Design Specification

I-sample RF Test and Calibration (CSTT)

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0 Document Control

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0.3 References, Abbreviations, Terms

Table of Contents

1 Introduction

Please note that the information contained in this document is preliminary, and subject to change without any further warning. Also the described calibration method is subject to change without any further warning.

The methods described in this document describe how the specific DRP calibration script is send and what has to be calibrated. This document only describes the RF calibration.

This document describes how the RF on I-sample are calibrated and tested during I-sample production. All tests and calibrations can be carried out through Enhanced Test Mode (ETM). The tests performed might not be suitable for a high volume production.

The document is temporary version and hence only covers the calibration currently implemented.

This document is based on the R&S CMU200 as the Base Station Simulator (BSS), and where a Signal Generator (SG) is necessary the Signal Generator included in the CMU200 are used.

All shield cans should be mounted on the MS before testing the RF (includes outer plastic if this is a part of the shielding).

The tests and calibrations described in this document are carried out using an external RF connector (conducted). Quality assurance and quality control tests are not described in this document, these kinds of tests are the responsibility of the manufacturer.

The manufacturer should verify the antenna and audio performance in separate tests after mechanical assembly, these kinds of tests are up to the manufacturer.

QA/QC tests could include (not exhaustive list):

- GSM850 / EGSM900 / DCS1800 / PCS1900 GPRS (Class 10) performance tests – normal and extreme conditions
- Antenna test – check that performance on internal antenna is OK
- Acoustic test – check that transducers are mounted properly in the mechanics
- Power consumption
- Other tests….

1.1 Basics for document

This document is based on the following SW release and API document.

SW Version	Validated on intermediate R&D release of N5.12 (N5.10.1).
API document	locosto_drp2_api_13_01_04_02719.doc version 1.11

1.2 References

RD810	90_01_08_00467_RD810_ETM_HLS V1.1
RD811	90_01_08_00462_RD811_CORE_TMM V1.3
RD813	90_01_08_00466_RD813_TMSH_HLS V1.1
RD814	90_01_08_00463_RD814_FFS_TMM V1.1
RD816	90_01_08_00464_RD816_RF_TMM_I-sample and the version V 1.4
APN222	RF band arrangement

2 General Conditions

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
2.1	Battery Supply Voltage	DC supply at battery connector	Vbatt		3.7 V_{DC}, ≥ 3 Amp	Power Supply
2.2	Ambient Temperature				+ 15°C + 35°C	

Before the FFS can be used for saving calibration parameters to a Flash it must be formatted and the full directory structure must be created. This only has to be done once, by executing the ETM commands listed in *Table 4.3*.

3 RF Calibration

3.1 Initialisation

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Test Equipment
3.1	Enable Testmode	See section A.1.2				
3.2	Set RF family	See section A.1.2				
3.3	Formatting the FFS and creating full data structure	See section A.1.2				

3.2 DRP Initial Calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Test Equipment
3.4	Calibrate the DCXO initial value	See section A.1.3				BSS
3.5	Tx-Rx Common Calibration	See section A.1.4				BSS

3.3 DRP Band Specific Calibration

3.3.1 EGSM900 DRP calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.6	Calibrate the LNA	Refer to Appendix A.1.5			According to Appendix A	BSS or Signal Generator
3.7	Calibrate the IQMC	Refer to Appendix A.1.6			According to Appendix A	BSS or Signal Generator
3.8	Calibrate the 400kHz poles of the SCF	Refer to Appendix A.1.7			According to Appendix A	BSS or Signal Generator
3.9	Calibrate the 270kHz poles and 400kHz of the SCF	Refer to Appendix A.1.8			According to Appendix A	BSS or Signal Generator
3.10	Calibrate the AFE gain steps	Refer to Appendix A.1.9			According to Appendix A	BSS or Signal Generator

3.3.2 GSM850 DRP calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.11	Calibrate the LNA	Refer to Appendix A.1.5			According to Appendix A	BSS or Signal Generator
3.12	Calibrate the IQMC	Refer to Appendix A.1.6			According to Appendix A	BSS or Signal Generator
3.13	Calibrate the 400kHz poles of the SCF	Refer to Appendix A.1.7			According to Appendix A	BSS or Signal Generator
3.14	Calibrate the 270kHz poles and 400kHz of the SCF	Refer to Appendix A.1.8			According to Appendix A	BSS or Signal Generator
3.15	Calibrate the AFE gain steps	Refer to Appendix A.1.9			According to Appendix A	BSS or Signal Generator

3.3.3 DCS1800 DRP calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.16	Calibrate the LNA	Refer to Appendix A.1.5			According to Appendix A	BSS or Signal Generator
3.17	Calibrate the IQMC	Refer to Appendix A.1.6			According to Appendix A	BSS or Signal Generator
3.18	Calibrate the 400kHz poles of the SCF	Refer to Appendix A.1.7			According to Appendix A	BSS or Signal Generator
3.19	Calibrate the 270kHz poles and 400kHz of the SCF	Refer to Appendix A.1.8			According to Appendix A	BSS or Signal Generator
3.20	Calibrate the AFE gain steps	Refer to Appendix A.1.9			According to Appendix A	BSS or Signal Generator

3.3.4 PCS1900 RX calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.21	Calibrate the LNA	Refer to Appendix A.1.5			According to Appendix A	BSS or Signal Generator
3.22	Calibrate the IQMC	Refer to Appendix A.1.6			According to Appendix A	BSS or Signal Generator
3.23	Calibrate the 400kHz poles of the SCF	Refer to Appendix A.1.7			According to Appendix A	BSS or Signal Generator
3.24	Calibrate the 270kHz poles and 400kHz of the SCF	Refer to Appendix A.1.8			According to Appendix A	BSS or Signal Generator
3.25	Calibrate the AFE gain steps	Refer to Appendix A.1.9			According to Appendix A	BSS or Signal Generator

3.4 DRP Calibration Date Storage

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.26	Save the calibrated data in the FLASH	Refer to Appendix A.1.10			According to Appendix A	BSS or Signal Generator

3.5 GSM Initial Calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.27	Calibrate the AFC	See section A.1.11				BSS

3.6 GSM Band Specific Calibration

3.6.1 GSM TX calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.28	Calibrate EGSM900 TX power	Refer to Appendix A.3 for obtaining TX power levels	RF Ext.	APC values	According to Appendix A	BSS power level measurement
3.29	Calibrate DCS1800 TX power	Refer to Appendix A.3 for obtaining TX power levels	RF Ext.	APC values	According to Appendix A	BSS power level measurement
3.30	Calibrate PCS1900 TX power	Refer to Appendix A.3 for obtaining TX power levels	RF Ext.	APC values	According to Appendix A	BSS power level measurement
3.31	Calibrate GSM850 TX power	Refer to Appendix A.3 for obtaining TX power levels	RF Ext.	APC values	According to Appendix A	BSS power level measurement

3.6.2 GSM RX calibration

No	Description	Input	TP/Pin/Ctrl	Output	Specification	Measurement Equipment
3.32	EGSM900 RX RSSI Channel Compensation	Refer to Appendix A.2			According to Appendix A	BSS or Signal Generator
3.33	DCS1800 RX RSSI Channel Compensation	Refer to Appendix A.2			According to Appendix A	BSS or Signal Generator
3.34	PCS1900 RX RSSI Channel Compensation	Refer to Appendix A.2			According to Appendix A	BSS or Signal Generator
3.35	GSM850 RX RSSI Channel Compensation	Refer to Appendix A.2			According to Appendix A	BSS or Signal Generator

4 RF Test

4.1 GSM850 - Test

4.1.1 GSM850 TX tests

No	Description	Input				TP/Pin/Ctrl	Output	Measurement Equipment
		Power level	Channels	Minumum Burst #	Measure methode			
4.1	Check TX power	5	128, 190, 251	20	Avg Burst Power	RF Ext.	TX signal	BSS power level measurement
		11	128, 190, 251					
		19	251					
4.2	Check template	5	128, 190, 251	20	Maximum	RF Ext.	TX signal	BSS power ramp measurement
		11	128, 190, 251					
		19	251					
4.3	Check switching spectrum	5	190	10	Maximum	RF Ext.	TX signal	BSS switching spectrum measurement
4.4	Check switching spectrum	11	190			RF Ext.	TX signal	BSS switching spectrum measurement
4.5	Check modulation spectrum	5	190	50	Average	RF Ext.	TX signal	BSS switching spectrum measurement
4.6	Check Peak Phase error	5, 11, 19	128, 190, 251	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement
4.7	Check RMS Phase error	5, 11, 19	128, 190, 251	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement

4.1.2 GSM850 RX test

No	Description	Generator level	Channels	Number of Bursts	Measurement Equipment
4.8	Check RSSI	-60 dBm	128, 189, 251	100	BSS
		-102 dBm	128, 189, 251	100	BSS
4.9	Check Noisefloor	OFF	128, 189, 251		BSS

