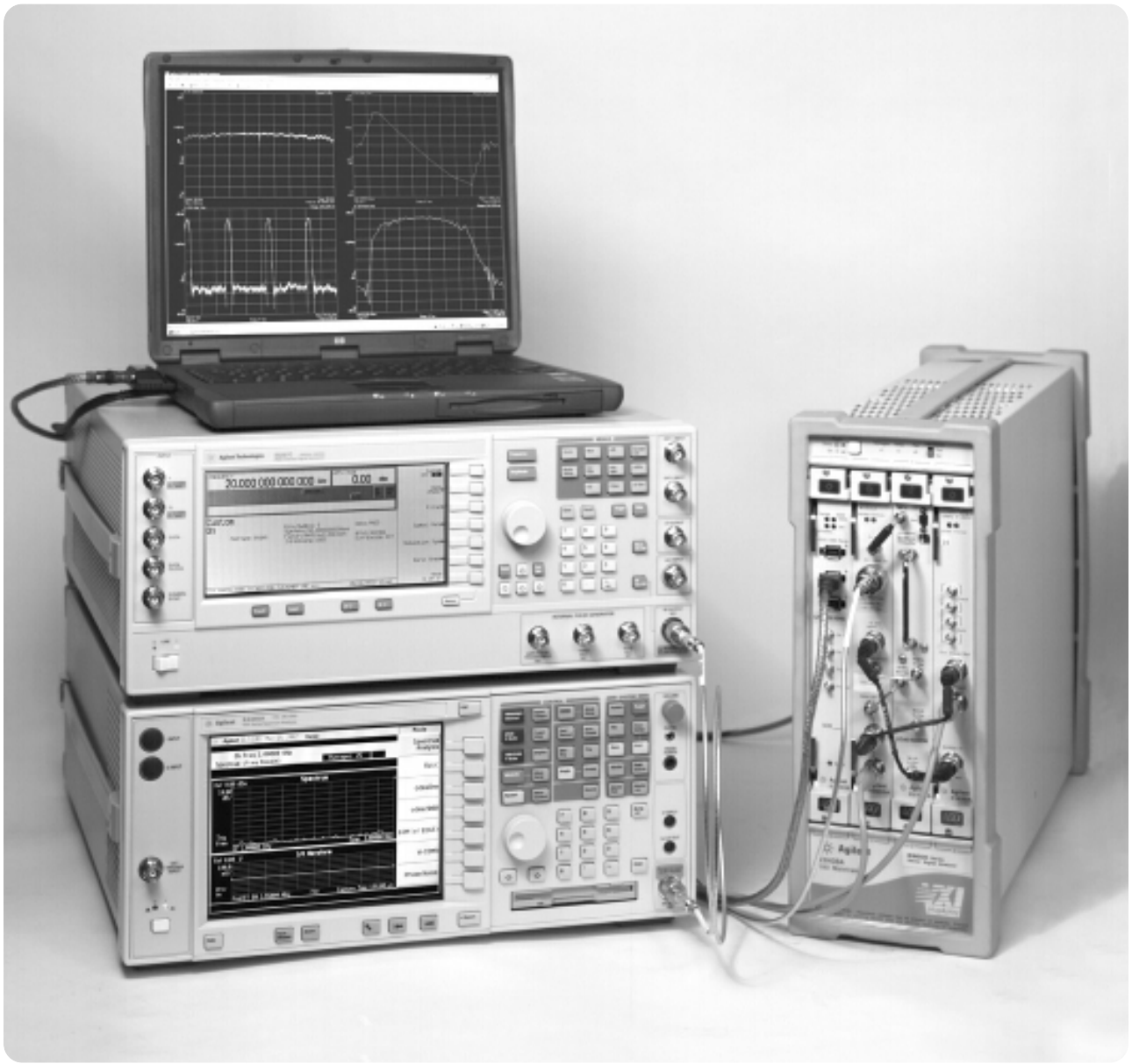
Agilent E8267C
PSG Vector Signal Generator
Self Guided Demo

Application Note 1423



Agilent Technologies

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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}

