| MISB MOTION IMAGERY STANDARDS BOARD | MISB ST 0601.16a |
|---|---|
| STANDARD | |
| UAS Datalink Local Set | 1 May 2020 |

# 1 Scope

MISB ST 0601 defines the Unmanned Air System (UAS) Datalink Local Set (LS) for UAS platforms. Typically produced on-board a UAS airborne platform, the UAS Datalink LS is encapsulated within a MPEG-2 Transport container along with compressed Motion Imagery, and transmitted over a wireless Datalink for dissemination.

The UAS Datalink LS is a bandwidth-efficient, extensible Key-Length-Value (KLV) metadata Local Set conforming to SMPTE ST 336. This standard defines the Local Set items with requirements for their use and provides additional details with examples.

Past versions of MISB ST 0601 provided a mapping to MISB EG 0104 *Predator UAV Basic Universal Metadata Set* metadata and Exploitation Support Data (ESD) metadata. MISB EG 0104 and ESD are both deprecated and from this version forward. If mapping MISB EG 0104 or ESD data to MISB ST 0601 Local Set, please refer to previous versions of MISB ST 0601.

(Quick link to items comprising **UAS Datalink Local Set** in numeric order, see Table 1, or in alphabetical order, see Table 2).

# 2 References

MISB references cited here-in reflect versions current to the publication date of a document. In the event of a MISB document correction, the corrected document will have a single letter Minor Version appended to the Major Version number per the MISB Document Development Process [1]. For example, corrections to ST 0001.2, which has a Major Version of 2, becomes ST 0001.2a, which includes a Minor Version of "a". The MISB will not update the referring document (this document) with the Minor Version number change. When acquiring any MISB reference listed below from an NGA repository the latest version may be either a Major or Minor Version.


[1] MISB Document Development Process, May 2020.

[2] SMPTE ST 336:2017 Data Encoding Protocol Using Key-Length-Value.

[3] MISB ST 0807.24 MISB KLV Metadata Registry, Oct 2019.

[4] MISB ST 0603.5 MISP Time System and Timestamps, Oct 2017.

[5] MISB ST 0107.4 KLV Metadata in Motion Imagery, Feb 2019.

[6] MISB MISP-2020.1: Motion Imagery Handbook, Oct 2019.

[7] MISB ST 0806.4 Remote Video Terminal Metadata Set, Feb 2014.
[8] MISB ST 0604.6 Timestamps for Class 1/Class 2 Motion Imagery, Oct 2017.
[9] SMPTE RP 210v13:2012 Metadata Element Dictionary.
[10] MISB ST 1010.3 Generalized Standard Deviation and Correlation Coefficient Metadata, Oct 2016.
[11] MIL-STD-2500C (CN2) National Imagery Transmission Format Version 2.1 for the National Imagery Transmission Format, Change Notice 2, 02 Jan 2019.
[12] MISB ST 1607 Constructs to Amend/Segment KLV Metadata, 2016.
[13] MISB ST 1201.4 Floating Point to Integer Mapping, Feb 2019.
[14] MISB ST 0102.12 Security Metadata Universal and Local Sets for Motion Imagery Data, Jun 2017.
[15] MISB ST 0903.4 Video Moving Target Indicator and Track Metadata, Oct 2014.
[16] MISB ST 1204.2 Motion Imagery Identification System (MIIS) Core Identifier, June 2019.
[17] MISB ST 1206.1 SAR Motion Imagery Metadata, Jun 2017.
[18] MISB ST 1002.2 Range Motion Imagery, Jun 2016.
[19] MISB ST 0801.6 Photogrammetry Metadata Set for Digital Motion Imagery, Feb 2018.
[20] MISB ST 1601.1 Geo-Registration Local Set, Nov 2018.
[21] MISB ST 1602.1 Composite Imaging Local Set, Nov 2018.
[22] MISB ST 0902.8 Motion Imagery Sensor Minimum Metadata Set, Nov 2018.

# 3 Acronyms

| | |
|---|---|
| **BER** | Basic Encoding Rules |
| **KLV** | Key Length Value |
| **LS** | Local Set |
| **MISB** | Motion Imagery Standards Board |
| **MISP** | Motion Imagery Standards Profile |
| **OID** | Object IDentifier |
| **RP** | Recommended Practice |
| **SDCC-FLP** | Standard Deviation Correlation Coefficient Floating Length Pack |
| **SMPTE** | Society of Motion Picture Television Engineers |
| **ST** | Standard |
| **UAS** | Unmanned Air System |
| **UL** | Universal Label |
| **US** | Universal Set |

# 4 Revision History

| Revision | Date | Summary of Changes |
|---|---|---|
| ST 0601.16 | 10/23/2019 | • Updated Items 26-33 to form a proper bounding box around the frame center lat/lon |

| | | |
|---|---|---|
| | | • Updated Items 43 and 44 - set the resolution to 2 pixels<br>• Updated Item 61 corrected length value in the example<br>• Updated Item 62 to use a valid example value<br>• Updated Item 63 to use a valid example value<br>• Added examples for Item 80 and 93<br>• Updated Items 82-89 so they form a proper bounding box around the frame center lat/lon<br>• Updated Item 94 corrected length value in the example<br>• Updated Item 124, set min value to one<br>• Updated Item 129 - KLV_uint to KLV_val (in KLV-To-Software) and Item 129's example to encode an alpha numeric string<br>• Added examples for Items 130, 138, 140, and 141<br>• Updated Item 141 - Figure 71 showed a leading bit equal to 1 which is incorrect; changed to 0<br>• Added "Continuous Zoom" to Table 4 |
| ST 0601.16a | 05/1/2020 | • Corrected table headers in Item 47 – Generic Flags. |

# 5 Introduction

UAS platforms operate over a limited-bandwidth wireless communications channel (i.e., UAS Datalink). Because of the high overhead in using a Universal Set for KLV metadata (see SMPTE ST 336 [2]), the bit-efficient Local Set form for encoding metadata items is more appropriate for transmitting metadata.

This standard defines a UAS Datalink LS according to SMPTE encoding rules, plus MISB specific data types and methods for conserving bandwidth. This standard is extensible for future metadata. Registration of new metadata items in the proper metadata dictionary (public or private) is a pre-requisite of using the metadata item in the UAS Datalink LS.

## *5.1 UAS Datalink Local Set Changes and Updates*

This document defines the UAS Datalink Local Set and is under configuration management. When updating MISB ST 0601 the MISB maintains the document version, revision history and date change.

# 6 UAS Datalink Local Set

## *6.1 Metadata Usage*

| Requirement(s) | |
|---|---|
| ST 0601.13-23 | Excepting the requirements for Tag 2 at the start and Tag 1 at the end of a UAS Datalink LS, any order of other items within the LS instance shall be valid. |
| ST 0601.13-24 | Except for items noted with "Multiples Allowed," all items within an instance of a UAS Datalink LS shall be included only once. |

| | |
|---|---|
| ST 0601.14-35 | Child-items within item 100 (Segment) or 101 (Amend), shall be allowed to duplicate items of their parent. |
| ST 0601.8-14 | The usage of all Tags within the UAS Datalink LS shall be consistent with the descriptions and clarifications contained within MISB ST 0601. |
| ST 0601.8-16 | UAS Datalink LS decoding systems that 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 Datalink LS packet. |
| ST 0601.8-17 | UAS Datalink LS decoding systems that understand the Height Above Ellipsoid (HAE) representation of certain metadata items shall use the HAE representation and ignore the Mean Sea Level (MSL) representation when both exist in the same UAS Datalink LS packet. |
| ST 0601.9-20 | When UAS Datalink LS decoding systems understand the extended representation of certain metadata items the decoder shall use the extended representation. |
| ST 0601.9-21 | When UAS Datalink LS decoding systems understand the extended representation of certain metadata items the decoder shall ignore the restricted representation when both exist in the same UAS Datalink LS packet. |

## 6.2 UAS Local Set Universal Label

The UAS Local Set 16-Byte UL "Key" is registered in MISB ST 0807 [3] as:

| |
|---|
| 06.0E.2B.34.02.0B.01.01.0E.01.03.01.01.00.00.00 (CRC 56773) |

| Requirement | |
|---|---|
| ST 0601.8-19 | Historical 16-byte Universal Label Keys shall be forbidden in future developments. |

## 6.3 UAS Datalink LS Packet Structure

Figure 1 illustrates the general structure of a UAS Datalink LS packet. A packet is a combination of a UL Key, the Length of the Value, and the Value. UAS Datalink LS items are encapsulated within the Value portion of the packet. UAS Datalink LS packets require the following items: Precision Time Stamp (Tag 2), UAS Datalink LS Version Number (Tag 65) and Checksum (Tag 1).

The Precision Time Stamp (Tag 2) is a sampled and quantized time value of the MISP Time System as defined in MISB ST 0603 [4]. The Precision Time Stamp represents the time of birth of the metadata within the packet. Section 6.4 provides details on Timestamps. The UAS Datalink LS Version Number (Tag 65) states the version of the MISB ST 0601 document used when constructing the packet. Section 6.6 provides details on version numbers. Each UAS Datalink LS packet includes a Checksum (Tag 1) to validate the contents of the whole packet. Section 6.6 provides details on Checksums.

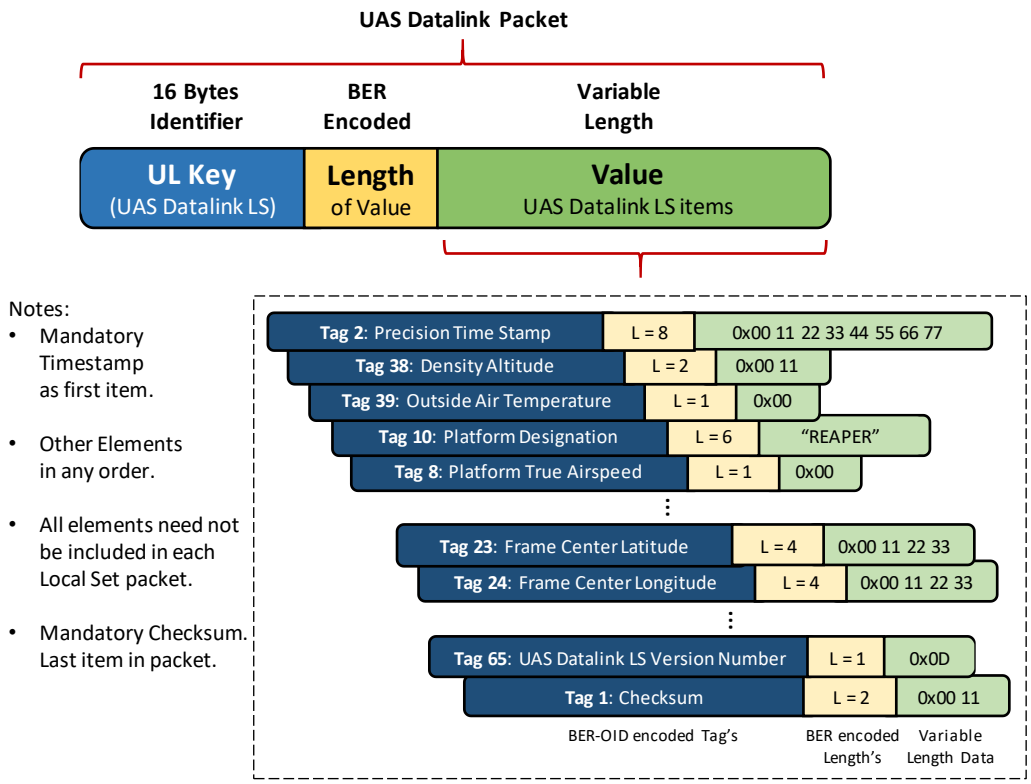


**Figure 1: Example of a UAS Datalink LS Packet**

A packet can include any combination of metadata items from the UAS Datalink LS. With the exception of the Precision Time Stamp and Checksum, the order of items within a UAS Datalink LS packet is arbitrary, unless dictated by use of any Standard Deviation Correlation Coefficient Floating Length Pack (SDCC-FLP). In addition, some items have multiple instances within a single packet, so a tag's use may not be unique in the LS (however the length and value will usually be different).

### 6.3.1 KLV Metadata in Motion Imagery

When using KLV Metadata in Motion Imagery, MISB ST 0107 [5] provides a set of baseline requirements.

| Requirement | |
|---|---|
| ST 0601.8-03 | All UAS Datalink LS metadata shall be expressed in accordance with MISB ST 0107. |

### 6.3.2 Nested Packs within the UAS Datalink LS

To reduce bandwidth, KLV pack structures provide the means to eliminate the tag and potentially the length when sending a group of related data items. Packs do not include tags and therefore have a predefined order of elements. There are two types of packs, Variable Length Packs (VLP) and Defined Length Packs (DLP).

A VLP is a group of items represented as length-value pairs with the item's tags suppressed. Lengths in BER short or long form precede each item's value as illustrated in Figure 2. The VLP

is constructed as a KLV triplet, where the Tag in Figure 2 is the tag for the VLP. The Length (Total) (in BER short or long form) represents the sum of all length-value pairs that follow. This length-value pair pattern continues for all represented items.

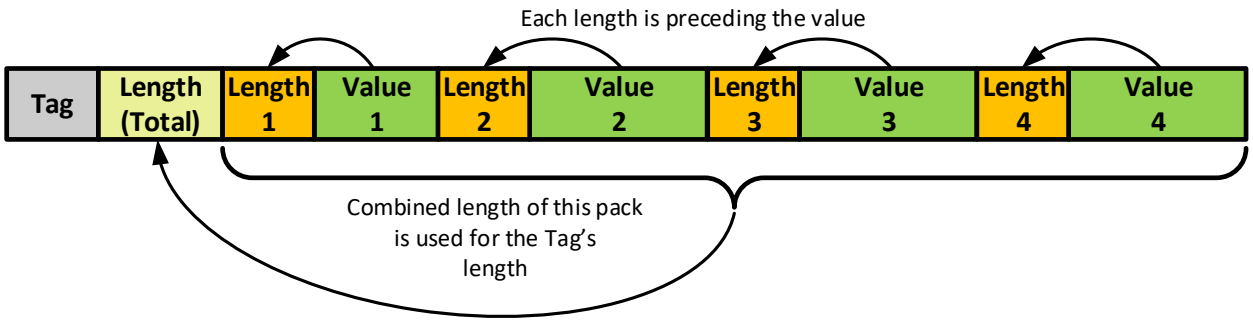


**Figure 2: Illustration of Variable Length Pack**

One exception to this pattern is where a length-value pairs value is unknown. In this case the length for the value is zero (0) and the value is omitted. This preserves the defined order of the pack in cases where a value is unknown or omitted. For example, Figure 3 shows a VLP with a list of country codes. The VLP begins with its Local Set tag and a total length of 9 bytes. The first length-value pair representing the first metadata item has a length of 3 bytes and a value of "CAN." The second item length-value pair has a length of 0 bytes, so the second value is undefined and not included. The last item length-value pair has a length of 3 bytes and a value of "FRA." With this list of country codes, the order is preserved, with the second item being undefined.

**Figure 3: Illustration of Variable Length Pack with a zero-ed element**

A DLP is a group of items, each with pre-defined or computable length. Figure 4 illustrates a DLP example. This illustration shows the Local Set tag for the DLP and a Length (Total) which is a sum of the three following values lengths i.e., length of Value 1 + length of Value 2 + length of Value 3. The item definitions (in Section 8) which utilize a DLP provides the pre-defined lengths or methods of computing the length of each item within the DLP. A DLP does not allow undefined values.

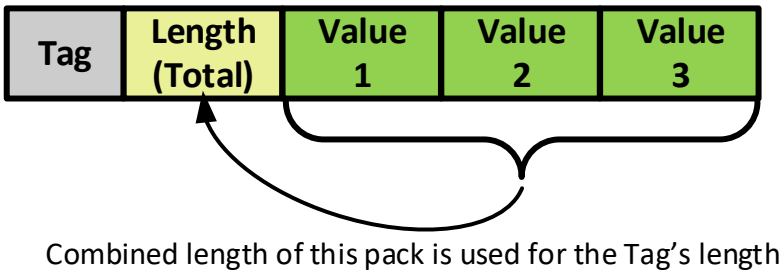


**Figure 4: Illustration of Defined Length Pack**

A DLP specification can vary the size of the final element, and when this occurs the DLP is then a Floating Length Pack (FLP). FLPs allow the final value to be a variable length value such as a string. To compute the length of the final value all previous element lengths are determined and subtracting from the Length (Total).

Both VLP and DLP structures become truncation packs when removing one or more of their items at the end of the pack, i.e., removing one or more length-pairs in a VLP or removing one or more values in a DLP. In both cases, the length (Total) of the VLP or DLP must reflect any truncation.

The Motion Imagery Handbook [6] provides additional details and references on Packs and truncation packs.

### 6.3.3 Nesting Local Sets within the UAS Datalink LS

To allow re-use of metadata items in the UAS Datalink LS (e.g., platform location, and sensor pointing angles), while providing greater flexibility to system implementers, other Local Sets with defined items in the UAS Datalink LS may nest within the UAS Datalink LS.

A nested Local Set is the same as any standalone metadata item defined within the UAS Datalink LS, where this document defines the tag, and the Length is determined by the size of its Value. The Value contains a complete set of Tag-Length-Value triplets defined by another standard or document. Figure 5 illustrates an example of a packet where the RVT LS (MISB ST 0806 [7]) nests within the UAS Datalink LS. In this example, UAS Datalink LS Tag 73's value is an RVT LS with its own defined tag list. The tags within the RVT LS are completely independent of the tags in the UAS Datalink LS. For example, as shown in Figure 5, the RVT LS defines Tag 8 as the Version Number while the UAS Datalink LS defines Tag 8 as the Platform True Airspeed. UAS Datalink LS embeds the RVT LS within the value of Tag 73 so Tag 8, for RVT LS, parses within the scope of Tag 73, while the Tag 8, for UAS Datalink LS parses within the scope of the UAS Datalink LS.

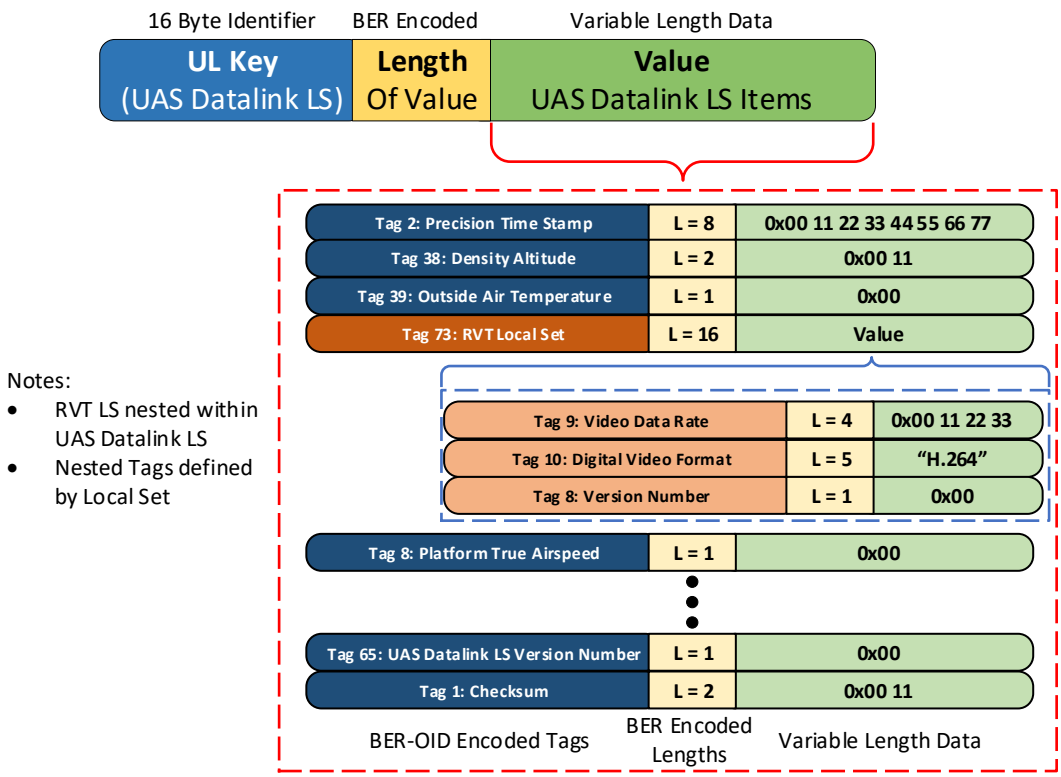


**Figure 5: Nested Packet Example**

### 6.3.4 Data Structures and Records

The nested Packs or Local Sets within the UAS Datalink LS are a collection of related values. From a software perspective, a collection of related values has various names such as a structure (C), or an object (java, C++). This document uses the general term, "record," for a collection of related values independent of the underlying KLV data format. Records are a collection of data fields with potentially different data types. Packs (VLP or DLP) and Local Sets are both instances of a record.

## *6.4 Packet Timestamp*

Metadata sources and the flight computer (or equivalent) operate on the same time reference, which is typically GPS derived. The metadata source provides a timestamp included in a UAS Datalink LS packet (as well as the Motion Imagery) to facilitate synchronizing a Motion Imagery frame to its corresponding metadata. This packet timestamp represents the time of birth of all Local Set items contained within a UAS Datalink LS packet.

It is mandatory to include a Precision Time Stamp representing absolute time as defined in MISB ST 0603 [4] in every UAS Datalink LS packet. The Precision Time Stamp (Tag 2) is an eight-byte unsigned integer counter of the number of SI Seconds (in microseconds) which have elapsed since midnight (00:00:00), January 1, 1970 (1970-01-01T00:00:00Z). Note: this time does not include leap seconds and therefore the Precision Time Stamp does not represent UTC. To convert the Precision Time Stamp to UTC, add or subtract leap seconds. The number of leap seconds may be represented by the Leap Seconds item (Tag 136) or from a current leap second

table. See the Motion Imagery Handbook [6] for details.

The first item of a UAS Datalink LS packet is the Precision Time Stamp as shown in Figure 6. It applies to all metadata in the packet and corresponds to the time of birth of all the data contained within the packet.

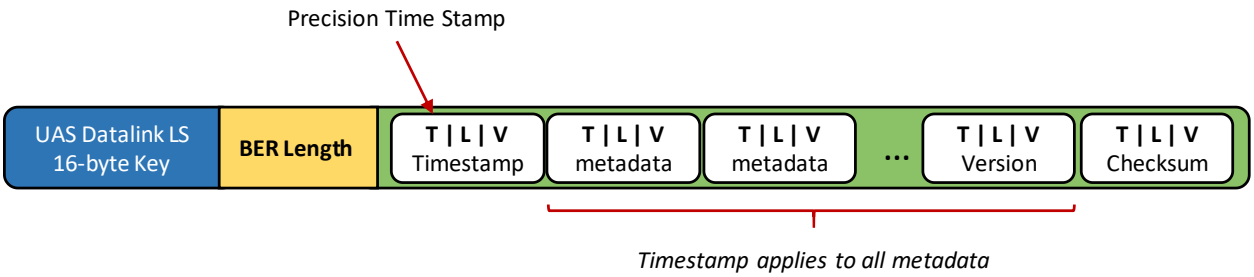


**Figure 6: Packet Timestamp Example**

| Requirement(s) | |
|---|---|
| ST 0601.8-09 | All instances of a UAS Datalink LS shall contain as their first item Tag 2, Precision Time Stamp – Microseconds. |
| ST 0601.8-10 | The value assigned to the Precision Time Stamp – Microseconds item (Tag 2) shall represent the time of birth of the metadata of all the items contained in that instance of the UAS Datalink LS. |

In some cases, the time of birth timestamp may not directly correspond to the sample time of a metadata value. Thus, the maximum timestamp error encountered will be the difference in time between the current metadata packet, and the packet immediately preceding it. A recommendation is for systems to adjust metadata repetition rates to meet timing criteria.

The Precision Time Stamp provides two purposes: a baseline time for coordinating or synchronizing metadata with Motion Imagery and the actual real-world time. MISP conformant Motion Imagery will contain a Precision Time Stamp within the Motion Imagery frames (see MISB ST 0604 [8]) and a Precision Time Stamp within each metadata packet. These Precision Time Stamps enable the correlation of Motion Imagery frames and the metadata. Any modifications to the metadata Precision Time Stamp will break the synchronization of the metadata and Motion Imagery frames.

There are some cases where the Precision Time Stamp does not correctly represent real-world time; therefore, a Correction Offset (Tag 137) provides a means to adjust the time presented to end users. The Correction Offset is typically a post-mission update and is usually a constant value for the whole mission or flight. The Correction Offset eliminates the need to do a post-mission change of the Precision Time Stamp value, which if changed can cause synchronization issues with the Motion Imagery frames. To compute the Corrected Time ($T_{Corrected}$) for display or other uses, add the Correction Offset ($T_{Correction}$) to the Precision Time Stamp ($T_{Precision}$), as shown in Equation 1.

$$T_{Corrected} = T_{Precision} + T_{Correction} \qquad \text{Equation 1}$$

To convert times to UTC, add the Leap Seconds ($L_{Seconds}$) offset as shown in Equation 2.

$$T_{Corrected} = T_{Precision} + T_{Correction} + (L_{Seconds} * 1{,}000{,}000) \qquad \text{Equation 2}$$

## 6.5 Report-on-Change

MISB ST 0601 assumes the Report-on-Change system described in the Motion Imagery Handbook. With exception of the three mandatory items (Tag 1-Checksum, Tag 2-Precision Time Stamp, and Tag 65-UAS Datalink LS Version Number), additional items update when their value changes or if a Metadata Refresh Period (i.e., 30-second period) has elapsed since the last item update. Receivers treat an item as undefined when the item does **not** update within a Metadata Refresh Period.

MISB ST 0107 [4] provides a set of baseline requirements when implementing Report-on-Change.

| Requirement | |
|---|---|
| ST 0601.15-36 | UAS Data-link LS items implemented using Report-on-Change shall adhere to the requirements for usage stated in MISB ST 0107. |

Except for mandatory items and items marked "Yes" for "Multiples Allowed?" (or MUL in Table 1 set to "Y"), all items within the UAS Datalink Local Set may use Zero Length Items (ZLI).

### 6.5.1 Metadata Distribution

Within a constrained bandwidth channel, shared by both Motion Imagery and metadata, transmitting a large amount of metadata at one time can impact the received quality of the Motion Imagery. To prevent this, the MISB recommends distributing the Known-Static metadata items over a 30-second refresh period. For example, instead of sending item A, B and C every 30 seconds at time 00:00:00, send item A every 30 seconds starting at time 00:00:00; send item B every thirty seconds starting at time 00:00:05 (five seconds later); send item C every thirty seconds starting at time 00:00:10 (10 seconds after the first item); etc. This distributes the metadata over time.

Further, some list items can be sent as individual list items (or small groups of items) distributed over multiple packets instead of all at once. Metadata items which allow this are noted in the "Details" section of the item description.

## 6.6 Packet Checksum and Version Number

A 16-bit checksum is included in every UAS Datalink LS packet as the last item; this aids detecting erroneous metadata from being presented with the Motion Imagery. The checksum is a running 16-bit summation through the entire packet beginning with the 16-byte Local Set Key and ending with the length field of the checksum LS item (see Figure 7).

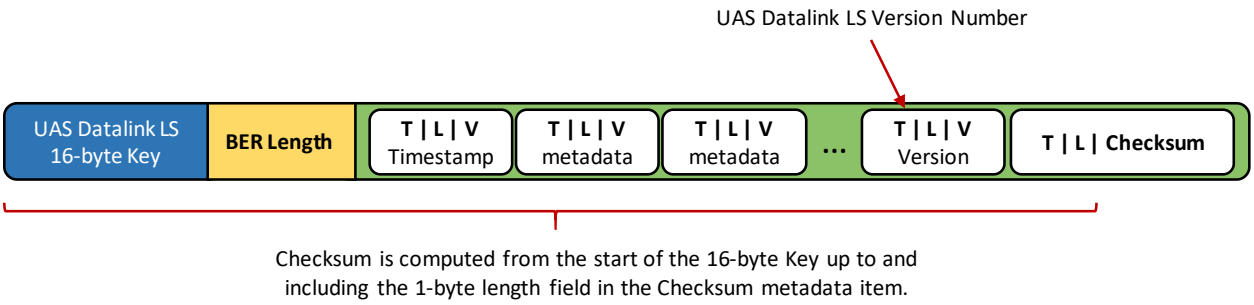


**Figure 7: Checksum Computation Range**

Note the presence of the three required Tag's: Precision Time Stamp, UAS Datalink LS Version Number and Checksum.

