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# APPLICATION NOTE

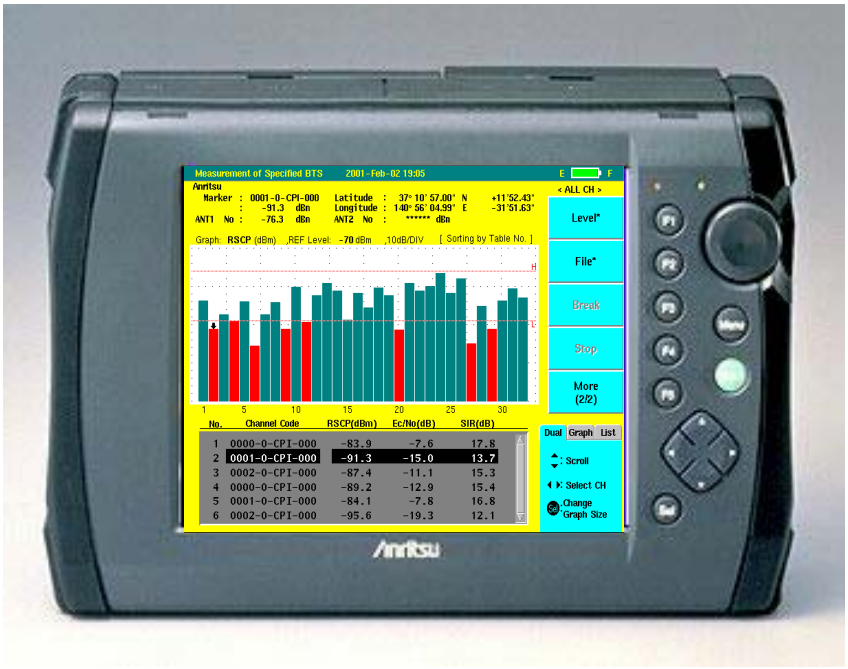
# ML8720B

## W-CDMA Area Tester

ANRITSU CORPORATION

# Application Note

# How to use the ML8720B W-CDMA Area Tester to optimize your cell planning network ?




**Product Marketing Dept.**
**Wireless Measurement Div.,**
**Measurement Business Center,**
**ANRITSU Co.**

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The main purpose of this document is to detail how the ML8720B should be used during a drive test to optimize correctly the cell planning of the network according to the experience of ANRITSU as a W-CDMA test intruments manufacturer.

## ML8720B Product Concept

ML8720B is a WCDMA scanner for 'area test' applications

- downlink (2100-2200 MHz)
- measures network coverage through measurement of UMTS pilot channels
  - CPICH and SCH channels
  - RSCP, Ec/No, SIR (Signal/Interference) measurements
- portable and rugged
  - includes control/recording PC and LCD display
  - easy to use menu system
  - battery operated
- directly connects to GPS for location reporting
  - can also use external trigger for measurement trigger on vehicle drive test survey

## ML8720B Product Features

High performance scanner for drive test systems :

- very good sensitivity (-117 dBm WCDMA measurement capability)
- 'true' RAKE receiver (1 - 6 fingers), 1.5 chip resolution
- dual scanner supports antenna diversity (*3GPP TS 25.215 v4.2.0 § 5.1.1)*

Key features for drive test systems :

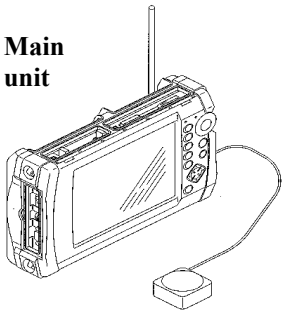
- higher sensitivity to record coverage of Node B when UE looses signals
- true RAKE receiver and antenna diversity captures real primary signal cell coverage, multipath and handover environment

## ML8720B Measurements

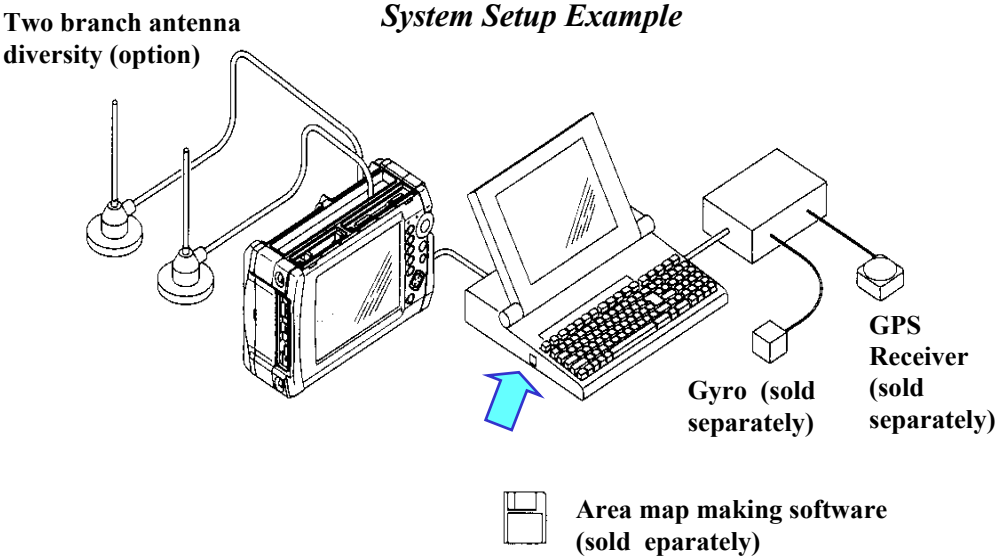
- Frequency range : 2110 to 2200MHz
- Receive signals :
  - CPICH (Common Pilot Channel)
    - measurement Items: RSCP, Ec/No, SIR.
  - P-SCH + S-SCH (Primary and Secondary Synchronization Channels)
    - fast cell search
- Measurement modes:
  - Specified BTS,
  - Unspecified BTS,
  - Spectrum monitor,
- 32 Measurement channels Measurement Display: All channel, Delay profile, Finger, Time variation

## ML8720B Typical Configuration

***Most compact configuration***



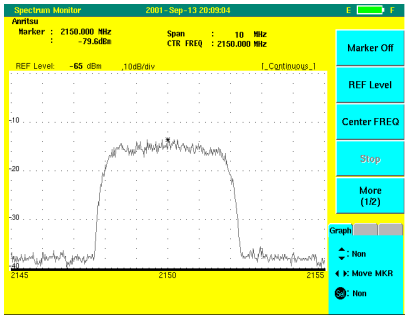

***System Setup Example***



# Measurement Items

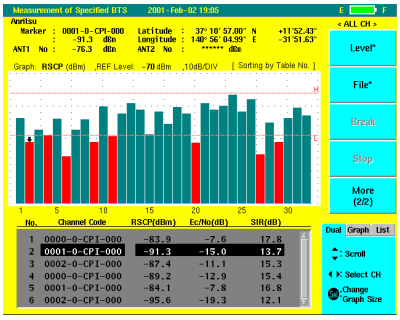
## *Spectrum Monitor*

This screen used to visually confirm the in-band wave. A frequency span of either 4, 10 or 90MHz can be selected.



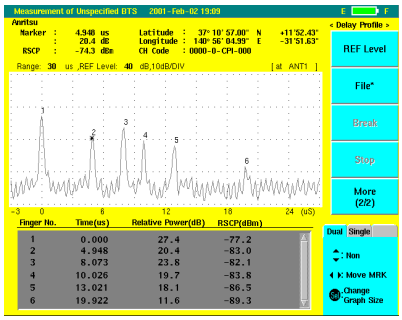

## *Channel Display*

The measurement results for all the receive channels (32 max.) can be displayed simultaneously as a graph and data. Additionally, it is possible to select the cumulative processing (max., min., median, average) for the internally accumulated data and the measurement interval setting.



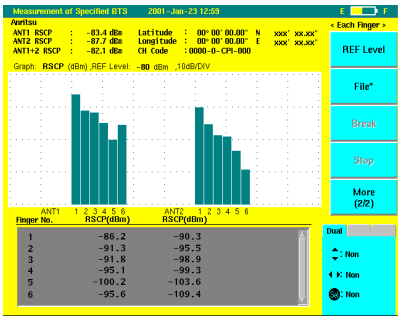

## *Delay Profile Display*

This displays the delay profile for the selected channel and the multi path can be confirmed visually. In addition, time or distance range can be selected for the horizontal axis.



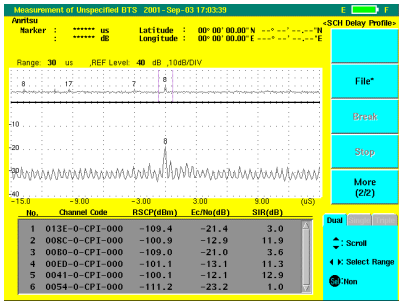

## *Finger Display*

This displays the measured results for each selected channel path (finger). When the diversity option is installed, the RSCP for up to 12 paths can be evaluated simultaneously.



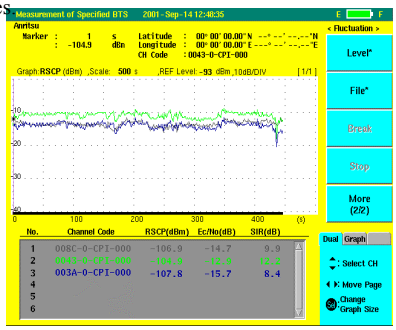

## *Unspecified BTS SCH Delay Profile*

This displays the relative delay status between each base station with correlative value of P-SCH. This screen is used to confirm frame transmission timing gap or overlap between base stations. Group No. is displayed on the graph to recognize base stations.




## *Specified BTS Fluctuation*

This displays the time fluctuation of the measured value for the the selected channel (max = 6 BTS at a time).
The time variation can be measured in 10ms intervals for 10ms to 500s. The distance variation can be measured with the speed pulse (external trigger) from 1 to 500 pulses.

