

UAS Datalink Local Metadata Set

1 Scope

This MISB Standard details the Unmanned Air System (UAS) Datalink Local Data Set (LDS) for UAS platforms. The UAS Datalink LDS is an extensible SMPTE (Society of Motion Picture Television Engineers) Key-Length-Value (KLV) Local Metadata Set designed for transmission through a wireless communications link (Datalink).

This Standard provides direction and requirements for the creation of a SMPTE 336m-2007 compliant Local Data Set for a reliable, bandwidth-efficient exchange of metadata among digital motion imagery systems within the DoD. This Standard also provides a mapping to Predator Exploitation Support Data (ESD) for continued support of existing metadata systems.

The UAS Local Data Set metadata is intended to be produced locally within a UAS airborne platform and included in an MPEG2 Transport Stream (or equivalent transport mechanism). The MPEG2 Transport Stream (or equivalent) also contains compressed motion imagery from sensors such as an Electro-Optical / Infrared (EO/IR) video capture device. Synchronization between the metadata and the appropriate video packet is highly desired and is the responsibility of the system designer. The MPEG2 Transport Stream (or equivalent) embedded with UAS LDS metadata is then transmitted over a medium bandwidth (e.g. 1 to 5Mb/s) wireless Datalink and then disseminated.

The scope of this document is to provide a framework for an extensible bandwidth efficient Local Data Set which enhances sensor captured imagery with relevant metadata. This Standard also provides a mapping between UAS Datalink Local Data Set items, ESD items, and Universal Data Set (UDS) items defined in the latest SMPTE KLV dictionary (RP-210) as well as in the MISB-managed Department of Defense (DoD) keyspace.

2 References

- 2.1 SMPTE ST 336:2007, Data Encoding Protocol Using Key-Length-Value
- 2.2 SMPTE RP 210v13:2012, Metadata Element Dictionary
- 2.3 MISB ST 0102.10, Security Metadata Universal and Local Sets for Digital Motion Imagery, Oct 2013
- 2.4 MISB EG 0104.5, Predator UAV Basic Universal Metadata Set, Dec 2006
- 2.5 MISB ST 0107.1, Bit and Byte Order for Metadata in Motion Imagery Files and Streams, Jun 2011
- 2.6 MISB RP 0701, Common Metadata System: Structure, Aug 2007
- 2.7 MISB EG 0806.3, Remote Video Terminal Local Data Set, Sep, 2009
- 2.8 MISB STD 0902.2, MISB Minimum Metadata Set, Oct 2013
- 2.9 MISB EG 0903, Video Moving Target Indicator Local Data Set
3 September, 2009
- 2.10 MIL-STD-2500C V2.1, National Imagery Transmission format Standard, May 2006
- 2.11 ASI-00209 Rev D, Exploitation Support Data (ESD) External Interface Control Document, 04 Dec, 2002
- 2.12 ISO 1000:1992(E), SI units and recommendations for the use of their multiples and of certain other units, 11 January, 1992 (This doc has been withdrawn by ISO 2009-11-17)
- 2.13 IEEE 1003.1-2013, Information Technology – Portable Operating System Interface (POSIX) Base Specifications, Issue 7
- 2.14 ISO/IEC 646:1991, Information Technology – ISO 7-bit coded Character Set for Information Interchange, 1991

3 Current Modifications and Changes

ST 0601.6 – UAS Datalink Local Data Set. October 24th, 2013

- Updated References
- Removed legacy change log retaining the current change record
- Changed STD to ST where applicable throughout
- Added Tag 94 – MIIS Core Identifier
- Addressed spelling errors throughout tables
- Clarified description of Platform Roll angle throughout
- Deprecated requirement REQ-2.08 (ST 0601 decoders shall accept Universal Keys with any version number represented within byte 8.) as this is difficult to enforce from a compliance perspective, and is in with another requirement specifying the exact 16-byte KLV key to use (REQ-1.02).
- Deprecated Section 5.1.1 as it related to REQ-2.08.
- Added requirement REQ-4.04 for systems to use the full-range metadata representations over range-limited encodings when both types are included within the same metadata packet.

4 Introduction

A SMPTE 336M Universal Data Set (UDS) provides access to a range of KLV formatted metadata items. Transmitting the 16-byte key, basic encoding rules (BER) formatted length, and data value is appropriate for applications where bandwidth isn't a concern. However, transmitting the 16-byte universal key quickly uses up the available bandwidth in bandwidth-challenged environments.

The Motion Imagery Standards Board (MISB) Engineering Guideline MISB EG 0104.5 entitled "Predator UAV Basic Universal Metadata Set" shows a translation between basic ESD and Universal Data Set (UDS) metadata items that exist in the most current version of the SMPTE KLV dictionary. The UDS items in the MISB EG 0104.5 document are more appropriate for higher bandwidth interfaces (e.g. > 10Mb/s) like for dissemination, whereas this document targets low to medium bandwidth interfaces (e.g. 1 to 5Mb/s).

UAS airborne platforms typically use a wireless communications channel that allots a limited amount of bandwidth for metadata. Because of the bandwidth disadvantages of using a Universal Data Set, it is more desirable to use a Local Data Set for transmission over a UAS Datalink. As discussed in SMPTE 336M, a Local Data Set can use a 1, 2 or 4-byte key with a 1, 2, 4-byte, or BER encoded length. This UAS Local Data Set uses BER encoded lengths and BER-OID encoded tags to minimize bandwidth requirements while still allowing the LDS ample room for growth.

This Standard identifies a way to encode metadata locally in the airborne platform into a standard KLV Local Data Set. This standardized method is intended to be extensible to include future relevant metadata with mappings between new LDS, UDS, and ESD metadata items (where appropriate). When a new metadata LDS item is added or required, action shall be taken to add an equivalent (i.e. identical in data format) Universal Data Set metadata item to the proper metadata dictionary (public or private) if the UDS metadata item does not already exist.

This method also provides a mapping between Local Data Set items and currently implemented Universal Data Set items defined in the SMPTE KLV dictionary (RP-210).

4.1 *Local Data Set Changes and Updates*

This document defines the UAS Datalink Local Metadata Set and is under configuration management. Any changes to this document shall be accompanied by a document revision and date change and coordinated with the managing organization.

Software applications that implement this interface shall allow for metadata items in the UAS Local Data Set that are unknown so that they are forward compatible with future versions of the interface.

5 UAS Datalink Local Data Set

This section defines the requirements for the UAS Datalink Local Data Set (LDS). These requirements are outlined here and used as references from within this text.

1. Overhead

REQ-1.01 Synchronization or time-alignment of a video frame with metadata is highly desired and is the responsibility of the system designer.

REQ-1.02 The 16-byte Universal Key for this UAS Local Data Set shall be:
 06 0E 2B 34 - 02 0B 01 01 - 0E 01 03 01 - 01 00 00 00

REQ-1.03 Historical 16-byte Universal Keys provided in Section 5.1 shall not be used in future developments.

2. KLV Rules

REQ-2.01 Formatting of ST 0601 metadata shall be compliant with SMPTE 336M-2007.

REQ-2.02 Implementations of this Standard shall parse unknown but properly formatted metadata UAS Local Data Set packets so as to not impact the reading of known tags within the same instance.

REQ-2.03 Metadata within this Standard shall be represented Most Significant Byte (MSB) first (Big-Endian).

REQ-2.04 Bytes within this Standard shall be represented Most Significant Bit (msb) first (Big-Endian byte encoding).

REQ-2.05 All instances of item tags within a UAS LDS packet shall be BER-OID encoded using the fewest possible bytes in accordance with SMPTE 336M-2007.

REQ-2.06 All instances of item length fields within a UAS LDS packet shall be BER Short, or BER Long encoded using the fewest possible bytes in accordance with SMPTE 336M-2007.

REQ-2.07 All instances of the UAS LDS where the computed checksum is not identical to the included checksum shall be discarded.

REQ-2.08 Depreciated in ST 0601.6.

3. Mandatory LDS items

REQ-3.01 All instances of the UAS LDS shall contain as their first element Tag 2, UNIX Time Stamp – Microseconds.

REQ-3.02 The value assigned to the UNIX Time Stamp - Microseconds item (Tag 2) shall represent the time of birth of the metadata of all the elements contained in that instance of the UAS LDS.

REQ-3.03 All instances of the UAS LDS shall contain as the final element Tag 1 (Checksum).

REQ-3.04 All instances of the UAS LDS shall contain Tag 65, UAS LDS Version number, within the ST 0601 metadata packet.

4. Metadata Requirements

- REQ-4.01 Excepting the requirements for Tag 2 beginning and Tag 1 ending any instance of the UAS LDS, an instance of the UAS LDS containing any number of properly formatted, unique tags in any order shall be valid.
- REQ-4.02 The usage of all tags within the UAS LDS shall be consistent with the descriptions and clarifications contained within Section 6 of this document.
- REQ-4.03 UAS LDS elements having incomplete descriptions (i.e.: “TBD”) shall be considered informative rather than normative.
- REQ-4.04 UAS LDS decoder systems which understand the full-range representation of certain metadata items shall use the full-range representation and ignore the range-restricted representation when both exist in the same UAS LDS packet.

5.1 LDS Universal Keys

The 16-byte Universal Key for this UAS Datalink Local Data Set is listed below:

Key: 06 0E 2B 34 - 02 0B 01 01 - 0E 01 03 01 - 01 00 00 00

Date Released: May 2006

Description: Released key defined in the MISB DoD Keyspace for the UAS LDS. Conforms to REQ-1.02.

A key history is provided below as a way to track the keys used in engineering and development. Note that the keys listed below are informative only. DO NOT use the below keys in any future development in conformance with REQ-1.03.

Key: 06 0E 2B 34 - 01 01 01 01 - 0F 00 00 00 - 00 00 00 00

Date Released: November 2005

Description: Experimental node key used in software development efforts at General Atomics prior to the assignment of a defined key.

Key: 06 0E 2B 34 - 02 03 01 01 - 01 79 01 01 - 01 xx xx xx

Date Released: October 25, 2005

Description: This key was released as a placeholder within early versions this document. Much development has been based around draft versions of this document which has used this key in some software implementations.

5.1.1 SMPTE Universal Key Version Number

Deprecated in ST 0601.6.

5.2 LDS Packet Structure

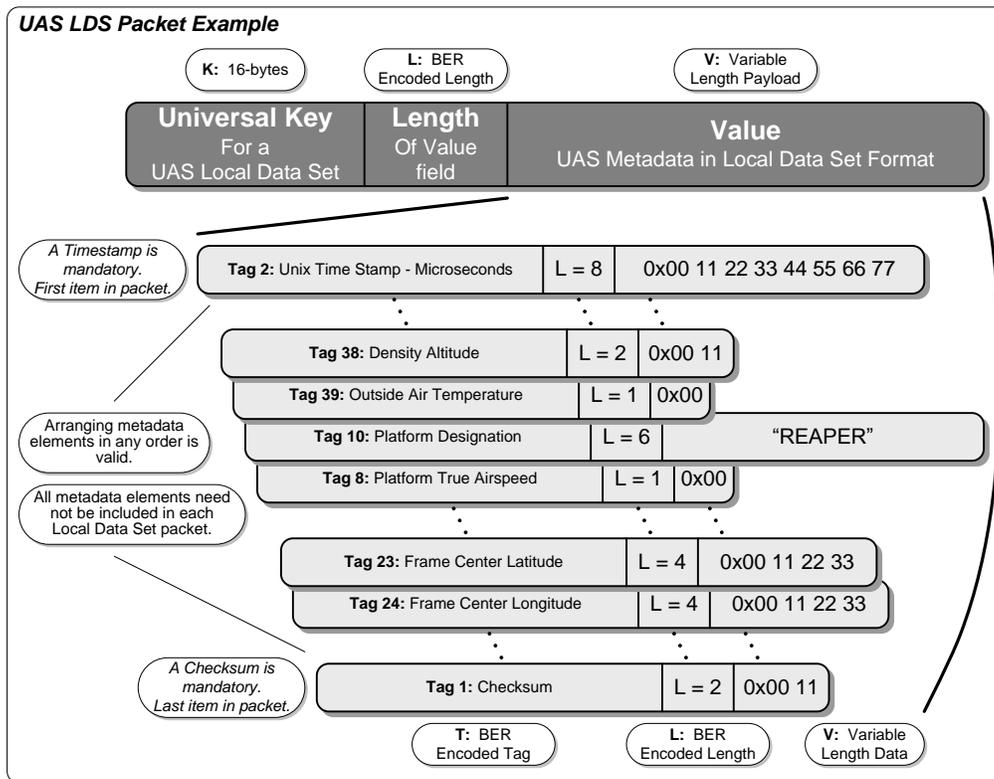


Figure 5-1: Example of a UAV Local Data Set Packet

Figure 5-1 shows the general format of how the LDS is configured. It is required that each LDS packet contain a Unix-based Coordinated Universal Time (UTC) timestamp that represents the time of birth of the metadata within the LDS packet to conform with REQ-3.01 and REQ-3.02. Time stamping of metadata is discussed in section 5.4. A checksum metadata item is also required to be included in each LDS packet to conform with REQ-3.03. Checksums are discussed in section 5.5.

Any combination of metadata items can be included in a UAS Local Data Set packet. Also the items within the UAV LDS can be arranged in any order. However the timestamp is always positioned at the beginning of an LDS packet and similarly the checksum always appears as the last metadata item due to algorithms surrounding its computation and creation [REQ-4.01].

5.2.1 Bit and Byte ordering

All metadata is represented using big-endian (Most Significant Byte (MSB) first) encoding [REQ-2.03]. Bytes are big-endian bit encoding (most significant bit (msb) first) [REQ-2.04].

5.2.2 Tag and Length Field Encoding

The UAS LDS metadata item tag and length fields are encoded using basic encoding rules (BER) for either short or long form encoding of octets [REQ-2.05, REQ-2.06]. This length encoding method provides the greatest level of flexibility for variable length data contained within a KLV packet.

See SMPTE 336M section 3.2 for further details.

5.2.2.1 BER Short Form Length Encoding Example

For UAS LDS packets and data elements shorter than 128 bytes, the length field is encoded using the BER short form. Length fields using the short form are represented

using a single byte (8 bits). The most significant bit in this byte signals that the long form is being used. The last seven bits depict the number of bytes that follow the BER encoded length. An example LDS packet using a short form encoded length is shown below:

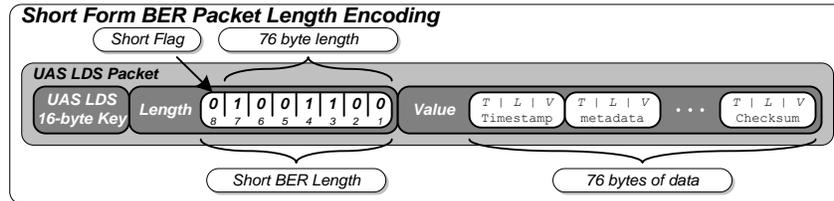


Figure 5-2: Example Short Form Length Encoding

Although this example depicts the length field of the entire LDS packet, short form BER encoding also applies to the individual item lengths within the LDS packet.

5.2.2.2 BER Long Form Length Encoding

For LDS packets and data elements longer than 127 bytes, the length field is encoded using the BER long form. The long form encodes length fields using multiple bytes. The first byte indicates long form encoding as well as the number of subsequent bytes that represent the length. The bytes that follow the leading byte are the encoding of an unsigned binary integer equal to the number of bytes in the packet. An example LDS packet using a long form encoded length is shown below:

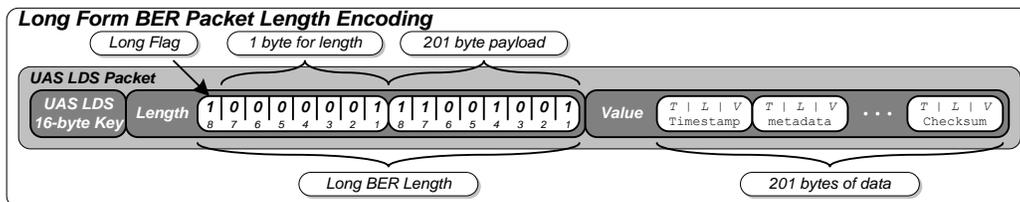


Figure 5-3: Example Long Form Length Encoding

Although this example depicts long form BER encoding on the length field of the entire LDS packet, long form BER encoding also applies to the individual item lengths within the LDS packet.

5.2.2.3 BER-OID Encoding for Tags

Also known as “primitive BER”, or “ASN.1 OID BER”, BER-OID encoding of tags differs from short and long form BER encoding used for KLV lengths as described in Sections 5.2.2.1 and 5.2.2.2.

Local KLV sets employing the use of BER-OID encoded tags can represent an almost limitless number of metadata items. BER-OID binary encoding allows the size of a tag space to increase through the inclusion of additional bytes when the tag number passes certain thresholds.

For instance, one BER-OID byte (or octet) can represent up to 127 different metadata items. Two bytes can represent 16,383 items. Generalizing for any number of bytes “N” used as a BER-OID tag, the number of tags that can be represented is $2^{7 \cdot N} - 1$.

When using BER-OID encoding for tags, each tag is represented as a series of one or more bytes. Bit 8 (msb) of each byte indicates whether it is the last in the series: bit 8 of the last byte (LSB) is zero, while bit 8 of each preceding byte (MSB’s) is one. Bits 7 to 1 of the bytes in the series collectively encode the metadata tag.

Conceptually, these groups of bits are concatenated to form an unsigned binary number whose most significant bit is bit 7 of the first byte, and whose least significant bit is bit 1 of the last octet.

As per REQ-2.05, the BER-OID encoded tag must use the fewest bytes possible. Equivalently, the leading byte(s) of the BER-OID tag must not have the value of 0x80.

BER-OID encoding examples for one, two, and three-byte encodings are shown as follows.

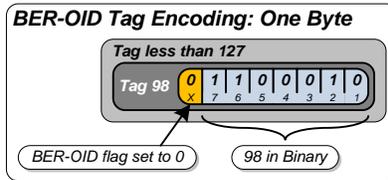


Figure 5-4: BER-OID Tag Encoding Using One Byte

Note that only 127 different tags are encoded using a single byte. Decoding is the reverse of encoding. This is the only tag encoding currently encountered in the UAS LDS.

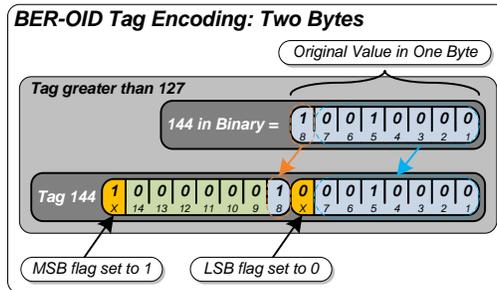


Figure 5-5: BER-OID Tag Encoding Using Two Bytes

Note that logical tags 128 through 16,383 are encoded using two bytes. Decoding is the reverse of encoding.

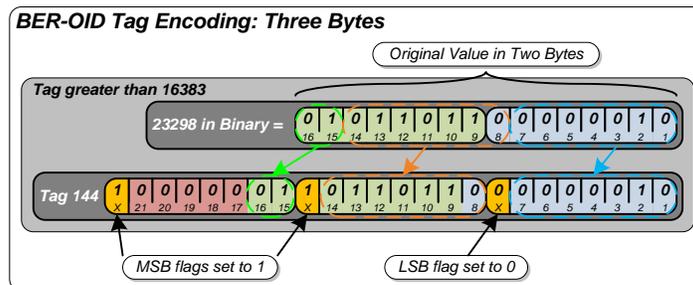


Figure 5-6: BER-OID Tag Encoding Using Three Bytes

Note that logical tags 16,384 through 2,097,151 are encoded using three bytes. Decoding is the reverse of encoding.

Although not currently in use, it is envisioned that a maximum of 2-bytes will be used to encode BER-OID tags within the UAS LDS in future revisions.

5.2.3 Nesting Local Sets within the UAS LDS

To provide a method to re-use commonly used metadata fields from the UAS LDS (platform location, and sensor pointing angles) while providing greater flexibility to system implementers, other Local Data Sets (with tag defined in the UAS LDS) may be nested within the UAS LDS.

A nested Local Data Set is treated the same as any other standalone metadata item defined within the UAS LDS where the tag is defined by this document, and the length field is determined by the size of the value portion. The nested set, however, typically has an increased length compared to other UAS LDS items, and the value portion conforms to the defining Local Data Set document.

An illustrative example packet showing the RVT LDS (EG 0806) nested within the UAS LDS is shown below:

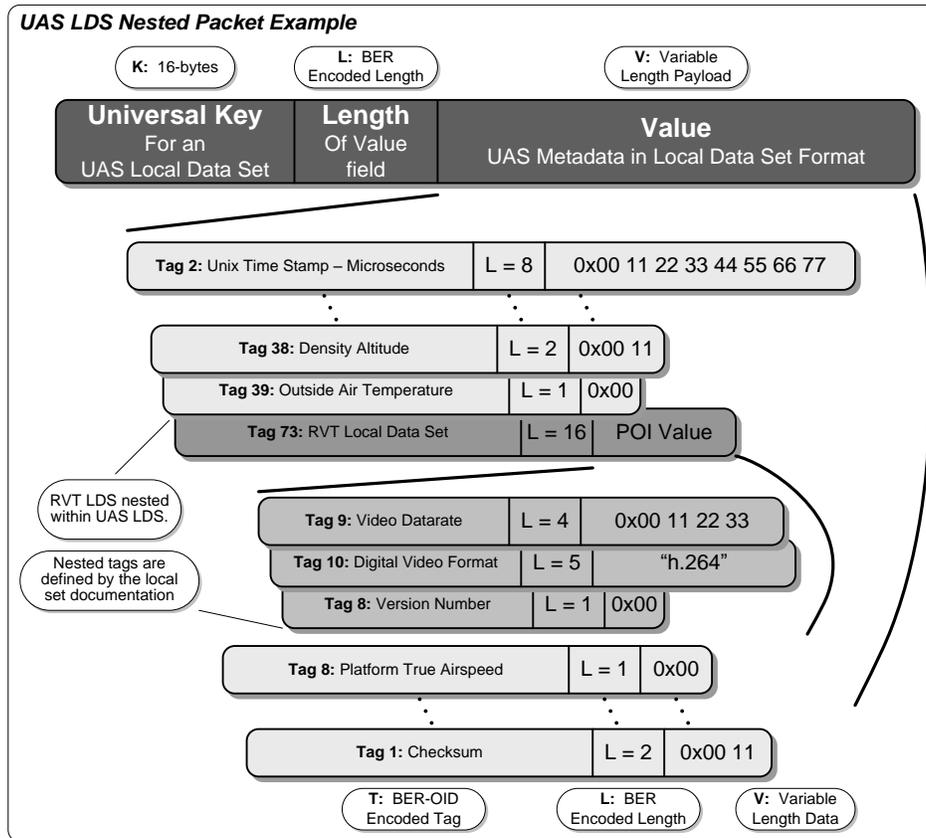


Figure 5-7 : Nested Packet Example

5.3 Data Collection and Dissemination

Within the air vehicle, metadata is collected, processed, and then distributed by the flight computer (or equivalent) through the most appropriate interface (SMPTE Serial Digital Interface (SDI), RS-422, 1553, Ethernet, Firewire, etc.). See the figure below:

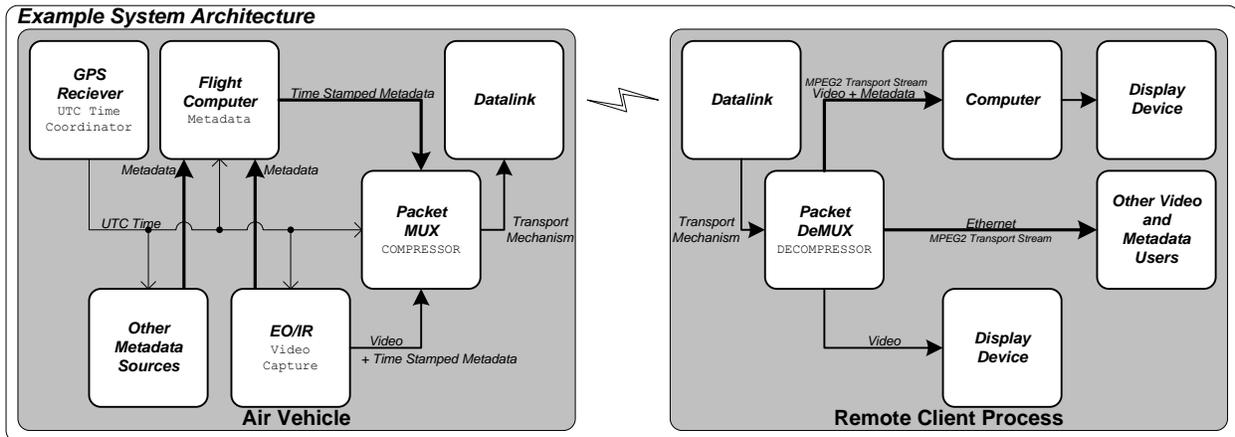


Figure 5-8: System Architecture

Sensors and other metadata sources pass metadata to the flight computer.

The flight computer (or equivalent) places a timestamp in the UAS LDS packet prior to passing it to the Video Encoder / Packet Multiplexer. See section 5.4 for more information about using timestamps in the LDS metadata packet.

The flight computer merges all appropriate metadata items and a timestamp into a LDS packet and transmits it with a checksum to the video encoder Packet Multiplexer. The encoder adds the metadata to a transport stream mechanism which is passed through a communications link to a remote client process that can decode and process the video and metadata contained within the transport stream. Users can then display and/or distribute the video and metadata as appropriate.

5.4 Time Stamping

Every LDS KLV packet is required to include a Unix-based UTC timestamp as a way to correspond the metadata with a standardized time reference. UTC time is useful to associate metadata with frames, and for reviewing time-critical events at a later date. This section describes how to include the mandatory timestamp within a UAS Local Data Set packet [REQ-3.01].

Metadata sources and the flight computer (or equivalent) are coordinated to operate on the same standard time, which is typically GPS derived. The metadata source provides a timestamp for inclusion in a LDS packet and the timestamp assists the accuracy of synchronizing each frame to its corresponding metadata set.

The timestamp (tag 2) is an 8 byte unsigned integer that represents the number of microseconds that have elapsed since midnight (00:00:00), January 1, 1970. This date is known as the Unix epoch and is discussed in the IEEE POSIX standard IEEE 1003.1.

When receiving packets of ST 0601 metadata, the time value represents the time of birth of all metadata items contained within the UAS LDS packet in accordance with [REQ-3.02]. When generating UAS LDS metadata packets, the most current metadata samples since the last metadata packet (with timestamp) are intended to be used and assigned the current time.

Generation of metadata packets introduces a situation where the time of birth timestamp may not directly correspond to when the metadata value was actually sampled. In this case, the maximum timestamp error encountered is the difference in time between the current metadata packet, and the packet which immediately precedes it.

Systems producing or accepting ST 0601 metadata streams are allowed to adjust metadata repetition rates to meet timestamp precision needs.

5.4.1 Packet Timestamp

An LDS Packet Timestamp is inserted at the beginning of the value portion of a UAS LDS packet.

The UTC timestamp represented by Tag 2 (UNIX Timestamp) applies to all metadata in the LDS packet. This timestamp corresponds to the time of birth of all the data within the LDS packet. This time can be used to associate the metadata with a particular video frame and be displayed or monitored appropriately.

An example LDS packet containing a timestamp is show below:

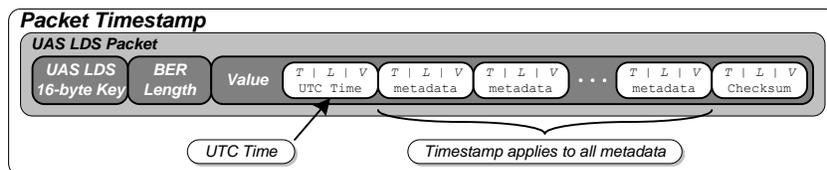


Figure 5-9: Packet Timestamp Example

5.5 Error Detection

To help prevent erroneous metadata from being presented with video, it is required that a 16-bit checksum is included in every UAS Local Data Set packet as the last item [REQ-3.03]. The checksum is a running 16-bit sum through the entire LDS packet starting with the 16 byte Local Data Set key and ending with summing the length field of the checksum data item.

The figure below shows the data range that the checksum is performed over:

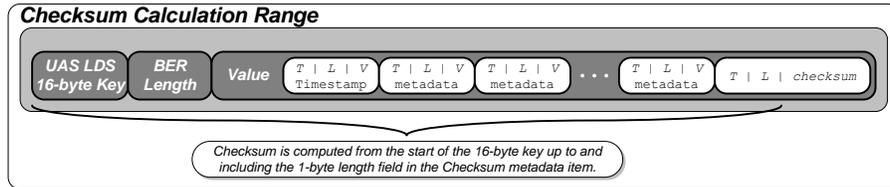


Figure 5-10: Checksum Computation Range

An example algorithm for calculating the checksum is shown below:

```

unsigned short bcc_16 (
    unsigned char * buff, // Pointer to the first byte in the 16-byte UAS LDS key.
    unsigned short len ) // Length from 16-byte UDS key up to 1-byte checksum length.
{
    // Initialize Checksum and counter variables.
    unsigned short bcc = 0, i;

    // Sum each 16-bit chunk within the buffer into a checksum
    for ( i = 0 ; i < len; i++)
        bcc += buff[i] << (8 * ((i + 1) % 2));
    return bcc;
} // end of bcc_16 ()

```

If the calculated checksum of the received LDS packet does not match the checksum stored in the packet, the user must discard this packet as being invalid [REQ-2.07]. The lost LDS packet is of little concern since another packet is available within reasonable proximity (in both data and time) to this lost packet.

6 UAS Local Data Set Tables

This section defines the content of the UAS Local Data Set as well as translation between LDS & ESD, and LDS and UDS data types.

For guidance on which items to include in ST 0601 packets, refer to ST 0902.1 (MISB Minimum Metadata Set) for a listing of a minimum set of UAS LDS metadata items.

6.1 UAS Local Data Set Items

Each UAS Local Data Set item is assigned an integer value for its tag, a descriptive name, and also has fields indicating the units, range, format, and length of the data item. More detailed information about the data item is included in the Notes column.

Notes:

- The columns labeled “Mapped UDS”, “Units”, “Format”, “Len” (for length) and “Notes” all apply to the Local Data Set ONLY and not ESD or UDS data types.
- “ESD Name” is the name assigned to an ESD metadata item labeled as a two-character digraph in the “ESD” column.
- An “x” within a field below indicates that no data is available.
- The “Mapped UDS” column is the Universal Data Set metadata key reserved to represent the length and data format specified by the referring LDS metadata item. The key is the only parameter which differs between UDS and tag of the LDS item. Note that LDS items which state “Use EG0104 UDS Key” may require conversion between LDS and UDS data types prior to representing an LDS item as a UDS item.
- The “UDS” column is an existing metadata key which the UAS LDS is mapped to in some applications (i.e.: EG0104). Note that the LDS and EG0104 data formats often differ between one another and a UDS key could not be used to represent the data in an LDS item without proper conversion first.

