


MY CUBESAT ACTIVITIES

Muhammad Noman

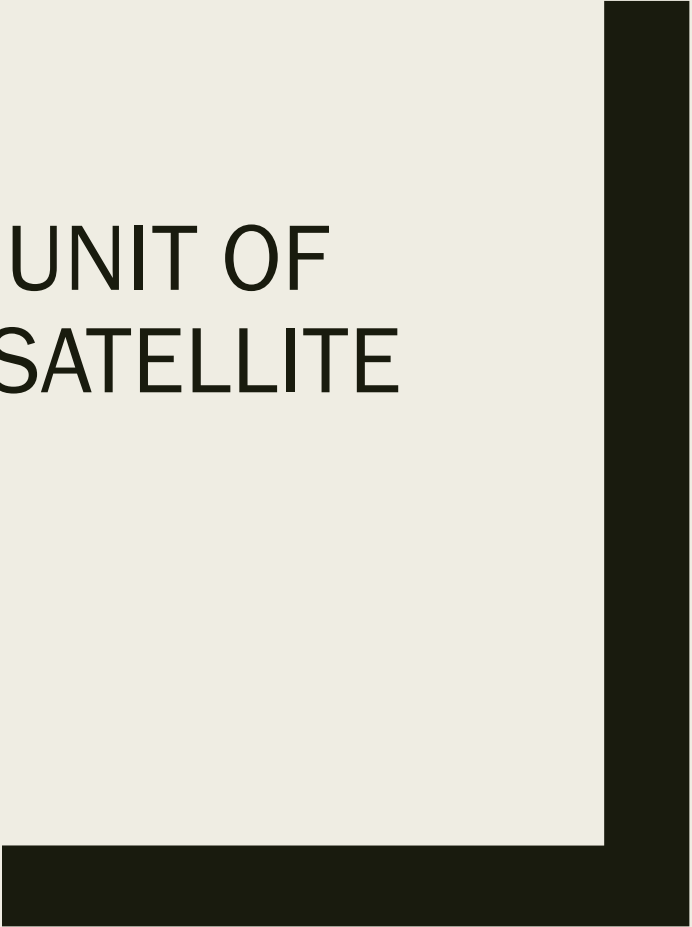


Contents

- Design of Magnetometer Unit for Pakistan National Student Satellite (PNSS-1)
- VHF/UHF Ground Station
- Design of Power Subsystem of ICUBE-2



DESIGN OF MAGNETOMETER UNIT OF
PAKISTAN NATIONAL STUDENT SATELLITE
(PNSS-1)



Pakistan National Student Satellite (PNSS-1)

- PNSS-1 was the initiative of SUPARCO (Space agency of Pakistan) to train and equip students for space industry
- Students of different universities were assigned Modules of satellite as their final year project.
- Design requirements were given by SUPARCO

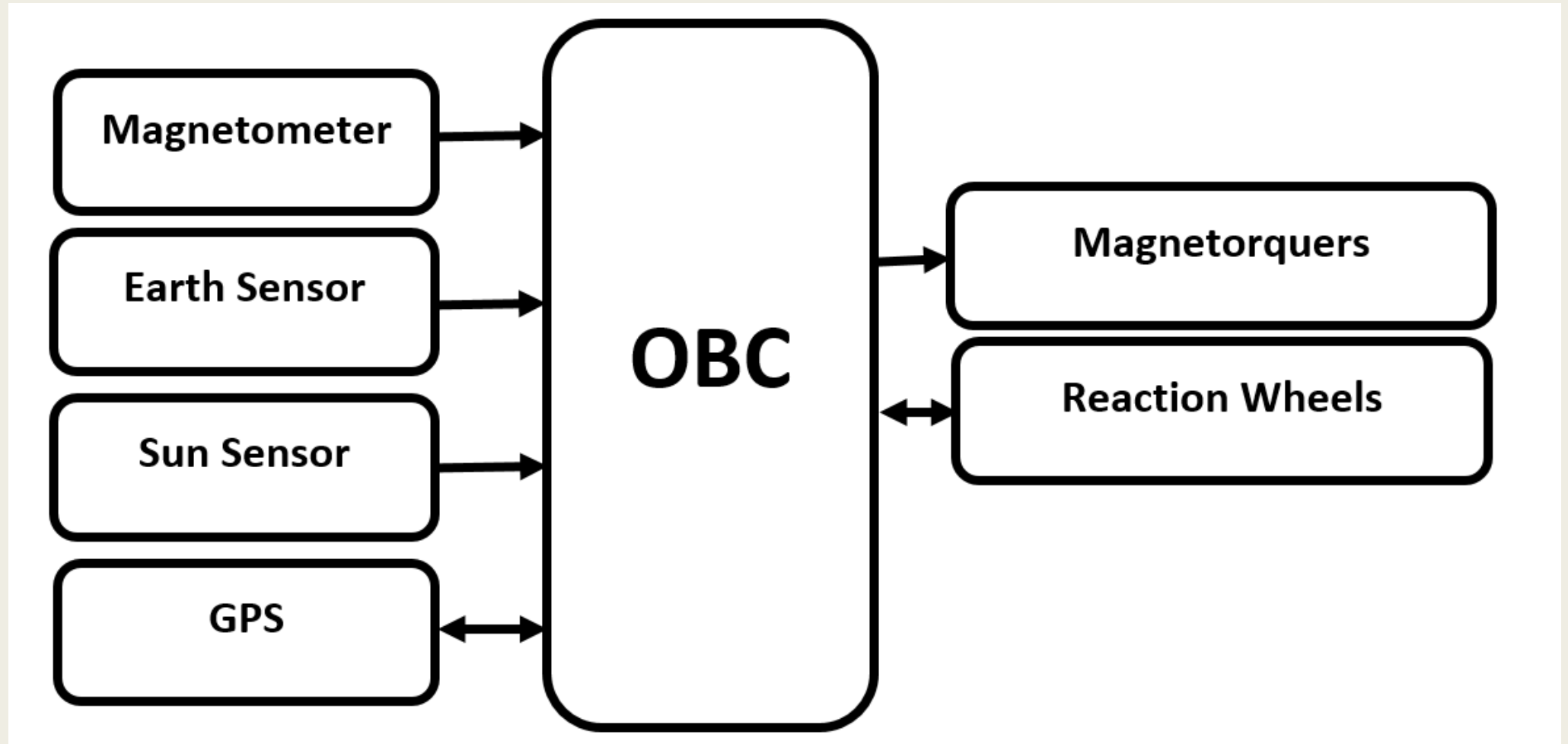
Attitude Determination and Control System (ADCS)

