MIXED SIGNAL IN-CIRCUIT FUNCTIONAL TEST SYSTEM

QT-200

PCB Diagnostic & Functional Test System

Qmax *is a global leader in the field of Automated Test Equipment PCB Repair, Diagnostic and Board Functional Test Systems. The* **QT-200** *Mixed Signal Functional Test System is a proven model being used by thousands of users world over for varied applications.* **QT-200** *can effectively test Digital, Analog and Mixed Technology ICs in In-Circuit, as wired condition and gives clear PASS-FAIL results. Hybrids, ASICs and house-coded ICs can be checked using QSM signature method. Optional IDDE software makes new device test program generation easy with graphical user interface.*

Qmax Users

• Airport Authorities / Airlines • Automobile Manufacturers • Defence / Space / Atomic Research Organisations • Defence Workshops / Factories • Electronics Manufacturing / Servicing Companies • Heavy Engineering Industries • Port Authorities • Power Corporations • Private Corporates • Public Sector Enterprises • Steel / Cement plants • Telecom/Telephone Industries • Textile Industries / Garment Machinery Manufacturers.

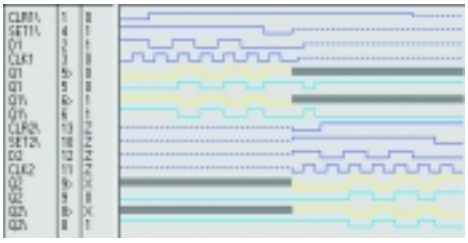
APPLICATIONS

• PCB Repair Centers • Production line Board Recovery / Functional Test Centers • In-house maintenance

POWERFUL FEATURES

- **In-Circuit Functional Test Library (Digital/Analog/Mixed Signal)** of >21K devices
- QSM VI Signature method for testing ASICs / Hybrids & Discretes
- Test logic families: **TTL / CMOS / ECL / EIA / LSI / Linear / Memory**
- In-circuit IC **identify** feature for house coded ICs and ICs with their number erased.
- **Automatic internal pull-up/down** for open collector and ECL devices
- Functional testing without need for learning from known good board or circuit diagram using Digital Simulators and Analog evaluation Software.
- On-Line Simulation makes accurate testing of sequential devices possible even when their Reset pins are disabled in In-Circuit conditions.
- Board **Learn / Compare mode** increases board recovery rate
- Built-in Resistance, Capacitance and Voltage **measurement capability**
- Powerful logic waveform display window for **failure confirmation**
- **CircuitTracer** for schematic generation / reverse engg. applications (Optional)
- IDDE software for easy **Device Test Program Generation** (Optional)
- Russian Device Library (Optional)

MOST USER FRIENDLY SOFTWARE FEATURES

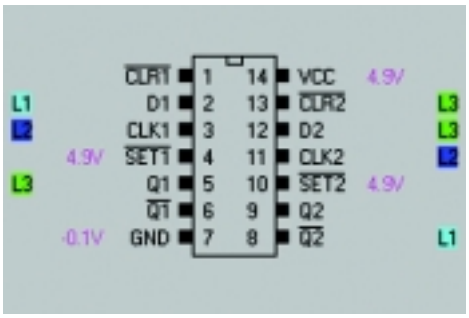


Powerful test pattern waveform for accurate failure analysis

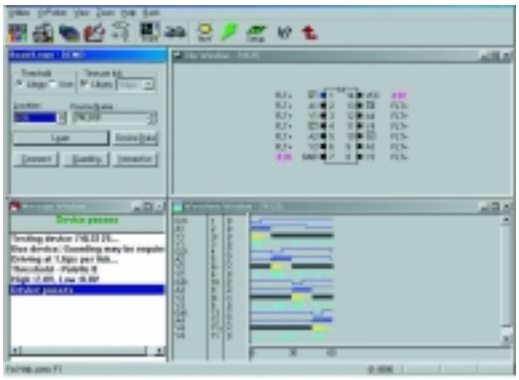
The resultant test waveform on the left shows the response of a 7474 tested in-circuit. QT200 library test a device under all possible conditions to ensure complete evaluation.

