Operating manual for Telefunken shortwave receiver E 437 S

English translation from the original German, 2018

TRANSLATION NOTES:

1. This translation was created as a contribution to the historical record. It is to be made freely available. If you are being asked to purchase this document, walk away and look for it on the Internet.
2. Pages in the translation correspond to pages of the same number in the German original.
3. Footnotes are used to provide clarity for an unusual word or translation, or to indicate a possible alternate translation. A footnote with a question mark denotes an uncertain meaning of the preceding word or phrase.
4. Wherever possible (and within the translator's ability!), German words are translated into corresponding American English electronics or radio idioms. So, for example, in the first paragraph on page 1, the literal translation of the types of operation would be "modulated and unmodulated telegraphy (transmission types A1 and A2)." I rendered this, instead, as "modulated and unmodulated telegraphy (modes A1 and A2)."

DISCLAIMER AND WARNING:

While this translation represents the translator's best efforts, there may be errors in the translation. Users should verify text, including component values, whenever possible by referring to the German original. The translator assumes no liability for any actions taken by those using this translation.

The radio equipment being described is over half a century old. Individual radios or other equipment may have failing components, broken insulation, or other hazards. Lethal voltages or currents may be present in the equipment when power is applied or after power is shut off. Those using this translation to attempt to repair or operate said equipment do so at their own risk. Users are responsible for ensuring they have the necessary skills and equipment for, and for consulting reference materials or experts relevant to, the safe diagnosis, repair, restoration or operation of antique electronic equipment. Users also are responsible for operating said equipment in compliance with relevant laws and regulations.

[COVER PAGE]

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TELEFUNKEN

WIRELESS TELEGRAPHY BUSINESS, LLC, BERLIN ZEHLENDORF

Six Circuit Receiver

E 437 S

[Title Page]

For Official Use Only!

TELEFUNKEN

WIRELESS TELEGRAPHY BUSINESS, LLC

BERLIN ZEHLENDORF, RING-OSTWEG

Six Circuit Receiver

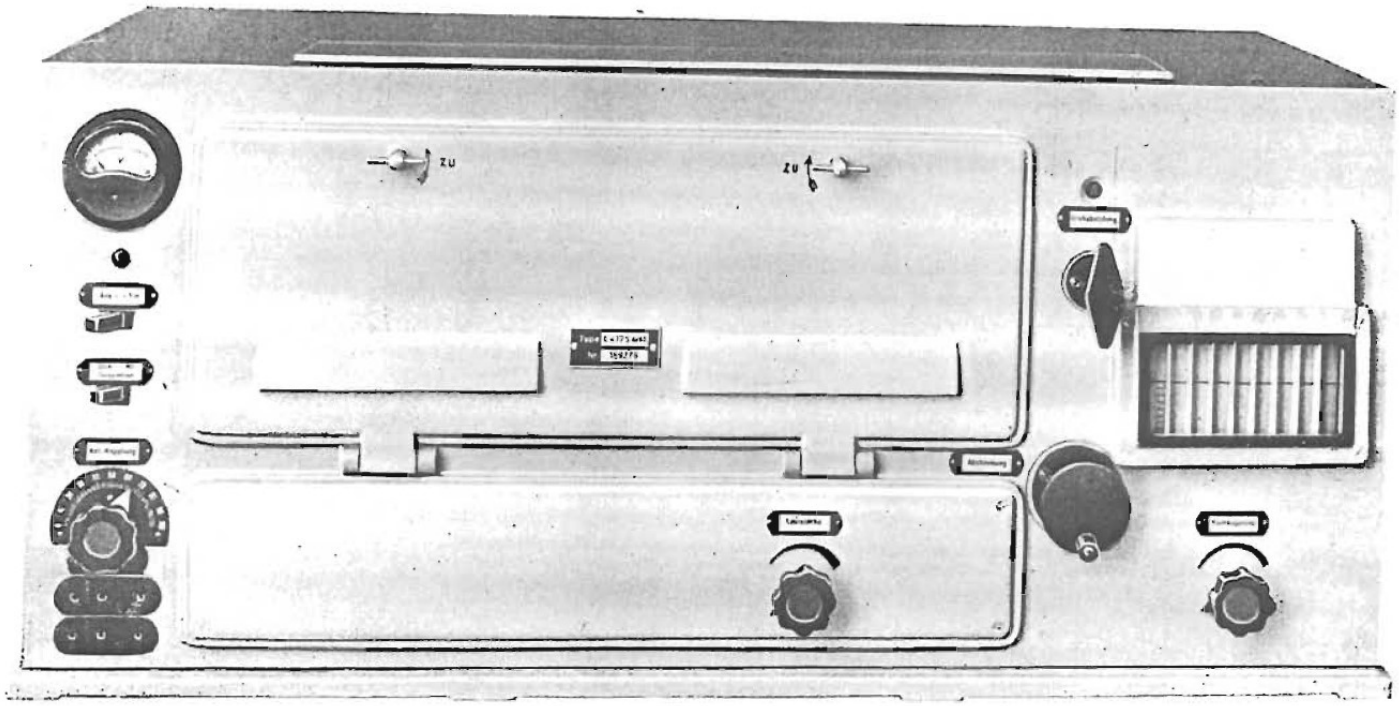
E 437 S

Frequency range: 1,500 – 25,000 kHz (200 – 12 meters)

