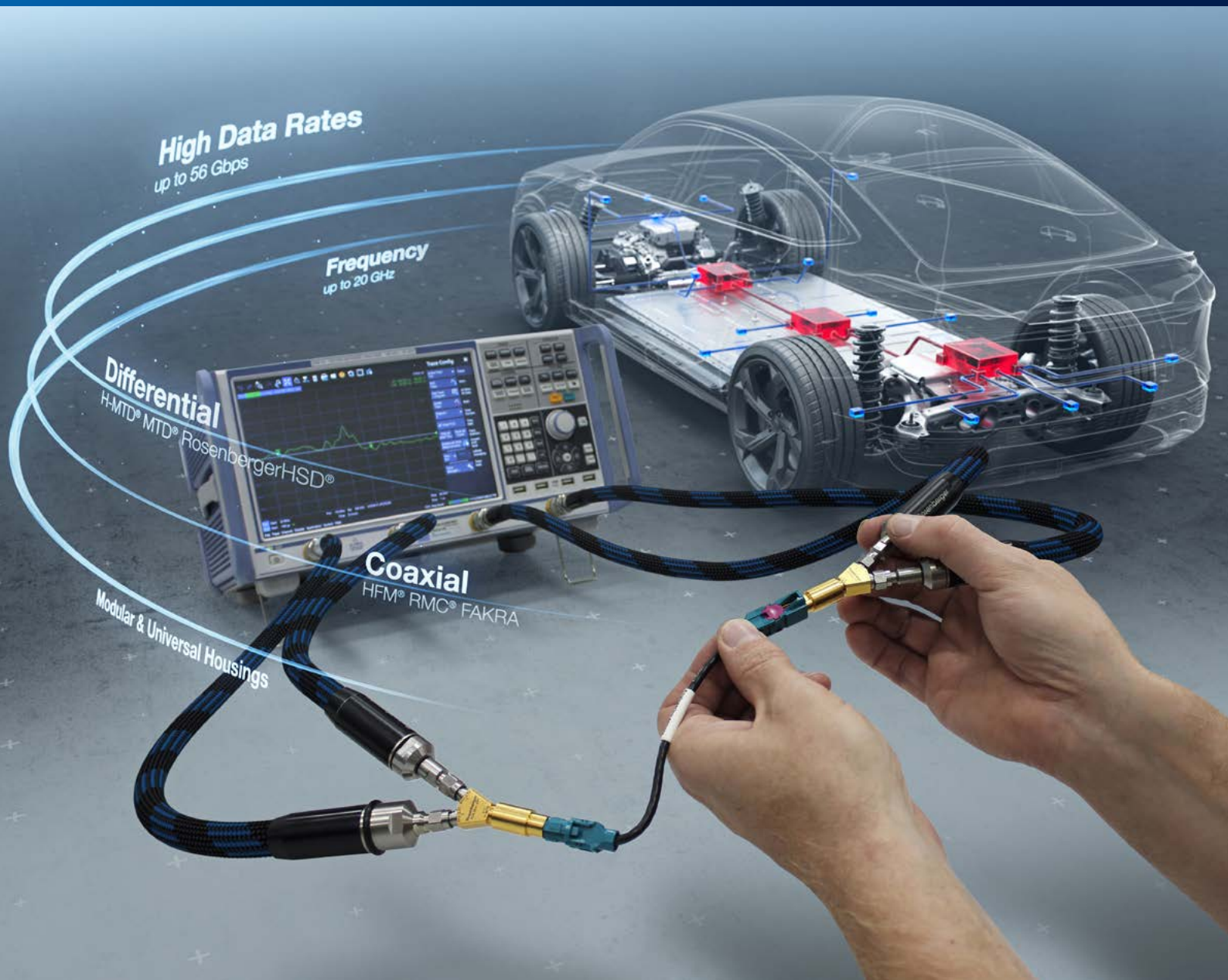
Rosenberger

Test & Measurement Equipment for Automotive Data Connectors

SEMICONDUCTOR & TEST



About Rosenberger

Rosenberger, a family owned company, is one of the world's leading manufacturers of impedance-controlled connectivity solutions in high-frequency, high-voltage and fiberoptic technology. Renowned companies in high-tech industries trust the precision and quality of Rosenberger products, e.g. mobile communication networks, data centers, test & measurement industries, automotive electronics, industrial and medical electronics, or aerospace engineering.

