**Qualification Report**

**OpenCellular - Connect1**

**System DVT**

Revision: 1.0

[17th Jan 2017]

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# Purpose

The purpose of this document is to capture test data for CONNECT 1 system DVT as part of Open Cellular Base Transceiver Station (BTS). The document is intended to provide a formal report of measured and validated parameters to qualify CONNECT 1 system as part of design validation testing to ensure consistent and reliable operation across all supported operating and environmental conditions.

# Scope

Perform DVT of CONNECT 1 GSM BTS, version-life 2 for system test cases. GSM 900 and GSM1900 bands are identified for DVT.

# References

1. Open Cellular - Connect1 DVT\_TestPlan\_System V1 https://github.com/markhor/OpenCellular

# Device-Under-Test (DUT) Details

1. System : Open cellular Connect -1
2. Sub-system : System
3. Hardware version : Life – 1 & Life -2
4. Software version : To be updated
	1. Openbsc: 5085e0b
	2. Osmo-trx: 2e5e2c5
	3. Uhd: f70dd85
5. Sample Count : 01

# Qualification Test Condition

Ambient Temperature - 25˚C

# Qualification Result Summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Board / System** |  | **Function** | **Test cases/specification** | **Status** |
| **Test ID** |
| System | Sys Clock 1.1 | CLOCK | Frequency accuracy (TX EVM ) | Fail |
| System | Sys Clock 1.2 | CLOCK | Lock detect | Pass |
| System | Sys Ctrl 1.1 | SYSTEM CONTROLS | LDO enables | Pass |
| System | Sys Ctrl 1.2 | SYSTEM CONTROLS | Power amplifier enables | Pass |
| System | Sys Ctrl 1.3 | SYSTEM CONTROLS | Regulator enables | Pass |
| System | Sys Ctrl 1.4 | SYSTEM CONTROLS | Switch controls and enabling 4 bands and 2 chains both on TX and RX side | Pass |
| System | Sys Ctrl 1.5 | SYSTEM CONTROLS | Reset sequencing | Pass |
| System | Sys Ctrl 1.6 | SYSTEM CONTROLS | System Alarms | Pass |
| System | Sys Ctrl 1.7 | SYSTEM CONTROLS | LED status  | Pass |
| System | Sys Pwr 1.1 | SYSTEM POWER | Total Power consumption | Pass |
| System | Sys Pwr 1.2 | System POWER | Power sequencing | Pass |
| System | Sys Pwr 1.3 | System POWER | Cold start with POE++ / Solar / Battery (internal/External) | Pass |
| System | Sys Pwr 1.4 | System POWER | Testing with POE++  | Pass |
| System | Sys Pwr 1.5 | System POWER | Testing with Solar  | Pass |
| System | Sys Pwr 1.6 | System POWER | Testing with Battery - Internal | Pass |
| System | Sys Pwr 1.7 | System POWER | Testing with Battery - External | Pass |
| System | Sys Pwr 1.8 | System POWER | Testing with DC source | Pass |
| System | Sys Tx 1.2 | System RF Tx | Mean transmitted RF carrier power | Pass |
| System | Sys Tx 1.7 | System RF Tx | Intermodulation attenuation  | Fail |
| System | Sys GPS 1.1 | System RF GPS | Sync module - GPS lock | Pass |
| System | Sys GPS 1.2 | System RF GPS | Sync module - GPS/ GSM Coex | Open |

NOTE: System RF Tx (Sys Tx 1.2, Sys Tx 1.7, Sys Tx 1.1, Sys Tx 1.3, Sys Tx 1.4, Sys Tx 1.5, Sys Tx 1.6, Sys Tx 1.7),

 System RF Rx (Sys Rx 1.1, Sys Rx 1.1,Sys Rx 1.2,Sys Rx 1.3,Sys Rx 1.4,Sys Rx 1.5,Sys Rx 1.6,Sys Rx 1.7,Sys Rx 1.8,Sys Rx 1.9,Sys Rx 1.10,Sys Rx 1.11,Sys Rx 1.12,Sys Rx 1.13,Sys Rx 1.14) and

 System Compliance (Sys Comp 1.1, Sys Comp 2.1, Sys Comp 3.1, Sys Comp 3.2, Sys Comp 3.3, Sys Comp 3.4, Sys Comp 3.5, Sys Comp 4.1, Sys Comp 4.2, Sys Comp 4.3, Sys Comp 4.4, Sys Comp 4.5, Sys Comp 5.1) tests are moved to Rev C release

# System Clock

**9.1.1 Test ID**

Sys Clock 1.1

**9.1.2 Purpose**

The purpose of this test case is to check system clock PLL performance

**9.1.3 Test and Measurement Method**

Refer to section 3 of Open Cellular - Connect1 System Test Specification document

**9.1.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.1.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.1.6 Test Results**

Lock Status

|  |  |
| --- | --- |
| **Test Condition** | **PASS / FAIL** |
| GPS lock detect | PASS |
| Clock PLL detect | PASS |

