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APPLICATION NOTE

ML8720B

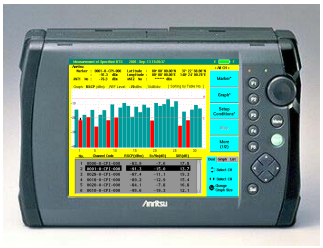
W-CDMA Area Tester

BCH Demodulation Function

ANRITSU CORPORATION

New option for the Anritsu ML8720B W-CDMA Area Tester

BCH Demodulation Function



Anritsu Corporation
Wireless Measurement Division
June 2005

PART 1
Introduction to BCH Demodulation

In the process of 3G network optimization, there are many serious concerns. Through customer visits, we determined that the major factors are:

a. Incorrect parameter setup at Node B

b. Interference and noise in the Uplink

Resultant Effects

1. Call Drops: When a subscriber moves to a neighbor cell

2. Unable to make a call: In spite of the mobile device indicating coverage

3. Slow data transmission: When downloading data such as pictures

BCH Demodulation provides a solution

What is BCH Demodulation?

BCH: Broadcast Channel

- This is one of the Downlink Transport Channels
- It is always transmitted to all Cells via the P-CCPCH

(Primary Common Control Physical Channel)

- It broadcasts fixed System and Cell information

Some of the Information transmitted by BCH

Cell ID, RNC Parameters, Measured Uplink Interference Power, Peripheral Cell Information, etc...

Value 1: Detection of incorrect Node-B parameters

Node-B Parameters

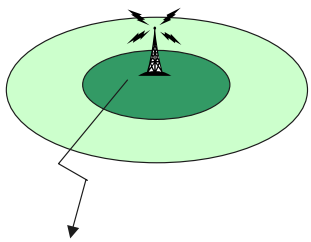
The initial values are changed as a result of either network field trials and debugging or coverage analysis of the radio environment.

RNC Parameters ?

Neighbor Cell List ?

Transmit Power ?

Cell-Id ?



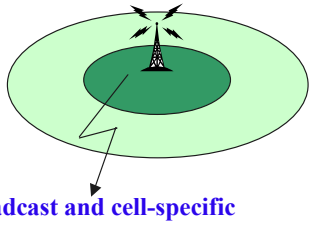
At the time of optimization, field engineers are sometimes not 100% sure of the current values and their validity.

A wrong parameter on a neighbor cell list may result in handover failure.

Value 1: Detection of incorrect Node-B parameters

The value of the Node-B parameters can be checked by means of the BCH demodulation feature without the need to access the site or NOC.

This ensures optimization of the area under the correct Node-B conditions.



Broadcast and cell-specific information contained in BCH (SIB1, SIB2, …, SIB18)

RNC Parameters

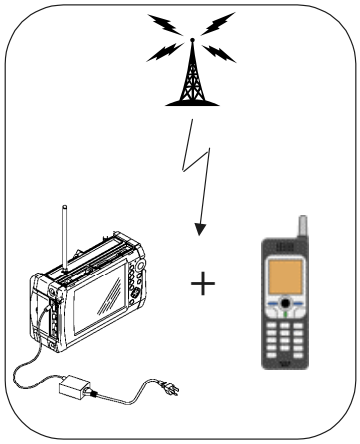
Neighbor List

Transmit Power

Cell-Id

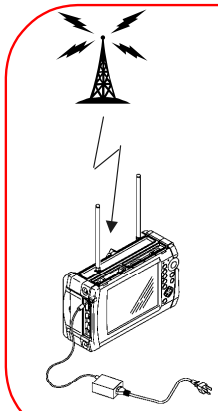
Value 1: Detection of incorrect Node-B parameters

Before



Few measurements other than P-CPICH made

Now



Broadcast Information in BCH (SIB1, 2,……18)

Example of captured data:

SIB3: Cell ID

SIB5: Transmission Power

SIB11: Neighbor List

P-CPICH measurements + BCH demodulation

Value 2: Evaluation of interference in the Uplink

Uplink interference can be caused by…..