Worldwide, the Rosenberger group operates a global network of R&D, manufacturing and assembly locations as well as Rosenberger sales offices in Europe, Asia, North and South America where more than 15,000 employees develop, produce and sell our products.

Contents

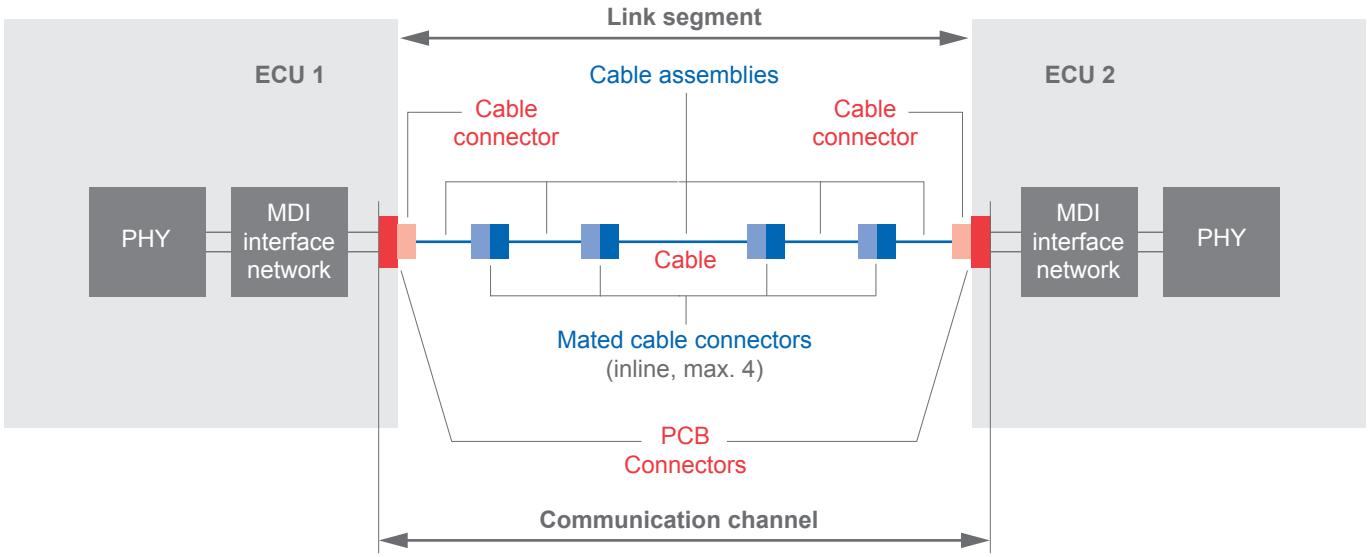
The Rosenberger online catalog contains the current data connector systems with specific details, including data sheets, assembly instructions and panel piercings.

www.rosenberger.com/ok/rf

Test & Measurement

The Need for Automotive Test Adaptors for High-speed Interfaces

Through standardization of automotive high-speed links a robust and reliable implementation over lifetime in the well-established “building block strategy”, i.e. second-source and multi-vendor procurement strategy at the OEM, is possible. An appropriate simulation framework based on intentionally worst-case models needs to be applied. That helps getting rid of any fragmented and/or inconsistent set of limits for the wiring harness supply chain for most of the high-speed protocols and paves the way to functional safety assessments in terms of Automotive Safety Integrity Levels (ASIL) and Failure In Time (FIT) rates, because of clear responsibilities and liability at each supplier level over the entire wiring harness supply chain. Therefore, test adaptors for automotive connector interfaces that are used for high-speed data transmission are required for many different use cases.