4.2 EGSM900 - Test

4.2.1 EGSM900 TX tests

No	Description	Input				TP/Pin/Ctrl	Output	Measurement Equipment
		Power level	Channels	Minumum Burst #	Measure methode			
4.10	Check TX power	5	975, 40, 124	20	Avg Burst Power	RF Ext.	TX signal	BSS power level measurement
		11	975, 40, 124					
		19	975, 40, 124					
4.11	Check template	5, 11, 19	975, 40, 124	20	Maximum	RF Ext.	TX signal	BSS power ramp measurement
4.12	Check switching spectrum	5	40	10	Maximum	RF Ext.	TX signal	BSS switching spectrum measurement
4.13	Check switching spectrum	11, 19	40			RF Ext.	TX signal	BSS switching spectrum measurement
4.14	Check modulation spectrum	5	40	50	Average	RF Ext.	TX signal	BSS switching spectrum measurement
4.15	Check Peak Phase error	5, 11, 19	975, 40, 124	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement
4.16	Check RMS Phase error	5, 11, 19	975, 40, 124	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement

4.2.2 EGSM900 RX test

No	Description	Generator level	Channels	Number of Bursts	Measurement Equipment
4.17	Check RSSI	-60 dBm	975, 40, 124	100	BSS
		-102 dBm	975, 40, 124	100	BSS
4.18	Check Noisefloor	OFF	975, 40, 124		BSS

4.3 DCS1800 - Test

4.3.1 DCS1800 TX tests

No	Description	Input				TP/Pin/Ctrl	Output	Measurement Equipment
		Power level	Channels	Minumum Burst #	Measure methode			
4.19	Check TX power	0	512, 710, 885	20	Avg Burst Power	RF Ext.	TX signal	BSS power level measurement
		8	512, 710, 885					
		15	512, 710, 885					
4.20	Check template	0, 8, 15	512, 710, 885	20	Maximum	RF Ext.	TX signal	BSS power ramp measurement
4.21	Check switching spectrum	0	710	10	Maximum	RF Ext.	TX signal	BSS switching spectrum measurement
4.22	Check switching spectrum	8, 15	710			RF Ext.	TX signal	BSS switching spectrum measurement
4.23	Check modulation spectrum	0	710	50	Average	RF Ext.	TX signal	BSS switching spectrum measurement
4.24	Check Peak Phase error	0, 8, 15	512, 710, 885	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement
4.25	Check RMS Phase error	0, 8, 15	512, 710, 885	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement

4.3.2 DCS1800 RX test

No	Description	Generator level	Channels	Number of Bursts	Measurement Equipment
4.26	Check RSSI	-60 dBm	512, 700, 885	100	BSS
		-102 dBm	512, 700, 885	100	BSS
4.27	Check Noisefloor	OFF	512, 700, 885		BSS

4.4 PCS1900 - Test

4.4.1 PCS1900 TX tests

No	Description	Input				TP/Pin/Ctrl	Output	Measurement Equipment
		Power level	Channels	Minumum Burst #	Measure methode			
4.28	Check TX power	0	512, 660, 810	20	Avg Burst Power	RF Ext.	TX signal	BSS power level measurement
		8	512, 660, 810					
		15	512, 660, 810					
4.29	Check template	0, 8, 15	512, 660, 810	20	Maximum	RF Ext.	TX signal	BSS power ramp measurement
4.30	Check switching spectrum	0	660	10	Maximum	RF Ext.	TX signal	BSS switching spectrum measurement
4.31	Check switching spectrum	8, 15	660			RF Ext.	TX signal	BSS switching spectrum measurement
4.32	Check modulation spectrum	0	660	50	Average	RF Ext.	TX signal	BSS switching spectrum measurement
4.33	Check Peak Phase error	0, 8, 15	512, 660, 810	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement
4.34	Check RMS Phase error	0, 8, 15	512, 660, 810	100	Max / Min	RF Ext.	TX signal	BSS switching spectrum measurement

4.4.2 PCS1900 RX test

No	Description	Generator level	Channels	Number of Bursts	Measurement Equipment
4.35	Check RSSI	-60 dBm	512, 660, 810	100	BSS
		-102 dBm	512, 660, 810	100	BSS
4.36	Check Noisefloor	OFF	512, 660, 810		BSS

A I-sample RF Calibration Procedures

A.1 Introduction

This Appendix describes the calibration procedures used at Texas Instruments A/S, Denmark using ETM modules version 1.4.2. Each Calibration procedure is illustrated with:

- Description of formulas and techniques required for obtaining and processing test results
- Listing of Test Mode SHell (TMSH) ver. 1.8.3 command sequences used for the calibration. (See 1.1)
- Listing of ETM module (dll) used in each calibration step (PC side)
- Verification techniques to verify calibration

The Flash File System (FFS) is used for storing all calibration parameters (See 1.1).

Please note this Appendix contains hints for getting started with Test Mode. All listings are based on the TMSH version matching the ETM implementation in the mobile station. Listings are not exactly as they would be for a production since TMSH is a laboratory tool using the *Command Interface* (Figure 1). Third party applications like production test tools have to use the *Functions Interface*. For details on how to use the *functions interface* and dll's refer to the ETM documentation listed in section 1.1.

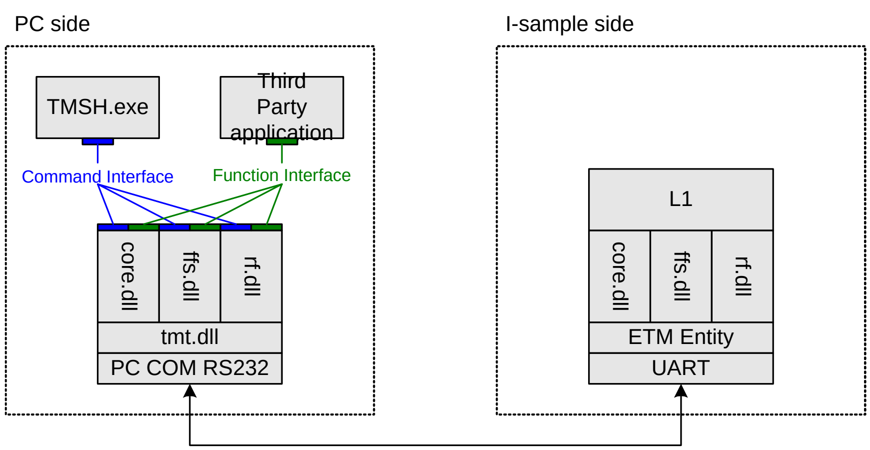

Figure 1, ETM system overview.

A.1.1 Test Equipment

The following test equipment is needed for performing the calibrations described in this Appendix:

- A laptop or stationary PC for with a connectivity interface for running the ETM SW.
- A Base Station Simulator (BSS),(e.g. R&S CMU200).
- A Signal Generator (SG), could be included in the BSS like in the CMU200 from R&S.
- Voltmeter and calibrated power supply.

- Misc. cables and level converters for interfacing to Mobile Station (MS).

A.1.2 Initialisation

In this document FFS are used to refer to some non-volatile memory.

The testmode must initial be enabled by ETM. This must be set previously to all other testmode commands.

Step	Equipment	Module	Action	Comment
1	ETM v. 1.8.3	RF	Tms 1	Enable testmode

Table 4.1: Command for enabling testmode.

The RF family used for I-sample must set by ETM. This must be set previously to all other testmode commands.

Step	Equipment	Module	Action	Comment
1	ETM v. 1.8.3	RF	rf_fam 61	Set the RF family to LoCosto

Table 4.2: Commands for setting the RF family.

Note: Before the FFS can be used for saving calibration parameters to a Flash it must be formatted and the full directory structure must be created. This only has to be done once, by executing the ETM commands listed in *Table 4.3*.

Step	Equipment	Module	Action	Comment
1	ETM v. 1.8.3	FFS	mkfs –f	Format FFS.
2	ETM v. 1.8.3	Core	me 100	Create full directory structure.

Table 4.3: Commands for formatting FFS and creating full directory structure.

RX Calibration Procedure

The calibration procedure can be summarized from the viewpoint of the Layer1 code as:

1. Supply the RF signal input expected by the DCXO calibration routine and run the DCXO Calibration routine.
2. Run the TX-RX Common Calibration routine.
3. Set the band and supply the RF signal expected by LNA center frequency calibration routine. Run the routine.
4. Set the band and supply the RF signal expected by IQMC Coefficient calibration routine. Run the routine.
5. Set the band and supply the RF signal expected by the Mixer Pole calibration routine. Run the routine.
6. Set the band and supply the RF signal expected by the SCF Pole calibration routine. Run the routine.
7. Set the band and supply the RF signal expected by the AFE Gain calibration part1 routine. Run the routine.
8. Save the calibrated data by running the Copy Script Data to Flash from DRP
9. Run the AFC Calibration routine

A.1.3 DCXO Calibration

This routine calibrates the DCXO, coarse frequency array and also the DCXO, DAC current. The routine expects a sinusoidal RF at a frequency of 869.2MHz and a level at -70 dBm.

