

FORM
development,
manufacturing
and support of
FORMULA®
Test Systems

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FORMULA® HF3 platform test systems

FORMULA® HF3 platform test systems come in two models – FORMULA® HF3 and FORMULA® HF3 512 – and are designed for functional testing of a wide range of high-speed VLSI circuits: microcontrollers; static and dynamic memory; masterslice VLSI circuits; ASICs, FPGA and others with up to 256/512 signal outputs and operating frequency up to 200 MHz.

Purpose and application

The FORMULA® HF3 Test System is an ATE for functional and parametric testing of ultrahigh frequency VLSI circuits.

The applications for FORMULA® HF3 are quality control of VLSI circuits, testing and studies of newly developed types of VLSI circuits, and production monitoring for serial products.

The FORMULA® HF3 meets the requirements of metrological standards in measurement and testing in microelectronics.

Basic technical characteristics and functional capabilities of FORMULA® HF3 platform test systems

The FORMULA® HF3 Test System was created for reliable measurement and testing of a wide range of VLSI circuits.

The key technical characteristics of the test systems are defined by the following values:

- Number of universal bidirectional pins – up to 256/512;
- Functional test frequency – up to 200 MHz per pin;
- Vector/error memory depth – up to 64 M/64 M vectors;
- Overall Timing Accuracy (OTA) – not more than ± 700 picosec.

FORMULA® has modular bus architecture that implements the principle of custom configuration of equipment with a choice of primary and secondary devices corresponding to the range of measurement and testing tasks.



The FORMULA® HF3 Test System is a functionally complete automated means of measurement for VLSI circuits and provides:

- High readiness of equipment for measurements and tests
- Automation of all stages of the measurement process and data management
- Operating modes with automated probes, automatic loaders, test equipment and instruments
- High-speed Multisite mode
- Reliability in round-the-clock operations
- User-friendly, fully functional software
- Quickly interchangeable test fixtures
- Automatic diagnostics and metrological calibration

Technical advantages

The hardware, software, design and technological solutions realized in the systems provide characteristics and properties vital in making measurements, and in performing tests and incoming inspection of VLSI circuits.

The test systems make it possible to perform comprehensive testing of a wide range of VLSI circuits.

Basic FORMULA® HF3/3-512 subsystems

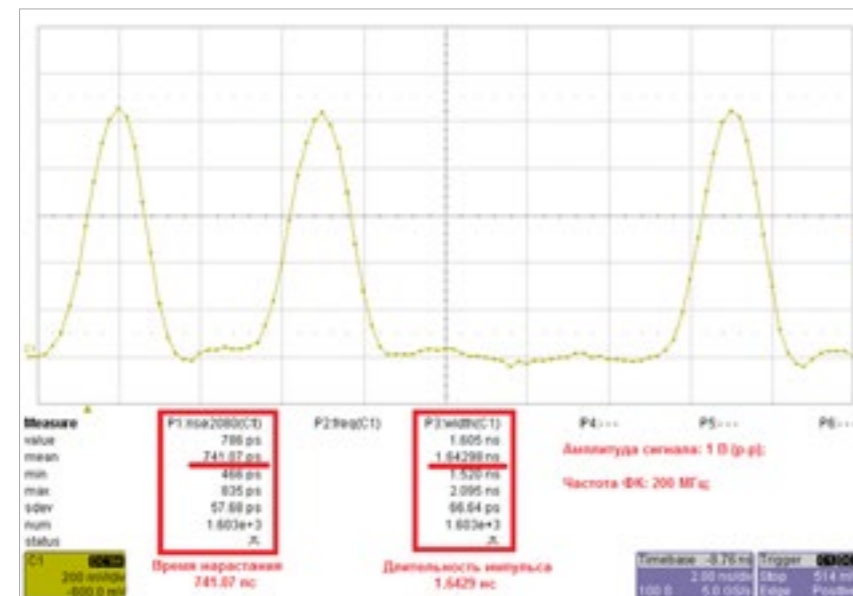
1. The functional testing subsystem with 256/512 pins and frequency up to 200 MHz per pin includes:

- A test pattern generator for functional testing of VLSI circuits
- An algorithmic test pattern generator to test high-speed memory VLSI circuits and other regular logic

High capacity vector memory depth (64 M per pin) and independent error memory depth (64 M per pin)

with the ability to combine memory depth between pins (up to 2 G), as well as support for all standard commands, make it possible to create functional tests of practically unlimited volume, providing thorough test coverage in the verification of VLSI circuits.

