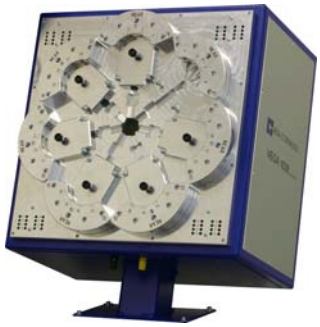
Automatic measuring system for LAN cables AXT & Cat 8 – HF only

Picture for information only



28 pairs connecting frame:
- *24 pairs / 750 MHz*
- *4 pairs up to 2 GHz*

- **The fastest measuring system on the market**
- **Checked against certified ISO 17025 standards**
- **High accuracy**
- **Easy to operate**
- **Designed to measure UTP, FTP and ISTP cables**
- **Can be upgraded with many options (LF measurements, ISO 17025 certified HF and LF calibration standards**)

Standards	Performs all tests on cables responding to: - ANSI/TIA-568-C.2 for Category 3, 5e, 6 and 6A - ANSI/TIA-568-C.2-1 for Category 8 - IEC 61156-5/-6 for Category 5e, 6, 6A, 7 and 7A - IEC 61156-7/-8 for cables up to 1200MHz - IEC 61156-9/-10 for Category 8.1 and 8.2
Test time	**4 attenuation**, **phase** and **impedance measurements**, **6 NEXT** and **6 FEXT** combinations measured **in 28 seconds only** **28 attenuation**, **phase** and **impedance measurements, 300 NEXT** and **300 FEXT** combinations measured in **8 minutes 30 seconds!!** (Network analyzer E50xx. Settings: IF bandwidth 3 kHz, 401 points per sweep)
Delivery package	- 28 pairs connecting frame: o Positions 1 to 4: 4 pairs for HF measurements up to 2 GHz o Positions 5 to 28: 24 pairs for HF measurements (750 MHz) - One state-of-the-art computer with a 17" color monitor - Operating Windows system - AESA measurement and result management software Optitest (1 license) - Power supplies, interfaces, connecting cables and measurement accessories - UPS unit 600W *Remark: the network analyzer can be supplied by AESA as an option. We can integrate an analyzer provided by the customer upon request.*
Article No:	00.2528.0001.0

1. Technical hardware features

- No movable parts for maximum measurement speed, accuracy and reliability.
- Connecting frame equipped with 2 baluns per pair for highly accurate measurements
- Low background noise level as low as -85dB at the maximum operating frequency
- Software assisted calibration method & Test heads with "open/short/load" facility allowing a fully automatic calibration procedure
- No other calibration is required, which speeds up the measurements
- Mechanical design studied to facilitate maintenance and servicing operations.

Important comments:

a) The OptiTest software is delivered with AESA ATE system. It allows preparing, performing, evaluating and managing the measurements. Optitest works in stand-alone and is protected with one hardware license dedicated to the concerned system.

OptiTest can be easily upgraded to CIQ 3.0, the AESA quality data management system, in keeping the same human-machine interface. CIQ 3.0 enables connecting the system to the company's LAN. AESA highly recommends migrating to CIQ 3.0 if several equipment are utilised.
In this way, all the specifications can be prepared at the office station (e.g. Quality Manager) and further used at any testing station. All the results are saved on the same server enabling consolidated reports, data evaluations and group analysis. Data can be easily interfaced with an ERP or accessible from other office stations through intranet as example (Industry 4.0).

