

FIELD AND DEPOT MAINTENANCE MANUAL

RT-3600

RECEIVER-TRANSMITTER, RADIO



PART I

TECHNICAL MANUAL

RECEIVER TRANSMITTER, RADIO RT-3600

PART I TECHNICAL MANUAL

JANUARY 1972



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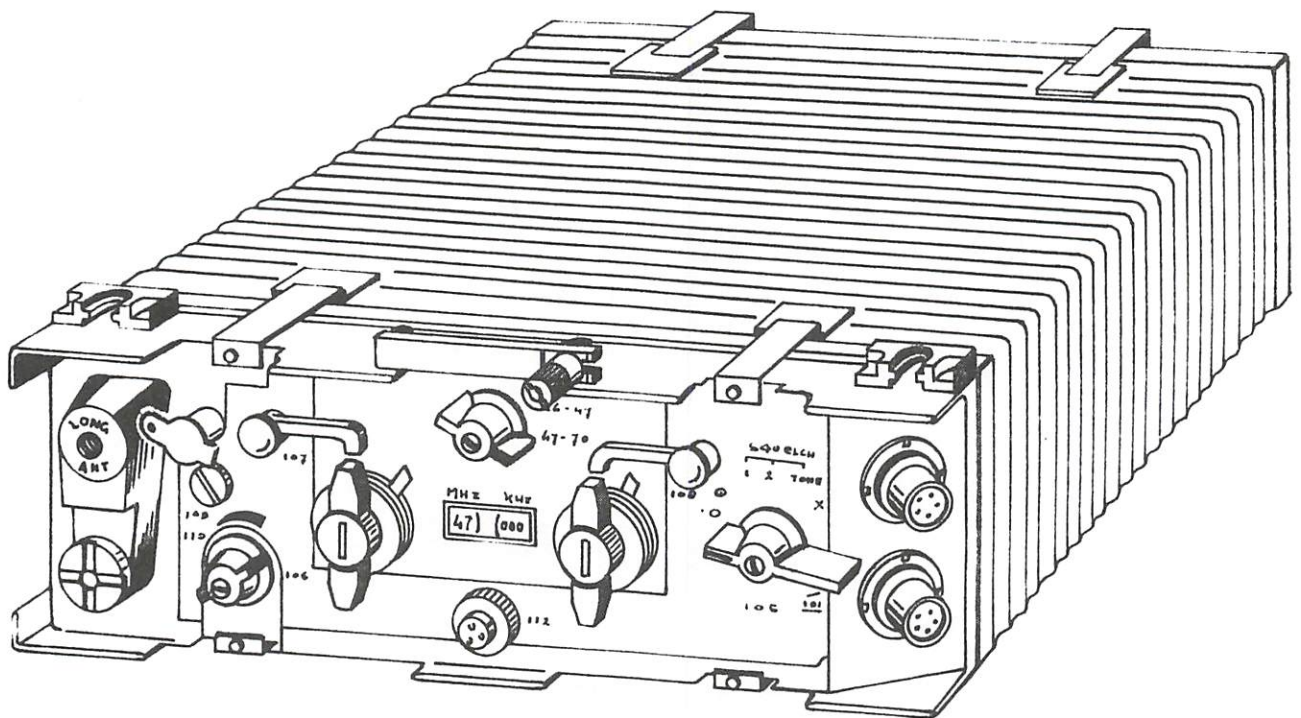
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RECEIVER - TRANSMITTER, RADIO RT-3600

Receiver - transmitter
radio RT-3600
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Note: Part II of this technical manual, containing the repair parts list of the RT-3600, is issued under separate cover.

CHAPTER 1Introduction and descriptionsSection 1 - Introduction1. SCOPE

This technical manual describes the operation and maintenance of the receiver-transmitter, radio RT-3600.

This unit, combined with a junction unit, power supply unit or 30 Watt RF-amplifier forms a combined piece of equipment which is used in a vehicle-borne installation.

The receiver-transmitter may also be combined with a battery holder. This combination is used in a portable installation.

2. DIFFERENCES AMONG MODELS

No known differences exist at the time being within the model covered in this manual.

3. TECHNICAL DATAa. General

Frequency range	- 26.000 - 69.950 MHz
Frequency bands	- 2
Band 26 - 47	- 26.000 - 46.950 MHz
Band 47 - 70	- 47.000 - 69.950 MHz
Tuning	- to channel frequencies which are multiples of 50 kHz.
	- to two preset channels
Number of channels	- 880
Mode of modulation	- F3 (frequency modulation)
Frequency swing	- + 10 kHz
Frequency accuracy	- + 3.5 kHz
Speech frequency band	- 300 - 3400 Hz
Data frequency band	- 300 - 8000 Hz
Supply voltage	- 15 V DC
Temperature range for operation	- -40°C to +55°C
	- -40°F to +130°F
for storage	- -65°C to +70°C
	- -85°F to +158°F
Atmospheric pressure	- down to - 200mm (max. altitude 10 km, 30.000 ft).
Relative humidity	- 100% (including condensation)

b. Receiver

Sensitivity	- 0.5 μ V for 10 dB SINAD and 10 kHz frequency deviation
Audio-frequency output power	- Adjustable up to 50 mW

- Squelch
- squelch switched off
 - squelch actuated by incoming carrier (sensitivity adjustable to two levels).
 - squelch actuated by 150 Hz tone on incoming carrier
- Channels with interference
- 34.500 MHz, 46.000 MHz, 47.900 MHz, 53.100 MHz, 57.500 MHz and 69.000 MHz.
- Current consumption (with portable use, function switch in position "⊙")
- less than 110 mA

c. Transmitter

RF-output

- portable version - 1 W or more
vehicle version - 2 W or more

Harmonic frequency rejection

- 26 - 30 MHz - 40 dB down or better
30 - 70 MHz - 60 dB down or better

- Current consumption (with portable use, function switch in position "⊙")
- less than 700 mA

d. Physical data

The transmitter-receiver is housed in a case having accommodation for an additional plug-in unit

- Dimensions - 252 x 104 x 303 mm
(9 15/16 x 4 1/8 x 11 15/16 in.)
- Weight - 5.8 kg (12.8 lbs)

4. COMPOSITION OF THE TRANSCEIVER

The transceiver is made up of eight modules.

A module is a piece of equipment which, mechanically and often electrically, forms a self-contained whole and which can be readily removed from the installation. When the exchangeable modules are removed from the unit, a chassis with front panel and wiring remains. This is what is called the "frame assembly" of the unit. The frame assembly is in itself also a module.

The transceiver consists of the following modules:

- Module 1: IF-amplifier and AF-amplifier
Module 2: modulator and phase discriminator
Module 3: harmonics generator and 1st mixer stage of receiver loop

Module 4: 2nd mixer stage of receiver loop and tone squelch

Module 5: stabilizer and phase discriminator

Module 6: RF-section of transmitter and receiver

Module 7: crystal oscillator

Module 10: frame assembly

The numbering of the electric parts such as resistors, capacitors, transistors etc. starts with 1 for each printed circuit and pin terminal board.

It may therefore happen that in one and the same drawing, one or more resistors R1, capacitors C1 etc. are shown. This cannot lead to any confusion in the drawing, as it will be perfectly clear to which printed circuit or terminal board the component in question pertains. Confusion in the text is avoided by making use, wherever and whenever necessary, of designations, such as 4A-R1, 5B-TS1, which means: resistor R1 on printed circuit 4A and transistor TS1 on printed circuit 5B.

5. CONNECTIONS AND CONTROLS (FIG. 2)

All controls and connectors are located on the front panel, with the exception of one connector, which is arranged at the rear of the unit.

Control or connector	Function
Connectors "101"	Used for plugging-in a micro-telephone set or a retransmission cable assembly.
Switch "102"	Used to select the band of the working frequency, thus: 26 - 47 : 26.000 to 46.950 MHz 47 - 70 : 47.000 to 69.950 MHz
Switch "103" "MHz"	Frequency selection in full megahertz values
Switch "104" "kHz"	Frequency selection in steps of 50 kHz
Mode switch "105"	Used to switch the transceiver on and off and to select mode of operation; positions: • ○ transceiver off ⊙ transceiver on; no squelch SQUELCH-1 noise squelch on; when no signal comes in, receiver is dead; receiver opens on an incoming carrier of given signal-to-noise ratio (high-sensitivity squelch).

Control or connector	Function
	SQUELCH-2 noise squelch on; when no signal comes in, receiver is dead; receiver opens on an incoming carrier of greater strength than in the SQUELCH-1 setting. SQUELCH-TONE noise squelch on; the receiver is dead unless an incoming carrier is modulated with a 150 Hz tone; in this setting the 150 Hz tone is generated during transmission. X wide-band facility
Volume control "106"	Used to adjust the strength of the receiver sound
Locks "107" and "108"	Used to lock channels previously selected.
Aerial socket "109"	For plugging in a long aerial e.g. AT-271A. (For portable use only).
Aerial socket "110"	For plugging in a short aerial e.g. AT-272A. (For portable use only).
Connector "111"	Used to connect an aerial via a 50 Ω coaxial cable; sockets "109" and "110" are then out of circuit (For portable use only).
Lampholder/push-button "112"	Pressing the pushbutton causes the face illumination to be lit. If the transceiver is used with the mode switch in one of the SQUELCH positions, the lamp lights on an incoming carrier. There is a dimming facility.

Section 2 - Description6. DESCRIPTION OF THE BLOCKDIAGRAM (FIG. 3)a. General

From an electrical point of view the transceiver consists of three sections:

- . the receiver
- . the frequency-governing part (frequency synthesizer)
- . the transmitter

These three sections will be discussed individually. Description will be with reference to the blockdiagram (fig. 3) and the numbers given between brackets (...) identify numbered items of that diagram.

When used as part of a vehicular installation, the transceiver receives the 15-volts DC supply voltage supplied by the vehicular battery via a power supply unit.

When used as part of a portable radio set, the transceiver receives the 15 volts from a battery holder.

b. Receiver

The signal comes in via the aerial. In the portable radio set the aerial is matched to the receiver input by aerial tuning unit (1). When used as part of a vehicular installation, this antenna tuning unit (1) is not used and the signal is delivered by an antenna tuning unit, mounted on top of the vehicle. The received signal goes via aerial relay (2), bandpass filter (3) and RF-amplifier (4) to the mixer (5). The frequency of the amplified signal is shifted in the mixer to the first intermediate frequency, 11.5 MHz as a result of being mixed with the output of the combination of tuned oscillator (6) and buffer amplifier (7). Oscillator (6) is stabilised in frequency by the synthesizer (see sub. c. below).

The 11.5 MHz signal is applied to crystal filter (8), which gives the receiver the required selectivity. Next the 11.5 MHz signal is mixed in stage (9) with a frequency of 11.975 MHz from crystal oscillator (10) and thus transposed to the second intermediate frequency of 475 kHz. Now IF-amplifier (11) introduces the bulk of the signal gain. Detector (12) extracts the audio-frequency modulation from the second IF and applies this audio signal to audio amplifier (13). Upon amplification the AF-signal reaches the telephone. The AF-amplifier (13) is turned on and off electronically by a squelch circuit (14 or 15) in such a way that, when no signal is being received, troublesome background noise is suppressed.

Circuit (14) is the carrier operated squelch circuit; it responds to incoming carrier signals of sufficient strength. This squelch may be set to two levels.

Circuit (15) is the tone operated squelch circuit; it responds only to signals accompanied by a 150 Hz tone. Tone squelch is useful when normal squelch operation is ineffective as a result of strong interference by signals with a wide modulation spectrum, such as radar signals. Further squelch operation can be switched off altogether.

In retransmission, squelch operation is invariably used. The squelch circuit of the receiving transceiver then operates the transmit/receive relay of the sending transceiver.

The 26.00 to 69.95 MHz frequency range is broken up into two bands:

-26.00 to 46.95 MHz

-47.00 to 69.95 MHz

and change-over is by means of a band switch.

Frequency selection is effected with two controls:

- one for selection of 1 MHz steps; its angular position is transmitted by gearwheels to a tuning capacitor.
- one for selection of 50 kHz steps which controls a crystal switch in the synthesizer, thus affecting tuning.

c. Frequency synthesizer

The frequency synthesizer ensures that oscillator (6) supplies the right frequency of the desired accuracy whatever channel is chosen.

For this purpose the output frequency of the oscillator (6) is compared with the sum of the frequencies produced by a number of crystal-stabilised oscillators. The comparison results in a regulating voltage which corrects the frequency error of the oscillator (6). Because the oscillator (6) has its output at the input of the regulating circuitry and its input at the output of that circuitry, a loop of circuits is formed, called a control or regulating loop. A portion of the output signal of oscillator (6) is applied through buffer amplifier (16) to mixer (17). This mixer also receives the output of 1 MHz crystal oscillator (20) via lowpass filter (18) and pulse generator (19). Mixing produces such frequencies that the bandpass filter (21) always delivers one frequency in the band 46.5 to 47.45 MHz. After amplification by (22) this signal is mixed in (23) with a signal produced by crystal oscillator (24) whose frequency depends on the position of the 50 kHz control. The mixing product, whose frequency is between 8.707 and 8.857 MHz, is passed on by bandpass filter (25), amplified by (26) and (27) and applied to phase discriminator (28).

At this point comparison is effected with the signal from crystal oscillator (29), whose frequency also depends on the position of the 50 kHz control.

The two frequencies applied to the phase discriminator must be equal and in phase. Any phase error (a frequency error is first revealed as a phase error) results in a direct voltage (via lowpass filter 30), which is applied as a regulating voltage to oscillator (6) where it has the effect of correcting the error. Thus the control loop is closed.

When the transceiver is switched on from cold, there is no synchronism yet between the two frequencies; further synchronism may be lost as a result of an external electrical or mechanical influence. In such cases synchronism is introduced immediately by modulating the frequency of oscillator (6) with a low-frequency voltage from 33 Hz oscillator (31).

When the frequency of oscillator (6) reaches, in the course of a frequency modulation swing, the correct value, the regulating voltage from the phase discriminator (28) will lock oscillator (6) to that frequency.

d. Transmitter

The microphone signal is amplified by microphone amplifier (32) and frequency-modulated in modulator (33) on to an 11.5 MHz signal from crystal oscillator (34). The 150 Hz tone generator (35) comes into action only when the tone squelch is used.

If tone squelch is used, the transmitter is modulated with 150 Hz during speech modulation. The 150 Hz tone falls outside the speech band.

The 11.5 MHz modulated signal is applied to phase discriminator (36) which forms the essential part of the transmitter frequency regulation loop. This loop bears much resemblance to the receiver control loop.

It works as follows:

The transmitter gets its frequency accuracy from the receiver. Portions of the outputs of receiver local oscillator (6) and transmitter oscillator (37) are mixed in stage (38). Like mixer (5) this mixer delivers a signal of 11.5 MHz if transmitter oscillator (37) delivers the correct frequency. Now the 11.5 MHz signal from mixer (38) is applied via buffer amplifier (39) to phase discriminator (36) for comparison with the modulated 11.5 MHz reference signal obtained from modulator (33) and crystal oscillator (34). The comparison results in a DC voltage, or regulating voltage, in the same way as in the frequency synthesizer.

The modulation of the transmitter oscillator (37) is effected via the regulation circuit and the lowpass filter (40). If modulation causes the frequency of the reference signal of oscillator (34) to vary, the control circuit will provide transmitter oscillator (37) with such a drive that the phase discriminator (36) is presented with the same variation from mixer (38). Consequently the transmitter oscillator (37) will undergo the

same frequency changes (frequency modulation) as crystal oscillator (34).

The output signal of the transmitter oscillator (37) is next fed through power amplifier (41) and then stripped of harmonics in filter (42). Via the aerial relay and the aerial tuning unit the signal is placed on the aerial.

A small portion of the transmitter power will find its way to the receiver input via the contact capacitance of the aerial relay (2), and since the receiver remains in normal operation during transmission, the signal will pass through the receiver and the modulation will be heard by the microphone operator through his telephone (side-tone effect). Thus the operator has a permanent check on transmitter performance.

7. DESCRIPTION OF THE CIRCUIT DIAGRAM

a. General (fig. 4)

The design and operation of the transceiver and the principle of frequency synthesis have already been dealt with rather exhaustively in para. 6, so that in the first instance it will be sufficient to make a few complementary observations with reference to the circuit diagram of the frame assembly, figure 4.

The various parts of which the equipment consists are described in greater detail in paras. b ... m.

The power supply voltage of +15 V comes in via terminal 11 of connector PD6. The supply voltage is switched on via a wafer of switch SK1.

The voltage of +15 V is used for the AF-amplifier in the receiver, transmit-receive relay RE2, squelch relay RE1, dial illumination-calling lamp LA1 and the transmitter, except the oscillator.

