Application Note

JD7105A Base Station Analyzer

WCDMA Measurements

Introduction

This document provides measurement guidelines using the base station analyzer JD7105A for WCDMA code domain analysis and helps conduct accurate measurements using the instrument's transmission (Tx) Analyzer feature for modulated signal analysis.

Universal Mobile Telecommunications Service - UMTS

UMTS is the evolution of GSM and includes the following two air-interface proposals submitted by the ITU to meet the requirements of IMT-2000.

- Frequency Division Duplex (FDD), paired 5 MHz carriers are used in the uplink and downlink as follows: uplink of 1920 to 1980MHz and downlink of 2110 to 2170MHz. Although a 5MHz is the nominal carrier spacing, it is possible to have a carrier spacing of 4.4 to 5MHz in steps of 200kHz.
- Time Division Duplex (TDD). A number of frequencies have been defined, including 1900 to 1920MHz and 2010 to 2025MHz, and a given carrier is used for both uplink and downlink and no separation is required

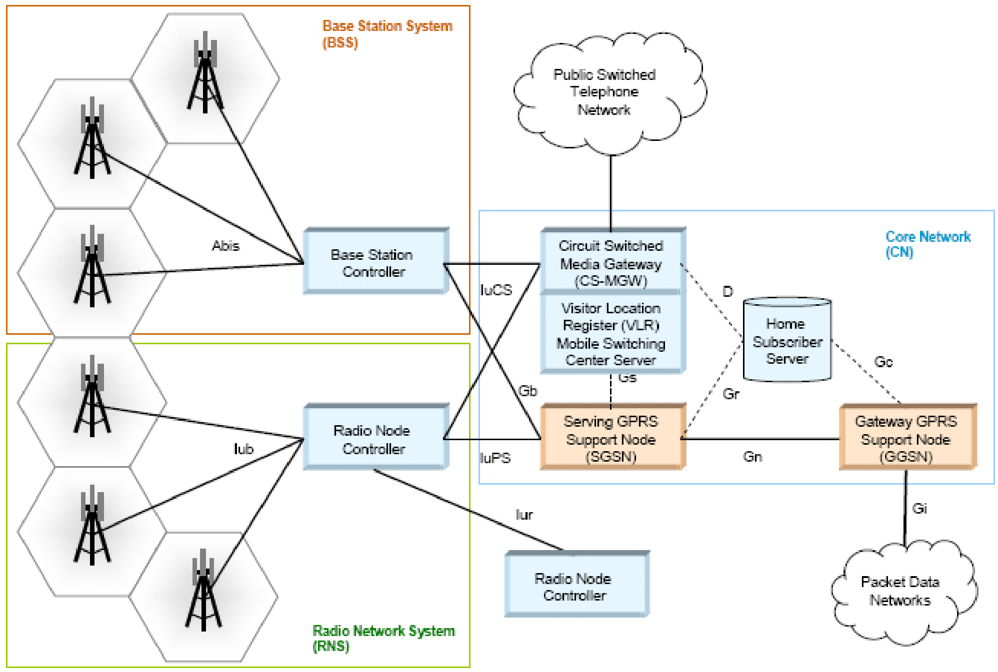
Wideband Code Division Multiple Access W-CDMA is the radio technology of UMTS and just like any CDMA system, user data are spread to a far greater bandwidth that the user rate though application of a spreading code, which is a higher-bandwidth pseudo-random sequence of bits known as chips.

The transmission from each user is spread by a different spreading code, and all users transmit at the same frequency at the same time. At the receiving end, the signal from one user is separated from those of other users by dispreading the set of received signals with the spreading code applicable to the user in question.

The ratio of the spreading rate (the number of chips per second) to the user data rate (the number of user data symbols per second) is known as the spreading factor. The greater the spreading factor, the greater is the ability to extract a given user's signal. In other words the higher the chip rate the higher number of users can be supported; alternatively, for a set number of users, the higher the chip rate the higher the data rates can be supported for each user.

Network Architecture

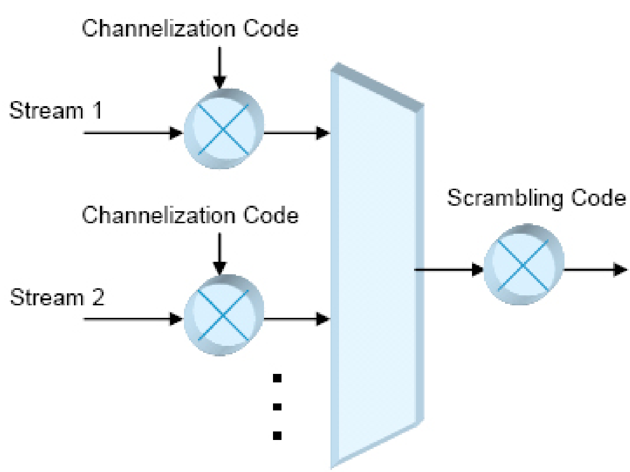
From a network architecture perspective many of the GSM network elements are reused in UMTS, where the MSC, HLR, SGSN, GGSN can be upgraded to support GSM and UMTS simultaneously. However, the radio access network in UMTS, known as UMTS Terrestrial Radio Access Network (UTRAN) and the elements that constitute the UTRAN, are different than GSM, therefore the reuse of GSM-BTC is limited. For BTS, some can be upgradable to UMTS.



