CCU DLCM
File: H_FCP_CCU_DLCM.xls
Author: E. Picallo

Procedure Summary

Objectives

This procedure describes the steps to perform the measurement of the remaining mass of Helium in the HTT by using the DLCM device (Direct Liquid Content Measurement).

There are 2 DLCM in Herschel located at the bottom of the tank. They consist in a 10 W heater on each, CCU-A and CCU-B, used to produce a heat pulse in the superfluid helium in the HTT. The temperature elevation is measured accurately to estimate the remaining mass of Helium.

Summary of Constraints

DLCM in parallel on A and B branches should be avoided. i.e. it is recommnended to use only one DLCM chain.

It is foreseen to use the DLCM only a few times during the mission, in order to limit the lifetime impact (each DLCM 200s x 10W heat pulse is equivalent to 0.5 day x 50mW of lifetime)

All instruments should be in Standby Mode and thermally stable with no L3He left inside the 3He coolers 3 hs before the DLCM.

During DLCM only acquire those CCU sensors needed for the measurament.

The DLCM operation will be done under ground visibility and only on ground request.

The DLCM parameters are:
- pre-monitoring phase is always fixed to 200 sec
- post-monitoring phase shall be set to 450 sec
- heating phase shall be set to 200 sec at BOL and can be reduced linearly to 60 sec (TBC) at EOL.

Spacecraft Configuration

Start of Procedure

CDMU in default configuration
LCL 37 (CCU A) and LCL 38 (CCU B) closed
CCU A and B configured "ON" and "VALID" on 1553 S/C bus
CCU A&B in monitoring mode
Instruments OFF or in STBY
Both the 3He coolers should be thermally OFF

End of Procedure

CDMU in default configuration
LCL 37 (CCU A) and LCL 38 (CCU B) closed
CCU A and B configured "ON" and "VALID" on 1553 S/C bus
CCU A&B in monitoring mode
Instruments OFF or in STBY
Both the 3He coolers should be thermally OFF

Reference File(s)

Input Command Sequences

Output Command Sequences

HFKDLCM1
HFKDLCM2
HFKDLCM3

Referenced Displays

ANDs	GRDs	SLDs
ZAZ9J999		(None)
ZAZ9P999		

Configuration Control Information

DATE	FOP ISSUE	VERSION	MODIFICATION DESCRIPTION	AUTHOR	SPR REF
30/07/08	1	1	Created	E. Picallo	
24/11/08		2	DLCM heating period = 180s, post meas = 1x30 sec	E. Picallo	
26/11/08		3	Post measurement period set to 450 sec only one DLCMactivated at a time constrain deleted	E. Picallo	
28/11/08		4	Both DLCM activated at the same time	E. Picallo	
01/12/08		5	DLCM Arm & DLCM On Blocked flags updated	E. Picallo	
17/12/08		6	DLCM on CCU A only added DLCM on CCU B only added	E. Picallo	
17/12/08		7	sequence generation	E. Picallo	
18/12/08		8	TC PerformCcuManag to start monitoring updated to disable ALL Spare channels	E. Picallo	
18/12/08	2	9	DLCM not compatible with decontamination constrain added	E. Picallo	
18/02/09	2.1	9.01	Validation : summary of constrain updated - DLCM used as a contingency added	E. Picallo	
25/03/09	2.2	10	comment on pre-heating and post-heating values for MUR, MU0, MIR and MI0 should not vary significantly added	E. Picallo	
09/11/09	3	11	Summary of constrains updated Stop the Monitoring mode for both CCUs berore DLCM Re-start CCU monitoring mode for both CCUs after DLCM	E. Picallo	

