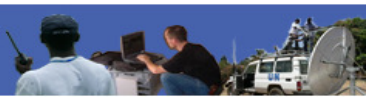
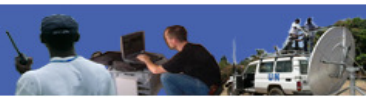


VHF and HF
Base Station Installation



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Introduction

The establishment of a radio room is required as an integral component of the Emergency Communication System (ECS) part of the United Nations' MOSS (Minimum Operation Security Standard).
The minimum configuration of communication equipment in a radio room is based of the MOSS requirements in accordance to the security phase.

A UN radio room is normally to be equipped with a HF base station, a VHF (or UHF) base station and a satellite telephone. Other communication tools like landlines telephones, fax machine and e-mail could be added where applicable.

This document is a guide for the installation of communication equipment for a radio room.

Example of a radio room setup

Communication equipment

VHF/UHF base station

VHF (Very High Frequency) or UHF (Ultra High Frequency) is primarily used for local communication. The standard VHF equipment to be used is Motorola GM360 series radios for base and mobile installations with DTMF (Dual Tone Multi-Frequency) microphone. A DTMF microphone is needed when select V system* is implemented.
The quantity of base radios to be installed is pending on the amount of channels to be monitored. Each radio is monitoring a separate channel.

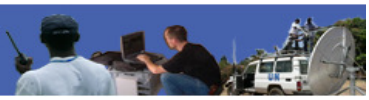
Multiple VHF base stations in a typical Inter Agency radio room monitoring a number of channels

*Select V is a selective tone-calling and identification system. All VHF radios must be programmed individually with a unique tone-code to be able to use this system.

HF base station

HF (High Frequency) is used for long distance communication where the stations are out of VHF coverage. The standard HF equipment to be used is Codan NGT SRx. A broadband antenna is included in the configuration.

Codan NGT SRx HF base radio with power supply



Radio room assessment

Before the actual installation of equipment inside or outside buildings, an assessment needs to be performed. During the assessment the following should be kept in mind:

- Antennas and masts should be erected as far away as possible from high voltage lines, tall buildings and trees or other metallic structures.
- The radio room should be located as close as possible to the antennas to minimize coaxial cable lengths, thus cable loss.
- The radio room should be secure from access by unauthorized personnel.
- The radios should be located where there will be minimal cable exposure to avoid clutter and accidental tripping.
- The radio room should be located near a grounding point, preferably next to the room.
- The radio room should be big enough for installing a sturdy table with ample space for all table top equipment and surrounding working space.
- A wall mounted overhead bookshelf is recommended for the installation of the VHF base radios. This is to avoid occupation of the work desk and for easy access of the radio operator.
- A secure area with full sunlight during the day should be sought. The location for the solar panels should be accessible for maintenance and should be as close as possible to the radio room due to a maximum cable length.
- The radio room should have enough power outlets and LAN installed.
- Where needed, a location for the installation of an air-conditioner should be sought.

Required installation tools

Tools

The following tools are needed for installation:

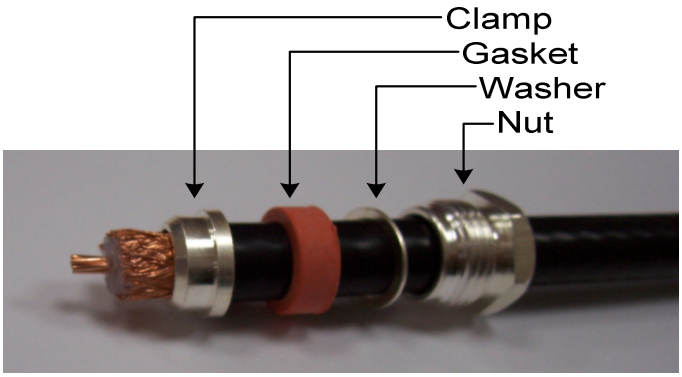
- Hammer Drill
- Masonry drill bits
- Metal drill bits
- Flat screw (-) driver
- Phillips (+) screw driver
- Side cutter
- Knife or blade cutter
- Adjustable wrenches
- Hammer
- Leveler
- Soldering iron
- Small flat file
- Multi meter

Connector assembly

It is essential connectors are properly fixed on coax cables. Equipment might get damaged or coverage levels might be less then expected if the connectors are not done as to standard. After fixing the connectors to the cable should be measured to check for any short circuits by means of a multi meter.

