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Fuze Interface Standardization

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51st Annual Fuze Conference
Nashville, TN

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Topics

- Background
- Standard Development Efforts
- Fuzing System Standard Structure
  - Serial Signal Interface
  - Power Interfaces
  - Discretes
  - Serial Communications Protocol
- Future Plans

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Background

- Spring 2003 – NAFAG AG-2 requested SAE assess airborne weapon fuze interoperability.
- Fall 2003 – SAE convened Technical Assessment Panel from 5 countries & 21 government organizations & companies
  - Identified three areas for fuze standardization
    - Weapon to Aircraft Interface
    - Fuze to Weapon Mechanical Interface
    - Fuze to Weapon Logical/Electrical Interface

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More Background

- March 2004 – NATO Air Armament Panel requests SAE study fuze interface standardization
- April 2004 – SAE initiates 2 Fuze Interface Task groups:
  - AS-1B6 (Fuze Systems) – R Clutterbuck Chair
  - AS-1B7 (Fuze Mechanical) – R Agarwala Chair
- April 2004 to Present – Task Groups develop draft standards
  - Focus here on Electrical/Logical Standard

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Standard Electrical & Logical Interface for Airborne Fuzes

- AS-5716 – SAE Aerospace Standard
  - General Requirements Overview
    - Signal Requirements
    - Power Requirements & Logic
    - Discrete Requirements
    - Time Line
    - Serial Communications Protocol
  - Fuze Side of Interface
    - Signal Requirements
    - Power Requirements
    - Discrete Requirements
  - Store Side of Interface
    - Signal Requirements
    - Power Requirements
    - Discrete Requirements

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Interface Signals

Store **Fuze**

Signal Lines

SIGNALS SERIAL PAIR

Power Lines

CARRIAGE PHASE POWER – PORT 1
WEAPON FLIGHT POWER – PORT 2
ARMING POWER – PORT 3
POWER RETURN – PORT 1
POWER RETURN – PORTS 2/3
TARGET DETECTION DEVICE POWER
ENVIRONMENT 2 DISCRETE POWER

Discrete Lines

RELEASE CONSENT MONITOR
SEPARATION DETECTION
ARM MONITOR
LOGIC SIGNAL RETURN
ARM INHIBIT
TARGET DETECTION DISCRETE
SAFETY GROUND (STRUCTURE)
CONTINUITY
ENVIRONMENT 2 DISCRETE PAIR (SIGNAL)

Power Application

Store Captive Carry

Weapon Free Flight

Weapon Prepare for Release

Weapon Release

Arming Delay Expires

Need Power for Communications (Port 1 Power)

- Configuration
- Arming Data
- Mission Data
- Status

Need Power for Environment Sensing (Port 2 Power)

Need Power for Arming (Port 3 Power)

Power Concepts

- Carriage Phase Power (Port 1)
  - Power for fuze to store communication during captive flight on the aircraft.
  - Could be derived from aircraft provided MIL-STD-1760 power
  - No Arming circuits powered
- Weapon Flight Power (Port 2)
  - Power normally used by store during all stages of free-flight.
  - Could be derived from store battery activated just prior to release.
  - Arming control circuits powered, but no arming energy.
- Arming Power (Port 3)
  - Power for arming the fuze.
  - Environmentally derived preferred.
- Power from Fuze (still being defined)
  - Power for a Target Detection Device (e.g. Proximity Sensor)
  - Power for a 2nd Environment Sensor (e.g. Air Data Sensor)

Separation Discrete Signals

- Standard imposes on store Requirement to provide fuze the following:
  - Release Consent from MIL-STD-1760 connector
  - Separation Detection from MIL-STD-1760 connector (Address Return)
- These two discrete signals (in combination with digital data) provide the means to detect separation of the MIL-STD-1760 umbilical connector and determine that the separation is from an intentional release.

