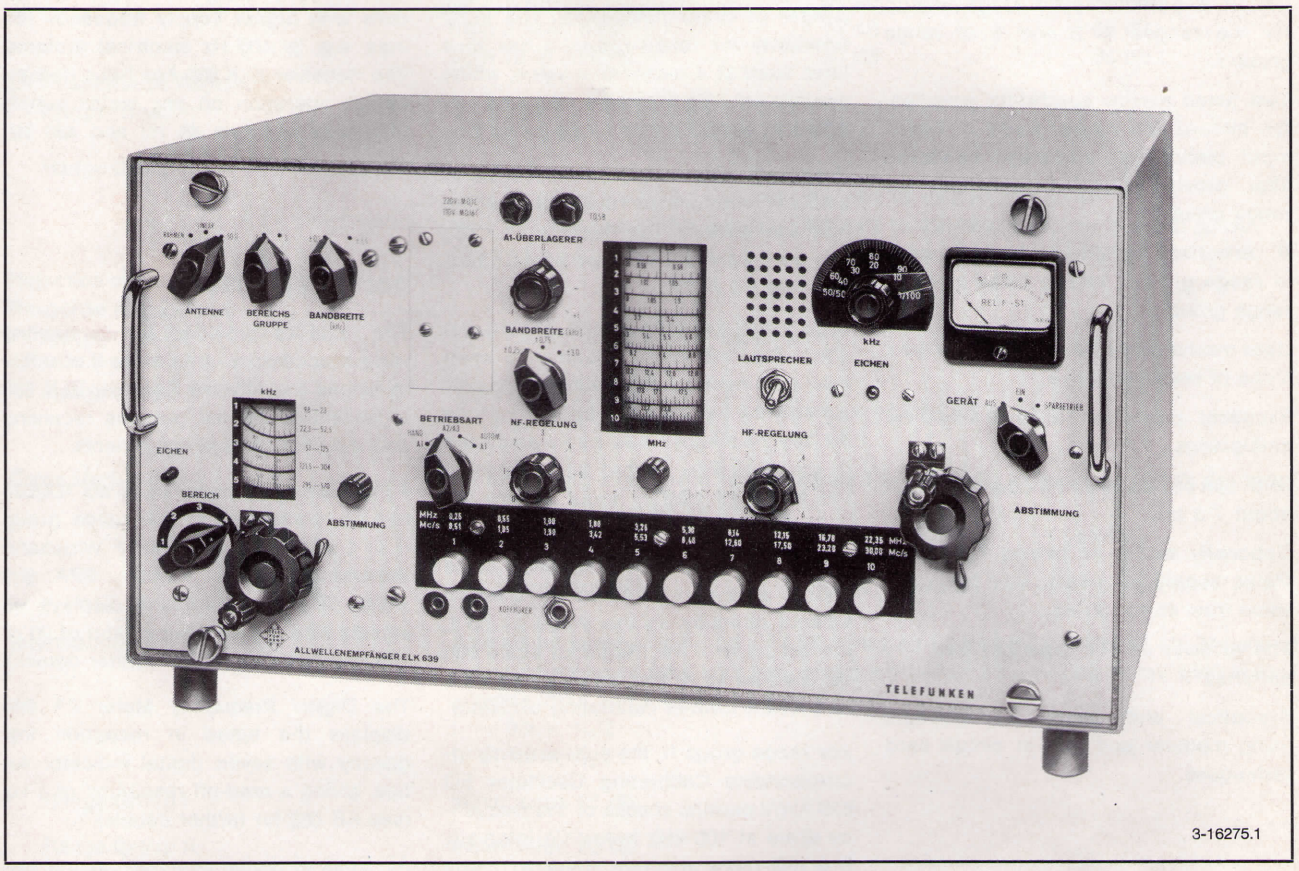
Receivers
Direction Finders

Allwave Receiver ELK 639/2 9.8 kHz to 30 MHz

Leaflet IB 630 E



Allwave Receiver ELK 639/2 in Desk Cabinet

Applications

The Allwave Receiver ELK 639 covers a large frequency range, so that it is suitable as service, search and monitor receiver for all types of mobile and fixed site radio receiving stations. The unit can also be used as spot frequency receiver with the help of a Crystal Oscillator QO 639 AW/1 which can be fitted subsequently. The universal mains/battery power supply section permits operation of the receiver in vehicles as well as on board small ships having only a battery electrical system. A loop antenna can be connected in the range group I, enabling the receiver to be used as LF direction finder. The Allwave Receiver ELK 639 is available as desk unit in a cabinet.

