM239
IC2204 74HC4053
C2228 10n
R2236 15K
IC2202 74HC32
R2213 15k
R2214 47k
R2215 150k
R2216 15k
R2217 47k
R2218 150k
IC2203 MC1458
R2227 22k
R2228 22k
C2224 10n
C2225 10n
C2226 100n
C2227 470p
R2230 1k
R2226 10k
R2221 15k
TR2201 BCW72
R2219 47k
C2223 N/F
R2220 N/F
0V DIG
0V ANA
+13V6
8V
5V
NON PRESCRIBED DA
SEQUENTIAL TONE ENCOD

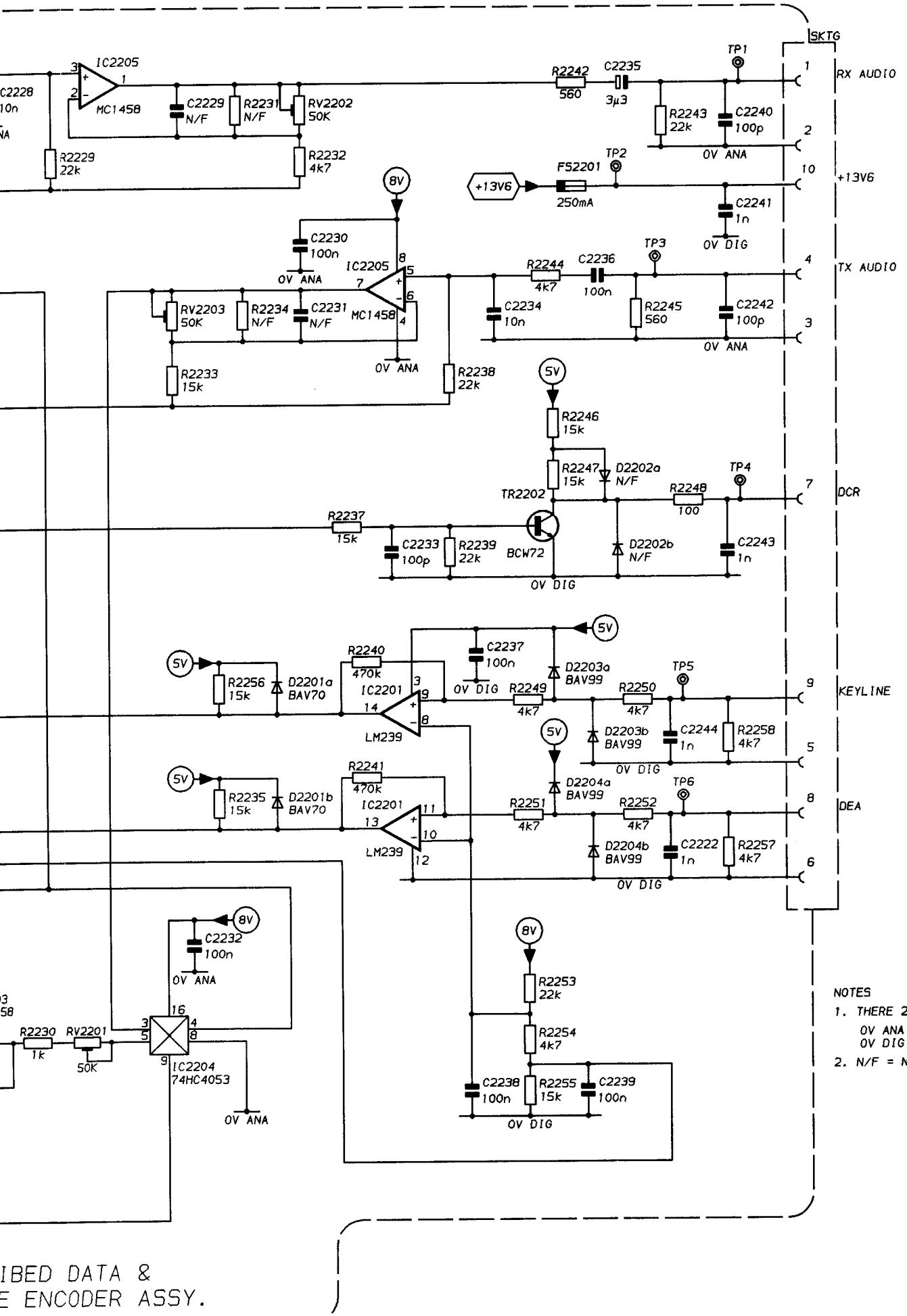


FIG 6.4 NON-PRESCRIBED DATA PWB CIRCUIT DIAGRAM

APPENDIX A
PARAMETER DESCRIPTIONS

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INTRODUCTION

Note: Parameters listed in this section are applicable only to the FM1100 Analogue radio.

Not all parameters listed here are valid for every FM1100 radio. When an invalid parameter is selected the PDP will display the message "ERR INVALID PARAM".

There are over 200 parameters which define the operation of the FM1100 radio, many of which contain a sequence of values rather than just one value, eg the 13 channel parameters which are replicated 100 times each (once for each channel).

The collection of parameters for each FM1100 radio is known as its configuration. Each parameter is identified by a unique number which is allocated according to the following functional areas:

#100 - #115	Channel parameters
#120 - #132	Scanning and voting
#140 - #148	Switch-on and switch-off action
#201 - #276	Decode and encode identities
#280 - #287	Tones and message actions
#301 - #313	Alarms and alerts
#320 - #336	Channel access restrictions
#391 - #397	┐ Console keys
#500 - #566	┘ and indicators
#901 - #948	Engineering, calibration and error counts
#990 - #996	Marketing parameters

The remaining sections in this chapter describe each of the parameters individually.

CHANNEL PARAMETERS

Each of the parameters in this first group has a separate instance for each of the 100 possible channels. These parameters are referenced by extended parameter numbers which consist of the concatenation of the parameter and channel numbers, separated by a period. Thus parameter #106.34 is the CTCSS decode frequency parameter for channel 34.

#101 - #102 Channel Frequencies

Parameters #101 and #102 of each channel define the receive and transmit frequencies to be used. Parameter #101 defines the receive frequency, while parameter #102 defines the transmit frequency.

Both frequencies are defined in MHz, up to 5 decimal places, and must be exact multiples of either 5,0kHz or 6,25kHz. The frequencies entered must be within the frequency band of the FM1100 radio, or the programmer will issue an error message during the validation procedure and will disallow them.

Both the receive and transmit frequencies for a channel must be zero if the channel is a voting scan group. If the transmit power for the channel (parameter #104) is zero, then the transmit frequency (parameter #102) should also be zero. This is because defining a transmit frequency is meaningless since the FM1100 radio cannot transmit on the channel anyway. The CDP will issue a warning message during the validation process if this situation occurs.

#103 Microcomputer Clock Offset

This parameter is used to apply a small frequency offset to the micro-computer clock in the FM1100 radio in order to move any harmonic interference off channel, while making an insignificant difference to the system timing.

The values it may take are:

0 - No offset
1 - Apply offset

This parameter will be automatically set by the CDP (during the validation process) for any channel whose receive frequency (parameter #101) is near a multiple of 0,5MHz.

#104 Transmitter Power

The transmitter power parameter may take one of 7 values, which correspond to the following set power levels:

0 - Transmission prohibited
1 - 1 watt
2 - 6 watts
3 - 10 watts
4 - 15 watts
5 - 25 watts
6 - 30 watts

Transmission on the relevant channel will not be permitted if the transmitter power is set to zero. The 30 watt setting is only allowed in bands A, B and E and will be disallowed in any other bands. (The frequency band is set by parameter #992.)

