Analyst *ems+ft* V12 System

In-Circuit and Functional Test System

The CheckSum ***Analyst***$_{ems+ftV12}$ is designed for testing most common circuit assemblies. It combines manufacturing defects analysis (ICT/MDA) with power-up functional test to provide extremely high fault coverage in a single, low-cost test station.

ICT/MDA testing tests the unit under test (UUT) without power applied. Using sophisticated measurement techniques such as DC and complex-impedance measurements and multi-point guarding it provides the capability to find the majority of faults such as shorts, opens and wrong or incorrectly installed components. By finding the majority of faults while the UUT is in the safe unpowered mode, and with very specific fault diagnostic messages, faulty UUTs can be repaired quickly.

Once the ICT/MDA tests have successfully completed, the ***Analyst***$_{ems+ftV12}$ provides the capability to power up the UUT to test for performance faults. This capability can be used to help ensure that the UUT will operate properly in its end environment, finding problems such as faulty ICs or other subtle performance problems.

The ***Analyst***$_{ems+ftV12}$ is designed to be used for most common circuit assemblies. It can perform effective power-down testing for most analog or digital assemblies being manufactured today. The power-up functional testing is ideally suited for lower frequency analog-type assemblies with some digital content.

CheckSum can ship the system to you complete with a ready-to-use test fixture and test program for one or more of your UUTs. You can use CheckSum's fixturing division to handle all of your fixturing and programming needs; or you can modify or add UUTs yourself or with the use of third-parties.

Power-Off Test Capabilities

For analog in-circuit testing (ICT/MDA), the System provides effective tools to find most faults. These measurements are made with signal injection/measurement, but without the UUT powered on. Measurements are taken at high speeds using a solid-state multiplexing system. Most complete ICT/MDA tests are well under ten seconds.

Opens/Shorts

The System can test from each point to each other point to detect faults. Open/short thresholds are typically in the 10Ω range, but can be programmed over the range of 2Ω to 50KΩ. Continuity tests can use either 1mA, 100µA, 10µA, or 1µA source current. Specified pairs of points can be designated as "no-cares" to allow the most effective diagnostics or to deal with points that are near threshold values.

Resistance Measurements

The System provides the ability to measure from 0Ω up to 19MΩ using various techniques to optimize the measurement effectiveness. You can choose between using a constant-current source (0.1µA to 100mA), a DC constant-voltage source (.02V to 2V full range), or AC complex-impedance measurements over the range of 100Hz - 1KHz. Resistance tests can be used with external sense (4-wire Kelvin measurements), and in conjunction with multi-point guarding to isolate individual components. Guard currents up to 100mA are available. Up to 16 distinct measurement and stimulus functions can be active during a single measurement.

Capacitance Measurements

The System provides the ability to measure from a few pF up to 20,000µF. You can choose between using a constant-current pulsed source (1mA to 10mA), or AC complex-impedance measurements over the range of 100Hz – 100KHz. Capacitance tests can be used with external sense (4-wire Kelvin measurements), and in conjunction with multi-point guarding to isolate individual components. Guard currents up to 100mA are available. Up to 16 distinct measurement and stimulus functions can be active during a single measurement.

Inductance Measurements

The System provides the ability to measure from a few µH up to 1000H. Measurements are made by using complex-impedance measurements with stimulus frequencies between 100Hz and 100KHz and full-range amplitudes of 0.02V to 2V. Inductance tests can be used with external sense (4-wire Kelvin measurements), and in conjunction with multi-point guarding to isolate individual components. Guard currents up to 100mA are available. Up to 16 distinct measurement and stimulus functions can be active during a single measurement.

Voltage Measurements

For UUTs that have batteries, the DC voltage can be measured. The DMM test measures up to 250V.

Transistors

Transistors can be tested as two diode junctions, or tested for Beta while in-circuit. The Beta test can help determine proper insertion polarity for transistors that can be installed backwards, but with the base still in the middle. This type of fault cannot typically be detected with diode

MultiWriter Technology is protected under U.S. Patent No. 7,802,021. TestJet Technology is protected under U.S. Patent Nos. 5,124,660 and 5,254,953.

testing of the junctions.

FETs
FETs can be tested for turn-on voltage. By sweeping a voltage into the gate while monitoring the Source/Drain impedance, the FET can be checked for proper orientation and operation.

Opto-Isolators
Opto-isolators can be tested by sourcing into the input leads while measuring the output impedance. By testing each device in the on and off state, high confidence is obtained.

Relays
Up to 24V with up to 100mA can be used to actuate relay coils. This allows testing of contacts in each state to ensure that the contacts are not shorted, and that the coil is operational.

Diodes
Diodes are tested by providing a constant current source (0.1µA to 100mA), then measuring the forward voltage drop, which is typically in the 0.6V to 0.8V range. This test ensures that the diode is installed, is in the proper orientation, and is not open or shorted.

Zener Diodes
Zeners are tested by providing a constant current source (0.1µA to 100mA), then measuring the forward voltage drop. Measurements up to 50V can be performed. This test ensures that the zener diode is installed, is in the proper orientation, and is not open or shorted. Zeners that cannot be brought to their full voltage due to current or voltage limiting can be tested as normal diodes or in some cases can be tested during the power-up stage.

LEDs
LEDs are tested like signal diodes, but normally have higher forward voltage drop. Special light-sensing probes can be added to customized test fixtures to detect brightness and color of LEDs and incandescent lamps.

Transformers
Transformers are typically tested for dc resistance of each coil to detect presence. Coils can also be tested for inductance, and a polarity test can be used to ensure that each coil is wired correctly. This can detect faults inherent to hand-loading of transformers with wire leads.

