Anritsu

MS8911B-052
DVB-TH SFN Field Measurement Software

MS8911B
Digital Broadcast Field Analyzer

Contents

Introduction

This document is intended for skillful use on MS8911B-052 DVB-T/H SFN Field Measurement Software* (Hereinafter, abbreviated to this software).

With this software, the user can accurately measure the level under SFN environment, although there are several incoming signals.   This software can actualize the measurement, which has been for long time considered very difficult to realize.

This document provides measurement procedure or precaution when using this software, so that the user can perform the correct measurement.   Principle of measurement is also described.   Please look over this document before using this software.

Section 1   How to Use this Document

1.1   When Using this Document For the First Time

We recommend the user to look over this document in series, before using this document for the first time.

1.2   When Checking in Accordance with the Intended Use

Please choose the necessary section from the following categories.

1. To know all about the MS8911B-052:   Section 2 Brief Introduction of this Software
2. To know about the principle of measurement: Section 3 Measurement Principle
3. To measure the field strength: Section 4 Field Strength Measurement
4. To measure the delay time: Section 5 Delay Time Measurement
5. To get the knack of measurement: Section 6   Measurement Key Points
6. To know whether the measurement is accurate: Section 7 Measurement Display

Section 2 Brief Introduction of this Software

2.1 MS8911B-052 DVB-T/H SFN Field Measurement Software

MS8911B-052 DVB-T/H SFN Field Measurement Software (hereinafter, abbreviated to this software) is the option for the MS8911B.   The user can use this software by installing this into the MS8911B*.   This software is targeted mainly to perform the following operation.

1.   To calculate the field strength accurately for each incoming signal, mainly under SFN environment
2.   To check the incoming electric signal or delay adjustment easily under SFN environment

*: When installing a software into the unit after having purchased MS8911B, Anritsu may take back the unit for software install.

2.2 Main Measurement Items and Functions

Main measurement items and functions are as follows.

- Delay time, signal level, field strength and DU ratio for each incoming signal
- Terminal level (channel power, terminal voltage, and field strength as the total power for all incoming signals)
- Impulse response realizing to measure the broad range of ± 1 ms
- Sidelobe canceling function for main signal

2.3   Field Strength Measurement under SFN Environment

When measuring the field strength for target broadcast station, the user conventionally had to stop the output from the other broadcast station.

With this software, the user can measure the level for each incoming signal under the situation where several DVB-T/H signals of the same frequency are existing, such as SFN environment.   So, there is no need to stop broadcasting, in order to calculate the field strength.
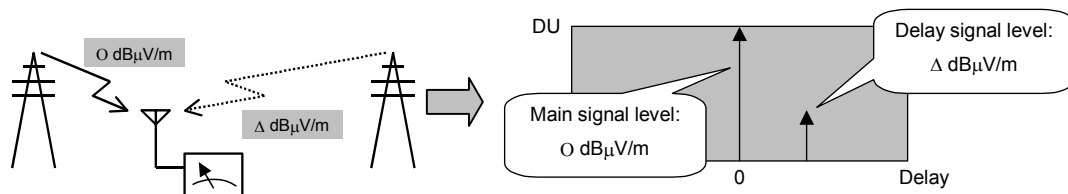
Figure 2.1   Level Measurement for Each Incoming Signal

2.4　SFN Delay Adjustment and its Verification

When constructing SFN, delay adjustment is performed by adjusting the launching timing of each broadcast station, so that time difference of the incoming signal within the reception area becomes, in the last result, fit into the guard interval.　When measuring the delay time for its verification, the delay time well over the guard interval length might occur.　In this case, with the conventional impulse response measurement making use of pilot, the correct measurement might be impossible.

By holding the broad range of about ±900 μs to measure, delay time can be easily checked even if there is a considerable delay.　Also, unexpected incoming signal from distant place can be, with high possibility, grasped.
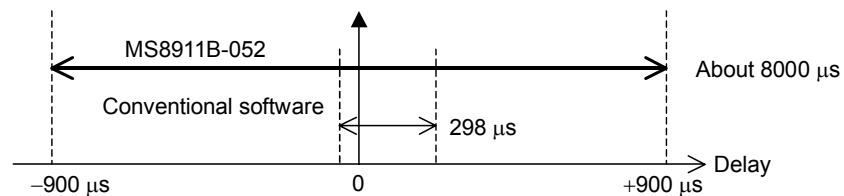
Figure 2.2　Impulse Response Measurement Range Comparison
(8MHz Band Width, 8K mode)

2.5　The Difference from the Conventional Software (Impulse Response)

This software (Especially impulse response measurement) has the following main differences from the conventional software such as MS8911B-050 DVB-T/H Analysis Software.

<Performance Digitalization such as DU ratio and absolute level for each incoming signal>

Impulse response performance standardization
Impulse response level accuracy improvement (Algorithm for measuring the accurate DU ratio is adopted)
Level display for each incoming signal
Automatic display of main signal absolute level, which is calculated by discriminating the necessary signals from impulse response and combining these signals with the measurement value
(From impulse response, incoming signal necessary to calculate is to be discriminated and figured out)
The level of another incoming signal (delay signal) can be read out by adjusting marker. This level value is calculated by using DU ratio, based on main signal level.

<Impulse Response Actualizing Wide Range of Measurement in Terms of Time>
Impulse response measurement is actualized, in which pseudo-path by alias does not occur within the wide range of about ±1ms, so that delay adjustment and its check can be smoothly done under SFN environment. [*]

[*]: In the conventional method, which uses the typical pilot, when the delay signal over one-third of OFDM symbol time range (At 8MHz Band Width, 8K mode, 896/3 = 298 (μs)) exists, pseudo-path is sometimes displayed at the different time position.