- Attitude— 3 dimensional orientation of a satellite with respect to a reference.
- Orient the solar panels towards sun and antenna towards ground



<http://www.animatedimages.org/cat-satellite-611.htm>

ADCS



Magnetometer

- Magnetometer measures 3-axes magnetic field of earth
- Comparison with World Magnetic Model (WMM).
- These results along with data from other sensors are used for attitude determination

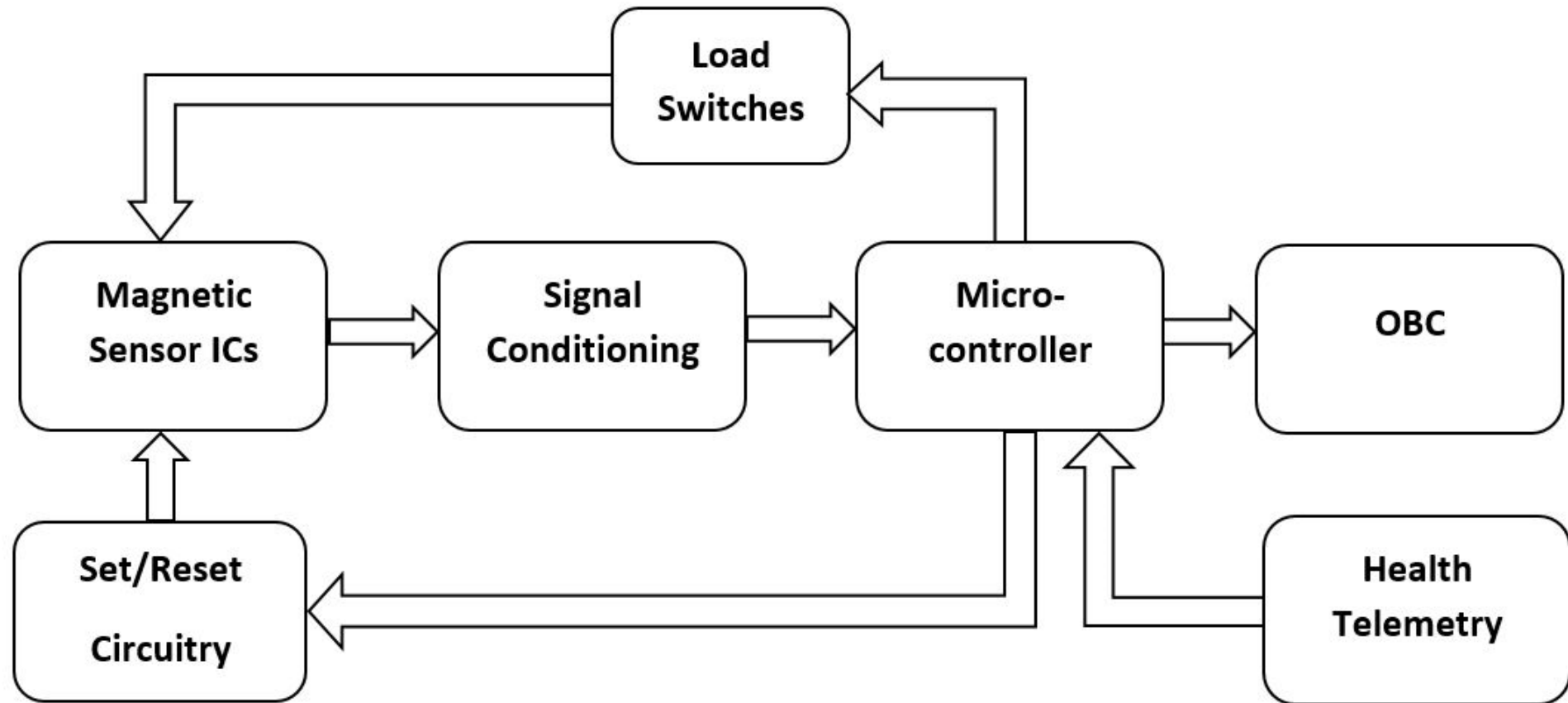
Project Deliverables

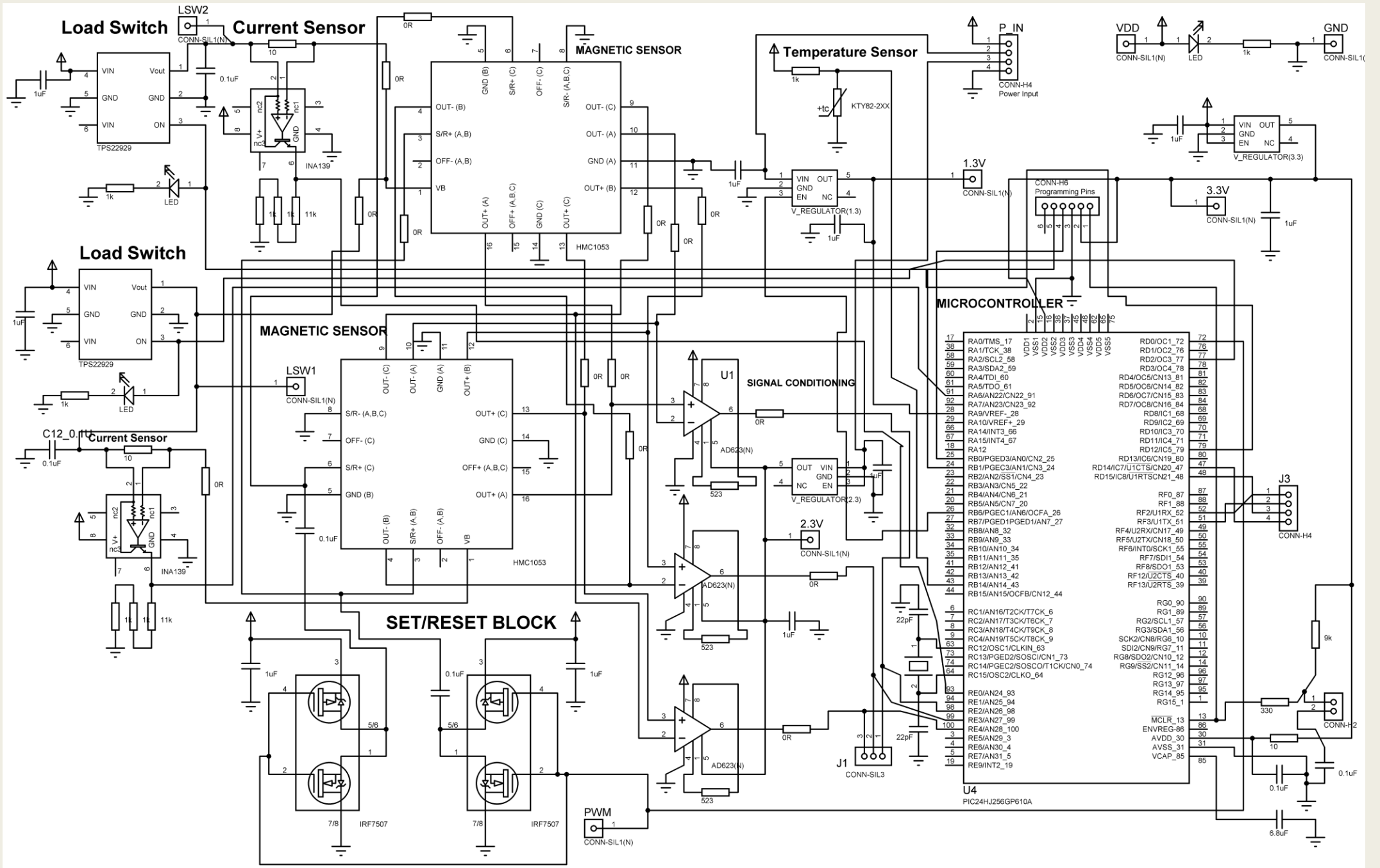
- Three axis Earth Magnetic field measurement.
- Magnetometer health telemetry collection (Temperature, voltage and current of sensor)
- Serial communication interface with ON Board Computer (OBC)

Design Requirements

Characteristics	Value
Operating voltage	+5VDC
Measurement range	+100,000 nTesla to -100,000 nTesla
Resolution	100 nTesla
Operating temperature range	-40 to +85 C
Power consumption	<500mW
Mass of the unit	< 200 grams
Dimensions	130x50x11 mm
Serial data update rate	38.4kbps