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Table 1: UAS Datalink Local Metadata Set data elements

TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
1	Checksum	06 0E 2B 34 01 01 01 01 0E 01 02 03 01 00 00 00	x	x	x	x	None	uint16	2	Checksum used to detect errors within a UAV Local Data Set packet. Lower 16-bits of summation. Performed on entire LDS packet, including 16-byte UDS key and 1-byte checksum length.
2	UNIX Time Stamp	Use EG0104 UDS Key	x	x	06 0E 2B 34 01 01 01 03 07 02 01 01 01 05 00 00	User Defined Time Stamp - microseconds since 1970	Microseconds	uint64	8	Coordinated Universal Time (UTC) represented in the number of microseconds elapsed since midnight (00:00:00), January 1, 1970. Derived from the POSIX IEEE 1003.1 standard. Resolution: 1 microsecond.
3	Mission ID	06 0E 2B 34 01 01 01 01 0E 01 04 01 03 00 00 00	Mn	Mission Number	06 0E 2B 34 01 01 01 01 01 05 05 00 00 00 00 00	Episode Number	String	ISO 646	V	Descriptive Mission Identifier to distinguish event or sortie. Value field is Free Text. Maximum 127 characters.
4	Platform Tail Number	06 0E 2B 34 01 01 01 01 0E 01 04 01 02 00 00 00	Pt	Platform Tail Number	x	x	String	ISO 646	V	Identifier of platform as posted. E.g.: "AF008", "BP101", etc. Value field is Free Text. Maximum 127 characters.
5	Platform Heading Angle	Use EG0104 UDS Key	Ih	UAV Heading (INS)	06 0E 2B 34 01 01 01 07 07 01 10 01 06 00 00 00	Platform Heading Angle	Degrees	uint16	2	Aircraft heading angle. Relative between longitudinal axis and True North measured in the horizontal plane. Map $0..(2^{16}-1)$ to $0..360$. Resolution: ~5.5 milli degrees.
6	Platform Pitch Angle	Use EG0104 UDS Key	Ip	UAV Pitch (INS)	06 0E 2B 34 01 01 01 07 07 01 10 01 05 00 00 00	Platform Pitch Angle	Degrees	int16	2	Aircraft pitch angle. Angle between longitudinal axis and horizontal plane. Positive angles above horizontal plane. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 20 . Use $-(2^{15})$ as "out of range" indicator. $-(2^{15}) = 0x8000$. Resolution: ~610 micro degrees.
7	Platform Roll Angle	Use EG0104 UDS Key	Ir	UAV Roll (INS)	06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00	Platform Roll Angle	Degrees	int16	2	Platform roll angle. Angle between transverse axis and transvers-longitudinal plane. Positive angles for lowered right wing. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 50 . Use $-(2^{15})$ as "out of range" indicator. $-(2^{15}) = 0x8000$. Res: ~1525 micro deg.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
8	Platform True Airspeed	06 0E 2B 34 01 01 01 01 0E 01 01 01 0A 00 00 00	As	True Airspeed	x	x	Meters/S econd	uint8	1	True airspeed (TAS) of platform. Indicated Airspeed adjusted for temperature and altitude. 0..255 meters/sec. 1 m/s = 1.94384449 knots. Resolution: 1 meter/second.
9	Platform Indicated Airspeed	06 0E 2B 34 01 01 01 01 0E 01 01 01 0B 00 00 00	Ai	Indicated Airspeed	x	x	Meters/S econd	uint8	1	Indicated airspeed (IAS) of platform. Derived from Pitot tube and static pressure sensors. 0..255 meters/sec. 1 m/s = 1.94384449 knots. Resolution: 1 meter/second.
10	Platform Designation	Use EG0104 UDS Key	Pc	Project ID Code	06 0E 2B 34 01 01 01 01 01 01 20 01 00 00 00 00	Device Designation	String	ISO 646	V	Use Platform Designation String e.g.: 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'IgnatER', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc. Value field is Free Text. Maximum 127 characters.
11	Image Source Sensor	Use EG0104 UDS Key	Sn	Sensor Name	06 0E 2B 34 01 01 01 01 04 20 01 02 01 01 00 00	Image Source Device	String	ISO 646	V	String of image source sensor. E.g.: 'EO Nose', 'EO Zoom (DLTV)', 'EO Spotter', 'IR Mitsubishi PtSi Model 500', 'IR InSb Amber Model TBT', 'LYNX SAR Imagery', 'TESAR Imagery', etc. Value field is Free Text. Maximum 127 characters.
12	Image Coordinate System	Use EG0104 UDS Key	Ic	Image Coordinate System	06 0E 2B 34 01 01 01 01 07 01 01 01 00 00 00 00	Image Coordinate System	String	ISO 646	V	String of the image coordinate system used. E.g.: 'Geodetic WGS84', 'Geocentric WGS84', 'UTM', 'None', etc.
13	Sensor Latitude	Use EG0104 UDS Key	Sa	Sensor Latitude	06 0E 2B 34 01 01 01 03 07 01 02 01 02 04 02 00	Device Latitude	Degrees	int32	4	Sensor Latitude. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 90 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~42 nano degrees.
14	Sensor Longitude	Use EG0104 UDS Key	So	Sensor Longitude	06 0E 2B 34 01 01 01 03 07 01 02 01 02 06 02 00	Device Longitude	Degrees	int32	4	Sensor Longitude. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 180 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~84 nano degrees.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
15	Sensor True Altitude	Use EG0104 UDS Key	Sl	Sensor Altitude	06 0E 2B 34 01 01 01 01 07 01 02 01 02 02 00 00	Device Altitude	Meters	uint16	2	Altitude of sensor as measured from Mean Sea Level (MSL). Map 0..(2 ¹⁶ -1) to -900..19000 meters. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.
16	Sensor Horizontal Field of View	Use EG0104 UDS Key	Fv	Field of View	06 0E 2B 34 01 01 01 02 04 20 02 01 01 08 00 00	Field of View (FOV-Horizontal)	Degrees	uint16	2	Horizontal field of view of selected imaging sensor. Map 0..(2 ¹⁶ -1) to 0..180. Resolution: ~2.7 milli degrees.
17	Sensor Vertical Field of View	06 0E 2B 34 01 01 01 07 04 20 02 01 01 0A 01 00	Vv	Vertical Field of View	x	x	Degrees	uint16	2	Vertical field of view of selected imaging sensor. Map 0..(2 ¹⁶ -1) to 0..180. Resolution: ~2.7 milli degrees. Requires data conversion between LDS value and SMPTE Mapped UDS Key.
18	Sensor Relative Azimuth Angle	06 0E 2B 34 01 01 01 01 0E 01 01 02 04 00 00 00	Az	Sensor Relative Azimuth Angle	x	x	Degrees	uint32	4	Relative rotation angle of sensor to platform longitudinal axis. Rotation angle between platform longitudinal axis and camera pointing direction as seen from above the platform. Map 0..(2 ³² -1) to 0..360. Resolution: ~84 nano degrees.
19	Sensor Relative Elevation Angle	06 0E 2B 34 01 01 01 01 0E 01 01 02 05 00 00 00	De	Sensor Relative Elevation Angle	x	x	Degrees	int32	4	Relative Elevation Angle of sensor to platform longitudinal-transverse plane. Negative angles down. Map -(2 ³¹ -1)..(2 ³¹ -1) to +/-180. Use -(2 ³¹) as an "error" indicator. -(2 ³¹) = 0x80000000. Res: ~84 ndeg.
20	Sensor Relative Roll Angle	06 0E 2B 34 01 01 01 01 0E 01 01 02 06 00 00 00	Ro	Sensor Relative Roll Angle	x	x	Degrees	uint32	4	Relative roll angle of sensor to aircraft platform. Twisting angle of camera about lens axis. Top of image is zero degrees. Positive angles are clockwise when looking from behind camera. Map 0..(2 ³² -1) to 0..360. Resolution: ~84 nano degrees.
21	Slant Range	Use EG0104 UDS Key	Sr	Slant Range	06 0E 2B 34 01 01 01 01 07 01 08 01 01 00 00 00	Slant Range	Meters	uint32	4	Slant range in meters. Distance to target. Map 0..(2 ³² -1) to 0..5000000 meters. 1 nautical mile (knot) = 1852 meters. Resolution: ~1.2 milli meters.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
22	Target Width	Use EG0104 UDS Key	Tw	Target Width	06 0E 2B 34 01 01 01 01 07 01 09 02 01 00 00 00	Target Width	Meters	uint16	2	Target Width within sensor field of view. Map 0..(2 ¹⁶ -1) to 0..10000 meters. 1 meter = 3.2808399 feet. Resolution: ~.16 meters.
23	Frame Center Latitude	Use EG0104 UDS Key	Ta	Target Latitude	06 0E 2B 34 01 01 01 01 07 01 02 01 03 02 00 00	Frame Center Latitude	Degrees	int32	4	Terrain Latitude of frame center. Based on WGS84 ellipsoid. Map -(2 ³¹ -1)..(2 ³¹ -1) to +/-90. Use -(2 ³¹) as an "error" indicator. -(2 ³¹) = 0x80000000. Resolution: ~42 nano degrees.
24	Frame Center Longitude	Use EG0104 UDS Key	To	Target Longitude	06 0E 2B 34 01 01 01 01 07 01 02 01 03 04 00 00	Frame Center Longitude	Degrees	int32	4	Terrain Longitude of frame center. Based on WGS84 ellipsoid. Map -(2 ³¹ -1)..(2 ³¹ -1) to +/-180. Use -(2 ³¹) as an "error" indicator. -(2 ³¹) = 0x80000000. Resolution: ~84 nano degrees.
25	Frame Center Elevation	06 0E 2B 34 01 01 01 0A 07 01 02 01 03 16 00 00	Te	Frame Center Elevation	x	x	Meters	uint16	2	Terrain elevation at frame center relative to Mean Sea Level (MSL). Map 0..(2 ¹⁶ -1) to -900..19000 meters. Resolution: ~0.3 meters.
26	Offset Corner Latitude Point 1	Use EG0104 UDS Key	Rg	SAR Latitude 4	06 0E 2B 34 01 01 01 03 07 01 02 01 03 07 01 00	Corner Latitude Point 1 (Decimal Degrees)	Degrees	int16	2	Frame Latitude, offset for upper left corner. Based on WGS84 ellipsoid. Use with Frame Center Latitude. Map -(2 ¹⁵ -1)..(2 ¹⁵ -1) to +/-0.075. Use -(2 ¹⁵) as an "error" indicator. -(2 ¹⁵) = 0x8000. Resolution: ~1.2micro deg, ~0.25meters at equator.
27	Offset Corner Longitude Point 1	Use EG0104 UDS Key	Rh	SAR Longitude 4	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0B 01 00	Corner Longitude Point 1 (Decimal Degrees)	Degrees	int16	2	Frame Longitude, offset for upper left corner. Based on WGS84 ellipsoid. Use with Frame Center Longitude. Map -(2 ¹⁵ -1)..(2 ¹⁵ -1) to +/-0.075. Use -(2 ¹⁵) as an "error" indicator. -(2 ¹⁵) = 0x8000. Resolution: ~1.2micro deg, ~0.25meters at equator.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
28	Offset Corner Latitude Point 2	Use EG0104 UDS Key	Ra	SAR Latitude 1	06 0E 2B 34 01 01 01 03 07 01 02 01 03 08 01 00	Corner Latitude Point 2 (Decimal Degrees)	Degrees	int16	2	Frame Latitude, offset for upper right corner. Based on WGS84 ellipsoid. Use with Frame Center Latitude. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 0.075 . Use $-(2^{15})$ as an "error" indicator. $-(2^{15}) = 0x8000$. Resolution: ~ 1.2 micro deg, ~ 0.25 meters at equator.
29	Offset Corner Longitude Point 2	Use EG0104 UDS Key	Rb	SAR Longitude 1	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0C 01 00	Corner Longitude Point 2 (Decimal Degrees)	Degrees	int16	2	Frame Longitude, offset for upper right corner. Based on WGS84 ellipsoid. Use with Frame Center Longitude. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 0.075 . Use $-(2^{15})$ as an "error" indicator. $-(2^{15}) = 0x8000$. Resolution: ~ 1.2 micro deg, ~ 0.25 meters at equator.
30	Offset Corner Latitude Point 3	Use EG0104 UDS Key	Rc	SAR Latitude 2	06 0E 2B 34 01 01 01 03 07 01 02 01 03 09 01 00	Corner Latitude Point 3 (Decimal Degrees)	Degrees	int16	2	Frame Latitude, offset for lower right corner. Based on WGS84 ellipsoid. Use with Frame Center Latitude. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 0.075 . Use $-(2^{15})$ as an "error" indicator. $-(2^{15}) = 0x8000$. Resolution: ~ 1.2 micro deg, ~ 0.25 meters at equator.
31	Offset Corner Longitude Point 3	Use EG0104 UDS Key	Rd	SAR Longitude 2	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0D 01 00	Corner Longitude Point 3 (Decimal Degrees)	Degrees	int16	2	Frame Longitude, offset for lower right corner. Based on WGS84 ellipsoid. Use with Frame Center Longitude. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 0.075 . Use $-(2^{15})$ as an "error" indicator. $-(2^{15}) = 0x8000$. Resolution: ~ 1.2 micro deg, ~ 0.25 meters at equator.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
32	Offset Corner Latitude Point 4	Use EG0104 UDS Key	Re	SAR Latitude 3	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0A 01 00	Corner Latitude Point 4 (Decimal Degrees)	Degrees	int16	2	Frame Latitude, offset for lower left corner. Based on WGS84 ellipsoid. Use with Frame Center Latitude. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 0.075 . Use $-(2^{15})$ as an "error" indicator. $-(2^{15}) = 0x8000$. Resolution: ~ 1.2 micro deg, ~ 0.25 meters at equator.
33	Offset Corner Longitude Point 4	Use EG0104 UDS Key	Rf	SAR Longitude 3	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0E 01 00	Corner Longitude Point 4 (Decimal Degrees)	Degrees	int16	2	Frame Longitude, offset for lower left corner. Based on WGS84 ellipsoid. Use with Frame Center Longitude. Map $-(2^{15}-1)..(2^{15}-1)$ to ± 0.075 . Use $-(2^{15})$ as an "error" indicator. $-(2^{15}) = 0x8000$. Resolution: ~ 1.2 micro deg, ~ 0.25 meters at equator.
34	Icing Detected	06 0E 2B 34 01 01 01 01 0E 01 01 01 0C 00 00 00	Id	Icing Detected	x	x	Icing Code	uint8	1	Flag for icing detected at aircraft location. 0: Detector off 1: No icing Detected 2: Icing Detected
35	Wind Direction	06 0E 2B 34 01 01 01 01 0E 01 01 01 0D 00 00 00	Wd	Wind Direction	x	x	Degrees	uint16	2	Wind direction at aircraft location. This is the direction the wind is coming from relative to true north. Map $0..(2^{16}-1)$ to $0..360$. Resolution: ~ 5.5 milli degrees.
36	Wind Speed	06 0E 2B 34 01 01 01 01 0E 01 01 01 0E 00 00 00	Ws	Wind Speed	x	x	Meters/Second	uint8	1	Wind speed at aircraft location. Map $0..255$ to $0..100$ meters/second. 1 m/s = 1.94384449 knots. Resolution: ~ 0.4 meters / second.
37	Static Pressure	06 0E 2B 34 01 01 01 01 0E 01 01 01 0F 00 00 00	Ps	Static Pressure	x	x	Millibar	uint16	2	Static pressure at aircraft location. Map $0..(2^{16}-1)$ to $0..5000$ mbar. 1 mbar = 0.0145037738 PSI. Resolution: ~ 0.08 Millibar

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
38	Density Altitude	06 0E 2B 34 01 01 01 01 0E 01 01 01 10 00 00 00	Da	Density Altitude	x	x	Meters	uint16	2	Density altitude at aircraft location. Relative aircraft performance metric based on outside air temperature, static pressure, and humidity. Map $0..(2^{16}-1)$ to $-900..19000$ meters. Offset = -900. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.
39	Outside Air Temperature	06 0E 2B 34 01 01 01 01 0E 01 01 01 11 00 00 00	At	Air Temperature	x	x	Celcius	int8	1	Temperature outside of aircraft. $-128..127$ Degrees Celsius. Resolution: 1 degree celsius.
40	Target Location Latitude	06 0E 2B 34 01 01 01 01 0E 01 01 03 02 00 00 00	x	x	x	x	Degrees	int32	4	Calculated Target latitude. This is the crosshair location if different from frame center. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 90 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~42 nano degrees.
41	Target Location Longitude	06 0E 2B 34 01 01 01 01 0E 01 01 03 03 00 00 00	x	x	x	x	Degrees	int32	4	Calculated Target longitude. This is the crosshair location if different from frame center. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 180 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~84 nano degrees.
42	Target Location Elevation	06 0E 2B 34 01 01 01 01 0E 01 01 03 04 00 00 00	x	x	x	x	Meters	uint16	2	Calculated target elevation. This is the crosshair location if different from frame center. Map $0..(2^{16}-1)$ to $-900..19000$ meters. Offset = -900. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.
43	Target Track Gate Width	06 0E 2B 34 01 01 01 01 0E 01 01 03 05 00 00 00	x	x	x	x	Pixels	uint8	1	Tracking gate width (x value) of tracked target within field of view. Closely tied to source video resolution in pixels.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
44	Target Track Gate Height	06 0E 2B 34 01 01 01 01 0E 01 01 03 06 00 00 00	x	x	x	x	Pixels	uint8	1	Tracking gate height (y value) of tracked target within field of view. Closely tied to source video resolution in pixels.
45	Target Error Estimate - CE90	06 0E 2B 34 01 01 01 01 0E 01 01 03 07 00 00 00	x	x	x	x	Meters	uint16	2	Circular Error 90 (CE90) is the estimated error distance in the horizontal direction. Specifies the radius of 90% probability on a plane tangent to the earth's surface. Res: ~0.0624 meters
46	Target Error Estimate - LE90	06 0E 2B 34 01 01 01 01 0E 01 01 03 08 00 00 00	x	x	x	x	Meters	uint16	2	Lateral Error 90 (LE90) is the estimated error distance in the vertical (or lateral) direction. Specifies the interval of 90% probability in the local vertical direction. Res: 0.0625 meters
47	Generic Flag Data 01	06 0E 2B 34 01 01 01 01 0E 01 01 03 01 00 00 00	x	x	x	x	None	uint8	1	Generic Flagged Metadata Position Format msb8..l1sb 1- Laser Range 1on,0off 2- Auto-Track 1on,0off 3- IR Polarity 1blk,0wht 4- Icing detected 1ice,0(off/no ice) 5- Slant Range 1measured, 0calc 6- Image Invalid 1invalid, 0valid 7,8- Use 0
48	Security Local Metadata Set	Use ST0102 UDS key for Local Data Sets.	x	x	06 0E 2B 34 02 03 01 01 0E 01 03 03 02 00 00 00	Security Local Metadata Set	None	Set	x	Local set tag to include the ST0102 Local Data Set Security Metadata items within ST0601. Use the ST0102 Local Set Tags within the ST0601 tag 0d48. The length field is the size of all ST0102 metadata items to be packaged within tag 0d48.
49	Differential Pressure	06 0E 2B 34 01 01 01 01 0E 01 01 01 01 00 00 00	x	x	x	x	Millibar	uint16	2	Differential pressure at aircraft location. Measured as the Stagnation/impact/total pressure minus static pressure. Map 0..(2^16-1) to 0..5000 mbar. 1 mbar = 0.0145037738 PSI. Res: ~0.08 mbar

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
50	Platform Angle of Attack	06 0E 2B 34 01 01 01 01 0E 01 01 01 02 00 00 00	x	x	x	x	Degrees	int16	2	Platform Attack Angle. Angle between platform longitudinal axis and relative wind. Positive angles for upward relative wind. Map $-(2^{15}-1)..(2^{15}-1)$ to +/-20. Use $-(2^{15})$ as an "out of range" indicator. $-(2^{15}) = 0x8000$. Res: ~610 micro degrees.
51	Platform Vertical Speed	06 0E 2B 34 01 01 01 01 0E 01 01 01 03 00 00 00	x	x	x	x	Meters/Second	int16	2	Vertical speed of the aircraft relative to zenith. Positive ascending, negative descending. Map $-(2^{15}-1)..(2^{15}-1)$ to +/-180 Use $-(2^{15})$ as an "out of range" indicator. $-(2^{15}) = 0x8000$. Resolution: ~ 0.0055 meters/second.
52	Platform Sideslip Angle	06 0E 2B 34 01 01 01 01 0E 01 01 01 04 00 00 00	x	x	x	x	Degrees	int16	2	The sideslip angle is the angle between the platform longitudinal axis and relative wind. Positive angles to right wing, neg to left. Map $-(2^{15}-1)..(2^{15}-1)$ to +/-20. Use $-(2^{15})$ as an "out of range" indicator. $-(2^{15}) = 0x8000$. Res: ~610 micro deg.
53	Airfield Barometric Pressure	06 0E 2B 34 01 01 01 01 0E 01 01 02 02 00 00 00	x	x	x	x	Millibar	uint16	2	Local pressure at airfield of known height. Pilot's responsibility to update. Map $0..(2^{16}-1)$ to 0..5000 mbar. 1013.25mbar = 29.92inHg Min/max recorded values of 870/1086mbar. Resolution: ~0.08 Millibar
54	Airfield Elevation	06 0E 2B 34 01 01 01 01 0E 01 01 02 03 00 00 00	x	x	x	x	Meters	uint16	2	Elevation of Airfield corresponding to Airfield Barometric Pressure. Map $0..(2^{16}-1)$ to -900..19000 meters. Offset = -900. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.
55	Relative Humidity	06 0E 2B 34 01 01 01 01 0E 01 01 01 09 00 00 00	x	x	x	x	Percent	uint8	1	Relative Humidity at aircraft location. Map $0..(2^8-1)$ to 0..100. Resolution: ~0.4%.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
56	Platform Ground Speed	06 0E 2B 34 01 01 01 01 0E 01 01 01 05 00 00 00	Gv	Platform Ground Speed	x	x	Meters/Second	uint8	1	Speed projected to the ground of an airborne platform passing overhead. 0..255 meters/sec. 1 m/s = 1.94384449 knots. Resolution: 1 meter/second.
57	Ground Range	06 0E 2B 34 01 01 01 01 0E 01 01 01 06 00 00 00	Gr	Ground Range	x	x	Meters	uint32	4	Horizontal distance from ground position of aircraft relative to nadir, and target of interest. Dependent upon Slant Range and Depression Angle. Map 0..(2^32-1) to 0..5000000 meters. 1 nautical mile (knot) = 1852 meters. Resolution: ~1.2 milli meters.
58	Platform Fuel Remaining	06 0E 2B 34 01 01 01 01 0E 01 01 01 07 00 00 00	Fr	Platform Fuel Remaining	x	x	Kilogram	uint16	2	Remaining fuel on airborne platform. Metered as fuel weight remaining. Map 0..(2^16-1) to 0..10000 Kilograms. 1 kilogram = 2.20462262 pounds. Resolution: ~.16 kilograms.
59	Platform Call Sign	06 0E 2B 34 01 01 01 01 0E 01 04 01 01 00 00 00	Cs	Platform Call Sign	x	x	String	ISO 646	V	Call Sign of platform or operating unit. Value field is Free Text.
60	Weapon Load	06 0E 2B 34 01 01 01 01 0E 01 01 01 12 00 00 00	Wl	Weapon Load	x	x	uint16	nibble	2	Current weapons stored on aircraft broken into two bytes: [K][L][V] = [0x41][0x02][[byte1][byte2]] [byteN] = [[nib1][nib2]], nib1= msn byte1-nib1 = Station Number byte1-nib2 = Substation Number byte2-nib1 = Weapon Type byte2-nib2 = Weapon Variant
61	Weapon Fired	06 0E 2B 34 01 01 01 01 0E 01 01 01 13 00 00 00	Wf	Weapon Fired	x	x	uint8	nibble	1	Indication when a particular weapon is released. Correlate with Unix Time stamp. Identical format to Weapon Load byte 2: [byteN] = [[nib1][nib2]] nib1 = Station Number nib2 = Substation Number

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
62	Laser PRF Code	06 0E 2B 34 01 01 01 01 0E 01 02 02 01 00 00 00	Lc	Laser PRF Code	x	x	None	uint16	2	A laser's Pulse Repetition Frequency (PRF) code used to mark a target. The Laser PRF code is a three or four digit number consisting of the values 1..8. Only the values 1111..8888 can be used without 0's or 9's.
63	Sensor Field of View Name	06 0E 2B 34 01 01 01 01 0E 01 02 02 02 00 00 00	Vn	Sensor Field of View Name	x	x	List	uint8	1	Names sensor field of view quantized steps. 00 = Ultranarrow 01 = Narrow 02 = Medium 03 = Wide 04 = Ultrawide 05 = Narrow Medium 06 = 2x Ultranarrow 07 = 4x Ultranarrow
64	Platform Magnetic Heading	06 0E 2B 34 01 01 01 01 0E 01 01 01 08 00 00 00	Mh	Platform Magnetic Heading	x	x	Degrees	uint16	2	Aircraft magnetic heading angle. Relative between longitudinal axis and Magnetic North measured in the horizontal plane. Map $0..(2^{16}-1)$ to $0..360$. Resolution: ~5.5 milli degrees.
65	UAS LDS Version Number	06 0E 2B 34 01 01 01 01 0E 01 02 03 03 00 00 00	Iv	ESD ICD Version	x	x	Number	uint8	1	Version number of the UAS LDS document used to generate a source of UAS LDS KLV metadata. 0 is pre-release, initial release (0601.0), or test data. 1..255 corresponds to document revisions ST0601.1 thru ST0601.255.
66	Target Location Covariance Matrix	06 0E 2B 34 02 05 01 01 0E 01 03 03 14 00 00 00	x	x	x	x	TBD	TBD	TBD	Covariance Matrix of the error associated with a targeted location. Details TBD.
67	Alternate Platform Latitude	06 0E 2B 34 01 01 01 01 0E 01 01 01 14 00 00 00	x	x	x	x	Degrees	int32	4	Alternate Platform Latitude. Represents latitude of platform connected with UAS. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 90 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~42 nano degrees.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
68	Alternate Platform Longitude	06 0E 2B 34 01 01 01 01 0E 01 01 01 15 00 00 00	x	x	x	x	Degrees	int32	4	Alternate Platform Longitude. Represents longitude of platform connected with UAS. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 180 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~84 nano degrees.
69	Alternate Platform Altitude	06 0E 2B 34 01 01 01 01 0E 01 01 01 16 00 00 00	x	x	x	x	Meters	uint16	2	Altitude of alternate platform as measured from Mean Sea Level (MSL). Represents altitude of platform connected with UAS. Map $0..(2^{16}-1)$ to $-900..19000$ meters. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.
70	Alternate Platform Name	06 0E 2B 34 01 01 01 01 0E 01 01 01 17 00 00 00	x	x	x	x	String	ISO 646	V	Name of alternate platform connected to UAS. E.g.: 'Apache', 'Rover', 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'IgnatER', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc. Value field is Free Text. Maximum 127 characters.
71	Alternate Platform Heading	06 0E 2B 34 01 01 01 01 0E 01 01 01 18 00 00 00	x	x	x	x	Degrees	uint16	2	Heading angle of alternate platform connected to UAS. Relative between longitudinal axis and True North measured in the horizontal plane. Map $0..(2^{16}-1)$ to $0..360$. Resolution: ~5.5 milli degrees.
72	Event Start Time - UTC	Use EG0104 UDS Key	x	Mission Start Time, Date, and Date of Collection	06 0E 2B 34 01 01 01 01 07 02 01 02 07 01 00 00	Event Start Date Time - UTC	Microseconds	uint64	8	Start time of scene, project, event, mission, editing event, license, publication, etc. Represented as the microseconds elapsed since midnight (00:00:00), January 1, 1970. Derived from the POSIX IEEE 1003.1 standard. Resolution: 1 microsecond.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
73	RVT Local Data Set	Use EG0806 RVT LDS 16-byte Key.	x	x	06 0E 2B 34 02 0B 01 01 0E 01 03 01 02 00 00 00	Remote Video Terminal Local Data Set	None	Set	x	Local set tag to include the EG0806 RVT Local Data Set metadata items within ST0601. Use the EG0806 Local Set Tags within the ST0601 tag 0d73. The length field is the size of all RVT LDS metadata items to be packaged within tag 0d73.
74	VMTI Local Data Set	Use ST0903 VMTI LDS 16-byte Key.	x	x	06 0E 2B 34 02 0B 01 01 0E 01 03 03 06 00 00 00	Video Moving Target Indicator Local Data Set	None	Set	x	Local set tag to include the ST0903 VMTI Local Data Set metadata items within ST0601. Use the ST0903 Local Set Tags within the ST0601 tag 0d74. The length field is the size of all VMTI LDS metadata items to be packaged within tag 0d74.
75	Sensor Ellipsoid Height	06 0E 2B 34 01 01 01 01 0E 01 02 01 82 47 00 00	x	x	x	x	Meters	uint16	2	Sensor Ellipsoid Height as measured from the reference WGS84 Ellipsoid. Map 0..(2 ¹⁶ -1) to -900..19000 meters. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.
76	Alternate Platform Ellipsoid Height	06 0E 2B 34 01 01 01 01 0E 01 02 01 82 48 00 00	x	x	x	x	Meters	uint16	2	Alternate Platform Ellipsoid Height as measured from the reference WGS84 Ellipsoid. Map 0..(2 ¹⁶ -1) to -900..19000 meters. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.
77	Operational Mode	06 0E 2B 34 01 01 01 01 0E 01 01 03 21 00 00 00	x	x	x	x	None	uint8	1	Indicates the mode of operations of the event portrayed in metadata. Enumerated. 0x00 = "Other" 0x01 = "Operational" 0x02 = "Training" 0x03 = "Exercise" 0x04 = "Maintenance" 0x05 = "Test"
78	Frame Center Height Above Ellipsoid	06 0E 2B 34 01 01 01 01 0E 01 02 03 48 00 00 00	x	x	x	x	Meters	uint16	2	Frame Center Ellipsoid Height as measured from the reference WGS84 Ellipsoid. Map 0..(2 ¹⁶ -1) to -900..19000 meters. 1 meter = 3.2808399 feet. Resolution: ~0.3 meters.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
79	Sensor North Velocity	06 0E 2B 34 01 01 01 01 0E 01 02 02 7E 00 00 00	x	x	x	x	Meters/Sec	int16	2	Northing velocity of the sensor or platform. Positive towards True North Map-(2 ¹⁵ -1)..(2 ¹⁵ -1) to +/-327 Use -(2 ¹⁵) as an "out of range" indicator. -(2 ¹⁵) = 0x8000. Resolution: ~ 1 cm/sec.
80	Sensor East Velocity	06 0E 2B 34 01 01 01 01 0E 01 02 02 7F 00 00 00	x	x	x	x	Meters/Sec	int16	2	Easting velocity of the sensor or platform. Positive towards East. Map-(2 ¹⁵ -1)..(2 ¹⁵ -1) to +/-327 Use -(2 ¹⁵) as an "out of range" indicator. -(2 ¹⁵) = 0x8000. Resolution: ~ 1 cm/sec.
81	Image Horizon Pixel Pack	06 0E 2B 34 02 05 01 01 0E 01 03 02 08 00 00 00	x	x	x	x	Pack	Pack		<tag 81><length> < start x0, start y0 // point p0 end x1, end y1 // point p1 start lat, start lon end lat, end lon >
82	Corner Latitude Point 1 (Full)	Use EG0104 UDS Key	Rg	SAR Latitude 4	06 0E 2B 34 01 01 01 03 07 01 02 01 03 07 01 00	Corner Latitude Point 1 (Decimal Degrees)	Degrees	int32	4	Frame Latitude for upper left corner. Full Range. Based on WGS84 ellipsoid. Map -(2 ³¹ -1)..(2 ³¹ -1) to +/-90. Use -(2 ³¹) as an "error" indicator. -(2 ³¹) = 0x80000000. Resolution: ~42 nano degrees.
83	Corner Longitude Point 1 (Full)	Use EG0104 UDS Key	Rh	SAR Longitude 4	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0B 01 00	Corner Longitude Point 1 (Decimal Degrees)	Degrees	int32	4	Frame Longitude for upper left corner. Full Range. Based on WGS84 ellipsoid. Map -(2 ³¹ -1)..(2 ³¹ -1) to +/-180. Use -(2 ³¹) as an "error" indicator. -(2 ³¹) = 0x80000000. Resolution: ~84 nano degrees.
84	Corner Latitude Point 2 (Full)	Use EG0104 UDS Key	Ra	SAR Latitude 1	06 0E 2B 34 01 01 01 03 07 01 02 01 03 08 01 00	Corner Latitude Point 2 (Decimal Degrees)	Degrees	int32	4	Frame Latitude for upper right corner. Full Range. Based on WGS84 ellipsoid. Map -(2 ³¹ -1)..(2 ³¹ -1) to +/-90. Use -(2 ³¹) as an "error" indicator. -(2 ³¹) = 0x80000000. Resolution: ~42 nano degrees.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
85	Corner Longitude Point 2 (Full)	Use EG0104 UDS Key	Rb	SAR Longitude 1	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0C 01 00	Corner Longitude Point 2 (Decimal Degrees)	Degrees	int32	4	Frame Longitude for upper right corner. Full Range. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 180 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~84 nano degrees.
86	Corner Latitude Point 3 (Full)	Use EG0104 UDS Key	Rc	SAR Latitude 2	06 0E 2B 34 01 01 01 03 07 01 02 01 03 09 01 00	Corner Latitude Point 3 (Decimal Degrees)	Degrees	int32	4	Frame Latitude for lower right corner. Full Range. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 90 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~42 nano degrees.
87	Corner Longitude Point 3 (Full)	Use EG0104 UDS Key	Rd	SAR Longitude 2	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0D 01 00	Corner Longitude Point 3 (Decimal Degrees)	Degrees	int32	4	Frame Longitude for lower right corner. Full Range. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 180 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~84 nano degrees.
88	Corner Latitude Point 4 (Full)	Use EG0104 UDS Key	Re	SAR Latitude 3	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0A 01 00	Corner Latitude Point 4 (Decimal Degrees)	Degrees	int32	4	Frame Latitude for lower left corner. Full Range. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 90 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~42 nano degrees.
89	Corner Longitude Point 4 (Full)	Use EG0104 UDS Key	Rf	SAR Longitude 3	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0E 01 00	Corner Longitude Point 4 (Decimal Degrees)	Degrees	int32	4	Frame Longitude for lower left corner. Full Range. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to ± 180 . Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~84 nano degrees.

