RAMBO ROVING FOR MICROWAVES

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I. INTRODUCTION

Many operators would like to set up stations for roving during microwave contest, but finding the best system components present a challenge. Several objectives are present for the system design, so this paper presents one way to configure a roving system. In configuring a system, the goals are to find a rugged container that will protect the system components from the weather and other elements in the environment such as heat and insects, keep the costs reasonable, and have a station that is easily transportable and versatile. By versatile, it is desirable to have a systems that is usable both roving and for other uses such as fixed station operation for both point to point communications and modes such as moonbounce (EME). The example shown here is for 1296 MHz, but the techniques are applicable to the other microwave bands as well.

II. THE SYSTEM CONFIGURATION

As is always the case, the initial thought is to run lots of power. However, if roving, the size and weight of the battery for operating a station with several hundreds of watts quickly modifies that thought. Especially when microwave roving, in some situations the operator may be faced with hauling equipment up a tower such as some of the abandoned fire tower, a lookout tower on a mountain top, or accessible by hiking ¼ to ½ mile to get to the edge of an elevated location that is beyond the absorbing foliage which can present severe signal attenuation. Placing the equipment on the ground and running feedline up a tower necessitates using heaving runs of low loss coax and a rotor, both which complicate the rover operation particularly for one person when out roving. Generally, the microwave rover will mount the station on a light weight stand such as an aluminum speak

stand, run lower power in the order of 20 to 25 watts, and use a smaller battery as a power source for the station. This configuration permits the rover to hand rotate the antenna, use minimum length transmission and power lines, and listen to the I.F. radio while peaking the antenna on the remote station sometimes in both azimuth and elevation.

With this in mind, the first goal is to find a suitable cabinet or case for the rover station. This container must keep the electronics equipment dry but must also permit the flow of air used to ventilate the equipment; i.e., keep it from overheating. The first attempt for this box was a mailbox. Obviously, the mailboxes are designed to keep the mail dry, and they are certainly cheap enough and readily available at Home Depot or Lowe's Home supply. The entrances/exits for the cabling going to the rover rig where all placed such that they went into the bottom of the mailbox. A side benefit is that by bringing the cables into the bottom of the box forms a natural drip loop since the any cables from above the rig make a 180 deg. turn to enter the box. Cables coming from the lower side, such as a power cable from a battery, are shielded from above by the box itself. However, there is a problem with mail boxes which became apparent after a season or two for the rover rig configuration and when leaving the mailbox sitting outside at the base of a tower used for point to point communications. The mail box, while keeping out the rain out, did not keep out the insects such as spiders and Lady Bugs. An attempt was made to tape the opening seams with duct tape, but it was still impossible to keep all of the insects out.

A more viable solution was to use an ammo case shown in Fig. 1. These are very cheap, $8 to $20 depending on where they are purchased, and seal completely tight around the lid.

Figure 1 - AMMO BOX FOR RAMBO ROVER STATION

The top can also be completely removed to allow the installation and placement of subsystem components. On the bottom of the ammo box, a couple of small, 2 3/8th inch, muffin fans were mounted, redundancy in case of failure of one of the fans. A round, circular saw the size to cut the holes in the bottom of the ammo box was purchased from Lowe's Home Supply, and this was used to cut the holes for the fans as well as two more holes at the other end of the bottom of the ammo case to permit the entrance of air. These holes were covered with copper, window screen to keep out the Lady Bugs, spiders, and other insects.

These ammo boxes work very well, have a handle for easy transportation, are rugged, and inexpensive. For many folks in this area, they are simply left over from shooting sessions. See Fig. 2 below.