The characteristics of the signals of the ATE universal pins ensure high-quality measurement of RF VLSI circuits and fully meet the requirements for signals at the functional test frequency of 200 MHz:



- Minimum pulse rising and falling edge duration – (0.7 ± 0.15) ns;
- Minimum pulse duration – (1.65 ± 0.15) ns.

RF signals are transmitted without distortion and frequency loss up to a distance of 1 m or more, which is important for certain types of tests.

One distinctive feature of the FORMULA® HF3 test system pins is that the signal characteristics – the rising edge and minimum duration of the pulse – are not dependent on the amplitude up to 8 V.

2. The parametric measurement subsystem includes:

- range of four-level signals reproduced, including differential signals, in the voltage range from -1.5 V to $+13$ V independently for each pin
- ranges of measurement sources:

Ranges	Sources	Quantity
0...+6 B; ± 250 μ A ... ± 4 A	VCC source and measure resource	8/16
-2 ...+15 B; ± 200 nA ... ± 400 mA	VDD source and measure resource	8/16
-2 ...+13 B; ± 200 nA ... ± 150 mA	multipin parametric measurement units (PMU)	8/16
-2 ...+11 B; ± 2 μ A ... ± 32 mA	per-pin parametric measurement units (PPMU)	256/512

The use of PPMUs enables Multisite mode for parallel high-speed testing of microcircuits on a wafer and in a package.

The high-voltage “33 pin” in each 32-pin pin-electronics unit has voltage up to 15 V and can be used for FLASH and ROM programming, as well as for testing DAC/ADC microcircuits such as operational amplifiers and comparators.

3 The precision subsystem for measurement of timing parameters of

VLSI circuits enables measurement of the propagation time delay of a signal, pulse duration, rising edge and falling edge, as well as other timing characteristics of VLSI circuits with accuracy determined on the basis of the following characteristics:

- Input Edge Placement Accuracy (IEPA) ± 150 ps
- Output Edge Placement Accuracy (OEPA) ± 250 ps
- Overall timing accuracy (OTA) ± 700 ps
- Minimum duration of pulse rising and falling edge – (700 ± 150) ps
- Minimum pulse duration – (1.65 ± 0.15) ns
- Time marker setting increment is 34 picosec.

The subsystem is based on the ATE’s universal measurement pins.

4. BIST technology

In view of the need among developers to perform in-circuit testing of VLSI circuits in the test model stage, the FORMULA® HF Ultra Test System can use BIST technology. A JTAG port integrated into the ATE that supports performance of all standard functions, including filling configuration files in FPGA, and also has an integrated JAM PLAYER with STAPL language support is used for this.

Use of the FORMULA® HF3 for testing of VLSI circuits under the environmental conditions

The design, hardware and software of the FORMULA® HF3 Test System create optimum conditions for testing microcircuits, including for testing combined with measurements, for example, using ThermoStream units and flow climatic chambers

An original heat-resistant UAP adapter with a spring device has been developed specially for FORMULA® HF3 test systems, and is also used for the FORMULA HF3-512 Test System for testing VLSI circuits with up to 256 signal outputs. The small area where the POGO-PIN contacts are located on the UAP adapter makes it possible to use compact accessories, reducing the costs of preparing for measurements.

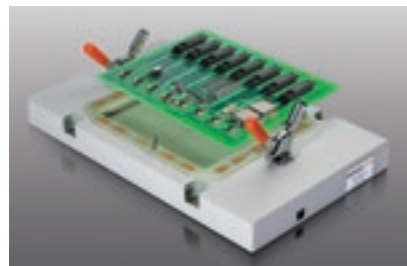
Measurements under temperature effects directly on the spring base, without using cables, and with-

out loss of signal quality are supported.

