FORMULA HFULTRA

FORM
development,
manufacturing
and support of
FORMULA®
Test Systems

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FORMULA® HF Ultra Test System

The FORMULA® HF Ultra Test System is the flagship of our line of FORMULA® HF VLSI circuit high frequency test systems.

Purpose and applications

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

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

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

Primary technical characteristics

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

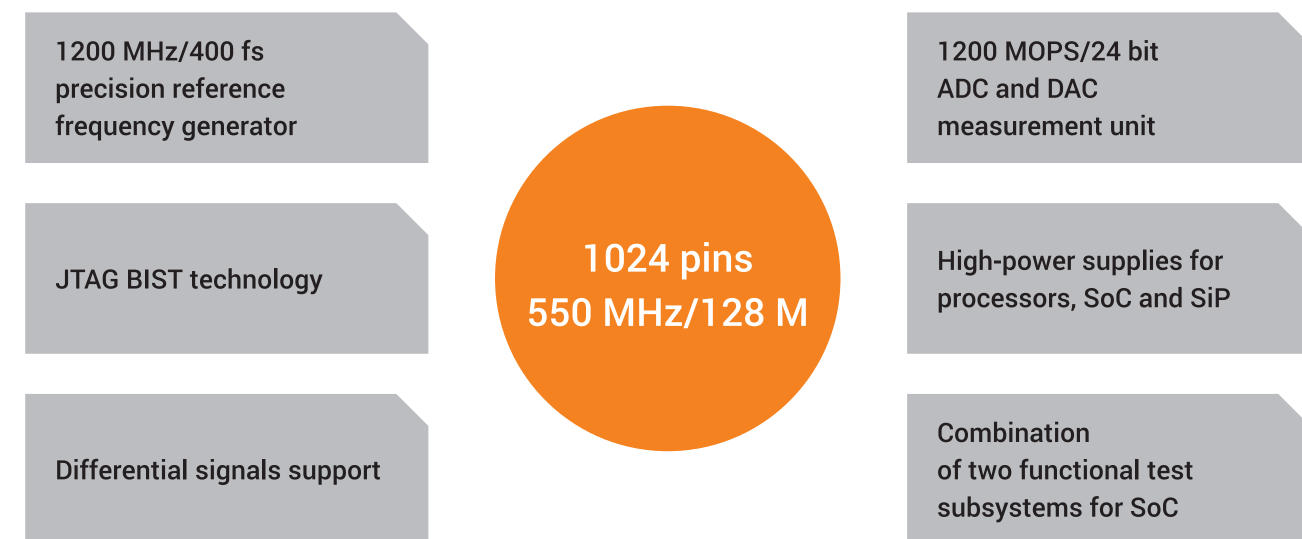
The key technical characteristics of the ATE are:

- Number of universal bidirectional pins — up to 1024
- Functional testing frequency — up to 550 MHz per pin
- Precision generator reference frequency — 1200 MHz
- Vector/error memory — up to 128 M/128 M vectors
- Overall Timing Accuracy (OTA) — not exceeding ±250 picosec
- DAC/ADC measurement unit — 1200 MOPS/24 bit

The FORMULA® HF Ultra 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
- High-speed Multisite mode
- Operating modes with automated probes, automatic loaders, test equipment and instruments
- Reliability in round-the-clock operations
- User-friendly, fully functional software
- Quickly interchangeable test fixtures
- Automatic diagnostics and metrological calibration

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.



Primary subsystems of FORMULA® HF Ultra

1. The function testing subsystem
for 1024 channels with a frequency up to 550 MHz per channel 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

The characteristics of the FORMULA® HF Ultra functional testing subsystem enable its successful use in testing ultrahigh frequency VLSI circuits with up to 1600–1700 outputs, such as ASICs and FPGA.

A mode with simultaneous use of the test pattern generator and algorithmic test pattern generator is provided for testing of VLSI circuits by functional testing and algorithmic testing methods in a single measurement cycle.