Definition of the automotive Ethernet link segment
Source: Open Alliance TC9 – Channel and component requirements for fully shielded 1000BASE-T1 and 2.5G/5G/10GBASE-T1 link segments

Channel

Link segment or communication channel

Assembly Level

Cable assembly

Mated pair

Component Level

PCB connector or PCB header

Cable connector

Cable

First of all, any kind of SI measurement on modules like cameras or head units benefits from an adaptation that doesn't alter the signal quality of the input or output signal when connecting the module to e.g. an oscilloscope, waveform generator or network analyzer.

Secondly, adaptors can be utilized to characterize cable assembly or whole link segments (including inlines). Frequently, S-parameters of link segments need to be measured and evaluated against limit lines from channel specifications of different protocols, like automotive Ethernet.

Moreover, with a pair of adaptors for the female and male "version" of the automotive connector interface it becomes even possible to "remove" the already very small effect of the test adaptors from the overall measurement through de-embedding, e.g. 2×Thru de-embedding. This is sometimes required by the measurement procedure described in the standard one needs to evaluate e.g. a link segment against.

In general, two types of adaptors can be distinguished. "Direct" adaptors and PCB-based adaptors. PCB based adaptors will have more influence on signal integrity as direct adaptors. PCB adaptors need to be utilized when the DUT shall e.g. be a link segment including a PCB header at both ends or the DUT is the PCB header itself.

Rosenberger contributed to the definitions of the measurement setups in standardizations like Open Alliance and Automotive Serdes Alliance and set up our portfolio of measurement adaptors accordingly. Therefore, we can directly provide you with "test equipment bundles" for many different test cases. Just contact us for further details.

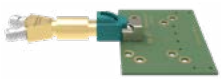
Apart from the required SI tests this also includes EMC related test.

Following a short comparison of different methods that are used when trying to remove the SI effects of fixtures.

Method	Description
Offset compensation	Can't take into account impedance variations along the fixture so RL will be incorrect
TRL calibration	Requires standards e.g. a match for low frequencies which is not available for automotive grade interfaces
Time-domain gating	Can only remove the reflections of the fixture not the loss
Simulation based fixture modeling and de-embedding	Very difficult to accurately match model to reality, couldn't cope with any deviations from the "nominal" simulation model
Measurement based fixture characterization and de-embedding	Requires an additional 2×Thru sample and accuracy will also depend on the algorithm that generates the fixture model.

Various Application Recommendations Depending on the Measurement Setup

Module/Head unit



Link segment

Cable assembly

PCB header

Cable connector

HFM® Products

Rosenberger HFM® (High-Speed FAKRA-Mini) is the best performing system of “Mini-Coax” connectors for the automotive industry. For frequencies up to 20 GHz, the intelligent modular system ensures fast transmission of high data rates up to 28 Gbps. Its innovative design addresses the growing requirement for cost savings as well as reduced weight and size.

Delivering space savings of up to 80 % compared to conventional FAKRA connectors, the Rosenberger HFM® connector system allows various modules to be accommodated in the smallest possible footprint.

The priority of autonomous driving and driver assistance systems is to ensure safety. It is required to determine exact positions, to continuously calculate routes and to detect and classify objects. High data volumes from several cameras, diverse sensors and navigation sources must be combined and transported for this purpose – in real time. Rosenberger HFM® is compliant to all common automotive standards.

