

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.

VHF/UHF FFSK MOBILE RADIOTELEPHONE TYPES FM1200/FM1300

SUPPLEMENT TO
FM1000 SERVICE MANUAL

ISSUE 2 JULY 1990

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FM1200/FM1300 FFSK MOBILE RADIOTELEPHONE - SUPPLEMENTARY INFORMATION

Philips Mobile Radiotelephone Types FM1200 and FM1300 are versions of the FM1000 series VHF/UHF FM radio providing digital signalling facilities for trunking systems. This supplement provides information regarding aspects of the equipments that differ from those described in the FM1000 Service Manual (Publication Reference No TP253) and should be read in conjunction with that publication. Section and side headings are given to facilitate cross-reference.

SECTION 1 INTRODUCTION

SUMMARY OF DATA

FFSK Signalling

Modulation	Fast Frequency Shift Keying (FFSK) logic 1 : 1 cycle of 1200Hz logic 0 : 1,5 cycles of 1800Hz
Bit rate	1200 Bits per second
Encoder frequency tolerance	±100ppm
Environmental condition	-30°C to +60°C

Tone-Signalling (Non-Prescribed Data PWB required)

Address Code Form	Encode only. Five sequential tones.
Tone Frequency Range	810 - 2800Hz (see Table 1.1 for specific frequencies).
Link Establishment Time (LET)	500 milliseconds

TABLE 1.1 - SELCALL TONE FREQUENCIES (FM1300 only)

FUNCTION	CODING CHARACTER	SYSTEM TONE FREQUENCIES				
		CCIR	EEA	ZVEI	DZVEI	ZVEI2
"0" TONE	0	1981	1981	2400	2200	2400
"1" TONE	1	1124	1124	1060	970	1060
"2" TONE	2	1197	1197	1160	1060	1160
"3" TONE	3	1275	1275	1270	1160	1270
"4" TONE	4	1358	1358	1400	1270	1400
"5" TONE	5	1446	1446	1530	1400	1530
"6" TONE	6	1540	1540	1670	1530	1670
"7" TONE	7	1640	1640	1830	1670	1830
"8" TONE	8	1747	1747	2000	1830	2000
"9" TONE	9	1860	1860	2200	2000	2200
GROUP TONE	A	2400	1055	2800	2600	886
EXTENDED TONE	B	930	930	810	1749	—
ALARM TONE	C	2247	2247	970	886	810
SELECTABLE TONE	D	991	991	886	810	—
REPEAT TONE	E	2110	2110	2600	2400	970
TONE LENGTH	(ms)	100	40	70	70	70

Note: All frequencies are in Hz.

Tone sets are NOT standard Philips ST-500 tone sets.

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



INTRODUCTION

Transceiver Types FM1200 and FM1300 are digital signalling radios designed for use in trunked mobile networks. The equipment differs from the FM1100 analogue transceiver in that it is fitted with a Digital Signalling version (FFSK) of the Control PWB assembly. Apart from operational differences and descriptions of ancillaries normally found only on FM1200 and FM1300 radios, this Service Supplement provides information on the FFSK Control PWB assembly only.

Although all standard FM1000 frequency bands can be supplied, the FM1200 radio is principally used on Band III (174 - 225MHz). It is fully approved to operate on the Band Three Radio Limited public network. These channel trunking systems allocate free channels to subscribers (for mobile-to-mobile or group calls) in real time. On completion of the call, the channel is made available for re-allocation to other subscriber calls.

Call connection and channel allocation is controlled by the base control system. Fast Frequency Shift Keying (FFSK) digital signalling to MPT1327 and MPT1343 specifications is employed.

FM1300 radios are designed for use on systems employing an extended version of the MPT1327 signalling protocol. For example, they allow manual channel selection for simplex or control channel working.

A Non-Prescribed Data PWB can be plugged into the Control PWB, allowing connection of an external MODEM (via a socket on the front of the radio) and generation of sequential tones for revertive paging. No provision is made for the decoding of sequential tones.

An RS232 interface (CCIT standard V24) is available, allowing connection of the radio's external message bus to MODEMs, printers, personal computers etc is available and is detailed in a separate publication.

TRUNKED MOBILE RADIOTELEPHONE SYSTEM

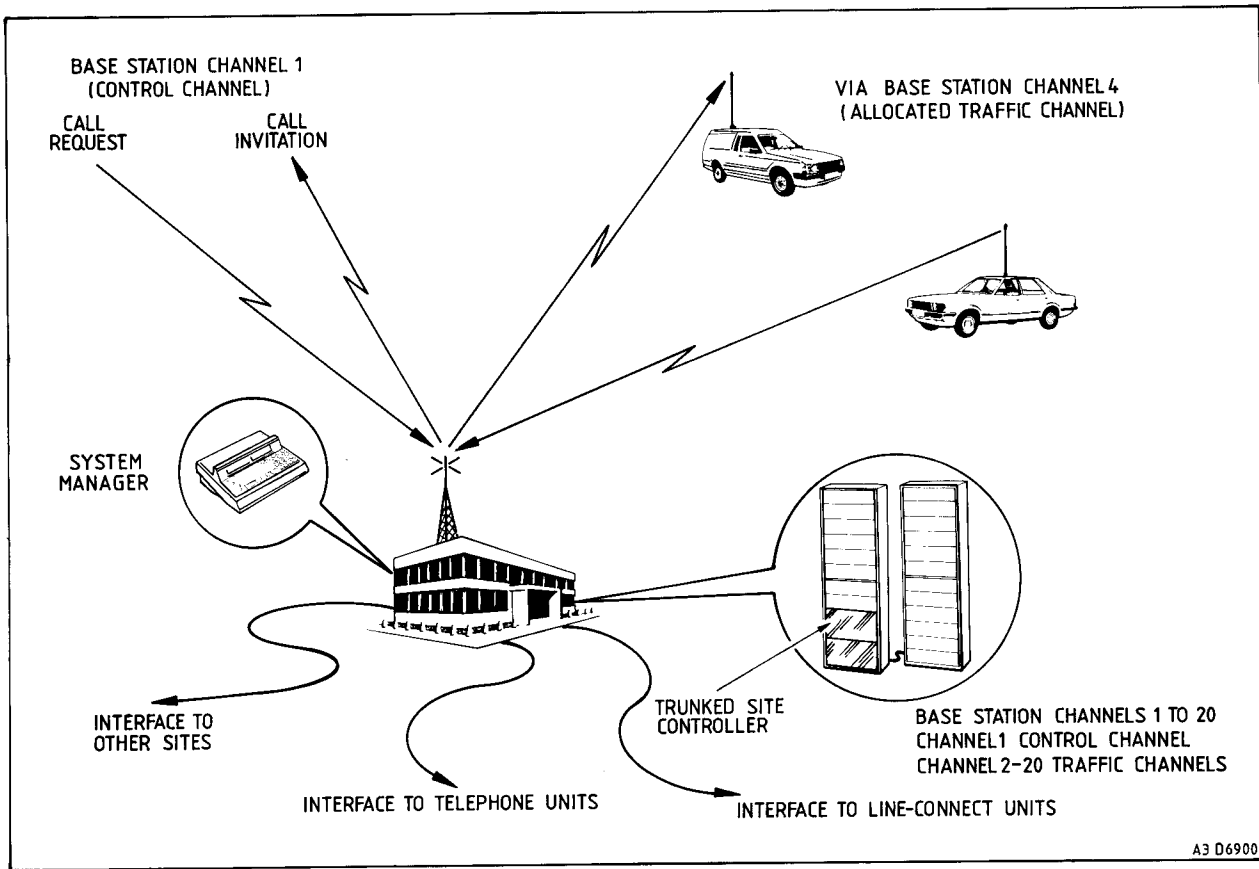


Fig 1.1 Typical System

Summary of Typical Facilities

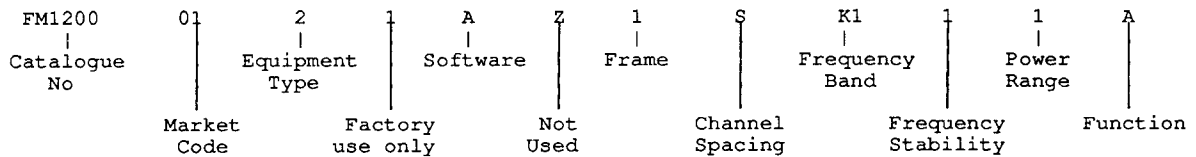
- a. All channels are shared between users.
- b. Traffic channels are allocated on first-come first-served basis.
- c. Mobile to mobile (individual or groups).
Mobile to dispatcher.
- d. Automatic queue facility for calls.

ASSOCIATED PRODUCTS

- | | |
|--------------------------------------|----------------------------------|
| (2) FM1200/FM1300 Keypad Console | (Publication Reference No TP251) |
| (7) External Interface Unit (RS232C) | (Publication Reference No TP874) |

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 West Germany
- 09 Canada
- 12 Finland
- 19 Malaysia
- 30 Hong Kong

Equipment Type

- 2 FFSK Transceiver Type FM1200
- 3 FFSK Transceiver Type FM1300

Software

- 0 Less EEPROM and EPROM
- A FM1200, Standard Console
- B FM1200, Keypad Console
- C FM1300, Standard Console
- D FM1300, Keypad Console

Frame

- 1 Standard Frame
- 2 Extended Frame (required for Keypad Console and/or External MODEM)

Channel Spacing

- S 12,5kHz
- R 20kHz
- V 25kHz

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 ± 5 ppm
- 2 ± 2 ppm

Power Range

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

Function

- 0 Less Control/Digital-Signalling PWB
- A FM1200 (FM)
- B FM1200 with Modem Interface (FM)
- C FM1300 (FM)
- D FM1300 with Modem Interface (FM)
- E FM1200 (PM)
- F FM1200 with MODEM Interface (PM)
- G FM1300 (PM)
- H FM1300 with MODEM Interface (PM)

GLOSSARY

Access Codes

Each base station sends access codes which identify the zone and area it is operating within. For a radio to be able to operate with that station, it must be programmed with one or more matching access codes.

Alarm

An emergency call which takes priority over all other calls and which is directed to one of the short-form memories.

CCSC

Control Channel System Codeword.

Comprehensive Hunt (FM1200 only)

When the carrier from a base station drops below a pre-determined signal level, the radio searches specific channels for an alternative base station within the same zone or area through which it can resume communications. If an alternative cannot be found and Comprehensive Hunt is enabled, then the radio searches all channels for any base station with which it is permitted to communicate. If Comprehensive Hunt is not enabled then the radio terminates communication and awaits action from the user.

DTI

Department of Trade and Industry. The radio regulatory body for the United Kingdom.

Emergency number

This is the identity of the station to which calls are directed.

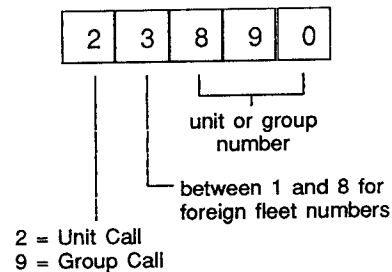
Fall-back channel number

The Fall-back channel is the channel the radio selects when no control channel is available, or when a base station instructs the radio to go to Fall-back mode. When in Fall-back mode the radio is operating as a single-channel simplex radio with signalling functions enabled.

Fleet details for 5-digit codes

This is a form of abbreviated dialling which allows the user to access units and/or groups in other fleets.

5-digit code



The last three digits of the code correspond to the unit or group number of the 'foreign' fleet.

Ident

A 13-bit number used for identification purposes. Ident values of between 1 and 8100 inclusive are assigned to individual units or groups, in which case they are associated with a prefix to form a 20-bit address.

Item warning

If the radio is programmed with transmit timer enabled, the Item warning parameter will issue a warning of impending time-out.

MPT1317

The Code of Practice for the transmission of digital information over land mobile radio systems (DTI April 1985).

MPT1323

Performance requirements for angle-modulated radio transmitters and receivers in the private mobile radio service (DTI October 1986).

MPT1327

Signalling standard specification for land mobile radio systems (DTI January 1988).

MPT1343

The system interface specification for radio units to be used with commercial trunked networks in Band III, sub-band 2 (DTI January 1988).

PABX

Private Access Business Exchange.

Prime despatcher

This is the identity of the station (eg the System Operator) to which priority calls are directed.

PSTN

Public-Switched Telephone Network.

RQC

Short data message request.

RQE

Emergency request.

RQQ

Status request.

RQR

Status request.

RQS

Simple request.

RQT

Call Diversion request.

RQX

Cancel/Abort request.

Single-digit dest(ination)s

This parameter allows you to program dial strings which relate to short-form destination numbers. Note that the dial strings may be used to select functions (such as 're-direct calls') in addition to telephone or user numbers.

Characters 0 - 9, * and # only may be used.

TSC

Trunked Site Controller.

SECTION 2 INSTALLATION & OPERATION

INSTALLATION

For installation information, refer to FM1000 Installation Instructions (Publication Reference No TP858).

OPERATION

Note: For detailed operation, refer to the following User Guides:

FM1200 with Standard Console
FM1200 with Keypad Console
FM1300 with Standard Console
FM1300 with Keypad Console

Publication Ref TP1949
Publication Ref TP1957
Publication Ref TP1991
Publication Ref TP1966

STANDARD CONSOLE

The Standard Console has eight function buttons, an ON/OFF button, a six-digit display, 16 programmable indicators, 10 function-specific indicators and a rotary volume control.

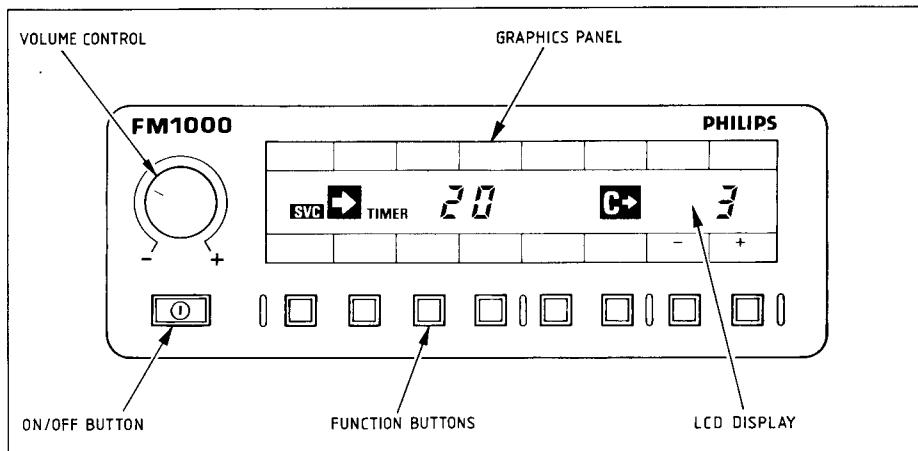


Fig 2.1 Controls and Indicators

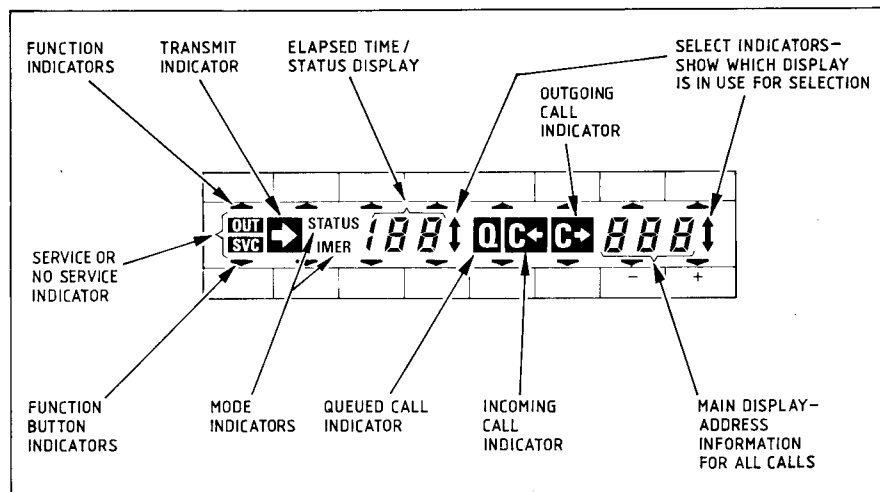


Fig 2.2 Standard Console Display

SUMMARY OF OPERATION

To Switch On

Press the ON/OFF button: The console illumination and display backlighting will light. The radio will enter a self-check routine during which time all display segments will briefly be visible before the radio will display its own unit number. After two seconds, the display will then revert to normal and the radio will be ready for operation.

To Receive a Call

A call is indicated by a double pip-tone (two short beeps), the Incoming Call indicator and the number of the caller.

1. Accept the call by operating the Press-To-Transmit or Call button, or by taking the microphone off-hook. A further tone will sound to indicate that the call may be answered.
2. Answer the call by operating the Press-to-Transmit button or taking the microphone off-hook and speaking.

To Make a Call

1. Select the number you wish to call.
2. Depress the Call button.
3. Wait until the call is set up (indicated by a beep or by the end of the Called Party ringing tone).
4. Remove microphone from the hook switch and make your call by operating the PTT button and speaking.
5. On completion of call replace microphone or press Clear button.

ALERT TONES

Type 1 - Key Click

This is a 1500Hz tone of 50ms duration. This provides a 'Click' every time a key is pressed.

Type 2 - Operator Alert (Buzz)

This is a 400Hz tone of 150ms duration.

Type 3 - Hard Error

This is a 400Hz tone which is on for 150ms and off for 150ms, repeated for 5 seconds.

Type 4 - Number Unobtainable (Unbroken Low Tone)

This is a continuous 400Hz tone which lasts for 5 seconds unless cancelled early (by going on-hook).

Type 5 - Call Fail (Broken Low Tone)

This is a 400Hz tone which is on for 370ms and off for 370ms, repeated for 5 Sec unless cancelled early (by going on-hook).

Type 6 - Call Queued, Transaction Confirmed, Call Clear (Double Pip)

This is a 400Hz tone which is on for 100ms, off for 100ms and on again for 100 mSec.

Type 7 - Call Set-up In Progress (Repeated Double Pip)

Double Pip tones as above but repeated every 6 seconds until a terminating event. This is used for Call Set Up In Progress (Outgoing and Incoming).

Type 8 - Go To Channel (Blip)

This is an 800Hz tone of 370ms duration.

Type 9 - Called Party, Alert (Telephone Ring - UK)

This is a 800Hz tone which is on for 500ms, off for 500ms and on again for 500ms, repeated every 4 seconds until a terminating event (eg call is answered).

Type 10 - Called Party, Alert (Telephone Ring - France)

This is a 800Hz tone which is repeated every 6 seconds until a terminating event (eg call is answered).

SECTION 3 TECHNICAL DESCRIPTION

CIRCUIT SUMMARY

The transceiver consists of five PWB assemblies as in FM1100, but the Control PWB is replaced by the following assembly:-

DIGITAL SIGNALLING comprising Non-Prescribed Data PWB (optional), main transceiver microprocessor with clock oscillator, EPROM, EEPROM, RAM, Shift Registers, timers, 30V generator and FFSK signalling circuits comprising microprocessor, EPROM, Address Latch, RAM, MODEM and peripheral devices.

All FM1200 control and signalling functions are provided by the Control/Digital Signalling PWB assembly. This PWB contains two 80C31 microprocessors IC312, IC548. IC312 acts as the main control for the FM1200, and communicates with peripheral devices (eg consoles and data programmers) via a serial bus. The bus is interrogated on a regular basis and the state of the FM1200 altered depending on information received. Control of the analogue part of the radio is achieved via serially driven shift registers, the outputs of which directly control the analogue functions. Certain internal voltages within the FM1200 radio are monitored via an Analogue-to-Digital (A-to-D) converter (IC301) and an input shift register (IC303). Customisation data, such as the frequency band and the key and indicator functions, are held in EEPROM (IC311) to which the microprocessor has access. IC548 controls all 'over the air' signalling via an FFSK MODEM (IC546). It decodes the incoming bit stream from the MODEM to detect valid signalling. Relevant signalling messages are then passed via a dedicated serial bus to the control microprocessor (IC312). Encoding of FFSK for transmission is performed by the signalling microprocessor which outputs binary data to the MODEM which converts it into FFSK audio.

The Non-Prescribed Data PWB allows interface between the radio and an externally-mounted MODEM. Sequential tone information generated by the signalling microprocessor may be processed on this PWB prior to transmission by the radio.

CONTROL/DIGITAL SIGNALLING PWB

Power Supply Circuits

When the FM1200 radio is switched on, unregulated DC is supplied to the Control PWB from the Analogue PWB via SKTB. This is used to supply two single chip voltage regulators which provide outputs of 5V and 8V respectively. The 5V line is used to feed the logic control circuitry and 8V is used to supply the audio circuitry for the FFSK signalling.

The unregulated DC input is also used to supply the 30V generator circuit which is required for the synthesiser loop filter. This is generated by IC318, a charge pump device. Adjustment of the 30V output is achieved by RV301 which senses the rectified and smoothed output of the device and feeds it back to its control pin.

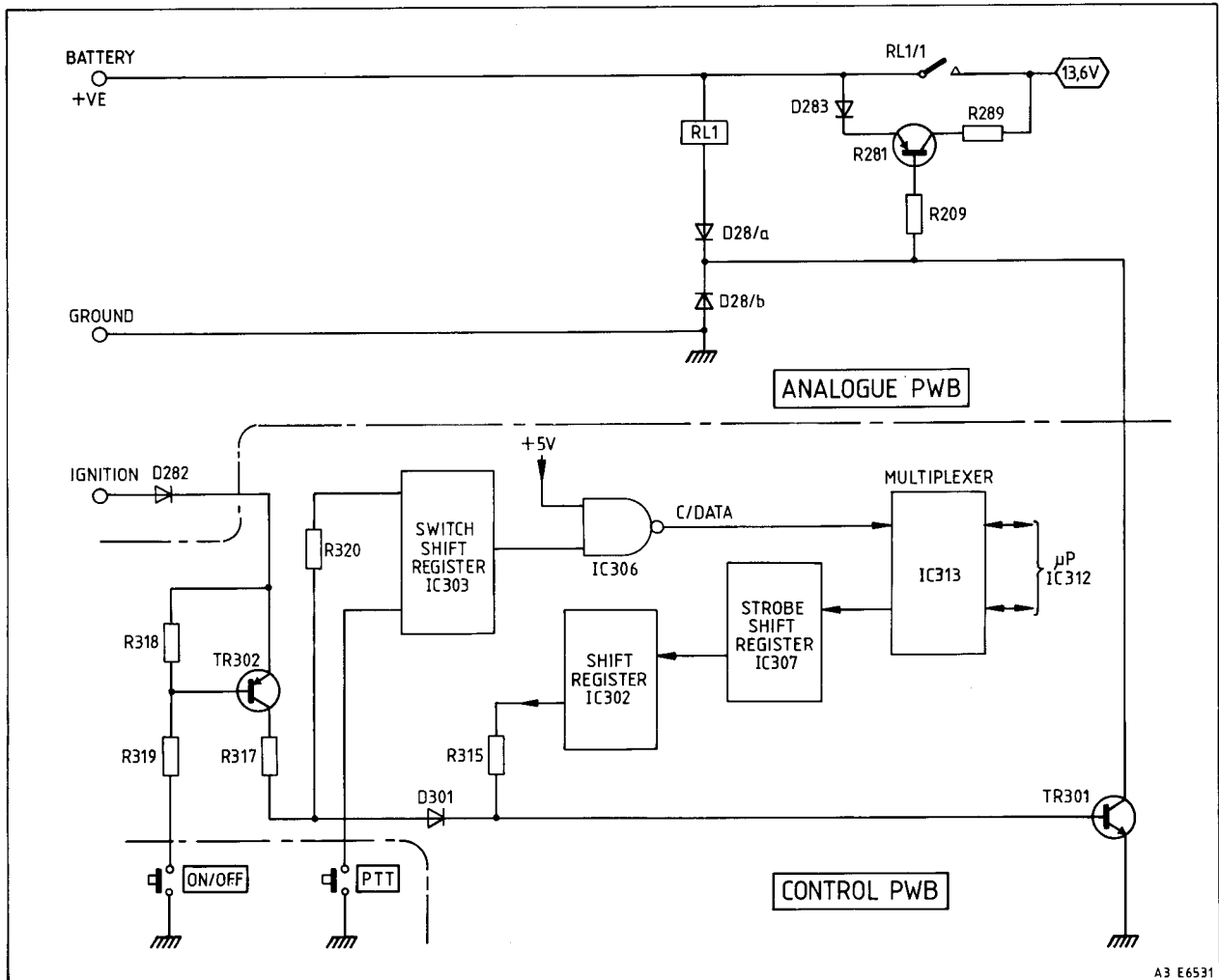


Fig 3.1 Power Supply Circuits Block Diagram

ON/OFF CIRCUIT

DC power from the vehicle battery (or other external PSU) is switched on or off by a relay mounted on the Analogue PWB. To switch the equipment on, the Ignition line must be connected to the external DC supply and the incoming on/off control line grounded (eg: by pressing the console on/off switch or plugging in a data programmer). TR302 effectively forms an AND gate with the ignition and on/off inputs. When the ignition line (TR302 emitter) is high and on/off line (TR302 base resistor) is low, TR302 switches on. This in turn switches on TR301, the collector load of which is the power on/off relay. When this occurs, the control microprocessor can hold the FM1200 radio on by setting Q4 of IC302 high. This feature also enables the data to be saved to EEPROM after detecting switch off. The state of the on/off line is monitored via the D0 input of the switch input register IC303.

