R 501. 28/11-91

Sailor

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INSTRUKTIONSBOG FOR
2182 kHz VAGTMODTAGER
R 501

INSTRUCTIONBOOK FOR
2182 kHz WATCHKEEPING
RECEIVER R 501

A/S S. P. RADIO · AALBORG · DENMARK

CONTENTS

GENERAL DESCRIPTION

SAILOR R501 complies with the requirements of the international convention for SAFETY OF LIFE AT SEA, 1974 (SOLAS), which states that on board all ships above 300 tons gross tonnage there must be continuous listening on the radiotelephonic emergency frequency 2182 kHz.

SAILOR R501 complies with the technical regulation from CEPT and requirements from national authorities.

SAILOR R501 is a single channel telephony receiver intended for reception of A2, A2H, A3 and A3H signals on the international emergency frequency 2182 kHz.

SAILOR R501 is provided with an automatic volume control ensuring that the receiver is muted, until a two-tone alarm signal or a navigation warning signal is received by which the manual volume control is connected and all traffic is heard from the loudspeaker.

SAILOR R501 has a built-in timing unit ensuring that the manual volume control is reconnected during the radiotelephonic silence periods; all traffic is heard from the loudspeaker.

SAILOR R501 has a built-in test tone generator, which is able to test the function of the tone decoder unit.

SAILOR R501 is built into an all-welded steel cabinet with anti-rust coated surfaces and nylon finish. Knobs and handles are made of solid bright chromium-plated brass.

TECHNICAL DATA

SAILOR R501 is a single channel receiver with crystal controlled receiver frequency.

Frequency:	2182 kHz fixed tuned
IF frequency:	334,582 kHz
Crystal frequency:	2516,582 kHz
Stability: long term:	Better than 3 ppm per year
Temperature: 0-50°C :	Better than 10 ppm
AF bandwidth:	Min. pass band -6 dB: 300 to 2800 Hz Min. attenuation -20 dB: 5 kHz
Sensitivity, 10 dB SN/N:	<20 dB/1 uV
Adjacent channel selectivity:	40 dB at -10 and +10 kHz 50 dB at -20 and +20 kHz
Blocking:	wanted signal 60 dB/1 uV blocking level >100 dB/1 uV
Cross modulation:	wanted signal 60 dB/1 uV cross modulation level >90 dB/1 uV
Intermodulation:	3rd order intermodulation Δf = 30 kHz intermodulation level >80 dB/1 uV
Operation temperature range:	-15°C to +55°C
Spurious rejection:	image rejection >80 dB IF rejection >90 dB all others >80 dB
Spurious emission:	P_{out} <1 nW into 10 ohm
Output power:	1 W into 8 ohm

Automatic gain control:

An increase of 70 dB from 30 dB/1 uV to 100 dB/1 uV of the input level causes an increase of not more than 10 dB in the AF output level.

Power supply:

24V DC ±10%	Mute on: 0,1A Mute off: 0,35A

TECHNICAL DATA cont.:

220V or 237V AC ±10%	Mute on:	0,01A
	Mute off:	0,04A
110V or 127V AC ±10%	Mute on:	0,02A
	Mute off:	0,08A

Muting device:

The receiver is provided with a muting device to silence the loudspeaker until one of the following signals is received:

a: the radiotelephone alarm signal
b: the navigational warning signal.

The RF input level at which the receiver can be switched from muted to normal receiving mode (traffic is heard from the loudspeaker), when receiving the signal a. or b., is less than 15 dB/uV for a modulation depth of 70%.

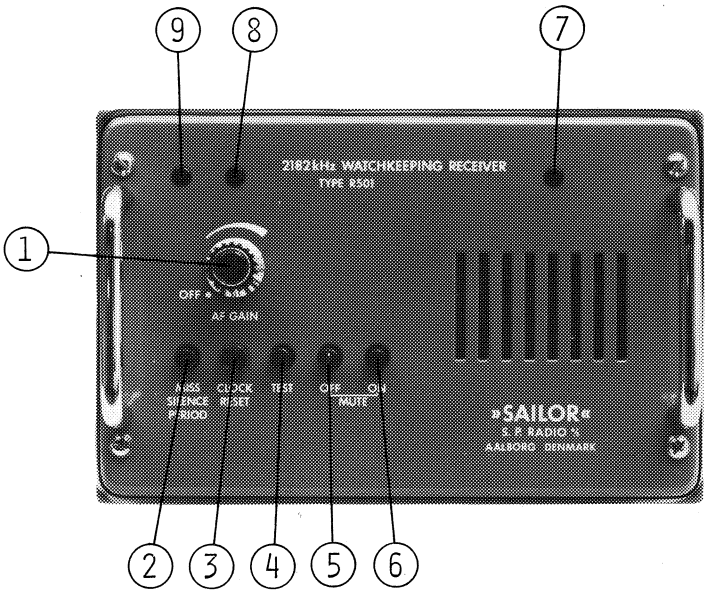
Timing device:

The receiver is provided with a timing device which automatically causes the mute to be lifted (traffic is heard from the loudspeaker) for the duration of the radiotelephone silence periods.

By means of a front plate control the facility can be taken out of operation at any time.

The stability of the timing device is better than 5 seconds in a month.

CONTROLS



(1) AF GAIN

With main switch and continuous volume control.

(2) MISS SILENCE PERIOD

When the push button is activated, the receiver is also muted during the radiotelephone silence periods.

When the push button is activated and released the receiver is also muted during the next following radiotelephone silence period.

(3) CLOCK RESET

Resets the internal timer. Is activated at the beginning of a radiotelephone silence period XX.00 or XX.30 hour.

(4) TEST

Starts a built-in tone generator for test of the mute circuit. Activate the push button for 6 seconds and the manual volume control is ON (traffic is heard from the loudspeaker).

CONTROLS cont.:

(5) MUTE OFF

Resets the receiver from muted mode to normal receiving mode (traffic is heard from the loudspeaker).

(6) MUTE ON

Sets the receiver from normal receiving mode to muted mode (the loudspeaker is silent).

(7) AERIAL TUNE

Matches the receiver to the aerial.

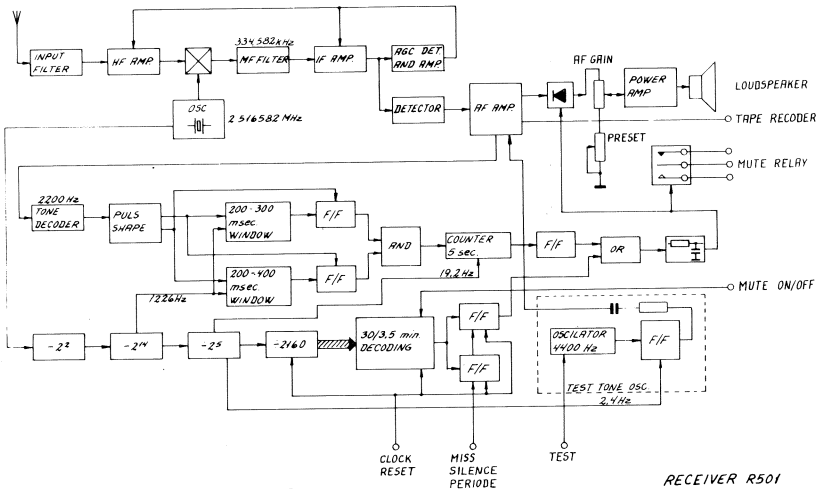
(8) TAPE RECORDER LEVEL

Preset of the AF output to the tape recorder.

(9) AF GAIN PRESET

Preset of the minimum of AF output level.

PRINCIPLE OF OPERATION



RECEIVER R501

The SAILOR R501 is a superheterodyne receiver using an IF of 334.6 kHz and is capable of receiving emissions of classes A2, A2H, A3 and A3H on the frequency 2182 kHz.

The input from the antenna is fed via a tuned circuit and a low gain RF amplifier to a mixer where the RF signal is mixed with the f_{LO} signal having the frequency of 2.516582 MHz, giving an IF signal of 334.582 kHz. This signal is fed via a tuned IF filter and a high gain IF amplifier to the AGC detector and amplifier and to the AF detector. The resulting AGC DC voltage is fed to the RF and IF amplifier regulating the gain. The signal from the AF detector is fed via a muting diode and the AF output amplifier to the loudspeaker. The AF detector signal is also fed via an amplifier to the tape recorder output terminals and to the tone decoder.

The tone decoder is selecting the wanted signal from the general traffic. The tone decoder is activated by the 2200 Hz signal and the 1300 Hz signal is seen as a space. The tone decoder output is pulse shaped and fed to two separate discriminators, one checks the length of the 2200 Hz signal and the other checks the length of the space. Are both the signal and the space

PRINCIPLE OF OPERATION cont.:

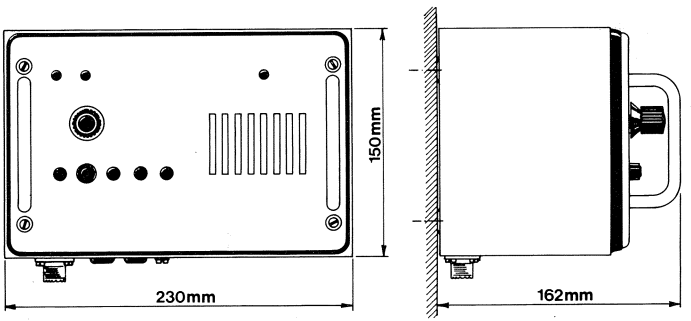
length correct the 5 seconds counter is started and after a period of 5 seconds correct signal and space a Flip/Flop is set, which opens the mute diode and the AF signal is fed via the output amplifier to the loudspeaker. By a push button on the front plate the Flip/Flop can be reset, closing the mute diode.

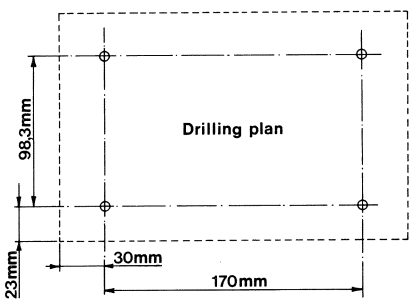
The f_{LO} signal is fed via a divider to a decoding unit. The output signal from the decoding unit is fed to a Flip/Flop, which by this signal is set for 3.5 minutes every 30 minutes. The Flip/Flop output signal in the set mode opens the mute diode and the AF signal is fed via the output amplifier to the loudspeaker. By a push button on the front plate the decoding unit is reset to open the mute diode during the radiotelephone silence periods. The facility can be taken out of operation at any time by resetting a Flip/Flop by means of a front plate push button.

A built-in test tone generator feeds a signal similar to the navigational warning signal to the 2200 Hz tone decoding unit. When the test push button on the front plate is activated for 6 seconds the mute diode opens and the entire logic decoding circuit has been tested.

INSTALLATION

SAILOR R501 Watch Keeping Receiver is because of its small external dimensions easy to install on a bulkhead, ceiling or panel.