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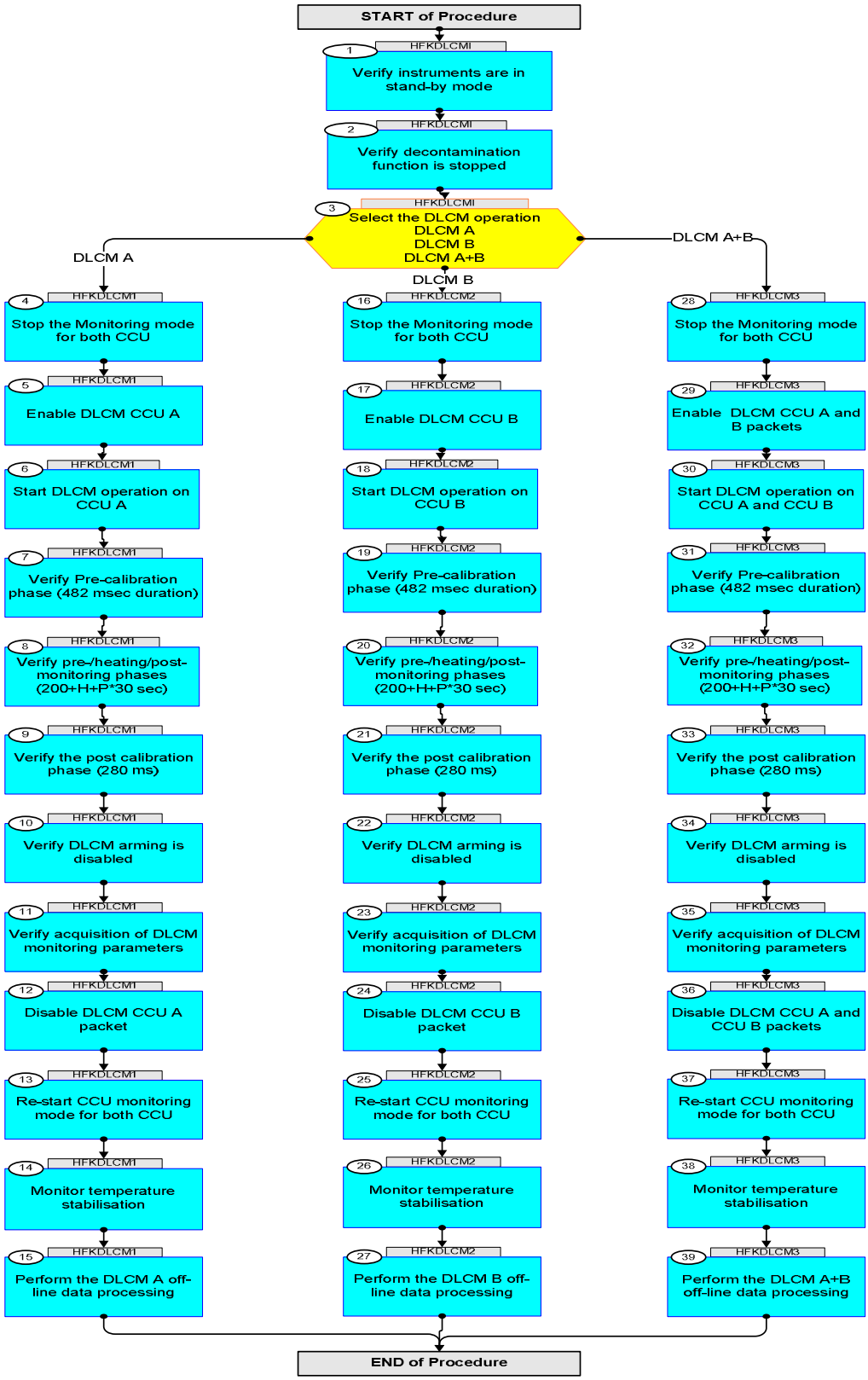
Procedure Flowchart Overview



Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Beginning of Procedure		
		TC Seq. Name :HFKDLCMI (Enable DLCM Initial) *TimeTag Type:* *Sub Schedule ID:*		
1		*Verify instruments are in stand-by mode*		Next Step: 2
		Verify HIFI mode Telemetry **HL_MODE_S** **HM258194**	**= standby**	(None)
		Verify PACS mode Telemetry **DP_TM_RATE** **PM049380**	**= NO PRIME**	(None)
		Verify SPIRE mode Telemetry **MODE** **SM00M500**	**= REDY**	(None)
2		*Verify decontamination function is stopped*		Next Step: 3
		Verify Telemetry **DhSts** **DEG17170**	**= Stopped**	AND=ZAZ9J999
3		*Select the DLCM operation* *DLCM A* *DLCM B* *DLCM A+B*		Next Step: DLCM A+B 28 DLCM A 4 DLCM B 16
		Performance of the DLCM in parallel on A and B branches should be avoided.		
		TC Seq. Name :HFKDLCM1 (Enable DLCM A) *TimeTag Type: N* *Sub Schedule ID:*		
4		*Stop the Monitoring mode for both CCU*		Next Step: 5
		Call procedure H_FCP_CCU_ACQP and select the option "Stop monitoring"		
		Execute Procedure: **H_FCP_CCU_ACQP** **CCU acquisition period update**		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
5		*Enable DLCM CCU A*		Next Step: 6
		Enable CCU_A DLCM (HK ID = 101 SID= 0x579E) Diagnostic packet		
		Execute Telecommand **EnableTmGen** *Command Parameter(s) :* **N DH017180** **Sub-Type DH019180** **Packet-ID DH020180** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : Enable Generation of Telemetry Packets	**DC900180** **1 <dec>** (Def) **Diag Report** **101 <dec>**	
6		*Start DLCM operation on CCU A*		Next Step: 7
6.1		*Verify the arming mode*		□
		Verify Telemetry **DLCMHArm_st A KM037300**	**= OFF**	AND=ZAZ9P999
6.2		*Send TC to Arm DLCM on CCU A*		□
		Execute Telecommand **CCUA_ArmDLCM** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUA DLCM Arming	**ZC0ZR999**	
6.3		*Verify the arming mode*		□
		Verify Telemetry **DLCMHArm_st A KM037300**	**= ON**	AND=ZAZ9P999
6.4		*Send TC to activate the DLCM sequence on CCU A*		□
		WARNING: DLCM arming will return to Idle mode if the "DLCM On" command is received too fast (<1 sec) or is not received within 180 sec.		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Set the values of the following parameters to activate the DLCM operation: **KP101300 = heating period between 0 and 200 sec** **KP102300 = post measurement period between 0 and 15 (measurements over P*30 seconds where P is parameter on command i.e. 0 to 450 sec).** **The Post measurement period needs to be maximum period (450 sec).** **The heated phase at begin of life (full tank) shall be 200 sec and can be reduced linearly to 60 sec (TBC) at the end of life. (empty tank)**		
		Execute Telecommand **CCUA_DLCMon** *Command Parameter(s) :* **DLCM HeatingPeriod CCUA KP101300** **DLCM PostMeasur CCUA KP102300** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUA DLCM ON	**ZC0ZT999** **200 <dec>** **15 <dec>**	
		Initiates DLCM sequence: **1) Pre-calibration measurements (482 ms.)** **2) Actual DLCM sequence: (measurement of temp. sensors, voltage and current over heater).** **– *Pre-monitoring* : Measurements over 200 sec** **– *Heating* : Heater ON and measurements over "Heating period" [sec] (parameter in the command).** **– *Post-monitoring* : Heater OFF and measurements over "Post measure period" * 30 [sec]** **3) Post-calibration measurements (280 ms)** Total execution time = 200.76 + H + 30 * P sec = 200.76 + 200 + 30 * 15 = 850.76 sec = 14 min		
		Note: The Pre-calibration and the Post-calibration are very quick and can not be easily monitored in real time.		
7		*Verify Pre-calibration phase (482 msec duration)*		Next Step: 8
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Idle**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
8		*Verify pre-/heating/post-monitoring phases (200+H+P*30 sec)*		Next Step: 9
