

FSpace Laboratory

F-1 CubeSat project

F-1 Telemetry Decoder

Software User Manual



Hanoi, September 2012

Table of Contents

1	Introduction	3
1.1	Purpose	3
1.2	Definitions and Acronyms	3
2	F-1 Cube Satellite	3
3	F-1 communication schemes for radio operators	4
3.1	UHF channel (only operational in daylight):	4
3.1.1	Pulse -Width-Modulation Morse code telemetry	5
3.1.2	F-1's callsign	5
3.2	VHF channel (operational during night time but may be turned on in daylight later)	6
4	Installation Guide.....	7
4.1	Environment Requirement	7
4.2	Installation Package	7
4.3	Installation Guide F-1 Telemetry Decoder	8
5	User Manual.....	10
5.1	Application Overview	10
5.1.1	Available Features	10
5.2	User Manual for Functions	11
5.2.1	Complete personal information.....	11
5.2.2	Decode data (OBC 1)	12
5.2.3	Decode Data OBC2.....	13
5.2.4	Submit data	14

1 Introduction

1.1 Purpose

This document is prepared as the software user manual for F-1 Telemetry Decoder, in scope of F-1 cube satellite project

1.2 Definitions and Acronyms

Acronym	Definition	Note
OBC 1	On board computer 1	
OBC 2	On board computer 2	

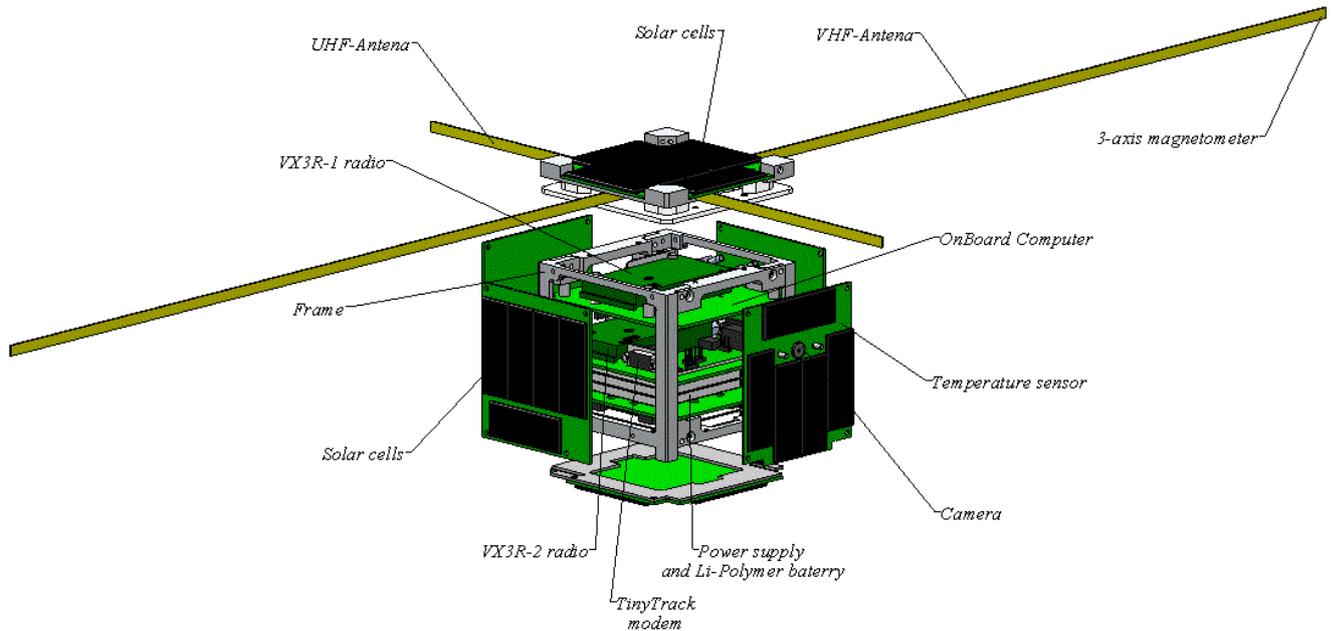
Table 1-1: Definitions and Acronyms

2 F-1 Cube Satellite

F-1 is a picosatellite (cubesat) developed at FSpace laboratory, FPT Technology Research Institute, FPT University in Hanoi, Vietnam. The project's goal is for education and training for young engineers and students about aerospace engineering. It carries a low-resolution camera, a magnetometer and some temperature sensors for study of space environment.



