

## Section 13. Integrating DDS-based Hardware into a System Environment

**Note - Please refer to Section 7 in the Analog Devices “High Speed Hardware Design Techniques” seminar book for complete detailed information on best practices for mixed-signal system implementation strategies, PCB layout, and power supply recommendations. Please visit the Analog Devices website at [www.analog.com](http://www.analog.com) for information on obtaining the seminar handout.**

DDS devices are examples of mixed-signal technology, which means they contain both digital and analog signals. High-frequency mixed-signal devices present a particular challenge in system implementation and PCB design. The combination of high-speed clocks and (up to) 12-bit data path resolutions in the sampled output, require a high degree of system and PCB layout consideration in order to protect the integrity of the output signal. Some common problems with DDS-based synthesizers that can be attributed to poor system implementation are:

- Excessive system clock feedthrough
- Degraded wideband spur performance
- Jitter in the output signal
- Degraded narrowband spur performance due to widening of the “skirt” around the fundamental
- Elevated noise floor in the output spectrum

### Ground plane

One of the fundamental requirements in implementing a successful high-speed mixed-signal PCB design is to incorporate large, low-impedance ground planes. Low-impedance ground planes acts as a return-path for high-frequency analog and digital signals and reduces the overall level of EMI/RFI emissions. DDS devices typically provide ground connections separately labeled as “digital ground” and “analog ground”. It is generally desirable to connect these analog and digital ground pins to a single massive ground plane within the PCB. All IC ground pins should be soldered directly to their corresponding ground planes to minimize series inductance. The IC’s power supply pins should be decoupled to the ground plane, as close as possible to the chip, with low-inductance ceramic surface-mount capacitors. If through-hole capacitors must be used, their leads should be less than 1mm in length and Ferrite beads may be employed to compensate for parasitic resonance. Multi-layer PCBs are recommended for “motherboard” designs, with individual layers utilized as a dedicated analog and digital ground planes.

### Power supplies

Most DDS devices will also have multiple supply pins labeled as “analog supply” and “digital supply” which identifies the nature of the stage that the individual pin is powering. It is recommended that separate analog and digital power supplies be used to power the associated pins. The preferred analog power supply is a linear supply with ripple limited to <1%. Digital supplies are typically switching supplies with output ripple in the range of up to 5%. It is common practice to utilize 3-terminal regulators to supply the voltage for mixed-signal devices that require non-standards voltage supplies for their analog sections.