Procedure

Step	Equipment	Module	Action	Comment
1	RF generator		Set frequency to 869.2 MHz	This is only valid if the GSM850 band is supported. If only EGSM900 is supported the frequency must be set to 925.2 MHz. [APN222]
2	RF generator		Set level -70dBm	
3	ETM v. 1.8.3	Rf	Drpcal 3	DCXO calibration

A.1.4 Tx-Rx Common Calibration

This routine performs the following calibrations:

1. DLO Period Inverse Calibration.
2. DLO acquisition to tracking ratio calibration.
3. PVT Bank calibration.
4. KDCO Inverse calibration.
5. ABE gain calibration using an internally generated signal.

Procedure

Step	Equipment	Module	Action	Comment
1	ETM v. 1.8.3	Rf	Drpcal 4	TX-RX common calibration

A.1.5 LNA Center Frequency Calibration

This routine adjusts the LNA register settings to provide a maximum gain at the center of the particular band of operation. The routine is band depended, and therefore the band to be calibrated must be specified. This routine expects a sinusoidal RF input with a frequency corresponding to the center of cellular band at a level of –60 dBm.

Procedure

Step	Equipment	Module	Action	Comment
1	RF generator		Set the center frequency	The center frequencies are: o EGSM: 942.4 MHz o GSM: 881.4 MHz o DCS: 1842.4 MHz o PCS: 1960 MHz
2	RF generator		Set level -60dBm	
3	ETM v. 1.8.3	Rf	Drpcal 5 BAND	LNA center frequency calibration (EGSM: 0, GSM: 1, DCS: 2, PCS: 3).

A.1.6 IQMC Coefficient Calibration

This routine calibrates the coefficients used by the IQMC block to correct for IQ-mismatch.

The routine is band depended and therefore the band to be calibrated must be specified. This routine expects a sinusoidal RF input with a frequency corresponding to the center of cellular band at a level of –60 dBm.

Procedure

Step	Equipment	Module	Action	Comment
1	RF generator		Set the center frequency	The center frequencies are: o EGSM: 942.4 MHz o GSM: 881.4 MHz o DCS: 1842.4 MHz o PCS: 1960 MHz
2	RF generator		Set level -60dBm	
3	ETM v. 1.8.3	Rf	Drpcal 6 BAND	IQMC coiffecient calibration (EGSM: 0, GSM: 1, DCS: 2, PCS: 3).

A.1.7 Mixer Pole Calibration

This routine calibrates the 400 KHz pole of the switched capacitor filter (SCF). The routine is band depended and therefore the band to be calibrated must be specified (EGSM: 0, GSM: 1, DCS: 2, PCS: 3). This routine expects a sinusoidal RF input with a frequency corresponding to the center of cellular band at a level of –60 dBm.

Procedure

Step	Equipment	Module	Action	Comment
1	RF generator		Set the center frequency	The center frequencies are: o EGSM: 942.4 MHz o GSM: 881.4 MHz o DCS: 1842.4 MHz o PCS: 1960 MHz
2	RF generator		Set level -60dBm	
3	ETM v. 1.8.3	Rf	Drpcal 7 BAND	Mixer pole calibration

A.1.8 SCF Pole Calibration

This routine calibrates the 270 KHz, and 400 KHz poles of the switched capacitor filter (SCF). The routine is band depended and therefore the band to be calibrated must be specified (EGSM: 0, GSM: 1, DCS: 2, PCS: 3). This routine expects a sinusoidal RF input with a frequency corresponding to the center of cellular band at a level of –60 dBm.

Procedure

Step	Equipment	Module	Action	Comment
1	RF generator		Set the center frequency	The center frequencies are: o EGSM: 942.4 MHz o GSM: 881.4 MHz o DCS: 1842.4 MHz o PCS: 1960 MHz
2	RF generator		Set level -60dBm	
3	ETM v. 1.8.3	Rf	Drpcal 8 BAND	SCF pole Calibration

A.1.9 AFE Gain Calibration

This routine calibrates a part of the AFE gain steps. (Higher gain steps) The routine is band depended and therefore the band to be calibrated must be specified (EGSM: 0, GSM: 1, DCS: 2, PCS: 3). This routine expects a sinusoidal RF input with a frequency corresponding to the center of cellular band at a level of –60 dBm.

Procedure

Step	Equipment	Module	Action	Comment
1	RF generator		Set the center frequency	The center frequencies are: o EGSM: 942.4 MHz o GSM: 881.4 MHz o DCS: 1842.4 MHz o PCS: 1960 MHz
2	RF generator		Set level -60dBm	
3	ETM v. 1.8.3	Rf	Drpcal 9 BAND	AFE Gain Calibration part 1

A.1.10 Copy Script Data to Flash from DRP

This routine copies the script data to the Flash from the DRP RAM. The DRP RAM address information is contained within the data structures.

Procedure

Step	Equipment	Module	Action	Comment
1	ETM v. 1.8.3	Rf	Drpcal 11	Copy Script Data to Flash from DRP
2	ETM v. 1.8.3	Core	Me 109	

A.1.11 DCXO (AFC) Calibration

In order to get initially synchronized with the network the MS needs to have accurate start up interval for the AFC DAC when performing FB search.

A start up interval is characterized by three start up values:

- AFC_CENTER
- AFC_HIGH
- AFC_LOW

Furthermore four C_Psi… parameters exist. These parameters characterize the dynamics of the crystal chosen.

A DCXO calibration means calibrating, calculating and writing the AFC start up values and the C_Psi… values to FFS.

Description

The calibration includes the following steps

1. The MS is set up to transmit at channel 40 at power level 12
2. The frequency error of the carrier is measured at different AFC DAC values with a BSS
3. The needed parameters are calculated
4. Download the parameters to the MS and AFC algorithm is activated
5. Temperature when calibrating the DCXO are specified in section 2

Procedure

Step	Equipment	Module	Action	Comment
1	ETM v. 1.8.3	Core	Tms 1	Enter ETM
2	ETM v. 1.8.3	Rf61	Rfpw 7 6 0	Set std to 6 (EGSM900/DCS1800) and band to 0 (EGSM900)
3	ETM v. 1.8.3	Rf61	Rfpw 2 40	Set TCH to 40
4	ETM v. 1.8.3	Rf61	Rfpw 8 0	Disable AFC algorithm
5	ETM v. 1.8.3	Rf61	Txpw 1 12	Set TX power level to 12
6	ETM v. 1.8.3	Rf61	Rfe 3	Do both RX and TX on TCH w/out network sync
7	ETM v. 1.8.3	Rf61	Rfpw 9 –4096	Set DAC value to –4096
8	BSS		Measure	Measure frequency error at channel 40 TS=5. With CMU, programming an expected frequency offset of -10 kHz can accelerate this measurement - results must be compensated for this frequency offset.
9				Store value in F1
10	ETM v. 1.8.3	Rf61	Rfpw 9 4096	Set DAC value to +4096
11	BSS		Measure	Measure frequency error at channel 40 TS=5. With CMU, programming an expected frequency offset of +10 kHz can accelerate this measurement - results must be compensated for this frequency offset.
12				Store value in F2
13	Calc. Psi & DACs			Calculate Parameters using (4.1) to (4.7)
14	ETM v. 1.8.3	Rf61	Rfpw 9 DAC_CENTER-100	Set frequency offset to 0 Hz in BSS. Set DAC value to DAC_CENTER-100
15	BSS		Measure	Measure frequency error at channel 40 TS=5
16				Store value in F3
17	ETM v. 1.8.3	Rf61	Rfpw 9 DAC_CENTER+100	Set DAC value to DAC_CENTER+100
18	BSS		Measure	Measure frequency error at channel 40 TS=5
19				Store value in F4
20				Calculate the remaining Parameters using (4.8)

Step	Equipment	Module	Action	Comment
				to (4.23)
21	ETM v. 1.8.3	Rf61	Rftw 9 C_Psi_sta_inv C_Psi_st C_Psi_st_32 C_Psi_st_inv DAC_INIT_NOM DAC_MIN_NOM DAC_MAX_NOM 2560	Write parameters to MS The last parameter "2560" is the threshold SNR value for which the MS detects reception gap (should not be changed) DAC_INIT_NOM is the normalized initial DAC crossing at 0 ppm DAC_MIN_NOM NOM is the crossing at -15 ppm DAC_MAX_NOM NOM is the crossing at +15 ppm
22	ETM v. 1.8.3	Rf61	Rfpw 9 DAC_INIT	Set DAC value to DAC_INIT
23	ETM v. 1.8.3	Core	Me 102	Store parameters to FFS
24	ETM v. 1.8.3	Core	Me 103	Store parameters to FFS
25	ETM v. 1.8.3	Rf61	Rfpw 8 1	Enable AFC algorithm