CONTROL MICROPROCESSOR

The control processor uses a nominal 12MHz clock frequency. This is provided by TR307, TR306, TR305 and XL301 which form a pullable oscillator circuit. On power up the microprocessor requires to be reset. This is performed by IC314 which applies a positive pulse of approx 20ms at the reset input of the microprocessor when it detects the 5V supply rail ramping up. In normal operation no further reset pulses should be applied.

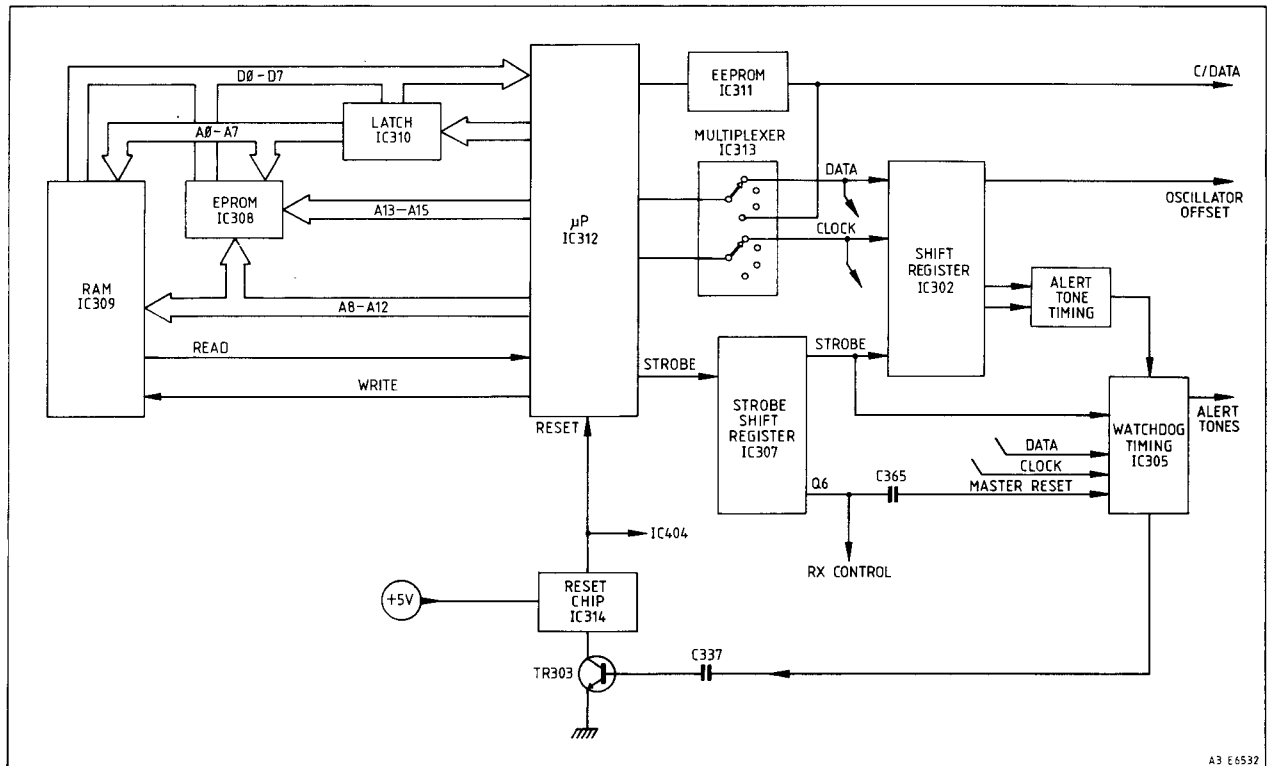


Fig 3.2 Microprocessor Block Diagram

The microprocessor executes software code held in a 64K EPROM (IC308) which it accesses via its external address/data bus D0 to D7 and A8 to A15. The device operates on a 8-bit wide data bus and 16-bit address bus. In order to reduce the pin count of the 80C31, the low order address bus is multiplexed with the data bus. To separate these functions an address latch (IC310) is used. This acts as a transparent latch gated by its LE input. When the microprocessor outputs its low order address it also sends out a positive pulse on its ALE line which gates the low address through to the output of the latch. Also connected to the external bus is an 8k x 8 static RAM (IC309) which also uses the address latch, but control of Read and Write functions is via two separate control lines from the microprocessor, "/RD" and "/WR".

To avoid data corruption during short power interruptions (FM1200 only), the RAM supply voltage is fed via a series diode and reservoir capacitor, which can maintain the contents of the RAM for at least 20 seconds. To avoid corruption at reset the reset pulse is inverted by TR309 which sets CHIP SELECT 'low', disabling the RAM for the duration of the reset pulse.

When first switched on, the microprocessor software will initialize the FM1200 radio by commands sent on the serial bus. Ports 3.1 and 3.0 on IC312 connect to a serial UART held on chip. This can be configured in a number of different ways determined by the radio software. The FM1200 utilizes two of the available UART modes and further sub-divides these depending on whether the bus connects to an external device or devices internal to the radio. A bi-directional multiplexer IC312 is used to connect the serial UART to each bus in turn. Selection is controlled by P1.1 and P1.0 of the microprocessor. The operation of each bus is explained below:

INTERNAL EXPANSION BUS (IEB)

This bus is formed by lines CLK and C/DATA from pins 11 and 4 of the multiplexer IC313. It is used to drive a number of Input and Output shift registers contained on both the Control PWB and the Analogue PWB.

To write to an output shift register (74HC4094), the microprocessor writes data into the shift registers on the C/DATA line. The Clock signal is provided by the CLK line which is connected to all shift registers on this bus. To write to any of the shift registers, it first sends out an 8-bit data byte corresponding to the output pattern it wishes to write to the selected shift register. This data will be stored in the strobe shift register (IC307). This is immediately followed by an address byte for the selected shift register. As the address byte is clocked into the strobe shift register the previous data byte is clocked out of it (on pin 10) and is clocked via the data inputs into all the output shift registers on the bus. By applying a pulse on P1.4, the strobe and output enable of IC307 are momentarily enabled causing the address byte to appear on its parallel outputs. This byte will be chosen so that a '1' is passed to the strobe of the required output register, hence only that shift register will be strobed, latching the required data byte onto its parallel outputs.

To read from the switch input shift register (74HC165), a similar technique is used. Bit Q4 of the strobe shift register is sent momentarily low. This is connected to the shift load input of the Switch Input Register IC303, causing data on its parallel inputs to be loaded into IC303's internal shift register. By applying eight clock pulses on the CLK line the data is serially clocked out from IC303 pin 9 via an open collector NAND gate (IC306) and read in by the microprocessor. To avoid contention when writing to the C/DATA line from the microprocessor, the open collector output of this NAND gate must be set high. This is achieved by sending eight clock pulses to the switch input register (which has its serial input tied to 0V), thus filling the shift register with '0's.

The switch input register is read every 10ms. Output devices on this bus are written to as required.

EXTERNAL EXPANSION BUS (EEB)

This bus operates in an identical manner to the Internal Expansion Bus but uses separate CLK, C/DATA and Strobe lines. It is used to interface with certain ancillaries such as the Keypad Microphone which has internal shift registers in it. Each ancillary also contains a separate strobe shift register which is enabled by a strobe signal from P1.2 of the microprocessor. IC315 is used as a line driver. When writing out on the bus the microprocessor enables this line driver by switching P1.3 low. Taking P1.3 low also sets the output of a NAND gate in IC306 high during writing to avoid bus contention. When P1.3 is set high the microprocessor reads from the bus. Incoming data is buffered by IC315 and passed via IC306 (now enabled) and IC313 to microprocessor IC312.

When first switched on, the microprocessor will read the bus to detect if any ancillary is connected. If so, it will 'poll' the bus every 10ms; otherwise the bus will be ignored until the FM1200 radio is next switched on or is reset.

EXTERNAL MESSAGE BUS (EMB)

In this mode the UART is set up as a 378 kilobit serial link communicating on the TxD and RxD lines on SKTC/PLA. The EMB is used to communicate with complex peripherals such as the Standard Console or the Portable Data Programmer. At switch-on, IC312 sends out a series of pre-defined messages to all the possible peripherals which can be connected to the radio. If connected, the peripheral will respond to the message and IC312 will then send out messages to the device every 10ms. If a peripheral device is not connected at the time of switch on, and hence doesn't reply, IC312 will assume that it is not connected and send no more messages to that device.

INTERNAL MESSAGE BUS (IMB)

This bus is similar to the EMB. However, the signalling microprocessor is the only device connected to it. To ensure fast communication from the signalling microprocessor to the control microprocessor, use is made of the control micro's INT0 input (to avoid having to wait for the control micro to request the transaction).

Analogue-to-Digital (A-to-D) Converter

IC301 is an 8-bit resolution A-to-D converter. It is used for monitoring the state of various voltages from the RF and audio parts of the radio. The following inputs are used:

- 1 Tune Volts: This is used for monitoring the VCO tuning voltage. If it is outside a certain range, it will increment a hardware error count in EEPROM. The radio will, however, remain operational.
- 2 Supply voltage: This is used when monitoring transmitter power to detect whether a reduction in transmitter power was caused by a reduced supply voltage.
- 3 Tx Temp: This is connected to a thermistor circuit held in the transceiver casting. If an excessive temperature is detected, the control unit will reduce the transmitter power by steps until the temperature falls again, or zero power is reached. If zero power is reached, the FM1200 radio will switch back to receive mode.
- 4 Noise Level: This is used to determine the quieting of the receiver and, if appropriate, open the squelch.
- 5 RSSI: This is a DC signal from the IF amplifier, used to determine the signal strength. It is used for squelch control and when hunting for a suitable channel to communicate with the trunked radio network.
- 6 Power Level: This input is from a diode detector circuit on the PA. It is used to monitor the transmit power. If excessive or too little power is detected, the output power is reduced in steps in the same way as with excessive temperature.
- 7 Volume: This input comes from the console volume potentiometer which gives a DC level depending on its setting. The microprocessor sets the digital audio attenuator on the analogue board according to this value.
- 8 Hook/Facility Switch: This is an input from the microphone. These switches are connected with resistors in such a way that the voltage on this pin depends on which combination of switches are closed, and enables their operation to be detected by the microprocessor software.

The A-to-D convertor uses the 5V rail on the Control PWB as a reference. It is driven from the Internal Expansion Bus using a method similar to that employed for the input and output shift registers. To enable a conversion, the microprocessor uses the IEB to inform the device which of the inputs is required to be converted. It then takes P3.5 low to signal that conversion should now take place. The chip uses the ALE line from the microprocessor as its system clock. (On average ALE will run at 2MHz as code is executed from the EPROM.)

Alert Tone Generator/Watchdog Timer

The alert tone generator is a simple RC inverter oscillator made up of C326,R328 to R331 and IC305 which contains on-chip inverters. The alert tone frequency and gating is controlled by IC302. The shift register outputs of IC302 are used to modify the oscillator's RC time constant depending on which alert tone is required, and the Q7 output is used to gate these tones on or off. The resultant audio is mixed with the loudspeaker audio on the Analogue PWB. IC305 also contains a series of cascaded dividers which reduce the RC oscillator frequency down by factors of 2. If allowed to run for long enough, a pulse will appear on the divider output at pin 1, causing TR303 to switch on and the reset chip to send a pulse to reset the microprocessors. In practice, this is prevented by C365, which transmits pulses from the strobe shift register and resets the cascaded dividers within IC305. However, if the software is not running properly, this will not occur, and a reset pulse will be generated.

Microprocessor Oscillator

IC312 is supplied directly from the oscillator output and supplies the signalling microprocessor via an internal buffer from its XTAL2 output. XL301, TR305 and associated components form a standard Colpitts oscillator. Transistors TR306, TR307 are used to switch in a different crystal load capacitance depending on the logic level at Q1 of IC302. The oscillator frequency can thus be offset slightly when a direct harmonic of the crystal falls close to the current receive frequency. Each time the radio tunes to a new channel, the microprocessor calculates whether frequency offset is necessary, or not. When transmitting, the oscillator is always set to its nominal 12,096MHz.

EEPROM

IC311 is a serial EEPROM used for storage of all customisation data. Depending on customer requirements a 512 byte or 2 kilobyte device is fitted (X2404 and X24C16 respectively). Electrical operation with each device is similar. On power up, the FM1200 radio reads customisation data into RAM before normal operation is commenced. The device uses I²C protocol which utilizes a CLK and DATA line to communicate with the microprocessor. When the microprocessor is communicating with this device, it uses the C/DATA line on the IEB to send and receive data, but generates a separate clock output from P1.5.

If any customisation data is modified (eg by a PDP), the microprocessor will save the changes to EEPROM at switch-off. If there are a substantial number of changes to the customisation data, there will be a noticeable delay between switching off at the console and the FM1200 internal relay opening (power down).

External Alert

This circuitry can be used as either an input or an output. In normal operation this is used as an output to switch an external device (eg a car horn) when the mobile is called. In this case, the microprocessor sets p1.6 high to switch on darlington pair TR308/TR304. The Darlington pair connect to the External Alert pin on the external power socket. This output is also sensed by the microprocessor via R324 and the switch input register. At switch-on, P1.6 is set low and hence TR304 collector floats high. If the External Alert pin is taken to 0V before switch-on, the microprocessor detects that it is being used as an input. This mechanism is used to place the FM1200 radio into test mode (see Section 4 of TP253).

FFSK Encoder/Decoder

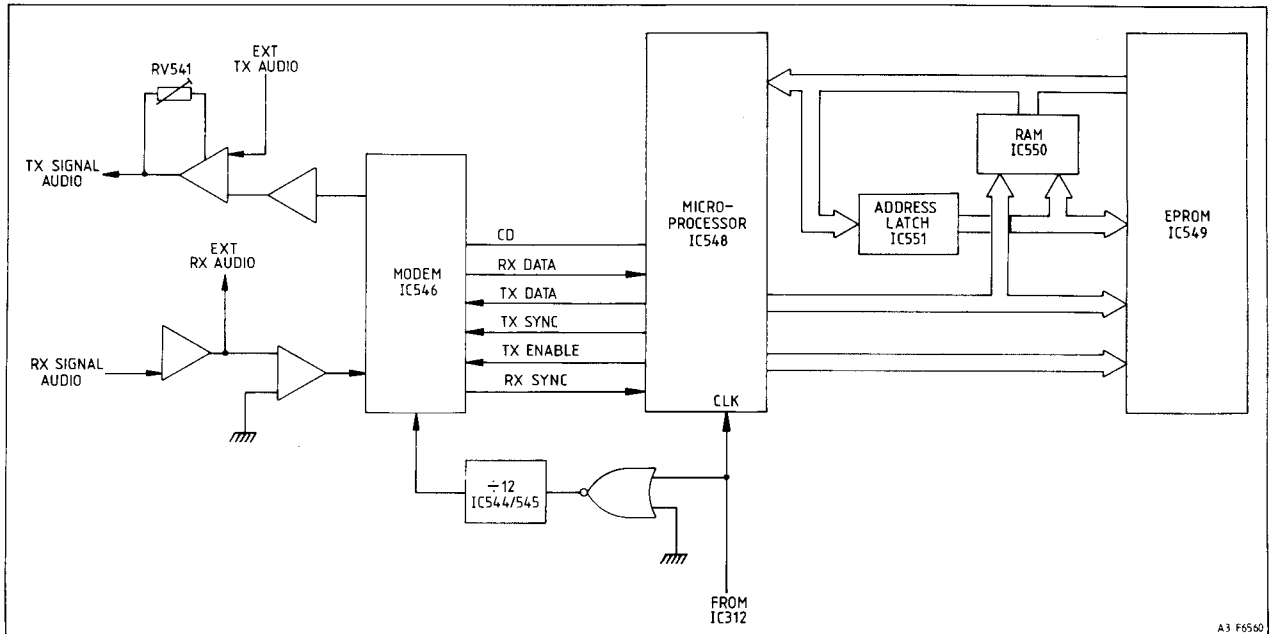


Fig 3.3 Digital Signalling Block Diagram

FFSK functions are controlled by microprocessor IC548 which relies on master processor IC312 for its clock signal (defining processing speed) and instructions from the console. Signalling data is stored in EPROM IC549, which is accessed via 8-bit address latch IC551. Data from the EPROM is loaded into RAM IC550 at switch on.

MODEM IC546 is a full duplex device, ie it can decode while encoding. Tx Data is clocked out from IC546 by pulses on the Tx Synch line from microprocessor IC548. Similarly, Rx Data is clocked in by Rx Synch pulses from IC548. A 1,008MHz clock signal is required to drive IC548; this is derived from IC312 clock. As IC312 clock runs at 12,096MHz, it is applied to flip-flops IC544, IC545, which divide the signal by 12 to produce 1,008MHz.

Signalling Microprocessor

The signalling microprocessor is also an 80C31 device and has external RAM (IC550) and EPROM (IC549) operating in a similar fashion to the main transceiver microprocessor. The signalling microprocessor interfaces with the FFSK MODEM IC546 via a number of control lines. The MODEM itself is a duplex device which is configured so that its receiver is permanently enabled. The transmit section generates 1800Hz and 1200Hz tones from incoming Tx Data sent to it at a bit rate of 1200bps. Tones and bit rate are generated by the MODEM from a reference frequency of 1,008MHz at its XTAL1 input. This is derived from the 12,096MHz microprocessor oscillator and divided by 12 by J-K flip-flops IC544 and IC545.

MODEM

CD - CARRIER DETECT

Carrier Detect is a logic signal sent from the MODEM receiver to the signalling microprocessor. A series of filters within the MODEM are set up to detect FFSK signalling frequencies. When FFSK signals are detected, the CD line goes 'high'. Operational speed of the CD line is determined by the value of C558 (connected to the CDT MODEM input) which controls a time constant within the IC.

RX DATA

This is the received serial data stream from the FFSK MODEM, which is read by the signalling microprocessor.

RX SYNC

This is a 1200Hz square-wave output from the MODEM, which is synchronised to the RxDATA output and is used to generate an interrupt to the microprocessor when the next bit of valid data is present on RxDATA. When no signalling or a noisy signalling is received, this output will exhibit 'jitter' as it repeatedly resynchronises.

TX EN - (TX ENABLE)

When the microprocessor wishes to transmit a message, it takes this line 'low' to enable the FFSK transmitter.

TX SYNC

This output is a 1200Hz square-wave from the MODEM. It is used to interrupt the signalling microprocessor to signal that it should output the next bit of data to be encoded. It will only be active when the TxEN is 'low'.

TX DATA

This line is used by the signalling microprocessor to output the data stream to be converted by the MODEM to FFSK audio.

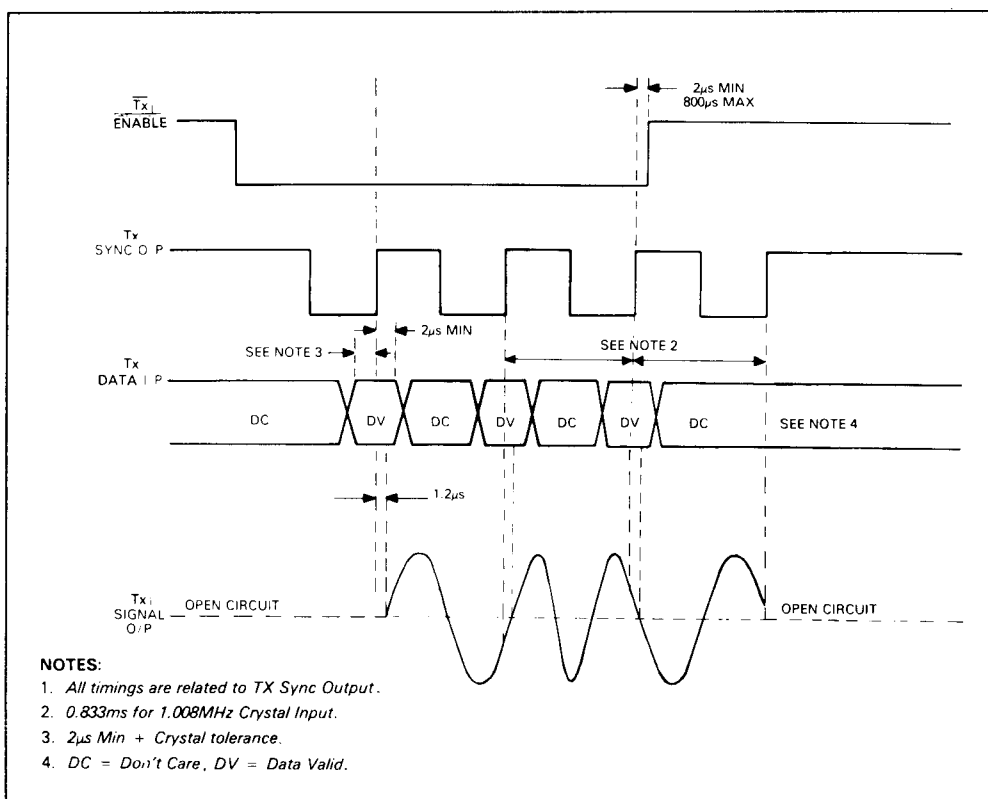


Fig 3.4 FFSK Transmit Timing Diagram

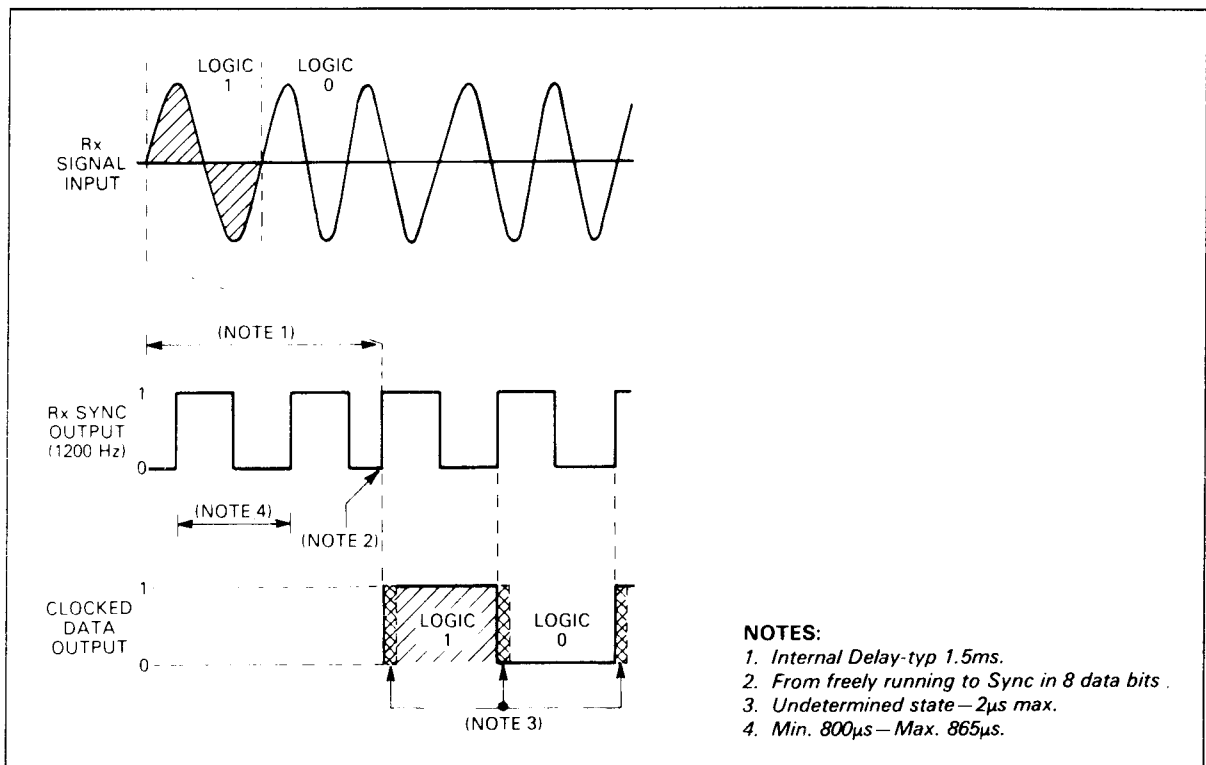


Fig 3.5 FFSK Receive Timing Diagram

FFSK Analogue Circuitry

FFSK is outputted from the Tx Audio output of IC546 when outgoing signalling is in progress. This signal is taken to inverting operational amplifier IC543, the gain of which is set via RV541 and associated resistors. The gain of this stage is altered to control the AF level to the FM modulator and hence set the required frequency deviation for data signalling. The bias pin from the MODEM is used to create a half rail for the operational amplifiers and is buffered by a unity gain amplifier (IC541). This output is fed through a low pass filter with a break point of approximately 15kHz to remove any high frequency components from the waveform. It is then fed to the modulator on the Analogue PWB.

