CHAPTER 6

CONTROL LOGIC

Contents

Illustrations

INTRODUCTION

1. The control functions provided by the Control Logic Unit are:

   (a) Selection of filters on the Harmonic Filter Assembly and, when operating the tranceiver with a non-resonant antenna, control of the external Antenna Tuning Unit.

   (b) Operation of the transceiver control panel OUT OF TUNE and FREQUENCY ERROR indicators.

   (c) Operation of the RX/TX relay located on the Harmonic Filter PCB.

In addition the Control Logic Unit incorporates a fault finding aid which, when enabled by inserting a temporary link, provides an indication of the operational state of the transceiver by means of LED's located on the Control Logic p.c.b.

CIRCUIT DESCRIPTION

2. Refer to Figure 2 for a circuit diagram of the Control Logic Unit.

3. The operation of the circuits that comprise the Control Logic Unit are described in the following paragraphs.

HARMONIC FILTER CONTROL

4. Ten complementary signals, switched by the synthesiser 10 x MHz, 1 x MHz and 100 x kHz Frequency Selectors are applied via inverting buffer amplifiers to the 8k memory (IC1) A0 – A9 address inputs. The memory 00 – 07 outputs provide the 8-bit latch (IC2) D0A – D3B data inputs. These are enabled in IC2 when the STROBE A and STROBE B inputs are at logic '1' (non-hopping synthesiser operation selected). Outputs Q0A – Q2A pass a binary number i.e. 1 – 6 to inputs A0 – A2 of the binary-to-decimal decoder (IC3). The input is decoded and given out as a logic '1' on one of the Q1 – 06 outputs, which is then changed to logic '0' by an inverter (IC4a – 4f). This provides an operating path for the respective A, B, C, D, E or F filter relays in the Harmonic Filter. IC1 is programmed to give 00 – 07 outputs appropriate to the synthesiser frequency selection.

5. When operating the transceiver in the Hopping mode, frequency changes made at the FREQUENCY selectors are inhibited until the Synthesiser is returned to the RESET condition. In order to prevent filter selections taking place when frequency changes, introduced by the synthesiser frequency hopping sequence, extend beyond the limit of the filter initially selected, the transfer of information through IC2 is inhibited by a logic '0' on the HOPPING FLAG input.

ANTENNA TUNING UNIT (ATU)

6. The ATU tunes when the transceiver control panel FUNCTION switch is set to TUNE. The switch, which is spring - loaded away from TUNE towards SSB, must be maintained in the TUNE position until the OUT OF TUNE indicator is extinguished.

OUT OF TUNE INDICATOR

7. The OUT OF TUNE indicator is driven by TR1 which is switched by the lamp flasher circuit comprising IC9c, IC9d, R20 and C7. The multivibrator is enabled by IC8b and initiated via IC12a.

(a) Using 50Ω Antenna
When an ATU is not connected to the transceiver and the transmitter is terminated correctly the logic levels in the input circuits are as follows:

ATU TUNING	–	logic '0'
HOPPING FLAG	–	logic '1'
(OV) TUNE INITIATE	–	logic '1'
ATU LINK	–	logic '1'
HIGH VSWR	–	logic '0'

The logic '1' levels at 1C8c.13 and IC9b.6 result in logic '0' levels at IC8b.5 and 3 respectively and IC8b.6 is at logic 1. This logic 1 causes a logic '0' at IC9d.11 which is applied to the base of TR1 via R18 and the transistor is cut-off. The switching of the HIGH VSWR input to logic '1' under fault conditions results in a logic '0' at IC9d.13 which enables IC9d output to be controlled by the input at IC9d.12. The high input is also inverted in IC12a and applied to IC9c.9 to initiate the multivibrator, which commences to generate a square wave output at a frequency de-determined by C7 and R20. The OUT OF TUNE indicator, illuminated when TR1 is switched on during positive excursions of the multivibrator square wave output, then provides a flashing indication of the fault.

(b) Using Non–Resonant Antenna (ATU Connected)
The connection of an ATU to the transceiver changes the ATU LINK signal input level from logic '1' to logic '0'. This enables the outputs of J–K flip-flops IC6a and IC6b, switched through IC8c, to control IC8c output. In the reset condition logic '0' levels are present at IC8b.3, 4 and 5. The operation of the flasher circuit under various operational conditions is, therefore, as described below:

(i) High VSWR
The circuit operates in a similar manner to that previously described.