Section 3   Measurement Principle

3.1   Outline

With the MS8911B-052, three kinds of measurement are simultaneously done at one time and by combining all the result together, the level for each incoming signal is calculated. (See figure 3.1)
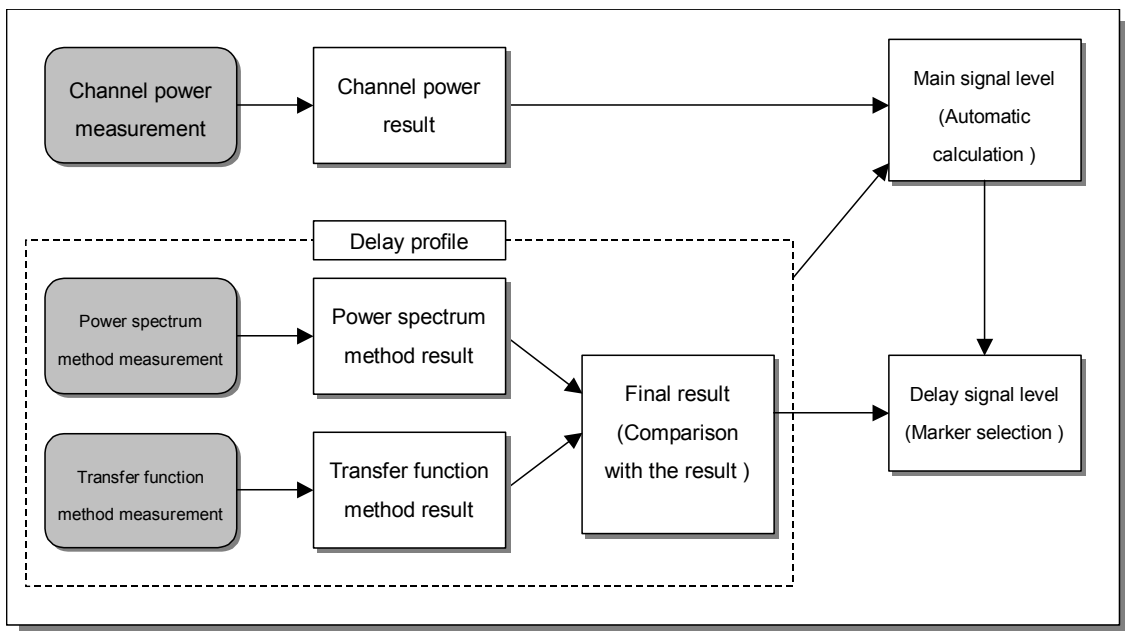
Figure 3.1   MS8911B-052 Measurement Outline

Basic Flow

1. 7.6-MHz (Band Width 8MHz) band channel power is measured
2. Impulse responses by different two algorithm (Power spectrum method and transfer function method) are measured
3. Pseudo-path is discriminated by comparison with impulse response result and then a impulse response is, as a result, derived
4. Main signal level is automatically calculated
5. Level and DU ratio are calculated by making the marker position on the impulse response as incoming signal

3.2   Channel Power (In-band Total Level)

In the measurement of channel power at figure 3.1, DVB-T/H signal power is measured. Here, signal power of 7.6-MHz (Bandwidth 8 MHz) bandwidth is simply measured to show the terminal input total level.

This measurement is using the same method with the channel power measurement (field strength measurement) of Anritsu MS8911B-050 DVB-T/H Analysis Software.   And this will bring, on the principle, the same results, in case of the same signal.   Also, in order to calculate the stable power even at one measurement, MS8911B-052 uses the averaging procedure for the channel power.   This is corresponding to 100 times in case of MS8911B-050.

3.3   Impulse response

In the measurement of impulse response at figure 3.1, impulse response showing the incoming signal DU ratio and delay time is measured.   To calculate the impulse response, the measurement methods by different algorithm are combined.

Power spectrum method
Transfer function method

There are the main following features for each principle.

	Power Spectrum Method	Transfer Function Method
Merits	•Even if signal quality is significantly deteriorated, the accurate DU ratio can be comparatively acquired	•Time advance or lag can be discriminated toward main signal •Pseudo-path is not likely to occur under good condition
Topics	•Time advance or lag cannot be discriminated toward main signal •Pseudo-path is likely to appear •Fixed pseudo-path is likely to occur, independently of signal quality	•When level is extremely deteriorated, or multi-paths, such as exceeding over guard interval exists, DU ratio accuracy is deteriorated.

By combining each result, more accurate impulse response can be achieved.

Section 4   Field Strength Measurement (Height Pattern Measurement)

4.1   Measurement Contents

This section introduces the method to measure field strength for target broadcast station under SFN environment.   First, height pattern measurement is taken for instance.

The following description is based on the assumption that incoming signal of higher level is to be measured.   In figure 4.1, incoming signal for broadcast station A is measured.
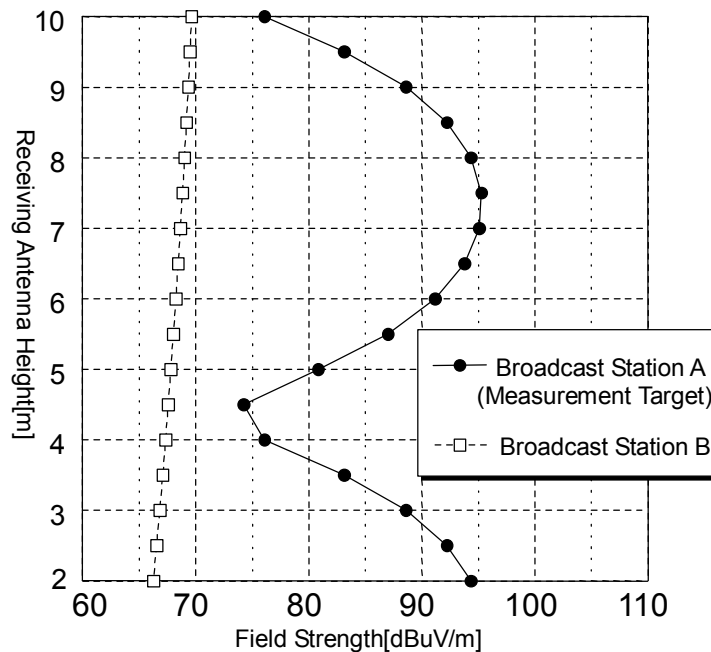
Figure 4.1   Example of Height Pattern Measurement

