

Upper bound Transmission Duty Factor Calculation for the PRS-950

Manufacturer: Sony Electronics
Type of device: Wireless eBook Reader
Model name: PRS-950
FCC ID: AK8PRS950

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Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>
A	July 14, 2010	Initial Issue
B	August 03, 2010	Fixed some typos
C	Sept. 02, 2010	Update UBTDF calculation based upon PRS-900 report with revision 1.3, issued on August 17. • Data rates used for GPRS/EDGE/WCDMA have been changed. • Download content percentage for eBooks and Periodicals categories have been changed • File size distribution percentage for each of category. • Event procedure has been updated based upon PRS-900 analysis.
D	Sept.03, 2010	Update Rev. C file based upon FCC review comments

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1. Executive Summary:

This document presents an analysis demonstrating that the Sony PRS-950 eReader (the “PRS-950”) qualifies for SAR test exclusion. It includes the calculation of an Upper Bound Transmission Duty Factor (“UBTDF”) for the PRS-950, based on FCC guidelines set forth in “Information requirements for FCC considerations of relevant upper bound transmission duty factors to qualify e-book devices/e-readers for SAR test exclusions,” dated January 7, 2010 and “RF Exposure procedure review: e-reader – estimating a conservative transmission duty factor” TCB council workshop presentation dated April 28, 2010. The max. data size limitation via 3G network is 10 MB via AT&T cellular network.

2. Product Overview:

PRS-950 is a hand-held content reader. Its relevant features are as follows:

- The PRS-950 allows an end user to browse, purchase and download books and periodicals from the Sony Reader Store via 3G or WiFi wireless data access. (Subject to service availability; 3G connection does not permit general internet browsing, but connects users to Sony’s proprietary Reader Store. Only WiFi connection can browse the internet).
- The wireless 3G data connection in the PRS-950 connects the end user to Sony’s proprietary Reader Store. It does not provide access to the public Internet generally, and does not, for example, permit Internet web browsing.
- WiFi and 3G radio will not transmit simultaneously.
- The PRS-950 allows an end user to read in either portrait or landscape format, using six adjustable font sizes.
- The PRS-950 features a 7” paper-like display and touch screen navigation.

3. Wireless Technology:

- The PRS-950 uses 3G wireless mobile broadband module manufactured by Qualcomm / Gobi 2000 (FCC ID: J9CGOBI2000, granted on Jan. 06, 2009) without voice communication capability. The wireless interface supports HSPA, UMTS, EDGE and GPRS data services.
- For WiFi connectivity, PRS-950 uses WiFi module / AR6102 (802.11 b/g) from Atheros Communications, Inc. 802.11 b/g module is used to connect WLAN to access the Sony eBook store.

4. Radio Protocols:

The PRS-950 supports following RF protocols:

1. GSM (850/1900 MHz)
GPRS (Class10)
EGPRS/EDGE (Class10)
2. UMTS / HSPA

- FDD BAND II (1900 MHz band)
- FDD BAND V (850 MHz band)
- 3. WiFi
 - 802.11 b (2.4 GHz band)
 - 802.11.g (2.4 GHz band)

WiFi is always the preferred radio access technology. PRS-950 will connect by WiFi before connection to the cellular network through any of the RF protocol it supports. If a supported WiFi WLAN is not found, PRS-950 will register and authenticate to the cellular network while continuing to search for WLAN access points at regular intervals. However, in no case will PRS-950 use more than one radio access technology at a time.

Of cellular protocols, HSPA represents the worst case for the purposes of calculating the UBTDF for the PRS-950, because HSPA requires continual transmission during the data download process. This “always-transmitting” mode is due in part to the use of HARQ or “Hybrid Automatic Repeat Request” and results in a source-based time averaging duty factor of 100%.

In summary, PRS-950 uses WiFi as the default means of connection and if WiFi are not available, it will use the cellular network.

5. Software Connection Manager:

When using a wireless connection the following priorities are used when content is required:

1. By WiFi, if a WLAN is available
2. By the cellular network if WiFi is not available.
3. Once the connection is made either via WLAN or 3G network, the software connection manager will apply to WiFi or 3G connectivity in the same way.

The software connection manager sequence of the PRS-950 in 3G network is as follows:

- The default mode of the PRS-950 wireless radio is OFF; user has to turn on the wireless function by switch on the wireless function.
- Once wireless function is turned on, PRS-950 will be seeking the connection to WLAN access; only if WLAN access is not available, PRS-950 will be seeking the connection to AT&T network.
- When the PRS-950 receives any of the following requests, 3G module is using the order of priority listed above in order to seek to wireless connection and prompts a download from the Sony eReader Store:
 1. A download request directly from the end user
 2. For subscribed content, where the end user has purchased a subscription to receive a new edition of periodical content on a daily, weekly or monthly basis, the Sony eReader Store server attaches a parameter to each edition of the downloaded content. This parameter designates the timing of the next download. The PRS-950 then activates the 3G module based on this parameter to access Sony eReader Store server and download the current edition.
- Following the completion of a download, and upon receipt of a command from the Sony eReader Store, the PRS-950 returns the 3G module to an IDLE state.

- After 10 minutes in the IDLE state without any further content requests, the PRS-950 switches OFF the 3G module off automatically.

6. Intended Use Cases:

PRS-950 uses its 3G network or WLAN access functionality to allow the user to use the Sony eReader Store as follows:

1. Browse and Search for content at Sony eReader Store.
 - The end-user may use the PRS-950 to access Sony eReader Store home page, which displays lists of available digital book content based on certain categories, such as bestsellers or new arrivals.
 - The user may also search for available digital book content by author or title.
2. Purchase and download the content from the Sony eReader Store.
 - After identifying a selection, the end user can view an overview of the content, information about the author of the content, user reviews of the content, and recommendations for additional content based on the title and the author of the selected content.
 - The end user may then select the content to buy on the store by following the purchase process and then will download the content to the device for reading.
3. Synchronize/Download previously purchased content from the Sony Reader Store to the PRS-950.
 - The end user may download content to a personal computer using the Reader Library PC software and then re-download the content to PRS-950 wirelessly via WiFi or 3G radio.
 - The end user may also transfer previously purchased content from a PC to the PRS-950 via USB cable.
 - The end user may also schedule the PRS-950 to download periodical content at pre-determined times.

The PRS-950 does not allow 3G wireless downloads of device software or firmware. The end user must perform any necessary software or firmware updates by downloading the update to a personal computer and then transferring the update to the PRS-950 or can be transferred via wireless LAN.

The PRS-950 is a data only device and does not support voice communications.

7. Data Rates

PRS-950 operates on the AT&T 3G Network in the USA and Puerto Rico and has no domestic or international roaming support. This SAR analysis is based on using this specific AT&T network configuration.

The AT&T 3G network allows the following data rates:

Data Protocol	Uplink	Downlink		
	Low-End Data Rate (kbps)	Low-End Data Rate (kbps)	High-End Data Rate (kbps)	Real-world Data Rate (kbps)
GPRS	9.05 (1 slot)	27	85.6 (4 slots)	35 (avg.)
EGPRS	10.6 (1 slot)	75	247.4 (4 slots)	75 – 135
WCDMA Rel. 99	128	220	384	220 – 320
HSDPA/HSUPA (HSPA)	500	700	7200	700 – 1700

In HSPA mode, where an uplink transmission occurs while downloading data, this analysis uses the lowest possible downlink data rate. For all other calculations, including those for WCDMA Rel. 99 and GPRS/EGPRS modes, this analysis uses the highest possible downlink data rate.