A very important point to remember is that the user must be given a chance to confirm if a DUT is really failing in-circuit or a false failure caused by another related IC. In the case of fan-out failure, a failing input pin connected to this fan-out node will cause the output pin to fail. This is NOT a REAL failure. QT200 provides enough capabilities to allow the user to confirm failure before removing a suspect failing IC from the PCB.

The blue color waveforms are the inputs to the Device Under Test (DUT). The yellow color signals are the "expected" waveform calculated by QT200. The light blue waveforms shows the actual output signals from the DUT. When the yellow and light blue waveforms matches, the QT200 indicate that the DUT is good. A failure will be shown in red. The frequency of the signals can be measured using two cursors. The test pattern must fully exercise all functions and conditions of the IC under test.



The screen on the left shows the DUT Clip/Link status and pins connected to power. QT200 will automatically take care of the in-circuit links and modify the drive pattern accordingly. The user need only to enter the number of the IC to be tested and QT200 will provide a clear pass or fail result, after testing the device in as-wired conditions.



Device Test Window showing Device Pass, IC in-circuit Link, pin voltage and test pattern.

PCB REPAIR TECHNIQUES

Q1 What is the accurate and fastest method in locating a fault during PCB troubleshooting when no schematics are available?

A1 The fastest and most accurate method available is the technique called the in-circuit IC functional test method (ICFT). This method uses a library of device models to test in isolation of a suspect IC in as wired condition, without having to remove them the PCB. This method gives more than 85% confidence level. In this method all devices on board must be tested and if all of them passes the test, then most probably the PCB is fixed and should work.

Q2 How does this ICFT method differs from the Conventional Board Test by ATEs?

A2 Conventional Board Test ATEs require time and technical manpower in developing the required test program (some times months) and also require the complete documentation of the board under test including schematics and other technical data. ICFT does not require the schematics and can test PCB without having to spend time and money in developing expensive test programs.

Q3 Does ICFT checks the board Integrity?

A3 ICFT is capable of testing the interconnections within the IC but it lacks the capability to test the interconnection between various ICs on a PCB and hence the whole board integrity is not checked as each IC is tested for its functionality using Clips. In most cases the when the PCB is returned for repair from field, it is unlikely that interconnections between ICs are bad unless the PCB is physically damaged and hence this is acceptable for use in fast troubleshooting of PCB from field.

Q4 Is ICFT, a Learn and Compare technique? Do the user needs a Good board?

A4 Qmax's ICFT is based on Library and there is no need of a good board in most cases. Also Qmax's ICFT applies auto compensation in its test vector depending upon the In-Circuit configuration of the device and provides clear PASS / FAIL message for each device tested irrespective of its In-Circuit configuration or links, unlike the other test systems, where the user need to learn the response from a good PCB or modify test program for each in-circuit configuration.

Q5 For which instances a Learn is required and what is board learn and compare?

A5 Though Qmax's ICFT can test accurately a device irrespective of its In-Circuit configuration, if the in-circuit links are suspected then you will need either schematics or a good board to confirm if the in-circuit links are correct and intentional and not caused by solder bridges or track opens that may occur during a re-work. Board Learn and test yield higher results as it can also compare the In-Circuit configurations. Also in testing EPROMS and PAL devices, the proprietary data of an EPROM and logical equation of a PAL is required and this can be accommodated in Board Learn and Test.

Q6 How does QT200 handle ASIC or proprietary devices?

A6 If the ASIC device data is available (at least the pin description) then using IDDE – GTPG one can create a test program in a short time. Also the Qmax's QSM VI Learn and Compare takes care of this kind of problems.

Q7 What is QSM VI?

A7 QSM VI is the second best method. This innovative VI method allows users to select, save and compare various VI trace signature combinations. This method allows detection of open/short between any pins/nodes on the device under test and functional failure from 70% to 80% degree of confidence on in-circuit components.