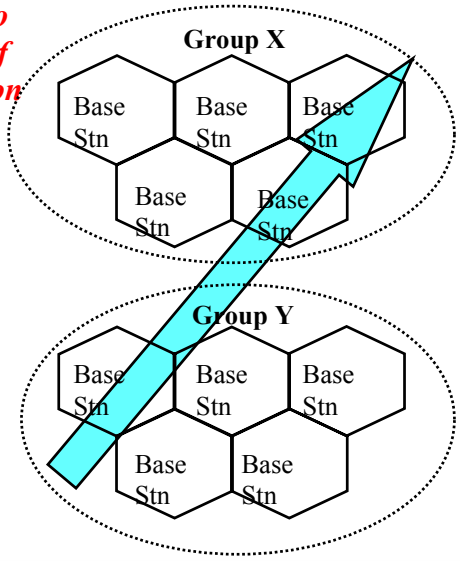


# ML8720B Example applications

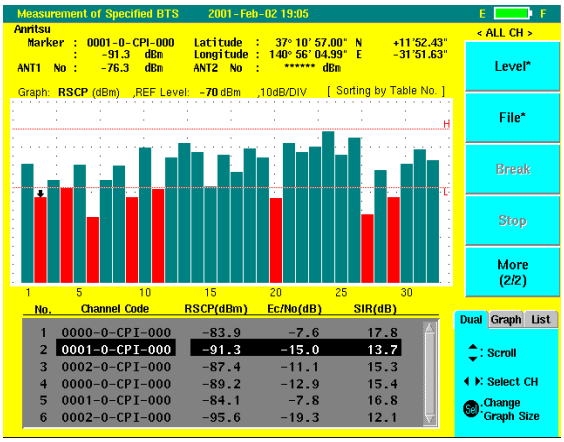
## First Step : *Cell Planning*

Use of **1 FINGER** only to capture the main biggest RSCP CPICH of every transmitting W-CDMA BTS.

***RSCP and Ec/No Measurements of Each Base Station***



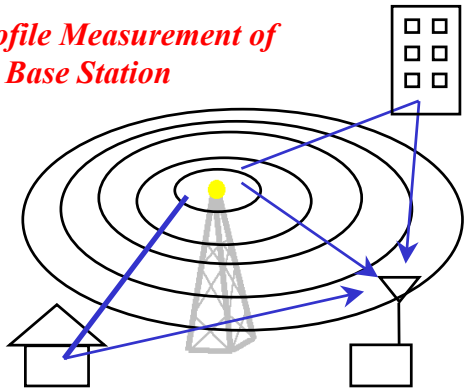

**RSCP**
**Ec/No**



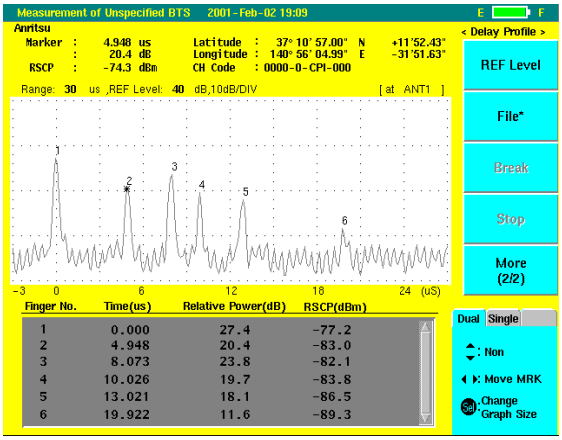

## First Step : *Cell Maintenance*

Use of 1 up to **6 FINGERS** to verify the effects of multipaths during the drive test in the cell.

***Delay Profile Measurement of Specified Base Station***

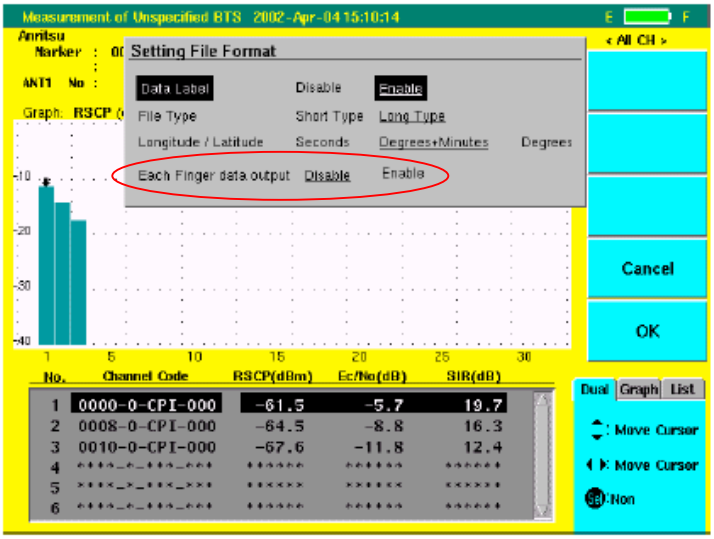


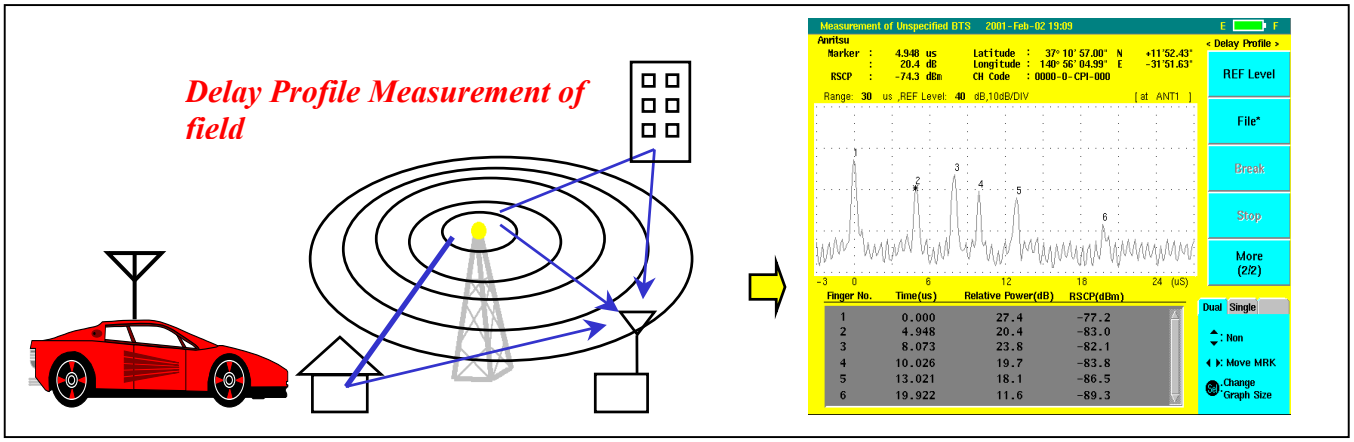
**Level**

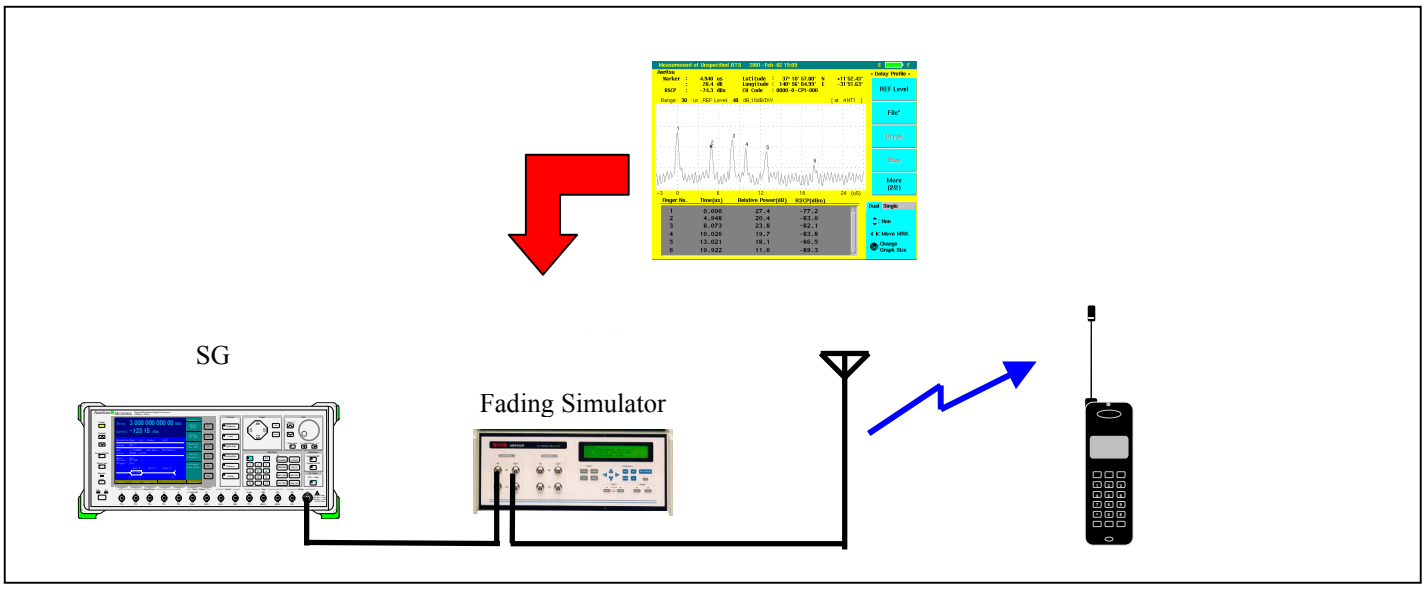


## First Step : *Evalustion of UE*

Multi-path environment in field is acquired by Each Finger Output function of ML8720B.
Then, based on acquired data, Fading Simulator reproduces multi-path environment of the field in laboratory.
UE is evaluated in the laboratory.



# Explanation of Transmit diversity

**1) About transmit diversity system**

Several systems are considered and adopted for transmit diversity.

- TSTD (Time Switched Transmit Diversity)
  The method to switch the antenna per slot
- STTD (Space Time Block Coding Based Transmit Antenna Diversity)
  The method to control the symbol pattern on ANT2 side (highlight the code partially) [refer to Figure1], enabling the combination of signal from two antennas.

Original symbol sequence

| S(1) | S(2) | S(3) | S(4) |
|---|---|---|---|

1 symbol

Transmit symbol sequences after STTD

Antenna 1

| S(1) | S(2) | S(3) | S(4) | • • • • |
|---|---|---|---|---|

Antenna 2

| -S(1) | S(2) | -S(3) | S(4) | • • • • |
|---|---|---|---|---|

* The ML8720B supports STTD.

**2) Description of operating outline for (transmit/receive) diversity in ML8720B W-CDMA Area Tester**

**Operating outline of transmit diversity**

In receiving transmit diversity signal, the signal is inputted only from ANT1 INPUT shown in Figure2.
Inputted received signal is branched via RF1 and IF1, then transmitted to the correlation/RAKE/combination section of each unit. (The signal is distributed to optional unit via route (1) of Figure2)
In correlation/RAKE/combination section of each unit, despreading is performed with each code corresponding to transmit diversity, then CPICH_RSCP and others are separately measured on ANT1 and ANT2 sides of base stations.
Measurement result includes each value measured on both ANT1 and ANT2 sides and composite value of ANT1 side + ANT2 side.