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TAG	LDS Name	Mapped UDS	ESD	ESD Name	UDS	UDS Name	Units	Format	Len	Notes
90	Platform Pitch Angle (Full)	Use EG0104 UDS Key	Ip	UAV Pitch (INS)	06 0E 2B 34 01 01 01 07 07 01 10 01 05 00 00 00	Platform Pitch Angle	Degrees	int32	4	Aircraft pitch angle. Angle between longitudinal axis and horizontal plane. Positive angles above horizontal plane. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. Use $-(2^{31})$ as an "out of range" indicator. $-(2^{31}) = 0x80000000$. Res: ~42 nano deg.
91	Platform Roll Angle (Full)	Use EG0104 UDS Key	Ir	UAV Roll (INS)	06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00	Platform Roll Angle	Degrees	int32	4	Platform roll angle. Angle between transverse axis and transvers-longitudinal plane. Positive angles for lowered right wing. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. Use $-(2^{31})$ as an "error" indicator. $-(2^{31}) = 0x80000000$. Resolution: ~42 nano degrees.
92	Platform Angle of Attack (Full)	06 0E 2B 34 01 01 01 01 0E 01 01 01 02 00 00 00	x	x	x	x	Degrees	int32	4	Platform Attack Angle. Angle between platform longitudinal axis and relative wind. Positive angles for upward relative wind. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. Use $-(2^{31})$ as an "out of range" indicator. $-(2^{31}) = 0x80000000$. Res: ~42 nano deg.
93	Platform Sideslip Angle (Full)	06 0E 2B 34 01 01 01 01 0E 01 01 01 04 00 00 00	x	x	x	x	Degrees	int32	4	Angle between the platform longitudinal axis and relative wind. Full Range. Positive angles to right wing, neg to left. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. Use $-(2^{31})$ as an "out of range" indicator. $-(2^{31}) = 0x80000000$. Res: ~42 nano deg.
94	MIIS Core Identifier	Use ST1204 MIIS Core 16-byte Key.	x	x	06 0E 2B 34 01 01 01 01 0E 01 04 05 03 00 00 00	Motion Imagery Identification System Core	None	Binary Value	x	Local set tag to include the ST1204 MIIS Core Identifier Binary Value within ST0601. Use according to the rules and requirements defined in ST1204.

Table 1: UAS Datalink Local Metadata Set data elements

6.2 Platform and Sensor Position and Rotation Metadata

To better assist the understanding and interoperability of the UAS LDS, this section describes the collective relationship between the multiple platform and sensor position and rotation metadata items available within the UAS LDS.

Together the platform location and attitude, along with the sensor relative pointing angles define the location of an image or image sequence. Metadata items for sensor location (tags 13, 14, & 15/75), platform rotations (tags 5, 6, & 7), and sensor rotations (tags 18, 19, & 20), along with Euler Angle order of operation rules are discussed in more detail in the subsections that follow.

6.2.1 Sensor Location

The metadata items associated with sensor location are:

1. *Latitude* - Sensor Latitude (tag 13)
2. *Longitude* - Sensor Longitude (tag 14)
3. *Height* - Sensor Altitude (tag 15), or Sensor Ellipsoid Height (tag 75)

6.2.2 Platform Rotations

The metadata items associated with platform attitude and rotations are:

1. *Platform Yaw* - Platform Heading Angle (tag 5)

The platform heading angle is defined as the angle between the platform longitudinal axis (line made by the fuselage) and true north measured in the horizontal plane. Angles increase in a clockwise direction when looking from above the platform. North is 0 degrees, east is 90, south is 180, and west is 270 degrees from true north.

2. *Platform Pitch* - Platform Pitch Angle (tag 6), or full-range Platform Pitch (tag 90)

The pitch angle of the platform is the angle between the longitudinal axis (line made by the fuselage) and the horizontal plane. Angles are positive when the platform nose is above the horizontal plane. Take special care for Platform Pitch angles equal to +/- 90.

3. *Platform Roll* - Platform Roll Angle (tag 7), or full-range Platform Roll (tag 91)

The rotation operation performed about the longitudinal axis forms the roll angle between the previous aircraft transverse-longitudinal plane and the new transverse axis location (line from wing tip to wing tip). Positive angles correspond to the starboard (right) wing lowered below the previous aircraft transverse-longitudinal plane.

6.2.3 Sensor Rotations

The metadata items associated with sensor rotations are:

1. *Sensor Relative Yaw* - Sensor Relative Azimuth Angle (tag 18)

The sensor relative azimuth angle is defined as the angle between the platform longitudinal axis (line made by the fuselage) and the sensor pointing direction, measured in the plane formed by the platform longitudinal and transverse axes (line from wing tip to wing tip). Angles increase in a clockwise direction when looking from above the platform, with 0 degrees forward along the longitudinal axis.

2. *Sensor Relative Pitch* - Sensor Relative Elevation Angle (tag 19)

The relative elevation angle of the sensor to the aircraft is the downward (or upward) pointing angle of the sensor relative to the plane formed by the longitudinal axis (line made by the fuselage) and the transverse axis (line from wing tip to wing tip). Sensor pointing angles below the platform longitudinal-transverse plane are negative.

3. *Sensor Relative Roll* - Sensor Relative Roll Angle (tag 20)

Sensors that are able to rotate their camera about the lens axis make use of this sensor relative roll angle. A roll angle of zero degrees occurs when the top and bottom edges of the captured image lie perpendicular to the plane created by the sensor relative depression angle axis. Positive angles are clockwise when looking from behind the camera.

6.2.4 *Euler Angle Order of Operations*

In order to properly determine the orientation of a sensor on an airborne platform using the UAS LDS metadata items outlined in Section 6.2, a specific order of position, and rotation angles must be followed. The order of operations required to determine a sensor's orientation is as follows:

1. Move a sensor to the geodetic Latitude, Longitude, and altitude using
 - a. Tag 13, Sensor Latitude
 - b. Tag 14, Sensor Longitude
 - c. Tag 15, Sensor Altitude (or tag 75: Sensor Ellipsoid Height)
2. Convert the geodetic coordinates to a geocentric system, then use a local-level North-East-Down (NED, right hand rule) sensor orientation.
3. Perform a Platform Rotation. Start with Yaw, then Pitch, the Roll.
 - a. Tag 5: Platform Heading Angle
 - b. Tag 6: Platform Pitch Angle
 - c. Tag 7: Platform Roll Angle

Refer to Figure 6-1 for the different platform rotations outlined in steps 2 and 3 above.

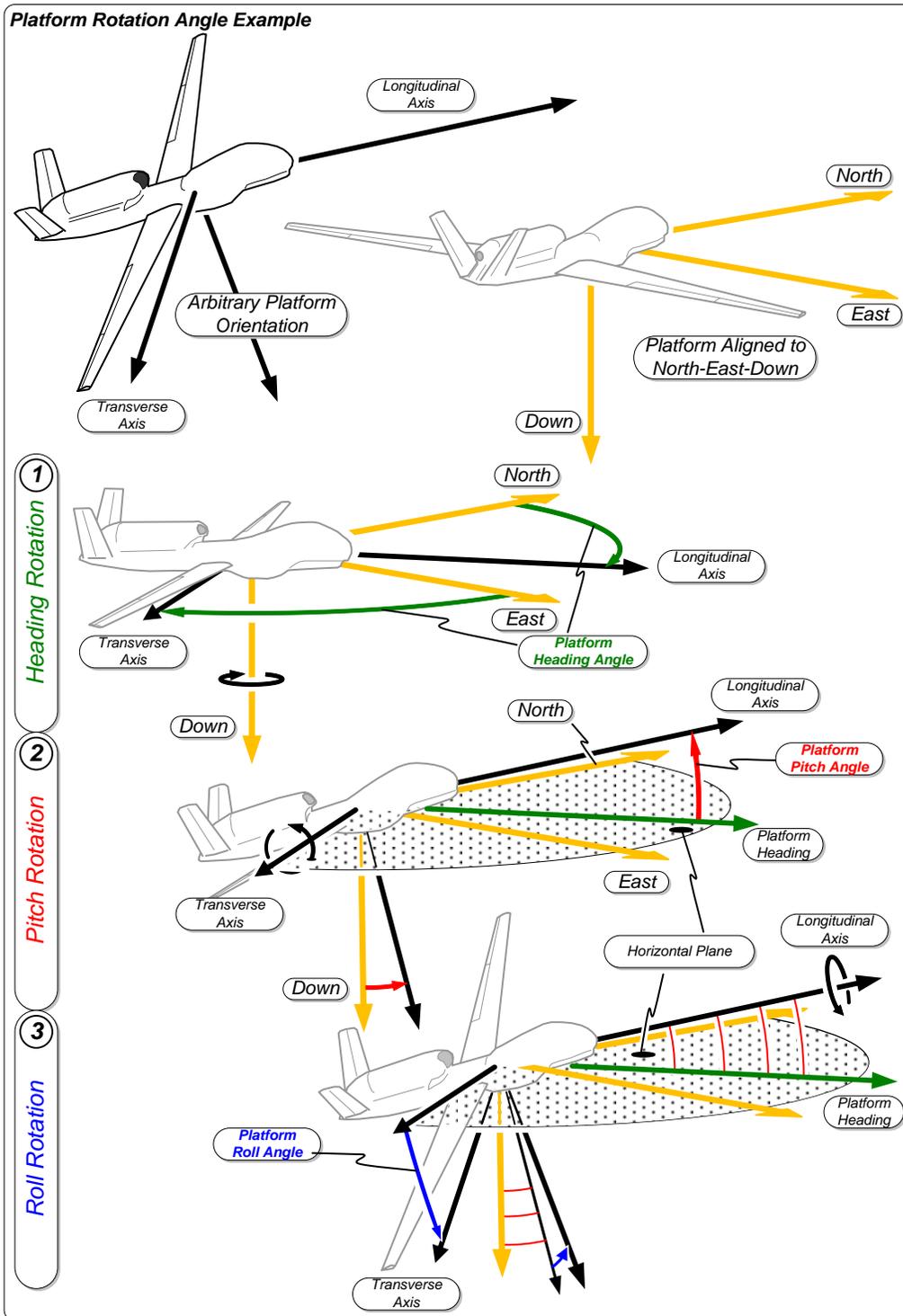


Figure 6-1 : Platform Rotation Angle Example

4. Perform a Sensor Rotation. Start with Yaw, then Pitch, then Roll.
 - a. Tag 18: Sensor Relative Azimuth Angle
 - b. Tag 19: Sensor Relative Elevation Angle
 - c. Tag 20: Sensor Relative Roll Angle

Refer to Figure 6-2 for the different sensor rotations outlined in steps 4 above.

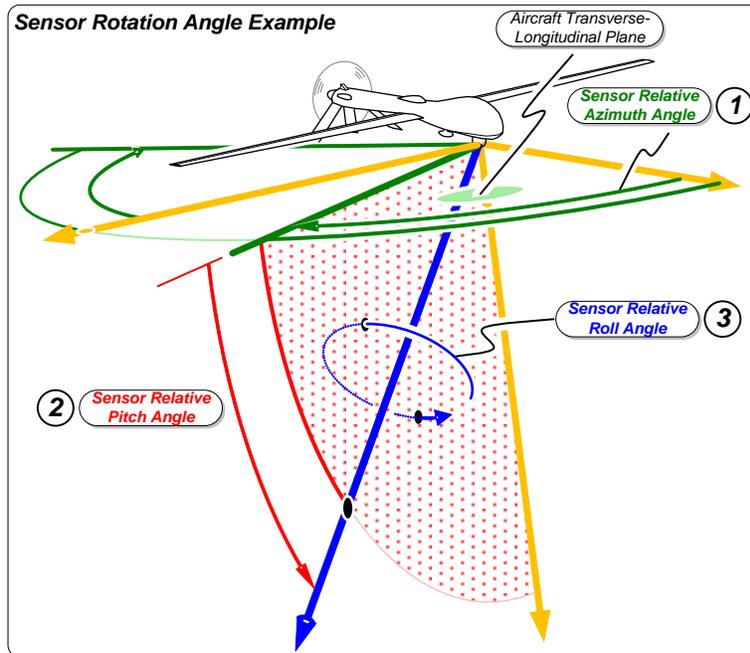


Figure 6-2 : Sensor Rotation Angle Example

Once the platform and sensor attitude is known, the user is free to use other metadata items like horizontal and vertical field of view to suit the purpose of an intended application.

6.3 Sensor Image Geoposition Corner Metadata

An example of corner-coordinate metadata as used in a motion imagery system is shown in Figure 6-2 below.

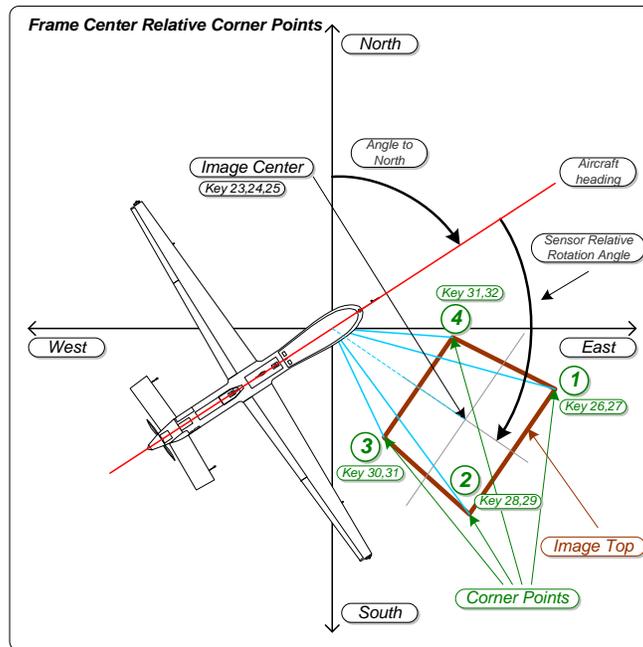


Figure 6-3: Corner Coordinate Metadata

The Sensor Image Corner Latitude/Longitude metadata consists of the items shown in Figure 6-10. Corner coordinates are numbered to conform to National Imagery Transmission Format (NITF) Standard numbering convention for single image frame corner coordinates.

See the NITF Standards document MIL-STD-2600C Version 2.1 for more information about corner coordinates. Corners not corresponding to geographic locations, i.e., above the horizon, are not to be included. This numbering scheme is different than the one used in the ESD interface described in ASI-00209 Rev D "Exploitation Support Data (ESD) External Interface Control Document".

Figure 6-1 shows a detailed mapping between metadata items for each corner point.

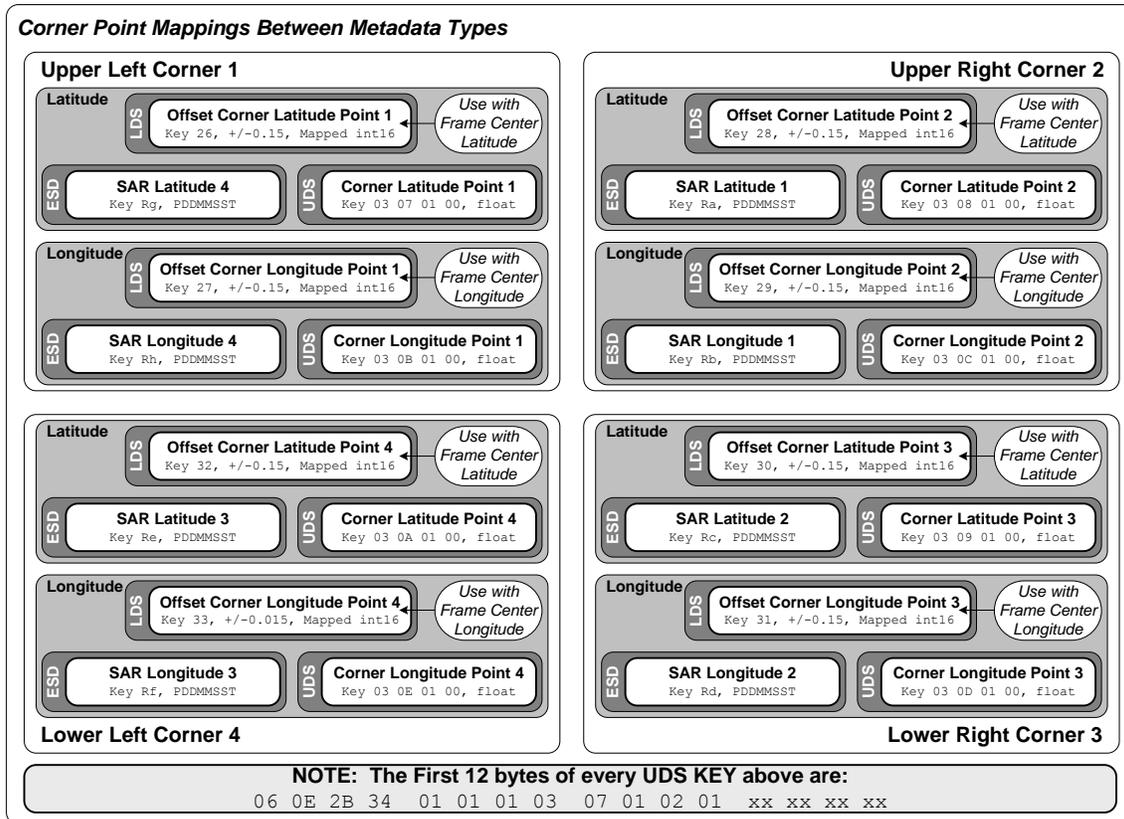


Figure 6-4: Corner Point Mapping

The LDS makes use of Offset Corner Point metadata items and requires addition with the LDS Frame Center coordinates to determine the actual corner points. This differs from the UDS and ESD data types which use corner point items that are independent of the frame center items and explicitly define actual corner coordinates without needing computation.

The LDS Offset Corner Points use a mapped 2-byte signed integer which is converted to a decimal and added as an offset to the respective decimal representation of LDS Frame Center SAR Latitude or Longitude to determine the actual corner point. This offset method used in the LDS only covers a finite area about an image center point (16.6km x 16.6km square area at the Equator) yet still adequately represents a typical motion imagery sequence while it conserves significant bandwidth over the UDS implementation. In comparison, each Latitude and Longitude UDS corner point has one 8-byte floating point value corresponding to decimal degrees which covers the entire globe.

6.4 Alternate Platform Guideline

Within the UAS LDS there are multiple metadata items which provide position and other relevant data about an “Alternate Platform”. These items differ from the “Platform” or “Sensor” metadata fields in that the “Alternate Platform” items provide no position or attitude information about an image sequence a UAS LDS stream is tied to.

Whenever a MISP compliant motion imagery stream is created (a binary sequence typically containing metadata (i.e. UAS LDS) and compressed video within an MPEG2 transport stream) within a sensor/platform system, the sensor and platform metadata fields directly relate to the imagery while the “Alternate Platform” fields describe an external platform.

For instance suppose Platform B is receiving a motion imagery stream from Platform A. The metadata Platform B receives would describe where Platform A is, as well as its sensor’s pointing angles. Should Platform A also include “Alternate Platform” metadata, those metadata fields would represent position data for Platform C, or D, or even Platform B, but Platform A must not represent itself within “Alternate Platform” fields.

As a general guideline, “Alternate Platform” fields do not directly describe a motion imagery sequence, but aid situational awareness to a motion imagery stream already described through metadata by the host platform.

6.5 Out of Range and Error Values

Various ST 0601 metadata items have special bit-pattern representations which indicate either the item is “Out of Range”, or there is an “Error”.

For instance, some angles within this Standard (such as platform pitch and roll) are represented as mapped integer values lying between a maximum and minimum angular value. Should the measured angular value lie outside the maximum or minimum value defined in this standard, the metadata source is given the ability to convey information that a value was measured and is “Out of Range”.

Other items such as latitudes and longitudes span entire angular dimensions and are not limited to an artificial minimum by this standard. In this case a single bit sequence is reserved to indicate that the metadata value is an “Error” instead of “Out of Range”.

While not all mapped integer metadata items have “Error” or “Out of Range” bit sequences, those that do should only use these special values sparingly.

Systems receiving ST 0601 metadata should also take care when parsing mapped integer items to check for “Error” or “Out of Range” values prior to using the data value being represented.

7 Conversions and Mappings between Metadata Types

Metadata items that are common amongst UAS LDS, Predator UDS, and ESD data formats each convey identical information. However, since each metadata format represents the same metadata items differently (e.g. mapped integer, float, string, etc.), the data resolution between format types is different. This section provides conversions and mappings between LDS, UDS, and ESD metadata items.

Fields marked with an “x” are to be considered not applicable.

Example conversions tables only containing information for the LDS do not have equivalent UDS or ESD representations.

7.1 Tag 1: Checksum Conversion

LDS Tag	1	Units	Range	Format
LDS Name	Checksum	None	0..(2 ¹⁶ -1)	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 03 01 00 00 00			
Notes	Conversion Formula			
- Checksum used to detect errors within a UAV Local Data Set packet.			x	
- Lower 16-bits of summation.			x	
- Performed on entire LDS packet, including 16-byte UDS key and 1-byte checksum length.				
Example Value	Example LDS Packet			
0x8C ED	[K][L][V] = [0d1][0d2][0x8C ED]			

7.1.1 Example 16-bit Checksum Code

```
unsigned short bcc_16 (
    unsigned char * buff, // Pointer to the first byte in the 16-byte UAS LDS key.
    unsigned short len ) // Length from 16-byte UDS key up to 1-byte checksum length.
{
    unsigned short bcc = 0, i; // Initialize Checksum and counter variables.
    for ( i = 0 ; i < len; i++)
        bcc += buff[i] << (8 * ((i + 1) % 2));
    return bcc;
} // end of bcc_16 ()
```

7.1.2 Sample Checksum Data

64 bits to checksum: 060E 2B34 0200 81BB

```

 060E
+ 2B34
-----
 3142
+ 0200
-----
 3342
+ 81BB
-----
B4FD <-- Final Checksum
```

7.2 Tag 2: UNIX Time Stamp Conversion

LDS Tag	2	Units	Range	Format	
LDS Name	UNIX Time Stamp	Microseconds	0..(2 ⁶⁴ -1)	uint64	
UDS Mapped Key	Use EG0104 UDS Key				
Notes		Conversion Formula			
<ul style="list-style-type: none"> - Coordinated Universal Time (UTC) represented in the number of microseconds elapsed since midnight (00:00:00), January 1, 1970. - Derived from the POSIX IEEE 1003.1 standard. - Resolution: 1 microsecond. 		<ul style="list-style-type: none"> x x 			
Example Value		Example LDS Packet			
Oct. 24, 2008. 00:13:29.913		[K][L][V] = [0d2][0d8][0x00 04 59 F4 A6 AA 4A A8]			
UDS Key	06 0E 2B 34 01 01 01 03 07 02 01 01 01 05 00 00	ESD Digraph	x		
UDS Name	User Defined Time Stamp - microseconds since 1970	ESD Name	x		
Units	Range	Format	Units	Range	Format
uSec	uint64	uint64	x	x	x
Notes		Notes			
<ul style="list-style-type: none"> - Time Stamp application defined by user. - 64 bit integer which represents the number of microseconds since Jan 1, 1970 UTC derived from the POSIX (IEEE 1003.1) standard. 		<ul style="list-style-type: none"> - x 			
UDS Conversion		ESD Conversion			
x		x			
<u>To UDS:</u>		<u>To ESD:</u>			
- x		- x			
<u>To LDS:</u>		<u>To LDS:</u>			
- x		- x			

7.2.1 Example UNIX Time Stamp

This metadata element represents UTC time as the number of microseconds elapsed since the UNIX epoch of January 1, 1970, and is contained within 8-bytes.

Unix time, or POSIX time, is a system used to discretely label a scale of time. This system is widely used within systems of differing underlying architectures. Unix time is an encoding of Coordinated Universal Time (UTC) and therefore accounts for the addition (or subtraction) of leap seconds. Leap seconds are used to synchronize the UTC clock metric with the yearly rotation period of the earth about the sun.

7.3 Tag 3: Mission ID Conversion

LDS Tag	3	Units	Range	Format
LDS Name	Mission ID	String	1..127	ISO 646
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 04 01 03 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Descriptive Mission Identifier to distinguish event or sortie. - Value field is Free Text. - Maximum 127 characters. 		<ul style="list-style-type: none"> x x 		
Example Value		Example LDS Packet		
MISSION01		[K][L][V] = [0d3][0d9][0x4D 49 53 53 49 4F 4E 30 31]		
UDS Key	06 0E 2B 34 01 01 01 01 01 05 05 00 00 00 00 00	ESD Digraph	Mn	
UDS Name	Episode Number	ESD Name	Mission Number	
Units	Range	Format	Units	Range
Number	x	Float	Alpha-Numeric	1..9
Notes		Notes		
- x		- Number to distinguish different missions started on a given day.		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- x		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		- x		

7.3.1 Example Mission ID

Format and contents of a Mission ID are to be determined.

7.4 Tag 4: Platform Tail Number Conversion

LDS Tag	4	Units	Range	Format
LDS Name	Platform Tail Number	String	1..127	ISO 646
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 04 01 02 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Identifier of platform as posted. - E.g.: "AF008", "BP101", etc. - Value field is Free Text. - Maximum 127 characters. 			x	
			x	
Example Value		Example LDS Packet		
AF-101		[K][L][V] = [0d4][0d6][0x41 46 2D 31 30 31]		
UDS Key	x	ESD Digraph	Pt	
UDS Name	x	ESD Name	Platform Tail Number	
Units	Range	Format	Units	Range
x	x	x	Number	0..3
Notes		Notes		
- x		- x		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- x		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		- x		

7.4.1 Example Platform Tail Number

Format and contents of a Platform Tail Number are to be determined.

7.5 Tag 5: Platform Heading Angle Conversion

LDS Tag	5	Units	Degrees	Range	0..360	Format	uint16
LDS Name	Platform Heading Angle						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Aircraft heading angle. Relative between longitudinal axis and True North measured in the horizontal plane. - Map 0..(2¹⁶-1) to 0..360. - Resolution: ~5.5 milli degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_5_dec} = \left(\frac{360}{65535} * \text{LDS_5} \right)$					
Example Value		Example LDS Packet					
159.9744 Degrees		[K][L][V] = [0d5][0d2][0x71 C2]					
UDS Key	06 0E 2B 34 01 01 01 07 07 01 10 01 06 00 00 00	ESD Digraph	Th				
UDS Name	Platform Heading Angle	ESD Name	UAV Heading (INS)				
Units	Degrees	Range	0..360	Format	Float	Units	Degrees
						Range	0..359.99
						Format	DDD.HH
Notes		Notes					
<ul style="list-style-type: none"> - Heading angle of platform expressed in degrees. - The Heading of an airborne platform is the angle from True North of its longitudinal axis projected onto the horizontal plane. 		<ul style="list-style-type: none"> - True heading of the aircraft. 					
UDS Conversion		ESD Conversion					
$\text{UDS_dec} = \left(\frac{360}{65535} * \text{LDS_uint} \right)$		$\text{ESD_dec} = \left(\frac{360}{65535} * \text{LDS_uint} \right)$					
<u>To UDS:</u>		<u>To ESD:</u>					
<ul style="list-style-type: none"> - UDS = (float)(360/0xFFFF * LDS) 		<ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. 					
<u>To LDS:</u>		<u>To LDS:</u>					
<ul style="list-style-type: none"> - LDS = (uint16)round(0xFFFF/360 * UDS) 		<ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to uint16. 					