Magnetometer Block Diagram



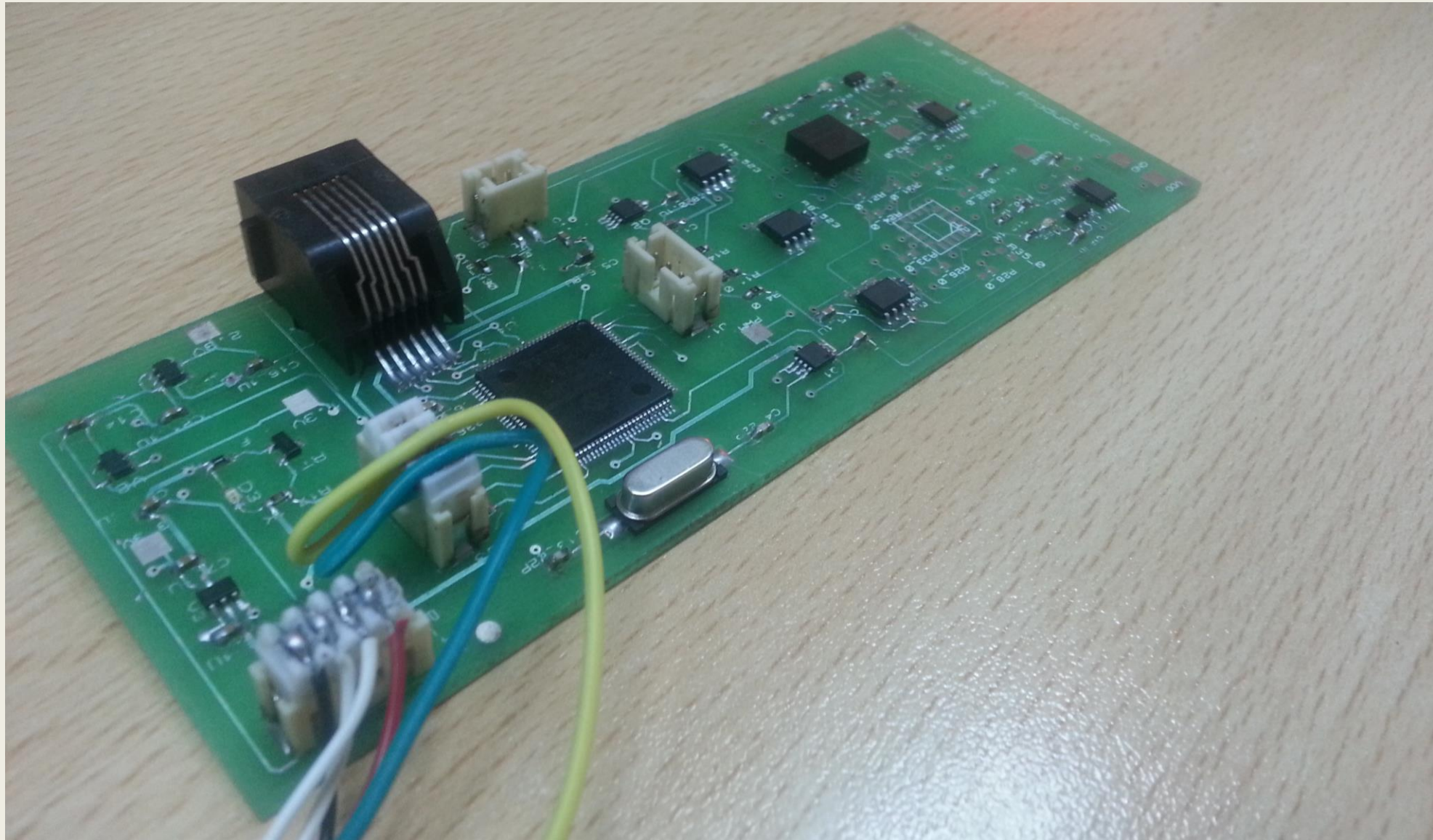


MICROCONTROLLER

17	RA0/TMS_17	RD0/OC1_72	72
38	RA1/TCK_38	RD1/OC2_76	76
58	RA2/SC1_58	RD2/OC3_77	77
59	RA3/SDA2_59	RD3/OC4_78	78
60	RA4/TDI_60	RD4/OC5/CN13_81	81
61	RA5/TDO_61	RD5/OC6/CN14_82	82
91	RA6/AN22/CN22_91	RD6/OC7/CN15_83	83
92	RA7/AN23/CN23_92	RD7/OC8/CN16_84	84
28	RA9/VREF+_28	RD8/IC1_68	68
29	RA10/VREF+_29	RD9/IC2_69	69
66	RA14/INT3_66	RD10/IC3_70	70
67	RA15/INT4_67	RD11/IC4_71	71
18	RA12	RD12/IC5_79	79
25	RB0/PGED3/AN0/CN2_25	RD13/IC6/CN19_80	80
24	RB1/PGEC3/AN1/CN3_24	RD14/IC7/U1CTS/CN20_47	47
23	RB2/AN2/SS1/CN4_23	RD15/IC8/U1RTSCN21_48	48
22	RB3/AN3/CN5_22		
21	RB4/AN4/CN6_21	RF0_87	87
20	RB5/AN5/CN7_20	RF1_88	88
26	RB6/PGEC1/AN6/OCFA_26	RF2/U1RX_52	52
27	RB7/PGED1/PGED1/AN7_27	RF3/U1TX_51	51
32	RB8/AN8_32	RF4/U2RX/CN17_49	49
33	RB9/AN9_33	RF5/U2TX/CN18_50	50
34	RB10/AN10_34	RF6/INT0/SCK1_55	55
35	RB11/AN11_35	RF7/SDI1_54	54
41	RB12/AN12_41	RF8/SDO1_53	53
42	RB13/AN13_42	RF12/U2CTS_40	40
43	RB14/AN14_43	RF13/U2RTS_39	39
44	RB15/AN15/OCFB/CN12_44		
6	RC1/AN16/T2CK/T7CK_6	RG0_90	90
7	RC2/AN17/T3CK/T6CK_7	RG1_89	89
8	RC3/AN18/T4CK/T9CK_8	RG2/SC1_57	57
9	RC4/AN19/T5CK/T8CK_9	RG3/SDA1_56	56
63	RC12/OSC1/CLKIN_63	SK2/CN8/RG9_10	10
73	RC13/PGED2/SOSC/CN1_73	SD2/CN9/RGT_11	11
74	RC14/PGEC2/SOSC/CN11_74	RG8/SDO2/CN10_12	12
64	RC15/OSC2/CLKO_64	RG9/SS2/CN11_14	14
83	RE0/AN24_93	RG12_96	96
94	RE1/AN25_94	RG13_97	97
98	RE2/AN26_98	RG14_95	95
99	RE3/AN27_99	RG15_1	1
100	RE4/AN28_100		