2. The parametric measurement subsystem includes:

A subsystem for reproduction and measurement of static electrical parameters with the following characteristics:

- 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 V; ±250 µA... ±4 A	VCC source and measure resource	32
-2...+15 V; ±200 nA... ±400 mA	VDD source and measure resource	32
-2...+13 V; ±200 nA...±150 mA	multipin parametric measurement units (PMU)	32
-2...+13 V; ±2 µA... ±50 mA	per-pin parametric measurement units (PPMU)	1024
-17...+17 V; –500 mA...+500 mA	HVDD measurement sources	8
Special power supplies for high-power VLSI circuits (multicore microprocessors, FPGA and other microcircuits with high power consumption)		
4.5 V/20 A	LVDD high-power supplies	2
3.5 V/50 A/100A	SPS power supply	1

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

HVDD supplies can be used to program FLASH and ROM, as well as for testing analog microcircuits and operating 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 picosec
- Output Edge Placement Accuracy (OEPA) ±250 picosec
- Overall timing accuracy (OTA) ±250 picosec
- Minimum duration of pulse rising and falling edge – (275±150) picosec
- Minimum pulse duration – (750±150) picosec
- Time marker setting increment is 11 picosec.

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

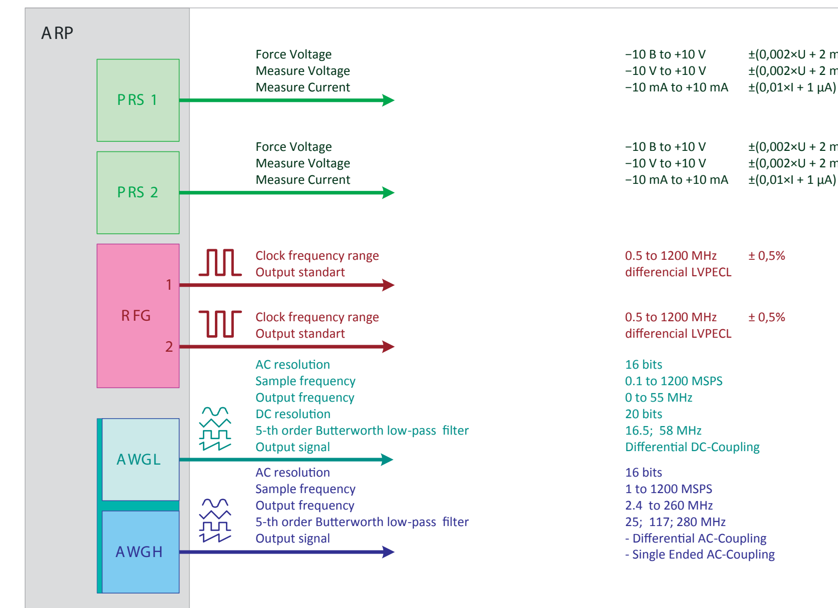
Compensation of signal distortions in a reception/transmission cycle independently for each pin and programmable generation of the signal rising/falling edge slope in the range from 100% to 25%, which is programmed and implemented independently by pin, is provided to preserve the pulse waveform and the requirements for connection to the microcircuit being tested.

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.

5. ARP DAC/ADC measurement unit

The FORMULA® Test System is equipped with a precision analog-digital unit for measurement of combined type microcircuits (DAC and ADC): 1200 MHz/1200 MOPS/(–10...+10) V, which enables measurement of timing and static conversion parameters of up to 14-bit high-speed ADC microcircuits when periodic signals with frequency up to 260 MHz are formed at their inputs, as well as measurement of the static conversion parameters of up to 16-bit low-frequency DAC and ADC microcircuits. The ARP unit includes the following functional devices:



- Precision two-pin clock pulse generator up to 1200 MHz
- Random waveform signal generator with high-frequency and low-frequency pins and conversion frequency up to 1200 MOPS
- Two precision 20/24-bit reference voltage sources with voltage range from –10 V to +10 V

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

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

Measurements under temperature effects directly on the spring base, without using cables, and without 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® HF Ultra 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 has an electrical lead with electronic control, which provides optimum workstation ergonomics in all operating modes.