**Operation outline of receive diversity**

In performing receive diversity, the signal is inputted to ANT1 INPUT and ANT2 INPUT shown in Figure1.
Each inputted received signal is transmitted to correlation/RAKE/combination section via each RF and IF.
(The signal on optional unit side is transmitted via route (2) of Figure1.)
In correlation/RAKE/combination section of each unit, despreading is performed with the same code, then CPICH_RSCP and others per receive antenna are separately measured.
Measured result includes each value measured on both ANT1 and ANT2 sides and composite value of ANT1 side + ANT2 side.

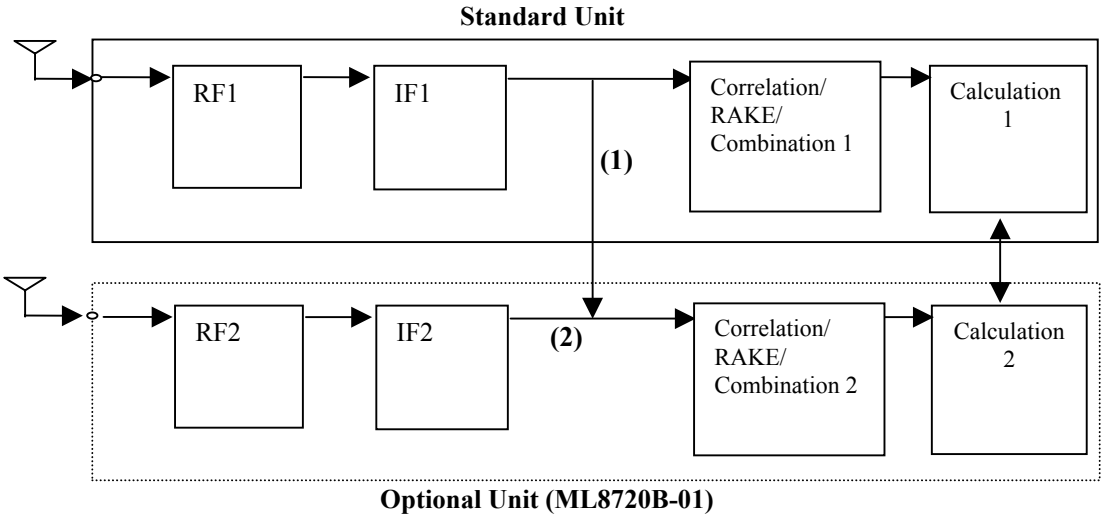



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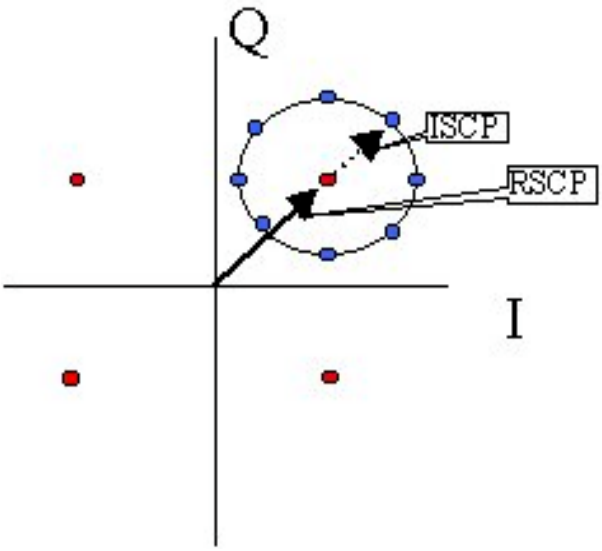
Figure2: Block Chart

**3) Bugs caused by inability of transmit diversity analysis**

The ML8720B is able to perform measurement by separating the signal from ANT1 and ANT2.
(ML8720B is able to measure the power of ANT1 and ANT2.)
The bugs as in below example are caused by inability of transmit diversity analysis.
e.g.) The transmission has failed because of defective ANT2.
In this case, it is almost impossible to find out the defects of ANT2.

# Explanation of SIR

- SIR:Signal-to-Interference Ratio
- SIR=RSCP/ISCP
- ISCP=Interference Signal Code Power
  Given only interference is received, the average power of the receive signal after despreading and combining.
  Equivalent to the RSCP value but now only interference is received instead of signal




The difference between SIR and Ec/No

**SIR**=RSCP/ISCP : The ratio of wanted signal to interfering signal
SIR is the ratio of specified cell to other cells (interfering signal).

Ec/No : Ec=RSCP, No=RSSI (total receive power)
"No" includes the power of specified cell as it indicates total receive power. For instance, DPCH power increases when the traffic is heavy during service. As a result, Ec/No is deteriorated by increasing No.

Conclusion
SIR measures the ratio of wanted signal of specified cell (P-CPICH) to interfering signal of other cells without the influence of traffic amount.

# Drive Test Issues

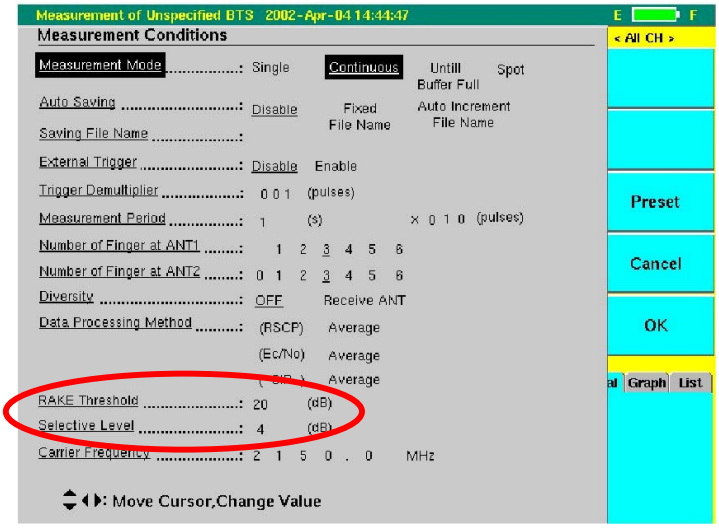
- ML8720B can activate 1 RAKE finger only, to capture strongest signal
  - Benefits : ensures drive test coverage measurements are on primary signal level, and does not rely on multipath from local temporary structures (trees, lorries, car, etc…) to provide cell coverage evaluation.
- ML8720B can activate up to 6 fingers (12 with antenna diversity)
  - Benefits : to evaluate the multipath environment with direct reporting on level of each finger.
- External trigger should be used for drive test survey
  - configure so that ML8720B makes 'average' over a fixed distance on the ground, do not use fixed 'time' that causes variation of distance as speed changes.
  - Trigger mode allows the ML8720B not to depend on the speed variation during traffic

# Paths estimation and Finger assignment in the rake receiver

## 1. Initial Search

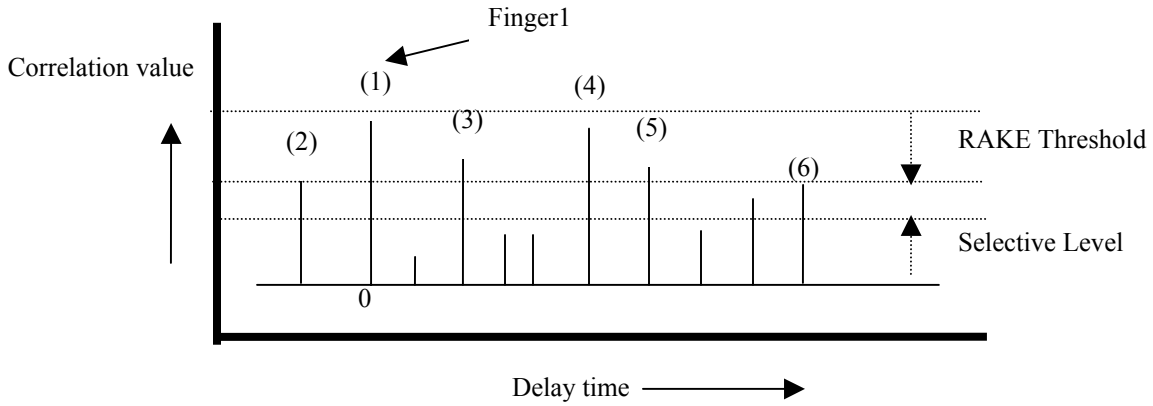
Path estimation and Finger assignment in initial search are performed following the procedures below.

(1) Acquisition of delay profile data.
(2) Detection of the path satisfying "Selective Level" and "RAKE Threshold " specified as parameter from above data.
Definition of "selective Level" : the value between noise floor (average value) and effective path.
Definition of "RAKE Threshold" : the lower limit value of effective path is the subtracted value (from the setting menu) from the path with the maximum correlation value.




Measurement Conditions Menu

(3) Selection of 6 large correlation values from above path candidates. (the case when Finger number is set to 6.)
(4) Assignment of the path indicating the maximum correlation value to Finger 1 among 6 paths.
Other paths are assigned to Finger2,3,4,5,6 following Finger1, in the order of short delay time.
However, if there are paths with fast arrival time from Finger1 to the instrument, paths are assigned to Finger2,3.... in the order of fast arrival time.
(5) Measurement is started at the timing of each path.




## 2. Finger Update

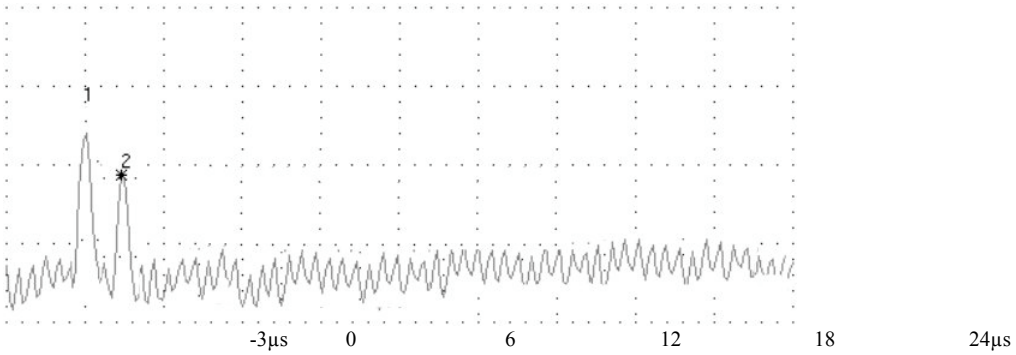
In 1ch measurement, delay profile is acquired in increments of 10ms, and similarly to above initial search, Finger assignment is repeated on the basis of acquired data.

