AMSAT Station Activities at TUARC K3TU

Dennis Silage K3DS

www.temple.edu/k3tu

TUARC Amateur Radio

K3TU

TEMPLE UNIVERSITY

AMATEUR RADIO CLUB

Go, Temple Owls!

BIG EAST CONFERENCE

College of Engineering

Philadelphia, Pennsylvania 19122 U.S.A.

GRID FM29 - PHILADELPHIA COUNTY

Temple University Amateur Radio Club (TUARC) has held the callsigns K3JKI (1960), WA3TVT (1973) and K3TU (1996)

TUARC is a University club and open to licensed students, staff, faculty and alumni.

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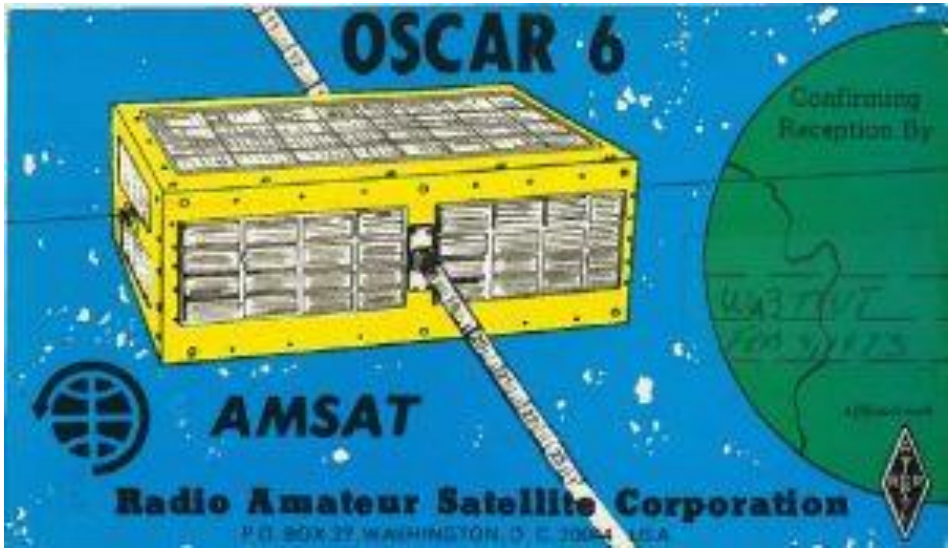
The Temple University Amateur Radio Club (TUARC) K3TU has a long history of AMSAT activities.

TUARC WA3TVT confirmed reception of OSCAR 6 in 1973.



Starting in 1984 TUARC became a laboratory for EE education and was supported with new equipment and antennas.

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The AMSAT station at WA3TVT in 1988 was a brand new 144 MHz ICOM IC271 and 440 MHz IC471. There was also a rare 1296 MHz IC1271.

TUARC at first used an unsophisticated ICOM CT-16 Satellite Interface Unit to lock the IC271 and IC471 together for uplink and downlink but not doppler shift correction.

The AMSAT antennas were KLM cross polarized Yagi for 144 and 440 MHz with a manual Yaesu/Kenpro azimuth-elevation (Az-El) rotor.

However this manual tracking configuration for AMSAT was hard to operate.

EE students have a capstone senior design project and TUARC sponsored the development of a microcomputer for automatic control of Az-El tracking.

The EE design project used a Z80 8-bit microcomputer to calculate the Az-El location for satellite tracking in ZBASIC.

Keplerian data is used for Az-El tracking. However, getting the data was more involved before the Internet. The microcomputer had a 3 MHz clock and no floating point co-processor.

The Az-El calculations were done before the satellite pass in non-real time and stored in battery-backup SRAM memory.

The IEEE sponsored a Region 2 (Middle Atlantic states) award for senior design projects. The Temple teams bested every other school two years in a row.


