



## A black and white photograph of a soldier in a forest. The soldier is wearing a helmet and a jacket, and is holding a rifle. He is looking to the left, with his hand near his face. The background shows a dense forest of evergreen trees.

## LA6NCA

## 1 USE

The radio set VHF-1 is a short range, man pack, portable, frequency modulated (FM) receiver-transmitter with a nominal range of 8 kilometers (5 miles). It is mainly designed for simplex voice communication within an infantry or battalion (or corresponding military units).

Small size and low weight enable the complete receiver-transmitter VHF-1 to be carried comfortably by the combat soldier without affecting his fighting ability and because of its extreme simplicity in operation, the equipment can be used efficiently by the ordinary infantry man without any prior training, even in complete darkness and under conditions of extreme cold. Fully sealed and waterproof, the VHF-1 is designed for combat-zone duty throughout the world.

The heart of the VHF-1 set is a digital frequency synthesizer which, in the frequency range 27 to 70 MHz provides any of 1720 simplex channels.

In combination with additional equipment, the VHF-1 can be remotely controlled, and two VHF-1 sets can constitute a repeater station. The VHF-1 also forms the basic unit in a VHF system which can be extended in stages up to a complete battle tank installation.

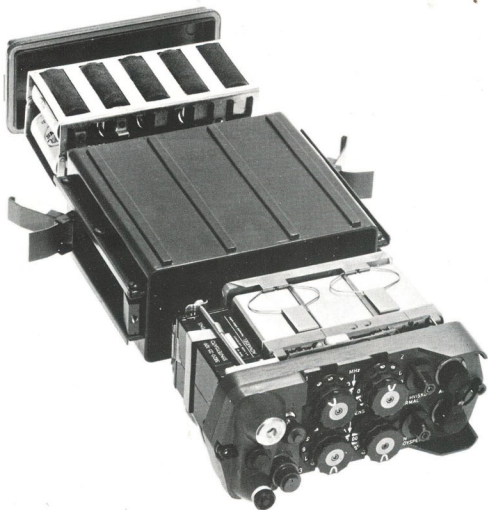


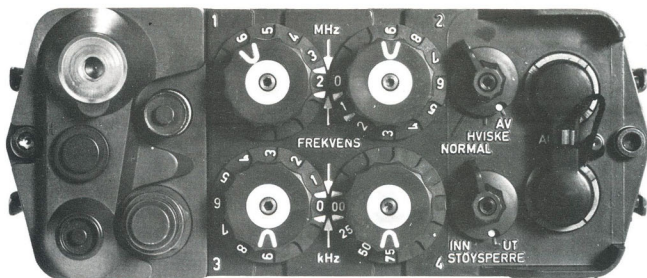
## 2 DESIGN

### 2.1 Mechanical Construction

The receiver-transmitter VHF-1 is housed within a robust and solid case. The main chassis is divided internally into two sections. The upper section contains the receiver-transmitter, and the lower section contains the battery holder. The VHF-1 utilizes a plug-in system, in which most of the functional units are assembled in ten plug-in module boxes. All the controls are arranged on the front panel.

The mechanical design complies with the data given in section 7 below, and has been subjected to the tests mentioned therein with reference to the British Defence Specification DEF-133.





## 2.2 Controls

The following controls are on the front panel:

1. Channel-selectors 1 to 4.
2. Squelch IN/OUT selector.
3. Function selector. (OFF-WHISPER-NORMAL)
4. Power selector. (0.3 W or 1.5 W)

## 2.3 Connectors

The following connectors are arranged on the front panel.

### a. Two audio-connectors.

Type U-183/U (Five-pole) connectors are used for the connection of the handset, headphones, remote-control unit and retransmission unit.

### b. Main antenna socket.

This is used for connection of the short or long whip antenna. Mounting and demounting of the whip antenna is simple and does not require the use of any special tool.

### c. 50-ohm BNC connector.

This connector is used for the connection of an external power amplifier or an auxiliary antenna.

### d. Counterpoise socket

This connector is used for the connection of the counterpoise.

### e. Battery connector.

This connector is used for the connection of an external power supply.

## 2.4 Accessories

### 2.4.1 Summary

The following accessories are supplied with the VHF-1:

- long (10 feet) antenna
- short (3 feet) antenna
- counterpoise
- handset
- set of headphones
- knapsack
- battery cable



### 2.4.2 Long Antenna

The long antenna is a multi-section 10 feet long whip antenna, consisting of 8 sections with each section fitting into the end of a wider section. An elastic cord threaded through the sections will hold it together under operating conditions. When the antenna is disassembled, the cord will keep the sections together as a group.

