



# Hosted Mode Low Power User Guide

Pinnacle™ 100 Modem

*Version 1.0*

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## REVISION HISTORY

Version	Date	Notes	Contributors	Approver
0.1	02/12/2020	Initial Release	Mike Richter	Matt Stergiou

## CONTENTS

1	Overview .....	5
2	Measurement Setup & Requirements .....	5
2.1	Reference Material .....	5
2.2	UwTerminalX .....	5
2.3	R&S CMW500 Block Diagram .....	5
2.4	Amarisoft Block Diagram .....	6
2.5	DVK Setup .....	6
3	Modem configuration.....	7
3.1	Pinnacle™ 100 Firmware and Application.....	7
3.2	Configure M.2.59 for nRF Low Power Operation.....	8
3.3	Configure Radio Technology (M1 vs NB1) and Band.....	8
3.4	Configure at+ksleep.....	8
4	LTE Cat-M1 Low Power Operation, R&S CMW500.....	9
4.1	Cat-M1 eDRX .....	9
4.2	Cat-M1 PSM — Once every Min .....	11
4.3	Cat-M1 PSM — Once every 10 Min .....	11
4.4	Cat-M1 PSM — Once every Hour .....	12
4.5	Cat-M1 PSM — Once every 8 Hours.....	12
4.6	Cat-M1 PSM — Once a Day.....	13
4.7	Cat-M1 eDRX & PSM Summary.....	13
4.8	Exiting the Low Power Mode .....	13
5	LTE Cat-NB1 Low Power Operation, R&S CMW500.....	14
5.1	Uplink Subcarrier Spacing: 15 kHz with 12 subcarriers.....	14
5.1.1	Cat-NB1 15KHz eDRX.....	14
5.1.2	Cat-NB1 15KHz PSM — Once every Min.....	16
5.1.3	Cat-NB1 15KHz PSM — Once every 10 Min.....	16
5.1.4	Cat-NB1 15KHz PSM — Once every Hour.....	17
5.2	Uplink Subcarrier Spacing: 3.75 kHz with MCS3.....	17
5.2.1	Cat-NB1 3.75KHz eDRX.....	17
5.2.2	Cat-NB1 3.75KHz PSM — Once every Min.....	18
5.2.3	Cat-NB1 3.75KHz PSM — Once every 10 Min.....	19
5.2.4	Cat-NB1 3.75KHz PSM — Once every Hour.....	19
5.3	Cat-NB1 eDRX & PSM Summary.....	20
5.4	Exiting the Low Power Mode .....	20
6	LTE Cat-M1 Low Power Operation, Amarisoft Callbox mini .....	20
6.1	Cat-M1 eDRX .....	20
6.2	Cat-M1 PSM — Once every Min .....	21

6.3	Cat-M1 PSM — Once every 10 Min .....	22
6.4	Cat-M1 PSM — Once every Hour .....	22
6.5	Cat-M1 eDRX & PSM Summary.....	23
6.6	Exiting the Low Power Mode .....	23
7	LTE Cat-NB1 Low Power Operation, Amarisoft Callbox mini .....	23
7.1	Uplink Subcarrier Spacing: 15 kHz with 12 subcarriers.....	23
7.1.1	Cat-NB1 15KHz eDRX.....	23
7.1.2	Cat-NB1 15KHz PSM — Once every Min.....	24
7.1.3	Cat-NB1 15KHz PSM — Once every 10 Min.....	25
7.1.4	Cat-NB1 15KHz PSM — Once every Hour.....	25
7.2	Uplink Subcarrier Spacing: 3.75 kHz with MCS3.....	26
7.2.1	Cat-NB1 3.75KHz eDRX.....	26
7.2.2	Cat-NB1 3.75KHz PSM — Once every Min.....	27
7.2.3	Cat-NB1 3.75KHz PSM — Once every 10 Min.....	27
7.2.4	Cat-NB1 3.75KHz PSM — Once every Hour.....	28
7.3	Cat-NB1 eDRX & PSM Summary.....	28
8	APPENDIX.....	29
8.1	CMW500 Cat-M1 Configuration.....	29
8.2	CMW500 Cat-NB1 15KHz Sub Carrier spacing Configuration .....	32
8.3	CMW500 Cat-NB1 3.75KHz Sub Carrier spacing Configuration .....	34
8.4	at+ksleep .....	36
8.5	at+cpsms .....	37
8.6	at+cedrxs .....	37
8.7	at+kbnfcfg .....	39
8.8	Amarisoft Callbox mini MME configuration .....	39

## 1 OVERVIEW

This guide is to aid more rapid development of embedded applications using the Pinnacle™ 100 modem using the Hosted-Mode firmware. This guide will describe the setup and operation of eDRX and PSM, as well as, providing current measurements of the modem, for both LTE Cat-M1 and Cat-NB1 with the use of a R&S CMW500 and a Amarisoft Callbox mini.

- PSM is intended for applications that seldom send data (once a day, for instance), and does not need to be reachable or reachable with long latency (several hours, for instance).
- eDRX is intended for applications that need to be reachable but tolerate latency in an order of magnitude of 10 seconds or more.

## 2 MEASUREMENT SETUP & REQUIREMENTS

### 2.1 Reference Material

- AirPrime\_HL7800\_Low\_Power\_Modes\_Application\_Note\_Rev2\_0.pdf
- AirPrime\_HL78xx\_AT\_Commands\_Interface\_Guide\_Rev9\_3.pdf
- CS-GUIDE-PINNACLE-100-DVK HW v1\_0.pdf
- Schematic-Pinnacle100 DVK
- CS-GUIDE-ATInterface-Pinnacle-100-Module v1\_11.pdf

The AirPrime HL7800 provides advanced and efficient low power modes in addition to 3GPP advanced power saving features like PSM (Power Saving Mode) and eDRX (extended DRX).

This document provides a detailed description of the AirPrime HL7800's low power modes while it is configured in PSM or eDRX.

### 2.2 UwTerminalX

In this document, UwTerminalX, is used to communicate with the Host UART of the Pinnacle™ 100 modem, and can be downloaded by visiting the Following link: <https://github.com/LairdCP/UwTerminalX>

### 2.3 R&S CMW500 Block Diagram

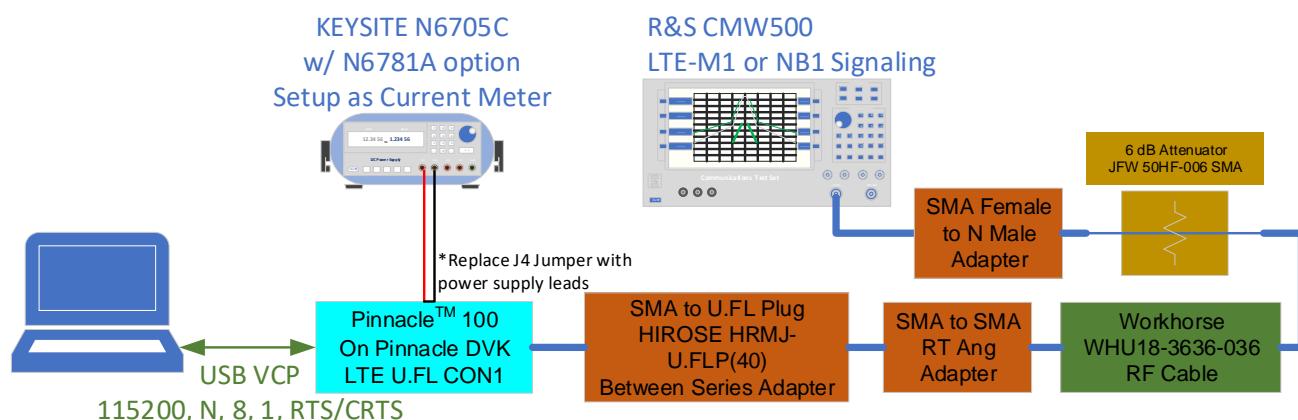


Figure 1: R&S CMW500 Test Configuration

## 2.4 Amarisoft Block Diagram

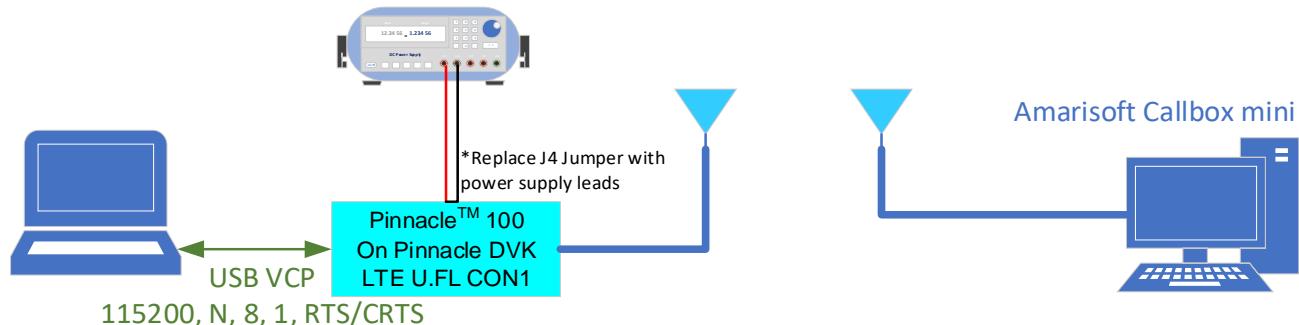


Figure 2: Amarisoft Test Configuration

## 2.5 DVK Setup

Setup the DVK's IO switches as shown in Figure 3. Place a Jumper Wire on IO M2.59 and connect to J9 Pin 11 (1.8V). The N6705C DC Power Analyzer setup as the Current Meter is connect using J4.

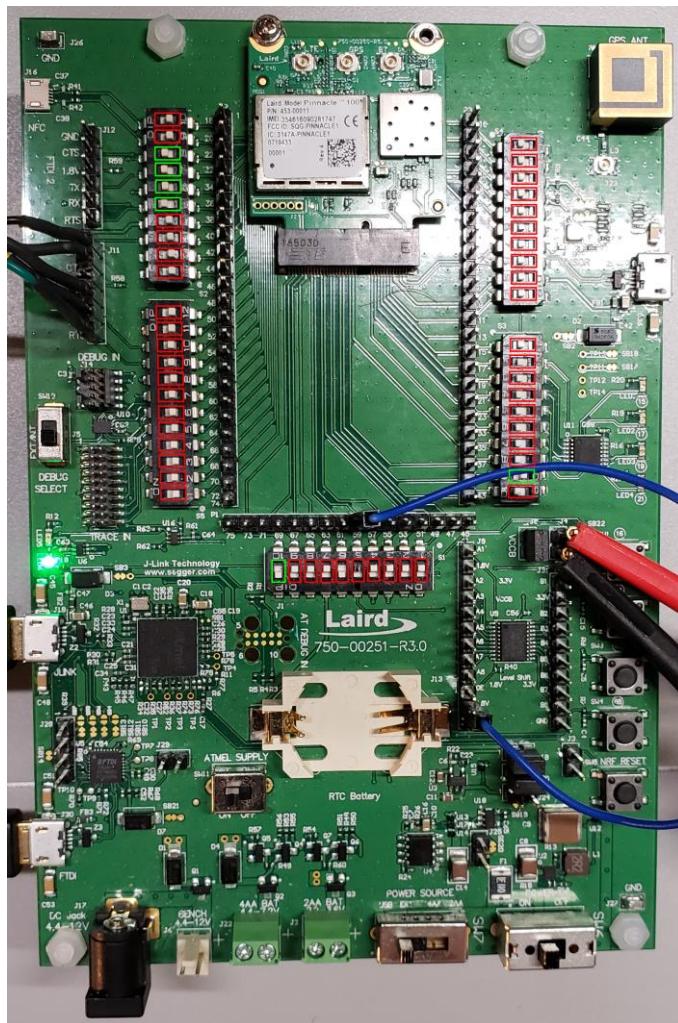


Figure 3: DVK Configuration

## 3 MODEM CONFIGURATION

### 3.1 Pinnacle™ 100 Firmware and Application

The modem's NRF chip is loaded with **120.3.3.35**, running Application: **1.01**, and the HL7800 is loaded with **4.3.8.0**.