Note: In order to display field strength correctly as the measurement value, correction table for field strength is necessary.

Refer to Section 4.3 Field Strength Display in this note, for details on the information.

4.2   Note when Measuring

Note the followings in order to measure the level for each incoming signal with this software.

When using a directional antenna, turn the antenna toward the direction of the incoming signal, of which level is to be measured.

4.3   Field Strength Display

By storing the field strength correction table on MS8911B beforehand, field strength can be directly read for measurement.   Field strength of the MS8911B can be calculated by the following steps.

1.   To measure the MS8911B terminal power
2.   With the following formula, the field strength is calculated

(Field strength [dBμV/m]) = (Terminal voltage [dBμV]) + (Correction [dB])

When calculating the field strength for each incoming signal, the same correction value is used.   In this case, "terminal value voltage" on the formula above means "terminal voltage for each incoming signal".

Refer to Section 2.2.3 System Connection described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual, for details on the information.

Note: Since the same correction table is used to convert the field strength for each channel and incoming signal, field strength might not be sometimes correctly displayed, for antenna gain becomes different when the arrival directions differs. In order to simultaneously calculate the field strength for several incoming signals, the correction value of antenna again has to be separately calculated.

4.4 Measurement Flow (Outline)

The following shows the operating procedure to calculate the field strength from height pattern. Refer to Section 4.5 Measurement Procedure in this note, for details on the information.

Preparation:

1. Adjust the antenna direction
2. Connect an antenna to the MS8911B

Adjustment:

3. Set the channel (frequency) to measure
4. Adjust the reference level (This can be automatically adjusted)
5. Set the measurement parameter (This can be automatically set)
6. Adjust the antenna direction

Measurement:

*: Repeat the steps of 7 to 10, as necessary.

7. Adjust the antenna height
8. Adjust the reference level
9. Makes a measurement
10. Records the measurement (Create the height pattern)
11. Calculate the field strength from the level

4.5   Measurement Procedure

Refer to the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual, for details on the following notation on the manual.

1. Antenna Direction Adjustment

    Turn the antenna in the direction of the incoming signal, of which level is to be measured.   Normally, direct antenna toward the direction of the broadcast station, which is measuring object.

    Note: The correction value, used to convert terminal power into field strength, is normally defined, based on the highest antenna gain.   When measuring, turn the highest gain into the direction of the incoming signal of which level is to be measured.

2. Connect an Antenna to the MS8911B

    Connect an antenna to the MS8911B.   If there is an excessive input to the MS8911B, be careful of the signal level to be input to the MS8911B, by inserting the attenuator between antenna and the MS8911B or turning off the pre-amplifier beforehand.

    Refer to Section 2.2.3 System Connection and 2.4.3 Reference Level Setting described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual, for details on the information.

3. Set the Channels (Frequency) to Measure

    Set the channels (or frequency) to measure.
    Refer to Section 2.4.2 Setup of Frequency/ Channel described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

4. Adjust the Reference Level

Adjust the reference level to make the hardware suitable for signal level.　Usually, use the function of Auto Reference Level.

Refer to Section 2.4.3 Reference Level Setting described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

5. Measurement Parameter Setting

To take a correct measurement, set the necessary parameters.　The followings are the necessary parameters.

1. Mode, GI, TPS Information

2. FFT start position as necessary

3. Antenna (Correction Level)　(This is necessary when reading the field strength directly)

4. Impedance

5. Impedance Loss

Detect Parameter function is helpful to set the Mode, GI, and TPS information.　Set the other parameter manually.

Refer to Section 2.4.4 Measurement Parameter Setup described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

In order to measure the target incoming signal accurately as much as possible, mode, GI and TPS information have to be set.　By adjusting FFT start position, occurrence of pseudo-path can be controlled in the measurement.

Refer to Section 6.3 Control of Pseudo-Path Occurrence in this note.

6. Fine adjust the antenna direction

Adjust the antenna direction, so that the target incoming signal level becomes the largest.　There are two methods to adjust the antenna direction.

1. Adjust the antenna, so that the channel power becomes the largest.

2. Adjust the antenna, so that the main signal level (incoming signal of measuring object) becomes the largest.

Refer to Section 2.4.5 Marker Setup, 2.4.6 Measurement Execution, 2.4.7 View on Measurements, 2.4.8 View on Impulse response, all of which are described in the

MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

Note: Antenna direction can be adjusted, only with channel power, on the condition that incoming signal of measuring object is fully larger than the another incoming signal level.   In this case, MS8911B-050 is very useful and the user can promptly measure and adjust the channel power.

When the incoming signal of measuring object is not fully larger than the level of another ones, the antenna direction cannot be accurately figured out, only with channel power.   In this case, use the MS8911B-052 and adjust the antenna direction with the level only for incoming signal.

7.   Adjust the antenna height to the level to measure.   (Repeat the steps of 7 to 10, as necessary)
Adjust the antenna height.   Repeat the steps of 7 to 10, depending on the measurement point number.