Engineering model of F-1 CubeSat



F-1 satellite components

Satellite specification:

Size: 10x10x10cm (1U cubesat)

Mass: 1kg

Structure: aluminum alloy T-6061

Power supply: body-mounted solar cells 1.5W in average, Li-Polymer rechargeable battery for energy storage

Main and backup computers: PIC18 and PIC16 microcontrollers

Communication: 02 independent transceivers (Yaesu VX-3R) using amateur radio VHF & UHF bands, transmission speed from 1200bps; AFSK modulation, KISS protocol

Payload: low resolution C328 cameras (640x480 maximum resolution)

Sensors: temperature sensors and 3-axis magnetometer

Attitude Control System: passive ADCS system consists of permanent magnets and hysteresis rods

3 F-1 communication schemes for radio operators

3.1 UHF channel (only operational in daylight):

- Frequency: 437.485 MHz
- Modulation: Narrow FM
- Power: about 0.3W RF
- Antenna: half-wave dipole

There are 3 types of beacons:

3.1.1 Pulse -Width-Modulation Morse code telemetry

- Baud rate: 20 wpm (configurable)
- Beacon interval: every 60 seconds (configurable)
- Beacon length: 10 characters, about 25 seconds each transmission
- Note: F-1 broadcasts prefix “zz” and suffix “zz” in addition to the beacon string to avoid the loss of the first and the last characters during reception so please ignore these characters

Beacon format

Beacon data format				
No	Data	Description	Size (bit)	Size (char)
1	F-1's callsign	“XV1VN”		5
2	OBC1 reset count	Number of OBC1's reset since the beginning	8	
3	Temperature 1	oC (temperature inside F-1)	8	
4	Temperature 2	oC (temperature outside F-1)	8	
5	Parity bit	0 if sum of item No2 to No4 is even 1 if sum of item No2 to No4 is odd	1	
Total				10
<p>Note:</p> <p>Temperature reading from sensors, will be added with 100 before transmission to ensure a positive number so please subtract 100 to get actual value</p> <p>- 25 bits, divide to 5 chunks of 5bit, each chunk becomes one byte.</p>				

Example:

Received Morse-coded string	zzXV1VN08CHHzz				
Callsign	XV1VN				
Data	0	9	F	N	Q
Decimal value	0	9	15	23	26
Binary value	00000	01001	01111	10111	11010
Bit stream	0000001001011111011111010				
Group into bytes	00000010	01011111	01111101	0	
Decimal	2	95	125	0	
Actual value	2	-5	25	0	
Data description	OBC1 reset count	Inside temperature (oC)	Outside temperature (oC)	Parity bit	

3.1.2 F-1's callsign

Once every 7 minutes F-1 broadcasts its callsign “XV1VN” via PWM Morse code automatically

3.2 VHF channel (operational during night time but may be turned on in daylight later)

- Frequency: 145.980 MHz
- Modulation scheme: AFSK/FM
- Power: about 1W RF
- Antenna: half-wave dipole
- Baud rate: 1200bps
- Beacon type and interval: one AX.25 packet every 30 seconds (interval configurable)
- You can use the below table for decoding 14 bytes data

FEND	Command	Data Type and offset	14 Bytes Data	FEND
C0	00	02 00 00	08 80 00 81 7E 28 88 93 8E 8C 91 90 8F 8F	C0

