BRAND NAME OR EQUAL – SALIENT CHARACTERISTICS

Requirement	Electron Paramagnetic Resonance (EPR) Spectrometer System Components
Brand Name Reference	Bruker BioSpin Corporation (ELEXSYS Series Components)
Target Agency	U.S. Air Force Academy (USAFA) Physics Department
Document Type	Technical Specifications & Salient Characteristics

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1. General System Requirement

The U.S. Air Force Academy (USAFA) requires high-performance, pulsed X-band Electron Paramagnetic Resonance (EPR) spectrometer components. The supplied system must be capable of generating complex microwave pulse sequences, digitizing transient EPR signals, and performing advanced measurements of spin relaxations in cryogenic materials.

To be considered "equal" and technically acceptable, the offered equipment must meet or exceed the following minimum physical, functional, and performance characteristics.

2. Minimum Technical & Performance Characteristics

2.1 Pulsed Microwave Amplifier

- **Frequency Range:** Must operate in the X-band (approximately 9 to 10 GHz).
- **Power Output:** Must provide a minimum of 600 Watts of pulsed microwave power.
- **Functionality:** Must be specifically designed for pulsed EPR applications, providing stable amplification with minimal phase/amplitude distortion across the required bandwidth.

2.2 Digital Pulsed X-Band Bridge & Circulator

- **Frequency:** X-band operation.
- **Control:** Must feature digital phase and amplitude control for precise microwave pulse generation.
- **Detection:** Must be capable of detecting fast transient EPR signals, including Free Induction Decays (FIDs) and spin echoes.
- **Routing:** Must include an integrated X-band circulator extension/assembly capable of handling the 600 W high-power input pulses and safely routing the returning weak emission signals to the receiver.

2.3 High-Speed Digitizer

- **Functionality:** Must provide high-speed, high-resolution dual-channel (real and imaginary/quadrature) digitization of the transient EPR signals to capture fast relaxation times (T_1 and T_2).

2.4 Arbitrary Waveform Generator (AWG)

- **Sampling Rate:** Must have a minimum sampling rate of 3.2 Giga-Samples per second (GS/s).
- **Functionality:** Must be fully integrated into the bridge/spectrometer system to allow for the creation of complex, user-defined shaped microwave pulses, advanced phase cycling, and multi-frequency pulse sequences.

2.5 System Control & Data Analysis Workstation

- **Computing Hardware:** Must include a dedicated PC workstation with a modern, currently supported operating system (e.g., Windows 11).
- **Display:** Must include a high-resolution monitor (minimum 24-inch, WUXGA 1920x1200 or equivalent).
- **Software Capabilities:** The provided software suite must include a comprehensive Graphical User Interface (GUI) for:
    - Full hardware control of the bridge, AWG, amplifier, and digitizer.
    - Programming and execution of custom pulsed EPR sequences.
    - Data acquisition, visualization, and processing of spin-lattice and spin-spin relaxation data.

2.6 Housing/Frame

- **Requirement:** Must include a structural frame, rack, or console appropriate for securely housing the bridge, amplifier, and associated electronic components in a standard laboratory environment.

3. Critical Integration Requirement (Go/No-Go)

The USAFA Physics Department currently owns and utilizes a proprietary Bruker microwave resonator. To ensure project success, the proposed system must meet the following integration criteria:

- **Hardware Integration:** The proposed “equal” system components (bridge, amplifier, circulator, etc.) must be capable of natively interfacing with this existing government-owned resonator.
- **Operational Validation:** The contractor must be able to perform required S-parameter characterization, impedance matching, and pulse calibration to ensure the new components drive the existing resonator efficiently.
- **Proof of Capability:** Proposals must include a detailed technical narrative explaining how the vendor will achieve this integration without degrading system performance.

4. Installation and Training

- **On-Site Installation:** The vendor must provide complete on-site installation of all delivered components.
- **System Buy-Off:** Following installation, the vendor must demonstrate successful system operation by conducting benchmark spin-echo measurements using the integrated system and the Government’s existing resonator.
- **Training:** The vendor must provide basic on-site familiarization training for USAFA personnel on system operation, AWG programming, and routine maintenance.