Application Note

LTE-Advanced Timing Measurement between Component Carriers

Demonstration using Signal Analyzer and Vector Signal Generator

MX269020A-001
LTE-Advanced FDD Downlink Measurement Software

MX370108A-001
LTE-Advanced FDD IQproducer

MX269022A-001
LTE-Advanced TDD Downlink Measurement Software

MX370110A-001
LTE-Advanced TDD IQproducer

MS2690A/MS2691A/MS2692A
Signal Analyzer

MG3710A
Vector Signal Generator

Introduction

The key carrier aggregation technology of LTE-Advanced increases data transmission speeds by sending multiple carriers simultaneously. Additionally, for flexibility, the carrier layout method uses both continuous and separated arrangements. In separated arrangement, the carriers are positioned separately in different frequency bands, resulting in increased frequency usage efficiency. Each carrier is called a component carrier (CC).

Section 6.5.3 Time alignment of the 3GPP TS36.141 V11.4.0 specification defines the time difference between two signals for base stations outputting multiple carriers such as Tx diversity, MIMO spatial, carrier aggregation, etc.

This application note explains how to output an LTE-Advanced carrier-aggregated downlink signal from a vector signal generator and how to measure the timing difference between component carriers using a signal analyzer.

Preparations

The following instruments are required for this demonstration:

- MG3710A Vector Signal Generator (Firmware Ver. 2.00.02 or newer, IQproducer Ver. 14.00 or newer)
  - Opt-032 1stRF 100 kHz to 2.7 GHz (Opt-034, Opt-036 also OK)
  - Opt-062 2ndRF 100 kHz to 2.7 GHz (Opt-064, Opt-066 also OK)

  - MX370108A LTE_IQproducer
  - MX370108A-001 LTE-Advanced FDD Option

  Or
  - MX370110A LTE TDD IQproducer
  - MX370110A-001 LTE-Advanced TDD Option

- MS2690A/MS2691A/MS2692A Signal Analyzer (Package Ver. 5.05.00 or newer) 2 sets
  - MX269020A LTE Downlink Measurement Software
  - MX269020A-001 LTE-Advanced FDD Downlink Measurement Software

  Or
  - MX269022A LTE TDD Downlink Measurement Software
  - MX269022A-001 LTE-Advanced TDD Downlink Measurement Software

- RF Cable 2 pcs
- BNC Cable 6 pcs
- 3-pin BNC Splitter 2 pcs

To simplify the operations described in this application note, the cable attenuation settings and calibration procedures are omitted. To measure more accurately, refer to the operation manual and add the required procedures.

Unless otherwise noted, the description of following procedures and figures is for LTE FDD measurement. The procedures for LTE TDD measurement are similar as for LTE FDD measurement. This document complements the procedures especially for LTE TDD measurement.

Measuring Discontinuous 2 Carrier Aggregation between Bands

Each CC at two bands is measured.

Table 1. Main Parameters of Created Waveform Pattern (Inter-band Discontinuous 2 Carrier Aggregation)

	Parameter	Value
Common Settings for Each Carrier	Test Model	E-TM1.1
Carrier 0	Center frequency band	800-MHz band
	Bandwidth	20 MHz
	Center frequency offset frequency	0 MHz
	Cell ID	1
Carrier 1	Center frequency band	2110-MHz band
	Bandwidth	10 MHz
	Center frequency offset frequency	0 MHz
	Cell ID	2

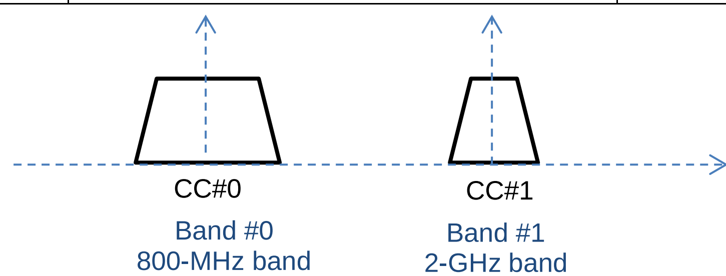

Fig. 1. Discontinuous 2 Carrier Aggregation between Bands

Set-up the instruments as shown in the diagram below. Split the reference signal and Marker1 outputs from the MG3710A Vector Signal Generator and input each to the two MS269xA Signal Analyzer units.
This note describes each signal analyzer measuring Band #0 and Band #1 as "SA#0" and "SA#1", respectively.

