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|--------------------------------------------------|----------------|---------------|
| <b>AEROSPACE<br/>STANDARD</b>                    | <b>AS6135™</b> | <b>REV. A</b> |
|                                                  | Issued         | 2012-12       |
|                                                  | Stabilized     | 2019-05       |
| Superseding AS6135                               |                |               |
| Interface Standard, Airborne EO/IR Systems, Data |                |               |

#### RATIONALE

The Technical Committee determines that the using community is moving towards newer technology and would like to alert users that this newer technology exists which may want to be considered for new design.

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## PREFACE

AS6135, Interface Standard, Airborne EO/IR Systems, Data, is a standard that defines the data interface between aircraft (manned and unmanned) and onboard EO/IR Systems. Its purpose is to promote platform to sensor system interface standardization by providing substantial, but not 100% commonality, interoperability, and interchangeability

This document was prepared by the AS-1C3 Electro-Optic/Infrared Mission Avionics Data Exchange (MADE) Task Group, under the jurisdiction of the AS-1C Subcommittee, Avionic Subsystems, of the SAE AS-1 Committee, Platform Systems and System Integration.

1.

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## 1. SCOPE

This standard defines the data interfaces between a host aircraft (“platform”) and an Electro-Optic/Infrared (EO/IR) sensor. These data interfaces cover various types of data including: imagery, metadata, command, status, and responses (CSR), geospatial position, time, test and maintenance, and hand-controller. This standard does not cover mechanical or electrical interfaces.

### 1.1 Relationship Between Aircraft/Sensor Interfaces and SAE Standards

Figure 1 shows the relationship between the various interfaces and the various SAE standards. AS6129 (electrical) covers connectors, power, conductors, fiber optics, and some aspects of data transport. AS6135 (data) covers data (e.g., imagery, metadata, as well as CSR). AS6135 overlaps AS6129 in the area of protocols for data transport. AS6135 and AS6129 are closely bound together because building a system based on these standards is dependent on the requirements from both standards. Also, requirements put in one standard can impact the options for updating the other standard.

NOTE: Regarding Figure 1, SAE is drafting a standard (AS6165) to cover maintenance and test which will overlap both AS6129 and AS6135. SAE is also drafting a standard (AS6169) which will cover the mechanical interface. AS6169 will overlap AS6129 with regard to connectors.

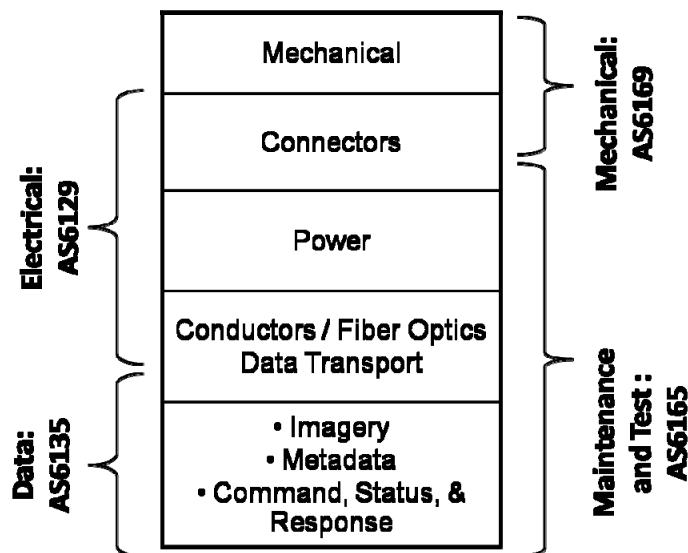


FIGURE 1 - RELATED SAE STANDARDS

### 1.2 Purpose

The intent of this standard is to enhance interoperability, commonality, and interchangeability among equipment provided by various EO/IR suppliers and avionic systems. Adoption of this standard will improve procurement flexibility for acquisition, system integrators, and platform providers. Relevant platforms include fixed wing, rotary wing, UAS (except for micro-UAS), and lighter than air vehicles. The approach adopted to accomplish these intents includes utilizing the same interface standards used elsewhere in the end-to-end system. This standard is also intended to encourage the move away from sensors that use interlaced acquisition, transport and/or format, as well as analog interfaces.