Special Features

Fully transistorised, giving high operational reliability, low power consumption (only 5 W when the scale illumination is switched off), long life and greatly reduced maintenance requirements.

Small dimensions and light weight.

Large frequency range 1 : 3000, divided into 15 sub-ranges.

Facilities provided for connecting a LF antenna with 50 Ω bottom end impedance, a linear antenna, a loop antenna and an HF antenna with 50 Ω bottom end impedance.

Range selector switch for range group I; pressbuttons for range selection in range group II.

Range selector switch for range group I fitted with plug-on switching boards.

High setting accuracy for frequency adjustment (tuning).

Frequency check facility for range group I with permanently incorporated calibrating oscillator giving a 20 kHz harmonic spectrum.

Frequency checks for range group II with Calibrating Oscillator EO 639 AW/2 which can be fitted subsequently and gives a 100 kHz harmonic spectrum, or with Bandspread Unit FL 639 AW/1.

Frequency scale calibration can be corrected by pointer displacement.

Crystal Oscillator QO 639 AW/1, with exchangeable plug-in crystal units for various spot frequencies in range group II can be fitted subsequently.

Double superheterodyne stage line-up for the ranges 1, 2 and 5 of range group I.

Two tuned narrow bandwidth preselector circuits for range group I. Tuned input circuit and interstage bandpass filter provide signal preselection for range group II.

IF selectivity switchable in four steps in range group I and in three steps in range group II.

Uses mechanical filters giving high flank slope of response curve.

Excellent protection against response ambiguities.

BFO can be tuned continuously through about ±3 kHz.

Optionally mains or battery operation. Mains supply frequency may have any value from 45 to 480 Hz.

The receiver can be powered from dry batteries.

Synoptical and sturdy construction, using modular and plug-in circuit card techniques.

Technical Remarks

The radio communication bands are nowadays so congested that the selectivity performance of a receiver is the factor deciding its operational suitability.

The good selectivity of the Allwave Receiver ELK 639 is achieved for the range group II with the help of three tuned preselector circuits and switch selected mechanical filters for three different IF bandwidths. In the range group I, good signal preselection is obtained by virtue of the inherently narrow-band input circuits in this frequency range. Furthermore, the IF bandwidth can be switched in four steps.

Superheterodyne receivers are inherently subject to response ambiguities, which must be suppressed to within tolerable limits. On account of its high signal preselection factors, the Receiver ELK 639 suppresses all spurious and unwanted responses by a factor of more than 60 dB.

The atmospherics level is large in the MF and HF ranges. Thus excessive receiver input sensitivity serves no useful purpose whilst producing a greater danger of cross-modulation. The input sensitivity for range group II has thus been fixed at a reasonable value, whilst operational requirements demand an optimum sensitivity for range group I.

Good receivers should be insensitive to ambient interference fields decoupled from the antenna. The Receiver ELK 639 has been carefully shielded against such interference fields.

Supply voltage fluctuations should not affect the frequency stability. To meet this requirement, the principal supply voltage as well as the supply voltage for the oscillators has been stabilised in the ELK 639, so that fluctuations of the mains or battery input voltage do not affect the performance.

The accuracy of the frequency scale should always be able to be checked without difficulty. In the range group I, the accuracy of the frequency scale can be checked at 20 kHz intervals with the help of the built-in calibrating oscillator.

For range group II, the subsequently incorporatable Calibrating Oscillator EO 639 AW/2 permits checks of the frequency scale at 100 kHz harmonic intervals. If a still more accurate check to 1 kHz tolerance is demanded, the Bandspread Unit FL 639 AW/1 can be fitted subsequently. The frequency scale reading can be corrected by displacing the pointer.

A good receiver should possess a large frequency range without sacrifice of setting accuracy. The Receiver ELK 639 covers the VLF, LF, MF and HF bands in 15 sub-ranges and is consequently very versatile in its applications.

The required movement of the tuning control knob should not be too small for search tuning, yet a facility for rapid passage from one end of the scale to the other is also desirable. The Receiver ELK 639 possesses coarse/fine switching in the tuning knobs. The mechanical reduction ratio is 16 : 1.

A lightweight receiver with low power consumption is desirable for mobile radio stations, in order to facilitate transportation and power supply. The Receiver ELK 639 is fully transistorised, has a small physical volume and weight as well as extremely low power consumption. Indeed, its low current drain even permits operation with a few monocells connected in series.