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VINCENT BENDIX AWARD
OF ALLIED CORPORATION
is presented to
the
IEEE Student Branch
at
Temple University
in recognition of
its outstanding project proposal
entitled
Amateur Radio Satellite Tracking System
during the year
1987-88


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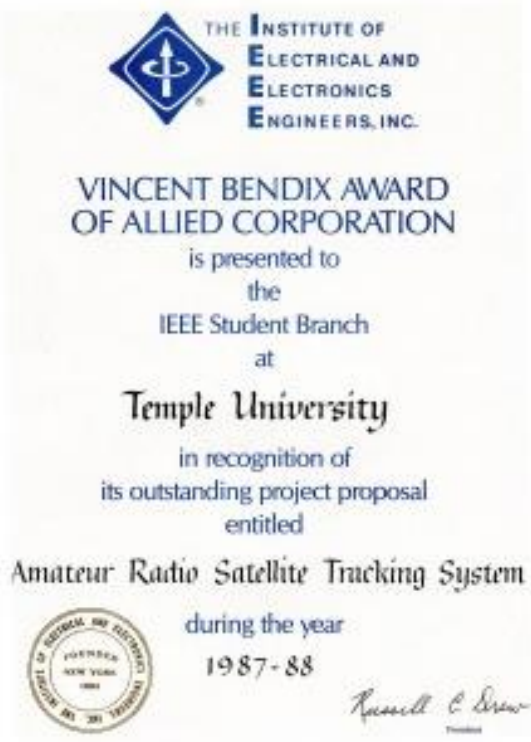
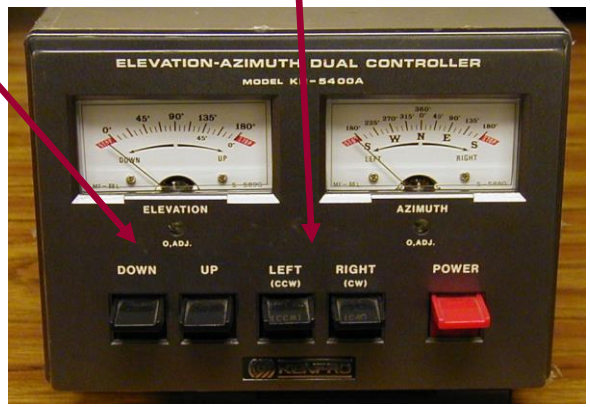
The first Bendix Award was for the initial Az-El tracking microcomputer. The second consecutive Bendix Award added doppler shift correction.



The Az-El tracking calculations set the initial Yagi position and operated the Up/Down (elevation) and Left/Right (azimuth) rotor switches.



The doppler shift correction was also done in non-real time and stored in SRAM. The correction voltage was applied to the RIT of the ICOM transceivers.

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These days Keplerian elements are sent by bulletins:

SB KEP @ ARL $ARLK028
ARLK028 Keplerian data

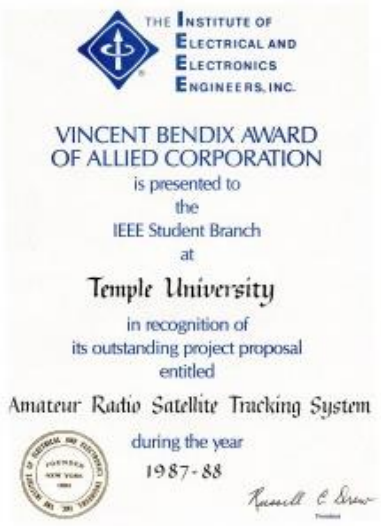
ZCZC SK28
QST de W1AW
Keplerian Bulletin 28 ARLK028
From ARRL Headquarters
Newington, CT April 7, 2020
To all radio amateurs

SB KEP ARL ARLK028
ARLK028 Keplerian data

Decode 2-line elsets with the following key:
1 AAAAAU 00 0 0 BBBBB.BBBBBBBB .CCCCCCCC 00000-0 00000-0 0 DDDZ
2 AAAAA EEE.EEEE FFF.FFFF GGGGGGG HHH.HHHH III.IIII JJ.JJJJJJJJKKKKKZ
KEY: A-CATALOGNUM B-EPOCHTIME C-DECAY D-ELSETNUM E-INCLINATION F-RAAN
G-ECCENTRICITY H-ARGPERIGEE I-MNANOM J-MNMOTION K-ORBITNUM Z-CHECKSUM

0 AO-07
1 7530U 74089B 20098.54802910 -.00000052 +00000-0 -41359-4 0 9996
2 7530 101.7929 068.7058 0012377 139.1122 338.5097 12.53642901077102

