**Anritsu**

# MS2781B Spectrum Analysis and Vector Signal Analysis with Bandwidths to 50 MHz
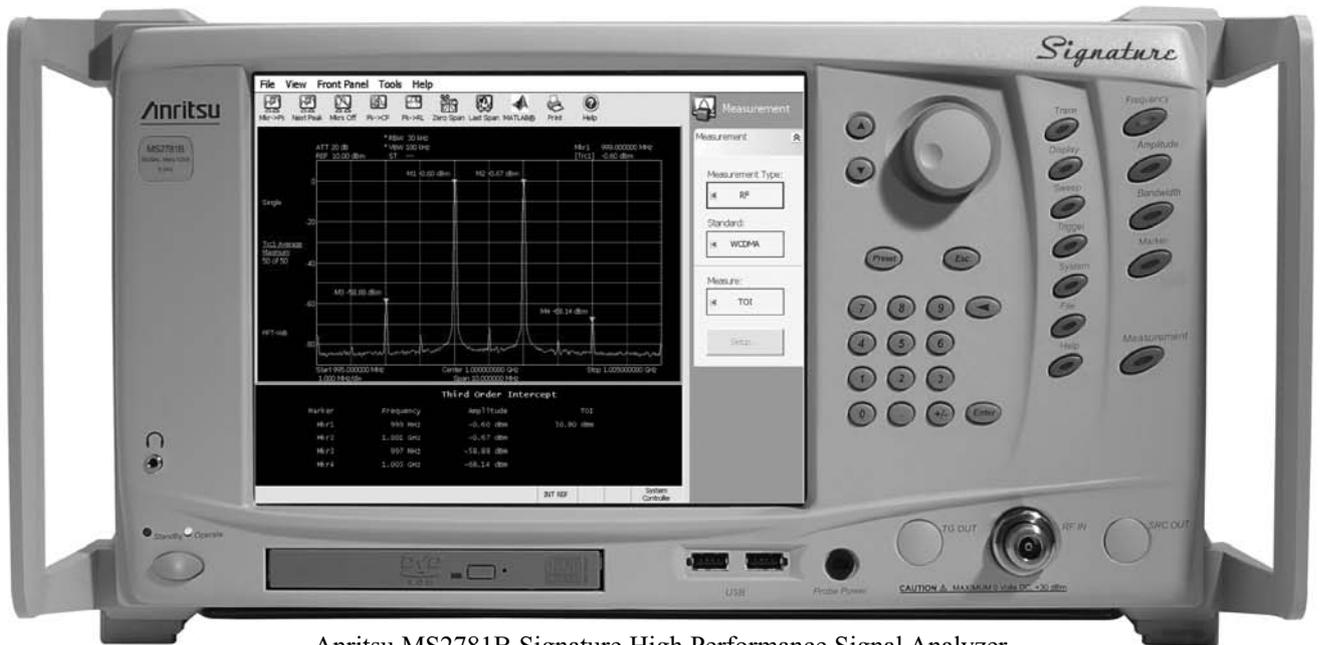
## MS2781B
Signature™

100 Hz to 8 GHz

### System Description

The Anritsu Signature™ High Performance Signal Analyzer is designed to provide exceptional spectrum analyzer performance and integrated vector signal analysis over the 100 Hz to 8 GHz frequency range.



Anritsu MS2781B Signature High Performance Signal Analyzer

## Exceptional performance to 8 GHz without the need for a preselector or bandswitching

The Signature RF block diagram illustrates how a Signature uses a 9.5 to 17.5 GHz synthesized first local oscillator and 9.5 GHz first IF (see Figure 1). This fundamental mixing approach allows the 100 Hz to 8 GHz range to be covered without bandswitching. Also, a preselector is not needed to eliminate image responses of the first LO. Preselectors can degrade the overall amplitude accuracy as well as the modulation analysis bandwidth and accuracy. Fundamental mixing to 8 GHz improves the sensitivity, high signal level performance (TOI) and dynamic range.

This combination of high sensitivity and high TOI provides exceptional dynamic range, which is key for making spurious and on/off ratio measurements.

## 8 MHz Spectrum Analyzer resolution bandwidths

Signature offers standard resolution bandwidths from 0.1 Hz to 8 MHz. Three conversions are used to achieve a typical displayed dynamic range of 130 dB.

## 30 MHz Demodulation Bandwidth (Option 22)

Option 22, 30 MHz IF Bandwidth, extends single FFT spectrum and I-Q vector measurements to 30 MHz. Baseband differential I & Q inputs are also added. The ability to turn off the anti-alias filter extends the capture bandwidth to 50 MHz.

## Comprehensive WCDMA/HSDPA/HSUPA Measurements (Option 30)

Option 30, WCDMA/HSDPA/HSUPA Measurements, allows a wide variety of Modulation Quality measurements on Handsets, Base Station (Node B) transmitters and related components. Combined with the standard RF measurements in Signature, these provide a complete suite of measurements for Engineering use, both in R&D and Manufacturing.

## Fully integrated vector signal analysis (Option 38)

Option 38, QAM/PSK Modulation Analysis, allows you to select the symbol rate, modulation type, and filtering to demodulate captured signals. Measurements include EVM, carrier leakage, and I-Q imbalance. Symbol table, constellation and vector diagrams enhance viewing of measurement results.

## Advanced connectivity

Signature can be remotely controlled via GPIB and Ethernet interfaces with SCPI commands that provide familiar spectrum analyzer function calls. IVI drivers simplify test system integration.

## Open Windows® XP operating system

Signature's Windows XP Professional environment and built-in PC provide a new level of connectivity, ease-of-use, and remote operation.