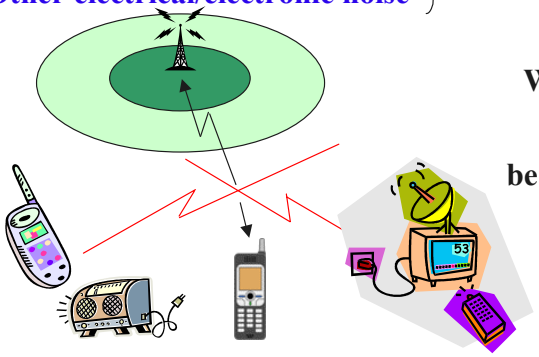
Other 3G UEs within the cell

- Poor power control (NW and UE)

RF sources

Other electrical/electronic noise

All these sources can generate energy that results in interference even though EMC and UE conformance testing is strict.

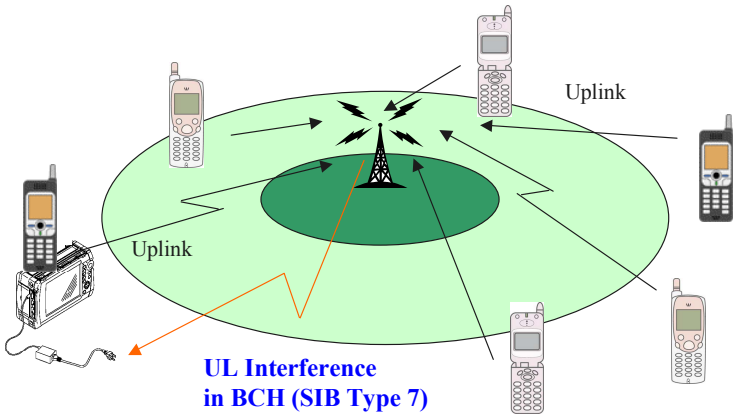


W-CDMA systems are noise limited, so communications can often be disrupted by noise and interference.

Excessive Uplink interference will cause restrictions to cell traffic.

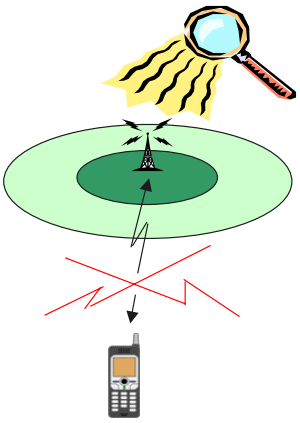
Value 2: Evaluation of interference in the Uplink

Using the ML8720B, it is possible to check the UL-Interference level, recorded at the Node-B, by demodulating the BCH and extracting the reported UL-Interference in the cell information from the SIB7 messages.



Value 2: Evaluation of interference in the Uplink

When the value of UL-Interference is large in an area where the traffic is low, a high level of interference may be restricting cell traffic.



Key point

Generally, the NOC (OMC) averages the value of the Node-B interference over a 15 minute period.

As a result, it is impossible to catch 'bursty' interference

The Anritsu ML8720B makes its measurements in real time and can capture 'bursty' interference.

Comparison 1: UE and ML8720B

Every UE supports BCH Demodulation, however there are functional restrictions.

1. **A UE demodulates only at times controlled by the UE Protocol Stack.**
   - **When the UE is first switched on and registers on the network**
   - **When a handover is initiated**
   - **In the call setup routine…**

2. **A UE cannot demodulate BCH signals from a specified Node-B.**

BCH Demodulation on ML8720B is continuous, real time, and calibrated

Comparison 2: UE and ML8720B

3. There is a Data Synchronization Difficulty

Even if there are some restrictions, it is possible to demodulate BCH with a UE. However it is difficult to merge and synchronize the demodulated signals and data received by a UE with P-CPICH received by a scanner.

When there is a call drop problem likely caused by high UL- Interference, it is necessary to compare the location and time of the downlink measurement data with the broadcast information.

By comparing this information, one can understand if the problem was caused by Uplink interference, Downlink interference, or erroneous Node-B parameters.

The ML8720B can save all the necessary information to compare.

BCH Demodulation function: Basic Specifications

Demodulation Data:

MIB, SB1, SB2, and SIB1 to SIB18 **[Related Standard: TS25.331]**

The measurement period for SIB7 is selectable from 2 to 300 sec.
As for other SIBs, the measurement period is not specified and depends on the radio environment.
Current thoughts are to set the measurement period to around 10 sec (3 times the retry time).