An example algorithm for calculating the checksum is given below:

```
unsigned short bcc_16 (
  unsigned char * buff, //Pointer to the first byte in the 16-byte UAS Datalink LS key.
  unsigned short len )   // Length from 16-byte US 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 packet does not match the checksum stored in the packet, the user is to discard the packet as being invalid. The lost packet is of little concern, since another packet is available within reasonable proximity (in both data and time) to this lost packet.

New metadata items are added to the MISB ST 0601 LS frequently; for this reason a version number (Tag 65) of ST 0601, which updates at a minimum rate of once every 30 seconds, identifies the version used.

| Requirement(s) | |
|---|---|
| ST 0601.8-08 | All instances of a UAS Datalink LS where the computed checksum is not identical to the included checksum shall be discarded. |
| ST 0601.8-11 | All instances of the UAS Datalink LS shall contain as the final item Tag 1, (Checksum). |
| ST 0601.8-12 | All instances of the UAS Datalink LS shall contain Tag 65, UAS Datalink LS Version Number. |

## *6.7 Motion Imagery/Metadata Synchronization - Informative*

The synchronization or time-alignment of a Motion Imagery frame with metadata within its

container is the responsibility of the system designer who needs to consider: enough bandwidth to accommodate the metadata without limiting the Motion Imagery; required update rates of metadata; presentation of Motion Imagery coincident with metadata at a receiver (i.e., receiver decoder buffer delay). Different applications will have differing requirements and metrics for the accuracy of such synchronization. In general, it is best to ensure systems insert both the Precision Time Stamp into a Motion Imagery frame and the metadata into the transport stream as close as possible to the point of collection.

# 7 UAS Datalink Local Set Items

This section provides a summary and overview of all the UAS Datalink LS items, with further details for each item in 8.

## *7.1 UAS Datalink Local Set Items Summary*

Table 1 lists a summary of the metadata items within the UAS Datalink LS. Full details of each item are in Section 8. The column designations are as follows:

- The “Tag” column is the KLV Local Set tag number for the item. The tag is an integer but encoded as a BER-OID value when used. Single-byte tags can represent tag numbers from 1 through 127. Tag numbers greater than 127 use two-bytes (or more).
- The “Name” column is the label associated with the tag. The Name is registered within the SMPTE RP 210 [9] or MISB ST 0807 metadata registry.
- The “Units” column indicates the units of the data specified in the Value field.
    - Units of “None” indicate the value is not a measurement and units do not apply
    - Units of “Set” or “Pack” indicate the value is a collection of information in the form of a Local Set or Pack
    - All other Units are SI enumerations (e.g., µs is micro-seconds, ° is degrees)
- The “Format” column indicates the item’s KLV format for the Value.
- The “Length” column indicates the nominal length of the value. This may be a required length or variable length depending on the value.
- The “SDCC” column indicates whether the item is usable within a Standard Deviation Correlation Coefficient Floating Length Pack (SDCC-FLP) structure. The details of the SDCC-FLP construct are in MISB ST 1010 [10].
    - The element can be a part of the SDDCC-FLP when this column is “Y”
    - The element may not be a part of the SDCC-FLP when this column is “N”
- The “MUL” column indicates whether an item may have multiple instances within a single instance of the UAS Datalink Local set.
    - When this column’s value is “Y” the item may have multiple instances
    - When this column’s value is “N” the item is unique within the instance of the LS

Notes:

- See the Motion Imagery Handbook for further information on Data types, such as IMAPB.
- Several Local Set items have the same UL Key but differ in its Type. For example, Tag 22-Target Width, uses a Type of uint16, and Tag 96-Target Width Extended, uses a Type of IMAPB. The Key for both, which is the same, has a MISB ST 0807 dictionary data type of "float." This is an allowed practice, where this document specifies (or overrides) the metadata items format within the dictionary. See the Motion Imagery Handbook (Section 7.5.2.2 Data Type Processing) for more information.

**Table 1: UAS Datalink Local Set**

| Tag | Name | Units | Format | Len | SDCC | MUL | Description |
|---|---|---|---|---|---|---|---|
| 1 | Checksum | None | uint16 | 2 | N | N | Checksum used to detect errors within a UAS Datalink LS packet |
| 2 | Precision Time Stamp | µs | uint64 | 8 | N | N | Timestamp for all metadata in this Local Set; used to coordinate with Motion Imagery |
| 3 | Mission ID | None | utf8 | V | N | N | Descriptive mission identifier to distinguish event or sortie |
| 4 | Platform Tail Number | None | utf8 | V | N | N | Identifier of platform as posted |
| 5 | Platform Heading Angle | ° | uint16 | 2 | Y | N | Aircraft heading angle |
| 6 | Platform Pitch Angle | ° | int16 | 2 | Y | N | Aircraft pitch angle |
| 7 | Platform Roll Angle | ° | int16 | 2 | Y | N | Platform roll angle |
| 8 | Platform True Airspeed | m/s | uint8 | 1 | Y | N | True airspeed (TAS) of platform |
| 9 | Platform Indicated Airspeed | m/s | uint8 | 1 | Y | N | Indicated airspeed (IAS) of platform |
| 10 | Platform Designation | None | utf8 | V | N | N | Model name for the platform |
| 11 | Image Source Sensor | None | utf8 | V | N | N | Name of currently active sensor |
| 12 | Image Coordinate System | None | utf8 | V | N | N | Name of the image coordinate system used |
| 13 | Sensor Latitude | ° | int32 | 4 | Y | N | Sensor latitude |
| 14 | Sensor Longitude | ° | int32 | 4 | Y | N | Sensor longitude |
| 15 | Sensor True Altitude | m | uint16 | 2 | Y | N | Altitude of sensor as measured from Mean Sea Level (MSL) |
| 16 | Sensor Horizontal Field of View | ° | uint16 | 2 | Y | N | Horizontal field of view of selected imaging sensor |
| 17 | Sensor Vertical Field of View | ° | uint16 | 2 | Y | N | Vertical field of view of selected imaging sensor |
| 18 | Sensor Relative Azimuth Angle | ° | uint32 | 4 | Y | N | Relative rotation angle of sensor to platform longitudinal axis |
| 19 | Sensor Relative Elevation Angle | ° | int32 | 4 | Y | N | Relative elevation angle of sensor to platform longitudinal-transverse plane |
| 20 | Sensor Relative Roll Angle | ° | uint32 | 4 | Y | N | Relative roll angle of sensor to aircraft platform |
| 21 | Slant Range | m | uint32 | 4 | Y | N | Slant range in meters |
| 22 | Target Width | m | uint16 | 2 | Y | N | Target width within sensor field of view |
| 23 | Frame Center Latitude | ° | int32 | 4 | N | N | Terrain latitude of frame center |
| 24 | Frame Center Longitude | ° | int32 | 4 | N | N | Terrain longitude of frame center |
| 25 | Frame Center Elevation | m | uint16 | 2 | N | N | Terrain elevation at frame center relative to Mean Sea Level (MSL) |
| 26 | Offset Corner Latitude Point 1 | ° | int16 | 2 | N | N | Frame latitude offset for upper left corner |
| 27 | Offset Corner Longitude Point 1 | ° | int16 | 2 | N | N | Frame longitude offset for upper left corner |
| 28 | Offset Corner Latitude Point 2 | ° | int16 | 2 | N | N | Frame latitude offset for upper right corner |
| 29 | Offset Corner Longitude Point 2 | ° | int16 | 2 | N | N | Frame longitude offset for upper right corner |
| 30 | Offset Corner Latitude Point 3 | ° | int16 | 2 | N | N | Frame latitude offset for lower right corner |
| 31 | Offset Corner Longitude Point 3 | ° | int16 | 2 | N | N | Frame longitude offset for lower right corner |
| 32 | Offset Corner Latitude Point 4 | ° | int16 | 2 | N | N | Frame latitude offset for lower left corner |
| 33 | Offset Corner Longitude Point 4 | ° | int16 | 2 | N | N | Frame longitude offset for lower left corner |
| 34 | Icing Detected | code | uint8 | 1 | N | N | Flag for icing detected at aircraft location |

| Tag | Name | Units | Format | Len | SDCC | MUL | Description |
|---|---|---|---|---|---|---|---|
| 35 | Wind Direction | ° | uint16 | 2 | N | N | Wind direction at aircraft location |
| 36 | Wind Speed | m/s | uint8 | 1 | N | N | Wind speed at aircraft location |
| 37 | Static Pressure | mbar | uint16 | 2 | N | N | Static pressure at aircraft location |
| 38 | Density Altitude | m | uint16 | 2 | N | N | Density altitude at aircraft location |
| 39 | Outside Air Temperature | ℃ | int8 | 1 | N | N | Temperature outside of aircraft |
| 40 | Target Location Latitude | ° | int32 | 4 | N | N | Calculated target latitude |
| 41 | Target Location Longitude | ° | int32 | 4 | N | N | Calculated target longitude |
| 42 | Target Location Elevation | m | uint16 | 2 | N | N | Calculated target elevation |
| 43 | Target Track Gate Width | Pixels | uint8 | 1 | N | N | Tracking gate width (x value) of tracked target within field of view |
| 44 | Target Track Gate Height | Pixels | uint8 | 1 | N | N | Tracking gate height (y value) of tracked target within field of view |
| 45 | Target Error Estimate – CE90 | m | uint16 | 2 | N | N | Circular error 90 (CE90) is the estimated error distance in the horizontal direction |
| 46 | Target Error Estimate – LE90 | m | uint16 | 2 | N | N | Lateral error 90 (LE90) is the estimated error distance in the vertical (or lateral) direction |
| 47 | Generic Flag Data | None | uint8 | 1 | N | N | Generic metadata flags |
| 48 | Security Local Set | None | set | V | N | N | MISB ST 0102 local let Security Metadata items |
| 49 | Differential Pressure | mbar | uint16 | 2 | N | N | Differential pressure at aircraft location |
| 50 | Platform Angle of Attack | ° | int16 | 2 | Y | N | Platform attack angle |
| 51 | Platform Vertical Speed | m/s | int16 | 2 | Y | N | Vertical speed of the aircraft relative to zenith |
| 52 | Platform Sideslip Angle | ° | int16 | 2 | Y | N | Angle between the platform longitudinal axis and relative wind |
| 53 | Airfield Barometric Pressure | mbar | uint16 | 2 | N | N | Local pressure at airfield of known height |
| 54 | Airfield Elevation | m | uint16 | 2 | N | N | Elevation of airfield corresponding to Airfield Barometric Pressure |
| 55 | Relative Humidity | % | uint8 | 1 | N | N | Relative humidity at aircraft location |
| 56 | Platform Ground Speed | m/s | uint8 | 1 | N | N | Speed projected to the ground of an airborne platform passing overhead |
| 57 | Ground Range | m | uint32 | 4 | N | N | Horizontal distance from ground position of aircraft relative to nadir, and target of interest |
| 58 | Platform Fuel Remaining | kg | uint16 | 2 | N | N | Remaining fuel on airborne platform |
| 59 | Platform Call Sign | None | utf8 | V | N | N | Call sign of platform or operating unit |
| 60 | Weapon Load | None | uint16 | 2 | N | N | Current weapons stored on aircraft |
| 61 | Weapon Fired | None | uint8 | 1 | N | N | Indication when a particular weapon is released |
| 62 | Laser PRF Code | None | uint16 | 2 | N | N | A laser's Pulse Repetition Frequency (PRF) code used to mark a target |
| 63 | Sensor Field of View Name | None | uint8 | 1 | N | N | Sensor field of view names |
| 64 | Platform Magnetic Heading | ° | uint16 | 2 | Y | N | Aircraft magnetic heading angle |
| 65 | UAS Datalink LS Version Number | None | uint8 | 1 | N | N | Version number of the UAS Datalink LS document used to generate KLV metadata |
| 66 | Deprecated | N/A | N/A | N/A | N | N | This item has been deprecated. |
| 67 | Alternate Platform Latitude | ° | int32 | 4 | N | N | Alternate platform latitude |
| 68 | Alternate Platform Longitude | ° | int32 | 4 | N | N | Alternate platform longitude |
| 69 | Alternate Platform Altitude | m | uint16 | 2 | N | N | Altitude of alternate platform as measured from Mean Sea Level (MSL) |
| 70 | Alternate Platform Name | None | utf8 | V | N | N | Name of alternate platform connected to UAS |
| 71 | Alternate Platform Heading | ° | uint16 | 2 | N | N | Heading angle of alternate platform connected to UAS |
| 72 | Event Start Time – UTC | µs | uint64 | 8 | N | N | Start time of scene, project, event, mission, editing event, license, publication, etc. |
| 73 | RVT Local Set | None | set | V | N | N | MISB ST 0806 RVT Local Set metadata items |
| 74 | VMTI Local Set | None | set | V | N | N | MISB ST 0903 VMTI Local Set metadata items |
| 75 | Sensor Ellipsoid Height | m | uint16 | 2 | Y | N | Sensor ellipsoid height as measured from the reference WGS84 ellipsoid |
| 76 | Alternate Platform Ellipsoid Height | m | uint16 | 2 | N | N | Alternate platform ellipsoid height as measured from the reference WGS84 Ellipsoid |
| 77 | Operational Mode | None | uint8 | 1 | N | N | Indicates the mode of operations of the event portrayed |

| Tag | Name | Units | Format | Len | SDCC | MUL | Description |
|---|---|---|---|---|---|---|---|
| | | | | | | | in Motion Imagery |
| 78 | Frame Center Height Above Ellipsoid | m | uint16 | 2 | N | N | Frame center ellipsoid height as measured from the reference WGS84 ellipsoid |
| 79 | Sensor North Velocity | m/s | int16 | 2 | Y | N | Northing velocity of the sensor or platform |
| 80 | Sensor East Velocity | m/s | int16 | 2 | Y | N | Easting velocity of the sensor or platform |
| 81 | Image Horizon Pixel Pack | None | dlp | V | N | N | Location of earth-sky horizon in the Imagery |
| 82 | Corner Latitude Point 1 (Full) | ° | int32 | 4 | N | N | Frame latitude for upper left corner |
| 83 | Corner Longitude Point 1 (Full) | ° | int32 | 4 | N | N | Frame longitude for upper left corner |
| 84 | Corner Latitude Point 2 (Full) | ° | int32 | 4 | N | N | Frame latitude for upper right corner |
| 85 | Corner Longitude Point 2 (Full) | ° | int32 | 4 | N | N | Frame longitude for upper right corner |
| 86 | Corner Latitude Point 3 (Full) | ° | int32 | 4 | N | N | Frame latitude for lower right corner |
| 87 | Corner Longitude Point 3 (Full) | ° | int32 | 4 | N | N | Frame longitude for lower right corner |
| 88 | Corner Latitude Point 4 (Full) | ° | int32 | 4 | N | N | Frame latitude for lower left corner |
| 89 | Corner Longitude Point 4 (Full) | ° | int32 | 4 | N | N | Frame longitude for lower left corner |
| 90 | Platform Pitch Angle (Full) | ° | int32 | 4 | Y | N | Aircraft pitch angle |
| 91 | Platform Roll Angle (Full) | ° | int32 | 4 | Y | N | Platform roll angle |
| 92 | Platform Angle of Attack (Full) | ° | int32 | 4 | Y | N | Platform attack angle |
| 93 | Platform Sideslip Angle (Full) | ° | int32 | 4 | Y | N | Angle between the platform longitudinal axis and relative wind |
| 94 | MIIS Core Identifier | None | byte | V | N | N | MISB ST 1204 MIIS Core Identifier binary value |
| 95 | SAR Motion Imagery Local Set | None | set | V | N | N | MISB ST 1206 SAR Motion Imagery Metadata Local Set metadata items |
| 96 | Target Width Extended | m | IMAPB | V | Y | N | Target width within sensor field of view |
| 97 | Range Image Local Set | None | set | V | N | N | MISB ST 1002 Range Imaging Local Set metadata items |
| 98 | Geo-Registration Local Set | None | set | V | N | N | MISB ST 1601 Geo-Registration Local Set metadata items |
| 99 | Composite Imaging Local Set | None | set | V | N | N | MISB ST 1602 Composite Imaging Local Set metadata items |
| 100 | Segment Local Set | None | set | V | N | Y | MISB ST 1607 Segment Local Set metadata items, used to enable metadata sharing |
| 101 | Amend Local Set | None | set | V | N | Y | MISB ST 1607 Amend Local Set metadata items, used to provide metadata corrections |
| 102 | SDCC-FLP | None | flp | V | N/A | Y | MISB ST 1010 Floating Length Pack (FLP) metadata item, providing Standard Deviation and Cross Correlation (SDCC) metadata |
| 103 | Density Altitude Extended | m | IMAPB | V | N | N | Density altitude above MSL at aircraft location |
| 104 | Sensor Ellipsoid Height Extended | m | IMAPB | V | Y | N | Sensor ellipsoid height extended as measured from the reference WGS84 ellipsoid |
| 105 | Alternate Platform Ellipsoid Height Extended | m | IMAPB | V | N | N | Alternate platform ellipsoid height extended as measured from the reference WGS84 ellipsoid |
| 106 | Stream Designator | None | utf8 | V | N | N | A second designation given to a sortie |
| 107 | Operational Base | None | utf8 | V | N | N | Name of the operational base hosting the platform |
| 108 | Broadcast Source | None | utf8 | V | N | N | Name of the source, where the Motion Imagery is first broadcast |
| 109 | Range To Recovery Location | km | IMAPB | V | N | N | Distance from current position to airframe recovery position |
| 110 | Time Airborne | s | uint | V | N | N | Number of seconds aircraft has been airborne |
| 111 | Propulsion Unit Speed | RPM | uint | V | N | N | The speed the engine (or electric motor) is rotating at |
| 112 | Platform Course Angle | ° | IMAPB | V | N | N | Direction the aircraft is moving relative to True North |
| 113 | Altitude AGL | m | IMAPB | V | Y | N | Above Ground Level (AGL) height above the ground/water |
| 114 | Radar Altimeter | m | IMAPB | V | Y | N | Height above the ground/water as reported by a RADAR altimeter |
| 115 | Control Command | None | dlp | V | N | Y | Record of command from GCS to Aircraft |
| 116 | Control Command Verification List | None | dlp | V | N | N | Acknowledgement of one or more control commands were received by the platform |
| 117 | Sensor Azimuth Rate | dps | IMAPB | V | Y | N | The rate the sensors azimuth angle is changing |
| 118 | Sensor Elevation Rate | dps | IMAPB | V | Y | N | The rate the sensors elevation angle is changing |

| Tag | Name | Units | Format | Len | SDCC | MUL | Description |
|---|---|---|---|---|---|---|---|
| 119 | Sensor Roll Rate | dps | IMAPB | V | Y | N | The rate the sensors roll angle is changing |
| 120 | On-board MI Storage Percent Full | % | IMAPB | V | N | N | Amount of on-board Motion Imagery storage used as a percentage of the total storage |
| 121 | Active Wavelength List | None | dlp | V | N | N | List of wavelengths in Motion Imagery |
| 122 | Country Codes | None | vlp | N/A | N | N | Country codes which are associated with the platform and its operation |
| 123 | Number of NAVSATs in View | count | uint | 1 | N | N | Count of navigation satellites in view of platform |
| 124 | Positioning Method Source | None | uint | 1 | N | N | Source of the navigation positioning information. (e.g., NAVSAT-GPS, NAVSAT-Galileo, INS) |
| 125 | Platform Status | None | uint | 1 | N | N | Enumeration of operational modes of the platform (e.g., in-route, RTB) |
| 126 | Sensor Control Mode | None | uint | 1 | N | N | Enumerated value for the current sensor control operational status |
| 127 | Sensor Frame Rate Pack | None | dlp | V | N | N | Values used to compute the frame rate of the Motion Imagery at the sensor |
| 128 | Wavelengths List | None | vlp | V | N | N | List of wavelength bands provided by sensor(s) |
| 129 | Target ID | None | utf8 | V | N | N | Alpha-numeric identification of a target |
| 130 | Airbase Locations | None | vlp | V | N | N | Geographic location of the take-off site and recovery site |
| 131 | Take-off Time | µs | uint | V | N | N | Time when aircraft became airborne |
| 132 | Transmission Frequency | MHz | IMAPB | V | N | N | Radio frequency used to transmit the Motion Imagery |
| 133 | On-board MI Storage Capacity | GB | uint | V | N | N | The total capacity of on-board Motion Imagery storage |
| 134 | Zoom Percentage | % | IMAPB | V | N | N | For a variable zoom system, the percentage of zoom |
| 135 | Communications Method | None | utf8 | V | N | N | Type of communications used with platform |
| 136 | Leap Seconds | s | int | V | N | N | Number of leap seconds to adjust Precision Time Stamp (Tag 2) to UTC |
| 137 | Correction Offset | µs | int | V | N | N | Post-flight time adjustment to correct Precision Time Stamp (Tag 2) as needed |
| 138 | Payload List | None | vlp | V | N | N | List of payloads available on the Platform |
| 139 | Active Payloads | None | byte | V | N | N | List of currently active payloads from the payload list (Tag 138) |
| 140 | Weapons Stores | None | vlp | V | N | N | List of weapon stores and status |
| 141 | Waypoint List | None | vlp | V | N | N | List of waypoints and their status. |

**Table 2** provides a list of the UAS Datalink Local Set names and tags in alphabetical order. Each name and tag provide a link to the details section for each tag.

## Table 2: Tags Sorted by Name

| Name | Tag | Name | Tag | Name | Tag |
|---|---|---|---|---|---|
| Active Payloads | 139 | MIIS Core Identifier | 94 | Segment Local Set | 100 |
