

High School Hams Reachable by Satellite

LASA High School Amateur Radio Club, K5LBJ, marks their 10th year by building a satellite station.

Ronny Risinger, KC5EES

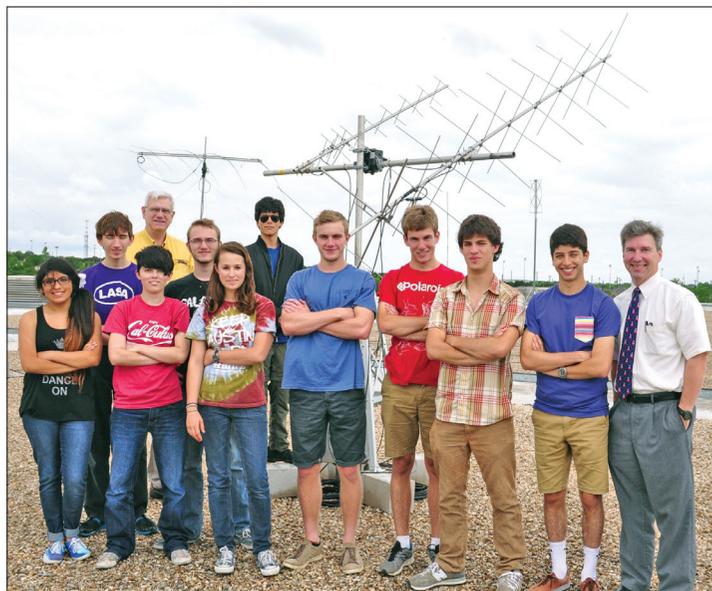
In 2004, K5LBJ, the Amateur Radio club at the Liberal Arts & Science Academy (LASA) High School in Austin, Texas, was formed and got on the air with equipment provided by the ARRL Education & Technology Program (ETP). Since its inception 10 years ago, K5LBJ has been very active, particularly in the ARRL's School Club Roundup contests, where they placed 1st in the high school division in 2006, 2010, and 2014. During that time, student interest in ham radio also gave rise to an elective Amateur Radio course taught by myself, a K5LBJ Trustee. This semester-long course allows students to explore all facets of radio, including phone, CW, and digital modes.

A Satellite Station of Their Own

Over the 2013 – 2014 school year, class members assisted in building a satellite tracking/communication station to expand into satellite modes. The project would be a means for completing the MAREA (Mars Lander Amateur Radio Robotics Exploration Activity) project, which sends robot commands embedded within Automatic Packet Reporting System (APRS) signals, which are relayed via the International Space Station digipeater. This allows students to experience the thrill of bouncing command signals through an orbiting spacecraft to simulate controlling a robot on the surface of Mars.¹

Overcoming funding issues was, of course, the biggest hurdle. Fortunately, I was able to work with the Amateur Radio community, LASA parents, and local businesses to purchase necessary equipment. Through a grant, I obtained the roof tower and elevation/azimuthal rotator. The ARRL ETP provided a computer interface for controlling the rotator via the computer. LASA parents purchased rotator control cables, while coax was obtained via a grant from the Dayton Amateur Radio Association (DARA).

It took quite a while to amass all of these components, but in fall 2013, K5LBJ began assembly. This would kick off a year of learning and exploration.



The students and mentors of K5LBJ, the LASA High School Amateur Radio Club in Austin, Texas, stand among the antennas on the roof of their school. The club, which celebrated its 10th anniversary in 2014, installed the satellite tracking/communication station shown in the background. These Juniors and Seniors are led by their instructor, Ronny Risinger, KC5EES (right), and mentor, Joe Fisher, K5EJL (left). [Ronny Risinger, KC5EES, photo]

Students in the Amateur Radio club came to the school's Radio Room during lunch to assemble the roof tower, construct sample control cables (under the guidance of longtime mentor and classroom Elmer, Joe Fisher, K5EJL), and to calibrate and test the rotator.

Raising the Tower

In January 2014, the students in the Amateur Radio elective class moved the assembled antenna tower to the roof. Realizing the tower needed a solid base to prevent it from tipping over, students gathered in the school's shop to pour concrete into cinder blocks while also mounting bolts into the mix. These blocks were hoisted to the roof and the satellite tower was bolted in place. The next step was to install antennas for 2 meters and 70 centimeters, which a local ham had donated.

The 2 meter antenna needed a little maintenance to repair broken elements. Using a second antenna for parts, students calculated

the necessary length and took the aluminum rods to the shop to cut them to size. Where elements were too long and no replacement could be scavenged, they used a handheld propane torch to braze two shorter elements together. This proved to be an exciting task, as students are not normally allowed to use a torch in the classroom. But, if the homebrew element of Amateur Radio is going to have any meaning, students must (with proper supervision) be allowed to build the gear themselves.

Tracking and Teamwork

After discussing the significance of very precise direction while tracking satellites, the class used Google Maps and various compasses to ensure that the tower was properly "parked," pointing to true north. Completing repair and installation of the satellite hardware kept them busy until mid-April 2014.

Once the hardware was in place, the software component came into focus.

Mentored by local satellite enthusiast Ron Parsons, W5RKN, K5LBJ worked out hardware and software issues related to computer control of rotators (tracking satellites across the sky) and automatic adjustment of radio frequency to account for Doppler shift. By the end of the spring 2014 semester, the K5LBJ satellite tracking/communication station was ready to be put through its paces.

