

Portable Communications System 2023

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Introduction

This UHF, VHF, HF configuration can be used for emergency communications or for just having fun outdoors.

Often, if something has a handle on it, it is considered portable. This is one of those portable system, which some may consider heavy or not since the FT-991A weighs 9.8 pounds. It certainly is not something that one would use for backpacking. This system may be a compromise between lightweight and heavy weight. A photographic backpack and trolley is used because it provides plenty of cushioning and wheels. The parts list also contains other items that may be useful such as an umbrella, a folding table, and a folding cart.

Radio

The Yaesu FT-991A was chosen as a transceiver, which weighs 9.8 pounds, because it was extremely versatile. It is a UHF, VHF, HF transceiver with all modes including C4FM (digital). It also has a built in antenna tuner. It has an output of up to 100 watts. For QRP operation, simply dial it down to 5 watts. It has a sound card interface for text type digital modes. There plenty of other choices.

Yaesu FT-991A Power Consumption (Approximate):

RX (no signal) - 1.8 A (13.8 volts)

RX (signal present) - 2.2 A (13.8 volts)

TX - 23 A (HF/50MHz 100W) (13.8 volts)

Power Source

ECO-WORTHY 12V 50Ah LiFePO4 Lithium Battery

3000+ Cycles Rechargeable Iron Phosphate Battery Built-in BMS

Capacity 50Ah

Battery Power 640Wh

Battery Voltage 12V

Max Charge/Discharge Current 50A/50A

Max Charge Voltage 14.5V

Discharge cut-off Voltage 10V

Battery Size 8.8 x 7 x 5.3 inch

Battery Weight 10.7 lbs

This battery will provide adequate of power even operating at 100 watts. There are plenty of other choices.

Power is rated in AH or amp hours. A 16.8 AH battery will provide 16.8 amps for 1 hour or 8.4 amps for 2 hours, 4.2 amps for 4 hours, and so on. For high power, a 110V AC switching power supply may be best if an 110V AC source is available.

$i \text{ (amp hours)} = i \text{ current draw (amps)} \times \text{time (hours)}$

It is NOT a good idea to run a battery down to zero. It is better to leave a 20% of charge.

Photographic Light Stand

The aluminum light stand extends to 9.5 feet high and collapses to 45" and easily fits into a case. The case is wide enough to accommodate the dipole mount and UHF/VHF mount, while permanently mounted to the top section of the light stand.

UHF/VHF Antenna

Many dual band mobile antennas can be used. The one selected for this project is the Diamond G7500A Dual band Mobile Antenna because of its high gain and relatively low height. The metal photographic light stand acts as a ground plane. The radiation patterns for UHF and VHF are line of sight. Usually, radio waves that bounce off the ionosphere are below 29 MHz.

G7500A Specifications:

Bands: 2m/70cm

Gain dBi: 3.5/6.0

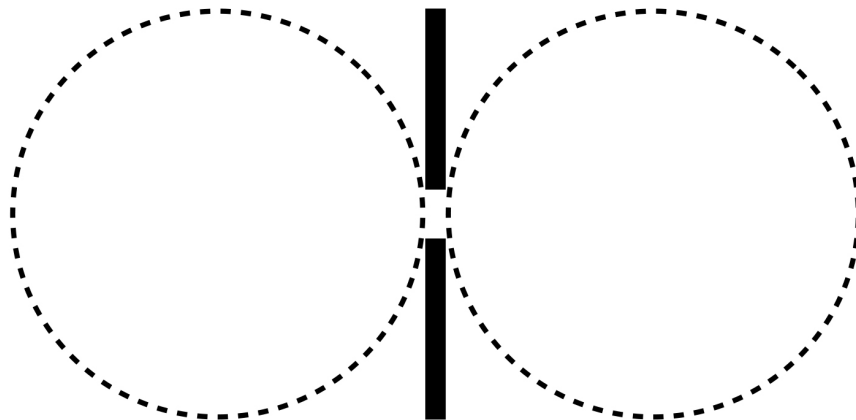
Watts: 150

Height: 40.6"

