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MICROWAVELENGTHS

Portable Microwave Operation

Some microwavers operate from portable locations because their homes are not ideal locations, while others choose portable operation for fun. Also, the rules of the ARRL 10 GHz and Up contest encourage portable operation.

Mountaintop operation is a distant memory as I write during a blizzard, listening to snow scatter on a 10 GHz beacon. However, by the time you read this, it will be time to start preparing for summer portable operation. Adequate preparation usually leads to successful and enjoyable operation.

Portable operators must be ready for sun, wind, cold, rain, snow, ice, fog and insects — and that's just in summer; winter operation is much more difficult in northern climes.

On a perfect day, like Figure 1, just being out is good, and making microwave contacts is a bonus. Most of the activity is during contests or activity weekends, however, so we must take what comes — fog and blizzards included.

Needle in a Haystack

The high-gain antennas needed for microwave DX are very sharp. We can't just point the dish in a random direction and call CQ. A small dish, like the DSS dish, has a beamwidth of perhaps 4° at 10 GHz, so our chances of pointing at a station are 4° out of 360°, or about one in a hundred. And he has to be pointed at us, another 1-in-100 chance. We are looking for a needle in a haystack. If we aren't on the same frequency, we aren't even looking in the right haystack!

So coordination is essential, to find a station, get pointed at each other and on the same frequency, and set up a sked. In the northeastern USA, we typically use 144.260 MHz as a microwave calling frequency to find other stations, then QSY to another frequency for actual liaison. Many of the better 10 GHz stations are able to regularly work 400 km or more, so the 2 meter liaison station must also be capable of this range. Medium power and a decent beam will do the job, but handhelds and rubber attenuators won't cut it. We tried repeaters years ago, but there was always some OF describing his gall-bladder operation in great detail tying up the repeater.

Once a station is found, we must point the dish at him. A GPS receiver will tell us our exact location; mountains generally stay in one place, but sometimes we find a good spot along the road and need to know the grid square. We exchange grid squares and calculate a bearing using a program like *BD*, or just with the GPS, and point the dish.

Aiming a dish seems pretty straightforward when you are sitting in a comfortable chair, but it isn't so easy in practice, even for experienced microwavers. The biggest problem is getting the dish pointed on the desired heading, with an accuracy better that the beamwidth of the dish. On a clear day, we have the sun to work with plus lots of visual landmarks. The position of the sun can be calculated accurately using a laptop or Palm handheld. Some of us leave the focusing string on the dish, so that when the shadow of the string falls on the center of the dish, as illustrated in Figure 2, the dish is pointed along the azimuth of the sun.

Overcast conditions are more difficult, but other landmarks may be useful. Distant mountains are good landmarks, but they tend to look alike in haze. Large commercial towers have strobe lights that make them more visible. When planning an expedition, I look

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Figure 1 — KB1VC operating 10 GHz on a perfect day.

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Figure 2 — String shadow on dish lines up with sun.

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Figure 3 — Azimuth setting circle or compass rose on tripod.

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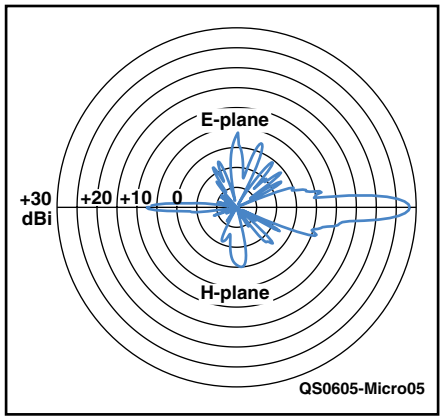

Figure 4 — Calculated radiation pattern for small dish.

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Figure 5 — Elevation tilt indicator mounted on side of transverter.

up nearby towers and calculate the bearings in advance.

Getting Bearings

Fog is even more difficult, but is common on mountaintops — they can be in the clouds even on an otherwise clear day. Here we have no choice but to use a magnetic compass.