### 2.4.3 Short Antenna

The short antenna is a one-section, 3 feet long whip antenna of a steel tape construction. It can be folded into a small space. A flexible joint at its base allows it to be set vertically irrespective of the receiver-transmitter VHF-1's position.

The antenna socket has two built-in microswitches which automatically connect the right antenna matching circuit, irrespective of whether the long or short antenna is used.

### 2.4.4 Counterpoise

The counterpoise consists of a rubber insulated copper wire, approximately 4 feet long, one end of which is provided with a plug for connection to the counterpoise socket on the front panel. The counterpoise plug also fits the main antenna socket and can be used as an antenna when a drastically reduced range is desired, or when the use of a whip antenna is not possible.





#### 2.4.5 Handset

The handset (H-67/N) consists of a microphone and a ear-phone section for transmitting and receiving signals. A push-to-talk switch is mounted in the handle of the handset.



#### 2.4.6 Headphone

The headphone (H-6/N) consists of a single earphone and a frame for the fastening of the headphone. The headphone can also be used with helmet and/or gas mask.



#### 2.4.7 Knapsack

The knapsack consists of a strong bag for the main unit and is provided with pockets for the accessories. The knapsack is also provided with hooks and slings for securing to the soldier's webbing, so that the VHF-1 can be carried on the chest without interfering with the soldier's mobility.



#### 2.4.8 Battery Cable

The battery cable is approximately 3-feet long and is provided with a multipin plug at one end for connection to the battery connector on the front panel, and a connector at the other end for connection to the battery holder, thereby allowing the batteries to be carried inside outer-clothing, during conditions of severe cold.

## 2.5 Additional Equipment

Additional equipment which can be provided includes:

Remote Control Equipment

Retransmission Unit

### 2.5.1 Remote Control Equipment

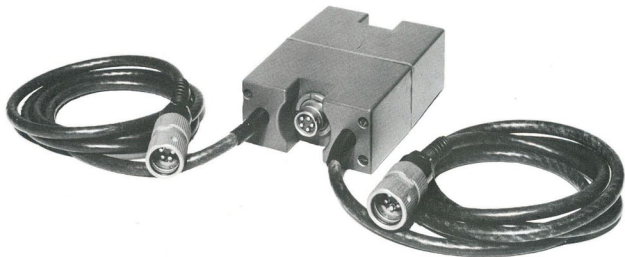
The remote control equipment consists of a local unit and a remote unit. The local unit is connected to one of the audio-connectors on the front of VHF-1. The remote unit is a standard Field Telephone set TP-5/N (or the equivalent). Both units have their own power supply.

The VHF-1 can, with the aid of the remote control equipment, be remote controlled up to a distance of 3.5 kilometers over two-wire field cable.

Normal telephone communication, including two-way calling is possible between the local and remote units. Tone calling is used, and the loudness can be adjusted in three steps.







### 2.5.2 Retransmission Unit

Two VHF-1 sets can be used to retransmit *automatically* the signals of two other radio sets that are too far apart to communicate directly. This action can be accomplished by connection of the retransmission unit.

The retransmission unit is provided with two cables for connection to the audio-connectors of the two VHF-1 sets. Through these cables the signals received by one VHF-1 are automatically transmitted by the other.

The unit is also provided with a connector for an H-67/N handset, which can be used to monitor the retransmission signals. In addition, a selector on the unit makes communication possible between the operators of the retransmission unit and the two remote sets.

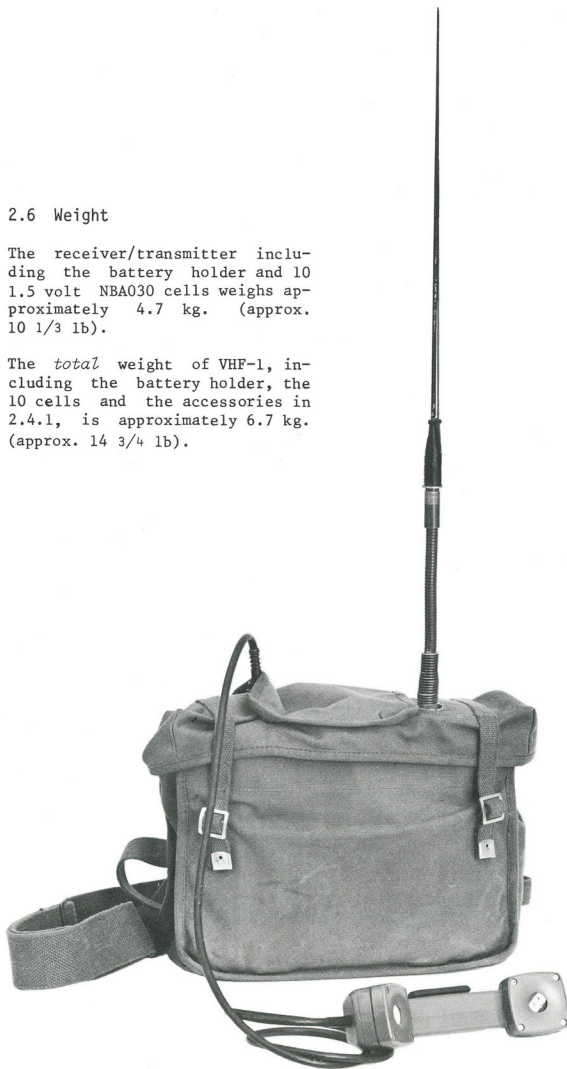
The retransmission unit is "passive", i.e. it has no power supply.