Unfiltered receiver audio is fed (without filtering) from the Analogue PWB. It is buffered by part of IC541 and fed to a clipper amplifier (IC541) which uses a pair of back-to-back diodes and feedback network to supply the correct level of clipped audio signal to the MODEM. It is then buffered and presented to the MODEM via a unity gain operational amplifier. A separate half rail is provided for the receive circuit by R544, R545 and C546.

NON-PREScribed DATA PWB

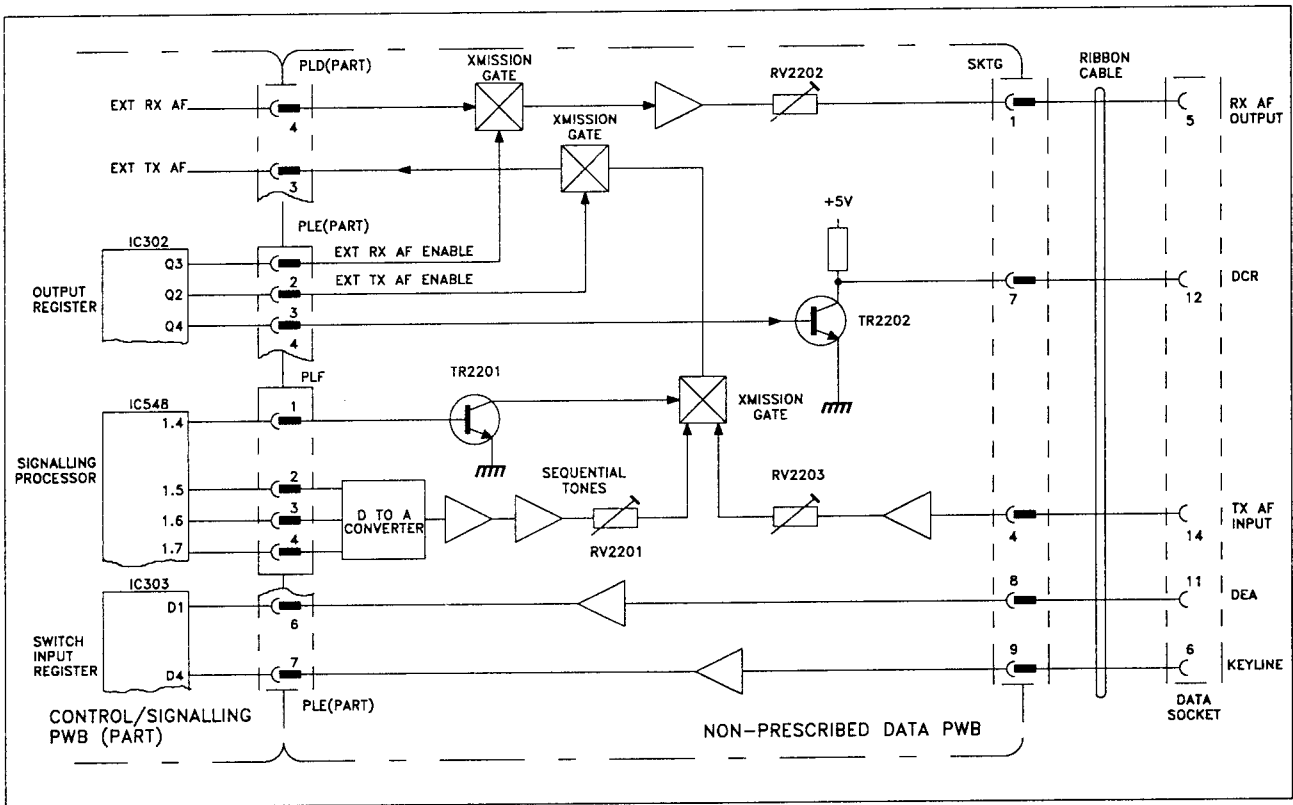


Fig 3.6 Non-Prescribed Data PWB Block Diagram

MODEM Interface

Unfiltered receiver audio at PLD4 is gated by IC204 which is enabled by the External Audio enable input, and then amplified by buffer IC205 to a 600ohm output on the front panel data socket. The gain of this section is adjusted by RV2202. Transmit audio from the external MODEM is applied via SKTG4 to IC2205 and is gain adjusted by RV2203. It passes two switches, the first, controlled by the signalling processor (Port 1.4), switches between external MODEM input and the on-board sequential tone encoder. This switch is set by default to enable transmission of data from the external MODEM, except when sequential tones are being generated. The second switch mutes audio to the Control PWB and is controlled by the Tx Audio Enable line. This switch is open except when accepting external MODEM data or sequential encode tones are generated. Transmitter audio is fed, via the Control PWB, directly into the modulation circuits of the Analogue PWB without any filtering.

The Tx and Rx Audio enable lines operate at +5V logic levels whereas the switches require +8V logic levels. Level shift for each audio enable line, DEA and KEYLINE is provided by a section of IC2201. IC2201 is a Schmitt Trigger buffer. Hysteresis is provided via C2238, R2254, R2253, R2255.

- DEA Data Equipment Available - informs radio that external device is ready to accept data.
- KEYLINE An external PTT operated from within the External MODEM. Both KEYLINE and DEA are read on separate lines of the Control PWB Switch Input Register, and will only key the transmitter when a data call is in progress.
- DCR Data Channel Ready - signal to external device inviting data to be sent. DCR will not be in 'ready' state until the radio is transmitting. This line is buffered by TR2202.

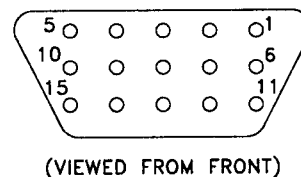
A +13V power source derived from the radio power supply is available for powering an external device. This supply is protected by a 250mA fuse.

Sequential Tone Encoding

Sequential signalling is controlled by the signalling microprocessor on the Control PWB. Encode tones are generated by the microprocessor on port 1 (pins 7, 8, 9), as a series of square-waves which are summed together by Digital-to-Analogue Converter (DAC) IC2202 and IC2203. The product is a 5-stepped squared waveform which is filtered by another stage of IC2203 to produce an acceptable sinusoidal waveform. The signal then passes via preset level potentiometer RV2201 (TONE DEVIATION LEVEL) before gating to the external Tx audio line.

Connections external to the radio are made by SKTG, which connects to a 15-way data socket (similar to the microphone connector). The pin numbering of the socket is as follows:

Pin Number	Connection
5	Rx Audio live
10	Rx Audio ground (analogue)
1	+13,6V
14	Tx Audio live
9	Tx Audio ground (analogue)
12	DCR (Data Channel Ready)
6	Keyline live
7	Keyline ground (digital)
11	DEA live
8	DEA ground (digital)



STANDARD CONSOLE

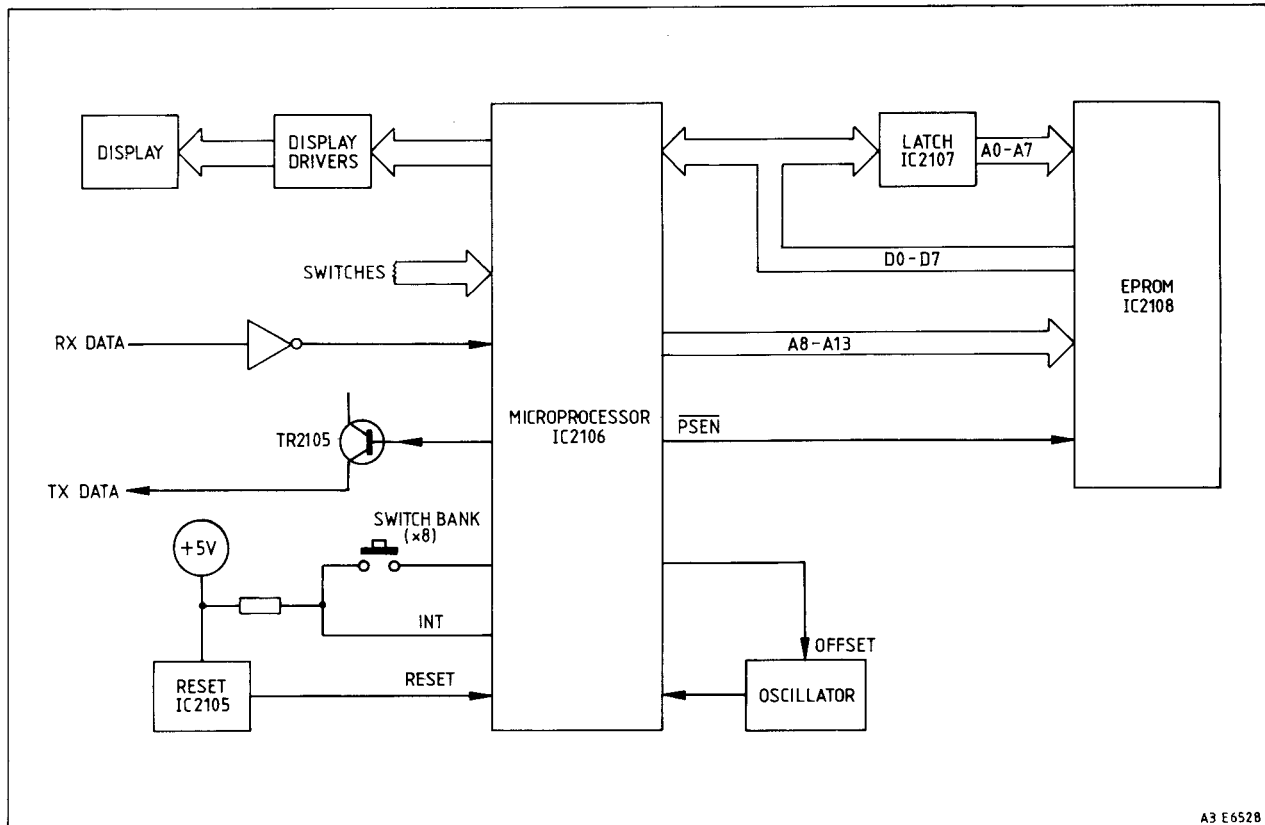


Fig 3.7 Standard Console Block Diagram

Microprocessor IC2106 receives and issues control information to and from peripheral devices. System operation is defined by a set of instructions either stored in EPROM IC2108 or masked within the processor, depending on the presence of R2103 or R2102. When R2103 is fitted, instructions are masked within the processor and IC2107 and IC2108 may be omitted from the PWB. When R2102 is fitted, instructions are read from EPROM IC2108.

Instructions within EPROM IC2108 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').

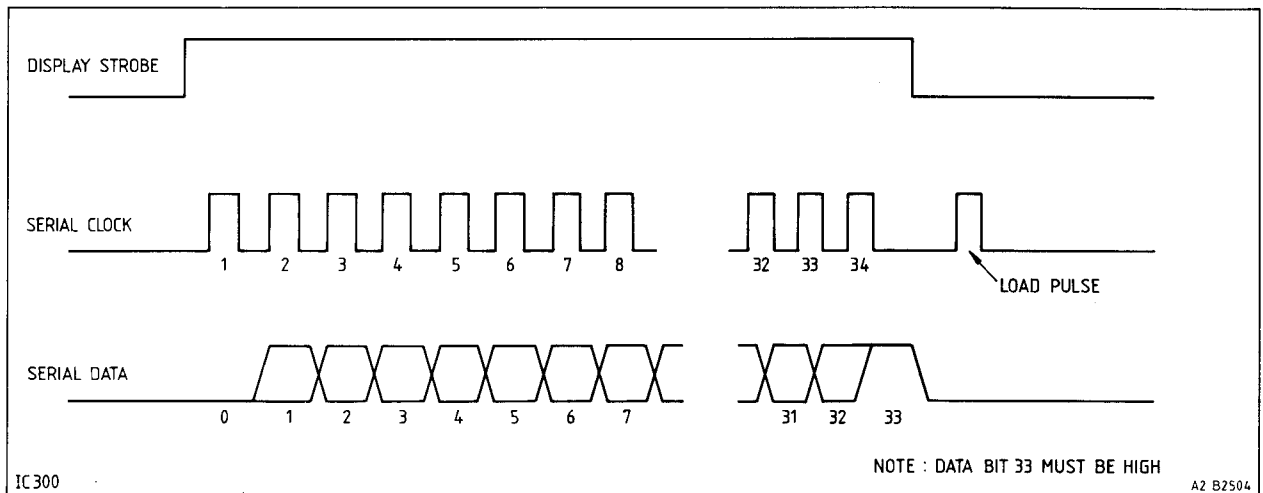


Fig 3.8 Display Driver Timing Diagram

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.

SECTION 4 SERVICING

PRECAUTIONARY NOTES AND GENERAL INFORMATION

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.

Electronic Security Device (FM1200 only)

Units for use on Band III trunked systems are required to have a unique security number. This is held in the signalling EPROM on the Control PWB. If this device is suspect, then the PWB should be replaced, and the customer and network provider informed of the new electronic serial number.

A cover is placed over the EPROM and bonded to the PWB to prevent unauthorised removal. This cover, the EPROM and the EPROM label must be intact when presented to your dealer or Philips Service Depot, if an Exchange Unit is required.

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 divided into sub-ranges. Code allocations are as follows:

Cct Ref	Printed Wire Board (PWB)	Sub-Ranges
301 - 600	Control/Digital Signalling	301-400 Transceiver Control 541-570 Digital Signalling
2101 - 2200	Standard Console	
2201 - 2260	Non-Prescribed Data	

CONSTRUCTION

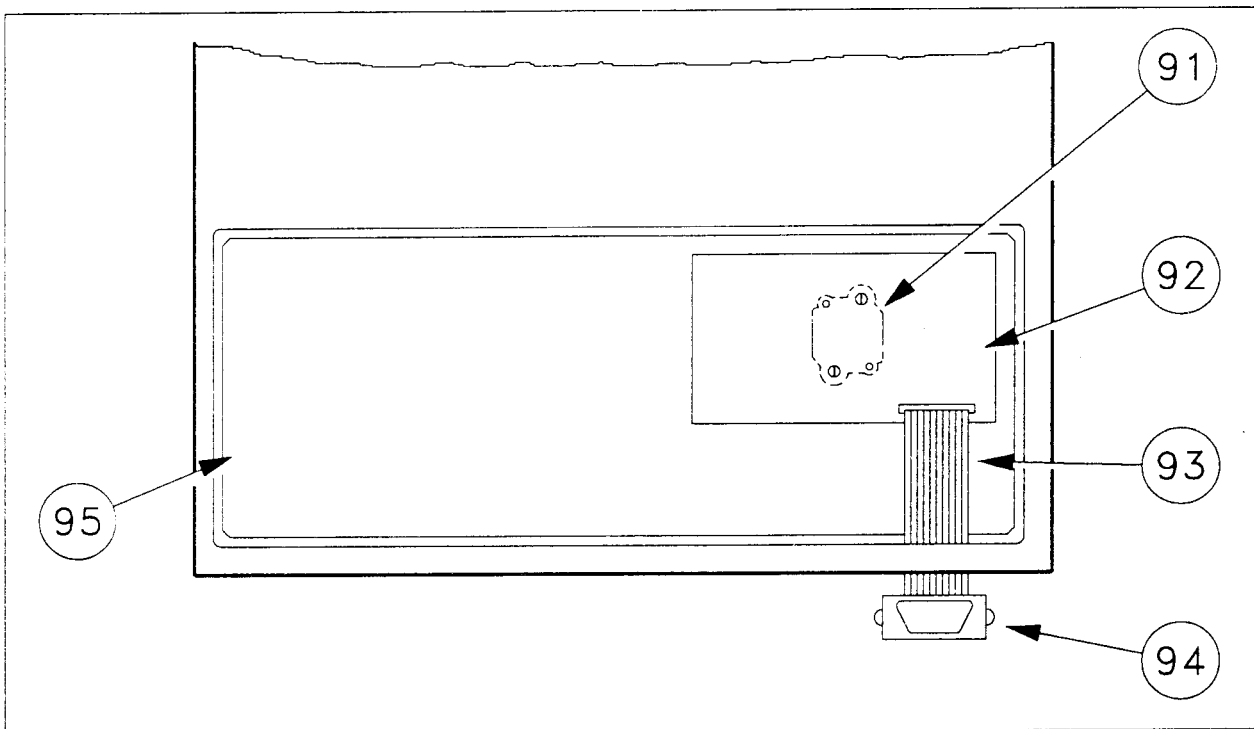


Fig 4.1 Non-Prescribed Data and Control PWBs

The Control/Digital Signalling PWB (95) for FM1200 or FM1300 radios is located in the same position as the corresponding assembly for FM1100. An optional Non-Prescribed Data PWB (92) may be plugged into the Control PWB via three in-line connectors and secured by a single screw which threads into the EPROM cover (91) of the Control PWB. A connector (94) similar to the standard microphone/data socket on the extended frame is connected to the Non-Prescribed Data PWB via a ribbon cable (93).

When the Non-Prescribed Data PWB is not used, the second data socket is replaced by a blanking piece.

TEST EQUIPMENT

CAUTION

It is possible for the radio to transmit short bursts of data 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	
Frequency Counter	68 - 520MHz 1000 - 2000Hz	
AF Signal Generator	67,0 - 2800Hz	
Modulation Meter	68 - 520MHz	Combined Test Set Marconi TF2955
RF Power Meter	50W, 50Ω	
AF Power Meter	3W, 3Ω	
Distortion Analyzer	True RMS reading	
Trunking Signalling Test Set		Schlumberger 4040 with Trunking Software
Portable Data Programmer	see TP862	
RF Signal Sampler	20dB min attenuation	Bird 4275-020
Keypad Console or Standard Console		Part No 3513 505 00561 Part No 3513 505 00911
FM1000 Test Interface	see TP253	Part No SH10089
Set of Trimming Tools		Part No AT00007

TEST MODE

To align the radio, it is necessary to override its signalling protocol. This is achieved by setting it into test mode.

To select test mode, switch off the radio and then connect pin 6 of the Battery Lead Assembly to pin 4 (0V).

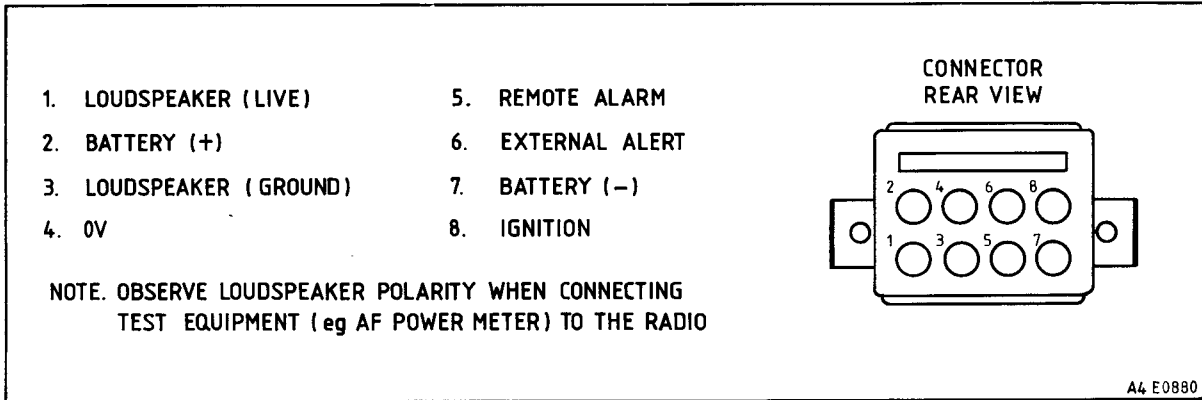


Fig 4.2 Battery Lead Connector

On selection of test mode, FM1200 radios tune to the Base Channel (Channel 0). In order to fully align the radio it will be necessary to select channels at the lower, middle and upper ends of the frequency band of the radio. The radio calculates its receiver and transmitter channels from a synthesiser base code. In order to select other frequencies this code must be changed. Note that it is only possible to select alignment channels in Test Mode.

Table 4.1 - Synthesiser Codes for Test Frequencies (FM1200 only)

Freq (MHz)	Code	Freq (MHz)	Code
68	10880	225	36000
75	12000	400	16000
78	12480	410	17600
88	14080	420	19200
132	21120	425	20000
138	22080	431	20960
144	23040	437	21920
146	23360	440	22400
153	24480	447	23520
156	24960	450	24000
160	25600	455	24800
174	27840	470	27200
183	29280	482	29120
192	30720	495	31200
200	32000	520	35200
208	33280		

On selection of test mode, FM1300 radios tune to Channel 1. Low, mid and high alignment channel frequencies are stored in EEPROM and reference to the Equipment Data Sheet should be made to identify these.

KEYPAD CONSOLES (FM1200 only)

Receiver and Transmitter Frequencies

By "dialling-in" certain number strings via the Keypad Console it is possible to alter the transmitter and receiver codes.

Overwrite Tx Test Base Code:

Enter "202nnnnn #" where "nnnnn" is the new Tx Test Base Code number.

For Example;

to change the base code to 192MHz (code 30720), type "20230720" followed by "#".

Overwrite Rx Test Base Code:

Enter "201nnnnn #" where "nnnnn" is the new Rx Test Base Code number.

The radio will only respond to new base codes if a valid receiver base code is entered. If a transmitter base code only is entered, the radio will ignore this code and use the existing code. This does not preclude entering the existing receiver base code with a new transmitter code.

FFSK Signalling

The dialled strings used to control the FFSK encoder can be dialled directly from the console keypad, as follows:-

Enter "30000001#"	to transmit a 1200Hz tone.
Enter "30000002#"	to transmit a 1800Hz tone.
Enter "30000003#"	to encode 101.. sequence.
Enter "30000000#"	to disable tone output.

STANDARD CONSOLES (FM1200 only)

Receiver and Transmitter Frequencies

When a Standard Console is used to change base codes, it must be used in conjunction with a Portable Data Programmer (PDP). Base Codes are entered into one of the radio's short-form memories and a key switch on the standard console is assigned to each code. The PDP programs the short-form memories within the radio. Once the new key function information is entered, it is read into the console's memory by disconnecting the PDP. The Console is then powered-up by switching it on at the ON-OFF switch.

Parameter number #630 is assigned to Short Form Memories with extension 0 to 9 for memories 0 to 9 respectively.

Enter "202nnnnn #" where "nnnnn" is the new Tx Test Base Code number.

For Example;
to change the base code to 192MHz (code 30720), type "20230720" followed by "#".

Overwrite Rx Test Base Code:

Enter "201nnnnn #" where "nnnnn" is the new Rx Test Base Code number.

If Parameter #630.0 (Short-Form Memory 0) is customised with 20112345 and parameter #501 (console key 1) is assigned value 130 (Short Form Memory 0), then pressing console key 1 will over-write the receiver base code with 12345, causing the radio to tune its new channel.

