Infrastructure Test System

TM500 TD-LTE Single UE

3GPP TD-LTE Release 8 Test

The industry standard test system for 3GPP LTE infrastructure development, test & demonstrations

- Functional, performance of TD-LTE base station and network equipment
- 3GPP LTE compliant operation at Layer 1, Layer 2, and higher layers (RRC/NAS)
- 150 Mbps, 20 MHz, MIMO, Closed Loop, multiple RF bands, Handover and CPRI
- Comprehensive control, measurement, data logging, display and analysis tools at all layers
- Powerful and scalable Software Defined Radio platform to support the future LTE technology roadmap and maximise return on investment
- Innovative test features to boost engineering productivity including high speed baseband logging, traffic data generators, and parameter override of closed control loops
- Remote and automation API
- Operation in the lab test and over the air
- Part of the TM500 product family that includes 3GPP LTE Multi-UE and Capacity test solutions
- Builds on heritage of global standard LTE FDD, HSPA/HSPA+ TM500 WCDMA test mobile
- Worldwide technical support and sales network

TM500 TD-LTE SYSTEM OVERVIEW

The 3GPP's Long Term Evolution (LTE) programmes are expected to deliver an increasingly better mobile user experience through improvements in end-user throughputs, sector capacity, and user plane latency. To achieve this requires some significant changes in parts of the network infrastructure and mobile user equipment.

The TM500 TD-LTE product is a major addition to the Aeroflex TM500 family of 3GPP test mobiles and a substantial commitment by Aeroflex to support the current and future technologies required for 3GPP LTE. Two key differentiators between FDD and TDD technologies are the UL-DL asymmetry and the special sub-frame. TM500 TD-LTE supports all UL-DL configurations defined by 3GPP to account for symmetrical and asymmetrical network traffic. The full range of special sub-frame configurations is also supported. Special sub-frame is defined by 3GPP in order to avoid UL and DL interfering to each other (each configuration applies to a different cell size).

Built upon a new and scalable software defined radio platform, the TM500 TD-LTE product targets development, demonstration and testing of 3GPP TD-LTE infrastructure equipment.

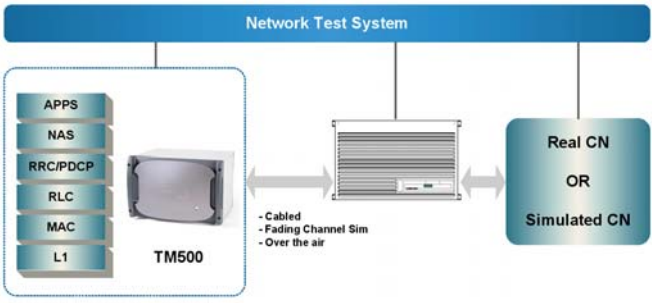
The range now also includes options for higher layers, higher category UEs, LTE FDD and Multi-UE operation. With its layered operation and automation interfaces the TM500 TD-LTE can additionally operate within an automated or wrap around test configuration.

Through years of experience in WCDMA/HSPA+ and working closely with customers on LTE FDD development and demonstrations, the TM500 TD-LTE product is primarily designed to help support and accelerate the overall development and test programme. The TM500 TD-LTE product offers the earliest access to the latest 3GPP functionality, before real handsets, as well as layered operation and high degree of logging and control.

Productivity enhancing tools simplify the development and running of test scenarios and include advanced test features such forced errors and event triggering. Highly flexible operation enables the TM500 TD-LTE to be used in many customer configurations including in the lab, over the air, manually or remotely or as part of an automated test system.

TYPES OF TESTING (OPERATIONAL CONFIGURATIONS)

The TM500 TD-LTE can be operated in a number of configurations.



In the lab

The TM500 TD-LTE operates as a 3GPP specification compliant UE test peer to support functional development, debug, integration and test of TD-LTE eNode-B and core network equipment. The TM500 TD-LTE can operate at component, module and system level and with or without the use of a fading channel simulator.

Outdoors

Designed for use over the air, the TM500 supports the requirements of early drive testing and proof of concept trials, exercising new features of the TD-LTE technology.

Demonstration

TM500 is ideal for demonstrating leading edge TD-LTE technology, including maximum rate transmissions, MIMO operation etc. Using its IP Driver interface, TM500 TD-LTE can support real time applications via a TCP/IP connection including high definition video streaming, files transfer, web browsing etc. The layered operation of the TM500 TD-LTE enables it to support the demonstration of partial as well as full complete network equipment configurations.