(ii) At Switch ON.
When power is initially applied to the transceiver, flip-flops IC6a and IC6b 'set' inputs, normally held at approximately 0,45V (logic '0') from the junction of R10 and R11, are at logic '1'. The flip-flop 'Q' outputs are therefore high and IC8a.9 is at logic '0'. This low, inverted in IC8c and IC8b, is applied to IC9d.13. As NOR gate IC9d inputs are both low, IC9d.11 is at logic '1'. Consequently TR1 is switched on and the OUT OF TUNE lamp is continuously illuminated. This condition persists until IC6a and IC6b are cleared by a + ve transition at IC6a.4 and IC6b.12.
The transceiver operating instructions state that when the OUT OF TUNE lamp is illuminated the control panel FUNCTION switch must be set to TUNE and held in this position until the lamp is extinguished. When the FUNCTION switch is set to TUNE, the TUNE INITIATE circuit is connected to 0V and the ATU commences to tune. Whilst the ATU is tuning the ATU TUNING circuit is held as logic '1'.
The + ve transition at IC9a.3, which is switched from the ATU TUNING logic '1' signal, clears J–K flip-flops IC6a and IC6b, which then give logic '0' Q outputs. The OUT OF TUNE lamp is not extinguished however because the low at IC8b.6 is maintained by IC9b logic '1' output. When IC9a.3 output is at logic '1' the tune tone is inhibited in the receiver audio output stages.
When antenna tuning has been completed the ATU TUNING circuit reverts to logic '0', which results in IC9b4 going to logic '0', IC8b.6 to logic '1' and IC9d.11 to Logic '0'.
The OUT OF TUNE lamp is therefore extinguished.
The operator may now release the FUNCTION switch and the transceiver operates in the quiescent condition.

(iii) Interruption of power supply
The circuit operation is as described in (ii) as the restoration of power is the same as the initial switch on.
The tuning procedure must be followed when the OUT OF TUNE indicator is illuminated.

(iv) Frequency changes > 10kHz
Frequency changes > 10kHz are detected in the quad exclusive OR gate IC7. 10MHz (A) , 1kHz (A), 100kHz (A) and 10kHz (A) frequency selection signals are applied to IC7c.9, IC7c.8, IC7d.13 respectively. A change in any one or combination of these inputs results in a logic '1' appearing at IC7b.4 or IC7a.3. The leading edge of the resulting +ve going pulse provides a CK input to IC6a to IC6b. The 'clocked' flip-flop 'Q' output is then switched to logic '1' and through the circuit action previously described and the OUT OF TUNE lamp is illuminated.
It should be noted that if the HOPPING FLAG is at logic '0' (SETTING selected at the Synthesiser) IC6a or IC6b does not give a logic '1' output when clocked and the OUT OF TUNE lamp is not illuminated.
The tune procedure must be followed when the OUT OF TUNE indicator is illuminated.

FREQUENCY ERROR INDICATOR

8. The 8k memory, IC1, is programmed to give logic '0' at the O0 – O7 outputs when an illegal frequency is selected. The resultant logic '1' at IC3.4 is applied via R21 to the base of TR3 which conducts providing a return path for the FREQUENCY ERROR indicator.

TX/RX RELAY CONTROL

9. The TX/RX relay (RLN) is located on the Harmonic Filter PCB. The de-energised condition of RLN is for receive (RX) and the energised condition for transmit (TX). The operation of the circuit, comprising IC5b, IC4a, and associated components, is initiated from the 0V (PTT) line. Descriptions are given below for the quiescent (receive) condition and for switching from receive to transmit and from transmit to receive.

(a) Quiescent Condition.
In the quiescent condition the 0V (PTT) line is held at logic '1' via R38, and relay RLN in the Harmonic Filter PCB is de-energised. The + 24 from the Harmonic Filter PCB is applied, via relay RLN and R15, to the base of transistor TR2 causing it to conduct and illuminate the 'RX' LED.

(b) Switching – Receive to Transmit
The transceiver is switched to the transmit mode when the 0V (PTT) line is connected to 0V. The 0V is inverted in IC5b and applied via D5 to IC4a where it is inverted to provide an operate path for relay RLN in the Harmonic Filter PCB. Relay RLN operates and changes the circuit from receive to transmit. The 0V on IC4a.16 illuminates the 'TX' LED. Transistor TR2 is cut-off and the 'RX' LED extinguished.

(c) Switching – Transmit to Receive
The transceiver returns to the receive mode when the 0V (PTT) line is disconnected from 0V. The operation of the circuit is the same as for the quiescent condition.

