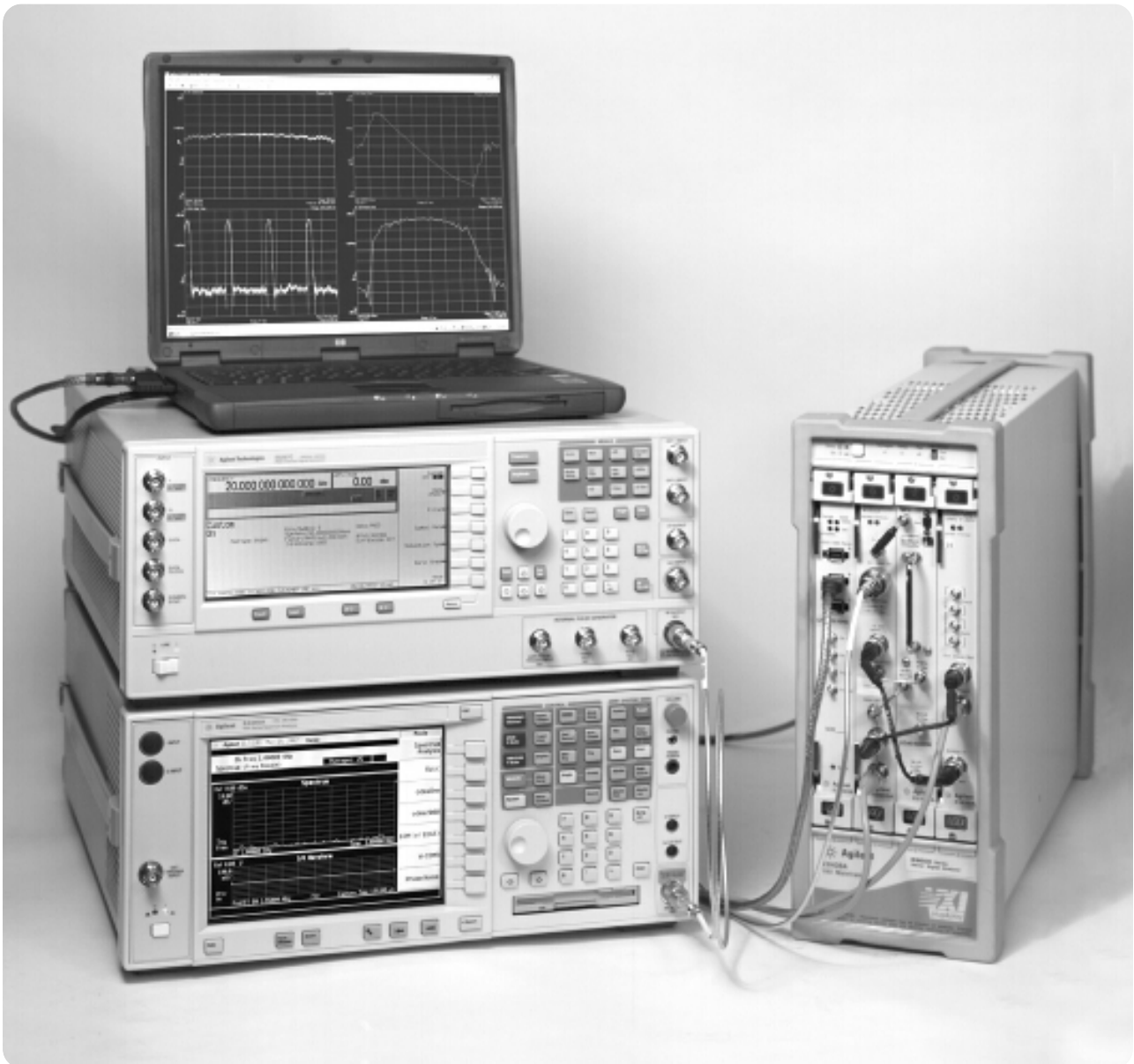


# Agilent E8267C PSG Vector Signal Generator Self Guided Demo

Application Note 1423



Agilent Technologies

## Table of contents

Part 1: Generic 64QAM signal at 20 GHz .....	3
Part 2: Multicarrier 64 QAM signal .....	5
Part 3: Two-tone .....	5
Part 4: Multitone signal .....	6
Part 5: Radar test pattern signal .....	7
Part 6: Measurement setups .....	9

## Conventions used in this demonstration

- Hard keys on the instrument front panel are shown as [Hard Keys]
- Soft keys at the right of the display are shown as [Soft Keys]
- Items which appear in the display area are shown as DISPLAY
- Front panel items are shown as FRONT PANEL
- Sequential commands are separated by ->.

