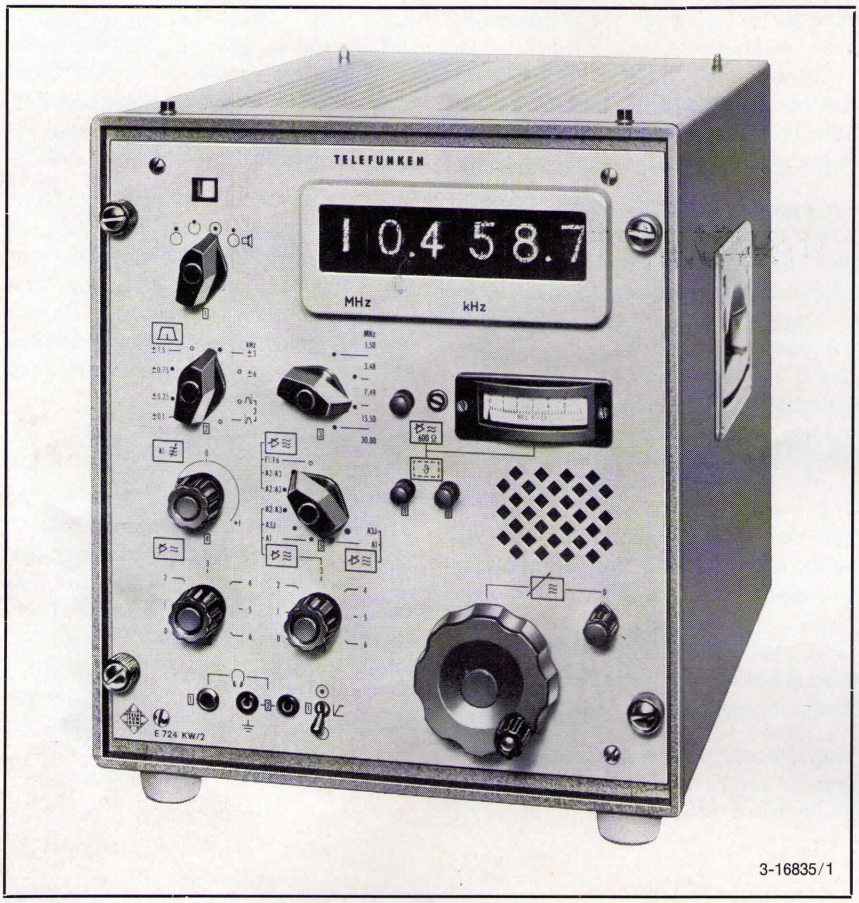
Receivers
Direction Finders

HF Receiver
E 724 KW/2
1.5 to 30 MHz

Leaflet
IB 467/2 E



HF Receiver E 724 KW/2

Applications

The HF Receiver E 724 is suitable for universal utilisation as service receiver for telegraphy and telephony traffic links, including SSB operation, and as search and surveillance receiver.

Special Features

Rapid and exact search operation with single-knob tuning control.

Electronic frequency read-out with digital numicator tubes giving uniform resolution throughout the frequency range.

Excellent setting accuracy, by virtue of digital readout of the reception frequency.

High precision crystal controlled reference frequency generator.

Upon request, fitted with binary coded output for remote communication or print-out of the reception frequency value.

Good frequency stability in the face of vibration, mechanical shock and temperature fluctuations, through the use of a variometer-tuned oscillator housed in a thermostat.

Five tuned RF preselector circuits.

Main selectivity (adjacent channel selectivity) provided by mechanical filters; a maximum number of eight different bandwidths can be provided.

Fully transistorised, with extensive utilisation of integrated circuits, thus small current drain, long life expectancy and little maintenance requirements.

Synoptically arranged, sturdy light alloy construction; small volume but good accessibility through adoption of modular assembly system.

Suitable for mains and battery operation.

Facility for connecting panorama units.

Suitable for incorporation in long distance traffic communications receiver equipments.

Operating ambient temperature range from −20 °C to +50 °C.

Technical Remarks

When searching for a wanted transmitter, it is desirable to be able to tune the receiver solely with reference to its frequency scale. This calls for very good scale resolution and high setting accuracy, especially for receiving SSB telephony and telegraphy signals.
In the E 724, the reception frequency is displayed with digital numicator tubes giving a resolution of 100 Hz.