Figure 4 shows the Firmware settings (highlight in **Yellow**)

```
UwTerminalX (v1.12a)
Terminal Config Speed Test Update About Logs Editor
CTS (green) DSR (red) DCD (red) RI (red) RTS (checked) DTR (checked) BREAK (unchecked) LocalEcho (checked) LineMode (checked) Clear Close Port
[COM61:115200,N,8,1,H]{cr} Download Tx Left: 0 Tx: 729 Rx: 11919 Last Rx: 12/02 @ 12:22:13 Cancel

ati0
ati0
HL7800
OK
ati9
ati9
HL7800.4.3.8
HL78xx.4.3.8.0.RK 02 01 02 00 74.20200122
2020/01/22 02:00:27
IMEI-SV: 3546160902817408
Legato RTOS: 18.09.3.ALTI250.rc3 2019/11/29 14:54:47
atSwi: 25.00
UBOOT: 01.03
Apps: RRAPP_02_01_02_00_69_020c71aff64756af95a5cf48eba6659dcae12247
MAC: ALTI250_02_01_02_00_68_FW
PHY: 12.50.222182
PMP: 222211
SBUB: 0
SBFW: 0
RPuK:
FPuK:
RBUB: 0
RBFW: 0
OK
Laird Connectivity Pinnacle 100, AppVer:1.01 LibVer:1.20
ati0
Pinnacle 100
OK
ati3
120.3.3.35
OK
ats109=2
OK
at&w
OK
atz
|
```

Figure 4: Query Firmware settings, configuring the NRF low power operation.

### 3.2 Configure M2.59 for nRF Low Power Operation

nRF Low Power Operation functionality is enabled by S Register 109.

Make sure the UART is communicating with the nRF by sending the **ati0** command; **Pinnacle 100 =nRF & HL7800 = HL7800**

*By default, the nRF will be communicating with HL7800 upon boot, to switch to communicate with the nRF, toggle the DTR check box, on and off, the console should now be switched, but check with ati0. By toggling the DTR signal, the UART will switch between radios.*

Send the following commands to the nRF, to enable the nRF low power operation, save the setting, and reboot. Connect a jumper from Pin M2.59 to J9 Pin 11. The jumper can be connected to either 1.8V (Low power disabled) [J9 Pin 11] or GND (Low Power enabled) [J9 Pin 12] depend on the desired operation. See Figure 3

**ATS109=2**  
**AT&W**  
**ATZ**

Figure 4 shows setting S Register 109 (highlight in **RED**)

### 3.3 Configure Radio Technology (M1 vs NB1) and Band

The Radio Technology must be configured and the supported bands: For this Guide, Band 20 is used.

To set the Radio Technology for Cat-M1:

at+ksrat=0  
at+kbnrcfg=0,80000

To set the Radio Technology for Cat-NB1:

at+ksrat=1  
at+kbnrcfg=1,80000

*Note: changing the radio technology will automatically reboot the modem. The kbnrcfg should be set after rebooting.*

### 3.4 Configure at+ksleep

Connect to the HL7800 and set at+ksleep.

at+ksleep=0,2

```
at+ksleep?  
at+ksleep?  
  
+KSLEEP: 0,2,0  
  
OK  
at+ksleep=0,2  
at+ksleep=0,2  
  
OK
```

Figure 5: Query and set +ksleep

## 4 LTE CAT-M1 LOW POWER OPERATION, R&S CMW500

### 4.1 Cat-M1 eDRX

Follow the steps below to configure the Pinnacle™ 100 modem for low power operation. Figure 6, shows the commands sent.

**at+cedrxs=1,4,5** (Note 1 & 2)

Toggle DTR to change from HL7800 to nRF radio comm

**at+aslp 1**

Toggle DTR to change from nRF to HL7800 radio comm

Move M2.59 Jumper from J9 Pin 11 (1.8V) to J9 Pin12 (GND)

Should see CTS Turn from Green to Red On UwTerminalX

Note 1: Per Sierra Wireless recommendations: Use eDRX cycle 81.92 sec, a PTW of 5.12 sec was selected, both parameters are controlled by the CMW500 setup

Note 2: That same sequence of commands is used to put the modem into PSM, except at+cedrx is replace by at+cpsms.

Note 3: The Current is observed using the Keysight N6705C DC Power Analyzer with ranges set to Auto to get wide dynamic current range from uA to A.

Figure 7 shows the PTW and eDRX cycle, and Figure 8 shows the Avg Current per hour is 1.064 mA.

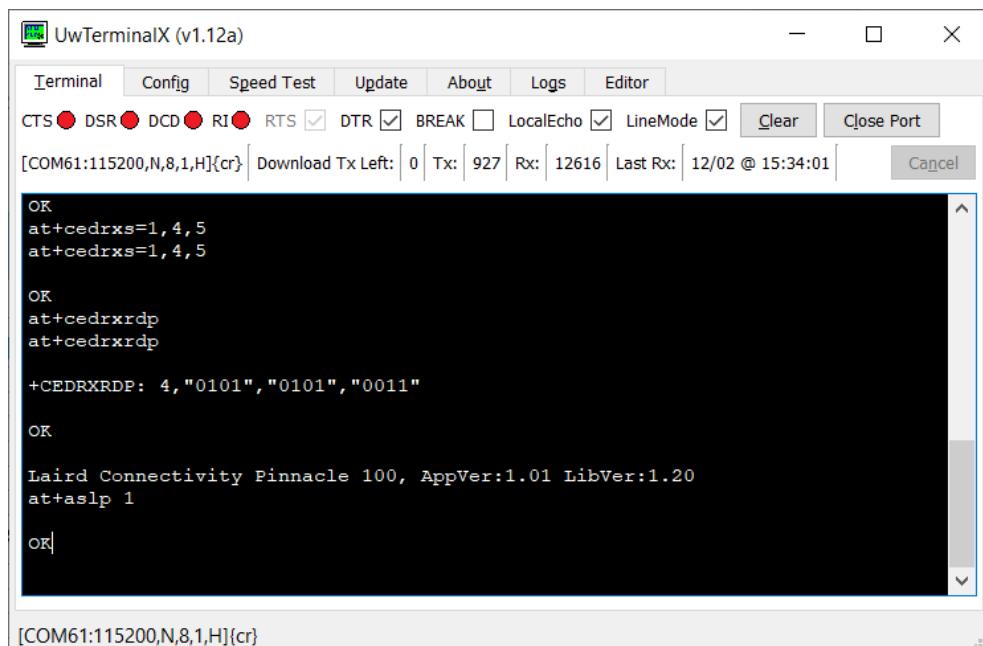


Figure 6: Cat-M1 Low Power Mode Command Sequence



Figure 7: Cat-M1, PSM, PTW and Cycle Time



Figure 8: Cat-M1, eDRX, Cycle Time 81.92 secs

## 4.2 Cat-M1 PSM — Once every Min

at+cpsms=1,,,"10100001","00001010" T3412 = "10100001" = 1 min; T3324 = "00001010" = 20 sec



Figure 9: Cat-M1, PSM, Once every 10 mins

## 4.3 Cat-M1 PSM — Once every 10 Min

at+cpsms=1,,,"00000001","00001010"



Figure 10: Cat-M1, PSM, Once every 10 mins

## 4.4 Cat-M1 PSM — Once every Hour

at+cpsms=1,,,"00100001","00001010"



Figure 11: Cat-M1, PSM, Once every hour

## 4.5 Cat-M1 PSM — Once every 8 Hours

at+cpsms=1,,,"00101000","00001010"



Figure 12: Cat-M1, PSM, Once every 8 hrs

## 4.6 Cat-M1 PSM — Once a Day

at+cpsms=1,,,"00111000","00001010"



Figure 13: Cat-M1, PSM, Once every Day

## 4.7 Cat-M1 eDRX & PSM Summary

Table 1 is a Summary of the current measurements of eDRX and PSM modes for LTE Cat-M1.

Table 1: Cat-M1 eDRX and PSM Modem currents

Low Power Mode	Timers		Avg Current/Hour mA H	Charge/Day mA H
	Cycle	PTW/cDRX		
eDRX	81.92 sec	5.12 sec	1.063773	25.530552
PSM	1 min	20 sec	4.874448	116.986752
	10 min	20 sec	0.614072	14.737728
	1 hr	20 sec	0.274957	6.598968
	8 hr	20 sec	0.135433	3.250392
	24 hr	20 sec	0.123752	2.970232

## 4.8 Exiting the Low Power Mode

Move M2.59 Jumper from J9 Pin 12 (1.8V) to J9 Pin11 (GND)

Should see CTS Turn from Red to Green On UwTerminalX

Toggle DTR to change from HL7800 to nRF radio comm

at+aslp 0

Toggle DTR to change from HL7800 to nRF radio comm

For eDRX: at+cedrxs=0

For PSM: at+cpsms=0

Low power mode has been exited.

## 5 LTE CAT-NB1 Low POWER OPERATION, R&S CMW500

### 5.1 Uplink Subcarrier Spacing: 15 kHz with 12 subcarriers

#### 5.1.1 Cat-NB1 15KHz eDRX

Follow the steps below to configure the Pinnalce™ 100 modem for low power operation. Figure 14,shows the commands sent.

```
at+cedrxs=1,5,5 (Note 1& 2)
Toggle DTR to change from HL7800 to nRF radio comm
at+aslp 1
Toggle DTR to change from nRF to HL7800 radio comm
Move M2.59 Jumper from J9 Pin 11 (1.8V) to J9 Pin12 (GND)
Should see CTS Turn from Green to Red On UwTerminalX
```

Note 1: Per Sierra Wireless recommendations: Use eDRX cycle 81.92 sec, a PTW of 10.24 sec was selected, both parameters are controlled by the CMW500 setup

Note 2: That same sequence of commands is used to put the modem into PSM, except at+cedrx is replace by at+cpsms.

Note 3: The Current is observed using the Keysight N6705C DC Power Analyzer with ranges set to Auto to get wide dynamic current range from uA to A.

Figure 15, shows the PTW and eDRX cycle, and Figure 16, shows the Avg Current per hour is 0.729 mA/H.

