PNG BST50 Base Station Release 2

with AXS-SW-0311 software

and

PNG CP50 Control Panel

Operation Manual
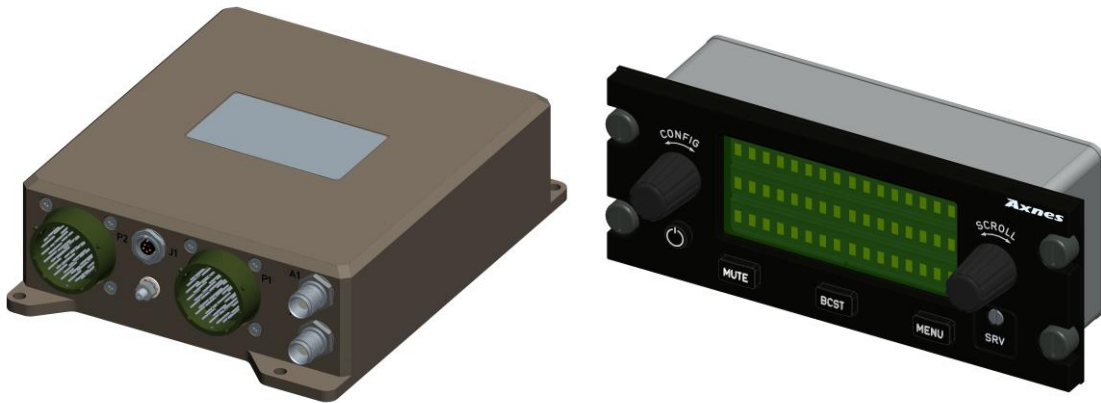
Revision history

Revision	Date	Description	List of affected pages
Issue A	2017-11-10	First revision for Release 2 (AXS-SW-0311)	All
Issue B	2017-11-20	Minor textual updates	
Issue C	2018-06-05	Included references to FCC standards	

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Section 1: General information

Axnes AS has delivered the Polycon system to the rotary wing Search and Rescue segment for decades. The system is widely adopted in this segment. The PNG system is based on the functionality in the previous system, but enhances the functionality and performance based on user feedback.

The PNG system incorporates the following main features:

- Wireless extension of aircraft intercom system with significant range and robustness.
- Full duplex operation.
- Uninterrupted communication.
- Support for keying of aircraft installed radios from the handheld.
- Support for multiple communication groups.
- Automatic microphone recognition on handhelds.
- Integrated Microphone for Patient/Casualty communication in the handheld.
- Handhelds are IP68 waterproof down to a depth of 3 meters.
- Active noise reduction on microphone inputs giving excellent audio quality and VOX performance in high/extreme noise environments.
- Adaptive NIVOX (Axnes patented VOX), monitoring ambient noise environment and minimising the effect of false triggers, and consequently noise flooding of intercom.
- GPS homing of handheld radios in the aircraft, on control panel and possible integration with map systems.
- AIS-SART compatible device location beacon in handheld.
- Support for mute and broadcast from aircraft side.
- Intercom operation in UHF band 397-470MHz.
- Handheld support for maritime VHF band for ship communication.
- Flexible intercom interface, supporting high and low impedance systems.
- All components available in NVG friendly versions.

Note: There are handhelds with different combinations of the following features: Waterproofing, GPS, AIS, VHF, Bluetooth and internal speaker.

1.1 Document References

Ref #	Doc. Title	Doc number
[1]	PNG Installation and Interface Control Document	AX-PNG-TER-0044
[2]	System Specification for PNG BST50, CP50 and MP50 series	AX-PNG-SPC-0019

1.2 System

The PNG system enables wireless communication inside and outside the aircraft. The system is very capable due to its robustness, range and noise reduction capabilities, as well as interception free communication between the entire crew.

The PNG system consists of one base station and one or more handheld rechargeable radios, chargers for the handhelds, as well as an optional control panel connected to the base station. The PNG Base Station and Control Panel are installed in the aircraft and supplied with power from the aircraft system.

The PNG handhelds implement functionality to suppress surrounding noise, and to secure optimal voice activation performance. They implement functionality to connect to the PNG Base Station in the helicopter (intercom mode), as well as functionality to communicate directly with other PNG handhelds, or handheld to other radios (direct mode).

The handheld radios are designed to be mechanically robust and the MP50 handheld radio is waterproof down to a depth of 3 meters to withstand extreme operating scenarios typically experienced in a SAR and multirole-configured aircraft.

Through the handheld internal microphone, the system enables communication with the survivor/ground rescue party without helmet removal.

Depending on the configuration and part number, the handhelds are equipped with a GPS receiver. The position of the handheld device may be polled by the PNG Base Station, and presented on the PNG Control Panel in the aircraft.

The PNG Base Station is typically connected to the aircraft ICS, and may support multiple connection points for audio. It is capable of delivering a PTT signal to other systems, as well as triggering transmission based on a received PTT signal or VOX activation.

1.3 Radio

The PNG system operates a wireless link between the PNG Base Station and the handheld radios in the UHF band. Exact frequency configuration is done at production, based on customer input to available frequencies and bandwidth in the region they are to be operated in. The PNG system will normally be configured within a 10 MHz band in the frequency range 397 to 470 MHz. The PNG Base Station will support the full 397 to 470 MHz range (depending on the antenna installation in the aircraft), while the handhelds support 10 MHz bands through the 397 to 470 MHz band, depending on the installed antenna. Antennas are available through the band.

The wireless link is a single frequency, duplex, interception free, digital radio link.

The handheld radios will operate at an output power of up to 400mW using a licence specific frequency allocation.

The PNG system will not set any limit to the number of simultaneous receivers, but the number of simultaneous transmitters is limited by the available bandwidth and allocated timeslots. The PNG system allows three simultaneous transmitting handhelds.

