OVERVIEW

A new satellite standard was proposed in 2009 for a satellite even smaller than the CubeSat. It was the PocketQub. Why PocketQub? This Fempto satellite is a 5 cm cube and can fit in your pocket. It can be configured in a group of eight and be launched with the Cal Poly P-POD as one CubeSat.

The PocketQub leverages the CubeSat standard in a way that benefits all parties. Increased launches of P-POD and decreased costs for education and basic research missions. The PocketQub electronics package seeks to contribute to this mission by offering all of the necessary bus electronics at minimal cost.

For additional information on the PocketQub standard please refer to SEF Spaceworks.

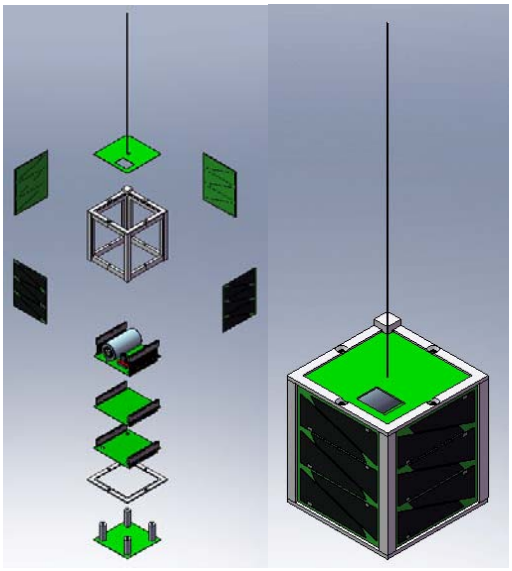

Figure 1—PocketQub Assembly

Applications:

- **Low Cost Space Demonstration Missions**
- **Low Cost Sub Orbital Missions**
- **Balloon Missions**
- **Classroom Excercises**

Features:

- **GMSK Transceiver:**
  - **TX, RX: 400 – 470 MHz**
  - **12 dBm**
  - **AX.25, 9600-38400 baud**
- **Transceiver Range Extender**
  - **TX: 30 dBm**
  - **RX: 12 dBm**
- **Antenna:**
  - **400 – 470 MHz**
  - **Whip end cap**
  - **USB Interface Access**
- **EPS:**
  - **System: 3.3V, 1 Amp**
  - **Solar Input: 25.0V, 1 Amp**
  - **USB Charger at 500 mA**
  - **Li-Ion Battery, 750 mAh**
  - **I2C Operation**
- **Solar Panel:**
  - **Voc: 15V**
  - **Vmp: 13V**
  - **6 TASC Cells**

For more information, contact:
info@astrodev.com

PocketQub emits RF radiation that may interfere with the use of other devices. Users must maintain proper licenses during operation.

PocketQub Electronics are static sensitive, take the necessary precautions

PocketQub Radio requires proper termination of transmitter in 50 Ohm load during operation.

PocketQub contains batteries which if improperly used may leak or explode. Extreme care should be taken during charging and operation.

Table of Contents

SOLAR PANEL

Absolute Minimum and Maximum Ratings

Parameter	Symbol	Min.	Nom.	Max.	Units
Solar Cell Performance	Please refer to TASC cell datasheet at: http://www.spectrolab.com/DataSheets/PV/PV_NM_TASC_ITJ.pdf				
Single Panel Voltages and Currents:					
Voltage Open Circuit	V_{oc}	13.0		15.0	V
Current Short Circuit	I_{bat}	0.015		0.028	A

Note: Please note extreme variation in cell quality has been noted in recent cell batches that may affect ultimate panel performance. While effort is made to ensure cell conformity, panel grading is provided at an additional cost.

Physical Characteristics

Parameter	Notes	Min.	Typ.	Max.	Units
Mass	Excluding connector	4.2	4.5	4.7	g
Maximum Thickness	Top of solder	1.0	1.25	1.5	mm
Width		38.25	40.0	40.75	mm
Length		48.25	49	49.75	mm
PCB Thickness	Standard FR-4 Material	0.55		0.62	mm

Note: The manufacturing process and respective PCB thickness, solar panel dimensions and flatness will vary with respect to temperature. The solar panel is flexible and should be mounted using the recommended practice.

