An Integrated Flight Termination Receiver Decoder and Flight Termination Safe and Arm

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to:

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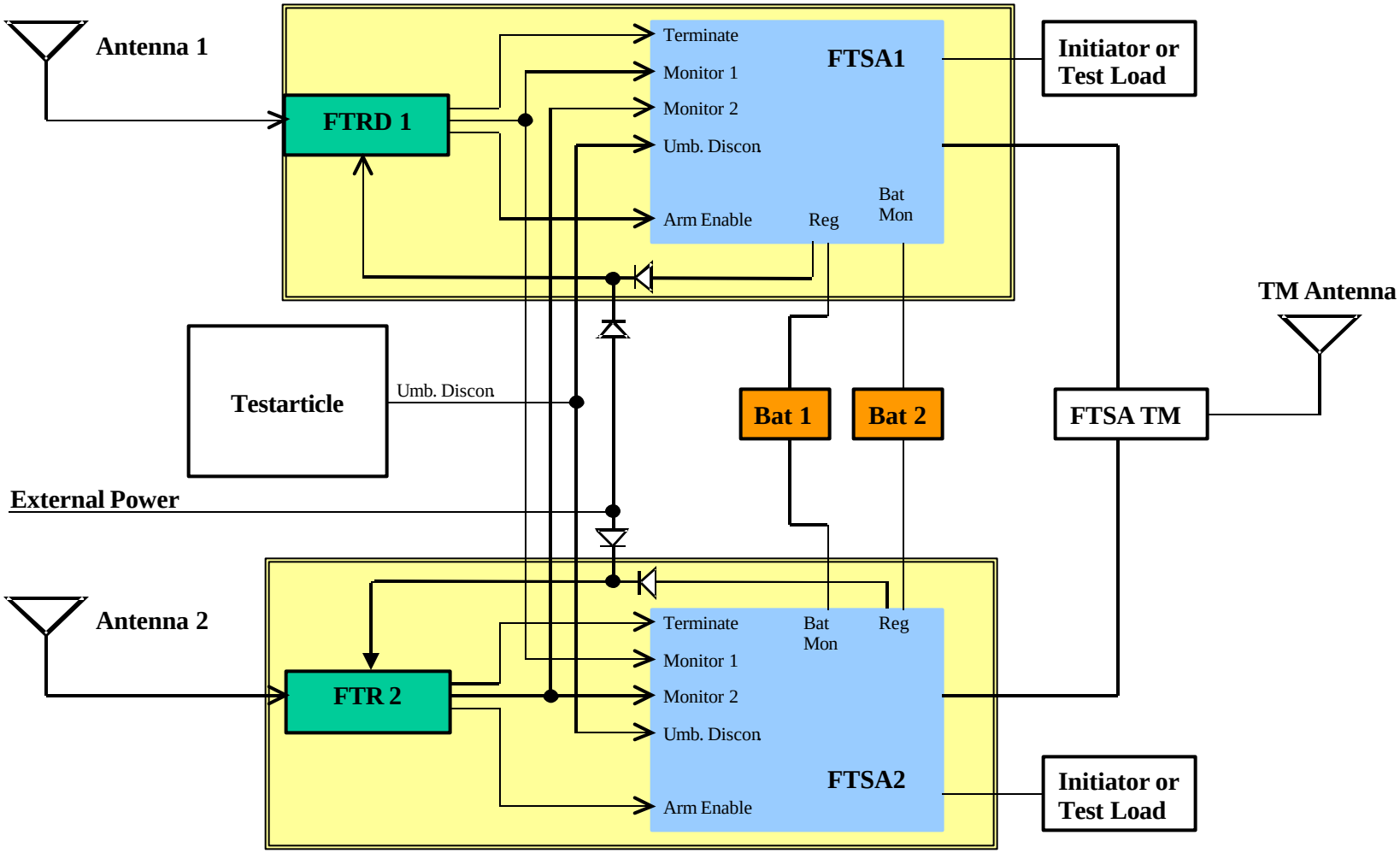
Background
KAMAN Aerospace

A Simtek Company

Joint Advanced Missile Instrumentation (JAMI)
Flight Termination Safe and Arm (FTSA)