SERVICING AND TEST INSTRUCTIONS

10. Procedures are given in the following paragraphs for testing the control logic circuits. Information relating to testing the 2758 EPROM is not given. If a fault is suspected in this device it should be checked by substituting a programmed replacement device obtained from the manufacturer.

TEST EQUIPMENT

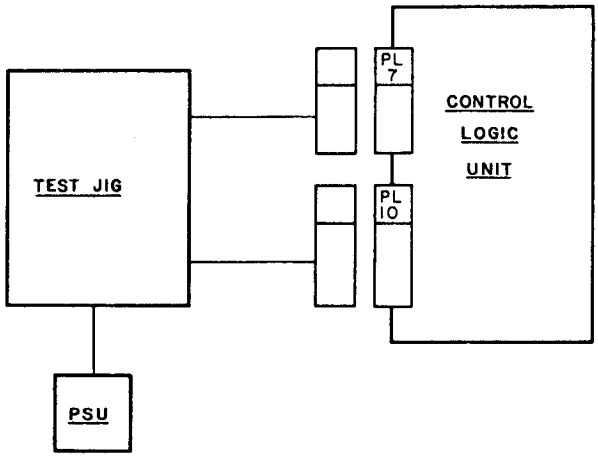
11. The following items of test equipment are required:

(a) PSU 0–24V d.c., 2A.

(b) Test Jig.

PRELIMINARY OPERATIONS

12. Connect the Control Logic Unit into the test configuration shown below. Fit a programmed EPROM into the board. Switch on +24V and ensure the current does not exceed 130mA.



TEST PROCEDURE

13. Circuit and component checks are as described in the following paragraphs.

LED Test

14. (a) Link PCB pin 2 and 3.
Check that all LED's illuminate.

(b) Remove the link from pins 2 and 3.

PTT Test

15. With no test jig pushbutton switch operated check that the PCB 'RX' LED (D14) is illuminated and that 'TX' LED (D15) is extinguished.

(a) Press the PTT switch.
Check that the TX LED's on the test jig and the Control Logic PCB illuminate. The RX LED (D14) should be extinguished.

(b) Release the PTT switch.
Check that the TX LED's are extinguished and the RX LED illuminated.

Filter Selection

16. (a) Set the Frequency selectors on the test jig to any frequency in the band 1,6 – 2,5MHz. Check that the Control Logic and Test Jig FILTER 'A' LED's are illuminated and that 'B', 'C', 'D', 'E' and 'F' are extinguished.

(b) Set the Frequency selectors to any frequency in the band 2,6 – 4,1MHz. Check that the FILTER 'B' LED's illuminate and that 'A', 'C', 'D', 'E' and 'F' are extinguised.

(c) Set the Frequency selectors to any frequency in the band 4,2 – 6,8MHz. Check that the FILTER 'C' LED's illuminate and that 'A', 'B', 'D', 'E' and 'F' are extinguished.

(d) Set the frequency selectors to any frequency in the band 6,9 – 11,2MHz. Check that the FILTER 'D' LED's illuminate and the 'A', 'B', 'C', 'E' and 'F' are extinguished.

(e) Set the Frequency selectors to any frequency in the band 11,3 – 18,4MHz. Check that the FILTER 'E' LED's illuminate and that 'A', 'B', 'C', 'D' and 'F' are extinguished.

(f) Set the Frequency selectors to any frequency in the band 18,5 – 29,9MHz. Check that the FILTER 'F' LED's illuminate and that 'A', 'B', 'C', 'D' and 'E' are extinguished.

Hopping Flag

17. (a) Set the Frequency selectors to 4,1MHz (Filter B).

(b) Depress Hopping switch and at the same time change the selected frequency to 4,2MHz. Check that Filter 'B' remains selected.

(c) Release the Hopping switch. Check that Filter 'C' is selected.

Frequency Error

18. (a) Set the Frequency selectors to a frequency below 1,6MHz. Check that the Control Logic and Test Jig FILTER LED's are all extinguished and that the FREQ. ERROR LED on the Test Jig is illuminated.

High VSWR

19. (a) Depress the VSWR switch on the Test Jig. Check that the OUT OF TUNE LED on the Test Jig flashes for 3 seconds and is then extinguished.

Antenna Coupler Connection.

20. (a) Set the Frequency selectors to 2MHz.

(b) Set the ATU switch to ON. Check that the ATU CONNECTED LED on the Control Logic and the OUT OF TUNE LED on the Test Jig are illuminated.