3	RE5/AN29_3	MCLR_13	13
4	RE6/AN30_4	ENVREG_98	98
5	RE7/AN31_5	AVDD_30	30
19	RE9/INT2_19	AVSS_31	31
		VCAP_85	85

U4
PIC24HJ256GP10A

Hardware



Results

Magnetic Field Measurement

- 3-axes magnetic field of earth is measured

$$X = 53771.82 \text{ nT}$$

$$Y = 23021.66 \text{ nT}$$

$$Z = 39721.27 \text{ nT}$$

- **Measurement range=-100,000nT to +100,000nT**
- When any axis is aligned with north pole magnetic field of the corresponding axis is maximum

Health Telemetry

- **Operating voltage** of the magnetometer=**5V**
- **Current** through the magnetic sensor=**13.63mA**
- **Voltage** across magnetic sensor=**4.86V**
- **Temperature** of the Magnetometer Unit=**25.85 °C** (in lab)

Serial Communication

- Serial communication using UART
- Serial data rate=38.4kbps
- 3-axis magnetic field and health data displayed on laptop

Received Data on Laptop

```
COM8 - PuTTY

////////////////////////////////////
///                               ///
///      PNSS-1 MAGNETOMETER      ///
///                               ///
////////////////////////////////////

      Earth's Magnetic Field

X = 53771.82 nT
Y = 23021.66 nT
Z = 39721.27 nT

      Sensor's Health Telemetry

Current = 13.63 mA
Temperature = 25.85 C
Voltage = 4.86 V
```

Power Dissipation

- Operating voltage=**5V**
- Current drawn by magnetometer=**35.4mA**
- Power dissipated in magnetometer= **177mW**
- Power dissipated in magnetic sensor= **$13.7 \times 4.86V = 66.4mW$**

Conclusion

All deliverables achieved!!