The stabiliser on printed-circuit 5A (which includes transistor TS1 fitted on the chassis) transforms the +15 V into +10.5 V and the latter voltage is then used to supply the remainder of the transmitter and receiver. Both the power supply voltage and the squelch are switched by SK1. With the latter set to "⊙", the squelch is inoperative. Contact 2r12 of SK1 then applies the +15 V direct to the AF-amplifier on printed circuit 1A of the receiver. At the other positions of SK1, this voltage is switched by squelch relay RE1, simultaneously with calling lamp LA1. The second contact of RE1 is used in retransmissions to switch on the transmitter of a second transceiver.

With SK1 set to "SQUELCH 1", the squelch will react to very weak signals. This is achieved by connecting resistor R3 to terminal 8 of printed circuit 1A. Setting the switch to "SQUELCH 2" decreases the sensitivity by approx. 5 dB. With SK1 set to "TONE", the 150 Hz oscillator is switched into circuit at the transmitting end, the tone filters (printed circuit 4B) being switched into circuit at the receiving end.

With switch SK1 set to "X", the AF-amplifiers of transmitter and receiver are so circuited that signals having a bandwidth in excess of the normal speech signal can be handled.

Connectors PD1 and PD2, which will take a handset, are used especially in the portable version of transceiver RT-3600.

In vehicular sets these connections are often taken via connector PD6 to other parts of the installation and the handset is then, as a rule, connected to other units of the installation.

There are several aerial connectors at the front of the transceiver: PD5 for a short whip aerial, PD4 for a longer whip aerial and PD3 for a 50 Ω aerial. PD3 is connected via mechanically coupled switch SK3 only when a plug is inserted in the socket.

Aerial connectors PD3, PD4 and PD5 are used only in the portable version of the transceiver; in vehicular applications, the aerial connection runs via the unit mounted behind the transceiver (junction box, 30 W RF-amplifier or power supply unit)

Potentiometer R1 is the volume control for the receiver. During transmission a resistor is connected in parallel via diodes GR5 and GR6, so that the volume of the transmitter's own signal when it is monitored is reduced and singing is prevented from occurring.

Transmitter relay RE2 is energized as soon as one of the contacts PD1-C, PD2-C or PD6-6 is earthed. This relay then switches on the 15 V and 10.5 V power supply voltages for the transmitter.

Switches SK4 and SK5, which are coupled with the tuning mechanism, are used for selecting the frequency ranges of a 30 W RF-amplifier, should any be used and for the antennè unit. SK4 is coupled with frequency range switch "102", whilst switch SK5, which consists of a disc with sliding contacts, shares its spindle with "MHz" knob "103".

b. The RF-section (see fig. 13)

Mechanically, the RF-sections of the transmitter and the receiver form one whole. It consists of a frame on which are fitted a number of variable capacitors and coils, all of which are driven by "MHz" tuning control "103". In addition, the frame contains frequency range switch "102" (shown in the drawing at the position for the 47 - 70 MHz range) and several printed circuits, viz.

- . the input bandpass filter of the receiver
- . the RF-amplifier of the receiver
- . the mixer stage of the receiver
- . the receiver oscillator
- . the mixer stage of the transmitter
- . the transmitter oscillator
- . the amplifier of the transmitter
- . the output power control circuit of the transmitter
- . the harmonic filters
- . the aerial tuning circuit

The input bandpass filter of the receiver, part of which is fitted on printed circuits 6A and 6B, provides the receiver with adequate image selectivity. In addition, the filter diminishes the chance of cross-modulation caused by strong spurious signals by attenuating these signals before they reach the RF-amplifier and the mixer stage. A requirement which has to be satisfied, however, is that the difference in frequency between the spurious signal and the signal to be received is not too small.

The filter consists of two circuits, which are tuned by means of variable capacitors C12h and C12g. For the high band, coils L8 and L9 are connected in parallel to L7 and L10 respectively. The circuits are coupled via L4, L5 and L6. The filter is followed by two protective diodes, GR1 and GR2, which safeguard the RF-amplifier against the very strong signals not suppressed by the filter.

The RF-amplifier of the receiver (printed circuit 6C) consists of a transistor in an earthed-emitter circuit. Coupling with the mixer stage is by means of a wideband transformer. The RF-amplifier consists of a transistor with a very low noise factor and good linearity. The low noise factor is necessary to obtain good sensitivity in spite of the attenuation which the input bandpass filter also presents to the required signals; good linearity is required to keep the chance of cross-modulation as small as possible.

The mixer stage of the receiver (printed circuit 6D) consists of a ring modulator with four diodes. The ring modulator offers the following advantages over the more conventional mixer circuits: very low noise, low cross-modulation and little stray radiation of the oscillator signal to the RF and IF-amplifiers.

There is not much objection against the ring modulator having conversion loss instead of conversion gain, as the gain in the circuit ahead of the IF-filter has to remain low so as to produce as little crossmodulation as possible. The use of an RF-amplifier cannot be avoided because the overall attenuation of the RF-band-pass filter, the mixer stage and the IF-filter is so high that the sensitivity would become too low in the absence of such an RF-amplifier.

The local oscillator of the receiver is fitted, for a major part, on printed circuit 6F. In addition to the injection signal for the receiver mixer stage, the local oscillator also supplies signals to the mixer stages of the transmitter loop and the receiver loop.

The oscillator, consisting of transistor 6F-TS1 in an earthed-emitter Hartley circuit, is roughly tuned over the 35.50 - 58.45 MHz range by means of variable capacitor C12f. Synchronization to exactly the required frequency is effected with the help of a control voltage supplied by the receiver loop; this control voltage is applied to varicap 6F-GR1.

Variable capacitor C12e ensures that the influence which the varicap exerts on the tuning remains constant throughout the range. Zener diode 6F-GR2 protects the varicap against peak voltages which may occur outside the synchronization.

Ferrite bead 6F-L1 prevents parasitic oscillations of transistor 6F-TS1 from occurring at a very high frequency. The signals for the transmitter loop and the receiver loop are taken direct from the oscillator. The signal for the mixer stage of the receiver is supplied via buffer amplifier 6F-TS2. This prevents the oscillator from being affected by very strong signals that come in. Circuit 6F-L4 - C12d ensures that the receiver mixer stage is driven by a practically undistorted oscillator signal. In the transmitter mixer stage (printed circuit 6E) the signal of the transmitter is mixed with that of the receiver oscillator.

The resulting 11.5 MHz signal is used in the transmitter loop for synchronizing the transmitter. A balanced mixer stage equipped with diodes is employed. An additional amplifier stage (transistor 6E-TS1) is utilized for the transmitter signal. A low-pass filter in the output ensures that only the mixing product of 11.5 MHz is taken to the transmitter loop.

The transmitter oscillator (printed circuit 6J) consists of transistor 6J-TS1 in an earthed-emitter Hartley circuit. The tuning coil for the low band is L2; for the high band L1 is connected in parallel to L2. Coarse tuning is by means of capacitor C12a, whilst synchronization to exactly the required frequency is effected with the help of a control voltage taken from the transmitter loop; this control voltage is applied to varicaps GR1 to GR4. Variable capacitor C12b ensures that the influence exerted by the varicap remains practically constant throughout the frequency range.

The signal coming from the transmitter oscillator via buffer amplifier 6J-TS2 is raised to the required output level in the transmitter amplifier (printed circuits 6M and 6N). A 2-stage wideband amplifier is used; coupling between the drive stage and the power stage, and between the power stage and the output is not by means of tuned circuits but with the help of wideband transformers.

The power control circuit (printed circuit 6P) ensures that the transmitter output power will not reach excessive values.

Furthermore, the transmitter is protected against the effects of excessive current consumption.

The power control circuit works as follows:

Diode 6H-GR1 rectifies a minor portion of the transmitter output signal and applies it to the base of transistor 6P-TS4, which begins to draw current, when the detected HF-voltage has a value of approx. 7 V.

This makes transistor 6P-TS1a draw current via diode 6N-GR1. An increase in current through diode 6N-GR1 causes a decrease in drive for the transmitter amplifier.

The current, which the transmitter amplifier consumes flows through resistors 6P-R6 and 6P-R7. When this current reaches a certain value, the voltage drop across these resistors becomes so high that transistor 6P-TS2 begins to draw current, which causes transistor 6P-TS1b and diode 6N-GR1 to draw current as well. This again decreases the drive of the transmitter amplifier.

This current limiting circuit goes into action at an earlier stage in portable sets than in vehicular sets. The reason for this is that in portable sets an inter-connection in the battery holder connects resistor 6P-R2 parallel to 6P-R3.

In portable sets the current limiting device goes into action at approx. 500 mA. This is desirable because of the limited capacity of the batteries.

Because the current limiting device in vehicular sets does not operate until a current of approx. 600 mA is reached, a higher transmitter output power is obtained, which is desirable indeed because of the attenuation introduced by the additional aerial filter in the junction unit.

The power control circuit protects the power transistor of the transmitter against excessively high peak voltages which might occur when a change-over to transmitting is made without an aerial being connected.

Next, the transmitter signal traverses one of the two low-pass filters on printed circuit 6L. Filter C1 to C9 - L2 to L5 serves for the low band (26 - 47 MHz) and filter C10 to C18 - L6 to L8 for the high band (47 - 70 MHz). Both filters introduce an attenuation of less than 1 dB in their pass range; the low-band filter has an attenuation of not less than 40 dB above 52 MHz, the high-band filter producing an attenuation of not less than 55 dB above 94 MHz.

The filters are necessary to obtain sufficient suppression of the harmonics because the wideband output of the transmitter amplifier passes on the higher harmonics that are produced without attenuating them.

The transmitter signal exits from the RF-section via PD4; in portable sets it re-enters via terminal A6 and then traverses the aerial tuning circuit consisting of printed circuit 6G and variable coils L1, L2 and L3.

c. The IF-amplifier (printed circuit 1B), see fig. 7

In the main, 11.5 MHz crystal filter U1 determines the selectivity of the receiver. The remaining IF-circuits are all fairly heavily damped and hence they cut off not quite so sharply.

Transistor TS1 is again of a type having a very low noise factor as, owing to the low RF-gain and the attenuation provided by the 1st mixer stage, the 1st IF-amplifier still has a substantial influence on the

overall noise factor of the receiver. The 11.5 MHz signal is amplified by transistors TS1 and TS2 and it is then mixed in transistor TS5 with the signal of 11.975 MHz derived from crystal oscillator TS3 - TS4. The resulting signal of 475 kHz is amplified by transistors TS6 to TS9. Diodes GR1 to GR10, which are connected across the primaries of the IF-transformers, ensure that the signal is limited and that possible amplitude modulation is suppressed. Ratio detector L1 - T7 - GR11 - GR12 demodulates the signal, whilst emitter-follower TS10 ensures that the AF-output has a low resistance value.

Circuit R41-C35 provides the necessary de-emphasis, whilst the wide-band signal, which is required when the function switch of transceiver RT-3600 is set to "X", is made available via coil L2 and terminal 11.

This wide-band signal is also used for the noise squelch.

d. The AF-amplifier in the receiver (printed circuit 1A)
see fig. 6

The AF-amplifier equipped with dual transistor TS9 provides a high-ohmic input, which does not present a load to the de-amphasis network and the 150 Hz filter. The signal is applied to the volume control by way of terminal 7 and then enters the AF-power amplifier via terminal 4. The latter power amplifier consists of d.c. coupled transistors TS10 and TS11, which drive the single-ended push-pull stage equipped with complementary transistor pair TS12-TS13. Diodes GR8 and GR9 ensure that the power stage has the correct quiescent point. The output power amounts to approx. 50 mW.

The input of the noise squelch circuit, terminal 9, is linked up with the wideband AF-output of the IF-amplifier. There is a strong noise signal at this point in the absence of an incoming carrier. Transistor TS1 amplifies this noise. Bandpass filter L1 - C1 - C2 - L2 - C3, which is tuned to 7 kHz, filters a narrow band out of the above-mentioned noise signal. As this band lies above the speech frequencies, the squelch does not react to speech. The filtered-out noise signal is further amplified by transistor TS2 and detected by diode GR2.

The direct voltage thus obtained makes transistor TS3 draw current, causing the Schmitt-trigger equipped with transistors TS4 and TS5 to take up the position at which TS4 is without current and TS5 carries current. As soon as a carrier of sufficient strength is received, the noise at terminal 9 will disappear almost completely. As a result, transistor TS3 ceases to draw current, the Schmitt-trigger changes over and transistor TS5 is also cut off. The information on the condition of transistor TS5 is taken to terminal 12 and from there to a circuit in module 5. The squelch relay is energized from the latter module when a signal comes in.

NTC resistor R2 ensures that the squelch circuit continues to work as it should throughout the temperature range.

Increasing the gain of transistor TS2 makes the squelch circuit operate on weaker noise, in other words, a stronger incoming carrier is required to make the squelch operate. This is done by decreasing the emitter resistance of transistor TS2. As shown on fig. ... the squelch "1" position of function switch SK1 connects resistor R3 via terminal 8 of printed circuit 1A in series with resistor 1A-R7. Setting the function switch SK1 to the squelch "2" position bridges this resistor R3, thus requiring a stronger incoming carrier to make the squelch operate as mentioned above.

With the function switch at the "TONE" squelch position, the +10.5 V is also applied to terminal 13 of the unit. The result of this is that transistor TS5 is made conductive via diode GR5, i.e. the squelch cuts out the AF-section of the receiver.

If a 150 Hz tone comes in via the tone filter in module 4, diode GR7 will demodulate this tone, with the result that transistor TS8 begins to draw current. Due to this, Schmitt trigger TS6 - TS7 changes over and transistor TS7 is then without current, while TS6 does carry current. This causes the anode voltage of diode GR5 to be lowered so much that transistor TS5 can cut off again. The noise detector is in operative in this position of SK1, as terminal 8 is open.

To sum up: the normal squelch operates on a lowering of the noise which occurs when not too weak a carrier is received. The tone squelch reacts exclusively to 150 Hz modulation of the received carrier.

e. Modulator and AF-section of the transmitter (printed circuit 2B) see fig. 9

The microphone must be connected to terminals 1 and 2 (earth). Zener diode GR3 stabilises the power supply for the carbon microphone. C18 - R15 give the signal the required pre-emphasis.

The microphone signal is first amplified by transistor TS4 and then limited by the long-tailed pair equipped with dual transistor TS6.

Limiting is necessary to obtain a high average modulation, for a speech signal contains very high peak voltages in relation to its average voltage. The ratio existing between the peak voltage and the average voltage can be improved considerably by clipping these peaks; this will not impair the intelligibility of the signal.

In this way, a speech signal of 10 V_{p-p} may be limited to 1 V_{p-p} without much loss of quality. If the signal is then amplified to 10 V_{p-p}, a 20 dB improvement of the signal strength will be obtained.

After limiter TS6, the signal traverses low-pass filter C24 - L5 - C25.

This filter, which has a cut-off frequency of 3400 Hz, limits the bandwidth of the transmitted signal and also removes a major portion of the higher harmonics produced by the limiting action.

Transistor TS7a will then raise the signal to the level required by the modulator. If the signal at the collector of transistor TS4 should be higher than the threshold voltage of transistor TS5, detection will take place in the latter transistor. The direct voltage thus obtained is smoothed by C23 and makes transistor TS3 draw current, with the result that voltage division occurs between R15 and R16 + TS3, so that the signal applied to transistor TS4 is attenuated. The resulting compression circuit reacts rapidly to a sudden increase in signal strength (time constant of R22-C23), but when a decrease of the signal strength occurs (say, in between words) the attenuation is maintained for a moment (time constant of R23-C23).

The circuit is so designed that whispering into the microphone still produces sufficient modulation. For normal speech, limiting amounts to approx. 20 dB. Shouting into the microphone will not increase the limiting action because the compression circuit then goes into action and keeps the level constant. GR4 and TS7b serve for temperature stabilisation of the quiescent point of transistors TS4 and TS7a respectively. Terminal 7 is the 150 Hz input of the circuit and used for the tone squelch. Terminal 8 is the wideband input, which is used when switch SK1 of transceiver RT-3600 is set to "X".

The 11.5 MHz oscillator consists of transistor TS1 in a Colpitts circuit. The frequency stability is improved by coupling circuit L2 - C4 - C5 - C6 - C7 - C27 - C30 with 11.5 MHz crystal KT1. The required frequency modulation is accomplished by applying the AF-signal to varicaps GR1 and GR2. The required frequency deviation is adjusted by varying the coupling of the tuned circuit and the crystal by means of trimmer C2. The modulated 11.5 MHz signal is taken to the output (terminal 12) via buffer amplifier TS2, and from there to the phase discriminator in the transmitter loop.

f. Phase discriminator in transmitter loop (printed circuit 2A) see fig. 8

The 11.5 MHz signal of the transmitter mixer stage enters via terminal 1. It is amplified in the earthed-base amplifier stages equipped with transistors TS9 and TS8. Limiting also takes place in these stages, so that the phase discriminator is driven by a signal of constant strength.