- **Cooperative Research and Development Agreement**
  - **Raymond Engineering Operations (REO)**
  - **Signed 12 April 1999**
- **Division of Responsibilities**
  - **China Lake**
    - **Electrical/Explosive Design and Development**
    - **Environmental Testing**
  - **REO**
    - **Packaging**
    - **Hardware Manufacturing**
- **Under Development, Proof-of-Design Phase**

Integrated FTRD FTSA FTS Concept



Integrated FTRD / FTS Benefits

- **Standardization**
- **Off-the-Shelf Availability**
- **Low Unit Cost**
- **Small Size & Weight**
- **Low Power Consumption**

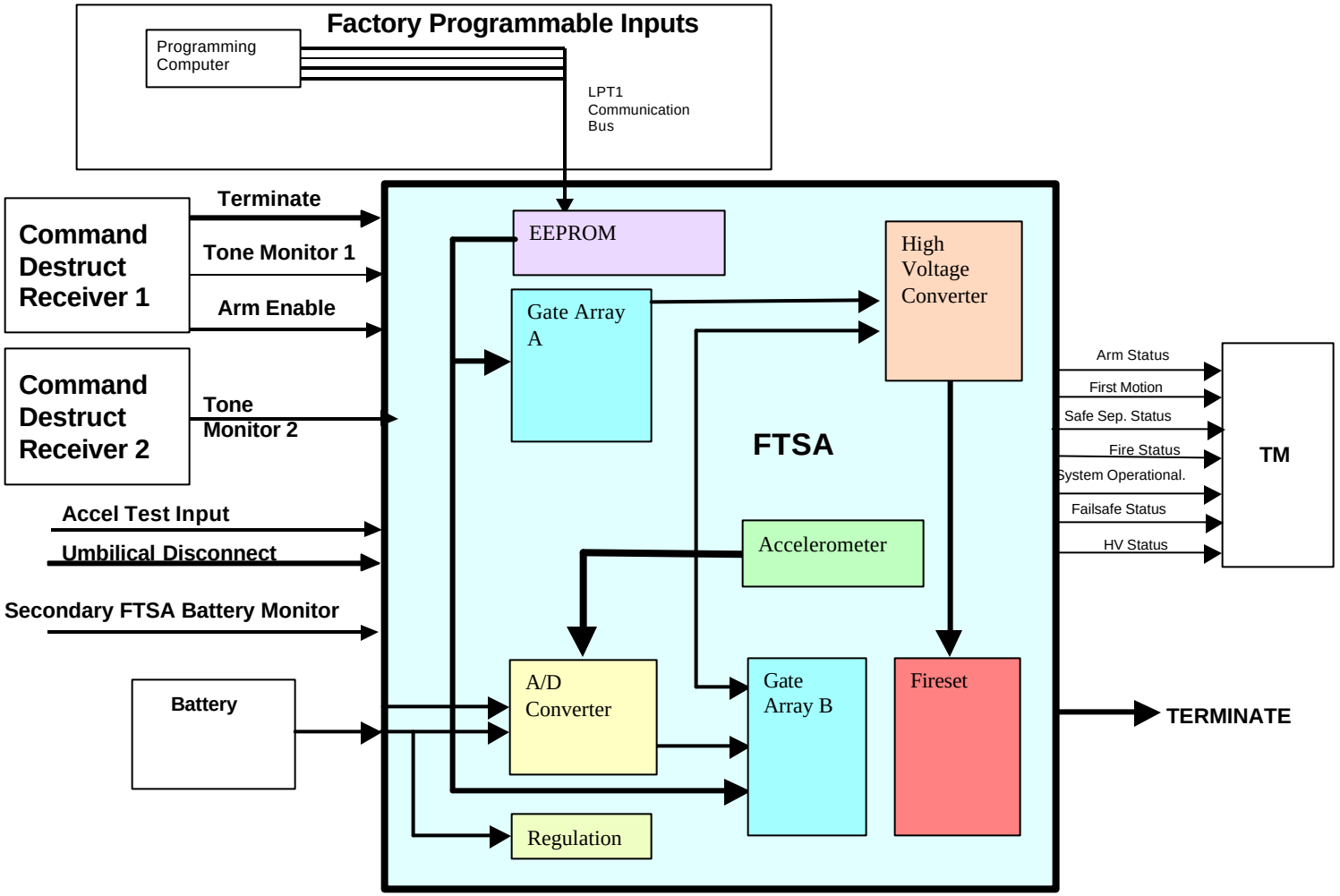
JAMI FTSA Background

JAMI FTSA

Proof of Design Unit

- **Compliant With RCC 319-99 (Tailored)**
- **Factory Programmable For Multiple Applications**
- **Small Size (~10in³/unit)**
- **Low Cost DTUPC**
- **Qualified To "Worst Case" Environmental Levels**
  - **Based on Environments of Potential Users**
- **Removable Explosives (EFI, Etc.)**
- **Fully Testable (Including HV Output)**

Block Diagram of JAMI FTSA



Universal FTRD SBIR PHASE 1 Team