The handheld radios support Maritime VHF mode, and channels can be configured in the 156-162MHz band.

1.4 Identification of article

PNG Base Stations in **the BST50** series with part numbers in the **AXS-BS-XXXX*** series

PNG Control Panels in **the CP50** series with part numbers in the **AXS-CP-XXXX*** series

*Note: XXXX indicates any number of characters at the end of the part number string.

Section 2: Operation

The PNG system consists of one PNG Base Station and one or more handheld radios. To make all units in the PNG system interoperable, each unit must be configured with compatible parameters. Configuration of the PNG system will imply setting of radio frequencies, defining groups and setting scrambling or encryption parameters.

Multiple configurations may be stored on a device to support different operational modes.

The PNG system can be preconfigured from the vendor, or the configuration may be set by the operator's avionics department.

Ahead of flight all units in the PNG system will be set to compatible configuration. Different types of operation may use different configurations, due to radio frequencies, group definitions or other parameters. During operation and in flight the configuration on the PNG Base Station is normally not changed, but may be required in some special conditions. Such conditions may be caused by radio interference, where alternative frequencies may be required, and an alternative configuration is selected.

The operational scenario may also require different handheld configurations to be loaded in different phases of the operation, e.g. to change group subscriptions during the mission. Switching between the handheld configurations is done by the handheld operator by a simple button push.

The installation of the PNG system in an aircraft is dependent on the aircraft type and use scenarios. The PNG Base Station may be installed in a static configuration with circuit breaker and a switch for power, and optionally switches for mute and broadcast. The system is in this configuration locked into one configuration for the Base Station.

Alternatively, and recommended, a PNG Control Panel may be installed. The PNG Control Panel supports rotary buttons and discreet buttons, for controlling active configuration, mute and broadcast, as well as power on/off. There is also a display that gives status information.

Actual placement and operation of switches or PNG Control Panel is dependent on the aircraft type and installation.

2.1 Groups

The PNG Base Station supports organising the communication on the wireless link into groups. Groups are a set of audio channels on the wireless link, and a set of physical audio interfaces on the base station. The PNG system will support 2 groups depending on the available radio resources (channel bandwidth).

The PNG Base Station will by default have audio to and from the first group on physical audio interface 0 and the second group on physical interface 1.

The handhelds are configured to listen (receive) to one or more groups (allowing simultaneous listening to multiple groups). Transmit is configured to one primary group

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through PTT/VOX, but it is possible to configure transmit to a secondary group through configuration and use of the secondary PTT on the handheld.

When the PNG system is set up, one or more configurations are defined, see section 2.2 Configurations.

2.2 Configurations

Both the handhelds and the PNG Base Station use configurations to control the behaviour of the devices. They can hold a number of configurations, with different operational parameters. A configuration contains a minimum of the following parameters:

- Logical name of the configuration
- Radio parameters (frequency, modulation, and channel bandwidth)
- Group subscriptions for receive
- Group subscriptions for transmit
- Configuration of remote PTT control (handheld activation of PTT from the PNG Base Station to the intercom)

The different pre-programmed configurations can be selected at start or during mission from the PNG Control Panel. Typically, there will be several configurations when different radio channels shall be made available. There can also be different configurations for different mission types as e.g. SAR and EMS missions.

The different configurations are selected on the PNG Control Panel with a rotary push button, and identified by the logical name. When selected, all relevant parameters are loaded.

On the handheld, the configuration is selected with the up/down arrows, and identified with a short two letter name and a long logical name (scrolling display).

Pre-programmed configurations can either be pre-ordered from the equipment vendor, or changed by a qualified equipment operator with a PC based programming tool.

2.2.1 Encryption

With the PNG system all user data are encrypted according to the AES-256 encryption standard before they are transmitted over the air. When delivered from factory, the PNG Base Station uses a default encryption key called "AXNES DEFAULT". Changing this encryption key requires the user to acquire an encryption key programming kit. Note that the PNG Base Station and all handhelds in a system must use the same encryption key in order to connect and communicate with each other.