8.   Adjust the reference level as necessary
When changing the antenna height, status of "over-range" or "under-range" are displayed on the measurement screen because of level change.
Refer to Section 2.4.3 Reference Level Setting described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

9.   To Take a Measurement
Takes a measurement and acquire a main-signal level.
Refer to Section 2.4.5 Marker Setup, 2.4.6 Measurement Execution, 2.4.7 View on Measurements and 2.4.8 View on Impulse response Measurements, all of which are described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

Note: For the accurate measurement of impulse response, target incoming signal of the impulse response has to be discriminated.   → Refer to Section 6.1 Judgement of Incoming Signal in this note.

10. To Record Measurements (Creation of Height Pattern)

The results gained at step 9 are recorded as height pattern of the measuring object field strength or power value for antenna height.   When the height pattern behavior is found to be different from expectation such as the movement of incoming signal display position, note that there is no error with reading the measurement.
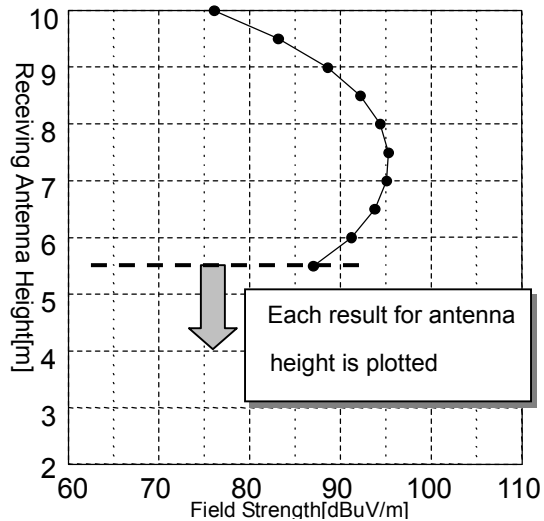
Figure 4.2   Height Pattern Creation

11. To Calculate the Field Strength

Calculate field strength E0, assuming that the maximum level point of height pattern is to be 2E0 (Ground return factor: 1).

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Section 5   Delay Time Measurement

5.1   Purpose

In order to adjust and check the delay quantity, each delay time among the broadcast stations is measured.

5.2   Note When Measuring

Please pay attention to the following points when measuring the delay time with this software.

1.   Be sure to choose the place in plain view from each broadcast station to measure the delay time, so that the direct signal can be measured.
2.   Avoid the unnecessary delay signal as much as possible, by thoughtfully choosing the measurement location.   This is to recognize the target incoming signal easily and correctly.

5.3   Measurement Flow

The steps necessary for measuring the delay time are as follows.   Refer to Section 5.4 Measurement Procedure in this note, for details on the information.
1.   Set an antenna
2.   Connect an antenna to the MS8911B.
3.   Set the channels (frequency) to measure
4.   Adjust the reference level (This can be automatically adjusted)
5.   Set a measurement parameter (This can be automatically adjusted)
6.   Start a measurement

5.4 Measurement Procedure

Please refer to the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

1. To set up an antenna

    Set up an antenna, so that all the incoming signal of which delay to measure can be received.

    Note: When measuring only delay time, measurement can be more smoothly done by not directing the antenna toward the target incoming signal.
    Refer to Section 6.4 Emphasizing the Target Incoming Signal in this note.

2. To connect the MS8911B to an antenna

    Connect an antenna to the MS8911B.   If there is an excessive input to the MS8911B, be careful of the signal level to be input to the MS8911B, by turning off the preamplifier beforehand or inserting the attenuator between an antenna and the MS8911B.
    Refer to Section 2.2.3 System Connection and 2.4.3 Reference Level Setting described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual, for details on the information.

3. To set the channels (frequency) to measure

    Set the channels (frequency) to measure.
    Refer to Section 2.4.2 Setup of Frequency/ Channel described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual, for details on the information.

4. To adjust the reference level

    Reference level is adjusted, to set the hardware compatible with signal level.   Usually, Auto Reference Level Function is used.
    Refer to Section 2.4.3 Reference Level Setting in this note.

5. To set the measurement parameter

    To perform the correct measurement, set the necessary parameters.   Necessary parameters are as follows.

1.   Mode, GI, TPS information

2.   FFT start position as necessary

3.   Antenna (Correct Level):   This is necessary to read the field strength directly

4.   Impedance

5.   Conversion loss

Detect Parameter Function is very useful for Mode, GI, TPS information.   Set other parameters manually.

Refer to Section 2.4.4 Measurement Parameter Setup described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

Note: In order to measure the target incoming signal as accurately as possible, the user has to set mode, GI and TPS information.   Adjusting FFT start position can control the pseudo-path occurrence in the measurement.

Refer to Section 6.3 Control of Pseudo-Path Occurrence in this note.

6.   Measurement

Take a measurement and calculate delay time among incoming signals.

Refer to Section 2.4.5 Marker Setup, 2.4.6 Measurement Setup, 2.4.7 View on Measurements, and 2.4.8 View on Impulse Response, all of which are described in the MS8911B Option052: DVB-T/H SFN Field Measurement Software Operation Manual.

Note: Discriminating the target incoming signal leads to the correct measurement in the impulse response.   Refer to Section 6.1 Judgement of Incoming Signal in this note.