CIQ not only handles the AESA testing equipment but can interface any other quality data equipment (electrical, mechanical, and dimensional) as well as process data (production monitoring).

b) **The remote maintenance** feature is using TeamViewer and allows AESA to get access to the customer's system using an internet connection. This allows updating or correcting the software, as well as diagnosing the reason of a breakdown in the system. The cost for an intervention using the remote maintenance is based on the addition of following points:
During the warranty period: Free of charge
Outside the warranty period: Working time of the AESA engineer

2. HF Parameters

2.1. Measured parameters

a. 24 pairs / 750 MHz

➢ **Attenuation (corrected at 20°C)**

Accuracy	772 kHz - 200 MHz	200 MHz - 400 MHz	400 MHz - 600 MHz	600 MHz - 750 MHz
-50 dB to -80 dB	± 1.7 dB	± 1.9 dB	± 3 dB	± 4 dB
-25 dB to -50 dB	± 0.6 dB	± 0.7 dB	± 0.9 dB	± 1.5 dB
-10 dB to -25 dB	± 0.3 dB	± 0.4 dB	± 0.8 dB	± 1.3 dB
0 dB to -10 dB	± 0.2 dB	± 0.4 dB	± 0.8 dB	± 1.3 dB

➢ **NEXT, FEXT, ANEXT, AFEXT**

Accuracy	772 kHz - 200 MHz	200 MHz - 400 MHz	400 MHz - 600 MHz	600 MHz - 750 MHz
-60 dB to -90 dB	± 2 dB	± 2.5 dB	± 4 dB	± 6 dB
-30 dB to -60 dB	± 1.4 dB	± 1.6 dB	± 1.5 dB	± 4 dB
-10 dB to -30 dB	± 0.8 dB	± 1 dB	± 1.5 dB	± 2 dB

➢ **Impedance (open/short and terminated 100Ω)**

Accuracy	772 kHz - 100 MHz	100 MHz – 350 MHz	350 MHz - 600 MHz	600 MHz - 750 MHz
70Ω - 90Ω	± 1.5Ω	± 2Ω	± 3Ω	± 4Ω
90Ω - 110Ω	± 1Ω	± 1.5Ω	± 2Ω	± 3Ω
110Ω - 130Ω	± 1.5Ω	± 2Ω	± 3Ω	± 4Ω

b. 4 pairs / 2 GHz

➢ **Attenuation (corrected at 20°C)**

Accuracy	772 kHz - 10 MHz	10 MHz - 100 MHz	100 MHz - 200 MHz	200 MHz - 400 MHz	400 MHz - 750 MHz	750 MHz - 1.5 GHz	1.5 GHz - 2.2 GHz
-50 dB to -80 dB	± 1.3 dB	± 1.5 dB	± 1.7 dB	± 1.9 dB	± 3 dB	± 4 dB	± 6 dB
-25 dB to -50 dB	± 0.5 dB	± 0.5 dB	± 0.6 dB	± 0.7 dB	± 0.9 dB	± 1.5 dB	± 2 dB
-10 dB to -25 dB	± 0.2 dB	± 0.2 dB	± 0.3 dB	± 0.4 dB	± 0.8 dB	± 1.3 dB	± 1.7 dB
0 dB to -10 dB	± 0.1 dB	± 0.1 dB	± 0.2 dB	± 0.4 dB	± 0.8 dB	± 1.3 dB	± 1.5 dB

➢ **Near-End Crosstalk NEXT & Far-End Crosstalk FEXT**

Accuracy	772 kHz - 10 MHz	10 MHz - 100 MHz	100 MHz - 200 MHz	200 MHz - 400 MHz	400 MHz - 750 MHz	750 MHz - 1.5 GHz	1.5 GHz - 2.2 GHz
-60 dB to -90 dB	± 2 dB	± 2 dB	± 2 dB	± 2.5 dB	± 4 dB	± 6 dB	± 8 dB
-30 dB to -60 dB	± 1.6 dB	± 1.4 dB	± 1.4 dB	± 1.6 dB	± 1.8 dB	± 4 dB	± 6 dB
-10 dB to -30 dB	± 0.5 dB	± 0.8 dB	± 0.8 dB	± 1 dB	± 1.5 dB	± 2 dB	± 3 dB