Standard VI trace: Normally this test is under power off condition. This is an acceptable method for detection of short or semi short on IC or failing components. The standard VI signature is referenced to ground. Its major problem is not being able to detect when two inputs that have the same signatures and shorted together. The resultant VI signature appears the same. For a 20 pin device it will learn 20 VI Trace for comparison. Standard Vi is effective up to 50% on average. Very good for short-circuit to ground only.

QSM VI: The QSM VI has a movable reference. It will learn all the VI trace signatures of all the pin combination and use these for comparison. This is a far more accurate method. Since it measures the VI impedance between all pins, it will be able to detect any leakage between the pins. This would result in a device functional failure. A 20 pin IC will have a total of 190 VI trace signatures. Moreover QSM VI can be carried out under power on condition. This allows the sink/source of the DUT to be compared. This is extremely useful in QA. QSM VI is effective up to 80% on an average.

Q8 Any other important points to take note when selecting a PCB repair systems?

A8 Make sure the tester you purchase has programmable time base, programmable drive/threshold levels, RAM based drive for accurate timing, Auto compensation for in-circuit configurations, Auto Pull up/down for Open collector/ open emitter devices, Auto guarding guide for reliable bus based device test, Simulation based test, Analog and mixed signal capability, Analog evaluation engine, proven library and best test interface to the device under test.

A Comprehensive Results Display

Guard pin control for bus devices

Resistor / Capacitor / Voltage Measurement selection

Time Base Select to test device under different speed

Display show test under Library Threshold or User definable threshold. This allows User to check for IC sink / Source / bus faults

