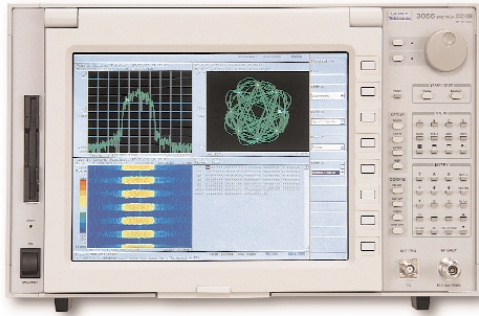# 3066 • 3086

Real-Time Spectrum Analyzers

Features and Benefits

Seamless Acquisition for Capture of Short Duration or Intermittent Events

Analyzes in Frequency, Time and Modulation Domain

DC to 3 GHz Coverage

Frequency Event Trigger for Acquisition of Burst or Infrequently Occurring Signals

Post Capture 1000:1 Zoom Allows Analysis of Individual Signals After Wideband Capture

Code Domain Power and Complementary Cumulative Distribution Function (CCDF) for IS-95, W-CDMA Signals

CCDF for Multi-carrier and W-CDMA Signals

Applications

1st, 2nd, and 3rd Generation Cellular/PCS R&D – Including GSM, CDMA, IS-136, PDC, W-CDMA

Signature Analysis

Spectrum Monitoring

Settling Time Measurements for Oscillators and Synthesizers

Phase Hit Capture and Measurement

Debugging of Hardware/Software Interface Problems

The 3066 and 3086 are DC to 3 GHz real-time spectrum analyzers that allow the seamless capture of frequency spectra with spans up to 30 MHz (5 MHz – 3066). This allows the spectrum of burst signals, such as those from GSM, IS-136, PDC or partial rate CDMA mobile stations, to be easily captured and examined. Real-time spectrum analyzers take a very different approach compared to traditional sweeping spectrum analyzers. Rather than acquiring one frequency step at a time, the real-time instrument captures a block of frequencies all at once. Because the instrument samples these full frames constantly (rather than waiting for each discrete frequency step to be measured), the signal can come or go as it pleases and the real-time spectrum analyzer will detect the change instantly.

The 12.1 in. color TFT display allows easy viewing of spectrum, waterfall displays, spectrograms and digital modulation analysis screens. Constellation and vector diagrams can be displayed, as well as frequency, phase, magnitude, I and Q versus time, for in-depth analysis of digitally modulated signals. Users can move a marker through the time record and analyze the modulation at any point. In particular, signals with symbol rates up to 20.48 Msymbols/sec (3066 – 5.3 Msymbols/sec) may be analyzed during and after capture. This facilitates analysis of W-CDMA signals with chip rates up to 16.384 Mcps.

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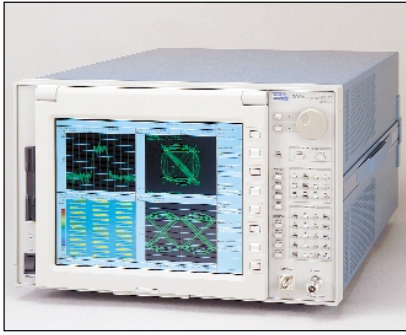
3086

In addition, a frequency mask trigger allows capture of randomly occurring or infrequent signals such as intermittent spurious emissions. If the user is not interested in the period between transmission bursts, the frequency mask trigger allows capture of the "burst-on" periods, thus maximizing the number of bursts that can be captured in memory for subsequent spectral, time or modulation analysis. The user can graphically define the frequency trigger mask; this allows the trigger condition to be generated by a particular event in the frequency domain irrespective of other activity within the displayed span. This is a major benefit when the trigger condition is used to capture signals arising from intermittent spurious or spectral re-growth events.

Option 1S, automatic waveform recording, can be used to store multiple memory blocks to the internal hard drive without operator intervention. This enables unattended monitoring and recording of transient events for later review.

A 1000:1 zoom capability permits analysis to be performed on an individual signal in a multi-signal environment.