The 11.5 MHz signal from the modulator comes in via terminal 6.

It is limited by diode GR6 and amplified by transistor TS7. Circuit C11-L1 ensures that the phase discriminator is again driven by a sinusoidal signal.

The actual phase discriminator is formed by transformer T1 and diodes GR7 and GR8.

If both signals applied to the phase discriminator have

the same frequency, the circuit produces a direct voltage whose magnitude is determined by the differences in phase of the two 11.5 MHz signals. This voltage is taken to the varicap in the transmitter oscillator by way of terminal 4. Naturally, the polarity is chosen in such a way that any change in frequency of the 11.5 MHz modulator results in a similar change in frequency of the transmitter oscillator, so that synchronization once it has been established will be maintained. Consequently, the transmitter oscillator then takes over the frequency modulation of the 11.5 MHz oscillator.

When the transmitter oscillator is not synchronized, say, when the transmitter is switched on or a change-over made to another frequency, the phase discriminator produces an alternating voltage with a frequency which equals the difference in frequency existing between the 11.5 MHz signal from the modulator and the signal from the transmitter mixer stage.

This alternating voltage causes the transmitter oscillator to be frequency modulated but, as a rule, not enough to regain the synchronous condition. This is the reason why a hunting oscillator is used.

The hunting oscillator is formed by the flip-flop equipped with transistors TS5 and TS6. The hunting oscillator operates on a frequency of approx. 33 Hz and (via capacitor C30) supplies a somewhat rounded-off triangular voltage to the phase discriminator.

This triangular voltage (approx. 8 V_{p-p}) provides the transmitter oscillator with frequency modulation such that the required frequency is traversed in any case. At that moment the phase discriminator takes over control and synchronization is restored. As the phase discriminator maintains the condition of synchronism, the output voltage of the phase discriminator will oppose the voltage of the hunting oscillator and eventually cancel it out almost completely. All that remains is a light 33 Hz phase modulation of the transmitter signal, which will not be noticeable because of the low frequency of the hunting oscillator.

The 150 Hz oscillator for the tone squelch is also fitted on printed circuit 2A. This RC oscillator consists of, inter alia, transistors TS1 to TS4. The frequency of the oscillator is determined, in the main, by C1 - C2 - R2 - R4. The limiter equipped with diodes GR4 and GR5 limits the amplitudes of the oscillations in such a way that transistors TS1 to TS3 will not bottom and a relatively undistorted sinusoidal signal is emitted via emitter-follower TS4. Diodes GR1 to GR3 are again used for temperature stabilization of the quiescent points of transistors TS1 to TS3. The frequency is adjusted by means of variable resistor R2, the amplitude of the output signal by means of R15. Capacitor C6 diminishes to some extent the distortion of the signal.

The power supply voltage of 10.5 V for the 150 Hz

oscillator is not switched on unless the function switch is set to the "TONE" squelch position.

g. 1 MHz harmonic generator (printed circuit 3A) see fig.10

The oscillator consisting of transistor TS1 and crystal KT1 generates a signal of 1 MHz. This signal is limited by diode GR1 and differentiated by circuit C8 - L4. Only the negative portion of the pulse-shaped signal thus obtained is let through by diodes GR2 and GR3. The resulting signal is rich in harmonics. Of these harmonics, low-pass filter C10 - L5 - C11 - L6 - C12 - L7 lets through the first up to and including the eleventh to the output, terminal 4.

The 1 MHz harmonics are used in the first mixer stage of the receiver loop (printed circuit 3B).

h. First mixer stage in the receiver loop (printed circuit 3B) see fig. 10

The signal of the local oscillator in the receiver (having a frequency between 35.50 and 58.45 MHz) enters via terminal 1. Attenuator R1 - R2 - R3 and the buffer amplifier equipped with transistor TS1 prevent retroaction to the oscillator in the receiver. It is also achieved that the mixer stage is driven by so strong a signal that minor variations of the oscillator signal have no influence worth mentioning on the strength of the output signal.

The signal of the 1 MHz harmonic generator (1 - 11 MHz) is applied to the mixer stage via terminal 4. The mixer stage is again a balanced circuit equipped with diodes (GR1 and GR2).

The (many) mixing products in this circuit always contain, for each frequency to which the receiver oscillator can be tuned, one signal in the 46.50 - 47.45 MHz band. This signal is filtered out by bandpass filter T2 - T3 and taken to the 2nd mixer stage in the transmitter loop.

Note: If the receiver oscillator is tuned to a frequency in the 46.50 - 47.45 MHz band, not one of the mixing products but the actual oscillator signal will be filtered out!

i. Second mixer stage in the receiver loop (printed circuit 4A) see fig.11

A signal (coming from the first mixer stage) having a frequency in the 46.50 - 47.45 MHz band enters via terminal 8. This signal is amplified by transistor TS1 and then applied to the mixer stage, transistor TS2.

A signal (coming from the crystal-oscillator unit) having a frequency of 37.793 MHz, 37.993 MHz, 38.193 MHz, 38.393 MHz or 38.593 MHz is applied to the mixer stage by way of terminal 5. This frequency is determined by the position of the "kHz" knob on the transceiver. Of the mixing products then produced, the signal having

a frequency between 8.707 MHz and 8.857 MHz is filtered out by bandpass filter L2 - L3 and amplified by transistor TS3.

Diode GR2 limits the signal, so that there is little change in the output signal when variations in strength occur in the input signals.

The quiescent point of mixing transistor TS2 is stabilized by diode GR1.

j. Phase discriminator in the receiver loop (printed circuit 5B) see fig. 12)

A signal having a frequency between 8.707 and 8.857 MHz and derived from the second mixer stage of the receiver loop comes in via terminal 1 and is amplified by transistor TS1.

A second signal, derived from the crystal oscillator unit and having a frequency of 8.707 MHz, 8.757 MHz, 8.807 MHz or 8.857 MHz, is applied to terminal 6. Diode GR3 limits this signal and transistor TS2 amplifies it. Circuit L6-C19 ensures that the phase discriminator is again driven by a sinusoidal signal. Diode GR4 stabilizes the quiescent point of transistor TS2 throughout the temperature range.

The actual phase discriminator consists of transformer T2 and diodes GR1 and GR2.

When the two signals have equal frequencies, the control voltage which is available at terminal 8 is proportional to the difference in phase of the two signals.

The control voltage is applied to the varicap of the receiver oscillator; naturally, the polarity has been so chosen that any tendency which the receiver oscillator may have to deviate from the required frequency is nipped in the bud.

When the set is switched on or when a change-over to another frequency is made, initially there is no synchronous condition. The signal in the control circuit then has a frequency which equals the difference in frequency of the two signals. This signal causes the receiver oscillator to be frequency modulated; as a rule it is not strong enough to restore the synchronous condition. This is the reason why in this case too the hunting oscillator in module 2 is used.

The 33 Hz square wave coming in via terminal 3 is converted into a triangular voltage by R 6-C13 and then applied to the control circuit.

The frequency modulation which this causes is so extensive that the required frequency is always reached, at which point the phase discriminator assumes control. In this case too, the 33 Hz hunting voltage is completely suppressed when the control circuit goes into action. Absorption circuits L2 - C15, L3 - C16, L4 - C17 and L5 - C18 are tuned to 200 kHz, 150 kHz, 100 kHz, and 50 kHz respectively. They suppress the interference which spurious mixing products might cause. Such inter-

ference is caused, inter alia, by the 47th harmonic of the 1 MHz oscillator, which harmonic, although very weak succeeds in penetrating into the loop.

k. The crystal oscillator unit (module 7) see fig. 15

This unit is equipped with two crystal oscillators. The first oscillator, containing transistor TS1, can be made to oscillate at frequencies of 37.793 MHz, 37.993 MHz, 38.193 MHz, 38.393 MHz or 38.593 MHz with the help of crystals KT1 to KT5. This is the oscillator which supplies the injection signal to the second mixing stage in the receiver loop.

The second oscillator, containing transistor TS2, can be tuned to frequencies of 8.707 MHz, 8.757 MHz, 8.807 MHz or 8.857 MHz with the help of crystals KT6 to KT9. This oscillator supplies the phase discriminator in the receiver loop with a reference signal. Together, the two oscillators provide facilities for synchronizing the receiver oscillator at multiples of 50 kHz. The first oscillator has facilities for five steps of 200 kHz (i.e. one 1 MHz step), the second oscillator providing four steps of 50 kHz, so that it can fill in the "holes" between the 200 kHz steps.

To simplify operation, both crystal selector switches are operated by means of the tuning control marked "kHz" on the front panel of the transceiver.

The two wafers of the switch, which select the required crystal, are so coupled by means of gearwheels that the "50 kHz"-wafer completes one revolution (and passes by all four crystals) every time the "200 kHz"-wafer moves to the next crystal.

A survey of the crystal oscillator frequencies at the various positions of the "kHz" control is given in the table below:

	37.793 MHz	37.993 MHz	38.193 MHz	38.393 MHz	38.593 MHz
8.707 MHz	000	200	400	600	800
8.757 MHz	050	250	450	650	850
8.807 MHz	100	300	500	700	900
8.857 MHz	150	350	550	750	950

To explain matters, a numerical example will be given of the frequency synthesis as it takes place in the receiver loop.

Let us assume that the transceiver has to be tuned to 26.000 MHz.

The "MHz" control is then set to "26" and the "kHz" control to "000".

The frequency of the receiver oscillator is then 26.000 + 11.500 = 37.500 MHz.

In the first mixer stage of the receiver loop, this signal is mixed with the 9th harmonic of the 1 MHz oscillator and this then results in a signal of 46.500 MHz. In the second mixer stage the signal is mixed with 37.793 MHz which yields a signal of $46.500 - 37.793 = 8.707$ MHz.

This signal is then compared, in the phase discriminator, with the 8.707 MHz signal of the second crystal oscillator, the resulting voltage being used for maintaining the receiver oscillator at the required frequency.

If the "kHz" switch is then set to the next higher step (frequency 26.050 MHz) the 8.757 MHz crystal is switched into circuit instead of the 8.707 MHz crystal.

The receiver oscillator then synchronizes on a frequency which is 50 kHz higher.

The 8.807 MHz and 8.857 MHz crystals are switched into circuit for frequencies of 26.100 MHz and 26.150 MHz respectively.

At the 26.200 MHz frequency, the first crystal oscillator moves to the next step: the frequency becomes 37.993 MHz, whilst the second crystal oscillator returns to the first crystal, i.e. to 8.707 MHz.

Thus, when the frequency is raised in steps of 50 kHz, all possible crystal combinations are utilized until a frequency of 26.950 MHz is reached.

For the next 50 kHz step the "MHz" control has to be set to "27", after which all frequencies between 27.000 MHz and 27.950 MHz can be covered with the help of the "kHz" knob. The crystal selection remains the same, but now the mixing product containing the 8th harmonic of 1 MHz is filtered out in the first mixer stage.

This is how frequency synthesis takes place, the "MHz" control being used, inter alia, for adjusting the tuning capacitor of the oscillator, the coarse setting of the frequency as it were, whilst the "kHz" control serves to select the crystals which determine at what frequency within the 1 MHz step synchronization will take place.

To simplify the electroning readjustment of the oscillator, mechanical coupling is provided between the "kHz" control and the tuning capacitors, in such a way that one complete revolution of the "kHz" control moves the tuning capacitor just as much as one step of the "MHz" control.

Even outside the state of synchronism, the oscillator is already fairly accurately tuned to the required frequency. Without the above-mentioned mechanical coupling, a deviation of ± 0.5 MHz at specific frequencies would be unavoidable in the unsynchronized condition.

1. Tone squelch filters (printed circuit 4B) see fig. 11

The AF-signal coming from the detector in the receiver enters via terminal 2. Via dual T-network R4 - C5 - R17 - C3 - R12 - R13 - C8 and terminal 1, this signal is taken to the AF-amplifier in the receiver.

The design of the network is such that for a frequency of

150 Hz the signals in the two branches at the output are in opposition of phase. Signals of 150 Hz are then suppressed almost completely, whilst the normal speech signals (300 - 3400 Hz) are let through with hardly any attenuation at all. The 150 Hz signal which can be added for the purposes of tone squelch is thus prevented from causing an annoying hum tone in the telephone or loud-speaker. The incoming AF-signal is also applied to the 4-stage amplifier equipped with transistors TS1, TS2 and TS3a.

Heavy feedback is applied to this amplifier via dual T-network R3 - C4 - R16 - C2 - R10 - R11 - C7.

The design of the network is such that feedback is discontinued for 150 Hz and hence the amplifier provides a high gain at this frequency; at other frequencies the gain is very little. The tone squelch signal (if any) which is filtered out in this manner is taken to the squelch circuit (in module 1) by way of the amplifier equipped with transistor TS3b and terminal 7.

m. Stabilizer and retransmission circuit (printed circuit 5A) see fig. 12

The stabilizer circuit transforms the battery voltage of 15 V of the transceiver into a stabilized voltage of 10.5 V.

This voltage of 10.5 V is used to supply those circuits in the transmitter and receiver which are sensitive to fluctuations of the power supply voltage. Because of its dissipation, the series-regulating transistor of the stabilizer circuit is not fitted on printed circuit 5A but in a bracket on the chassis of the transceiver.

In the circuit diagram of printed circuit 5A this transistor is shown in broken lines between terminals 2, 3 and 4.

The battery voltage of +15 V is applied to terminal 1. After the current has passed through resistor R4 and the series-regulating transistor, a voltage of +10.5 V becomes available at terminal 2.

The stabilizer circuit works as follows. Variations, if any, in the output voltage are passed on by zener diode GR5, without being attenuated to the amplifier with long-tailed pair TS4 - TS5. Zener diodes GR3 and GR4 keep the base voltage of transistor TS4 constant. Emitter follower TS3 passes on the amplified voltage variations to the base of the series-regulating transistor, the polarity obviously being such as to oppose the original variation in voltage and cancel it out almost completely. The circuit is protected against excessive current consumption in the following manner. When the current consumption increases to approx. 170 mA, the voltage drop across resistor R4 has become so large that transistor TS1, which is normally without current, begins to draw current. As a result of this, transistor TS2 also begins to draw current and the base voltage of

transistor TS4 then goes down. When the output voltage has decreased to approx. 10 V below the battery voltage, the base current of transistor TS1 is further increased by the current which begins to flow via zener diode GR1 and resistor R7. The result is that the output voltage decreases to almost zero. It remains zero even when the overload is removed. The transceiver has to be switched off and back on again to restore normal operation.

The above-mentioned protective circuit also goes into action when the battery voltage increases to more than 21 V because transistor TS1 receives base current via zener diode GR1.

In this case too, the set can only be restored to normal operation by switching it off and back on. Such an excessively high battery voltage can occur only when the set is in vehicular use and the power supply unit of the installation should happen to become defective. The circuit incorporating transistor TS6 serves for energizing the squelch relay. For this purpose, terminal 6 is connected to the squelch circuit in module 1, while terminal 7 can be earthed by the transmit contact.

The +15 V is applied to terminal 5 by way of the coil of the squelch relay.

If a signal is received which causes the squelch to operate, a positive voltage is present on terminal 6. It makes transistor TS6 draw current and the squelch relay operate. The latter relay switches on the power supply voltage for the AF-amplifier and for the squelch lamp.

For retransmissions, an extra contact of the squelch relay switches on the transmitter of the other transceiver. Terminal 7 is earthed during transmissions. It is then impossible for the squelch relay to operate. The AF-amplifier then receives its power supply voltage via a contact of the transmit-receive relay, so that the signal of the transceiver to which it pertains is yet audible. Without this precaution, the signal from a transmitter would cause the squelch relay in its own set to operate. In that case retransmission would be impossible because both transmitters would begin to operate and continue operating as soon as a signal were received.

CHAPTER 2MaintenanceSection 1 - Electrical testing, trouble-shooting and repair.8. GENERAL

This section gives the testing, trouble-shooting and electrical repairwork of the transmitter-receiver. The tracing and locating of a faulty module (the frame assembly is in itself also a module) will be described in para. 9.

Module testers are used when testing, trouble-shooting or adjusting modules 1 to 7.

The module tester takes the form of a small desk into which the module under test will be plugged. An array of push-buttons permits the supply voltage to be connected to or removed from certain parts of the circuit and allows the measuring instruments to be connected to particular terminals of the module circuit.

Trouble-shooting of a module always starts with the testing of the module; when a certain reading is not correct follow the instructions given. After each repair, repeat the test sequence.