F-1's AX.25 packet format

Beacon Data format:			
No	Data	Description	Size (bit)
1	Date time	Date: dd/mm/y: 5/4/3=12 bits	29
		Time: hh/mm/ss: 5/6/6=17 bits	
2	Battery voltage	Battery voltage multiplied by 100, divide by 100 to get actual value	11
3	Solar cells voltage	Solar cells voltage multiplied by 10, divide by 10 to get actual value	8
4	Temperature 1	°C (side 1)	8
5	Temperature 2	°C (side 2)	8
6	Temperature 3	°C (side 3)	8
7	Temperature 4	°C (side 4)	8
8	Temperature 5	°C (side 5)	8
9	Temperature 6	°C (side 6)	8
10	Temperature 7	°C (inside solar cell)	8
11	Temperature 8	°C (onboard)	8
Total			112 bits = 14 bytes
<p>Note:</p> <p>- <i>Temperature reading from sensors, will be added with 100 before transmission to ensure a positive number so please subtract 100 to get actual value</i></p> <p>- <i>112 bits, divide to 14 chunks of 8bits, each chunk becomes one byte</i></p> <p>- <i>years beginning from 2012, current year = 2012 -> Y = 0</i></p>			

4 Installation Guide

4.1 Environment Requirement

Due to all modules of the project are developed on .NET platform, production environment needs to fulfill these following requirements:

- ❖ Operating system: Windows XP, Windows Vista, Windows 7
- ❖ Framework: .NET Framework 3.5 or later (<http://www.microsoft.com/en-us/download/details.aspx?id=17718>)

4.2 Installation Package

User needs to download and install the following file: F-1 Telemetry Decoder (.msi file)

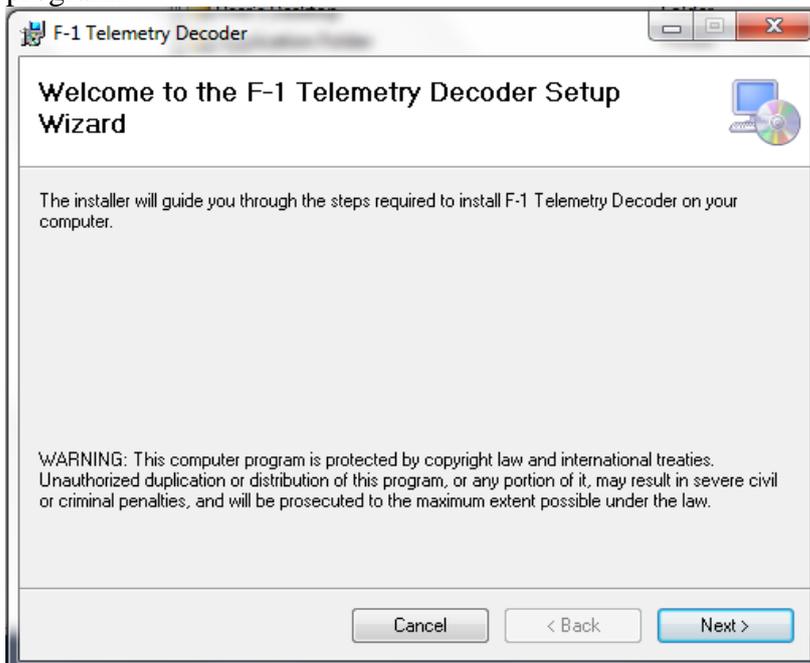
4.3 Installation Guide F-1 Telemetry Decoder

***Note:** Please installation .Net framework first. You can download at <http://www.microsoft.com/en-us/download/details.aspx?id=17718>