Option 16: IS-95 and W-CDMA Code Domain Power for the 3086

CDMA and W-CDMA Base Station developers use code domain power measurements to verify correct operation of their designs. BTS amplifier designers rely upon Complementary Cumulative Distribution Functions (CCDF) to verify the input and output amplitude distributions of their test waveforms. When equipped with options 16 and 20, the 3086 now meets these needs for IS-95 and W-CDMA designs. The real-time nature of the 3086 spectrum analyzer brings unique advantages to this application.

The 3086 with option 16 processes the W-CDMA down-link signals as defined in "Specifications for W-CDMA Mobile Communication System Experiment Version 1.1" and offers extensive analysis capability including:

▶ **Code-domain power**
The analyzer measures the relative power to total power for each channel with 1024 channels maximum

▶ **Time vs. code-domain power**
The analyzer measures the relative power at symbol points for each channel as a time series

▶ **Code-domain power spectrogram**
The analyzer measures the code-domain power continuously for maximum 160 slots (0.1 s) and displays spectrogram for each slot

▶ **Modulation accuracy**
The analyzer measures EVM (error vector magnitude), amplitude error, phase error, waveform quality, and origin offset for each channel

For customers who need code domain analysis of IS-95 base station signals, option 16 also provides code power measurements for IS-95 signals over a 6144 symbol period.

Option 20 CCDF (3066 and 3086) Feature Summary

Option 20 records the statistical nature of a signal, and plots the probability of exceeding a measured average value for the waveform. A large amount of data is collected in the memory of the 3086, and Complementary Cumulative Distribution Function (CCDF) can be shown over selected periods of time to determine the effect of code selection or multi-carrier additions on the peak-to-average ratio of the waveform. Base station amplifier designers use this information to judge the distortion performance of their products. The rapid changes that occur in base station power outputs require a real-time bandwidth higher than the occupied bandwidth of the signals measured. The 3086 provides unique capability due to its 30 MHz real-time bandwidth, allowing CCDF measurements on up to 6 W-CDMA carriers simultaneously. In the 3066, CCDF measurements over a 5 MHz real-time bandwidth is possible.

Option 15: IS-95 Code Domain Power for the 3066 Spectrum Analyzer

OPTION 15 (3066) FEATURE SUMMARY:

Option 15 offers the measurement functions listed below:

▶ **Code-domain power**
Measures the relative code power to total power for each channel

▶ **Code-domain power vs. Time (codegram)**
The analyzer measures the code-domain power continuously for 6144 symbols (0.32 s) maximum and displays spectrogram for each symbol

▶ **Modulation accuracy and vector display**
Measures EVM (error vector magnitude), amplitude error, phase error, waveform quality, and origin offset for all signals

INPUT/MEMORY MODE RELATED

Input Mode – RF, Baseband; Wideband, IQ (3086 only).

Input Connector – N type (RF, Baseband, Wideband), BNC type (IQ).

Input Impedance – 50 Ω.

VSWR (N type) – 1.5 (Reference Level ≥-20 dBm).

Acquisition Mode – Roll, Block.

Acquisition Memory Size – 16 Mbytes.

Acquisition Memory Management –
RF, Baseband Input.
  Memory Mode: Frequency, Dual, Zoom.
  FFT Points: 1024, 256 (Frequency Mode).
  FFT Window: Rectangular, Hamming, Blackman-Harris.
  Block Size:
    1 to 16,000 Frames (Frequency Mode, 256 pt).
    1 to 4,000 Frames (Frequency Mode, 1024 pt).
    1 to 2,000 Frames (Dual, Zoom Mode).
  Minimum Frame Update Time:
    20 µs (Frequency Mode, 256 pt).
    80 µs (Frequency Mode, 1024 pt).
    160 µs (Dual, Zoom Mode).

Wideband, IQ Input (3086 only) –
  Memory Mode: Zoom.
  FFT Points: 1024.
  FFT Window: Rectangular, Hamming, Blackman-Harris.
  Block Size: 1 to 2,000 Frames.
  Minimum Frame: 25 µs.