IC Presence/Orientation
Integrated circuits (ICs) can be tested by using the ICs test. This test measures each IC pin to VSS and VDD, checking for the presence of the IC's internal protection diodes. This test detects most faults such as shorted pins, open pins or mis-clocked or wrong ICs. In some cases, faults may not be detected if the IC pins are bussed or devices of similar pin-topology are interchanged.

IC Pin Connections
If the System is configured with the optional SMT-2 option, it can detect opens to IC pins, even though the pin is bussed to other ICs. This advanced technology (licensed to CheckSum by Agilent), uses a sophisticated software/hardware algorithm to measure the minute capacitance between the PCB and the IC for each pin. If a pin is open, the capacitance significantly decreases. This technology can be used for most non-power and ground lines on the ICs.

Capacitor Polarity
In some cases, constant-current and voltage measurements of a polarized capacitor can be used to detect incorrect polarity since the capacitor draws additional current as the voltage increases in the incorrect polarity. As a practical matter, this technique cannot be used in many cases during in-circuit testing because of voltage or parallel impedance limitations. In this case, the SMT-2 option can be used to detect the polarity of most axial/SMT aluminum and tantalum capacitors up to about 200µF.

Quick-Test
To test UUTs without programming, CheckSum offers the `Auto-Program' algorithm. This allows you to place a known-good UUT on the test fixture for the System to self-program itself. Other boards can then be tested to find differences that may be indicative of faults. Detected properties include open/shorts, resistance, capacitance and diode junction presence. While this algorithm does not provide the detailed diagnostic messages of a fully programmed UUT, it can help get boards up on the System quickly for use while programming, or as a complete test on prototype or short runs.

Power-On Functional Test Capabilities

Once power-off testing is completed, the ***Analyst**ems+ftV12* can power up the UUT to test for proper performance. This can be done on the same fixture as the ICT/MDA test so that minimal time is spent transferring, loading and unloading your UUT.

Since the ***Analyst**ems+ftV12* has a combined solid-state and relay switch matrix, most power-up testing is done with relays that provide high current ratings and higher voltage-standoff for the UUT. UUTs with voltages up to about ±12V are accommodated with the solid-state multiplexing, and voltages up to 250Vp-p are accommodated when using the System's relay switching.

When greater than 40 volts is present at the UUT during test, the test fixture should be designed with safety shielding to help prevent the operator from coming in contact with the signals.

The System can be placed in 19 inch rack space, and off-the-shelf measurement/stimulus instruments or programmable power supplies can be configured to meet your special requirements.

Power Supply Capability

The ***Analyst***$_{ems+ftV12}$ system can be configured with optional power supplies used to power-up your UUT.

Optional Power Supplies

PS-UUT-L2 power supply option includes:
2 programmable supplies, 0 to 60 VDC, up to 12.5A

PS-1 fixed power supply option includes:
+5VDC @ 8A, +12VDC @ 2.5A, -12VDC @ 1A, +24VDC @ 2.5A,and 24VAC (line frequency) @ 0.75A

The optional power module provides switched +5VDC @ 1A, +12VDC @ 1A, and -12VDC @ 0.1A are available at the fixture interface panel.

Variable Supplies

Variable DC supplies include ±10VDC (600Ω source impedance), ±12VDC (100mA source current), and –10mA to +10mA constant current.

Contact Closures

The PS-1 power supply option provides 24 additional, individually programmable, 1A Form-A power relays that can be used for switching power and signals at the fixture interface panel.

Measurement Capability

DC Volts

The system can measure up to 250VDC in a fully differential input mode. Ranges include 0.2V, 0.6V, 2V, 6V, 10V, 20V, 60V, 200V and 600V (rated to 250V) and auto-range.

AC Volts

The system can measure up to 250V*RMS*. The true RMS measurements are provided with AC or AC+DC coupling. Ranges include 0.2V, 0.6V, 2V, 6V, 20V, 60V, 200V, 600V (rated to 250V) and auto-range.

Frequency

Frequency measurements can be made from DC to 10MHz. Higher frequencies can be performed if the test fixture includes a pre-scaler. The UUT ground-referenced input can be from 300mV to 5V, and can be AC or DC coupled. The trigger level can be set in the range of ±2.2V.

Period

Period measurements can be made from 12.8 milliseconds to 128 seconds. The UUT ground-referenced input can be from 300mV to 5V, and can be AC or DC coupled. The trigger level can be set in the range of ±2.2V, and can be set to respond to rising or falling transitions. Period measurements can be made with A and/or B inputs.

Counts

Counts can be made of up to 65,535 events based on the trigger event occurring. The UUT ground-referenced trigger input can be from 300mV to 5V, and can be AC or DC coupled. The trigger level can be set in the range of ±2.2V, and can be set to respond to rising or falling transitions. Up to 5MHz signals can be counted.

Stimulus Capability

DC Volts

The System has three DC voltage signal sources, each of which can source up from ±10V, and providing up to 10mA of current. These sources are internally sensed.

Sine Wave

The System can provide sine wave output in the range of 100mV to 20Vp-p (7V*RMS*). The frequency selection range is 1Hz to 50KHz. Sine wave output is UUT ground-referenced and can provide up to 10mA of output.

Square Wave

The System can provide square wave output. The amplitude can be up to ±10V with reference to UUT ground, or can be between two programmable amplitudes each from ±10V, with up to 10mA. The frequency selection range is 1Hz to 50KHz.

DC Current

The System provides two 100mA current sources with programmable voltage. Each source can be programmed to a compliance voltage between ±12V. When used together, the sources can provide up to 24V differentially.

