4. THEORY OF OPERATION

CONTENTS

APPENDICES

4. THEORY OF OPERATION

4.1 GENERAL

The CR91 is a double conversion superheterodyne HF SSB /ISB receiver. A fast locking "fractional N" synthesizer provides 1 Hz steps over the complete range of 10 kHz to 30 MHz. Microprocessor techniques has been used to obtain a control system that is just as suitable for manual surveillance and search applications as for computer control.

Functionally, the CR91 receiver can be divided in four parts:

- the signal path (Input Filter, RF Unit, IF Filter, AF/AF Board, ISB Board and Connection Board)
- the frequency generating circuits (Synthesizer and Reference Board)
- the control part (Panel Board 1, Panel Board 2, Control Board and Connection Board)
- the power supply

In addition there is the Mother Board which apart from its interconnecting function holds some filtering components.

4.2 FUNCTIONAL DESCRIPTION (appendix 4:1)

Signal Path

In the range 1.6 to 30 MHz, the required input selectivity is obtained by nine suboctave filters that are switched in by PIN-diodes. Below 1.6 MHz a low-pass filter is used. A 20 dB antenna input attenuator can be switched in manually from the front panel and is switched in automatically if the input signal exceeds 4 volt.

For operation in the Very Low Frequency (VLF) end of the range, the antenna input can be switched to a high input impedance unity gain amplifier. In this way, useful input signals down to 10 kHz can be obtained from electrically short open antennas.

In the RF Unit, the signal is first amplified some 8 dB in a wide band gain controlled amplifier. The signal is then up-converted to the first IF of 125.2 MHz by mixing with 125.2 to 155.2 MHz from the synthesizer. Selectivity at the first IF is obtained from two crystal filters, one two-pole and one four-pole. Compensation for the filter loss is provided by the isolation amplifier between the filters. The signal is now down-converted to the second IF at 200 kHz and passed through a mechnical roofing filter. The bandwidth at this point is 6.8 kHz.

The RF Unit provides three outputs: one that can be used for an external panoramic unit, one for the IF Filter Unit and one for the optional ISB Board.

The IF Filter Unit provides six different bandwidths for the channel A IF amplifier (IF/AF Board). When the WIDE bandwidth is selected, the IF Filter Unit just passes the signal, the selectivity is determined by the filter in the RF unit.

Almost all the receiver gain is obtained from the IF-amplifiers on the IF/AF Board (channel A) and the ISB Board (channel B). AGC control is applied across these amplifiers and the level at the AM/SSB detectors is virtually constant. Delayed AGC is also fed back to the RF Unit.

If the VERY NARROW bandwidth is selected, an additional filter on the IF/AF Board is switched in. The purpose of this filter is to reduce wide band noise from the IF amplifier.

On the IF/AF Board, the BFO frequency to the detector is obtained from a phase lock loop. The frequency to the detector can be set to any 100 Hz step between 200.3 and 201.8 kHz for CW mode and to any 100 Hz step between 200.3 and 202.8 kHz for FSK mode. The frequency is set to 200.0 kHz in SSB and ISB modes, and the BFO is switched off in mode AM.

When ISB is used, the optional ISB Board is needed. It operates in a similar way to the IF/AF Board. The ISB Board has a switch on the AF channel A/B (loudspeaker) output which is closed only if channel B is selected when ISB is used. In all other cases this switch is open and the corresponding switch on the IF/AF Board is closed.

The loudspeaker amplifier is located on Panel Boards 2, and the gain is controlled by the AF potentiometer on the front panel.

Frequency Generation

All frequencies generated, including the BFO and the 125 MHz second local oscillator, are derived from the 25 MHz voltage tuned crystal oscillator (VCXO) on the Reference Board. This VCXO oscillator is phase locked to the built-in 5 MHz oven controlled reference oscillator or to an external frequency standard.

The synthesizer covers the band 125.2 to 155.2 MHz in 1 Hz steps. The VCO is controlled by a single phase-locked loop utilizing a new phase interpolating technique ("fractional N" synthesizer).

Control

The receiver subunits are controlled via a high speed serial data bus on the Mother Board. The serial bus comprises data, clock and four strobe signals. The bus signals are connected to serial to parallell converters (shift registers) in the subunits. The strobe signals serve to latch the current state of the receiving shift registers at an instant suitable for the corresponding subunit. In this way only three pins on the synthesizer board connector are required to enter 30 bits of frequency information.

The messages on the serial bus are assembled from the receiver setting information by a microprocessor on the Control Board. The microprocessor communicates in serial form with the Front Panel and a remote/computer control port using standard ASCII code. Battery backed up CMOS-memory provides non-volatile storage for 100 programmable channels.

The Front Panel is also built around a microprocessor. When a key is pressed, an ASCII character is sent to the Control Board in the receiver. On the Control Board, the memory image of the receiver setting is changed accordingly, and the ASCII character is echoed to the Front Panel. As a result of the echoed character, the display is updated to confirm the new setting.

Control Format

The ASCII coded data words sent between the Front Panel and the Control Board and with remote/computer control all have the same format:

- 1 start bit
- 7 data bits (ASCII)
- 1 parity bit (odd)
- 1 stop bit

Control Codes

The ASCII characters used to control the CR91 receiver are listed below. Note that some of the characters can not be sent from the CR91 panel. These special codes are used in systems where the receiver is controlled from a computer or some special device.

FUNCTION	HEX	ECHO	ASCII CHAR
MODE:			
CW	41	YES	A
FSK	42	YES	B
AM	43	YES	C
SSB	44	YES	D
AFSK	45	YES	E
ISB	46	YES	F
BANDWIDTH:			
VERY NARROW	47	YES	G
NARROW	48	YES	H
MEDIUM	49	YES	I
WIDE	4A	YES	J
USB	4B	YES	K
LSB	4C	YES	L
TEST POSITION:			
S-METER	4D	YES	M
CHAN A	4E	YES	N
CHAN B	4F	YES	O
AUXILLIARY	3D	YES	=
SYNC	2C	YES	,
EXTERNAL	3B	YES	;

FUNCTION	HEX	ECHO	ASCII CHAR
-20 dB			
OFF	50	YES	P
ON	51	YES	Q
Hi Z:			
OFF	52	YES	R
ON	53	YES	S
TUNING KNOB:			
FAST	6C	YES	l
MED	6D	YES	m
SLOW	6E	YES	n
OFF	6F	YES	o
KEYBOARD FUNCTION:			
AUX	3A	YES	:
CHAN	2F	YES	/
AGC	23	YES	#
FREQ	28	YES	(
KEYBOARD:			
0	30	YES	0
1	31	YES	1
2	32	YES	2
3	33	YES	3
4	34	YES	4
5	35	YES	5
6	36	YES	6
7	37	YES	7
8	38	YES	8
9	39	YES	9
RCL	3F	YES	?
STO/EXEC	29	YES	)
OPERATING MODE:			
DIR	58	YES	X
PROG	59	YES	Y
REM	5A	YES	Z

FUNCTION	HEX	ECHO	ASCII CHAR
RF-GAIN:			
UP	54	NO	T
DOWN	55	NO	U
BFO:			
UP	56	NO	V
DOWN	57	NO	W
KEYPAD (SS91):			
SET SCAN	20	YES	SP
SCAN OFF	21	YES	!
START SCAN	22	YES	"
STOP	2A	YES	*
PREV	24	YES	$
NEXT	25	YES	%
SET LOW	26	YES	&
SET HIGH	27	YES	/
START SWEEP	5C	YES	\
SPEED/DWELL TIME:			
UP	5B	NO	[
DOWN	5D	NO	]
TUNING KNOB:			
UP (+1 step)	70	NO	p
(+2 step)	71	NO	l
(+3 ")	72	NO	r
(+4 ")	73	NO	s
(+6 ")	74	NO	t
(+10 ")	75	NO	u
(+16 ")	76	NO	v
(+25 ")	77	NO	w
(+40 ")	78	NO	x
(+64 ")	79	NO	y
DOWN (-1 step)	60	NO	a
(-2 steps)	61	NO	b
(-3 ")	62	NO	c
(-4 ")	63	NO	d
(-6 ")	64	NO	d
(-10 ")	65	NO	e
(-16 ")	66	NO	f
(-25 ")	67	NO	g
(-40 ")	68	NO	h
(-64 ")	69	NO	i

FUNCTION	HEX	ECHO	ASCII CHAR
LOUDSPEAKER SELECT:			
CHAN A	6A	YES	j
CHAN B	6B	YES	k
MUTING:			
ON	3C	YES	<
OFF	3E	YES	>
AGC DUMP	40	YES	@
TEST VALUE:			
POLL	2D	YES	-
CONTINUOUS	2B	YES	+
REMOTE FUNCTIONS:			
LOCAL LOCKOUT	2E	YES	.
SET CNTRL MODE	7B	YES	{
SET DEVICE MODE	7D	YES	}

Power Supply

The power supply is connected to AC mains via a solid state relay which is operated from the battery supported +5V when the receiver is switched on. The receiver's ON or OFF state is latched in battery powered CMOS circuits on the Connection Board, and is automatically restored after a mains failure.

4.3 CIRCUIT DESCRIPTIONS

Signal Path (appendices 4:2 and 4:3)

Input Filters

Circuit diagram appendix 4:6

The signal from the antenna input X4 is first filtered in a low-pass filter. Normally the signal is coupled via two relays K1 and K2 to a limiting circuit (diodes V22-V27). The limiting circuit can withstand extreme overvoltage conditions for a short time until the 20 dB attenuator is automatically switched in via K2. The input resistor in the attenuator is mounted on the receiver chassis and can dissipate 20W.

The 20 dB attenuator can also be switched in manually via a control signal from the input logic (shift register D4). if high Z is selected, the relay K1 will divert the RF signal through a high input impedance amplifier V51. In this case protection against overvoltage is provided through the action of R3, R4 and the diodes V1 - V16.

The frequency information obtained from the input logic (shift registers D2 and D3) is converted to BCD-coded band select data in PROM D1. Individual band select signals are obtained from the BCD to decimal decoder D7. Below 1.6 MHz a low-pass filter is switched in via K3 and K4. The remaining filters are switched in by PIN diodes. T1 and T2 provides 200 ohm terminating impedance for the band-pass filters.

RF Unit

Circuit diagram appendix 4:7

The RF Unit has a wide-band amplifier to which delayed AGC is applied. Approximately 20 dB of gain reduction can be obtained by the combined action of PIN diodes V10-V15 and the LED/LSR units B1 and B2. The PIN diodes shunt the input of the amplifier and the photoresistors shunt the output. R43 is adjusted to activate the AGC circuit at approx 30 dB above the sensitivity threshold.

The signal is now mixed with the frequency from the synthesizer and an IF signal at 125.2 MHz is obtained. The IF signal is filtered in two crystal filters, one 2-pole and one 4-pole. An isolating amplifier V2 compensates for the filter loss. The IF signal is now down-converted to 200 kHz by mixing with 125 MHz.

At 200 kHz filtering is applied by means of the mechanical filter Z3. The bandwidth at this point is 6.8 kHz. The amplifier V6-V7 provides three outputs: X5 to the IF Filter Unit, X6 to the ISB Board and X7 which can be used for a (narrow band) panoramic unit.

IF Filter Unit

Circuit diagram appendix 4:8

In the IF Filter Unit there is one filter corresponding to each bandwidth that can be selected from the Front Panel. The standard filters are specified in section 1.3. The IF Filter Unit exists in several versions with different types of filters.

When a bandwidth is selected, this information is sent on the serial data bus and latched in shift register D1 by strobe 4. Three bits of information are converted to filter select signals in BCD to decimal converter D3. When WIDE bandwidth is selected, the filter is a low-pass filter and the bandwidth is determined by the filter in the RF Unit. When VERY NARROW bandwidth is selected the filter select signal is also used on the IF/AF Board to switch in an extra filter on this board.

The signal from the RF Unit on X2 is transformed to 200 ohm impedance level by T1. The filters are switched by PIN diodes and the output to X3 is via a buffer amplifier V14.

IF/AF Board

Circuit Diagram, appendices 4:9/1 and 4:9/2

(Also refer to App. 4.3 for a functional block diagram).

The IF/AF Board contains circuits to handle several important functions of the receiver.

- an IF Amplifier with a coarse gain of about 100 dB, under AGC control and with facility to switch in a very narrow - 300 Hz bandwidth - 200 kHz IF filter
- a detector for AM and SSB, switched through Emission Mode information fed to the board
- an audio amplifier for Channel A, and switched output for external amplifier (A/B channel)
- a phase-locked VCO, supplying the SSB detector injection signal, tuneable in 100 Hz steps
- AGC circuits: sensing the IF signal and comparing against a reference, then via the data processor an appropriate AGC level is set up, with respect to the built-in program
- a microprocessor to organize the main functions of the assembly, receives input data, controls output signals and with consideration of received inputs

The IF input over X2 is peak-tuned with L127 and applied to cascaded amplifiers V143 ... V146, three of which are controlled by AGC. A further aid in keeping the output level is the PIN-diode attenuator with V121, V122. The attenuator threshold level - about 100 uV input - is factory-set with R126.

Cascaded amplifiers drive emitter follower V148 which outputs IF signal to X3, the Channel A IF output, to the AGC diode rectifier V108 and to the last IF amplifier stage with V175. The path to V175 is either through bilateral switch D164 to R165 and then to the base of the transistor, or through the very narrow bandfilter Z159. Resistor R165 becomes an attenuator with the input impedance of the base components, compensating the insertion loss of Z159.

The detector operates as a product (SSB) detector when transistor V68 is cutoff. The BFO signal level from V53 is normally 3 V peak-to-peak. Transformer T176 is tuneable and adjusted for maximum output. An envelope detector (AM) is obtained when V68 is biased to conduction, forward-biasing germanium diode V183. Simultaneously transistor V66 conducts, forward-biasing V103 and also cutting off the VCO. When V103 conducts, the gain of V175 is increased about 4 times, becuase the 330 ohm resistor R105 is no

longer in the negative feedback path, being decoupled by the 100 nF capacitor C104. In this way the lower output from the detector on AM is compensated. The AM Enable signal is delivered from the processor.

Audio output from the detector is first amplified in D188, passed through the AF Mute circuit with D203 and peak limiter V207, V208 and then through D212, which constitutes an active LP-filter (cutoff frequency 3,5 kHz) to the LINE LEVEL potentiometer (accessible from the rear). The output level at X1.30a, and after amplification in D217, can be set to -20...+10 dBm. The output impedance after D217 is quite low. The direct low-power output is switched under processor control through D223.

The VCO with FETs V34, V36 is controlled from the sample-and-hold detector built with the four bilateral switches D7-11-15-17. The discriminator samples charges to capacitor C16, passes the charge to C25, there sets up a voltage which is filtered in a double-T and then via V27 varies the capacitance of varicap diode V131, and hence the VCO frequency.

The phase-locked loop uses 100 Hz as the reference, obtained through fixed dividers in D278, and producing 100 Hz spikes in monostable multivibrator D286. The output controls the sawtooth ramp on C12 + C13 in the phase discriminator. The other signal for comparison is taken from the VCO output transistor V46 to a variable divider in D278. The divisor is obtained from the microprocesor, which under program control fetches information from the appropriate sources:

- BFO pitch control (external)
- Emission Mode
- Center frequency at FSK-mode selected on S269

The signal controls the other three switches, and results in a constant output signal when the divided frequency from the VCO becomes 100 Hz exactly.

Input data to the microprocessor enters the IF/AF Board in serial form: is clocked into two 8-stage shift & store bus registers, D291 and D292. The output terminals are connected to the internal Address/Data bus. Following signals can be retrieved on the outputs:

D291		pin no	D292
BFO	8	4	(8)
	4	5	MODE 4
	2	6	2
	1	7	1
MGC	8	14	MGC Off
	4	13	AGC Off
	2	12	Time Const. 2
	1	11	1

The MODE truth table is as follows:

Mode	4	2	1
A1A	0	0	1
F1	0	1	0
A3E	0	1	1
SSB	1	0	0
ISB "A"	1	0	1
ISB "B"	1	1	0

The AGC voltage is set up by the microprocessor with the view to keep the signal level constant at the input of the comparator D91. Thus a digital "level" from the processor is converted to analogue in D246, passed to operational amplifier D251, where the factory-set AGC threshold potentiometer R249 controls the level from which the AGC operation is to be applied. After further amplification in D258 the AGC voltage is applied to internal amplifiers and also externally available over X1.30c. Internally V85 serves as an AGC Mute cirucit, shorting AGC and +5V when transistor V85 is switched on from the processor. Main AGC characteristics are in the program, e.g. attack time and "hang-on" time, others - like the three time constants 0,1 - 1 - 5 s - are front panel selected in addition to their default values. A certain hysteresis in comparator D91 is obtained because the reference "window" is opened slightly when the comparator has signalled that a new AGC voltage is required.

The microprocessor is reset on Power-Up from the two transistors V81, V82, constituting a power-up circuit with output taken from capacitor C84.

ISB Board

Circuit diagrams, appendices 4:10/1 and 4:10/2

(Also refer to Appendix 4:3 for a functional block diagram).

The ISB Board serves to receive lower sideband signals only. It is functionally identical to the IF/AF Board what concerns IF signal amplification, AGC and audio circuits. MGC, BFO and detector VCO are not required. The product detector oscillator signal is here the 200 kHz refrence signal. The IF filter Z7 is normally a 200 kHz LSB filter.

Connection Board

Circuit diagram appendix 4:11

The Connection Board comprises the two line transformers T1 and T2 and the muting circuits (B3, V5-V7). The Connection Board has two muting inputs: one to X2/6 and X2/3 with V28 interface, and one to X3/3 with open collector interface. A third input is provided at 12a on the board connector and allows the muting function to be controlled from the Control Board. The remote control interface and the ON/OFF logic is also on the Connection Board but is described under "Control" below.

Frequency Generation (appendix 4:2)

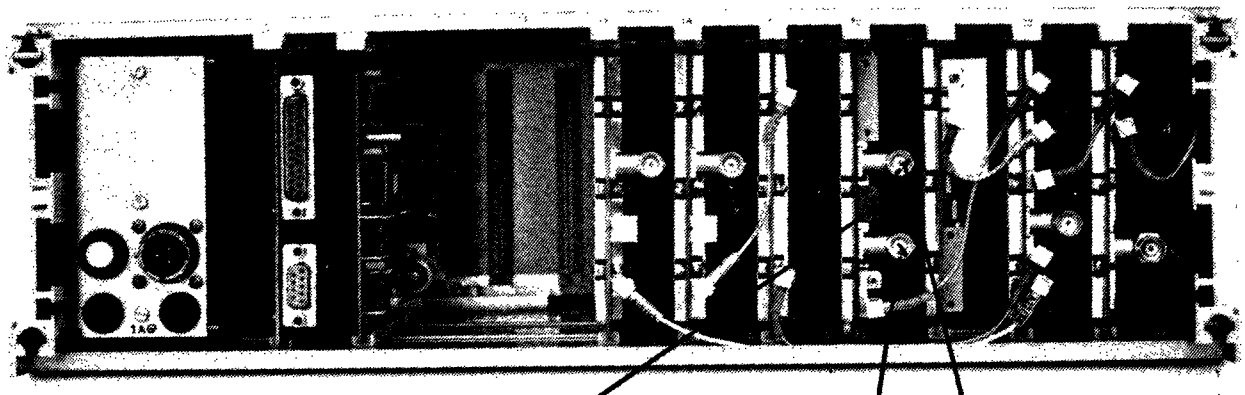
Reference Board

Circuit diagrams appendices 4:13 and 4:14.

All frequencies are derived from the Reference Board where a MXO (Master X-tal Oscillator) at 5 MHz is used as a reference. The MXO consists of an OCXO (Oven Controlled X-tal Oscillator). The 5 MHz reference signal is first divided by 2 in D2 and is then used to control a VCXO (Voltage Controlled X-tal Oscillator) V3 at 25 MHz in a phase locked loop (PLL).

Instead of the internal OXCO, it is possible to connect an external master reference signal at 5 MHz to the BNC connector X2 on the rear of the Reference Board (figure 4:1).

Selection between the internal and the external reference signal is made with switch S1, located on the rear edge of the board. S1 controls a switch built up with gates (D1) for the two reference signals. To minimize the power consumption, the DC supply for the OCXO is also disconnected in the external position of S1.



Switch for selection of

internal or external master oscillator

Lower pos = Internal
Upper pos = External

Input for external master oscillator

Master oscillator output (50 ohm)

Figure 4:1 Rear of the CR91

The 25 MHz signal of the VCXO is multiplied by 5 in V4 to obtain a 125 MHz signal which is filtered an supplied to the RF Unit through the connector X5 on the rear of the board. The 25 MHz signal is also divided by 5 in D4 to obtain a 5 MHz signal. This signal is supplied to connectors X3 and X4 and can be used as a reference signal for other equipment or at frequency adjustment of the internal OCXO. The 5 MHz signal is further divided by 2 and 5 in D3 to provide 2.5 MHz and 1 MHz.

The 2.5 MHz signal is compared to the divided reference signal in the phase/frequency detector D5 and the error signal controls the VCXO via V8 and V9.

The 1 MHz signal is buffered through D6 and supplied to the synthesizer and also further divided by 5 in D2 to 200 kHz which is supplied to the IF/AF Board and the ISB Board.

With R57 it is possible to adjust the frequency of the OCXO to compensate for drift due to ageing.

By comparing the two input signals to the phase detector in an exclusive or gate (D6), an active low test signal is obtained from V10 if an unlocked condition of the PLL occurs. This signal is "wired or" connected with a corresponding signal from the synthesizer and is monitored by the Control Board. The internal control voltage ot the varicap diode V23 is also available at the board connector as a test point.

Synthesizer

Circuit diagrams, appendices 4:14 and 4:15.

The Synthesizer must produce a signal that can be set in 1 Hz steps to any frequency in the range 125.2 - 155.2 MHz. The principle employed to obtain this signal is the so called "fractional N" synthesizer. This type of synthesizer is best described as an ordinary one loop indirect synthesizer with some added refinements to allow setting the frequency to fractions of the reference frequency.

The reference frequency (f_r) in this case is 100 kHz so the 10 MHz, 1 MHz and 100 kHz frequency control signals can be applied directly to the variable ratio divider. The division ratio N will vary between 1252 and 1551 and the VCO frequency fo = N * fr.

In a "fractional N" synthesizer the remaining frequency control digits, i this case 10 kHz, 1 kHz, 100 Hz, 10 Hz and 1 Hz, are added to an accumulator register once per sample period i.e. in this case once every 10 microseconds (1/fr). The accumulator register overflows when the contents exceeds 100000 i.e. when we have "saved up" to a whole period of the reference frequency. The overflow signal is used to set the divider to N+1 during the following sample period.

In this way the average frequency of the VCO can be set to any value, but the spectral purity would be poor due to the discontinuous way in which the fractional phase is added. The last refinement is a D/A converter, which allows an analogue property, proportional to the content of the accumulator, to be added to the output from the phase comparator and cancel the jitter. In the CR91 syntheiszer this analogue properaty is the length of two pulses used to control current sources that charge an integrating capacitor during the sample period.

The CR91 synthesizer is built up with thick-film hybrid circuits (A2-A5). The input logic (serial bus interface) is in A3 together with the accumulator adder and a phase/frequency comparator. A2 holds the variable ratio divider and the D/A converter. All frequency control lines except for the 1 Hz digit are coupled to A2. The 1 Hz digit is only required in the accumulator/adder, four BCD digits resolution is enough for the D/A converter. ADD (A3:33) is the overflow signal from the accumulator. T1 and T2 (A2:1 and A2:2) are the pulses from the D/A converter and are used in the phase generator A4. The phase comparator summing network and integrator is in A5, and the control voltage to the VCO is available at the jumper X5/X6.

The VCO, which is mounted as a subunit on the synthesizer board, can be coarse tuned in 32 steps by switching in any combination of 5 binary weighted capacitors over the resonant circuit with PIN diodes. The switching of the capacitors is controlled by the state of an up/down counter (D11-D12). If the control voltage to the VCO falls outside the range set by R7-R11, the window detector D5/1, D5/2 and D6 will enable pulses to the up/down counter via pulse control circuit D7-D9. Depending on the polarity at D6:3, the counter will count up or down until the control signal is again within the window and a steady state can be achieved. If the frequency error is large as for instance when the 10 MHz digit is changed, the pulses from the phase detector in A3 will overlap, and the pulse frequency to the up/down counter will increase through the action of D7/1. In this way the time to obtain phase lock is minimized.

From the VCO there are two buffered outputs to the connectors X2 and X3 at the rear edge of the board. One of these is used to supply the RF Unit with the 125.2 - 155.2 MHz signal. The variable ratio divider in A2 obtains the VCO signal via a separate buffer amplifier on the board.

Control (appendix 4:4)

General

The CR91 is a microprocessor controlled receiver. It follows that the sequence of events that take place when for instance a button on the front panel is pressed, is determined by software and can not be explained by examining the circuit diagrams.

In the following, the control hardware is first described using the circuit diagrams, and then some aspects of the software are discussed together with the functional block diagram.

Panel Board 1

Circuit diagram, appendix 4:16

The Panel Board 1 provides the interface to the operator i.e. it holds the push-buttons, potentiometers and displays used by the operator. The interface to the microprocessor on Panel Board 2 is via the expander port D1. This expander port has four bidirectional 4-bit ports P4-P7. P7 is used together with the 4 to 16 line decoder D2 and open collector buffers D3-D5 to obtain 16 scan outputs that are used both to scan the push-button keys and the displays.

The push-button keys are connected to form a 3 by 16 matrix and a key closure can be detected by sinking one at a time of the scan outputs and examining the three common lines coupled to P4. Every scan line is also coupled to the cathodes of a set of LED's. These LED's are either part of the 7-segment digits in D6-D7 or individual LED's mounted in the push-buttons.

When a particular scan line is low, the illumination data for the corresponding LED's is latched in P5-P6 and applied to the LED's via the driver transistors V1-V8. In this way any individual LED is only on for 1/16 of the time. The intensity of the LED's can be adapted to the ambient light conditions by reducing this time even more. This is done via the inhibit input to D2 by a pulse from a one-shot on Panel Board 2. The one-shot (D6) is triggered once for every scan increment and the pulse width is controlled by the "DIMMER" potentiometer R13 on Panel Board 1.

The remaining input of P4 allows an extension of the keyboard matrix and can be connected together with P7 to the keypad SS91.

Panel Board 2

Circuit diagram, appendix 4:17

Panel Board 2 holds the microprocessor, circuits for communication with the Control Board, A/D converter, the tuning knob logic and the loudspeaker amplifier.

The microprocessor D7 (type 8039) has built-in data memory but is used with external program memory D10. D8 serves to latch the low order address bits from the multiplexed data bus. The interface to the expander port on Panel Board 1 is via the lower half of port P2 (P20-P23) and PROG.

Communication with the Control Board is via the serial interface circuit (UART) D14, which is connected to the processor bus. The baudrate is determined by the clock signal supplied from the counter circuits D9, D11, D12 and D15. The 400 kHz ALE signal is used as input to D9. Baudrates between 50 and 4800 can be selected via S1.

The A/D converter D13 is also connected to the processor bus and allows the processor to determine the setting of the RF and the BFO potentiometer (and the SPEED/DWELL TIME potentiometer on SS91 if this unit is used).

The main tuning knob is mounted directly on the axis of a small DC generator. The DC voltage is amplified and rectified in D1 and D2 respectively and applied to a voltage to frequency converter D3. When a pulse is obtained from D3, the polarity (= direction of rotation) is latched in the lower half of D4. The upper half of D4 will generate an interrupt to the processor. When the interrupt has been serviced, D4 is set and can receive another pulse.

Every time D4 is set, C5 is discharged via V4, reducing the sensitivity of D3 while C5 is charged again. This effect can only be observed when the knob is turned very slowly, but allows the last digit to be set to a specific value despite the fact that the resolution of the knob is approx 2500 steps/turn.

Should a character be received (RX RDY = 1) while the tuning knob is turned, it will be given the highest priority since a new interrupt cannot occur while RX RDY = 1.

The loudspeaker amplifier D5 is connected to the built-in loudspeaker and to an external loudspeaker output via X5/14. The built-in loudspeaker can be switched off by V5.

Control Board

Circuit diagram, appendix 4:10

The Control Board holds a microprocessor system (type 8085) and some specialized hardware to interface the CR91 receiver subunits. The microprocessor system is built around an 8085 microprocessor D1 operating with a 6 MHz crystal (3 MHz clock). D11 is used to latch the low order address lines from the multiplexed data bus. The program is stored in D10 (EPROM) which normally can hold 8 Kbyte, but is replaced with a 16 Kbyte circuit if the SS91 sweep/scan option is purchased.

Data memory is provided by CMOS circuits D17 and D24. These can hold 2 Kbyte each, and are supplied from the battery supported +5V. The battery backup circuit D19, D28, V3 and V4 disables the CMOS memory and resets the processor if the normal +5V falls below 4.8 volt. In this way, the stored data is retained during mains failures and when the receiver is switched off. The lithium battery used can supply the memory for at least 5 years.

Communication with the front panel and with the remote/computer control port is provided by serial interface circuits D4 and D5 (UART). Both transmit

and receive buffers are handled via interrupt. The bit clocks that determines the baudrate, are provided by the timer/counter circuit D13. The baudrate is set individually for D4 and D5 by software at power up. Normally D4 is set to 2400 Baud and D5 to one of four baudrates depending on the jumpers X3 and X4 (see section 2.3).

The third channel of D13 is used to provide the timing signal required by the operating system and is coupled directly to the interrupt controller D14.

The data and clock signals to the 20 Kbit/s receiver synchronous serial data bus are provided by D3, D6, D21 and D22. When a byte is loaded into D3, the 8 data bits are shifted out serially and a clock pulse is provided in the center of each data bit. The end of the sequence is signalled by an interrupt signal to D14. The required strobe signals are provided by the 8 bit latch D7. The muting output and the select addresses to the A/D converter D15 are also obtained from D7.

The D/A converter D16 together with D23 and V8 is used to set a lower threshold for the voltage on the AGC line. This threshold coincides with the setting of the RF gain potentiometer on the front panel. The lower part of D23 generates a signal that is available on the Connection Board and can indicate if the signal level (AGC voltage) is higher than a threshold set by the RF gain potentiometer.

Connection Board

Circuit diagram, appendix 4:11

The Connection Board holds the V28 interface for the remote or computer control port and the logic to switch the CR91 ON or OFF locally or remotely.

The (floating) V28 REMOTE IN signal to X2/9 and X2/5 is converted to TTL level via opto-coupler B2, D3/2 and V2. The REMOTE OUT signal at 8c on the board connector, is converted to V28 level in D4/1 and the output is on X2/4. The REMOTE OUT signal is also available at X3/14 for monitoring purposes.

The ON/OFF status of the CR91 is stored in latch D3/3-D3/4. If no remote control line is connected, this latch can be set or reset by the ON and OFF push-buttons on the front panel. If a mains failure occurs while the CR91 is switched on, pulses with a very short duty cycle are generated by D3/1 and D2/2. These pulses attempt to switch on the CR91, and once the mains is restored, the power supply will respond and the +5V will latch the circuits in the ON condition.

When remote control lines are connected, the ON/OFF latch is forced to agree with the condition on the remote control line. Mark signal (minus to X2/9) corresponds to ON. D2/1 provides a pulse after every mark to space transition that prevents the CR91 to be switched off during the space bits. A sustained space condition on the remote control line will keep the CR91 switched off.

Control Unit (Keypad) SS91 (optional)

Circuit diagram, appendix 4:22

The SS91 is an extension of the CR91 front panel and holds 9 push-buttons and a potentiometer. The push-buttons are connected to nine scan lines provided by the BCD to decimal decoder D1. Input to D1 is the binary coded scan signals from expander port P7 on Panel Board 1. The sense line from the push-buttons and the output from the SPEED/DWELL TIME potentiometer are returned to Panel Board 2 via X1/2 and X1/8 respectively.

Control Software

The function of the CR91 controls as outlined in Chapter 3 is fairly obvious in most cases. In some situations, however, the behaviour of the receiver is easier to understand if the underlying principle is known.

Update of front panel memory

When the CR91 is switched on, the display memory (microprocessor internal RAM) is empty, and must be updated with the last setting information from the battery backed up CMOS memory on the Control Board. This is initiated from the panel processors power-up routine by sending an update request"?" to the Control Board. When this request is received, a sequence of 25 ASCII characters are sent to the front panel. The first character is a "?" that tells the front panel to interprete the following 24 characters as update information. Apart from at power-up, the update sequence is sent to the front panel in three situations:

- when the RCL button on the front panel is pressed
- when the Main Tuning Knob has been used
- When the CR91 is switched from remote (REM) to local (DIR)

Tuning Knob operation

When the tuning knob is turned, pulses are generated and the panel processor is interrupted. If the knob is turned slowly, one ASCII character per pulse is sent to the Control Board, but even at 2400 Baud, a maximum of 240 characters/second can be sent when each character is 10 bits. Therefore, when the pulse rate is increased, the pulses are accumulated between characters and an ASCII character corresponding to an approximation of the sum is sent to the Control Board. In this way 20 different ASCII codes are dedicated to this function (see code table at page 4.6). In order to increase speed, the front panel frequency display memory is up-dated at the same time as the character is sent, and the "tuning" characters are not echoed. This means that if a character is lost (only possible with remote control) the frequency display would no longer show the actual frequency of the receiver. Therefore an update request is sent to the Control Board each time the knob stops turning, and the panel display is thus forced to agree with the actual frequency of the receiver. Normally, there is no difference between the displayed frequency and the actual frequency, and the above action is totally transparent to the operator.

Program Mode and the STO/EXEX and RCL buttons

On the Control Board, the receiver parameters are kept in memory as three data structures:

- the working memory
- the buffer memory
- the channel memory

The working memory determines the actual setting of the CR91, and the data sent on the serial bus is always taken from the working memory. The buffer memory is the link between the Front Panel and the working memory.

When for instance the AM button on the front panel is pressed, the buffer memory location holding the MODE information is changed and then the complete buffer memory is copied to the working memory and the receiver is updated i.e. all working memory data is sent on the serial bus.

When the keyboard is used, say to set the frequency, the buffer memory is changed for each keystroke, but is not copied to the working memory until the STO/EXEC button is pressed. That is why the keyboard entry procedure can be terminated and the old data recovered by pressing the RCL button.

Generally speaking, the STO/EXEC button copies the buffer memory to the working memory and updates the receiver while the RCL button copies the working memory to the buffer memory and updates the Front Panel.

Operations on the channel memory are performed when the STO/EXEC or RCL button is used while channel function is selected on the Front Panel. When channel function is selected (the LED i the CHAN button is on), pressing the RCL button means that the content of the channel memory location addressed by the selected channel number, is copied to the buffer memory which is then copied to the working memory. Both the receiver and the panel is updated. Pressing the STO/EXEC button with channel function copies the buffer memory to the channel memory location addressed by the channel number.

In program mode (PROG), the working memory is "write protected", i.e. the front panel commands only affect the buffer memory. If channel function is selected while in program mode, the data is exchanged between the channel memory and the buffer memory only. When the program mode is left (by pressing DIR) the buffer memory is copied to the working memory and the receiver updated as if a STO/EXEC command had been given. If this is not desired, the RCL button can be pressed before the DIR button, in which case the working memory is first copied to the buffer memory and the Front Panel updated to the setting the receiver had before program mode was entered.

RF and BFO potentiometers

These potentiometers are connected between +5V and ground, and an A/D converter provides the processor at the Front Panel with a binary number corresponding to the potentiometer setting.

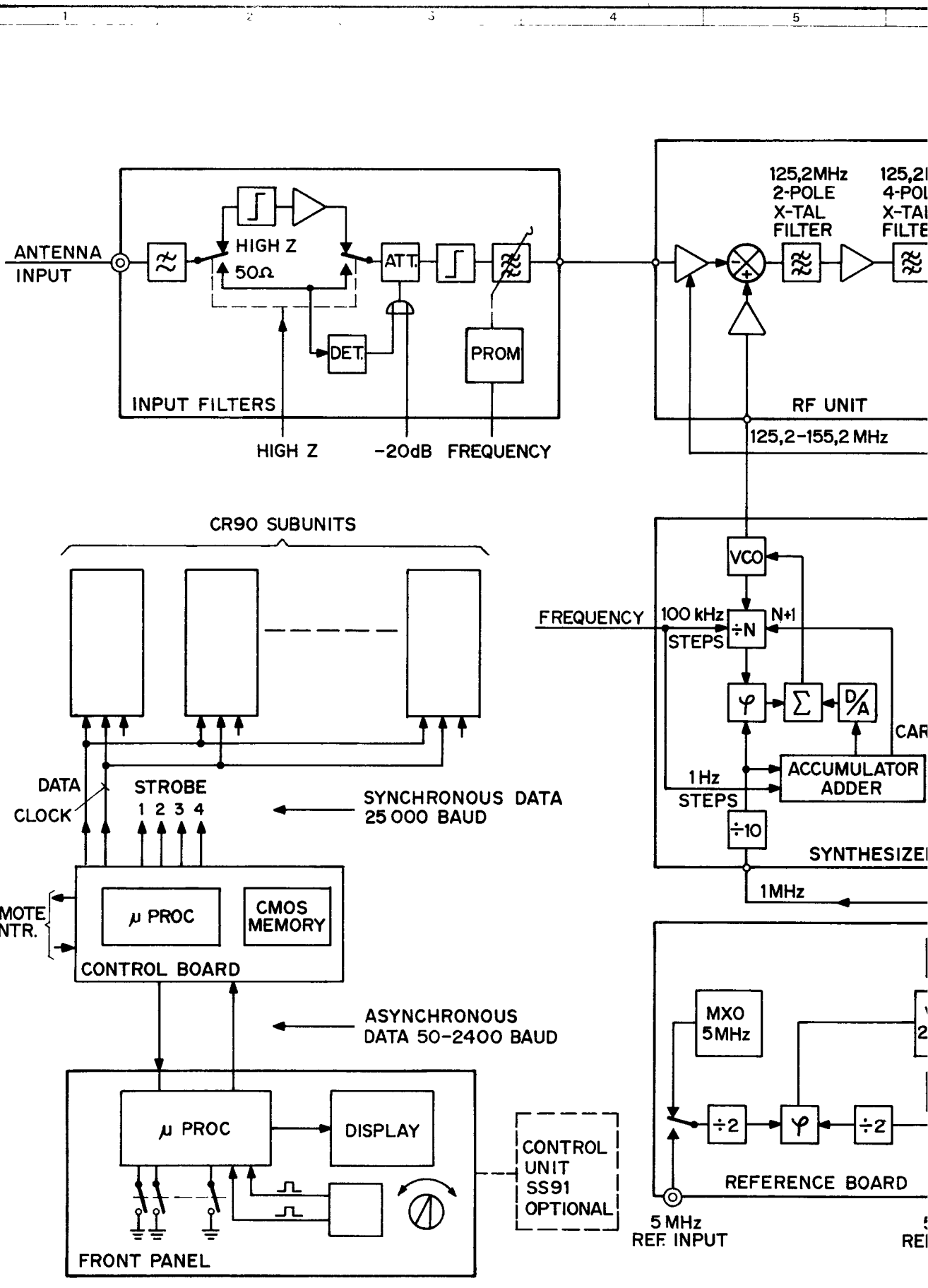
On the Control Board the RF gain and BFO data are taken from two byte-variables that must be made to follow the potentiometer settings. The principle is as follows:

At power-up (and any update sequence) the potentiometer data from the Control Board is copied to corresponding data locations (variables) at the Front Panel. These variables are periodically compared to the A/D converted setting of the potentiomters and incremeneted or decremented until equal. Each time a variable is incremented or decremented, an increment or decrement command is also sent to the Control Board, forcing the variable at that end to agree with the potentiometer setting.

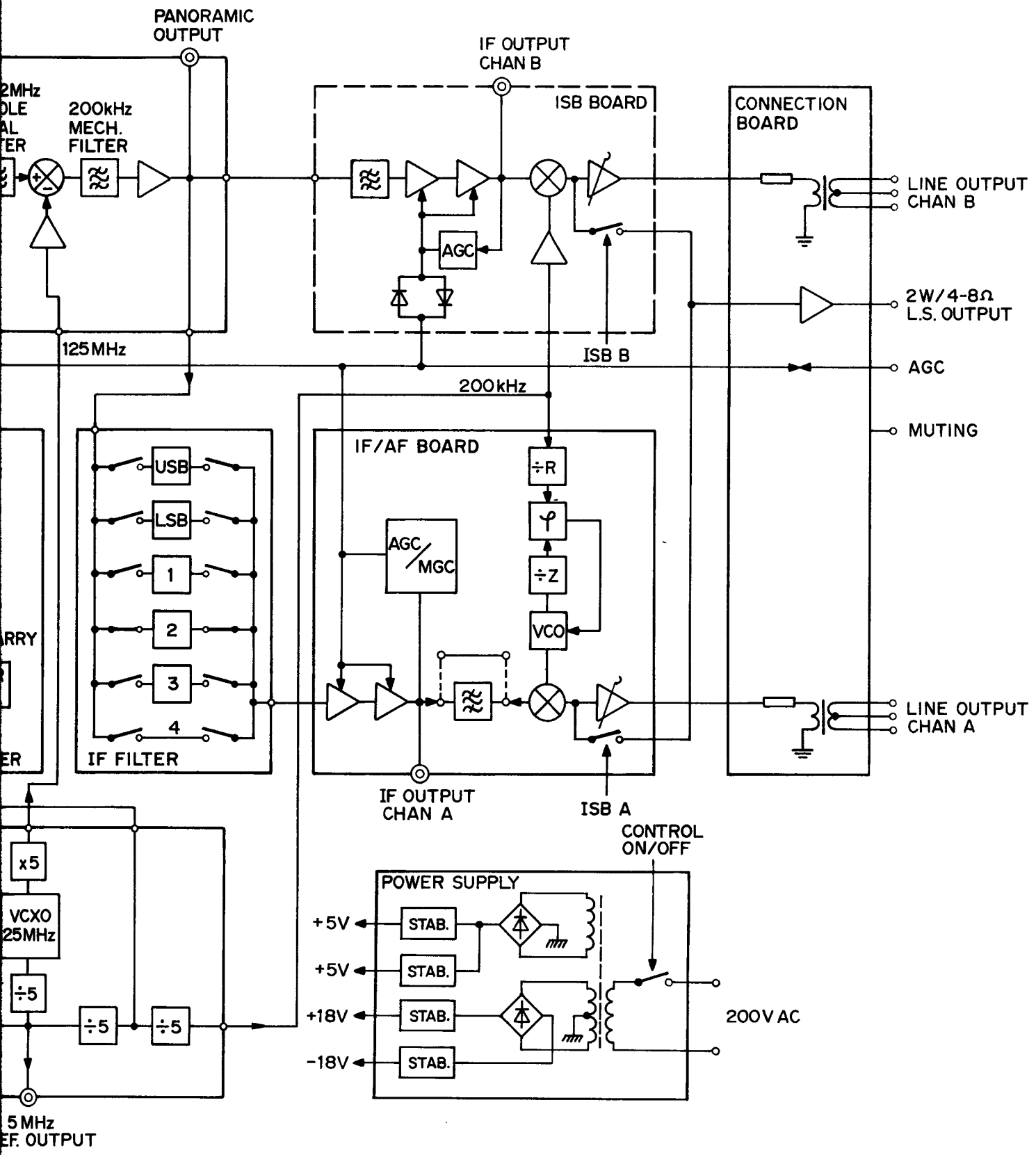
Power Supply

Circuit diagram, appendix 4:20

Transformer T1 is connected to AC mains via a solid state relay which is operated from the battery supported +5V when the receiver is switched on. S01 is mounted on the rear of the unit and allows the power supply to be switched on even if the battery should be discharged. There are two +5V regulators. Regulator D4 supplies the logic circuits and is adjusted to +5.2V. Regulator D3 supplies the display circuits on the front panel.



CR91 CONTROL SYSTEM



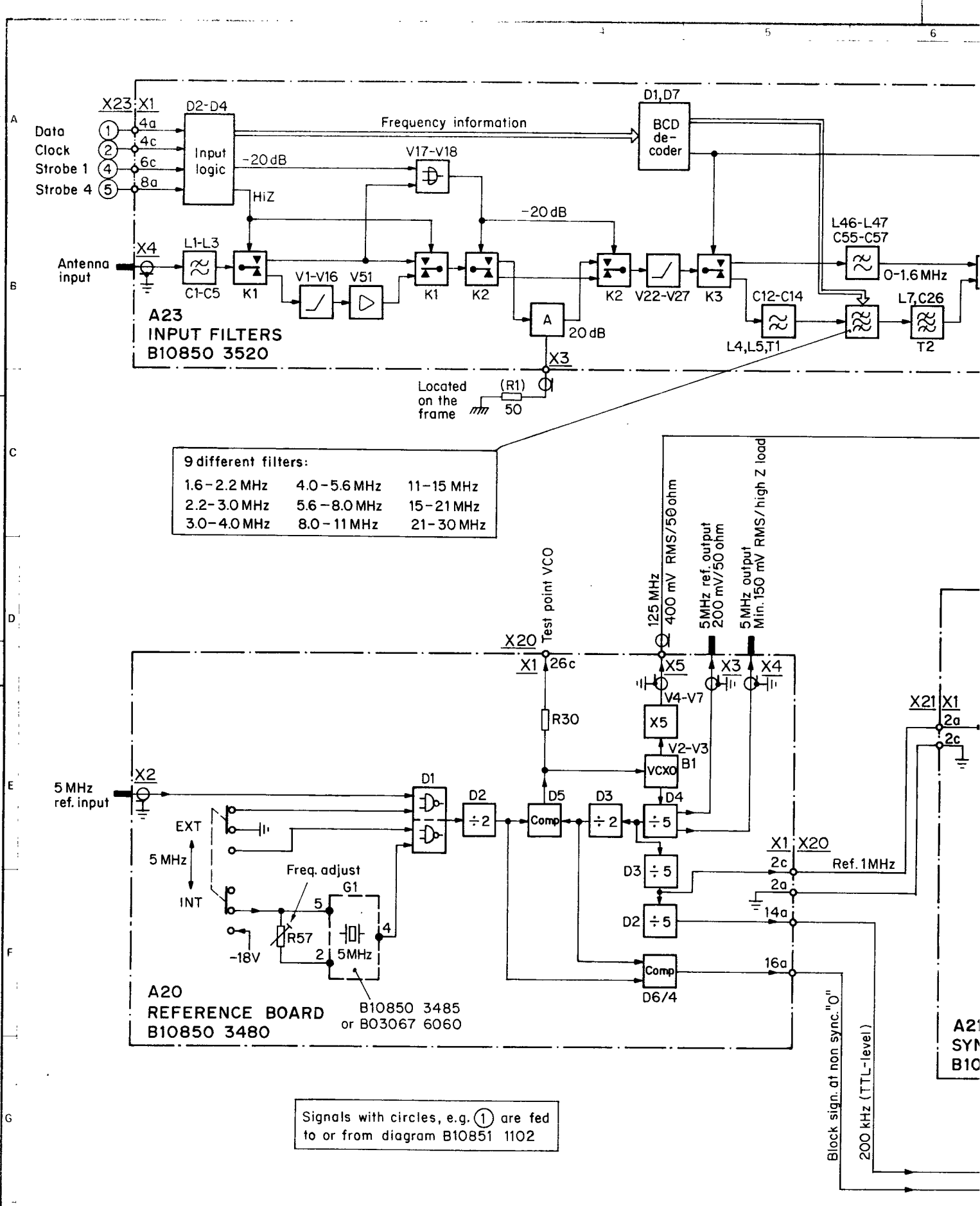
APP 4.1

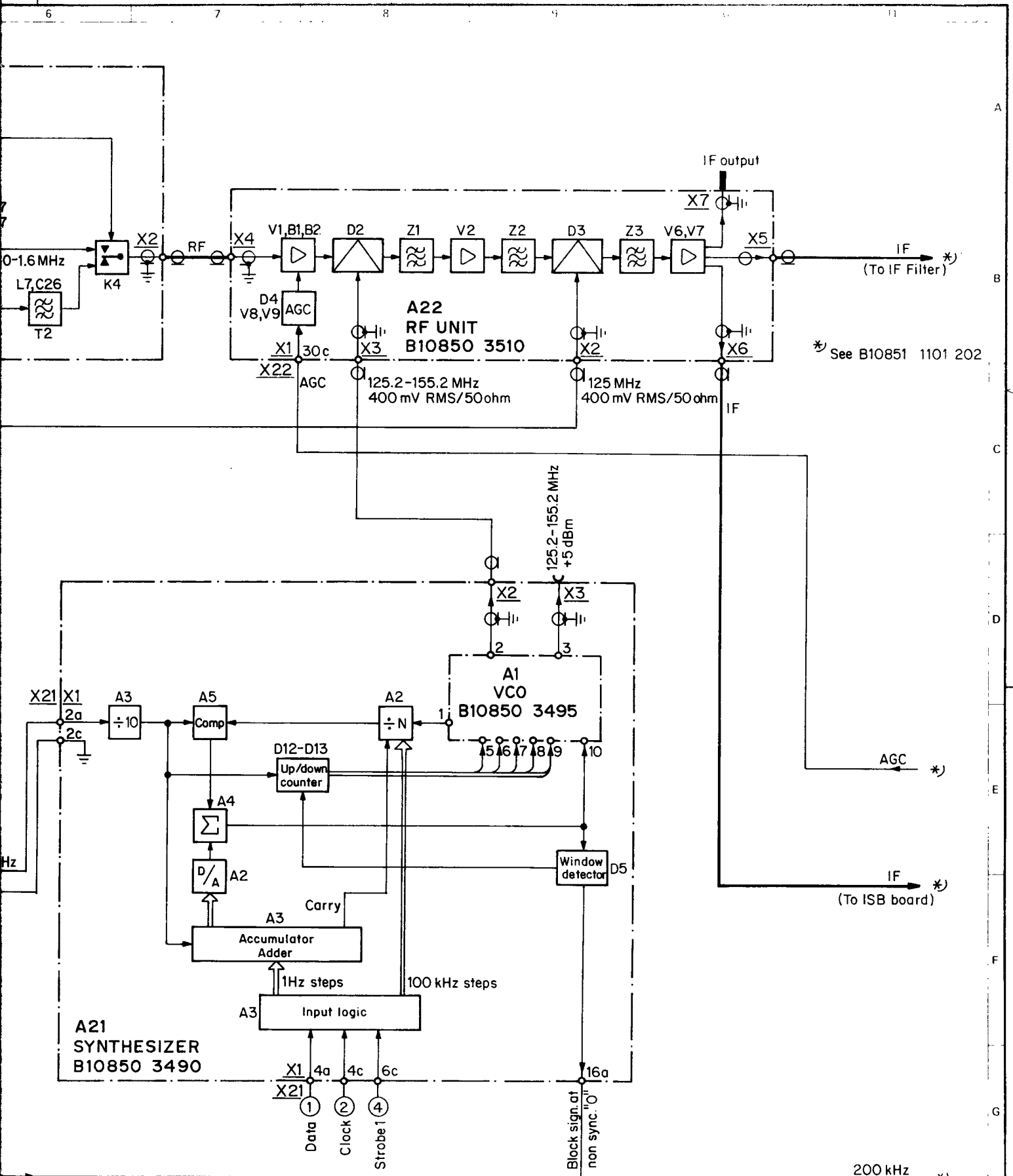
ED	DATE-NO				
SIGNATURES					
ED	DATE-NO	1	820104	2	830926
SIGNATURES					

ITT

SRT RECEIVER CR91 BLOCK DIAGRAM

B10851 1100 2


X23 X1
Data
Clock
Strobe 1
Strobe 4
4a
4c
6c
8a
D2-D4
Input logic
Frequency information
D1,D7
BCD de-coder
-20 dB
V17-V18
HiZ
-20 dB
L46-L47
C55-C57
0-1.6 MHz
X4
Antenna input
L1-L3
C1-C5
K1
V1-V16
V51
K1
K2
K2
V22-V27
K3
C12-C14
L4,L5,T1
L7,C26
T2
A
20 dB
X3
A23
INPUT FILTERS
B10850 3520
Located on the frame
(R1)
50
9 different filters:
1.6 - 2.2 MHz
2.2 - 3.0 MHz
3.0 - 4.0 MHz
4.0 - 5.6 MHz
5.6 - 8.0 MHz
8.0 - 11 MHz
11 - 15 MHz
15 - 21 MHz
21 - 30 MHz
Test point VCO
125 MHz 400 mV RMS/50 ohm
5MHz ref. output 200 mV/50 ohm
5 MHz output Min. 150 mV RMS/high Z load
X20
X1 26c
X5
X3
X4
V4-V7
R30
X5
V2-V3
VCXO
B1
X2
5 MHz ref. input
D1
D2
÷2
D5
Comp
D3
÷2
D4
÷5
EXT
5 MHz
INT
Freq. adjust
G1
5
4
R57
2
5MHz
-18V
D3
÷5
D2
÷5
Comp
D6/4
X1 X20
2c
2a
14a
16a
Ref. 1MHz
X21 X1
2a
2c
A20
REFERENCE BOARD
B10850 3480
B10850 3485
or B03067 6060
Block sign. at non sync. "0"
200 kHz (TTL-level)
Signals with circles, e.g. (1) are fed to or from diagram B10851 1102