# Rake receiver minimum resolution

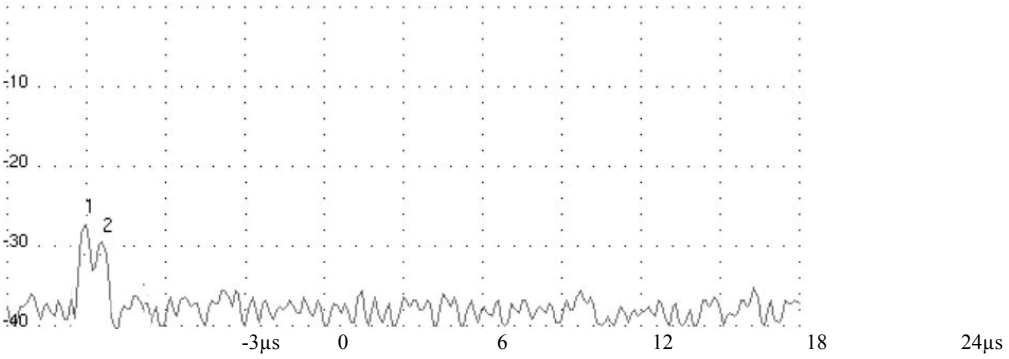
The minimum resolution of the ML8720B rake receiver is **1.5 chip**.

This means that the ML8720B will not be able to dicriminate two paths if not separated of 1.5 chips at least. If it's not the case, the ML8720B will see a combination of the two close fingers and calculate one RSCP value.

Nota : **1.5 chip** translated in X meters path difference is 1.5 * 260ns = **390ns**
This means that two different paths must be separated of 390ns at least to be seen as two different paths on the ML8720B rake receiver.




Ideal case where the 2 paths are sufficiently separated (more than 1.5 chip)




Case where the 2 paths (F1 and F2) are reaching the chip resolution limit of the rake receiver

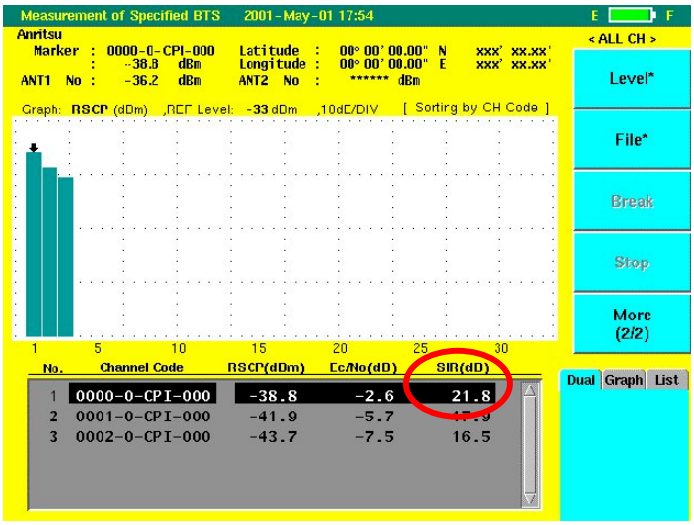
If the fingers 1 and 2 in the above example were to merge together the ML8720B will see them as one “large” finger.
The measured interference measured by the ML8720B will then be altered. Because the finger 2 is too close to the finger 1, the SIR should be modified letting the user think that there may be some phenomenon in the multipath analysis.
This effect could easily be seen having a look at the SIR value.

The INTERFERENCE depends on the following aspects :

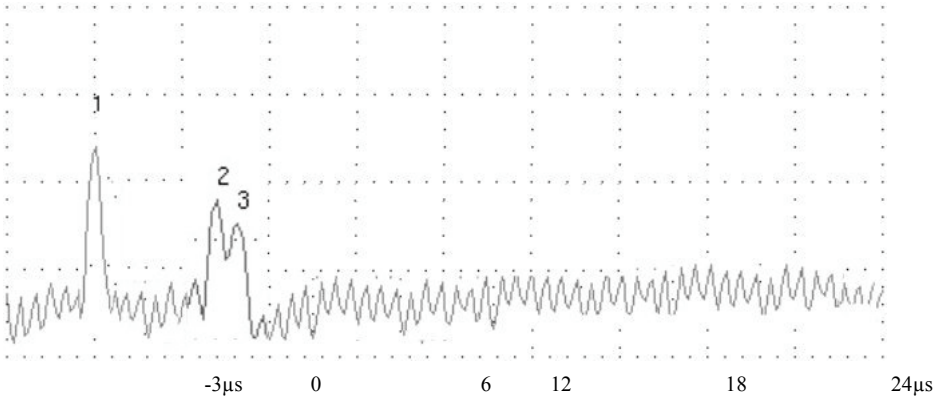
INTERFERENCE = (Other Scrambling Code BTS effects) + Multipath of the considered BTS

If the other BTS levels in the neighbour cells interfer with the active BTS in communication with the UE, or if the mutlipath of the active BTS is affected, this implies that the SIR result will show a decrease towards 0dB.
So, if the SIR value is small (in dB unit), this may mean that the cell is scrambled by other BTS (scrambling codes) or that there might be 2 close fingers on the main first finger on the rake receiver.

By analysing the SIR value (in the ALL CHANNEL screen), the user should then conclude that the he should take care of the multipath aspects on the considered BTS.




He should then switch ON the 6 fingers on the Rake Receiver to have a look carefully on the multipath effects.




The above example shows a case where the Fingers 2 and 3 would not affect the Finger 1 as there are far away from the main first finger even if there are too close to each other.

So, the SIR value should not be modified so much.

**<u>CONCLUSIONS RELATED TO THE RAKE RECEIVER USE</u> :**

* Use 1 FINGER to make the cell planning and have a look at the RSCP value and eventually at the SIR value. If the SIR value is small then switch on the 6 FINGERS analysis in the Measurement conditions menu.

* Use 6 FINGERS to make a complete analysis of the considered cell to understand correctly and verifiy the effects of the multipath in this particular cell.

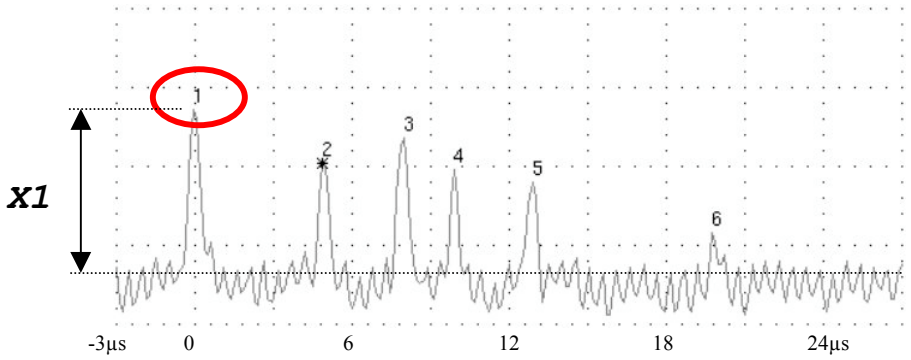
# RSCP measurement analysis on both .DAT and .FIG data files

**.DAT** file example (extract)

| UNSPECIFIED BTS ( SHORT ) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MAPD=01 | DATE=2002/07/11 | DML= 1 | INT=0.50S | FRQ=2167.0 | MODE=2 AVE AVE AVE | UNIT=DBM | RP=0000.0000N 00000.0000E | | |
| NO | TIME | LATITUDE | LONGITUDE | ANT1_NO | ANT2_NO | CH1_CODE | CH1_RSCP_USR | CH1_ECNO_USR | CH1_SIR_USR |
| 1 | 13:23:22 | 4851.4810N | 00220.8320E | -85.1 | -999.9 | 002E-0-CPI-000 | -93.3 | -8.3 | 12.7 |
| 2 | 13:23:22 | 4851.4810N | 00220.8320E | -85.1 | -999.9 | 002E-0-CPI-000 | -92.9 | -8.1 | 12.5 |
| 3 | 13:23:23 | 4851.4800N | 00220.8320E | -84.9 | -999.9 | 002E-0-CPI-000 | -92.7 | -7.9 | 12.6 |
| 4 | 13:23:23 | 4851.4800N | 00220.8320E | -84.9 | -999.9 | 002E-0-CPI-000 | -92.8 | -8 | 12 |
| 5 | 13:23:24 | 4851.4800N | 00220.8320E | -85 | -999.9 | 002E-0-CPI-000 | -92.6 | -7.7 | 11.7 |
| … | … | … | … | … | … | … | … | … | … |
| … | … | … | … | … | … | … | … | … | … |

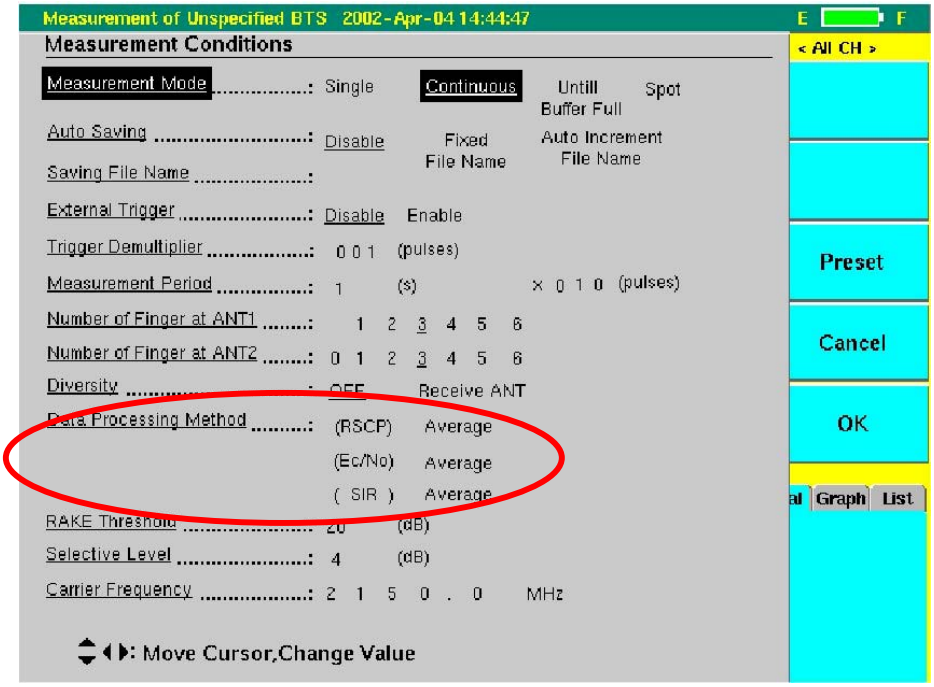
**.FIG** file example (extract)