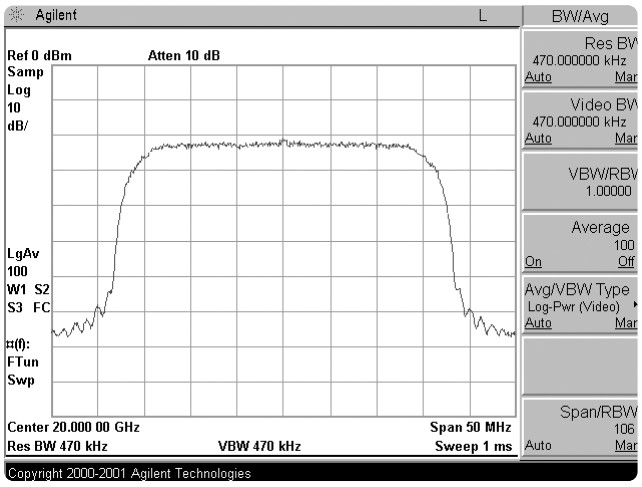

Figure 1. Spectrum of the 64QAM signal

Measurement – occupied bandwidth

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

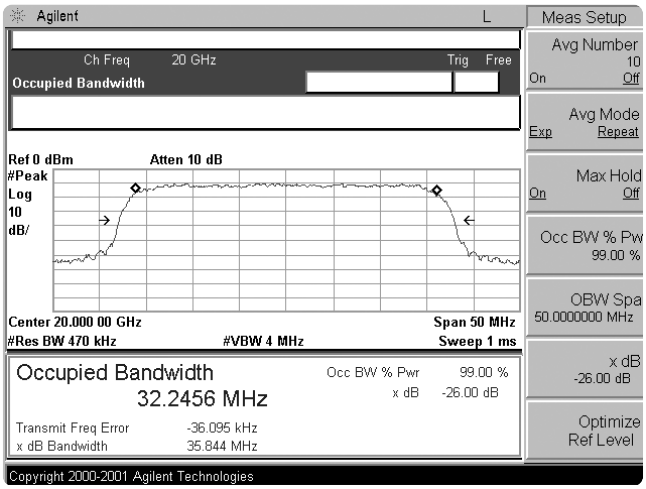

Figure 2. Occupied bandwidth measurement

Measurement – channel power

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

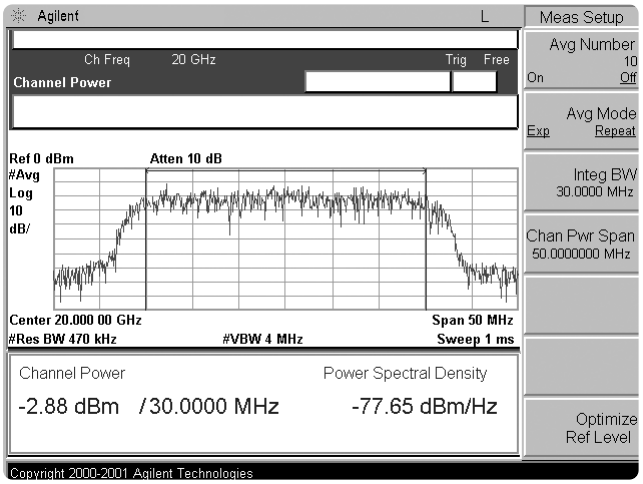

Figure 3. Channel power measurement

E8267C setup

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

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

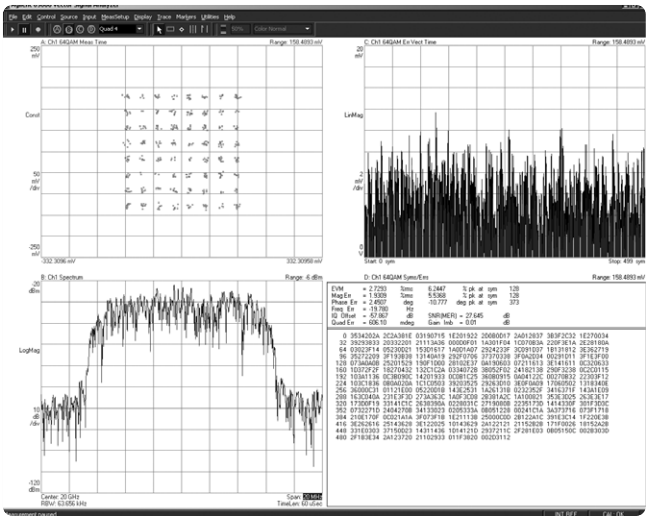

Figure 4. 64QAM constellation and EVM measurement

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] -> {Msps}
- [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}

