

The EME misadventures of K4SQC and W4ZST

2014-15-16

When a young man's fancy turns to thoughts of EME stations and operations, there is no telling where it will end up or the struggles and mistakes encountered along the way. May this story help make the trip easier for you and keep you from making some of the same mistakes.

Johnny Kludt K4SQC decided some time back that he wanted to get on 2m EME with a portable station since he lives in a subdivision with restrictions that won't allow him to set up real antennas there. He assembled equipment and antennas for a very nice, much more than minimal, 2m EME station and with help from Bob Lear W4ZST got a tower trailer (1) to install the antennas to be used portable.

All was well and good until it was discovered that trying to set up a pair of 21+ foot boom, M² 2m XP20, cross-pol antennas with an Az-El rotator on the tower trailer was more like a 3 man job and thus not really a good idea for portable operation, especially for one operator wanting to be able to do it.

So Johnny asked Bob if he could bring the station and trailer to the W4ZST shack location and set it up there to at least get it on the air and get some experience with EME operating. The W4ZST shack is also used by the W4NH Fourlanders for contest operating every year for the January contest and as a back-up location when the group is unable to make their usual portable location trip to NC for the June and September contests. There was space to set up the antennas and room in the shack for the station and Bob agreed as this would allow him to also experience 2m EME and more as will be seen. This started in the summer of 2014.

The K4SQC 2m EME station is made up of a Flex 1500 driving a DEMI 2m transverter with split RX/TX RF connections for separate receive and transmit feedlines, then on to an M² 2M-1K2 solid-state amplifier. A nice dual-core Win7 computer and the M² S2 sequencer properly operate the Flex and control the station and the trailer mounted M² dual-polarity TR relay and preamp box. The pair of M² 2m20XP cross-pol antennas were initially installed with an AlphaSpid RAS Az-El rotator. The station also has an G3RUH GPS receiver to supply reflack to both the DEMI and the Flex 1500. PowerSDR 2.7 Software ran the Flex, MoonSked to control the rotator, either SPIDROT or PstRotator driver software and WSJT V9 for viewing and decoding the EME signals.

One of the first problems encountered was with the RAS rotator. It turned out that the rotor had a progressing mechanical problem that allowed it to operate normally at first but continued to stop operating after increasingly shorter periods. This of course interrupted operations when we were unable to continue tracking. It was finally returned for warranty work and replaced by a Yaesu G-5500 rotator, LVB tracker interface and the Yaseu GS232 software driver for MoonSked. This has been a rock solid system. We haven't had to realign the rotator for at least a year and a half now. Johnny is a very experienced satellite operator and knows well how to set up an Az-El rotator and get it properly calibrated. Early on, we both used to go out and look at the antennas to see if they were pointed properly at the moon but now we just turn things on and find a frequency and look for the traces and decodes as we are confident that the antennas are on target, which is very nice for those times when it's cloudy and we can't see the moon visually anyway. We spent a good amount of time early on just tracking and looking for signals until we had confidence in our abilities and the equipment before attempting to transmit and make QSO's.

Which now brings us to attempting our first QSO. This was in September of 2014. We copied a nice trace calling CQ and called back with our first sequence. Not copying a response, we kept transmitting first sequence until we realized we weren't hearing anything. We tested the preamp with the sequencer which has in/out control of the preamp. It did not appear to be the preamp so that left the transverter front end. I substituted an older DEMI transverter of mine on RX and again had signals so it was the transverter. Sent off to DEMI to have the front end FET replaced. I didn't have any of that one in stock here. Also tested the preamp and decided that it may have also been bad and sent it back to M² for repair. In the meantime, we kept listening with my transverter on RX but since I didn't have split RX/TX RF connections I couldn't connect it in the normal way. After some thought, I decided that we could get back on the air by changing some connections in the relay box and going with just a single feedline for RX/TX and horizontal polarization only. This worked and got us back on the air and we finally made some QSO's. Johnny had wanted to try to do the ARRL EME contest in late September and November weekends but we didn't get things back up and running until after that. I finally made a Q in December of 2014. BTW, my older transverter was not synthesized and still used a crystal with no reflock but we were making QSO's with it and not having any problems. I think once it got warmer than usual and we did see some drift in screen traces but that didn't happen for long.

