Low Phase Noise Amplifiers
30 Years of Design & Manufacturing Experience

- Over 600 Microwave employees
- Access to lower cost manufacturing (Spectrum Commercial RF facilities in Mexico and China)
- State College, PA facility - 275,000 sq. ft.

A | Columbia, MD  
   Acquired July 2002 (FSY)
B | Delmar, DE  
   Acquired February 2004 (Salisbury Engineering)
C | Palm Bay, FL  
   Acquired October 2004 (Q-bit)
D | Philadelphia, PA  
   Acquired February 2005 (Amplifonix)
E | State College, PA  
   Acquired January 2007 (EMF Systems)
F | Marlborough, MA  
   Acquired September 2008 (Satcon-Film MicroElectronics)
G | Nashua, NH  
   Acquired XXXXXX 2010 (Sage Electronics)
Microwave Components & Systems Business | SpectrumMicrowave.com
- Amplifiers, Mixers, Switches, Oscillators & Sources
- RF/Microwave Filters, Diplexers & Multiplexers, Integrated Multifunction Modules
- Thin Film Substrates, Hybrid Assembly Services

EMI Filter & Components Business | specemc.com
- EMI Surge Suppression Components & Modules
- Power Line Filters & Power Entry Modules
- Interconnect Devices
- Terminal Blocks & Passive Components

Power Management Systems | specpower.com
- Power Management & Distribution Systems
- AC & DC Power Strips
- Power Monitoring Equipment: Environmental, Electrical, Security, Mechanical

Sensors & Controls Business | specsensors.com
- Potentiometers, Temp Sensing Probes, Surge Current Limiters
**Product Line Overview**

**Hybrid Components, Mixers & Advanced Technologies**
- In-house thin & thick film capability
- 30 year heritage design database
- Quick turn prototypes (2-4 days)
- Complete testing & ESS capability
- Rapid military to low cost conversion
- Modular assemblies

**Filter Components & Integrated Filter Assemblies**
- Complete filter solutions
- In-house machining
- Complete testing & ESS capability
- 20 year heritage design database
- Focused design centers for quick turn prototypes (2-4 weeks)

**Frequency Sources & Integrated Microwave Assemblies**
- 80% critical component content
- In-house development of ATE
- 8 IMA engineers with 22 years average experience
Low Phase Noise Amplifiers

What do all these sophisticated systems have in common?
Spectrum Microwave supports all these systems due in part to the expertise of their engineers and superior technology that makes us the pinnacle of Low Phase Noise excellence.

All these systems require exceptionally low phase noise performance amplifiers.
What is Phase Noise and why is it so important?
Every signal has Phase Noise so some degree, sometimes it is seen as jitter of some kind, but simply put...
...it is unwanted noise on both sides of the carrier signal caused by random variations of the frequency and phase of the carrier.
Even the best oscillators and signal generators have some degree of phase noise, expressed in dBc/Hz.
Remember, all passive and active components contribute to phase noise to some degree, some more than others. Noise figure (dB) manifests itself as a reduction of the output S/N ration of the device.
Besides Noise Figure, there is an additional characteristic of noise, the 1/f corner.
The 1/f corner, or sometimes referred to as the “knee” of the curve, is the point where the Phase Noise slope drops by 10dB per decade.
So why is Phase Noise so important for my design?
As the graph illustrates, a poor $1/f$ knee places the signal into the thermal noise region. Moving the $1/f$ corner closer to the carrier results in removing the noise from the signal.
So how does Phase Noise effect Doppler radar, missile illuminators and other data transmission systems?
Low Phase Noise is a key element in a Missile Illuminator
Low Phase Noise Amplifiers

For example, the objective of the system is to detect and amplify small reflected target signals. Simply put, degraded Phase Noise can result in the loss of the intended target signal.
Low Phase Noise Amplifiers

Degraded Phase Noise also impacts the bit error rate (BER) of all data transmission systems.

Improving the Phase Noise results in substantial BER performance improvement by increasing the S/N ratio in the receiver.
For all Doppler Radar designs, improving the Sub-clutter Visibility (SCV) is the bottom line. This allows the radar to see small moving objects on its screen.
Excessive Phase Noise will degrade the SCV of the system. Improving the Phase Noise however increases the cancelled S/N ratio thereby improving the SCV.
How does Spectrum Microwave measure Phase Noise?
Low Phase Noise Amplifiers

Unlike measuring Phase Noise in a VCO, amplifiers require a much more sensitive measuring system with an extremely low noise floor.
A typical noise floor for measuring VCO’s may only be on the order of -145 to -150 dBc/Hz.
For Low Phase Noise Amplifiers, a noise floor of at least -180 @ 100kHz (offset from the carrier) is required in order to minimize the noise floor contribution to the amplifier’s additive phase noise.
Low Phase Noise Amplifiers

Spectrum Microwave accomplishes this feat using an “enhanced” Agilent ES5500 system coupled with a modified IFR low noise synthesizer.
This enables us to meet the required Low Noise Floor criteria for measuring Low Phase Noise Amplifiers.
At Spectrum Microwave, we optimize our designs for low Phase Noise and...
...provide both typical and guaranteed Phase Noise data on our amplifiers.
So if you want the maximum performance out of your design...
Low Phase Noise Amplifiers

...call us to learn more about Spectrum Microwave’s Low Phase Noise Amplifiers.

888-553-7531
We incorporate the latest design software in all our processes and procedures.

**Design Tools:**
- Ansoft Designer
- Agilent Eagleware Genesys
- Orcad
- Cadence Allegro
- SolidWorks
- AutoCAD
- P-Spice
- Sonnet Pro EM Simulator
ISO 9001:2000 Quality Operating System

- MIL-PRF-38534 Product Screening and qualification capability
  - Device screening and groups A, B, C, and D qualification (when required by order)
  - Environment testing per MIL-STD-883 test methods

- Other specifications guidelines
  - J-STD-001 Class 3 and IPC-A-610, for eutectic attach and general oldering processes
  - IPC-7711 and IPC-7721, for rework and authorized repair operations

- Quality assurance programs
  - Calibration recall program for test and measurement equipment
  - Facility ESD program
  - Failure analysis and corrective action system
  - Internal ISO audit program
  - Operator training program