## Integrated compatibility with MATLAB (Option 40)

Signature expands the ability to analyze RF signals with simulation and analysis tools from the industry leader, The MathWorks. Signature provides an interface to easily transfer captured trace data and I-Q Vectors into MATLAB® and Simulink® for further analysis. DSP demodulator models created in MATLAB and Simulink can be applied to Signature data to evaluate new or proprietary modulation formats.

## WiMAX measurements (Option 41)

Mobile and Fixed WiMAX Modulation Measurements provides all the key measurements for your WiMAX device, including Relative Constellation Error (RCE), Carrier Frequency Offset, I/Q Offset, Constellation Diagrams, RCE versus Symbol, and RCE versus sub-carrier.

## Phase Noise Measurements (Option 52)

Measure the frequency stability of oscillators, with a log plot of phase noise versus offset or phase noise versus time at one offset. Advanced capabilities include instrument noise & phase noise compensation, selectable FFT or swept operation by decade, and multiple measurements with color differentiation.
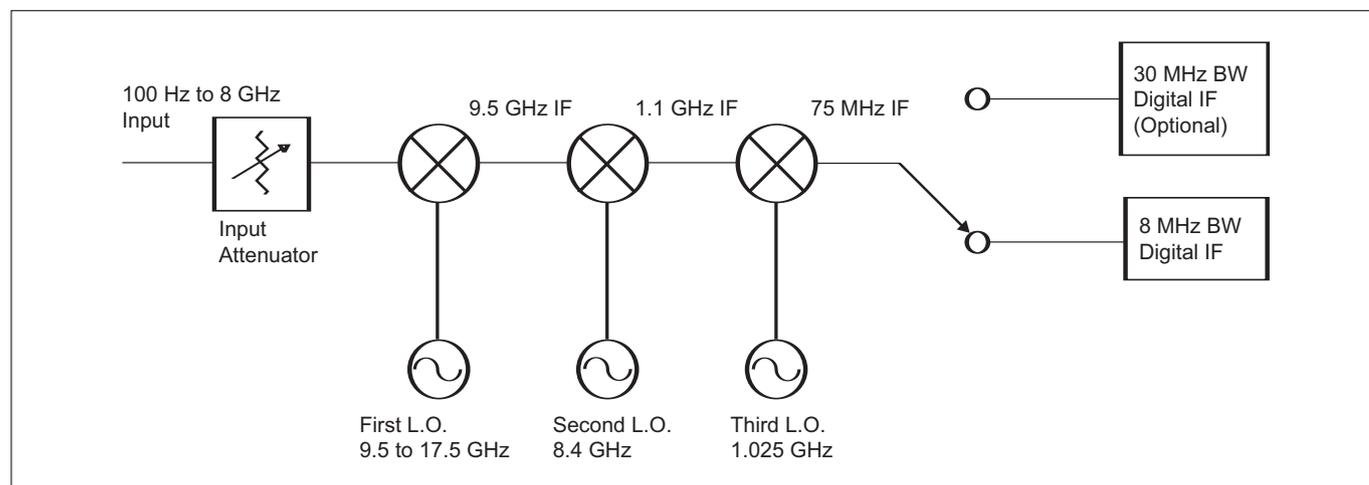


*Figure 1, Signature RF block diagram (L.O. frequencies are nominal values)*

# Frequency Related Specifications

**Frequency Range:** 100 Hz to 8 GHz

**Bands (Architecture):** Single-band, fundamentally mixed, image free

**Frequency Resolution:** 1 Hz

**Frequency Span Range:** 10 Hz to 8 GHz, 0 Hz

**Frequency Span Accuracy:**

**Span ≤33 MHz:** 0.3% of span
**33 MHz <Span ≤80 MHz:** 1.4%
**Span >80 MHz:** 1.0 % of span

**Frequency Readout Accuracy:** ± marker freq * reference accuracy + span accuracy + RBW accuracy * RBW + 0.5 * last digit

**Swept Resolution Bandwidth (RBW):**

**RBW Range:** 10 Hz to 8 MHz (1/2/3/5)
**RBW Shape Factor (60 dB/3 dB), nominal:** 4.6
**RBW Accuracy:** 10 Hz to 2 MHz: 5%
　　　　　　　　3 MHz and 5 MHz: 10%

**Modulation Analysis Bandwidth:**

**Standard:** 8 MHz
**With Option 22:** 30 MHz
**With Option 22 and anti-alias filter turned off:** 50 MHz

## *FFT*

**FFT RBWs:** 0.1 Hz to 100 kHz (1,2,3,5)
**Wideband FFT (requires Option 22):** 100 Hz to 3 MHz (1, 2, 3, 5)

**FFT Span:**
**Standard:** 10 Hz to 1 MHz
**Wideband FFT (requires Option 22):** 1 MHz to 30 MHz

**FFT Span/RBW:** ≤30,000
**Wideband FFT (requires Option 22):** No restriction

**Video Bandwidth (VBW):** 1 Hz to 10 MHz (1/2/3/5)

**SSB Phase Noise (dBc/Hz @ 1 GHz):**

10 Hz Offset: <–90
100 Hz Offset: <–90
1 kHz Offset: <–109
10 kHz Offset: <–116
100 kHz Offset: <–116
1 MHz Offset: <–139
5 MHz Offset: <–142
10 MHz Offset: <–142