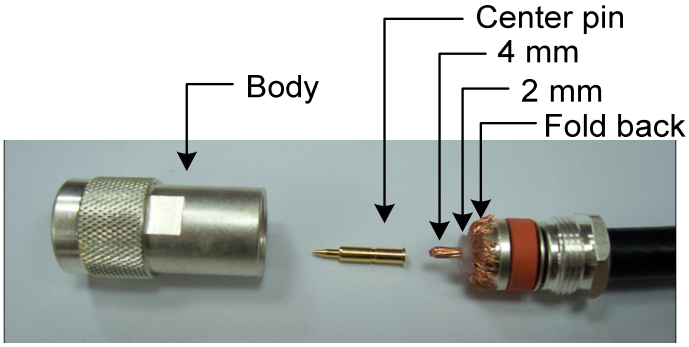
N-type connector assembly

- Place nut, washer and rubber gasket on the cable respectively.
- Cut and remove about 7 mm of outer jacket. Make sure you do not cut the copper braid.
- Fold out braided copper shielding. Cut and remove dielectric insulator to expose 4mm of inner conductor.
- Pull braid forward and taper towards center conductor. Slip in ring clamp over the braid and push back towards jacket.



RG-213 and N-type connector, back part assembly

- Fold back braid over ring clamp and trim excess braid to proper length (just enough to cover clamp below ring lip).

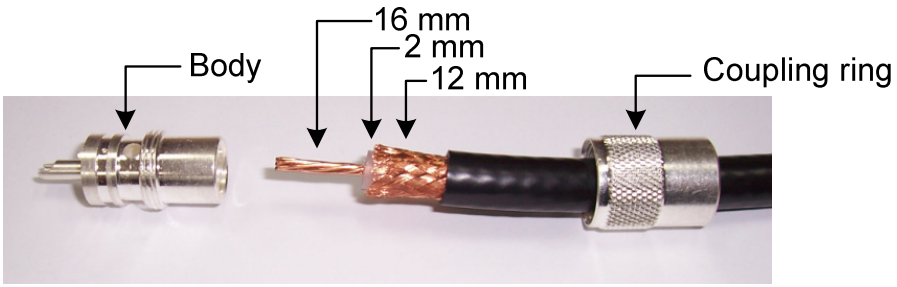


RG-213 and N-type connector, total assembly

- Tin centre conductor, insert into centre pin and solder. Remove excess solder lead.
- Insert cable and parts into connector body making sure pin is aligned centre and properly seated.
- Tighten nut and body by using 2 adjustable wrenches.
- Measure the completed coax cable with a multi meter to ensure there is no short circuit between the centre conductor and the braid.

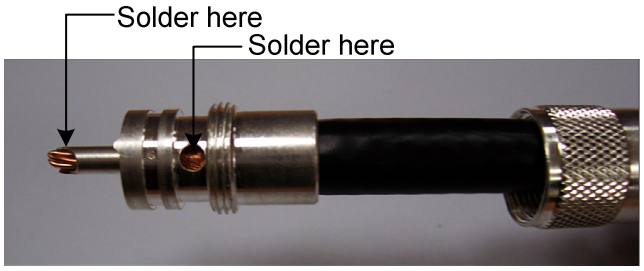
PL259 connector assembly

- Unscrew coupling ring from plug body and place on cable. Cut end of cable to make it even.
- Cut and remove about 30 mm of outer jacket making sure not to cut the copper braid.
- Cut exposed copper braid down to 12 mm. Cut and remove dielectric insulator to expose 16 mm of inner conductor. Tin centre conductor with solder.