8.1		*Verify Pre-monitoring phase (200 sec duration)*		□
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Pre-Mon**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
8.2		*Verify Heating phase (over "Heating period" [sec] duration)*		□
		Verify that the DLCM enters in the Heating phase (selected duration between 0 and 200 sec)		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= ON**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Heating**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
8.2.1		*Monitor the DLCM heater voltage & current and temperature sensors*		□
		Verify Voltage DLCM1 heater CCU A Telemetry **CCU_A_DLCM_V KD272300**		AND=ZAZ9P999
		Verify Current DLCM1 heater CCU A Telemetry **CCU_A_DLCM_I KD273300**		AND=ZAZ9P999
		Verify data from CCU A (DLCM 1 heated ; CCU A is connect with DLCM 1, Heater H 101 and the temperature sensors T 105 and T 102)		
		Verify DLCM1 temperature Telemetry **C100_0_T105 KD201302**		AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify DLCM2 temperature Telemetry **C100_0_T102 KD200302**		AND=ZAZ9P999
8.3		*Verify Post-monitoring phase (over "Post measure period" * 30 sec)*		
		After the selected heating duration, verify DLCM enters in the Post-monitoring phase (selected duration 450 sec)		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Post-Mon**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
9		*Verify the post calibration phase (280 ms)*		Next Step: 10
		At the end of the Post-monitoring phase, DLCM enters in Post-calibration phase indicated in the TM parameter KM628300		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Idle**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Post-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
10		*Verify DLCM arming is disabled*		Next Step: 11
		Verify Telemetry **DLCMHArm_st A KM037300**	**= OFF**	AND=ZAZ9P999
11		*Verify acquisition of DLCM monitoring parameters*		Next Step: 12

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify the following DLCM Pre/Post-heating calibration and DLCM temperature sensors: **Pre-heating calibration data:** **- MUR, used for gaincalibration,** **- MU0, used for offset calibration,** **- MIR, used for gain calibration,** **- MI0, used for offset calibration.** **Post-heating calibration data:** **- MUR, used for gain calibration,** **- MU0, used for offset calibration,** **- MIR, used for gain calibration,** **- MI0, used for offset calibration.**		
		Verify Mur of CCU A in pre-heating calibration Telemetry **CCU_A_Mur_pre KD600300**		AND=ZAZ9P999
		Verify Mu0 of CCU A in pre-heating calibration Telemetry **CCU_A_Mu0_pre KD601300**		AND=ZAZ9P999
		Verify Mir of CCU A in pre-heating calibration Telemetry **CCU_A_Mir_pre KD602300**		AND=ZAZ9P999
		Verify Mi0 of CCU A in pre-heating calibration Telemetry **CCU_A_Mi0_pre KD603300**		AND=ZAZ9P999
		Verify Mur of CCU A in post-heating calibration Telemetry **CCU_A_Mur_post KD613300**		AND=ZAZ9P999
		Verify Mu0 of CCU A in post-heating calibration Telemetry **CCU_A_Mu0_post KD612300**		AND=ZAZ9P999
		Verify Mir of CCU A in post-heating calibration Telemetry **CCU_A_Mir_post KD611300**		AND=ZAZ9P999
		Verify Mi0 of CCU A in post-heating calibration Telemetry **CCU_A_Mi0_post KD610300**		AND=ZAZ9P999
		Verify DLCM1 temperature Telemetry **C100_0_T105 KD201302**		AND=ZAZ9P999
		Verify DLCM2 temperature Telemetry **C100_0_T102 KD200302**		AND=ZAZ9P999
		The pre-heating and post-heating values for MUR, MU0, MIR and MI0 should not vary significantly. **Where:** **- Voltage measurement reference source voltage (MUR)** **- Conversion result from voltage measurement short circuit (MU0)** **- Current measurement reference source voltage (MIR)** **- Current measurement short circuit voltage (MI0)**		
12		*Disable DLCM CCU A packet*		Next Step: 13