7.5.1 Example Platform Heading Angle

The platform heading angle is defined as the angle between longitudinal axis (line made by the fuselage) and true north measured in the horizontal plane. Angles increase in a clockwise direction when looking from above the platform. North is 0 degrees, east is 90, south is 180, and west is 270 degrees from true north. Refer to the figure below:

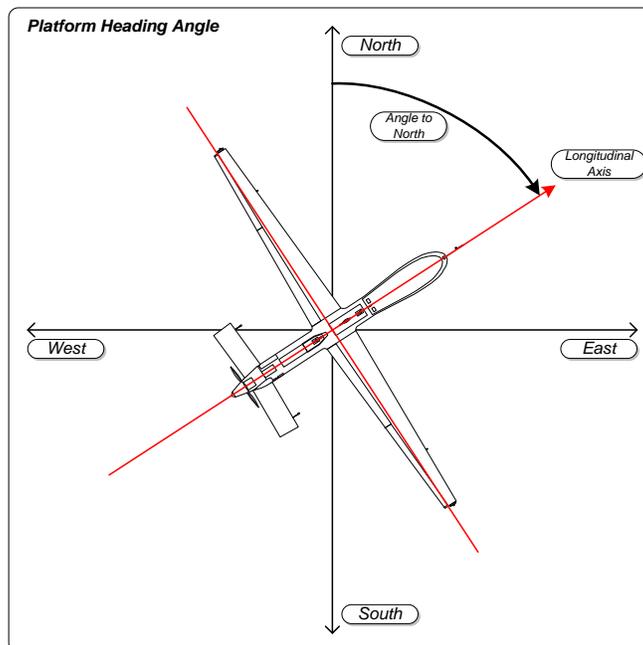


Figure 7-1: Platform True Heading Angle

7.6 Tag 6: Platform Pitch Angle Conversion

LDS Tag	6	Units	Degrees	Range	+/- 20	Format	int16
LDS Name	Platform Pitch Angle						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Aircraft pitch angle. Angle between longitudinal axis and horizontal plane. - Positive angles above horizontal plane. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-20. - Use $-(2^{15})$ as "out of range" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~610 micro degrees. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right)$ $LDS_06_dec = \left(\frac{40}{65534} * LDS_int \right)$					
Example Value		Example LDS Packet					
-0.4315251 Degrees		[K][L][V] = [0d6][0d2][0xFD 3D]					
UDS Key	06 0E 2B 34 01 01 01 07	ESD Digraph	Ip				
UDS Name	07 01 10 01 05 00 00 00 Platform Pitch Angle	ESD Name	UAV Pitch (INS)				
Units	Degrees	Range	+/- 90	Format	Float	Units	Degrees
						Range	+/- 20.00
						Format	PDD.HH
Notes		Notes					
<ul style="list-style-type: none"> - Pitch angle of platform expressed in degrees. - The Pitch of an airborne platform describes the angle the longitudinal axis makes with the horizontal (i.e., equi-potential gravitational surface); 		<ul style="list-style-type: none"> - Pitch angle of the aircraft. 					
UDS Conversion		ESD Conversion					
$UDS_dec = \left(\frac{40}{65534} * LDS_int \right)$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (float)(40/0xFFFFE * LDS) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFFE/40 * UDS) 		$ESD_dec = \left(\frac{40}{65534} * LDS_int \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 					

7.6.1 Example Platform Pitch Angle

For legacy purposes, both range-restricted (Tag 6) and full-range (Tag 90) representations of Platform Pitch Angle MAY appear in the same ST 0601 packet. A single representation is preferred favoring the full-range version (Tag 90) as per REQ-4.04.

The pitch angle of the platform is the angle between the longitudinal axis (line made by the fuselage) and the horizontal plane. Angles are positive when the platform nose is above the horizontal plane.

Pitch angles are limited to +/- 20 degrees to increase metadata resolution within this range. Should the aircraft experience flight maneuvers beyond this range, an "out of range" indication shall be made within this metadata item. Refer to the figure to the right:

Note that the int16 used in the LDS value is encoded using two's complement.

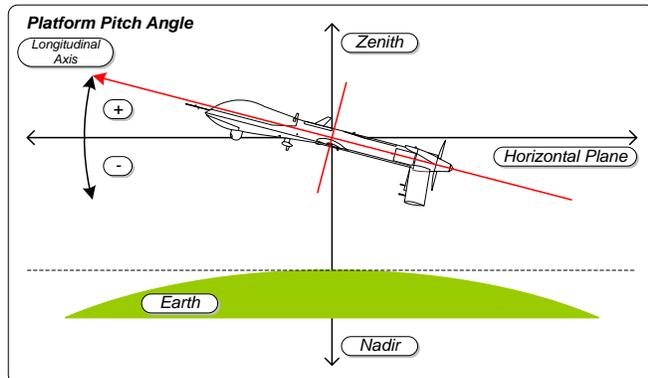


Figure 7-2: Platform Pitch Angle

7.7 Tag 7: Platform Roll Angle Conversion

LDS Tag	7	Units	Degrees	Range	+/- 50	Format	int16
LDS Name	Platform Roll Angle						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Platform roll angle. Angle between transverse axis and transvers-longitudinal plane. Positive angles for lowered right wing. - Map $(-2^{15}-1)..(2^{15}-1)$ to +/-50. - Use $-(2^{15})$ as "out of range" indicator. - $-(2^{15}) = 0x8000$. - Res: ~1525 micro deg. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right)$ $LDS_07_dec = \left(\frac{100}{65534} * LDS_int \right)$					
Example Value		Example LDS Packet					
3.405814 Degrees		[K][L][V] = [0d7][0d2][0x08 B8]					
UDS Key	06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00	ESD Digraph	Ir				
UDS Name	Platform Roll Angle	ESD Name	UAV Roll (INS)				
Units	Degrees	Range	+/- 90	Format	Float	Units	Degrees
Range	+/- 90	Format	Float	Range	+/- 50.00	Format	PDD.HH
Notes		Notes					
<ul style="list-style-type: none"> - Roll angle of platform expressed in degrees. - The Roll of an airborne platform is rotation about its longitudinal (front-to-back) axis; - Wings level is zero degrees, positive (negative) angles describe a platform orientation with the right wing down(up). 		<ul style="list-style-type: none"> - Roll angle of the aircraft. 					
UDS Conversion				ESD Conversion			
$UDS_dec = \left(\frac{100}{65534} * LDS_int \right)$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (float)(100/0xFFFE * LDS) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFE/100 * UDS) 				$ESD_dec = \left(\frac{100}{65534} * LDS_int \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 			

7.7.1 Example Platform Roll Angle

For legacy purposes, both range-restricted (Tag 7) and full-range (Tag 91) representations of Platform Roll Angle MAY appear in the same ST 0601 packet. A single representation is preferred favoring the full-range version (Tag 91) as per REQ-4.04.

The rotation operation performed about the longitudinal axis forms the roll angle between the previous aircraft transverse-longitudinal plane and the new transverse axis location (line from wing tip to wing tip). Positive angles correspond to the starboard (right) wing lowered below the previous aircraft transverse-longitudinal plane.

Roll angles are limited to +/- 50 degrees to increase metadata resolution within this range. Should the aircraft experience flight maneuvers beyond this range, an "out of range" indication shall be made within this metadata item. Refer to the figure to the right:

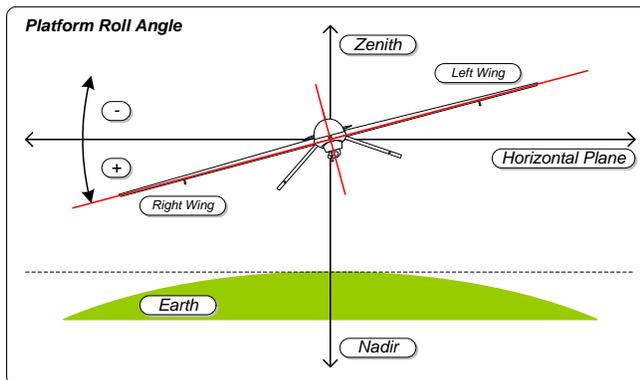


Figure 7-3: Platform Roll Angle

Note that the int16 used in the LDS value is encoded using two's complement.

7.8 Tag 8: Platform True Airspeed Conversion

LDS Tag	8	Units	Meters/Second	Range	0..255	Format	uint8
LDS Name	Platform True Airspeed						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 0A 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - True airspeed (TAS) of platform. Indicated Airspeed adjusted for temperature and altitude. - 0..255 meters/sec. - 1 m/s = 1.94384449 knots. - Resolution: 1 meter/second. 		$\text{LDS_dec} = \text{LDS_int}$ $\text{LDS_08_dec} = \text{round}(\text{LDS_08})$					
Example Value		Example LDS Packet					
147 m/Sec		[K][L][V] = [0d8][0d1][0x93]					
UDS Key	x	ESD Digraph	As				
UDS Name	x	ESD Name	True Airspeed				
Units	x	Units	Knots	Range	0..999	Format	N
Notes	- x	Notes	- True airspeed of the aircraft.				
UDS Conversion		ESD Conversion					
<p><u>To UDS:</u></p> <ul style="list-style-type: none"> - x <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - x 		$\text{ESD_dec} = \left(\text{LDS_uint} * \frac{1.94384449 \text{ knots}}{1 \text{ meters/second}} \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Map LDS to integer. - Convert integer value to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to integer. - Map integer to uint8. 					

7.8.1 Example Platform True Airspeed

True airspeed is the actual speed an aircraft is traveling relative through the air mass in which it flies. Without a relative wind condition, the true airspeed is equal to the speed over the ground. The true airspeed of the aircraft is calculated using the outside temperature, impact pressure (pitot tube), and static pressure.

7.9 Tag 9: Platform Indicated Airspeed Conversion

LDS Tag	9	Units	Meters/Second	Range	0..255	Format	uint8
LDS Name	Platform Indicated Airspeed						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 0B 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Indicated airspeed (IAS) of platform. Derived from Pitot tube and static pressure sensors. - 0..255 meters/sec. - 1 m/s = 1.94384449 knots. - Resolution: 1 meter/second. 		$\text{LDS_dec} = \text{LDS_int}$ $\text{LDS_09_dec} = \text{round}(\text{LDS_09})$					
Example Value		Example LDS Packet					
159 m/Sec		[K][L][V] = [0d9][0d1][0x9F]					
UDS Key	x	ESD Digraph	Ai				
UDS Name	x	ESD Name	Indicated Airspeed				
Units	x	Units	Knots	Range	0..999	Format	N
Notes	- x	Notes	- Indicated airspeed of the aircraft.				
UDS Conversion		ESD Conversion					
$\text{LDS_int} = \text{LDS_dec}$		$\text{ESD_dec} = \left(\text{LDS_uint} * \frac{1.94384449 \text{ knots}}{1 \text{ meters/second}} \right)$					
<u>To UDS:</u>		<u>To ESD:</u>					
- x		- Map LDS to integer.					
<u>To LDS:</u>		- Convert integer value to ASCII.					
- x		<u>To LDS:</u>					
		- Convert ASCII to integer.					
		- Map integer to uint8.					

7.9.1 Example Platform Indicated Airspeed

The indicated airspeed of an aircraft is calculated from the difference between static pressure, and impact pressure. Static pressure is measured by a sensor not directly in the air stream and impact pressure is measured by a Pitot tube positioned strategically within the air stream. The difference in pressure while moving provides a way to calculate the indicated platform airspeed.

7.10 Tag 10: Platform Designation Conversion

LDS Tag	10	Units	Range	Format
LDS Name	Platform Designation	String	1..127	ISO 646
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Use Platform Designation String - e.g.: 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'IgnatER', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc. - Value field is Free Text. - Maximum 127 characters. 			x	x
Example Value		Example LDS Packet		
MQ1-B		[K][L][V] = [0d10][0d5][0x4D 51 31 2D 42]		
UDS Key	06 0E 2B 34 01 01 01 01 01 01 20 01 00 00 00 00	ESD Digraph	Pc	
UDS Name	Device Designation	ESD Name	Project ID Code	
Units	Range	Format	Units	Range
String	1..32	ISO 646	Number	0..99
Notes		Notes		
<ul style="list-style-type: none"> - Identifies the "house name" of the device used in capturing or generating the essence. - 32 characters maximum. - ISO7 character set. 		<ul style="list-style-type: none"> - The Project ID of the Collection Platform. - (e.g., Predator, Outrider, Pioneer, etc.) 		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- Convert string to Project ID Code.		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		- Convert Project ID Code to string.		

7.10.1 Example Platform Designation

The platform designation metadata item distinguishes which platform is carrying the motion imagery generating payload equipment. Some current platforms are shown below:



Figure 7-4: Example Platforms

Note: Some systems use the UDS key 06 0E 2B 34 01 01 01 03 01 01 21 01 00 00 00 00 to represent Platform Designation instead of the 16-byte key shown above (Device Designation) as used in EG0104.5.

7.11 Tag 11: Image Source Sensor Conversion

LDS Tag	11	Units	String	Range	1..127	Format	ISO 646
LDS Name	Image Source Sensor						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - String of image source sensor. - E.g.: 'EO Nose', 'EO Zoom (DLTV)', 'EO Spotter', 'IR Mitsubishi PtSi Model 500', 'IR InSb Amber Model TBT', 'LYNX SAR Imagery', 'TESAR Imagery', etc. - Value field is Free Text. - Maximum 127 characters. 		<ul style="list-style-type: none"> x x 					
Example Value		Example LDS Packet					
EO		[K][L][V] = [0d11][0d2][0x45 4F]					
UDS Key	06 0E 2B 34 01 01 01 01	ESD Digraph	Sn				
UDS Name	04 20 01 02 01 01 00 00 Image Source Device	ESD Name	Sensor Name				
Units	String	Range	1..32	Format	ISO 646	Units	Name Code
Range		Format		Units	0..7	Range	N
Notes	<ul style="list-style-type: none"> - Indicates the type of the image source. - 32 characters maximum. - ISO7 character set. 			Notes			
			<ul style="list-style-type: none"> - Identifies the source of the video image. - 0: EO Nose - 1: EO Zoom (DLTV) - 2: EO Spotter - 3: IR Mitsubishi PtSi Model 500 - 4: IR Mitsubishi PtSi Model 600 - 5: IR InSb Amber Model TBD - 6: Lynx SAR Imagery - 7: TESAR Imagery 				
UDS Conversion				ESD Conversion			
x				x			
<u>To UDS:</u>				<u>To ESD:</u>			
- x				- Convert string to ID code.			
<u>To LDS:</u>				<u>To LDS:</u>			
- x				- Convert ID code to string.			

7.11.1 Example Image Source Sensor

A sample imaging source sensor is shown in the figure below:



Figure 7-5: Sample Imaging Sensor

7.12 Tag 12: Image Coordinate System Conversion

LDS Tag	12	Units	Range	Format
LDS Name	Image Coordinate System	String	1..127	ISO 646
UDS Mapped Key	Use EG0104 UDS Key			
Notes	Conversion Formula			
- String of the image coordinate system used.			x	
- E.g.: 'Geodetic WGS84', 'Geocentric WGS84', 'UTM', 'None', etc.			x	
Example Value	Example LDS Packet			
WGS-84	[K][L][V] = [0d12][0d6][0x57 47 53 2D 38 34]			
UDS Key	06 0E 2B 34 01 01 01 01 07 01 01 01 00 00 00 00	ESD Digraph	Ic	
UDS Name	Image Coordinate System	ESD Name	Image Coordinate System	
Units	Range	Format	Units	Range
String	1..4	ISO 646	Code	0..3
Format			N	
Notes	Notes			
- Identifies the Digital Geographic Information Exchange Standard (DIGEST) geo-referenced coordinate system used at image capture.			- Identifies the image coordinate system used.	
- ISO7 character set.			- 0: Geodetic WGS84	
			- 1: Geocentric WGS 84	
			- 2: UTM	
			- 3: None	
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- Convert string to ID code.		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		- Convert ID code to string.		

7.12.1 World Geodetic System – 1984 (WGS 84)

The World Geodetic System of 1984 (WGS 84) is a 3-D, Earth-centered reference system developed originally by the U.S. Defense Mapping Agency. This system is the official GPS reference system.

7.12.2 Universal Transverse Mercator (UTM)

UTM is the projection of the earth onto a cylinder. The Universal Transverse Mercator Projection (UTM) divides the globe, excluding the extreme polar areas, into 100km x100km sections and projects each section onto a separate plane that is tangent to the globe at a point within that section. An orthorectifying grid is applied to the projection and results in very minor distortions as no location is greater than 140 km from the point of tangency. Distances, angles and shapes are very accurately depicted within each plane using this earth coordinate system.

Applications exist which convert between UTM and WGS84 coordinate systems and their different datum references.

7.12.3 Notes and Clarification

As of Standard 0601.4, a reference to “DIGEST V2.1 Part 3 Sec 6.4” within the UAS LDS section has been removed due to the reference’s inapplicability to the Image Coordinate System metadata item.

“Geodetic WGS84” is the preferred Image Coordinate System. “UTM” and other values are provided for sake of completeness to map items between legacy metadata sets.

7.13 Tag 13: Sensor Latitude Conversion

LDS Tag	13	Units	Range	Format
LDS Name	Sensor Latitude	Degrees	+/- 90	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Sensor Latitude. Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~42 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_13_dec} = \left(\frac{180}{4294967294} * \text{LDS_13} \right)$		
Example Value		Example LDS Packet		
60.1768229669783 Degrees		[K][L][V] = [0d13][0d4][0x55 95 B6 6D]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 02 04 02 00	ESD Digraph	Sa	
UDS Name	Device Latitude	ESD Name	Sensor Latitude	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
				PDDMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Specifies a sensor's geographic location in decimal degrees of latitude. - Positive values indicate northern hemisphere. - Negative values indicate southern hemisphere. 		<ul style="list-style-type: none"> - Latitude of the aircraft. + Means North Latitude. All Latitude coordinates use WGS84. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{180}{4294967294} * \text{LDS_int} \right)$		$\text{ESD_dec} = \left(\frac{180}{4294967294} * \text{LDS_int} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double) (180/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/180 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.13.1 Example Latitude

Latitude is the angular distance north or south of the earth's equator, measured in degrees along a meridian. Generated from GPS/INS information and based on the WGS84 coordinate system.

Note that this LDS item for Sensor Latitude represents the imaging sensor location versus the aircraft position as represented by the ESD digraph.

In a realized system, this LDS item takes into account the lever arm distance between a platform's GPS antenna (or known central platform position) to a sensor's general location (like the center of a gimballed sensor).

While accounting for a lever arm in this crude way is sufficient for many Motion Imagery systems, it is recommended for the user to explore use of Photogrammetric metadata sets (i.e. MISB EG0801) for improved representations of system accuracies.

Note that the int32 used in the LDS value is encoded using two's complement.

7.14 Tag 14: Sensor Longitude Conversion

LDS Tag	14	Units	Range	Format
LDS Name	Sensor Longitude	Degrees	+/- 180	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Sensor Longitude. Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_14_dec} = \left(\frac{360}{4294967294} * \text{LDS_14} \right)$		
Example Value		Example LDS Packet		
128.426759042045 Degrees		[K][L][V] = [0d14][0d4][0x5B 53 60 C4]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 02 06 02 00	ESD Digraph	So	
UDS Name	Device Longitude	ESD Name	Sensor Longitude	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Specifies a sensor's geographic location in decimal degrees of longitude. - Positive values indicate eastern hemisphere. - Negative values indicate western hemisphere. 		<ul style="list-style-type: none"> - Longitude of the aircraft. + Means East Longitude. All Longitude coordinates use WGS84. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		$\text{ESD_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double)(360/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/360 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.14.1 Example Longitude

Longitude is the angular distance on the earth's surface, measured east or west from the prime meridian at Greenwich, England, to the meridian passing through a position of interest. Generated from GPS/INS information and based on the WGS84 coordinate system.

Note that this LDS item for Sensor Longitude represents the imaging sensor location versus the aircraft position as represented by the ESD digraph.

In a realized system, this LDS item takes into account the lever arm distance between a platform's GPS antenna (or known central platform position) to a sensor's general location (like the center of a gimbaled sensor).

While accounting for a lever arm in this crude way is sufficient for many Motion Imagery systems, it is recommended for the user to explore use of Photogrammetric metadata sets (i.e. MISB EG0801) for improved representations of system accuracies.

Note that the int32 used in the LDS value is encoded using two's complement.

7.15 Tag 15: Sensor True Altitude Conversion

LDS Tag	15	Units	Range	Format
LDS Name	Sensor True Altitude	Meters	-900..19000	uint16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Altitude of sensor as measured from Mean Sea Level (MSL). - Map 0..(2¹⁶-1) to -900..19000 meters. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_15_dec} = \left(\frac{19900}{65535} * \text{LDS_15} \right) - 900$		
Example Value		Example LDS Packet		
14190.72 Meters		[K][L][V] = [0d15][0d2][0xC2 21]		
UDS Key	06 0E 2B 34 01 01 01 01 07 01 02 01 02 02 00 00	ESD Digraph	S1	
UDS Name	Device Altitude	ESD Name	Sensor Altitude	
Units	Range	Format	Units	Range
Meters	Float	Float	Feet	+/- 0..99,999
Notes	Notes			Format
<ul style="list-style-type: none"> - Altitude of sensor as measured from Mean Sea Level (MSL), (default metres). 	<ul style="list-style-type: none"> - Altitude of the aircraft (MSL). 			PN
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{19900}{65535} * \text{LDS_uint} \right) - 900$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (float)((19900/0xFFFF) * LDS - 900) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (uint16)round(0xFFFF/19900 * (UDS + 900)) 		$\text{ESD_dec} = \left(\frac{19900}{65535} * \text{LDS_uint} - 900 \right) * \frac{3.2808399\text{ft}}{1\text{m}}$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Account for units. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Account for units. - Map decimal to uint16. 		

7.15.1 Example True Altitude

True Altitude is the true vertical distance above mean sea level.

For improved modeling accuracy it is suggested to alternatively use Sensor Ellipsoid Height (tag 75) should GPS be used to determine altitude.

Note that this LDS item for Sensor Altitude represents the imaging sensor location versus the aircraft position as represented by the ESD digraph.

In a realized system, this LDS item takes into account the lever arm distance between a platform's GPS antenna (or known central platform position) to a sensor's general location (like the center of a gimbaled sensor).

While accounting for a lever arm in this crude way is sufficient for many Motion Imagery systems, it is recommended for the user to explore use of Photogrammetric metadata sets (i.e. MISB EG0801) for improved representations of system accuracies.

7.16 Tag 16: Sensor Horizontal Field of View Conversion

LDS Tag	16	Units	Degrees	Range	0..180	Format	uint16
LDS Name	Sensor Horizontal Field of View						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Horizontal field of view of selected imaging sensor. - Map 0..(2¹⁶-1) to 0..180. - Resolution: ~2.7 milli degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_16_dec} = \left(\frac{180}{65535} * \text{LDS_16} \right)$					
Example Value		Example LDS Packet					
144.5713 Degrees		[K][L][V] = [0d16][0d2][0xCD 9C]					
UDS Key	06 0E 2B 34 01 01 01 02	ESD Digraph	Fv				
UDS Name	04 20 02 01 01 08 00 00	ESD Name	Field of View				
Units	Degrees	Range	0..180	Format	Float	Units	Degrees
Range	0..180	Format	Float	Range	0..180.00	Format	DDD.HH
Notes		Notes					
<ul style="list-style-type: none"> - Sensor Horizontal field of view. 		<ul style="list-style-type: none"> - Angle of view of the lens on the selected camera. Horizontal, across baseline of image, projected onto the terrain (flat terrain model at DTED or other best available elevation data). 					
UDS Conversion				ESD Conversion			
$\text{UDS_dec} = \left(\frac{180}{65535} * \text{LDS_uint} \right)$				$\text{ESD_dec} = \left(\frac{180}{65535} * \text{LDS_uint} \right)$			
<u>To UDS:</u>				<u>To ESD:</u>			
<ul style="list-style-type: none"> - UDS = (float)(180/0xFFFF * LDS) 				<ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. 			
<u>To LDS:</u>				<u>To LDS:</u>			
<ul style="list-style-type: none"> - LDS = (uint16)round(0xFFFF/180 * UDS) 				<ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Map decimal to uint16. 			

7.16.1 Example Sensor Horizontal Field of View

The field of view of a lens is defined as the angle over the focal plane where objects are recorded on a film or electro-optical sensor. Field of view is dependent upon the focal length of the lens, and the physical size of the sensor. Typical imaging devices have a square or rectangular imaging sensor. The image (or sequence of images) is typically captured as a square or rectangle and displayed to a user with image edges perpendicular to level sight.

The distance between left edge and right edge is represented as an angle in the horizontal field of view metadata item. Refer to the figure below:

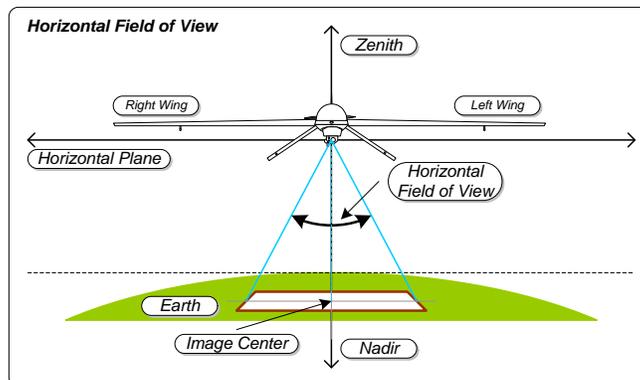


Figure 7-6: Horizontal Field of View

7.17 Tag 17: Sensor Vertical Field of View Conversion

LDS Tag	17	Units	Degrees	Range	0..180	Format	uint16
LDS Name	Sensor Vertical Field of View						
UDS Mapped Key	06 0E 2B 34 01 01 01 07 04 20 02 01 01 0A 01 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Vertical field of view of selected imaging sensor. - Map 0..(2¹⁶-1) to 0..180. - Resolution: ~2.7 milli degrees. - Requires data conversion between LDS value and SMPTE Mapped UDS Key. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_17_dec} = \left(\frac{180}{65535} * \text{LDS_17} \right)$					
Example Value		Example LDS Packet					
152.6436 Degrees		[K][L][V] = [0d17][0d2][0xD9 17]					
UDS Key	x	ESD Digraph	Vv				
UDS Name	x	ESD Name	Vertical Field of View				
Units	x	Units	Degrees	Range	0..180.00	Format	DDD.HH
Range	x	Range					
Format	x	Format					
Notes		Notes					
- x		<ul style="list-style-type: none"> - Angle of view of the lens on the selected camera. Vertical across baseline of image, projected onto the terrain (flat terrain model at DTED or other best available elevation data). 					
UDS Conversion		ESD Conversion					
x		$\text{ESD_dec} = \left(\frac{180}{65535} * \text{LDS_uint} \right)$					
<u>To UDS:</u>		<u>To ESD:</u>					
- x		<ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. 					
<u>To LDS:</u>		<u>To LDS:</u>					
- x		<ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Map decimal to uint16. 					

7.17.1 Example Sensor Vertical Field of View

The field of view of a lens is defined as the angle over the focal plane where objects are recorded on a film or electro-optical sensor. Field of view is dependent upon the focal length of the lens, and the physical size of the sensor. Typical imaging devices have a square or rectangular imaging sensor. The image (or sequence of images) is typically captured as a square or rectangle and displayed to a user with image edges perpendicular to level sight.

The distance between top edge and bottom edge is represented as an angle in the vertical field of view metadata item. Refer to the figure below:

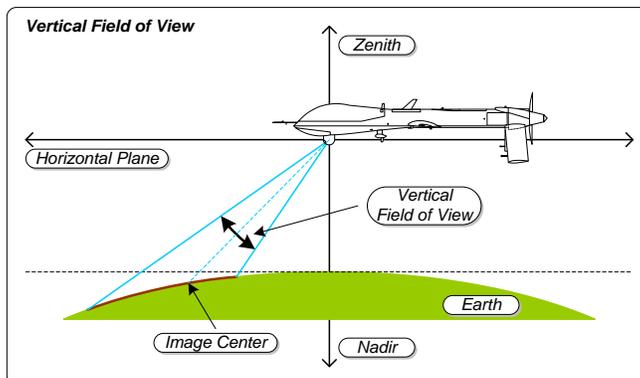


Figure 7-7: Vertical Field of View

7.18 Tag 18: Sensor Relative Azimuth Angle Conversion

LDS Tag	18	Units	Degrees	Range	0..360	Format	uint32
LDS Name	Sensor Relative Azimuth Angle						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 02 04 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Relative rotation angle of sensor to platform longitudinal axis. Rotation angle between platform longitudinal axis and camera pointing direction as seen from above the platform. - Map 0..(2^32-1) to 0..360. - Resolution: ~84 nano degrees. 		$LDS_dec = \left(\frac{LDS_range}{uint_range} * LDS_uint \right)$ $LDS_18_dec = \left(\frac{360}{4294967295} * LDS_18 \right)$					
Example Value		Example LDS Packet					
160.719211474396 Degrees		[K][L][V] = [0d18][0d4][0x72 4A 0A 20]					
UDS Key	x	ESD Digraph	Az				
UDS Name	x	ESD Name	Sensor Relative Azimuth Angle				
Units	x	Range	x	Format	x		
		Degrees	0..359.99	DDD.HH			
Notes		Notes					
- x		<ul style="list-style-type: none"> - Relative rotation angle of sensor to aircraft platform in azimuth. Rotation angle between aircraft fuselage chord and camera pointing direction as seen from above the platform. 					
UDS Conversion				ESD Conversion			
x				$ESD_dec = \left(\frac{360}{4294967294} * LDS_int \right)$			
<u>To UDS:</u>		<u>To ESD:</u>					
- x		- Convert LDS to decimal.					
<u>To LDS:</u>		- Convert decimal to ASCII.					
- x		<u>To LDS:</u>					
		- Convert ESD ASCII to decimal.					
		- Map decimal to uint32.					

7.18.1 Example Sensor Relative Azimuth Angle

The relative rotation angle of the sensor is the angle formed between the platform longitudinal axis (line made by the fuselage) and the sensor pointing direction as measured in the plane formed by the platform longitudinal and transverse axis (line from wing tip to wing tip). Refer to the figure below:

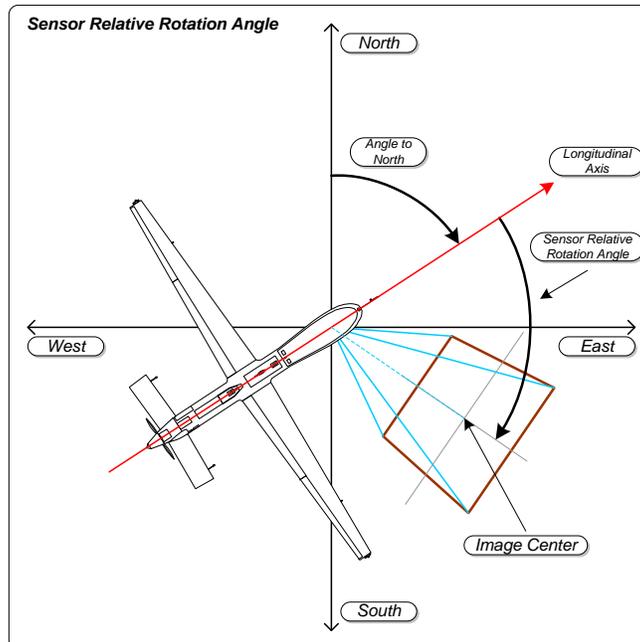


Figure 7-8: Relative Rotation Angle

7.19 Tag 19: Sensor Relative Elevation Angle Conversion

LDS Tag	19	Units	Degrees	Range	+/- 180	Format	int32
LDS Name	Sensor Relative Elevation Angle						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 02 05 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Relative Elevation Angle of sensor to platform longitudinal-transverse plane. Negative angles down. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Res: ~84 ndeg. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right)$ $LDS_19_dec = \left(\frac{360}{4294967294} * LDS_19 \right)$					
Example Value		Example LDS Packet					
-168.792324833941 Degrees		[K][L][V] = [0d19][0d4][0x87 F8 4B 86]					
UDS Key	x	ESD Digraph	De				
UDS Name	x	ESD Name	Sensor Relative Elevation Angle				
Units	x	Range	x	Format	x	Units	Degrees
						Range	+/- 180.00
						Format	PDDD.HH
Notes		Notes					
- x		<ul style="list-style-type: none"> - Relative Elevation Angle of sensor to aircraft platform. Level flight with camera pointing forward is zero degrees. Negative angles down. 					
UDS Conversion				ESD Conversion			
x				$ESD_dec = \left(\frac{360}{4294967294} * LDS_int \right)$			
<u>To UDS:</u>				<u>To ESD:</u>			
- x				<ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. 			
<u>To LDS:</u>				<u>To LDS:</u>			
- x				<ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Map decimal to uint32. 			