APP 4.2

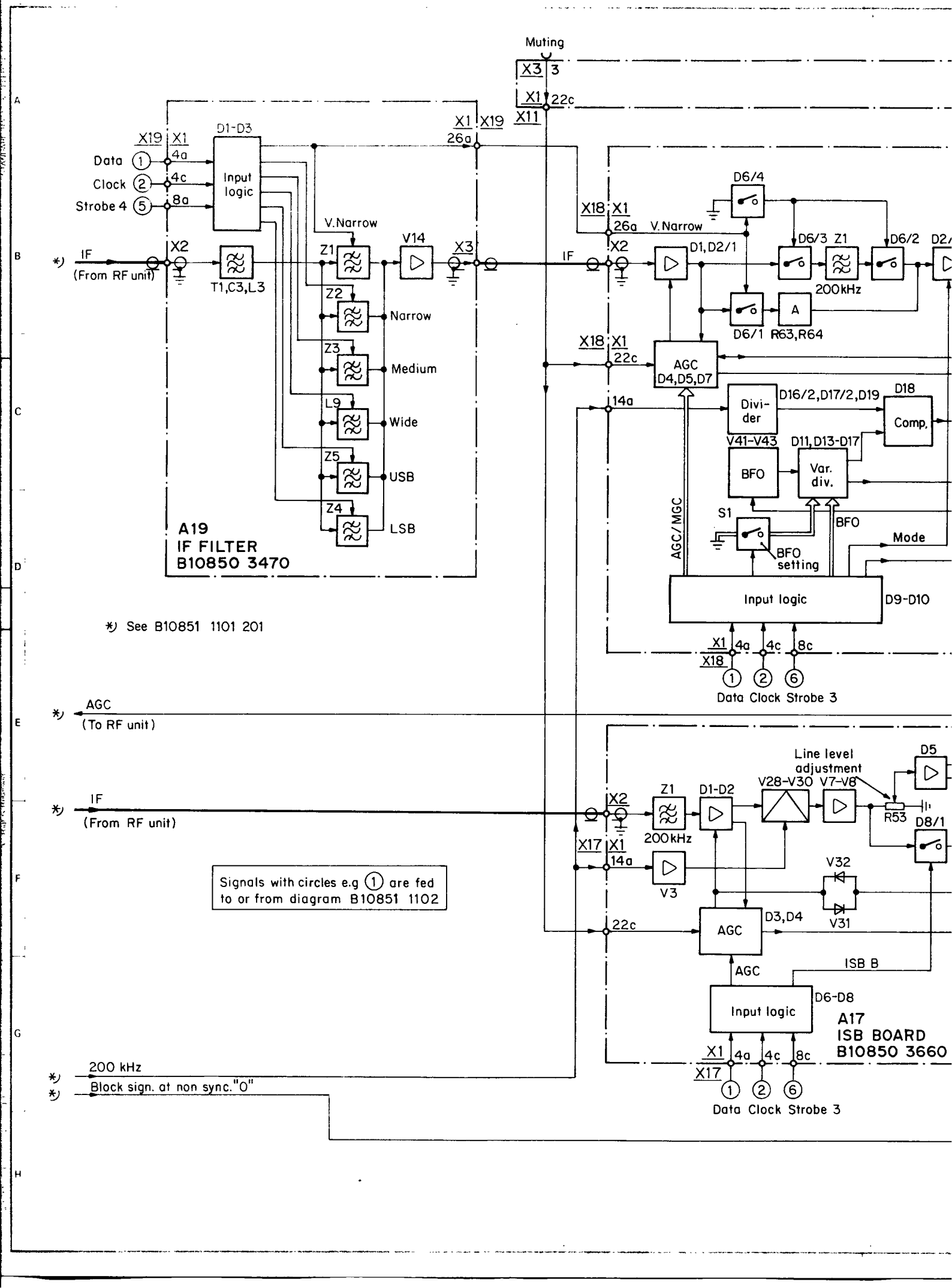
ED DATE-NO		
SIGNATURES		
ED DATE-NO	1 830929	
SIGNATURES		

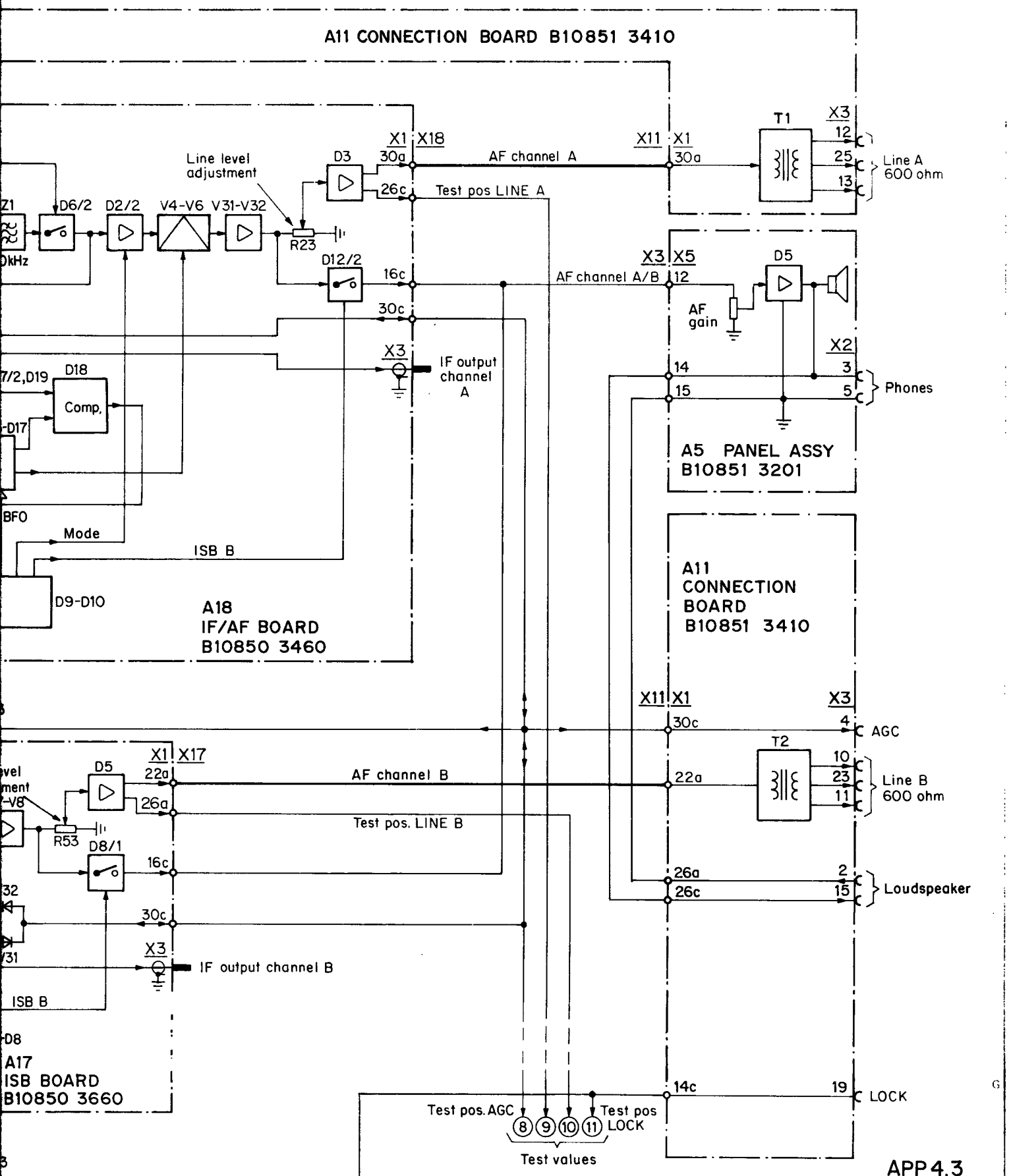
ITT

SRT

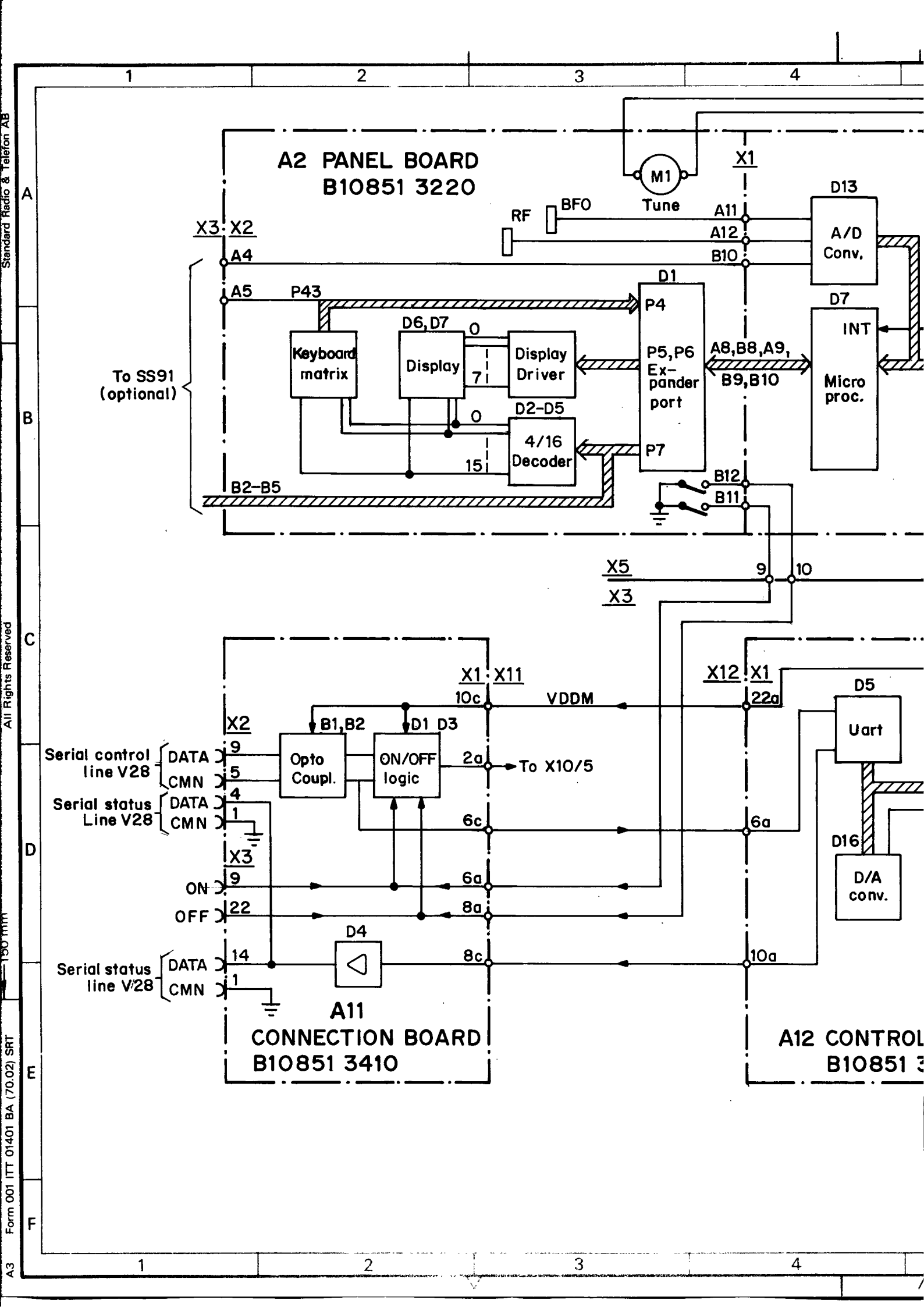
CR91
RECEPTION
Functional block diagram

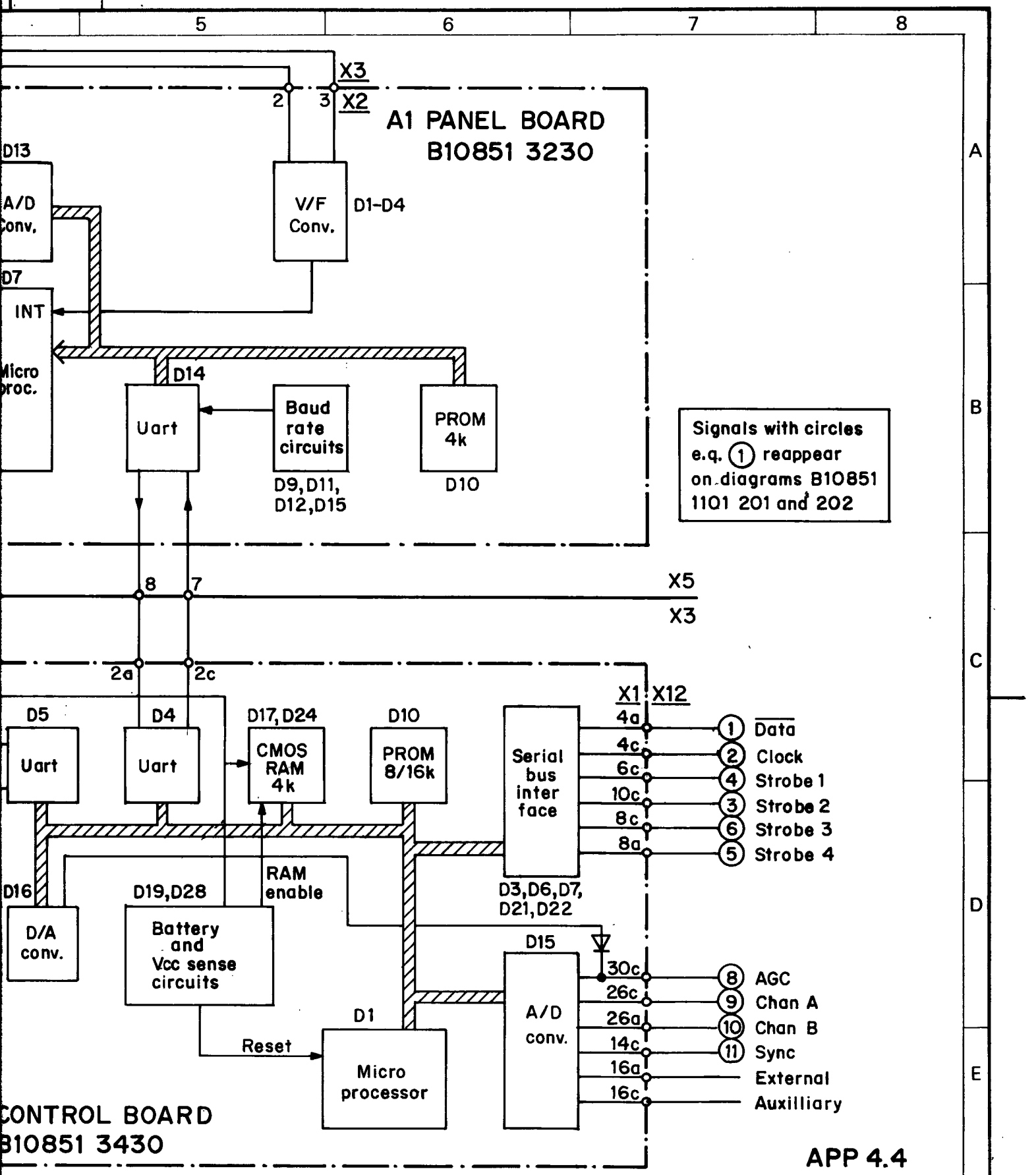
B10851 1101 201


Muting
X3 3
X1 22c
X11
X1 X19
26a
X19 X1
Data 1 4a
Clock 2 4c
Strobe 4 5 8a
D1-D3
Input logic
V.Narrow
V14
X3
IF
(From RF unit)
X2
T1,C3,L3
Z1
Z2
Narrow
Z3
Medium
L9
Wide
Z5
USB
Z4
LSB
A19
IF FILTER
B10850 3470
*) See B10851 1101 201
X18 X1
26a
V.Narrow
D6/4
D1,D2/1
D6/3 Z1
200kHz
D6/2
D6/1
A
R63,R64
X18 X1
22c
AGC
D4,D5,D7
14a
Divi-
der
D16/2,D17/2,D19
D18
Comp.
V41-V43
BFO
D11,D13-D17
Var.
div.
AGC/MGC
S1
BFO
BFO
setting
Mode
Input logic
D9-D10
X1 4a 4c 8c
X18
1 2 6
Data Clock Strobe 3
*) AGC
(To RF unit)
*) IF
(From RF unit)
Signals with circles e.g 1 are fed
to or from diagram B10851 1102
X2
Z1
200kHz
D1-D2
V28-V30
V7-V8
Line level
adjustment
R53
D5
D8/1
X17 X1
14a
V3
V32
V31
22c
AGC
D3,D4
AGC
ISB B
Input logic
D6-D8
A17
ISB BOARD
B10850 3660
X1 4a 4c 8c
X17
1 2 6
Data Clock Strobe 3
*) 200 kHz
*) Block sign. at non sync."0"



1	830926		
ITT		SRT	CR91 RECEPTION Functional block diagram
			B10851 1101 202





ED DATE - NO.			
SIGNATURES			
ED DATE - NO.	1	830929	
SIGNATURES			

ITT

SRT

CR91 CONTROL
Functional block diagram

B10851 1102 3

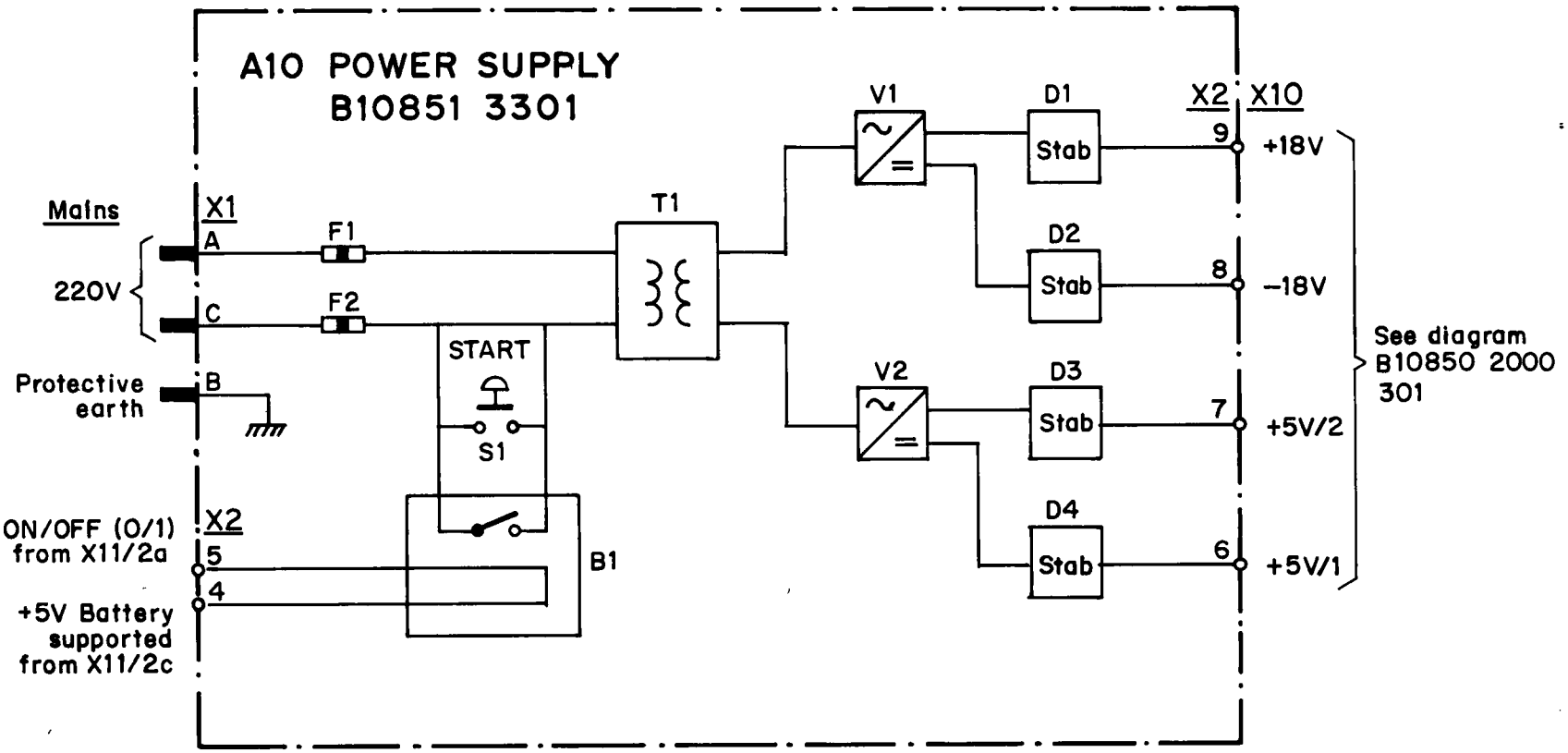
ITT

SRT

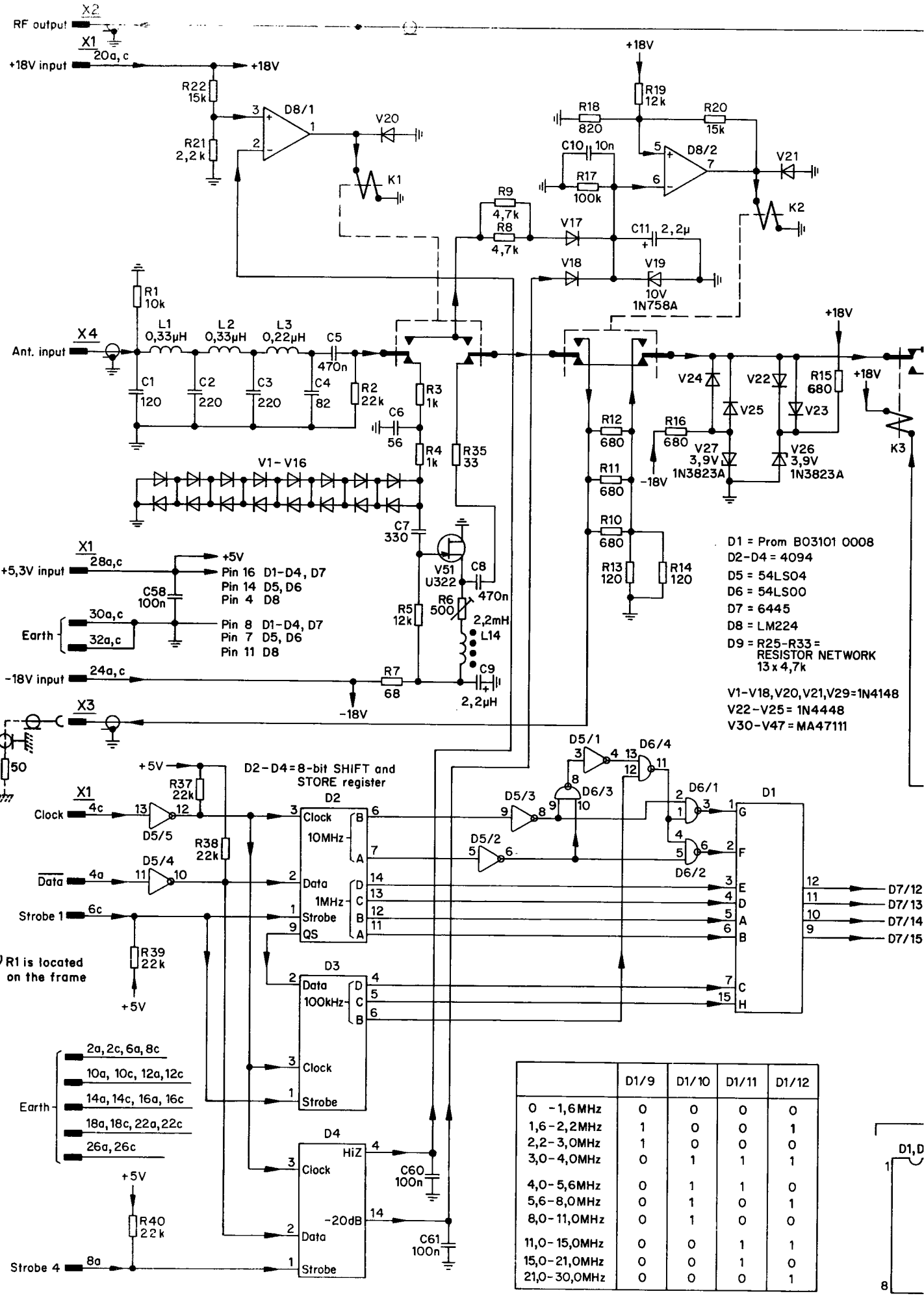
POWER SUPPLY
Function block diagram

B10851 1103 4

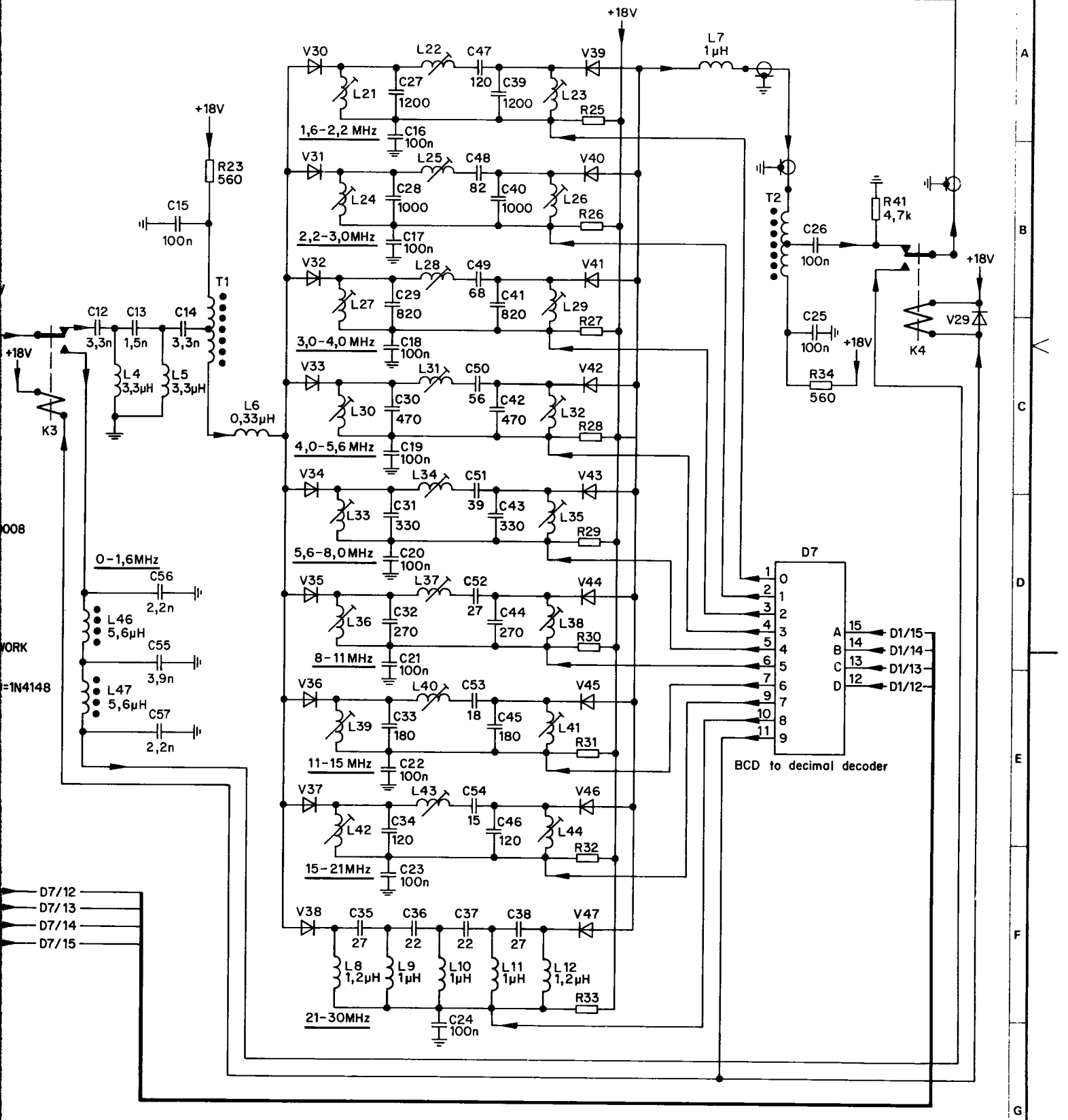
	ED	DATE-NO.
SIGNATURES		
ED	1	830929
DATE-NO.		
SIGNATURES		
ED		
DATE-NO.		
SIGNATURES		



APP 4.5



	D1/9	D1/10	D1/11	D1/12
0 -1,6MHz	0	0	0	0
1,6-2,2MHz	1	0	0	1
2,2-3,0MHz	1	0	0	0
3,0-4,0MHz	0	1	1	1
4,0-5,6MHz	0	1	1	0
5,6-8,0MHz	0	1	0	1
8,0-11,0MHz	0	1	0	0
11,0-15,0MHz	0	0	1	1
15,0-21,0MHz	0	0	1	0
21,0-30,0MHz	0	0	0	1



APP.4.6

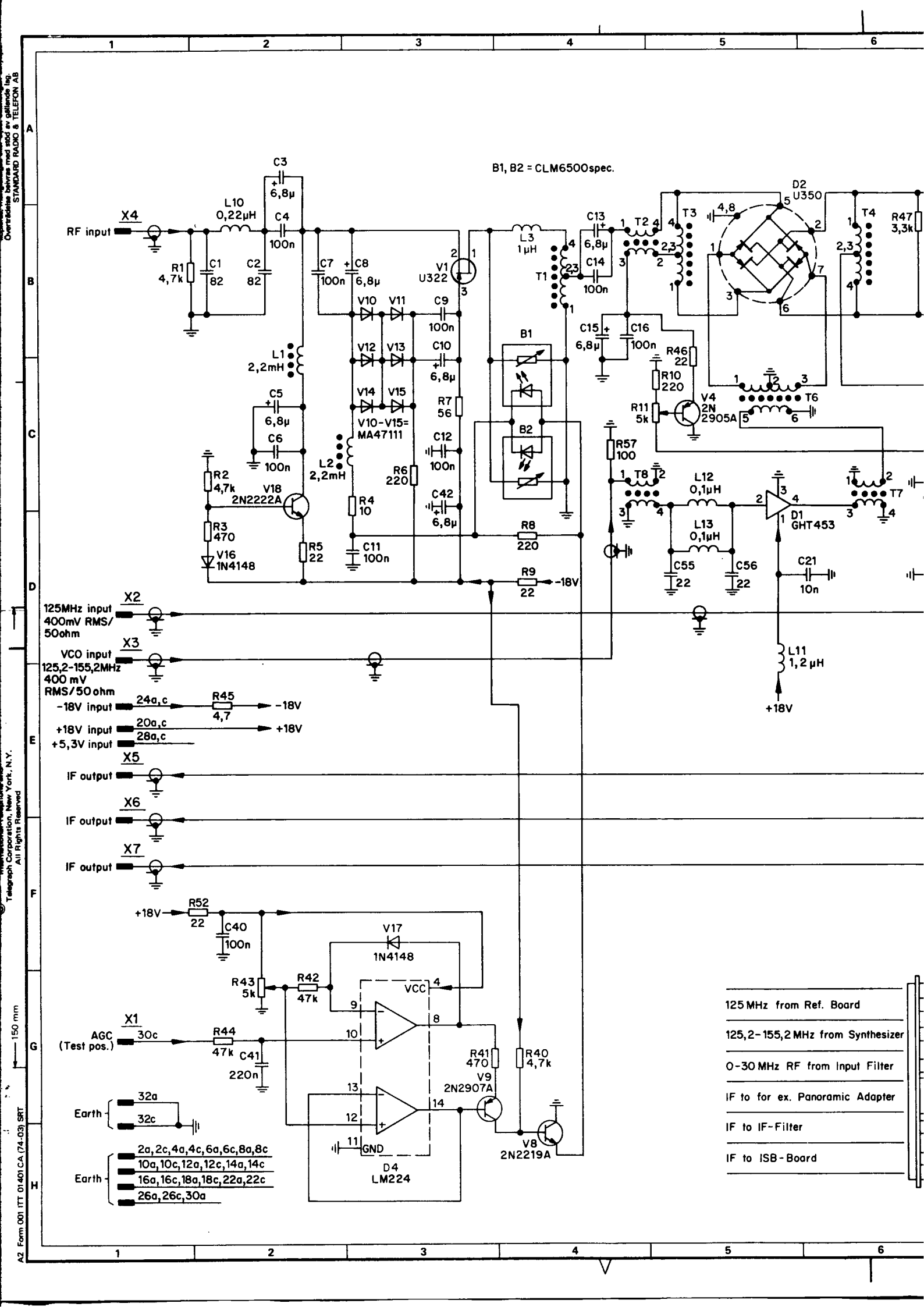
ED	DATE-NO					
SIGNATURES						
ED	DATE-NO	1	790410	2	811021	
SIGNATURES		EW				

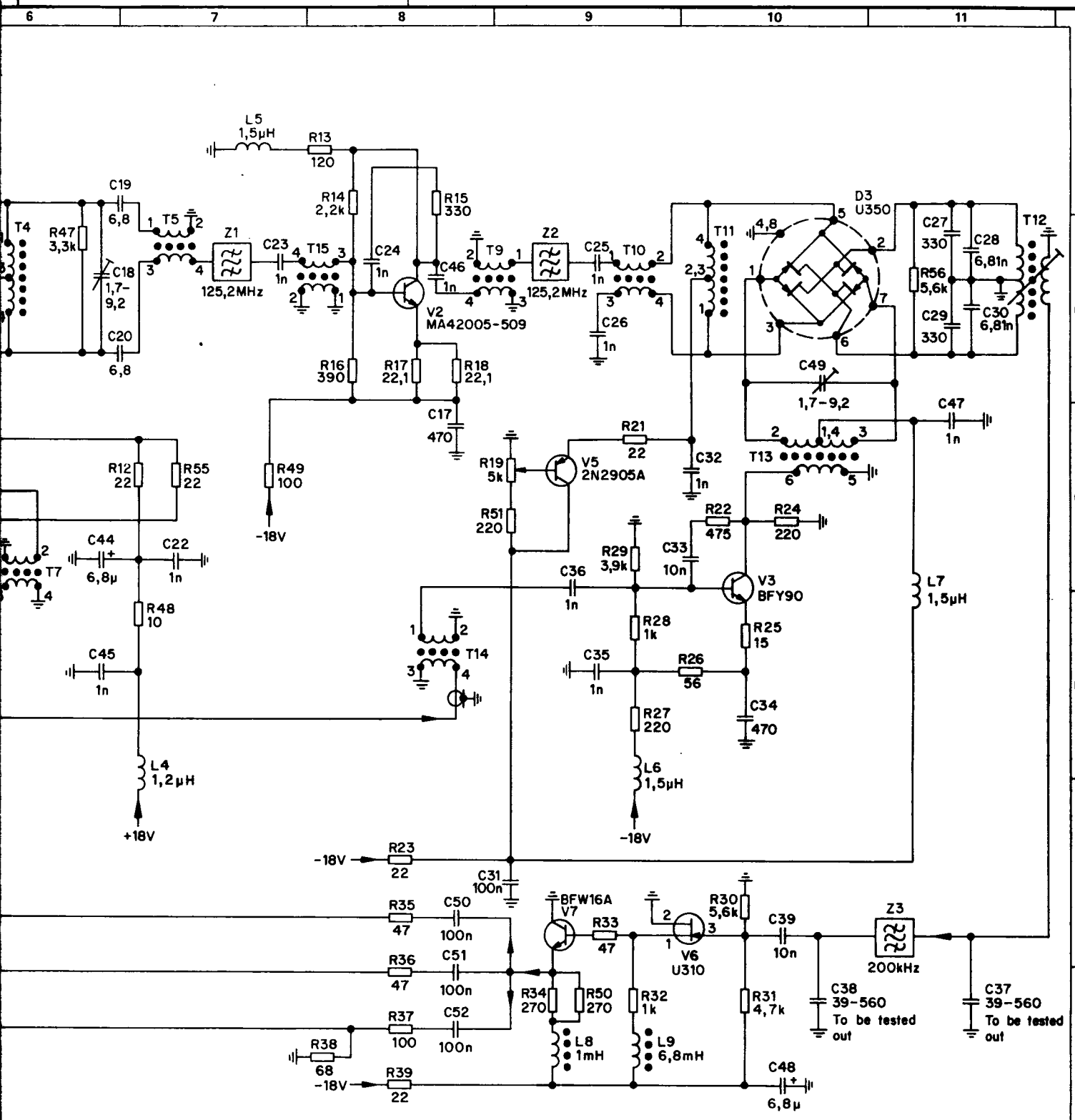
ITT

SRT

INPUT FILTERS
Circuit diagram

B10850 2520 2E



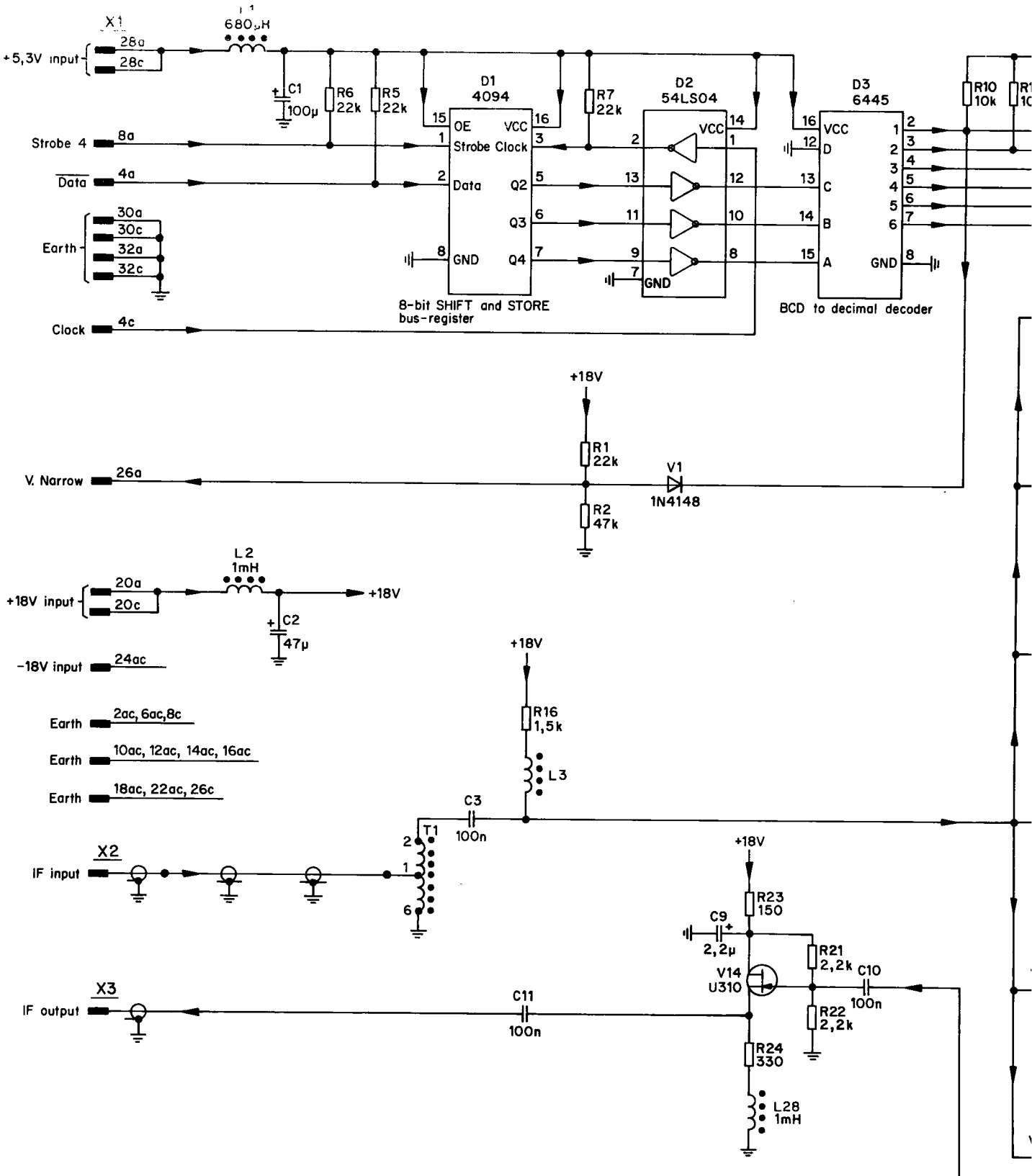


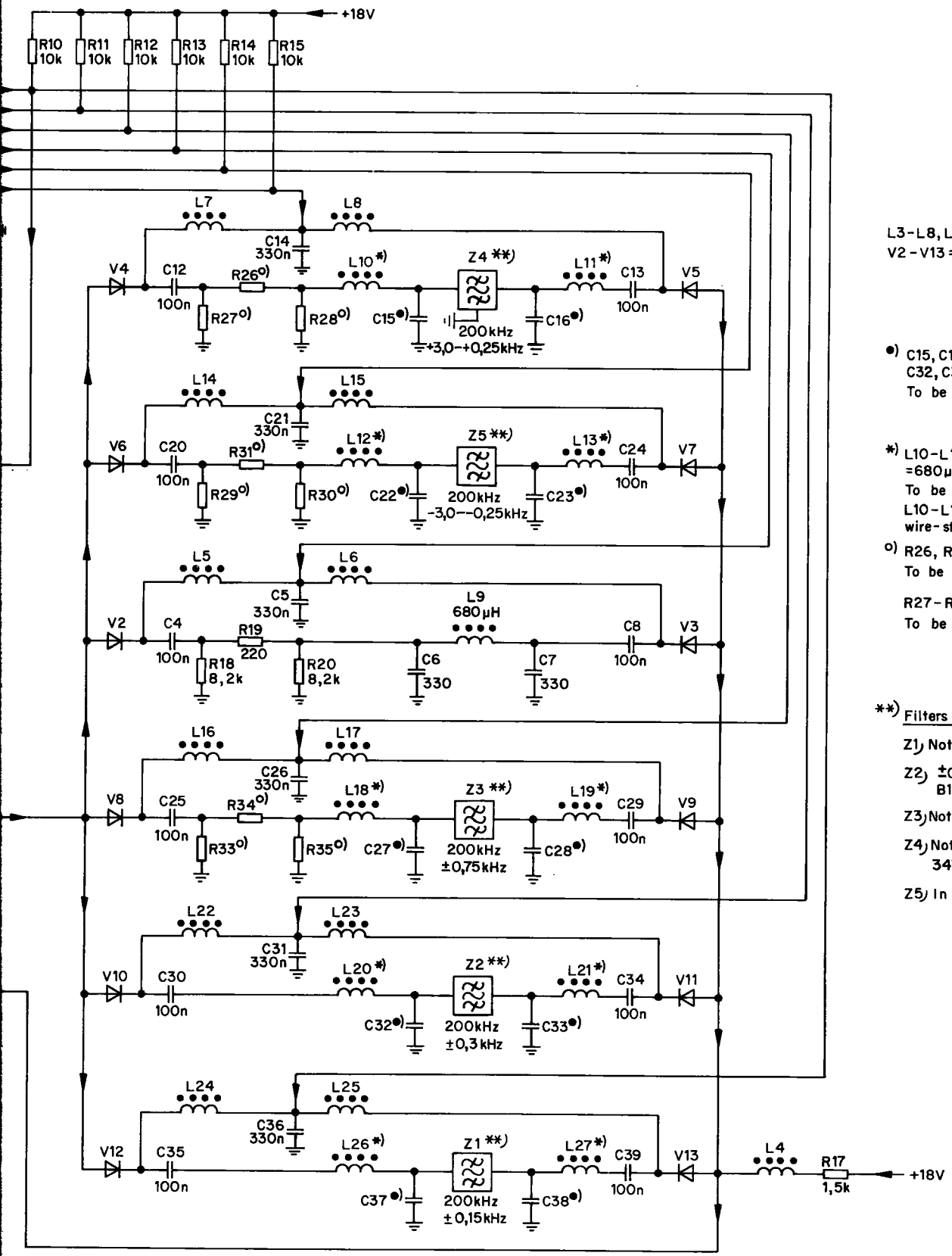
APP.4.7

ED	DATE–NO.							
	SIGNATURES							
ED	DATE–NO.	1	790411	2	800813	3	840917	
	SIGNATURES	EW		MF		KGF		

ITT SRT RF UNIT Circuit diagram

B 10850 2510 2E





L3-L8, L14-L17, L22-L25 = 6,8mH
V2-V13 = MA4711

•) C15, C16, C22, C23, C27, C28, C32, C33, C37, C38 = 39-1000
To be tested out

*) L10-L13, L18-L21, L26, L27 = =680µH-1mH
To be tested out
L10-L13 replaced by wire-strapping

o) R26, R31, R34 = 100-270
To be tested out

R27-R30, R33, R35 = 5,6-18k
To be tested out

**) Filters in different variants.

Z1) Not in variant B10850 3476

Z2) ±0,2kHz in variant B10850 3471

Z3) Not in variant B10850 3476

Z4) Not in variants B10850 3475 and B10850 3476

Z5) In all four variants

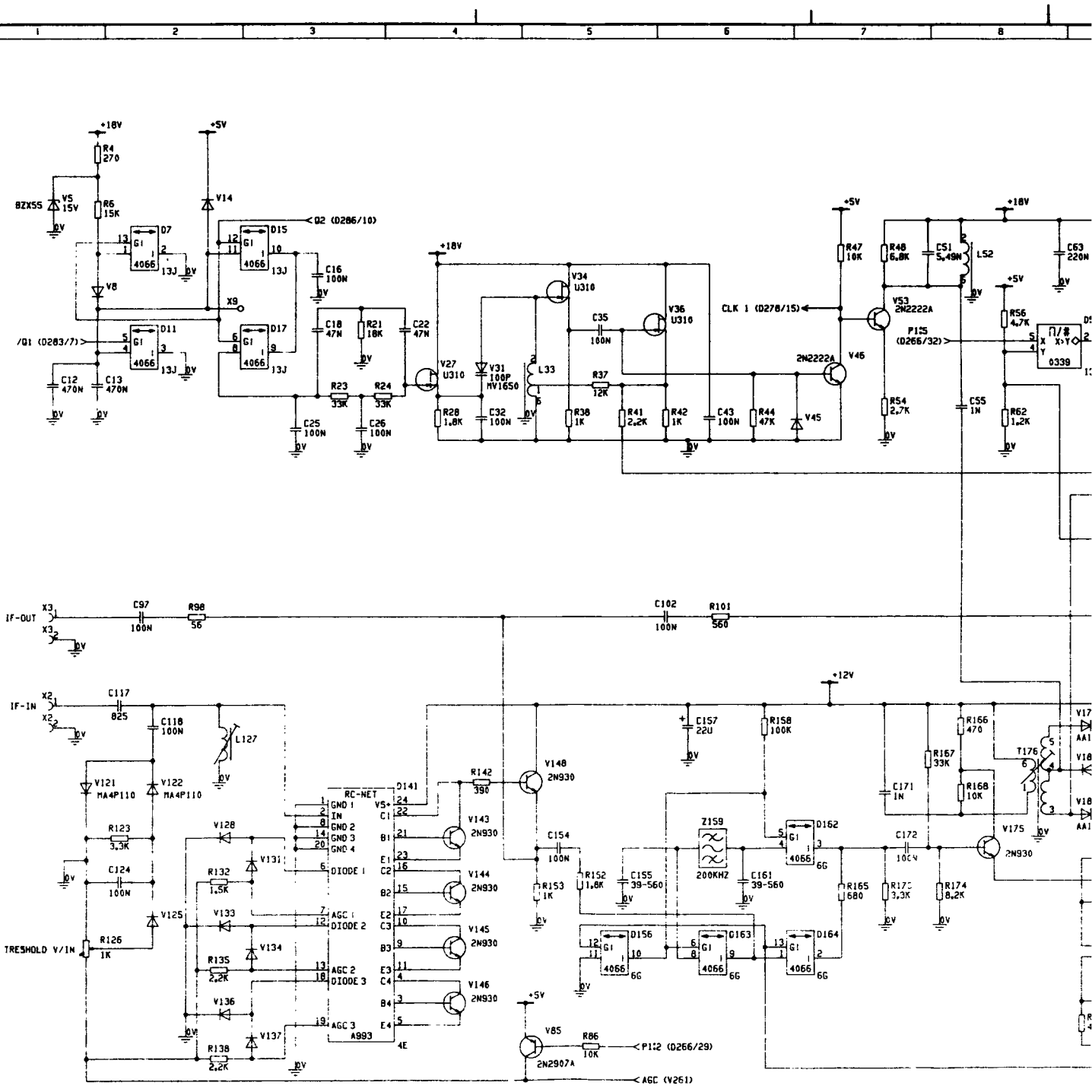
APP.4.8

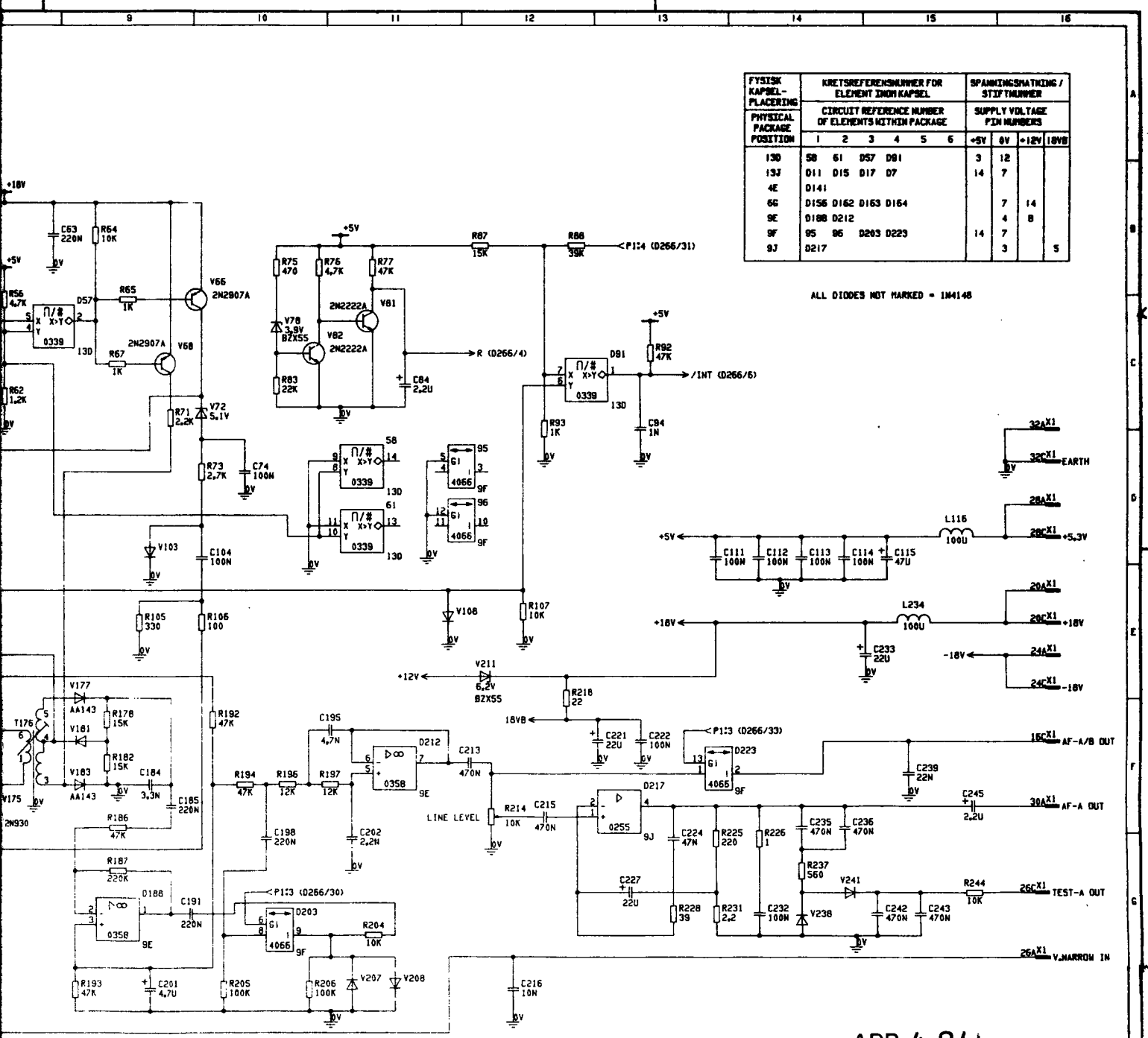
ED	DATE-NO				
SIGNATURES					
ED	DATE-NO.	1	790320	2	790518
SIGNATURES		EW Bel AT.		EW	

ITT

SRT IF FILTER Circuit diagram

B10850 2470 2E


+18V
+5V
+12V
R4 270
BZX55 V5 15V
R6 15K
V8
V14
D7
D15
D11
D17
4066
13J
Q2 (D286/10)
/Q1 (D283/7)
X9
C16 100N
C18 47N
R21 18K
C22 47N
C12 470N
C13 470N
C25 100N
C26 100N
R23 33K
R24 33K
V27 U310
V31 100P MV1650
L33
V34 U310
V36 U310
C35 100N
R28 1,8K
C32 100N
R38 1K
R41 2,2K
R42 1K
C43 100N
R44 47K
V45
CLK 1 (D278/15)
R47 10K
V46 2N2222A
V53 2N2222A
R48 6,8K
CS1 5,49N
LS2
C63 220N
P15 (D266/32)
R56 4,7K
R54 2,7K
C55 1N
R62 1,2K
0339
IF-OUT
X3
C97 100N
R98 56
C102 100N
R101 560
IF-IN
X2
C117 825
C118 100N
L127
V121 MA4P110
V122 MA4P110
R123 3,3K
C124 100N
TRESHOLD V/IN
R126 1K
V125
V128
V131
V133
V134
V136
V137
R132 1,5K
R135 2,2K
R138 2,2K
RC-NET
A993
4E
GND 1
IN
GND 2
GND 3
GND 4
DIODE 1
AGC 1
DIODE 2
AGC 2
DIODE 3
AGC 3
D141
R142 390
V143 2N930
V144 2N930
V145 2N930
V146 2N930
V148 2N930
C154 100N
R153 1K
R152 1,8K
C155 39-560
C157 22U
R158 100K
Z159 200KHZ
C161 39-560
D162
D163
D164
D156
6G
R165 680
C171 1N
C172 100N
R173 3,3K
R174 8,2K
R166 470
R167 33K
R168 10K
T176
V175 2N930
V85 2N2907A
R86 10K
P12 (D266/29)
AGC (V261)



FYSISK KAPSEL-PLACERING	KRETSREFERENSNUMMER FOR ELEMENT INOM KAPSEL						SPÄNNINGSMATNING / STIFTNUMMER			
PHYSICAL PACKAGE POSITION	CIRCUIT REFERENCE NUMBER OF ELEMENTS WITHIN PACKAGE						SUPPLY VOLTAGE PIN NUMBERS			
	1	2	3	4	5	6	+5V	0V	+12V	18VB
13D	S8	S1	D57	D91			3	12		
13J	D11	D15	D17	D7			14	7		
4E	D141									
6G	D156	D162	D163	D164				7	14	
9E	D188	D212						4	8	
9F	S5	S6	D203	D223			14	7		
9J	D217							3		5