One of the priorities in the design of the system was to develop methods for the ATE to signal transmission back and forth to the device under test (DUT) with minimal signal loss and distortion.

An original new-generation contact system, designed for measurements under both normal conditions and in the temperature range from -60 °C to +125 °C, was developed especially for the FORMULA® HF3 Test System.

Reliability, convenience, fast installation, and attachment and replacement of test fixtures are achieved by using a precision spring device, special frames for large test fixtures and POGO-PIN contacts that guarantee at least a million test fixture connections.



The ATE is equipped with means for integration with external equipment, including probes, test equipment and external instruments.

The measurement unit rotation manipulator makes it possible to change the slope angle from 0 to 90 degrees, and provides optimum workstation ergonomics in all operating modes.



FORMULA® HF3 software complex

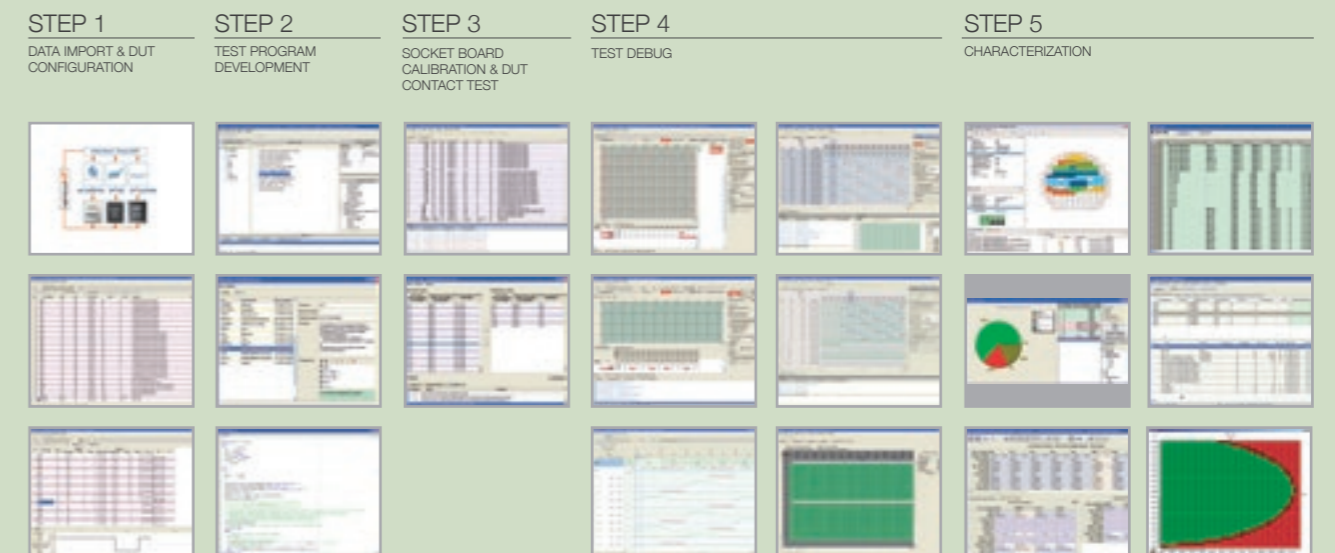
The FORMULA® Test System software complex FormHF is the GUI-based environment designed for all stages of the measurement process. Only "5 steps" are required to develop and debug software, perform measurements and analyze deviations

Test System diagnostics and calibration control and automatic generation of test protocols are supported.