➢ **Impedance (open/short and terminated 100Ω)**

Accuracy	772 kHz - 10 MHz	10 MHz - 100 MHz	100 MHz - 350 MHz	350 MHz - 750 MHz	750 MHz - 1.5 GHz	1.5 GHz - 2.2 GHz
70Ω - 90Ω	± 1Ω	± 1.5Ω	± 2.5Ω	± 3.5Ω	± 4.5Ω	± 6Ω
90Ω - 110Ω	± 0.75Ω	± 1.5Ω	± 2Ω	± 3Ω	± 4Ω	± 5Ω
110Ω - 130Ω	± 1Ω	± 1.5Ω	± 2.5Ω	± 3.5Ω	± 4.5Ω	± 6Ω

2.2. Calculated HF Parameters

- Fitted Impedance
- Return Loss (RL) (Open/Short and Terminated 100Ω) (fully complex method)
- NEXT Worst Case, Power Sum, Power Sum Worst Case
- FEXT Worst Case, Power Sum
- Individual ACR, ACR Worst Case, Power Sum ACR
- Global Power Sum (NEXT + FEXT)
- ELFEXT Pair to Pair, Worst Case, Power Sum, Power Sum Worst Case
- Velocity of Propagation (VOP)
- Propagation Delay (Phase Delay), Group Delay, Delay Skew
- Etc…

2.3. Statistical HF Parameters

Statistical HF means (pair)

Maximum value, absolute maximum value
Minimum value, absolute minimum value
Average value, absolute average value
Standard deviation, standard deviation (n-1)
Average standard deviation
Quadratic average
Minimum margin, average margin
Etc…

Statistical HF means (cable)

Minimum and maximum value
Frequency for minimum or maximum values
Pair for minimum or maximum values
Minimum margin to the limit
Frequency of minimum cable margin
Value for minimum cable margin
Average of the minimum margin for each pair
Etc…

3. Main software features of OptiTest

OptiTest is a stand-alone application specially designed for the cable and wire data capture with AESA and former M.E.A. automatic testing equipments. This module is a part of the AESA's Quality Management System CIQ 3.0 designed for the cable manufacturers.*

- The software has been developed in the Microsoft® Windows™ environment and complies with the Windows features.
- User-friendly OptiTest software package, to be operated easily with a mouse or the keyboard.
- All data gathered with OptiTest can be used for further statistical evaluations and combined with other measurements gathered during the overall production process, from incoming good inspection until to the dispatch of the finished product.
- No HF or LF knowledge required, ideal for shop floor integration.
- Driver for the implemented Network Analyzer.
- Full automatic measurements.
- The measurements can be performed in the sweep mode and/or by using frequency tables.
- Open choice for start/stop frequencies and number of points (for HF sweep measurements, the test system allows to enter an unlimited number of measurement points, which is not limited by the specified number of points described in the manual of the Analyzer itself.
- Choice of logarithmic or linear scales.
- Fully self-configurable reports.
- Fully automatic calibration management including automated calibration procedure, calibration management depending on parameters to be measured.
- Possibility to create an unlimited number of cable specifications and test sequences.
  These "test specifications" will be stored with an individual customised name and are easily used by the operator for the call up of the specific cable type to be tested.
- Possibility to generate complex limit curves. Most of the limits and formulas recommended by the international standards are integrated. Their variables are programmable to enable the preparation of special specifications

OptiTest consists in CIQ 3.0 QDM and MERLIN modules* for LF, HF and HV measurements. It facilitates the tasks itemized below:

- Creation and administration of test specifications
- Performance of tests
- Report generation after testing
- Basic statistic evaluation

The core features of OptiTest comprise among others data evaluations and archiving functions as well as the connection of testing equipment.

