GippsTech 2016

SARC1 High Altitude Balloon Payload
For The
2016 Global Space Balloon Challenge

By

Julie VK3FOWL and Joe VK3YSP

GippsTech 2016 Presentations

Projects inspired by Primary School Amateur Radio Clubs:

1. **SARC1 HAB Payload for 2016 GSBC**
2. **AIS Saves Lives**
3. **Mini Satellite-Antenna Rotator**
4. **Speech Synthesiser for the FT-817**

Primary School Amateur Radio Clubs

"CQ CQ..."

SCHOOL

VK3SRC   SCHOOL AMATEUR RADIO CLUB NETWORK

SARC Objectives

- SARC is not a Foundation Licence course
- Mission: To develop interest in science, technology, engineering and mathematics through Amateur Radio
- Weekly lunchtime radio club meetings:
  - Safe, inclusive, developmental
  - On-air experience
  - Organised activities
  - Team missions
  - Group projects

Welcome to SARCNET

This site is a free on-line resource for anyone associated with or thinking about setting up a School Amateur Radio Club. That is, a fun, school lunch-time activity for a select group of students who would rather be tinkering with electronic gadgets and exploring the air waves than dodging footballs or watching cricket.

School Amateur Radio Clubs are a neat way to get in an extra shot of science and technology, while exercising your on-air conversational skills and tuning up your enquiring minds. It will expand your horizons, build your confide

nce, harness your creativity and help you develop new skills. Each week there will be different activities to whet your appetite. SARC members learn to work together as a group and help each other through some pretty exciting challenges.

This site is for school principals, teachers, parents, students and amateur radio enthusiasts. It provides inspiration, ideas, articles, news and activities all free to download, modify and use as you wish.

The first thing we would like to give you for free is our total encouragement and support for this very worthwhile and successful activity. Please do not hesitate to contact us for advice.

Next, please read our SARC article with an introduction by our biggest supporter, school principal Mr. Michael Day.

Then check out our frequently asked questions page. Have a look at the schools already participating in this program and some of the amazing activities they do. You can download our booklet which provides a handy reference for all SARC members. There is also a proposal to start a club, a form for new members to fill out and a newsletter to kick things off at school.

Oh, and did we mention a challenge? Well, your mission, should you decide to accept it, could well be on our missions page. These exciting role-play adventures will certainly test all of your skills.

Finally, keep up to date with all the news. Don't forget that when you set up your own School Amateur Radio Club and your school is listed here, you can contribute to this site by sending us your own news articles, activities and missions. You will also receive our regular SARC newsletter by e-mail.

Good luck from Julie VK3FOWL and Joe VK3YSP. For more information see about SARCNET.

School Amateur Radio Club members are a select group of students.

Projects

School Amateur Radio Clubs have inspired a number of very interesting radio and electronic projects. We are developing more all the time. We include them here so that you can be inspired too! Everything is free of course. Our software is released under the GNU General Public Licence. So you can pretty much do what you want with it, provided you just keep the copyright statement and reference to this site.

High Altitude Balloon Payload MTG004

This project was our first Global Space Balloon Challenge payload. It transmits alternating JT9/JT65 telemetry on 30m SSB. It was launched on 19 April 2015. For more details please see our Amateur Radio magazine article and GippsTech technical presentation:

- Melbourne Amateur Radio and Technology Group - Global Space Balloon Challenge
- GippsTech 2015 High Altitude Balloon Presentation

High Altitude Balloon Payload SARC1

This project is our second Global Space Balloon Challenge payload. It transmits BPSK31 telemetry on 434.650MHz FM. It was launched as part of the 2016 ANZAC Day Amateur Radio Special Event. Both SARC students and Melbourne region Scouts participated in the launch and then tracking the payload on their mobile devices.

- SARC1 Payload Configuration
- GippsTech 2016 SARC1 Presentation

A Speech Synthesizer for the Yaesu FT-817

This project enables the whole SARC class to hear the frequency, mode and signal strength of our Yaesu FT-817 transceiver. The project was nicknamed "Rachel" after the synthetic British female voice we used for text-to-speech conversion. It could also be useful for operators with impaired vision. For more details please see our Amateur Radio magazine article and source code:

- Amateur Radio magazine article
- Arduino source code
- MP3 files for the project
- GippsTech 2016 Rachel Presentation

Mini Satellite-Antenna Rotator

This project lets SARC students to track Amateur Radio satellites using our solar-powered, portable, amateur satellite-antenna rotator.

