# Agilent E6432A
# VXI Microwave Synthesizer

## Product Overview

**High-performance microwave capability in a VXI module**

- 10 MHz to 20 GHz
- –90 dBm to +20 dBm
- < 350 µs frequency switching time
- 1 Hz frequency resolution
- AM, FM and pulse modulation
- Optional I/Q modulation and IF upconversion

The Agilent E6432A VXI microwave synthesizer is designed to help you meet your measurement challenges in advanced microwave applications that require high-performance, microwave-frequency synthesized signals, including:

- Broadband digital communications
- Satellite systems
- Avionics test
- Smart munitions test
- Microwave digital radio
- Radar/EW
- Manufacturing ATE
- Field repair

The Agilent E6432A VXI microwave synthesizer is a fast, flexible, rugged, system-optimized signal source with high-performance microwave capability.

The E6432A VXI microwave synthesizer provides fast switching, low phase noise, high spectral purity, and synthesizer accuracy. The three-slot, C-size, register-based

VXI architecture makes it ideal for system integrators who want a fast, flexible signal source in a scalable format.

**Agilent Technologies**
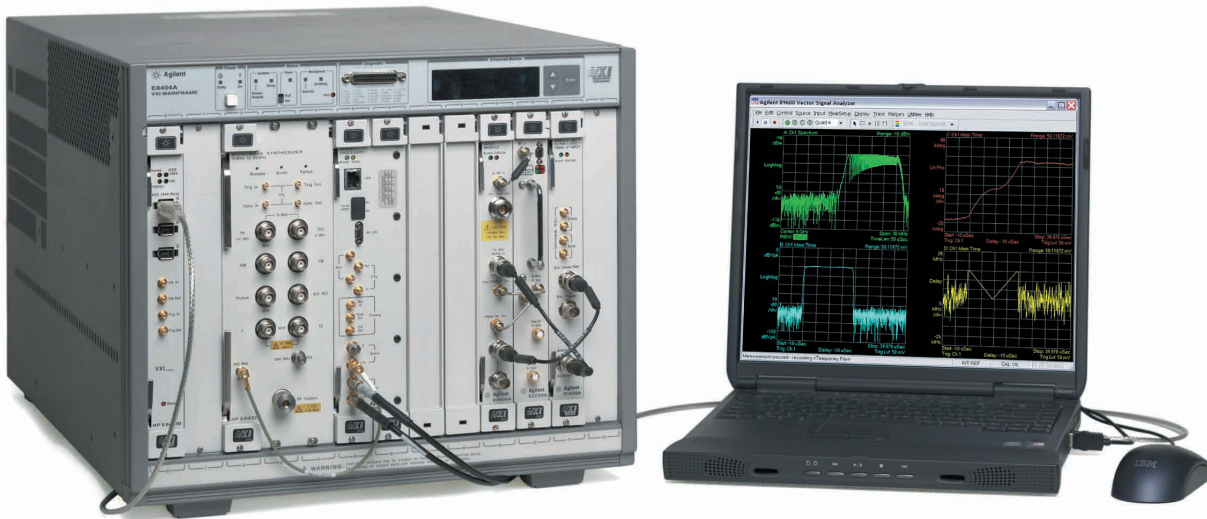
System configuration

**Advanced microwave measurements with maximum throughput**

Whether you are working in high-volume manufacturing or a field environment, you need to quickly design and configure solutions that will give you the advanced microwave measurements performance you need, while maximizing test throughput. You need instruments that will integrate easily with other equipment to form complete, flexible test solutions.

The E6432A VXI microwave synthesizer has the performance and flexibility you need. It is a C-size, 3-slot VXI module that covers the frequency range of 10 MHz to 20 GHz with 1 Hz resolution. Its amplitude range is from –90 dBm to +20 dBm.

This module delivers CW signals with low phase noise and excellent spectral purity. When combined with external arbitrary waveform generators, the module can deliver AM, FM, and pulse signals with state-of-the-art performance. Optional I/Q modulation and IF upconversion are also available.