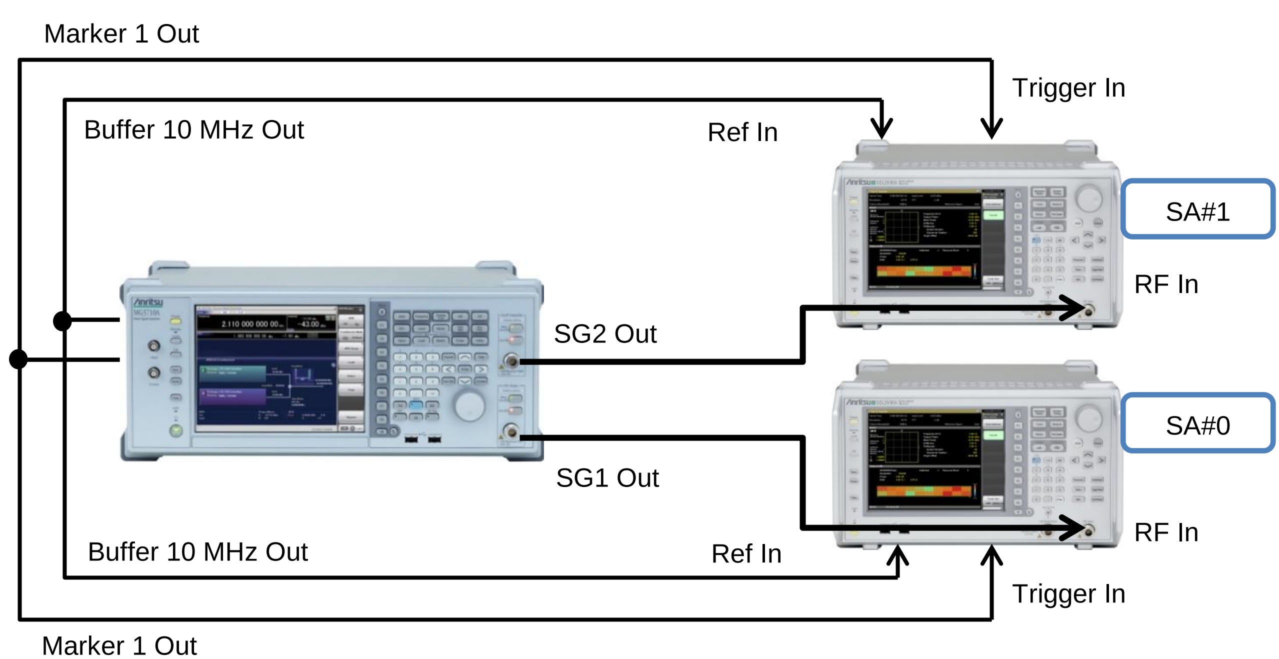

Fig. 2. Connection Setup (Inter-band Discontinuous 2 Carrier Aggregation)

Vector Signal Generation Preparations

Use IQproducer built into the MG3710A to create the output signal pattern.
The vector signal generator operation procedure is described below.

