Agilent 33210A at a Glance

The Agilent Technologies 33210A is a 10 MHz synthesized function generator with built-in arbitrary waveform and pulse capabilities. Its combination of bench-top and system features makes this function generator a versatile solution for your testing requirements now and in the future.

**Convenient bench-top features**
- Up to 10 standard waveforms
- Built-in 14-bit 50 MSa/s waveform capability
- Precise pulse waveform capabilities with adjustable edge time
- LCD display provides numeric and graphical views
- Easy-to-use knob and numeric keypad
- Instrument state storage with user-defined names
- Portable, ruggedized case with non-skid feet

**Flexible system features**
- Four downloadable 8K-point arbitrary waveform memories
- GPIB (IEEE-488), USB, and LAN remote interfaces are standard
- LXI Class C Compliant
- SCPI (Standard Commands for Programmable Instruments) compatibility

**Note:** Unless otherwise indicated, this manual applies to all Serial Numbers.
The Front Panel at a Glance

1 Graph Mode/Local Key
2 On/Off Switch
3 Modulation/Sweep/Burst Keys
4 State Storage Menu Key
5 Utility Menu Key
6 Help Menu Key
7 Menu Operation Softkeys
8 Waveform Selection Keys

9 Manual Trigger Key (used for Sweep and Burst only)
10 Output Enable/Disable Key
11 Knob
12 Cursor Keys
13 Sync Connector
14 Output Connector

Note: To get context-sensitive help on any front-panel key or menu softkey, press and hold down that key.
The Front-Panel Display at a Glance

**Menu Mode**

- **Mode Information**
- **Trigger Information**
- **Units**
- **Output Status**
- **Numeric Readout**
- **Display Icon**
- **Softkey Labels**

**Graph Mode**

To enter or exit the Graph Mode, press the **Graph** key.

In Graph Mode, only one parameter label is displayed for each key at one time.
Front-Panel Number Entry

You can enter numbers from the front-panel using one of two methods.

Use the knob and cursor keys to modify the displayed number.

1. Use the keys below the knob to move the cursor left or right.
2. Rotate the knob to change a digit (clockwise to increase).

Use the keypad to enter numbers and the softkeys to select units.

1. Key in a value as you would on a typical calculator.
2. Select a unit to enter the value.
The Rear Panel at a Glance

**Note:** The External and Internal 10 MHz Reference Terminals (1 and 2, above) are present only if Option 001, External Timebase Reference, is installed. Otherwise, the holes for these connectors are plugged.

**WARNING** For protection from electrical shock, the power cord ground must not be defeated. If only a two-contact electrical outlet is available, connect the instrument’s chassis ground screw (see above) to a good earth ground.
In This Book

Specifications Chapter 1 lists the function generator’s specifications.

Quick Start Chapter 2 prepares the function generator for use and helps you get familiar with a few of its front-panel features.

Front-Panel Menu Operation Chapter 3 introduces you to the front-panel menu and describes some of the function generator’s menu features.

Calibration Procedures Chapter 4 provides calibration, verification, and adjustment procedures for the function generator.

Block Diagram Chapter 5 describes block and power supply operation of the function generator.

Disassembly and Repair Chapter 6 provides guidelines for returning your function generator to Agilent Technologies for servicing, or for servicing it yourself. This chapter also contains a list of replaceable parts for the function generator and how to order the parts.

Backdating Chapter 8 describes the differences between this manual and older issues of this manual.

You can contact Agilent Technologies at one of the following telephone numbers for warranty, service, or technical support information.

In the United States: (800) 829-4444
In Europe: 31 20 547 2111
In Japan: 0120-421-345

Or use our Web link for information on contacting Agilent worldwide.

www.agilent.com/find/assist

Or contact your Agilent Technologies Representative.
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Specifications
Chapter 1  Specifications
Agilent 33210A Function / Arbitrary Waveform Generator

Waveforms

Standard: Sine, Square, Ramp, Triangle, Pulse, Noise, DC

Built-in Arbitrary (Option 002[1]):
- Exponential rise
- Exponential fall
- Negative ramp
- Sin(x)/x
- Cardiac

Waveform Characteristics

Sine
Frequency: 1 mHz to 10 MHz, 1 mHz resolution

Amplitude Flatness: \[2, 3\]

<table>
<thead>
<tr>
<th></th>
<th>&lt; 100 kHz</th>
<th>100 kHz to 5 MHz</th>
<th>5 MHz to 10 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Relative to 1 KHz)</td>
<td>0.1 dB</td>
<td>0.2 dB</td>
<td>0.3 dB</td>
</tr>
</tbody>
</table>

Harmonic Distortion: \[3, 4\]

<table>
<thead>
<tr>
<th>Frequency</th>
<th>DC to 20 kHz</th>
<th>20 kHz to 100 kHz</th>
<th>100 kHz to 1 MHz</th>
<th>1 MHz to 10 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 1 Vpp</td>
<td>-70 dBc</td>
<td>-65 dBc</td>
<td>-50 dBc</td>
<td>-40 dBc</td>
</tr>
<tr>
<td>&lt; 1 Vpp</td>
<td>-70 dBc</td>
<td>-60 dBc</td>
<td>-50 dBc</td>
<td>-40 dBc</td>
</tr>
</tbody>
</table>

Total Harmonic Distortion: \[3, 4\]
DC to 20 kHz: 0.04%

Spurious (Non-Harmonic) Output: \[3, 5\]
DC to 1 MHz: -70 dBc
1 MHz to 10 MHz: -70 dBc +6 dB/octave

Phase Noise (10 kHz offset): -115 dBc / Hz, typical

Square
Frequency: 1 mHz to 10 MHz, 1 mHz resolution
Rise/Fall Time: 20 ns
Overshoot: < 2%
Variable Duty Cycle: 20% - 80% (to 5 MHz), 40% - 60% (to 10 MHz)
Asymmetry (@ 50% Duty): 1% of period + 5 ns
Jitter (RMS): 1 ns + 100 ppm of period

Ramp, Triangle
Frequency: 1 mHz to 100 kHz, 1 mHz resolution
Linearity: < 0.1% of peak output
Variable Symmetry: 0.0% to 100.0%

Pulse
Frequency: 1 mHz to 5 MHz, 1 mHz resolution
Pulse Width (period < 10 s): 40 ns minimum, 10 ns resolution
Variable Edge Time: 20 ns to 100 ns
Overshoot: < 2%
Jitter (RMS): 300 ps + 0.1 ppm of period

Noise
Bandwidth: 7 MHz, typical

8-K Arbitrary Waveform Generator
(Option 002[1])
Frequency: 1 mHz to 3 MHz, 1 mHz resolution
Waveform Length: 2 to 8K points
Amplitude Resolution: 14 bits (including sign)
Sample Rate: 50 MSa/s
Minimum Rise/Fall Time: 70 ns, typical
Linearity: < 0.1% of peak output
Settling Time: < 500 ns to 0.5% of final value
Jitter (RMS): 6 ns + 30 ppm
Non-volatile Memory: Four waveforms
## Common Characteristics

### Frequency

**Accuracy**: [6]
- 90 days: ± (10 ppm + 3 pHz)
- 1 year: ± (20 ppm + 3 pHz)
**Resolution**: 1 µHz

### Amplitude

**Range**:
- Into 50 Ω: 10 mVpp to 10 Vpp
- Into open circuit: 20 mVpp to 20 Vpp
**Accuracy** (at 1 kHz): [2], [3]
- ± 2% of setting ± 1 mVpp
**Units**: Vpp, Vrms, dBm
**Resolution**: 3 digits

### DC Offset

**Range** (peak AC + DC):
- ± 5 V into 50 Ω
- ± 10 V into open circuit
**Accuracy**: [2], [3]
- ± 2% of offset setting
- ± 0.5% of ampl. ± 2 mV
**Resolution**: 3 digits

### Main Output

**Impedance**: 50 Ω typical
**Isolation**: 42 Vpk maximum to earth
**Protection**: Short-circuit protected, overload automatically disables main output

### External Frequency Reference (Option 001)

**Rear Panel Input**:
- **Lock Range**: 10 MHz ± 500 Hz
- **Level**: 100 mVpp to 5 Vpp
- **Impedance**: 1 kΩ typical
- **Lock Time**: < 2 seconds

**Rear Panel Output**:
- **Frequency**: 10 MHz
- **Level**: 632 mVpp (0 dBm), typical
- **Impedance**: 50 Ω typ, AC coupled

### Phase Offset

**Range**: +360 to -360 degrees
**Resolution**: 0.001 degrees
**Accuracy**: 20 ns

## Modulation

### AM

**Carrier Waveforms**: Sine, Square
**Source**: Internal/External
**Internal Modulation**: Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
**Depth**: 0.0% to 120.0%

### FM

**Carrier Waveforms**: Sine, Square
**Source**: Internal/External
**Internal Modulation**: Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
**Deviation**: DC to 5 MHz

### PWM

**Carrier Waveforms**: Pulse
**Source**: Internal/External
**Internal Modulation**: Sine, Square, Ramp, Triangle, Noise, Arb (2 mHz to 20 kHz)
**Deviation**: 0% to 100% of pulse width

### External Modulation Input

(for AM, FM, PWM)

**Voltage Range**: ± 5 V full scale
**Input Resistance**: 5 kΩ typical
**Bandwidth**: DC to 20 kHz
Chapter 1 Specifications
Agilent 33210A Function / Arbitrary Waveform Generator

Sweep

Waveforms: Sine, Square, Ramp
Type: Linear or Logarithmic
Direction: Up or Down
Sweep Time: 1 ms to 500 s
Trigger Source: Single, External, or Internal
Marker: Falling edge of Sync signal (programmable frequency)

Burst [7]

Waveforms: Sine, Square, Ramp
Type: Counted (1 to 50,000 cycles), Infinite, Gated
Start/Stop Phase: +360 to -360 degrees
Internal Period: 1 µs to 500 s
Gate Source: External Trigger
Trigger Source: Single, External, or Internal

Trigger Characteristics

Trigger Input:
- Input Level: TTL compatible
- Slope: Rising or falling, selectable
- Pulse Width: > 100 ns
- Input Impedance: > 10 kΩ, DC coupled
- Latency: < 500 ns
- Jitter (RMS): 6 ns (3.5 ns for Pulse)

Trigger Output:
- Level: TTL compatible into > 1 kΩ
- Pulse Width: > 400 ns
- Output Impedance: 50 Ω, typical
- Maximum Rate: 1 MHz
- Fanout: ≤ 4 Agilent 33210As (or equivalent)

Programming Times (typical)

<table>
<thead>
<tr>
<th>Configuration Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function Change</td>
</tr>
<tr>
<td>Frequency Change</td>
</tr>
<tr>
<td>Amplitude Change</td>
</tr>
<tr>
<td>Select User Arb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Arb Download Times (binary transfer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB 2.0</td>
</tr>
<tr>
<td>2 K points</td>
</tr>
<tr>
<td>4 K points</td>
</tr>
<tr>
<td>8K points</td>
</tr>
</tbody>
</table>

Download times do not include setup or output time.
## General

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>CAT II</td>
</tr>
<tr>
<td></td>
<td>100 to 240 V @ 50/60 Hz (-5%, +10%)</td>
</tr>
<tr>
<td></td>
<td>100 to 120 V @ 400 Hz (± 10%)</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>50 VA maximum</td>
</tr>
<tr>
<td>Operating Environment</td>
<td>IEC 61010</td>
</tr>
<tr>
<td></td>
<td>Pollution Degree 2</td>
</tr>
<tr>
<td></td>
<td>Indoor Location</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>0 °C to 55 °C</td>
</tr>
<tr>
<td>Operating Humidity</td>
<td>5% to 80% RH, non-condensing</td>
</tr>
<tr>
<td>Operating Altitude</td>
<td>Up to 3000 meters</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-30 °C to 70 °C</td>
</tr>
<tr>
<td>Floating Connector Shields</td>
<td>Shields may float at ± 42 V (peak) relative to earth ground.</td>
</tr>
<tr>
<td>(Output, Sync, and Modulation In only):</td>
<td></td>
</tr>
<tr>
<td>State Storage Memory</td>
<td>Power off state automatically saved. Four user-configurable stored states.</td>
</tr>
<tr>
<td>Interface</td>
<td>LAN, LXI-C 10/100, Ethernet, USB 2.0, and GPIB standard</td>
</tr>
<tr>
<td>Language</td>
<td>SCPI - 1993, IEEE-488.2</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>Bench Top: 261.1 mm by 103.8 mm by 303.2 mm</td>
</tr>
<tr>
<td></td>
<td>Rack Mount: 212.8 mm by 88.3 mm by 272.3 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>3.4 kg (7.5 lbs)</td>
</tr>
<tr>
<td>Safety Designed to</td>
<td>UL-1244, CSA 1010, EN61010</td>
</tr>
<tr>
<td>EMC Tested to</td>
<td>MIL-461C, EN55011, ENS0082-1</td>
</tr>
<tr>
<td>Vibration and Shock</td>
<td>MIL-T-28800, Type III, Class 5</td>
</tr>
<tr>
<td>Acoustic Noise</td>
<td>30 dBa</td>
</tr>
<tr>
<td>Warm-up Time</td>
<td>1 hour</td>
</tr>
<tr>
<td>LXI Compliance</td>
<td>LXI Class C, V. 1.0</td>
</tr>
</tbody>
</table>