Module tester TS-3606 (figs. 19 and 20) is used when testing modules 1 and 2 and printed circuits 4B and 5A.

Module tester TS-3607 (figs. 21 and 22) is used when testing modules 3 and 7 and printed circuits 4A and 5B.

Module tester TS-3603 (figs. 17 and 18) is used when testing module 6

The frame assembly (module 10) may be best tested with tested modules 1 to 7 fitted, following the test procedures for the transceiver, see para. 9.

By means of the circuit diagram (fig. 4) the test will give an indication which part of the circuit is at fault.

Then using the wiring diagram (fig. 34) wiring list (para. 30) and an ohmmeter the faulty part(s) can be located.

9. TESTING AND TROUBLE-SHOOTING OF THE TRANSCEIVER

Measuring instruments required.

- (1) Stabilised adjustable power supply 15 V 1 A or more (e.g. Philips PE 1510) to be connected to connector PD6 contacts 11 (+) and 12 (-).
- (2) VHF-signal generator: frequency range 26 MHz - 70 MHz, output 0,3 μ V and up (frequency modulated) (e.g. Rohde & Schwarz SMAF) to be connected to connector PD6 coaxial contact A2.
- (3) Tone generator (e.g. Philips PM 5100) to be connected to the external modulation connector of the VHF-signal generator.
- (4) RF-power probe SO-3613 with dummy load 50 Ω 5 W

(5) Multimeter with 50 μ A range or better (e.g. Philips PM 2403).

(6) Handset with 5-pole connector.

Note: It is advised to construct an auxiliary cable assembly, to facilitate the connection of the test equipment and the power supply. This cable assembly consists of a 15-pole connector (to match connector PD6 at the rear side of the transceiver) with 13 wires and 2 coaxial wires (50 Ω) attached. The wires, connected to pin 1 to 13, are terminated in insulated pin bushings. The coaxial wires connected to coaxial connectors A1 and A2 should be terminated in a suitable coaxial plug. Mark each wire with the number of the connector pin.

Set the controls to the following positions:

. RT-3600	"105" to $\bullet \bigcirc$ "106" fully clockwise "102" to "26 - 47" "103" to 26 MHz "104" to 000 kHz
. VHF-signal generator	frequency to 26 MHz mod. freq. to 1000 Hz deviation 10 kHz output 0 V
. Tone generator	output 0 V
. Stabilised power supply	set voltage to 15 V

The test procedure is given in the form of tables.

The first column gives the sequence number of each test to be performed.

The second column states what operations are to be performed and what result this operation should have if all is well.

The third column states what actions should be taken to eliminate the fault if the correct result, as given in the second column, is not obtained.

The numbers between brackets (.) refer to the measuring instruments listed above.

a. Testing the receiver

Test no	Operation and normal indication	Corrective action
1	Switch power supply (1) on Press lamp "112" Lamp "112" does not light.	. replace frame assembly

Test no	Operation and normal indication	Corrective action
2	Set switch "105" successively to positions "  , SQUELCH-1, -2, -TONE and "X"; after pressing lamp "112", the lamp should light in each position of switch "105".	. replace lamp . replace frame assembly
3	Set switch "105" to "  " and measure with meter (5) 15 V DC between the following contacts: "101/C" (+) and "101/A" (-) (2x) "PD6/6" (+) and "PD6/12" (-) "PD6/10" (+) and "PD6/12" (-)	. replace frame assembly
4	Connect handset (6) to a connector "101". Handset produces noise.	. replace module 1 . replace module 4 . replace module 5 . replace frame assembly
5	Set the output voltage of the signal generator (2) to 2 μ V and if necessary adjust the frequency for maximum signal in the handset (6). The handset gives a loud 1000 Hz tone.	Noise from handset: . replace module 1 . replace module 6 . replace frame assembly Rattling noise from handset: . replace module 3 . replace module 4 . replace module 5 . replace module 6 . replace module 7 . replace frame assembly
6	Set knobs "103" and "104" and the signal generator (2) successively to the following frequencies. 27.050 MHz 32.600 MHz 28.100 MHz 33.800 MHz 29.150 MHz 35.000 MHz 30.200 MHz 45.000 MHz 31.400 MHz 46.050 MHz Repeat the operation of test 5 for each frequency. A loud 1000 Hz tone should be heard from the handset (6).	Noise from handset: . Replace module 6 Rattling noise from handset: . replace module 7 . replace module 3 . replace module 4 . replace module 5 . replace module 6 . replace frame assembly

Test no	Operation and normal indication	Corrective action
7	Set switch "102" to "47 - 70" and knobs "103" and "104" and the signal generator (2) successively to the following frequencies 69.050 MHz 58.050 MHz 47.000 MHz Repeat the operation of test 5 for each frequency. A loud 1000 Hz tone should be heard from the handset (6).	. replace module 6
8	Set switch "105" to "SQUELCH-1" and set output of signal generator (2) to zero. Lamp "112" does not light and no noise is heard in the handset (6).	. replace module 1 . replace module 5 . replace frame assembly
9	Set the output of signal generator (2) to 0,5 μV. Lamp "112" lights and a loud 1000 Hz tone is heard from the handset (6).	. replace module 1 . replace module 5 . replace frame assembly
10	Set switch "105" to SQUELCH-2" and set output of signal generator (2) to zero. Lamp "112" does not light and no noise is heard in the handset (6)	. replace module 1 . replace frame assembly
11	Set the output of signal generator (2) to 1 μV. Lamp "112" lights and a loud 1000 Hz tone is heard from the handset (6).	. replace module 1 . replace frame assembly
12	Turn volume control knob "106" anti-clockwise and back again. Signal strength of 1000 Hz tone from handset drops and rises steadily.	. replace frame assembly

Test no	Operation and normal indication	Corrective action
13	Set the output of signal generator (2) to zero. Press lamp "112". No noise is heard from the handset (6).	. replace frame assembly
14	Set switch "105" to "TONE" and set the output of signal generator (2) to 0,3 μ V. No signal is heard from the handset (6) and lamp "112" does not light.	. replace module 1 . replace module 4 . replace frame assembly.
15	Switch off the 1000 Hz modulation of signal generator (2) Adjust the modulation of signal generator (2) to 150 Hz, and deviation to 3 kHz, using tone generator(3). Lamp "112" lights and noise is heard in the handset (6).	. replace module 1 . replace module 4 . replace frame assembly
16	Set switch "105" to "X". Adjust the modulation of signal generator (2) again to 1000 Hz and deviation to 10 kHz. Set the output voltage of the signal generator (2) to 10 μ V. A weak 1000 Hz tone is heard in the handset (6).	. replace module 1 . replace frame assembly
17	Set switch "105" to "•○" Disconnect and remove signal generator (2).	
b. <u>Testing the transmitter</u> Connect the cable "03" RF-power probe (4) to connector PD6/A1. Connect multimeter (5) to "01" (+) and "02" (-) of the probe. Connect the 50 Ω dummy load to the coaxial socket "04" of RF-power probe (4).		

Test no.	Operation and normal indication	Corrective action
18	Set switch "105" successively to "⊙", SQUELCH-1", "2", and "TONE" and speak in each setting into the microphone of the handset (6) while pressing the push-to-talk switch of the handset. Side tone is heard from the handset (6) (Set is tuned to 47.000 MHz since test 7)	. replace module 2 . replace frame assembly
19	Set switch "105" to "SQUELCH-2" and press the push-to-talk switch. Check the output power of the transmitter. Multimeter (5) indicates 8 μ A or more.	. replace module 6 . replace frame assembly
20	Set knobs "103" and "104" to 58.050 MHz and 69.050 MHz. At each frequency setting press the push-to-talk switch of the handset (6). Multimeter (5) indicates 8 μ A or more.	. replace module 6 . replace frame assembly
21	Set switch "102" to "26 -47" and knobs "103" and "104" to 46.050 MHz, 35.000 MHz and 27.050 MHz. At each frequency setting press the push-to-talk switch of the handset (6). Multimeter (5) indicates 8 μ A or more.	. replace module 6 . replace frame assembly
22	Set switch "105" to "TONE" and press the push-to-talk switch of the handset (6). A very weak 150 Hz tone is heard in the handset (6). (Multimeter (5) indicates 8 μ A or more).	. replace module 2 . replace frame assembly

Test no	Operation and normal indication	Corrective action
23	Set switch "105" to "X". Connect the output of tone generator (3) to contacts "101" "101/B" and "101/A" (earth) of the free connector "101". Set the output of tone generator (3) to 1000 Hz 1,5 V. A weak tone is heard in the handset (6).	. replace module 2 . replace frame assembly
24	Set switch "105" to "●○" Disconnect the RF-power probe and the tone generator.	
<u>c. Testing the band-switching</u> Switch multimeter (5) to an "ohms" range. Connect one test lead on the multimeter to PD6-12. Switch "105" remains in the "●○" position. Set switch "102" to "47 - 70".		
Test no	Operation and normal indication	Corrective action
25	Connect second test lead of multimeter (5) to PD6-2. Turn switch "103" from "47" to "69". Meter (5) shows 0 Ω from "55" to "64", infinite from "47" to "54" and from "65" to "69".	. replace frame assembly
26	Connect second test lead of multimeter (5) to PD6-4 Turn switch "103" from "47" to "69". Meter (5) shows 0 Ω from "51" to "69", infinite from "47" to "50".	. replace frame assembly
27	Connect second test lead of multimeter (5) to PD6-1. Turn switch "103" from "47" to "69". Meter (5) shows 0 Ω from "49" to "59", infinite from "60" to "69". In the positions "47" and "48" the meter shows either a very high or a low resistance, depending on the polarity.	. replace frame assembly

Test no	Operation and normal indication	Corrective action
	Reverse the test leads to check this. Set switch "102" to "26 - 47". Meter (5) shows infinite resistance with switch "103" in the red sector of the scale.	
28	Connect second test lead of multimeter (5) to PD6-9 Meter (5) shows 0 Ω . Set switch "102" to 47 - 70. Meter (5) shows infinite resistance.	. replace frame assembly
29	Connect second test lead of multimeter (5) to PD6-8 Meter (5) shows 0 Ω . Set switch "102" to 26 - 47 Meter (5) shows infinite resistance (switch "103" in the red sector of the scale).	. replace frame assembly
30	Disconnect multimeter (5)	

10. Testing module 1.
to be issued later
11. Trouble-shooting and adjusting module 1.
to be issued later

12. Testing module 2
to be issued later

13. Trouble-shooting and adjusting module 2
to be issued later

14. Testing module 3a. General

The test instructions for module 3 breakdown into two procedures, one for printed circuit 3A (harmonics generator) and one for printed circuit 3B (push-pull mixer).

The two circuits are tested individually on module tester TS-3607.

When a printed circuit is being tested, the presence of the other circuit is not required although it need not be removed.

b. Testing printed circuit 3A

Measuring instruments required:

1. Module tester TS-3607
2. Stabilised adjustable power supply 15V DC, 1A or more (e.g. Philips PE 1510) to be connected to BD1 (+) and BD2 (-) of TS-3607.
3. Multimeter 20000 Ω /V (e.g. Philips PM 2411) to be connected to BD3 (+) and BD4 (-).
4. Oscilloscope (e.g. Philips PM 3200) (for trouble-shooting only).
5. Not applicable
6. Selective voltmeter for 1-15 MHz, to be connected to BD15.
7. Frequency counter (e.g. Philips PM 6630 with PM 6633) to be connected to BD16.
8. Not applicable.
9. Multimeter (e.g. Philips PM 2403) (for trouble-shooting only)

For testing, proceed as follows:

Note: The numbers between brackets (.) refer to the measuring instruments listed above.

1. Connect the module tester up in accordance with the instructions given above. Make sure that not a single pushbutton is pressed and that no inter-connecting leads are connected to the front of the module tester,
2. Inserts the module 3 or the printed circuit 3A to be tested in the correct holder on the tester and make sure that the module holders for modules 4 and 5 are not occupied.
3. Set the supply (2) to 10,5 V and press pushbutton "D1". Meter (3) indicates 0.8 - 1.2 mA.
If wrong, see subpara. 15b item 1.

4. Set the frequency counter so that it can measure a signal of 1 MHz at 1 mV.
Interconnect BD19 and BD20.
Frequency counter measures 1 MHz $\pm$ 50 Hz.
If wrong, see subpara. 15b item 2.
5. Adjust the selective voltmeter for an input impedance of 50 Ω , for input frequencies of 1-15 MHz and for voltages from 0.02-3 mV. Remove connection from BD20 and interconnect BD19 and BD21.
Check the indication of the selective voltmeter at the following frequencies:

<u>Frequency:</u>	<u>Selective voltmeter reading</u>
1 MHz	0,4 - 3 mV
5 MHz	0.4 - 3 mV
11 MHz	0.4 - 3 mV
12 MHz	6 dB or more below reading at 11 MHz
15 MHz	24 dB or more below reading at 11 MHz

If wrong, see subpara. 15b item 3.

6. If alle requirements are met, printed circuit 3A has approval for use.

c. Testing printed circuit 3B

Measuring instruments required:

1. Module tester TS-3607
2. Stabilised adjustable power supply 15V DC 1A or more (e.g. Philips PE 1510) to be connected to BD1 (+) and BD2 (-) of TS-3607.
3. Multimeter 20000 Ω /V (e.g. Philips PM 2411) to be connected to BD3 (+) and BD4 (-).
4. Not applicable
5. Not applicable
6. Selective voltmeter for 26-70 MHz to be connected to BD15
7. Not applicable
8. Signal generator type Schomandl MS-100M to be connected to BD17.
9. Multimeter (e.g. Philips PM 2403) (for trouble-shooting only)
10. VHF millivoltmeter for 44 MHz, 20-1500 mV (e.g. meter (9) + VHF probe Philips PM-9200) (for trouble-shooting only).

For testing proceed as follows:

Note: The numbers between brackets (.) refer to the measuring equipments listed above.

1. Connect the module tester up in accordance with the instructions given above. Make sure that not a single pushbutton is pressed and that no interconnecting leads are connected to the front of the module tester.
2. Insert the module 3 or the printed circuit 3B to be tested in the correct holder on the tester and make sure that the module holders for modules 4 and 5 are not occupied.
3. Set the power supply (2) to 10,5 V and press push-button "D2". Meter (3) indicates 3.8-4.8 mA. If wrong, see subpara. 15c item 1.
4. Interconnect BD22 and BD25
Interconnect BD21 and BD24
5. Set generator (8) to 45 MHz, EMF 1V- 14 dB
6. Adjust the selective voltmeter (6) for an input impedance of 50 Ω and for signals of 36-58 MHz, 1 mV
7. Adjust the selective voltmeter (6) to the frequencies given below and measure the indicated input voltage

<u>Frequency</u>	<u>Input voltage</u>
47 MHz	50 dB or more above 1 μ V
36 MHz } 58 MHz }	40 dB or more below value at 47 MHz

If wrong, see subpara. 15c item 2.

8. Adjust the signal generator (8) to the frequencies given below, EMF 1V-14 dB and check selective voltmeter reading:

<u>generator freq.</u>	<u>selective volt-meter tuned to</u>	<u>selective volt-meter input</u>
45 MHz	47 MHz	0 dB (reference)
47 MHz	47 MHz	50 to 66 dB above 1 μ V
44,5 MHz	46,5 MHz	-0.8 to +1.2 dB } from re-
45.5 MHz	47.5 MHz	-0.8 to +1.2 dB } ference

If wrong, see subpara. 15c item 3.

9. Adjust the signal generator (8) for 45 MHz EMF 1V - 14 dB and set the selective voltmeter (6) for 47 MHz. Check and note the reading of meter (6). Now set the attenuator of the signal generator (8) to -8 dB. Indication on meter (6) increases 3 dB or less. If wrong, see subpara. 15c item 4.

10. The selective voltmeter (6) is set for 47 MHz. Adjust the signal generator (8) successively to 36 MHz, 42 MHz, 54 MHz and 58 MHz (EMF 1V 14 dB). The selective voltmeter indicates 50 dB or more above 1 μ V at the above mentioned frequencies of the generator (8). If wrong, see subpara. 15c item 5.
11. If all requirements are met, printed circuit 3B has approval for use.

15. Trouble-shooting and adjusting of module 3

a. General

Like testing, also the trouble-shooting is described individually for the two printed circuits of module 3. Trouble-shooting always starts with the test procedure described in paragraph 14.

When reading is not correct, remove the cover from the module and proceed directly to the indicated item of this paragraph.

Refer to paragraph 26 for the instructions for the repair of the module.

After completing the repair of printed circuit 3B, subject the circuit to the adjusting procedure given in sub. paragraph 15d, then test the circuit again as described in sub. paragraph 14c.

b. Trouble-shooting printed circuit 3A (see fig. 10)

1. Quiescent current is not correct.

Using meter (9) measure the following DC voltages.