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Disable CCU_A DLCM (HK ID = 101 SID = 0x579E) Diagnostic packet		
		Execute Telecommand **DisableTmGen** *Command Parameter(s) :* **N** **DH017180** **Sub-Type** **DH019180** **Packet-ID** **DH020180** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : Disable Generation of Telemetry Packets	**DC902180** **1 <dec>** (Def) **Diag Report** **101 <dec>**	
13		*Re-start CCU monitoring mode for both CCU*		Next Step: 14
		Call procedure H_FCP_CCU_ACQP and select "routine monitoring" (period 512 sec) or Recycling/decontamination (period 8 sec)		
		Execute Procedure: **H_FCP_CCU_ACQP** **CCU acquisition period update**		
14		*Monitor temperature stabilisation*		Next Step: 15
		Monitor the time required for temperature stabilisation (temperature sensors T 105 and T 102)		
15		*Perform the DLCM A off-line data processing*		Next Step: END
		TC Seq. Name :HFKDLCM2 (Enable DLCM B) *TimeTag Type: N* *Sub Schedule ID:*		
16		*Stop the Monitoring mode for both CCU*		Next Step: 17
		Call procedure H_FCP_CCU_ACQP and select the option "Stop monitoring"		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Execute Procedure: **H_FCP_CCU_ACQP** **CCU acquisition period update**		
17		*Enable DLCM CCU B*		Next Step: 18
		Enable CCU_B DLCM (HK ID = 103 SID= 0x5AAA) Diagnostic packet		
		Execute Telecommand **EnableTmGen** *Command Parameter(s) :* **N DH017180** **Sub-Type DH019180** **Packet-ID DH020180** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : Enable Generation of Telemetry Packets	**DC900180** **1 <dec>** (Def) **Diag Report** **103 <dec>**	
18		*Start DLCM operation on CCU B*		Next Step: 19
18.1		*Verify the arming mode*		□
		Verify Telemetry **DLCMHArm_st B KM037301**	**= OFF**	AND=ZAZ9P999
18.2		*Send TC to Arm DLCM on CCU B*		□
		Execute Telecommand **CCUB_ArmDLCM** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUB DLCM Arming	**ZC0ZS999**	
18.3		*Verify the arming mode*		□
		Verify Telemetry **DLCMHArm_st B KM037301**	**= ON**	AND=ZAZ9P999
18.4		*Send TC to activate the DLCM sequence on CCU B*		□