*Please contact AESA for more information about the Quality Management System CIQ 3.0

www.aesaciq.com www.aesa-cortaillod.com

***depending on the ordered system**

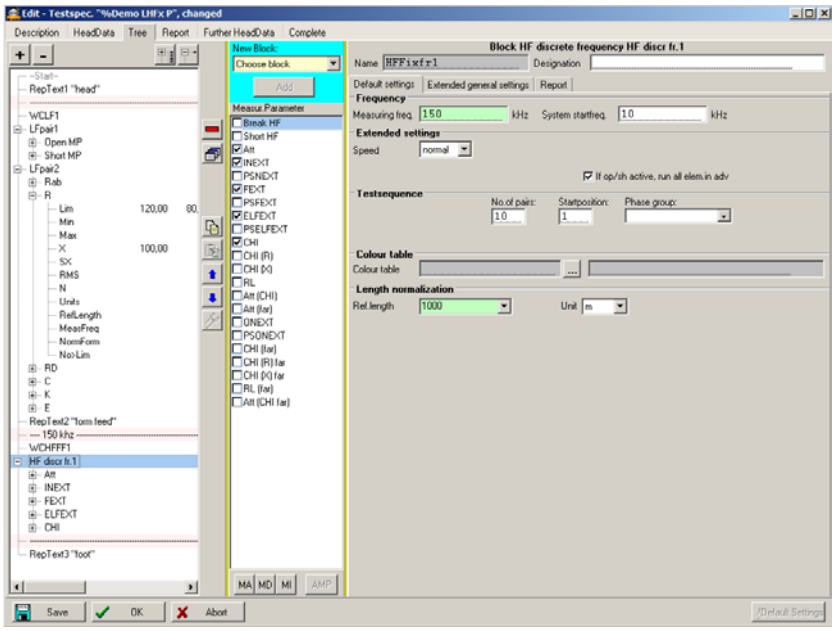
3.1. Test Plan Creation (Example includes options)

A wide range of measurement modes are available as options, such as HF Sweep, HF Sweep(Alien), HF Coax-50, HF Coax-75, HF fixed frequency, LF single cores, LF pairs, LF triples, LF quads, LCL, LCTL, TCL,

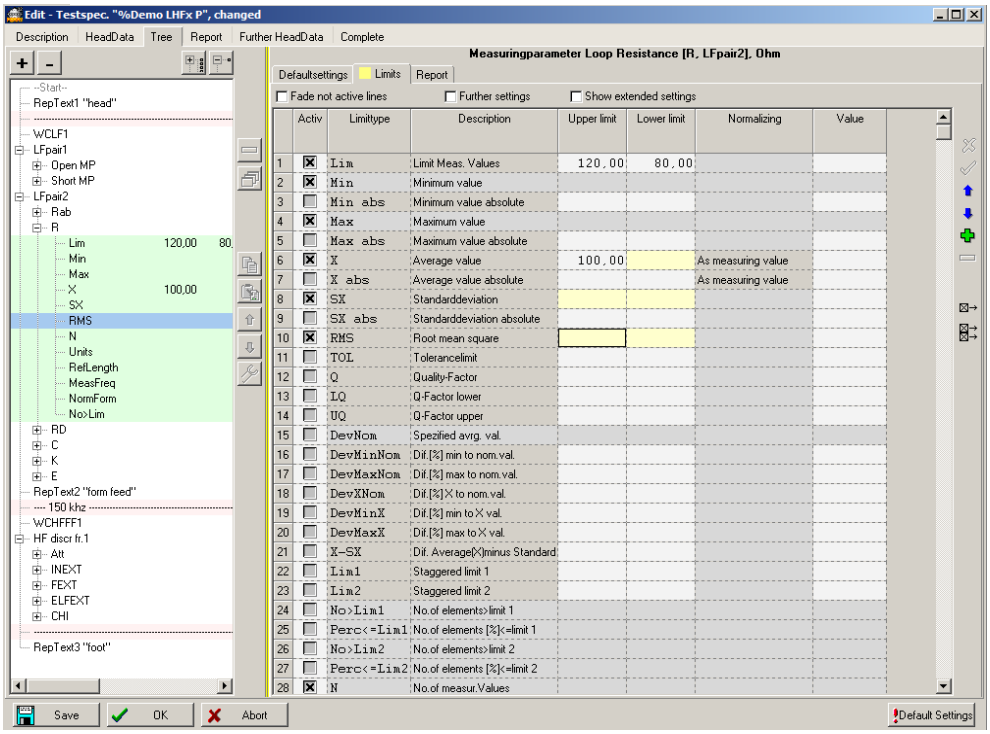
TCTL, TI, AS, worst case summaries for HF-Sweep / LF / HF discrete frequencies, inductance, conductance and high voltage.