Calculations

Constants used in the calculations:

N_{step}=8192

V_0=2.4V

F_{GSM}=900*10^6 Hz

Fb=270833 Hz

Calculate linear constants:

F1=measured frequency error at AFC DAC=-4096 (4.1)

F2=measured frequency error at AFC DAC=4096 (4.2)

$$a = \frac{(F2 - F1)}{8192} \quad (4.3)$$

$$b = F2 - (a \cdot 4096) \quad (4.4)$$

Calculate the three DAC values used in AFC_INI start-up procedure:

$$DAC\_CENTER = \frac{0 - b}{a} \quad (4.5)$$

$$-8192 \leq DAC\_MIN = \frac{-13500 - b}{a} \quad (4.6)$$

$$8192 \geq DAC\_MAX = \frac{13500 - b}{a} \quad (4.7)$$

Fine trimming the center value (DAC_INIT):

F3= measured frequency error at AFC DAC (4.8)

= DAC_CENTER - 100

F4 = measured frequency error at AFC DAC (4.9)

= DAC_CENTER + 100

$$a2 = \frac{(F4 - F3)}{200} \quad (4.10)$$

$$b2 = F4 - a2 \cdot (DAC\_CENTER + 100) \quad (4.11)$$

$$DAC\_INIT = \frac{0 - b2}{a2} \quad (4.12)$$

*Note: All “DAC” & "C_Psi..." parameters should be rounded to the nearest integer before storing in FFS

$$DAC\_INIT\_NOM = DAC\_INIT \cdot 4 \quad (4.13)$$

$$DAC\_MIN\_NOM = DAC\_MIN \cdot 4 \quad (4.14)$$

$$DAC\_MAX\_NOM = DAC\_MAX \cdot 4 \quad (4.15)$$

*Note: All “DAC” & "C_Psi..." parameters should be rounded to the nearest integer before storing in FFS

Calculate Ψ (Psi) values:

$$Fr = \frac{(F2 - F1) \cdot 2}{69.23} \quad (4.16)$$

$$F_0 = 13000000 + \left(\frac{b2}{69.23}\right) \quad (4.17)$$

$$\Psi_{sta} = \frac{2 \cdot \pi}{Fb} \cdot F_{GSM} \cdot \frac{Fr}{F_0 \cdot V_0} \cdot \frac{V_0}{N_{step}} \quad (4.18)$$

$$\Psi_{st} = 0.8 \cdot \Psi_{sta} \quad (4.19)$$

*Note: All “DAC” & "C_Psi..." parameters should be rounded to the nearest integer before storing in FFS aThe needed values are then:

$$C\_Psi\_sta\_inv = (\Psi_{sta})^{-1} \quad (4.20)$$

$$C\_Psi\_st = \Psi_{st} \cdot 2^{16} \quad \text{(F0.16)} \quad (4.21)$$

$$C\_Psi\_st\_32 = \Psi_{st} \cdot 2^{32} \quad \text{(F0.32)} \quad (4.22)$$

$$C\_Psi\_st\_inv = (\Psi_{st})^{-1} \quad (4.23)$$

*Note: All “DAC” & "C_Psi..." parameters should be rounded to the nearest integer before storing in FFS

Note that even though the values are calculated from GSM 900 band only ($F_{GSM}=900*10^6$ Hz) they are also valid for 1800 DCS band and with good approximation for the GSM 850 and 1900 PCS bands.

A.2 RX RSSI Channel Compensation

In order to have the MS report RSSI within the required limits, calibration of the RX band must be performed.

A.2.1 Description

To obtain the RSSI channel compensations values the following steps have to be performed:

1. Setup the mobile to receive on the BCCH ARFCN specified in Table 4.4.
2. Set the generator level to *TL* specified in Table 4.4.
3. Set test frequency as specified in Table 4.4 plus 67kHz.
4. Measure *DSP_PMx*.
5. Calculate *ChanCalX = DSP_PM_GM – DSP_PMx* (ChanCalX rounded to nearest 0.5 dB)
6. Repeat step 1 to 6 until all channels have been calibrated (Table 4.4).
7. Download *ChanCalX* table to MS.

GSM850					
ARFCN Interval		**Test ARFCN**	***AGC* setting [dB]**	***TL* [dBm]**	**Test frequency [MHz]**
128	138	128	0	-68,5	869.2
139	157	148	0	-68,5	873.2
158	178	168	0	-68,5	877.2
179	199	**189**	0	-68,5	881.4
200	217	208	0	-68,5	885.2
218	239	228	0	-68,5	889.2
240	251	251	0	-68,5	893.4
EGSM900					
975	991	975	0	-68,5	925.2
992	1009	1000	0	-68,5	930.2
1010	1023	1017	0	-68,5	933.6
0	10	1	0	-68,5	935.2
11	30	20	0	-68,5	939.0
31	51	**37**	0	-68,5	942.4
52	71	62	0	-68,5	947.4
71	90	80	0	-68,5	951.0
91	112	100	0	-68,5	955.0
113	124	124	0	-68,5	959.8

DCS1800					
512	548	512	0	-68,5	1805.2
549	622	585	0	-68,5	1819.8
623	680	660	0	-68,5	1834.8
681	745	**698**	0	-68,5	1842.4
746	812	790	0	-68,5	1860.8
813	860	835	0	-68,5	1867.8
861	885	885	0	-68,5	1879.8
PCS1900					
512	548	512	0	-68,5	1930.2
549	622	585	0	-68,5	1944.8
623	680	**661**	0	-68,5	1960
681	745	700	0	-68,5	1967.8
746	795	790	0	-68,5	1985.8
796	810	805	0	-68,5	1988.8

Table 4.4. Test settings for calibrating the RX channel compensation. Centre channel for each band is marked with bold. This channel is used for measurement of the *DSP_PM_GM* level.

A.2.2 Procedure

Step	Equipment	Module	Action	Comment
1	ETM v. 1.24	Core	TMS 1	Enter ETM.
2	ETM v. 1.24		Rfe 0	Stop RF
3	ETM v. 1.24	Rf61	RFPW 7 6 0	Set std to 6 (EGSM900/DCS1800) and band to 0 (EGSM900)
4a	ETM v. 1.24	Rf61	RFPW 8 0	Disable AFC algorithm.
4b	ETM v. 1.24	Rf61	RFPW 9 DAC_INIT	Set DAC value to DAC_INIT (See A.1.11)
4c	ETM v. 1.24	Rf61	RXPW 8 0	Disable AGC algorithm.
5	ETM v. 1.24	Rf61	SCW 16 1	Set number of loops per RX measurement to 1
6	ETM v. 1.24	Rf61	SCW 17 1	Set number of loops per RX auto measurement to 1
7	ETM v. 1.24	Rf61	SCW 18 1	Set number of loops per RX auto measurement to 1
8	ETM v. 1.24	Rf61	SCW 24 2	Set auto stats to MOST_RECENT_RX_STATS
9	ETM v. 1.24	Rf61	SCW 25 0x4003	auto stats bitmask: DSP_PM, RSSI, and successes
10		Rf61	RXPW 1 0	Set AGC gain to 0 dB.
11	SG or BSS		*TL* = -68,5 dBm	Set *TL* according to Table 4.4.
12	SG or BSS		Test frequency + 67kHz	Set test frequency to centre channel + 67kHz • EGSM900 channel 37 • DCS1800 channel 698 • PCS1900 channel 661 • GSM850 channel 189
13	ETM v. 1.24	Rf61	RFPW 1 *BCCH ARFCN*	Select BCCH arfcn according to step ABOVE
14	ETM v. 1.24	Rf61	Rfe 13	Enable rfe_fb0
15	ETM v. 1.24	Rf61	RFE 12	Receive on FCH. Returns *DSP_PM_GM*
16	ETM v. 1.24	Rf61	RFPW 1 *BCCH ARFCN*	Select BCCH arfcn according to Table 4.4.
17	SG or BSS		Test frequency + 67kHz	Set test frequency according to Table 4.4. + 67kHz
18	ETM v. 1.24	Rf61	RFE 12	Receive on FCH without network synchronization.