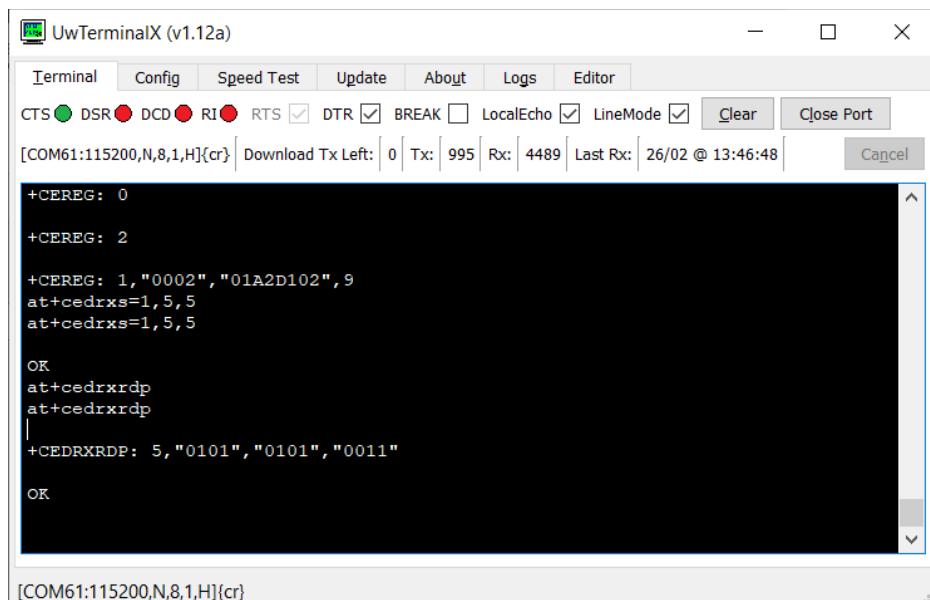


Figure 14: eDRX Cat-NB1, Low Power Mode Command Sequence

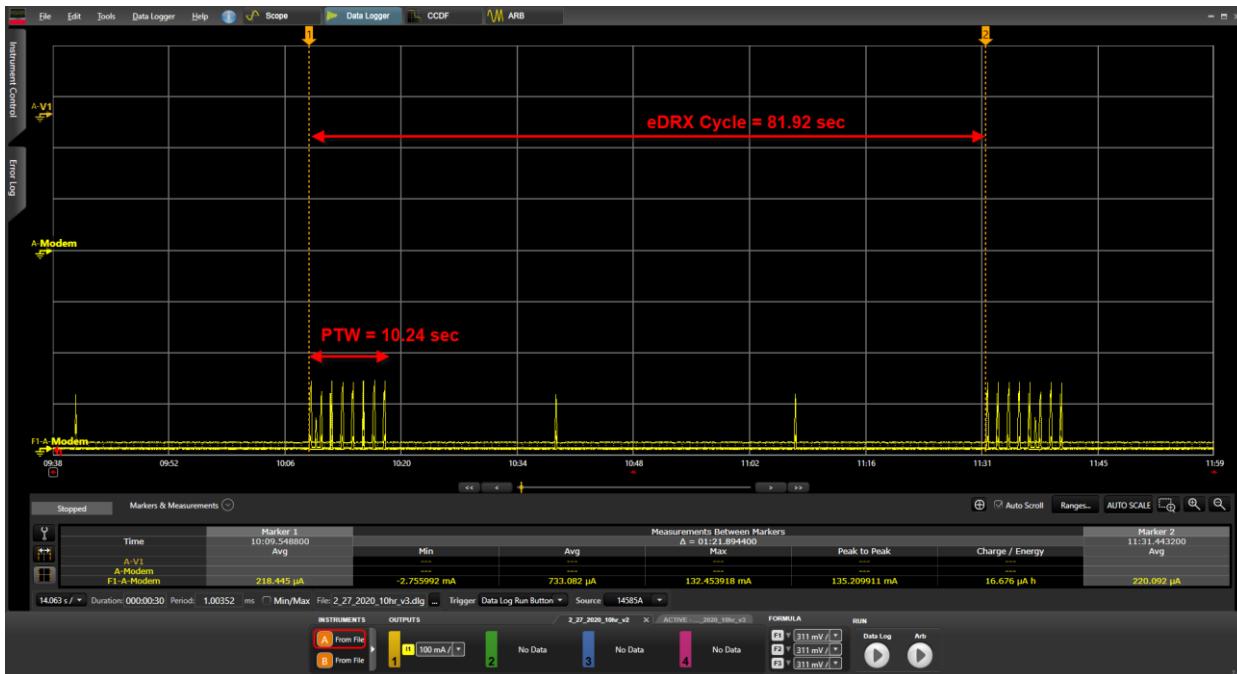


Figure 15: eDRX Cat-NB1 15KHz, PTW and Cycle Time

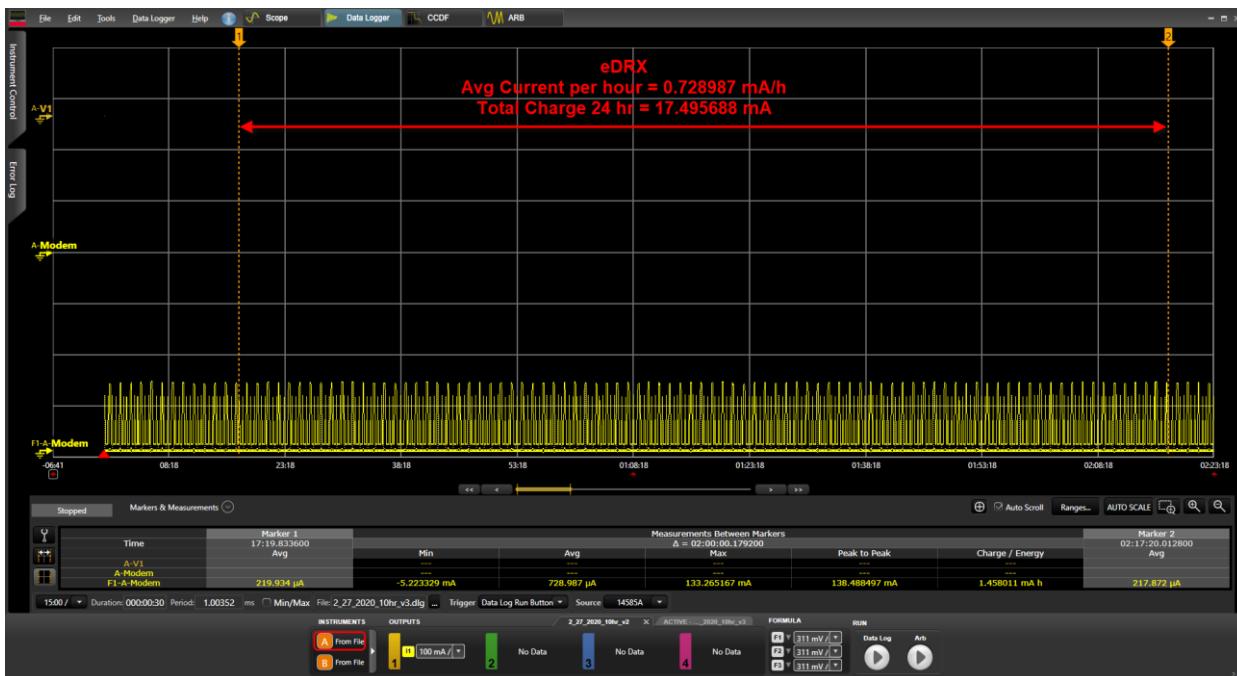


Figure 16: eDRX Cat-NB1 15KHz, Cycle Time 81.92 sec

### 5.1.2 Cat-NB1 15KHz PSM — Once every Min

at+cpsms=1,,,"10100001","00001010" T3412 = "10100001" = 1 min; T3324 = "00001010" = 20 sec



Figure 17: PSM Cat-NB1 15KHz, Once every min

### 5.1.3 Cat-NB1 15KHz PSM — Once every 10 Min

at+cpsms=1,,,"00000001","00001010"

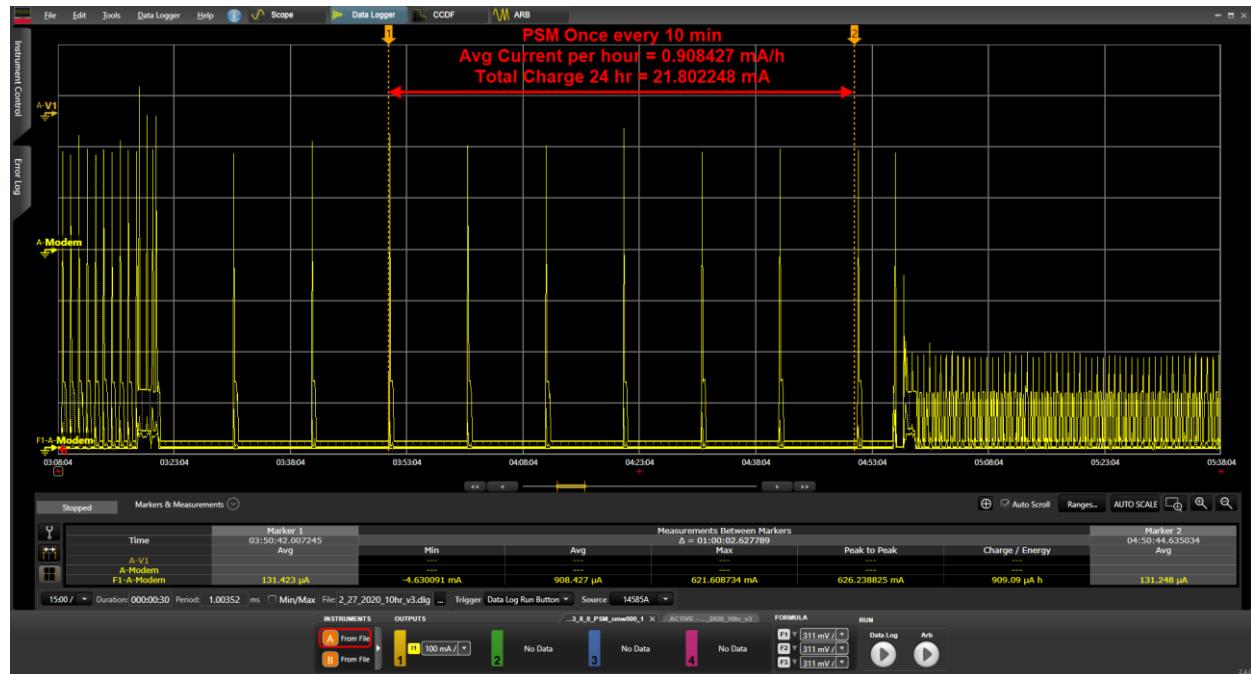


Figure 18: PSM Cat-NB1 3.75KHz, Once every 10 mins

### 5.1.4 Cat-NB1 15KHz PSM — Once every Hour

at+cpsms=1,,,"00100001","00001010"



Figure 19: PSM Cat-NB1 3.75KHz, Once every hour

## 5.2 Uplink Subcarrier Spacing: 3.75 kHz with MCS3

### 5.2.1 Cat-NB1 3.75KHz eDRX

Same commands as 5.1.1 Cat-NB1 15KHz eDRX on page 14.