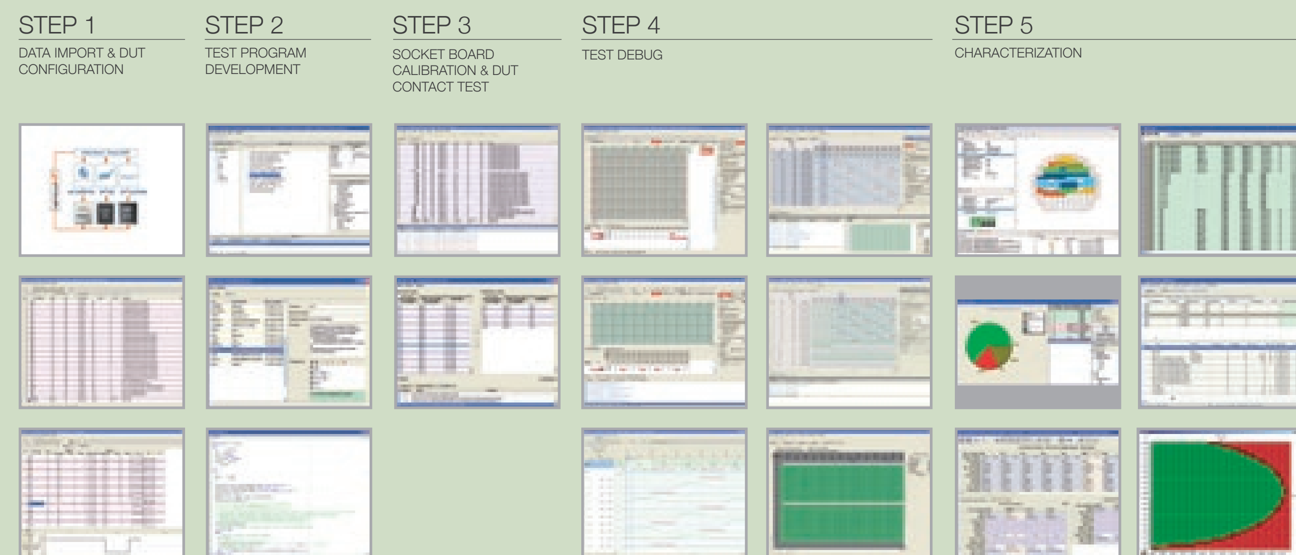
FORMULA® HF Ultra Test System software complex

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 recordings 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

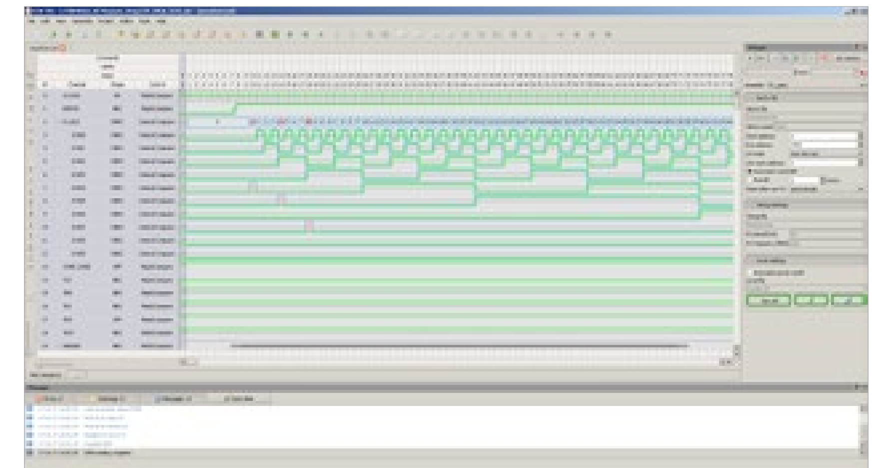
Testing process control includes automatic documentation of the data used to confirm the conformity or nonconformity to the set requirements of the DUTs. The test routines are generated with various levels of detail, from "Accept/Reject" inspection to comprehensive reports on measurement modes and results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