AEA/Timewave also later produced the functionally similar ST-1 Satellite Tracker.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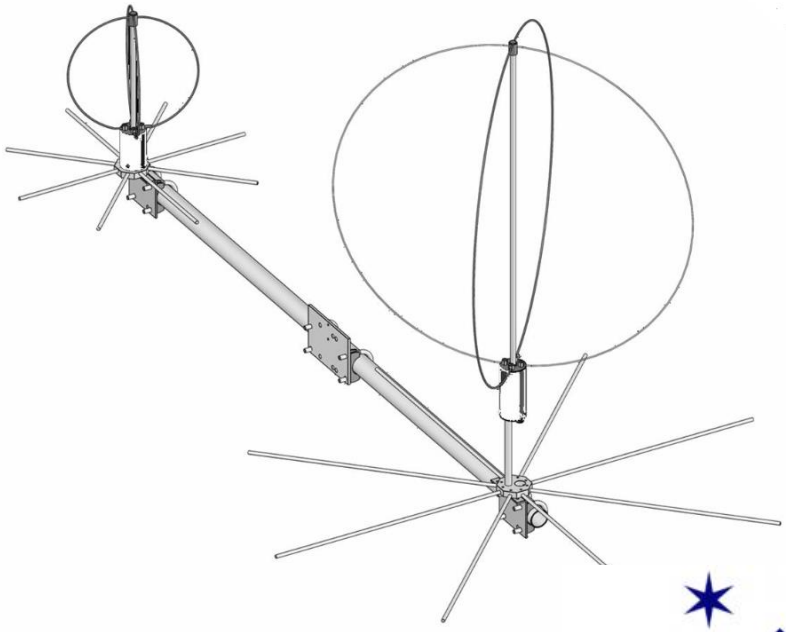
The large Az-El satellite array was heavy and subjected to high wind loads. From 1988 to 2009 the array was rebuilt four times due to damage.

In 2014 the last damage to the Az-El satellite array caused its reconfiguration. The array was replaced by M2 *windmill* antennas for 144 and 440 on the same tower.

The M2 satellite antennas only have a gain of 5.5 dBic but are omnidirectional. The KLM Yagi had a gain of > 15 dbic.



Received signal strength was increased by in-line RF switched (up to 160 W) VHF and UHF GaAsFet preamps with 24 and 16 dB gain and NF ≈ 5.5 dB.

The loss of transmit signal (10 dB) was not a problem since ≈ 5 W was used with the Az-EL Yagi and > 50 W was available from a Kenwood TS-2000 transceiver.

The Kenwood TS-2000 transceiver replaced the ICOM transceivers and has built-in 144 MHz and 440 MHz satellite capability.

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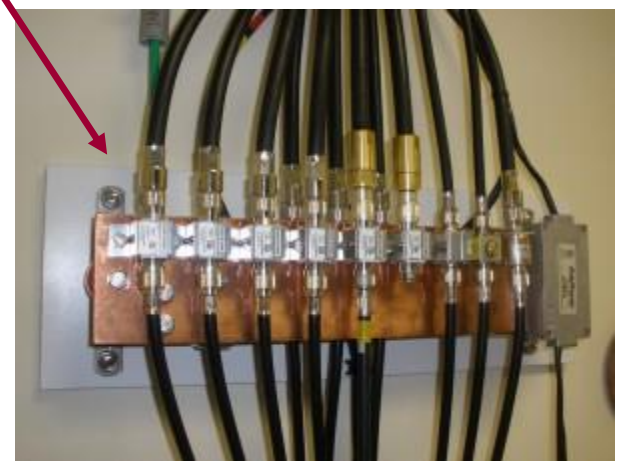
The Diamond X300A on the same tower is used to work 144 and 440 analog FM repeaters.

The Diamond X300A antenna was struck by lightening and destroyed but K3TU has grounding and Polyphaser arrestors.