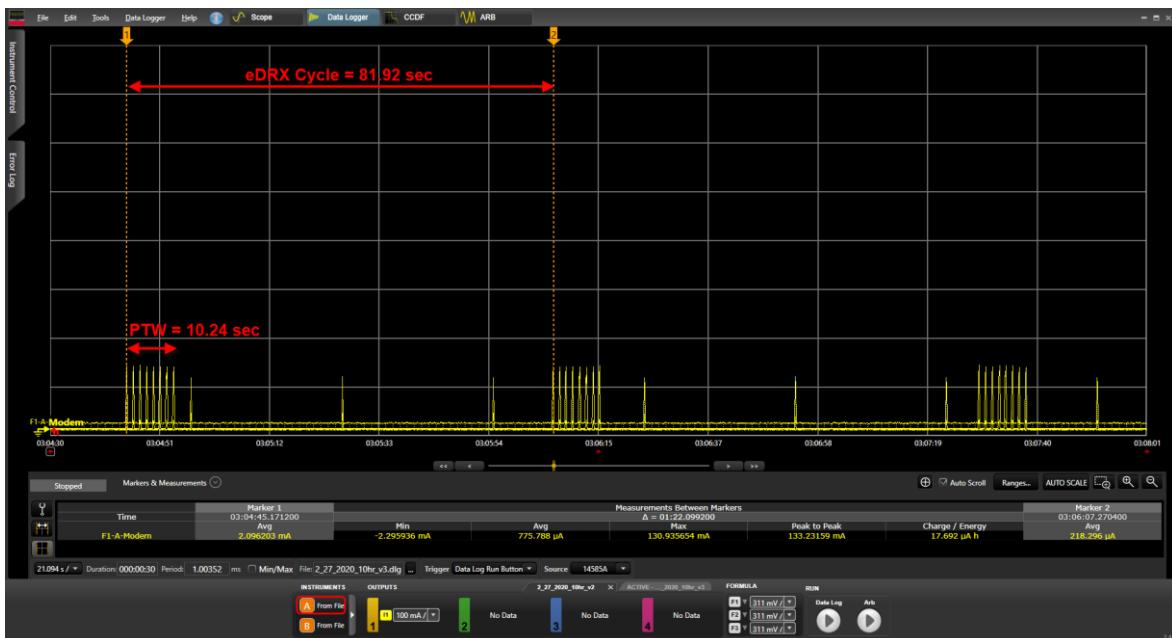


Figure 20: eDRX Cat-NB1 3.75Khz, PTW and Cycle Time

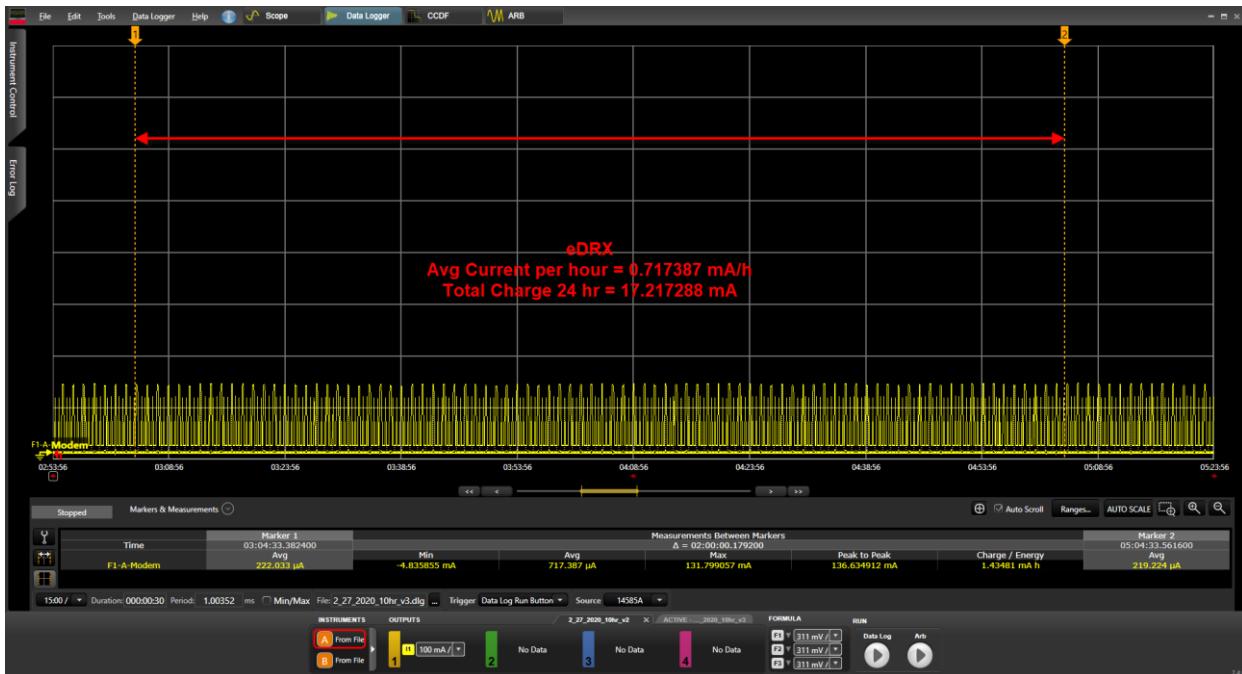


Figure 21: eDRX Cat-NB1 3.75KHz, Cycle Time 81.92 sec

### 5.2.2 Cat-NB1 3.75Khz PSM — Once every Min

at+cpsms=1,,,"10100001","00001010" T3412 = "10100001" = 1 min; T3324 = "00001010" = 20 sec



Figure 22: PSM Cat-NB1 3.75KHz, Once every min

### 5.2.3 Cat-NB1 3.75KHz PSM — Once every 10 Min

at+cpsms=1,,,"00000001","00001010"



Figure 23: PSM Cat-NB1 3.75KHz, PSM, Once every 10 min

### 5.2.4 Cat-NB1 3.75KHz PSM — Once every Hour

at+cpsms=1,,,"00100001","00001010"



Figure 24: PSM Cat-NB1 3.75KHz, Once every hour

## 5.3 Cat-NB1 eDRX & PSM Summary

Table 2 is a summary of the current measurements of eDRX and PSM modes for LTE Cat-NB1 15KHz.

Table 3 is a summary of the current measurements of eDRX and PSM modes for LTE Cat-NB1 3.75KHz.

**Table 2: Cat-NB1 15KHz eDRX and PSM Modem currents**

Low Power Mode	Timers		Avg Current/Hour mA H	Charge/Day mA H
	Cycle	PTW/cDRX		
eDRX	81.92 sec	10.24 sec	0.728987	17.495688
PSM	1 min	20 sec	7.758774	186.210576
	10 min	20 sec	0.908427	21.802248
	1 hr	20 sec	0.329765	7.914360

**Table 3: Cat-NB1 3.75KHz eDRX and PSM Modem currents**

Low Power Mode	Timers		Avg Current/Hour mA H	Charge/Day mA H
	Cycle	PTW/cDRX		
eDRX	81.92 sec	10.24 sec	0.717387	17.217288
PSM	1 min	20 sec	14.701911	352.845864
	10 min	20 sec	1.697441	40.738584
	1 hr	20 sec	0.445537	10.692888

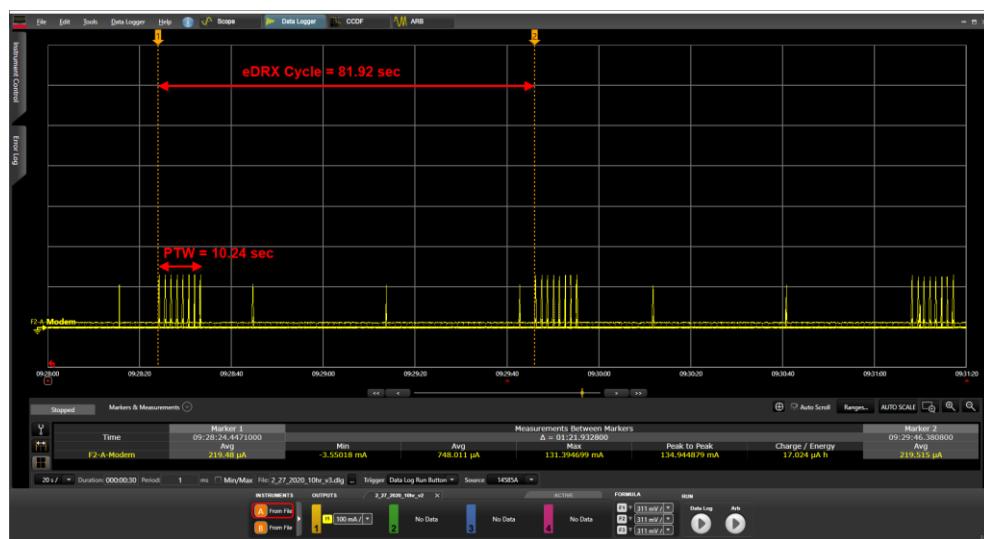
## 5.4 Exiting the Low Power Mode

See [4.8 on page 13](#) Exiting the Low Power Mode

# 6 LTE CAT-M1 LOW POWER OPERATION, AMARISOFT CALLBOX MINI

## 6.1 Cat-M1 eDRX

Same commands used as section 4.1 on page 9 4.1 Cat-M1 eDRX.



**Figure 25: Cat-M1 eDRX; PTW and Cycle Time**

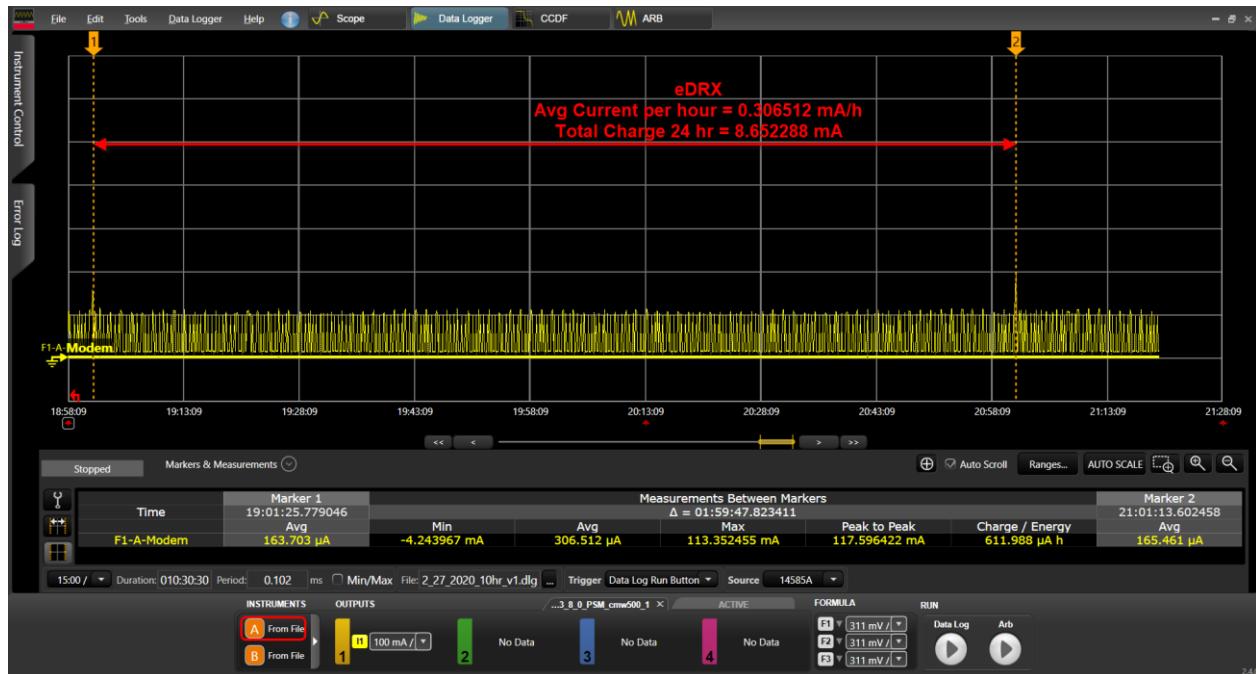


Figure 26: Cat-M1, eDRX, Cycle Time 81.92 secs

## 6.2 Cat-M1 PSM — Once every Min

at+cpsms=1,,,"10100001","00001010" T3412 = "10100001" = 1 min; T3324 = "00001010" = 20 sec



Figure 27: Cat-M1, PSM, Once every 10 mins

## 6.3 Cat-M1 PSM — Once every 10 Min

at+cpsms=1,,,"00000001","00001010"

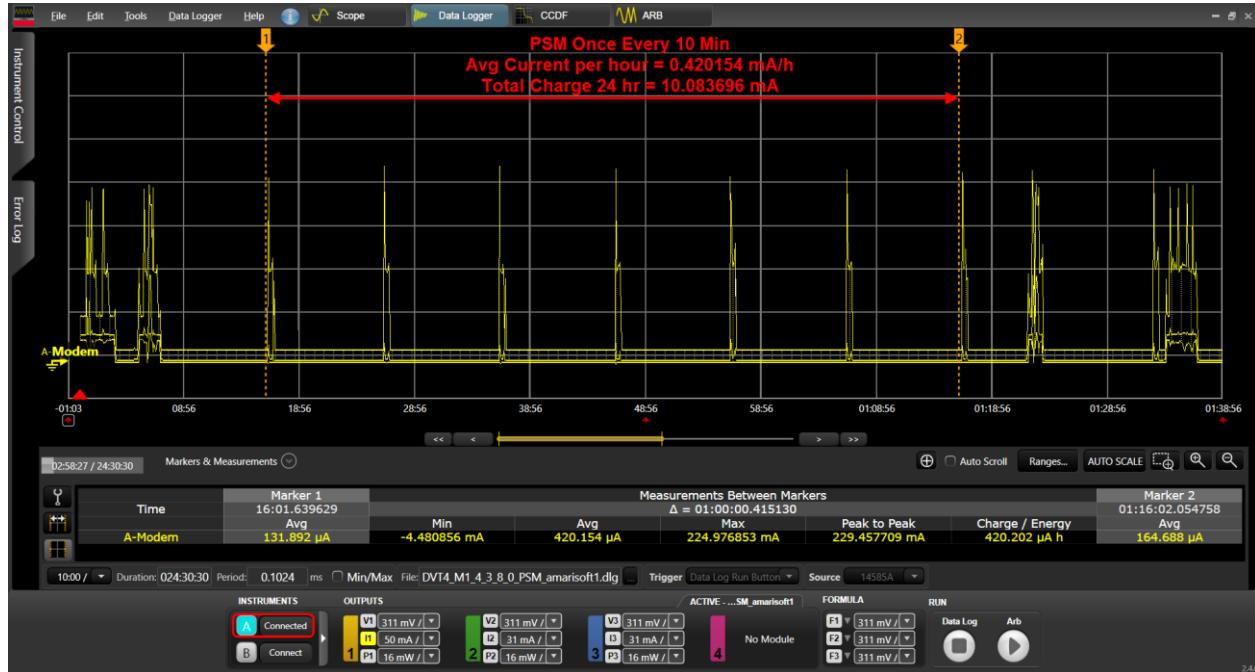


Figure 28: Cat-M1, PSM, Once every 10 mins

## 6.4 Cat-M1 PSM — Once every Hour

at+cpsms=1,,,"00100001","00001010"

