Technology Focus

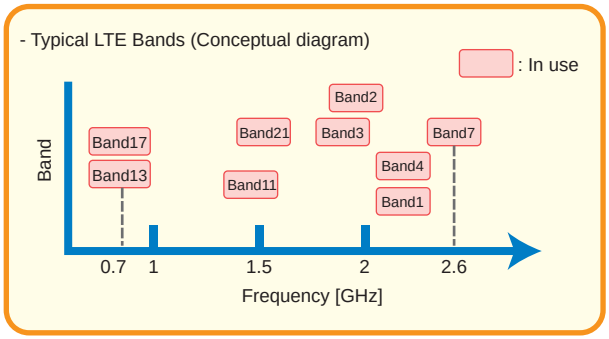
EMC Solutions Target Noise in LTE Devices

Along with the diversification of wireless communication services, such as online games and streaming contents, in recent years, there is a growing demand for an increase in data transfer rate and a reduction in delay time. In addition, improvement of efficiency of the use of frequencies in the radio band is deemed necessary so that many users can download data simultaneously and efficiently.

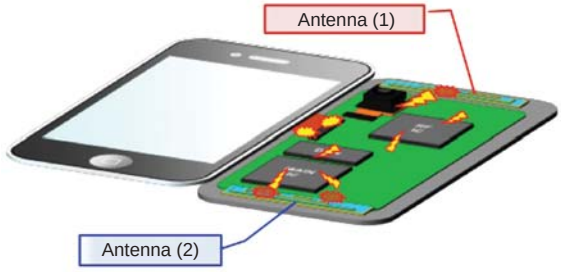
However, the conventional wireless communication technologies (2G, 3G) are unable to sufficiently meet all these requirements. In order to achieve higher data transfer rate, shorter delay time, and more efficient use of frequencies, a wireless communication standard called Long Term Evolution (LTE) has been proposed and is being put into practical use worldwide.

Meanwhile, in devices provided with wireless communication function, an intra-system electromagnetic compatibility (EMC) problem (self-poisoning problem), where noise of the devices themselves impairs their own communication performance, may occur. To ensure the maximum performance of LTE, it is necessary to solve this issue.

This article by Murata Manufacturing Co., Ltd. exemplifies and explains solutions to control noise that affects the integrity of communication in LTE, and also introduces processes on how to select the EMC solution components necessary for implementing these solutions.

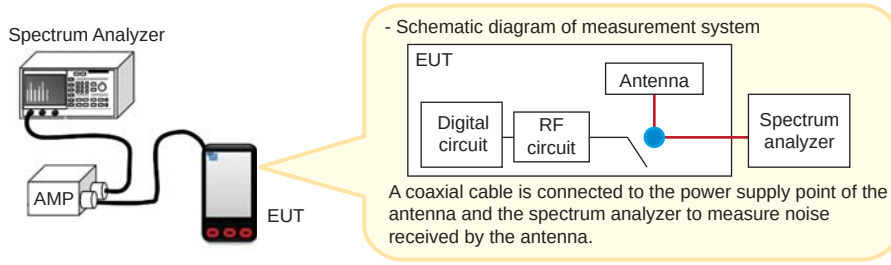


(a) Point I: LTE is available in a wide range of frequencies

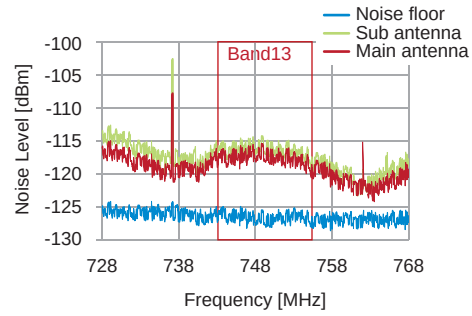


(b) Point II: MIMO is allowed for LTE.

Fig. 1: Points to consider on dealing with noise



(a) Overview of the system for measuring coupling noise for the antennas



(b) Coupling noise for the antennas

Fig. 2: Measurement of coupling noise for the antennas

Noise Affecting LTE Performance

First, some points that should be considered more carefully when investigating and dealing with noise in LTE compared with conventional wireless communication technologies are examined. The two can be regarded as the main points:

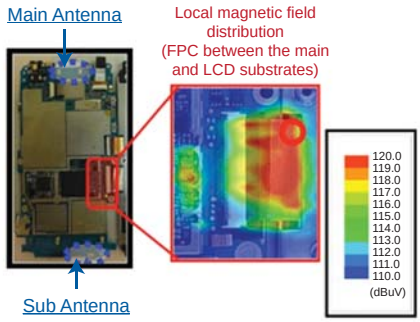
Noise in a wide range of frequencies [Fig. 1(a)]

The first point is that it is necessary to deal with noise over a wide bandwidth of frequencies when developing a device that conforms to the requirements of telecommunications firms in different countries.