UMTS Network Architecture

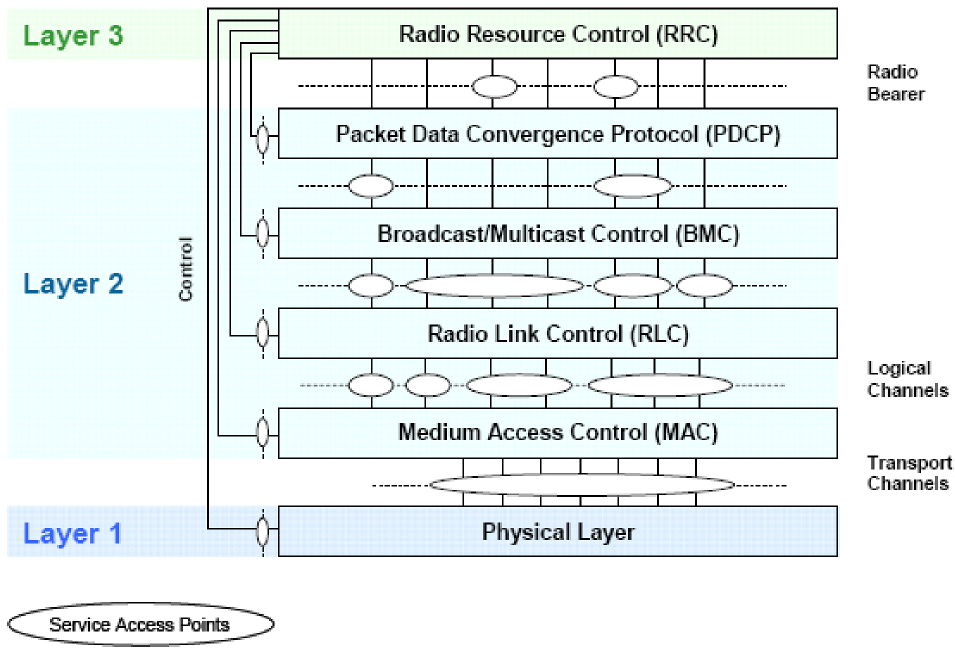
UMTS takes a two-step approach for the air interface transmission:

- Channelization Code: It is used to combine or separate multiple data streams from a given user, where the data streams are spread to the chip rate of a spreading code that operates at 3.84Mcps. The channelization codes are known as Orthogonal Variable Spreading Factor (OVSF) codes.
- Scrambling Codes: Are used to separate transmission from different users, where the combined set of spread signals is scrambled also at the chip rate.



Protocol Architecture

The radio interface is composed of the following three layers:



Physical Layer

The UMTS Terrestrial Radio Access (UTRA) has two operation modes:

- Frequency Division Duplex (FDD), where the uplink and downlink transmissions use two separated radio frequencies.
- Time Division Duplex (TDD), where the uplink and downlink transmissions use the same radio frequency with synchronized time intervals.

At the lowest level the physical layer covers the Radio Frequency (RF) processing, spreading, scrambling and modulation, coding and decoding for support of forward error correction, power control, timing advance, and soft handover execution.

The physical layer transport services to MAC and higher layers through transport channels that are classified as follows:

- Common Transport, where there is a need for in-band identification of the mobile.
  – Random Access Channel (RACH)
  – Forward Access Channel (FACH)
  – Downlink Shared Channel (DSCH)
  – Uplink Shared Channel (USCH)
  – Broadcast Channel (BCH)
  – High Speed Downlink Shared Channel (HS-DSCH)
- Dedicated Transport, where the mobiles are identified by the physical channel, such as code and frequency for FDD, and time slot and frequency for TDD.
  – Dedicated Channel (DCH)
  – Enhanced Dedicated Channel (E-DCH)

The physical layer is expected to perform the following functions in order to provide the data transport service:

- Macro-diversity/combining and soft handover execution
- Error detection on transport channels and indication to higher layers
- FEC encoding / decoding of transport channels
- Multiplexing of transport channels and de-multiplexing of coded composite transport channels
- Rate matching of coded transport channels to physical channels
- Mapping of coded composite transport channels on physical channels
- Frequency and time (chip bit, slot, frame) synchronization
- Radio characteristics measurements including FER, SIR, interference power, among others and indication to higher layer
- Inner-loop power control
- RF processing
- Synchronization shift control
- Beam forming
- MIMO Transmission
- Hybrid ARQ soft-combining for HS-DSCH and E-DCH

Base Station Analyzer

Overview

The JD7105A is a Base Station Analyzer for installation and maintenance of modern wireless communication systems. It combines the functionality of spectrum analysis, cable and antenna analysis, power meter, and modulation analysis, including:

- cdmaOne/cdma2000
- EVDO
- GSM/GPRS/EDGE
- WCDMA/HSDPA
- TD-SCDMA

The modulation measurement suite of the Base Station Analyzer provides not only RF parametric analysis but also modulation parametric analysis of modern wireless communication systems. Built-in wireless standard test procedures allow users to test each of the following items with a single button action.

WCDMA/HSDPA Analyzer

- WCDMA Channel Power
- Multi-channel Power
- Adjacent Channel Leakage Power Ration (ACLR)
- WCDMA Spurious Emission Mask
- WCDMA Occupied Bandwidth
- WCDMA Code Domain Error Vector Magnitude (EVM)
- Peak Coded Domain Error (PCDE)
- Auto Scramble Search

This document focused on the measurements and the conformance with UMTS (WCDMA) standard 3GPP TS 25.104 v8.6.0.

3GPP Base Stations Radio (FDD)

The specifications and definitions described in this section are in accordance with 3GPP standards.

Base Station Classes

There are four main classes of base stations:

1. Macro Cell. It is a wide area base station with a base station (BS) to user equipment (UE) coupling loss equal to 70dB.
2. Micro Cell. It is a medium range base station with a BS to UE minimum coupling loss equal to 53dB.
3. Pico Cell. It is a local area base station with a BS to UE minimum coupling loss equal to 45dB.
4. Femto Cell. It is characterized as a Home base station.

Frequency Bands

The UMTS-FDD is designed to operate in the following uplink and downlink bands based on a chip rate of 3.84Mcps.

Band	Up Link Frequencies (MHz)	Down Link Frequencies (MHz)
I	1920 – 1980	2110 – 2170
II	1850 – 1910	1930 – 1990
III	1710 – 1785	1805 – 1880
IV	1710 – 1755	2110 – 2155
V	824 – 849	869 – 894
VI	830 – 840	875 – 885
VII	2500 – 2570	2620 – 2690
VIII	880 – 915	925 – 960
IX	1749.9 – 1784.9	1844.9 – 1879.9
X	1710 – 1770	2110 – 2170
XI	1427.9 – 1452.9	1475.9 – 1500.9
XII	698 – 716	275 – 746
XIII	777 – 787	746 – 756
XIV	788 – 798	758 – 768

Channel Number

The carrier frequency is designated by the UMTS absolute channel number defined as follows:

Uplink: $N_U = 5 * (F_{UL} - F_{UL-Offset}), \{F_{UL\_Low} \leq F_{UL} \leq F_{UL\_High}\}$