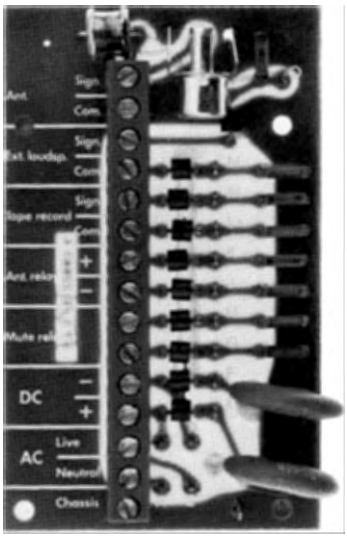




For mounting, dismantle the four screws on the front plate and disconnect the power and coaxial plug placed inside the cabinet. The four holes seen at the bottum of the cabinet should be used for mounting the cabinet on the bulkhead, ceiling or panel.

INTERCONNECTION BOARD

The external connections to the SAILOR R501 are attached to the connection board placed inside the receiver cabinet.



ANT: Connected to the external antenna plug.

EXT. LOUDSPEAKER: An external 8 ohms loudspeaker may be connected to this two terminals.

TAPE RECORDER: AF output intended for tape recorder, output level is adjusted from the front plate.
OUTPUT: 0.3V_{RMS} by R_g = 2 kohm.

ANT. RELAY: (ANT.MUTE RELAY) The terminals are connected to the antenna relay coil. When connected to 24V DC the antenna input terminal is connected to chassis.
24V DC/40 mA.

MUTE RELAY: The two terminals are short-circuited when MUTE ON.
Intended for automatic start and stop of tape recorder.
Can also be used to activate an external alarm bell.
Max. 24V DC/1 Amp.

DC: Is the receiver supplied with a DC power supply the external 24V DC mains is connected to these two terminals.

AC: Is the receiver supplied with an AC power supply, the external 110-127-220 or 237V AC mains are connected to these two terminals.
By AC mains the terminals marked A-B-C and D must be connected: A to B and C to D.

WARNING! Do not connect an AC mains and a 24V DC mains to the receiver at the same time.

POWER SUPPLY

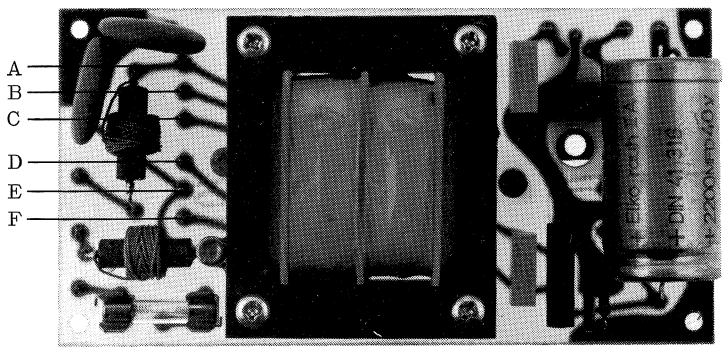
SAILOR R501 can be supplied with a 24V DC power supply unit or an AC power supply unit working on 110-127-220 and 237V AC. The AC and the DC power supply units are mounted on two different printed circuit boards which are interchangeable when wanted.

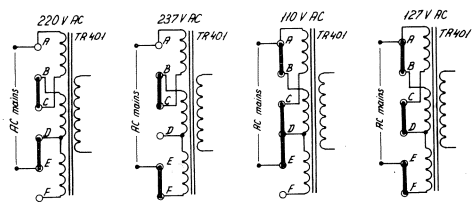
DC POWER SUPPLY

The nominal DC voltage to the DC power supply units is 24 Volt, the minimum input voltage is 18 Volt and the maximum input voltage is 32 Volt.

AC POWER SUPPLY

The AC power supply unit permits operation from 110-127-220 and 237V AC. The six terminal rows located on the power supply p.c. board is interconnected as shown below.





AERIAL AND EARTH LEAD

As aerial use a 5-20 m long wire or a whip aerial of minimum 4 m. The aerial must be placed as high and as clear as possible. The lead from the aerial to the set must be a good quality of coaxial cable ET10M or similar. It is important that the lead-in is as short as possible, and not laid near other electric cables.

The earth wire, insulated copper wire not less than 2.5 sq. mm. thick, should be connected to the hull (in iron vessels) or through a wide copper band to the keel bolt or (in wooden vessels) to a metal plate not less than one sq. m. placed outside the hull and below the water line. The earth wire should be as short as possible. A good earth connection is of decisive importance for low-noise reception.

All joints should be made by soldering.

The aerial is via the PL259 plug connected to the cabinet and the earth wire is connected to the receiver via the screw on the outside of the cabinet.

AERIAL TUNE

When the receiver is properly installed the aerial must be tuned. This is done by means of the aerial trimmer placed behind the blind cover to the extreme right on the receiver front plate.

For tuning use the following procedure.

1. Press the button MUTE ON.
2. Turn the aerial tune by means of an insulated trimming stick for max. volume of noise or signal.

SETTING OF AF PRESET CONTROL

When the aerial trimmer has been adjusted the AF preset control placed behind the blind cover to the extreme left on the front plate can be adjusted.

1. Turn the AF GAIN to minimum output power.
2. Press the button MUTE ON.
3. Turn the AF preset control by means of an insulated trimming stick to a suitable minimum output power.

SETTING OF AF OUTPUT TO TAPE RECORDER

When a tape recorder is used it is necessary to adjust the AF output to the recorder. The AF output is adjusted by a trimmer placed behind a blind cover on the front plate.

SETTING OF INTERNAL CLOCK CIRCUIT

When the receiver has been installed it is necessary to activate the front plate push button CLOCK RESET to give the internal clock circuit a proper starting time.

Activate the push button at the beginning of a radiotelephone silence period XX.00 or XX.30 hour.

FUNCTION CHECK

When the receiver R501 is installed and the after installation adjustments are done it is necessary to carry out a function check as described below.

1. Turn the POWER ON/OFF switch to its ON position.
   Noise or traffic should be heard from the loudspeaker.
2. Press the MUTE ON push button.
   No noise or traffic should be heard from the loudspeaker.
3. Press the MUTE OFF push button.
   Noise or traffic should be heard from the loudspeaker.
4. Press the MUTE ON push button.
   Press the TEST push button for 6 seconds.
   Noise or traffic should be heard from the loudspeaker.
5. Press the MUTE ON push button.
   Press the RESET push button at the start of a radiotelephone silence period XX.00 or XX.30 hour.
   Noise or traffic should be heard from the loudspeaker for a period of 3 minutes and 35 seconds.
   Press and release the latching switch MISS SILENCE PERIOD.
   One hour after the RESET push button has been pressed, noise or traffic should be heard from the loudspeaker for a period of 3 minutes and 35 seconds.

SERVICE

1. MAINTENANCE
2. NECESSARY TEST EQUIPMENT
3. PERFORMANCE CHECK
4. ADJUSTMENT PROCEDURE

1. MAINTENANCE

When the SAILOR R501 WATCH KEEPING RECEIVER has been correctly installed, the maintenance can, depending on the environment and working hours, be reduced to a monthly function check and to a performance check at the service workshop at intervals not exceeding 5 years. A complete function check list is enclosed in the INSTALLATION section and a complete performance check list is enclosed in the PERFORMANCE CHECK section.
Also inspect the antennas, cables and plugs for mechanical defects, salt deposits, corrosion and any foreign bodies.

Any repair of the set should be followed by a FUNCTION CHECK of the receiver.

NECESSARY TEST EQUIPMENT

OSCILLOSCOPE:	
Bandwidth	0 - 25 MHz
Sensitivity	2mV/cm
Input impedance	1 Mohm//30 pF
Triggering	EXT-INT-ENVELOPE
E.g. Philips	PM3212

PASSIVE PROBE:	
Attenuation	10x
Input resistance DC	10 Mohm
Input capacitance	15 pF
Compensation range	10 pF - 30 pF
E.g. Philips	PM9396

MULTIMETER:	
Ranges	100mV - 30V
Input impedance	10 Mohm
Accuracy (f.s.d.)	$\pm$2%
E.g. Philips	PM2505

AF VOLTMETER:	
Ranges	100mV - 30V
Input impedance	10 Mohm
Accuracy (f.s.d.)	$\pm$5%
Frequency range	100 Hz - 5 kHz
E.g. Philips	PM2505

TONE GENERATOR:	
Frequency range	200 - 3000 Hz
Output	$3V_{RMS}$
Output impedance	$\leq$ 600 ohm
E.g. Philips	PM5107

NECESSARY TEST EQUIPMENT cont.:

SIGNAL GENERATOR:

Frequency range	1 - 3 MHz
Output impedance	50 ohm
Output voltage	1uV -100mV EMF
Modulation	AM, 30%, 1000 Hz
E.g. Philips	PM5326

FREQUENCY COUNTER:

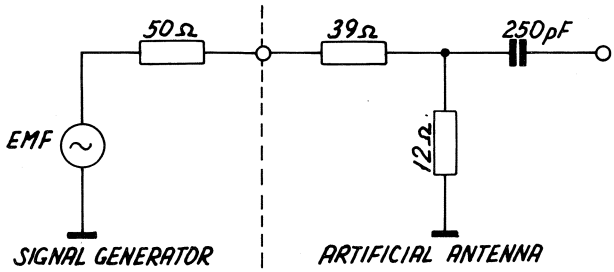
Frequency range	100 Hz - 10 MHz
Resolution	0,1 Hz at f $\geq$ 2 MHz
Accuracy	$1 \cdot 10^{-7}$
Sensitivity	$100mV_{RMS}$
Input impedance	1 Mohm
E.g. Philips	PM6611/03

POWER SUPPLIES:

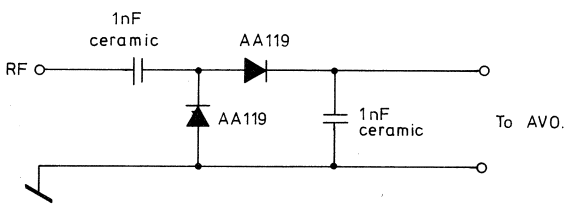
DC:	
V_{out}	24V DC
I_{out}	0,5A DC
E.g. Philips	PE1537
AC:	
V_{out}/I_{out}	220/0,1A
V_{out}/I_{out}	110/0,16A

ARTIFICIAL ANTENNA:

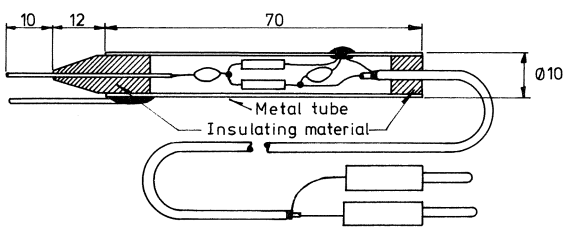
The components of the artificial antenna are a non-inductive resistor of value 10 ohm in series with a capacitor of value 250 pF.



DIODE PROBE:



LAYOUT OF THE PROBE



PERFORMANCE CHECK

Connect the signal generator through the artificial antenna to the receiver antenna input terminals, signal generator frequency f_G = 2182 kHz, EMF output voltage V_G at -53 dBm ≃60 dB/uV ≃ 1 mV_{RMS} modulation to 30% with a 1 kHz tone from the tone generator.

