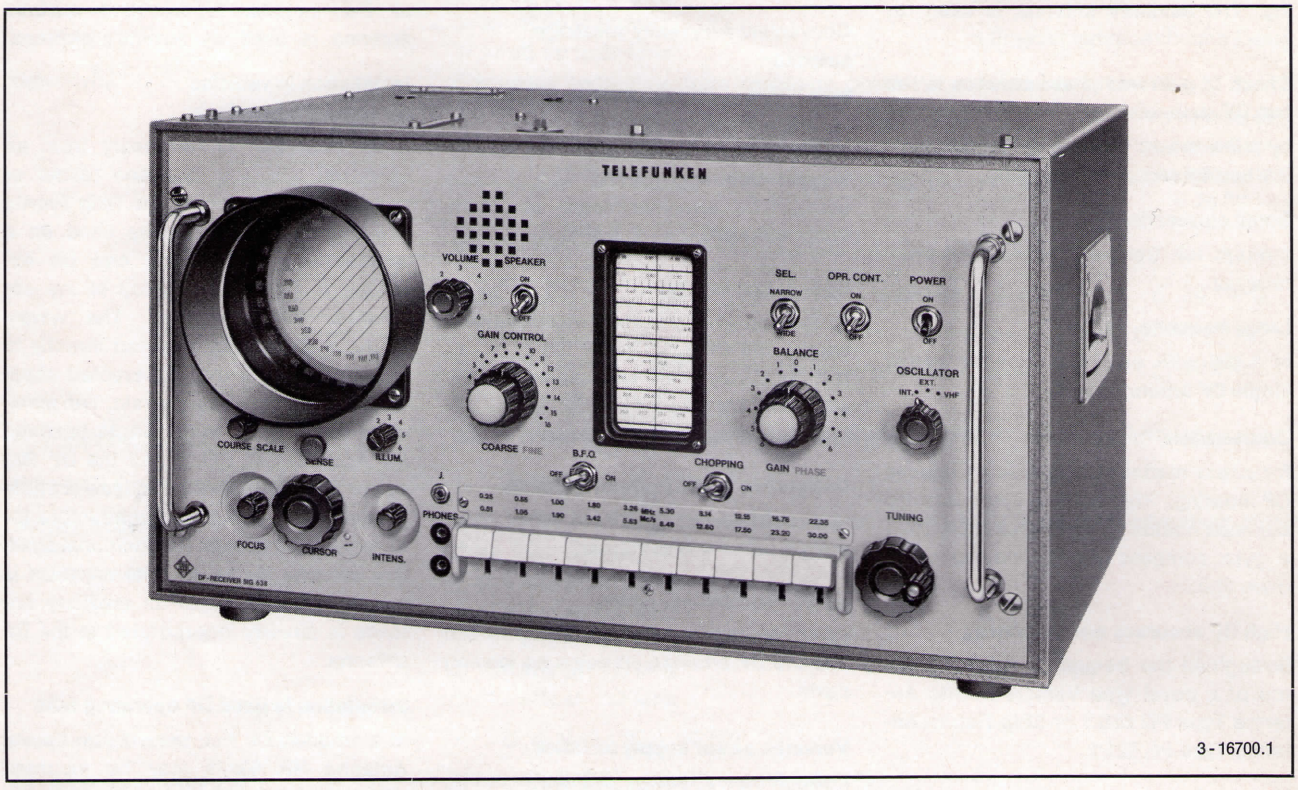
Receivers
Direction Finders

TELEGON IV

Cathode Ray
Direction Finder
Equipment
PST 638/3

Leaflet
IB 423/2 E



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Cathode Ray DF Receiver SiG 638/3

TELEGON IV

MF-HF Cathode Ray DF Equipment with Course Scale, PST 638/3

Frequency Ranges: 250 to 510 kHz and 0.55 to 30 MHz

General Remarks

Direction finders for modern radio reconnaissance and surveillance tasks must fulfil very exacting demands. It must be possible to take unambiguous DF bearing readings for transmitters operating on closely adjacent frequencies and radiating only very brief signals. Further requirements are a large frequency range, extension with ancillary equipment, compact assembly and small current drain so that the units can also be operated in motor vehicles or on board ships.