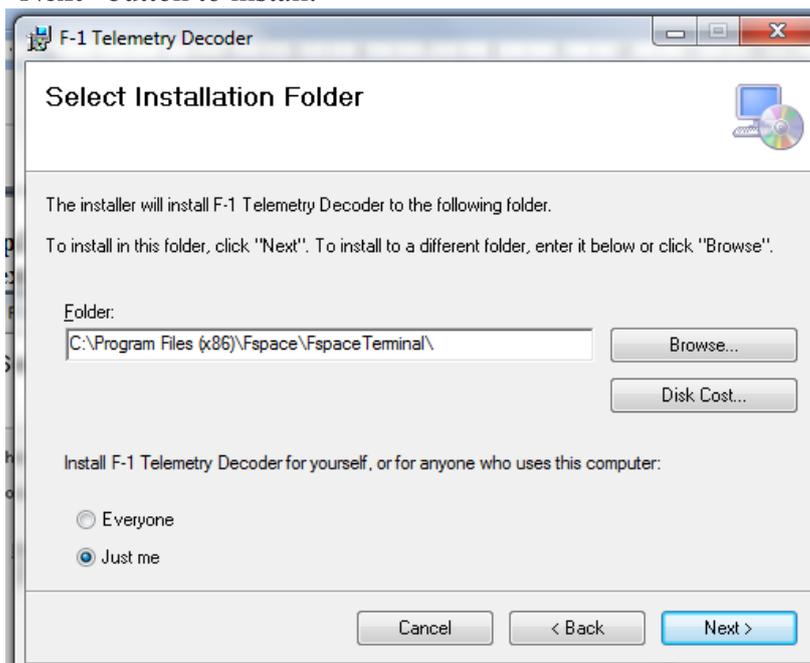
These following steps show installation guide for F-1 Telemetry Decoder.

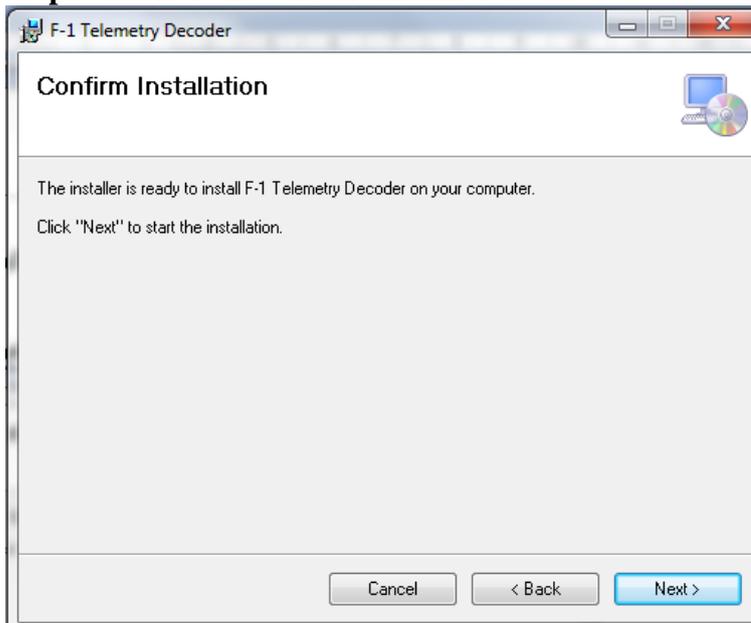
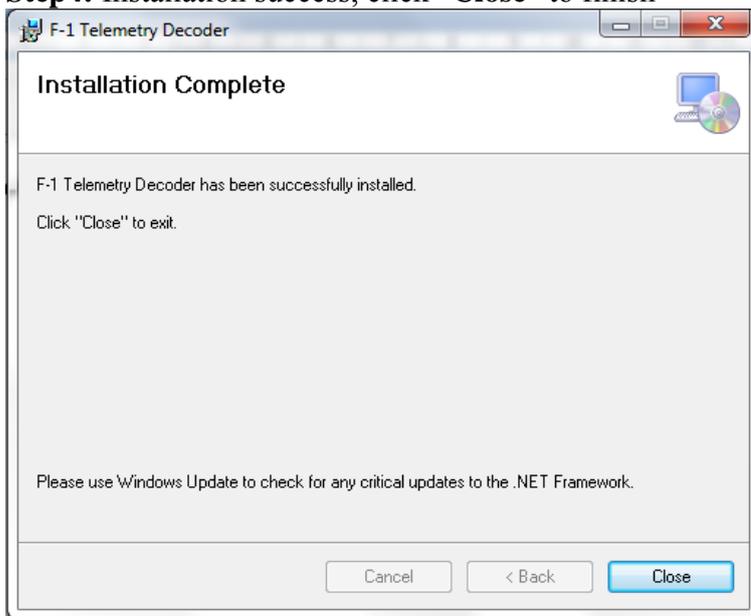
Step1: Firstly, open the **F-1 Telemetry Decoder.msi** file.