Note: In most equipments set up for service, the key functions will already be customised either with CALL0, CALL1, CALL2 etc where CALL0 is assigned to short form memory 1. Alternatively, where [+] and [-] keys are customised, the same effect can be achieved by scrolling the display via [+] and [-] keys to the relevant memory and pressing [CALL].

The radio will only respond to new base codes if a valid receiver base code is entered. If a transmitter base code only is entered, the radio will ignore this code and use the existing code. This does not preclude entering the existing receiver base code with a new transmitter code.

FFSK Signalling

Note: The dialled strings used to control the FFSK encoder MUST be programmed into the radio's short-form memories before testing commences. Once programmed, pressing the appropriate Console key will then have the same effect as dialling the full string from the Keypad Console.

Using a PDP, customise the radio as follows:

Parameter	Customisation Data	Function	Console Key
#630.0 #501	30000001 130	Enable 1200Hz	Key 1
#630.1 #502	30000002 131	Enable 1800Hz	Key 2
#630.2 #503	30000000 132	Disable Tones	Key 3

To encode any FFSK tone, the radio must be set to transmit.

KEYPAD CONSOLES (FM1300 only)

Receiver and Transmitter Frequencies

Transmitter and receiver channels are pre-programmed into the radio (parameters #609 and #610 respectively). To select a channel from the Keypad Console, the radio must first be in test mode.

To select a normal Speech Channel:

Enter "201nnn #" where "nnn" is the number of the speech channel required.

To select a NPD Channel:

Enter "202nnn #" where "nnn" is the channel number of the NPD channel required (receiver and transmitter audio will be routed through the NPD Interface PWB).

FFSK Signalling

The dialled strings used to control the FFSK encoder can be dialled directly from the console keypad, as follows:-

Enter "300001#" to transmit a 1200Hz tone.
Enter "300002#" to transmit a 1800Hz tone.
Enter "300003#" to encode 101.. sequence.
Enter "300005#" to encode 5-Tone sequence.
Enter "300000#" to disable tone output.

STANDARD CONSOLES (FM1300 only)

Receiver and Transmitter Frequencies

Transmitter and receiver channels are pre-programmed into the radio (parameters #609 and #610 respectively). To select a channel from the Keypad Console, the radio must first be in test mode.

To select a normal Speech Channel:

Enter "201nnn #" where "nnn" is the number of the speech channel required.

To select a NPD Channel:

Enter "202nnn #" where "nnn" is the channel number of the NPD channel required (receiver and transmitter audio will be routed through the NPD Interface PWB).

If Parameter #630.0 (Short-Form Memory 0) is customised with 201123 and parameter #501 (Console key 1) is assigned value 130 (Short Form Memory 0), then pressing console key 1 will tune the radio to channel 123.

FFSK Signalling

Note: The dialled strings used to control the FFSK encoder MUST be programmed into the radio's short-form memories before testing commences. Once programmed, pressing the appropriate Console key will then have the same effect as dialling the full string from the Keypad Console.

Using a PDP, customise the radio as follows:

Parameter	Customisation Data	Function	Console Key
#630.0 #501	300001 130	Enable 1200Hz	Key 1
#630.1 #502	300002 131	Enable 1800Hz	Key 2
#630.2 #503	300003 132	Enable 101.. Sequence	Key 3
#603.3 #504	300004 132	Enable Paging Tones	Key 4
#630.4	300000	Disable Tones	Key 5

To encode any FFSK tone, the radio must be set to transmit.

FAULT DIAGNOSIS

General

To locate faults related to the software detection of hardware inputs (eg the squelch input or the PTT line), the first point of investigation should be the input detection device concerned. For example, the PTT line and the test mode input both use the Switch Input register to interface with the control unit. Therefore, if the unit ignores the PTT line but can be placed in test mode (by taking External Alert 'low') then the Switch Input register is being read correctly and the fault must lie somewhere between the microphone and the relevant input pin of the Switch Input register.

Error Alert Tones

When powered up, the Control PWB performs a series of checks on the radio unit and provides an audio indication if any of these checks fail. These checks are detailed below.

Unit generates a 400 Hz tone which is on for 150ms and off for 150ms. Total Duration 5 seconds.

- a) Radio is not customised or EEPROM not fitted.
- b) The radio is unable to communicate with the console, either because the console is disconnected, or a fault exists in the console or bus connected to it.
- c) Signalling microprocessor (IC548) not running.

As above, but the Console momentarily generates a test display (all segments on) and then goes blank.

- a) The signalling microprocessor has detected a fault such as the MODEM not functioning or a short circuit on a microprocessor port.

Unit generates a 400Hz tone which is on for 150ms and off for 150ms, lasting indefinitely. The console briefly generates a test display (all segments on) and then goes to 'Idle' display (No, SVC, --0).

- a) Synthesiser not locked (tone will cease if synthesiser locks).

Note: Powering up in Test Mode may cause this alert to occur but providing it ceases after approximately 5 seconds it may be ignored.

Unit does not generate Alert Tone and, although console is backlit, the display remains blank.

- a) Control (IC312) microprocessor not running.

ALIGNMENT PROCEDURE

RF adjustment of the radio should be carried out as detailed in the FM1000 Service Manual (TP253).

FFSK ALIGNMENT (Frequency Modulation)

ADJUST	ACTION
1.	With the radio set to transmit, select 1200Hz tone output.
2. RV541	Adjust to give 60% ($\pm 10\%$) peak system deviation.
3.	Select 1800Hz tone output.
4. RV541	Check modulation. If level is not 60% ($\pm 10\%$) peak system deviation, re-adjust RV541.
5. RV541	Repeat steps 2 to 4, adjust for the best balance until both are within $\pm 10\%$ of 60% peak system deviation.

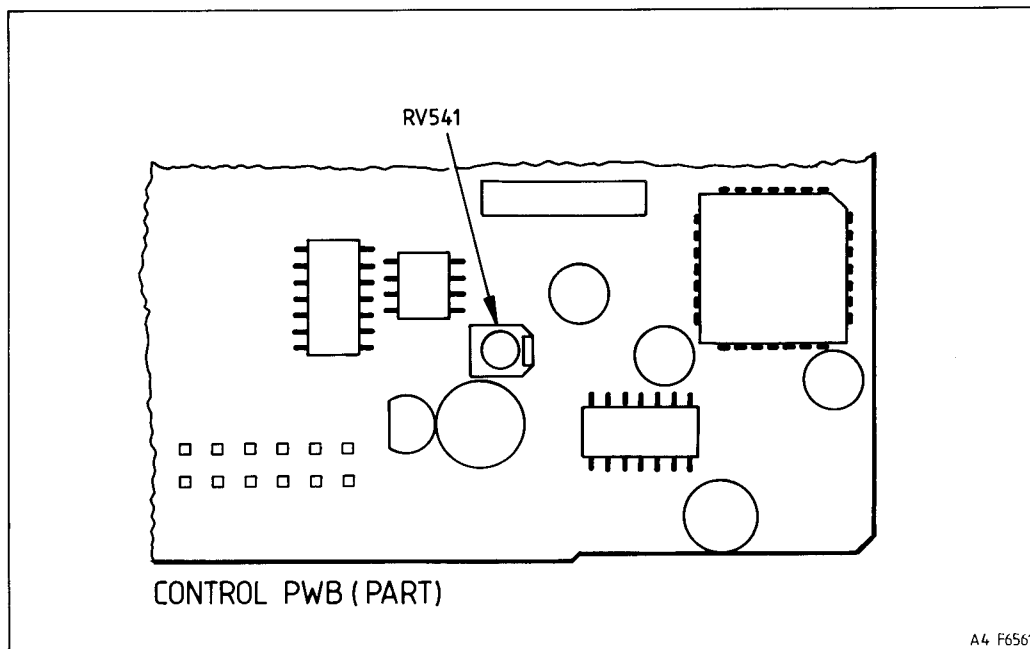


Fig 4.3 Location of RV541

FFSK ALIGNMENT (Phase Mod)

ADJUST	ACTION
1.	With the radio set to transmit, select 1200Hz tone output.
2. RV541	Adjust to give 40% ($\pm 10\%$) peak system deviation.
3.	Select 1800Hz tone output.
4. RV541	Check modulation. If level is not 60% ($\pm 10\%$) peak system deviation, re-adjust RV541.
5. RV541	Repeat steps 2 to 4, adjust for the best balance until 1200Hz tones is within $\pm 10\%$ of 40% peak system deviation and 1800Hz tone is within $\pm 10\%$ of 60% peak system deviation.

SEQUENTIAL TONE ENCODING (FM1300 Non-Prescribed Data only)

1. Select Paging Mode from Keypad Console. Check that tone deviation is 60% ($\pm 10\%$) peak system deviation. Adjust RV2201 on Non-Prescribed Data PWB if necessary to achieve this.

PERFORMANCE CHECKS

Carry out RF Performance Checks as detailed in the FM1000 Service Manual (TP253).

FFSK SIGNALLING

Note: These checks require the radio to be in test mode and, where a Standard Console is in use, dial strings stored in short-form memories, as detailed earlier in this Section.

Connect the radio to a 50 Ω dummy load or power meter and a modulation meter with its demodulated output connected to an audio frequency counter.

1. Key the radio to transmit and select 1200Hz tone modulation. Check that the modulation frequency is 1200Hz ($\pm 1\%$), and that the modulation level is within the following limits:

Phase Modulation	Frequency Modulation
40% ($\pm 10\%$) psd	60% ($\pm 10\%$) psd.
2. Select 1800Hz tone modulation. Check that the modulation frequency is 1800Hz ($\pm 1\%$), and that the modulation level is within 60% ($\pm 10\%$) peak system deviation (FM and PM radios).
3. Select "no-tone" modulation. Check that all modulation ceases. Set the radio to receive.
4. Air-check radio on trunking system used by subscriber.

SEQUENTIAL TONE ENCODING (FM1300 Non-Prescribed Data only)

1. Select Paging Mode from the Keypad Console. Check that tone deviation does not exceed 70% peak system deviation.

TEST DATA (FM1200 only)

Calculation of Tx & Rx Synthesiser base codes

$$\text{Synthesiser Base Code} = \frac{\text{Channel Frequency} - \text{Base Frequency}}{\text{Reference Frequency}}$$

where:- Base Frequency = 0MHz for VHF and 300MHz for UHF Bands.

Reference Frequency

6,25kHz or 5,0kHz (depending on channel spacing)

SECTION 5 PARTS LIST

VHF/UHF FM MOBILE RADIOTELEPHONE TYPES FM1200 & FM1300

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	

Description	Part No	Remarks
Control/Digital Signalling PWB	———	see table below
Non-Prescribed Data PWB	3513 500 01051	
Screw, st, FM2,2 x 6mm	3513 993 57002	1/NPD PWB - chassis
Bracket, Socket Housing, Grey	3513 900 40051	2 off
Clamp	3513 900 80021	
Connector, Blanking, Grey	3513 900 60241	
PCB Flexible, Data	3513 506 00321	
Socket, 15-way, Data	4313 324 40071	
Screw, st, psm, FM2,5 x 8mm	3513 993 57023	2/Clamp, 4/Socket Housing

TABLE 5.1 - CONTROL/DIGITAL-SIGNALLING PWB

	FM	PM
FM1200	3513 500 01671	3513 500 01681
FM1300	3513 500 01691	3513 500 01701

FM1200 radios built before December 1989 use 3513 500 01671

STANDARD CONSOLE

FM1200
FM1300

3513 505 00911
to be advised

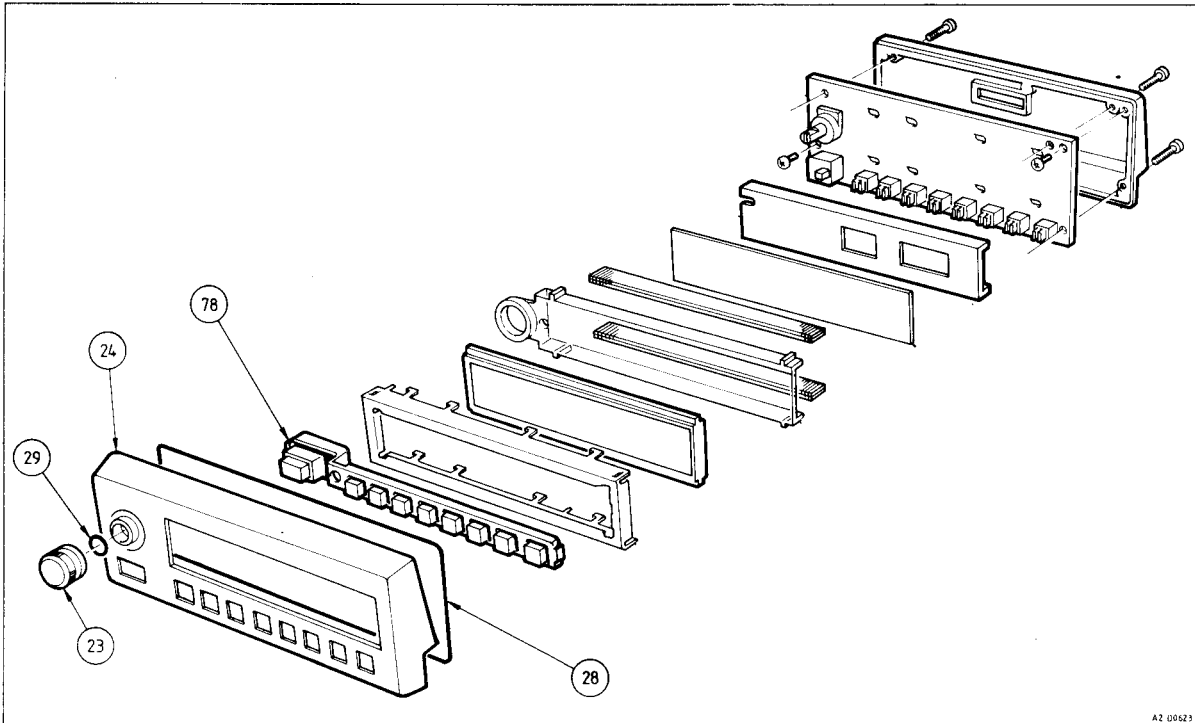
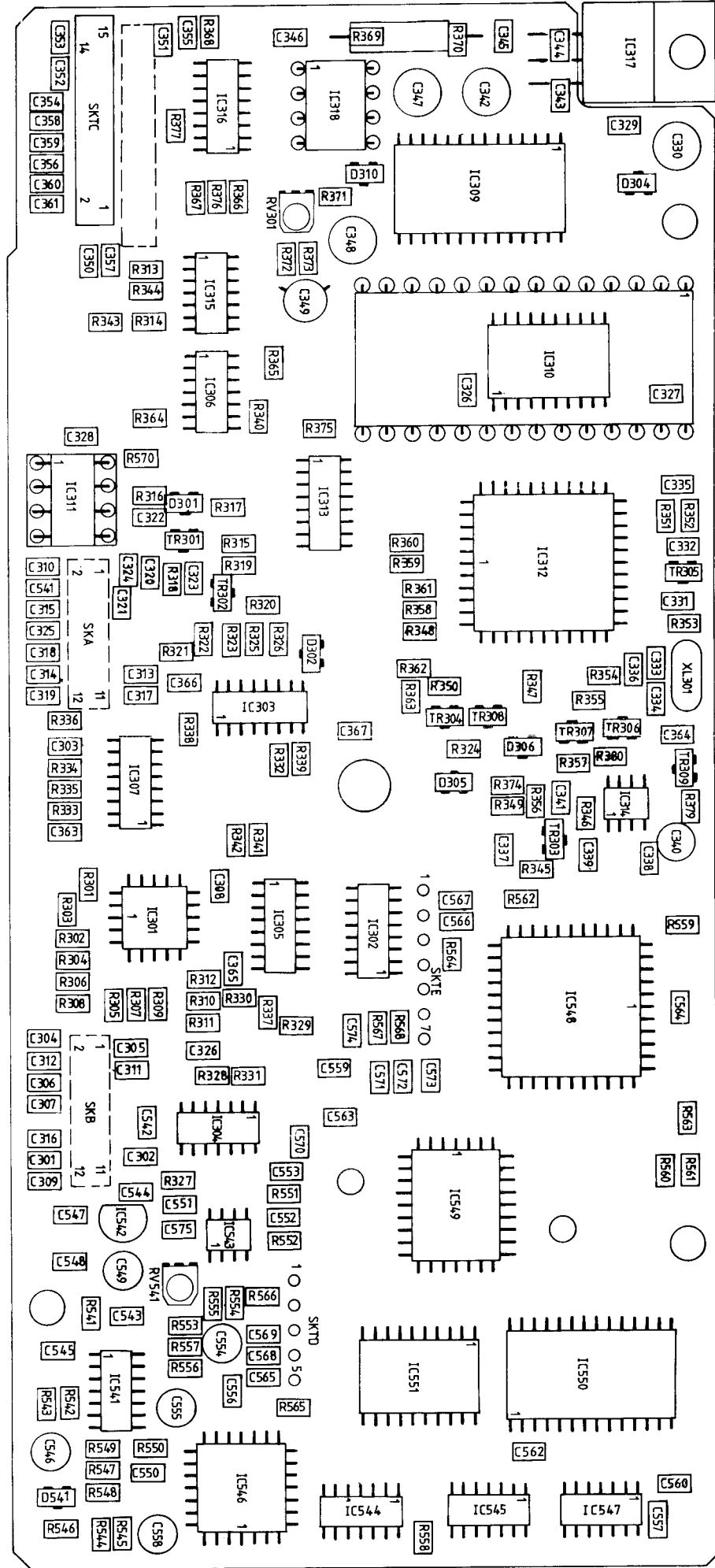
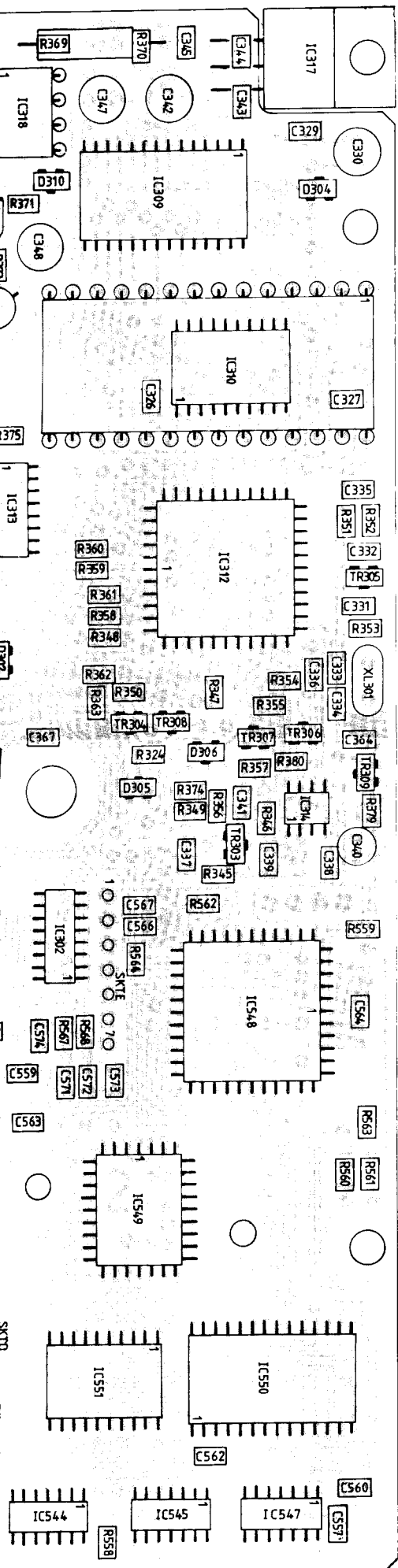


Fig 5.1 Exploded Diagram - Standard Console

Item	Description	Part No	Remarks
(23)	Knob, Volume, Grey	3513 903 00091	
(24)	Housing, Front, Grey	3513 902 30081	
(28)	Gasket	3513 902 10011	
(29)	"O" Ring, Rubber	3513 905 60021	
(78)	Switch Membrane, Grey	3513 900 20081	

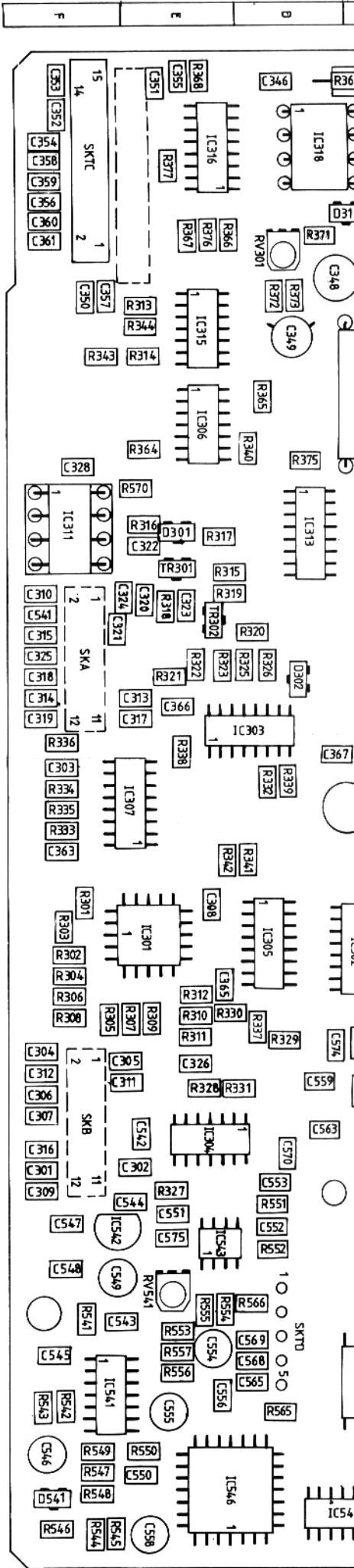
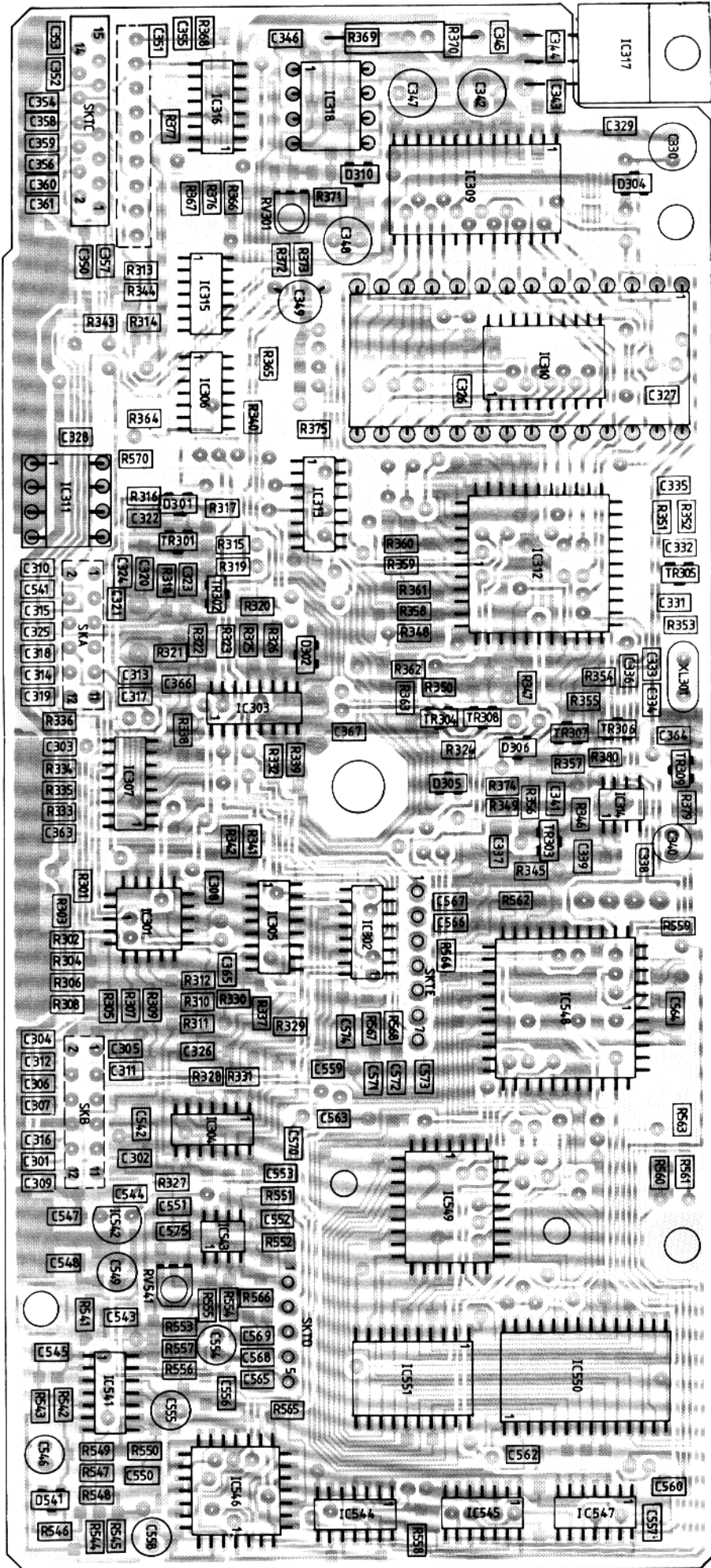
Screws:

—	Screw, st, pan, pozi, M2,5 x 5mm	2522 175 21037	4/PWB-Back Plate
—	Screw, st, psm, thr, 2,2 x 10mm	3513 993 57005	4/Backplate-Front Housing



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FIG. 6.1 CONTROL/DIGITAL SIGNALLING PWB
COMPONENT LOCATION DIAGRAM

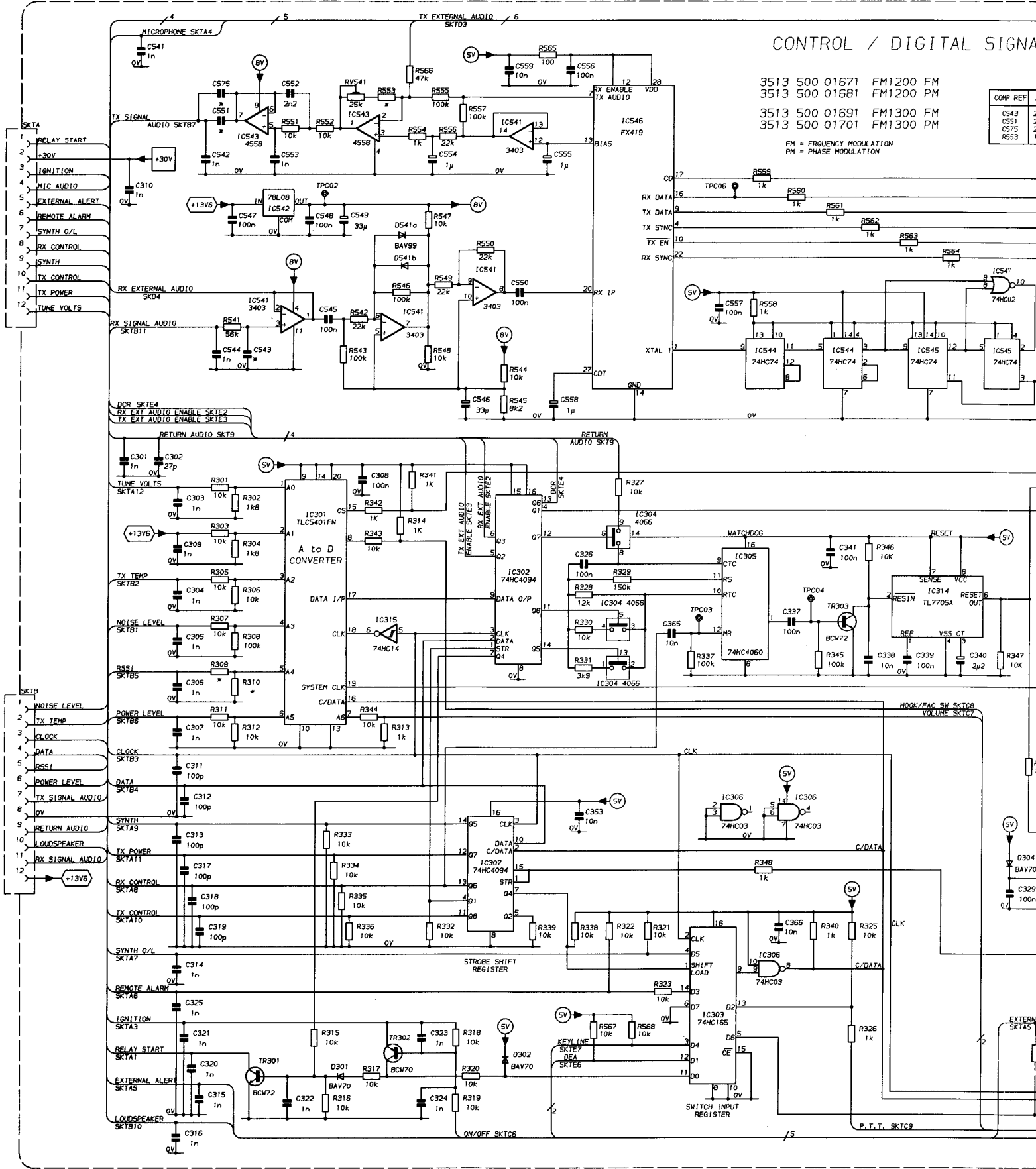


CONTROL / DIGITAL SIGNAL

3513 500 01671 FM1200 FM
 3513 500 01681 FM1200 PM
 3513 500 01691 FM1300 FM
 3513 500 01701 FM1300 PM

COMP REF	DESCRIPTION
C543	
C551	
C575	
R553	

FM = FREQUENCY MODULATION
 PM = PHASE MODULATION



COMP REF	DESCRIPTION
D302	
D301	
R349	
R348	
R347	
R346	
R345	
R344	
R343	
R342	
R341	
R340	
R339	
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R1	

CONTROL / DIGITAL SIGNALLING ASSEMBLY

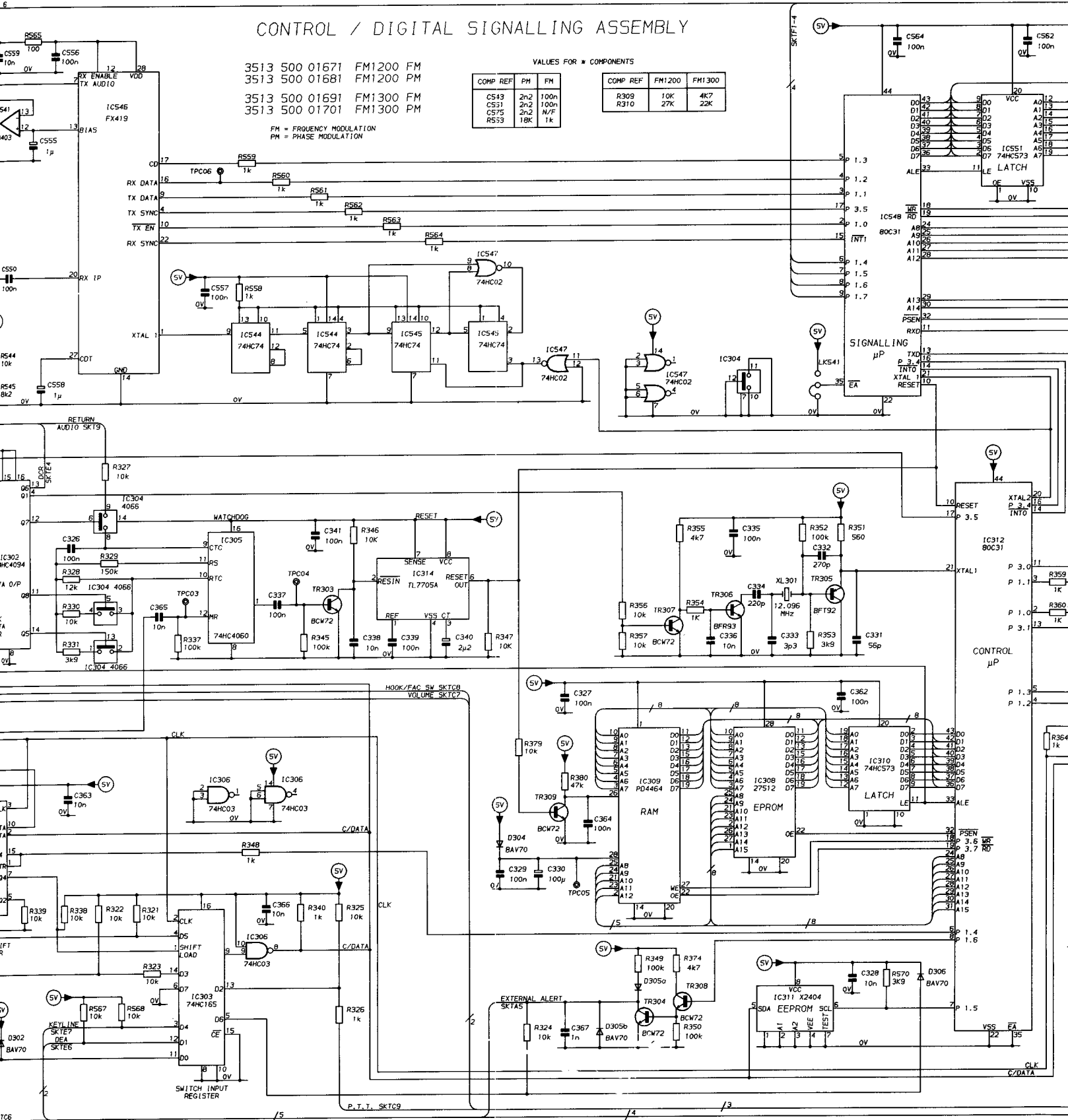
3513 500 01671 FM1200 FM
 3513 500 01681 FM1200 PM
 3513 500 01691 FM1300 FM
 3513 500 01701 FM1300 PM

FM = FREQUENCY MODULATION
 PM = PHASE MODULATION

VALUES FOR * COMPONENTS

COMP REF	PM	FM
C543	2n2	100n
C531	2n2	100n
C575	2n2	N/F
R553	18K	1K

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



ALLING ASSEMBLY

VALUES FOR * COMPONENTS

PM	FM	COMP	REF	FM1200	FM1300
2n2	100n	R309		10K	4K7
2n2	100n	R310		27K	22K
2n2	N/F				
18K	1k				

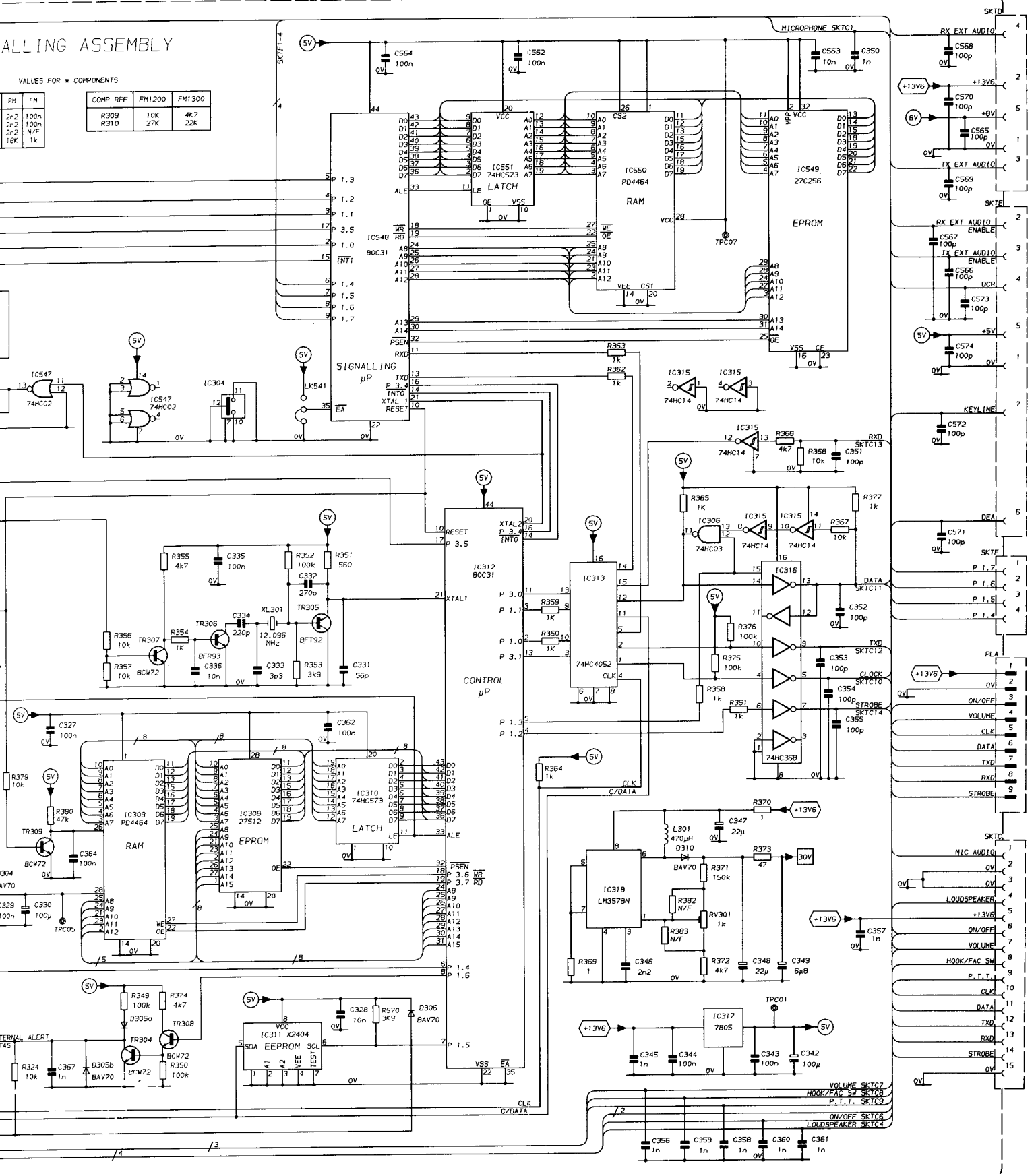
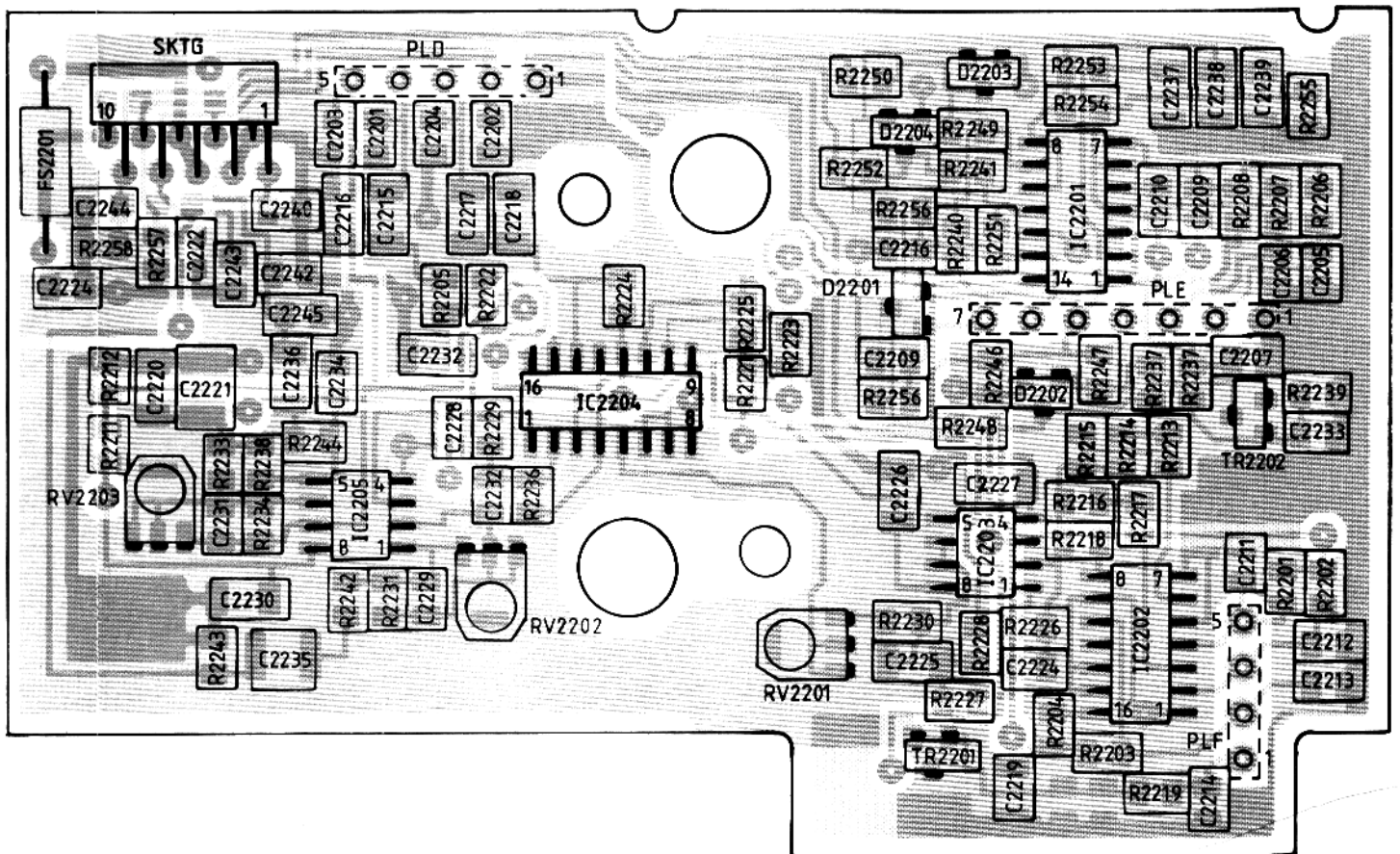
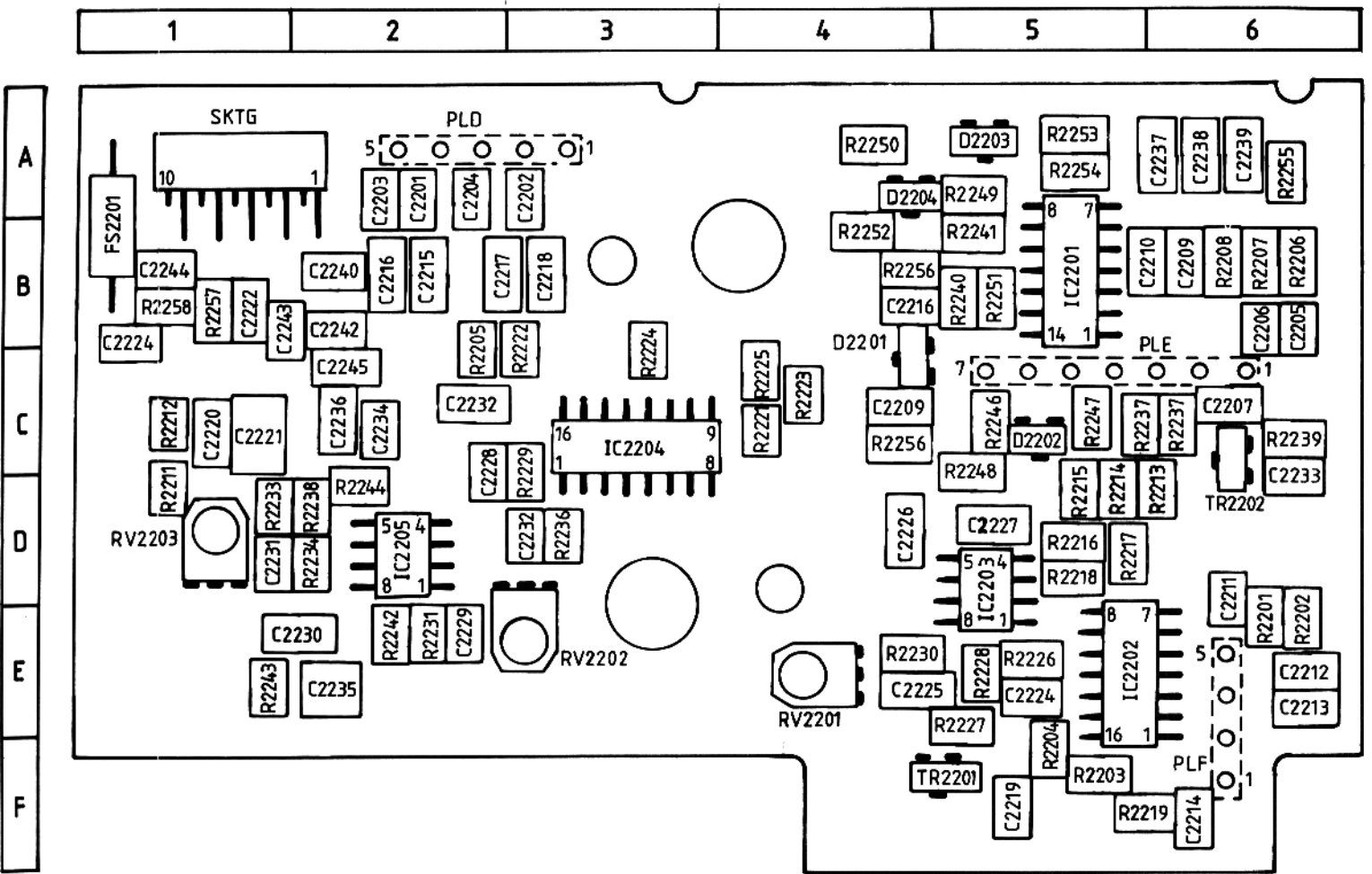
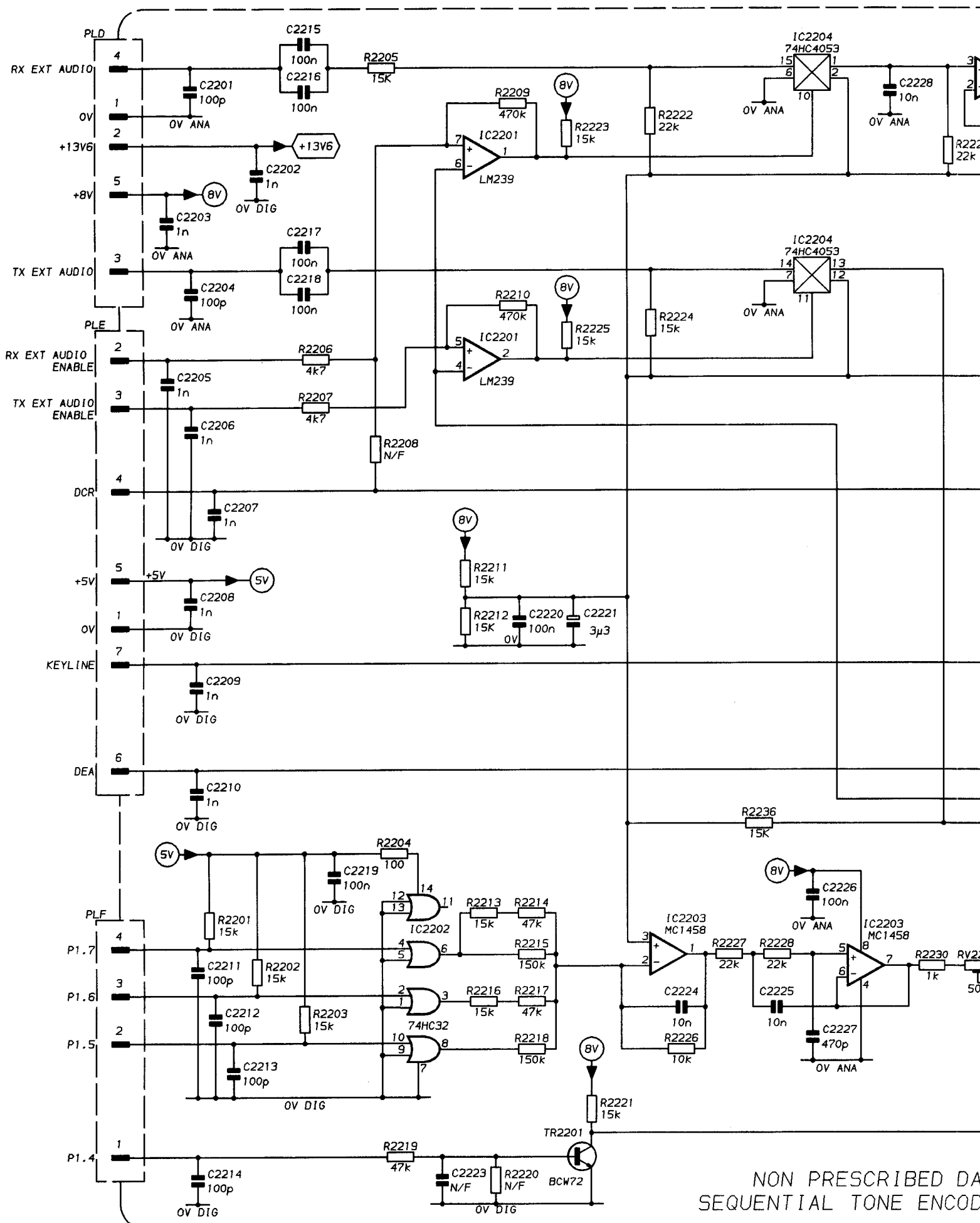