2.3 General UI

Rotary/push configuration selector

Rotary/push menu navigator

SR Search Rescue

SYS: OK   TX:----

Push button system on/off

Push button mute on/off

Push button broadcast on/off

Push button menu activation/back

Service connector
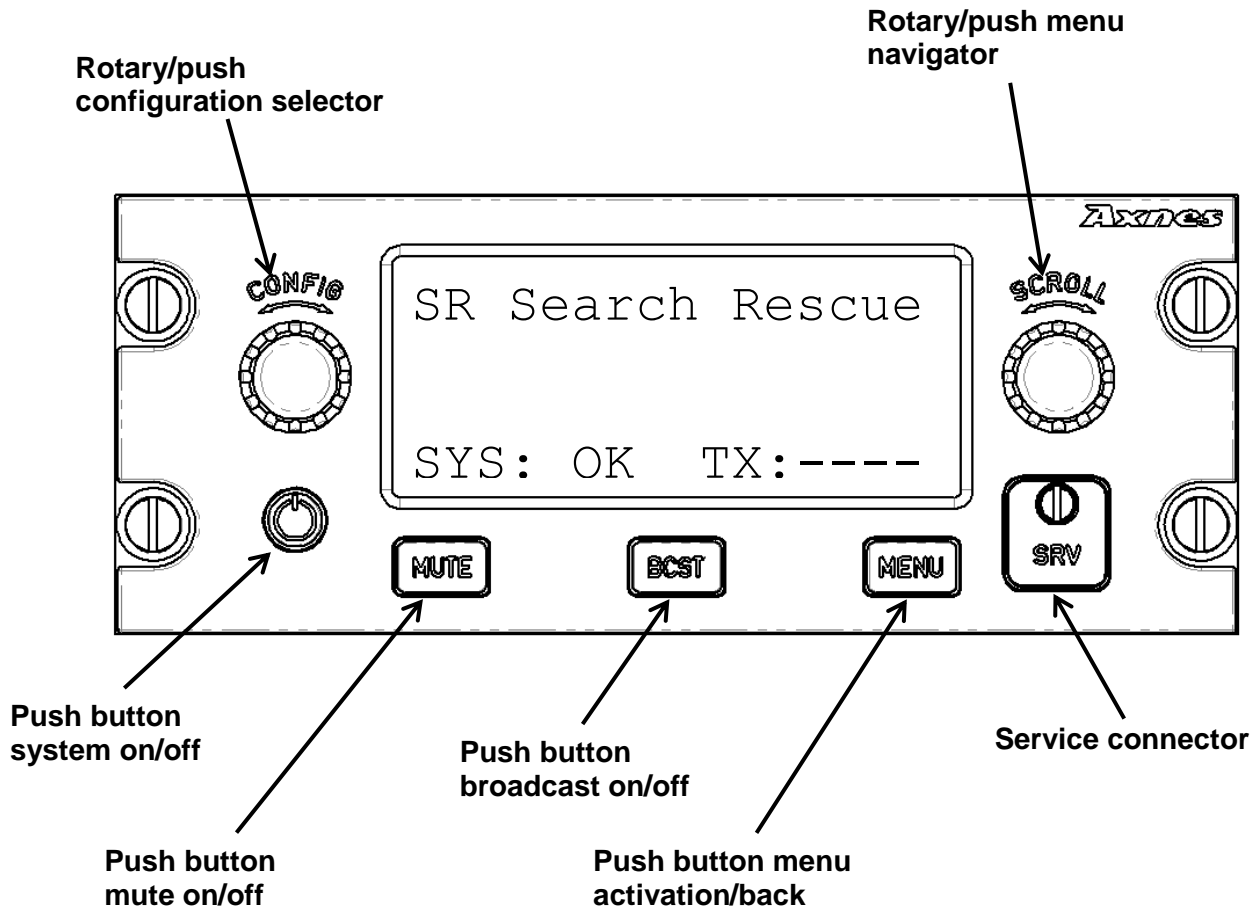
The PNG Base Station itself has no visible UI. All control and status of the behaviour is reflected in the PNG Control Panel.

The UI consist of a 3 lines by 16 characters LED matrix display, two rotary push buttons, a power on/off button, two buttons for activating / deactivating mute and broadcast, and one button for activating menu mode.

2.4 Power on/off

The PNG Base Station and Control Panel will by default automatically turn on when power is applied. The system will conduct an initial in-built test, check communication link with base station and report status on the control panel, refer to section 2.11 Error conditions.

After power-up, the system loads the last used configuration and is ready for use.

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The system can be turned off by a push and hold of the power on/off button for 3 seconds. The system can be re-activated through a short push on the on/off button. At re-activation, the last used configuration is loaded.

2.5 System standby and base station transmit
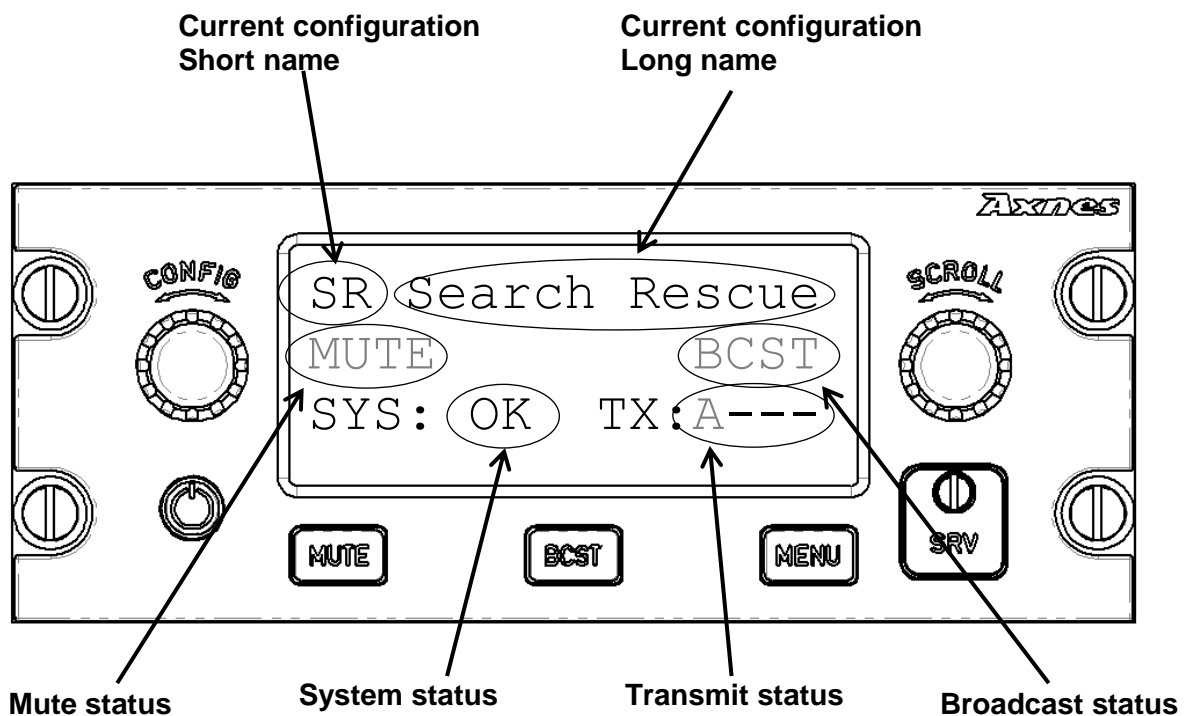
When the PNG system is powered up and in standby mode, or the PNG Base Station is transmitting, the PNG Control Panel will show the following information:

- **Current configuration** – The short and long configuration name of the selected configuration is shown on the first line of the control panel.
- **Broadcast and mute status** – Broadcast and mute status is shown with the text MUTE and BCST on the second line of the control panel. MUTE is shown if mute is activated and otherwise empty. BCST is shown if broadcast is activated and otherwise empty.