7.19.1 Example Sensor Relative Elevation Angle

The relative elevation angle of the sensor to the aircraft is the downward (or upward) pointing angle of the sensor relative to the plane formed by the longitudinal axis (line made by the fuselage) and the transverse axis (line from wing tip to wing tip). Sensor pointing angles below the platform longitudinal-transverse plane are negative. Refer to the figure below:

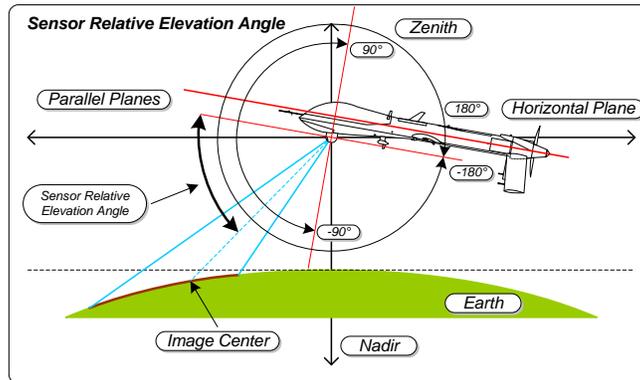


Figure 7-9: Sensor Relative Elevation Angle

Note that the int32 used in the LDS value is encoded using two's complement.

7.20 Tag 20: Sensor Relative Roll Angle Conversion

LDS Tag	20	Units	Range	Format
LDS Name	Sensor Relative Roll Angle	Degrees	0..360	uint32
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 02 06 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Relative roll angle of sensor to aircraft platform. Twisting angle of camera about lens axis. Top of image is zero degrees. Positive angles are clockwise when looking from behind camera. - Map 0..(2³²-1) to 0..360. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_20_dec} = \left(\frac{360}{4294967295} * \text{LDS_20} \right)$		
Example Value		Example LDS Packet		
176.865437690572 Degrees		[K][L][V] = [0d20][0d4][0x7D C5 5E CE]		
UDS Key	x	ESD Digraph	Ro	
UDS Name	x	ESD Name	Sensor Relative Roll Angle	
Units	Range	Units	Range	Format
x	x	Degrees	0..359.99	DDD.HH
Notes		Notes		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - Relative roll angle of sensor to aircraft platform. Twisting angle of camera about lens axis. Top of image is zero degrees. Positive angles are clockwise when looking from behind camera. 		
UDS Conversion		ESD Conversion		
x		$\text{ESD_dec} = \left(\frac{360}{4294967294} * \text{LDS_uint} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		<ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. 		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		<ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Map decimal to uint32. 		

7.20.1 Example Sensor Relative Roll Angle

Sensors that are able to rotate their camera about the lens axis make use of this sensor relative roll angle. A roll angle of zero degrees occurs when the top and bottom edges of the captured image lie perpendicular to the plane created by the sensor relative depression angle axis. Positive angles are clockwise when looking from behind the camera.

7.21 Tag 21: Slant Range Conversion

LDS Tag	21	Units	Meters	Range	0..5,000,000	Format	uint32
LDS Name	Slant Range						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Slant range in meters. Distance to target. - Map 0..(2^32-1) to 0..5000000 meters. - 1 nautical mile (knot) = 1852 meters. - Resolution: ~1.2 milli meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_dec} = \left(\frac{5000000}{4294967295} * \text{LDS_uint} \right)$					
Example Value		Example LDS Packet					
68590.98 Meters		[K][L][V] = [0d21][0d4][0x03 83 09 26]					
UDS Key	06 0E 2B 34 01 01 01 01 07 01 08 01 01 00 00 00	ESD Digraph	Sr				
UDS Name	Slant Range	ESD Name	Slant Range				
Units	Meters	Range	Float	Format	Float	Units	Nautical Miles
Range		Range	0..18.00	Format	II.HH	Range	
Notes		Notes					
<ul style="list-style-type: none"> - Distance from the sensor to the center point on ground of the framed subject (image) depicted in the captured essence, (default metres) 		<ul style="list-style-type: none"> - Distance between the sensor and the target. 					
UDS Conversion				ESD Conversion			
$\text{UDS_dec} = \left(\frac{5000000}{4294967295} * \text{LDS_uint} \right)$				$\text{ESD_dec} = \left(\frac{5000000}{4294967295} * \text{LDS_uint} \right) * \frac{1852\text{knot}}{1\text{m}}$			
<u>To UDS:</u>				<u>To ESD:</u>			
<ul style="list-style-type: none"> - UDS = (float)(5000000/0xFFFFFFFF * LDS) 				<ul style="list-style-type: none"> - Convert LDS to decimal. - Account for units. - Convert knots to ASCII. 			
<u>To LDS:</u>				<u>To LDS:</u>			
<ul style="list-style-type: none"> - LDS = (uint32)round(0xFFFFFFFF/5000000 * UDS) 				<ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Account for units. - Convert feet to uint32. 			

7.21.1 Example Sensor Slant Range

The slant range is the distance between the sensor and image center. Refer to the figure below.

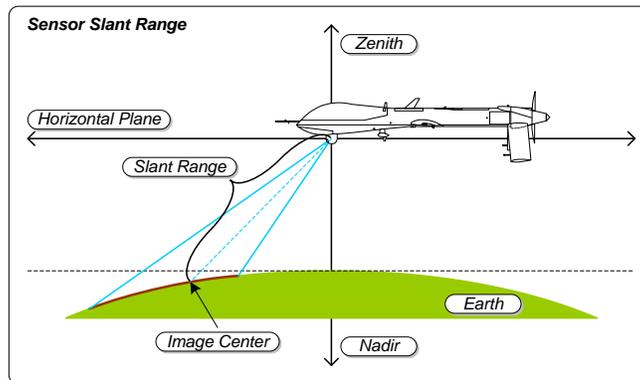


Figure 7-10: Sensor Slant Range

As of STANDARD 0601.3 Generic Flag Data 01 (tag 47) contains a flag which indicates weather Slant Range is “Computed” or “Measured”. By default the Slant Range is set to “Computed”. “Measured” is to be used when a ranging device (radar, or laser) is providing Slant Range estimates.

7.22 Tag 22: Target Width Conversion

LDS Tag	22	Units	Meters	Range	0..10,000	Format	uint16
LDS Name	Target Width						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Target Width within sensor field of view. - Map 0..(2¹⁶-1) to 0..10000 meters. - 1 meter = 3.2808399 feet. - Resolution: ~.16 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_dec} = \left(\frac{10000}{65535} * \text{LDS_uint} \right)$					
Example Value		Example LDS Packet					
722.8199 Meters		[K][L][V] = [0d22][0d2][0x12 81]					
UDS Key	06 0E 2B 34 01 01 01 01	ESD Digraph	Tw				
UDS Name	07 01 09 02 01 00 00 00	ESD Name	Target Width				
Units	Meters	Range	Float	Format	Float	Units	Feet
Range		Range	0..99,999	Format	N	Range	
Notes	<ul style="list-style-type: none"> - Horizontal half width of the target frame image; used to compute the four corner points of the frame, (default metres) 			Notes			
				<ul style="list-style-type: none"> - Width of the EO/IR Payloads field of view on the ground 			
UDS Conversion				ESD Conversion			
$\text{UDS_dec} = \left(\frac{10000}{65535} * \text{LDS_uint} \right)$				$\text{ESD_dec} = \left(\frac{10000}{65535} * \text{LDS_uint} \right) * \frac{3.2808399\text{ft}}{1\text{m}}$			
To UDS:				To ESD:			
<ul style="list-style-type: none"> - UDS = (float)(10000/0xFFFF * LDS) 				<ul style="list-style-type: none"> - Convert LDS to decimal. - Account for units. - Convert feet to ASCII. 			
To LDS:				To LDS:			
<ul style="list-style-type: none"> - LDS = (uint16)round(0xFFFF/10000 * UDS) 				<ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Account for units. - Convert meters to uint32. 			

7.22.1 Example Sensor Target Width

The target width is the linear ground distance between the center of both sides of the captured image. Refer to figure below.

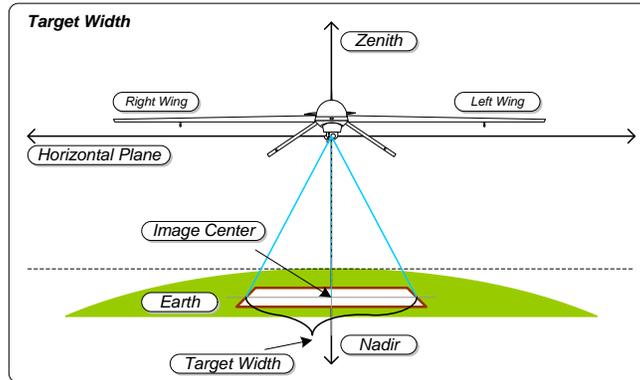


Figure 7-11: Target Width

Note: SMPTE periodically makes updates to its use of metadata keys and has made a change denoting Target Width as the half-width of the image. Despite this change in the SMPTE definition, the MISB continues to interpret Target Width for ST 0601 as full-width.

7.23 Tag 23: Frame Center Latitude Conversion

LDS Tag	23	Units	Range	Format	
LDS Name	Frame Center Latitude	Degrees	+/- 90	int32	
UDS Mapped Key	Use EG0104 UDS Key				
Notes		Conversion Formula			
<ul style="list-style-type: none"> - Terrain Latitude of frame center. Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~42 nano degrees. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right)$ $LDS_23_dec = \left(\frac{180}{4294967294} * LDS_23 \right)$			
Example Value		Example LDS Packet			
-10.5423886331461 Degrees		[K][L][V] = [0d23][0d4][0xF1 01 A2 29]			
UDS Key	06 0E 2B 34 01 01 01 01 07 01 02 01 03 02 00 00	ESD Digraph	Ta		
UDS Name	Frame Center Latitude	ESD Name	Target Latitude		
Units	Range	Format	Units	Range	Format
Degrees	+/- 90	Double	Degrees	+/- 90.00	PDDMMSSST
Notes			Notes		
<ul style="list-style-type: none"> - Specifies the video frame center point geographic location in decimal degrees of latitude. - Positive values indicate northern hemisphere. - Negative values indicate southern hemisphere. 			<ul style="list-style-type: none"> - Latitude of the EO/IR payload's aimpoint on the ground. + Means North latitude. All latitude coordinates use WGS84. 		
UDS Conversion			ESD Conversion		
<p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)(180/0xFFFFFFFF * LDS) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int32)round(0xFFFFFFFF/180 * UDS) 			$ESD_dec = \left(\frac{180}{4294967294} * LDS_int \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int32. 		

7.23.1 Example Frame Center Latitude

The center of the captured image or image sequence has a real earth coordinate represented by a latitude-longitude-altitude triplet. Frame centers that lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object) and should either not be reported, or be reported as an "error".

Note that the int32 used in the LDS value is encoded using two's complement.

7.24 Tag 24: Frame Center Longitude Conversion

LDS Tag	24	Units	Range	Format
LDS Name	Frame Center Longitude	Degrees	+/- 180	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Terrain Longitude of frame center. Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_24_dec} = \left(\frac{360}{4294967294} * \text{LDS_24} \right)$		
Example Value		Example LDS Packet		
29.157890122923 Degrees		[K][L][V] = [0d24][0d4][0x14 BC 08 2B]		
UDS Key	06 0E 2B 34 01 01 01 01 07 01 02 01 03 04 00 00	ESD Digraph	To	
UDS Name	Frame Center Longitude	ESD Name	Target Longitude	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
Format			Format	PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Specifies the video frame center point geographic location in decimal degrees of longitude. - Positive values indicate eastern hemisphere. - Negative values indicate western hemisphere. 		<ul style="list-style-type: none"> - Longitude of the EO/IR payload's aimpoint on the ground. + Means East longitude. All longitude coordinates use WGS84. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		$\text{ESD_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double) (360/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/360 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.24.1 Example Frame Center Longitude

The center of the captured image or image sequence has a real earth coordinate represented by a latitude-longitude-altitude triplet. Frame centers that lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object) and should either not be reported, or be reported as an "error".

Note that the int32 used in the LDS value is encoded using two's complement.

7.25 Tag 25: Frame Center Elevation Conversion

LDS Tag	25	Units	Range	Format
LDS Name	Frame Center Elevation	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 0A 07 01 02 01 03 16 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Terrain elevation at frame center relative to Mean Sea Level (MSL). - Map 0..(2^16-1) to -900..19000 meters. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_25_dec} = \left(\frac{19900}{65535} * \text{LDS_25} \right) - 900$		
Example Value		Example LDS Packet		
3216.037 Meters		[K][L][V] = [0d25][0d2][0x34 F3]		
UDS Key	x	ESD Digraph	Te	
UDS Name	x	ESD Name	Frame Center Elevation	
Units	Range	Format	Units	Range
x	x	x	Feet	+/- 0..99,999
Notes		Notes		
- x		- Terrain elevation at frame center.		
UDS Conversion		ESD Conversion		
<p><u>To UDS:</u></p> <ul style="list-style-type: none"> - x <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - x 		$\text{ESD_dec} = \left(\frac{19900}{65535} * \text{LDS_uint} - 900 \right) * \frac{3.2808399\text{ft}}{1\text{m}}$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Account for units. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Account for units. - Map decimal to uint16. 		

7.25.1 Example Frame Center Elevation

The center of the captured image or image sequence has a real earth coordinate represented by a latitude-longitude-altitude triplet. Frame centers that lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object) and should either not be reported, or be reported as an “error”.

The altitude is represented as height above mean sea level (MSL).

7.26 Tag 26: Offset Corner Latitude Point 1 Conversion

LDS Tag	26	Units	Range	Format
LDS Name	Offset Corner Latitude Point 1	Degrees	+/-0.075	int16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Latitude, offset for upper left corner. Based on WGS84 ellipsoid. - Use with Frame Center Latitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right) + LDS_23_dec$ $LDS_26_dec = \left(\frac{0.15}{65534} * LDS_26 \right) + LDS_23_dec$		
Example Value		Example LDS Packet		
-10.579637999887 Corrected Degrees		[K][L][V] = [0d26][0d2][0xC0 6E]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 07 01 00	ESD Digraph	Rg	
UDS Name	Corner Latitude Point 1 (Decimal Degrees)	ESD Name	SAR Latitude 4	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
			Format	PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Latitude coordinate of corner 1 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		<ul style="list-style-type: none"> - The latitude of the upper left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$UDS_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_23_dec$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFE * LDS) + LDS_23_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFE/0.15 * (UDS - Frame_Center_LAT)) 		$ESD_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_23_dec$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.26.1 Example Corner Latitude Point 1

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range should either not be reported, or be reported as an "error".

Corner point 1 is the upper left corner of the captured image as highlighted in red.

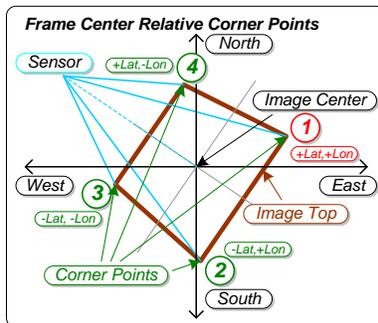


Figure 7-12: Offset Corner Point 1

The Offset Corner Latitude Point 1 is added to the Frame Center Latitude metadata item to determine the Latitude of the first corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.27 Tag 27: Offset Corner Longitude Point 1 Conversion

LDS Tag	27	Units	Range	Format
LDS Name	Offset Corner Longitude Point	Degrees	+/-0.075	int16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude, offset for upper left corner. Based on WGS84 ellipsoid. - Use with Frame Center Longitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right) + LDS_24_dec$ $LDS_27_dec = \left(\frac{0.15}{65534} * LDS_27 \right) + LDS_24_dec$		
Example Value		Example LDS Packet		
29.1273677986333 Corrected Degrees		[K][L][V] = [0d27][0d2][0xCB E9]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0B 01 00	ESD Digraph	Rh	
UDS Name	Corner Longitude Point 1 (Decimal Degrees)	ESD Name	SAR Longitude 4	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Longitude coordinate of corner 1 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 		<ul style="list-style-type: none"> - The longitude of the upper left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$UDS_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_24_dec$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFFE * LDS) + LDS_24_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFFE/0.15 * (UDS - Frame_Center_LON)) 		$ESD_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_24_dec$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.27.1 Example Corner Longitude Point 1

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range, should either not be reported, or be reported as an "error".

Corner point 1 is the upper left corner of the captured image. See figure for Tag 26 above.

The Offset Corner Longitude Point 1 is added to the Frame Center Longitude metadata item to determine the Longitude of the first corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.28 Tag 28: Offset Corner Latitude Point 2 Conversion

LDS Tag	28	Units	Range	Format
LDS Name	Offset Corner Latitude Point 2	Degrees	+/-0.075	int16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Latitude, offset for upper right corner. Based on WGS84 ellipsoid. - Use with Frame Center Latitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right) + LDS_23_dec$ $LDS_28_dec = \left(\frac{0.15}{65534} * LDS_28 \right) + LDS_23_dec$		
Example Value		Example LDS Packet		
-10.5661816260963 Corrected Degrees		[K][L][V] = [0d28][0d2][0xD7 65]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 08 01 00	ESD Digraph	Ra	
UDS Name	Corner Latitude Point 2 (Decimal Degrees)	ESD Name	SAR Latitude 1	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Latitude coordinate of corner 2 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		<ul style="list-style-type: none"> - The latitude of the upper right corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$UDS_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_23_dec$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFE * LDS) + LDS_23_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFE/0.15 * (UDS - Frame_Center_LAT)) 		$ESD_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_23_dec$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.28.1 Example Corner Latitude Point 2

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range, should either not be reported, or be reported as an "error".

Corner point 2 is the upper right corner of the captured image as highlighted in red.

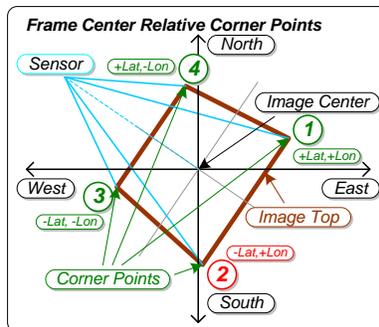


Figure 7-13: Offset Corner Point 2

The Offset Corner Latitude Point 2 is added to the Frame Center Latitude metadata item to determine the Latitude of the second corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.29 Tag 29: Offset Corner Longitude Point 2 Conversion

LDS Tag	29	Units	Range	Format
LDS Name	Offset Corner Longitude Point 2	Degrees	+/-0.075	int16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude, offset for upper right corner. Based on WGS84 ellipsoid. - Use with Frame Center Longitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right) + LDS_24_dec$ $LDS_29_dec = \left(\frac{0.15}{65534} * LDS_29 \right) + LDS_24_dec$		
Example Value		Example LDS Packet		
29.140824172424 Corrected Degrees		[K][L][V] = [0d29][0d2][0xE2 E0]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0C 01 00	ESD Digraph	Rb	
UDS Name	Corner Longitude Point 2 (Decimal Degrees)	ESD Name	SAR Longitude 1	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Longitude coordinate of corner 2 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 		<ul style="list-style-type: none"> - The longitude of the upper right corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$UDS_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_24_dec$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFFE * LDS) + LDS_24_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFFE/0.15 * (UDS - Frame_Center_LON)) 		$ESD_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_24_dec$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.29.1 Example Corner Longitude Point 2

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range, should either not be reported, or be reported as an "error".

Corner point 2 is the upper right corner of the captured image. See figure for Tag 28 above.

The Offset Corner Longitude Point 2 is added to the Frame Center Longitude metadata item to determine the Longitude of the second corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.30 Tag 30: Offset Corner Latitude Point 3 Conversion

LDS Tag	30	Units	Range	Format	
LDS Name	Offset Corner Latitude Point 3	Degrees	+/-0.075	int16	
UDS Mapped Key	Use EG0104 UDS Key				
Notes	<ul style="list-style-type: none"> - Frame Latitude, offset for lower right corner. Based on WGS84 ellipsoid. - Use with Frame Center Latitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 				
Conversion Formula	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right) + \text{LDS_23_dec}$ $\text{LDS_30_dec} = \left(\frac{0.15}{65534} * \text{LDS_30} \right) + \text{LDS_23_dec}$				
Example Value	-10.5527275411938 Corrected Degrees	Example LDS Packet	[K][L][V] = [0d30][0d2][0xEE 5B]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 09 01 00	ESD Digraph	Rc		
UDS Name	Corner Latitude Point 3 (Decimal Degrees)	ESD Name	SAR Latitude 2		
Units	Range	Format	Units	Range	Format
Degrees	+/- 90	Double	Degrees	+/- 90.00	PDDMMSSST
Notes	<ul style="list-style-type: none"> - Latitude coordinate of corner 3 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		Notes		
UDS Conversion			ESD Conversion		
$\text{UDS_dec} = \left(\frac{0.15}{65534} * \text{LDS_int} \right) + \text{LDS_23_dec}$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFE * LDS) + LDS_23_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFE/0.15 * (UDS - Frame_Center_LAT)) 			$\text{ESD_dec} = \left(\frac{0.15}{65534} * \text{LDS_int} \right) + \text{LDS_23_dec}$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.30.1 Example Corner Latitude Point 3

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range, should either not be reported, or be reported as an "error".

Corner point 3 is the lower right corner of the captured image as highlighted in red.

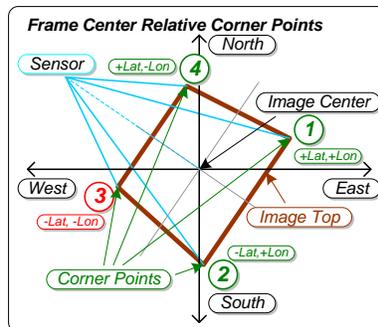


Figure 7-14: Offset Corner Point 3

The Offset Corner Latitude Point 3 is added to the Frame Center Latitude metadata item to determine the Latitude of the third corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.31 Tag 31: Offset Corner Longitude Point 3 Conversion

LDS Tag	31	Units	Range	Format
LDS Name	Offset Corner Longitude Point 3	Degrees	+/-0.075	int16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude, offset for lower right corner. Based on WGS84 ellipsoid. - Use with Frame Center Longitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right) + \text{LDS_24_dec}$ $\text{LDS_31_dec} = \left(\frac{0.15}{65534} * \text{LDS_31} \right) + \text{LDS_24_dec}$		
Example Value		Example LDS Packet		
29.1542782573265 Corrected Degrees		[K][L][V] = [0d31][0d2][0xF9 D6]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0D 01 00	ESD Digraph	Rd	
UDS Name	Corner Longitude Point 3 (Decimal Degrees)	ESD Name	SAR Longitude 2	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Longitude coordinate of corner 3 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 		<ul style="list-style-type: none"> - The longitude of the lower right corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{0.15}{65534} * \text{LDS_int} \right) + \text{LDS_24_dec}$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFFE * LDS) + LDS_24_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFFE/0.15 * (UDS - Frame_Center_LON)) 		$\text{ESD_dec} = \left(\frac{0.15}{65534} * \text{LDS_int} \right) + \text{LDS_24_dec}$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.31.1 Example Corner Longitude Point 3

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range, should either not be reported, or be reported as an "error".

Corner point 3 is the lower right corner of the captured image. See figure for Tag 30 above.

The Offset Corner Longitude Point 3 is added to the Frame Center Longitude metadata item to determine the Longitude of the third corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.32 Tag 32: Offset Corner Latitude Point 4 Conversion

LDS Tag	32	Units	Range	Format
LDS Name	Offset Corner Latitude Point 4	Degrees	+/-0.075	int16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Latitude, offset for lower left corner. Based on WGS84 ellipsoid. - Use with Frame Center Latitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right) + LDS_23_dec$ $LDS_32_dec = \left(\frac{0.15}{65534} * LDS_32 \right) + LDS_23_dec$		
Example Value		Example LDS Packet		
-10.5392711674031 Corrected Degrees		[K][L][V] = [0d32][0d2][0x05 52]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0A 01 00	ESD Digraph	Re	
UDS Name	Corner Latitude Point 4 (Decimal Degrees)	ESD Name	SAR Latitude 3	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Latitude coordinate of corner 4 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		<ul style="list-style-type: none"> - The latitude of the lower left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$UDS_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_23_dec$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFE * LDS) + LDS_23_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFE/0.15 * (UDS - Frame_Center_LAT)) 		$ESD_dec = \left(\frac{0.15}{65534} * LDS_int \right) + LDS_23_dec$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.32.1 Example Corner Latitude Point 4

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range, should either not be reported, or be reported as an "error".

Corner point 4 is the lower left corner of the captured image as highlighted in red.

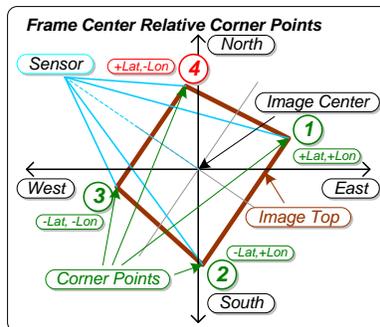


Figure 7-15: Offset Corner Point 4

The Offset Corner Latitude Point 4 is added to the Frame Center Latitude metadata item to determine the Latitude of the fourth corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.33 Tag 33: Offset Corner Longitude Point 4 Conversion

LDS Tag	33	Units	Range	Format
LDS Name	Offset Corner Longitude Point 4	Degrees	+/-0.075	int16
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude, offset for lower left corner. Based on WGS84 ellipsoid. - Use with Frame Center Longitude. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-0.075. - Use $-(2^{15})$ as an "error" indicator. - $-(2^{15}) = 0x8000$. - Resolution: ~1.2micro deg, ~0.25meters at equator. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right) + \text{LDS_24_dec}$ $\text{LDS_33_dec} = \left(\frac{0.15}{65534} * \text{LDS_33} \right) + \text{LDS_24_dec}$		
Example Value		Example LDS Packet		
29.1677346311172 Corrected Degrees		[K][L][V] = [0d33][0d2][0x10 CD]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0E 01 00	ESD Digraph	Rf	
UDS Name	Corner Longitude Point 4 (Decimal Degrees)	ESD Name	SAR Longitude 3	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Longitude coordinate of corner 4 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 		<ul style="list-style-type: none"> - The longitude of the lower left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{0.15}{65534} * \text{LDS_int} \right) + \text{LDS_24_dec}$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)((0.15/0xFFFFE * LDS) + LDS_24_dec) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int16)round(0xFFFFE/0.15 * (UDS - Frame_Center_LON)) 		$\text{ESD_dec} = \left(\frac{0.15}{65534} * \text{LDS_int} \right) + \text{LDS_24_dec}$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int16. 		

7.33.1 Example Corner Longitude Point 4

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, or corner points lying outside of the mapped range, should either not be reported, or be reported as an "error".

Corner point 4 is the lower left corner of the captured image. See figure for Key 32 above.

The Offset Corner Longitude Point 4 is added to the Frame Center Longitude metadata item to determine the Longitude of the fourth corner point of a motion image. Both KLV data items must be converted to decimal prior to addition to determine the actual measured or calculated motion imagery corner point. Value is encoded using two's complement.

7.34 Tag 34: Icing Detected Conversion

LDS Tag	34	Units	Range	Format	
LDS Name	Icing Detected	Icing Code	0..255	uint8	
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 0C 00 00 00				
Notes		Conversion Formula			
<ul style="list-style-type: none"> - Flag for icing detected at aircraft location. - 0: Detector off - 1: No icing Detected - 2: Icing Detected 		<ul style="list-style-type: none"> x x 			
Example Value		Example LDS Packet			
Invalid Icing Code		[K][L][V] = [0d34][0d1][0x9B]			
UDS Key	x	ESD Digraph	Id		
UDS Name	x	ESD Name	Icing Detected		
Units	Range	Format	Units	Range	Format
x	x	x	Icing Code	0..2	N
Notes			Notes		
<ul style="list-style-type: none"> - x 			<ul style="list-style-type: none"> - Output of the aircrafts icing detector - 0: Detector off - 1: No icing detected - 2: Icing detected 		
UDS Conversion			ESD Conversion		
x			x		
<u>To UDS:</u>			<u>To ESD:</u>		
- x			- Convert string to ID code.		
<u>To LDS:</u>			<u>To LDS:</u>		
- x			- Convert ID code to string.		

7.34.1 Example Icing Detected

This metadata item signals when the icing sensor detects water forming on its vibrating probe.

7.35 Tag 35: Wind Direction Conversion

LDS Tag	35	Units	Range	Format
LDS Name	Wind Direction	Degrees	0..360	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 0D 00 00 00			
Notes	<ul style="list-style-type: none"> - Wind direction at aircraft location. This is the direction the wind is coming from relative to true north. - Map 0..(2¹⁶-1) to 0..360. - Resolution: ~5.5 milli degrees. 			
	Conversion Formula			
	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_35_dec} = \left(\frac{360}{65535} * \text{LDS_35} \right)$			
Example Value	235.924 Degrees	Example LDS Packet		
		[K][L][V] = [0d35][0d2][0xA7 C4]		
UDS Key	x	ESD Digraph	Wd	
UDS Name	x	ESD Name	Wind Direction	
Units	Range	Format	Units	Range
x	x	x	Degrees	0..359
Notes	<ul style="list-style-type: none"> - x - Direction (from North) from which the wind is blowing at the aircraft location 			
	UDS Conversion		ESD Conversion	
	x		$\text{ESD_dec} = \left(\frac{360}{65534} * \text{LDS_uint} \right)$	
<u>To UDS:</u>	<ul style="list-style-type: none"> - x 			
<u>To LDS:</u>	<ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. 			
	<ul style="list-style-type: none"> - x - Convert ESD ASCII to decimal. - Map decimal to uint16. 			

7.35.1 Example Wind Direction

The direction the air body around the aircraft is coming from relative to true north.