MP1 : 3.7 - 4.6 V

MP2 : 2.8 - 4.1 V

MP3 : 10.5 V

If wrong, check R1, R2, R3, TS1 and associated components.

2. If no output signal: refer to items 1 and 3.

If output signal available but frequency not correct: check L1, KT1 and C3.

3. Output level of harmonics generator not correct: check the RF signals with the oscilloscope at the following test points.

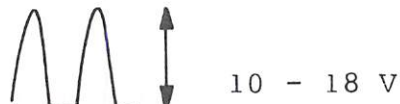
MP1:



MP2:



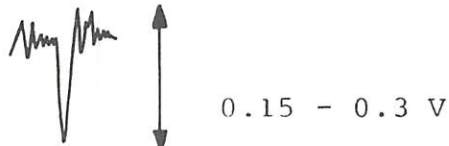
MP3:



MP4:



MP5:



If wrong, check the components involved.

c. Trouble-shooting printed circuit 3B (see fig. 10)

1. Quiescent current is not correct.
Using meter (9) measure the following DC voltages:
MP1 : 3.4 - 4.7 V MP3 : 6.6 - 7.7 V
MP2 : 4.3 - 5.2 V MP4 : 0.9 - 1.8 V
If wrong, check the components involved.
2. The selectivity of the 47 MHz bandpass filter is insufficient.
Check all components of this filter and if necessary readjust the filter as described in subpara. 11d.
If no output at all, check the parts of the mixer stage .
3. Mixer stage incorrect.
Readjust the printed circuit as described in sub. para 15d. If not possible, check the parts of filter and mixer stage.
4. Limiting action of mixer stage insufficient,
Adjust the signal generator for 44 MHz, EMF 1V- 0dB
Measure with meter (10) the AC voltage at the following test points:
MP1 : 310 - 460 mV
MP3 : 840 - 1260 mV
MP4 : 24 - 36 mV
If wrong, check the parts involved.
5. Mixer stage incorrect.
Check the parts of the mixer stage.
After completing repair of the printed circuit 3B the adjusting procedure of subpara. 15d must be performed.

d. Adjusting printed circuit 3B (see fig. 10)

For measuring equipment required, see subpara. 14c.

1. Connect the measuring equipment up as mentioned in subpara. 14c.
2. Remove the cover from the module and install the special adjusting cover for module 3.
3. Make sure that not a single pushbutton on the module tester is pressed and insert the module holder "3".
Remove all interconnecting leads from the front of the module tester.
4. Set the power supply (2) to 10.5 V and press pushbutton "D1".
5. Interconnect BD22 and BD25.
Interconnect BD21 and BD24.
6. Adjust generator (8) for 45 MHz, EMF 1V -14 dB

7. Adjust selective voltmeter (6) for an input impedance of 50 Ω and for signals of 36 - 58 MHz 1 mV.
8. Adjust selective voltmeter for 47 MHz.
9. Adjust the cores of transformers T2 "B" and T3 "A" for maximum indication of the selective voltmeter (approx. 0.6 mV)
10. Adjust generator (8) for 47 MHz, EMF 1V -14 dB.
11. Adjust trimmer "C9" for an indication on the selective voltmeter (8) of 60.8 - 62.3 dB above 1 μ V.
12. Adjust the generator (8) for 44.5 MHz, EMF 1V -14 dB.
13. Adjust selective voltmeter (6) for 46.5 MHz and note its indication.
14. Adjust the generator for 45.5 MHz, EMF 1V -14 dB.
15. Adjust selective voltmeter (6) for 47.5 MHz and note its indication.
16. The voltages measured in steps 13 and 15 may differ 0.4 dB or less.
If wrong, tune to the lowest of the two voltages and adjust T2 "B" and TS3 "A" until this requirement is met.
17. After the adjustment, replace the original cover and carry out the test procedure laid down in subpara. 14c.

16. Testing module 4a. General

The printed circuits 4A and 4B of module 4 have to be tested on different module testers (4A on TS-3607, 4B on TS-3606)

There is no need, however, to remove the one not under test.

b. Testing printed circuit 4A

Measuring instruments required:

1. Module tester TS-3607
2. Stabilised adjustable power supply 15 V DC 1A or more (e.g. Philips PE 1510) to be connected to BD1 (+) and BD2 (-) of TS-3607.
3. Multimeter 20000 Ω /V (e.g. Philips PM 2411) to be connected to BD3 (+) and BD4 (-).
4. Not applicable
5. Not applicable
6. Selective voltmeter for 1-15 MHz, to be connected to BD15.
7. Not applicable.
8. Signal generator, type Schomandl MS-100M to be connected to BD17.
9. Multimeter (e.g. Philips PM 2403) (for trouble-shooting only)
10. VHF millivoltmeter for 5-50 MHz with T-pad and 50 Ω terminaling resistance (for trouble-shooting only)
11. Sweep generator + oscilloscope (e.g. Rohde & Schwarz SWOB III) (for trouble-shooting only)
12. Logarithmic amplifier (part of instrument (11)). for trouble-shooting only).
13. Module 7, part of the module tester and installed in place

For testing, proceed as follows:

Note: The numbers between brackets (.) refer to the measuring instruments listed above.

1. Connect the module tester up in accordance with the instructions given above. Make sure that not a single pushbutton is pressed and that no inter-connecting leads are connected to the front of the module tester.

2. Insert the module 4 or printed circuit 4A to be tested in the correct holder and make sure that the module holders for modules 3 and 5 are not occupied.
Check that module 7 is in place.
3. Set the power supply (2) to 10.5 V DC.
Press pushbutton "D3". Meter (3) indicates 3.5 - 5 mA.
If wrong, see subpara. 17b item 1
4. Interconnect BD21 and BD28
Interconnect BD22 and BD27
Interconnect BD26 and BD34.
5. Set the drive mechanism of the crystal oscillator to "400" and press "D6".
6. Adjust generator (8) for 46.975 MHz, EMF 1V - 74 dB
7. Adjust selective voltmeter (6) for an input impedance of 50 Ω and for signals of 8.782 MHz 100 mV and a bandwidth of 4 kHz.
8. Check the indication of the selective voltmeter (6) as a function of the attenuator position of the generator (8) and compare this with the following table:

<u>attenuator</u>	<u>selective voltmeter</u>
-74 dB	8 - 25 mV
-64 dB	30 - 55 mV
-54 dB	50 - 70 mV
-44 dB	50 - 75 mV
-40 dB	50 - 80 mV

If wrong, see subpara. 17b item 2.

9. Set the stepped attenuator back to -74 dB and adjust the generator (8) and selective voltmeter (6) following the table below.
The EMF of generator (8) must be kept to 1 V - 74 dB and the crystal oscillator set to "400".

<u>Generator (8)</u>	<u>selective voltmeter (6)</u>	
<u>frequency</u>	<u>frequency</u>	<u>voltage</u>
46.975	8.782 MHz	0 dB (reference)
46.900	8.707 MHz	0-1.5 dB
47.050	8.857 MHz	0-1.5 dB
46.100	7.907 MHz	-20 dB or less
47.850	9.657 MHz	-20 dB or less

If wrong, see para 17b item 3.

10. If all requirements are met, printed circuit 4A has approval for use.

c. Testing printed circuit 4B
To be issued later.

17. Trouble-shooting and adjusting module 4a. General

Like testing, also the trouble-shooting is described individually for the two printed circuits.

Trouble-shooting always starts with the test procedure described in paragraph 16.

When a reading is not correct, remove the cover from the module and proceed directly to the indicated item of this paragraph.

Refer to paragraph 26 for the instructions for the repair of the module.

After completing repair of printed circuit 4A, subject the circuit to the adjusting procedure given in subparagraph 17d, then test the circuit again as described in subparagraph 16b.

b. Trouble-shooting printed circuit 4A (see fig. 11)

1. Quiescent current is not correct.

Using meter (9) measure the following DC voltages against earth.

MP1 : 3.3 - 4.6 V	MP6 : 10.3 V or more
MP2 : 4.2 - 5.1 V	MP7 : 3.3 - 4.6 V
MP3 : 9.8 - 10.3 V	MP8 : 4.2 - 5.1 V
MP4 : 0.5 - 0.9 V	MP9 : 9.8 - 10.3 V
MP5 : 0.1 V or less	

If wrong, check the components involved.

2. Insufficient limiting of mixer stage.

Leave the stepped attenuator of the generator in the 40 dB position

Using meter (10), measure the following AC voltages

MP3 : 50 mV or more
MP6 : 10 mV or more
MP9 : 100 mV or more

If wrong, check the components involved.

If necessary, read just the circuit by the procedure given in subparagraph 17d.

3. If the voltage indications on the selective voltmeter deviate, this points towards lack of symmetry or insufficient selectivity.

In that case resort to the adjusting instructions given in subparagraph 17d.

If adjustment is not possible, check the components of the circuit or circuits involved.

c. Trouble-shooting printed circuit 4B

To be issued later

d. Adjusting printed circuit 4A (see fig. 11)

For measuring instruments required see para 16b, however, remove the selective voltmeter and connect the logarithmic amplifier (12) to BD15 and the oscilloscope of instrument (11) to the logarithmic amplifier.

For adjustment, proceed as follows:

1. Prepare the measuring set-up as described above.
2. Make sure that not a single pushbutton is pressed and that no interconnecting leads are connected to the front of the module tester.
3. Remove the cover from the module and install the special adjusting cover of module 4.
4. Check that module 7 of the module tester is in position in the tester and insert module 4 in the correct holder. Make sure that the holders for modules 3 and 5 are not occupied.
5. Set the power supply (2) to 10.5V DC. Set the drive mechanism of the crystal oscillator to position "400" (38,193 MHz)
6. Switch on the supply voltage and the crystal oscillator by pressing "D3" and "D6".
7. Press "D4" to place a 10-ohm resistance across the output of the mixer stage.
8. Interconnect BD22 and BD27.
Interconnect BD26 and BD34.
9. Connect meter (10) to BD28.
10. Adjust generator (8) for 46.975 MHz, EMF 1V - 34 dB.
11. If meter (10) does not give any indication, even when set to its most sensitive range, the cores of L2 "A", L3 "B" and T3 "E" must be adjusted until some indication on meter (10) is observed.
12. Adjust the cores of transformers T1 "C" and T2 "D" for maximum reading on meter (10).
13. Disconnect meter (10) from BD28 and remove interconnection BD22 - BD27.
14. Interconnect BD27 and BD29.
Interconnect BD21 and BD28.
15. Adjust the sweep generator (11) for a centre frequency of 47 MHz, a frequency swing of 2 MHz and an output voltage of approx. 100 μ V.
The signal of generator (8), to be taken from BD22 must be used as "marker" (EMF 1V - 0 dB).

16. Adjust the bandpass filter response curve, displayed on the oscilloscope, with L2 "A" and L3 "B" until the the following requirements are met.

<u>Marker frequency</u>	<u>Output level</u>
8.782 MHz	0 dB (reference)
8.707 MHz (= -75 kHz)	0 dB $\pm$ 1.5 dB
8.857 MHz (= +75 kHz)	0 dB $\pm$ 1.5 dB
7.907 MHz (= -875 kHz)	-20 dB or less
9.657 MHz (= +875 kHz)	-20 dB or less

17. Remove the resistance across the output of the mixer stage by releasing "D4".
18. Adjust T3 "E" for maximum output and optimum symmetry of the bandpass response curve.
19. Set the drive mechanism of the crystal oscillator to position "800" (38.593 MHz)
20. Take a note of the now displayed bandpass response curve. It should drop at the high frequency side
21. Set the drive mechanism of the crystal oscillator to position "000" (37.793 MHz).
22. Take a note of the now displayed band pass respond curve. It should drop at the low frequency side.
23. Adjust T1 "C" so, that the amplitudes of the response curves displayed in steps 20 and 22 are equal.
24. Adjust T3 "E" so, that the drops of both curves of step 20 and 22 have broadly the same shape.
25. Adjust T2 "D" to maximum amplitude.
26. Repeat steps 18 through 25 if necessary.
27. Replace the original cover on the module and give it a test run as described in paragraph 16b.

18. Testing module 5

a. General

The printed circuits 5A and 5B of module 5 have to be tested on different module testers. (5A on TS-3606, 5B on TS-3607).

There is no need, however, to remove the one not under test.

b. Testing printed circuit 5A

To be issued later

c. Testing printed circuit 5B

Measuring instruments required:

1. Module tester TS-3607
2. Stabilised adjustable power supply 15V DC, 1A or more (e.g. Philips PE 1510) to be connected to BD1 (+) and BD2 (-) of TS-3607.
3. Multimeter 20000 Ω/V (e.g. Philips PM 2411) to be connected to BD3 (+) and BD4 (-).
4. Oscilloscope (e.g. Philips PM 3200) to be connected to BD5 and BD6 (earth)
5. Electronic multimeter (e.g. Philips PM 2403) to be connected to BD7 and BD8
- 6 and 7. Not applicable.
8. Signal generator, type Schomandl MS-100M to be connected to BD17.
9. Multimeter (e.g. Philips PM 2403) (for troubleshooting only).
- 10, 11 and 12. Not applicable.
13. Module 7, part of the module tester and installed in place.

For testing, proceed as follows:

Note: The numbers between brackets (.) refer to the measuring instruments listed above.

1. Connect the module tester up in accordance with the instructions given above. Make sure that not a single pushbutton is pressed and that no interconnecting leads are connected to the front of the module tester.
2. Insert the module 5 or printed circuit 5B to be tested in the correct holder and make sure that the module holders of module 3 and 4 are not occupied. Check that module 7 is in place.
3. Press pushbutton "D5".
Meter (3) indicates 3.5 - 7.5. mA.
if wrong, see subpara. 19c item 1.
4. Interconnect BD22 and BD30.
Interconnect BD32 and BD33.
5. Set the drive mechanism of the crystal oscillator to "050" and press "D6".
6. Adjust generator (8) for approx. 8.757 MHz, EMF 1V - 20 dB.

The oscilloscope now displays an alternating voltage whose frequency is the difference between the x-tal oscillator and signal generator frequencies. Detune the generator (8) until the beat frequency is approx. 50 Hz.

The voltage of this 50 Hz signal must be approx. 12V peak to peak. If wrong, see subpara. 19c item 2.

7. Remove interconnection BD22 - BD30
Set the drive mechanism of the crystal oscillator successively to "000", "050", "100" and "150".
The DC voltage variation resulting from this and indicated on meter (5) should not exceed 300 mV.
If wrong, see subpara. 19c item 3.
8. Release "D6" and interconnect again BD22 and BD30.
9. Vary the generator frequency between 8.5 MHz and 9 MHz (EMF 1V - 20 dB). The DC voltage variation resulting from this and indicated on meter (5) may not exceed 300 mV.
If wrong, see para. 19c item 3.
10. Press "D6" and set the drive mechanism of the crystal oscillator to "050" (8.757 MHz).
11. Adjust generator (8) for 8.757 MHz, EMF 1V - 20 dB.
The oscilloscope screen should now display a beat voltage. Adjust the generator frequency until beat voltage is approx. 50 Hz.
Take a note of the beat amplitude and use this value as the 100% reference in checking the frequency response of the control loop against the following table.

<u>beat frequency</u>	<u>beat voltage</u>
45-55 Hz (20 m sec.)	100% (reference)
900-1100 Hz (1 m sec.)	20 - 40 %
4500-5500 Hz (200 μ sec.)	3 - 9 %
9000-11000 Hz (100 μ sec.)	2 - 4 %

Note: More accuracy in determining the beat voltage amplitude can be achieved by switching off the horizontal deflection.

If wrong, see subpara. 19c item 4.

12. Remove connection BD22 to BD30 and connect BD22 to BD31. Release "D6" and set the attenuator of the generator (6) to 0 dB.
13. Set the generator (6) to the frequencies indicated below and measure the corresponding peak to peak voltages on the oscilloscope.

Generator

50 kHz $\pm$ 100 Hz, 1V
100 kHz $\pm$ 100 Hz, 1V
150 kHz $\pm$ 100 Hz, 1V
200 kHz $\pm$ 100 Hz, 1V

Oscilloscope

140 mV p/p or less
112 mV p/p or less
98 mV p/p or less
84 mV p/p or less

If wrong, see subpara. 19c item 5.

14. If all requirements are met, the printed circuit 5B has approval for use.

19. Trouble-shooting and adjusting module 5a. General

Like testing, the trouble-shooting is described individually for the two printed circuits of module 5. Trouble-shooting always starts with the test procedure described in paragraph 18.

When a reading is not correct, remove the cover from the module and proceed directly to the indicated item of this paragraph.

Refer to paragraph 26 for the instructions for the repair of the module.