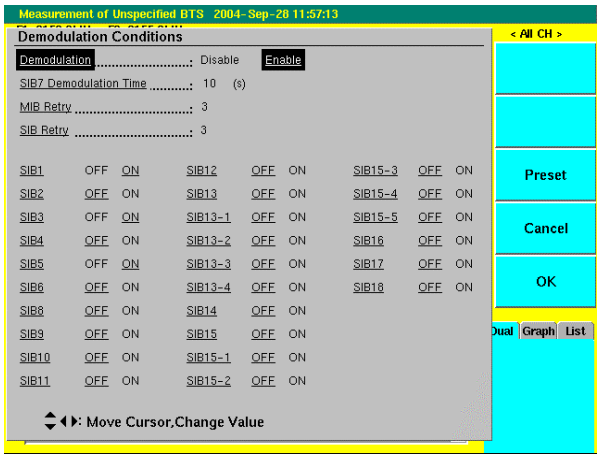
Performance:

Processing time: 0.5s (2 frames of P-CCPCH)
Probability: more than 50% (typical 70%) at SIR10dB, 0 to 100km/h

PART 2
Anritsu BCH Demodulation Software Applications

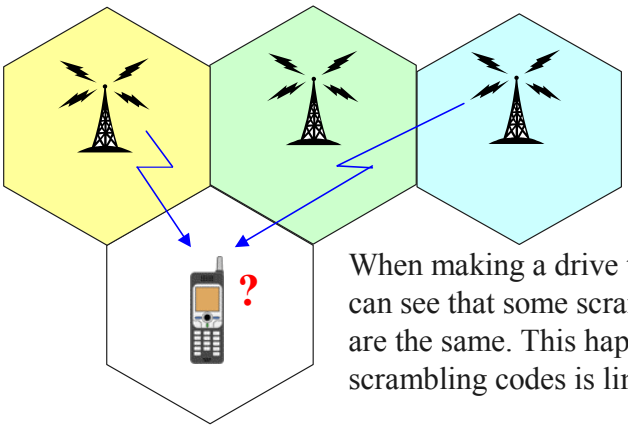
The purpose of ML8720B BCH Demodulation is to use SIB (System Information Block) information. SIB information helps find problems like call drop or handover failure.

SIB information ranges from 1 to 18, and some of these will be used for future applications. Currently, the most important SIBs are SIB3, 5, 7, and 11 because most of the current optimization problems are related to these items. In this document, we introduce the application or value of the information from these SIBs. Anritsu's BCH Demodulation software provides SIB3 and SIB7 in real-time.



SIB3 (Cell ID): Application 1

The value of using SIB3 information is to identify the measured cell. A UE checks its location using this information.

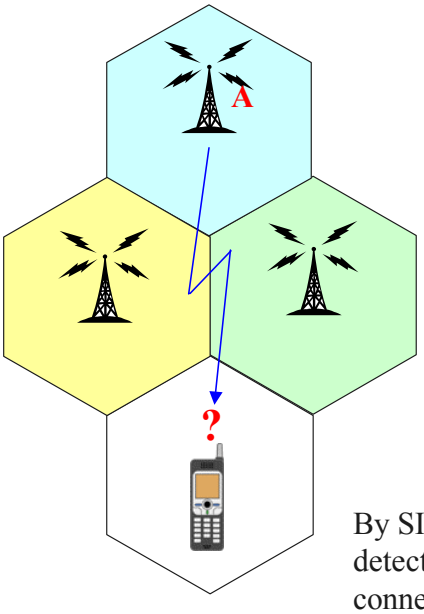


Without Cell ID, those cells with the same scrambling code might cause confusion and one cannot ensure which Node-B a detected signal originated from.

When making a drive test in a densely populated area, one can see that some scrambling codes from different cells are the same. This happens because the number of primary scrambling codes is limited to 512.

By demodulating SIB3 one can check in real-time that the detected signal is the correct one (assuming connection to a data collection tool.)

SIB3 (Cell ID): Application 2



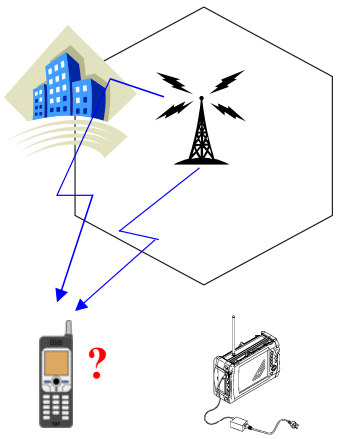
One can check if the current signal is from the nearest cell by SIB3. If not, the call can drop as the neighbor cell list will be in correct for the UE's actual location.