The MF-HF Cathode Ray DF Equipment with Course Scale, PST 638/3 TELEGON IV, fulfils these requirements.

Applications

The Cathode Ray DF Equipment PST 638/3 is intended for groundwave direction finding in the frequency range from 250 kHz to 30 MHz. With the exception of the cathode ray tube for the visual DF display, this DF receiver is fully transistorised and assembled in light alloy construction, so that it is particularly suitable for mobile DF stations. Various jacks have been provided on the rear of the unit for connecting accessory units, such as adapters for extending the frequency range, auxiliary units for frequency readout, for panorama display, for radio teletype operation and for documentation of the communications content of the received transmissions.

Special Features

Visual DF method
with azimuth display on cathode ray tube

Omnidirectional and DF reception facilities
combined in a single receiver. Continuous monitoring of the communications content of the received signals during DF operation, without changeover switching. The auxiliary antenna is used for direct omnidirectional reception.

Check of gain and phase balance in the two DF channels
by pulse driven chopper commutation of the two DF reception channels.

Small current drain
through full transistorisation of the DF receiver.

Large frequency range
of 1:120 with only one receiver and a single DF antenna system.

Course scale
for direct readout of the true or relative DF bearing. The course scale can be adjusted manually, or automatically from a gyro compass via the course scale drive unit.

High DF accuracy and sensitivity
throughout the frequency range, by virtue of a novel type Vehicle Ferrite Antenna Type PR 638/1 or Ship Ferrite Antenna Type PR 821/2.

No separate auxiliary antenna
required when using the Ship Ferrite Antenna Type PR 821/2, since the auxiliary antenna is incorporated in this DF antenna system.

Relative field strength determinations
can be made the DF vehicle is within the proximity field of the observed transmitter. The change of display line length on the screen of the cathode ray tube and the setting of the coarse RF gain control switch are noted for this purpose.
The switch setting of the coarse RF gain control can also be displayed remotely on an externally connected meter mounted, for example, in the driver cabin of the DF vehicle.

Compensation of D-errors in vehicle and shipboard installations
(symmetrical quadrantal DF errors) with two adjustable resistors in the unit, accessible from the top of the cabinet. The two adjustable compensating resistors can be associated optionally with the frequency subranges 1 to 10 by making suitable connections on the transfer soldering tagstrip located in the Antenna Matching Units AP 638/2 and AP 821/2.

High selectivity
provided by mechanical filters in the IF aural channel, for both bandwidth settings.

Convenient frequency subrange selection
with pushbutton switches.

High setting accuracy
for the frequency tuning with a drum scale. The effective scale length is about 660 mm for each subrange.

Built-in test oscillator
for testing the DF antenna (operational check), the DF function of the receiver, the frequency scale calibration and the electrical balance of the RF feeder cables during installation thereof.

Calibration of the frequency scales
is possible from the front panel, with the aid of the test oscillator.

Small maintenance costs,
since the receiver is fully transistorised and the DF antenna contains no moving parts.

Versatile power supply facilities
through built-in power unit which can be operated on a 110/220 V, 45 to 480 Hz, AC mains supply, or from a 24 volt battery or 24 volt DC board electrical system.

JAN and MIL specifications
have been satisfied to a large extent.

Utilisation Possibilities

Installation in cars and lorries with metallic bodywork
The Vehicle Ferrite Antenna PR 638/1 for the DF frequency range from 250 kHz to 30 MHz is attached to the roof of the vehicle, e.g. on the luggage carrier. Two RF feeder cables and a control cable are installed from the antenna to the DF Receiver SiG 638/3. These must be taken through the roof of the vehicle. A separate auxiliary antenna is also required for DF sense determination. The luggage carrier can be used for this purpose, if it is insulated with respect to the vehicle bodywork.
The DF Receiver SiG 638/3 is powered by a 24 volt battery which is charged by a second engine-driven dynamo.

Installation in lorries or vans with wooden or plastic bodywork
If necessary for camouflaging, it is also permissible here to mount the Vehicle Ferrite Antenna PR 638/1 in the interior of the vehicle. A star-form surface antenna is used as auxiliary antenna.