### Note:
Specifications are subject to change without notice. For the latest specifications, go to the Agilent 33210A product page and find the 33210A Datasheet.

www.agilent.com/find/33210A

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

### Footnotes:

1. To upgrade your 33210A to include arbitrary waveform functionality, go to www.agilent.com/find/33210U.
2. Add 1/10th of output amplitude and offset specification per °C for operation outside the range of 18 °C to 28 °C.
3. Autorange enabled.
4. DC offset set to 0 V.
5. Spurious output at low amplitude is -75 dBm (typical).
6. Add 1 ppm / °C (average) for operation outside the range of 18 °C to 28 °C.
7. Sine and square waveforms above 3 MHz are allowed only with an “infinite” burst count.
8. These shields must all float at the same potential to avoid instrument damage.
Chapter 1 Specifications
Agilent 33210A Function / Arbitrary Waveform Generator

Product Dimensions

All dimensions are shown in millimeters.
Quick Start
Quick Start

One of the first things you will want to do with your function generator is to become acquainted with the front panel. We have written the exercises in this chapter to prepare the instrument for use and help you get familiar with some of its front-panel operations. This chapter is divided into the following sections:

- To Prepare the Function Generator for Use, on page 19
- To Adjust the Carrying Handle, on page 20
- To Set the Output Frequency, on page 21
- To Set the Output Amplitude, on page 22
- To Set a DC Offset Voltage, on page 24
- To Set the High-Level and Low-Level Values, on page 21
- To Select “DC Volts”, on page 22
- To Set the Duty Cycle of a Square Wave, on page 27
- To Configure a Pulse Waveform, on page 28
- To View a Waveform Graph, on page 29
- To Output a Stored Arbitrary Waveform, on page 30
- To Use the Built-In Help System, on page 31
- To Rack Mount the Function Generator, on page 33
To Prepare the Function Generator for Use

1 **Check the list of supplied items.**

Verify that you have received the following items with your instrument. If anything is missing, please contact your nearest Agilent Sales Office.

- Power cord (for country of destination).
- Certificate of Calibration.
- Agilent 33210A Product Reference CD (product software, programming examples, and manuals).
- USB 2.0 cable.

Note: All of the 33210A product documentation is provided on the Agilent 33210A Product Reference CD that comes with the product, and is also available on the Web at [www.agilent.com/find/33210A](http://www.agilent.com/find/33210A). Printed (hardcopy) manuals are available as an extra cost option.

2 **Connect the power cord and turn on the function generator.**

The instrument runs a short power-on self test, which takes a few seconds. When the instrument is ready for use it displays a message about how to obtain help, along with the current GPIB address. The function generator powers up in the sine wave function at 1 kHz with an amplitude of 100 mV peak-to-peak (into a 50Ω termination). At power-on, the Output connector is disabled. To enable the Output connector, press the Output key.

If the function generator does not turn on, verify that the power cord is firmly connected to the power receptacle on the rear panel (the power-line voltage is automatically sensed at power-on). You should also make sure that the function generator is connected to a power source that is energized. Then, verify that the function generator is turned on.

If the power-on self test fails, “Self-Test Failed” is displayed along with an error code. See Chapter 6 for information on self-test error codes, and for instructions on returning the function generator to Agilent for service.
Chapter 2  Quick Start
To Adjust the Carrying Handle

To adjust the position, grasp the handle by the sides and pull outward.
Then, rotate the handle to the desired position.
To Set the Output Frequency

At power-on, the function generator outputs a sine wave at 1 kHz with an amplitude of 100 mV peak-to-peak (into a 50Ω termination). The following steps show you how to change the frequency to 1.2 MHz.

1 Press the “Freq” softkey.

The displayed frequency is either the power-on value or the frequency previously selected. When you change functions, the same frequency is used if the present value is valid for the new function. To set the waveform period instead, press the Freq softkey again to toggle to the Period softkey (the current selection is highlighted).

2 Enter the magnitude of the desired frequency.

Using the numeric keypad, enter the value “1.2”.

3 Select the desired units.

Press the softkey that corresponds to the desired units. When you select the units, the function generator outputs a waveform with the displayed frequency (if the output is enabled). For this example, press MHz.

Note: You can also enter the desired value using the knob and cursor keys.
Chapter 2  Quick Start
To Set the Output Amplitude

To Set the Output Amplitude

At power-on, the function generator outputs a sine wave with an amplitude of 100 mV peak-to-peak (into a 50Ω termination). The following steps show you how to change the amplitude to 50 mVrms.

1  **Press the “Ampl” softkey.**

The displayed amplitude is either the power-on value or the amplitude previously selected. When you change functions, the same amplitude is used if the present value is valid for the new function. To set the amplitude using a high level and low level, press the **Ampl** softkey again to toggle to the **HiLevel** and **LoLevel** softkeys (the current selection is highlighted).

2  **Enter the magnitude of the desired amplitude.**

Using the numeric keypad, enter the value “50”.

3  **Select the desired units.**

Press the softkey that corresponds to the desired units. When you select the units, the function generator outputs the waveform with the displayed amplitude (if the output is enabled). For this example, press **mVRMS**.

**Note:** You can also enter the desired value using the knob and cursor keys.
You can easily convert the displayed amplitude from one unit to another. For example, the following steps show you how to convert the amplitude from Vrms to Vpp.

4 **Enter the numeric entry mode.**

Press the \( _+/^- \) key to enter the numeric entry mode.

<table>
<thead>
<tr>
<th>Select the units by pressing a key below.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( mVpp )</td>
</tr>
</tbody>
</table>

5 **Select the new units.**

Press the softkey that corresponds to the desired units. The displayed value is converted to the new units. For this example, press the \( Vpp \) softkey to convert 50 mVrms to its equivalent in volts peak-to-peak.

To change the displayed amplitude by decades, press the right-cursor key to move the cursor to the units on the right side of the display. Then, rotate the knob to increase or decrease the displayed amplitude by decades.
To Set a DC Offset Voltage

At power-on, the function generator outputs a sine wave with a dc offset of 0 volts (into a 50Ω termination). The following steps show you how to change the offset to -1.5 mVdc.

1 Press the “Offset” softkey.

The displayed offset voltage is either the power-on value or the offset previously selected. When you change functions, the same offset is used if the present value is valid for the new function.

2 Enter the magnitude of the desired offset.

Using the numeric keypad, enter the value “-1.5”.

3 Select the desired units.

Press the softkey that corresponds to the desired units. When you select the units, the function generator outputs the waveform with the displayed offset (if the output is enabled). For this example, press mVDC.

Note: You can also enter the desired value using the knob and cursor keys.
To Set the High-Level and Low-Level Values

You can specify a signal by setting its amplitude and dc offset values, as described previously. Another way to set the limits of a signal is to specify its high-level (maximum) and low-level (minimum) values. This is typically convenient for digital applications. In the following example, let's set the high-level to 1.0 V and the low-level to 0.0 V.

1 Press the "Ampl" softkey to select "Ampl".

2 Press the softkey again to toggle to 'HiLevel'.

   Note that both the Ampl and Offset softkeys toggle together, to HiLevel and LoLevel, respectively.

3 Set the "HiLevel" value.

   Using the numeric keypad or the knob, select a value of "1.0 V". (If you are using the keypad, you will need to select the unit, "V", to enter the value.)

4 Press the "LoLevel" softkey and set the value.

   Again, use the numeric keypad or the knob to enter a value of "0.0 V".

   Note that these settings (high-level = "1.0 V" and low-level = "0.0 V") are equivalent to setting an amplitude of "1.0 Vpp" and an offset of "500 mVdc".
Chapter 2  Quick Start
To Select “DC Volts”

To Select “DC Volts”

You can select the “DC Volts” feature from the “Utility” menu, and then set a constant dc voltage as an "Offset" value. Let's set "DC Volts" = 1.0 Vdc.

1 **Press **(Utility) **and then select the DC On softkey.**

The Offset value becomes selected.

![Offset value selected](image)

2 **Enter the desired voltage level as an "Offset".**

Enter 1.0 Vdc with the numeric keypad or knob.

![Enter voltage level](image)

You can enter any dc voltage from -5 Vdc to +5 Vdc.
To Set the Duty Cycle of a Square Wave

At power-on, the duty cycle for square waves is 50%. You can adjust the duty cycle from 20% to 80% for output frequencies up to 5 MHz. The following steps show you how to change the duty cycle to 30%.

1 **Select the square wave function.**
   Press the [Square] key and then set the desired output frequency to any value up to 5 MHz.

2 **Press the “Duty Cycle” softkey.**
   The displayed duty cycle is either the power-on value or the percentage previously selected. The duty cycle represents the amount of time per cycle that the square wave is at a high level (note the icon on the right side of the display).

3 **Enter the desired duty cycle.**
   Using the numeric keypad or the knob, select a duty cycle value of “30”. The function generator adjusts the duty cycle immediately and outputs a square wave with the specified value (if the output is enabled).
To Configure a Pulse Waveform

You can configure the function generator to output a pulse waveform with variable pulse width and edge time. The following steps show you how to configure a 500 ms pulse waveform with a pulse width of 10 ms and edge times of 50 ns.

1 **Select the pulse function.**

   Press the **Pulse** key to select the pulse function and output a pulse waveform with the default parameters.

2 **Set the pulse period.**

   Press the **Period** softkey and then set the pulse period to 500 ms.

3 **Set the pulse width.**

   Press the **Width** softkey and then set the pulse width to 10 ms. The pulse width represents the time from the 50% threshold of the rising edge to the 50% threshold of the next falling edge (note the display icon).

4 **Set the edge time for both edges.**

   Press the **Edge Time** softkey and then set the edge time for both the rising and falling edges to 50 ns. The edge time represents the time from the 10% threshold to the 90% threshold of each edge (note the display icon).
To View a Waveform Graph

In the Graph Mode, you can view a graphical representation of the current waveform parameters. The softkeys are listed in the same order as in the normal display mode, and they perform the same functions. However, only one label (for example, **Freq** or **Period**) is displayed for each softkey at one time.

1 **Enable the Graph Mode.**

Press the **Graph** key to enable the Graph Mode. The name of the currently selected parameter, shown in the upper-left corner of the display, and the parameter's numeric value field are both highlighted.

2 **Select the desired parameter.**

To select a specific parameter, note the softkey labels at the bottom of the display. For example, to select period, press the **Period** softkey.

- As in the normal display mode, you can edit numbers using either the numeric keypad or the knob and cursor keys.
- Parameters which normally toggle when you press a key a second time also toggle in the Graph Mode. However, you can see only one label for each softkey at one time (for example, **Freq** or **Period**).
- To exit the Graph Mode, press **Graph** again.

The **Graph** key also serves as a **Local** key to restore front-panel control after remote interface operations.
Chapter 2  Quick Start

To Output a Stored Arbitrary Waveform

To Output a Stored Arbitrary Waveform

**Note:** Arbitrary waveforms are optionally available with the 33210A (Option 002). To upgrade your 33210A to include arbitrary waveform functionality, go to [www.agilent.com/find/33210A](http://www.agilent.com/find/33210A).

There are five built-in arbitrary waveforms stored in non-volatile memory. The following steps show you how to output the built-in “exponential fall” waveform from the front panel.

For information on creating a custom arbitrary waveform, refer to “To Create and Store an Arbitrary Waveform” in the *User’s Guide*.

1. **Select the arbitrary waveform function.**
   
   When you press the \[Arb\] key to select the arbitrary waveform function, a temporary message is displayed indicating which waveform is currently selected (the default is “exponential rise”).

2. **Select the active waveform.**
   
   Press the **Select Wform** softkey and then press the **Built-In** softkey to select from the five built-in waveforms. Then press the **Exp Fall** softkey.
   
   The waveform is output using the present settings for frequency, amplitude, and offset unless you change them.

   The selected waveform is now assigned to the \[Arb\] key. Whenever you press this key, the selected arbitrary waveform is output. To quickly determine which arbitrary waveform is currently selected, press \[Arb\].


To Use the Built-In Help System

The built-in help system is designed to provide context-sensitive assistance on any front-panel key or menu softkey. A list of help topics is also available to assist you with several front-panel operations.

1 View the help information for a function key.

Press and hold down the Sine key. If the message contains more information than will fit on the display, press the ↓ softkey or turn the knob clockwise to view the remaining information.

**Sine Function**
The Agilent 33210A can output a sinusoidal waveform at frequencies from 1 mHz to 10 MHz.
- For DC, press [Utility] and select "DC On".

Press DONE to exit Help.

2 View the help information for a menu softkey.

Press and hold down the Freq softkey. If the message contains more information than will fit on the display, press the ↓ softkey or rotate the knob clockwise to view the remaining information.