FIG 6.2 CONTROL/DIGITAL SIGNALLING PCB CIRCUIT DIAGRAM

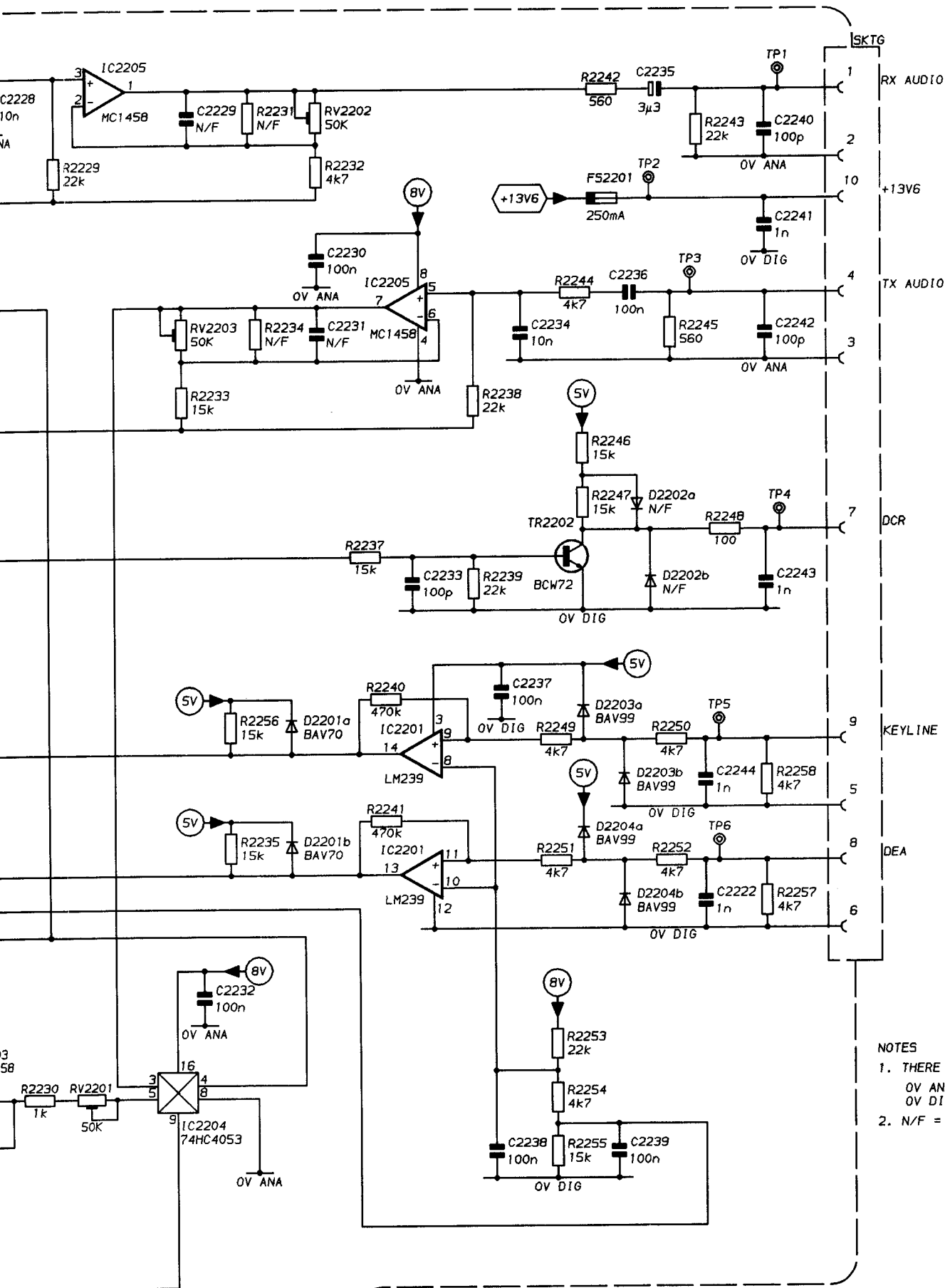


A3 F6600

FIG 6.3 NON-PREScribed DATA PWB COMPONENT LOCATION DIAGRAM



NON PRESCRIBED DA
SEQUENTIAL TONE ENCODER

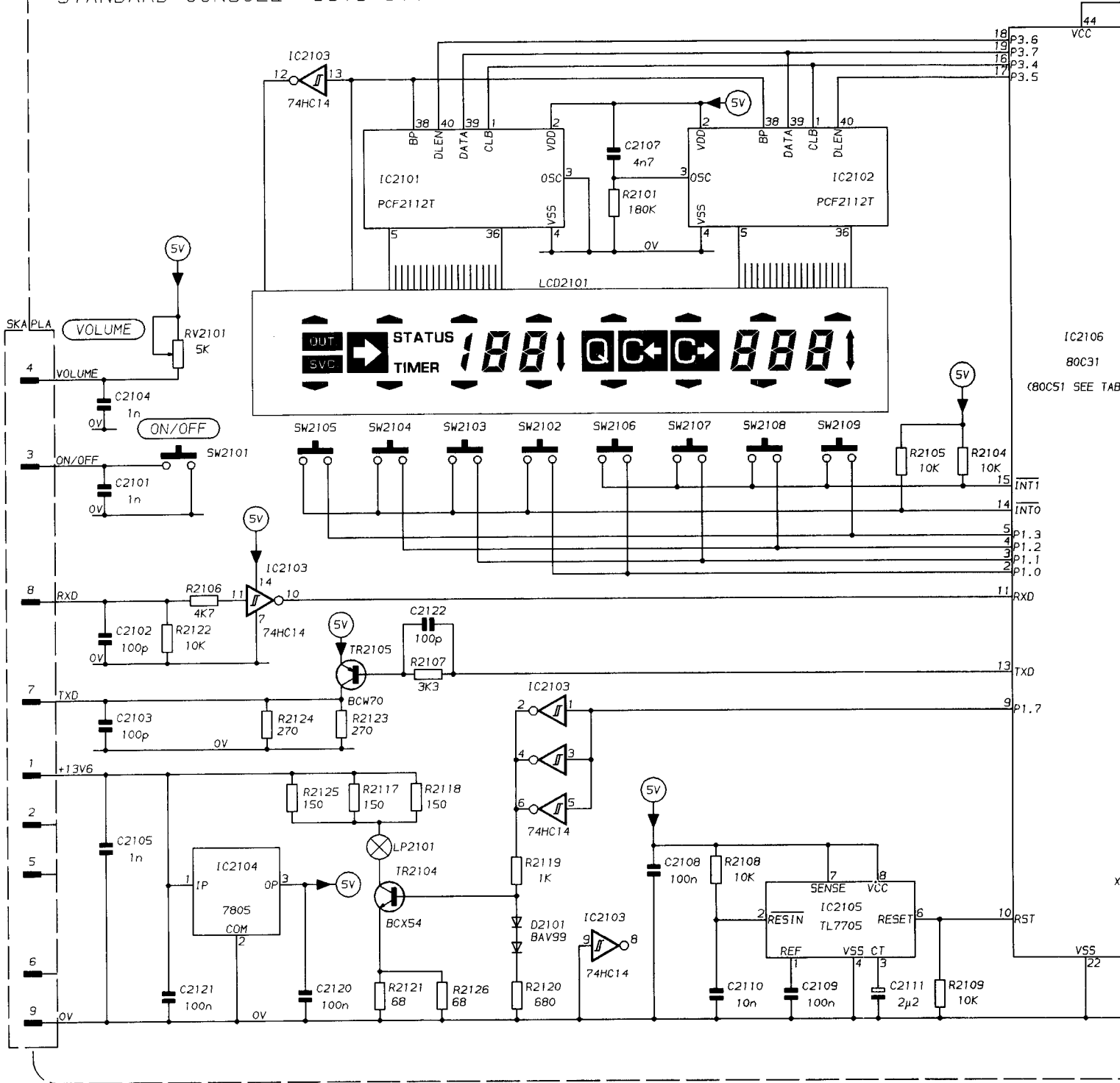


- NOTES
1. THERE 2 GROUNDS ON PCB
OV ANA = ANALOGUE GRND
OV DIG = DIGITAL GRND
 2. N/F = NOT FITTED

IBED DATA &
E ENCODER ASSY.

FIG 6.4 NON-PREScribed DATA PWB
CIRCUIT DIAGRAM

STANDARD CONSOLE 3513 500 00702

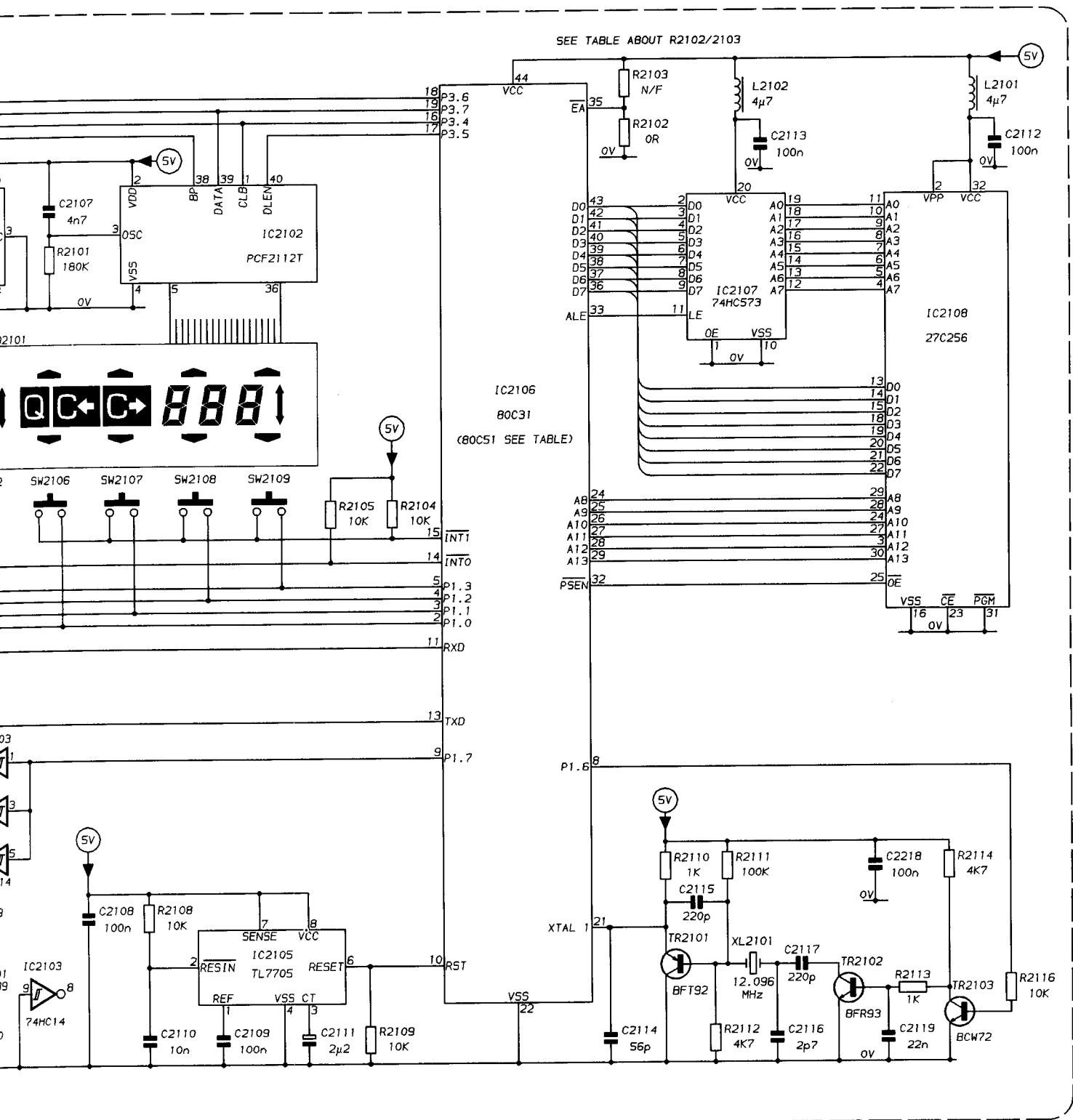


NOTES
1. N/F = NOT FITTED

MEMORY ACCESS

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

FIG 6.6 FM1200/FM1300 STANDARD CONSOLE
CIRCUIT DIAGRAM



SEE TABLE ABOUT R2102/2103

IC2106
80C31
(80C51 SEE TABLE)

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

APPENDIX A

FM1200 CUSTOMISATION FUNCTIONS

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#551-558 Visual Indicator Functions 1-8	A.6
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#602 * Channel Separation Code	A.8
#603 * Reference Frequency	A.8
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#616 Network Group Numbers 0-3	A.9
#622 Own Fleet Group Base Ident	A.9
#623 Maximum Own Fleet Unit Number	A.10
#624 Maximum Own Fleet Group Number	A.10
#630 Short-Form Memories 0-9	A.10
#631 ** Short-Form Memory Labels 0-9	A.10
#632 Alarm Function	A.10
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#640 ** 5-Digit Fleet Routing Codes 0-9	A.11
#641 ** 5-Digit Prefixes 0-9	A.11
#642 ** 5-Digit Base Identities 0-9	A.11
#643 ** 5-Digit Maximum Numbers 0-9	A.11
#650 Inter-Fleet Group Flag	A.11
#651 Despatcher Control	A.11
#652 Status Control	A.11
#653 SDM Control	A.12
#654 Equipment Control	A.12
#655 Include Call Control	A.12
#656 Maximum Transmitted Status	A.12
#657 PABX Calls Permitted	A.12
#658 PSTN Calls Permitted	A.12
#659 Queue Length	A.12

NETWORK ACCESS and REGISTRATION PARAMETERS

#670	Type of Selected Network	A.13
#671	Identity of Selected Network	A.13
#672	Zone Sub-field Length	A.13
#673	Area Sub-field Length	A.13
#674	Radio Unit Control Category	A.14
#675	Home Zone	A.14
#676	Access Authorization Types 0-9	A.14
#677	Access Authorization Values 0-9	A.14
#680	Normal Hunt Channel Numbers 0-31	A.14
#681	Normal Hunt Channel Types 0-31	A.14
#682	Network Minimum Channel Number	A.14
#683	Network Maximum Channel Number	A.14
#684	Comprehensive Hunt Flag	A.15
#685 **	Minimum Non-Applicable Channel Nos 0-9	A.15
#686 **	Maximum Non-Applicable Channel Nos 0-9	A.15
#690	Fall-back Channel Number	A.15
#691	Network-Dependent Data for Fall-back	A.15
#695	INFO field for RQR	A.15

THRESHOLD VALUES and TIMEOUTS

#700	NC1 - Continuous Channel	A.16
#701	NC1 - Time-shared Channel	A.16
#702	NC2 - Continuous Channel	A.16
#703	NC2 - Time-shared Channel	A.16
#704 *	ND1	A.16
#705 *	ND2	A.16
#706 *	NE	A.16
#707 *	NI	A.16
#708 *	NR	A.16
#709 *	NT	A.16
#710	NV - continuous channel	A.16
#711	NV - time-shared channel	A.16
#712 *	NW	A.16
#713	NX1 - Continuous Channel	A.17
#714	NX1 - Time-shared Channel	A.17
#715	NX2 - Continuous Channel	A.17
#716	NX2 - Time-shared Channel	A.17
#717	NZ1	A.17
#718	NZ2	A.17
#730-742 *	Timeouts	A.17
#743	Call Limit Time	A.18

ENGINEERING and MARKETING PARAMETERS

#900	EPROM Part Number	A.19
#901	Synthesiser Reference Crystal	A.19
#902	Second Oscillator Injection	A.19
#903	Write Count	A.19
#904	EEPROM Type	A.19
#905	Software Version	A.19
#906	Software Part No	A.19
#907	Electronic Serial Number	A.19
#908	Memory Check	A.20
#909	Market Variation	A.20
#910	HF Transmitter Power Compensation	A.20
#911-916	Transmitter Power Calibration Points 1-6	A.20
#921-924	Receiver Audio Noise Calibration Points 1-4	A.20
#931-934	Receive Signal Strength Calibration Points 1-4	A.20
#941-#948	Error Accounting	A.20
#989	Hardware Code for Labels	A.21
#990	Country Code	A.21
#991	Market Application Code	A.21
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#994	Frequency Stability	A.21
#995	Signalling Type	A.21
#996	Console Type	A.21
#998	Console Graphics Label	A.22
#999	TEE Customisation State	A.22

INTRODUCTION

Note: Certain parameters (marked *) must be set to defined values for MPT1343 operation. Other parameters (marked **) are only required when the radio incorporates keypad dialling, or are otherwise optional, and are not available for customisation if the radio is fitted with the small (512 byte) EEPROM.

Parameters listed in this appendix are applicable only to the FM1200 FFSK radio.

Not all parameters listed here are valid for every FM1200 radio. When an invalid parameter is selected the PDP will display the message 'ERR INVALID PARAM'.

This section defines the parameters and functions that are available for customising the FM1200 radio.

FM1200 functions are customised by storing parameters in non-volatile memory which control the operation of the radio. Facilities are provided in the Control and Signalling Unit to allow external programming devices (such as the Portable Data Programmer and the Comprehensive Data Programmer) to read and write individual parameters or all the customisation parameters.

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

- Keys and Indicators
- Transceiver Parameters
- Own Address and Fleet Address Data
- Network Access and Registration Parameters
- Threshold Values and Timeouts
- Engineering and Marketing Parameters

KEYS AND INDICATORS

#500-508 Key Functions 0 - 8

These parameters define the function of each key on the console/microphone combination. Parameter #500 refers to key number 0 which is the facility key on the microphone. Parameters #501 to #508 refer to keys 1 to 8 (numbered from left to right).

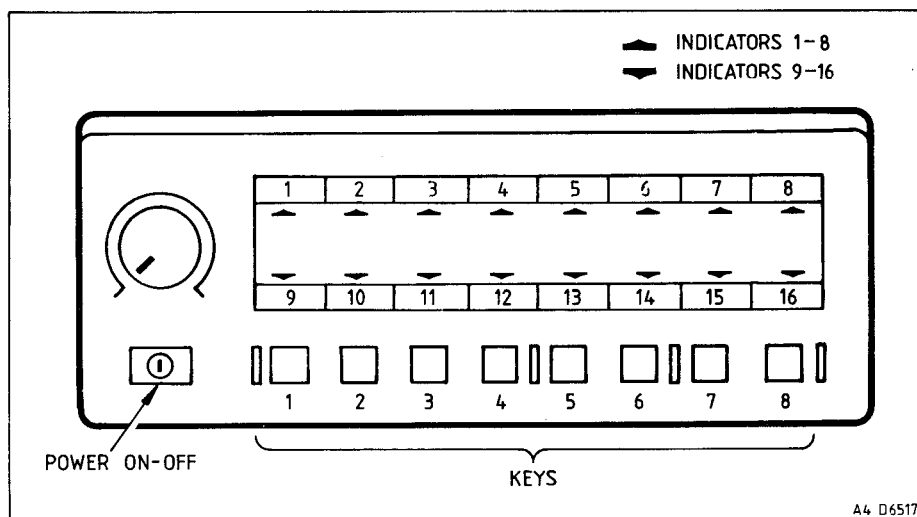


Fig A.1 Standard Console

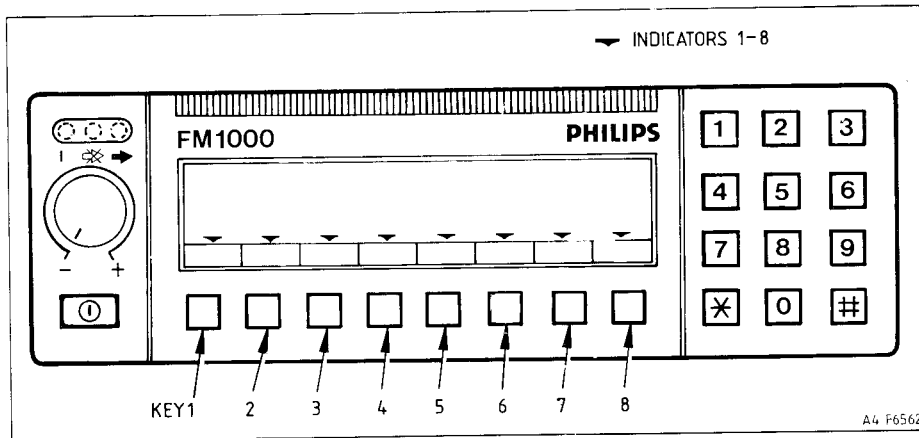


Fig A.2 Keypad Console

Available functions are as follows:

0 - 128	Null	142	* Call-back
129	Call	143	* Modifier
130	Call 0	144	* Status
.	.	145	Delete
.	.	146	Increment
139	Call 9	147	Decrement
140	Clear	148	* External Alert Enable
141	* Busy	149	* Memory

In addition to defining the function of the keys, parameters #501 to #508 also define the meaning of the indicators associated with the keys. If any of these parameters is set to a value marked with a "*" above, the indicator will have the corresponding meaning; otherwise, these indicators are unused.

#551-558 Visual Indicator Functions 1-8

These parameters define the functions of the simple console indicator that are not associated with keys. Parameters #551 to #558 refer to indicators 1 to 8 (normally numbered from left to right).

Available functions are as follows:

0-128	Null
129	JoinQ
130	LeavQ
131	Divert
132	Cancel Divert
133	Cancel Incoming Diversions
134	Emergency
135	Broadcast
136	Priority
137	Non-prescribed data

#570-582 Audible Confidence Indicator Definitions

The radio unit is capable of generating a range of predefined audible signals. The following parameters determine which of these signals is used for each audible confidence indicator.

The indicators are sub-divided into four categories as follows:

- Parameters #570-#572 define indicators which must be audible for MPT1343 operation:

#570	Go To Channel
#571	Alert
#572	Incoming Call Set Up In Progress

- Parameters #573-577 also define indicators which are mandatory under MPT1343 operation, but which may be provided either by audible or visual means:

#573	Outgoing Call Set Up In Progress
#574	Call Fail
#575	Number Unobtainable
#576	Call Clear
#577	Transaction Confirmed

- Parameters #578-579 define indicators which are optional under MPT1343, but which, if programmed, will be implemented as described in MPT1343:

#578	Call Queued
#579	Called Party Ringing

- Remaining parameters define other indicators.

#580	Key Click
#581	Operator Alert
#582	Hard Error Alert

Each parameter takes one of the following values:

- 0 - No Tone
- 1 - Click
- 2 - Buzz
- 3 - Five Second Error
- 4 - Unbroken Low Tone
- 5 - Broken Low Tone
- 6 - Double Pip
- 7 - Repeated Double Pip
- 8 - Blip
- 9 - Telephone Ring

#598 Minimum Alert Volume Setting

Minimum volume setting for audible confidence indicators, in the range 0 to 15.

#599 Maximum Alert Volume Setting

Maximum volume setting for audible confidence indicators, in the range 0 to 15. Must be greater than or equal to the Minimum Alert Volume Setting.

TRANSCEIVER PARAMETERS

The following parameters control transceiver operation.