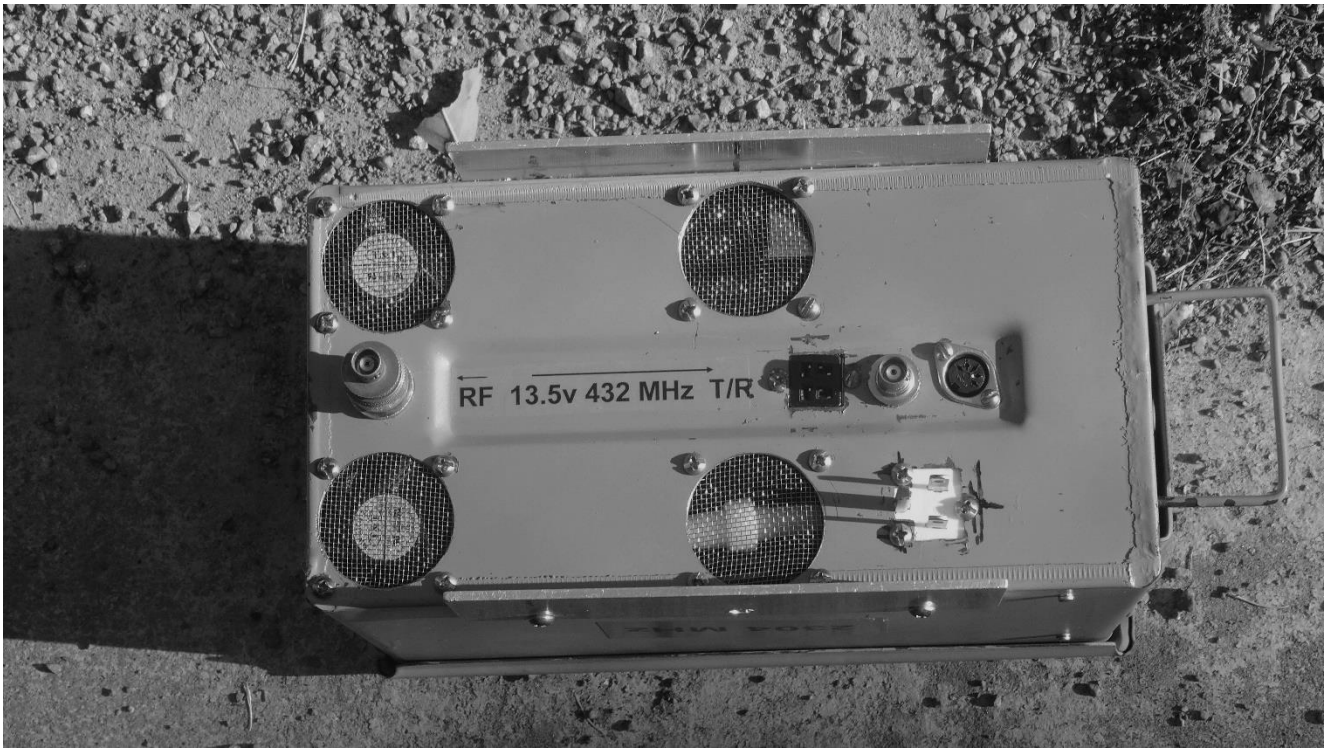

Figure 2 - BOTTOM VIEW OF ROVER CASE

The ammo box has two aluminum plates, available at the home supply store, attached to the sides of the box so that it can sit inside two angle aluminum rails on the side of a tower. This lets the rig sit at the base of the tower well above the ground level for home station use and also keeps the bottom of the ammo box above the ground when sitting the ammo box on the ground, keeping dirt and weeds out of the rig. The box has a Type-N connector for the antenna feedline, a four conductor Jones plug (or Power Pole) for D.C. input voltage, a BNC connector for the I.F., and a small connector for the key line for switching from transmit to receive. It also has a 120 V.A.C. plug in order that an A.C. extension cord can power the internal A.C. power supply for extended home station use or for those rare, almost non- existent occasions where A.C. power is available when roving. The four conductor Jones plug is wired so that it provide D.C. power to the rig when

operating from A.C. power and disconnects the internal A.C. supply when D.C. power is applied to the Jones plug.

III. THE ROVER CONFIGURATION

The block diagram for the rover station is shown below in Fig. 3.