**Frequency / Period**
Sets the waveform frequency or period. Press this softkey again to toggle between the choices.

Press DONE to exit Help.
Chapter 2  Quick Start
To Use the Built-In Help System

3  View the list of help topics.

Press the Help key to view the list of available help topics. To scroll through the list, press the ↑ or ↓ softkey or rotate the knob. Select the third topic “Get HELP on any key” and then press SELECT.

Press DONE to exit Help.

4  View the help information for displayed messages.

Whenever a limit is exceeded or any other invalid configuration is found, the function generator will display a message. For example, if you enter a value that exceeds the frequency limit for the selected function, a message will be displayed. The built-in help system provides additional information on the most recent message to be displayed.

Press the Help key, select the first topic “View the last message displayed”, and then press SELECT.

Press DONE to exit Help.

Local Language Help: The built-in help system is available in multiple languages. All messages, context-sensitive help, and help topics appear in the selected language. The menu softkey labels and status line messages are not translated.

To select the local language, press the Home key, press the System softkey, and then press the Help In softkey. Select the desired language.
To Rack Mount the Function Generator

You can mount the Agilent 33210A in a standard 19-inch rack cabinet using one of two optional kits available. Instructions and mounting hardware are included with each rack-mounting kit. Any Agilent System II instrument of the same size can be rack-mounted beside the Agilent 33210A.

Note: Remove the carrying handle, and the front and rear rubber bumpers, before rack-mounting the instrument.

To remove the handle, rotate it to vertical and pull the ends outward.

To remove the rubber bumper, stretch a corner and then slide it off.
Chapter 2 Quick Start
To Rack Mount the Function Generator

To rack mount a single instrument, order adapter kit 5063-9240.

To rack mount two instruments side-by-side, order lock-link kit 5061-8769 and flange kit 5063-9212. Be sure to use the support rails in the rack cabinet.

In order to prevent overheating, do not block the flow of air into or out of the instrument. Be sure to allow enough clearance at the rear, sides, and bottom of the instrument to permit adequate internal air flow.
Front-Panel Menu Operation
Front-Panel Menu Operation

This chapter introduces you to the front-panel keys and menu operation. This chapter does not give a detailed description of every front-panel key or menu operation. It does, however, give you an overview of the front-panel menus and many front-panel operations. Refer to the Agilent 33210A User’s Guide for a complete discussion of the function generator’s capabilities and operation.

- Front-Panel Menu Reference, on page 37
- To Select the Output Termination, on page 39
- To Reset the Function Generator, on page 39
- To Read the Calibration Information, on page 40
- To Unsecure and Secure for Calibration, on page 41
- To Store the Instrument State, on page 44
- To Configure the Remote Interface, on page 45
Front-Panel Menu Reference

This section gives an overview of the front-panel menus. The remainder of this chapter contains examples of using the front-panel menus.

<table>
<thead>
<tr>
<th>Mod</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configure the modulation parameters for AM, FM, and PWM.</strong></td>
</tr>
<tr>
<td>• Select the modulation type.</td>
</tr>
<tr>
<td>• Select an internal or external modulation source.</td>
</tr>
<tr>
<td>• Specify AM modulation depth, modulating frequency, and modulation shape.</td>
</tr>
<tr>
<td>• Specify FM frequency deviation, modulating frequency, and modulation shape.</td>
</tr>
<tr>
<td>• Specify PWM deviation, modulating frequency, and modulation shape.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sweep</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configure the parameters for frequency sweep.</strong></td>
</tr>
<tr>
<td>• Select linear or logarithmic sweeping.</td>
</tr>
<tr>
<td>• Select the start/stop frequencies or center/span frequencies.</td>
</tr>
<tr>
<td>• Select the time in seconds required to complete a sweep.</td>
</tr>
<tr>
<td>• Specify a marker frequency.</td>
</tr>
<tr>
<td>• Specify an internal or external trigger source for the sweep.</td>
</tr>
<tr>
<td>• Specify the slope (rising or falling edge) for an external trigger source.</td>
</tr>
<tr>
<td>• Specify the slope (rising or falling edge) of the “Trig Out” signal.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Burst</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configure the parameters for burst.</strong></td>
</tr>
<tr>
<td>• Select the triggered (N Cycle) or externally-gated burst mode.</td>
</tr>
<tr>
<td>• Select the number of cycles per burst (1 to 50,000, or Infinite).</td>
</tr>
<tr>
<td>• Select the starting phase angle of the burst (-360° to +360°).</td>
</tr>
<tr>
<td>• Specify the time from the start of one burst to the start of the next burst.</td>
</tr>
<tr>
<td>• Specify an internal or external trigger source for the burst.</td>
</tr>
<tr>
<td>• Specify the slope (rising or falling edge) for an external trigger source.</td>
</tr>
<tr>
<td>• Specify the slope (rising or falling edge) of the “Trig Out” signal.</td>
</tr>
</tbody>
</table>
### Store and recall instrument states.

- Store up to four instrument states in non-volatile memory.
- Assign a custom name to each storage location.
- Recall stored instrument states.
- Restore all instrument settings to their factory default values.
- Select the instrument’s power-on configuration (last or factory default).

### Configure system-related parameters.

- Generate a dc-only voltage level.
- Enable/disable the Sync signal which is output from the “Sync” connector.
- Select the output termination (1Ω to 10 kΩ or Infinite).
- Enable/disable amplitude autoranging.
- Select the waveform polarity (normal or inverted).
- Select the GPIB address.
- Specify the LAN configuration (IP address and network configuration).
- Select how periods and commas are used in numbers displayed on the front panel.
- Select the local language for front-panel messages and help text.
- Enable/disable the tone heard when an error is generated.
- Enable/disable the display bulb-saver mode.
- Adjust the contrast setting of the front-panel display.
- Perform an instrument self-test.
- Secure/unsecure the instrument for calibration and perform manual calibrations.
- Query the instrument’s firmware revision codes.

### View the list of Help topics.

- View the last message displayed.
- View the remote command error queue.
- Get HELP on any key.
- How to generate a dc-only voltage level.
- How to generate a modulated waveform.
- How to create an arbitrary waveform.
- How to reset the instrument to its default state.
- How to view a waveform in the Graph Mode.
- How to synchronize multiple instruments.
- How to obtain Agilent Technical Support.
To Select the Output Termination

The Agilent 33210A has a fixed series output impedance of 50 ohms to the front-panel Output connector. If the actual load impedance is different than the value specified, the displayed amplitude and offset levels will be incorrect. The load impedance setting is simply provided as a convenience to ensure that the displayed voltage matches the expected load.

1 Press [Utility].

2 Navigate the menu to set the output termination.
Press the Output Setup softkey and then select the Load softkey.

3 Select the desired output termination.
Use the knob or numeric keypad to select the desired load impedance or press the Load softkey again to choose “High Z”.

To Reset the Function Generator

To reset the instrument to its factory default state, press [Store Recall] and then select the Set to Defaults softkey. Press YES to confirm the operation.

For a complete listing of the instrument’s power-on and reset conditions, see “Agilent 33210A Factory Default Settings” in the User’s Guide.
Chapter 3  Front-Panel Menu Operation

To Read the Calibration Information

You can access the instrument’s calibration memory to read the calibration count and calibration message.

**Calibration Count**  You can query the instrument to determine how many calibrations have been performed. Note that your instrument was calibrated before it left the factory. When you receive your instrument, read the count to determine its initial value. The count value increments by one for each calibration point, and a complete calibration may increase the value by many counts.

**Calibration Message**  The instrument allows you to store one message in calibration memory. For example, you can store the date when the last calibration was performed, the date when the next calibration is due, the instrument’s serial number, or even the name and phone number of the person to contact for a new calibration.

---

You can **record** a calibration message only from the remote interface and only when the instrument is unsecured.

You can **read** the message from either the front-panel or over the remote interface. You can read the calibration message whether the instrument is secured or unsecured.

---

1 **Select the Cal Info interface.**

Press (utility) and then select the **Cal Info** softkey from the “Test/Cal” menu.

The first line in the display shows the calibration count.
The second line shows the calibration message.
The last line indicates the current version of the firmware.

The calibration information will time-out and disappear after a few seconds. Select the **Cal Info** softkey to show the information again.

2 **Exit the menu.**

Press the **DONE** softkey.
To Unsecure and Secure for Calibration

This feature allows you to enter a security code to prevent accidental or unauthorized adjustments of the instrument. When you first receive your instrument, it is secured. Before you can adjust the instrument, you must unsecure it by entering the correct security code.

- The security code is set to **AT33210A** when the instrument is shipped from the factory. The security code is stored in non-volatile memory, and does not change when power has been off, after a Factory Reset (**RST** command), or after an Instrument Preset (**SYSTem:PRESet** command).

- The security code may contain up to 12 alphanumeric characters. The first character must be a letter, but the remaining characters can be letters, numbers, or an underscore (_). You do not have to use all 12 characters but the first character must always be a letter.

**Note**

If you forget your security code, you can disable the security feature by applying a temporary short inside the instrument as described in “To Unsecure the Instrument Without the Security Code” on page 71.
Chapter 3  Front-Panel Menu Operation
To Unsecure and Secure for Calibration

To Unsecure for Calibration

1 Select the Secure Code interface.

Press and then select the Test/Cal softkey.

2 Enter the Secure Code.

Use the knob to change the displayed character.

and

Use the arrow keys to move to the next character

When the last character of the secure code is entered, the instrument will be unsecured.

3 Exit the menu.

Press the DONE softkey.
To Secure After Calibration

1 Select the Secure Code interface.

Press [Utility] and then select the [Test/Cal] softkey.

2 Enter a Secure Code.

Enter up to 12 alphanumeric characters. The first character must be a letter.

Use the knob to change the displayed character. Use the arrow keys to move to the next character.

3 Secure the Instrument.

Select the [Secure] softkey.

4 Exit the menu.

Press the [DONE] softkey.
To Store the Instrument State

You can store the instrument state in one of four non-volatile storage locations. A fifth storage location automatically holds the power-down configuration of the instrument. When power is restored, the instrument can automatically return to its state before power-down.

1 Select the desired storage location.
Press and then select the Store State softkey.

2 Select a custom name for the selected location.
If desired, you can assign a custom name to each of the four locations.

- The name can contain up to 12 characters. The first character must be a letter but the remaining characters can be letters, numbers, or the underscore character ("_”).
- To add additional characters, press the right-cursor key until the cursor is to the right of the existing name and then turn the knob.
- To delete all characters to the right of the cursor position, press +/-.
- To use numbers in the name, you can enter them directly from the numeric keypad. Use the decimal point from the numeric keypad to add the underscore character ("_”) to the name.

3 Store the instrument state.
Press the STORE STATE softkey. The instrument stores the selected function, frequency, amplitude, dc offset, duty cycle, symmetry, as well as any modulation parameters in use. The instrument does not store volatile waveforms created in the arbitrary waveform function.
To Configure the Remote Interface

The Agilent 33210A supports remote interface communication using a choice of three interfaces: GPIB, USB, and LAN (LXI Class C compliant). All three interfaces are "live" at power up. The following sections tell how to configure the remote interface from the instrument front panel.

**Note:** Two CDs, provided with your instrument, contain connectivity software to enable communications over the remote interfaces. See “Connectivity Software and Product CDs” on page 128 of the User’s Guide for the Agilent 33210A for further information on these CDs and the software they contain.

**GPIB Configuration**

1. **Select the “I/O” menu.**
   
   Press the `Utility` and then press the `I/O` softkey.

2. **Set the GPIB address.**
   
   Use the knob and cursor keys or the numeric keypad to select a GPIB address in the range 0 through 30 (the factory default is “10”).
   
   The GPIB address is shown on the front-panel display at power-on.

3. **Exit the menu.**
   
   Press the `DONE` softkey.

**USB Configuration**

The USB interface requires no front panel configuration parameters. Just connect the Agilent 33210A to your PC with the appropriate USB cable. The interface will self configure. Press the `Show USB Id` softkey in the “I/O menu” to see the USB interface identification string. Both USB 1.1 and USB 2.0 are supported.
Chapter 3  Front-Panel Menu Operation

To Configure the Remote Interface

LAN Configuration

There are several parameters that you may need to set to establish network communication using the LAN interface. Primarily, you will need to establish an IP address. You may need to contact your network administrator for help in establishing communication with the LAN interface.

1  Select the “I/O” menu.
Press and then press the I/O softkey.

2  Select the “LAN” menu.
Press the LAN softkey.

You can select Modify Settings to change the LAN settings, or Current Config to view the current LAN settings (including the MAC address).
Press Modify Settings.

From this menu, you can select Reset LAN to restart the LAN, IP Setup to set an IP address and related parameters, DNS Setup to configure DNS, or Password to set a password for the Web Server Interface.

Note: To set a password use the knob and cursor keys (use to delete all characters to the right of the cursor position). The Web Server Interface will prompt for the password to protect certain windows. For further information, see “Agilent 33210A Web Interface” on page 136 of the User’s Guide for the Agilent 33210A.
To use the Agilent 33210A on the network, you must first establish an IP setup, including an IP address, and possibly a subnet mask and gateway address. Press the IP Setup softkey. By default, both DHCP and Auto IP are set to On.