When the license screen appears, read and click “**Next**” button if you want to setup the program.



Step2: On next screen, click “**Browse**” button to select destination folder, and finally click “**Next**” button to install.



Step3: Click “Next” to start installation**Step4: Installation success, click “Close” to finish**

5 User Manual

5.1 Application Overview

5.1.1 Available Features

The below list is available features for user

No.	Functions	Description
1	Decode data (OBC 1)	This feature allows user to decode F-1 CW data (OBC1 on UHF)
2	Decode data (OBC 2)	This feature allows user to decode F-1 telemetry data (OBC2 on VHF)
3	Submit data	This feature allows user submit data that received

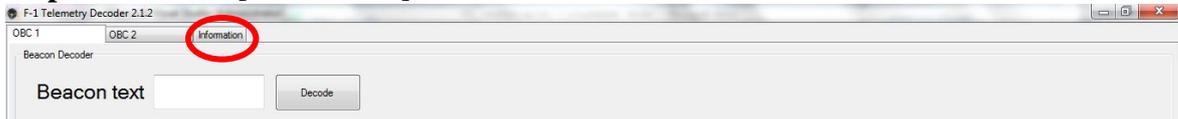
Table 5-1: Available features for users

5.2 User Manual for Functions

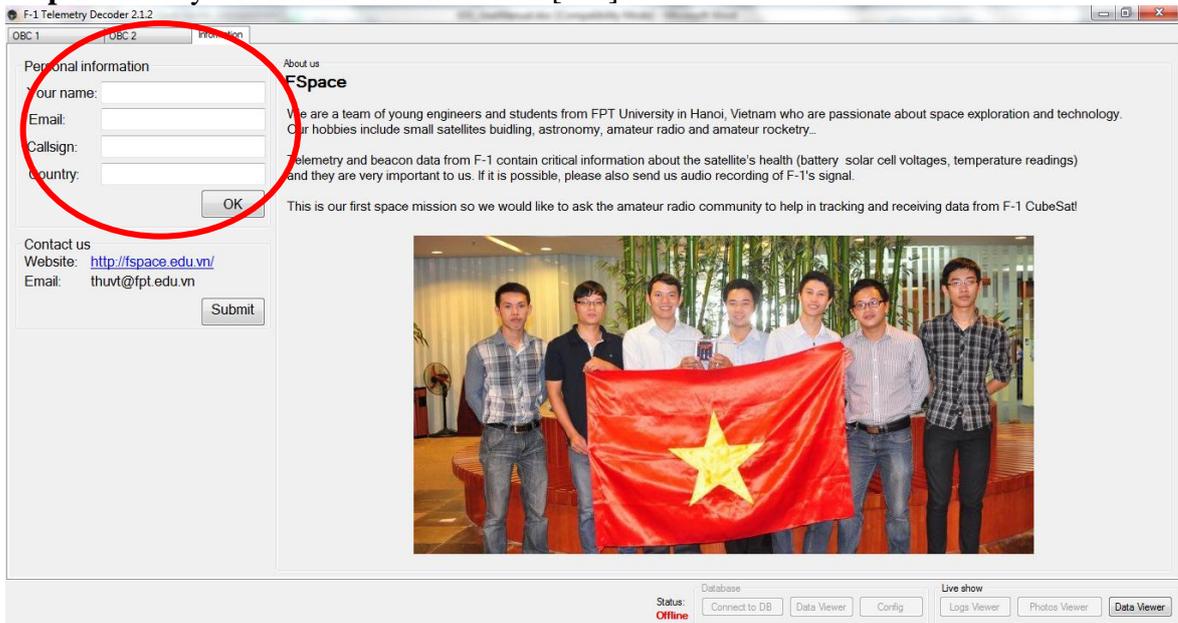
Our client software allows you to submit decoded data from F-1 to our server so at the first time running the software, you are recommended to input your personal information so that we can acknowledge your contribution.