Frequency Standard Related

Characteristic	Description
Reference frequency	10 MHz
Initial frequency tolerance	± 0.1 ppm
Frequency stability	
Aging	±0.0005 ppm/day
Temperature	±0.002 ppm (5 to 40°C)

RF INPUT RELATED

Frequency –
Range: 10 MHz to 3 GHz.
Center Frequency Settability: 0.1 Hz.
Span: 100 Hz to 3 GHz.
Vector Span: 100 Hz to 6 MHz.
Real-time Span: 100 Hz to 5 MHz.
Number of Bins:
  641 (100 Hz to 2 MHz span).
  801 (5 MHz span).
  481 (6 MHz span).
  Span/6250 + 1 (span ≥ 10 MHz).
Spectrum Purity: –100 dBc/Hz (1 GHz CF, 200 kHz span, 0 dBm ref, 10 kHz offset).
Residual FM: 3 Hz p-p.

Amplitude –
Reference Level: –50 dBm to +30 dBm.
Maximum Nondestructive Input Power: +30 dBm.
Self Gain-Calibration Accuracy: ±1.0 dB at 25 MHz within 5°C temperature variation.
Flatness: ±2.0 dB (10 MHz to 3 GHz).
Input Equivalent Noise: –140 dBm/Hz.
3rd Order Distortion: –65 dBc (–10 dBfs input, at 1 GHz).
Residual Response: –70 dBfs (0 dBm ref, 5 MHz span).
Image Suppression: 70 dB.
Spurious Free Dynamic Range (1 GHz CF, 0 dBm REF, sinusoidal signal at the center, spur apart more than 10 kHz from the signal):
  80 dB at 50 kHz span.
  75 dB at 100 kHz span.
  70 dB at 200 kHz and 500 kHz span.
  65 dB at 1/2/5 MHz span.

BASEBAND INPUT RELATED

Frequency –
Range: DC to 10 MHz.
Center Frequency Settability: 0.1 Hz.
Span: 100 Hz to 10 MHz.
Vector Span: 100 Hz to 6 MHz.
Real-time Span: 100 Hz to 5 MHz.
Number of Bins:
  641 (100 Hz to 2 MHz span).
  801 (5 MHz and 10 MHz span).
  481 (6 MHz span).
Spectrum Purity: –100 dBc/Hz (5 MHz CF, 200 kHz span, 0 dBm ref, 10 kHz offset).
Residual FM: 2 Hz p-p.

Amplitude –
Reference Level: –30 dBm to +30 dBm.
Maximum Nondestructive Input Power: +30 dBm.
Reference Level Accuracy: ±0.5 dB at 5 MHz.
Flatness: ±1.0 dB (1 MHz to 10 MHz).
Input Equivalent Noise: –150 dBm/Hz.
2nd Harmonic Distortion: –70 dBc (at 4.5 MHz).
DC Offset: –40 dBfs.
Residual Response: –70 dBfs (5 MHz CF, 5 MHz span, 0 dBm ref).
Alias Suppression: 65 dB.
Spurious Free Dynamic Range (5 MHz CF, 0 dBm ref, sinusoidal signal at the center, spur apart more than 10 kHz from the signal):
  85 dB at 50 kHz span.
  80 dB at 100 kHz span.
  75 dB at 200 kHz span.
  70 dB at 500 kHz span.
  70 dB at 1/2/5 MHz span.

WIDEBAND INPUT RELATED (3086 ONLY)

Frequency –
Range: 50 MHz to 3 GHz.
Center Frequency Settability: 0.1 Hz.
Span: 10 MHz, 20 MHz, 30 MHz.
Vector Span: 10 MHz, 20 MHz, 30 MHz.
Number of Bins:
  501 (10 MHz and 20 MHz span).
  751 (30 MHz span).

Amplitude –
Reference Level: –50 dBm to +30 dBm.
Maximum Nondestructive Input Power: +30 dBm.
Flatness within Span: ±1 dB (25°C ±5°C).
Input Equivalent Noise: –140 dBm/Hz.
3rd Order Distortion: –65 dBc (–10 dBfs input, at 1 GHz).
Residual Response: –60 dBfs (0 dBm ref, 30 MHz span).
Image Suppression: 70 dB.
Spurious Free Dynamic Range (1 GHz CF, 0 dBm ref, sinusoidal signal at the center, spur apart more than 500 kHz from the signal):
  65 dB at 10 MHz span.
  60 dB at 20 MHz and 30 MHz span.