7.36 Tag 36: Wind Speed Conversion

LDS Tag	36	Units	Meters/Second	Range	0..100	Format	uint8
LDS Name	Wind Speed						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 0E 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Wind speed at aircraft location. - Map 0..255 to 0..100 meters/second. - 1 m/s = 1.94384449 knots. - Resolution: ~0.4 meters / second. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_36_dec} = \left(\frac{100}{255} * \text{LDS_36} \right)$					
Example Value		Example LDS Packet					
69.80392 m/s		[K][L][V] = [0d36][0d1][0xB2]					
UDS Key	x	ESD Digraph	Ws				
UDS Name	x	ESD Name	Wind Speed				
Units	x	Range	x	Format	x		
					Units	Range	Format
					Knots	0..99	NN
Notes		Notes					
- x		- Wind Speed (relative to the Earth) at the aircraft location.					
UDS Conversion				ESD Conversion			
x				$\text{ESD_dec} = \left(\frac{100}{255} * \text{LDS_uint} \right) * \frac{1.94384449 \text{knots}}{1 \text{m/s}}$			
<u>To UDS:</u>				<u>To ESD:</u>			
- x				- Convert LDS to decimal.			
<u>To LDS:</u>				- Account for units.			
- x				- Convert knots to ASCII.			
				<u>To LDS:</u>			
				- Convert ESD ASCII to decimal.			
				- Account for units.			
				- Convert meters to uint8.			

7.36.1 Example Wind Speed

The speed of the body of air that surrounds the aircraft relative to the ground is captured in this wind speed metadata item.

7.37 Tag 37: Static Pressure Conversion

LDS Tag	37	Units	Millibar	Range	0..5000	Format	uint16	
LDS Name	Static Pressure							
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 0F 00 00 00							
Notes	<ul style="list-style-type: none"> - Static pressure at aircraft location. - Map 0..(2¹⁶-1) to 0..5000 mbar. - 1 mbar = 0.0145037738 PSI. - Resolution: ~0.08 Millibar 							
	Conversion Formula							
	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_37_dec} = \left(\frac{5000}{65535} * \text{LDS_37} \right)$							
Example Value	3725.185 mbar	Example LDS Packet	[K][L][V] = [0d37][0d2][0xBE BA]					
UDS Key	x	ESD Digraph	Ps					
UDS Name	x	ESD Name	Static Pressure					
Units	x	Range	x	Format	x	Units	PSI	
						Range	0..99.99	
						Format	DD.HH	
Notes	<ul style="list-style-type: none"> - x 							
	Notes							
	- Static Pressure							
	UDS Conversion				ESD Conversion			
	x				$\text{ESD_dec} = \left(\frac{5000}{65535} * \text{LDS_uint} \right) * \frac{0.0145037738 \text{PSI}}{1 \text{mbar}}$			
<u>To UDS:</u>	- x							
<u>To LDS:</u>	- x							
<u>To ESD:</u>	<ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. 							
<u>To LDS:</u>	<ul style="list-style-type: none"> - Convert ESD ASCII to decimal. - Map decimal to uint16. 							

7.37.1 Example Static Pressure

The static pressure is the pressure of the air that surrounds the aircraft. Static pressure is measured by a sensor mounted out of the air stream on the side of the fuselage. This is used with impact pressure to compute indicated airspeed, true airspeed, and density altitude.

7.38 Tag 38: Density Altitude Conversion

LDS Tag	38	Units	Range	Format
LDS Name	Density Altitude	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 10 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Density altitude at aircraft location. Relative aircraft performance metric based on outside air temperature, static pressure, and humidity. - Map 0..(2¹⁶-1) to -900..19000 meters. - Offset = -900. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_38_dec} = \left(\frac{19900}{65535} * \text{LDS_38} \right) - 900$		
Example Value		Example LDS Packet		
14818.68 Meters		[K][L][V] = [0d38][0d2][0xCA 35]		
UDS Key	x	ESD Digraph	Da	
UDS Name	x	ESD Name	Density Altitude	
Units	Range	Format	Units	Range
x	x	x	Feet	+/- 99,999
Notes			Notes	
- x			- Density Altitude of the aircraft.	
UDS Conversion		ESD Conversion		
x		$\text{ESD_dec} = \left(\frac{19900}{65535} * \text{LDS_uint} - 900 \right) * \frac{3.2808399\text{ft}}{1\text{m}}$		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- Convert LDS to decimal.		
<u>To LDS:</u>		- Account for units.		
- x		- Convert decimal to ASCII.		
		<u>To LDS:</u>		
		- Convert ESD ASCII to decimal.		
		- Account for units.		
		- Map decimal to uint16.		

7.38.1 Example Density Altitude

Density altitude is the pressure altitude corrected for non-standard temperature variation. Density altitude is a relative metric of the takeoff, climb, and other performance related parameters of an aircraft.

7.39 Tag 39: Outside Air Temperature Conversion

LDS Tag	39	Units	Range	Format
LDS Name	Outside Air Temperature	Celcius	-128..+127	int8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 11 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Temperature outside of aircraft. - -128..127 Degrees Celsius. - Resolution: 1 degree celsius. 		$\text{LDS_dec} = \text{LDS_int}$ $\text{LDS_39_dec} = \text{LDS_39}$		
Example Value		Example LDS Packet		
84 Celcius		[K][L][V] = [0d39][0d1][0x54]		
UDS Key	x	ESD Digraph	At	
UDS Name	x	ESD Name	Air Temperature	
Units	Range	Format	Units	Range
x	x	x	Celcius	+/- 99
Notes		Notes		
- x		- Outside air temperature measured at the aircraft		
UDS Conversion		ESD Conversion		
x		ESD_dec = LDS_int		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- Convert int8 to string.		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		- Convert string to int8.		

7.39.1 Example Outside Air Temperature

The measured temperature outside of the platform is captured in the outside air temperature metadata item.

Note that the value is encoded using two's complement.

7.40 Tag 40: Target Location Latitude Conversion

LDS Tag	40	Units	Range	Format
LDS Name	Target Location Latitude	Degrees	+/- 90	int32
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 02 00 00 00			
Notes	Conversion Formula			
<ul style="list-style-type: none"> - Calculated Target latitude. This is the crosshair location if different from frame center. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~42 nano degrees. 	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_40_dec} = \left(\frac{180}{4294967294} * \text{LDS_40} \right)$			
Example Value	Example LDS Packet			
-79.1638500518929 Degrees	[K][L][V] = [0d40][0d4][0x8F 69 52 62]			

7.40.1 Example Target Location Latitude

The crosshair or target location of a captured image or image sequence has a real earth coordinate represented by a latitude-longitude-elevation triplet and may differ from the center of the captured image. Target locations that lie above the horizon do not correspond to a point on the earth and should either not be reported, or be reported as an "error".

Note that the int32 used in the LDS value is encoded using two's complement.

7.41 Tag 41: Target Location Longitude Conversion

LDS Tag	41	Units	Range	Format
LDS Name	Target Location Longitude	Degrees	+/-180	int32
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 03 00 00 00			
Notes	Conversion Formula			
<ul style="list-style-type: none"> - Calculated Target longitude. This is the crosshair location if different from frame center. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~84 nano degrees. 	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_41_dec} = \left(\frac{360}{4294967294} * \text{LDS_41} \right)$			
Example Value	Example LDS Packet			
166.400812960416 Degrees	[K][L][V] = [0d41][0d4][0x76 54 57 F2]			

7.41.1 Example Target Location Longitude

The crosshair or target location of a captured image or image sequence has a real earth coordinate represented by a latitude-longitude-elevation triplet and may differ from the center of the captured image. Target locations that lie above the horizon do not correspond to a point on the earth and should either not be reported, or be reported as an "error".

Note that the int32 used in the LDS value is encoded using two's complement.

7.42 Tag 42: Target Location Elevation Conversion

LDS Tag	42	Units	Range	Format
LDS Name	Target Location Elevation	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 04 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Calculated target elevation. This is the crosshair location if different from frame center. - Map 0..(2¹⁶-1) to -900..19000 meters. - Offset = -900. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_42_dec} = \left(\frac{19900}{65535} * \text{LDS_42} \right) - 900$		
Example Value	Example LDS Packet			
18389.05 Meters	[K][L][V] = [0d42][0d2][0xF8 23]			

7.42.1 Example Target Location Elevation

The crosshair or target location of a captured image or image sequence has a real earth coordinate represented by a latitude-longitude-elevation triplet and may differ from the center of the captured image. Target locations that lie above the horizon do not correspond to a point on the earth and should either not be reported, or be reported as an “error”.

7.43 Tag 43: Target Track Gate Width Conversion

LDS Tag	43	Units	Range	Format
LDS Name	Target Track Gate Width	Pixels	0..512	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 05 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Tracking gate width (x value) of tracked target within field of view. - Closely tied to source video resolution in pixels. 		$\text{LDS_dec} = 2 * \text{LDS_uint}$ $\text{LDS_43_dec} = \text{round}(2 * \text{LDS_43})$		
Example Value		Example LDS Packet		
6 Pixels		[K][L][V] = [0d43][0d1][0x03]		

7.43.1 Example Target Track Gate Width

The target track gate width is used with Target Tracking Sensors that specify the pixel width of a tracking gate to be displayed about a target location.

7.44 Tag 44: Target Track Gate Height Conversion

LDS Tag	44	Units	Range	Format
LDS Name	Target Track Gate Height	Pixels	0..512	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 06 00 00 00			
Notes	<ul style="list-style-type: none"> - Tracking gate height (y value) of tracked target within field of view. - Closely tied to source video resolution in pixels. 			
	Conversion Formula			
	$\text{LDS_dec} = 2 * \text{LDS_uint}$ $\text{LDS_44_dec} = \text{round}(2 * \text{LDS_44})$			
Example Value	Example LDS Packet			
30 Pixels	[K][L][V] = [0d44][0d1][0x0F]			

7.44.1 Example Target Track Gate Height

The target track gate height is used with Target Tracking Sensors that specify the pixel height of a tracking gate to be displayed about a target location.

7.45 Tag 45: Target Error Estimate - CE90 Conversion

LDS Tag	45	Units	Meters	Range	0..4095	Format	uint16
LDS Name	Target Error Estimate - CE90						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 07 00 00 00						
Notes	<ul style="list-style-type: none"> - Circular Error 90 (CE90) is the estimated error distance in the horizontal direction. - Specifies the radius of 90% probability on a plane tangent to the earth's surface. - Res: ~0.0624 meters 			Conversion Formula			
				$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_45_dec} = \left(\frac{4095}{65535} * \text{LDS_45} \right)$			
Example Value	425.319 Meters	Example LDS Packet		[K][L][V] = [0d45][0d2][0x1A 95]			

7.45.1 Example Target Error Estimate – Circular Error 90% (CE90)

Target covariance values are represented in an easting-northing-up coordinate system centered about the target point. This is shown below:

Covariance Matrix:

$$Q = \begin{bmatrix} \sigma_e^2 & \sigma_{en} & \sigma_{eu} \\ \sigma_{ne} & \sigma_n^2 & \sigma_{nu} \\ \sigma_{ue} & \sigma_{un} & \sigma_u^2 \end{bmatrix}$$

Min and Max Sigma Values:

$$\sigma_{max}^2 = \frac{(\sigma_e^2 + \sigma_n^2) + \sqrt{(\sigma_e^2 + \sigma_n^2)^2 - 4(\sigma_e^2 \sigma_n^2 - \sigma_{en}^2)}}{2}$$

$$\sigma_{min}^2 = \frac{(\sigma_e^2 + \sigma_n^2) - \sqrt{(\sigma_e^2 + \sigma_n^2)^2 - 4(\sigma_e^2 \sigma_n^2 - \sigma_{en}^2)}}{2}$$

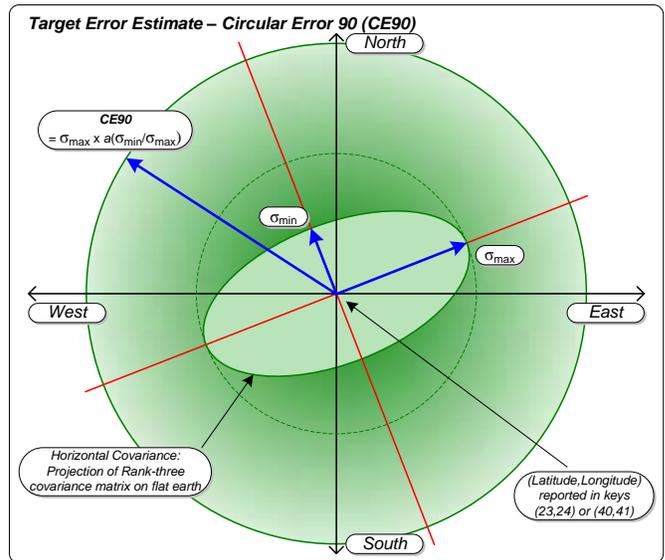


Figure 7-16: Target Error Estimate - Circular Error 90%

CE90 represents the 90 percent probability circular error radius of absolute horizontal accuracy. With σ_{max} and σ_{min} known, the Circular Error for 90% confidence can be

calculated as: $CE90 = \sigma_{max} \cdot a\left(\frac{\sigma_{min}}{\sigma_{max}}\right)$ where $a(x) = 0.4194x^2 + 0.0774x + 1.648$. This is one

means for determining CE90 from statistical data in the easting-northing-up coordinate system, yet similar calculations are allowed.

7.46 Tag 46: Target Error Estimate - LE90 Conversion

LDS Tag	46	Units	Range	Format
LDS Name	Target Error Estimate - LE90	Meters	0..4095	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 08 00 00 00			
Notes	<ul style="list-style-type: none"> - Lateral Error 90 (LE90) is the estimated error distance in the vertical (or lateral) direction. - Specifies the interval of 90% probability in the local vertical direction. - Res: 0.0625 meters 			
Example Value	609.0718 Meters	Example LDS Packet	[K][L][V] = [0d46][0d2][0x26 11]	
			$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_46_dec} = \left(\frac{4095}{65535} * \text{LDS_46} \right)$	

7.46.1 Example Target Error Estimate – Linear Error 90% (LE90)

Target covariance values are represented in an easting-northing-up coordinate system centered about the target point. This is shown below:

Covariance Matrix:

$$Q = \begin{bmatrix} \sigma_e^2 & \sigma_{en} & \sigma_{eu} \\ \sigma_{ne} & \sigma_n^2 & \sigma_{nu} \\ \sigma_{ue} & \sigma_{un} & \sigma_u^2 \end{bmatrix}$$

Min and Max Sigma Values:

$$\sigma_{max}^2 = \frac{(\sigma_e^2 + \sigma_n^2) + \sqrt{(\sigma_e^2 + \sigma_n^2)^2 - 4(\sigma_e^2 \sigma_n^2 - \sigma_{en}^2)}}{2}$$

$$\sigma_{min}^2 = \frac{(\sigma_e^2 + \sigma_n^2) - \sqrt{(\sigma_e^2 + \sigma_n^2)^2 - 4(\sigma_e^2 \sigma_n^2 - \sigma_{en}^2)}}{2}$$

LE90 represents the 90 percent probability linear error of absolute vertical accuracy.

With the vertical (or “up”) variance known (σ_u), the 90 percent linear error can be calculated as $LE90 = 1.645 \cdot \sigma_u$. This is one means for determining LE90 from statistical data in the easting-northing-up coordinate system, yet similar calculations are allowed.

7.47 Tag 47: Generic Flag Data 01 Conversion

LDS Tag	47	Units	Range	Format
LDS Name	Generic Flag Data 01	None	uint8	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 01 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Generic Flagged Metadata - Position Format msb8..1lsb - 1- Laser Range 1on,0off - 2- Auto-Track 1on,0off - 3- IR Polarity 1blk,0wht - 4- Icing detected 1ice,0(off/no ice) - 5- Slant Range 1measured, 0calc - 6- Image Invalid 1invalid, 0valid - 7,8- Use 0 		<ul style="list-style-type: none"> x x 		
Example Value		Example LDS Packet		
49		[K][L][V] = [0d47][0d1][0x31]		

7.47.1 Example Generic Flag Data 01

Miscellaneous yes / no aircraft and image related data items are logged within the Generic Flag Data 01 metadata item.

Updates in ST 0601.3 include an indication (bit 5) that Slant Range (tag 21) is either “calculated” (0) or “measured” (1).

Updates in ST 0601.5 include the Image Invalid flag (bit 6). This flag indicates the state of the associated motion imagery as being “valid” (0) or “invalid” (1). An invalid (or unusable) image can be due to a lens change, bad focus, or other camera parameter which significantly degrades the image quality.

7.48 Tag 48: Security Local Metadata Set Conversion

LDS Tag	48	Units	Range	Format	
LDS Name	Security Local Metadata Set	None	Set	Set	
UDS Mapped Key	Use ST0102 UDS key for Local Data Sets.				
Notes		Conversion Formula			
<ul style="list-style-type: none"> - Local set tag to include the ST0102 Local Data Set Security Metadata items within ST0601. Use the ST0102 Local Set Tags within the ST0601 tag 0d48. - The length field is the size of all ST0102 metadata items to be packaged within tag 0d48. 		<ul style="list-style-type: none"> x x 			
Example Value		Example LDS Packet			
x		[K][L][V] = [0d48][0dx][x]			
UDS Key	06 0E 2B 34 02 03 01 01 0E 01 03 03 02 00 00 00	ESD Digraph	x		
UDS Name	Security Local Metadata Set	ESD Name	x		
Units	Range	Format	Units	Range	Format
x	x	x	x	x	x
Notes		Notes			
- x		- x			
UDS Conversion		ESD Conversion			
x		x			
<u>To UDS:</u>		<u>To ESD:</u>			
- x		- x			
<u>To LDS:</u>		<u>To LDS:</u>			
- x		- x			

7.48.1 Example Security Local Data Set

Both Universal Set tags and Local Set tags are defined for KLV formatted DoD security items in MISB ST 0102. When incorporated within ST 0601, multiple security metadata KLV Local Set triplets are allowed to be contained within the 0d48 UAS LDS metadata item.

7.49 Tag 49: Differential Pressure Conversion

LDS Tag	49	Units	Range	Format
LDS Name	Differential Pressure	Millibar	0..5000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 01 00 00 00			
Notes	Conversion Formula			
<ul style="list-style-type: none"> - Differential pressure at aircraft location. Measured as the Stagnation/impact/total pressure minus static pressure. - Map 0..(2¹⁶-1) to 0..5000 mbar. - 1 mbar = 0.0145037738 PSI. - Res: ~0.08 mbar 	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_49_dec} = \left(\frac{5000}{65535} * \text{LDS_49} \right)$			
Example Value	Example LDS Packet			
1191.958 mbar	[K][L][V] = [0d49][0d2][0x3D 07]			

7.49.1 Example Differential Pressure

Differential pressure provides a method of calculating relative velocity of an item as it passes through a fluid, or conversely the velocity of a fluid as it passes by an item. Velocity can be determined by differential pressure by the following:

$$v_1 = \sqrt{\frac{2p_d}{\rho}}$$

where p_d is the measured differential pressure ($p_d = \text{impact pressure minus static pressure} = p_i - p_s$), and ρ is the density of the fluid outside the item.

7.50 Tag 50: Platform Angle of Attack Conversion

LDS Tag	50	Units	Range	Format
LDS Name	Platform Angle of Attack	Degrees	+/- 20	int16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 02 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Platform Attack Angle. Angle between platform longitudinal axis and relative wind. - Positive angles for upward relative wind. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-20. - Use $-(2^{15})$ as an "out of range" indicator. - $-(2^{15}) = 0x8000$. - Res: ~610 micro degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_50_dec} = \left(\frac{40}{65534} * \text{LDS_50} \right)$		
Example Value		Example LDS Packet		
-8.670177 Degrees		[K][L][V] = [0d50][0d2][0xc8 83]		

7.50.1 Example Platform Angle of Attack

For legacy purposes, both range-restricted (Tag 50) and full-range (Tag 92) representations of Platform Angle of Attack MAY appear in the same ST 0601 packet. A single representation is preferred favoring the full-range version (Tag 92).

The angle of attack of an airborne platform is the angle formed between the relative wind and platform longitudinal axis (line made by the fuselage). Positive angles for wind with a relative upward component. Refer to the figure below.

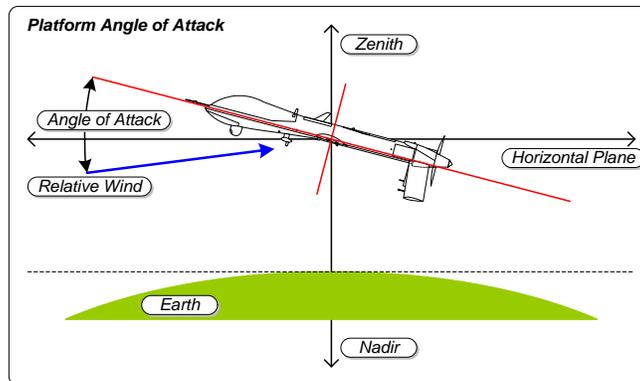


Figure 7-17: Platform Angle of Attack

Note that the int16 used in the LDS value is encoded using two's complement.

7.51 Tag 51: Platform Vertical Speed Conversion

LDS Tag	51	Units	Range	Format
LDS Name	Platform Vertical Speed	Meters/Second	+/- 180	int16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 03 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Vertical speed of the aircraft relative to zenith. Positive ascending, negative descending. - Map-(2¹⁵-1)..(2¹⁵-1) to +/-180 - Use -(2¹⁵) as an "out of range" indicator. - -(2¹⁵) = 0x8000. - Resolution: ~ 0.0055 meters/second. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_51} = \left(\frac{360}{65534} * \text{LDS_51} \right)$		
Example Value	Example LDS Packet			
-61.88693 m/s	[K][L][V] = [0d51][0d2][0xD3 FE]			

7.51.1 Example Vertical Speed

The vertical speed metadata item is the climb or decent rate in meters per second of an airborne platform in the zenith direction. Positive values indicate an ascending platform, while negative values indicate descending.

Note that the int16 used in the LDS value is encoded using two's complement.

7.52 Tag 52: Platform Sideslip Angle Conversion

LDS Tag	52	Units	Range	Format
LDS Name	Platform Sideslip Angle	Degrees	+/- 20	int16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 04 00 00 00			
Notes	<ul style="list-style-type: none"> - The sideslip angle is the angle between the platform longitudinal axis and relative wind. - Positive angles to right wing, neg to left. - Map $-(2^{15}-1)..(2^{15}-1)$ to +/-20. - Use $-(2^{15})$ as an "out of range" indicator. - $-(2^{15}) = 0x8000$. - Res: ~610 micro deg. 			
Conversion Formula	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_52_dec} = \left(\frac{40}{65534} * \text{LDS_52} \right)$			
Example Value	Example LDS Packet			
-5.082475 Degrees	[K][L][V] = [0d52][0d2][0xDF 79]			

7.52.1 Example Platform Sideslip Angle

For legacy purposes, both range-restricted (Tag 52) and full-range (Tag 93) representations of Platform Sideslip Angle MAY appear in the same ST 0601 packet. A single representation is preferred favoring the full-range version (Tag 93).

The angle formed between the platform longitudinal axis (line made by the fuselage) and the relative wind is the sideslip angle. A negative sideslip angle is depicted in the figure below:

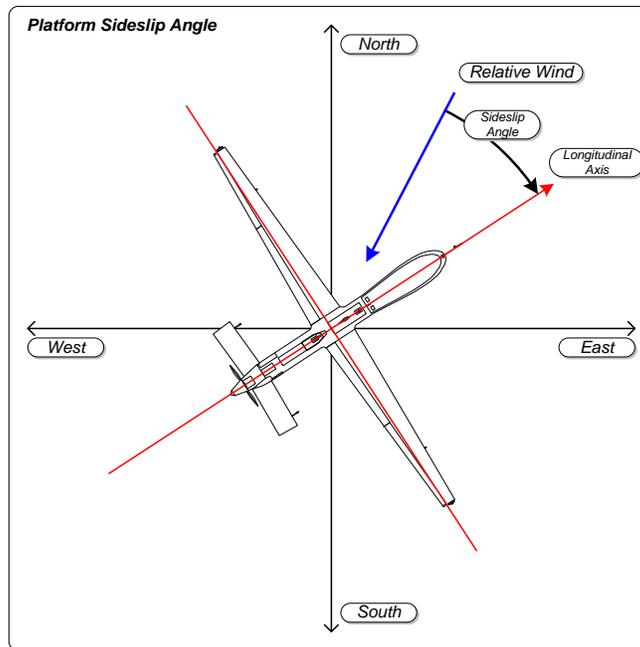


Figure 7-18: Platform Sideslip Angle

Note that the int16 used in the LDS value is encoded using two's complement.

7.53 Tag 53: Airfield Barometric Pressure Conversion

LDS Tag	53	Units	Range	Format
LDS Name	Airfield Barometric Pressure	Millibar	0..5000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 02 02 00 00 00			
Notes	Conversion Formula			
<ul style="list-style-type: none"> - Local pressure at airfield of known height. Pilot's responsibility to update. - Map 0..(2¹⁶-1) to 0..5000 mbar. - 1013.25mbar = 29.92inHg - Min/max recorded values of 870/1086mbar. - Resolution: ~0.08 Millibar 	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_53_dec} = \left(\frac{5000}{65535} * \text{LDS_53} \right)$			
Example Value	Example LDS Packet			
2088.96 mbar	[K][L][V] = [0d53][0d2][0x6A F4]			

7.53.1 Example Barometric Pressure at Airfield

Barometric pressure at airfield is used with altimeters to display airfield elevation when on the airfield.

7.54 Tag 54: Airfield Elevation Conversion

LDS Tag	54	Units	Range	Format
LDS Name	Airfield Elevation	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 02 03 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Elevation of Airfield corresponding to Airfield Barometric Pressure. - Map 0..(2¹⁶-1) to -900..19000 meters. - Offset = -900. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_int} \right) - \text{Offset}$ $\text{LDS_54_dec} = \left(\frac{19900}{65535} * \text{LDS_54} \right) - 900$		
Example Value		Example LDS Packet		
8306.806 Meters		[K][L][V] = [0d54][0d2][0x76 70]		

7.54.1 Example Airfield Elevation

Airfield elevation established at airfield location. This relates to the Barometric Pressure at Airfield metadata item.

7.55 Tag 55: Relative Humidity Conversion

LDS Tag	55	Units	Range	Format
LDS Name	Relative Humidity	Percent	0..100	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 09 00 00 00			
Notes	<ul style="list-style-type: none"> - Relative Humidity at aircraft location. - Map 0..(2⁸-1) to 0..100. - Resolution: ~0.4%. 			
	Conversion Formula			
	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_55_dec} = \left(\frac{100}{255} * \text{LDS_55} \right)$			
Example Value	Example LDS Packet			
50.58823%	[K][L][V] = [0d55][0d1][0x81]			

7.55.1 Example Relative Humidity

Relative humidity is the ratio between the water vapor density and the saturation point of water vapor density and is expressed here as a percentage.

7.56 Tag 56: Platform Ground Speed Conversion

LDS Tag	56	Units	Range	Format
LDS Name	Platform Ground Speed	Meters/Second	0..255	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 05 00 00 00			
Notes	<ul style="list-style-type: none"> - Speed projected to the ground of an airborne platform passing overhead. - 0..255 meters/sec. - 1 m/s = 1.94384449 knots. - Resolution: 1 meter/second. 	Conversion Formula		
		$\text{LDS_dec} = \text{LDS_int}$ $\text{LDS_56_dec} = \text{round}(\text{LDS_56})$		
Example Value	140 m/s	Example LDS Packet		
		[K][L][V] = [0d56][0d1][0x8C]		
UDS Key	x	ESD Digraph	Gv	
UDS Name	x	ESD Name	Platform Ground Speed	
Units	Range	Format	Units	Range
x	x	x	Knots	0..999
Notes	- x	Notes		
		- Speed on the ground of an airborne platform passing overhead.		
UDS Conversion		ESD Conversion		
	x	ESD_dec = LDS_uint		
<u>To UDS:</u>	- x	<u>To ESD:</u>	- Convert LDS to decimal.	
			- Convert decimal to ASCII.	
<u>To LDS:</u>	- x	<u>To LDS:</u>	- Convert ESD ASCII to decimal.	
			- Map decimal to uint16.	

7.56.1 Example Platform Ground Speed

The ground speed of an airborne platform is the aircraft's speed as projected onto the ground.

7.57 Tag 57: Ground Range Conversion

LDS Tag	57	Units	Range	Format	
LDS Name	Ground Range	Meters	0..5,000,000	uint32	
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 06 00 00 00				
Notes		Conversion Formula			
<ul style="list-style-type: none"> - Horizontal distance from ground position of aircraft relative to nadir, and target of interest. Dependent upon Slant Range and Depression Angle. - Map 0..(2^32-1) to 0..5000000 meters. - 1 nautical mile (knot) = 1852 meters. - Resolution: ~1.2 milli meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_57_dec} = \left(\frac{5000000}{4294967295} * \text{LDS_57} \right)$			
Example Value		Example LDS Packet			
3506979 Meters		[K][L][V] = [0d57][0d4][0xB3 8E AC F1]			
UDS Key	x	ESD Digraph	Gr		
UDS Name	x	ESD Name	Ground Range		
Units	Range	Format	Units	Range	Format
x	x	x	Nautical Miles	0..18.00	II.HH
Notes		Notes			
- x		- Horizontal distance between the sensor and the target. Measured in Nautical Miles.			
UDS Conversion			ESD Conversion		
x			$\text{ESD_dec} = \left(\frac{5000000}{4294967295} * \text{LDS_uint} \right) * \frac{1852\text{knot}}{1\text{m}}$		
<u>To UDS:</u>			<u>To ESD:</u>		
- x			- Convert LDS to decimal.		
<u>To LDS:</u>			- Account for units.		
- x			- Convert decimal to ASCII.		
			<u>To LDS:</u>		
			- Convert ESD ASCII to decimal.		
			- Account for units.		
			- Convert ASCII to uint32.		

7.57.1 Example Ground Range

Ground range is the horizontal distance between the aircraft/sensor location and the target of interest and does not account for terrain undulations.

7.58 Tag 58: Platform Fuel Remaining Conversion

LDS Tag	58	Units	Range	Format
LDS Name	Platform Fuel Remaining	Kilogram	0..10,000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 07 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Remaining fuel on airborne platform. Metered as fuel weight remaining. - Map 0..(2¹⁶-1) to 0..10000 Kilograms. - 1 kilogram = 2.20462262 pounds. - Resolution: ~.16 kilograms. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_58_dec} = \left(\frac{10000}{65535} * \text{LDS_58} \right)$		
Example Value		Example LDS Packet		
6420.539 kg		[K][L][V] = [0d58][0d2][0xA4 5D]		
UDS Key	x	ESD Digraph	Fr	
UDS Name	x	ESD Name	Platform Fuel Remaining	
Units	Range	Format	Units	Range
x	x	x	Pounds	0..99,999
Notes		Notes		
- x		- Remaining fuel on airborne platform. Metered as fuel weight remaining.		
UDS Conversion		ESD Conversion		
x		$\text{ESD_dec} = \left(\frac{10000}{65535} * \text{LDS_uint} \right) * \frac{2.0462262\text{lbs}}{1\text{kg}}$		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- Convert LDS to decimal.		
<u>To LDS:</u>		- Account for units.		
- x		- Convert decimal to ASCII.		
		<u>To LDS:</u>		
		- Convert ESD ASCII to decimal.		
		- Account for units.		
		- Map decimal to uint16.		