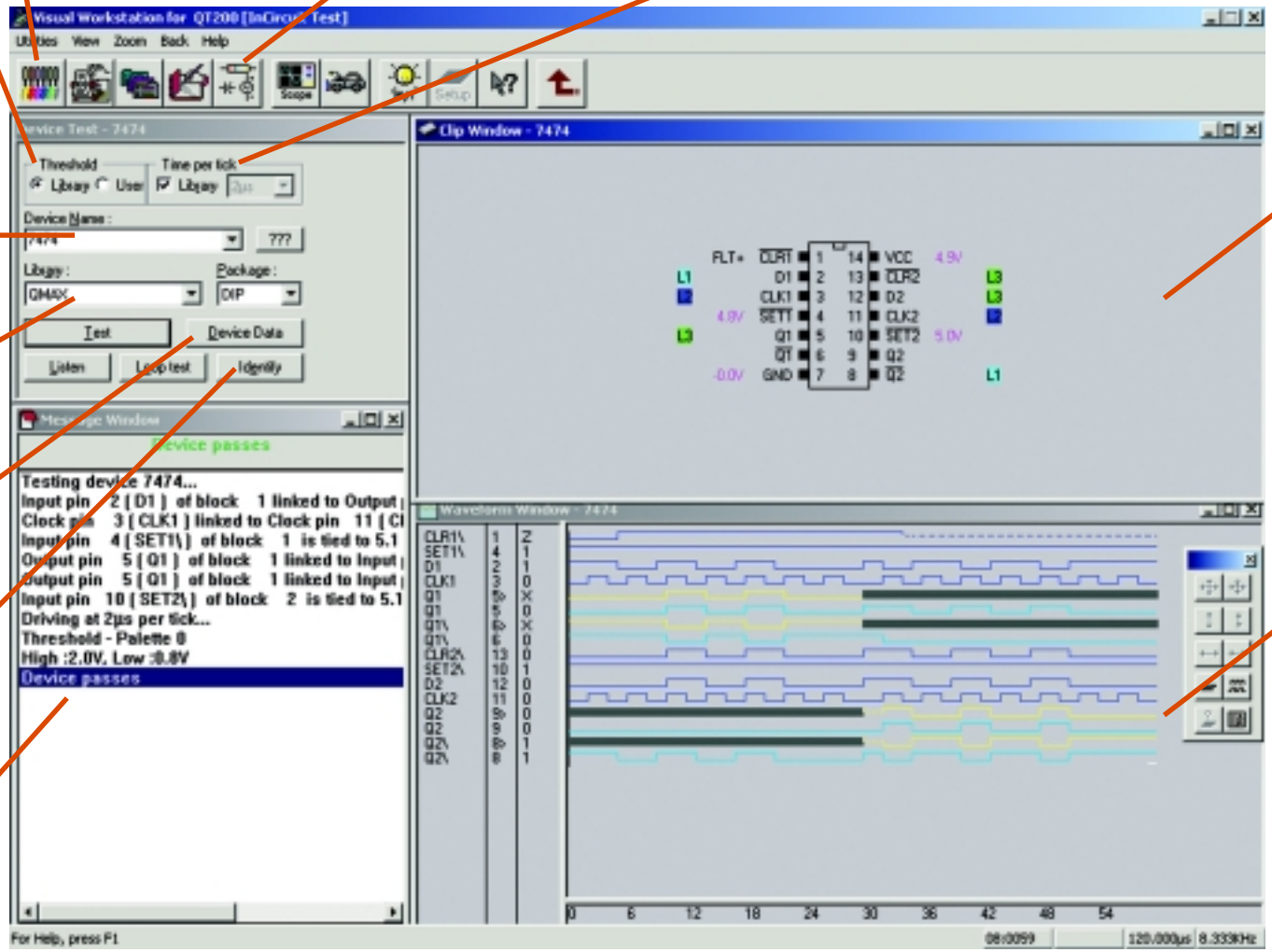
Enter name of IC and press Enter

Library Window show which library is being used (Qmax User or Others)

Device Data provide user with IC pin out and functional description

Identify allows user to identify unmarked / unknown devices in-circuit

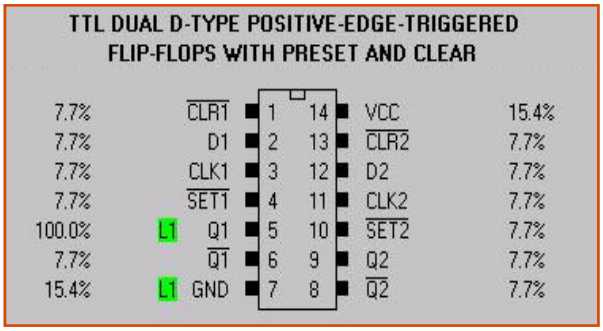
Test Message Window provide complete test message for confirmation failure analysis



Clip Status Window provide user with information on which pins are linked, connected to power. Power-on impedance / voltage at every pin of the IC under test are displayed. Exceptionally low or abnormal impedance on IC pin will indicate possibly source / sink problem

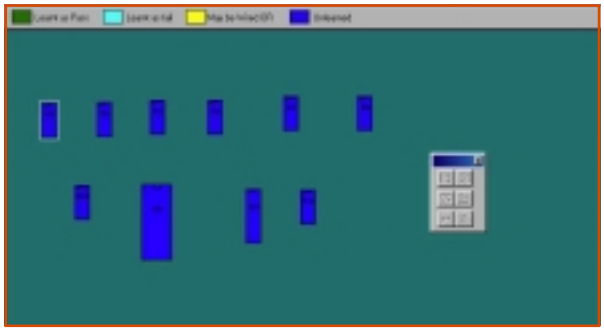
Waveform Analysis Window gives user an opportunity to verify and pass / fail results on the DUT. This feature helps the user to prevent wrongful removal of good devices from the DUT. Many PCB test system do not allow the user to verify a device failure. This is a very important feature