IQ INPUT RELATED (3086 ONLY)

Frequency –
Range: ±15 MHz.
Span: 10 MHz, 20 MHz, 30 MHz.
Vector Span: 10 MHz, 20 MHz, 30 MHz.
Number of Bins:
  501 (10 MHz and 20 MHz span).
  751 (30 MHz span).

Amplitude –
Reference Level: 100 mV (amplitude of IQ signal).
Maximum Nondestructive Input Power: ±5 V.
Flatness within Span: ±0.5 dB (25°C ±5°C).
Residual Response: –60 dBfs (30 MHz span).
Alias Suppression: 55 dB.
Spurious free dynamic range (1 GHz CF, 0 dBm ref, sinusoidal signal at the center, spur apart more than 500 kHz from the signal):
  65 dB at 10 MHz span.
  60 dB at 20 MHz and 30 MHz span.

FRAME TIME RELATED

Frame Time (3086)

Span	1024 point	256 point
Baseband Mode:		
10 MHz	80 µs	20 µs
RF Mode and Baseband Mode:		
6 MHz	80 µs	20 µs
5 MHz	160 µs	40 µs
2 MHz	320 µs	80 µs
1 MHz	640 µs	160 µs
500 kHz	1280 µs	320 µs
200 kHz	3200 µs	800 µs
100 kHz	6.4 ms	1.6 ms
50 kHz	12.8 ms	3.2 ms
20 kHz	32 ms	8 ms
10 kHz	64 ms	16 ms
5 kHz	128 ms	32 ms
2 kHz	320 ms	80 ms
1 kHz	640 ms	160 ms
500 Hz	1280 ms	320 ms
200 Hz	3200 ms	800 ms
100 Hz	6400 ms	1600 ms
Wideband/IQ Input Modes: 3086 Only		
30 MHz	25 µs	25 µs
20 MHz	25 µs	25 µs
10 MHz	50 µs	50 µs

Minimum Frame Update Time

Span	1024 point FFT	256 point FFT
Baseband/Frequency Mode		
10 MHz	80 µs	20 µs
RF/Baseband/Frequency Mode		
500 kHz to 6 MHz	80 µs	20 µs
50 kHz to 500 kHz	200 µs	50 µs
5 kHz to 20 kHz	2000 µs	500 µs
500 Hz to 2 kHz	20 ms	5 ms
200 Hz	50 ms	12.5 ms
100 Hz	100 ms	25 ms
RF/Baseband/Dual Mode		
500 kHz to 6 MHz	160 µs	N/A
50 kHz to 500 kHz	400 µs	N/A
5 kHz to 20 kHz	4 ms	N/A
500 Hz to 2 kHz	40 ms	N/A
200 Hz	100 ms	N/A
100 Hz	200 ms	N/A
RF/Baseband/Zoom Modes		
5 MHz	160 µs	N/A
2 MHz	320 µs	N/A
1 MHz	640 µs	N/A
500 kHz	1.28 ms	N/A
200 kHz	3.2 ms	N/A
100 kHz	6.4 ms	N/A
50 kHz	12.8 ms	N/A
20 kHz	32 ms	N/A
10 kHz	64 ms	N/A
5 kHz	128 ms	N/A
2 kHz	320 ms	N/A
1 kHz	640 ms	N/A
500 Hz	1280 ms	N/A
200 Hz	3200 ms	N/A
100 Hz	6400 ms	N/A
Wideband/IQ Input Modes – 3086 Only		
30 MHz	25 µs	N/A
20 MHz	25 µs	N/A
10 MHz	50 µs	N/A

TRIGGER RELATED

Trigger Mode – Auto, Normal, Quick, Delayed, Interval, Quick-interval, Timeout, Auto, Normal [RF (span ≤ 6 MHz) and Baseband Input, Wideband and IQ Input (3086 only)].
Trigger Source – Internal/External.
Trigger Domain – Frequency, Time.
Trigger Position – 0 to 100%.
Frequency Trigger Mask –
Frequency Resolution: 1 bin.
Trigger Level Range: 0 dBfs to –70 dBfs.
Time Trigger Mask –
Time Resolution: 1 data point.
Trigger Level Range: 0 dBfs to –40 dBfs.
External Trigger Threshold Level – 1.6 V.