| UNSPECIFIED BTS ( FINGER ) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MAPD=01 | DATE=2002/07/11 | FINGERS=1 | DML= 1 | INT=0.50S | FRQ=2167.0 | MODE=2 | UNIT=DBM | RP=0000.0000N 00000.0000E | | |
| NO | TIME | LATITUDE | LONGITUDE | RSSI | CH1_CODE | CH1_MAX_RSCP | CH1_RSSI | CH1_F1_DLY | CH1_F1_RSCP | CH1_F2_DLY |
| 1 | 13:23:22 | 4851.4810N | 00220.8320E | -85.1 | 002E-0-CPI-000 | -91.8 | -84.5 | 0 | -91.8 | … |
| 2 | 13:23:22 | 4851.4810N | 00220.8320E | -85.1 | 002E-0-CPI-000 | -90.1 | -83.6 | 0 | -90.1 | … |
| 3 | 13:23:23 | 4851.4800N | 00220.8320E | -84.9 | 002E-0-CPI-000 | -93.1 | -85 | 0 | -93.1 | … |
| 4 | 13:23:23 | 4851.4800N | 00220.8320E | -84.9 | 002E-0-CPI-000 | -92.8 | -84.7 | 0 | -92.8 | … |
| 5 | 13:23:24 | 4851.4800N | 00220.8320E | -85 | 002E-0-CPI-000 | -92.5 | -84.9 | 0 | -92.5 | … |
| … | … | … | … | … | … | … | … | … | … | … |
| … | … | … | … | … | … | … | … | … | … | … |




It's not possible to make only one drive test (even with one single finger ON ) and to take care of the .FIG file only : the RSCP value of the Finger 1 of the FIG file represents the max value of the RSCP of the Finger 1 during the measurement period (above example is 0.50 s, ie one MAX value among 50 measurements (10ms*50=0.50s)). The FIG file gives a kind of picture of the MAX RSCP value of the FINGER in Delay Profile Mode.

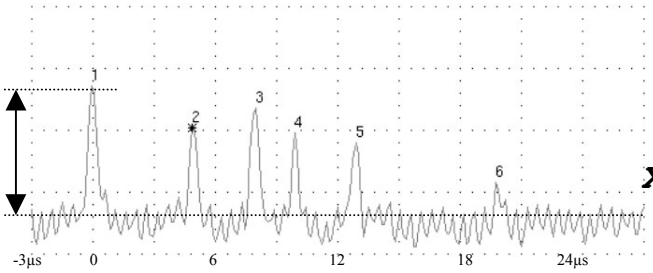
On the other hand, the DAT file gives an AVERAGE of the RSCP (if AVE is selected in the data processing of the ML8720B (Measurement conditions Menu)).



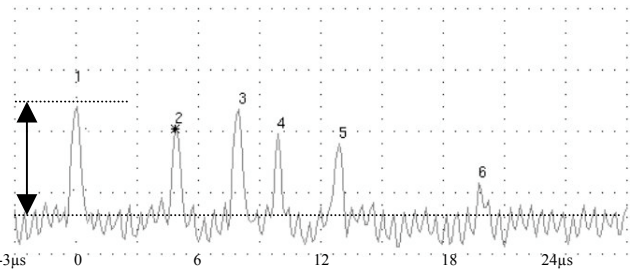

This is why the CH1_RSCP_USR value (-93.3dBm) may be different and lower than the CH1_MAX_RSCP value (-91.8dBm) as the DAT file is an AVERAGE of the 50 values measured in 0.5 second and the FIG file a MAXIMUM displayed value of RSCP (in that case).

The FINGER amplitude (RSCP) value designed by ***X*** on the delay profile graph above shows the way the decision is taken to define which of the 2 cases is the highest value for the FINGER 1.

***X1***




***X2***




One measurement in 10ms | Other measurement in 10ms, 10ms after

In this example above, lets represent a measurement (Delay profile) with a 20ms measurement period on 1 Base Station. This means 2 different measurements in 20ms time (=2*10ms).

Here, ***X1 > X2*** on FINGER 1 (on the rake receiver), so the stored CH1_F1_RSCP data in the FIG file will be the first one …

This clearly shows that the drive test should take part in 2 different measurements :

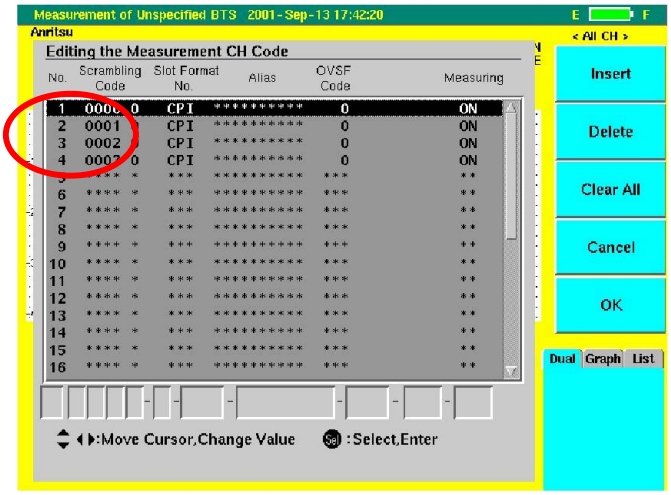
- First part is a drive test with only **1 FINGER** ON to verify the coverage of the cell thanks to the first biggest Finger (RSCP value) processed in the DAT file. The FIG file will give the information about the most optimistic conditions as it displays a picture of the MAX value of the chosen FINGER (ie a better RSSI power value in the cell).
- Second part could consist on making the same measurement in the same cell, achieving a **6 FINGERS** analysis. The RSCP value of the DAT file should take into acount the effects of the observed FINGERS on the field (from 1 up to 6). The RSCP of each FINGERS in the FIG file will give some information of the best case where the FINGER 1 was measured with the highest value (RSCP) within the measurement period.

The **CH1_RSSI** value of the FIG file represents the calculated value of the RSSI in CHANNEL 1 (ie for the Base Station 1) at the time the MAX value of the RSCP of the FINGER 1 was observed.
So, the CH1_RSSI value (of the FIG file) may not have the same value as the ANT1_No (of the DAT file) as they are not processed the same way (one is a MAX value, the other is an AVERAGE value).

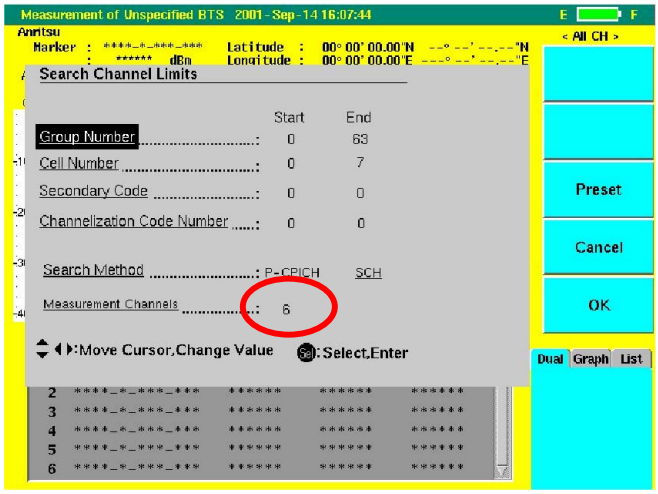
**So, we strongly recommend the Operator to use the DAT file as it gives the RSCP value of the CPICH channel depending on the AVERAGE of the RSCP of the FINGER 1 within the measurement period.**

# Measurement period

The measurement period first depends of the number of Base Stations to be captured in **Specified BTS Mode** or of the number of channels to have a look at in **Unspecified BTS Mode** (see below).




This figure shows an example of 4 BTS with known Scrambling Code to have a look at.




This figure shows an example where the ML8720B should look after 6 unknown BTS.

As the minimum sampling rate of the ML8720B is 10ms for each captured BTS, if the ML8720B is set to search for 6 BTS (as detailed in the Unspecified BTS Mode figure above) this means that the total measurement period will be 60ms before each BTS (CPICH RSCP value) would be refreshed.

Every measured value of the ML8720B (No, RSCP, Ec/No, SIR, Delay Profile of each finger) will depend on the number of wanted or chosen BTS scanning.

Whatever the measurement period is (either with the internal trigger or the external trigger), the ML8720B will be measuring the RSCP (and Ec/No and SIR) of each BTS every 10ms.

If the measurement period is fixed at 1 second and scanning 1 BTS only, this means that the ML8720B will make 100 measurements in 1s period (100 * 10ms = 1s).
Taking into acount the data processing set in the Measurement conditions menu (AVERAGE for instance), the ML8720B will process the 100 data and calculate the AVERAGE of all these 100 data.
The result will then take place into the DAT file and the FIG file (for intance in the RSCP column value).