CHECK OF +15V REGULATOR

1. Connect the voltmeter to the terminal of the red wire on the decoder board.
2. Check that the voltage is 15V ±0,75V.

CHECK OF +5V REGULATOR

1. Connect the voltmeter to the terminal of the yellow and red wire on the decoder board.
2. Check that the voltage is 5V ±0,25V.

CHECK OF LOCAL OSCILLATOR FREQUENCY

1. Connect the counter to the f_{LO} output terminals on the receiver board.
2. Check that the frequency is 2.516.582 ±1 Hz.

CHECK OF LOCAL OSCILLATOR OUTPUT VOLTAGES

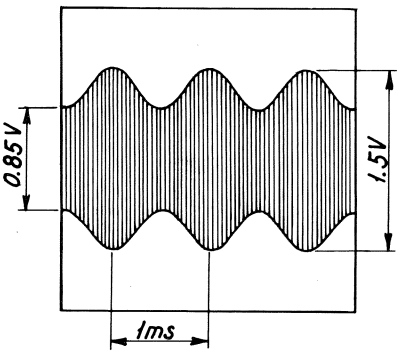
1. Connect the diode probe to pin 4 of IC101.
2. Measure: 1.1V ±0,3V.
3. Connect the diode probe to the f_{LO} output terminals on the receiver board.
4. Measure: 3,5V ±0,5V.

CHECK OF DETECTOR LEVEL

1. Connect the diode probe to pin 7 of IC101.
2. Measure: 1,2V ±0,3V.

PERFORMANCE CHECK cont.:

3. Connect the passive probe to pin 7 of IC101.
4. Measure on an oscilloscope.



5. Connect the AF voltmeter to the joint R134/C159.
6. Measure: $0.1V_{RMS} \pm 0,03V_{RMS}$.

CHECK OF AF OUTPUTS

1. Connect the AF voltmeter to the tone decoder output terminal (brown wire) on the receiver board.
2. Measure: $0,2V_{RMS} \pm 0,05V_{RMS}$.
3. Connect the AF voltmeter to the tape recorder output terminal (grey/blue wire) on the receiver board.
4. Measure: $0,6V_{RMS} \pm 0,15V_{RMS}$ with R153 adjusted for maximum output.
5. Connect the AF voltmeter to the loudspeaker output terminal (red/black wire) on the receiver board.
6. Press the MUTE OFF push button.
   Adjust AF GAIN to minimum output voltages.
   Adjust R125 to minimum output voltage.
7. Measure: $0,18V_{RMS} \pm 0,04V_{RMS}$.
8. Adjust R125 and AF GAIN to maximum output voltage.
9. Measure: $3,4V_{RMS} \pm 0,4V_{RMS}$.
10. Press the MUTE ON push button and the loudspeaker is silent.

PERFORMANCE CHECK cont.:

CHECK OF SENSITIVITY

1. Adjust the signal generator output voltage V_G to -74,5 dBm ≃ 38,5 dB/uV ≃ 84 uV_{RMS}.
2. Press the MUTE OFF push button.
3. Adjust the AF output voltage by means of the AF GAIN to 250 mV_{RMS}.
4. Switch the modulation tone off.
5. Switch the AF voltmeter to the 100 mV range.
6. Measure: AF output noise level less than 80 mV_{RMS}.

CHECK OF AGC

1. Switch the modulation tone on again.
2. Switch the AF voltmeter to the 1 V_{RMS} range.
3. Adjust the signal generator output voltage V_G to -13 dBm ≃ 100 dB/uV ≃100 mV_{RMS}.
4. Measure: AF output voltage level less than 0,6 V_{RMS}.
5. Connect the passive probe to the oscilloscope and to the loudspeaker output terminal (red/black wire) on the receiver board.
6. Adjust the AF output voltage by means of the AF GAIN until the voltage is 6 V_{PP}.
   Now a sinusoidal signal is seen, distortion is typical around 3%.

CHECK OF AF BANDWIDTH

1. Adjust the AF output voltage by means of the AF GAIN to 250 mV_{RMS}.
2. Turn the frequency of the AF tone generator to 2700 Hz.
3. Measure: AF output voltage greater than 130 mV_{RMS}.
4. Turn the frequency of the AF tone generator to 350 Hz.
5. Measure: AF output voltage greater than 130 mV_{RMS}.

CHECK OF ANTENNA RELAY

1. Connect 24V DC to the antenna relay terminals placed on the interconnection board.
2. Adjust the signal generator output voltage V_G to -40 dBm ≃ 73 dB/uV ≃4,5mV$_{RMS}$.
3. Press the push button MUTE OFF noise and no AF tone is heard from the loudspeaker.
4. Disconnect the 24V DC to the antenna relay.
5. A 350 Hz tone is heard from the loudspeaker.

CHECK OF 30 MINUTES GENERATOR

1. Disconnect the link between pin 5 of IC206 and pin 10 of IC209.
2. Connect pin 1 of IC206 and pin 10 of IC209.
3. Turn the frequency of the tone generator to 1 kHz.
4. Press the MUTE ON push button and thereafter the RESET push button.
5. Control that the receiver is switched to the MUTE OFF mode when the RESET push button is activated and that it stays in that mode for 6,7 seconds. Thereafter the receiver goes to the MUTE ON mode for 49,6 seconds and thereafter to the MUTE OFF mode for 6,7 seconds and this sequence continues.
6. Press and release the MISS SILENCE PERIOD push button when the receiver is in the MUTE ON mode. The next following MUTE OFF period will be missing and thereafter the receiver will continue with the sequence mentioned in point 5.
7. Disconnect the link between pin 1 of IC206 and pin 10 of IC209.
8. Connect pin 5 of IC206 to pin 10 of IC209.
9. Press the MUTE ON push button and thereafter the RESET push button.
10. Control that the receiver is switched to the MUTE OFF mode when the RESET push button is activated and that it stays in this mode for 3 minutes and 35 seconds.

PERFORMANCE CHECK cont.:

CHECK OF THE FREQUENCY DECODER

1. Connect the passive probe to pin 8 of IC202 and to the oscilloscope.
2. Control that the voltage level at pin 8 is 5V DC.
3. Turn the frequency of the tone generator to 2050 Hz.
4. Control that the voltage level at pin 8 is 0V DC.
5. Turn the frequency of the AF tone generator to 2350 Hz.
6. Control that the voltage level at pin 8 is 0V DC.
7. Turn the frequency of the AF tone generator to 2400 Hz.
8. Control that the voltage level at pin 8 is 5V DC.

CHECK OF THE TEST TONE GENERATOR

1. Connect the passive probe to pin 3 of IC205 and to the counter.
2. Press the TEST push button and measure the frequency 4400 Hz $\pm$10 Hz.
3. Connect the passive probe to pin 13 of IC203 and to the oscilloscope.
4. Press the TEST push button and control that the 2200 Hz tone pulses have a length of 208 msecs.and that the gap between the 2200 Hz tone pulses is 208 msecs.

CHECK OF TONE DECODER

1. Press the TEST push button and a signal similar to the navigational warning signal is heard from the loudspeaker.
2. Press the MUTE ON push button.
3. Press the TEST push button for 6 seconds.
4. When the TEST push button is released a 2400 Hz tone is heard from the loudspeaker.

ADJUSTMENT PROCEDURE

The adjustment procedure described below is carried out with the equipment described in the NECESSARY TEST EQUIPMENT section.

ADJUSTMENT OF RF INPUT FILTER

1. Connect the signal generator through the artificial antenna to the input terminals, signal generator frequency f_G at 2182 kHz, EMF output voltage V_G at -70 dBm $\simeq$43 dB/μV $\simeq$ 140 μV_{RMS}.
2. Connect a DC meter to the joint R128/D105.
   Meter range: 300 mV DC.
3. Adjust AERIAL TUNE to its center position.
4. Adjust the screw cores of L103, L105 and L107 to be 1 mm above the coil formers.
5. Adjust the screw cores of L103, L105 and L107, by means of an insulated trimming stick, to maximum meter reading (approx. 200 - 500 mV).
   The adjustments should be done very carefully to obtain maximum receiver sensitivity.

ADJUSTMENT OF LOCAL OSCILLATOR FREQUENCY

1. Connect the passive probe to the f_{LO} output terminals on the receiver board and connect the probe to the counter.
2. Adjust C103 to f_{LO} = 2516.582 kHz.

ADJUSTMENT OF IF FILTER

1. Connect the joint of R128 and R132 to ground.
2. Connect the joint of R128 and D105 to a variable DC voltage V_{DC}, $V_{DC} \leq 4V$.
3. Connect the signal generator through the artificial antenna to the antenna input terminals, signal generator frequency f_G = 2182 kHz, EMF output voltages V_G at -40 dBm $\simeq$ 73 dB/uV $\simeq 4{,}5mV_{RMS}$.
4. Connect diode probe to pin 7 of IC101. Diode probe connected to multimeter range 100 mV DC.
5. Adjust the screw cores of L101 and L108 to be in level with the top of the coil formers.

ADJUSTMENT PROCEDURE cont.:

6. Adjust the screw cores of L101, L102, L104, L106 and L108 to maximum meter reading in the 3V range.
   When the DC meter reading is above 2,5V DC, adjust the DC voltage connected to the joint R128 and D105 until the meter reading is below 2,5V DC.
7. Set f_C = 2185,5 kHz, adjust the screw cores of L102, L104 and L106 until the meter reading is 6 dB below the point 6 meter reading. Beware that the point 6 meter reading do not change more than 1 dB.
8. Set f_C = 2178,5 kHz, adjust the screw cores of L102, L104 and L106 to a meter reading 6 dB below the point 6 meter reading. Beware that the point 6 meter reading do not change more than 1 dB.
9. Repeat point 7 and 8 and control the point 6 meter reading.

ADJUSTMENT OF FREQUENCY DECODER IC202

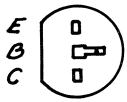
1. Connect an AF tone generator to the modulation input terminals of the signal generator.
2. Connect the signal generator through the artificial antenna to the antenna input terminals, signal generator frequency f_G = 2182 kHz, EMF output voltages V_G at -40 dBm $\simeq$ 73 dB/uV $\simeq 4,5mV_{RMS}$, modulated to 30% with a 1 kHz tone from the tone generator.
3. Connect the passive probe to pin 8 of IC202 or to the joint R202/R205 and to an oscilloscope adjusted to show 5V DC.
4. Adjust the frequency of the tone generator until a high to low voltage transition is seen on the oscilloscope. R204 is adjusted until this high to low transition takes place at a tone generator frequency of 2050 Hz.
5. Adjust the frequency of the tone generator until a low to high transition is seen on the oscilloscope. R204 is adjusted until this low to high transition takes place at a tone generator frequency of 2360 Hz.

ADJUSTMENT OF TEST TONE GENERATOR

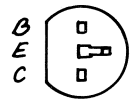
1. Connect the counter to pin 3 of IC205.
2. Press the TEST push button and adjust R209 until the frequency is 4400 Hz.