With DHCP On, an IP address will automatically be set by DHCP (Dynamic Host Configuration Protocol) when you connect the Agilent 33210A to the network, provided the DHCP server is found and is able to do so. DHCP also automatically deals with the subnet mask and gateway address, if required. This is typically the easiest way to establish LAN communication for your instrument. All you need to do is leave DHCP On.

With Auto IP On, if DHCP fails to assign an IP address, Auto IP will attempt to do so after a time-out period.

However, if you cannot establish communication by means of DHCP or Auto IP, you will need to manually set an IP address, and a subnet mask and gateway address if they are in use. Follow these steps:

1. Set the “IP Address.” Press the softkeys to select DHCP Off and Auto IP Off. The manual selection softkeys appear and the current IP address is displayed:

   ![IP Address Screen](image)

   Contact your network administrator for the IP address to use. All IP addresses take the dot-notation form "nnn.nnn.nnn.nnn" where "nnn" in each case is a byte value in the range 0 through 255. You can enter a new IP address using the numeric keypad (not the knob). Just type in the numbers and the period delimiters using the keypad. Use the left cursor key as a backspace key. Do not enter leading zeros. For further information, see “More about IP Addresses and Dot Notation” at the end of this section.
To Configure the Remote Interface

b. **Set the “Subnet Mask.”** The subnet mask is required if your network has been divided into subnets. Ask your network administrator whether a subnet mask is needed, and for the correct mask. Press the **Subnet Mask** softkey and enter the subnet mask in the IP address format (using the keypad).

![Subnet Mask](image)

<table>
<thead>
<tr>
<th>DHCP</th>
<th>Auto-IP</th>
<th>IP Address</th>
<th>Subnet Mask</th>
<th>Default Gateway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>255.255.0.0</td>
<td>Off</td>
</tr>
</tbody>
</table>

c. **Set the “Default Gateway.”** The gateway address is the address of a gateway, which is a device that connects two networks. Ask your network administrator whether a gateway is in use and for the correct address. Press the **Default Gateway** softkey and enter the gateway address in the IP address format (using the keypad).

d. **Exit the “IP Setup” menu.** Press **DONE** to return to the “Modify Settings” menu.

4 **Configure the “DNS Setup” (optional).**

DNS (Domain Name Service) is an Internet service that translates domain names into IP addresses. Ask your network administrator whether DNS is in use, and if it is, for the host name, domain name, and DNS server address to use.

Start at the “Modify Settings” menu.

![DNS Setup](image)

<table>
<thead>
<tr>
<th>Reset LAN</th>
<th>IP Setup</th>
<th>DNS Setup</th>
<th>Password</th>
<th>DONE</th>
</tr>
</thead>
</table>

Press the **DNS Setup** softkey to display the “Host Name” field.

![Host Name](image)

a. **Set the “Host Name.”** Enter the host name. The host name is the host portion of the domain name, which is translated into an IP address. The host name is entered as a string using the knob and cursor keys to select and change characters. The host name may
Chapter 3 Front-Panel Menu Operation

To Configure the Remote Interface

include letters, numbers, and dashes ("-"). You can use the keypad for
the numeric characters only.

Press \/+ to delete all characters to the right of the cursor position.

b. **Set the “Domain Name.”** Press the Domain Name softkey and enter
the domain name. The domain name is translated into an IP address.
The domain name is entered as a string using the knob and cursor
keys to select and change characters. The domain name may include
letters, numbers, dashes ("-"), and periods ("."). You can use the
keypad for the numeric characters only.

Press \/+ to delete all characters to the right of the cursor position.

c. **Set the “DNS Server” address.** Press the DNS Server softkey and
enter the address of the DNS server in the IP address format (using
the keypad).

5 Exit the menus.

Press **DONE** to exit each menu in turn, or press \[Utility\] to exit the “Utility”
menu directly.

---

**More about IP Addresses and Dot Notation**

Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a byte value)
such as IP addresses must be expressed with care. This is because
most web software on the PC will interpret byte values with leading zeros
as octal numbers. Thus, "255.255.020.011" is actually equivalent to the
decimal "255.255.16.9" rather than "255.255.20.11" because ".020" is
interpreted as "16" expressed in octal, and ".011" as "9". To avoid confu-
sion it is best to use only decimal expressions of byte values (0 to 255),
with no leading zeros.

The Agilent 33210A assumes that all IP addresses and other dot-not-
aton addresses are expressed as decimal byte values, and strips all lead-
ing zeros from these byte values. Thus, if you try to enter
"255.255.020.011" in the IP address field, it becomes "255.255.20.11" (a
purely decimal expression). You should enter exactly the same expres-
sion, "255.255.20.11" in your PC web software to address the instru-
ment. Do not use "255.255.020.011"—the PC will interpret that address
differently due to the leading zeros.
Calibration Procedures
Calibration Procedures

This chapter contains procedures for verification of the instrument's performance and adjustment (calibration). The chapter is divided into the following sections:

- Agilent Technologies Calibration Services, on page 53
- Calibration Interval, on page 53
- Adjustment is Recommended, on page 53
- Time Required for Calibration, on page 54
- Automating Calibration Procedures, on page 55
- Recommended Test Equipment, on page 56
- Test Considerations, on page 57
- Performance Verification Tests, on page 58
- Internal Timebase Verification, on page 62
- AC Amplitude (high-impedance) Verification, on page 63
- Low Frequency Flatness Verification, on page 64
- 0 dB Range Flatness Verification, on page 65
- +10 dB Range Flatness Verification, on page 67
- +20 dB Range Flatness Verification, on page 69
- Calibration Security, on page 71
- Calibration Message, on page 73
- Calibration Count, on page 73
- General Calibration/Adjustment Procedure, on page 74
- Aborting a Calibration in Progress, on page 75
- Sequence of Adjustments, on page 75
- Self-Test, on page 76
- Frequency (Internal Timebase) Adjustment, on page 77
- Internal ADC Adjustment/Self Calibration, on page 78
- Output Impedance Adjustment, on page 79
- AC Amplitude (high-impedance) Adjustment, on page 81
- Low Frequency Flatness Adjustment, on page 84
- 0 dB Range Flatness Adjustments, on page 85
- +10 dB Range Flatness Adjustments, on page 87
- +20 dB Range Flatness Adjustment, on page 89
- Calibration Errors, on page 92
Closed-Case Electronic Calibration  The instrument features closed-case electronic calibration. No internal mechanical adjustments are required. The instrument calculates correction factors based upon the input reference value you set. The new correction factors are stored in non-volatile memory until the next calibration adjustment is performed. Non-volatile EEPROM calibration memory does not change when power has been off or after a remote interface reset.

Agilent Technologies Calibration Services

Agilent Technologies offers calibration services at competitive prices. When your instrument is due for calibration, contact your local Agilent Service Center for recalibration. See Types of Service Available on page 104 for information on contacting Agilent.

Calibration Interval

The instrument should be calibrated on a regular interval determined by the measurement accuracy requirements of your application.

A 1-year interval is adequate for most applications. Accuracy specifications will remain valid only if adjustment is made at regular calibration intervals. Accuracy specifications are not valid beyond the 1-year calibration interval. Agilent does not recommend extending calibration intervals beyond 2 years for any application.

Adjustment is Recommended

Specifications are valid only within the period stated from the last adjustment. Whatever calibration interval you select, Agilent recommends that complete re-adjustment always be performed at the calibration interval. This is necessary to ensure that the instrument will remain within specification for the next calibration interval. This criteria for re-adjustment provides the best long-term stability.

Performance data measured during Performance Verification Tests does not mean that the instrument will remain within these limits unless the adjustments are performed.

Use the Calibration Count feature (see page 73) to verify that all adjustments have been performed.
Time Required for Calibration

The Agilent 33210A can be automatically calibrated under computer control. With computer control you can perform the complete calibration procedure and performance verification tests in approximately 30 minutes once the instrument is warmed-up (see “Test Considerations” on page 57). Manual adjustments and verifications, using the recommended test equipment, will take approximately 2 hours.
Automating Calibration Procedures

You can automate the complete verification and adjustment procedures outlined in this chapter if you have access to programmable test equipment. You can program the instrument configurations specified for each test over the remote interface. You can then enter read-back verification data into a test program and compare the results to the appropriate test limit values.

You can also adjust the instrument from the remote interface. Remote adjustment is similar to the local front-panel procedure. You can use a computer to perform the adjustment by first selecting the required function and range. The calibration value is sent to the instrument and then the calibration is initiated over the remote interface. The instrument must be unsecured prior to initiating the calibration procedure.

For further information on programming the instrument, see chapters 3 and 4 in the Agilent 33210A User’s Guide.
Chapter 4  Calibration Procedures

**Recommended Test Equipment**

The test equipment recommended for the performance verification and adjustment procedures is listed below. If the exact instrument is not available, substitute calibration standards of equivalent accuracy.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Requirements</th>
<th>Recommended Model</th>
<th>Use*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Multimeter</td>
<td>ac volts, true rms, ac coupled accuracy: ±0.02% to 1 MHz dc volts accuracy: 50 ppm resolution: 100 µV Resistance Offset-compensated accuracy: ±0.1Ω</td>
<td>Agilent 3458A</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Power Meter</td>
<td>100 kHz to 100 MHz 1 µW to 100 mW (~30 dBm to +20 dBm) accuracy: 0.02 dB resolution: 0.01 dB</td>
<td>Agilent E4418B</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Power Head</td>
<td>100 kHz to 100 MHz 1 µW to 100 mW (~30 dBm to +20 dBm)</td>
<td>Agilent 8482A</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Attenuator</td>
<td>–20 dB</td>
<td>Agilent 8491A Opt 020</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Frequency Meter</td>
<td>accuracy: 0.1 ppm</td>
<td>Agilent 53131A Opt 010 (high stability)</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Oscilloscope**</td>
<td>500 MHz 2 Gs/second 50Ω input termination</td>
<td>Agilent 54831B</td>
<td>T</td>
</tr>
<tr>
<td>Adapter</td>
<td>N type (m) to BNC (m)</td>
<td>N type (m) to BNC (m)</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Cable</td>
<td>BNC (m) to dual-banana (f)</td>
<td>Agilent 10110B</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Cable (2 required)</td>
<td>Dual banana (m) to dual banana (m)</td>
<td>Agilent 11000-60001</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Cable</td>
<td>RG58, BNC (m) to dual banana</td>
<td>Agilent 11001-60001</td>
<td>Q, P, T</td>
</tr>
<tr>
<td>Cable</td>
<td>RG58, BNC (m) to BNC (m)</td>
<td>Agilent 8120-1840</td>
<td>Q, P, T</td>
</tr>
</tbody>
</table>

* Q = Quick Verification  P = Performance Verification  T = Troubleshooting

** An oscilloscope is not required for calibration, only for troubleshooting.
Test Considerations

For optimum performance, all procedures should comply with the following recommendations:

- Assure that the calibration ambient temperature is stable and between 21 °C and 25 °C (23 °C ±2 °C).
- Assure ambient relative humidity is less than 80%.
- Allow a 1-hour warm-up period before verification or adjustment.
- Keep the measurement cables as short as possible, consistent with the impedance requirements.
- Use only RG-58 or equivalent 50Ω cable.
Performance Verification Tests

Use the Performance Verification Tests to verify the measurement performance of the instrument. The performance verification tests use the instrument's specifications listed in the “Specifications” chapter beginning on page 11.

You can perform three different levels of performance verification tests:

- **Self-Test**  A series of internal verification tests that give high confidence that the instrument is operational.

- **Quick Verification**  A combination of the internal self-tests and selected verification tests.

- **Performance Verification Tests**  An extensive set of tests that are recommended as an acceptance test when you first receive the instrument or after performing adjustments.

**Self-Test**

A brief power-on self-test occurs automatically whenever you turn on the instrument. This limited test assures that the instrument is operational.

To perform a complete self-test:

1. Press **Utility** on the front panel.

2. Select the **Self Test** softkey from the “Test/Cal” menu.

A complete description of the self-tests can be found in chapter 6. The instrument will automatically perform the complete self-test procedure when you release the key. The self-test will complete in approximately 15 seconds.

- If the self-test is successful, “Self Test Passed” is displayed on the front panel.

- If the self-test fails, “Self Test Failed” and an error number are displayed.

- If repair is required, see chapter 6, ”Disassembly and Repair,” for further details.
Quick Performance Check

The quick performance check is a combination of internal self-test and an abbreviated performance test (specified by the letter Q in the performance verification tests). This test provides a simple method to achieve high confidence in the instrument's ability to functionally operate and meet specifications. These tests represent the absolute minimum set of performance checks recommended following any service activity. Auditing the instrument's performance for the quick check points (designated by a Q) verifies performance for normal accuracy drift mechanisms. This test does not check for abnormal component failures.

To perform the quick performance check, do the following:

1. Perform a complete self-test. A procedure is given on page 58.
2. Perform only the performance verification tests indicated with the letter Q.
3. If the instrument fails the quick performance check, adjustment or repair is required.