(c) Depress the TUNE INITIATE switch and hold down.
Check that the TUNE INITIATE and ATU TUNE LED's on the Control Logic are illuminated. The OUT OF TUNE LED on the Test Jig remains on for 3 seconds and is then extinguished together with the ATU TUNE on the Control Logic. At the same time the TUNE TONE MUTE LED's on the Test Jig and Control Logic are illuminated.

(d) Release the TUNE INITIATE switch.
Check that both TUNE TONE MUTE LED's are extinguished.

(e) Set the Frequency selectors to 12MHz.
Check that the OUT OF TUNE LED is illuminated.
Repeat steps (c) and (d).

(f) Set the Frequency selectors to 13MHz.
Check that the OUT OF TUNE LED is illuminated.
Repeat steps (c) and (d).

(g) Set the Frequency selectors to 13,1MHz.
Check that the OUT OF TUNE LED is illuminated.
Repeat steps (c) and (d).

(h) Set the Frequency selectors to 13,11MHz.
Check that the OUT OF TUNE LED is illuminated.
Repeat steps (c) and (d).

(i) Set the Hopping switch to ON.

(k) Set the Frequency selectors to 3,11MHz.
Check that the OUT OF TUNE LED does not illuminate.

(l) Set the Hopping switch to OFF.
Check that the OUT OF TUNE LED remains extinguished.

AM TX

21. (a) Set the AM switch to ON.
Check that the AM 9V LED on the Test Jig and the AM TX LED on the Control Logic illuminates.

(b) Set the AM switch to OFF.
Check that the AM 9V and AM TX LED's are extinguished.

PARTS LIST

22. The component tolerances and ratings given in these parts list are optimum. However if such components are not immediately available alternative with closer tolerances and/or higher wattage or voltage ratings may be used in manufacture or supplied as replacements.

23. When ordering replacements please quote the full description including the circuit reference and the Order No.

CONTROL LOGIC PCB

FIG. NO.	REF.	ORDER NO.	CODIFICATION	ITEM	DESCRIPTION	NO/UNIT
		1300-0865		**PCB**	**CONTROL LOGIC ASSY**	
				Capacitors		
	C1	2600-3292			Ceramic 100nF 10p.c. 50V	
	C2	2500-6070			Tantalum 10uF 20p.c. 35V	
	C3	2500-6046			Tantalum 47uF 20p.c. 16V	
	C4	2600-3292			Ceramic 100nF 10p.c. 50V	
	C5	2500-6064			Tantalum 1uF 20p.c. 35V	
	C6	2600-3292			Ceramic 100nF 10p.c. 50V	
	C7	2600-3708			Ceramic 220nF 10p.c. 50V	
	C8	2600-3292			Ceramic 100nF 10p.c. 50V	
	C9	2600-3266			Monolithic 10nF 10p.c. 100V	
	C10	2400-1017			Electrolytic 10uF 40V	
	C11	2600-3292			Ceramic 100nF 10p.c. 50V	
	C12	2600-3292			Ceramic 100nF 10p.c. 50V	
	C13	2600-3292			Ceramic 100nF 10p.c. 50V	
	C14	2600-3292			Ceramic 100nF 10p.c. 50V	
	C15	2600-3266			Ceramic 10nF 10p.c. 100V	
	C16				Not Used	
	C17	2600-3374			Ceramic 1nF 10p.c. 200V	
				Connectors		
	PL7	3300-1588			Plug, Ansley 609–1002M, 10-way	
	PL10	3300-9508			Plug, Ansley 609–2602M, 26-way	
				Diodes		
	D1	3600-0288			Zener 4V7, 400mW, BZX79C4V7	
	D2	3600-0404			IN4153	
	D3	3600-0404			IN4153	
	D4	3600-1363			AAZ18	
	D5	3600-0404			IN4153	

CONTROL LOGIC PCB (Cont.)

FIG. NO.	REF.	ORDER NO.	CODIFICATION	ITEM	DESCRIPTION	NO/UNIT
	D6	3600-0404			IN4153	
	D7	3600-0404			IN4153	
	D8	3600-1222			LED Type MV5753	
	D9	3600-1222			LED Type MV5753	
	D10	3600-1222			LED Type MV5753	
	D11	3600-1222			LED Type MV5753	
	D12	3600-1222			LED Type MV5753	
	D13	3600-1222			LED Type MV5753	
	D14	3600-1222			LED Type MV 5753	
	D15	3600-1222			LED Type MV5753	
	D16	3600-1222			LED Type MV5753	
	D17	3600-1222			LED Type MV5753	
	D18	3600-1222			LED Type MV5753	
	D19	3600-1222			LED Type MV5753	
	D20	3600-1222			LED Type MV5753	
	D21	3600-1222			LED Type MV5753	
	D22	3600-0404			IN4153	
	D23	3600-1363			AAZ18	
	D24	3600-0404			IN4153	
				Integrated Circuits		
	IC1	6600-0008			2758 8k EPROM (programmed)	
	IC2	3600-0780			4508 Dual 4-Bit Latch	
	IC3	3600-0779			4028 Octal Decoder	
	IC4	3600-0964			ULN 2003	
	IC5	3600-0683			4049, Hex Buffer / Inv.	
	IC6	3600-0630			4027, Dual, J.K. Flip-Flop	
	IC7	3600-0755			4070, Quad, Excl. OR	
	IC8	3600-0558			4025, Triple, 3 I/P NOR	