Installation in vehicles for special operations
If DF operation is necessary from an obscured site, e.g. between blocks of buildings or in a forest, the Ship Ferrite Antenna PR 821/2 may be used on a winch-driven mast which can be extended to look over the top of the obstruction when required. The winch-driven mast may be attached directly to the vehicle, or it may be erected separated therefrom on the terrain. The maximum permissible cable length between the Antenna PR 821/2 and the DF Receiver SiG 638/3 is 50 m. A special cable is used here, containing conductors for all required functions. An additional auxiliary antenna for sense determination is not required, because an auxiliary antenna is already incorporated in the DF antenna.

Installation in fixed DF operating huts
In a wooden DF hut, the Vehicle Ferrite Antenna PR 638/1 may be mounted under the roof, but it must be mounted centrally on top of the roof of the hut when the latter is built with bricks or concrete. In this case power supply can be drawn either from a 24 volt battery or from a local power mains supply.

Installation in small ships with few superstructures
The Vehicle Ferrite Antenna PR 638/1 is mounted on the top deck of the ship. The DF Receiver SiG 638/3 is installed in the cabin space below deck. The normal cable length between the DF antenna and the DF receiver is 1.5 m. Power supply is either from the 24 volt DC board electrical system or from a 110 or 220 V, 45 to 480 Hz, AC board electrical system.

Installation in larger ships with numerous superstructures
The Ship Ferrite Antenna PR 821/2 is intended for this purpose. It is mounted

at the highest point on the ship, on the summit of the mast. The DF Receiver SiG 638/3 is installed in the interior of the ship. The maximum permissible length of cable between the DF Antenna PR 821/2 and the DF Receiver is 50 m. A special cable is used here, containing conductors for all required functions. A separate auxiliary antenna for sense determination is not required, because the sense antenna is already incorporated in the DF Antenna PR 821/2.

Accessory Units

Digital Frequency Meter FA 990

This unit provides exact readout of the frequency to which the DF receiver is tuned. The readout range of the FA 990/30 covers from 10 kHz to 30 MHz. The frequency is displayed digitally with a resolution of ±1 Hz. The first oscillator frequency of the DF receiver is actually measured. A RF output has been provided for this purpose on the SiG 638/3. The intermediate frequency is automatically subtracted from the first oscillator frequency inside the digital frequency meter, so that the actual reception frequency is displayed directly. A Type FA 990/100 Digital Frequency Meter is required if a VHF adapter is connected ahead of the DF Receiver SiG 638/3. This frequency meter provides a readout range from 10 kHz to 90 MHz and from 20 kHz to 180 MHz.

Course Scale Drive Unit KA 638

for automatic adjustment of the course scale under the control of the gyro compass.
The Course Scale Drive Unit KA 638/2 is mounted on the top side of the cabinet of the Cathode Ray DF Receiver SiG 638/3 and can be fitted with gyro repeater units from the Anschütz, Plath or Sperry systems.

Servo Control System SNS 638

for automatic adjustment of the course scale under the control of the gyro compass.
The SNS 638 is incorporated into the Cathode Ray DF Receiver SiG 638/3 and matches the Anschütz System course encoder which operates with 115 V / 400 Hz.

Panorama Adapter PaG 724/525

This unit provides a display on the screen of a cathode ray tube, of the signals present within a frequency band whose width can be selected optionally to be 20 kHz or 100 kHz. For connecting the PaG 724/525, it is necessary to incorporate the additional Broadband Output Unit (Panorama Output Unit) BPA 638/2 into the DF Receiver SiG 638/3. The panorama output unit is incorporated in the factory to special order, but it can also be fitted subsequently.

Teletype Keying Unit (FSK Converter) TSG 455

for operating teletypewriters, facsimile recorders or other data processing equipment. Connection is made to the "narrow bandwidth" IF output on the DF Receiver SiG 638/3.

Tape Recorder

(standard commercial type)
for recording the communications signal contents of the received transmissions. Connection is made to the 600 Ω AF line output of the DF Receiver SiG 638/3.

Possible Extensions

As HF Long Distance DF Equipment

The DF antenna is here a U-Adcock Antenna System A 396/3 or A 396/5 m. An Adcock Adapter AV 638/2 is connected in front of the DF Receiver SiG 638/3, to function as coordinate transformer (see KB 083/E for further details).