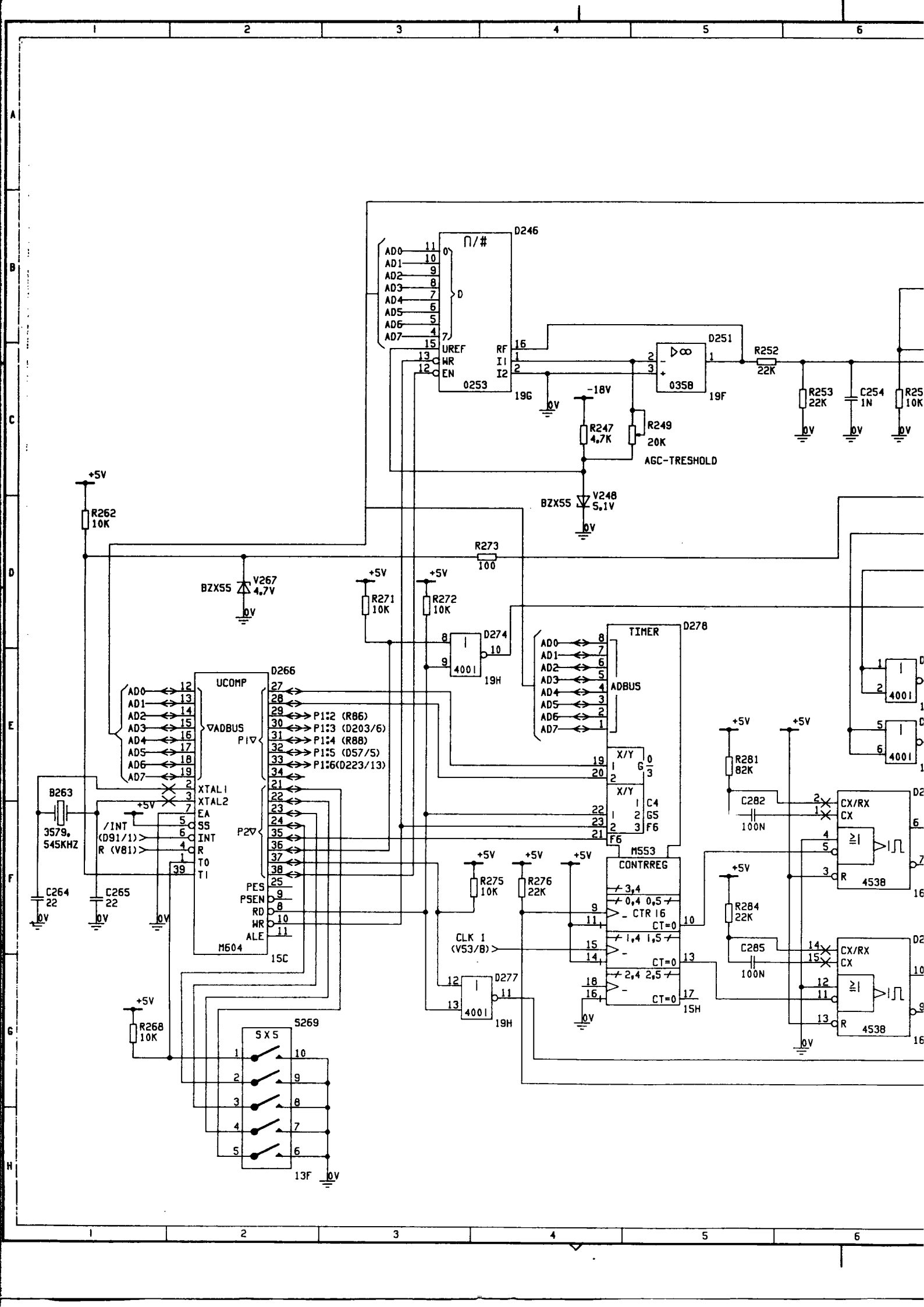
ALL DIODES NOT MARKED = 1N4148

APP 4:9/1

EDITIONS	A7	A2
	3	3
	2	2
	1	1
SHEETS	1	2

ED DATE-NU.						
SIGNATURES						
ED DATE-NO.	1	83-09-05	2	83-12-13	3	84-06-20
SIGNATURES	KJN		KJN		KJN	

ITT CR90/91 IF-AF BOARD | SRT CR90/91 MF-LF KORT | B 10850 2001 7 | 1/2


D246
0253
D251
0358
R252
22K
R253
22K
C254
1N
R247
4.7K
R249
20K
AGC-TRESHOLD
-18V
BZX55 V248
5,1V
R262
10K
R273
100
BZX55 V267
4,7V
R271
10K
R272
10K
D274
4001
19H
D278
TIMER
ADBUS
X/Y
X/Y
M553
CONTRREG
CTR 16
CT=0
15H
D266
UCOMP
M604
15C
P1:2 (R86)
P1:3 (D203/6)
P1:4 (R88)
P1:5 (D57/5)
P1:6(D223/13)
B263
3579,
545KHZ
C264
22
C265
22
/INT
(D91/1)
R (V81)
CLK I
(V53/B)
R275
10K
R276
22K
D277
19H
R281
82K
C282
100N
R284
22K
C285
100N
CX/RX
CX
4538
R268
10K
S X 5
5269
13F
+5V
0V

FYSISK KAPSEL-PLACERING / PHYSICAL PACKAGE POSITION	KRETSREFERENSNUMMER FOR ELEMENT INOM KAPSEL / CIRCUIT REFERENCE NUMBER OF ELEMENTS WITHIN PACKAGE						SPANNINGSMATNING / STIFTNUMMER / SUPPLY VOLTAGE PIN NUMBERS			
	1	2	3	4	5	6	0V	+5V	+18V	
15C	D266						20	26,40		
15H	D278						12	24		
16G	D292						8	16		
16H	D283	D286					8	16		
18G	D291						8	16		
19F	D251	D258					4		8	
19G	D246						3	14		
19H	D274	D277	D287	D288			7	14		

ALL DIODES NOT MARKED = 1N4148

V256 V257 D258 V259 V261

C254 1N R255 10K 0V 0V

0358 19F

AGC (V85)

30C X1 AGC OUT

22C X1 MUTING IN

4C X1 CLOCK IN

4A X1 /DATA IN

14A X1 200 KHZ IN

8C X1 STROBE 3 IN

D291 D292 4,5 4,5C1/C2 C3 G4 G5/F6 4094 ID AD0 AD1 AD2 AD3 AD4 AD5 AD6 AD7 18G 16G

D287 D288 4001 19H

D283 D286 CX/RX CX ≥1 R 4538 16H

X289 /Q1 (D11/5)

X290 Q2 (D15/12)

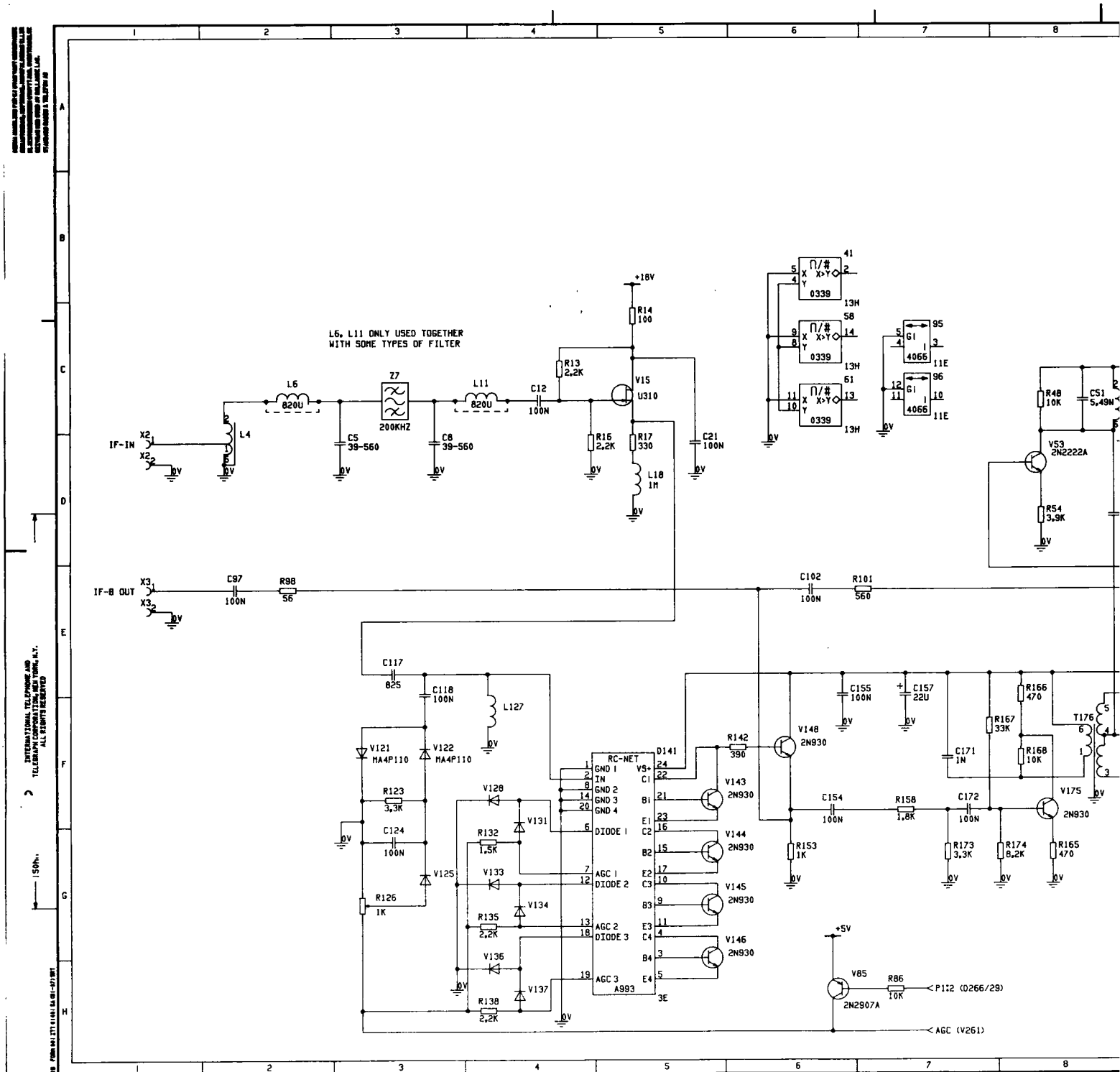
APP 4:9/2

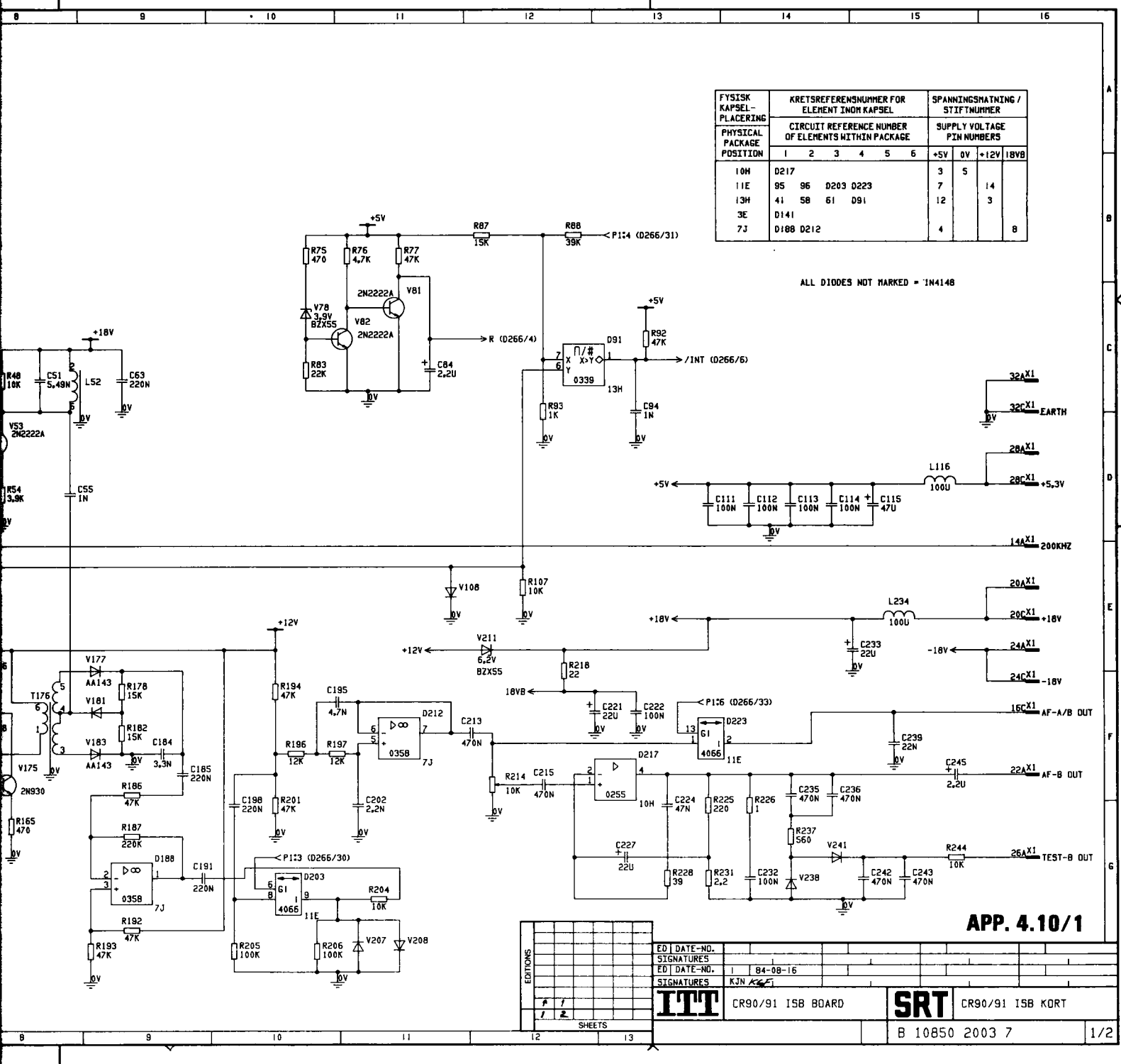
ED | DATE-NO.							
SIGNATURES							
ED | DATE-NO.	1 | 83-09-05		2	83-11-23	3	84-06-20	
SIGNATURES	KJN		KJN		KJN		

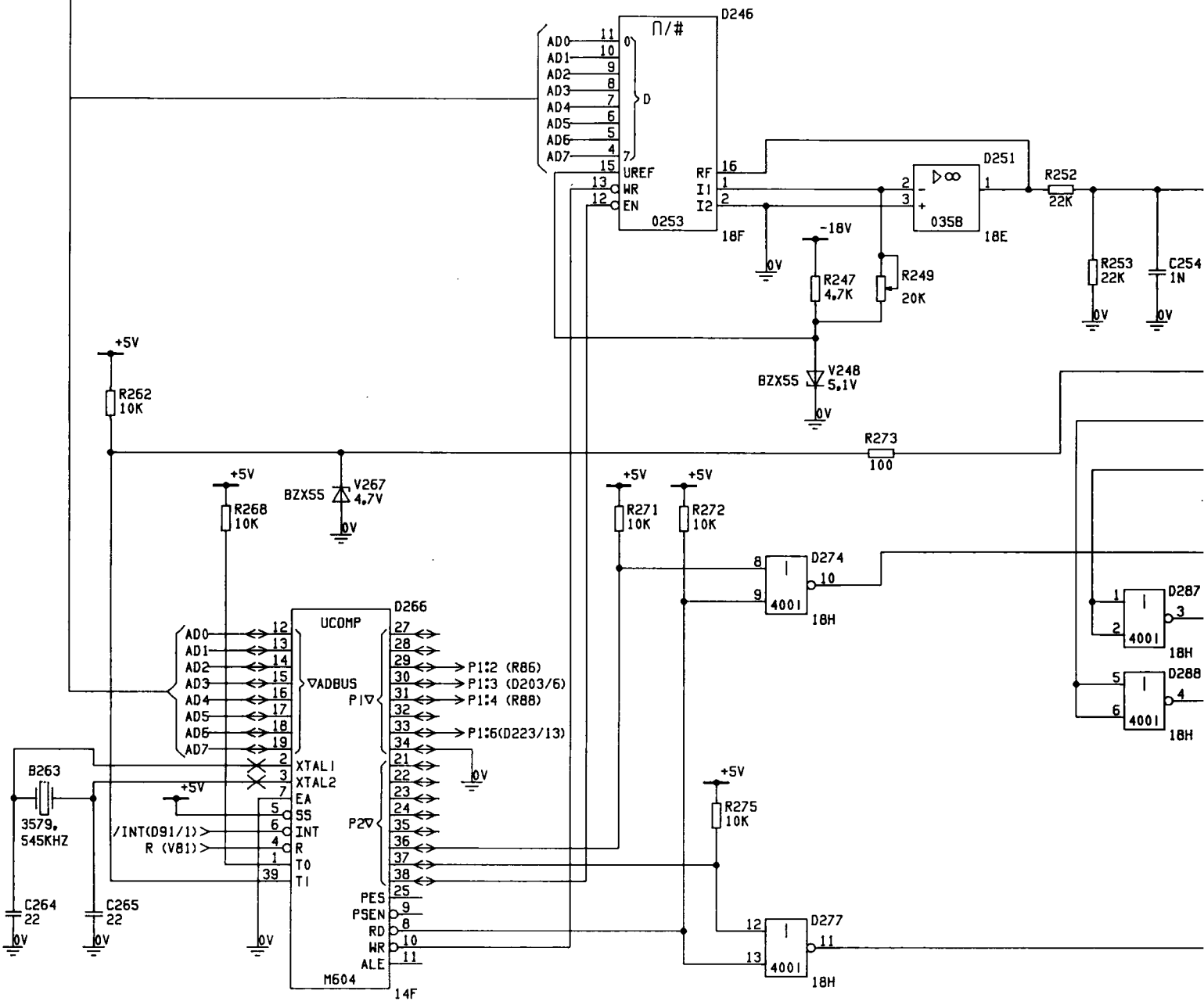
ITT CR90/91 IF-AF BOARD

SRT CR90/91 MF-LF KORT

B 10850 2001 2 2/2

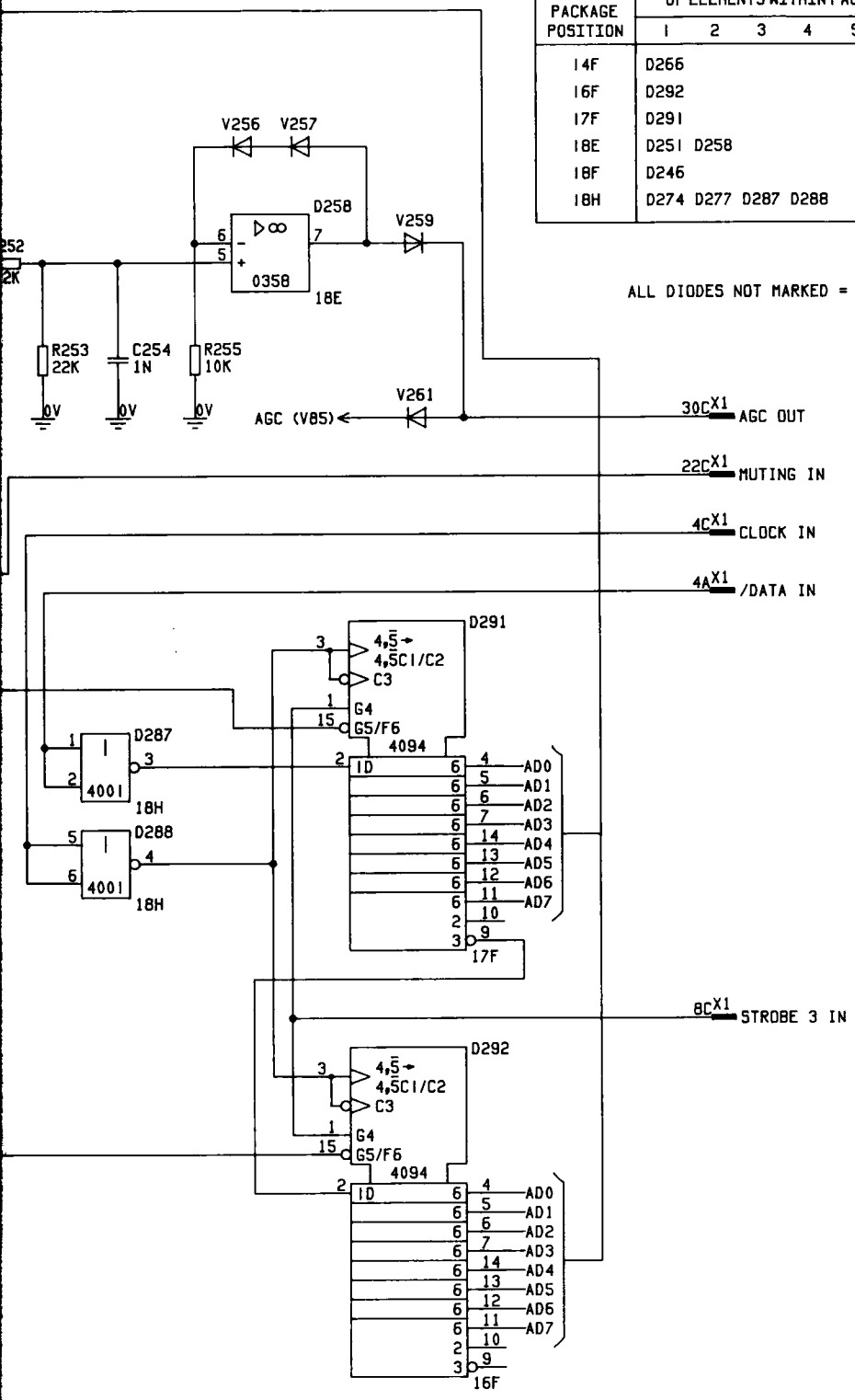

L6, L11 ONLY USED TOGETHER
WITH SOME TYPES OF FILTER
IF-IN
IF-8 OUT
L4
L6
820U
Z7
200KHZ
L11
820U
C5
39-560
C8
39-560
C12
100N
R13
2,2K
R14
100
+18V
V15
U310
R15
2,2K
R17
330
L18
1M
C21
100N
C97
100N
R98
56
C102
100N
R101
560
0339
4066
V53
2N2222A
R48
10K
C51
5,49N
R54
3,9K
C117
825
C118
100N
L127
V121
MA4P110
V122
MA4P110
R123
3,3K
C124
100N
R126
1K
V125
V128
V131
R132
1,5K
V133
V134
R135
2,2K
V136
V137
R138
2,2K
RC-NET
A993
GND 1
IN
GND 2
GND 3
GND 4
DIODE 1
AGC 1
DIODE 2
AGC 2
DIODE 3
AGC 3
VS+
C1
B1
E1
C2
B2
E2
C3
B3
E3
C4
B4
E4
D141
R142
390
V143
2N930
V144
2N930
V145
2N930
V146
2N930
V148
2N930
C155
100N
C157
22U
C154
100N
R158
1,8K
C172
100N
V175
2N930
R153
1K
R166
470
R167
33K
R168
10K
T176
C171
1N
R173
3,3K
R174
8,2K
R165
470
+5V
V85
2N2907A
R86
10K
P112 (D266/29)
AGC (V261)
0V


FYSISK KAPSEL-PLACERING
PHYSICAL PACKAGE POSITION
KRETSREFERENSNUMMER FOR ELEMENT INOM KAPSEL
CIRCUIT REFERENCE NUMBER OF ELEMENTS WITHIN PACKAGE
SPANNINGSMATNING / STIFTNUMMER
SUPPLY VOLTAGE PIN NUMBERS
1 2 3 4 5 6 | +5V | 0V | +12V | 18V8
10H D217 | 3 | 5 | |
11E 95 96 D203 D223 | 7 | | 14 |
13H 41 58 61 D91 | 12 | | 3 |
3E D141 | | | |
7J D188 D212 | 4 | | | 8
ALL DIODES NOT MARKED = 1N4148
+5V
+18V
+12V
-18V
18V8
0V
R87 15K
R88 39K
P114 (D266/31)
R75 470
R76 4,7K
R77 47K
V78 3,9V BZX55
V81 2N2222A
V82 2N2222A
R83 22K
C84 2,2U
R (D266/4)
D91 0339 13H
R92 47K
/INT (D266/6)
R93 1K
C94 1N
R48 10K
C51 5,49N
L52
C63 220N
V53 2N2222A
R54 3,9K
C55 1N
L116 100U
C111 100N
C112 100N
C113 100N
C114 100N
C115 47U
32A X1
32C X1 EARTH
28A X1
28C X1 +5,3V
14A X1 200KHZ
V108
R107 10K
L234 100U
C233 22U
20A X1
20C X1 +18V
24A X1
24C X1 -18V
V211 6,2V BZX55
R218 22
C221 22U
C222 100N
P116 (D266/33)
D223 4066 11E
16C X1 AF-A/B OUT
C239 22N
C245 2,2U
22A X1 AF-B OUT
V177 AA143
V181 AA143
V183 AA143
T176
R178 15K
R182 15K
C184 3,3N
V175 2N930
C185 220N
R186 47K
R187 220K
R165 470
R192 47K
R193 47K
D188 0358 7J
C191 220N
R194 47K
C195 4,7N
D212 0358 7J
C213 470N
R196 12K
R197 12K
C198 220N
R201 47K
C202 2,2N
P113 (D266/30)
D203 4066 11E
R204 10K
R205 100K
R206 100K
V207
V208
R214 10K
C215 470N
D217 0255 10H
C224 47N
R225 220
R226 1
C235 470N
C236 470N
R237 560
V241
R244 10K
26A X1 TEST-B OUT
C227 22U
R228 39
R231 2,2
C232 100N
V238
C242 470N
C243 470N
APP. 4.10/1
EDITIONS
SHEETS
ED | DATE-NO.
SIGNATURES
ED | DATE-NO. | 84-08-16
SIGNATURES | KJN
ITT
CR90/91 ISB BOARD
SRT
CR90/91 ISB KORT
B 10850 2003 7
1/2


D246
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
D
UREF
WR
EN
RF
I1
I2
0253
18F
D251
0358
18E
R252
22K
R253
22K
C254
1N
-18V
R247
4,7K
R249
20K
0V
+5V
R262
10K
BZX55
V248
5,1V
R273
100
R268
10K
V267
4,7V
R271
10K
R272
10K
D274
4001
18H
D287
D288
UCOMP
ADBUS
P1
P2
P1:2 (R86)
P1:3 (D203/6)
P1:4 (R88)
P1:6(D223/13)
XTAL1
XTAL2
EA
SS
INT
R
T0
T1
PES
PSEN
RD
WR
ALE
M604
14F
B263
3579,
545KHZ
C264
22
C265
22
/INT(D91/1)
R (V81)
R275
10K
D277

FYSISK KAPSEL-PLACERING	KRETSREFERENSNUMMER FOR ELEMENT INOM KAPSEL	SPANNINGSMATNING / STIFTNUMMER			
PHYSICAL PACKAGE POSITION	CIRCUIT REFERENCE NUMBER OF ELEMENTS WITHIN PACKAGE				
	1 2 3 4 5 6	0V	+5V	+18V	
14F	D266	20	40		
16F	D292	8	16		
17F	D291	8	16		
18E	D251 D258	4		8	
18F	D246	3	14		
18H	D274 D277 D287 D288	7	14		

ALL DIODES NOT MARKED = 1N4148



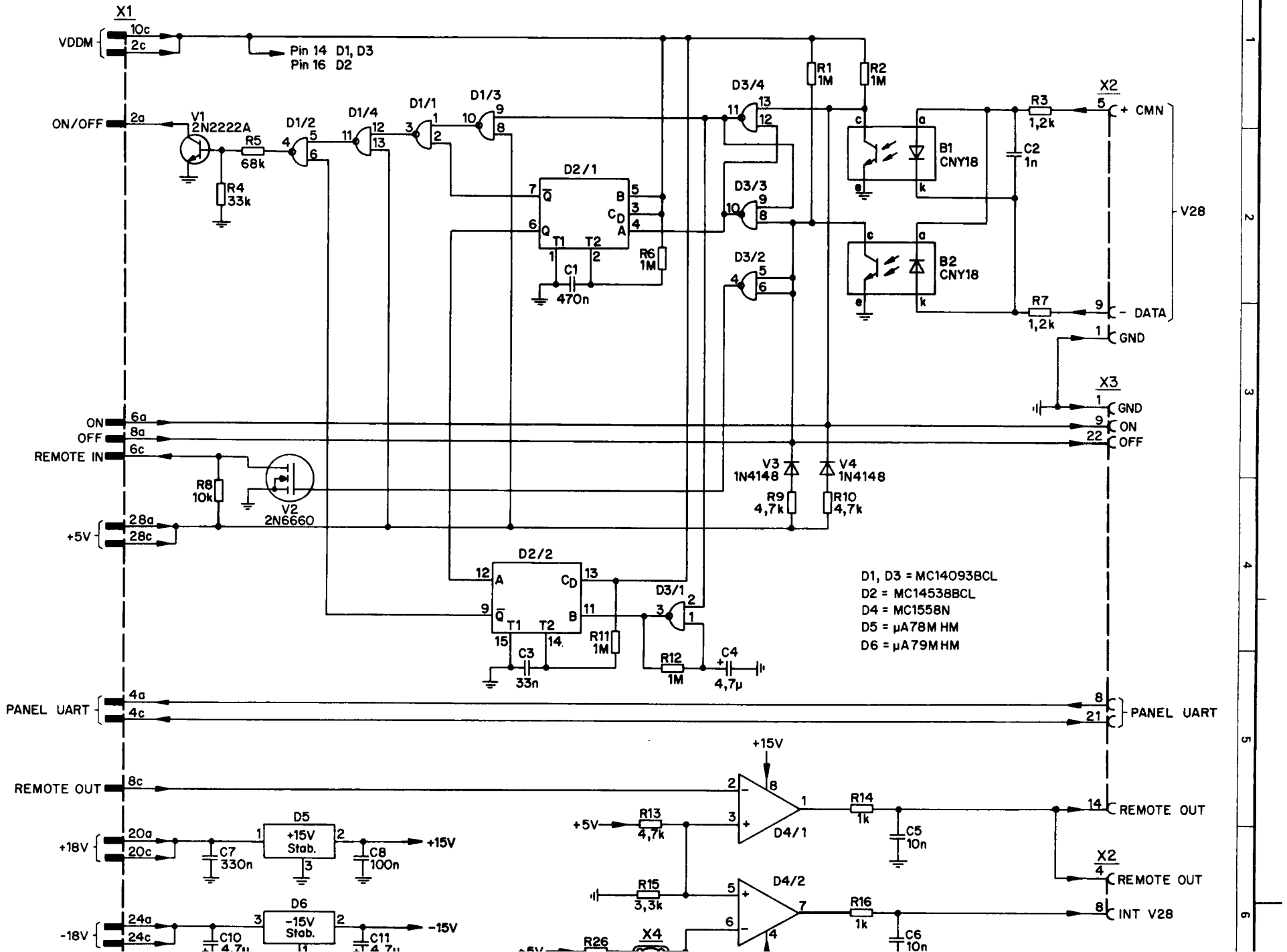
APP. 4.10/2

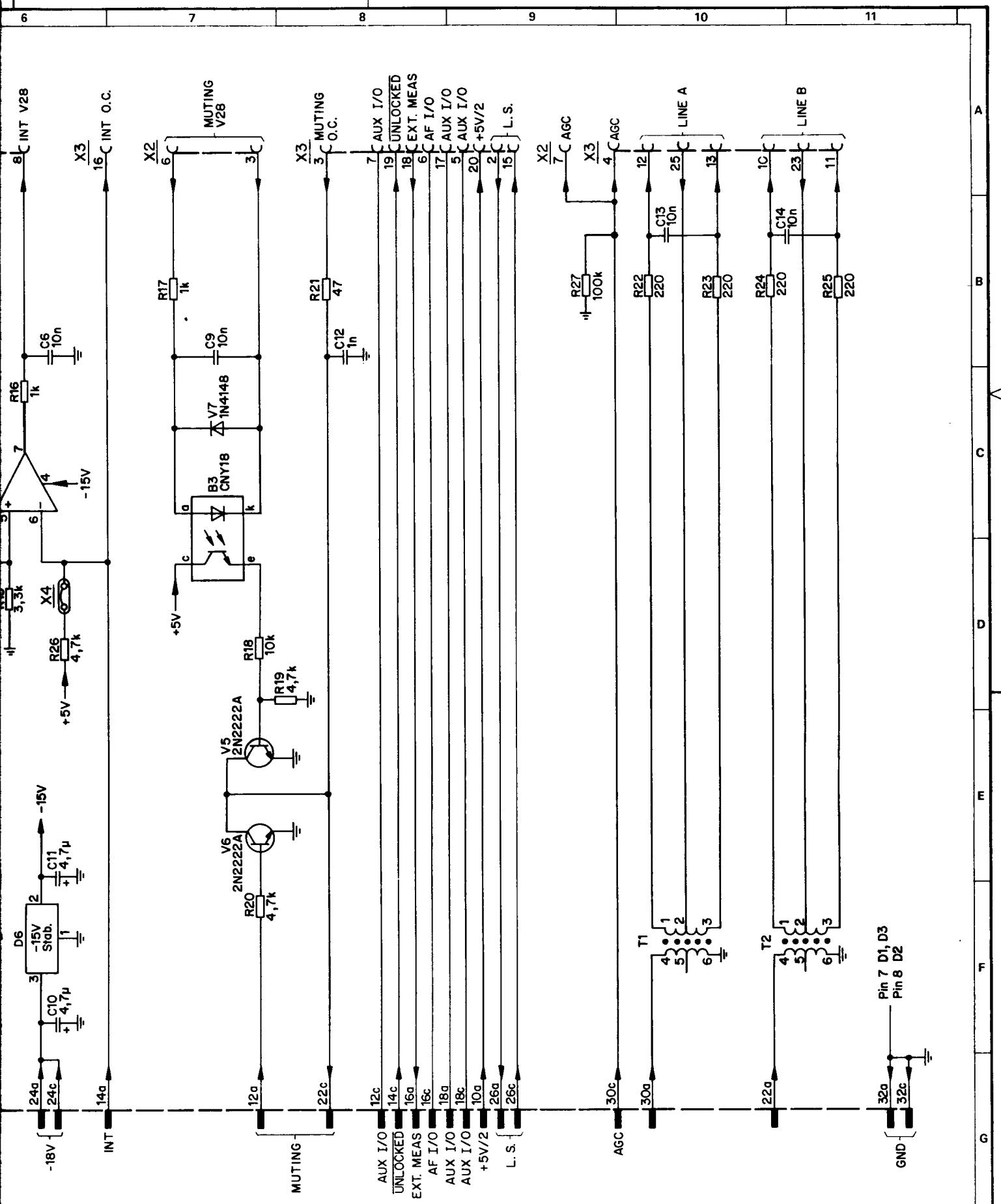
ED DATE-NO.									
SIGNATURES									
ED DATE-NO.	1	84-08-16							
SIGNATURES	KJN								

ITT CR90/91 ISB BOARD | SRT CR90/91 ISB KORT

B 10850 2003 2 | 2/2

A2 Form 001 ITT 01401 CA (74 03) SRT





APP.4.11

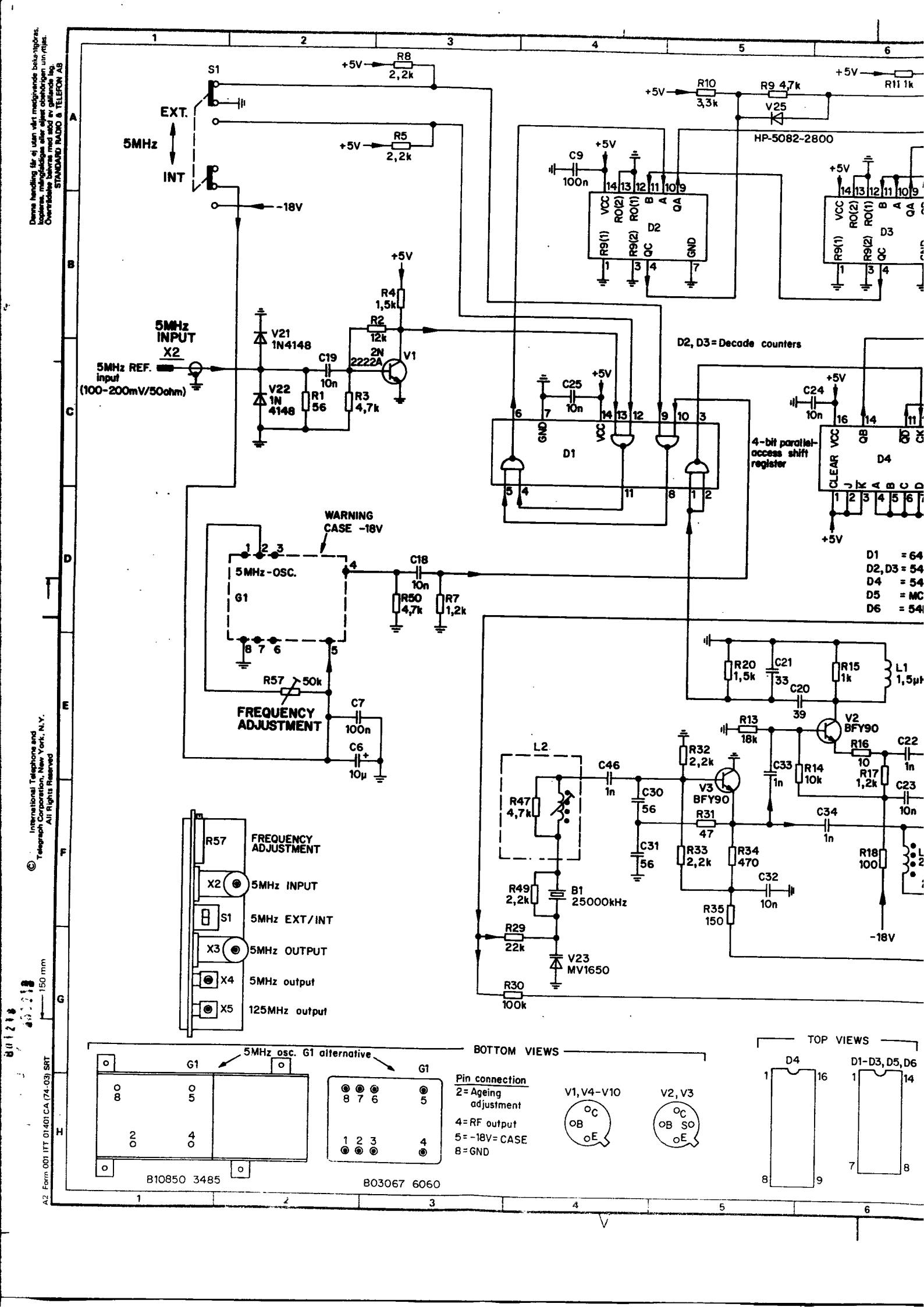
ED DATE-NO						
SIGNATURES						
ED DATE-NO	1	830929	2	831109		
SIGNATURES	EW		EW			

ITT

SR

CR91
CONNECTION BOARD
Circuit diagram

B10851 2410 2


S1
EXT.
5MHz
INT
-18V
+5V
R8
2,2k
R5
2,2k
R10
3,3k
R9 4,7k
V25
HP-5082-2800
R11 1k
C9
100n
D2
D3
5MHz
INPUT
X2
5MHz REF. input
(100-200mV/50ohm)
V21
1N4148
V22
1N
4148
C19
10n
R1
56
R2
12k
R4
1,5k
R3
4,7k
2N
2222A
V1
D2, D3 = Decade counters
C25
10n
D1
C24
10n
4-bit parallel-access shift register
D4
WARNING
CASE -18V
5MHz-OSC.
G1
C18
10n
R50
4,7k
R7
1,2k
R57 50k
FREQUENCY
ADJUSTMENT
C7
100n
C6
10µ
D1 = 64
D2, D3 = 54
D4 = 54
D5 = MC
D6 = 54
R20
1,5k
C21
33
R15
1k
L1
1,5µH
C20
39
R13
18k
V2
BFY90
R16
10
C22
1n
L2
C46
1n
R32
2,2k
C33
1n
R14
10k
R17
1,2k
C23
10n
R47
4,7k
C30
56
V3
BFY90
R31
47
C34
1n
C31
56
R33
2,2k
R34
470
R18
100
R49
2,2k
B1
25000kHz
C32
10n
R35
150
R29
22k
V23
MV1650
R30
100k
-18V
R57
FREQUENCY ADJUSTMENT
X2
5MHz INPUT
S1
5MHz EXT/INT
X3
5MHz OUTPUT
X4
5MHz output
X5
125MHz output
150 mm
BOTTOM VIEWS
5MHz osc. G1 alternative
G1
B10850 3485
B03067 6060
Pin connection
2 = Ageing adjustment
4 = RF output
5 = -18V = CASE
8 = GND
V1, V4-V10
V2, V3
TOP VIEWS
D4
D1-D3, D5, D6
Dessa handling får ej utan vårt medgivande beko-mtgöras, kopieras, mångfaldigas eller eljest obehörigen utnyttjas. Överträdelse beivras med stöd av gällande lag.
STANDARD RADIO & TELEFON AB
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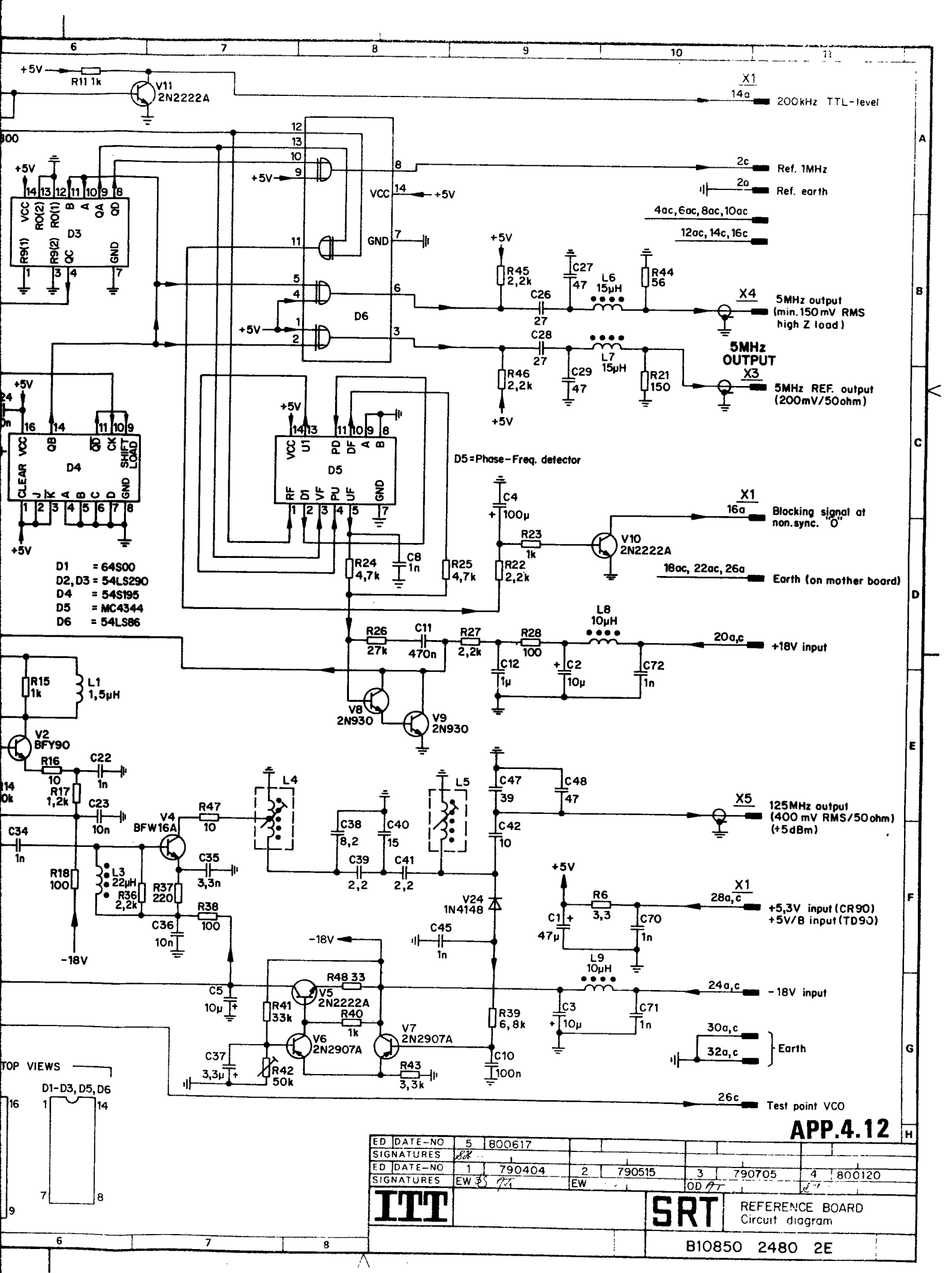
A2 Form 001 ITT 01401 CA (74-03) SRT


+5V
R11 1k
V11 2N2222A
X1
14a
200kHz TTL-level
2c
Ref. 1MHz
2a
Ref. earth
4ac, 6ac, 8ac, 10ac
12ac, 14c, 16c
D3
D6
R45 2,2k
C27 47
L6 15µH
R44 56
C26 27
X4
5MHz output (min. 150 mV RMS high Z load)
C28 27
L7 15µH
5MHz OUTPUT
R46 2,2k
C29 47
R21 150
X3
5MHz REF. output (200mV/50ohm)
D4
D5
D5=Phase-Freq. detector
C4 100µ
R23 1k
V10 2N2222A
X1
16a
Blocking signal at non.sync. "0"
R24 4,7k
C8 1n
R25 4,7k
R22 2,2k
18ac, 22ac, 26a
Earth (on mother board)
D1 = 64S00
D2, D3 = 54LS290
D4 = 54S195
D5 = MC4344
D6 = 54LS86
R26 27k
C11 470n
R27 2,2k
R28 100
L8 10µH
20a,c
+18V input
C12 1µ
C2 10µ
C72 1n
R15 1k
L1 1,5µH
V8 2N930
V9 2N930
V2 BFY90
R16 10
C22 1n
R17 1,2k
C23 10n
V4 BFW16A
R47 10
L4
L5
C47 39
C48 47
C42 10
X5
125MHz output (400 mV RMS/50 ohm) (+5dBm)
C34 1n
C38 8,2
C40 15
C39 2,2
C41 2,2
R18 100
L3 22µH
R36 2,2k
R37 220
C35 3,3n
R38 100
C36 10n
-18V
V24 1N4148
C45 1n
+5V
R6 3,3
C1 47µ
C70 1n
X1
28a,c
+5,3V input (CR90)
+5V/8 input (TD90)
L9 10µH
R48 33
V5 2N2222A
R41 33k
R40 1k
V7 2N2907A
V6 2N2907A
C5 10µ
C37 3,3µ
R42 50k
R43 3,3k
R39 6,8k
C10 100n
C3 10µ
C71 1n
24a,c
-18V input
30a,c
32a,c
Earth
TOP VIEWS
D1-D3, D5, D6
26c
Test point VCO
APP.4.12
ED DATE-NO 5 800617
SIGNATURES
ED DATE-NO 1 790404 2 790515 3 790705 4 800120
SIGNATURES EW EW OD
ITT
SRT
REFERENCE BOARD
Circuit diagram
B10850 2480 2E

Form 001 ITT 01401 BA (70 02) SRT

A3

D1/4

R1
1,8k

D1/2
5
6
7

R3
10,0k

V6
6,2V

R2
10,0k

R6
17,8k

D1/11

D1/4
12
13
14

R10
4,7k

R11
10

R12
10

R13
1k

R7
200k

2 3 4

1

R8
13,3k

R4
50
10

9

R9
1,21k

V1 V2

C2 33
C3 0-4,7
x)

5
6

B1

B10850 3487

8 7

R5
0-10k
(E96
steps)

C1
100n

BOTTOM VIEWS

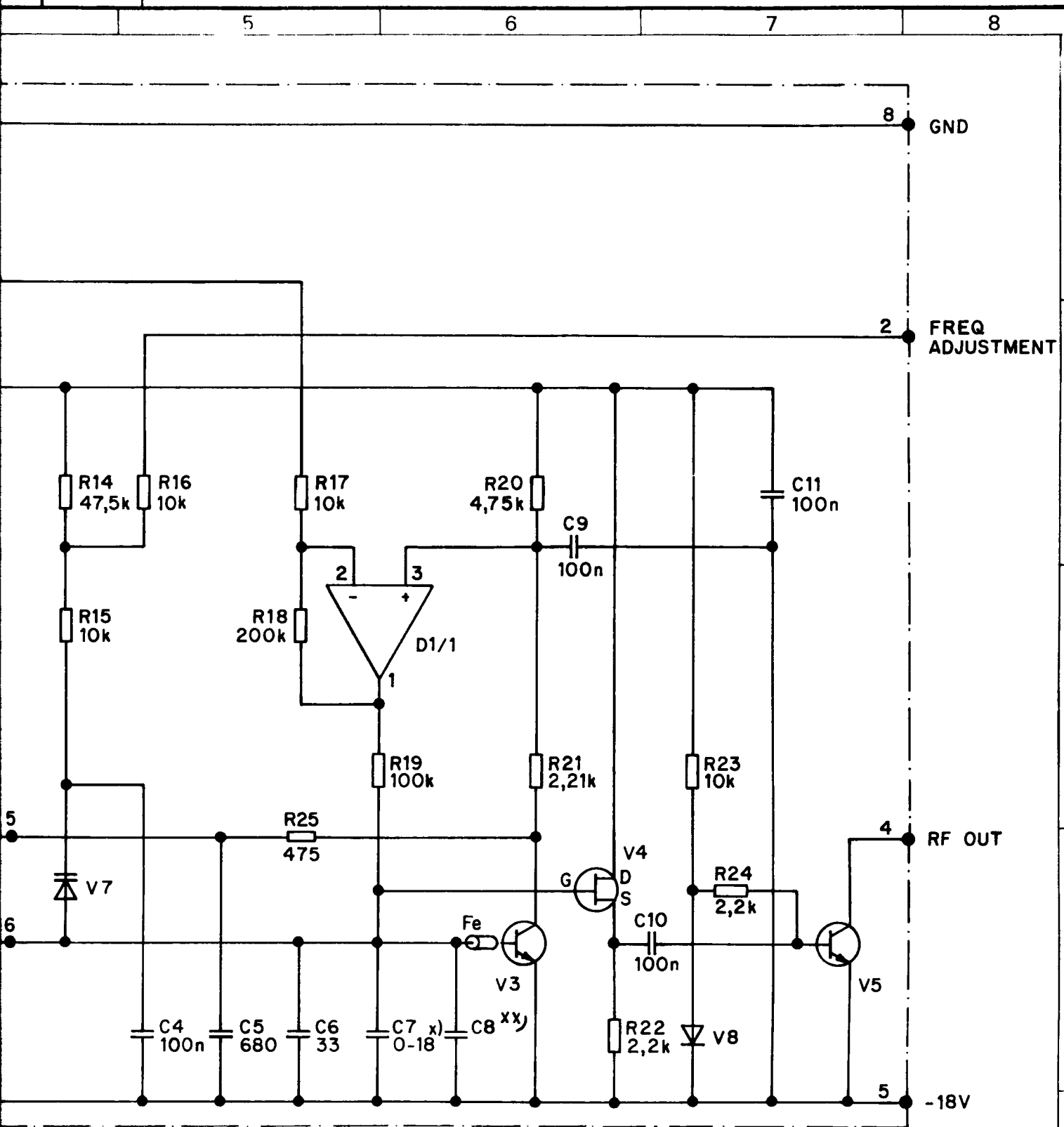
Pin connection
2 = Frequency adjustment
4 = RF output
5 = -18V
8 = GND

G1
8
5
2
4

V3,V5
C
B
E
CASE

V4
G
D
S

BD139 E C B
BD291 B C E
V1
V2
E C B



xx) To be tested out

V1 = BD291/BD139
V2 = BD332
V3 = BFY90
V4 = 2N4416A
V5 = BFY90
V6 = 1N827A
V7 = MV1648
V8 = 1N4148

D1 = LM224A (Quad op. ampl.)

x) E12 steps

APP.4.13

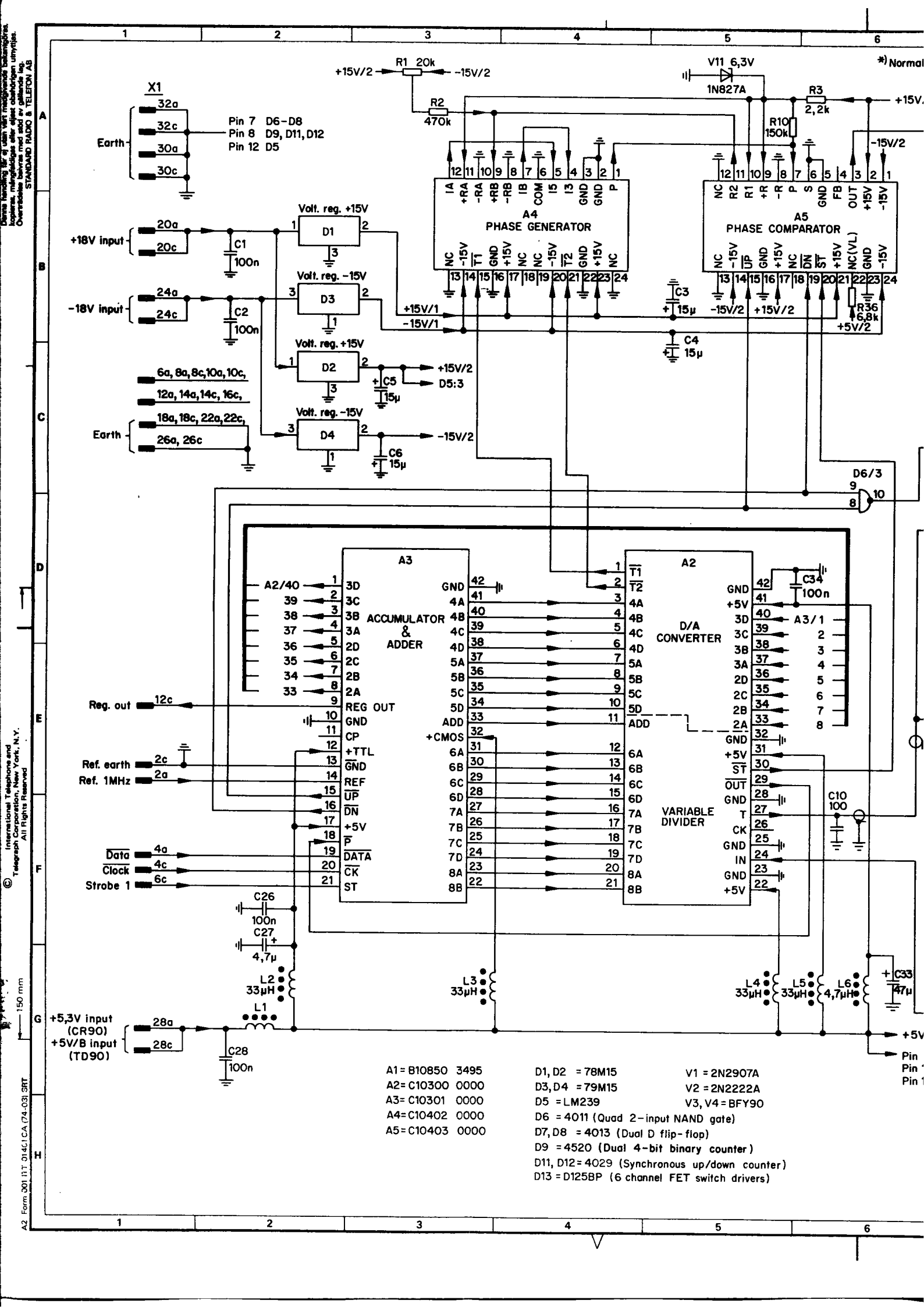
B1

ED	DATE - NO.							
SIGNATURES								
ED	DATE - NO.	1	790905	2	830907	3	831202	4	840607
SIGNATURES		OD		MFn		LBg		LBg/MFn	