PIN CONFIGURATIONS

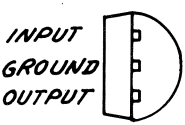
BOTTOM VIEW



BC238B
BC548B
BC558C

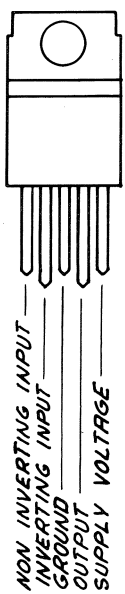


BF199

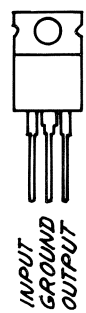


LM78L05ACZ

FRONT VIEW



TDA2002

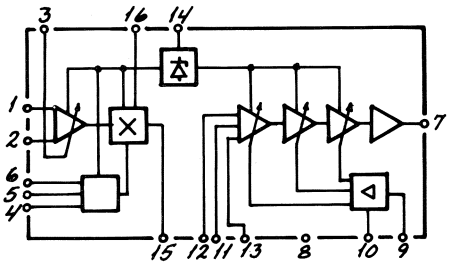


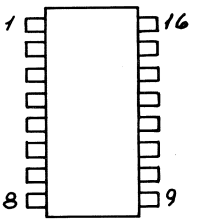
LM340T-15

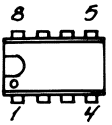
PIN CONFIGURATIONS CONT.:

TOP VIEW

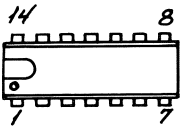
TCA440I



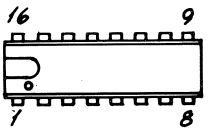




LM555
LM567CN



MC14001BCP
CD4011BE
CD4012BE
CD4013BE
MC14023BCP
MC14024BCP
MC14093CP
DM74LS74N



MC14020BCP
CD4040BE

RECEIVER BOARD (100) R501

Symbol	Description			Manufact.	
R101	Resistor	100Kohm ±5%	0.33W	Philips	2322 211 13104
R102	Resistor	330 ohm ±5%	0.5W	Philips	2322 212 13331
R103	Resistor	15 ohm ±5%	2.5W	Philips	2322 192 31509
R104	Resistor	27Kohm ±5%	0.33W	Philips	2322 211 13273
R105	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R106	Resistor	1Kohm ±5%	0.33W	Philips	2322 211 13102
R107	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R108	Resistor	220 ohm ±5%	0.33W	Philips	2322 211 13221
R109	Resistor	5E6 ohm ±5%	0.33W	Philips	2322 211 13568
R110	Resistor	3.3Kohm ±5%	0.33W	Philips	2322 211 13332
R111	Resistor	4.7Kohm ±5%	0.33W	Philips	2322 211 13472
R112	Resistor	1Kohm ±5%	0.33W	Philips	2322 211 13102
R113	Resistor	33Kohm ±5%	0.33W	Philips	2322 211 13333
R114	Resistor	6.8Kohm ±5%	0.33W	Philips	2322 211 13682
R115	Resistor	1.5Kohm ±5%	0.33W	Philips	2322 211 13152
R116	Resistor	390 ohm ±5%	0.33W	Philips	2322 211 13391
R117	Resistor	150 ohm ±5%	0.33W	Philips	2322 211 13151
R118	Resistor	56 ohm ±5%	0.33W	Philips	2322 211 13569
R119	Resistor	3.9Kohm ±5%	0.33W	Philips	2322 211 13392
R120	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R121	Resistor	220 ohm ±5%	0.33W	Philips	2322 211 13221
R122	Resistor	47 ohm ±5%	0.33W	Philips	2322 211 13479
R123	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R124	Resistor	33Kohm ±5%	0.33W	Philips	2322 211 13333
R125	Potentiometer	4K7 ohm		Noble	$TM8KH_1$ - 1S
R126	Resistor	470 ohm ±5%	0.33W	Philips	2322 211 13471
R127	Resistor	3K3 ohm ±5%	0.33W	Philips	2322 211 13332
R128	Resistor	1Kohm ±5%	0.33W	Philips	2322 211 13102
R129	Resistor	1Mohm ±5%	0.33W	Philips	2322 211 13105
R130	Resistor	82Kohm ±5%	0.33W	Philips	2322 211 13823
R131	Resistor	1Kohm ±5%	0.33W	Philips	2322 211 13102
R132	Potentiometer	10Kohm ±5%		A.B.Elec.	VC10
R133	Resistor	5E6 ohm ±5%	0.33W	Philips	2322 211 13568
R134	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R135	Resistor	100Kohm ±5%	0.33W	Philips	2322 211 13104
R136	Resistor	1Kohm ±5%	0.33W	Philips	2322 211 13102
R137	Resistor	82Kohm ±5%	0.33W	Philips	2322 211 13823
R138	Resistor	12Kohm ±5%	0.33W	Philips	2322 211 13123
R139	Resistor	1.5Kohm ±5%	0.33W	Philips	2322 211 13152
R140	Resistor	1Kohm ±5%	0.33W	Philips	2322 211 13102

RECEIVER BOARD (100) R501

Symbol	Description		Manufact.	
R141	Resistor 33Kohm ±5%	0.33W	Philips	2322 211 13333
R142	Resistor 10Kohm ±5%	0.33W	Philips	2322 211 13103
R143	Resistor 680 ohm ±5%	0.33W	Philips	2322 211 13681
R144	Resistor 5E6 ohm ±5%	0.33W	Philips	2322 211 13568
R145	Resistor 4.7Kohm ±5%	0.33W	Philips	2322 211 13472
R146	Resistor 47Kohm ±5%	0.33W	Philips	2322 211 13473
R147	Resistor 47Kohm ±5%	0.33W	Philips	2322 211 13473
R148	Resistor 3.3Kohm ±5%	0.33W	Philips	2322 211 13332
R149	Resistor 10 ohm ±5%	0.5W	Philips	2322 212 13109
R150	Resistor 12 ohm ±5%	0.5W	Philips	2322 212 13129
R151	Resistor 10 ohm ±5%	0.5W	Philips	2322 212 13109
R152	Resistor 12 ohm ±5%	0.5W	Philips	2322 212 13129
R153	Potentiometer 1Kohm		Noble	TM8KH$_1$ - 1S
R154	Resistor 1Kohm ±5%	0.33W	Philips	2322 211 13102
R155	Resistor 10Kohm ±5%	0.33W	Philips	2322 211 13103
R156	Resistor 10Kohm ±5%	0.33W	Philips	2322 211 13103
R157	Resistor 10Kohm ±5%	0.33W	Philips	2322 211 13103
R158	Resistor 10Kohm ±5%	0.33W	Philips	2322 106 13103
R159	Resistor 180 Kohm ±5%	0.33W	Philips	2322 211 13184
C101	Capacitor polyester 0.1uF±20%	250V	Philips	2222 344 40104
C102	Capacitor polyester 0.1uF±20%	250V	Philips	2222 344 40104
C103	Capacitor trim. 2-18pF	100V	DAU	107-2901-018
C104	Capacitor polystyrene 3n3F ±5%	63V	Philips	2222 425 23302
C105	Capacitor electrolyt 4u7F±20%	50V	ROE	EKI00AA147H
C106	Capacitor polystyrene 560pF±5%	250V	Philips	2222 426 25601
C107	Capacitor ceramic 22pF±5%	500V	KCK	HM60SJCH220J
C108	Capacitor ceramic 51pF±5%	50V	KCK	HE60SJCH510J
C109	Capacitor trim. 5-60pF	100V	DAU	009-4901-060
C110	Capacitor ceramic 22pF±5%	500V	KCK	HM60SJPH220J
C111	Capacitor ceramic 33pF±5%	500V	KCK	HM74SJPH330J
C112	Capacitor polyester 0.22uF±20%	100V	Philips	2222 344 24224
C113	Capacitor polystyrene 390pF± 5%	630V	Philips	2222 427 23901
C114	Capacitor polystyrene 390pF± 5%	630V	Philips	2222 427 23901
C115	Not used			
C116	Capacitor ceramic 39pF± 5%	50V	KCK	HE50SJCH390J
C117	Capacitor electrolyt 10uF±20%	35V	ROE	EKI00AA210H
C118	Capacitor ceramic op68±0,25pF	250V	Ferroperm	9/0110.9
C119	Capacitor polyester 0.1uF ±20%	100V	Philips	2222 344 24104
C120	Capacitor polystyrene 3n3F ± 5%	63V	Philips	2222 425 23302

RECEIVER BOARD (100) R501

Symbol	Description			Manufact.	
C121	Capacitor ceramic	100pF ± 5%	500V	KCK	HM11SJPH101J
C122	Capacitor electrolyt	4u7F ±20%	50V	ROE	EKI00AA147H
C123	Capacitor ceramic	10nF -20/+80	50V	KCK	HE50SJYF103Z
C124	Capacitor ceramic	39pF ± 5%	50V	KCK	HE50SJCH390J
C125	Capacitor ceramic	op68 ±0.25pF	250V	Ferroperm	9/0110.9
C126	Capacitor polystyrene	3n3F ± 5%	63V	Philips	2222 425 23302
C127	Capacitor ceramic	100pF ± 5%	500V	KCK	HM11SJPH101J
C128	Capacitor ceramic	8pF ±0.5pF	50V	KCK	HE40SJCH080D
C129	Capacitor ceramic	51pF ±5%	50V	KCK	HE60SJCH510J
C130	Capacitor polystyrene	2n4F ±5%	63V	Philips	2222 425 22402
C131	Capacitor polystyrene	3n3F ±5%	63V	Philips	2222 425 23302
C132	Capacitor polyester	0.1uF±20%	100V	Philips	2222 344 24104
C133	Capacitor polystyrene	1n0F ± 5%	63V	Philips	2222 425 21002
C134	Capacitor electrolyt	4u7F ±20%	50V	ROE	EKI00AA147H
C135	Capacitor polyester	0.1uF±20%	100V	Philips	2222 344 24104
C136	Capacitor ceramic	10nF-20/+80%	50V	KCK	HE70SJYF103Z
C137	Capacitor polyester	0.1uF ±20%	100V	Philips	2222 344 24104
C138	Capacitor electrolyt	4u7F ±20%	50V	ROE	EKI00AA147H
C139	Capacitor polyester	0.1uF ±20%	100V	Philips	2222 344 24104
C140	Capacitor polyester	0.1uF ±20%	100V	Philips	2222 344 24104
C141	Capacitor electrolyt	4u7F ± 20%	50V	ROE	EKI00AA147H
C142	Capacitor electrolyt	4u7F ± 20%	50V	ROE	EKI00AA147H
C143	Capacitor electrolyt	10uF ± 20%	35V	ROE	EKI00AA210H
C144	Capacitor electrolyt	4u7F ± 20%	50V	ROE	EKI00AA147H
C145	Capacitor electrolyt	4u7F ± 20%	50V	ROE	EKI00AA147H
C146	Capacitor electrolyt	47uF ± 20%	35V	ROE	EKI00AA247H
C147	Capacitor electrolyt	0.47uF± 20%	50V	ROE	EKI00AA047H
C148	Capacitor polyester	10nF ± 10%	400V	Philips	2222 344 55103
C149	Capacitor polystyrene	390pF± 5%	630V	Philips	2222 427 23901
C150	Capacitor electrolyt	47uF ± 20%	25V	ROE	EKI00AA247E
C151	Capacitor ceramic	33pF± 5%	500V	KCK	HM74IPH330J
C152	Capacitor ceramic	270pF± 10%	400V	Ferroperm	9/0129.9
C153	Capacitor ceramic	270pF± 10%	400V	Ferroperm	9/0129.9
C154	Capacitor polyester	0.1uF± 10%	100V	Philips	2222 344 24104
C155	Capacitor electrolyt	220uF± 20%	10V	ROE	EKI06CC322C
C156	Capacitor ceramic	270pF± 10%	400V	Ferroperm	9/0129.9
C157	Capacitor ceramic	10nF-20/+80%	50V	KCK	HE70SJYF103Z
C158	Capacitor polyester	0.1uF± 20%	100V	Philips	2222 344 24104
C159	Capacitor ceramic	10nF-20/+80%	50V	KCK	HE70SJYF103Z
C160	Capacitor ceramic	270pF± 10%	400V	Ferroperm	9/0129.9
C161	Capacitor ceramic	10nF-20/+80%	50V	KCK	HE70SJYF103Z