CONTROL AND LOGGING

Management of the TM500 TD-LTE is carried out through the Test mobile Application (TMA) software supplied with the system. The TM500 TD-LTE can also be controlled by an external system, such as a customer's remote automated test system.

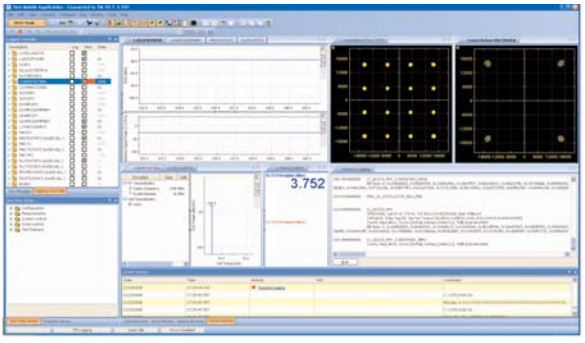
TMA is an integrated software suite that provides an easy and intuitive user interface for: creating and running test scripts; data logging and measurements as well as the analysis of test sessions and data. To enhance productivity The TMA incorporates valuable features such as test step and template libraries, drag and drop selection, session browser, command line, error monitor, real time logging and graphical charting windows.

In the TM500TD-LTE the logging accounts for the UL-DL asymmetry to facilitate debugging in cases where one UL/DL sub-frame carries HARQ ACK/NACK for multiple DL/UL sub-frames. User can then not only test the HARQ functionality but also verify that the eNodeB meets the processing time required in order to close the round trip time.

Script Production: The TMA includes script control tools that provide a fast and easy way to create and control test scripts via a PC-based graphical user interface. The tool includes a library of test command sequences that enable easy configuration of test mobile and the associated 3GPP parameters. The TMA also validates the test scripts, detecting any sequencing or parameter range errors before executing the test scenario on the TM500.

Measurements and Data Logging: The measurement tools enable the user to selectively log and display measurement information from the test. Detailed measurements from Layer 1, 2 and/or 3 tests can be displayed in real time using the charting facility. In addition, all measurements are logged to file for post test analysis. These log files can be used to replay test sessions within the charting tool or can be exported to other tools for further analysis.

Event Triggering: A new event-based triggering tool allows the user to start the measurement logging based upon a specific event, such as a 3GPP measurement or handover request. This powerful feature allows the user to define, co-ordinate and analyze detailed test scenarios.



TEST MODES

The TM500 incorporates a number of test modes which enable an incremental, layered approach to development and testing of the TD-LTE stack from the PHY layer and upwards. Detailed functionality can be tested at a modular level, enabling very early testing of eNode B features even during the development stage. TM500 supports test features that enable early uplink and downlink operation to be validated independently. In addition 3GPP control signalling can be overridden and scripted to enable early test of closed control loops or to simulate error or fault conditions.

HARQ Mode. This mode of operation provides detailed test features targeting analysis of the PHY layer and HARQ retransmission processes. Independent BER and BLER analysis are supported for each HARQ process using data source/sinks configured to standard PN or user defined data sequences. Used in conjunction with the charting measurement tools, these features enable the user to monitor the real time operation of the UL and DL physical data link.

MAC Mode. The MAC mode adds analysis of the full eNode B MAC operation to the PHY / HARQ functionality. MAC mode adds MAC header monitoring, MAC PDU creation and MAC SDU extraction to the HARQ mode. The received payload data is evaluated for each logical channel and HARQ using data sinks. BLER is measured using the post-HARQ CRC results. Each logical channel can be connected to a separate data source or sink.

RLC Mode. The RLC mode supports full RLC functionality including Transparent Mode, Unacknowledged Mode and Acknowledged Mode operation. This enables the user to analyse the RLC, MAC and PHY operation within the eNode B, The data content is transmitted and received as RLC PDUs, bypassing the PDCP layer. RLC mode control is via specific configuration commands as well as providing scripted control for SDU insertion into RLC buffers and for logging of data and state information.

PDCP Mode. This mode adds PDCP header functionality, enabling features such as PDU duplication and discard detection that may occur during handover procedures.

Higher Layers. (option) The Higher Layers mode adds analysis of RRC and NAS layer operation on the eNode B.