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Separation Discrete Signals Application

Store Captive Carry

Weapon Release

Weapon Free Flight

Platform

28 VDC1 (Power)

RC (Disc)

11R (CTS)

MIL-STD-1760

Umbilical Separation - 1760 Address Lines open

Store Battery Activated

Store

Port 1 (Power)

RC (Disc)

Port 2 (Power)

Fuze Detects Opening of 1760 Address Lines

Fuze knows weapon has separated – first arming criteria met

Fuze

Additional Fuze Control Discrete Signals

- Standard allows store the Option to provide fuze the following:
  - Arm Inhibit to hold off arming during long flights
  - Target Detection to command function (if fuze utilizes Detonate on Target Detection Mode)
- The Task Group is developing additional discrete signals to enhance interoperability:
  - Environment 2 Discrete (Signal)
  - Environment 2 Discrete (Spare)

  These signals will standardize the signal characteristics from second environment sensors mounted outside fuzes (air probes, wind speed sensors, etc.)

Serial Communications

Store Captive Carry

Weapon Release

Weapon Free Flight

Platform

11R (Arm Dly) **13R (Msn Data)** **11R (Msn Data)** **RC (Disc)** **11R (CTS)**

MIL-STD-1760

11T (CTSS)

Store

11R (Arm Dly) **Mission Data** **Mission Data** **RC (Disc)** **FPS** **FRI** **Mission Data** **Mission Data**

Fuze

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Serial Communications

CMD	Data from	Description	Data content	Fuze response	Notes
C	Fuze	Get fuze identifier	Fuze Identity	Fuze to Sends fuze identifier	
I	Store	Fuze hard reset	None	None	Simulates power cycling
M	Store	Fuze Mission data	Fuzing Control Data	Fuze accepts mission data	
S	Fuze	Fuze Mission data	Fuzing Data	Fuze provides its mission data – same data as “M”	
A	Store	Send Fuze Arming data	Entire Contents of MIL-STD-1760 11R Message	Fuze arming logic accepts arming times	
Q	Fuze	Queries Arming time and status	Arming Data	Fuze sends 7 byte.message with Arming times plus current arming status	.
F	Store	Fuze launch sequence commands	TWO Bytes: “PS” “RI” “OS”	”PS” directs fuze to perform irreversible actions (linked to CTS). “RI” informs fuze release is imminent. “OS” revokes “RI”.	

Mission Data

Word	Description	Content
1	Mode 1	8 bits defining modes
2	Mode 2	8 bits defining modes
3	Status	8 bits defining status (fuze only)
4	Time (LB)	1760 data entities….
5	Time (UB)	
6	Velocity (LB)	
7	Velocity (UB)	
8	Void/Layer	
9	Distance (LB)	
10	Distance (UB)	

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Fuzing Modes

1. Function At Impact
2. Function On Time After Impact
3. Function At Altitude (Barometric)
4. Function At Height Above Ground
5. Function At Depth After Impact
6. Function On Target Detection
7. Function On Time after Target Detection
8. Function On Interference Detected

1. Function On Void After Impact
2. Function On Layer After Impact
3. Enable Detection of Low Capacitor Voltage
4. Enable Long Detonation Delay
5. Function at End Of Life
6. Reserved
7. Reserved
8. Reserved

Arming Data (from Fuze)

Word	Description	Content
1	Arming Time (LB)	
2	Arming Time (HB)	
3	High Drag Time (LB)	
4	High Drag Time (HB)	
5	Arming Status Word	See next slide
6	Checksum (LB)	
7	Checksum (HB)	

Arming Status Word

Bit	Description	Content
1	Prelaunch Status	1/0 = Good/Bad
2	Fuze Ready to Release	1/0 = Yes/No
3	Arm State	1/0 = Armed/Safe
4	Arm Inhibit Status	1/0 = Inhibit/Free
5	Reserved	0
6	Reserved	0
7	Reserved	0
8	Reserved	0

Fuze Launch Sequence Commands

FPS – Fuze Prepare to Separate – Fuze may perform non-irreversible actions

FRI – Fuze Release Imminent – Store reporting CTSS to Platform. Fuze begin monitoring separation.

FOS – Fuze Omit Separation – Store or Platform aborting mission. Fuze ceases monitoring separation.

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Next SAE AS-1B6 Meeting

July 10-11, Seattle WA (Boeing Facility)

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