DISPLAY/VIEW

Data Display –
Waveform:
  Frequency vs. Amplitude/Phase.
  Frequency vs. I/Q voltage.
  Time vs. Amplitude/Phase.
  Time vs. I/Q voltage.
Spectrogram: Time vs. Frequency vs. Amplitude/Phase.
Waterfall:
  Time vs. Frequency vs. Amplitude/Phase.
  Time vs. Frequency vs. I/Q Voltage.
  Time vs. Amplitude/Phase Multi-Frame.
  Time vs. I/Q Voltage Multi-Frame.
AM Demodulation: Time vs. Modulation depth.
FM Demodulation: Time vs. Frequency deviation.
PM Demodulation: Time vs. Phase deviation.
FSK Demodulation: Time vs. Frequency deviation.
Polar: Vector diagram, Constellation diagram.
Eye Pattern: I, Q, Trellis.
Symbol Table: Binary, Octal, Hexadecimal.
Error Vector: EVM, Magnitude error, Phase error, Waveform quality (ρ).

View –
Number of Views: 1, 2, 4.
Settable Views: 8 maximum.
Display Traces: 2 on waveform display.

LCD Panel –
Size: 12.1 inch.
Display Resolution: 1024 x 768 pixels.
Color: 256 color (maximum).

DIGITAL DEMODULATION RELATED

Digital Demodulation Related

Characteristic	Description
Demodulator	
Carrier type	Continuous, Burst
Modulation format	BPSK, QPSK, π/4 Shift DQPSK, 8PSK, OQPSK, 16QAM, 64QAM, GMSK
Measurement filter	Root Cosine
Reference filter	Cosine, Gauss
Filter parameter	α/BT: 0.0001 to 1, 0.0001 step
Maximum symbol rate	5.3 Msps (RF, Baseband); 20.48 Msps (Wideband, IQ; the 3086 only)
Standard setup	PDC, PHS, NADC, TETRA, GSM, CDPD, IS-95, T-53
Display format	
Vector diagram	Symbol/locus display, Frequency error measurement, Origin offset measurement
Constellation diagram	Symbol display, Frequency error measurement, Origin offset measurement
Eye diagram	I/Q/Trellis display (1 to 16 symbols)
Error vector diagram	EVM, Magnitude error, Phase error, Waveform quality (ρ) measurement
Symbol table	Binary, Octal, Hexadecimal
Error measurement accuracy	10 frames averaged
PDC	EVM <1.2%, Mag error <1.0%, Phase error <0.8° (100 kHz span)
PHS	EVM <1.4%, Mag error <1.2%, Phase error <0.8° (1 MHz span)
GSM	EVM <1.8%, Mag error <1.2%, Phase error <1.0° (1 MHz span)
IS-95 reverse link	EVM <2.0% (5 MHz span)
QPSK, 4.096 Msps, 2 GHz	EVM <2.5% (20 MHz span)
QPSK, 16.384 Msps, 2 GHz	EVM <3.0% (30 MHz span, 25°C ±5°C)

MARKER ZOOM RELATED

Marker –
Marker Type: Normal, Delta, Band-Power.
Search Function: Peak Right, Peak Left, Maximum.
Link between Views: On/Off.

Measurement Function – Noise Power, Power within Band, C/N, Adjacent Channel Power, Occupied Bandwidth.

Digital Zoom –
Zoom Ratio: 2 to 1000.
Maximum Span in the Zoom Mode: 5 MHz (RF, Baseband), 30 MHz (Wideband, IQ, 3086 only).

SYSTEM CONTROLLER

Pentium MMX 200 MHz, 64 Mbyte SIMM, Windows 95, PCI, ISA, TMP68301 16 MHz, 2.1 Gbyte 3.5 inch EIDE, 1.44 Mbyte floppy drive, GPIB IEEE488.1, Keyboard PC/AT. (order separately), Centronics parallel port, SCSI 2.

ENVIRONMENTAL

Temperature Range –
Operating: +5 to +40°C (floppy not used), +10 to +40°C (floppy used).
Nonoperating: –20 to +60°C.

Humidity – Operating and nonoperating: 80% non-condensing. Maximum wet-bulb temperature 29°C.