# 1. Generic 64QAM signal at 20 GHz

## E8267C setup

- [Frequency] -> [20] -> {GHz}
- [Amplitude] -> [0] -> {dBm}
- [Mode] -> {Custom} -> {Real Time I/Q Baseband} -> {Modulation type} -> {Select} -> {QAM} -> {64QAM}
- [Return] -> {Symbol Rate} -> [30] -> {Msps}
- [Return] -> {Filter} -> {Select} -> {Root Nyquist}
- {Filter Alpha} -> [0.35]
- [Return] -> {Custom on}
- [RF on]

## PSA setup

- [Frequency] -> [20] -> {GHz}
- [Span] -> [50] -> {MHz}
- [BW/Avg] -> {Average on}

## Measurement – occupied bandwidth

- [Measure] -> {Occupied BW}
- [Measure setup] -> {OBW Span} -> [50] -> {MHz}
- [Measure setup] -> {Max Hold On}

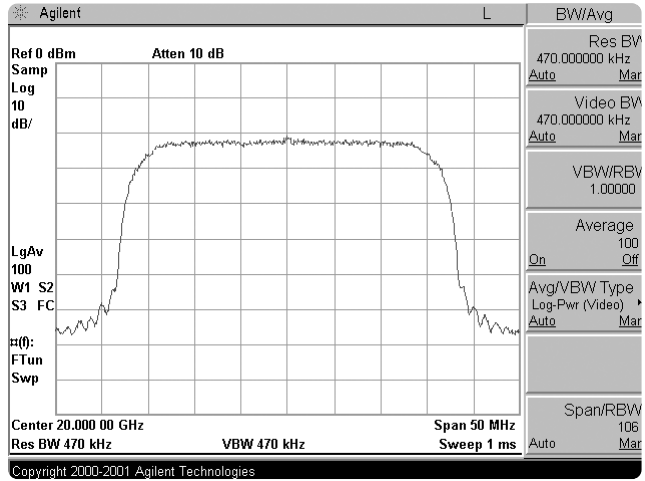


Figure 1. Spectrum of the 64QAM signal

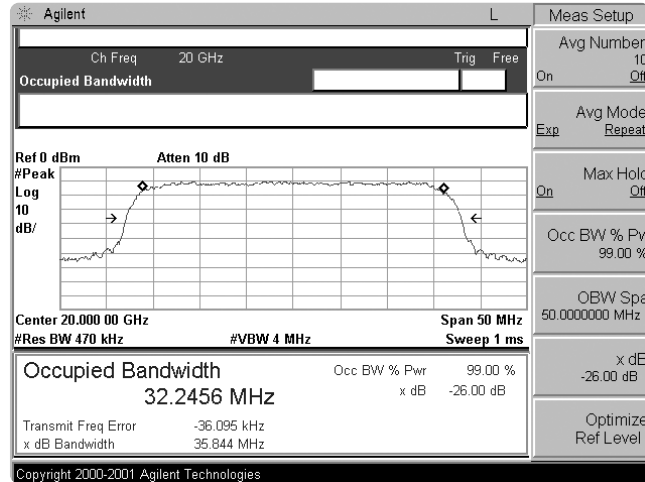


Figure 2. Occupied bandwidth measurement

## Measurement – channel power

- [Measure] -> {Channel Power}
- [Measure setup] -> {Integ BW} -> [30] -> {MHz}
- [Measure setup] -> {Chan Pwr Span}-> [50] -> {MHz}