**Note : ANRITSU's experience in the past with 3G operators (mainly located in Japan) pointed out that 50 meters should be a realistic averaged distance when making outdoor W-CDMA measurement on the field to correctly measure the effects of the multipath.**

**So, the dynamic characteristic of the measurement (RSCP and SIR) when driving from 0 to 100km/h should be averaged for a distance of 50 meters.**

**Depending on this 50 meters distance average, the user should set a correct trigger (internal trigger if the ML8720B is used in a lab (constant speed) or external trigger coming from the sensor pulses of the wheel of the car) to ensure true measurements with the maximum accuracy for the RSCP and SIR.**

Some measurement periods  examples in case of using the internal trigger :

To apply the 50 meters averaging that was explained above, with the internal trigger (in a lab) the measurement period of the ML8720B must be in relationship with the speed simulation (including fading propoagation or not). Here are some values we recommend :

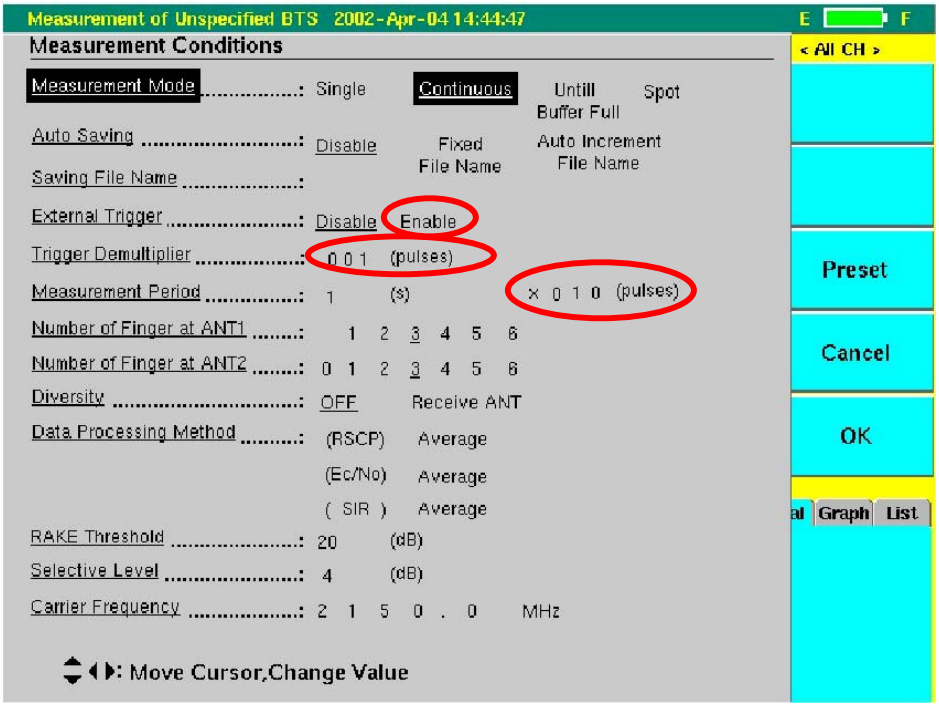
- Speed of 0km/h : 30s
- Speed of 3km/h : 30s
- Speed of 20km/h : 8s
- Speed of 50km/h : 3s
- Speed of 100km/h : 2s

100km/h = 27,7m/s (measurement period could be 2s to achieve a 50m averaging (2*27m ≈ 50m) )

## External Trigger Dividing Rate use

When the **speed pulse** is used for the external trigger, an external trigger dividing rate can be calculated from the maximum speed and speed pulse interval as in the following formula :

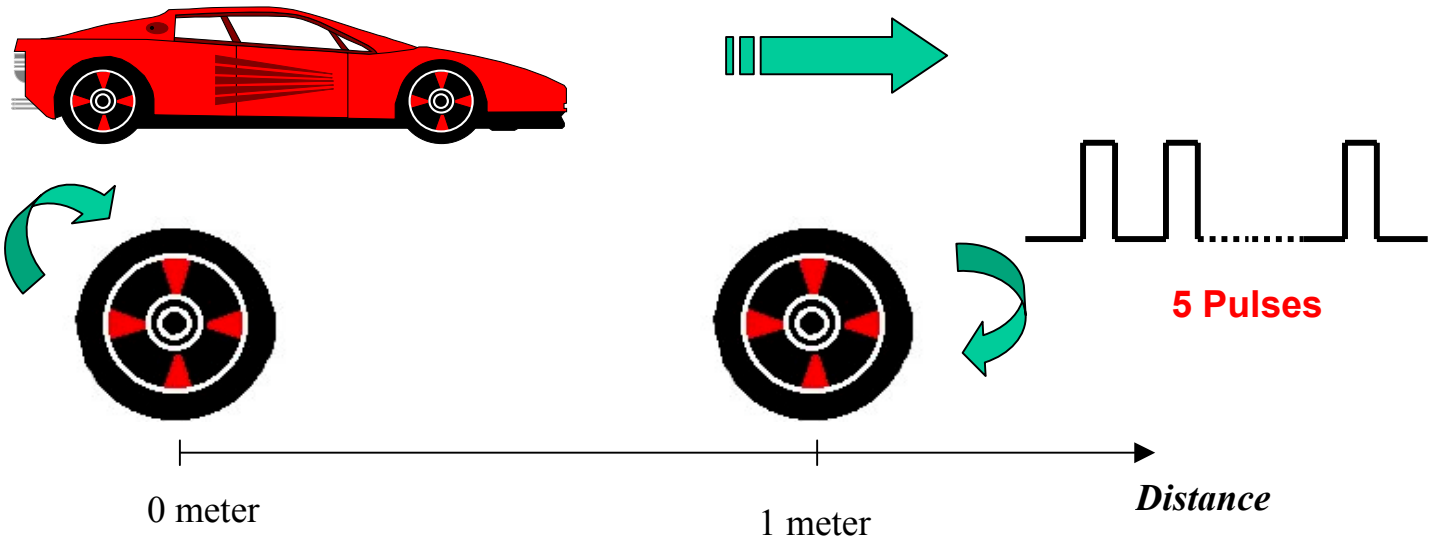
**External trigger dividing rate ≥ Max. speed (km/h) ≥ (No. of measurement channels) / (External pulse interval (m) * 360)(round fractions at decimal points)**




Measurement conditions Menu

## External Trigger use example

Lets take an example to make sure that the ML8720B makes a measurement sample every 50 meters :




1 wheel with 5 pulse sensors around.
In this case, if 1 round corresponds to 1 meter (for instance 5 pulses) in distance :

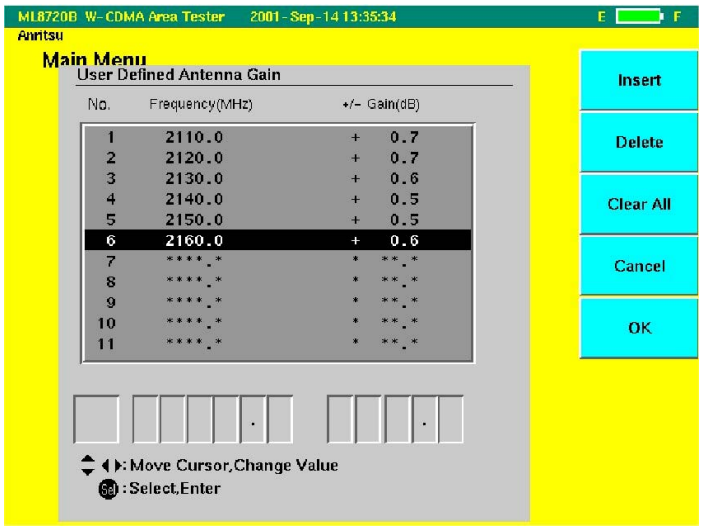
to get an average on 50 meters (because of fading conditions on the ground) to correctly sample the signal on the antenna we recommend the following settings :

* 5 pulses / meter  implies to chose the Demultiplier = 5
* **Measurement period** must be chosen then at **50**.

} In the Measurement Conditions Menu

# ANRITSU's Antenna Specifications

The antenna specifications that are a standard composition for ML8720B W-CDMA Area Tester are described below.



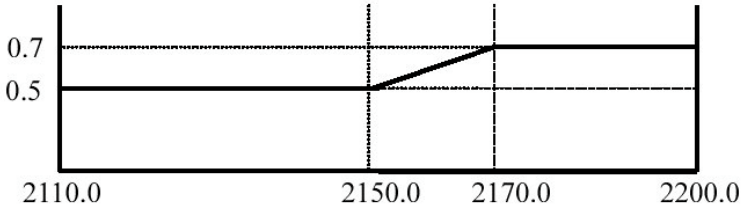

User Defined Antenna Gain

## Antenna Gain Specifications

The antenna gain *(*)* for a standard composition is stored in the internal memory of the ML8720B W-CDMA Area Tester. Therefore, measurement value can be corrected without inputting user antenna gain vs frequency by setting the antenna correction to the standard value.

Our UMTS antenna (reference is Z0516) properties are as follow :

| Frequency (MHz) | Relative gain of antenna (dB) |
|---|---|
| 2110 | 0.7 |
| 2120 | 0.7 |
| 2130 | 0.6 |
| 2140 | 0.5 |
| 2150 | 0.5 |
| 2160 | 0.5 |
| 2170 | 0.6 |
| 2180 | 0.9 |
| 2190 | 1.0 |
| 2200 | 1.1 |

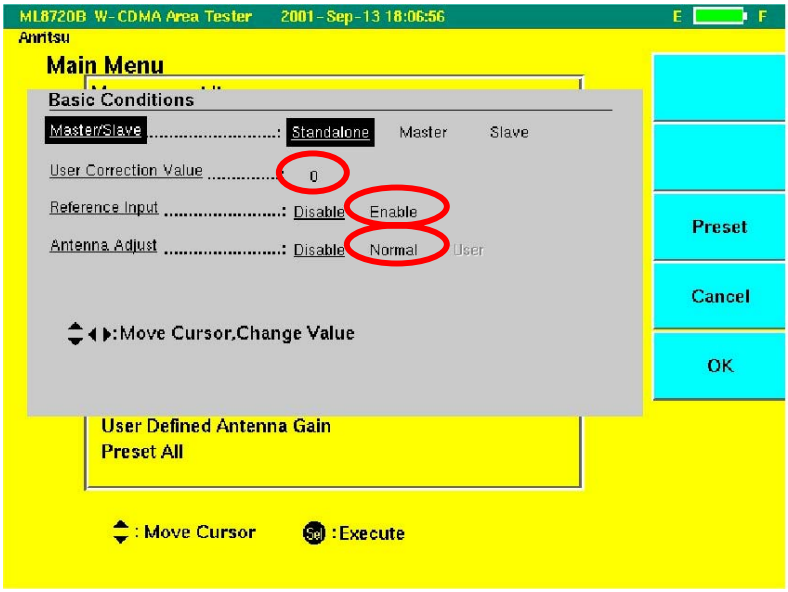



ANRITSU's UMTS antenna gain vs frequency

## Cable Loss for Antenna Mounting

The cable loss for a standard composition antenna mounting (reference is Z0517) (length is 5 meters) for the ML8720B W-CDMA Area Tester is 2.5 dB in the UMTS frequency band (Down Link).