CONTROL LOGIC PCB (Cont.)

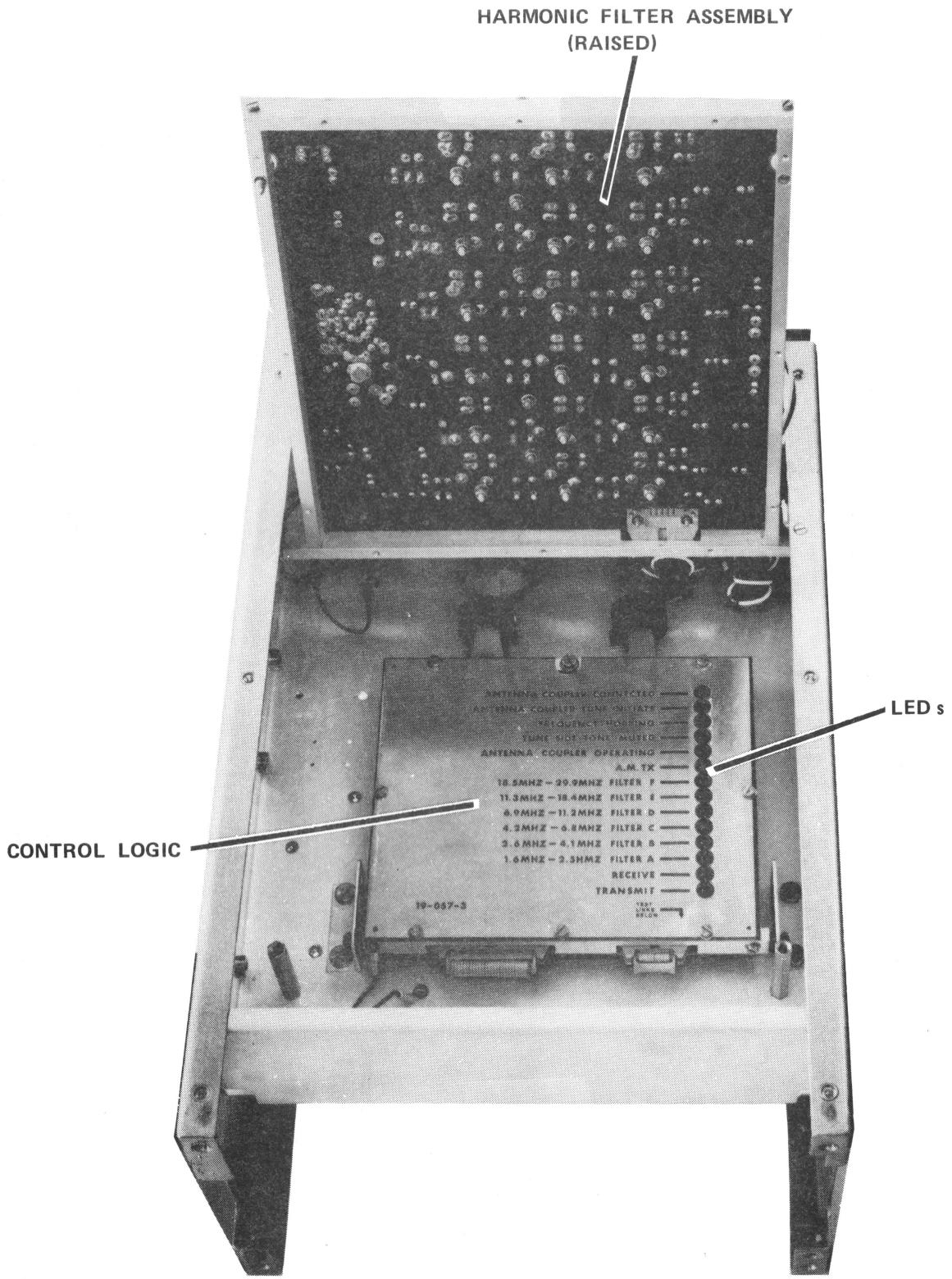
FIG. NO.	REF.	ORDER NO.	CODIFICATION	ITEM	DESCRIPTION	NO/UNIT
	IC9	3600-0549			4001, Quad, 2 I/P NOR	
	IC10	3600-0683			4049, Hex Buffer / Inv.	
	IC11	3600-0683			4049, Hex Buffer / Inv.	
	IC12	3600-0683			4049, Hex Buffer / Inv.	
	IC13	3600-6043			4502B, Strobed Hex Buffer / Inv.	
	IC14	3600-6043			4502B, Strobed Hex Buffer / Inv.	
	IC15	3600-6604			Regulator, +5V, TO220, 7805	
				Resistors		
	R1	2000-0349			Carbon 10k 5p.c. 0,25W	
	R2	2000-0349			Carbon 10k 5p.c. 0,25W	
	R3				Not Used	
	R4	2000-0349			Carbon 10k 5p.c. 0,25W	
	R5	2000-0349			Carbon 10k 5p.c. 0,25W	
	R6	2000-0341			Carbon 2k2 5p.c. 0,25W	
	R7	2000-0361			Carbon 100k 5p.c. 0,25W	
	R8	2000-0341			Carbon 2k2 5p.c. 0,25W	
	R9	2000-0361			Carbon 100k 5p.c. 0,25W	
	R10	2000-0352			Carbon 18k 5p.c. 0,25W	
	R11	2000-0340			Carbon 1k8 5p.c. 0,25W	
	R12	2000-0349			Carbon 10k 5p.c. 0,25W	
	R13	2000-0349			Carbon 10k 5p.c. 0,25W	
	R14	2000-0341			Carbon 2k2 5p.c. 0,25W	
	R15	2000-0361			Carbon 100k 5p.c. 0,25W	
	R16	2000-0349			Carbon 10k 5p.c. 0,25W	
	R17	2000-0349			Carbon 10k 5p.c. 0,25W	
	R18	2000-0355			Carbon 33k 5p.c. 0,25W	