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		WARNING: DLCM arming will return to Idle mode if the "DLCM On" command is received too fast (<1 second) or is not received within 180 sec.		
		Set the values of the following parameters to activate the DLCM operation: **KP101301 = heating period between 0 and 200 sec** **KP102301 = post measurement period between 0 and 15 (measurements over P*30 seconds where P is parameter on command i.e. 0 to 450 sec).** **The Post measurement period needs to be maximum period (450 sec).** **The heated phase at begin of life (full tank) shall be 180 sec and can be reduced linearly to 60 sec at the end of life (empty tank).**		
		Execute Telecommand **CCUB_DLCMon** *Command Parameter(s) :* **DLCM HeatingPeriod CCUB KP101301** **DLCM PostMeasur CCUB KP102301** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUB DLCM ON	**ZC0ZU999** **200 <dec>** **15 <dec>**	
		Initiates DLCM sequence: **1) Pre-calibration measurements (482 ms.)** **2) Actual DLCM sequence: (measurement of temp. sensors, voltage and current over heater).** **– *Pre-monitoring* : Measurements over 200 sec** **– *Heating* : Heater ON and measurements over "Heating period" [sec] (parameter in the command).** **– *Post-monitoring* : Heater OFF and measurements over "Post measure period" * 30 [sec]** **3) Post-calibration measurements (280 ms)** Total execution time = 200.76 + H + 30 * P sec = 200.76 + 200 + 30 * 15 = 850.76 sec = 14 min		
		Note: The Pre-calibration and the Post-calibration are very quick and can not be easily monitored in real time.		
19		*Verify Pre-calibration phase (482 msec duration)*		Next Step: 20
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Idle**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
20		*Verify pre-/heating/post-monitoring phases (200+H+P*30 sec)*		Next Step: 21
20.1		*Verify Pre-monitoring phase (200 sec duration)*		□
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Pre-Mon**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
20.2		*Verify Heating phase (over "Heating period" [sec] duration)*		□
		Verify that the DLCM enters in the Heating phase (selected duration between 0 and 200 sec)		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= ON**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Heating**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
20.2.1		*Monitor the DLCM heater voltage & current and temperature sensors*		□
		Verify Voltage DLCM2 heater CCU B Telemetry **CCU_B_DLCM_V KD272301**		AND=ZAZ9P999
		Verify Current DLCM2 heater CCU B Telemetry **CCU_B_DLCM_I KD273301**		AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify data from CCU B (DLCM 2 heated ; CCU B is connect with DLCM 2, Heater H 102 and the temperature sensors T 104 and T 101)		
		Verify DLCM2 Temperature Telemetry **C100_0_T104 KD201303**		AND=ZAZ9P999
		Verify DLCM1 Temperature Telemetry **C100_0_T101 KD200303**		AND=ZAZ9P999
20.3		*Verify Post-monitoring phase (over "Post measure period" * 30 sec)*		
		After the selected heating duration, verify DLCM enters in the Post-monitoring phase (selected duration 450 sec)		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Post-Mon**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
21		*Verify the post calibration phase (280 ms)*		Next Step: 22
		At the end of the Post-monitoring phase, DLCM enters in Post-calibration phase indicated in the TM parameter KM628301		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Idle**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Post-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
22		*Verify DLCM arming is disabled*		Next Step: 23
		Verify Telemetry **DLCMHArm_st B KM037301**	**= OFF**	AND=ZAZ9P999
23		*Verify acquisition of DLCM monitoring parameters*		Next Step: 24

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify the following DLCM Pre/Post-heating calibration and DLCM temperature sensors: **Pre-heating calibration data:** **- MUR, used for gaincalibration,** **- MU0, used for offset calibration,** **- MIR, used for gain calibration,** **- MI0, used for offset calibration.** **Post-heating calibration data:** **- MUR, used for gain calibration,** **- MU0, used for offset calibration,** **- MIR, used for gain calibration,** **- MI0, used for offset calibration.**		
		Verify Mur of CCU B in pre-heating calibration Telemetry **CCU_B_Mur_pre KD600301**		AND=ZAZ9P999
		Verify Mu0 of CCU B in pre-heating calibration Telemetry **CCU_B_Mu0_pre KD601301**		AND=ZAZ9P999
		Verify Mir of CCU B in pre-heating calibration Telemetry **CCU_B_Mir_pre KD602301**		AND=ZAZ9P999
		Verify Mi0 of CCU B in pre-heating calibration Telemetry **CCU_B_Mi0_pre KD603301**		AND=ZAZ9P999
		Verify Mur of CCU B in post-heating calibration Telemetry **CCU_B_Mur_post KD613301**		AND=ZAZ9P999
		Verify Mu0 of CCU B in post-heating calibration Telemetry **CCU_B_Mu0_post KD612301**		AND=ZAZ9P999
		Verify Mir of CCU B in post-heating calibration Telemetry **CCU_B_Mir_post KD611301**		AND=ZAZ9P999
		Verify Mi0 of CCU B in post-heating calibration Telemetry **CCU_B_Mi0_post KD610301**		AND=ZAZ9P999
		Verify Voltage DLCM heater CCU B Telemetry **CCU_B_DLCM_V KD272301**		AND=ZAZ9P999
		Verify Current DLCM heater CCU B Telemetry **CCU_B_DLCM_I KD273301**		AND=ZAZ9P999
		Verify DLCM2 Temperature Telemetry **C100_0_T104 KD201303**		AND=ZAZ9P999
		Verify DLCM1 Temperature Telemetry **C100_0_T101 KD200303**		AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		The pre-heating and post-heating values for MUR, MU0, MIR and MI0 should not vary significantly. **Where:** **- Voltage measurement reference source voltage (MUR)** **- Conversion result from voltage measurement short circuit (MU0)** **- Current measurement reference source voltage (MIR)** **- Current measurement short circuit voltage (MI0)**		
24		*Disable DLCM CCU B packet*		Next Step: 25
		Disable CCU_B DLCM (HK ID = 103 SID =0x5AAA) Diagnostic packet		
		Execute Telecommand **DisableTmGen** *Command Parameter(s) :* **N** **DH017180** **Sub-Type** **DH019180** **Packet-ID** **DH020180** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : Disable Generation of Telemetry Packets	**DC902180** **1 <dec>** (Def) **Diag Report** **103 <dec>**	
25		*Re-start CCU monitoring mode for both CCU*		Next Step: 26
		Call procedure H_FCP_CCU_ACQP and select "routine monitoring" (period 512 sec) or Recycling/decontamination (period 8 sec)		
		Execute Procedure: **H_FCP_CCU_ACQP** **CCU acquisition period update**		
26		*Monitor temperature stabilisation*		Next Step: 27
		Monitor the time required for temperature stabilisation (temperature sensors T 104 and T 101)		
27		*Perform the DLCM B off-line data processing*		Next Step: END