I did spend considerable time looking over the connections, especially the sequencer outputs to make sure that we didn't have something out of whack there. Also double checking the relay wiring in the outdoor box which has two T/R relays, an H/V selection relay and also relays to switch the preamp in and out of the RX circuit. Also looked over the output levels of the Flex and the transverter(s), trying to find some explanation for what took out the transverter.

Next, we got Johnny's transverter back from DEMI with the FET replaced. Also got the preamp back from M² and they said there was nothing wrong with it. So much for my abilities to test preamps, even with a Noise Figure meter!! So the repaired transverter goes back in to the set-up, the relay box returned to normal connections for separate RX and TX feedlines (LMR-600, BTW) and back on the air again. Well, guess what? First attempted QSO resulted in the same problem, took out the front end FET in the transverter. After consulting with Steve at DEMI, he suggested that I put a wattmeter in the RX line and see how much power was coming back on the RX line during TX periods. There was the problem! 2 watts back! AHA said Steve, the FET certainly won't take that. Turns out the M² relays only have about 25 dB isolation at 2m and with the amp making 800W out for JT, that's the 2 watts. Then Steve remembered that others had also had this problem with their transverters with split RX and TX connections also using T/R relays with only about 25 dB isolation. In older transverters like mine, there is a T/R relay inside that disconnects the RX input during transmit and of course that relay has enough isolation to protect the transverter from itself! In the early models of the newer, high power DEMI transverters with split RF outputs, there was no relay in the RX line at all. So now, I ordered a relay like Steve had been putting in since to protect the FET and of course another new FET which I replaced this time myself and installed the relay too. I also ordered another spare FET, not having a lot of confidence any more! Fortunately this was the problem and solution, so now the station operated properly with Johnny's transverter. Be aware though that up until this time, we had made about a hundred Q's using the crystal controlled transverter on RX and without reflock so it seems that using older gear shouldn't stop you from getting on with it for EME. We did the 2015 ARRL EME contest weekends that way making 58 QSO's then and I had made about 65 Q's in the weeks before the contest while learning how. Also we were using H pol exclusively. Don't worry the story is still not over.

Since we had not had enough problems to keep me busy, Johnny suggested that since I had a very good 432 contest station (2) that would be capable of EME, that we should put up some antennas so that we

could be on two bands for the 2015 EME contest. Well the station itself was already set up and I had another tower trailer available along with four K1FO 25's. So we got started putting together an H-frame with tubing I had around along with a Yaesu G-5400 Az-El rotator. It didn't take long for us to realize that four antennas were a lot more work than the two 2m ones, even though they are physically smaller and lighter. We quickly decided to just put up two of the antennas with vertical polarization using a metal cross-boom. I did not have good boom to mast clamps for the 4 antenna setup. Advice from WA4NJP was to just go with the two antennas for simplicity and he felt we would still make Q's. I also had put a mast mounted preamp up with the two antennas. This will be significant later as you'll see. This was only completed just days before the 2015 contest first weekend and I never had a chance to even make a practice QSO on 432. In typical fashion around here, I was at least a couple of hours late even trying to make my first QSO. I made my first easily with one of the Big Gun European stations. I was trying to run about 600 watts at first. I then made three more Eu Q's in about an hour and a half before noticing that the traces were slanting off and I'm not decoding. Also the transverter was getting awfully hot. This was my older DEMI transverter with a crystal oscillator and about 35 watts max output, designed pre JT era for normal SSB/CW operation. It just quit working altogether. Interestingly at the time it quit, Johnny decoded my 432 CQ on the 2m station. Talked to WA4NJP for advice and he suggested putting a fan on the transverter and turning the power down. I did do that with my amp output power now about 400 W and copied quite a few more stations but only worked one more station for the first contest weekend.

