



## **Prevention Method of Electromagnetic Interference by Implementing NFC Radio Active Signal for Touchpad**

**Hideto Horikoshi\***, **Hidekazu Chujo**

Subsystem Development, Wireless Module Development, Touch Device Development

Lenovo Yamato Laboratory, Yokohama, Japan

Email: [JL03288@lenovo.com](mailto:JL03288@lenovo.com)\*, [chujo@lenovo.com](mailto:chujo@lenovo.com)

### **Abstract**

This paper reviews the patented control method of preventing the electromagnetic interference from NFC antenna to touchpad sense lines efficiently. The NFC antenna was integrated under the touchpad by implementing NFC\_radio\_active signal from the NFC module to the touchpad sensor controller IC. The conventional control method required fine-tuning of the touchpad sensor firmware was required to detect and learn the NFC antenna trace in order to prevent this electromagnetic interference.

**Keywords:** NFC; touchpad;interference; NFC\_radio\_active signal; NFC radio; NFC antenna pattern trace; NFC touch mark icon

## 1. Introduction

The metal-covered ultrabook PCs were required to integrate NFC antenna under the touchpad because the NFC radio cannot radiate through the metal palm-rest cover. In this case, the prevention method of the electromagnetic interference from NFC antenna to the touchpad sense lines is required.

## 2. Conventional Prevention Method in Touchpad

Figure 1 shows the conventional NFC antenna integrated in the touchpad PCB of the ThinkPad ultrabook PCs launched in 2013. The NFC antenna is indicated in yellow line. The conventional prevention method of the electromagnetic interference in the touchpad consisted of the following three countermeasures[1]. (1) filtering 13.56MHz frequency against sensor scanning, (2) adjusting touchpad sensor scanning frequency, (3) tuning touchpad sensor firmware. Especially number (3) tuning touchpad sensor firmware required a lot of test cases with various NFC cards/tags because the touchpad firmware had to judge which was touched on the touchpad, finger or NFC card/tag/device. Since there was no signal notification from the NFC module to the touchpad controller IC, the firmware had to learn the NFC antenna pattern trace data in order to judge it as a NFC electromagnetic noise from NFC antenna. The firmware had to identify the NFC electromagnetic noise by the scanned trace data of the NFC antenna. This caused much workload to the firmware.

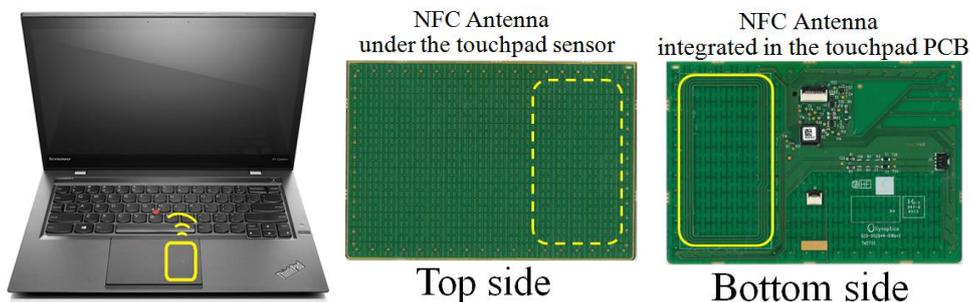


Figure 1. Conventional NFC antenna integrated in the touchpad

## 3. New Prevention Method for Touchpad

Figure 2 shows the new NFC antenna integrated under the touchpad PCB[2] of the ThinkPad ultrabook PCs launched in 2017. The NFC antenna location is described in yellow line. The

NFC antenna size and location were changed to improve the usability described later. The touchpad has the new signal notification from the NFC module to the touchpad .