[Stamp:] Navy Yard Kiel

FN/Lit Nr128B

Edition 587 VM



Six-circuit receiver E 437 S

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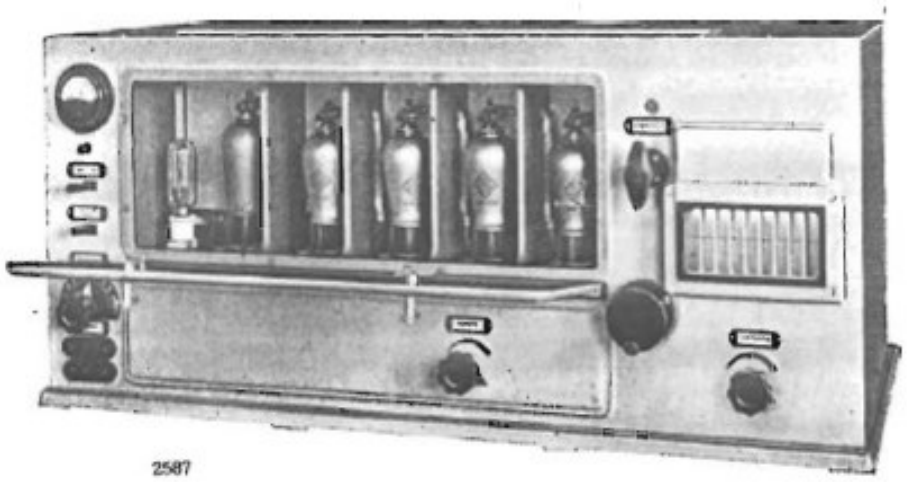

Figure 1: Front view of receiver, cover opened

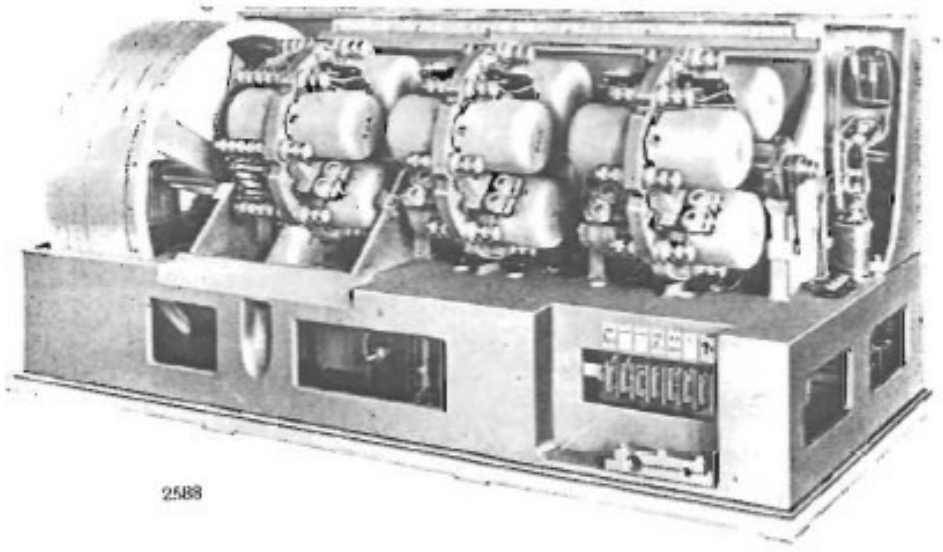

Figure 2: Rear view, protective cover removed

A. General

I. Intended use

The E 437 S equipment is a high sensitivity 6-circuit[1] tuned radio frequency (TRF)[2] receiver for receiving unmodulated and modulated telegraphy (transmission modes A1 and A2, respectively) as well as telephony (transmission mode A3).

The receiver functions as a shortwave receiver and is especially suited for operation in stationary and shipboard radio stations.

II. Exterior construction

The receiver, the exterior construction of which is shown in the title picture, is completely armored[3] by a fitted and fastened metal cover. In the picture the operating knobs, and the open cover that allows insertion of the tubes, are visible.

Figure 1 shows the front view with the opened cover, with five tubes and the neon bulb in place.

Figure 2 shows a view of the rear of the receiver after removal of the metal cover. On the left is visible the drum with the eight frequency range scales, on the axis of which the coils for the individual frequency bands are mounted. To the lower right are the connections for the antenna, ground, and power sources.

III. Technical data

Frequency range: The overall frequency range of the receiver is 1500 – 25,000 kHz (200 – 12 meters). This is divided into individual bands as follows:

Band I	1500 – 2000 kHz	(200 – 136.4 m)
Band II	2100 – 3100 kHz	(142.9 – 96.8 m)
Band III	3000 – 4400 kHz	(100 – 68.2 m)
Band IV	4200 – 6300 kHz	(71.5 – 47.6 m)
Band V	6000 – 9100 kHz	(50 – 33 m)
Band VI	8799 – 12,800 kHz	(34.5 – 23.5 m)
Band VII	12,500 – 18,400 kHz	(24 – 16.3 m)
Band VIII	17,800 – 25,000 kHz	(16.9 – 12 m)

Features: As a six-circuit receiver, the apparatus features a three-stage HF amplifier, a regenerative Audion[4] tube and an audio frequency stage. The six stages are arranged in a ganged operation and are tuned with a single knob. Of these six tuned circuits, two function as tubeless input circuits, three as grid circuits for the successive three HF amplifier tubes, and one as an Audion[4] circuit. The regenerative feed-

[1] Perhaps “six stage” is more appropriate English translation.
[2] The original German says a “direct” receiver, but it means a TRF receiver. Although not specified in this paragraph, the E 437 S is a TRF regenerative receiver.
[3] The original German “gepanzert” translates to armored or iron-clad – that’s why an armored tank was called a Panzer. Perhaps in this case the intended meaning was “protected.”
[4] Per some research of German websites, the term “Audion” apparently is used in German to describe the use of a tube as both a detector and amplifier. In this case, as described in the text, it is a regenerative amplifier.

back makes possible the reception of signals from an unmodulated (toneless)[5] transmitter.

The apparatus includes in the HF section a volume control that, by changing the screen grid voltage of the first two HF tubes, changes the sensitivity of the apparatus without affecting the tuning.

Tube assembly: The apparatus is equipped with five directly-heated[6] RENS 1284 high frequency pentodes.