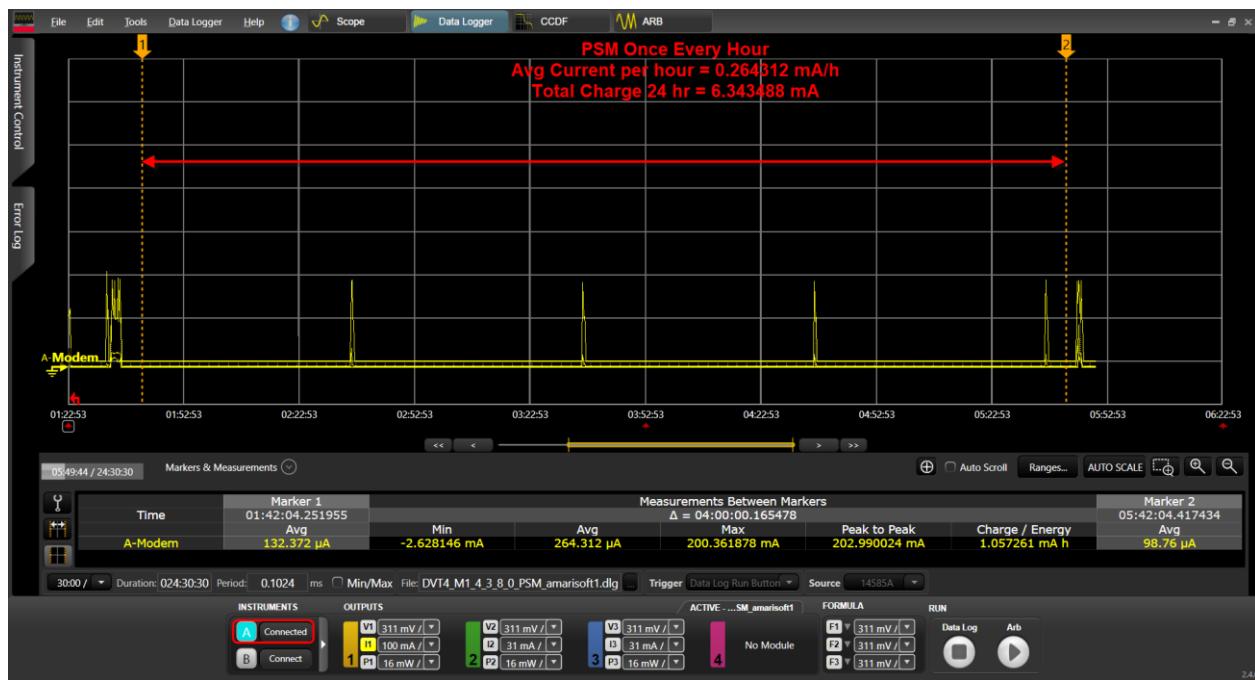


Figure 29: Cat-M1, PSM, Once every hour

## 6.5 Cat-M1 eDRX & PSM Summary

Table 4 is a Summary of the current measurements of eDRX and PSM modes for LTE Cat-M1.

**Table 4: Cat-M1 eDRX and PSM Modem currents**

Low Power Mode	Timers	Avg Current/Hour mA H	Charge/Day mA H
Cycle	PTW/cDRX		
eDRX	81.92 sec	10.24 sec	0.360512
PSM	1 min	20 sec	2.994226
	10 min	20 sec	0.420154
	1 hr	20 sec	0.264312

## 6.6 Exiting the Low Power Mode

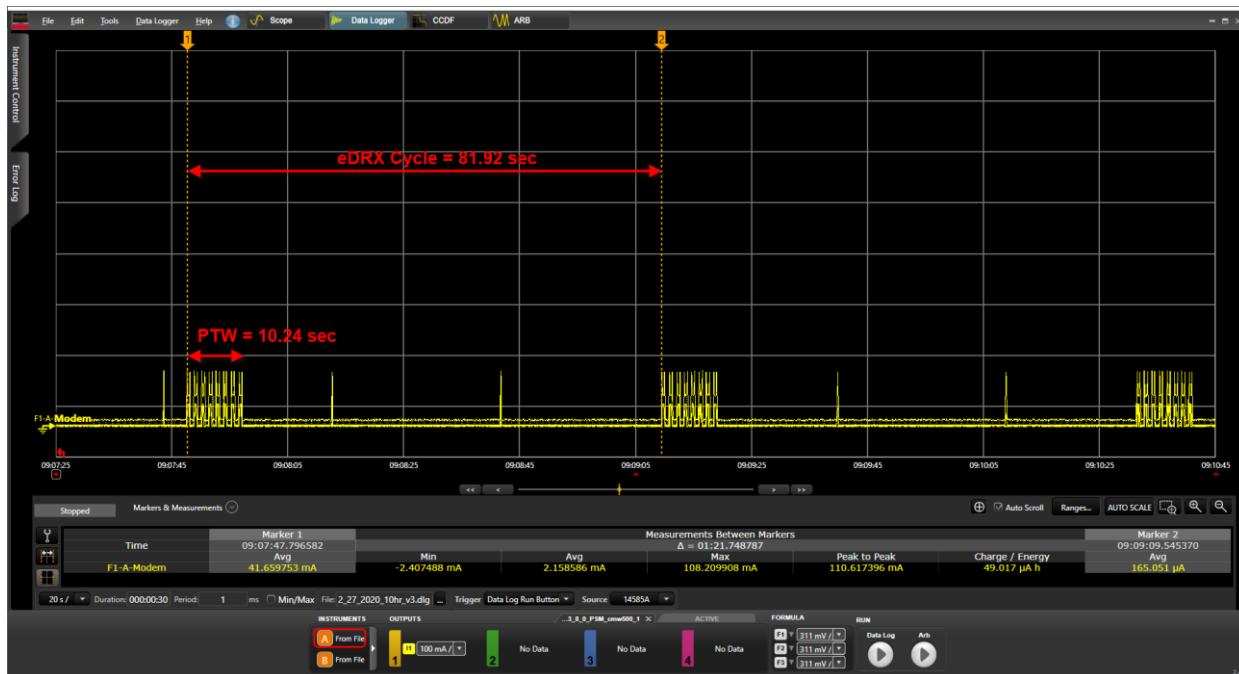
See [4.8 on page 13 Exiting the Low Power Mode](#)

# 7 LTE CAT-NB1 LOW POWER OPERATION, AMARISOFT CALLBOX MINI

## 7.1 Uplink Subcarrier Spacing: 15 kHz with 12 subcarriers

### 7.1.1 Cat-NB1 15KHz eDRX

Same commands used as section 5.1.1 on page 14 4.1Cat-NB1 15KHz eDRX.



**Figure 30: eDRX Cat-NB1 15KHz, PTW and Cycle Time**



Figure 31: eDRX Cat-NB1 15KHz, Cycle Time 81.92 sec

### 7.1.2 Cat-NB1 15KHz PSM — Once every Min

at+cpsms=1,,,"10100001","00001010" T3412 = "10100001" = 1 min; T3324 = "00001010" = 20 sec



Figure 32: PSM Cat-NB1 15KHz, Once every min

### 7.1.3 Cat-NB1 15KHz PSM — Once every 10 Min

at+cpsms=1,,,"00000001","00001010"

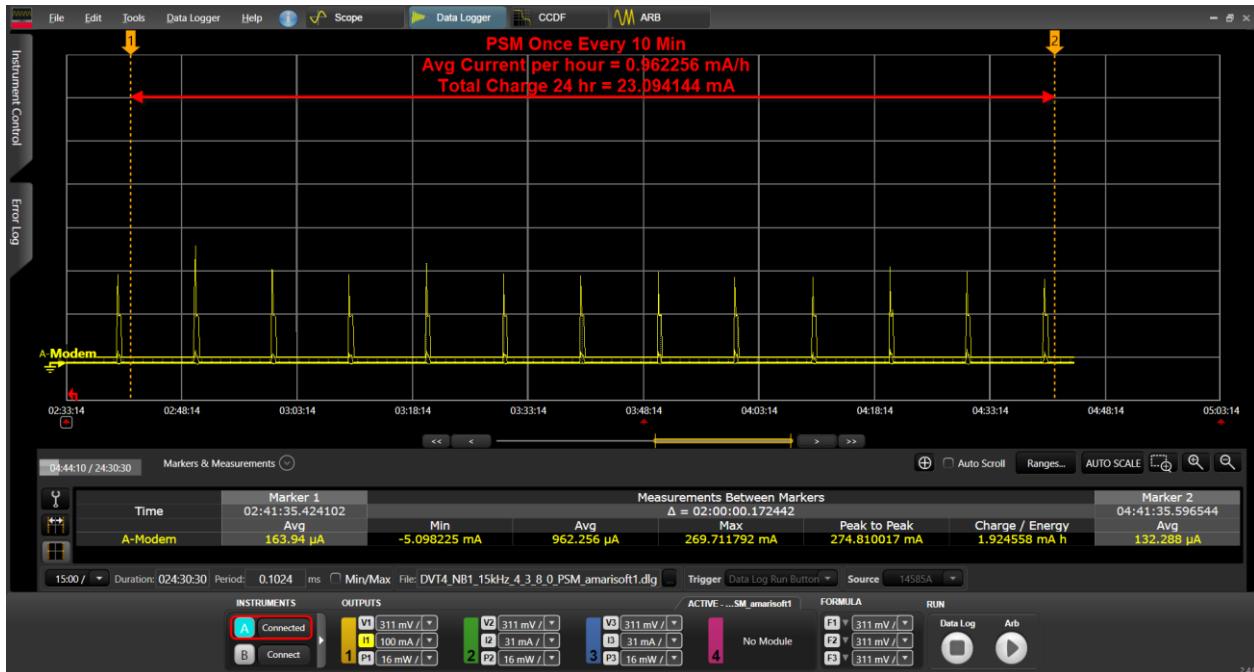


Figure 33: PSM Cat-NB1 3.75KHz, Once every 10 mins

### 7.1.4 Cat-NB1 15KHz PSM — Once every Hour

at+cpsms=1,,,"00100001","00001010"



Figure 34: PSM Cat-NB1 3.75KHz, Once every hour

## 7.2 Uplink Subcarrier Spacing: 3.75 kHz with MCS3

### 7.2.1 Cat-NB1 3.75KHz eDRX

Same commands used as section 5.1.1 on page 14 4.1Cat-NB1 15KHz eDRX.