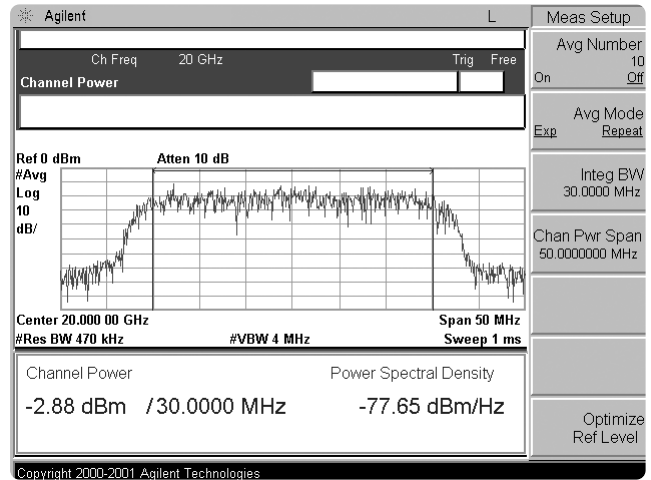


Figure 3. Channel power measurement

## E8267C setup

- {Symbol Rate} -> [10] -> {Mps}

## VSA setup

- Display -> Layout -> Quad 4
- MeasSetup -> Demodulator -> Digital Demod
- Demo Properties -> Format -> 64 QAM
- Symbol Rate -> 10 MHz
- Result Length -> 500 Symbols
- Filter Tab -> Measurement Filter -> Root Raised Cosine
- Reference Filter -> Raised Cosine
- Alpha/BT -> 0.35
- Close
- Range -> 0 dBm
- Center -> 20 GHz
- Span -> 20 MHz

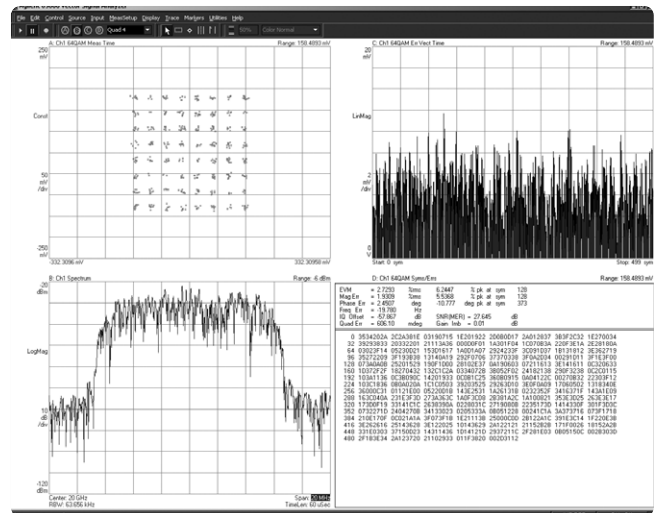


Figure 4. 64QAM constellation and EVM measurement

## 2. Multi Carrier 64 QAM signal

### E8267C setup

- [Frequency] -> [20] -> {GHz}
- [Amplitude] -> [0] -> {dBm}
- [Mode] -> {Custom} -> {Real Time I/Q Baseband} -> {Modulation type} -> {Select} -> {QAM} -> {64QAM}
- [Return] -> {Symbol Rate} -> [30] -> {Mps}
- [Return] -> {Filter} -> {Select} -> {Root Nyquist}
- [Filter Alpha] -> [0.35]
- [Return] -> {Store Custom Dig Mod State} -> {Store to File} -> [6] -> [4] -> {Q} -> {A} -> {M} -> {Enter}
- [Return] -> [Return] -> {Multicarrier On}
- {Multicarrier Define} -> {Initialize Table} -> {Carrier Setup} -> {More} -> {Custom Digital Mod State} -> {Select File}
- {# of Carriers} -> [4]
- {Frequency Spacing} -> [20] -> {MHz}
- {Done}
- [Return] -> {Digital Modulation On}
- [RF On]

### PSA setup

- [Frequency] -> [20] -> {GHz}
- [Span] -> [200] -> {MHz}
- [BW/Avg] -> {Average On}

## 3. Two-tone

### E8267C setup

- [Frequency] -> [20] -> {GHz}
- [Amplitude] -> [0] -> {dBm}
- [Mode] -> {Two Tone} -> {Freq Separation} -> [30] -> {MHz}
- {Apply Settings}
- {Two Tone On}
- [Mux] -> {Modulator Atten} -> [18] -> {dB}
- [RF On]