Figure 1 shows their arrangement as viewed from left to right:

1. Final[7] tube (Position[8] 78),
2. First HF tube (Position 23),
3. Second HF tube (Position 38),
4. Third HF tube (Position 54),
5. Audion[4 above] tube (Position 65).

Selectivity: The basis is a modulation of 400hz. This results in:

> In Bands I through IV, for a detuning[9] of +/- 0.5%, the selectivity is 1/40 – 1/80 or 32 to 38 dB,
> in Bands V and VI, for a detuning of +/- 0.2%, the selectivity is 1/50 to 1/100 or 34 to 40 dB,
> in Bands VII and VIII, for a detuning of +/- 0.1%, the selectivity is 1/50 or 34 dB.

In practical operation, this means that the field strength of a ± 0.5% (or 0.2% or 0.1%, respectively) interfering transmitter[10] must be up to 80 (or 100 or 50, respectively) times greater than the received transmitter to produce the same sound level in the headphones.

These values are understood to be approximations, in that they depend on the adjustment of the regenerative feedback. A not inconsiderable role is that way played aside from the anode voltage and grid voltage of the tubes.[11]

Sensitivity: To provide a 1-volt output voltage (at 4000 ohms) to the headphones, on telephony the receiver requires at input:

> In Bands I through VI, approximately 2 to 10 µV,
> In Band VII, approximately 4 to 30 µV, and
> In Band VIII, approximately 15 to 50 µV.

For telegraphy, values of about half these can be expected.

Frequency accuracy: The variation over the entire frequency range is between 0.1% and 2%.

Display accuracy: This depends on the frequency band and on Band I averages 3.65 kHz per degree, or 0.95 kHz per mm. By Band VIII this falls off to 38 kHz per degree, or 9.9 kHz per mm.

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[5] Meaning CW, as opposed to modulated CW (MCW).
[6] Refers to directly heated cathodes.
[7] "Final" here means the last tube in the circuit, in this case an audio amplifier tube.
[8] "Position" here refers to the number on the parts list. The number on the parts list also identifies each component on the schematic.
[9] Perhaps a bandwidth of +/- 0.5% on either side of the center frequency?
[10] In many places, the original text uses the word "transmitter" where the intended meaning seems to be "transmitted signal."
[11] Meaning of sentence unclear.

Volume control: The volume control ratio, determined by the ratio of the HF input voltages to the final position of the volume control, is 1:200 for the antenna coupling when set midways, and for the volume control is more than 1: 50,000.[12]

Audio Frequency Band and Tone Selectivity: The apparatus is set for the reproduction of a frequency band of approximately 250 – 3000 Hz.

For increased selectivity during reception of a toneless[13] transmitter[14] or a transmitter with a 900 Hz modulation tone[15], a tone selection can be activated. This operates by using resonance to provide selective amplification and audibility of a 900 Hz tone. Interfering signals producing audible frequencies below 830 Hz and over 970 Hz are thereby substantially weakened.

Electrical power supply: The tubes can be heated using a DC or AC electrical system. An anode voltage of 200 volts DC is required.

Mechanical layout: The apparatus is isolated in an aluminum housing. The high-grade ceramic materials used for isolation also guarantee great electrical stability despite the effects of temperature and humidity. The marine apparatus, which is tropicalized as much as possible, is completely armored by the metal cover that is screwed in place.

Dimensions and weight:	Height:	approximately 335 mm (~ 13.2 inches)
	Width:	approximately 768 mm (~ 30.2 inches)
	Depth:	approximately 360 mm (~ 14.2 inches)
	Weight:	approximately 44 kg (~ 97.0 pounds)

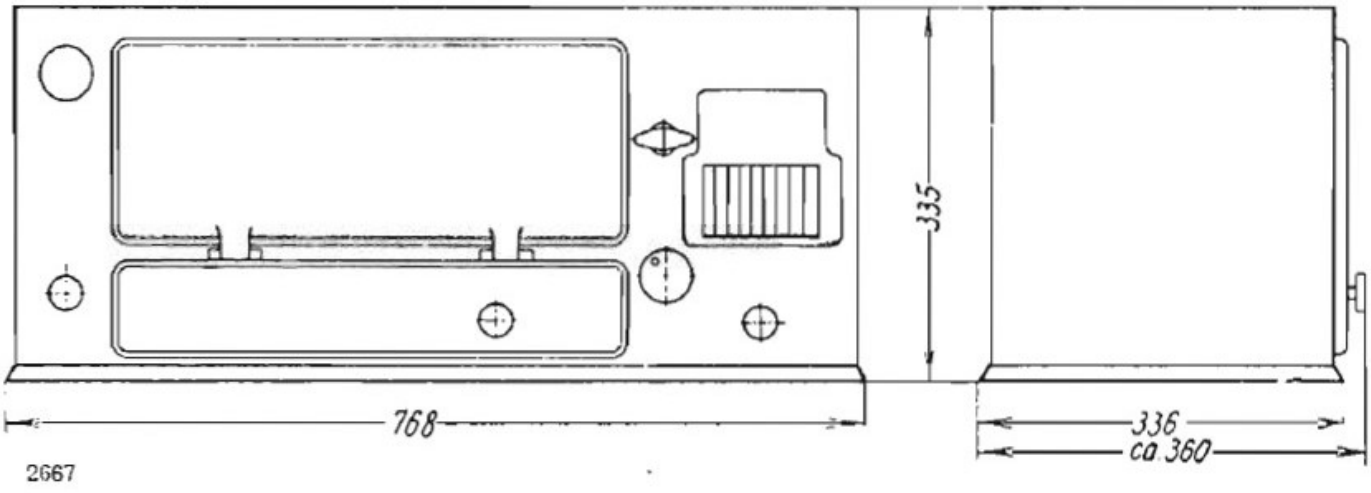


Figure 3: Dimensional drawing, scale 1:10[16]

[12] As will be seen in the operating guide (page 11, item II.b.8), the authors of the guide considered the roles of both the antenna trimmer and the volume control in determining the received audio level.
[13] Meaning CW.
[14] The original German "Sender" translates to "transmitter," but in context the intended meaning probably was "signal."
[15] Apparently MCW with a 900Hz modulation.
[16] The scale "1:10" appears in the original German-language manual. The scale in this translated document may differ.