Performance Verification Tests

The performance verification tests are recommended as acceptance tests when you first receive the instrument. The acceptance test results should be compared against the specifications given in chapter 1. After acceptance, you should repeat the performance verification tests at every calibration interval.

If the instrument fails performance verification, adjustment or repair is required.

Adjustment is recommended at every calibration interval. If adjustment is not made, you must guard band, using no more than 80% of the specifications listed in chapter 1, as the verification limits.
Special Note: Amplitude and Flatness Verification Procedures

Measurements made during the AC Amplitude (high-impedance) Verification procedure (see page 63) are used as reference measurements in the flatness verification procedures (beginning on page 64). Additional reference measurements and calculated references are used in the flatness verification procedures. Photo-copy and use the table on page 61 to record these reference measurements and perform the calculations.

The flatness verification procedures use both a DMM and a Power Meter to make the measurements. To correct the difference between the DMM and Power Meter measurements, the Power Meter reference measurement level is adjusted to set the 0.00 dB level to the DMM measurement made at 1 kHz. The flatness error of the DMM at 100 KHz is used to set the required 0.00 dB reference.

The instrument internally corrects the difference between the high-Z input of the DMM and the 50 Ω input of the Power Meter when setting the output level.

The reference measurements must also be converted from Vrms (made by the DMM) to dBm (made by the Power Meter).

The equation used for the conversion from Vrms (High-Z) to dBm (at 50 Ω) is as follows:

\[
\text{Power (dBm)} = 10 \log(5.0 \cdot V_{\text{rms}}^2)
\]

Flatness measurements for the –10 db, –20 d B, and –30 dB attenuator ranges are verified as a part of the 0 dB verification procedure. No separate verification procedure is given for these ranges.
Amplitude and Flatness Verification Worksheet

1. Enter the following measurements (from procedure on page 63).

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Reference Level</th>
<th>Vrms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1kHz</td>
<td>0 dB</td>
<td></td>
</tr>
<tr>
<td>1kHz</td>
<td>10 dB</td>
<td></td>
</tr>
<tr>
<td>1kHz</td>
<td>20 dB</td>
<td></td>
</tr>
</tbody>
</table>

2. Calculate the dBm value of the rms voltages.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Reference Level</th>
<th>dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1kHz</td>
<td>0 dB</td>
<td></td>
</tr>
<tr>
<td>1kHz</td>
<td>10 dB</td>
<td></td>
</tr>
<tr>
<td>1kHz</td>
<td>20 dB</td>
<td></td>
</tr>
</tbody>
</table>

3. Enter the following measurements (from the procedure on page 64).

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Reference Level</th>
<th>Vrms</th>
</tr>
</thead>
<tbody>
<tr>
<td>100kHz</td>
<td>0 dB</td>
<td></td>
</tr>
<tr>
<td>100kHz</td>
<td>10 dB</td>
<td></td>
</tr>
<tr>
<td>100kHz</td>
<td>20 dB</td>
<td></td>
</tr>
</tbody>
</table>

4. Calculate the dBm value of the rms voltages.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Reference Level</th>
<th>dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>100kHz</td>
<td>0 dB</td>
<td></td>
</tr>
<tr>
<td>100kHz</td>
<td>10 dB</td>
<td></td>
</tr>
<tr>
<td>100kHz</td>
<td>20 dB</td>
<td></td>
</tr>
</tbody>
</table>

5. Calculate the offset values.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Offset</th>
<th>dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>100kHz</td>
<td>0 dB</td>
<td></td>
</tr>
<tr>
<td>100kHz</td>
<td>10 dB</td>
<td></td>
</tr>
<tr>
<td>100kHz</td>
<td>20 dB</td>
<td></td>
</tr>
</tbody>
</table>
Internal Timebase Verification

This test verifies the output frequency accuracy of the instrument. All output frequencies are derived from a single generated frequency.

1. Connect a frequency counter as shown below (the frequency counter input should be terminated at 50 Ω).

2. Set the instrument to the output described in the table below and measure the output frequency. Be sure the instrument output is enabled.

<table>
<thead>
<tr>
<th>Function</th>
<th>Amplitude</th>
<th>Frequency</th>
<th>Nominal</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sine Wave</td>
<td>1.00 Vpp</td>
<td>10.000,000.0 MHz</td>
<td>10.000 MHz</td>
<td>± 200 Hz*</td>
</tr>
</tbody>
</table>

* The error is ± 100 Hz within 90 days of calibration, or ± 200 Hz within one year.

3. Compare the measured frequency to the test limits shown in the table.
Chapter 4 Calibration Procedures

AC Amplitude (high-impedance) Verification

This procedure checks the ac amplitude output accuracy at a frequency of 1 kHz, and establishes reference measurements for the higher frequency flatness verification procedures.

1. Set the DMM to measure Vrms Volts. Connect the DMM as shown below.

![DMM Connection Diagram]

2. Set the instrument to each output described in the table below and measure the output voltage with the DMM. Press [Utility] to set the output impedance to High–Z. Be sure the output is enabled.

### Agilent 33210A

<table>
<thead>
<tr>
<th>Output Setup</th>
<th>Function</th>
<th>Frequency</th>
<th>Amplitude</th>
<th>Nominal</th>
<th>Error 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>High Z</td>
<td>Sine Wave</td>
<td>1.000 kHz</td>
<td>20.0 mVrms</td>
<td>± 0.00091 Vrms</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
<td>Sine Wave</td>
<td>1.000 kHz</td>
<td>67.0 mVrms</td>
<td>± 0.00138 Vrms</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
<td>Sine Wave</td>
<td>1.000 kHz</td>
<td>200.0 mVrms</td>
<td>± 0.00271 Vrms</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
<td>Sine Wave</td>
<td>1.000 kHz</td>
<td>670.0 mVrms</td>
<td>± 0.00741 Vrms</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
<td>Sine Wave</td>
<td>1.000 kHz</td>
<td>2.000 Vrms</td>
<td>± 0.0207 Vrms</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
<td>Sine Wave</td>
<td>1.000 kHz</td>
<td>7.000 Vrms</td>
<td>± 0.0707 Vrms</td>
</tr>
<tr>
<td>Q</td>
<td>Square Wave 4</td>
<td>1.000 kHz</td>
<td>900.0 mVrms</td>
<td>0.900 Vrms</td>
<td>± 0.0100 Vrms</td>
</tr>
</tbody>
</table>

1. Enter the measured value on the worksheet (page 61) as 1kHz_0dB_reference.
2. Enter the measured value on the worksheet (page 61) as 1kHz_10dB_reference.
3. Enter the measured value on the worksheet (page 61) as 1kHz_20dB_reference.
4. Based upon 1% of setting ±1 mVpp (50 Ω); converted to Vrms for High–Z.

3. Compare the measured voltage to the test limits shown in the table.
Chapter 4 Calibration Procedures

Low Frequency Flatness Verification

This procedure checks the AC amplitude flatness at 100 kHz using the reference measurements recorded in the Amplitude and Flatness Verification Worksheet. These measurements also establish an error value used to set the power meter reference. The transfer measurements are made at a frequency of 100 kHz using both the DMM and the power meter.

1 Set the DMM to measure ac Volts. Connect the DMM as shown in the figure on page 63.

2 Set the instrument to each output described in the table below and measure the output voltage with the DMM. Press Utility to set the output impedance to High-Z. Be sure the output is enabled.

<table>
<thead>
<tr>
<th>Agilent 33210A</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Setup</td>
<td>Function</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
</tr>
<tr>
<td>Q</td>
<td>High Z</td>
</tr>
</tbody>
</table>

\(^1\) Enter the measured value on the worksheet (page 61) as 100kHz_0dB_reference.
\(^2\) Enter the measured value on the worksheet (page 61) as 1kHz_10dB_reference.
\(^3\) Enter the measured value on the worksheet (page 61) as 100kHz_20dB_reference.

3 Compare the measured voltage to the test limits shown in the table.

4 You have now recorded all the required measurements on the worksheet (page 61). Complete the worksheet by making all the indicated calculations.
0 dB Range Flatness Verification

This procedure checks the high frequency ac amplitude flatness above 100 kHz on the 0dB attenuator range. (Flatness is relative to 1 kHz.)

1 Connect the power meter to measure the output amplitude of the instrument as shown below.

2 Set up the function generator as follows:
   - Output impedance: 50 Ω (press Utility and select Output Setup).
   - Waveform: Sine
   - Frequency: 100 kHz
   - Amplitude: 3.51 dBm

   Make sure the output is enabled.

3 On the power meter, use the Relative Power function to set the current reading as the reference value. This will allow you to compare future measurement results in dB.

4 Set the power meter offset to equal the 100kHz_0dB_offset value previously calculated. This sets the power meter to directly read the flatness error specification relative to 1 kHz. 100kHz_0dB_offset is calculated on the Amplitude and Flatness Verification Worksheet.
Chapter 4  Calibration Procedures

0 dB Range Flatness Verification

5  Set the function generator to each output described in the table below and measure the output amplitude with the power meter (the relative measurement in dB).

<table>
<thead>
<tr>
<th>Output Setup</th>
<th>Function</th>
<th>Amplitude</th>
<th>Frequency</th>
<th>Nominal</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>100.000 kHz</td>
<td>0 dB</td>
<td>± 0.1 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>200.000 kHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>500.000 kHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>2.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>3.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>4.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>5.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>8.000 MHz</td>
<td>0 dB</td>
<td>± 0.3 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+3.51 dBm</td>
<td>10.000 MHz</td>
<td>0 dB</td>
<td>± 0.3 dB</td>
</tr>
</tbody>
</table>

6  Compare the measured output to the test limits shown in the table.
+10 dB Range Flatness Verification

This procedure checks the high frequency ac amplitude flatness above 100 kHz on the +10dB attenuator range. (Flatness is relative to 1 kHz.)

1. Connect the power meter to measure the output amplitude of the instrument as shown on page 65.

2. Set up the function generator as follows:
   - Output impedance: 50 Ω (press and select Output Setup).
   - Waveform: Sine
   - Frequency: 100 kHz
   - Amplitude: 13.00 dBm

   Make sure the output is enabled.

3. On the power meter, use the Relative Power function to set the current reading as the reference value. This will allow you to compare future measurement results in dB.

4. Set the power meter offset to equal the 100kHz_10dB_offset value previously calculated. This sets the power meter to directly read the flatness error specification relative to 1 kHz. 100kHz_10dB_offset is calculated on the Amplitude and Flatness Verification Worksheet.
5 Set the instrument to each output described in the table below and measure the output amplitude with the power meter (the relative measurement in dB).

<table>
<thead>
<tr>
<th>Output Setup</th>
<th>Function</th>
<th>Amplitude</th>
<th>Frequency</th>
<th>Nominal</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>100.000 kHz</td>
<td>0 dB</td>
<td>± 0.1 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>200.000 kHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>500.000 kHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>2.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>3.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>4.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>5.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>8.000 MHz</td>
<td>0 dB</td>
<td>± 0.3 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+13.00 dBm</td>
<td>10.000 MHz</td>
<td>0 dB</td>
<td>± 0.3 dB</td>
</tr>
</tbody>
</table>

6 Compare the measured output to the test limits shown in the table.
+20 dB Range Flatness Verification

This procedure checks the high frequency ac amplitude flatness above 100 kHz on the +20dB attenuator range. (Flatness is relative to 1 kHz.)

1 Connect the power meter to measure the output voltage of the instrument as shown below.

![Power Meter Diagram](image)

**Caution**

Most power meters will require an attenuator or special power head to measure the +20 dB output.

2 Set up the function generator as follows:
   - Output impedance: 50 Ω (press `Utility` and select Output Setup).
   - Waveform: Sine
   - Frequency: 100 kHz
   - Amplitude: 23.90 dBm

   *Make sure the output is enabled.*

3 On the power meter, use the Relative Power function to set the current reading as the reference value. This will allow you to compare future measurement results in dB.
4 Set the power meter offset to equal the 100kHz_20dB_offset value previously calculated. This sets the power meter to directly read the flatness error specification relative to 1 kHz. 100kHz_20dB_offset is calculated on the Amplitude and Flatness Verification Worksheet.

5 Set the instrument to each output described in the table below and measure the output amplitude with the power meter.

<table>
<thead>
<tr>
<th>Output Setup</th>
<th>Function</th>
<th>Amplitude</th>
<th>Frequency</th>
<th>Nominal</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>100.000 kHz</td>
<td>0 dB</td>
<td>± 0.1 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>200.000 kHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>500.000 kHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>2.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>3.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>4.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>5.000 MHz</td>
<td>0 dB</td>
<td>± 0.2 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>8.000 MHz</td>
<td>0 dB</td>
<td>± 0.3 dB</td>
</tr>
<tr>
<td>Q 50 Ω</td>
<td>Sine Wave</td>
<td>+23.90 dBm</td>
<td>10.000 MHz</td>
<td>0 dB</td>
<td>± 0.3 dB</td>
</tr>
</tbody>
</table>

6 Compare the measured output to the test limits shown in the table.
Calibration Security

This feature allows you to enter a security code to prevent accidental or unauthorized adjustments of the instrument. When you first receive your instrument, it is secured. Before you can adjust the instrument, you must unsecure it by entering the correct security code.