8. HSPA UBTDF

8.1. Worst Case operation

HSDPA requires the implementation of Hybrid Automatic Repeat Request (“HARQ”)¹ and Channel Quality Indicator (“CQI”)² functionality, both of which initiate uplink transmissions during the receipt of downloaded data. Therefore, the highest UBTDF for HSPA occurs when the download takes the longest time, which in turn occurs when the available downlink data rate is the lowest. The lowest downlink data rate for HSPA is 700 kbps. This data rate is the theoretically lowest downlink data rate. Real-world downlink data rates will be normally higher, resulting in a decrease in download duration.

8.2. Content categories

The available content in the bookstore is categorized according to sizes and types of content.

File size categories:

¹ HARQ requests data blocks that are not correctly received by the mobile device to be transmitted again.

² HSDPA also measures the downlink physical channel quality and transmits the CQI in the uplink control channel to the Node B. The Node B calculates, according to these values, the number of physical channels, the modulation scheme and the data rate.

The following size categories can be found in the book store:

- < 1 MB
- 1 – 1.5 MB
- 1.5 – 2 MB
- 2 – 5 MB
- 5 – 10 MB

Downloads of file sizes bigger than 10MB are not supported by the 3G wireless function of the eBook reader.

Content categories:

The contents are categorized in:

- Random content downloads (eBooks, short articles and on-demand news downloads)
- Periodicals (magazines and newspapers)

8.3. Upper bound transmission duration

For each file size category, it is possible to calculate the longest download time.

The transmission duration can be calculated according to the following formula:

$$\text{Upper bound transmission duration} = \frac{\text{File size}}{\text{upper bound data rate}}$$

Example: File Category 5 – 10 MB

$$\text{Upper bound transmission duration} = \frac{10 \text{ MB} \cdot 1024 \frac{\text{KB}}{\text{MB}} \cdot 8 \frac{\text{bit}}{\text{byte}}}{700\text{kbps}} = 117.03 \text{ seconds}$$

The following table lists the upper bound transmission duration of each file size category and the percentage of the total downloads for each file size category.

File size [MB]	Upper bound transmission duration [sec.]	Random content Downloads (%)	Periodicals Downloads (%)
< 1	11.70	72.38	69.57
1 – 1.5	17.55	6.53	21.74
1.5 – 2	23.41	4.95	4.35
2 – 5	58.51	11.37	4.35
5 – 10	117.03	4.77	0.00

The above numbers are based on assumptions for current as well as future distributions in the book store.

8.4. Weighted download duration (HSPA)

The average download time of each type of downloadable content is calculated as follows:

$$\text{Download duration} = \text{upper bound transmission duration} \cdot \% \text{ of total downloads}$$

Example: File Category 2-5 MB

$$\text{Download duration} = 58.51 \text{ seconds} \cdot 11.37 \% = 58.51 \text{ seconds} \cdot 0.1137 = 6.66 \text{ seconds}$$

The total average download duration of each type of content equals the sum of all download durations of all different file size categories.

File size [MB]	Upper bound transmission duration [sec.]	Random content downloads % of total downloads	Random content Download durations [sec.]	Periodicals % of total downloads	Periodicals Download durations [sec.]
< 1	11.70	72.38	8.47	69.57	8.14
1 – 1.5	17.55	6.53	1.15	21.74	3.82
1.5 – 2	23.41	4.95	1.16	4.35	1.02
2 – 5	58.51	11.37	6.66	4.35	2.55
5 – 10	117.03	4.77	5.59	0.00	0.00
Total:			23.03		15.53

Based on recorded values by Sony, the percentage of types of content downloaded are the following:

- Random content downloads: 55.09%
- Periodicals: 44.91%

These numbers were recorded directly in Sony's Reader Store. It is forecast that these numbers also will not have a noticeable change in the future. When multiplying these numbers with the download durations of the appropriate type of content, the result is the weighted download time per type of content:

$$\text{Weighted download time per type of content} = \text{download duration} \cdot \text{percentage of content}$$

Example: Random content downloads

$$\text{Weighted download time per type of content} = 23.03 \text{ sec} \cdot 0.5509 = 12.69 \text{ seconds}$$

The weighted download duration of all types of content is the sum of the different weighted download times.

Type of content	Average Download Duration [sec.]	Type of content (%)	Weighted Download Duration [sec.]
Random content downloads	23.03	55.09	12.69
Periodicals	15.53	44.91	6.98
Weighted download time			19.67

The weighted download time represents the average download duration regardless of its size or type.

8.5. Duration of Events - UBTDF calculation (HSPA)

Calculation of the UBTDF requires the definition of the various events that an end user follows when searching for and purchasing an random content downloads or periodical on the PRS-950.

The following table describes these events, and lists the duration of each event and the measured TX-ON time for each event. Both the measured TX-on times and event duration are conservative values that represent a worst-case condition.

<u>STEP</u>	<u>EVENT</u>	<u>Event Duration [sec.]</u>	<u>TX-ON Duration [sec.]</u>
1	Power up module and register on Network The wireless module is powered on and registers on the network.	29	9
2	Launch Store Application User presses the Store button the store menu appears on screen.	22	5
3	Review on Store Home menu User views the store home screen, checks the boxes for “Bestsellers” and “New Arrivals,” and reads the list of available titles.	61	0
4-1	Search for content (1) User presses the search button, enters an author’s name and presses enter. Device displays search results.	44	6
4-2	Review search results User sorts search results by title and reviews the list of available titles.	25	0
4-3	Select an item for purchase User selects an item for purchase.	11	6
4-4	Review search results User reads the following information: “Author”, “Reviews”, “Add info”, “You may also like” and “More by this author”.	164	0
5-1	Search for content (2) User presses the search button, enters an author’s name and presses enter. Device displays search results.	33	9
5-2	Review search results User sorts search results by title and reviews the list of available titles.	10	0
5-3	Select an item for purchase User selects an item for purchase.	9	9

5-4	Review search results User reads the following information: “Author”, “Reviews”, “Add info”, “You may also like”, “Recently viewed” and “More by this author”.	150	0
6-1	Purchase transaction User presses “buy now” and confirms.	20	10
6-2	Download content The selected content downloading to device.	28	20
6-3	Purchase completed User returns to the home menu by pressing the home button.	10	1
Total (sec.)		616	75
UBTDF		<u>12.18 %</u>	

The plots of the measurements can be found in the appendix of this document.

Some steps require an action from a user. The duration of these events is based on the duration that a person needs to complete these actions. These duration values are derived from user program testing and reflect conservative usage durations to ensure upper bounds limitations are being tested. The TX-ON times have been all measured except for the event “Download content”. For this event, the duration is calculated by adding (8) seconds* to the weighted download time calculated in a previous section (19.67 seconds).