CONTROL LOGIC PCB (Cont.)

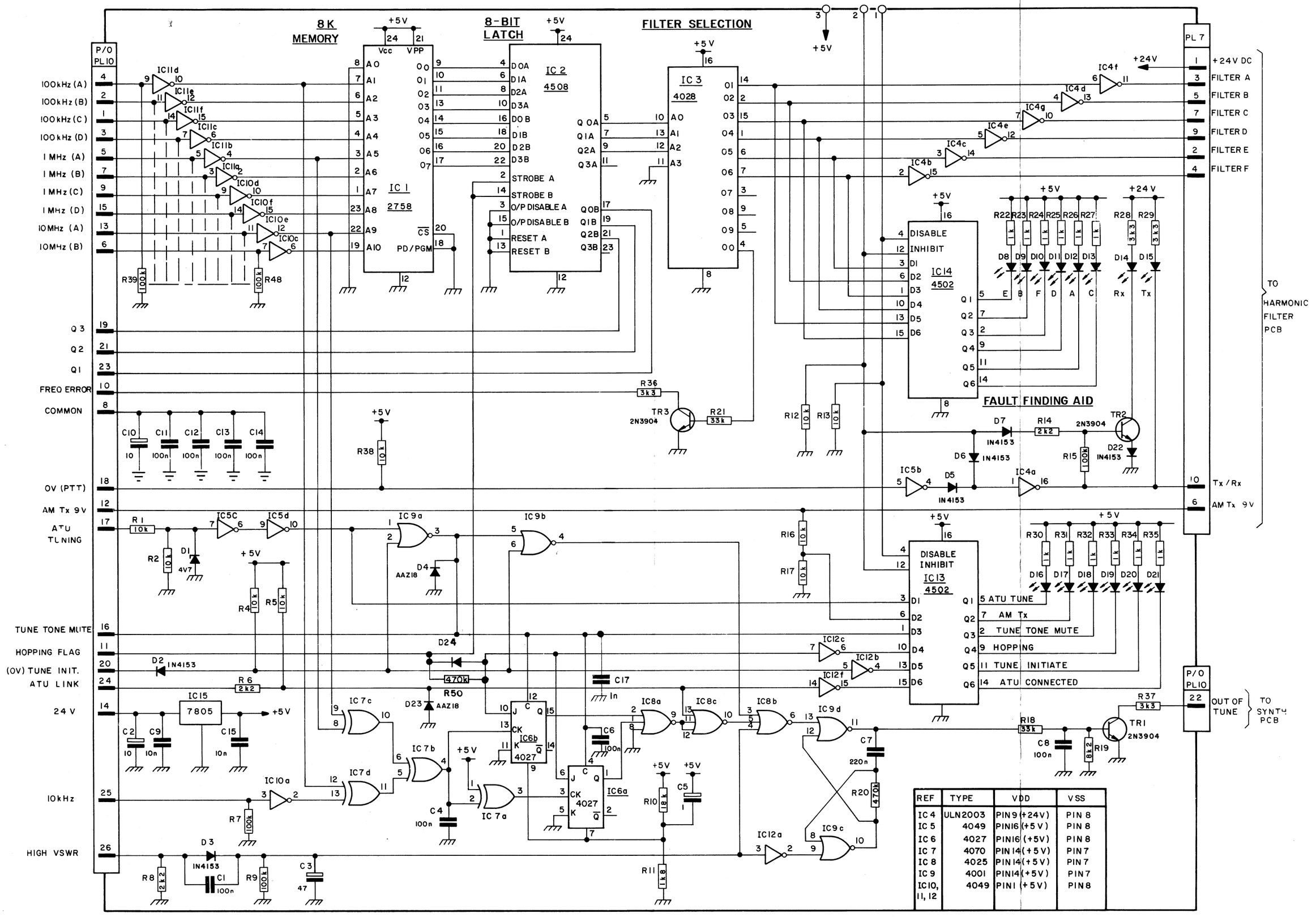
FIG. NO.	REF.	ORDER NO.	CODIFICATION	ITEM	DESCRIPTION	NO/UNIT
	R19	2000-0348			Carbon 8k2 5p.c. 0,25W	
	R20	2000-0369			Carbon 470k 5p.c. 0,25W	
	R21	2000-0355			Carbon 33k 5p.c. 0,25W	
	R22	2000-0337			Carbon 1k 5p.c. 0,25W	
	R23	2000-0337			Carbon 1k 5p.c. 0,25W	
	R24	2000-0337			Carbon 1k 5p.c. 0,25W	
	R25	2000-0337			Carbon 1k 5p.c. 0,25W	
	R26	2000-0337			Carbon 1k 5p.c. 0,25W	
	R27	2000-0337			Carbon 1k 5p.c. 0,25W	
	R28	2000-0343			Carbon 3k3 5p.c. 0,25W	
	R29	2000-0343			Carbon 3k3 5p.c. 0,25W	
	R30	2000-0337			Carbon 1k 5p.c. 0,25W	
	R31	2000-0337			Carbon 1k 5p.c. 0,25W	
	R32	2000-0337			Carbon 1k 5p.c. 0,25W	
	R33	2000-0337			Carbon 1k 5p.c. 0,25W	
	R34	2000-0337			Carbon 1k 5p.c. 0,25W	
	R35	2000-0337			Carbon 1k 5p.c. 0,25W	
	R36	2000-0343			Carbon 3k3 5p.c. 0,25W	
	R37	2000-0343			Carbon 3k3 5p.c. 0,25W	
	R38	2000-0349			Carbon 10k 5p.c. 0,25W	
	R39	2000-0361			Carbon 100k 5p.c. 0,25W	
	R40	2000-0361			Carbon 100k 5p.c. 0,25W	
	R41	2000-0361			Carbon 100k 5p.c. 0,25W	
	R42	2000-0361			Carbon 100k 5p.c. 0,25W	
	R43	2000-0361			Carbon 100k 5p.c. 0,25W	
	R44	2000-0361			Carbon 100k 5p.c. 0,25W	
	R45	2000-0361			Carbon 100k 5p.c. 0,25W	
	R46	2000-0361			Carbon 100k 5p.c. 0,25W	
	R47	2000-0361			Carbon 100k 5p.c. 0,25W	
	R48	2000-0361			Carbon 100k 5p.c. 0,25W	

CONTROL LOGIC PCB (Cont.)

