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Man-Go Pack, All Mode (VHF/UHF/HF) Portable Go-Kit, on and Off Grid, for Emergency Communications System

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ABSTRACT

The design and implementation of a Man-Go Pack are to build a combination of a Manpack radio and a Go-kit in one package. The design of the Man Go Pack for Emergency Communication (EmCom) follows the design principle of building a device that is portable and can be operated in any condition and situation. From the results and findings, it was noted that the construction of the manpack is easy but needs smaller and light integral devices to make it more compact. The device will work to almost all of the amateur band, commercial, and marine frequency. Weather channels such as from the NOAA can also be monitored on the device. The device can be operated as both Manpack for portable operations and also as a field radio in a Go-kit configuration. The device can be simply deployed in an emergency situation especially when normal communication infrastructure failed during the disaster. With the low cost of construction, the device is highly recommended for the Local Government Unit Emergency Communication Device. The LGU's can also be developed or build a similar device for emergency communication purposes. The device can be used as portable and field operation for amateur radio hobbyists in pursuing distant contact or DX.

KEYWORDS: *Emergency Communication, Portable Radio, Field Operation, Amateur Radio, Go-kit*

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INTRODUCTION

An emergency communication (EmCom) system is used and maintained by government, organization, or individual in which the main purpose is to support two-way communication of emergency usage (ARRL, 2005). The systems are designed to include basic communication system and the latest communication system in a single composite communication technology to optimize the communication capabilities during disaster and emergencies. Emergency Communication is the most important component in disaster preparedness. It plays a dynamic part in ensuring higher chance of survival during any type of disaster. In the recent disaster that occurs from all over the world revealed how crucial and important communication is during this crisis. From the rescue and relief operation, dispatching first responders, and coordinating with loved ones, during these times the emergency communications infrastructure is important for the safety of the community.

The past disasters and emergencies have shown the limitations of using cellular phones to coordinate with each other. Even if the repeater sites are operational, the network could not handle the volumes of people trying to contact their families or getting help. Even when there is no disaster, communication facilities sometimes cannot be relied on. During the Typhoon Ketsana (TS Ondoy), in 2019, communications through cell phone were badly damaged and inoperable for at least two (2) days leaving the rescue effort and other emergency communication services to sort for commercial and amateur VHF/UHF/HF communication system (PDA, 2019). During Typhoon Yolanda in 2013, one of the strongest typhoons to make landfall ever recorded in the world's history. A vast expanse of the provinces on the Visayas Region lost telecommunication services vital to disaster response, thus again gives technical and rescue response more difficult. Typhon Quinta, Ulysses, and Super typhoon Rolly in 2020, wipe-out the communication facilities of the Local Government Units and other government and private agencies in the Island of Catanduanes, Philippines. Communication within the island and outside of the province is cut and the national government doesn't know the status of the Island after the devastation of the super typhoon. Assessment of the extend of the devastation became more difficult, since airports and ports were also damaged. For several days, survivors could not contact their government for help or get their message across to loved ones in other areas to inform them that they were alive and needed help. It is also difficult to mobilize police officers, Red Cross, fire fighters, and health workers without proper communication. The Communication system intended for this event has failed.

Methodology

The Principles and practices of engineered projects play a factor in the design and implementation of the project (Toyado, 2019). Plans, specifications, and estimates of the

structures are derived from good engineering practices that will result in a good and reliable device. Devices and instruments, such as radio, tuners, battery, the solar panel are selected based on their usability and applicability for the project. The criteria of selection for this are; low cost, low weight and small form factor, reliability, and able to operate with low power and QRP mode. The device will be designed to perform the desired performance. Testing is done for the device by independent users as well as performing tests using electronic measuring instrumentations. The design is focused on the lowest weight to needs criteria. The construction will also use value engineering to obtain the lowest cost versus performance. Computer Software will help analyze the performance of the device. Testing done by a human operator will also be evaluated by the performance and operability as intended of the device.

Design of the Device

The design of the man pack/Go kit for Emergency Communication follows the design principle of building a device that is portable and can be operated in any condition and situation. This design and construction will be based on all available low-cost materials and radios for the project. The element and parts diagram of the device is shown in Fig 1.