See “To Unsecure and Secure for Calibration”, on page 41 for a procedure to enter the security code from the front panel. Use the CAL:SEC:STAT ON command to enter the security code using the remote interface.

- The security code is set to AT33210A when the instrument is shipped from the factory. The security code is stored in non-volatile memory, and does not change when power has been off, after a Factory Reset ("RST" command), or after an Instrument Preset (SYSTem:PRESet command).

- The security code may contain up to 12 alphanumeric characters. The first character must be a letter, but the remaining characters can be letters, numbers, or an underscore (_). You do not have to use all 12 characters but the first character must always be a letter.

Note

If you forget your security code, you can disable the security feature by applying a temporary short inside the instrument as described below.

To Unsecure the Instrument Without the Security Code

To unsecure the instrument without the correct security code, follow the steps below. See “To Unsecure and Secure for Calibration” on page 41. See “Electrostatic Discharge (ESD) Precautions” on page 106 before beginning this procedure.

Note

If you do not have a record of the security code, there are two codes you may wish to try before you use the procedure below. First try AT33210A (the factory default code). If that code does not work, you may wish to try the single letter A as the security code. If someone has re-secured calibration without entering a new code, the default code is the letter A.

1. Disconnect the power cord and all input connections.

2. Disassemble the instrument using the “General Disassembly Procedure” on page 113.
Chapter 4  Calibration Procedures

Calibration Security

3 Apply a temporary short between the two exposed metal pads on the A1 assembly. The general location is shown in the figure below. On the PC board, the pads are marked CAL ENABLE.

4 Apply power and turn on the instrument.

WARNING  Be careful not to touch the power line connections or high voltages on the power supply module. Power is present even if the instrument is turned off.

5 The display will show the message “Calibration security has been disabled”. The instrument is now unsecured.

6 Turn off the instrument and remove the power cord.

7 Reassemble the instrument.

Now you can enter a new security code, see “To Unsecure and Secure for Calibration”, on page 41. Be sure you record the new security code.
Calibration Message

The instrument allows you to store one message in calibration memory. For example, you can store the date when the last calibration was performed, the date when the next calibration is due, the instrument’s serial number, or even the name and phone number of the person to contact for a new calibration.

You can record a calibration message only from the remote interface and only when the instrument is unsecured. Use the CAL:STRING <message> command.

You can read the message from either the front-panel or over the remote interface. You can read the calibration message whether the instrument is secured or unsecured. Reading the calibration message from the front panel is described on “To Read the Calibration Information”, on page 40. Use the CAL:STRING? query to read the message over the remote interface.

Calibration Count

You can query the instrument to determine how many calibrations have been performed. Note that your instrument was calibrated before it left the factory. When you receive your instrument, read the count to determine its initial value. The count value increments by one for each calibration point, and a complete calibration may increase the value by many counts. See “To Read the Calibration Information”, on page 40. Use the CAL:COUNT? query to read the count over the remote interface.
Chapter 4 Calibration Procedures

General Calibration/Adjustment Procedure

The following procedure is the recommended method to complete an instrument calibration. This procedure is an overview of the steps required for a complete calibration. Additional details for each step in this procedure are given in the appropriate sections of this chapter.

1. Read “Test Considerations” on page 57.

2. Unsecure the instrument for calibration (see page 71).

3. Perform the verification tests, beginning on page page 58, to characterize the instrument (incoming data).

4. Press \textit{Utility} on the front panel.

5. Select the “Test / Cal” menu.

6. Select \textit{Perform Cal}.

7. Enter the \textit{Setup Number} for the procedure being performed. The default setup number is “1” and, from the front panel, the number will increment as the procedures are performed.

8. Select \textit{BEGIN}.

9. For setups that require an input, adjust the value shown in the display to the measured value and select \textit{ENTER VALUE}.

10. The setup will automatically advance to the next required value.

\textbf{Note} To cancel the adjustment procedure, select \textit{CANCEL STEP}. The display will return to the setup number entry.

11. When finished, select \textit{END CAL}.

12. Secure the instrument against calibration.

13. Note the new security code and calibration count in the instrument’s maintenance records.
Aborting a Calibration in Progress

Sometimes it may be necessary to abort a calibration after the procedure has already been initiated. You can abort a calibration at any time by turning off the power. When performing a calibration from the remote interface, you can abort a calibration by issuing a remote interface device clear message followed by a \*RST.

The instrument stores calibration constants at the end of each adjustment procedure. If you lose power, or otherwise abort an adjustment in progress, you will only need to perform the interrupted adjustment procedure again.

**Caution**

If power is lost when the instrument is attempting to write new calibration constants to EEPROM, you may lose all calibration constants for the function. Typically, upon re-applying power, the instrument will report error “-313, Calibration Memory Lost”.

Sequence of Adjustments

The adjustment sequence shown in the following sections of this chapter is recommended to minimize the number of test equipment set-up and connection changes.

You may perform individual adjustments as necessary. Setups 1 through 7 **must** be performed in order and **must** be performed **before** any other setup procedure.
Self-Test

Self-Test is performed as the first step to ensure the instrument is in working order before beginning any additional adjustments.

Note

Be sure to follow the requirements listed in “Test Considerations” on page 57 before beginning any adjustments.

1 Press [Utility] on the front panel. Select Perform Cal on the “Test / Cal” menu. Enter setup number “1” and select BEGIN.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Performs the Self-test. The Main Output is disabled during test.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

2 If the instrument fails any self-test, you must repair the instrument before continuing the adjustment procedures.

Note

The self-test procedure takes approximately 15 seconds to complete.
Chapter 4  Calibration Procedures
Frequency (Internal Timebase) Adjustment

Frequency (Internal Timebase) Adjustment

The function generator stores a calibration constant that sets the VCXO to output exactly 10 MHz.

1. Set the frequency counter resolution to better than 0.1 ppm and the input termination to 50 Ω (if your frequency counter does not have a 50 Ω input termination, you must provide an external termination). Make the connections shown below.

2. Use a frequency counter to measure the output frequency for each setup in the following table.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Nominal Signal</th>
<th>Frequency</th>
<th>Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>&lt;10 MHz</td>
<td>1 Vpp</td>
<td>Output frequency is slightly less than 10MHz</td>
</tr>
<tr>
<td>3</td>
<td>&gt;10 MHz</td>
<td>1 Vpp</td>
<td>Output frequency is slightly more than 10MHz</td>
</tr>
<tr>
<td>4</td>
<td>~10 MHz</td>
<td>1 Vpp</td>
<td>Output frequency should be near 10MHz</td>
</tr>
<tr>
<td>5*</td>
<td>10 MHz</td>
<td>1 Vpp</td>
<td>Output frequency should be 10MHz ±1ppm</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.

3. Using the numerical keypad or knob, adjust the displayed frequency at each setup to match the measured frequency. Select ENTER VALUE.

4. After performing setup 5:
   a. If your calibration procedures require you to verify the adjustment just made, exit the calibration menu and perform “Internal Timebase Verification”, on page 62.
   b. If you are making all the adjustments and then verifying the instrument’s performance, continue with the next procedure in this chapter.
Internal ADC Adjustment/Self Calibration

The function generator stores calibration constants related to the gain and offset of the internal ADC. Setup 6 must always be performed before any later adjustments are attempted. The internal ADC is then used as a source for the calibration constants generated in setup 7.

1 Make the connections as shown below.

2 Set the DMM to display 5 1/2 digits.

3 Enter the following setup, and then measure the dc value.

<table>
<thead>
<tr>
<th>Nominal Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup DC level</td>
</tr>
<tr>
<td>6* ~1.1 Vdc ±10% Calibrates the internal ADC.</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.

4 Enter the measured value of the dc source using the numeric keypad or knob.

5 Disconnect all cables from the rear panel Modulation In connector.

Note: This setup requires approximately 15 seconds to complete.
Chapter 4  Calibration Procedures
Output Impedance Adjustment

6 Enter and begin the following setup.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7*</td>
<td>Self-calibration. The output is disabled.</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.

7 There are no specific operational verification tests for setups 6 and 7 since the constants generated affect almost all behavior of the instrument. Continue with the next adjustment procedure in this chapter.

---

Output Impedance Adjustment

The function generator stores calibration constants for the output impedance. The output impedance constants are generated with and without the distortion filter and using all five attenuator paths.

1 Set the DMM to measure offset-compensated, four-wire Ohms. Set the DMM to use 100 NPLC integration. Make the connections as shown below.
Chapter 4  Calibration Procedures

Output Impedance Adjustment

2 Use the DMM to make a resistance measurement at the front panel Output connector for each setup in the following table. The expected measured value is approximately 50 Ω.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>8*</td>
<td>-30dB</td>
</tr>
<tr>
<td>9*</td>
<td>-20dB</td>
</tr>
<tr>
<td>10*</td>
<td>-10dB</td>
</tr>
<tr>
<td>11*</td>
<td>0dB</td>
</tr>
<tr>
<td>12*</td>
<td>+10dB</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.

3 Using the numeric keypad or knob, adjust the displayed impedance at each setup to match the measured impedance. Select ENTER VALUE.

4 There are no specific operational verification tests for Output Impedance. Continue with the next adjustment procedure in this chapter.
AC Amplitude (high-impedance) Adjustment

The function generator stores a calibration constant for each high-impedance attenuator path. The gain coefficient of each path is calculated using two measurements; one with the waveform DAC at + output and one with waveform DAC at - output. The setups, therefore, must be performed in pairs.

1. Connect the DMM as shown below.

![Diagram of DMM connection](image)
AC Amplitude (high-impedance) Adjustment

2 Use the DMM to measure the dc voltage at the front-panel Output connector for each setup in the following table.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Nominal Signal</th>
<th>DC level</th>
<th>Output of dB range</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>13 +0.015 V</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>14* -0.015 V</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>15 +0.05 V</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>16* -0.05 V</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>17 +0.15 V</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>18* -0.15 V</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>19 +0.50 V</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>20* -0.50 V</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>21 +0.15 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>22* -0.15 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>23 +0.50 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>24* -0.50 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>25 +1.5 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>26* -1.5 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>27 +5 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>28* -5 V</td>
<td>Amplifier In</td>
<td></td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.
Chapter 4  Calibration Procedures

AC Amplitude (high-impedance) Adjustment

3  Using the numeric keypad or knob, adjust the displayed voltage at each setup to match the measured voltage. Select ENTER VALUE. (Entered values are rounded to the nearest 100 µV).

4  After performing setup 28:

   a. If your calibration procedures require you to verify the adjustment just made, exit the calibration menu and perform “AC Amplitude (high-impedance) Verification”, on page 63.

   b. If you are making all the adjustments and then verifying the instrument’s performance, continue with the next procedure in this chapter.
Low Frequency Flatness Adjustment

The Low Frequency Flatness adjustment calculates the flatness response of 3 attenuator paths with the Elliptical filter and 2 attenuator paths with the Linear Phase filter.

1 Set the DMM to measure Vrms. Make the connections shown on page 81.

2 Use the DMM to measure the output voltage for each of the setups in the table below.

<table>
<thead>
<tr>
<th>Nominal Signal</th>
<th>Setup</th>
<th>Frequency</th>
<th>Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29*</td>
<td>1 kHz</td>
<td>0.56 Vrms</td>
</tr>
<tr>
<td></td>
<td>30*</td>
<td>100 kHz</td>
<td>0.56 Vrms</td>
</tr>
<tr>
<td></td>
<td>31*</td>
<td>1 kHz</td>
<td>0.56 Vrms</td>
</tr>
<tr>
<td></td>
<td>32*</td>
<td>100 kHz</td>
<td>0.56 Vrms</td>
</tr>
<tr>
<td></td>
<td>33*</td>
<td>1 kHz</td>
<td>1.7 Vrms</td>
</tr>
<tr>
<td></td>
<td>34*</td>
<td>100 kHz</td>
<td>1.7 Vrms</td>
</tr>
<tr>
<td></td>
<td>35*</td>
<td>1 kHz</td>
<td>5.6 Vrms</td>
</tr>
<tr>
<td></td>
<td>36*</td>
<td>100 kHz</td>
<td>5.6 Vrms</td>
</tr>
<tr>
<td></td>
<td>37*</td>
<td>1 kHz</td>
<td>5.6 Vrms</td>
</tr>
<tr>
<td></td>
<td>38*</td>
<td>100 kHz</td>
<td>5.6 Vrms</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.

3 Using the numeric keypad or knob, adjust the displayed voltage at each setup to match the measured voltage. Select ENTER VALUE.