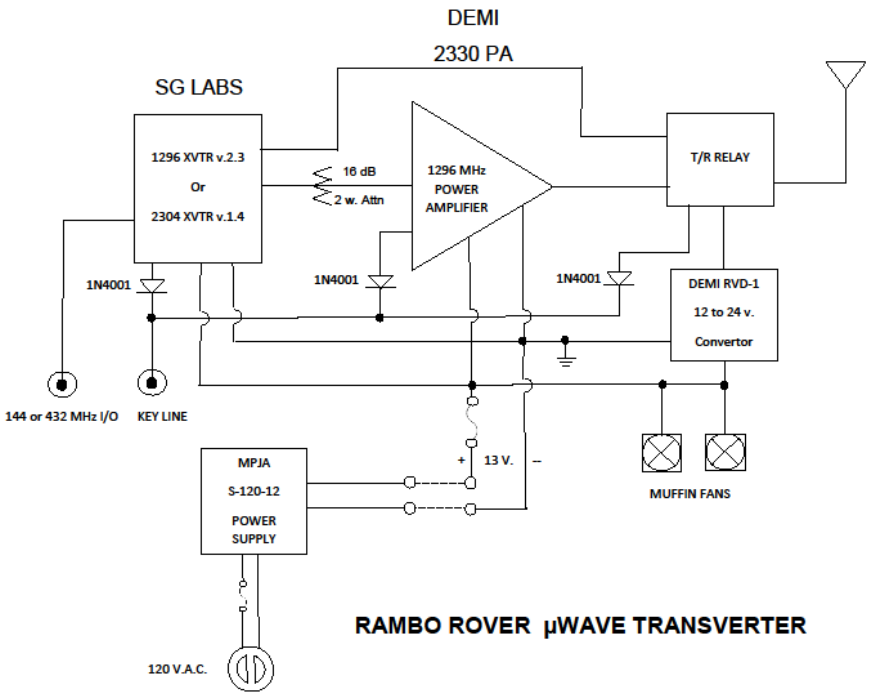

Figure 3 - RAMBO ROVER BLOCK DIAGRAM

For this system, the basic exciter used is the SG Labs 1296 V2.3 for 1296 MHz. A second SG Labs XVTR v1.4 was used for 2304 MHz, but it follows the same approach as that for the 1296 version built in another ammo box. The 1296 MHz version is described in this article, but both rigs used the same approach. The 2 watt output of the SG Lab exciter is 2 watts, and this is excessive as drive power for the DEMI 2330 power amplifier (PA) for 1296 MHz which was already on hand. To keep from overdriving the PA, an inexpensive 2 watt, 16 dB attenuator with SMA connectors was purchased from eBay. Since this rig is used on single sideband and CW, the 2 watt attenuator will accommodate the 2 watt output of the exciter without

overheating as long as the key down time isn't excessive. One of the low loss, low cost readily available microwave relays is used for the T/R function, and a DEMI RVD-1 voltage converter is used to develop the 26 volts coil voltage necessary to pull in the relay while the 13 V.D.C. will keep the relay held keyed.

To isolate the various system components, classical 1N4001diodes are used on the key lines for the SG Labs transceiver, the DEMI PA, and the change-over relay. Also of note is the MPJA (Marvin P. Jones & Asso.) switching power supply. This small, light-weight supply, S-120-12, is adjustable to 13.5 volts, supplies 10 amps of current, and does not appear to introduce additional noise to the 1296 receiver input. For a cost of ~ $14, it negates the necessity to build a supply as the components cannot be purchased for that price. The four terminals on the Jones plug are shown to depict how either the A.C. supply or an external D.C. source, the battery, can be switched to power the rig from either house current or a battery.

IV. HOME STATION USE

For home station use, the decision was made to use the lowest loss coax available going up the tower but to keep the rig at the base of the tower. Tower mounted rigs are, no doubt, the most efficient configuration, but because of surge effects, the operator must be prepared to climb the tower fairly often or have a tower whereby the rig can be lowered to the ground. A good compromise is to use low loss coax up the tower, place the rig at the bottom of the tower where it can be accessed and maintained, and run the I.F. line inside the shack to cut down on RF losses. This may introduce an additional 1 or 2 dB feedline loss in front of the receive preamplifier, but keep in mind that the antenna is looking at a nominal 290 deg. K propagation median and not the 50 deg. K as typical with EME. As long as the receiver system noise temperature is less than 290 deg. K, the placement of the rig at ground level is o.k.

A tower tray is constructed from angle aluminum by attaching two pieces of angle aluminum to the tower legs extending out from the tower as support arms. On top of these support arms, two more pieces of angle aluminum are spaced such that the standoff rails attached to the ammo case fit within the angle aluminum shown in

Fig. 4. Fig. 5 shows the standoff rails attached to the side of the ammo case. These rails also keep the bottom of the ammo case off of the ground and out of the dirt when moving the rig from the car to the tower or other operating position.