RG-213 and PL259 connector, total assembly

- Screw the plug body into cable until braid is past the soldering ports. Solder body to braid through the soldering ports with a large soldering iron. Be careful not to smear solder on the screw thread.
- Measure the completed coax cable with a multi meter to ensure there is no short circuit between the centre conductor and the braid.
- Solder centre conductor to centre contact. Do not use excessive heat.



RG-213 and PL259 connector, soldering

- Pull coupling ring towards plug body and screw in for final assembly.

HF base installation

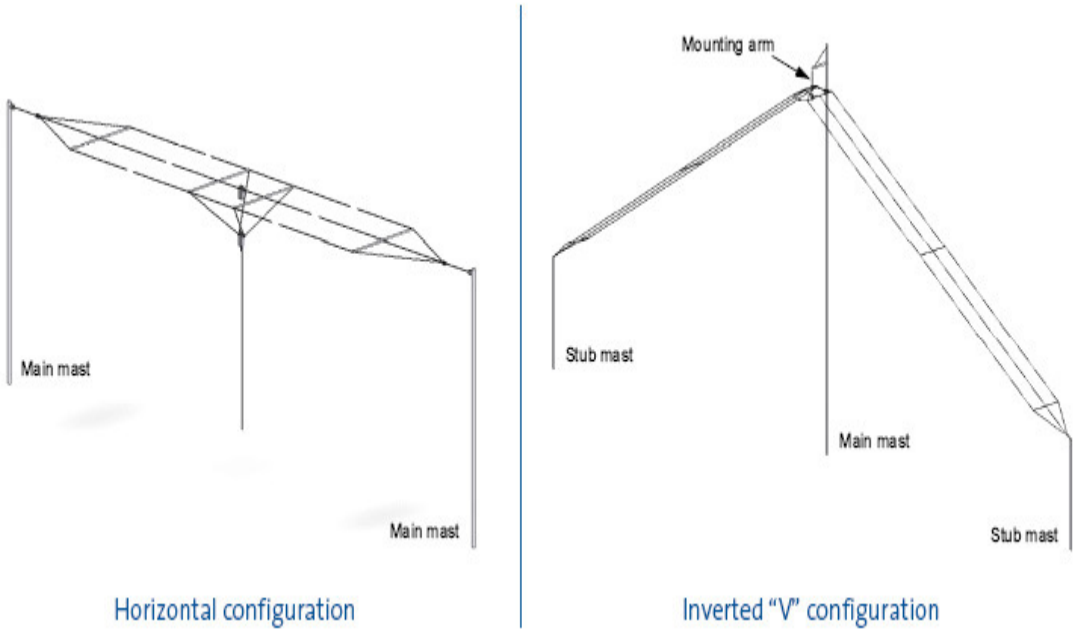
Equipment and materials

The following equipment and materials are needed to install a HF base set-up:

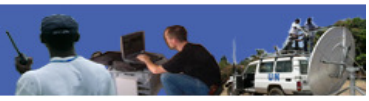
- HF base Transceiver, Codan NGT SRx
- Switched power supply, Codan TS3020
- HF Multi wire Broadband antenna, Codan C463
- RG213 coaxial cable
- PL259 connectors
- Lightning arrestor, Polyphaser IS-B50LU
- Amalgamating tape
- Plastic tie wraps
- Ducting
- Screws and wall plugs

Broadband HF antenna configurations

The multi-wire broadband antenna can be installed in a horizontal or inverted "V" configuration. The appropriate configuration for a particular installation can be decided by considering the desired direction of radiation and the available space for the installation.



Codan C463 antenna configurations



As a general rule, the antenna should be installed on a horizontal configuration with the broadside oriented towards the intended transmission direction. In situations where there is not enough space available to install a proper horizontal configuration or the intended contact locations are scattered and not aligned in a particular direction, it is preferable to install the antenna in an Inverted "V" configuration. When installed in the Inverted "V" configuration, the antenna effectively works as omni-directional.