| Active Wavelength List | 121 | Mission ID | 3 | Sensor Azimuth Rate | 117 |
| Airbase Locations | 130 | Number of NAVSATs in View | 123 | Sensor Control Mode | 126 |
| Airfield Barometric Pressure | 53 | Offset Corner Latitude Point 1 | 26 | Sensor East Velocity | 80 |
| Airfield Elevation | 54 | Offset Corner Latitude Point 2 | 28 | Sensor Elevation Rate | 118 |
| Alternate Platform Altitude | 69 | Offset Corner Latitude Point 3 | 30 | Sensor Ellipsoid Height | 75 |
| Alternate Platform Ellipsoid Height | 76 | Offset Corner Latitude Point 4 | 32 | Sensor Ellipsoid Height Extended | 104 |
| Alternate Platform Ellipsoid Height Extended | 105 | Offset Corner Longitude Point 1 | 27 | Sensor Field of View Name | 63 |
| Alternate Platform Heading | 71 | Offset Corner Longitude Point 2 | 29 | Sensor Frame Rate Pack | 127 |
| Alternate Platform Latitude | 67 | Offset Corner Longitude Point 3 | 31 | Sensor Horizontal Field of View | 16 |
| Alternate Platform Longitude | 68 | Offset Corner Longitude Point 4 | 33 | Sensor Latitude | 13 |
| Alternate Platform Name | 70 | On-board MI Storage Capacity | 133 | Sensor Longitude | 14 |
| Altitude AGL | 113 | On-board MI Storage Percent Full | 120 | Sensor North Velocity | 79 |
| Amend Local Set | 101 | Operational Base | 107 | Sensor Relative Azimuth Angle | 18 |
| Broadcast Source | 108 | Operational Mode | 77 | Sensor Relative Elevation Angle | 19 |
| Checksum | 1 | Outside Air Temperature | 39 | Sensor Relative Roll Angle | 20 |
| Communications Method | 135 | Payload List | 138 | Sensor Roll Rate | 119 |
| Composite Imaging Local Set | 99 | Platform Angle of Attack | 50 | Sensor True Altitude | 15 |
| Control Command | 115 | Platform Angle of Attack (Full) | 92 | Sensor Vertical Field of View | 17 |
| Control Command Verification List | 116 | Platform Call Sign | 59 | Slant Range | 21 |
| Corner Latitude Point 1 (Full) | 82 | Platform Course Angle | 112 | Static Pressure | 37 |
| Corner Latitude Point 2 (Full) | 84 | Platform Designation | 10 | Stream Designator | 106 |
| Corner Latitude Point 3 (Full) | 86 | Platform Fuel Remaining | 58 | Take-off Time | 131 |
| Corner Latitude Point 4 (Full) | 88 | Platform Ground Speed | 56 | Target Error Estimate - CE90 | 45 |
| Corner Longitude Point 1 (Full) | 83 | Platform Heading Angle | 5 | Target Error Estimate - LE90 | 46 |
| Corner Longitude Point 2 (Full) | 85 | Platform Indicated Airspeed | 9 | Target ID | 129 |
| Corner Longitude Point 3 (Full) | 87 | Platform Magnetic Heading | 64 | Target Location Elevation | 42 |
| Corner Longitude Point 4 (Full) | 89 | Platform Pitch Angle | 6 | Target Location Latitude | 40 |
| Correction Offset | 137 | Platform Pitch Angle (Full) | 90 | Target Location Longitude | 41 |
| Country Codes | 122 | Platform Roll Angle | 7 | Target Track Gate Height | 44 |
| Density Altitude | 38 | Platform Roll Angle (Full) | 91 | Target Track Gate Width | 43 |
| Density Altitude Extended | 103 | Platform Sideslip Angle | 52 | Target Width | 22 |
| Deprecated | 66 | Platform Sideslip Angle (Full) | 93 | Target Width Extended | 96 |
| Differential Pressure | 49 | Platform Status | 125 | Time Airborne | 110 |
| Event Start Time - UTC | 72 | Platform Tail Number | 4 | Transmission Frequency | 132 |
| Frame Center Elevation | 25 | Platform True Airspeed | 8 | UAS Datalink LS Version Number | 65 |
| Frame Center Height Above Ellipsoid | 78 | Platform Vertical Speed | 51 | VMTI Local Set | 74 |
| Frame Center Latitude | 23 | Positioning Method Source | 124 | Wavelengths List | 128 |
| Frame Center Longitude | 24 | Precision Time Stamp | 2 | Waypoint List | 141 |
| Generic Flag Data | 47 | Propulsion Unit Speed | 111 | Weapon Fired | 61 |
| Geo-Registration Local Set | 98 | Radar Altimeter | 114 | Weapon Load | 60 |
| Ground Range | 57 | Range Image Local Set | 97 | Weapons Stores | 140 |
| Icing Detected | 34 | Range To Recovery Location | 109 | Wind Direction | 35 |
| Image Coordinate System | 12 | Relative Humidity | 55 | Wind Speed | 36 |
| Image Horizon Pixel Pack | 81 | RVT Local Set | 73 | Zoom Percentage | 134 |
| Image Source Sensor | 11 | SAR Motion Imagery Local Set | 95 | | |
| Laser PRF Code | 62 | SDCC-FLP | 102 | | |
| Leap Seconds | 136 | Security Local Set | 48 | | |

## 7.2 Platform and Sensor Position and Rotation Metadata

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

Together the platform location and attitude, along with the sensor relative pointing angles define the location of an image or image sequence (i.e., Motion Imagery). Metadata items for sensor location (Tags 13, 14, and 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.

### 7.2.1 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), or Sensor Ellipsoid Height Extended (Tag 104). Note: a single instantiation is preferred, which is Tag 75 | Tag 104, for HAE-based photogrammetric purposes.

### 7.2.2 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.

### 7.2.3 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 can 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.

### 7.2.4 Euler Angle Order of Operations

To properly determine the orientation of a sensor on an airborne platform using the UAS Datalink LS metadata items outlined in Section 7.2, 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 or Tag 104: Sensor Ellipsoid Height Extended). Note: a single instantiation is preferred, which is Tag 75 | Tag 104, for HAE-based photogrammetric purposes.
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 8 for the different platform rotations outlined in steps 2 and 3 above.

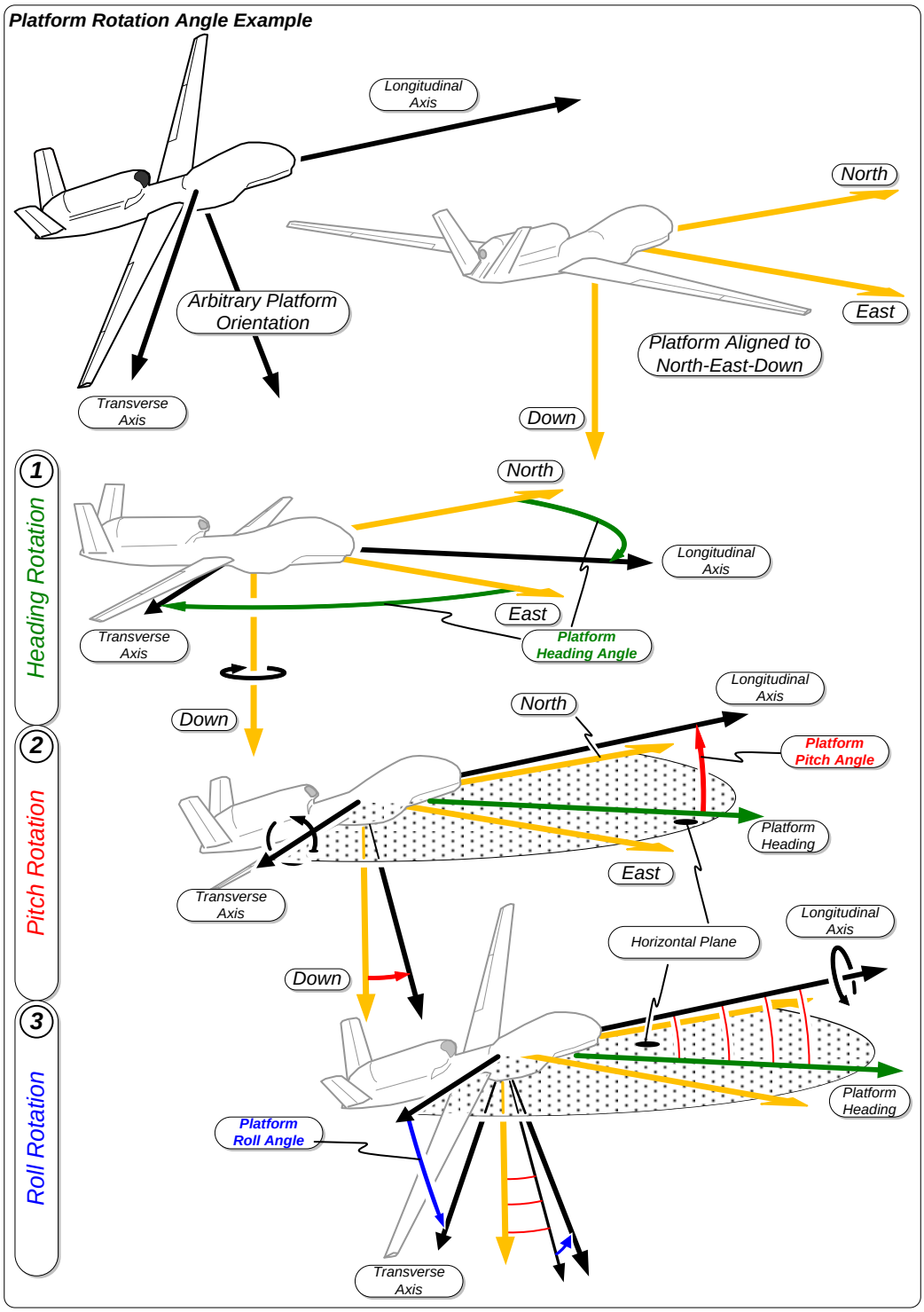


**Figure 8 : Platform Rotation Angle Example**

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 9 for the different sensor rotations outlined in steps 4 above.

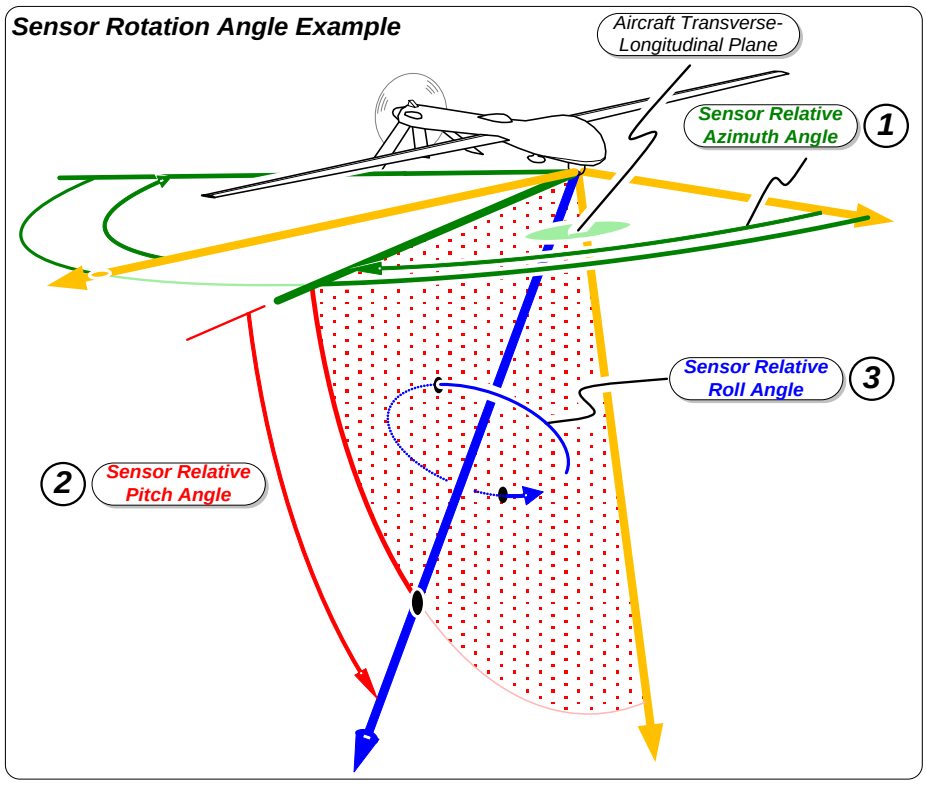


**Figure 9 : Sensor Rotation Angle Example**

Once the platform and sensor attitude are 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.

## 7.3 Sensor Image Geographic Corner Metadata

Each pixel in a Motion Imagery frame represents a geographic point in the scene. Providing the coordinates for every pixel is difficult to compute and would require a large amount of bandwidth to transmit to receivers. Instead the UAS Datalink LS includes a summary of the center and bounding area, or corner points, of the image. Figure 10 illustrates an example of corner-coordinate metadata as used in a Motion Imagery system.

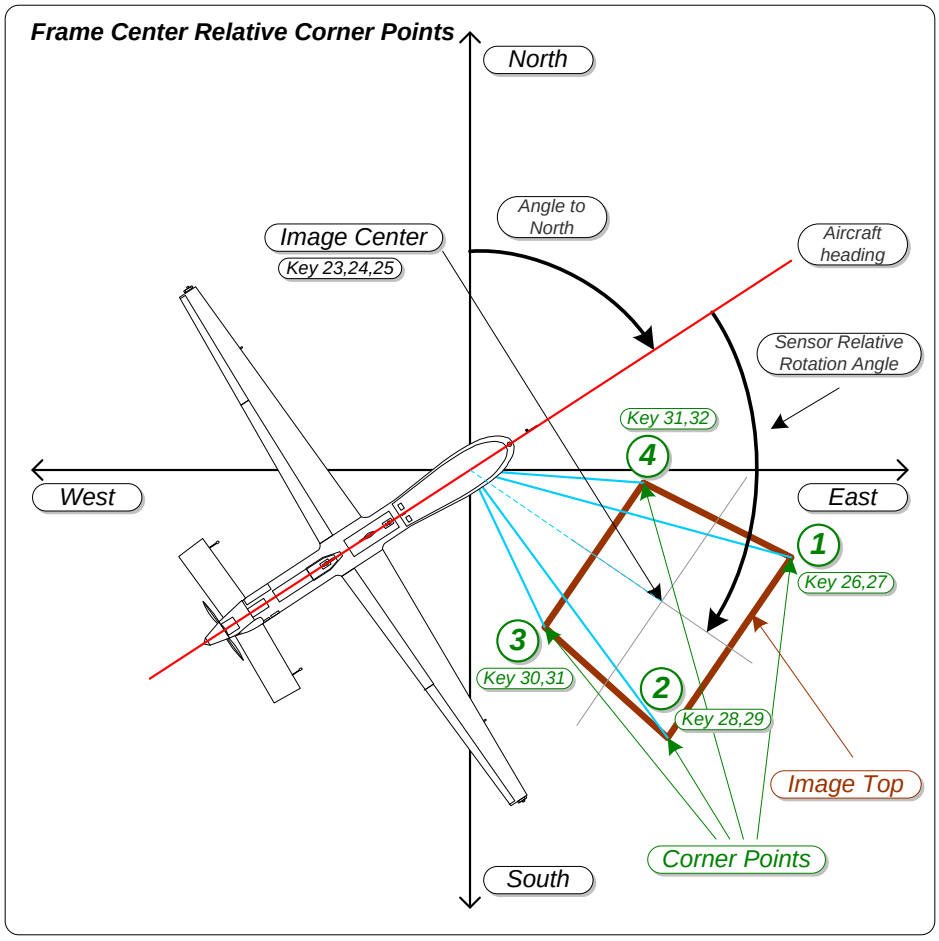


**Figure 10: Corner Coordinate Metadata**

The Sensor Image Corner Latitude/Longitude metadata consists of the items shown in Figure 11. 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-2500 [11] for more information about corner coordinates. Corners not corresponding to geographic locations, i.e., above the horizon, are not included in the metadata since they are undefined.

The UAS Datalink LS provides two different methods for representing the corner coordinates which can provide either a savings in band width or provide an enhanced range. The two methods are absolute coordinates and relative to center point offsets.

Tag's 82-89 are used when absolute corner coordinates are known. Figure 11 shows the mapping

of absolute corner point coordinates to their respective tag's. Each Latitude and Longitude absolute corner point has one 8-byte floating point value corresponding to decimal degrees which covers the entire globe.

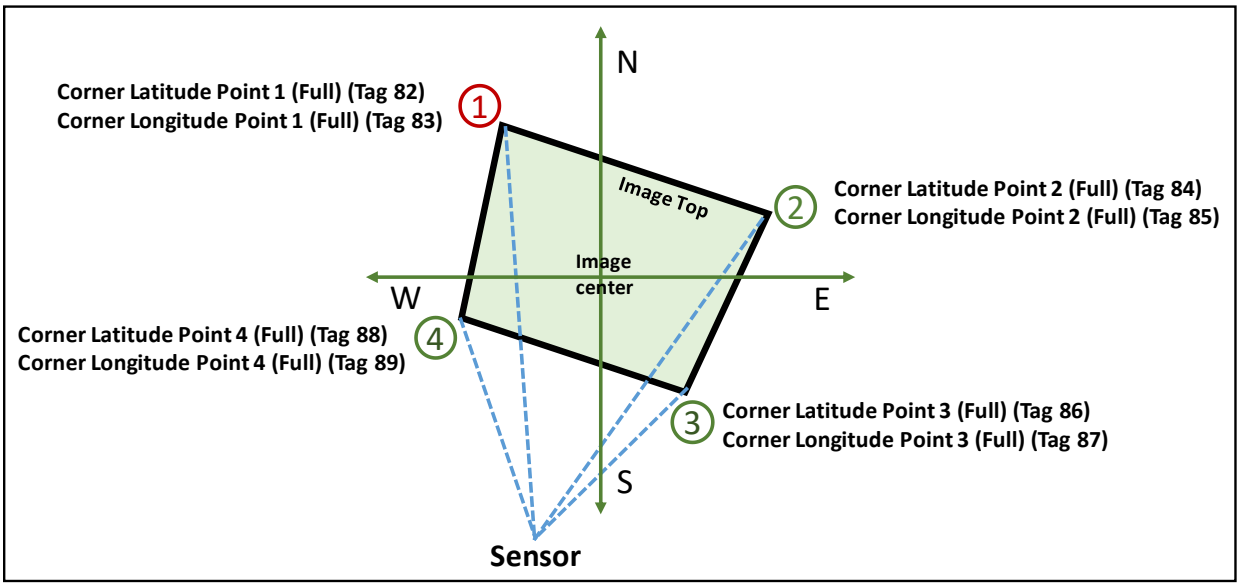


**Figure 11: Corner Points Based on Absolute Positions**

When relative offsets from the Image center point are only available, the corner point coordinates are computed using the Image center and its corner point offset information. Figure 12 shows this situation where the red interior lines indicate offsets from the Image center point to each respective corner point coordinate. The UAS Datalink LS Tag's 26-33 makes use of Offset Corner Point metadata items and requires addition with the Frame Center coordinates to determine the actual corner points.

The UAS Datalink LS 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 LS Frame Center Latitude or Longitude to determine the actual corner point. This offset method used in the LS 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 specification using absolute position information.

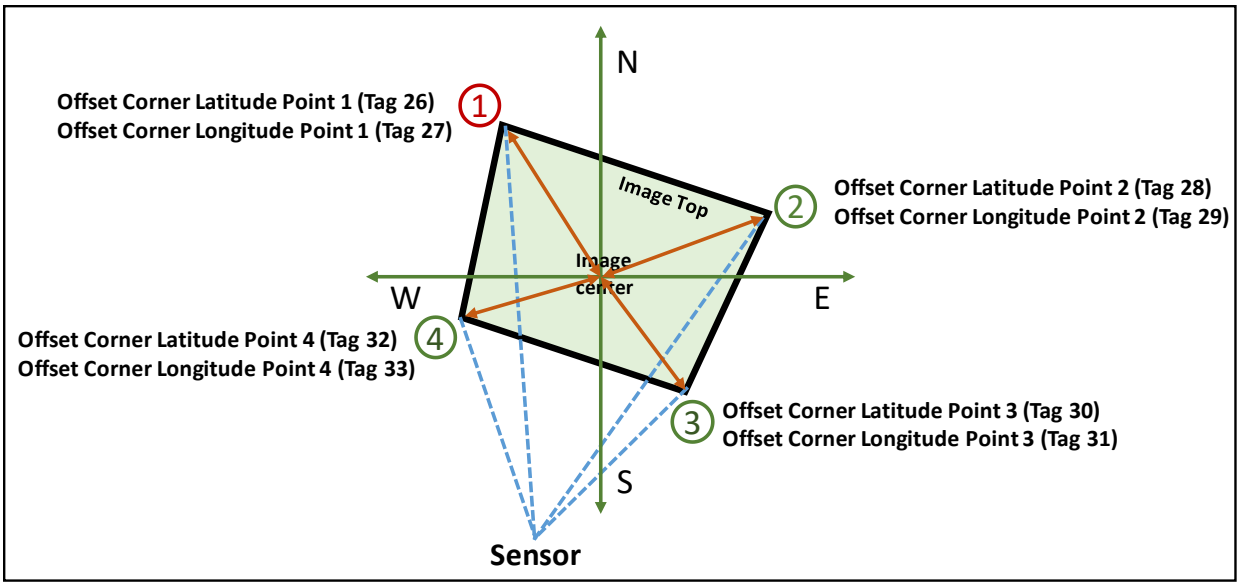


**Figure 12: Corner Points Calculated Using Offsets from Image Center**

SAR imagery uses the same UAS Datalink LS Tag's as described above, but the positions of the corner points is different for SAR imagery as is shown in Figure 13. Either the absolute or relative specification of the corner points can be used, but their interpretation of position is different.

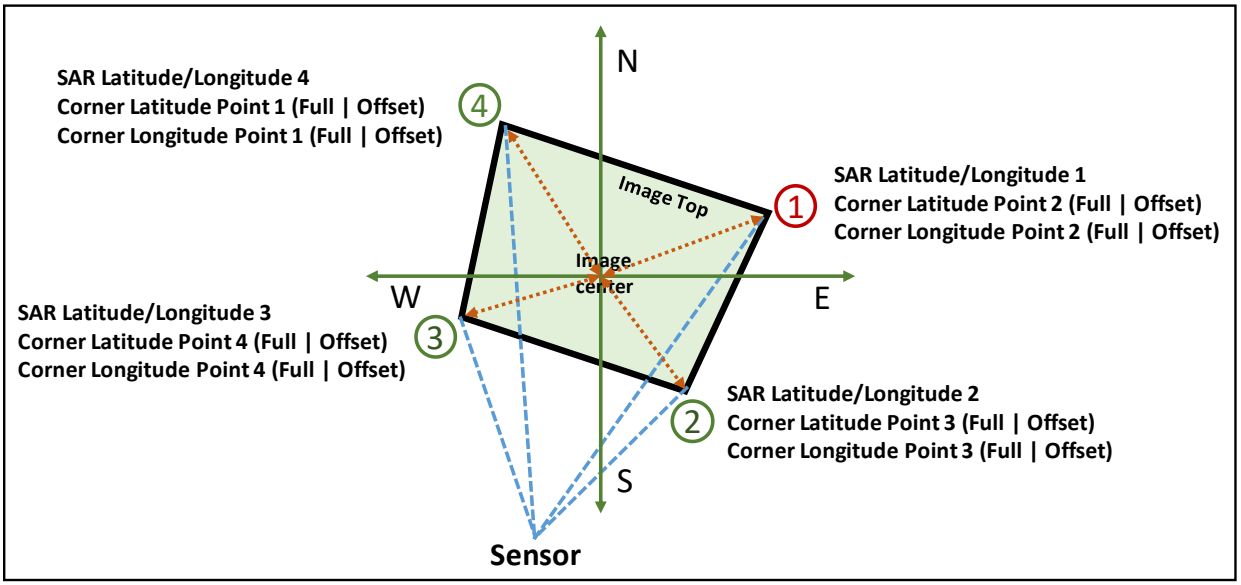


**Figure 13: Corner Points Ordering for SAR**

## 7.4 Alternate Platform Guideline

Within the UAS Datalink LS 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 field in that the "Alternate Platform" items provide no position or attitude information about an image sequence to which a UAS Datalink LS stream is tied.

Whenever a Motion Imagery stream is created (a binary sequence typically containing metadata (i.e., UAS Datalink LS) with compressed Motion Imagery encapsulated in an MPEG-2 transport stream), the sensor and platform metadata items directly relate to the imagery acquired on the platform, whereas the "Alternate Platform" items 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. If Platform A also includes "Alternate Platform" metadata, those metadata fields would represent position data for Platform C, or D, or even Platform B, but in any case, Platform A does not represent itself using "Alternate Platform" items.

"Alternate Platform" items do not directly describe Motion Imagery collected by an alternate platform, but rather aid situational awareness through metadata to Motion Imagery collected by a host platform.

## 7.5 Special Values

Various MISB ST 0601 metadata items allow special values or special bit-pattern representations to signal a condition. These include: "Out of Range" or "N/A (Off-Earth)," and. "Reserved."

The "Out of Range" special value signals an item's value exceeds the defined range. As an example, some angles within this standard (such as platform pitch and roll) use mapped-integer values lying between a maximum and minimum angular value.

| Requirement | |
|---|---|
| ST 0601.13-27 | When a value recedes below its minimum or exceeds its maximum range and the item allows an 'Out of Range' special value, the 'Out of Range' special value shall be used. |

The "N/A (Off-Earth)" special value signals a latitude or longitude value is not computable because the sensor is not pointing on the earth. For example, if a sensor performs a self-inspection of the platform (e.g., check for ice on the wings) the center point latitude and longitude are not valid points on the earth.

| Requirement | |
|---|---|
| ST 0601.13-28 | When a position consisting of a latitude/longitude moves beyond the surface of the earth and the item allows an 'N/A (Off-Earth)' special value, the 'N/A (Off-Earth)' special value shall be used. |

Systems receiving MISB ST 0601 metadata will need to check for "Out of Range" or "N/A (Off-Earth)" values prior to using the data value in computation or for display.

For historical reasons the "Reserved" value maintains backward compatibility with older versions of MISB ST 0601.

### 7.6 Segment LS and Amend LS within the UAS Datalink LS

New use cases require changing, adding, and sharing of one or more items within a metadata set. The Segment LS-Tag 100 enables defining shared common metadata items, while reusing metadata items in describing multiple unique image areas within an image (see for example, the Composite Imaging LS). The Amend LS-Tag 101 enables editing, adding, and deleting metadata, while preserving existing metadata (see for example, the Geo-Registration LS). The Motion Imagery Handbook discusses the theory underlying these Local Set constructs, while MISB ST 1607 [12] provides guidance in their use.

## 8 UAS Datalink LS Item Details

This section provides detailed information on each metadata item including information about their use along with a software and a KLV format mapping. The software format is the format of the value within a computer program (e.g., float, double, int), while the KLV format (e.g., mapped floating point, IMAP) is the bit-efficient representation when transmitting the metadata.

The left side of Figure 14 illustrates metadata items (Time, Position, etc.) represented in common software formats (int, float, etc.). A metadata encoder (e.g., computer, sensor, or Motion Imagery encoder) encodes the Software Format values into their binary KLV Format (Tag 1, Tag 2, etc.). The KLV Format metadata along with the Motion Imagery are transmitted to one or more receivers which decode the KLV Format metadata back into Software Format values for display, computation, or other uses as shown in the right side of the figure.

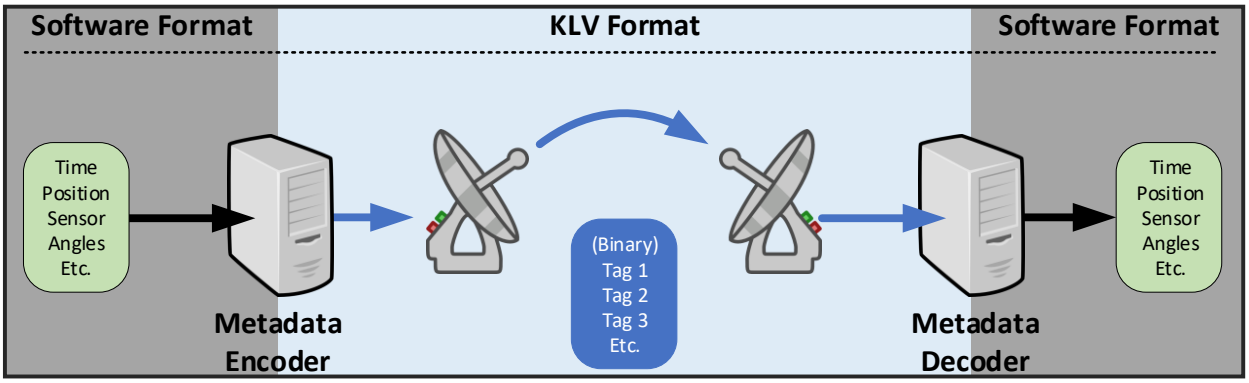


**Figure 14: Illustration of Software Format and KLV Format usage**

In each metadata item's subsection below, an item "summary table" presents the item's information followed by examples or further detail as needed. Each summary table contains the following information:

- **Description** – A brief description of the tag's meaning.
- **Units** – The units used for measured items. "None" indicates the item is not a measured quantity.
- **Format (Software)** – The data format used within a software application to represent the

value of an item. Formats are:

- byte – One or more bytes which represent a binary value
- int8 – 8-bit, 2's complement signed integer
- int16 – 16-bit, 2's complement signed integer
- int32 – 32-bit, 2's complement signed integer
- int64 – 64-bit, 2's complement signed integer
- uint8 – 8-bit, unsigned integer – i.e., single byte
- uint16 – 16-bit unsigned short
- uint32 – 32-bit unsigned integer
- uint64 – 32-bit unsigned long
- float32 – 32-bit IEEE 754 floating point value
- float64 – 64-bit IEEE 754 floating point value
- string – A list of characters
- record – A data structure of related values
- list – A list of values
- N/A – Not Applicable

- **Min (Software)** – Specifies the minimum value allowed for the value
- **Max (Software)** – Specifies the maximum value allowed for the value
- **Format (KLV)** – The data format used within the KLV Local Set. Formats are:
  - int – Variable length, 2's complement signed integer
  - int8 – 8-bit, 2's complement signed integer
  - int16 – 16-bit, 2's complement signed integer
  - int32 – 32-bit, 2's complement signed integer
  - uint – Variable length unsigned integer
  - uint8 – 8-bit, unsigned integer – i.e., single byte
  - uint16 – 16-bit unsigned short
  - uint32 – 32-bit unsigned integer
  - uint64 – 32-bit unsigned long
  - IMAPB – Mapping using the IMAPB method (see MISB ST 1201 [13])
  - byte – One or more bytes which represent a binary value
  - dlp – Defined length pack
  - vlp – Variable length pack
  - flp – Floating length pack
  - set – Local Set
  - utf8 – String of characters following the utf8 standard
- **Min (KLV)** – Specifies the minimum value allowed for the value. When mapping values the Min(KLV) can be very different than the Min(Software).
- **Max (KLV)** – Specifies the maximum value allowed for the value. When mapping values the Max(KLV) can be very different than the Max(Software).
- **Offset (KLV)** – specifies the offset used when mapping between software and KLV formats
- **Length** – specifies the nominal length to use. If Required Length has a value other than "N/A" then the length will equal the Required Length. A length of "Variable" means the length is determined at run-time for the Tag-Length-Value item.
- **Max Length** – specifies the recommended maximum length. With some items the underlying standard or data structure does not have a limit. If the Max Length is not

determinable it will have a value of "Not Limited." Network guards may use this value as a check to prevent data leaks.

- **Required Length** – specifies a required length, if one exists. With a required length the value portion of the Tag-Length-Value is not to exceed the number of required length bytes nor the value be less than the required length. See requirement below.
- **Resolution** – specifies the smallest representative values in the KLV format. With variable length values a list of resolutions based on the length is provided.
- **Special Values** – specifies signaling values for numeric values, such as "Out of Range" or "N/A (Off-Earth)," if they exist for the item. A Special Value listed as "None" indicates there are no special values, currently, for the item. A Special Value listed as "N/A" indicates special values do not apply to the item because it is not a numeric value (e.g., a string or set are not numeric items).
- **Allowed in SDCC Pack** – a Yes or No indication if the item is allowed in a Standard Deviation Cross Correlation (SDCC) Pack. Yes, indicates the item is allowed in the SDDC Pack.
- **Multiples Allowed –** a Yes or No indication if multiple instances of the tag are allowable in a single instantiation of a UAS Datalink LS. Yes, indicates multiple instances of the item may be in the LS.
- **Software Value to KLV Value** – Defines the method (i.e., an equation) of converting from a Software Value to its KLV Value.
    - IMAPB represents the forward mapping of a Software Value to a KLV Value using the min, max, length and [soft] value.
- **KLV Value to Software Value** – Defines the method (i.e., an equation) of converting from a KLV Value to its Software Value. The KLV Value bit pattern in each equation is interpretable in diverse ways. $KLV_{uint}$ means to interpret the value as an unsigned integer. $KLV_{int}$ means to interpret the value as a two's complement integer. $KLV_{val}$ means to interpret as a byte (or utf8 character).
    - RIMAPB represents the reverse mapping of a KLV Value to its Software Value using the min, max, length and [KLV] value.
- **Example Software Value** – Example value in the native format of the value.
- **Example KLV Value** – Example of the Tag-Length-Value after encoding the Software value. The tag and length are in base 10 and prefixed with "0d," while the value is in base 16 (i.e., hex) and prefixed with "0x."
- **KLV Key** – Specifies the UL (Key) for the given tag. The Key is defined in either the DoD KLV dictionary ( [3]) or the SMPTE KLV dictionary [9].
- The bottom section of the summary table provides notes, clarification, purpose, or other information about the metadata item.

| Requirement | |
|---|---|
| ST 0601.13-29 | When a metadata item has a *Required Length* numerically specified in this standard, the KLV encoded value for the item shall use exactly the number of bytes specified by the Required Length. |

Programmer's Notes: the "Example Value" for a tag is shown in full precision, beyond a tag's resolution, so programmers can verify they are using the right formulas. The number of

significant digits expressed is determined as follows:

1) Based on the dynamic range and the precision needed the number of bits in an integer is determined.
2) The precision, and the maximum value determines the type of value to use (single precision float vice double).
3) The type of value determines the number of digits (7 to 9 for single, 15 to 17 for double) needed. Nine- and 17-digits account for any rounding issues in the final digits. The final one or two digits may be different for different complier optimization/hardware.

## 8.1 Tag 1: Checksum

| Description | | | | | |
|---|---|---|---|---|---|
| Checksum used to detect errors within a UAS Datalink LS packet | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint16 | 0 | (2^16)-1 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | N/A |
| **Length** | | **Max Length** | | **Required Length** | |
| 2 | | 2 | | 2 | |
| **Resolution** | | **Special Values** | | | |
| N/A | | None | | | |
| **Required in LS?** | Mandatory | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{val}}$ | | | | |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ | | | | |
| **Example Software Value** | | **Example KLV Item (All Hex)** | | | |
| | | **Tag** | **Len** | **Value** | |
| 0x8C ED | | 01 | 02 | 8CED | |
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.02.03.01.00.00.00 (CRC 56132) | | | | |

- Lower 16-bits of summation
- Performed on entire LS packet, including 16-byte US key and 1-byte checksum length
- Checksum is mandatory in every UAS Datalink LS packet

### 8.1.1 Details

#### 8.1.1.1 Example 16-bit Checksum Code