Requirements	Required	Achieved
3-axes magnetic field measurement	+100,000 nTesla to -100,000 nTesla	+100,000 nTesla to -100,000 nTesla
Health telemetry	Temp, current, voltage	Temp, current, voltage
Serial communication interface	38.4kbps	38.4kbps
Operating voltage	+5VDC	+5VDC
Resolution	100 nTesla	48.8nTesla
Operating temperature range	-40 to +85 °C	-40 to +85 °C
Power consumption	<500mW	177mW
Mass of the unit	< 200 grams	30 grams
Dimensions	130x50x11 mm	130x50x11 mm



VHF/UHF GROUND STATION

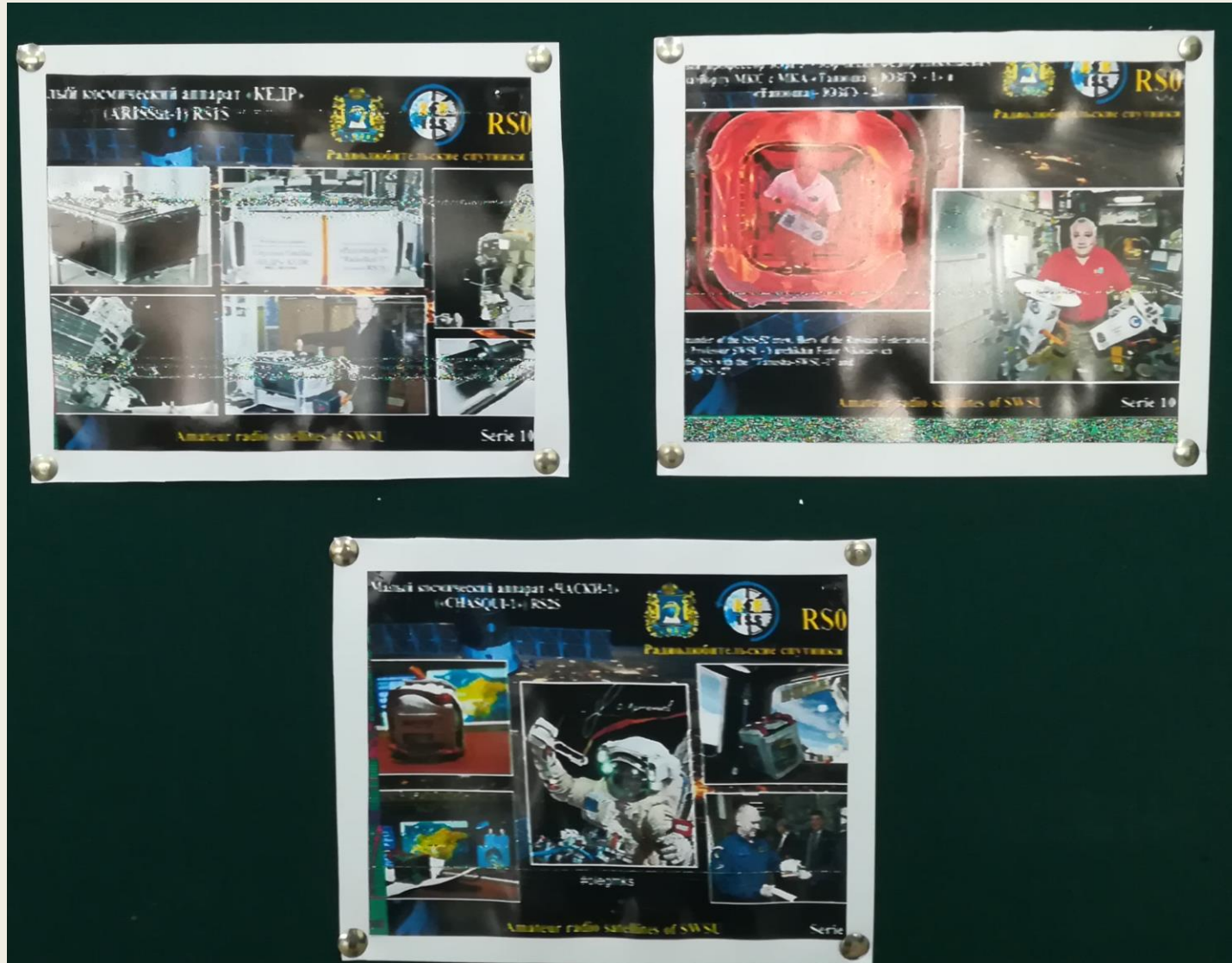
List of tracked satellites

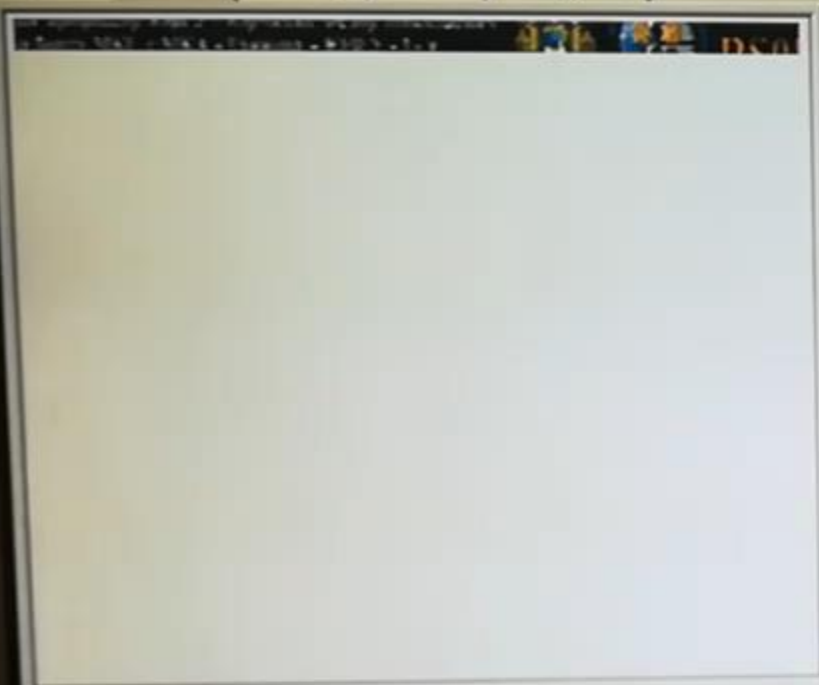
- International Space Satation
- CAS-4A and 4B
- XW-2C and 2D
- Ukube-1
- EO-88
- NO-84
- AO-73

Transponder/Repeater active Telemetry/Beacon only No signal Conflicting reports ISS Crew (Voice) Active

Name	Jun 6	Jun 5	Jun 4	Jun 3	Jun 2	Jun 1
AISAT-1		1	11 11 2	1 1	11 1	12 1 1
BHUTAN-1		1	1 1	1	1	1
CubeBel-1	1	2 1	11 1 2	1 21	1 21	1 11
CUTE-1		2 1	1 1	1	1	1
MAYA-1			11	1	1	
UiTMSAT-1		1	1	1	11 1	