As Groundwave and Long Distance DF Equipment

e. g. for installation in vehicles. A Ferrite DF Antenna PR 638/1 is incorporated in the vehicle for short range (groundwave) DF operation. The Adcock Antenna System A 396 is used for long distance DF operation. The changeover switching is effected with an Antenna Changeover Switch AU 638, whereby the Adcock Adapter AV 638/2 is in circuit only for long distance DF operation. For mobile DF equipments, the Adcock antenna system can be erected 60 to 70 m distant from the DF receiver, depending on the chosen antenna base (see KB 083/E).

As VHF Direction Finder for the Frequency Range from 20 to 80 MHz, or from 60 to 180 MHz

A VHF Adapter UK 638/80 or UK 638/180 is connected ahead of the DF Receiver SiG 638/3. An H-Adcock Antenna System A 638/80 or A 638/180 is required as VHF DF antenna. An HF DF antenna can be connected to the VHF adapter in addition to the VHF DF antenna. Changeover between VHF and HF operation is effected with a switch in the VHF adapter (see KB 076/E).

As VHF Direction Finder for the Frequency Range from 20 to 180 MHz

In this case, both VHF Adapters UK 638/80 and UK 638/180 must be connected in front of the DF Receiver SiG 638/3. The VHF range group switching is effected with a Changeover Switching Unit BU 638. Both the Antenna Systems A 638/80 and A 638/180 are required for the VHF DF operation, and these antenna systems must be erected separated from the DF operating hut. An HF DF antenna system can be connected additionally to the VHF Adapter UK 638/80. (See KB 076/E.)

As VLF DF Equipment for the Frequency Range from 9.8 to 570 kHz

A VLF DF Adapter LW 638 is here connected ahead of the DF Receiver SiG 638/3. This adapter also covers the previous frequency gap from 510 to 550 kHz. The DF antenna system consists of four pressure-proof Ferrite Antennas PR 761/4 or PR 638/1, or PR 821/2. (See KB 080/E.)

Mechanical Assembly of the Cathode Ray DF Receiver SiG 638/3

The Cathode Ray DF Receiver SiG 638/3 consists of a light alloy frame in which the two receiver chains are mounted in modular construction. The complete unit is assembled with 10 different modules which are interconnected via plug connectors and thus can readily be taken out for maintenance and servicing. Extension cables have been provided to permit operation of the removed modules outside the receiver for carrying out tests and making measurements. Part of the circuitry of the unit uses printed circuits. Maintenance is facilitated by comprehensive designations of all connections and components. All external connections of the cathode ray DF receiver are located at the rear of the unit, except for the headset connecting jack and the jack for the remote readout meter for the setting of the coarse RF gain control switch, which are located on the front panel. The connectors at the rear of the

unit face upwards, so that the DF receiver can be pushed right against a rear wall without obstruction through the cable connections.

Mechanical Assembly of the DF Antennas

The Vehicle Ferrite Antenna PR 638/1 consists of several ferrite rods mounted at right angles on a glass fiber reenforced polyester baseplate. Plug connectors for the DF signal voltages and for the control voltage are located at the center of the baseplate. The components and ferrite rods are protected from possible damage by a covering hood made of glass fiber reenforced polyester.

The Ship Ferrite Antenna PR 821/2 possesses the same construction as the Vehicle Ferrite Antenna PR 638/1, but here the upper covering hood is conically shaped to reduce antenna icing and to prevent birds from perching on it. The underside of the antenna is also protected by a covering hood, carrying an aluminium flange block at its center for mounting the antenna on the mast. The plug connectors for the DF and control voltages are also located here. The inner sides of the two covering hoods are strip-metallised. These metallic coatings are employed as auxiliary antenna for sense determination.