Section 6   Measurement Key Points

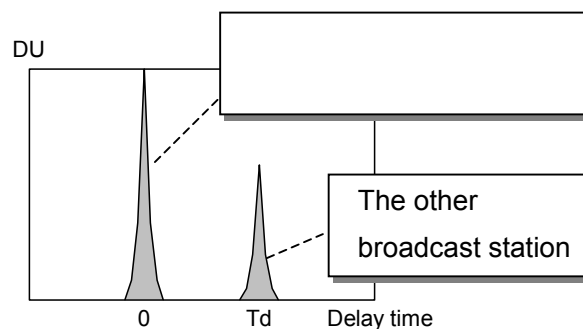### 6.1   Judgement of Incoming Signal

In order to correctly measure the field strength under SFN environment, it is very important to judge the target incoming signal from among several incoming signals.

The following conditions can be helpful to judge the incoming signal.

1. Delay time difference among incoming signals or the information of which incoming signal from the station will arrive first have to be figured out.
2. If there is no information, delay time can be assumed with the other methods.

Refer to Section 6.4 Emphasizing on the target incoming signal in this note.

This software is displaying the highest level's incoming signal as main signal at the location of time 0.   When the user can know the station delivering the incoming signal by the antenna adjustment, incoming signal for another broadcast station is thought to be existing at the location of the assumed delay time.   Even if the user cannot know the detailed information about delay time, only figuring out which incoming signal arrives first would be more helpful to assume the station delivering incoming signal.
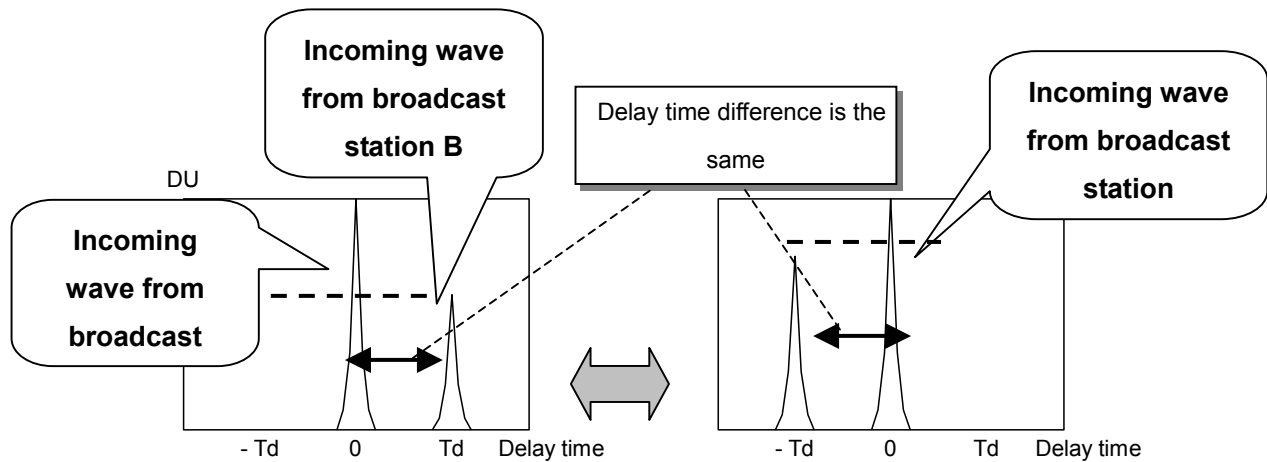

Figure 6.1   Judgement of Incoming Signal

(When Knowing Delay Time among Broadcast Stations (=Td))

6.2   When Level Relationship among Incoming Signals is Reversed

When the level relationship among incoming signals is reversed while measuring the height pattern for two incoming signals, the phenomenon in the figure 6.2 might occur.
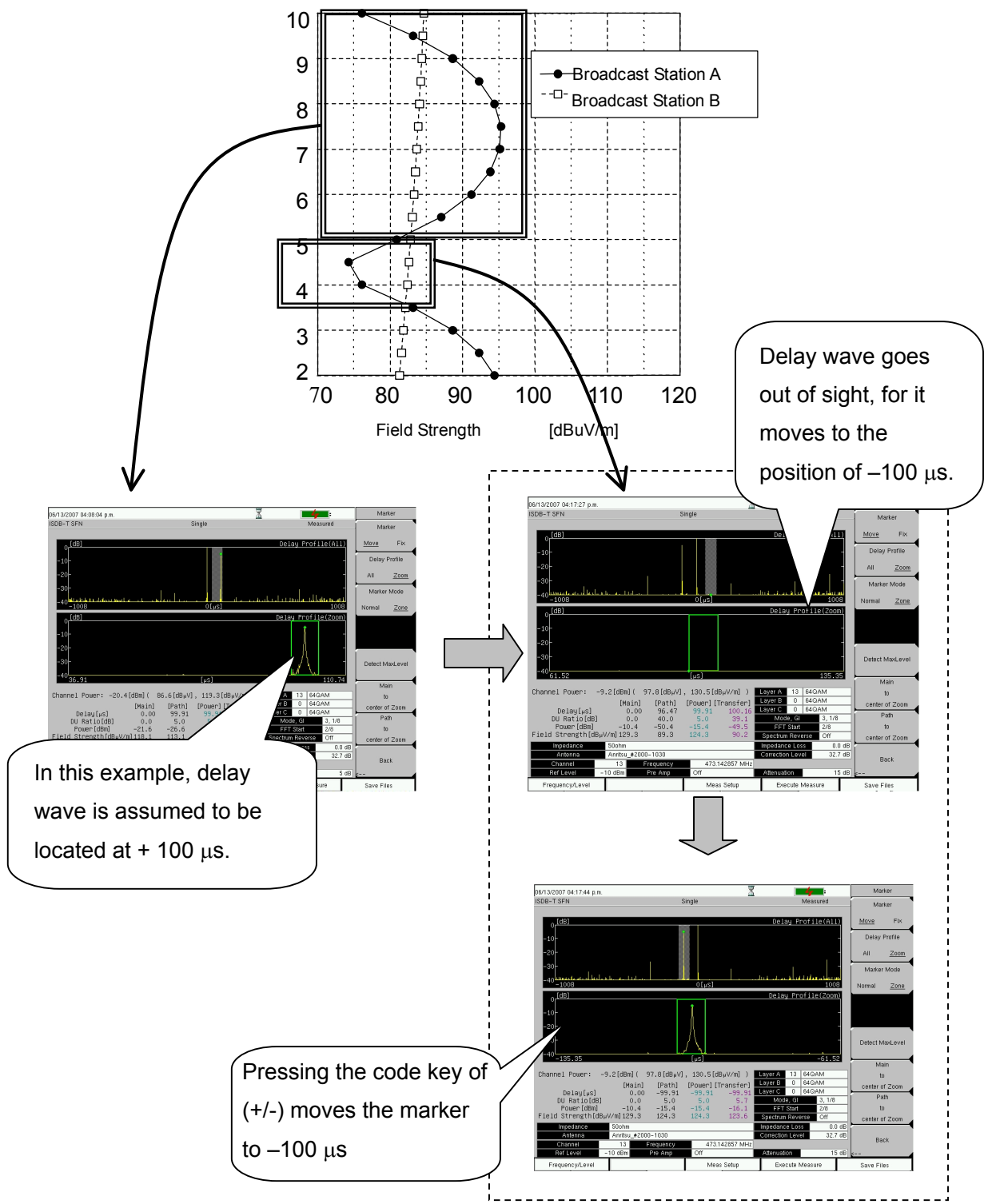