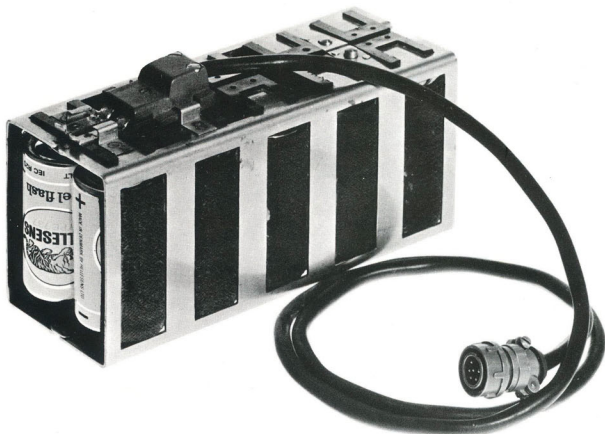


## 2.6 Weight

The receiver/transmitter including the battery holder and 10 1.5 volt NBA030 cells weighs approximately 4.7 kg. (approx. 10  $\frac{1}{3}$  lb).

The *total* weight of VHF-1, including the battery holder, the 10 cells and the accessories in 2.4.1, is approximately 6.7 kg. (approx. 14  $\frac{3}{4}$  lb).





## 2.7 Type of Battery

The normal power source is 10 cells of type NBA030. The cells are placed in a battery holder which can be mounted below the receiver transmitter VHF-1 or carried separately using the battery cable.

The NBA030 cells may be substituted by NiCd cells of the same dimensions.

### 2.7.1 Lifetime Expectancy of Battery

The lifetime expectancy of the battery is approximately 12 hours with dry cells and 20 hours with NiCd cells (with 9:1 receive-transmit ratio).

### 2.7.2 Variation of Electrical Performance According to State of Battery

The data given are covered within the battery voltage limits of 10 to 15 volts.

### 3 OPERATING DATA

#### 3.1 Tuning

It is possible without outside assistance to tune VHF-1 to any channel within the frequency range. VHF-1 can be tuned with one hand. The four channel selectors can be locked and/or preset to give rapid selection between 2 pre-determined channels.

#### 3.2 Channel Selection and Frequency Indication

Channel selection is possible in total darkness. The setting can be read directly in frequency.

#### 3.3 Warming Up Time

VHF-1 is ready for use in 2 seconds (max.) after switching on.

#### 3.4 Use of Gloves or Mittens

VHF-1 can be operated by an operator wearing gloves or mittens.

#### 3.5 Sustained Operation

VHF-1 can be used for continuous transmission or reception without the risk of overheating.

#### 3.6 Gas Mask

VHF-1 can be used by an operator wearing a gas mask.

#### 3.7 Whisper Modulation

A whisper speech facility allows the VHF-1 to be used in close proximity to the enemy; a whispered message is transmitted at full power whilst a reduction is made in the audio output of the headset or handset.

### 4 ELECTRICAL DATA

Frequency range	27 MHz to 70 MHz
Channel separation	25 kHz
Number of channels	1,720



#### 4.1 Frequency Stability and Setting Accuracy

The unmodulated transmitter frequency does not deviate more than  $\pm 1.5$  kHz from the nominal channel frequency during the simultaneous influence of the indicated variations of temperature, humidity and voltage.

#### 4.2 Modulation

The VHF-1 employs narrow band frequency modulation (F3) at 5 kHz deviation.

#### 4.3 Frequency Deviation

The nominal frequency deviation is  $\pm 5$  kHz at a modulation frequency of 1 kHz. For modulation frequencies between 300 and 3,000 Hz the frequency deviation is within  $\pm 1$  dB and  $-3$  dB relative to the reference frequency of 1 kHz.

