With its level of performance, this compact general purpose signal generator delivers outstanding value for money.

**Leaders in Conformance**
- WiMAX Forum™ Approved Protocol Conformance Tester
- Commitment to support WiMAX Forum™ mandatory certification
- Independent third party validation
- Automated DUT testing

**Innovators in Development**
- Single hardware platform to test Base Station, Mobile Station and all RF profiles
- Scripted MAC with a highly configurable PHY
- Development program to including MIMO 2 x 2, Beam-forming, Handover and Application testing
- Full training, support, installation and enhancements package included

Time to market for device manufacturers is critical. Sales volumes and profits are far higher for those that bring new products to market fastest. To meet these corporate goals, manufacturers have to reduce the development time for new devices. However the WiMAX feature set is constantly evolving and this brings ever-greater complexity to the technical specifications and with it the need for more compliance testing before a new device can be launched. The impact of these is to lengthen the development process.

To solve this problem, Aeroflex has invested heavily in positioning itself as a leader in protocol R&D and conformance testing and has a proven track record of delivering the most sophisticated solutions ahead of the game. Aeroflex also emphasizes the importance of fully testing and debugging its solutions before release so that its customers do not waste time having to do so.

**Product Overview**

The MiNT T2230/1 AIME/CT provides a complete Mobile WiMAX (802.16e) protocol testing solution for either WiMAX Base Stations or Subscriber/Mobile Stations. The AIME software option for use during development, with fully configurable behavior and the CT option, a fully certified WiMAX Forum Protocol Conformance Tester gives Aeroflex’s customers the upgrade path required to take a device from R&D to market. This allows the MiNT T2230/1 to be easily matched to the development cycle of devices from initial R&D through to market access.

The test system is co-developed by Aeroflex and AT4Wireless and uses the latest picoChip software physical layer to give the control and configurability necessary to meet the industry’s testing requirements. The advanced hardware platform of the MiNT T2230/1 allows it to evolve with the changing IEEE, ETSI and WiMAX Forum specifications. This future proof design combined with the Aeroflex enhancement package will protect your investment throughout the introduction of new features and the development life of your devices.

The development partnership between Aeroflex and AT4 Wireless has united experience, expertise and long standing relationships with industry bodies. The experience of both companies has been acquired over 15 years delivering development, certification and parametric test equipment for wireless technologies including Bluetooth, RFID, GSM, CDMA,UMTS and fixed WiMAX (802.16d).

Aeroflex is a customer focused company with an extensive world wide support organization and many years of experience. This level of focus is crucial for Aeroflex to deliver a total solution where elements such as reliability, support and customization are recognized to be of equal importance. The combination of a strong customer focus, protocol expertise and experience enables solutions to be tailored to meet the specific needs of the user thereby maximizing customers’ return on investment.
802.16e DEVELOPMENT

Air Interface Monitor Emulator (AIME)

- Flexible IEEE 802.16e message framework
- Tests MAC control and user plane
- Run time debug
- Slave and master automation modes
- Use external triggers to control Script Flow

Digital Cellular Protocol Experience

Aeroflex offers its customers extensive, easy to use tools for development, diagnostics and certification testing across a range of wireless technologies from GSM to UMTS and CDMA EVDO RevA. Experience has been gained developing test systems since the launch of digital cellular technology. Market leading test systems, with intra and inter-system handover with WiFi and Advanced-GPS, have allowed Aeroflex customers to release advanced, conformant features early to market thus establishing a lead position in industry.

Flexible RF

The MiNT T2230/1 AIME/CT development test solution uses a software configurable multi-band radio. This advanced RF card combined with the software physical layer enables the test system to support radio frequencies 2.3-2.7 GHz and 3.3-3.9 GHz against any combination of prioritized bandwidths. The test system is capable of testing prototype hardware when configured as non-WiMAX Forum profiles.