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		TC Seq. Name :HFKDLCM3 (Enable both DLCM) *TimeTag Type: N* *Sub Schedule ID:*		
28		*Stop the Monitoring mode for both CCU*		Next Step: 29
		Call procedure H_FCP_CCU_ACQP and select the option "Stop monitoring"		
		Execute Procedure: **H_FCP_CCU_ACQP** **CCU acquisition period update**		
29		*Enable DLCM CCU A and B packets*		Next Step: 30
		Enable the follwoing Diagnostic packets: **CCU_A DLCM (HK ID = 101 SID= 0x579E)** **CCU_B DLCM (HK ID = 103 SID =0x5AAA)**		
		Execute Telecommand **EnableTmGen**	**DC900180**	
		Command Parameter(s) : **N** **DH017180** **2 <dec>** **Sub-Type** **DH019180** **Diag Report** **Packet-ID** **DH020180** **101 <dec>** **Sub-Type** **DH019180** **Diag Report** **Packet-ID** **DH020180** **103 <dec>**		
		TC Control Flags : **GBM IL DSE** **--Y -- ---**		
		Subsch. ID : 10 Det. descr. : Enable Generation of Telemetry Packets		
30		*Start DLCM operation on CCU A and CCU B*		Next Step: 31
30.1		*Verify the arming mode*		
		Verify Telemetry **DLCMHArm_st A** **KM037300**	**= OFF**	AND=ZAZ9P999
		Verify Telemetry **DLCMHArm_st B** **KM037301**	**= OFF**	AND=ZAZ9P999
30.2		*Send TC to Arm DLCM on CCU A and CCU B*		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Execute Telecommand **CCUA_ArmDLCM** *TC Control Flags :* **GBM IL DSE** **-SY -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUA DLCM Arming	**ZC0ZR999**	
		Execute Telecommand **CCUB_ArmDLCM** *TC Control Flags :* **GBM IL DSE** **-E- -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUB DLCM Arming	**ZC0ZS999**	
30.3		*Verify the arming mode*		
		Verify Telemetry **DLCMHArm_st A** **KM037300**	**= ON**	AND=ZAZ9P999
		Verify Telemetry **DLCMHArm_st B** **KM037301**	**= ON**	AND=ZAZ9P999
30.4		*Send TC to activate the DLCM sequence on CCU A and CCU B*		
		WARNING: DLCM arming will return to Idle mode if the "DLCM On" command is received too fast (<1 sec) or is not received within 180 sec.		
		WARNING: the telecommands CCU A DLCM ON and CCU B DLCM ON shall be issued without any delay (<500ms between these two telecommnads). **To ensure that the two DLCMon commands (ZC0ZT999 and ZC0ZU999) are sent at the same time those TCs are blocked (encoded in the same CLTU) .**		
		Set the values of the following parameters to activate the DLCM operation: **KP101300/1 = heating period between 0 and 200 sec** **KP102300/1 = post measurement period between 0 and 15 (measurements over P*30 seconds where P is parameter on command i.e. 0 to 450 sec).** **The Post measurement period needs to be maximum period (450 sec).** **The heated phase at begin of life (full tank) shall be 180 sec and can be reduced linearly to 60 sec (TBC) at the end of life (empty tank).**		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Execute Telecommand **CCUA_DLCMon** *Command Parameter(s) :* **DLCM HeatingPeriod CCUA KP101300** **DLCM PostMeasur CCUA KP102300** *TC Control Flags :* **GBM IL DSE** **-SY -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUA DLCM ON	**ZC0ZT999** **200 <dec>** **15 <dec>**	
		Execute Telecommand **CCUB_DLCMon** *Command Parameter(s) :* **DLCM HeatingPeriod CCUB KP101301** **DLCM PostMeasur CCUB KP102301** *TC Control Flags :* **GBM IL DSE** **-E- -- ---** *Subsch. ID : 10* Det. descr. : TC(8,4,8,1) for CCUB DLCM ON	**ZC0ZU999** **200 <dec>** **15 <dec>**	
		Initiates DLCM sequence: **1) Pre-calibration measurements (482 ms.)** **2) Actual DLCM sequence: (measurement of temp. sensors, voltage and current over heater).** **– *Pre-monitoring* : Measurements over 200 sec** **– *Heating* : Heater ON and measurements over "Heating period" [sec] (parameter in the command).** **– *Post-monitoring* : Heater OFF and measurements over "Post measure period" * 30 [sec]** **3) Post-calibration measurements (280 ms)** Total execution time = 200.76 + H + 30 * P sec = 200.76 + 200 + 30 * 15 = 850.76 sec = 14 min		
		Note: The Pre-calibration and the Post-calibration are very quick and can not be easily monitored in real time.		
31		*Verify Pre-calibration phase (482 msec duration)*		Next Step: 32
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Idle**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Idle**	AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
32		*Verify pre-/heating/post-monitoring phases (200+H+P*30 sec)*		Next Step: 33
32.1		*Verify Pre-monitoring phase (200 sec duration)*		□
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Pre-Mon**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Pre-Mon**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
32.2		*Verify Heating phase (over "Heating period" [sec] duration)*		□
		Verify that the DLCM enters in the Heating phase (selected duration between 0 and 200 sec)		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= ON**	AND=ZAZ9P999
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= ON**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Heating**	AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Heating**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
32.2.1		*Monitor the DLCM heater voltage & current and temperature sensors*		
		Verify Voltage DLCM1 heater CCU A Telemetry **CCU_A_DLCM_V KD272300**		AND=ZAZ9P999
		Verify Current DLCM1 heater CCU A Telemetry **CCU_A_DLCM_I KD273300**		AND=ZAZ9P999
		Verify Voltage DLCM2 heater CCU B Telemetry **CCU_B_DLCM_V KD272301**		AND=ZAZ9P999
		Verify Current DLCM2 heater CCU B Telemetry **CCU_B_DLCM_I KD273301**		AND=ZAZ9P999
		Verify data from CCU A (DLCM 1&2 heated ; CCU A is connect with DLCM 1, Heater H 101 and the temperature sensors T 105 and T 102)		
		Verify DLCM1 temperature Telemetry **C100_0_T105 KD201302**		AND=ZAZ9P999
		Verify DLCM2 temperature Telemetry **C100_0_T102 KD200302**		AND=ZAZ9P999
		Verify data from CCU B (DLCM 1&2 heated ; CCU B is connect with DLCM 2, Heater H 102 and the temperature sensors T 104 and T 101)		
		Verify DLCM2 Temperature Telemetry **C100_0_T104 KD201303**		AND=ZAZ9P999
		Verify DLCM1 Temperature Telemetry **C100_0_T101 KD200303**		AND=ZAZ9P999
32.3		*Verify Post-monitoring phase (over "Post measure period" * 30 sec)*		
		After the selected heating duration, verify DLCM enters in the Post-monitoring phase (selected duration 450 sec)		