#### 4.4 Deviation Limiter

The audio-frequency input circuits are provided with a deviation limiter in order to ensure that with an increase in the modulation signal of 14 dB above the normal level, a maximum increase of 3 dB in the frequency deviation results.

#### 4.5 Side Tone

The side tone is arranged so that its presence indicates that a modulated RF signal is present at the input of the antenna matching network.

#### 4.6 RF Output Power of Transmitter

At normal battery voltage (12 V) the output power is not less than 1.5 W in the selector position HIGH POWER and not less than 0.3 W in the position LOW POWER.

For a 30% reduction of the battery voltage, the nominal output power is reduced by maximum 30%.

#### 4.7 RF Output Impedance (BNC Connector)

The output circuit is designed to give the rated power to a resistive load of 40-60 ohms.

#### 4.8 AF Input Level of Transmitter

The microphone input circuit is designed to accept an input signal within the entire dynamic range, which can be expected from an electro-dynamic microphone. The input sensitivity is such that a signal of 1 kHz at a maximum level of 5 mV EMF, from a source with an internal impedance of 600 ohms, gives a nominal frequency deviation.

#### 4.9 AF Input Impedance of Transmitter

The AF input impedance of the transmitter is 300 ohms unbalanced in the frequency range of 500 to 3,500 Hz.

#### 4.10 Pre-emphasis

Pre-emphasis is not used in the VHF-1.

#### 4.11 Spurious and Harmonic Radiation

The attenuation of harmonics of the transmitter frequency is greater than 60 dB. All other undesired radiated frequencies, except frequencies inherent in the noise spectrum of the transmitter, are attenuated by more than 80 dB.

#### 4.12 Receiver Sensitivity

An RF input signal of nominal frequency with a level of 0.5  $\mu$ V EMF, a frequency deviation of 5 kHz, and a modulation frequency of 1 kHz, gives a minimum of 10 dB SINAD (signal+noise+distortion-to-noise+distortion ratio).

#### 4.13 Receiver AF Output Power

The AF output power of the receiver is minimum 1 mW in 600 ohms.

#### 4.14 Receiver AF Output Impedance

The AF output impedance of the receiver is 600 ohms.

#### 4.15 Receiver AF Frequency Response

The frequency response, within +1 dB and -3 dB, is 300 to 3,000 Hz.

#### 4.16 Receiver IF Limiting

The AF output power varies by a maximum of 3 dB when an RF input signal, modulated by a signal of 1 kHz and with a nominal deviation, varies from 1  $\mu$ V to 100,000  $\mu$ V.

#### 4.17 Intermodulation

Third-order intermodulation products are attenuated by at least 50 dB.



#### 4.18 Protection of Receiver Input Circuits

The receiver input can tolerate a 10 W signal on the antenna terminal from a source with internal resistance of 50 ohms.

#### 4.19 Reduction of Receiver Sensitivity (Desensitisation)

When an interfering signal, 10% off tune and 85 dB above the desired signal is present, a maximum increase in the desired signal of 6 dB is required to maintain the original SINAD ratio of 10 dB.

#### 4.20 Receiver IF Suppression

This is better than 80 dB below the desired signal.

#### 4.21 Receiver Image-frequency Attenuation

The image frequency is attenuated to minimum 60 dB below the desired signal.

#### 4.22 Interfering Signal Rejection

Interfering signals, (except image-frequency signals and signals of frequencies closer than  $\pm 2\%$  from the desired frequency), with levels 80 dB above the reference signal mentioned in 4.15, and with modulation as the reference signal, results in a maximum SINAD ratio of 10 dB. For frequencies separated by less than  $\pm 2\%$  from the desired frequency, the level is 60 dB above the reference signal.

#### 4.23 Adjacent Channel Response

The selectivity of the receiver is such that a signal in an adjacent channel with a level of 60 dB above the reference sensitivity of the receiver, does not reduce a SINAD ratio of 13 dB by more than 3 dB.

#### 4.24 Noise Modulation

The maximum total noise modulation in receiver and transmitter is minimum 40 dB below the nominal signal level, not taking the thermal noise in the RF circuits into account.

#### 4.25 Harmonic Distortion

Harmonic distortion is less than 10% for both receiver and transmitter at a frequency deviation of  $\pm 5$  kHz, and normal output power.

#### 4.26 Squelch

Tone squelch is used. The tone frequency is 150 Hz  $\pm$  4 Hz. Normal squelch-tone deviation is 1.5 kHz, but if a deviation of 3 kHz is required, this can be selected by removing an internal strap. Noise squelch and noise/tone squelch can be supplied optionally.