It is often necessary to be able to connect radio equipment to mains circuits with higher supply frequency ratings, e.g. to 400 Hz electrical systems. The Receiver ELK 639 has been designed for operation on any mains supply frequency between 45 Hz and 480 Hz.

Accessory Units

The facilities provided for connecting various accessory units make it possible to extend the Allwave Receiver ELK 639 to constitute special purpose receiving and direction finding equipments.

A Panorama Accessory Unit PaG 724/525 can be connected to the range group II in conjunction with the IF Wideband Panorama Output Module BPA 639 AW/2. The panorama unit displays all signals within a frequency band of 20 or 100 kHz (see KB 070 for further details).

The Digital Frequency Meter FA 990 displays the tuned in reception frequency with seven digital indicator tubes, giving a read-off resolution of 1 Hz (see KB 063 for further details).

All types of digital communications signals using FSK telegraphy (e. g. teletype transmissions) can be demodulated by connecting a teletype keying unit (FSK converter) (see KB 068 for further details).

By interposing a DF Accessory Unit PV 897 ahead of the Receiver ELK 639, the latter can be used as DF receiver in the frequency range from 1.3 to 30 MHz, in conjunction with a 6 mast Adcock antenna system (see KB 029 for further details).

In conjunction with a Phase/Amplitude Regulator Unit PAR 1039 and the DF Accessory Unit PV 897, the Receiver ELK 639 can be employed as HF directional rejection receiving equipment in the frequency range from 1.3 to 30 MHz (see KB 030 for further details).

Technical Specifications

Frequency Range:	9.8 kHz to 30 MHz
Frequency Sub-Ranges of Range Group I:	Range 1 9.8 to 23.0 kHz Range 2 22.3 to 52.5 kHz Range 3 51.0 to 125.0 kHz Range 4 121.5 to 304.0 kHz Range 5 295.0 to 570.0 kHz
Frequency Sub-Ranges of Range Group II:	Range 1 0.25 to 0.51 MHz Range 2 0.55 to 1.05 MHz Range 3 1.00 to 1.90 MHz Range 4 1.80 to 3.42 MHz Range 5 3.26 to 5.53 MHz Range 6 5.30 to 8.48 MHz Range 7 8.14 to 12.60 MHz Range 8 12.15 to 17.50 MHz Range 9 16.78 to 23.20 MHz Range 10 22.35 to 30.00 MHz
Types of Service:	A1 CW Telegraphy A2 MCW Telegraphy above about 100 kHz A3 AM Telephony above about 100 kHz A4 AM Facsimile, Picture Transmission, above about 100 kHz In conjunction with accessory units: F1 2-Frequency FSK Telegraphy (Teletype, Multiplex) F4 2-Frequency FSK Telegraphy (Facsimile, Weather Maps) F6 4-Frequency FSK Telegraphy (2 teletype channels, Code I or Code II) carrier frequency at least 50 kHz
Read-Off Accuracy:	
Range Group I:	circular scale, coarse: fine reduction ratio = 1 : 16 1 mm scale displacement corresponds to about: 0.2 kHz in Range 1 0.3 kHz in Range 2 0.55 kHz in Range 3 1.1 kHz in Range 4 1.33 kHz in Range 5
Range Group II:	cylindrical scale with 294 mm graduation length, coarse: fine reduction ratio = 1 : 16 1 mm scale displacement corresponds to about: 0.9 kHz in Range 1 1.7 kHz in Range 2 3.0 kHz in Range 3 5.3 kHz in Range 4 7.1 kHz in Range 5 10.8 kHz in Range 6 15.0 kHz in Range 7 18.0 kHz in Range 8 22.0 kHz in Range 9 26.0 kHz in Range 10
Setting Accuracy:	ambient temperature range +15 °C to +25 °C; after two hours operating time:
Rang Group I:	up to 23 kHz better than ± 0.2 kHz up to 52.5 kHz better than ± 0.3 kHz up to 125 kHz better than ± 1.0 kHz up to 570 kHz better than ± 1.5 kHz

Range Group II:

up to 1.0 MHz better than ± 2.5 kHz
up to 3.4 MHz better than ± 5.0 kHz
up to 8.4 MHz better than ± 10.0 kHz
up to 30.0 MHz better than ± 25.0 kHz

Only for Range Group II:

When using the subsequently incorporatable Bandspread Unit FL 639 AW/1 in ambient temperature range + 10 °C to + 40 °C, better than 1 kHz;
in ambient temperature range + 15 °C to + 25 °C, better than 0.5 kHz.
Instead of the bandspread unit, a Calibrating Oscillator EO 639 AW/2 with 100 kHz harmonic spectrum can be fitted subsequently for making frequency calibration checks.