Applications

- Measurement technology
- Autonomous driving
- Driver assistance systems
- Navigation
- Infotainment
- Rear seat entertainment
- WiGig (Wireless Gigabit)

Benefits

- Modular system – saving up to 80 % installation space
- Real-time data transmission
- Optional connector position assurance (CPA)
- Waterproof variants

For more information
refer to our website:

www.rosenberger.com/hfm

HFM® Test Adaptors

Test Adaptors with Housing

Rosenberger No.	Description	Connectors	Product
02K1AM-KA0S3	Adaptor With HFM® housing single	RPC-2.92 female HFM® female	
02K1AM-SA0S3	Adaptor With HFM® housing single	RPC-2.92 female HFM® male	
02S1AM-KA0S3	Adaptor With HFM® housing single	RPC-2.92 male HFM® female	
02S1AM-SA0S3	Adaptor With HFM® housing single	RPC-2.92 male HFM® male	

Test Adaptors without Housing for Universal Use

Rosenberger No.	Description	Connectors	Product
02K1AM-KA1S3	Adaptor Without HFM® housing	RPC-2.92 female HFM® female	
02K1AM-SA1S3	Adaptor Without HFM® housing	RPC-2.92 female HFM® male	
02S1AM-KA1S3	Adaptor Without HFM® housing	RPC-2.92 male HFM® female	
02S1AM-SA1S3	Adaptor Without HFM® housing	RPC-2.92 male HFM® male	

Universal adaptors can be used with each HFM® connector (single, double, quad, standard and waterproof)

Test Adaptors Waterproof

Rosenberger No.	Description	Connectors	Product
02K8AM-K01S3	Adaptor With HFM® housing quad Waterproof	4 × RPC-2.92 female 1 × HFM® female	
02K8AM-S01S3	Adaptor With HFM® housing quad Waterproof	4 × RPC-2.92 female 1 × HFM® male	
02S8AM-K01S3	Adaptor With HFM® housing quad Waterproof	4 × RPC-2.92 male 1 × HFM® female	
02S8AM-S01S3	Adaptor With HFM® housing quad Waterproof	4 × RPC-2.92 male 1 × HFM® male	

HFM® Test PC-Boards

Test PC-Board

Rosenberger No.	Description	Coding	Packing Unit	Product
PCB-P3001-SB	Test PC-Board Impedance 50 Ω	1 × HFM® male AMS29D-40MZ5-y 4 × RPC-2.92 female 02K249-40ML5	1	
PCB-T2503-SB-01	Test PC-Board Impedance 50 Ω	1 × HFM® male AMS29A-40MZ5-y 3 × RPC-2.92 female 02K721-40MS3	1	
PCB-T2504-SB-01	Test PC-Board Impedance 50 Ω	1 × HFM® male AMS29B-40MZ5-y 4 × RPC-2.92 female 02K721-40MS3	1	
PCB-T2505-SB-01	Test PC-Board Impedance 50 Ω	1 × HFM® male AMS29C-40MZ5-y 4 × RPC-2.92 female 02K721-40MS3	1	

RMC® Products

RMC® (Rosenberger Mini-Coax) connector system for frequencies up to 9 GHz and with a modular design for fast data transmission applications.

The space-saving design combines the requirement for cost savings as well as the reduction of weight and size.

Applications

- Measurement technology
- Camera applications
- Driver assistance systems
- Autonomous driving
- Navigation
- Infotainment
- Internet and mobile communication

Benefits

- Small dimensions – optimized used of space
- Modular system – saving installation space
- Waterproof variants

For more information
refer to our website:

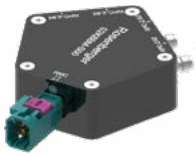
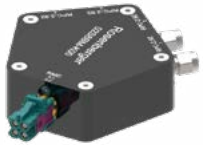
www.rosenberger.com/rmc

Test Adaptors without Housing for Universal Use

Rosenberger No.	Description	Connectors	Product
02K1BM-K00S3	Adaptor Without RMC® housing	RPC-2.92 female RMC® female	
02K1BM-S00S3	Adaptor Without RMC® housing	RPC-2.92 female RMC® male	
02S1BM-K00S3	Adaptor Without RMC® housing	RPC-2.92 male RMC® female	
02S1BM-S00S3	Adaptor Without RMC® housing	RPC-2.92 male RMC® male	