Altitude –
Operating: Up to 2,000 m (6,500 ft).
Nonoperating: Up to 12,000 m (40,000 ft).

Random Vibration –
Operating: 0.27 g, 5 to 500 Hz, 10 minutes each axis.
Nonoperating: 2.28 g, 5 to 500 Hz, 10 minutes each axis.

Shock – Nonoperating: 20 g half-sine, 11 ms duration, 3 shocks per axis in each direction (18 shocks total).

Package Product –
Vibration and Bounce: Meets ASTM D999-75, Method A, Para. 3.1g, (NSTA proj. 1-A-B-1).
Drop: Meets ASTM D775-61, Method 1, Para. 5, (NSTA proj. 1-A-B-2).

EMC COMPLIANCE

Emissions –
Enclosure: EN55011 Class A, limits for radiated emissions.
AC Main: EN61000-3-2 Power line harmonics; EN55011 Class A, limits for radiated emissions.

Immunity –
Enclosure: EN61000-4-2 ESD (Up to 8 kV, 150 pF through 330 Ω) Internal terminals of connectors do not allow ESD test.
AC Main: EN61000-4-3 Radiation; EN61000-4-4 Fast Transient Burst; EN61000-4-5 Surge; EN61000-4-6 Conductive Immunity.

SAFETY

Safety – UL3111-1, CSA231, EN61010-1, IEC61010-1.

POWER

Line Voltage – 100 to 240 VAC Nominal.
Line Frequency – 47 Hz to 66 Hz.
Line Fuse – 10 A, fast.
Primary Circuit Dielectric Voltage Withstand Grounding Impedance –
1,500 Vrms, 50 Hz for 15 s, without breakdown. Verify continuity of grounding connection, by any suitable means, between a representative part required to be grounding and attachment– plug cap grounding pin. (0.1 Ω at 30 A).
Maximum Power – 280 W.
Maximum Line Current – 3.0 A rms at 50 Hz.
Surge Current – 15 A at 100 VAC; 30 A at 200 VAC.

Physical Characteristics

Dimensions	mm	in
Height	270	10.6
Width	430	16.9
Depth	600	23.6
Weight	**kg**	**lb**
Net	28	62

WARRANTY

One year parts and labor.

3086
Real-time Spectrum Analyzer.
Includes: User Manual, U.S. Power Cord, mouse.

3086 OPTIONS
Opt. 1S – Data capture software.
Opt. 16 – W-CDMA and IS-95 Code Domain Power for 3086.
Opt. 20 – CCDF measurements for 3086.

3066
Real-time Spectrum Analyzer.
Includes: User Manual, U.S. Power Cord.

3066 OPTIONS
Opt. 1S – Data capture software.
Opt. 15 – IS-95 Code Domain Power for 3066.
Opt. 20 – CCDF for 3066.

MEASUREMENT SERVICE OPTIONS
Opt. C3 – Three years of calibration services.
Opt. C5 – Five years of calibration services.
Opt. D1 – Test Data.
Opt. D3 – Test data (requires Opt. C3).
Opt. D5 – Test data (requires Opt. C5).
Opt. R3 – Three years of repair protection.
Opt. R5 – Five years of repair protection.

INTERNATIONAL POWER OPTIONS
Opt. A1 – Universal Euro 220 V, 50 Hz.
Opt. A2 – United Kingdom 240 V, 50 Hz.
Opt. A3 – Australian 240 V, 50 Hz.
Opt. A4 – North American 240 V, 60 Hz.
Opt. A5 – Switzerland 220 V, 50 Hz.

RECOMMENDED ACCESSORIES
PC Display Analysis Software (3066) – Order SL7PC66.
SL7PC66 Opt. 15 – IS-95 Code Domain Power for SL7PC66.
SL7PC66 Opt. 20 – CCDF for SL7PC66.
PC Display Analysis Software (3086) – Order SL7PC86.
SL7PC86 Opt. 16 – W-CDMA IS-95 Code Domain Power for SL7PC86.
SL7PC86 Opt. 20 – CCDF for SL7PC86.

For further information, contact Tektronix:

Worldwide Web: for the most up-to-date product information visit our web site at: www.tektronix.com/Measurement/commtest/

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