** Eight (*) seconds are needed for the PDP (Packet Data Protocol) context to be finished.*

8.6. Maximum Average Conducted Output Power (HSPA)

According to the test report of the integrated radio module, the maximum average conducted output power values are the following:

Band V/ HSDPA

Mode	Sub-test	AVG Power (dBm)		
		Frequency(MHz)		
		826.4	826.4	826.4
		Channel		
		4132	4183	4233
HSDPA	1	23.84	23.81	23.71
	2	23.64	23.7	23.54
	3	23.07	23.21	23.08
	4	23.05	23.14	23.02

** Offset = 0.26dB*

Band II / HSDPA

Mode	Sub-test	AVG Power (dBm)		
		Frequency(MHz)		
		1852.4	1852.4	1852.4
		Channel		
		9262	9400	9538

HSDPA	1	23.65	23.69	23.10
	2	23.60	23.64	23.08
	3	23.27	23.16	22.82
	4	23.26	23.14	22.80

* Offset = 0.41dB

BAND V / HSUPA

Mode	Sub-test	AVG Power (dBm)		
		Frequency(MHz)		
		824.2	836.6	848.8
		Channel		
		4132	4183	4233
HSUPA	1	23.61	23.9	23.54
	2	22.14	22.52	22.18
	3	22.08	23.1	22.11
	4	21.91	22.56	21.83
	5	23.06	23.01	22.97

* Offset = 0.26dB

BAND II / HSUPA

Mode	Sub-test	AVG Power (dBm)		
		Frequency(MHz)		
		1852.4	1880	1907.6
		Channel		
		9262	9400	9538
HSUPA	1	23.66	23.61	23.31
	2	21.89	21.99	21.52
	3	22.71	22.82	22.56
	4	22.03	21.95	21.06
	5	23.01	23.08	23.08

* Offset = 0.41dB

The highest values (marked in bold in the table) are:

- 23.84 dBm for HSDPA Band V
- 23.69 dBm for HSDPA Band II

Note: Since PRS-950 is primary used for download, HSUPA is addressed as part of HSPA with HSDPA.

The average output power values can be calculated, considering the UBTDF, as follows:

$$\text{Correction factor [dBm]} = 10 \cdot \log(\text{UBTDF}) = 10 \cdot \log(0.1218) = -9.1 \text{ dBm}$$

Average output power values for HSDPA:

- HSDPA Band V: $23.84 \text{ dBm} - 9.1 \text{ dBm} = 14.74 \text{ dBm} = 29.79 \text{ mW}$
- HSDPA Band II: $23.69 \text{ dBm} - 9.1 \text{ dBm} = 14.59 \text{ dBm} = 28.33 \text{ mW}$

RF Low Power Threshold:

The RF low power threshold (in mW) is defined by FCC as $\frac{60}{f[\text{GHz}]}$:

- HSDPA Band V: $\frac{60}{f[\text{GHz}]} = \frac{60}{0.836 \text{ GHz}} = 71.77 \text{ mW} > 29.79 \text{ mW}$
- HSDPA Band II: $\frac{60}{f[\text{GHz}]} = \frac{60}{1.88 \text{ GHz}} = 31.91 \text{ mW} > 28.33 \text{ mW}$

Conclusion: Since the calculated average output power values are lower than the RF low power threshold, this device should qualify for SAR test exclusion.

9. GPRS/EGPRS UBTDF

9.1. Worst Case operation

Unlike HSPA, in this mode, there is no continuous uplink transmission while downloading data. Therefore, the worst case occurs when the download time is as short as possible and this happen with the highest downlink data rate.

As previously indicated, the highest possible downlink data rates for 2G are:

- 85.6 kbps for GPRS.
- 247.4 kbps for EGPRS.

9.2. Download duration (GPRS/EGPRS)

For the download duration calculation this time, a file size of 0.5 MB is used, since it represents the worst-case condition. The average file size that a user downloads will be normally higher.

The conservative download time for 2G operations is the following:

$$\text{Download duration (GPRS)[sec]} = \frac{0.5 \text{ MB} \cdot 1024 \frac{\text{KB}}{\text{MB}} \cdot 8 \frac{\text{bit}}{\text{byte}}}{85.6 \text{ kbps}} = 47.85 \text{ sec}$$

$$\text{Download duration (EGPRS)[sec]} = \frac{0.5 \text{ MB} \cdot 1024 \frac{\text{KB}}{\text{MB}} \cdot 8 \frac{\text{bit}}{\text{byte}}}{247.4 \text{ kbps}} = 16.55 \text{ sec}$$

9.3. Duration of Events - UBTDF calculation (GPRS/EGPRS)

The same events as for the HSPA case are indicated. All TX-ON times have been also measured for 2G operations. The values in the table below correspond to the longest transmitter on-time and shortest event duration expected for each event. The event duration and TX-ON times for both GPRS and EGPRS are similar for most events. The only difference between the two modes occurs in the download duration time, as calculated in the previous section.

STEP	EVENT	Event Duration [sec.]	TX-ON Duration [sec.]
1	Power up module and register on Network The wireless module is powered on and registers on the network.	29	4
2	Launch Store Application User presses the Store button the store menu appears on screen.	22	3
3	Review on Store Home menu User views the store home screen, checks the boxes for “Bestsellers” and “New Arrivals,” and reads the list of available titles.	61	0
4-1	Search for content (1) User presses the search button, enters an author’s name and presses enter. Device displays search results.	44	11
4-2	Review search results User sorts search results by title and reviews the list of available titles.	25	0

4-3	Select an item for purchase User selects an item for purchase.	11	8
4-4	Review search results User reads the following information: "Author", "Reviews", "Add info", "You may also like" and "More by this author".	164	0
5-1	Search for content (2) User presses the search button, enters an author's name and presses enter. Device displays search results.	33	12
5-2	Review search results User sorts search results by title and reviews the list of available titles.	10	0
5-3	Select an item for purchase User selects an item for purchase.	9	9
5-4	Review search results User reads the following information: "Author", "Reviews", "Add info", "You may also like", "Recently viewed" and "More by this author".	150	0
6-1	Purchase transaction User presses "buy now" and confirms.	20	10
6-2	Download content The selected content downloading to device.	47 for GPRS 16 for EGPRS	0
6-3	Purchase completed User returns to the home menu by pressing the home button.	10	1
Total (sec.)		635 (GPRS) 604 (EGPRS)	58
UBTDF		<u>9.14 % for GPRS</u> <u>9.61 % for EGPRS</u>	

The plots of these measurements can also be found in the Appendix of this document.

9.4. Maximum Average Conducted Output Power (GPRS/EGPRS)

Frequency (MHz)	CH	CLASS 8	
		GMSK Mode	
		AV Power (dBm)	Frame AV power (dBm)
824.2	128	31.69	22.66
836.6	190	31.58	22.55
848.8	251	31.28	22.25
1850.2	512	29.21	20.18
1880.0	661	29.04	20.01
1909.8	810	28.86	19.83

Frequency (MHz)	CH	CLASS 10	
		GMSK Mode	
		AV Power (dBm)	Frame AV power (dBm)

824.2	128	31.56	25.54
836.6	190	31.46	25.44
848.8	251	31.20	25.18
1850.2	512	29.16	23.14
1880.0	661	29.00	22.98
1909.8	810	28.82	22.80

Note: Farm AV Power = AV Power + 10Log(Uplink time slot / 8)

Class 8 Frame AV Power = AV Power – 9.03 dB, Class 10 Frame AV Power = AV Power- 6.02dB

Frequency (MHz)	CH	Class 8	
		8-PSK Mode	
		AV Power (dBm)	Frame AV power (dBm)
824.2	128	27.54	18.51
836.6	190	27.46	18.43
848.8	251	27.24	18.21
1850.2	512	26.16	17.13
1880.0	661	26.04	17.01
1909.8	810	25.96	16.93

Frequency (MHz)	CH	Class 10	
		8-PSK Mode	
		AV Power (dBm)	Frame AV power (dBm)
824.2	128	27.48	21.46
836.6	190	27.42	21.40
848.8	251	27.19	21.17
1850.2	512	26.08	20.06
1880.0	661	25.98	19.96
1909.8	810	25.94	19.92

Note : Farm AV Power = AV Power + 10Log(Uplink time slot / 8)

