Power source system of Fit-sat (Niwaka)

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Cube sat Niwaka (Fit-sat) has three electric power sources in it. namely,

1.　Photovoltaic cell blocks. (four faces of cube-sat)　0 to 5V ,max 250mA each

2.　1 cell Li-ion rechargeable battery.　　　　　　　Nominal 3.7V. 1400mAh

3.　3cells Li-ion rechargeable batteries.　　　　　　Nominal 11.1V, 1400mAh

Each solar cell face of Cube-sat. has two photovoltaic sheets connected in series.

Max .emf. ≒0~ 5V.

Each voltage of four solar cell blocks is connected together through diode OR .

Selected voltage of Photovoltaic cell block is convert into 5V through MPPT circuit.

On the other hand, the power consumption of the cube-sat electronic circuit is following,　ⅰ）

Always consumes.

　　Beacon TX. + Command RX　＋Control MPUs + Sensors　≒７０ｍＡ（avg.）．　　5V

ⅱ）Consumes at command instruction execution time.

　　・Accumulation data transmitter（ＵＨＦ）　　　　　≒７００ｍＡ（avg.）．　5V

　　・Cameras + picture transmitter(SHF)　　　　　　　≒1.5Ａ（avg.）．　　　10V

　　・High-intensity LEDs blink　　　　　　　　　　　≒10Ａ（avg.）．　　　10V

Three sources of power supply are prepared for 5V line that is used for always operating circuit.

1.　Photovoltaic cell's Power converts into 5V through MPPT circuit.　（for day time）

2.　Step up to 5V through DC/DC conv. from 1 cell Li-ion battery.　　（for night time）

3.　Step down to 5V through DC/DC conv. from 3 cells Li-ion battery.　（for emergencies）

Li-ion rechargeable batteries are charged by photovoltaic cell's surplus power in day time.

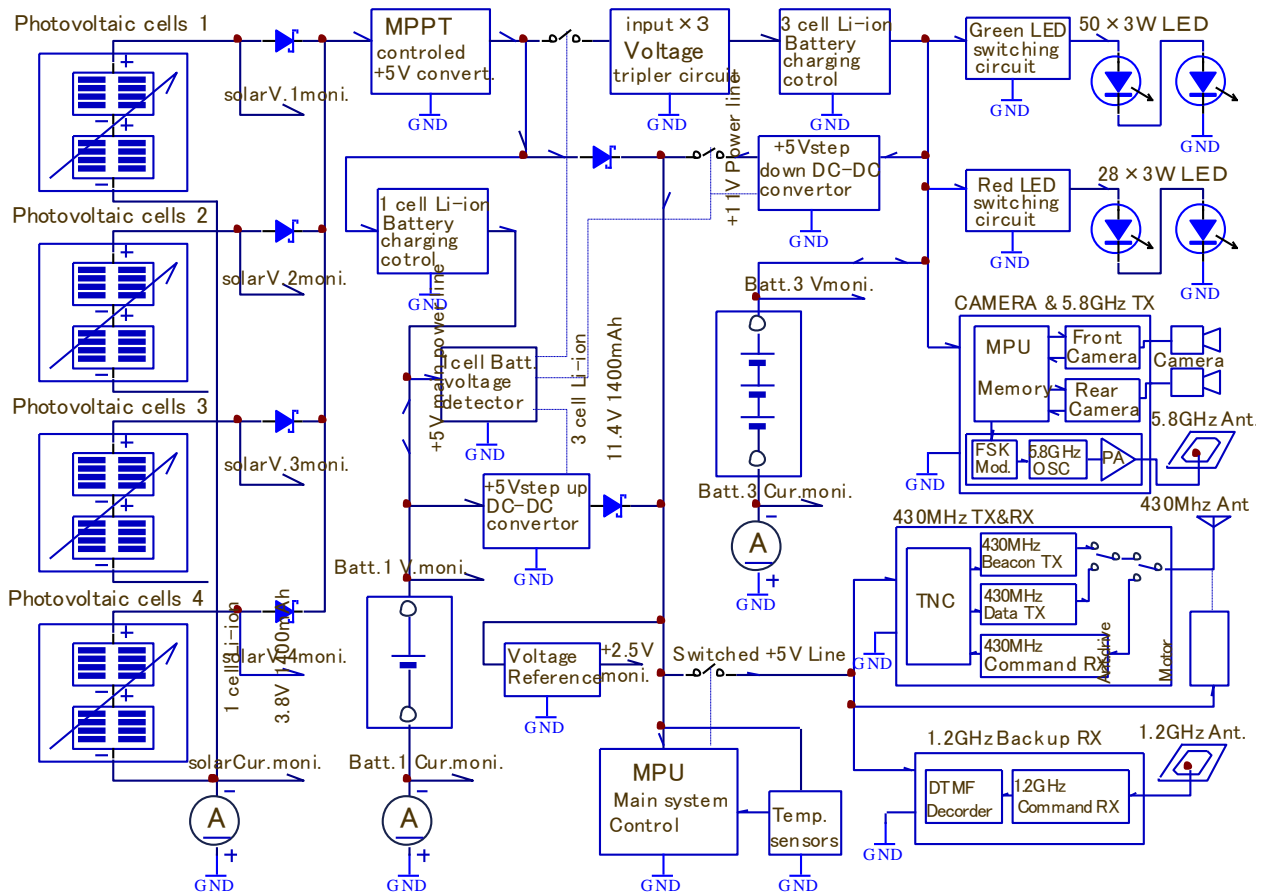The one cell battery is charged through a control circuit from 5V MPPT circuit output.