### 5 REPAIRS AND MAINTENANCE

VHF-1 has been designed in accordance with NATO regulation STANAG 2817 from the Military Bureau of Standardization: "Requirements as to construction and design to simplify maintenance of electronic and electrical equipment for army units".

### 6 RELIABILITY

For the main unit and accessories the average time between faults is more than 500 hours with a probability of 90%. For the additional equipment the corresponding average time between faults is more than 1,000 hours. These requirements will also be met after a storage time of five years or an operating time of 5,000 hours or a combination of these criteria. In this connection a storage time of one year will be considered equivalent to 1,000 operating hours.

When VHF-1 is used in combat this will be regarded as operating time even if the unit has not been switched on.

### 7 PROTOTYPE TESTING AND APPROVAL

7.1 All quality and shock resistance tests have been performed in accordance with the "British Defence Specification DEF-133".

7.2 The prototype with the battery holder mounted, has been subjected to tests as indicated in the table on Page 15. "Table L3 in DEF-133".





Test No.	Test	DEF-133 clause
1	Visual Examination and Functioning Tests	6.1
2	Resonance Search Test	8.1
3	Vibration Functional Test	8.2
4	Vibration Endurance Test	8.3
5	Dry Heat Test	11.0
6	Damp Heat Test	11.0
7	Low Temperature Exposure Test	12.0
8	Low Temperature/Low Pressure Test "C"	12.2
9	Damp Heat Test	11.1
10	Sealing Test (Pressure)	15.5
11	Driving Rain Test	15.1
12	Immersion Test "C"	15.3
13	Dry Heat Test "A"	11.0
14	Driving Dust Test	10.1
15	Driving Sand Test	10.2
16	Damp Heat Test	11.1
17	Tropical Life Test	11.2
18	Mould Growth Test	11.3
19	Corrosion Test, Salt	14.0
20	Corrosion Test, Acid	14.1
21	Corrosion Test, Alkaline	14.2
22	Contamination Test	14.3
23	Drop Test (x)	7.1
24	Toppling Test	7.4
25	Bump Test	7.0
26	Shock or Impact Test "B"	7.3
27	Packing Information Drop Test	7.2
28	Visual Examination and Functioning Tests	6.1
(x)	Height 1 meter ( approx. 3.3 feet)	

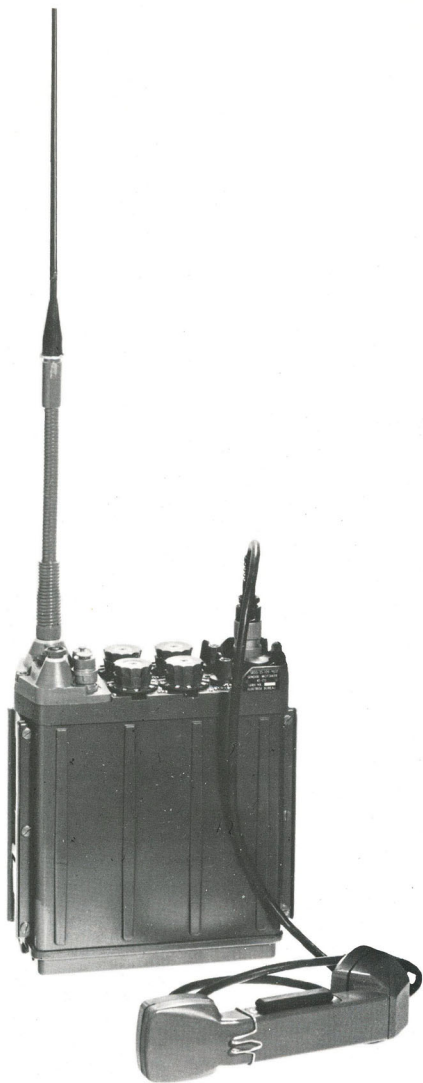
### 7.3 Functioning Tests

Complete functioning tests as referred to in DEF-133 consist of:

1. Measurement of receiver/transmitter frequency
2. Measurement of transmitter output power
3. Measurement of transmitter AF frequency response
4. Measurement of harmonic and spurious radiation
5. Measurement of receiver sensitivity
6. Measurement of selectivity
7. Measurement of undesired response
8. Measurement of harmonic distortion, receiver and transmitter
9. Measurement of receiver AF frequency response

### 8 COMPONENTS

All electrical components are selected from "NATO Electronic Parts Recommendation, NEPR" or are approved by GIHSB (Generalinspektøren for Hærens Samband).





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MANUFACTURED BY**



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