RECEIVER BOARD (100) R501

Symbol	Description		Manufact.	
C162	Capacitor electrolyt	470uF± 20% 16V	ROE	EB00GD347D
C163	Capacitor polyester	10nF± 10% 400V	Philips	2222 344 55103
C164	Capacitor polyester	0.1uF± 20% 100V	Philips	2222 344 24104
C165	Capacitor polyester	15nF± 10% 400V	Philips	2222 344 55153
C166	Capacitor electrolyt	1uF± 20% 50V	ROE	EKI00AA110H
C167	Capacitor polyester	10nF± 10% 400V	Philips	2222 344 55103
C168	Capacitor polyester	10nF± 10% 400V	Philips	2222 344 55103
C169	Capacitor polyester	10nF± 10% 400V	Philips	2222 344 55103
C170	Capacitor electrolyt	1uF± 20% 50V	ROE	EKI00AA110H
C171	Capacitor polyester	470nF± 20% 100V	Philips	2222 344 24474
C172	Capacitor electrolyt	10uF ±20% 35V	ROE	EKI00AA210H
C173	Capacitor polystyrene	3n3F± 5% 63V	Philips	2222 425 23302
L101	Coil	TL144	S.P.	6-0-20659B
L102	Coil	TL003B	S.P.	TL003B
L103	Coil	TL293	S.P.	6-0-22608
L104	Coil	TL003B	S.P.	TL003B
L105	Coil	TL293	S.P.	6-0-22608
L106	Coil	TL003B	S.P.	TL003B
L107	Coil	TL293	S.P.	6-0-22608
L108	Coil	TL292	S.P.	6-0-22607
L109	Coil 470uH ±5%	Kaschke	Trafomo	Bavform 200
RE101	Relay	Takamisawa	ITT	LZ12H/LZ12
X101	Crystal f=2516.582 kHz		Croven	1811 CCCN80-49
D101	Diode		ITT	1N4148
D102	Z - diode 18V		ITT	MZP4746
D103	Diode		ITT	1N4148
D104	Diode		ITT	1N4148
D105	Diode		ITT	1N4148
D106	Diode		ITT	1N4148
D107	Diode		ITT	1N4148
D108	Diode		ITT	1N4148
T101	Transistor		Philips	BF199
T102	Transistor		Philips	BF199
T103	Transistor		Siemens	BC238B
T104	Transistor		Philips	BC558C
T105	Transistor		Siemens	BC238B

RECEIVER BOARD (100) R501

Symbol	*Description*	*Manufact.*	
T106	Transistor	Siemens	BC238B
T107	Transistor	Siemens	BC238B
IC101	Integrated circuit AM radio	Siemens	TCA44I
IC102	Integrated circuit Power-amp.	SGS	TDA2002A

A

TONE DECODE BOARD (200) R501

Symbol	Description			Manufact.	
R201	Resistor	15Kohm ±5%	0.33W	Philips	2322 211 13153
R202	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R203	Resistor	8.2Kohm ±5%	0.33W	Philips	2322 211 13822
R204	Potentiometer	4.7Kohm A.B. Elec.		J.D.F.	HC10-10215
R205	Resistor	150Kohm ±5%	0.33W	Philips	2322 211 13154
R206	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R207	Resistor	5.6Kohm ±5%	0.33W	Philips	2322 211 13562
R208	Resistor	39Kohm ±5%	0.33W	Philips	2322 211 13393
R209	Potentiometer	22Kohm A.B. Elec.		J.D.F.	HC10-10215
R210	Resistor	3.3Kohm ±5%	0.33W	Philips	2322 211 13332
R211	Resistor	150Kohm ±5%	0.33W	Philips	2322 211 13154
R212	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R213	Resistor	150Kohm ±5%	0.33W	Philips	2322 211 13154
R214	Resistor	150Kohm ±5%	0.33W	Philips	2322 211 13154
R215	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R216	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R217	Resistor	5.6Kohm ±5%	0.33W	Philips	2322 211 13562
R218	Resistor	33Kohm ±5%	0.33W	Philips	2322 211 13333
R219	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R220	Resistor	33Kohm ±5%	0.33W	Philips	2322 211 13333
R221	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R222	Resistor	10Kohm ±5%	0.33W	Philips	2322 211 13103
R223	Resistor	330 ohm ±5%	0.33W	Philips	2322 212 13331
R224	Resistor	82Kohm ±5%	0.33W	Philips	2322 211 13823
R225	Resistor	47Kohm ±5%	0.33W	Philips	2322 211 13473
R226	Resistor	22Kohm ±5%	0.33W	Philips	2322 211 13223
R227	Resistor	47Kohm ±5%	0.33W	Philips	2322 211 13473
R228	Resistor	100 Kohm ±5%	0.33W	Philips	2322 211 13104
C201	Capacitor electrolyt	1uF ±20%	50V	ROE	EKI00AA110H
C202	Capacitor tantal	1uF-20/+50%	35V	ERO	ETP1A
C203	Capacitor ceramic	10nF-20/+80%	50V	KCK	HE70SJYF103Z
C204	Capacitor polyester	0.1uF ±10%	100V	Philips	2222 344 25104
C205	Capacitor polyester	0.1uF ±10%	100V	Philips	2222 344 25104
C206	Capacitor electrolyt	4.7uF ±20%	50V	ROE	EKI00AA147H
C207	Capacitor polyester	10nF ±10%	400V	Philips	2222 344 55103
C208	Capacitor polyester	47nF ± 5%	250V	Philips	2222 344 42473
C209	Capacitor ceramic	10nF-20/+80%	50V	KCK	HE70SJYF103Z
C210	Capacitor polyester	10nF ± 5%	400V	Philips	2222 344 53103
C211	Capacitor polyester	33nF ±20%	400V	Philips	2222 344 54333
C212	Capacitor polyester	22nF ±20%	400V	Philips	2222 344 54223

TONE DECODE BOARD (200) R501

Symbol	Description	Manufact.	
C213	Capacitor ceramic 150pF ±10% 50V	KCK	HE40SJYB151K
C214	Capacitor electrolyt 1uF ±20% 50V	ROE	EKI00AA110H
C215	Capacitor electrolyt 1uF ±20% 50V	ROE	EKI00AA110H
C216	Capacitor electrolyt 33uF ±20% 16V	ROE	EKI00AA233D
C217	Capacitor electrolyt 1uF ±20% 50V	ROE	EKI00AA110H
C218	Capacitor ceramic 10nF -20/+80% 50V	KCK	HE70SJYF103Z
RE201	Relay Takamisawa	ITT	LZ12H/LZ12
D201	Diode	ITT	1N4148
D202	Diode	ITT	1N4148
D203	Diode	ITT	1N4148
D204	Diode	Motorola	1N4002
D205	Diode	ITT	1N4148
D206	Diode (For two tones test insert D206)	ITT	1N4148
T201	Transistor	Siemens	BC238B
T202	Transistor	Siemens	BC238B
IC201	Integrated circuit 5V power	National	78L05ACZ
IC202	Integrated circuit Tone decoder	National	LM567CN
IC203	Integrated circuit Data F/F	National	CD4013BE
IC204	Integrated circuit Data F/F	National	DM74LS74N
IC205	Integrated circuit Timer	National	LM555
IC206	Integrated circuit Counter 7 bit	Motorola	MC14024BCP
IC207	Integrated circuit Counter 14 bit	Motorola	MC14020BCP
IC208	Integrated circuit 2 input Schmitt trig	Motorola	MC14093BCP
IC209	Integrated circuit Counter 12 bit	National	CD4040BE
IC210	Integrated circuit 2 input nor	Motorola	MC14001BCP
IC211	Integrated circuit 2 input nand	National	CD4011BE
IC212	Integrated circuit Counter 12 bit	National	CD4040BE
IC213	Integrated circuit 4 input nand	National	CD4012BE
IC214	Integrated circuit 2 input nand	National	CD4011BE
IC215	Integrated circuit Counter 12 bit	National	CD4040BE
IC216	Integrated circuit 2 input nor	Motorola	MC14001BCP
IC217	Integrated circuit Data F/F	National	CD4013BE
IC218	Integrated circuit 3 input nand	Motorola	MC14023BCP
IC219	Integrated circuit Data F/F	National	CD4013BE
IC220	Integrated circuit Counter 7 bit	Motorola	MC14024BCP
IC221	Integrated circuit 2 input nor	Motorola	MC14001BCP
IC222	Integrated circuit 3 input nand	Motorola	MC14023BCP
IC223	Integrated circuit 2 input nand	National	CD4011BE

DC POWER SUPPLY BOARD (300) R501

Symbol	*Description*	*Manufact.*	
R301	Resistor 100Kohm ±5% 0.33W	Philips	2322 211 13104
C301	Capacitor polyester 470nF ±20% 100V	Philips	2222 344 25474
C302	Not used		
C303	Not used		
C304	Capacitor polyester 0.22uF ±20% 100V	Philips	2222 344 24224
C305	Capacitor polyester 0.1uF ±20% 100V	Philips	2222 344 24104
L301	Coil TL079	S.P.	TL079
L302	Coil TL079	S.P.	TL079
F301	Fuse 0.5A	RadioParts	480514
F302	Fuse 0.5A	RadioParts	480514
D301	Diode	Motorola	1N4002
IC301	Integrated circuit 15V power regulator	National	LM340T15

220V AC POWER SUPPLY BOARD (400) R501

Symbol	*Description*	*Manufact.*	
R401	Resistor 100Kohm ±5% 0.33W	Philips	2322 211 13104
C401	Capacitor ceramic 4.7nF 5KV	Ferroperm	9/0138.9
C402	Capacitor ceramic 4.7nF 5KV	Ferroperm	9/0138.9
C403	Capacitor polyester 0.1uF ±20% 100V	Philips	2222 344 24104
C404	Capacitor electrolyt 2200uF 40V	ROE	EG00MG422G
C405	Capacitor polyester 10nF ±10% 400V	Siemens	B32560-D6103K
C406	Capacitor polyester 0.1uF ±20% 100V	Philips	2222 344 24104
L401	Coil TL079	S.P.	TL079
L402	Coil TL079	S.P.	TL079
F401	Fuse 0.16A	RadioParts	480508
TR401	Power transformer	Tradania	TD3899
D401	Integrated circuit diode bridge	Philips	BY179
IC401	Integrated circuit 15V power regulator	National	LM340T15