Downlink: $N_D = 5 * (F_{DL} - F_{DL\_Offset}), \{F_{DL\_Low} \leq F_{DL} \leq F_{DL\_High}\}$

The values of each variable are defined by each band, as follows:

Band	Up Link Frequencies (MHz)			Down Link Frequencies (MHz)		
	F_{UL_Offet}	F_{UL}		F_{DL_Offet}	F_{DL}	
		F_{UL_Low}	F_{UL_High}		F_{DL_Low}	F_{DL_High}
I	0	1922.4	1977.6	0	2112.4	2167.6
II	0	1852.4	1907.6	0	1932.4	1987.6
III	1525	1712.4	1782.6	1575	1807.4	1877.6
IV	1450	1712.4	1752.6	1805	2112.4	2152.6
V	0	826.4	846.6	0	871.4	891.6
VI	0	832.4	837.6	0	877.4	882.6
VII	2100	2502.4	2567.6	2175	2622.4	2687.6
VIII	340	882.4	912.6	340	927.4	957.6
IX	0	1752.4	1782.4	0	1847.4	1877.4
X	1135	1712.4	1767.6	1490	2112.4	2167.6
XI	733	1430.4	1450.4	736	1478.4	1498.4
XII	-22	700.4	713.6	-37	730.4	743.6
XIII	21	779.4	784.6	-55	748.4	753.6
XIV	12	790.4	765.6	-63	760.4	765.6

NOTE: The JD7105A has all the frequency bands with the corresponding channel number in its internal database.

Base Station – Physical Characterization

The majority of the problems in Base Stations are related to the physical infrastructure composed of cables, connectors, and antennas. The performance metrics that characterize and locate the physical malfunction in Base Stations are the following:

- Voltage Standing Wave Ratio (VSWR) or Return Loss (RL)
- Distance to fault (DTF)
- Cable Loss (CL)

Power Transfer

To get maximum power transfer, all the transmission line must have a match impedance match, since any difference in impedance will minimize the power transfer from the Base Station radio to the antenna.

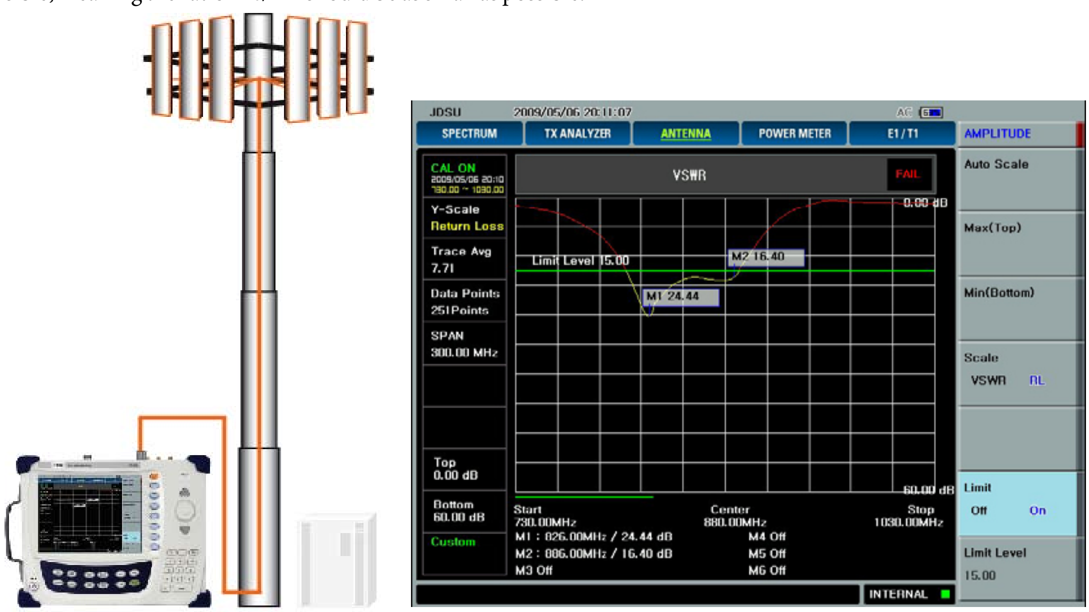
An impedance mismatch at the antenna system produces a reflective 'traveling wave' which goes in the opposite direction from the incident wave. As the two traveling waves cross each other in opposite direction, it is produce an interference pattern called a "standing wave". VSWR is the ratio between the power sent forward to the cable and/or antenna and the amount of power that is reflected back to the transmitter.

JD7105A Base Station Analyzer Application

The JD7105A has a Cable and Antenna Analysis function which sends multiple signals based on a configurable frequency range, with which measures any standing wave created by the transmission line.

The JD7105A can set a maximum limit line for acceptable reflections, indicating a PASS/FAIL condition and indicating at what frequencies the Base Station's transmission line is not performing properly.

Similarly to VSWR, Return Loss measures the power reflected from imperfections in the transmission line. It is defined as a ratio (PR / PT), representing the power of the wave reflected from the imperfection (PR) to that of the incident, or transmitted, wave, (PT). For maximum transmitted power, the return loss should be as small as possible, meaning the ratio PR / PT should be as small as possible.



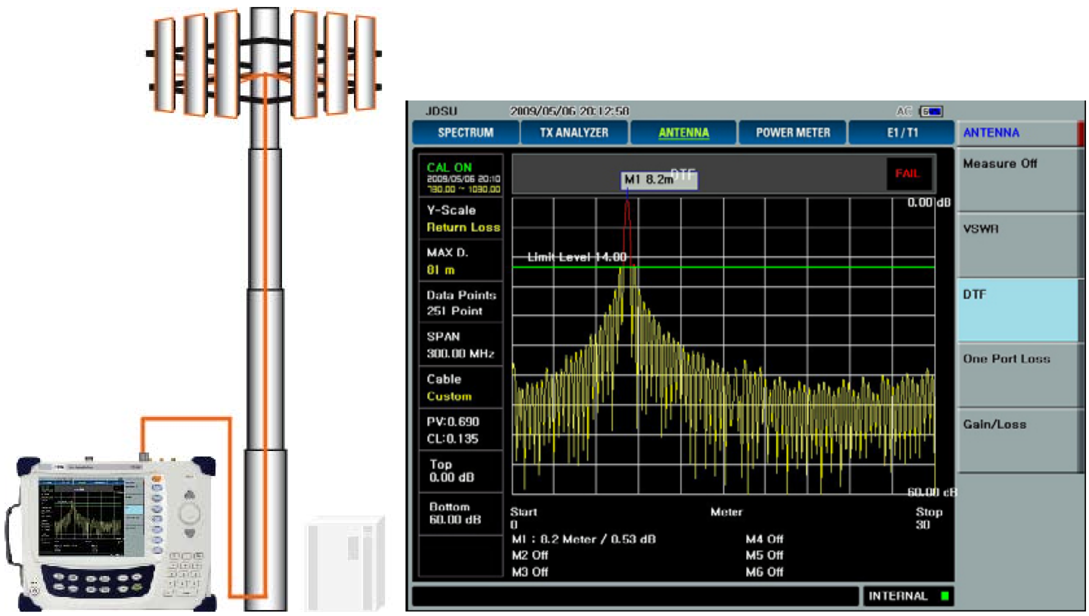
JD7105A Cable and Antenna Analysis – VSWR