- Amateur Radio magazine article
- Construction details
- Arduino source code
- GippsTech 2016 Rotator Presentation

AIS Receiver

This project lets SARC students track vessels coming into port. It is an Automatic Identification System (AIS) receiver. It picks up information about passing vessels and uploads it to an AIS server over the Internet. Students can check out pictures and information about the ships and costal receiving stations on a web site.

- Amateur Radio magazine article
- Construction details
- GippsTech 2016 AIS Presentation

Related Information

Please note that this site is currently under constant construction and revision since January 2016. Please check back regularly to see new or updated news, activities and missions. Please contact us if you would like to be added to our mailing list.

ANZAC DAY AMATEUR RADIO SPECIAL EVENT

ALL DAY EVENT AT VICTORY PARK BENTLEIGH

PRESENTED BY:
- SCHOOL AMATEUR RADIO CLUB NETWORK (VK3SRC)
- MELBOURNE REGION SCOUTS (VK3SAA)

THANKS TO :
- SCOUTS AUSTRALIA
- MOORABBIN AND DISTRICT RADIO CLUB
- FIRST AID TRAINING GROUP
- BENTLEIGH RSL

SARC/SCOUT ON-AIR DEMONSTRATIONS

Thanks to: Pete VK3HEX

Thanks to: Emilka

SARC SOLDERING DEMONSTRATION

MORSE CODE PRACTICE

MDRC HISTORICAL RADIO DISPLAY

Thanks to:
Moorabbin and District Radio Club
Ron VK3AFW
Colin VK3UDC

FIRST AID - CPR PRACTICE

Thanks to: Pete VK3HEX and Kerry from First Aid Training Group

SCOUT HERITAGE DISPLAY

Thanks to: Scout Heritage Victoria

HIGH-ALTITUDE BALLOON DISPLAY

SCOUT ENGINEERING DISPLAY

Thanks to: Murray VK3MJT Melbourne Cubs Commissioner

ANZAC DAY CEREMONY

AMATEUR RADIO DIRECTION FINDING

Thanks to: SRESU
Bryan VK3YNG and Kevin VK3KAB

HAB PRE-LAUNCH SEQUENCE

HIGH ALTITUDE BALLOON LAUNCH SYSTEM
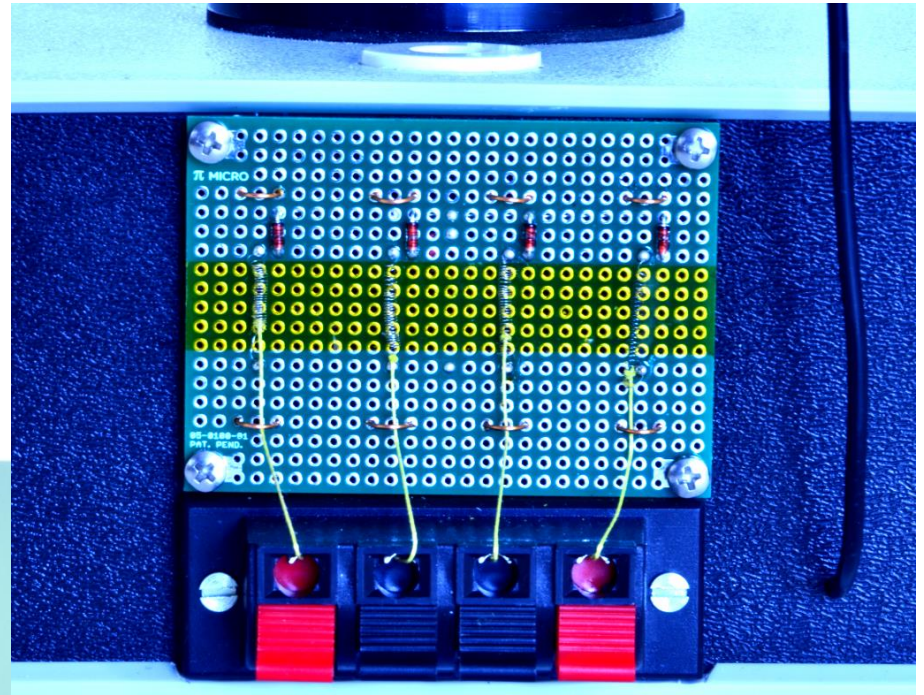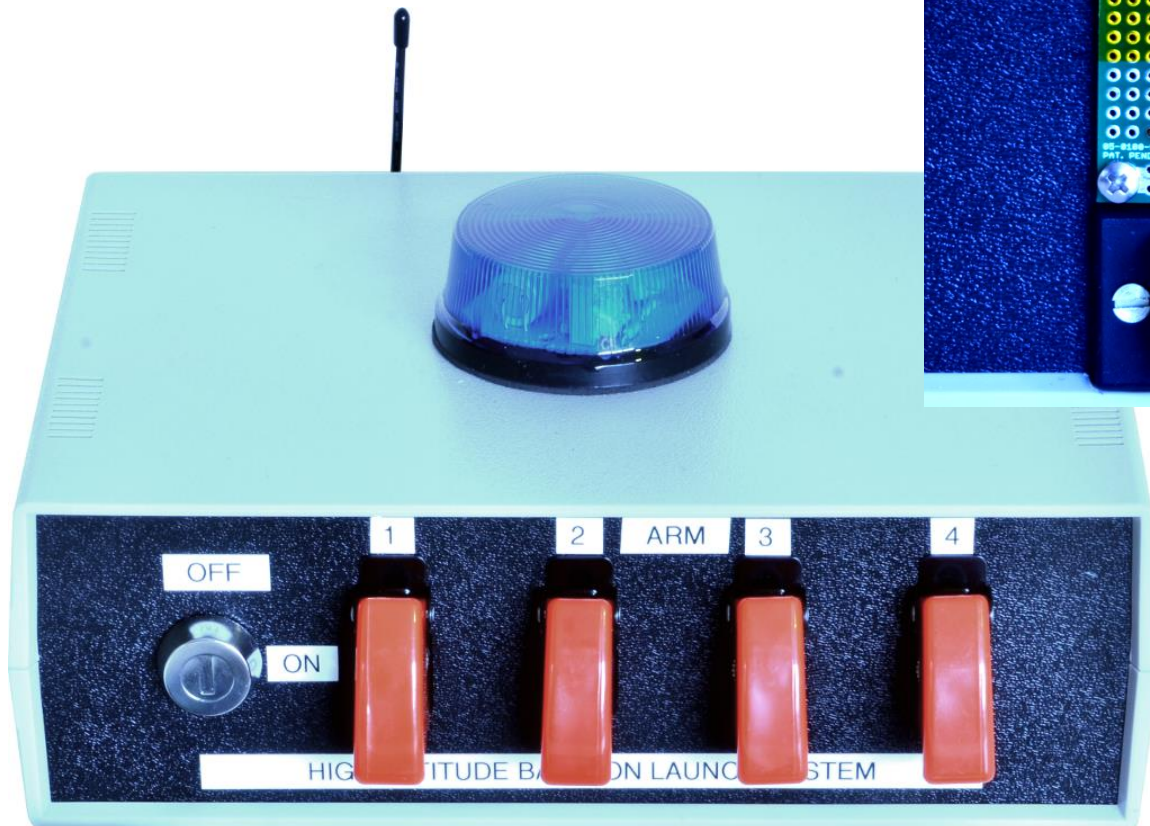
HIGH-ALTITUDE BALLOON LAUNCH

Thanks to: Anthony VK3YSA, Kent VK3TER and Ben Gillies

2016 GLOBAL SPACE BALLOON CHALLENGE

"Where people around the world simultaneously fly high altitude balloons, celebrating an age where anyone can reach the edge of space"