ITT SRT

CRYSTAL OSCILLATOR
Circuit diagram

B10850 2485 3E



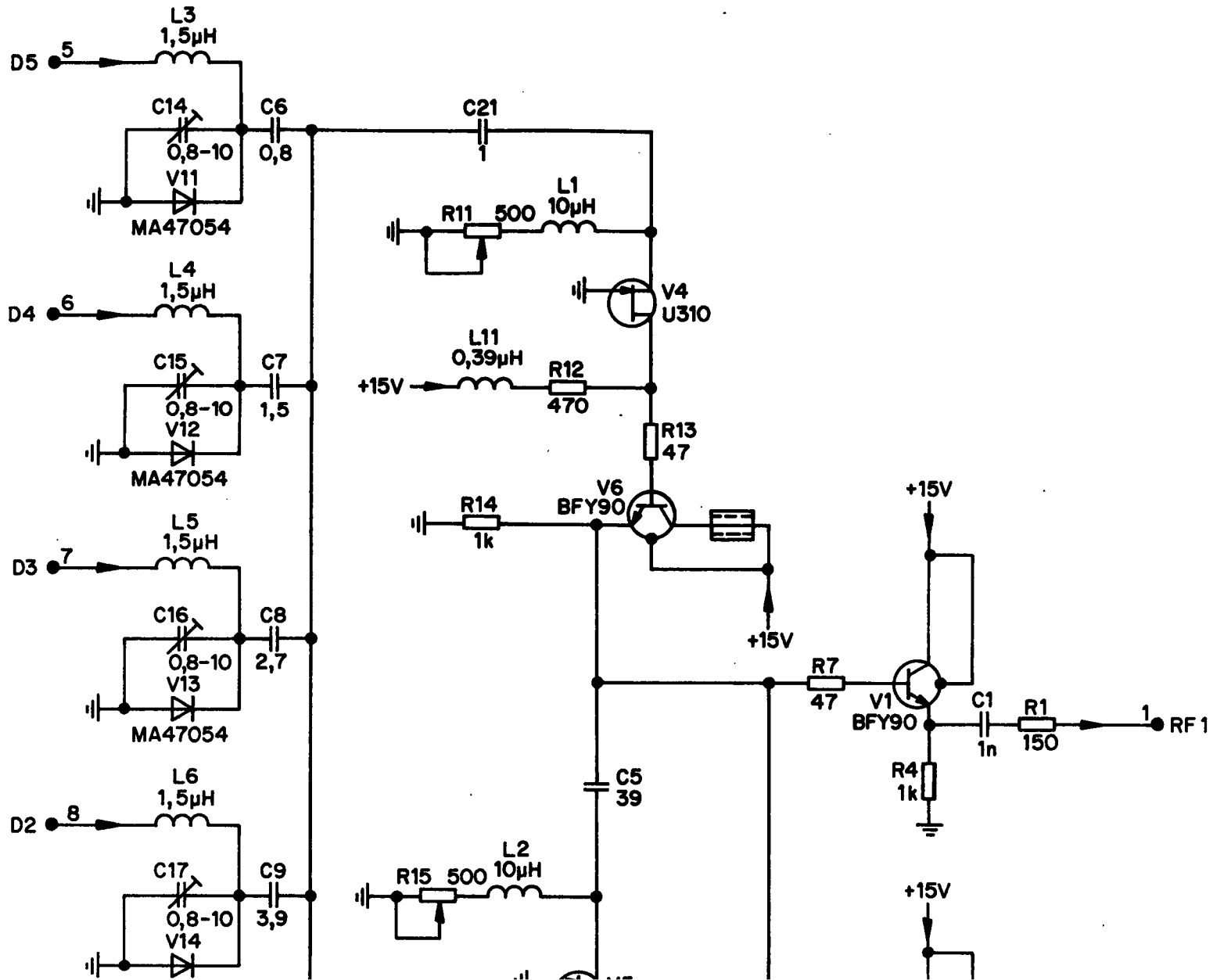
APP.4.14

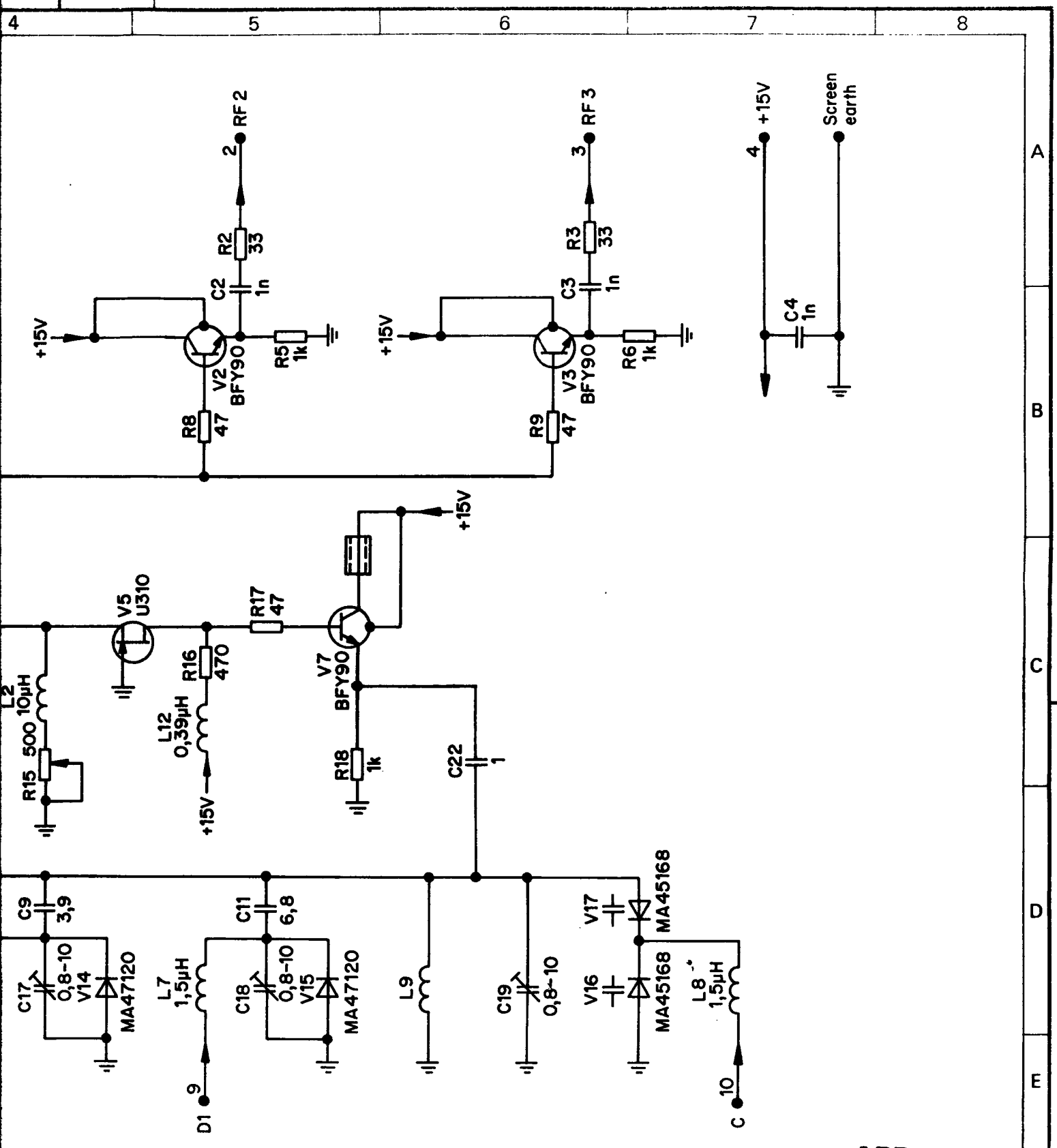
ED	DATE–NO.							
SIGNATURES								
ED	DATE–NO.	1	790327	2	790516	3	800122	4	830609
SIGNATURES		EW		EW				HPn	

ITT SRT

SYNTHESIZER
Circuit diagram

B10850 2490 2E





APP.4.15

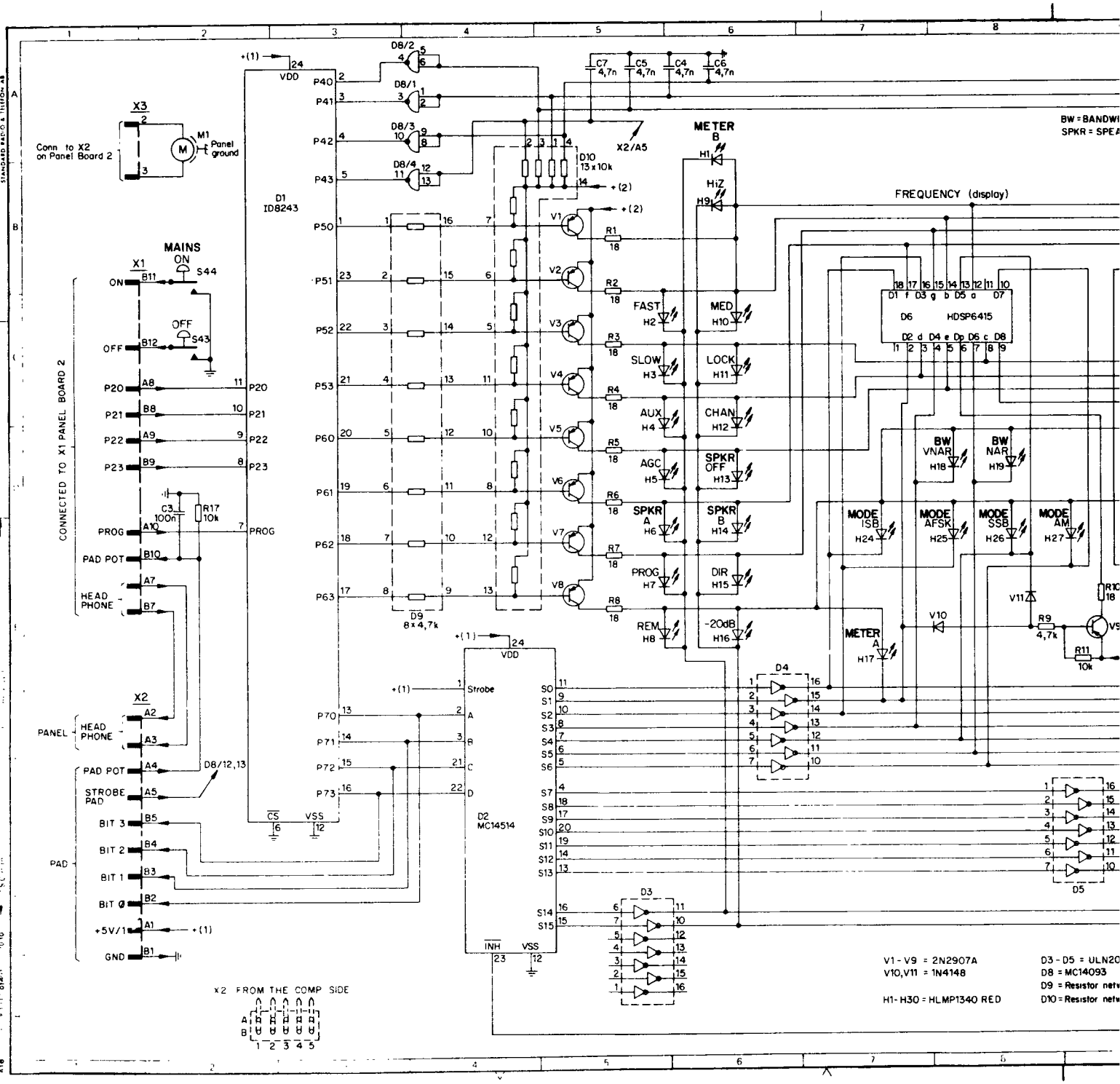
ED	DATE - NO.						
	SIGNATURES						
ED	DATE - NO.	1	790327	2	800121	3	800826
	SIGNATURES	EW can AT		SH um		SH ami	

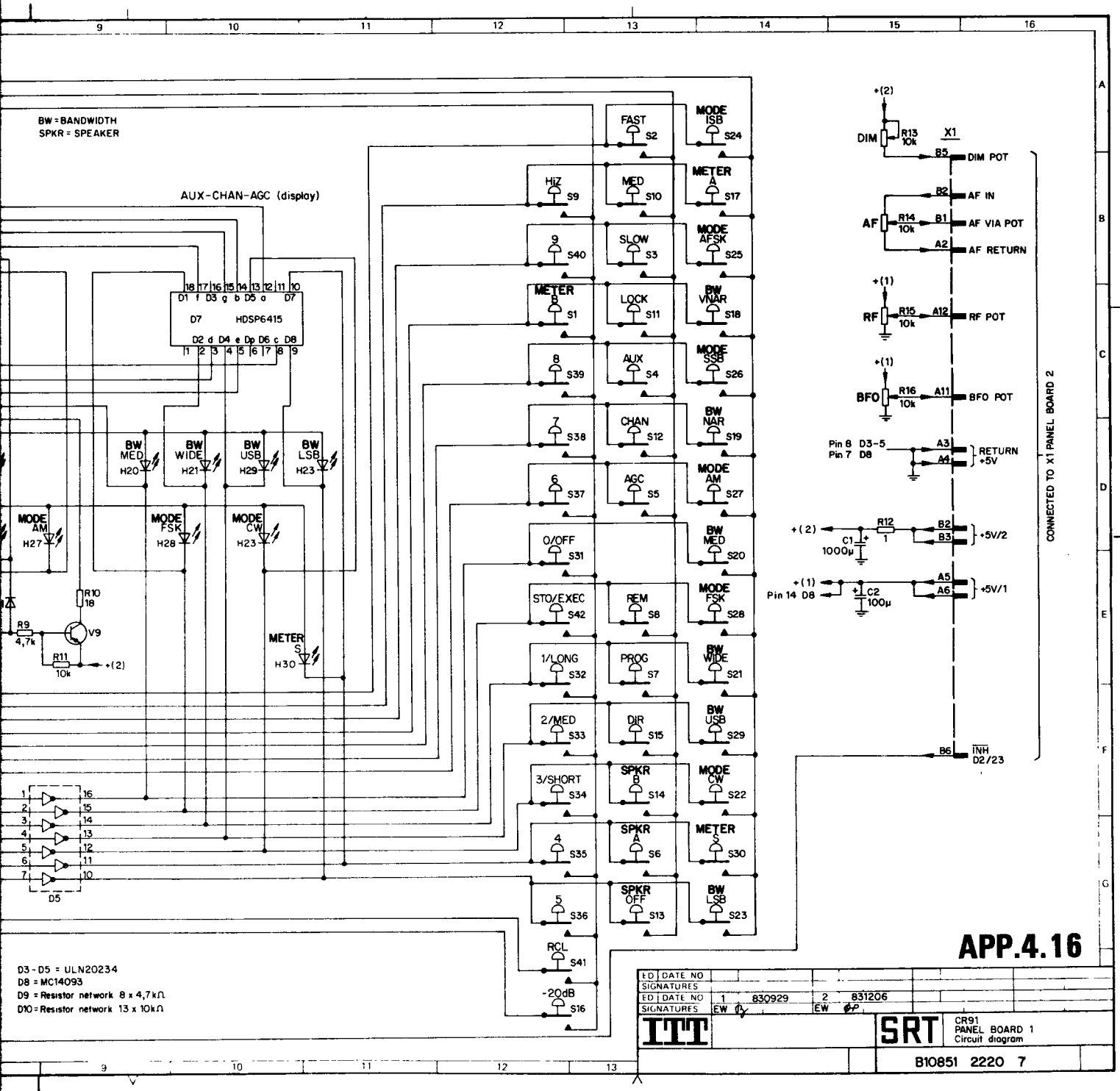
ITT

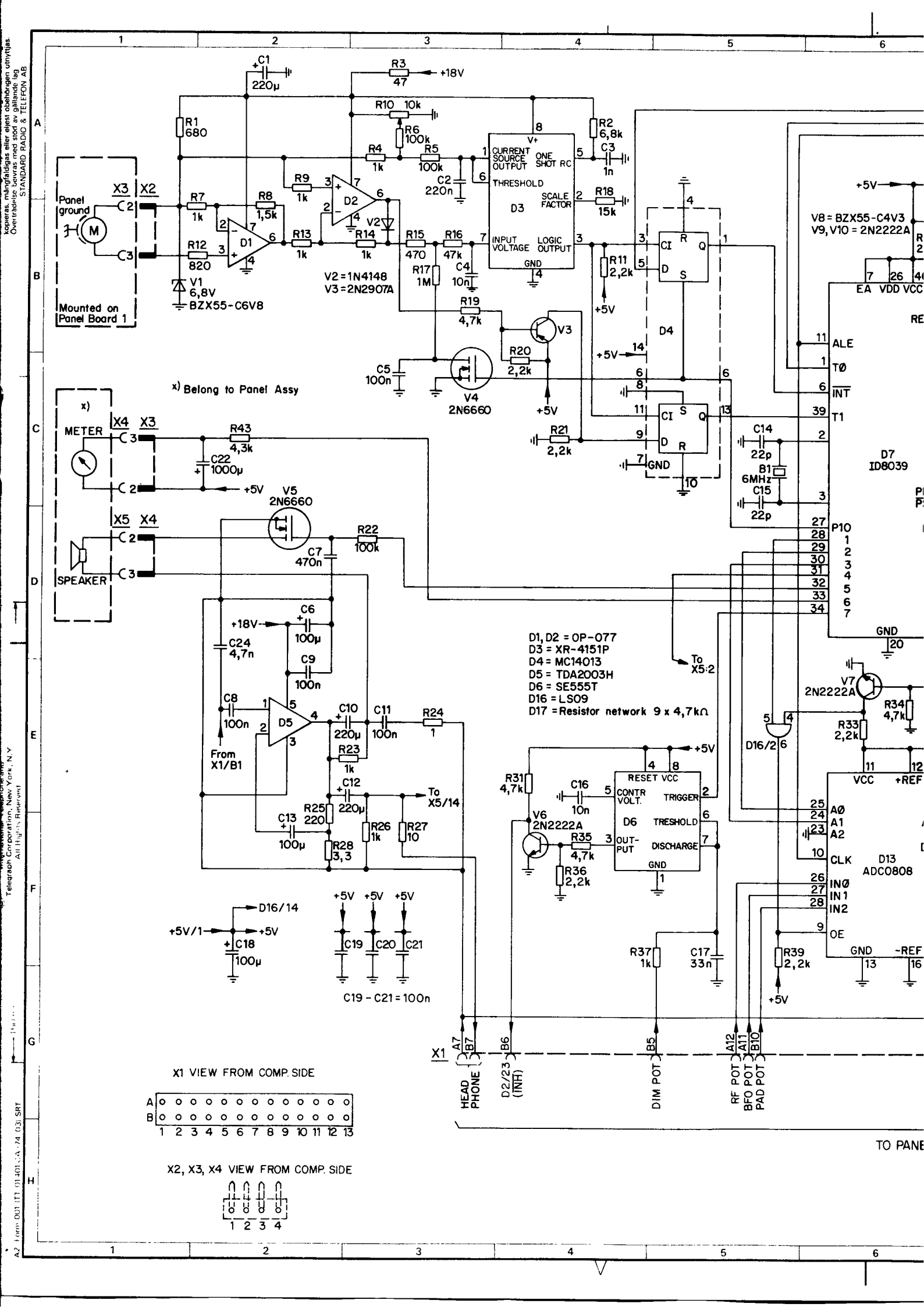
SRT

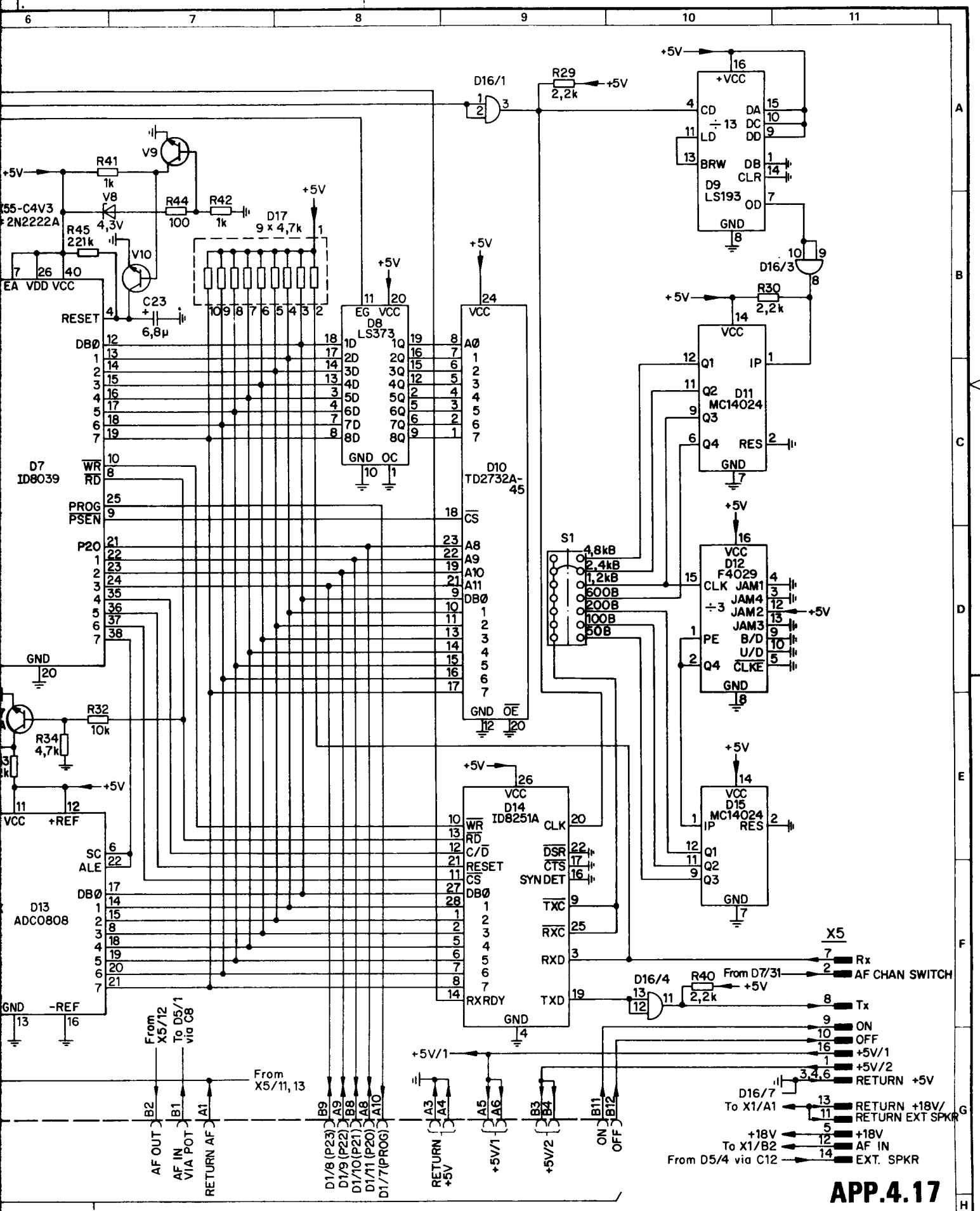
VCO BOARD
Circuit diagram

B10850 2495 3E


X3
Conn to X2 on Panel Board 2
M1
Panel ground
MAINS
X1
ON
S44
OFF
S43
CONNECTED TO X1 PANEL BOARD 2
PROG
PAD POT
HEAD PHONE
X2
PANEL
STROBE PAD
BIT 3
BIT 2
BIT 1
BIT Ø
+5V/1
GND
PAD
D1 ID8243
D2 MC14514
D8/1
D8/2
D8/3
D8/4
D8/12,13
D9 8x4,7k
D10 13x10k
C3 100n
R17 10k
C4 4,7n
C5 4,7n
C6 4,7n
C7 4,7n
X2/A5
X2 FROM THE COMP SIDE
METER B
HiZ
FAST
MED
SLOW
LOCK
AUX
CHAN
AGC
SPKR OFF
SPKR A
SPKR B
PROG
DIR
REM
-20dB
METER A
FREQUENCY (display)
D6 HDSP6415
BW VNAR
BW NAR
MODE ISB
MODE AFSK
MODE SSB
MODE AM
D4
D5
V1 - V9 = 2N2907A
V10,V11 = 1N4148
H1 - H30 = HLMP1340 RED
D3 - D5 = ULN20
D8 = MC14093
D9 = Resistor netw
D10 = Resistor netw


BW = BANDWIDTH
SPKR = SPEAKER
AUX-CHAN-AGC (display)
HDSP6415
BW MED H20
BW WIDE H21
BW USB H29
BW LSB H23
MODE AM H27
MODE FSK H28
MODE CW H23
METER S H30
R10 18
R9 4,7k
V9
R11 10k
+(2)
D5
FAST S2
HiZ S9
9 S40
METER B S1
8 S39
7 S38
6 S37
O/OFF S31
STO/EXEC S42
1/LONG S32
2/MED S33
3/SHORT S34
4 S35
5 S36
RCL S41
-20dB S16
MED S10
SLOW S3
LOCK S11
AUX S4
CHAN S12
AGC S5
REM S8
PROG S7
DIR S15
SPKR B S14
SPKR A S6
SPKR OFF S13
MODE ISB S24
METER A S17
MODE AFSK S25
BW VNAR S18
MODE SSB S26
BW NAR S19
MODE AM S27
BW MED S20
MODE FSK S28
BW WIDE S21
BW USB S29
MODE CW S22
METER S S30
BW LSB S23
+(2)
DIM R13 10k
X1
B5 DIM POT
B2 AF IN
AF R14 10k
B1 AF VIA POT
A2 AF RETURN
+(1)
RF R15 10k
A12 RF POT
+(1)
BFO R16 10k
A11 BFO POT
Pin 8 D3-5
Pin 7 D8
A3
A4
RETURN +5V
+(2)
C1 1000µ
R12 1
B2
B3
+5V/2
+(1)
Pin 14 D8
C2 100µ
A5
A6
+5V/1
CONNECTED TO X1 PANEL BOARD 2
B6 INH D2/23
D3 - D5 = ULN20234
D8 = MC14093
D9 = Resistor network 8 x 4,7kΩ
D10 = Resistor network 13 x 10kΩ
APP.4.16
ED DATE NO
SIGNATURES
ED DATE NO 1 830929 2 831206
SIGNATURES EW EW
ITT
SRT
CR91
PANEL BOARD 1
Circuit diagram
B10851 2220 7


Panel ground
Mounted on Panel Board 1
V1 6,8V BZX55-C6V8
V2=1N4148
V3=2N2907A
V4 2N6660
V5 2N6660
V7 2N2222A
V6 2N2222A
V8=BZX55-C4V3
V9, V10=2N2222A
x) Belong to Panel Assy
METER
SPEAKER
D1, D2 = OP-077
D3 = XR-4151P
D4 = MC14013
D5 = TDA2003H
D6 = SE555T
D16 = LS09
D17 = Resistor network 9 x 4,7kΩ
D7 ID8039
D13 ADC0808
From X1/B1
To X5:2
To X5/14
D16/14
C19 - C21 = 100n
X1 VIEW FROM COMP. SIDE
X2, X3, X4 VIEW FROM COMP. SIDE
HEAD PHONE
D2/23 (INH)
DIM POT
RF POT
BFO POT
PAD POT
TO PANE



APP.4.17

ED	DATE-NO								
SIGNATURES									
ED	DATE-NO	1	830929	2	831206	4	840305	5	840629
SIGNATURES		EW		EW		EW		RFn/MFn	

ITT SRT

CR91 Front Panel
PANEL BOARD 2
Circuit diagram

B10851 2230 2

ITT SRT

CR91 PANEL ASSY Circuit diagram

B10851 2200 4

ED	DATE-NO	SIGNATURES
1	830929	
2	840214	

METER

P1

B1

SPEAKER

X4 X3

X5 X4

X2 X3

PANEL BOARD 2
B10851 3230
A1 (Circuit diagram B10851 2230 2)

X5

Conn. to X3/Mother board

*) Belongs to Panel Board 2
(See circuit diagram B10851 2230 2)

X1 X1

M1 M

PANEL BOARD 1
B10851 3220
A2 (Circuit diagram B10851 2220 7)

X2 X3 X1

+5V STROBE Bit 0 Bit 1 Bit 2 Bit 3 DWELL TIME RETURN

A1 A5 B2 B3 B4 B5 A4 B1

1 2 3 4 5 6 8 7

PANEL

Headphone

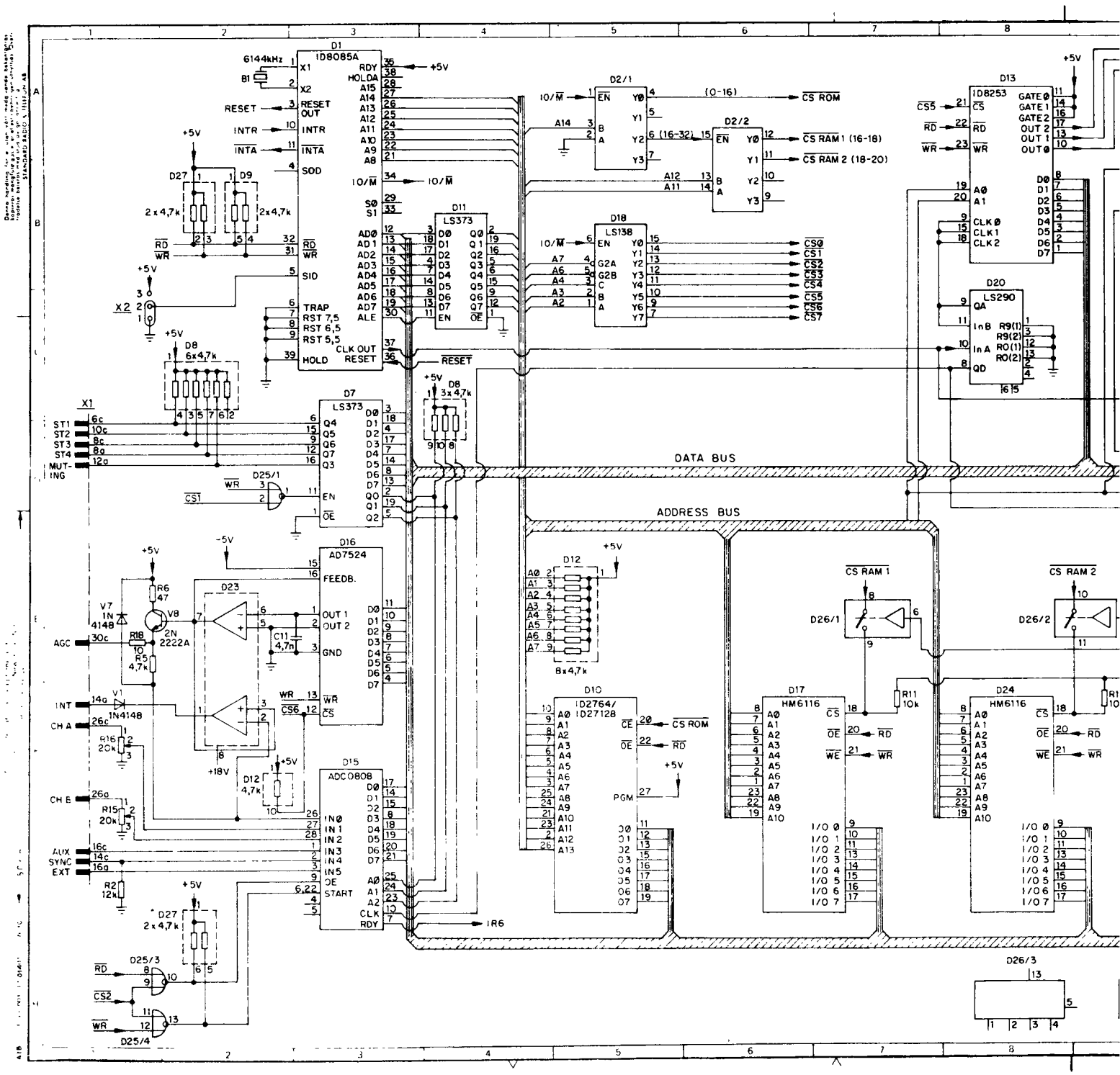
A2 A3

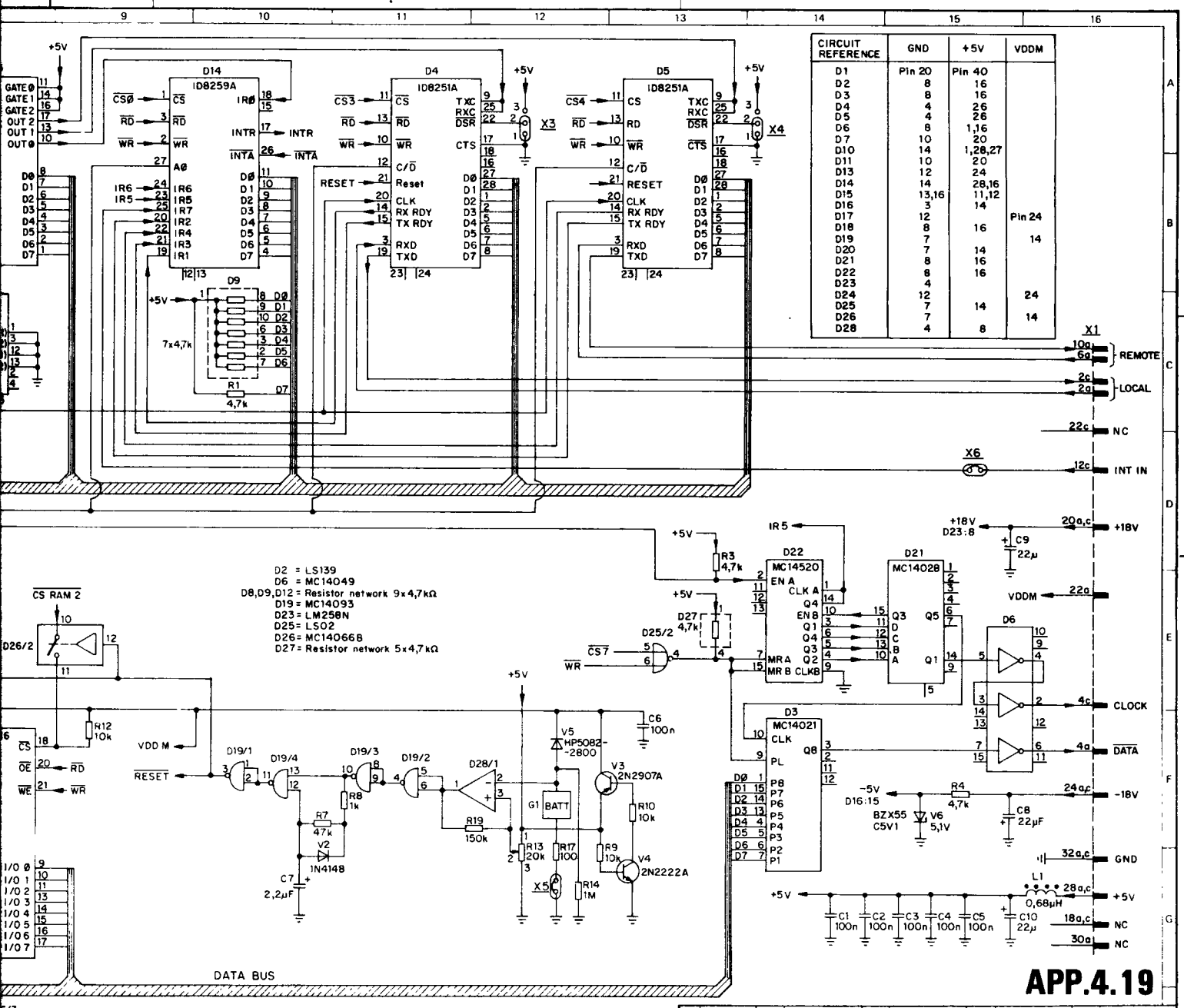
X2 1 2 3 4 5

PAD
CONTROL UNIT SS91

PHONES

APP.4.18


D1
ID8085A
6144kHz
X1
X2
RESET
INTR
INTA
SOD
SID
TRAP
RST 7,5
RST 6,5
RST 5,5
HOLD
CLK OUT
RESET
RDY
HOLDA
A15
A14
A13
A12
A11
A10
A9
A8
IO/M
S0
S1
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
ALE
+5V
D27
D9
2x4,7k
D8
6x4,7k
3x4,7k
D11
LS373
D7
D12
4,7k
D2/1
D2/2
LS138
D18
(0-16)
(16-32)
CS ROM
CS RAM 1 (16-18)
CS RAM 2 (18-20)
CS0
CS1
CS2
CS3
CS4
CS5
CS6
CS7
D13
ID8253
GATE0
GATE1
GATE2
OUT 2
OUT 1
OUT0
CLK0
CLK1
CLK2
D20
LS290
D25/1
D25/3
D25/4
D26/1
D26/2
D26/3
DATA BUS
ADDRESS BUS
X1
ST1
ST2
ST3
ST4
MUT-
ING
D16
AD7524
FEEDB.
OUT 1
OUT 2
GND
D23
R6
47
V7
1N
4148
V8
2N
2222A
AGC
R18
R5
4,7k
C11
4,7n
INT
CH A
CH B
AUX
SYNC
EXT
R16
20k
R15
20k
R2
12k
D15
ADC0808
IN0
IN1
IN2
IN3
IN4
IN5
OE
START
CLK
RDY
IR6
D10
ID2764/
ID27128
PGM
D17
HM6116
D24
HM6116
I/O 0
I/O 1
I/O 2
I/O 3
I/O 4
I/O 5
I/O 6
I/O 7
R11
10k
CS RAM 1
CS RAM 2
RD
WR
CS
OE
WE

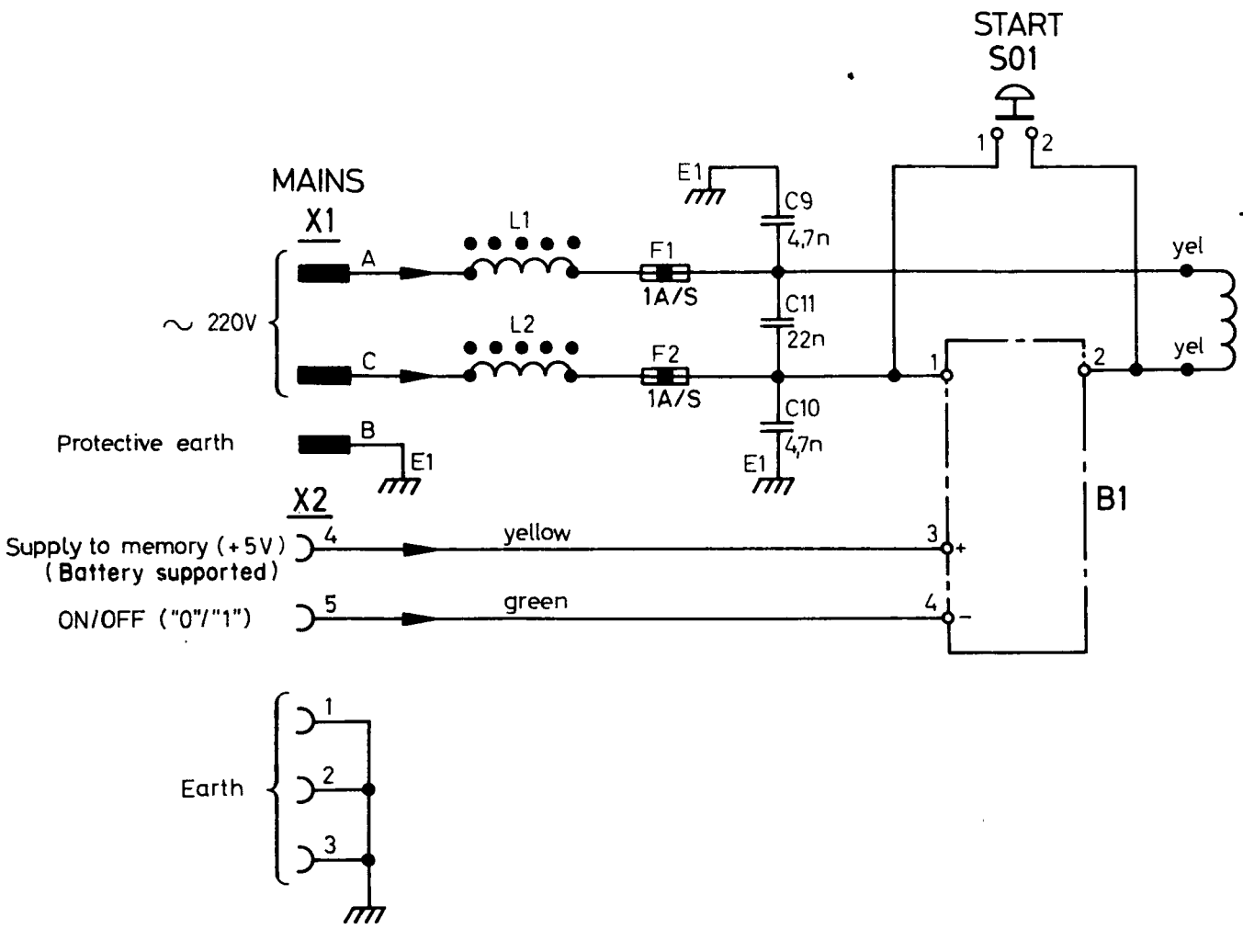


CIRCUIT REFERENCE	GND	+5V	VDDM
D1	Pin 20	Pin 40	
D2	8	16	
D3	8	16	
D4	4	26	
D5	4	26	
D6	8	1,16	
D7	10	20	
D10	14	1,28,27	
D11	10	20	
D13	12	24	
D14	14	28,16	
D15	13,16	11,12	
D16	3	14	
D17	12		Pin 24
D18	8	16	
D19	7		14
D20	7	14	
D21	8	16	
D22	8	16	
D23	4		
D24	12		24
D25	7	14	
D26	7		14
D28	4	8	

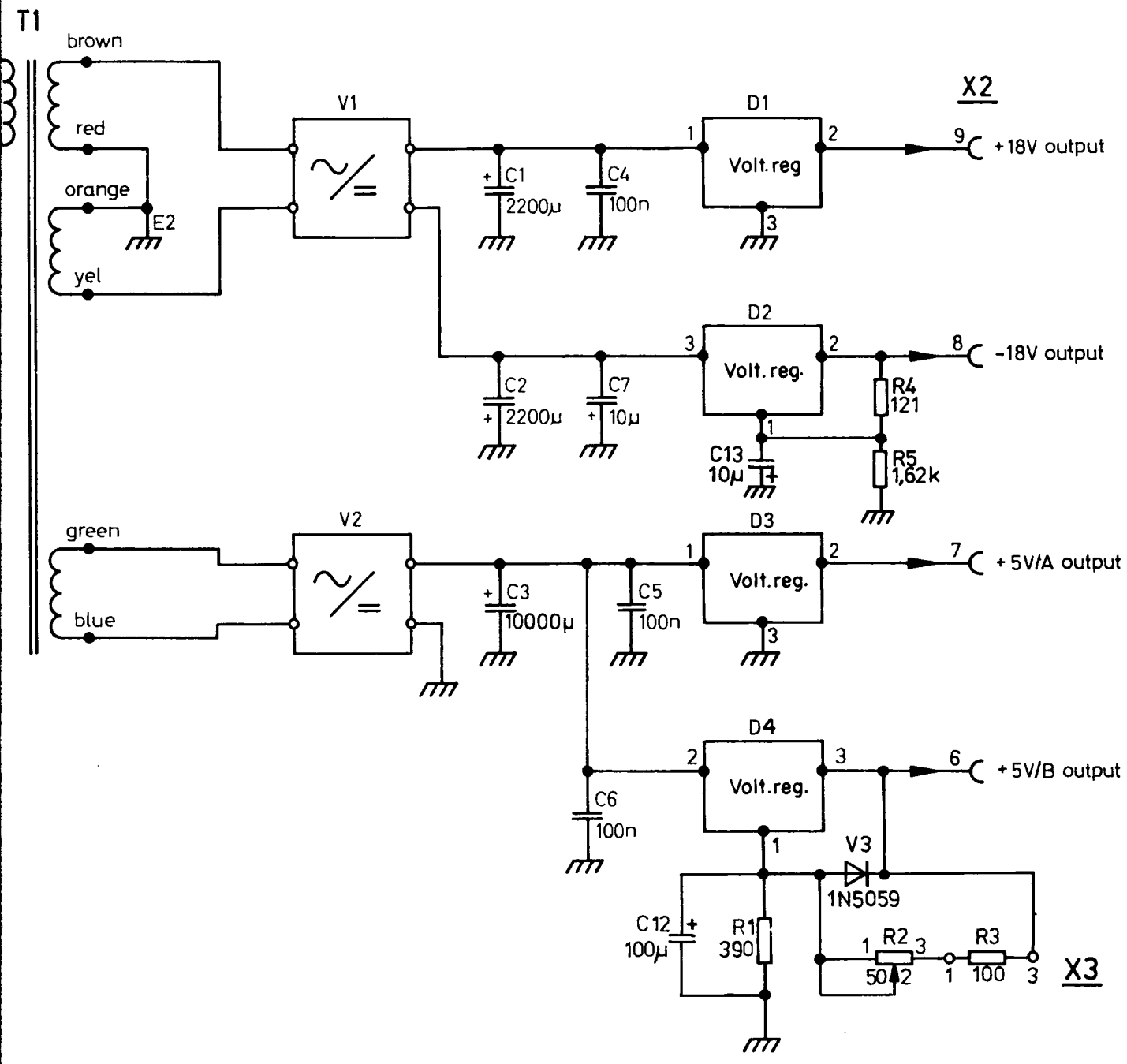
ED DATE NO				
SIGNATURES				
ED DATE NO	1 830929	2 831206	2:1 840323	
SIGNATURES	GHS	EW	RFn	

ITT SRT CR91 CONTROL BOARD Circuit diagram

B10851 2430 7



D4 = LM217
D1 = 7818
D2 = LM237
D3 = LM209
B1 = D2402
V1-V2 = MDA990-3



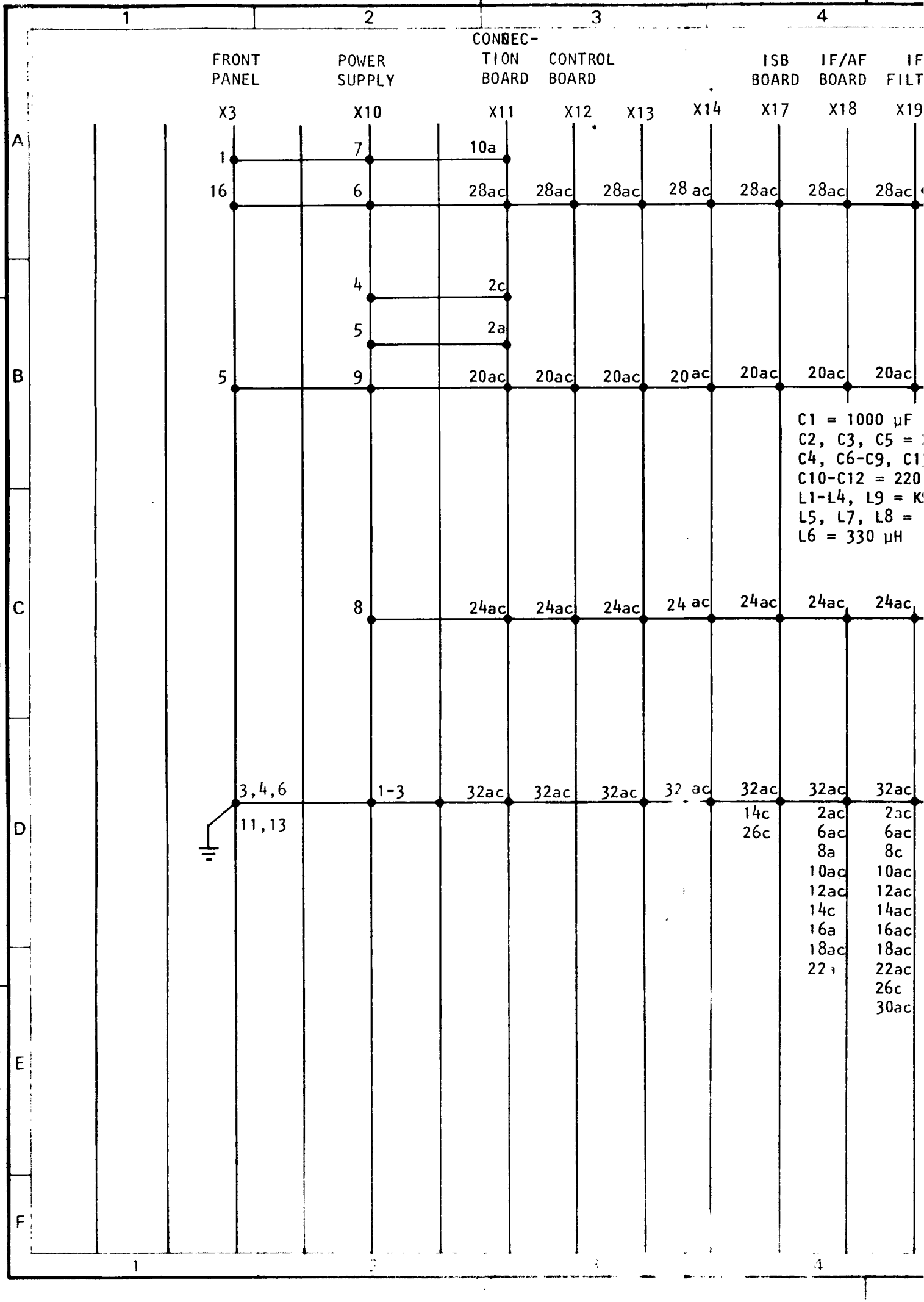
APP.4.20

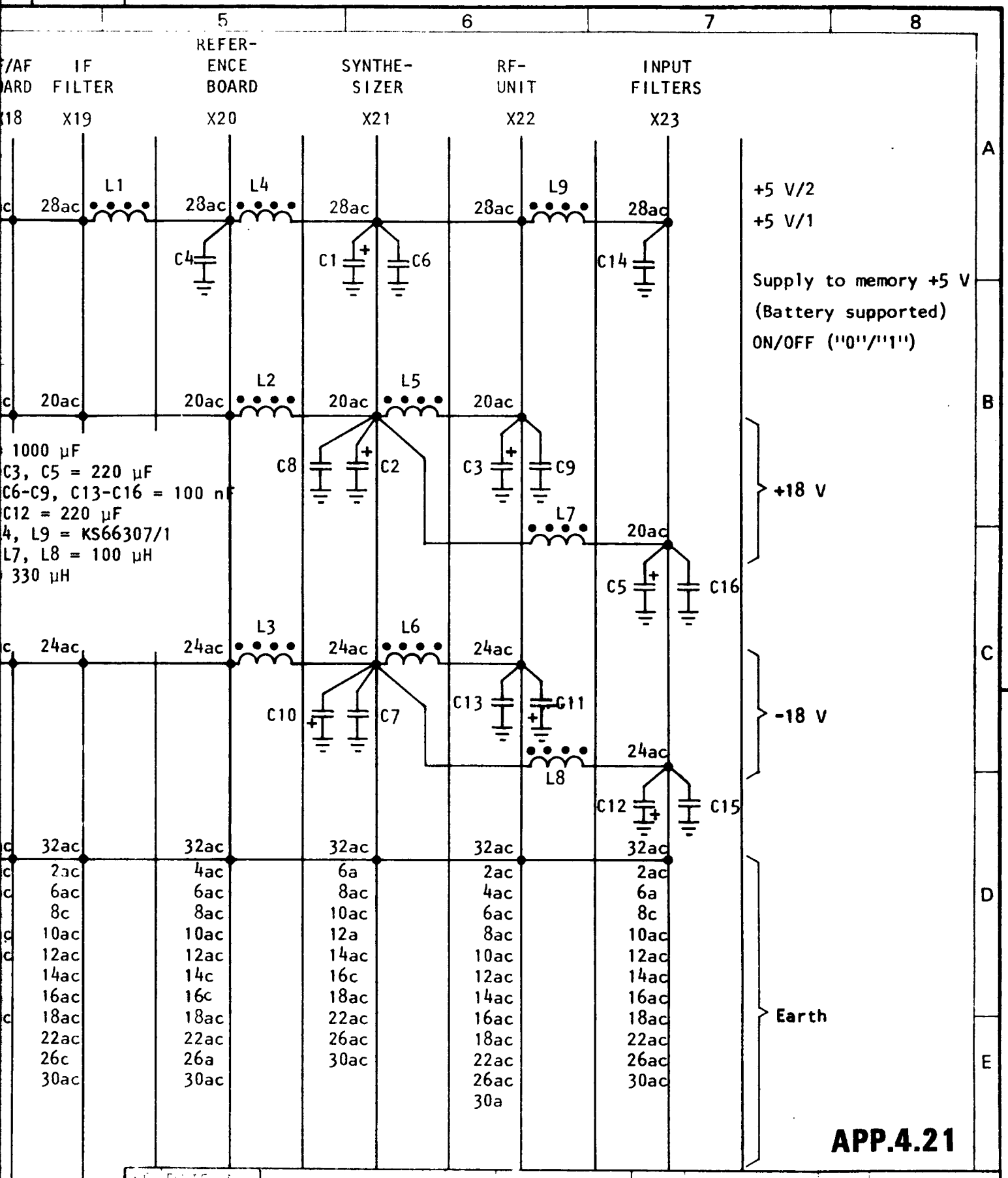
ED DATE NO					
SIGNATURES					
ED DATE NO	1 830907		2 840626		3 840827
SIGNATURES	MFn		LBs		LBs

ITT SRT

CR91
AC - SUPPLY
Circuit diagram

B10851 2301 3





APP.4.21

DATE / SIGNATURES			
DATE / SIGNATURES	1 [illegible]3913 UR/RFn	2 831108 UR/RJn	2:1 840813 RU/LEg

ITT

CONNECTION DIAGRAM

SRT

CR91
MOTHER BOARD A1 B10851 3110
DC-SUPPLY

B10851 2110 3

ITT

SRT

B10851 2050 4

CR91 CONTROL UNIT SS91
Circuit diagram

ED	DATE-NO.	SIGNATURES
1	830929	
2	840214	ELW
3	840507	KGF/MFn

B10851 3010

X1 W1

+5V 1 6
STROBE 2 1
BIT 0 3 2
BIT 1 4 3
BIT 2 5 4
BIT 3 6 5
DWELL TIME 8 7
RETURN 7 8

R2 560

U1

16 +VCC
15 A
14 B
13 C
12 D
GND 8

D1

0 1
1 2
2 3
3 4
4 5
5 6
6 7
7 9
8 10

SWEED SPEED
DWELL TIME
R1 1k
C1 100µ

UPPER S1
LOWER S4
SWEEP
START S7
SET SCAN S2
SCAN
RES SCAN S3
PREV S5
NEXT S6
STOP S8
START S9

APP.4.22

D1=54LS145J

5. MAINTENANCE

CONTENTS

5. MAINTENANCE

5.1 DISMANTLING AND ASSEMBLING

To remove a sub-unit (PC-board), depress the plastic grip which locks the board to the top cover and withdraw the board. DO NOT REMOVE OR REPLACE A PC BOARD WITH POWER ON. When replacing subunits, make sure that the intended slot is used --- the number on the plastic grip must match the number on the edge of the top cover.