Step	Equipment	Module	Action	Comment
				Returns *DSP_PMx*
19			Calculate *ChanCalX*	Calculate *ChanCalX = DSP_PM_GM – DSP_PMx*
Proceed with step 16 and forward until all channels in the selected band have been measured and compensation values calculated.				
20	ETM v. 1.24	Rf61	RFTW 25 10 *ChanCalX… 124 ChanCalX… 991 ChanCalX … 1023 ChanCalX*	Download RX (EGSM900 example) channel compensation values to MS.
21	ETM v. 1.24	Rf61	RFTR 25	Check that RX channel compensation has been written to MS.
Repeat from step 3 for remaining bands (GSM850, DCS1800 and PCS1900).				
22	ETM v. 1.24	Core	ME 106	Store *ChanCalX* in FFS.
23	ETM v. 1.24	Rf61	RXPW 8 1	Enable AGC algorithm.
24	ETM v. 1.24	Rf61	SCW 16 0	Default settings
25	ETM v. 1.24	Rf61	SCW 17 0	Default settings
26	ETM v. 1.24	Rf61	SCW 18 0	Default settings

Table 4.5: Procedure for obtaining the RX RSSI channel compensation table. To select GSM850 change step 2 to [RFTW 7 7 0], for DCS1800 change step 2 to [RFPW 7 6 1] and for and for PCS1900 change step 2 to [RFPW 7 3 0]. Note that the RFTW command (step 20) is for EGSM900 only. For GSM850 the corresponding command should be step 20 = [RFTW 25 138 ChanCalX …251 ChanCalX 0 0 0 0 0 0 0 0], three sets of dummy parameters [0 0] is added in order to meet the table size . For DCS1800 the corresponding command should be step 20 = [RFTW 25 548 ChanCalX…885 ChanCalX 0 0 0 0 0 0], three sets of dummy parameters [0 0] is added in order to meet the table size . And for PCS1900 the corresponding command should be step 20 = [RFTW 25 548 ChanCalX…810 ChanCalX 0 0 0 0 0 0 0 0], four sets of dummy parameters [0 0] is added in order to meet the table size .

Note: Channel compensation values can only be saved in steps of ½dB, therefore it has to be rounded to nearest ½dB value.

A.2.3 Verification

Step 21in *Table 4.5* serve as verification of the calibration.

A.3 TX Power Calibration

The TX power levels needs to be calibrated in order to achieve the required accuracy.

A.3.1 Description

To calibrate the TX power levels the following steps have to be performed for all bands:

1. Setup the mobile to transmit on the channel specified in Table 4.8.
2. Measure the output power "Pout" in dBm corresponding to the APC steps defined in Table 4.6.
3. Calculate the corresponding "Vout" using (4.24)

$$Vout_{n+1,n} = \frac{\sqrt{10^{\frac{Pout_{n+1,n}}{10}} \times 10^{-3} \times 50}}{10^{-3}} [mVrms] \tag{4.24}$$

4. Calculate the corresponding "Slope" coefficient between each of the APC Steps using (4.25).

$$Slope_{n+1,n} = \frac{Vout_{n+1} - Vout_{n}}{APC_{n+1} - APC_{n}} [mVrms / LSB] \tag{4.25}$$

5. Calculate the corresponding "Offset" value for each of the APC step using (4.26).

$$Offset_{n+1,n} = Vout_{n+1,n} - APC_{n+1,n} \times Slope_{n+1,n} [mVrms] \tag{4.26}$$

6. Lookup the "Slope" coefficient and "Offset" value for the target power level where $Vout_{Set} \leq Vout$ starting from the top.
7. Calculate the corresponding APC set point for the target power level using (4.27).

$$APC_{Set} = \frac{Vout_{n+1,n} - Offset_{n+1,n}}{Slope_{n+1,n}} \tag{4.27}$$

8. Proceed with the steps above until all power levels have been calibrated.
9. Download the new APC data to the MS.

Index (n)	GSM850 APC value	EGSM900 APC value	DCS1800 APC value	PCS1900 APC value
APC4	450	450	400	400
APC3	180	180	150	150
APC2	100	100	100	100
APC1	70	70	60	60

Table 4.6:APC value for TX power calibration

GSM850 Channel	EGSM900 Channel	DCS1800 Channel	PCS1900 Channel
190	40	710	660

Table 4.7:Channels for TX power calibration

Power level	GSM850 channel 190 $Pout_{Set}$ [dBm]	EGSM900 channel 40 $Pout_{Set}$ [dBm]	DCS1800 channel 710 $Pout_{Set}$ [dBm]	PCS1900 channel 660 $Pout_{Set}$ [dBm]
0	32.2	32.2	29.2	29.2
1	32.2	32.2	28	28
2	32.2	32.2	26	26
3	32.2	32.2	24	24
4	32.2	32.2	22	22
5	32.2	32.2	20	20
6	31	31	18	18
7	29	29	16	16
8	27	27	14	14
9	25	25	12	12
10	23	23	10	10
11	21	21	8	8
12	19	19	6	6
13	17	17	4	4
14	15	15	2	2
15	13	13	0	0
16	11	11	0	0
17	9	9	0	0
18	7	7	0	0
19-28	5	5	0	0
29-31	5	5	0	0

Table 4.8:GSM850, EGSM900, DCS1800 and PCS1900 Pout target for all power levels used on I-sample.

A.3.2 Procedure

Step	Equipment	Module	Action	Comment
1	ETM v. 1.8.3	Core	TMS 1	Enter ETM.
2	ETM v. 1.8.3	Rf61	RFPW 7 6 0	Set std to EGSM900
3	ETM v. 1.8.3	Rf61	RFPW 2 40	Set TCH to 40.
4	ETM v. 1.8.3	Rf61	RFE 3	Do both RX and TX.
5	ETM v. 1.8.3	Rf61	TXPW 1 5	Select power level 5 EGSM900.
6	ETM v. 1.8.3	Rf61	TXPW 4 APC	Set the *APC* value.
7	BSS		Measure the average output power	Trig on TSC 5.
8	Continue with step 6 to 7 until the output power on "*APC steps*" have been measured.			
10	Convert the measured output power into "*mVrms*".			
11	Calculate the "*Slope*" coefficients and "*Offset*" value.			
12	Calculate the calibrated set points for the APC, as a piece wise linear approximation.			
13	ETM v. 1.8.3	Rf61	TXPW 4 APC	Download the calibrated APC set point power level 5 to the MS.
15	ETM v. 1.8.3	Rf61	TXPW 1 6	Select power level 6 EGSM900.
16	Continue with step 13 to 15 until the rest of the power levels "TXPW 1 0-31" have been downloaded.			
17	ETM v. 1.8.3	Rf61	RFE 0	Stop doing RX and TX
18	ETM v. 1.8.3	Core	ME 104	Store *APC* levels in FFS.

Table 4.9: Procedure for calibration of the TX power levels. This procedure has to be performed for all bands. To select GSM850 change step 2 to [rfpw 7 7 0](Powerlevels 5-19), for DCS1800 change step 2 to [RFPW 7 6 1](Powerlevels 0-15) and for PCS1900 change step 2 to [RFPW 7 3 0] (Powerlevels 0-15).

B Miscellaneous

B.1 TX Power Versus Channel Compensation

The ‘TX power versus channel compensation’ makes it possible to reduce the variation in TX power over channels. This makes it easier to meet specification - especially at highest and lowest power levels. Furthermore it makes it possible to minimize Pout at each power level while still meeting specification – which means current saving. This is not done on I-sample.

B.1.1 Description

To use ‘TX power versus channel compensation’ the following steps have to be performed (for GSM900):

1. Do the TX Power Calibration described in *Section A.3*(setting Pout to 32.2 @ ch40 on PCL 5 etc.).
2. Make sure that the channel compensation tables in FFS are set to zero channel compensation (i.e. compensation coefficient = 128).
3. Set the MS up to transmit on the channels specified in *Table 4.10*. Measure the TX powers at the “calibration channels” specified in *Table 4.10* at PCL5 and calculate the APC value using the technique described in *Section 0*.

   EXAMPLE:

   APC is set to 450 @ channel 40 to obtain a Pout on 32.2 dBm - corresponding to 9109 mVrms.

   Then with APC=450 Pout @ channel 14 is measured to 31.8 dBm - corresponding to 8699 mVrms.

   Now the new APC value at the calibration channel is calculated:

$$\text{APC\_at\_cal\_ch} = \text{APC\_at\_center\_ch} + \frac{\text{Vout\_ch\_40}[\text{mVrms}] - \text{Vout\_ch\_14}[\text{mVrms}]}{\text{Slope\_coefficient\_for\_Vout\_PLmax}[\text{mVrms/LSB}]} \quad (4.28)$$

$$\Downarrow$$

$$\text{APC at calibration channel} = 450 + \frac{9109\,\text{mVrms} - 8699\,\text{mVrms}}{20\,\text{mVrms/LSB}}$$

$$\Downarrow$$

$$\text{APC at calibration channel} = 471$$

4. Calculate the Compensation Coefficients based on the new APC value (which sets the TX power):

$$\text{Compensation Coefficient} = \frac{\text{APC at calibration channel} * 128}{\text{APC at center channel}} \quad (4.29)$$

Note: From (4.29) it is seen that Compensation Coefficient = 128 means no compensation.