I've tried electronic ones, but have found that a good handheld compass with a needle is more reliably accurate, and has been since before Columbus was sailing. Compasses are affected by nearby metal, so get clear of the car, sight down the needle, and find the desired heading. Don't forget to correct for magnetic declination — here in New England, one must add about 16° to the true bearing to get the magnetic bearing.

In some places, there is enough iron in the ground to affect compass readings — I know of one mountain where a compass is useless. What now? Try to walk a straight line with a handheld GPS long enough for it to indicate a heading — a short walk is probably not too accurate, but enough to get started.

The initial heading is used to set the compass rose or setting circle on the tripod — see Figure 4. This is marked in degrees and rotates with the dish, indicating the bearing where the dish is pointed. The Oregon Rule Company (**www.oregonruleco.com**) has nice adhesive-backed ones to stick on a round plate — I used a platter from an old 5¼ inch disk drive. If the platter moves rather than the pointer, then the degree markings must be counterclockwise rather than the normal clockwise direction.

Refining Headings

Once we have a heading, even a rough one, we can keep refining it. Perhaps there is a local station or beacon available — then we can calculate the bearing for the beacon, peak on it, and refine the heading. A beacon also helps check our frequency calibration. Then, as we work a few more distant stations, we keep refining the heading until corrections are very small.

The refinements are necessary because it is hard to tell by eye exactly where a dish is pointing, and most dishes have squint — the difference between the electrical boresight and the apparent one — and because even good compass readings are only accurate to 2 or 3°. If we are careful, we can get the initial heading close enough to fall within the 3 dB beamwidth of a small dish, perhaps 4° at 10 GHz. For larger dishes or higher microwave frequencies, the beamwidth is smaller and getting the initial setup close enough to find the first station or beacon becomes much harder.

The initial heading is important because of the radiation pattern of a dish antenna. Figure 4 plots the calculated radiation pattern for a small dish, 12 λ in diameter. This typical pattern has a sharp beam surrounded by a deep null on each side, at an angle of about twice the 3-dB beamwidth, then a series of sidelobes separated by nulls. So if the beamwidth of our DSS dish is 4° and we are off by 7° or 8°, the signal we are looking for will fall in a null and never be heard. At this point, an experienced operator will move the dish in very small increments, 1° or less, tuning carefully with each movement, while a neophyte will be seen swinging the dish wildly in all directions.

The elevation is also important, but much easier. Since most interesting signals will be on the horizon, the dish should start out level. This is best done from a location with no ground reflection, like a hilltop, and peaking on a moderately distant station. Then a stick-on bubble level can be affixed for future reference. The one in Figure 5 was found by KA1OJ at the RV department of the large discount store found in every neighborhood. These RV levels come in sets, one for front-to-back leveling, and the other for side-to-side. I calculated that marks on the side-to-side one are roughly 1° increments, so I chose that one.

We have noticed that distant tropo stations often peak at 2 to 5° elevation. For a very weak signal, the improvement might be enough to make copying CW possible, while for a slightly stronger station, it might be the difference between CW and SSB.

With the RV elevation indicator, it is possible to vary the elevation in small increments and return to the best position or back to level.

A real DX contact might involve alternating transmissions until one station detects a signal, then both stations peaking carefully until signals are strong enough to copy CW, perhaps with many repeats. Contact rates may not be high, but they feel like an accomplishment.

Of course, most microwave contacts are not that difficult — perhaps one or two in day, but making those two would make it a good day. Many contacts are armchair copy on phone, even over several hundred kilometers when tropo conditions are good.

Now that I've described the difficulty of pointing a dish, you might understand why I urge beginners to start with a horn antenna — broad and easy to point. Not only will they make 90% of the contacts anyway, they will do it with far less trouble.

It's Spring — Time to Head Outdoors!

In future columns on portable operation, I will try to describe some other details. But don't wait, get out and try it yourself — even just VHF operation. Going out with an experienced operator would be better than just reading, since I am bound to forget something obvious. Just take a pad and paper, take notes, and keep a list of all the things you forgot. I invariably forget something! QST