The data interface is designed to facilitate the:

- Interconnection between EO/IR sensor systems and the avionics systems hosted by the platform
- Exchange of data and metadata between sensor systems and sensor data processors
- Maintenance and test of EO/IR systems

### 1.3 Application

This standard applies to all platforms and EO/IR sensors that interface with each other. AS6135 addresses turreted EO/IR sensor systems. Future revisions of AS6135 may address other EO/IR sensor systems such as pods. AS6135 covers sensors and platforms presently in concept development stages, future platforms, and sensor developments, and upgrades to legacy platforms. This standard is intended for use by procuring agencies and as a general guideline for industry.

## 2. REFERENCES

### 2.1 Applicable Documents

The documents listed in this section are cited in Sections 3 and 4 of this standard. This section does not include documents cited in other sections of this standard, or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in Sections 3 and 4 of this standard, whether or not they are listed here.

The following publications form a part of this document to the extent specified herein. When specified herein, the specified revision level of a document shall be used. Otherwise, the latest revision level of the specified document is implied.

#### 2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AS6129 Interface Standard, Airborne EO/IR Systems, Electrical

#### 2.1.2 Government Documents

|                 |                                                                                                                                     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|
| ICD-GPS-060B    | GPS User Equipment (Phase III) Interface Control Document for the Precise Time and Time Interval (PTTI) Interface. 12 February 2002 |
| MIL-STD-2500C   | National Imagery Transmission Format Version 2.1 for the National Imagery Transmission Format Standard (NITF 2.1), 2006-05          |
| MISB EG 0802.1  | H.264/AVC Coding and Multiplexing, 2010-09                                                                                          |
| MISB MISB 6.2   | Motion Imagery Standards Board (MISB), Motion Imagery Standard Profile (MISP), 2011-6                                               |
| MISB RP 0403.1  | Bit-Serial Digital Interface for Infrared Motion Imagery, 2010-02                                                                   |
| MISB STD 9701   | Standard Definition Digital Motion Imagery, Compression Systems (MISP)                                                              |
| MISB STD 0102.9 | Security Metadata Universal and Local Sets for Digital Motion Imagery, 2010-09                                                      |
| MISB STD 0601.4 | UAS Datalink Local Metadata Set, 2010-3                                                                                             |
| MISB STD 0603.1 | Common Time Reference for Digital Motion Imagery Using Coordinated Universal Time (UTC), Jun 2011                                   |
| MISB STD 0604.2 | Time Stamping and Transport of Compressed Motion Imagery and Metadata, 2011-06                                                      |
| MISB STD 0605.3 | Inserting Time Stamps and Metadata in High Definition Uncompressed Video, 2011-06                                                   |

|                               |                                                                                                                                  |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| MISB STD 0807.8               | MISB KLV Metadata Dictionary, 2011-10                                                                                            |
| MISB STD 0902.1               | Motion Imagery Sensor Minimum Metadata Set, 2010-06                                                                              |
| NAVSTAR ICD GPS 060 -B        | GPS User Equipment (Phase III) Interface Control Document for the Precise Time and Time Interval (PTTI) Interface. 2002-02       |
| NTB STDI-0002 v 4.0           | The Compendium of Controlled Extensions (CE) for the National Imagery Transmission Format (NITF) 2011-08                         |
| STANAG 4586 Ed 2, amendment 2 | STANDARD INTERFACES OF UAV CONTROL SYSTEM (UCS) FOR NATO UAV INTEROPERABILITY, Ed. 2, amendment 2                                |
| U.S. Army PM ICD 2.1.1        | U.S. Army Unmanned Aircraft Systems (UAS) Project Office Private Messages Interface Control Document (ICD) Version 2.1.1 2011-09 |