4 After performing setup 38:
   a. If your calibration procedures require you to verify the adjustment just made, exit the calibration menu and perform "Low Frequency Flatness Verification", on page 64.
   b. If you are making all the adjustments and then verifying the instrument’s performance, continue with the next procedure in this chapter.
0 dB Range Flatness Adjustments

1. Connect the power meter as shown on page 87.

2. Use the power meter to measure the output amplitude for each of the setups in the table below.

**Note**
Setup 39 establishes the power meter reference for all the remaining setups in this table. You must always perform setup 39 before any of the following setups.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Frequency</th>
<th>Amplitude</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>39*</td>
<td>100 kHz</td>
<td>0.28 Vrms</td>
<td>Power Meter Reference for 0 dB Range</td>
</tr>
<tr>
<td>40*</td>
<td>200 kHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>41*</td>
<td>500 kHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>42*</td>
<td>1.5 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>43*</td>
<td>3 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>44*</td>
<td>4 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>45*</td>
<td>6 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>46*</td>
<td>8 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>47*</td>
<td>9.9 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Elliptical Filter</td>
</tr>
<tr>
<td>48*</td>
<td>200 kHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Linear Phase Filter</td>
</tr>
<tr>
<td>49*</td>
<td>500 kHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Linear Phase Filter</td>
</tr>
<tr>
<td>50*</td>
<td>1.5 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Linear Phase Filter</td>
</tr>
<tr>
<td>51*</td>
<td>3.0 MHz</td>
<td>0.28 Vrms</td>
<td>Flatness for 0 dB, Linear Phase Filter</td>
</tr>
<tr>
<td>52</td>
<td></td>
<td></td>
<td>Setup not used for this instrument</td>
</tr>
<tr>
<td>53</td>
<td></td>
<td></td>
<td>Setup not used for this instrument</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.
Chapter 4  Calibration Procedures  
0 dB Range Flatness Adjustments

**Note**  
Setups 52 and 53 (previous page) are not used in this instrument. From the front panel, press the Enter softkey to advance the setup from 52 to 53. No number entry is required.

3 Using the numeric keypad, adjust the displayed amplitude at each setup to match the measured amplitude (in dBm). Then select **ENTER VALUE**.

**Note**  
In order to get dBm you must use the numeric keypad (not the knob) to enter the number, and then select “dBm”.

4 After performing setup 51:

   a. If your calibration procedures require you to verify the adjustment just made, exit the calibration menu and perform “0 dB Range Flatness Verification”, on page 65.

   b. If you are making all the adjustments and then verifying the instrument’s performance, continue with the next procedure in this chapter.
+10 dB Range Flatness Adjustments

**Note**
The Linear Phase path is not adjusted. It is approximated using the other path's values.

1. Connect the power meter as shown below.

2. Use a power meter to measure the output amplitude for each of the setups in the table on the next page.

**Note**
Setup 54 establishes the power meter reference for all the remaining setups in this table. You must always perform setup 54 before any of the following setups.
Chapter 4  Calibration Procedures

+10 dB Range Flatness Adjustments

3  Using the numeric keypad, adjust the displayed amplitude at each setup to match the measured amplitude (in dBm). Then select ENTER VALUE.

Note In order to get dBm you must use the numeric keypad (not the knob) to enter the number, and then select “dBm”.

4  After performing setup 62:

   a. If your calibration procedures require you to verify the adjustment just made, exit the calibration menu and perform “+10 dB Range Flatness Verification”, on page 67.

   b. If you are making all the adjustments and then verifying the instrument’s performance, continue with the next procedure in this chapter.

<table>
<thead>
<tr>
<th>Setup</th>
<th>Frequency</th>
<th>Amplitude</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>54*</td>
<td>100 kHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>55*</td>
<td>200 kHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>56*</td>
<td>500 kHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>57*</td>
<td>1.5 MHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>58*</td>
<td>3.0 MHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>59</td>
<td>4.0 MHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>60*</td>
<td>6.0 MHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>61*</td>
<td>8.0 MHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
<tr>
<td>62*</td>
<td>9.9 MHz</td>
<td>0.9 Vrms</td>
<td>12 dBm, Flatness for 10 dB, Elliptical Filter</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.
+20 dB Range Flatness Adjustment

**Caution**
Most power meters will require an attenuator (–20 dB) or special power head to measure the +20 dB output.

Be sure to correct the measurements for the specifications of the attenuator you use. For example, if the nominal attenuator value is –20 dB at the specified frequency, you must add 20 dB to the power meter reading before entering the value.

1. Make the connections as shown below:

![Connection Diagram]

2. Use the power meter to measure the output amplitude for each of the setups in the table on the next page.

**Note**
Setup 63 establishes the power meter reference for all the remaining setups in this table. You must always perform setup 63 before any of the following setups.
## Nominal Signal

<table>
<thead>
<tr>
<th>Setup</th>
<th>Frequency</th>
<th>Amplitude</th>
<th>Flatness for 20 dB, Filter Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>63*</td>
<td>100 kHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>64*</td>
<td>200 kHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>65*</td>
<td>500 kHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>66*</td>
<td>1.5 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>67*</td>
<td>3.0 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>68*</td>
<td>4.0 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>69*</td>
<td>6.0 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>70*</td>
<td>8.0 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>71*</td>
<td>9.9 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Elliptical Filter</td>
</tr>
<tr>
<td>72*</td>
<td>200 kHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Linear Phase Filter</td>
</tr>
<tr>
<td>73*</td>
<td>500 kHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Linear Phase Filter</td>
</tr>
<tr>
<td>74*</td>
<td>1.5 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Linear Phase Filter</td>
</tr>
<tr>
<td>75*</td>
<td>3.0 MHz</td>
<td>2.8 Vrms</td>
<td>22 dBm, Linear Phase Filter</td>
</tr>
</tbody>
</table>

* Constants are stored after completing this setup.
3 Using the numeric keypad, adjust the displayed amplitude at each setup to match the measured amplitude (in dBm). Then select ENTER VALUE.

Note
In order to get dBm you must use the numeric keypad (not the knob) to enter the number, and then select “dBm”.

4 After performing setup 75:
   a. If your calibration procedures require you to verify the adjustment just made, exit the calibration menu and perform “+20 dB Range Flatness Verification”, on page 69.
   
   b. If you are making all the adjustments and then verifying the instrument’s performance, verify the output specifications of the instrument using the “Performance Verification Tests”, on page 58.

You have now completed the recommended adjustment procedures. Verification of the output specifications is recommended.
Chapter 4 Calibration Procedures

Calibration Errors

The following errors are failures that may occur during a calibration. System error messages are described in the Agilent 33210A User's Guide. Self-test error messages are described beginning on page 110 of this document.

701 Calibration error; security defeated by hardware jumper
The function generator’s calibration security feature has been disabled by temporarily shorting the two “CAL ENABLE” pads on the internal circuit board as described starting on page 73.

702 Calibration error; calibration memory is secured
A calibration cannot be performed when calibration memory is secured. See “To Unsecure and Secure for Calibration”, on page 41 for a procedure to enter the security code from the front panel. Use the \texttt{CAL:SEC:STAT ON} command to enter the security code using the remote interface.

703 Calibration error; secure code provided was invalid
Invalid security code specified with the \texttt{CAL:SEC:STAT ON} command.

706 Calibration error; value out of range
You have entered a value that was unexpected by the calibration firmware. For example, if a number is expected such a 50.XX ohms, and you enter 10 ohms, that number is outside the expected range of valid inputs.

707 Calibration error; signal input is out of range
Occurs during the ADC Adjustment, setup 6, if the 1 Volt input voltage is too high. May also occur during self-calibration (setup 7), run self-test to diagnose cause of problem.

707 Calibration error; cal edge time; rise time cal error
707 Calibration error; cal edge time; fall time cal error
707 Calibration error; cal edge time; default values loaded
Indicates a failure in the rise-time or fall-time circuitry has prevented calibration. The edge-time was calibrated using default values, limiting accuracy. Service is required to correct the problem and achieve design accuracy for the rise and fall times.
Chapter 4  Calibration Procedures

Calibration Errors

850  Calibration error; set up is invalid
You have selected an invalid calibration setup number with the `CAL:SET` command.

851  Calibration error; set up is out of order
Certain calibration steps require a specific beginning and ending sequence. You may not enter into the middle of a sequence of calibration steps.
Chapter 4  Calibration Procedures

Calibration Errors
Block Diagram
Block Diagram

This chapter provides a high-level overview of the instrument's functional block diagram. For more information on servicing the instrument, see Chapter 6, “Disassembly and Repair.”

- Block Diagram, on page 97
- Power Supplies, on page 100
The function generator’s circuits may be divided into three main categories: power supplies, analog circuits, and digital circuits. The instrument is further divided into floating and earth referenced circuitry.

This discussion refers to the block diagram on page 100.

The Main Processor combines many instrument functions onto one custom IC. It interfaces directly with the GPIB and LAN interfaces, and through a controller chip with the USB interface. A 50 MHz crystal oscillator provides the clock signal for U101 operations. A 24 MHz clock is used for USB operations.

The Main Processor communicates with the Front Panel and performs the keyboard scanning. Serial data is used to write to the display. The cross-isolation communication with the Synthesis IC uses optically isolated serial data links.

The Synthesis IC is a gate array and performs most of instrument functions. This gate array has an on-board UART. A 50 MHz voltage-controlled oscillator provides the main clock for the Synthesis IC and the Waveform DAC. The Synthesis IC implements clock generation, pulse generation, DDS and modulation functions, and sets the output waveform and function.

The system DAC outputs various control voltages that are multiplexed into track and hold circuits. These output voltages are used to correct the output waveform for various offsets, rise times, and calibration values. If present, the optional external timebase circuitry provides an input and output for an external time base. A Sync Out signal is available at the front panel.

Some of the output voltages are read back to the Synthesis IC via the System ADC. Here, voltages from various circuits in the instrument are multiplexed with the Modulation IN signal and measured by the Synthesis IC.
The 14-bit waveform DAC is loaded with data from the Synthesis IC. The output is then fed through one of two filters before being buffered and sent to the Main Output Circuitry. The two filters are:

- A 9th order elliptical filter with a cutoff frequency of 23.5 MHz. This filter includes sin(x)/x correction. This filter is used for continuous sine and squarewaves.

- A 7th order linear phase filter with a cutoff frequency of 12.5 MHz. This filter is used for ramp, noise, and arbitrary waveforms.

A portion of the output sine wave is squared by a comparator and used to create a variable duty cycle signal used by the Synthesis IC to create the squarewave, pulse generator clock, and sync signals.

The squarewave DAC output is split into two opposite value signals and applied to a multiplexer. The output of this multiplexer is a square wave or pulse signal with the correct duty cycle. The rising edge and falling edge of the signal are adjusted and the signal is buffered and sent to the Main Output Circuit.

The Main Output circuit accepts one of two inputs; the sine/arb waveform or the squarewave/pulse waveform. Once selected, the signal can be applied to one or both attenuators and/or a +20 dB amplifier. The attenuators and amplifier are used to create the requested output signal amplitude.

<table>
<thead>
<tr>
<th>Amplitude Range (Vpp into 50 Ω)</th>
<th>Offset &lt;2.5 V</th>
<th>Offset &gt;2.5 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 V to 3.16 V</td>
<td>Out</td>
<td>Out In</td>
</tr>
<tr>
<td>3.16 V to 1 V</td>
<td>In</td>
<td>Out In</td>
</tr>
<tr>
<td>1 V to 0.316 V</td>
<td>Out Out</td>
<td>Out In</td>
</tr>
<tr>
<td>0.316 V to 0.1 V</td>
<td>In Out</td>
<td>In</td>
</tr>
<tr>
<td>0.1 V to 0.0316 V</td>
<td>Out In</td>
<td></td>
</tr>
<tr>
<td>0.0316 to 0.01 V</td>
<td>In In</td>
<td></td>
</tr>
</tbody>
</table>

The output is protected by a relay. When the relay is open, the instrument can read the value of the Main Output Circuit. The output relay is opened on user command, if a current overload is detected, or if a voltage over-range condition is found.
Power Supplies

The line input voltage is filtered and applied to the main power supply. The main power supply provides all power to the instrument. Secondary power supplies are contained on the main circuit board. The secondary power supplies include both isolated and earth-referenced supplies.
Disassembly and Repair
Service

This chapter discusses the procedures involved for returning a failed instrument to Agilent Technologies for service or repair. Subjects covered include the following:

- Operating Checklist, on page 103
- Types of Service Available, on page 104
- Repackaging for Shipment, on page 105
- Cleaning, on page 105
- Electrostatic Discharge (ESD) Precautions, on page 106
- Surface Mount Repair, on page 106
- Troubleshooting Hints, on page 107
- Self-Test Procedures, on page 109
- Mechanical Disassembly, on page 112
- Replaceable Parts, on page 124
Operating Checklist

Before returning your instrument to Agilent Technologies for service or repair, check the following items:

Is the instrument inoperative?
- Verify that the ac power cord is connected to the instrument.
- Verify that the front-panel On/Standby switch has been pushed.

Is the display working?
- If the display appears blank, but front-panel keys are lit (and the fan is working), the display screen saver may be enabled. Press any key to restore the display.
- If the display appears blank, but front-panel keys are lit (and the fan is working), the display contrast setting may be too low. Use the menu to set the display contrast.

