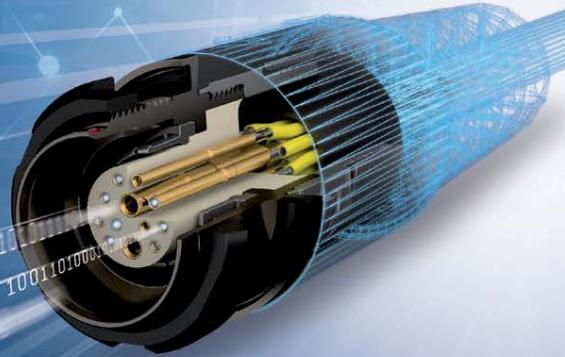


Transmission of data transmission protocols such as HDMI® 2.0<sup>1</sup>, USB® 3.1 Gen1<sup>1</sup>, Ethernet<sup>1</sup>, CAT 5<sup>1</sup>, CAT 6<sub>A</sub><sup>1</sup>, FireWire<sup>®1</sup>, eSATA<sup>®1</sup>



**High-speed data transfer**  
An ODU AMC High-Density with a hybrid special contact configuration for transmitting power and data according to the USB® 3.1 Gen1<sup>1</sup> standard.

<sup>1</sup> These ODU specific connectors can transmit common data transmission protocols such as USB® 3.1 Gen1, HDMI® 2.0, Ethernet, CAT 5, CAT 6<sub>A</sub>, FireWire® and eSATA®, but they are not USB®, HDMI®, Ethernet, CAT- and eSATA®-standard connectors.

Both the sheer volume of data to be transmitted and the electro-mechanical requirements of data transmission connectors are growing exponentially. When it comes to high-speed data transfer, these demands and the requirements of high-frequency transmission need to be combined in a connector – so optimal signal integrity can be ensured throughout the entire product life cycle.

## 05 HIGH-SPEED DATA TRANSFER FOR THE MOST DEMANDING REQUIREMENTS

Knowhow, the use of suitable materials as well as the testing of S-parameters\* at the earliest possible stage safeguard the permanently stable nature of signal integrity. In addition, and designed to fit each application, ODU high-speed connectors meet further requirements such as high contact density and a maximum number of mating cycles, tightness, low weight, vibration resistance and ruggedness.

\* S-parameters = frequency-dependent scattering parameters; transmission and reflection measurement on inputs and outputs of a high-frequency system.

# ODU HIGH-SPEED SOLUTIONS: SYNERGETIC DEVELOPMENT FROM A SINGLE SOURCE

Early on in the conceptual phase of developing high-speed connectors, simulation tools are used to check the S parameters, the characteristic wave impedance and the voltage standing wave ratio. These tests provide important information for the CAD models of the product designers. The simulated interaction of the FEM calculations and CAD design enables important functional properties of new developments to be checked in advance and optimized according to the specific application. These reliable FEM forecast models are based on the comprehensive ODU-specific data-base whose results stem from systematic measurements and tests.

## The perfect interplay of development and design

Among other things, the development and design departments both assess the following key factors and come to an agreement on the details of the product and implementation concept:

- The selection of a plastic for the insulator depends on more than simply its permissible, suitable temperature range. For example, it must also exhibit a stable dielectric constant over a certain frequency.
- The contacts must do more than simply be reliable and continuously transmit current. They must also ensure that the connector has the correct characteristic wave impedance.
- The arrangement of contacts must not only withstand voltages (compliance with clearance and creepage distances). It must also reduce crosstalk between the signal pairs.
- Depending on the application, the housing must be watertight and simultaneously provide good electromagnetic shielding.



### High-speed solutions

Contact arrangements especially for data transmission and appropriately shielded implementations are available for many of our products (4 positions for CAT 5<sup>1</sup> and USB<sup>®</sup> 2.0<sup>1</sup>, 10 positions for USB<sup>®</sup> 3.1 Gen1<sup>1</sup>).

<sup>1</sup> These ODU specific connectors can transmit common data transmission protocols such as USB<sup>®</sup> 2.0, USB<sup>®</sup> 3.1 Gen1 and CAT 5, but they are not USB<sup>®</sup>- and CAT-standard connectors.

**Special solutions through intensive knowledge transfer**  
Through the interdisciplinary, networked interaction among various ODU departments, the limits on the possible are constantly being redefined, including in the high-speed area.

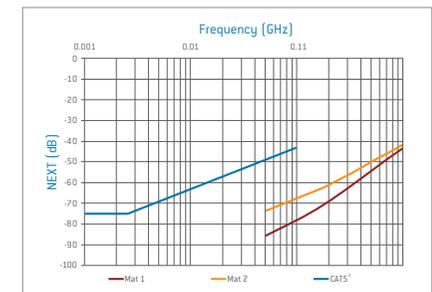
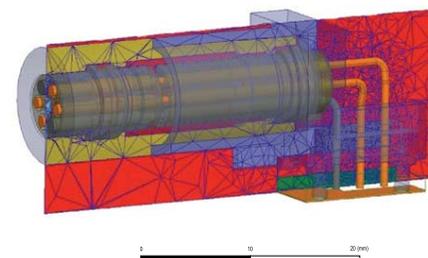


## Accurate FEM models

The objective of the simulation procedure is a validated statement on the basis of a reliable FEM forecast model, such as regarding mechanical stability, high-frequency transmission and dynamic behavior. The reliability of the connector system and long-term behavior are also simulated.

