MultiOne by Signify

MultiOne

Configuration tool

Configuration in a luminaire

Application Note

How to configure a built-in driver from the outside of the luminaire with NFC.

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Version 1.0
14 oct 2021
OEM Tools & Services

Signify

1. Introduction

Drivers for lighting applications can be configured by means of NFC (Near Field Communication). With this technique electro-magnetic waves are generated by an antenna, which is picked up by a tag in the driver. The tag (antenna and accompanying IC) is passive, which means that it gets the power needed from the electro-magnetic wave from the sending antenna (inductive coupling).
The communication is possible by modulating the electro-magnetic wave. Since the distance of operation is small compared to the wavelength of the electro-magnetic wave, only the magnetic part of the wave is interacting.

It would be beneficial when a driver could be configured once it is completely assembled in a luminaire. In that case the OEM can produce the luminaire, and only at a late stage in the production decide for what application the luminaire will be used and load the corresponding configuration file. Even alterations in the field could be possible without having to open the luminaire.

To be able to configure a driver in a luminaire, the electro-magnetic waves must be able to reach the tag of the driver. So, it is not only the distance from antenna to the tag of driver but also the material through which the electro-magnetic waves travel to reach the tag is important. Obviously, a luminaire of which the outer shell is made of metal (Faraday cage) will not allow the electro-magnetic waves to pass through, and the tag cannot be reached. Drivers in a plastic luminaire will normally not be a problem to configure, providing the antenna is strong enough.

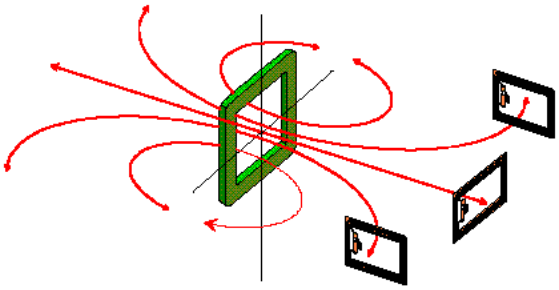
This application note describes some attention points and design rules to make “configuration in a luminaire” possible.

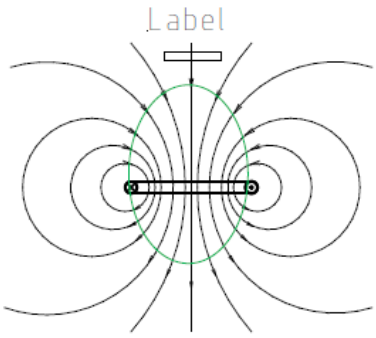
2. Conclusion

Configuration with an NFC reader/antenna of a driver from the outside of a luminaire is possible when the luminaire is completely made of plastic. When there is (too) much metal in the neighborhood configuration might not be feasible.

3. Short technical explanation of NFC

NFC operates at a resonance frequency of 13.56MHz. The electro-magnetic field is almost like the field of a bipolar antenna. The coupling between tag and antenna is optimal when the tag is perpendicular to the magnetic field lines. This implies that in the middle of the FEIG antenna the tag should be parallel to the plane of the antenna. At the outer ends of the antenna the tag should be perpendicular to the plane of field of the antenna. See the pictures for a graphical representation.