**Residual FM:** <1 Hz in 1 second, nominal

**Reference Oscillator Aging Rate:** $5x10^{-10}$/day; $1x10^{-7}$/year

**Reference Oscillator Temperature Drift:** $5x10^{-9}$ over 0 to 50ºC

# Amplitude Related Specifications

*Intermodulation Distortion (20ºC to 30ºC)*

**Third-Order Intercept (TOI):**

**<100 MHz:** >19 dBm
**≥100 MHz:** >22 dBm, +25 dBm typical

**Second Harmonic Intercept:** >38 dBm

**1 dB Compression Point:** >10 dBm

## *Noise*

**Displayed Average Noise Level (DANL) (note 5):**

10 MHz to 1 GHz: <–167 dBm
>1 GHz to 2.5 GHz: <–166 dBm
>2.5 GHz to 5.5 GHz: <–165 dBm
>5.5 GHz to 8 GHz: <–163 dBm

**Noise Figure (0 dB input attenuation, <-20 dBm reference level):**
<16 dB typical @ 1 GHz

## *Amplitude Uncertainty (20° to 30°C)*

**Amplitude Uncertainty at 50 MHz (note 2):** <0.1 dB

**Frequency Response at 10 dB Attenuation:** <0.4 dB

**Frequency Response from Attenuator Switching:** <0.2 dB (note 8)

**Additional Frequency Response in FFT Mode:** <0.1 dB

**Reference Level Switching Uncertainty:**
**Without Attenuator Changes:** <0.2 dB
**With Attenuator Changes:** <0.25 dB

**RBW Switching Uncertainty (RBW ≤3 MHz):** <0.15 dB

**Log Fidelity (<–10 dBm mixer level [note 4],
0 to 80 dB below reference level, signal to noise >25 dB):** <0.07 dB

**Power Bandwidth Uncertainty (RBW 10 Hz to 1 MHz):** 0.1 dB

**VSWR (≥10 dB attenuation):**
**≤3 GHz:** <1.3
**>3 GHz:** <1.5

**Combined Amplitude Accuracy (95% confidence, note 3):** <0.65 dB

## *Ranges*

**Reference Level Range:** –150 to +30 dBm in 0.01 dB steps

**Scale Type:** Log or Linear

**Log Scale per Division:** 0.1 to 20 dB

**Max Average Power (10 dB attn.) w/o Damage:** +30 dBm

**Input Attenuator Range:** 0 to 62 dB, 2 dB steps nominal

**Displayed Dynamic Range:** 130 dB typical

## *Spurious*

**Spurious Responses (–10 dBm mixer level,
span ≤3 MHz [note 6]):**

f <300 kHz from carrier, –70 dBc
f ≥300 kHz from carrier, –80 dBc

**Residual Responses (≥10 MHz):** <–95 dBm

**Image Rejection:** <–90 dBc, <–105 dBc typical

**IF Rejection:** <–80 dBc, <–100 dBc typical

## *Other Amplitude Related*

**Calibrator Frequency:** 50 MHz, internal connection

**Amplitude Axis Units:** dBm, dBmV, dBµV, W, and A

## Sweep Related Characteristics

**Trigger Source(s):** Free Run, Line, External (±10V @ 10 kΩ), Video, IF Power (Wide BW)

**Frequency Domain Sweep Time:**

  **Span ≤4 GHz:** 5 ms to 10,000 seconds

  **Span >4 GHz:** 16 ms to 10,000 seconds

**Time Domain (Zero Span) Sweep Time:**
200 µsec to 10,000 seconds

**Sweep Time Accuracy:**

  **Span = 0 Hz:** 0.1%

  **Span >0 Hz (Swept):** 1%

  **Pre/Post Trigger:** –Sweep Time to 65 ms

## Display Related Characteristics

**Detector Modes:** Auto, Normal, Max Peak, Min Peak, RMS, Average, Sample (available simultaneously)

**Trace Functions:** Normal, View, Max Hold, Min Hold, Average, Blank

**Traces per Graph:** Up to 5

**Waveform Math:** User can export trace data in CSV format for external processing. Additional math available using MATLAB from The Mathworks. See Connectivity to MATLAB (Option 40) for more details.

## Marker Related Characteristics

**Markers:** Normal, Delta, Display Line, Noise, Phase Noise (Delta CW to Noise)

**Marker Frequency Resolution:** 0.2% of span

**Marker Amplitude Resolution:** 0.01 dB

**Marker Functions:** Marker to peak, marker to next peak, marker to min., marker to reference level, marker to center frequency

**Peak Functions:** Peak to center, peak to reference level

## "Smart" Signal Analyzer Measurements

**Channel Power:**

  **Standards Measured:** WCDMA (UMTS), user defined

  **Channel Power Uncertainty:** 0.67 dB (Note 10)

**Adjacent Channel Power Ratio (ACPR):**

  **Standards Measured:** WCDMA (UMTS), user defined

  **Offsets Measured:** Up to 6

  **ACPR Uncertainty:** 0.5 dB (Note 11)

**Multi-Carrier Channel Power:**

  **Standards Measured:** WCDMA (UMTS), user defined

  **Number of Carriers:** 1 to 12, plus adjacent and 2 alternate channels

  **Channel Power Uncertainty:** 0.67 dB (Note 10)

**Occupied Bandwidth:**

  **Frequency Accuracy:** ±Span/500 Nominal

**Third-Order Intercept (TOI):** Measure third order products and intercept from two tones

## Internal PC Functionality

**Interfaces:** USB, Ethernet, VGA, Parallel printer

**USB Functionality:** USB access to printers, CDs, disks, cameras, memory devices

**Internal Hard Disk Drive:** ≥40 GB
"Restore" partition on internal Hard Disk Drive

**Removable Media Drive:** CD R/W + DVD-ROM

**Processor:** Pentium 4 or greater

## Options

Allows seamless transfer of Signature measurements and setup information into the MATLAB workspace. Supports MATLAB 7 (revision 14 or R2007a). Simulink can access this information via the "To Workspace" and "From Workspace" blocks.

Allows viewing of MATLAB computed results, super-imposed on the Signature measurement display. MATLAB computed results may be set to automatically update with current measurements. Handshake between Signature and MATLAB ensures synchronization, such as for averaging. MATLAB must be purchased from The MathWorks (www.mathworks.com).