Universal adaptors can be used with each RMC® connector (single, double, quad, standard and waterproof)

Test Adaptors

Rosenberger No.	Description	Connectors	Product
02K8BM-K00S3	Adaptor With RMC® housing quad	4 × RPC-2.92 female 1 × RMC® female	
02K8BM-S00S3	Adaptor With RMC® housing quad	4 × RPC-2.92 female 1 × RMC® male	
02S8BM-K00S3	Adaptor With RMC® housing quad	4 × RPC-2.92 male 1 × RMC® female	
02S8BM-S00S3	Adaptor With RMC® housing quad	4 × RPC-2.92 male 1 × RMC® male	

Test PC-boards are available on request.

FAKRA Products

Rosenberger FAKRA* industry standard compatible connectors are designed to fulfill the rigorous mechanical and environmental requirements of the automotive industry. Ensuring maximum electrical and mechanical performance, these high quality FAKRA connectors feature specific color coded plastic housings in accordance with the FAKRA coding industry standard. Thirteen distinct mechanical and color codes enable easy identification and unique keying to avoid mis-mating and additional one neutral coding.

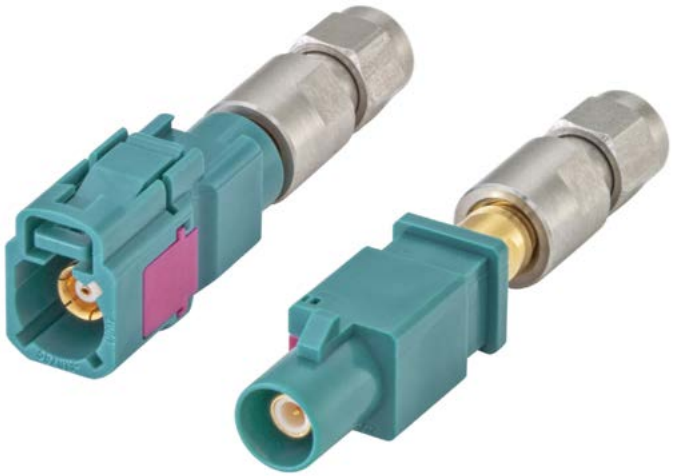
* FAKRA: Fachkreis Automobil (Automobile expert group)

Applications

- Measurement technology
- Camera applications
- Sensors for detection, evaluation and reaction
- Radio antenna
- GPS telematics or navigation
- Infotainment and television
- Internet and mobile communication
- RF Bluetooth and WLAN applications

Benefits

- Fulfill the tough requirements of the automotive industry
- No misuse due to secure coding system
- Primary and secondary locking systems lead to high assembling security
- Multiple housings for space savings and quick plug-in operations



For more information
refer to our website:

www.rosenberger.com/fakra

Test Adaptors with Housing

Rosenberger No.	Description	Connectors	Product
03K159-K20S3	Adaptor With FAKRA housing single	RPC-3.50 female FAKRA female	
03K159-S20S3	Adaptor With FAKRA housing single	RPC-3.50 female FAKRA male	
03S159-K20S3	Adaptor With FAKRA housing single	RPC-3.50 male FAKRA female	
03S159-S20S3	Adaptor With FAKRA housing single	RPC-3.50 male FAKRA male	

Test Adaptors without Housing for Universal Use

Rosenberger No.	Description	Connectors	Product
02K159-KA1S3	Adaptor Without FAKRA housing	RPC-2.92 female FAKRA female	
02K159-SA1S3	Adaptor Without FAKRA housing	RPC-2.92 female FAKRA male	
02S159-KA1S3	Adaptor Without FAKRA housing	RPC-2.92 male FAKRA female	
02S159-SA1S3	Adaptor Without FAKRA housing	RPC-2.92 male FAKRA male	

Universal adaptors can be used with each FAKRA connector (single, double, standard and waterproof)

H-MTD® Products

Rosenberger H-MTD® is a differential connector system for high-speed data transmission of up to 20 GHz or 56 Gbps, contained in a compact yet robust automotive grade housing.