LilacSat-2	1		1	1	1 1	
FS-3		1		1	1	1
[A]_AO-7				1	1 1	
[B]_AO-7	1 1	1 11	111112	1 11	211 122111	111 111312
XI-V		1		1	1	
AO-92_L/v					1522 221 31	
AO-92_U/v	51 121	1 31	1 2231 31 2	1212 21 2	1 1	32 2221131
AO-95_U/v		11 1 12	11 1	1 1 1	11 12	11 1 111
[B]_UO-11		1 1	1 1	1 1	1 1	1 1
RS-15		2 1	2 111	2 11	2	2
LO-19			1	1	1	
FO-29	121114	11 1 1 21 1 2 3 11	211 1 1 2 1321 1 121 1111 3			
XW-2A	11 21	11	1 1	1 111	111 121 3	11 12 1
XW-2B	1	1 1 1	11 1 1	1 1	1 1111 1	111 12
XW-2C		1 11 1	11 3 11	11 11 1	2	21 11
XW-2D	1	1 1	11 1	1 1	1 1 1	1 1 1
XW-2E		1	1	1	1	11
XW-2F	1 1 1 1 1	1 1 3 11	1 11	1 11	111 1 1	2 11 1
CAS-4A	1	1 11	1111 1	12 11	1211 11	1 111 1
CAS-4B		1 2 11	211 21	1 2	23 2	1 31 1
SO-50	1	1	1 23 1 24	111	2 111112	1
HO-68				1		
AO-73		21	1	1 1	1	1
IO-86		1 1 211	1	122	111111	1 1 1221

Images received from ISS

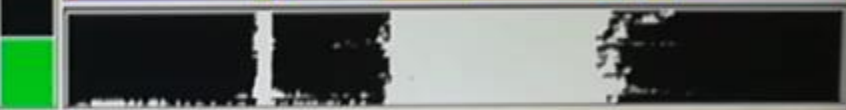
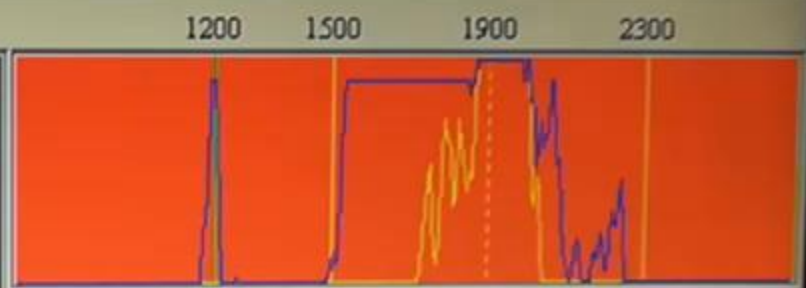




RX Mode

- Auto
- Robot 36
- Robot 72
- AVT 90
- Scottie 1
- Scottie 2
- ScottieDX
- Martin 1
- Martin 2
- PD120