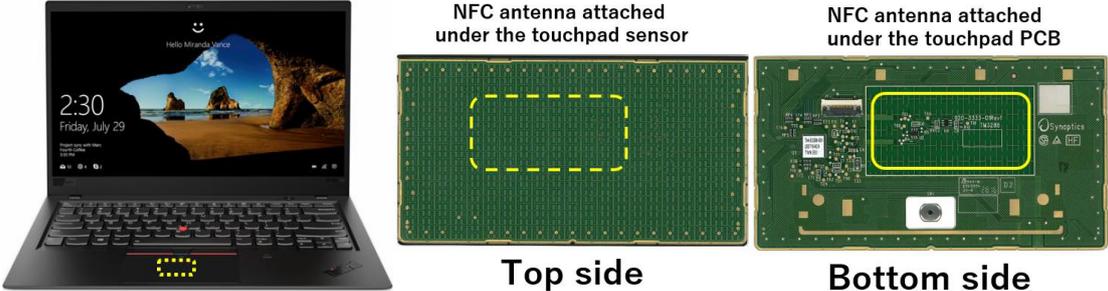


Figure 2. New NFC antenna integrated under the touchpad

Figure 3 shows the new NFC\_radio\_active signal generated by the NFC module to the touchpad controller IC. This NFC\_radio\_active signal allowed the touchpad firmware to identify the NFC noise from the NFC antenna. The touchpad firmware could easily detect the NFC radio noise by this NFC\_radio\_active signal without sensing the NFC radio from the NFC antenna pattern trace data. Prior to the NFC radio generation by NFC module, the NFC\_radio\_active signal was asserted to let the touchpad firmware in the touchpad controller IC notify the NFC radio activation. After the NFC\_radio\_active signal was asserted, the touchpad controller IC could prepare for lowering the sensitivity of the touchpad sense lines in order to disregard the NFC radio noise[3]. The set-up time of NFC\_radio\_active signal is 1.2ms before NFC radio generation and the hold time of the NFC\_radio\_active signal is 0.4ms after turning the NFC radio off. The touchpad firmware always could detect the status of NFC radio activity by this signal.

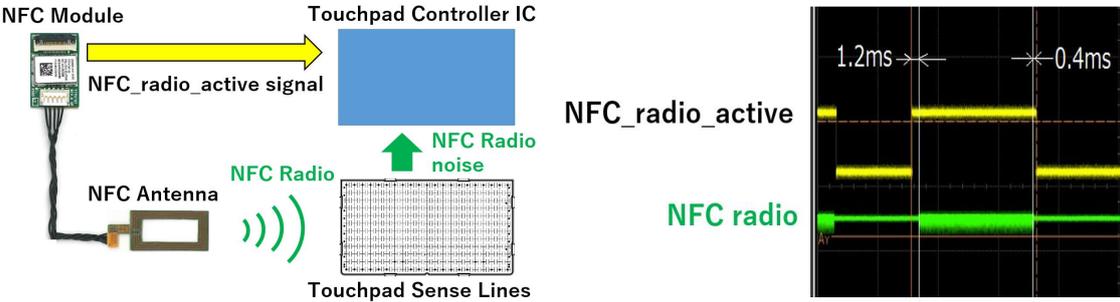
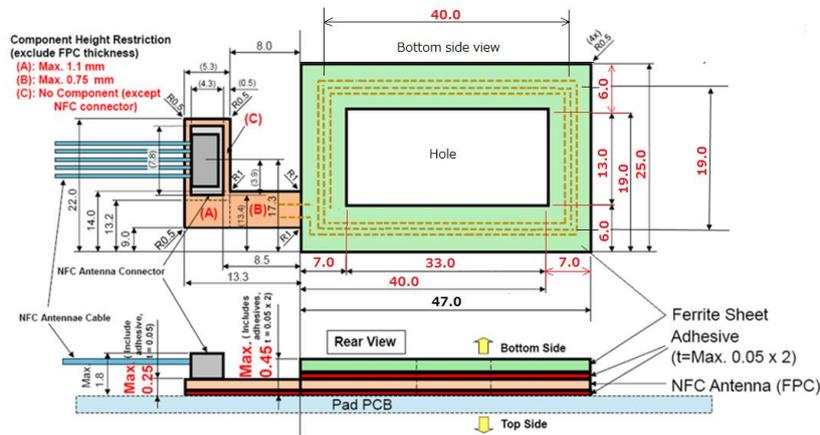


Figure 3. NFC\_Active signal from NFC module to Touchpad

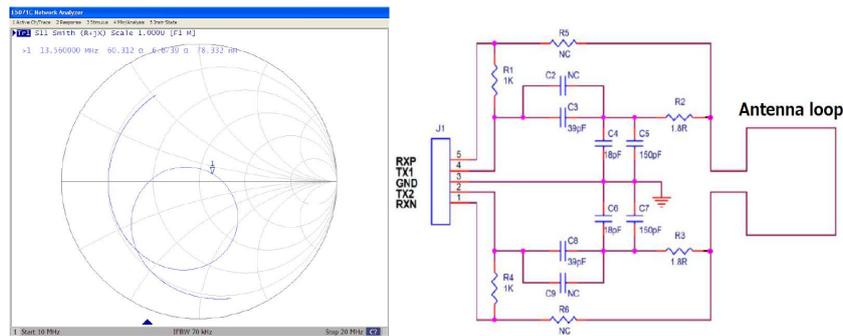
## 4. New NFC Antenna Specification

Figure 4 shows the NFC antenna assembly structure with the matching components. It was attached on the bottom side of the touchpad PCB. The matching components are populated on the orange colored area (A) and (B) of the drawing.