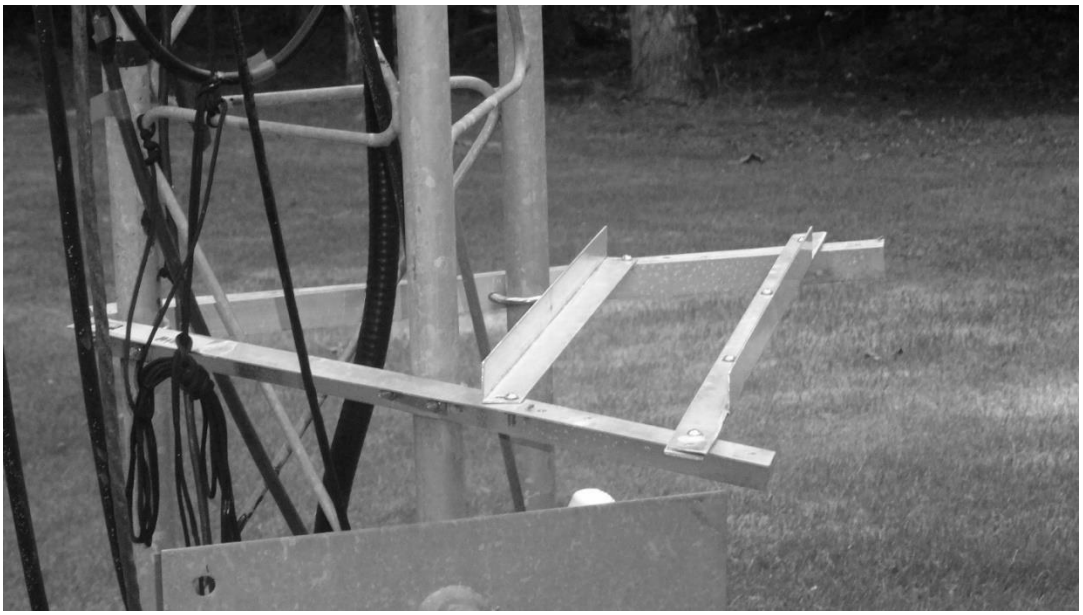

Figure 4 - TOWER MOUNTING ARMS

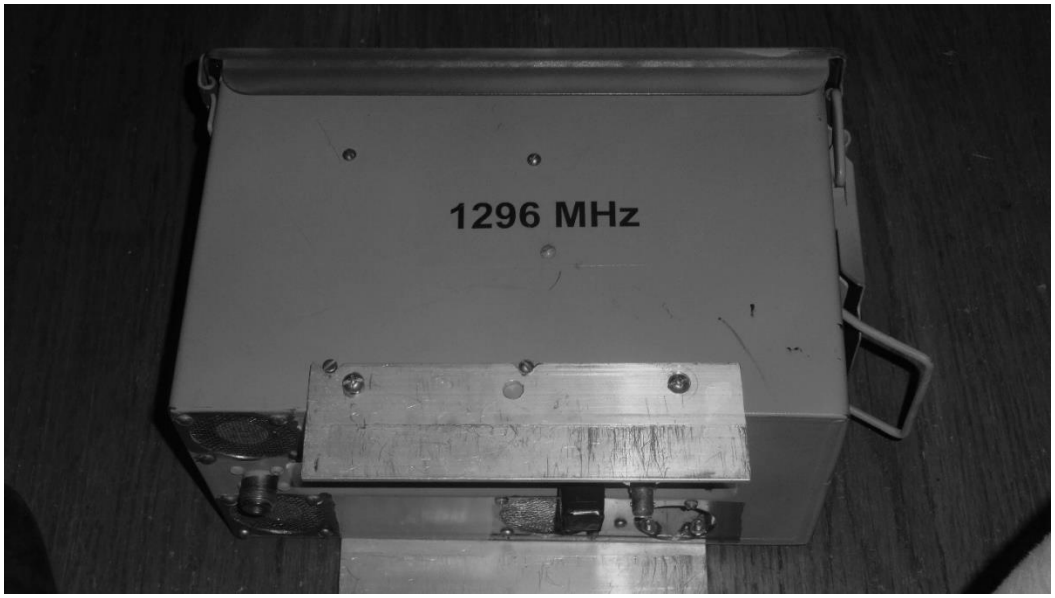

Figure 5 – SIDE RAILS ON CASE

The ammo case sitting in the tower mount is shown in Fig. 6. This arrangement provides a natural “drip loop” for cabling in and out of the transverter to keep water out of the cables and connectors.

Figure 6 - RIG ATTACHED TO TOWER

V. AUXILARY EQUIPMENT

Two antenna configurations are shown, one for the roving and one for the home fixed station. A small antenna that a compliments a multi-band, microwave rover station is the Vivaldi antenna. While there are several manufacturers of Vivaldi antennas, a version by RF Space which is useful in that it provides adequate gain, handles up to 50 watts of power, an acceptable SWR, and covers all of the popular microwave bands. This antenna is shown below in Fig. 7.