Fault Location

Distance to Fault (DTF) is a measurement to identify the fault locations in the Base Station's transmission line. Most Base Stations consists of various types of coaxial cables, connectors and devices such as dividers and surge arrestors, and antennas; where all are exposed to environmental factors that affect their performance due to corrosion, the presence of water, damaged components among others. It is the DTF metric which identifies the fault location of any of element in the Base Station's transmission line.

JD7105A Base Station Analyzer Application

The JD7105A DTF measurement performs a frequency reflectrometer identifying fault locations on distances up to 1,250m (4,125ft).



JD7105A Cable and Antenna Analysis -DTF

Power Verification

A quick power verification of the power transmitted by the radio is commonly performed during installation and maintenance of Base Stations.

JD7105A Base Station Analyzer Application

The RF power meter of the JD7105A uses a band power measurement methodology based on spectrum measurements taking the RMS power from the raw data received from FFT in the defined frequency span, resulting in an accurate power measurement.

In addition, the JD7105A provides a logging capability of power measurements which allows tracking power variations in the Base Station.

JD7105A Power Meter

Base Station – Air Interface

The base station's air interface as the last access point to mobile users and must be constantly monitor for its performance since it involves other sources that directly or indirectly might affect the reach or quality of service to mobile users, including the following:

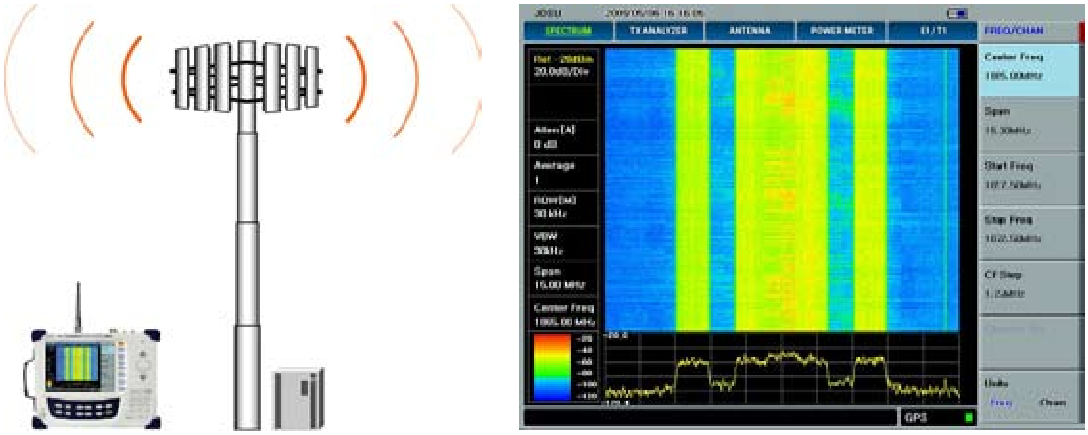
- Spectrum Environment, which characterizes the spectrum activity, identifying possible interfering signals.
- Signal Integrity, verifying the signal's RF structure.
- Transmission Analysis, performing a signal demodulation.
- Multipath Profile, verifying the signal's reflection at particular locations do not interfere with the base station's carrier.

Spectrum Environment

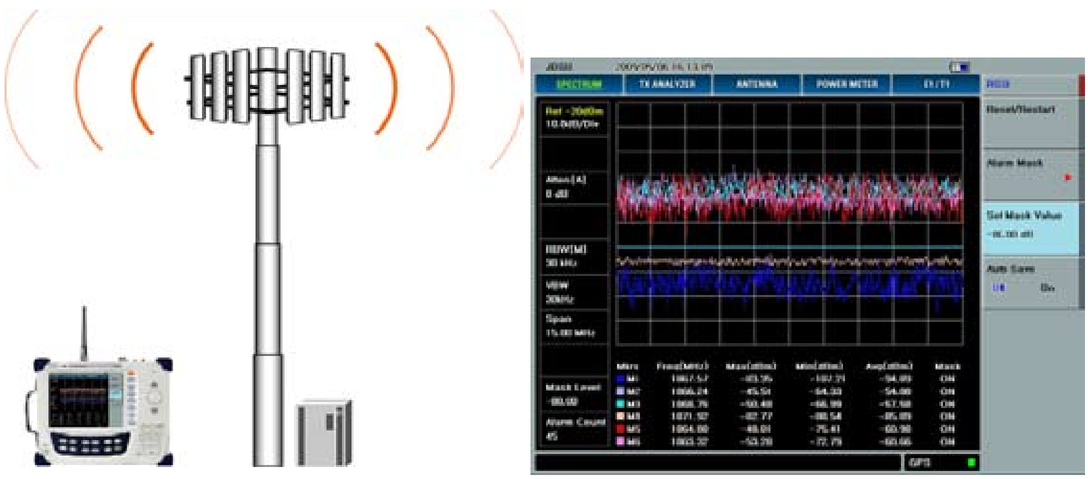
The spectrum is shared among different systems and services such as mobile communications, mobile radios, paging, wireless local area networks, and digital video broadcasting. In addition to the licensed systems, the spectrum is also occupied by unlicensed transmitters, reflections, and fading. The composition of all these signals is making a very complex environment which must be routinely monitored in order to maximize service performance.

