AR Modular RF

Amplifiers To Support Software-Defined Radios

By Neil Ross, AR Modular RF

Advancing Radio Technology

Like all technologies, military tactical radios are evolving. With the help of software-based transceiver architectures, military tactical radios are taking advantage of faster, more complex waveforms with new radios supporting modern modulations and communications protocols. Following these advancements, the ancillary hardware supporting these radios must keep pace. Specifically, software-defined radios (SDRs) — which rely more on software for signal processing than hardware components — require more agile and responsive booster amplifiers with greater speed, precision, and versatility to maintain signal integrity and extend communications.

In recent years, the demands new tactical radio systems are placing on the physical layer performance of supporting hardware have increased by orders of magnitude. However, what can be done with relative ease in software and at very small signal levels (i.e., the digital domain) is not so easily accomplished at higher RF power levels (i.e., the analog domain). As the tactical radio market moves beyond the use of legacy proprietary waveforms (e.g., SINCGARS, DAMA) and embraces modern, often commercial technologies (e.g., LTE, CDMA, MANET, and mesh networks), booster amplifier designers face new challenges.

With this shift from hardware to software-based communications signal processing, radio designers are taking advantage of every single clock cycle to push as much data through as possible. As a result, key booster amplifier metrics have shifted from the frequency to the time domain. Booster amplifiers are no longer simply gauged and graded by power and frequency alone, but by speed of response and communication link metrics including packet and bit error rates.

Also, the stakes for booster amplifier performance are far greater in the digital domain. If any element of a digital communications link — including a booster amplifier — does not perform as demanded, the result is not simply poor or garbled communications, but packets are lost and communications cease.

T/R Switching Speed

Amplifier transmitter-to-receive (T/R) switching speed is among the greatest challenges associated with supporting SDRs and their new, faster communications protocols. To ensure clear, consistent communication, several new factors must be considered as part of booster amplifier design because if a booster amplifier does not track a host radio's transmitter signal and does not switch quickly enough, it misses the start of the communications burst, packets are dropped, and communication fails. In short, T/R switching must be fast and occur with deterministic certainty.

The physical layer — the RF energy transmitted by a host radio — is the first piece of the puzzle. A booster amplifier must track not only an RF burst, but it must also determine the frequency of that burst in order to fully keep pace with a host radio's switching speed, all while faithfully and accurately amplifying the transmitted signal with fidelity.

Part of the challenge for a booster amplifier comes from the fact that many SDRs typically transmit at relatively low power levels, i.e., milliwatt level. Matching the speed and agility of a lower power tactical radio with a booster amplifier operating at much higher power levels can challenge the laws of physics. With voltages and current many magnitudes of order higher in booster amplifiers than in tactical radios, responding quickly is an art.

To address the challenges faced using modern, faster switching waveforms, AR Modular RF has completely redesigned our booster amplifier architecture. At its core is a new, software-based command and control system that supports fast and deterministic operation. Leveraging this infrastructure, we aim for our amplifiers to continue being both waveform and radio agnostic to provide our customers the simplest support. Whether you operate in AM or FM, narrow band or wide band, and whatever your required switching speed, our boosters will be able to amplify your signal.

Deterministic Certainty

AR Modular RF has built its new amplifier architecture based on determining two critical pieces of information: the start of the TX RF burst and the frequency of that burst. With this information, each element of AR Modular RF's new booster amplifiers is critically and precisely controlled with deterministic certainty. Put another way, our new architecture allows not only for fast T/R switching, but controlled switching.

Consider a sports car with a powerful engine: when you stomp on the accelerator, if the switch from stationary to in-motion is not properly managed, the wheels may spin wildly, and the rear end may kick out before gaining traction. However, traction control software can optimize that accelerator response to ensure the vehicle takes off as quickly and smoothly as possible. Similarly, AR Modular RF's new SDR booster amplifiers provide optimized performance. Through customizable software control, amplifier response is

accurate, precise, high-speed, and deterministic to the sub-microsecond. The result is a perfect, critically-damped time-domain response of the RF waveform envelope.

Final Thoughts

SDR and tactical radio designs continue to push the envelope with their performance and consequently demand more from the hardware and ancillary products that support their operation. AR Modular RF has embraced the challenge of providing more advanced products by building a new, multidisciplinary engineering team. Some team members have been building amplifiers for decades, while others have backgrounds and years of experience with embedded systems, as well as with designing and testing custom radios.

The marriage of these diverse backgrounds has resulted in an amplifier company that inherently understands radios, radio performance, and the challenges faced by radio manufacturers. Speed, precision, accuracy, and agility — these are the terms that best describe AR Modular RF's new booster amplifier architecture, expected to provide the fastest switching speed of any product on the market. Whether mobile, air, ground or man-pack, AR Modular RF is your booster amplifier solution provider.

AR Modular RF plans to have functional prototypes by SOFIC 2022 (May 2022) with production units of available for sale by Q3 or early Q4 2022. To learn more, contact the author and visit us at www.arww-modularrf.com.

About the Author

Neil Ross, Director Technical Programs at AR Modular RF, is a wireless industry veteran with over 20 years of experience defining, designing, developing, and manufacturing radio frequency (RF) hardware for transceiver front ends, custom radios, and power amplifiers. At AR Modular RF, Neil is responsible for the company's technical vision which includes defining and executing both the technology and product roadmaps. Though now focused on power amplifier design, Neil's deep knowledge of radios is driving the transformation and modernization of AR Modular RF's power amplifiers to support modern radios.

About AR Modular RF

AR Modular RF is a global leader in broadband, sub-band, and discrete frequency non-EMC RF amplifiers and amplifier systems. Its products are used in military communications, electronic warfare, homeland security, high-tech medical equipment, and more. The company is a member of the AR family of companies that includes AR RF/Microwave Instrumentation, SunAR RF Motion, and AR Europe.

AR products supply a multitude of unique RF solutions to companies around the world. The company's limitless support network reaches the far corners of the globe. AR products are backed by the company's warranty, the best and most comprehensive warranty in the industry. When companies purchase from any AR company, they have the peace of mind that comes from knowing the global leader will be there to help with any problems today, tomorrow, and always.