7.58.1 Example Platform Fuel Remaining

Platform fuel remaining indicates the current weight of fuel present on the host platform and is measured in kilograms.

7.59 Tag 59: Platform Call Sign Conversion

LDS Tag	59	Units	Range	Format
LDS Name	Platform Call Sign	String	1..127	ISO 646
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 04 01 01 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Call Sign of platform or operating unit. - Value field is Free Text. 			x	
			x	
Example Value		Example LDS Packet		
TOP GUN		[K][L][V] = [0d59][0d7][0x54 4F 50 20 47 55 4E]		
UDS Key	x	ESD Digraph	Cs	
UDS Name	x	ESD Name	Platform Call Sign	
Units	Range	Format	Units	Range
x	x	x	String	0..9
Notes		Notes		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - First nine characters of the Call Sign of a group or squadron. 		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - Truncate LDS String and convert to ESD 		
<u>To LDS:</u>		<u>To LDS:</u>		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - Convert ESD string to LDS 		

7.59.1 Example Platform Call Sign

The platform call sign is used to distinguish groups or squadrons of platforms within different operating units from one another. Call sign is often related to the aircraft tail number.

7.60 Tag 60: Weapon Load Conversion

LDS Tag	60	Units	uint16	Range	x	Format	nibble
LDS Name	Weapon Load						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 12 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Current weapons stored on aircraft broken into two bytes: - [K][L][V] = [0x41][0x02][[byte1][byte2]] - [byteN] = [[nib1][nib2]], nib1= msn - byte1-nib1 = Station Number - byte1-nib2 = Substation Number - byte2-nib1 = Weapon Type - byte2-nib2 = Weapon Variant 							
Example Value		Example LDS Packet					
45016		[K][L][V] = [0d60][0d2][0xAF D8]					
UDS Key	x	ESD Digraph	W1				
UDS Name	x	ESD Name	Weapon Load				
Units	x	Range	x	Format	x		
Notes		Notes					
- x		- x					
UDS Conversion				ESD Conversion			
x				x			
<u>To UDS:</u>		<u>To ESD:</u>					
- x		- x					
<u>To LDS:</u>		<u>To LDS:</u>					
- x		- x					

7.60.1 Example Weapon Load

Weapon load is broken into two bytes with the first byte indicates the aircraft store location, and the second byte indicates store type. Each byte is broken into two nibbles with [nib1] being the most significant nibble with bit order [3210] where 3=msb.

Aircraft store location is indicated by station number which starts numbering at the outboard left wing as store location 1 and increases towards the outboard right wing. Each station can have a different weapon installed, or multiple weapons on the same station. In a multiple weapon per station situation, the substation number begins at 1 and increases from there. A substation number of 0 indicates a single store located at the station. The Store Location byte has two nibbles with the first most significant nibble indicating station number, and the second indicating substation number. Note an example store location diagram below:

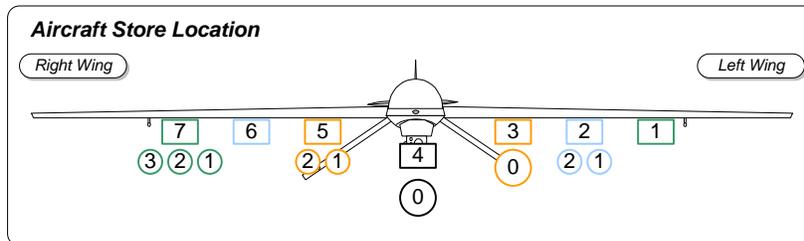


Figure 7-19: Aircraft Store Location

The weapon type byte is also broken into two nibbles with the first most significant nibble indicating weapon type and the second nibble indicating weapon variant.

A listing of available weapons is TBD.

7.61 Tag 61: Weapon Fired Conversion

LDS Tag	61	Units	uint8	Range	x	Format	nibble
LDS Name	Weapon Fired						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 13 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Indication when a particular weapon is released. Correlate with Unix Time stamp. - Identical format to Weapon Load byte 2: - [byteN] = [[nib1][nib2]] - nib1 = Station Number - nib2 = Substation Number 		<ul style="list-style-type: none"> x x 					
Example Value		Example LDS Packet					
186		[K][L][V] = [0d61][0d2][0xBA]					
UDS Key	x	ESD Digraph	Wf				
UDS Name	x	ESD Name	Weapon Fired				
Units	x	Units	x	Range	x	Format	x
Notes		Notes					
- x		- x					
UDS Conversion				ESD Conversion			
x				x			
<u>To UDS:</u>		<u>To ESD:</u>		<u>To ESD:</u>		<u>To LDS:</u>	
- x		- x		- x		- x	
<u>To LDS:</u>		<u>To LDS:</u>		<u>To LDS:</u>		<u>To LDS:</u>	
- x		- x		- x		- x	

7.61.1 Example Weapon Fired

The Weapon Fired metadata item has the same format as the first byte of the Weapon Load metadata item indicating station and substation location of a store. Byte 1 is broken into two nibbles with [nib1] being the most significant nibble with bit order [3210] where 3=msb.

When included in a KLV packet, the weapon fired item should be correlated with the mandatory timestamp to determine the release time of a weapon.

7.62 Tag 62: Laser PRF Code Conversion

LDS Tag	62	Units	Range	Format
LDS Name	Laser PRF Code	None	0..65535	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 02 01 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - A laser's Pulse Repetition Frequency (PRF) code used to mark a target. - The Laser PRF code is a three or four digit number consisting of the values 1..8. - Only the values 1111..8888 can be used without 0's or 9's. 		<ul style="list-style-type: none"> x x 		
Example Value		Example LDS Packet		
50895		[K][L][V] = [0d62][0d2][0xC6 CF]		
UDS Key	x	ESD Digraph	Lc	
UDS Name	x	ESD Name	Laser PRF Code	
Units	Range	Format	Units	Range
x	x	x	None	1111..8888
Notes		Notes		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - A laser's Pulse Repetition Frequency (PRF) code used to mark a target. - The Laser PRF code is a three or four digit number consisting of the values 1..8. - Only the values 1111..8888 can be used without 0's or 9's. 		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - Convert LDS uint to ASCII. 		
<u>To LDS:</u>		<u>To LDS:</u>		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - Convert ASCII to LDS uint. 		

7.62.1 Example Laser PRF Code

When enabled, laser designators can generate a pulsed signal according to a Pulse Repetition Frequency (PRF) Code which distinguishes one laser beam from another.

7.63 Tag 63: Sensor Field of View Name Conversion

LDS Tag	63	Units	Range	Format
LDS Name	Sensor Field of View Name	List	0..255	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 02 02 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Names sensor field of view quantized steps. - 00 = Ultranarrow - 01 = Narrow - 02 = Medium - 03 = Wide - 04 = Ultrawide - 05 = Narrow Medium - 06 = 2x Ultranarrow - 07 = 4x Ultranarrow 		<ul style="list-style-type: none"> <li style="text-align: right;">x <li style="text-align: right;">x 		
Example Value		Example LDS Packet		
209		[K][L][V] = [0d63][0d1][0xD1]		
UDS Key	x	ESD Digraph	Vn	
UDS Name	x	ESD Name	Sensor Field of View Name	
Units	Range	Format	Units	Range
x	x	x	Code	00..NN
Notes		Notes		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - Names sensor field of view quantized steps. - 00 = Ultranarrow - 01 = Narrow - 02 = Medium - 03 = Wide - 04 = Ultrawide - 05 = Narrow Medium - 06 = 2x Ultranarrow - 07 = 4x Ultranarrow 		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- Convert LDS uint to ASCII.		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		- Convert ASCII to LDS uint.		

7.63.1 Example Sensor Field of View Name

The field of view name is a way to indicate to the operator the current lens used on the motion imagery sensor.

The Sensor Field of View names are for generic guidance and do not correspond to specific field of view values. Refer to Horizontal and Vertical Field of View metadata items (tags 16 & 17) for specific aperture angles.

7.64 Tag 64: Platform Magnetic Heading Conversion

LDS Tag	64	Units	Degrees	Range	0..360	Format	uint16
LDS Name	Platform Magnetic Heading						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 08 00 00 00						
Notes	<ul style="list-style-type: none"> - Aircraft magnetic heading angle. Relative between longitudinal axis and Magnetic North measured in the horizontal plane. - Map 0..(2¹⁶-1) to 0..360. - Resolution: ~5.5 milli degrees. 			Conversion Formula			
				$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right)$ $\text{LDS_64_dec} = \left(\frac{360}{65535} * \text{LDS_64} \right)$			
Example Value		Example LDS Packet					
311.8682 Degrees		[K][L][V] = [0d64][0d2][0xDD C5]					
UDS Key	x	ESD Digraph	Mh				
UDS Name	x	ESD Name	Platform Magnetic Heading				
Units	x	Range	x	Format	x	Units	Degrees
						Range	0..359.99
						Format	DDD.HH
Notes	- x			Notes			
				- Aircraft magnetic heading angle. Relative between fuselage chord line and Magnetic North.			
UDS Conversion				ESD Conversion			
			x	$\text{ESD_dec} = \left(\frac{360}{65535} * \text{LDS_uint} \right)$			
<u>To UDS:</u>				<u>To ESD:</u>			
- x				- Convert LDS to decimal.			
<u>To LDS:</u>				- Convert decimal to ASCII.			
- x				<u>To LDS:</u>			
				- Convert ESD ASCII to decimal.			
				- Map decimal to uint16.			

7.64.1 Example Magnetic Heading

Note figure below:

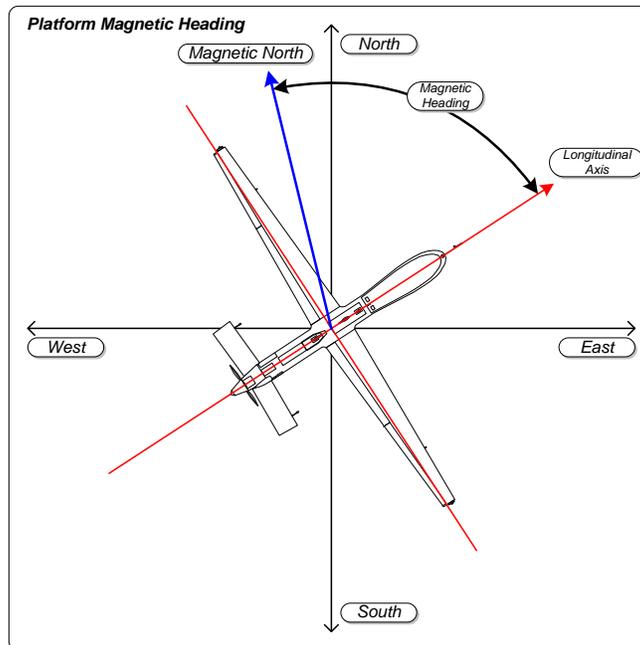


Figure 7-20: Magnetic Heading

7.65 Tag 65: UAS LDS Version Number Conversion

LDS Tag	65	Units	Range	Format
LDS Name	UAS LDS Version Number	Number	0..255	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 03 03 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Version number of the UAS LDS document used to generate a source of UAS LDS KLV metadata. - 0 is pre-release, initial release (0601.0), or test data. - 1..255 corresponds to document revisions ST0601.1 thru ST0601.255. 		<ul style="list-style-type: none"> x x 		
Example Value		Example LDS Packet		
Version 232		[K][L][V] = [0d65][0d1][0xE8]		
UDS Key	x	ESD Digraph	Iv	
UDS Name	x	ESD Name	ESD ICD Version	
Units	Range	Format	Units	Range
x	x	x	Number	0..99
Notes		Notes		
<ul style="list-style-type: none"> - x 		<ul style="list-style-type: none"> - Version of the ESD System use to encode ESD Data. - 0 corresponds to documents ASI-119 and ASI-209. - 1..99 corresponds to document revisions of ST0601.1 thru ST 0601.99. 		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
- x		- Convert uint to ASCII.		
<u>To LDS:</u>		<u>To LDS:</u>		
- x		- Convert ASCII to uint.		

7.65.1 Example UAS LDS Version Number

The UAS LDS version number metadata item is used to indicate which version of ST 0601 is used as the source standard of UAS LDS metadata. This item is not required in every packet of metadata, but is useful when included periodically.

7.66 Tag 66: Target Location Covariance Matrix Conversion

LDS Tag	66	Units	Range	Format
LDS Name	Target Location Covariance Matrix	TBD	TBD	TBD
UDS Mapped Key	06 0E 2B 34 02 05 01 01 0E 01 03 03 14 00 00 00			
Notes	Conversion Formula			
- Covariance Matrix of the error associated with a targeted location. - Details TBD.			TBD	TBD
Example Value	Example LDS Packet			
x	[K][L][V] = [0d66][0dTBD][x]			

7.66.1 Example Target Location Covariance Matrix

Details TBD

7.67 Tag 67: Alternate Platform Latitude Conversion

LDS Tag	67	Units	Range	Format
LDS Name	Alternate Platform Latitude	Degrees	+/- 90	int32
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 14 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Alternate Platform Latitude. Represents latitude of platform connected with UAS. - Based on WGS84 ellipsoid. - Map -(2³¹-1)..(2³¹-1) to +/-90. - Use -(2³¹) as an "error" indicator. - -(2³¹) = 0x80000000. - Resolution: ~42 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_67_dec} = \left(\frac{180}{4294967294} * \text{LDS_67} \right)$		
Example Value		Example LDS Packet		
-86.041207348947 Degrees		[K][L][V] = [0d67][0d4][0x85 A1 5A 39]		

7.67.1 Example Latitude

Latitude is the angular distance north or south of the earth's equator, measured in degrees along a meridian. Generated from GPS/INS information and based on the WGS84 coordinate system.

The Alternate Platform is an airborne or ground based platform that is connected via direct datalink to a UAS generating motion imagery and metadata.

Note that the int32 used in the LDS value is encoded using two's complement.

7.68 Tag 68: Alternate Platform Longitude Conversion

LDS Tag	68	Units	Range	Format
LDS Name	Alternate Platform Longitude	Degrees	+/- 180	int32
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 15 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Alternate Platform Longitude. Represents longitude of platform connected with UAS. - Based on WGS84 ellipsoid. - Map -(2³¹-1)..(2³¹-1) to +/-180. - Use -(2³¹) as an "error" indicator. - -(2³¹) = 0x80000000. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_68_dec} = \left(\frac{360}{4294967294} * \text{LDS_68} \right)$		
Example Value		Example LDS Packet		
0.155527554524842 Degrees		[K][L][V] = [0d68][0d4][0x00 1C 50 1C]		

7.68.1 Example Longitude

Longitude is the angular distance on the earth's surface, measured east or west from the prime meridian at Greenwich, England, to the meridian passing through a position of interest. Generated from GPS/INS information and based on the WGS84 coordinate system.

The Alternate Platform is an airborne or ground based platform that is connected via direct datalink to a UAS generating motion imagery and metadata.

Note that the int32 used in the LDS value is encoded using two's complement.

7.69 Tag 69: Alternate Platform Altitude Conversion

LDS Tag	69	Units	Range	Format
LDS Name	Alternate Platform Altitude	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 16 00 00 00			
Notes	<ul style="list-style-type: none"> - Altitude of alternate platform as measured from Mean Sea Level (MSL). Represents altitude of platform connected with UAS. - Map 0..(2¹⁶-1) to -900..19000 meters. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 			
	Conversion Formula			
	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_69_dec} = \left(\frac{19900}{65535} * \text{LDS_69} \right) - 900$			
Example Value	Example LDS Packet			
9.445334 Meters	[K][L][V] = [0d69][0d2][0x0B B3]			

7.69.1 Example Platform Altitude

The Alternate Platform Altitude is a true altitude or true vertical distance above mean sea level. Measurement is GPS derived.

The Alternate Platform is an airborne or ground based platform that is connected via direct datalink to a UAS generating motion imagery and metadata.

7.70 Tag 70: Alternate Platform Name Conversion

LDS Tag	70	Units	Range	Format
LDS Name	Alternate Platform Name	String	1..127	ISO 646
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 17 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Name of alternate platform connected to UAS. - E.g.: 'Apachce', 'Rover', 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'IgnatER', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc. - Value field is Free Text. - Maximum 127 characters. 		<ul style="list-style-type: none"> x x 		
Example Value		Example LDS Packet		
APACHE		[K][L][V] = [0d70][0d6][0x41 50 41 43 48 45]		

7.70.1 Example Alternate Platform Name

The Alternate Platform Name metadata item distinguishes which platform is connected with the UAS which is generating motion imagery and metadata products. The alternate platform can be airborne or ground based and is to be described sufficiently (yet with brevity) in text using this metadata item.

The Alternate Platform is an airborne or ground based platform that is connected via direct datalink to a UAS generating motion imagery and metadata.

7.71 Tag 71: Alternate Platform Heading Conversion

LDS Tag	71	Units	Range	Format
LDS Name	Alternate Platform Heading	Degrees	0..360	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 18 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Heading angle of alternate platform connected to UAS. Relative between longitudinal axis and True North measured in the horizontal plane. - Map 0..(2¹⁶-1) to 0..360. - Resolution: ~5.5 milli degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_71_dec} = \left(\frac{360}{65535} * \text{LDS_71} \right)$		
Example Value		Example LDS Packet		
32.60242 Degrees		[K][L][V] = [0d71][0d2][0x17 2F]		

7.71.1 Example Alternate Platform Heading

The Alternate Platform heading angle is defined as the angle between the alternate platform longitudinal axis (line made by the fuselage) and true north measured in the horizontal plane. Angles increase in a clockwise direction when looking from above the platform. North is 0 degrees, east is 90, south is 180, and west is 270 degrees from true north.

The Alternate Platform is an airborne or ground based platform that is connected via direct datalink to a UAS generating motion imagery and metadata.

7.72 Tag 72: Event Start Time - UTC Conversion

LDS Tag	72	Units	Range	Format
LDS Name	Event Start Time - UTC	Microseconds	0..(2^64-1)	uint64
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Start time of scene, project, event, mission, editing event, license, publication, etc. - Represented as the microseconds elapsed since midnight (00:00:00), January 1, 1970. - Derived from the POSIX IEEE 1003.1 standard. - Resolution: 1 microsecond. 		<ul style="list-style-type: none"> x x 		
Example Value		Example LDS Packet		
April 16, 1995. 13:44:54		[K][L][V] = [0d72][0d8][0x00 02 D5 CF 4D DC 9A 35]		
UDS Key	06 0E 2B 34 01 01 01 01 07 02 01 02 07 01 00 00	ESD Digraph	x	
UDS Name	Event Start Date Time - UTC	ESD Name	Mission Start Time, Date, and Date of Collection	
Units	Range	Format	Units	Range
Date/Time	'YYYYMMDDhhmmss'	ISO 8601	x	x
Notes		Notes		
<ul style="list-style-type: none"> - The absolute beginning date and time of the project, mission, scene, editing event, license, publication etc. - Formatted text as: 'YYYYMMDDhhmmss' 		<ul style="list-style-type: none"> - The LDS Event Start Time - UTC can be converted to three ESD items: - Mission Start Date (Md) - Mission Start Time (Mc) - Date of Collection (Cd) - Refer to EG0104 for details on these ESD items. 		
UDS Conversion		ESD Conversion		
x		x		
<u>To UDS:</u>		<u>To ESD:</u>		
- Convert uint64 to formatted string.		- x		
<u>To LDS:</u>		<u>To LDS:</u>		
- Convert formatted string to uint64.		- x		

7.72.1 Example Event Start Time – UTC

Unix time, or POSIX time, is a system used to discretely label a scale of time. This system is widely used within systems of differing underlying architectures. Unix time is an encoding of Coordinated Universal Time (UTC) and therefore accounts for the addition (or subtraction) of leap seconds. Leap seconds are used to synchronize the UTC clock metric with the yearly rotation period of the earth about the sun.

This POSIX time metadata value is used to represent the start time of a mission, or other event related to the motion imagery collection.

Event Start Time is to be interpreted as an arbitrary time hack indicating the start of some event.

7.73 Tag 73: RVT Local Data Set Conversion

LDS Tag	73	Units	None	Range	Set	Format	Set
LDS Name	RVT Local Data Set						
UDS Mapped Key	Use EG0806 RVT LDS 16-byte Key.						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Local set tag to include the EG0806 RVT Local Data Set metadata items within ST0601. Use the EG0806 Local Set Tags within the ST0601 tag 0d73. - The length field is the size of all RVT LDS metadata items to be packaged within tag 0d73. 		<ul style="list-style-type: none"> x x 					
Example Value		Example LDS Packet					
x		[K][L][V] = [0d73][0dx][x]					
UDS Key	06 0E 2B 34 02 0B 01 01 0E 01 03 01 02 00 00 00	ESD Digraph	x				
UDS Name	Remote Video Terminal Local Data Set	ESD Name	x				
Units	None	Range	Set	Format	Set		
		Units	x	Range	x	Format	x
Notes		Notes					
- x		- x					
UDS Conversion				ESD Conversion			
x				x			
<u>To UDS:</u>		<u>To ESD:</u>					
- x		- x					
<u>To LDS:</u>		<u>To LDS:</u>					
- x		- x					

7.73.1 Example RVT Local Data Set Conversion

ST 0601 Tag 73 allows users to include, or nest, RVT LDS (EG0806) metadata items within ST 0601.

This provides users who are required to use the RVT LDS data fields (Points of Interest, Areas of Interest, etc.) a method to leverage the data fields contained within ST 0601 (like platform location, and sensor pointing angles).

7.74 Tag 74: VMTI Local Data Set Conversion

LDS Tag	74	Units	None	Range	Set	Format	Set
LDS Name	VMTI Local Data Set						
UDS Mapped Key	Use ST0903 VMTI LDS 16-byte Key.						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Local set tag to include the ST0903 VMTI Local Data Set metadata items within ST0601. Use the ST0903 Local Set Tags within the ST0601 tag 0d74. - The length field is the size of all VMTI LDS metadata items to be packaged within tag 0d74. 		<ul style="list-style-type: none"> x x 					
Example Value		Example LDS Packet					
x		[K][L][V] = [0d74][0dx][x]					
UDS Key	06 0E 2B 34 02 0B 01 01 0E 01 03 03 06 00 00 00	ESD Digraph	x				
UDS Name	Video Moving Target Indicator Local Data Set	ESD Name	x				
Units	None	Range	Set	Format	Set	Units	x
						Range	x
						Format	x
Notes		Notes					
- x		- x					
UDS Conversion				ESD Conversion			
x				x			
<u>To UDS:</u>				<u>To ESD:</u>			
- x				- x			
<u>To LDS:</u>				<u>To LDS:</u>			
- x				- x			

7.74.1 Example VMTI Local Data Set Conversion

ST 0601 Tag 74 allows users to include, or nest, VMTI LDS (ST0903) metadata items within ST 0601.

This provides users who are required to use the VMTI LDS data fields a method to leverage the data fields contained within ST 0601 (like platform location, and sensor pointing angles, or frame center).

7.75 Tag 75: Sensor Ellipsoid Height Conversion

LDS Tag	75	Units	Range	Format
LDS Name	Sensor Ellipsoid Height	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 01 82 47 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Sensor Ellipsoid Height as measured from the reference WGS84 Ellipsoid. - Map 0..(2¹⁶-1) to -900..19000 meters. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_75_dec} = \left(\frac{19900}{65535} * \text{LDS_75} \right) - 900$		
Example Value		Example LDS Packet		
14190.72 Meters		[K][L][V] = [0d75][0d2][0xC2 21]		

7.75.1 Example Sensor Ellipsoid Height

The Sensor Ellipsoid Height is the vertical distance between the sensor and the WGS84 Reference Ellipsoid. Measurement is GPS derived.

7.76 Tag 76: Alternate Platform Ellipsoid Height Conversion

LDS Tag	76	Units	Range	Format
LDS Name	Alternate Platform Ellipsoid Height	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 01 82 48 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Alternate Platform Ellipsoid Height as measured from the reference WGS84 Ellipsoid. - Map 0..(2¹⁶-1) to -900..19000 meters. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_76_dec} = \left(\frac{19900}{65535} * \text{LDS_76} \right) - 900$		
Example Value		Example LDS Packet		
9.445334 Meters		[K][L][V] = [0d76][0d2][0x0B B3]		

7.76.1 Example Alternate Platform Ellipsoid Height

The Alternate Platform Ellipsoid Height is the vertical distance between the sensor and the WGS84 Reference Ellipsoid. Measurement is GPS derived.

The Alternate Platform is an airborne or ground based platform that is connected via direct datalink to a UAS generating motion imagery and metadata.

7.77 Tag 77: Operational Mode Conversion

LDS Tag	77	Units	Range	Format
LDS Name	Operational Mode	None	None	uint8
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 03 21 00 00 00			
Notes	Conversion Formula			
- Indicates the mode of operations of the event portrayed in metadata. Enumerated. - 0x00 = "Other" - 0x01 = "Operational" - 0x02 = "Training" - 0x03 = "Exercise" - 0x04 = "Maintenance" - 0x05 = "Test"			x x	
Example Value	Example LDS Packet			
x	[K][L][V] = [0d77][0dx][x]			

7.77.1 Example Operational Mode

The Operational Mode provides an indication of the event portrayed in the metadata. This allows for categorization of motion imagery streams and is often useful for archival systems.

7.78 Tag 78: Frame Center Height Above Ellipsoid Conversion

LDS Tag	78	Units	Range	Format
LDS Name	Frame Center Height Above Ellipsoid	Meters	-900..19000	uint16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 03 48 00 00 00			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Center Ellipsoid Height as measured from the reference WGS84 Ellipsoid. - Map 0..(2¹⁶-1) to -900..19000 meters. - 1 meter = 3.2808399 feet. - Resolution: ~0.3 meters. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{uint_range}} * \text{LDS_uint} \right) - \text{Offset}$ $\text{LDS_78_dec} = \left(\frac{19900}{65535} * \text{LDS_78} \right) - 900$		
Example Value		Example LDS Packet		
9.445334 Meters		[K][L][V] = [0d78][0d2][0x0B B3]		

7.78.1 Example Frame Center Height Above Ellipsoid

The Frame Center Ellipsoid Height is the vertical distance on the ground within the center of the motion imagery frame and the WGS84 Reference Ellipsoid. Measurement is GPS derived.

7.79 Tag 79: Sensor North Velocity Conversion

LDS Tag	79	Units	Range	Format
LDS Name	Sensor North Velocity	Meters/Sec	+/-327	int16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 02 7E 00 00 00			
Notes	Conversion Formula			
<ul style="list-style-type: none"> - Northing velocity of the sensor or platform. Positive towards True North - Map-(2¹⁵-1)..(2¹⁵-1) to +/-327 - Use -(2¹⁵) as an "out of range" indicator. - -(2¹⁵) = 0x8000. - Resolution: ~ 1 cm/sec. 	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_79} = \left(\frac{654}{65534} * \text{LDS_79} \right)$			
Example Value	Example LDS Packet			
x	[K][L][V] = [0d79][0dx][x]			

7.79.1 Example Sensor North Velocity

The Northing velocity of the sensor is the sensor movement rate in the north direction. Positive values indicate a sensor approaching True North.

Note that the int16 used in the LDS value is encoded using two's complement.

7.80 Tag 80: Sensor East Velocity Conversion

LDS Tag	80	Units	Range	Format
LDS Name	Sensor East Velocity	Meters/Sec	+/-327	int16
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 02 02 7F 00 00 00			
Notes	Conversion Formula			
<ul style="list-style-type: none"> - Easting velocity of the sensor or platform. Positive towards East. - Map-(2¹⁵-1)..(2¹⁵-1) to +/-327 - Use -(2¹⁵) as an "out of range" indicator. - -(2¹⁵) = 0x8000. - Resolution: ~ 1 cm/sec. 	$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_80} = \left(\frac{654}{65534} * \text{LDS_80} \right)$			
Example Value	Example LDS Packet			
x	[K][L][V] = [0d80][0dx][x]			

7.80.1 Example Sensor East Velocity

The Easting velocity of the sensor is the sensor movement rate in the east direction. Positive values indicate a sensor approaching east.

Note that the int16 used in the LDS value is encoded using two's complement.

7.81 Tag 81: Image Horizon Pixel Pack Conversion

LDS Tag	81	Units	Range	Format
LDS Name	Image Horizon Pixel Pack	Pack	Pack	Pack
UDS Mapped Key	06 0E 2B 34 02 05 01 01 0E 01 03 02 08 00 00 00			
Notes	<pre> - <tag 81><length> - < start x0, start y0 // point p0 - end x1, end y1 // point p1 - start lat, start lon - end lat, end lon - > </pre>			
Conversion Formula	See Notes below.			
Example Value	Example LDS Packet			
x	[K][L][V] = [0d81][0dx][x]			

7.81.1 Description of Image Horizon Pixel Pack

The Image Horizon Pixel Pack allows a user to separate sky and ground portions of an image by defining a line representing the horizon. The method for detecting where the horizon is within the image is left to the system implementer.

The line representing the horizon which transects the image is defined by a vector with start and end points which must lie on the extents of the image. This is called the Horizon Vector. The horizontal (x) and vertical (y) coordinates are represented in a relative scale (from 0 to 100%) with (x,y) equal to (0%,0%) being the top left corner of the image.

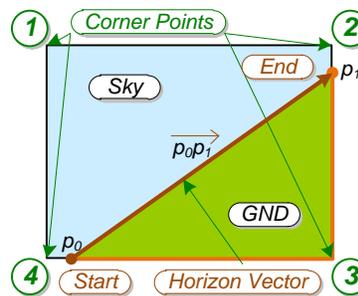


Figure 7-21: Horizon Vector

Once start and end coordinates are defined, the pixels to the right of this Horizon Vector designates the ground region, while pixels to the left represent sky. Refer to Figure 7-21.

With the Horizon Vector defined, only the image corner points to the right are considered valid and allowed to be included within a ST 0601 packet. No invalid corner coordinates are allowed when the Image Horizon Pixel Pack is included in the same ST 0601 packet.

The Horizon Line and valid corner coordinates define the Pixel Frame (PF) (i.e. a polygon) which represents ground pixels.

In the example shown in in Figure 7-21, corner point number 3 is the only valid corner point and is used with the start and end points to define a 3-point Pixel Frame.

Examples for 3-point, 4-point, and 5-point Pixel Frames are shown in Figure 7-22.

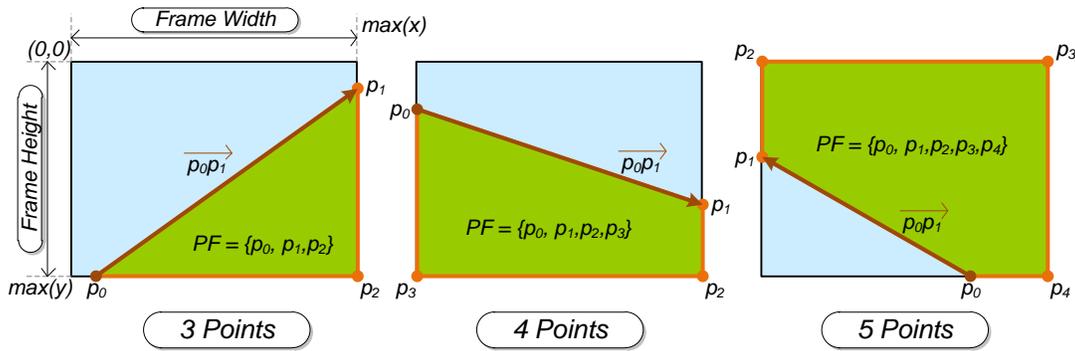


Figure 7-22: Pixel Frame Examples

Note that the pixel points p_0 through p_4 do not always directly correspond with the offset (tags 26-33) or absolute (tags 82-89) corner coordinates defined within this document.