Technical Specifications

Frequency (Wavelength) Range:

0.25 to 30 MHz (λ = 10 to 1200 m), divided into 10 subranges with a gap from 0.51 to 0.55 MHz

Subranges:

1	0.25 to 0.51 MHz	(585.0 to	1200,0 m)
2	0.55 to 1.05 MHz	(286.0 to	545.0 m)
3	1.00 to 1.90 MHz	(158.0 to	300.0 m)
4	1.80 to 3.42 MHz	(87.7 to	167.0 m)
5	3.26 to 5.53 MHz	(54.3 to	92.0 m)
6	5.30 to 8.48 MHz	(35.7 to	56.5 m)
7	8.14 to 12.60 MHz	(23.8 to	36.7 m)
8	12.15 to 17.50 MHz	(17.2 to	24.0 m)
9	16.78 to 23.20 MHz	(12.9 to	17.9 m)
10	22.35 to 30.00 MHz	(10.0 to	13.4 m)

Service Types:

A 1 CW telegraphy
A 2 MCW telegraphy
A 3 AM telephony

DF Operating Modes:

a) Cathode Ray DF Operation, Mode I, with channel chopping and restricted aural monitoring
b) Cathode Ray DF Operation, Mode II, without channel chopping, with simultaneous aural reception

DF Accuracy:

better than $\pm 1^{\circ}$

DF Sensitivity:

For a DF bearing accuracy of $\pm 1^{\circ}$, the following field strengths are required at the DF operating site for the Vehicle Ferrite Antenna PR 638/1 and for the Ship Ferrite Antenna PR 821/2:

Frequency MHz	PR 638/1	PR 821/2
0.5	20 µV/m	8 µV/m
5.0	5 µV/m	5 µV/m
10.0	4 µV/m	4 µV/m
15.0	4 µV/m	4 µV/m
25.0	5 µV/m	5 µV/m

measured with a signal/noise ratio of 2:1

Setting Accuracy:

Drum scale with approx. 660 mm graduated length and separate illumination for each subrange
1 mm scale movement corresponds to about

0.4 kHz in Subrange 1	4.8 kHz in Subrange 6
0.8 kHz in Subrange 2	6.8 kHz in Subrange 7
1.4 kHz in Subrange 3	8.1 kHz in Subrange 8
2.5 kHz in Subrange 4	9.7 kHz in Subrange 9
3.5 kHz in Subrange 5	11.6 kHz in Subrange 10

Frequency scale reduction drive coarse : fine = 1:16

Intermediate Frequency: 525 kHz

IF Bandwidth:

a) Aural channel, switch-selectable in 2 steps
"narrow" $\geqq \pm$ 225 Hz for 3 dB down
"broad" $\geqq \pm$1700 Hz for 3 dB down
b) DF channels $\geqq \pm$250 Hz for 3 dB down

The aural channel is fitted with mechanical filters for both bandwidth settings.

IF Breakthrough Rejection: $>$ 60 dB
(dropping to about 10 dB at 0.51 MHz and 0.55 MHz)

Image Frequency Rejection:
$>$ 60 dB up to 10 MHz
$>$ 50 dB up to 14 MHz
$>$ 40 dB up to 20 MHz
$>$ 27 dB up to 30 MHz

Selectivity: Frequency separation from passband center for a response attenuation of

	3 dB	20 dB	40 dB	60 dB	Tolerance of Passband Center Frequency at + 20 °C
DF Channels	$\geqq$ 250 Hz	$\leqq$ 1.5 kHz	$\leqq$ 2.5 kHz	$\leqq$ 3.75 kHz	
Aural Channel, narrow	$\geqq$ 225 Hz	$\leqq$ 400 Hz	$\leqq$ 600 Hz	$\leqq$ 950 Hz	$\leqq \pm$0.1 kHz
Aural Channel, broad	$\geqq$ 1700 Hz	$\leqq$ 4 kHz	$\leqq$ 5 kHz	$\leqq$ 6.5 kHz	$\leqq \pm$0.2 kHz

AF Passband: 200 to 6000 Hz for $\pm$3 dB down, with respect to 1000 Hz reference frequency

Harmonic Distortion Factor: $<$ 10 % for all AF outputs

Setting Accuracy: at +15 °C to +25 °C ambient temperature and after 2 hours of operation, better than

$\pm$ 10.0 kHz at 30.0 MHz
$\pm$ 7.0 kHz at 10.0 MHz
$\pm$ 5.0 kHz at 5.0 MHz
$\pm$ 3.0 kHz at 1.5 MHz
$\pm$ 1.3 kHz at 0.3 MHz