FIG. NO.	REF.	ORDER NO.	CODIFICATION	ITEM	DESCRIPTION	NO/UNIT
	R49				Not Used	
	R50	2000-0369			Carbon 470k 5p.c. 0,25W	
				Transistor		
	TR1	3600-0185			2N3904, Si, NAN	
	TR2	3600-0185			2N3904, Si, NAN	
	TR3	3600-0185			2N3904, Si, NAN	



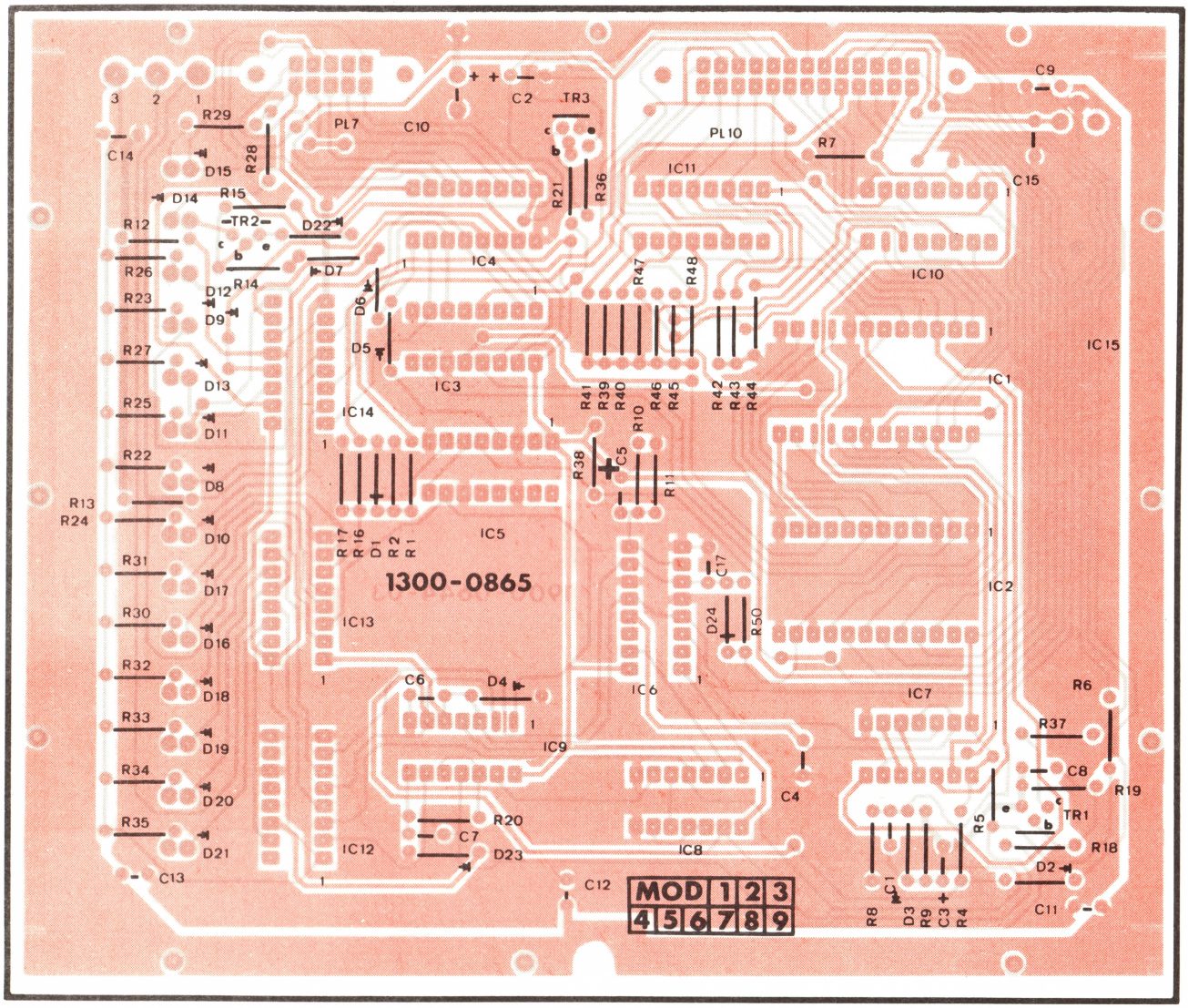
CONTROL LOGIC



REF	TYPE	VDD	VSS
IC 4	ULN2003	PIN 9 (+24V)	PIN 8
IC 5	4049	PIN16 (+5V)	PIN 8
IC 6	4027	PIN16 (+5V)	PIN 8
IC 7	4070	PIN 14 (+5V)	PIN 7
IC 8	4025	PIN 14 (+5V)	PIN 7
IC 9	4001	PIN14 (+5V)	PIN 7
IC10, 11, 12	4049	PIN1 (+5V)	PIN 8

CONTROL LOGIC : CIRCUIT DIAGRAM

FIG. 2



PCB Component Side:

PCB Track Side:

CONTROL LOGIC PCB
COMPONENT LOCATION