The FormHF software provides automation and tracking of all these processes by creating record-

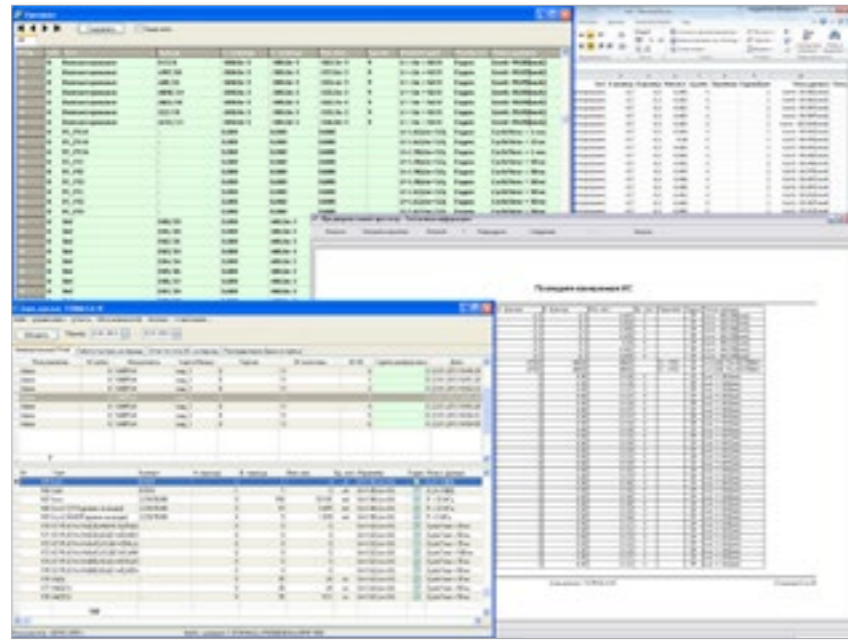
ings and restricting personnel access rights to equipment and databases.

The FormHF software complex is essentially a system for automation of the laborious process of development and debugging of test programs which has been adapted for use by a wide range of technical specialists without using programming languages. It supports all standard methods for testing microcircuits, as well as translation of tests from the standard eVCD, WGL, SVF and INTEL/HEX formats.



Documentation of data and results

Testing process control includes automatic documentation of the data used to confirm the conformity or nonconformity to the set requirements of the DUTs. The test routines are generated with various levels of detail, from "Accept/Reject" inspection to comprehensive reports on measurement modes and results for each microcircuit and each parameter; statistical reports can be generated for any period by lots, types of microcircuits and other criteria.



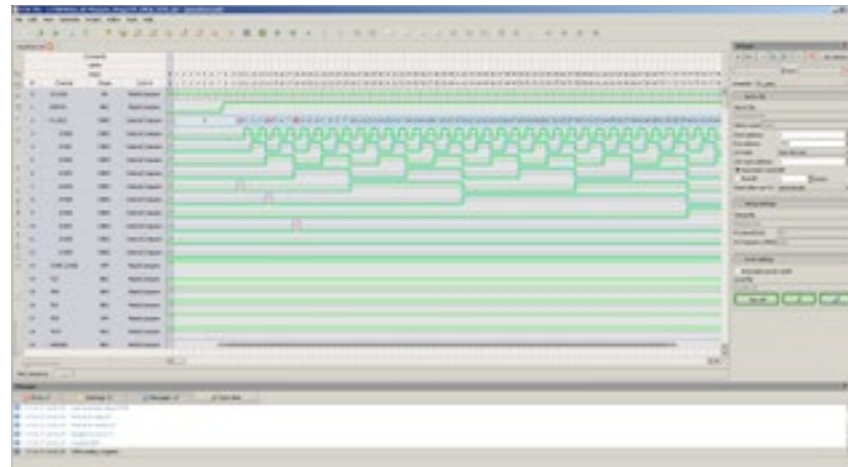
The test records are saved, easily converted to standard forms used by the Client, and serve as the documentary and metrological basis for managing deviations, and as a basis for quality complaint follow-up at the incoming inspection stage.

Analysis and display

ATE integrated analytical tools are used for analysis of functional and parametric deviations detected during measurements and debugging of test programs.