Class 8 Frame AV Power = AV Power – 9.03 dB, Class 10 Frame AV Power = AV Power- 6.02dB

The average output power values can be calculated, considering the UBTDF, as follows:

$$\text{Correction factor [dBm]}(\text{GPRS}) = 10 \cdot \log(\text{UBTDF}) = 10 \cdot \log(0.0914) = -10.39 \text{ dBm}$$

$$\text{Correction factor [dBm]}(\text{EGPRS}) = 10 \cdot \log(\text{UBTDF}) = 10 \cdot \log(0.0961) = -10.17 \text{ dBm}$$

Average output power values (GPRS/EGPRS):

- GPRS 850 MHz: 25.54 dBm – 10.39 dBm = 15.15 dBm = 32.73 mW
- GPRS 1900 MHz: 23.14 dBm – 10.39 dBm = 12.75 dBm = 18.84 mW
- EGPRS 850 MHz: 21.46 dBm – 10.17 dBm = 11.29 dBm = 13.46 mW
- EGPRS 1900 MHz: 20.06 dBm – 10.17 dBm = 9.89 dBm = 9.75 mW

RF Low Power Threshold:

The RF low power threshold (in mW) is defined by FCC as $\frac{60}{f[\text{GHz}]}$:

$$\text{GPRS/EGPRS 850 MHz: } \frac{60}{f[\text{GHz}]} = \frac{60}{0.836 \text{ GHz}} = \mathbf{71.77 \text{ mW}} > \mathbf{32.73 \text{ mW and } 13.46 \text{ mW}}$$

$$\text{GPRS/EGPRS 1900 MHz: } \frac{60}{f[\text{GHz}]} = \frac{60}{1.88 \text{ GHz}} = \mathbf{31.91 \text{ mW}} > \mathbf{18.84 \text{ mW and } 9.75 \text{ mW}}$$

Conclusion: Since the calculated average output power values are lower than the RF low power threshold, this device should qualify for SAR test exclusion.

10. W-CDMA Rel. 99 UBTDF

10.1. Worst Case operation

As in the case of 2G operations, there is no continuous transmission when downloading data. Therefore, the worst case for WCDMA Release 99 is also when the download time is as short as possible and the downlink data rate as high as possible. The highest possible downlink data rate for WCDMA Release 99 is 384 kbps.

10.2. Download duration (W-CDMA Rel. 99)

For the download duration calculation this time, a file size of 0.5 MB is used, since it represents a worst-case condition. The average file size that a user downloads will be normally higher. The conservative download time for 2G operations is the following:

$$\text{Download duration [sec]} = \frac{\text{File size}}{\text{data rate}}$$
$$\text{Download duration [sec]} = \frac{0.5 \text{ MB} \cdot 1024 \frac{\text{KB}}{\text{MB}} \cdot 8 \frac{\text{bit}}{\text{byte}}}{384 \text{ kbps}} = 10.66 \text{ sec}$$

10.3. Duration of Events - UBTDF calculation (W-CDMA Rel. 99)

The same events as for the previous cases are indicated. All TX-ON times have been also measured.

<u>STEP</u>	<u>EVENT</u>	<u>Event Duration [sec.]</u>	<u>TX-ON Duration [sec.]</u>
1	Power up module and register on Network The wireless module is powered on and registers on the network.	29	4
2	Launch Store Application User presses the Store button the store menu appears on screen.	22	3
3	Review on Store Home menu User views the store home screen, checks the boxes for "Bestsellers" and "New Arrivals," and reads the list of available titles.	61	0
4-1	Search for content (1) User presses the search button, enters an author's name and presses enter. Device displays search results.	44	11
4-2	Review search results User sorts search results by title and reviews the list of available titles.	25	0
4-3	Select an item for purchase User selects an item for purchase.	11	8
4-4	Review search results User reads the following information: "Author", "Reviews", "Add info", "You may also like" and "More by this author".	164	0

5-1	Search for content (2) User presses the search button, enters an author's name and presses enter. Device displays search results.	33	12
5-2	Review search results User sorts search results by title and reviews the list of available titles.	10	0
5-3	Select an item for purchase User selects an item for purchase.	9	9
5-4	Review search results User reads the following information: "Author", "Reviews", "Add info", "You may also like", "Recently viewed" and "More by this author".	150	0
6-1	Purchase transaction User presses "buy now" and confirms.	20	10
6-2	Download content The selected content downloading to device.	10	0
6-3	Purchase completed User returns to the home menu by pressing the home button.	10	1
Total		598	58
UBTDF		<u>9.70 %</u>	

10.4. Maximum Average Conducted Output Power (W-CDMA Rel. 99)

The maximum average conducted output power values for WCDMA Release 99 are taken directly from the integrated module's test report:

EUT Mode	Frequency (MHz)	CH	Avg. Power (dBm)
WCDMA Band II	1852.4	9262	23.67
	1880.0	9400	23.71
	1907.6	9538	23.36

* Offset = 0.26dB

EUT Mode	Frequency (MHz)	CH	Avg. Power (dBm)
WCDMA Band V	826.4	4132	23.94
	836.6	4183	24.09
	846.6	4233	23.84

*Offset = 0.41dB

The highest output power values are marked bold in this table.

The average output power values can be calculated, considering the UBTDF, as follows:

$$\text{Correction factor [dBm]} = 10 \cdot \log(\text{UBTDF}) = 10 \cdot \log(0.0970) = -10.13 \text{ dBm}$$

Average output power values (W-CDMA Rel. 99):

- WCDMA Band V: $24.09 \text{ dBm} - 10.13 \text{ dBm} = 13.96 \text{ dBm} = 24.89 \text{ mW}$
- WCDMA Band II: $23.71 \text{ dBm} - 10.13 \text{ dBm} = 13.58 \text{ dBm} = 22.8 \text{ mW}$

RF Low Power Threshold:

The RF low power threshold (in mW) is defined by FCC as $\frac{60}{f[\text{GHz}]}$:

$$\text{WCDMA Band V: } \frac{60}{f[\text{GHz}]} = \frac{60}{0.836 \text{ GHz}} = 71.77 \text{ mW} > 24.89 \text{ mW}$$

$$\text{WCDMA Band II: } \frac{60}{f[\text{GHz}]} = \frac{60}{1.88 \text{ GHz}} = 31.91 \text{ mW} > 22.8 \text{ mW}$$

Conclusion: Since the calculated average output power values are lower than the RF low power threshold, this device should qualify for SAR test exclusion.