Cameras +5.8GHzTX and High-intensity LEDs power are supplied from 3cell batteries line.

The three cells battery are charged through 5V MPPT circuit, voltage multiply circuit and charge control circuit.

Please refer to attached Block Diagram.

(Notes). The additional switching circuit, protection circuit and measuring amp. circuit
suicide circuit etc. are omitted.

Power Line Block diagram of Fit-sat.(NIWAKA)

Photovoltaic cells 1

solarV.1moni.

MPPT
controled
+5V convert.
GND

input×3
Voltage
tripler circuit
GND

3 cell Li-ion
Battery
charging
cotrol
GND

Green LED
switching
circuit
GND

50×3W LED

+5Vstep
down DC-DC
convertor
GND

Red LED
switching
circuit
GND

28×3W LED

Photovoltaic cells 2

solarV.2moni.

1 cell Li-ion
Battery
charging
cotrol
GND

GND

Batt.3 Vmoni.

CAMERA & 5.8GHz TX

MPU

Memory

Front Camera
Rear Camera

Camera

5.8GHz Ant.

Photovoltaic cells 3

solarV.3moni.

1cell Batt.
voltage
detector
GND

+5Vstep up
DC-DC
convertor
GND

3 cell Li-ion 11.4V 1400mAh

Batt.3 Cur.moni.

A
GND

FSK
Mod.
5.8GHz
OSC
PA
GND

430Mhz Ant

430MHz TX&RX

430MHz
Beacon TX
430MHz
Data TX
430MHz
Command RX

TNC

Motor

Photovoltaic cells 4

solarV.4moni.

Batt.1 V.moni.

1 cell Li-ion 3.8V 1400mAh

+5V main power line

Voltage
Reference
GND

+2.5V
moni.

Switched +5V Line
GND

1.2GHz Backup RX

1.2GHz Ant.

DTMF
Decorder
1.2GHz
Command RX
GND

solarCur.moni.

A
GND

Batt.1 Cur.moni.

A
GND

MPU
Main system
Control
GND

Temp.
sensors
GND

+1.1V Power line

Picture of control circuit PCB.
(Notes) this is not final PCB

MPU side.

Battery side.