If required, the top cover can be removed by loosening the screws along the side edges. When the top cover is replaced, ensure that the upper edges of the boards slide into the guides on the inside of the cover. Alternatively, all plug-in units can be withdrawn before attempting to replace the top cover.

In this case, place the receiver on a table with ample space behind the receiver rear and withdraw all board simultaneously without removing the interconnection cables. When the top cover is replaced, the card pack with interconnecting coaxial cables can be nudged into the proper slots. The Connection Board and the Control Board are replaced last.

The Front Panel is mounted with screws which are accessible on the top and bottom of the unit (figure 5:1). The panel assembly is connected to the Mother Board with a ribbon cable.

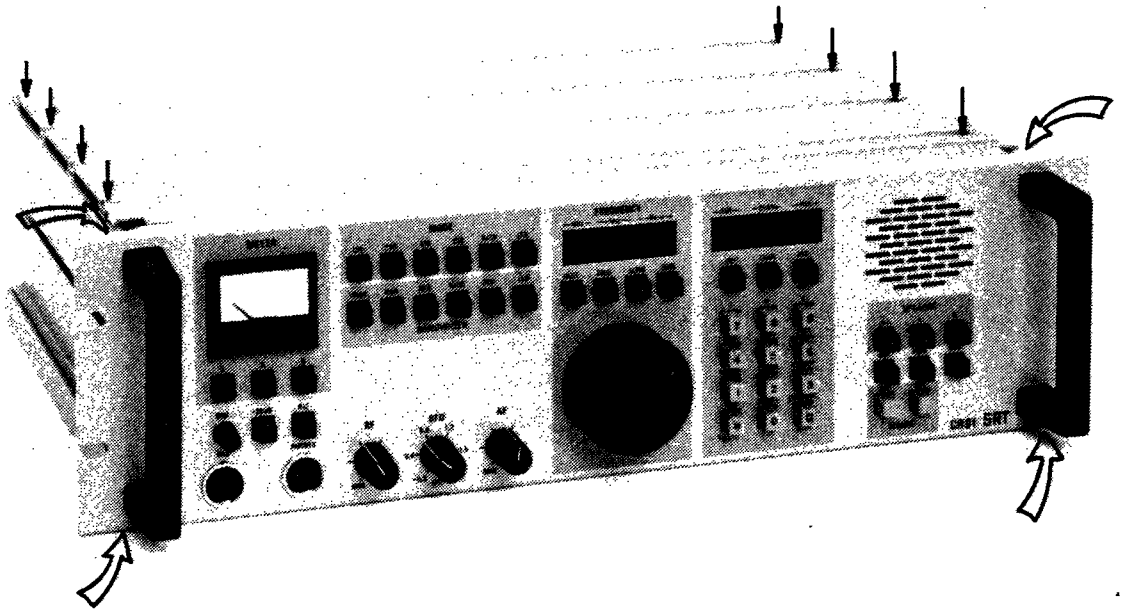


Figure 5:1 Removal of Front Panel and top cover

5.2 RECALIBRATION OF THE MASTER OSCILLATOR

Before the Master Oscillator (MXO) is adjusted, the receiver must have been switched on for at least one hour. The frequency adjustment can be carried out in two different ways depending on whether an accurate (to within 1 part in 10^8) frequency counter is available or not.

Adjustment with Frequency Counter

1. Remove the top cover of the receiver
2. Connect the frequency counter to the 5 MHz output (figure 5:2) on the Reference Board (position 20)
3. Adjust with R57 on the Reference Board to 5 MHz +-0.1 Hz

Adjustment with Lissajous-pattern

1. Remove the top cover of the receiver
2. Set the receiver to mode AM and bandwidth NARROW
3. Tune the receiver to a station which transmits a master frequency
4. Connect the horizontal channel of an oscilloscope to the IF output (figure 5:2) on the IF/AF Board (position 18)
5. Connect the vertical channel of the oscilloscope to the 5 MHz output on the Reference Board (figure 5:2)
6. Adjust R57 on the Reference Board until the Lissajous-pattern on the CRT screen is stationary

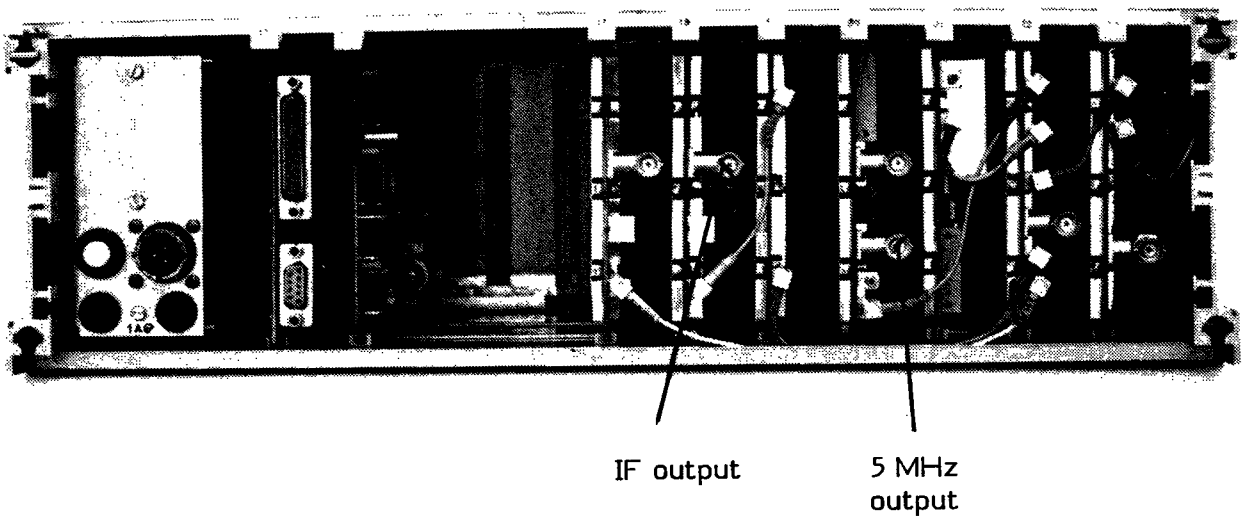


Figure 5:2 Rear of CR91

5.3 FUNCTION CHECK

This chapter describes checks which can be carried out without instruments. Checks with instruments are described in chapter 5.4 FAULT FINDING and in section 6. REPAIR AND ALIGNMENT.

If more than one CR91 receiver is available, errors can easily be isolated by swapping plug-in boards.

Most faults can by simple checks be isolated to one of the following:

- Reception error (Input Filters, RF Unit, IF Filter, IF/AF Board, ISB Board and Front Panel)
- Frequency error (Reference Board and Synthesizer)
- Control error (Front Panel, Control Board and Connection Board)
- Power supply error (Power Supply and Connection Board)

Reception Error

A reception error is present if the sensitivity appears reduced or the receiver is completely silent. In the latter case, check if both loudspeaker output and line output are silent. If so, the error is most likely on the IF/AF Board (or the ISB Board if the fault was in channel B).

If the line output is normal, the fault is probably in the loudspeaker amplifier on the Front Panel (Panel Board 2).

If the audio levels are normal but the sensitivity appears reduced, connect the antenna directly to X4 on the RF Unit and check if the sensitivity is restored. If so, replace the Input Filters unit.

If the sensitivity was not improved, remove the antenna, set the receiver to SSB, USB at 15 MHz. A noise should be heard in the loudspeaker. If the input coaxial cable to the IF/AF Unit (X2) is removed, the noise level shall decrease. If not, the fault is in the RF Unit or the IF Filter. The fault can be isolated to one of these by connecting the RF Unit (X5 or X6) directly to the IF/AF Board (X2). If the noise is decreased when the above connection is broken, the fault was in the IF Filter. If the noise is still unaffected, the RF Unit is faulty.

Frequency Generation Error

A frequency generation error is present if known stations do not appear as expected or if it is obvious that the frequency does not change when the displayed frequency is changed.

Set the frequency to 0.00 MHz, mode CW and bandwidth WIDE. A tone should be heard in the loudspeaker. Check that the frequency tuning operates normally (knob in SLOW, MED and FAST) -- make sure that the frequency changes for each new digit. If the frequency change as heard in the loudspeaker does not agree with the frequency change as observed on the display, the Synthesizer is defect.

If everything seems normal so far, try to identify known stations (i.e. broadcast stations and stations transmitting standard frequencies) and find out if the error is limited to some particular digits in the decades from 1 kHz to 10 MHz. If so, the Synthesizer is defect.

If the absolute error seems to be proportional to the tuned frequency and less than 500 Hz at 5 MHz, the error is probably in the Master Oscillator on the Reference Board.

Control Error

A control error will normally result in a display not responding when new commands are given with the push-buttons. It is difficult to isolate the fault to the Front Panel or the Control Board. However, if more than one CR91 receiver is available, swap the Control Boards and check if the fault follows the Control Board.

Power Supply Error

If the display is not lit when the ON button is pressed, check first that mains are connected and that the fuses on the power supply are OK. If the receiver can be switched on with the push-button on the rear of the power supply, the fault is with the ON/OFF circuits on the Connection Board or the lithium battery on the Control Board is discharged.

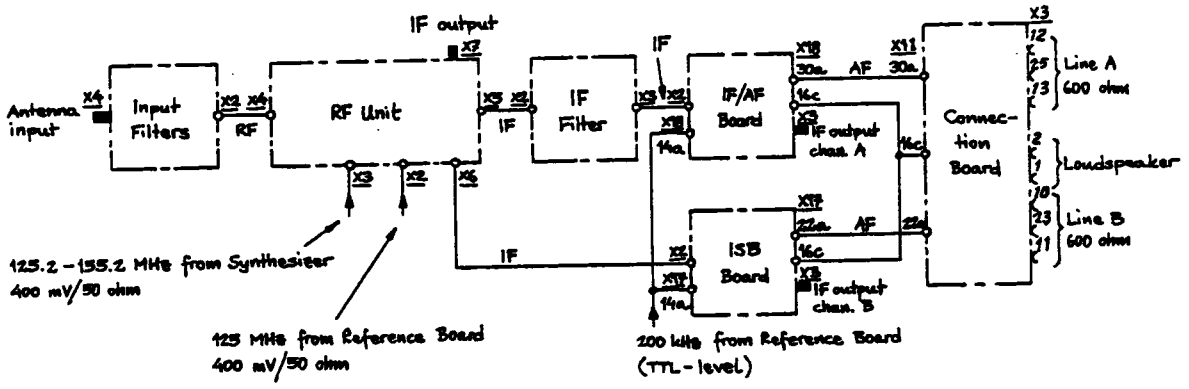


Figure 5:3. Reception circuits

5.4 FAULT FINDING

If some test instruments are available, the location of a faulty sub-unit is greatly facilitated. A suitable set of instruments could be the following:

1. Signal generator, e.g. HP606B
2. Distortion analyzer, e.g. HP334A
3. Frequency counter accurate to 1 part in 10^8
4. Oscilloscope with bandwidth more than 10 MHz
5. RF millivoltmeter, e.g. Boonton 99B
6. Digital multimeter, any type

The test procedures outlined below are applied in the same situations as described in 5.3 FUNCTION CHECK.

Reception Error (figure 5:3)

If the receiver is silent, see 5.3. Otherwise connect the signal generator to the antenna input and the distortion analyzer to the line output channel A. Check the sensitivity at one frequency within each band of the Input Filter unit (band limits: App 4.6). The required input signal in SSB mode, USBand with -20 dB and HiZ OFF, should be less than 0.6 uV EMF for 12 dB SINAD. If the sensitivity is significantly lower in one band, the Input Filter unit is faulty.

If the sensitivity is low on all frequencies, the faulty unit can be isolated by measuring the sensitivity at the following inputs:

X4 on the RF Unit:	approx 0.5 uV EMF/12 dB SINAD
X2 on the IF Filter Unit:	approx 2 uV EMF/12 dB SINAD *
X2 on the IF/AF Board:	approx 1 uV EMF/12 dB SINAD

*) measure with 199 kHz

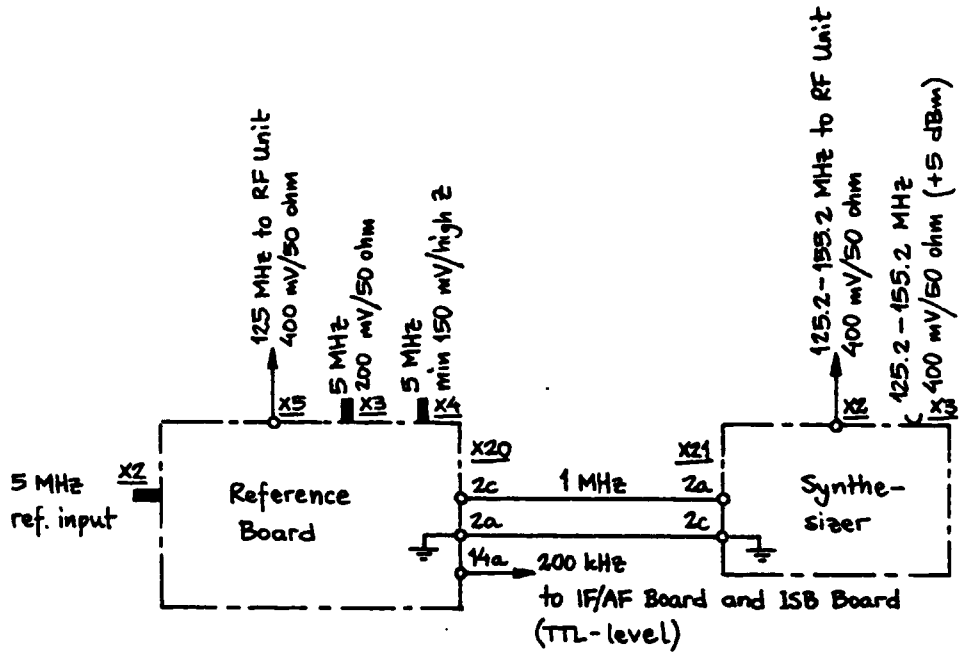


Figure 5:4. Frequency generation circuits

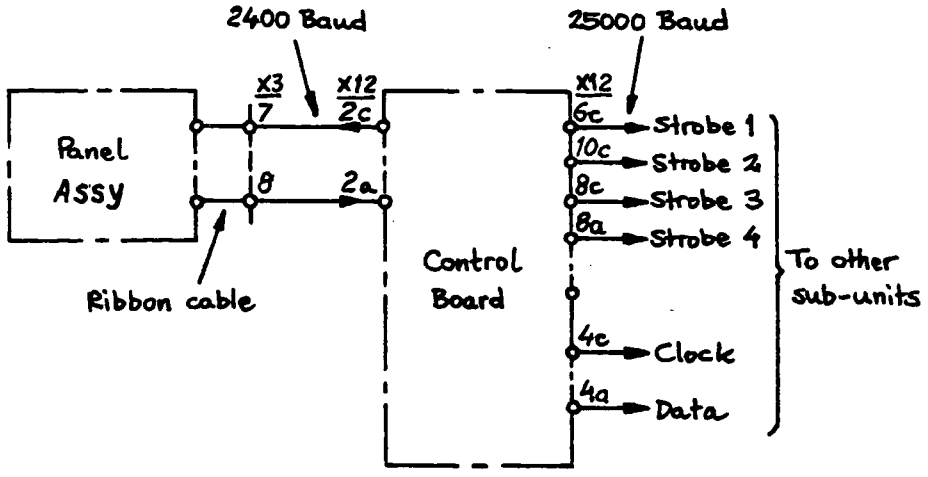


Figure 5:5. Control circuits

Frequency Generation Error (figure 5:4)

1. Measure with RF millivoltmeter and frequency counter in X3 on the Reference Board. The frequency should be 5 MHz +- 0.5 Hz and the voltage approx 200 mV/50 ohm

2. Measure in X5 on the Reference Board. The frequency should be 125 MHz +-10 Hz and the voltage approx 400 mV/50 ohm

Small frequency errors can be corrected by adjustment according to 5.2 RECALIBRATION OF THE MASTER OSCILLATOR. If the values measured above is significantly outside the limits given, replace the Reference Board.

3. Measure in X3 on the Synthesizer. The frequency should be 135.2 MHz +-10 Hz if the receiver is tuned to 10.0 MHz. The voltage should be approx 400 mV/50 ohm

If required, measure on other frequencies. If the expected frequency is not obtained, replace the Synthesizer.

Control Error (figure 5:5)

1. Check with oscilloscope on X3/21 at the Connection Board that a character is sent when e.g. the SSB button is pressed. Check also that characters are sent when the knob is turned. If the characters are missing, replace the Front Panel

2. Check on X3/8 at the Connection Board that two characters (test meter data) are sent at approx 50 millisecond intervals from the Control Board. If the characters are missing, replace the Control Board.

3. Check also that the data, clock and strobe signals appear on the serial bus when STO/EXEC is pressed. Use an extender board in one of the spare slots and measure with oscilloscope on the pins according to the functional block diagram appendix 4:4. If any of the signals are missing, replace the Control Board.

   NOTE: the strobe 2 signal is only present if a special sub-unit is installed

Power Supply Error

If the power supply cannot be switched on from the front panel, measure the voltage over the battery on the Control Board. If the voltage is less than 3.4V, replace the battery. If the power supply can be switched on, use an extender board and measure the DC voltages as follows:

- on 20 ac	+18V +-0.5V
- on 24 ac	-18V +-0.5V
- on 28 ac	+5.2V +-0.2V
- on X3/20 (Connection Board)	+5.0V +-0.2V

If any of the voltages are outside the limits, replace the AC supply.

6. REPAIR AND ALIGNMENT

CONTENTS

6. REPAIR AND ALIGNMENT

6.1 GENERAL

Most of the CR91 sub-units are screened with the shields soldered in place. In addition, the alignment of the sub-units requires sophisticated test equipment and in some cases special tests fixtures. Any other form of repair than exchange of sub-units is therefore NOT recommended in the field. Fault finding and repair on component level should only be performed by trained personnel. The few adjustments that can be performed in the field are described below.

6.2 ADJUSTMENTS

The CR91 normally need not be adjusted in the field. However, if certain sub-units have been replaced, some adjustments relevant to the particular installation might be required.

1. If remote control is used, the baudrate for the remote port might be changed (see chapter 2.3)

2. The line levels may need adjustment (see chapter 2.3)

3. The center frequency in FSK and AFSK mode must be set to the proper value (see chapter 2.3)

4. The switch for selection of frequency standard must be checked (se chapter 2.3)

5. The internal frequency standard may need adjustment (see chapter 5.2)

6.3 TESTS AFTER REPAIR

When a sub-unit has been replaced, or when a replacement receiver has been installed, the operating condition of the receiver should be checked thoroughly. If no test equipment is available, try to tune the receiver to known stations over the frequency range and try out all modes of operation. With test equipment, proceed as follows:

1. Check that the receiver can be controlled according to section 3. OPERATION

2. Connect a signal generator at 1.888888 MHz to the antenna input and connect a distortion analyzer to X3 pins 12 and 13 on the Connection Board. Select SSB with USB. The set up should be according to figure 6:1

3. Check the sensitivity of the receiver. An input signal of 0.6 uV EMF should give 12 dB SINAD

4. Repetat item 3 for frequencies, modes and bandwidths as follows:

Frequency (MHz)	Mode	Bandwidth	Sensitivity for 12 dB SINAD
1.888888	SSB	LSB	0.6 uV EMF
26.555555	FSK	MEDIUM	0.5 uV EMF
26.555555	CW	NARROW	0.3 uV EMF
26.555555	CW	V NARROW	0.2 uV EMF

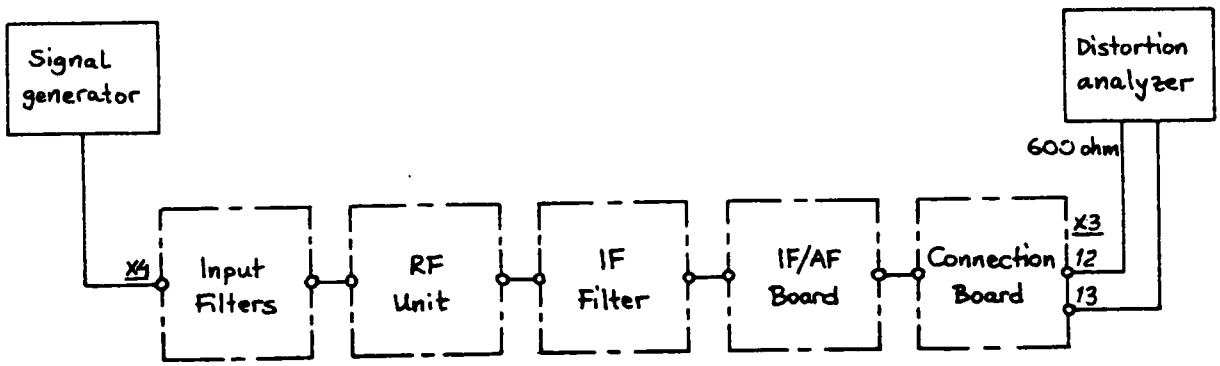


Figure 6:1 Set-up for check of sensitivity

5. Check the sensitivity for frequency 26.555555 MHz, mode AM and bandwidth WIDE. An input signal of 3.0 uV EMF 30% modulation should give 12 dB SINAD

6. Set the receiver frequency to 10.000000 MHz, mode SSB and USB. The -20 dB attenuator and Hi Z should be off. Connect the signal generator and the distortion analyzer according to figure 6:2. Increase the signal generator level by 120 dB. The output level should change less than 3 dB.

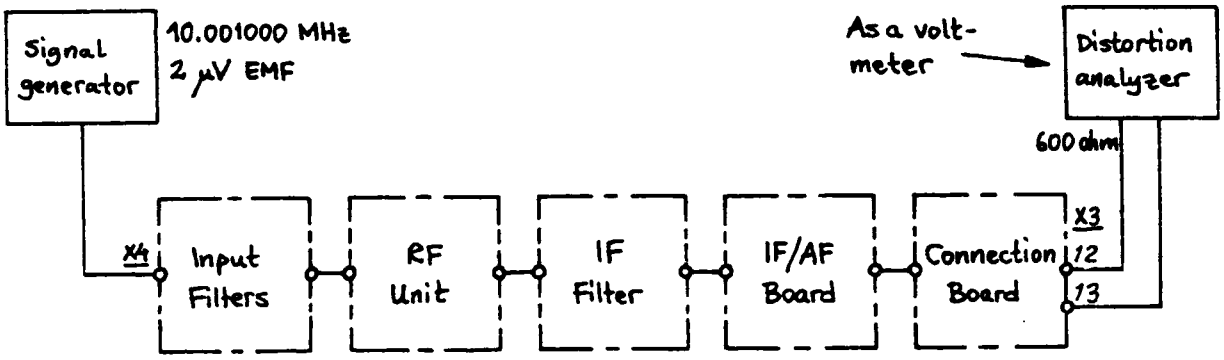
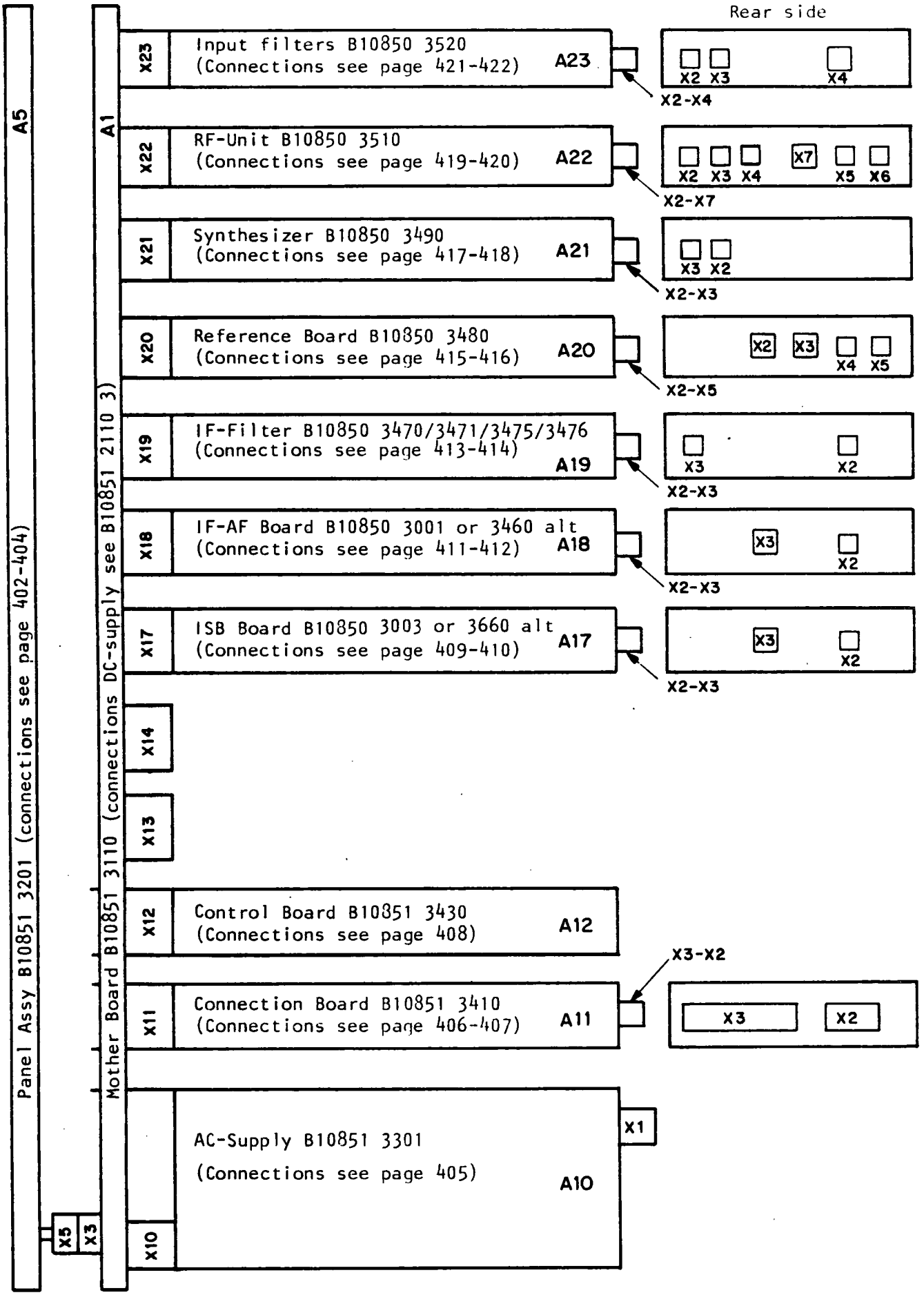


Figure 6:2 Set-up for check of AGC range

7. CONNECTION TABLES



	1	830919	2	840813			
	Bol		RU/LEg				

ITT

SRT

CR91
UNIT'S LOCATION AND
REFERENCE KEY

B10851 2000 401 22

8202228

CONNECTION TABLE

B10851 2000 402

ITT SRT

PANEL ASSY B10851 3201 A5
PANEL BOARD 1
B10951 3220

SIGNATURES	ED	DATE-NO.	SIGNATURES	ED	DATE-NO.
RU/RFn	1	830919			

CONN. x 1	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
A2		X	AF pot. (return)	AØ1/X1/A2
A3		X	GND (return +5 V)	/A3
A4		X	GND (return +5 V)	/A4
A5	X		+5 V/1	/A5
A6	X		+5 V/1	/A6
A7	X		AF to headphone (return)	/A7
A8	X	X	Expander data bus (P20)	/A8
A9	X	X	Expander data bus (P22)	/A9
A10	X		Expander data control (PROG)	/A10
A11		X	BFO pot. wiper	/A11
A12		X	RF pot. wiper	/A12
B1		X	AF from AF pot.	/B1
B2	X		AF to AF pot.	/B2
B3	X		+5 V/2	/B3
B4	X		+5 V/2	/B4
B5		X	DIMMER pot.	/B5
B6	X		INHIBIT to D2 (dimmer function)	/B6
B7	X		AF to headphone	/B7
B8	X	X	Expander data bus (P21)	/B8
B9	X	X	Expander data bus (P23)	/B9
B10		X	SS91 SPEED/DWELL-TIME pot.	/B10
B11		X	PWR ON	/B11
B12		X	PWR OFF	/B12
X2				
A1		X	+5 V/1 to SS91	SS91/X1/1
A2		X	AF to headphone	Panel/X2/3
A3		X	AF to headphone (return)	/5
A4	X		SS91 SPEED/DWELL-TIME pot.	SS91/X1/8
A5	X		STROBE	/2
B1	X		GND	/7
B2		X	Scan address bit Ø	/3
B3		X	Scan address bit 1	/4
B4		X	Scan address bit 2	/5
B5		X	Scan address bit 3	/6

CONNECTION TABLE

ITT SRT

PANEL ASSY B10851 3201 A5
PANEL BOARD 2
B10851 3230

B10851 2000 403

SIGNATURES	ED	DATE-NO.
RU/RFn	1	830919

CONN. x 1	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
A2	X		AF pot. (return)	AØ2/X1/A2
A3	X		GND (return +5 V)	/A3
A4	X		GND (return +5 V)	/A4
A5		X	+5 V/1	/A5
A6		X	+5 V/1	/A6
A7		X	AF to headphone (return)	/A7
A8	X	X	Expander data bus (P20)	/A8
A9	X	X	Expander data bus (P22)	/A9
A10		X	Expander data control (PROG)	/A10
A11	X		BFO pot. wiper	/A11
A12	X		RF pot. wiper	/A12
B1	X		AF from AF pot.	/B1
B2		X	AF to AF pot.	/B2
B3		X	+5 V/2	/B3
B4		X	+5 V/2	/B4
B5	X		DIMMER pot.	/B5
B6		X	INHIBIT to D2 (dimmer function)	/B6
B7		X	AF to headphone	/B7
B8	X	X	Expander data bus (P21)	/B8
B9	X	X	Expander data bus (P23)	/B9
B10	X		SS91 SPEED/DWELL-TIME pot.	/B10
B11	X		PWR ON	/B11
B12	X		PWR OFF	/B12
X2				
2	X		Main tuning sensor MØ1	MØ1/X3/2
3	X		Main tuning sensor MØ1	/3
X3				
2		X	Test meter PØ1	PØ1/X4/2 (+)
3		X	Test meter PØ1	/3 (-)
X4				
2		X	Loudspeaker BØ1	BØ1/X5/2
3		X	Loudspeaker BØ1	/3

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CONNECTION TABLE

B10851 2000 404

SIGNATURES	ED	DATE—NO.
	1	830919
	2	831206
	3	840813

SIGNATURES	ED	DATE—NO.

PANEL ASSY B10851 3201 A5
PANEL BOARD 2
B10851 3230

CONN. x 5	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
1	X		+5 V/2	X10/7, X11/10a
2		X	AF chan. switch	See CR91R
3		X	GND (return +5 V)	See B10851 2110 3
4		X	GND (return +5 V)	See B10851 2110 3
5	X		+18 V	X10/9, see also B10851 2110 3
6		X	GND (return +5 V)	See B10851 2110 3
7	X		Serial data to panel	X11/4a, X12/2c
8		X	Serial data from panel	X11/4c, X12/2a
9		X	PWR ON	X11/6a
10		X	PWR OFF	X11/8a
11				
12	X		AF to panel	X11/16c, X13/16c, X14/16c, X17/16c, X18/16c
13		X	GND (return +5 V)	See B10851 2110 3
14		X	External loudspeaker output	X11/26c
15	X		External loudspeaker return	X11/26a
16	X		+5 V/1	X10/9, see also B10851 2110 3

CONNECTION TABLE

LTT
SRT

ED	DATE-NO.
SIGNATURES	
ED	DATE-NO.
SIGNATURES	RU/REn 1 830919
ED	DATE-NO.
SIGNATURES	RU/LEq 2 840813
ED	DATE-NO.
SIGNATURES	

POWER SUPPLY A10
B10851 3301

B10851 2000 405

CONN. x 10	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
1		X	GND	See B10851 2110 3
2		X	GND	See B10851 2110 3
3		X	GND	See B10851 2110 3
4	X		Battery backed up +5 V (VDDM)	X11/2c
5	X		PWR ON/OFF	X11/2a
6		X	+5 V/1	See B10851 2110 3
7		X	+5 V/2	X3/1, X11/10a
8		X	-18 V	See B10851 2110 3
9		X	+18 V	See B10851 2110 3

CONNECTION TABLE

B10851 2000 406

CONNECTION BOARD A11
B10851 3410

SIGNATURES	ED	DATE-NO.	SIGNATURES	ED	DATE-NO.
RU/REc	1	830919			
	2	831108			
RU/LEq	3	840813			

CONN. x 11	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a		X	PWR ON/OFF	X10/5
2c		X	VDDM	X10/4
4a	X		Serial data to panel	X3/7, X12/2c
4c	X	X	Serial data from panel	X3/8, X12/2a
6a	X		PWR ON	X3/9
6c		X	Remote control serial data	X12/6a
8a	X		PWR OFF	X3/10
8c	X		Backsignalling serial data	X12/10a
10a	X		+5 V/2	X3/1, X10/7
10c	X		VDDM	X12/22a
12a	X		Muting	X12/12a, X13/12a, X14/12a, X17/12a
12c	X	X	Auxilliary I/O (reserv)	X12/12c, X13/12c, X14/12c, X17/12c
14a	X		Interrupt from Control Board	X12/14a
14c	X		UNLOCKED	X12/14c, X20/16a, X21/16a
16a		X	External measure	X12/16a
16c	X	X	AF I/O	X3/12, X13/16c, X14/16c, X17/16c, X18/16c
18a	X	X	Auxilliary I/O (reserv)	X12/18a, X13/18a, X14/18a, X17/18a
18c	X	X	Auxilliary I/O (reserv)	X12/18c, X13/18c, X14/18c, X17/18c
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a	X		AF LINE B	X13/22a, X14/22a, X17/22a
22c		X	Muting	X12/22c, X13/22c, X14/22c, X17/22c, X18/22c
24a	X		-18 V	See B10851 2110 3
24c	X		-18 V	See B10851 2110 3
26a		X	External L.S. return	X3/15
26c	X		External L.S.	X3/14
28a	X		+5 V/1	See B10851 2110 3
28c	X		+5 V/1	See B10851 2110 3
30a	X		AF LINE A	X18/30a
30c	X		AGC	X12/30c, X13/30c, X14/30c, X17/30c, X18/30c
				X22/30c
32a	X	X	GND	See B10851 2110 3
32c	X	X	GND	See B10851 2110 3

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SRT

CONNECTION TABLE

B10851 2000 407

CONNECTION BOARD A11
B10851 3410

SIGNATURES	ED	DATE-NO.	SIGNATURES	ED	DATE-NO.
RU/RFn	1	830919			

CONN. x 2	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
1	X	X	GND	
2			N.C.	
3	X		Muting V28 CMN (floating)	
4		X	REMOTE OUT V28	
5	X		REMOTE IN CMN (floating)	
6	X		Muting V28 in (floating)	
7			AGC	
8		X	INTERRUPT out V28	
9	X		REMOTE IN DATA (floating)	
X3				
1		X	GND	
2		X	External loudspeaker return	
3	X		O.C. muting input	
4		X	AGC	
5	X	X	Auxilliary I/O 1	
6			AF I/O	
7	X	X	Auxilliary I/O 2	
8		X	Serial data to panel	
9	X		PWR ON	
10		X	AF LINE B 600 ohm	
11		X	AF LINE B 600 ohm	
12		X	AF LINE A 600 ohm	
13		X	AF LINE A 600 ohm	
14		X	REMOTE OUT V28	
15		X	External loudspeaker out	
16	X	X	O.C. interrupt out	
17	X	X	Auxilliary I/O 3	
18	X		External measure input	
19		X	"Not synchronized" alarm output	
20		X	+5 V/2	
21	X	X	Serial data from panel (O.C.)	
22	X		PWR OFF	
23		X	LINE B center tap	
24			N.C.	
25		X	LINE A center tap	

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CONNECTION TABLE

B10851 2000 408

ITT SRT

CONTROL BOARD A12
B10851 3430

SIGNATURES	ED	DATE-NO.	SIGNATURES	ED	DATE-NO.
RU/REn	1	830919			
RU/LEq	2	840813			

CONN. x 1	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a	X		Serial data from panel	X3/8, X11/4c
2c		X	Serial data to panel	X3/7, X11/4a
4a		X	DATA	X13/4a, X14/4a, X17/4a, X18/4a, X19/4a, X21/4a, X23/4a
4c		X	CLOCK	X13/4c, X14/4c, X17/4c, X18/4c, X19/4c, X21/4c, X23/4c
6a	X		REMOTE IN serial data	X11/6c
6c		X	STROBE 1	X13/6ac, X14/6ac, X17/6ac, X21/6c, X23/6c
8a		X	STROBE 4	X13/8a, X14/8a, X17/8a, X19/8a, X23/8a
8c		X	STROBE 3	X13/8c, X14/8c, X17/8c, X18/8c
10a		X	REMOTE OUT	X11/8c
10c		X	STROBE 2	X13/10ac, X14/10ac, X17/10ac
12a		X	Muting	X11/12a, X13/12a, X14/12a, X17/12a
12c	X		Interrupt input	X11/12c, X13/12c, X14/12c, X17/12c
14a		X	Interrupt output	X11/14a
14c		X	Sync. alarm	X11/14c, X20/16a, X21/16a
16a	X		External measure	X11/16a
16c	X		Auxilliary measure	X13/16c, X14/16c, X17/16c
18a			Aux	X11/18a, X13/18a, X14/18a, X17/18a
18c			Aux	X11/18c, X13/18c, X14/18c, X17/18c
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a		X	VDDM	X11/10c
22c			Muting	X11/22c, X13/22c, X14/22c, X17/22c, X18/22c
24a	X		-18 V	See B10851 2110 3
24c	X		-18 V	See B10851 2110 3
26a	X		CHANNEL B measure	X13/26c, X14/26c, X17/26c
26c	X		CHANNEL A measure	X18/26c
28a	X		+5 V/1	See B10851 2110 3
28c	X		+5 V/1	See B10851 2110 3
30a			Reserve	X13/30a, X14/30a, X17/30a
30c	X	X	AGC/MGC	X11/30c, X13/30c, X14/30c, X17/30c, X18/30c, X22/30c
32a	X	X	GND	See B10851 2110 3
32c	X	X	GND	See B10851 2110 3

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CONNECTION TABLE

ITT SRT

B10851 2000 409

ISB BOARD A17
B10850 3003 or 3660 alt

SIGNATURES	ED	DATE-NO.	SIGNATURES	ED	DATE-NO.
RU/REq	1	830919			
	2	831108			
RU/LEq	3	840813			

CONN. x 17	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a			GND	13/2ac, 14/2ac
2c			GND	13/2ac, 14/2ac
4a	X		DATA	12/4a, 13/4a, 14/4a, 18/4a, 19/4a, 21/4a, 23/4a
4c	X		CLOCK	12/4c, 13/4c, 14/4c, 18/4c, 19/4c, 21/4c, 23/4c
6a			STROBE 1	12/6c, 13/6ac, 14/6ac, 21/6c, 23/6c
6c			STROBE 1	12/6c, 13/6ac, 14/6ac, 21/6c, 23/6c
8a			STROBE 4	12/8a, 13/8a, 14/8a, 19/8a, 23/8a
8c	X		STROBE 3	12/8c, 13/8c, 14/8c, 18/8c
10a			STROBE 2	12/10c, 13/10ac, 14/10ac
10c			STROBE 2	12/10c, 13/10ac, 14/10ac
12a			Muting from Control Board	11/12a, 12/12a, 13/12a, 14/12a
12c			Interrupt to Control Board (reserve)	11/12c, 12/12c, 13/12c, 14/12c
14a	X		200 kHz	18/14a, 20/14a
14c			GND	See B10851 2110 3
16a			Aux measure	14/16a, 13/16a, 12/16c
16c		X	AF Channel A/B	3/12, 11/16c, 13/16c, 14/16c, 18/16c
18a			Aux	11/18a, 12/18a, 13/18a, 14/18a
18c			Aux	11/18c, 12/18c, 13/18c, 14/18c
20a			+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a		X	AF Channel B	11/22a, 13/22a, 14/22a
22c	X		Muting in	11/22c, 12/22c, 13/22c, 14/22c, 18/22c
24a	X		-18 V	See B10851 2110 3
24c	X		-18 V	See B10851 2110 3
26a		X	Channel B measure	12/26a, 13/26a, 14/26a
26c			GND	See B10851 2110 3
28a	X		+5 V/1	See B10851 2110 3
28c	X		+5 V/1	See B10851 2110 3
30a			AF Channel A	12/30a, 13/30a, 14/30a
30c	X	X	AGC	11/30c, 12/30c, 13/30c, 14/30c, 18/30c, 22/30c
32a	X	X	GND	See B10851 2110 3
32c	X	X	GND	See B10851 2110 3

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CONNECTION TABLE

ITT SRT

ISB BOARD A17
B10850 3003 or 3660 alt

B10851 2000 410

ED	DATE-NO.	SIGNATURES
1	830919	RU/RFn
2	840813	RU/LEq

CONN. A17	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO
X2	X		IF input	A22/X6 (from RF Unit)
X3		X	IF output Channel B	

CONNECTION TABLE

B10851 2000 411

SRT

IF/AF BOARD A18
B10350 3001 or 3460 alt.

SIGNATURES	DATE-NO.	SIGNATURES	DATE-NO.
RU/RFa	830919		
RU/LEq	840813		

CONN. x 18	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a			GND	See
2c			GND	See
4a	X		DATA	12/4a, 13/4a, 14/4a, 17/4a, 19/4a, 21/4a,23/4a
4c	X		CLOCK	12/4c, 13/4c, 14/4c, 17/4c, 19/4c, 21/4c,23/4c
6a			GND	See B10851 2110 3
6c			GND	See B10851 2110 3
8a			GND	See B10851 2110 3
8c	X		STROBE 3	12/8c, 13/8c, 14/8c, 17/8x
10a			GND	See B10851 2110 3
10c			GND	See B10851 2110 3
12a			GND	See B10851 2110 3
12c			GND	See B10851 2110 3
14a	X		200 kHz (TTL-level)	17/14a, 20/14a
14c			GND	See B10851 2110 3
16a			GND	See B10851 2110 3
16c		X	AF Channel A/B	3/12, 11/16c, 13/16c, 14/16c, 17/16c
18a			GND	See B10851 2110 3
18c			GND	See B10851 2110 3
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a			GND	See B10851 2110 3
22c	X		Muting in	11/22c, 12/22c, 13/22c, 14/22c, 17/22c
24a			-18 V	See B10851 2110 3
24c			-18 V	See B10851 2110 3
26a	X		Very narrow select	19/26a
26c		X	Channel A measure	12/26c
28a			+5 V/1	See B10851 2110 3
28c	X		+5 V/1	See B10851 2110 3
30a		X	AF Channel A	11/30a
30c	X	X	AGC	11/30c, 12/30c, 13/30c, 14/30c, 17/30c, 22/30c
32a			GND	See B10851 2110 3
32c			GND	See B10851 2110 3

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CONNECTION TABLE

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SRT

IF/AF BOARD A18
B10850 3001 or 3460 alt.

B10851 2000 412

	SIGNATURES	DATE-NO.
ED	RU/RFn1	1 830919
ED	RU/LEq	2 840813

CONN. A18	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO
X2	X		IF input	A19/X3 (from IF filter)
X3		X	IF output Channel A	

CONNECTION TABLE

B10851 2000 413

ITT SRT

IF FILTER A19
B10850 3470

SIGNATURES	ED DATE-NO.
RU/RFn1	1 830919
RU/LEq	2 840813

CONN. x 19	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a			GND	See B10851 2110 3
2c			GND	See B10851 2110 3
4a	X		$\overline{\text{DATA}}$	12/4a, 13/4a, 14/4a, 17/4a, 18/4a, 21/4a,23/4a
4c	X		CLOCK	12/4c, 13/4c, 14/4c, 17/4c, 18/4c, 21/4c,23/4c
6a			GND	See B10851 2110 3
6c			GND	See B10851 2110 3
8a	X		STROBE 4	12/8a, 13/8a, 14/8a, 17/8a, 23/8a
8c			GND	See B10851 2110 3
10a			GND	See B10851 2110 3
10c			GND	See B10851 2110 3
12a			GND	See B10851 2110 3
12c			GND	See B10851 2110 3
14a			GND	See B10851 2110 3
14c			GND	See B10851 2110 3
16a			GND	See B10851 2110 3
16c			GND	See B10851 2110 3
18a			GND	See B10851 2110 3
18c			GND	See B10851 2110 3
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a			GND	See B10851 2110 3
22c			GND	See B10851 2110 3
24a			-18 V	See B10851 2110 3
24c			-18 V	See B10821 2110 3
26a		X	Very narrow select	18/26a
26c			GND	See B10851 2110 3
28a	X		+5 V/1	See B10851 2110 3
28c	X		+5 V/1	See B10851 2110 3
30a			GND	See B10851 2110 3
30c			GND	See B10851 2110 3
32a			GND	See B10851 2110 3
32c			GND	See B10851 2110 3

CONNECTION TABLE

B10851 2000 414

SRT

IF FILTER A19
B10850 3470

SIGNATURES	ED	DATE-NO.
RU/RFm	1	830919

CONN. A19	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO
X2	X		IF input	A22/X5 (from RF Unit)
X3		X	IF output	A18/X2 (to IF/AF Board)

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CONNECTION TABLE

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REFERENCE BOARD A20
B10850 3480

B10851 2000 415

SIGNATURES	ED	DATE-NO.	SIGNATURES	ED	DATE-NO.
RU/REn	1	830919			
RU/LEq	2	840813			

CONN. x 20	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a		X	GND (1 MHz return)	21/2c
2c		X	1 MHz Reference output	21/2a
4a			GND	See B10851 2110 3
4c			GND	See B10851 2110 3
6a			GND	See B10851 2110 3
6c			GND	See B10851 2110 3
8a			GND	See B10851 2110 3
8c			GND	See B10851 2110 3
10a			GND	See B10851 2110 3
10c			GND	See B10851 2110 3
12a			GND	See B10851 2110 3
12c			GND	See B10851 2110 3
14a		X	200 kHz TTL-level	17/14a, 18/14a
14c			GND	See B10851 2110 3
16a		X	Sync. alarm	11/14c, 12/14c, 21/16a
16c			GND	See B10851 2110 3
18a			GND	See B10851 2110 3
18c			GND	See B10851 2110 3
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a			GND	See B10851 2110 3
22c			GND	See B10851 2110 3
24a	X		-18 V	See B10851 2110 3
24c	X		-18 V	See B10851 2110 3
26a			GND	See B10851 2110 3
26c		X	Test point VCO	
28a	X		+5 V/1	See B10851 2110 3
28c	X		+5 V/1	See B10851 2110 3
30a			GND	See B10851 2110 3
30c			GND	See B10851 2110 3
32a			GND	See B10851 2110 3
32c			GND	See B10851 2110 3

CONNECTION TABLE

B10851 2000 416

ITT SRT

REFERENCE BOARD A20
B10850 3480

	SIGNATURES	DATE-NO.
ED	RU/RFn	1
ED		830919

CONN. A20	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO
X2	X		5 MHz REF input, 100-200 mV/50 ohm	
X3		X	5 MHz REF output, 200 mV/50 ohm	
X4		X	5 MHz Output > 150 mV RMS/High Z load	Not used in CR91
X5		X	125 MHz Output 400 mV/50 ohm	A22/X2 (to RF Unit)

820228

CONNECTION TABLE

B10851 2000 417

LTT

SRT

SYNTHESIZER A21
B10850 3490

SIGNATURES	DATE-NO.
RU/RFm	1 830919
RU/LEq	2 840813

CONN. x 21	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a	X		1 MHz Reference	20/2c
2c	X		GND (1 MHz return)	20/2a
4a	X		$\overline{\text{DATA}}$	12/4a, 13/4a, 14/4a, 17/4a, 18/4a, 19/4a, 23/4a
4c	X		CLOCK	12/4c, 13/4c, 14/4c, 17/4c, 18/4c, 19/4c, 23/4c
6a			GND	See B10851 2110 3
6c	X		STROBE 1	12/6c, 13/6ac, 14/6ac, 17/6ac, 21/6c, 23/6c
8a			GND	See B10851 2110 3
8c			GND	See B10851 2110 3
10a			GND	See B10851 2110 3
10c			GND	See B10851 2110 3
12a			GND	See B10851 2110 3
12c		X	Test point register out	
14a			GND	See B10851 2110 3
14c			GND	See B10851 2110 3
16a		X	Sync. alarm	11/14c, 12/14c, 20/16a
16c			GND	See B10851 2110 3
18a			GND	See B10851 2110 3
18c			GND	See B10851 2110 3
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a			GND	See B10851 2110 3
22c			GND	See B10851 2110 3
24a	X		-18 V	See B10851 2110 3
24c	X		-18 V	See B10851 2110 3
26a			GND	See B10851 2110 3
26c			GND	See B10851 2110 3
28a			+5 V/1	See B10851 2110 3
28c			+5 V/1	See B10851 2110 3
30a			GND	See B10851 2110 3
30c			GND	See B10851 2110 3
32a			GND	See B10851 2110 3
32c			GND	See B10851 2110 3

CONNECTION TABLE

ITT SRT

SYNTHESIZER A21
B10850 3490

B10851 2000 418

	SIGNATURES	DATE-NO.	ED
	RW/RFn	830919	1

CONN. A21	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO
X2		X	125.2-155.2 MHz, 400 mV/50 ohm	A22/X3 (to RF Unit)
X3		X	125.2-155.2 MHz, 400 mV/50 ohm	Not used in CR91

CONNECTION TABLE

LTT

SRT

RF UNIT A22
B10850 3510

B10851 2000 419

SIGNATURES	DATE-NO.
RU/REn1	1 830919
RU/LEq	2 840813

CONN. x 22	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a			GND	See B10851 2110 3
2c			GND	See B10851 2110 3
4a			GND	See B10851 2110 3
4c			GND	See B10851 2110 3
6a			GND	See B10851 2110 3
6c			GND	See B10851 2110 3
8a			GND	See B10851 2110 3
8c			GND	See B10851 2110 3
10a			GND	See B10851 2110 3
10c			GND	See B10851 2110 3
12a			GND	See B10851 2110 3
12c			GND	See B10851 2110 3
14a			GND	See B10851 2110 3
14c			GND	See B10851 2110 3
16a			GND	See B10851 2110 3
16c			GND	See B10851 2110 3
18a			GND	See B10851 2110 3
18c			GND	See B10851 2110 3
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a			GND	See B10851 2110 3
22c			GND	See B10851 2110 3
24a	X		-18 V	See B10851 2110 3
24c	X		-18 V	See B10851 2110 3
26a			GND	See B10851 2110 3
26c			GND	See B10851 2110 3
28a	X		+5 V/1	See B10851 2110 3
28c	X		+5 V/1	See B10851 2110 3
30a			GND	See B10851 2110 3
30c			AGC	11/30c, 12/30c, 13/30c, 14/30c, 17/30c, 18/30c, 22/30c
32a	X	X	GND	See B10851 2110 3
32c	X	X	GND	See B10851 2110 3

CONNECTION TABLE

ITT

SRT

RF UNIT A22
B10850 3510

B10851 20C0 420

	SIGNATURES	DATE-NO.
ED	RU/KFn	1
SIGNATURES		
ED	DATE-NO.	830919
SIGNATURES		

CONN. A22	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO
X2	X		125 MHz input, 400 mV/50 ohm	A20/X5 (from Reference Board)
X3	X		125.2-155.2 MHz input, 400 mV/50 ohm	A21/X2 (from Synthesizer)
X4	X		RF input	A23/X2 (from Input Filters)
X5		X	IF output	A19/X2 (to IF Filter)
X6		X	IF output	A17/X2 (to ISB Board)
X7		X	IF output	Panoramic Unit, i.e. PAN 300