*(*) When an antenna mounting is used to connect ML8720B W-CDMA Area Tester and an antenna, set the loss value (2.5dB) to the* user correction value *in the Basic Conditions Menu (see below).*



# Files formats of the ML8720B

The following is an example of **Unspecified BTS measured data file** in **Short size (.DAT extension)**.

```
UNSPECIFIED BTS (SHORT) ↓
MAPD=05,DATE=2000/09/11,DML= 10,INT=  0.10S,FRQ=2115.4, MODE=2 AVE AVE AVE,UNIT=DBM,RP=0000.0000N 00000.0000E↓
NO, TIME, LATITUDE, LONGITUDE, ANT1_NO, ANT2_NO, CH1_CODE, CH1_RSCP_USR, CH1_ECNO_USR, CH1_SIR_USR, CH2_CODE,  … ↓
0000001,09:34:06,3734.2347N,14012.2458E, -104.2, -105.1,
01A3-0-CPI-000,-105.3, -3.5 ,-123.5,
01A4-0-CPI-000,-105.3, -3.5 ,-123.5,
01A5-0-CPI-000,-105.3, -3.5 ,-123.5,                    } Number of channels (Value: MAPD=)
01A6-0-CPI-000,-105.3, -3.5 ,-123.5,
01A7-0-CPI-000,-105.3, -3.5 ,-123.5 ↓
0000002,09:34:07,3734.2352N,14012.2490E, -104.2, -105.1,
01A3-0-CPI-000,-105.3,-125.3, -3.5 ,-123.5,
01A4-0-CPI-000,-105.3,-125.3, -3.5 ,-123.5,
01A5-0-CPI-000,-105.3,-125.3, -3.5 ,-123.5,
01A7-0-CPI-000,-105.3,-125.3, -3.5 ,-123.5,
01A8-0-CPI-000,-105.3,-125.3, -3.5 ,-123.5 ↓
0000003,09:34:08,3734.2387N,14012.2511E, -104.2, -105.1,
   |
   | The data obtained in one-measurement period is indicated in one line. Number of lines is equal to the measured data .
   | (Only one line when single sweep MODE=1)
NEOT↓
```

MAPD=05 : Measurement Channel Count  (01 to 32)
DATE=2000/09/11 : Date
DML= 10 : External Trigger dividing rate (1 to 100)
INT=  0.10S : Measurement Span in seconde (S) or External Trigger Multiple (P)
FRQ=2115.4 : Measurement Frequency (MHz)
MODE=2 : Measurement Mode  1=Single  2=Continuous  3=Until Buffer Full
AVE : AVE=Average Value  000=Min Value  100=Max Value  050=Mean Value
UNIT=DBM : Display Unit (dBm ou dBµV)
RP=0000.0000N 00000.0000E : Reference Position (Latitude DDMM.mmmm [North or South]
Longitude DDDMM.mmmm [East or West] )

0000001 : Output No of processed value (7 digits)
09:34:06 : Measurement Time
3734.2347N,14012.2458E : Measurement Position (Displacement direction in Latitude et Longitude)
-104.2 : ANT2 No (dBm ou dBµV)
-105.1 : ANT1 No (dBm ou dBµV)

01A3-0-CPI-000 : CH(1) Measurement Value :  Scrambling Code No (HEX) , Primary/secondary Code (HEX) , Slot Format No , Code No (000 to SF-1)
,-105.3 : RSCP
-3.5 : Ec/No
,-123.5 : SIR

**In Long size**, the data order of RSCP,Ec/No,SIR from CH(1) to CH(n) after 4th line is as follows:
RSCP (User's specification) , RSCP(Min. value) , RSCP(Max. value) , RSCP(Average value),
Ec/No (User's specification) , Ec/No (Min.value) , Ec/No (Max. value) , Ec/No (Average value),
SIR (User's specification) , SIR(Min. value) , SIR(Max. value) , SIR (Average value)

The following is an example of **Unspecified BTS measured Each Finger data file (.FIG extension)**.

```
UNSPECIFIED BTS (FINGER) ↓
MAPD=05,DATE=2000/09/11,FINGERS=3 ,DML=  1, INT= 1.00S , FRQ=2115.4, MODE=2,UNIT=DBM,RP=0000.0000N 00000.0000E↓
NO, TIME, LATITUDE, LONGITUDE, RSSI,  CH1_CODE, CH1_RSCP_MAX, CH1_RSSI, CH1_F1_DLY, CH1_F1_RSCP, CH1_F2_DLY, CH1_F2_RSCP,
CH1_F3_DLY, CH1_F3_RSCP,
CH2_CODE, CH2_RSCP_MAX, CH2_RSSI, CH2_F1_DLY, CH2_F1_RSCP, CH2_F2_DLY, CH2_F2_RSCP, CH2_F3_DLY, CH2_F3_RSCP ,  …
……
CH5_CODE, CH5_RSCP_MAX, CH5_RSSI, CH5_F1_DLY, CH5_F1_RSCP, CH5_F2_DLY, CH5_F2_RSCP, CH5_F3_DLY, CH5_F3_RSCP ↓
0000001,09:34:06,3734.2347N,14012.2458E, -69.0,
01A3-0-CPI-000, -75.3, -69.1 ,0.0, -76.0, 24.5, -75.3, , ,
01A4-0-CPI-000,-78.3, -68.8, 0.0, -78.3, 17.0, -83.1, 22.5, -85.0,
01A5-0-CPI-000,- 78.3, -68.8, 0.0, -78.3, 17.0, -83.1,
01A6-0-CPI-000,- 80.0, -68.9, 0.0, -80.1,,,,,
01A7-0-CPI-000,- 78.3, -68.8, 0.0, -78.3, 17.0, -83.1, ↓
0000002,09:34:07,3734.2352N,14012.2490E, -69.0,
01A3-0-CPI-000,-75.1, -68.8, 0.0, -75.1, 24.5, -76.3,,,
01A4-0-CPI-000,-80.1 -68.9, 0.0, -80.1,,,,,
…… ↓
   |
   | The data obtained in one-measurement period is indicated in one line. Number of lines is equal to the measurement data.
   | (Only one line when single sweep MODE=1)
NEOT↓
```

Number of channels (Value: MAPD=)

MAPD=05 : Measurement Channel Count  (01 to 32)
DATE=2000/09/11 : Date
FINGER= 3  : Maximum synthetic finger number (1 to 6)
DML=  10 : External trigger dividing rate (1 to 100)
INT= 1.00S : Measurement Span in seconde (S) ou External Trigger Multiple (P)
FRQ=2115.4 : Measurement Frequency (MHz)
MODE=2 : Measurement Mode  1=Single  2=Continuous  3=Until Buffer Full
UNIT=DBM : Display Unit (dBm ou dBµV)
RP=0000.0000N 00000.0000E : Reference Position (latitude DDMM.mmmm [North or South]
Longitude DDDMM.mmmm [East or West] )

0000001 : Output No of processed value (7 digits)
09:34:06 : Measurement Time
3734.2347N,14012.2458E : Measurement Position (Displacement direction in Latitude et Longitude)
-69.0 : RSSI (dBm ou dBµV)

01A3-0-CPI-000 : CH(1) Measurement Value :  Scrambling Code No (HEX) , Primary/secondary Code (HEX) , Slot Format No , Code No (000 to SF-1)
-75.3 : RSCP maximum
-69.1 : RSSI Instant value Finger 1
,0.0 : Delay quantity
-76.0 : RSCP
……

The following is an example of **Specified BTS** measured data file in **Short size (.DAT)**.

```
SPECIFIED BTS BTS (SHORT) ↓
MAPD=05,DATE=2000/09/11,DML= 10,INT=  0.10S, FRQ=2115.4, MODE=2 AVE AVE AVE, UNIT=DBM, RP=0000.0000N 00000.0000E↓
CH01=02B5-0-CPI-000,CH02=02B6-0-CPI-000,CH05=02B7-0-CPI-000, CH06=02B8-0-CPI-000,CH09=02B9-0-CPI-000↓
NO, TIME, LATITUDE, LONGITUDE, ANT1_NO, ANT2_NO, CH1_CODE, CH1_RSCP_USR, CH1_ECNO_USR, CH1_SIR_USR, CH2_CODE,  … ↓
0000001,09:34:06,3653.2439N, 13724.8526E, -104.8, -105.2,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5 ↓
0000002,09:34:07,3653.2442N,13724.8533E, -104.2, -105.1,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5,
-105.3, -3.5 ,-123.5 ↓
0000003,09:34:08,3653.2468N, 13724.8555, -104.1, -105.0,
   |
   |  The data obtained in one-measurement period is indicated in one line. Number of lines is equal to the measured data .
   |  (Only one line when single sweep MODE=1)

NEOT↓
```

Number of channels (Value: MAPD=)

MAPD=05 : Measurement Channel Count  (01 to 32)
DATE=2000/09/11 : Date
DML= 10 : External Trigger dividing rate (1 to 100)
INT=  0.10S : Measurement Span en seconde (S) ou External Trigger Multiple (P)
FRQ=2115.4 : Measurement Frequency (MHz)
MODE=2 : Measurement Mode  1=Single  2=Continuous  3=Until Buffer Full
AVE : AVE=Average Value  000=Min Value  100=Max Value  050=Mean Value
UNIT=DBM : Display Unit (dBm ou dBµV)
RP=0000.0000N 00000.0000E : Reference Position (latitude DDMM.mmmm [North or South]
Longitude DDDMM.mmmm [East or West] )

CH01 : Channel No 1 to 32
01A3-0-CPI-000 : CH(1) Measurement Value :  Scrambling Code No (HEX) , Primary/secondary Code (HEX) , Slot Format No , Code No (000 to SF-1)
,-105.3 : RSCP
-3.5 : Ec/No
,-123.5 : SIR
In **Long size**, the data order of (1) to (n) after 5th line is as follows:
RSCP (User's specification) , RSCP(Min. value) , RSCP (Max. value) , RSCP (Average value),
Ec/No (User's specification) , Ec/No(Min. value) ,  Ec/No (Max. value) , Ec/No (Average value),
SIR (User's specification)  , SIR (Min. value)  , SIR (Max. value)  , SIR (Average value)