CONNECTION BOARD (500) R501

Symbol	Description			Manufact.	
C501	Capacitor polyester	10nF ±10%	400V	Siemens	B32560-D3103K
C502	Capacitor polyester	22nF ±10%	250V	Siemens	B32560-D3223K
C503	Capacitor polyester	22nF ±10%	250V	Siemens	B32560-D3223K
C504	Capacitor polyester	22nF ±10%	250V	Siemens	B32560-D3223K
C505	Capacitor polyester	22nF ±10%	250V	Siemens	B32560-D3223K
C506	Capacitor polyester	22nF ±10%	250V	Siemens	B32560-D3223K
C507	Capacitor polyester	22nF ±10%	250V	Siemens	B32560-D3223K
C508	Capacitor polyester	22nF ±10%	250V	Siemens	B32560-D3223K
C509	Capacitor ceramic	4.7nF	5KV	Ferroperm	9/0138.9
C510	Capacitor ceramic	4.7nF	5KV	Ferroperm	9/0138.9
FP501	Ferrit bead	3B		Philips	4322 020 34400
FP502	Ferrit bead	3B		Philips	4322 020 34400
FP503	Ferrit bead	3B		Philips	4322 020 34400
FP504	Ferrit bead	3B		Philips	4322 020 34400
FP505	Ferrit bead	3B		Philips	4322 020 34400
FP506	Ferrit bead	3B		Philips	4322 020 34400
FP507	Ferrit bead	3B		Philips	4322 020 34400
FP508	Ferrit bead	3B		Philips	4322 020 34400
FP509	Ferrit bead	3B		Philips	4322 020 34400
FP510	Ferrit bead	3B		Philips	4322 020 34400
GL501	Neon lamp			Siemens	B1-C90-Q69-X151
J501	Coax jack	ZEHNDER		T.Larsen	172500715
P501	Coax socket	ZEHNDER		T.Larsen	172505893
P502	Terminal row	Wieland		E.F.M.	251121353

MAIN CHASSIS (600) R501

Symbol	*Description*	*Manufact.*	
J601	Power jack	Hirschmann	Leist 100
P601	Power socket	Hirschmann	Bolei 100
P602	Coax socket	K.V.Hansen	S0239
S601	Power Switch/AF gain 10Kohm	Noble	V24L5(10x6.5)S (U12DV-S)14S 10A10Kohm
S602 -S606	Change-over switches	Schadow	5xF17.55-2U O.A.-TA1=AA
SP601	Loudspeaker (8 ohm)	Videbæk	

CIRCUIT DESCRIPTIONS AND COMPONENT LOCATIONS

CIRCUIT DESCRIPTION RECEIVER BOARD (100)

This unit contains the analog signal handling part of the receiver.

INPUT BANDPASS-FILTER

The aerial signal is from the input terminals fed through a three section bandpass-filter to the RF amplifier. The input of the bandpass-filter is protected by a neon lamp GL501 placed on the interconnection board and the diodes D101 and D102 limiting the peak voltage across the coil L103 to 13 Volt. The input filter is tuned to the center frequency 2182 kHz.

RF AMPLIFIER AND MIXER

The RF signal from the bandpass-filter is fed to pin 1 of IC101, which is the input terminal to the RF amplifier and mixer. Pin 16 of IC101 is the mixer output terminal with the IF signal of 334.582 kHz and pin 4 of IC101 is the f_{LO} = 2516.582 kHz input signal to the mixer.

OSCILLATOR

The f_{LO} oscillator signal to the mixer is taken from transistor T102, which acts as emitter follower to the crystal oscillator T101. The crystal oscillator is of the Pierce Colpitts type.

IF FILTER, AMPLIFIER AND DETECTOR

The IF filter is a five-element tuned filter fed by the signal from pin 16 IC101. The filter output signal is fed via capacitor C137 and the IF amplifier located between pin 12 and pin 7 of IC101, to the AF detector transistor T103 and to the AGC amplifier transistor T106.

AGC AMPLIFIER AND DETECTOR

The IF signal amplified by the transistor T106 is peak-rectified by transistor T104 and fed to the capacitors C144 and C150. The resulting DC voltages on C144 is fed to pin 9 of IC101, which is the AGC input pin to the IF stage. When the voltage across C144 is above 0.6 Volt, diode D105 is conducting and the voltage at pin 3 of IC101 increases, regulating the gain of the RF stage. When the IF signal to transistor T104 decreases the transistor is non-conducting and the AGC DC voltage will decrease but at a slow speed because of the charge on capacitor C150. The resistor R132 is adjusted until a proper initial IF gain is obtained. When the TEST button is pressed 5V is fed through R146 to the AGC circuit reducing the gain of the RF and IF stage.

CIRCUIT DESCRIPTION RECEIVER BOARD (100) cont.:

AF AMPLIFIER

From the detector transistor T103 the AF signal is fed to transistor T105. The collector signal is fed to transistor T107 which acts as an emitter follower. The signal fed through resistor R156 is the AF signal fed to the tone decoder. The R153 signal is fed through R154 to the tape recorder output terminal. C172 acts as the common terminal for the tape recorder output.

The AF signal at the emitter of T105 is fed via the mute diode D106 and the RC-filters consisting of R148/C168 and R127/C148 to the AF GAIN potentiometer.

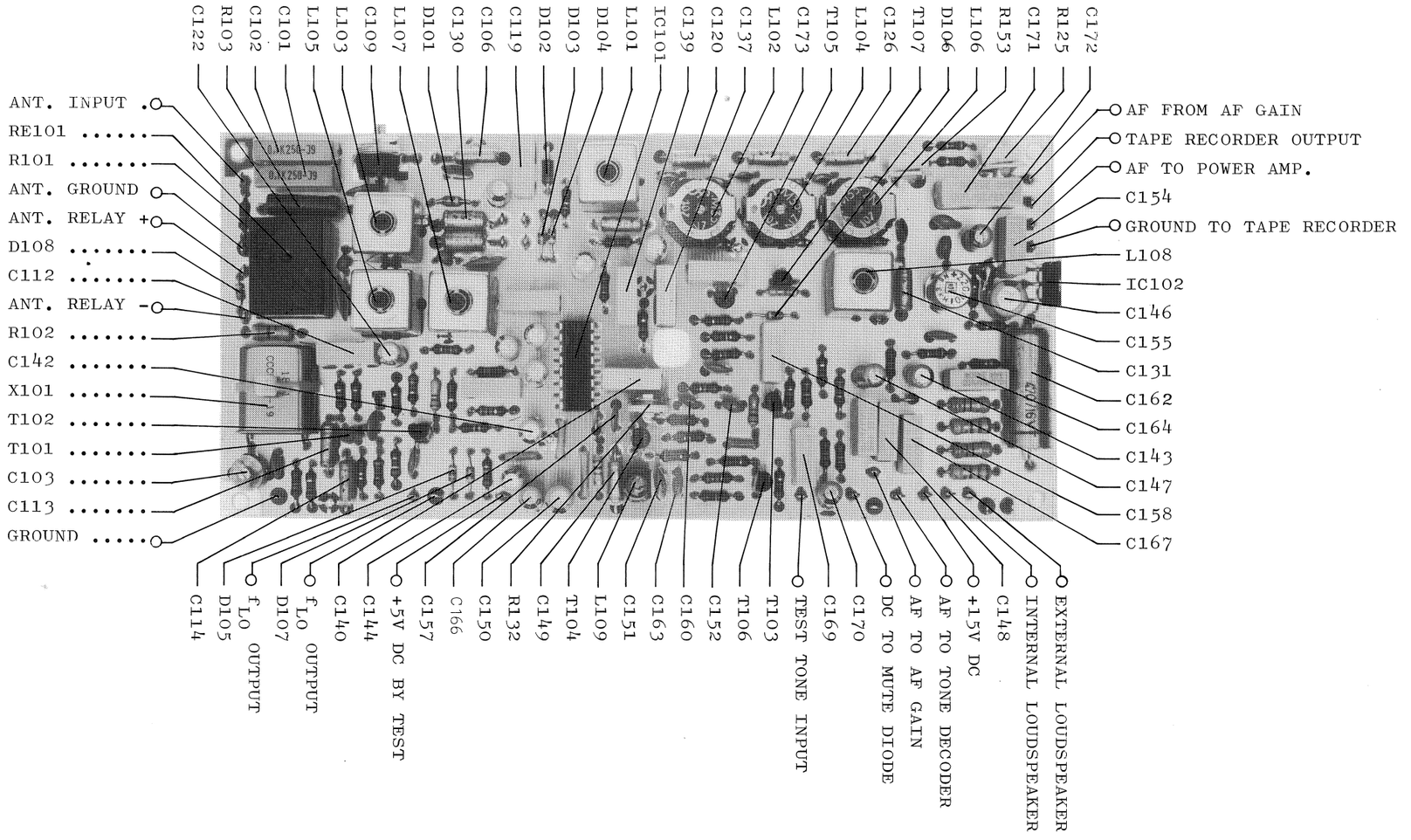
The bottom of the AF GAIN potentiometer is connected to R125, and the midst point of the AF GAIN potentiometer is connected to the input terminal of IC102, which acts as the AF power amplifier. The output of the power amplifier is fed via C162 to the two output terminals, one is used by the internal loudspeaker and the other is used by an external loudspeaker.

MUTE ON/OFF

When MUTE OFF 5 Volt is fed via R157 and R155 to the mute diode D106, which in this mode is forward biased. When MUTE ON the mute input terminal is grounded and the mute diode D106 is reverse biased.

TEST

When the TEST button is activated an AF signal similar to the navigational warning signal is fed via C169/R147 to transistor T105. A 5 Volt DC signal is fed via R146/D107 to the AGC circuit adjusting the gain of the RF and IF stage to minimum.



CIRCUIT DESCRIPTION TONE DECODER BOARD (200)

This printed circuit board contains the digital signal handling part of the receiver.

REFERENCE CLOCK GENERATOR

The local oscillator f_{LO} = 2516.582 kHz signal is from the receiver board fed to the reference divider unit comprising IC204, IC207 and IC206.

30 MINUTES CLOCK GENERATOR

A 1.2 Hz reference signal from the reference divider IC206 pin 5 is fed to a divider by 2160 unit comprising IC209, IC212 , and IC213, IC214. The IC214 pin 11 and pin 3 output goes high when the counter IC209 reaches the number 2160, the pin 3 output resets the counter IC209 to its zero state and a new counter cycle can begin. The pulse of the output of IC214 pin 11 is fed to IC217 as a clock pulse, which transfers the data information to the output terminals of IC217. A high voltage level on IC217 pin 9 is by the clock pulse transferred to a low voltage level on pin 12 which means MUTE OFF. 3.5 minutes later a high voltage level on IC209 pin 12 results in a high voltage level on IC217 pin 10 resetting pin 12 IC219 to its high state, which means MUTE ON.