5.2.1 Complete personal information

Step 1: Go to tab [Information]



Step 2: Insert your information then click [OK]



Step 3: Click [OK] to finish

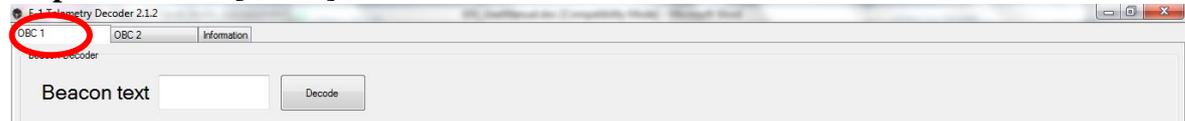


5.2.2 Decode data (OBC 1)

The format of F-1 CW data (excluding possible prefix and suffix “z” characters):

Callsign	Data (5 characters)
XVIVN	XXXXX

Step 1: Go to tab [OBC1]

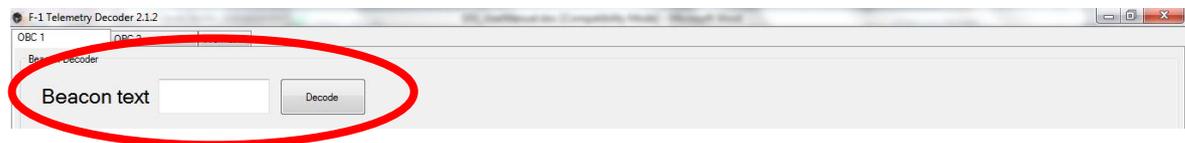


Step 2: Input data string into [Textbox]

For example: you receive a string XVIVNABCDF

You should input “ABCDF”

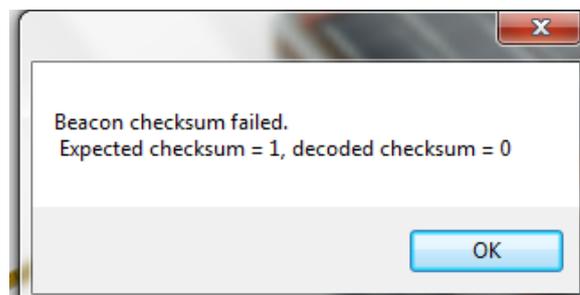
Then click [Decode]



Step 3a: If your string is correct.



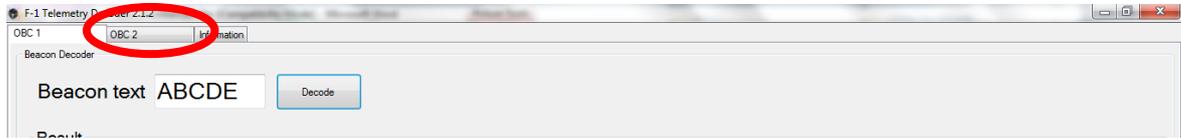
Step 3b: If your string is not correct (beacon checksum failed). A messages box will be shown