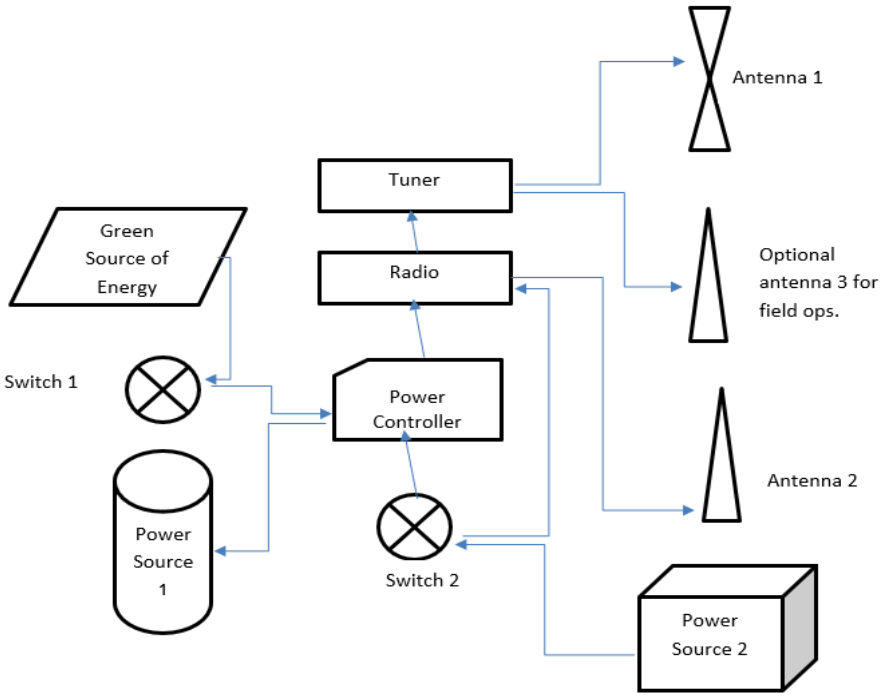

Figure 1 – The device diagram

Components

The components are sourced out from local and international supplier to acquire the best fit part for the device.

Table 1- Components of the device

Component	Description
Solar Panel	10 watts with 12V Cell Solar Panel Module
Radio	Rugged, innovative, multiband, multimode portable transceiver for the amateur radio MF/HF/VHF/UHF bands. Providing coverage of the 160-10 meter bands plus the 6 m, 2 m, and 70 cm bands, includes operation on the SSB, CW, AM, FM, and Digital modes, and it's capable of 20-Watt portable operation using internal batteries, or up to 100 Watts when using an external 13.8-volt DC power source.
Power supply 1 (Battery)	valve-regulated lead-acid battery (VRLA), maintenance free motorcycle battery, designed for motorcycle for maximum performance and excellent reliability
Power Supply 2 (Switching Power Supply)	Switching power supply to supply the radio for a 100w output capability on HF and 50 watts on VHF and 25 watts on UHF. It is lightweight and efficient. 30 amps rated current with 12V output voltage
Solar Controller Unit	Solar controller unit, 12/24V auto, 10 amps rated current, with +5V/1.2A USB terminal output which can charge mobile phone, fans and other electronic device
Antenna 1	Mobile monoband antenna for portable operation. Small, lightweight, efficient, and easy-to-use. Dual center and distributed loading that radiates efficiently
Antenna 2	VHF/UHF rubber ducky antenna. Electrically short monopole antenna that functions somewhat like a base-loaded whip antenna. Maximum gain is 2.15dBi (430MHz)
Antenna 3 (optional for Field – Go-Kit Operation)	Dipole antenna that consists of a conductive wire or rod that is half the length of the maximum wavelength the antenna is designed to operate at end to end.
Chassis of the device	Aluminum for lightweight and rigid construction. 1” Angular aluminum and 1” Flat bar aluminum are used for main frame structure. Rivets are used to connect the chassis. Painted with Automotive paint for durability and aesthetic appearance
Wires, switches, and connectors	Automotive wire for operation in a DC mode. Commercial grade double throw switch.RG58 coaxial wire for radio transmitter and antenna. PL259 and eye terminal for connectors

Assembly of the Device

The subsequent steps are followed to build the device

1. Preparation of all materials, equipment, and tools.
2. Assembly of chassis that includes cutting of aluminum Angle bar 2 pcs 22mm, 4pcs - 37mm 2 pcs 17mm, Aluminum Flat bars 2 pcs - 22 mm , 2 pcs - 17mm, and 50mm angle bars and bent for antenna mounting. of the antenna. To hold battery and switches, additional 4 pcs 10mm angle. Rivets is used to form the chassis. Sprayed with automotive paint for durability.
3. Assembly of the Power Source. Cut automotive wires exactly to the length of the connections between power sources and connect the witches. Trim the power voltage of the Power Switching Supply to 13.9 volts
4. Assembly of the controllers. Connect the power sources to the controllers, and test the connections.
5. Attached the power source and switches to the chassis
6. Attached radio and tuners
7. Attached controllers
8. Attached antenna system

Figure 2 Completed devices in Go-kit and Manpack configurations

Results

The design of the Man-Go Pack for EmCom follows the design principle of building a device that is portable and can be operated in any condition and situation. The construction is made up of aluminum material for lightweight and portability. The actual size of the device is 22cm width, 37 cm depth, and 17 cm height without the external power switching supply. The width increases to 26cm if the PS is connected to the chassis. The chassis can be encased into a piece of luggage and or a backpack making it more versatile and easier to transport in the field. Pedestrian operation is convenient since it can be operated in front of the user at the back while in transit or in motion. The antenna can be a sweep, for field operation and on pedestrian mode. The device, therefore, is compact and in one package.