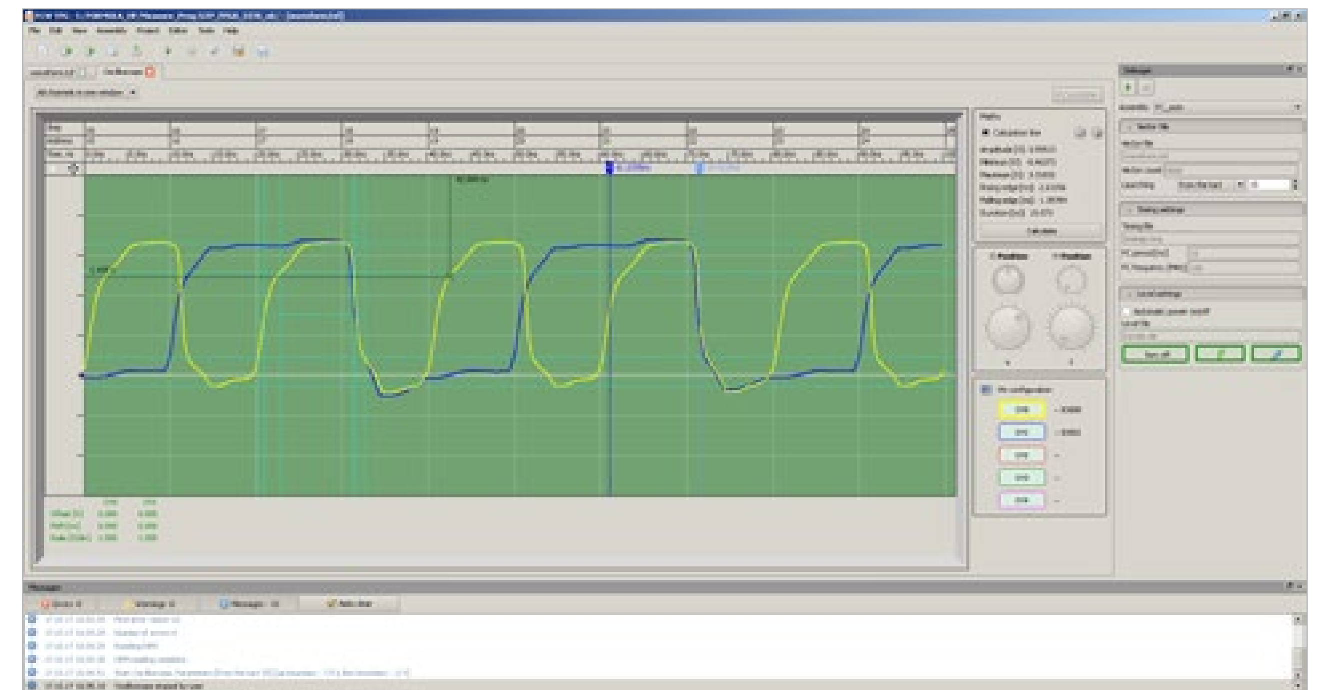
The test records are saved, easily converted to standard forms used by the Client, and serve as the documentary and metrological basis for managing deviations, and as a basis for quality complaint follow-up at the incoming inspection stage.

