Test Plan Design Report

Test Project: ReHAB-T
Test Plan: Pre-flight Smoke Test (Integrated)

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Test Project for ReHAB Technological missions

Test Suite : OBC.mega328

Test Suite : Startup

Test Case rehab-t-1: Startup - Complete

Summary:

Check if module starts up properly after Vcc-ON

- GPS Initialization
- Buzzer test
- SD-card init
- LOG created
- Default values before GPS fix

Preconditions:

1. Connect OBC to Bus Analyzer if not integrated.
2. Connect GPS module or GPS simulator
3. Insert SD Card

#:	Step actions:	Expected Results:
1	Turn on power	System starts. Startup message transmitted on debug port
2	GPS Initialization	GPS configured properly
3	SD-Card init	SD Card Initialized
4	Buzzer Test	Buzzer beeps five times (Everything Initialized)
5	Telemetry Message	Contains default GPS values
6	Check SD-Card	LOG files created

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-110: Startup - No GPS

Summary:

Check if module starts up properly after Vcc-ON

- GPS Initialization
- Buzzer test
- SD-card init
- LOG created
- Default values before GPS fix

Preconditions:

1. Connect OBC to Bus Analyzer if not integrated.
2. Do not connect GPS module or GPS simulator
3. Insert SD Card

#:	Step actions:	Expected Results:
1	Turn on power	System started Startup Message sent on debug line
2	GPS init	GPS init failed with "Airborne Mode Error"
3	Buzzer	Buzzer beeps three times
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Case rehab-t-111: Startup - No SD Card

Summary:

Check if module starts up properly after Vcc-ON

- GPS Initialization
- Buzzer test
- SD-card init
- LOG created
- Default values before GPS fix

Preconditions:

1. Connect OBC to Bus Analyzer if not integrated.
2. Connect GPS module or GPS simulator
3. Do not insert SD Card

#:	Step actions:	Expected Results:
1	Turn on power	System started Startup Message sent on debug line
2	SD Card init	SD Card init fails with "No SD Card" message
3	Buzzer	One long beep
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Case rehab-t-2: GPS parser

Summary:

Check GPS parser operation

- GPGGA
- Time
- Latitude, Longitude
- Altitude
- GPS Fix

#:	Step actions:	Expected Results:
1	First GPS Fix	As the first fix established buzzer beeps two times
2	GPS latitude on Northen hemisphere	latitude format: +DDmm.mmm
3	GPS latitude on Southern hemisphere	latitude format: -DDmm.mmm
4	GPS longitude on Eastern hemisphere	longitude format: +DDDmm.mmm
5	GPS longitude on Western hemisphere	longitude format: -DDmm.mmm
6	GPS altitude under 32 767 m	
7	GPS altitude over 32 767 m	
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Case rehab-t-3: Outgoing Telemetry

Summary:

Check TMLTM packet format on UPRA-BUS SICL line

```
$TMLTM,hhmmss,pllll.lll,pyyyyy.yyy,aaaaa,eeee,oooo*cc
```

hhmmss	GPS Time : hh-hours, mm-minutes, ss-seconds
pllll.lll	GPS Latitude : p : + N, - S, llll.lll-latitude NMEA format
pyyyyy.yyy	GPS Longitude : p : + E, - W, yyyyy.yyy-longitude NMEA format
aaaaa	GPS Altitude in Meters
eeee	External Temperature : eeee/10 °C
oooo	OBC Temperature : oooo/10 °C
*cc	Checksum

sample:

```
$TMLTM,123541,+4807.038,+01131.000,00545,0123,0123*47
```

GPS Time: 12:35:41 (UTC)

Coordinates: N 48.1173, E 11.51677 (decimal)

Altitude: 545m

External Temperature: 12.3°C

OBC Module Temperature: 12.3°C

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-4: Outgoing COM-housekeeping request

Summary:

Check TMHKR housekeeping data request on UPRA-BUS SICL

```
$TMHKR,m,,*cc
```

m	Module ID
*cc	Checksum

Module ID

- C - COM
- D - DAU
- E - EPS
- S - Complete System (GND only)
- P1 - Payload1
- P2 - Payload2
- P3 - Payload3

Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	
Relations	blocks - rehab-t-5:Incoming COM-housekeeping	

Test Case rehab-t-5: Incoming COM-housekeeping

Summary:

TCHKD Message processing, incoming on UPRA-BUS SICL

```
$TCHKD,t,v,m*cc
```

t	Module temperature in centigrade: (t/10)°C
v	Module BusVoltage (m/100)V
m	Number of sent telemetry packets
*cc	Checksum

sample:

```
$TCHKD,0123,336,198*47
```

temperature: 12.3°C

busvoltage: 3.36 V

sent messages: 198

#:	Step actions:	Expected Results:
1	OBC Send TMHKR on SICL	COM respond to message with TCHKD
2	Check TCHKD format on SICL	Format matches
3	Check message ID ('m')	Message ID matches
4	Check temperature data in Telemetry Log on SD Card	Temperature data stored correctly
5	Test for connection timeout: 1. Disconnect COM from BUS 2. OBC Send TMHKR on SICL	• No response on BUS • OBC returns with timeout

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Relations	depends on - rehab-t-4:Outgoing COM-housekeeping request	

Test Case rehab-t-22: Internal Temperature

Summary:

Check internal module temperature value:

- in TMLTM message
- in Telemetry Log on SD Card

Preconditions:

Use an external thermometer as control

Module should run for at least 5 mins before measurement

#:	Step actions:	Expected Results:
1	Check temperature in TMLTM message	Temperature value is valid (only minimal difference to the control thermometer)
2	Check temperature in Telemetry Log on SD Card	Temperature value is valid (only minimal difference to the control thermometer) Tmeperature matches TMLTM temp data
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Case rehab-t-24: External Temperature

Summary:

Check external temperature from MCP9700:

- in TMLTM message
- in Telemetry Log on SD Card

Preconditions:
Use an external thermometer as control
Module should run for at least 5 mins before measurement

#:	Step actions:	Expected Results:
1	Check temperature in TMLTM message	Temperature value is valid (only minimal difference to the control thermometer)
2	Check temperature in Telemetry Log on SD Card	Temperature value is valid (only minimal difference to the control thermometer) Tmeperature matches TMLTM temp data
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Case rehab-t-6: Timing

Summary: Check if timing for automated functions is properly set	
Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-7: SD-card

Summary:

Check SD card related functions

- Log created
- Log in correct format
- Missing SD Card

<table>
<tr><th>#:</th><th>Step actions:</th><th>Expected Results:</th></tr>
<tr><td>1</td><td>Check SD Card for log</td><td>Telemetry Log created: data.csv</td></tr>
<tr><td>2</td><td>Check Telemetry Log format</td><td>
<table>
<tr><th>time</th><th>latitude</th><th>longitude</th><th>altitude</th><th>ext_temp</th><th>OBC_temp</th><th>COM_temp</th></tr>
<tr><td>hhmmss</td><td>(+/-)ddmm.mmmmm</td><td>(+/-)dddmm.mmmmm</td><td>a</td><td>ddd [0.1°C]</td><td>ddd [0.1°C]</td><td>ddd [°C]</td></tr>
</table>
Sample:

time,latitude,longitude,altitude,ext_temp,OBC_temp,COM_temp<CR><LF>
336677,+9500.000,+18888.000,0,217,227,022<CR><LF>
336677,+9500.000,+18888.000,0,420,153,022<CR><LF>
093735,+4728.40460,+01903.65498,105,194,263,022<CR><LF>
</td></tr>
<tr><td>3</td><td>Remove SD Card while OBC still operates</td><td>OBC returns "file error" error</td></tr>
<tr><td>4</td><td>Insert SD Card with no restart after Step #3</td><td>Successful logging</td></tr>
<tr><td>5</td><td>Restart OBC without SD Card</td><td>OBC returns "No SD CARD" error</td></tr>
<tr><td>6</td><td>Insert SD Card with no restart after Step #5</td><td>OBC returns "No SD CARD" error</td></tr>
<tr><td>Execution type:</td><td colspan="2">Manual</td></tr>
<tr><td>Estimated exec. duration (min):</td><td colspan="2"></td></tr>
<tr><td>Priority:</td><td colspan="2">Medium</td></tr>
</table>