The device utilizes HF, VHF, and UHF radio band to enable the operator of the device to contact h other stations, government agencies, rescue, and other radio services. For amateur Frequency, almost all of the amateur band can be operated by the device. On amateur Radio Service in the Philippines, The Philippine Amateur Radio Association or DX1PAR uses 7.095 as standby frequency for the National Traffic System in the Philippines. The device is set to this frequency as it is the primary frequency for Ham Emergency Radio Operation (HERO) in the Philippines.

On 2-meter band, all frequencies from 144.00 MHz to 146.00 MHz can be covered by the device including 145.00 MHz which is the emergency calling frequency of the Philippines. From the Memorandum Order No. 01006-2012 of the National Telecommunication Commission (NTC), frequencies are allocated for the exclusive use and operations of the radio communication system of any agencies, organization, responding to disaster and emergencies under the close supervision of the National Disaster Risk Reduction and Management Council (NDRRMC); as follows TX/RX: 440.225/445.225 MHz, and TX/RX: 430.375/445.375 Mhz. The device is equipped with the UHF band can be used in these frequencies thus the device is useable in Emergency Communications. The device can even to the commercial frequency in order to make a two-way communication from the National Government Agency, Non-government Organization, and other Radio Volunteers Network.

The device can transmit and listen to the marine frequency as designated. It is capable of monitoring distress call in marine frequency used by marine transportation and also a commercial fishing vessel within the Pacific and the West Philippine seas. Most of commercial fishing vessels in the Philippines, fishing the area such as Bajo de Masinloc and Panatag Shoal can be monitored and make two-way communication using the device. Their fisherman are using the frequency 7.400 MHz, on USB (Upper Side Band) to communicate with other fishermen's on the seas and on the land. The device can also listen to the weather channel on VHF for the latest weather update and conditions.

The device can also be used as a portable charger for electronic devices such as cell phone, laptop, and iPad. The controller is equipped with a 5 volts output USB-type connector to charge mobile devices. The 12 volts output of the battery can be also used to power light bulbs of 12 volts rating. Since the controller can be switch to 24volts mode, a laptop charger can be connected using an alligator connector for charging. With the on-board Power switching devices, the

device can also power other radios, gadgets, lighting systems that are using a 12-volt DC or direct current.

The device is designed to be an off-grid on-grid EmCom Radios. The device can run on a 220V Alternating Current from the grid line. With this mode, the radio can produce a maximum output of 100watts on HF, 50 watts on VHF, and 20watts on UHF. Can also use big antennas for longer contact. The off-grid mode is a feature of the device for Man pack Operation. The unit is being powered by a 12volts, 5AH battery. The battery can power the unit with 5 watts of power in HF, UHF, and VHF mode. The battery can be used for 24hours in standby or monitoring mode and 6hours in transmitting mode on normal QSO.

The rigid construction and design of the device, and its lightweight, give the operator in a Man pack mode to communicate in two way in bot HF, UHF, and VHF mode with 5 watts or QRP mode. The device can be operated in a Pedestrian mode. It can also be a good choice for hams operation in SOTA or Summit on the Air Operation. It can be easily packed inside a 40 liters backpack.

The device can also be used as a tactical, go kit mode for command center used in field communication, emergency communication, and contest communication. The device can be easily deploying in a table and operates with the onboard antenna system for QRP mode. For more power, if the device is connected to a grid system, the device can operate in 100watts of power in HF, 50 watts on VHF, and 20watts on UHF.

Conclusion and Recommendation

The construction of the man pack is easy but needs smaller and light integral devices to make it more compact. The device will work to almost all of the amateur band, commercial, and marine frequency. Weather channels such as from the NOAA can also be monitored on the device. The device can be operated as both Man pack for portable operations and also as a field radio in a Go-kit configuration. The device can be simply deployed in an emergency situation especially when normal communication infrastructure failed during the disaster. With the low cost of construction, the device is highly recommended for the Local Government Unit Emergency Communication Device. The LGU's can also be developed or build a similar device for emergency communication purposes.

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