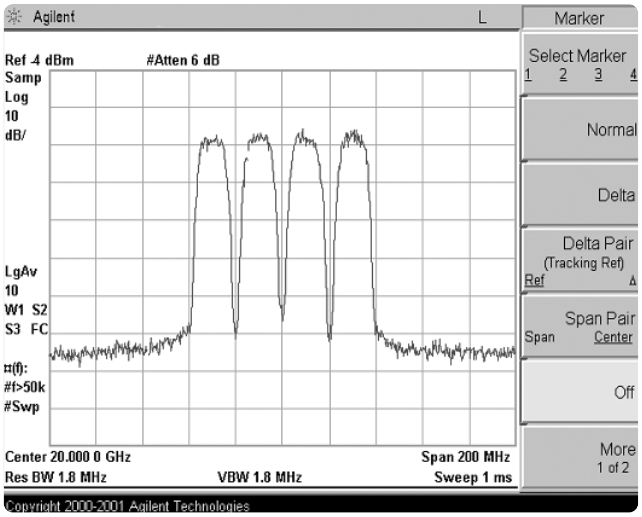

Figure 5. MultiCarrier 64QAM signal

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}

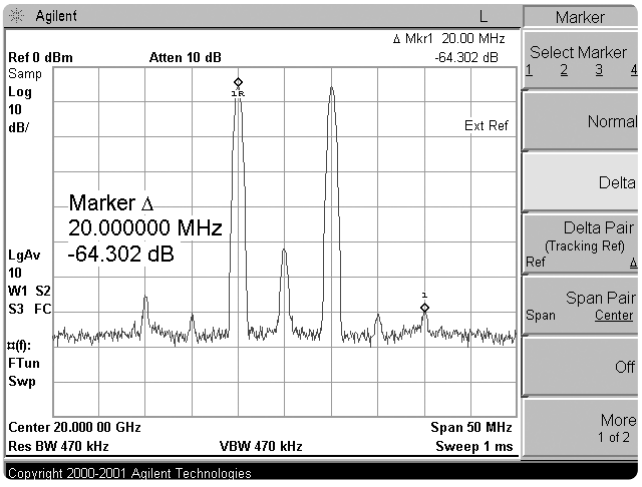

Figure 6. Twotone

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}

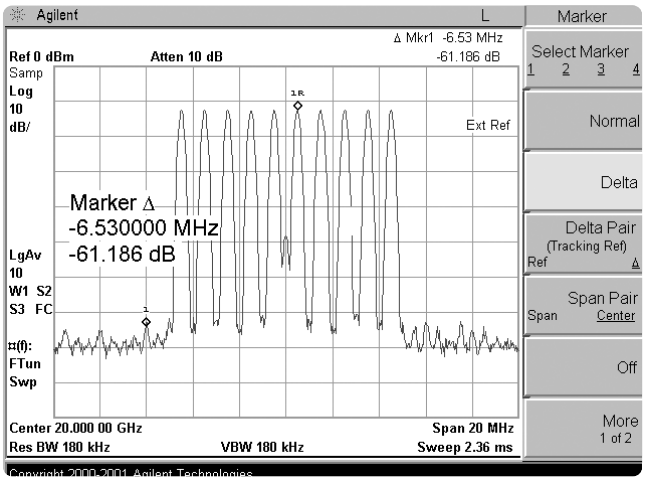

Figure 7. Multitone

E8267C setup (multi-tone 2)