Designed Dimensions

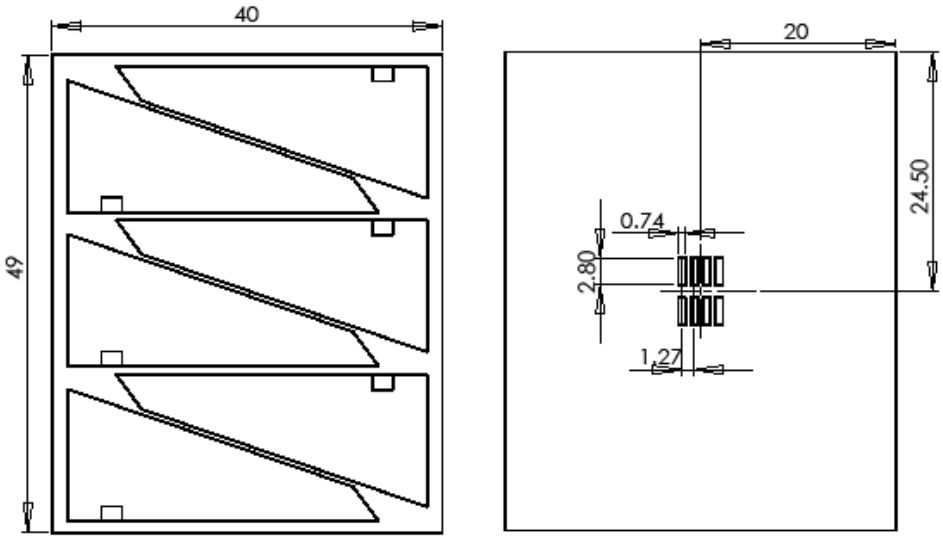

Figure 2 Physical Dimensioned Drawing

Typical Performance Characteristics

Pending test.

Connection Information

The bottom of the solar panel includes a 1.27 mm, 4 x 2 connector footprint for the Samtec FTSH or similar connector. Standard panels connect to the footprint using paired wire with a 0.1” connector for the EPS.

Block Diagram

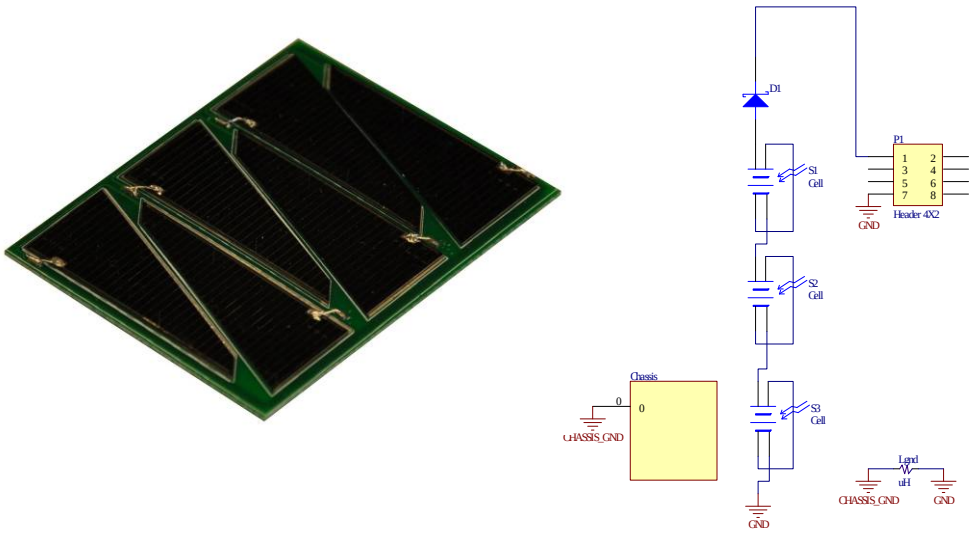

Figure 3--Block Diagram.

Interface Header Description

Table 1 -- Pinout.

Header Pin	Pin #	Pin Name	Typical Current	Summary
V_String	1	Solar String '+'	10 to 28 mA	
V_Gnd	4	Solar String '–'	10 to 28 mA	
NC	2,3,5,6,7,8			All remaining unconnected

Recommended Mounting Method

The recommended mounting method is bonding. The unique nature of the structure and panels lend to simple bonding of aluminum and fiberglass. Bonding should only be applied at the four corner points to prevent warping from CTE effects.