I didn't do anything to the 432 station before the second contest weekend, got on then with a little more experience and confidence and worked another 11 stations in the two days. Only worked two US stations which could be because of the vertical polarity but I was very happy to also work Australia for my last Q of the contest. Johnny and I had used our own calls separately for the two bands for this contest. We sent in our logs. I was extremely surprised to end up getting a certificate for Third Place Single Op All Mode 432 from ARRL. Not too bad a showing for my first try and only 17 Q's total for the contest. As many of you know, 432 just does not have the participation and popularity it once had.

I didn't try to make any more 432 Q's on activity weekends but I kept thinking about being able to run more power when I did get back on. None of my radios would produce more than about 35 watts but I found I had a driver amp that had been given to me with that had one of the newer Mitsubishi high power bricks in it. AHA I said, that will drive the amp to full output on CW or SSB and I can still run more power on JT than I had for the contest. Do you see it coming? So I put the driver amp in line after the transverter and adjusted the drive level of the transverter down but enough for the brick amp to put out about 50 watts to drive the amp to full power. Well, not paying enough attention in my zeal to finally see the amp put out legal limit, which I had never done since I had it, I keyed it up and was tuning the amp at 1500 W for a few seconds until I saw it suddenly drop power, so I immediately unkeyed and then remembered that the preamp was up at the antennas and NOT rated anywhere near legal limit. Naturally I didn't think to try this with the dummy load which I did have available. You can see the utter destruction of the preamp as it's passed around. I don't think any part of it is salvageable except maybe the plastic box and mounting bracket! Another warning to pay more attention to what you are doing, especially when it involves high power!

In 2016 we made more 2m EME Q's, Johnny when he wanted to come up and operate and myself, sometimes feeling guilty that I was making more Q's than Johnny with his station!

So comes the 2016 ARRL EME contest weekends. This time Johnny suggested that we do it as a multi-op using the W4NH callsign. Active Fourlanders Ron WW8RR and Kim WG8S joined us for the contest. The two stations were still set up here and ready to go, the only difference was that I had a

different, borrowed 432 transverter and had put a preamp for 432 in the shack rather than up at the antennas. I only had about 25 feet of LMR-600 feedline anyway so it was probably OK (except for Murphy's upcoming visit!) I had worked on making a mast mounted preamp box with properly rated relays but with problems I ran out of time to get it done in time for the contest. Now remember that we really didn't have any problems during the previous year contest, all the adventures taking place at other times. The borrowed transverter was because I had been working on updating my transverter with an Apollo reflock board and splitting the output to separate RX and TX connectors, I had some sort of oscillation problem and couldn't get it sorted.

One difference this year was that moonrise was at a different azimuth (but we didn't think about that ahead of time) and the antennas for the two bands were actually lined up one behind the other at that azimuth and were actually too close together. Well the first Q of the contest was made on 432 and then not another for the next 30 minutes when Johnny finally got ready on 2m and made his first Q. Well of course something had to happen and it did. When he transmitted with his 800W with JT, the 432 antennas were directly behind and looking right up the booms of 2m. That was enough to take out both the 432 preamp FET AND the front end FET in the transverter at the same time. That took us off 432 for a while as my own 432 transverter was unavailable. Fortunately, Ron had his 432 contest station radio with him and put that in to drive the amp along with another preamp and made the next 432 Q's off the moon about 5 or 6 hours later! It did take us some time troubleshooting to figure out what we had done. Another valuable lesson about running high power. So the first contest weekend we made 30 Q's on 2m and 4 total on 432. On the chat pages there was much discussion about how bad conditions were for 432 and everyone was having trouble making Q's there.