[Procedure]

1. Press [IQpro] to start IQproducer.
2. Press [LTE FDD] at the System (Cellular) tab to start LTE IQproducer. (Press [LTE TDD] for TDD)
3. Set System to LTE-Advanced.
4. Set Carrier Aggregation Mode to Inter-band.
5. Select the Band #0 tab.
6. Put a check mark in the Status checkbox for Band #0 Component Carrier 0.
7. Press [E-TM1.1] for Band #0 Component Carrier 0.
8. Set Band #0 Bandwidth to 20 MHz and Cell ID to 1 and press [OK].
9. Select the Band #1 tab.
10. Put a check mark in the Status checkbox for Band #1 Component Carrier 0.
11. Press [E-TM1.1] for Band #1 Component Carrier 0.
12. Set Band #1 Bandwidth to10 MHz and Cell ID to 1 and press [OK].

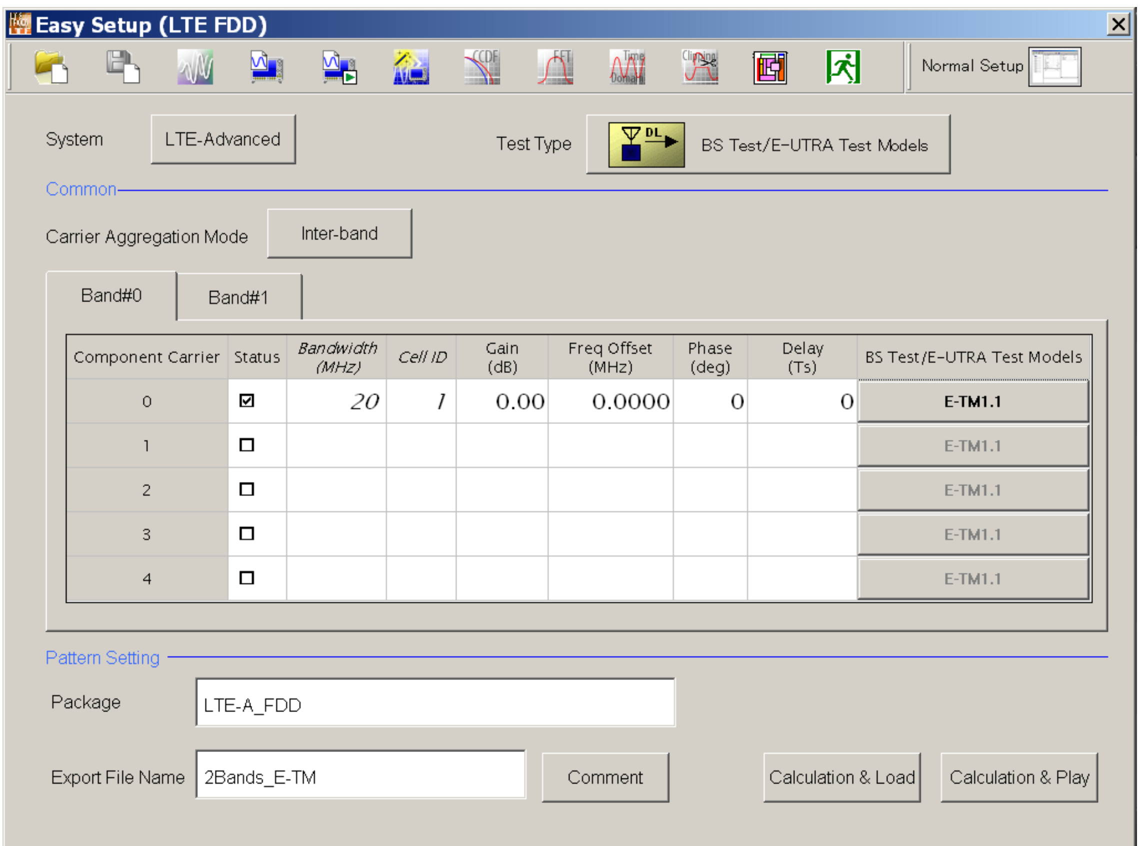

Fig. 3. IQproducer Settings (Inter-band Discontinuous 2 Carrier Aggregation)

13. Press [Calculation & Play].
    The package name is LTE-A_FDD (LTE-A_TDD for TDD) and the pattern name is 2Bands_E-TM.
14. When the SG Setting window is displayed, set the frequency and level for SG1 and SG2 and press [OK].
    Use the following settings in this demonstration:
    SG1 Frequency 800 MHz
    SG1 Amplitude –10 dBm
    SG2 Frequency 2110 MHz
    SG2 Amplitude –10 dBm

15. Press RF Output [Mod On/Off] and [On/Off] to output the modulation signal.
16. Press 2nd RF Output [Mod On/Off] and [On/Off] to output the modulation signal.
17. Press [SG1].