Digital I/O

The standard configuration of the ***Analyst***$_{ems+ftV12}$ includes 96 digital I/O pins. These pins can be relay-connected to the UUT in byte increments. Within each byte, each pin can be set to be an input (tri-state output) or an output. Since each pin has a 10KΩ pull-up (in conjunction with totem-pole outputs), it is compatible with most logic families. VCC for output can be selected to be +5V or +3.3V.

Boundary-Scan

The ***Analyst****ems+ftV12* can be configured with an optional Boundary-Scan test capability. This allows the System to be used with UUTs that have been designed to accommodate boundary-scan, or have on-board devices that support boundary-scan. In addition, boundary scan can be used by some programmable devices to perform in-system programming and program verification.

MultiWriter ISP System

MultiWriter is the first ICT-based ISP system designed from the ground up specifically for popular serial-bus programming protocols. MultiWriter solves the productivity bottleneck created by today's multi-panel boards and large, data-hungry ISP chips. MultiWriter can simultaneously program up to 384 ISP chips at near data-book speeds.

Other System I/O

In addition to the power/stimulus/measurement capabilities already mentioned, the System has a number of other functions available. These options include:

8	1A Form-C Relay contacts (FUNC-2/PWR-2)
2	+5VDC 1A fused outputs (FUNC-2/PWR-2)
2	+12VDC 1A fused outputs (FUNC-2/PWR-2)
2	–12VDC 0.1A fused outputs (FUNC-2/PWR-2)
16	Bits of Digital I/O / Relay drivers (FUNC-2/PWR-2)
1	Switched ground (PWR-2)
24	1A Form-A Relay contacts (PS-1 option)

System Switching Topology

The ***Analyst****ems+ftV12* offers a flexible switching topology to minimize custom circuitry and to allow assemblies to be easily programmed.

The system uses a 400 x 16 solid-state analog bus that allows each test point to be connected to one of 16 places. Each point can be a measure source high, measure source low, measure sense high, measure sense low, guard source, guard sense, or DC/AC signal source. The solid-state matrix provides high speed and reliability for power-down testing, or for functional testing of points that do not exceed ±12V referenced to the controller chassis.

Between the UUT and the solid state switching, the system has a relay switch matrix. This can be used to individually isolate any or all of the test points from the UUT during power-up testing. The relay bus is configured as a 400 x 2 (plus disconnect) matrix. When in the power-up mode, the relay matrix can be used to source and measure any two test point inputs. This can be used in conjunction with the solid-state matrix for test points with low voltage. The system can measure the voltage of any test point prior to connecting it to the ICT/MDA electronics to ensure that it can be safely connected without damaging the solid state inputs. The system also has a voltage monitoring/discharging function that requires specified UUT test points to be at a safe voltage level before continuing. The system power-up circuit resets the switch matrix to a safe position during power-up.

Digital test points are available at the fixture interface blocks. They can be relay-disconnected during power-down test, then enabled (by byte) during power-up test.

Power supplies are available at the fixture interface blocks. They must be relay disconnected during power-down test. This includes the ground signals so that the UUT is fully floating.

There are two special 2x16 relay busses available. One is connected to the 100mA current sources and the other to the DMM high-voltage inputs. These can be handy, for example, when selectively applying voltage to multi-UUT panels assemblies.

System Software

The system comes complete with a comprehensive, yet easy-to-use software package. Running in the Windows environment, users find it to be intuitive and efficient. It is network-compatible and includes comprehensive on-line help. There are several major blocks in the software package:

Testing Environment

The system can be setup to accommodate a variety of internal philosophies about how to present data to the operator.

In the most simple case, the operator places the UUT into the fixture, then uses the Start and Safety switches on the front panel to start the test. The fixture actuates, and the test begins. Once the test is completed, the screen shows a large red FAIL or green PASS indication, and the fixture is de-actuated. Testing status is shown on the monitor, along with red (fail), green (pass) and amber (busy) lights on the stack-light and front panel.

The operator can then choose to ReTest, or move to the next UUT. Most users configure the system to automatically print out a test report of component failures on the system printer if the UUT fails. The operator then attaches the failure report to the bad UUT, and sends it off for repair. The next UUT is then put into the fixture and the process starts over again. This simple operation cycle is easy to use by unskilled operators.

The system can be set up to halt on each failure if you would like your operators to be able to repeat steps, or repair the UUT as faults occur.

You can also view a real-time Pareto report of failures during each batch of UUTs. By observing this sorted table of specific failures, you can quickly detect repetitive process faults.

Test reports can be automatically generated in a variety of configurations, or can be manually selected by the operator.

The system can display graphical information about the UUT to help the operator test and repair the UUT. The system can display a picture of the UUT, the schematic, probe information, or text with relevant portions of the display annunciated (e.g., circled) based on the failure at hand.

Panelized UUTs are accommodated during testing operations. As the test is performed; you can observe a graphical status representation of the panel as each UUT in the panel is tested. At the end of the test, each UUT in the panel is shown as a pass/fail/skip, and result reports are separated by UUT.

While there is a wide variety of capabilities for the operator, you can use the system's login capability to tailor the resources available to each user. Not only does this provide ease of use based on operator skill level; it can provide integrity to test programs and the system configuration so they cannot be modified by unauthorized personnel.

The system can log serial numbers of assemblies, either through manual entry, or via an optional bar-code reader.

Statistical Process Control

The system can be set up so that it logs statistical data. When this is enabled; you can obtain several types of reports. Reports can be limited by beginning date and time and ending date and time. You can also report on all UUTs, or choose particular ones to analyze.

The Production report lists which UUTs have been tested, the failure rate and how many defects have occurred. This is valuable to determine overall production, production by shift, production by UUT, and production failure rates.