```
unsigned short bcc_16 (
  unsigned char * buff, //Pointer to the first byte in the 16-byte UAS Datalink LS key.
  unsigned short len )  //Length from 16-byte US 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 ()
```

#### 8.1.1.2 Sample Checksum Data

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

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

## 8.2 Tag 2: Precision Time Stamp

| Description | | | | | |
|---|---|---|---|---|---|
| Timestamp for all metadata in this Local Set; used to coordinate with Motion Imagery | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Micro-seconds (µs) | **Software** | uint64 | 0 | (2^64)-1 | |
| | **KLV** | uint64 | 0 | (2^64)-1 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| 8 | 8 | 8 |

| Resolution | Special Values |
|---|---|
| 1 microsecond | None |

| Required in LS? | Mandatory | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| Oct. 24, 2008. 00:13:29.913 | 02 | 08 | 0004 59F4 A6AA 4AA8 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.02.01.01.01.05.00.00 (CRC 64827) |
|---|---|

- Represented in the number of microseconds elapsed since midnight (00:00:00), January 1,1970 not including leap seconds. See MISB ST 0603
- Precision Time Stamp is mandatory in every UAS Datalink LS packet

### 8.2.1 Details

This metadata item is an implementation of the MISP Time System. This item represents time as the number of microseconds elapsed since January 1, 1970 (1970-01-01T00:00:00Z) using an unsigned eight (8) byte integer. A Precision Time Stamp discretely labels a scale of time. The Precision Time Stamp does not include leap seconds and therefore the Precision Time Stamp does not represent UTC.

The Precision Time Stamp is critical for synchronizing metadata to the Motion Imagery by correlating it to a Precision Time Stamp embedded in the Motion Imagery. See Section 6.4 for further information about the usage and importance of the Precision Time Stamp in UAS Datalink Local Set.

## 8.3 Tag 3: Mission ID

| Description | | | | | |
|---|---|---|---|---|---|
| Descriptive mission identifier to distinguish event or sortie | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| MISSION01 | 03 | 09 | 4D49 5353 494F 4E30 31 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.04.01.03.00.00.00 (CRC 65358) |
|---|---|

- Value field is Free Text
- Suggested maximum: 127 characters
- Format and contents of a Mission ID are mission dependent

## 8.4 Tag 4: Platform Tail Number

| Description | | | | | |
|---|---|---|---|---|---|
| Identifier of platform as posted | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| AF-101 | 04 | 06 | 4146 2D31 3031 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.04.01.02.00.00.00 (CRC 35322) |
|---|---|

- E.g.: "AF008," "BP101," etc.
- Value field is Free Text
- Suggested maximum: 127 characters
- Format and contents of a Platform Tail Number are mission dependent

## 8.5 Tag 5: Platform Heading Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Aircraft heading angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | 0 | 360 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~5.5 milli degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{65535}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 159.974365 Degrees | 05 | 02 | 71C2 |

| KLV Key | 06.0E.2B.34.01.01.01.07.07.01.10.01.06.00.00.00 (CRC 23727) |
|---|---|

- Relative between longitudinal axis and True North measured in the horizontal plane
- Map 0..(2^16)-1 to 0..360

### 8.5.1 Details

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 Figure 15:

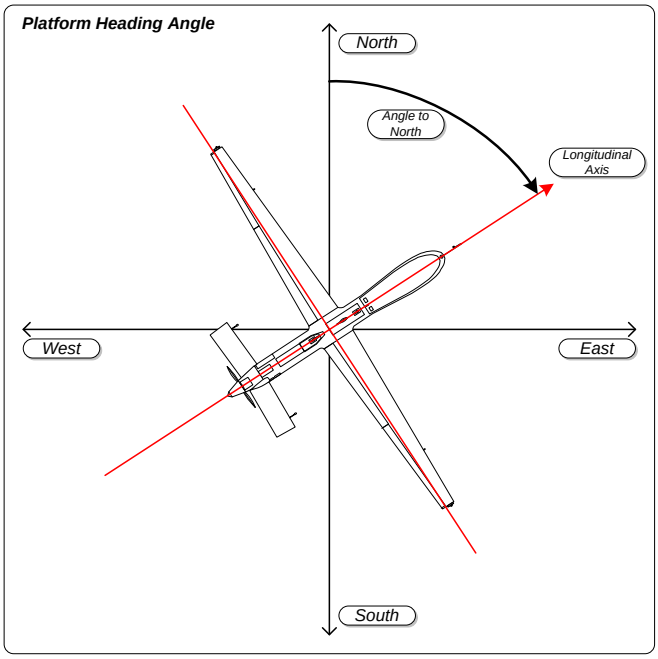


**Figure 15: Platform True Heading Angle**

## 8.6 Tag 6: Platform Pitch Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Aircraft pitch angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -20 | 20 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~610 micro degrees | 0x8000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{40}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{40}{65534}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -0.431531724 Degrees | 06 | 02 | FD3D |

| KLV Key | 06.0E.2B.34.01.01.01.07.07.01.10.01.05.00.00.00 (CRC 51059) |
|---|---|

- Angle between longitudinal axis and horizontal plane
- Positive angles above horizontal plane
- Map -((2^15)-1)..(2^15)-1 to +/-20
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.6.1 Details

For legacy purposes, both range-restricted (Tag 6) and full-range (Tag 90) representations of Platform Pitch Angle MAY appear in the same MISB ST 0601 packet. A single representation is preferred favoring the full-range version (Tag 90) as per Section 6.1.

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 (see Figure 16). Pitch angles are limited to +/- 20 degrees to increase metadata resolution within this range.

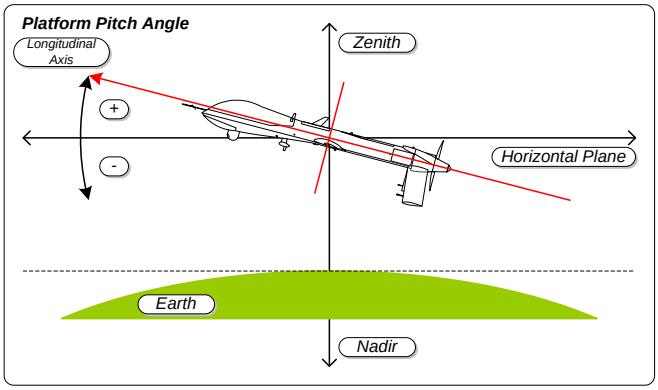


Figure 16: Platform Pitch Angle

## 8.7 Tag 7: Platform Roll Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Platform roll angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -50 | 50 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1525 micro degrees | 0x8000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{100}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{100}{65534}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 3.40586566 Degrees | 07 | 02 | 08B8 |

| KLV Key | 06.0E.2B.34.01.01.01.07.07.01.10.01.04.00.00.00 (CRC 45511) |
|---|---|

- Angle between transverse axis and transverse-longitudinal plane
- Positive angles for lowered right wing
- Map -((2^15)-1)..(2^15)-1 to +/-50
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.7.1 Details

For legacy purposes, both range-restricted (Tag 7) and full-range (Tag 91) representations of Platform Roll Angle MAY appear in the same MISB ST 0601 packet. A single representation is preferred favoring the full-range version (Tag 91) as per Section 6.1.

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 (see Figure 17). Roll angles are limited to +/- 50 degrees to increase metadata resolution within this range.

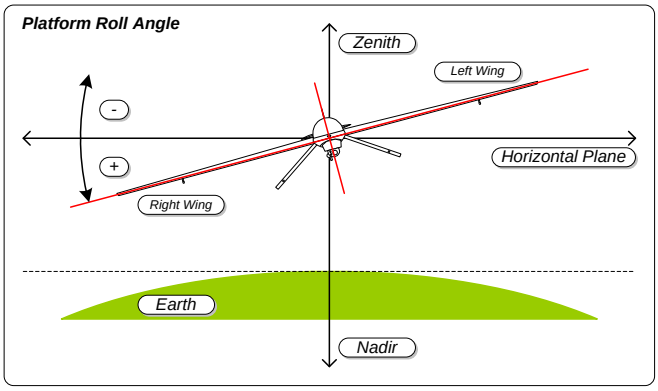


**Figure 17: Platform Roll Angle**

## *8.8 Tag 8: Platform True Airspeed*

| Description | | | | | |
|---|---|---|---|---|---|
| True airspeed (TAS) of platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters/Second (m/s) | **Software** | uint8 | 0 | 255 | |
| | **KLV** | uint8 | 0 | 255 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| 1 meter/second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 147 Meters/Second | 08 | 01 | 93 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.0A.00.00.00 (CRC 20280) |
|---|---|

- Indicated Airspeed adjusted for temperature and altitude
- 1 m/s = 1.94384449 knots

### 8.8.1 Details

True airspeed is the actual speed an aircraft is traveling relative through the air mass in which it travels. 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.

## 8.9 Tag 9: Platform Indicated Airspeed

| Description | | | | | |
|---|---|---|---|---|---|
| Indicated airspeed (IAS) of platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters/Second (m/s) | **Software** | uint8 | 0 | 255 | |
| | **KLV** | uint8 | 0 | 255 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| 1 meter/second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 159 Meters/Second | 09 | 01 | 9F |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.0B.00.00.00 (CRC 14732) |

- Derived from Pitot tube and static pressure sensors
- 1 m/s = 1.94384449 knots

### 8.9.1 Details

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.

## 8.10 Tag 10: Platform Designation

| Description | | | | | |
|---|---|---|---|---|---|
| Model name for the platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| MQ1-B | 0A | 05 | 4D51 312D 42 |

| KLV Key | 06.0E.2B.34.01.01.01.01.01.01.20.01.00.00.00.00 (CRC 36601) |
|---|---|

- e.g.: 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'IgnatER', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc
- Value field is Free Text
- Suggested maximum: 127 characters

### 8.10.1 Details

The platform designation metadata item distinguishes which platform is carrying the Motion Imagery generating payload equipment. Figure 18 shows example platforms.

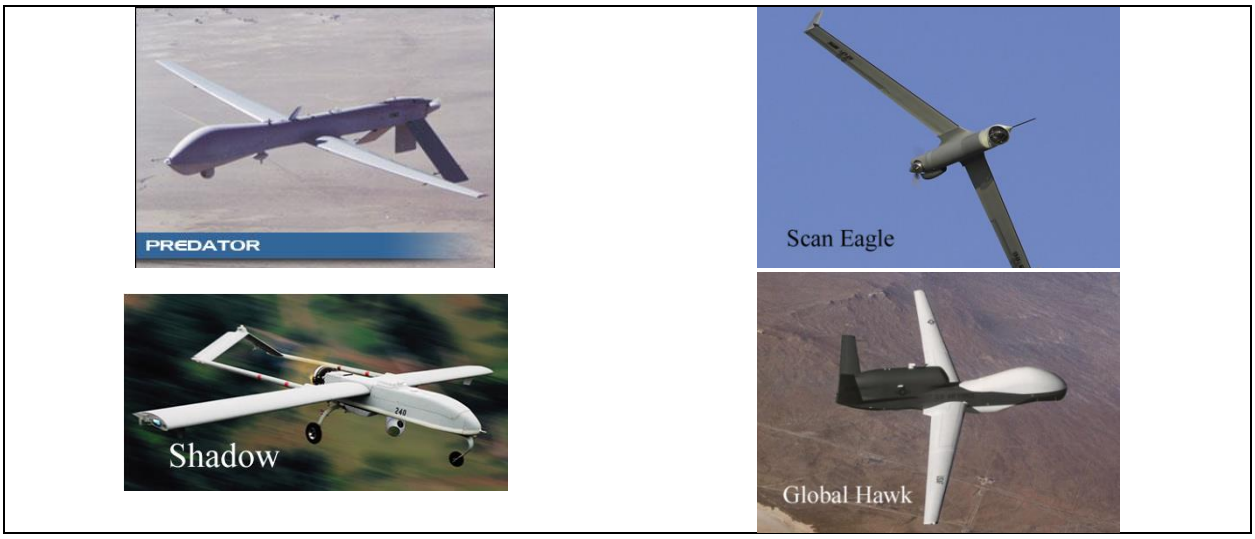


**Figure 18: Example Platforms**

## 8.11 Tag 11: Image Source Sensor

| Description | | | | | |
|---|---|---|---|---|---|
| Name of currently active sensor | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| EO | 0B | 02 | 454F |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.04.20.01.02.01.01.00.00 (CRC 53038) |

- 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
- Suggested maximum: 127 characters

### 8.11.1 Details

Figure 19 shows a sample imaging source sensor.

**Figure 19: Sample Imaging Sensor**

## 8.12 Tag 12: Image Coordinate System

| Description | | | | | |
|---|---|---|---|---|---|
| Name of the image coordinate system used | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| WGS-84 | 0C | 06 | 5747 532D 3834 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.07.01.01.01.00.00.00.00 (CRC 32410) |

- E.g.: 'Geodetic WGS84', 'Geocentric WGS84', 'None'
- Suggested maximum 127 characters

### 8.12.1 Details

#### 8.12.1.1 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.

#### 8.12.1.2 Notes and Clarification

As of MISB ST 0601.4, a reference to “DIGEST V2.1 Part 3 Sec 6.4” within the UAS LS section has been removed because of the reference’s inapplicability to the Image Coordinate System metadata item. “Geodetic WGS84” is the preferred Image Coordinate System. Other values are provided for sake of completeness to map items between legacy metadata sets.

## 8.13 Tag 13: Sensor Latitude

| Description | | | | | |
|---|---|---|---|---|---|
| Sensor latitude | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "Reserved" |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 60.176822966978335 Degrees | 0D | 04 | 5595 B66D |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.02.04.02.00 (CRC 8663) |
|---|---|

- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90

### 8.13.1 Details

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.

In a realized system, this item accounts for 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 way is sufficient in many Motion Imagery systems, the MISB recommends exploring the use of Photogrammetric metadata sets (i.e., MISB ST 0801) for improved representations of system accuracies.

## 8.14 Tag 14: Sensor Longitude

| Description | | | | | |
|---|---|---|---|---|---|
| Sensor longitude | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "Reserved" |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 128.42675904204452 Degrees | 0E | 04 | 5B53 60C4 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.02.06.02.00 (CRC 20407) |
|---|---|

- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180

### 8.14.1 Details

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.

In a realized system, this item accounts for 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 way is sufficient in many Motion Imagery systems, the MISB recommends exploring the use of Photogrammetric metadata sets (i.e., MISB ST 0801) for improved representations of system accuracies.

## 8.15 Tag 15: Sensor True Altitude

| Description | | | | | |
|---|---|---|---|---|---|
| Altitude of sensor as measured from Mean Sea Level (MSL) | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 14190.7195 Meters | 0F | 02 | C221 |

| KLV Key | 06.0E.2B.34.01.01.01.01.07.01.02.01.02.02.00.00 (CRC 13170) |
|---|---|

- Map 0..(2^16)-1 to -900..19000 meters
- 1 meter = 3.2808399 feet

### 8.15.1 Details

For legacy systems, Tag 15 and Tag 75 | Tag 104 are allowed with preference for Tag 75 | Tag 104.

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

For improved modeling accuracy use Sensor Ellipsoid Height (Tag 75) or Sensor Ellipsoid Height Extended (Tag 104).

In a realized system, this LS item accounts for 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 way is sufficient in many Motion Imagery systems, the MISB recommends exploring the use of Photogrammetric metadata sets (i.e., MISB ST 0801) for improved representations of system accuracies.

## 8.16 Tag 16: Sensor Horizontal Field of View

| Description | | | | | |
|---|---|---|---|---|---|
| Horizontal field of view of selected imaging sensor | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | 0 | 180 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~2.7 milli degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{180}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 144.571298 Degrees | 10 | 02 | CD9C |

| KLV Key | 06.0E.2B.34.01.01.01.02.04.20.02.01.01.08.00.00 (CRC 23753) |
|---|---|

- Map 0..(2^16)-1 to 0..180

### 8.16.1 Details

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 Figure 20.

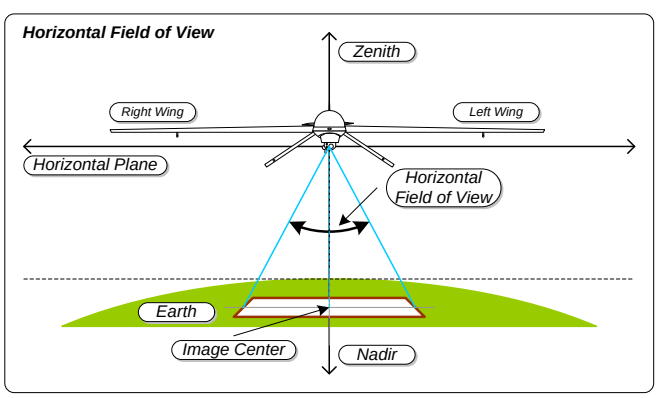


**Figure 20: Horizontal Field of View**

## 8.17 Tag 17: Sensor Vertical Field of View

| Description | | | | | |
|---|---|---|---|---|---|
| Vertical field of view of selected imaging sensor | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | 0 | 180 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~2.7 milli degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{180}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 152.643626 Degrees | 11 | 02 | D917 |

| KLV Key | 06.0E.2B.34.01.01.01.07.04.20.02.01.01.0A.01.00 (CRC 30292) |
|---|---|

- Map 0..(2^16)-1 to 0..180

### 8.17.1 Details

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 Figure 21.

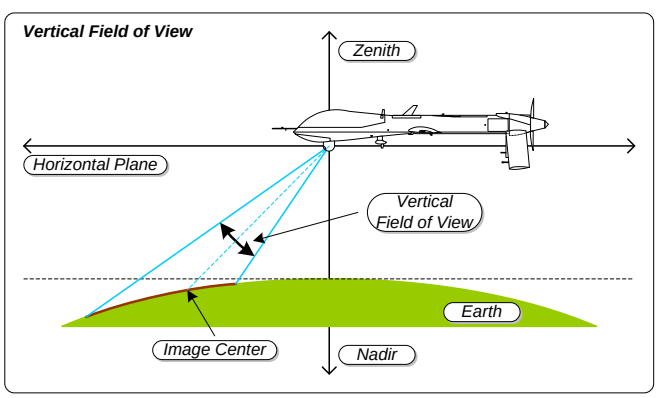


**Figure 21: Vertical Field of View**

## 8.18 Tag 18: Sensor Relative Azimuth Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Relative rotation angle of sensor to platform longitudinal axis | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | 0 | 360 | |
| | **KLV** | uint32 | 0 | (2^32)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967295}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{360}{4294967295}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 160.71921143697557 Degrees | 12 | 04 | 724A 0A20 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.04.00.00.00 (CRC 944) |
|---|---|

- Rotation angle between platform longitudinal axis and camera pointing direction as seen from above the platform
- Map 0..(2^32)-1 to 0..360

### 8.18.1 Details

The relative azimuth angle of a 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 Figure 22.

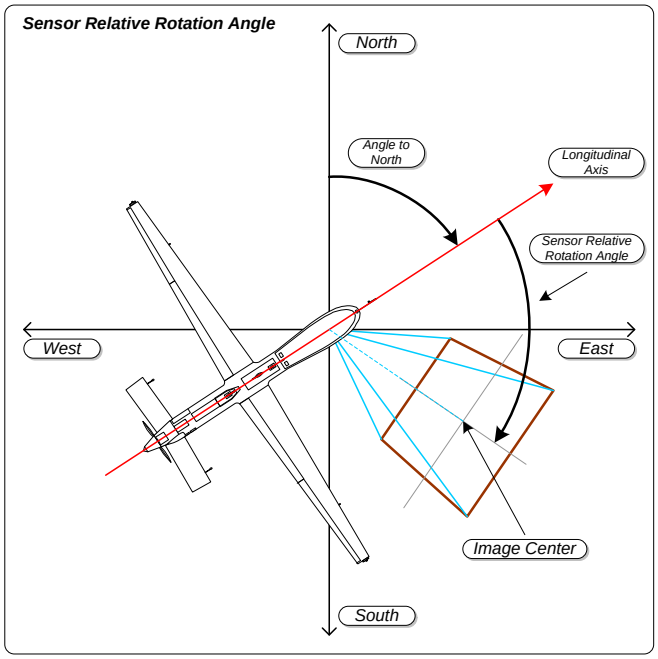


**Figure 22: Relative Rotation Angle**

## 8.19 Tag 19: Sensor Relative Elevation Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Relative elevation angle of sensor to platform longitudinal-transverse plane | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "Reserved" |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967295}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -168.79232483394085 Degrees | 13 | 04 | 87F8 4B86 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.05.00.00.00 (CRC 29956) |
|---|---|

- Negative angles down
- Map -((2^31)-1)..(2^31)-1 to +/-180

### 8.19.1 Details

The relative elevation angle of a 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 Figure 23:

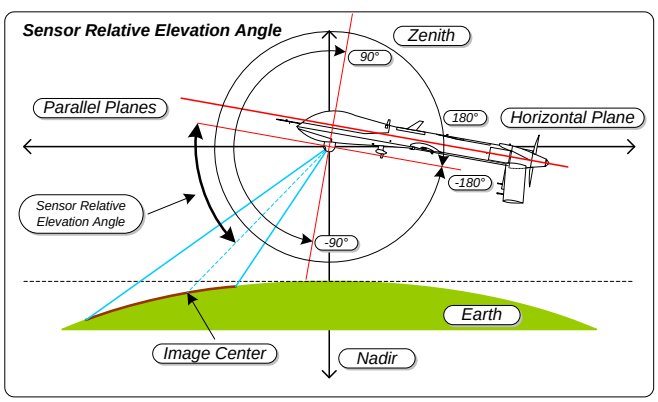


**Figure 23: Sensor Relative Elevation Angle**

## 8.20 Tag 20: Sensor Relative Roll Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Relative roll angle of sensor to aircraft platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | 0 | 360 | |
| | **KLV** | uint32 | 0 | (2^32)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967295}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{360}{4294967295}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 176.86543764939194 Degrees | 14 | 04 | 7DC5 5ECE |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.06.00.00.00 (CRC 61144) |
|---|---|

- 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

### 8.20.1 Details

Sensors able to rotate their camera about the lens axis, make use of this Sensor Relative Roll Angle item. 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.

## 8.21 Tag 21: Slant Range

| Description | | | | | |
|---|---|---|---|---|---|
| Slant range in meters | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | 0 | 5,000,000 | |
| | **KLV** | uint32 | 0 | (2^32)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~1.2 milli meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967295}{5000000}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{5000000}{4294967295}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 68590.983298744770 Meters | 15 | 04 | 0383 0926 |

| KLV Key | 06.0E.2B.34.01.01.01.01.07.01.08.01.01.00.00.00 (CRC 16588) |
|---|---|

- Distance to target
- Map 0..(2^32)-1 to 0..5000000 meters
- 1 nautical mile (knot) = 1852 meters

### 8.21.1 Details

The slant range is the distance between the sensor and image center. Refer to Figure 24.

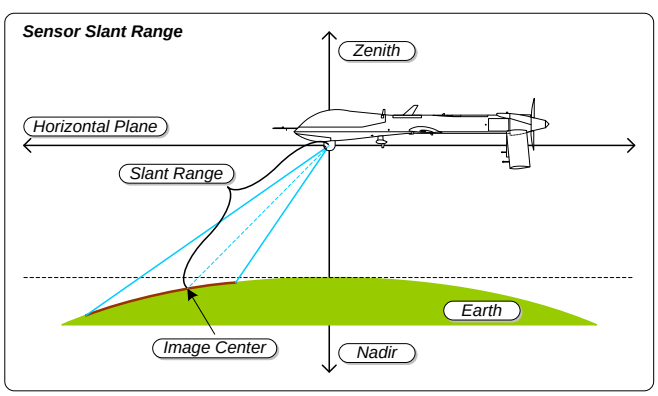


**Figure 24: Sensor Slant Range**

As of MISB ST 0601.3 Generic Flag Data 01 (Tag 47) contains a flag which indicates whether Slant Range is "Computed" or "Measured." By default, the Slant Range is set to "Computed." "Measured" is used when a ranging device (radar, or laser) is providing Slant Range estimates.

## 8.22 Tag 22: Target Width

| Description | | | | | |
|---|---|---|---|---|---|
| Target width within sensor field of view | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | 0 | 10,000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.16 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{10000}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{10000}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 722.819867 Meters | 16 | 02 | 1281 |

| KLV Key | 06.0E.2B.34.01.01.01.01.07.01.09.02.01.00.00.00 (CRC 60350) |
|---|---|

- Map 0..(2^16)-1 to 0..10000 meters
- 1 meter = 3.2808399 feet

### 8.22.1 Details

For legacy purposes, both restricted (Tag 22) and extended (Tag 96) representations of Target Width MAY appear in the same MISB ST 0601 packet. A single representation is preferred, with the extended version (Tag 96) being favored as per Section 6.1.

The target width is the linear ground distance between the center of both sides of the captured image. Refer to Figure 25.

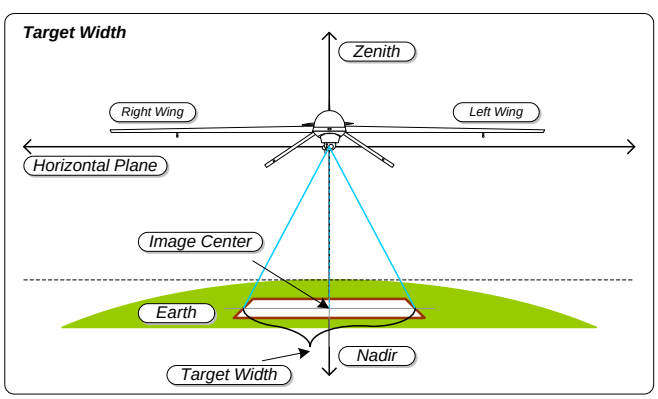


**Figure 25: Target Width**

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 MISB ST 0601 as full-width.

## 8.23 Tag 23: Frame Center Latitude

| Description | | | | | |
|---|---|---|---|---|---|
| Terrain latitude of frame center | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -10.542388633146132 Degrees | 17 | 04 | F101 A229 |

| KLV Key | 06.0E.2B.34.01.01.01.01.07.01.02.01.03.02.00.00 (CRC 17862) |
|---|---|

- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.23.1 Details

The center of the captured image or image sequence has a real earth coordinate represented by a latitude-longitude-altitude triplet. Frame centers which lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object) and are reported using the special value for "N/A (Off-Earth)."

## 8.24 Tag 24: Frame Center Longitude

| Description | | | | | |
|---|---|---|---|---|---|
| Terrain longitude of frame center | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 29.157890122923014 Degrees | 18 | 04 | 14BC 082B |

| KLV Key | 06.0E.2B.34.01.01.01.01.07.01.02.01.03.04.00.00 (CRC 63334) |
|---|---|

- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.24.1 Details

The center of the captured image or image sequence has a real earth coordinate represented by a latitude-longitude-altitude triplet. Frame centers which lie above the horizon typically do not correspond to a point on the earth (an example being the tracking of an airborne object) and are reported using the special value for "N/A (Off-Earth)."

## 8.25 Tag 25: Frame Center Elevation

| Description | | | | | |
|---|---|---|---|---|---|
| Terrain elevation at frame center relative to Mean Sea Level (MSL) | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 3216.03723 Meters | 19 | 02 | 34F3 |

| KLV Key | 06.0E.2B.34.01.01.01.0A.07.01.02.01.03.16.00.00 (CRC 57054) |
|---|---|

- Map 0..(2^16)-1 to -900..19000 meters

### 8.25.1 Details

For legacy purposes, both MSL (Tag 25) and HAE (Tag 78) representations of Frame Center Elevation MAY appear in the same MISB ST 0601 packet. A single representation is preferred favoring the HAE version (Tag 78).

The center of the captured image or image sequence has a real earth coordinate represented by a latitude-longitude-altitude triplet. When a frame center lies above the horizon and does not correspond to a point on the earth, the MISB recommends not reporting the Frame Center Elevation.

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

## 8.26 Tag 26: Offset Corner Latitude Point 1

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude offset for upper left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_23_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{23_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 0.0136602540 Degrees | 1A | 02 | 1750 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.07.01.00 (CRC 23392) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Latitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.26.1 Details

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 26). Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

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 an image. Convert both KLV items to decimal values prior to the addition.

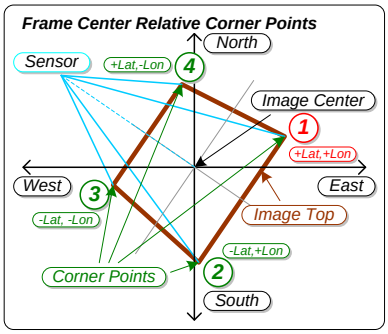


**Figure 26: Offset Corner Point 1 (Corner Point 1 highlighted in red)**

## 8.27 Tag 27: Offset Corner Longitude Point 1

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude offset for upper left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_24_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{24_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 0.0036602540 Degrees | 1B | 02 | 063F |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0B.01.00 (CRC 11777) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Longitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.27.1 Details

The corner points of a captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value for "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

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 an image. Convert both KLV items to decimal values prior to the addition.

## 8.28 Tag 28: Offset Corner Latitude Point 2

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude offset for upper right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_23_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{23_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| -0.0036602540 Degrees | 1C | 02 | F9C1 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.08.01.00 (CRC 30545) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Latitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.28.1 Details

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 27). Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

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 an image. Convert both KLV items to decimal values prior to the addition.

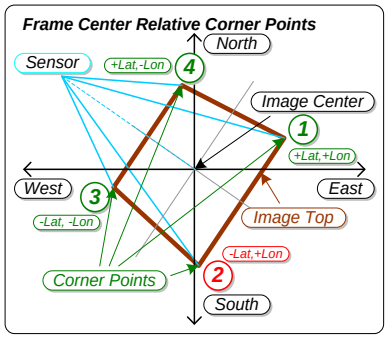


Figure 27: Offset Corner Point 2 (Corner Point 2 highlighted in red)

## 8.29 Tag 29: Offset Corner Longitude Point 2

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude offset for upper right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_24_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{24_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 0.0136602540 Degrees | 1D | 02 | 1750 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0C.01.00 (CRC 43921) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Longitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.29.1 Details

The corner points of a captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value for "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

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 corner point of an image. Convert both KLV items to decimal values prior to the addition.

## 8.30 Tag 30: Offset Corner Latitude Point 3

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude offset for lower right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_23_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{23_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -0.0110621778 Degrees | 1E | 02 | ED1F |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.09.01.00 (CRC 16481) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Latitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.30.1 Details

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 28). Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

The Offset Corner Latitude Point 3 is added to the Frame Center Latitude metadata item to determine the latitude of the first corner point of an image. Convert both KLV items to decimal values prior to the addition.

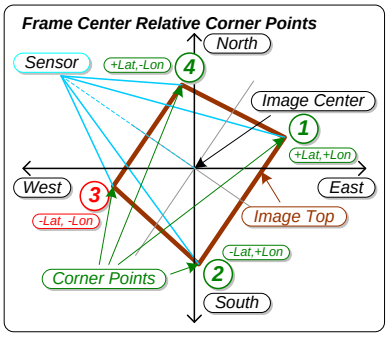


**Figure 28: Offset Corner Point 3 (Corner Point 3 highlighted in red)**

## 8.31 Tag 31: Offset Corner Longitude Point 3

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude offset for lower right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_24_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{24_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| -0.0051602540 Degrees | 1F | 02 | F732 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0D.01.00 (CRC 40097) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Longitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.31.1 Details

The corner points of a captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value for "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

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 corner point of an image. Convert both KLV items to decimal values prior to the addition.

## 8.32 Tag 32: Offset Corner Latitude Point 4

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude offset for lower left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_23_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{23_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{23_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 0.0010621778 Degrees | 20 | 02 | 01D0 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0A.01.00 (CRC 6449) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Latitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.32.1 Details

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 29). Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

The Offset Corner Latitude Point 4 is added to the Frame Center Latitude metadata item to determine the latitude of the first corner point of an image. Convert both KLV items to decimal values prior to the addition.

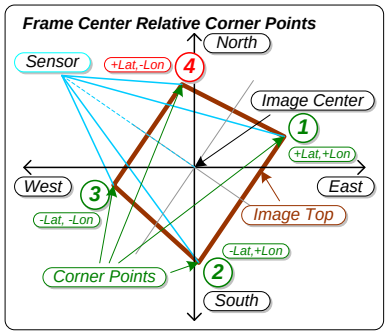


**Figure 29: Offset Corner Point 4 (Corner Point 4 highlighted in red)**

## 8.33 Tag 33: Offset Corner Longitude Point 4

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude offset for lower left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -0.075 | 0.075 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | Tag_24_Value |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1.2 micro degrees | 0x8000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{0.15}\right) * \left(\mathrm{Soft_{Val}} - \mathrm{LS_{24_{val}}}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{dec}}} = \left(\frac{0.15}{65534}\right) * \mathrm{KLV_{int}} + \mathrm{LS_{24_{val}}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -0.0121602540 Degrees | 21 | 02 | EB3F |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0E.01.00 (CRC 50673) |
|---|---|

- Based on WGS84 ellipsoid
- Use with Frame Center Longitude
- Map -((2^15)-1)..(2^15)-1 to +/-0.075
- 1.2 micro degrees is ~0.25 meters at equator
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.33.1 Details

The corner points of a captured image or image sequence have a real earth coordinate represented by a latitude-longitude pair. Corner points which lie above the horizon typically do not correspond to a point on the earth and are reported using the special value for "N/A (Off-Earth)." When any corner point offsets are outside of the mapped range, the MISB recommends not reporting corner point offsets and instead using the full precision corner points (Tags 82 through Tags 89).

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 corner point of an image. Convert both KLV items to decimal values prior to the addition.

## 8.34 Tag 34: Icing Detected

| Description | | | | | |
|---|---|---|---|---|---|
| Flag for icing detected at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Icing Code (code) | **Software** | uint8 | 0 | 2 | |
| | **KLV** | uint8 | 0 | 2 | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 1 | 1 | 1 |

| **Resolution** | **Special Values** |
|---|---|
| N/A | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| Icing Detected | 22 | 01 | 02 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.0C.00.00.00 (CRC 26785) |
|---|---|

- 0: Detector off
- 1: No icing Detected
- 2: Icing Detected

### 8.34.1 Details

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

## 8.35 Tag 35: Wind Direction

| Description | | | | | |
|---|---|---|---|---|---|
| Wind direction at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | 0 | 360 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~5.5 milli degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{360}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 235.924010 Degrees | 23 | 02 | A7C4 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.0D.00.00.00 (CRC 7701) |
|---|---|

- The direction the air body around the aircraft is coming from relative to true north
- Map 0..(2^16)-1 to 0..360

## 8.36 Tag 36: Wind Speed

| Description | | | | | |
|---|---|---|---|---|---|
| Wind speed at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters/Second (m/s) | **Software** | float32 | 0 | 100 | |
| | **KLV** | uint8 | 0 | 255 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| ~0.4 meters/second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{255}{100}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{100}{255}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 69.8039216 Meters/Second | 24 | 01 | B2 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.0E.00.00.00 (CRC 34249) |
|---|---|

- The speed of the body of air that surrounds the aircraft relative to the ground
- Map 0..255 to 0..100 meters/second
- 1 m/s = 1.94384449 knots

## *8.37 Tag 37: Static Pressure*

| Description | | | | | |
|---|---|---|---|---|---|
| Static pressure at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Millibar (mbar) | **Software** | float32 | 0 | 5000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 2 | 2 | 2 |

| **Resolution** | **Special Values** |
|---|---|
| ~0.08 millibar | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{5000}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{5000}{65535}\right) * \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 3725.18502 Millibar | 25 | 02 | BEBA |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.0F.00.00.00 (CRC 62333) |
|---|---|

- Map 0..(2^16)-1 to 0..5000 mbar
- 1 mbar = 0.0145037738 PSI

### 8.37.1 Details

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.

## 8.38 Tag 38: Density Altitude

| Description | | | | | |
|---|---|---|---|---|---|
| Density altitude at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 14818.6770 Meters | 26 | 02 | CA35 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.10.00.00.00 (CRC 15412) |
|---|---|

- 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

### 8.38.1 Details

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.

## 8.39 Tag 39: Outside Air Temperature

| Description | | | | | |
|---|---|---|---|---|---|
| Temperature outside of aircraft | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Celsius (°C) | **Software** | int8 | -128 | +127 | |
| | **KLV** | int8 | -128 | 127 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| 1 degree celsius | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 84 Celsius | 27 | 01 | 54 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.11.00.00.00 (CRC 19072) |

- The measured temperature outside of the platform

## 8.40 Tag 40: Target Location Latitude

| Description | | | | | |
|---|---|---|---|---|---|
| Calculated target latitude | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -79.163850051892850 Degrees | 28 | 04 | 8F69 5262 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.03.02.00.00.00 (CRC 36472) |
|---|---|

- This is the crosshair location if different from frame center
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.40.1 Details

The crosshair or target location of a captured image or image sequence has real earth coordinates represented by a latitude-longitude-elevation triplet and may differ from the center of the captured image. Target locations which lie above the horizon do not correspond to a point on the earth and are reported using the special value “N/A (Off-Earth).”

## 8.41 Tag 41: Target Location Longitude

| Description | | | | | |
|---|---|---|---|---|---|
| Calculated target longitude | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 166.40081296041646 Degrees | 29 | 04 | 7654 57F2 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.03.03.00.00.00 (CRC 63692) |
|---|---|

- This is the crosshair location if different from frame center
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.41.1 Details