Test Case rehab-t-8: Timeouts

Summary:

Check if no deadlocks stop the operation

- GPS timeout
- Message timeouts

#:	Step actions:	Expected Results:
1	Disconnect GPS Module	GPS timeout occurs
2	Reconnect GPS module	Nominal operation
3	Disconnect a subsystem	SICL timeout occurs
4	Reconnect subsystem	Nominal operation
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Suite : COM.RFxxx

Test Case rehab-t-9: Startup

Summary:

COM module start up

Start up Message format:

```
$TCSTR,u,a*cc
```

u	UHF transceiver startup (0-inactive, 1-active)
a	APRS transmitter startup (0-inactive, 1-active)
*cc	Checksum

sample:

```
$TCSTR,1,0*cc
```

UHF is present, APRS is not present

Preconditions:

Connect BUS-TESTER to COM module to monitor SICL operations

#:	Step actions:	Expected Results:
1	Turn power on	COM module starts up Startup message sent on SICL Startup message in correct format

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-10: Incoming Telemetry message

Summary:

Incoming Telemetry message:

- TMLTM processed
- Telemetry radio packet created in proper format
- Radio pacet sent via RF transciever

UHF Telemetry packet format:

```
$$CCCCCCC,iii,hhmmss,(+/-)xxxx.xxx,(+/-)xxxxx.xxx,aaaaa,eeee,ooo,rrr,
```

$$	START bytes
CCCCCC	callsign
iii	Message ID*
hhmmss	GPS time (UTC) (hh-hours, mm-minutes, ss-seconds)
(+/-)xxxx.xxx	latitude (NMEA format)
(+/-)xxxxx.xxx	longitude (NMEA format)
aaaaa	altitude (m)
eeee	external temperature (*10 °C -> eee.e°C)
ooo	OBC module temperature (*10 °C -> ooo°C)
rrr	COM module temperature (*10 °C -> rrr°C)

** Message ID shows the last three digits of the sent message and increments with every new message. After COM restart the Message ID set back to 0.*

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-11: Incoming Housekeeping request

Summary:

Incoming Housekeeping request message:

- TMHKR processed
- Housekeeping data read properly
- TCHKD messages sent in proper format

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-13: Incoming Radio Message	
Summary: Incoming radio message processing • Handshake sent automatically	
Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-23: Internal Temperature		
Summary: Check internal module temperature value: • in TCHKD message		
Preconditions: Use an external thermometer as control Module should run for at least 5 mins before measurement		
#:	Step actions:	Expected Results:
1	Check temperature in TCHKD message	Temperature value is valid (only minimal difference to the control thermometer)
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Suite : Integrated Flight System

Test Suite : Flight Operations

Test Case rehab-t-34: Radio Downlink	
Summary: Check radio downlink, message format, message data • OBC+COM+EPS+GPS • Battery Powered • GPS bypass, PC simulator, valid GPS data, short, controlled datastream • Radio link to GND Output • GND Logs • DIAG Logs	
Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-35: Radio Uplink	
Summary: Check processing of incoming radio packets • OBC+COM+EPS+GPS • Battery Powered • GPS bypass, PC simulator, valid GPS data, short, controlled datastream • Radio link to GND Output • GND Logs • DIAG Logs	
Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-30: Telemetry - Valid GPS

Summary:

Check telemetry processing with PC-GPS Simulator providing valid GPS messages.