In most cases, this can be verified by the scrambling Code, but many operators manage cell maintenance by Cell ID rather than by scrambling code. Therefore, it is easier to compare the measurement data with the Cell ID information held at NOC. Also, this can avoid the confusing situation of the same scrambling code being used for different cells.

By SIB3 demodulation one can check in real time that the detected signal is from the nearest cell (assuming connection with a data collection tool.)

SIB5 (Transmission Power): Application

The purpose of using the SIB5 information is to compare the transmitted power from the Node-B as measured by the ML8720, with the estimated value which is calculated by subtracting the theoretical power loss due to distance from the Node-B Tx power value stated in SIB5.

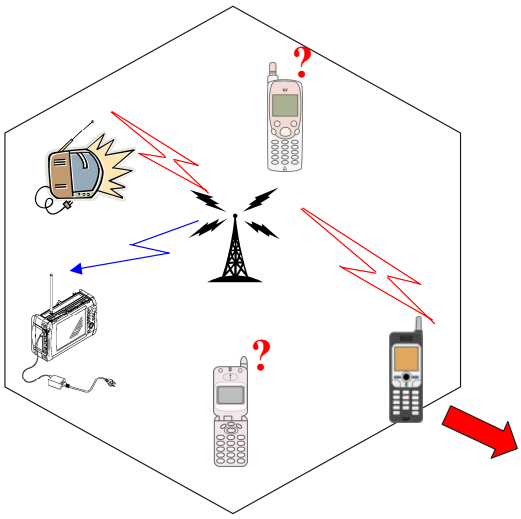


If the actual power is less than the estimated simulated value, it is assumed that the UE detects only reflected signals due to obstacles such as buildings.

If the actual power is larger than the estimated simulated value, it indicates that there is something wrong with the power control system of the Node-B or that there are erroneous parameter settings.

With SIB5, one can check that the parameters on the specific Node-B are correct (used together with SIB3 information)

SIB7 (UL-Interference): Application

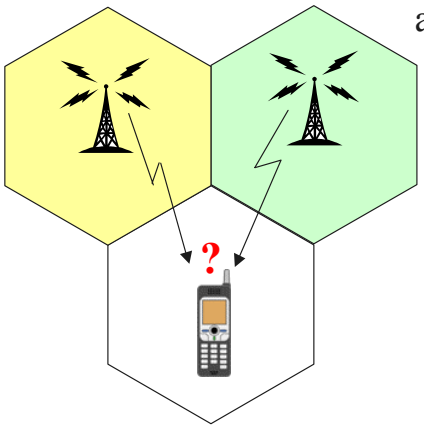


One can quantify if the UL-interference exists by using SIB7.

If UL-interference exists in a cell, it would disturb the other users (call drops, slow data download,…)

A UE that fails to control its minimum output power function or has poor power control could generate significant power, resulting in UL-interference.

SIB11 (Neighbor List): Application



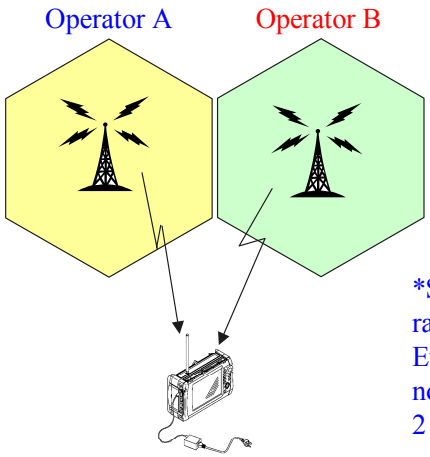
One can verify that the neighbor cell list provided by the Node-B reflects the actual network situation for neighbor cells.

UEs usually seek neighbor cells based on the SIB11. If the actual neighbor cells do not reflect SIB11, then UE mobility is detrimentally affected.

When you analyze the cause for calls dropping after optimization, you can identify if there are missing neighbor cells.

In conjunction with Option 03 (2nd RF)

If the BCH demodulation function is used in conjunction with option 03 (2nd RF), it can provide a BCH benchmark between operators.



One can compare the SIB parameters for each operator. This combined solution is provided only by the Anritsu scanner because option 03 is also equipped with an another rake receiver*.

*Some other scanners support 8 or 12 frequencies with 1 rake receiver and the frequencies are switched by software. Even if a BCH feature is supported in the future, it will not be possible to do a simultaneous BCH demodulation of 2 frequencies due to the time it takes to demodulate BCH.