Report generation is very easy. If set by default, a highly comprehensive report is generated, containing a limit case compilation with graphics and for each measuring block a separate summary with related graphics. It goes without saying that dedicated features for customised reports are also available.

Example of selecting the Parameters to be measured (and printed)



Example of adding the required limits for LF or HF specifications



3.2. Document

a) Reports

OptiTest offers various report options such as:
- Test certificates for the customer
- Creating (control) quality charts
- Graphical HF evaluations

The results may be printed, stored as PDF files, or sent as emails.

It is also possible to create data files for Office products such as Microsoft Excel.

b) Evaluation

All data are available for evaluation at any time. Thus, all test data of a cable can be collectively evaluated and printed.

Some examples of how to perform evaluations are:
- Sample list sorted by test order
- Search with pre-defined or customized filters (e.g. searching for the last 20 samples by cable number, date, certain characteristics)
- Free search through the data pool with user-specific search criteria

Filters and search criteria normally generate sample lists which facilitate multiple further actions as:
- Display and process measured values
- Print reports and labels
- Generate quality charts (statistics)

c) Archiving

Windows backup function used for archiving the data.

d) Statistics

Filtering tool: Select a group of measurements according to various criteria such as:

- Cable specification
- Cable structure
- Production period
- Production line, test station
- Etc…

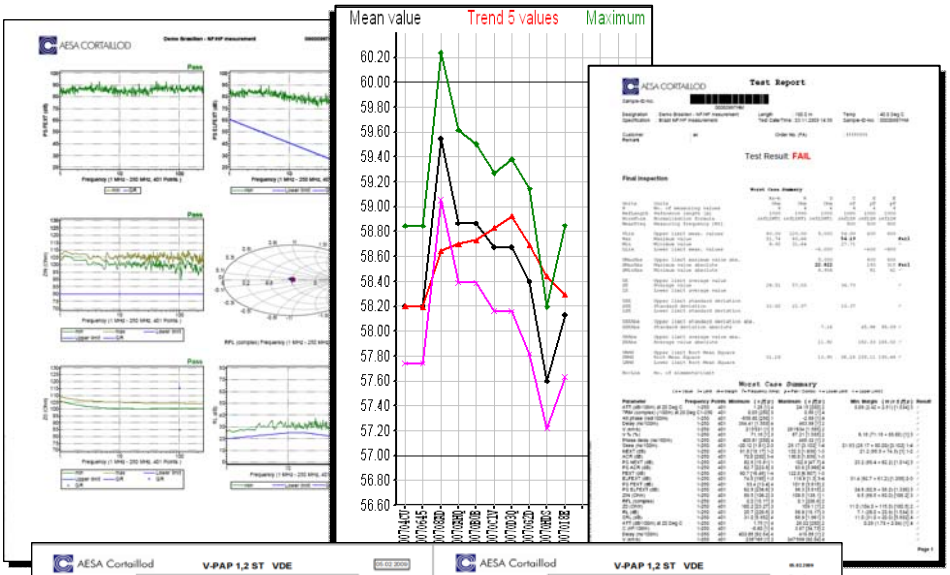
Following the measurements management, this powerful tool allows generating many types of statistics.

Worst case values for a pair or a cable
- Pair identification with extreme values
- Min, max, average values
- Standard deviation, quality factor, RMS values
- Etc…