#600 * Receiver Synthesiser Base Code

This code is in the range 0 - 65535. It is an offset above a base frequency in steps equal to the reference frequency (parameter #603) that defines the frequency of forward protocol channel 0, from which the frequency of other channels can be derived (NB protocol channels are numbered from 1). The base frequency is 0MHz for VHF frequency bands and 300MHz for UHF frequency bands.

(MPT1343 operation requires forward protocol channel 0 to be 201,200MHz. As the reference frequency (parameter #603) is defined as 6,25kHz, this corresponds to a value of 32192 for this parameter.)

#601 * Transmitter Synthesiser Base Code

This code is in the range 0 - 65535. It is an offset above the base frequency in steps equal to the reference frequency (parameter #603) that defines the frequency of return protocol channel 0, from which the frequency of other channels can be derived (NB protocol channels are numbered from 1). The base frequency is 0MHz for VHF frequency bands and 300MHz for UHF frequency bands.

(MPT1343 operation requires return protocol channel 0 to be 193,200MHz. As the reference frequency (parameter #603) is defined as 6,25kHz, this corresponds to a value of 30912 for this parameter.)

#602 * Channel Separation Code

This code, when multiplied by the reference frequency (parameter 603), gives the channel frequency separation.

(MPT1343 requires a channel separation of 12,5kHz, ie a value of 2.)

#603 * Reference Frequency

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

(In order to allow the 12,5kHz channel separation required by MPT1343, this parameter must be set to 6,25kHz.)

#604 Transmitter Power

One of 6 standard power levels must be specified:

- | | |
|---------------|--------------|
| 1 - 2,5 Watts | 4 - 15 Watts |
| 2 - 6 Watts | 5 - 25 Watts |
| 3 - 10 Watts | 6 - 30 Watts |

#606 Squelch Opening Point

One of 7 preset squelch opening points:

- 0 - Always open (when receiving speech on a traffic channel)
- 1 - 9dB SINAD
- 2 - 12dB SINAD
- 3 - 15dB SINAD
- 4 - 18dB SINAD
- 5 - 21dB SINAD
- 6 - 24dB SINAD

#607 Squelch Closing Point

One of 7 preset squelch closing points with values as for squelch opening point; NB must be less than or equal to the squelch opening point:

#608 Microcomputer Clock Offsets 0-9s

Certain channels require a small offset to be applied to the microcomputer clock frequency, in order to prevent harmonic interference with the receiver. The protocol channels on which this is required are normally calculated by the radio; however, this parameter is provided to allow the internal algorithm to be overridden.

The parameter is an array of 10 integers, representing protocol channels (in the range 0 to 1023) on which the internal algorithm is found to fail. Unused items within this array must be set to zero.

OWN ADDRESS and FLEET ADDRESS DATA

Items in this section define:

- (a) the radio unit's own addresses (ie addresses to which it responds).
- (b) predefined addresses, ranges of addresses, and fleets which the radio unit may call.
- (c) call-types which the radio unit may make or receive, in addition to those given by the user-interface definition.

#615 Network Individual Number

This is a nine or ten digit dialled number which fully specifies the individual address (PREFIX and IDENT) of the radio. It also defines the radio's own fleet base ident. Used for all outgoing requests, and for incoming individual calls.

#616 Network Group Numbers 0-3

These are the nine or ten digit dialled numbers which fully specify the group numbers to which the radio will respond.

#622 Own Fleet Group Base Ident

The lowest Ident in the range 0 to 8100 assigned to the block of identities used for own-fleet group calls. Zero implies that the fleet has no group addresses.

#623 Maximum Own Fleet Unit Number

Highest unit number (within a fleet) that can be dialled or displayed, in the range 20 to 89 or 200 to 899. Used for range-checking on own fleet dialled calls, and to determine whether 2 or 3 digit dialling is appropriate.

#624 Maximum Own Fleet Group Number

Highest group number (within a fleet) that can be dialled or displayed in the range 90 to 99 or 900 to 998. Used for range-checking on own fleet dialled calls, and to determine whether 2 or 3 digit dialling is appropriate.

#630 Short-Form Memories 0-9

This array contains 10 predefined call destinations, for short-form dialling. These are stored in the form of the equivalent dialled-strings, each of up to 32 digits, allowing the full range of MPT1343 keypad facilities to be accessed. Unused elements must be blank ie have a NULL as the first digit.

Short-form memory 0 is the normal default (eg prime despatcher) when a call is made without specifying a destination. Short-form memory 9 is the default for emergency calls (prime emergency number) unless it is not programmed, in which case 0 is the default.

#631 ** Short-Form Memory Labels 0-9

These 16 character strings are used to display (on Keypad Consoles), a textual description of a called destination, when using short-form memory dialling.

#632 Alarm Function

Defines the action of the radio unit when a remote alarm is initiated. Takes values as follows:

- 0 - no function
- 10 - initiate call to short-form memory 0 (if permitted by state)
- 19 - initiate call to short-form memory 9

Other values are to be defined.

#635 ** Status Labels 0-30

These 16 character strings are used to display (on Keypad Consoles), a textual description of the meaning of transmitted or received status digits. The value of item 0 in this array is not accessible by the data-programmers, but is provided for compatibility with other extension parameters.

#637 Abbreviated Dialling Limit

Specifies the maximum value of 'nn' in abbreviated dial strings of the form '**nn#'. The value is specified by the network operator and is in the range 0 to 49. This parameter must be set to zero if this dialling type is not supported by the selected network, or is not required on the radio unit.

#640 ** 5-Digit Fleet Routing Codes 0-9

This parameter stores an array of fleet routing codes, used for 5-digit inter-fleet dialling. Each code is a two or three digit number commencing with 2 or 9. Two digit routing codes must be used when the required fleet uses 3 digit unit/group numbers, and vice versa. Codes commencing with 2 are used for individual calls only, and codes commencing with 9 for group calls only, as recommended by MPT1343.

Note that if both 2-digit and 3-digit codes are used, care must be taken to ensure that there is no ambiguity between them. For example, if 23 is a Fleet Routing Code, then the numbers 230 to 239 cannot be used for Fleet Routing Codes.

Unused codes must be set to zero.

#641 ** 5-Digit Prefixes 0-9

This array of integers represents the prefixes (in the range 0 to 127) to be used for inter-fleet calls made using the corresponding Fleet Routing Codes (parameter #640).

#642 ** 5-Digit Base Identities 0-9

Each item in this array represents a base identity (in the range 0 to 8100) for the fleet accessed by the corresponding Fleet Routing Code (parameter #640). This is either an individual or a group base identity, according to the first digit of the routing code.

#643 ** 5-Digit Maximum Numbers 0-9

Each item in this array represents the highest unit or group number (as appropriate) which may be dialled in the fleet accessed by the corresponding Fleet Routing Code. These values are used for range-checking of dialled numbers.

#650 Inter-Fleet Group Flag

This parameter determines whether the radio is allowed to make inter-fleet group calls; it applies to all available dialling methods.

- 0 = Inter-fleet group calls barred
- 1 = Inter-fleet group calls permitted

#651 Despatcher Control

Controls the ability of the radio to receive despatcher call back requests.

- 0 = Despatcher off
- 1 = Despatcher on

#652 Status Control

Controls the ability of the radio to receive status messages other than despatcher call back requests.

- 0 = Status off
- 1 = Status on

#653 SDM Control

Controls the ability of the radio to receive short data messages.

- 0 = SDM off
- 1 = SDM on

#654 Equipment Control

Controls the type(s) of call the radio is able to receive.

- 0 = Speech Calls Only
- 1 = Data Calls Only
- 2 = Speech and Data Calls

#655 Include Call Control

Controls the ability of the radio to make include call requests.

- 0 = Include calls disabled
- 1 = Include calls permitted

#656 Maximum Transmitted Status

Defines the maximum status value which can be transmitted by the unit. Values may range up to 99. If set to zero, status transmission is disabled, except for JoinQ and LeavQ requests. Values in the range 1 to 30 restrict status transmission to RQCs.

#657 PABX Calls Permitted

Controls the ability of the radio to make PABX calls.

- 0 = PABX calls not permitted
- 1 = PABX calls permitted

#658 PSTN Calls Permitted

Controls the ability of the radio to make PSTN calls.

- 0 = PSTN calls not permitted
- 1 = PSTN calls permitted

#659 Queue Length

This item in the range 0-20, defines the length of the incoming call queue in the radio. Setting the value to 0, will disable the queuing of incoming calls.

NETWORK ACCESS and REGISTRATION PARAMETERS

These parameters control the following processes:

- (a) hunting for a control channel.
- (b) assessing whether the radio is authorised to be active on a particular control channel.
- (c) registering on a control channel.

#670 Type of Selected Network

Defines the type (national or regional) of the network which the radio may access.

- 0 = Regional network
- 1 = National network

These values correspond with the value of bit 1 of the System Identity Code to be received. This bit also determines the partitioning of the NET/OPID field and the Network-Dependent Data (NDD) field in the System Identity Code.

#671 Identity of Selected Network

This defines the network which the radio may access, subject to the authorization checks described in MPT1343.

For national networks (ie if parameter #670 = 1), values are as follows:

- 0 National network No 1
- 1 National network No 2
- 2 reserved
- 3 reserved

For regional networks, values may be in the range 0 to 127, and will be defined for each network by the Department of Trade & Industry.

When checking a received System Identity Code, this parameter must be compared with the NET or OPID field, as appropriate.

#672 Zone Sub-field Length

Defines the length in bits of the zone sub-field within the NDD field of the System Identity code.

For national networks, as defined by parameter #670, values must be in the range 0 to 9. For regional networks, values must be in the range 0 to 4.

#673 Area Sub-field Length

Defines the length in bits of the area sub-field within the NDD field of the System Identity code.

For national networks, as defined by parameter #670, values must be in the range 0 to 9. For regional networks, values must be in the range 0 to 4.

If the Area Sub-field Length is zero, the radio unit is not required to register by random access.

#674 Radio Unit Control Category

A network may restrict access on a control channel to particular categories of radio. This value must be checked against the LAB sub-field of the System Identity Code. Valid values are as follows:

- 0 = Control Category A
- 1 = Control Category B
- 2 = Control Category C
- 3 = Control Category D

#675 Home Zone

Radio unit's home registration zone. Up to 9 bits may be significant, as defined by the zone sub-field length (parameter #672).

#676 Access Authorization Types 0-9

Items in this array of integers specify the type of the corresponding Access Authorization Value (parameter #677), as follows:

- 0 = Not programmed
- 1 = Zone Identity
- 2 = Area Identity
- 3 = Full Identity

#677 Access Authorization Values 0-9

Items in this array of integers may represent zone identities, area identities or full identities which the radio is allowed to access, as defined by the corresponding item in parameter #676, ie up to 9 bits may be significant.

#680 Normal Hunt Channel Numbers 0-31

This array specifies the protocol channels, in the range 0 to 1023, to be included in the Normal Hunt Sequence. The list is terminated by a channel with value 0.

#681 Normal Hunt Channel Types 0-31

This array of flags indicates on which of the normal hunt channel numbers (parameter #680) the radio unit should expect to encounter time-sharing. Each flag may take one of two values:

- 0 = Continuous Channel
- 1 = Time-shared Channel

#682 Network Minimum Channel Number

The minimum channel number used by the network, in the range 1 to 1023. This forms the lower limit for the Comprehensive Hunt Sequence.

#683 Network Maximum Channel Number

The maximum channel number used by the network, in the range 1 to 1023. This forms the upper limit for the Comprehensive Hunt Sequence.

#684 Comprehensive Hunt Flag

This parameter specifies whether the Comprehensive Hunt Sequence should be used during control channel acquisition.

- 0 = Comprehensive Hunt disabled
- 1 = Comprehensive Hunt enabled

#685 ** Minimum Non-Applicable Channel Numbers 0-9

An array of up to 10 channel numbers, in the range 0 to 1023, which define the minima of ranges of channels to be omitted from the Comprehensive Hunt. (The corresponding entries in parameter 686 define the maxima.) If less than 10 values are needed, the unused items should be set to 0.

#686 ** Maximum Non-Applicable Channel Numbers 0-9

An array of up to 10 channel numbers, in the range 0 to 1023, which define the maxima of ranges of channels to be omitted from the Comprehensive Hunt. (The corresponding entries in parameter #686 define the minima.) If less than 10 values are needed, the unused items should be set to 0.

#690 Fall-back Channel Number

Protocol channel number for fall-back service, in the range 0 to 1023. Set to 0 if fall-back service is not required.

#691 Network-Dependent Data for Fall-back

Specifies the value of the NDD field in the System Identity Code, to be used for confirmation on the fall-back channel. Either 9 or 4 bits are significant, according to whether the Selected Network (parameter #671) is a national or regional network.

Note that in fall-back mode, the entire NDD field must always be checked for confirmation. There is no mechanism specified for disabling this check, or for checking only certain sub- fields of the NDD.

#695 INFO field for RQR

Specifies the value to be used for the 15-bit INFO field in the registration request (RQR).

THRESHOLD VALUES and TIMEOUTS

- #700 NC1 - Continuous Channel
- #701 NC1 - Time-shared Channel
- #702 NC2 - Continuous Channel
- #703 NC2 - Time-shared Channel

Sample sizes to be used for error checking on CCSCs. May range from 0 to 255. Separate values are provided for use on continuous and time-shared control channels. NC1 defines the sample size to be used when error checking is carried out prior to final confirmation on a control channel. NC2 defines the sample size to be used after confirmation on a control channel.

#704 * ND1

Number of Disconnect messages sent by individually-called radio unit (for MPT1343 operation, this parameter must be set to 3).

#705 * ND2

Number of Disconnect messages sent by calling radio unit (for MPT1343 operation, this parameter must be set to 5).

#706 * NE

Maximum number of random access transmissions of RQE (for MPT1343 operation, this parameter must be set to 16).

#707 * NI

Maximum number of traffic channel transmissions of RQS or RQX, used for implementing include calls (for MPT1343 operation, this parameter must be set to 4).

#708 * NR

Maximum number of random access transmissions of RQD, RQQ, RQR, RQS, RQT or RQX (for MPT1343 operation, this parameter must be set to 8).

#709 * NT

This parameter defines the maximum permitted TSC response delay to unsolicited messages on the traffic channel. The parameter takes a value in the range 1 to 12, represent delays of 103 to 1236 bit periods, in steps of 103 bit periods. (For MPT1343 operation, this parameter must be set to 1.)

- #710 NV - continuous channel
- #711 NV - time-shared channel

These parameters define the number of successive CCSCs required to select a System Identity Code for verification, in the range 1 to 16. Separate values are provided for continuous and time-shared channels.

#712 * NW

Value of WAIT assumed at start of session (for MPT1343 operation, this parameter must be set to 5).

#713 NX1 - Continuous Channel
#714 NX1 - Time-shared Channel
#715 NX2 - Continuous Channel
#716 NX2 - Time-shared Channel

These parameters define the maximum number of codeword errors allowed within an error checking sample. Separate values are provided for use on continuous and time-shared control channels. NX1 defines the limit to be used when error checking is carried out prior to final confirmation on a control channel. NX2 defines the limit to be used after confirmation on a control channel.

#717 NZ1

When performing final checking of a control channel prior to confirmation, this parameter determines the number of codeword samples of size NC1 which must be checked. If any of these samples produces a codeword sample error event, then the channel is rejected.

#718 NZ2

While the radio is confirmed on a control channel, NZ2 defines the maximum number of successive codeword sample error events which may be detected before the unit leaves the control channel and recommences hunting.

#730 * TA

Time-out for called radio unit after accepting AHY, in seconds (for MPT1343 operation, this parameter must be set to 60).

#731 * TB

Time barred from calling same ident after receiving ACK(QUAL=0), ACKX, ACKV, ACKB(QUAL=0), or any ident after receiving ACKT(QUAL=0), in seconds (for MPT1343 operation, this parameter must be set to 2).

#732 TC

Time-out for requesting radio unit attempting random access, in seconds. For MPT1343 operation, values may range from 0 to 120 seconds, in 10 second steps.

#733 TD

Registration record timeout, in minutes. For MPT1343 operation, values may range from 0 to 70 minutes, in 5 minute steps.

#734 * TF

Value of TS in fall-back mode, in seconds (for MPT1343 operation, must be set to 180).

#735 * TI

Time-out for requesting radio unit waiting for further signalling for an Include call, in seconds (for MPT1343 operation, this parameter must be set to 2).

#736 TJ

Time-out for requesting radio unit waiting for further signalling or a control channel transaction with the TSC, in seconds. For MPT1343 operation, values may range from 0 to 60 seconds, in 10 second steps.

#737 TN

Radio unit's inactivity time-out on a traffic channel, in seconds. For MPT1343 operation, values may range from 0 to 10 seconds, in 1 second steps.

#738 * TP

Maximum interval between periodic messages (within speech items) at the start of a session, in seconds (for MPT1343 operation, this parameter must be set to 5).

#739 TS

Time after which the radio unit returns to the control channel acquisition procedures if no system identity code is decoded, in seconds. For MPT1343 operation, values may range from 0 to 10 seconds, in 1 second steps.

#740 TT

Maximum item duration, in seconds. (For MPT1343 operation, values may range from 0 to 60 seconds, in 10 second steps.)

#741 * TW

Time-out for calling radio unit waiting for further signalling for a call or transaction that may require queuing, in seconds (for MPT1343 operation, this parameter must be set to 5).

#742 * TX

Value of TC in fall-back mode, in seconds (for MPT1343 operation, must be set to 180).

#743 Call Limit Time

Time-out on the length of a call in seconds in the range 0 to 255. Zero implies that there is no call limit time.

ENGINEERING and MARKETING PARAMETERS

#900 EPROM Part Number

This ASCII string is stored in the CDP, not the radio, and is used to print the main EPROM label.

#901 Synthesiser Reference Crystal

This parameter is used when programming the synthesiser and must match the crystal in the transceiver.

- 0 - 8,40MHz
- 1 - 7,20MHz
- 2 - 7,80MHz
- 3 - 9,00MHz

#902 Second Oscillator Injection

This parameter is for identification purposes only as follows:

- 0 - injection low
- 1 - injection high

#903 Write Count

This contains a value in the range 0 - 65535 used to record the number of times data has been written into the non-volatile alterable memory. When the write count exceeds about 50 000, there is a possibility of the EEPROM losing its erase ability, and replacement should be considered. This situation is unlikely to occur in less than about 10 years of normal use.

#904 EEPROM Type

Indicates the size of EEPROM in use.

- 0 - 512 bytes
- 1 - 2048 bytes

#905 Software Version

This parameter contains the version number of the software stored in the main EPROM. Since it is part of the main FM1200 software it cannot be altered by the CDP or PDP .

#906 Software Part Number

A 17 character string which is read-only. This parameter may replace #905 on some radios.

#907 Electronic Serial Number

A 38 bit security number is programmed into the EPROM by the factory. So that this number can be interrogated, the radio unit converts it to ASCII in the following form:

xxx/yy/zzzzzz where xxx is the manufacturer's code,
yy is the model, and
zzzzzz is the serial number.

#908 Memory Check

For manufacturing purposes only.

#909 Market Variation

Reserved for identification. Values range from 0 to 65535.

#910 HF Transmitter Power Compensation

This parameter stores a value in the range 0 - 255, and is used for high frequency compensation of the transmitter power. The value 128 corresponds to a compensation factor of 1,0. It is applied in the top part of the frequency band in use.

#911-916 Transmitter Power Calibration Points 1 - 6

These parameters store calibration values in the range 0 - 127 corresponding to the 6 standard power settings (see parameter #604).

#921-924 Receiver Audio Noise Calibration Points 1 - 4

These parameters store calibration values in the range 0 - 255 defining the noise levels corresponding to:

- #921 - 9dB (+1dB) SINAD
- #922 - 12dB (+1dB) SINAD
- #923 - 15dB (+1dB) SINAD
- #924 - 18dB (+1dB) SINAD

#931-934 Receive Signal Strength Calibration Points 1 - 4

These parameters store calibration values in the range 0 - 255 defining the Receive Signal Strength levels corresponding to:

- #931 - 15dB (+1dB) SINAD
- #932 - 18dB (+1dB) SINAD
- #933 - 21dB (+1dB) SINAD
- #934 - 24dB (+1dB) SINAD

#941-#948 Error Accounting

To assist in fault diagnosis, the radio keeps an account of internal errors in eight different categories. The contents of each of these are set to zero at the time of manufacture and after servicing, and are available for inspection by a service engineer. When an error occurs, the contents of the relevant category is incremented.

The maximum count in any one category is 255. When this value has been reached, it is not incremented again until it has been reset to zero. It should be reset to zero after the equipment has been serviced.

The eight error categories are:

- #941 Temperature Error Count
- #942 Hardware Error Count
- #943 Peripheral Error Count
- #944 Message Error Count
- #945 Access Error Count
- #946 Operator Error Count
- #947 Lock Error Count
- #948 Power Error Count

#989 Hardware code for labels

This 17-byte parameter is held in the CDP configuration files only, and is used to specify the hardware code for label printing. (It may also serve to identify the hardware variant with which the supplied configuration is designed to be compatible.)

#990 Country Code

Used for identification purposes. Values range from 0 to 255.

#991 Market Application Code

Used for identification purposes. Values range from 0 to 65535.

#992 Frequency Band

This is used when programming the synthesiser and in the calculation of Tx power. It takes values as follows:

Code	Band	Frequency (MHz)
0	E0	68 - 88
1	B0	132 - 156
2	A9	146 - 174
3	K1	174 - 208
4	K2	192 - 225
5	TM	400 - 440
6	T4	425 - 450
7	U0	440 - 470
8	WM	470 - 520

#994 Frequency Stability

This parameter is used to indicate the frequency stability of the reference crystal installed in the FM1200. Its possible values are:

- 0 - 5ppm
- 1 - 2ppm

#995 Signalling Type

This parameter identifies the type of signalling in use. Its possible values are:

- 0 No Signalling
- 1 Sequential Tone Signalling
- 2 Digital Signalling

This value should be set to '2' in all FM1200 sets.

#996 Console Type

Indicates the type of console in use.

- 0-128 - Not used
- 129 - Standard Console
- 130 - Keypad Console
- 131 - Keypad handset
- 132 - Text message display

#998 Console Graphics Label

This 17-byte parameter is held in the CDP configuration files only, and is used to specify the console graphics label which is suitable for use with supplied configuration.

#999 TEE Customisation State

Used for manufacturing purposes only.

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FM1300 CUSTOMISATION FUNCTIONS

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#712	NW	B.19
#730	TA	B.19
#731	TB	B.19
#732	TC	B.19
#734	TF	B.20
#735	TI	B.20
#736	TJ	B.20
#737	TN	B.20
#738	TP	B.20
#739	TS	B.20
#740	TT	B.20
#741	TW	B.20
#742	TX	B.20
#743	Call Limit Time	B.21
#750	LA	B.21
#751	LH	B.21
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#755	TO	B.21
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ENGINEERING and MARKETING PARAMETERS

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INTRODUCTION

Note: Parameters listed in this appendix are applicable only to the FM1300 FFSK radio.

Not all parameters listed here are valid for every FM1300 radio. When an invalid parameter is selected the PDP will display the message 'ERR INVALID PARAM'.

This section defines the parameters and functions that are available for customising the FM1300 radio.

FM1300 functions are customised by storing parameters in non-volatile memory which control the operation of the radio. Facilities are provided in the Control and Signalling Unit to allow external programming devices (such as the Portable Data Programmer and the Comprehensive Data Programmer) to read and write individual parameters or all the customisation parameters.

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

- Key and Indicator Definitions
- Transceiver Parameters
- Own Address Data
- Engineering and Marketing Parameters

KEYS AND INDICATORS

#500-508 Key Functions 0 - 8

These parameters define the function of each key on the console/microphone combination. Parameter #500 refers to key number 0 which is the facility key on the microphone. Parameters #501 to #508 refer to keys 1 to 8 (numbered from left to right).