When the front plate push button MISS SILENCE PERIODE is activated a high voltage level on IC217 pin 4 resets pin 1 IC217 to its low state. This low voltage level is fed to pin 9 with the result that the next clock pulse on pin 11 transfers a high voltage level to pin 12 IC217 and the MUTE OFF state is bypassed, the receiver is muted during the silence periode. The same clock pulse, at pin 3 IC217, sets a high voltage level on pin 1 and this high voltage level is via R214 fed to pin 9 with the result that the receiver during the following silence periode is set in MUTE OFF state.

When the front plate push button CLOCK RESET is activated a high voltage level on pin 6/8 of IC217 and on pin 8/9 of IC214 resets the counter circuit.

MUTE SWITCH CIRCUIT

A low voltage level either on pin 8 or pin 9 of IC223 results in a high voltage level on pin 10. This high voltage level is fed via R218 to charge the capacitor C216, with the result that the emitter voltage of transistor T201 gradually rises to 5V. The emitter signal of transistor T201 is fed to the receiver board as a MUTE OFF signal. The emitter signal also drives transistor T202 which drove the relay RE201.

CIRCUIT DESCRIPTION TONE DECODER BOARD (200) cont.:

FREQUENCY DECODER

IC202 is a FREQUENCY DECODER which is fed by the receiver AF signal at pin 3. The output on pin 8 is low when the frequency of the input AF signal is within the detection bandwidth of the decoder. The detection bandwidth is ±150 Hz and the center frequency is 2200 Hz. The center frequency is adjusted by resistor R204.

The output from pin 8 IC202 is fed via R205 to IC208 which acts as a noise suppressing circuit, the two outputs on pin 4 and 10 of IC208 are in opposition and the output on pin 10 is in phase with the decoder output pin 8. The two outputs of IC208 are fed to the window discriminators.

WINDOW DISCRIMINATORS

The window discriminator consists of two separate circuits. One circuit examines if the length of the 2200 Hz tone pulse is between 195 ms. and 305 ms. and the other circuit examines if the length of the gap between the 2200 Hz pulses is between 195 ms. and 405 ms.

The counter IC212 is inactive until the start of a 2200 Hz tone pulse. It then starts to count 1228 Hz pulses from the reference clock generator, input at pin 10 of IC212. After 195 ms. pin 4 of IC216 goes high which results in a high voltage level on the input of pin 9 of IC219.

Does the end of the 2200 Hz tone pulse fall outside the window, the high voltage level on pin 9 of IC219 remains high until the counter after 305 ms. is stopped by a low voltage level on pin 6 of IC211, this low voltage level is via IC211 fed to pin 13 of IC216 as a high voltage level, and to pin 10 of IC219, resetting the flip/flop IC219. Is the 2200 Hz tone pulse longer than 305 ms. the flip/flop IC219 pin 13 is reset to a low voltage level.

When the end of the 2200 Hz tone pulse falls before the window, or before pin 9 of IC219 goes high, 195 ms. after counter start, a low to high transition at pin 11 of IC219 caused by the end of the 2200 Hz tone pulse will transfer the pin 9 low voltage level to output pin 13. Is the 2200 Hz tone pulse shorter than 195 ms. the flip/flop IC219 pin 13 is kept low.

When the end of the 2200 Hz tone pulse falls inside the window, pin 9 of IC219 is high and a low to high transition at pin 11 of IC219 caused by the end of the 2200 Hz tone pulse will transfer the pin 9 high voltage level to output pin 13.

CIRCUIT DESCRIPTION TONE DECODER BOARD (200) cont.:

Is the 2200 Hz tone pulse inside the discriminator window the flip/flop IC219 pin 13 is kept high.

The operation of the counter IC215 and the gating circuit IC210, IC221 and IC218 are very similar to the operation of IC212, IC211, IC222 and IC216, just described. The counter IC215 controls pin 5 of IC219 so that it is high for a periode between 195 ms. and 405 ms. after the end of a 2200 Hz tone pulse. The flip/flop IC219 output pin 1 is kept high if the gap between the 2200 Hz tone pulses is between 195 ms. and 405 ms.

5 SECONDS TIMER

When the 2200 Hz tone pulses and the gap between those are approved by the window discriminators pin 2 and 8 of IC222 are high, as pin 1 is high too, the output pin 9 is low. This low voltage level is fed to the counter IC220 which starts to count 19.2 Hz pulses received from the reference clock generator at pin 1. If the incoming signal is a valid alarm or navigation warning signal, the pin 2 of IC220 signal remains low and the counter IC220 continues to count pulses until it reaches 178 after 4.6 secs, then IC222 pin 6 goes low stopping the counter and the low to high transition on pin 3 of IC203 sets a low voltage level on pin 2. This low voltage level is via pin 8 of IC223 fed to the receiver board switching the mute diode on, the receiver is in MUTE OFF mode.

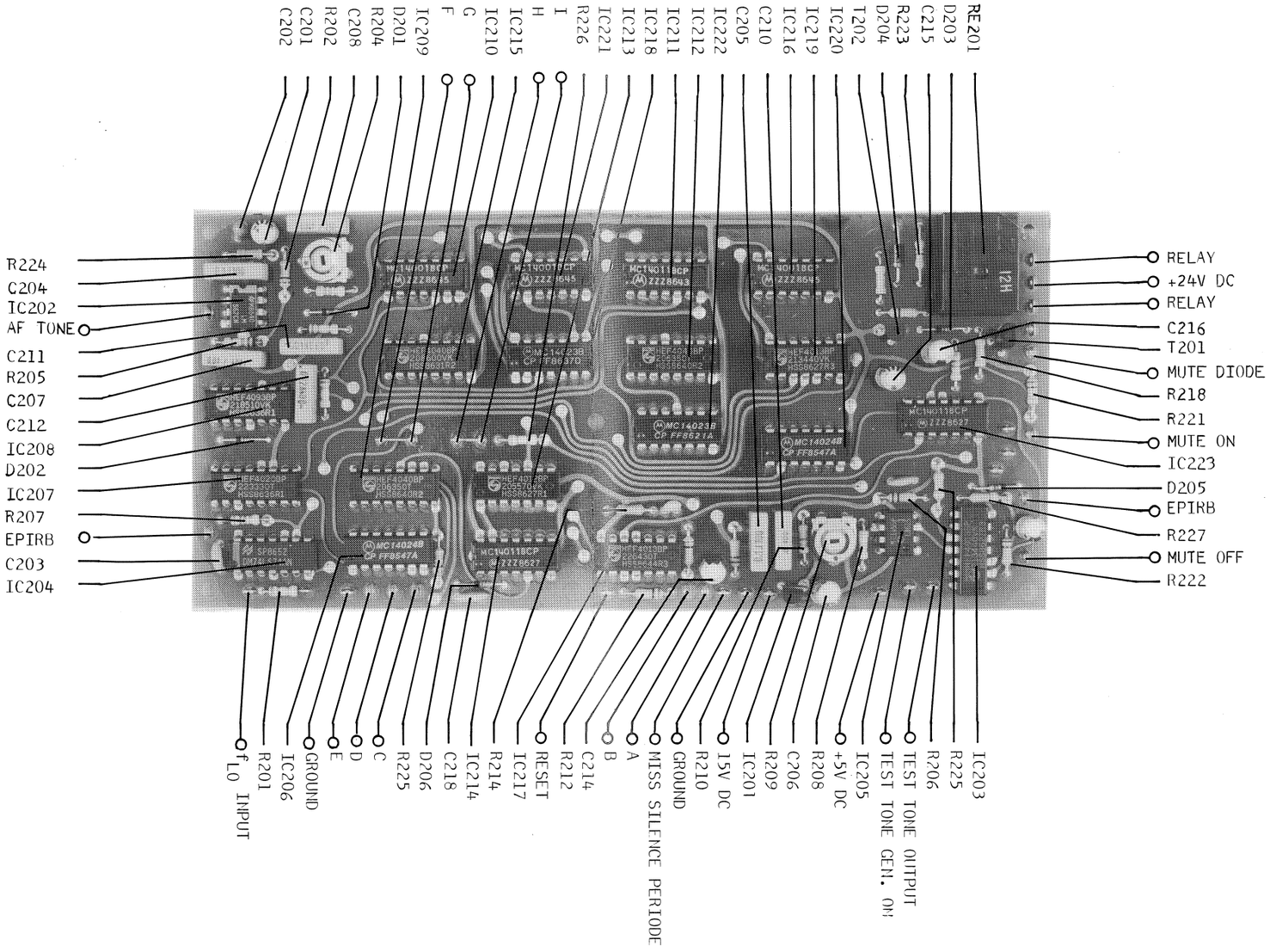
MUTE ON/OFF

The front plate push button MUTE OFF is connected to IC203 pin 6. A high voltage level on pin 6 sets a low voltage level on pin 2. This low voltage level is via pin 8 of IC223 fed to the receiver board, switching the mute diode on, the receiver is in MUTE OFF mode.

The front plate push button MUTE ON is connected to pin 4 of IC203 and to IC223 pin 12/13. A high voltage level on this line sets a high voltage level on pin 2 of IC203 and the mute diode on the receiver board is switched off. A high voltage level on IC223 pin 12/13 resets the counter IC220 and the flip/flop IC217, which interrups the MUTE OFF during a silence periode.

TEST TONE GENERATOR

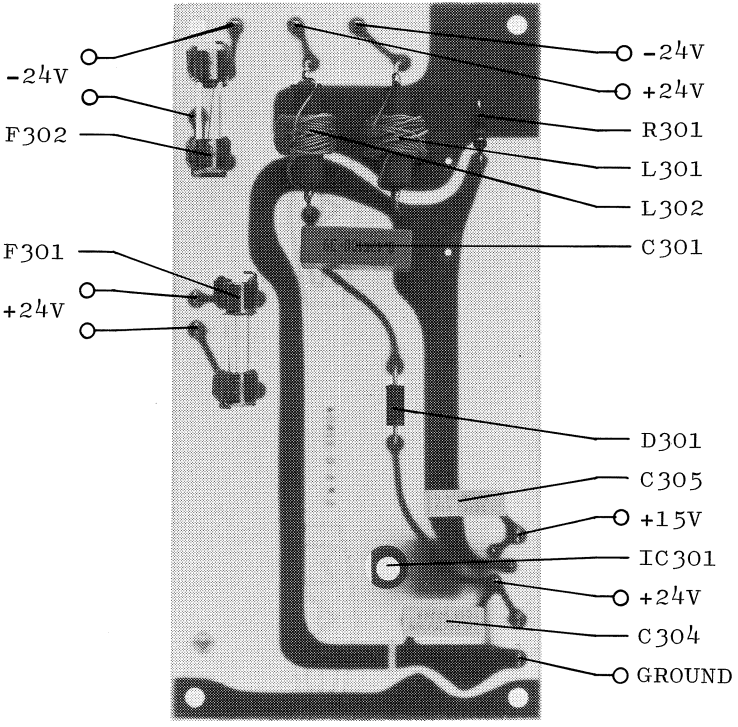
When the front plate push button TEST is activated a high voltage level on pin 4 of IC205 starts the oscillator at the frequency 4400 Hz. The output of IC205 pin 3 is fed to the clock input pin 11 of IC203. This flip/flop is reset at pin 10 by a 2.4 Hz signal from the reference clock generator. The combination of the two signals gives a signal similar to the navigation warning signal at the output pin 13 of IC203.