822018

CONNECTION TABLE

LTT

SRT

B10851 2000 421

INPUT FILTERS A23
B10850 3520

SIGNATURES	ED. DATE-NO.
RU/REg	1 830919
	2 831108
RU/LEg	3 840813

CONN. x 23	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO X
2a			GND	See B10851 2110 3
2c			GND	See B10851 2110 3
4a	X		$\overline{\text{DATA}}$	12/4a, 13/4a, 14/4a, 17/4a, 18/4a, 19/4a, 21/4a, (23/4a)
4c	X		CLOCK	12/4c, 13/4c, 14/4c, 17/4c, 18/4c, 19/4c, 21/4c, (23/4c)
6a			GND	See B10851 2110 3
6c	X		STROBE 1	12/6c, 13/6ac, 14/6ac, 17/6ac, 21/6c
8a	X		STROBE 4	12/8a, 13/8a, 14/8a, 17/8a, 19/8a
8c			GND	See B10851 2110 3
10a			GND	See B10851 2110 3
10c			GND	See B10851 2110 3
12a			GND	See B10851 2110 3
12c			GND	See B10851 2110 3
14a			GND	See B10851 2110 3
14c			GND	See B10851 2110 3
16a			GND	See B10851 2110 3
16c			GND	See B10851 2110 3
18a			GND	See B10851 2110 3
18c			GND	See B10851 2110 3
20a	X		+18 V	See B10851 2110 3
20c	X		+18 V	See B10851 2110 3
22a			GND	See B10851 2110 3
22c			GND	See B10851 2110 3
24a	X		-18 V	See B10851 2110 3
24c	X		-18 V	See B10851 2110 3
26a			GND	See B10851 2110 3
26c			GND	See B10851 2110 3
28a	X		+5 V/1	See B10851 2110 3
28c	X		+5 V/	See B10851 2110 3
30a			GND	See B10851 2110 3
30c			GND	See B10851 2110 3
32a			GND	See B10851 2110 3
32c			GND	See B10851 2110 3

CONNECTION TABLE

ITT

SRT

	SIGNATURES	DATE-NO.
ED	RJ/RFn	1
		830919

B10851 2000 422

INPUT FILTERS A23
B10850 3520

CONN.	SIGNAL IN	SIGNAL OUT	FUNCTION	CONNECTED TO
X2		X	RF output	A22/X4 (to RF Unit)
X3		X	50 ohm dummy load	The dummy is located on the frame
X4	X		Antenna input	

8. SPARE PARTS

Component lay-outs

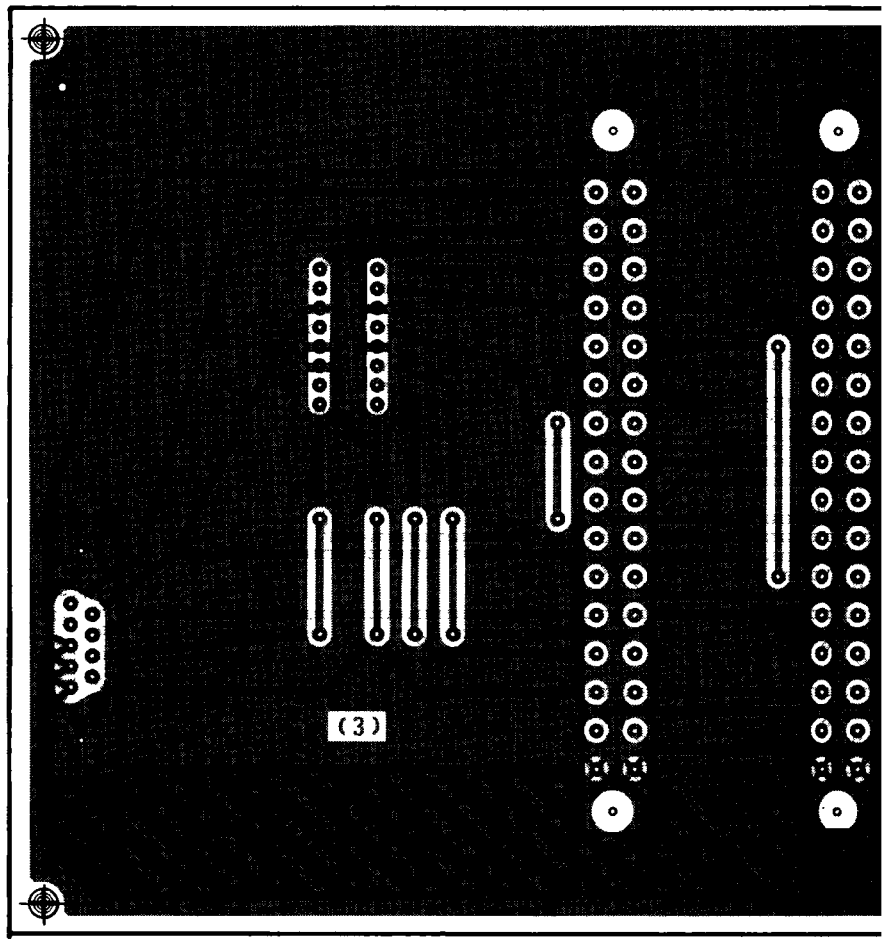
Mother Board	B10851	1110	8
Panel Board 1		1122	8
Panel Board 2		1123	8
PCB to Control Unit		1111	4
Connection Board		1141	4
Control Board		1143	4
IF/AF Board	B10850	1170	4
IF Filter		1147	4
Reference Board		1148	4
Crystal Oscillator (belongs to Ref Board)		1185	4
PCB to Crystal Oscillator		1186	4
Synthesizer		1149	4
VCO Board (belongs to Synthesizer)		1195	4
RF Unit		1151	4
Input Filters		1152	4
ISB Board		1171	4

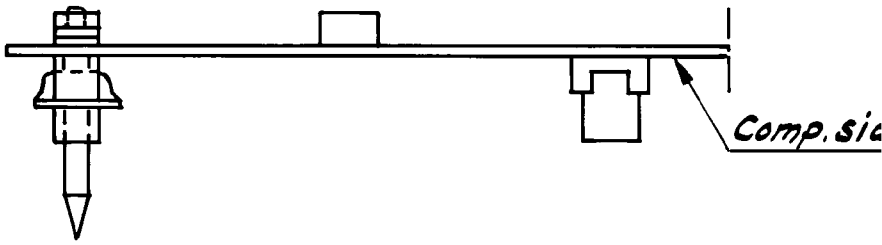
Component lists

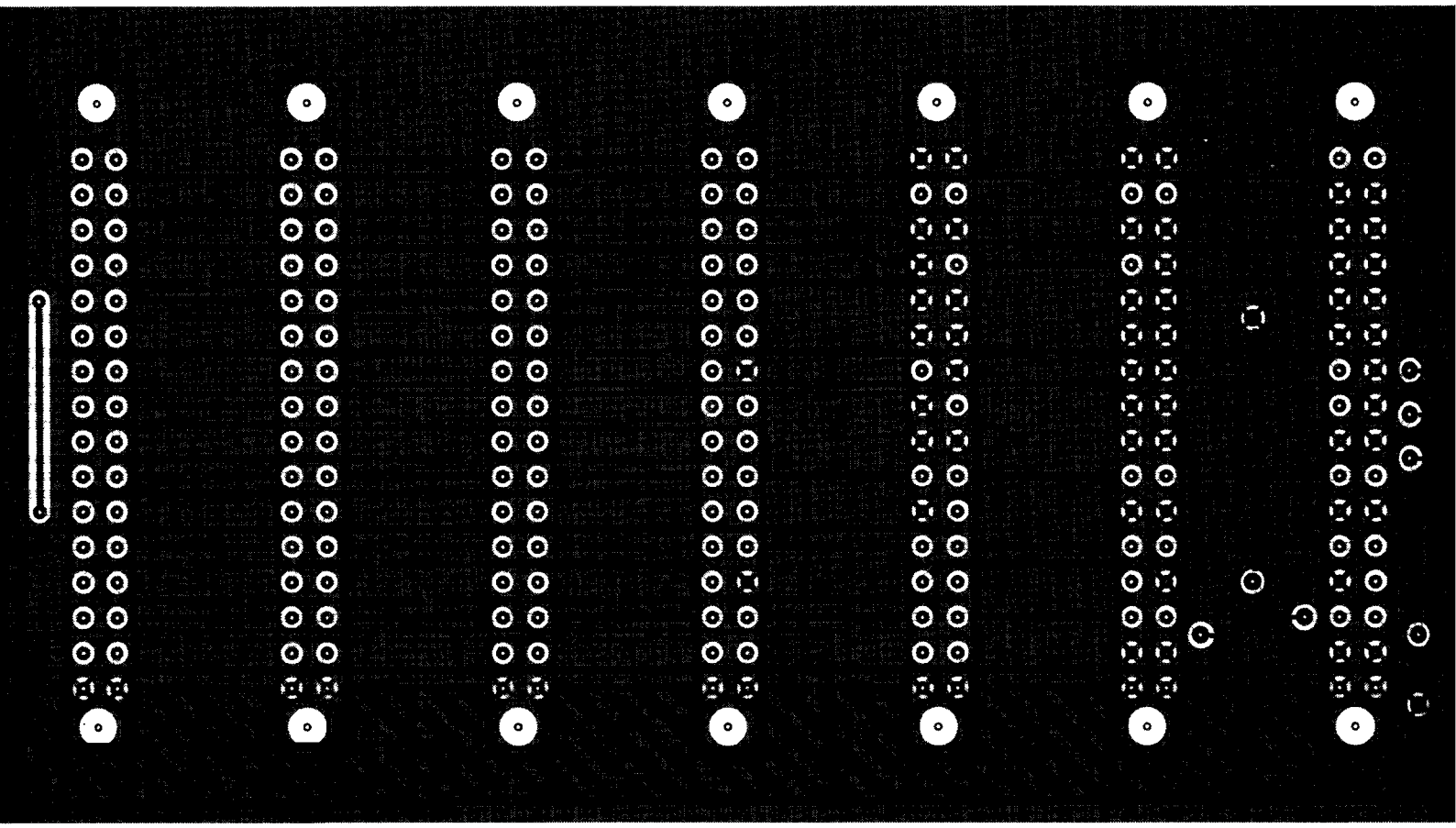
Instructions for ordering of spare parts

Receiver CR91(see chapter 7, B10851 2000 401-may vary due to variant)

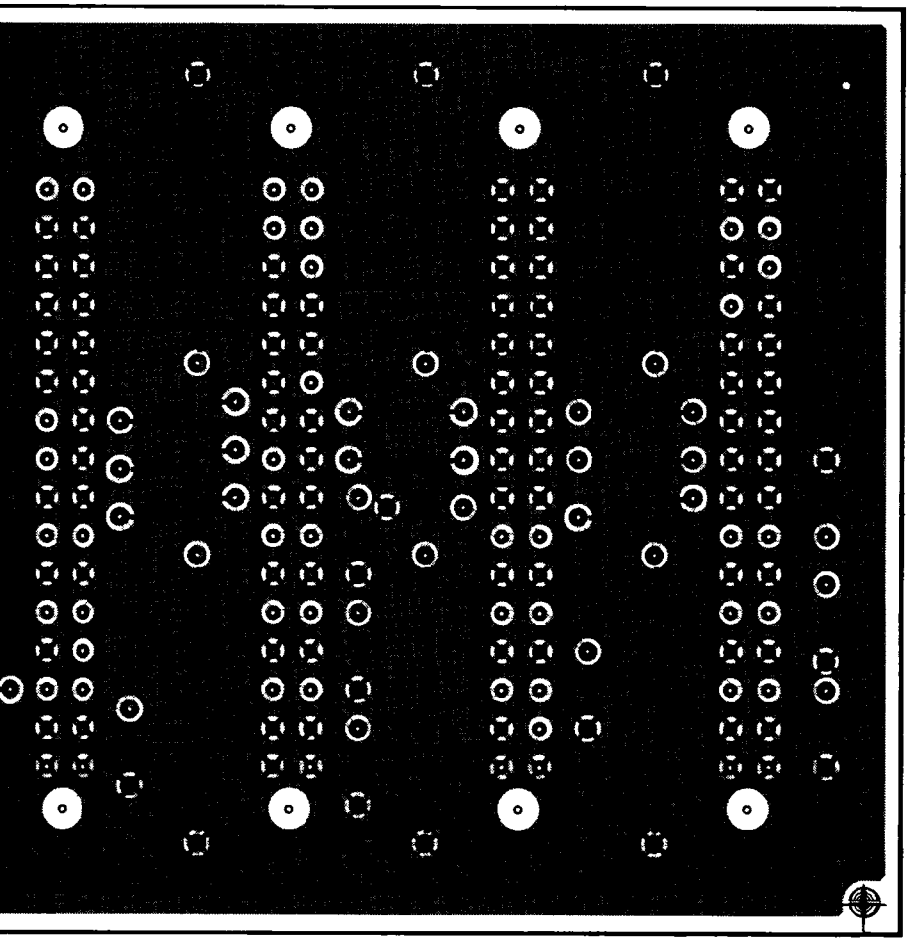
Control Unit	B10851	2050	01
PCB to Control Unit		2010	01
Mother Board		2110	01-02
Panel Assy		2200	01
Panel Board 1		2220	01-04
Panel Board 2		2230	01-04
Power Supply		2301	01
Connection Board		2410	01-03
Control Board		2430	01-02
IF/AF Board	B10850	2001	01-08
IF Filter (BW VERY NARROW = 0.3 kHz)		2470	01-02
IF Filter (without LSB)		2475	01-02
Reference Board		2480	01-04
Crystal Oscillator (belongs to Ref Board)		2485	01-03
Synthesizer		2490	01-03
VCO Board (belongs to Synthesizer)		2495	01
RF Unit		2510	01-04
Input Filters		2520	01-04
ISB Board		2003	01-06





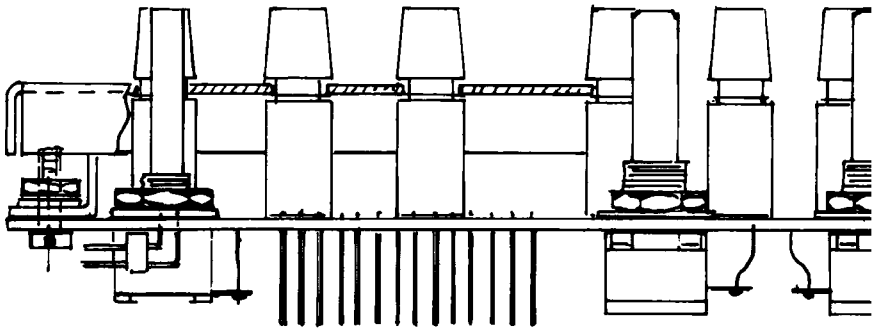


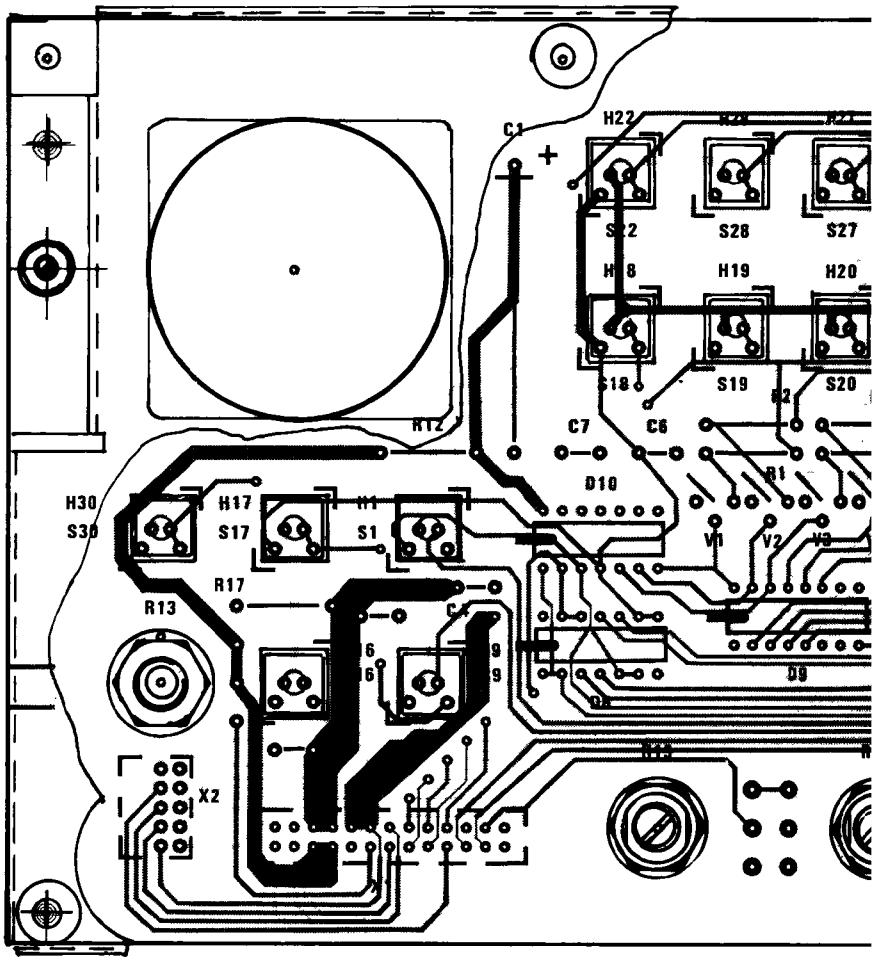
Comp. side

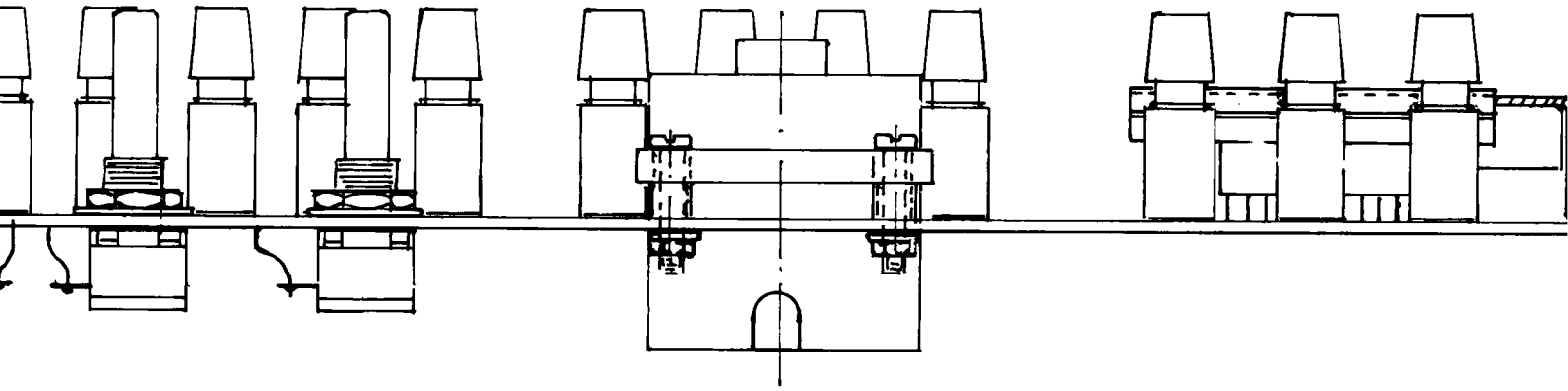


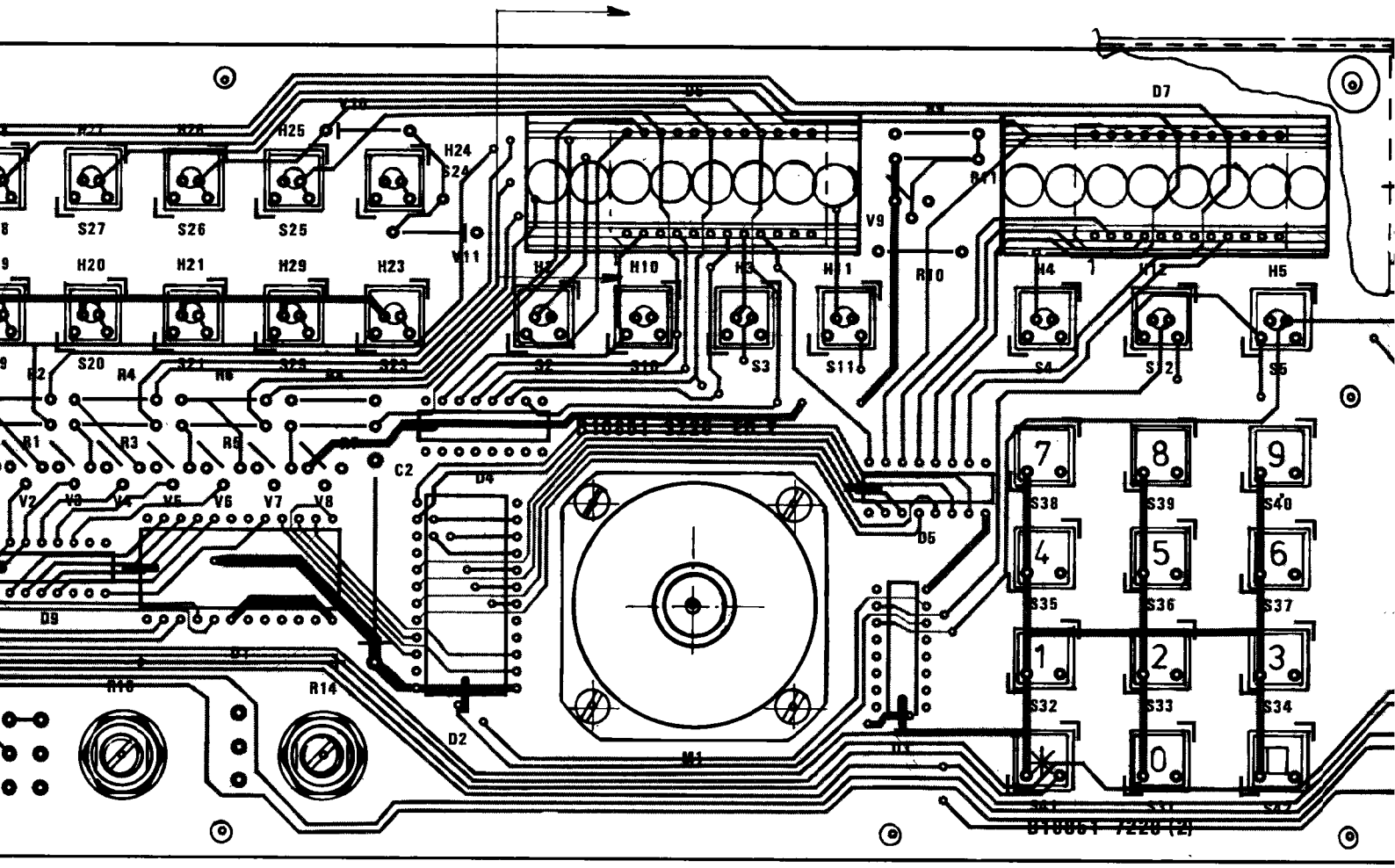
ED.	DATE - NO.		
	SIGNATURES		
ED.	DATE - NO.	1	830815
	SIGNATURES		

ITT	Carte mère	SRT	Mother Board
			B10851 1110 8

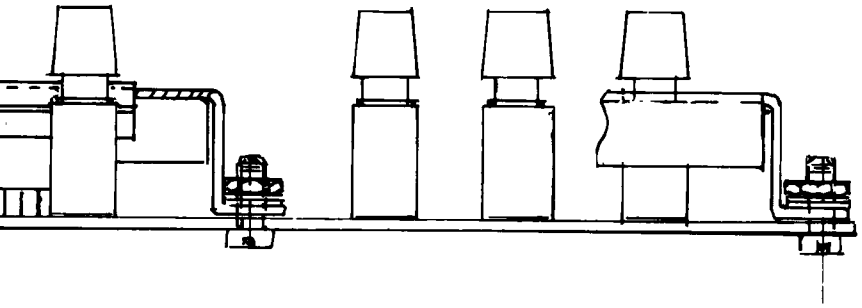


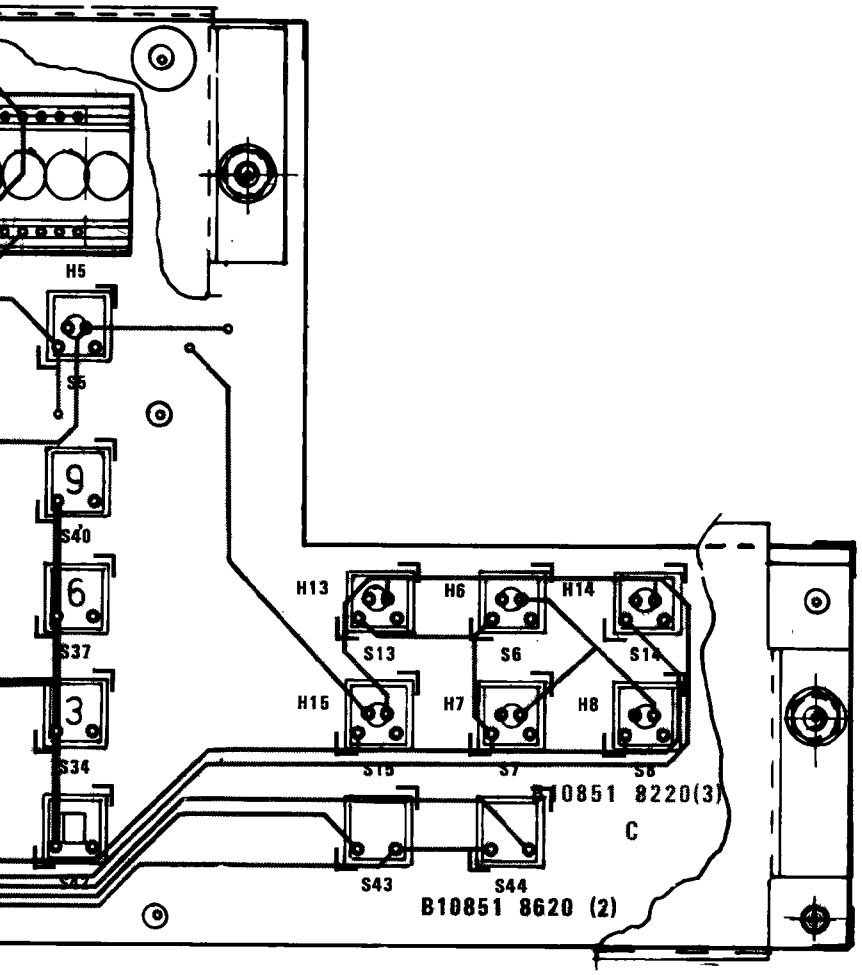

C1
+
H22
S22
S28
S27
H18
H19
H20
S18
S19
S20
C7
C6
D10
H30
S30
H17
S17
S1
V1
V2
R17
R13
X2




D7
H25
H24
S24
S27
S26
S25
V11
H20
H21
H29
H23
S20
R4
R1
R3
V2
V3
V4
V5
V6
V7
V8
C2
D4
D9
R10
R14
D2
V9
R10
H4
H5
S3
S11
S4
S12
S5
S38
S39
S40
S35
S36
S37
S32
S33
S34
7
8
9
4
5
6
1
2
3
0

8	9	10	11





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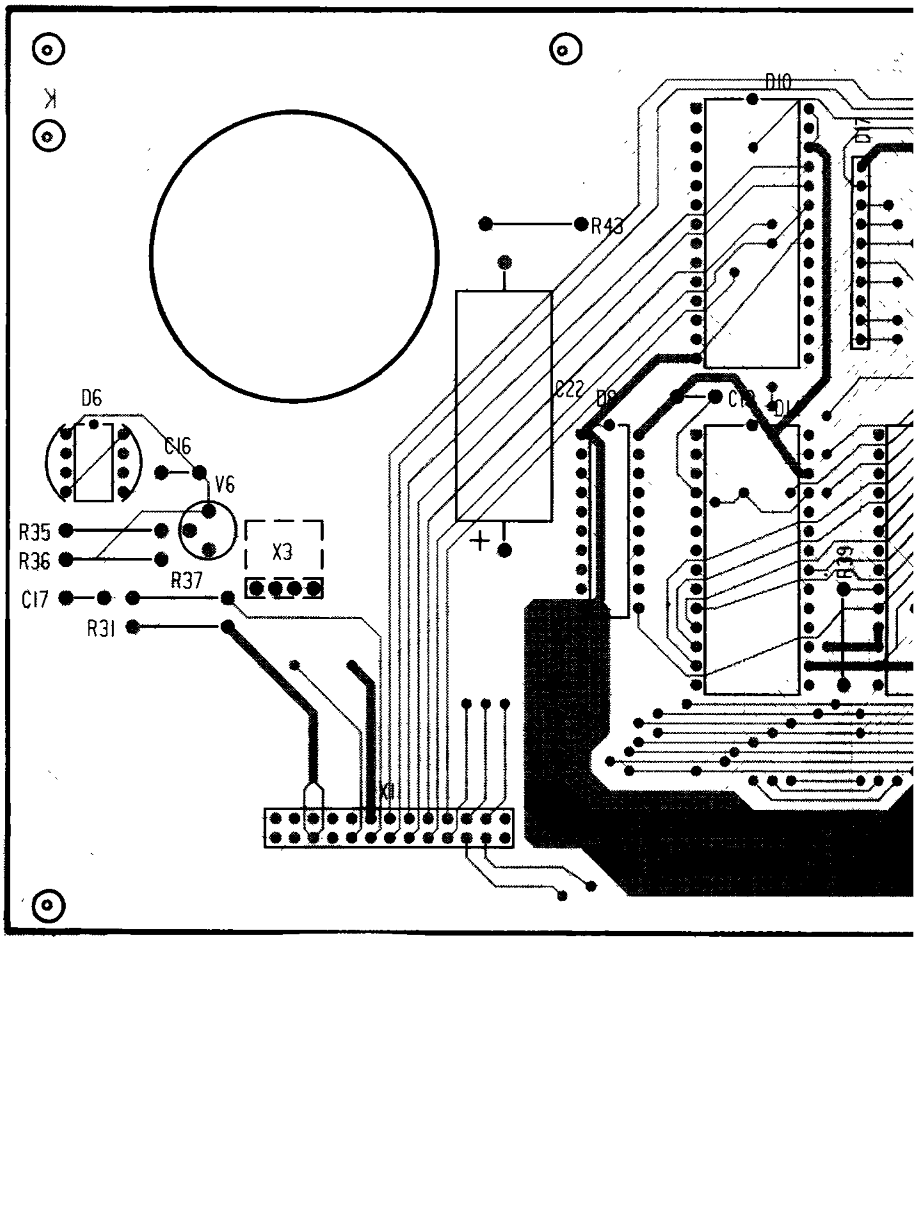
SIGNATURES								
ED	DATE–NO.	1	830815	2	841011			
SIGNATURES		SHG		Bol SHg				

ITT	CARTE DU PANNEU 1	SRT	PANEL BOARD 1
			B10851 1122 8

1	2	3	4

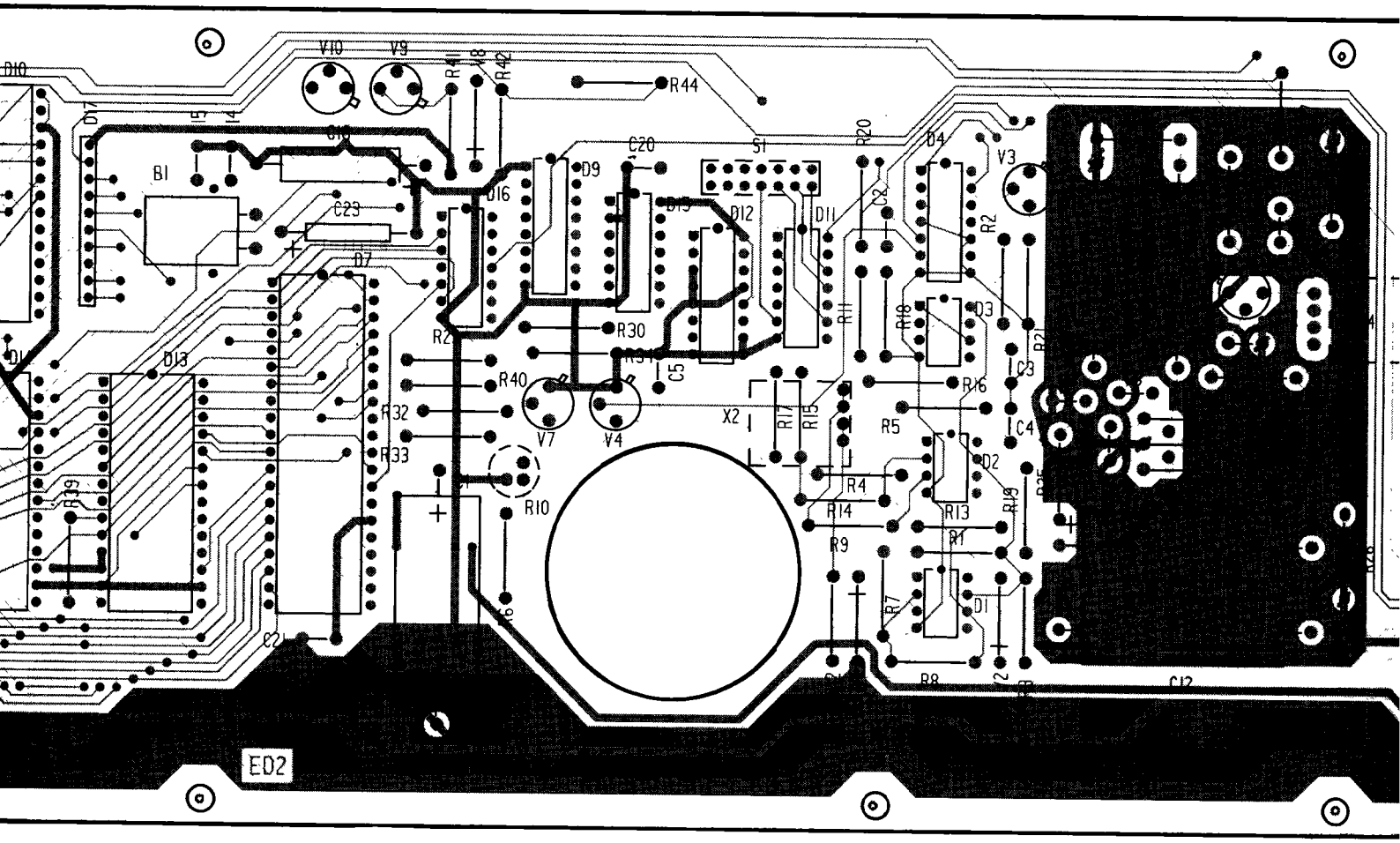


1	2	3	4

150 mm

Form 001 ITT 01401 DA (70.02)

A2A


V10
V9
R41
R42
R44
D10
D17
B1
C23
D7
D16
D9
C20
S1
D12
D11
R20
D4
V3
R2
D3
R18
R11
R30
R31
C5
R40
V7
V4
X2
R17
R15
R5
C3
C4
R16
D2
R4
R14
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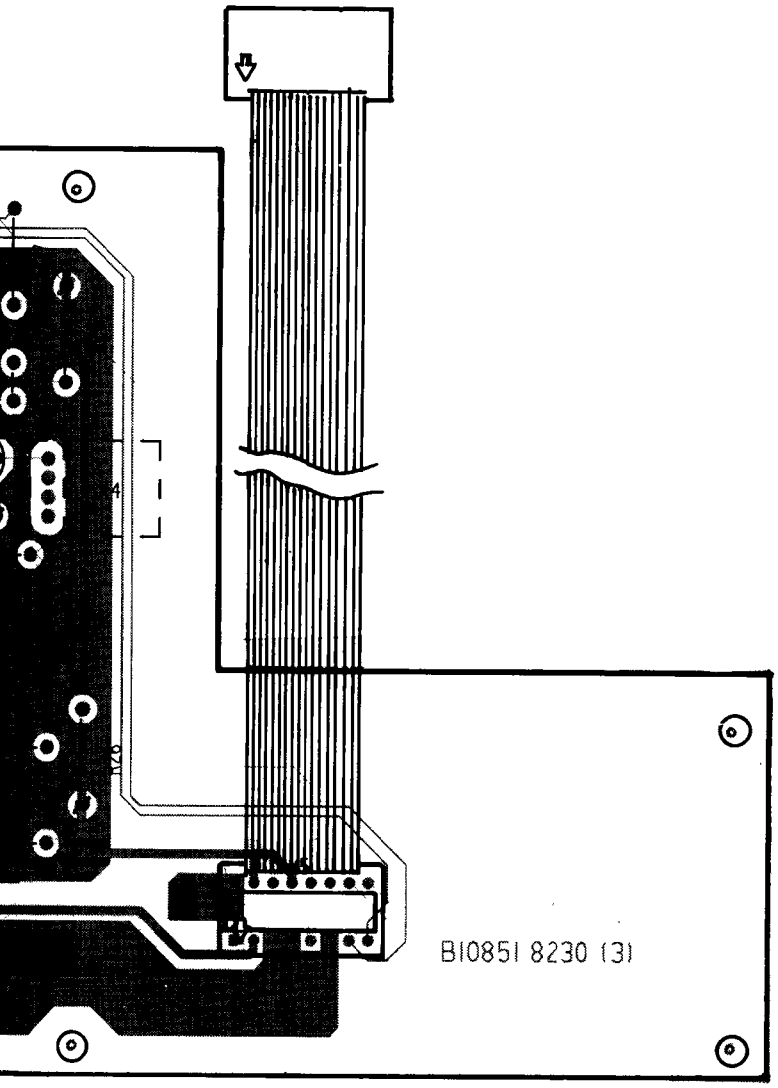
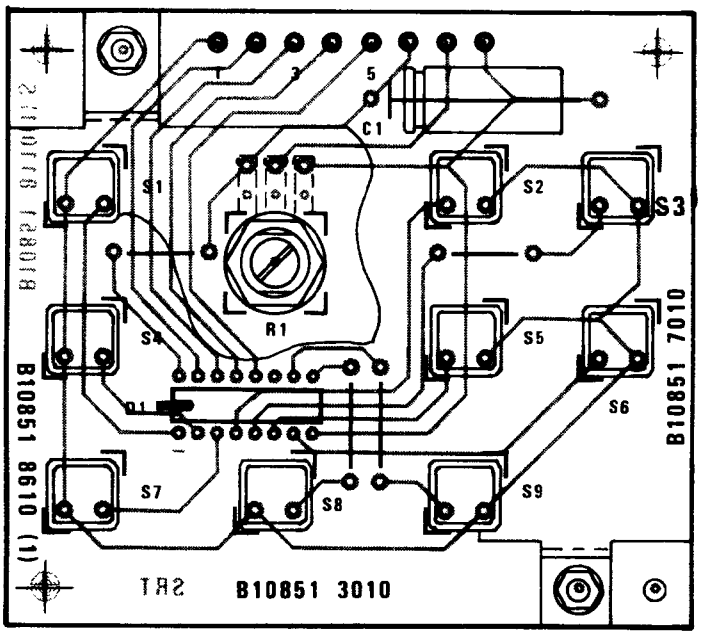
R33
R10
R6
R39
D13
C21
ED2



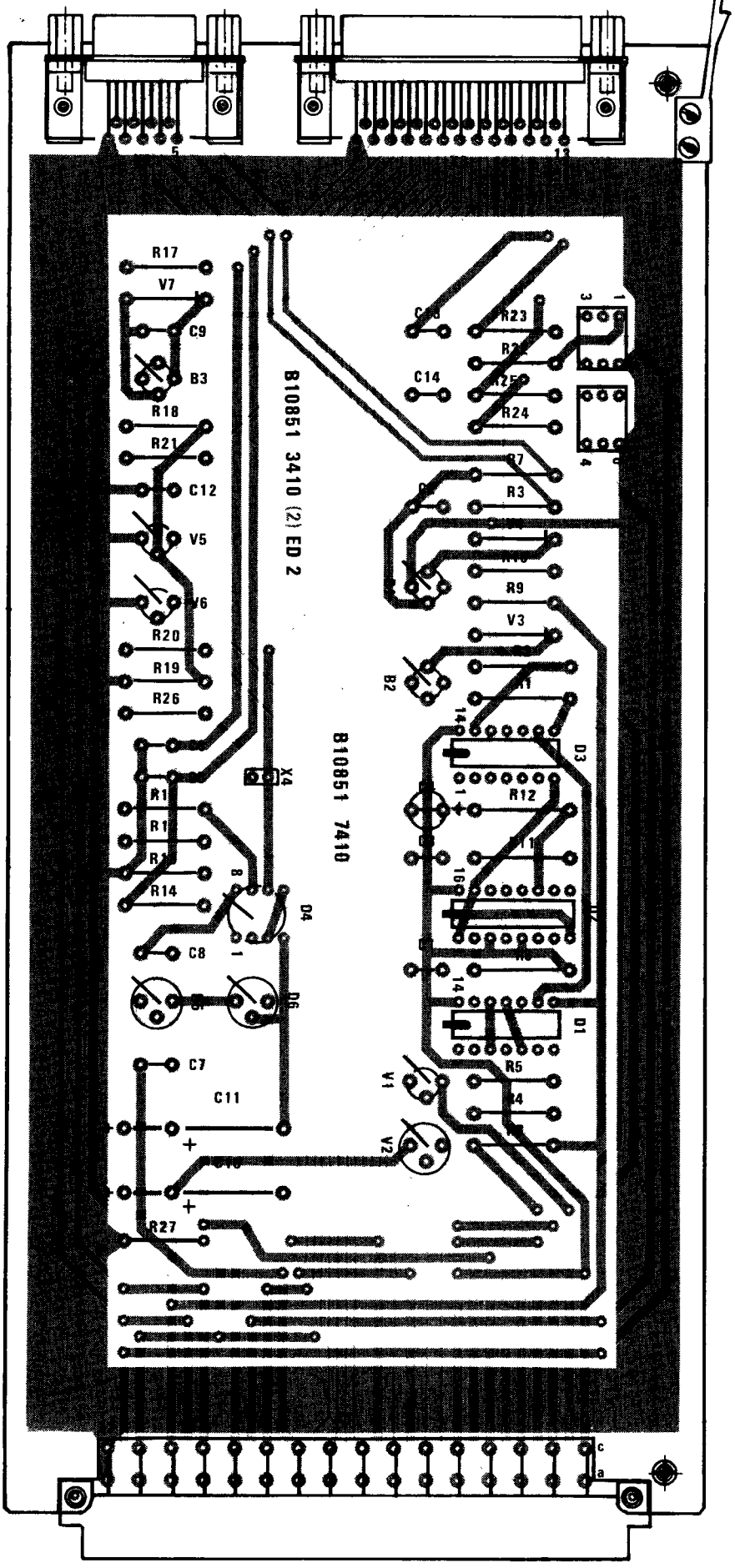
ED.	DATE - NO.							
	SIGNATURES							
ED.	DATE - NO.	1	830815		2	841011		
	SIGNATURES	SRG		Bol				

ITT	CARTE DE PANNEU 2	SRT	PANEL BOARD 2
			B10851 1123 B



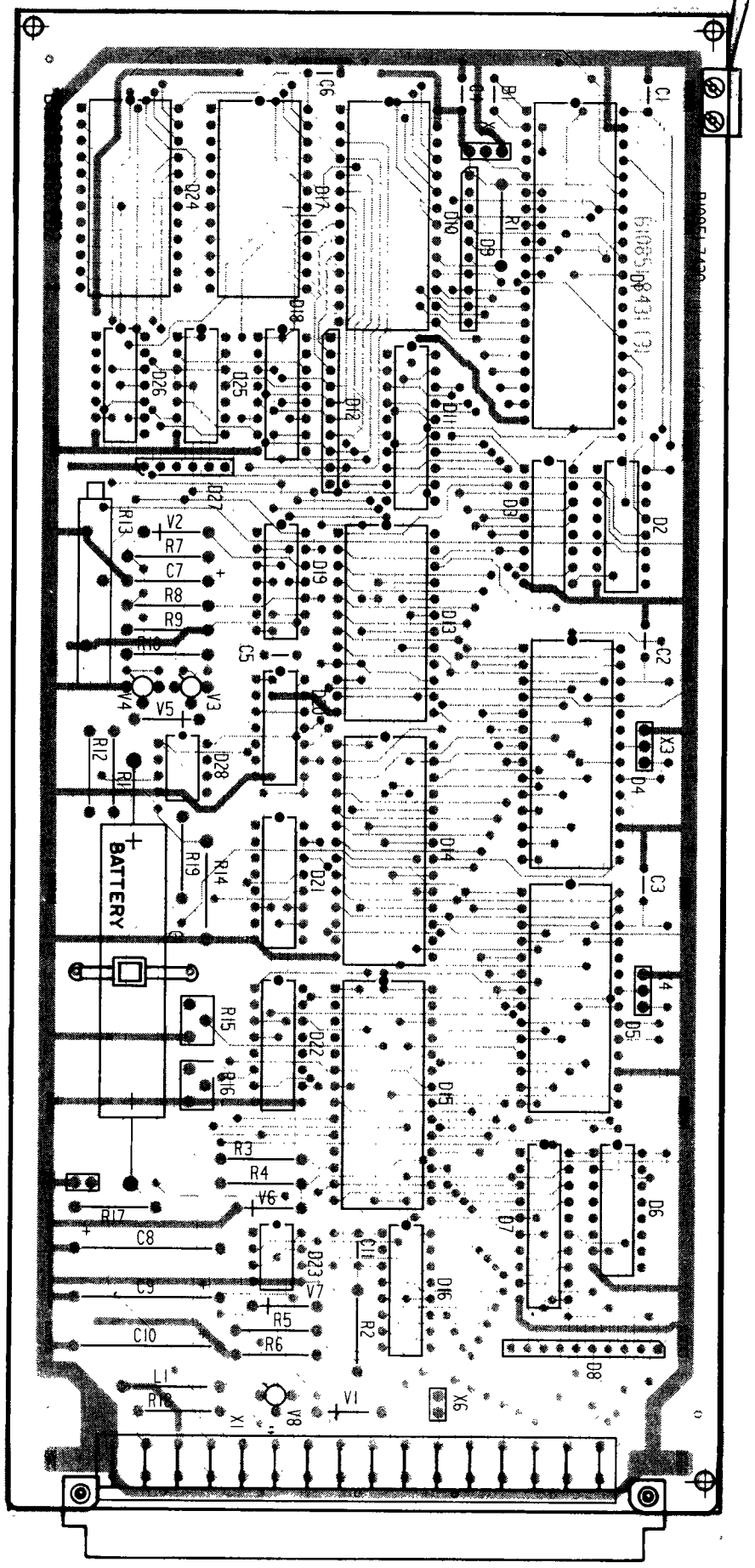
1 830906

ITT	CARTE UNITÉ DE COMMANDE	SRT	PCB CONTROL UNIT
			B10851 1111 4



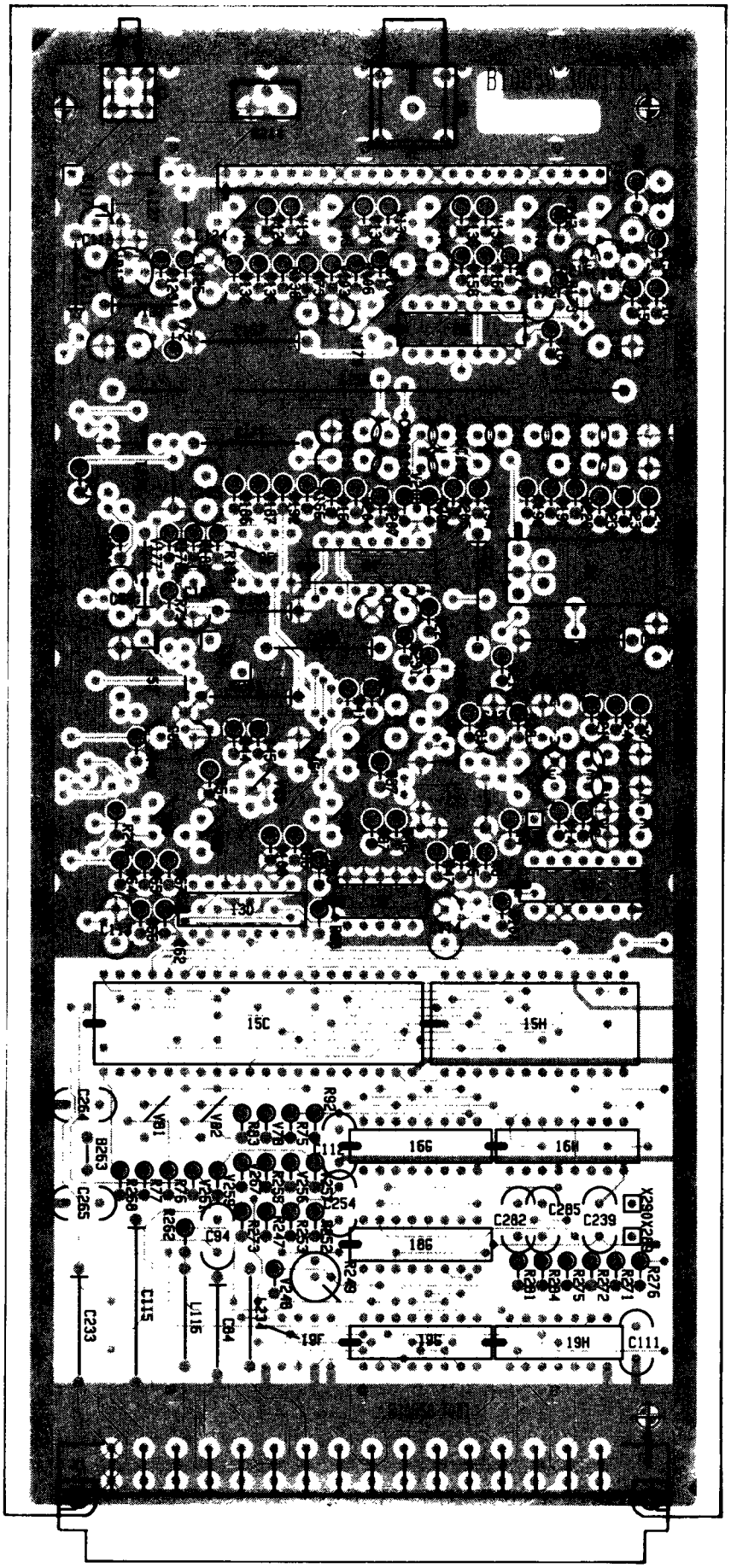
1	830815	2	841011	3		4	

ITT	CARTE DE CONNEXION	SRT	CONNECTION BOARD
			B10851 1141 4



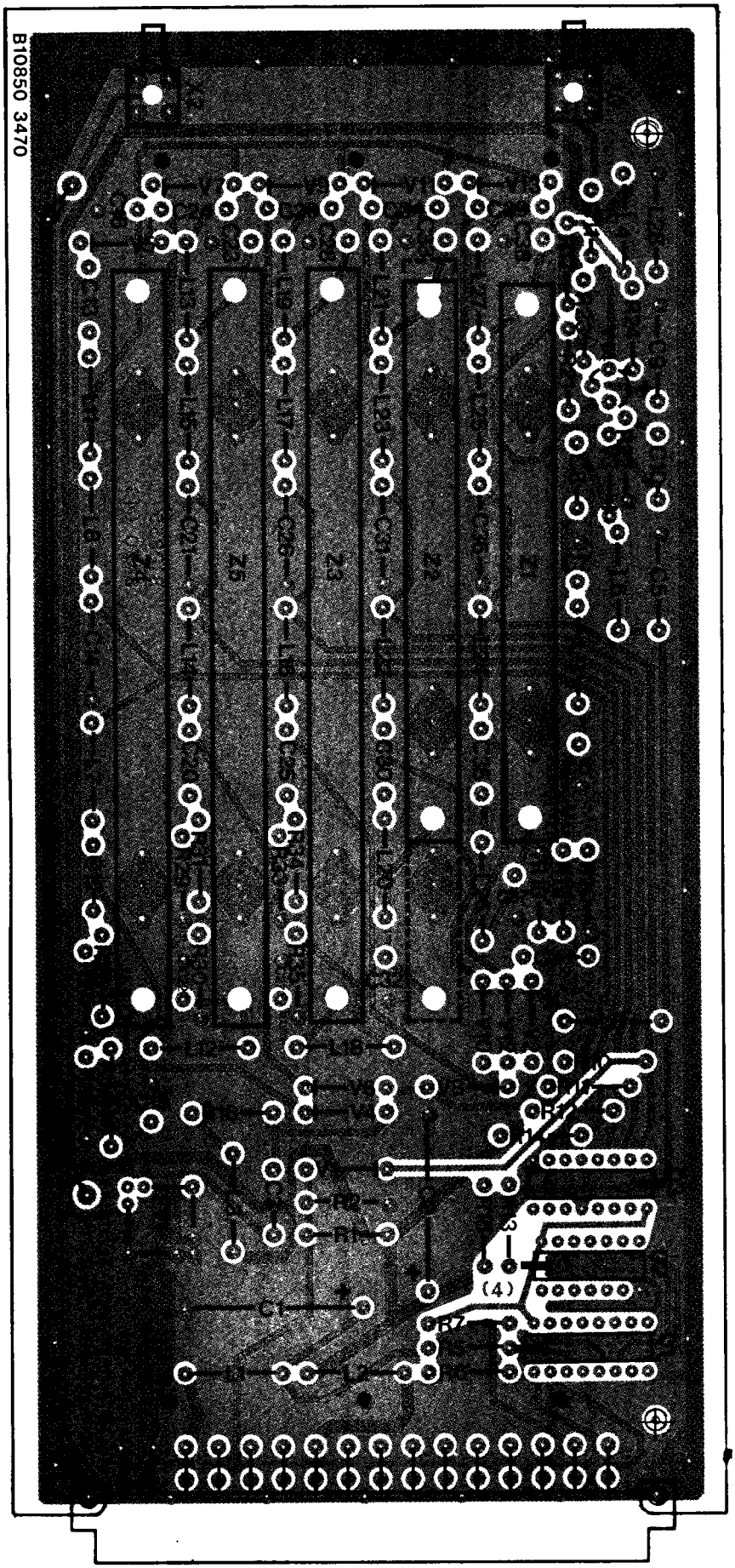
Rev.	1	2	3	4
	830815	841011		

ITT	CARTE DE COMMANDE	SRT	CONTROL BOARD
			B10851 1143 4



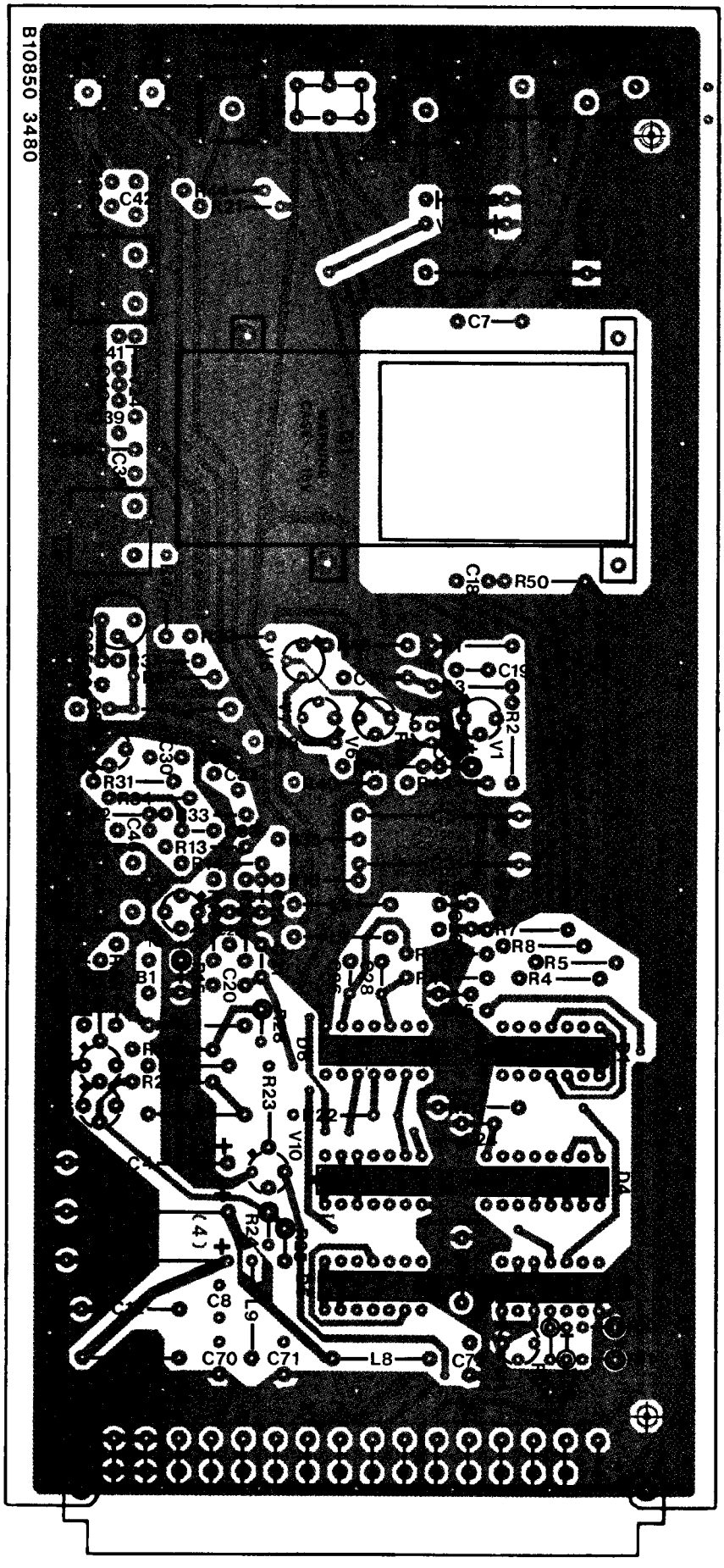
ITT	CR90/91 Carte FI/BF	SRT	CR90/91 IF-AF Board
			B10850 1170 4