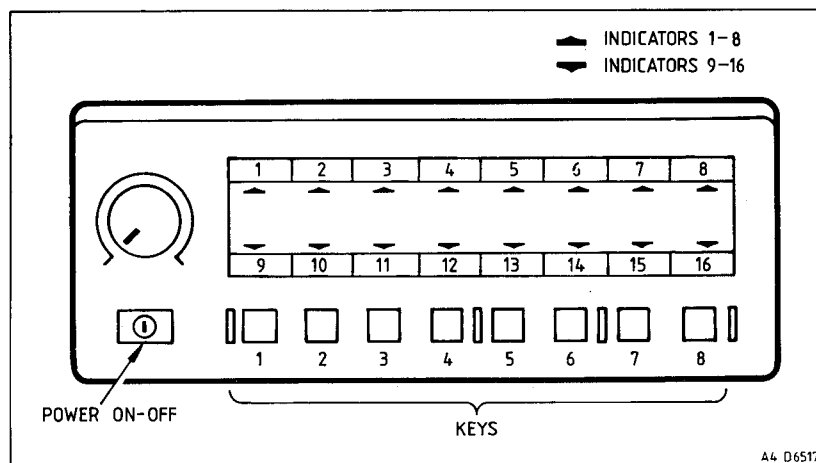


Fig B.1 Standard Console

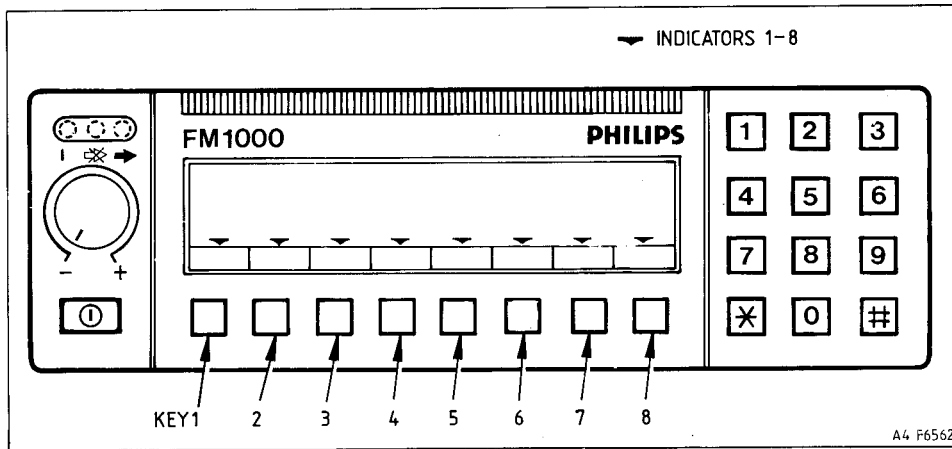


Fig B.2 Keypad Console

Available functions are as follows:

0 - 128	Null	142	* Call-back
129	Call	143	* Modifier
130	Call 0	144	* Status
.	.	145	Delete
.	.	146	Increment
139	Call 9	147	Decrement
140	Clear	148	* External Alert Enable
141	* Busy	149	* Memory
		150	* Registration
		151	Dispatcher
		152	* Paging
		153	* Alarm
		154	* Control
		155	Repeat Last Number

In addition to defining the function of the keys, parameters #501 to #508 also define the meaning of the indicators associated with the keys. If any of these parameters is set to a value marked with an asterisk (*), the indicator will have the corresponding meaning; otherwise indicators are unused.

Multi-Function Key Functions

These parameters define the functions which can be selected using the <Modifier>, <Registration> and <Control> keys on the Keypad Console. Unused options for each key must be set to Null.

#520 Modifier Key Functions 0 - 7

0 - 128	Null
200	Call-Back Request
201	Cancel Call-Back
202	Emergency
203	Priority
204	Non-prescribed data
205	Conference
206	Open Channel
207	Clear Open Channel

#521 Registration Key Functions 0 - 13

0 - 128 Null
210 Display Own Number
211 Select Own Number
212 Display Group Number
213 Select Group Number
214 Select Control Relay
215 Select Control Channel
216 Select Adj Chan 1
217 Select Adj Chan 2
218 Select Simplex Chan 1
219 Select Simplex Chan 2
220 Select Network channel
221 Select Channel Display
222 Cancel Channel Display
223 Select Automatic Mode

#522 Control Key Functions 0 - 5

0 - 128 Null
230 Select Busy Mode
231 Select Call-Back Mode
232 Select External Alert
233 Select Paging
234 Select Divert
235 Select Normal Mode

#551-558 Visual Indicator Functions

These parameters define the function of the simple console indicators that are not associated with keys. Parameters 551 to 558 refer to indicators 1 to 8 (normally numbered from left to right).

Available functions are as follows:

0 - 128 Null
129-137 Reserved for FM1200
140 Call-Back Request
141 Cancel Call-Back
142 Emergency
143 Priority
144 Non-prescribed data
145 Conference
146 Open Channel
147 Clear Open Channel

#570-582 Audible Confidence Indicator Definitions

The radio unit is capable of generating a range of predefined audible signals. The following parameters determine which of these signals is used for each audible confidence indicator.

#570	Go To Channel
#571	Alert
#572	Incoming Call Set Up In Progress
#573	Outgoing Call Set Up In Progress
#574	Call Fail
#575	Number Unobtainable
#576	Call Clear
#577	Transaction Confirmed
#578	Call Queued
#579	Called Party Ringing
#580	Key Click
#581	Operator Alert
#582	Hard Error Alert

Each parameter takes one of the following values (see 3.18):

- 0 - No Tone
- 1 - Click
- 2 - Buzz
- 3 - Five Second Error
- 4 - Unbroken Low Tone
- 5 - Broken Low Tone
- 6 - Double Pip
- 7 - Repeated Double Pip
- 8 - Blip
- 9 - Telephone Ring (UK)
- 10 - Telephone Ring (Europe/US)

#598 Min Alert Volume Setting

Minimum volume setting for audible confidence indicators, in the range 0 to 15.

#599 Max Alert Volume Setting

Maximum volume setting for audible confidence indicators, in the range 0 to 15. Must be greater than or equal to the Min Alert Volume Setting.

TRANSCEIVER PARAMETERS

The following parameters control transceiver operation.

Available channels

These parameters define the relationship between the channel ident in the GTC message and the actual transmission and reception frequencies. They also define the TX power, Tx and Rx reference frequencies and micro-processor offset.

The code for the receive and transmit synthesiser programming is saved as a number in the range 0 - 65535. This is to be used as an offset above a base frequency in steps of a size equal to the reference frequency (see parameter #612), and defines the actual receive frequency. Injection offsets are computed internally. The base frequency is dependant on the frequency band (parameter 992), as follows:

Band	Base Frequency
E	0MHz
B	0MHz
A	0MHz
K1	0MHz
K2	0MHz
U	300MHz
TM	300MHz
T4	300MHz
W	300MHz

If 0 is stored, the channel is regarded as being unprogrammed.

#609 Receive frequency 0 - 128

Defines the receive frequency for each of the possible 128 channels. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

#610 Transmit frequency 0 - 128

Defines the transmit frequency for each of the possible 128 channels. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

#611 Transmit power 0 - 128

Defines the transmit power for each of the possible 128 channels. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

One of 6 standard power levels must be specified:

- 1 - 2,5 Watts
- 2 - 6 Watts
- 3 - 10 Watts
- 4 - 15 Watts
- 5 - 25 Watts
- 6 - 30 Watts

#612 Receive reference frequency 0 - 128

Defines the receiver reference frequencies for each of the possible 128 channels. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

0 = 5,0kHz
1 = 6,25kHz

#613 Transmit reference frequency 0 - 128

Defines the transmitter reference frequencies for each of the possible 128 channels. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

0 = 5,0kHz
1 = 6,25kHz

#614 Microcomputer clock offset 0 - 128

Certain channels may require a small offset to be applied to the microcomputer clock frequency, in order to prevent harmonic interference with the receiver. This parameter indicates whether or not this offset needs to be applied for each of the 128 possible channels. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

#678 Control channel marker 0 - 128

Defines any of the possible 128 channels as a potential control channel. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

0 = NOT a control channel
1 = Potential control channel.

#679 Fall Back Mode 2 (FBM2) channel marker 0 - 128

Defines any of the possible 128 channels as a potential FBM2 channel. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters.

0 = NOT a FBM2 channel
1 = Potential FBM2 channel.

#606 Squelch Opening Point

Defines the squelch opening point for all channels. One of 7 preset squelch opening points:

0 - Always open (when receiving speech on a traffic channel)
1 - 9dB SINAD
2 - 12dB SINAD
3 - 15dB SINAD
4 - 18dB SINAD
5 - 21dB SINAD
6 - 24dB SINAD

#607 Squelch Closing Point

Defines the squelch closing points for all channels. One of 7 preset squelch closing points with values as for squelch opening point (must be less than or equal to the squelch opening point):

#668 Simplex channels 0 - 1

Specifies the characteristics of the two simplex channels. The value is in the range 1 - 128 and refers to an entry in the available channels table which is defined by parameters #609 - #614, #678 and #679.

#669 Paging channel

Specifies the characteristics of the revertive paging channel. The value is in the range 1 - 128 and refers to an entry in the available channels table which is defined by parameters #609 - #614, #678 and #679.

#627 Paging address

Paging address for either 5 tone or digital pager, up to 7 digits long.

#629 Pager type

Specifies the type of signalling system used for paging.

- 0 = Null - paging not allowed
- 1 = CCIR
- 2 = EEA
- 3 = ZVEI1
- 4 = ZVEI2
- 5 = DZVEI
- 6 = POCSAG

#628 SYNC Word Type

This information is used by the radio to determine which SYNC word value to use. It is coupled to the modulation type as follows:

- 0 = SYNC for Frequency Modulation (C4D7)
- 1 = SYNC for Phase Modulation (B433)

#621 Automatic Mode

Defines the response of the radio to an incoming open channel GTC message.

- 0 = Automatic
- 1 = Semi Automatic.

#639 Unit Type

Specifies which type of equipment the unit is configured to be. The parameter may take the following values:

- 0 = Radio mobile
- 1 = Radio Despatcher
- 2 = Radio PABX
- 3 = Radio Fixed Station
- 4 = Transportable

OWN ADDRESS DATA

Items in this section define the units own individual address and group addresses (ie addresses to which the radio responds).

#617 Own Individual Address

Radio unit address.

#618 Own Individual External Equipment address

The address of any external equipment connected to the radio. If the first byte of the string is customised to 255 then this parameter is NULL.

#619 Own Group Addresses 0-9

1-9 are the pre-defined groups which can be altered by the user. The value of item 0 in the array is not accessible by the data-programmers but is provided for compatibility with other extension parameters. If the first byte of any of these strings is customised to 255 then the parameter is NULL.

#620 Two-Digit Dialling Base Address

Base address to which two digit number entries are added to get the actual destination address for signalling.

#625 Fixed Station Sub-Category

Value required to be passed to the fixed station interface equipment during initialisation.

#626 Radio PABX Numbers 0 - 31

Contains the 32 possible PABX numbers, which are required to be passed to the radio PABX interface equipment during initialisation.

TN100 ADDRESS DATA

Items in this section define the individual and group addresses required for TN100 operation. These include certain external addresses such as the emergency call destinations, despatcher destinations, and PSTN/PABX destinations.

#633 Emergency Destination Type

Controls the type of emergency call made using the TN100 default emergency addressing system.

- 0 = Emergency 1 (uses special ident 8140)
- 1 = Emergency 2 (uses special ident 8141)

#634 Emergency Fallback Address

Destination address used by the radio unit if configured for Emergency 1 (parameter #633) and while operating in FBM2. If the first byte of the string is customised to 255 then this parameter is NULL.

#636 Despatcher Destination Address

Normal despatcher address, used for comparison with dialled string in FBM2, to identify a call to a despatcher so that the fallback despatcher address can be substituted.

#637 Despatcher Fallback Address

Address used by the radio unit, on detecting a call to a despatcher request, while operating in FBM2. If the first byte of the string is customised to 255 then this parameter is NULL.

#638 Customer Identity

This ASCII character string is 16 digits long and is displayed during initialisation along with the units own address.

MEMORY AND STATUS DATA

Items in this section define the predefined addresses which the radio unit may select using the memory facilities, and the strings associated with those addresses and status values.

#630 Short-Form Memories 0 - 9

This array contains 10 pre-defined call destinations, for short-form dialling. These are stored in the form of the equivalent digit strings, of up to 32 digits each, allowing the full range of keypad facilities to be accessed.

Short-form memory 0 is the normal default (eg prime despatcher) when a call is made without specifying a destination.

#631 Short-Form Memory Labels 0-9

This array contains 10, 16 character labels, for short form dialling. These labels are displayed on the Alphanumeric console when their corresponding short-form number is entered.

#632 Alarm Function

Controls the effect of closing a switch connected to the external alarm input. The available functions are as follows:

- 0 No function
- 1 - 8 Reserved for future definition
- 9 Type 1 Emergency Call
- 10 - 19 Type 2 Emergency call to address in memory Call0 - Call9
- 20 - 29 Reserved for future definition

#635 Status Labels 0 - 30

These 16 character strings are used to display (on alpha-numeric display consoles), a textual description of the meaning of transmitted or received status digits. The value of item 0 in this array is not accessible by the data-programmers, but is provided for compatibility with other extension parameters.

USER FACILITY RESTRICTIONS

Parameters in this section define the call-types which the radio unit may make or receive.

#651 Call-Back Control (Renamed)

Controls the ability of the radio to receive call-back requests. If this ability is required on the Numeric Display Console, a <Delete> key must also be programmed (see parameters 500-508) in order to control the call queue.

- 0 = Call-Back off
- 1 = Call-Back on

#644 Status Interrogation Control

Control the ability of the radio to receive status interrogation requests.

- 0 = Status interrogation off
- 1 = Status interrogation on

#652 Status Control

Controls the ability of the radio to receive status messages other than despatcher call-back requests and status interrogation requests.

- 0 = Status off
- 1 = Status on

#653 Short Data Message (SDM) Control

Controls the ability of the radio to receive user defined short data messages (ie FUNC = 0).

- 0 = SDM off (SDM (FUNC=0) rejected).
- 1 = SDM on (all SDMs accepted).

#654 Equipment Control

Controls the type(s) of call the radio is able to receive.

- 0 = Speech Calls Only
- 1 = Data Calls Only
- 2 = Speech and Data Calls

#655 Include Call Control

Controls the ability of the radio to make include call requests.

- 0 = Include calls disabled
- 1 = Include calls permitted

#656 Maximum Transmitted Status

Defines the maximum status value which can be transmitted by the unit. Values may range up to 29. If set to zero, status transmission is disabled, except for call back, cancel call back and send status requests.

#657 PABX Calls Permitted

Controls the ability of the radio to make PABX calls.

- 0 = PABX calls not permitted
- 1 = PABX calls permitted

Note: For TN100 operation parameters #657 and #658 should be set to the same value.

#658 PSTN Calls Permitted

Controls the ability of the radio to make PSTN calls.

- 0 = PSTN calls not permitted
- 1 = PSTN calls permitted

Note: For TN100 operation parameters 657 and 658 should be set to the same value.

#659 Queue Length

The length of the call queue.

- 0 = No Call Queue
- 1-99 = Call Queue of length 1 - 99

#645 Select User Id Permitted

Controls the ability of the radio to select own user identity.

- 0 = Not permitted
- 1 = Permitted

#646 Select Group Id Permitted

Controls the ability of the radio to select own group identities.

- 0 = Not permitted
- 1 = Permitted

#647 Manual Channel Selection Permitted

Controls the ability of the radio to select manual channel selection facilities.

- 0 = Manual channel select not permitted
- 1 = Manual channel select permitted

#648 Simplex Channel Selection Permitted

Controls the ability of the radio to select simplex channel selection facilities.

- 0 = Simplex channel select not permitted
- 1 = Simplex channel select permitted

#649 Despatcher Call Set-Up Permitted

Controls the ability of the radio to use the despatcher call set up facility.

- 0 = Despatcher call set up not permitted
- 1 = Despatcher call set up permitted

#660 Status interrogation Permitted

Controls the ability of the radio to send status interrogation commands (status 30).

- 0 = Status interrogation not permitted.
- 1 = Status interrogation permitted.

#661 Discreet Listening Permitted

Controls the ability of the radio to request discreet listening and therefore remote call clear-down.

- 0 = Discreet listening not permitted.
- 1 = Discreet listening permitted.

#662 Dynamic Group Composition Permitted

Controls the ability of the radio to send dynamic group composition and cancellation messages (SDM FUNC=1 and 2 respectively).

- 0 = Dynamic group composition not permitted
- 1 = Dynamic group composition permitted.

#663 Open Channel Creation Permitted

Controls the ability of the radio to use the open channel create/clear facilities.

- 0 = Not permitted
- 1 = Permitted

#664 Priority Call Permitted

Controls the ability of the radio to make priority call requests.

- 0 = Priority calls disabled
- 1 = Priority calls permitted

#665 Type 2 Emergency Calls Permitted

Controls the ability to make Type 2 emergency calls.

- 0 = Type 2 Emergency call disabled
- 1 = Type 2 Emergency calls permitted

#666 Network Channel Selection Permitted

Controls the ability of the radio to select channel monitoring.

- 0 = Channel monitoring disabled
- 1 = Channel monitoring permitted

#667 Conference Calls Permitted

Controls the ability of the radio to initiate conference calls.

- 0 = Conference calls not permitted.
- 1 = Conference calls permitted.

NETWORK ACCESS AND REGISTRATION PARAMETERS

These parameters control the following processes:

- a) hunting for a control channel.
- b) assessing whether the radio is authorised to be active on a particular control channel.
- c) registering on a control channel.

#698 Network Size

Defines the size of the TN100 network on which the radio is to operate.

- 0 = Large
- 1 = Very Large

#699 Network Name

Defines the name of the network on which the radio is to operate.

- Range 0 - 31 for Large network
- Range 0 - 3 for Very Large network

#697 Network Channel Password

Password entered by the user and validated by the radio when Network Channel operation is requested. If the password is not validated use of the facility is prohibited.

#687 Home Channel

Defines the channel on which the radio will operate as a preference.

#688 Home Relay

Defines the relay on which the radio will operate as a preference when it is operating on its Home Channel (see 687).

THRESHOLD VALUES AND TIMEOUTS

#704 ND1

Number of Disconnect messages sent by individually-called radio unit.

#705 ND2

Number of Disconnect messages sent by calling radio unit.

#706 NE

Maximum number of random access transmissions of RQE.

#707 NI

Maximum number of traffic channel transmissions of RQS or RQX, used for implementing include calls.

#708 NR

Maximum number of random access transmissions of RQD, RQQ, RQR, RQS, RQT or RQX.

#709 NT

This parameter defines the maximum permitted TSC response delay to unsolicited messages on the traffic channel. The parameter takes a value in the range 1 to 12, represent delays of 103 to 1236 bit periods, in steps of 103 bit periods.

#712 NW

Value of WAIT assumed at start of session.

#730 TA

Time-out for called radio unit after accepting AHY, in seconds.

#731 TB

Time barred from calling same ident after receiving ACK(QUAL=0), ACKX, ACKV, ACKB(QUAL=0), or any ident after receiving ACKT(QUAL=0), in seconds.

#732 TC

Time-out for requesting radio unit attempting random access, in seconds.

#734 TF

Value of TS in fall-back mode, in seconds.

#735 TI

Time-out for requesting radio unit waiting for further signalling for an Include call, in seconds operation, this parameter must be set to 2).

#736 TJ

Time-out for requesting radio unit waiting for further signalling or a control channel transaction with the TSC, in seconds.

#737 TN

Radio unit's inactivity time-out on a traffic channel, in seconds.

#738 TP

Maximum interval between periodic messages (within speech items) at the start of a session, in seconds.

#739 TS

Time after which the radio unit returns to the control channel acquisition procedures if no system identity code is decoded, in seconds.

#740 TT

Maximum item duration, in seconds.

#741 TW

Time-out for calling radio unit waiting for further signalling for a call or transaction that may require queuing, in seconds.

#742 TX

Value of TC in fall-back mode, in seconds.

#743 Call Limit Time

Time-out on the length of a call in seconds in the range 0 to 255. Zero implies that there is no call limit time.

#750 LA

Absolute minimum value of signal strength for a useable relay signal.

0	=	9dB SINAD
1	=	12dB SINAD
2	=	15dB SINAD
3	=	18dB SINAD

The values above refer to the Receiver Audio Noise Calibration Points as defined by params #921 - #924.

#751 LH

Hysteresis threshold for relay signal strength. When leaving a relay because it has fallen below LA another relay is not considered unless it LH above the relay just relinquished. Value in the range 0 - 255 (it is recommended that this value be set to the equivalent of 0dB, 3dB, 6dB or 9dB).

#752 LD

Relative threshold for relay signal strength, used when current relay signal strength is below LE. Value in the range 0 - 255 (it is recommended that this value be set to the equivalent of 0dB, 6dB, 9dB or 12dB).

#755 TO

Timeout for no activity on open channel, in seconds. For TN100 this will be 30.

#756 TM

Time between receiver monitoring periods while transmitting a continuous item in seconds. For TN100 this will be 20.

#757 TXX

Time that transmission is disabled after a timeout on item length (TT) in seconds.

ENGINEERING and MARKETING PARAMETERS

#900 EPROM Part Number

This ASCII string is stored in the CDP, not the radio, and is used to print the main EPROM label.

#901 Synthesiser Reference Crystal

This parameter is used when programming the synthesiser and must match the crystal in the transceiver.

0	-	8,40MHz
1	-	7,20MHz
2	-	7,80MHz
3	-	9,00MHz

#902 Second Oscillator Injection

This parameter is for identification purposes only as follows:

0	-	injection low
1	-	injection high

#903 Write Count

This contains a value in the range 0 - 65535 used to record the number of times data has been written into the non-volatile alterable memory. When the write count exceeds about 50 000, there is a possibility of the EEPROM losing its erase ability, and replacement should be considered. This situation is unlikely to occur in less than about 10 years of normal use.

#904 EEPROM Type

Indicates the size of EEPROM in use.

0	-	512 bytes
1	-	2048 bytes

#905 Software Version

This parameter contains the version number of the software stored in the main EPROM. Since it is part of the main FM1300 software it cannot be altered by the CDP or PDP .

#906 Software Part Number

A 17 character string which is read-only. This parameter may replace parameter #905 on some radios.

#907 Electronic Serial Number

A 38 bit security number is programmed into the EPROM by the factory. So that this number can be interrogated, the radio unit converts it to ASCII in the following form:

xxx/yy/zzzzzz

where	xxx	=	manufacturer's code
	yy	=	model number
	zzzzzz	=	the serial number

#908 Memory Check

For manufacturing purposes only.

#909 Market Variation

Reserved for identification. Values range from 0 to 65535.

#910 HF Transmitter Power Compensation

This parameter stores a value in the range 0 - 255, and is used for high frequency compensation of the transmitter power. The value 128 corresponds to a compensation factor of 1,0. It is applied in the top part of the frequency band in use.

#911-916 Transmitter Power Calibration Points 1 - 6

These parameters store calibration values in the range 0 - 127 corresponding to the 6 standard power settings (see parameter #604).

#921-924 Receiver Audio Noise Calibration Points 1 - 4

These parameters store calibration values in the range 0 - 255 defining the noise levels corresponding to:

- #921 9dB (+1dB) SINAD
- #922 12dB (+1dB) SINAD
- #923 15dB (+1dB) SINAD
- #924 18dB (+1dB) SINAD

#931-934 Receive Signal Strength Calibration Points 1 - 4

These parameters store calibration values in the range 0 - 255 defining the Receive Signal Strength levels corresponding to:

#931	15dB (+1dB) SINAD
#932	18dB (+1dB) SINAD
#933	21dB (+1dB) SINAD
#934	24dB (+1dB) SINAD

#941-#948 Error Accounting

To assist in fault diagnosis, the radio keeps an account of internal errors in eight different categories. The contents of each of these are set to zero at the time of manufacture and after servicing, and are available for inspection by a service engineer. When an error occurs, the contents of the relevant category is incremented.

The maximum count in any one category is 255. When this value has been reached, it is not incremented again until it has been reset to zero. It should be reset to zero after the equipment has been serviced.

The eight error categories are:

#941	Temperature Error Count
#942	Hardware Error Count
#943	Peripheral Error Count
#944	Message Error Count
#945	Access Error Count
#946	Operator Error Count
#947	Lock Error Count
#948	Power Error Count

#989 Hardware code for labels

This 17-byte parameter is held in the CDP configuration files only, and is used to specify the hardware code for label printing. (It may also serve to identify the hardware variant with which the supplied configuration is designed to be compatible.)

#990 Country Code

Used for identification purposes. Values range from 0 to 255.

#991 Market Application Code

Used for identification purposes. Values range from 0 to 65535.