11. WLAN Analysis

11.1. RF conducted output power / WLAN

802.11b data rate 1Mbps

Cable loss = 0		Output power	
CH	Frequency (MHz)	AV power(dBm)	AV power (mW)
1	2412	11	12.59
6	2437	11.91	15.52
11	2462	11.85	15.31

*Offset = 0.50dB

802.11g data rate 6Mbps

Cable loss = 0		Output power	
CH	Frequency (MHz)	AV power(dBm)	AV power (mW)
1	2412	10.92	12.36
6	2437	11.65	14.62
11	2462	11.85	15.31

*Offset = 0.50dB

11.2. RF Exposure output power

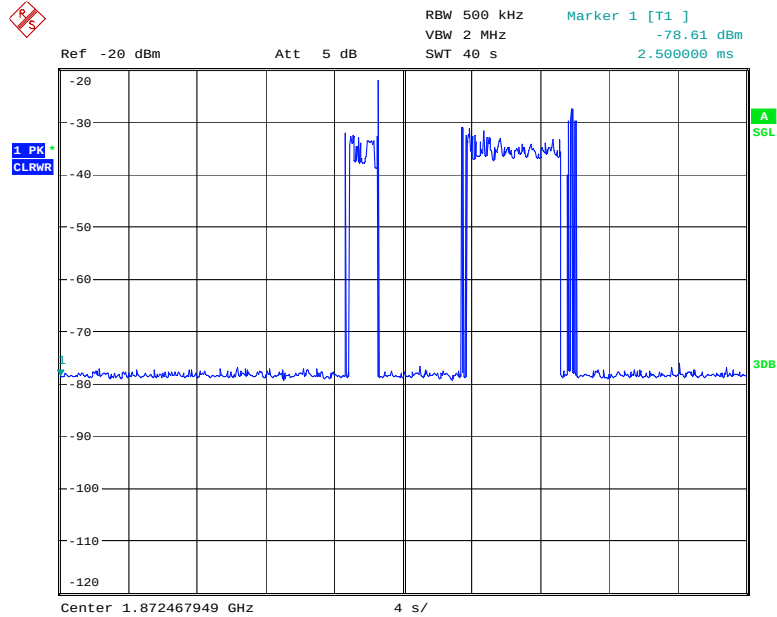
RF Exposure Low Power Threshold ($60/f(\text{GHz})$)

Frequency Band	$60/f(\text{GHz})$ f(GHz)= middle frequency in GHz	Low Power Threshold
WLAN/2.4 GHz/25.247	60/2.437	24.62 mW
Conclusion	Measured average output power is below RF Exposure Low Power Threshold. SAR analysis is not required.	

Appendix (Measurement Plots)

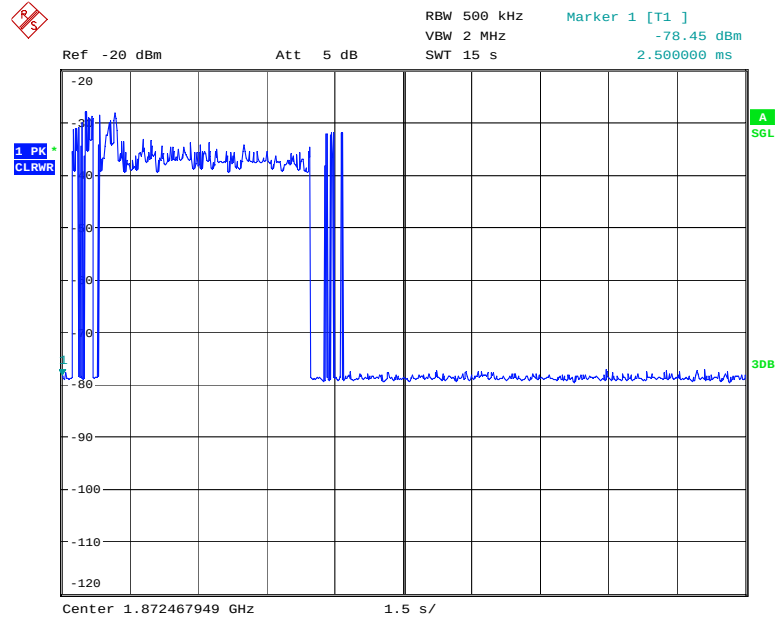
1. HSPA Plots:

Step 1: Power up module and register on network (HSPA)
TX-ON duration = 9 sec



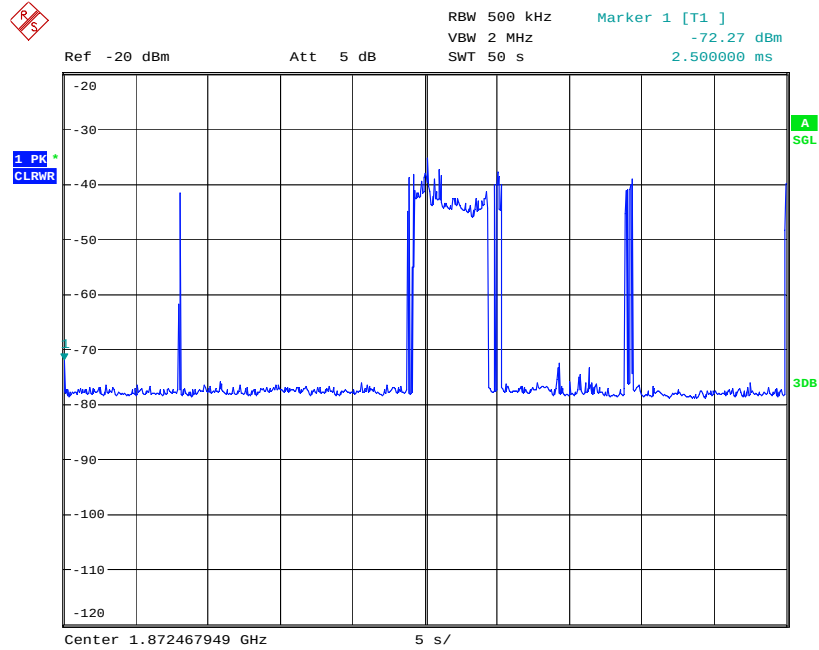
Date: 8.APR.2010 10:34:00

Step 2: Launch Store Application (HSPA)
TX-ON duration = 5 sec



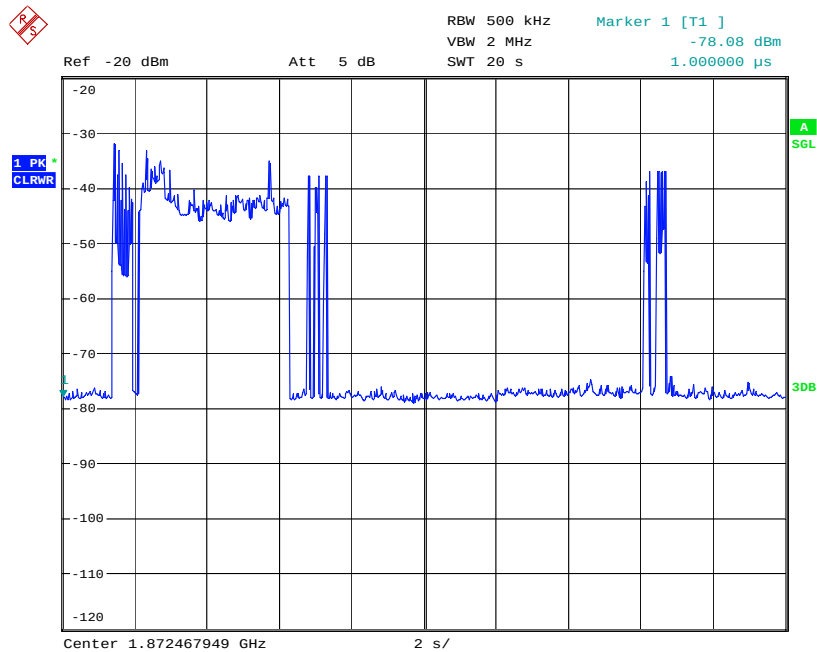
Date: 8.APR.2010 10:36:57

Step 4-1: Search for Content (1) (HSPA)
TX-ON duration = 6 sec



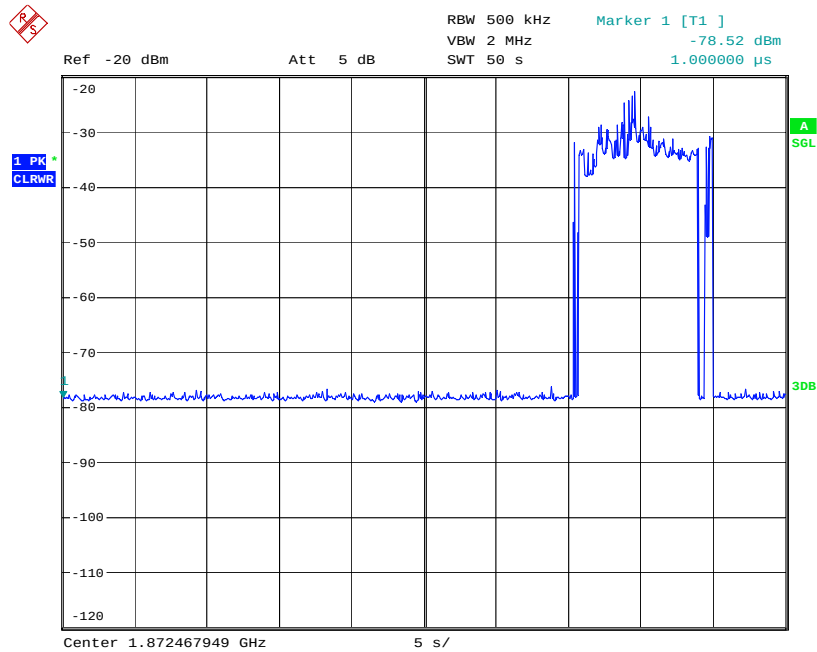
Date: 8.APR.2010 10:44:25

Step 4-3: Select an item for purchase (HSPA)
TX-ON duration = 6 sec



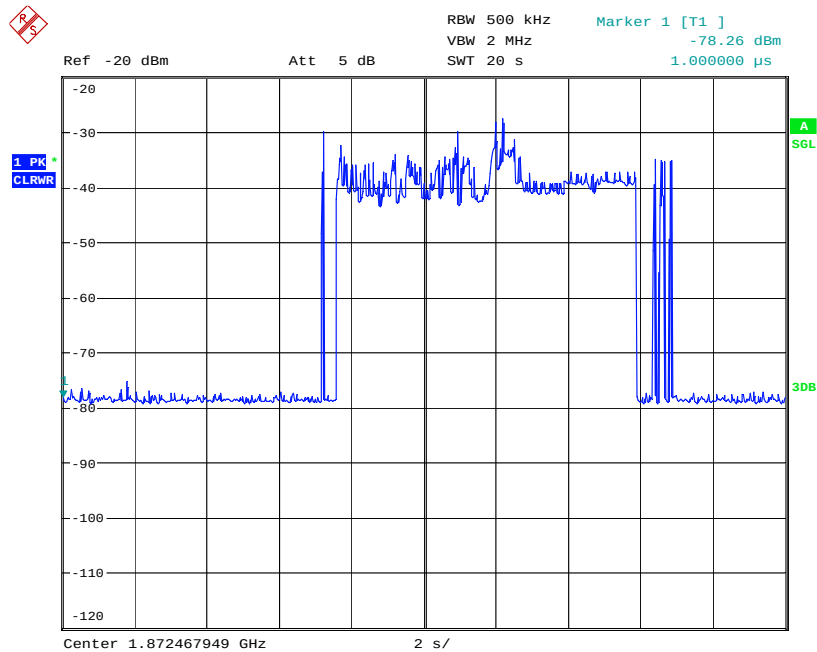
Date: 8.APR.2010 10:51:55

Step 5-1: Search for content (2) (HSPA)
TX-ON duration = 9 sec



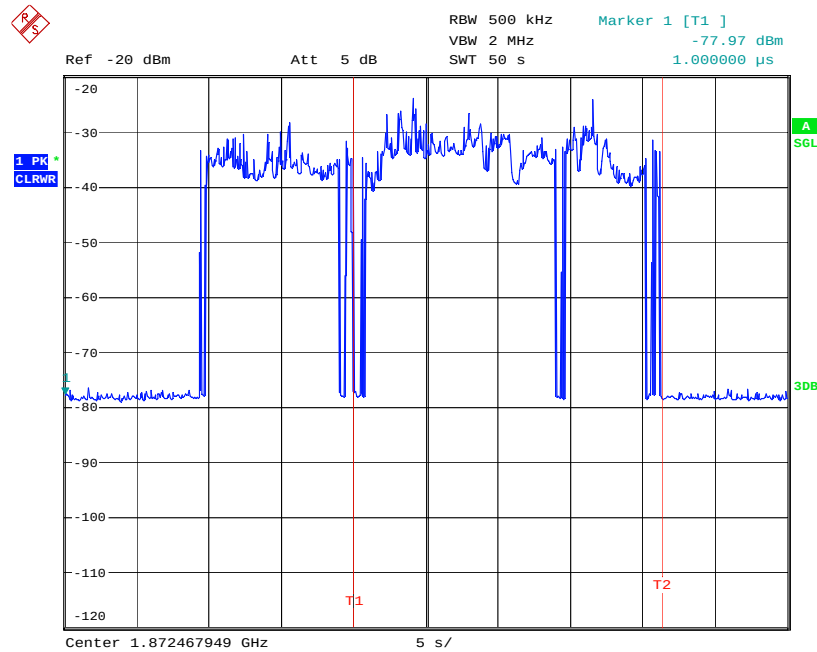
Date: 8.APR.2010 10:57:44

Step 5-3: Select an item for purchase (HSPA)
TX-ON duration = 9 sec



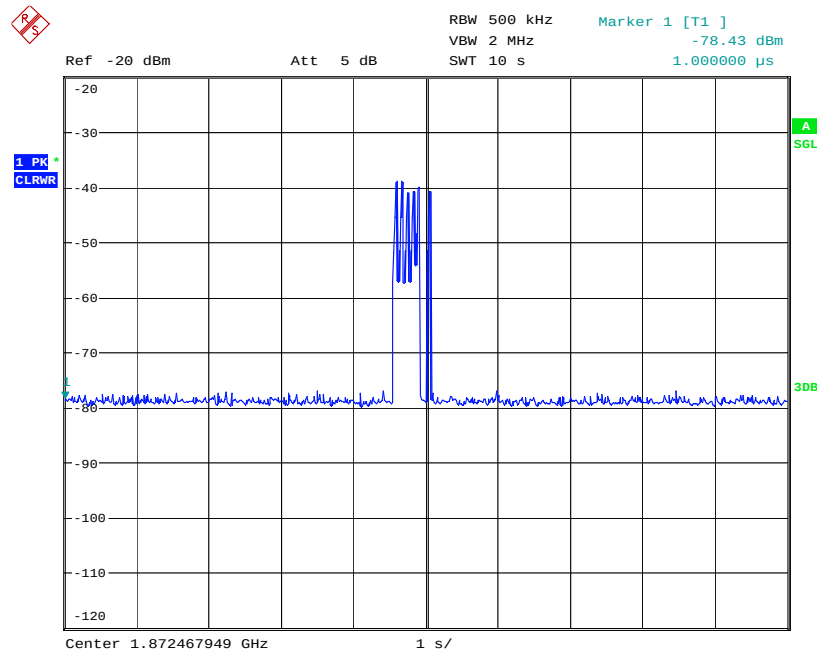
Date: 8.APR.2010 11:00:48

Step 6-1: Purchase transaction (HSPA) (before first red line)
TX-ON duration = 10 sec