18. Press [Mode] → [→] (Function Menu page 2) → [F8] Sync Multi SG → [F1] Sync Type to set SG1 and SG2.
19. Press [Mode] → [→] (Function Menu page 2) → [F2] Start/Frame Trigger → [F2] Mode to set Frame.
20. Press [Mode] → [→] (Function Menu page 2) → [F2] Start/Frame Trigger → [F3] Source to set Trigger Key.

The above operations complete the MG3710A Vector Signal Generator output signal preparations. At this point in time, the vector signal generator is waiting for trigger input and is not outputting any modulation signal.

Fig. 4. MG3710A Vector Signal Generator Setting Example

Signal Analyzer Preparations

Set the signal analyzer as follows:

[Procedure]
(1) Setting SA#0
1. Press [Application Switch] and select [3GLTE Downlink] ([LTE-TDD Downlink] for TDD).
2. Press [Measure] → [F1] Modulation Analysis.
3. Set [F3] Channel Bandwidth to 20 MHz.
4. Press [Frequency] and set the frequency to 800 MHz.
5. Press [Amplitude] and set the input level to –10 dBm.
6. Press [Trigger] → [F1] to set Trigger Switch to On, and [F2] to set Trigger Source to External.

(2) Setting SA#1
7. Press [Application Switch] and select [3GLTE Downlink] ([LTE-TDD Downlink] for TDD).
8. Press [Measure] → [F1] Modulation Analysis.
9. Set [F3] Channel Bandwidth to 10 MHz.
10. Press [Frequency] and set the frequency to 2100 MHz.
11. Press [Amplitude] and set the input level to –10 dBm.
12. Press [Trigger] → [F1] to set Trigger Switch to On, and [F2] to set Trigger Source to External.

The above operation completes the preparations for starting measurement by the two MS269xA Signal Analyzer units.

Measurement

The signal is output from the vector signal generator and measured by the signal analyzers. At the first stage, the trigger is awaited by the two signal analyzers to start measurement. Next, the MG3710A Vector Signal Generator outputs the signal. At this time, the marker signal output at the head of the waveform pattern is input to the trigger inputs of the signal analyzers, which both simultaneously start measurement of the output waveform pattern.

Repeat the following measurement procedure when there are several measurement results.

[Procedure]

1. Press [Single] for each of SA#0 and SA#1 to start measurement. This sets both signal analyzers to the trigger wait state.