### PSA setup

- [Frequency] -> [20] GHz
- [Span] -> 50 MHz
- [BW/Ave] -> {Average On}

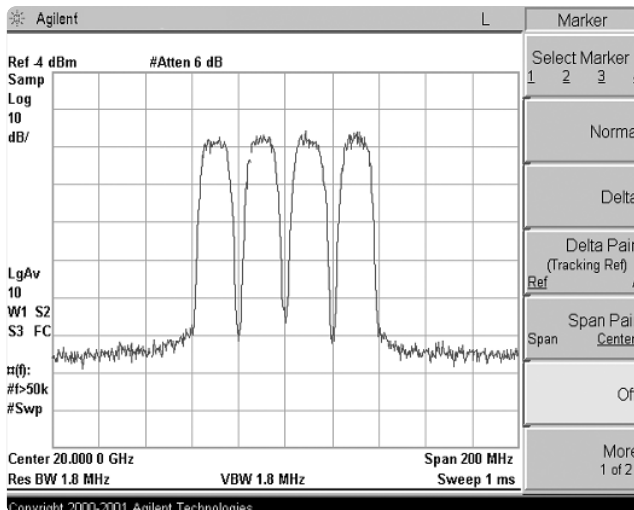


Figure 5. MultiCarrier 64QAM signal

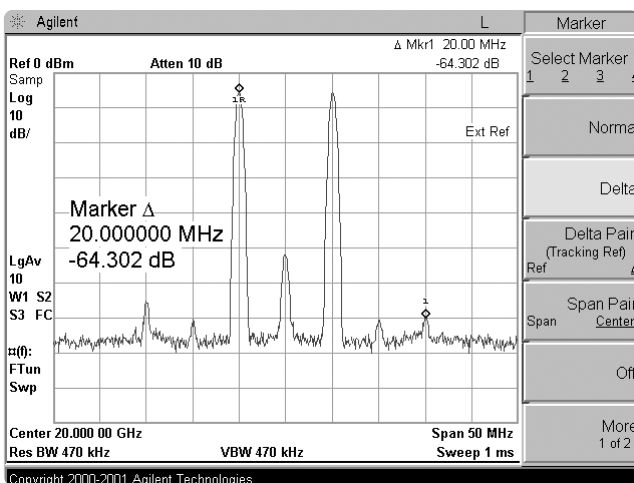


Figure 6. Twotone

## 4. Multi-tone signal

### E8267C setup (multi-tone 1)

- [Frequency] -> [20] -> {GHz}
- [Amplitude] -> [0] -> {dBm}
- [Mode] -> {Multitone} -> {Initialize Table} -> {Number Of Tones} -> [10]
- {Freq Spacing} -> [1] -> {MHz}
- {Initialize Phase} -> {Random}
- {Random Seed} -> {Random}
- {Done}
- {Multitone On}
- [RF On]

### PSA setup (multi-tone 1)

- [Frequency] -> [20] -> {GHz}
- [Span] -> [20] -> {MHz}
- [BW/Avg] -> {Average On}

### E8267C setup (multi-tone 2)

- {Goto Row} -> [3] -> {Enter}
- {Toggle State}
- {Goto Row} -> [5] -> {Enter}
- Press Right arrow once
- [-10] -> {dB}
- {Apply Multitone}