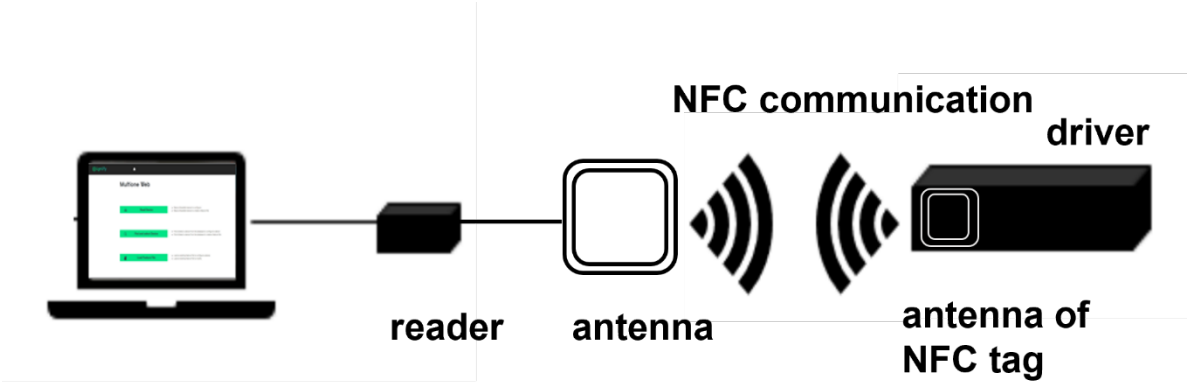
When metal is in the neighborhood, the magnetic field lines penetrate the metal and cause eddy currents on the metal surface. These eddy currents create another magnetic field opposite to the original field from the reader antenna.
The net result is that the original field lines are being suppressed, and that the field lines cannot pass through the metal.
The better the metal can conduct the eddy currents, the worse the field lines will pass the metal. The conductivity of the metal housing is directly proportional to the diminishing of the field lines through the metal surface. Aluminum has a higher specific conductivity than steel and an aluminum housing is often made of thicker material, so an aluminum housing will repel more field lines than a housing made of steel.

Another characteristic of conducting material in the neighborhood of the antenna is a shift of the resonance frequency. The frequency will increase, and above a certain limit the reader will switch-off to prevent violation of the EMC regulations. In that case the antenna must be tuned again with adding extra capacitors on the tuning board of the antenna. We advise this to be done by a skilled engineer. For more information see the annex.

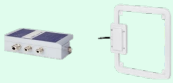
4. NFC Interfaces

The system consists of a reader and an antenna connected to a computer. The programming can be done with one of the “MultiOne” programs. (see: MultiOne Configurator | Signify Company Website)

To configure drivers with NFC, you need the following system:



MultiOne is supporting several readers/antennas, the following are interesting to use for the purpose of configuration in a luminaire: LCN9640, LCN 9630 and FEIG ECCO smart.

Signify naming	FEIG naming	picture	sending power	dimensions of the antenna	how to apply
LCN9630	MR102		**1.2W**		**manually operated**
LCN9640	antenna ID ISC.ANT310/310 reader ID ISC.LR(M)1002-E		**4-8W** **4W default**	**310 x 310 mm**	**table top**
Future	ECCO smart		**1.5W**	**8.7 x 4.8 x 2.6**	**handheld**

- Since sending power is an important parameter to be able to energize the antenna in the driver, the LCN9640 might be the best solution, especially for luminaires made of plastic.
- Using the LCN9630 for metal luminaires, a hole in the luminaire is proposed. This antenna is useful since it is small and has therefore concentrated magnetic flux lines.
- The FEIG ECCO smart is a powerful handheld device. At this moment this cannot be used together with MultiOne, efforts are being made to support this device soon.

In the next paragraph these reader/antenna combinations are described.

5. Description of antennas/readers

5.1. LCN9640

This is not very clear. The antenna is connected to the reader with a SMA coax connector. The reader is connected to the computer via a USB connection. The transmitting power is default 4W but can be increased up to 5W using FEIG ISOStart software. In the datasheet, FEIG states that at 4W sending power, in ideal situations, the distance of detecting a tag is 60cm. A more practical value for configuring with MultiOne is to use a maximum distance of 20cm.
The antenna must be mounted on a workbench not containing metal in its reading range. Detailed instructions can be found in the design-in guide of the ANT310 x 310 (see Annex).
This antenna can be purchased via FEIG (Contact Partner - Contact - FEIG ELECTRONIC); the FEIG naming is ID ISC LR1002 (reader), ISC.ANT310/310 (antenna), and power supply.