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Post-Mon**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Post-Mon**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Pre-calib**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Pre-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
33		*Verify the post calibration phase (280 ms)*		Next Step: 34
		At the end of the Post-monitoring phase, DLCM enters in Post-calibration phase indicated in the TM parameter KM628300/1		
		Verify State of DLCM heater Telemetry **DLCMheat_stat MA KM634300**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM heater Telemetry **DLCMheat_stat MB KM634301**	**= OFF**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MB KM622301**	**= Idle**	AND=ZAZ9P999
		Verify State of DLCM sequencer (execution phase) **DLCM_stat MA KM622300**	**= Idle**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MA KM628300**	**= Post-calib**	AND=ZAZ9P999
		Verify Pre- and Post- Calibration status Telemetry **Pre_post_cal MB KM628301**	**= Post-calib**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MA KM621300**	**= NOTACTIVE**	AND=ZAZ9P999
		Verify State of Monitoring sequencer Telemetry **MonSeq_stat MB KM621301**	**= NOTACTIVE**	AND=ZAZ9P999
34		*Verify DLCM arming is disabled*		Next Step: 35

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		Verify Telemetry **DLCMHArm_st A** **KM037300**	**= OFF**	AND=ZAZ9P999
		Verify Telemetry **DLCMHArm_st B** **KM037301**	**= OFF**	AND=ZAZ9P999
35		*Verify acquisition of DLCM monitoring parameters*		Next Step: 36
		Verify the following DLCM Pre/Post-heating calibration and DLCM temperature sensors: **Pre-heating calibration data:** **- MUR, used for gaincalibration,** **- MU0, used for offset calibration,** **- MIR, used for gain calibration,** **- MI0, used for offset calibration.** **Post-heating calibration data:** **- MUR, used for gain calibration,** **- MU0, used for offset calibration,** **- MIR, used for gain calibration,** **- MI0, used for offset calibration.**		
35.1		*Verify acquisition of DLCM monitoring parameters on CCU A*		
		Verify Mur of CCU A in pre-heating calibration Telemetry **CCU_A_Mur_pre** **KD600300**		AND=ZAZ9P999
		Verify Mu0 of CCU A in pre-heating calibration Telemetry **CCU_A_Mu0_pre** **KD601300**		AND=ZAZ9P999
		Verify Mir of CCU A in pre-heating calibration Telemetry **CCU_A_Mir_pre** **KD602300**		AND=ZAZ9P999
		Verify Mi0 of CCU A in pre-heating calibration Telemetry **CCU_A_Mi0_pre** **KD603300**		AND=ZAZ9P999
		Verify Mur of CCU A in post-heating calibration Telemetry **CCU_A_Mur_post** **KD613300**		AND=ZAZ9P999
		Verify Mu0 of CCU A in post-heating calibration Telemetry **CCU_A_Mu0_post** **KD612300**		AND=ZAZ9P999
		Verify Mir of CCU A in post-heating calibration Telemetry **CCU_A_Mir_post** **KD611300**		AND=ZAZ9P999
		Verify Mi0 of CCU A in post-heating calibration Telemetry **CCU_A_Mi0_post** **KD610300**		AND=ZAZ9P999
		Verify DLCM1 temperature Telemetry **C100_0_T105** **KD201302**		AND=ZAZ9P999
		Verify DLCM2 temperature Telemetry **C100_0_T102** **KD200302**		AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		The pre-heating and post-heating values for MUR, MU0, MIR and MI0 should not vary significantly. **Where:** **- Voltage measurement reference source voltage (MUR)** **- Conversion result from voltage measurement short circuit (MU0)** **- Current measurement reference source voltage (MIR)** **- Current measurement short circuit voltage (MI0)**		
35.2		*Verify acquisition of DLCM monitoring parameters on CCU B*		
		Verify Mur of CCU B in pre-heating calibration Telemetry **CCU_B_Mur_pre KD600301**		AND=ZAZ9P999
		Verify Mu0 of CCU B in pre-heating calibration Telemetry **CCU_B_Mu0_pre KD601301**		AND=ZAZ9P999
		Verify Mir of CCU B in pre-heating calibration Telemetry **CCU_B_Mir_pre KD602301**		AND=ZAZ9P999
		Verify Mi0 of CCU B in pre-heating calibration Telemetry **CCU_B_Mi0_pre KD603301**		AND=ZAZ9P999
		Verify Mur of CCU B in post-heating calibration Telemetry **CCU_B_Mur_post KD613301**		AND=ZAZ9P999
		Verify Mu0 of CCU B in post-heating calibration Telemetry **CCU_B_Mu0_post KD612301**		AND=ZAZ9P999
		Verify Mir of CCU B in post-heating calibration Telemetry **CCU_B_Mir_post KD611301**		AND=ZAZ9P999
		Verify Mi0 of CCU B in post-heating calibration Telemetry **CCU_B_Mi0_post KD610301**		AND=ZAZ9P999
		Verify Voltage DLCM heater CCU B Telemetry **CCU_B_DLCM_V KD272301**		AND=ZAZ9P999
		Verify Current DLCM heater CCU B Telemetry **CCU_B_DLCM_I KD273301**		AND=ZAZ9P999
		Verify DLCM2 Temperature Telemetry **C100_0_T104 KD201303**		AND=ZAZ9P999
		Verify DLCM1 Temperature Telemetry **C100_0_T101 KD200303**		AND=ZAZ9P999

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
		The pre-heating and post-heating values for MUR, MU0, MIR and MI0 should not vary significantly. **Where:** **- Voltage measurement reference source voltage (MUR)** **- Conversion result from voltage measurement short circuit (MU0)** **- Current measurement reference source voltage (MIR)** **- Current measurement short circuit voltage (MI0)**		
36		*Disable DLCM CCU A and CCU B packets*		Next Step: 37
		Disable the following Diagnostic packets: **CCU_A DLCM (HK ID = 101 SID = 0x579E)** **CCU_B DLCM (HK ID = 103 SID =0x5AAA)**		
		Execute Telecommand **DisableTmGen** *Command Parameter(s) :* **N DH017180** **Sub-Type DH019180** **Packet-ID DH020180** **Sub-Type DH019180** **Packet-ID DH020180** *TC Control Flags :* **GBM IL DSE** **--Y -- ---** *Subsch. ID : 10* Det. descr. : Disable Generation of Telemetry Packets	**DC902180** **2 <dec>** **Diag Report** **101 <dec>** **Diag Report** **103 <dec>**	
37		*Re-start CCU monitoring mode for both CCU*		Next Step: 38
		Call procedure H_FCP_CCU_ACQP and select "routine monitoring" (period 512 sec) or Recycling/decontamination (period 8 sec)		
		Execute Procedure: **H_FCP_CCU_ACQP** **CCU acquisition period update**		
38		*Monitor temperature stabilisation*		Next Step: 39
		Monitor the time required for temperature stabilisation (temperature sensors T 101, T 102 , T 104 and T 105)		
39		*Perform the DLCM A+B off-line data processing*		Next Step: END

Step No.	Time	Activity/Remarks	TC/TLM	Display/ Branch
End of Procedure				