Analysis of the wireless charging technologies impact on the charging process parameters of mobile devices

Michał Filipiak[1], *Damian* Głuchy[1,*], *Maksymilian* Godek[1]

Poznan University of Technology, Piotrowo 3A, 60-965 Poznan, Poland

Abstract. The paper deals with wireless charging of mobile devices. Quick Charge and USB Power Delivery technologies were presented; in relation to cooperation with induction chargers. Charging measurements for devices were carried out with the reference to the previously described standard and technology. Characteristics showing the changes in power and state of charge during the charging process for various measurement variants were made.

1 Introduction

The problem of supplying the receivers is widely discussed in terms of both generating and providing energy. The dynamic development of engineering often requires combining different technical solutions [1-3].
The wireless charging technology of mobile devices emerged a few years ago. While this solution wasn't power-rich at first, the convenience of using this technology led to a significant improvement of the wireless chargers and the receivers, where today most of them are smartphones. The maximum possible power that could be transmitted over the wireless charger onto the receiving device has increased significantly over the past few years. Alongside, newer and newer technologies were being applied to the existing standards and the result is for example the reverse wireless charging technology where the smartphone can also be a source of wireless power. Nowadays, even technologies such as Quick Charge can be applied to a set of chargers and receivers [4].

2 Technologies used in charging mobile devices

Among technology cooperating with wireless chargers distinguish among others, Quick Charge and USB Power Delivery. The first of them uses the most widespread type of connector for mobile devices, i.e. USB type A and micro USB. It reduces the time needed to recharge the battery by increasing the current and voltage. This has a direct impact on the amount of energy transmitted. Unfortunately, this solution requires the use of dedicated electronic elements both on the charger and receiver. USB Power Delivery, on the other hand, uses USB type C to increase the number of connectors, which eliminates the need of the implementation of other electronic elements. In addition, it allows to transfer up to 100 W power to the receiver, operating on several pre-defined voltage levels (5 V / 9 V / 15 V / 20 V) and current values up to 5 A.

3 Testing wireless chargers along with various models of smartphones

Two wireless chargers were tested on the following receivers: Sony Xperia XZ2 and Sony Xperia XZ3. Both of them are characterized by a similar technical specification, including battery capacities, but differ in the type of charging technology that is being used. Xperia XZ2 supports Qualcomm's Quick Charge 3.0, while Xperia XZ3 supports USB Power Delivery.
Two types of wireless chargers were included in the research - a standard one with rated power 7,5 W and the one that supports Quick Charge 3.0 with a maximum of 12 W power output. Both chargers needed to be powered by additional wall chargers. The standard one was provided with power by a conventional charger (5V / 2,4A), while the second one was powered with a charger that also supports Quick Charge 3.0 (3,6-20V / 3A) which has a maximum of 18 W power. The study focused on the monitoring of the charging process' in the range of 2% to 100% state of charge using the two previously mentioned wireless chargers. The charging speed and parameters on which the chargers worked were monitored [5].
The tests showed that both phones benefit from wireless charging, by the increase of charging process speed if the wireless charger which supports the Quick Charge 3.0 technology is being used. Moreover, the Xperia XZ3, equipped with USB Power Delivery, charged faster than Xperia XZ2 in case where the standard wireless charger was used. The XZ2 phone on the other hand charged faster than XZ3 when the results of the charging process with Quick Charge technology were compared. The Xperia XZ2 was charging overwhelmingly slow with the

* Corresponding author: damian.gluchy@put.poznan.pl

use of the standard charger, but the charging process was noticably faster when the charger with Quick Charge technology was used. The charging process in these cases is given in the form of state of charge changes in Figure 1 and the power change in Figure 2 and 3.

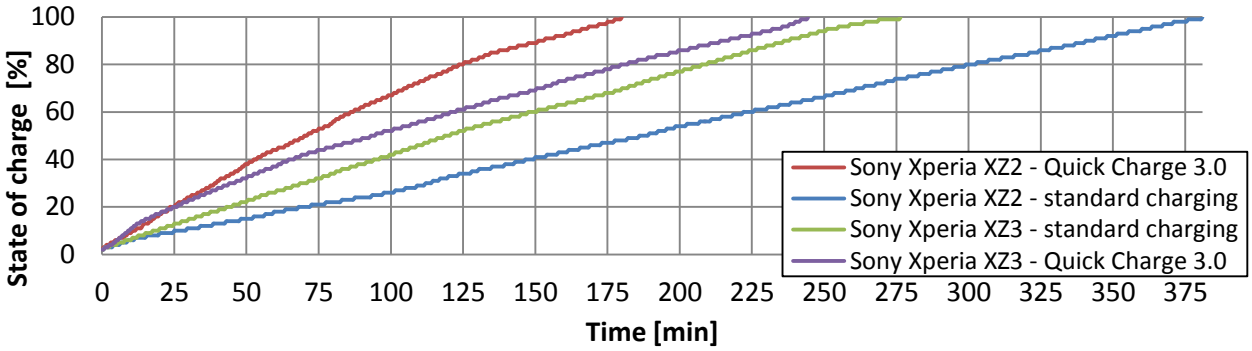

Fig. 1. State of charge characteristics as a function of time for Quick Charge and standard charging for selected smartphone models.