These tools include:

- Logic Analyzer hardware
- Oscilloscope
- Error Chart



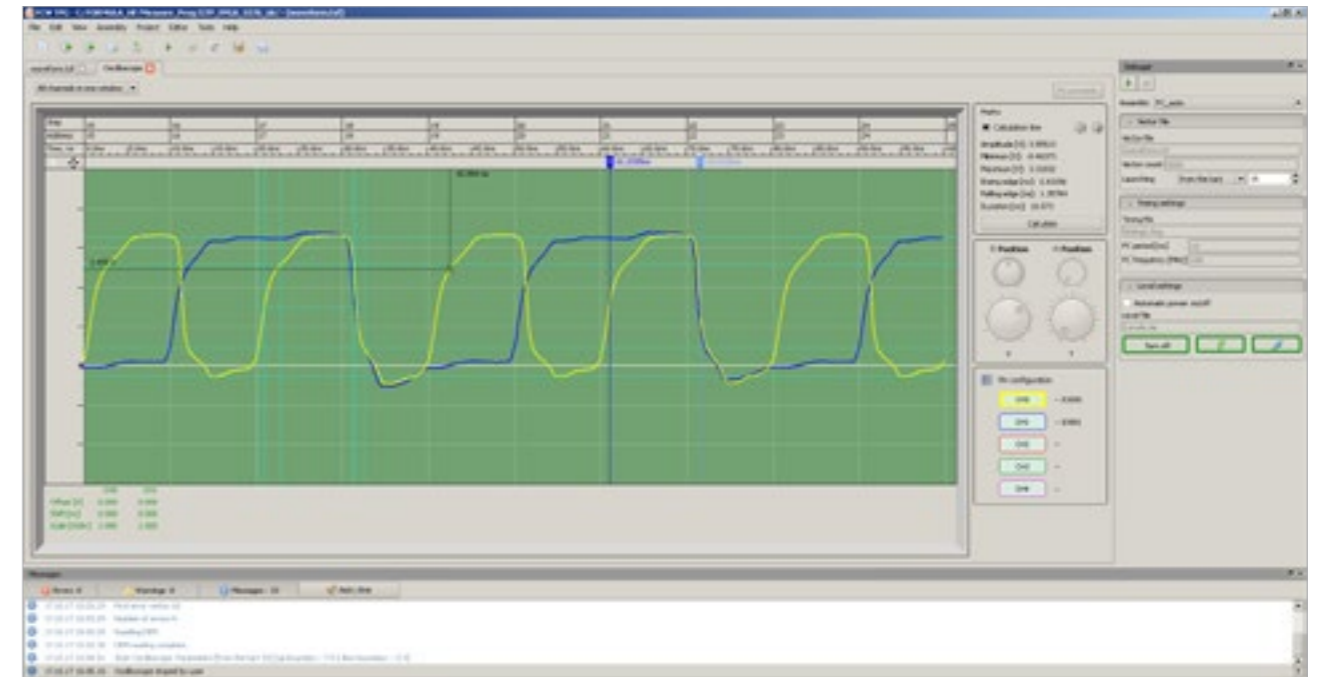
The following tools are used to study the serviceable ranges and reliability of VLSI circuits: SHMOO diagrams and DRV analysis.

The FormHF software complex as a whole transforms development of a test program into a unique

type of assembly for designed parts that reduces the time for test development and debugging to a few days.

Graphic interpretation of measurements enables fast assessment of measurement results and study

of the behavior of the instrument measured in a range of impact to make the necessary corrections to the design of VLSI circuits and/or production technology.