Figure 6.2   Reversion Phenomenon

When the level size is reversed, delay signal (other than time 0) is the incoming signal, which has been a main signal. However, delay time difference among each incoming signal is not changed.

For the countermeasure, marker position can be displaced symmetrically, based on the delay time 0. Symmetric displacement can be done by pressing the code key of +/−. See Figure 6.3.

Note: Reversion phenomenon of the incoming signal level might occur in the following conditions.

1.   When DU ratio between the target incoming signal and the other ones is small
2.   When antenna height is changed

In this example, delay wave is assumed to be located at + 100 μs.

Delay wave goes out of sight, for it moves to the position of −100 μs.

Pressing the code key of (+/-) moves the marker to −100 μs

Figure 6.3   Marker Migration by Code Key (+/−)

(When Level Relationship is Reversed)

6.3   Pseudo-path Occurrence (FFT Start Position Adjustment)

Pseudo-path might occur, depending on the condition such as DU ratio or delay time difference among incoming signals.

1.   When there exists a strong delay signal over GI range
2.   When there are a great number of incoming signals
3.   When FFT start position is not appropriate

By adjusting the FFT start position so that the main delay signal is fit within the GI range, characteristic of transfer function method is improved and pseudo-path can be controlled. Refer to Section 3.3 Impulse Response in this note.

By adjusting the FFT start position to fit the main delay signal into the range of GI, characteristic of transfer function method can be improved and pseudo-path can be sometimes controlled.   Refer to Section 3.3 Impulse Response in this note.
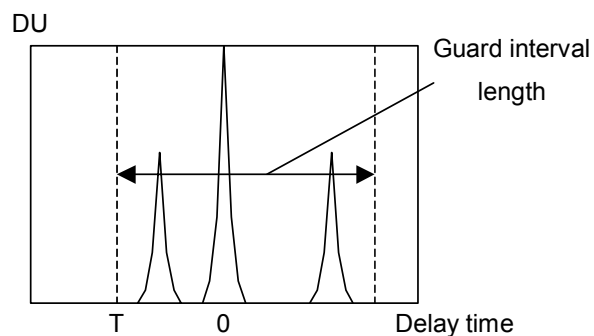
Figure 6.4   FFT Start Position Adjustment

When simulating the GI range to include the main incoming signal, the rough standard is as shown in table 6.1.   In this case, a starting point of the GI range is supposed to be T in the figure 6.4.   However, note that pseudo-path is likely to occur with variability.

**Table 6.1   FFT Start Position Standard**

T Position	FFT Start Position
0 to - (Guard Interval)	0/8 to 8/8 0/8 Fixed to 8/8 Fixed

6.4   Emphasizing the Target Incoming Signal

In order to emphasize the target incoming signal in the measurement of delay time, please try the following methods.

1.   Change the antenna direction
2.   Use a non-directional antenna or weak-directional antenna, such as dipole antenna
3.   Prepare several high-directional antennas, direct each antenna toward the target broadcast station and combine each antenna's signal.

