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Agilent 53310A
Modulation Domain Analyzer
Data Sheet



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Product Description

This section offers a brief description of the Agilent Technologies 53310A Modulation Domain Analyzer. It follows the menu structure of the product and describes its operation. For specifications, see the Product Specifications and Characteristics section.

Function

Frequency

Channel: A, B, or C (Optional)

Time Interval

Measurement: +TI or ±TI
Channel: A and B (Separate) or A only (Common)
Start: ⌐↑ or ⌐↓
Stop: ⌐↑ or ⌐↓

Input

Channels A and B

Voltage Threshold Range:
- Manual: +10 V to –10 V, settable in 2.5 mV steps
- Auto: Find 50% Threshold

Coupling: ac or dc
Impedance: 1 MΩ or 50 Ω
Hysteresis: Min to Max, settable in ten steps

Channel C (Optional)

Voltage Threshold: 0 volts
Coupling: ac
Impedance: 50 Ω
Hysteresis: Minimum

External Arm

Voltage Threshold: 0V, TTL (1.5 Volts), or ECL (–1.3 Volts)

Vertical/Histogram Display Range

Display measurement range is settable as Center and Span, or Minimum and Maximum. For frequency measurements, the maximum display value can be selected no larger than eight times the minimum display value.

Timebase

Main Timebase

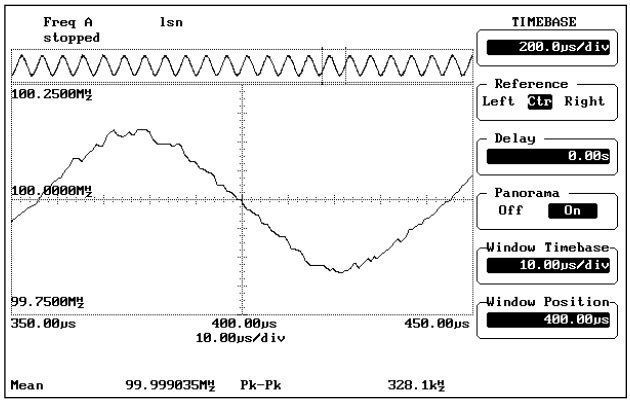
Range:
- Panorama Off: 1 µs/div to 1 s/div
- Panorama On: 1 to 20 times the window timebase setting (standard); 1 to 80 times the window timebase (Option 001)

Window Timebase

Range: 1 µs/div to 1 s/div
Position: Adjustable throughout the panorama

Trigger

Display Position: Left, Center, or Right
Delay: Adjustable



Dual timebases allow you to capture all the information you want, as shown in the panorama, while analyzing measurement details in the window.

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Trigger

Mode: Auto or Triggered
Triggered:
- Edge Trigger
  - Slope: ⌐ or ¬ of External
- Value Trigger
  - Source: Frequency or Time Interval measurements, depending on measurement function
- Range
  - Frequency: 80% of minimum display value to 120% of maximum display value
  - Time Interval: full measurement range
  - Slope: ⌐ or ¬
  - HF Reject: On or Off

Display

Type: "vs Time" or Histogram
- Frame type: Frame, Axes, Grid, or Off

vs Time
Acquisition Mode: Real Time or Repetitive
Real Time Persistence: Single or Infinite
Repetitive Averaging: On or Off

Histogram

Probability Scale (percent): Log or Linear
Probability Scaling: Auto or Manual
Accumulate: On or Off

Markers

Horizontal and vertical markers are available in "vs Time" and Histogram displays. Markers can be used in conjuction with automated analysis. They may also be used to delimit a portion of the measurement data for detailed analysis.

Histogram

Histogram Type: Histogram from "vs Time" or Fast Histogram
Accumulate: On or Off
Fast Histogram:
- Acquire Start: Auto, or External Start on ⌐ or ¬ edge
- Number of Measurements: 1 to 16 million per acquisition, $>10^{14}$ can be accumulated.