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

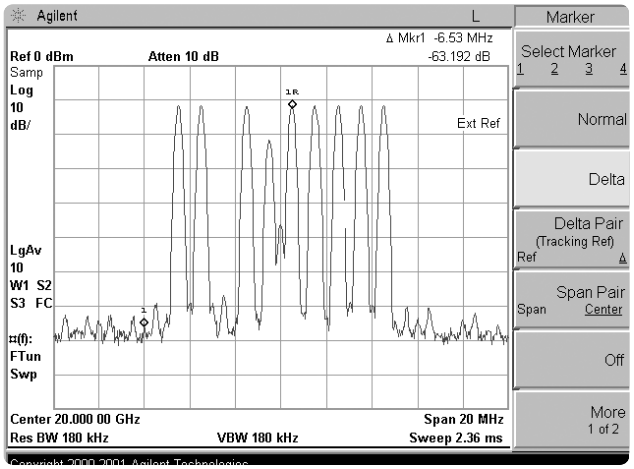

Figure 8. Multitone

5. Radar test pattern signal

MATLAB® signal generation

- First visit www.agilent.com/find/psg
- Click on the E8267C link
- At the bottom of the page click on Software, Firmwave & 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

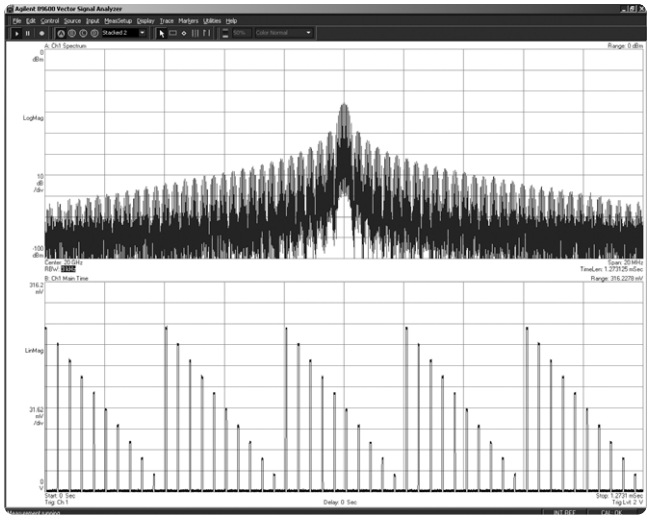

Figure 9. pulsepat

6. Measurement setups

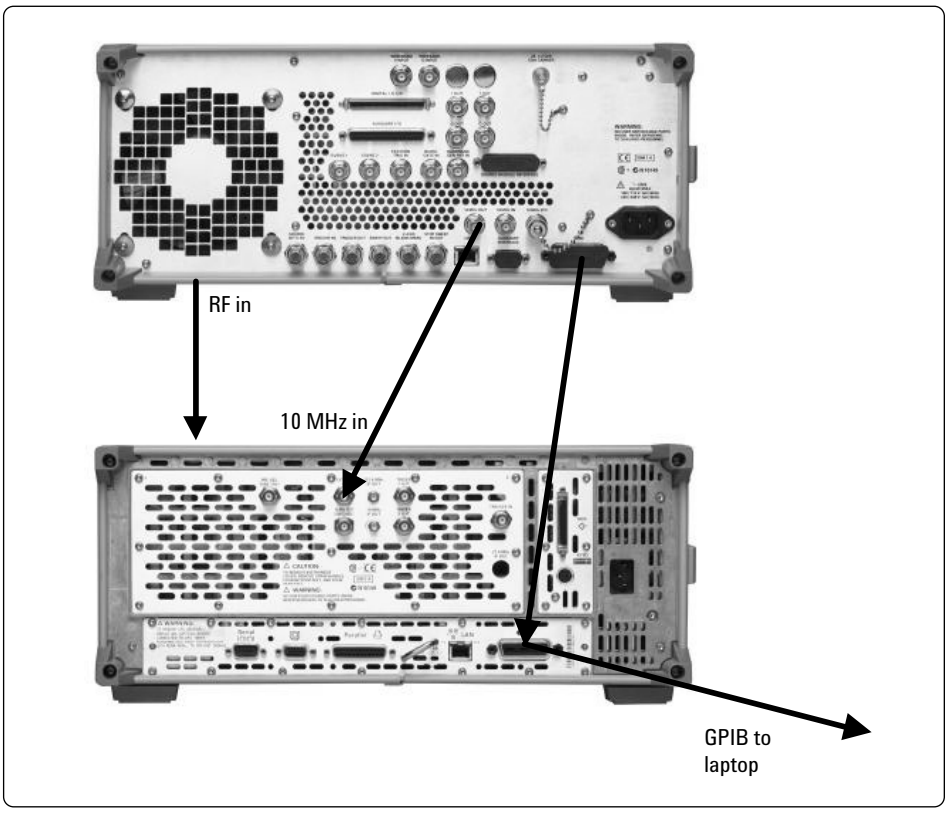

Figure 10. PSG – PSA setup

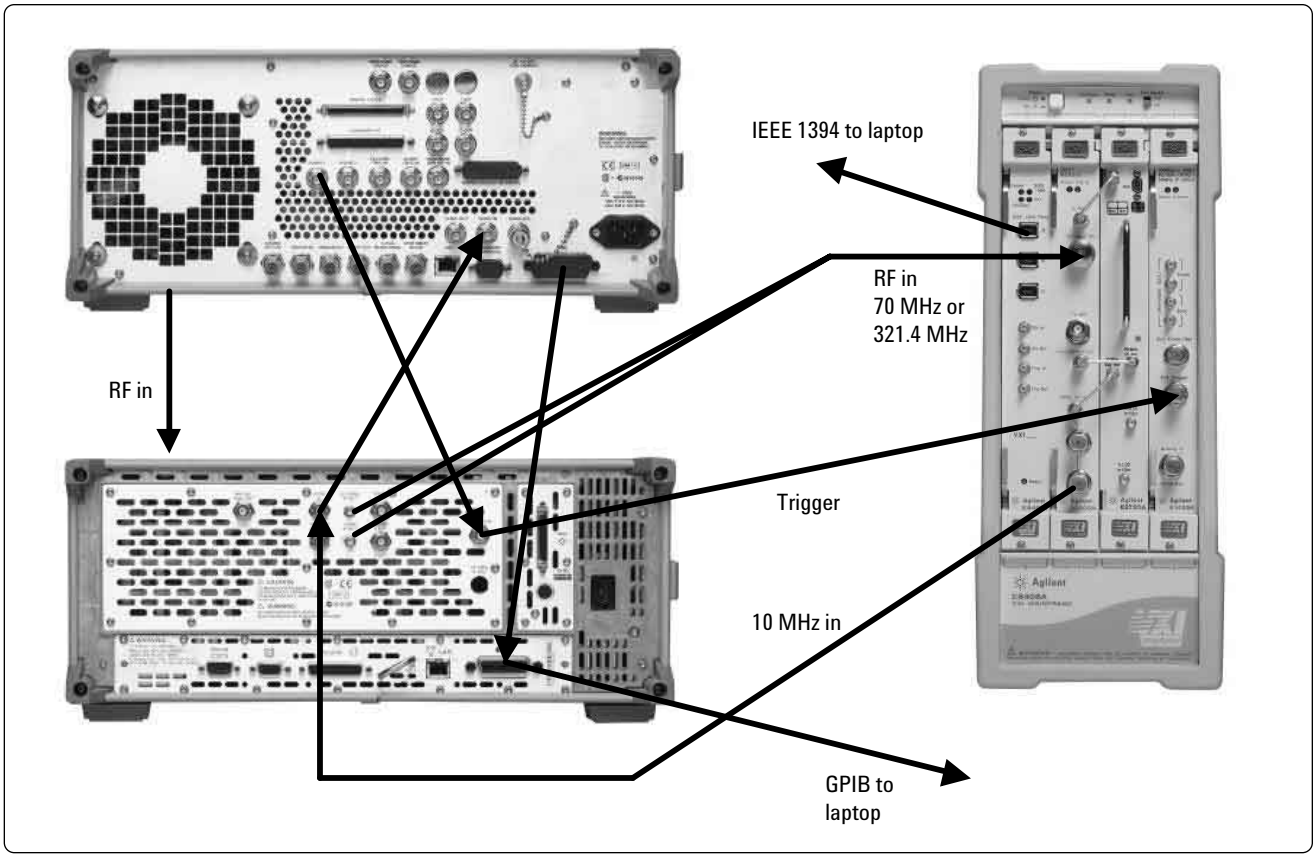