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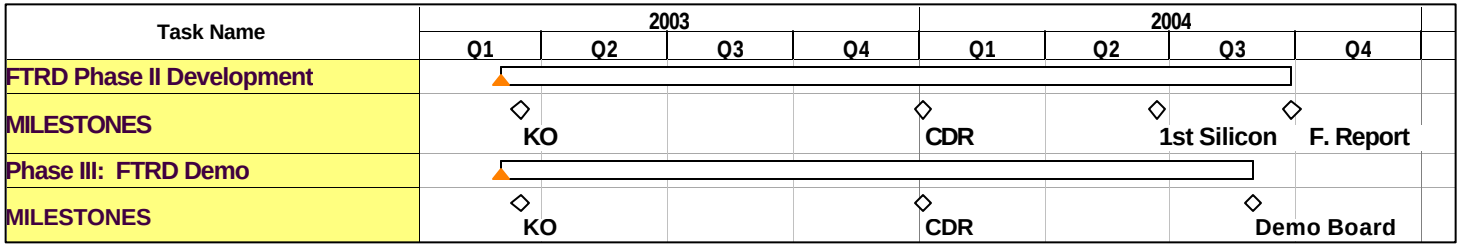
SBIR Contract No. DAAB07-02-C-L602

Program Objective Phase I SBIR

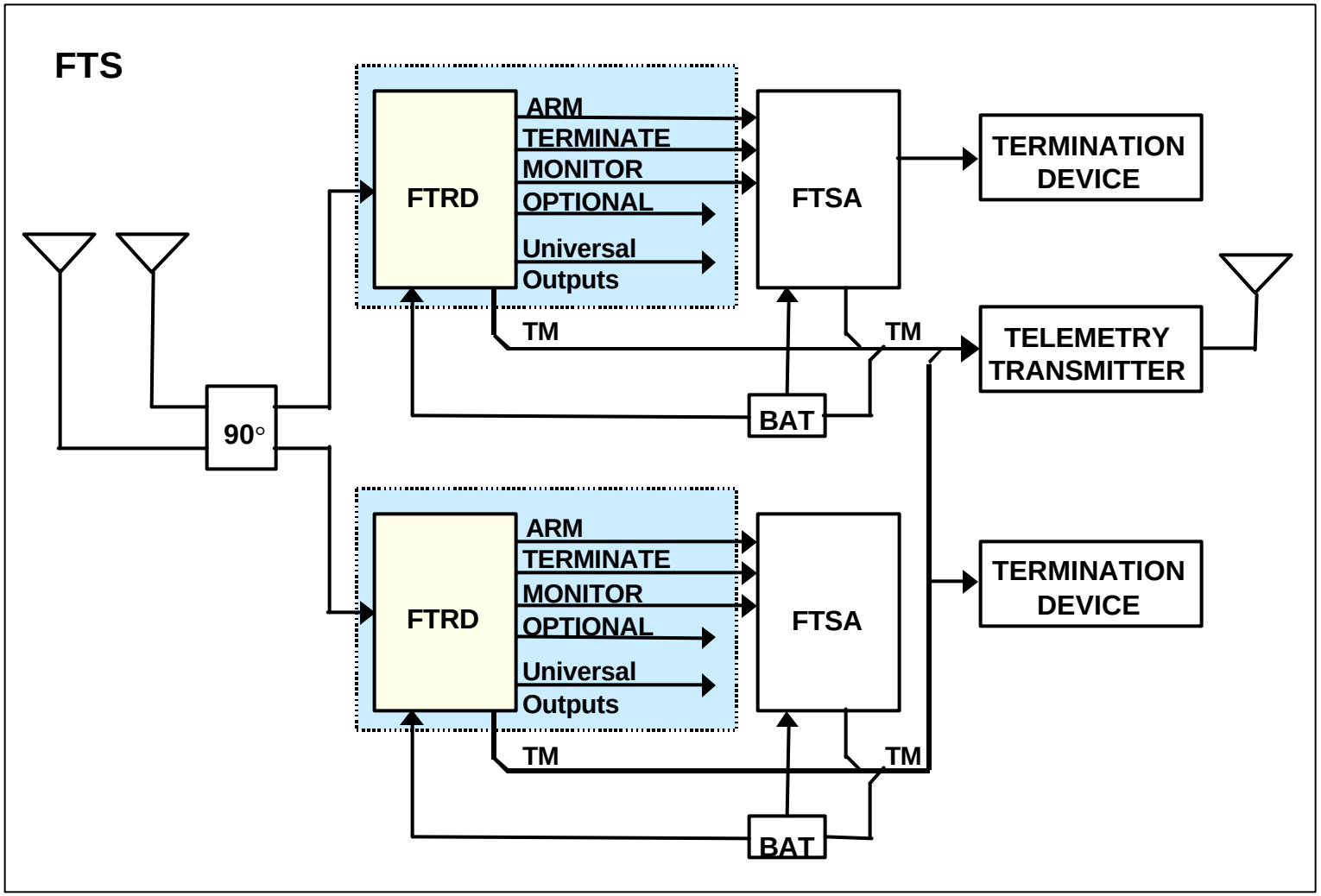
- **Assess feasibility of developing, and performance of a standardized universal FTRD within the constraints of RCC 319-99**
- **Detail an optimum architecture for the FTRD**
- **Determine the feasibility of an Integrated FTRD/ FTSA**
- **Phase I Completed**
- **Phase II proposal submitted, November 05, 2002**

