DTUsat On Board Computer (OBC) System Summary

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Most recent version is found at:

dtusat.dtu.dk -> SysEng -> Files -> Systembeskrivelser -> obc.pdf

Things to change/finish

System Function

The On Board Computer consists of the only processor in the satellite. The major tasks of the OBC is to:

- Communicate with earth using the Radio
- Control the magnetometer
- Control the Camera
- Control the Tether
- Measure temperature, current and voltages all over the satellite.

This document concerns the OBC hardware. The software used is described at the dtusat website and in the cvs repository (cvs.dtusat.dtu.dk)

Picture of Prototype

Bottom: An OTP PROM in the flight version replaces the ribbon cable.

Top: The IDC connectors are mounted at the top for testing purpose only. In the flight version they must be at the bottom.

Mass

Including connectors the mass of the OBC is 37 g

Physical Dimensions

82 mm x 91mm. A drawing of the pcb with the location of connectors, holes and cuts can be found at dtusat.dtu.dk -> SysEng -> Files -> Tegninger 3-12-2002.zip
Drawing

Power

The current drawn by the OBC is 50 mA. It increases sligthly when the flash in programmed.

The levels for the latchup detection circuit is set at the following values (~ 3 times normal):

Processor and oscillator: 66 mA

Memory: 33 mA

Other: 18 mA

Environmental Properties

Vacuum

A previous version of the OBC PCB, which included most of the flight components, has been placed in vacuum. The components were not tested electricaly during or after the vacuum. There were no visible damage of the components

Temperature

All components selected for the OBC are specified to work in the range -40 to +85 degrees.

Radiation

The processor and flash and chips are tested to 10 krad without any functional effects. The current drawn by the increased sligthly.

Vibration

The OBC has not yet been vibration tested. No problems are anticipated.

Hardware Interface

Connections in test plug:

TBD

Connections to POWER:

Pad	Connection	Direction	Pad	Connection	Direction
1	Vsol a		2	Vsol a	
3	Vsol b		4	Vsol b	
5	Vbat a		6	Vbat a	
7	Vbat b		8	Vbat b	
9	Vunreg		10	Vunreg	
11	Gnd		12	Gnd	
13	3V6		14	3V6	
15	LatchUp		16	LatchUp	
17			18		
19	SPI SEL3	Out active low	20	SPI SEL4	Out active low
21	SPI OUT	Out	22	SPI IN	In
23	SPI CLK	Out	24	Sign	In
25	Temp	In/out	26		

Pad	Connection	Direction	Pad	Connection	Direction
27	3V3REG		28	3V3REG	
29	3V6		30	3V6	
31	Gnd		32	Gnd	
33	Vunreg		34	Vunreg	

Connections to RADIO:

Connector 1:

Pad	Connection	Direction	Pad	Connection	Direction
1	Vunreg		2	Vunreg	
3	Gnd		4	Gnd	
5	3V3		6	3V3	

Connector 2:

Pad	Connection	Direction	Pad	Connection	Direction
1	Gnd		2	Gnd	
3	SPI SEL1	Out active lov	4	SPI SEL2	Out active low
5	SPI OUT	Out	6	SPI IN	In
7	SPI CLK	Out	8	UART CLK	In
9	UART TX	Out	10	UART RX	In
11	TX enable	Out	12	RX enable	Out
13	Gain8	Out	14	Gain16	Out
15	IRQ	In	16	LatchUp	
17	Temp	In/Out	18	Ant. Release	Out active high
19	Gnd		20	Gnd	

Connector 3:

Pad	Connection	Direction	Pad	Connection	Direction
1	Gnd		2	Ant. Release	
3	3V3		4	3V3	
5	Gnd		6	Vunreg	

Connections to ACDS:

Pad	Connection	Direction	Pad	Connection	Direction
1	Vbat		2	Vbat	
3	Gnd		4	Gnd	
5	PWM1	Out	6	PWM2	Out
7	PWM3	Out	8	PWM-control	Out