### *GPIB Interface (Option 3)*

SH1, AH1, T6, SR1, RL1, PP0, DC1, C0 or C1
Note: Programming for options 41 and 52 are not supported via GPIB.

### *External Hard Disk Drive (Option 4)*

Internal disk drive removed, rear panel Serial-ATA connector provides connection to external hard drives. Includes two external disk drives with complete Signature software.

### *30 MHz Demodulation Bandwidth (Option 22)*

Complex modulated signals with up to 50 MHz bandwidth can be captured and analyzed. Also includes baseband differential I & Q inputs. Option 22 must be factory installed and calibrated.

**Max Single-FFT Span:** 30 MHz (Note 9)

**Modulation Analysis BW:** 30 MHz, 50 MHz with anti-alias filter turned off

**I-Q Inputs:** 30 MHz combined BW

**Additional Frequency Response Error in Wideband FFT mode:** 1 dB (nominal)

### *WCDMA and HSDPA/HSUPA Modulation Analysis (Option 30)*

**Link Direction:** Downlink and Uplink

**Inputs:** RF

**Measurements Functions:** See page 7

**Specifications:** See page 7

### *QAM/PSK Modulation Analysis (Option 38)*

**Modulation Analysis BW:** 8 MHz
  **With Option 22:** 30 MHz, 50 MHz with anti-alias filter turned off

**Symbol Rate Range:** 10 kHz to 4 MHz
  **With Option 22:** 10 kHz to 20 MHz, 30 MHz with anti-alias filter turned off

**Modulation Formats:** BPSK, QPSK, π/4 DQPSK, 8 PSK, 3π/8 - 8PSK, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM

**Filtering:** Root-raised-cosine, a=0.1 to 1

**Analysis Length:** 100 to 10k symbols

**EVM:** (20ºC to 30ºC) Test Conditions >–20 dBm, QPSK and 64 QAM modulation, alpha = 0.22, reference level optimized
  **For Carrier Frequency <3 GHz (Note 7):** 1.25% 0.1 to 6 MHz, 2% 6 to 15 MHz, 2.5% 15 to 20 MHz
  **For Carrier Frequency from 3 GHz to 6 GHz:** Error due to frequency response = 1%

### *Signature Measurements Transfered to MATLAB:*
  Traces (in dBm)
  IQ vectors (in Volts)

### *IQ Vector Parameters:*
  **Sample rate:** 428 kHz to 21.4 MHz (9 settings)
  With Option 22: 100 kHz to 50 MHz (21 settings)
  **Capture Length:**
    2 million samples (>4.5 seconds for the minimum sample rate)
    With Option 22: 10 million samples (1.28 sec max for some sample rates)
  **Bandwidth:**
    Varies with sample rate; 8 MHz max
    With Option 22: 30 MHz max, 50 MHz with anti-alias filter off
  **Handshake:** On/Off

## WIMAX Modulation Analysis (Option 41)

Supports IEEE 802.16d/e with compliance to WiBro (requires Option 22)

**Conformance:** 802.16 OFDMA (Mobile WiMAX/WiBro), 802.16 OFDM (Fixed WiMAX)

**Link Type:** Uplink, Downlink

**Duplexing Mode:** TDD, FDD (Burst transmission required on both Uplink and Downlink)

**Max. Capture Duration:** 200 ms to 1.28s, depending on bandwidth

**Bandwidths:** All WiMAX permissible values (1.25, 1.5, 1.75, 2.5, 3, 3.5, 5, 6, 7, 8.75, 10, 12, 14, 15, 17.5, 20, 24, and 28 MHz)

**Cyclic Prefix Values:** 1/4, 1/8, 1/16, 1/32

**Auto Cyclic Prefix detection:** OFDMA: Yes, OFDM: No

**FFT sizes:** OFDMA: 128, 512, 1024, 2048, OFDM: 256

**Modulation Formats:** BPSK (pilots) QPSK, 16QAM, 64QAM (auto detection (OFDM only) or manual)

**Preamble Detection**
  OFDM: Auto Detection
  OFDMA: Manually Set

### Analysis Configuration

**OFDMA:**
  **Zone selection within RF burst**
  **Number of Zones that can be analyzed simultaneously:** 1
  **Zone types supported:**
    **Downlink:** PUSC, FUSC, and OFUSC
    **Uplink:** PUSC and OPUSC

  **Number of Bursts in measurements:** up to 8
**OFDM:**

  **Number of Bursts in measurements:** 1
  Selective analysis by symbol range and carrier number

### Pilot Tracking

  **OFDMA Downlink, OFDM:** Amplitude, Phase, or Timing (user selectable)
  **OFDMA Uplink:** Timing

### Equalizer Training

  **OFDM:** Channel Estimation Sequence, with or without Pilots
  **OFDMA Downlink:** Channel Estimation Sequence, with or without Pilots and Data Symbols
  **OFDMA Uplink:** Pilots, with or without Data Symbols

### RF Measurements

Power (RSSI), Burst Carrier to Interference and Noise Ratio (CINR), Power vs. Time, Spectrum (FFT), Spectral Flatness (absolute and Delta between Adjacent Channels), Complementary Cumulative Distribution Function (CCDF), Crest Factor

### Modulation Measurements

EVM (RCE) including Peak and Peak Position, EVM vs. Carrier and vs. Symbol, IQ Offset, IQ Gain Imbalance, Quadrature Error, Carrier Frequency Error, Symbol Clock Error, Data Symbols (not decoded), FCH information fields, MAP information fields

**Residual EVM (RCE):** <0.5% (46 dB, see note 12)

## Phase Noise Measurements (Option 52)

Plot of Single-Sideband Phase Noise versus Offset

**Displays:**

  Multiple phase noise trace plots on the same scale, each in a different color

  Smoothed Traces
  Instrument Phase Noise Specification
  Limit Lines
  Phase Noise vs. time at a user-specified offset
  Integrated noise in seconds, degrees, or Hz