Sampling

Modes: Auto, Edge, or Time
Auto: Constant event sampling based on Timebase settings
Edge:
- Channel A or B: Every 1 to 256 events
- External: Every event

Time: 400 ns – 1 second

Utility

GPIB/Print setup
Mode: Addressed or Talk Only
Clicker: On or Off
Screen Saver: On or Off
Calibration and Diagnostic routines

Autoscale

Setup parameters are automatically determined to display the dynamics of the input signal. Measurement function and input conditioning should be selected prior to pressing Autoscale.

Automated Analysis

Built-in analysis functions include: Minimum, Maximum, Peak to Peak, Mean, 1/Mean, Standard Deviation, (Modulation) Rate, 1/Rate, and Probability.

Save/Recall

Ten measurement setups can be stored and recalled.

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Product Specifications and Characteristics

Both warranted specifications and operating characteristics of the Agilent 53310A are discussed in this section. To distinguish warranted specifications from operating characteristics, *specifications are highlighted throughout in italics.*

Frequency Measurements

Range

Channel A: *10 Hz to 200 MHz*
Channel B: *10 Hz to 100 MHz*
Channel C: *50 MHz to 2.5 GHz*

Maximum Measurement Rate

Fast Histogram: 1.5 MHz
Other Modes: 1 MHz

Resolution

Maximum available measurement resolution or display resolution, whichever is greater

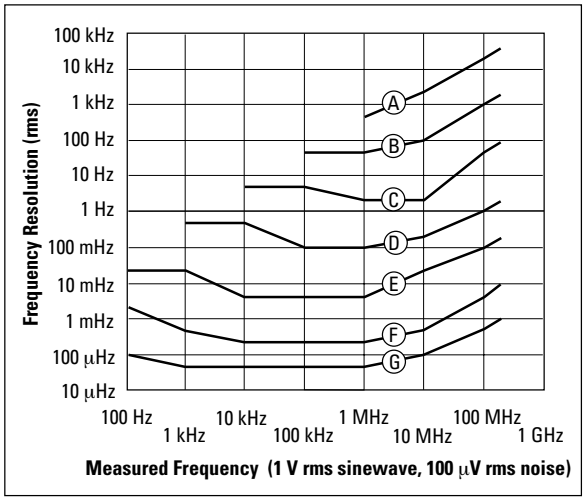
Maximum Available Measurement Resolution
(Auto Sampling):
See Graph 1 for Channels A and B
See Graph 2 for Option 030 Channel C

Note: Option 031 High Resolution 2.5 GHz Channel C offers superior measurement resolution. Refer to "Dynamic Frequency and Jitter Analysis at the Touch of a Button," Agilent 53310A brochure.

Display Resolution:
vs Time, or Histogram of vs Time
Window Off: Display Span/256
Window On: Display Span/224
Fast Histogram: Display Span/450

Accuracy: ±[*Resolution + (Frequency x Reference Error)*†]

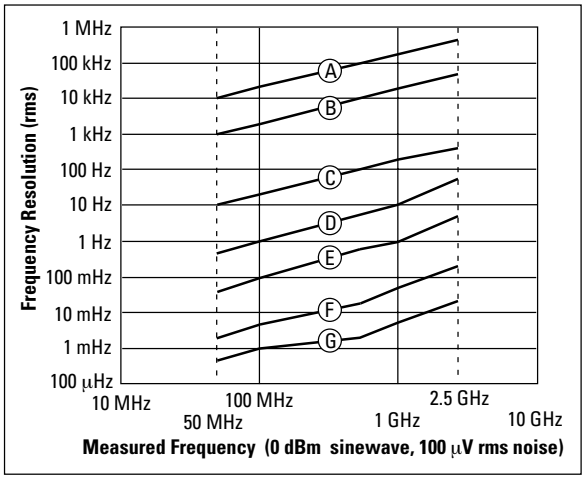
† Refer to Graph 3.



Graph 1. Maximum available frequency resolution for Channels A and B. Larger timebase settings and averaging will reduce the effects of random noise and improve resolution.