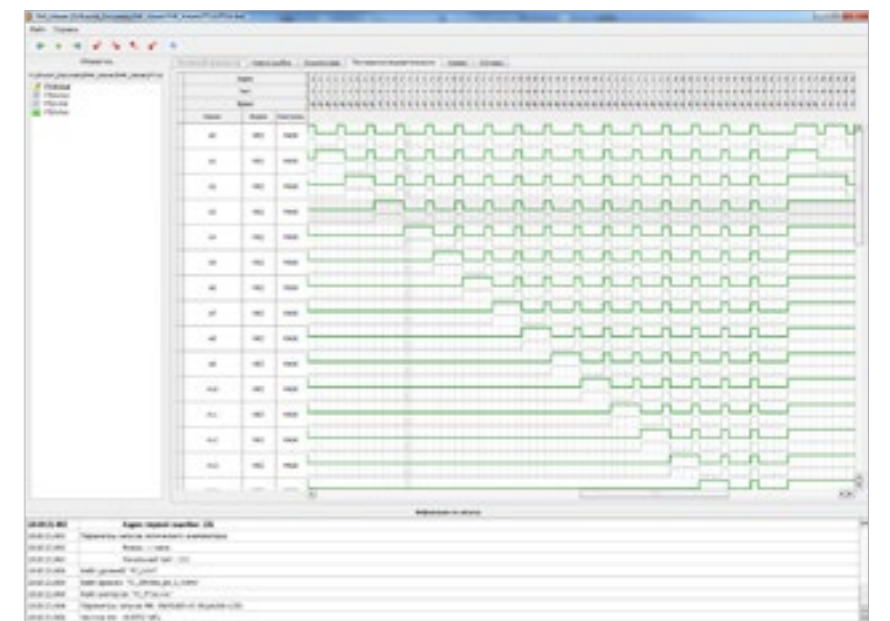
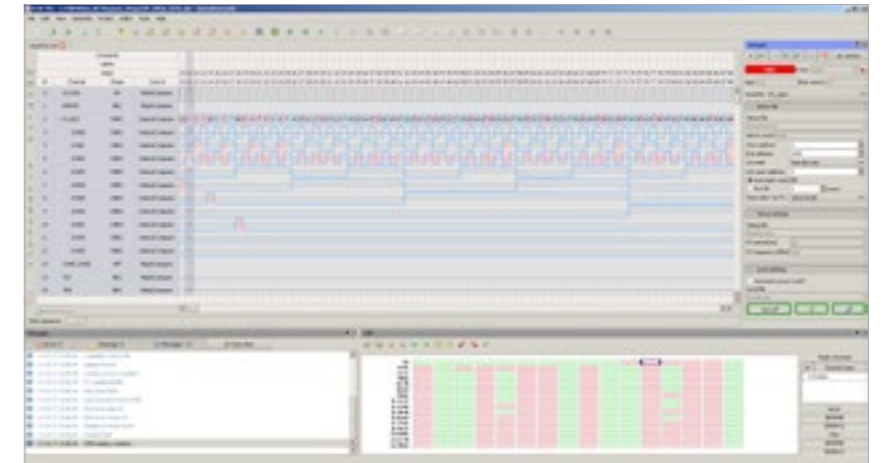
External development media

The FORMULA® HF3 Test System software environment, while self-sufficient, nevertheless does not limit the developer to the use of only FormHF software; it also enables him to use integrated development environments (IDE) with C++/Pascal language support as desired. This approach provides new possibilities, when necessary, for "manual" changes to automatically generated program code in those cases where creation and use of non-standard measurement methods is required.

Automation of service and metrological support

The intelligent tools of the FormHF software complex automate and minimize FORMULA® HF Ultra Test System maintenance, including diagnostics, adjustment and metrological calibration.

The FormHF software service package covers all aspects of FORMULA® HF3 Test System operation, including testing of equipment serviceability, fault detection and verification of metrological compliance.



Test fixtures

The FORMULA® delivery package includes standard installation frames for test boards and complete documentation for independent development of accessories by the Client.

The design of the frames permits accessories of various dimensions.

Custom and factory-ready TestBox® Test Solutions

So that FORMULA® HF3 Test System clients can more quickly achieve their business objectives and promptly see a return on investment, FORM offers both factory-ready and custom TestBox® Test Solutions for measuring specific types of microcircuits: under normal conditions and under the impact of extreme temperatures.