**Optimized for automated test systems**

Designed for demanding performance in automated test systems, the E6432A VXI microwave synthesizer's high-speed architecture and register-based design support switching between any two arbitrary carrier frequencies in typically less than 150 µs, or any two amplitudes within its vernier range in less than 50 µs. This switching speed makes the E6432A ideal for automated

testing in applications requiring a large number of test frequencies. A deep list mode and comprehensive triggering allow the host computer to offload source management to the measurement system, shortening development time and achieving maximum measurement throughput.

**Fast frequency and amplitude switching**

Fully settled tuning between any two arbitrary frequencies across the entire frequency band requires less than 350 µs. Frequency switching to within 50 kHz of the desired frequency is typically 150 µs or less. Amplitude-only switching between any two power levels without an attenuator step change to 0.05 dB of the desired power is typically less than 80 us. Power level changes

utilizing the optional step attenuator are less than 20 ms. The fast frequency switching results in decreased measurement time in scenarios where throughput is currently limited by the time it takes to retune the signal source. Examples of such scenarios include antenna testing, TR module, RFIC and MMIC testing.

## Precision AM, FM and pulse modulation

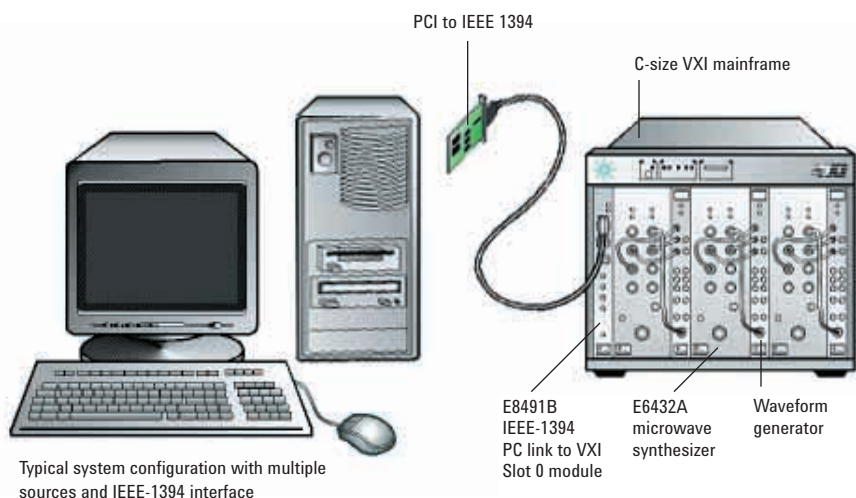The AM modulation has a band width of 250 kHz and deep AM capability in both linear and exponential modes. The FM modulation has a band width of 50 kHz to 8 MHz and sensitivity to 1 MHz/volt. Option 2 extends the range to 1 KHz to 10 MHz. The pulse modulation features 10 nanosecond rise and fall times with 15-nanosecond minimum pulse widths and 80 dB on/off ratio.

## Optional broadband I/Q modulation

With the emergence of broadband digital communications, you need a source that can deliver digital modulation in wide bandwidths as well as analog modulation for flexibility and complete solutions.

A broadband I/Q modulator, available as Option UNG, is integrated into the E6432A. This modulator accepts I and Q baseband vector signals and modulates the microwave carrier up to 20 GHz. This modulator can be calibrated to give accurate amplitude response at any RF frequency. With a bandwidth of greater than 40 MHz and a dynamic range of greater than 40 dB, Option UNG is ideal for emerging broadband communications that require more bandwidth than the common wireless cellular formats. The E6432A Option UNG serves such applications as wireless LAN (IEEE 802.11), Ka-band satellite digital transparent and digital regenerative payloads, NPR measurements, radar/EW, and LMDS with the help of external banded upconverters. VXI arbitrary waveform generators with wide bandwidths are available to generate the I and Q vectors. AM bandwidths greater than 1 MHz are possible with this option.



PCI to IEEE 1394

C-size VXI mainframe

E8491B
IEEE-1394
PC link to VXI
Slot 0 module

E6432A
microwave
synthesizer

Waveform
generator

Typical system configuration with multiple sources and IEEE-1394 interface

Additional adjustments of the I/Q circuitry inside the E6432A compensate for imbalances in the baseband source to provide the lowest error vector magnitude and the highest overall modulation quality for the most demanding vector signal applications.

**Optional IF upconversion**

E6432 Option 300 lets you upconvert wide-bandwidth signals into the microwave domain with bandwidths greater than 130 MHz. You can use this option to create unique solutions for broadband wireless, satellite test, and demanding radar applications.