GMSK Modulation accuracy

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | Middle Channel | **Test ResultPASS / FAIL** |
| ARFCN | Frequency(MHz) | RMS phase error(deg) | Margin |
| Specification |   |   | < 5 deg |  deg |
| Chain 1 | GSM 900 | 35 | 942 | 0.8 | 4.2 | PASS |
| GSM 1800 | 696 | 1842 | 0.5 | 4.5 | PASS |
| Chain 2 | GSM 900 | 35 | 942 | 0.9 | 4.1 | PASS |
| GSM 1800 | 696 | 1842 | 0.7 | 4.3 | PASS |

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | Middle Channel | **Test ResultPASS / FAIL** |
| ARFCN | Frequency(MHz) | Peak phase error(deg) | Margin |
| Specification |   |   | < 20deg |  deg |
| Chain 1 | GSM 900 | 35 | 942 | 2.3 | 17.7 | PASS |
| GSM 1800 | 696 | 1842 | 1.8 | 18.2 | PASS |
| Chain 2 | GSM 900 | 35 | 942 | 2.3 | 17.7 | PASS |
| GSM 1800 | 696 | 1842 | 2.1 | 17.9 | PASS |

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | Middle Channel | **Test ResultPASS / FAIL** |
| ARFCN | Frequency(MHz) | Mean frequency error(Hz) | Margin |
| Specification |   |   |  GSM900 < 50Hz, GSM1800 < 90Hz |  Hz |
| Chain 1 | GSM 900 | 35 | 942 | 2 | 48 | PASS |
| GSM 1800 | 696 | 1842 | 2 | 88 | PASS |
| Chain 2 | GSM 900 | 35 | 942 | 1.6 | 48.4 | PASS |
| GSM 1800 | 696 | 1842 | 1 | 49 | PASS |

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | Middle Channel | **Test ResultPASS / FAIL** |
| ARFCN | Frequency(MHz) | RMS phase error(deg) | Peak phase error (deg) | Mean frequency error(Hz) | Mean frequency error(ppm) |
| Specification |   |   | < 5 deg | < 20 deg |  GSM900 < 50Hz, GSM1800 < 90Hz | < 0.05 ppm |
| Chain 1 | GSM 900 | 35 | 942 | 0.8 | 2.3 | 2 | 2.123E-09 | PASS |
| GSM 1800 | 696 | 1842 | 0.5 | 1.8 | 2 | 1.086E-09 | PASS |
| Chain 2 | GSM 900 | 35 | 942 | 0.9 | 2.3 | 1.57 | 1.667E-09 | PASS |
| GSM 1800 | 696 | 1842 | 0.7 | 2.12 | 1 | 5.429E-10 | PASS |

# System Controls - 1.1, 1.2, 1.3, 1.4

**9.2.1 Test ID**

Sys Ctrl 1.1, 1.2, 1.3, 1.4

**9.2.2 Purpose**

The purpose of this test is to validate the response of System control functions. This test covers the following test ID

|  |  |  |
| --- | --- | --- |
| Test ID | Subsystem | Test case |
| Sys Ctrl 1.1 | SYSTEM CONTROLS | LDO enables |
| Sys Ctrl 1.2 | SYSTEM CONTROLS | Power amplifier enables |
| Sys Ctrl 1.3 | SYSTEM CONTROLS | Regulator enables |
| Sys Ctrl 1.4 | SYSTEM CONTROLS | Switch controls and enabling 4 bands and 2 chains both on TX and RX side |

**9.2.3 Test and Measurement Method**

Refer to section 4.1.1 of Open Cellular - Connect1 System Test Specification document