Figure 35: eDRX Cat-NB1 3.75KHz, PTW and Cycle Time

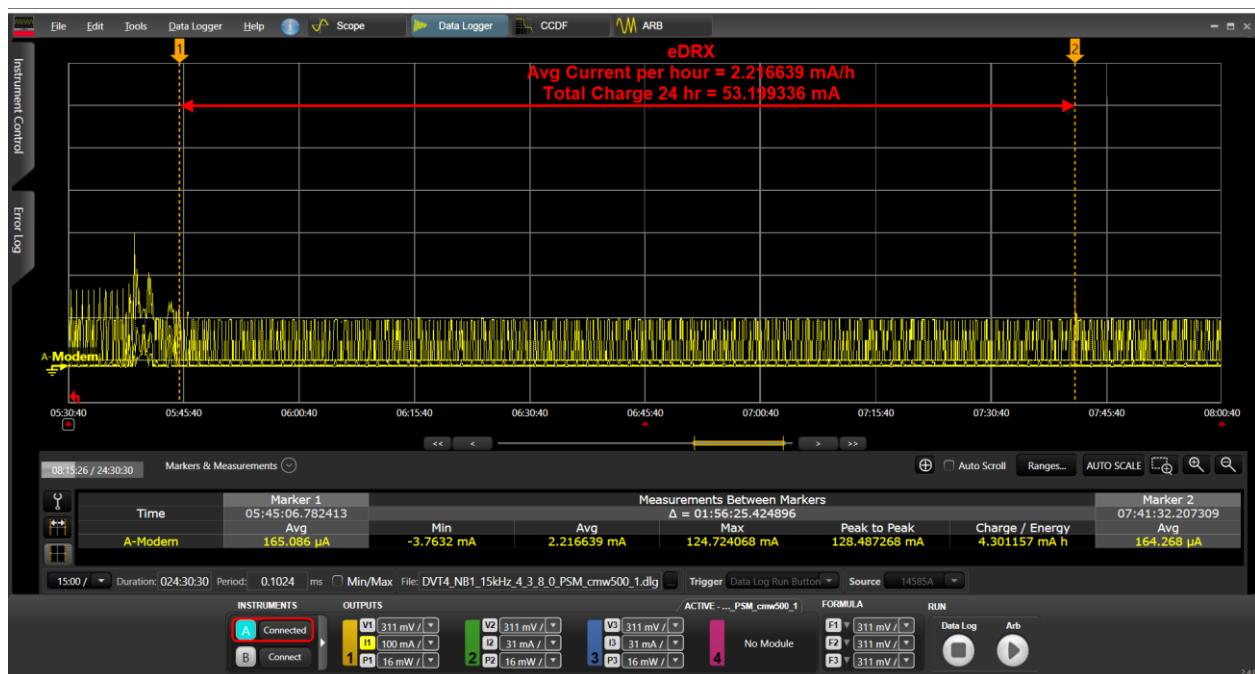


Figure 36: eDRX Cat-NB1 3.75KHz, Cycle Time 81.92 sec

## 7.2.2 Cat-NB1 3.75KHz PSM — Once every Min

at+cpsms=1,,,"10100001","00001010" T3412 = "10100001" = 1 min; T3324 = "00001010" = 20 sec

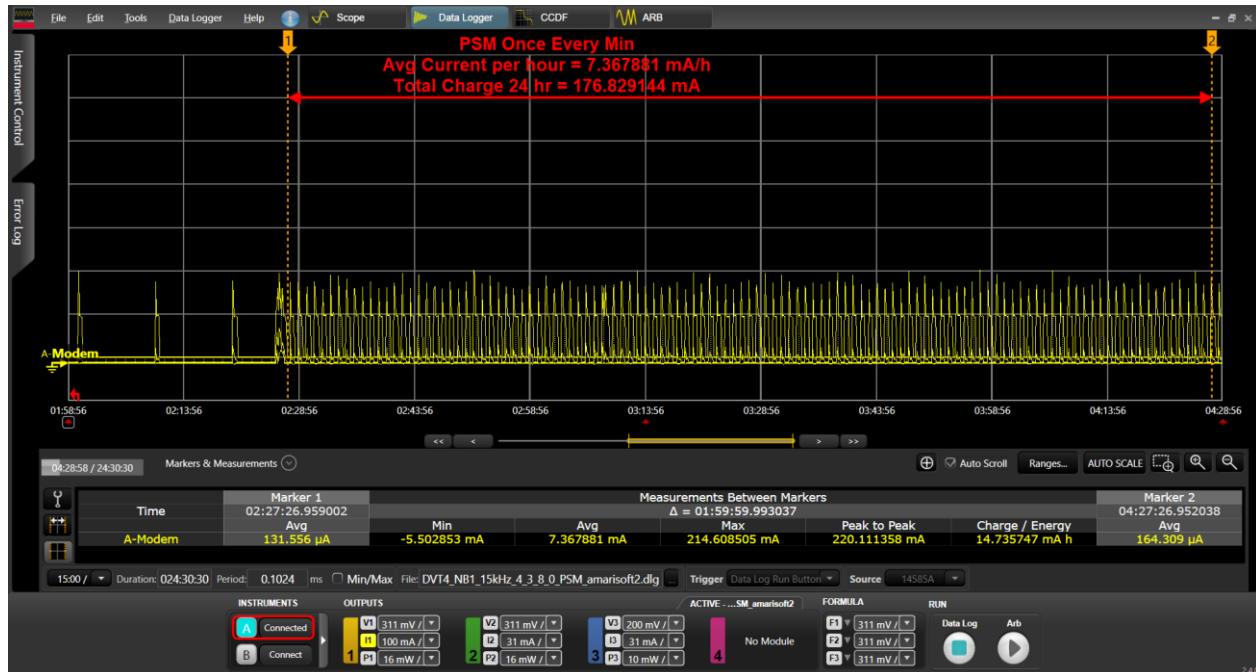


Figure 37: PSM Cat-NB1 3.75KHz, Once every min

## 7.2.3 Cat-NB1 3.75Khz PSM — Once every 10 Min

at+cpsms=1,,,"00000001","00001010"

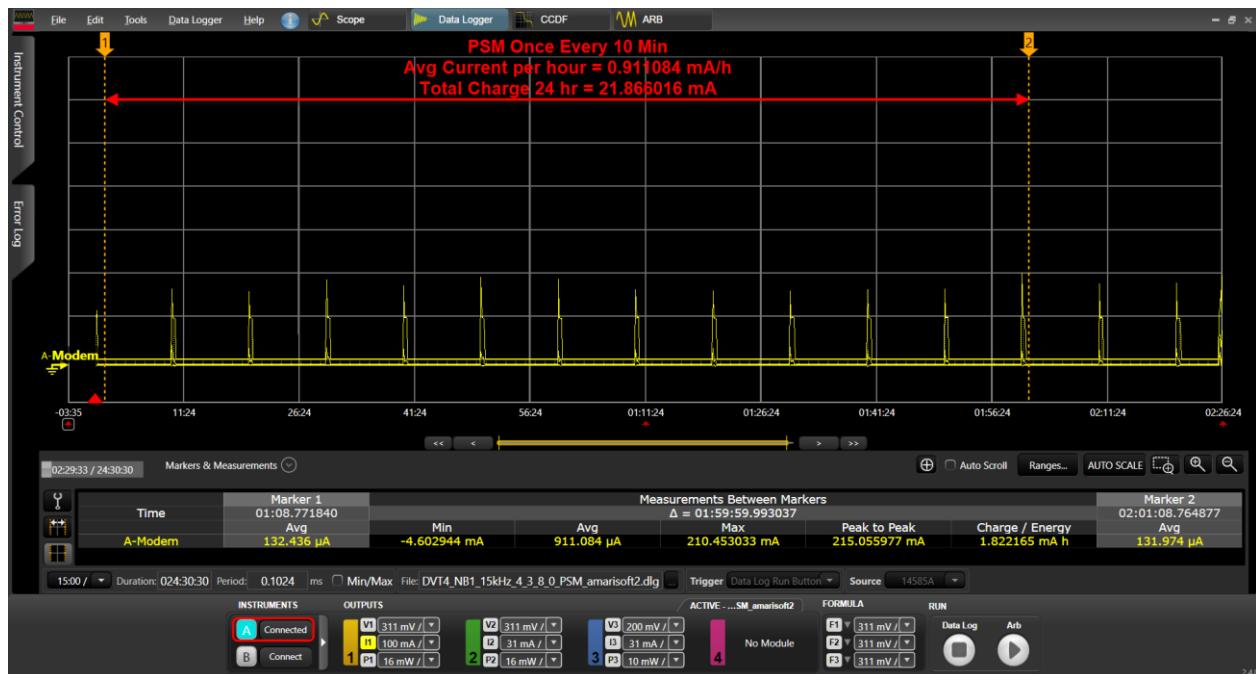


Figure 38: PSM Cat-NB1 3.75Khz, PSM, Once every 10 mins

### 7.2.4 Cat-NB1 3.75KHz PSM — Once every Hour

at+cpsms=1,,,"00100001","00001010"



Figure 39: PSM Cat-NB1 3.75KHz, Once every hour

### 7.3 Cat-NB1 eDRX & PSM Summary

Table 5 is a summary of the current measurements of eDRX and PSM modes for LTE Cat-NB1 15KHz.

Table 6 is a summary of the current measurements of eDRX and PSM modes for LTE Cat-NB1 3.75KHz.

Table 5: Cat-NB1 15KHz eDRX and PSM Modem currents

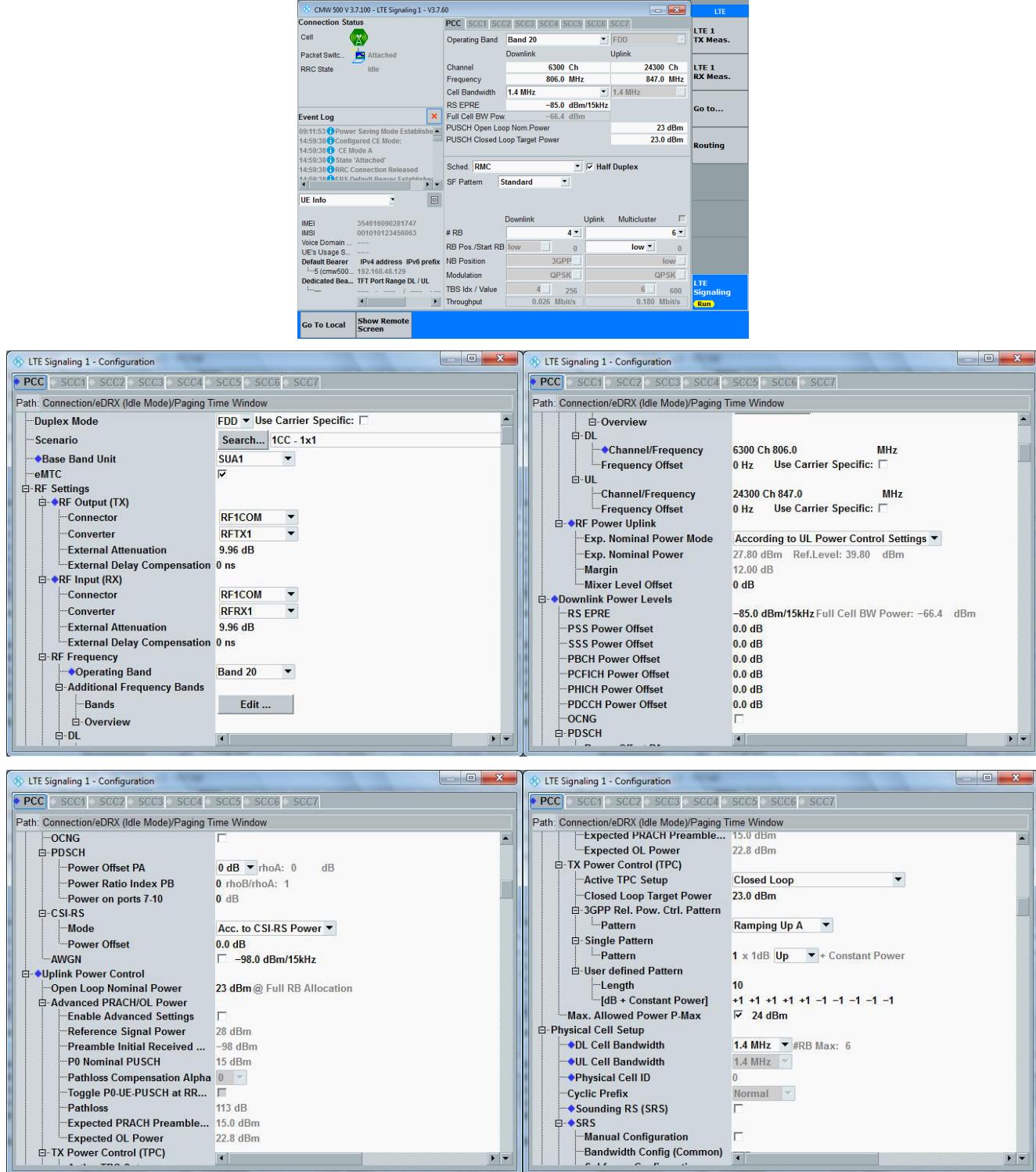
Low Power Mode	Timers		Avg Current/Hour mA H	Charge/Day mA H
	Cycle	PTW/cDRX		
eDRX	81.92 sec	10.24 sec	1.873913	44.973912
PSM	1 min	20 sec	10.004246	240.101904
	10 min	20 sec	0.962256	23.094144
	1 hr	20 sec	0.342722	8.225328

Table 6: Cat-NB1 3.75KHz eDRX and PSM Modem currents

Low Power Mode	Timers		Avg Current/Hour mA H	Charge/Day mA H
	Cycle	PTW/cDRX		
eDRX	81.92 sec	10.24 sec	2.216639	53.199336
PSM	1 min	20 sec	7.367881	176.829144
	10 min	20 sec	0.911084	21.866016
	1 hr	20 sec	0.357948	8.590752

## 8 APPENDIX

### 8.1 CMW500 Cat-M1 Configuration



The image displays six windows from the Pinnacle™ 100 Modem configuration software, specifically for Hosted Mode Low Power settings. Each window shows a hierarchical tree view of configuration parameters under the 'LTE Signaling 1 - Configuration' tab.