Internal-shielded construction of the Agilent E6432A reduces EMI to give you more flexibility in how you position the module in your rack.

**Using I/Q and IF signals together**

The E6432A has the unique ability to combine the IF and I/Q signals to create unique spectra. An application of this technique is shown in the figures below where a broadband noise signal with a notch is
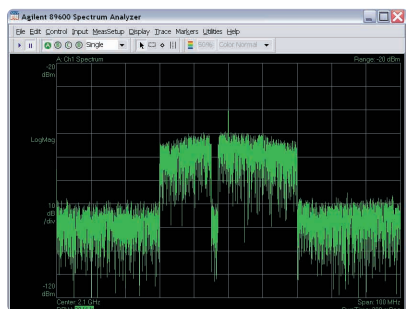


You can generate a noise power ratio signal with a notch using an arbitrary waveform generator and the I/Q modulation of the E6432A.
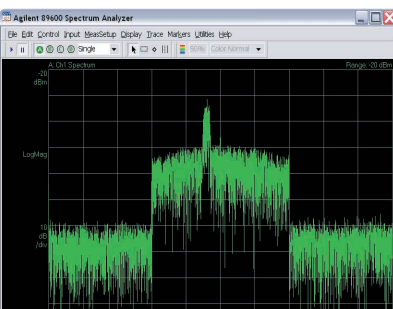


A comms signal is added into the notch using the E9825A and the IF modulation of the E6432A. Signals are combined without any calculations.
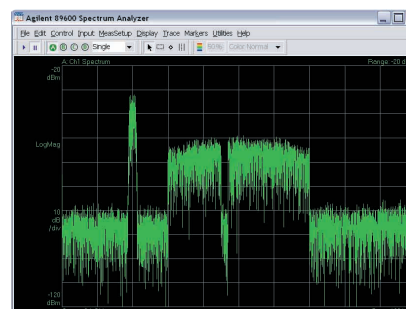


The comms signal is moved outside the noise. Again, no recalculations are required.

generated through the I/Q inputs and a separate communication signal is applied to the IF upconversion. Note that the carrier frequencies can be changed independently without recalculating or reformatting the data.

### Spectrally pure, free of harmonics and spurious signals

The E6432A uses patented assembly shielding to reduce cross talk between modules and limit problems caused by ingress. Critical circuitry is contained within two hybrid thin and thick film microcircuits. DC-to-DC converters inside the module carefully filter and re-regulate the VXI mainframe power supplies. These features combine to give the E6432A its high level of technical performance in the VXI form factor.

### Easy programming

A VXI*plug&play* driver simplifies communication with the E6432A. Examples and programming tips for C, Visual Basic, Visual Studio NET, Agilent VEE, LabView and Lab Windows are available in the Web-based help program provided with the VXI*plug&play* driver.
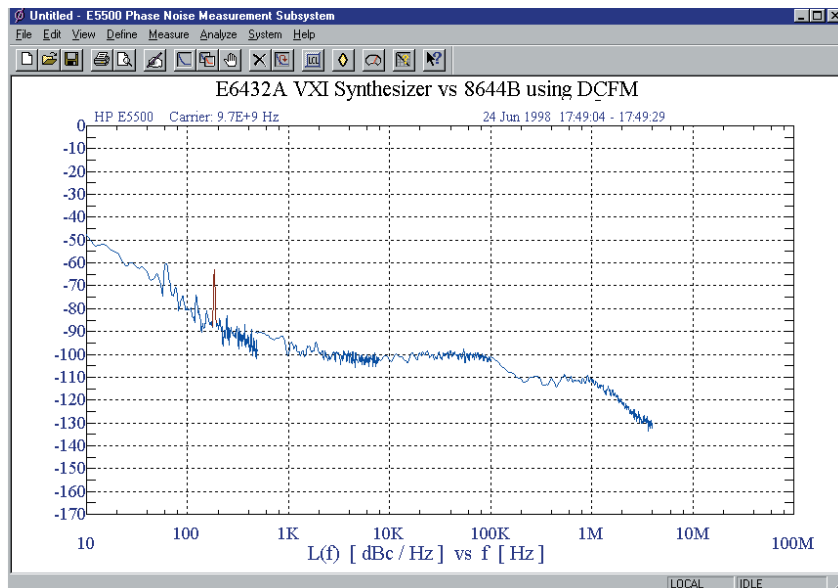


Typical phase noise graph of the Agilent E6432A

An optional SCPI client lets you use ASCII strings written in SCPI language to command and control the instrument.