- OBC+COM+EPS+GPS
- Battery Powered
- GPS bypass, PC simulator, valid GPS data, short, controlled datastream
- Radio link to GND

Output

- SD Log
- GND Logs
- DIAG Logs

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-31: Telemetry - Invalid GPS

Summary:

Check telemetry processing with PC-GPS Simulator providing invalid GPS messages with no fix

- OBC+COM+EPS+GPS
- Battery Powered
- GPS bypass, PC simulator, invalid GPS data, short, controlled datastream
- Radio link to GND

Output

- SD Log
- GND Logs
- DIAG Logs

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-82: Telemetry - No GPS Connection

Summary:

Check telemetry processing with PC-GPS Simulator providing invalid GPS messages with no fix

- OBC+COM+EPS+GPS
- Battery Powered
- GPS bypass, PC simulator, no GPS data (signal off), short, controlled datastream
- Radio link to GND

Output

- SD Log
- GND Logs
- DIAG Logs

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-32: House keeping

Summary:

Check collected house keeping data: COM module temperature, OBC module temperature

- OBC+COM+EPS+GPS
- Battery Powered
- GPS bypass, PC simulator, valid GPS data, short, controlled datastream
- Radio link to GND

Output

- SD Log
- GND Logs
- DIAG Logs

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-33: Environmental Data

Summary:

Check collected environmental data: External Temperature

- OBC+COM+EPS+GPS
- Battery Powered
- GPS bypass, PC simulator, valid GPS data, short, controlled datastream
- Radio link to GND

Output

- SD Log
- GND Logs
- DIAG Logs

Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Case rehab-t-93: BEACON mode

Summary:

Test BEACON mode activation:

In NORMAL mode:

- Increase altitude over 1000m
- Decrease altituder under 300m

In BEACON mode:

- Increase altitude over 500m
- Decrease altitude under 300m

#:	Step actions:	Expected Results:
1	Increase altitude over 1000m	Stays in NORMAL mode
2	Decrease altitude under 300m	BEACON mode activates under 500m
3	Increase altitude in BEACON mode over 500m	Automatic switch to NORMAL mode over 500m
4	Decrease altitude under 300m	BEACON modes activates under 500m
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Suite : Preconditions

Test Case rehab-t-85: Inegrated Tests	
Summary: 1. Place and connect the prepared modules on the testboard 2. Place and connect diagnostic cards on the testboard 3. Connect additional wiring 4. Properly fix the modules and cables **----------** **ALWAYS USE DUMMY LOAD OR ANTENNA ON RF COMPONENTS!** **----------**	
Execution type:	Manual
Estimated exec. duration (min):	
Priority:	Medium

Test Suite : EPS proto

Test Case rehab-t-99: Power Output		
Summary: Test 3v3 and 5v0 voltage output		
#:	Step actions:	Expected Results:
1	Connect bench PSU to Battery IN	
2	Check 3V3 output	3V0 - 3V6 output
3	Check 5V0 output	5V5 stable output
4	Check GPS voltage	GPS gets the UNREG voltage and starts up
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Case rehab-t-100: Low voltage operation		
Summary: Check outputs by lowering the input voltage		
#:	Step actions:	Expected Results:
1	Set input voltage from 6V to 4V by steps	
2	Check 3V3 output	3V0 - 3V3
3	Check 5V0 output	5V0 - 4V0
4	Check GPS voltage	GPS operates through voltage drop
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	

Test Case rehab-t-101: Start Pin		
Summary: Check Start Pin operation		
#:	Step actions:	Expected Results:
1	Remove Start Pin	• 0V at 3V3 DC-DC converter Input • 0V at 5V0 DC-DC converter Input • 0V at outputs
2	Connect Start Pin	• Proper voltage at Outputs • UNREG voltage at DC-DC inputs
Execution type:	Manual	
Estimated exec. duration (min):		
Priority:	Medium	