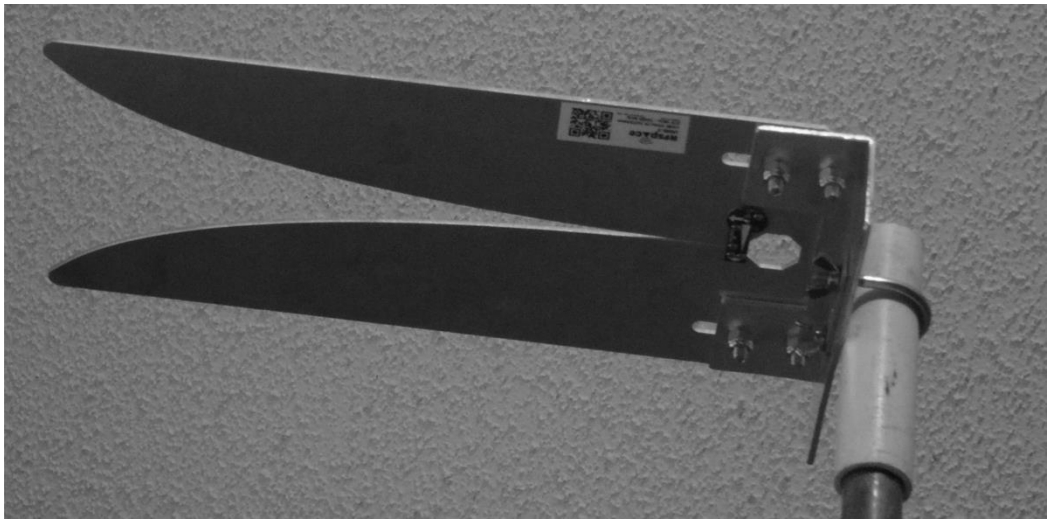

Figure 7 - VIVALDI ANTENNA, 1.2 TO 12 GHz

For home station use, a dual band BBQ grill, dish reflector will provide excellent performance for both 1296 and 2304 MHz shown in Fig. 8. This antenna uses a Log Periodic Feed by placing the phase centers of both bands at a position to straddle the focal point of the BBQ grill reflector. The BBQ grill reflectors are available as WiFi antennas or short range data link antennas usually for 2400 MHz. The measured gains for this antenna are 16 dBd for 1296 MHz and 21 dBd for 2304 MHz. Both gains are approximated 1 dB below that achievable for a 2 ft. x 3 ft. reflector optimized for single band operation with the feed phase center at the focal point, but that's the price of compromise for one antenna to cover both of these bands. The one antenna is certainly easier to transport and setup than two of these antennas, one for each band.

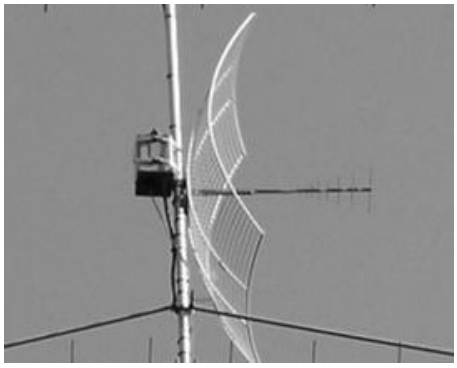

Figure 8 - 1296/2304 MHz ANTENNA FOR HOME USE

Power for the rover rig is provided by a Suaoki Li-Ion battery. This particular 13 volt battery provides 18 amp-hours of energy, 300 amps of peak current, and weighs ~ 3 lbs. There is also an additional low current output which can be set to 5, 9 or 12 volts to provide power for a 10 MHz TCXO or other reference source. It also has a couple of USB outputs for USB powered devices. Batteries similar to this one are now available through the Wal-Mart website to be delivered to a nearby store for pickup. The newer version of these batteries also include an internal fuse to prevent catastrophic results (explosion) should the terminals accidently be shorted. The battery is shown in Fig. 9 on the following page. To say the least, this battery is considerably easier to transport to the top of a tower than a deep cycle, lead acid battery!

Figure 9 – SMALL, LIGHT WEIGHT BATTERY FOR ROVING

VI. CONCLUSION

Roving, especially microwave roving, is extremely interesting, challenging, and rewarding. The recent introduction of modern subcomponents permits the microwave ham to configure an efficient station that isn't too bulky to take along, and it provides the opportunity to have some exiting QSO's such as my most rewarding operation a couple of year ago during the 10 GHz contest weekend when WA5YWC was operating on Grand Isle, south of New Orleans, and I was set up on Mexico Beach, some 25 miles S.E. of Panama City, FL. That particular QSO across the Gulf of Mexico was at a distance of 285 miles, my best DX on 10 GHz to date. The only factor that prevented QSO's of 600 to 800 miles was the lack of activity down the South Texas coastline.