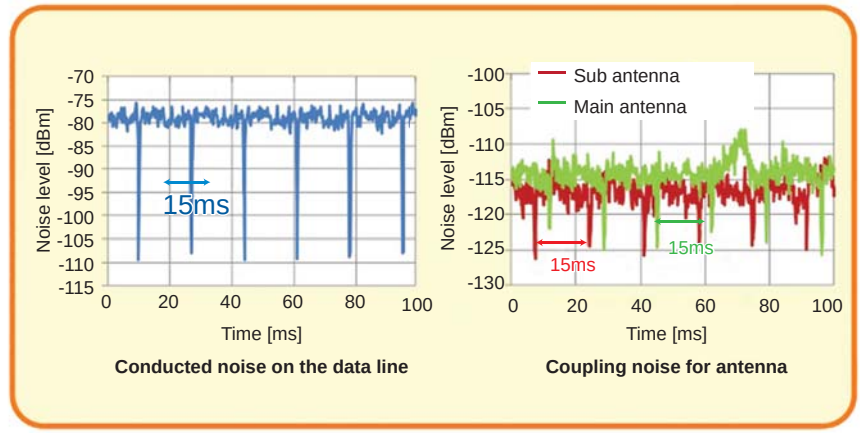
While LTE is applied to 700MHz bands, such as Bands 13 and 17, it is also applied to 2.6GHz bands, such as Band 7. As it is also scheduled to be applied to a variety of frequency bands from now on, it is necessary to provide a solution to noise across a wide bandwidth when developing an LTE device that can be used worldwide.

Noise in MIMO systems [Fig. 1(b)]

The second point is a multiple-input, multiple-output (MIMO) antenna, which is an antenna technology using multiple antennas, is employed. In conventional wireless communication technologies, a

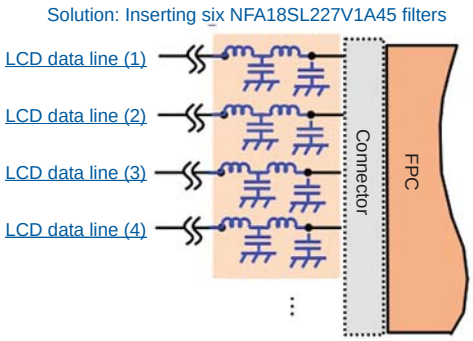


(a) Local magnetic field distribution on the FPC connected to the LCD

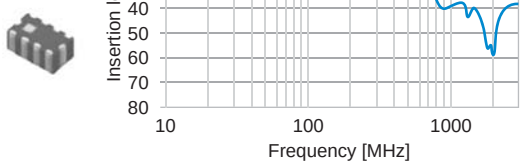


(b) Time variation in noise (751 MHz)

Fig. 3: Results of investigation into the noise source



(a) Details of the solution to noise



Product No.	Nominal Cut-off Frequency	Rated Current	Rated Voltage	Insulation Resistance (Min.)
NFA18SL207V1A45	220MHz	25 mA	10 Vdc	1000 MΩ

Characteristics of NFA18SL227V1A45, LC filter inserted into data lines

Fig. 4: Solution to noise

single antenna is used to receive signals. It is possible to prevent a reduction in the communication integrity by implementing noise suppression measures for only this antenna. In MIMO, however, as two or more antennas are used to receive multiple signals, all the relevant antennas must be taken into consideration to provide a noise solution.

Noise Solutions in LTE Devices

Next, an actual investigation into the noise and an example of a noise solution is discussed. For example, an LTE smartphone for Band 13 (700MHz band) was used.

Results of noise investigation

The investigation has been carried out, as shown in Fig. 2(a), with the line to the antennas cut off and a coaxial cable connected to the antenna side. Also, the coaxial cable was connected to the spectrum analyzer via the signal amplifier to look into noise coupling to the antennas (This noise is hereafter referred to as "coupling noise for the antennas").

The results of measurement showed the wideband noise coupled to both the main and sub antennas, as shown in Fig. 2(b). It seems that this noise impairs the signal-to-noise (S/N) ratio of received signals, affecting the integrity of communication.

Next, an examination of the noise source mentioned above showed high-level noise on the data lines of the flexible cable that connects between the LCD screen and the main substrate shown in Fig. 3(a). Also, in order to determine whether this conducted noise is the same as the coupling noise for the antennas, the time variation of the noises was examined. As a result, it was found that the noises had the same period, as shown in Fig. 3(b).