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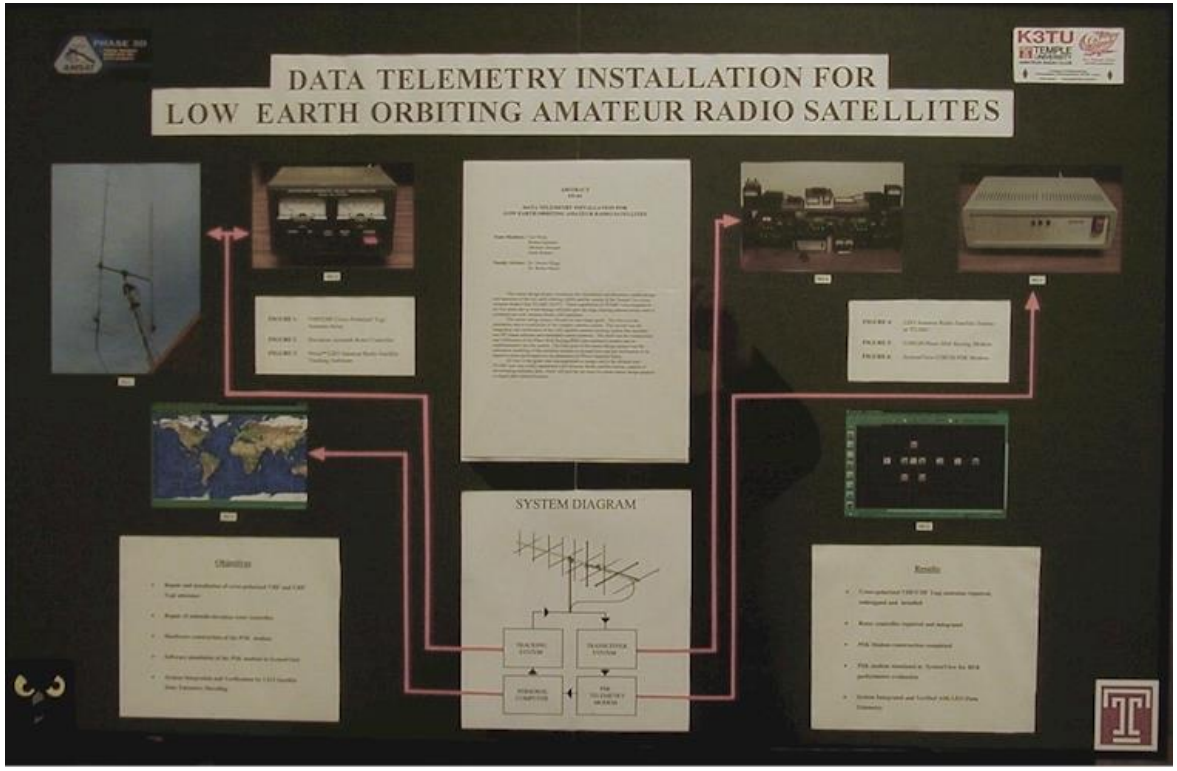
Capstone EE senior design projects have continued with the development of experimental modems for satellite telemetry.



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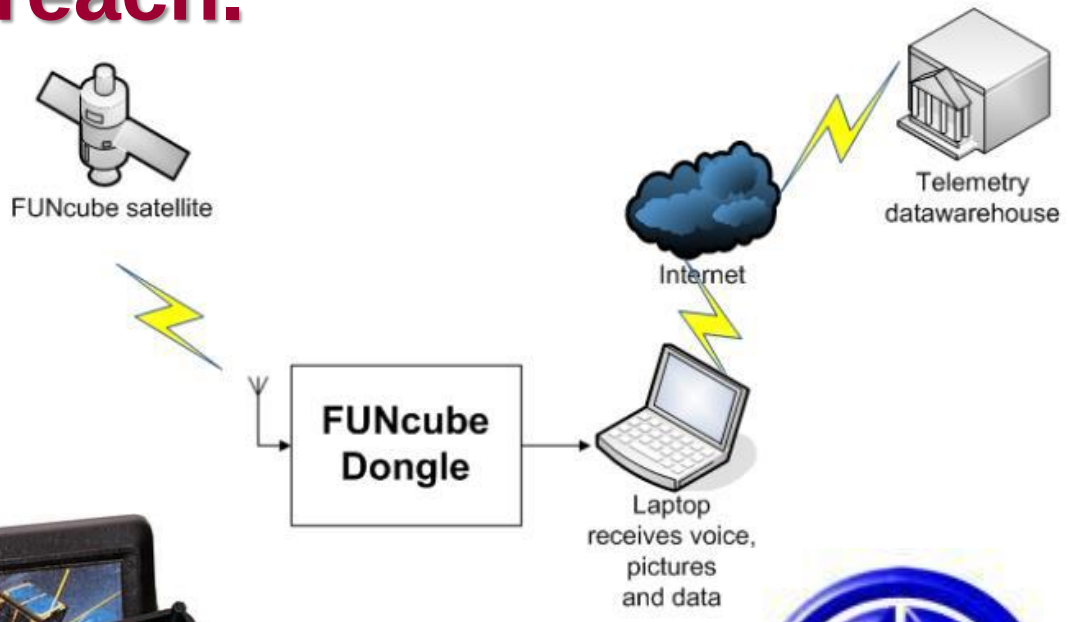
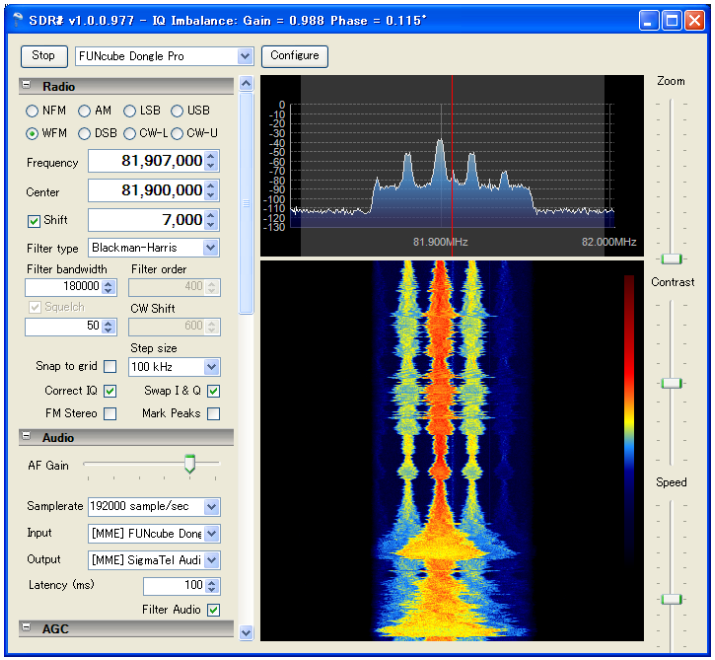
TUARC supports the FUNCube satellite telemetry project initiated by AMSAT UK for STEM outreach.

