

Whitepaper M12 Magnetics HARTING

People | Power | Partnership

Abstract: Technical solutions with integrated transducers are an important component in modern communication systems – without them broadband information transfer with high signal integrity would not be possible over Ethernet networks.

Transducers are inductive components in communication systems, which in general share a similar design with transformers. Whilst traditional transformers have been optimised for power transfer to have the highest possible efficiency, transducers enable relatively high broadband information transfer with the highest possible signal quality. Maintenance of a good signal is therefore more important than optimised efficiency.

The transducer signals play a supporting role in regarding quality within Ethernet networks. They ensure that communication between two clients over an Ethernet-based system is characterised by good signal quality.

Other important properties of a transducer include its linearity, or least possible distortion. In fact, distortion can lead to falsification of the signal, meaning it can no longer be read by a receiver. In a worst case scenario, this can lead to reduced functionality or termination of an application.

State of the Art:

Transducers are used for galvanic isolation, signal transfer, isolation of potentials and for balancing in local Ethernet networks. They are already standard in conjunction with RJ45 printed circuit board (PCB) ports and have established themselves in the wider market.

The following figure (1) illustrates the discrete¹ design of a solution, which is frequently used at present during development, e.g. of a switch with M12 connectors. In this case, the transducer is installed as a separate component on the PCB between the Ethernet chip and each connector and therefore requires a certain amount of space.

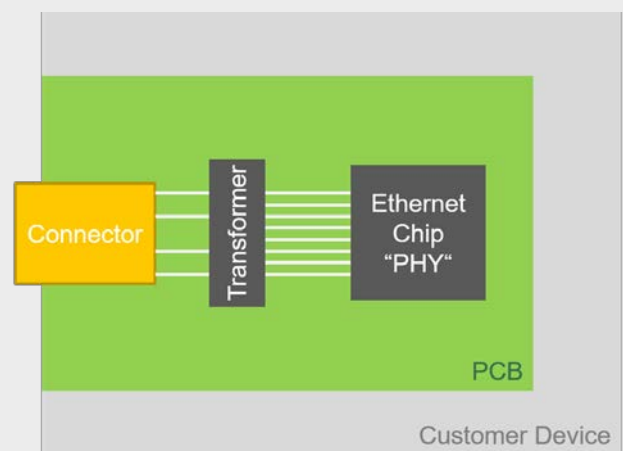


Figure 1 – Previous arrangement of connectors and peripherals

For example, in the case of a 16-port switch, the spatial requirement that must be reserved is enormous. Within this arrangement, the transducer fulfils two important functions. Firstly, it ensures galvanic isolation and therefore protects the Ethernet chip (PHY) from inputting external voltages. Secondly, the transducer contributes to improved signal quality.

The whitepaper demonstrates in the following the possibility of foregoing the need for a transducer as a separate component in the future. It will also be shown how the associated design costs can be reduced during. The focus lies on a simple design-in through component reduction and the associated space savings on the circuit board. This subject will play an important role in the future, particularly regarding current trends in miniaturisation.

Challenges in Future Applications:

Increasing numbers of manufacturers are joining the striking miniaturisation trend within industry; making their devices smaller, more compact and smarter. The prime motivators are the desire to remain competitive long-term and to reduce costs.

¹In this case, „discrete“ refers to the isolated positioning of connectors and transducers on circuit boards, which has been common up to now.

Whitepaper M12 Magnetics HARTING

People | Power | Partnership

To allow manufacturers to reduce the size of their devices, the required components must also shrink. In the case of transducers, which are used as standard, this is only possible to a limited extent as a discrete design, as shown in figure (1), would require too much space on a circuit board when used with M12 connectors. This means that it will no longer be possible to use those tried and tested components, which are currently standard. A smaller, more compact solution must be found.

HARTING – The Solution:

The solution developed by HARTING combines traditional M12 connectors for circuit boards and a transducer in a single component, without increasing the area needed by the M12 connectors. The space required for the transducer on the circuit board is therefore freed up, as the transducer is now housed within the connector itself.

This means that developers can design their devices significantly smaller and more compact. Each M12 plug connector with integrated transducer, allows approx. 30% of circuit board area to be saved compared with a discrete design as shown in Figure (2). In addition, it offers a balanced solution with respect to signal integrity as the transducer, including all relevant electronic components, is already integrated within the M12 connector. Aside from the general M12 specifications according to IEC 61076-2-101/109 and the Ethernet specifications according to IEEE 802.3, M12 connectors with integrated transducers also fulfil the higher specifications of railway applications regarding shock and vibration according to IEC 61373.

Aside from a D-coded version for fast Ethernet applications, an X-coded 1 Gbit or 10 Gbit version will also be produced to provide higher transfer rates. All versions will be produced in linear or angular designs, with or without PoE/PoE+, in order to ensure energy supply to smaller devices, e.g. switches, as well as purely data transmission.



Figure 2 – Demonstrator with previous solution and new M12 Magnetics

About HARTING / Contact Details:

HARTING technology group develops custom solutions and products, such as connectors for energy and data transfer, e.g. in mechanical engineering, railway systems, wind energy systems, factory automation and the telecommunication sector, using their expertise in electrical, electronic and optical connector, transfer and network engineering, as well as production, mechatronics and software design.

The author has been an active member of HARTING technology group since 2008. He started initially as an application engineer within the mechanical engineering department at HARTING Deutschland, and has now overseen the M8/M12 pin connector and 7/8" solutions for HARTING Electronics as Product Manager since 2013.

For additional information, please contact:

Dipl. Ing. (FH) Matthias Domberg
Global Product Manager Device Connectivity

HARTING Electronics GmbH
Marienwerder Str. 3
32339 Espelkamp
Email: Matthias.Domberg@HARTING.com
<http://www.HARTING.com>
Phone: +49 (0)57 72 47-9746
Mobile: +49 (0)175 436-6925