The Pareto report lists the faults sorted by occurrence. For example, you might find that your greatest source of error on one assembly is R101. You might find that frequently the roll of parts used to feed R101 is incorrect, or perhaps the part is difficult to install, or a particular shift is having more trouble than others.

The X-Bar/Sigma reports are used to show, by individual analog measurement, the mean (average), standard deviation, 3-sigma limits, Cp and Cpk. This data is graphically displayed with a predicted distribution curve and high/low test limits. While this information can be used to monitor process measurements, it is more often used to help fine-tune test program tolerances. By observing the data, even with a relatively small programming sample size, it is practical to set control limits that are applicable to a wider range of UUTs.

Raw statistics data is logged on the disk in ASCII format, comma-delimited, so that you can write your own custom analysis software if desired.

Test Program Generation

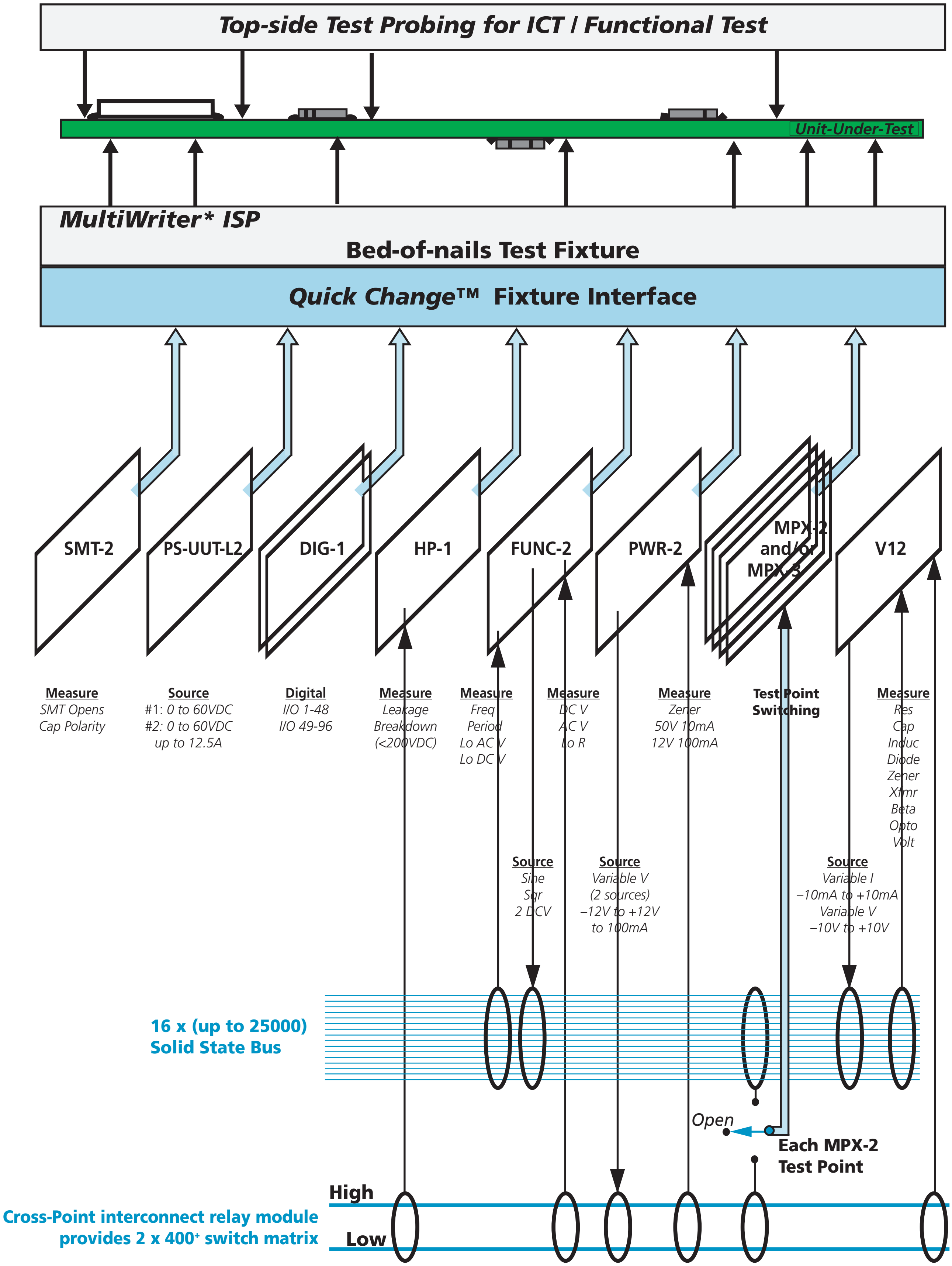
The system includes all the software necessary to write and modify your test programs. Many users have CheckSum build test fixtures and write test programs; however, many users do these functions in-house or use local contractors to help in this effort.

Test programs are generated in an interactive spreadsheet-like environment, with each line specifying one test step. Typical test steps include RES (resistance test), CAP (capacitance test), CONT(inuity test), JMPx (jump based on some conditional), MEMx (memory math), RELAY (specify relay closure), SINEV (source sine wave), DIGO (digital output). The line contains other information relevant to the step. For example, a RESistance test step would include two test point names and numbers, a measurement range, nominal (expected) value, and high and low test limits.

The test programming language is rich in features. In addition to normal measurement and stimulus test types, features include mathematics functions, file I/O, jump based on measurements, math, or operator input, display of messages, operator input, interactive adjustment routines, calling of external programs that you have written, and a host of other capabilities to make programming easy and flexible.