Apart from ensuring high-bitrate data transmission and savings on installation space and weight, a further major advantage of this connector system is its modularity, providing the flexibility to support a wide range of Ethernet applications and industry protocols.

The application field of the Rosenberger H-MTD® is countless as it can be used with a variety of different cables including Shielded Twisted Pair, Unshielded Twisted Pair and new High-Performance cables. With H-MTD® the customer can count on an interface that accommodates future vehicle networks, applications and protocols.

Applications

- Measurement technology
- Camera systems 4k and higher
- Driver assistance systems
- Autonomous driving
- High resolution displays
- Rear seat entertainment

Benefits

- High frequency range/data rates up to 20 GHz/56 Gbps
- Modular system – saving up to 80% of installation space
- Primary and secondary lock
- Open to all protocols: Ethernet (100 Mbps, 1 Gbps, Multi-Gigabit), LVDS, APIX 3, FPD4, PCIe Gen3

For more information
refer to our website:

www.rosenberger.com/h-mtd

H-MTD® Test Adaptors

Test Adaptors with H-MTD® Housing

Rosenberger No.	Description	Connectors	Product
02K3E6-K00S5	Y-Adaptor With H-MTD® housing single	2 × RPC-2.92 female 1 × H-MTD® female	
02K3E6-S00S5	Y-Adaptor With H-MTD® housing single	2 × RPC-2.92 female 1 × H-MTD® male	
02S3E6-K00S5	Y-Adaptor With H-MTD® housing single	2 × RPC-2.92 male 1 × H-MTD® female	
02S3E6-S00S5	Y-Adaptor With H-MTD® housing single	2 × RPC-2.92 male 1 × H-MTD® male	

Test Adaptors without H-MTD® Housing for Universal Use

Rosenberger No.	Description	Connectors	Product
02K3E6-K01S5	Y-Adaptor Without H-MTD® housing	2 × RPC-2.92 female 1 × H-MTD® female	
02K3E6-S01S5	Y-Adaptor Without H-MTD® housing	2 × RPC-2.92 female 1 × H-MTD® male	
02S3E6-K01S5	Y-Adaptor Without H-MTD® housing	2 × RPC-2.92 male 1 × H-MTD® female	
02S3E6-S01S5	Y-Adaptor Without H-MTD® housing	2 × RPC-2.92 male 1 × H-MTD® male	

Universal adaptors can be used with each MTD® connector (single, double, quad, standard and waterproof)

H-MTD® Coupler

Coupler Kit

Rosenberger No.	Description	Connectors	Product
DCDP-H-MTD-1G	Coupler Kit including: 1 × coupler H-MTD® 2 × cable assemblies LCA-109-1000-Z 2 × cable assemblies LCA-101-1000-Z-Z	2 × H-MTD® male E6S215-40ML5-Z 4 × SMA female 32K264-40ML5	

H-MTD® Test PC-Boards

Test PC-Boards

Rosenberger No.	Description	Connectors	Product
PCB-T2003-SB-01	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S10A-40MT5-Z 4 × RPC-2.92 female 02K721-40MS3	
PCB-T3503-SB-01	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S10F-40MT5-Z 4 × RPC-2.92 female 02K721-40MS3	
PCB-S3401-SB-01	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S20A-40MT5-Z 4 × RPC-2.92 female 02K721-40MS3	
PCB-T0601-SB-01	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S20B-40MT5-Z 6 × RPC-2.92 female 02K721-40MS3	
PCB-T0602-SB-01	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S20D-40MT5-Z 10 × RPC-2.92 female 02K721-40MS3	
PCB-T0704-SB-02	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S20F-40MT5-Z 12 × RPC-2.92 female 02K721-40MS3	