Understanding the correct material parameters in the respective frequency range of the application is particularly important for reaching an accurate FEM

model in high-frequency technology. This data is available thanks to many years of systematic basic research and high-frequency simulation experience. Which is why today, ODU can refer to a stable, accurate FEM model and offer its customers significantly shortened development times up until the prototype stage as well as process reliability for serial production.



### Material comparison and adjustment to standard specifications:

Even in the early conceptual stage, simulation can help make certain statements about future high-frequency behavior and aid in selecting the best possible variations.

# OPTIMIZED RECEPTACLE CONNECTION VIA FLEXIBLE PCBs

When it comes to high-speed data transmission, the connector itself must be taken into consideration, along with the connecting cable on the mating side and the PCB termination on the device side. For the optimum connection of the receptacle to the PCBs, ODU has developed a solution for transmitting high-frequency signals via flexible or rigid-flex PCBs, as the case may be.

By means of this new development, an innovative connector and connection concept which is easier to assemble has become available on the market – for the demanding application area of magnetic resonance imagery (MRI). Moreover, the principle can be used with, and modified for, other applications.

Despite the high requirements of an impedance adjustment to  $50\ \Omega$  with a voltage standing wave ratio of  $VSWR \leq 1.1$ , ODU has managed to ensure this for the entirety of ODU's supplied path (cable connection – rigid-flex – connector – rigid-flex – cable connection).

The PCB layout of the connector's PCB termination plays a decisive role in this case. The simulation procedure available at ODU enables the board layout

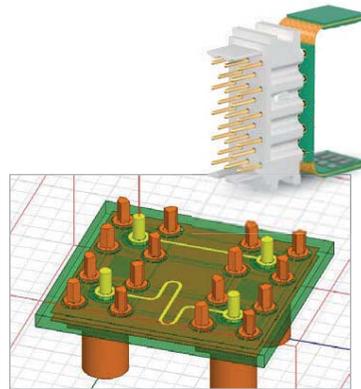
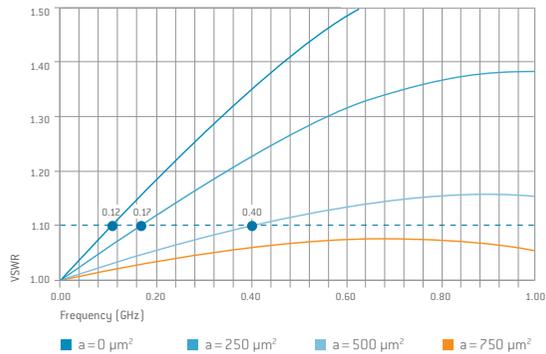
to be taken into consideration as well, and thereby to synchronize the signal integrity of the overall systems.

### Example: the connection of a standard SMA connector

The PCB has a double-sided design. The signal is routed on the board with controlled impedance as a microstrip line. For this purpose, one side is used only as a ground layer and the second side contains the cable routing.

The design of the print layout on the board plays a decisive role in the transmission behavior. The diagram depicts the voltage standing wave ratio of four different termination layouts. The limit value thereby changes from 120 MHz to over 1 GHz at a strict limit value of  $VSWR = 1.1$ .

VSWR – OPTIMIZATION VIA A CHANGE TO THE PARAMETERS "a"



Crucial for the signal integrity: the PCB layout

Parameter a – Diameter of the undercut

# ODU CONNECTORS IN HIGH-SPEED DATA TECHNOLOGY

Customers trust ODU's high-speed products and system solution varieties tailored to their specific application area:

1. In **medical technology**, our ODU-MAC White-Line modular connector system is used in imaging diagnostics for transmitting high-resolution X-ray, CT and MRI images. High-quality contacts guarantee the transmission properties of the signals. Non-magnetic varieties are also included in our standard portfolio.



2. In **railway technology**, train couplings are fitted with ODU high-speed interfaces that transmit Gigabit Ethernet<sup>1</sup>. These interfaces are reliably stable for 50,000 mating cycles and remain fully functional at all times, even in harsh environments and when exposed to strong vibration. Such applications typically make use of ODU's springwire contacts or the ODU SPRINGTAC. They offer a consistently low contact resistance, thereby ensuring minimal insertion loss at the same time.



3. In **military technology**, ODU AMC data technology interfaces are typically used: In addition to being high-speed performers, they offer IP69 tightness and vibration resistance. The interfaces are easy to clean, compact and lightweight, while also offering a high number of mating cycles. They also ensure quick and secure mating and demating.



4. ODU has developed an application-specific small connector for the **oil industry** that is used in a pipeline inspection system. It is pressure-tight to 200 bar and combines data rates according to FireWire<sup>®</sup> S800<sup>1</sup> with power contacts in a shock- and vibration-resistant variety.



<sup>1</sup> These ODU specific connectors can transmit common data transmission protocols such as FireWire<sup>®</sup> and Ethernet, but they are not FireWire<sup>®</sup>- and Ethernet-standard connectors.