EPS

Absolute Minimum and Maximum Ratings

Parameter	Symbol	Min.	Nom.	Max.	Units
Storage Temperature	$T_{storage}$	-20		100	°C
Operation Temperature	$T_{operational}$	0		80	°C
Voltages and Currents:					
Battery Voltage	V_{batt}	2.8	3.6	4.2	Volts
Battery Current	I_{batt}			0.650	Amps
3.3V Bus Voltage	V_{bus}		3.3V		Volts
3.3V Bus Current	I_{bus}		1.5		Amps
USB Voltage	V_{usb}	4.5	5.0	5.5	Volts
USB Charge Current	I_{usb}		0.1	0.5	Amps
Solar Panel Voltage	V_{solar}	7.5		35	Volts
Solar Panel Current	I_{solar}	0.01		2.0	Amps

Note:

Physical Characteristics

Parameter	Notes	Min.	Typ.	Max.	Units
Mass			30		g
Maximum Thickness			18		mm
Width		40	41	41.5	mm
Length		40.0	41.0	41.5	mm
PCB Thickness	Standard FR-4 Material	0.55		0.62	mm

Note:

Designed Dimensions

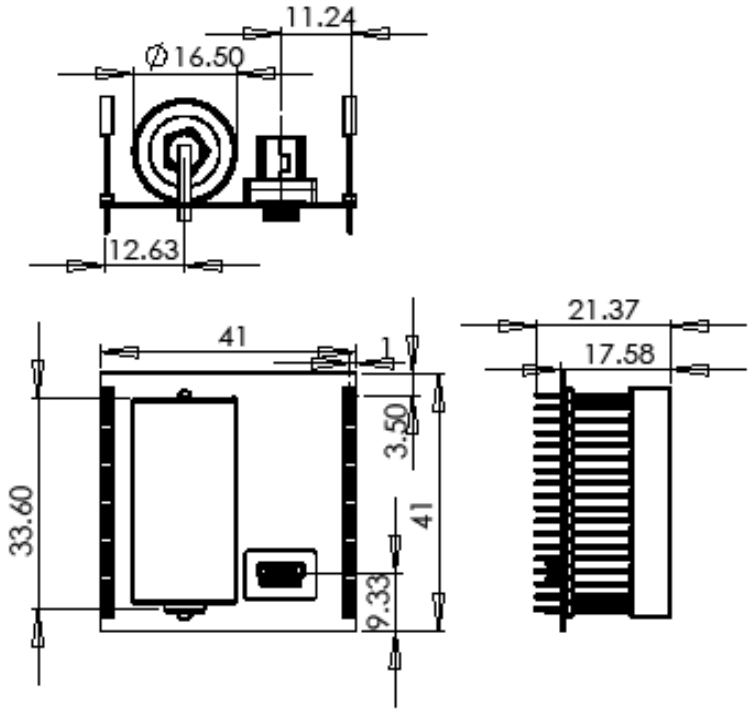

Figure 4 EPS Board Phyiscal Dimensions

Typical Performance Characteristics

Pending Test.

Connection Information

The PocketQub EPS interfaces to the satellite bus and four solar panels. Solar panels are connected with standard 0.1", single row, two pin headers. These four headers are located at the negative terminal of the battery. The satellite bus is a 2mm, single row, 18 pin header from Samtec (#ESQT-118-02-X-S-XXX). The USB power and debugging interface is a standard mini USB connector capable of supporting up to 500 mA of current. The USB interface consists of a CP2102 USB/UART bridge that interfaces to the satellite bus for debugging.

Block Diagram

In Progress.

Figure 5--Block Diagram.

Interface Header Description

Table 2 -- Satellite Bus Pinout (Left Side).

Header Pin	Pin #	Pin Name	Typical Current	Summary
Ground	1	GND	0.010 – 1.2	
3.3V Bus	2	3.3V_SYS_OUT	0.010 – 1.2	
I^2C Clock	3	SCL	Logic	
I^2C Data	4	SDA	Logic	
EPS Interrupt	5	POW_INT	Logic	
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			

	14			
	15			
	16			
	17			
	18			

Table 3 -- Satellite Bus Pinout (Right Side).