**9.2.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Typical

System/Test Load: Typical

**9.2.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.2.6 Test Results**

GSM band configuration, Attenuation control

|  |  |  |  |
| --- | --- | --- | --- |
| **Tx Chain** | **Band** | **AD9361 att = -20** | **Test RESULTPASS / FAIL** |
| **Tx Att = 0** | **Tx Att = 1** | **Tx Att = 5** | **Tx Att = 10** | **Tx Att = 15** |
|  |  | **dBm** | **dB** | **dB** | **dB** | **dB** |
| **Ch1** | GSM850 | 27.5 | 0.7 | 4.3 | 9 | 13.9 | PASS |
| GSM900 | 28.2 | 1 | 4.9 | 9.7 | 14.6 | PASS |
| GSM1800 | 22.4 | 0.8 | 4.6 | 10.4 | 14.4 | PASS |
| GSM1900 | 19.5 | 0.9 | 4.9 | 9.8 | 14.8 | PASS |
| **Ch2** | GSM850 | 27.8 | 0.6 | 4.3 | 9 | 13.9 | PASS |
| GSM900 | 28.4 | 0.8 | 4.7 | 9.6 | 14.5 | PASS |
| GSM1800 | 22.4 | 0.86 | 4.7 | 9.6 | 14.5 | PASS |
| GSM1900 | 20.8 | 0.83 | 4.7 | 9.7 | 14.6 | PASS |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rx Chain** | **Band** | **Rx Att = 0** | **Rx Att = 5** | **Rx Att = 10** | **Rx Att = 15** | **Test RESULTPASS / FAIL** |
| **dBm** | **dB** | **dB** | **dB** |
| **Ch1** | GSM850 | -22 | 5.5 | 10.4 | 15.3 | PASS |
| GSM900 | -21.1 | 4.9 | 9.8 | 14.7 | PASS |
| GSM1800 | -40 | 5.5 | 10.4 | 15.4 | PASS |
| GSM1900 | -27 | 4.8 | 9.8 | 14.7 | PASS |
| **Ch2** | GSM850 | -22.5 | 5 | 10 | 14.9 | PASS |
| GSM900 | -21.2 | 4.9 | 9.8 | 14.8 | PASS |
| GSM1800 | -35.9 | 5.3 | 10.5 | 15.4 | PASS |
| GSM1900 | -28 | 4.7 | 9.7 | 14.6 | PASS |

Bypass configuration

|  |  |  |
| --- | --- | --- |
|   | **Chain 1** | **Chain 2** |
| Bypass A | Config | Bypass 1  | Bypass 2 |
| RF path | Tx | Rx |
| Bypass B | Config | Bypass 2 | Bypass 1 |
| RF path | Rx | Tx |

|  |  |  |
| --- | --- | --- |
| Tx Attn Settings | AD9361 | 10dB |
| Digital Att | 10dB |
| Rx Attn Settings | ANT input  | -30 dBm |

|  |  |  |
| --- | --- | --- |
|   | Power (dBm) | **Test RESULTPASS / FAIL** |
| GSM850 | GSM900 | GSM1800 | GSM1900 |
| Bypass A | Tx | Ch1 | 2.8 | 2.8 | 0.5 | 0.4 | PASS |
| Rx  | Ch2 | -37 | -37.8 | -40 | -43.3 | PASS |
| Bypass B | Tx | Ch2 | 2.66 | 2.7 | -0.19 | -0.8 | PASS |
| Rx  | Ch1 | -38 | -37.8 | -39.8 | -41.3 | PASS |

# System Controls - LED

**9.3.1 Test ID**

Sys Ctrl 1.7

**9.3.2 Purpose**

The purpose of this test is to validate the response of front PANEL LED to system state

**9.3.3 Test and Measurement Method**

Refer to section 4.1.4 of Open Cellular - Connect1 System Test Specification document

**9.3.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Typical

System/Test Load: Typical

**9.3.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.3.6 Test Results**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **#** | **SYSTEM STATUS** | **LED STATUS** | **LED COLOR** | **SYSTEM TEST CONDITION** | **TEST STATUS**  | **Remarks** |
| 1 | System Boot | Circulating | GREEN |  System BOOT | PASS | System BOOT(TIVA tasking issue, circulating stops in between)LED needs to circulate clockwise. For this the TASK needs to run continuously in TIVA. But in between some other task will take over TIVA and for that period LED circulation will stop. |
| 2 | System Running | Pulsing | GREEN | System BOOT completes | PASS |  SYSTEM RUNNING: LED panel need to pulsate in GREEN (N RESET toggle every 5 second) |
| 3 | System Failure | Pulsing | RED |  Associate this to any alarm on GBC (temperature, Over current) We can set the threshold for any temperature sensor low enough to trigger this alarm and get the LED status. | PASS | SYSTEM failure: LED panel need to pulsate in RED. (N reset toggle every 5 seconds)Temperature: (INTEL three temperature limits , LOW, HIGH, CRITICAL: HIGH limit set to 34degC)Current : (TIVA default current ~152 mA, Set limit to 100mA to simulate alarm |
| 4 | Radio Failure | Flash – Left | RED | Associate this to Radio alarms (RF power, return loss failure, lock detect failure)GPS lock alarm  (delay set to 2minutes) | PASS |   |
| 5 | Backhaul Failure | Flash - Right | RED | N/A | N/A | Test can be performed when BACKHAUL feature is up |

# System Controls - ALARM

**9.4.1 Test ID**

Sys Ctrl 1.6

**9.4.2 Purpose**

The purpose of this test is to validate the system ALARM reporting.