### Virtual front panel

To simplify your diagnostic procedures and troubleshooting, a virtual front panel, provided as a part of the VXI*plug&play* driver and installed automatically with the driver software, allows you to control the synthesizer as if it is a stand alone product. The panel

allows direct control of the RF output, leveling , ALC and modulation. In addition, the virtual front panel provides access to configuration, list mode, self-test and calibration panels. You can access all of the features of the virtual front panel directly through the programmatic interface.

## List and triggering modes

A deep list mode of up to 128 k entries provides sequence memory for very long test scenarios. Each entry may hold settings for frequency, amplitude, attenuator setting, settling and blanking modes, and a marker. The host computer constructs the list array and downloads the array into the E6432A VXI microwave synthesizer hardware prior to execution.

The synthesizer provides three ways to execute a sequence, free-run, sync and triggered. A sequence repeat feature is available for any trigger mode.

All events available on the front panel are also available on the TTL trigger bus. Interrupts and variable dwell and settling times in the sequence may also be enabled when test needs require dwelling at a specific point for longer periods of time.
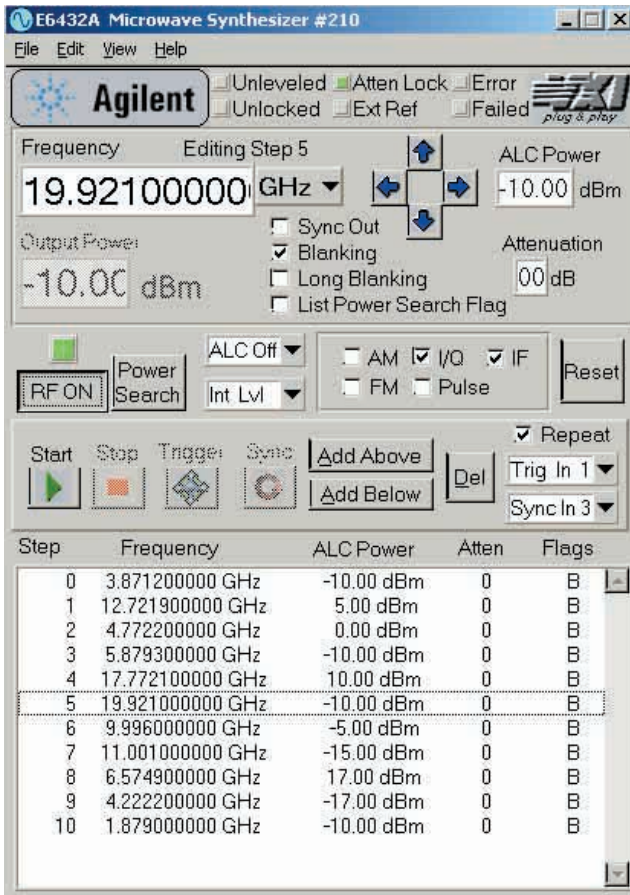
Virtual front panel with list mode activated

# Specifications

## Frequency characteristics

| | |
|---|---|
| **Range** | 10 MHz to 20 GHz |
| **Accuracy** | same as time base |
| **Resolution** | 1 Hz |
| **Switching time** | < 350 µs, < 150 µs (typical) |

## Output characteristics

**Output power**
Range
(with Option 1E1)[1]

−20 to +17 dBm
−90 to +16 dBm

**Maximum leveled output power**
Without step attenuator[1]

| Frequency range | Standard | Option UNF | Option UNH | Options UNF & UNH |
|---|---|---|---|---|
| 10 MHz to 2 GHz | +17 dBm | +17 dBm | +13 dBm | +13 dBm |
| 2 GHz to 20 GHz | +17 dBm | +20 dBm | +17 dBm | +20 dBm |

| | |
|---|---|
| **Vernier accuracy** | ±0.5 dB from −10 to +10 dBm<br>±1.3 dB from −20 to +20 dBm |
| **Resolution** | 0.02 dB |
| **Switching time** | < 50 µs across ALC range,<br>< 20 ms with attenuator step change |
| **External ALC range** | 40 dB |

