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Frequency Matters.

Size Matters with Empower RF

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MWJ: *Empower RF has a history of high-quality, high performance products, how was the company formed?*

BP: The Company was founded in 1999 by Effi Bainvoll, entrepreneur and RF engineer. The private equity firm, Summit Partners, initially invested in the Company in 2006 and became majority shareholders in 2012.

MWJ: *Since taking over as CEO in 2009, what have been your priorities for Empower RF and what progress has been made in these areas?*

BP: My key objectives have been focused on building a foundation from which to grow - sounds pretty basic, I know, but we are in the midst of transforming from "project by project" product designs into platform architectures which provide distinct and measureable technical differentiators for customers in our target markets of Electronic Attack, Communications, Radar, and Test and Measurement.

We're maturing as a company, aligning all facets of the organization around the common architecture approach and continuing to service our legacy business is the call to action for all of us. That's the priority, that's the work in process.

MWJ: *What do you see as the major growth areas for Empower RF over the next few years?*

BP: We continue to stay the course on our targeted markets – Electronic Attack, Communications, Radar, and Test & Measurement. Forward looking, we see considerable interest and leverage for our Next Generation "Size Matters" products and sub-products. Government and Defense related programs, commercial test requirements, and other non-defense end users have a demand for the technology advancements and user interface functionality that Empower products provide. The significant size and weight advantages of our next generation platforms open up a number of applications not previously considered for solid state PAs at this output power. Remote monitoring and control of such a system via Ethernet TCP/IP interfaces, Web access and powerful onboard operating system, has likewise presented a number of interesting opportunities for deployment of the amplifiers.

MWJ: *Empower RF uses various device technologies such as GaAs, LDMOS, GaN, MOSFET, etc. – what are the major tradeoffs in deciding on which technology is best for a new application?*

BP: Empower has a very knowledgeable RF Power Amplifier Engineering staff and we have invested significant effort into characterizing the latest in all RF power device technologies. The decision to use a particular device technology is based on bandwidth, input signal modulation, output power level, linearity, efficiency, operating frequency, and user application. Key trade-offs include cost, efficiency, linearity and output power - balancing those trade-offs with the end user application (and environment) will lead you to the "best fit" device technology.

MWJ: *Empower has delivered over 30,000 RCIED jammers at production rates exceeding 1000 amplifiers per month – what were some of the major challenges in producing products at such a high rate with military performance?*

BP: Supply chain and vendor deliveries are always a challenge when managing production volumes and rates of those magnitudes. Manufacturing and test throughput are carefully planned and managed daily to insure smooth, continuous delivery rates with a high yield of success and reliability. Specific to the RCIED programs, identifying and qualifying a network of design and manufacturing partnerships was also a critical element in managing the "surge". As you know, those programs have subsided now. Our partnership approach lessened our exposure to high fixed costs and capital expenses.

MWJ: *What are some of the major challenges in producing very rugged amplifiers for the EMC/EMI and industrial markets?*

BP: EMI/EMC and Industrial power amplifiers are required to have extremely high reliability, high MTBF, and they must have the ability to operate into high load VSWR conditions at full output power. With the roll out of our next generation platforms, we are bringing optimized performance which meets these industry requirements and, at the same time, we are raising the stakes on cost savings and systems "on air" time.

MWJ: *What were the biggest challenges in designing your newest 1 kW broadband amplifiers in a 5U package?*

BP: There is always some level of resistance when designing and launching an innovative product. We were operating "out of the comfort zone" with regard to historical designs and the organizational environment needed to allow the new engineering team to execute their vision had to be nurtured. We also had to be prepared to invest in extensive modeling, simulation, and software development. These things take time, and along with that, we're balancing tactical requirements and supporting legacy products.

From a technical standpoint, we are maximizing the use of well engineered building blocks that are designed for commonality, re-use, and integration into a scalable, open architecture platform. Our goal was to maximize "watts per cubic inch" using the latest in RF devices, unique matching techniques, low loss combining techniques, thermal management, and a dynamic user interface all packaged in a rugged, efficiently manufactured chassis. Specific to "ease of use", our goal was to deliver a platform that could be easily monitored and controlled in a standalone configuration as well as within the framework of the end user system architecture. Our intuitive interface and use of a non-proprietary, standard browser are important enablers in delivering an optimized user experience.

We have succeeded in delivering on our key design goals and, as you suggest, it's been a challenging assignment for our organization.

MWJ: *What innovations were used to fit all that power into such a small package and still maintain performance over temperature and other environmental requirements?*

BP: Our approach devotes considerable attention and engineering to both the RF platform (device selection, innovative matching circuits and low loss combining techniques) and the architecture devoted to thermal design, packaging, redundant power supplies, and embedded diagnostics for monitoring, status, reporting and control. The systems are fully self-protected and controlled to make adjustments for environmental conditions, over temperature, excessive load VSWR, input over drive or other non-typical operating conditions. This allows the user to operate under any and all adverse conditions. We have several patents being submitted for this architecture.

MWJ: *What other electronic features are included in this family of products (IP control, power supply, etc.)?*

BP: That's a great question and thanks for asking. We are delivering much more than just 1 kW RF power in an industry leading 5U chassis. Our onboard combination of microprocessors and FPGA's gives us fast logic / high speed decisions for monitoring, protecting, and controlling the amplifier. Dynamic adjustments linked to this processing power and digital controls are focused on maximizing system "on air" time as well as power output under all conditions. This next generation HPA has the ability to seamlessly change between modulated, CW, and pulse signals while maintaining the appropriate output power.

Also important to note is the fact that our Linux based operating system hosts both an embedded web server (to link to the "outside" world) and a separate application for handling the RF monitoring, control, calibration, and dynamic adjustments which are unique to the operating conditions of the amplifier.

Systems integration for the end user is simplified by use of a non-proprietary interface – i.e., a standard web browser. With that connection, the HPA can be pulled into the end user's "network" of critical system components - monitoring and controlling the unit within the framework of their system architecture.