QSM VI — An Innovative Technique



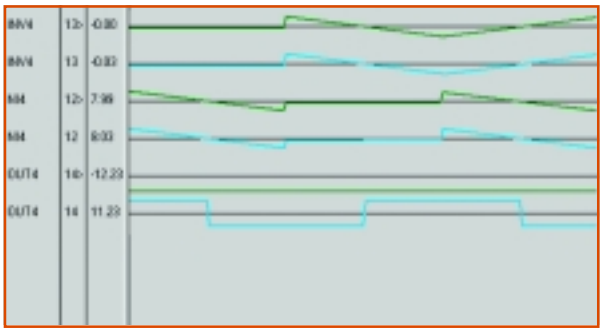
Screen shows QSM VI detecting a 7474 failing due to illegal short to GND on pin 5. Occurrence failures stands at 100.0% on pin 5. Other pins give a 7.7% Occurrence failure. This very important feature indicates an “external” problem rather than an “internal” IC failure.

Overview of Board Under Test (BUT)



Screen shows Board View featuring ICs under test’s position are displayed for easy location during Board Test Compare Mode. ICs will be shown in **Green** if it Passes; **Red** if it Fails; **Yellow** if learned as Wired OR and **Deep Blue** if Unlearnt.

In-Circuit Functional Testing of Analog ICs

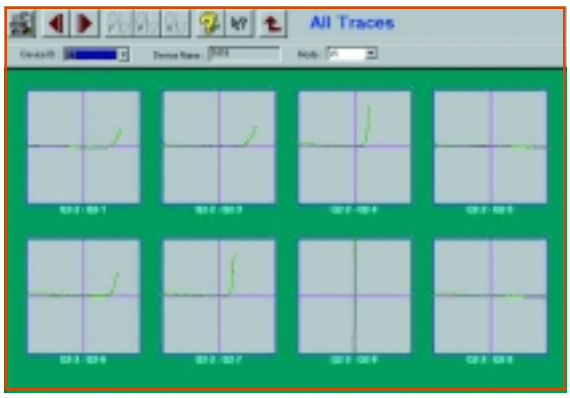


Screen shows functional test waveform of an op-amp (LM348). The actual output response is shown in black at pin 14. The waveform shows real functional test of linear devices. The green traces at pin 12 and 13 are the inputs from the QT200 drivers. The resultant inputs are shown in black on trace 4 and 5 from the top. The test pattern functionally check the op-amp during linear and saturation mode. This test is performed in-circuit. QT200 has an evaluation engine that allows the user to test linear devices in-circuit without the need to learn from a known good board. This is another very powerful feature found on QT200. Without this feature, you will need to learn the response from a known good board.

Functional Testing of Mixed Signal ICs

Functional Test on a DAC08. The 8 inputs are driven with a binary data stream. The DAC08 output at pin 4 is a current source and therefore connected to an op-amp circuit. QT200 flying channel is used to pick the output response form this op-amp output. QT200 analyses the result and declared that the DAC08 passes the test. This functional test is performed under power-on and in-circuit. QT200 offers the unique capability to test mixed signal type devices using its both digital and analog drivers simultaneously.

QSM VI — A Powerful Tool for Failure Analysis



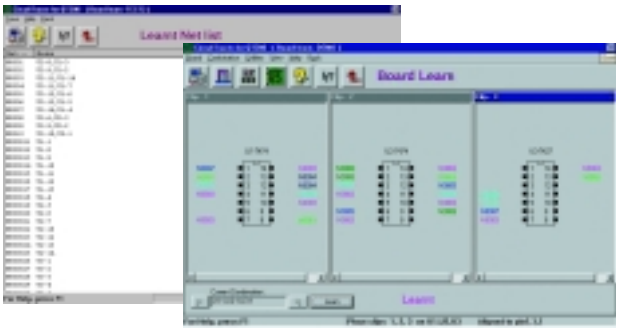
QSM VI multiple display screen showing pin failures with reference to other pins. Deviation and Occurrence failure (a feature unique with Qmax systems) provides a very powerful failure analysis tool.