I did try to work on the 'smoked transverters and preamp and got the borrowed 432 transverter and the preamp going with replaced FET's. No wonder Kostro calls them 'front end fuses'! Anyway, then I decided to leave well enough alone and didn't try to change anything on the stations for the second weekend. Not good enough, said Murphy. Although things went well on Friday night of the second weekend, Ron didn't make any Q's despite showing up on the liveCQ page and trying lots of times on 432. It wasn't conditions this time, just no good decodes and unfortunately, little activity. I operated the 2m station on Friday night and made 28 Q's, mostly by getting a frequency and calling CQ. A lot of fun. Johnny had a local club commitment Saturday morning and didn't come up for the Friday night moon pass. Ron had to go home after moonset on Saturday morning. I got some sleep and Johnny came up about dinner time. Then on Saturday night at moonrise, the 2m antennas and the 432 antennas were again lined up pretty well with 432 behind the 2m ones like last month. Well, this time the 432 station took out both the 2m preamp and the front end of the transverter before 2m could make a Q! I put my 2m transverter in Johnny's station and promptly took it's front end out also. I tried yet another 2m transverter I had but it was DOA already so that pretty much shot our 2m activities for the night. It would have taken much effort to get another 2m station going, what with different interfacing, audio connections, etc. using a 2m all-mode in place of the Flex 1500 and transverter. And the fact that I was actually making some Q's on 432. Only another six Q's for Saturday night. BTW, we weren't wringing out the 432 amp, only ran about 500 watts this year vs 400 last year.

We are seriously going to have to relocate the antennas so that we don't have one station shooting up the rear of the other or v-v which is how it worked. Still have transverters and preamps to try to repair and eventually get my new relay box going too. One nice thing about relays in series for protecting the preamps. When you put two relays in series, the isolations ADD, so two 25 dB relays results in 50 dB of isolation, not just adding 3 dB like one might have expected like doubling power or antennas. We didn't learn fast enough but we did finally learn a lot of things that we should and shouldn't do. When we did the 2017 January VHF contest here with W4NH, we did make some more EME Q's on 2m and

432 but we were paying attention and fortunately the moon times during the contest were at elevations that didn't cause problems between the two stations. Get on the air and have fun but we hope you won't have these problems, only the successes.

Johnny keeps saying things like “Why don't we try 6m EME?” and “How about getting on 1296 EME since it's so popular” and “Since we have an existing 222 contest station (2) capable of EME, let's put it on the air!” Even the W4NH guys are asking why can't we get on some more bands? We've also been considering using two preamps and two receivers to be able to feed both the horizontal and vertical antenna signals to decode simultaneously (3). Can't wait to see how many things will get smoked trying all that. What could possibly go wrong?

Summary: Even with all the problems we've had, we have had successes. As of this writing K4SQC has 100 Q's and 30 countries on 2m both contests and casual, W4ZST has 109 Q's and 40 countries on 2m, all casual, 17 Q's and 12 countries on 432 from a contest and W4NH has 58 Q's and 30 countries on 2m along with 12 Q's and 10 countries on 432 during contests over the past couple of years. We just found out that W4NH ended up 5th place in the 'all-band, all-mode MultiOp' category for the 2016 ARRL EME contest, even though we were only two bands and digital mode only. We are also trying to imagine what might have been if we hadn't been off the air for so much of the contest.

Good Luck and try not to duplicate some of our less than optimum technical experiences!

73, Bob W4ZST

References:

- (1) “Tower Trailers” by W4ZST in the 2007 SHVFS Conference Proceedings, Atlanta, GA. and “Tower Trailers revisited” by W4ZST in the 2015 SVHFS Conference Proceedings, Morehead, KY.
- (2) “The W4NH Portable Contest Stations” by W4ZST in the 2015 SVHFS Conference Proceedings, Morehead, KY.
- (3) MAP65 by K1JT, <http://physics.princeton.edu/pulsar/K1JT/map65.html>