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- **System status** – The system status is shown on the third line. The system is continuously monitored, and as long as no error conditions are detected, SYS: OK is indicated. If errors are detected, an error code will be shown in this field, see section 2.11 Error conditions.
- **Transmit status** – The transmit status is indicated as TX:----, where the dash positions indicate activity on group A or B. A dash indicates transmit inactive, and a letter indicates active transmission to a group. When the PNG Base Station transmits to a group, the respective group is shown in the TX status, e.g. TX: -B--. Note that some configurations of the system will only support one group (A).

2.6 Broadcast

The BCST button can be pushed to activate broadcast mode. When pushed, broadcast is indicated in the standby display on the second line with the letters BCST.

When broadcast mode is activated, the audio connected to the physical audio interface 0 of the PNG Base Station is sent to all groups.

Broadcast mode will override MUTE. When the BCST button is pushed again, the broadcast mode is deactivated and the BCST indication on the PNG Control Panel is removed.

2.7 Mute

The MUTE button can be pushed to activate mute mode. When pushed, mute is indicated in the standby display on the second line with the letters MUTE.

MUTE mode will mute all audio to and from the wired intercom. The wireless users can still communicate handheld to handheld. Broadcast will override MUTE in downlink direction (see section 2.6 Broadcast).

When the MUTE button is pushed again, the mute mode is deactivated and the MUTE indication on the PNG Control Panel is removed.

2.8 Receive mode
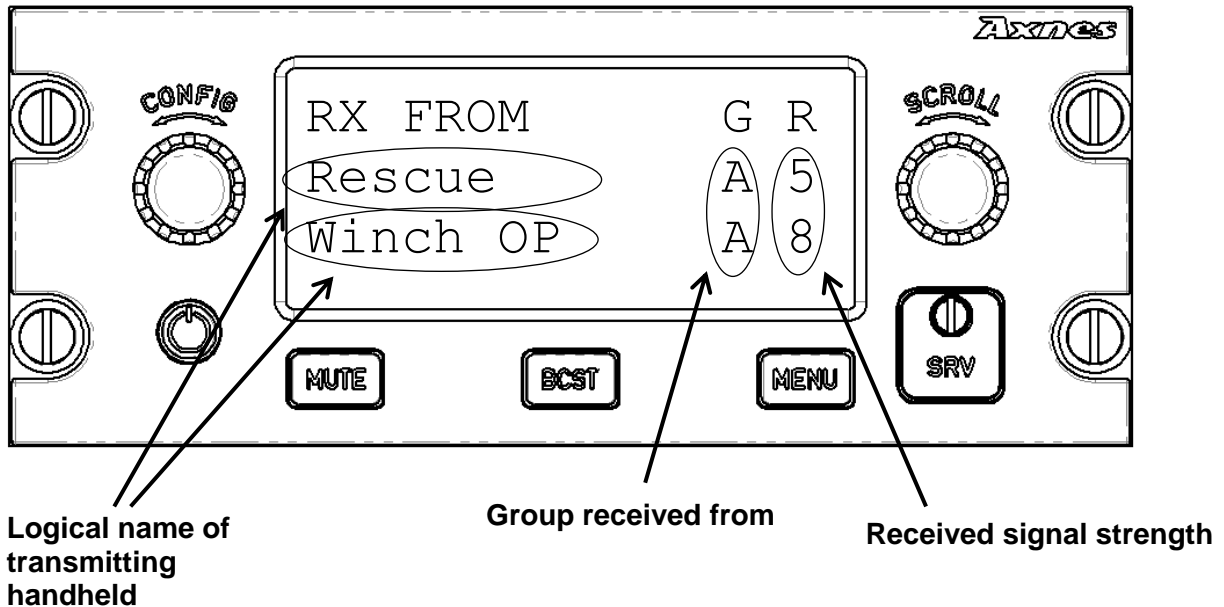

Logical name of transmitting handheld

Group received from

Received signal strength

When the PNG Base Station receives audio from one or more handhelds, the PNG Control Panel will show the following information:

- **Transmitting handheld** – The logical name of the transmitting handheld is shown in line two (and in line three if more than one is transmitting).
- **Group received from** – On the same line as the name of the transmitting handheld, the group which is received from is shown as a letter A or B.
- **Received signal strength** – On the same line as the name of the transmitting handheld, the received signal strength is shown. Signal strength is a number between 0 and 9 and indicates strength and quality of the signal. 9 indicates a strong signal or good quality, and a lower number indicates a degraded signal.

If more than two handhelds are transmitting at the same time, the two that started transmitting last will have priority in the display.