Does the instrument fail self-test?
Remove all external connections to the instrument. Errors may be induced by signals present on the external wiring during a self-test. Long test leads, even leads that are otherwise unconnected, can act as an antenna causing pick-up of ac signals.
Types of Service Available

If your instrument fails during the warranty period, Agilent Technologies will repair or replace it under the terms of your warranty. After your warranty expires, Agilent offers repair services at competitive prices.

Extended Service Contracts

Many Agilent products are available with optional service contracts that extend the covered period after the standard warranty expires. If you have such a service contract and your instrument fails during the covered period, Agilent Technologies will repair or replace it in accordance with the contract.

Obtaining Repair Service (Worldwide)

To obtain service for your instrument (in-warranty, under service contract, or post-warranty), contact your nearest Agilent Technologies Service Center. They will arrange to have your unit repaired or replaced, and can provide warranty or repair-cost information where applicable.

To obtain warranty, service, or technical support information you can contact Agilent Technologies at one of the following telephone numbers:

- In the United States: (800) 829-4444
- In Europe: 31 20 547 2111
- In Japan: 0120-421-345

Or use our Web link for information on contacting Agilent worldwide:

www.agilent.com/find/assist

Or contact your Agilent Technologies Representative.

Before shipping your instrument, ask the Agilent Technologies Service Center to provide shipping instructions, including what components to ship. Agilent recommends that you retain the original shipping carton for use in such shipments.
Repackaging for Shipment

If the unit is to be shipped to Agilent for service or repair, be sure to:

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the model number and full serial number.
- Place the unit in its original container with appropriate packaging material for shipping.
- Secure the container with strong tape or metal bands.

If the original shipping container is not available, place your unit in a container which will ensure at least 4 inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

Agilent suggests that you always insure shipments.

Cleaning

Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent. Disassembly is not required or recommended for cleaning.
Electrostatic Discharge (ESD) Precautions

Almost all electrical components can be damaged by electrostatic discharge (ESD) during handling. Component damage can occur at electrostatic discharge voltages as low as 50 volts.

The following guidelines will help prevent ESD damage when servicing the instrument or any electronic device.

- Disassemble instruments only in a static-free work area.
- Use a conductive work area to reduce static charges.
- Use a conductive wrist strap to reduce static charge accumulation.
- Minimize handling.
- Keep replacement parts in original static-free packaging.
- Remove all plastic, foam, vinyl, paper, and other static-generating materials from the immediate work area.
- Use only anti-static solder suckers.

Surface Mount Repair

Surface mount components should only be removed using soldering irons or desoldering stations expressly designed for surface mount components. Use of conventional solder removal equipment will almost always result in permanent damage to the printed circuit board and will void your Agilent Technologies factory warranty.
Troubleshooting Hints

This section provides a brief check list of common failures. Before troubleshooting or repairing the instrument, make sure the failure is in the instrument rather than any external connections. Also make sure that the instrument is accurately calibrated within the last year (see “Calibration Interval”, on page 53). The instrument’s circuits allow troubleshooting and repair with basic equipment such as a 6½ digit multimeter.

**Unit is Inoperative**

- Verify that the ac power cord is connected to the instrument.
- Verify that the front-panel On/Standby switch has been pushed.

**Is the display working?**

- If the display appears blank, but front-panel keys are lit (and the fan is working), the display screen saver may be enabled. Press any key to restore the display.
- If the display appears blank, but front-panel keys are lit (and the fan is working), the display contrast setting may be too low. Use the **Utility** menu to set the display contrast.

**Unit Fails Self-Test**

Ensure that all terminal connections (both front panel and rear terminals) are removed while the self-test is performed.
Power Supply

Verify the main power supply.

**WARNING**

Shock Hazard. To check the power supplies, remove the instrument cover as described in “Mechanical Disassembly”, on page 112.

The main power supply provides a +12 Vdc supply to the main circuit board. All other supplies are derived from this supply. This supply is energized at all times while the line power cord is connected.

<table>
<thead>
<tr>
<th>Power Supply</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>+12 V</td>
<td>11.4 V</td>
<td>12.6 V</td>
</tr>
</tbody>
</table>

- Circuit failure can cause heavy supply loads which may pull down the supply output voltage. Disconnect the main supply from the A1 circuit board to test.
- Always check the supply is free of oscillations using an oscilloscope.
- The main power supply provides an input fuse (type UL/IEC127, rated 250VAC H 3.15A) to protect against the danger of fire in the event of a failure of the power supply circuitry. However, this fuse will not fail (“open” or “blow”) in normal power supply operation. The fuse fails only in the event of a significant overload indicating a failure of the power supply circuitry. **Replace the entire main power supply assembly if the input fuse fails.** Note that a power supply failure may be caused by a failure elsewhere in the instrument.
Self-Test Procedures

Power-On Self-Test

Each time the instrument is powered on, a small set of self-tests are performed. These tests check that the minimum set of logic and output hardware are functioning properly. In addition to some basic checks, the power-on self test consists of tests 601 through 632.

Complete Self-Test

To perform a complete self-test:

1. Press Utility on the front panel.

2. Select the Self Test softkey from the “Test / Cal” menu.

A complete description of the self-tests is given in the next section. The instrument will automatically perform the complete self-test procedure when you release the key. The self-test will complete in approximately 30 seconds.

- If the self-test is successful, “Self Test Pass” is displayed on the front panel.
- If the self-test fails, “Self Test Fail” and an error number are displayed.
Self-Tests
A complete self-test performs the following tests. A failing test is indicated by the test number and description in the display.

601
**Self-test failed; system logic**
This error indicates a failure of the main processor, system RAM, or system ROM.

603
**Self-test failed; waveform logic**
This error indicates that the waveform logic in the synthesis IC has failed.

604
**Self-test failed; waveform memory bank**
This error indicates either the waveform RAM or the synthesis IC has failed.

605
**Self-test failed; modulation memory bank**
This error indicates the modulation memory bank in the synthesis IC has failed.

606
**Self-test failed; cross-isolation interface**
This error indicates that the cross-isolation interface between the main processor and Synthesis IC has failed, or that the synthesis IC itself has failed.

619 to 621
619: **Self-test failed; leading edge DAC**
620: **Self-test failed; trailing edge DAC**
621: **Self-test failed; square-wave threshold DAC**
623: **Self-test failed; dc offset DAC**
624: **Self-test failed; null DAC**
625: **Self-test failed; amplitude DAC**
These errors indicate a malfunctioning system DAC, or failed DAC multiplexer channels.

622
**Self-test failed; time base calibration DAC**
This error indicates that the time base calibration DAC in the synthesis IC, or voltage controlled oscillator has failed.
626 - 629

626: Self-test failed; waveform filter path select relay
627: Self-test failed; -10 dB attenuator path
628: Self-test failed; -20 dB attenuator path
629: Self-test failed; +20 dB amplifier path

These errors indicate that the specified relay is not being properly switched or the attenuator/amplifier is not providing the expected amplification or gain. These self-tests use the internal ADC to verify that attenuators are operating properly.

630

Self-test failed; internal ADC over-range condition
This error indicates a probable ADC failure. The failure could be of the system ADC, the ADC input multiplexer, or the ADC input buffer amplifier.

631

Self-test failed; internal ADC measurement error
This error indicates a probable ADC failure. The failure could be of the system ADC, the ADC input multiplexer, or the ADC input buffer amplifier.

632

Self-test failed; square/pulse DAC test failure
This error indicates a probable failure of the square/pulse DAC.
Mechanical Disassembly

For procedures in this manual, the following tools are required for disassembly:

- T20 Torx driver (most disassembly)
- T15 Torx driver (support plate and fan removal)
- 9/16-inch or adjustable open-end wrench (rear-panel BNC connectors)

The following tools may also be needed if further disassembly is required.

- 7 mm nut driver (rear-panel GPIB connector)

**WARNING**

SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should remove the instrument covers. To avoid electrical shock and personal injury, make sure to disconnect the power cord from the instrument before removing the covers. Some circuits are active and have power applied even when the power switch is turned off.
General Disassembly Procedure

1. Turn off the power. Remove all cables from the instrument.

2. Rotate the handle upright and pull off.

3. Pull off the instrument bumpers.

4. Loosen the two captive screws in the rear bezel and remove the rear bezel.
Chapter 6  Disassembly and Repair

Mechanical Disassembly

5  Slide off the instrument cover.

6  Remove the two screws securing the power supply deck to the chassis. Lift off the deck. The power supply assembly is attached to the deck.
Chapter 6  Disassembly and Repair
Mechanical Disassembly

7 Lay the deck and power supply assembly to the side.

Many of the service procedures can now be performed without further disassembly. Troubleshooting and service procedures that require power be applied can be performed with the instrument in this state of disassembly.

**WARNING**

SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should remove the instrument covers. Dangerous voltages may be encountered with the instrument covers removed.
Removing the Main Power Supply Assembly

Loosen the captive screw securing the power supply cover to the deck. Slide the power supply cover and power supply and lift from the deck. Slightly spread the ends of the power supply cover and slide the power supply out of the cover. Disconnect the line input, ground, and output cables from the power supply. The main power supply should be replaced as an assembly.

**WARNING**

Always be sure to re-attach the green ground wire to the power supply before operating the instrument.
Front-Panel Removal Procedure

1. Gently lift both ends of the flat flex cable connector actuator and disconnect the cable from the main PC board (A1 assembly).

**Caution**

To prevent damage to the cable and connector, use care when lifting the actuator. Excessive or uneven force may damage the actuator or connector.
2 Remove the two screws from the front edge of the main PC board (A1 assembly).
3 Push the side flanges of the chassis inward while lifting off the front panel. There should now be enough play in the chassis sides and front panel assembly to allow the side of the front panel to be disconnected from the chassis.
Front-Panel Disassembly

1. Loosen the captive screw holding the support plate. Lift the end of the support plate and rotate out of the front panel assembly.
2. Unplug the inverter cable from the keyboard PC board (A2 assembly). Gently lift both ends of the flat flex cable connector actuator and disconnect the cable from the PC board. Lift out the display assembly.

**Caution**

To prevent damage to the cable and connector, use care when lifting the actuator. Excessive or uneven force may damage the actuator or connector.
3 Pull to remove the knob. Lift out the keyboard PC board (A2 assembly).
External Timebase Circuit Board Disassembly

The External Timebase is an option to the basic instrument (Option 001). Remove the hex nuts and washers holding the rear panel 10 MHz In and 10 MHz Out BNC connectors. Pull the External Timebase PC board (A3 assembly) from the back panel as shown below. Then unplug the captive ribbon cable from the keyed connector on the main PC board (J 601 on the A1 assembly). Remove the A3 assembly from the chassis.
Replaceable Parts

This section contains information for ordering replacement parts for your instrument. The parts lists are divided into the following sections.

Parts are listed by part number. The replaceable parts lists include a brief description of each part with applicable Agilent part number.

To Order Replaceable Parts

You can order replaceable parts from Agilent using the Agilent part number. Note that not all parts listed in this chapter are available as field-replaceable parts. To order replaceable parts from Agilent, do the following:

1. Contact your nearest Agilent Sales Office or Service Center.
2. Identify the parts by the Agilent part number shown in the replaceable parts list.
3. Provide the instrument model number and serial number.
## Parts List

<table>
<thead>
<tr>
<th>Agilent Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0960-2545</td>
<td>Rotary Encoder</td>
</tr>
<tr>
<td>1250-2913</td>
<td>MOD IN BNC</td>
</tr>
<tr>
<td>1250-3569</td>
<td>Output/Sync BNC</td>
</tr>
<tr>
<td>1252-2161</td>
<td>GPIB Connector</td>
</tr>
<tr>
<td>1253-5030</td>
<td>LAN Connector</td>
</tr>
<tr>
<td>2090-0886</td>
<td>Display</td>
</tr>
<tr>
<td>33210-60201</td>
<td>Front Panel</td>
</tr>
<tr>
<td>33210-80001</td>
<td>Opt 001 Retrofit Kit</td>
</tr>
<tr>
<td>33220-66502</td>
<td>Front Panel PCB</td>
</tr>
<tr>
<td>33220-67601</td>
<td>Assembly Line Filter</td>
</tr>
<tr>
<td>33220-68501</td>
<td>Fan Assembly</td>
</tr>
<tr>
<td>33220-84101</td>
<td>Cover</td>
</tr>
<tr>
<td>33220-87910</td>
<td>Power Supply Assembly</td>
</tr>
<tr>
<td>33220-88304</td>
<td>Rear Bezel</td>
</tr>
<tr>
<td>33250-49301</td>
<td>Window</td>
</tr>
<tr>
<td>33250-87401</td>
<td>Knob</td>
</tr>
<tr>
<td>34401-45021</td>
<td>Handle</td>
</tr>
<tr>
<td>34401-86020</td>
<td>Bumper Kit</td>
</tr>
</tbody>
</table>
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Replaceable Parts
Backdating

This chapter normally contains information necessary to adapt this manual to instruments not directly covered by the current content.

At this printing, the manual applies to all instruments.