Test PC-Boards Waterproof

Rosenberger No.	Description	Connectors	Product
PCB-T2003-SB-02	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S14A-40MT5-Z waterproof 4 × RPC-2.92 female 02K721-40MS3	
PCB-S3401-SB-02	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S24A-40MT5-Z waterproof 4 × RPC-2.92 female 02K721-40MS3	
PCB-T0601-SB-02	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S24B-40MT5-Z waterproof 6 × RPC-2.92 female 02K721-40MS3	
PCB-T0602-SB-02	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD® male E6S24D-40MT5-Z waterproof 10 × RPC-2.92 female 02K721-40MS3	

Test PC-Boards +6 Power Pin

Rosenberger No.	Description	Connectors	Product
PCB-T2003-SB-03	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD®+6 male 99S1HC-40MT5-Z 6 × SMA female 32K101-400L5 4 × RPC-2.92 female 02K721-40MS3	
PCB-T2003-SB-04	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD®+6 male 99S1HG-40MT5-Z 6 × SMA female 32K101-400L5 6 × RPC-2.92 female 02K721-40MS3	
PCB-T1401-SB-01	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD®+6 male 99S2HC-40MT5-Z 6 × SMA female 32K101-400L5 4 × RPC-2.92 female 02K721-40MS3	
PCB-T1401-SB-02	Test PC-board Impedance 100 Ω Frequency range DC to 10 GHz	1 × H-MTD®+6 male 99S2HG-40MT5-Z 6 × SMA female 32K101-400L5 6 × RPC-2.92 female 02K721-40MS3	

MTD® Products

The Rosenberger MTD® connection system is an industry standard * Ethernet transmission system for optimized jacketed Twisted-Pair cables. Its excellent transmission and electrical performance, reduced weight, size and cost benefits have set new standards for 100 Mbps and 1 Gbps single connection Ethernet implementation in vehicles.

Compared to other solutions a key advantage of Rosenberger's connection system is the impedance-controlled transition area from cable to connector interface. Its small size in combination with several coding features allows multiple wire pairs to be placed in close proximity ensuring installation space is kept to a minimum. Furthermore, the honeycomb structure provides low crosstalk, good symmetry and can be extended modularly.

* MTD® fulfills channel requirements in terms of adaptation, symmetry and cross talk according to 100BASE-T1, 1000BASE-T1 (for 1-way connection), OPEN Alliance TC2 and BroadR-Reach® Spec 3.2.

Applications

- Measurement technology
- Ethernet transmission systems in automobiles
- For 100BASE-T1 and 1000BASE-T1

Benefits

- Connector system for optimized jacketed cables
- Optimized in weight and installation space
- Designed for chip-to-chip applications

For more information
refer to our website:

www.rosenberger.com/mtd

Test Adaptors

Rosenberger No.	Description	Connectors	Product
02K3E7-K01S5	Y-Adaptor With MTD® housing	2 × RPC-2.92 female 1 × MTD® female	
02K3E7-S01S5	Y-Adaptor With MTD® housing	2 × RPC-2.92 female 1 × MTD® male	

Coupler Kit

Rosenberger No.	Description	Connectors	Product
DCDP-MTD-1G	Coupler Kit including: 1 × coupler MTD® 2 × cable assemblies LAQ-114-1000-Z 2 × cable assemblies LAQ-111-1000-Z-Z	2 × MTD® male 4 × SMA male	

Test PC-Boards

Rosenberger No.	Description	Connectors	Product
PCB-T4503-SB1	Test PC-board Impedance 100 Ω Frequency range DC to 1 GHz	4 × SMA female 1 × MTD® male right angle	
PCB-T3301-SB1	Test PC-board Impedance 100 Ω Frequency range DC to 1 GHz	4 × SMA female 1 × MTD® male straight	