Scripting Environment

The flexibility necessary to emulate a base station or mobile/subscriber station has been achieved by dividing the Medium Access Control (MAC) layer into two parts. The real time operations such as ranging are run in the lower MAC whereas the non-real time operations are performed by a script running live on a control PC. This enables the MAC layer to react to external triggers, user plane or control plane data allowing the user to test all aspects of their implementation.

The MiNT T2230/1 employs a fully scripted upper MAC layer that uses Testing and Test Control Notation R3 (TTCN-3) to offer users the configurability they expect from a protocol development system. TTCN-3 is an open standard written by ETSI for the purpose of defining and performing repeatable testing. Testing 'Technologies' TTCN-3 development environment, TT Work Bench is chosen by Aeroflex as the scripting and test case execution environment for the MiNT T2230/1 on account of its successful deployment in the 6401 - UMTS (W-CDMA) Protocol Conformance and Development Platform. Aeroflex has been able to use the unique and powerful features offered by TT Work Bench, to deliver a flexible development environment capable of real-time graphical logging, non-real time operation, campaign management and source code cross-referencing.

Test Case Development and Execution

A comprehensive suite of scripts that recreate realistic scenarios such as network entry and end to end (service flow) connections have been delivered and enhanced on a regular basis to cover testing for all of the 802.16e functionality required. These test scripts can be used on their own or as a foundation to develop a complete test suite. Thus, simplifying an organization's test program to use a signal test platform to develop, debug and verify the protocol implementation of a device at all stages from early development through to certification.

Conformance test cases can be modified or scripts created to extend the mandated certification program to provide a comprehensive product test plan. Test plans can be made up of both positive and negative testing by executing 'Valid' or 'Invalid Behavior' conformance test case, or by developing custom scripts. This comprehensive testing ability can be automated by sequencing test cases and executed campaigns, forming a complete Base Station (BS) or Mobile/Subscriber Station (MS/SS) test plan from a single platform. The development environment allows scripts to be developed using a test harness without the need for local hardware. Remote test case development can therefore be performed in parallel to execution, minimizing testing downtime and maximizing efficiency.

Powerful Logging and Analysis Tools

The Aeroflex MAC message codex (encoder and decoder) is based upon an IEEE 802.16e framework and is therefore compatible across multiple standard releases. This allows the user to perform both tight and slack testing of standards and will allow scripts to be run in non-WiMAX Forum, un-harmonized modes.

The Aeroflex developed logging and analysis tools are provided with the test system to allow users fully decoded access to messages between the test system and the device under test. The Aeroflex Log Manager provides real-time protocol logging and file management on the control PC. The license-free MiNT Log Analyzer application fully decodes protocol messages enabling development team members to carry out post analysis of test runs at their own workstation. These powerful tools combine to give the user a complete test environment with access to all the information needed to resolve problems efficiently and quickly.

Test results can be freely distributed by exporting to a web page (HTML). This format includes a graphical representation of the message flow for high level analysis and full protocol decode for detailed investigation. Diagnosis of standards issues, timing problems and message corruptions can therefore be carried out by teams working at a distance, thus making the most of available engineering resources.
Protocol Analysis

An immature physical layer may cause problems in higher layers and can cause protocol tests to fail. These problems can be costly to diagnose without the correct tools. The MiNT T2230/1 fully decodes physical layer messages on a frame by frame basis, thus reducing the time and resources required to resolve issues in the physical layer that cause test cases or scripts to fail. Incorrectly or poorly built messages are not discarded but are displayed as raw binary/ASCII values ensuring that all issues can be fully investigated.

Physical Layer Decode

System Features

The Uplink and Downlink Media Access Protocol (UL-MAP and DL-MAP) are completely configurable through the use of run time parameters. These parameters also define variables such as physical layer configurations, testing timers and whether features are enabled or not. Parameters can be modified by the campaign manager to perform regression tests covering every last detail such as running identical scripts sequentially covering all combinations of modulation, coding schemes and burst profiles, with or without security and across all RF profiles. This allows the user to execute exhaustive test plans with complete coverage without modifying scripts.