1 840622 2 841003 3



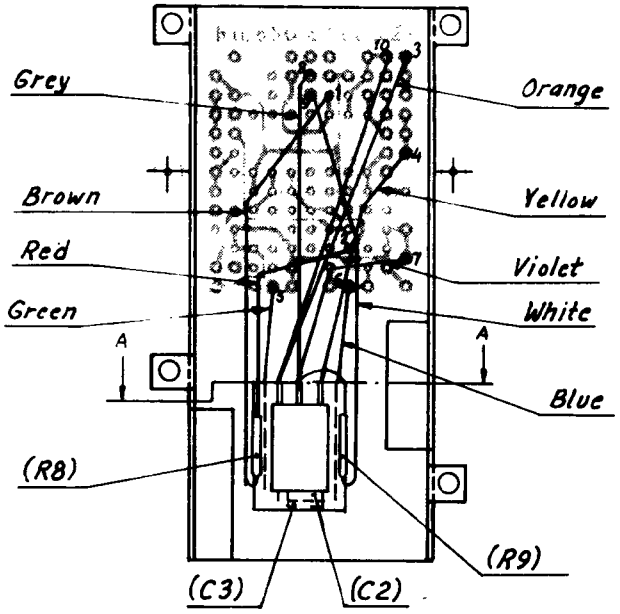
ITT	CR90 Filtre FI	SRT	CR90 IF FILTER
			B10850 1147 4

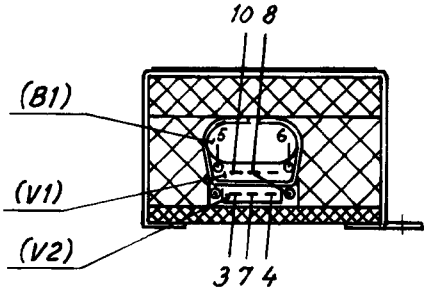
1 | 810108 | 2 | 3



ITT	CR90 Carte de référence	SRT	CR90 Reference Board
			B10850 1148 4

1 B10108 2 3





A-A

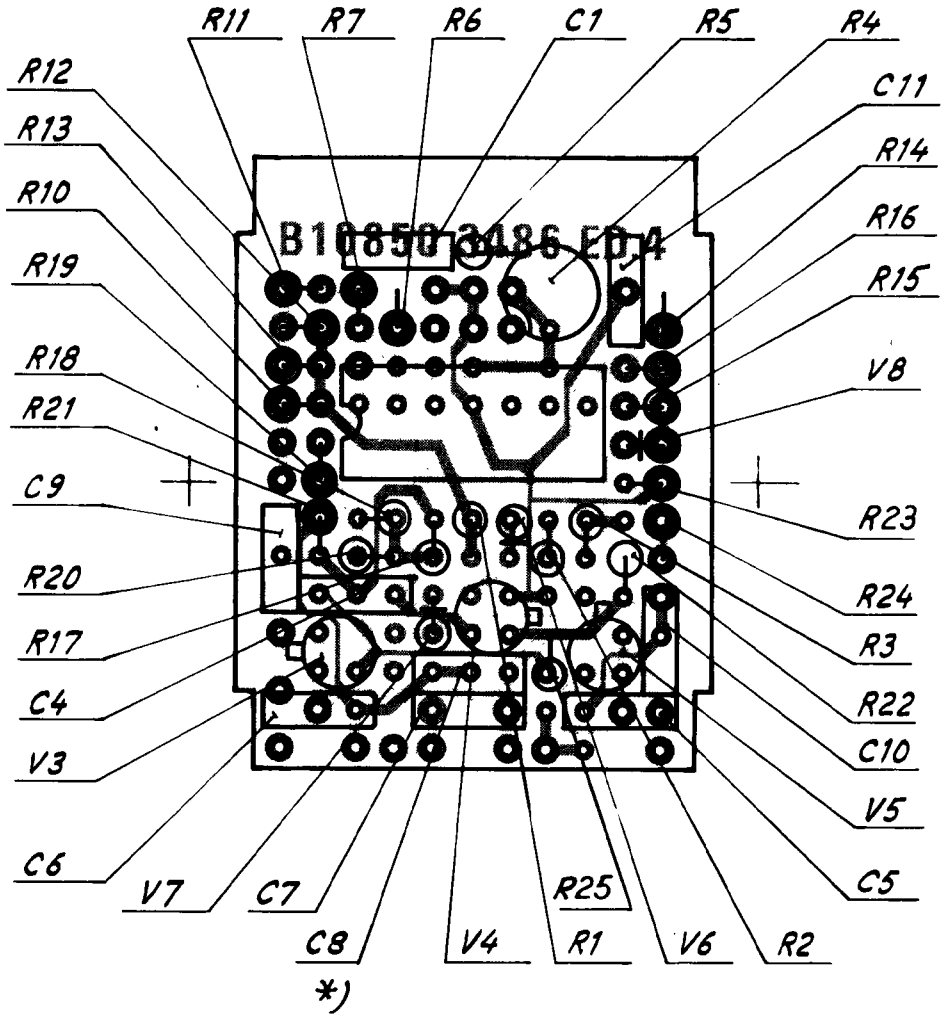
ED	DATE - NO						
SIGNATURES							
ED	DATE - NO	1	810108	2	841011		
SIGNATURES		SK		BoL			

ITT

SRT

CR90
Crystal Oscillator

B10850 1185 4



*) C8 not mounted

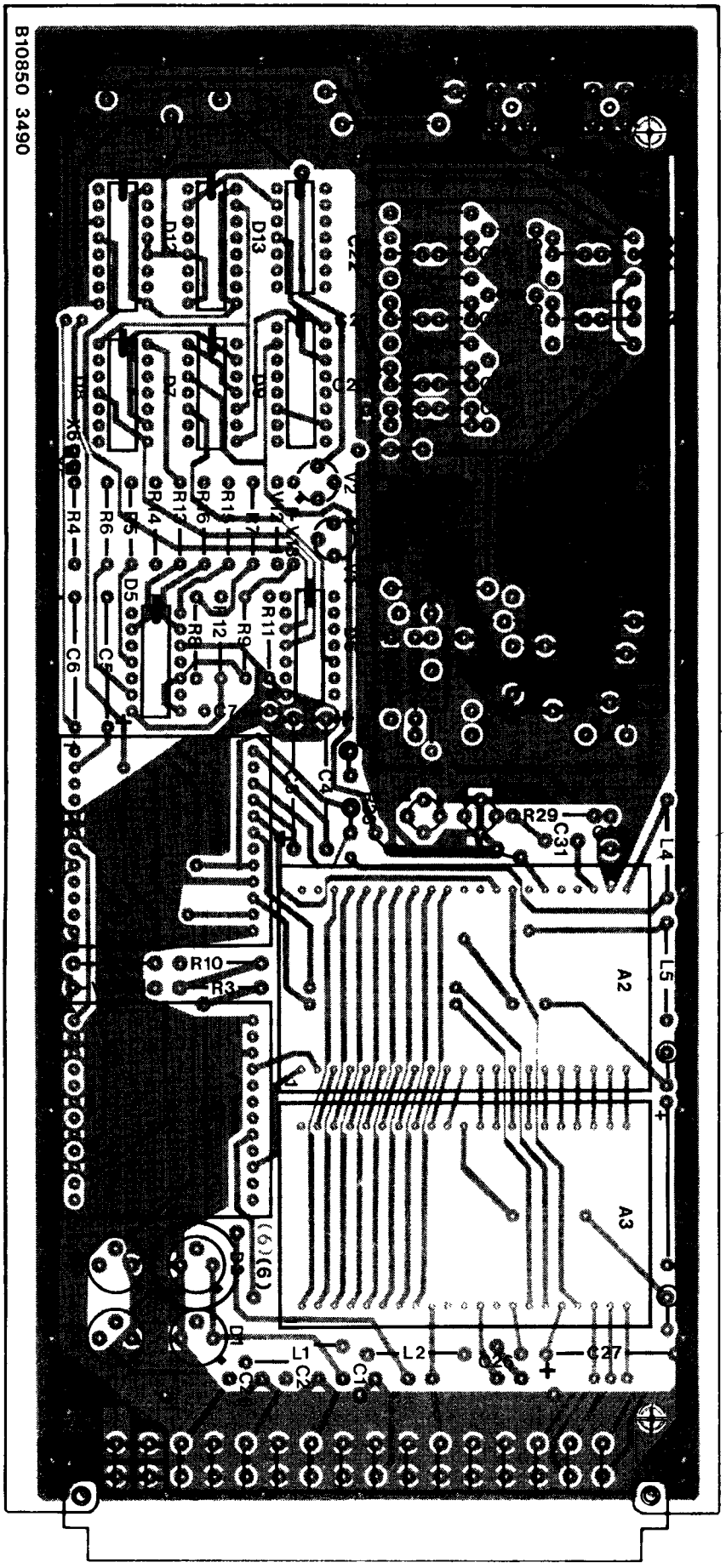
ED	DATE-NO.									
SIGNATURES										
ED	DATE-NO	1	810108		2	840607		3	841011	
SIGNATURES		SBK			LBg/MFn			Bol	SBK	

ITT CR90
PCB pour osc. à cristal

SRT CR90
PCB to Crystal oscillator

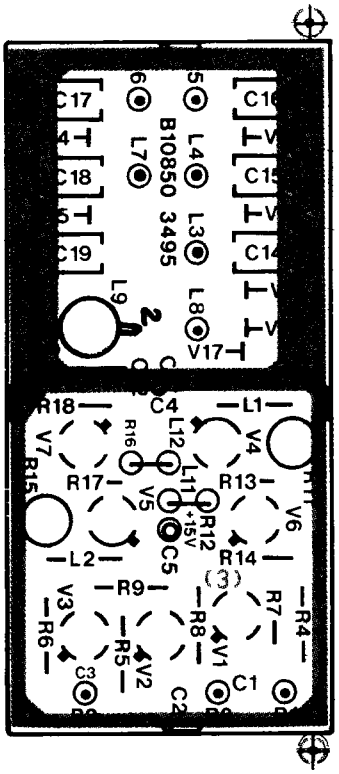
B10850 1186 4

A4 B10850 01111 01401 AA (73 11) SRT



1	B10108			
2	B30921			
3	B41011			

ITT	CR90 Synthétiseur	SRT	CR90 Synthesizer
		B10850 1149 4	1/2



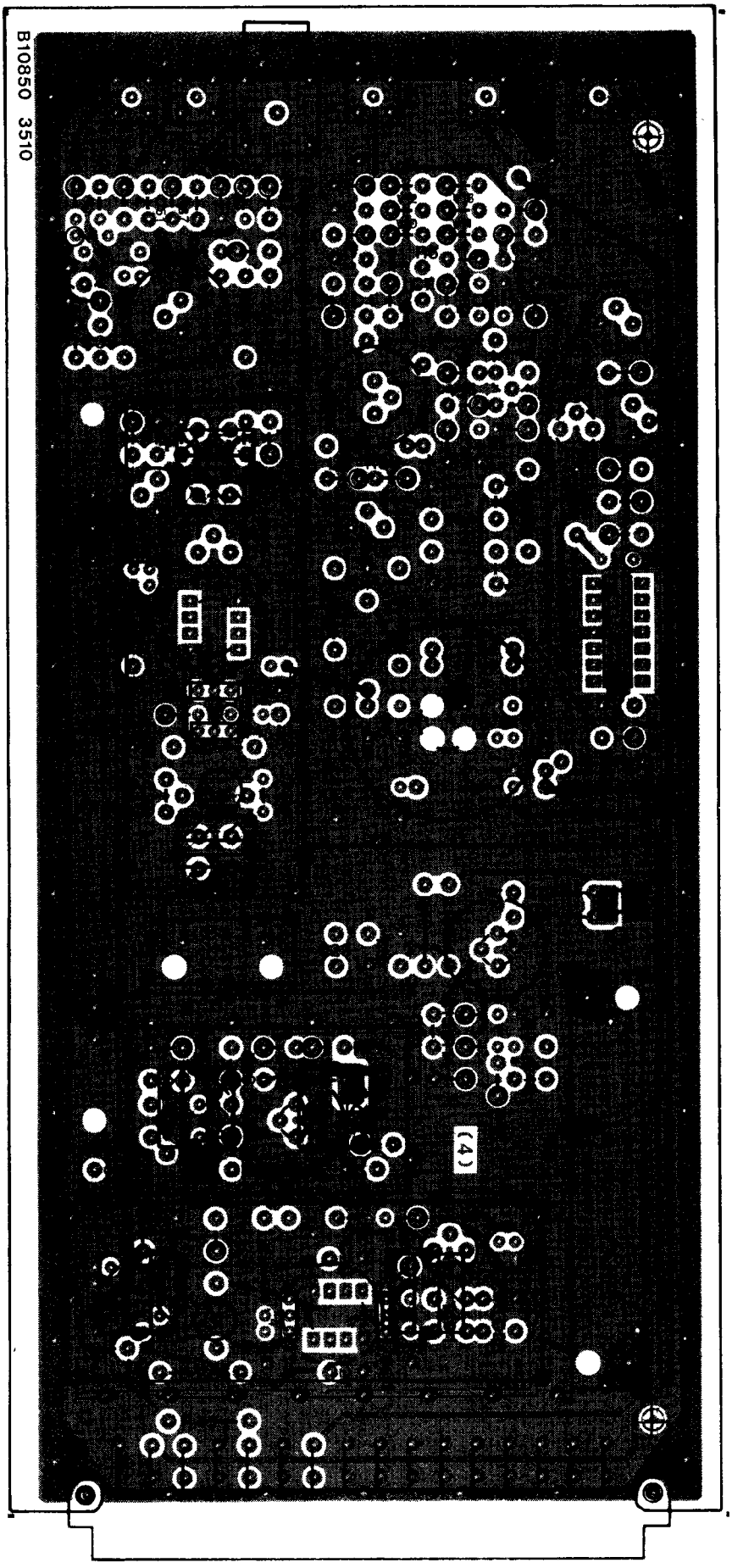
5=L3 (D5)
6=L4 (D4)
7=L5 (D3)
8=L6 (D2)
9=L7 (D1)

10=L8 (C)

1=R1 (RF1)
2=R2 (RF2)
3=R3 (RF3)
4=+15V

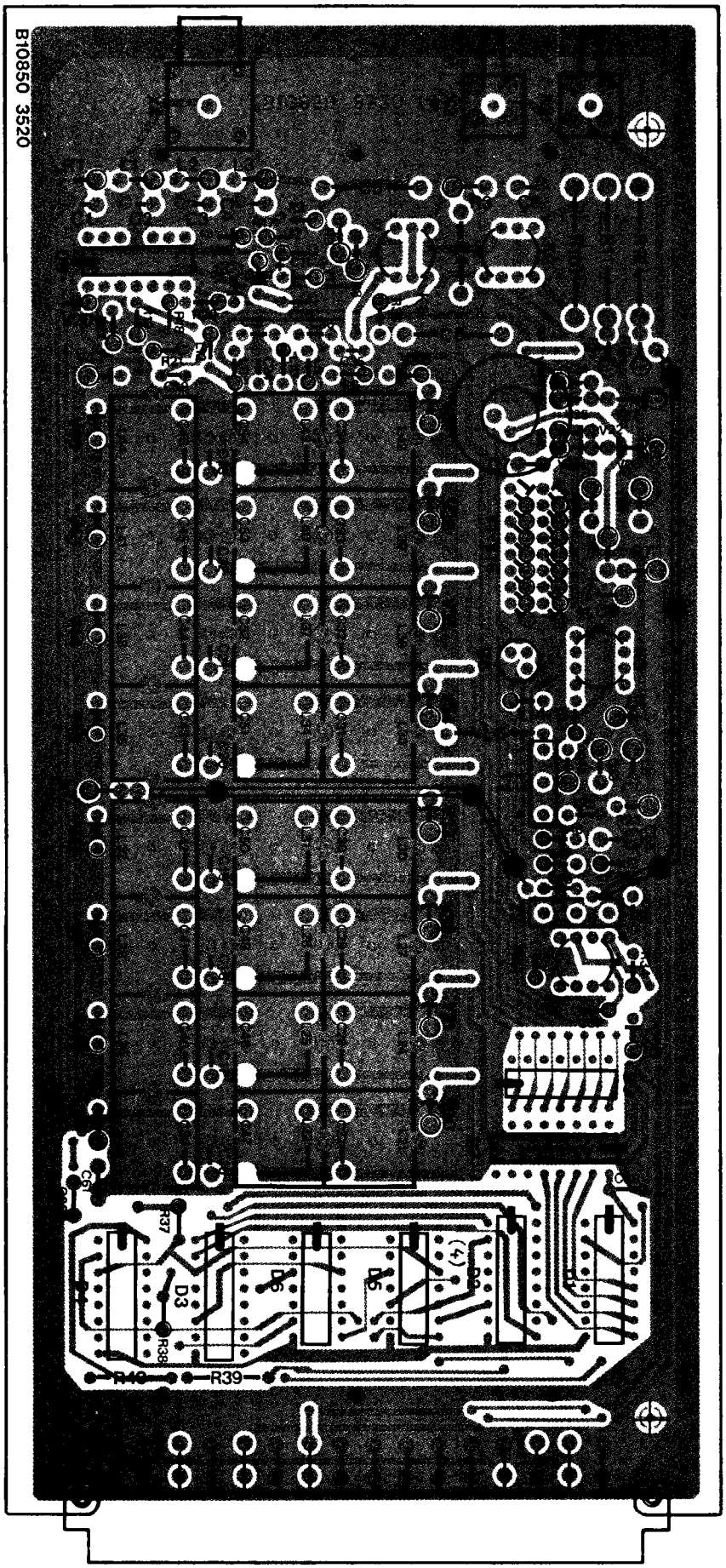
ED	DATE	NO								
SIGNATURES										
ED	DATE	NO								
SIGNATURES										

ITT	CR90 Carte VCO	SRT	CR90 VCO Board
		B10850 1195 4	1/2



1	810108	2	841011

ITT	CR90 Unité HF	SRT	CR90 RF Unit
			B10850 1151 4



ITT	CR90 Filtres d'entrée	SRT	CR90 Input Filters
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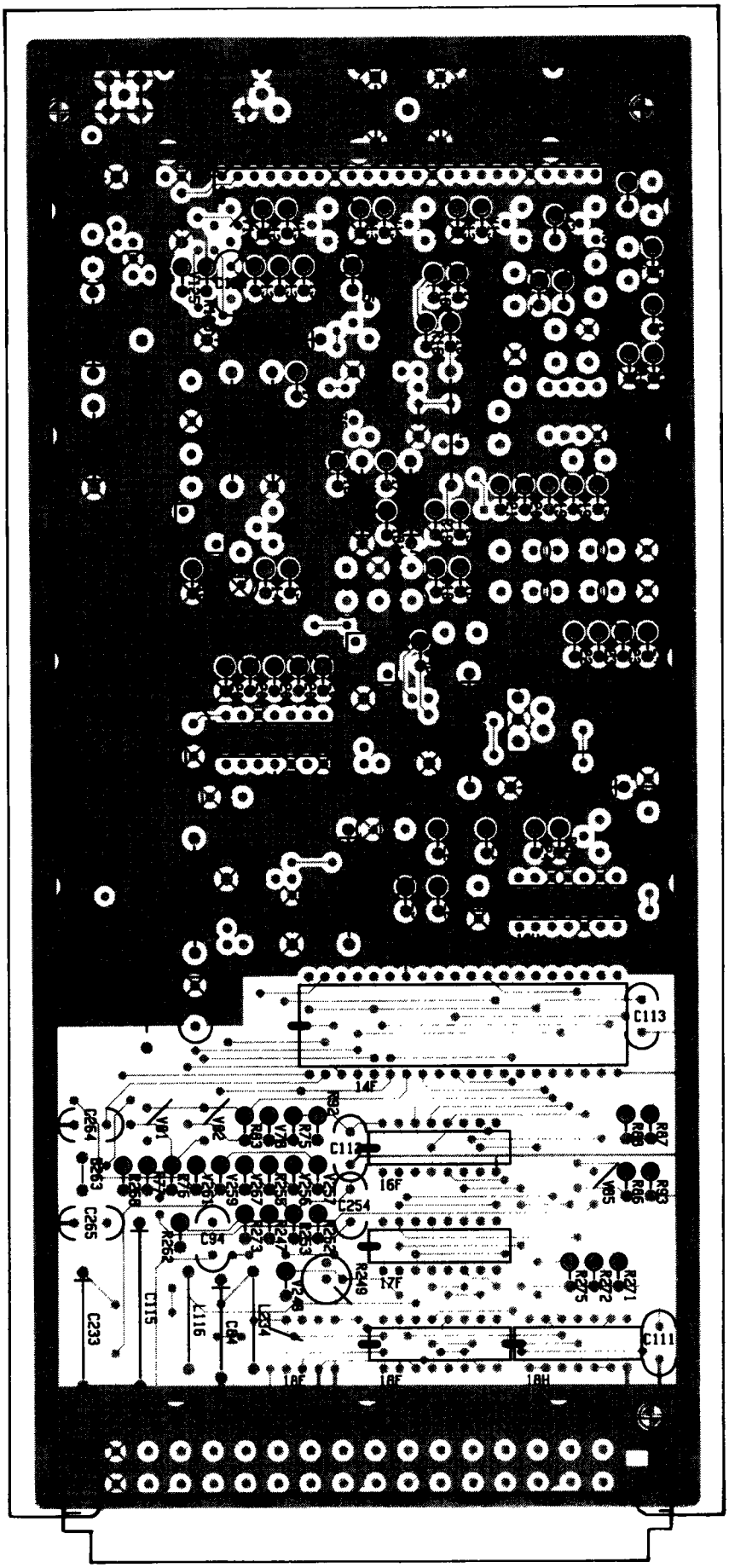

ITT	CR90/91 Carte ISB	SRT	CR90/91 ISB Board
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CR 91 PROG

Några extra kommandon och inställningar som kan programeras.

1. Kalibrering av S-Metern

I senare versioner av "firm-ware" kan man kalibrera S-metern så att skalan från 0 -> + 100 dBuV stämmer inom ett par dB.

För kalibrering krävs:

En signalgenerator (gärna HP 8640 eller liknande) med utsignal stegbar från 0 dBuV (= 0.5 uV klämspänning) till + 100 dBuV (= 50 mV klämspänning) i 10 dB steg.

Att mottagaren har varit igång en halv timme (eller mer) för att få dämpsatsernas absoluta verkan att stabiliseras.

Kalibrering:

Anslut signalgeneratorn till mottagarens antenningång.

Ställ mottagaren på 13 MHz, USB, AGC lång och RF-kontrollen fullt medurs.

Ställ signalgeneratorn på på mottagarens frekvens + 1 kHz, utsignal 0 dBuV (= 0.5 uV klämspänning) och kontrollera att en 1 kHz ton hörs i högtalaren.

Tryck på PROG och därefter på S-METER precis fem gånger och kontrollera att S-metern hoppar till något obestämt läge en bit upp på skalan.

Tryck på S-METER en gång och öka signalegeneratorns utsignal 10 dB.
Tryck igen på S-METER och öka ytterligare 10 dB.
Fortsätt så tills 100 dBuV uppnåts, dvs 11 lägen på signalgeneratorns dämpsats.

Tryck nu en ytterligare gång på S-METER och ställ in (finjustera) signalgeneratornivån så att exakt100 dBuV visas på instrumentet. Normalt skall det gå att få denna inställning på samma dämpsatsläge som för det sista + 100 dBuV- läget.

Efter denna "ensning" av slutläget på instrumentet, avlsutas kalibreringen genom att trycka på DIR, dvs gå ur PROG.

Kolla att de inprogramerade instrumentlägena har lagrats och stämmer med skalan genom att stega signalgeneratorns utsignal precis som vid kalibrering, dvs från 0 dBuV -> + 100 dBuV.

Ibland kan det ta ett par gånger innan man trycker och stegar i rätt ordning så att lagringen av värden sker vid rätt nivå.

2. Mode/Bandbredd koppling.

Det går att koppla Mode och Bandbredd till varandra så att t.ex USB medför att filter för USB alltid ställs in som default.

Det går också att "koppla bort" denna automatiska koppling så att man kan behålla den bandbredd man hade innan man bytte Mode.

Det hela går till så att man i PROG trycker minst fem gånger på den bandbredd man vill ha kopplad till den Mode som för tillfället är inställd. Vid återgång till DIR skall kopplingen ha skett.

Bortkoppling sker genom att man i PROG trycker minst fem gånger på den Mode man INTE vill skall vara kopplad till någon automatisk bandbredd. Glöm inte att återgå till DIR:

Ja, det var väl de enklaste PROG-funktioerna som inte finns beskrivnai standardmanualen.

73 de Roffe

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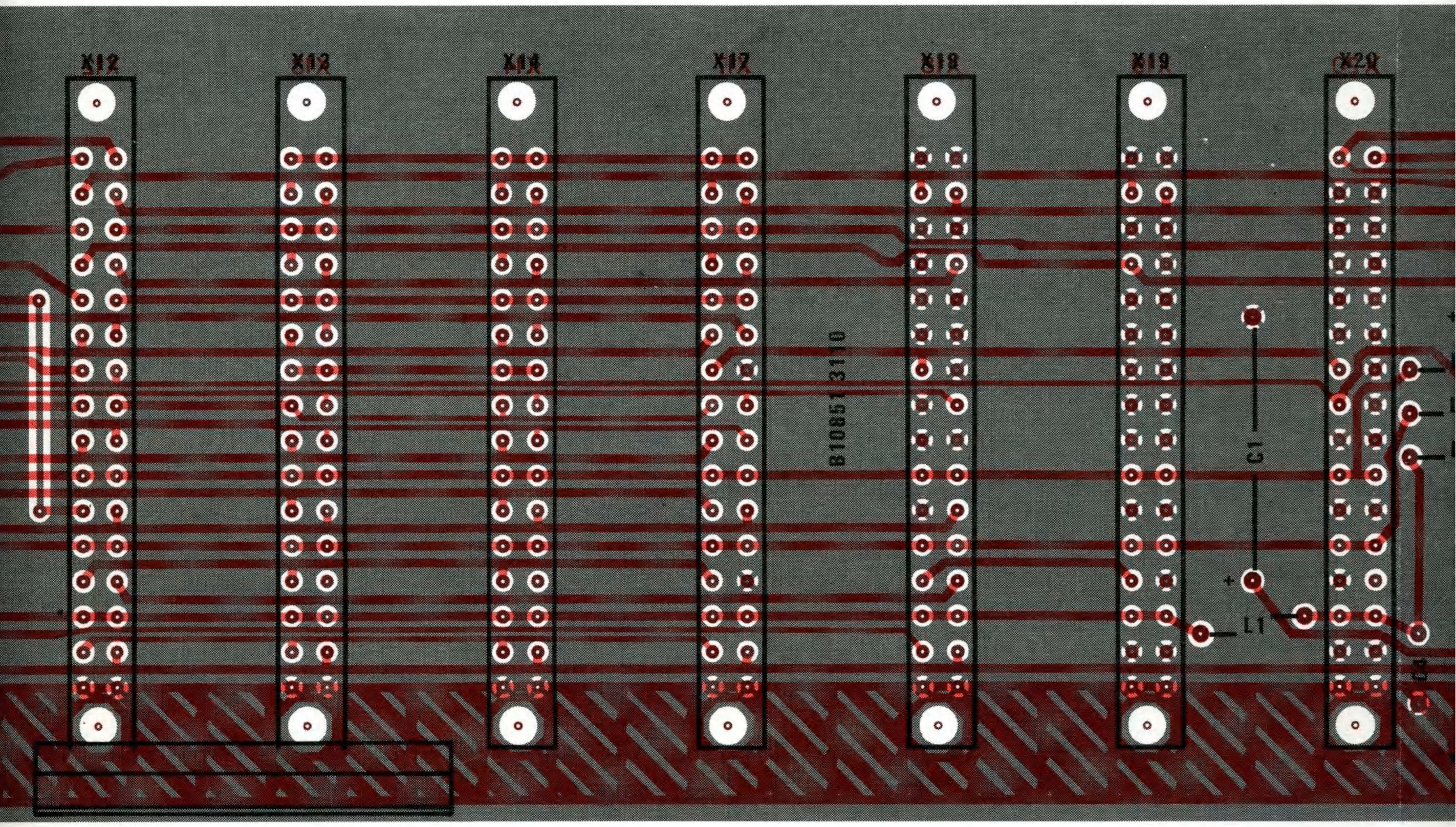

Comp. side

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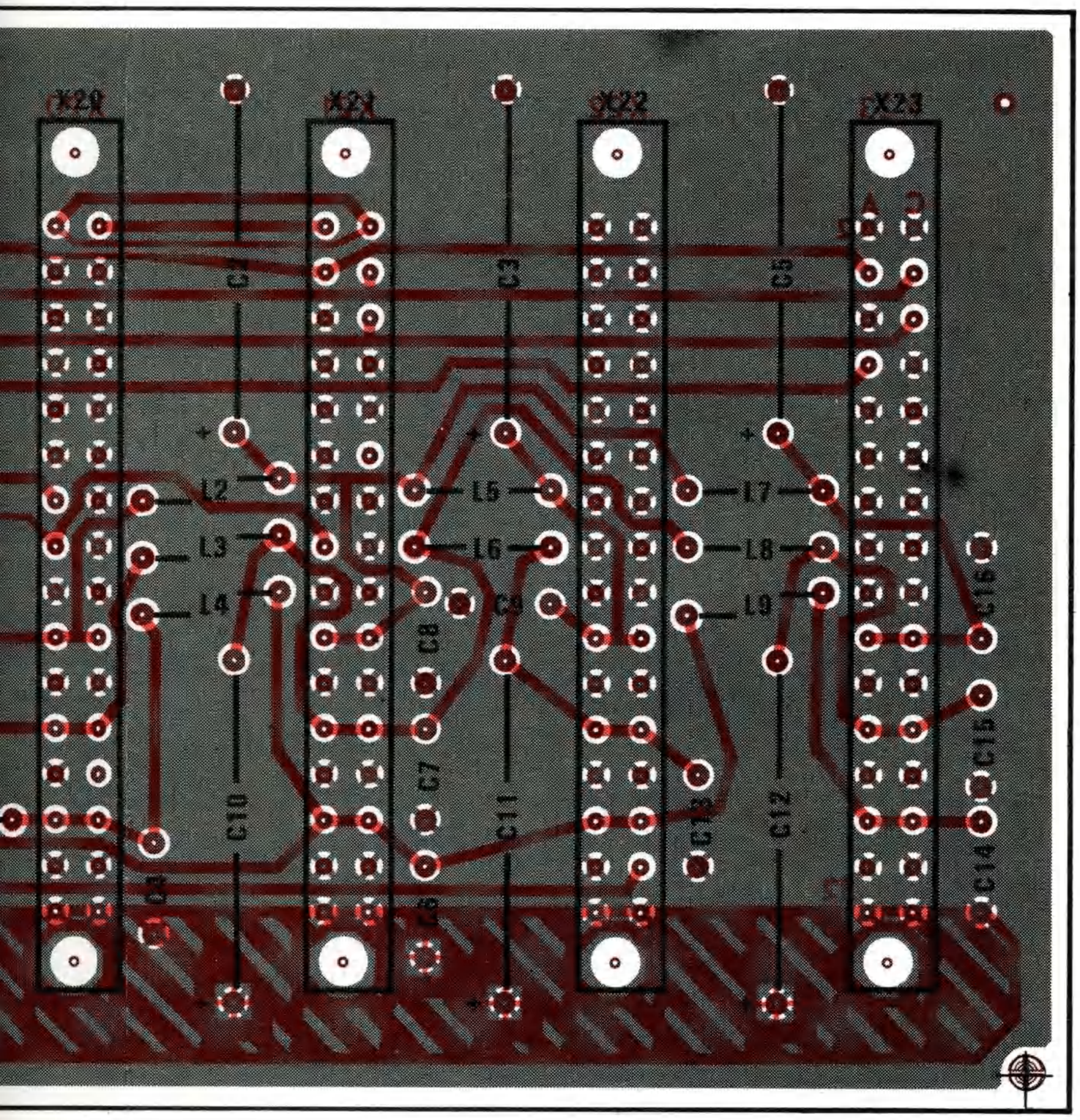

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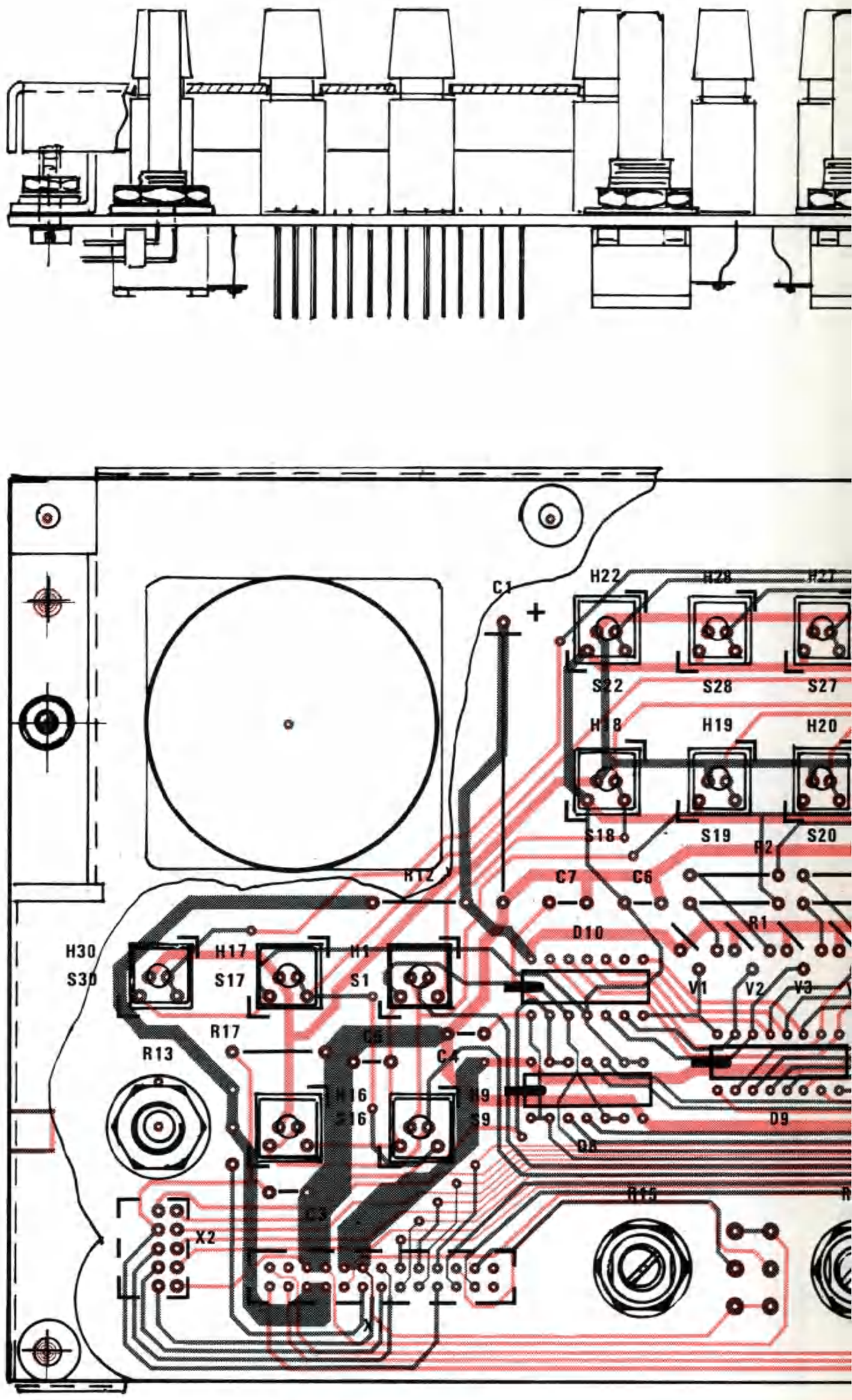
C1
+
H22
H28
H27
S22
S28
S27
H18
H19
H20
S18
S19
S20
R2
C7
C6
R1
D10
V1
V2
V3
H30
S30
H17
S17
H1
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D9
D8
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C3
X2
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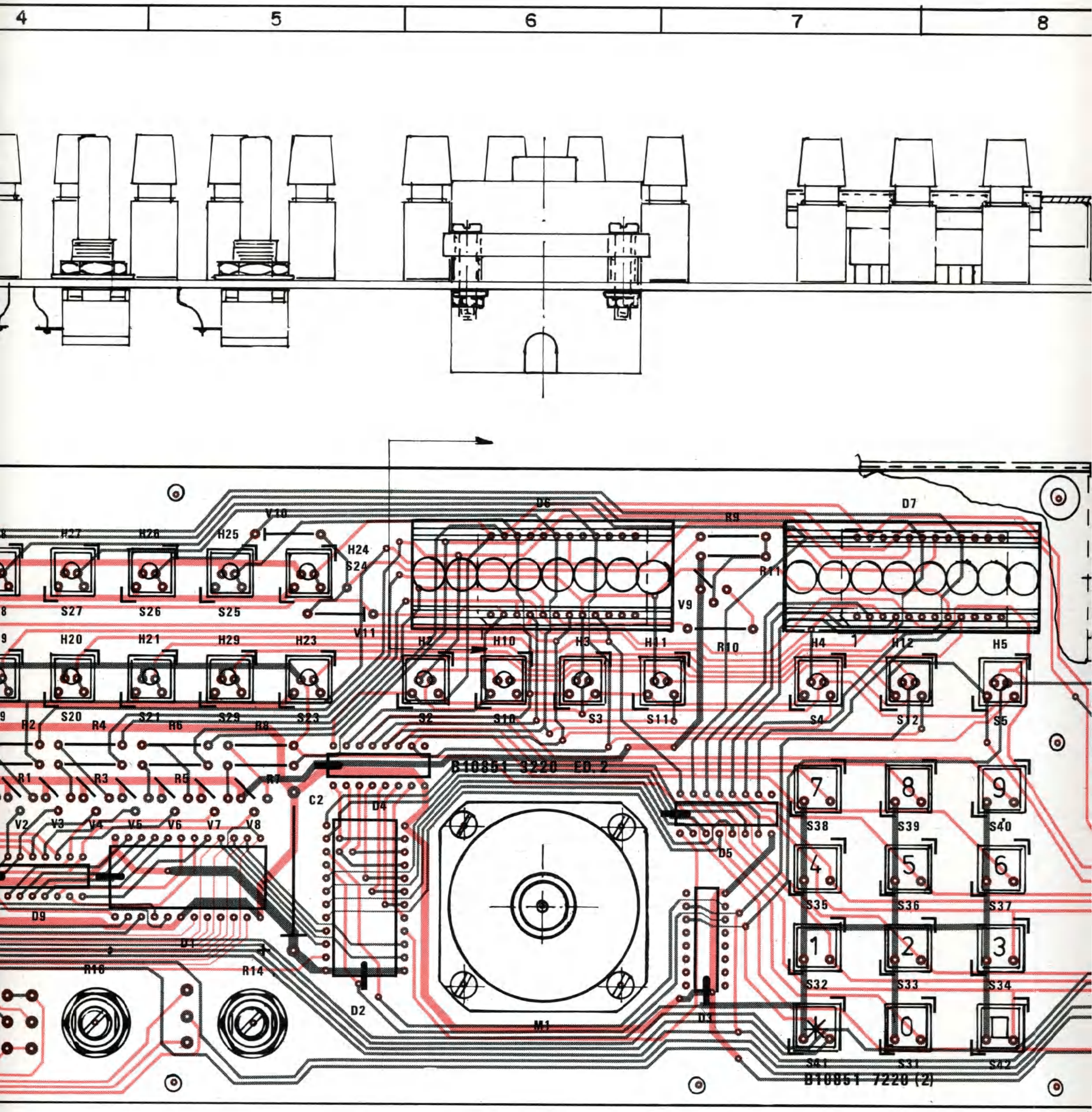
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5
6
7
8
D6
D7
V10
H27
H26
H25
H24
S24
R9
R11
V9
V11
H2
H10
H3
H11
R10
H4
H12
H5
S27
S26
S25
H20
H21
H29
H23
S20
S21
S29
S23
S2
S10
S3
S11
S4
S12
S5
R4
R6
R8
R2
R1
R3
R5
R7
V2
V3
V4
V5
V6
V7
V8
B10851 3220 ED.2
C2
D4
D5
7
8
9
S38
S39
S40
4
5
6
S35
S36
S37
1
2
3
S32
S33
S34
S41
S31
S42
D9
D1
R16
R14
D2
M1
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ED
SIGNA
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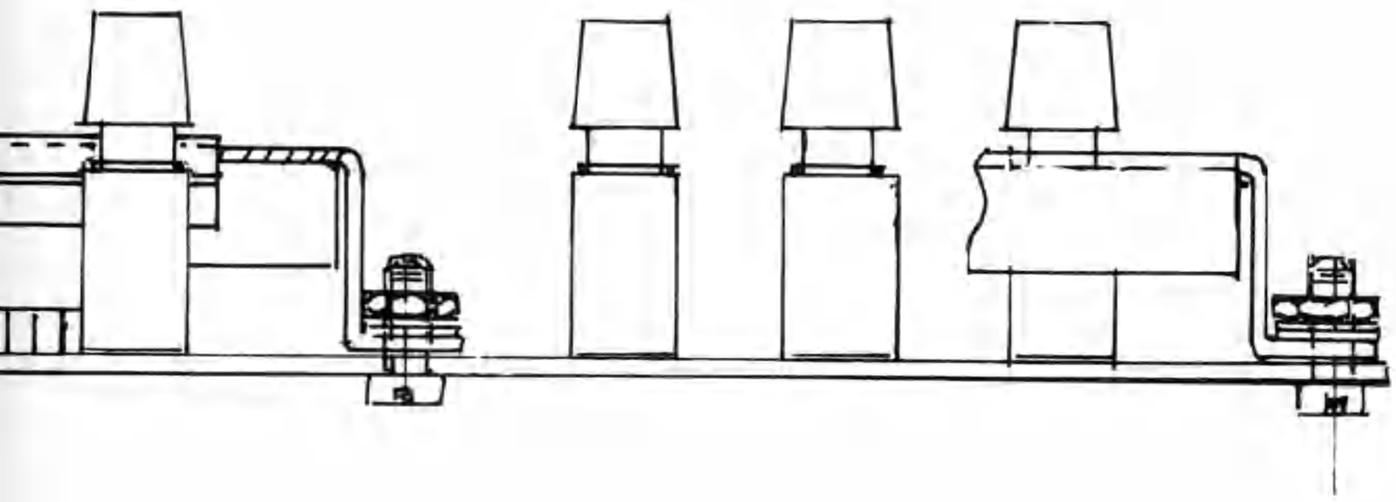
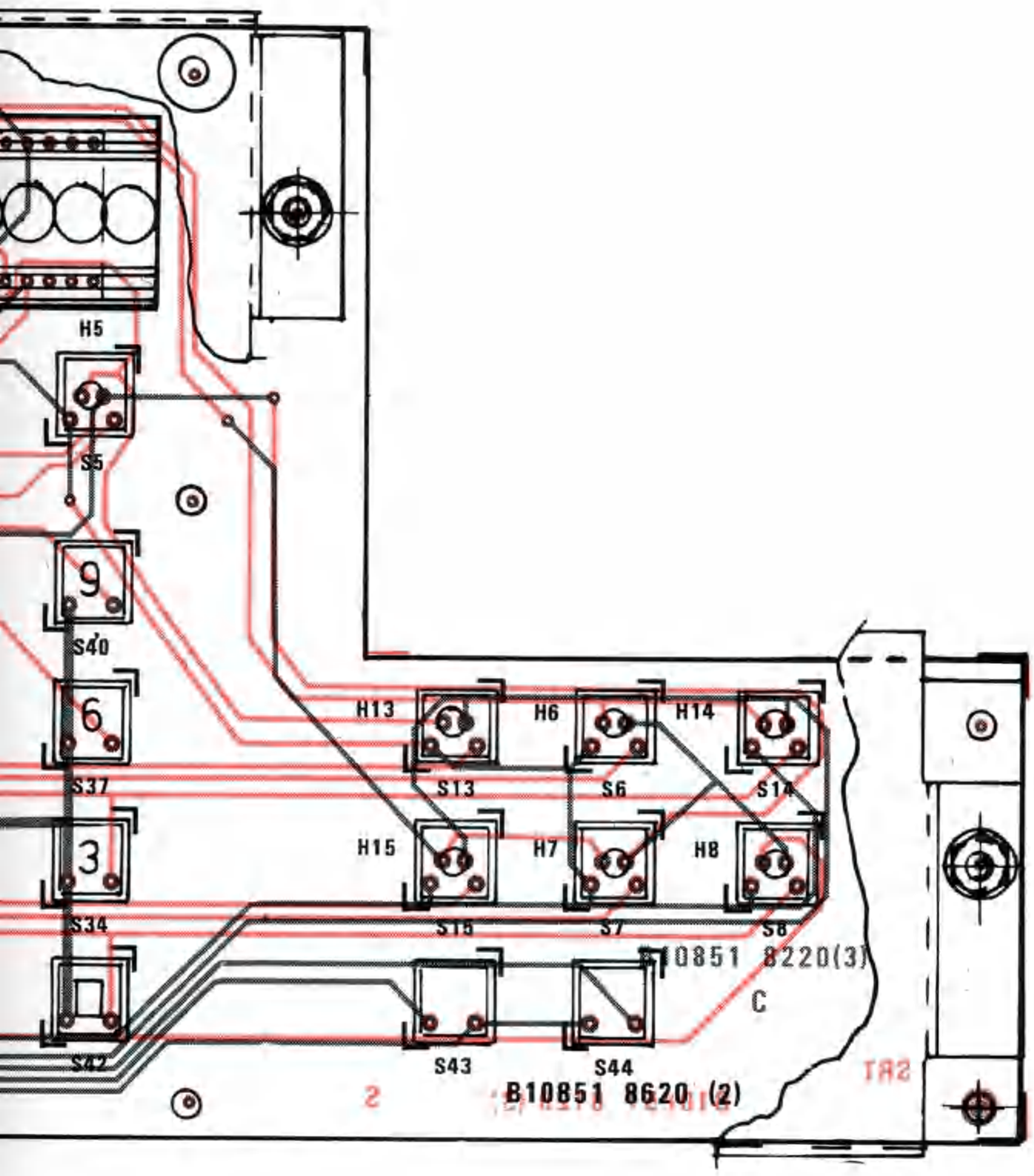
SIGNA

8 | 9 | 10 | 11





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ITT | CARTE DU PANNEU 1 | SRT | PANEL BOARD 1

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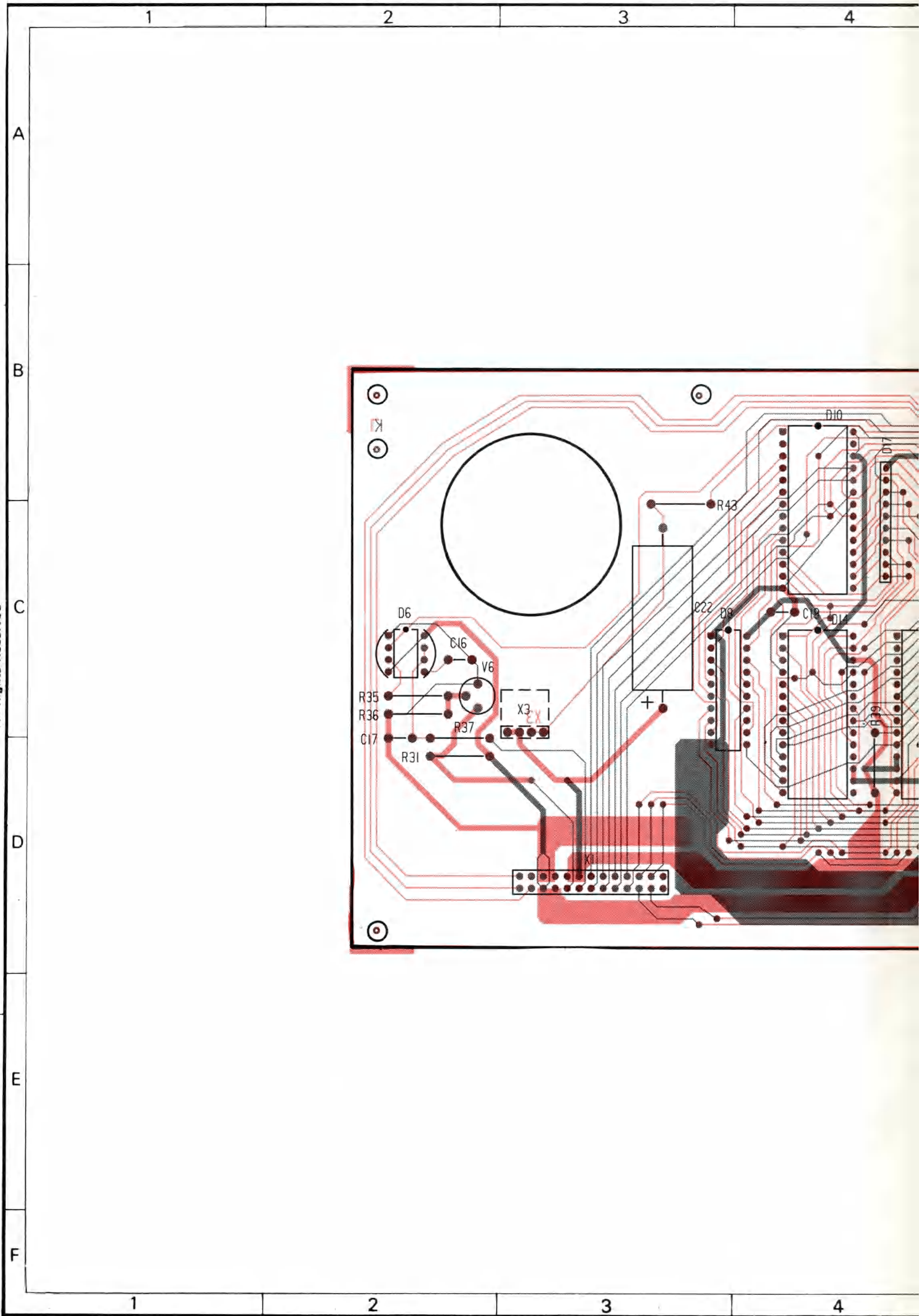