Each test program can be up to 30,000 steps, and test programs can be transparently linked together to provide unlimited length (for all practical purposes) programs, or to allow you to make libraries of program segments that you can reuse.

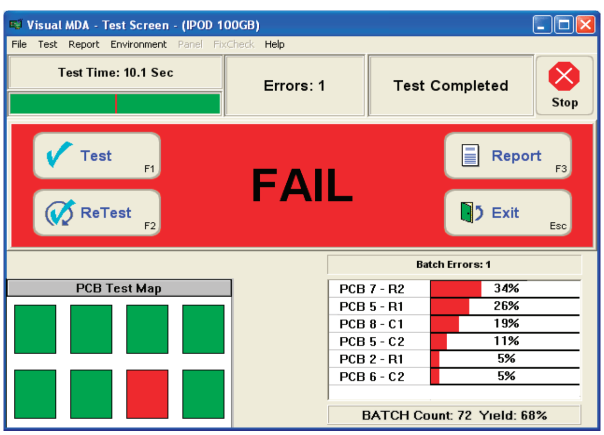
CheckSum Analyst *ems+ftV12* ICT/Functional Test System



* Options MPX-2, MPX-3, PWR-2, FUNC-2, HP-1, DIG-1, PS-UUT-L2, SMT-2

If you have CAD data for your assemblies, it can be used to generate the preliminary ICT/MDA test program and a wiring report. The system accepts ASCII net list and component information from many popular CAD formats including OrCAD, P-Cad, Mentor, HP-BCF, Cadence, Racal-Redac, Viewlogic, Tango, Veribest, ComputerVision, Pads2000, Scicards, Fabmaster and Accel. Even if you are using another CAD package, it may be able to generate output for one of the supported formats. The automatically generated program contains test steps for the components in the net list, and a wiring report. Once the fixture is built and wired, you can load the generated program, then fine-tune test steps as necessary. Typically, about 70% of the generated steps initially pass. Once the program is interactively optimized with appropriate ranges, polarities and guard points, you can self-learn CONTinuity and ICs data, and the power-down test is ready to use. Functional programming is hand-entered to meet the specific needs of the UUT.

Entry or generation of programs can be done off-line in your office. Optimizing the program is done on the test station and involves choosing the best methods of making measurements. While in the test program editor, you can execute tests. If you are not satisfied with the result, you can enter a menu that displays the measurement taken



with a variety of techniques and ranges. You can quickly choose the best technique/range, add guard points, change polarity or add delays to obtain the best test results. Other tools include X-Bar/Sigma, measurement time, and time/voltage displays for each basic measurement type.

Panelization facilities include a step-and-repeat mode. This allows you to specify the panelized format and the initial wiring points for each PCB in the panel. Once you have written and debugged the first UUT in the panel, the system will then automatically generate the steps for the other PCBs. At run-time, the operator can elect to skip PCBs in the panel that are not populated or known-defective.

Station Configuration

The station configuration software is used to set up the station's software and hardware environment.

To manage the system hardware, the station configuration software provides for specification of the hardware configuration in the system and includes a comprehensive self-test facility for each module. The self-test software checks each module for proper operation. In many cases, the system also performs self-calibration of modules against internal standards. This data is then saved to the system disk for future use. If external traceability is necessary in your installation, the system can be checked against an external calibration module (included), and the functional test electronics can be calibrated against typical external standards using included interactive software.

The login capability can be enabled to allow users to login to the system. This can be used so that reports and internal SPC logs contain the operator name. Optionally, passwords can be assigned for each user. Each user can be assigned privileges, to the level of each individual menu selection in the system.

Reporting capabilities can be configured to meet a wide variety of needs. Test reports can be output on demand, always, or on failure only. The reports can contain all results, or just results for failed steps. The header format, and amount and order of information for each step can be specified, as well as the destination device (e.g., which printer, or to the monitor). Test program reports can also be configured to include or exclude specific data. SPC data-logging can be disabled, or enabled for pass-only steps, pass and fail steps, or just test summary information.

Accessories & Options

The system can be configured with additional test point modules and other options that can expand the system to 5200 test connections.

MPX-3-200	200 Test Point Module
CR-2	24 Point Milli-Ohm Meter Module
HP-1	High Voltage Module, 24 TPs
Blank Filler for rack (1U, 2U, or 3U)	
Ribbons and paper for the T-120-2P Printer	

Resistance Measurement using DMM

ems+ftV12 Specifications

Resistance Measurement

Resistors are measured with a choice of DC-constant-current, DC-constant-voltage, or AC-complex-impedance measurements. Low impedance measurements can be externally sensed.

Measurement using DC Current Stimulus

Range F.S.	Current	Voltage at F.S.	Accuracy
19Ω	10mA	0.2 V	2% F.S.
190Ω *	10mA	2 V	1% F.S.
1.9KΩ *	1mA	2 V	1% F.S.
19KΩ *	0.1mA	2 V	1% F.S.
190KΩ *	10μA	2 V	1% F.S.
1.9MΩ *	1μA	2 V	2% F.S.
19MΩ	0.1μA	2 V	5% F.S.

*0.2V ranges are available. For 0.2V ranges, multiply typical accuracy by 3. For internally sensed measurements, add 2Ω to accuracy. Maximum voltage may exceed full-scale value during over-range.