On May 28, 2014, students had their first success in tracking the FunCube satellite (AO-73). This CubeSat relays a wide array of data to the ground, including readings on temperature and battery/solar panel voltages. This data stream can be received and interpreted by a “Dashboard,” which is available online from the satellite’s builders.² Using their station to track the tiny satellite, K5LBJ began to receive its signal. The Dashboard then began to display the various readouts indicating the satellite’s condition.

Hard-Earned Success

This was a pivotal moment for students to realize that they were able to capture this data from a satellite in orbit and then convey it, via the Internet, back to the builders to assist them in evaluation of the satellite’s function. In the classroom, I used the voltage data to discuss how this data (reflecting voltages from each panel on the CubeSat) could be used to determine the satellite’s rotation speed and its orbit. Beaming with pride, the Amateur Radio class students posed for a photo by their satellite tracking/communication station (as seen in the lead photo).

Over the summer of 2014, the Austin Amateur Radio Club (AARC) had funded the purchase of K5LBJ’s dedicated satellite radio, an Icom 910H. As soon as school began, K5LBJ members set to the task of pairing the new radio to the control software (*SatPC32*, *AGWPE*, and *UISS*) via a RIGblaster “Plug and Play” device. Success would soon follow.

In September 2014, the club made its first voice contacts via satellite. Using SO-50, the club spoke with two Texas stations, and hams in Illinois and Tennessee. After spending a few weeks working out the software issues related to packet, in October 2014 K5LBJ digipeated its first successful packet via the International Space Station, acknowledged by XE1MEX in Mexico (see Figure 1). To test their capa-

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Fm RS0ISS To CQ <UI pid=F0 Len=36 >[17:05:31]
>ARISS - International Space Station

Fm XE1MEX To APRS Via RS0ISS* <UI pid=F0 Len=43 >[17:05:39]
:NWS :>Hello all from XE1MEX in EK08MU

Fm K5LBJ To CQ Via RS0ISS <UI pid=F0 Len=63 >[17:06:00]
:XE1MEX :73 de K5LBJ, LASA High School in Austin, TX (EM10eh)

Fm XE1MEX To APRS Via RS0ISS* <UI pid=F0 Len=56 >[17:06:27]
:BLNQL1/1:XE1C0-9,WA6YET,N7NEU-6,K5LBJ,N0SPB-10{UISS53}

Fm K5LBJ To CQ Via RS0ISS <UI pid=F0 Len=47 >[17:06:50]
LASA High School in Austin, TX via ISS (EM10eh)

Fm K5LBJ To CQ Via RS0ISS <UI pid=F0 Len=47 >[17:07:56]
LASA High School in Austin, TX via ISS (EM10eh)

Fm K5LBJ To CQ Via RS0ISS* <UI pid=F0 Len=47 >[17:07:58]
LASA High School in Austin, TX via ISS (EM10eh)

Fm K9JKM To CQ Via RS0ISS* <UI pid=F0 Len=33 >[17:08:33]
=4211.29N/08827.08W-Greetings :-)

Fm W19EWS To T3PQ0P Via RS0ISS* <UI pid=F0 Len=53 >[17:08:42]
't' 1 -/]Medic from New Berlin,WI.QLS via QRZ/ISS.=
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Figure 1 — A close-up of the UISS screenshot of K5LBJ’s first ISS packet exchanges.

bility to receive Weatherfax images from the NOAA-15 satellite, the students began tracking weather satellites. Now, each day, K5LBJ posts satellite images of their area on a hallway monitor to update students on not only the weather, but also the fact that students received these images directly from the satellite.

Looking to the Future

Naturally, these achievements created excitement among the LASA students taking the spring Amateur Radio elective course. As they began 2015, these students were abuzz about the upcoming completion of the MAREA project, which is slated to be finished this spring.

As with any classroom, however, novel interests lead to “teachable moments.” As such, students are now focusing their attention on exploring software defined radio (SDR) using RTL-SDR USB devices. Due to this activity — meant to expose students to SDR while receiving weather images from NOAA 15/18/19 — they have not been focusing on making voice contacts via satellite as much. There is a discussion beginning among schools involved in the School Club Roundup (SCR) to attempt some scheduled EME in the upcoming October 2015 SCR.

K5LBJ, like so many other amateur stations around the world, took time to actively monitor the SSTV images sent from the ISS during the period of February 23 – 25, 2015. The Russians were using SSTV to send a variety of images of Yuri Gagarin, the first human to enter outer space and to orbit the Earth. Over a few days, we captured 10 unique images.

As the construction of K5LBJ’s satellite

tracking/communication station demonstrates, such tasks require lots of time, money, and cooperation. However, with patience and assistance from the community, the wonders of Amateur Radio can be explored in the modern-day high school classroom.

¹www.arrrl.org/marea-ham-radio-robotics
²funcube.org.uk/working-documents/funcube-telemetry-dashboard/

ARRL member Ronny Risinger, KC5EES, earned his Technician license in 1993 and upgraded to Amateur Extra class in 2005. He has been teaching Social Studies topics for 18 years at the Liberal Arts & Science Academy High School in Austin, Texas. Since 2004, he has been the Trustee of the LASA High School Amateur Radio Club, K5LBJ, which has taken top honors in the ARRL School Club Roundup contest in 2006, 2010, and 2014. He is a graduate of the University of Texas at Austin, where he earned a BA in Government, and then graduated with honors from South Texas College of Law. He has been a licensed attorney since 1994, was a member of the 2008 Electoral College, and is a National Board Certified educator. Ronny is married to Tina, KC5BZA, and they have three children, including a daughter recently licensed as KG5FFG. You can reach Ronny at kc5ees@arrrl.net.