The Adventures continue (and Murphy has maybe taken up elsewhere) 2017-18-19

In 2017 we again did the ARRL EME contest weekends with K4SQC on 2m and W4ZST on 432. This time Johnny made a third place showing on 2m and I was further down the standings on 432 as many more stations have been getting (back) on 432 EME. I had built a new preamp/relay box and had set up 432 for dual polarity but probably not in the best way. I had put the four FO25 antennas on a metal horizontal boom with two antennas 45 degrees left and two antennas 45 degrees right so that I effectively had X polarization. I know that many other stations do their dual-polarity in the X position rather than the perpendicular Cross position. I had the proper horizontal separation between the pairs of antennas. Should have worked in theory but really didn't work well at all. I didn't make many Q's. Later I found that the antennas were not well-matched and had higher SWR readings. There were two preamps in the relay box and a polarization-switching relay. The control panel was at the operator position and I also had put in provision to lock out changing polarity while transmitting. Took these antennas down after the contest and decided to not try that again. I still plan to either put a second set of elements vertically on a pair of the antennas to make them cross-pol or buy a new pair as I feel that having dual polarity would be beneficial on 432 and also would allow eventual use of MAP65.

In the Jan 2018 VHF contest we did some more EME. We also think that we copied our EME echo on 6m using WSJT echo mode at moonrise. Not sure but we'll try again. On 2m we collected 14 EME Q's on what was predicted as about the worst moon conditions for the year. Just goes to show what power WSJT has for us. On 222 we also tried to hear our echo at moonrise but not sure if we really did see anything. We did try 222 EME with K5QE but no decodes. The moon was above our antennas at that time. Ron WW8RR made 2 EME Q's on 432 during the contest. Johnny noticed a problem with the 2m antenna rotator elevation at the end of the contest. The elevation rotor froze up on us. Just quit and stuck at about 20 degrees elevation. Azimuth still worked OK. We couldn't move the rotator manually like we usually can so something major is wrong, jammed gears or something.

Anyway, since Johnny wanted to be ready to try to work the upcoming Bouvet Island DXpedition on 2m EME, we needed to get it fixed. The elevation rotor has the cross-boom through the rotor itself so it's not an easy job to work with that having 21' boom cross-pol yagi antennas on each end of the 12' cross-boom. When Johnny and I put it up, we determined that it was definitely a 3 man job! I thought of a way to take the rotor out and replace it without having to completely dis-assemble the entire set up. But I also thought that it was at least a 4 man job to do this properly and we did have four of us here for the project. I have a bunch of masonry type scaffolding and we set up two sections high on each side of the tower trailer, lowered the antennas as low as the mast will go and I made some 2x4 upper rest and safety rails. We don't think we can tilt the weight of these antennas over like we do with the contest antennas on trailers. We were able to remove the right side antenna with it's fiberglass boom extension, support post and feedline support rail from the solid aluminum cross-boom that runs through the rotator and rest it all on the safety rails. Then we managed to slide the rest of all the left side antenna system with the cross-boom out of the rotor body onto the scaffolding on the other side. Now the rotor was easily replaced and we just reversed our dis-assembly and got it all back together. Probably took as much time setting up and taking down the scaffolding as it did to do the antenna work, but it was safe and more efficient than complete dis-assembly. We did the whole job in 2 1/2 hours but it did take our 4 man crew to do it this way.

Before the June 2018 VHF contest we decided to set up Az-El antennas for 222 EME. We have a very nice 222 contest station belonging to NX9O, our 222 band captain. He also had purchased some XP antennas years ago and never done anything. (Brian and I did set up and try about 15 years ago at my old QTH with some older KLM antennas but no success). Johnny wanted us to try 222 and he put the antennas together recently and I figured up what we needed to do to get them in the air and use them for the contest also. We only had to obtain a fiberglass cross-boom as we had everything else already. (Johnny and I did this because Brian NX9O is still too busy working and we are retired.) Brian is 222 centric and always has wanted to get on EME so we are helping the situation out! The station is an FT-1000MP, DEMI 222-28HP transverter with reflock, Lunar Link amp, sequencer and 2 of the M2 222XP30 antennas with full Az-El. We run MoonSked and GS232 to track and have experience with that on the other bands. I used the dual-polarity relay box I had made for 432 and just put two new DEMI 222 preamps in it. We did try on 222 but didn't make any Q's. One thing I learned and would like to pass on is to put the antennas together on a low mast so that you can get the balance correct and the feedline lengths worked out properly. Since I did this, when we put them up in the air we've had no problems and have even taken them down because we needed the trailer for a mountain-top contest and put them back up afterward, leaving the antennas on the halves of the cross booms so that we didn't have to completely dis-assemble the setup.