#105 Squelch

The squelch parameter may take values between 0 and 6 which define preset squelch levels as follows:

0 - Always open (subject to signalling)
1 - 9dB SINAD
2 - 12dB SINAD
3 - 15dB SINAD
4 - 18dB SINAD
5 - 21dB SINAD
6 - 24dB SINAD

The recommended setting for standard PMR use is 12dB SINAD.

#106 - #107 CTCSS Frequencies

Parameters #106 and #107 define which of the EIA standard RS-220-A frequencies are to be used for the CTCSS functions on this channel. Parameter #106 defines the CTCSS decode frequency, and parameter #107 defines the CTCSS encode frequency. The values 1 to 38 correspond to the following tone frequencies:

1 - 67,0Hz	11 - 97,4Hz	21 - 136,5Hz	31 - 192,8Hz
2 - 71,9Hz	12 - 100,0Hz	22 - 141,3Hz	32 - 203,5Hz
3 - 74,4Hz	13 - 103,5Hz	23 - 146,2Hz	33 - 210,7Hz
4 - 77,0Hz	14 - 107,2Hz	24 - 151,4Hz	34 - 218,1Hz
5 - 79,7Hz	15 - 110,9Hz	25 - 156,7Hz	35 - 225,7Hz
6 - 82,5Hz	16 - 114,8Hz	26 - 162,2Hz	36 - 233,6Hz
7 - 85,4Hz	17 - 118,8Hz	27 - 167,9Hz	37 - 241,8Hz
8 - 88,5Hz	18 - 123,0Hz	28 - 173,8Hz	38 - 250,3Hz
9 - 91,5Hz	19 - 127,3Hz	29 - 179,9Hz	
10 - 94,8Hz	20 - 131,8Hz	30 - 186,2Hz	

If a value of zero is specified, the CTCSS decode or encode function will be disabled. If the radio is not to use CTCSS signalling on this channel then both these parameters must be zero.

#108 Signalling Enable

This parameter may take one of two values and enables or disables the sequential tone signalling on a channel without affecting the CTCSS unit. The two values are:

0 - Signalling disabled on this channel
1 - Signalling enabled

If the radio does not have sequential tone signalling capability, this parameter must be set to zero.

#109 Voting Scan Group

This parameter indicates which voting scan group, if any, this channel represents. Values of 1 to 6 indicate that selection of this channel is to invoke voting using scan group 1 to 6 respectively (parameters #121 - #126), while a value of 0 indicates that this is a single channel and not a voting scan group.

#110 Channel Encode Identity

This parameter contains a value between 1 and 8 which indicates which of the encode identities (stored in parameters #231 to #238) is to be transmitted when the 'Send-0' key is activated while the FM1100 radio is operating on this channel.

#111 - #112 Reference Frequencies

Parameters #111 and #112 set the receive and transmit reference frequencies, which are used in calculating the parameters in the frequency synthesiser. The meanings of the values are:

0 - 5,0kHz reference frequency
1 - 6,25kHz reference frequency

Note that these values will be calculated by the CDP itself (from the entered transmit and receive frequencies) and so should not normally require editing.

#115 Channel Lock

This parameter determines whether the channel is locked or not. Its permissable values are:

0 - Channel not locked
1 - Channel locked

When a channel is locked, it may not be used by the FM1100 radio, although it is a valid, programmed channel. At least one channel must be unlocked. This parameter enables a fleet of mobiles to be all programmed with the same channel data, while restricting certain mobiles to using only certain channels.

Note: These parameters are relevant only to issues 2 and 3 software only.

#120 Scanning Type

The FM1100 radio will scan for either occupied channels or for valid calls, depending on the setting of this parameter. When scanning for occupied channels, the scanning will pause when a signal above the squelch threshold is detected until either the scanning resumption timer (parameter #127) has timed out, or until a transmission is started. When scanning for valid calls only, scanning will continue until, and will stop when, a valid call is recognised. The values for this parameter are:

0 - Scan for occupied channel
1 - Scan for valid calls

#121 - #126 Scan Group Members

Parameters #121 to #126 define scan groups 1 to 6 respectively. Each parameter defines up to ten scanning channels and an optional priority channel. The channel numbers lie within the range 0 to 99, while typing a space in the field indicates an unused member of the scan group. Each used scan group must contain more than one channel, and none of the channels in any of the scan groups can be voting channels.

#127 Scanning Resumption Timer

This parameter gives the time delay (between 1 and 255 seconds) which will elapse before scanning resumes once it has stopped due to either a valid call or an occupied channel being detected. If set to zero, scanning will not restart unless the user explicitly instructs the FM1100 radio to do so.

#130 Voting Type

The voting type parameter governs whether the FM1100 radio votes on all marked channels (ie the ones on which the correct tone is detected), or just on the occupied channels. Its values are:

0 - Voting on occupied channels
1 - Voting on all marked channels

#131 Free Tone Frequency

This parameter specifies the frequency of the free tone, selected from the following options:

0 - No free tone	
1 - 873Hz	5 - 679Hz
2 - 820Hz	6 - 638Hz
3 - 770Hz	7 - 600Hz
4 - 723Hz	8 - 563Hz

Frequencies of 873Hz and 820Hz will not be allowed unless the EEA tone system has been specified for the tone decoder. If voting on marked channels has been selected (by parameter #130), and sequential signalling is in use then this parameter cannot be zero. If sequential signalling is not in use then a free
tone is meaningless and this parameter must be set to zero.

#132 Inter Free-tone period

This defines the period (in 100's of milliseconds) which occurs between each free tone. Any value from 0 to 255 (representing 0 to 25,5 seconds) may be specified.

Note: These parameters are relevant only to issue 4 software onwards.

#121 - #126 Search Group Members

Parameters #121 to #126 define search groups 1 to 6 respectively. Each parameter defines up to 10 searching channels and optional priority channel. The channels numbers lie within the range 0 to 99, while typing a space in the field indicates an used member of the search group. Each used search group must contain more than one channel, and none of the channels in any of the search groups can be searching channels.

#127 Search Pause Timer

This parameter gives the time delay (between 1 and 255 seconds) which will elapse before searching resumes once it has stopped due to either a valid call or an occupied channel being detected. If set to zero, searching will not restart unless the user specifically instructs the radio to do so.

#128 Global Priority Channel

Values in the range 0-255. If not required, use 255. Used when Dual Watch is turned on without frequency searching; if frequency-searching is on, the searching priority channel is used, if defined; otherwise the channel specified here is used.

#133 Search Clear Function

Used to define the function of the 'Clear' key when pressed while Frequency Searching is in operation:

0	Remove current channel from search group until searching terminates.
1-254	Remove current channel from search group for the time specifed, in units of 1 second.
255	No function.

#134 Search Transmit Function

Defines the channel to be selected when the FM1100 radio is required to transmit while searching is in progress, if not paused on a channel.

0 Use priority channel, if defined for current search group, or first valid channel in search group.

1 Use last channel on which a pause occurred; before the first pause, or if channel has been removed from group with 'Clear' key, revert to effect of setting this parameter to '0'.

2 Search for the first channel with carrier present.

3 Search for the first channel without carrier.

#135 Search Threshold

Determines the signal strength at or above which frequency searching is terminated prematurely without voting. Setting this parameter high causes voting on weak signals to occur; setting it low suppresses voting - searching terminates on the first valid signal.