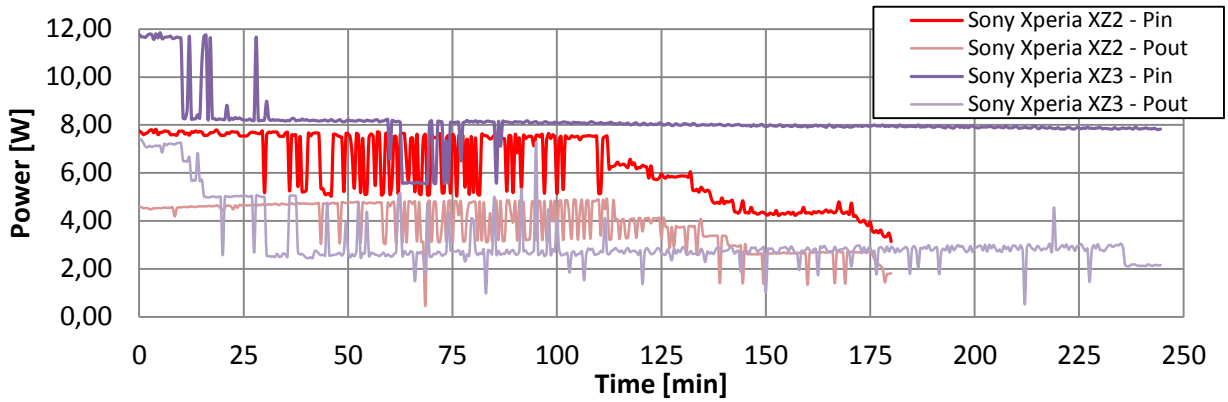

Fig. 2. Characteristics of input and output power for Quick Charge charging for selected smartphone models.

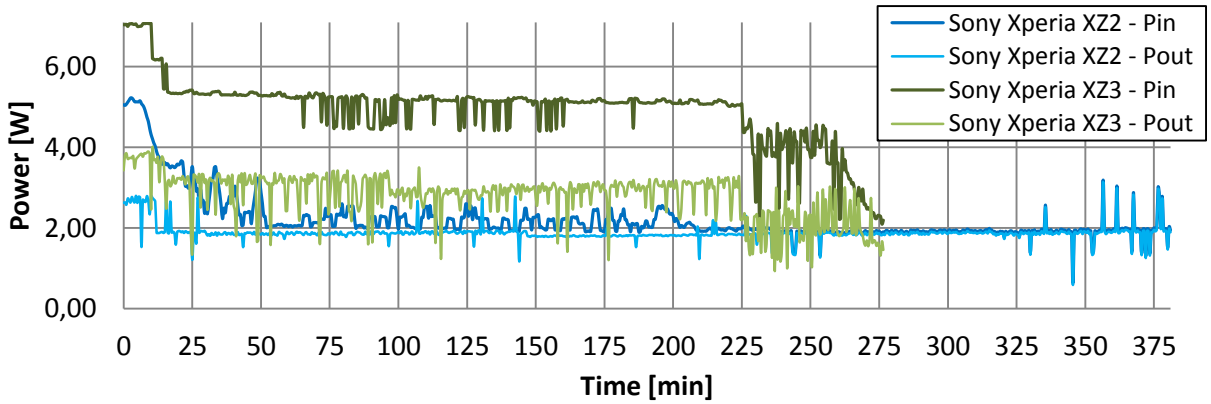

Fig. 3. Characteristics of input and output power for standard charging for selected smartphone models.

4 Summary

The work describes wireless charging technology and the possibility of its cooperation with other technologies in the transmission of energy to mobile devices. The tests have shown a significant impact on the level of transmitted power and the efficiency of the charging process, both the type of wireless chargers and the type of the receiver and the technology implemented in it.

References

1. D. Kurz. L. Morawska, R. Piechota, G. Trzmiel, E3S Web of Conferences, vol. 44, 2018.
2. L. Kasprzyk, Przegląd Elektrotechniczny, Volume: 88 Issue: 7B 2012, pp. 131-133
3. A. Dobrzycki, S. Mikulski, W. Opydo, *Appl. Sci.* 2019, *9*(8)
4. D. Burzyński, D. Głuchy D, M. Godek, ITM Web of Conferences 19, nr 01025, 2018
5. M. Filipiak, D. Głuchy D, M. Godek, Poznan University of Technology Academic Journals. Electrical Engineering, 99, 2019 pp. 41-52