B. Mode of operation

I. Receiver circuit

The receiver is operated directly at its location.

A differential capacitor (Position 2) is connected between the antenna (A)[17] and the ground[18] (E). The first receiver circuit is connected across the differential capacitor. This capacitor, which also trims the antenna, additionally prevents detuning of the first circuit by the connected antenna. A neon bulb (1) is connected between the antenna and ground to protect the receiver from overvoltages in the antenna that, for example, can be produced by atmospheric discharges or a strong transmitter operating nearby; the neon bulb operates when these voltages exceed 70 V.

The first stage[19] does not use a tube and consists of inductor 6 and tuning capacitor 4. (Capacitors 8 and 5, connected in parallel to the inductor, are trimmer capacitors that are tuned only once, at the factory test bay).

The second stage, likewise tubeless, is connected to the first by capacitor 9 and consists of an inductor (13) and a tuning capacitor (10). (Capacitors 14 and 11 are trimmer capacitors.)

The third stage, which is formed by inductor 19 and tuning capacitor 16, is capacitively coupled to the second circuit through capacitor 15. The third stage is also the grid circuit for the first HF tube (23).

The fourth stage is formed by an inductor (33) and a tuning capacitor (30). [Trimmer capacitors 34 and 31 are in this circuit.] The fourth stage, which is in the anode circuit for the first HF tube (23), is coupled to the grid of the second HF tube (38) by capacitor 36.

The fifth stage consists of inductor 46 and tuning capacitor 44. [Trimmer capacitor 49 is in this circuit.] The fifth stage is in the anode circuit of the second HF tube (38). It is coupled to the grid of the third HF tube by capacitor 54.

The sixth stage, with inductor 61 and tuning capacitor 58 [and with trimmer capacitor 59], drives the grid of the Audion[4] [above] tube (65). Inductor 63 provides feedback back to inductor 61. The degree of feedback is controlled by potentiometer 102, which changes the screen grid voltage.

The audio frequency supplied from the Audion tube (65) is coupled through transformer 71 to the grid of the audio frequency tube (78). The remaining high frequency component after the Audion tube will be bled off through the system of resistor 142 and capacitor 68. The audio frequency transformer is a resonance transformer for 900 Hz. Reception with tone selection occurs when switch 69 is in the "**mit**"[20] position. In the unmarked[21] switch position, the transformer's secondary winding acts in combination with capacitor 72 as a resonance circuit for the 900 Hz tone frequency.

Transformer 86 in the anode circuit of the audio frequency tube (78) serves as the output transformer of the apparatus. The impedance of its secondary winding,

[17] Capital letters and component numbers refer to the component number on the parts list and on the schematic.
[18] In German, ground is "Erde," thus the abbreviation E.
[19] Instead of "stage," the original German literally says "tuning circuit." This is true of all six "stages" described on this page.
[20] Literally means "with" in English – left untranslated since it is a panel label.
[21] Not clear why the text refers to an "unmarked switch position" since the panel switch is labeled, the previous sentence refers to that label, and the switch and associated capacitor and transformer are labeled in the schematic.

with capacitors through 92, protects the receiver against high frequency static that can develop over the headphone lines (connected at points 7 and 8).

A similar protection against static over the operating voltage supply is provided by the choke and capacitors 104 through 117.

Potentiometer 138 serves as the volume control, and can be manually operated if regulation by differential capacitor 2 does not suffice.

The DC power meter (125) available in the receiver measures not only the filament voltage, but by pressing button 130 also measures the anode voltage. Furthermore, the emission of each tube can be individually measured with this meter. For this purpose, pushbuttons 131 through 135 are used are for each of the five receiver tubes.

II. Power supply

The apparatus can use an AC or DC electrical system for the filaments. The filament voltage should be 4.6 volts, and the current consumption averages 5.8 amperes.

The anode voltage can be drawn from a 200-volt anode battery that can provide 28 mA for long periods, or an equivalent power supply unit.

C. Operating instructions

I. Initial operation

The receiver's tubes can be heated with an AC or DC power supply. Connection tab 176, mounted on the apparatus behind the tone selectivity switch, accordingly is connected to either the symbol "**–**"or "**~**". The grid bias voltage is delivered at resistor 177.

Note that when the AC current power supply equipment is used, in which the filament voltage midpoint is connected via a hum removal potentiometer to the negative anode terminal, the connection between point 4 and point 5 on the input terminals must be open.

Connect the operating current source. The pin designations are clearly listed on the connection terminals on the rear of the housing (Figure 2) and on the plug on the connection cable.

Filament voltage:	4.6 V, 5.8 A.
Anode voltage:	200 V, 28 mA.

The tubes require 4 V filament voltage as measured directly at the tube socket. However, since chokes 106 and 107 in the filament supply line cause a voltage drop, an input voltage of 4.6 V must be present at the connection terminal. [The specified 4.6 V should only be indicated at the connection terminal, while the meter (125) should show a deflection of 4 V].

When operating using the power supply from the company C. Lorenz AG, special care must be taken to ensure proper filament voltage because filament current consumption by individual tubes is not always exactly equal and can lead to

an improper rise in voltage. To equalize these voltage fluctuations, in this power supply a potentiometer is connected in parallel to the iron-hydrogen resistor[22] and a second resistor (172) is present in the receiver as load resistor for the tube filaments. These two resistors are set to their maximum values for initial setup of the receiver; this takes place by turning them to the left as far as they will go, once lead #3 in the wiring harness is connected to regulator position 3. The meter (125) then indicates the high voltage, which is set to the normal value by using the control in the receiver. Alternatively. if the meter indicates the filament voltage is too low, the control in the power supply should be adjusted accordingly.