Values in the range 0 - 255 may be specified, 0 representing zero signal level and 255 representing a high signal level.

#136 Dual Watch Closed Interval

Defines the time between successive samples of the priority channel in multiples of 10ms. Range is 4 - 1000 (ie 40ms - 10s).

#137 Dual Watch Open Interval

Defines the time between successive samples of the priority channel in multiples of 10ms. Range is 4 -100 (ie 40ms - 10ms).

#138 Dual Watch Off-Hook Interval

Defines the time between successive samples of the priority channel in multiples of 10ms. Range is 4 -100 (ie 40ms - 10ms).

SWITCH-ON AND SWITCH-OFF ACTION

#140 Switch-on Channel

Defines the channel (between 0 and 99) that the FM1100 radio will use when it is first switched on. The channel defined must be unlocked (ie parameter #115 must be zero) and must be valid (ie fully programmed). Entering spaces causes the FM1100 radio to restart on the channel which was in use when it was switched off.

#141 Switch-on Automatic Identity

Values of 1 to 8 will indicate which of the encode identities (parameters #231 to #238 respectively) will be automatically transmitted at switch-on. The identity pointed to must have at least one tone in it. If the FM1100 radio is configured to use the saved user-defined identity (parameter #146) then the encode identity pointed to by this parameter must contain at least one value '#' (the code for a user-defined value).

Entering spaces or a zero indicates that no automatic identity at switch-on is required. If no signalling is in use then this parameter must be set to zero.

#142 Switch-off Status Storage

At switch-on, the FM1100 radio will be either restored to the status immediately before switch-off, or will revert to the default status each time. This parameter controls these alternatives as follows:

0 - Current status is saved at switch-off and restored at switch-on
1 - Current status not saved; the pre-determined switch-on status (#143) is used at every switch-on

#143 Switch-on Status Identity

This parameter defines up to 2 tones which will be used as the FM1100 radio status at each switch-on. It may contain values from 0 - 9 or A - D. If the FM1100 radio is equipped with a no-display console, then this parameter cannot be used, and must be cleared by typing a space as its first character.

#144 Switch-on Condition

Specifies whether the FM1100 radio is set in the open- or closed-channel condition after any switch-on communications have been completed. If no signalling has been installed, or encode-only operation has been specified, then the FM1100 radio will be set to the open-channel condition regardless of this parameter.

0 - Channel set to closed-channel condition on switch-on
1 - Channel opened at switch-on

#145 Switch-on Reset

Determines whether the FM1100 radio performs an automatic timed reset at switch-on. If enabled, the FM1100 radio resets itself into the closed-channel condition at a time after switch-on defined by the reset timer (parameter #328). The values of this parameter are:

0 - No timed reset
1 - Timed reset after switch-on

#146 Switch-on User Defined Identity

This parameter determines whether the user-defined decode is reset at switch-on to the pre-determined decode defined by parameter #147, or whether the user-defined decode which was active at switch-off is retained. The choices are:

0 - Use the user-defined identity which was active at switch-off
1 - Use the pre-determined user-defined identity (parameter #147)

This parameter must be set to 1 if the radio has a Basic (No-display) Console.

#147 Pre-detemined User-defined Identity

This parameter contains a sequence of up to 15 tones (each in the range 0 - 9 or A - D) which will be used as the user-defined values in the switch-on encode identity if parameter #146 is set to 1. If the user-defined values are not used anywhere (ie the value '#' does not appear anywhere in parameters #201 - #208 or #231 - #238) then the pre-determined user-defined identity will never be used.

#148 Switch-on Console Mode

The switch-on console mode determines whether the user's numeric console (if present) starts up in channel-entry or status-entry mode at switch-on. The modes are selected as follows:

0 - Channel-entry
1 - Status-entry

If no signalling system is in use, then this parameter must be set to 0 so that the FM1100 radio always starts up in channel-entry mode.

#149 Display Reversion

This parameter indicates whether the display is to revert to the switch-on mode (as defined by #148) after any period of non-use. The possible values are:

0 - No Function
1 - The Display reverts to switch-on console mode.

#150 Key Beep

This parameter governs whether the FM1000 generates a brief key beep each time a key is pressed. Its possible values are:

0 - No Key Beep
1 - Key Beep whenever a key is pressed.

#151 Tone Burst

This is a flag which indicates whether or not a tone burst (as defined by parameters #152 and #153 is generated when the 'Send 8' key is pressed. The possible values for this parameter are:

1 No tone burst
2 Generate tone burst.

#152 Tone Burst Frequency

If the tone burst frequency is enabled by #151, then this parameter is used to specify the frequency of the tone. It may take any value between 0 and 255, which correspond to frequencies of 4,5kHz to 30kHz in 100Hz steps.

#153 Tone Burst Duration

This parameter specifies the duration of the tone burst. It make take values between 0 and 255 representing 0 to 2,55 seconds in steps of 10ms.

Reserved for future use.

DECODE AND ENCODE IDENTITIES

The decode and encode identities define the tone sequences for sequential tone signalling. The decode identities define those sequences which the FM1100 radio will recognise on receiving them, while the encode sequences are the signals which it transmits.

The diagrams on the next page give an example of how the decode identies are defined. Each decode identity is defined as a sequence of up to 17 tones. These tones may either be a standard tone (as defined under #201-208) or they may be special tones such as a no-tone (ie a pause in the sequence) or a user-defined tone. Note that the identities only define the number of the tone to use - ie which row of Table A.1 is to be used for each tone. The actual frequencies of each tone also depend on parameters #282 and #283 which defines the tone systems (ie the column of Table A.1) to be used.

As well as defining which tones are to be used, the decode identities also specify the length of each tone. This is done in two stages. Firstly, parameters #211 - #218 specifiy which of eight possible timers is to be used for that tone. Secondly, parameters #261 - #268 define the durations of each of the eight timers.

Parameter #202 defines decode identity 2 as consisting of the tones 7, 9, 4 and 0. Parameter #212 states that timers 1, 1, 3 and 1 respectively are to be used for the tones. Parameters #261 and #263 define timers 1 and 3 to be 70ms and 120ms respectively. Decode identity 2 is therefore 70ms of tone 7, 70ms of tone 9, 120ms of tone 4 and 70ms of tone 0.

The encode identities are defined in a similar manner using parameters #241 - #248 to define the timings and #283 to define which tone system to use. Note that the decode and encode identities use the same set of timer values (parameters #261 - #268).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
#201																	
#202	7	9	4	0													
#203	8	8	D	2	#	F	5										
#204																	
#205	4	3	2	1	0												
#206																	
#207	6	7	2	4	D	9	F	3	*	8	#	0	0	1	6	9	4
#208																	

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
#211																	
#212	1	1	3	1													
#213	1	2	4	8	8	2	1										
#214																	
#215	1	2	5	8	8												
#216																	
#217	4	2	1	8	2	1	3	1	2	2	8	3	3	1	2	4	4
#218																	

#261	7
#262	102
#263	12
#264	6
#265	0
#266	18
#267	
#268	4

Top: Parameters #201 - #208 define the decode identities. Each consists of up to 17 tones.

Centre: Parameters #211 - #218 specify which tone timer to use for each identity.

Left: Parameters #261 - #268 specify the actual lengths of tone timers 1 to 8 respectively.

