

# 6402 Internal Multipath Fading Simulator

Option 6402-156 for the CDMA-AIME System

**AEROFLEX**  
A passion for performance.



- Internal solution for simulating multipath fading located within the baseband modules of the 6402 platform.
- Supports up to eight independent fading taps –eight individually configurable paths for each RFchannel.
- Provides an unprecedented degree of flexibility in allocating cells and fading taps with no manual reconfiguration.
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- An all-digital solution: the addition of fading and noise has not introduced any new analog components.
- Meets and exceeds the needs of all 3GPP2, CCF, CTIA and CDG conformance tests.
- Accuracy and resolution are determined purely by word widths; hence almost arbitrary relative accuracy is achievable.
- Generates completely repeatable test scenarios.
- Provides a hardware solution to meet customers' specific needs at minimum cost.
- Provides a unique ability to emulate dynamic environments including traditional Rayleigh or Doppler path gain variation.

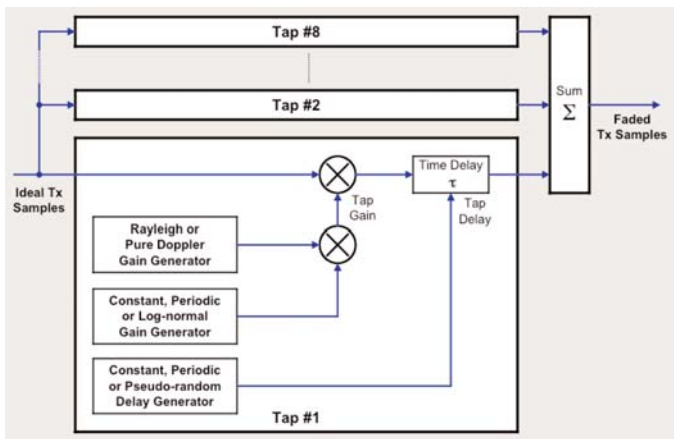
## PRODUCT DESCRIPTION

The Aeroflex 6402 radio test platform is shown below. This is a modular system consisting of a number of 6U compact PCI modules.

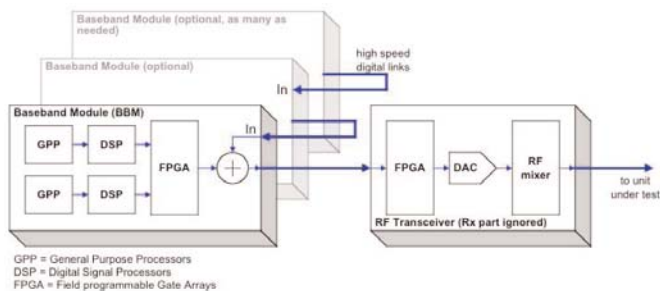


Each baseband module in the 6402 platform is a single-width compactPCI card consisting of several general purpose processors (GPPs), digital signalprocessors (DSPs), a large field programmable gate array (FPGA) and a bi-directional high-speed digital link.

The multipath fading simulator in each baseband module is illustrated on the following page. Each baseband module provides support for up to eight fading taps, where each tap applies independent time varying gain and delay to the transmitted signal.



The Aeroflex radio test platform was designed to have a scalable baseband and RF resource. As fading is applied in the baseband modules, it is also a scalable resource. For scenarios requiring more than 8 taps, additional baseband modules can be used. Additional baseband modules can be used to provide extra cells, extra antennas or extra fading taps, with no change to physical connectivity.

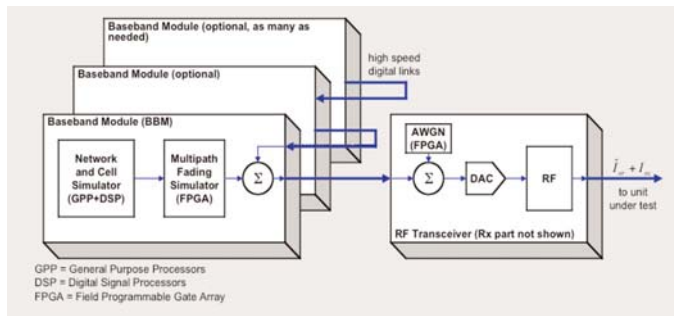


The Aeroflex approach of emulating all cells, antennas and paths in the digital domain, and combining before analog-to-digital conversion, means that there is no loss of accuracy when emulating realistic scenarios.

The simulator is designed to meet all known requirements for cellular mobile radio systems such as UMTS, CDMA2000 and GSM.

## OVERVIEW

The general purpose processing and DSP sections in the baseband modules produce baseband samples representing the output of one or many cells. The FPGA in each baseband module combines the signals from the DSP section and applies multipath fading. When the signal arrives at the radio transceiver module AWGN is added in the FPGA to emulate other interfering cells.