Configurable DL/UL MAP

The MiNT T2230/1 features a highly customisable Upper Tester or Test Interface to control the Device Under Test (DUT). Device automation removes the need for permanent operator when running remotely or executing test campaigns, freeing valuable resources. The DUT can be controlled via AT-commands over a serial connection, loop-back to an application running on the controller PC or remotely using web services over an LAN connection. This option allows the test system to run for hours or even days with minimal user intervention, maximizing the usage of the test system and reducing unnecessary engineering resources.

Slave and Master Modes

The MiNT T2230/1 tester can operate in slave or master modes. In master mode, the test system can control the device under test and/or external test equipment for example to trigger an RF measurement. In slave mode, the system can be driven by an external module over LAN, which could co-ordinate testing at a higher level or remote location. This flexibility gives the option to implement centralized or distributed testing architectures.

Customization

Meeting customers’ needs is a key factor contributing to Aeroflex’s success delivering development test solutions. Aeroflex is able to continually develop and release enhancements because the hardware platform and software implementations are based on an extensible and robust foundation. If a feature does not appear on our roadmap, or appears later than required by a particular customer, Aeroflex will have open discussions on a consultancy basis and where possible will customize the test system to fulfill individual testing needs.

Develop Against an Approved Platform

The MiNT T2230/1 is a WiMAX Forum approved Protocol Conformance Tester that will be used in Designated Certification Laboratories to certify commercial devices. The benefits of developing a protocol implementation using such test equipment can not be understated. With Certification costs fixed by the WiMAX forum at over $500 per hour, purchasing a combined development and conformance test system will enable your company to design, develop and verify your Mobile WiMAX device efficiently, minimizing the risk and financial impact of certification.
802.16e CONFORMANCE TESTING

- Supports all WiMAX Forum™ frequencies and bandwidths
- Device Under Test Automation
- Support for all PICS + PIXITS
- Experts in protocol conformance and experience with ETSI

WiMAX Forum™ Approved - Get Certified!

A key requirement of Mobile WiMAX equipment is its ability to roam and therefore for any Mobile Subscriber (MS/SS) Station to interoperate with any Base Station (BS). This is driving the need to certify products against WiMAX Forum approved Conformance Test Equipment that has been validated by an independent third party. The WiMAX Forum has approved the MiNT T2230/1 Protocol Conformance Tester (PCT) as a platform to certify Mobile WiMAX devices in Designated Certification Laboratories. The WiMAX Forum is an industry-led, not-for-profit organization formed to certify and promote the compatibility and interoperability of broadband wireless products based upon the harmonized IEEE 802.16/ETSI HiperMAN standard. Protocol certification for MS/SS and BS is mandatory and the vendor is responsible for investigating, fixing and financing retests caused by failure during certification in a WiMAX Forum Designated Test Laboratories. Testing against an approved device in your development labs will therefore provide great financial savings by keeping the conformance test houses out of the development cycle.

All WiMAX Forum profiles

The MiNT T2230/1 is supplied with a software configurable radio, enabling you to run regression campaigns across all profiles from the one test platform. This is the only platform that allows you to confidently test every aspect of your implementation before submitting it to a WiMAX Forum Designated Test Laboratory.

ETSI

Aeroflex has been a member of ETSI for over 15 years and built up a wealth of experience, actively contributing to develop standards including 3GPP for UMTS. This experience has proved invaluable, understanding the procedures and standards involved, to allow Aeroflex to take the lead in Mobile WiMAX Protocol Conformance Testing. It is this lead that enables Aeroflex's customers to continually be first to market with reliable, interoperating devices that make use of the very latest features.

Platform and Software Environment

Aeroflex has achieved its leading position by developing user friendly, intuitive test equipment that users can begin to use with only hours of training. Features such as single click run and automatic parameter generation are easy to use, saving time and freeing up valuable engineering resource to focus on developing conformant products. The experience and knowledge gained over many years is being continuously applied to enhancing the MiNT T2230/1, to ensure that it remains the industry's leading Protocol Conformance Tester and development system of choice.