Pad	Connection	Direction	Pad	Connection	Direction
9	3V3		10	3V3	
11			12		
13	Temp sens	In/out	14		
15	SPI SEL0	Out active low	16	SPI SEL1	Out active low
17	SPI SEL2	Out active low	18	SPI SEL3	Out active low
19	SPI CLK	Out	20	SPI IN	In
21	SPI OUT	Out	22	Mag. Reset	Out
23	3V3		24	3V3	
25	Gnd		26	Gnd	
27	Latch Up		28	Latch Up	
29	Sunsensor 8		30	Sunsensor 1	
31	Sunsensor 2		32	Sunsensor 3	
33	Sunsensor 4		34	Sunsensor 5	
35	Sunsensor 6		36	Sunsensor 7	

Connections to PAYLOAD:

Connector 1

Pad	Connection	Direction	Pad	Connection	Direction
1	Sunsensor 6		2	Sunsensor 7	
3	Sunsensor 4		4	Sunsensor 5	
5	Sunsensor 2		6	Sunsensor 3	
7	Temp	In/out	8	Sunsensor 1	
9	Sunsensor 8		10		
11			12		

Connector 2

Pad	Connection	Direction	Pad	Connection	Direction
1	Gnd		2	Gnd	
3	Latchup		4	Latchup	
5	Spi clk	Out	6	Spi select 5	Out active low
7	Spi in	In	8	Spi select 6	Out active low
9	Spi out	Out	10	Spi select 11	Out active low
11	3v3		12	3v3	
13	Tet. Deploy	Out active high	14	Tet. Deploy	Out active high
15	Vunreg		16	Vunreg	
17	3v3		18	3v3	

Pad	Connection	Direction	Pad	Connection	Direction
19	Gnd		20	Gnd	
21	Cam. Seriel clk	Out	22		
23	Cam. Seriel rx	In	24	Cam .Reset	Out active low
25	Cam. Seriel tx	Out	26	Cam. Power	Out

Measurement Interface

The temperature sensors and the SPI components are always powered, so measurements can be made at any time.

Analog-to-digital converter

The radio ADC is a MAX1248 enabled by DRI_SPI_SELECT_OBC. Is measures the current drawn by different parts of the OBC.

Channel	Measurement	Software ID	Conversion factor
0	Current drawn by Flash, PROM and RAM	0x9F	0,00925
1	Processor and oscillator	0xDF	0,01387
2	all other components onboard + temperature sensor and adc on the power board.	0xAF	0,00925
3	gnd connection of the current sense amplifier.	0xEF	

The sequence for reading a channel is:

```
dri_spi_select(DRI_SPI_SELECT_OBC);
dri_spi_write_8bit("software id");
value = dri_spi_read_16bit();
dri_spi_select_none();
value = (value>>5) & 0x03FF;
```

For channel 0,1 and 2:

The value read is converted to current in mA by subtracting the measurement from channel 3 and then multiplying with the conversion factor shown.

Temperature channels

The OBC has 1 one-wire DS18B20 temperature sensor on board

Board no	64 bit one-wire ID
1	0x
2	0x
3	0x
4	0x

Self Test

1. Check contents of PROM by calculating checksum or by comparing with af copy of the prom contents
2. Check that external RAM is functional:
   - Write 0x00 to all adresses
   - Check that first address constains 0x00, then write 0xFF. Continue with the rest of the address space
   - Repeat with the values 0xAA and 0x55
3. Check that the flash is functional
   - Erase entire flash
   - Check that first address contains 0xFF. Then write 0xAA and read and compare with 0x55. Write 0x55 and chech by comparing with 0x00. Continue with the rest of the flash addresse space
4. Messure current using the method described in "Measurement Interface". The readings should be in the following range

Channel ID	Range
0	x.x to y.y mA (0xZZ to 0xVV hex)
1	x.x to y.y mA (0xZZ to 0xVV hex)
2	x.x to y.y mA (0xZZ to 0xVV hex)
3	x.x to y.y mA (0xZZ to 0xVV hex)

5. Measure the temperature using one of the ID's listed in " Measurement Interface". It should be in the range 20 to 30 degrees (0xAA to 0xBB hex).
6. Write sysinfo block to flash

Contatcs

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Current Project State

Design of all hardware is finished, PCBs has been produced, and components are mounted.

Remaining work:

- Test and selection of flight version of the board
- Integration tests