After an operating time of about 10 minutes has passed, power control for the tubes is assessed by pressing the button for the relevant tube. The volume control and the regeneration control are turned completely to the right, and the range switch is set in the position between two ranges by measurement of the Audion power. For the emissions measurement, the indicator on the meter should deflect approximately to the red line. If the red line is not reached, the emission is too low and the tube should be exchanged for a new one.

Note: the negative filament and anode connections in the receiver are <u>not</u> connected directly to ground, so that optional grounded power sources can be connected. It is therefore necessary to note that the metal housing of the tubes is connected to the cathode, while the receiver chassis[23] obviously must be grounded. Since the negative voltage is not grounded, a voltage differential exists between the negative voltage present on the metal tube housing and "ground" on the chassis, which must be considered when replacing the tubes.

II. Reception (see Figure 4)[24]

1. Switch on the apparatus using the "**Aus-Ein**" ("Off – On") toggle switch.
2. Set the desired band with the **Grobabstimmung** (band switch, literally "Coarse tuning") control.
3. Set the **Antennenkopplung** (antenna trimmer) to 50 on a trial basis.
4. Turn the **Lautstärkegegler** (volume control) to the midway position.

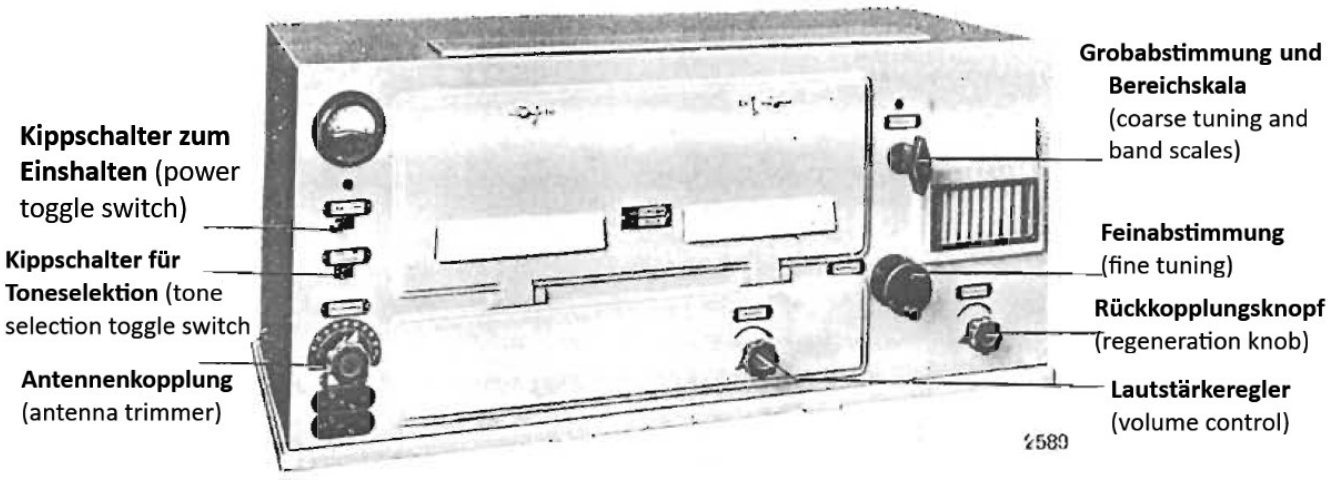


Figure 4. Front view of receiver

[22] An iron-hydrogen resistor is a positive temperature coefficient thermistor and consists of a hydrogen- filled glass bulb similar to an incandescent lamp containing an iron wire. They were current regulating devices, now obsolete. See German Wikipedia.
[23] Or "housing," but in this context referring to grounding, chassis seems more appropriate.
[24] In the following instructions, the German control name is in **bold print**, followed by the English translation in parentheses.

a) For unmodulated telegraphy

5. Set the **Rückkopplungsknopf** (regeneration knob) just past the point of oscillation (which can be recognized by the extra noise in the headphones).
6. With the **Feinabstimmung** (fine tuning), set the received signal to the desired pitch. (A pitch of 900 Hz is preferred. If necessary, proceed to step 9).
7. Experimentally turn the **Antennenkopplung** (antenna trimmer knob) left and right until the setting for the loudest reception is found.
8. Set the **Lautstärkeregler** (volume control) to the desired volume.
9. The 900 Hz frequency can be selectively emphasized through use of the audio frequency resonance by using the **Kippschalter für Tonselektion** (toggle switch for tone selection).

b) For telephony and modulated telegraphy

5. Set the **Rückkopplungsknopf** (regeneration knob) just before the point of oscillation.
6. Experimentally turn the **Antennenkopplung** (antenna trimmer knob) left and right to maximize the volume.
7. With the **Feinabstimmung** (fine tuning), carefully tune to the received signal.
8. Use the **Lautstärkeregler** (volume control) (and, if necessary, the **Rückkopplungsknopf** (regeneration knob) as well) to set the desired volume.