Frequency Drift

Range Group I:

≦ 5 Hz/°C in sub-range 1
≦ 10 Hz/°C in sub-range 2
≦ 45 Hz/°C in sub-ranges 3 to 5

Range Group II:

$< \pm (3 \cdot 10^{-5}/°C + 35\ Hz)$
$< 2 \cdot 10^{-6} + 50$ Hz for mains voltage fluctuations of ± 10% and battery voltage fluctuations from 21.5 V to 31 V

Spot Frequency Reception

Range Group II:

A Crystal Oscillator QO 639 AW/1 can be fitted additionally and subsequently. Crystal units can be plugged into this oscillator module externally, for setting any desired spot frequency in the range from 1 to 23 MHz with crystal accuracy.
Uncertainty: $2 \cdot 10^{-6}/°C$ at room temperature
Pulling Range: about $\pm 1 \cdot 10^{-4}$, adjustable on front panel

Sensitivity

Range Group I:

$< 10\ kT_o$ (10 dB) for 10 kHz at 50 Ω input
$< 5\ kT_o$ (7 dB) above 20 kHz at 50 Ω input

Range Group II:

average value $10\ kT_o$ (10 dB)

Signal/Noise Ratio

Range Group I:

≧ 10 dB for A1, bandwidth ± 100 Hz and 0.2 µV input EMF, R input = 50 Ω

Range Group II:

≧ 10 dB for A1, bandwidth ± 250 Hz and 0.3 µV input EMF
≧ 20 dB for A3, bandwidth ± 3 kHz, 30% modulation depth and 10 µV input EMF

Intermediate Frequency

Range Group I:

1st. IF	2nd. IF	Range
180 kHz	525 kHz	1, 2 and 5
525 kHz	–	3 and 4

Range Group II:

525 kHz

IF Bandwidths and IF Selectivity

Range Group I:

In the Ranges 1 to 3 the IF bandwidth is determined by the bandwidth of the input and interstage preselector circuits in the ± 1.5 kHz setting.

Preselector Bandwidth for 3 dB drop	Range 1	Range 2	Range 3
	± 175 Hz	± 300 Hz	± 600 Hz

Resulting in the following values:

Bandwidth Switch Setting		Ranges	Bandwidth 3 dB drop	Separation from Passband Center for 60 dB drop	Tolerance of Passband Center Frequency + 10 °C to + 40 °C
Range Group I	Range Group II				
± 1.5	± 3.0	4 to 5	≧ ± 1.5 kHz	≦ ± 4.2 kHz	≦ + 400/-400 Hz
± 1.5	± 0.75	4 to 5	≧ ± 0.70 kHz	≦ ± 2.5 kHz	≦ + 250/-200 Hz
± 1.5	± 0.25	2 to 5	≧ ± 0.25 kHz	≦ ± 0.90 kHz	≦ + 200/-150 Hz
± 0.1	any setting	1 to 5	≧ ± 0.1 kHz	≦ ± 0.55 kHz	≦ + 175/-125 Hz

Range Group II:

Switch Setting	Bandwidth 3 dB drop	Separation from Passband Center for 60 dB drop	Tolerance of Passband Center Frequency +10 °C to +40 °C
± 0.25	≧ ± 0.25 kHz	≦ ± 0.9 kHz	≦ +200/– 150 Hz
± 0.75	≧ ± 0.70 kHz	≦ ± 2.5 kHz	≦ +250/– 200 Hz
± 3.0	≧ ± 2.7 kHz	≦ ± 6.5 kHz	≦ +300/– 250 Hz

Image Frequency Rejection

Range Group I: ≧ 70 dB

Range Group II:

	Mean Value	Minimum Value
up to 2 MHz	95 dB	80 dB
from 2 to 12 MHz	75 dB	65 dB
from 12 to 30 MHz	50 dB	35 dB

IF Breakthrough Rejection

Range Group I: ≧ 70 dB

Range Group II: ≧ 90 dB
from 250 kHz to 400 kHz and from 600 kHz to 1050 kHz > 60 dB
from 400 kHz to 510 kHz and from 600 kHz to 550 kHz dropping to about 30 dB (IF gap)

Rejection of other Response Ambiguities

Range Group I: ≧ 60 dB for antenna EMF up to 10 mV

Range Group II: up to 12 MHz ≧ 60 dB, 12 to 30 MHz ≧ 50 dB } for antenna EMF up to 10 mV