After completing repair of printed circuit 5B subject the circuit to the adjusting procedure described in subpara. 19d, then test the circuit again as described in subpara. 18c.

After completing repair of printed circuit 5A subject the circuit to the test procedure of subpara. 18b.

b. Trouble-shooting and repairing printed circuit 5A.

To be issued later.

c. Trouble-shooting and repairing printed circuit 5B (see fig 12)

1. If the quiescent current deviates from the permissible range (3.5 - 7.5 mA) measure the following DC voltages at the indicated test points with multimeter (9).

MP1 : 2.3 - 2.7 V	MP5: 3.8 - 4.3 V
MP2 : 2.9 - 3.3 V	MP6: 3.2 - 3.7 V
MP3 : 10.5 V	MP7: 3.5 - 4.5 V
MP4 : 10.5 V	

If wrong, check the parts involved.

2. If there is no beat voltage, check the various components of the phase discriminator.
If the beat voltage is less than 12 volts p-p, check diode GR3 and capacitors C4 and C21; if these components are found to be in good working order, carry out the adjusting procedure of subpara. 19d below.
3. When the phase discriminator balance is tested, the DC voltage variation must not exceed 300 mV. If it is more, check capacitors C8 and C9 and if these are found all right, carry out the adjusting procedure of subpara. 19d. below.
4. If the frequency response of the control loop does not meet the requirements, check capacitors C14 and C23 and resistor R7.
5. If the desired minimum voltage is not reached, readjust the coil in question or replace it.

d. Adjusting procedure printed circuit 5B (see fig 12)

For measuring instruments required, see subpara. 18c.

(1) Adjusting the phase discriminator.

1. Prepare the measuring set-up described in subpara. 18c.
2. Fit the special adjusting cover on the module and insert the module in the holder "5" on the module tester.
Make sure that module 7 is in place inside the module tester.
3. Remove the interconnecting cables from the front of the module tester. Check that all pushbuttons on the tester are not pressed.
4. Set meter (3) to the 10 mA range and adjust the power supply (8) to 10.5 V.

5. Interconnect connector BD22 to BD20 and BD32 to BD33.
 6. Set generator (2) to approx. 8.757 MHz 1 Volt - 40 dB. Set the drive mechanism of the crystal oscillator (module 7) to position "050" (8.757 MHz)
 7. Press pushbutton "D5" and "D6"
The oscilloscope screen should now display an alternating voltage whose frequency is the difference between the generator frequency and the crystal oscillator frequency.
Detune the generator (2) until the beat frequency is between 40 and 60 Hz.
 8. Adjust the core of transformer T2 "E" for maximum amplitude of the beat signal.
 9. Adjust the attenuator to -20 dB.
 10. Adjust trimmer C19 "F" for maximum amplitude of the beat signal.
 11. Release "D6", thus switching off the crystal oscillator.
 12. Set the generator for internal frequency modulation and modulate its signal with 1000 Hz. The frequency deviation should be 100 kHz.
 13. Adjust trimmer C8 "G" for minimum amplitude of the 1000 Hz voltage.
 14. Repeat steps 5 to 12 until the maxima and minima no longer change.
- (2) Adjusting the series-resonant circuits.
1. Carry out steps 1 to 4 described under (1) "Adjusting the phase discriminator"
 2. Interconnect connector BD22 to BD31 and set attenuator to 0 dB.
 3. Set the generator for an output of 50 kHz $\pm$ 100 Hz, 1 Volt and press pushbutton "D5".
 4. Adjust the core of coil L2 "A" for minimum signal amplitude on the oscilloscope.
 5. Set the generator to 100 kHz $\pm$ 100 Hz; 1 Volt EMF and adjust the core of coil L3 "B" for minimum signal amplitude on the oscilloscope.
 6. Set the generator to 150 kHz $\pm$ 100 Hz; 1 Volt EMF and adjust the core of coil L4 "C" for minimum signal amplitude on the oscilloscope.
 7. Set the generator to 200 kHz $\pm$ 100 Hz; 1 Volt EMF and adjust the core of coil L5 "D" for minimum signal amplitude on the oscilloscope.

8. Repeat steps 3 to 7 until the minima remain unchanged.

After adjustment, subject the module once more to the test run described in subpara. 18c.

20. Testing module 6

To be issued later

21. Trouble-shooting and adjusting module 6

To be issued later.

22. Testing module 7a. General

Module 7 consists of:

Printed circuit 7A, an oscillator unit.

Printed circuit 7B, a 4-crystal unit set for approx. 8.7 MHz and

Printed circuit 7C, a 5-crystal unit set for approx. 38 MHz

Switch SK1 on the module tester controls selection in the two crystal unit sets thus simulating the "kHz" tuning control.

The switch is engraved in kHz steps ("000", "050", "100" etc. up to "950")

The crystal oscillator unit always produces two frequencies according to the following plan: positions "000" to "150" of SK1: 37.793 MHz crystal and one of the four crystals of printed circuit 7B (about 8.7 MHz). Position "200" to "350" of SK1: 37.993 MHz and again one of the four crystals of 7B etc.

Instructions for the insertion of module 7 in the module tester and for its removal as well as hints for the removal and re-installation of the module are given in subpara. 25 item (6).

b. Testing module 7

Measuring instruments required.

1. Module tester TS-3607
2. Stabilised adjustable power supply 15V DC, 1A or more (e.g. Philips PE 1510, to be connected to BD1 (+) and BD2 (-).
3. Multimeter 20.000 Ω /V or better (e.g. Philips PM 2411) to be connected to BD3 (+) and BD4 (-).
4. Not applicable
5. Not applicable
6. Not applicable
7. Frequency counter, to be connected to BD16.
8. Not applicable
9. Electronic multimeter (e.g. Philips PM 2403) (for trouble-shooting only).
10. Multivoltmeter, to be connected to a T-piece with 50 Ω termination, Connect the T-piece to BD17.

For testing proceed as follows:

1. Connect the module tester up as indicated above and check that not a single pushbutton is pressed. Remove all interconnecting coaxial cables from the front of the module tester.

2. Adjust the power supply (5) to 10.5 V and set meter (3) to the 10 mA DC range.
3. Remove the reference module 7 from its position in the module tester and insert the module 7 to be tested in its place. For the insertion and removal of the module please refer to para. 25
4. Press pushbutton "D6" to apply the supply voltage to the module under test. Meter (3) indicates 6-8 mA. If wrong, see para. 23 item 1.
5. Interconnect BD20 to BD23 and BD22 to BD26. Using meter (10), check the oscillator output voltage and determine its frequency with the frequency counter as follows:

<u>SK1 at position</u>	<u>X tal freq. MHz</u>	<u>Max. freq. error</u>	<u>Output mV</u>
"000"	37.793	+ 320 Hz	200 - 275
"200"	37.993	+ 320 Hz	200 - 275
"400"	38.193	+ 320 Hz	200 - 275
"600"	38.393	+ 320 Hz	200 - 275
"800"	38.593	+ 320 Hz	200 - 275

If wrong, see para. 23 item 2.

6. Remove the connection BD22 to BD26 and interconnect BD22 to BD32, the same equipment as in step 5, take measurements as outlined below:

<u>SK1 at position</u>	<u>X tal freq. MHz</u>	<u>Max. freq. error</u>	<u>Output mV</u>
"000"	8.707	+ 72 Hz	200 - 250
"050"	8.757	+ 72 Hz	200 - 250
"100"	8.807	+ 72 Hz	200 - 250
"150"	8.857	+ 72 Hz	200 - 250

If wrong, see para. 23 item 3.

7. If all requirements are met, module 7 has approval for use.

23. Trouble-shooting module 7a. Inserting the module in the tester

1. Take the module out of transceiver RT-3600 in the way described in subpara 25 item
2. Loosen the quick-fastener, which secures the hinged-flap to the module tester, then remove the reference module from its position behind this flap in exactly the same way as described in subpara 25.
3. Insert module 7 in the place of the reference module again consulting subpara 25.
4. Tighten the quick fastener.

b. Trouble-shooting procedure (see fig. 15)

Trouble-shooting always starts with the testing of the module as described in para. 22

When a reading is not correct, follow the instructions given.

After each repair, repeat the test sequence of para 22. The test points on the printed circuits of the module can be reached after removing the cover of the module. Instructions for disassembly of the module are given in para 28.

1. If the current deviates from the indicated range, measure with meter (9) the following DC voltages
 MP1 : 5 - 6.6 V
 MP2 : 5.4 - 7.2 V
 If not correct, test transistors TS1 and TS2, coils L1 to L4 and resistors R1, R2, R4, R5, R7 and R8.
2. If no output voltage is measured at all five frequencies, check capacitors C3 to C5 and the spring contacts of the rotary crystal switch.
 If the output voltage is too high for all frequencies check capacitor C5.
 If no output voltage at a particular frequency, check the crystal in question.
 If the frequency error exceeds ± 320 Hz, adjust trimmer C11 "A" until the requirements are met for all frequencies. If not possible, replace the crystal giving the greatest frequency error.
3. If no output voltage is measured at all four frequencies, check capacitors C6, C7 and C8, resistors R9 and R10 as well as the contacts of the rotary switch track.
 If the output is too high, check capacitor C8.
 If no output voltage is observed at a particular frequency. Replace the crystal in question.
 If the frequency error exceeds ± 72 Hz, replace the crystal in question.

24. Testing and trouble-shooting of the frame assembly
module 10

The frame assembly can be best tested with approved modules 1 to 7 installed following the test procedure for the receiver-transmitter described in paragraph 9.

Using the circuit diagram (fig. 4) wiring list (para.30) wiring diagram (fig 16) and an ohmmeter, the faulty part(s) can be located.

The meachanical repair of the frame assembly is described in para. 29.

Section 2 - Mechanical construction, maintenance and repair25. DISASSEMBLY AND ASSEMBLY OF THE RECEIVER-TRANSMITTER(1) General

The disassembly and assembly (or: removal and installation) of parts is given in the logical order. Note, however, that a disassembly sequence need not always be pursued right to the end.

(2) Removing the receiver-transmitter from the cabinet

- . Set frequency range switch 102 to position "47 -70".
- . Set "kHz" control 104 to position "000".
- . Set "MHz" control 103 on front to position "47".
- . Loosen the four set screws in the four bridge clamps, swing the clamps outwards and remove the receiver transmitter from the cabinet.

(3) Replacing modules 1 to 5

- . Loosen the captive screws at the underside of the chassis
- . Pull the module in question out of its holder by the two rings on top of the module
- . A locating pin fitted to each module prevents faulty insertion of a module in its holder.
- . After inserting a module, snap the rings back over the projections and tighten the captive screws.

(4) Replacing module 6 (see fig. 23)

- . Check that the controls are positioned as instructed in item (2) above.
- . Remove the clamps (4) and (7).
- . Pull out the four coaxial connectors (2, 5, 8 and 9) The connector at the top, left front, has to be disengaged gently with tweezers or long-nose pliers.
- . Take the module out of its holder. You can remove amplifier (3) from the module by loosening the two screws (6).
- . Loosen the three captive screws (1) with secure module 6
- . To install module 6, proceed in the reverse order.

For disassembly and assembly of the coaxial connectors, see figure 30.

(5) Swinging the front down (see fig. 23)

- . Set controls 102, 103 and 104 to 47.000 MHz as mentioned in item (2) above.

- . Pull coaxial connector (9) clear with tweezers or long-nose pliers.
- . Loosen the two captive screws and swing the front downwards. When doing so, be careful not to distort the fork attached to the frequency range switch.
- . When replacing the front,
 - check that the controls are in the position 47.000 MHz
 - make sure that the fork of switch 102 is correctly located (if necessary guide the pin or fork into position).

Also replace the coaxial connector (9).

(6) Replacing module 7 (see fig. 24)

- . Remove the three screws (6) and lockwashers (7).
- . Take the module from its holder.
- . When fitting module 7, watch that the projection on the spur gear hub enters the cut-away part of the bush as indicated on the figure.
- . Next press the module into its holder, then fit the screws and lockwashers

26. DISASSEMBLY AND ASSEMBLY OF MODULES 1 to 5.

Loosen the two screws on top of the module and remove the cover.

Unscrew the five fastening screws of the circuit to be repaired and remove this circuit.

Removing a part from a printed circuit may be best done by first cutting the connecting wires, after which the part may be removed and the wires unsoldered. Parts that are glued to the print may be removed by carefully heating the glue with a soldering iron.

If the part has a plastic envelope, cut the plastic envelope first, then cut the wires, after which the part may be removed from the print and the glued envelope may be removed with the soldering iron. Be very careful not to damage the printed wiring.

When new parts are to be glued to the printed circuit use a cement composed of an epoxy resin and a catalyst (hardening agent) (e.g. Philips code nos 1322 501 36601 and 1322 502 14301).

Proceed as follows:

- . Carefully degrease the parts to be glued together.
- . Mix equal parts of epoxy resin and catalyst thoroughly taking care to avoid air bubbles in the mixture. A mixture so prepared is immediately ready for use and will remain workable for about 45 minutes at approx 18°C (65°F).

When the mixture thickens, do not try to dilute it. Never prepare more of the mixture than you will need immediately.

- . Apply the cement with a small brush or spatula.
- . Allow the cement to set. This takes 3 hours at 70°C (160°F) in an oven.
If the hardened glue must have high electrical surface resistance, do not prepare and apply the cement at relative humidities of 60% and upwards.
Parts having a weight of over 15 grammes have to be glued to the print. This is also the case with parts having connecting wires exceeding a length of 25 mm (1") and a weight of over 5 grammes.
During assembly of the modules care should be taken that the two printed circuits are mounted correctly in respect to each other and the earthing pins on the bottom.
The best way to insure this is to assemble the module without fastening the screws completely.
Then insert the module in the right socket of its test jig and give the screws a final turn.

27. DISASSEMBLY AND ASSEMBLY OF MODULE 6

(1) Repair of the RF amplifier (see fig. 32)

- (a) Replacing the amplifier case bandpass filter and the parts on the amplifier chassis (see figure 32).

For replacement of the amplifier case and bandpass filter, proceed as follows:

Note: For replacement of circuit 6P there is no need for removing amplifier case (3) from amplifier chassis (2); see item (1) (b).

- . Remove the two screws which secure amplifier cover (4) to the amplifier case (3) and remove the two lockwashers
- . Unsolder the coaxial cables from terminals 5, 6, 1 and 9 of circuit 6P and mark the connecting wires. Further unsolder from underneath the termination of pin 9 of circuit 6N. If required, consult the wiring diagram (fig. 34)
- . Take the amplifier case from the amplifier chassis after removing the two screws and washers from the rearside of the chassis.
- . For putting the amplifier case back, proceed in the reverse order.
- . To remove the bandpass filter (5):

- . Unsolder the terminating wires of terminals 1 to 4 of the bandpass filter from underneath (see also fig. 34).
- . Remove the bandpass filter from the chassis after removing the two screws and lockwasher from the rearside of the chassis.
- . For fitting the bandpass filter proceed in the reverse order.

The way in which components and circuits of the amplifier and bandpass filter have to be removed and refitted is described in item (1)(b).

The removal and replacement of the remaining components of the amplifier chassis should take place as follows:

- . Amplifier bracket (8) can be replaced after removing the bandpass filter (5) and removing the two countersunk head screws. When fitting the amplifier bracket, make sure that PD1 is connected to the inner conductor and PD2 to the outer conductor (screen) of the coaxial cable.
- . Detector circuit 6H, microswitches SK1 and SK2 (10) and socket connector PD4 (6) can be replaced as shown on the figure. Mark the connecting wires for identification when unsoldering them. When reinstalling everything, consult wiring diagram figure 34.

(b) Replacing components and circuits of the amplifier and bandpass filter (see fig. 32).

To replace printed circuit 6P, proceed as follows:

- . Unsolder the connecting wires from pins 1, 2, 4, 5, 6, 7 and 9 of 6P (11) and mark them for identification: see also fig. 34.
- . Remove the two posts (13) one screw and the three washers and take the printed circuit out of the case.
- . For re-installing the printed circuit in the case proceed in the reverse order.

To replace printed circuits 6M and 6N, proceed as follows:

- . Unsolder all connecting wires from the pins of the two circuits and mark the wires.
- . Unsolder leaf spring (22) by heating the joint whilst pressing the spring down and remove leaf spring after removing the two screws and lockwashers.
- . Remove clamp (21) with printed circuits 6M and 6N and transistor (41) from the amplifier case after removing the two screws and washers at the side of the case.

- . Now the printed circuits and transistor 2N3632 can be replaced as indicated on the figure.
- . For refitting the parts and printed circuits, proceed in the reverse order whilst consulting the wiring diagram

Transistor BFW16 (15) can be replaced by removing the two screws and washers. When fitting a new transistor, make sure that top washer (16) and mica bottom washer (14) are mounted correctly. For replacement of the transistor there is no need to remove clamp (21).