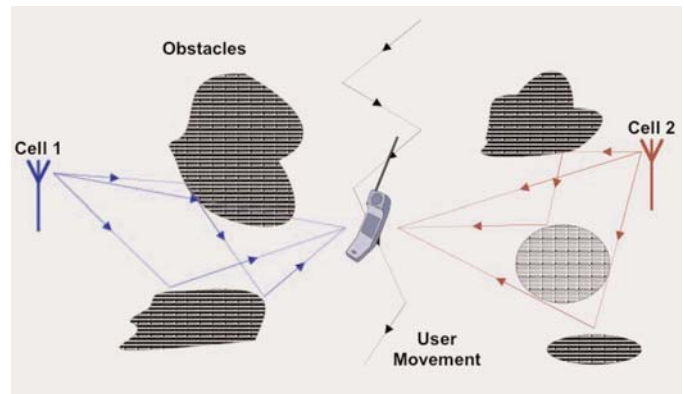
This is an all-digital solution: the addition of fading and noise has not introduced any new analog components. This minimizes any

calibration issues, and user-defined seed values make the signal passed to the analog components totally repeatable—right down to the LSB (least significant bit) of every sample.

Accuracy and resolution are determined purely by word widths, so nearly arbitrary relative accuracy is achievable. For example, an accuracy specification of  $\pm 0.1$  dB for  $I_{of}/I_{oc}$  is easily met by the 6402 test platform with no calibration. In most cases, it is the accuracy of this ratio that dictates the accuracy of the test.

## DYNAMIC CHANGING ENVIRONMENTS

The radio channel between cell site and user equipment is as variable as the location and velocity of the user. The ability of the user equipment to adapt to this changing environment is poorly covered in conformance tests, owing to the limitations of traditional test equipment.



3GPP has addressed this issue with the introduction of tests using moving and transient paths (refer to 3GPP TS 34.121 Annex D). This allows a limited test of the user equipment dynamic capability, but is still a step removed from a realistic scenario.

As well as the traditional Rayleigh or Doppler path gain variation, the Aeroflex radio test platform extends dynamic testing in the following ways:

- The user may set a periodically time-varying velocity for the mobile station relative to the cell site.
- All taps may have a periodically time-varying average gain.
- All taps may have a time-varying delay, either periodic or pseudo-randomly chosen.
- Log-normal gain variations may be added to all taps to simulate the time varying shadows created by physical obstacles.

The fading simulator configuration is updated every 0.6 ms to give the effect of a smoothly changing environment. The use of powerful DSPs to calculate the new configuration means that updates can be applied in real-time from the combined effects of velocity, gain and delay – there is no need to cycle through a limited table of parameters.

The patterns of variation of velocity, gain and delay can be completely unrelated so that the overall period of environmental variation is arbitrarily long. All patterns are seeded in such a way as to be precisely repeatable.

## FUNCTIONAL SPECIFICATIONS

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### Number of taps supported

8 per baseband module

### Mobile velocity

0 - 600 km/h

Resolution - 0.1 km/h

Accuracy  $\pm 0.03$  km/h

### Tap mean gain

-50 dB - 0 dB or OFF

Resolution 0.1 dB

Accuracy  $\pm 0.05$  dB

### Tap reference phase

0 - 359.9°

Resolution 0.1°

Accuracy  $\pm 0.01^\circ$

### Tap complex gain variation

None

Pure Doppler:

Bearing angle 0 - 359.9°

Resolution 0.1°

Accuracy  $\pm 0.01^\circ$

Rayleigh:

Classical Doppler spectrum

Flat spectrum

### Tap real gain variation

None

Log-normal:

Feature Spacing 1 - 10000 m

Resolution 1 m

Accuracy  $\pm 1$  m

Standard Deviation 0 - 10 dB

Resolution 0.1 dB

Accuracy  $\pm 0.1$  dB

Periodic:

Sinusoidal, Square or Triangular Wave

Period 10 ms - 3600000 ms, Resolution 1 ms

Range as per tap mean gain range

### Tap delay

0 - 30000 ns

Resolution 1 ns

Accuracy  $\pm 1$  ns

### Tap delay variation

None

Random Set:

Selected from 1 - 256 uniformly distributed delays

Update Period 10 ms - 3600000 ms, Resolution 1 ms

Range as per tap delay range

Periodic:

Sinusoidal, Square or Triangular Wave

Period 1 ms to 1 hr, resolution 1 ms

Range as per tap delay range

### AWGN properties

Absolute range/resolution/accuracy as per 6400 platform

Relative level accuracy  $\pm 0.1$  dB

Bandwidth:

1x Radio system bandwidth

2x Radio system bandwidth

### LICENSE OPTIONS

Note: Support for Multipath Fading requires the following Aeroflex software options.

- Option 6402-156 – Support for internal fading simulator
- Option 6402-152 – Support for internal AWGN

This is applicable to the 6402-010 and 6402-020 hardware.

Further requirements are detailed below:

- The CDMA-AIME system software must be installed on the Controller PC.
- The Controller PC must be connected to the 6402 system.

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