Legend for Graphs 1 and 2

	Timebase Setting (Interval at Center: Auto)	Interval at Center Setting (Interval at Center: Manual)
Ⓐ	20 µs/Div	1 µs
Ⓑ	200 µs/Div	10 µs
Ⓒ	2 ms/Div	100 µs
Ⓓ	20 ms/Div	1 ms
Ⓔ	200 ms/Div	10 ms
Ⓕ		100 ms
Ⓖ		0.5 s



Graph 2. Maximum available frequency resolution for Option 030 2.5 GHz Channel C. Larger timebase settings and averaging will reduce the effects of random noise and improve resolution.

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Time Interval Measurements

+ Time Interval

Range: *+20 ns to +1 second*

Maximum Measurement Rate:

Fast Histogram: 2.5 MHz

Other Modes: 1.25 MHz

± Time Interval

Range: *–0.5 s to +0.5 second*

Maximum Measurement Rate:

Fast Histogram: 2.0 MHz

Other Modes: 1.25 MHz

Resolution

Maximum available measurement resolution or display resolution, whichever is greater

Maximum Available Measurement Resolution:

$$\sqrt{\left(200\,\text{ps rms}\ *\right)^2 + \left(\text{Threshold Trigger Errors}^{\dagger\dagger\dagger}\right)^2}$$

Notes

1) Threshold trigger errors are usually negligible for input slew rates >5V/µs.

2) Through averaging, maximum available measurement resolution can be significantly improved.

Display Resolution:

vs Time, or Histogram of vs Time

Panorama Off: Display Span/256

Panorama On: Display Span/224

Fast Histogram: Display Span/450

Accuracy: ± *Resolution*

±(Time Interval x Reference Error) ††

±Start Threshold Level Timing Error ‡

±Stop Threshold Level Timing Error ‡

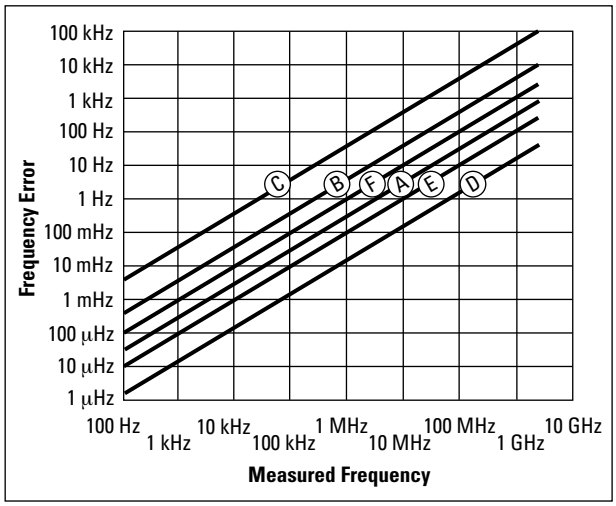
±1 ns Systematic Error

* 125 ps rms typical

†† Refer to Graph 4.

††† Refer to Graph 5.

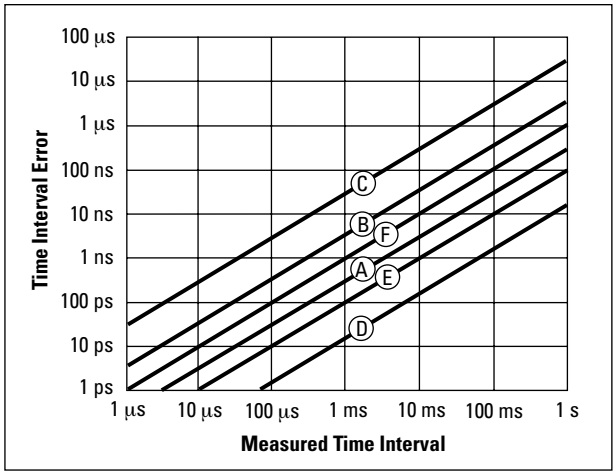
‡ Refer to Graph 6.



Graph 3. Frequency Reference Error. Crystal aging will affect your frequency accuracy.