By changing the directional characteristic and reducing DU among incoming signals, direct signal from each broadcast station can be easily seen.   (See figure 6.5)
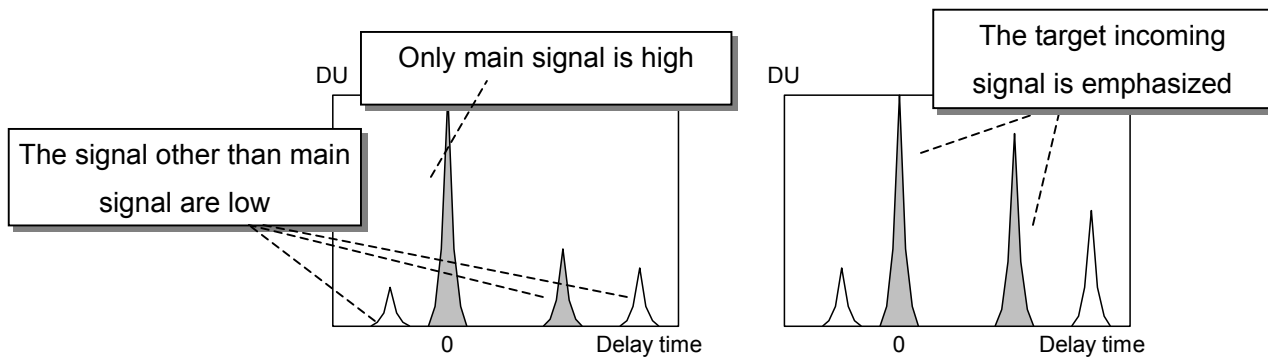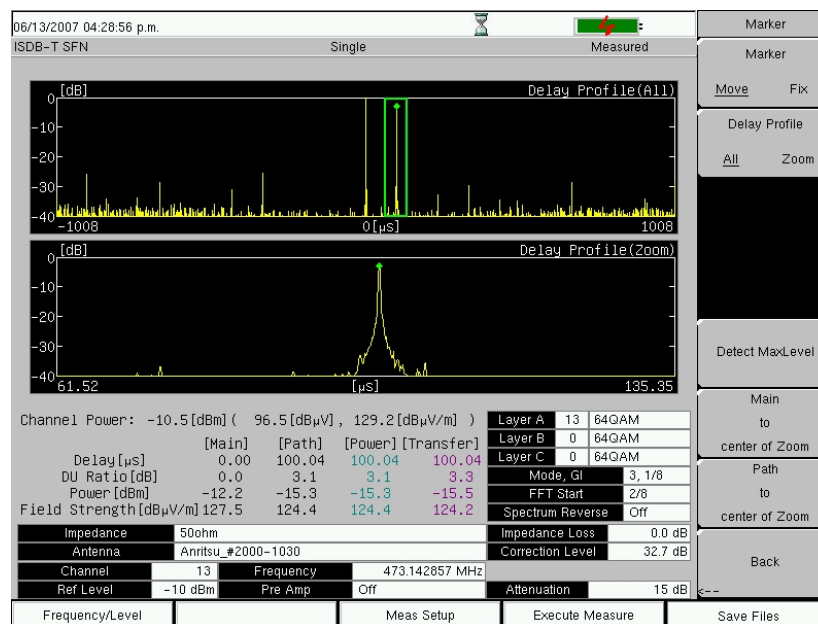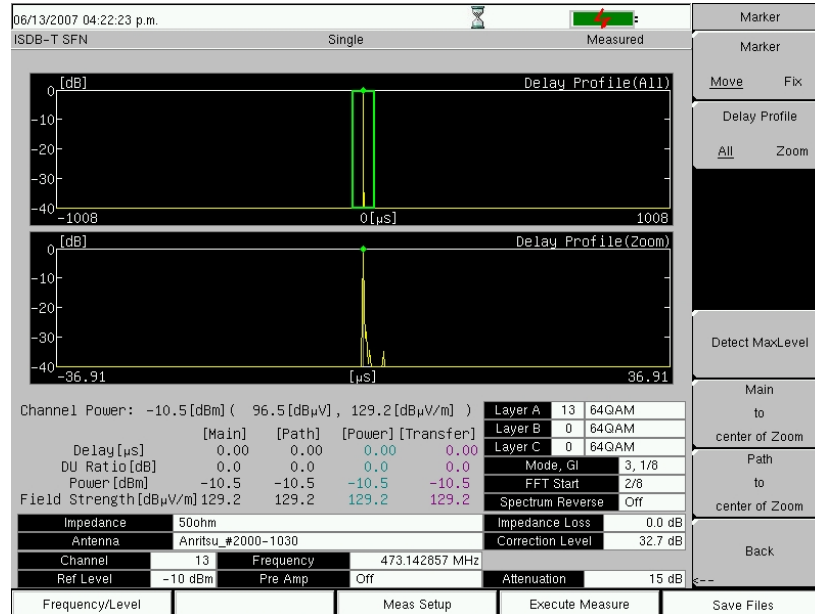

Figure 6.5   Impulse Response Examples by the Directional Characteristic Difference

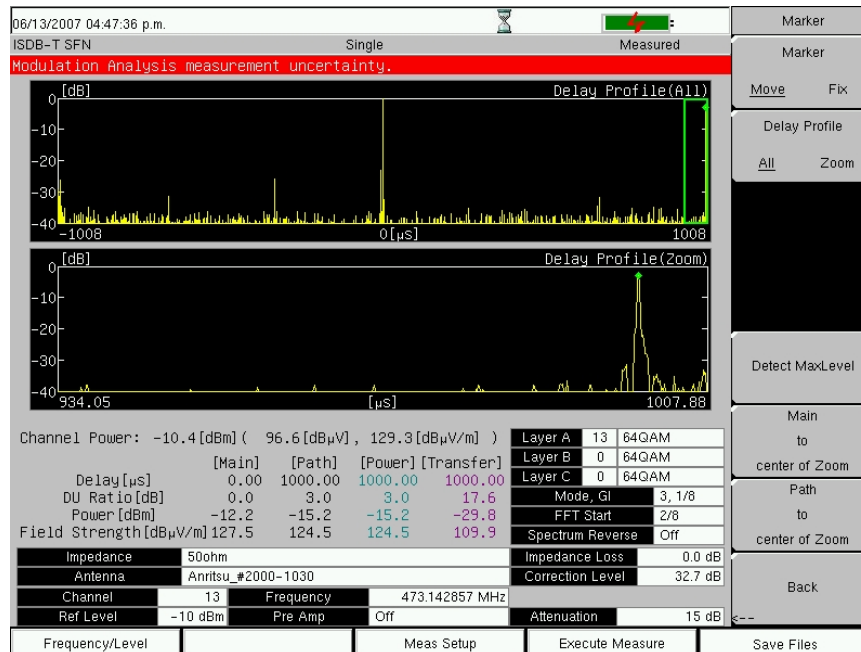**(Left: Strong-directional antenna, Right: Weak-directional antenna)**

Section 7   Measurement Display

7.1   Measurement Example Without Status Display

Figure 7.1   Measurement Example

(Figure above: when there is not delay signal,

Figure lower: DU = 3 dB, when there is 100-μs delay signal)

7.2 Measurement Example

Figure 7.2 **Display Example of "Modulation Analysis Measurement Uncertainty".**
(Delay signal: DU= 3dB, 1000 μs)

When a delay signal exceeding over GI or many incoming signal exist, all of which deteriorate signal quality, the upper line of "Modulation Analysis Measurement Uncertainty" might sometimes light up.   In this case, the wrong measurements might be displayed, so the user has to check whether or not the measurements are right.