To replace printed circuit 6L, proceed as follows:

- . Take the bandpass filter from the amplifier chassis as described in (1)(a).
- . Loosen the two screws used to fix the cover.
- . The printed circuit is soldered in place in the case. For replacement it has to be unsoldered.
- . For refitting, proceed in the reverse order.

(2) Repair of the tuning unit; 6-2

(a) Replacement of the coil assembly (see figure 33)

The coil assembly (16) can be replaced after unsoldering the wires from micro-switches SK3 and SK4 (11) and from printed circuit 6G (1) and after removing the four screws (19) and washers.

Mark the connecting wires.

The micro-switches SK3 and SK4 can now be removed by removing the four screws and eight washers.

For refitting, proceed in the reverse order.

For replacement of leaf spring (2) printed circuit 6G (1), micro-switch SK5 (6), flat spring (3) and socket connector (9), see the figure.

When replacing the crank (15), watch the following points. Before fitting set the band switch to the "high band" position (which means that micro-switches SK3 and SK4 are both depressed). The crank (15) and the slot in the coupler (4) should then both point upwards vertically as shown on the figure.

(b) Replacement of the bandpass filter circuits (fig. 33).

For replacement of bandfilter 6B, proceed as follows:

- . Remove the cover.
- . Unsolder coil L4 from coil L10 and the wire from the tap on L10 to 6C.
Mark the wires. Remove coils L4 and L5.
- . Remove the four screws and eight washers and take bandpass filter (26) together with micro-switch SK7 (24) out of the section of the case, taking care that the pin which engages connector BS2 does not get damaged.

- . For replacement of micro-switch SK7 (24) see the figure
- . For re-fitting the bandpass filter and microswitch, proceed in the reverse order. Make sure that connector BS2 is brought down correctly over the contact pin.

The replacement of bandfilter 6A is effected in much the same way. Feedthrough terminals (27) and (28) are glued in position. To remove them, heat the glue with, for example, a soldering iron. To glue a new feed through terminal in place, follow the instructions given in paragraph 29 item (17). For your information the feed through terminals differ in length!

(c) Replacing the remaining printed circuits.

Printed circuits 6C, 6D, 6E, 6J and 6F can be replaced simply by unsoldering their connecting wires and removing the circuits fixing screws.

When installing circuits, consult wiring diagram fig. 34. When installing circuit 6J, use an amplifier case as jig, to ensure that 6J is mounted in the correct position.

28. DISASSEMBLY AND ASSEMBLY OF MODULE 7

Fig. 35 shows how module 7 can be taken apart into its constituent elements, the crystal sets and the oscillator unit.

(1) Disassembly

- . Remove cover (8) by removing the four screws and lockwashers.
- . Take oscillator unit (6) out of bearing box (3) by removing four screws and washers.
- . Loosen the two captive screws (9), then lift crystal unit sets (4) and (10) out of the bearing box (3).
- . Detach wire spring (2) and remove retaining ring (16)
Spur gear unit (15) can now be removed.
- . Using an offset hexagonal spanner ("Allen key"), loosen the two set screws which secure the hubs (11) in position. Now spur gear shaft (1) as well as headless shoulder pin (12) and spur gear (13) can be taken out of the ball-bearings.
- . Spur gear (13) is secured to pin (12) with set screw (14) and a socket set screw.

(2) Assembly

- . Attach spur gear (13) to pin (12) by tightening set screw (14) and the socket set screw.
- . Slip the pin (12) into the ball-bearing.
- . Fit hub (11) over pin (12), making sure that the key on the hub is at an angle of 90 degrees to set screw (14) of the spur gear (13). See detail on the figure
- . Tighten the two socket-head screws of the hub.
- . Slip shaft (1) into the other ball-bearing and tighten the two socket-head screws of the other hub.
- . Now bring spur gear unit (15) on to the pin stub and secure it with retaining ring (16).
- . Now turn the two hubs (11) so that their "keys" point in the directions shown on the figure .
- . Press the spur gear unit (15) into mesh with the shaft and spur gear (13). Check the orientation of the hubs, then fit wire spring (2).

- . Check once again the positioning of the drive mechanism.
- . Place the two crystal unit sets 7B and 7C on the hubs.
Assembly 7B has eight soldered joints on its printed wiring, assembly 7C (10) has ten joints.
- . Tighten the two captive screws (9).
- . Fit all remaining parts in the reverse order compared with the disassembly sequence.

Cylindrical pins (7) can, after replacement, be bonded in place following the instructions of paragraph 29, item (17).

(3) Moulding cushioning pads for the crystal unit sets.

The two crystal unit sets contain cushioning pads of a silicon rubber foam material. The pads are prepared from silicon rubber and a catalyst, respective Philips code numbers 1322 506 23101 and 2322 506 23001.

The pads can easily be pried out with, for example a knife or pointed object.

When a crystal unit set has been cleaned of its foam pad, a crystal can be replaced after which a new pad has to be moulded.

Act as follows:

- . Check that the crystal unit set is correctly installed and contains no wire cutting, tin spatters or pieces of foam rubber
- . Prepare a mould (any material will do). The mould should be cylindrical, its length being about 1,5 cm and its diameter equal to the diameter of the printed wiring disc.
- . Place inside this cylinder, truly centred, a second cylinder whose diameter is 10 mm, equal to that of the hub, item 11 on figure 35. If the cylinder is of metal, it can be fastened to the printed circuit with a screw and nut.
- . Grease the inside of the mould lightly with vaseline.
- . Take a number or cup and put inside it a polythene (plastic) bag so that the inside of the tumbler is lined with polythene. Make sure that the volume of the tumbler is sufficient for the quantities to be prepared.
- . Fill the tumbler with 100 parts (by weight) of foam rubber compound and add 6 parts (by weight) of the catalyst.
To obtain 1 cu. decimeter = 1 litre of foam pad you need about 115 grams of silicon rubber compound and catalyst together.

- . Take the polythene bag out of the tumbler and twist its top shut . Be sure to trap as little air as possible in the bag.
- . Knead and roll the bag with your hands for about 30 seconds.
- . Cut off one corner of the bag and squeeze the mixture into the mould, spreading it as evenly as possible over the bottom.
- . Allow the mixture to set for about 2 hours at room temperature (20°C, 70°F).
- . After it has become rigid, the foam continues to release corrosive fumes. To stop this, cure the mixture for about 16 hours in a ventilated oven heated to 70°C (160°F).
- . Remove the mould. The maximum height of a crystal assembly is 13.5 mm. Cut away the excess material from the pad with a razor-sharp knife.

29. DISASSEMBLY AND ASSEMBLY OF MODULE 10 (FRAME ASSEMBLY)

(1) Replacement of the rubber seal (fig. 24)

The rubber seal (9) is glued to the front.

Pull the old seal from the groove and remove the remaining glue with a special thinner (Philips order code 1322 508 72501).

Carefully clean both the groove and the new seal with a special cleaning fluid (Philips order code 1322 510 50701) Do not keep the seal more than 10 sec. in the cleaning fluid. Dry the seal with oilfree compressed air.

Apply a very thin layer of glue (Philips order code 1322 508 72401) to the bottom of the groove. The layer of glue should be appr. 2 mm wide and without interruptions or thick spots.

Let the glue dry for 20 to 30 minutes and carefully press the seal in the groove. Remove excess glue with the special thinner. Let the glue dry for 48 hours.

Before mounting the unit in the cabinet the seal should be greased lightly with silicon grease (Philips order code 1322 504 98001).

Warning: all ingredients used are inflammable. Keep fire away! Clean the hands carefully afterwards.

(2) The cleaning and greasing of rubber O-rings

All rubber O-rings used with the switches, the connectors and potentiometer R1 should be greased before mounting.

If an O-ring has been dirtied during disassembly it can be wiped clean with a dry cloth. Afterwards it should be greased again. Even slightly damaged O-rings should be replaced. The greasing of the O-rings is done in the following way.

- . Prepare a mixture of 60 parts by weight silicone

grease type DC33 light (manufacturer DOW CORNING) and 40 parts by weight refined petrol.
See to it that the grease is completely dissolved.

- . Dip the O-ring in the mixture but do not immerse it for more than 10 seconds.
- . Let the O-ring dry for 24 hours.

If too much solvent evaporates, a new mixture should be prepared. Greased O-rings which are not used at once should be wrapped in plastic foil. The silicone grease should not come in contact with other parts of the set.

If necessary use cleaning fluid nr. 14 (Philips order code 1322 501 06401) to remove grease.

Warning: The mixture of silicone grease and refined petrol is inflammable, gives off poisonous fumes and may damage the skin after prolonged contact. Keep fire away, have a fume exhaust working and wear gloves.

(3) Air leakage

Air leakage can be tested only, of course, with a RT-3600 combined in a case together with e.g. a junction unit. Alternatively the unit can be tested in a specially designed case.

After removing the screw on the front of the unit a fitting comes available for attaching a compressed air hose. Pressurise the case inside with a maximum of 0.1 atmosphere above normal. In this condition immerse the case in a tank of water. No air bubbles should escape.

(4) Replacement and maintenance of the blocks (fig.24)

The blocks (10) have to be mounted accurately. The intervening space is given on the figure. These blocks and the headed shoulder pins are not to be painted.

(5) Replacing the aerial socket (see fig. 24)

For removing the aerial socket, act as follows:

- . Unsolder the two aerial terminations and capacitor C4: mark the connecting wires.
- . Loosen the two nuts (4) and (5) and remove them with all remaining parts.
- . You can now remove the aerial socket (1) from the front of the transceiver front.
- . For installation, proceed as indicated on the figure and watch that rubber washers (2) and (3) are correctly fitted.

(6) Replacing connector PD3 and microswitches SK3 and SK4 (see fig. 25)

- . Unsolder the wires from the part to be removed and mark them for later identification.
 - . Connector PD3 (1) can be removed by removing nut (3) using a socket spanner and removing soldering tag (2).
 - . Switch SK4 (7) can be removed by unscrewing the two screws.
 - . Switch SK3 (6) can be removed by first removing bracket (4) to which SK3 is connected. Remove the bracket by unscrewing the two screws.
 - . For installation, proceed in the reverse order and check the figure for the correct position of the parts concerned.
- After resoldering the wires remove the markers.

(7) Replacing potentiometer R1, microswitch SK2 and the lamp holder (see figure 26)

To remove potentiometer R1, follow the figure. Take care to mark its terminating wires.

When installing a potentiometer, watch that the retaining stud grips the recess of the potentiometer back face. For the removal of the switch SK2 and the lamp holder, act as follows:

- . Unsolder all electrical terminations and mark the wires
- . Remove the bracket-and-spring (8) by removing the screws and washers. You can now replace microswitch SK2. You can replace lamp holder contact (9) and diode GR2 (10) after removing two screws and washers
- . For fitting new parts, proceed in the reverse order. After completing the soldering joints, remove the markers from the terminations.

(8) Replacing audio connectors PD1 and PD2 (see fig. 27)

- . Remove the screws (7) which secure terminal board (8).
- . Remove the screw, the washer and clamp (1) which hold the cableform in place.
- . Now press the entire cableform upwards until the terminations of the connectors can be unsoldered. Mark the terminating wires.
If you have insufficient clearance for unsoldering remove successively the knob, the nut (2) and the washer (3) from switch SK1 (4). Pressing the switch slightly upwards now provides adequate working space.
- . Loosen the two nuts (6) from the front end and remove the two connectors (5).
- . For assembly and installation, work in the reverse order. Finally remove the markers from the terminating wires.

(9) Replacing relay RE1, transistor TS1 and terminal board 1 (see fig. 28)

- . Remove shield (6) by removing the five screws (7) and lockwasher (8).
- . You can now remove the relay (10). Mark its connecting wires.
- . If transistor TS1 has to be replaced, first detach terminal board 1 (12), then unsolder the transistor wires, marking each wire for correct wiring-up of the new transistor. Then remove the screws which secure heat-sink bracket (9). Then you can replace the transistor as shown on the drawing.
- . For mounting, proceed in the reverse order.
- . The coaxial pin connectors in PD6 can be taken apart as described in (10) below. If there is insufficient room for this, unscrew terminal board 1 (12) and bracket (9), but without unsoldering the wiring. Corner piece (15) can now be turned into the desired position after loosening the screws.

(10) Replacing relay RE2 and terminal board 2 (see figure 29)

The removal or installation of the relay and of the components on terminal board 2 (2) is easiest after the shield (6 fig. 28) has been removed by removing the five screws (7 fig. 28) and lockwashers (8 fig. 28)

- . When removing relay RE2 (1) and terminal board 2 (2) mark their wires.
- . Remove the relay and terminal board by taking off the screws and washers.
- . When fitting new components, make sure to connect the diodes and electrolytic capacitor up for the correct polarity (see marking rings on components).

(11) Assembly of RF cables with miniature coaxial connectors (see fig 30)

The instructions which follow cover both straight and right-angle coaxial miniature connectors. Reference will be made to the ten "figures" into which the figure has been subdivided.

1. Right-angle connector (Figs. 1 to 5)

- . Cut away sheath and dielectric; tin the conductor. See figs. 1 and 2.
- . Turn clamping bush (1) and cap (3) loose, then remove clamp (2) and socket contact (4). See fig. 5.

- . Slip clamping bush (1) on to cable; then push clamp (2) over the braid until it rests against the edge of the sheath. Fig. 3.
- . Fold the braid back over the clamp (Fig. 4) and cut away so that no strands reach beyond cone of clamp.
- . Insert socket contact into housing (5), making sure that it is in the correct position.
- . Press the cable end with clamping bush and clamp into the housing
- . Solder the conductor to the socket contact with a miniature soldering iron.
- . Tighten the clamping bush and the cap.

2. Straight connector (Figs. 6 to 10)

- . Cut the sheath back, then strip away 1,5 mm (1/16 inch) of the dielectric.
- . Disassemble the connector by turning clamping bush (1) and clamp (2) loose. Remove the socket contact (3). See Fig. 10.
- . Slip the clamping bush over the sheath; push the clamp over the braid against the edge of the sheath as shown in Fig. 7.
- . Fold the braid back over the clamp and cut away strands which outreach the clamp. Tin the inner conductor. Fig. 8 and 9.
- . Press the cable into the socket contact and solder the joint with a miniature soldering iron (see Fig. 10).
- . Slip the housing (4) over the socket contact and the clamp, then tighten the clamping bush,

(12) Replacing miniature connectors (see fig. 31)

The miniature coaxial connectors are held together in the 15-pole connector PD6 situated at the back of the receiver-transmitter RT-3600.

For removal, act as follows:

- . Pull the knob of the auxiliary tool out, then place tool over connector.
See drawing 31 Figs. 3 and 4.
- . Push knob of tool inwards to disengage socket connector from fixed connector (Fig. 5).
- . Unsolder cap (2), sleeve (3) and the inner conductor of the coaxial cable (Figs. 1 and 2)

For assembly and mounting, act as follows:

- . Cut the sheath of the coaxial cable back some 10 to 15 mm (1/2 inch)
- . Cut the dielectric back 1 to 1.5 mm. (1/16 inch)
- . Slip inner conductor with dielectric into housing (1). Guide the braid round the inlet sprout. Cut the braid so that it does not extend beyond the sprout.

- . Check that the inner conductor can be soldered in the given position to the contact in the housing (1).
- . Push sleeve (3) over the braid and sprout, then solder where indicated in fig. 2.
- . Solder cap (2) on the housing (1).
- . Press the connector into the 15-pole connector block from the back. A sharp "click" is heard when the connector snaps into position in the block.

(13) Removing and fitting the tuning dials (see fig. 36)

To remove the dials, proceed as follows:

- . Set the band switch control, knob "102", to position "47 - 70"
- . Set the MHz control, knob "103" to a reading of "47" on the associated dial.
- . Set the kHz control, knob "104" to a reading of "000" on the associated dial.
- . Remove knobs "102", "103" and "104" as described in the manual for operator and organizational maintenance, then swing the front down.
- . Remove module 7 (see subpara. 25 item (6)).
- . Remove - as shown on fig. 37 - the two screws and the nut which secure the curve unit to the front, then remove the curve unit.
- . Remove the differential unit - as shown on fig. 38 - by removing the three screws.
- . Return now to fig. 36
Unsolder the connecting wires from band switch contact plate (11) and mark them for identification. Next remove the two screws and take away the contact plate (11).
- . Loosen the two set screws of the tangential catches (13) and (14), then remove the catches together with shaft (25) and rubber O-ring (24).
- . Slacken the two set screws of gearwheel (12) and remove dial (10), shaft (28) and rubber O-ring (27).
- . Remove dial (15), shaft (22) and rubber O-ring (21) by loosening the two set screws of the built-up gearwheel on the kHz dial.