The crosshair or target location of a captured image or image sequence has real earth coordinates 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 are reported using the special value “N/A (Off-Earth).”

## 8.42 Tag 42: Target Location Elevation

| Description | | | | | |
|---|---|---|---|---|---|
| Calculated target elevation | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 18389.0471 Meters | 2A | 02 | F823 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.03.04.00.00.00 (CRC 43489) |
|---|---|

- This is the crosshair location if different from frame center
- Map 0..(2^16)-1 to -900..19000 meters
- 1 meter = 3.2808399 feet

### 8.42.1 Details

The crosshair or target location of a captured image or image sequence has real earth coordinates represented by a latitude-longitude-elevation triplet and may differ from the center of the captured image. When target locations lie above the horizon and do not correspond to a point on the earth, the MISB recommends not reporting the Target Locations Elevation.

## *8.43 Tag 43: Target Track Gate Width*

| Description | | | | | |
|---|---|---|---|---|---|
| Tracking gate width (x value) of tracked target within field of view | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Pixels | **Software** | uint16 | 0 | 510 | |
| | **KLV** | uint8 | 0 | 255 | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 1 | 1 | 1 |

| **Resolution** | **Special Values** |
|---|---|
| 2 pixels | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{round}\left(\frac{\mathrm{Soft_{Val}}}{2}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = 2 * \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 6 Pixels | 2B | 01 | 03 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.03.05.00.00.00 (CRC 57173) |
|---|---|

- Closely tied to source Motion Imagery

### 8.43.1 Details

For Target Tracking Sensors which display a box or gate around the target location, the Target Track Gate Width specifies the width in pixels for the displayed tracking gate.

## *8.44 Tag 44: Target Track Gate Height*

| Description | | | | | |
|---|---|---|---|---|---|
| Tracking gate height (y value) of tracked target within field of view | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Pixels | **Software** | uint16 | 0 | 510 | |
| | **KLV** | uint8 | 0 | 255 | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 1 | 1 | 1 |

| **Resolution** | **Special Values** |
|---|---|
| 2 pixels | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{round}\left(\frac{\mathrm{Soft_{Val}}}{2}\right)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = 2 * \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 30 Pixels | 2C | 01 | 0F |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.03.06.00.00.00 (CRC 17545) |
|---|---|

- Closely tied to source Motion Imagery

### 8.44.1 Details

For Target Tracking Sensors which display a box or gate around the target location, the Target Track Gate Height specifies the height in pixels for the displayed tracking gate.

## 8.45 Tag 45: Target Error Estimate - CE90

| Description | | | | | |
|---|---|---|---|---|---|
| Circular error 90 (CE90) is the estimated error distance in the horizontal direction | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | 0 | 4095 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 2 | 2 | 2 |

| **Resolution** | **Special Values** |
|---|---|
| ~0.0624 meters | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{4095}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{4095}{65535}\right) * \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 425.215152 Meters | 2D | 02 | 1A95 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.03.07.00.00.00 (CRC 12861) |
|---|---|

- Specifies the radius of 90% probability on a plane tangent to the earth's surface

### 8.45.1 Details

Target covariance values are represented in an easting-northing-up coordinate system centered about the target point as illustrated in Figure 30:

**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:**

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

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

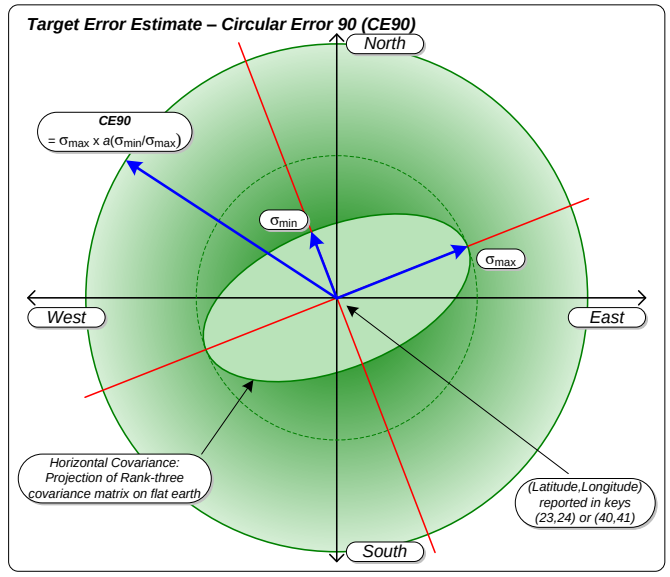


**Figure 30: Target Error Estimate - Circular Error 90%**

CE90 represents the 90 percent probability circular error radius of absolute horizontal accuracy. With $\sigma_{\max}$ and $\sigma_{\min}$ 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.

## 8.46 Tag 46: Target Error Estimate - LE90

| Description | | | | | |
|---|---|---|---|---|---|
| Lateral error 90 (LE90) is the estimated error distance in the vertical (or lateral) direction | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | 0 | 4095 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| 0.0625 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{4095}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{4095}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 608.9231 Meters | 2E | 02 | 2611 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.03.08.00.00.00 (CRC 59091) |
|---|---|

- Specifies the interval of 90% probability in the local vertical direction

### 8.46.1 Details

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:**

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

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

LE90 represents the 90 percent probability linear error of absolute vertical accuracy.
With the vertical (or "up") variance known ($\sigma_u$), 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.

## *8.47 Tag 47: Generic Flag Data*

| Description | | | | | |
|---|---|---|---|---|---|
| Generic metadata flags | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint8 | 0 | 63 | |
| | **KLV** | uint8 | 0 | 63 | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 1 | 1 | 1 |

| **Resolution** | **Special Values** |
|---|---|
| N/A | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 49 | 2F | 01 | 31 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.03.01.00.00.00 (CRC 5540) |
|---|---|

- See Details

### 8.47.1 Details

The Generic Data Flags are miscellaneous boolean (yes / no) aircraft and image related data settings which are individual bits in a single byte value. Table 3 lists six settable bit-flags along with two reserved values for potential future use.

**Table 3: Generic Flag Data**

| Bit | Setting Name | One[a] Indicates | Zero[a] Indicates | Comments |
|---|---|---|---|---|
| 0 | Laser Range | Laser on | Laser off | Laser Range Finder can be used to aid in geo-positioning. |
| 1 | Auto-Track | Auto-Track on | Auto-Track off | Sensor steering is automatically controlled by on-board tracking system. |
| 2 | IR Polarity | Black Hot | White Hot | IR sensors resulting image has either black values indicating hot or white values indicating hot. |
| 3 | Icing Status | Icing Detected | No Icing Detected | Icing status on the aircraft (i.e., the wings). Icing on wings can affect the continuation of the mission. |
| 4 | Slant Range | Measured | Calculated | Slant range is measured (i.e., using Laser Range Finder) or calculated using gimbal/aircraft position and angles. |
| 5 | Image Invalid | Image Invalid | Image Valid | An invalid image may result from a lens change, bad focus or other camera issues which significantly degrades the image. |
| 6 | Reserved | Not Used | Always Zero | Always Zero |
| 7 | Reserved | Not Used | Always Zero | Always Zero. |

[a] Version 16 of ST 0601 unintentionally inverted the column definitions; Version 16a uses the correct column definitions.

Figure 31 illustrates the bit-flags within the byte value along with an example value of 0x03 which indicates the Auto-Tracker is on and the Laser Range Finder is on. The least significant bit (LSBit) is the Laser Range setting and the most significant bit (MSBit) is a reserved value. If more flags are added in the future, which require additionally bytes, the new flags will be added as "Most Significant Bytes." The current byte value shown in Figure 31 will then be the Least Significant Byte.

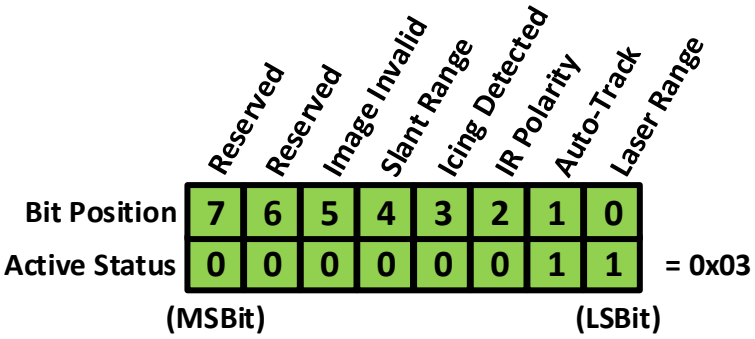


**Figure 31: Generic Flag Data Byte**

## 8.48 Tag 48: Security Local Set

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 0102 local let Security Metadata items | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 0102 |
| **KLV Value To Software Value** | See MISB ST 0102 |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| N/A | 30 | - | N/A |

| KLV Key | 06.0E.2B.34.02.03.01.01.0E.01.03.03.02.00.00.00 (CRC 40980) |
|---|---|

- Use the MISB ST 0102 Local Set tags within the MISB ST 0601 item 48
- The length field is the size of all MISB ST 0102 metadata items to be packaged within item 48

### 8.48.1 Details

MISB ST 0102 [14] allows for the use of either Universal Set or Local Set methods. However, to minimize bandwidth when incorporating MISB ST 0102 into an instance of the UAS Datalink LS, the Local Set method is required.

| Requirement | |
|---|---|
| ST 0601.14-31 | When incorporating the ST 0102 Security Metadata set into an instance of the UAS Datalink Local Set, the ST 0102 format shall use the Local Set format. |

## 8.49 Tag 49: Differential Pressure

| Description | | | | | |
|---|---|---|---|---|---|
| Differential pressure at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Millibar (mbar) | **Software** | float32 | 0 | 5000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 2 | 2 | 2 |

| **Resolution** | **Special Values** |
|---|---|
| ~0.08 millibar | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{5000}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{5000}{65535}\right) * \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 1191.95850 Millibar | 31 | 02 | 3D07 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.01.00.00.00 (CRC 20775) |
|---|---|

- Measured as the Stagnation/impact/total pressure minus static pressure
- Map 0..(2^16)-1 to 0..5000 mbar
- 1 mbar = 0.0145037738 PSI

### 8.49.1 Details

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 ( $p_d$ = impact pressure minus static pressure = $p_i - p_s$ ), and $\rho$ is the density of the fluid outside the item.

## 8.50 Tag 50: Platform Angle of Attack

| Description | | | | | |
|---|---|---|---|---|---|
| Platform attack angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -20 | 20 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~610 micro degrees | 0x8000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{40}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{40}{65534}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -8.67030854 Degrees | 32 | 02 | C883 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.02.00.00.00 (CRC 51963) |
|---|---|

- Angle between platform longitudinal axis and relative wind
- Positive angles for upward relative wind
- Map -((2^15)-1)..(2^15)-1 to +/-20
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.50.1 Details

For legacy purposes, both range-restricted (Tag 50) and full-range (Tag 92) representations of Platform Angle of Attack MAY appear in the same MISB 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 Figure 32.

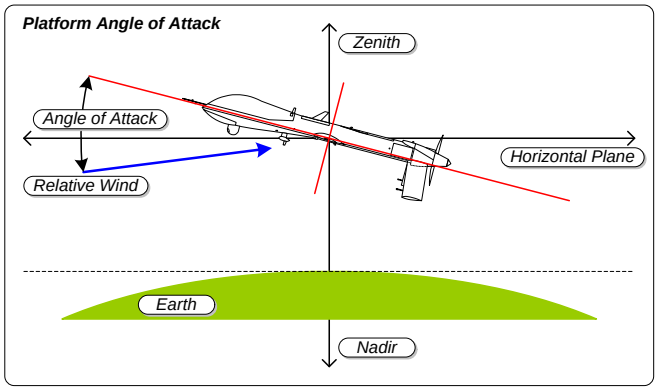


**Figure 32: Platform Angle of Attack**

## 8.51 Tag 51: Platform Vertical Speed

| Description | | | | | |
|---|---|---|---|---|---|
| Vertical speed of the aircraft relative to zenith | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters/Second (m/s) | **Software** | float32 | -180 | 180 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.0055 meters/second | 0x8000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{65534}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| -61.8878750 Meters/Second | 33 | 02 | D3FE |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.03.00.00.00 (CRC 48207) |
|---|---|

- Positive ascending, negative descending
- Map -((2^15)-1)..(2^15)-1 to +/-180
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.51.1 Details

Platform Vertical Speed 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.

## 8.52 Tag 52: Platform Sideslip Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Angle between the platform longitudinal axis and relative wind | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | -20 | 20 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~610 micro degrees | 0x8000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{40}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{40}{65534}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -5.08255257 Degrees | 34 | 02 | DF79 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.04.00.00.00 (CRC 60770) |
|---|---|

- Positive angles to right wing, neg to left
- Map -((2^15)-1)..(2^15)-1 to +/-20
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.52.1 Details

For legacy purposes, both range-restricted (Tag 52) and full-range (Tag 93) representations of Platform Sideslip Angle MAY appear in the same MISB 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. Figure 33 illustrates a negative sideslip angle.

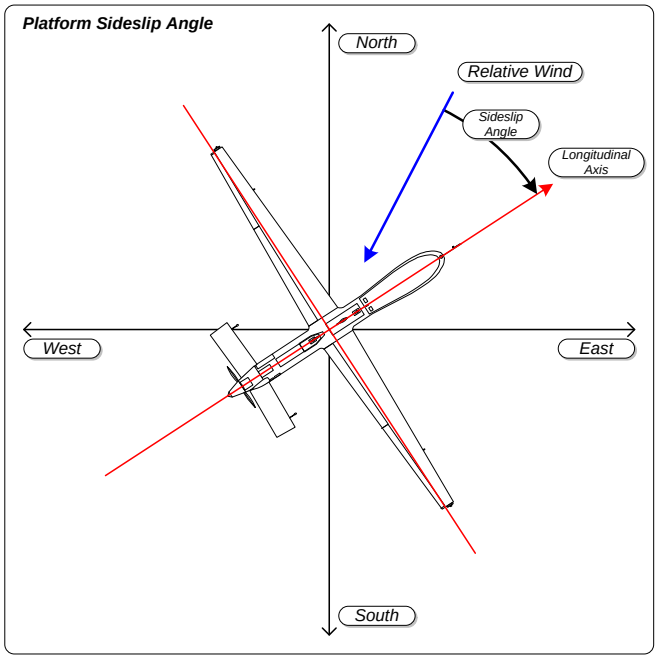


**Figure 33: Platform Sideslip Angle**

## 8.53 Tag 53: Airfield Barometric Pressure

| Description | | | | | |
|---|---|---|---|---|---|
| Local pressure at airfield of known height | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Millibar (mbar) | **Software** | float32 | 0 | 5000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.08 millibar | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{5000}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{5000}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 2088.96010 Millibar | 35 | 02 | 6AF4 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.02.00.00.00 (CRC 9257) |
|---|---|

- Pilot's responsibility to update
- Map 0..(2^16)-1 to 0..5000 mbar
- 1013.25mbar = 29.92inHg
- Min/max recorded values of 870/1086 mbar

### 8.53.1 Details

Altimeters use the Airfield Barometric Pressure to calibrate their values and display airfield elevation.

## 8.54 Tag 54: Airfield Elevation

| Description | | | | | |
|---|---|---|---|---|---|
| Elevation of airfield corresponding to Airfield Barometric Pressure | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{int}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 8306.80552 Meters | 36 | 02 | 7670 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.03.00.00.00 (CRC 21149) |
|---|---|

- Map 0..(2^16)-1 to -900..19000 meters
- 1 meter = 3.2808399 feet

### 8.54.1 Details

Airfield Elevation is measured at the airfield location. This relates to the Airfield Barometric Pressure metadata item.

## 8.55 Tag 55: Relative Humidity

| Description | | | | | |
|---|---|---|---|---|---|
| Relative humidity at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Percent (%) | **Software** | float32 | 0 | 100 | |
| | **KLV** | uint8 | 0 | (2^8)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| ~0.4% | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{255}{100}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{100}{255}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 50.5882353 Percent | 37 | 01 | 81 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.09.00.00.00 (CRC 54500) |
|---|---|

- Map 0..(2^8)-1 to 0..100

### 8.55.1 Details

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

## *8.56 Tag 56: Platform Ground Speed*

| Description | | | | | |
|---|---|---|---|---|---|
| Speed projected to the ground of an airborne platform passing overhead | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters/Second (m/s) | **Software** | uint8 | 0 | 255 | |
| | **KLV** | uint8 | 0 | 255 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| 1 meter/second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 140 Meters/Second | 38 | 01 | 8C |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.05.00.00.00 (CRC 39894) |

- 0..255 meters/sec
- 1 m/s = 1.94384449 knots

### 8.56.1 Details

Platform Ground Speed is the aircraft's speed as projected onto the ground.

## *8.57 Tag 57: Ground Range*

| Description | | | | | |
|---|---|---|---|---|---|
| Horizontal distance from ground position of aircraft relative to nadir, and target of interest | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | 0 | 5,000,000 | |
| | **KLV** | uint32 | 0 | (2^32)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~1.2 milli meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967295}{5000000}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{5000000}{4294967295}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 3506979.0316063400 Meters | 39 | 04 | B38E ACF1 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.06.00.00.00 (CRC 10) |
|---|---|

- Dependent upon Slant Range and Depression Angle
- Map 0..(2^32)-1 to 0..5000000 meters
- 1 nautical mile (knot) = 1852 meters

### 8.57.1 Details

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

## *8.58 Tag 58: Platform Fuel Remaining*

| Description | | | | | |
|---|---|---|---|---|---|
| Remaining fuel on airborne platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Kilogram (kg) | **Software** | float32 | 0 | 10,000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.16 kilograms | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{10000}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{10000}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 6420.53864 Kilograms | 3A | 02 | A45D |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.07.00.00.00 (CRC 30398) |
|---|---|

- Metered as fuel weight remaining
- Map 0..(2^16)-1 to 0..10000 Kilograms
- 1 kilogram = 2.20462262 pounds

### 8.58.1 Details

Platform Fuel Remaining indicates the current weight of fuel present on the platform.

## 8.59 Tag 59: Platform Call Sign

| Description | | | | | |
|---|---|---|---|---|---|
| Call sign of platform or operating unit | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| TOP GUN | 3B | 07 | 544F 5020 4755 4E |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.04.01.01.00.00.00 (CRC 4646) |

- Value field is Free Text

### 8.59.1 Details

The Platform Call Sign distinguishes groups or squadrons of platforms within different operating units from one another. Call sign is often related to the aircraft tail number.

## 8.60 Tag 60: Weapon Load

| Description | | | | | |
|---|---|---|---|---|---|
| Current weapons stored on aircraft | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint16 | 0 | 2^16-1 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 2 | 2 | 2 |

| **Resolution** | **Special Values** |
|---|---|
| N/A | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 45016 | 3C | 02 | AFD8 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.12.00.00.00 (CRC 53596) |
|---|---|

- Broken into two bytes: [T][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

### 8.60.1 Details

Note: the Weapon Stores (Tag 140) replaces the Weapon Load (Tag 60) and Weapon Fired (Tag 61) for providing information about Weapons and their status.

The Weapon Load item is composed of two bytes: the first byte indicates the aircraft store location, and the second byte indicates the store type. Each byte is composed of 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 its numbering at the outboard left wing as store location 1 and increases towards the outboard right wing (see Figure 34). Each station can have a different weapon installed, or multiple weapons on the same station. For multiple weapons per station, the substation number begins at 1. A substation number of 0 indicates a single store located at the station. The aircraft store location byte has two nibbles: the first most significant nibble indicates Station Number; the second nibble the Substation Number.

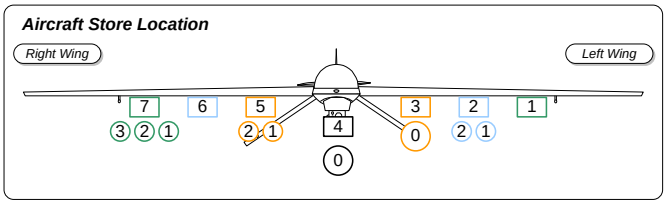


**Figure 34: Aircraft Store Location**

The weapon type byte is also composed of two nibbles: the first most significant nibble indicates Weapon Type; the second nibble indicates Weapon Variant. A list of available weapons is undefined.

## 8.61 Tag 61: Weapon Fired

| Description | | | | | |
|---|---|---|---|---|---|
| Indication when a particular weapon is released | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint8 | 0 | 255 | |
| | **KLV** | uint8 | 0 | 255 | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 1 | 1 | 1 |

| **Resolution** | **Special Values** |
|---|---|
| N/A | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 186 | 3D | 01 | BA |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.13.00.00.00 (CRC 42984) |
|---|---|

- Correlate with Precision Time Stamp
- Identical format to Weapon Load byte 2:
- [byteN] = [[nib1][nib2]]
- nib1 = Station Number
- nib2 = Substation Number

### 8.61.1 Details

Note: the Weapon Stores (Tag 140) replaces the Weapon Load (Tag 60) and Weapon Fired (Tag 61) for providing information about Weapons and their status.

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 composed of two nibbles with [nib1] being the most significant nibble with bit order [3210] where 3=msb.

When included in a KLV packet, correlate the Weapon Fired item with the mandatory timestamp to determine the release time of a weapon.

## 8.62 Tag 62: Laser PRF Code

| Description | | | | | |
|---|---|---|---|---|---|
| A laser's Pulse Repetition Frequency (PRF) code used to mark a target | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint16 | 0 | 65535 | |
| | **KLV** | uint16 | 0 | 65535 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| N/A | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 1743 | 3E | 02 | 06CF |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.02.02.01.00.00.00 (CRC 28949) |

- The Laser PRF code is a three or four digit number consisting of the values 1..8
- Only the values 111..8888 can be used without 0's or 9's

### 8.62.1 Details

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

## 8.63 Tag 63: Sensor Field of View Name

| Description | | | | | |
|---|---|---|---|---|---|
| Sensor field of view names | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint8 | 0 | 7 | |
| | **KLV** | uint8 | 0 | 7 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| N/A | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 2 | 3F | 01 | 02 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.02.02.02.00.00.00 (CRC 60105) |

- Enumerated list of names to indicate the lens type in use

### 8.63.1 Details

The Sensor Field of View Name indicates the Motion Imagery sensor's current lens type. Table 4 lists the allowed Field of View Names.

**Table 4: Field of View Names**

| Value | Meaning |
|---|---|
| 0 | Ultranarrow |
| 1 | Narrow |
| 2 | Medium |
| 3 | Wide |
| 4 | Ultrawide |
| 5 | Narrow Medium |
| 6 | 2x Ultranarrow |
| 7 | 4x Ultranarrow |
| 8 | Continuous Zoom |
| 9-255 | Reserved – Do not use |

This item is for generic guidance and does not correspond to a specific field of view value. Refer to Sensor Horizontal Field of View Conversion (Tag 16) and Sensor Vertical Field of View Conversion (Tag 17) metadata items for specific aperture angles.

## 8.64 Tag 64: Platform Magnetic Heading

| Description | | | | | |
|---|---|---|---|---|---|
| Aircraft magnetic heading angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | 0 | 360 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~5.5 milli degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} = \left(\frac{360}{65535}\right) * \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 311.868162 Degrees | 40 | 02 | DDC5 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.08.00.00.00 (CRC 41552) |
|---|---|

- Relative between longitudinal axis and Magnetic North measured in the horizontal plane
- Map 0..(2^16)-1 to 0..360

### 8.64.1 Details

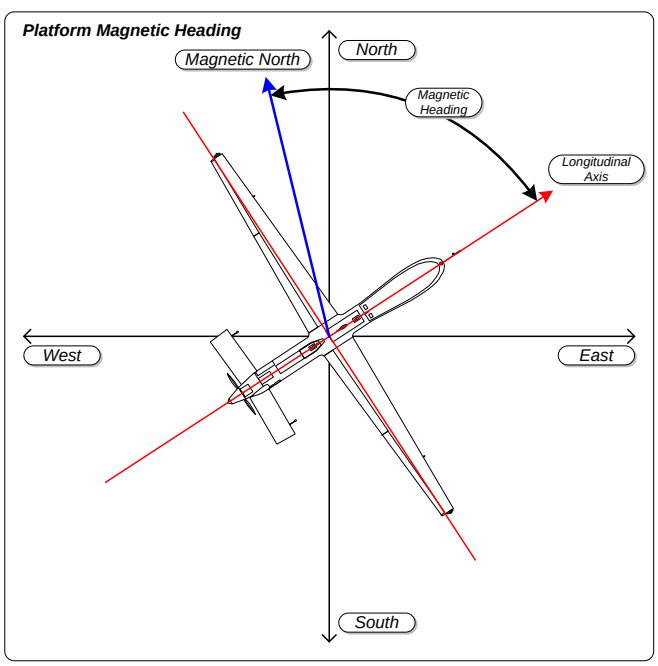


**Figure 35: Magnetic Heading**

## 8.65 Tag 65: UAS Datalink LS Version Number

| Description | | | | | |
|---|---|---|---|---|---|
| Version number of the UAS Datalink LS document used to generate KLV metadata | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Number (None) | **Software** | uint8 | 0 | 255 | |
| | **KLV** | uint8 | 0 | 255 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| N/A | None |

| Required in LS? | Mandatory | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 13 | 41 | 01 | 0D |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.02.03.03.00.00.00 (CRC 13868) |
|---|---|

- Indicates the version of MISB ST 0601 used as the source standard when encoding the metadata into KLV
- 0 is pre-release, initial release (0601.0), or test data
- 1..255 corresponds to document revisions MISB ST 0601.1 thru MISB ST 0601.255
- UAS Datalink LS Version Number is mandatory in every UAS Datalink LS packet

## 8.66 Tag 66: Deprecated

| Description | | | | | |
|---|---|---|---|---|---|
| This item has been deprecated. | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| N/A | **Software** | N/A | N/A | N/A | |
| | **KLV** | N/A | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| N/A | N/A | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | N/A |
| **KLV Value To Software Value** | N/A |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| N/A | 42 | - | N/A |

| KLV Key | 06.0E.2B.34.02.05.01.01.0E.01.03.03.14.00.00.00 (CRC 28126) |
|---|---|

- The Target Location Covariance Matrix is supported using the Standard Deviation and Cross Correlation Floating Length Pack (SDCC-FLP) pack - see Tag 102.

## 8.67 Tag 67: Alternate Platform Latitude

| Description | | | | | |
|---|---|---|---|---|---|
| Alternate platform latitude | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "Reserved" |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -86.041207348947040 Degrees | 43 | 04 | 85A1 5A39 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.14.00.00.00 (CRC 63173) |
|---|---|

- Represents latitude of an airborne or ground based platform connected via direct datalink with UAS
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90

## 8.68 Tag 68: Alternate Platform Longitude

| Description | | | | | |
|---|---|---|---|---|---|
| Alternate platform longitude | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 4 | 4 | 4 |

| **Resolution** | **Special Values** |
|---|---|
| ~84 nano degrees | 0x80000000 = "Reserved" |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 0.15552755452484243 Degrees | 44 | 04 | 001C 501C |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.15.00.00.00 (CRC 32881) |
|---|---|

- Represents longitude of an airborne or ground based platform connected via direct datalink with UAS
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180

## 8.69 Tag 69: Alternate Platform Altitude

| Description | | | | | |
|---|---|---|---|---|---|
| Altitude of alternate platform as measured from Mean Sea Level (MSL) | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 9.44533455 Meters | 45 | 02 | 0BB3 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.16.00.00.00 (CRC 7085) |
|---|---|

- Represents altitude of platform connected with UAS
- Map 0..(2^16)-1 to -900..19000 meters
- 1 meter = 3.2808399 feet

### 8.69.1 Details

For Legacy systems, Tag 69 and Tag 76 | Tag 105 are allowed with preference for Tag 76 | Tag 105.

The Alternate Platform Altitude is the altitude of an airborne or ground based platform connected via direct datalink to a UAS generating Motion Imagery and metadata. The Alternate Platform Altitude is a true altitude or true vertical distance above mean sea level.

## 8.70 Tag 70: Alternate Platform Name

| Description | | | | | |
|---|---|---|---|---|---|
| Name of alternate platform connected to UAS | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| APACHE | 46 | 06 | 4150 4143 4845 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.17.00.00.00 (CRC 27929) |
|---|---|

- E.g.: 'Apachce', 'Rover', 'Predator', 'Reaper', 'Outrider', 'Pioneer', 'Warrior', 'Shadow', 'Hunter II', 'Global Hawk', 'Scan Eagle', etc.
- Value field is Free Text
- Suggested maximum: 127 characters

### 8.70.1 Details

The Alternate Platform Name metadata item distinguishes a platform which is generating Motion Imagery and metadata products and relates to the referring UAS. The alternate platform can be airborne, or ground based and is to be described sufficiently (yet with brevity) in text using this metadata item.

An alternate platform is an airborne or ground based platform connected via direct datalink to a UAS generating Motion Imagery and metadata.

## 8.71 Tag 71: Alternate Platform Heading

| Description | | | | | |
|---|---|---|---|---|---|
| Heading angle of alternate platform connected to UAS | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float32 | 0 | 360 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~5.5 milli degrees | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{65535}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 32.6024262 Degrees | 47 | 02 | 172F |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.18.00.00.00 (CRC 47607) |
|---|---|

- Relative between longitudinal axis and True North measured in the horizontal plane
- Map 0..(2^16)-1 to 0..360

### 8.71.1 Details

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 connected via direct datalink to a UAS generating Motion Imagery and metadata.

## 8.72 Tag 72: Event Start Time - UTC

| Description | | | | | |
|---|---|---|---|---|---|
| Start time of scene, project, event, mission, editing event, license, publication, etc. | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Micro-seconds (µs) | **Software** | uint64 | 0 | (2^64)-1 | |
| | **KLV** | uint64 | 0 | (2^64)-1 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| 8 | 8 | 8 |

| Resolution | Special Values |
|---|---|
| 1 microsecond | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| April 16, 1995. 13:44:54 | 48 | 08 | 0002 D5CF 4DDC 9A35 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.07.02.01.02.07.01.00.00 (CRC 11991) |

- Represented as the microseconds elapsed since midnight (00:00:00), January 1, 1970

### 8.72.1 Details

A Precision Time Stamp discretely labels a scale of time and is widely used within systems of differing underlying architectures. The Precision Time Stamp, which does not include leap seconds, is specified in MISB ST 0603. In converting the Precision Time Stamp to UTC, leap seconds are added (or subtracted). See the Motion Imagery Handbook for appropriate conversions.

The Event Start Time - UTC metadata item is used to represent the start time of a mission, or other event related to the Motion Imagery collection.

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

## 8.73 Tag 73: RVT Local Set

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 0806 RVT Local Set metadata items | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | Not Limited | N/A |

| **Resolution** | **Special Values** |
|---|---|
| N/A | N/A |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 0806 |
| **KLV Value To Software Value** | See MISB ST 0806 |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| N/A | 49 | - | N/A |

| **KLV Key** | 06.0E.2B.34.02.0B.01.01.0E.01.03.01.02.00.00.00 (CRC 17945) |
|---|---|

- Use the MISB ST 0806 Local Set within the MISB ST 0601 Tag 73.
- The length field is the size of all RVT LS metadata items to be packaged within Tag 73

### 8.73.1 Details

The RVT Local Set item allows users to include, or nest, RVT LS (MISB ST 0806 [7]) metadata items within MISB ST 0601.

This provides users who are required to use the RVT LS metadata items (Points of Interest, Areas of Interest, etc.) a method to leverage the data field contained within MISB ST 0601 (i.e., platform location, and sensor pointing angles).

## 8.74 Tag 74: VMTI Local Set

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 0903 VMTI Local Set metadata items | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 0903 |
| **KLV Value To Software Value** | See MISB ST 0903 |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| N/A | 4A | - | N/A |

| KLV Key | 06.0E.2B.34.02.0B.01.01.0E.01.03.03.06.00.00.00 (CRC 51307) |
|---|---|

- Use the MISB ST 0903 Local Set within the MISB ST 0601 Tag 74.
- The length field is the size of all VMTI LS metadata items to be packaged within Tag 74

### 8.74.1 Details

The VMTI Local Set allows users to include, or nest, VMTI LS (MISB ST 0903 [15]) metadata items within MISB ST 0601.

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

## *8.75 Tag 75: Sensor Ellipsoid Height*

| Description | | | | | |
|---|---|---|---|---|---|
| Sensor ellipsoid height as measured from the reference WGS84 ellipsoid | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 2 | 2 | 2 |

| **Resolution** | **Special Values** |
|---|---|
| ~0.3 meters | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | Yes | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 14190.7195 Meters | 4B | 02 | C221 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.02.01.82.47.00.00 (CRC 16670) |
|---|---|

- Map 0..(2^16)-1 to -900..19000 meters
- 1 meter = 3.2808399 feet

### 8.75.1 Details

For legacy systems, Tag 15 and Tag 75 | Tag 104 are allowed with preference for Tag 75 | Tag 104.

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

## 8.76 Tag 76: Alternate Platform Ellipsoid Height

| Description | | | | | |
|---|---|---|---|---|---|
| Alternate platform ellipsoid height as measured from the reference WGS84 Ellipsoid | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 9.44533455 Meters | 4C | 02 | 0BB3 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.02.01.82.48.00.00 (CRC 27951) |
|---|---|

- Map 0..(2^16)-1 to -900..19000 meters
- 1 meter = 3.2808399 feet

### 8.76.1 Details

For Legacy systems, Tag 69 and Tag 76 | Tag 105 are allowed with preference for Tag 76 | Tag 105.

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