Table A.1

#201 - #208 Decode Identities

Parameters #201 to #208 each contain a sequence of up to 17 tones which are used as the decode identities. Each tone is identified by a single value as indicated in the table of tone frequencies below, but the length and frequency of the selected tones depend on which type of signalling is in use. The sequential tone signalling unit in the FM1100 radio, which encodes and decodes multiple tone messages between 4 and 17 tones in length, operates with the following standard tone signalling systems:

Philips ST-500 CCIR	CML CCIR
Philips ST-500 EEA	CML EEA
Philips ST-500 ZVEI	CML ZVEI
Philips ST-500 DZVEI	CML DZVEI

Although Table A.2 shows the durations of the tones within each system being of equal length, the FM1100 radio actually varies the length of the transmitted tones according to the timer values set in parameters #211 - #218. The lengths specified in Table A.2 are therefore ignored, with the result that the FM1100 radio does not distinguish between Philips ST-500 EEA and ST-500 CCIR tone systems.

The tones and pseudo-tones (such as the no-tone value) are all represented in the CDP (and PDP) by single characters. Tones 0 - 9 are entered as the digits 0 - 9, the letters A - F and the characters '*' and '#'. The end of each tone sequence is indicated by typing a space.

In Philips ST-500 tone systems, tone A is the Group tone, and tone C is the Alarm/Reset tone. In CML systems, this is not always the case. Parameters #280 and #286 define the group and remote reset tones respectively for use in any of the tone systems. Tone E is always used as the repeat tone in all tone systems, and so should not be used in identities.

Parameters #201 to #208 simply define which tones are to be used; the durations of the tones must be specified in parameters #211 to #218. Any combination of tones or special values (apart from the repeat tone) may be entered for all the identities, with a few exceptions. There cannot be two no-tone values (two Fs) in sequence, nor an F immediately followed by a C. An unused identity is indicated by entering the terminator (a space) for its first value.

The tone frequencies (all given in Hz) which are used for sequential tone signalling correspond to the tone numbers as follows:

Table A.2

	Philips ST-500				CML				
Tone	CCIR	EEA	ZVEI	DZVEI	EEA	CCIR	ZVEI	DZVEI	ZVEI2
0	1981	1981	2400	2200	1981	1981	2400	2200	2400
1	1124	1124	1060	970	1124	1124	1060	970	1060
2	1197	1197	1160	1060	1197	1197	1160	1060	1160
3	1275	1275	1270	1160	1275	1275	1270	1160	1270
4	1358	1358	1400	1270	1358	1358	1400	1270	1400
5	1446	1446	1530	1400	1446	1446	1530	1400	1530
6	1540	1540	1670	1530	1540	1540	1670	1530	1670
7	1640	1640	1830	1670	1640	1640	1830	1670	1830
8	1747	1747	2000	1830	1747	1747	2000	1830	2000
9	1860	1860	2200	2000	1860	1860	2200	2000	2200
A	1055	1055	970	825	1055	2400	2800	2600	886
B	—	—	—	—	930	930	810	—	—
C	2400	2400	2800	2600	2247	2247	970	886	810
D	—	—	—	—	991	991	886	810	—
E	2110	2110	2600	2400	2110	2110	2600	2400	970
Std Tone Lgth (ms)	100	40	70	70	40	100	70	70	70

As well as the 15 tone numbers, the following special values may also be entered into the decode identities:

F - No tone
\# - User-selectable decode tone
* - Message tone
space - End of sequence

#211 - #218 Decode Identity Timing

Parameters #211 to #218 each contain up to 17 length codes which correspond to the tones defined in parameters #201 to #208 respectively. Each of the length codes is a value between 1 and 8, indicating which of the tone timers (parameters #261 to #268) to use for each tone in each sequence.

#221 - #228 Decode Identity Functions

Each of the eight decode identities (defined in parameters #201 to #208), must have a specified decode function. Each parameter may take values between 0 and 16 which correspond to functions as follows:

0 - No function
1 - Individual Call 1
2 - Individual Call 2
3 - Individual Call 3
4 - Individual Call 4
5 - Individual Call 5
6 - Individual Call 6
7 - Individual Call 7
8 - Individual Call 8
9 - Group Call 1
10 - Group Call 2
11 - Group Call 3
12 - Group Call 4
13 - Group Call 5
14 - Group Call 6
15 - Group Call 7
16 - Group Call 8

Thus if the decode identity function for the fourth decode identity is set to 12, an incoming tone sequence matching that in parameters #204 (the tones) and #214 (their lengths) would cause the FM1100 radio to indicate that a group call 4 had been received.

If any of the decode functions are defined (ie non-zero) then one of parameters #551-#566 must correspond to the same function, or must have the value of the general call function. This is because the FM1100 radio must have an indicator which it can use to indicate that a call has been received; either an indicator specifically for that function or the general call indicator must be programmed.

#231 - #238 Encode Identities

These parameters define the encode identities, which may be used by any functions which require an identity to be transmitted. Each identity consists of up to 17 values, as defined for the decode identities (parameters #201 - #208).

#241 - #248 Encode Identity Timings

These eight parameters define the durations of each of the tones defined in parameters #231 - #238, as detailed for the decode identity timings (parameters #211 - #218).

In addition to the 15 tone numbers, the value "*" may be entered as a user-selectable or status encode digit.

#261 - #268 Tone Timers

The tone timer parameters allow up to eight different tone lengths to be used by the FM1100 radio in the encode and decode identities. Each tone timer may take any value between 0 and 255, representing 0 to 2,55 seconds in increments of 10ms. The durations of individual tones used in decode identities may not be less than 40ms.

A duration of zero indicates that a continuous tone is to be used (which can only be stopped by switching off the FM1100 radio).

#270 - #276 Encode Identity Functions

Parameters #231 - #238 and #241 - #248 define the encode identity tones and durations respectively, but the identities are meaningless until they have been assigned to particular functions. Parameters #270 - #276 each assign one of the encode identities to a particular function as follows:

270 - Off-Hook identity
271 - On-Hook identity
272 - Individual call acknowledge
273 - Individual reset acknowledge
274 - Paging identity
275 - PTT identity
276 - Alarm identity

The value of each of these parameters should be in the range 0 - 8. Values of 1 to 8 indicate which of the encode identities should be used for that function, while a value of zero or a space indicates that the function is not required.

TONES AND MESSAGE ACTIONS

#280 Group Tone

This parameter specifies which tone (in the range 0 - 9 or A - D) is to be used within the individual call address when a group call is set up. A value of F or a space indicates that no group tone is required. The Group tone cannot be the same as the remote reset tone (parameter #286). In Philips ST-500 tone systems, tone A is normally the Group tone.

#281 Link Establishment Time

This parameter defines the link establishment time in multiples of 10ms. It may take any value between 1 and 255 (representing 10ms to 2,55 seconds).

#282 - #283 Tone System Selection

Parameter #282 specifies which tone system will be used for sequential tone decoding, while parameter #283 specifies the system for encoding. The tone systems are chosen from the following list:

0 - Encoder/Decoder disabled
1 - Philips ST-500 CCIR/EEA
2 - Philips ST-500 ZVEI
3 - Philips ST-500 DZVEI
4 - CML CCIR
5 - CML EEA
6 - CML ZVEI
7 - CML DZVEI
8 - ZVEI2

If the sequential tone signalling system is not in use then both these parameters must be zero.

#284 Message Function

The message function parameter defines how the FM1100 radio uses incoming message digits after decoding. The only option currently available is to display them on the FM1100 console. This parameter must be set to zero.