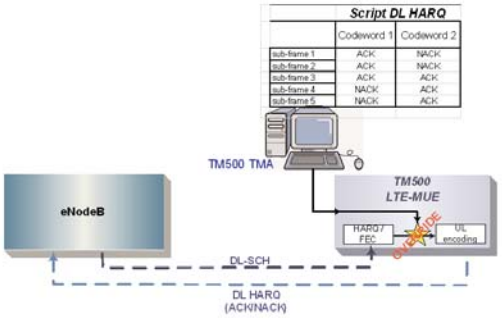
TEST CAPABILITIES/FEATURES

To help accelerate testing and integration the TM500 TD-LTE incorporates enhanced test and analysis features. These can also be used to simulate test scenarios, enabling early module level testing during development and integration phases.

Scripted Control & Corruption. TD-LTE relies on a number of closed control loops which report information such as channel quality, RF propagation conditions and data integrity. Typical closed loop parameters include CQI, MIMO feedback (CSI), power control and HARQ. Such information is normally based on real time measurements over the air. To simplify the simulation and repeatability of such scenarios, TM500 TD-LTE provides the ability to override these signalled values using script commands and to corrupt the control information.

EXAMPLE Configuration – Downlink HARQ Override.

In a laboratory environment with a static, cable connection between the TM500 TD-LTE and the eNodeB it is likely that BLER will be zero. If suitable fading channel simulator and interference generator equipment is not available this can limit the testing of HARQ. The TM500 TD-LTE provides the capability for early HARQ testing by DL HARQ ACK/NACK override to force BLER. Using the TMA the user scripts a sequence of ACK/NACKs for one or two codewords. The user defined HARQ is then fed into the eNodeB over the UL.



DL-HARQ Override

Data Generation and Evaluation:

The Ethernet interface can be used to source and sink real data from any application running on a PC for example. Alternatively the TM500 TD-LTE is able to transmit pre-defined data on the uplink and analyse received data on the downlink. Data can also be routed via an interface for external generation or analysis. The TM500 TD-LTE also includes a data service generator tool with which traffic data can be generated in profiles that simulate those encountered with real world applications running over the network. These features are very powerful in providing repeatable and deterministic data generation and analysis.

AUTOMATED AND REMOTE OPERATION

Remote and automated operation is essential for modern test equipment. With the TM500 TD-LTE remote and automated control interfaces the TM500 TD-LTE system can be controlled via a standard Ethernet interface from the next room or another country. The TM500 TD-LTE automation interface enables the supplied management software or the customer's own control system to operate the TM500 TD-LTE commands, measurements, data logging and displays. The automation interface also supports control of multiple TM500s.

SUPPORT

Aeroflex has built up an experienced, knowledgeable and highly responsive customer support team for the TM500. The team provides global support from both local in-country offices and from the core engineering group. Support is delivered on-site as well as helpdesk, email and telephone as appropriate. Benefits of the support package also include hands-on support and training plus access to 3GPP specification migration updates and feature enhancements via a dedicated customer FTP site.

Aeroflex can also provide customised premium warranty support and training to meet specific needs on request.

SPECFICATION

GENERAL

Specification version

3GPP Release 8 (Sept 2008)

UE Capability

UE Category 2 operation with data rates to DL 50 Mbps, UL 25 Mbps
UE Category 3&4 option with data rates to DL 150 Mbps, UL 50 Mbps
UE Category 5 option available 2009 extending DL rates to 300 Mbps

RF Frequency Bands

Available UTRA TD-LTE Bands : 38 and 40, with other bands available on request. See ordering information for option combinations

Power Class

Class 3 (+23 dBm)

Max RF Input Power

-25 dBm

PHYSICAL LAYER FEATURES

OFDM DL; SC-FDMA UL; Cyclic Prefix;

DL Modulation QPSK, 16 QAM, 64 QAM;

UL Modulation QPSK, 16 QAM, 64 QAM (with UE Cat 5 option); VRB;

DL and UL adaptation

Diversity: DL Tx and RX diversity ; SISO; MIMO : 2x2 ; 4x2 ; 4x4 [with UE Cat 5 option]

Physical Channels

P-SCH/ S-SCH / RS; PUSCH; PBCH; PUCCH, SRS; PRACH; PDSCH; PCFICH; PDCCH; PHICH

LAYER 2 FEATURES

HARQ; MAC; RLC (TM, UM, AM); PDCP header; IP Driver

Transport Channels

RACH; UL-SCH; DL-SCH; PCH; BCH/D-BCH

PROCEDURES

UL closed loop power control; group & sequence hopping; PUSCH hopping; UL control information CQI (SISO & MIMO), PMI, RI; UL timing control; initial cell search; persistent scheduling; random access procedures

MEASUREMENTS

Layer 1 Receive

Modulation; SIR estimation; CQI; UL grant, DL assignment; PMI; RSSI; Reference Signal Received Power and Quality (RSRP and RSRQ)

Layer 1 Signalling

MIMO control information; DL resources assignment; UL scheduling grant; HARQ signalling plus decoded transport block size; CRC result; BER, BLER and L1 data throughput etc.