Figure 11. PSG – PSA – 89640A setup

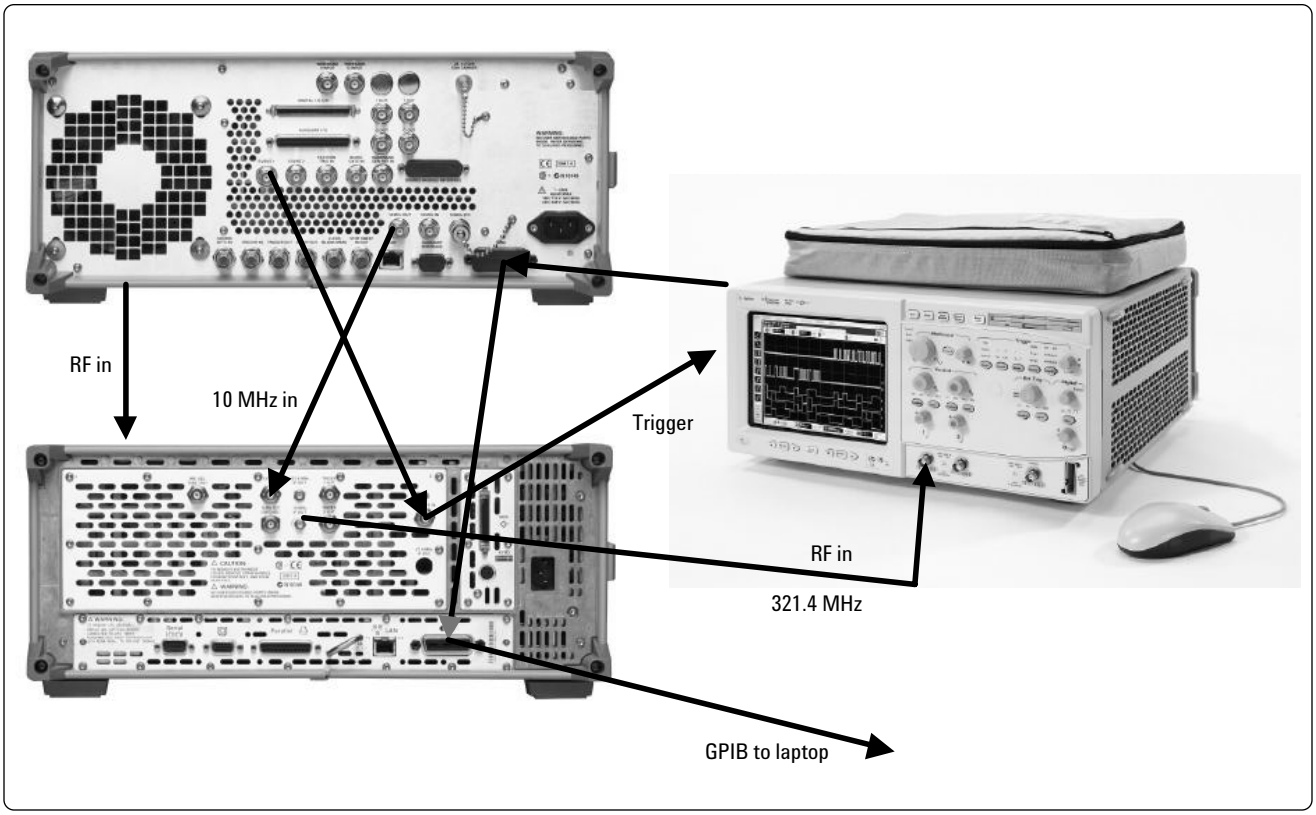

Figure 12. PSG – PSA – Infinium setup

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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Online Assistance:
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