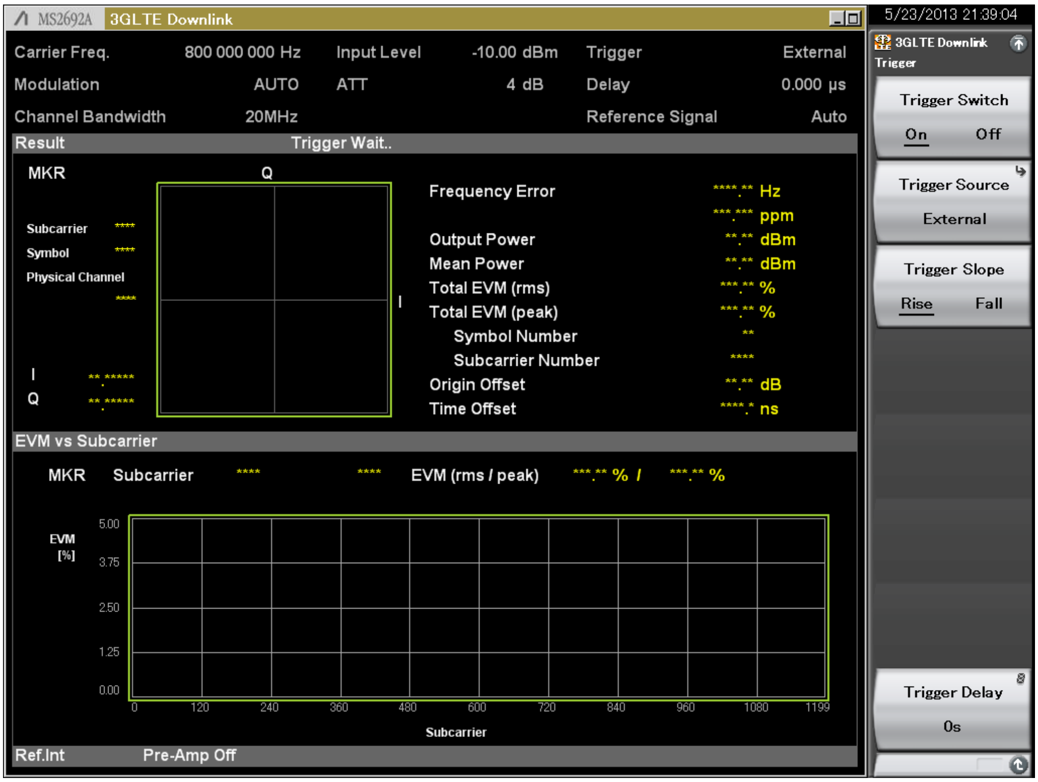

Fig. 5. Signal Analyzer (SA#0) Waiting for Trigger Input

2. Press [Mode] → [→] (Function Menu page 2) → [F2] Start/Frame Trigger → [F8] Trigger Key for the vector signal generator.

The above operation captures the measurement results shown in Figs. 6 and 7 for signal analyzer SA#0 and SA#1, respectively.