For the fall 2018 EME contest first weekend we had three stations on the air: 2m, 222 and 432. Johnny's station was up on 2m and using his call K4SQC, made 33 QSO's. Brian's 222 station was on and he made his first 222 EME QSO during the contest. Unfortunately, he and the other station were

the only two stations active on 222 for the weekend. My W4ZST 432 station was on and I made 21 QSO's. In all cases, we did better for the weekend on all the bands than any other contest weekend that we have been on. The other highlight is that we didn't have any major equipment problems. That's got to be a first for a contest here. We even had good tracking with computer control which was very helpful since it was completely overcast on Friday night, but since we could hear signals, we knew we were on target. It's the first time I had set antennas up without Johnny's help and I also set up the 222 and 432 stations. I built a new relay box for 432 because I had relegated the first one I built to Brian's station back in June for the VHF contest. Johnny had high SWR on vertical polarization Friday night and Saturday afternoon we checked the feed lines and found water in both ends of the 2m vertical drop. Dried them out and solved that problem. We had had 2 inches of rain on Thursday and Friday before the contest started. This is the first time we've had water in the coax connectors and will be more aware of that in the future if we see any changes in our SWR that causes the amplifier to automatically shut down. Can't have that!

My 432 station was previously identical to Brian's with the exception that the transverter and amp were for 432. I had used that station for the past three years for the EME contests That's the only times I have done 432 EME. I did however this time change over to a Flex 1500 for the radio and was quite pleased with the SDR and it's panadaptor. Same software setup as Johnny's station and I built another relay box for this contest. I ran my Lunar Link amp at only 500W out. I was using a pair of K1FO 25 element yagis with Vertical Polarization only. I do plan to make them into X-pol antennas sometime. That should help my RX since I would be able to hear someone with the other polarity better. But I have so far done best with V-pol.

We are also discussing changing back over to WSJT-x version. We started to do this early this year and ran into some problems as it was quite new then. The WSJT JT65B mode that we use for EME on the VHF bands is the same in both versions. Go Figure! The x-version has the new FT8 and MSK144 modes that we use for terrestrial contacts and contesting but the EME modes are supposedly the same in both versions. That's not what we and some others are experiencing. Some folks are running both JT10 and JT-x simultaneously to see which decodes better. Johnny is going to try to get that set up for the second half of the contest this month. His computer is capable of running all those programs simultaneously.

The second weekend I upped my 432 power to 650 watts and made 8 more Q's for a total of 29 on 432. Johnny changed his station over to his Flex6700 and his 2m transverter and had 20 more Q's for a total of 53 and Brian ended up with two Q's total. That's all the stations that were on 222 for the contest. He did make first place on 222 single band. The others were multi-band operators. Johnny and I didn't place this time. There were a lot more stations on.

For the January 2019 VHF contest, we were again QRV on 2, 222 and 432 EME, making 9 Q's on 2m, none on 222 (everybody was too busy on 6m FT8 apparently) and one on 432.

Now Johnny is hot for 1296. He had put together a new station to use on 1296 terrestrial for the January contest and we hope soon to get it going on EME. We are going to use four 45 element loop yagis that are not yet set up completely. The station uses Johnny's Flex 6700, a new DEMI 1296 HP transverter and a W6PQL 150 W solid-state amplifier. He is also building a relay/preamp box to be mounted up at the antennas, using a DEMI preamp. The story of this adventure will have to wait for another time.

222 (left) and 432 EME stations Fall 2018



2m EME station



222 EME Yagis



2m and 432 EME yagis