**Instrument Noise Compensation:**

  Phase Noise (requires low-phase-noise reference signal at the test frequency)

**Sweep Mode:** FFT and Swept, controllable by decade

**Averaging (specifiable by decade):**
  Trace averaging for FFT
  VBW for swept

**Minimum Offset:** 10 Hz

**Maximum Offset:** 100 MHz

## Comprehensive WCDMA and HSDPA Measurements

| | QPSK | Composite | Single-Code | Single-Code Compressed Mode |
|---|---|---|---|---|
| **Modulation Measurements** | | | | |
| EVM (RMS, Peak, and Peak Position) | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Magnitude and Phase Error | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| IQ Offset | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Frequency Error | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Scramble Code (automatically determined) | Not Applicable | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Channel Power (with or without RRC filtering) | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Primary, Secondary, and Total Sync Channel (SCH) Power | Not Applicable | Downlink only | Downlink only | Downlink only |
| Peak Code-Domain Error (PCDE) | Not Applicable | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Bitstream | Not Applicable | Not Applicable | Downlink and Uplink | Downlink and Uplink |
| **Modulation Graphs** | | | | |
| Constellation | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Vector Diagrams | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Power vs. Time | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| EVM versus Time | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Magnitude Error versus Time | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Phase Error versus Time | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Eye Diagrams | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |

| Code-Domain Graphs | Graph | Zoom | Table |
|---|---|---|---|
| Code-Domain Power | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |
| Code-Domain Error | Downlink and Uplink | Downlink and Uplink | Downlink and Uplink |

## RF Measurements

Channel Power
ACLR
Multi-Carrier Power
Occupied Bandwidth
CCDF
Spectrum Masks

| Specifications | 3GPP TS 25.141 Clause | Instrument Tolerance Interval | 3GPP Required Test Instrument Tolerance[1] | Conditions 95% confidence, 20-30ºC, Frequency 500 MHz to 3 GHz, Mixer Level –10 to –25 dBm, sufficient averaging. |
|---|---|---|---|---|
| Power Uncertainty | 6.2.1 | <0.67 dB | <0.7 dB | Note 10 |
| CPICH Power Uncertainty | 6.2.2 | <0.65 dB | <0.8 dB | |
| Frequency Error | 6.3 | <10 Hz | <12 Hz | Frequency References Locked |
| Power Control Step Uncertainty | 6.4.2 | <0.1 dB | <0.1 dB | |
| Power Control Dynamic Range Uncertainty | 6.4.3 | <0.3 dB | <1.1 dB | |
| Total Power Dynamic Range Uncertainty | 6.4.4 | <0.2 dB | <0.3 dB | |
| Occupied Bandwidth Uncertainty | 6.5.1 | <38 kHz | 100 kHz | |
| Code Domain Power Floor | – | <–50 dB | – | |
| ACLR     Floor (1 Carrier)     Uncertainty | 6.5.2.2 <br> >75 dB <br> <0.5 dB | | – <br> <0.8 dB | Nominal, optimum mixer level and reference level <br><br> ACLR= 45 to 55 dB |
| EVM     Floor     Uncertainty | 6.7.1 <br> <1% <br> <1% | | – <br> 2.5% | Composite, Single-Code, or QPSK <br> Optimal Reference Level and Attenuation <br> EVM 15 to 20% |
| Peak Code-Domain Error (PCDE)     Floor     Uncertainty | 6.7.2 <br> <–50 dB <br> <1.0 dB | | – <br> <1.0 dB | PCDE –30 to –36 dB |
| Transmitted Code Power Absolute Uncertainty | H.3 | <0.64 dB | <0.9 dB | Note 3 |
| Transmitted Code Power Relative Uncertainty | H.3 | <0.2 dB | <0.2 dB | |
| Transmitted Carrier Power Uncertainty | H.4 | <0.07 dB | <0.3 dB | |

1: 3GPP TS 25.141 version 6.12.0 December 2005, subclause 4.1 and Annex G

## General Specifications

*Power Requirements*

**AC:** 85-264 VAC, 47-63 Hz

**Power Consumption:**

  **Operating:** 400 VA

  **Standby:** 30 VA

**Display:** 26.6 cm (10.4 inches) XGA Color with touch screen

**Weight**: <28 kg (62 lbs)

**Dimensions:** 242 H x 432 W x 508 D mm
                (9.5 H x 17 W x 20 D in.)

**Warranty:** 3 years

**Calibration Interval:** 1 year

**Temperature Range:**

  **Operating Temperature Range:** 0 to +50°C

  **Storage Temperature Range:** –40 to +75°C

**EMI Compatibility:** Meets the emission and immunity requirements of:

        EN61326: 1998
        EN55011: 1998 / CISPR 11: 1997 Group 1
        Class A
        EN61000-3-2: 1995 + A14
        EN61000-3-3: 1995
        EN61000-4-2: 1995 – 4 kV CD, 8 kV AD
        EN61000-4-3: 1997 – 3 V/m
        EN61000-4-4: 1995 – 0.5 kV SL, 1 kV PL
        EN61000-4-5: 1995 – 0.5 kV DM, 1 kV CM
        EN61000-4-6: 1996 – 3V
        EN61000-4-11: 1994 – 100%/1 cycle

**Safety:** Meets safety requirements of Low Voltage/Safety Standard 72/73/EEC – EN61010-1: 2001

## Notes to Specifications

*Note 1*

For swept spectrum measurements

*Note 2*

50 MHz, 0 dBm input, Source VSWR <1.1, 10 dB input attenuation, 500 kHz RBW, 0 dBm reference level

*Note 3*

95% Confidence Amplitude Error Calculation, (CW Signals, 20 to 30°C) 95% confidence level is determined by RSS combination of the individual standard errors. Uniform distribution is used for all contributors except VSWR error.