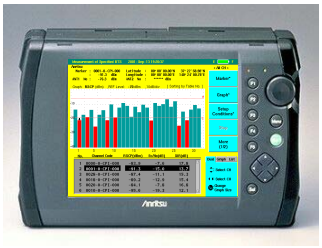
Summary

1. **BCH Demodulation is a powerful solution for:**
   a. **Node B parameter verification**
   b. **Detection and reduction of interference in the up-link**

2. **The value of the ML8720B BCH Demodulation exceeds that of a combined scanner and UE solution because:**
   a) **The UE demodulates only at specified times.**
   b) **The UE does not demodulate signals from specified Node-Bs.**
   c) **The UE does not synchronize the demodulated signals received by the UE and standard scanner.**

New option for the Anristu ML8720B W-CDMA Area Tester

APPENDIX



Anritsu Corporation
Wireless Measurement Division
November 2004

Appendix

BCH Demodulation function: Basic Specifications

Demodulation Data:
MIB, SB1, SB2, and SIB1 to SIB18 **[Related Standard:TS25.331]**

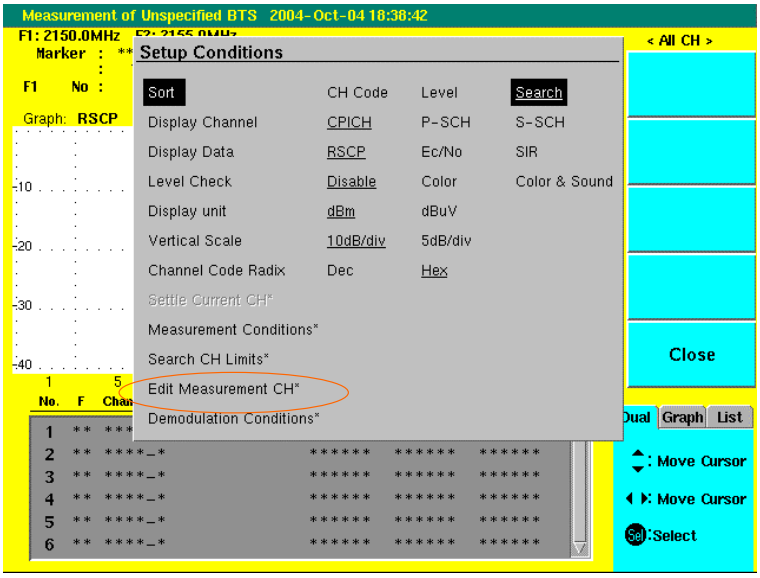
The measurement period for SIB7 is selectable from 2 to 300 sec.
As for other items, the measurement period is not specified and it depends on radio environment. One idea about the measurement period is around 30 sec. (the condition of the retry time at "3").

Performance:
Typical Value : 1 block (2 frame) 98% at Ec/No -17dB

Demodulation time:
Typical Value : 1 block (2 frame) less than 0.5s

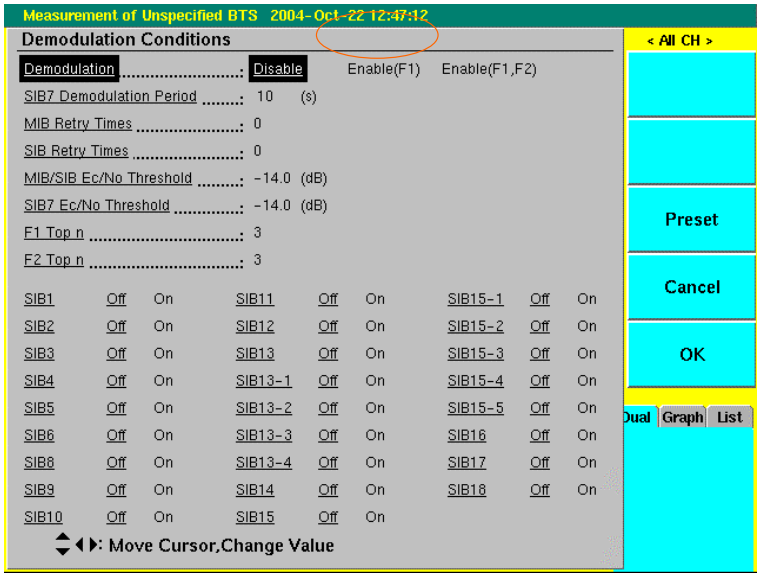
Appendix

BCH Demodulation function: Setting parameter [1]