**9.4.3 Test and Measurement Method**

Refer to section 4.1.3 of Open Cellular - Connect1 System Test Specification document

**9.4.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Typical

System/Test Load: Typical

**9.4.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**Test Results**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Device** | **Refdes** | **I2C address** | **Alert condition** | **PASS/FAIL** | **MODULE** | **Comments** |
| INA226 | U239 | 45 | MSATA current sensing | PASS | GBC |   |
| INA226 | U183 | 41 | PWR\_12V\_ALRT | PASS |   |
| INA226 | U185 | 44 | PWR\_12V\_ALRT | PASS |   |
| INA226 | U182 | 40 | PWR\_12V\_ALRT | PASS |   |
| SE98ATP,547 | U210 | 18 | TEMPSEN\_TIVA\_EVNT1 | PASS | Checked for both high and low temperature alerts. |
| SE98ATP,547 | U211 | 19 | TEMPSEN\_TIVA\_EVNT1 | PASS | Checked for both high and low temperature alerts. |
| SE98ATP,547 | U212 | 1A | TEMPSEN\_TIVA\_EVNT1 | PASS | Checked for both high and low temperature alerts. |
| SE98ATP,547 | U213 | 1C | TEMPSEN\_TIVA\_EVNT2 | PASS | Checked for both high and low temperature alerts. |
| SE98ATP,547 | U214 | 1D | TEMPSEN\_TIVA\_EVNT2 | PASS | Checked for both high and low temperature alerts. |
| SE98ATP,547 | U215 | 1F | TEMPSEN\_TIVA\_EVNT2 | PASS | Checked for both high and low temperature alerts. |
| INA226 | U2104 | 40 | SYS\_ALERT | PASS | RFSDR |   |
| INA226 | U2105 | 41 | SYS\_ALERT | PASS |   |
| INA226 | U32 | 44 | 12V\_ALRT | N/A | Not connected to SYSALERT |
| SE98ATP,547 | U1803 | 18 | CH1\_TEMP\_SEN\_ALERT\_CPU | N/A | not implemented, Parts being changed in REVC |
| SE98ATP,547 | U2003 | 1F | CH2\_TEMP\_SEN\_ALERT\_CPU | N/A | not implemented, Parts being changed in REVC |

# System Controls - RESET

**9.5.1 Test ID**

Sys Ctrl 1.5

**9.5.2 Purpose**

The purpose of this test is to validate the RESETs.

**9.5.3 Test and Measurement Method**

Refer to section 4.1.2 of Open Cellular - Connect1 System Test Specification document

**9.5.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Typical

System/Test Load: Typical

**9.5.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR00008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.5.6 Test Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S.No. | Device | RESET through  | RESULT PASS / FAIL | REMARKS |
| 1 | TIVA | U187, BU4329G-TR, used for monitoring 3.3VDC TIVA  | PASS | 3.3VDC bus voltage is less than 2.9V than TIVA stays in RESET |
| 2 | INTEL | through TIVA , TIVA\_RESET\_TO\_PROC  | PASS |   |
| 6 | ETHERNET switch | through TIVA, TIVA\_ETHSW\_RESET | PASS |   |
| 7 | RFSDR RESET  | through TIVA, TIVA\_TRXFE\_RESET | PASS | Requires rework, updated in revC |
| 8 | FX3 | through TIVA, IOE\_FX3\_RESE (IO xepander, address 0x1B) | PASS |   |
| 11 | RFSDR I/O expander  | through TIVA, TIVA\_TRXFECONN\_GPIO1through TIVA, TIVA\_RESET\_TO\_PROC  | PASS | Requires rework, updated in revC |
| 12 | SYNC | Through TIVA, - TIVA\_SYNC\_RESET  | PASS | Requires rework, updated in revC |

# System Tx – Mean Transmitted RF carrier power

**9.6.1 Test ID**

Sys Tx 1.2

**9.6.2 Purpose**

The purpose of this test case is to validate system Tx performance such that the mean transmitted RF carrier power at the system antenna port is within acceptable limits.

**9.6.3 Test and Measurement Method**

Refer to section 6.1.2 of Open Cellular - Connect1 System Test Specification document

**9.6.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.6.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.6.6 Test Results**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BAND** | **Tx Chain** | **ARFCN** | **FreqMHz** | **RF powerdBm** | **Dig Attn** | **Power Supplycurrent (A)** | **Spec33+/- 2dBm** | **RF Power Margin****(dBm)** | **RESULT PASS / FAIL** |
| GSM900 | 1 | 63 | 947.6 | 33 | 12 | 2.1 | 33 +/- 2 | 2 | PASS |
| GSM900 | 2 | 63 | 947.6 | 33.5 | 12 | 2.1 | 33 +/- 2 | 1.5 | PASS |
| GSM1800 | 1 | 698 | 1842.4 | 33.4 | 2 | 2.1 | 33 +/- 2 | 1.6 | PASS |
| GSM1800 | 2 | 698 | 1842.4 | 34 | 2 | 2.1 | 33 +/- 2 | 1 | PASS |

Specification: 33 ± 2 dBm

# System Tx - Intermodulation Attenuation

**9.7.1 Test ID**

Sys Tx 1.7

**9.7.2 Purpose**

The purpose of this test case is to check system Tx performance for Intermodulation Attenuation performance.