J. Parts List

for Receiver E 437 S

Part #	Number of pieces	Description
1	1	Neon bulb Te 50
2	1	Differential capacitor (Ritscher), opposing rotors each 390 pF ± 20%
3	1	Trimmer capacitor 5-25 pF
4	1	Variable capacitor 15-115 pF
5	1	Trimmer capacitor 5-15 pF
6	1	Coil unit for Bands I-VIII
7	1	Band switch
8	1	Trimmer capacitor for Bands I-VIII, 4-17 pF For this purpose, as needed for each, 1 fixed capacitor For Bands I-VII 5 pF For Band VIII 35 pF
9	1	Coupling capacitor 5 pF
10	1	Variable capacitor from 15-115 pF
11	1	Trimmer capacitor from 5-25 pF For this purpose, as needed, one fixed capacitor 15 pF
12	1	Band switch
13	1	Coil unit for Bands I-VIII
14	1	Trimmer capacitor for Bands I-VIII, 4-17 pF For this purpose, as needed, 1 fixed capacitor for each For Bands I-VII 10 pF For Band VIII 35 pF
15	1	Coupling capacitor 5 pF
16	1	Variable capacitor from 15-115 pF
17	1	Trimmer capacitor 5-25 pF
18	1	Band switch
19	1	Coil unit for Bands I-VIII
20	1	Trimmer capacitor for Bands I-VIII, 4-17 pF For this purpose, as needed, 1 fixed capacitor for each For Bands I-VI 5 pF For band VII 15 pF For Band VIII 35 pF
21	1	Capacitor 25,000 pF ± 20%
22	1	Resistor 8 kΩ ± 5%
23	1	Tube RENS 1284
24	1	Capacitor 25,000 pF ± 20%
25	1	Capacitor 25,000 pF ± 20%
26	1	Resistor 200 kΩ ± 5%
27	1	Capacitor 25,000 pF ± 20%
28	1	Capacitor 25,000 pF ± 20%

Part #	Number of pieces	Description
29	1	Resistor 5 kΩ ± 5%
30	1	Variable capacitor for 15-115 pF
31	1	Trimmer capacitor 5-25 pF
32	1	Band switch
33	1	Coil unit for Bands I-VIII
34	1	Trimmer capacitor for Bands I-VIII, 4-17 pF, For this purpose, as needed, 1 fixed capacitor for each For Bands I-VI 5 pF For Band VIII 35 pF
35	1	Resistor 10 kΩ ± 5%
36	1	Capacitor 5 pF ± 10%
37	1	Resistor 1 MΩ ± 5%
38	1	Tube RENS 1284
39	1	Capacitor 25,000 pF ± 20%
40	1	Resistor 100 k Ω ± 5%
41	1	Capacitor 25,000 pF ± 20%
42	1	Capacitor 25,000 pF ± 20%
43	1	Capacitor 25,000 pF ± 20%
44	1	Variable capacitor 15-115 pF
45	1	*This number not used*
46	1	Coil unit for Bands I-VIII
47	1	Band switch
48	1	Resistor 5 kΩ ± 5%
49	1	Trimmer capacitor for Bands I-VIII, 4-17 pF For this purpose, as needed, 1 fixed capacitor for each For Bands I-VI 5 pF For band VII 20 pF For Band VIII 40 pF
50	1	Capacitor 50 pF ± 10%
51	1	Resistor 1 MΩ ± 5%
52	1	Capacitor 25,000 pF ± 20%
53	1	Resistor 100 kΩ ± 5%
54	1	Tube RENS 1284
55	1	Resistor 40 kΩ ± 5%
56	1	Capacitor 25,000 pF ± 20%
57	1	Capacitor 5 pF ± 10%
58	1	Variable capacitor from 15-115 pF
59	1	Trimmer capacitor 5-25 pF For this purpose, as needed, 1 fixed capacitor 5 pF
60	1	Band switch
61	1	Coil unit for Bands I-VIII
62	1	Capacitor 25,000 pF ± 20%
63	1	Feedback coupling inductor
64	1	*This number not used*