Deviation failures provide indication of how badly a pin deviates from that of a known good signature. Occurrence failure gives an indication of frequencies of failures of a pin with reference to all the other pins. The combination of these two reports provides the user with very good indication as to the nature of the failed components or ICs.

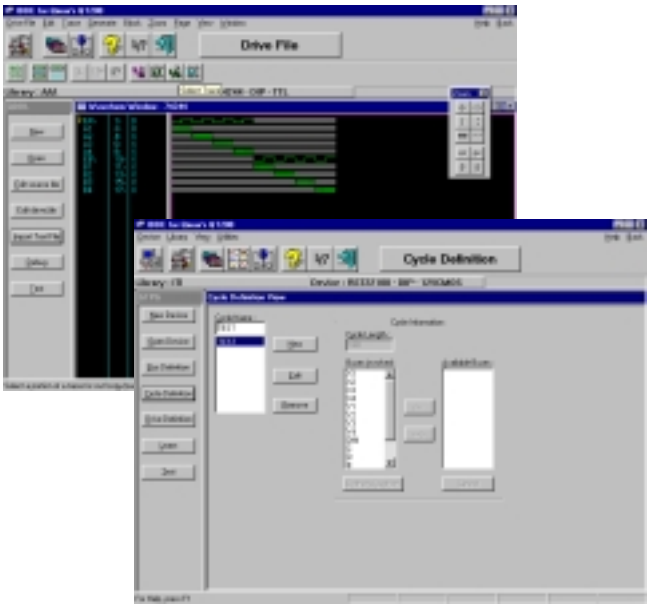
QSM VI is very effective in detecting failures on custom ICs and components. It has been used by IC manufacturers in their Failure Analysis department; Production line as stuffed PCB Recovery System and complements the ICFT in normal PCB repair.

CircuitTracer (Optional)

This optional software package helps the user to trace the intra links between the pins of an IC and also the interlinks between pins of various ICs which can be accessed through appropriate test clips. The software detects the links, which are colour coded and further it automatically generates the Netlists. The Netlist file is then converted to file formats, which are compatible to CAD software packages like ORCAD or EDWIN. This process helps in Reverse Engineering of the PCB *i.e.* to generate the Schematic Diagram / Circuit Diagram of the Board Under Test from the board itself.



Integrated Device Development Environment — IDDE (Optional)



IDDE is also an Optional Software Package which is extremely useful for Device Test Program Generation. IDDE stands for Integrated Device Development Environment. There are three modes in this package, namely,

QDDL : Qmax Device Description Language, which is mainly used for generating test program for SSI / MSI devices using logic primitives and simple commands.

WEST : Waveform Event Specification & Testing is for LSI/ VLSI ICs. Test Program generation using WEST requires Training and it is similar to C language.

GTPG : In Graphical Test Program Generation mode the user can directly define the required test input waveforms for the Device Under Test or even for the entire Board Under Test graphically and if the expected Output waveforms are known to the user the same also can be defined. Otherwise the output from Known Good Board can be learnt and stored as master reference for future comparisons. This mode is extremely useful to test devices / simple boards without any need to write complex test programs.

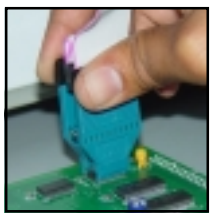
Test Interface (Optional)

SOIC clip for in-circuit testing of SMD devices. Various pin counts clips are available to handle the different ICs. The test clip is interfaced to the test clip via a test cable assembly connected to the QT200 front panel.

Qmax TO39 type test probes designed for functional/VI testing of transistors from the solder side. This access to the pins greatly improves the test-ability of many ICs on a board under test.

Qmax SOIC probes designed specially for effective inter-face to the IC under test. It comes with wide and narrow body type. The user press the test probes against the IC under test. Test time varies between 2 to 4 secs. depending on the host computer speed.

Qmax TO5 and TO39 type solder side test probes. These can be interfaced to QT200 via test cable assembly.