After removal of the dials the three lenses (windows) can be replaced. Clean the lens seats properly (residual glue) and be careful that no glass chips find their way into the transceiver. For the method of bonding the new lenses in place, see the instructions in paragraph 29 item (16) below.

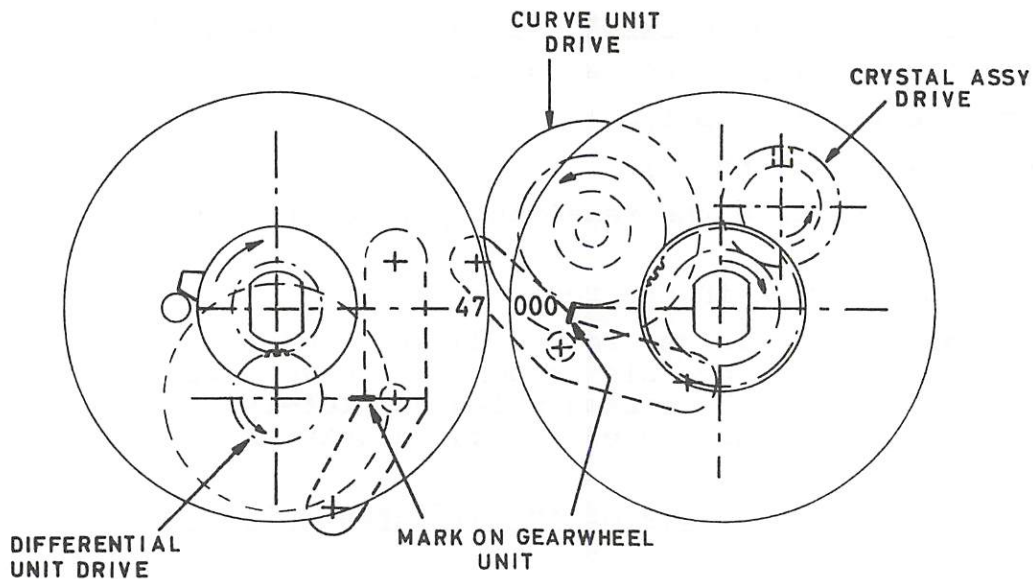
The pawl (1) can be replaced after loosening nuts (7) and (8). When fitting a new pawl, set the pawl with the rubber O-ring in the blocking position (swung upwards) and fit the torsion spring (6) over the pawl spindle, hooking its eyelet round pin (5) as shown on the figure.

Run nut (7) on the spindle and insert the wire end of the torsion spring (6) in the hole of the nut. Next tighten the nut just so much that further tightening would make it difficult to disengage and turn down the pawl. In this position, fit lock nut (8) to immobilise nut (7) in relation to the spindle.

Pawl (23) can be handled in the same manner. Take care not to mistake one torsion spring for the other ((6) has a right-hand wind, (18) a left hand wind). Cylindrical pins (5) and (19) are a force fit in the front. They can be tapped home with a small hammer.

For installing the dials, act as follows:

- . Fit shaft (28) with an O-ring in the appropriate bearing, then turn it counter-clockwise as far as it will go.
- . Fit on this shaft dial (10) with mask and gearwheel (12). Now turn the dial so that both windows (lenses), viz. (9) and (26), show the number "47". It may be necessary for this to rotate the mask. Then tighten the two set screws in gearwheel (12).
- . Fit the band switch contact plate (11) by fitting the two screws, and four washers, then solder its connections.
- . Fit shaft (25) with rubber O-ring (24) into its bearing and fit tangential catch (13) on it. Then tighten the set screws of the catch. If required turn the dial mask so that number 47 appears.
- . Fit shaft (22) with rubber O-ring (21) in the bearing and fasten dial (15) on it by tightening the two set screws in the built-up gearwheel.
- . Install the knobs marked "102", "103" and "104" as described in the manual for operator and organizational maintenance. Mount knob "102" in the "47-70" position.
- . Check the adjustment of the differential unit; the reference mark on the gearwheel unit should be in the position illustrated in the figure above.



- . Mount the differential unit on the transceiver front by fitting the three washers and screws.
- . Check the alignment of the curve unit; the mark on the gearwheel should be in the position shown in the figure above. Set the notch in the crystal assy. drive - likewise into the position indicated in the figure above.
- . Turn dial (15) until the window shows the number "000".
- . Now install the curve unit, fitting the two screws, the nut and the washers.
- . Install module 7, and make sure that the socket-head set screw appearing as item (14) on fig. 35 enters the notch of the crystal assy. drive of the curve unit.
- . Install tangential catch (14) in the position shown on fig. 36. Its height should be 49 ± 0.2 mm from the front.
The angle of $60 \pm 2^\circ$ specified holds good for the case that knob "102" is in position "47 - 70" as prescribed above.
- . After swinging down the front, check that the band change-over switch of the RF tuning unit is working correctly.

(14) Disassembly and assembly of the curve unit (fig. 37)

For disassembly, proceed as follows:

- . Remove extension spring (1)
- . Remove leaf spring (2)
- . Never disassemble the remaining part of the curve unit.

For assembly, work in the reverse order

Note: The curve unit has to be adjusted very accurately. For this reason the curve unit should never be disassembled completely. In case of damage the entire curve unit should be replaced.

(15) Disassembly and assembly of the differential unit (see fig. 38)

For disassembly, proceed as follows:

- . Remove extension spring (1)
- . Remove plate insulator (3) and leaf spring (2)
- . Remove extension spring (4)
- . Remove retaining ring (5) and torsion spring (6)
- . Never disassemble the remaining part of the differential unit.

For assembly, work in the reverse order.

Note: The differential unit has to be adjusted very accurately. For this reason the differential unit should never be disassembled completely. In case of damage the entire differential unit should be replaced.

(16) Replacing the terminal boards (see fig. 23)

If the terminal boards (10) or (11) are replaced care should be taken that the boards are mounted in the correct position.

To insure correct alignment of the terminal boards with the earth sockets in the chassis, use spare modules 2, 6 and/or 4 as jig before tightening the screws. Tighten the screws with a torque of 4,5 kg/cm. Spare modules should also be plugged in the terminal board before soldering the wires to the contacts. This improves the alignment of the contacts.

(17) Gluing instructions

The lenses and several other parts are to be glued in place with a cement composed of an epoxy resin and a catalyst (hardening agent). These have Philips order code nos. 1322 501 36601 and 1322 502 14301, respectively.
Proceed as follows:

- . Carefully degrease the parts to be glued together
- . Mix 14 parts (by weight) of epoxy resin and 1 part (by wt.) of catalyst thoroughly, taking care to avoid air bubbles in the mixture.
A mixture so prepared is immediately ready for use and will remain workable for about 45 minutes at approx. 18°C (65°F).
When the mixture thickens, do not try to dilute it. Never prepare more of the mixture than you will need immediately.
- . Apply the cement with a small brush or spatula.
- . Allow the cement to set. This takes about 24 hours at 25°C (77°F) but only 2 hours when heated to 70°C (160°F) in an oven.

If the hardened glue must have high electrical surface resistance, do not prepare and apply the cement at relative humidities of 60% and upwards.

Section 3 - Wiring list30. WIRING LIST

Use the list below in combination with fig. 16.

This figure shows, in addition to the routing of the wiring harness, the numbers of terminations and components. Typically 1A-2 designates pin 2 of printed-circuit 1A; printed-circuit 1A is, by definition, an element of module 1.

No	Colour	From	To	Wiring harness
2	Violet-white	1A-2	board 2 - B6	1
3	Blue-white	1A-3	SK1 - 2F5	1
4	Blue-white	SK1-2F4	PD6 - 5	1
5	Cond.	1A - 4	R1 - 2	1
	screen	1A - 1	R1 - 3	1
7	Orange-white	1B - 1	1B - 8	1
8	Orange-white	1A - 5	board 1 - B2	1
9	Cond.	1A - 6	4B - 1	1
	screen	solder tag	4B - 4	1
10	Cond.	1A - 7	R1 - 1	1
	screen	solder tag	R1 - 3	1
11	Brown	1A - 8	SK1 - 1R2	1
12	Red	1A - 10	SK1 - 1F3	1
13	Green-white	1A - 12	5A - 6	1
14	Slate	1A - 13	SK1 - 1F12	1
15	Blue	1A - 14	4B - 7	1
20	Cond.	1B - 10	4B - 2	1
	screen	1B - 9	4B - 4	1
21	Cond.	1B - 11	SK1 - 2F6	1
	screen	solder tag	PD1 - A	1
22	Coax.-Cond.	1B - 14	socket) 6BD2	1
	1st screen	1B - 13	shell)	1
	2nd screen	1B - 13	-	1
27	Coax.-Cond.	2A - 1	socket) 6BD1	1
	screen	2A - 2	shell)	1
28	Yellow	2A - 3	6 - A8	1
29	Cond.	2A - 4	6 - A9	1
	screen	2A - 2	-	1
30	Coax.-Cond.	2A - 6	2B - 12	1
	screen	2A - 5	2B - 11	1
31	Orange-white	2A - 7	board 1 - B3	1
32	Green	2A - 8	5B - 3	1
33	Yellow-white	2A - 10	SK1 - 1F8	1
34	Blue	2A - 11	2B - 7	1
39	Cond.	2B - 1	SK1 - 2F11	1
	screen	2B - 2	PD1 - A	1
40	Yellow	2B - 4	RE2 - 7	1
41	Yellow	RE2 - 7	SK1 - 1F7	1

<u>No.</u>	<u>Colour</u>	<u>From</u>	<u>To</u>	<u>Wiring harness</u>
42	Cond. screen	2B - 8	SK1 - 2F12 PD2 - A	1 1
47	Orange-white	3A - 5	4A - 4	1
48	Orange-white	4A - 4	5B - 4	1
49	Orange-white	5B - 4	board 1 - A3	1
54	Coax.-cond screen	3B - 1 3B - 2	6 - B6 6 - B5	1 1
59	Coax.-cond screen	4A - 1 4A - 2	5B - 1 5B - 2	1 1
60	Coax.-cond 1st screen 2nd screen	4A - 5 4A - 6 solder tag	7A - 2 7A - 1 7A - A1	1 1 1
65	Slate	4B - 3	SK1 - 1F12	1
69	Orange	PD6 - 10	RE1 - 1	1
70	Orange	5A - 1	RE1 - 1	1
71	Orange	5A - 1	RE2 - 1	1
72	Orange	RE2 - 1	SK1 - 2R5	1
73	Orange	SK1 - 2R5	SK2 - C	1
74	Orange-white	5A - 2	board 1 - B3	1
75	White	5A - 3	board 1 - A1	1
76	Blue	5A - 4	board 1 - B1	1
77	Slate	5A - 5	RE1 - 5	1
78	Brown	5A - 7	board 1 - C1	1
79	Brown	5A - 7	PD1 - C	1
80	Brown	board 1 - C1	PD6 - 6	1
85	Coax.-cond 1st screen 2nd screen	5B - 6 5B - 5 solder tag	7A - 6 7A - 7 7A - A2	1 1 1
86	Coax.-cond screen	5B - 8 5B - 7	6 - B1 6 - B2	1 1
91	Orange-white	6 - B3/B4	board 1 - B4	1
92	White	6 - A1	PD6 - 13	1
93	Coax.-cond. cond. screen	6 - A3 6 - A4 6 - A5	pin PD5 pin PD4	1 1 1
94	Coax.-cond. screen	6 - A6 6 - A5	SK3 - NC solder tag	1 1
95	Violet	6 - A7	RE2 - 3	1
96	Coax.-cond screen	socket) shell) 6-BD3	pin) shell) PD6-A2	1 1
97	Coax.-cond screen	socket) shell) 6-BD4	pin) shell) PD6-A1	1 1
102	Orange-white	7A - 5	board 1 - A3	1
106	Slate-white	8B - 1	PD6 - 1	1
107	Brown-white	8B - 3	PD6 - 2	1
108	Black	8B - 5	solder tag	1
112	Violet	9A - 3	board 2 - A6	1
113	Violet	board 2 - A6	RE1 - 3	1
118	Blue	PD1 - E	RE1 - 7	1

<u>No</u>	<u>Colour</u>	<u>From</u>	<u>To</u>	<u>Wiring harness</u>
119	Blue	RE1 - 7	PD6 - 7	1
122	Black	PD6 - sold.tag	RE1 - 4	1
123	Cond.	PD6 - 3	SK1 - 1R8	1
	screen	solder tag	PD2 - A	1
124	Orange-white	PD6 - 11	SK1 - 2R2	1
125	Coax. cond.	PD6 - 14	SK3 - C	1
	screen	PD6 - 15	solder tag	1
126	Black	1A - 1	solder tag	1
127	Black	1A - 11	solder tag	1
128	Black	2A - 12	solder tag	1
129	Orange-white	RE2 - 4	board 1 - A4	1
130	Slate	RE2 - 5	board 1 - C4	1
131	Brown-white	RE2 - 2	SK1 - 2R10/11	1
133	Coax.-cond.	R1 - 1	board 2 - B1	1
	screen	R1 - 3	board 2 - B4	1
134	Black	5A - 8	solder tag PD6	1
135	Orange-white	1A - 5	1B - 1	1
136	Green	SK1 - 1R3	board 2 - A7	1
137	White	SK1 - 1R4	board 2 - B7	1
138	Orange-white	SK1 - 1F2	board 1 - A4	1
139	Violet-white	SK1 - 2R12	board 2 - B6	1
140	Black	PD6 - 12	solder tag	1
141	Yellow-white	8B - 2	PD6 - 4	1
142	Red-white	PD6 - 8	GR7 - 1 (K)	1
143	Slate	SK4 - NC	PD6 - 9	1
146	Black	1B - 13	solder tag	1
147	-	6 - A7	C11	
148	Bare	1A - 9	1B - 11	
149	-	C11	6 - A5	
150	Bare	2A - 3	2B - 4	
151	Red-white	GR7 - 1 (K)	SK4 - NO	
152	Bare	3A - 3	3B - 3	
154	Bare	3A - 4	3B - 4	
155	Bare	3A - 5	3B - 5	
156	Black	3A - 6	solder tag	
157	Bare	3B - 6	3A - 6	
158	Coax. cond.	3B - 8	4A - 8	
	screen	3B - 7	4A - 7	
159	Bare	4B - 8	4B - 6	
160	Bare	4B - 6	4B - 5	
161	Black	4B - 5	solder tag	
162	Bare	RE1 - 1	RE1 - 8	
163	Bare	RE2 - 1	RE2 - 8	
164	Black	GR7 - 2 (A)	8B - 4	
165	Violet	RE2 - 3	board 2 - A5	
166	-	earthing tag PD4	C4	
167	-	C4	earthing tag PD3	
168	-	7A - 5	+C1	
169	-	-C1	7A - A2	
170	Black	PD1 - A	PD2 - A	

<u>No</u>	<u>Colour</u>	<u>From</u>	<u>To</u>	<u>Wiring harness</u>
172	White	PD1 - B	PD2 - B	
173	Black	PD1 - A	solder tag	
174	Green-white	PD1 - B	SK1 - 2F7	
174a	Black	PD2 - A	solder tag	
175	Green	PD1 - D	SK1 - 2F1	
176	White	PD1 - D	PD2 - D	
177	Brown	PD1 - C	PD2 - C	
178	Blue	PD1 - E	PD2 - E	
179	-	1A - 5	C8	
180	-	C8	solder tag	
181	-	9A - 2	R4	
182	Black	SK4 - C	solder tag	
183	-	R4	solder tag earth	
184	-	-C2	solder tag	
185	-	+C2	SK1 - 2R3	
186	Bare	SK1 - 1F3/4/5	interconnected	
187	Bare	SK1 - 2F8/9/10/11	SK1 - 1R9/10/11/12	
188	Bare	SK1-2F2/3/4/5	interconnected	
189	Bare	SK1-2R2/4	interconnected	
190	White	SK3-NO	PD3-Pin	
191	-	SK3-NO	C5	
192	-	C5	solder tag PD3	
193	-	TS1 - C (red)	board1 - B2	
194	-	TS1 - E (blue)	board1 - A1	
195	-	TS1 - B (yellow)	board1 - B1	
196	Bare	SK1 - 2R3/5	interconnected	
197	-	1B - 13	C6	
198	-	C6	1B - 14	
199	-	1A - 11	C7	
200	-	C7	1A - 14	
201	-	+C10	board1 - A1	
202	Bare	SK1 - 2R10	SK1 - 2R11	
203	-	C10	solder tag PD6	
204	White	9A-GR2-K	LA1 - 1	
205	White	9A-GR2-K	SK2 - NO	
206	-	5A3	+C9	
207	-	-9C	5A4	