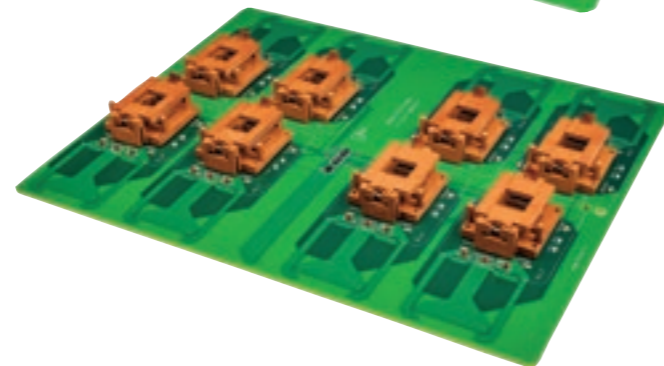
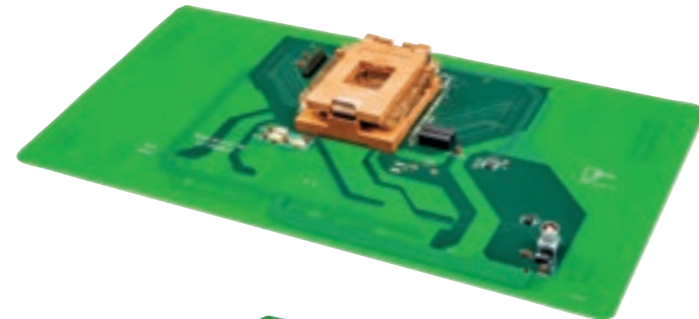
Each TestBox® Test Solution includes:

- specialized test fixture for connecting a specific type of VLSI circuit
- a disk with VLSI circuit test program
- A data sheet with TestBox® operating manual
- Manufacturer's warranty

A group of experienced engineers at our testing laboratory develops designs and software for Test Solutions. The quality of TestBox® Test Solutions is the result of their correspondence to the regulations on ECB and electronic components, technical requirements and Client specifications.

By purchasing the TestBox®, Clients can significantly reduce the time required to put their products on the market.

Today, more than 550 types of Test Solutions already developed are used by FORMULA® Test System Clients, providing consistent metrological support for quality control of electronic components.



Manufacturer's services

To reduce the Client's time and costs for support work, FORM offers the following technical services to FORMULA® HF3 Test System Clients:

- Integration of FORMULA® HF3 Test Systems into the Client's technological, informational and testing infrastructure, with connection of external equipment, instruments and IT networks
- Scheduled maintenance, repair and metrological services at the place where the ATE is operated
- Organization of workstations based on FORMULA® HF3 Test Systems with a database for ensuring traceability of measurements
- Expansion of the ATE configuration according to a list of typical options, or with custom development of options

Delivery composition of FORMULA® Test System

The FORMULA® HF3 Test System has modular bus architecture and allows for custom hardware and software configuration according to the design versions indicated in the type description of the means of measurement.

The configuration of each Test System is determined based on an analysis of the Client's tasks,

requirements and preferences, and is reflected in the Delivery Specification, as well as in the data sheet for each Test System.

The delivery set includes complete operating and metrological documentation and an initial calibration certificate.

Manufacturer's warranties and operator support

FORMULA® Test System warranty service and maintenance in operations are provided by the developer and manufacturer, FORM.

The hardware warranty is 1 year and provides for free visits by engineers to the place where the ATE is operated for warranty repair and unscheduled metrological calibration.

At the end of the warranty period, FORM offers Clients a service contract and provides technical service and metrological service upon individual Client request.

The FORM technical support service provides FORMULA® Test System Clients with the following unlimited free services:

- Consultation via telephone, email and fax, during terminal sessions, and directly at FORM premises
- Methodological assistance in complaint analysis
- Remote ATE diagnostics with fault detection
- Updating of software versions
- Arranging for maintenance and repair
- Information on new ATE options and new Test Solutions

Delivery time and price

The FORMULA® HF3 Test System delivery time is from 9 to 15 weeks depending on the configuration.

The cost includes:

- 1 year warranty
- Delivery to the Client's address, with installation and connection of the ATE on the Client's premises

- Client personnel training on rules for FORMULA® ATE operation and development of test programs
- Commissioning of Test System with application of TestBox® Test Solutions.

FORM develops,
produces, delivers
and supports the
ECB FORMULA®
Test System
in operation



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