Adaptor

Rosenberger No.	Description	Product
E7C10T-900X5-y	Daisy-chain adaptor Double vertical 10BASE-T1S	

-y please fill in requested coding

RosenbergerHSD® Products

RosenbergerHSD®, a homogeneous impedance-controlled interconnect system for high-speed data applications, is a high-performance digital system for low-voltage differential signals which prevents interference from cross-talk and external sources. RosenbergerHSD® is a 100 Ω fully-shielded interconnect system that can use shielded twisted quad cables.

The RosenbergerHSD® system features mechanical keying, latching, color code options, and a minimum size to satisfy global automotive requirements.

Applications

- Measurement technology
- LVDS camera
- Infotainment systems
- USB
- IEEE 1394 applications

Benefits

- RosenbergerHSD® and variants fulfill the demanding requirements of the automotive industry
- Prevents misuse due to secure coding system
- Primary and secondary locking systems lead to high assembling security
- No contact pin damage possible

For more information
refer to our website:

www.rosenberger.com/hsd

Test Adaptors

Rosenberger No.	Description	Connectors	Product
02K1D4-K00S3	Adaptor With RosenbergerHSD® housing single	4 × RPC-2.92 female 1 × HSD female	
02K1D4-S00S3	Adaptor With RosenbergerHSD® housing single	4 × RPC-2.92 female 1 × MTD® male	
02S1D4-K00S3	Adaptor With RosenbergerHSD® housing single	4 × RPC-2.92 male 1 × HSD female	
02S1D4-S00S3	Adaptor With RosenbergerHSD® housing single	4 × RPC-2.92 male 1 × MTD® male	

Test PC-Board

Rosenberger No.	Description	Connectors	Product
PCB-L1501-SB	Test PC-board Impedance 100 Ω Frequency range DC to 6 GHz	4 × SMA female 1 × RosenbergerHSD® male	

Test PC-boards for electrical evaluations are available on request.

Quality & Environment

The quality of Rosenberger products, solutions and services is an essential part of our corporate strategy.

Ensuring the optimum quality of products and services and taking responsibility for our environment are fundamental elements of Rosenberger's corporate philosophy. Our quality philosophy does not only cover the optimization of parts and products, but also the continuous improvement of all company processes: from product development, planning, procurement, production, sales, logistics right through to environmental policy. To summarize, we want to offer maximum benefits for our customers all over the world.

We aim to act in an environmentally conscious manner, use materials economically, protect natural resources, recycle, and ensure energy efficiency.

In recognition of continuously improving processes and applying quality management systems, Rosenberger has won a number of prestigious quality and environmental excellence awards.

Complete Control with Innovative Technology

Industrial image processing guarantees fully automatic machine inspection. A combination of hardware and software ensures error-free execution of complex production. Digital sensors inside industrial cameras with special optics for image acquisition analyze and monitor all process steps. If products are in need of adjustment they are immediately scanned prior to checking for errors against the respective design data.

IMDS System

Rosenberger has been registered in the IMDS database (International Material Data System) since 2001.

IMDS reports for automotive customers are provided as a part of the PPAP documentation.

www.mdsystem.com

Certificates

- IATF 16949
- DIN EN 9100
- ISO 9001
- ISO 14001
- ISO 45001
- ISO 50001
- DaKKs accreditation according to DIN EN ISO 17025

Learn more about Rosenberger certifications:

www.rosenberger.com/certifications

Information Security – TISAX®

Information security is an integral part of our corporate culture. Rosenberger was audited at TISAX® (Trusted Information Security Assessment Exchange).

Learn more about Rosenberger information security:

www.rosenberger.com/company/information-security

Rosenberger No.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Website

For more information refer to our website:
www.rosenberger.com/aut-test

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