JD7105A Base Station Analyzer Application

Signal interference in wireless networks negatively affects transmission coverage and mobile capacity, limiting the overall network performance. Unavoidable signal interference is becoming more prevalent in the wireless community with the increasing number of active transmitters on the RF spectrum.



JD7105A Interference Analysis - Spectrogram



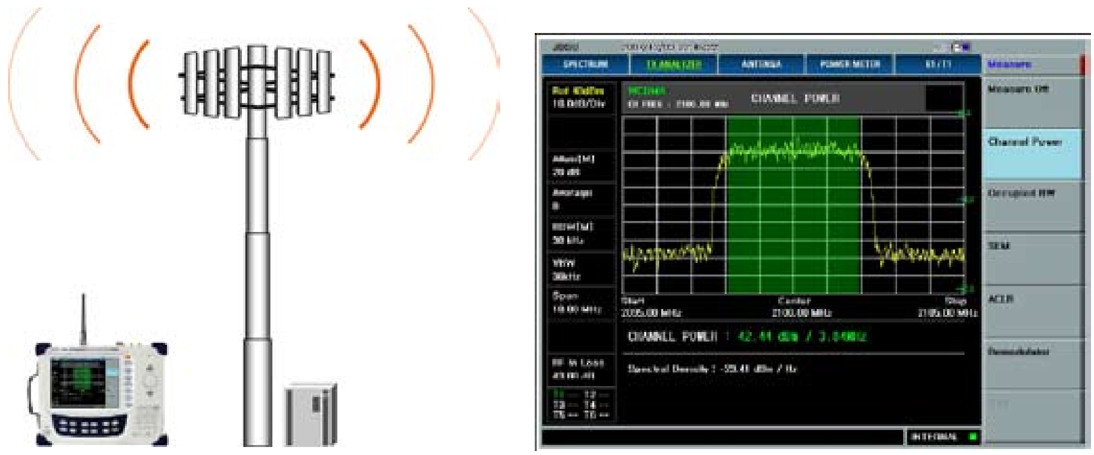
JD7105A Interference Analysis - RSSI

Signal Integrity

The signal verification over the air is similar to the transmission characteristics defined by 3GPP at the Base Station, taking into account that the signal is being affected by the signals present in the air environment, nevertheless the core signal must remain with the same basic characteristics including signal waveform and channel power.

JD7105A Base Station Analyzer Application

The channel power measurement identifies the channel power within a specified bandwidth (5 MHz, as defined by 3GPP UTRA specifications, and the power spectral density (PSD).



JD7105A WCDMA Channel Power Measurement

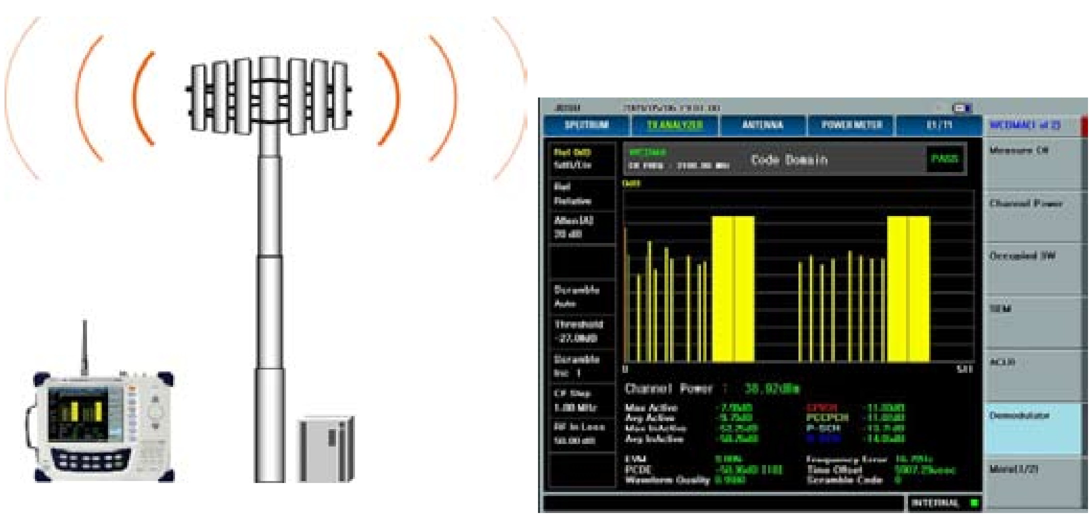
Transmission Analysis

The base station's transmission analysis covers the overall performance indication of the base station transmission related to the internal structure of the spread signal, including channel's power distribution, as well as signal quality metrics such as Error Vector Magnitude (EVM) and modulation accuracy (rho) covering potential problems caused by baseband filtering, I/Q modulation anomalies, filter amplitude, phase deviation, and power amplifier distortions.

JD7105A Base Station Analyzer Application

The Code Domain Power (CDP) analysis measures a variety of different factors including the distribution of power across the set of code channels, normalized to the total power. This measurement helps to verify that each code channel is operating at its proper level and helps to identify problems throughout the transmitter design from coding to the RF section.

It also identifies system imperfections, such as amplifier non-linearity, showing an undesired distribution of power in the code domain.



JD7105A WCDMA Transmission Analysis

JD7105A Over the Air Measurements

3GPP Base Station Transmitter Characteristics

The 3GPP Base Station Transmitter Characteristics described in this section are based on the standard 3GPP TS 25.104 – Base Station (BS) radio transmission and reception (FDD).

Unless otherwise stated the requirements in this section assume transmission without diversity or Multiple Input (MIMO). In case of diversity or MIMO the transmission requirements apply to each antenna connector separately, with the others terminated.

Base Station Output Power

The rated output power of the base station is the mean power level per carrier declared by the manufacturer at the antenna connector.