2.9 Configuration change

Rotary push button for configuration navigation

Logical name of configurations

Configuration activated if config rotary button pushed
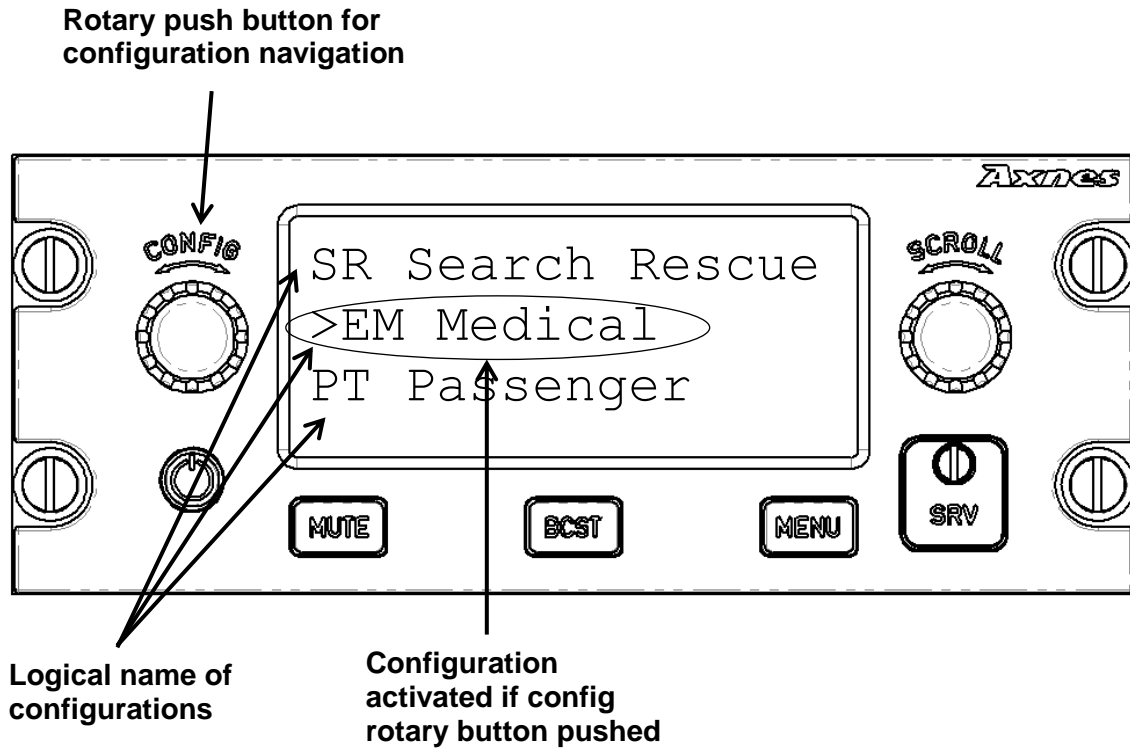
To change configuration, the config rotary push button is used. Rotating the button will list all programmed configurations by its logical name. Pushing the rotary button will select the configuration indicated with the ">".

After 5 seconds of inactivity the display will return to standby display mode.

2.10 Menu

Rotary push button for menu navigation, push for select

Activate menu mode and navigate up
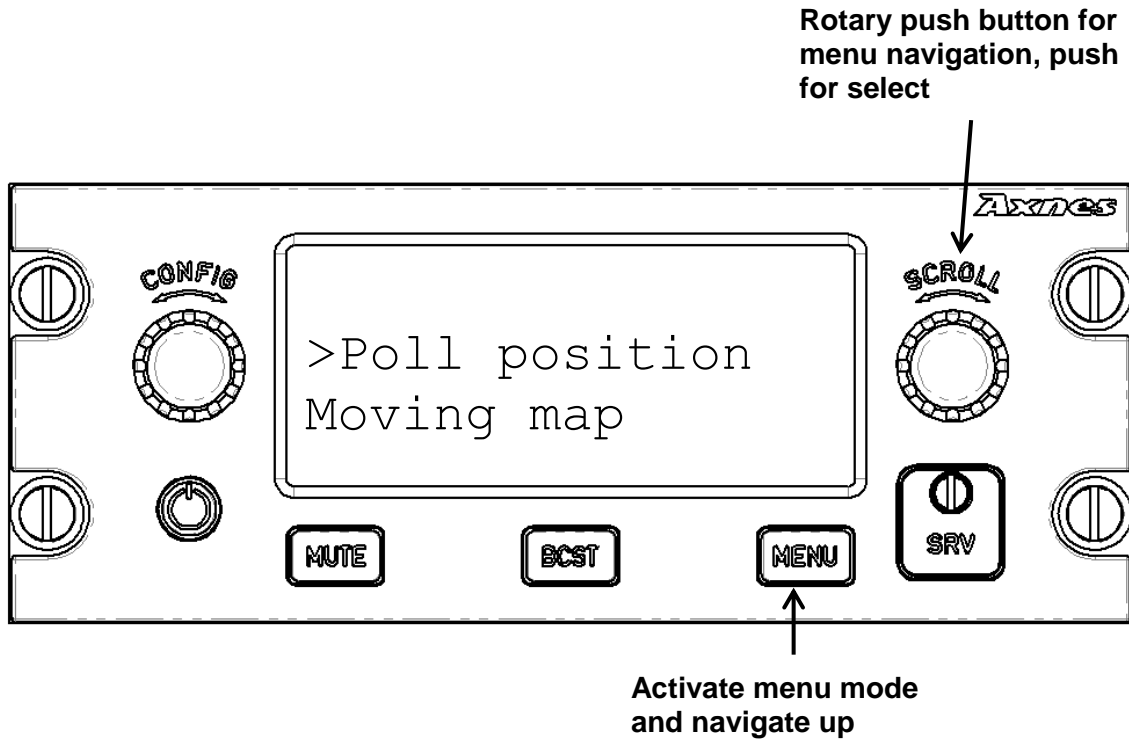
The menu navigation of the CP50 is a four-way navigation consisting of the "MENU" button, left and right scroll with the "Scroll" rotary push button and push on the "Scroll" rotary push button.

The "MENU" button activates the menu mode. When inside menu mode, it is used to navigate upwards in the menu hierarchy (multiple pushes to "MENU" will return to standby mode). The left and right scroll with the "Scroll" rotary push button will navigate up and down in a menu list. Pushing the "Scroll" rotary push button will select the indicated menu entry.