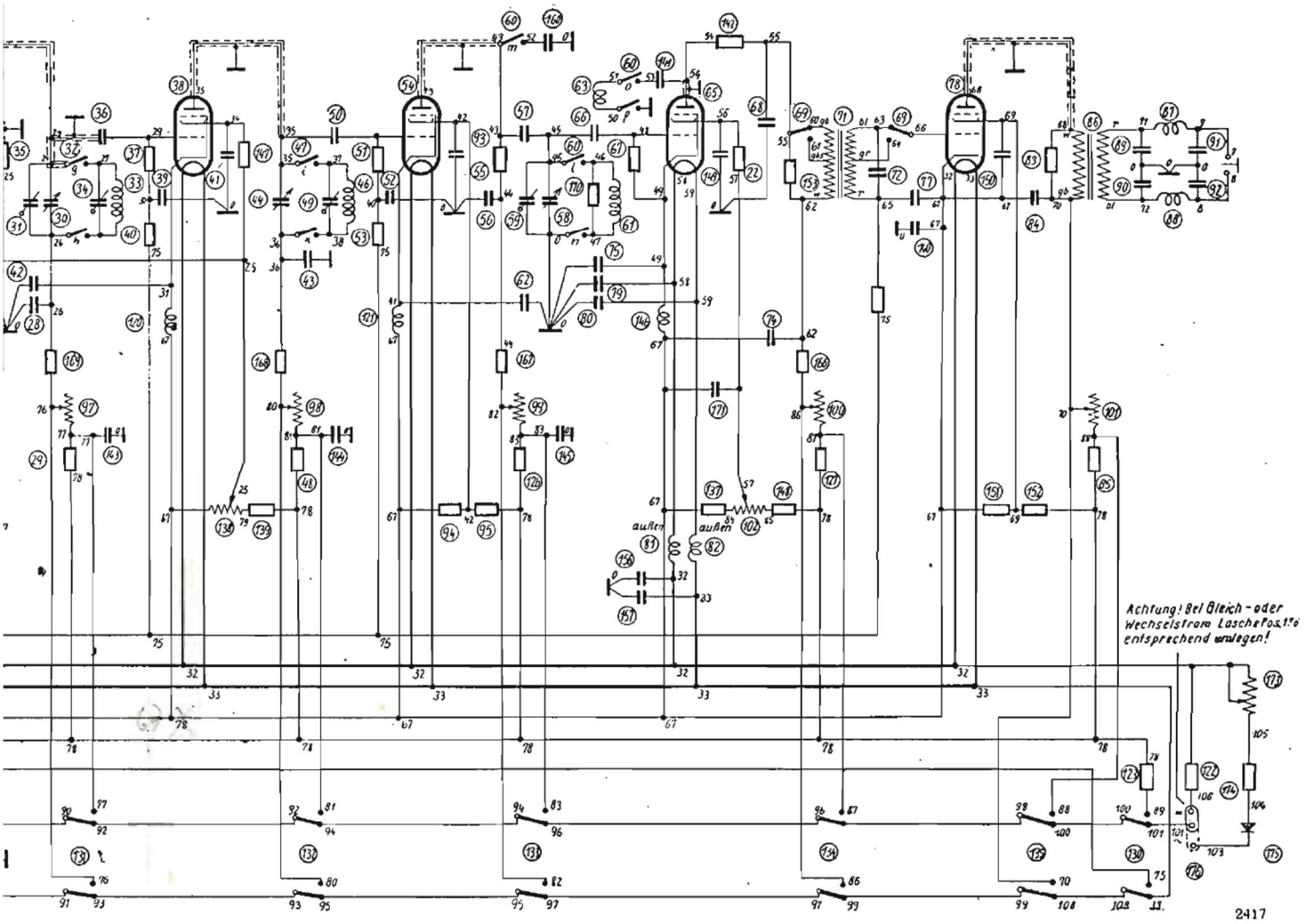
Part #	Number of pieces	Description
65	1	Tube RENS 1284
66	1	Capacitor 20 pF ± 5%
67	1	Resistor 1 MΩ ± 5%
68	1	Capacitor 500 pF ± 10%
69	1	2 pole toggle switch
70	1	Capacitor 5000 pF ± 20%
71	1	Transformer from Bv. u. Pv. S3417 H[25]
72	1	Trimmer capacitor 5-25 pF For this purpose, as needed, 1 fixed capacitor 50 pF
73	1	Resistor 200 kΩ ± 5%
74	1	Capacitor 1 µF ± 10%
75	1	Capacitor 25,000 pF ± 20%
76	1	*This number not used*
77	1	Capacitor 1 µF ± 10%
78	1	Tube RENS 1284
79	1	Capacitor 25,000 pF ± 20%
80	1	Capacitor 25,000 pF ± 20%
81	1	Flat coil (or “pancake coil”)
82	1	Flat coil (or “pancake coil”)
83	1	Resistor 15 kΩ ± 5%
84	1	Capacitor 1 µF ± 10%
85	1	Resistor 2 kΩ ± 5%
86	1	Output transformer from Bv. u. Pv. A 1326 H[26]
87	1	Flat coil (or “pancake coil”)
88	1	Flat coil (or “pancake coil”)
89	1	Capacitor 1000 pF ± 20%
90	1	Capacitor 1000 pF ± 20%
91	1	Capacitor 1000 pF ± 20%
92	1	Capacitor 1000 pF ± 20%
93	1	Capacitor 1000 pF ± 20%
94	1	Resistor 100 kΩ ± 5%
95	1	Resistor 100 kΩ ± 5%
96	1	*This number not used*
97	1	Variable resistor approximately 50 Ω with isolated shaft
98	1	Variable resistor approximately 50 Ω with isolated shaft
99	1	Variable resistor approximately 50 Ω with isolated shaft
100	1	Variable resistor approximately 50 Ω with isolated shaft
101	1	Variable resistor approximately 50 Ω with isolated shaft
102	1	Noise-free potentiometer approximately 50 kΩ, 0.5W, linear, initial value ≤ 200 Ω
103	1	Resistor 10 kΩ ± 5%
104	1	Flat coil (or “pancake coil”)
105	1	Flat coil (or “pancake coil”)
106	1	Choking coil

[25] This appears to mean the transformer was made by the firm Bv & Pv, model # S 3417 H