**Power level accuracy and flatness**
These specifications apply to frequencies between 100 MHz and 2 GHz after a power
correction is performed. For frequencies < 100 MHz accuracy and flatness degrade by
0.5 dB. For frequencies > 2 GHz, accuracy and flatness degrade by 0.1 dB

| Output power range | Accuracy | Flatness |
|---|---|---|
| −10 dBm to max. power | ±1.2 dB | ±0.9 dB |
| −10 to +10 dBm | ±0.8 dB | ±0.5 dB |
| −20 to −10 dBm | ±1.1 dB | ±0.7 dB |
| −60 to −20 dBm | ±1.1 dB | ±0.7 dB |
| −90 to −60 dBm | ±1.4 dB | ±1.1 dB |

| | |
|---|---|
| **VSWR at 50 ?** | 1.6:1 (typical) |

## Specifications (Continued)

### Spectral purity

| | |
|---|---|
| **Harmonics** | |
| 10 MHz to 2 GHz | < –25 dBc |
| (with Option UNH) | < –55 dBc |
| | |
| 2–20 GHz | < –55 dBc |
| | < –65 dBc (typical) |
| | |
| **Spurious response** | < –55 dBc |
| | < –70 dBc (typical) |
| | |
| **SSB phase noise** | < –70 dBc/Hz at 100 Hz |
| | < –90 dBc/Hz at 10 kHz |

**Phase noise of carrier
frequency 8.1 GHz**
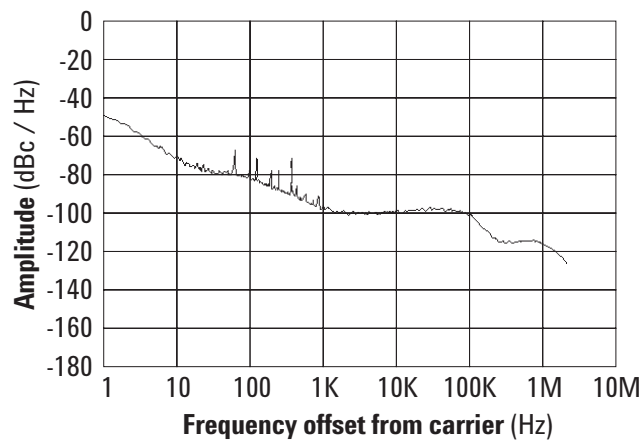
# Modulation

| | |
|---|---|
| **AM depth** | −20 dBm in normal mode<br>50 dB below max. output in deep mode |
| **AM rate** | DC to 250 kHz (typical) |
| **AM accuracy** | < 7% of depth |
| **FM maximum deviation**<br>Option 002 | > 8 MHz<br>> ±85 MHz |
| **FM rate**<br>Option 002 | 100 kHz to 8 MHz<br>1 kHz to 10 MHz |
| **FM sensitivity**<br>Option 002 | 1 MHz/V<br>100 kHz/V, 1 MHz/V, 10 MHz/V |
| **FM accuracy** | 30% at 1 V p-p and 1 MHz rate |
| **FM flatness** | ±1 dB over specified rate range |
| **Maximum FM index** Option 002 | > 180 |

## Pulse modulation RF > 560 MHz to < 2 GHz

| | |
|---|---|
| On/off ratio | > 80 dB |
| PRF range | 10 Hz to 10 MHz, (DC to 10 MHz; ALC off) |
| Minimum pulse width | 3.0 μs (leveled),<br>50 ns (unleveled) |
| Rise/fall time | < 25 ns |
| Power level accuracy<br>(relative to CW) | 0.3 dB (typical, leveled)<br>0.5 dB (typical, unleveled, following power search) |
| Video feedthrough | < 5% of envelope (typical) |
| Compression | < ±16 ns (typical) |
| Overshoot and ringing | < ±15% (typical) |