The following is an example of **Specified BTS measured Each Finger data file (.FIG extension)**.

```
SPECIFIED BTS (FINGER) ↓
MAPD=05,DATE=2000/09/11,FINGERS=3 ,DML=  1, INT= 1.00S , FRQ=2115.4, MODE=2,UNIT=DBM,RP=0000.0000N 00000.0000E↓
CH01=02B5-0-CPI-000,CH02=02B6-0-CPI-000, … ↓
NO, TIME, LATITUDE, LONGITUDE, RSSI,  CH1_CODE, CH1_RSCP_MAX, CH1_RSSI, CH1_F1_DLY, CH1_F1_RSCP, CH1_F2_DLY, CH1_F2_RSCP,
CH1_F3_DLY, CH1_F3_RSCP,
CH2_CODE, CH2_RSCP_MAX, CH2_RSSI, CH2_F1_DLY, CH2_F1_RSCP, CH2_F2_DLY, CH2_F2_RSCP, CH2_F3_DLY, CH2_F3_RSCP ,  …
……
CH5_CODE, CH5_RSCP_MAX, CH5_RSSI, CH5_F1_DLY, CH5_F1_RSCP, CH5_F2_DLY, CH5_F2_RSCP, CH5_F3_DLY, CH5_F3_RSCP ↓
0000001,09:34:06,3734.2347N,14012.2458E, -69.0,
-75.3, -69.1 ,0.0, -76.0, 24.5, -75.3, , ,
-78.3, -68.8, 0.0, -78.3, 17.0, -83.1, 22.5, -85.0,
- 78.3, -68.8, 0.0, -78.3, 17.0, -83.1,
- 80.0, -68.9, 0.0, -80.1,,,,,
- 78.3, -68.8, 0.0, -78.3, 17.0, -83.1, ↓
0000002,09:34:07,3734.2352N,14012.2490E, -69.0,
-75.1, -68.8, 0.0, -75.1, 24.5, -76.3,,,
-80.1 -68.9, 0.0, -80.1,,,,,
…… ↓
   |
   |  The data obtained in one-measurement period is indicated in one line. Number of lines is equal to the measurement data.
   |  (Only one line when single sweep MODE=1)
NEOT↓
```

Number of channels (Value: MAPD=)

MAPD=05 : Measurement Channel Count  (01 to 32)
DATE=2000/09/11 : Date
FINGER= 3  : Maximum synthetic finger number (1 to 6)
DML=  10 : External trigger dividing rate (1 to 100)
INT= 1.00S : Measurement Span en seconde (S) ou External Trigger Multiple (P)
FRQ=2115.4 : Measurement Frequency (MHz)
MODE=2 : Measurement Mode  1=Single  2=Continuous  3=Until Buffer Full
UNIT=DBM : Display Unit (dBm ou dBµV)
RP=0000.0000N 00000.0000E : Reference Position (latitude DDMM.mmmm [North or South]
Longitude DDDMM.mmmm [East or West] )
0000001 : Output No of processed value (7 digits)
09:34:06 : Measurement Time
3734.2347N,14012.2458E : Measurement Position (Displacement direction in Latitude et Longitude)
-69.0 : RSSI (dBm ou dBµV)

02B5-0-CPI-000: CH(1) Measurement Value :  Scrambling Code No (HEX) , Primary/secondary Code (HEX) , Slot Format No , Code No (000 to SF-1)
-75.3 : RSCP maximum
-69.1 : RSSI Instant value Finger 1
,0.0 : Delay quantity
-76.0 : RSCP

The following is an example of **delay profile** measured data file.
Also, delay profile measured data file includes each Finger's RSCP value and synthesized RSCP value.

```
DELAY PROFILE↓
MANT=2,NA1FIG=6,NA2FIG=5,DATE=2000/09/11,TIME=09:34:06,UNIT=DBM, FRQ=2115.4,RP=0000.0000N 00000.0000E,PP=3724.2375N 13735.3409E,
CH= 01B5-0-CPI-000,PEAK1=041↓
N01= -43.3,NO2= -45.1,RSCP1= -56.8, RSCP2= -57.4, RSCP= -55.8↓
01, 45, -40.5, 45, -40.3↓
02, 58, -50.2, 59, -50.5↓
03, 82, -55.1, 82, -55,9↓
04,130, -60.1,129, -62.2↓
05,243, -65.4.245, -63.5↓
06,339, -66.3,   ,    ↓
001, +5.6, +4.7↓
002, +5.2, +3.5↓
        |
        |
512, +4.4, +2.5↓
NEOT↓
```

MANT=2: Measurement ANTenna count (1 ou 2)
NA1FIG=6 NA2FIG=5 : ANT1 et ANT2 finger count 1 to 6
DATE=: Date
TIME=: Time
UNIT=DBM: Display Unit (dBm ou dBµV)
FRQ=2115.4 : Measurement Frequency (MHz)
RP=0000.0000N 00000.0000E : Reference Position (latitude DDMM.mmmm [North or South]
Longitude DDDMM.mmmm [East or West] )
PP= : Measurement Position, Displacement direction in Latitude (DDMM.mmmm[NS]) et en Longitude DDDMM.mmmm [EW]

CH : Channel No 1 to 32
01B5-0-CPI-000: Measurement Value : Scrambling Code No (HEX) , Primary/secondary Code (HEX) , Slot Format No, Code No (000 to SF-1)
PEAK1=041 : 1st Peak position (reference point for finger allocation)
N01= NO2= : ANT1 No et ANT2 No
RSCP1= RSCP2= : RSCP des ANT1 et ANT2
RSCP= : synthèse du RSCP combiné
01 : Finger No
45 : ANT1 Path (estimated result) (1 to 512)
-40.5 : ANT1 RSCP
45 : ANT2 Path (estimated result) (1 to 512)
-40.3 : ANT2 RSCP

001 : Data No (3 digit)
+5.6 : ANT1 correlation value
+4.7 : ANT2 correlation value

The following is an example of **spectrum** measured data file

```
SPECTRUM MONITOR↓
DATE=2000/09/11,TIME=09:34:06,UNIT=DBM,SPAN=90,CFRQ=2155.000, RP=0000.0000N 00000.0000E,PP=3724.2375N 13735.3409E↓
2153.000, -59.8↓
2153.004, -60.2↓
    |
    |
    |
2157.000,- 47.5↓
NEOT↓
```

DATE= : Date
TIME= : Heure
UNIT= : dBm ou dBµV ou dBµV/m
SPAN= : Excursion en Frequency (MHz)
CFRQ= : Frequency centrale (MHz)

RP=0000.0000N 00000.0000E : REF Position (latitude DDMM.mmmm [North or South]
Longitude DDDMM.mmmm [East or West] )
PP= : Measurement Position , Displacement direction in Latitude (DDMM.mmmm[NS]) et en Longitude DDDMM.mmmm [EW]

2153 : Frequency
000 : Code No (0 to 501)
-59.8 : Level

# CONCLUSIONS

To achieve a correct drive test on the fiels, here are our recommendations :

- Use the EXTERNAL TRIGGER to correctly set the 50m averaging to get true RSCP measurements of the CPICH of the BTS whatever the speed is (see configuration and explanations pages 15 and 16).

- MAIN DRIVE TEST :
  Select 1 FINGER (in the Measurement Conditions Menu) to measure an AVERAGE RSCP of the CPICH on the rake receiver. This finger 1 will always be the highest one (in power) where ever it is in the DELAY PROFILE display. This will allow the Operator to make a correct cell planning to capture all the transmitting BTS. The result will not depend on the multipath. This is implies a realistic cell planning as the result on the finger 1 should not be affected by the multipath, even with temporary reflexions between the ML8720B and the BTS.
  This step may be consisered as the first one to achieve to complete a cell planning of the network.
  This means the OPTIMIZATION STEP of the network during the cell planning.

- COMPLEMENTARY or VERIFICATION DRIVE TEST :
  Second Step : Select up to 6 FINGERS (in the Measurement Conditions Menu) to verify the effects of multipath in the cell on the CPICH channel in the FIG file provided by the ML8720B.
  This means more the MAINTENANCE STEP of the network in case of propagation reflexions.

- The .FIG file represents a picture of the MAXIMUM value of the RSCP of the CPICH measured during the measurement period (with internal or external trigger settings).

- The .DAT file gives to the user the processed measured data (RSCP, Ec/No and SIR) for every capatured BTS depending on data processing choices (in the Measurement Conditions Menu).

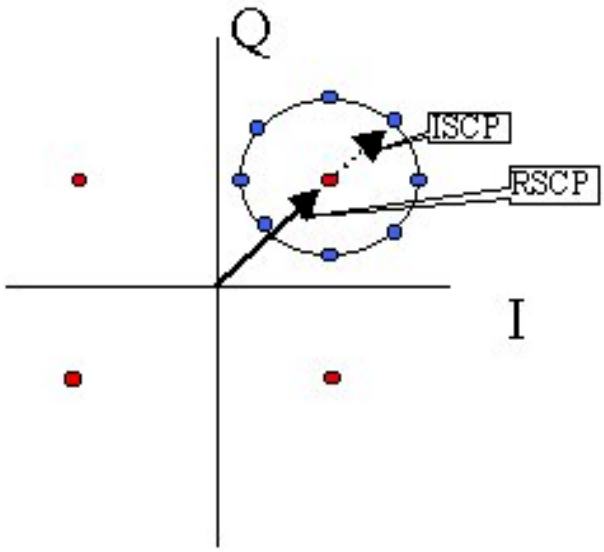
- Using the .DAT file results with 1 FINGER selection allows the user to make quick and reliable measurements on every captured CPICH channel to decide wether there should be some effects of multipath or not (having a look at the SIR value at the time as the RSCP value).

- As the ML8720B integrates a true RAKE RECEIVER, it allows to discriminate the different multipaths as defined by the 3GPP specification (*3GPP TS 25.215 v4.2.0 § 5.1.1*) with its very low sensitivity (-117dBm on the RSCP, lower than a UE's sensitivity) .
  The ML8720B can then be used as a real UMTS UE with its rake receiver to get more power instantly especially to reproduce the case of a UE receiving DCH data froma BTS. In that case, all the available power will be needed for the analysis.
  The RAKE RECEIVER provides the only way to ascertain precisely where a mobile phone will have reception problems.

- None of the RSCP, Ec/No nor SIR should depend on the speed of the vehicle if the measurement period is correctly set to make an averaged data sample every 50 meters on the ground as pointed out from ANRITSU's experience on UMTS cell planning with our main customers.
  The higher the speed of the vehicle is the faster the ML8720B needs to sample. The lower the speed of the vehicle is, the slower the measurement sample of the ML8720B should be to correctly take into acocunt the effects of multipath propagation.

## GLOSSARY

- CPICH : Common Pilot Channel
- RSCP:Received Signal Code Power
- No:Total in-band received power (RSSI)
- Ec/No:Received energy per chip divided by the power density in the band
- SIR:Signal-to-Interference Ratio
- SIR=RSCP/ISCP
- ISCP=Interference Signal Code Power
  Given only interference is received, the average power of the receive signal after despreading and combining. Equivalent to the RSCP value but now only interference is received instead of signal



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Specifications are subject to change without notice.

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