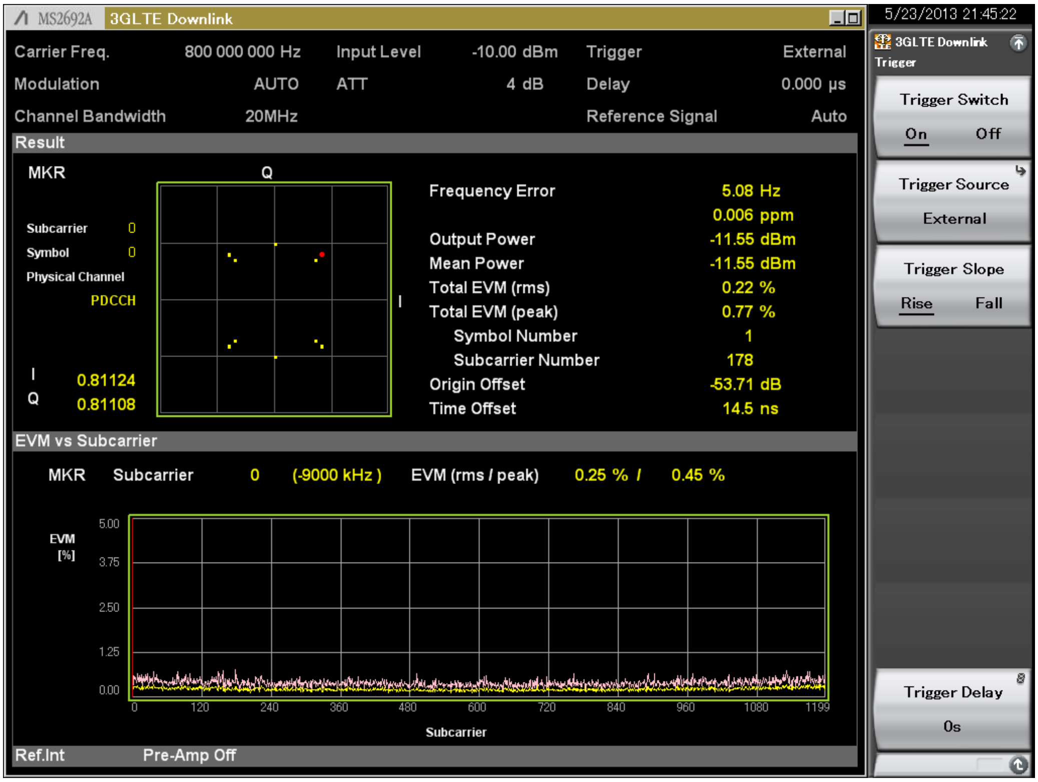

Fig. 6. CC#0 Measurement Results (SA#0)

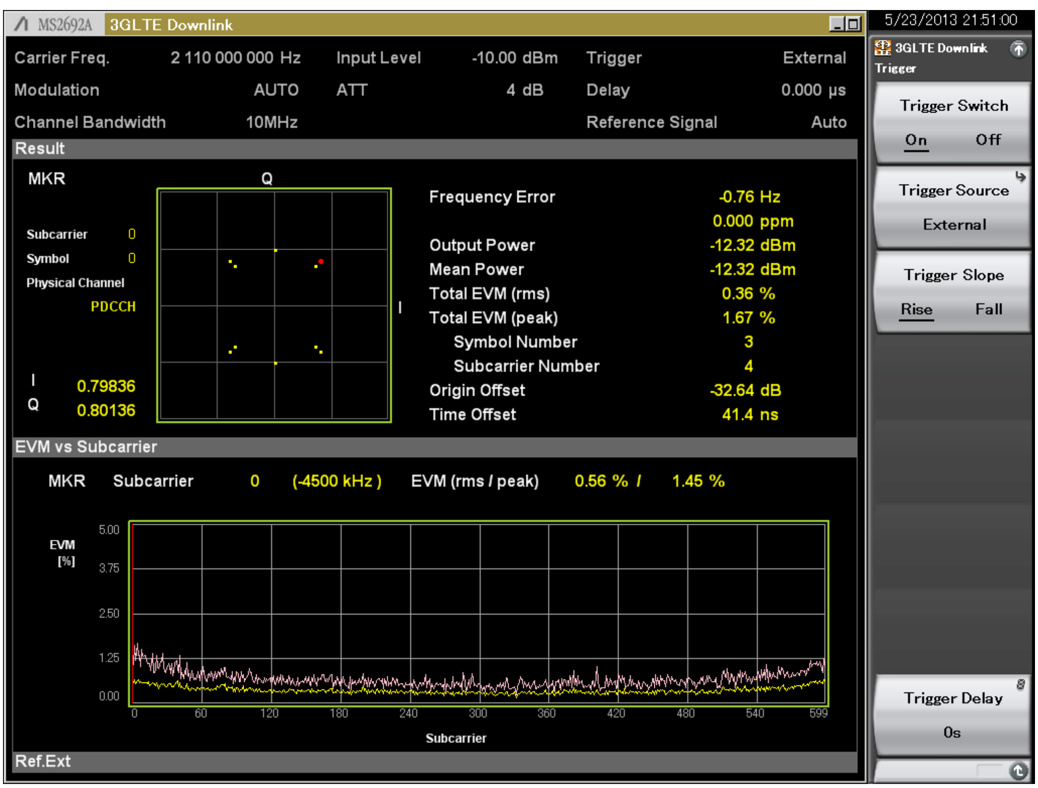

Fig. 7. CC#1 Measurement Results (SA#1)

We can see that the timing for the CC#0 and CC#1 frame headers is 14.5 ns and 41.4 ns, respectively, and the relative difference is 26.9 ns.

Specifications are subject to change without notice.

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