Measurement using AC/DC Voltage Stimulus

Range	Source Voltage, Typical	Accuracy
0Ω to 10KΩ	3.8V DC or 2VAC RMS	1% Value+0.5Ω
10KΩ to 100KΩ	3.8V DC or 2VAC RMS	2% Value
100KΩ to 1MΩ	3.8V DC or 2VAC RMS	4% Value
1MΩ to 10MΩ	3.8V DC or 2VAC RMS	10% Value (20% @ 1KHz)

0.2V & .02V sources are also available. For 0.2V, multiply accuracy by 3. For .02V, multiply accuracy by 10 (not specified above 1MΩ). For internally sensed measurements, add 2Ω to accuracy. Available AC stimulus frequencies 100Hz and 1KHz. Technique is fully auto-ranging. Source current is less than 10mA.

Resistance Measurement using DMM

Ranges	2Ω, 6Ω, 20Ω, autorange (including lead resistance)
Resolution	.05% of full range
Accuracy	
2-Wire	± 2Ω
4-Wire	± 7% ± 0.1Ω
Ohms Source	100mA

DMM from FUNC-2

Inductance Measurement

Inductors are measured with AC-complex-impedance measurements. Effective measurement range is 1μH - 1000H.

Range	Accuracy			
	100KHz	10KHz	1KHz	100Hz
1μH - 10μH	4%+0.5μH	4%+0.5μH	10%+2μH	–
10μH - 100μH	4%+2μH	4%+2μH	10%+4μH	–
100μH - 1mH	4%	4%	4%	10%
1mH - 10mH	10%	4%	4%	4%
10mH - 100mH	–	10%	4%	4%
100mH - 1H	–	–	10%	4%
1H - 10H	–	–	–	10%
10H - 100H	–	–	–	10%
100H - 1000H	–	–	–	20%

Specifications assume residual inductance is offset. Specifications apply to 2V source. 0.2 and 0.02V sources are also available. For 0.2V, multiply accuracy by 3. For 0.02V, multiply accuracy by 10. Technique is fully auto-ranging. Source current is less than 10mA. Measurements less than 100μH should be externally sensed for full accuracy.

Capacitance Measurement

Capacitors are measured with a choice of DC-constant-current or AC-complex-impedance measurements. Measurements can be effectively made from 2pF - 20,000μF [3].

Range	Accuracy					
	100KHz	10KHz	1KHz	100Hz	1mA	10mA
1pF - 100pF	4%[1]	4%[1]	4%[1]	–	–	–
100pF - 1000pF	4%[2]	4%[2]	4%[2]	10%[2]	–	–
1000pF - 0.01μF	10%	4%	4%	4%	–	–
0.01μF - 0.1μF	–	4%	4%	4%	–	–
0.1μF - 1μF	–	10%	4%	4%	–	–
1μF - 10μF	–	–	4%	4%	–	–
10μF - 100μF	–	–	10%	4%	4%	–
100μF - 1000μF	–	–	–	10%	10%	4%
1000μF - 20000μF	–	–	–	10%	20%	10%

Notes:

1. ± 5pF
2. ± 10pF
3. While small isolated capacitances (pF region) can effectively be tested by the system, often times in-circuit influences such as parallel impedances in IC's degrade measurements. Values less than 100pF can be difficult to measure in many circuits.

Specifications assume residual capacitance is offset and apply to 2V source. 0.2V and 0.02V sources are also available. For 0.2V, multiply accuracy by 3. For 0.02V, multiply accuracy by 10. Technique is fully auto-ranging. Source current is less than10mA.

Guarding Capability

The test system provides guarding to minimize the effects of parallel impedances. Without special wiring, any test point can be used as a measurement point, a guard point, or an external sense point. All points can be guarded (with selected deletions), or up to six individual guard-points can be simultaneously used. Each measurement or guard point can be externally sensed.

Guarding uses a separate guard amplifier for each guard point to provide extremely precise guarding. Even without guarding, the system can often directly measure components of different types connected in parallel, such as a capacitor and a resistor, using complex-impedance measurements.

Guarding

Maximum Current per Test Point	10mA
Max. Number of Simultaneous Guard Points	6 (or guard-all less selected points)
Maximum Total Guard Current (V12)	20mA

Typical Resistance Measurement Accuracy Degradation when using Guarding:

Guard Ratio	Multiply Accuracy
1:1	x 1
10:1	x 2
100:1	x 3

Any test point can be designated as a guard or external guard sense point without special wiring, except Power points.

Voltage Measurement

Diode and Zener Diode Measurement

Standard diodes, LEDs and zener diodes are tested by applying a constant current to the anode and cathode, then measuring the resultant voltage (forward voltage drop). Measurements of up to 50V can be performed using up to 100 mA of applied current.

Diode Test Type

Accuracy

	Source Current		
Range	10mA	1mA	0.1mA
2V	±40mV	±40mV	±40mV
10V *	±200mV	±200mV	±200mV

* Typical constant current to 7V compliance

Zener Test Type

Range	Source Current	Accuracy
20V	10mA	±300mV

DC Voltage Measurement

DC Voltage Measurement (VOLT test type)

Measurement Range	Accuracy
± 0.2V	4mV
± 2.0V	40mV
± 10 V	200mV

Ranges are bipolar. Stimulus may float ±8V from controller chassis ground.

DC Voltage Measurement (DMM test type)

Ranges**	200mV, 600mV, 2V, 6V, 2V, 60V, 200V, 600V (max input 250V), auto-range
Accuracy	0.5% of range
Resolution	0.05% of range

** Maximum voltage connected to MPX points must not exceed ±12 volts with respect to the controller chassis. Maximum voltage applied to test points must not exceed ±250 volts with respect to the controller chassis. The LOW bus can be connected to the controller chassis during a DMM test under software control.