5.2. LCN9630

The antenna is connected to the reader with an SMA coax connector. The reader is connected to the computer by USB connection. The transmitting power is 1.2W. The antenna is handheld and should be positioned by the operator to the desired position. This antenna can be purchased via Signify web-shop: Home page | Philips OEM Sample Shop EMEA

5.3. FEIG ECCO smart

This is a handheld device, which can be connected to computer, tablet or smartphone by USB or by BLE. The device has 2 perpendicular antennas, which give a maximum opportunity to connect to a tag in a driver.

6. Luminaire made of plastic

In case the luminaire is made of plastic, the LCN9640 is a good choice to use. The antenna is placed on a workbench (not made of metal!) and the luminaire can be positioned in such a way that communication is possible.
Often the heatsink for the LED's is made of metal, which can hamper the communication. In that case configuration from the outside of a luminaire is not possible.

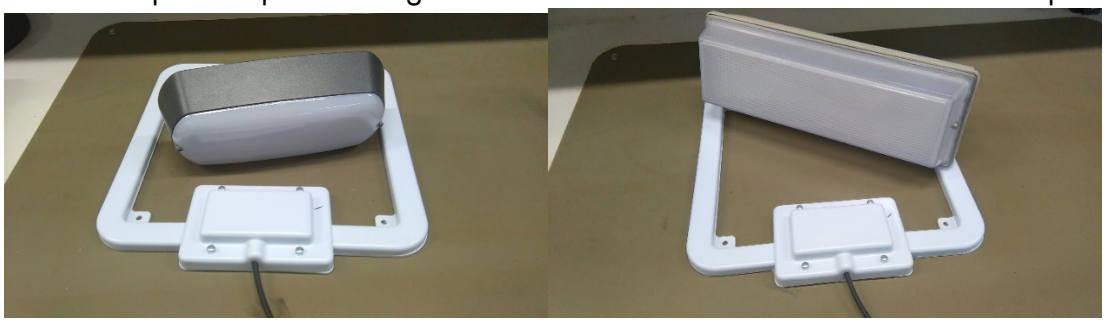
In general, the following recommendations in designing a luminaire can be made to increase the possibilities for configuring the driver from outside the luminaire.

Since electromagnetic waves will be hindered by metal and not by plastic or glass:

- Make a sufficient "line of sight" for the (electro)magnetic waves from the NFC tag of the driver to the external antenna, without metal interference in the way.
- Try to get the NFC tag of the driver close to a side of the luminaire. The indication of the NFC tag on the driver is shown with this symbol: 

- Position the driver in the luminaire such that the NFC tag can be parallel to the external antenna.
- Experiment to find the optimal position of the luminaire with respect to the antenna.