These results led to the conclusion that the data lines of the LCD are the noise source that affects the integrity of communication.

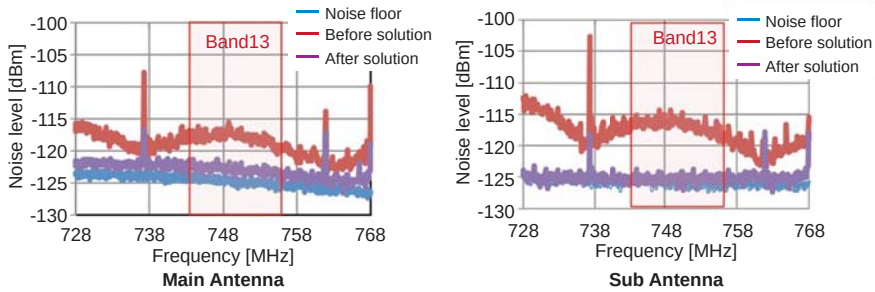
Solution to noise

As the noise source was discovered, a solution to the noise was then implemented. As a solution, the LC combined noise suppression filters (NFA18SL-227V1A45), shown in Fig. 4(b), were inserted into the data lines of the LCD. The reason for selecting these filters is that they can significantly reduce noise while minimizing the effects on signal waveforms. If another frequency band is taken into consideration, other parts that are effective in eliminating noise over a wide bandwidth need to be selected.

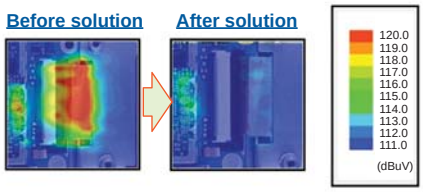
Effects of noise solution

Next, the effects of the noise suppression filters are examined. When the coupling noise for the antennas were checked, it was found that in both the main and sub antennas, the use of noise suppression filters reduced the noise close to the noise floor, as shown in Fig. 5(a). It was also found that the local magnetic field strength was also reduced considerably by the noise suppression filters, as shown in Fig. 5(b). Moreover, it was determined that there are no problems in the integrity of waveforms, as shown in Fig. 5(c).

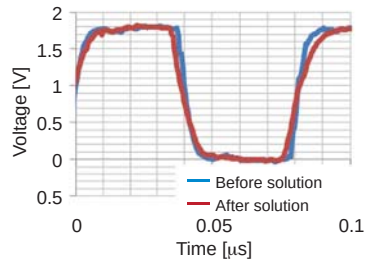
Finally, data before and after the implementation of the noise solution are compared to see how the integrity of communication in LTE was improved. Fig. 6 shows the results of over-the-air (OTA) measurement of the throughput and the minimum receiver sensitivity. The measurement system used a reverberation chamber in order to examine the integrity of communication using MIMO. The results of measurement show that both the minimum receiver sensitivity and the throughput were improved significantly.



(a) Reduction in coupling noise for the antenna

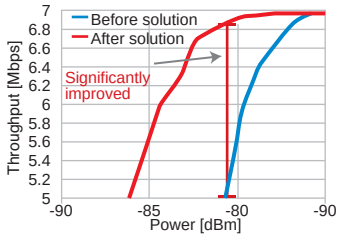


(b) Reduction in local magnetic field

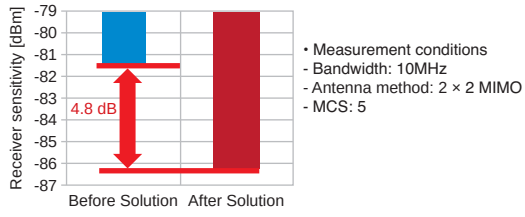


(c) Waveform integrity (LCD data line)

Fig. 5: Effects of solution to noise



Results of throughput measurement



Results of receiver sensitivity (TIS) measurement

Fig. 6: Improvement in communication integrity through noise solution

Thus, it has been found that the integrity of communication can be improved by inserting an appropriate number of EMC solution components in the right locations to reduce noise.

Conclusion

This example solution demonstrates that a solution to noise is essential in order to improve the communication integrity, and the important point of the solution is to use an EMC solution component in an appropriate location. It can be considered that also in other bands, noise can be reduced by selecting a filter that is effective in eliminating noise over a wide bandwidth, like the EMC solution component used in this example, enabling the integrity of communication to be improved.

Murata Manufacturing continues its research on how to deal with noise to offer solutions through which customers can effectively use its EMC solution components.

About This Article:

The author is Masaki Nakase from the Application Development Section, Product Development Dept. 1, EMI Filter Division, Murata Manufacturing Co., Ltd.