#285 Call Acknowledge Mode

The FM1100 radio may provide manual, automatic or no acknowledgement of incoming calls. If no acknowledgement is required then the receiver audio and PTT are immediately enabled on receipt of a valid call. In automatic acknowledge mode the FM1100 radio transmits the call acknowledge identity (pointed to by parameter #272) before enabling the audio and PTT. In manual acknowledge mode, the FM1100 radio generates an audible tone for four seconds, and waits for the user to acknowledge the call by keying the call acknowledge button. The FM1100 radio then sends the acknowledge identity before enabling the channel as before.

The choice is made as follows:

0 - No call acknowledgement
1 - Automatic call acknowledge (transpond)
2 - Manual call acknowledge

A value of 2 (manual call acknowledge) will not be allowed unless one of the buttons has been assigned the function of manual call acknowledge (ie one of parameters #500 - #516 has the value 26).

#286 Remote Reset Tone

If remote resets are to be performed by a reset tone on the end of a valid identity, then a reset tone must be specified by this parameter. The specified tone will automatically be appended to individual and group call addresses. The reset tone specified may be in the range 0 - 9 or A - D, while a value of F or a space indicates that no reset tone will be recognised. The reset tone may not be the same as the group tone (parameter #280). The remote reset tone is normally tone C in Philips ST-500 tone systems.

#287 3rd Tone Reset

If this parameter is set, the current channel will be closed on reception of an incoming tone sequence whose first three tones match the first three tones of any one of the decode identities specified by parameters #201 - #208, as long as the rest of the tone sequence does not decode to a valid message. This parameter may take one of two values as follows:

0 - No 3rd tone reset
1 - 3rd tone reset enabled

#288 Guard Tone Function

Values in the range 0 to 2 are permitted. The following functions have been defined:

0 - Ignore leading 'repeat' tones.

ALARMS AND ALERTS

Parameters #301 - #307 allow the FM1100 radio to respond in several ways to an alarm condition. An alarm condition arises when the user keys either the button which has been programmed as the alarm key, or when the remote alarm switch is operated. The first thing that the FM1100 radio does when an alarm occurs is to look at parameter #305 to see if one of the channels has been designated as a special alarm channel. If an alarm channel has been nominated, then the FM1100 radio switches to it immediately, otherwise it remains on the channel where it is currently operating.

Next, the alarm identity is transmitted, if one has been defined by parameter #276. The FM1100 radio then enters a cycle of transmitting, receiving and waiting as illustrated in Fig A.1.

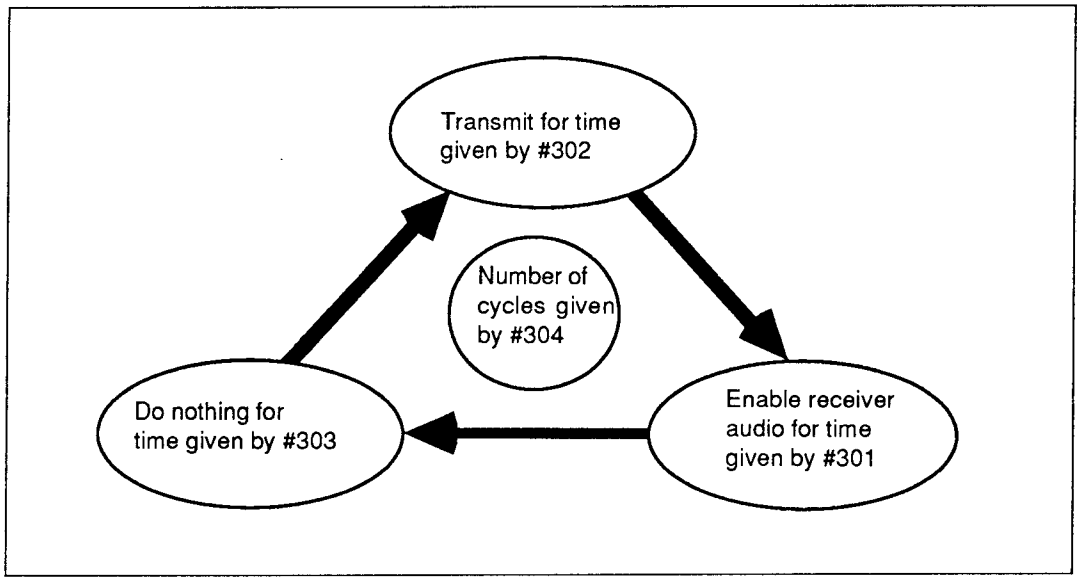

Fig A.1

#301 Alarm Live Receive Timer

When an alarm condition occurs, the receiver audio will be enabled for the time specified by this parameter. Values of 1 to 255 will enable the receiver audio for between 1 and 255 seconds, while a value of zero indicates that the receiver audio is disabled whilst the alarm condition prevails.

#302 Alarm Live Transmit Timer

This parameter specifies the time during which the FM1100 radio stays in transmit with an unmuted microphone during an alarm condition. Values of 1 to 255 indicate that the microphone is to be enabled for between 1 and 255 seconds respectively, while a value of zero indicates that the FM1100 radio is to return to receive mode immediately after sending its alarm identity.

#303 Alarm Closed Receive Timer

This parameter gives the delay after the alarm receive timer has expired before the alarm sequence repeats. It is specified in one-second increments from 0 to 255 seconds.

#304 Alarm Repeat Count

This parameter specifies the number of times that the alarm cycle is to be repeated. It may take values from 1 to 255. If set to zero, the alarm cycles will be continuously repeated until a remote reset is received.

The alarm repeat count cannot be zero (ie continuously repeated) if the three tone reset (parameter #287) is disabled and no group tone (parameter #286) has been defined, or no tone decoding system has been specified (parameter #282) since there will then be no way to stop the alarm sequence.

#305 Alarm Channel

A value in the range 0 to 99 in this parameter indicates a special alarm channel to which the FM1100 radio will automatically switch when the alarm button is activated. If a special alarm channel is not required, this parameter may be set to 255, or a space may be entered, in which case the FM1100 radio will not change channel when an alarm occurs.

The selected alarm channel must not be locked (parameter #115), and must not have a transmit power setting of zero (parameter #109), since both these conditions prevent the channel from being used.

#306 Alarm Switch-Off Inhibit

This facility prevents the FM1100 radio from being switched off while an alarm is active. The console will be turned off, so the radio will appear to be turned off, but the FM1100 radio will continue to execute the specified number of alarm cycles. The alarm live receive portion of the sequence will be omitted, however, so that the radio will remain silent throughout.

Under such conditions, the alarm condition will only be reset by a reset message from the system controller, or when the cycle count has been reached. The values for this parameter are:

0 - No switch-off inhibit
1 - Switch-off inhibit enabled

#307 External Alert During Alarm

The FM1100 radio may be configured to activate the external alert function (eg to switch on the vehicle's horn and/or lights) during an alarm condition if enabled by this parameter.

0 - External alert remains off
1 - External alert switched on for duration of alarm

#310 Busy Alert

This parameter indicates whether the FM1100 radio generates a busy tone if the user tries to transmit while the selected channel is busy. (The busy tone is generated locally as a warning to the user, not transmitted.) Its values are:

0 - No busy tone
1 - Busy tone generated

#311 - #312 Incoming Call Alerts

Parameters #311 and #312 dictate whether the FM1100 radio will issue an audible call alert on receipt of incoming calls. Parameter #311 controls individual calls, and parameter #312 controls group calls. The call alerts operate in both open- and closed-channel conditions and cause the appropriate call indicator to be turned on.