### 2.1.3 Industry Documents

|                       |                                                                                                                                         |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| ANSI/TIA/EIA-422-B    | Electrical Characteristics of Balanced Voltage Differential Interface Circuits (RS-422)                                                 |
| IEEE-1588-2008        | Precision Clock Synchronization Protocol for Networked Measurement and Control Systems. Precision Timed Protocol (PTP/IEEE 1588)        |
| IEEE-802.3ab          | Physical Layer Parameters and Specifications for 1000 Mb/s Operation Over 4 Pair of Category 5 Balanced Copper Cabling, Type 1000BASE-T |
| IEEE-802.3ae          | Media Access Control (MAC) Parameters, Physical Layers, and Management Parameters for 10 Gb/s Operation                                 |
| ISO/IEC 13818-1:2007  | Information technology - Generic coding of moving pictures and associated audio information, Part 1: Systems                            |
| ISO/IEC 14496-10:2009 | Information Technology - Coding of audio-visual objects Part 10: Advanced video coding                                                  |
| ISO/IEC 15444-1:2004  | Information Technology - JPEG 2000 image coding system: Core coding system                                                              |
| ITU-T Rec. H.264      | Advanced Video Coding for Generic Audio Visual Services 2009-03. (ISO/IEC 14496-10:2009)                                                |
| RFC 768               | User Datagram Protocol, 1980-08                                                                                                         |
| RFC 791               | Internet Protocol, 1981-09 ( <i>Updated by RFC 1349</i> )                                                                               |
| RFC 792               | Internet Control Message Protocol (ICMP)                                                                                                |
| RFC 959               | File Transfer Protocol (FTP)                                                                                                            |
| RFC 2460              | Internet Protocol v6 (IPv6), 1998-12 ( <i>updated by RFC 5095, RFC 5722, RFC 5871, RFC 6437</i> )                                       |
| RFC 2818              | HTTP Over Transport Layer Security (TLS)                                                                                                |
| RFC 3376              | Internet Group Management Protocol (IGMP), Version 3                                                                                    |
| RFC 4251              | The Secure Shell (SSH) Protocol Architecture                                                                                            |

|                      |                                                                                                                                           |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| SMPTE RP 214:2002    | Packing KLV Encoded Metadata and Data Essence into SMPTE 291 Ancillary Data Packets (Archived 2007). <sup>2</sup>                         |
| SMPTE ST 12-1:2008   | Television - Time and Control Code                                                                                                        |
| SMPTE ST 12-2:2008   | Television - Transmission of Time Code in the Ancillary Data Space                                                                        |
| SMPTE ST 125:1995    | Television - Component Video Signal 4:2:2 - Bit-Parallel Digital Interface                                                                |
| SMPTE ST 259:2008    | Television - SDTV Digital Signal/Data - Serial Digital Interface                                                                          |
| SMPTE ST 274:2008    | Television - 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates |
| SMPTE ST 291:1998    | SMPTE 291-1998: Ancillary Data Packet and Space Formatting                                                                                |
| SMPTE ST 292-0:2011  | SMPTE Bit-Serial Interfaces at 1.5 Gb/s - Roadmap for the 292 Document Suite                                                              |
| SMPTE ST 292-1:2011  | 1.5 Gb/s Signal/Data Serial Interface                                                                                                     |
| SMPTE ST 293:2003    | Television - 720 x 483 Active Line at 59.94-Hz Progressive Scan Production - Digital Representation                                       |
| SMPTE ST 296:2010    | Television - 1280 x 720 Progressive Image Sample Structure - Analog and Digital Representation and Analog Interface                       |
| SMPTE ST 297:2006    | Television - Serial Digital Fiber Transmission System for SMPTE 259,SMPTE 344,SMPTE 292 and SMPTE 424Signals                              |
| SMPTE ST 349:2001    | Television - Transport of Alternate Source Image Formats through SMPTE 292 (Archived 2006)                                                |
| SMPTE ST 424:2006    | Television - 3 Gb/s-Signal/Data Serial Interface                                                                                          |
| SMPTE ST 425-0:2011  | SMPTE Bit-Serial Interfaces at 3 Gb/s - Roadmap for the 425 Document                                                                      |
| SMPTE ST 425-1:2011  | Source Image Format and Ancillary Data Mapping for the 3 Gb/s Serial Interface                                                            |
| SMPTE ST 435-1:2009  | 10 Gb/s Serial Signal/Data Interface - Part 1: Basic Stream Distribution                                                                  |
| SMPTE ST 435-2:2009  | 10 Gb/s Serial Signal/Data Interface - Part 2: 10.692 Gb/s Stream - Basic Stream Data Mapping                                             |
| SMPTE ST 435-3:2009  | 10 Gb/s Serial Signal/Data Interface - Part 3: 10.692 Gb/s Optical Fiber Interface                                                        |
| SMPTE ST 2048-0:2011 | SMPTE ROADMAP 2048 x 1080 and 4096 x 2160 Digital Cinematography Production Image Formats FS/709 - Roadmap for the 2048 Document Suite    |
| SMPTE ST 2048-1:2011 | 2048 x 1080 and 4096 x 2160 Digital Cinematography Production Image Formats FS/709                                                        |
| SMPTE ST 2048-2:2011 | 2048 x 1080 Digital Cinematography Production Image FS/709 Formatting for Serial Digital Interface                                        |
| WGS84                | World Geodetic System 1984                                                                                                                |