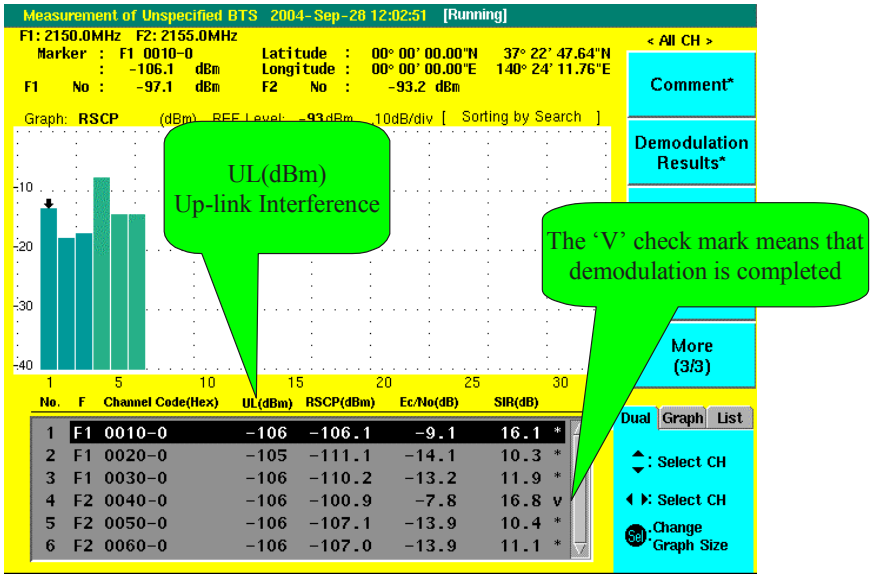
Appendix

BCH Demodulation function: Setting parameter [2]



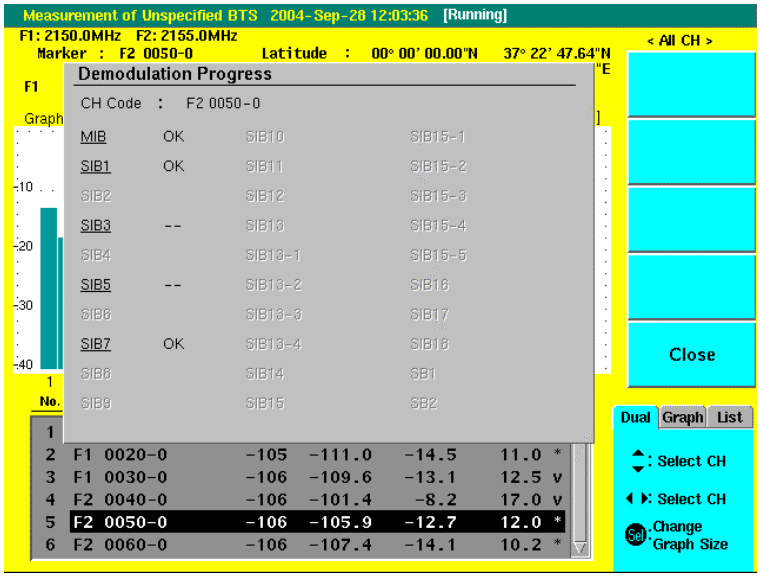
Appendix

BCH Demodulation function: Display Image [1]



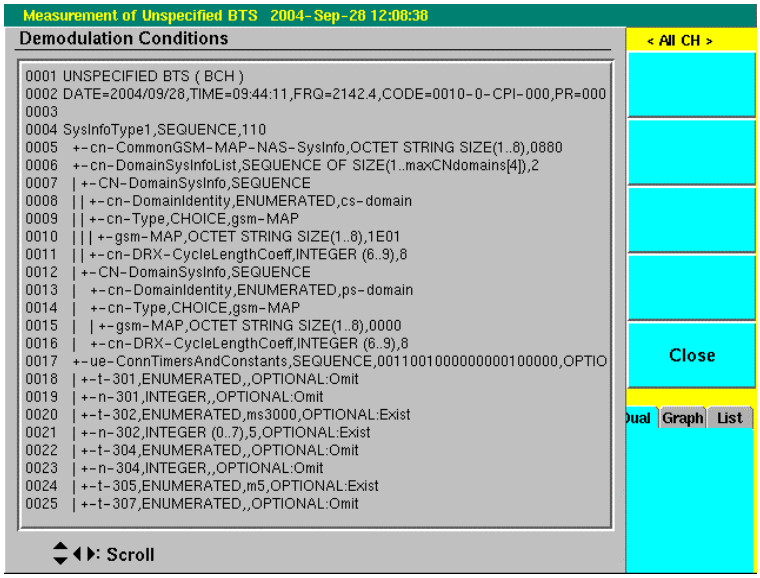
Appendix

BCH Demodulation function: Display Image [2]