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The first push on the menu button will activate top level menu. The menu hierarchy is illustrated below:

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SW Hash:
…

Boot SW:
AX-SW-…
Rel: …

Serial Num:
…

Capabilities:
…

Config CRC:
…

Dimming table
CRC:
…

Crypto Key name:
…
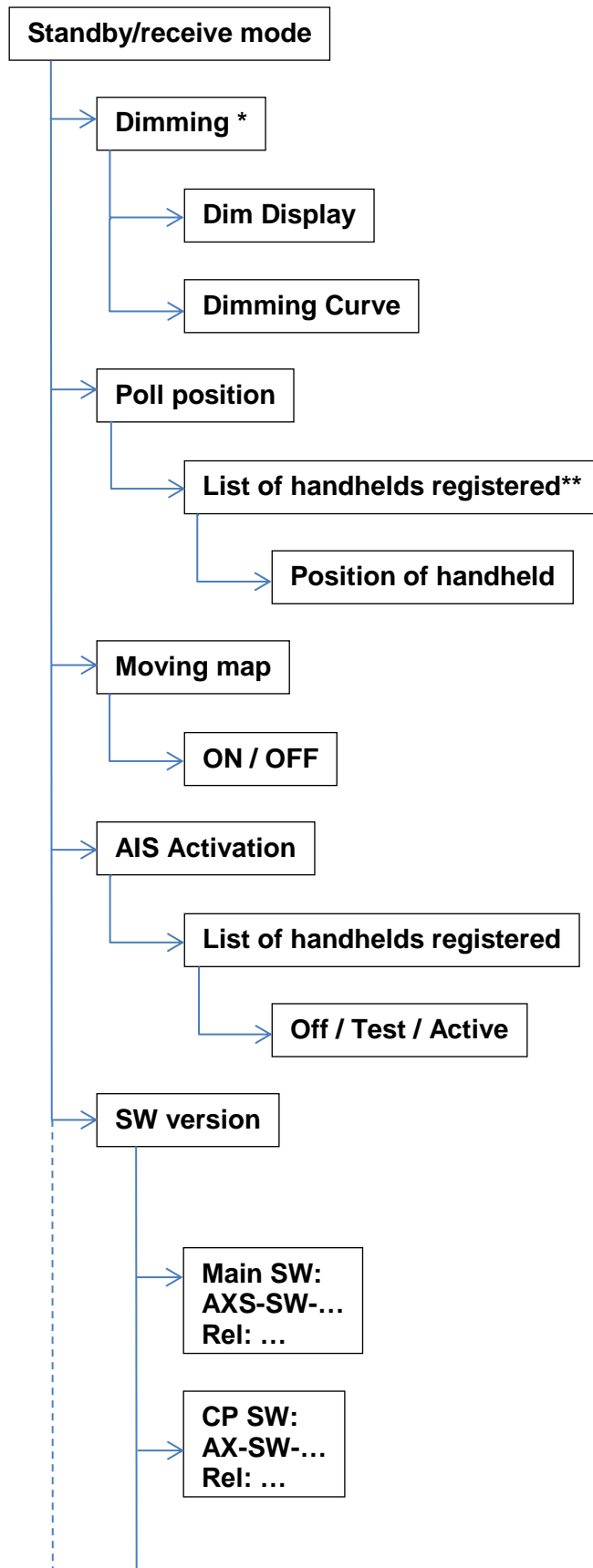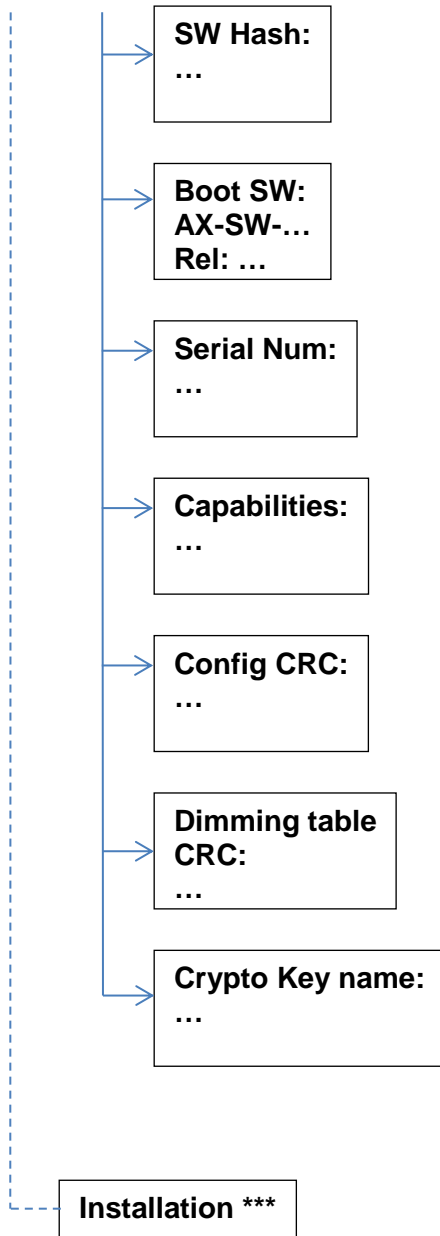
Installation ***

* Note: Refer to 2.10.1 Dimming

** Note: Handhelds that fail to respond to Base station queries for 200 seconds, will be removed from the list of handhelds.

*** Note: The Installation Menu may be available on the CP50 Control Panel depending on the configuration of the BST50. See ref. [1] for further information.

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2.10.1 Dimming

If the CP50 is connected to the cockpit or cabin analogue dimming signal, the CP50 illumination will follow the main dimming level in the cockpit or cabin. The illumination of the PNG Control Panel display and buttons follows the voltage on the dimming pins according to the dimming curve chosen in the Dimming Curve menu. There are three predefined dimming curves (Day Mode, Night Mode and NVG Mode), but new ones can be created by the operator's avionics department.