Legend for Graphs 3 and 4

Time Since Last Calibration	Standard Reference	Option 010 Reference
1 Month	Ⓐ	Ⓓ
1 Year	Ⓑ	Ⓔ
10 Years	Ⓒ	Ⓕ



Graph 4. Time Interval Reference Error. Crystal aging will affect your time interval accuracy.

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Time Axis in vs Time

Resolution

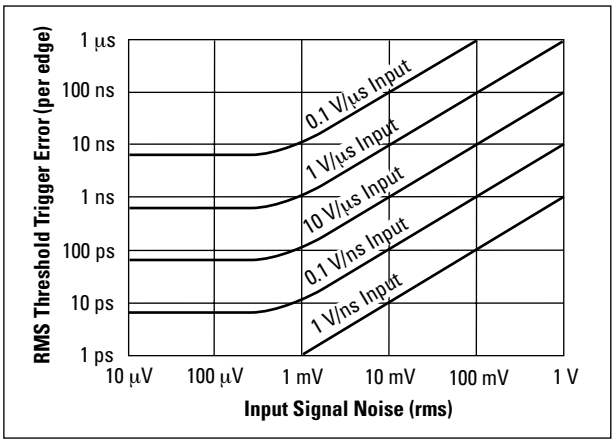
Main Timebase Setting/45, with panorama off
Window Timebase Setting/45, with panorama on
Accuracy: Resolution

Note: Time aliasing can occur when time between measurements exceeds 360 divisions.

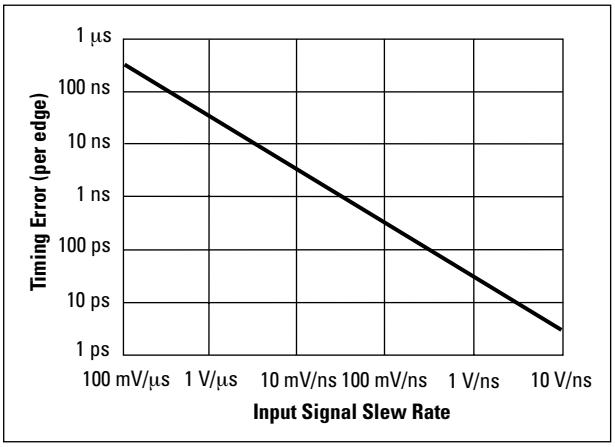
Inputs

Channel A and B

Sensitivity (minimum hysteresis): *20 mV rms sine wave to 100 MHz (25 mV rms sine wave for Freq A from 100 MHz to 200 MHz)*
Minimum Pulse Width: *5 ns at 60 mV p-p (2.5 ns at 75 mV p-p for Frequency A measurements above 50 MHz)*
Input Amplifier Noise: 600 µV rms
Threshold Drift: ±3 mV after warm-up at 25°C
Voltage Threshold Accuracy: *±(25 mV + 1% of Threshold Value)*
Maximum Hysteresis: Increases the minimum input signal amplitude required by a factor of three, providing additional noise immunity.
Impedance: 50 Ω or 1 MΩ (500 kΩ in common)
ac Coupling: 100 Hz cutoff frequency
Capacitance (1 MΩ): <20 pF (<30 pF in common)
Dynamic Range (ac): *60 mV p-p to 5 V p-p*
Signal Operating Range (dc):
1 MΩ: *±10 volts*
50 Ω: *±5 volts*
Damage Level:
1 MΩ: *40 V rms for <5 kHz, 5 V rms for >5 kHz*
50 Ω*: 5 V rms*



Graph 5. Noise on the input signal will add error to time-interval measurements. Error is associated with both start and stop edges.



Graph 6. Voltage Threshold Level Timing Error varies with input slew rate. Error is associated with both start and stop edges.