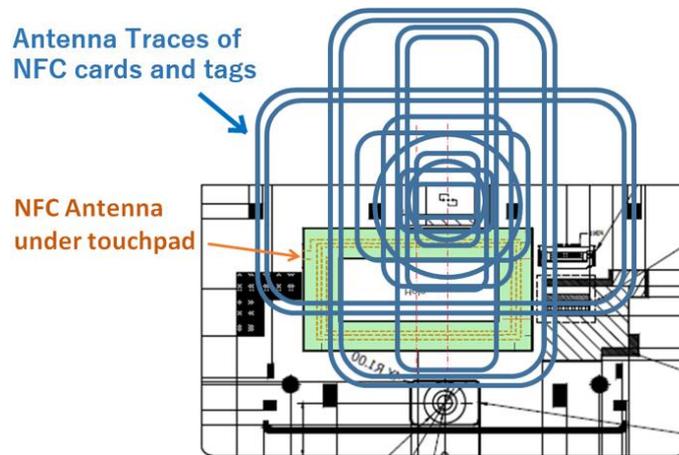
**Figure 4. New NFC Antenna including matching components**

The NFC antenna matching impedance was described as  $Z_{\text{match}}=60.312-6.6739j(\Omega)$  and  $L_{\text{match}}=78.332(\text{nH})$  including matching circuit according to the  $S_{11}$  Smith Chart shown by Figure 5.



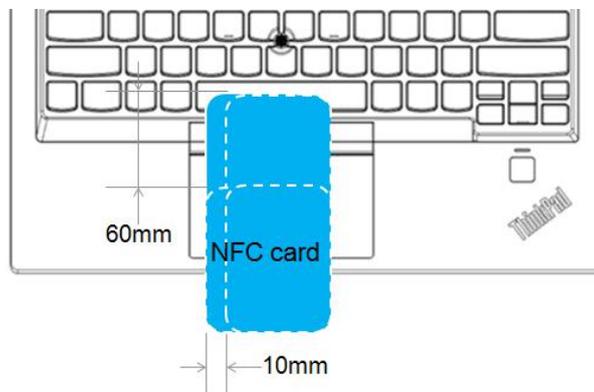
**Figure 5. S11 Smith chart including antenna matching circuit**

Figure 6 shows the NFC tags and cards alignment to the NFC icon touch mark (☞) located outside of the NFC antenna. There are six types of size of ISO standard contactless IC cards and tags[4]. Users usually tap the NFC icon touch mark aligned with the center of the NFC card or tag.



**Figure 6. ISO Standard IC Cards and Tags alignment**

Figure 7 shows the NFC card such as employee NFC card detection area for unlocking screen or login use cases. Table 1 summarized the NFC function specification differences between conventional touchpad with NFC antenna and new touchpad with NFC antenna.



**Figure 7. NFC card detection area**

**TABLE 1. NFC Specification Comparison**

<i>Item</i>	<i>Conventional touchpad with NFC antenna in 2013</i>	<i>New touchpad with new NFC antenna in 2017</i>
Antenna location	Integrated in the bottom layer of the touchpad PCB	Attached under the touchpad PCB
Antenna commonarity	Not common antenna included in the touchpad PCB	Common antenna across all touchpad PCBs
NFC Radio Active signal	Not supported	Supported
NFC antenna size (mm)	30 x 60	25 x 47
Number of turns of NFC antenna loop	4	3
NFC smart card detection area (mm)	80 x 20	60 x 10

<i>Item</i>	<i>Conventional touchpad with NFC antenna in 2013</i>	<i>New touchpad with new NFC antenna in 2017</i>
NFC module host interface	SM Bus	I2C

## 5. Conclusion

The new NFC\_radio\_active signal was generated by the NFC module for the touchpad firmware to lower the sensitivity of the touchpad sense lines during the NFC radio activity. This NFC\_radio\_active signal also allowed the touchpad firmware to detect the NFC radio easily. This NFC\_radio\_active signal also made the touchpad firmware simple because the touchpad firmware did not have to learn the pattern of the NFC antenna pattern trace. The touchpad firmware can lower the sensitivity during NFC radio activity. This signal can also be applied for any other touch devices such as touch panel controller IC which controls touch sense lines of the touch panels where the NFC antenna is integrated nearby. The new NFC antenna and NFC\_radio\_active signal control method was implemented into the 3-button clickpad of ThinkPad X1 Carbon and T480s.

## REFERENCES

- [1] NFC Antenna Integration Into 5-Button Trackpad for Metal-Covered Ultrabooks, IEEE GCCE2014 Paper, Hideto Horikoshi, Yi Zheng
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