2016 GLOBAL SPACE BALLOON CHALLENGE

HAB Group: School Amateur Radio Club Network

HAB Project: ANZAC Day Special Amateur Radio Event

Balloon type: 90cm Qualatex Microfoil 12683

Balloon expected cruising altitude: 4000m

CASR 1998 101.E Type: Small unmanned free balloon

CASA approval: Not required

Glen Eira City Council Permit Local Law 314: Not required

Launch location: Bentleigh, Victoria, Australia

Launch date: 10:30am (0030UTC) Monday 25 April 2016

Launch window: 11/4/2016 – 9/5/2016

SARC1 PAYLOAD CONFIGURATION

Radio Frequency: 434.650MHz

Antenna Polarization: Vertical

Radio Mode: FM

Telemetry Mode: BPSK31

Telemetry Frequency: 1255Hz

Payload callsign: VK3YSP

Payload name: SARC1

Payload type: Telemetry only

Payload weight: 50g

Polystyrene enclosure: 120mm

Payload battery: 3 x AAA L92 Lithium

Payload GPS: Ublox NEO 6MV2

GPS dynamic model: Airborne < 1g

GPS max altitude: 50,000m

GPS antenna: UHF dipole

Payload temperature sensor: LM35

Payload CPU: 16MHz Pro Micro

Payload transceiver: DORJI DRA818U

Payload antenna. UHF dipole

Payload frame rate: 1/min
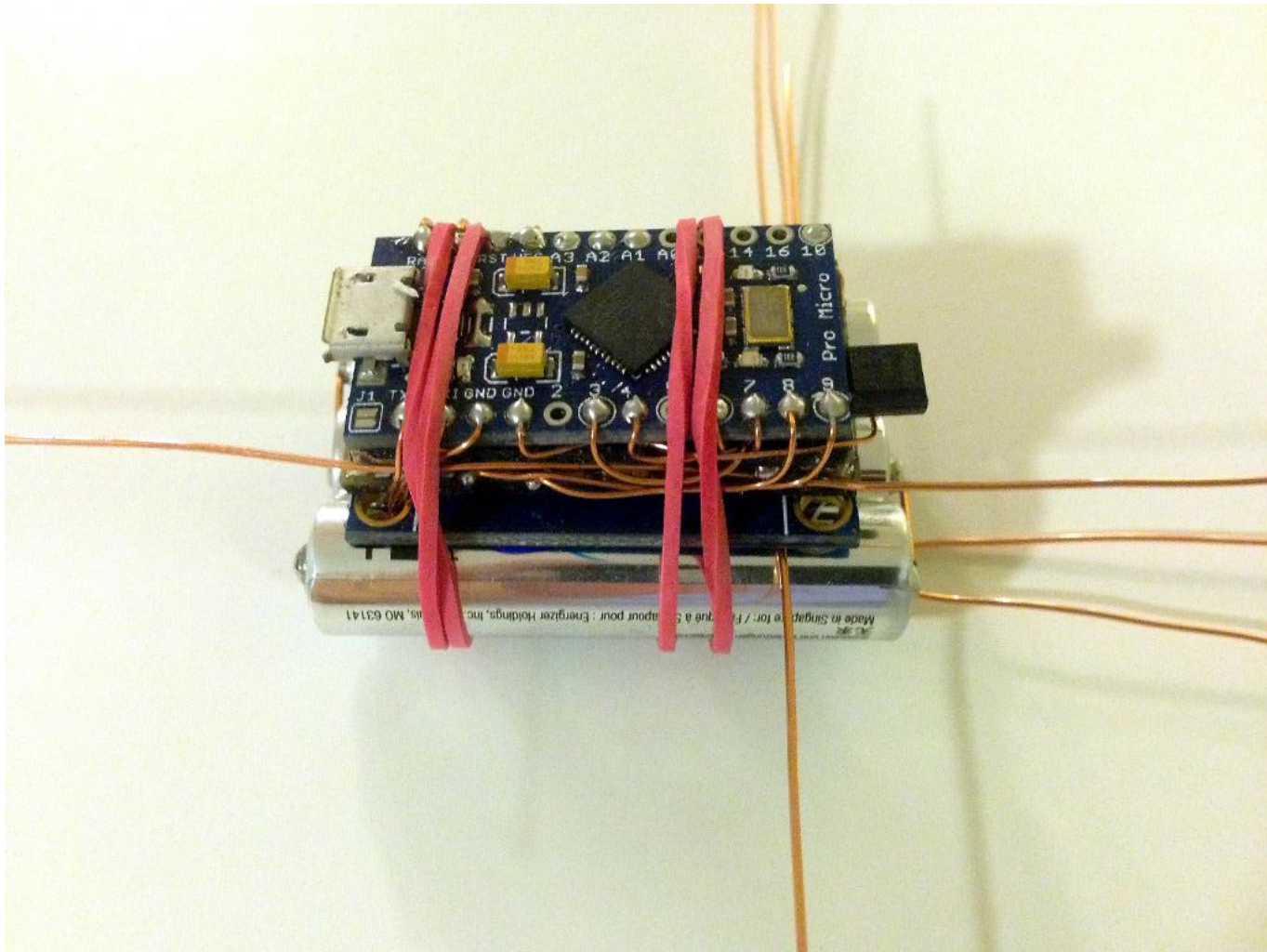
Payload RF output power: 500mW