<sup>2</sup> <http://store.smpte.org/product-p/rp%200214-2002.htm>

## 2.2 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 2.3 Definitions

**COMMAND, STATUS, AND RESPONSE INTERFACE:** Defines the data elements and message sets passed between the host platform and the sensor used to control the operation of the sensor. This interface may also be used to check sensor operation. The protocol for passing these messages is handled in co-ordination with the AS6129. AS6129 also covers the requirements for conductors/fiber optics. The following types of information are passed through the Command, Status, and Response Interface:

- a. **COMMANDS:** The set of all digital instructions transmitted to the EO/IR sensor from the controller which directs its operation. These instructions come from an operator, from the aircraft, or from a pre-programmed set of instructions. These commands, for example, instruct the EO/IR sensor where to point, and which features to utilize in gathering images, such as: slew left; turn on stabilization; lock onto a geo-location; change magnification to X; display black as hot versus white hot; turn on image fusion; etc.
- b. **STATUS:** Digital information returned from the EO/IR sensor back to the operator, aircraft, or recorder which provides feedback on sensor operation and other indications of its condition. Examples of this information include: magnification level, azimuth and elevation, stabilization setting, output scale setting for thermal sensors, heading, etc. Another example is the Built-In Test (BIT) information which might occur periodically, in response to a command, or only if a fault or warning is detected. Status information can overlap with metadata. Status can include non-embedded Imagery metadata, Geospatial Position and Time, Hand Controller, and/or Maintenance data
- c. **RESPONSES:** Digital information returned from the EO/IR sensor back to the operator, aircraft, in reply or reaction to a command. Responses are a sub-set of Status. For example, if the command is to turn on stabilization, the response could be "stabilization is on".

**COMMONALITY:** A shared feature or attribute. Or a shared set of features or attributes.<sup>3</sup>

**ELECTRONICS CONTROL UNIT (ECU):** An electronic unit logically between the platform and the sensor, typically inside the aircraft, which is part of the sensor system, but external to the turret.

**ELECTRO-OPTIC/INFRARED (EO/IR) SENSOR:** A sensor which generates images based on a specific region of the electromagnetic spectrum (UV, Visible, Near-Infrared (NIR), Short Wave Infrared (SWIR), Mid-Wave Infrared (MWIR) and/or Long Wave Infrared (LWIR). It can be either the imager itself (e.g., a night vision camera) or a turret (gimbal) or pod which includes the imager. The turret or pod may also contain lasers operating in the EO/IR spectrum

**EO/IR SENSOR POD:** An aerodynamically shaped fixed housing containing an EO/IR Sensor external to the aircraft, typically mounted on a pylon.