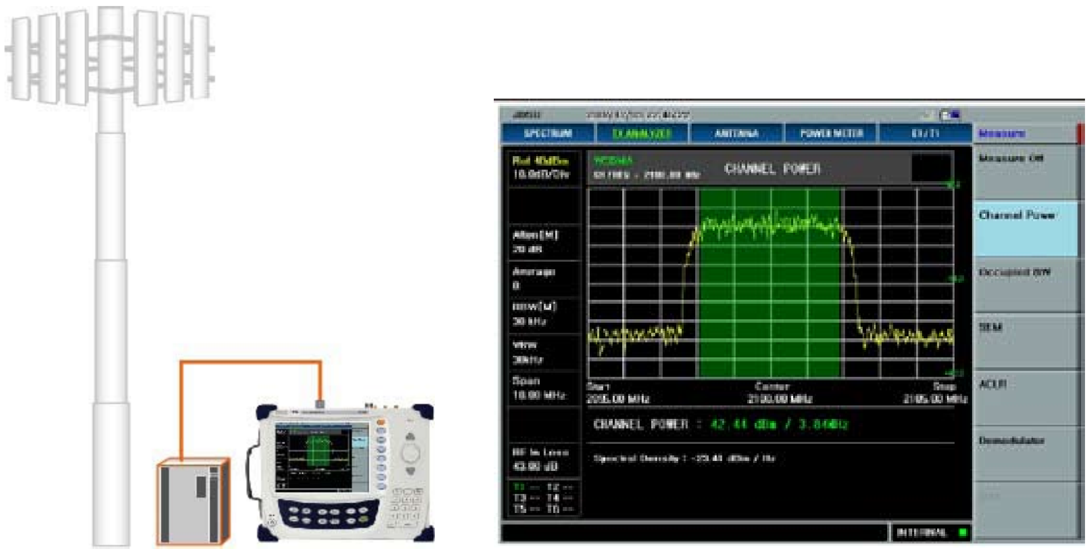
Base Station Class	Rated Output Power
Macro Cell	No upper limit
Micro Cell	≤ +38 dBm
Pico Cell	≤ +24 dBm
Femto Cell	≤ +20 dBm (without diversity or MIMO) ≤ +17 dBm (with diversity or MIMO)

Minimum Requirement

- In normal conditions the Base Station maximum power shall remain within ± 2 dB of the manufacturer's rated output power.
- In extreme conditions the Base Station maximum power shall remain within ± 2.5 dB of the manufacturer's rated output power.

JD7105A Base Station Analyzer Application

The Channel Power measurement shows the total transmitted power within the channel integration bandwidth of 5.00MHz. The measurement acquires a number of points representing the input signal in the time domain and it transforms this information into the frequency domain using FFT and calculates the channel power.



JD7105A WCDMA Channel Power Measurement

Base Station Frequency Error

The modulated carrier frequency of the Base Station shall be accurate to within the accuracy range of the following table over a period of one time slot.

Base Station Class	Accuracy
Macro Cell	± 0.05 ppm
Micro Cell	± 0.1 ppm
Pico Cell	± 0.1 ppm
Femto Cell	± 0.25 ppm

JD7105A Base Station Analyzer Application

The JD7105A demodulator provides a complete code domain power view including the following channel composition and quality information:

- Channel Power
- Error Vector Magnitude
- Peak Code Domain Error
- Waveform Quality
- Frequency Error
- Time Offset
- Scramble Code

JD7105A WCDMA Demodulator – Frequency Error Indicator

Base Station Power Dynamics

Power control is used to limit the interference level. The transmitter uses a quality-based power control on the downlink.

Base Station Power Control Dynamic Range

The power control dynamic range is the difference between the maximum and minimum code domain power of a code channel for a specified reference condition.

Minimum Requirement

Downlink power control dynamic range:

- Maximum code domain power: ≥ -3dB
- Minimum code domain power: ≤ -28dB

JD7105A Base Station Analyzer Application

The code domain power composite view provides information about the in-channel characteristics of the WCDMA signal. It directly informs the user of the active channels with their individual channel power.

JD7105A WCDMA Demodulator – Channel Power Indicator

Station Total Power Dynamic Range

The total power dynamic range is the difference between the maximum and minimum output power for a specified reference condition.

Minimum Requirement

- The total power dynamic range shall be ≥ 18dB

Base Station Primary CPICH Power

Primary CPICH power is the code domain power of the Common Pilot Channel. Primary CPICH power is indicated on the Broadcast Channel (BCH).

Minimum Requirement

Primary CPICH power is the code domain power shall be within ± 2.1dB of the Primary CPICH code domain power indicated on the BCH.

JD7105A Base Station Analyzer Application

The code domain power composite view provides information about the in-channel characteristics of the WCDMA signal. It directly informs the user of the active channels with their individual channel power and the power level of the following channels:

- CPICH – Code Pilot Channel.
- PCCPCH – Primary Common Control Physical Channel.
- P-SCH – Primary Synchronization Channel.
- S-SCH – Secondary Synchronization Channel.

JD7105A WCDMA Demodulator – CPICH Power Indicator

Base Station Output RF Emissions

Base Station Occupied Bandwidth

The occupied bandwidth is the width of a frequency band such that below the lower and above the upper frequency limits the mean power emitted are each equal to a specified percentage β/2 of the total mean transmitted power. The value of β/2 shall be taken as 0.5%.

Minimum Requirement

- The occupied channel bandwidth shall be less than 5MHz based on a chip rate of 3.84Mcps.

JD7105A Base Station Analyzer Application

Occupied Bandwidth measures the bandwidth containing 99% of the total transmitted power. The spectrum shape of a WCDMA signal can give a useful qualitative insight into the transmitter's operation. Any distortion to the spectrum shape might be an indication of degradation of the transmitter's performance.

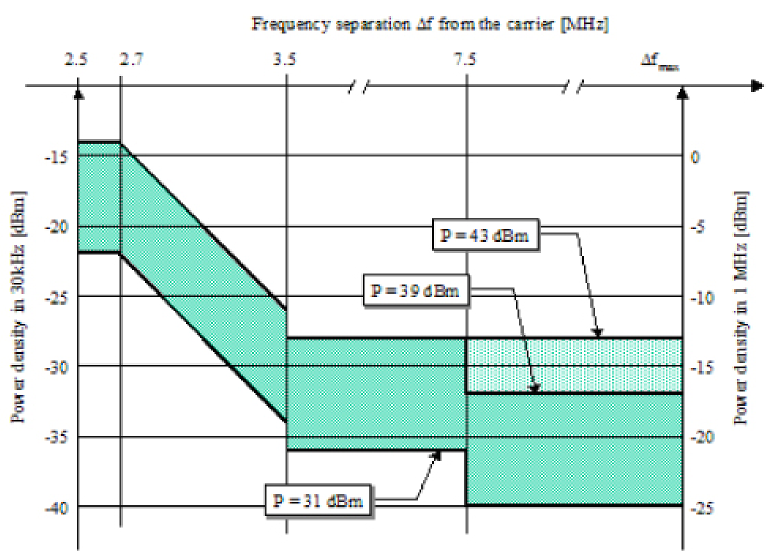
JD7105A WCDMA Occupied Bandwidth Measurement

Base Station Out of Band Emission

Out of band emissions are unwanted emissions immediately outside the channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions.
This out of band emission requirement is specified in terms of a Spectrum Emission Mask (SEM) and Adjacent Channel Power Ratio (ACPR).