U-shaped distribution is used for VSWR error.

| | Error Specification (dB) | σ |
|---|---|---|
| Amplitude Uncertainty at 50 MHz [dB] | 0.1 | 0.06 |
| Frequency Response at 10 dB Attenuation [dB] | 0.4 | 0.23 |
| Frequency Response from Attenuator Switching [dB] | 0.2 | 0.12 |
| Reference Level Switching Uncertainty with Attenuator Changes [dB] | 0.25 | 0.14 |
| RBW Switching Uncertainty [dB] | 0.15 | 0.09 |
| Log Fidelity [dB] | 0.07 | 0.04 |
| VSWR 1.5 Error (DUT VSWR 1.2) | 0.15 | 0.11 |
| RSS Combined Error | | 0.33 |
| 95% Confidence Level for Combined Errors (Combined Errors * 1.96) | | 0.65 |

*Note 4*

Mixer level = signal level minus attenuation

*Note 5*

RBW = 0.1 Hz, FFT mode, 0 dB attenuation, average detector

*Note 6*

Specifications apply to mixer level ≤–30 dBm for signals near 3186 MHz and ≤–50 dBm for signals near 4780 MHz

*Note 7*

For symbol rates ≥10 MHz, the carrier frequency must be >500 MHz

*Note 8*

Compared to 10 dB attenuator setting, for 20, 30, and 40 dB attenuator settings. For other attenuator settings:
≤3 GHz: <0.4 dB
>3 GHz: <0.65 dB

*Note 9*

Spurious performance for 30 MHz FFT span may be degraded when attenuation is set manually

*Note 10*

95% Confidence Amplitude Error Calculation, similar to note 3. However Power Bandwidth Uncertainty is included. Uses RMS detection and sufficient averaging to reduce the measurement variance (Swept Method only).

*Note 11*

The most significant contribution to ACPR uncertainty is the instruments measurement floor.

*Note 12*

0 dBm signal level, optimum reference level and attenuation settings. For OFDMA, Residual EVM measured over a 100 symbol 64 QAM, 1024 FFT, 10 MHz bandwidth, fully loaded PUSC segment with PN sequence data. For OFDM, Residual EVM measured over a 100 symbol 64 QAM PN packet.

*Specification Conditions*

The specifications presented are covered by the product warranty unless indicated as typical or nominal. Specifications apply under the following conditions unless otherwise noted:

· The analyzer has been calibrated within the specified Calibration Interval

· No error or warning messages

· Over the 0° C to 50° C operating range

· After a 30 minute warm up at ambient temperature

· At least 2 hours of storage or operation at the operating temperature

· Sweep Time Coupling = Accy for amplitude and frequency specificationsTypical specifications describe expected performance beyond the warranted values.

Characteristics or nominal specifications describe expected product performance as designed or performance that may not be measured in the manufacturing process.
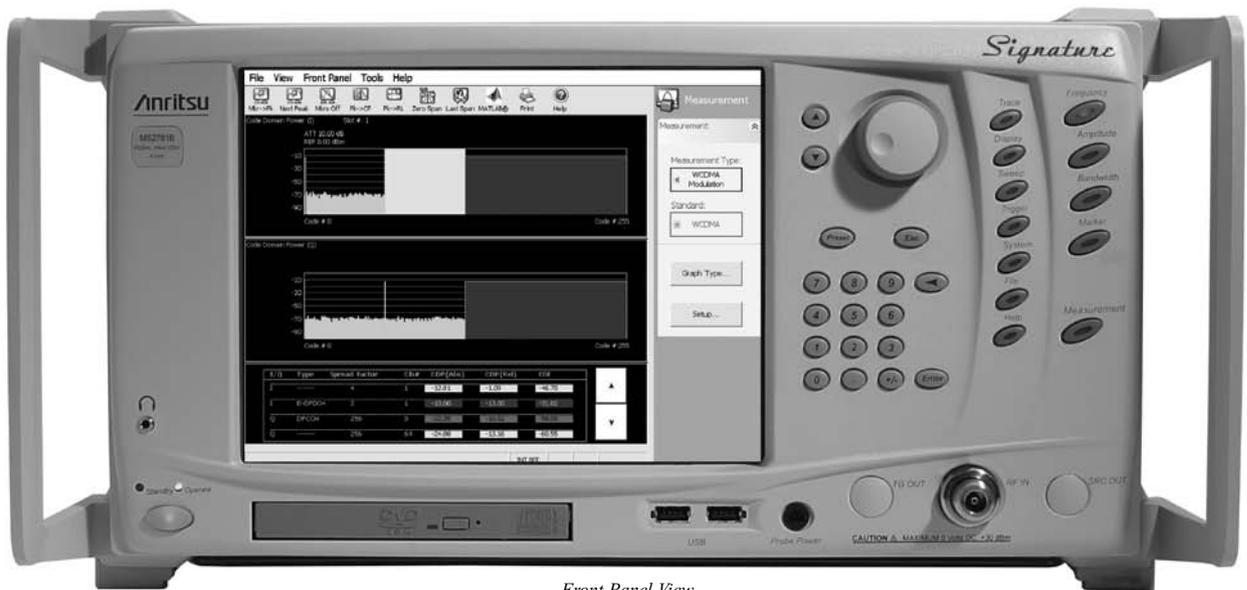
*Front Panel View*