Payload min operating voltage: 2.7V
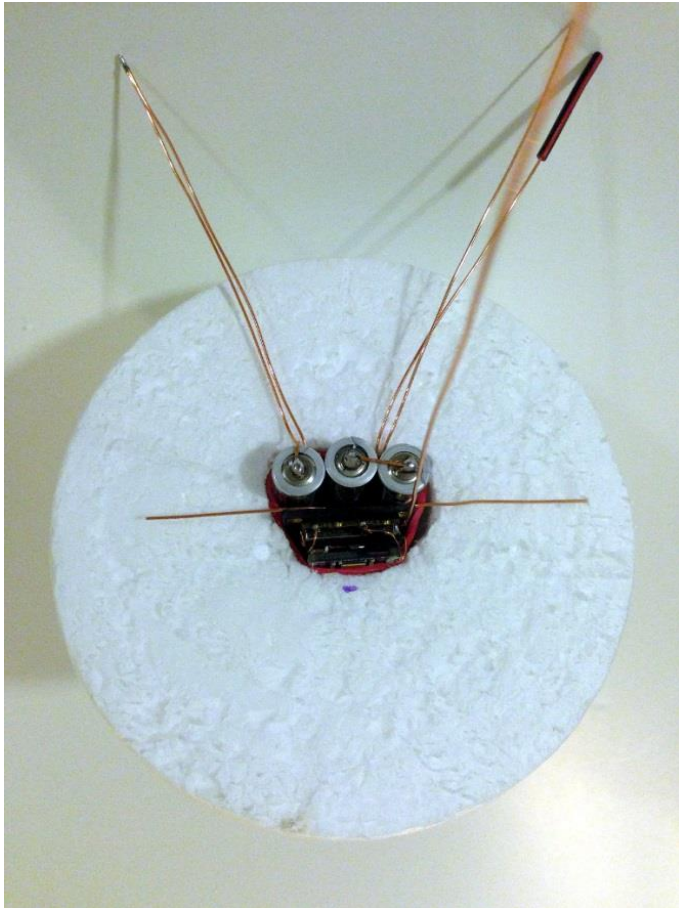
Payload endurance: 6.5 hours