ETSI specified parameters (PIXITS & PICS) control run time variables including basic physical layer configurations like burst profiles and RF frequencies and test case variables such as repeat request pass/fail threshold. These parameters can be edited and a test case re-run with no need to recompile, thus minimizing testing down time. Devices can be verified in a consistent manner, repeating tests against a snapshot or profile of these parameters. Profiles can be saved, reloaded or even generated from the DUTs basic capabilities or a default template. This level of control gives the user the essential ability to repeat tests and system configurations ensuring the validity of test case results.

Test Architecture

The system can be fully automated and controlled remotely using web services over LAN to run test cases and campaigns, generate logs and modify parameters. This enables a distributed testing architecture to be implemented by an organization to maximize system use and get the most from their investment.

Protocol logs can be saved directly to a corporate LAN by connecting the control PC via a dedicated network port. Remote access of these logs is then possible, using the license-free MiNT Log Analyzer. Any team member across the organization can be utilized to analyze test results, enabling the most efficient use of project resources.

The Test Interface is a WiMAX Forum specification to enable automated testing of a Device Under Test (DUT). Aeroflex supports the WiMAX Forum Test Interface and the MiNT T2230/1 will support this DUT control at the earliest opportunity. This interface will be a standard interface that will enable campaigns of multiple test cases to be performed automatically without an operator. This will free engineering resources during regression and pre-certification testing.

Running validated conformance test cases for certification requires a comprehensive list of parameters to be matched exactly with the device under test. The parameter generator, a tool to automatically generate these parameters, has been one of the most warmly received features of Aeroflex Protocol Conformance Testers. The value of this tool lies in the reduction in device integration time as test operators and developers may lack the expertise from a conformance test case perspective to match parameters accurately. Without the advanced toolset or access to an expert knowledgebase such as the Aeroflex Applications Support Engineers, it is difficult to ensure the validity of test results.

Sequences of test cases or scripts called campaigns can be created, saved and modified to be able to perform repeatable testing. This is especially important during regression testing to be able to discover and diagnose issues introduced with new features that could cause a fail during certification. Testing against the MiNT T2230/1 will mit-
igate the risk of being late to market and financial impact of a resubmission as you will be able to perform identical tests to a WiMAX Forum Designated Laboratory before you submit your device for certification.

Consultancy and Support
Aeroflex will support customers, using their expert knowledge base and experience of certification test procedures to reduce the customer effort and ease the financial impact of conformance testing. Where necessary, Aeroflex will support customers with parameter settings during testing to ensure they get the most out of their test solution, minimizing system down time.

World Class Support
Support to Suit Your Needs
Application support, hardware support and enhancements come together in one package. Aeroflex offers levels of service to suit all customers from extended annual renewals to Premium Support upgrades with a 24/7 telephone Helpdesk, guaranteed repair turnaround and zero cost calibration. Aeroflex’s worldwide expert support network is available with all support packages and is sure to exceed your expectations and prove an invaluable resource to reduce the impact of certification.

Following the Standards
Aeroflex has experience developing protocol development and conformance test equipment against both mature and immature standards. As standards evolve, new software releases are made available via an internet software portal. This gives Aeroflex customers the confidence that their devices are tested against the latest standards and ready to be submitted to a WiMAX Forum Designated Laboratory at the earliest opportunity.

Installation, Commissioning and Training
On-site installation, commissioning and training of the MiNT T2230/1 is included in the first years support contact. Aeroflex will work with customers to ensure devices interoperate with the test equipment and that engineers are properly trained, allowing them to get the most from their equipment at the earliest opportunity.

Telephone Help Desk
The Aeroflex telephone help desk is a customer’s first point of service contact for any hardware or software issue, if you have any questions or require some information. A specialized engineer from a dedicated team will be assigned to the case until a resolution is achieved ensuring that any downtime is kept to a minimum.

Application Software Support Program
Aeroflex has regional support worldwide that is able to provide an impeccable level of service to our customers. This program includes access to expert help and assistance in addition to user downloadable software upgrades and enhancements.