Phase II and III Plan



- **Proposed Phase II (submitted 11/05/02)**
  - **19-month plan to design and build first-pass RFIC**
  - **CDR of circuit design/layout at 10 months**
  - **First silicon at 16 months**
  - **Final report at 19 months, after Phase III evaluation**
- **Concurrent Phase III (Kaman REO funding)**
  - **18-month plan with most activity in last seven months**
  - **Incorporate Kaman FTRD requirements and design-for-manufacturability at the outset**

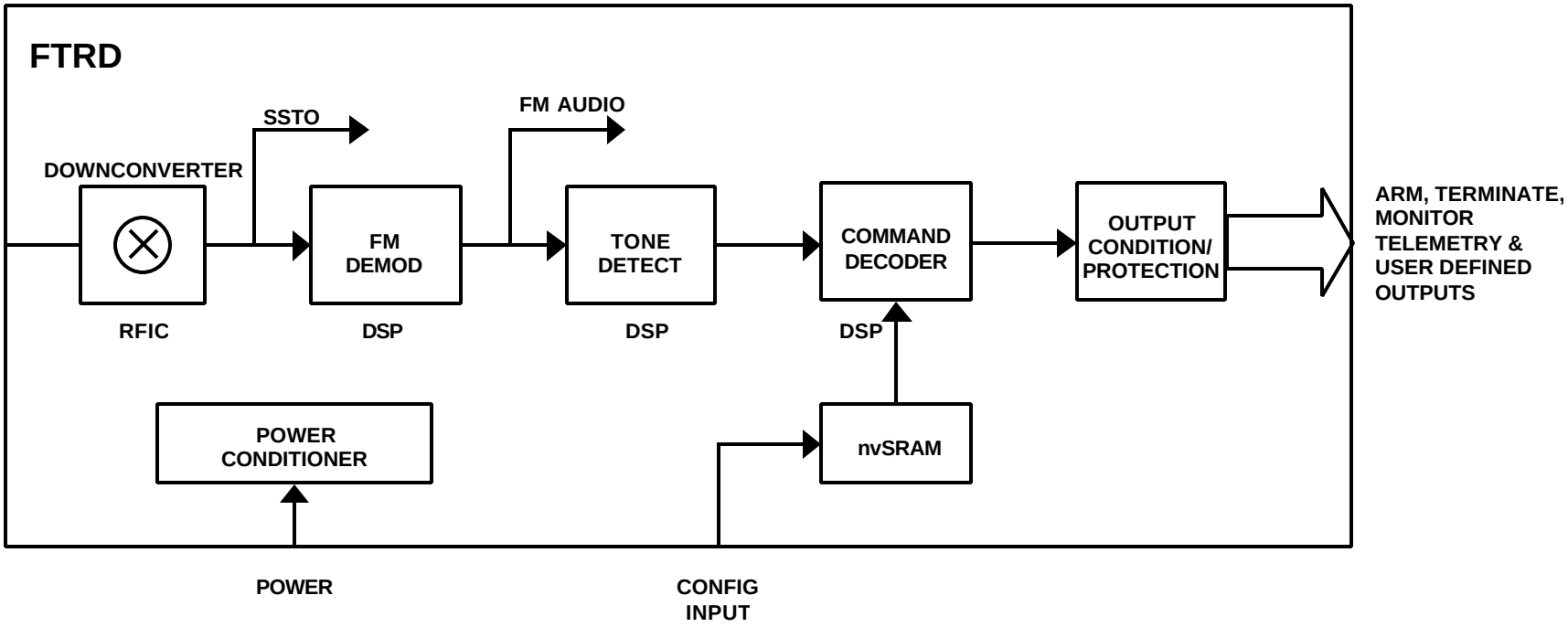
Universal Flight Termination System



Universal FTRD Requirements

- **Compliant With RCC 319-99 Tailored and 313-01**
- **Factory Programmable for Multiple Applications**
- **Small Size – Compatible with JAMI FTSA Area**
- **Low Cost DTUPC**
- **Designed to “Worst Case” Environmental Levels**
  - **Based on Environments of Potential Users**
- **Fully Testable**

Standard Flight Termination and Receiver Decoder (FTRD)



FTRD Functions

- **Detect and lock to command signal**
- **Detect RCC signals**
- **Decode tones and sequences (including ARM, TERMINATE, MONITOR, OPTIONAL, CHECK CHANNEL)**
- **Output commands (ARM, TERMINATE, etc.)**
- **Output telemetry signals**
- **Provide programmable interface**
- **Support installation and checkout testing**
- **Support sensitivity testing**
- **Support Day-of-Use check**
- **Commanded and power-up self-test**

FTRD and FTSA Programmability

FTRD Programmability

- **Command frequency (406-450 MHz), 0.5 MHz resolution**
- **Fail-safe mode**
  - **Fail-safe enable / disable**
  - **Three-tone mode (FTSA) also provides this operating mode)**
    - **Loss of RF signal, threshold and delay timer**
    - **Loss of power, threshold, delay timer**
  - **Four-tone mode**
    - **Fail-safe enabled / disabled by preset RCC tones**

FTSA Programmability

- **Failsafe Enable**
  - **Loss of Monitor (tone drop out time)**
  - **Loss of Power (Minimum BAT Volt)**
- **First Motion Enable**
  - **First Motion Valid Time**
- **Acceleration Enable**
  - **Axis of Acceleration**
  - **Acceleration Level**
- **Umbilical Disconnect Enable**
- **Safe Separation Time**
- **Arm Enable**
- **Command Arm (TBD)**

FTRD/ FTSA Programmability (Cont.)

- **Programmable Outputs**
  - RCC tone output mapping
  - Tone sequence output mapping
  - Response time, delay time
  - Secure mode ARM and TERMINATE sequence programming
- Self-test tailoring
- Telemetry signal command output mapping
- Enable valid tone frequencies