CIRCUIT DESCRIPTION DC POWER SUPPLY BOARD (300)

The DC mains is from the input terminals fed to two fuses F301/ F302 and via the front plate switch and the noise suppressing circuit L301/L302 and C301 to the diode D301 which gives protection in the event of the DC supply being connected with reversed polarization. The integrated circuit stabilizer IC301 provides a nominal 15V DC output.

If it is wanted to change the DC mains supply to an AC mains supply it is necessary to change the DC mains p.c. board by an AC mains p.c. board. This is easily done because the p.c. boards are interchangeable.

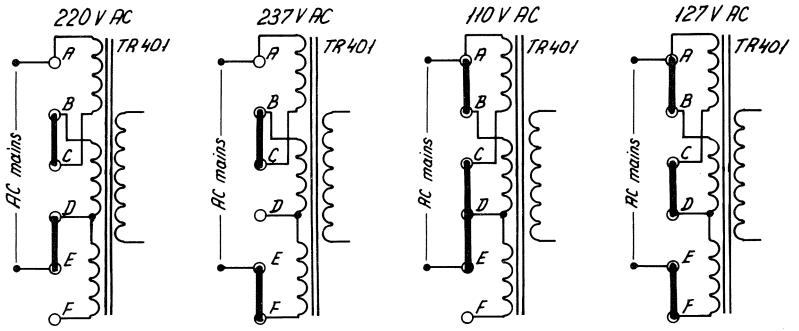

-24V
-24V
F302
F301
+24V
-24V
+24V
R301
L301
L302
C301
D301
C305
+15V
IC301
+24V
C304
GROUND

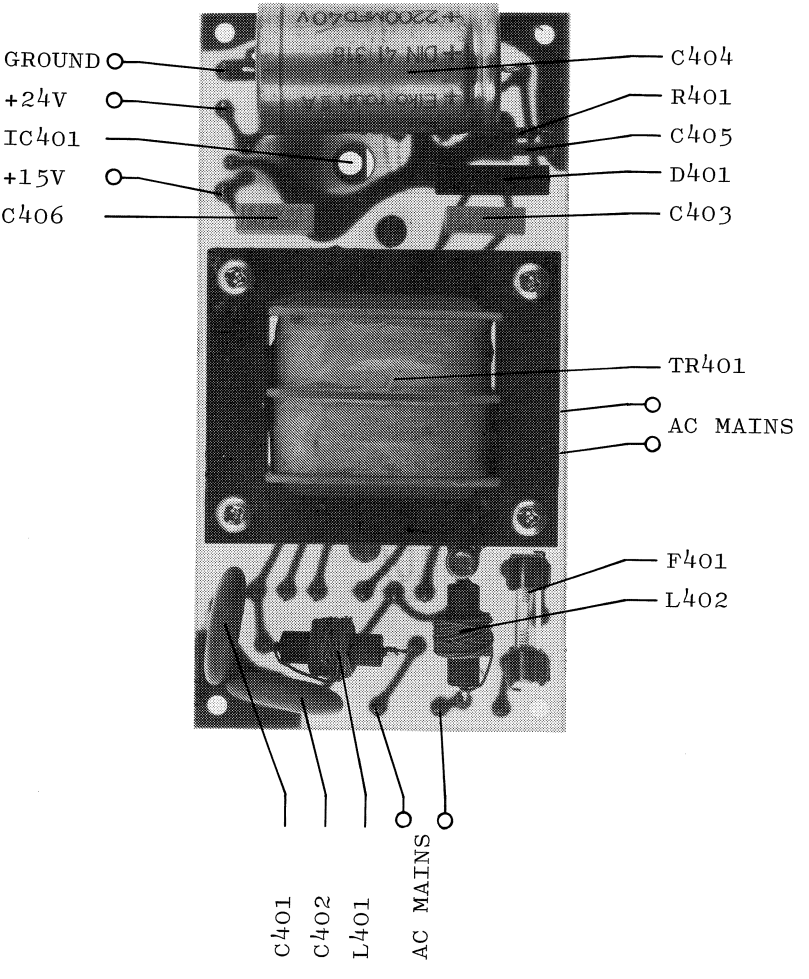
CIRCUIT DESCRIPTION AC POWER SUPPLY BOARD (400)

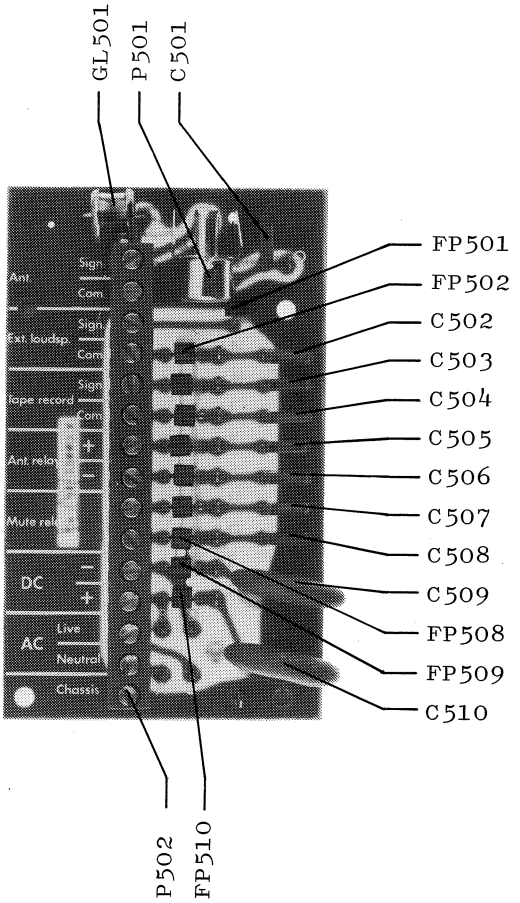
The AC mains is from the input terminal fed to a fuse F401 and a link placed on the POWER SUPPLY p.c. board. From the p.c.b. the AC mains is fed via the front plate switch back to the POWER SUPPLY board. From the noise suppressing circuit L401/L402 and C401/C402 the AC mains is fed via an arrangement of links to the primary winding of TR401. The arrangement of links allows the transformer TR401 to be wired for 110-127-220 and 237V AC mains. The links are arranged as seen below.

The secondary winding of TR401 feeds a full wave rectifier circuit D401. C404 is a reservoir capacitor. The DC voltage at C404 is fed to an integrated circuit stabilizer IC401 which provides a nominal 15V DC output.

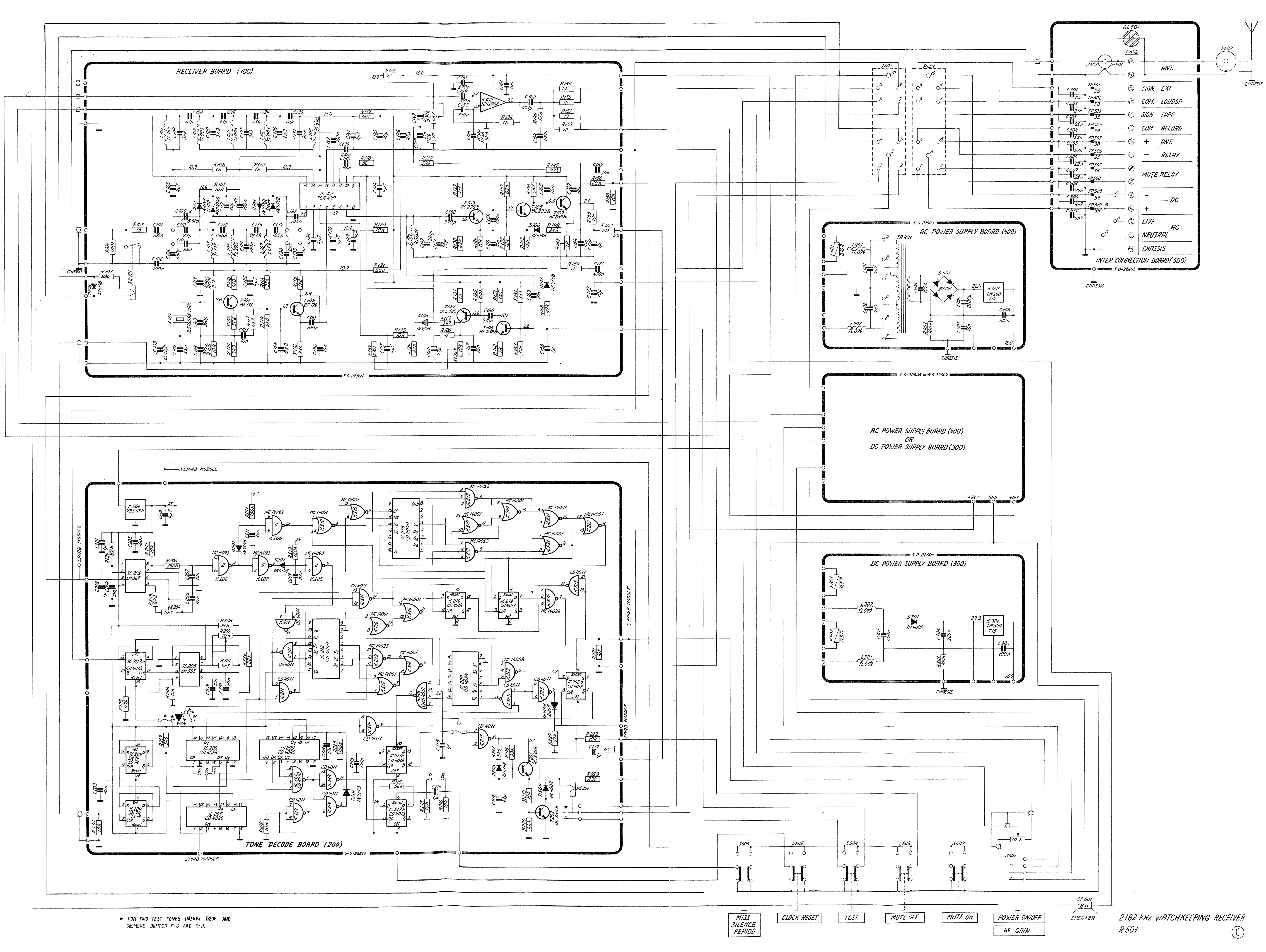
If it is wanted to change the AC mains supply to a DC mains supply it is necessary to change the AC mains p.c. board by a DC mains p.c. board. This is easily done because the p.c. boards are interchangeable.




GROUND
+24V
IC401
+15V
C406
C404
R401
C405
D401
C403
TR401
AC MAINS
F401
L402
C401
C402
L401
AC MAINS


GL501
P501
C501
FP501
FP502
C502
C503
C504
C505
C506
C507
C508
C509
FP508
FP509
C510
P502
FP510
Ant
Sign
Com
Ext. loudsp.
Tape record
Ant. relay
Mute rel
DC
AC
Live
Neutral
Chassis

R501 4-0-22770C



* FOR TWO TEST TONES INSERT D206 AND REMOVE JUMPER F-G AND K-H.

2182 kHz WATCHKEEPING RECEIVER
R501

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