7.81.2 Image Horizon Pixel Pack Example

To show how to use the Image Horizon Pixel Pack, consider the following example for sample 720p airborne imagery:

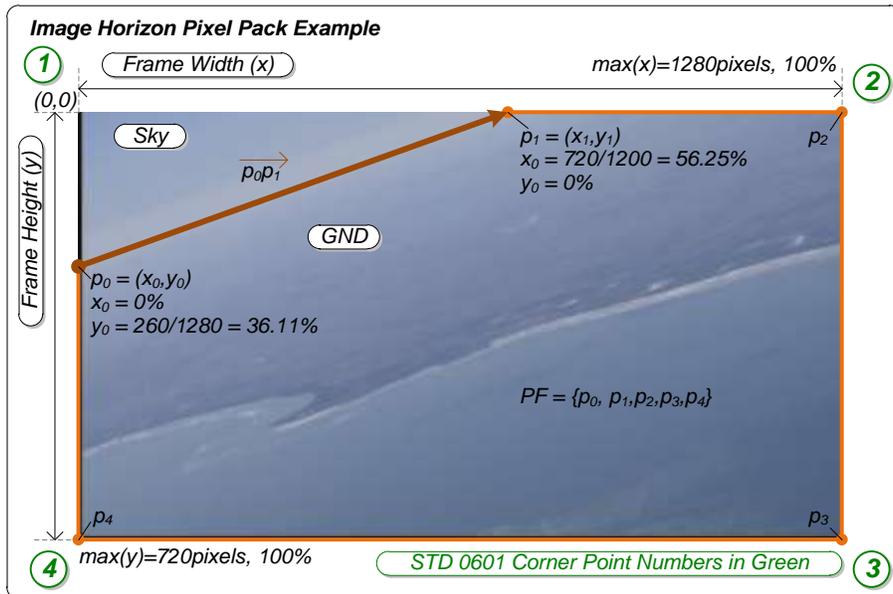


Figure 7-23: Image Horizon Pixel Pack Example

In the example above, the horizon (barely visible through haze) is covered by the Horizon Vector with $p_0 = (0\%, 36.11\%)$, and $p_1 = (56.25\%, 0)$.

7.81.3 Decoding the Image Horizon Pixel Pack

When an Image Horizon Pixel Pack only includes the x & y coordinates of the Horizon Vector and not the geo-locations, the Horizon Vector is used to determine the image pixel coordinates (derived from the relative values) which construct the Pixel Frame.

When the latitudes and longitudes of the Horizon Vector are included, these geo-locations along with the valid offset or absolute corner coordinates in the same ST 0601 packet are then matched with the appropriate points defined by the Pixel Frame.

7.81.4 Floating Length Pack Definition for the Image Horizon Pixel Pack

The Image Horizon Pixel Pack makes use of a Floating Length Pack as described by MISB EG 0701 and allows a user to include or exclude data items as necessary. The first items defined within this pack are the start and end x & y coordinates representing the start and end of the Horizon Vector. These are then followed by real earth latitude-longitude geo-coordinate pairs for the start and end points of the Horizon Vector.

As used here, the minimum required components are the start and end x & y points defining the Horizon Vector in image space, and the latitudes/longitudes of these points are optional (but recommended). Contents are defined below:

Local Set Key		Name			
06 0E 2B 34 - 02 05 01 01 0E 01 03 02 - 08 00 00 00		Image Horizon Pixel Pack			
Constituent Elements					
Key	Name	Notes	Units/Range	Format	Len
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 01 00 00	Start x0	The X coordinate (in percent) of an X-Y pair representing the start point of a vector crossing an image. Top left of image is 0,0 with positive X increasing to the right. To be used with Start y0. Mandatory in the Image Horizon Pixel Pack.	Percent [0..100]	UInt8	1
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 02 00 00	Start y0	The Y coordinate (in percent) of an X-Y pair representing the start point of a vector crossing an image. Top left of image is 0.0 with positive Y increasing down. To be used with Start x0. Mandatory in the Image Horizon Pixel Pack.	Percent [0..100]	UInt8	1
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 03 00 00	End x1	The X coordinate (in percent) of an X-Y pair representing the end point of a vector crossing an image. Top left of image is 0,0 with positive X increasing to the right. To be used with End y0. Mandatory in the Image Horizon Pixel Pack.	Percent [0..100]	UInt8	1
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 04 00 00	End y1	The Y coordinate (in percent) of an X-Y pair representing the end point of a vector crossing an image. Top left of image is 0.0 with positive Y increasing down. To be used with End x0. Mandatory in the Image Horizon Pixel Pack.	Percent [0..100]	UInt8	1
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 05 00 00	Start Latitude	The Latitude of the Start point (x0,y0) on the image border. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. Use (-2^{31}) as an "error" indicator. Optional (but recommended).	Degrees [-90..+90]	Int32	4
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 06 00 00	Start Longitude	The Longitude of the Start point (x0,y0) on the image boarder. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. Use (-2^{31}) as an "error" indicator. Optional (but recommended).	Degrees [-180..+180]	Int32	4
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 07 00 00	End Latitude	The Latitude of the End point (x1,y1) on the image boarder. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. Use (-2^{31}) as an "error" indicator. Optional (but recommended).	Degrees [-90..+90]	Int32	4
06 0E 2B 34 01 01 01 01 0E 01 01 02 09 08 00 00	End Longitude	The Longitude of the End point (x1,y1) on the image boarder. Based on WGS84 ellipsoid. Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. Use (-2^{31}) as an "error" indicator. Optional (but recommended).	Degrees [-180..+180]	Int32	4

7.82 Tag 82: Corner Latitude Point 1 (Full) Conversion

LDS Tag	82	Units	Range	Format
LDS Name	Corner Latitude Point 1 (Full)	Degrees	+/- 90	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Latitude for upper left corner. - Full Range. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~42 nano degrees. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right)$ $LDS_82_dec = \left(\frac{180}{4294967294} * LDS_82 \right)$		
Example Value		Example LDS Packet		
-10.579637999887 Corrected Degrees		[K][L][V] = [0d82][0d2][0xC0 6E]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 07 01 00	ESD Digraph	Rg	
UDS Name	Corner Latitude Point 1 (Decimal Degrees)	ESD Name	SAR Latitude 4	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Latitude coordinate of corner 1 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		<ul style="list-style-type: none"> - The latitude of the upper left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$UDS_dec = \left(\frac{180}{4294967294} * LDS_int \right)$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)(180/0xFFFFFFFF * LDS) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int32)round(0xFFFFFFFF/180 * UDS) 		$ESD_dec = \left(\frac{180}{4294967294} * LDS_int \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int32. 		

7.82.1 Example Corner Latitude Point 1(Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, should either not be reported, or be reported as an "error".

Corner point 1 is the upper left corner of the captured image as highlighted in red.

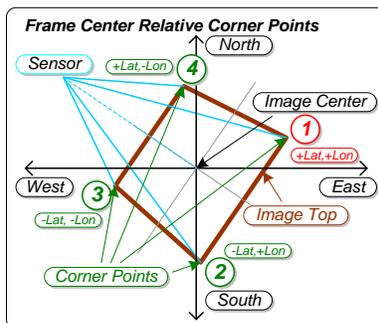


Figure 7-24: Offset Corner Point 1

Value is encoded using two's complement.

7.83 Tag 83: Corner Longitude Point 1 (Full) Conversion

LDS Tag	83	Units	Range	Format
LDS Name	Corner Longitude Point 1 (Full)	Degrees	+/- 180	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude for upper left corner. - Full Range. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_83_dec} = \left(\frac{360}{4294967294} * \text{LDS_83} \right)$		
Example Value		Example LDS Packet		
29.1273677986333 Corrected Degrees		[K][L][V] = [0d83][0d2][0xCB E9]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0B 01 00	ESD Digraph	Rh	
UDS Name	Corner Longitude Point 1 (Decimal Degrees)	ESD Name	SAR Longitude 4	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
Format			Format	PDDDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Longitude coordinate of corner 1 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 		<ul style="list-style-type: none"> - The longitude of the upper left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		$\text{ESD_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double)(360/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/360 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.83.1 Example Corner Longitude Point 1 (Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object), should either not be reported, or be reported as an "error".

Corner point 1 is the upper left corner of the captured image. See figure for Tag 82 above.

7.84 Tag 84: Corner Latitude Point 2 (Full) Conversion

LDS Tag	84	Units	Range	Format
LDS Name	Corner Latitude Point 2 (Full)	Degrees	+/- 90	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Latitude for upper right corner. - Full Range. - Based on WGS84 ellipsoid. - Map -(2^31-1)..(2^31-1) to +/-90. - Use -(2^31) as an "error" indicator. - -(2^31) = 0x80000000. - Resolution: ~42 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_84_dec} = \left(\frac{180}{4294967294} * \text{LDS_84} \right)$		
Example Value		Example LDS Packet		
-10.5661816260963 Corrected Degrees		[K][L][V] = [0d84][0d2][0xD7 65]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 08 01 00	ESD Digraph	Ra	
UDS Name	Corner Latitude Point 2 (Decimal Degrees)	ESD Name	SAR Latitude 1	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
				PDDMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Latitude coordinate of corner 2 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		<ul style="list-style-type: none"> - The latitude of the upper right corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{180}{4294967294} * \text{LDS_int} \right)$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)(180/0xFFFFFFFF * LDS) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int32)round(0xFFFFFFFF/180 * UDS) 		$\text{ESD_dec} = \left(\frac{180}{4294967294} * \text{LDS_int} \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int32. 		

7.84.1 Example Corner Latitude Point 2 (Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, should either not be reported, or be reported as an "error".

Corner point 2 is the upper right corner of the captured image as highlighted in red.

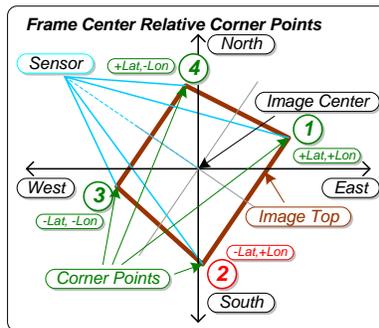


Figure 7-25: Offset Corner Point 2

Value is encoded using two's complement.

7.85 Tag 85: Corner Longitude Point 2 (Full) Conversion

LDS Tag	85	Units	Range	Format
LDS Name	Corner Longitude Point 2 (Full)	Degrees	+/- 180	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude for upper right corner. - Full Range. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_85_dec} = \left(\frac{360}{4294967294} * \text{LDS_85} \right)$		
Example Value		Example LDS Packet		
29.140824172424 Corrected Degrees		[K][L][V] = [0d85][0d2][0xE2 E0]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0C 01 00	ESD Digraph	Rb	
UDS Name	Corner Longitude Point 2 (Decimal Degrees)	ESD Name	SAR Longitude 1	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
Notes	UDS Conversion		ESD Conversion	
<ul style="list-style-type: none"> - Longitude coordinate of corner 2 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 	$\text{UDS_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double) (360/0xFFFFFFFF * LDS) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int32)round(0xFFFFFFFF/360 * UDS) 		$\text{ESD_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int32. 	

7.85.1 Example Corner Longitude Point 2 (Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object), should either not be reported, or be reported as an "error".

Corner point 2 is the upper right corner of the captured image. See figure for Tag 84 above.

7.86 Tag 86: Corner Latitude Point 3 (Full) Conversion

LDS Tag	86	Units	Range	Format
LDS Name	Corner Latitude Point 3 (Full)	Degrees	+/- 90	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Latitude for lower right corner. - Full Range. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~42 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_86_dec} = \left(\frac{180}{4294967294} * \text{LDS_86} \right)$		
Example Value		Example LDS Packet		
-10.5527275411938 Corrected Degrees		[K][L][V] = [0d86][0d2][0xEE 5B]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 09 01 00	ESD Digraph	Rc	
UDS Name	Corner Latitude Point 3 (Decimal Degrees)	ESD Name	SAR Latitude 2	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
				PDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Latitude coordinate of corner 3 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		<ul style="list-style-type: none"> - The latitude of the lower right corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{180}{4294967294} * \text{LDS_int} \right)$ <p><u>To UDS:</u></p> <ul style="list-style-type: none"> - UDS = (double)(180/0xFFFFFFFF * LDS) <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - LDS = (int32)round(0xFFFFFFFF/180 * UDS) 		$\text{ESD_dec} = \left(\frac{180}{4294967294} * \text{LDS_int} \right)$ <p><u>To ESD:</u></p> <ul style="list-style-type: none"> - Convert LDS to decimal. - Convert decimal to ASCII. <p><u>To LDS:</u></p> <ul style="list-style-type: none"> - Convert ASCII to decimal. - Map decimal to int32. 		

7.86.1 Example Corner Latitude Point 3 (Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, should either not be reported, or be reported as an "error".

Corner point 3 is the lower right corner of the captured image as highlighted in red.

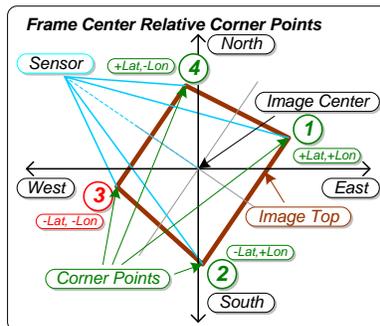


Figure 7-26: Offset Corner Point 3

Value is encoded using two's complement.

7.87 Tag 87: Corner Longitude Point 3 (Full) Conversion

LDS Tag	87	Units	Range	Format
LDS Name	Corner Longitude Point 3 (Full)	Degrees	+/- 180	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude for lower right corner. - Full Range. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_87_dec} = \left(\frac{360}{4294967294} * \text{LDS_87} \right)$		
Example Value		Example LDS Packet		
29.1542782573265 Corrected Degrees		[K][L][V] = [0d87][0d2][0xF9 D6]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0D 01 00	ESD Digraph	Rd	
UDS Name	Corner Longitude Point 3 (Decimal Degrees)	ESD Name	SAR Longitude 2	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
Format			Format	PDDDDMMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Longitude coordinate of corner 3 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 		<ul style="list-style-type: none"> - The longitude of the lower right corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		$\text{ESD_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double)(360/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/360 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.87.1 Example Corner Longitude Point 3 (Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object), should either not be reported, or be reported as an "error".

Corner point 3 is the lower right corner of the captured image. See figure for Tag 86 above.

7.88 Tag 88: Corner Latitude Point 4 (Full) Conversion

LDS Tag	88	Units	Range	Format
LDS Name	Corner Latitude Point 4 (Full)	Degrees	+/- 90	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Latitude for lower left corner. - Full Range. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~42 nano degrees. 		$UDS = (\text{double})(180/0xFFFFFFFF * LDS)$ $LDS_88_dec = \left(\frac{180}{4294967294} * LDS_88 \right)$		
Example Value		Example LDS Packet		
-10.5392711674031 Corrected Degrees		[K][L][V] = [0d88][0d2][0x05 52]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0A 01 00	ESD Digraph	Re	
UDS Name	Corner Latitude Point 4 (Decimal Degrees)	ESD Name	SAR Latitude 3	
Units	Range	Format	Units	Range
Degrees	+/- 90	Double	Degrees	+/- 90.00
				PDDMSSST
Notes		Notes		
<ul style="list-style-type: none"> - Latitude coordinate of corner 4 of an image or bounding rectangle. - Positive (+) is northern hemisphere. - Negative (-) is southern hemisphere. 		<ul style="list-style-type: none"> - The latitude of the lower left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$UDS_dec = \left(\frac{180}{4294967294} * LDS_int \right)$		$ESD_dec = \left(\frac{180}{4294967294} * LDS_int \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double)(180/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/180 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.88.1 Example Corner Latitude Point 4 (Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth, should either not be reported, or be reported as an "error".

Corner point 4 is the lower left corner of the captured image as highlighted in red.

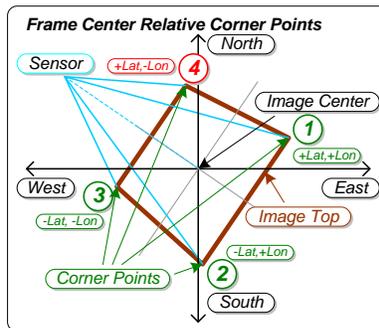


Figure 7-27: Offset Corner Point 4

Value is encoded using two's complement.

7.89 Tag 89: Corner Longitude Point 4 (Full) Conversion

LDS Tag	89	Units	Range	Format
LDS Name	Corner Longitude Point 4 (Full)	Degrees	+/- 180	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Frame Longitude for lower left corner. - Full Range. - Based on WGS84 ellipsoid. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-180. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~84 nano degrees. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_89_dec} = \left(\frac{360}{4294967294} * \text{LDS_89} \right)$		
Example Value		Example LDS Packet		
29.1677346311172 Corrected Degrees		[K][L][V] = [0d89][0d2][0x10 CD]		
UDS Key	06 0E 2B 34 01 01 01 03 07 01 02 01 03 0E 01 00	ESD Digraph	Rf	
UDS Name	Corner Longitude Point 4 (Decimal Degrees)	ESD Name	SAR Longitude 3	
Units	Range	Format	Units	Range
Degrees	+/- 180	Double	Degrees	+/- 180.00
Format			Format	
			PDDDDMMSSST	
Notes		Notes		
<ul style="list-style-type: none"> - Longitude coordinate of corner 4 of an image or bounding rectangle. - Positive (+) is eastern hemisphere. - Negative (-) is western hemisphere. 		<ul style="list-style-type: none"> - The longitude of the lower left corner of the SAR image box. 		
UDS Conversion		ESD Conversion		
$\text{UDS_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		$\text{ESD_dec} = \left(\frac{360}{4294967294} * \text{LDS_int} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double)(360/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/360 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.89.1 Example Corner Longitude Point 4 (Full) Conversion

For legacy purposes, both range-restricted (Tags 26-33) and full-range (Tag 82-89) representations of Image Corner Coordinates MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per REQ-4.04.

The corner points of the captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object), should either not be reported, or be reported as an "error".

Corner point 4 is the lower left corner of the captured image. See figure for Tag 88 above.

7.90 Tag 90: Platform Pitch Angle (Full) Conversion

LDS Tag	90	Units	Range	Format
LDS Name	Platform Pitch Angle (Full)	Degrees	+/- 90	int32
UDS Mapped Key	Use EG0104 UDS Key			
Notes		Conversion Formula		
<ul style="list-style-type: none"> - Aircraft pitch angle. Angle between longitudinal axis and horizontal plane. - Positive angles above horizontal plane. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "out of range" indicator. - $-(2^{31}) = 0x80000000$. - Res: ~42 nano deg. 		$UDS = (\text{double})(180/0xFFFFFFFF * LDS)$ $LDS_{90_dec} = \left(\frac{180}{4294967294} * LDS_{90} \right)$		
Example Value		Example LDS Packet		
-0.4315251 Degrees		[K][L][V] = [0d90][0d2][0xFD 3D]		
UDS Key	06 0E 2B 34 01 01 01 07	ESD Digraph	Ip	
UDS Name	07 01 10 01 05 00 00 00 Platform Pitch Angle	ESD Name	UAV Pitch (INS)	
Units	Range	Format	Units	Range
Degrees	+/- 90	Float	Degrees	+/- 20.00
Notes		Notes		
<ul style="list-style-type: none"> - Pitch angle of platform expressed in degrees. - The Pitch of an airborne platform describes the angle the longitudinal axis makes with the horizontal (i.e., equi-potential gravitational surface); 		<ul style="list-style-type: none"> - Pitch angle of the aircraft. 		
UDS Conversion		ESD Conversion		
$UDS_{dec} = \left(\frac{180}{4294967294} * LDS_{int} \right)$		$ESD_{dec} = \left(\frac{180}{4294967294} * LDS_{int} \right)$		
<u>To UDS:</u>		<u>To ESD:</u>		
- UDS = (double)(180/0xFFFFFFFF * LDS)		- Convert LDS to decimal.		
<u>To LDS:</u>		- Convert decimal to ASCII.		
- LDS = (int32)round(0xFFFFFFFF/180 * UDS)		<u>To LDS:</u>		
		- Convert ASCII to decimal.		
		- Map decimal to int32.		

7.90.1 Example Platform Pitch Angle (Full) Conversion

For legacy purposes, both range-restricted (Tag 6) and full-range (Tag 90) representations of Platform Pitch Angle MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tag 90) being favored as per REQ-4.04.

The pitch angle of the platform is the angle between the longitudinal axis (line made by the fuselage) and the horizontal plane. Angles are positive when the platform nose is above the horizontal plane. This item allows unrestricted pitch angle values.

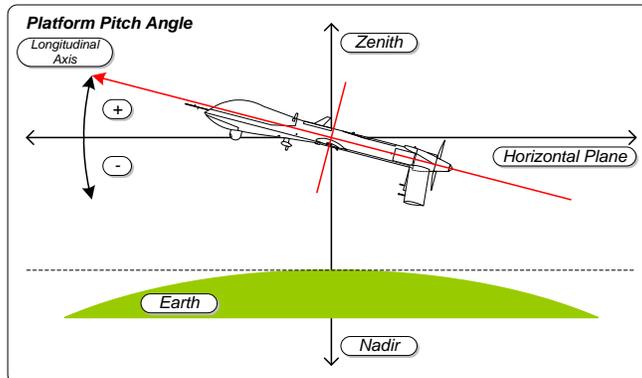


Figure 7-28: Platform Pitch Angle

Note that the int32 used in the LDS value is encoded using two's complement.

7.91 Tag 91: Platform Roll Angle (Full) Conversion

LDS Tag	91	Units	Degrees	Range	+/- 90	Format	int32
LDS Name	Platform Roll Angle (Full)						
UDS Mapped Key	Use EG0104 UDS Key						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Platform roll angle. Angle between transverse axis and transvers-longitudinal plane. Positive angles for lowered right wing. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "error" indicator. - $-(2^{31}) = 0x80000000$. - Resolution: ~42 nano degrees. 		$LDS_dec = \left(\frac{LDS_range}{int_range} * LDS_int \right)$ $LDS_91_dec = \left(\frac{180}{4294967294} * LDS_91 \right)$					
Example Value		Example LDS Packet					
3.405814 Degrees		[K][L][V] = [0d91][0d2][0x08 B8]					
UDS Key	06 0E 2B 34 01 01 01 07 07 01 10 01 04 00 00 00	ESD Digraph	Ir				
UDS Name	Platform Roll Angle	ESD Name	UAV Roll (INS)				
Units	Degrees	Range	+/- 90	Format	Float	Units	Degrees
Range		Range	+/- 50.00	Format	PDD.HH	Range	
Format		Format		Format		Format	
Notes		Notes					
<ul style="list-style-type: none"> - Roll angle of platform expressed in degrees. - The Roll of an airborne platform is rotation about its longitudinal (front-to-back) axis; - Wings level is zero degrees, positive (negative) angles describe a platform orientation with the right wing down(up). 		<ul style="list-style-type: none"> - Roll angle of the aircraft. 					
UDS Conversion				ESD Conversion			
$UDS_dec = \left(\frac{180}{4294967294} * LDS_int \right)$				$ESD_dec = \left(\frac{180}{4294967294} * LDS_int \right)$			
<u>To UDS:</u>				<u>To ESD:</u>			
- UDS = (double)(180/0xFFFFFFFF * LDS)				- Convert LDS to decimal.			
<u>To LDS:</u>				- Convert decimal to ASCII.			
- LDS = (int32)round(0xFFFFFFFF/180 * UDS)				<u>To LDS:</u>			
				- Convert ASCII to decimal.			
				- Map decimal to int32.			

7.91.1 Example Platform Roll Angle (Full) Conversion

For legacy purposes, both range-restricted (Tag 7) and full-range (Tag 91) representations of Platform Roll Angle MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tag 91) being favored as per REQ-4.04.

The rotation operation performed about the longitudinal axis forms the roll angle between the previous aircraft transverse-longitudinal plane and the new transverse axis location (line from wing tip to wing tip). Positive angles correspond to the starboard (right) wing lowered below the previous aircraft transverse-longitudinal plane. This item allows unrestricted roll angles.

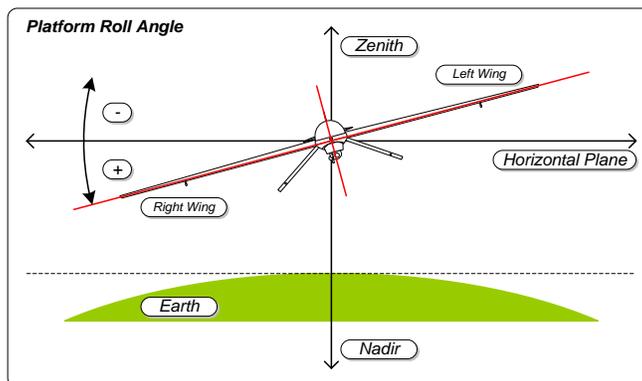


Figure 7-29: Platform Roll Angle

7.92 Tag 92: Platform Angle of Attack (Full) Conversion

LDS Tag	92	Units	Degrees	Range	+/- 90	Format	int32
LDS Name	Platform Angle of Attack (Full)						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 02 00 00 00						
Notes		Conversion Formula					
<ul style="list-style-type: none"> - Platform Attack Angle. Angle between platform longitudinal axis and relative wind. - Positive angles for upward relative wind. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "out of range" indicator. - $-(2^{31}) = 0x80000000$. - Res: ~42 nano deg. 		$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_92_dec} = \left(\frac{180}{4294967294} * \text{LDS_92} \right)$					
Example Value		Example LDS Packet					
-8.670177 Degrees		[K][L][V] = [0d92][0d2][0xc8 83]					

7.92.1 Example Platform Angle of Attack (Full) Conversion

For legacy purposes, both range-restricted (Tag 50) and full-range (Tag 92) representations of Platform Angle of Attack MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tag 92) being favored as per REQ-4.04.

The angle of attack of an airborne platform is the angle formed between the relative wind and platform longitudinal axis (line made by the fuselage). Positive angles for wind with a relative upward component. Refer to the figure below.

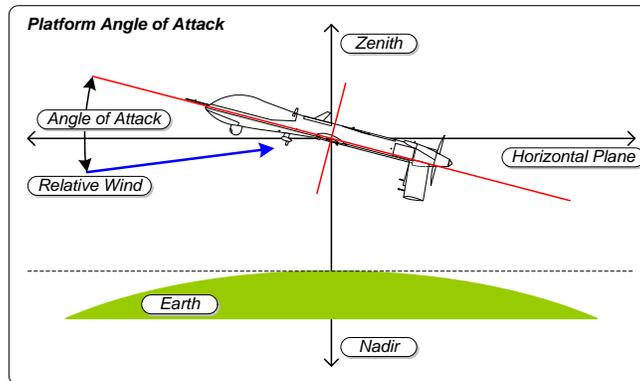


Figure 7-30: Platform Angle of Attack

Note that the int32 used in the LDS value is encoded using two's complement.

7.93 Tag 93: Platform Sideslip Angle (Full) Conversion

LDS Tag	93	Units	Degrees	Range	+/- 180	Format	int32
LDS Name	Platform Sideslip Angle (Full)						
UDS Mapped Key	06 0E 2B 34 01 01 01 01 0E 01 01 01 04 00 00 00						
Notes	<ul style="list-style-type: none"> - Angle between the platform longitudinal axis and relative wind. - Full Range. - Positive angles to right wing, neg to left. - Map $-(2^{31}-1)..(2^{31}-1)$ to +/-90. - Use $-(2^{31})$ as an "out of range" indicator. - $-(2^{31}) = 0x80000000$. - Res: ~42 nano deg. 			Conversion Formula			
				$\text{LDS_dec} = \left(\frac{\text{LDS_range}}{\text{int_range}} * \text{LDS_int} \right)$ $\text{LDS_93_dec} = \left(\frac{360}{4294967294} * \text{LDS_93} \right)$			
Example Value	x			Example LDS Packet			
				[K][L][V] = [0d93][0dx][x]			

7.93.1 Example Platform Sideslip Angle (Full) Conversion

For legacy purposes, both range-restricted (Tag 52) and full-range (Tag 93) representations of Platform Sideslip Angle MAY appear in the same ST 0601 packet. A single representation is preferred, with the full-range version (Tag 93) being favored as per REQ-4.04.

The angle formed between the platform longitudinal axis (line made by the fuselage) and the relative wind is the sideslip angle. A negative sideslip angle is depicted in the figure below:

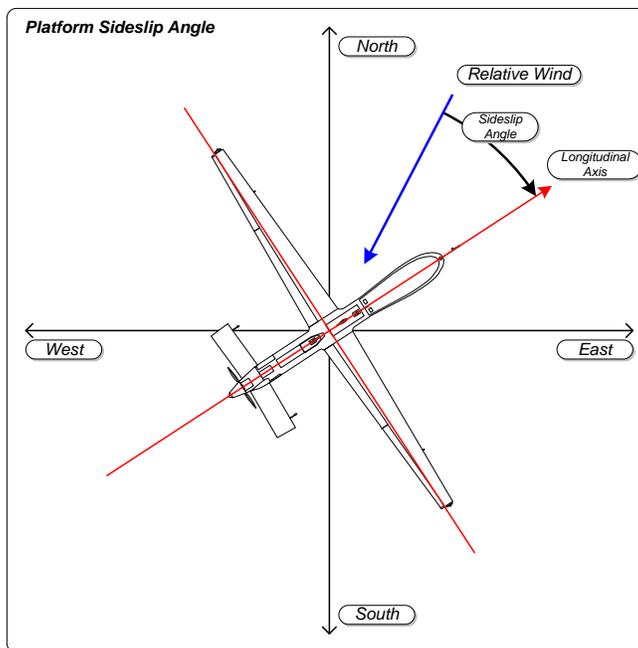


Figure 7-31: Platform Sideslip Angle

Note that the int32 used in the LDS value is encoded using two's complement.

7.94 Tag 94: MIIS Core Identifier

LDS Tag	94	Units	None	Range	None	Format	Binary Value
LDS Name	MIIS Core Identifier						
UDS Mapped Key	Use ST1204 MIIS Core 16-byte Key.						
Notes	- Local set tag to include the ST1204 MIIS Core Identifier Binary Value within ST0601. Use according to the rules and requirements defined in ST1204.	Conversion Formula			x		
					x		
Example Value	x	Example LDS Packet					
		[K][L][V] = [0d94][0dx][x]					
UDS Key	06 0E 2B 34 01 01 01 01 0E 01 04 05 03 00 00 00	ESD Digraph			x		
UDS Name	Motion Imagery Identification System Core	ESD Name			x		
Units	None	Units	x	Range	x	Format	x

7.94.1 Example MIIS Core Identifier Details

ST 0601 Tag 94 allows users to include the MIIS Core Identifier (ST1204) Binary Value (opposed to the text-based representation) within ST 0601. Tag 94's value does not include ST1204's 16 byte Key or length, only the value portion.

See ST1204 for generation and usage requirements.