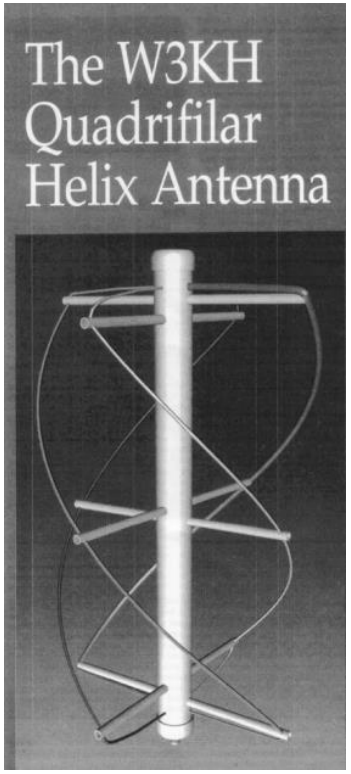


AMSAT-UK

The FUNCube dongle uses freeware software such as SDR#.



A homebrew quadrifilar antenna is use for reception.



AMSAT-UK

TUARC has other station activities.

The Kenwood TS-2000 AMSAT Station at K3TU doubles as the primary HF station.

TUARC Amateur Radio

TUARC is active on HF and has a big signal with the Mosley CL-33-M Yagi at 130 feet.

TUARC Amateur Radio

144 MHz, 440 MHz and 1296 MHz all-mode station

TUARC Amateur Radio

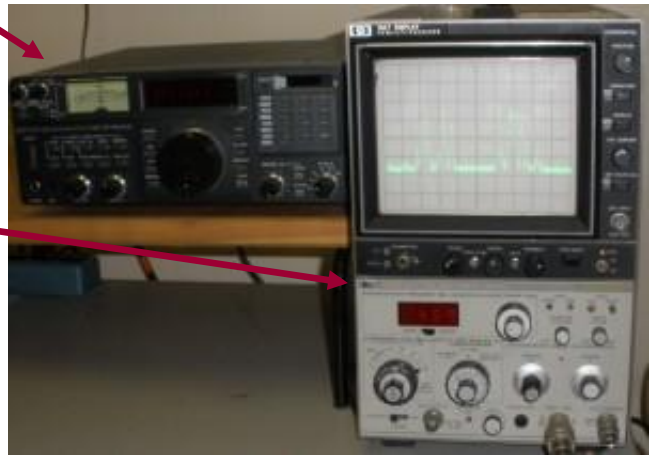
Linked cross-band 224.8 MHz and 442.8 MHz analog FM repeaters

144.39 MHz APRS station

RF spectrum analysis:

ICOM R7000

HP 8558B



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