Spectrum Emission Mask

The mask defined applies to base stations transmitting on a single RF carrier.



3GPP TS 25.104 Spectrum Emission Mask Limits

JD7105A Base Station Analyzer Application

The Spectrum Emission Mask (SEM) measurement includes the out-of-band spurious emissions. As it applies to WCDMA, this is the power contained in a specified frequency bandwidth, at certain offsets relative to the total carrier power. It may also be expressed as a ratio of power spectral densities between the carrier and the specified offset frequency band.

The SEM measures spurious signal levels in up to five pairs of offset or region frequencies and relates them to the carrier power. The reference channel integration bandwidth method is used to measure the carrier channel power and offset or region powers.

- When Offset is selected, SEM measurements are made relative to the carrier channel frequency bandwidth.
- When Region is selected, absolute SEM measurements are made, specifying the start and stop RF frequencies.

In this process, the reference channel integration bandwidth is analyzed using the automatically defined resolution bandwidth, which is much narrower than the channel bandwidth. The results are displayed both as relative power in dBc, and as absolute power in dBm.

JD7105A WCDMA Spectrum Emmision Mask Measurement

Adjacent Channel Leakage Power Ratio (ACLR)

Adjacent Channel Leakage Power Ratio (ACLR) is the ratio of the Root-Raised Cosine (RRC) filtered mean power centered on the assigned channel frequency to the RRC filtered mean power centered on an adjacent channel frequency.

Minimum Requirement

Base Station adjacent offset below the first of above the last carrier frequency used.

- ± 5MHz : > 45dB
- ± 10MHz: > 50dB

JD7105A Base Station Analyzer Application

Adjacent Channel Leakage power Ratio (ACLR) is the power contained in a specified frequency channel bandwidth relative to the total carrier power expressed as a ratio of power spectral densities between the carrier and the specified offset frequency band.

JD7105A WCDMA Adjacent Channel Leakage Ratio Measurement

Protection of the BS receiver of own or different BS

This requirement shall be applied in order to prevent the receivers of the Base Station being desensitized by emissions from a Base Station transmitter. This is measured at the transmit antenna port for any type of Base Station which has common or separate Tx/Rx antenna ports.

Protection of the BS receiver of own or different BS

The power of any spurious emission shall not exceed the following:

- Macro Cells: -96 dBm @ 100kHz BW
- Micro Cells: -86 dBm @ 100kHz BW
- Pico Cells: -82 dBm @ 100kHz BW
- Femto Cells: -82 dBm @ 100kHz BW

Base Stations Co-existing with Other Systems in the Same Geographical Area

These requirements may be applied for the protection of User Equipment and/or Base Stations operating in other frequency bands in the same geographical area. The requirements may apply in geographic areas in which both UTRA FDD operating in frequency bands I to XIV and a system operating in another frequency band than the FDD operating band are deployed.

The system operating in the other frequency band may be GSM900, DCS1800, PCS1900, GSM850 and/or FDD operating in bands I to XIV.

Minimum Requirement

System in the same area	Co-existence Band	Maximum Level	Measurement Bandwidth	Note
GSM900	921 - 960 MHz	-57 dBm	100 kHz	This requirement does not apply to UTRA FDD operating in band VIII
	876 - 915 MHz	-61 dBm	100 kHz	For the frequency range 880-915 MHz, this requirement does not apply to UTRA FDD operating in band VIII, since it is already covered by the requirement in sub-clause 6.6.3.2.
DCS1800	1805 - 1880 MHz	-47 dBm	100 kHz	This requirement does not apply to UTRA FDD operating in band III
	1710 -1785 MHz	-61 dBm	100 kHz	This requirement does not apply to UTRA FDD operating in band III, since it is already covered by the requirement in sub-clause 6.6.3.2.
PCS1900	1930 - 1990 MHz	-47 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band II
	1850 - 1910 MHz	-61 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band II, since it is already covered by the requirement in sub-clause 6.6.3.2.
GSM850 or CDMA850	869 - 894 MHz	-57 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band V
	824 - 849 MHz	-61 dBm	100 kHz	This requirement does not apply to UTRA FDD BS operating in frequency band V, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band I	2110 - 2170 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band I
	1920 - 1980 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band I, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band II	1930 - 1990 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band II
	1850 - 1910 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band II, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band III	1805 - 1880 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band III
	1710 - 1785 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band III, since it is already covered by the requirement in sub-clause 6.6.3.2.

Minimum Requirement

System in the same area	Co-existence Band	Maximum Level	Measurement Bandwidth	Note
FDD Band IV	2110 - 2155 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band IV
	1710 - 1755 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band IV, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band V	869 - 894 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band V
	824 - 849 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band V, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band VI	860 - 895 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VI
	2500 - 2570 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VII, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band VII	2620 - 2690 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VII
	2500 - 2570 MHz	-61 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VII, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band VIII	925 - 960 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VIII.
	880 - 915 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band VIII, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band IX	1844.9 - 1879.9 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band IX
	1749.9 - 1784.9 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band IX, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band X	2110 - 2170 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band X
	1710 - 1770 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band X, since it is already covered by the requirement in sub-clause 6.6.3.2.

Minimum Requirement

System in the same area	Co-existence Band	Maximum Level	Measurement Bandwidth	Note
FDD Band XI	1475.9 - 1500.9 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band XI
	1427.9 - 1452.9 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band XI, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band XII	728 - 746 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band XII
	698 - 716 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band XII, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band XIII	746 - 756 MHz	-52 dBm	1 MHz	his requirement does not apply to UTRA FDD BS operating in band XIII
	777 - 787 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band XIII, since it is already covered by the requirement in sub-clause 6.6.3.2.
FDD Band XIV	758 - 768 MHz	-52 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band XIV
	788 - 798 MHz	-49 dBm	1 MHz	This requirement does not apply to UTRA FDD BS operating in band XIV, since it is already covered by the requirement in sub-clause 6.6.3.2.