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Channel C (Option 030)
Sensitivity: *–25 dBm to 1.5 GHz, –20 dBm from >1.5 GHz to 2.0 GHz, –15 dBm from >2.0 GHz to 2.5 GHz*
Maximum Input Level: *+7 dBm*
Damage Level: *+15 dBm*
Note: For specifications on the Option 031 High Resolution 2.5 GHz Channel C, refer to "Dynamic Frequency and Jitter Analysis at the Touch of a Button," 53310A brochure.

External Arm
Impedance: 1 MΩ
Delay: <10 ns
Note: Sensitivity, Minimum Pulse Width, Signal Operating Range, and Damage Level of the External input are the same as that of Channel B.

Frequency Reference
Standard Crystal
Temperature Stability: *<8 x 10^{-6}, referenced to 25°C*
Short Term Stability: *<4 x 10^{-9} for 1 second average*
Aging Rate: *<3 x 10^{-7}/month*

Option 010 High Stability Oven Reference
Temperature Stability: *<7 x 10^{-9}, referenced to 25°C*
Short Term Stability: *<4 x 10^{-11} for 1 second average*
Aging Rate: *<5 x 10^{-10}/day, <1 x 10^{-7}/year*
Warmup: *Within 5 x 10^{-9} of final value*, 10 minutes after turn-on***
When:
1) 53310A is operated in a 25°C environment
2) Oscillator off-time** was less than 24 hours
3) Oscillator aging rate was <5 x 10^{-10} per day prior to turn-off**

Rear Panel Connectors
GPIB
Controls: The Agilent 53310A provides full programmability. All instrument settings and operating modes, except specific self-test routines, may be remotely programmed via GPIB (IEEE Std 488.1-1987). The programming codes and formats comply with IEEE Standard Codes, Formats, Protocols, and Common Commands (IEEE Std 488.2-1987), and Standard Commands for Programmable Instruments (SCPI) Standard, Version 1990.0.

Data Acquisition and Transfer Rate: A 450 point data record can be acquired and transferred to a computer at a rate ~17 times per second, as tested with an HP 9000, Series 300 controller. For this test, a 1-MHz carrier was applied to the analyzer with a timebase setting of 40 µs/division.

Data Transfer Rates: ~175 kByte/s

Interface Capabilities: SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E2

Test Limit Output
The Test Limit Output will go high when measurements fall outside the display range of the Fast Histogram. In "vs Time" mode, it will indicate each time the Value Trigger condition is met following the pre-trigger delay.

Operating Range: Low <0.6 V and High >1.5 V into 50 Ω

Frequency Standard Input
Frequency: 5 MHz or 10 MHz
Operating Range: 1 V p-p to 5 V p-p, into 1 kΩ
Damage Level: 10 V rms

Frequency Standard Output
Frequency: 10 MHz, or the External Reference if the Frequency Standard Input is used.
Operating Range (ac coupled):
50 Ω: >1 V p-p square wave
1 MΩ: >2 V p-p square wave

Power Requirements
Voltage: 115/230 Vac (–25% to +15%)
Frequency: 48 to 66 Hz
Maximum Power: 300 VA

General
Operating Temperature: 0 to 55°C
Weight: 10 kg net, 18 kg shipping
Dimensions: 425 mm W x 194 mm H x 363 mm D (440 mm D with handle extended)

Warranty
The Agilent 53310A Modulation Domain Analyzer comes with a one-year return-for-service warranty.

* "Final value" is defined as oscillator frequency 24 hours after turn-on.
** "Turn-off","turn-on", and "off-time" apply to periods when power is disconnected from the 53310A rear panel.

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Specifications — Option 031

Both warranted specifications and operating characteristics of the Agilent 53310A are discussed in this section. To distinguish warranted specifications from operating characteristics, *specifications are highlighted throughout in italics.*

Input Conditions
Range: *50 MHz to 2.5 GHz*
Sensitivity:
–13 dBm 50 MHz to 200 MHz
–17 dBm 200 MHz to 2 GHz
–12 dBm 2 GHz to 2.5 GHz
Maximum Input Level: *+20 dBm*
Damage Level:*+23 dBm*
Impedance: 50 Ω
Coupling: ac
RF Burst Width: 50 µs to CW