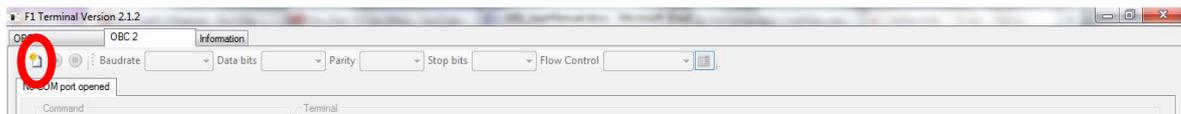
5.2.3 Decode Data OBC2

**You should connect this program with your transceiver first.*

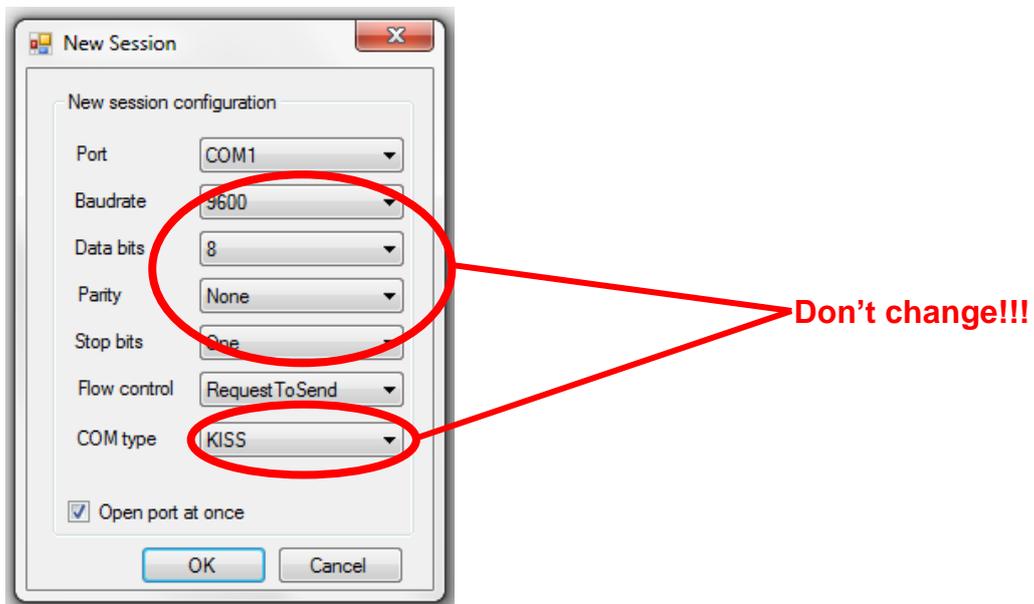
Step1: Go to tab [OBC2]



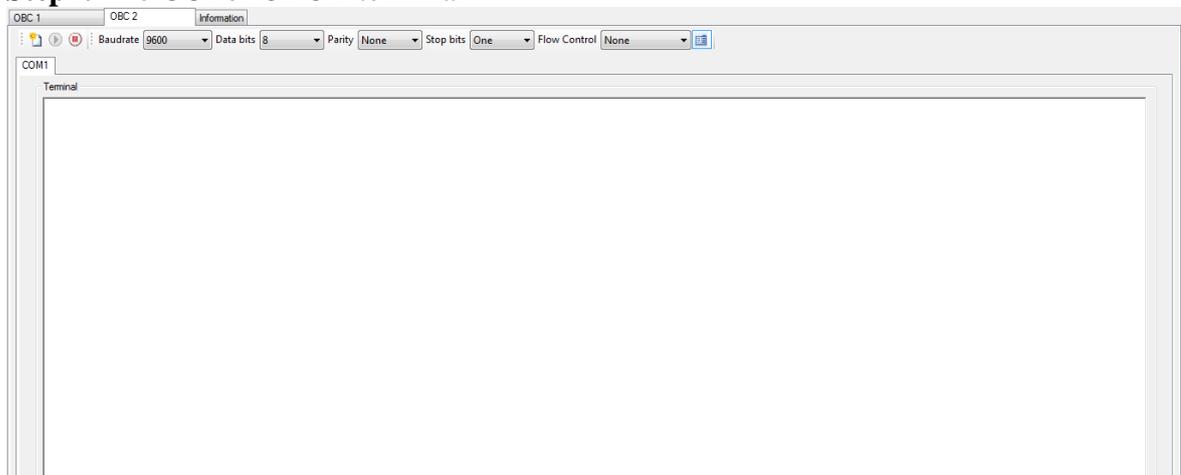
Step2: Click [New Session] button to connect program with your transceiver



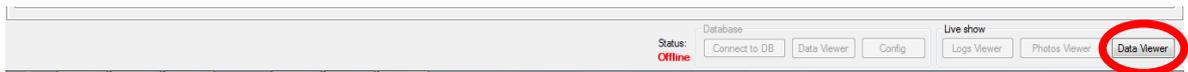
Step3: Select configuration and click [OK]