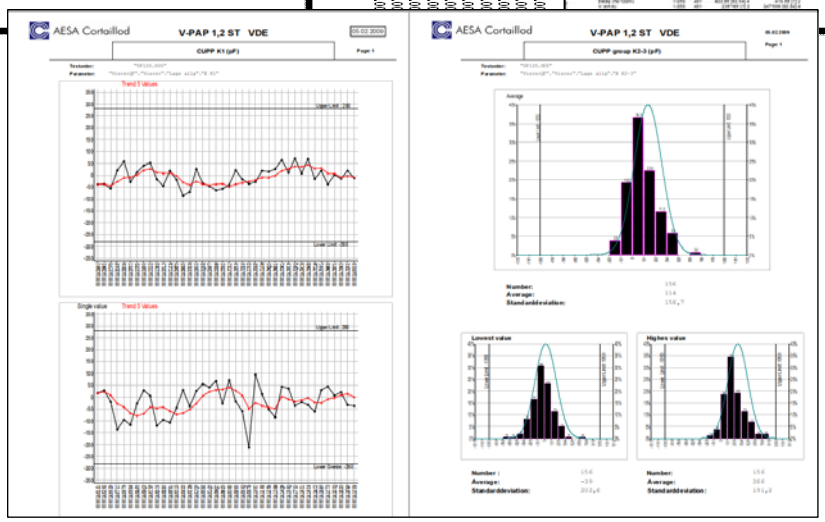
These statistical means are calculated for all measured LF (and partly HF) parameters

e) Graphical presentation

- Statistical distribution (Gauss type curve)
- Evolution and parameter survey in function of the time
- Measurements repartition in a defined time period to determine the testing load



Examples of test and statistical reports with AESA Optitest



Examples of statistical reports with AESA Optitest

Options

➢ *Set of 5 standards (resist. & capacit.) type AESA 9000*

Article No: 45.9000.0001.0

Complete ISO 17025 certified LF calibration standards.

The kit of certified LF calibration standards is composed of:

- **Standard type 9001**
  C1,2 with 19,20 nF ± 0,1 % ± 30 ppM/°C
- **Standard type 9002**
  C1,2 with 192,0 nF ± 0,1 % ± 30 ppM/°C
- **Standard type 9003**
  C3 with 16,00 nF ± 0,1 % ± 30 ppM/°C
  K1, K2, K3 with 16000 pF ± 0,1 % ± 30 ppM/°C
- **Standard type 9004**
  E1, E2, E3 with 12000 pF ± 0,1 % ± 30 ppM/°C
- **Standard type 9005**
  RA, RD with 192 Ω ± 0,01 % ± 2 ppM/°C
  RB, RC with 1920 Ω ± 0,01 % ± 2 ppM/°C

ISO 17025 ACCREDITED

➢ *Set of HF calibration standards (attenuators and loads) type AESA 9800*

Article No: 45.9800.0001.0

With each sold measuring system, AESA delivers a "daily" calibration kit to create the different calibration files necessary to measure LAN cables. These easy-to-use standards have obviously been developed in the symmetrical way as they are placed immediately after the balun transformers to get the maximum accuracy. Unfortunately, these "daily" standards cannot be referenced to primary standards. But AESA has developed its HF technology by using hi-tech strategic components. These miniaturized resistors are sorted and guaranteed up to 3GHz. Tolerance: 1% (50 ppm/deg.) for values between 50 and 200Ω.

ISO 17025 ACCREDITED

During a quality control calibration, the symmetric elements have to be replaced by 50Ω coaxial standards which are this time certified. In fact, with an appropriate set of terminations and attenuators, it is possible to prove within a certain tolerance that our VEGA system (network analyzer + HF multiplexer + connecting frame) is measuring correctly. It is also possible to prove that the calibration used for the measurement of LAN cables has been done correctly.

The kit of certified HF calibration standards is composed of:

- 2 attenuation references –3dB type 9801
- 2 attenuation references –6dB type 9802
- 2 attenuation references –10dB type 9803
- 2 attenuation references –20dB type 9804
- 2 attenuation references –30dB type 9805
- 2 x 50Ω terminations
- 2 special connectors for the terminations
- 4 HF connecting cables for the attenuation
- 1 set of small HF material

➢ *LF measuring parameters option*

Article No: 50.0001.0039.0

The low frequency parameters measuring technology provides a self-calibration. It is designed to test up to 4 pairs or 2 quads. Different measuring frequencies are integrated in the capacitance bridge. They can be used depending on the length of the cable.