SARC1 PICTORIAL SCHEMATIC
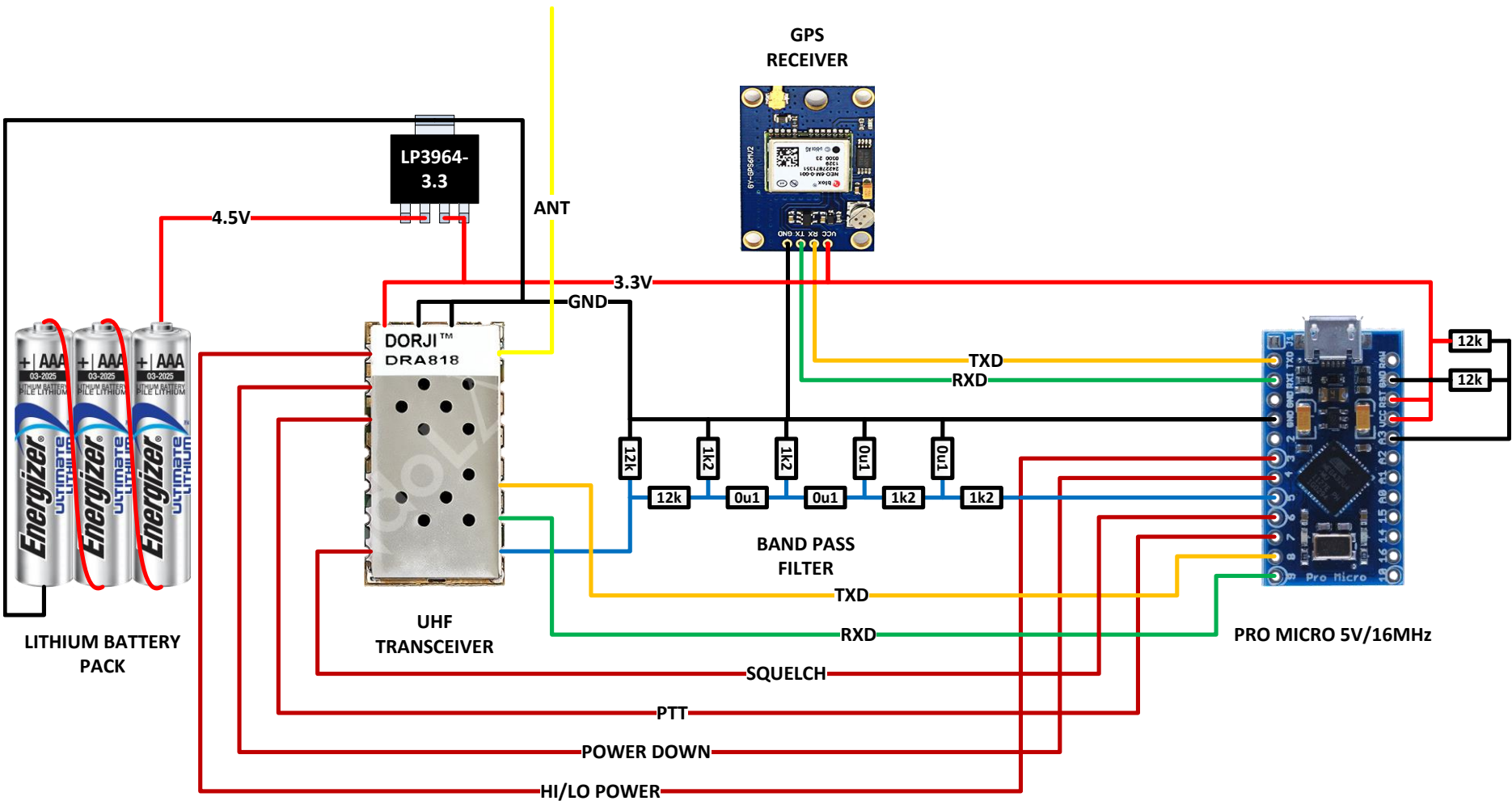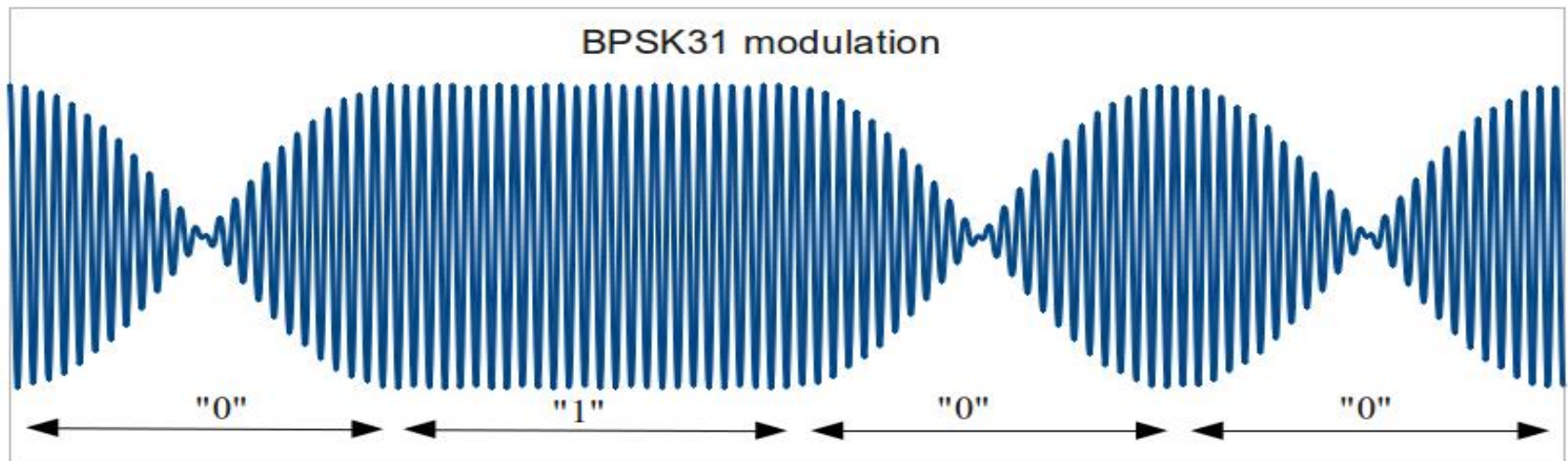
SARC1 ELECTRONICS PACK

SARC1 PAYLOAD

BPSK31 ENCODING

- First encode text using **Varicode**
- Then send code at 31.25 baud using **Binary Phase Shift Keying**
- Send 1 with no phase reversal. Send 0 with a cosine-modulated phase reversal.
- Phase changes occur at minimum level to avoid phase "clicks"

BPSK31 modulation

"0"   "1"   "0"   "0"

VARICODE

- Invented by **Peter Martinez G3PLX**
- Based on Morse code!
- Variable length code up to 12 bits
- Common characters have shorter codes
- Each character starts with 1 and ends with 00

Example:

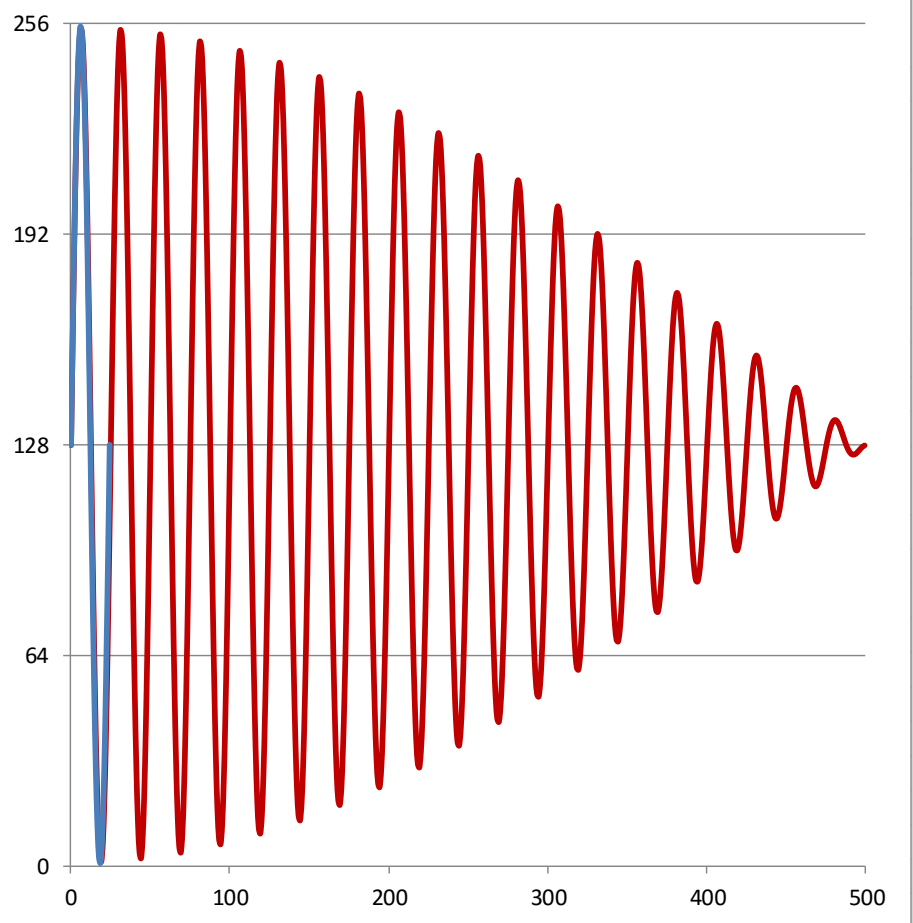| 101100	100	101111100	11100	10110100	1100
a	\<space\>	c	o	d	e

WAVEFORM GENERATION

- Create a **lookup table** of waveform values
- Setup a **hardware timer** to generate a phase-correct PWM square wave at the waveform sample rate.
- Use the timer's overflow **Interrupt Service Routine** to load a new waveform value from the lookup table into the PWM generator at the end of each PWM cycle.
- Use a **Band Pass Filter** to filter the PWM output.

Hint:

- Use a **spreadsheet** to create the waveform values
- The BPSK31 waveform is a cosine-modulated sinewave:

=COS(2*PI()*A12/$B$4/$B$5/2)*SIN(2*PI()*MOD(A12,$B$4)/$B$4)

Clock Frequency (Hz)	16000000	16000000	16000000	16000000
Clock Divisor	512	512	512	512
Samples per second	31250	31250	31250	31250
Samples per cycle	25	50	40	20
Cycles per symbol	40	20	25	50
Samples per symbol	1000	1000	1000	1000
Cycles per second	1250	625	781.25	1562.5
Seconds per symbol	0.032	0.032	0.032	0.032
Symbols per second	31.25	31.25	31.25	31.25
Degrees to radians	0.017			

Sample	Float	Byte	Hex	Float	Byte	Hex
0	0.000	128	80	0.000	128	80
1	0.249	160	A0	0.249	160	A0
2	0.482	189	BD	0.482	189	BD
3	0.685	215	D7	0.685	215	D7
4	0.844	235	EB	0.844	235	EB
5	0.951	249	F9	0.951	249	F9
6	0.998	255	FF	0.998	255	FF
7	0.982	253	FD	0.982	253	FD
8	0.905	243	F3	0.905	243	F3
9	0.770	226	E2	0.771	226	E2
10	0.587	203	CB	0.588	203	CB
11	0.368	175	AF	0.368	175	AF
12	0.125	144	90	0.125	144	90
13	-0.125	112	70	-0.125	112	70
14	-0.368	81	51	-0.368	81	51
15	-0.587	53	35	-0.588	53	35
16	-0.770	30	1E	-0.771	30	1E
17	-0.904	13	0D	-0.905	13	0D
18	-0.981	3	03	-0.982	3	03
19	-0.996	1	01	-0.998	1	01
20	-0.949	7	07	-0.951	7	07
21	-0.842	21	15	-0.844	21	15
22	-0.683	41	29	-0.685	41	29
23	-0.480	67	43	-0.482	67	43
24	-0.248	97	61	-0.249	96	60
25	0.000	128	80	0.000	128	80