DSP
AFC LMS



Log

Call His 595 My

Name Qth

Note

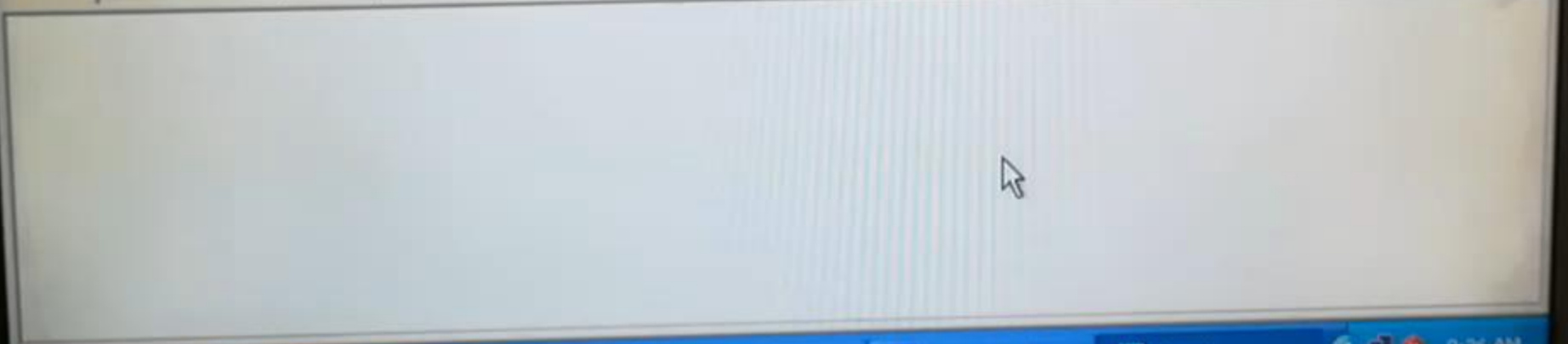
QSL RxID TxID

Lock ReSync Auto history

QSO Data Find Clear List 14.230

S pix S.templates 1 | 2 | 3 | 4

Show with template Draft 25/25



171

NAYIF-1 Dashboard

File Capture Window Help

Whole O... High... Fitter Messages Realtime

- Sun Sensors
 - Panel X+
 - Panel X-
 - Panel Y+
 - Panel Y-
 - Panel Z+
 - Panel Z-
- iMTQ Magnetometer
 - Magnetic Field X
 - Magnetic Field Y
 - Magnetic Field Z

Data Collection

[Antenna Bus 1 \(AntS\)](#)
OK

[Antenna Bus 2 \(AntS\)](#)
OK

[Power Supply \(EPS\)](#)
OK

[Radio Board \(RF\)](#)
OK

[Power Amplifier \(PA\)](#)
OK

[iMTQ](#)
Failed

[Interface Board \(ASIB\)](#)
OK

Antenna (AntS)

[Temperature A](#)
14.1 °C

[Temperature B](#)
14.1 °C

[Antenna 1 Status](#)
Deployed

[Antenna 2 Status](#)
Deployed

[Antenna 3 Status](#)
Deployed

[Antenna 4 Status](#)
Deployed

Decoding

[Error count](#)
0

[Frequency](#)
2632

Satellite Mode

[In Eclipse](#)
0

[In Safemode](#)
0

[Apply before flight](#)
ON

[SW deployment](#)
Disabled

[SW deployment delay](#)
OFF

Power (CCT)

[3.3v Voltage](#)
3300.00 mV

[5.0v Voltage](#)
4901.66 mV

iMTQ

[Mode](#)
Self test

[Error](#)
5

[Config set](#)
ON

[MCU temp.](#)
85 °C

[Up Time](#)
349525 Sec.

Radio Board (RF)

[CMD RX Doppler](#)
136 kHz

[CMD RX RSSI](#)
255 dBm

[Temp](#)
4.75 °C

[3v3 RX Current](#)
40.70 mA

[3.3v TX Current](#)
50.24 mA

[5v TX Current](#)
27.98 mA

Battery

[Voltage](#)
8271 mV

[Temp](#)
1 °C

Power Amp (PA)

[Forward Power](#)
460.70 mW

[Reverse Power](#)
26.60 mW

[Temp](#)
11.9 °C

[Bus Current](#)
124.00 mA

X Panels

[Voltage](#)
4497 mV

[Current](#)
184 mA

[+ Sun Sensor](#)
90 Raw

[- Sun Sensor](#)
13 Raw

Y Panels

[Voltage](#)
4297 mV

[Current](#)
512 mA

[+ Sun Sensor](#)
33 Raw

[- Sun Sensor](#)
225 Raw

Z Panels

[Voltage](#)
3755 mV

[Current](#)
56 mA

[+ Sun Sensor](#)
7 Raw

[- Sun Sensor](#)
19 Raw

Power (EPS)