5. Download the channel compensation table, which are the Compensation Coefficients together with the intervals/sub bands defined in Table 4.10, to the MS.
6. Store the channel compensation table in FFS.
7. Repeat the procedure for GSM850, DCS and PCS bands.

GSM900			DCS1800		
Interval [Ch]	Cal. Ch.	Typ.comp. coefficient	Interval [Ch]	Cal. Ch.	Typ.comp. coefficient
0 - 27	14	*128*	512 – 553	533	*128*
28 - 47	40	**128**	554 – 594	574	*128*
48 - 66	57	*128*	595 – 636	615	*128*
67 - 85	76	*128*	637 – 677	657	*128*
86 - 104	95	*128*	678 – 720	700	**128**
105 – 124	114	*128*	721 – 760	740	*128*
975 – 994	985	*128*	761 – 802	781	*128*
995 - 1023	1009	*128*	803 – 885	844	*128*
GSM850			PCS1900		
Interval [Ch]	Cal. Ch.	Typ.comp. coefficient	Interval [Ch]	Cal. Ch.	Typ.comp. coefficient
128 – 134	131	*128*	512 – 549	531	*128*
135 – 150	143	*128*	550 – 586	568	*128*
151 – 166	159	*128*	587 – 623	605	*128*
167 – 182	175	*128*	624 – 697	660	**128**
183 – 197	190	**128**	698 – 726	712	*128*
198 – 213	206	*128*	727 – 754	740	*128*
214 – 229	222	*128*	755 – 782	768	*128*
230 - 251	241	*128*	783 – 810	796	*128*

Table 4.10: Definition of channel intervals/sub bands and the channels on which measure the TX power. The "Typical Compensation Coefficients" may be used as initial compensation values, but for precision each board must be calibrated individually. Note that the sub band containing the center channel should have no compensation, i.e. compensation value = 128.

B.1.2 Procedure

Step	Equipment	Module	Action	Comment
1.	ETM v. 1.8.3	Core	TMS 1	Enter ETM.
2.	ETM v. 1.8.3	Rf61	RFPW 7 6 0	Set std to 6 (EGSM900/DCS1800) and band to 0
3.	ETM v. 1.8.3	Rf61	RFTR 17	Verify that all compensation values are equal to 128 (i.e. no compensation). If not, do step 11 with x01 to x07 set to 128 before continuing with step 4.
4.	ETM v. 1.8.3	Rf61	RFE 3	Do both RX and TX.
5.	ETM v. 1.8.3	Rf61	TXPW 1 5	Select power level 5 EGSM900.
6.	ETM v. 1.8.3	Rf61	RFPW 2 14	Set TCH to 14 (Refer to *Table 4.10* for calibration channels).
7.	BSS		Measure the average output power	Trig on TSC 5.
8.	Calculate the APC value needed to obtain a TX power on 32.2 dBm – using (4.28).			
9.	Calculate the Compensation Coefficient, x01, for first sub band – using (4.29).			
10.	Repeat step 5 to 8 until all 7 Compensation Coefficient's, x01 to x07, have been found.			
11.		Rf61	RFTW 17 27 x01 47 128 66 x02 85 x03 104 x04 124 x05 994 x06 1024 x07 27 128 47 128 66 128 85 128 104 128 124 128 994 128 1024 128 27 128 47 128 66 128 85 128 104 128 124 128 994 128 1024 128 27 128 47 128 66 128 85 128 104 128 124 128	Download the Compensation tables to the MS.

Step	Equipment	Module	Action	Comment
			994 128 1024 128	
12.	ETM v. 1.8.3	Rf61	RFPW 2 14	Set TCH to 14.
13.	BSS		Measure the average output power.	Trig on TSC 5.
14.	Verify that the output power at PCL5/PCL0 is within 32.2+/-0.25 for GSM850 and EGSM900 and 29.2 +/-0.25 for DCS/PCS. Continue with step 13 to 15 until the rest of the calibration channels in *Table 4.10* have been verified.			
15.	ETM v. 1.8.3	Rf61	RFE 0	Stop doing RX and TX.
16.	ETM v. 1.8.3	Core	ME 104	Store Compensation Tables in FFS.

Table 4.11: Procedure for TX Power versus Channel Compensation. This procedure has to be performed for all bands. To select GSM850 change step 2 to [RFPW 7 7 0], for DCS1800 change step 2 to [RFPW 7 6 1] and for PCS1900 change step 2 to [RFPW 7 3 0]. Refer to Table 4.10 for calibration channels.

B.1.3 Verification

Step 12 to 14 in *Table 4.11* serve as verification of the calibration.

B.2 Non Signalling Synchronized Mode

It is possible to enter Non Signalling Synchronized Mode on the CMU200 using ETM and perform different measurements. This is not currently used on the I-sample.

C TMSH to API conversion.

Shell command	Function API Command	Comment
General commands, core.dll		
Use core	int core_initialize(void)	Called before use of core commands
Core_proto 1	int core_protocol_etm(int sid)	
Tms 1	int testmode_enable(int sid)	
Me 100	int misc_enable_mkdirs(int sid)	
Me 102	int misc_enable_write_rfcal(int sid)	
Me 103	int misc_enable_write_rfcfg(int sid)	
Me 104	int misc_enable_write_txcal(int sid)	
Me 105	int misc_enable_write_txcfg(int sid)	
Me 106	int misc_enable_write_rxcal(int sid)	
Me 107	int misc_enable_write_rxcfg(int sid)	
Me 108	int misc_enable_write_syscal(int sid)	
Me 109	int misc_enable_write_syscfg(int sid)	
FFS commands, ffs.dll		
mkfs	int ffs_format_flash(int sid, const char *flash_name);	name = “/ffs”
RF commands, rf.dll		
Rf_fam	int rf_fam_set(int fam)	
Drpcal 1	Int drp_dummy(int sid)	Used for fly back calibration
Drpcal 2	Int drp_read_from_flash(int sid)	Not used
Drpcal 3	Int drp_dcxo_calib(int sid)	
Drpcal 4	Int drp_tx_rx_common(int sid)	
Drpcal 5	Int drp_lna_cfreq(int sid, unsigned char band)	
Drpcal 6	Int drp_iqmc(int sid, unsigned char band)	
Drpcal 7	Int drp_mixer_pole(int sid, unsigned char band)	
Drpcal 8	Int drp_scf_pole(int sid, unsigned char band)	
Drpcal 9	Int drp_afe_gain_1(int sid, unsigned char band)	

Shell command	Function API Command	Comment
Drpcal 10	Int drp_afe_gain_2(int sid, unsigned char band)	Not used
Drpcal 11	Int drp_write_to_flash(int sid)	
Rfpw 1	Int rf_param_write_bcch(int sid, unsigned short bcch_arfcn);	
Rfpw 2	int rf_param_write_tch(int sid, unsigned short tch_arfcn)	
Rfpw 3	int rf_param_write_mon(int sid, unsigned short mon_arfcn)	
Rfpw 4	int rf_param_write_arfcn_pdtch(int sid, unsigned short pdtch_arfcn)	
Rfpw 7	int rf_param_write_band(int sid, unsigned char standard, unsigned char band)	
Rfpw 8	int rf_param_write_afc_enable(int sid, unsigned short bool_enable)	
Rfpw 9	int rf_param_write_afc_dac(int sid, short afc_dac)	
Rfpw 10	int rf_param_write_afc_initial(int sid, short afc_initial)	
Rfpw 20	int rf_param_write_gprs_multislot_class(int sid, unsigned short multislot_class)	
Rfpw 40	int rf_param_write_ramp_profile_enable(int sid, unsigned char enable)	
Rfpw 41	int rf_param_write_cust_rfmd_cal_enable(int sid, unsigned char enable)	
Rfe 0	int rf_enable_stop(int sid)	
Rfe 1	int rf_enable_rx(int sid)	
Rfe 2	int rf_enable_tx(int sid)	
Rfe 3	int rf_enable_txrx(int sid)	
Rfe 4	int rf_enable_gprs(int sid)	
Rfe 8	int rf_enable_cont_rx(int sid)	
Rfe 9	int rf_enable_cont_tx(int sid)	
Rfe 10	int rf_enable_bcch(int sid)	
Rfe 11	int rf_enable_sb(int sid)	
Rfe 12	int rf_enable_fb1(int sid)	
Rfe 13	int rf_enable_fb0(int sid)	
Rfe 15	int rf_enable_pm(int sid)	
Rfe 16	int rf_enable_gprs_mon(int sid)	
Rfe 19	int rf_enable_txrxmon_tch(int sid)	
Rfe 27	int rf_enable_txrxmon(int sid)	
Rfe 29	int rf_enable_edge_tx_cont(int sid)	
Rftw 6	int rf_table_write_agc_words_PASCAL(int sid, unsigned short	