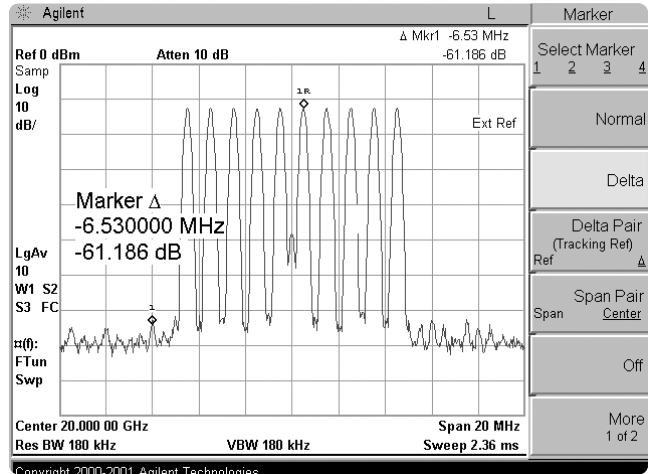


Figure 7. Multitone

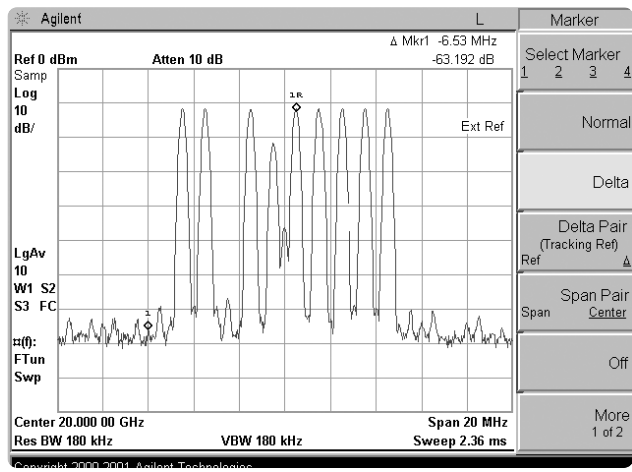


Figure 8. Multitone

## 5. Radar test pattern signal

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MATLAB® signal generation

- First visit [www.agilent.com/find/psg](http://www.agilent.com/find/psg)
- Click on the E8267C link
- At the bottom of the page click on Software, Firmware & Drivers
- Download the PSG/ESG Download Assistant Software
- Install on your computer for use with MATLAB® 6.0 or higher
- Store the following file in MATLAB® as a pulsepat.m

%Script file: pulsepat.m

```
%  
% Purpose:  
% To calculate and download an arbitrary waveform file that simulates a  
% simple antenna scan pulse pattern to the PSG vector signal generator.  
%  
% Define variables:  
%  
% n    – counting variable (no units)  
% t    – time (seconds)  
% rise – raised cosine pulse rise-time definition (samples)  
% on   – pulse on-time definition (samples)  
% fall – raised cosine pulse fall-time definition (samples)  
% off  – pulse off-time definition (samples)  
% i    – in-phase modulation signal (samples)  
% q    – quadrature modulation signal (samples)  
  
n=4;           % defines the number of points in the rise-time & fall-time  
t=1:2/n:1-2/n; % number of points translated to time  
rise=(1+sin(t*pi/2))/2; % defines the pulse rise-time shape  
on=ones(1,120); % defines the pulse on-time characteristics  
fall=(1+sin(-t*pi/2))/2; % defines the pulse fall-time shape  
off=zeros(1,896); % defines the pulse off-time characteristics  
  
% arrange the i-samples and scale the amplitude to simulate an antenna scan  
% pattern comprised of 10 pulses  
i = .707*[rise on fall off ...  
    [.9*[rise on fall off]]...  
    [.8*[rise on fall off]]...  
    [.7*[rise on fall off]]...  
    [.6*[rise on fall off]]...  
    [.5*[rise on fall off]]...  
    [.4*[rise on fall off]]...  
    [.3*[rise on fall off]]...  
    [.2*[rise on fall off]]...  
    [.1*[rise on fall off]]];
```

```

% set the q-samples to all zeroes
q = zeros(1,10240);

% define a composite iq matrix for download to the PSG using the
% PSG/ESG Download Assistant
IQData = [i + (j * q)];

% define a marker matrix and activate a marker to indicate the beginning of the waveform
Markers = zeros(2,length(IQData)); %fill Marker array with zero ie. no markers set
Markers(1,1) = 1; %set Marker to first point of play back

% make a new connection to the PSG over the GPIB interface
io = agt_newconnection('gpib',0,19);

% verify that communication with the PSG has been established
[status, status_description,query_result] = agt_query(io,'*idn?');
if (status < 0) return; end

% set carrier frequency and power on the PSG using the PSG Downlaod Assistant
[status, status_description] = agt_sendcommand(io, 'SOURce:FREQuency 20000000000');
[status, status_description] = agt_sendcommand(io, 'POWer 0');

sampclk = 40000000; % defines the ARB Sample Clock for playback

% download the iq waveform the the PSG baseband generator for playback
[status, status_description] = agt_waveformload(io, IQData, 'pulsepat', sampclk, 'play', 'no_normscale',
Markers);

% Turn on RF ouput power
[status, status_description ] = agt_sendcommand( io, 'OUTPut:STATe ON' );

From the MATLAB® command line type -> pulsepat