An alternate platform is an airborne or ground based platform that is connected via direct datalink to a UAS generating Motion Imagery and metadata.

## *8.77 Tag 77: Operational Mode*

| Description | | | | | |
|---|---|---|---|---|---|
| Indicates the mode of operations of the event portrayed in Motion Imagery | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint8 | 0 | 5 | |
| | **KLV** | uint8 | 0 | 5 | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 1 | 1 | 1 |

| **Resolution** | **Special Values** |
|---|---|
| N/A | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 1 (Operational) | 4D | 01 | 01 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.03.21.00.00.00 (CRC 8938) |
|---|---|

- Enumerated list of values, see details

### 8.77.1 Details

Operational Modes in Table 5 provide an indication of the event portrayed in the metadata. This allows for categorization of Motion Imagery streams and is often useful for archival systems.

**Table 5: Operation Modes**

| Value | Meaning |
|---|---|
| 0 | Other |
| 1 | Operational |
| 2 | Training |
| 3 | Exercise |
| 4 | Maintenance |
| 5 | Test |
| 6-255 | Reserved - Do Not Use |

## 8.78 Tag 78: Frame Center Height Above Ellipsoid

| Description | | | | | |
|---|---|---|---|---|---|
| Frame center ellipsoid height as measured from the reference WGS84 ellipsoid | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float32 | -900 | 19000 | |
| | **KLV** | uint16 | 0 | (2^16)-1 | -900 |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~0.3 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65535}{19900}\right) * (\mathrm{Soft_{Val}} + 900)$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{uint_{range}}}\right) * \mathrm{KLV_{uint}} - \mathrm{Offset} = \left(\frac{19900}{65535}\right) * \mathrm{KLV_{uint}} - 900$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 9.44533455 Meters | 4E | 02 | 0BB3 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.02.03.48.00.00.00 (CRC 18095) |
|---|---|

- Map 0..(2^16)-1 to -900..19000 meters
- 1 meter = 3.2808399 feet

### 8.78.1 Details

For legacy purposes, both MSL (Tag 25) and HAE (Tag 78) representations of Frame Center Elevation MAY appear in the same MISB ST 0601 packet. A single representation is preferred favoring the HAE version (Tag 78).

Frame Center Ellipsoid Height Above Ellipsoid is the vertical distance of the image's center point on the ground and the WGS84 Reference Ellipsoid. Measurement is GPS derived.

## 8.79 Tag 79: Sensor North Velocity

| Description | | | | | |
|---|---|---|---|---|---|
| Northing velocity of the sensor or platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters/Second (m/s) | **Software** | float32 | -327 | 327 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1 cm/sec | 0x8000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{654}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{654}{65534}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 25.4977569 Meters/Second | 4F | 02 | 09FB |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.02.02.7E.00.00.00 (CRC 59278) |
|---|---|

- Sensor movement rate in the north direction
- Positive towards True North
- Map -((2^15)-1)..(2^15)-1 to +/-327
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

## 8.80 Tag 80: Sensor East Velocity

| Description | | | | | |
|---|---|---|---|---|---|
| Easting velocity of the sensor or platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters/Second (m/s) | **Software** | float32 | -327 | 327 | |
| | **KLV** | int16 | -((2^15)-1) | (2^15)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 2 | 2 | 2 |

| Resolution | Special Values |
|---|---|
| ~1 cm/sec | 0x8000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{65534}{654}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{654}{65534}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 12.1 Meters/Second | 50 | 02 | 04BC |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.02.02.7F.00.00.00 (CRC 37178) |
|---|---|

- Sensor movement rate in the east direction
- Positive towards East
- Map -((2^15)-1)..(2^15)-1 to +/-327
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

## 8.81 Tag 81: Image Horizon Pixel Pack

| Description | | | | | |
|---|---|---|---|---|---|
| Location of earth-sky horizon in the Imagery | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | dlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 20 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| N/A | 51 | - | N/A |

| KLV Key | 06.0E.2B.34.02.05.01.01.0E.01.03.02.08.00.00.00 (CRC 37658) |
|---|---|

- Floating Length Pack. Start x0, Start y0, End x0, End y0 are required
- Lat/Lon pairs are optional

### 8.81.1 Details

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.

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 36.

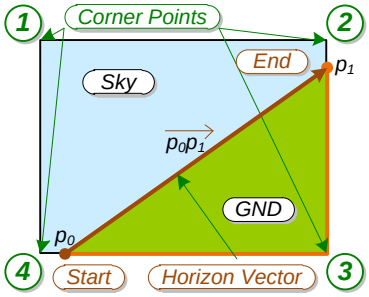


**Figure 36: Horizon Vector**

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

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

In the example shown in in Figure 36, 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 a 3-point, 4-point, and 5-point Pixel Frame are shown in Figure 37.

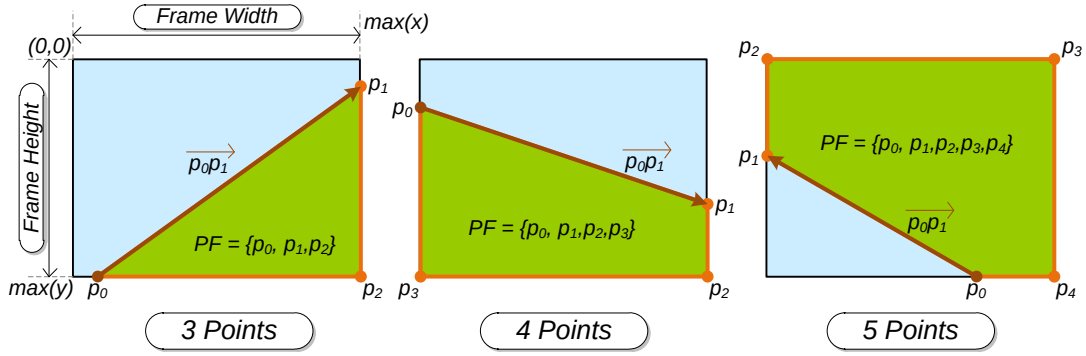


**Figure 37: Pixel Frame Examples**

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.

## 8.81.2 Example

The example in Figure 38 shows how to use the Image Horizon Pixel Pack for sample 720p airborne imagery. The horizon (barely visible through haze) is covered by the Horizon Vector with $p_0$ = (0%, 36.11%), and $p_1$ = (56.25%, 0).

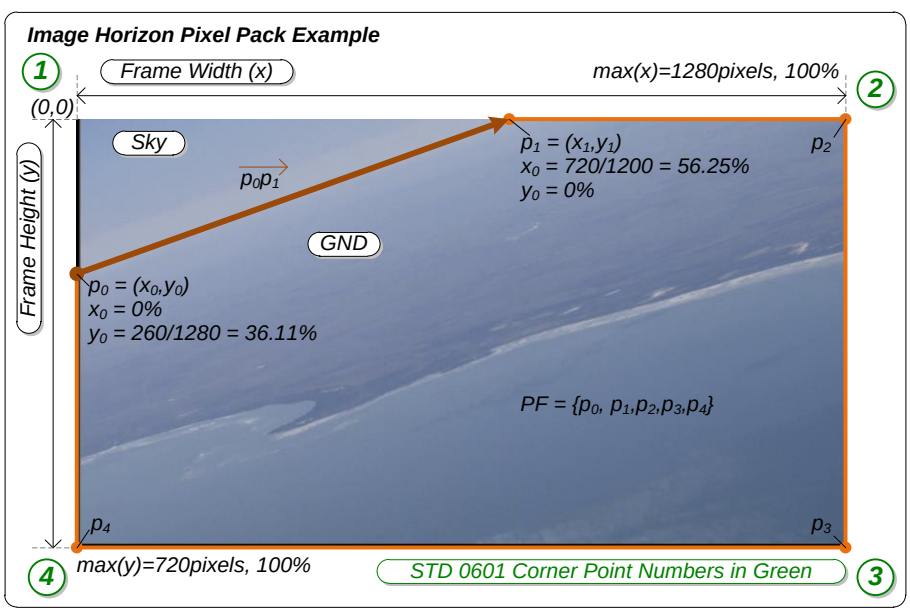


**Figure 38: Image Horizon Pixel Pack Example**

## 8.81.3 Decoding the Image Horizon Pixel Pack

When an Image Horizon Pixel Pack only includes the x and 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 MISB ST 0601 packet are then matched with the appropriate points defined by the Pixel Frame.

### 8.81.4 Floating Length Pack Definition for the Image Horizon Pixel Pack

The Image Horizon Pixel Pack makes use of a Floating Length Pack as described in the Motion Imagery Handbook which allows a user to include or exclude data items as necessary. The first items defined within this pack are the Start x0, Start y0 and End x1, End y1 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 x0, Start y0 and End x1, End y1end points defining the Horizon Vector in image space. The latitudes/longitudes of these points are optional, but the MISB recommends providing them. The Image Horizon Pixel Pack is defined in Table 6.

The “Key” column indicates the Universal Label key for the corresponding metadata item as defined in MISB ST 0807. The “Name” column is the corresponding name of the metadata item. The “Units/Range” column provides the units of measurement for the item’s value, and the range of allowed values. The “Type” column indicates the data type used for the value of the item. This is directly related to the “Length” column, which indicates the number of bytes allotted to the item value. Finally, the “M/O” column indicates whether the corresponding metadata item is mandatory (i.e., “M”), or optional (i.e. “O”). However, the MISB recommends providing the optional values.

## Table 6: Image Horizon Pixel Pack

| Local Set Key | Name |
|---|---|
| 06 0E 2B 34 02 05 01 01 0E 01 03 02 08 00 00 00 (CRC 37658) | Image Horizon Pixel Pack |

| Constituent Elements | | | | | | |
|---|---|---|---|---|---|---|
| Key | Name | Notes | Units/Range | Type | Len | M/O |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 01 00 00 (CRC 3334) | 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.<br>Mandatory in the Image Horizon Pixel Pack. | Percent [0..100] | uint8 | 1 | M |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 02 00 00 (CRC 21590) | 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.<br>Mandatory in the Image Horizon Pixel Pack. | Percent [0..100] | uint8 | 1 | M |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 03 00 00 (CRC 25446) | 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.<br>Mandatory in the Image Horizon Pixel Pack. | Percent [0..100] | uint8 | 1 | M |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 04 00 00 (CRC 59126) | 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.<br>Mandatory in the Image Horizon Pixel Pack. | Percent [0..100] | uint8 | 1 | M |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 05 00 00 (CRC 53702) | Start Latitude | The Latitude of the Start point (x0,y0) on the image border. Based on WGS84 ellipsoid.<br>Map -(2^31-1)..(2^31-1) to +/-90.<br>Use (-2^31) as an "error" indicator.<br>Optional (but recommended). | Degrees [-90..+90] | int32 | 4 | O |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 06 00 00 (CRC 34966) | Start Longitude | The Longitude of the Start point (x0,y0) on the image boarder. Based on WGS84 ellipsoid.<br>Map -(2^31-1)..(2^31-1) to +/-180.<br>Use (-2^31) as an "error" indicator.<br>Optional (but recommended). | Degrees [-180..+180] | int32 | 4 | O |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 07 00 00 (CRC 49062) | End Latitude | The Latitude of the End point (x1,y1) on the image boarder. Based on WGS84 ellipsoid.<br>Map -(2^31-1)..(2^31-1) to +/-90.<br>Use (-2^31) as an "error" indicator.<br>Optional (but recommended). | Degrees [-90..+90] | int32 | 4 | O |
| 06 0E 2B 34 01 01 01 01 0E 01 01 02 09 08 00 00 (CRC 37783) | End Longitude | The Longitude of the End point (x1,y1) on the image boarder. Based on WGS84 ellipsoid.<br>Map -(2^31-1)..(2^31-1) to +/-180.<br>Use (-2^31) as an "error" indicator.<br>Optional (but recommended). | Degrees [-180..+180] | int32 | 4 | O |

## 8.82 Tag 82: Corner Latitude Point 1 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude for upper left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -10.528728379108287 Degrees | 52 | 04 | F106 9B63 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.07.01.00 (CRC 23392) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.82.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 39). Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

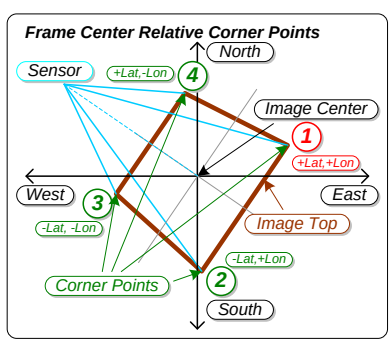


**Figure 39: Offset Corner Point 1 (Corner Point 1 highlighted in red)**

## 8.83 Tag 83: Corner Longitude Point 1 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude for upper left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 29.161550376960857 Degrees | 53 | 04 | 14BC B2C0 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0B.01.00 (CRC 11777) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.83.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

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

## 8.84 Tag 84: Corner Latitude Point 2 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude for upper right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -10.546048887183977 Degrees | 54 | 04 | F100 4D00 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.08.01.00 (CRC 30545) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.84.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 40). Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

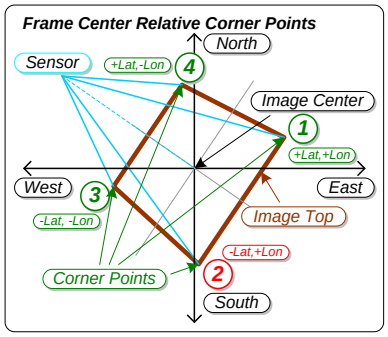


**Figure 40: Offset Corner Point 2 (Corner Point 2 highlighted in red)**

## 8.85 Tag 85: Corner Longitude Point 2 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude for upper right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 29.171550376960860 Degrees | 55 | 04 | 14BE 84C8 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0C.01.00 (CRC 43921) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.85.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

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

## 8.86 Tag 86: Corner Latitude Point 3 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude for lower right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -10.553450810972622 Degrees | 56 | 04 | F0FD 9B17 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.09.01.00 (CRC 16481) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.86.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 41). Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

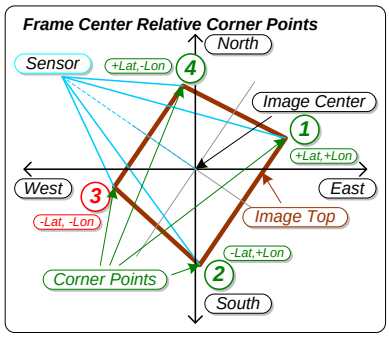


**Figure 41: Offset Corner Point 3 (Corner Point 3 highlighted in red)**

## 8.87 Tag 87: Corner Longitude Point 3 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude for lower right corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 29.152729868885170 Degrees | 57 | 04 | 14BB 17AF |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0D.01.00 (CRC 40097) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.87.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

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

## 8.88 Tag 88: Corner Latitude Point 4 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame latitude for lower left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{180}{0\mathrm{xFFFFFFFE}} * \mathrm{LS}\right) = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -10.541326455319641 Degrees | 58 | 04 | F102 052A |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0A.01.00 (CRC 6449) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.88.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair (see Figure 42). Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

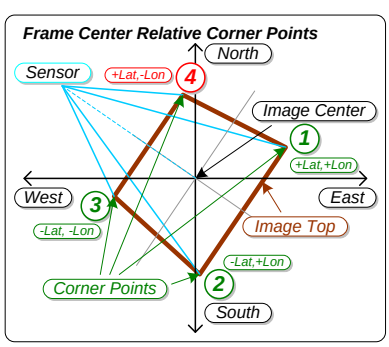


**Figure 42: Offset Corner Point 4 (Corner Point 4 highlighted in Red)**

## 8.89 Tag 89: Corner Longitude Point 4 (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Frame longitude for lower left corner | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "N/A (Off-Earth)" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 29.145729868885170 Degrees | 59 | 04 | 14B9 D176 |

| KLV Key | 06.0E.2B.34.01.01.01.03.07.01.02.01.03.0E.01.00 (CRC 50673) |
|---|---|

- Full Range
- Based on WGS84 ellipsoid
- Map -((2^31)-1)..(2^31)-1 to +/-180
- See Requirement ST 0601.13-28 when the location moves beyond the surface of the earth.

### 8.89.1 Details

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 MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tags 82-89) being favored as per Section 6.1.

The corner points of a captured image or image sequence have real earth coordinates represented by a latitude-longitude pair. Corner points that lie above the horizon typically do not correspond to a point on the earth and are reported using the special value "N/A (Off-Earth)."

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

## 8.90 Tag 90: Platform Pitch Angle (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Aircraft pitch angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{180}{0\mathrm{xFFFFFFFE}} * \mathrm{LS}\right) = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -0.43152510208614414 Degrees | 5A | 04 | FF62 E2F2 |

| KLV Key | 06.0E.2B.34.01.01.01.07.07.01.10.01.05.00.00.00 (CRC 51059) |
|---|---|

- Angle between longitudinal axis and horizontal plane. Positive angles above horizontal plane
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.90.1 Details

For legacy purposes, both range-restricted (Tag 6) and full-range (Tag 90) representations of Platform Pitch Angle MAY appear in the same MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tag 90) being favored as per Section 6.1.

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 (see Figure 43).

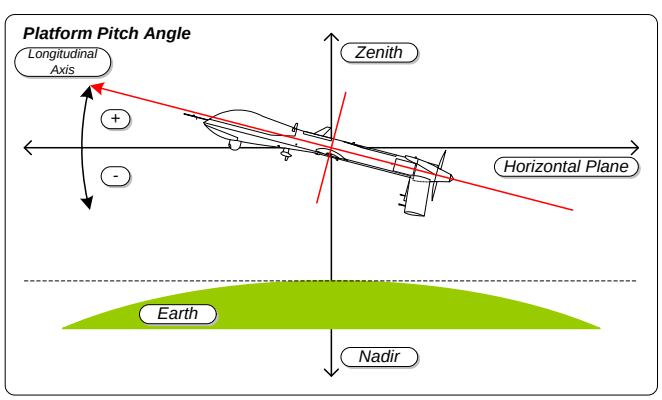


**Figure 43: Platform Pitch Angle**

## 8.91 Tag 91: Platform Roll Angle (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Platform roll angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 3.4058139815022304 Degrees | 5B | 04 | 04D8 04DF |

| KLV Key | 06.0E.2B.34.01.01.01.07.07.01.10.01.04.00.00.00 (CRC 45511) |
|---|---|

- Angle between transverse axis and transverse-longitudinal plane.
- Positive angles for lowered right wing
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.91.1 Details

For legacy purposes, both range-restricted (Tag 7) and full-range (Tag 91) representations of Platform Roll Angle MAY appear in the same MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tag 91) being favored as per Section 6.1.

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 (see Figure 44).

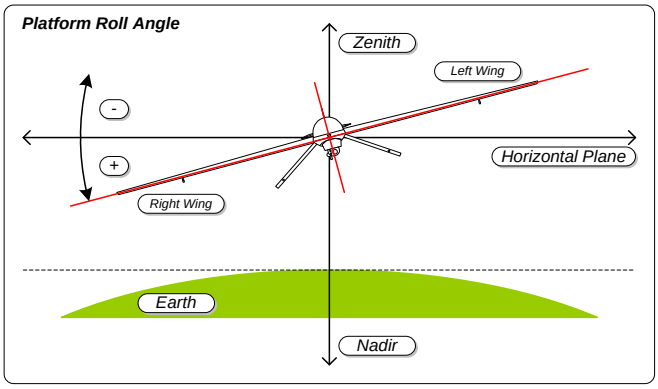


**Figure 44: Platform Roll Angle**

## 8.92 Tag 92: Platform Angle of Attack (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Platform attack angle | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -90 | 90 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~42 nano degrees | 0x80000000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{180}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{180}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -8.6701769841230370 Degrees | 5C | 04 | F3AB 48EF |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.02.00.00.00 (CRC 51963) |
|---|---|

- Angle between platform longitudinal axis and relative wind
- Positive angles for upward relative wind
- Map -((2^31)-1)..(2^31)-1 to +/-90
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.92.1 Details

For legacy purposes, both range-restricted (Tag 50) and full-range (Tag 92) representations of Platform Angle of Attack MAY appear in the same MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tag 92) being favored as per Section 6.1.

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 Figure 45.

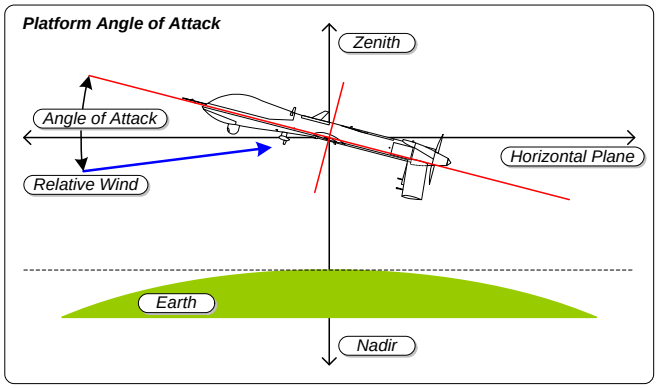


**Figure 45: Platform Angle of Attack**

## 8.93 Tag 93: Platform Sideslip Angle (Full)

| Description | | | | | |
|---|---|---|---|---|---|
| Angle between the platform longitudinal axis and relative wind | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | -180 | 180 | |
| | **KLV** | int32 | -((2^31)-1) | (2^31)-1 | None |

| Length | Max Length | Required Length |
|---|---|---|
| 4 | 4 | 4 |

| Resolution | Special Values |
|---|---|
| ~84 nano degrees | 0x80000000 = "Out of Range" indicator |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \left(\frac{4294967294}{360}\right) * \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \left(\frac{\mathrm{LS_{range}}}{\mathrm{int_{range}}}\right) * \mathrm{KLV_{int}} = \left(\frac{360}{4294967294}\right) * \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -47.683 Degrees | 5D | 04 | DE17 9323 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.04.00.00.00 (CRC 60770) |
|---|---|

- Full Range
- Positive angles to right wing, neg to left
- Map -((2^31)-1)..(2^31)-1 to +/-180
- See Requirement ST 0601.13-27 when the value is not within the specified KLV min/max range.

### 8.93.1 Details

For legacy purposes, both range-restricted (Tag 52) and full-range (Tag 93) representations of Platform Sideslip Angle MAY appear in the same MISB ST 0601 packet. A single representation is preferred, with the full-range version (Tag 93) being favored as per Section 6.1.

The angle formed between the platform longitudinal axis (line made by the fuselage) and the relative wind is the sideslip angle. Figure 46 illustrates a negative sideslip angle.

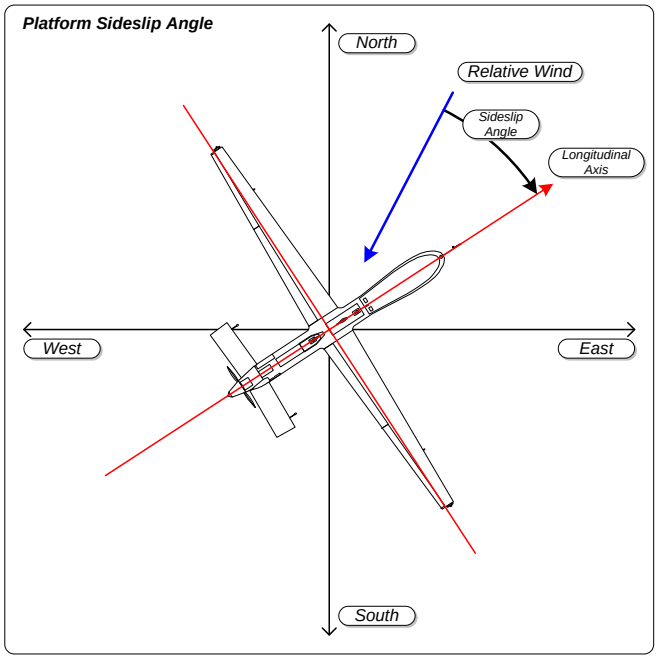


**Figure 46: Platform Sideslip Angle**

## 8.94 Tag 94: MIIS Core Identifier

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1204 MIIS Core Identifier binary value | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | byte | N/A | N/A | |
| | **KLV** | byte | N/A | N/A | None |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | 50 | N/A |

| **Resolution** | **Special Values** |
|---|---|
| N/A | N/A |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1204 |
| **KLV Value To Software Value** | See MISB ST 1204 |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 0170:F592-F023-7336-4AF8-AA91-62C0-0F2E-B2DA/ 16B7-4341-0008-41A0-BE36-5B5A-B96A-3645:D3 (Text version of a Core ID with Physical Sensor ID and Virtual Platform ID – see MISB ST 1204 for explanation) | 5E | 22 | 0170 F592 F023 7336 4AF8 AA91 62C0 0F2E B2DA 16B7 4341 0008 41A0 BE36 5B5A B96A 3645 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.04.05.03.00.00.00 (CRC 30280) |

- Use according to the rules and requirements defined in ST 1204

### 8.94.1 Details

The MIIS Core Identifier allows users to include the MIIS Core Identifier (MISB ST 1204 [16]) Binary Value (opposed to the text-based representation) within MISB ST 0601. Tag 94's value does not include MISB ST 1204's 16-byte Key or length, only the value portion.

See MISB ST 1204 [16] for generation and usage requirements.

## *8.95 Tag 95: SAR Motion Imagery Local Set*

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1206 SAR Motion Imagery Metadata Local Set metadata items | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | Not Limited | N/A |

| **Resolution** | **Special Values** |
|---|---|
| N/A | N/A |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1206 |
| **KLV Value To Software Value** | See MISB ST 1206 |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| N/A | 5F | - | N/A |

| **KLV Key** | 06.0E.2B.34.02.0B.01.01.0E.01.03.03.0D.00.00.00 (CRC 54900) |
|---|---|

- Use according to the rules and requirements defined in MISB ST 1206

### 8.95.1 Details

The SAR Motion Imagery Local Set item allows users to include the SAR Motion Imagery Metadata (MISB ST 1206) within MISB ST 0601. The SARMI metadata set allows users to exploit both sequential synthetic aperture radar (SAR) imagery and sequential SAR coherent change products as Motion Imagery.

See MISB ST 1206 [17] for generation and usage requirements.

## 8.96 Tag 96: Target Width Extended

| Description | | | | | |
|---|---|---|---|---|---|
| Target width within sensor field of view | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | 0 | 1,500,000 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 8 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 64 meters<br>3 bytes = 0.25 meters | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(0, 1500000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(0, 1500000, \mathrm{Length}, \mathrm{KLV_{Val}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 13,898.5463 Meters | 60 | 03 | 00D9 2A |

| KLV Key | 06.0E.2B.34.01.01.01.01.07.01.09.02.01.00.00.00 (CRC 60350) |
|---|---|

- Range of 0 to 1,500,000 m established as maximum distance visible from an altitude of 40,000 m
- To be consistent with Tag 22 Target Width, recommend a length of 3 bytes which provides ~0.25 meters of resolution

### 8.96.1 Details

For legacy purposes, both distance-restricted (Tag 22) and extended (Tag 96) representations of Target Width MAY appear in the same MISB ST 0601 packet. A single representation is preferred, with the extended version (Tag 96) being favored as per Section 6.1.

The target width is the linear ground distance between the center of both sides of the captured image. Refer to Figure 47. As Target Width (Tag 22) limits the distance to 10,000 meters, this limit is no longer sufficient to support current capabilities. Target Width Extended is intended to allow for the maximum viewable distance from an altitude of 40,000 meters which is sufficient for all airborne UAS systems.

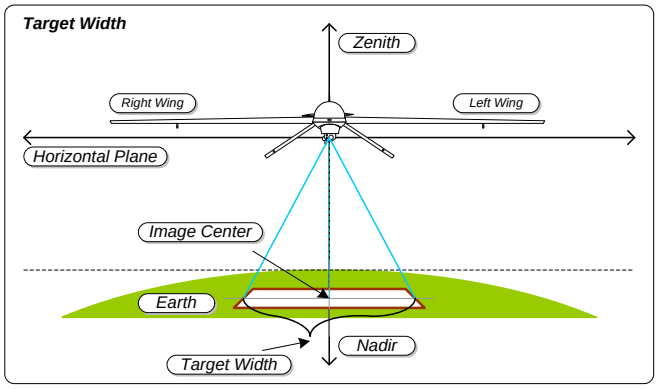


**Figure 47: Target Width**

## 8.97 Tag 97: Range Image Local Set

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1002 Range Imaging Local Set metadata items | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1002 |
| **KLV Value To Software Value** | See MISB ST 1002 |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| N/A | 61 | - | N/A |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.0B.01.01.0E.01.03.03.0C.00.00.00 (CRC 41152) |

- See Details

### 8.97.1 Details

The Range Image Local Set item allows users to include the Range Image LS (MISB ST 1002 [18]) within MISB ST 0601. Range Motion Imagery is a temporal sequence of range images. Each range image is a collection of range measurements from a sensor to target scene. A range measurement is the distance (e.g., meters) from an object (or area) in the scene to the sensor. The KLV structures of this standard are intended to allow for flexibility, efficient packing, and future extensions. Range Motion Imagery can be used standalone, or in collaboration with other Motion Imagery.

See MISB ST 1002 [19] for generation and usage requirements.

## *8.98 Tag 98: Geo-Registration Local Set*

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1601 Geo-Registration Local Set metadata items | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | Not Limited | N/A |

| **Resolution** | **Special Values** |
|---|---|
| N/A | N/A |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1601 |
| **KLV Value To Software Value** | See MISB ST 1601 |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| N/A | 62 | - | N/A |

| **KLV Key** | 06.0E.2B.34.02.0B.01.01.0E.01.03.03.01.00.00.00 (CRC 39238) |
|---|---|

- See Details

### 8.98.1 Details

The Geo-Registration Local Set item allows users to include the Geo-Registration Local Set (MISB ST 1601 [20]) within the UAS Datalink LS. MISB ST 1601 supports the identification of a geo-registration algorithm and standard deviations and correlation coefficients output from a geo-registration process.

See MISB ST 1601 for generation and usage requirements.

## 8.99 Tag 99: Composite Imaging Local Set

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1602 Composite Imaging Local Set metadata items | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1602 |
| **KLV Value To Software Value** | See MISB ST 1602 |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| N/A | 63 | - | N/A |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.0B.01.01.0E.01.03.03.02.00.00.00 (CRC 666) |

- See Details

### 8.99.1 Details

The Composite Imaging Local Set item supports the composition of several Motion Imagery source images into one composite Motion Imagery image. Such use cases include: tiled images, picture-in-picture, stacked images, and blended images. The composition is destructive, where background image information replaces foreground image information.

See MISB ST 1602 [21] for generation and usage requirements.

## 8.100 Tag 100: Segment Local Set

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1607 Segment Local Set metadata items, used to enable metadata sharing | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | Yes |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1607 |
| **KLV Value To Software Value** | See MISB ST 1607 |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| N/A | 64 | - | N/A |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.0B.01.01.0E.01.03.03.03.00.00.00 (CRC 29742) |

- See Details

### 8.100.1 Details

The principles underlying the Segment LS construct are found in the Motion Imagery Handbook; MISB ST 1607 [12] defines its rules of usage. At a high level, consider a UAS Datalink LS as consisting of a parent set of tags, and one or more child sets of tags. Segment LS enables use of MISB ST 0601 tags at the parent level, and reuse of the same tags – possibly and likely with different tag values – or other tags not specified at the parent level or at the child level, effectively adding tags with new values. A use of a tag at the parent level is applicable across the MISB ST 0601 set, whereas use of the same tag within the Segment LS signals its use as restricted to the purpose indicated by other tags present within the Segment LS. For example, a Tag 94 MIIS Core Identifier at the parent level applies to the entire Motion Imagery frame; a Tag 94 within a Segment LS may apply to a second senor image overlay and its specific sensor MIIS Core Identifier.

In cases where the MISB ST 0902 [22] mandatory set of tags (which are a subset of MISB ST 0601) are distributed between a parent/child set, the MISP requirement for the MISB ST 0902 set is still satisfied.

It is incumbent on the system implementer to meet all required metadata items for conformance, such as MISB ST 0902 metadata, regardless of whether the items are present in a parent or a child set.

## 8.101 Tag 101: Amend Local Set

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1607 Amend Local Set metadata items, used to provide metadata corrections | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | set | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | Yes |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1607 |
| **KLV Value To Software Value** | See MISB ST 1607 |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| N/A | 65 | - | N/A |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.0B.01.01.0E.01.03.03.03.01.00.00 (CRC 17182) |

- See Details

### 8.101.1 Details

In applying the Amend Local Set, it is best to take the perspective of the receiver of the data. Described in Section 6.3.3 is the concept of nesting a Local Set within a MISB ST 0601 Local Set.

The principles underlying the Amend LS construct are found in the Motion Imagery Handbook; MISB ST 1607 [12] defines it rules for usage; an application of its use is found in MISB ST 1601 [20]. At a high level, consider a UAS Datalink LS as consisting of a parent set of tags, and one or more child sets of tags. Amend LS enables use of MISB ST 0601 tags at the parent level, and reuse of the same tags – possibly and likely with different tag values – or other tags not specified at the parent level at the child level, effectively adding tags with new values. A use of a tag at the parent level is applicable across the MISB ST 0601 LS, whereas use of the same tag within the Amend LS signals its use as restricted to the purpose indicated by other tags present within the Amend LS. For example, a Tag 13 Sensor Latitude at the parent level may also be at a child level, but with a different value. A receiver can choose either value to complete a MISB ST 0601 set. In effect, the value of a tag can be changed for the same tag.

Metadata originating at its source is always maintained and never discarded. Values which “replace” existing values are basically “added” to the overall MISB ST 0601 metadata stream.

## 8.102 Tag 102: SDCC-FLP

| Description | | | | | |
|---|---|---|---|---|---|
| MISB ST 1010 Floating Length Pack (FLP) metadata item, providing Standard Deviation and Cross Correlation (SDCC) metadata | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | flp | N/A | N/A | N/A |
| **Length** | | **Max Length** | | **Required Length** | |
| Variable | | Not Limited | | N/A | |
| **Resolution** | | **Special Values** | | | |
| N/A | | N/A | | | |
| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | Yes |

| | |
|---|---|
| **Software Value To KLV Value** | See MISB ST 1010 |
| **KLV Value To Software Value** | See MISB ST 1010 |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| N/A | 66 | - | N/A |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.05.01.01.0E.01.03.03.21.00.00.00 (CRC 64882) |

- See Details

### 8.102.1 Details

In applying the SDCC-FLP item, it is advised to review the usage of the SDCC-FLP (Standard Deviation Correlation Coefficient Floating Length Pack) construct presented in MISB ST 1010 [10]. The allowed metadata items from MISB ST 0601 for use in the SDCC-FLP are denoted with a "Y" in the MISB ST 0601 Table 1 column labeled SDCC FLP.

The SDCC defines a compact structure for two data lists: Standard Deviation and Cross Correlation values. The data type and size for each list must be self-consistent; all Standard Deviation values must be the same type and size; all Cross Correlation values must be the same type and size. The type and size of each list can be determined at runtime.

Important: In version 10 of MISB ST 0601 the Standard Deviation values are restricted to IEEE floating point values. Future versions of MISB ST 0601 may allow for the use IMAP values after appropriate limits are defined for each Standard Deviation.

Cross Correlation values may use either IEEE or IMAP types as needed by the system producing the SDCC pack. Each value indicated with a "Y" in the SDCC FLP column of Table 1 can have uncertainty (i.e., standard deviation or sigma, σ) computed or measured information. Additionally, each value can be correlated to any of the other value resulting in a potential correlation coefficient value for that pair of values. Values with no correlation result in a correlation coefficient value of zero for that pair of values.

MISB ST 1010 defines how to package the standard deviation and correlation coefficient values. Per MISB ST 1010, at runtime the list of values with standard deviation values defined constitutes the Refined Source List. The Refined Source List values are written into the UAS

Datalink Local Set immediately followed by the SDCC-FLP, where each row of the SDCC-FLP upper triangular matrix is in the same order as the values just written in the Local Set.

The SDCC-FLP has five defining parameters: Matrix Size, Parse Control, Bit Vector, Standard Deviation Elements (values), and the Correlation Coefficient Elements (values).

#### 8.102.1.1 Matrix Size

The Matrix Size is set to the value of the Refined Source List. This value will be less than or equal to the size of the Source List.

#### 8.102.1.2 Parse Control

UAS Datalink LS only uses the Mode 2 Parse Control mode. Consult MISB ST 1010 for further description of Mode 1 and 2 of the Parse Control.

| Requirement | |
|---|---|
| ST 0601.10-22 | The UAS Datalink Local Set shall only include SDCC-FLPs using Mode 2 Parse Control, as defined in MISB ST 1010. |

Five values in the Mode 2 Parse Control are computed at runtime: $C_s$, $S_f$, $S_{len}$, $C_f$, and $C_{len}$.

- The $C_s$ value indicates the SDCC-FLP uses a sparse representation of the correlation coefficient values.