**EO/IR SENSOR TURRET:** A motorized gimballed mount for one or more EO/IR Sensors permitting rotation about one or more axes. This rotation allows the sensors to be pointed relatively independent of the platform on which it is mounted.

**FRAME:** A single image from a sensor.

<sup>3</sup> Derived from definition in: the American Heritage® Dictionary of the English Language, Fourth Edition copyright ©2000 by Houghton Mifflin Company, updated in 2009. Published by Houghton Mifflin Company. All rights reserved.

**GEOSPATIAL POSITION DATA:** Data in reference to translational and rotational position, velocity, and acceleration, etc. of the aircraft and current time. Characteristics of the data include (1) Minimum rate data to be provided, (2) Data latency, (3) Maximum time stamp error (if data latency cannot be met), (4) Data format to be reported in WGS 84 Height Above Ellipsoid (HAE).

**IMAGE:**

1. A visible impression obtained by a camera, telescope, microscope, or other device, or displayed on a computer or video screen.<sup>4</sup>
2. An optical counterpart or appearance of an object, as is produced by reflection from a mirror, refraction by a lens, or the passage of luminous rays through a small aperture and their reception on a surface.<sup>5</sup>

**IMAGE COMPRESSION:** Compression is the encoding of information while reducing the bandwidth or bits required. Image Compression is the compression of an image for storage or transmission.<sup>6</sup>

- a. **TRUE LOSSLESS IMAGE COMPRESSION:** A form of image compression where the decompressed image is numerically identical to the source image.
- b. **VISUALLY LOSSLESS IMAGE COMPRESSION:** A form of image compression where there is no subjective loss of image quality.
- c. **LOSSY IMAGE COMPRESSION:** A form of image compression wherein there may be loss in subjective image fidelity.

**IMAGE FORMAT:** The horizontal and vertical pixel densities and the temporal update rate. May also denote how an image or image sequence is packaged, stored and transported. This includes compression methods such as H.264, formats such as NITF, and interface standards such as SMPTE ST 292-1.

**INTERCHANGEABILITY:** A condition which exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability, and are capable of being exchanged one for the other without alteration of the items themselves, or of adjoining items, except for adjustment, and without selection for fit and performance<sup>7</sup>.

**INTEROPERABILITY:** The ability of two or more systems or components to exchange information and to use the information that has been exchanged.<sup>8</sup>

**METADATA:** Data about the Imagery. Examples include:

- a. The time the image was generated.
- b. The location of and information about the platform, e.g., latitude, longitude, altitude, pitch, roll, and heading of the platform.

<sup>4</sup> (<http://oxforddictionaries.com/definition/image?q=image>) visited 4/10/2012

<sup>5</sup> <http://dictionary.reference.com/browse/image> visited 4/1/2011

<sup>6</sup> <http://www.thefreedictionary.com/image+compression>

<sup>7</sup> Federal Standard 1037C, Telecommunications: Glossary of Telecommunication Terms. <http://www.its.bldrdoc.gov/fs-1037/fs-1037c.htm> Visited on March 22, 2011.

<sup>8</sup> IEEE Glossary

- c. Information about the sensor, e.g., azimuth and elevation of the gimbal, the zoom level.
- d. Information about the target at the time the image(s) were taken, e.g., latitude and longitude.

Metadata can be incorporated into the image file and/or be sent in parallel.

**MOTION IMAGERY:** A sequential or continuous stream of images, utilizing MISB formats, that enable observation of the dynamic behavior of objects within the scene.