When the measurements are wrongly displayed, the following phenomenon might appear. When the line of "Modulation Analysis Measurement Uncertainty" appears on the screen, please remeasure again to check the measurement.

Figure 7.3 shows that display values of [Delay Signal] and [Power] are different, when marker is adjusted to the target delay signal.
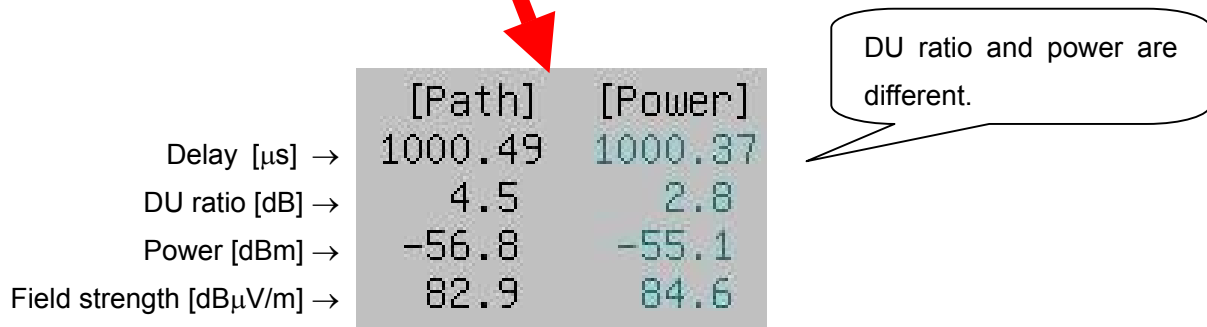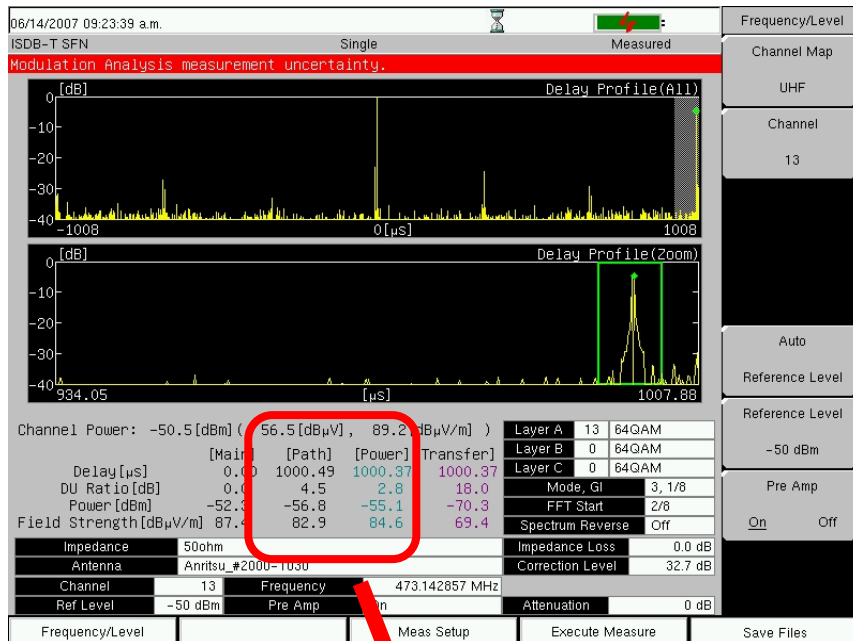
Figure 7.3   Example when the Measurements are Wrongly Displayed

(When the values of delay signal and power are different)

Notes: Measurements of [Delay Signal] are usually calculated from the result of [Power] (Power Spectrum Method).   And if the values are different as the figure 7.3 shows, the following situations might be the reason.

1.   Delay signal is wrongly taken away for a poor judgement of pseudo-path
2.   When a pseudo-path is remained by a poor judgement of pseudo-path

Section 8   Glossary

Reference Level: Signal level standard, which is input to the MS8911B.   When there exists a signal only within the channel of measuring object, reference level corresponding to a signal level becomes the optimal value.

Sidelobe: This means a part which is spreading like a fan, centering around an actual delay time, when each incoming signal is displayed on the impulse response.

Total Level: Signal power including all the incoming signals.   This indicates the level measurements such as MS8911B-050.

Delay time: This indicates a delay time of incoming signal, when main signal is based on.   However, under SFN, since delay adjustment is included, path difference cannot be necessarily converted, by using delay time.

Delay signal: This indicates a signal existing when the delay time for impulse response is other than 0.

Incoming signal: Signal reaching to the reception edge.   This includes all the signal, such as main signal or delay signal.

Main signal: This indicates the highest level signal of impulse response.   Usually, this means the direct signal.
(Time of main signal is 0, which is delay time reference)

DU: Desired vs Undesired.   Ratio between signal and undesired signal.

ERP: Effective Radiation Power

SFN: Single Frequency Network

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