Maximum Measurement Rate
Fast Histogram: 1.5 MHz
Other Modes: 1 MHz
Fast Sampling: 8 MHz (repetitive)

External Local Oscillator Input
Level: +6dBm (±1dB)
Impedance: 50 Ω
Frequency Range: 150 MHz to 2.5 GHz

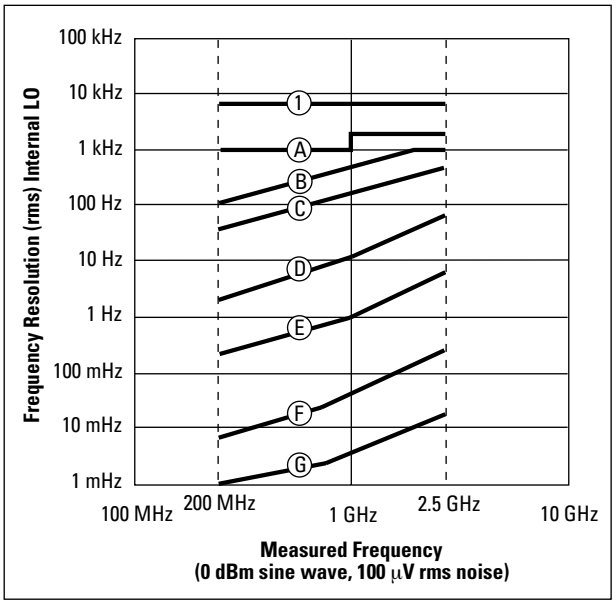
Resolution
Maximum available measurement resolution or display resolution, whichever is greater

Maximum Available Measurement Resolution
(Auto Sampling): *see Graph A*
Display Resolution:
vs Time or Histogram of vs Time
Window Off: Display Span/256
Window On: Display Span/224
Fast Histogram: Display Span/450

Accuracy: ±*[Resolution + (Frequency x Reference Error*)]*

RF Envelope Trigger
Level: Adjustable in 100 steps (e.g., –25 dBm to 0 dBm @ 1 GHz)
Output: 0 to 0.4 volt into 50 Ω or TTL level into high impedance

Maximum Available Frequency Resolution



Graph A. Maximum available frequency resolution for Option 031 Channel C. Larger timebase setting and averaging will reduce the effects of random noise and improve resolution. Please refer to Graph 2 on page 4 for resolution over the 50 MHz – 200 MHz band.

	Timebase Setting Interval @ center: Auto	Interval @ Center Setting (Interval @ Center: Manual)	Frequency Resolution (Ext. LO)†
1		125 ns††	7 kHz
A	≤ 20 µs/Div	1 µs	1 kHz
B	200 µs/Div	10 µs	20 Hz
C	2 ms/Div	100 µs	5 Hz
D	20 ms/Div	1 ms	2 Hz
E	200 ms/Div	10 ms	50 mHz
F		100 ms	5 mHz
G		0.5 s	2 mHz

† Typical resolution over the 200 MHz to 2.5 GHz range using an Agilent 8663A Synthesizer as an external LO
†† Fast Sampling mode

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Specifications — Option 305

Minimum System Requirements

Agilent 53310A:

Works with any option, but Fast (repetitive) Sample Rate is not supported.

IBM-compatible PC:

386-based with coprocessor
4 Mbyte RAM
2 Mbyte hard disk space
MS-DOS® 5.0
Windows® 3.1
IEEE 488.2 Interface:
HP 82335A or HP 82341A
National Instruments
AT-GPIB or AT-GPIB/TNT
with NI-488.2 version 2.1.1
drivers for Windows

Performance Characteristics

Typical Performance (1 GHz Carrier)

Off. Freq	IF	Noise Floor
<10 Hz	20 Hz	–180 dB
100 Hz	200 Hz	–170 dB
1 kHz	2 kHz	–160 dB
10 kHz	20 kHz	–150 dB
100 kHz	200 kHz	–140 dB
500 kHz	1 MHz	–130 dB

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