For radio reconnaissance it is necessary to sweep-tune through large frequency ranges as rapidly as possible. Once the wanted transmitter has been found, its frequency must be precisely determinable.
The E 724 has been designed as a single superheterodyne receiver with continuously tuned free-running oscillator (VFO tuning system). This provides genuine single-knob tuning control with only 4 frequency subranges. The actual frequency of the sole frequency-determining oscillator is measured with a digital

frequency meter and converted to the reception frequency by electronic computation. This obviates all previously necessary calibrating procedures, so that the reception frequency can be read-off directly and accurately.

Remote communication or registration of the reception frequency value is necessary for some purposes.
Upon request, the E 724 can be fitted with a binary coded output of the reception frequency value, e.g. for connecting a data printer for quick registration, or a repeater display unit for remote readout of the reception frequency.

The setting accuracy and readout tolerance of the receiver are determined only by the precision of the crystal reference frequency. The E 724 incorporates a high precision 1 MHz crystal reference frequency generator housed in a thermostat. The operating voltage is carefully stabilised.

High readout resolution and setting accuracy call for correspondingly good frequency stability of the receiver tuning. The frequency-determining oscillator of the E 724 is tuned by inductance variation with a ferrite core. The frequency subrange selection is effected by switching oscillator frequency multiplier. Thus there are no sliding, switching or plug contacts within the frequency-determining circuit. Airtight sealing prevents entry of moisture and dust. The oscillator is housed in a proportionally regulated thermostat and the operating voltage is carefully stabilised.

Mechanical vibration is encountered in vehicles. This must not adversely affect the performance of a receiver.
In this respect the inductively tuned oscillator is superior to a conventional variable capacitor tuning system, since the former is assembled as a mechanically self-contained module attached to the receiver via a rigid baseplate, so that no shear and torsional contortions can result.

The dense congestion in the HF bands calls for outstandingly good selectivity of the receiver.
Thus the main selectivity (adjacent channel selectivity) of the E 724 has been provided in lumped form with mechanical filters ahead of the IF amplifier.

A superheterodyne receiver is inherently prone to response frequency ambiguities. The number of subsidiary response frequencies increases with the number of frequency conversions employed in the receiver circuit line-up.
The E 724 has been designed a single superheterodyne receiver, to keep the number of possible subsidiary response frequencies small.

The residual subsidiary response frequencies must be suppressed to a sufficient extent, so that they do not interfere with normal operation.
The E 724 possesses 5 tuned RF circuits for signal frequency preselection and thus achieves high rejection factors for image frequencies and IF breakthrough.

The atmospherics interference level is large in the HF band. A transmitter can be received properly only if its signal strength at the site of the receiver exceeds the atmospherics noise level. Thus excessive receiver sensitivity is of no use, and actually detrimental, because the susceptibility of the receiver to cross-modulation increases with increasing input sensitivity.
Thus excessive input sensitivity has been deliberately avoided in the E 724.

It should be possible to operate the receiver independently of a mains power supply. The E 724 is fully transistorised. Apart from numerous other advantages (small volume, light weight, little maintenance), this results in small current drain, making possible battery operation. The E 724 is easily converted for battery operation.

The receiver should be adaptable to all encountered types of service. The E 724 forms the basic unit of a carefully planned equipment system. Facilities have been provided for connecting numerous ancillary units, permitting full extension to long distance traffic communications receiver equipments.

Small size is important not only in vehicles, but also for utilisation in fixed-site stations, so that the receiver together with the ancillary units usually required for handling present day traffic, can be accommodated within the limited space available in the radio operator working position.
The volume of the E 724 is less than 20 % of that of the HF Communications Receiver E 104 previously utilised for comparable tasks.

Technical Specifications

Frequency Range: 1.5 MHz to 30 MHz

Service Types:

A1	CW telegraphy
A2	MCW telegraphy
A3	AM telephony
A3J	SSB telephony

In conjunction with ancillary units:

F1	2-frequency FSK telegraphy (teletype, multiplex)
F1	3-frequency FSK telegraphy (data transmission)
F4	2-frequency FSK telegraphy (facsimile, weather maps)
F6	4-frequency FSK telegraphy (Code 1 and 2, Channel A and B)
A3A	SSB telephony with AGC and AFC according to residual carrier component
A3B	SSB telephony with two independent sidebands (ISB)
A4	facsimile, picture transmission

Frequency Subranges:

Subrange 1:	1.50 to 3.48 MHz
Subrange 2:	3.46 to 7.48 MHz
Subrange 3:	7.45 to 15.50 MHz
Subrange 4:	15.40 to 30.00 MHz