Mount: UHF

Element Phasing: 1/2l / 2-5/8l

HF Antenna



Horizontally Mounted Dipole Radiation Pattern

A dipole hamstick configuration is used with the MFJ 347 dipole mount. The dipole configuration is heavier than the UHF/VHF antenna and likely will require guying during moderate to high wind speeds. Water bottles filled with water can also be used to weigh down the light stand. The hamsticks are recommended because they are somewhat portable and they can be tuned prior to use. Then the antenna can be taken apart without tools and without affecting the tuning. Fully assembled, the hamsticks extend to approximately 8 feet long. With two hamsticks in a dipole configuration, there will be a total length of approximately 16 feet. Disassembled, the length of the hamsticks are 44-49 inches long. The dipole antenna used in this project is horizontally mounted. Mini hamsticks are available, but won't perform as well as the full length hamsticks.

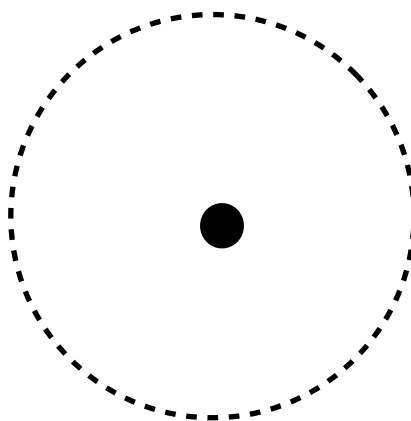
Near Vertical Incident Sky wave (NVIS) is accomplished using horizontal dipole configuration for communications at distances from 200 miles to 800 miles. NVIS uses frequencies below 29 MHz to obtain a bounce off of the ionosphere.

Long distance propagation uses radio waves that are reflected from the ionosphere and return to earth at some distance away. Radio waves that are radiated at a very low angle, travel a long distance to reach the ionosphere at a very shallow angle and return to earth far away. When the angle of radiation increases, the radio waves reach the ionosphere at a greater angle, and return to earth closer to their point of origin. Signals that reach the ionosphere at a higher angle of incidence will not be reflected at all, but will continue out into space. The area of reflection that would have occurred is the "skip zone". Depending on operating frequencies, antennas, and propagation conditions, this skip zone can start at roughly 12 to 18 miles and extend out to several hundred miles, preventing communications.

NVIS antennas are designed to minimize the ground wave (low takeoff angle) radiation and maximize the sky wave (very high takeoff angle, 60-90 degrees). Essentially, the NVIS antenna radiates a wave almost straight up, then bounces from the ionosphere and returns to the Earth in a circular pattern around the transmitter. Because of the near-vertical radiation angle, there is no skip zone. Communications are continuous out to several hundred miles from the transmitter. The nearly vertical angle of radiation requires the use of lower frequencies, usually 2-10 MHz. This type of propagation is excellent when communicating over hills and mountains. These frequencies are the same frequencies that contain a lot of atmospheric noise, such as distant thunderstorms. The NVIS antenna is optimized for listening to signals from nearby areas, and minimizes the reception of signals from distant sources.

One of the most effective antennas for NVIS is a dipole that is mounted from 0.1 to 0.25 wavelengths above ground. When a dipole is brought very close to ground, the angle of radiation increases. In the range of 0.1 to 0.25 wavelengths above ground, vertical and nearly vertical radiation reaches a maximum. A dipole can be used at even lower heights, resulting in some loss of vertical gain, but often, a more substantial reduction in noise and interference from distant regions. Heights of 5 to 10 feet above ground are not unusual for NVIS operation.

Vertical antennas are omnidirectional. This configuration can be used as a vertical antenna by adding a UHF to 3/8 inch adapter and replacing the VHF/UHF antenna with a hamstick. There is great controversy whether to use horizontal or vertical antenna configurations.