Cross Modulation: An interfering signal with the specified EMF and 50% modulation depth produces a cross modulation factor of 10%

Wanted Signal	Interfering signal	Detuning
100 µV unmodulated	≦ 10 mV, m = 50%	± 20 kHz

Intermodulation: Wanted transmitter with 100 µV EMF tuned to f_N and then switched off. Measured signal/interference ratio with two interfering transmitters having 15 mV EMF at 50 Ω antenna input and the frequencies
$f_1 = 0.9 \times f_N/2$
$f_2 = 1.1 \times f_N/2$

Range Group I: mean value 25 dB

Range Group II: mean value 20 dB

Parasitic Radiation: Voltage produced by oscillator at receiver input terminated with 60 Ω

Range Group I: ≦ 20 µV

Range Group II:

	Mean Value	Maximum Value
up to 12 MHz	20 µV	50 µV
12 to 30 MHz	50 µV	100 µV

AGC: The IF and AF output voltages change by less than 6 dB for input voltage fluctuations between 1 µV and 50 mV.
The AGC function can be switched off for MGC. The AGC voltage is available externally for measuring purposes and for diversity operation.

AGC Time Constant: about 0.5 s

BFO: tunable through at least ±3 kHz, Temp. Coeff ≦ 10 Hz/°C

RF Input

Range Group I: 50 Ω coaxial, protected against high antenna voltages up to 20 V rms EMF with Ri = 50 Ω. Linear antenna 100 to 1500 pF, protected against high antenna voltages up to 20 V rms EMF.
Loop antenna approx. 25 µH

Range Group II:

Switch Setting	Bandwidth 3 dB drop	Separation from Passband Center for 60 dB drop	Tolerance of Passband Center Frequency +10 °C to +40 °C
± 0.25	≧ ± 0.25 kHz	≦ ± 0.9 kHz	≦ +200/– 150 Hz
± 0.75	≧ ± 0.70 kHz	≦ ± 2.5 kHz	≦ +250/– 200 Hz
± 3.0	≧ ± 2.7 kHz	≦ ± 6.5 kHz	≦ +300/– 250 Hz

Image Frequency Rejection

Range Group I: ≧ 70 dB

Range Group II:

	Mean Value	Minimum Value
up to 2 MHz	95 dB	80 dB
from 2 to 12 MHz	75 dB	65 dB
from 12 to 30 MHz	50 dB	35 dB

IF Breakthrough Rejection

Range Group I: ≧ 70 dB

Range Group II: ≧ 90 dB
from 250 kHz to 400 kHz and from 600 kHz to 1050 kHz > 60 dB
from 400 kHz to 510 kHz and from 600 kHz to 550 kHz dropping to about 30 dB (IF gap)

Rejection of other Response Ambiguities

Range Group I: ≧ 60 dB for antenna EMF up to 10 mV

Range Group II: up to 12 MHz ≧ 60 dB, 12 to 30 MHz ≧ 50 dB } for antenna EMF up to 10 mV

Cross Modulation: An interfering signal with the specified EMF and 50% modulation depth produces a cross modulation factor of 10%

Wanted Signal	Interfering signal	Detuning
100 µV unmodulated	≦ 10 mV, m = 50%	± 20 kHz

Intermodulation: Wanted transmitter with 100 µV EMF tuned to f_N and then switched off. Measured signal/interference ratio with two interfering transmitters having 15 mV EMF at 50 Ω antenna input and the frequencies
$f_1 = 0.9 \times f_N/2$
$f_2 = 1.1 \times f_N/2$

Range Group I: mean value 25 dB

Range Group II: mean value 20 dB

Parasitic Radiation: Voltage produced by oscillator at receiver input terminated with 60 Ω

Range Group I: ≦ 20 µV

Range Group II:

	Mean Value	Maximum Value
up to 12 MHz	20 µV	50 µV
12 to 30 MHz	50 µV	100 µV

AGC: The IF and AF output voltages change by less than 6 dB for input voltage fluctuations between 1 µV and 50 mV.
The AGC function can be switched off for MGC. The AGC voltage is available externally for measuring purposes and for diversity operation.

AGC Time Constant: about 0.5 s

BFO: tunable through at least ±3 kHz, Temp. Coeff ≦ 10 Hz/°C

RF Input

Range Group I: 50 Ω coaxial, protected against high antenna voltages up to 20 V rms EMF with Ri = 50 Ω. Linear antenna 100 to 1500 pF, protected against high antenna voltages up to 20 V rms EMF.
Loop antenna approx. 25 µH