- Top Left:** Shows settings for SRS (Small Cell Reference Signal), TDD (Time Division Duplex), PRACH (Physical Random Access Channel), and Network.
- Top Right:** Shows settings for Neighbor Cell, LTE, GSM, WCDMA FDD, CDMA2000, 1xEV-DO, TD-SCDMA, and TD-SCDMA.
- Middle Left:** Shows detailed settings for TU-SL DMA, Cell Reselection, Identity, Security Settings, and UE Identity.
- Middle Right:** Shows settings for RAN Value, UE Identity, Timer and Constants, Time, and NAS Signaling.
- Bottom Left:** Shows settings for IAU Reject Cause, Synchronization, eMTC, and CE Mode.
- Bottom Right:** Shows settings for Level 1, Level 2, and Level 3 PRACH configurations.

**Screenshot 1: LTE Signaling 1 - Configuration (PCC)**

- Path: Connection/eDRX (Idle Mode)/Paging Time Window
- Q rxlevmin: -140 dBm
- PRACH:
  - Configuration Index: 3
  - Frequency Offset: 0
  - Max Preamble Atte...: 3
  - Repetitions per Pre...: 1
  - Max MPDCCH Repet...: 1
- Connection:
  - Easy Mode
  - Band/Frequency/BW change
  - Group Hopping
  - UE Category
  - UE Category 0 allowed
  - PSM allowed
  - IMS Emergency Support
  - eCall over IMS Support
  - Default Paging Cycle
  - PCCCH-Config nB
  - Additional Spectrum Emission
  - UE Meas. Filter Coefficient
  - Connection Type
  - Testmode

**Screenshot 2: LTE Signaling 1 - Configuration (PCC)**

- Path: Connection/eDRX (Idle Mode)/Paging Time Window
- UE Meas. Filter Coefficient: FC4
- Connection Type: Testmode
- Testmode:
  - Use "Activate Testmode" M...
- Default Bearer:
  - RLC Mode
  - IP version
  - APN
  - QCI
- SIB Reconfiguration
- Keep RRC Connection
- Downlink MAC Padding
- Downlink MAC Error Insertion
- MIMO Settings:
  - Transmission Mode
  - DCI Format
  - Antenna Configuration
  - Transmission Scheme

**Screenshot 3: LTE Signaling 1 - Configuration (PCC)**

- Path: Connection/eDRX (Idle Mode)/Paging Time Window
- Transmission Scheme: SISO
- Graphic:
- UE Transmit Antenna Selection
- Scheduling Type:
  - RMC
  - Half Duplex
  - SF Pattern
- DL:
  - # Resource Blocks: 4
  - RB Position/Start RB: low
  - NB Position: 3GPP
  - Modulation Type: QPSK
  - Transport Block Size Ind...: 4
  - Transport Block Size

**Screenshot 4: LTE Signaling 1 - Configuration (PCC)**

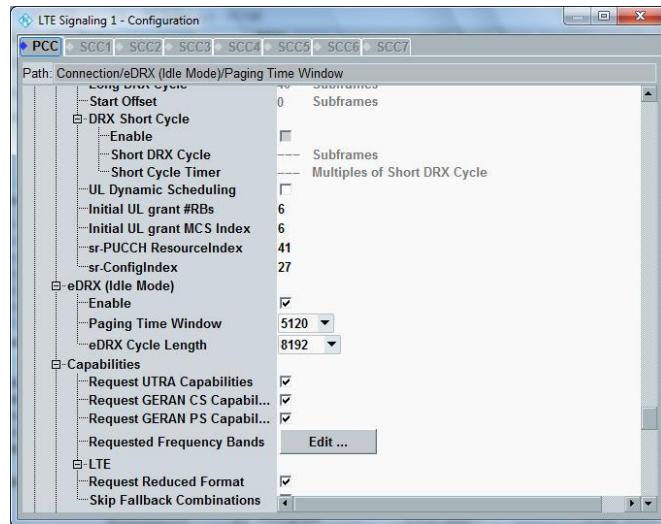
- Path: Connection/eDRX (Idle Mode)/Paging Time Window
- Transport Block Size Ind...: 4
- UL:
  - Transport Block Size: 256
  - Throughput: 0.026 Mbit/s
  - # Resource Blocks: 6
  - RB Position/Start RB: low
  - NB Position: low
  - Modulation Type: QPSK
  - Transport Block Size Ind...: 6
  - Transport Block Size: 600
  - Throughput: 0.180 Mbit/s
- PUSCH Hopping
- TTI Bundling
- Max Throughput
- ROHC:
  - Enable header Compression
  - Enable For:
    - Profile 0x0001 (IP/UDP/RTP)
    - Profile 0x0002 (IP/UDP)
    - Profile 0x0004 (IP)
    - Profile 0x0006 (IP/TCP)
  - Uplink only ROHC:
    - Enable Uplink only header compression
    - Profile 0x0006 (IP/TCP)

**Screenshot 5: LTE Signaling 1 - Configuration (PCC)**

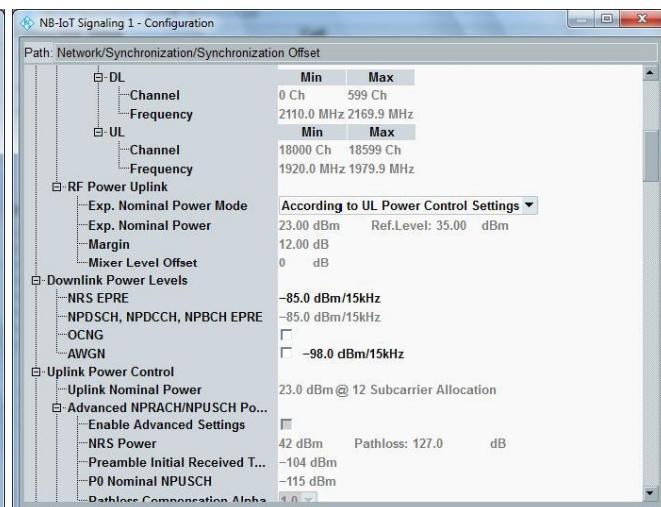
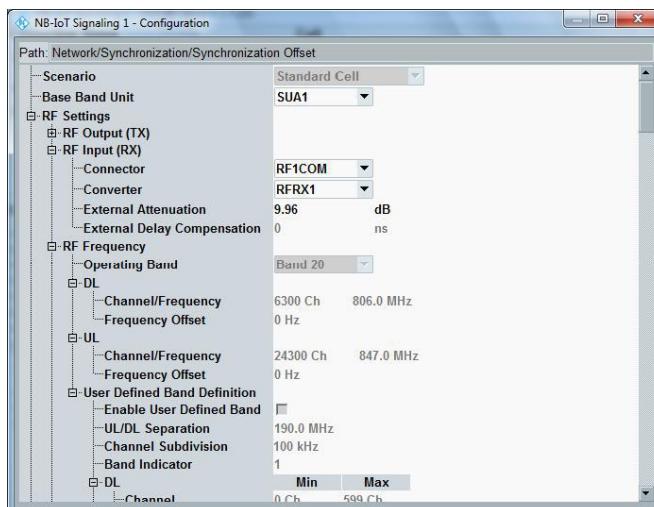
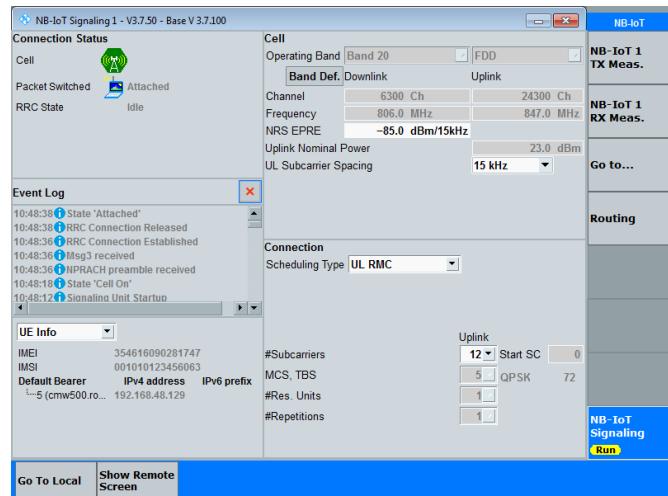
- Path: Connection/eDRX (Idle Mode)/Paging Time Window
- Max Throughput:
  - DL: 0.026 Mbit/s
  - UL: 0.180 Mbit/s
- ROHC:
  - Enable header Compression
  - Enable For:
    - Voice and Video Bearers
  - Profile 0x0001 (IP/UDP/RTP)
  - Profile 0x0002 (IP/UDP)
  - Profile 0x0004 (IP)
  - Profile 0x0006 (IP/TCP)
- Uplink only ROHC:
  - Enable Uplink only header compression
  - Profile 0x0006 (IP/TCP)
- PDCCH:
  - PDCCH Symbol Config
  - Reduced PDCCH
  - Aggr. Level DL/UL Config
  - #PDCCH Symbols:
    - Aggreg. Level DL DCI (C-RN...: 4 CCE
    - Aggreg. Level UL DCI (C-RN...: 4 CCE
    - Aggreg. Level DL DCI (SI-R...: 4 CCE
- PUCCH:
  - PUCCH format for CA
  - Act.PUCCH format for CA
- Operating Band Change

**Screenshot 6: LTE Signaling 1 - Configuration (PCC)**

- Path: Connection/eDRX (Idle Mode)/Paging Time Window
- Act.PUCCH format for CA
- Operating Band Change
- Frequency Change
- CSFallback (MO):
  - Target RAT: GSM
  - Band: GSM900
  - Channel: 20 Ch
  - Band Indicator: GSM1800
- Accept Multiple Def.Bearer
- DL HARQ:
  - Number of HARQ Transmiss...: 2
  - Redundancy Version Codin...: TS 36.101 {0,1,2,3}/{0,0,1,2}
  - User Defined Sequence: Length: 4 { 0 0 0 0 }
- Connected DRX:
  - Connected DRX: DRX\_S
  - On Duration Timer
  - Inactivity Timer
  - Retransmission Timer
  - Long DRX Cycle
  - Start Offset
  - E-DRX Short Cycle