- The $S_f$ value defines the data format type of the standard deviation values, either IMAP (see MISB ST 1201 [13]) or IEEE Floating Point values. MISB ST 1010 does not allow the mixing of types; therefore, convert all standard deviation values to one type.
- The MISB recommends using four-byte IEEE Floating Point values for standard deviation values.
- The $S_{len}$ value defines the number of bytes each standard deviation value uses. Add more bytes if a system requires greater precision.
- The $C_f$ value defines the data format type of the correlation coefficient values (i.e., either IEEE Floating Point or MISB ST 1201 mapped values).
- The $C_{len}$ value defines the number of bytes for each correlation coefficient value. Systems requiring greater precision can use more bytes.

#### 8.102.1.3 Bit Vector

As discussed in MISB ST 1010 correlation coefficient data can be a sparse matrix. The Bit Vector indicates where to eliminate the zeros in the SDCC-FLP. See MISB ST 1010 Appendix A to determine when to use the Bit Vector. The decision to use the Bit Vector can be made at run time.

#### 8.102.1.4 Standard Deviation Values

The standard deviation values in IEEE Floating Point and included in the SDCC-FLP in the same order of the Refined Source List.

#### 8.102.1.5 Correlation Coefficient Values

The correlation coefficient values converted to the desired data format, either IEEE Floating Point or MISB ST 1201 mapped values, and included in the SDCC-FLP. The rows and columns of the correlation coefficient matrix are in the same order as the Refined Source List.

## 8.103 Tag 103: Density Altitude Extended

| Description | | | | | |
|---|---|---|---|---|---|
| Density altitude above MSL at aircraft location | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | -900 | 40000 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 8 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-900, 40000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-900, 40000, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 23,456.24 Meters | 67 | 03 | 2F92 1E |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.10.00.00.00 (CRC 15412) |
|---|---|

- Relative aircraft performance metric based on outside air temperature, static pressure, and humidity
- Max Altitude: 40,000m for airborne systems
- For resolution < 1.0m, a length of >= 3 bytes is required

### 8.103.1 Details

For legacy purposes, both range restricted (Tag 38) and range extended (Tag 103) representations of Density Altitude MAY appear in the same MISB ST 0601 packet. A single representation is preferred, with the range extended version (Tag 103) being favored as per Section 6.1.

The purpose of Density Altitude Extended is to increase the range of altitude values currently defined in Tag 38 Density Altitude to support all CONOPs for airborne systems.

## 8.104 Tag 104: Sensor Ellipsoid Height Extended

| Description | | | | | |
|---|---|---|---|---|---|
| Sensor ellipsoid height extended as measured from the reference WGS84 ellipsoid | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | -900 | 40000 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 8 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 2 meters<br>3 bytes = 78.125 mm | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-900, 40000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-900, 40000, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 23,456.24 Meters | 68 | 03 | 2F92 1E |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.02.01.82.47.00.00 (CRC 16670) |
|---|---|

- Max Altitude of 40,000m for airborne systems
- For resolution < 1.0m, a length of >= 3 bytes is required

### 8.104.1 Details

For legacy systems, Tag 15 and Tag 75 | Tag 104 are allowed with preference for Tag 75 | Tag 104.

The purpose of Sensor Ellipsoid Height Extended is to increase the range of altitude values currently defined in Tag 75 Sensor Ellipsoid Height to support all CONOPs for airborne systems.

## 8.105 Tag 105: Alternate Platform Ellipsoid Height Extended

| Description | | | | | |
|---|---|---|---|---|---|
| Alternate platform ellipsoid height extended as measured from the reference WGS84 ellipsoid | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | -900 | 40000 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | 8 | N/A |

| **Resolution** | **Special Values** |
|---|---|
| 2 bytes = 2 meters<br>3 bytes = 78.125 mm | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-900, 40000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-900, 40000, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 23,456.24 Meters | 69 | 03 | 2F92 1E |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.02.01.82.48.00.00 (CRC 27951) |
|---|---|

- Max Altitude of 40,000m set for airborne systems
- For resolution < 1.0m, a length of >= 3 bytes is required

### 8.105.1 Details

For Legacy systems, Tag 69 and Tag 76 | Tag 105 are allowed with preference for Tag 76 | Tag 105.

The purpose of Alternate Platform Ellipsoid Height Extended is to increase the range of altitude values currently defined in Tag 76 Alternate Platform Ellipsoid Height to support all CONOPs for airborne systems.

## 8.106 Tag 106: Stream Designator

| Description | | | | | |
|---|---|---|---|---|---|
| A second designation given to a sortie | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| BLUE | 6A | 04 | 424C 5545 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) |
|---|---|

- Stream Designator represents a shorthand descriptor for a particular Motion Imagery data stream, typically delivered over IP (Internet Protocol)
- Stream designator is typically tied to the IP of a particular GCS. This is primarily a USAF designator. (example – feed color of Blue)

## 8.107 Tag 107: Operational Base

| Description | | | | | |
|---|---|---|---|---|---|
| Name of the operational base hosting the platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{Val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| BASE01 | 6B | 06 | 4241 5345 3031 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) |

- Operational Base indicates the location for the Launch Recovery Equipment (LRE)

## 8.108 Tag 108: Broadcast Source

| Description | | | | | |
|---|---|---|---|---|---|
| Name of the source, where the Motion Imagery is first broadcast | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{utf8}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| HOME | 6C | 04 | 484F 4D45 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) |

- Broadcast Source is the location (i.e., airbase) for where the Motion Imagery originates or is first broadcast
- Example - Creech, Cannon, etc.

## 8.109 Tag 109: Range To Recovery Location

| Description | | | | | |
|---|---|---|---|---|---|
| Distance from current position to airframe recovery position | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| KM | **Software** | float32 | 0 | 21000 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 1 KM<br>3 bytes = 3.9 meters<br>4 bytes = 1.525 cm | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(0{,}21000, \mathrm{Length}, \mathrm{Soft_{val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(0{,}21000, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 1.625 KM | 6D | 03 | 0001 A0 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.30.00.00.00 (CRC 2938) |

- None

### 8.109.1 Details

The Range To Recovery Location is the minimum distance from the current aircraft position to the aircraft recovery position. The distance is computed over the surface of the earth at the given altitude of the aircraft (i.e., not a straight-line distance potentially through the earth). The furtherst distance is a point on the opposite side of the earth, at the given altitude.

The maximum value for the IMAPB computation results from the recovery location on the opposite side of the earth from the aircraft flying at the maximum altitude of 40,000 m. The largest radius of the ellipsoid earth is at the equator, with the WGS84 radius equal to 6,378,137.0 m. This radius plus the maximum altitude is 6,418,137 meters, which equals r. Half the circumference, C, of a circle with this radius is the maximum value.

$$C = 2\pi r = 2 * 6{,}418{,}137 * \pi = 40{,}326{,}344$$

$$\frac{1}{2}C = 20{,}163{,}172$$

This value is rounded up to 21 million meters or 21,000 Km.

## 8.110 Tag 110: Time Airborne

| Description | | | | | |
|---|---|---|---|---|---|
| Number of seconds aircraft has been airborne | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Seconds (s) | **Software** | uint32 | 0 | 2^32-1 | |
| | **KLV** | uint | 0 | 2^32-1 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 1 second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 19887 seconds (05:31:27) | 6E | 02 | 4DAF |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.31.00.00.00 (CRC 32206) |
|---|---|

- This item is related to the "Take-Off Time" (Tag 131)
- Suggest using "Time airborne" (Tag 110) or "Take-Off Time" (Tag 131) but not both in the same MISB ST 0601 Local Set

### 8.110.1 Details

Time Airborne is a continual count of the number of seconds since the aircraft took off from the ground (or ship). The Take-Off time (Tag 131) is the timestamp indicating when the aircraft became airborne. The Time Airborne and Take-Off Time are related mathematically using the Precision Time Stamp (Tag 2), so the Local Set needs only one of these items to compute the other.

To compute the Time Airborne ($T_{Air}$) from the Take-Off Time ($T_{Takeoff}$) and the current Precision Time Stamp ($T_{Precision}$) use Equation 3.

$$T_{Air} = Round\left[\frac{T_{Precision} - T_{Takeoff}}{1000000}\right] \qquad \text{Equation 3}$$

To compute the Take-Off Time ($T_{Takeoff}$) from the Time Airborne ($T_{Air}$) and the Precision Time Stamp ($T_{Precision}$) use Equation 4.

$$T_{Takeoff} = T_{Precision} - (T_{Air} * 1000000) \qquad \text{Equation 4}$$

The Time Airborne value supports flight times up to $2^{32}$-1 seconds or 136 years.

## 8.111 Tag 111: Propulsion Unit Speed

| Description | | | | | |
|---|---|---|---|---|---|
| The speed the engine (or electric motor) is rotating at | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Revolutions Per Minute (RPM) | **Software** | uint32 | 0 | (2^32)-1 | |
| | **KLV** | uint | 0 | (2^32)-1 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 1 revolution/minute | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 3000 revolutions per minute | 6F | 02 | 0BB8 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.32.00.00.00 (CRC 58898) |

- RPMs can apply to combustion engine or electric motor propelling the aircraft
- With multi-rotor aircraft, use an average or other representative value

## 8.112 Tag 112: Platform Course Angle

| Description | | | | | |
|---|---|---|---|---|---|
| Direction the aircraft is moving relative to True North | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees (°) | **Software** | float64 | 0 | 360 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | 8 | N/A |

| **Resolution** | **Special Values** |
|---|---|
| 2 bytes = 16.625 milli-degrees | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(0{,}360, \mathrm{Length}, \mathrm{Soft_{val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(0, 360, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 125 degrees | 70 | 02 | 1F40 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.33.00.00.00 (CRC 37030) |
|---|---|

- Length is variable based on users desired accuracy
- 0 (or 360) is true north, east is 90, south is 180, west is 270

### 8.112.1 Details

The Platform Course is the direction the platform is moving (not necessarily the direction the platform is pointing). The "course" is illustrated in Figure 48 in red; the UAS is pointed southwest (Tag 5 – Platform Heading Angle), the wind is from the west-northwest (to the east southeast) (Tag 35 – Wind Direction) – the platform's "course" is moving to the south east. Other directional tags are the Platform Magnetic Heading (Tag 64) and Platform Side Slip Angle (Full) (Tag 52). Platform Course is directly measurable by on-board navigation or estimated computationally by comparing the last known position to current position.

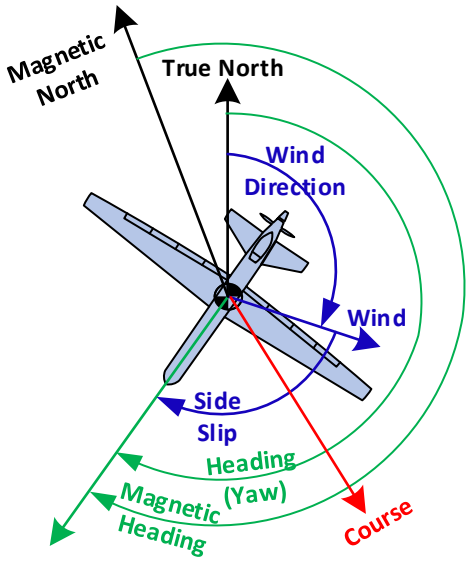


**Figure 48: Platform Course compared to other directional data.**

## 8.113 Tag 113: Altitude AGL

| Description | | | | | |
|---|---|---|---|---|---|
| Above Ground Level (AGL) height above the ground/water | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | -900 | 40000 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 2.0 meters<br>3 bytes = 0.7 cm | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-900{,}40000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-900{,}40000, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 2150 meters | 71 | 03 | 05F5 00 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.34.00.00.00 (CRC 49547) |
|---|---|

- Max Altitude of 40,000m for airborne systems

### 8.113.1 Details

Altitude - AGL (Above Ground Level) is the distance measured from the ground (or terrain) to the aircraft. Different devices and techniques measure altitude using different reference points, as illustrated in Figure 49.

Height Above Ellipsoid altitude is the distance from the WGS84 Ellipsoid and the aircraft. Mean Sea Level (MSL) altitude is the distance from the WGS84 Geoid and the aircraft. Density altitude is a computational value using air pressure and temperature.

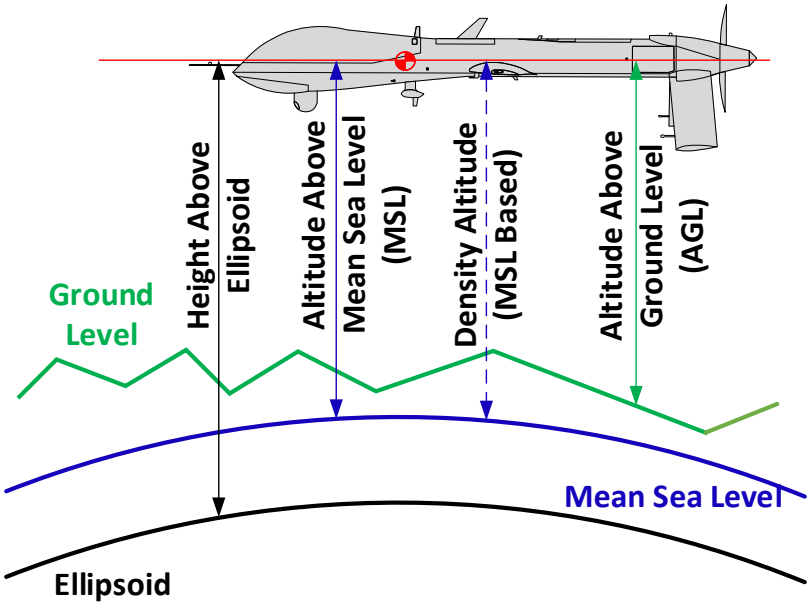


**Figure 49: Comparison of HAE, Altitude MSL, Density Altitude and Altitude AGL**

## 8.114 Tag 114: Radar Altimeter

| Description | | | | | |
|---|---|---|---|---|---|
| Height above the ground/water as reported by a RADAR altimeter | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Meters (m) | **Software** | float64 | -900 | 40000 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 2.0 meters<br>3 bytes = 0.7 cm | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-900{,}40000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-900{,}40000, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 2154.50 meters | 72 | 03 | 05F7 40 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.01.35.00.00.00 (CRC 46911) |
|---|---|

- Max Altitude of 40,000m for airborne systems
- Radar Altimeter height is AGL, see Tag 113 for AGL definition

## 8.115 Tag 115: Control Command

| Description | | | | | |
|---|---|---|---|---|---|
| Record of command from GCS to Aircraft | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | dlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | N/A | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | Yes |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 5, "Fly to Waypoint 1" | 73 | 13 | 0511 466C 7920 746F 2057 6179 706F 696E 7420 31 |

| KLV Key | 06.0E.2B.34.02.05.01.01.0E.01.03.01.01.00.00.00 (CRC 36543) |
|---|---|

- A copy of the command and control values used to request platform/sensor to perform an action
- Tag 116 uses the Command ID to signal validation
- Command is a "string" format defined by platform vendor
- Control Command Verification (Tag 116) shows acknowledgement of the command

### 8.115.1 Details

The purpose of the Control Command (Tag 115) and Command Acknowledgement (Tag 116) items are to report the commands issued to the platform/sensor and the acknowledgement of those commands. The Control Command defines a command ID and the command string which describes the command or action to perform. At some later time, the command is acknowledged by the platform and Tag 116 records the acknowledgement, by just restating the Command ID. Figure 50 provides an illustration of the data flow where the GCS issues a command (A) to the platform and at the same time records the command with a Command ID (#5) in the metadata stream. The platform receives and acknowledges the command (B) by sending some form of acknowledgement to the GCS. The GCS matches the Command ID with the original command and records the acknowledgement of the command in the KLV.

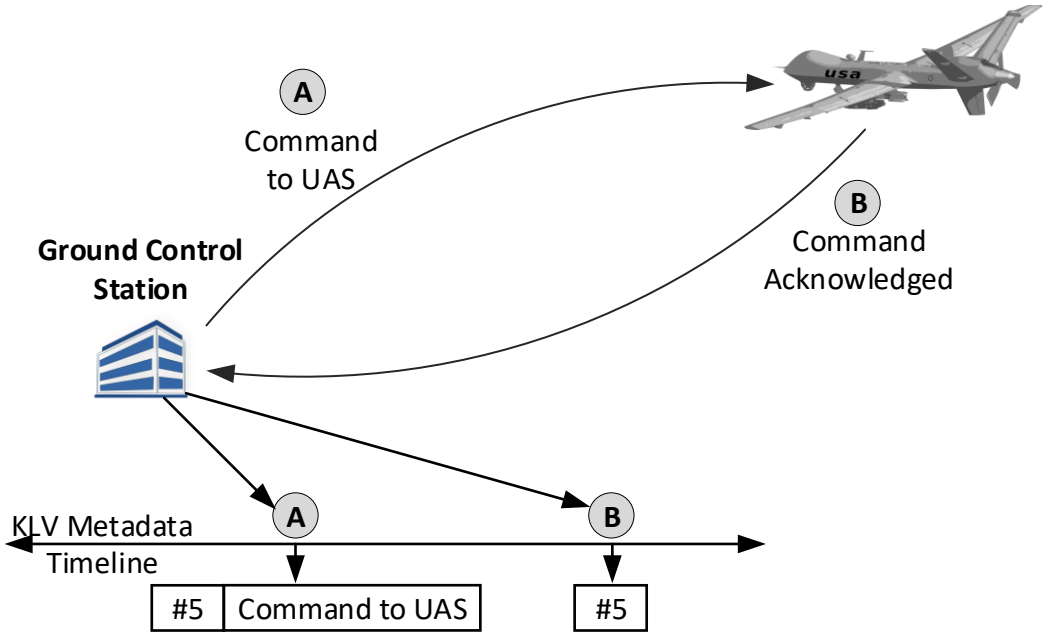


**Figure 50: Control Command Usage**

This Control Command value has four components combined into a KLV Pack: Command ID, Command String Length, Command String and Command Time.

The Command ID is a BER-OID integer value to track the command. This is an increasing and unique number assigned to each command as it is issued. Tag 116 uses the command ID to show the command acknowledgement.

The Command String Length encodes the length of the Command String in BER short or long form.

The Command String is a utf8 value which describes the command. This string has a maximum length of 127 characters. The format and content of the string is vendor defined.

The Command Time is the Precision Time Stamp when first issuing the command to the platform. Item 115 is repeatable to meet Report-on-Change requirements (i.e., updates every 30 seconds) before item 116 acknowledges the Command. On the first use of item 115, for a specific Command ID, the Command Time defaults to the Precision Time Stamp of the packet. On subsequent repeats of the item, systems can optionally include the Command Time from the first use of the Command Pack for the specific Command ID.

Combining the Command ID, Command String, and the optional Command Time forms the pack structure, as shown in Figure 51.

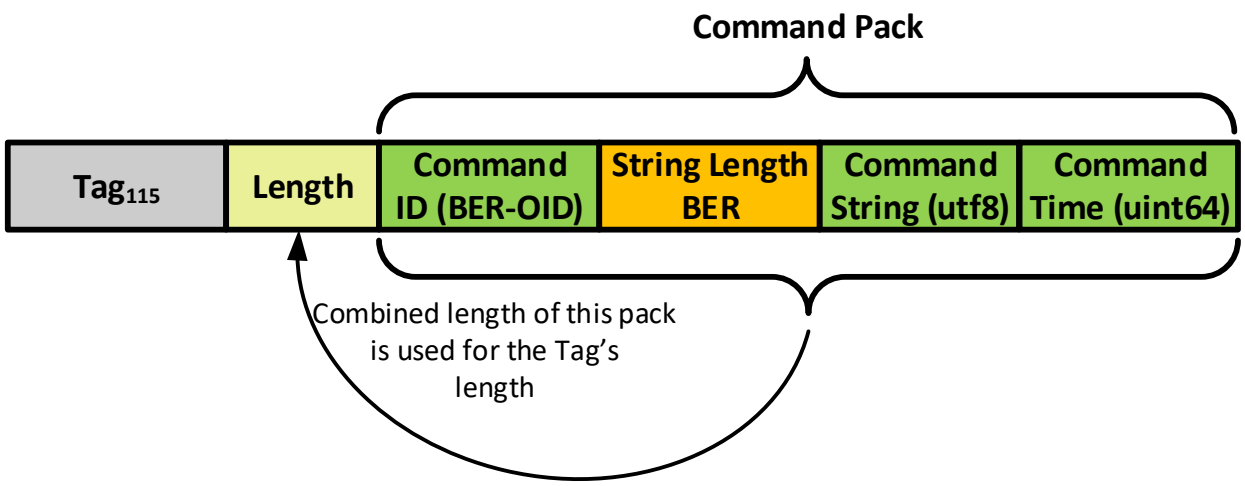


**Figure 51: Command Pack**

Table 7 lists the KLV Universal Labels (UL) for the values defined in the Command Pack. The Tag 115 summary table defines the Command Pack UL.

**Table 7: Universal Labels for Command Pack values**

| Key | Name | Type | Len | M/O |
|---|---|---|---|---|
| 06.0E.2B.34.01.01.01.01.0E.01.01.01.36.00.00.00 (CRC 11491) | Command ID | uint (BER-OID) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) | Command String | utf8 | v | M |
| 06.0E.2B.34.01.01.01.03.07.02.01.01.01.05.00.00 (CRC 64827) | Command Time | uint64 | 8 | O |

## 8.116 Tag 116: Control Command Verification List

| Description | | | | | |
|---|---|---|---|---|---|
| Acknowledgement of one or more control commands were received by the platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | list | N/A | N/A | |
| | **KLV** | dlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | N/A | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| Verification of command 3 and 7 | 74 | 02 | 0307 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.05.01.01.0E.01.03.02.11.00.00.00 (CRC 31690) |

- Records validation of control commands recorded in Tag 115
- See Tag 115 details for description of how this item is used

### 8.116.1 Details

The Control Command Verification List is a variable length pack of one or more BER-OID values. Each value is a verification or acknowledgement of a Control Command sent to the platform – see Tag 115 for more details.

As illustrated in Figure 52, the Local Set item consists of the tag, followed by the Length and then one or more BER-OID Control Command Verification Identifiers from Tag 115.

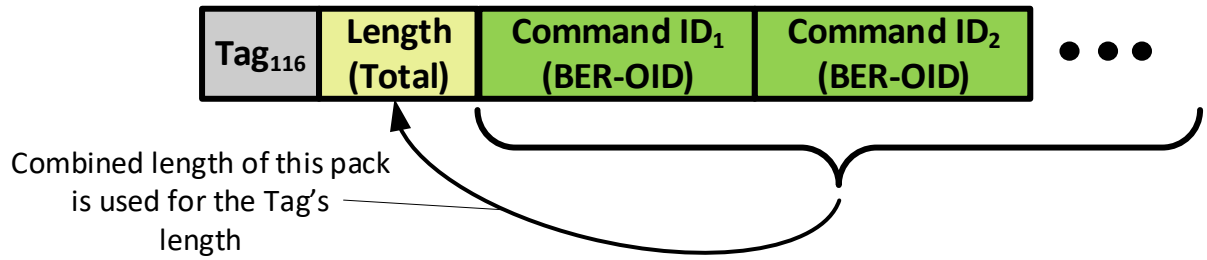


**Figure 52: Control Command Verification List VLP**

## 8.117 Tag 117: Sensor Azimuth Rate

| Description | | | | | |
|---|---|---|---|---|---|
| The rate the sensors azimuth angle is changing | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees Per Second (dps) | **Software** | float32 | -1000.0 | 1000.0 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 0.0625 degrees/second<br>3 bytes = 0.000244 degrees/second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-1000, 1000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-1000.0, 1000.0, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 1 degree/second | 75 | 02 | 3E90 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.09.00.00 (CRC 16251) |
|---|---|

- Uses the same orientation as Sensor Relative Azimuth Angle (Tag 18)
- Refer to Tag 18's diagram: From above the aircraft looking down, when the sensor is moving clockwise the rate is positive and negative when its moving counter-clockwise

## 8.118 Tag 118: Sensor Elevation Rate

| Description | | | | | |
|---|---|---|---|---|---|
| The rate the sensors elevation angle is changing | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees Per Second (dps) | **Software** | float32 | -1000.0 | 1000.0 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 0.0625 degrees/second<br>3 bytes = 0.000244 degrees/second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-1000, 1000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-1000.0, 1000.0, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 0.004176 degrees/second | 76 | 03 | 3E80 11 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.0A.00.00 (CRC 26155) |
|---|---|

- Uses the same orientation as Sensor Relative Elevation Angle (Tag 19)
- Refer to Tag 19's diagram: From the side view of the aircraft shown, when the sensor is moving clockwise the rate is positive and negative when its moving counter-clockwise

## 8.119 Tag 119: Sensor Roll Rate

| Description | | | | | |
|---|---|---|---|---|---|
| The rate the sensors roll angle is changing | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Degrees Per Second (dps) | **Software** | float32 | -1000.0 | 1000.0 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 0.0625 degrees/second<br>3 bytes = 0.000244 degrees/second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | Yes | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(-1000, 1000, \mathrm{Length}, \mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(-1000.0, 1000.0, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| -50 degrees/second | 77 | 02 | 3B60 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.0B.00.00 (CRC 20763) |
|---|---|

- Uses the same orientation as Sensor Relative Roll Angle (Tag 20)
- Refer to Tag 20's description: From behind the sensor, when the sensor is moving clockwise the rate is positive and negative when its moving counter-clockwise

## 8.120 Tag 120: On-board MI Storage Percent Full

| Description | | | | | |
|---|---|---|---|---|---|
| Amount of on-board Motion Imagery storage used as a percentage of the total storage | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Percentage (%) | **Software** | float32 | 0 | 100.0 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 3 | N/A |

| Resolution | Special Values |
|---|---|
| 2 bytes = 0.004 percent<br>3 bytes = 1.5E-5 percent | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(0,100,\mathrm{Length},\mathrm{Soft_{Val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(0,100,\mathrm{Length},\mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 72 % Full | 78 | 02 | 4800 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.0C.00.00 (CRC 54411) |
|---|---|

- Used with "On-board MI Storage Capacity" (Tag 133), if available, to determine remaining recording storage space

## 8.121 Tag 121: Active Wavelength List

| Description | | | | | |
|---|---|---|---|---|---|
| List of wavelengths in Motion Imagery | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | list | N/A | N/A | |
| | **KLV** | dlp | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | Not Limited | N/A |

| **Resolution** | **Special Values** |
|---|---|
| N/A | N/A |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 1,3 (Visible and NIR) | 79 | 02 | 0103 |

| **KLV Key** | 06.0E.2B.34.02.05.01.01.0E.01.03.02.0A.00.00.00 (CRC 32370) |
|---|---|

- Used with Wavelengths List (Tag 128)

### 8.121.1 Details

The Active Wavelength List provides a list of wavelengths used by the sensor to generate the Motion Imagery. This value updates when the sensor changes and the new sensor has a different wavelength than the last sensor used. For example, the sensor changes from a visible light to an infrared sensor. Multiple wavelengths identifiers support multi-band sensors or sensors which fuse multiple wavelength bands.

As illustrated in Figure 53, the Local Set item consists of the tag, followed by the Length and then one or more BER-OID identifiers from the Wavelength List (see Tag 128).

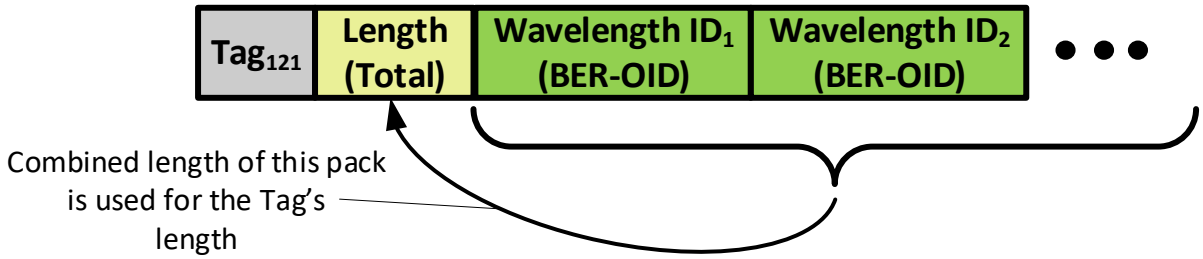


**Figure 53: Illustration of Active Sensor Wavelength List VLP**

The Wavelength ID's are used to reference the sensors wavelength information from the Wavelength table defined in Tag 128.

Figure 54 illustrates three examples of different Active Sensors. The first two are nominal Visible light and IR sensors. The third example shows a blended sensor which uses both Visible light and NIR to form the image.

| | | | | |
|---|---|---|---|---|
| $Tag_{121}$ | 1 | 0x01 | | **Visible Light Sensor** |
| $Tag_{121}$ | 1 | 0x02 | | **Infrared Sensor** |
| $Tag_{121}$ | 2 | 0x01 | 0x03 | **Visible Light blended with Near Wave Infrared (NIR) Sensor** |

**Figure 54: Examples of Active Sensor Wavelength List**

## 8.122 Tag 122: Country Codes

| Description | | | | | |
|---|---|---|---|---|---|
| Country codes which are associated with the platform and its operation | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | vlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| N/A | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| Canada, (Unknown Country), France | 7A | 0B | 010E 0343 414E 0003 4652 41 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.04.01.01.0E.01.03.03.02.00.00.00 (CRC 35241) |

- None

### 8.122.1 Details

The Country Codes item provides country related information about the platform and its operation. The country which own and fly aircraft, along with where the platform is flying, and the country observed in the Motion Imagery scene are all needed information. For example, Country A is flying Country B's UAV over Country C while imaging Country D and Country E performs analysis and classification of the Motion Imagery. There are five country codes of interest: Operator Country, Manufacture Country, Overflight Country, Object Country (Motion Imagery Scene) and Classifying Country. For the example above:

- Operator = Country A
- Manufacture = Country B
- Overflight Country = Country C
- Object Country = Country D
- Classifying country = Country E

Table 8 lists the definitions for each of the different Country Code types.

**Table 8: Country Definitions**

| Function | Description |
|---|---|
| Overflight Country | The country the platform is operating or flying over. This may be different than the country within the scene of the Motion Imagery. |
| Operator Country | Country where the operator is located. For example, a GCS operator. |
| Country of Manufacture | The Country where the platform was manufactured. |
| Object Country | The country within the Motion Imagery scene or the "Object" of the Motion Imagery. **Note: This value is an item in MISB ST 0102 and is not included in this item's country codes list.** |
| Classifying Country | The country which initially analyzes or classified the Motion Imagery. **Note: This value is an item in MISB ST 0102 and is not included in this item's country codes list.** |

The Country Codes item is a four item Variable Length Pack (VLP), which contains: Country Coding Method, Overflight Country Code, Operator Country Code, and Country Code of Manufacture. The first VLP item is the Country Coding Method, an enumeration integer from the list of methods in MISB ST 0102 – Table 2: Security Metadata Local Set Elements, Tag 12. The value indicates how to interpret the country codes specified in the VLP. Each country code is a string (utf8) encoded according to the coding method specified in the first item of the VLP.

Figure 55 illustrates the VLP structure for the item. Construct the Local Set item by first encoding Tag 122 then include the Length (Total) using the BER short or long form method. Next, each of the four length-value pairs follows the Length (Total) in the exact order indicated. Each length-value pair length is encoded using BER short or long form encoding.

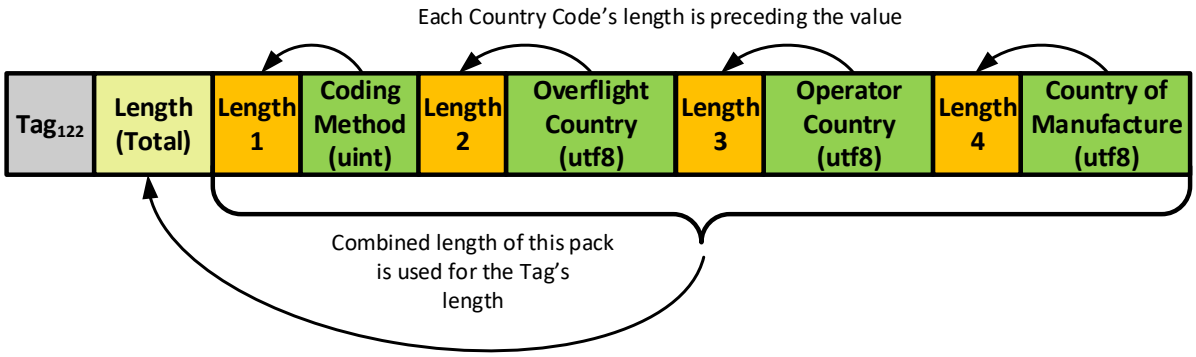


**Figure 55: Illustration of Country Code List VLP**

If one of the country values is unknown, set the length for the country code to zero (0) and do not include the country code string. For example, Figure 56 illustrates the case where the operator country is unknown. Assuming the Coding Method is *GENC three letter*, the Overflight Country is Canada, the Operating Country is unknown (thus the length is set to zero (0)), and the Country Code of Manufacture for the platform is France.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **$Tag_{122}$** | **11** | **1** | **0x0E** | **3** | **CAN** | **0** | **3** | **FRA** |

**Figure 56: Illustration of Unknown Country in VLP**

There are two truncation cases for the VLP: if the Country Code of Manufacture is unknown (since it is the last item in the list), or if both the Operator Country and Country Code of Manufacture are unknown (the last two items in the VLP). When truncating a value, the length-value pair are both removed.

Table 9 lists the KLV Universal Labels (UL) for the values defined in the Country Codes list. The Tag 122 summary table defines the Country Code List UL.

**Table 9: Universal Labels for Country Code List values**

| UL (Key) | Name | Type | Len | M/O |
|---|---|---|---|---|
| 06.0E.2B.34.01.01.01.03.07.01.20.01.02.06.00.00 (CRC 38813) | Coding Method | uint | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) | Overflight Country | utf8 | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) | Operator Country | utf8 | v | O |
| 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) | Country of Manufacture | utf8 | v | O |

## 8.123 Tag 123: Number of NAVSATs in View

| Description | | | | | |
|---|---|---|---|---|---|
| Count of navigation satellites in view of platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| count | **Software** | uint | 0 | 255 | |
| | **KLV** | uint | 0 | 255 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| 1 | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 7 (Satellites) | 7B | 01 | 07 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.0D.00.00 (CRC 58299) |

- Number of satellites used to determine position
- Used with Positioning Method Source (Tag 124) for NAVSAT Types

## 8.124 Tag 124: Positioning Method Source

| Description | | | | | |
|---|---|---|---|---|---|
| Source of the navigation positioning information. (e.g., NAVSAT-GPS, NAVSAT-Galileo, INS) | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint | 1 | 255 | |
| | **KLV** | uint | 1 | 255 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| N/A | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 3 (INS and GPS Positioning) | 7C | 01 | 03 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.0E.00.00 (CRC 47851) |
|---|---|

- A set of flags specifying the source(s) of positioning information
- A value with all bits set to zero does not have meaning and is not allowed

### 8.124.1 Details

The Positioning Method Source is an integer interpreted as a set of bit flags as indicated in Table 10. Bit zero is the Least Significant Bit (LSB).

**Table 10: Position Methods by Bit Location**

| Bit | Type | Name | Country |
|---|---|---|---|
| 0 | INS | On-board Inertial Navigation System | N/A |
| 1 | NAVSAT | GPS | United States |
| 2 | NAVSAT | Galileo | E.U. |
| 3 | NAVSAT | QZSS | Japan |
| 4 | NAVSAT | NAVIC | India |
| 5 | NAVSAT | GLONASS | Russia |
| 6 | NAVSAT | BeiDou-1 | China |
| 7 | NAVSAT | BeiDou-2 | China |

For example, a value of three (or binary 0000 0011) indicates “On-board Inertial Navigation System” and “GPS” provide the positioning information for the platform.

To support potential future growth of this item, any additional Positioning Methods will be added in more significant bytes. The bit positions stated above are in the least significant byte of the value.

## 8.125 Tag 125: Platform Status

| Description | | | | | |
|---|---|---|---|---|---|
| Enumeration of operational modes of the platform (e.g., in-route, RTB) | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint | 0 | 12 | |
| | **KLV** | uint | 0 | 12 | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| 1 | 1 | 1 |

| **Resolution** | **Special Values** |
|---|---|
| N/A | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 9 (Egress) | 7D | 01 | 09 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.37.00.00.00 (CRC 23127) |
|---|---|

- Use table in Details to resolve enumeration name

### 8.125.1 Details

The Platform Status is an enumeration of modes for the platform throughout the life-cycle of a single flight. Table 11 lists the modes:

**Table 11: Platform Status Modes**

| Value | Name | Description |
|---|---|---|
| 0 | Active | Platform active but with unknown status |
| 1 | Pre-flight | Platform is performing pre-flight tasks |
| 2 | Pre-flight-taxiing | Platform is taxiing before take-off |
| 3 | Run-up | Engine run-up before take-off |
| 4 | Take-off | Platform is taking off |
| 5 | Ingress | Platform is flying to first target |
| 6 | Manual operation | Human is piloting the platform |
| 7 | Automated-orbit | Automated system is piloting platform |
| 8 | Transitioning | Platform is transitioning to new target |
| 9 | Egress | Platform if flying to recovery location (i.e., Return to Base (RTB) |
| 10 | Landing | Platform is landing – wheels down |
| 11 | Landed-taxiing | Platform has landed and is taxiing |
| 12 | Landed-Parked | Platform is parked after mission, awaiting power down |
| 13-255 | Reserved | Reserved for future expansion - Do not use |

Some modes may be appropriate to use at the same time, for example “Manual Operation” and “Take-off” could be occurring at the same time. Use the mode which describes the situation with the most detail.

## 8.126 Tag 126: Sensor Control Mode

| Description | | | | | |
|---|---|---|---|---|---|
| Enumerated value for the current sensor control operational status | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | uint | 0 | 6 | |