0 - No call alert
1 - Call alert enabled

#313 Acknowledge Alert

The acknowledge alert parameter determines whether the FM1100 radio will generate an audible acknowledge alert when a reset message is received, under either open- or closed-channel conditions.

0 - No acknowledge alert
1 - Acknowledge alert enabled

#314 Talk-Now Alert

The customising data must indicate if a 'Comfort Tone' is to be generated when an identity has been sent as a result of pressing the PTT key (see '#322 Send with PTT').

0 - No Talk-Now Alert
1 - Talk-Now Alert

CHANNEL ACCESS RESTRICTIONS

#320 Transmit Inhibit

This parameter detemines whether or not the radio is prevented from transmitting in the closed-channel condition, if the receive channel contains a signal which exceeds the squelch threshold.

0 - No inhibit
1 - Transmit inhibit enabled

#321 Open Channel With Send

This parameter partially determines the condition of a channel (ie either open or closed) after one of the send keys has been pressed, and the corresponding encode identity has been transmitted. It controls the channel condition as follows:

0 - Channel remains in previous condition
1 - Channel set to open condition

#322 Send With PTT

If this parameter is set, the user may use the PTT to transmit the PTT encode identity (parameter #275) while in the closed-channel condition.

0 - PTT identity not transmitted
1 - PTT identity transmitted when PTT keyed while in the closed-channel condition

#323 Open Channel with PTT

When the PTT is keyed on a channel, this parameter determines whether the channel changes to the open condition or not. The function is controlled as follows:

0 - Channel remains in previous condition
1 - Channel set to open condition

#324 Transmission Timer

This parameter defines the maximum length of time for which the FM1100 radio may transmit continuously. It may take values of 1 to 255 representing 1 to 255 seconds, or may take the value zero, indicating that no transmission timer is required.

#325 Release Timer

The release timer defines the time delay which must occur between succesive transmissions. If the user attempts to start another transmission before the release timer has expired then it will be reset and the count will start again. The timer is specified in seconds (between 1 and 255) or zero may be set if the release timer is to be unused.

#326 Open Channel With Hookswitch

This parameter determines whether the selected channel is set to the open-channel condition when the microphone is taken off its hook or whether it remains in its current condition. The choices are:

0 - Channel condition unchanged
1 - Channel set to open condition when microphone taken off-hook

#327 Release Function

When the PTT is released, the FM1100 radio may take one of three actions. It may simply stop transmitting immediately, or it may transmit either the entire PTT identity, or transmit just the first tone of the PTT identity (thus giving a single pip) before ending the transmission. These options are selected as follows:

0 - No action
1 - Encode the PTT identity (parameter #275)
2 - Encode a pip tone

#328 Reset Timer

If a channel in the open condition is not used for the time set by this parameter, then it will automatically revert to the closed-channel condition. The call lamp will not be affected. The timer may be specified to be between 1 and 255 seconds, with a zero value indicating that the timer is not required.

#330 Reset With Hookswitch

This parameter determines what action the FM1100 radio will take when the microphone is placed back on its hook. The choices of action are:

0 - No action taken
1 - The FM1100 radio is reset (set to closed-channel) when the microphone goes on-hook

#331 Call Lamp Remote Reset

This determines whether the call lamp is extinguished by a remote reset or not.

0 - Call lamp unaffected
1 - Call lamp extinguished by a remote reset

#332 Auto Interrogate

When auto interrogate is employed, the FM1100 radio transmits its individual reset acknowledge identity (parameter #273) on receipt of an individual call which contains the reset tone.

0 - No auto-interrogate
1 - Auto-interrogate on receipt of individual remote reset

#333 Low Power Level

This parameter defines the transmitter power setting when the FM1100 radio is set to low-power mode by pressing the low power button. The power levels correspond to the following values:

0 - Transmission prohibited
1 - 1 watt
2 - 6 watts
3 - 10 watts
4 - 15 watts

#334 Paging Channel

The paging channel is a special channel that the FM1100 radio uses for forwarding paging messages. If a message arrives at an FM1100 which has had paging turned on, then the message will be re-transmitted on the selected channel. Values of 0 to 99 may be used to select the appropriate channel, while a value of 255 indicates that forwarding of paging messages is not required. Definition of a paging channel will not be allowed unless one of the buttons has been programmed to provide the paging on/off function (parameters #500 - #516).

User-defined CTCSS

This parameter determines whether the FM1100 radio derives its CTCSS tones from the parameters corresponding to the current channel (parameters #101 - #114) or whether the CTCSS tones are defined by the user. If user-defined CTCSS tones are used, then the same tones will be used for both receive and transmit. The values are:

0 - CTCSS tones are derived from parameters #106 and #107 for each channel
1 - User-defined CTCSS tone is used for both receive and transmit

#336 CTCSS Reverse Tone Burst

Dictates whether the FM1100 radio uses a reverse tone burst which is a standard feature of some CTCSS systems. The reverse tone burst involves shifting the phase of the CTCSS signal by a nominal 126° for 150ms after the PTT is released.

0 - No reverse tone burst
1 - Use CTCSS reverse tone burst

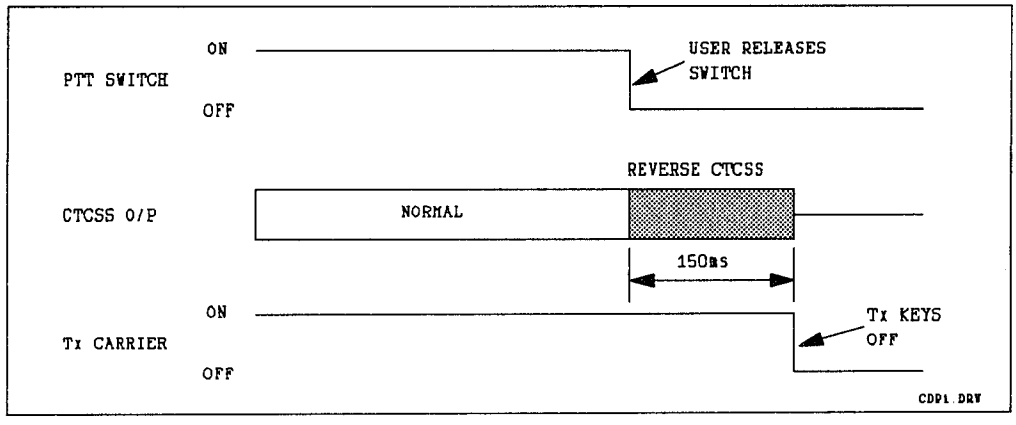

Fig A.2

CONSOLE KEYS AND INDICATORS

Each of the keys and indicators on the console is individually programmable, as long as certain conditions outlined below are fulfilled. Figures A.3 - A.5 show the layout of keys and indicators on the Basic, Standard (Display) and Keypad Consoles respectively.