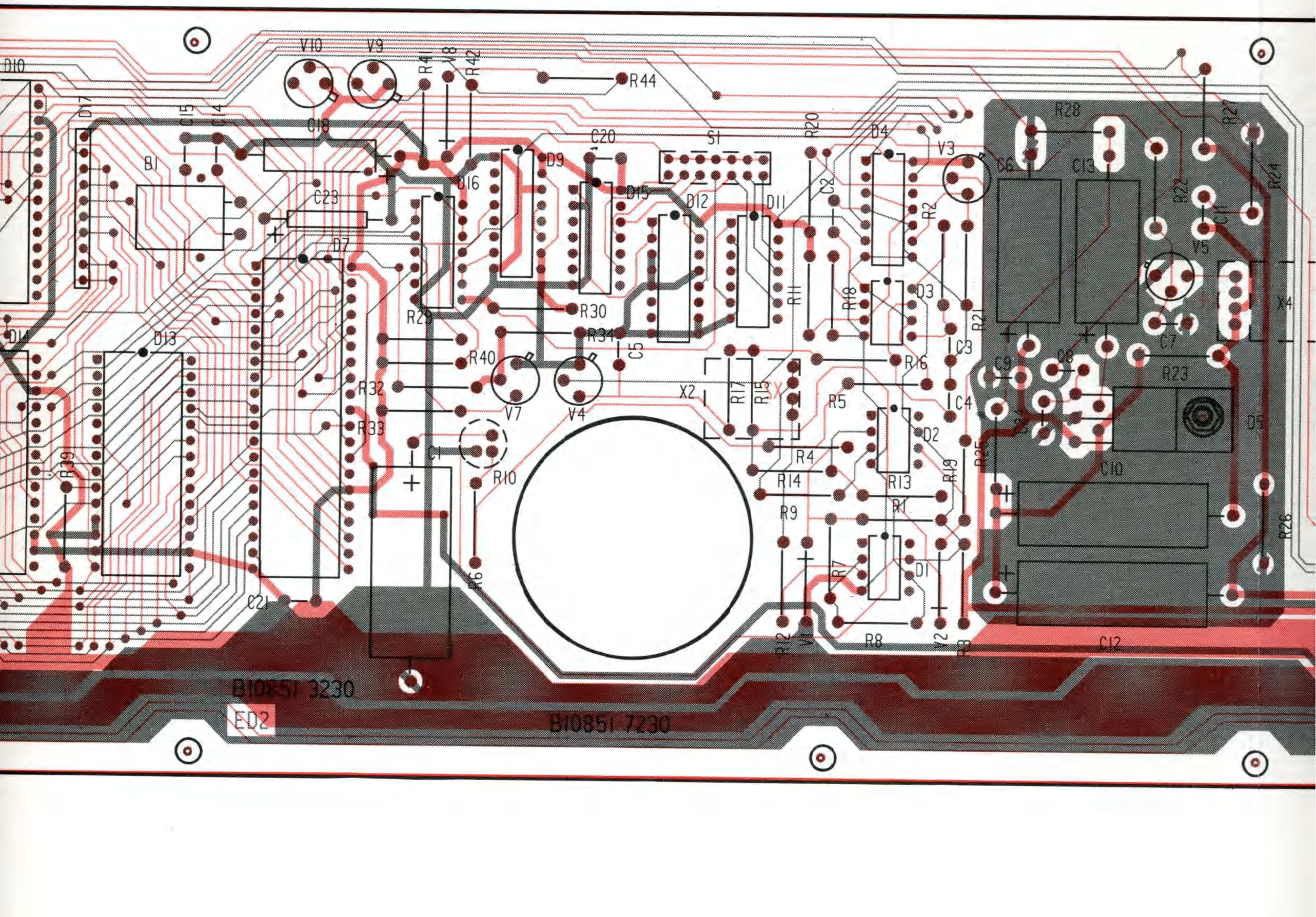
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V9
R41
R43
R42
R44
C18
C20
S1
D10
D17
C19
C14
B1
C23
D16
D9
D15
D12
D11
R20
D4
V3
C6
C13
R28
R22
R24
C11
V5
X4
C7
C8
C9
R23
D5
C10
C12
D7
D13
R29
R30
R34
C5
R40
R32
R33
V7
V4
X2
R17
R15
R5
D2
R4
R14
R13
R19
R25
R26
R9
R1
D1
R7
R8
V2
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C1
R10
R6
C21
R39
R2
R21
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C4
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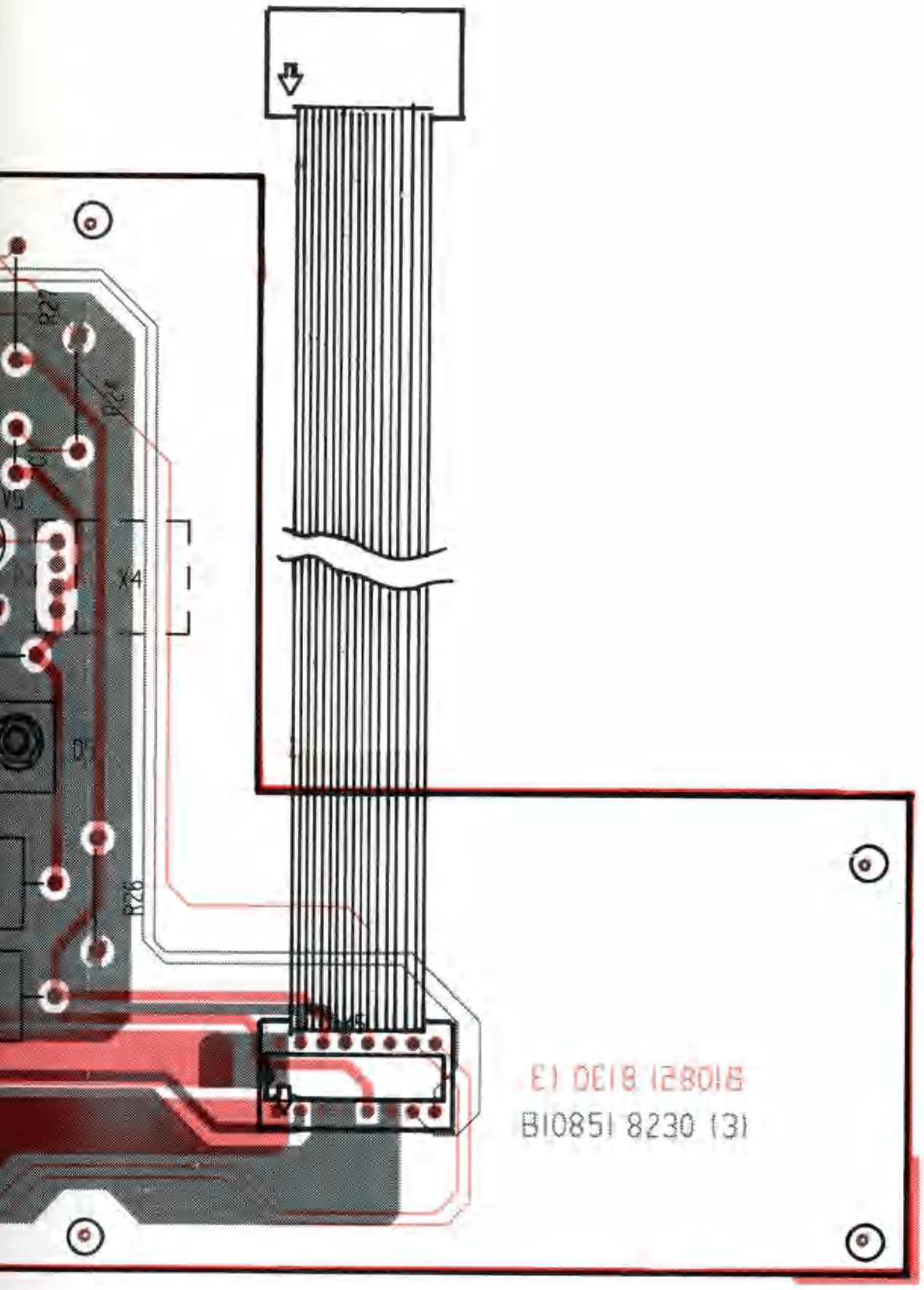

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ED. DATE - NO.	1	830815	2	841011			
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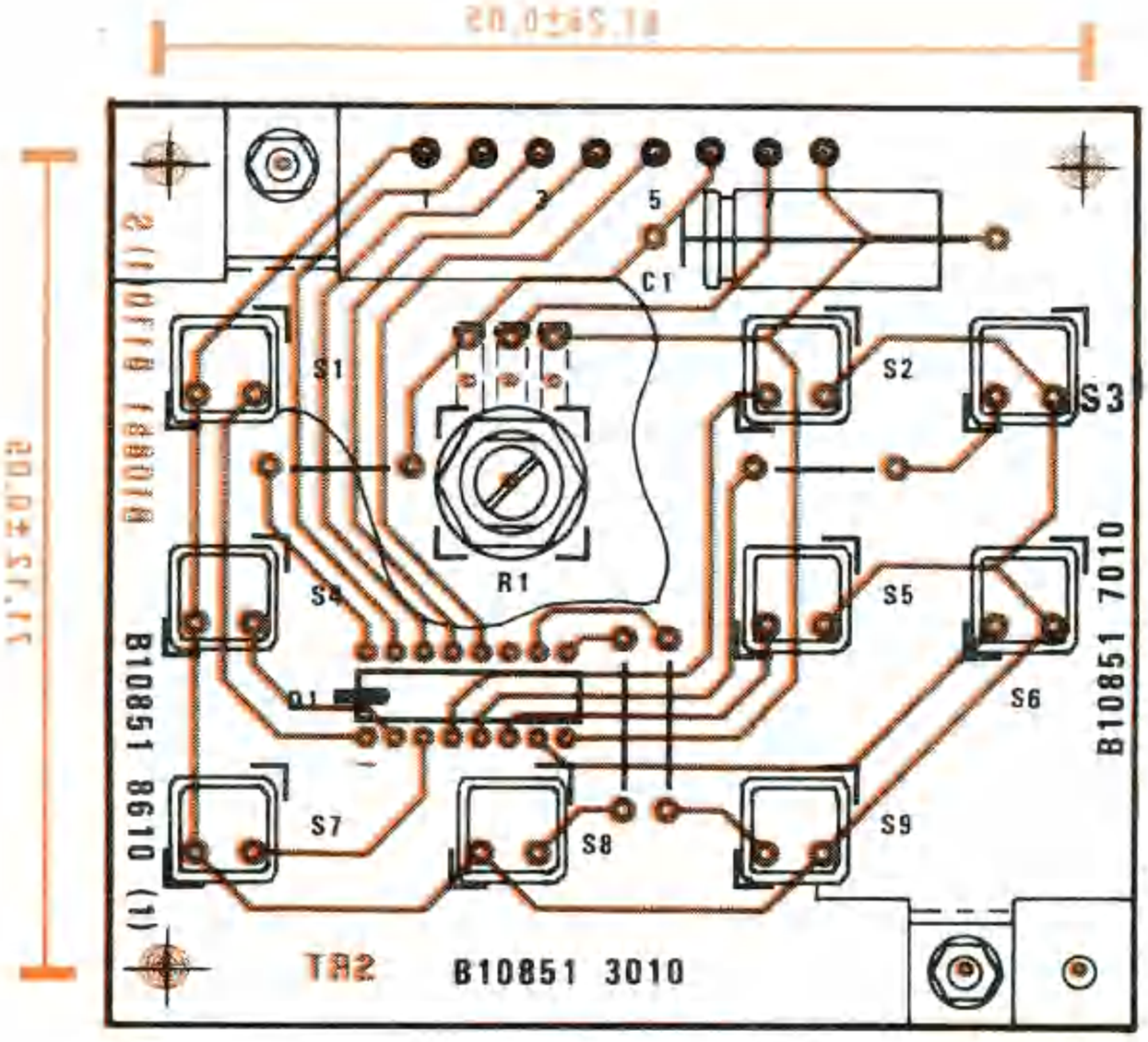

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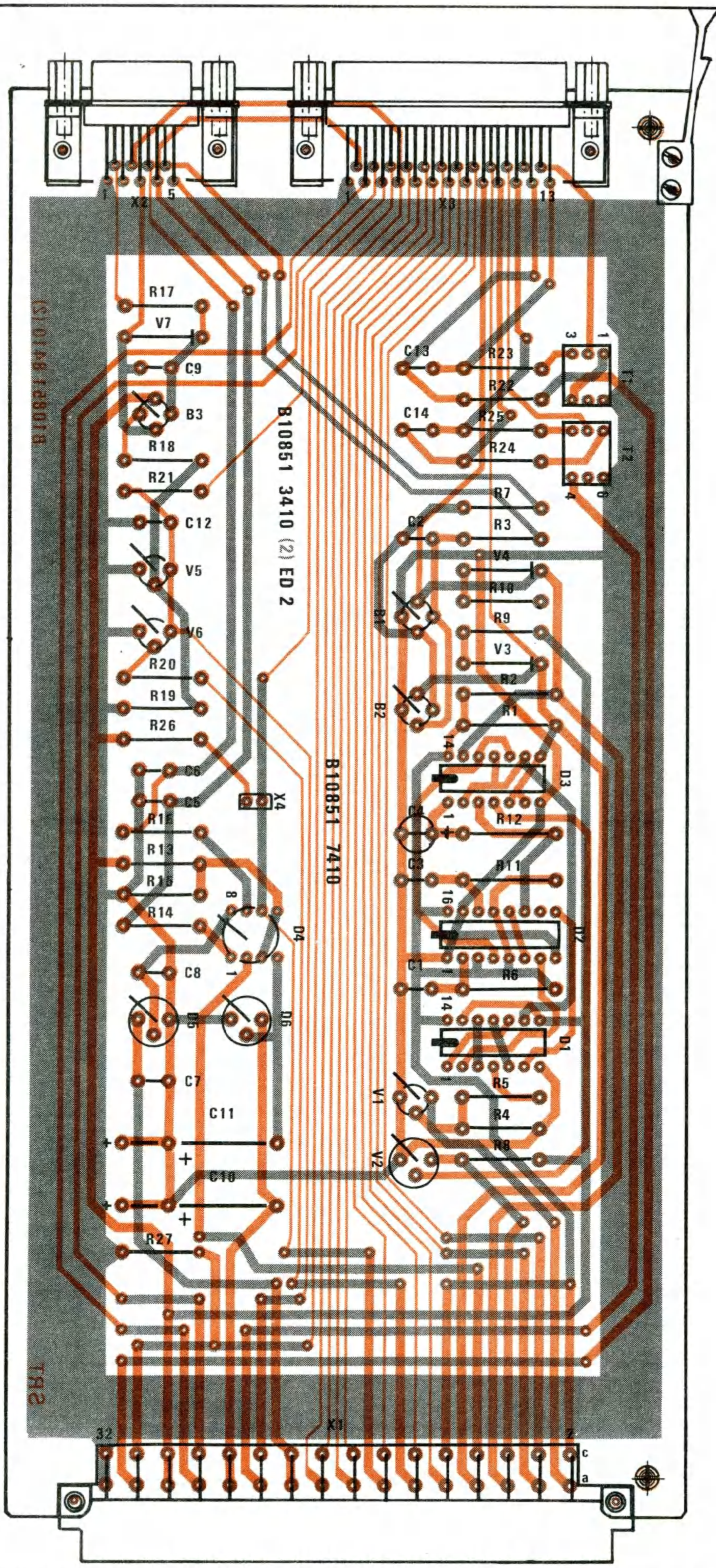

1	830815	2	841011	3

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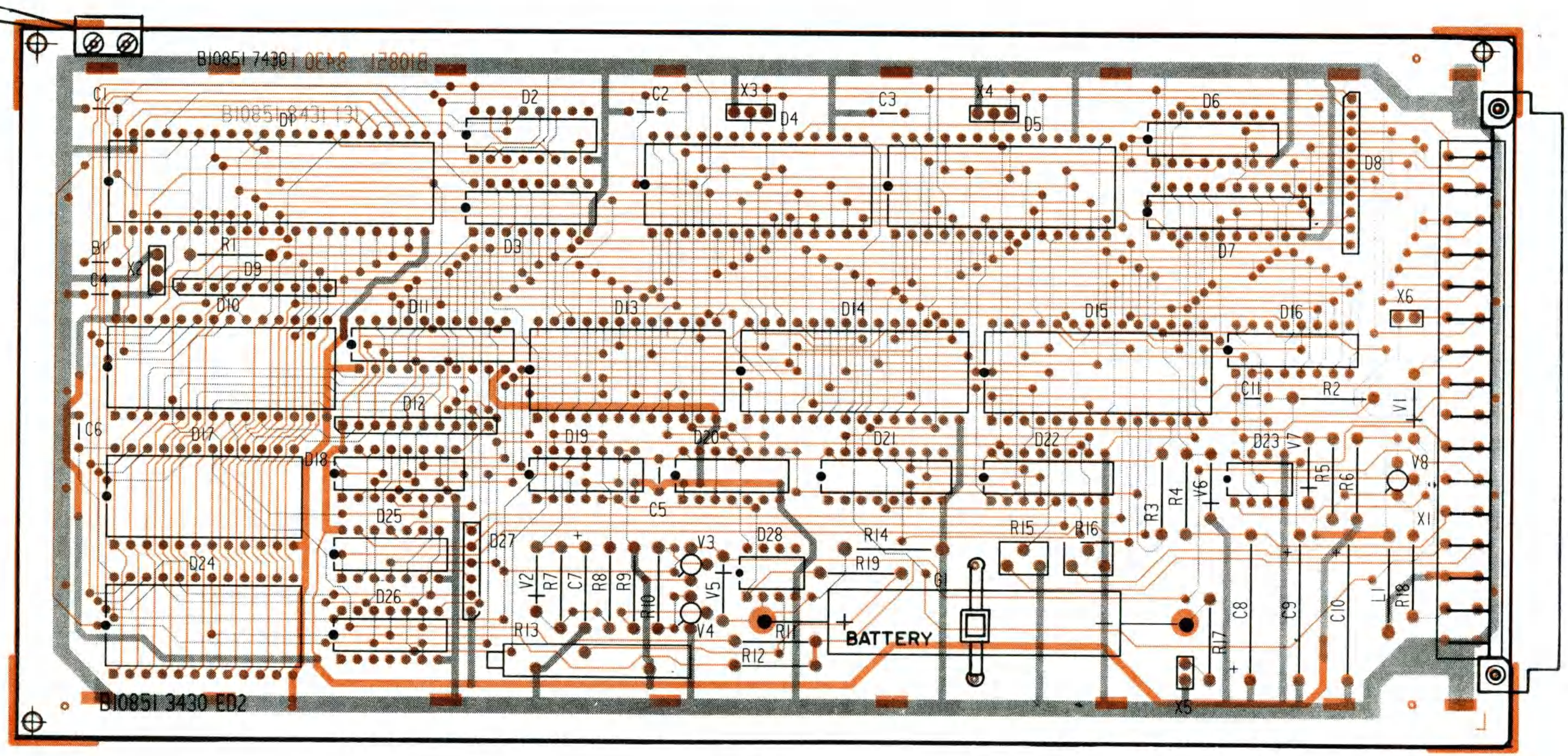

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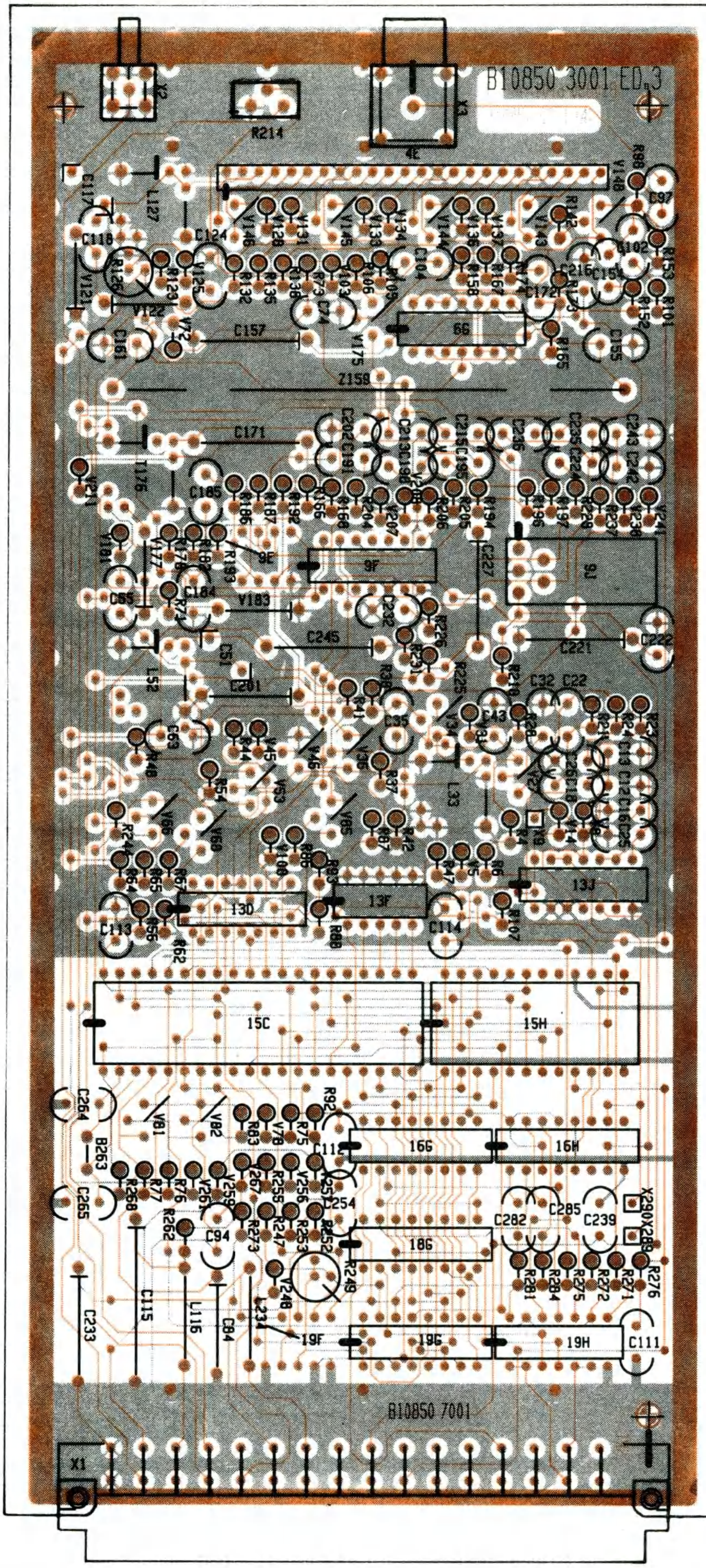
CONTROL BOARD



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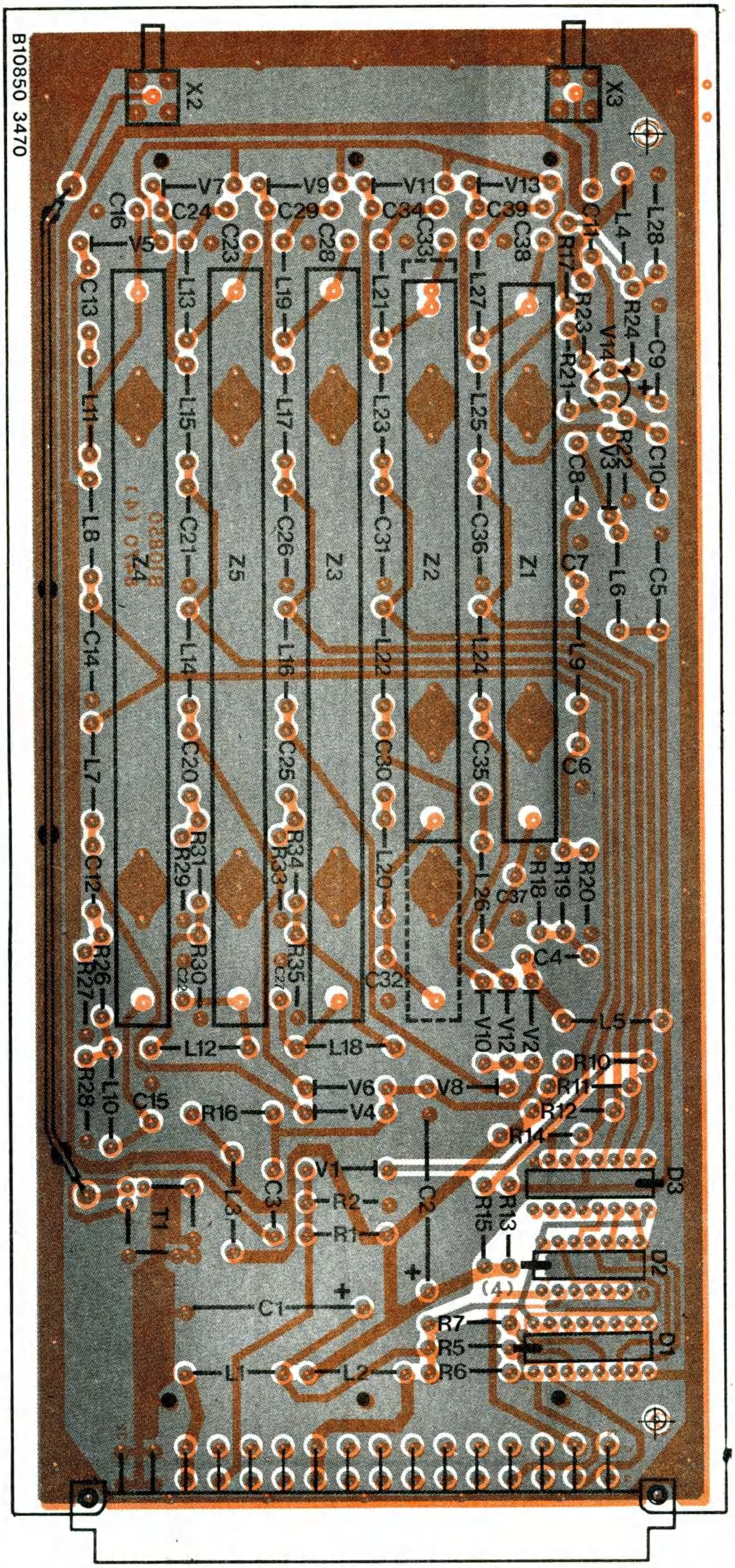
			B10850 1170 4



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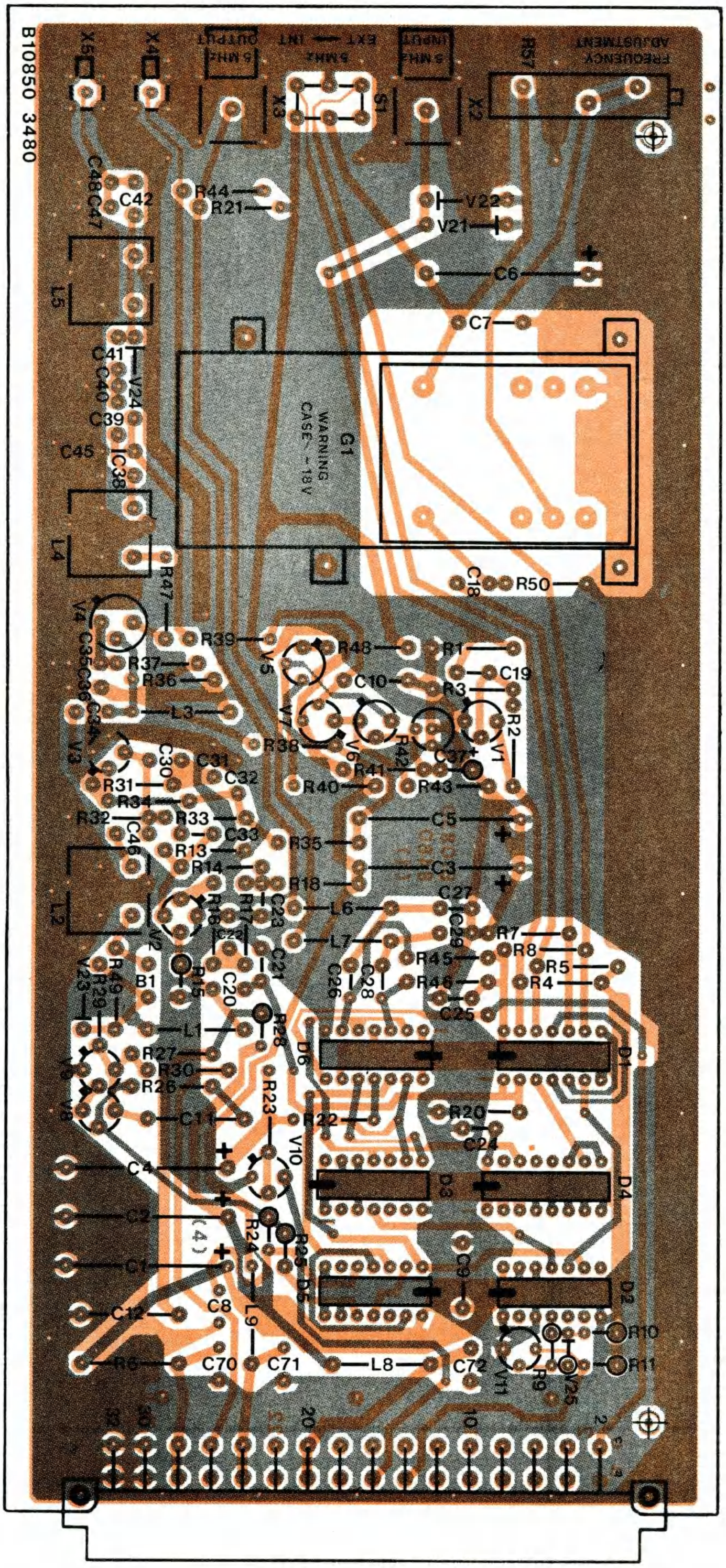

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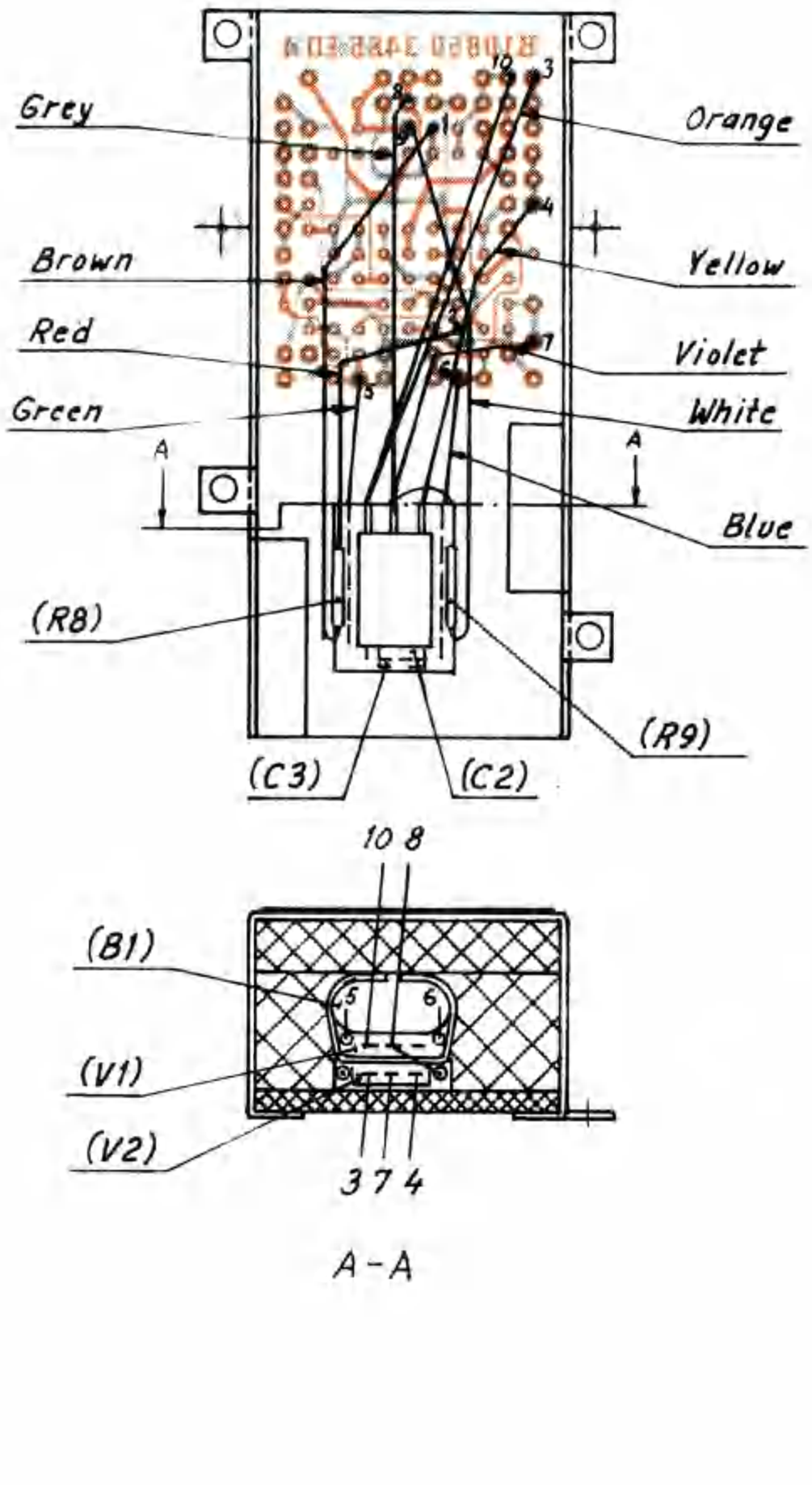

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SRT

CR90
Crystal Oscillator

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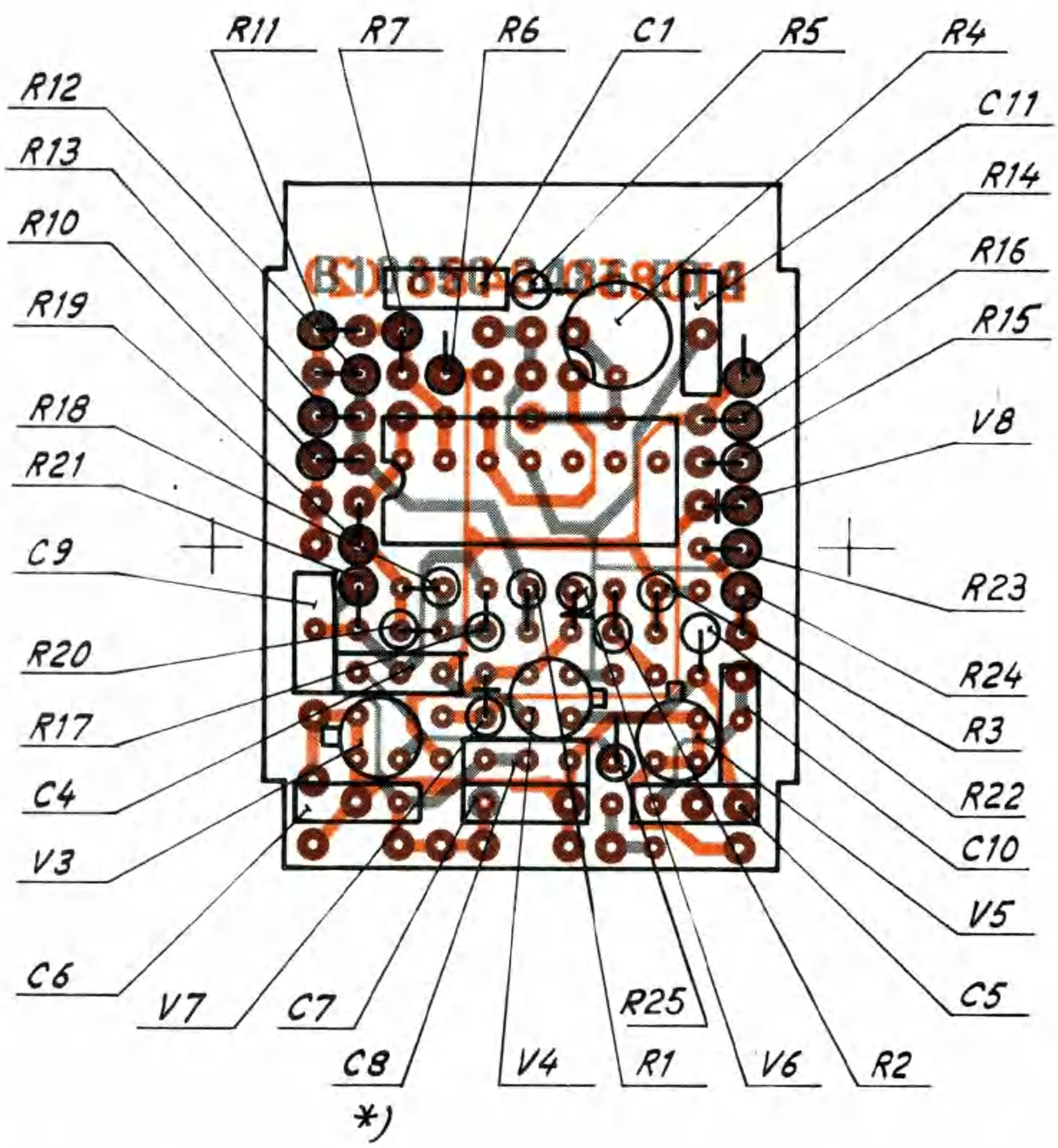

*) C8 not mounted

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ITT CR90
PCB pour osc. à cristal

SRT CR90
PCB to Crystal oscillator

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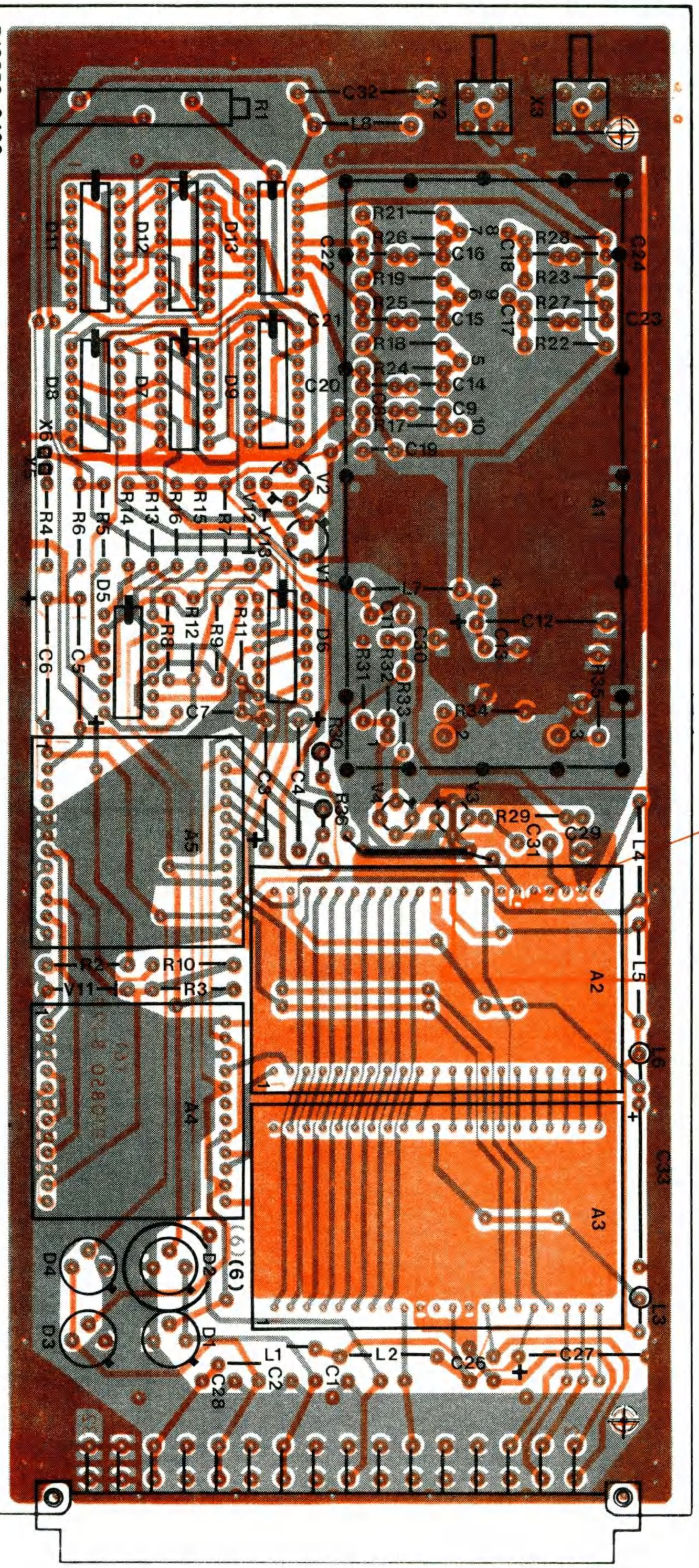

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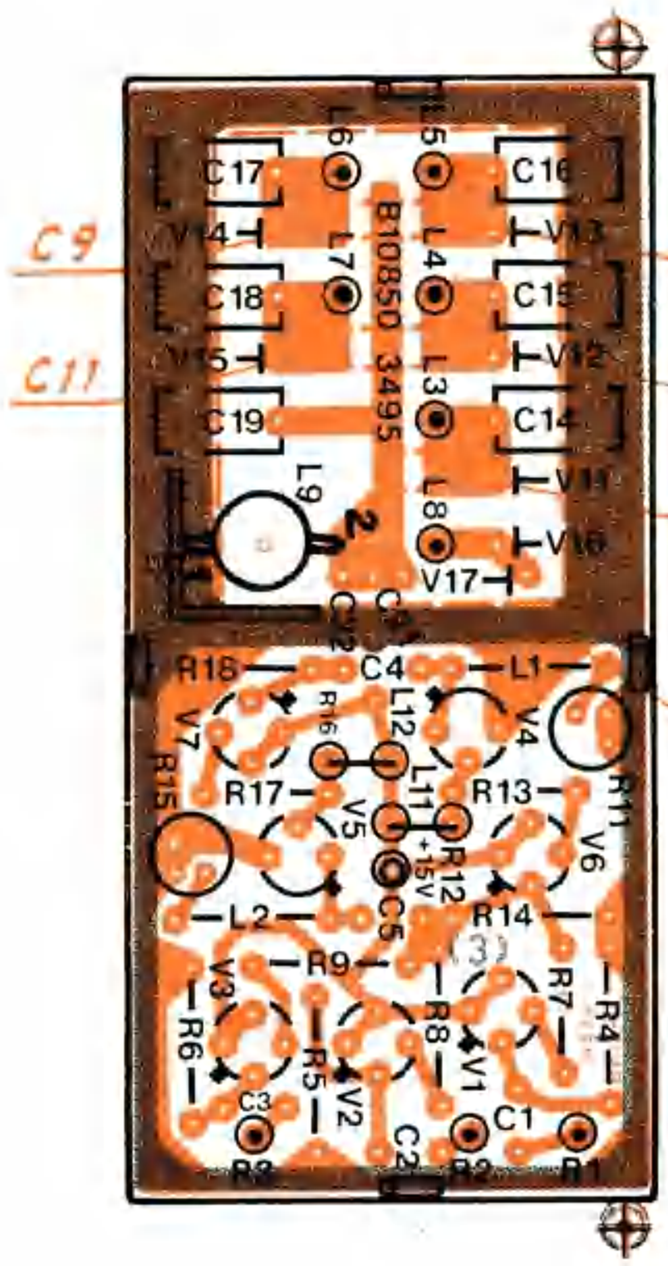
		B10850 1149 4	1/2



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6=L4 (D4)
7=L5 (D3)
8=L6 (D2)
9=L7 (D1)

10=L8 (C)

1=R1 (RF1)
2=R2 (RF2)
3=R3 (RF3)
4=+15V

ED	DATE	NO							
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ITT CR90 Carte VCO

SRT CR90 VCO Board

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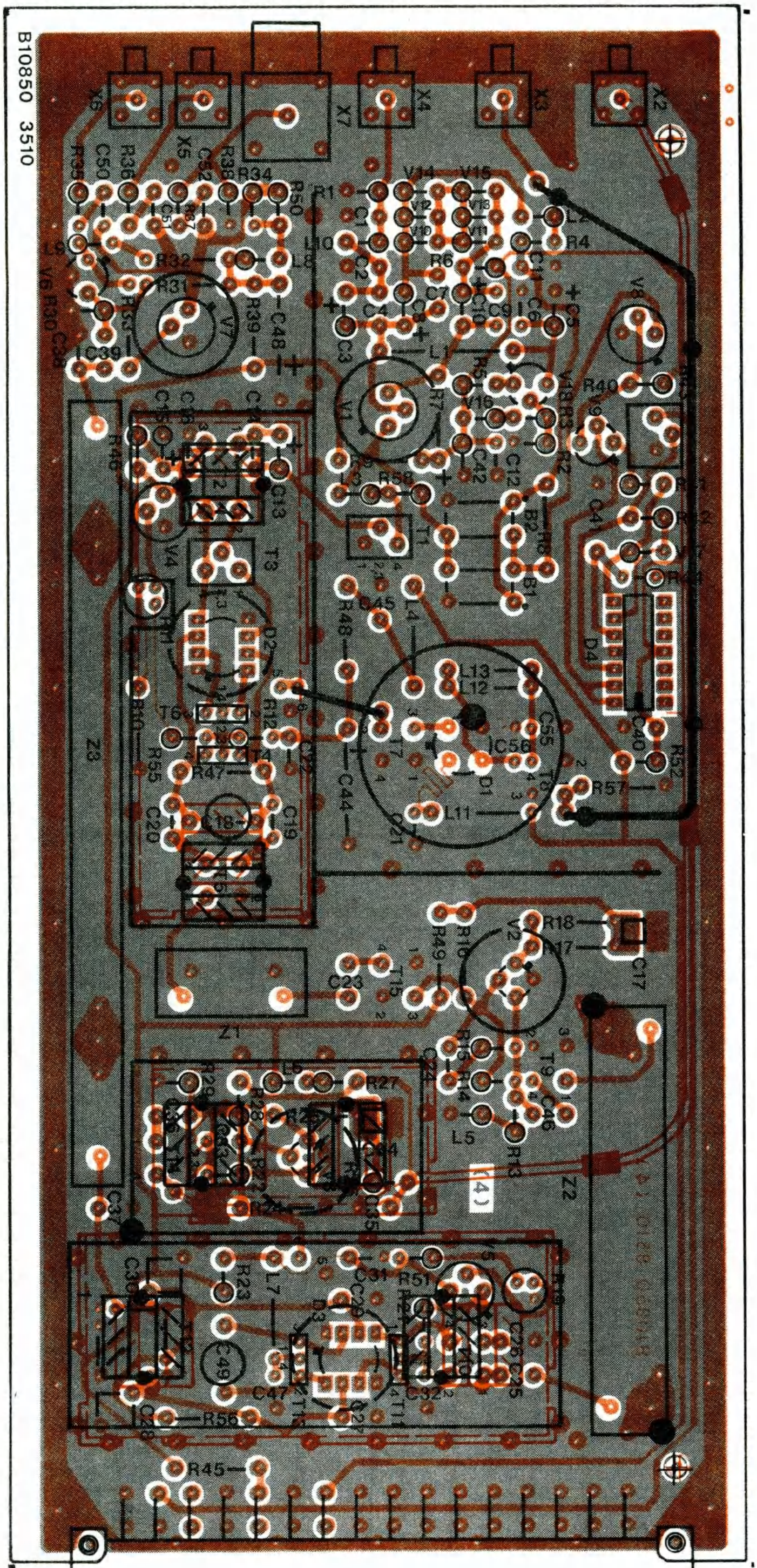

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4			

ITT	CR90 Unitè HF	SRT	CR90 RF Unit
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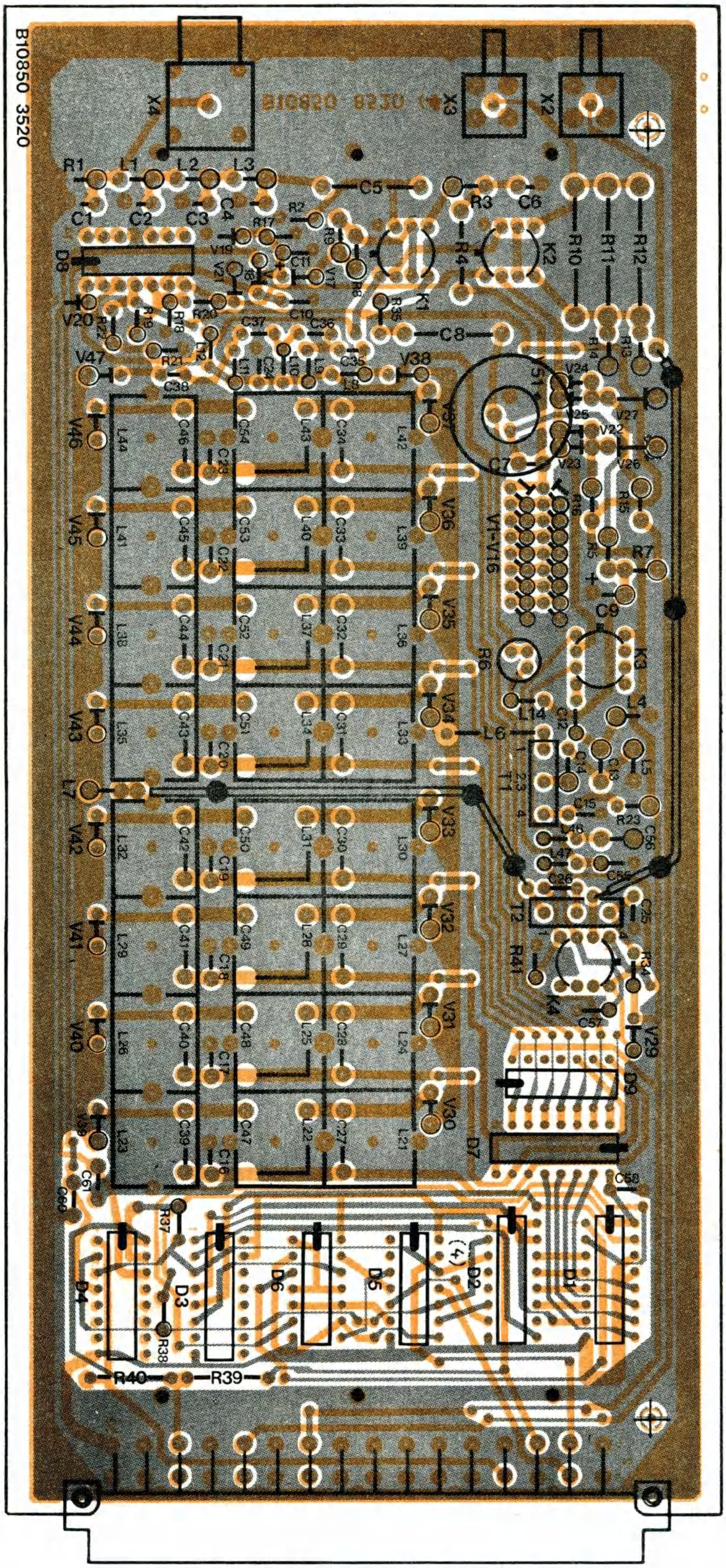

ITT	CR 90 Filtres d'entrée	SRT	CR 90 Input Filters
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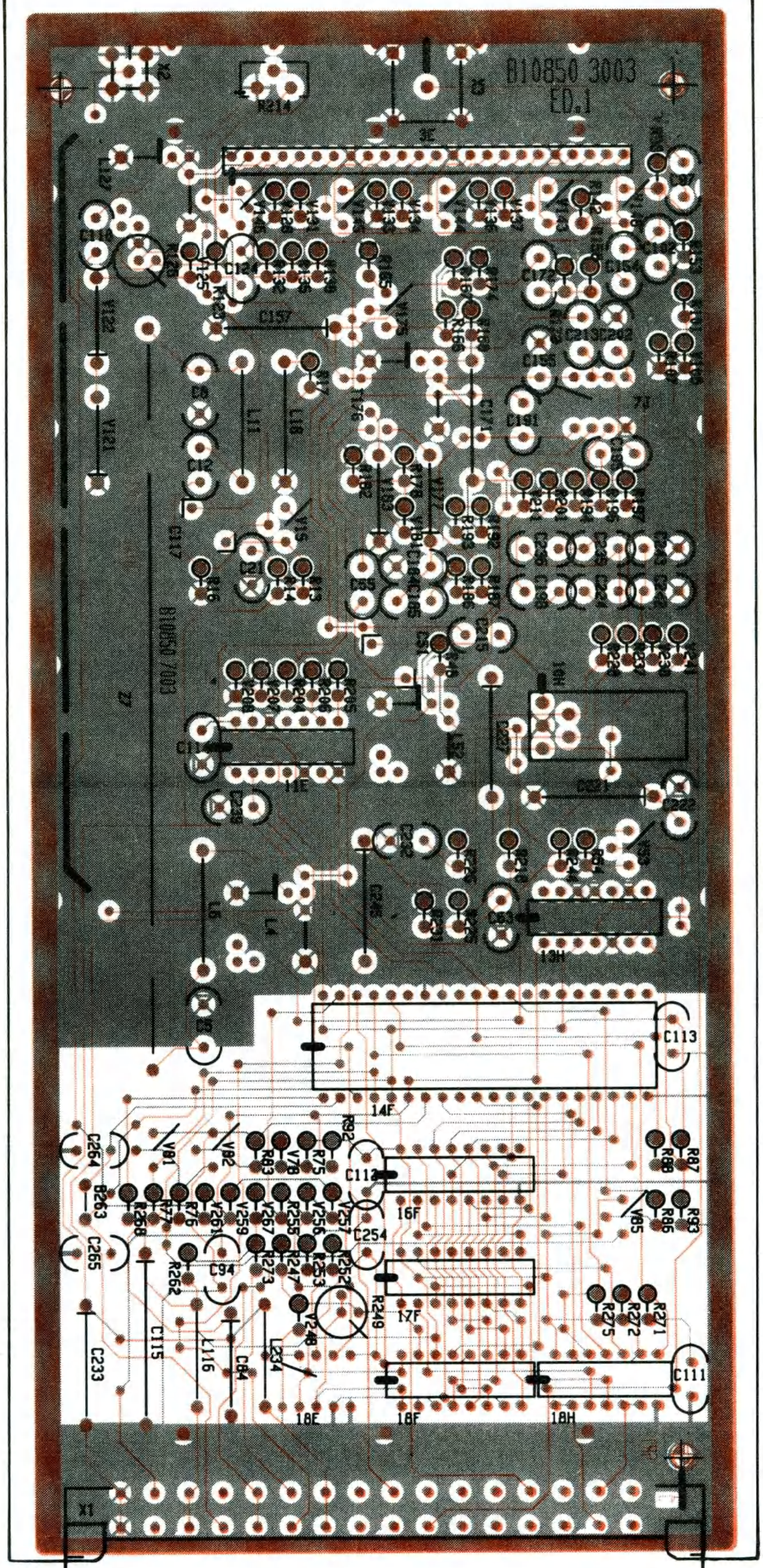

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ITT	CR90/91 Carte ISB	SRT	CR90/91 ISB Board
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