**9.7.3 Test and Measurement Method**

Refer to section 6.1.8 of Open Cellular - Connect1 System Test Specification document

**9.7.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.7.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.7.6 Test Results**

**GSM900**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CHAIN  | BAND | ARFCN | FREQUENCY | Tx Power | Interfere Power |
| 1 | GSM900 | 38 | 942.6 MHz | 32.5 dBm | 3 dBm |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Interferer Freq(MHz) | Interferer Offset(kHz) | IM3-(dBm) | IM3+(dBm) | Measure BW (kHz) | SPEC | PASS/FAIL | Margin (dB) |
| 934.6 | 8 |   | -30 | **300** | -36dBm (300KHz) | FAIL | -6 |
| 936.6 | 6 |   | -34 | 100 | -32dBm (100kHz) | PASS | 2 |
| 938.6 | 4 |   | -33 | 100 | -32dBm (100kHz) | PASS | 1 |
| 940.8 | 1.8 |   | -34 | 100 | -32dBm (100kHz) | PASS | 2 |
| 944.4 | 1.8 | -33 |   | 100 | -32dBm (100kHz) | PASS | 1 |
| 946.6 | 4 | -31 |   | 100 | -32dBm (100kHz) | FAIL | -1 |
| 948.6 | 6 | -31 |   | 100 | -32dBm (100kHz) | FAIL | -1 |
| 950.6 | 8 | -26 |   | **300** | -36dBm (300KHz) | FAIL | -10 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CHAIN  | BAND | ARFCN | FREQUENCY | Tx Power | Interfere Power |
| 2 | GSM900 | 38 | 942.6 MHz | 32.5 dBm | 3 dBm |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Interferer Freq(MHz) | Interferer Offset(kHz) | IM3-(dBm) | IM3+(dBm) | Measure BW (kHz) | SPEC | PASS/FAIL | Margin (dB) |
| 934.6 | 8 |   | -31 | **300** | -36dBm (300KHz) | FAIL | -5 |
| 936.6 | 6 |   | -33 | 100 | -32dBm (100kHz) | PASS | 1 |
| 938.6 | 4 |   | -36 | 100 | -32dBm (100kHz) | PASS | 4 |
| 940.8 | 1.8 |   | -36 | 100 | -32dBm (100kHz) | PASS | 4 |
| 944.4 | 1.8 | -34 |   | 100 | -32dBm (100kHz) | PASS | 2 |
| 946.6 | 4 | -32 |   | 100 | -32dBm (100kHz) | FAIL | 0 |
| 948.6 | 6 | -31 |   | 100 | -32dBm (100kHz) | FAIL | -1 |
| 950.6 | 8 | -26 |   | **300** | -36dBm (300KHz) | FAIL | -10 |

**GSM1800**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CHAIN  | BAND | ARFCN | FREQUENCY | Tx Power | Interfere Power |
| 1 | GSM1800 | 699 | 1842.6 | 33.4 dBm | 3 dBm |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Interferer Freq(MHz) | Interferer Offset(kHz) | IM3-(dBm) | IM3+(dBm) | Measure BW (kHz) | SPEC | PASS/FAIL | Margin (dB) |
| 1834.6 | 8 |   | -43 | **300** | -36dBm (300KHz) | PASS | 7 |
| 1836.6 | 6 |   | -48 | 100 | -32dBm (100kHz) | PASS | 14 |
| 1838.6 | 4 |   | -47 | 100 | -32dBm (100kHz) | PASS | 15 |
| 1840.8 | 1.8 |   | -47 | 100 | -32dBm (100kHz) | PASS | 15 |
| 1844.4 | 1.8 | -44 |   | 100 | -32dBm (100kHz) | PASS | 12 |
| 1846.6 | 4 | -47 |   | 100 | -32dBm (100kHz) | PASS | 15 |
| 1848.6 | 6 | -48 |   | 100 | -32dBm (100kHz) | PASS | 16 |
| 1850.6 | 8 | -43 |   | **300** | -36dBm (300KHz) | PASS | 7 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CHAIN  | BAND | ARFCN | FREQUENCY | Tx Power | Interfere Power |
| 2 | GSM1800 | 699 | 1842.6 | 33 dBm | 3 dBm |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Interferer Freq(MHz) | Interferer Offset(kHz) | IM3-(dBm) | IM3+(dBm) | Measure BW (kHz) | SPEC | PASS/FAIL | Margin (dB) |
| 1834.6 | 8 |   | -41 | **300** | -36dBm (300KHz) | PASS | 5 |
| 1836.6 | 6 |   | -43 | 100 | -32dBm (100kHz) | PASS | 10 |
| 1838.6 | 4 |   | -43 | 100 | -32dBm (100kHz) | PASS | 8 |
| 1840.8 | 1.8 |   | -43 | 100 | -32dBm (100kHz) | PASS | 11 |
| 1844.4 | 1.8 | -43 |   | 100 | -32dBm (100kHz) | PASS | 11 |
| 1846.6 | 4 | -41 |   | 100 | -32dBm (100kHz) | PASS | 9 |
| 1848.6 | 6 | -39 |   | 100 | -32dBm (100kHz) | PASS | 7 |
| 1850.6 | 8 | -36 |   | **300** | -36dBm (300KHz) | PASS | 0 |

**9.7.7 Failure resolution**

Intermod products are failing by worst case by 10dB. The intermods are getting generated at PA. For every 1dB reduction in interferer the intermod is expected to reduce by 3dB. In revC isolator is added at PA output. The isolator provides typical isolation of 15dB. With this the intermod levels are expected to come down by ~45dB thereby meeting specs by good margins.