DIP type test clip for through hole ICs. Standard accessories come with 16, 20, 24 and 40 pin DIP type test clip. QT200 feature auto-clipping, which allows the user to place the test clip without the need to align pin one of the test clip to pin one of the IC under test. This greatly improves the test speed and productivity.

Qmax solder side 20 pin test probes designed for high density PCB. Access from the solder side allows the user to test ICs which otherwise would be blocked by other components.

(For more information on Qmax Test Interface accessories ask for Qmax Clips & Probes brochure)

SPECIFICATIONS

DIGITAL TEST CAPABILITY

No of i/o channel	: 48 Channels expandable to 96 channels – Desk Top Version
Drive output Current	: 650mA per pin/channel as per Interim Defence Standards 00-53/1.
Pin Memory	: 8K X4 bits RAM behind each pin.
Pattern Depth	: 8K test vectors.
Pattern Rate	: 500 KHz.
Clock Rate	: 0.25 MHz (Min. Clock tick 0.5 MHz)
Test Rate	: Programmable from 62.5 Hz to 0.5 MHz.
Loops & Conditional Loops	: Unlimited.
Drive States	: Hi, Low and Tristate Hybrid pin drivers detachable by user.
Driver High	: 0 to +10V Programmable in steps of 80mV.
Drive Low	: 0 to –10V Programmable in steps of 80mV.
Sense High	: +/–10V, 80mV accuracy
Sense Low	: +/–10V, 80mV accuracy
Input impedance	: 100K minimum
Sensor Threshold	: Dual.
Terminator	: Programmable 100K to 50 E pull up / Down. Programmable value to +/– 13 V.
Guard / Flying channel	: 8 channels programmable. Expandable up to 16.
Functions	: True Digital/Analog Device power-on In-circuit Functional IC Test; In-circuit Unknown Device Identify; Loop Test, Board Learn/Compare Test, In-circuit Impedance/Resistance, Capacitance and Voltage Measurement; Automatic circuit compensation; Automatic pull-up/down for open collector and ECL ICs; Automatic Guarding Guide for Bus based devices. Logic Analyzer Display for failure analysis; Digital Scope display; Multiple Test Library; Interactive QSM VI Signature Technique for general purpose PCB repair; Clear Pass/Fail indication for ease of use; On-line Design Rule Checker; Circuit Tracer (optional); IDDE for test program generation (optional); On-line help function.
DUT power supply	: Software controlled automatic ON-OFF with manual override; +5V @ 8A, –5V @ 2A, +12V @ 2.5A, –12V @ 0.9A. (Optional higher current ratings are available on request.)
Measurements	: R : up to 2 MOHMS C : 100 pF — 10,000 µF V : +/– 13V DC
Failure data display	: Logic Timing Diagram / Waveform / Clip status / Message Window in single screen.

ANALOG PIN ELECTRONICS

Analog Test Methodology	: Clip-on Analog Functional test.
Analog Test Frequency	: 0.0078 Hz. Minimum to 0.25 MHz Maximum .
No of Pins/Channels	: 3 (exp. 6) independent Drive / Sense multiplexed to 48 (96).
DC Voltage	: + / –13V.
Drive output Current	: 250mA per pin / ch.
Max Input	: 26V.
Input impedance	: > 2 meg Ohms
Pulse Width	: 2 µsec to 16 milli sec.
Programmable Load	: 50 E, 200 E, 1K, 10K and 100K: V up to +/–13V Programmable.
DC stimulus	: 8 programmable.
Resolution	: 12 bits ADC / DAC for each channel.
Drive Pattern	: User definable and standard waveform include sine, ramp, triangle, square etc.

ANALOG PIN ELECTRONICS (contd.)