Header Pin	Pin #	Pin Name	Typical Current	Summary
Ground	19	GND	0.010 – 1.2	
3.3V Bus	20	3.3V_SYS_OUT	0.010 – 1.2	
LDO 3.3V	21	3.3V_LDO	0.001 – 0.050	
N/C	22			
Solar Voltage	23	V_Solar	0.010 – 0.028	
Battery Voltage	24	V_Batt	0.010 – 2.0	
	25			
	26			
	27			
	28			
	29			
	30			
	31			
	32			
UART USB TX	33	USB_TX	Logic	
UART USB RX	34	USB_RX	Logic	
3.3V USB LDO	35	3.3V_USB	0.001 – 0.020	
5V USB Bus	36	5V_USB	0.005 – 0.5	

Communications

The PocketQub EPS is configured through I^2C communications over the spacecraft bus. A PCA9534 I2C to GPIO bridge is used to control I/O lines of the EPS. The bridge slave address is 0x24. Table 4 lists the GPIO lines available for configuring the EPS. For detailed information regarding the PCA9534 device and communications refer to http://focus.ti.com/docs/prod/folders/print/pca9534a.html.

Table 4 -- EPS Configuration Item.

Configuration Item	I/O Line	Value	Input/Output	Summary
Bus Shutdown	0	High*	Read/Write	3.3V Bus On
		Low		3.3V Bus Off
N/C	1	High	Read/Write	Unused
		Low		Unused
	2	High*		Battery Charge Termination Time
		Low		Battery Charge Termination Rate
	3	High	Read	Battery Charge OK
		Low		Battery Charge Fault
	4	High*	Read/Write	Battery Charge Enabled

		Low		Battery Charge Shutdown
	5	High	Read	Battery Charge Done
		Low		Battery Charge In Progress
	6	High	Read/Write	Unused
		Low		Unused
	7	High	Read/Write	Unused
		Low		Unused

Note: * Notes default

RADIO

Absolute Minimum and Maximum Ratings

Parameter	Symbol	Min.	Nom.	Max.	Units
Voltages and Currents:					

Note:

Physical Characteristics

Parameter	Notes	Min.	Typ.	Max.	Units
Mass					g
Maximum Thickness					mm
Width		40	41	41.5	mm
Length		40.0	41.0	41.5	mm
PCB Thickness	Standard FR-4 Material	0.55		0.62	mm

Note:

Designed Dimensions

Typical Performance Characteristics

Connection Information

Block Diagram

Figure 6--Block Diagram.

Interface Header Description

Table 5 -- Pinout.

Header Pin	Pin #	Pin Name	Typical Current	Summary

COMMUNICATING WITH THE POCKETQUB

Refer to interface application note for detailed instructions.

POCKETQUB CONFIGURATION PROGRAM

Refer to PocketQub configuration program application note for detailed instructions.

PROTECTING AGAINST ELECTROSTATIC DISCHARGE

The PocketQub electronics should be handled according to ESD protocols.

BATTERY SAFETY

To avoid risk of injury, observe the following conditions in using or storing your lithium ion battery:

- Do not disassemble or open, crush, bend or deform, puncture, or shred.
- Do not modify or remanufacture, attempt to insert foreign objects into the battery, immerse or expose to water or other liquids, or expose to fire, explosion, or other hazard.
- Only use the battery for the PocketQub.
- Only use the battery with the PocketQub EPS charging system. Use of an unqualified battery or charger may present a risk of fire, explosion, leakage or other hazard.
- Do not short circuit a battery or allow metallic or conductive objects to contact the battery terminals.
- Replace the battery only with another battery that has been qualified with the system. Use of an unqualified battery may present a risk of fire, explosion, leakage, or other hazard.
- Promptly dispose of used batteries in accordance with local regulations.
- Battery usage by children should be supervised.
- Avoid dropping the PocketQub and battery. If the battery is dropped, especially on a hard surface, and the user suspects damage, return it for repair or purchase a new one.
- Improper battery use may result in a fire, explosion, or other hazard.

TRADEMARKS

DISCLAIMER

All information in this document is subject to change at anytime. Look for continued updates at:
http://www.astrodev.com/

PocketQub are sold as test devices and require users to gain experimental license from the FCC for use in terrestrial and satellite missions.

NOTES