Frequency Drift: $< \pm (3 \times 10^{-5} / °C + 35$ Hz)

Receiver Sensitivity: mean value 10 kT_o (10 dB) in each subrange

Beat Frequency Oscillator (BFO): f = 526 kHz, crystal controlled; can be switched off for A2/A3 reception

RF Inputs:
a) 2 $\times$ 120 Ω, balanced, for the DF voltages
b) 1 $\times$ 120 Ω, balanced, for the omnidirectional voltage for sense determination
c) 1 $\times$ 50 to 75 Ω, coaxial, for external oscillator or other purposes

RF Output: 1 $\times$ 50 to 75 Ω, coaxial, 1st. oscillator frequency, for connecting a frequency meter or for other purposes

IF Inputs:
a) 1 coaxial input, DF channel 1
b) 1 coaxial input, DF channel 2

Both inputs intended for connecting a VLF adapter unit

IF Outputs:
a) 1 $\times$ 50 to 75 Ω, coaxial, DF channel 1
b) 1 $\times$ 50 to 75 Ω, coaxial, DF channel 2

Both outputs are intended for remoting functions
c) 2 $\times$ 50 to 75 Ω, coaxial, about 0.1 V, from the azimuth-independent aural channel
d) 1 $\times$ 50 to 75 Ω, coaxial, broadband, for connecting an HF panorama adapter or for other purposes (the Panorama Output Unit BPA 638/2 is incorporated only to special order)

AF Outputs:
a) Loudspeaker (can be switched off), permanently built-in
power output 0.25 W, impedance 10 Ω
b) Headset
power output 50 mW, impedance 4 kΩ

c) Line Output, 600 Ω, 0 dB
d) AF input and demodulator output for connecting various ancillary units

Gain Control: separate manual RF and AF gain controls

RF Gain Control Range: about 1:100 000, divided into 16 fixed steps and one continuously variable range, each giving a control factor of about $\sqrt{5}$ (7 dB)

DF Antennas:
a) Vehicle Ferrite Antenna, Type PR 638/1 for the frequency range from 0.25 to 30 MHz (separate auxiliary antenna required)
b) Ship Ferrite Antenna, Type PR 821/2, with built-in sense antenna; frequency range 0.25 to 30 MHz

Sense Determination: as quadrant indication. When the sense button is actuated, two radial lines appear on the cathode ray tube, marking the quadrant containing the direction of incidence of the observed wavefront.

Semiconductors Fitted

SiG 638/3:	84 transistors
BPA 638/2	6 transistors
PR 821/2	6 transistors

Cathode Ray Tube: DP 10/14

Crystals Fitted: 4 crystals 525 kHz, 1 crystal 526 kHz, 1 crystal 100 kHz

Circuit Line-Up of Receiver: DF input section — 2 RF channels for the North/South and East/West DF voltages, each with 3 tuned RF circuits — first RF oscillator — 3 IF channels for the two DF voltages and for the aural monitoring signal with AF section — pulse generator — input chopper stage — output chopper stage — display unit with high voltage section — test oscillator (crystal harmonic spectrum) for operational check of the equipment and individual units and for calibrating the frequency scales

Power Supply:
a) 110 or 220 V, ± 10 %, 45 to 480 Hz
b) from 24 V battery (21.5 to 30 V), negative pole to chassis

Power Consumption: about 66 VA for mains operation
about 48 W for battery operation

Ambient Temperature Range:
+ 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

Dimensions and Weights:

	Height mm	Width mm	Depth mm	Weight approx. kg
Cathode Ray DF Receiver SiG 638/3	294*	544	483	37.2
Vehicle Ferrite Antenna PR 638/1	155	820	820	25.0
Ship Ferrite Antenna PR 821/2	800	816	816	43.0
Matching Unit AP 638/2	150	250	208	1.85
Matching Unit AP 821/2	150	250	208	1.95
Panorama Output Unit BPA 638/2	35	230	105	0.51

* with shock mounts, 314 mm

AEG-TELEFUNKEN
Geschäftsbereich Nachrichten- und Datentechnik
Export
Fachbereich Hochfrequenztechnik
Technische Informationsstelle
79 Ulm · Elisabethenstraße 3

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