```



## E8267C setup

- No setup required. All parameters are set in MATLAB® code.
- To verify:
  - [Mode] -> {Dual ARB}
  - The selected Waveform should be WFM1:PULSEPAT
  - The Sample Clock should be 40 MHz

## VSA setup

- Display -> Layout -> Stacked 2
- Range -> 0 dBm
- Center -> 20 GHz
- Span -> 20 MHz
- RBW -> 3 kHz
- Input -> Trigger -> Type -> External
- MeasSetup -> ResBW -> Frequency Points -> 102401
- Display -> Active Trace -> Active B
- Trace -> Format -> Format -> Linear Mag

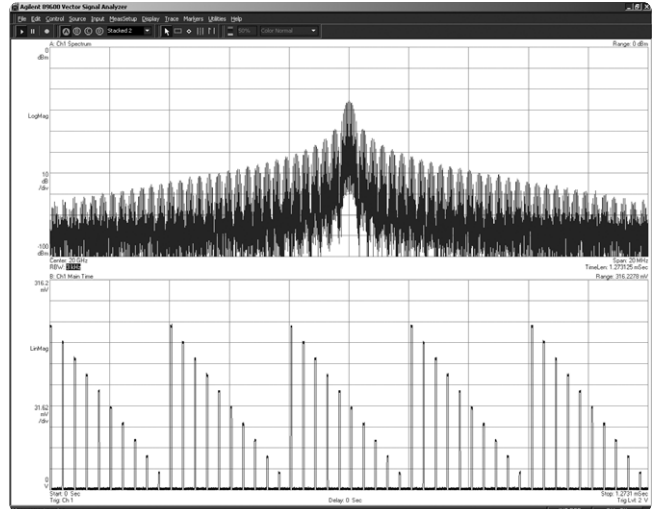


Figure 9. pulsepat