[Bus Current](#)
283 mA

[Panel Current](#)
343 mA

[Boost Conv1 Temp](#)
2 °C

[Boost Conv2 Temp](#)
4 °C

[Boost Conv3 Temp](#)
4 °C

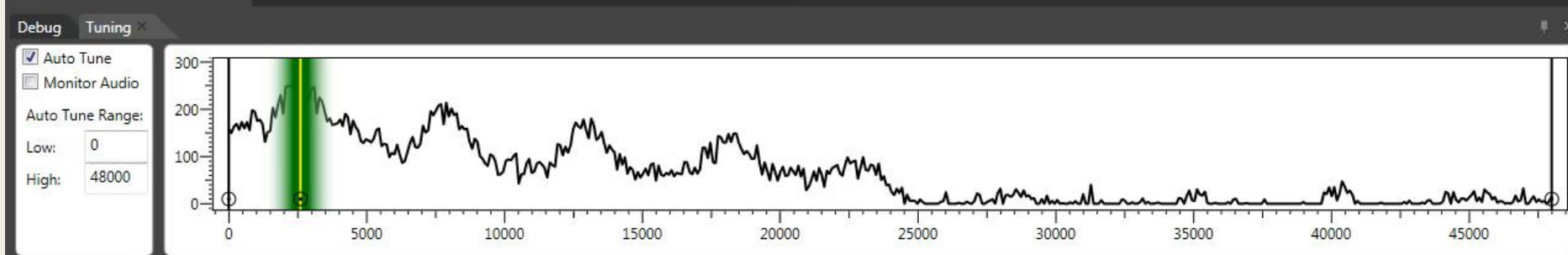
[Reboot Count](#)
53


[Reset Cause](#)
Watchdog

[Channel current 5.0v](#)
3 mA

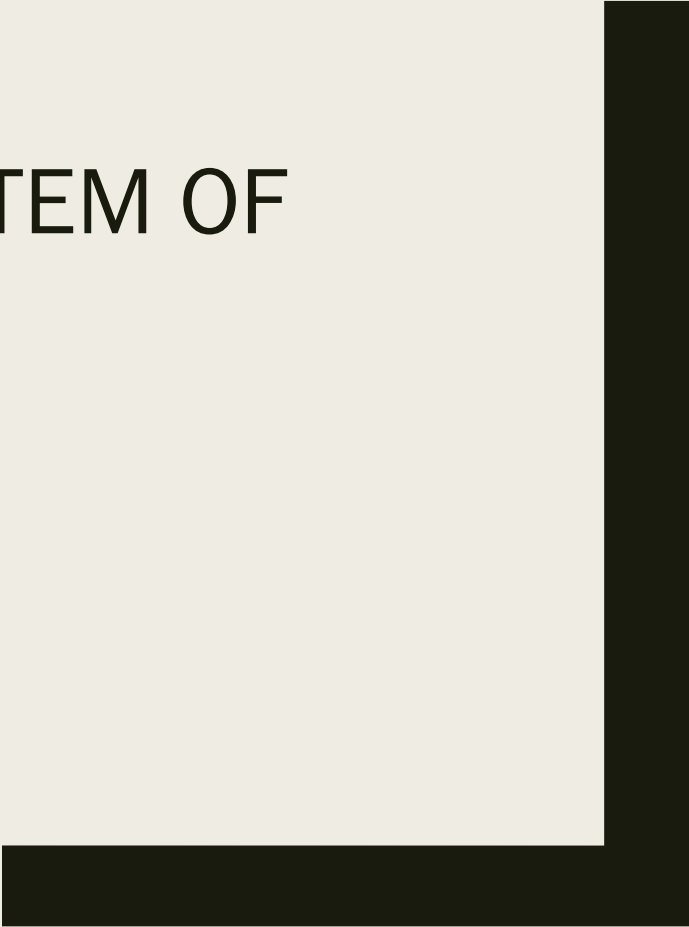
[Latch Count 5.0v](#)
0

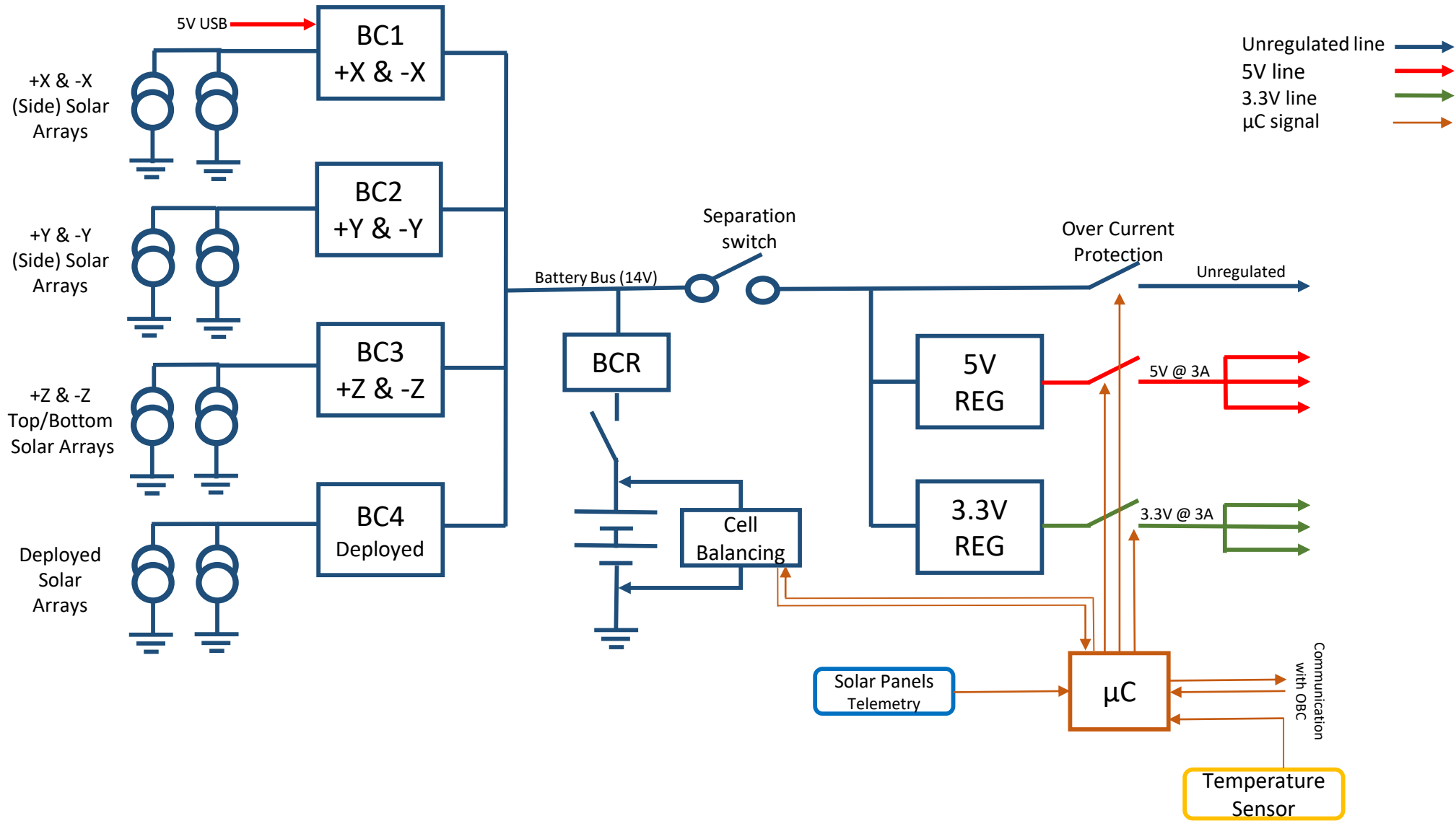
[Power Tracking Mode](#)
MPPT





DESIGN OF POWER SUBSYSTEM OF
ICUBE2







SUCCES PLAN → Management
→ operation

PRICE ⇌ VA

SHARE

concept

ONE TEAM

LOADING

TARGET

IDEA

STRATEGY