Programmable OUPUTS

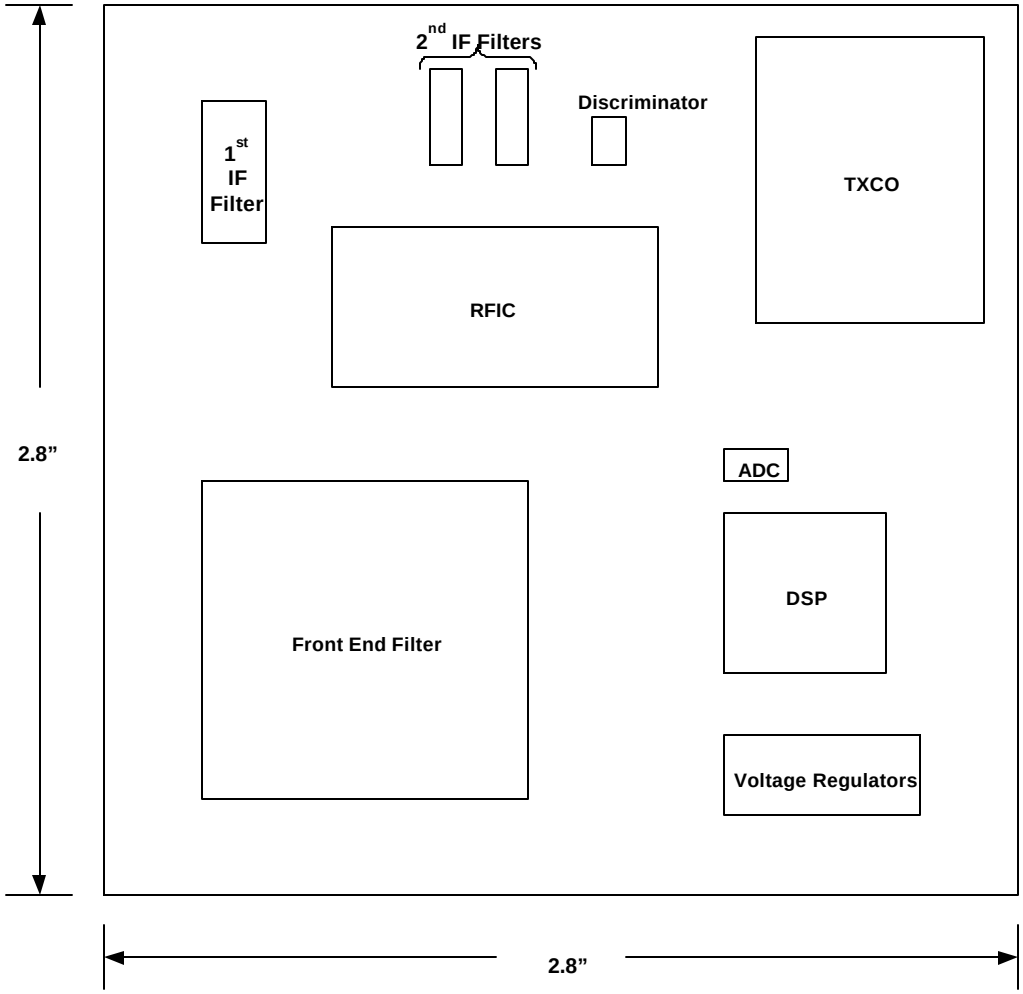
- Flight Destruct (Explosive)
- Safe/Arm Status
- Fire Status
- Safe Separation Status
- First Motion Status
- System Operational
- Failsafe Status

FTRD Approach

- **Single SiGe RFIC**
  - **Two stage down-converter to baseband I/Q outputs**
  - **Low-power and minimal external components**
  - **Low-cost**
- **Synthesized 1st LO for tuning over 406-450 MHz**
- **Low-power COTS DSP**
  - **Performs IF filtering, FM demodulation, and tone detection**
  - **Supports proposed EFTS waveform with minimal reprogramming**

Preliminary FTRD Board Layout

IF Demod with DSP tone detect (most components)



Integrated FTRD/ FTSA Summary

FTRD

- Will meet Performance Requirements of JAMI and RCC 319-99 Tailored
- Designed to Fit within FTSA Module Width and Length
- Size: 2.8” x 2.8” x 0.375”
- Weight: < 5 ounces
- Based on Environments of Potential Users
- Power: 0.6 W
- ***Can Support Proposed EFTS Waveform and High Alphabet***

FTSA

- Compliant With RCC 319-99 (Tailored)
- Factory Programmable For Multiple Applications
- Small Size (~10in^3/unit)
- Low Cost DTUPC
- Qualified To “Worst Case” Environmental Levels
  - Based on Environments of Potential Users
- Removable Explosives (EFI, Etc.)
- Fully Testable (Including HV Output)