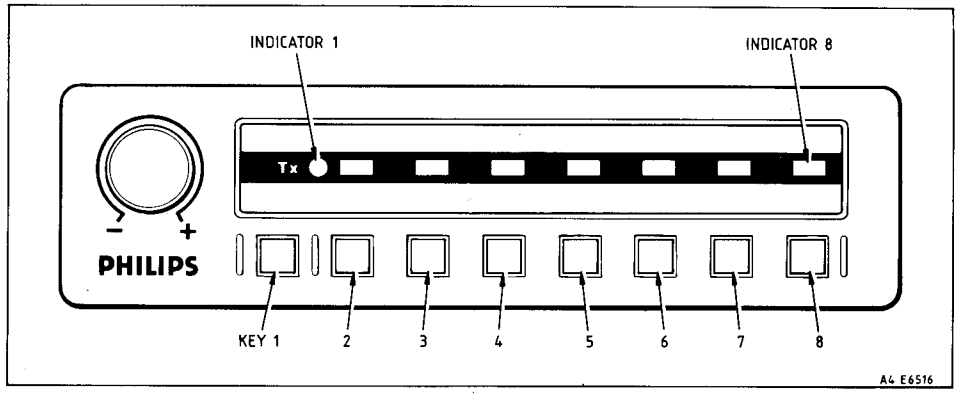

Fig A.3 Basic Console

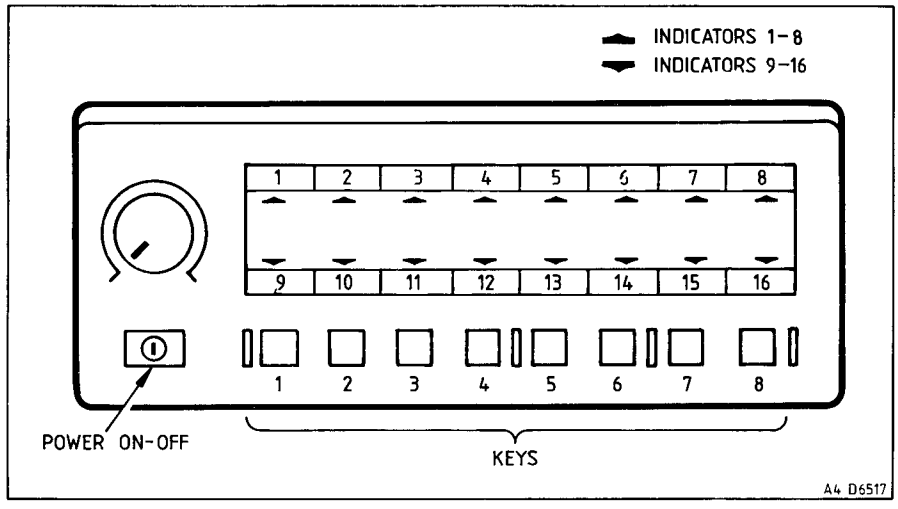

Fig A.4 Standard Console

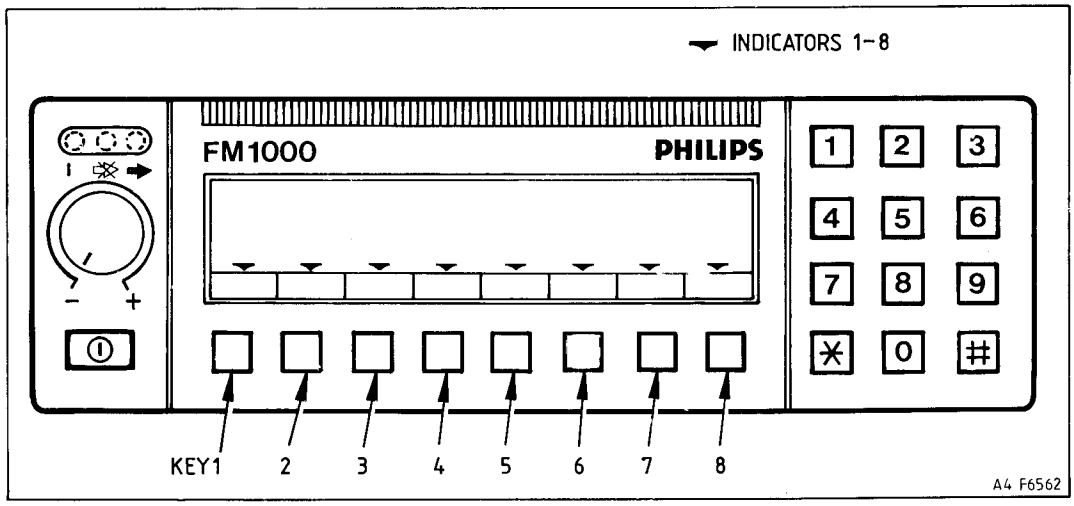

Fig A.5 Keypad Console

#391 - #397 Channel Key Data

Parameters #500 - #516 allow certain keys on the console and/or keypad to be assigned channel key functions. The parameters between #391 and #397 are used to specify which channel is selected by each channel key. Each may be set to a valid channel number in the range 0 - 99, or a space may be entered if the channel key is not used.

Thus if parameter #393 is set to 45, pressing channel key 3 will cause the FM1100 radio to switch to channel 45. (Note that channel key 3 is only a logical function - not a physical button. The relationship between physical buttons and their functions is specified by parameters #500 - #516).

The channel keys can only be used in conjunction with the no-display console; channel selection on the numeric display consoles is performed by incrementing and decrementing the channel number displayed on the console.

#500 - #516 Key Functions

The FM1100 radio contains up to 16 keys on the console, and a facility key on the microphone, each of which may be individually programmed to perform a particular function. The locations of the keys are as follows:

#500	Key 0:	Microphone facility button
#501 - 508	Keys 1 - 8:	Located on Basic or Display Consoles
#509 - 516	Keys 9 - 16:	Not used at present

The function of each of the console keys is normally fixed for each application package, and so cannot be altered.

Functions 50 - 53 are only valid when CTCSS signalling is in use, while functions 0 - 8, 10 - 11, 13, 26 and 46 - 47 are only valid when sequential signalling is in use. Functions 27 - 44 are reserved for future use.

A space should be entered for any key which is not assigned a function. Each key can be assigned a function drawn from the following list:

0 - Send 0
1 - Send 1
2 - Send 2
3 - Send 3
4 - Send 4
5 - Send 5
6 - Send 6
7 - Send 7
8 - Send 8
9 - Alarm
10 - Local Reset
11 - Monitor/local reset
12 - Squelch override/local reset
13 - External alert
14 - Mute microphone
15 - Scan on/off
16 - Clear
17 - Priority scan on/off
18 - Channel key 1
19 - Channel key 2
20 - Channel key 3
21 - Channel key 4
22 - Channel key 5
23 - Channel key 6
24 - Channel key 7
25 - Low power on/off
26 - Manual call acknowledge
27 - Digit 0
28 - Digit 1
29 - Digit 2
30 - Digit 3
31 - Digit 4
32 - Digit 5
33 - Digit 6
34 - Digit 7
35 - Digit 8
36 - Digit 9
37 - Digit A
38 - Digit B
39 - Digit C
40 - Digit D
41 - Digit E
42 - Digit F
43 - DTMF *
44 - DTMF #
45 - Mute loudspeaker
46 - Paging on/off
47 - Mode
48 - + key
49 - - key
50 - Control of CTCSS encode

51 - Control of CTCSS decode
52 - Control of CTCSS en/decode
53 - CTCSS set-up key
54 - Illumination On/Off
55 - User-defined Channel
56 - CTCSS increment
57 - Status increment
58 - Status access
59 - Channel access
60 - DTMF mode
61 - Tone-burst function
62 - Define decode
63 - unused
64 - Status mode

#551 - #566 Console Indicators

#551 - #558	Indicators 1 - 8 Basic & Display Consoles
#559 - #566	Indicators 9 - 16 Display Console only

Each key may be assigned a function drawn from the following list:

0 - No function
1 - Individual call 1
2 - Individual call 2
3 - Individual call 3
4 - Individual call 4
5 - Individual call 5
6 - Individual call 6
7 - Individual call 7
8 - Individual call 8
9 - Group call 1
10 - Group call 2
11 - Group call 3
12 - Group call 4
13 - Group call 5
14 - Group call 6
15 - Group call 7
16 - Group call 8
17 - General call
18 - Channel key 1
19 - Channel key 2
20 - Channel key 3
21 - Channel key 4
22 - Channel key 5
23 - Channel key 6
24 - Channel key 7
25 - CTCSS on/off
26 - Monitor indicator
27 - Scan indicator
28 - Priority scan
29 - Alarm indicator
30 - Microphone mute
31 - External alert
32 - Busy indicator
33 - Loudspeaker mute
34 - Paging indicator
35 - Transmit indicator
36 - Out-of-range
37 - Low power indicator
38 - Power-on indicator
39 - Status mode
40 - Channel mode
41 - CTCSS setup
42 - Message indicator
43 - User-defined channel
44 - Transmit tone
45 - Squelch override
46 - Identity access
47 - Channel access
48 - DTMF indicator
49 - User-defined decode mode
50 - Dual Watch indicator

The function of each of the console indicators is normally fixed for each application package, and so cannot be altered. Functions 25 and 41 are only valid when CTCSS signalling is in use, while functions 1 - 17, 31, 34, 36, 39 and 42 are only valid when sequential signalling is in use.

If the radio has a Basic (No-Display) Console, one of the indicators must be assigned to be the transmit indicator (ie one of parameters #551 - #566 must have the value 35).

ENGINEERING, CALIBRATION AND ERROR COUNTS

#900 EPROM Label

The label to be printed on the EPROM may be entered in this field. The maximum length for the label is currently 12 characters.

#901 Synthesiser Reference Crystal

This parameter MUST be set so that it matches the frequency of the reference crystal installed in the FM1100 radio. The possible frequencies are:

0 - 8,4MHz
1 - 7,2MHz
2 - 7,8MHz
3 - 9,0MHz

The required reference crystal is calculated during the validation procedure, and this parameter is automatically set to the corresponding code. The CDP issues a message during the validation process indicating which crystal is required. Further information on selecting and changing this crystal is given in Section 4.

#902 Second Oscillator Injection

The FM1100 radio uses a first IF of 21,4MHz, and a second IF of 455kHz. There is therefore a choice of frequencies which could be used for the second oscillator injection frequency - either 20,495MHz or 21,855MHz, depending on whether 455kHz is added to or subtracted from 21,4MHz. The choice between the two depends on the frequency band that the FM1100 radio is configured to operate on, and this parameter must match the frequency of the second oscillator crystal.

0 - Injection low (20,945MHz)
1 - Injection high (21,855MHz)

The required second oscillator crystal frequency is calculated during the validation procedure, and this parameter is automatically set to the corresponding code. The CDP issues a message during the validation process indicating which crystal is required. Further information on selecting and changing this crystal is given in Section 4.

#903 Write Count

This parameter contains a count of the number of times that data has been written to the EEPROM in the FM1100 radio. This will occur every time the FM1100 radio is switched off. It is possible that the EEPROM will start to lose its ability to erase data correctly after some 50 000 erasures (10 years under normal conditions), and so replacement of the EEPROM chip should be considered when the write count approaches this level. The protection level of this parameter will always be set to level 3, so that its value may be read although it cannot be edited by the CDP or PDP.

#904 EEPROM Type

This parameter is used to inform the FM1100 radio of the type of EEPROM which has been installed. The possible values are:

0 - 512 bytes
1 - 2048 bytes

#905 Software Version

Indicates the version number of the software in EPROM. Since it is part of the main FM1100 software, it cannot be altered by the CDP or the PDP.

#906 Software Part Number

A 17 alpha-numeric character string which is Read-only. This parameter may replace #905 on some equipments.

#907 Serial Number

This parameter may appear on some PDP displays, although the PDP will be unable to overwrite it and the CDP will be unable to read it at all. This parameter gives the serial number of the equipment as a 13-character string, and should agree with the number on the equipment serial number plate/label.

#909 Market Variation

Two bytes of data which are reserved for future use.

#910 HF Transmitter Power Compensation

Stores a value between 0 and 255 which is used for high-frequency compensation of the transmitter power-control calibration points in the top half of the frequency band in use. Mid-range (ie a value of 128) corresponds to a compensation factor of 1.0.

#911 - #916 Transmitter Power Calibration Points

These six parameters store the calibrated values (between 0 and 127) which correspond to the six possible power levels of 1W, 6W, 10W, 15W, 25W and 30W respectively.

#921 - #924 Receiver Audio Noise Calibration Points

These four parameters store calibrated values (between 0 and 255) which correspond to noise levels of 9dB, 12dB, 15dB and 18dB SINAD respectively.

#931 - #934 RSSI Calibration Points

These four parameters store calibrated values (between 0 and 255) which correspond to RSSI levels of 15dB, 18dB, 21dB and 24dB SINAD respectively.

#941 - #948 Error Counts

The FM1100 radio maintains eight error counters to assist in fault tracing and debugging. Each of the error counts should be reset to zero after the equipment has been serviced. The functions of the error counters relate to parameter numbers as follows:

#941 - Temperature errors
#942 - Hardware errors
#943 - Peripheral errors
#944 - Message errors
#945 - Access errors
#946 - User errors
#947 - Lock errors
#948 - Power errors

MARKETING PARAMETERS

The final group of parameters are used for identification purposes and to reflect the hardware configuration of the FM1100 radio in some way.

#990 Country Code

A single byte of data for identification purposes.

#991 Market Application Code

Two bytes of data for identification purposes.

#992 Frequency Band

This parameter indicates which frequency band the FM1100 radio will operate on. The value of the parameter may be between 0 and 8, which corresponds to the following frequency bands:

0 - Band E0 (68 - 88MHz)
1 - Band B0 (132 - 156MHz)
2 - Band A9 (146 - 174MHz)
3 - Band K1 (174 - 208MHz)
4 - Band K2 (192 - 225MHz)
5 - Band TM (400 - 440MHz)
6 - Band T4 (425 - 450MHz)
7 - Band U0 (440 - 470MHz)
8 - Band WM (470 - 520MHz)

#993 Channel Spacing

This is a single byte of data used for identification purposes to indicate the spacing of the channels within the selected frequency band. The values are:

0 - 12,5kHz
1 - 20kHz
2 - 25kHz

#994 Frequency Stability

This parameter is used to indicate the frequency stability of the reference crystal installed in the FM1100 radio. Its possible values are:

0 - ±5,0ppm
1 - ±2,0ppm

#995 Signalling Type

This parameter specifies whether sequential tone signalling is in use or not. Its possible values are:

0 - No signalling
1 - Sequential Tone signalling

Note that this parameter only relates to the sequential tone signalling; CTCSS signalling may be used together with, or instead of, sequential signalling.

#996 Console Type

This parameter is used to inform the FM1100 radio of which type of console has been attached to it. The valid values are:

0 - Basic (No-Display) Console
4 - Standard (Display) Console using 4-digit display
6 - Standard (Display) Console using 6-digit display
10 - Keypad Console

#997 ID Schedule Code

The ID schedule code is a two digit number which is briefly displayed on the console (in the position of the status digits) at power-up. The schedule code can therefore be used as a means of providing the user with a means of identifying which unit he is using. The schedule code may take values between 0 and 99, or 255 if the schedule code is to be unused.

#998 Console Graphics Label

This parameter appears on the CDP, not in the FM1100 radio.

#999 TEE Customization State

Used for manufacturing purposes only.