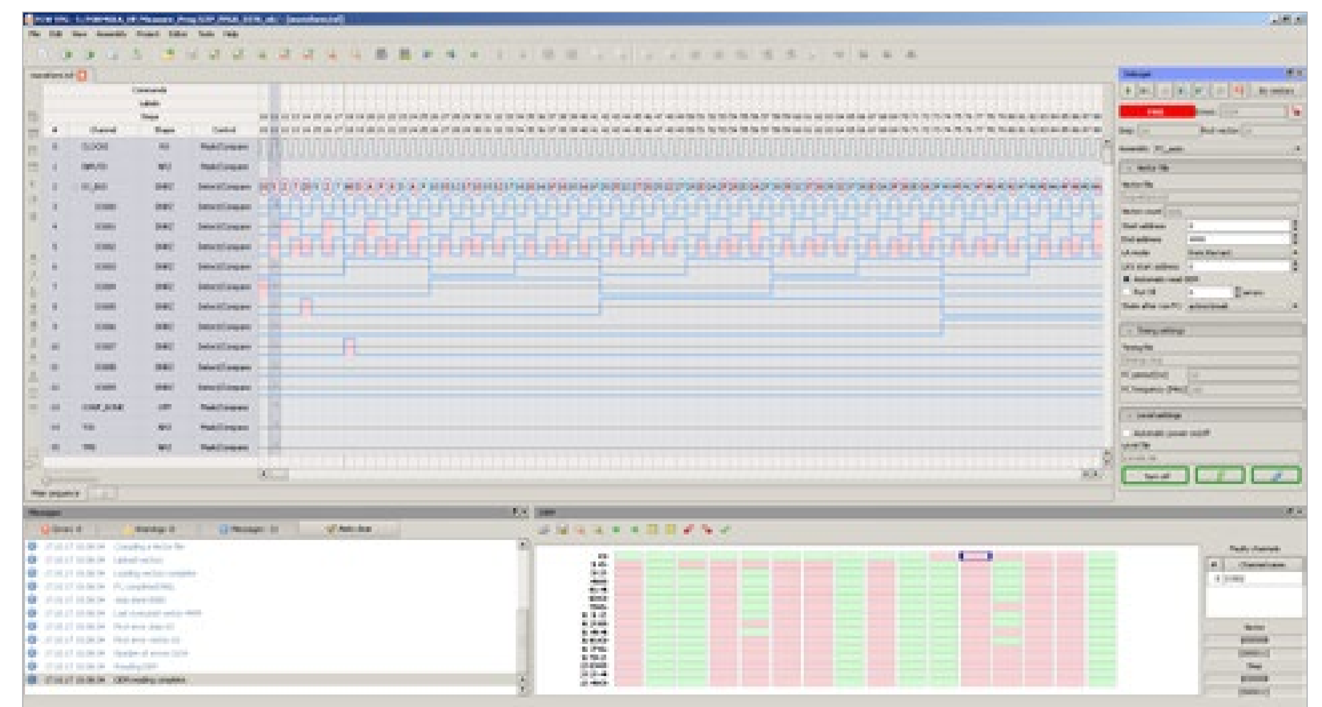
Analysis and display

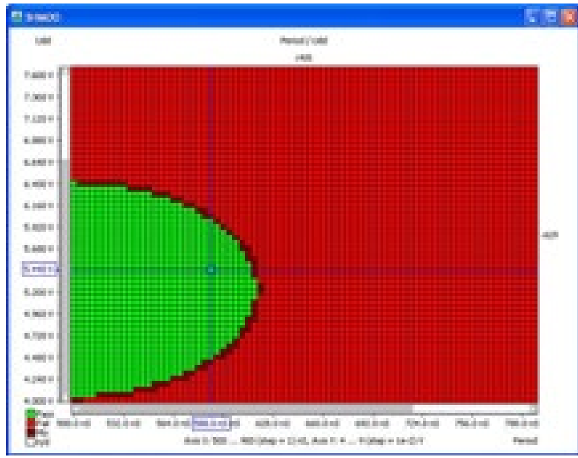
ATE integrated analytical tools are used for analysis of functional and parametric deviations detected during measurements and debugging of test programs. These tools include:

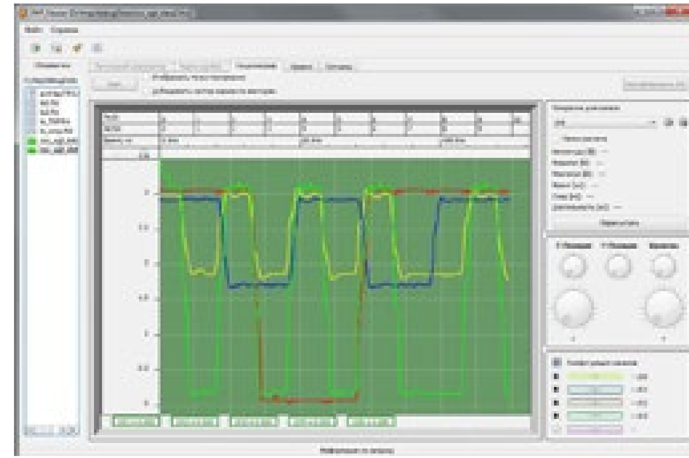
- Logic Analyzer hardware
- Oscilloscope
- Error Chart