Shell command	Function API Command	Comment
	agc_data_36[36])	
Rftw 7	int rf_table_write_agc_words_CLARA(int sid, unsigned short agc_data_27[27])	
Rftw 8	int rf_table_write_agc_words_RITA(int sid, unsigned short agc_data_20[20])	
Rftw 9	int rf_table_write_afc_params_vcxo(int sid, unsigned int psi_params_4[4], short dac_params_4[4])	
Rftw 10	int rf_table_write_afc_params(int sid, unsigned int afc_params_4[4])	
Rftw 12	int rf_table_write_agc_params_global(int sid, unsigned int agc_params_4[4])	
Rftw 13	int rf_table_write_agc_table_il2max(int sid, unsigned char il2max_table_121[121])	
Rftw 14	int rf_table_write_agc_table_il2pwr(int sid, unsigned char il2pwr_table_121[121])	
Rftw 15	int rf_table_write_agc_table_il2av(int sid, unsigned char il2av_table_121[121])	
Rftw 16	int rf_table_write_tx_levels(int sid, unsigned short apc_data_32[32], unsigned char ramp_index_32[32], unsigned char chan_cal_index_32[32])	
Rftw 17	int rf_table_write_tx_cal_chan(int sid, unsigned short arfcn_limit_32[32], short chan_cal_32[32])	
Rftw 18	int rf_table_write_tx_cal_temp(int sid, short temperature_5[5], short apc_cal_5[5])	
Rftw 19	int rf_table_write_tx_cal_extr(int sid, short data_5[5])	
Rftw 20	int rf_table_write_tx_cal_temp_2nd(int sid, short temperature_5[5], short a_5[5], short b_5[5], short c_5[5])	
Rftw 22	int rf_table_write_tx_levels_apc_band(int sid, unsigned short apc_params_32[32])	
Rftw 23	int rf_table_write_tx_levels_ramp_i_band(int sid, unsigned char ramp_params_32[32])	
Rftw 24	int rf_table_write_tx_levels_table_i_band(int sid, unsigned char table_32[32])	
Rftw 25	int rf_table_write_rx_cal_chan(int sid, unsigned short upper_bound_10[10], short agc_calib_10[10])	
Rftw 26	int rf_table_write_rx_cal_temp(int sid, short temperature_11[11], short agc_calib_11[11])	
Rftw 31	int rf_table_write_agc_params(int sid, unsigned short g_magic, unsigned short lna_att, unsigned short lna_switch_thr_low, unsigned short lna_switch_thr_high)	
Rftw 80	int rf_table_write_rf_tx_data(int sid, unsigned short tx_data_16[16])	
Rftw 81	int rf_table_write_rf_rlc_data_cs1(int sid, unsigned char cs1_data_23[23])	

Shell command	Function API Command	Comment
Rftw 82	int rf_table_write_rf_rlc_data_cs2(int sid, unsigned char cs2_data_34[34])	
Rftw 83	int rf_table_write_rf_rlc_data_cs3(int sid, unsigned char cs3_data_39[39])	
Rftw 84	int rf_table_write_rf_rlc_data_cs4(int sid, unsigned char cs4_data_54[54])	
Rftw 85		
Rftw 86	int rf_table_write_tx_cal_chan_8psk(int sid, unsigned short arfcn_limit_32[32], short chan_cal_32[32])	
Rftw 87		
Rftw 88		
Rftw 89		
Rftw 90	int rf_table_write_rf_rlc_data_mcs1(int sid, unsigned char mcs1_data_27[27])	
Rftw 91	int rf_table_write_rf_rlc_data_mcs2(int sid, unsigned char mcs2_data_33[33])	
Rftw 92	int rf_table_write_rf_rlc_data_mcs3(int sid, unsigned char mcs3_data_42[42])	
Rftw 93	int rf_table_write_rf_rlc_data_mcs4(int sid, unsigned char mcs4_data_49[49])	
Rftw 94	int rf_table_write_rf_rlc_data_mcs5(int sid, unsigned char mcs5_data_63[63])	
Rftw 95	int rf_table_write_rf_rlc_data_mcs6(int sid, unsigned char mcs6_data_81[81])	
Rftw 96	int rf_table_write_rf_rlc_data_mcs7(int sid, unsigned char mcs7_data_121[121])	
Rftw 97	int rf_table_write_rf_rlc_data_mcs8(int sid, unsigned char mcs8_data_145[145])	
Rftw 98	int rf_table_write_rf_rlc_data_mcs9(int sid, unsigned char mcs9_data_157[157])	
Rftw 99	int rf_table_write_power_reduction_gmsk(int sid, unsigned char table_4[4])	
Rftw 100	int rf_table_write_power_reduction_8psk(int sid, unsigned char table_4[4])	
Rftw 101	int rf_table_write_predist_set(int sid, unsigned char table_number, unsigned char pcl, unsigned int ampm1, unsigned int ampm2, unsigned int amam1, unsigned int amam2, unsigned int delay, unsigned char prange)	
Rftw 102	int rf_table_write_predist_param(int sid, unsigned char table_number, unsigned char pcl, unsigned char param_number, unsigned int param_value)	
Rftw 103		
Rftw 104		
Rftw 105	int rf_table_write_predist_vrange(int sid, unsigned char vrange)	
Rftw 106	int rf_table_write_rfmd_tx_ramp_profile (int sid, int rmp_18[18])	

Shell command	Function API Command	Comment
Rftw 107	int rf_table_write_rfmd_parmp1 (int sid, int parmp1)	
Rftw 108	int rf_table_write_rfmd_afcd (int sid, int afcd)	
Rftw 109	int rf_table_write_rfmd_dac1 (int sid, int dac1)	
Rftw 110	int rf_table_write_rfmd_pgain (int sid, int pgain)	
Rftw 111	int rf_table_write_rfmd_pllx1 (int sid, int pllx1)	
Rftw 112	int rf_table_write_rfmd_amam1 (int sid, int amam1)	
Rftw 113	int rf_table_write_rfmd_amam2 (int sid, int amam2)	
Rftw 114	int rf_table_write_rfmd_ampm1 (int sid, int ampm1)	
Rftw 115	int rf_table_write_rfmd_ampm2 (int sid, int ampm2)	
Rftw 116	int rf_table_write_rfmd_delay (int sid, int delay)	
Rftw 117	int rf_table_write_rfmd_vrange (int sid, unsigned char vrange)	
Rftw 118		
Rftw 119		
Txpw 1	int tx_param_write_power(int sid, short tx_pwr_level)	
Txpw 4	int tx_param_write_apc(int sid, short tx_apc_dac)	
Txpw 5	int tx_param_write_ramp(int sid, short tx_ramp_template)	
Txpw 6	int tx_param_write_cal_chan_index(int sid, short tx_chan_cal_table)	
Txpw 8	int tx_param_write_burst_type(int sid, short tx_burst_type)	
Txpw 9	int tx_param_write_burst_data(int sid, short tx_burst_data)	
Txpw 10	int tx_param_write_timing_advance(int sid, short tx_timing_advance)	
Txpw 11	int tx_param_write_training(int sid, short tx_training_seq)	
Txpw 13	int tx_param_write_power_skip(int sid, short tx_pwr_skip)	
Txpw 14	int tx_param_write_cal_flags(int sid, unsigned short tx_flags_cal)	
Txpw 15	int tx_param_write_misc_flags(int sid, unsigned short tx_flags_platform)	
Txpw 17	int tx_param_write_iqswap(int sid, unsigned short tx_flags_iq_swap)	
Txpw 18	int tx_param_write_flags(int sid, unsigned short tx_flags_all)	
Txpw 20	int tx_param_write_gprs_power0(int sid, unsigned short tx_gprs_power0)	
Txpw 21	int tx_param_write_gprs_power1(int sid, unsigned short tx_gprs_power1)	
Txpw 22	int tx_param_write_gprs_power2(int sid, unsigned short tx_gprs_power2)	
Txpw 23	int tx_param_write_gprs_power3(int sid, unsigned short tx_gprs_power3)	
Txpw 24	int tx_param_write_gprs_power4(int sid, unsigned short tx_gprs_power4)	
Txpw 25	int tx_param_write_gprs_power5(int sid, unsigned short tx_gprs_power5)	
Txpw 26	int tx_param_write_gprs_power6(int sid, unsigned short tx_gprs_power6)	