## 6. Measurement setups

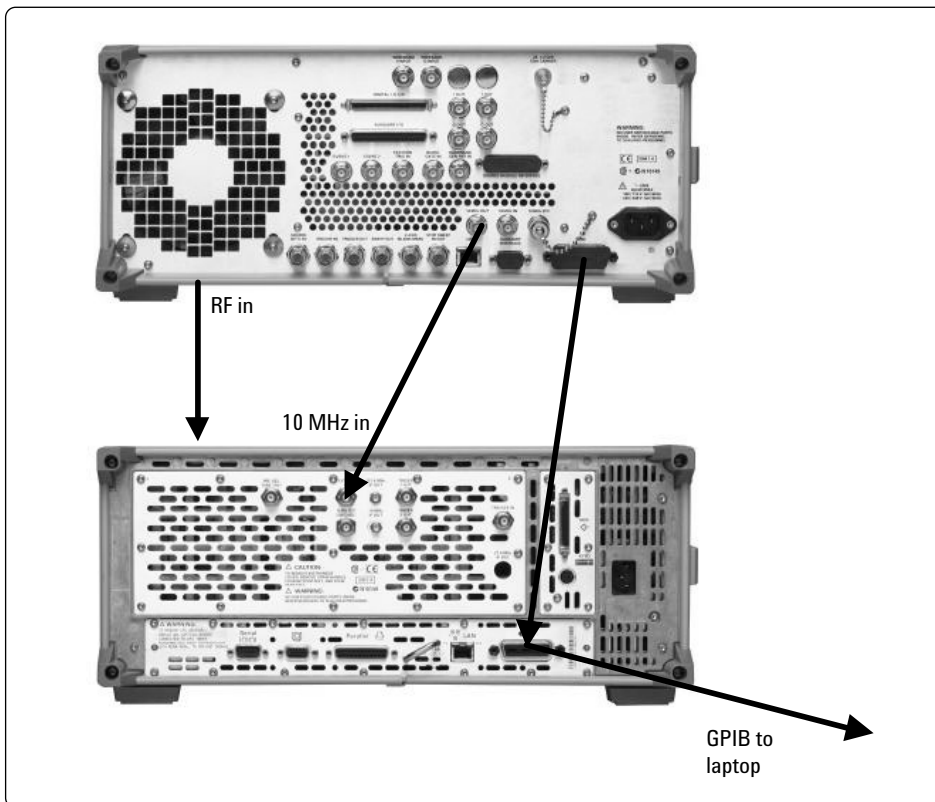


Figure 10. PSG – PSA setup

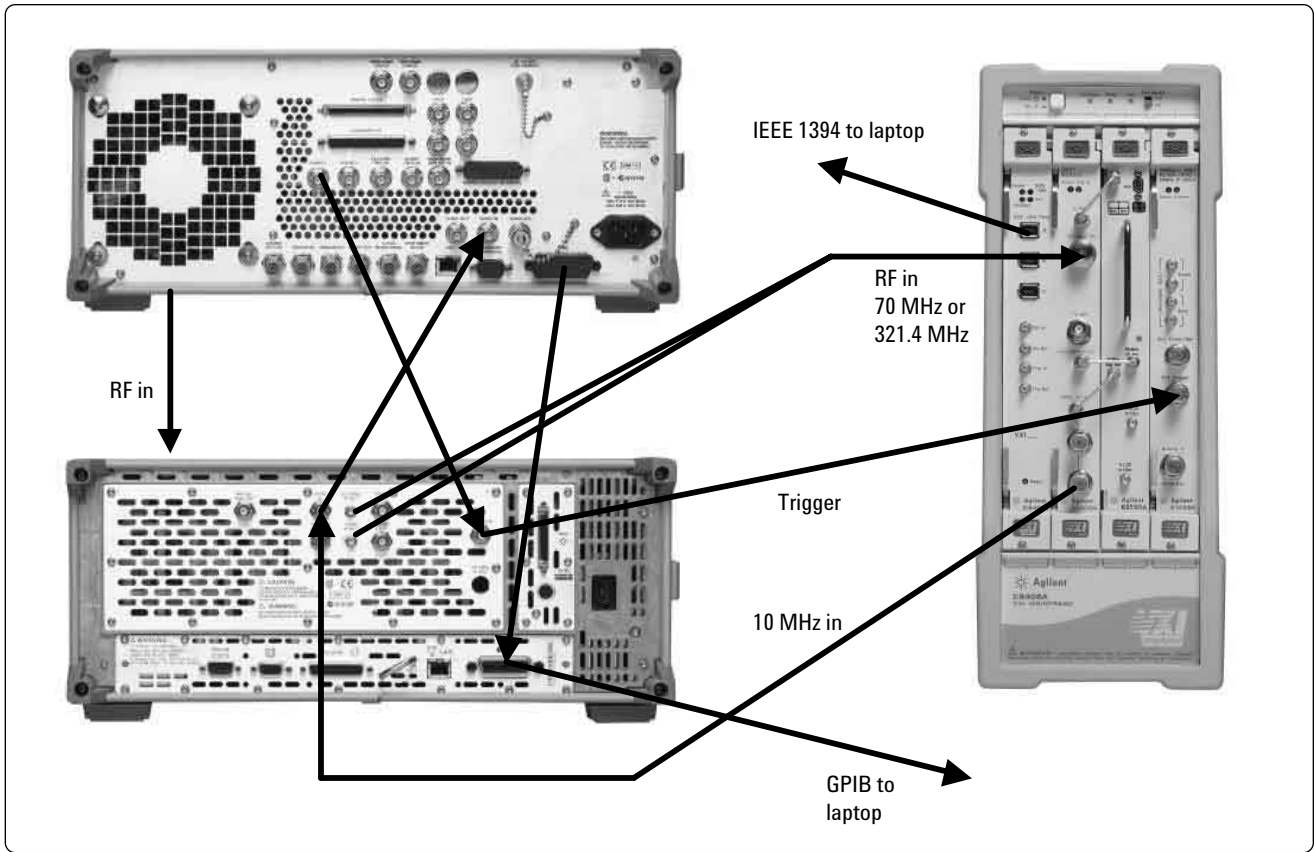


Figure 11. PSG – PSA – 89640A setup

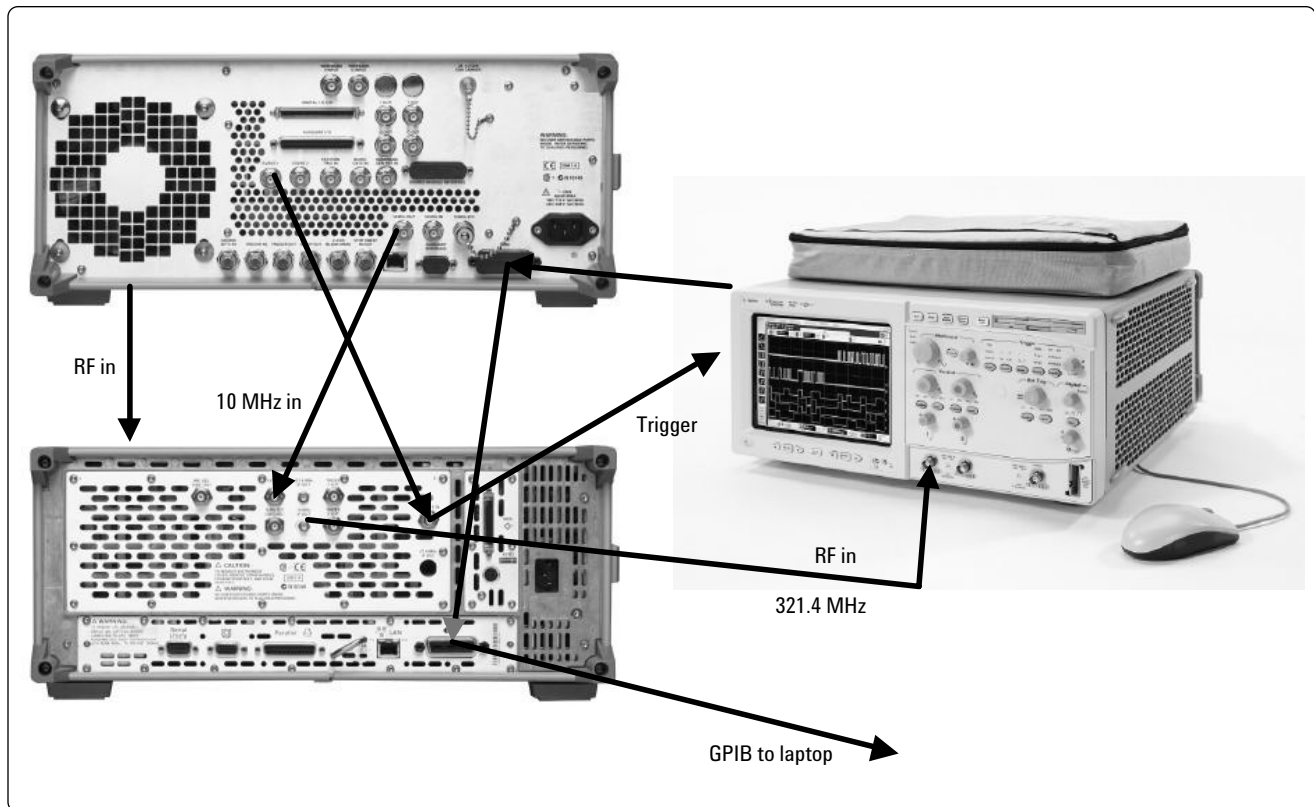


Figure 12. PSG – PSA – Infinium setup



## Related literature

*Agilent PSG Signal Generators, Brochure*  
Literature number 5988-7538EN

*Agilent E8267C PSG Vector Signal Generator, Data Sheet*  
Literature number 5988-6632EN

*Agilent E8247C/E8257C PSG Analog/CW  
Signal Generator, Data Sheet*  
Literature number 5988-7454EN

*Agilent PSG Vector Self Guided Demo,*  
Literature number 5988-8087EN

*Agilent E8247C/E8257C PSG Analog/CW Self Guided Demo,*  
Literature number 5988-2414EN

*Agilent E8267C PSG Vector Configuration Guide*  
Literature number 5988-7541EN

*Agilent E8247C/E8257C PSG Analog/CW Configuration Guide,*  
Literature number 5988-7879EN

*Agilent PSG Series Product Note: Millimeter Head*  
Literature number 5988-2567EN

*Agilent PSG Two-tone and Multi-tone  
Application Note AN 1410*  
Literature number: 5988-7689EN

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