Note: With the default dimming curves and no voltage on the dimming pins, the display will go completely black when the Night Mode or the NVG Mode dimming curves are selected. The Day Mode has illumination even if the dimming pins have no voltage and is the default dimming curve chosen after a power off/on, so turning the control panel off and on again can be used to get illumination back in the display if the display goes black by accidently choosing a dimming curve with unintended low illumination.

In addition to dimming control on the analogue dimming input according to the chosen dimming curve, the illumination can be manually adjusted up and down in the Dim Display menu. The new brightness level is used until the next power off. When turning the PNG Control Panel off and then on again, the dimming value is reset to a pre-defined value set in the installation menu.

2.10.2 Poll position

Position age counter
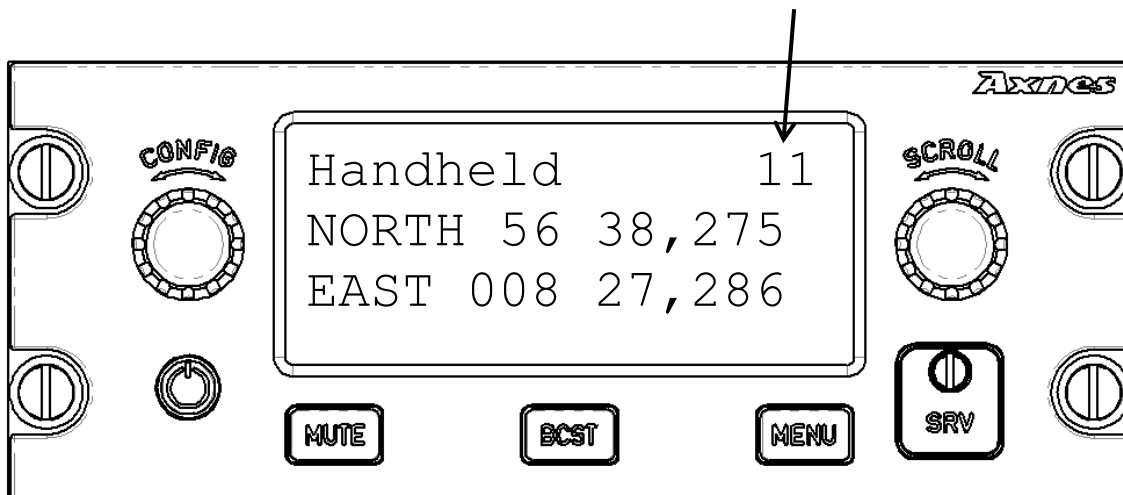
Some of the handhelds provided with the PNG system may incorporate a GPS receiver. Units with the GPS receiver enabled will register to the PNG Base Station and appear listed by their configured logical name, under the poll position menu.

The available handhelds can be polled for their position by selecting the handheld name.

The position will appear in the display, initially with dashes, indicating that the position is not available, while waiting for the GPS lock. As soon as GPS lock is established, the long/lat position of the handheld will be displayed. The position is updated at a configurable interval, with a default value of 10 seconds. The position age counter in the top right corner indicates the age of the shown position. If the handheld loses GPS lock or loses contact with the PNG Base Station, the last known position will remain in the display while the age counter continues to count.

2.10.3 Map system

The position of the handhelds can be reported to a map system connected to the PNG Base Station. The position reporting is turned on and off through the menu on the PNG Control Panel.

The position is polled at a configurable interval, and reported to the map system at the same rate. The actual poll rate is dependent on the number of handhelds with active GPS. It is possible to disable GPS reporting from the individual handhelds by using the menu in the handheld.

2.10.4 AIS Activation

For handhelds equipped with AIS functionality, the position of the handheld can be sent with a message format compatible with standard AIS position reports, using the AIS-SART format. This functionality can be activated either from the handheld with the AIS-button, or it can be activated remotely from the AIS-menu on the PNG Control Panel.

From the menu on the PNG Control Panel the state of the AIS position reporting for each handheld can remotely be set to either Off, Test or Active.

- The Off-option will deactivate sending of AIS position reports from the chosen handheld.
- The Test-option will activate sending of one burst of AIS test messages from the chosen handheld and then deactivates.
- The Activate-option will activate sending of standard AIS-SART position reports from the chosen handheld.

Note: Activation of either of these options will override the current state for the chosen handheld. If the handheld was currently active sending AIS position reports, choosing the Off-option from the PNG Control Panel menu will deactivate sending of AIS position reports.

When remotely changing the handheld AIS state, this will give an audio feedback to the handheld user, either via the headset or the internal loudspeaker.

Note: The PNG handhelds are NOT AIS-SART transponder, but implements functionality to send AIS-SART compatible messages to improve ongoing operations.

2.10.5 Software versions

The following information can be displayed:

- Main SW version
- CP SW version
- Boot SW version
- Programmed serial number (Shall match S/N on the Label)
- Capabilities programmed
- Configured CRC stored on the device (can be used to identify the configuration)
- Dimming Table CRC
- Crypto Key Name

2.10.6 Installation

The Installation menu may be available, depending on the configuration of the PNG Base Station. See ref. [1] for further information.

2.11 Error conditions

The PNG system status is continuously monitored and indicated in the standby/TX display. When the system operates with no error detected, the system status is indicated as SYS: OK. If an abnormal condition is detected, the system status is reported as SYS: ERR, or SYS: E [error code], where [error code] is a vendor specific number.

If the PNG Base Station is not operating normally, check the PNG Control Panel for error indications. Check also connectors for proper attachment, and external antenna connection with cabling.

A malfunction might be corrected by rebooting the system by switching the system off and then on again.

If the system becomes unresponsive, a hardware reset can be initiated by holding the power on/off button for 12 sec.