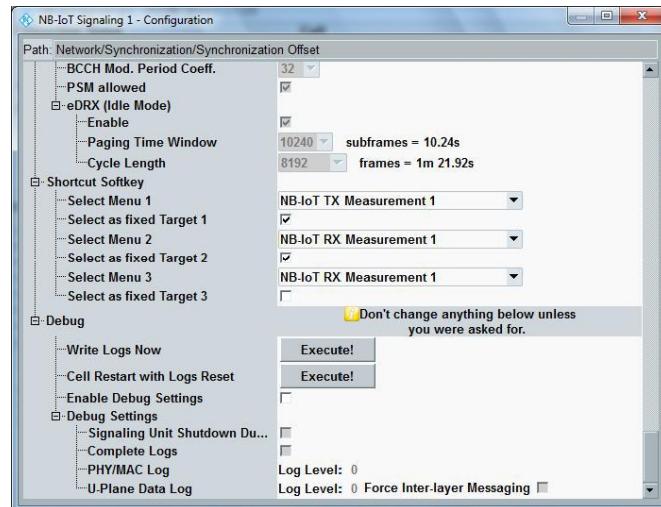


## 8.2 CMW500 Cat-NB1 15KHz Sub Carrier spacing Configuration

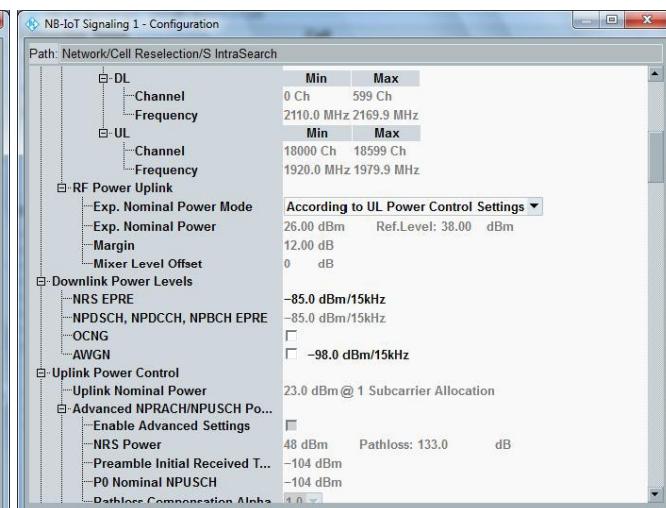
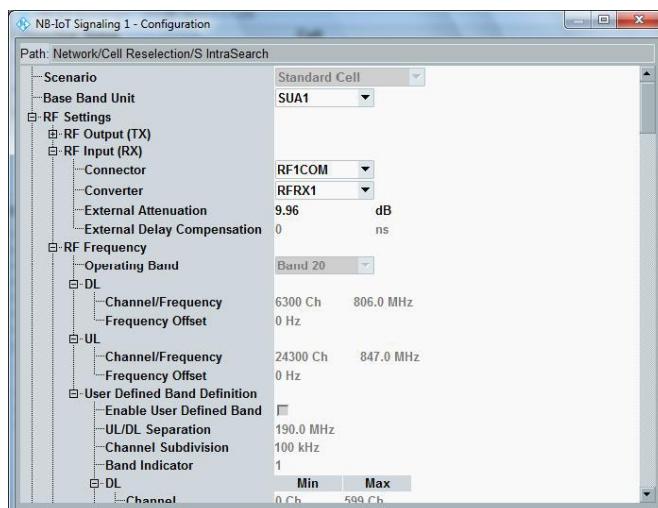
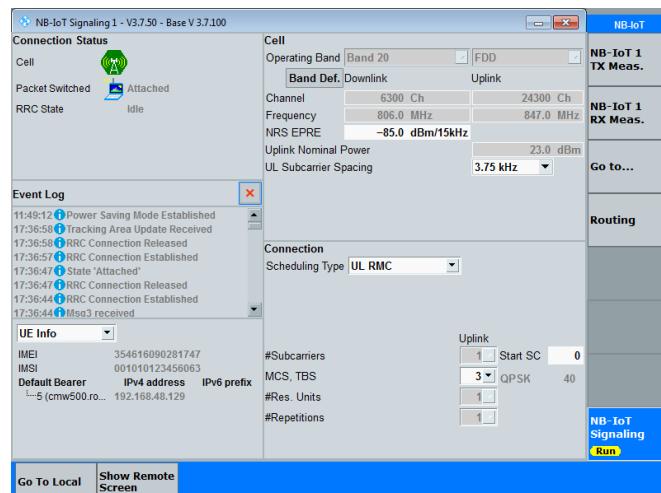


The figure consists of six windows from the Pinnacle™ 100 Modem configuration software:

- Top Left:** NB-IoT Signaling 1 - Configuration. Path: Network/Synchronization/Synchronization Offset. Shows parameters like P0 Nominal NPUCH (-115 dBm), Pathloss Compensation Alpha (1.0), and LTE Bandwidth (10 MHz).
- Top Right:** NB-IoT Signaling 1 - Configuration. Path: Network/Synchronization/Synchronization Offset. Shows parameters like No Response to Preambles (Off), Power Ramping Step (2 dB), and Cell Identity (MCC: 001, MNC: 01, TAC: 1).
- Middle Left:** NB-IoT Signaling 1 - Configuration. Path: Network/Synchronization/Synchronization Offset. Shows Security Settings (Authentication, Integrity Algorithm, Secret Key, etc.) and Synchronization Zone (1 ms).
- Middle Right:** NB-IoT Signaling 1 - Configuration. Path: Network/Synchronization/Synchronization Offset. Shows Connection Type (Testmode), Data Application (C-IoT Optimization, IP version), and UL/DL RMC Scheduling.
- Bottom Left:** NB-IoT Signaling 1 - Configuration. Path: Network/Synchronization/Synchronization Offset. Shows User defined Scheduling (UL, DL, HARQ, NPDCCH) and Max. Num. Repetitions Rmax (1).
- Bottom Right:** NB-IoT Signaling 1 - Configuration. Path: Network/Synchronization/Synchronization Offset. Shows Max. Num. Repetitions Rmax (1), Rmax (8), and Debug options (Don't change anything below unless you were asked for).

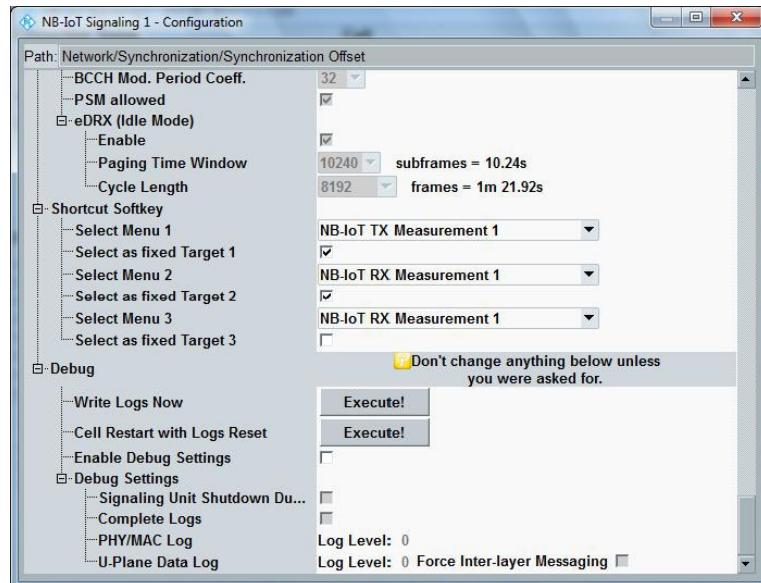


## 8.3 CMW500 Cat-NB1 3.75KHz Sub Carrier spacing Configuration



The image displays six windows from the Pinnacle™ 100 Modem configuration software:

- NB-IoT Signaling 1 - Configuration (Top Left):** Path: Network/Cell Reselection/S IntraSearch. Settings include P0 Nominal NPUSCH (-104 dBm), Pathloss Compensation Alpha (1.0), and various LTE parameters like LTE Bandwidth (10 MHz), LTE Control Region Size (1 OFDM Symbols), and LTE Frequency (DL: 895.7 MHz, UL: 850.7 MHz).
- NB-IoT Signaling 1 - Configuration (Top Right):** Path: Network/Cell Reselection/S IntraSearch. Shows NPRACH settings (No Response to Preambles Off, Power Ramping Step 2 dB) and NB-IoT Cell Identity (MCC 001, MNC 01, TAC 1, E-UTRAN Cell Identifier 0000 0000 0000 0001 0000 0000 bin).
- NB-IoT Signaling 1 - Configuration (Bottom Left):** Path: Network/Cell Reselection/S IntraSearch. Security settings (Authentication checked, SNOW3G (EIA1)), UE Identity (Default IMSI 00101012345603), and Timers (e.g., T3412 Extended 5 s, CMW Time 11/11/2011 11:11:00).
- NB-IoT Signaling 1 - Configuration (Bottom Middle):** Path: Network/Synchronization/Synchronization Offset. Synchronization settings (Synchronization Zone 1, Synchronization Offset 0 μs), Connection Type (Testmode), and UL RMC Scheduling (Subcarriers 3, Start Subcarrier: 0, Modulation: QPSK, Transport Block Size: 40).
- NB-IoT Signaling 1 - Configuration (Bottom Left):** Path: Network/Synchronization/Synchronization Offset. UL RMC Scheduling (Subcarriers 3, Start Subcarrier: 0, Modulation: QPSK, Transport Block Size: 88) and User-defined Scheduling (Alternating DL/UL pattern).
- NB-IoT Signaling 1 - Configuration (Bottom Right):** Path: Network/Synchronization/Synchronization Offset. NPDCCH settings (Max. Num. Repetitions Rmax 1, Rmax 8, Periodicity T 8 frames, SF Offset 2 frames), eDRX (Idle Mode) settings (Enable checked, Paging Time Window 10240 subframes = 10.24s, 8192 frames = 1m 21.92s), and a note: "Don't change anything below unless you were asked for."



## 8.4 at+ksleep

at+ksleep=0,2

- 0 – Sleep mode permission is driven by a HW signal (DTR).
- 2 – Hibernate

## 8.5 at+cpsms

at+cpsms=0

- at+cpsms=1,,,"10100001","00001010" (Enable,,,,"T3412","T3324")
- 0 – Disable the use of PSM
- 1 – Enable the use of PSM

### T3412 Timer

Bit							
8	7	6	5	4	3	2	1
Unit			Timer value				

\*Bits 5 to 1 represent the binary coded timer value and unit is coded by bits 8, 7, & 6 as below:

Bit			
8	7	6	
0	0	0	value is incremented in multiples of 10 minutes
0	0	1	value is incremented in multiples of 1 hour
0	1	0	value is incremented in multiples of 10 hours
0	1	1	value is incremented in multiples of 2 seconds
1	0	0	value is incremented in multiples of 30 seconds
1	0	1	value is incremented in multiples of 1 minute
1	1	0	value is incremented in multiples of 320 hours
1	1	1	value indicates that the timer is deactivated

T3412 = "10100001"  
101 = 1 min  
00001 = 1  
T3412 = 1 min x 1 = 1 min

### T3324 Timer

Bits 8, 7 & 6 represent the Time Increment Unit per Table

Bits 5 to 1 represent the binary coded timer value and unit is coded as below:

Bit			
8	7	6	
0	0	0	value is incremented in multiples of 2 seconds
0	0	1	value is incremented in multiples of 1 minute
0	1	0	value is incremented in multiples of 10 hours
1	1	1	value indicates that the timer is deactivated

T3324 = "00001010"  
000 = 2 sec  
01010 = 10  
T3324 = 2 sec x 10 = 20 sec

## 8.6 at+cedrxs

- at+cedrxs=0 (Disable)  
at+cedrxs=1,4,5 (Enable,Cat-M1,81.92 sec)  
at+cedrxs=1,5,5 (Enable,Cat-NB1,81.92 sec)



## 8.7 at+kbndcfg

at+kbndcfg=1,80000 (RAT,BAND)

- 0 – Radio Access Technology (Cat-M1)
- 1 – Radio Access Technology (Cat-NB1)
- 80000 – Band 20

If multiple bands are required, add the bit masks together, Ex: Bands 1 ,2, 3, & 4 => at+kbndcfg=0,f

0000 00000000 00000000	Not available
0000 00000000 00000001	LTE Band 1 (2000MHz)
0000 00000000 00000002	LTE Band 2 (1900MHz)
0000 00000000 00000004	LTE Band 3 (1800MHz)
0000 00000000 00000008	LTE Band 4 (1700MHz)
0000 00000000 00000010	LTE Band 5 (850MHz)
0000 00000000 00000080	LTE Band 8 (900MHz)
0000 00000000 00000100	LTE Band 9 (1900MHz)
0000 00000000 00000200	LTE Band 10 (2100MHz)
0000 00000000 00000800	LTE Band 12 (700MHz)
0000 00000000 00001000	LTE Band 13 (700MHz)
0000 00000000 00002000	LTE Band 14 (700MHz)
0000 00000000 00010000	LTE Band 17 (700MHz)
0000 00000000 00020000	LTE Band 18 (8000MHz)
0000 00000000 00040000	LTE Band 19 (800MHz)
0000 00000000 00080000	LTE Band 20 (800MHz)
0000 00000000 01000000	LTE Band 25 (1900MHz)
0000 00000000 02000000	LTE Band 26 (800MHz)
0000 00000000 04000000	LTE Band 27 (800MHz)
0000 00000000 08000000	LTE Band 28 (700MHz)
0002 00000000 00000000	LTE Band 66 (1800MHz)

## 8.8 Amarisoft Callbox mini MME configuration

To set T3412 on the Amarisoft callbox mini add the following TAU timer to the mme configuration (mme-ims.cfg)

/\* TAU update timer in secs \*/

t3412: 300, /\*Here T3412 is now set to 5 minutes\*/