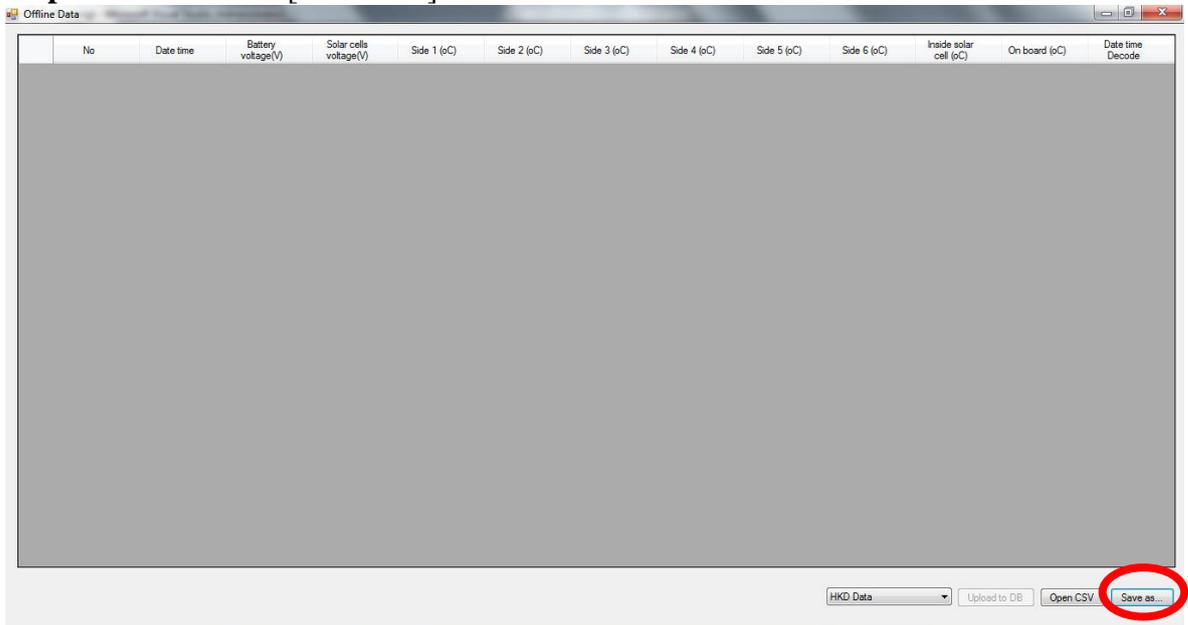
Step4: The GUI of OBC 2 terminal



Step5: Click [Data Viewer] to view decoded data

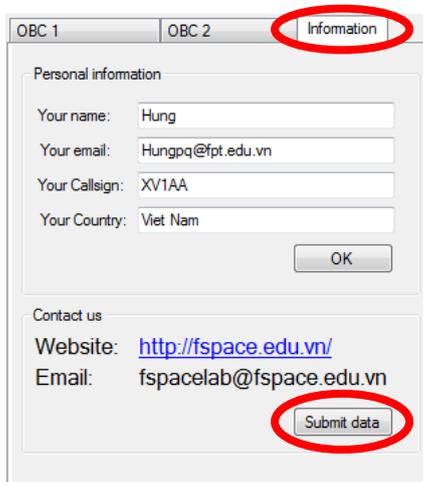


Step6: You can click [Save as...] to save data to CSV file.



5.2.4 Submit data

Go to tab [Information] and click [Submit data] button

A screenshot of the 'Information' tab in the software interface. The tab is circled in red. The form contains two sections: 'Personal information' with fields for 'Your name' (Hung), 'Your email' (Hungpq@fpt.edu.vn), 'Your Callsign' (XV1AA), and 'Your Country' (Viet Nam), and 'Contact us' with fields for 'Website' (http://fspace.edu.vn/) and 'Email' (fspacelab@fspace.edu.vn). There are 'OK' and 'Submit data' buttons. The 'Submit data' button is circled in red.