If error condition is persistent, the unit should be sent for service at an Axnes authorised repair centre.

Authorised repair centres are published at www.axnes.com

Section 3: Technical data

3.1 Technical data for BST50

3.1.1 Operation

Radio:	Duplex, single frequency
Frequency:	397-470 MHz, customer specified channels, see Note 1
VOX operation:	Axnes Aviation patented NIVOX, ensures no loss and operation in high noise environment
Number of wireless users:	Unlimited
Number of groups:	2
Number of radio configurations:	Up to 20
Encryption:	Scrambling and AES-256
Operating temperature:	-45°C to +70°C
Storage temperature:	-55°C to +85°C
Moving map interface:	RS232

Note 1: The following birdie frequencies should be avoided if possible because of reduced receiver sensitivity: 156, 408, 420, 432, 444, 450, 456, 468 MHz.
US market is limited to 405-470MHz.

3.1.2 Power supply

Supply voltage:	10 – 33 VDC
Current consumption (typ):	Operation 285mA (@ 400mW TX and 28V, including control panel)
Protection:	3A internal fuse Reverse voltage protection

3.1.3 Audio interface 0-3

Line output level:	0.8-850mV rms, 150Ω load impedance, 1KHz test signal 0.46-37.5mV rms, 5Ω load impedance, 1KHz test signal
Line input impedance:	10K Ω at 1 kHz
Line input level:	70-5000 mV rms
PTT out:	Supported on audio interface 0 and 1. Open collector output, active low
PTT in:	Supported on audio interface 0 and 1. Active ground, internal pullup.
Broadcast and mute activation:	Active ground, internal pullup.

3.1.4 Connectors

Power and Digital ICS i/f P1:	Amphenol 451 02 Y 20 41 P 50
Analog ICS i/f P2:	Amphenol 451 02 Y 20 41 P W 50

Primary Antenna A2:   TNC female
Secondary Antenna A1:   TNC female

3.1.5   Radio characteristics

Frequency: 397-470 MHz (customer configurations) Note 1.
Channel separation: 25 KHz
Modulation: 16QAM
Frequency stability: <5 ppm
Receiver sensitivity <97dBm at BER 10^{-2}
Output power: 30-400 mW (nom 400 mW) @ A2, A1 17 dB below
Antenna impedance: 50 Ω

Note 1: The following birdie frequencies should be avoided if possible because of reduced receiver sensitivity:
156, 408, 420, 432, 444, 450, 456, 468 MHz.
US market is limited to 405-470MHz.

3.1.6   **Dimensions BST50**

Physical dimensions: W=193 mm, H = 53 mm, D = 150 mm
Weight: 1270 g
Mounting: Wall-mounting with M5 bolts

3.1.7   **Material**

Material: Nickel plated aluminium chassis

3.2 Technical data CP50
3.2.1   **Operation**

Operating temperature: -45°C to +70°C
Storage temperature: -55°C to +85°C
Dimming control: 0-14V or 0-28V

3.2.2   **Power supply**

Supply voltage: Supply from BST50

3.2.3   Connectors

To BST50:   Amphenol PT02Y12-8P

3.2.4   Dimensions CP50

Physical dimensions: W=146 mm, H = 57.2 mm, D = 39 mm behind mounting
                                        rail, D=25.4 in front of mounting rail
Weight: 330 g
Mounting: DZUS

3.2.5   Material

Material: Nickel plated aluminium chassis
                                        PC300

Note 1: The following birdie frequencies should be avoided if possible because of reduced receiver sensitivity:
408, 420, 432, 444, 450, 456, 468 MHz.

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Section 4:   Qualifications

The PNG system is qualified to the relevant sections of:

- RTCA DO-160G Environmental conditions and test procedures for airborne equipment.
- Specification EN 302 561 V1.2.1 (2009-12) Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Radio equipment using constant or non-constant envelope modulation operating in a channel bandwidth of 25 kHz, 50 kHz, 100 kHz or 150 kHz; Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive
- RTCA DO-178C / EASA ED-12C Software Considerations in Airborne Systems and Equipment Certification

- FCC 47 CFR Part 15B 15.109 Radiated emissions

- FCC 47 CFR Part 90 and Part 2, UHF transceiver: 90.205/2.1046, 90.209/2.1049, 90.213/2.1055, 90.207/2.1047, 90.210/2.1051, 90.210/2.1053, 90.221, 90.214

Detailed qualifications are published in the System Specification (ref. [2])

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Section 5: Recommended maintenance

The BST50 Base Station and CP50 Control Panel is operated on condition, and no service intervals are recommended.

Latest service information and approved service centres will be available at Axnes resource website:

http://www.axnes.com/

or contact Axnes AS at:

Phone: +47 37 04 08 00

E-mail: post@axnes.com

It is recommended to keep the unit clean with a moist cloth, and remove any salt deposits. Protective oil can be used on DZUS fasteners if needed. Clean electrical contacts when disconnected if needed.

Any repairs are to be undertaken by Axnes AS or approved partners only.

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Section 6: Abbreviations

AES	Advanced Encryption Standard
AIS SART	Automatic Identification System Search And Rescue Transmitter
BS	BaseStation
CP	Control Panel
CRC	Cyclic Redundancy Check. Used for validation of datasets.
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HH	HandHeld
HS	HeadSet
HW	Hardware
ICS	InterCom System
MMI	Man Machine Interface
NIVOX	None Interrupted Voice activated transmission
NVG	Night Vision Goggles
PNG	Not an acronym, PNG is the name of the new system
PTT	Push To Talk
SW	Software
UART	Universal Asynchronous Receiver Transmitter
UHF	Ultra High Frequency
UI	User Interface
USB	Universal Serial Bus
VHF	Very High Frequency
VOX	Voice Activated Transmission