HF antenna installation

- For a horizontal configuration the minimum distance between the masts is 30 meters and recommended minimum height should be 10 meters.
- For an inverted "V" configuration the recommended minimum height for main mast is 10 meters and is 3 meters for stub masts.
- Prepare two (for inverted "V" configuration one rope) UV protected halyard ropes at two times mast height lengths.
- Unroll the broadband antenna on the ground making sure that there are no tangles or sharp bends on the wires.
- Attach the coaxial cable to the balun on the antenna and seal with amalgamating tape. Make sure to install a strain relief support for the cable to prevent damage.
- Pass through the pulleys one end of each rope and attach to each end of the antenna.
- Attach the pulleys to each mast or buildings and raise the masts to the required height incase of a horizontal configuration.
- For an inverted "V" configuration, pass through the pulley one end of the rope and attach to the mid section attachment point of your multi-wire antenna.
- The antenna can now be raised. Make sure the coaxial cable does not get tangled or sharply bent and the ropes are taut enough only to allow for small sag on the antenna wires.
- Run the coaxial cable to the lightning arrestor point identified with "antenna", cut and terminate the cable with a PL-259 connector. Connect the cable to the lightning arrestor, prepare and run a coaxial cable from arrestor to HF Transceiver.

HF transceiver installation

- Place the desktop microphone/speaker console on the work table within easy reach of the radio operator.
- Connect the console to the transceiver using the provided control cable. Each cable is labeled.
- Connect the antenna cable to the transceiver and install the braided ground cable between the back of the consol and the back of the transceiver.

- Mount the HF transceiver in a secure location with good ventilation. It can be mounted on the table top or hidden out of sight as frequent access to the transceiver is not necessary. Connect the dedicated grounding point on the back of the transceiver to a proper grounding point outside the building.
- Connect the power leads to the transceiver. The DC power cord needs to be connected to the power supply and the solar panel.
- Program the radio with the appropriate codeplug and check the SWR of the whole system.
- Make test calls to finalize the installation.

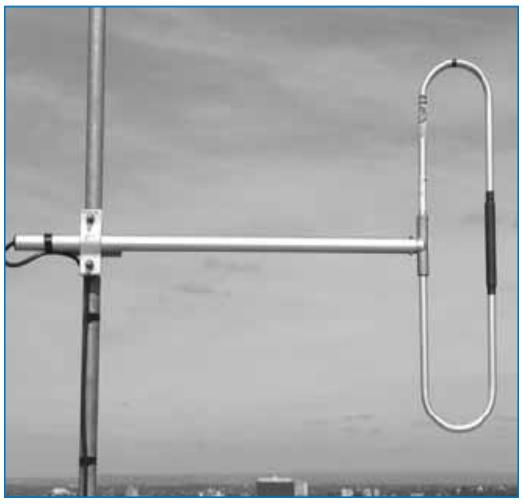
VHF base installation

Equipment and materials

The following equipment and materials are needed to install a VHF base set-up:

- VHF base transceiver, Motorola GM360
- VHF side mounted dipole antenna, SMD2
- Antenna mast
- RG213 50 Ohm coaxial cable
- N-type connectors, Male
- PL259 connectors
- Lightning arrestor, Polyphaser IS-B50LU
- Amalgamating tape
- Plastic tie wraps
- Cable clips
- Ducting
- Screws and wall plugs

Side mounted dipole antenna installation

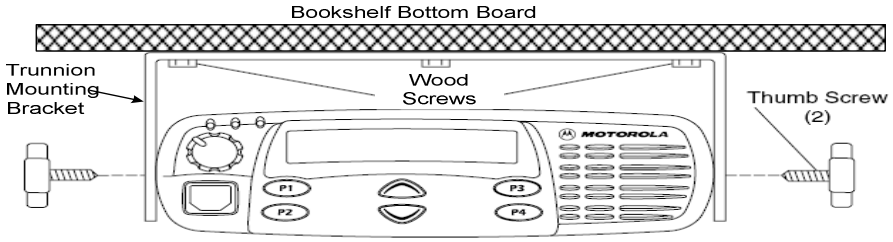


- The VHF antenna should be mounted as high as possible, with a clear view on all directions. The higher the antenna is, the further it can "see", meaning a greater coverage.
- There is a compromise between getting the antenna as high as possible and keeping the coaxial cable run as short as possible. At VHF frequencies, the signal strength losses for RG213 cable are about 50% for every 30 meters of cable length. Choose a suitable location for the antenna or radio room for minimal cable run.