Shell command	Function API Command	Comment
Txpw 27	int tx_param_write_gprs_power7(int sid, unsigned short tx_gprs_power7)	
Txpw 28	int tx_param_write_gprs_slots(int sid, unsigned short tx_gprs_slots)	
Txpw 29	int tx_param_write_gprs_coding(int sid, unsigned short tx_gprs_coding)	
Txpw 30	int tx_param_write_apc_gmsk(int sid, unsigned short apc_gmsk)	
Txpw 31	int tx_param_write_apc_8psk(int sid, unsigned short tx_apc_8psk)	
Txpw 32	int tx_param_write_ramp_8psk(int sid, unsigned short tx_ramp_8psk)	
Txpw 33	int tx_param_write_cal_chan_index_8psk(int sid, unsigned short tx_cal_chan_index_8psk)	
Txpw 35	int tx_param_write_apc_min_8psk(int sid, unsigned short tx_apc_min_8psk)	
Txpw 35	int tx_param_write_apc_min_gmsk(int sid, unsigned short tx_apc_min_gmsk)	
Txpw 36	int tx_param_write_AM_loop_bandwidth_cal(int sid, unsigned char AO)	
Txpw 37	int tx_param_write_tbf_mode(int sid, unsigned short tx_tbf_mode)	
Txpw 38	int tx_param_write_AM_loop_cal_mode(int sid, unsigned char mode)	
Txpw 39?	int tx_param_write_gprs_coding(int sid, unsigned short tx_gprs_coding)	
Scw 16	int stats_config_write_rfe_loops(int sid, unsigned short loops)	
Scw 17	int stats_config_write_rfe_result_loops(int sid, unsigned short loops)	
Scw 18	int stats_config_write_rfe_reset_loops(int sid, unsigned short loops)	
Scw 20	int stats_config_write_gprs_slots(int sid, unsigned short slots)	
Scw 24	int stats_config_write_type(int sid, unsigned short type)	
Scw 25	int stats_config_write_bitmask(int sid, unsigned int bitmask)	GPRS

D Test limits

D.1 GSM850 - Test limits

D.1.1 GSM850 TX tests

No	Description	Input		Specification (ETSI 51010)	Measurement Equipment
		Power level	Channels		
4.37	Check TX power	5	128, 190, 251	TX power ±3 dB	BSS power level measurement
		11	128, 190, 251	TX power ±3 dB	
		19	251	TX power ±5 dB	
4.38	Check template	5	128, 190, 251	Standard template PASS	BSS power ramp measurement
		11	128, 190, 251		
		19	251		
4.39	Check switching spectrum	5	190	± 400 kHz < -19dBm ± 600 kHz < -21dBm ± 1200 kHz < -21dBm ± 1800 kHz < -24dBm	BSS switching spectrum measurement
4.40	Check switching spectrum	11	190	± 400 kHz < -23dBm ± 600 kHz < -26dBm ± 1200 kHz < -32dBm ± 1800 kHz < -36dBm	BSS switching spectrum measurement
4.41	Check modulation spectrum	5	190	± 100 kHz < +0,5dBc ± 200 kHz < -30dBc ± 250 kHz < -33dBc ± 400 kHz < -60dBc ± 600 to <1800kHz < -60dBc	BSS switching spectrum measurement
4.42	Check Peak Phase error	5, 11, 19	128, 190, 251	Peak phase error ≤20 °	BSS switching spectrum measurement

4.43	Check RMS Phase error	5, 11, 19	128, 190, 251	RMS phase error ≤5 °	BSS switching spectrum measurement

D.1.2 GSM850 RX test

No	Description	Generator level	Channels	Specification 51010-1	**Measurement Equipment**
4.44	Check RSSI	-60 dBm	128, 189, 251	-60 ± 2	BSS
		-102 dBm	128, 189, 251	-4 ≤ -102 ≤ 2	BSS
4.45	Check Noisefloor	OFF	128, 189, 251	<(-108) -3	BSS

D.2 EGSM900 - Test

D.2.1 EGSM900 TX tests

No	Description	Input		Specification (ETSI 51010)	Measurement Equipment
		Power level	Channels		
4.46	Check TX power	5	975, 40, 124	TX power ±3 dB	BSS power level measurement
		11	975, 40, 124	TX power ±3 dB	
		19	975, 40, 124	TX power ±5 dB	
4.47	Check template	5, 11, 19	975, 40, 124	Standard template PASS	BSS power ramp measurement
4.48	Check switching spectrum	5	40	± 400 kHz < -19dBm ± 600 kHz < -21dBm ± 1200 kHz < -21dBm ± 1800 kHz < -24dBm	BSS switching spectrum measurement
4.49	Check switching spectrum	11, 19	40	± 400 kHz < -23dBm ± 600 kHz < -26dBm ± 1200 kHz < -32dBm ± 1800 kHz < -36dBm	BSS switching spectrum measurement
4.50	Check modulation spectrum	5	40	± 100 kHz < +0,5dBc ± 200 kHz < -30dBc ± 250 kHz < -33dBc ± 400 kHz < -60dBc ± 600 to <1800kHz < -60dBc	BSS switching spectrum measurement
4.51	Check Peak Phase error	5, 11, 19	975, 40, 124	Peak phase error ≤20 °	BSS switching spectrum measurement
4.52	Check RMS Phase error	5, 11, 19	975, 40, 124	RMS phase error ≤5 °	BSS switching spectrum measurement

D.2.2 EGSM900 RX test

No	Description	Generator level	Channels	Specification 51010-1	**Measurement Equipment**
4.53	Check RSSI	-60 dBm	975, 40, 124	-60 ± 2	BSS
		-102 dBm	975, 40, 124	-4 ≤ -102 ≤ 2	BSS
4.54	Check Noisefloor	OFF	975, 40, 124	<(-108) -3	BSS

D.3 DCS1800 - Test

D.3.1 DCS1800 TX tests

No	Description	Input		Specification (ETSI 51010)	Measurement Equipment
		Power level	Channels		
4.55	Check TX power	0	512, 710, 885	TX power ±3 dB	BSS power level measurement
		8	512, 710, 885	TX power ±3 dB	
		15	512, 710, 885	TX power ±5 dB	
4.56	Check template	0, 8, 15	512, 710, 885	Standard template PASS	BSS power ramp measurement
4.57	Check switching spectrum	0	710	± 400 kHz < -22dBm ± 600 kHz < -24dBm ± 1200 kHz < -24dBm ± 1800 kHz < -27dBm	BSS switching spectrum measurement
4.58	Check switching spectrum	8, 15	710	± 400 kHz < -23dBm ± 600 kHz < -26dBm ± 1200 kHz < -32dBm ± 1800 kHz < -36dBm	BSS switching spectrum measurement
4.59	Check modulation spectrum	0	710	± 100 kHz < -36dBm ± 200 kHz < -36dBm ± 250 kHz < -36dBm ± 400 kHz < -36dBm ± 600 to <1800kHz < -56dBc	BSS switching spectrum measurement
4.60	Check Peak Phase error	0, 8, 15	512, 710, 885	Peak phase error ≤20 °	BSS switching spectrum measurement
4.61	Check RMS Phase error	0, 8, 15	512, 710, 885	RMS phase error ≤5 °	BSS switching spectrum measurement

D.3.2 DCS1800 RX test

No	Description	Generator level	Channels	Specification 51010-1	**Measurement Equipment**
4.62	Check RSSI	-60 dBm	512, 700, 885	-60 ± 2	BSS
		-102 dBm	512, 700, 885	-4 ≤ -102 ≤ 2	BSS
4.63	Check Noisefloor	OFF	512, 700, 885	<(-107) -3	BSS

D.4 PCS1900 - Test

D.4.1 PCS1900 TX tests

No	Description	Input		Specification (ETSI 51010)	Measurement Equipment
		Power level	Channels		
4.64	Check TX power	0	512, 660, 810	TX power ±3 dB	BSS power level measurement
		8	512, 660, 810	TX power ±3 dB	
		15	512, 660, 810	TX power ±5 dB	
4.65	Check template	0, 8, 15	512, 660, 810	Standard template PASS	BSS power ramp measurement
4.66	Check switching spectrum	0	660	± 400 kHz < -22dBm ± 600 kHz < -24dBm ± 1200 kHz < -24dBm ± 1800 kHz < -27dBm	BSS switching spectrum measurement
4.67	Check switching spectrum	8, 15	660	± 400 kHz < -23dBm ± 600 kHz < -26dBm ± 1200 kHz < -32dBm ± 1800 kHz < -36dBm	BSS switching spectrum measurement
4.68	Check modulation spectrum	0	660	± 100 kHz < -36dBm ± 200 kHz < -36dBm ± 250 kHz < -36dBm ± 400 kHz < -36dBm ± 600 to <1800kHz < -56dBc	BSS switching spectrum measurement
4.69	Check Peak Phase error	0, 8, 15	512, 660, 810	Peak phase error ≤20 °	BSS switching spectrum measurement
4.70	Check RMS Phase error	0, 8, 15	512, 660, 810	RMS phase error ≤5 °	BSS switching spectrum measurement

D.4.2 PCS1900 RX test

No	Description	Generator level	Channels	Specification 51010-1	**Measurement Equipment**
4.71	Check RSSI	-60 dBm	512, 660, 810	-60 ± 2	BSS
		-102 dBm	512, 660, 810	-4 ≤ -102 ≤ 2	BSS
4.72	Check Noisefloor	OFF	512, 660, 810	<(-107) -3	BSS