AC Voltage Measurement (DMM test type)

Ranges**	200mV, 600mV, 2V, 6V, 20V, 60V, 200V, 600V (max input 250V RMS), autorange
Accuracy	2% of range (40Hz to 1KHz) 5% of range (1KHz to 10KHz)
Resolution	0.05% of range
Input	AC or AC+DC Coupled

** Maximum voltage connected to MPX points must not exceed ±12 volts with respect to the controller chassis. Maximum voltage applied to test points must not exceed ±250 volts with respect to the controller chassis. The LOW bus can be connected to the controller chassis during a DMM test under software control.

DMM Measurement Information

Voltage Levels	The DMM can take fully floating differential measurements.
Measurement Speed	~60msec. (AC readings and filtered DC readings ~500msec.)

DMM from FUNC-2

Opens/Shorts Measurement

The system self-learns a known-good UUT, then tests against this map. The continuity map can be edited and no-care conditions can be specified for measurements where components exist, and either condition is acceptable.

Connection/Open Thresholds	Separately programmable from 2Ω - 50KΩ
Typical Test Time for 400 Test Points	1-2 seconds

(Test time depends on UUT circuit topology)

Low Threshold Continuity (rated speed)

Range	Threshold
1mA	2Ω to 50Ω

High Threshold Continuity (lower speed)

Range	Threshold
100µA	20Ω to 500Ω
10µA	200Ω to 5KΩ
1µA	2KΩ to 50KΩ

IC-Orientation/Presence Measurement

IC presence and orientation is verified by checking the semiconductor junctions of the protection diodes typically present between IC pins and the UUT power supplies. Using a proprietary algorithm, the system self-learns a mapping of these ICs and tests against this map. The map can be manually edited for specification of specific tests and no-cares.

Constant Current Ranges	Threshold
0.1mA/1mA	0 to 2V
1mA/10mA	0 to 2V

Opto-isolator Testing

Diode Drive	Measurement Stimulus	Measurement Threshold
0mA to 10mA	1mA	0 to 2V

Transistor Testing

Three terminal devices can be measured between the power terminals (e.g., collector and emitter) while biasing the control terminal with another test point using voltage or current. This can effectively measure the operation, and in most cases the polarity of devices such as FETs, SCRs and transistors.

Third Terminal Drive	Measurement Stimulus	Measurement Threshold
0mA to +1mA	1mA	0 to +2V
–10V to +10V	1mA	0 to +2V
0mA to –1mA	–1mA	0 to –2V
+10V to –10V	–1mA	0 to –2V

Discharge

Discharge Load	250Ω
Discharge Threshold	5V typical
Maximum Discharge Voltage	250V

Sourced from MPX-2

Voltage Sourcing

Low Power Sourcing

DCV 1 and DCV 2

Amplitude	–10V to +10V in 5mV steps
Accuracy	1% ±5mV
Test Point Source Resistance	< 1KΩ

Sourced from FUNC-2

DCV 5

Amplitude	–10V to +10V in 80mV steps
Accuracy	±0.3V
Test Point Source Resistance	< 1KΩ

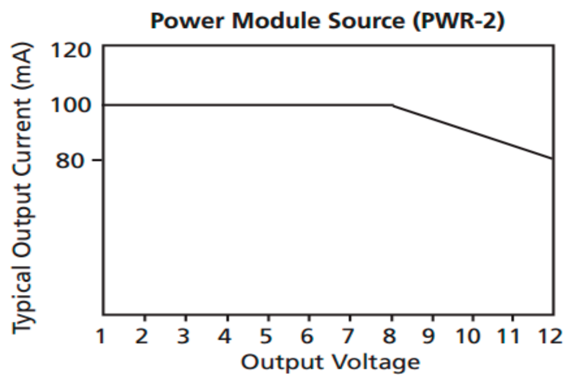
Sourced from V12

High Power Sourcing

DCV 3 and DCV 4

Amplitude	–12V to +12V in 6mV steps
Accuracy	3% ±0.05V when not in current limit
Test Point Source Resistance	< 4Ω

Sourced from PWR-2



Current Measurement Accuracy	10% ±2mA
Voltage Measurement Accuracy	3% ±0.05V when in current limit

DCV 6

Amplitude	+5V or +12V controller chassis referenced
Current	Limited by resetable fuse with <8Ω resistance at 0.145A at 20° C.

Sourced from MPX-2

Constant Current Sourcing

Low Power Sourcing

Range	Resolution	Accuracy
–1mA to 1mA	4μA	3% ±4μA
–10mA to 10mA	40μA	3% ±40μA

Sourced from V12

High Power Sourcing

Fixed Current	100mA ±5%
Compliance Voltage	> 8V

Sourced from PWR-2

Function Generator Waveform Sourcing

All three stimuli are available simultaneously with some limitations (sine and square frequencies must match, square wave must be UUT ground-referenced). When switched through the solid-state test points, the total path resistance is 1KΩ or less. Each function generator output can source up to 10mA into low impedances, but the current/voltage is limited by the switch resistance.

Functions	DC Voltage / Sine Wave / Square Wave
Frequency Range	DC, 1 Hz - 100 KHz
Common	UUT ground-referenced
Frequency Accuracy	.01%
Amplitude Accuracy	1% of full scale (DC) 5% of full scale (20Hz to 1KHz) 10% of full scale (1KHz to 20KHz)
Sine Amplitude	100mV to 20Vp-p (0.1dB steps)
Square Wave Amplitude	Each level programmable from –10V to +10V (5mV steps)
DC V Amplitude	Programmable from –10V to +10V (5mV steps)
Source to	Solid state bus and unswitched at fixture interface

Sourced from FUNC-2

DIGITAL I/O

Available are 96 dedicated test points (two DIG-1 modules with 48 points each). These test points are relay isolated when not in use. They can be wired in parallel with the general purpose test points.