## Modulation (Continued)

### Pulse modulation RF 2–20 GHz

| | |
|---|---|
| On/off ratio | > 80 dB |
| PRF range | 10 Hz to 10 MHz (DC to 10 MHz; ALC off) |
| Minimum pulse width | 3.0 µs (leveled),  15 ns (unleveled) |
| Rise/fall time | < 10 ns |
| Power level accuracy (relative to CW) | 0.3 dB (typical, leveled) 0.5 dB (typical, unleveled, following power search) |
| Video feedthrough | < 5 mV (typical) |
| Compression | < ±15 ns (typical) |
| Overshoot and ringing | < ±10% (typical) |

### I/Q modulation (Option UNG only)

| | |
|---|---|
| I/Q bandwidth | > 40 MHz (typical, ±2 dB uncorrected) |
| I/Q sensitivity | 0.5 V pk for 100% modulator drive level |
| I and Q offset range | ±100% |
| I and Q gain range | ±4 dB |
| Quadrature adjustment range | ±10 degrees |
| I and Q input attenuator range | 0 to 12 dB in 2 dB steps |
| Origin offset: | < –45 dBc (typical) |
| Dynamic error vector magnitude[2,3] | < 1.2% rms (typical) |

1  Adding step attenuator (Option 1E1) degrades maximum output power by 1 dB, 2 to 20 GHz.

2  These I/Q specifications apply only after an internal calibration, and are valid for 10 days at a
   calibration temperature of ±5 degrees. These specifications include I/Q impairments of an Agilent
   Technologies ESG-D Series signal generator with Option UND as the baseband I/Q source.

3  Measured at 2 MS/s QPSK, root raised cosine filter with ? = 0.35, 14 dB IF attenuation,
   maximum output level = 0 dBm, and ALC off.

## Modulation (Continued)

**Option 300 IF upconversion specifications**

| IF input performance parameters | |
| --- | --- |
| IF center frequency | 300 MHz |
| Instantaneous signal bandwidth | ±65 MHz (130 MHz total) |
| Conversion gain | 10 dB nominal |
| IF flatness | ±2.5 dB |
| Group delay | ±1.5 ns |
| IM3 | <-55 dBc @ +10 dBm output power |
| Noise floor | <-130 dBm/Hz @ 20 GHz |
| Input gain compression (1 dB) | +12 dBm |

**List mode**

| Accuracy | same as time base |
| --- | --- |
| Minimum step size | same as frequency resolution |
| Number of points | 128 k |
| Switching time | same as CW |
| Dwell time | 5 µs to 32 ms |

**VXI characteristics**

| Size | C |
| --- | --- |
| Slots | 3 |
| VXI device type | register based servant |
| Instrument driver | VXI*plug&play* using Windows NT®, Windows 2000 or Windows XP |

**General specifications**

| Operating temperature range | 0 to +55° C |
| --- | --- |
| Size mm (in) | 91.4 (3.6) W x 261.6 (10.3) H x 370.8 (14.6) D |
| Weight | 7.16 KG (15.8 lbs) |
| RF output connector | 3.5 mm |

**Power Supply Requirements**

| (V) | +5 | −5.2 | −2 | +12 | −12 | +24 | −24 | +5 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| DC current (A) | 10 | 2.35 | 0 | 2.4 | 1.0 | 0.4 | 0.15 | 0 |
| Dynamic current (A) | 2 | 0.1 | 0 | 0.8 | 0.05 | 0.5 | 0.03 | 0 |
| | | | | | (w/step att.) | | | |

## Ordering information

| | |
|---|---|
| **Agilent E6432A** | VXI Microwave Synthesizer |
| **Option 002** | Add enhanced frequency modulation |
| **Option 1E1** | Add 70 dB step attenuator |
| **Option UNF** | Add high power (+20 dBm) 2–20 GHz |
| **Option UNG** | Add I/Q modulator |
| **Option UNH** | Add improved spectral purity (10 MHz to 2 GHz) |
| **Option 300** | Add IF upconversion |

Contact your Agilent sales representative for more information.

## Warranty information

All Agilent products described in this document are warranted against defects in material and workmanship for a period of one year from date of shipment.

## Related Agilent literature

- An Introduction to the Agilent E6432A *plug&play* Driver
  Product Note
  5968-3660E

- Creating Frequency Lists Using a Spreadsheet and ActiveX
  Product Note
  5968-8434E

- N7501A
  Technical Overview
  5989-1018EN

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