# System Power – AUX source, total power consumption

**9.8.1 Test ID**

Sys Pwr 1.1, 1.8

**9.8.2 Purpose**

The purpose of this test case is to ensure systems total power consumption is within specified limits. This test also validates the functionality with DC (AUX) source for power system during max power transmission along with supporting external battery charging.

**9.8.3 Test and Measurement Method**

Refer to section 5.1.1 of Open Cellular - Connect1 System Test Specification document

**9.8.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.8.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.8.6 Test Results**

**WITHOUT BATTERY CHARGING**

POWER SOURCE – AUX 18VDC

GSM900



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 8.64 | 31.74 | 40.38 | 4.62 | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

GSM1800



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 6.47 | 30.85 | 37.32 | 7.68 | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

**WITH BATTERY CHARGING**

POWER SOURCE – AUX 22VDC

GSM900



STEP 1 (BASELINE)

|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 8.95 | 24.63 | 33.58 | 11.42 | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

STEP 2 (at 22VDC without battery charging)

|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 8.94 | 24.53 | 33.47 | 11.53 | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

STEP 3 (at 22VDC with battery charging)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | **Battery Charging**  | **Battery Charge Current A** | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  | Functional | Spec < 10.8A |  |
| 8.93 | 23.49 | 32.43 | 12.57 | OK | 5.7 | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

# System Power – Solar power

**9.9.1 Test ID**

Sys Pwr 1.5

**9.9.2 Purpose**

The purpose of this test case is to validate system performance when operated with Solar power source.

**9.9.3 Test and Measurement Method**

Refer to section 5.1.5 of Open Cellular - Connect1 System Test Specification document

**9.9.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.9.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.9.6 Test Results**

**WITHOUT BATTERY CHARGING**

GSM900



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 12.40 | 31.50 | 43.90 | 1.1 | PASS |

GSM1800



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 12.68 | 31.54 | 44.22 | 0.78 | PASS |

**WITH BATTERY CHARGING**

NOTE: No RF transmission, with electronic load

STEP 1: No battery connected

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Value** | **Parameter** | **Units** | **Specification** |
| Solar Source | 21.48 | Voltage on Solar Source Display | V |  |
| 2.05 | Current on Solar Source Display | A |  |
| 44.034 | Power from Solar Source | W | < 45W |
| 21.86 | Voltage on GBC Front panel connector | V |  |
| Electronic Load | 3.4 | Current on Electronic load | A |  |
| 12 | Voltage on electronic load terminals | V |  |
| 40.8 | Power to Electronic Load | W |  |

STEP 2: External battery connected

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Value** | **Parameter** | **Units** | **Specification** |
| Solar Source | 20.1 | Voltage on Solar Source Display | V |  |
| 5.06 | Current on Solar Source Display | A |  |
| 101.706 | Power from Solar Source | W | < 165W |
| 20.3 | Voltage on GBC Front panel connector | V |  |
| Electronic Load | 3.4 | Current on Electronic load | A |  |
| 12 | Voltage on electronic load terminals | V |  |
| 40.8 | Power to Electronic Load | W |  |



|  |  |  |
| --- | --- | --- |
| **Charge Current** | Margin(in Amp) | RESULT (PASS/FAIL) |
| Spec (< 10.8A) |  |  |
| 6A | 4.8A | PASS |

STEP 3: Internal battery connected

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Value** | **Parameter** | **Units** | **Specification**  |
| Solar Source | 21.26 | Voltage on Solar Source Display | V |  |
| 2.522 | Current on Solar Source Display | A |  |
| 53.61772 | Power from Solar Source | W | < 65.4W |
| 21.55 | Voltage on GBC Front panel connector | V |  |
| Electronic Load | 3.4 | Current on Electronic load | A |  |
| 12 | Voltage on electronic load terminals | V |  |
| 40.8 | Power to Electronic Load | W |  |



|  |  |  |
| --- | --- | --- |
| **Charge Current** | Margin(in Amp) | RESULT (PASS/FAIL) |
| Spec (< 1.8A) |  |  |
| 1.7A | 0.1 A | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

# System Power - POE

**9.10.1 Test ID**

Sys Pwr 1.4

**9.10.2 Purpose**

The purpose of this test case is to ensure systems functions normally when powered with POE source.