## Front Panel Inputs and Outputs

**RF Input:**  Type-N Female, 50Ω , DC coupled

**Probe Power:**  +15V ±7%/130 mA, –12.6V ±10%/45 mA

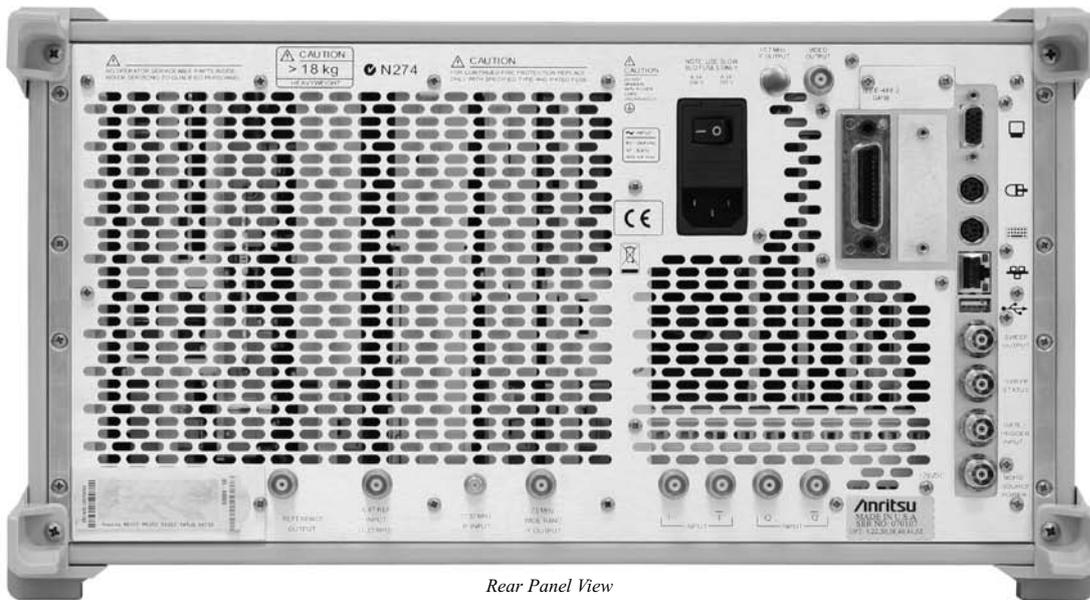**Touch Screen Display:**  Contact sensitive

**Front Panel Keypad:**  Preset, Menu keys, Help key, Measurement key, Numerical entry pad, Entry/Knob, Increment/Decrement keys

**Operate/Standby**

**CD R/W + DVD-ROM**

**USB:**  2 ports Type A, Version 1.1

**Headphone Jack**:  CD audio

*Rear Panel View*

## Rear Panel Inputs and Outputs

**Power Supply Input Voltage:** 85-264 VAC; 47 to 63 Hz

**AC Power Switch:** Mains power switch

**Wide Bandwidth Log Video Output:** 2.5V nominal, full scale into 50Ω

**75 MHz Wide Band IF Output:**
  **Frequency:** 75 MHz nominal
  **Level (–10 dBm @ 1st mixer):** –11.5 dBm ±3 dB
  **Bandwidth:** >40 MHz

**IF Input:** Not Used

**Reference Frequency (EXT REF) Input:**
  **Input Level:** –6 dBm <Input signal <+10 dBm
  **Frequency:** Any frequency from 1 to 25 MHz with 1 MHz resolution and 1.544 or 2.048 MHz.
  (Derate SSB Phase Noise by 3 dB w/Ext Ref of 1.544 MHz)

**Reference Frequency Output:**
  **Output Level:** 8 dBm ±3 dB
  **Frequency**:
    **If external reference not used:** 10 MHz
    **If external reference used:** Same as external reference frequency

**Sweep Output:** Not used

**Sweep Status Output:** TTL, active low when sweeping

**External Trigger Input:** BNC (±10 V nominal, into 10 kΩ)

**Noise Source Power:** 28 VDC (switchable), >60 mA available current

**GPIB:** See Option 3 description

**Ethernet:** 10BASE-T, 100BASE-TX, 1000BASE-T

**VGA Monitor Output:** Matches instrument front panel display resolution

**I and Q Inputs (Option 22):** 50Ω or 1 MΩ, switchable unbalanced or differential,
±2.5V max (signal to ground or between differential inputs)

**USB:** Type A Port, Version 2.0

**Keyboard:** PS/2

**Mouse:** PS/2

# Ordering Information

## Models

MS2781B High Performance Signal Analyzer (100 Hz to 8 GHz)

## Options

| | |
|---|---|
| MS2780/1 | Rack Mount Adapter, with slides |
| MS2780/1A | Rack Mount Adapter, no slides |
| MS2780/3 | GPIB Interface |
| MS2780/4 | External Hard Disk Drive |
| MS2780/22 | 30 MHz Demodulation Bandwidth (includes baseband differential I & Q inputs) |
| MS2780/30 | WCDMA and HSDPA/HSUPA Modulation Analysis |
| MS2780/38 | QAM/PSK Modulation Analysis |
| MS2780/40 | Connectivity to MATLAB |
| MS2780/41 | WiMAX Modulation Analysis supports 802.16d/e with compliance to WiBro (requires Option 22) |
| MS2780/52 | Phase Noise Measurements |
| Es50MMD | Extends warranty to 5 years |
| MS2780/98 | Z540/ISO Guide 25 Calibration |
| MS2780/99 | Premium Calibration |

## Included Accessories

Power Cord, Operating and Programming Manual (printed and CD-ROM), Restore software CD set, USB Optical Mouse, Blank CD R/W disc, Spare Fuse

## Option Requirements

| | |
|---|---|
| Option 1 | Not Option 1A |
| Option 1A | Not Option 1 |
| Option 3 | None |
| Option 4 | None |
| Option 22 | None |
| Option 30 | None |
| Option 38 | None |
| Option 40 | None |
| Option 41 | Option 22 (30 MHz Demodulation Bandwidth) |
| Option 52 | None |
| Option 98 | Not Option 99 (Option 99 includes Option 98) |
| Option 99 | Not Option 98 (Option 99 includes Option 98) |