Number of Bits	96 individual input or output
Logic Level	Selectable 3.3V or 5V, TTL/CMOS compatible
Output Sink	10mA at 3.3V, 24mA at 5V
Output Source	3mA
Input Load	10KΩ pull-up to 3.3V or 5V

Sourced from DIG-1

High Current Digital I/O

Provides digital capabilities that allow you to perform low-speed digital input and output for test of UUT functionality. The digital I/O capability can also be used to drive relays or send and receive digital signals and switch closures controlling test flow.

Open-collector outputs can directly control external relays requiring up to 100mA when used with an external source. The digital outputs can be left floating, or jumper-connected through pull-ups to either +5V or +12V. The status of the eight bits can be read back by the system.

Number of Bits	8 on PWR-2 and 8 on FUNC-2
Direction	Output with readback
Logic Family	5V TTL/LS/CMOS
Outputs	Open-collector with pull-up
Distribution	Back panel connector and fixture interface
Sink/Source	Sink 100mA. Source determined by pull-up resistor
Pull-ups	10KΩ socketed pull-up to +5V or +12V

Sourced from PWR-2 and FUNC-2

Power Supplies

Bussed Power Supplies

See the previous section regarding Voltage and Constant Current Sourcing.

Dedicated High Power

PS-UUT-L2 Programmable power supplies:	
#1: 0 to 60VDC, up to 12.5A	
#2: 0 to 60VDC, up to 12.5A	

The PS-UUT-L2 voltage output has remote sense and progammable current limit. Total power should not exceed 750 watts for each unit.

PS-UUT-L2 Accuracy:

Voltage Output	0.05% of Vout + 30mV
Current Output	
Iout > 50mA to 12.5A	0.10% of Iout + 25mA
Iout < 50mA	0.10% of Iout + 50mA

PS-1 fixed voltages with relay switching:
+5V at 8A, controller chassis referenced
+12V at 2.5A, controller chassis referenced
–12V at 1A, controller chassis referenced
+24V at 2.5A, controller chassis referenced
24VAC Line Frequency at 0.75A, floating transformer output

The PS-1 DC voltages are short-circuit current limited. Total DC power drawn should not exceed 75 watts. The AC voltage is fuse protected.

Dedicated Low Power Outputs

FUNC-2	12V @ 1A, 5V @ 1A, –12V @ 0.1A fused and switched
PWR-2	12V @ 1A, 5V @ 1A, –12V @ 0.1A fused and switched
DIG-1	5V @ 1A fused and switched

Undedicated Relays

FUNC-2	4 SPDT, 1A relays, less than 2Ω lead resistance
PWR-2	4 SPDT, 1A relays, less than 2Ω lead resistance
PS-1	24 N.O. SPST, 1A relays, less than 2Ω lead resistance

TestJet Technology*

The system can discriminate up to three pins on the same network on the same IC. Up to 24 top probes can be connected to each module. With SMT-2-EXP optional modules, up to 384 components can be tested. Each module contains a relay driver for low impedance grounding in the fixture.

Measurement Range	Resolution
0fF to 300fF	2fF
20fF to 3000fF	20fF

Capacitance Polarity

The SMT-2 module can also be used to measure polarity of capacitors. The SMT-2 makes use of special top-sensing probes and can be used for aluminum and tantalum polarized capacitors in axial and SMT packages, up to approximately 200µF. Radial aluminum electrolytic capacitors generally cannot be tested using this technology. Up to 24 top probes can be connected to each module. With SMT-2-EXP optional modules, up to 384 components can be tested. Each module contains a relay driver for low impedance grounding in the fixture.

Operating Environment

The test system operating temperature range is 0°C to +35°C with 0 to 80% RH (without condensation). Rated accuracy at ±10°C from calibration temperature. Maximum altitude for operation is 3000m (9843 ft.).

Calibration and General Notes

The system calibration cycle is 6 months. To obtain stated accuracies, low impedance measurements (less than about 100Ω) may require external sensing to compensate for typical 5Ω to 10Ω lead resistance beyond internal sense points. Self-test performs automatic offset characterization for this lead resistance.

All specifications shown are typical accuracies when measuring isolated components. Accuracies may degrade depending on surrounding circuitry. Specifications are typical for a 400-point system with externally sensed measurements when impedances are less than 100Ω.

There are some limitations on the number of simultaneous sources available. Unless otherwise stated, all measurements and stimulus are from the V12 system electronics.

CheckSum Analyst *ems+ftV12* ICT/Functional Test System

CheckSum test systems utilize sophisticated capabilities such as guarding, complex-impedance measurement, vectorless test with TestJet Technology*, in-system programming with the CheckSum MultiWriter ISP system, Boundary-Scan, and fully integrated functional test.

By providing reliable, high-performance, easy-to-use, PC-based in-circuit test (ICT) systems with excellent support and documentation, CheckSum is able to sell its products at a fraction of the cost of comparable test systems from traditional ATE companies.

Our installed base of 3000 systems worldwide is a proven solution for customers ranging from consumer, automotive, and industrial OEMs to global contract manufacturers. In addition, CheckSum is the only U.S. ATE vendor supplying complete turnkey bed-of-nails test fixtures, program and support.

CheckSum designs, develops and manufactures the critical components of its test systems. Test systems include the measurement electronics, software and fixturing components that provide a complete system solution. In addition, CheckSum can provide custom fixturing and programming for your assemblies.

This fundamental product and engineering-oriented approach to design, sales and support has allowed CheckSum sales to grow significantly each year, from its start in 1987 to a multi-million dollar corporation.

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