Description	Designation for pairs	Designation for quads	Accuracy	Scale
Conductor resistance	Ra, Rb	Ra, Rb Rc, Rd	± 0,1% + 10 mΩ	0 - 19,999 kΩ
Loop resistance	R	R1, R2		
Resistance unbalance	DR	DR1, DR2, DR3	Computed	%, Ω
Capacitance	C	C1, C2, C3	± 0,25% ± 10pF @800 Hz / 1kHz ± 0,25% ± 10pF @125 Hz ± 0,25% ± 50pF @12,5Hz	0 – 2'000nF
Capacitance unbalance	K	K1 – K12	± 1% ± 6pF @800 Hz / 1kHz	
Capacitance unbalance to ground	Ei, Ea, E	Ei1-Ei3 Ea1-Ea3 E1-E3	± 1% ± 3pF @125 Hz ± 1% ± 30pF @12,5 Hz	

Calculated parameters at 800Hz – 1 kHz

Attenuation
Characteristic Impedance
Crosstalk
Phase
Velocity of propagation (VOP)

Statistical parameters

Maximum and minimum measured values
Absolute minimum measured value
Average value
Quadratic average
Standard deviation
Upper quality factor
Lower quality factor
RC product
Standard deviation RC
Variance

➢ *Spare parts*

AESA recommends following set of spare parts for an operation safety of two years:

Vega Type	HF measurement only (Mini kit)	Including optional LF measurement (Full kit)
1 CKE measuring bridge type KM		✓
1 R measuring bridge type RM		✓
1 LF relay matrix board type AZU		✓
2 test heads (4 if two different connecting frames)	✓	✓
2 HF relays (3 if two different connecting frames)	✓	✓
1 control boards set	✓	✓
1 set of HF cable	✓	✓
1 set of different mechanical and electronic hardware	✓	✓
Article No	50.0900.0003.0	50.0900.0002.0

➢ *Common Mode parameters*

The AESA VEGA systems can be delivered with additional options such as coaxial cable testing, LCL, LCTL, TCL, TCTL, EL LCTL and EL TCTL parameters testing, transfer impedance measurements, screening and coupling attenuation testing, etc…

LCL option 4 pairs Article No: 51.0001.0024.0

Other options available upon request.

➢ *Transfer Impedance Kit, inc. Coupling and Screening Attenuation 2.3-9.8 mm*

To perform Transfer Impedance measurements with the triaxial method, following accessories are required:

- One hardware package to prepare the sample and take care for the impedance adaptation
- One software package (specific module

Article No: 51.0001.0035.0

This option allows measuring the transfer impedance, the shield attenuation and the coupling attenuation when knowing the impedance of the internal coaxial cable created with the sample under test. This impedance can be keyed in our software to perform then the different required calculations.
If the impedance of the internal coaxial cable needs to be determined with accuracy (to get more accurate measurements), our customer needs a TDR option. Several TDR test equipment exist on the market. However, we still have the possibility to implement the TDR option of your network Analyzer.

With this price, our customer performs the tests directly on the unbalanced port of his Network Analyzer. To avoid this, it is possible to add a multiplexer with a coaxial 50Ω and 75Ω switch to allow to connect the cable under test to a different port. This is mainly to avoid numerous manipulations on the expensive output ports of the Network Analyzer.

Important remarks:

This multiplexer corresponds to our coaxial cable measurements option. Please refer to this option for technical details.
If our customer has also to consider the Longitudinal Conversion Loss (LCL, LCTL) measurements option, the 50Ω and 75Ω coaxial multiplexer is obviously only required once.

- ***Network Analyzer***

  Keysight E5061B 100kHz-3.0GHz with S parameters Article No: 51.0001.0050.0

  Rohde & Schwarz ZNB4 (9 kHz – 4.5 GHz) Article No: 51.0001.0061.0

  Other types can be proposed upon request.

- ***Printer*** Article No: 51.0500.0021.0

  LaserJet printer.