BPSK31 DECODING AND UPLOADING

ON-LINE TRACKING WITH HABHUB

SARC1 was tracked by:
Rhett VK3GHZ
Peter VK3XCO
Dean VK3NFI
Frank VK3FADI
Joe VK3YSP
Paul VK3DBP
David VK3KCX
Karl VK3LN
Mark VK3OHM
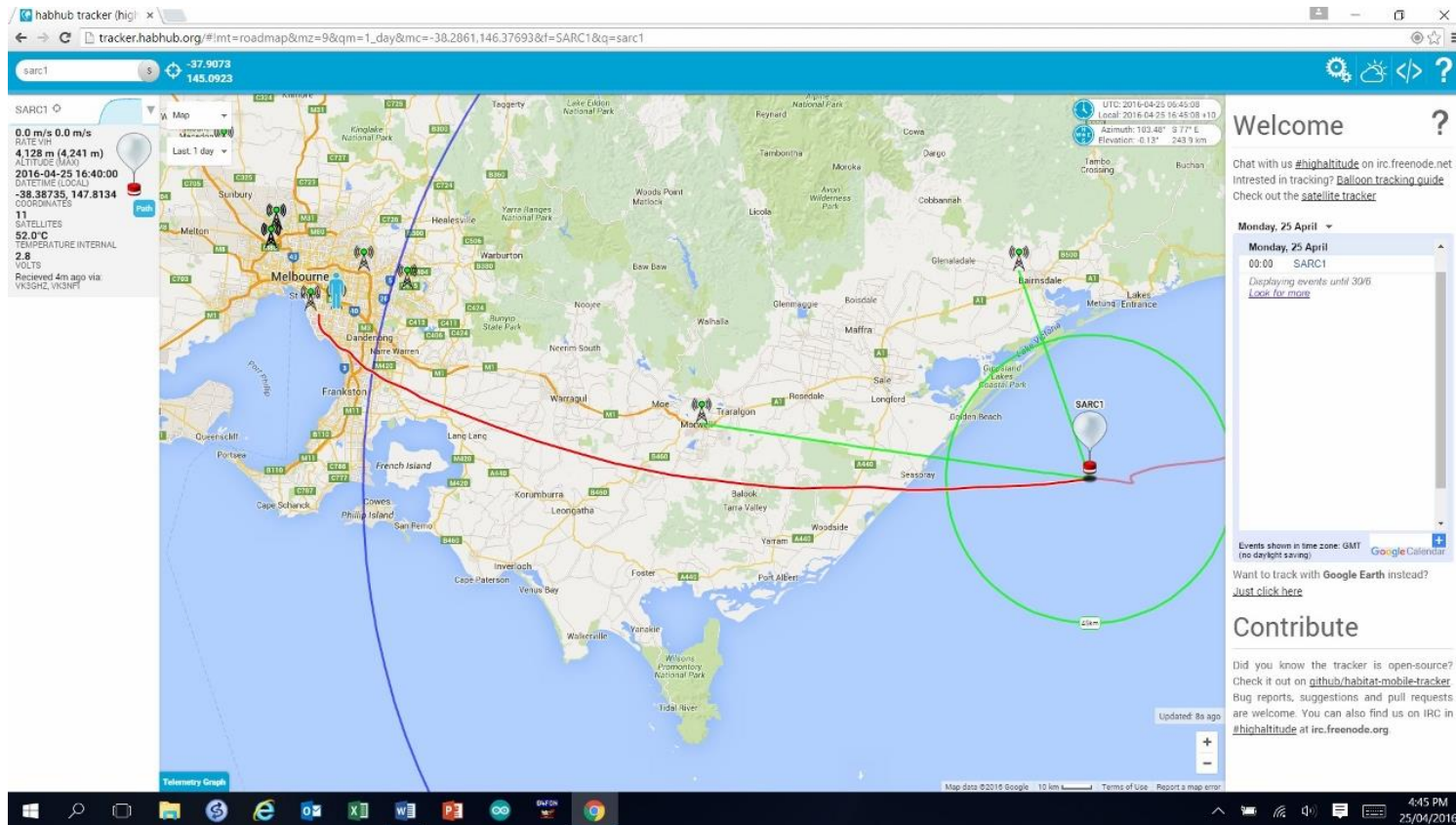
SARC1 TELEMETRY DATA PLOT

SOURCES/LINKS

- http://www.sarcnet.org/projects.html
- http://www.arrl.org/files/file/Technology/tis/info/pdf/x9907003.pdf
- https://www.casa.gov.au/standard-page/casr-part-101-unmanned-aircraft-and-rocket-operations
- https://www.balloonchallenge.org/