Appendix

BCH Demodulation function: Display Image [3]



Appendix

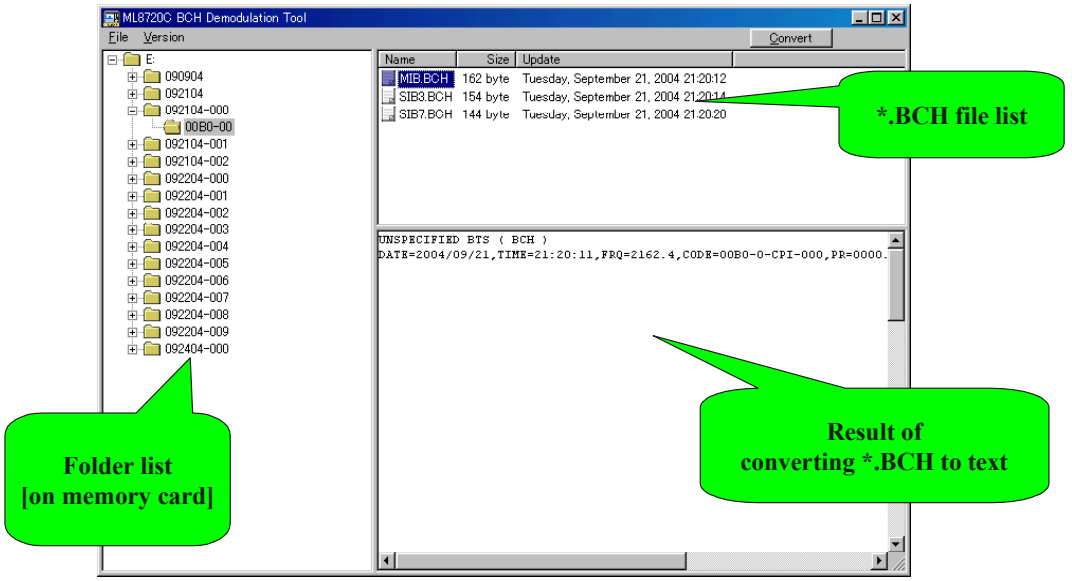
BCH Demodulation: UL data file

Up-link Interference data: (*.ULD) text file

```
UNSPECIFIED BTS ( UPLINK )
MAPD=10,DATE=2004/10/06,DML= 1,INT=1.00S,FRQ=2162.4,MODE=2,UNIT=DBM,RP=
NO,TIME,LATITUDE,LONGITUDE,CH1_CODE,CH1_UPLINK,CH2_CODE,CH2_UPLINK,
0000014,06:46:46,3736.4580N,14027.8490E,0088-0-CPI-000,-106,0080-0-CPI-000,-105,,,,,,
0000027,06:46:59,3736.4580N,14027.8480E,0088-0-CPI-000,-106,0080-0-CPI-000,-105,,,,,,
0000042,06:47:14,3736.4580N,14027.8480E,0088-0-CPI-000,-106,0080-0-CPI-000,-105,,,,,,
0000045,06:47:17,3736.4570N,14027.8480E,0088-0-CPI-000,-106,0080-0-CPI-000,-105,,,,,,
0000055,06:47:27,3736.4550N,14027.8440E,0088-0-CPI-000,-106,0080-0-CPI-000,-105,,,,,,
0000068,06:47:40,3736.4430N,14027.8560E,0088-0-CPI-000,-106,0080-0-CPI-000,-105,,,,,,
0000082,06:47:54,3736.3790N,14027.8500E,0088-0-CPI-000,-106,0080-0-CPI-000,-105,,,,,,
```

Appendix

BCH Demodulation: BCH Demodulation Tool*



* Standard accessory for BCH Demodulation Software

Anritsu

Specifications are subject to change without notice.

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050203

Printed on 100% Recycled Paper

No.ML8720B-E-F-2-(1.00) Printed in Japan 2005-7 AKD