Layer 1 Transmit

CQI; PMI; repetition factors; HARQ information; UL/DL timing offset; buffer occupancy Tx power etc.

Comprehensive measurements and logging allow verification that RF Rx/Tx switching time requirements are met.

Layer 2

MAC transmit and receive statistics; overhead due to padding ratio; RLC

Latency

L1 and L2 latency measurements

Transport Monitoring

Data extraction from test points within the L1/L2 encoder and decoder chain including FEC, MAC, RLC and PDCP inputs and outputs

ENHANCED TEST FEATURES

Comprehensive analysis tools including real-time charting of constellations and throughput

PN sequence and Fixed Frame data generators and evaluators supporting BER/BLER

Override of uplink control

PMI, CQI, HARQ ACK/NACK, buffer occupancy information and ARQ status

Override of received downlink control information

Including HARQ, grant information, timing adjust and MIMO control signalling

Forced errors and Negative test features

Including forced corruption of UL-SCH enabling validation of e-Node B HARQ operation ; L1L2 control channel miss

Discontinuous reception (DRX)

Functional test that eNodeB behaves as expected during DRX cycle

PHYSICAL, ENVIRONMENTAL & SAFETY

Voltage Range

90 to 250V AC

Nominal Power consumption

350 VA

AC Frequency range

50 – 60 Hz

Dimensions (HWD)

31 cm x 38 cm x 39 cm

12.2" x 14.9" x 15.4"

Mass

22 kg (48.5 lbs.)

Operating Temperature range

0°C to 40°C

Storage Temperature range

-40°C to +70°C

Humidity

10% to 90% RH (non-condensing)

CERTIFICATION

Safety

IEC/EN 6101-1 :2001 +C1 :2002 + C2 :2003

EMC

IEC/EN 61326-1 :2006. RF Emission Class A, Immunity Table 1.

RoHS

Compliant

INTERFACES

RF

Independent Rx/Tx connector N-type (female)

Duplexed Rx/Tx connector N-type (female)

Digital

CPRI (optional)

Frequency Reference

10 MHz external reference

Separate IN/OUT, SMC

Timing Trigger

Timing marker. Separate IN/OUT, SMC

Two USB ports

Controller

Ethernet (GbE) 1000 Base-T with RJ-45

PC SPECIFICATION

The recommended minimum PC (not supplied) specification for running the TM500 PC controller application is shown below:

Processor

Intel® Viiv™ Core™ 2 Duo E6320 processor

Operating System

Windows™ XP Professional

Memory

2048 MB

Display

1600 x 900

Hard Drive

250 GB

Ethernet

10/100/1000 Base-T

ORDERING INFORMATION

The following lists the TM500 LTE Single UE product codes and available options

Baseline	Product Code
HW Platform	TM500-C
One RF Module	See below
SUE TD-LTE L1L2 Cat 2 SW	TK503-C

Options

Support	SA067
Higher layer I/F	TK540-C
RRC	TK545-C
RoHC	TK546-C
NAS	TK537-C
UE Cat 3 upgrade	TK513-C
UE Cat 4 upgrade	TK514-C
UE Cat 5 upgrade	TK515-C
Available TD-LTE RF Bands	
TD-LTE Band 38/FDD band 1 Module	TK-586-C
TD-LTE Band 40/FDD band 1 Module	TK-583-C
Available LTE FDD RF Bands	
FDD Band 1&9 Module	TK-580-C
FDD Band 1&7 Module	TK-581-C
FDD Band 12&13 Module	TK-584-C
FDD Band 1&4&10 Module	TK-585-C
CPRI	TK505-C

Packages

Package deals are available for purchase of multiple units/options. Contact your local Aeroflex Sales Office for further information.

ADDITIONAL TM500 LTE PRODUCTS

Other TM500 LTE products available:

LTE FDD Single UE SW	TK503-C
LTE FDD Multi-UE	TK506-C
LTE TDD Multi-UE	TK510-C

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AEROFLEX
A passion for performance.

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.

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