Date: 8.APR.2010 11:08:55

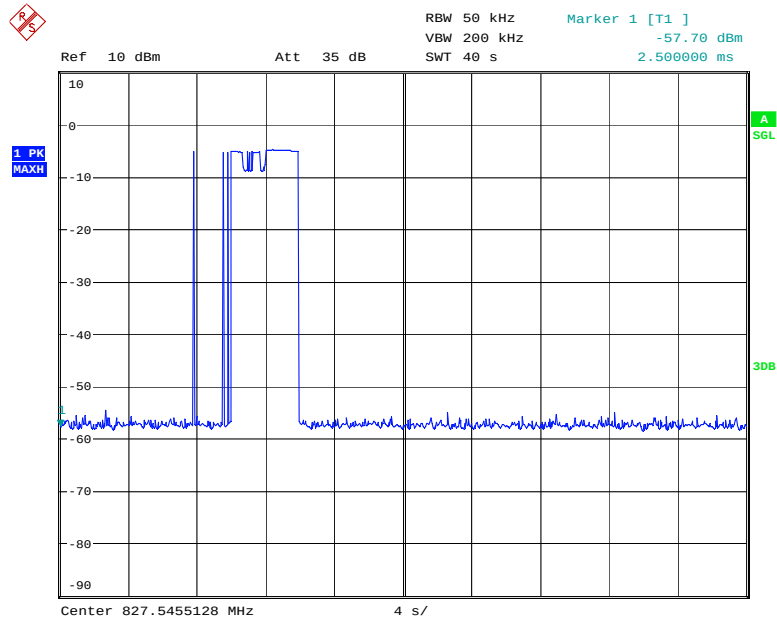
Step 6-3: Purchase completed (HSPA)
TX-ON duration = 1 sec



Date: 8.APR.2010 11:14:40

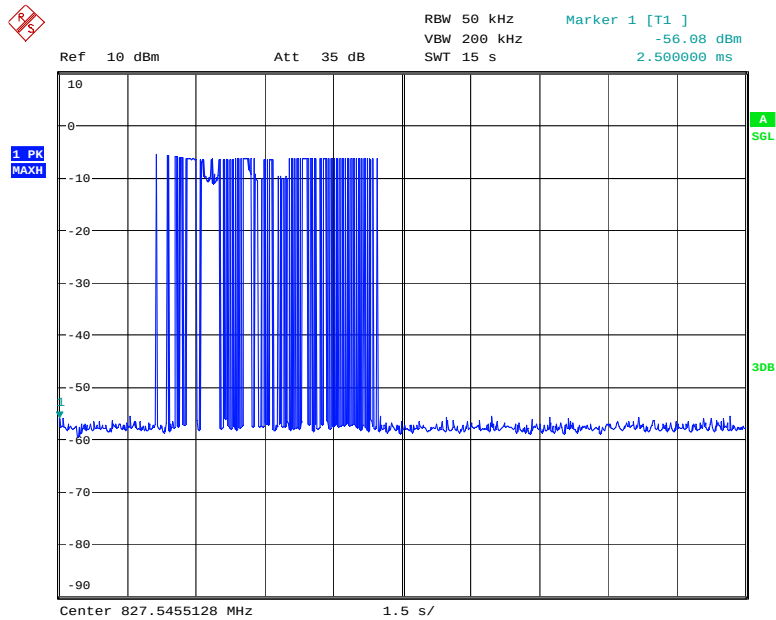
2. 2G Plots:

Step 1: Power up module and register on network (2G) TX-ON duration = 4 sec



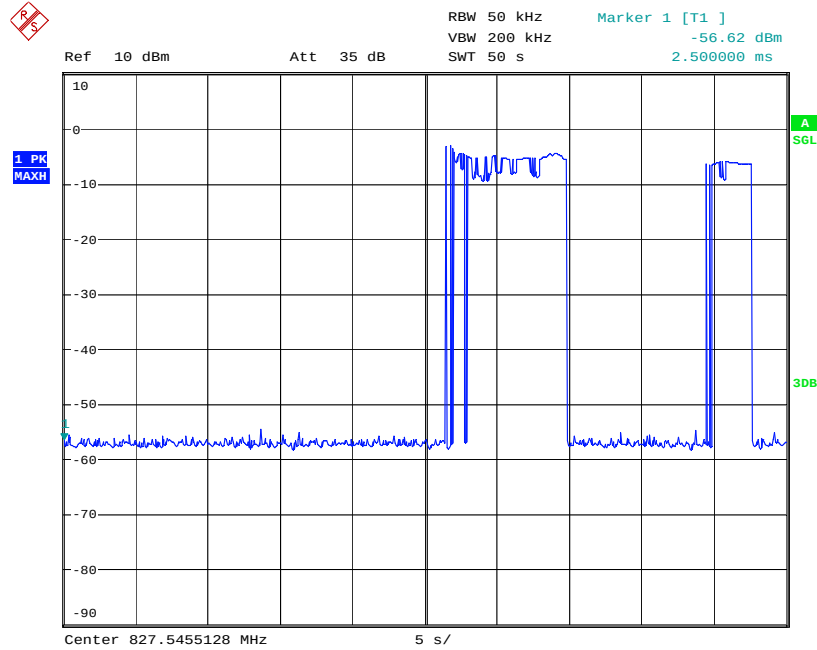
Date: 8.APR.2010 11:32:06

Step 2: Launch store application (2G) TX-ON duration = 3 sec



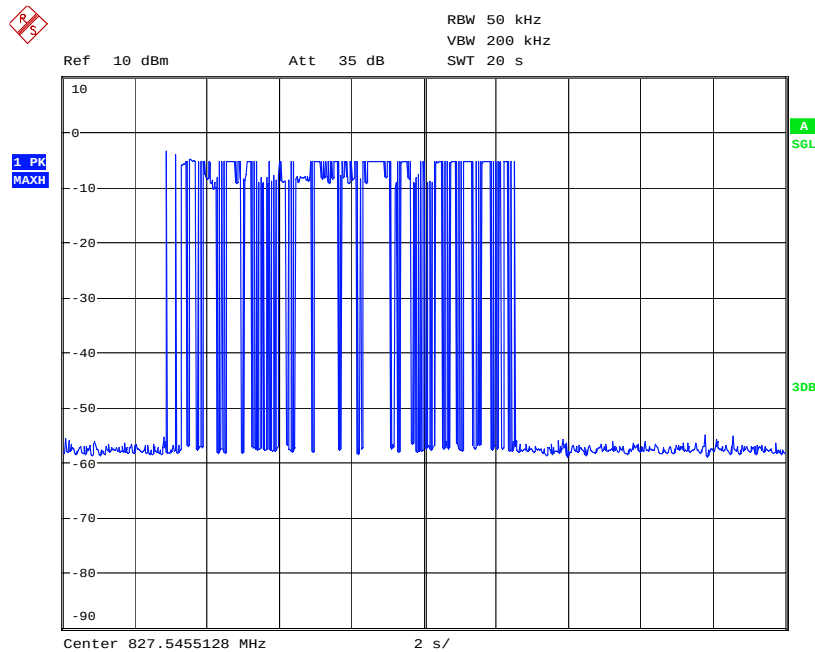
Date: 8.APR.2010 11:33:08

Step 4-1: Search for content (I) (2G)
TX-ON duration = 11 sec



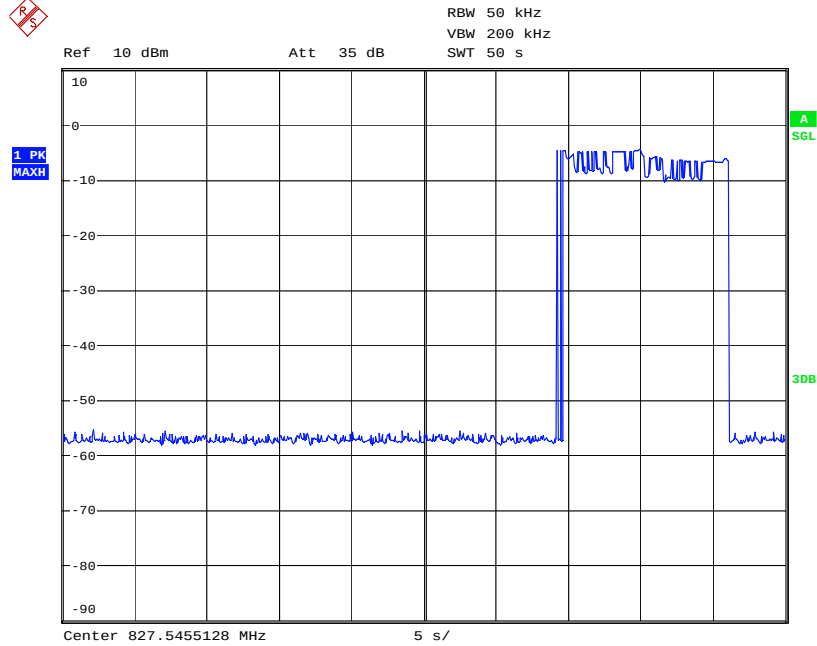
Date: 8.APR.2010 11:36:47

Step 4-3: Select an item for purchase (2G)
TX-ON duration = 8 sec



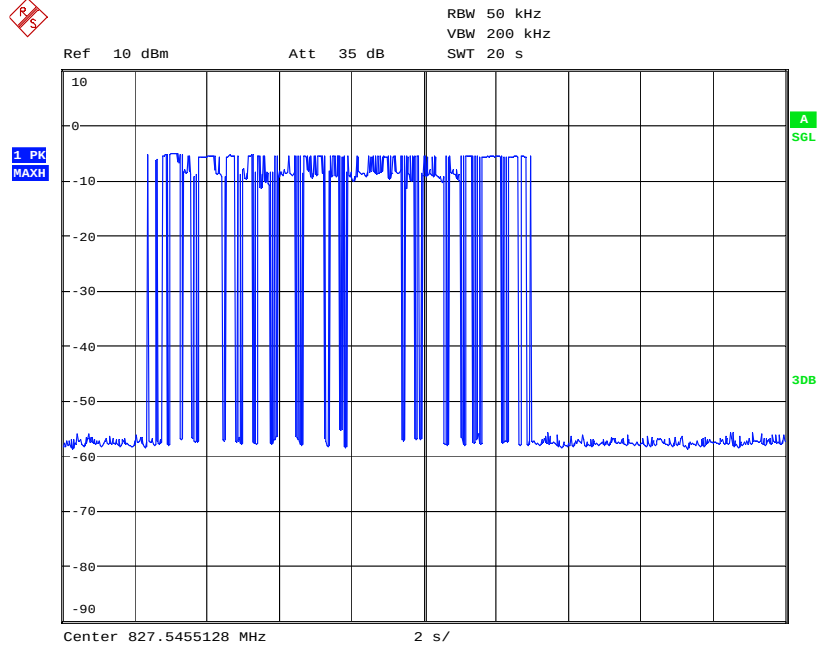
Date: 8.APR.2010 11:43:34

Step 5-1: Search for content (2) (2G)
TX-ON duration = 12 sec



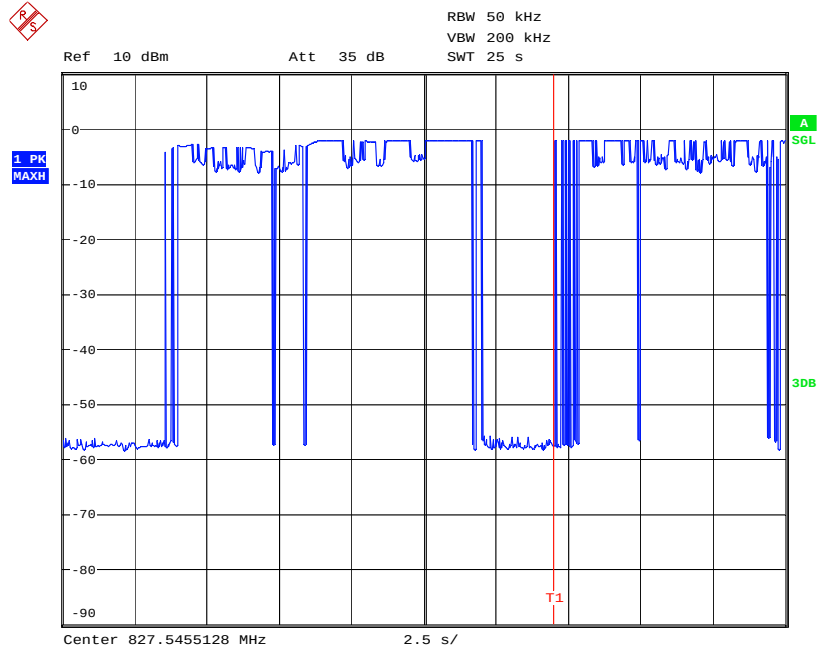
Date: 8.APR.2010 11:49:08

Step 5-3: Select an item for purchase (2G)
TX-ON duration = 9 sec



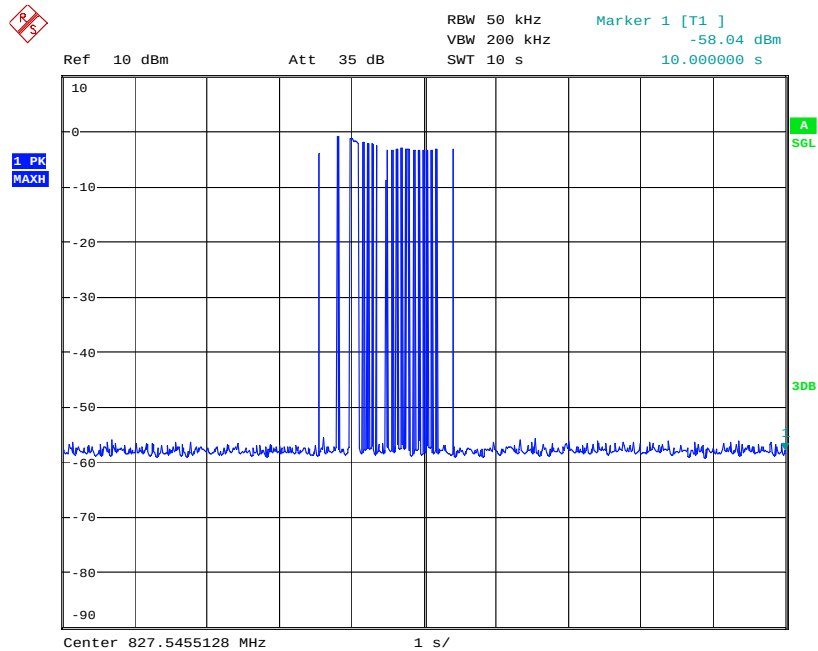
Date: 8.APR.2010 11:54:49

Step 6-1: Purchase transaction (2G) (before red line)
TX-ON duration = 10 sec



Date: 8.APR.2010 12:14:00

Step 6-3: Purchase completed (2G)
TX-ON duration = 1 sec



Date: 8.APR.2010 12:18:23