## Optional Accessories

| | |
|---|---|
| 10410-00273 | Additional printed Operation Manual |
| 10410-00274 | Additional printed Programming Manual |
| 10410-00275 | Signature Maintenance Manual |
| 1N50B | Limiter/DC Block, N(m), to N(f), 50$\Omega$, 1 MHz to 3 GHz. |
| 1N50C | Limiter, N(m) to N(f), 50$\Omega$, 10 MHz to 18 GHz |
| 42N50A-30 | 30 dB Attenuator, 50 Watt N(m) to N(f) |
| 12N50-75B | 75W Matching Pad, DC to 3 GHz, 50$\Omega$ N(m) to 75$\Omega$ N(f) |
| 11N50B | Power Divider, 1 MHz to 3 GHz, 50$\Omega$, N(f) input, N(f) output |
| 2100-1 | GPIB Cable 1M |
| 2100-2 | GPIB Cable 2M |

# Anritsu

**ANRITSU Corporation**
5-1-1 Onna, Atsugi-shi, Kanagawa, 243-8555 Japan
Phone: +81-46-223-1111
Fax: +81-46-296-1264

**- U.S.A.**
**ANRITSU Company**
1155 East Collins Boulevard, Suite 100,
Richardson, Texas 75081
Toll Free: 1-800-ANRITSU (267-4878)
Phone: +1-972-644-1777
Fax: +1-972-671-1877

**- Canada**
**ANRITSU Electronics Ltd.**
700 Silver Seven Road, Suite 120, Kanata,
Ontario K2V 1C3, Canada
Phone: +1-613-591-2003
Fax: +1-613-591-1006

**- Brazil**
**ANRITSU Electrônica Ltda.**
Praca Amadeu Amaral, 27-1 andar
01327-010 - Paraiso, São Paulo, Brazil
Phone: +55-11-3283-2511
Fax: +55-11-3886940

**- U.K.**
**ANRITSU EMEA Ltd.**
200 Capability Green, Luton, Bedfordshire LU1 3LU, U.K.
Phone: +44-1582-433280
Fax: +44-1582-731303

**- France**
**ANRITSU S.A.**
9, Avenue du Québec Z.A. de Courtaboeuf
91951 Les Ulis Cedex, France
Phone: +33-1-60-92-15-50
Fax: +33-1-64-46-10-65

**- Germany**
**ANRITSU GmbH**
Nemetschek Haus, Konrad-Zuse-Platz 1
81829 München, Germany
Phone: +49 (0) 89 442308-0
Fax: +49 (0) 89 442308-55

**- Italy**
**ANRITSU S.p.A.**
Via Elio Vittorini, 129, 00144 Roma, Italy
Phone: +39-06-509-9711
Fax: +39-06-502-2425

**- Sweden**
**ANRITSU AB**
Borgafjordsgatan 13, 164 40 Kista, Sweden
Phone: +46-8-534-707-00
Fax: +46-8-534-707-30

**- Finland**
**ANRITSU AB**
Teknobulevardi 3-5, FI-01530 Vantaa, Finland
Phone: +358-20-741-8100
Fax: +358-20-741-8111

**- Denmark**
**ANRITSU A/S**
Kirkebjerg Allé 90 DK-2605 Brondby, Denmark
Phone: +45-72112200
Fax: +45-72112210

**- Spain**
**Anritsu EMEA Ltd.**
**Oficina de Representación en España**
Edificio Veganova
Avda de la Vega, n° 1 (edf 8, pl1, of 8)
28108 ALCOBENDAS - Madrid, Spain
Phone: +34-914905761
Fax: +34-914905762

**- United Arab Emirates**
**ANRITSU EMEA Ltd.**
**Dubai Liaison Office**
P O Box 500413 - Dubai Internet City
Al Thuraya Building, Tower 1, Suite 701, 7th Floor
Dubai, United Arab Emirates
Phone: +971-4-3670352
Fax: +971-4-3688460

**- Singapore**
**ANRITSU Pte. Ltd.**
60 Alexandra Terrace, #02-08, The Comtech (Lobby A)
Singapore 118502
Phone: +65-6282-2400
Fax: +65-6282-2533

**- India**
**ANRITSU Pte. Ltd.**
**India Liaison Office**
Unit No.S-3, Second Floor, Esteem Red Cross Bhavan,
No.26, Race Course Road, Bangalore 560 001 India
Phone: +91-80-32944707
Fax: +91-80-22356648

**- P. R. China (Hong Kong)**
**ANRITSU Company Ltd.**
Units 4 & 5, 28th Floor, Greenfield Tower, Concordia Plaza,
No. 1 Science Museum Road, Tsim Sha Tsui East,
Kowloon, Hong Kong, P.R. China
Phone: +852-2301-4980
Fax: +852-2301-3545

**- P. R. China (Beijing)**
**ANRITSU Company Ltd.**
**Beijing Representative Office**
Room 1515, Beijing Fortune Building,
No. 5 , Dong-San-Huan Bei Road,
Chao-Yang District, Beijing 100004, P.R. China
Phone: +86-10-6590-9230
Fax: +82-10-6590-9235

**- Korea**
**ANRITSU Corporation, Ltd.**
8F Hyunjuk Bldg. 832-41, Yeoksam-Dong,
Kangnam-ku, Seoul, 135-080, Korea
Phone: +82-2-553-6603
Fax: +82-2-553-6604

**- Australia**
**ANRITSU Pty Ltd.**
Unit 21/270 Ferntree Gully Road, Notting Hill
Victoria, 3168, Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

**- Taiwan**
**ANRITSU Company Inc.**
7F, No. 316, Sec. 1, Neihu Rd., Taipei 114, Taiwan
Phone: +886-2-8751-1816
Fax: +886-2-8751-1817