- Mount the cross bracket on the antenna boom about 20 cm from the end. Make sure the bracket is aligned parallel to the dipole before tightening the bolts.
- Mount the antenna to the mast making sure the dipoles' top and bottom end is oriented correctly. Level the antenna and fully tighten the clamp bolts.
- Attach the coaxial cable to the antenna and seal with amalgamating tape. Affix the cable to the mast with tie wrap leaving enough slack to avoid sharp bends on the cable.
- The antenna mast can now be raised making sure to tie wrap the cable to the mast every two meters to distribute the strains on the cable.
- Run RF cable to the lightning arrestor connection point, cut and terminate with appropriate connector (PL259 for Polyphaser). Connect the cable to the lightning arrestor, prepare and run cable from arrestor to base radio.

VHF base transceiver installation

- The preferred and most convenient way to install the base radio is to hang it on an overhead bookshelf at about eye level when sitting down.
- Fix the mounting bracket underneath the overhead bookshelf with appropriate size wood screws.



- Plug the DC power cable to the base radio and connect the RF pigtail.
- Mount the base radio to the bracket using the thumb screws. Adjust the tilt of the radio to a convenient viewing angle and tighten the thumb screws.
- Connect the pigtail to the antenna cable and the power leads to the 12V DC power source. Make sure there is no tension on the pigtail by supporting the coax cable with tie wraps.
- Program the radio with the appropriate codeplug and check the SWR of the whole system.
- Attach the microphone to the radio and make some test calls.

DC power source installation

The UN standard HF and VHF/UHF radio equipment is designed to operate on a 12 Volt DC power source. The DC power source should be able to provide the demanded current from the transceivers. This can be achieved by installing a calculated sized battery charged by either an automatic charger or a solar pack.

Solar Power Pack Installation

Solar panel array

The following equipment and materials are needed to install a solar pack:

- Solar pack Kyocera, containing 2x 115Ah batteries, PVC box with control unit, 4x solar panels with brackets, power cable and meter.
- Plastic tie wraps
- Cable clips
- Ducting
- Screws and wall plugs

The PVC box with the batteries and the control unit should be located as close as possible to the radio equipment and away from temperature extremes. The batteries should have good ventilation.

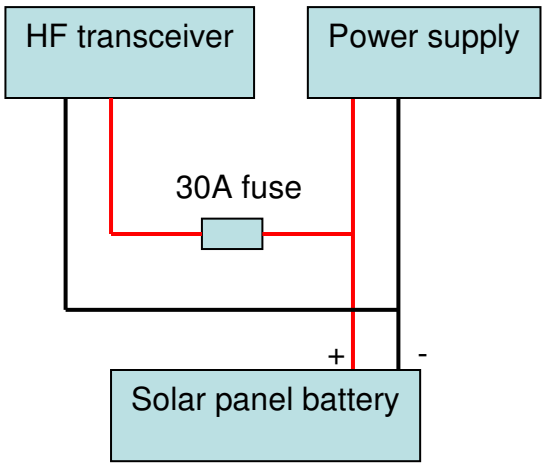
- Both batteries are connected to each other. The positive poles form the positive circuit, while the negative poles form the negative circuit.
- Assemble the battery pack and connect them to the control unit making sure all connections are on correct polarity.
- Connect all DC power cabling from the radio equipment directly to the battery clamps.
- Connect the temperature sensor cable (grey) to a negative pole of the battery.
- Connect the meter to the control unit.
- Assemble your solar array kit according to the manufacturer's instruction manual. Make sure to install it at an angle to receive maximum sunlight all

throughout the day (rule of thumb is the latitude at the location plus 15 degrees). Installing the array in a sloping angle also minimizes the accumulation of dust and debris.