**9.10.3 Test and Measurement Method**

Refer to section 5.1.4 of Open Cellular - Connect1 System Test Specification document

**9.10.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.10.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.10.6 Test Results**

GSM900



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 8.65 | 30.42 | 39.07 | 5.93  | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

GSM1800



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 8.67 | 28.30 | 36.97 | 8.03 | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

# System Power – External Battery

**9.11.1 Test ID**

Sys Pwr 1.7

**9.11.2 Purpose**

The purpose of this test case is to ensure systems functions normally when powered with External battery.

**9.11.3 Test and Measurement Method**

Refer to section 5.1.7 of Open Cellular - Connect1 System Test Specification document

**9.11.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.11.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.11.6 Test Results**

GSM900



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 9.05 | 28.17 | 37.22 | 7.78 | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

GSM1800



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 9.07 | 28.94 | 38.01 | 6.99  | PASS |

Note:-

GBC Power (in W) = TIVA + ATOM + MSATA

RFSDR Power (in W) = FPGA + Ch1 + Ch2

Total Power (in W) = GBC Power + RFSDR Power

# System Power – Internal Battery

**9.12.1 Test ID**

Sys Pwr 1.6

**9.12.2 Purpose**

The purpose of this test case is to ensure systems functions normally when powered with Internal battery.

**9.12.3 Test and Measurement Method**

Refer to section 5.1.6 of Open Cellular - Connect1 System Test Specification document

**9.12.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.12.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0018

**9.12.6 Test Results**

GSM900



|  |  |  |
| --- | --- | --- |
| **TOTAL POWER CONSUMPTION** |  | RESULT (PASS /FAIL) |
| **GBCW** | **RFSDRW** | **TotalW** | Total Power Margin(in W) |
| Spec (10W) | Spec (35W) | Spec (45W) |  |  |
| 10.58 | 31.61 | 42.19 | 2.79 | PASS |

# System Power – Cold Start

**9.13.1 Test ID**

Sys Pwr 1.3

**9.13.2 Purpose**

The purpose of this test case is to validate the logic for COLD start

**9.13.3 Test and Measurement Method**

Refer to section 5.1.3 of Open Cellular - Connect1 System Test Specification document

**9.13.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.13.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.13.6 Test Results**

|  |  |  |
| --- | --- | --- |
| VALIDATION STEP | OBSERVATION | REMARKS |
| Ambient temperature | 21 degC |   |
| Threshold value | 30 degC | for INTEL temperature Sensor |
| **Before temperature threshold**  |   |   |
| GBC power | OK |   |
| RF board power | ON HOLD |   |
| PA enables | ON HOLD |   |
| FX3 reset (active low) | ON HOLD |   |
| **After temperature threshold**  |   |   |
| GBC power | OK |   |
| RF board power | OK |   |
| PA enables | OK |   |
| FX3 reset (active low) | OK |   |
| **Test result (PASS / FAIL)** | **PASS** | Functional Validation of COLD START LOGIC |

# System Power – Power (Initialization) Sequence

**9.14.1 Test ID**

Sys Pwr 1.2

**9.14.2 Purpose**

The purpose of this test case is to validate the logic for system power up (initialization sequence)

**9.14.3 Test and Measurement Method**

Refer to section 5.1.2 of Open Cellular - Connect1 System Test Specification document

**9.14.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.14.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.14.6 Test Results**

| **S.No** | **Initialization Process Step** | **Device involved** | **RESULTOK / NOK** | **REMARKS** |
| --- | --- | --- | --- | --- |
| 1 | a | Check Power source | POE | OK | POE not connected |
| b |   | Solar/AUX | OK | Detected AUX power source |
| c |   | Lithium-ion Battery | OK | Detected Li-ion battery |
| d |   | Lead Acid Battery | OK | Lead acid not Connected |
| e |   | PSE  | OK | POE not connected, powered by AUX |
| 2 | a | Check - INTEL out of RESET | PSTRST | OK | Checking INTEL out of RESET |
| b |   | COREPOWER | OK | Checking INTEL power OK |
| 3 | a | Check - MSATA out of RESET |   | OK | Checking MSATA out of RESET |
| 4 | a | Check - RF out of RESET |   | OK | Checking RFSDR out of RESET |
| 5 | a | Checking Device presense | INA226 - GBC (4) | OK | Checks the presence of Current and Voltage monitoring devices on GBC |
| b |   | INA226 - RF (3) | OK | Checks the presence of Current and Voltage monitoring devices on RFSDR |
| c |   | Temp Sensor - GBC (6) | OK | Checks the presence of temperature sensors on GBC |
| d |   | Temp Sensor - RF (2) | OK | Checks the presence of temperature sensors on RFSDR |
| e |   | Sync module | OK | Checks the presence of Sync Module |
| f |   | LED module | OK | Checks the presence of LED module |
| 6 | a | Configuration / Initialization of Sensors | INA226 - GBC (4) | OK | Configuring INA226 on GBC |
| b |   | INA226 -RF (3) | OK | Configuring INA226 on RFSDR |
| c |   | PSE  | OK | no POE connected |
| d |   | Lead Acid | OK | Configuring charge controller for Lead Acid battery |
| e |   | Lithium-ion | OK | Configuring charge controller for Li-ion battery |
| f |   | Temp Sensor - GBC (6) | OK | Configuring temperature sensor limits for GBC |
| g |   | Temp Sensor - RF (2) | OK | Configuring temperature sensor limits for RFSDR |
| h |   | Sync module | OK | Configuring I/O expander for SYNC module |
| i |   | LED module | OK | Configuring I/O expander for LED module |
| 7 | a | Checking device Status | INA226 - GBC (4) | OK | Monitoring bus currents and voltages for GBC |
| b |   | INA226 - RF (3) | OK | Monitoring bus currents and voltages for GBC |
| c |   | Temp Sensor - GBC (6) | OK | Monitoring temperature reading on GBC |
| d |   | Temp Sensor - RF (2) | OK | Monitoring temperature reading on RFSDR |
| FINAL STATUS | PASS |   |