Vertically Mounted Radiation Pattern

Parts List

YAESU FT-991A HF/50/140/430MHz All-Mode Field Transceiver, \$1,299.95

MFJ-1610T, HF Stick, 10M, 3/8-24, Whip, Mobile Antenna - \$35 x 2 at MFJ

MFJ-1620T, HF Stick, 20M, 3/8-24, Whip, Mobile Antenna - \$35 x 2 at MFJ

MFJ-1640T, HF Stick, 40M, 3/8-24, Whip, Mobile Antenna - \$35 x 2 at MFJ

MFJ-1680T, HF Stick, 80M, 3/8-24, Whip, Mobile Antenna - \$35 x 2 at MFJ

Tram Stainless Steel So-239 to So-239 Antenna Mirror Mount (3270)
\$30 at Amazon

MFJ-347 Aluminum Dipole Mount
\$35 at MFJ

CB Antenna Connector Adapter 3/8 x 24 Threaded Antenna Mount to UHF PL-259 (SO239 Mount)
\$20 at Amazon

Neewer Heavy Duty Light Stand 10 Feet/3 Meters Adjustable Spring Cushioned Metal Photography Tripod Stand for Photo Studio Softbox, Flash Monolight, Ring Light and Other Photographic Equipment(Black)
\$70 at Amazon

ECO-WORTHY 12V 50Ah LiFePO4 Lithium Battery 3000+ Cycles Rechargeable Iron Phosphate Battery Built-in BMS, Perfect for Travel Trailer, Trolling Motor, RV, Marine, Solar, Power Wheel Chair Group 22NF
Battery Capacity 50Ah
Battery Power 640Wh
Battery Voltage 12V
Max Charge/Discharge Current 50A/50A
Max Charge Voltage 14.5V
Discharge cut-off Voltage 10V
Battery Size 8.8 x 7 x 5.3 inch
Battery Weight 10.7 lbs
\$160 at Amazon

ULTRAPOWER 4Amp 12.8V-14.6V Lithium LifePO4 Battery Charger,4-Stage Automatic Repair Intelligent Lithium Battery Charger for Cars, Motorcycles, Lawn Mowers, Toy Cars, Golf Carts, LifePO4 Batteries
\$28 at Amazon

PAEKQ 10AWG 45A Connector to O Ring Terminal, Compatible with Anderson Connector Port, Dual Positive/Negative ATC Style Fuse Holder Cable, for Portable Solar Generators and Battery Charge- 2Ft
\$16 at Amazon

TORIBIO 50" Tripod Case Bag With Deluxe Padded Waterproof Heavy-Duty Multi-Function Tripod Carrying Case with Strap, Suit for Lights, Speakers, Cameras, Booms, Microphone Stands
\$50 at Amazon

Neewer 2-in-1 Wheeled Camera Backpack Luggage Trolley Case
Anti-shock Detachable Padded Compartment, Hidden Pull Bar and Strap, Durable, Waterproof for Camera, Tripod, Lens for Air Traveling
Dimensions: 19.2x12.9x7.87 inches
\$93 at Amazon

ABCCANOPY Heavy Duty Water Saddlebag Design 4 Water Weight Bags for Photo Video Studio Stand, Backyard, Outdoor Patio, Sports (Black) - \$23 at Amazon

GCI Outdoor Compact Camp 25 Outdoor Folding Table
Open size: 24.8 x 25 x 28.2 Inches, Folded size: 24.8 x 2 x 24.3 Inches
Rated to withstand a weight load capacity of 60 Pounds.
Unit weight: 6.2 Pounds
\$63 at Amazon

Wondershade Ultimate Portable Sun Shade Umbrella, Lightweight Adjustable Instant Sun Protection
Portable sun shade Blocks 98% of harmful UV rays
Telescoping, tripod base adjusts from 3' to 8' tall with 60" diameter umbrella top
\$60 at Amazon

Mac Sports WTC-111 Outdoor Utility Wagon, Solid Blue
LARGE CAPACITY - Sets up in seconds, No assembly required! Outside Dimensions Approx: 35" x 20" x 23". Size (inside)- Approx. 32 L x 20.1 W x 17.4 H inches. Size Unfolded- Approx. 35.5 L x 20.1 W x 22.5 H inches, Weight 22.5 pounds
\$90 at Amazon