Tuning

Coarse Drive:	13.5 revolutions in each subrange
Fine Drive (mechanically reduced):	400 revolutions in each subrange
Tuning – Fine (electrically reduced):	about ±200 Hz (for 270° rotation angle)
Frequency Readout:	6-digit non-flicker display with digital numicator tubes
Resolution:	100 Hz
Readout Error:	$\leq 50\ \text{Hz} + 4 \times 10^{-7} f_e$

Frequency Drift

for +10 °C to +40 °C:	Subrange 1: mean 4 Hz/°C Subrange 2: mean 8 Hz/°C Subrange 3: mean 15 Hz/°C Subrange 4: mean 30 Hz/°C
for ±10% mains voltage fluctuation or 21.5 to 30 V battery voltage fluctuation:	≦ 50 Hz

RF Input (Antenna)

Signal Voltage:	0.5 µV to 100 mV EMF
Permissible Overvoltage:	≦ 10 V EMF
Impedance:	50 to 75 Ω, coaxial
Threshold Sensitivity:	mean value 10 kT_o (10 dB)
Parasitic Oscillator Voltage across 60 Ω:	Subranges 1, 2 and 3; mean value 20 µV Subrange 4; mean value 50 µV

Broadband IF Output

Nominal Frequency:	525 kHz
Bandwidth:	about ± 2% of reception frequency, max. 100 kHz
Impedance:	about 50 Ω
Voltage across 50 Ω (with AGC):	≧ 20 µV for 1 µV antenna EMF ≧ 100 µV for 100 µV antenna EMF ≧ 1 mV for 100 mV antenna EMF

Narrow Bandwith IF Output

Nominal Frequency:	525 kHz
Voltage across 50 Ω (with AGC):	≧ 50 mV
Voltage Variation (with AGC):	≦ ±2 dB for 0.5 µV to 100 mV antenna EMF
Impedance:	about 20 Ω

Image Frequency Rejection Factors:

	Mean Value	Minimum Value
1.5 to 10 MHz	95 dB	80 dB
10 to 25 MHz	70 dB	60 dB
25 to 30 MHz	60 dB	50 dB

IF Breakthrough Rejection Factor: 1.5 to 30 MHz — 100 dB

Bandwidths and Selectivity:

Nominal Bandwidth (kHz)	6 dB Bandwidth (kHz)	60 dB Bandwidth (kHz)	Tolerance of Passband Center Frequency (Hz)
± 0.10 *	≧ ± 0.10	≦ ± 0.55	≦ 150
± 0.25	≧ ± 0.22	≦ ± 0.90	≦ 180
± 0.75	≧ ± 0.70	≦ ± 2.5	≦ 250
± 1.5	≧ ± 1.45	≦ ± 4.0	≦ 300
± 3.0	≧ ± 2.7	≦ ± 6.5	≦ 300
± 6.0	≧ ± 5.7	≦ ±12.5	≦ 300
USB	≧ 2.9	≦ ± 8.0	≦ 300
LSB	≧ 2.9	≦ ± 8.0	≦ 300

* only for A1 service type

The bandwidths of ± 0.25 kHz, ± 0.75 kHz and ± 3 kHz have been incorporated in the basic version.

Cross-Modulation:

2 unmodulated transmitters produce a signal/interference ratio of ≧ 20 dB for

	Antenna EMF (mean value)	Detuning
Wanted Transmitter	100 µV	0
Interfering Transmitter 1	3 mV	± 20 kHz
Interfering Transmitter 2	3 mV	± 40 kHz
Interfering Transmitter 1	15 mV	$\frac{f_E}{2} \cdot 1.1$
Interfering Transmitter 2	15 mV	$\frac{f_E}{2} \cdot 0.9$

AF Outputs

Loudspeaker: max. 0.4 W into built-in loudspeaker

Headset 19 mm Sockets: max. 20 mW into 4000 Ω

Jack Connector: max. 20 mW into 4000 Ω

600 Ω AF Line Output (fitted only to special order)

Nominal Signal Level: 0 dBm (max. +10 dBm)

Signal Level Change with AGC: ≦ ± 2dB for 0.5 µV to 100 mV antenna EMF

Impedance: 600 Ω ±10 %

AF Passband: 300 to max. 5700 Hz, depending on bandwidth setting

Frequency Response: level to within ± 3 dB or better

A1 Service Type

Signal/Noise Ratio: ≧ 10 dB for 0.4 µV antenna EMF, ± 0.25 kHz bandwidth

AGC Time Constant: +20 dB in about 100 ms
−20 dB in about 2 s

Beat Frequency Oscillator (BFO): tunable through ± 3 kHz, $T_k \leqq 10$ Hz/°C

A2/A3 Service Types

Signal/Noise Ratio: ≧ 20 dB for 10 µV antenna EMF, ± 3 kHz bandwidth, m = 0.3

Cross-Modulation: A modulated interfering transmitter produces a signal/noise ratio of ≧14 dB for:

	Antenna EMF	Modulation Factor	Detuning
Wanted Transmitter	100 µV	50 %	0
Interfering Transmitter	30 mV	50 %	± 20 kHz
Interfering Transmitter	100 mV	50 %	± 20 %

AGC Time Constant: ± 20 dB in about 100 ms

Harmonic Distortion Factor:	$\leqq$ 5 % for 0 dBm and 1 mV antenna EMF, m = 0.3
A3J Service Type	
Signal/Noise Ratio:	$\geqq$ 20 dB for 3 µV antenna EMF, 3 kHz bandwidth
AGC Time Constant:	+ 20 dB in about 100 ms − 20 dB in about 2 s
Harmonic Distortion Factor:	$\leqq$ 5 % for 0 dBm, 1 mV antenna EMF
Carrier Reinsertion Oscillator:	frequency uncertainty $\leqq$ 20 Hz frequency drift $\leqq$ 20 Hz
Oscillator Output	
Frequency:	2 MHz to 32 MHz
Voltage:	$\geqq$ 5 mV across 50 Ω
Impedance:	about 50 Ω
Crystal Reference Frequency Output	
Frequency:	100 kHz
Frequency Uncertainty:	$\leqq 2 \cdot 10^{-7}$
Frequency Drift:	$\leqq 2 \cdot 10^{-7}$
Ageing:	$\leqq 1 \cdot 10^{-6}$/year
Voltage:	$\geqq$ 4 V_{pp} EMF
Impedance:	about 2 kΩ
Frequency Meter Output:	A frequency meter output can be provided upon request.
Binary Coded Output:	1-2-4-8 Code
Voltage for "L":	$\geqq$ 5.5 V EMF
Voltage for "O":	$\leqq$ 0.5 V EMF
Impedance:	about 5 kΩ
Takeover Blockage:	by short-circuiting to chassis
Short Circuit Impedance:	< 50 Ω
Takeover Pulse	
Voltage Amplitude:	$\geqq$ 5 V_{pp} EMF
Impedance:	about 50 Ω
Pulse Duration (Width):	about 300 µs
Repetition Frequency:	$\leqq$ 25 Hz
Mains Power Supply	
Voltage:	110/220 V ±10 %
Frequency:	45 to 480 Hz
Power Consumption:	for "preheating" max. 80 VA (at +25 °C for about 15 minutes after switching on) during "operation" about 60 VA at +25 °C
Battery Power Supply	
Voltage:	21.5 to 30 V, negative pole to chassis
Permissible Overvoltage:	max. 90 V for 1 ms
Current Drain:	max. 3 A for "preheating" (at +25 °C for about 15 minutes after switching on) during "operation" about 1.5 A at +25 °C
Ambient Conditions	
Temperature:	+10 °C to +40 °C full guarantee of performance specifications − 20 °C to +50 °C may be operated − 40 °C to +70 °C may be stored

Humidity:

Operation is permissible for 96 hours at +40 °C ambient temperature and 90 % relative humidity. A mean relative humidity of 75 % is permissible throughout the service life of the unit.

Vibration and Shock:

No damage results if the switched-on unit is subjected to vibration with a stroke of ± 0.5 mm at 10 to 30 Hz, or with an acceleration of 2 g at 30 to 70 Hz.
The unit is able to operate whilst being subjected to vibration with a stroke of ± 1 mm at 5 Hz.
No damage results if the switched-on unit is subjected to a jolt with 10 g acceleration and 10 ms duration.

Dimensions and Weights:

	Height mm	Width mm	Depth mm	Weight approx. kg
in cabinet:	315 *	274	350	24
as drawer unit:	270	256	324	20

* overall dimension, including rubber feet

Scope of Delivery

1 HF Receiver E 724 KW/2 with desk cabinet

1 Description and Operating Instructions

1 Mains Cable with Grounded Plug, according to Drawing No. 5L 4941.001-58

1 Antenna Plug HF 4/13, 50 to 75 Ω, Type SHF 13/s-2, suitable for Type 1.5/6.5 L Cable, according to Drawing No. 5N 4521.401-11

1 26-pole Shorting Plug, according to Drawing No. 52.1260.041-00

1 Set of Spare Fuses

Further details are given in our Description KB 031/1 E.

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