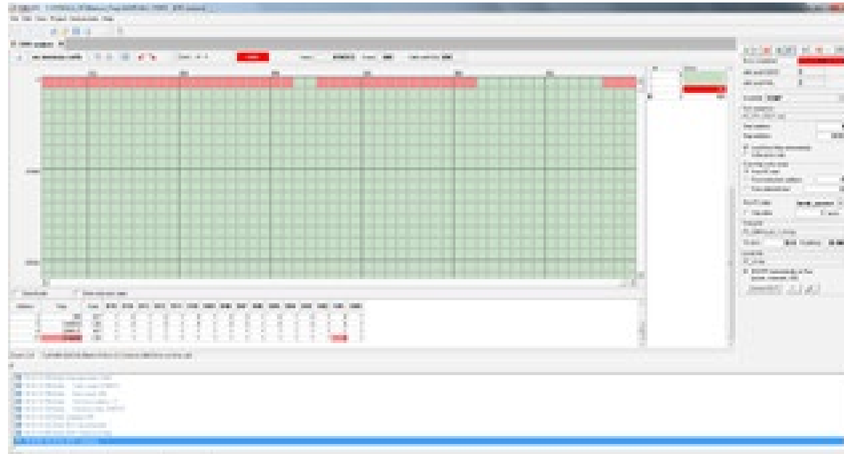




The following tools are used to study the serviceable ranges and reliability of VLSI circuits: SHMOO diagrams and DRV analysis.

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® HF Ultra 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® HF Ultra 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.

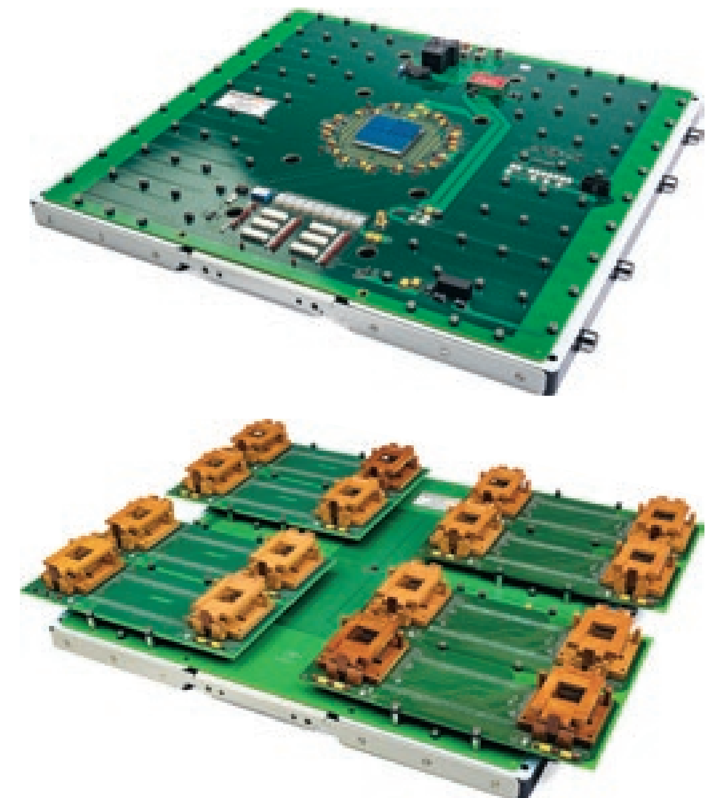
Custom and factory-ready TestBox® Test Solutions

So that FORMULA® HF Ultra 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® HF Ultra Test System Clients:

- Integration of FORMULA® HF Ultra 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® HF Ultra 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® HF Ultra 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® HF Ultra 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®
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in operation

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