[26] Apparently, another transformer from Bv & Pv, model # A 1326 H

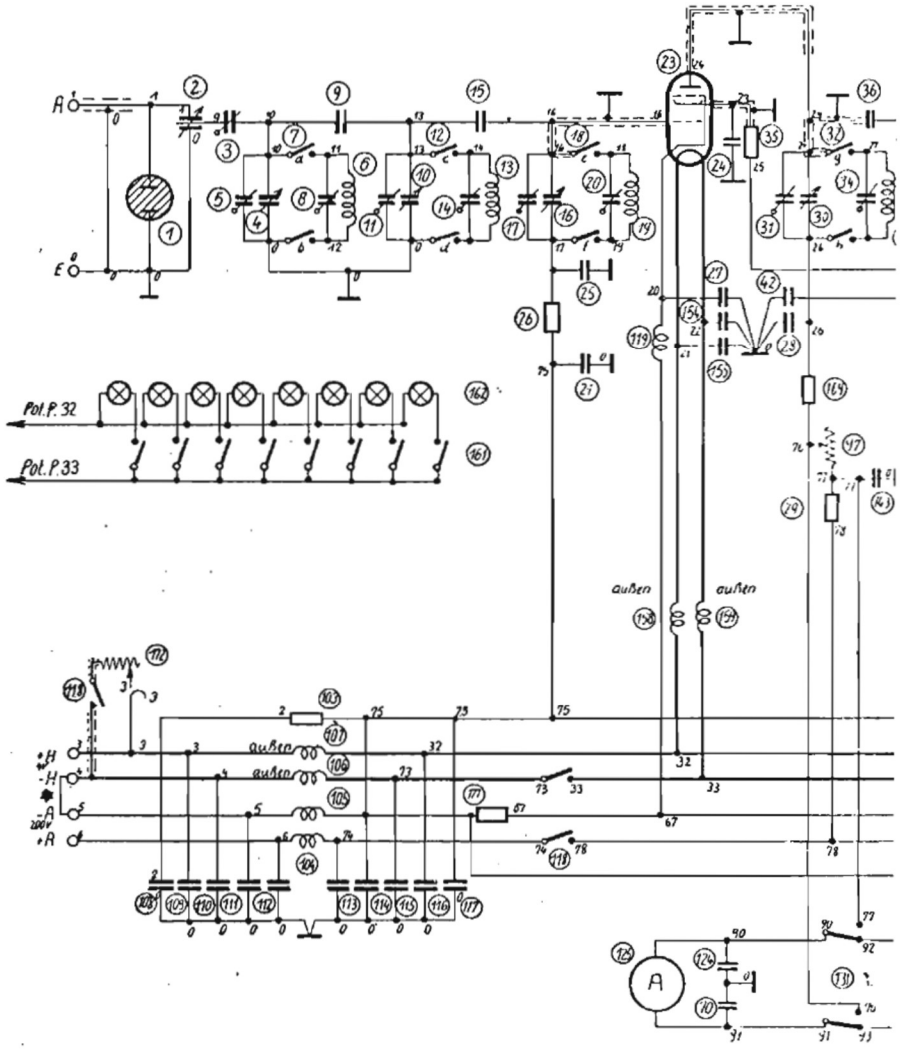
Part #	Number of pieces	Description
107	1	Choking coil
108	1	Capacitor 0.1 µF ± 20%
109	1	Capacitor 0.1 µF ± 20%
110	1	Capacitor 0.1 µF ± 20%
111	1	Capacitor 0.1 µF ± 20%
112	1	Capacitor 0.1 µF ± 20%
113	1	Capacitor 0.1 µF ± 20%
114	1	Capacitor 0.1 µF ± 20%
115	1	Capacitor 0.1 µF ± 20%
116	1	Capacitor 0.1 µF ± 20%
117	1	Capacitor 0.1 µF ± 20%
118	1	Three-pole toggle switch
119	1	Flat coil (or “pancake coil”)
120	1	Flat coil (or “pancake coil”)
121	1	Flat coil (or “pancake coil”)
122	1	Dropping resistor (or “series resistor) for the filament voltage, 4900 Ω ± 1%, 0.8 mA
123	1	Dropping resistor (or “series resistor) for the anode voltage, 249,900 Ω ± 1%, 0.8 mA
124	1	Capacitor 5000 pF ± 20%
125	1	Moving coil meter, 1 mA at full deflection, impedance 100 Ω, with double scale
126	1	Resistor 500 Ω ± 5%
127	1	Resistor 500 Ω ± 5%
128	1	*This number not used*
129	1	*This number not used*
130	1	Pushbutton with 2 switching contacts
131	1	Pushbutton with 2 switching contacts
132	1	Pushbutton with 2 switching contacts
133	1	Pushbutton with 2 switching contacts
134	1	Pushbutton with 2 switching contacts
135	1	Pushbutton with 2 switching contacts
136	1	*This number not used*
137	1	Resistor 8 kΩ ± 5%
138	1	Noise-free potentiometer 50 kΩ, 0.5W, linear, initial value ≤ 200 Ω
139	1	Resistor 30 kΩ ± 5%
140	1	Capacitor 1 µF ± 10%
141	1	Capacitor array, 1000 pF, composed of 2 capacitors each 500 pf ± 10%
142	1	Resistor 5 kΩ ± 5%
143	1	Capacitor 1 µF ± 10%
144	1	Capacitor 1 µF ± 10%
145	1	Capacitor 1 µF ± 10%
146	1	Flat coil (or “pancake coil”)

Part #	Number of pieces	Description
147	1	Resistor 10 kΩ ± 5%
148	1	Resistor 30 kΩ ± 5%
149	1	Capacitor 25,000 pF ± 20%
150	1	Capacitor 1 µF ± 10%
151	1	Resistor 25 kΩ ± 5%
152	1	Resistor 20 kΩ ± 5%
153	1	Resistor 15 kΩ ± 5%
154	1	Capacitor 25,000 pF ± 20%
155	1	Capacitor 25,000 pF ± 20%
156	1	Capacitor 25,000 pF ± 20%
157	1	Capacitor 25,000 pF ± 20%
158	1	Flat coil (or "pancake coil")
159	1	Flat coil (or "pancake coil")
160	1	Capacitor array, comprised of 1 capacitor each for: Band I 5000 pf ± 20% Band II 2000 pf ± 20% Band III 2000 pf ± 20% Band IV 1000 pf ± 20% Band V 300 pf ± 20% Band VI 50 pf ± 20% Band VII 100 pf ± 20%
161	1	Drum switch
162	8	Incandescent bulbs (4 V, 0.3 A) for 8 bands
163-165		*These numbers not used*
166	1	Resistor 2 kΩ ± 5%
167	1	Resistor 2 kΩ ± 5%
168	1	Resistor 2 kΩ ± 5%
169	1	Resistor 2 kΩ ± 5%
170	1	Resistor array, comprised of 1 resistor each for: Band I 150 kΩ ± 5% Band II 70 kΩ ± 5% Band III 150 kΩ ± 5% Band IV 70 kΩ ± 5% Band V 200 kΩ ± 5%% Band VI 50 kΩ ± 5% Band VII 50 kΩ ± 5%
171	1	Capacitor 1 µF ± 10%
172	1	Filament load resistor (regulator), 20 Ω ± 10%, 10 W
173	1	Resistor 1900 Ω ± 10%, with clip
174	1	Resistor 500 Ω ± 5%
175	1	Selenium rectifier for 4 V and 0.03 A, varnished for humidity resistance
176	1	Changeover (AC or DC) link
177	1	Resistor 70 Ω ± 5%



Attention! During use of the AC power supply, in which the filament voltage midpoint is connected via a hum removal potentiometer to the negative anode terminal, the connection between point 4 and point 5 on the input terminals must be open.

Receiver E 437 S


Pol.P.32
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