Two examples of positioning the luminaire such that communication is possible



Picture 1

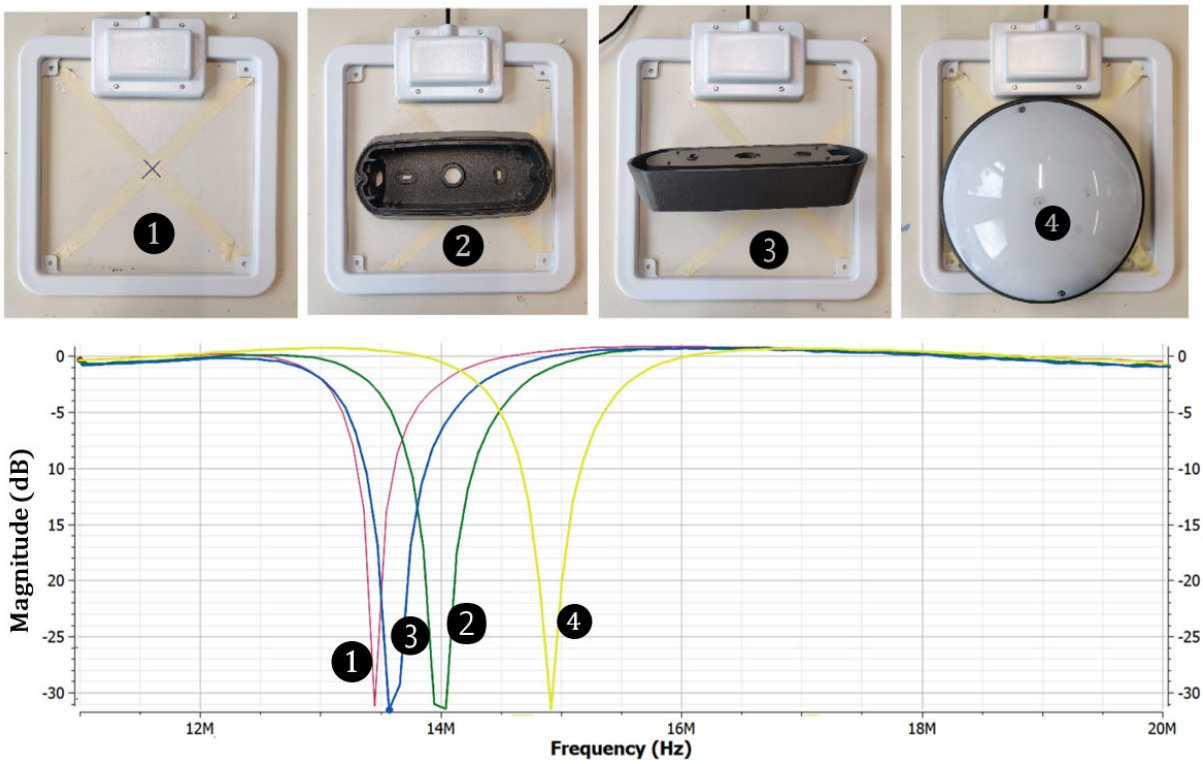
7. Luminaire made of metal

When the luminaire is made of metal, the magnetic field of the antenna will be hampered.
A hole in the luminaire will make it possible that EM fields can enter the luminaire.
In this case the LCN9630 antenna or ECCO smart can be best used.
The hole can be covered by a plastic part.

For aluminum housing (thickness of material 6mm) a hole of at least 50mm diameter is needed to enable communication. For a metal sheet housing (thickness of material 1.5mm) the minimum diameter is 30mm. These diameter values are indication; in specific cases these might not be the optimum values.
In all cases the antenna of the driver must be well positioned w.r.t. to the hole, and not further away from the housing than 10mm. Experiments are necessary to find the right position and the optimum diameter.

Annex: How to tune an antenna.

An antenna from factory is tuned at a resonance frequency of 13.56MHz, and an impedance of 50Ω. There is a small frequency bandwidth in which the antenna can work.
Metal in the neighborhood will change this value. If that is the case the electronics in the reader will switch off to prevent violations of the EMC regulations. In that case it is necessary to change the tuning of the antenna again to fulfill f = 13.56MHZ and Z_0 = 50 Ω. This can be done by adding capacitors.
In the picture 2 you can see some examples of the measured frequency shifts. The graph show the reflected electrical signal (S11), and is measured with a VNA (see further). When there is a dip in the reflected signal, it means that there is a maximum in the signal which is sent by the antenna (resonance frequency).



Picture 2

Picture: reflected signal when metal is in the neighborhood of the antenna. Signal 1 is ideal at the resonance of 13.56MHz.

In the FEIG documentation on the ANT310/310 it is described how to tune the antenna using an VSWR (Voltage Standing Wave Ratio).

Adobe Acrobat Document

This can also be done (and is probably easier) by a VNA (Vector Network Analyzer), such as:
[Home | Pocket VNA]

Or:
[DG8SAQ VNWA 3 and 3EC Low Cost Vector 1.3 GHz Network Analyzer VNA (sdr-kits.net)]

It is advised that this investigation and tuning is done by a skilled engineer.

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