Software Updates
Aeroflex is committed to ensuring that their products will evolve to meet the changing conditions and requirements of the markets they serve. The conditions and requirements are subject to change for a number of reasons, including evolution of specifications or standards and industry drivers. Under the Application Software Support Program you have instant access to the latest software ensuring that your devices get to and remain at the forefront of the market.

Enhancements
Aeroflex is continually improving our products through both our own research and customer input to make test systems more comprehensive whilst remaining simple and intuitive to use. Aeroflex has developed many advanced tools for previous technologies such as the Script Wizard, Parameter Generator, and in-built test case status and Test Purpose information. Enhancements developed will be made available to participants in the Application Software Support Program. This will ensure that customers have access to and can benefit from the latest enhanced features as soon as they are implemented.
**SPECIFICATION**

**SCRIPTING FEATURES**
- Test Script / Campaign Generation
  - Generate, Edit & Save Scripts & Parameters (PICS)
  - Create Test Campaigns
- Test Script / Campaign Execution
  - Automatic: Stop & Reset
  - Manual: Pause & Resume
  - External triggers: Step by step Execution
- Test Results
  - Test Verdict & Summary: Test report

**PHY SUPPORT**
- DL subcarrier allocation
  - PUSC: PUSC w/ all subchannels
  - FUSC: AMC 2x3
- UL subcarrier allocation
  - PUSC: AMC 2x3
- Ranging & BW request
  - Initial: HO
  - Periodic: BW request
- Fast-feedback
  - 6-bit
- Channel coding
  - Repetition: Randomization
  - CC: CTC
- H-ARQ
  - Chase Combining
- Synchronization
  - BS time synchronization
  - BS-Bs freq synchronization
- Power control
  - Closed-loop power control
  - Open-loop power control
- CINR measurement
  - Physical CINR using Preamble
  - Effective CINR using pilots
- Modulation
  - DL QPSK
  - DL 64 QAM
  - UL 16 QAM
- MAP Support
  - Normal MAP
  - Compressed MAP
  - Sub-DL-UL MAP
- MIMO
  - All IO-MIMO items
  - Beamforming
  - All IO-BF items
- Band Classes
  - All current WiMAX Forum Certification Band Class Profiles supported.

**LOGGING FEATURES**
- Multi-layer logging
  - PHY, MAC, Packet, Message Layers
- Logging Control
  - Selective capture triggers
  - Selective pre & post capture filtering
- Logging Displays
  - Message sequence charts
  - Display statistics
  - Packet decoding
- General packet information
  - Time-tag, packet length, data rate, signal strength
- General MAC header
  - MAC addresses, ID, subheader details
- Packet Contents
  - Raw Data, CRC fields, HEX, BIN, ASCII, etc

**MAC SUPPORT**
- CS
  - PHS, IPv4, IPv6, IPv4 with ROHC, IPv6 with ROHC
- MAC PDU formats
  - Packing/fragmentation
  - Packing ARQ feedback payload
  - ARQ
    - MAC ARQ
  - PHY Support
    - HARQ Support
    - Feedback mechanism
  - QoS
    - BS initiated Service Flow operations
    - MS initiated Service Flow operations
  - Data delivery services
    - UGS: RT-VR
    - NRT-VR: BE
    - ERT-VR: BE
  - Request -Grant mechanism
    - Request -Grant mechanism
  - General HO support
    - HO initiated by BS
    - HO initiated by MS
  - Handover
    - Neighbor advertisement: Scanning
    - HO optimization: CID & SAID update
  - Sleep-Idle
    - Sleep mode: Idle mode
    - Expedited network re-entry from Idle mode
  - Cryptographic suites
    - No data encryption, no data authentication and 3-DES, 128
    - CCM-Mode 128-bit AES, CCM-Mode, AES Key Wrap with 128-bit key
  - Security
    - PKMv2 support
    - CMAC
    - Security associations
    - MBS (IO item)
  - Multi-Bs MBS
  - Misc
    - MS's Network Entry issued by BS restart
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