# System RF – GPS lock

**9.15.1 Test ID**

Sys GPS 1.1

**9.15.2 Purpose**

The purpose of this test case is to validate GPS receiver performance.

**9.15.3 Test and Measurement Method**

Refer to section 8.1.1 of Open Cellular - Connect1 System Test Specification document

**9.15.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.15.5 DUT Sample Information**

 RF-SDR Board Serial Number – WZ1630LIFE2SDR0008

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.15.6 Test Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GPSDO Lock detect** | **GPSDO lock time****(Spec < 15mts)** | **Margin****For GPSDO Lock** | **40MHz reference output** | **RESULT****PASS /FAIL** |
| OK | 10 minutes | 5 Minutes | OK | PASS |

# System RF – GPS-GSM Coexistence

**9.16.1 Test ID**

Sys GPS 1.2

**9.16.2 Purpose**

Purpose: To test the coexistence of GPS-GSM in the same BOX. GSM signal transmission should have no impact on GPS signal reception.

**9.16.3 Test and Measurement Method**

Refer to section 8.1.2 of Open Cellular - Connect1 System Test Specification document

**9.16.4 Test Condition**

Ambient Temperature: 25˚C

Operating Voltage: Nominal

System/Test Load: Typical

**9.16.5 DUT Sample Information**

 RF-SDR Board Serial Number –WZ1630LIFE2SDR00 08

GBC Board Serial Number – WZ1630LIFE2GBC0022

**9.16.6 Test Results**

**GPS - Standalone**

|  |  |  |  |
| --- | --- | --- | --- |
| S.No | GPS Signal Level (dBm) | C/No(dBm/Hz) | Remarks |
| 1 | -140 | 26 | No GPS Fix |
| 2 | -135 | 31 | GPS fix |
| 3 | -130 | 38 | GPS fix |
| 4 | -125 | 42 | GPS fix |
| 5 | -120 | 45 | GPS fix |
| 6 | -115 | 49 | GPS fix |
| 7 | -110 | 51 | GPS fix |
| 8 | -105 | 51 | GPS fix |

**GPS-GSM900 Coexistence**

GSM Tx Power = 33dBm

GPS Signal Input = -130dBm

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable Attenuation(dB)** | **Total GSM - GPS Isolation (dB)** | **C/No** | **Remarks** |
| no GSM transmission | 38 | GPS Fix |
| 40 | 50 | 35 | GPS Fix |
| 35 | 45 | 33 | GPS Fix |
| 30 | 40 | 31 | GPS Fix |
| 25 | 35 | 29 | GPS Fix |
| 20 | 30 | 28 | GPS Fix |
| 15 | 25 | 25 | no GPS fix |

**GPS-GSM1800 Coexistence**

GSM Tx Power = 33dBm

GPS Signal Input = -130dBm

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable Attenuation(dB)** | **Total Gsm - GPS Isolation (dB)** | **C/No(dBc / Hz)** | **Remarks** |
| no GSM transmission | 35 | GPS Fix |
| 40 | 50 | 34 | GPS Fix |
| 35 | 45 | 33 | GPS Fix |
| 30 | 40 | 31 | GPS Fix |
| 25 | 35 | 31 | GPS Fix |
| 20 | 30 | 30 | GPS Fix |
| 15 | 25 | 29 | no GPS fix |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  **Parameter** | **Specification** | **Result** | **Margin** | **RESULT****PASS / FAIL** |
| With and input of -130dBm, GPS Fix and PLL Lock to be achieved for up to a minimum of GPS-GSM isolation of | 35 dB | 30dB | 5 dB | PASS  |
| Time for GPSDO lock detect for GPS input of -130dBm and GPS-GSM coupling of 35dB | < 15 minutes | 6 minutes | 9 Minutes | PASS |

# History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SL.no | Date | Version | Author | Comments |
| 1 | February 9th, 2017 | 1.0 | OpenCellular Team | First Release |