- Connect the solar array to the control unit with the provided cable, switch on the circuit breaker and check the meter readings. Compare and confirm the charging current is within the range of the specifications.

Additional power supply

- If needed, a separate power supply could be used to charge the batteries overnight or in case of a faulty solar pack.



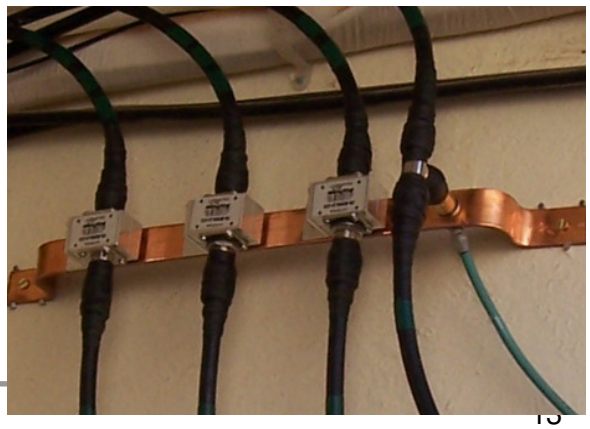
Power source interconnection

Grounding and lightning protection

A proper grounding is required for effective HF communication and lightning protection. It is mandatory for all radio installations utilizing outdoor antennas for personnel and equipment safety. Both of these requirements can be achieved by the proper installation of a lightning arrestor on the coaxial cables prior to entry into the radio room. The lightning arrestors should be installed on the outside of the building.

Lightning arrestor installation

- Locate the building common grounding point closest to the radio room and run a 6 mm2 bare copper grounding cable to where you plan to mount the lightning arrestors.
- Fabricate a ground bus bar using 3 x 30 x 350 mm copper or aluminum strip.

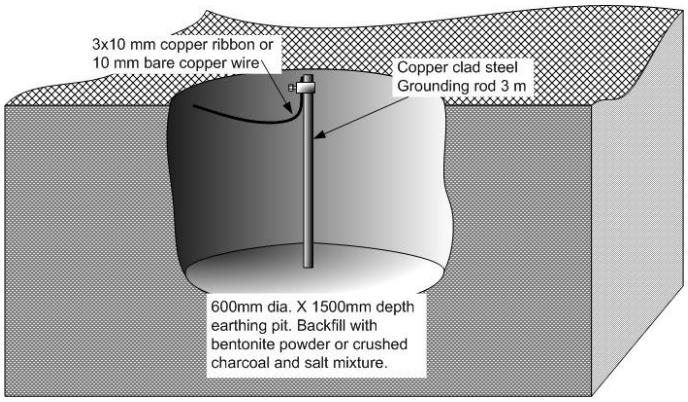


Mount the bus bar on a wall outside the building but nearby the radio room and connect the grounding cable.

- Mount the lightning arrestors on the bus bar, connect the antenna and equipment cables and seal all connectors and lightning arrestors with amalgamating tape.

Earth interface installation

- In case a common grounding point is not available. A proper earth interface (grounding) installation should be made close to the radio room.
- A grounding pit with a minimum diameter of 600mm and depth of 1500mm should be dug in a suitable location with good soil moisture.



- Drive down a 3 meter (copper clad) steel ground rod. Connect the ground bus bar to the grounding rod using 3x10mm copper tape or 10 mm bare copper ground wire with appropriate clamp hardware.
- Backfill the grounding pit with Bentonite powder and wet with water until Bentonite expands to full saturation (about 300%).
- If Bentonite powder is not available, an alternative backfill can be made using a mixture of crushed charcoal and common salt.
- A slight depression towards the middle of the pit should be left when backfilling to allow for watering to adjust moisture of the soil in dry areas.