**STILL IMAGERY:** One or more individual images that use the NITF format.

**TRANSPORT:** A mechanism to move, carry, convey or transfer data and/or electrical/optical signals from one place to another

**VIDEO:** A type of Motion Imagery, typically at frame rates used in television broadcasting. The word “video” has also been used to include non-television formats such as those found in the consumer internet community.

## 2.4 Acronyms

Table 1 shows the list of Acronyms.

TABLE 1 - ACRONYMS

| Acronym   | Description                                               |
|-----------|-----------------------------------------------------------|
| 1000BaseT | 1000 Megabits per Second, Baseband, Twisted Pair          |
| aka       | Also Known As                                             |
| ANSI      | American National Standards Institute                     |
| AS        | Aerospace Standard (e.g., SAE AS6135)                     |
| AS-1      | Aircraft Systems & Systems Integration group (SAE)        |
| AVC       | Advanced Video Coding                                     |
| BIT       | Built-In-Test                                             |
| C&S       | Command and Status                                        |
| CSR       | Command, Status, and Response                             |
| CSRM      | Command, Status, and Response Message                     |
| DISR      | DoD Information Technology Standards and Profile Registry |
| DHCP      | Dynamic Host Configuration Protocol                       |
| DLI       | Data Link Interface                                       |
| ECU       | Electronics Control Unit                                  |
| ECUSI     | Electronics Control Unit – Sensor Interface               |
| EG        | Engineering Guidance                                      |
| EIA       | Electronic Industry Association                           |
| EO/IR     | Electro-Optic Infrared                                    |
| FPS       | Frames Per Second                                         |
| FTP       | File Transfer Protocol                                    |
| Gb/s      | Gigabits per second                                       |
| GEOINT    | Geospatial Intelligence                                   |
| GIG       | Global Information Grid                                   |

TABLE 1 - ACRONYMS (CONTINUED)

| Acronym | Description                                                     |
|---------|-----------------------------------------------------------------|
| GPS     | Global Positioning System                                       |
| GWG     | Geospatial Intelligence Working Group (NGA)                     |
| HAE     | Height Above Ellipsoid                                          |
| HTTP    | Hypertext Transfer Protocol (world wide web protocol)           |
| HTTPS   | Hypertext Transfer Protocol Secure                              |
| IAW     | In Accordance With                                              |
| ICD     | Interface Control Document                                      |
| ICMP    | Internet Control Message Protocol                               |
| IEC     | International Electro-Technical Commission                      |
| IEEE    | Institute of Electronics and Electrical Engineers               |
| IETF    | Internet Engineering Task Force                                 |
| IGMP    | Internet Group Management Protocol                              |
| IP      | Internet Protocol                                               |
| IPv4    | Internet Protocol version 4                                     |
| IPv6    | Internet Protocol version 6                                     |
| IR      | Infrared                                                        |
| ISO     | International Organization for Standardization                  |
| ISR     | Intelligence Surveillance Reconnaissance                        |
| ISR TF  | Intelligence Surveillance Reconnaissance Task Force             |
| ITU-T   | International Telecommunications Union's Standardization Sector |
| JPEG    | Joint Photographic Experts Group                                |
| KLV     | Key, Length, Value                                              |
| LWIR    | Long Wave Infrared                                              |
| MAC     | Media Access Control                                            |
| Mbps    | Mega-bits per second                                            |
| MIL     | Military                                                        |
| MISB    | Motion Imagery Standards Board (NGA GWG)                        |
| MISP    | Motion Imagery Standard Profile                                 |
| MPEG    | Moving Picture Experts Group                                    |
| MWIR    | Mid-Wave Infrared                                               |
| NATO    | North Atlantic Treaty Organization                              |
| NGA     | National Geospatial-Intelligence Agency                         |
| NIAT    | NGA Interoperability Action Team                                |
| NIOP    | Navy InterOperability Profile                                   |
| NIR     | Near-Infrared                                                   |
| NITF    | National Imagery Transmission Format                            |
| NITFS   | National Imagery Transmission Format Standard                   |