Pin Memory	: 8K X 24 bits RAM. This is used to store, drive or read signals from the pin under test.
Frequency	: 0.25 Hz to 250 KHz
Amplitude	: 0.1V to +/– 13V Peak.
Drive Source Impedance	: Programmable in 5 steps from 50 Ohms to 100 kOhms.
Function Generator	: Can be used as a Function Gen. with max. amp of +/– 13V.
DRC Check	: Auto DRC check on Interactive / Board Learn / Test

QSM AND VI TRACE

Test Method	: Qmax Signature Method (QSM) and Standard VI Trace as universal test technique.
Drive pattern	: Sine wave at 2.5V High @ 25mA, Med @ 6.25mA, Low @ 1.25mA 8.0V High @ 20mA, Med @ 4mA, Low @ 0.4mA 13V High @ 6.5mA, Med @ 0.65mA, Low @ 0.065mA
Drive Frequencies	: 40 Hz, 312 Hz, 2.5 KHz.
Test Methods/ Features	: Test Interpretation • Comparison (Pass / Fail) Modes : Linear / Non Linear • Node wise • Dual Probe – Direct on-line "live" comparison mode; Configurable for use with Test fixtures; able to detect any illegal shorts / open between any pins / nodes; Deviation and occurrences failure report for effective failure analysis • Interactive live mode • Direct on-line comparison • On Screen Board layout • Auto / Manual of component Signature • True adjacent pin short test • Quick compare test store • Built-in component library • Dual probe – Selectable voltage / Frequency ranges • No UUT power required

DIGITAL OSCILLOSCOPE

No of Channels	: 3 (Single or Multiple trace)
Resolution	: 12 Bit Resolution.
Amplitude	: 0-13V (In 5 Ranges)
Time Base	: 80 µsec. to 9.6 millisec.
Trigger	: Auto, Normal, Single, positive or negative trigger
Input Impedance	: 50 Ohms to >5 MOhms.
Sampling rate	: 0.5 MHz to 1.9 KHz
Memory	: 8K memory per channel.

ESD DAMAGE TEST

Drive Frequencies	: 40 Hz, 312 Hz, 2.5 KHz.
Drive Voltages	: 13V Max. to 2.5V Min.
Drive Current	: 25mA Max. @ 2.5V to 0.065mA Min. @ 13V

GENERAL

CE Mark	: Approved
Interface	: USB Interface ver. 2.0 with Windows 2000 / XP operating system (Optional).
Power requirement	: 110VAC@8A / 220VAC@4A. Auto-switchable with short-circuit protection. UL, VDE, CSA, NEMKO, BABT, CB, CE MARK approved SMPS unit. Equipment case earthed.
Physical Dimension	: Approx. 47 cm (W) X 41.5 cm (D) x 29 cm (H).
Weight	: Approx. 30Kgs net.

Qmax — *where standards are set; not matched.*

Visit us at www.qmaxtest.com

Manufactured at ISO Registered Facility

Qmax Test Equipments Pvt. Ltd.,
Elcot Avenue, I.T. Highway, Sholinganallore, Chennai 600 119. India.
Tel : (91)-44-2450 9627 (30 Lines) **Fax :** (91)-44-2450 9631 **E-mail :** factory@qmaxtest.com

Qmax Test Technologies Pvt. Ltd.,
#239, I.T. Highway, Sholinganallore, Chennai 600 119. India.
Tel : (91)-44-2450 9627 (30 Lines) **Fax :** (91)-44-2450 9631 **E-mail :** chennai@qmaxtest.com

Qmax Test Technologies Pvt. Ltd.,

BANGALORE	–	Tel : (91)-80-220 8034, 220 8035	Telefax : (91)-80-220 8036	E-mail : bangalore@qmaxtest.com
DELHI	–	Tel : (91)-11-2585 0127, 2574 5049	Telefax : (91)-11-2571 9870	E-mail : delhi@qmaxtest.com
KOLKATA	–	Tel : (91)-33-2359 3530, 2358 3958	Telefax : (91)-33-2359 3530	E-mail : kolkata@qmaxtest.com
MUMBAI	–	Tel : (91)-22-2578 0416, 2578 0425	Telefax : (91)-22-2578 0425	E-mail : mumbai@qmaxtest.com

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