Base Station Transmit Modulation

Transmit modulation is specified in three parts, Frequency Error, Error Vector Magnitude and Peak Code Domain Error. These specifications are made with reference to a theoretical modulated waveform.

The theoretical modulated waveform is created by modulating a carrier at the assigned carrier frequency using the same data as was used to generate the measured waveform. The chip modulation rate for the theoretical waveform shall be exactly 3.84 Mcps. The code powers of the theoretical waveform shall be the same as the measured waveform, rather than the nominal code powers used to generate the test signal.

Error Vector Magnitude

The Error Vector Magnitude (EVM) is a measure of the difference between the reference waveform and the measured waveform. The EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference power expressed as a percentage (%).

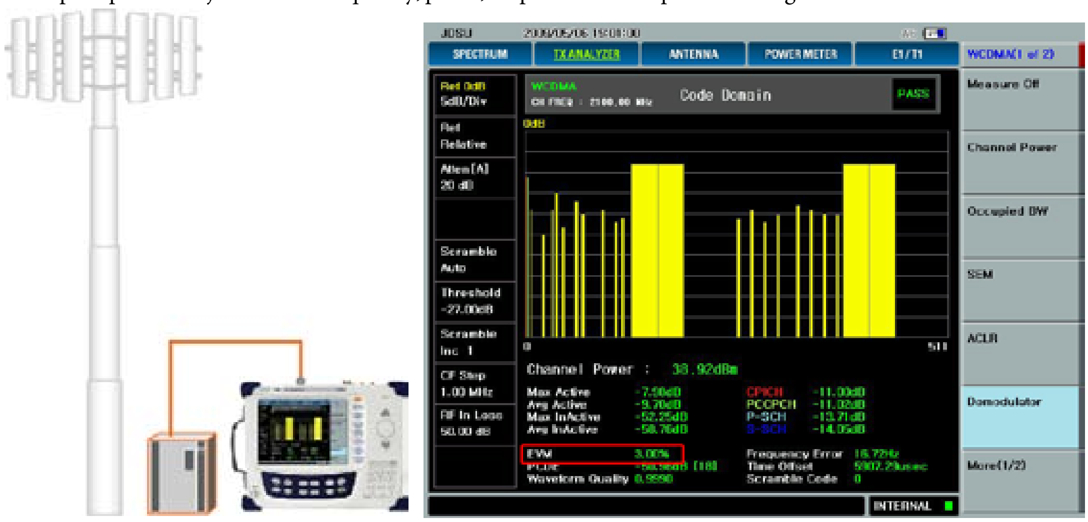
The measurement interval is one timeslot as defined by the C-PICH (when present) otherwise the measurement interval is one timeslot starting with the beginning of the SCH. The requirement is valid over the total power dynamic range.

Minimum requirement

- The Error Vector Magnitude shall not be: < 17.5 % (QPSK modulation).
- The Error Vector Magnitude shall not be: < 12.5 % (16QAM modulation)

JD7105A Base Station Analyzer Application

The Error Vector Magnitude (EVM) is the difference between a reference waveform and the measured waveform. Both waveforms pass through a matched Root Raised Cosine filter with bandwidth of 3.84MHz and roll-off α=0.22 and a post-process adjustment of frequency, phase, amplitude and chip clock timing.



JD7105A WCDMA Demodulator - Error Vector Magnitude Indicator

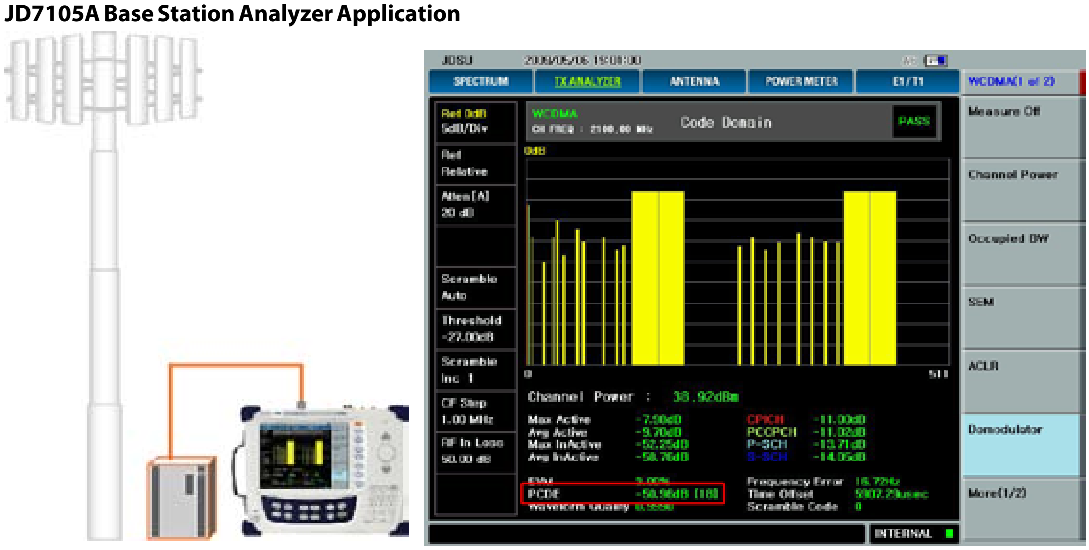
Peak Code Domain Error

The Peak Code Domain Error is defined as the maximum value for the Code Domain Error for all codes. The measurement interval is one timeslot as defined by the C-PICH (when present) otherwise the measurement interval is one timeslot starting with the beginning of the SCH.

Minimum requirement

- The peak code domain error shall not exceed -33 dB at spreading factor 256

JD7105A Base Station Analyzer Application



JD7105A WCDMA Demodulator - Peak Code Domain Error Indicator

References

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  3rd Generation Partnership Project;
  Technical Specification Group Radio Access Network
  Base Station (BS) radio transmission and reception (FDD) (Release 8)
- 3G Wireless Networks – Second Edition
  Clint Smith, P.E.
  Daniel Collins
- JD7105A Base Station Analyzer – User's Manual
- Interference Analysis – Overview

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