| | **KLV** | uint | 0 | 6 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| 1 | 1 | 1 |

| Resolution | Special Values |
|---|---|
| N/A | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 5 (Auto-Holding Position) | 7E | 01 | 05 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.0F.00.00 (CRC 36315) |

- Use table in Details to resolve enumeration name

### 8.126.1 Details

The Sensor Control Mode provides an enumeration of the operational status of a sensor. Table 12 lists the possible modes.

**Table 12: Sensor Control Modes**

| Value | Name | Description |
|---|---|---|
| 0 | Off | The sensor is powered off |
| 1 | Home Position | The sensor is in its “home” or “lock” position (e.g., locked for landing) |
| 2 | Uncontrolled | No person or system is controlling the sensor |
| 3 | Manual Control | A person is directing the sensor |
| 4 | Calibrating | The sensor is calibrating (e.g., IR NUC) |
| 5 | Auto - Holding Position | An autonomous system is controlling the sensor positioning which is in a holding mode pointing at a specific stationary ground position |
| 6 | Auto - Tracking | An autonomous system is controlling the sensor positioning which is tracking an object |
| 7-255 | Reserved | Reserved for future expansion - Do not use |

## 8.127 Tag 127: Sensor Frame Rate Pack

| Description | | | | | |
|---|---|---|---|---|---|
| Values used to compute the frame rate of the Motion Imagery at the sensor | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | dlp | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | 16 | N/A |

| **Resolution** | **Special Values** |
|---|---|
| N/A | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 60000/1001 = 59.94 fps | 7F | 05 | 83D4 6087 69 |

| **KLV Key** | 06.0E.2B.34.02.05.01.01.0E.01.03.02.10.00.00.00 (CRC 3454) |
|---|---|

- The sensor frame rate may be different than the encoded frame rate

### 8.127.1 Details

The Sensor Frame Rate Pack consists of two unsigned integers used to compute the frame rate. The ratio of the two integers provides the capability to compute both integer and drop-frame frame rates. For example, typical integer frame rates of 30, 60 are the ratio of 30/1 and 60/1, respectively. While drop-frame rates of 29.97 and 59.94 are the ratio of 30000/1001 and 60000/1001, respectively.

The Sensor Frame Rate Pack is a two-element truncation pack where the first element is the numerator in BER-OID format, and the second element is the denominator in BER-OID format, as shown in Figure 57.

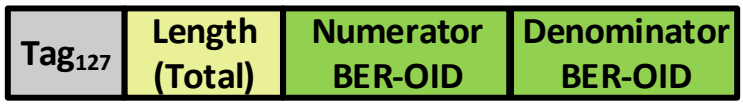


**Figure 57: Sensor Frame Rate Pack**

If the pack does not include the second value, the denominator defaults to a value of one (1).

Table 13 lists the KLV Universal Labels (UL) for the values defined in the Sensor Frame Rate Pack. The Sensor Frame Rate Pack UL is defined in the Tag 127 summary table.

**Table 13: Universal Labels for Sensor Frame Rate Pack**

| Key | Name | Type | Len | M/O |
|---|---|---|---|---|
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.10.00.00 (CRC 57993) | Numerator | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.23.00.00 (CRC 32380) | Denominator | uint (ber-oid) | v | O |

## 8.128 Tag 128: Wavelengths List

| Description | | | | | |
|---|---|---|---|---|---|
| List of wavelength bands provided by sensor(s) | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | list | N/A | N/A | |
| | **KLV** | vlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 21,1000, 2000, NNIR (Narrow NIR) | 8100 | 0E | 0D15 0000 07D0 0000 0FA0 4E4E 4952 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.04.01.01.0E.01.03.02.01.00.00.00 (CRC 47140) |

- Used with Active Wavelength List (Tag 121)

### 8.128.1 Details

The Wavelengths List is a list of information used by the on-board sensors which collect Motion Imagery. This item is a companion to Active Wavelength List (Tag 121).

Table 14 shows predefined sensor records which support a set of common wavelengths used by sensors. The Active Wavelength List (Tag 121) can use these predefined wavelength bands if they are sufficient for the given platform's sensors. If a platform/sensor requires more specific or customized wavelength records, this item enables their definition. Any custom Wavelengths List records are sent at a minimum of once every 30 seconds. If the predefined wavelengths are sufficient for the platforms sensors there is no need to send a Wavelengths List item.

A sensor wavelength record contains a numeric identifier (ID), min/max wavelengths, and a unique name for display on remote terminals, etc. The ID is a unique number for the wavelength record. Custom wavelength records begin at ID 21 and increment as needed. A custom wavelength record persists only for a given flight. The "Min" and "Max" wavelengths define the range of the band. The "Name" is a unique string describing the band. The sensor wavelength record does not include the "Description," it is only in the table for informational purposes.

See the Motion Imagery Handbook Section 3.1 for information on these wavelengths and descriptions.

**Table 14: Predefined Wavelength Information Records**

| ID | Min (nm) | Max (nm) | Name | Description |
|---|---|---|---|---|
| 1 | 380 | 750 | VIS | Visible light |
| 2 | 750 | 100,000 | IR | Infrared |
| 3 | 750 | 3000 | NIR | Near/Short Wave Infrared |
| 4 | 3000 | 8000 | MIR | Mid-wave Infrared |
| 5 | 8000 | 14000 | LIR | Long-wave Infrared |
| 6 | 14000 | 100,000 | FIR | Far-Infrared |
| 7-20 | Reserved | Reserved | | Reserved for future use |

The Wavelengths List item is a list of wavelength records formatted as a Variable Length Pack (VLP). Each value of the VLP is a separate wavelength record formatted as a Floating Length Pack (FLP). The FLP consists of four fields, in order: Wavelength ID, Min Wavelength, Max Wavelength and Wavelength Name. The Wavelength ID is a BER-OID encoded integer. The Wavelength Min and Wavelength Max values are IMAPB(0,1e9,4) which provides a precision of ~½ a nanometer, and covers the spectrum range from X-Rays to VHF. The Wavelength Name is a utf8 string of characters with varying length. Figure 58 illustrates the FLP.

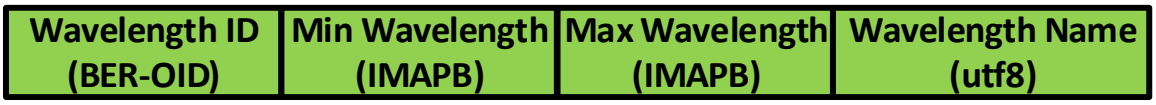


**Figure 58: Wavelength Record in FLP**

Combining one or more FLP's, along with each of their lengths, forms the Wavelengths List Local Set item's VLP as illustrated in Figure 59.

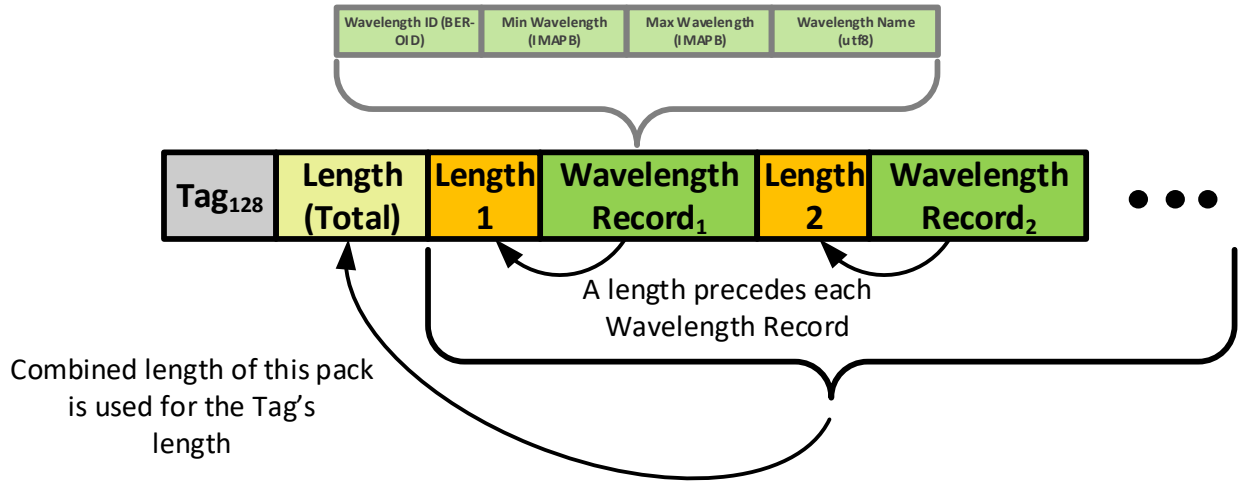


**Figure 59: Wavelengths List VLP**

Each Wavelength Record's length provides the information to parse all the Wavelength Records items properly. Given a Wavelength Record FLP, the Wavelength ID in BER-OID format can be one or more bytes. The BER-OID format is self-describing providing the rules for obtaining the number of bytes for the value. The Wavelength Min and Wavelength Max values are both four

(4) bytes each. Subtracting the sum of the Wavelength ID BER-OID bytes, and the eight bytes from the Wavelength Min / Wavelength Max from the VLP length determines the length of the Wavelength Name string: $Name_{len} = Length_1 - (BEROID_{len} + 8)$

Sending all Wavelength Records in one UAS Datalink LS is unnecessary and could contribute to bandwidth compromises. Sending Wavelength Records using multiple UAS Datalink LS's distributes the metadata and reduces these issues.

Table 15 lists the KLV Universal Labels (UL) for the values defined in the Wavelengths Record FLP. The Tag 128 summary table defines the Wavelengths List UL.

**Table 15: Universal Labels for Wavelength Record Values**

| Defined Length Pack Key | | | | Name |
|---|---|---|---|---|
| 06.0E.2B.34.02.05.01.01.0E.01.03.02.0F.00.00.00<br>(CRC 49719) | | | | Wavelength Record |
| Constituent Elements | | | | |
| Key | Name | Type | Len | M/O |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.12.00.00<br>(CRC 36073) | Wavelength ID | uint<br>(ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.11.00.00<br>(CRC 54713) | Minimum Wavelength | float<br>(IMAPB) | 4 | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.11.00.00<br>(CRC 54713) | Maximum Wavelength | float<br>(IMAPB) | 4 | M |
| 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00<br>(CRC 48077) | Wavelength Name | utf8 | v | M |

## 8.129 Tag 129: Target ID

| Description | | | | | |
|---|---|---|---|---|---|
| Alpha-numeric identification of a target | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 32 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| A123 | 8101 | 04 | 4131 3233 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) |
|---|---|

- Platform/Mission specific identifier for a target.
- Format is application specific

## 8.130 Tag 130: Airbase Locations

| Description | | | | | |
|---|---|---|---|---|---|
| Geographic location of the take-off site and recovery site | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | record | N/A | N/A | |
| | **KLV** | vlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 24 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| (38.841859, -77.036784, 3),<br>(38.939353, -77.459811, 95)<br><br>[See Bullet Note Below] | 8102 | 18 | 0B40 6BC2 0919 BDA5 5407 0E00 0B40 783C B819 A292 7407 C600 |

| KLV Key | 06.0E.2B.34.02.04.01.01.0E.01.03.01.01.00.00.00 (CRC 22262) |
|---|---|

- Truncation Pack which includes the Latitude, Longitude and HAE for both sites
- If Take-off and Recovery sites are the same only provide the Take-off site
- Example Software Value shows two triplets, where each triplet is a location (latitude, longitude, elevation)

### 8.130.1 Details

The Airbase Locations item is a Variable Length Pack (VLP) describing either the take-off location, the recovery location or both within a Location Defined Length Pack (DLP).

Both the take-off and recovery locations are coordinates with WGS84 Latitude, Longitude and Height Above Elliposd (HAE). Each location is described in a DLP containing IMAPB values for latitude, longitude and HAE. The latitude and longitude are each four (4) bytes and the HAE is three (3) bytes, as illustrated in Figure 60.

| Latitude | Longitude | HAE |
|---|---|---|
| IMAPB(-90,90,4) | IMAPB(-180,180,4) | IMAPB(-900, 9000,3) |

**Figure 60: Location DLP**

The lengths have been choosen to provide a 1 meter or better precision. The WGS84 earth radius, R, of 6378137 meters at the equator, is used to compute the circumference of $2\pi R = 40{,}075{,}017$ meters. Using this circumference as the worst case (i.e., spherical model), the latitude and longitude precision values are computed. One meter of precision is 1/40,075,017$^{th}$ of the earth circumference.

For latitude values, one meter of precision is $180 * \frac{1}{40075017} = 4.49$ micro-degrees. With the maxium magnitude of +/- 90 degrees and 4.49 micro-degrees the Software value requires an

IEEE double precision floating point value. IMAPB requires 4 bytes to provide the same precision. Using IMAP(-90,90,4) provides 11.9 microdegrees or 1.19 cm of precision.

For longitude values, one meter of precision is $360 * \frac{1}{40075017} = 8.98$ micro-degrees. With a maxium magnitude of +/- 180 degrees and 8.89 micro-degrees the software value requires an IEEE double precision floating point value. IMAPB requires 4 bytes to provide the same preicsion. Using IMAPB(-180,180,4) provides 23.8 micro-degrees of 2.65 cm of precision.

For HAE with a range from -600 to 9000 meters and similar precisions (1 meter or better) requires using three bytes. Using IMAPB(-600, 9000, 3) provides 0.19 cm of precision.

The Airbase Locations VLP contains the take-off location, followed by the recovery location, with each preceded by the length of the location as shown in Figure 61.

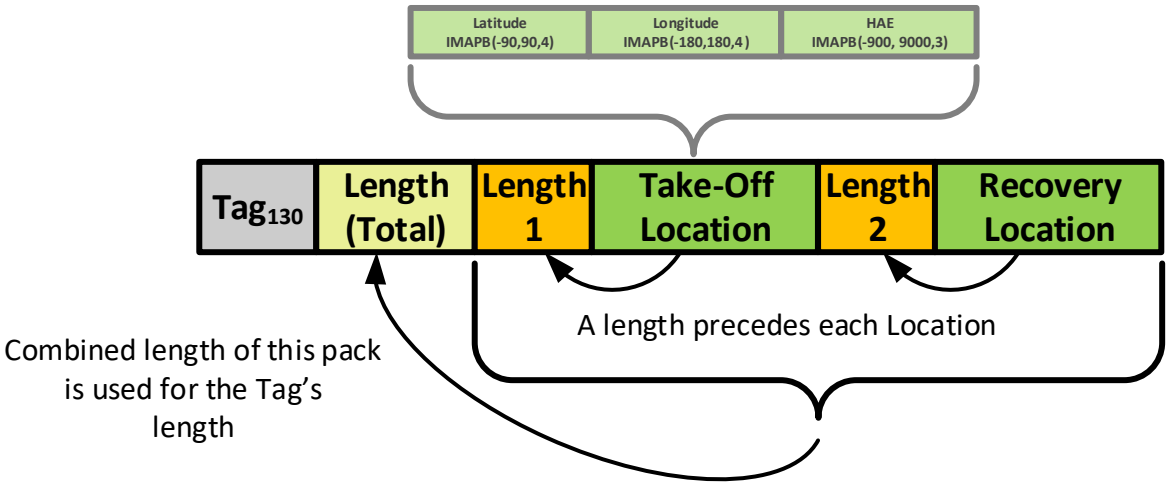


**Figure 61: Airbase Locations VLP**

The Airbase Locations item has several bandwidth optimizations:

1) Do not include the Recovery Location (i.e., truncate it), if the Take-Off Location and the Recovery Location are the same. When a receiver parses the location, if the Recovery Location is absent then the Recovery Location is set equal to the Take-Off location, i.e., the aircraft is doing a round trip back to the take-off location.
2) If either the Take-Off Location or Recovery Location is unknown, the length for the respective location's value is set to zero (0). Therefore, when a receiver parses the item and either the Take-Off Location or Recovery Location length is zero, the Software Values for the location are set to an "unknown."
3) If both the Take-Off Location and Recover Locations are unknown, Tag 130 does not appear in the Local Set.
4) Do not include the HAE value (i.e., truncate it) in either location if it is unknown.

Table 16 lists the KLV Universal Labels (UL) for the values defined in the Locations Pack. The Tag 130 summary table defines the Airbase Locations Pack UL.

**Table 16: Universal Labels for Locations Pack values**

| Defined Length Pack Key | | | | Name |
|---|---|---|---|---|
| 06.0E.2B.34.02.05.01.01.0E.01.03.02.0B.00.00.00 (CRC 2246) | | | | Location Pack |
| Constituent Elements | | | | |
| Key | Name | Type | Len | M/O |
| 06.0E.2B.34.01.01.01.01.0E.01.01.03.28.00.00.00 (CRC 53661) | Latitude | float (IMAPB) | 4 | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.03.29.00.00.00 (CRC 42793) | Longitude | float (IMAPB) | 4 | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.03.2A.00.00.00 (CRC 15605) | HAE | float (IMAPB) | 3 | O |

## 8.131 Tag 131: Take-off Time

| Description | | | | | |
|---|---|---|---|---|---|
| Time when aircraft became airborne | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Microseconds (µs) | **Software** | uint64 | 0 | (2^64)-1 | |
| | **KLV** | uint | 0 | (2^64)-1 | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | 8 | N/A |

| **Resolution** | **Special Values** |
|---|---|
| 1 microsecond | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 2018-06-21T13:43:57.122999 | 8103 | 08 | 0005 6F27 1B5E 41B7 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.01.38.00.00.00 (CRC 36537) |
|---|---|

- Represented in the number of microseconds elapsed since midnight (00:00:00), January 1, 1970 not including leap seconds
- See MISB ST 0603
- See details for Time Airborne (Tag 110) for description and usage

## 8.132 Tag 132: Transmission Frequency

| Description | | | | | |
|---|---|---|---|---|---|
| Radio frequency used to transmit the Motion Imagery | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| MHz | **Software** | float64 | 1 | 99999 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| **Length** | **Max Length** | **Required Length** |
|---|---|---|
| Variable | 4 | N/A |

| **Resolution** | **Special Values** |
|---|---|
| 2 bytes = 4 MHz<br>3 bytes = 15.625 KHz | None |

| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(1\ ,99999, \mathrm{Length}, \mathrm{Soft_{val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(1, 99999, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| **Example Software Value** | **Example KLV Item (All Hex)** | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 2.4 GHz | 8104 | 03 | 0257 C0 |

| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.13.00.00 (CRC 48089) |
|---|---|

- The Radio Frequency used to transmit the UAS Motion Imagery from the platform to the ground station or satellite uplink

## 8.133 Tag 133: On-board MI Storage Capacity

| Description | | | | | |
|---|---|---|---|---|---|
| The total capacity of on-board Motion Imagery storage | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Gigabytes (GB) | **Software** | uint32 | 0 | (2^32)-1 | |
| | **KLV** | uint | 0 | (2^32)-1 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 1 Gigabyte | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 10,000 GB (10 TB) Hard Drive | 8105 | 02 | 2710 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.14.00.00 (CRC 15945) |
|---|---|

- Used with "On-Board Storage Percent Full" (Tag 120) to determine remaining storage/time available for recording

## 8.134 Tag 134: Zoom Percentage

| Description | | | | | |
|---|---|---|---|---|---|
| For a variable zoom system, the percentage of zoom | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Percent (%) | **Software** | float32 | 0 | 100.0 | |
| | **KLV** | IMAPB | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 1 byte = 1%<br>2 bytes = .0039% | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{IMAPB}(0, 100.0, \mathrm{Length}, \mathrm{Soft_{val}})$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{RIMAPB}(0, 100.0, \mathrm{Length}, \mathrm{KLV_{uint}})$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 55.0 % | 8106 | 02 | 3700 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.15.00.00 (CRC 2425) |
|---|---|

- Percentage of Zoom of the sensor system
- Includes both digital and optical zoom
- 0% means no zoom, 100% means fully zoomed

## 8.135 Tag 135: Communications Method

| Description | | | | | |
|---|---|---|---|---|---|
| Type of communications used with platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | string | N/A | N/A | |
| | **KLV** | utf8 | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 127 | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{val}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| Frequency Modulation | 8107 | 14 | 4672 6571 7565 6E63 7920 4D6F 6475 6C61 7469 6F6E |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) |
|---|---|

- Type of signal used to communicate with platform

## 8.136 Tag 136: Leap Seconds

| Description | | | | | |
|---|---|---|---|---|---|
| Number of leap seconds to adjust Precision Time Stamp (Tag 2) to UTC | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| Seconds (s) | **Software** | int32 | -(2^31) | (2^31)-1 | |
| | **KLV** | int | -(2^31) | (2^31)-1 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 4 | N/A |

| Resolution | Special Values |
|---|---|
| 1 Second | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{int}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| 30 seconds | 8108 | 01 | 1E |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.00.00.00 (CRC 41450) |
|---|---|

- Add this value to Precision Time Stamp (Tag 2) to convert to UTC
- When adjusting Precision Time Stamp to UTC multiply this leap second value by 1,000,000 to convert it to microseconds
- See handbook for more details on Leap Seconds and the MISP Time System
- See "Packet Timestamp" section for more information on the use of this item

## 8.137 Tag 137: Correction Offset

| Description | | | | | |
|---|---|---|---|---|---|
| Post-flight time adjustment to correct Precision Time Stamp (Tag 2) as needed | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| microseconds (µs) | **Software** | int64 | -(2^63) | (2^63)-1 | |
| | **KLV** | int | -(2^63) | (2^63)-1 | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | 8 | N/A |

| Resolution | Special Values |
|---|---|
| 1 microsecond | None |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | $\mathrm{KLV_{val}} = \mathrm{Soft_{Val}}$ |
| **KLV Value To Software Value** | $\mathrm{Soft_{val}} = \mathrm{KLV_{uint}}$ |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| 1:23:45.678901 (5025678901 ms) | 8109 | 05 | 012B 8DC6 35 |

| KLV Key | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.17.00.00 (CRC 26393) |
|---|---|

- Add value to Precision Time Stamp (Tag 2) to correct time
- This value DOES NOT INCLUDE leap seconds offset. See Leap Seconds (Tag 136) to add leap second offset
- See "Packet Timestamp" section for more information on the use of this item

## 8.138 Tag 138: Payload List

| Description | | | | | |
|---|---|---|---|---|---|
| List of payloads available on the Platform | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | list | N/A | N/A | |
| | **KLV** | vlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| (0, 0, "VIS Nose Camera")<br>(1, 0, "ACME VIS Model 123")<br>(2, 0, "ACME IR Model 456")<br><br>[See Bullet Note Below] | 810A | 3F | 0312 0000 0F56 4953 204E 6F73 6520 4361<br>6D65 7261 1501 0012 4143 4D45 2056 4953<br>204D 6F64 656C 2031 3233 1402 0011 4143<br>4D45 2049 5220 4D6F 6465 6C20 3435 36 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.04.01.01.0E.01.03.01.02.00.00.00 (CRC 52522) |

- List of Payloads on-board platform. Payloads include non-Motion Imagery sensors
- Used with Active Payloads (Tag 139)
- Example Software Value shows three triplets, where each triplet is a Payload Record (Identifier, Type, Name)

### 8.138.1 Details

The Payload List provides type and name of all relevant payloads on the platform. The Payload List may contain optical sensors and non-optical payload packages such as SIGINT, LIDAR, or RADAR systems. Some of the items in the Payload List will have further wavelength information provided in the Wavelengths List when they become active. This list does not contain any weapons, see Tag 140 for listing platform weapons.

The Payload List is a Floating Length Pack (FLP) which contains a Payload Record. A Payload Record consists of four elements: Payload Identifier, Payload Type, Name Length and Payload Name. The Payload Identifier is a unique BER-OID integer sequentially assigned starting with the number zero (0). The Active Payload (Tag 139) uses the Payload Identifier to specify which payloads are active. The Payload Type is a BER-OID enumeration from Table 17. The Name Length encodes the length of the Payload Name in BER short or long form. The Payload Name is a descriptive name of the payload defined by the metadata encoder.

**Table 17: Payload Type Enumeration**

| Payload Type | Enumeration Meaning |
|---|---|
| 0 | Electro Optical MI Sensor |
| 1 | LIDAR |
| 2 | RADAR |

| | |
|---|---|
| 3 | SIGINT |
| 4 | SAR |

Note: With a FLP, the final element's length can be determined automatically; however, by including the Name Length the Payload Record enables future expansion.

| Requirement | |
|---|---|
| ST 0601.13-30 | When including a Payload List (Tag 138) in the UAS Datalink LS, the Payload Identifier value shall start at zero (0) and increment by one (1) for each additional payload. |

Figure 62 illustrates the four items in a Payload Record.

**Figure 62: Payload Record FLP**

The Payload List starts with a Payload Count in BER-OID format. The Payload Count is the total number of payloads on the platform. Following the Payload Count, a series of Payload Records within a VLP as shown in Figure 63. Preceding each Payload Record in the list is the BER (short or long form) value of the Payload Record's length. The Length (Total) of all Payload Records and their lengths follows Tag 138.

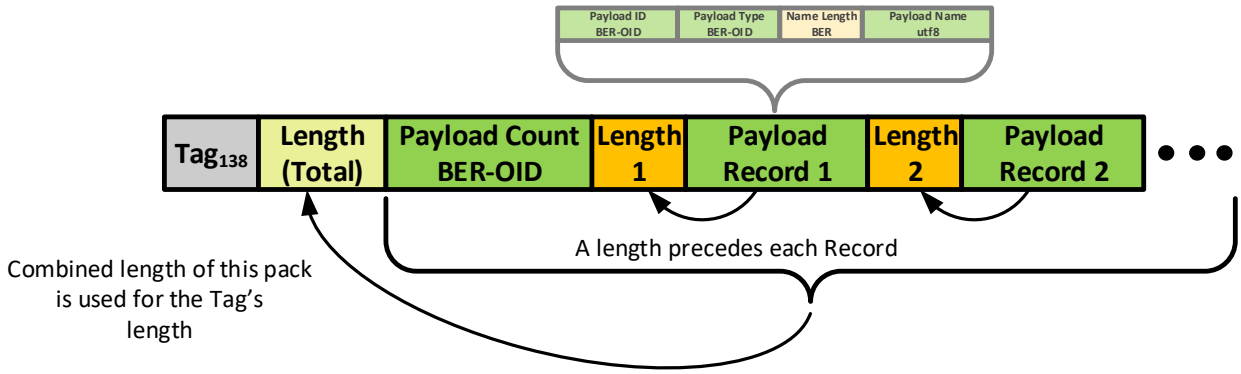


**Figure 63: Payload List VLP**

Table 18 shows an example Payload List.

**Table 18: Example Payload List**

| Payload Identifier | Payload Type | Payload Name |
|---|---|---|
| 0 | 0 | VIS Nose Camera |
| 1 | 0 | ACME VIS Model 123 |
| 2 | 0 | ACME IR Model 456 |
| 3 | 1 | NO COMP - LIDAR |
| 4 | 4 | SAR Model X |

Figure 64 shows the KLV value for the Example Payload List in Table 18.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 138 | 95 | 5 | 18 | 0 | 0 | 15 | VIS Nose Camera | 21 | 1 | 0 | 18 | ACME VIS Model 123 | (Continued on Next Line) |
| | | | 20 | 2 | 0 | 17 | ACME IR Model 456 | 16 | 3 | 3 | 13 | LIDAR Model S | (Continued on Next Line) |
| | | | 14 | 4 | 4 | 11 | SAR Model X | | | | | | |

**Figure 64: Example Payload List KLV**

Sending all Payload Records in one UAS Datalink LS is unnecessary and could contribute to bandwidth compromises. Sending Payload Records using multiple UAS Datalink LS's distributes the metadata and reduces these issues. In each Payload List, the Payload Count is constant and contains the total number of payloads on-board the platform.

Table 19 provides the KLV UL and other information for the Payload Count. Table 20 lists the KLV ULs for the Payload Record Pack and the values within the pack. The Tag 138 summary table defines the Payload List KLV UL.

**Table 19: Universal Label for Payload Count**

| UL (Key) | Name | Type | Len | M/O |
|---|---|---|---|---|
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.16.00.00 (CRC 20521) | Payload Count | uint (ber-oid) | v | M |

**Table 20: Universal Labels for Payload Record Pack values**

| Defined Length Pack Key | Name | | | |
|---|---|---|---|---|
| 06.0E.2B.34.02.05.01.01.0E.01.03.02.0C.00.00.00 (CRC 23019) | Payload Record | | | |
| Constituent Elements | | | | |
| UL (Key) | Name | Type | Len | M/O |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.19.00.00 (CRC 31768) | Payload ID | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.18.00.00 (CRC 19240) | Payload Type | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) | Payload Name | utf8 | v | M |

## 8.139 Tag 139: Active Payloads

| Description | | | | | |
|---|---|---|---|---|---|
| List of currently active payloads from the payload list (Tag 138) | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | list | N/A | N/A | |
| | **KLV** | byte | N/A | N/A | N/A |
| **Length** | | **Max Length** | | **Required Length** | |
| Variable | | Not Limited | | N/A | |
| **Resolution** | | **Special Values** | | | |
| N/A | | N/A | | | |
| **Required in LS?** | Optional | **Allowed in SDCC Pack?** | No | **Multiples Allowed?** | No |

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| Payload ID's 0,1, and 3 are Active | 810B | 01 | 0B |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.1A.00.00 (CRC 9544) |

- Denotes which payloads from the Payload List (Tag 138) are currently active

### 8.139.1 Details

The Active Payloads item is a list of the subset of payloads from the Payload List which are currently in use. The list is a series of Payload Identifiers which map into the Payload List allowing receivers to determine the Active Payload Names.

The list is a series of bits which represent which payloads are active. A bit value of one (1) means the payload is active, a bit value of zero (0) means the payload is not active. Using the example from the Payload List (Tag 138), if payloads 0, 1, and 3 are active, bits 0, 1, and 3 will be set in the Active Payloads Value, as shown in Figure 65. The result for this example is a single byte with the value of 0x0B.

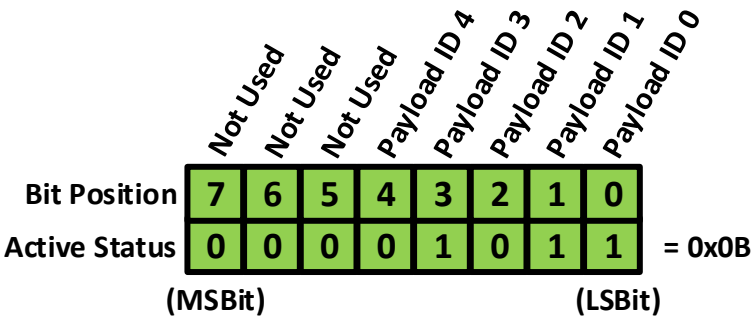


**Figure 65: Active Payloads Example**

Use additional bytes when the Payload List (Tag 138) has more than eight payloads.

## 8.140 Tag 140: Weapons Stores

| Description | | | | | |
|---|---|---|---|---|---|
| List of weapon stores and status | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | list | N/A | N/A | |
| | **KLV** | vlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | Tag | Len | Value |
| (1, 2, 3, 1,(1, 3), "Harpoon")<br>(0, 0, 0, 1,(1, 3), "GBU-15")<br>(0, 0, 0, 2,(4, 4), "Hellfire")<br><br>[See Bullet Note Below] | 810C | 2D | 0E01 0203 0182 0307 4861 7270 6F6F 6E0D 0000 0001 8203 0647 4255 2D31 350F 0000 0002 8804 0848 656C 6C66 6972 65 |

| KLV Key | 06.0E.2B.34.02.04.01.01.0E.01.03.01.03.00.00.00 (CRC 48030) |
|---|---|

- Example Software Value shows three value groups, where each group is a Weapons Record (Station Id, Hardpoint ID, Carriage ID, Store ID, Status, Weapon Type)

### 8.140.1 Details

The Weapons Stores is a list of Weapons Records. Each record contains Weapon Location, Weapons Status, and Weapons Identity encoded as a Variable Length Pack (VLP). The Weapon Location is a physical address on the platform using Station Number, Hardpoint ID, Carriage ID and Store ID. The Weapon Status contains two parts: General Status and Engagement Status of the weapon. The General Status is an enumeration with the values in Table 21.

**Table 21: Weapon/Store State (General Status)**

| Status | Meaning | Description |
|---|---|---|
| 0 | Off | No power operating power is available to the Store |
| 1 | Initialization | Operating Power is on and the Store is initializing |
| 2 | Ready/Degraded | Store initialization completed – full capability not available |
| 3 | Ready/All Up Round | Store initialization completed – full capability is available |
| 4 | Launch | Dedicated release<br>processes started including activation of irreversible functions |
| 5 | Free Flight | Store has successfully separated from the platform |
| 6 | Abort | Either commanded into or safety critical anomaly detected. |
| 7 | Miss Fire | Weapon miss-fired |
| 8 | Hang Fire | Weapon which does not separate from aircraft when activated for employment or jettison. |
| 9 | Jettisoned | Intentional or emergency separation of weapon from aircraft with the weapon in the unarmed state (fuze-safe). |
| 10 | Stepped Over | Weapon is bypassed due to failure. Weapon can still be jettisoned. |
| 11 | No Status Available | Unknown status |
| 12 – 127 | Reserved | Future status |

The Engagement Status in Table 22 lists engagement functions.

**Table 22: Engagement Status**

| ID | Name | Description |
|---|---|---|
| 1 | Fuze Enabled | Fuze functions are set |
| 2 | Laser Enabled | Laser functions are set |
| 3 | Target Enabled | Target functions are set |
| 4 | Weapon Armed | Master Arm is set |

The Storage (or Weapon) Type is a string which names the type of weapon.

A Weapons Record's items encode into a VLP with seven values as shown in Figure 66.

| Station ID BER-OID | Hardpoint ID BER-OID | Carriage ID BER-OID | Store ID BER-OID | Status BER-OID | Type Length BER | Weapon Type utf8 |
|---|---|---|---|---|---|---|

**Figure 66: Weapons Record**

The first four values define the Weapons Location in BER-OID format. These are Station ID, Hardpoint ID, Carriage ID and Store ID. The next value is the Weapon Status (labeled "Status" in the figure) also in BER-OID format using two bytes. The Weapon Status encodes both the General Status and Engagement Status into the two bytes as shown in Figure 67.

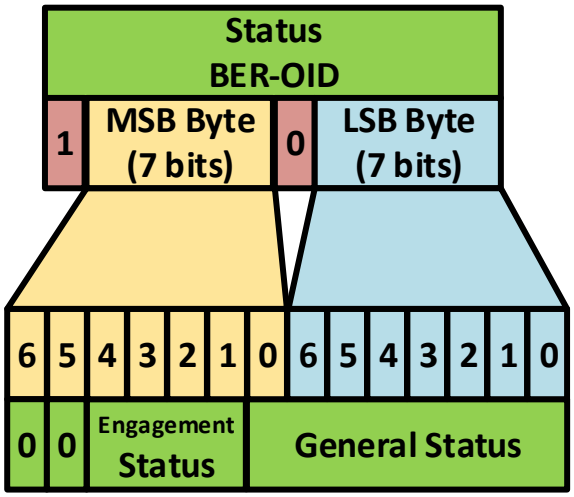


**Figure 67: Status BER-OID bit pattern**

After decoding the Weapons Status BER-OID value, a 14-bit value remains. The least significant eight (8) bits are the General Status, the next four (4) bits are the Engagement Status, and the remaining bits are set to zero for future use. To conserve bandwidth, if the Engagement Status bits are all zero (0) and the high-order bit of the General Status is zero (0) the most significant byte may be eliminated from the status value. Future additions to the status value will add more significant bytes if needed; the bits for Engagement and General status will not change.

Following status information, a BER short or long form value defines the length of the Weapon Type string which follows the length.

A VLP structure encodes a list of Weapons Records, where the Weapons Record's length precedes each record, as shown in Figure 68.

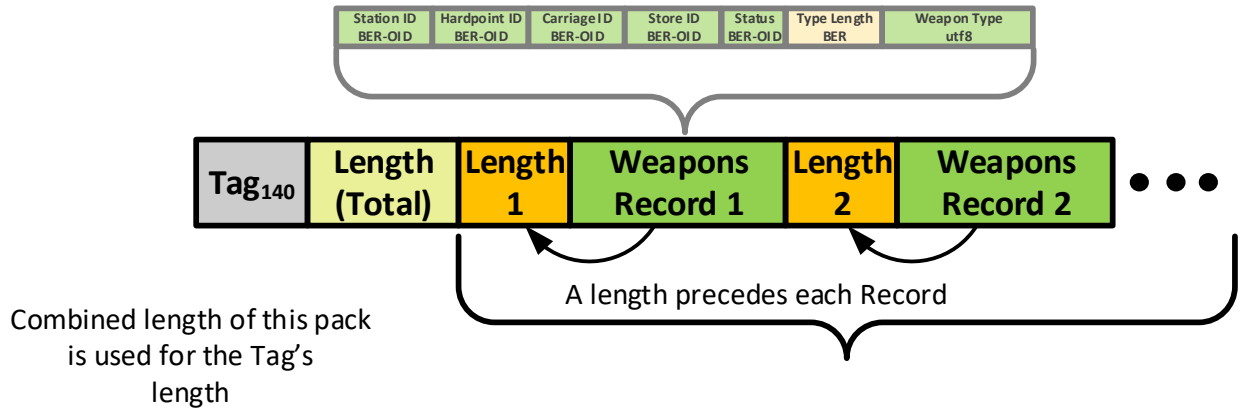


**Figure 68: Weapons Stores List VLP**

Sending all Weapons Records in one UAS Datalink LS is unnecessary and could contribute to bandwidth spikes. Sending Weapons Records over multiple UAS Datalink LS's, smooths out the metadata bandwidth and reduces the possibility of bandwidth spikes.

Table 23 lists the KLV Universal Labels (UL) for the values defined in the Weapons Record Pack. The Weapons Stores List UL is defined in the Tag 140 summary table.

**Table 23: Universal Labels for Weapons Record Pack values**

| Defined Length Pack Key | Name | | | |
|---|---|---|---|---|
| 06.0E.2B.34.02.05.01.01.0E.01.03.02.0D.00.00.00 (CRC 12127) | Weapon Record | | | |
| Constituent Elements | | | | |
| Key | Name | Type | Len | M/O |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.1E.00.00 (CRC 63880) | Station ID | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.1C.00.00 (CRC 38888) | Hardpoint ID | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.1B.00.00 (CRC 4728) | Carriage ID | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.1F.00.00 (CRC 52920) | Store ID | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.1D.00.00 (CRC 41176) | Status | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.04.03.03.00.00.00 (CRC 48077) | Weapon Type | utf8 | v | M |

## 8.141 Tag 141: Waypoint List

| Description | | | | | |
|---|---|---|---|---|---|
| List of waypoints and their status. | | | | | |
| **Units** | | **Format** | **Min** | **Max** | **Offset** |
| None | **Software** | list | N/A | N/A | |
| | **KLV** | vlp | N/A | N/A | N/A |

| Length | Max Length | Required Length |
|---|---|---|
| Variable | Not Limited | N/A |

| Resolution | Special Values |
|---|---|
| N/A | N/A |

| Required in LS? | Optional | Allowed in SDCC Pack? | No | Multiples Allowed? | No |
|---|---|---|---|---|---|

| | |
|---|---|
| **Software Value To KLV Value** | See Details |
| **KLV Value To Software Value** | See Details |

| Example Software Value | Example KLV Item (All Hex) | | |
|---|---|---|---|
| | **Tag** | **Len** | **Value** |
| (0, 1, (1, 1), (38.889422, -77.035162, 200))<br>(1, 2, (1, 0), (38.889268, -77.049918, 250))<br>(2, 32767, (0, 1), (38.889741, -77.012933, 100))<br>(3, -2, (0, 0), (38.889822, -77.010092, 300))<br><br>[See Bullet Note Below] | 810D | 40 | 0F00 0001 0340 71D8 9419 BDBF E708 9800<br>0F01 0002 0240 71D3 8819 BCCE 2408 FC00<br>0F02 7FFF 0140 71E3 0819 BF2C 1B07 D000<br>0F03 FFFE 0040 71E5 AF19 BF5A A709 6000 |

| | |
|---|---|
| **KLV Key** | 06.0E.2B.34.02.04.01.01.0E.01.03.01.04.00.00.00 (CRC 60083) |

- Example Software Value shows four value groups, where each group is a Waypoint Record (Waypoint Id, Prosecution Order, Info Value, and geo location (latitude, longitude, elevation))

### 8.141.1 Details

Waypoints are a series of aircraft destinations used to navigate the aircraft to certain locations. Waypoints are typically included in a flight plan and known at the beginning of a mission; however, depending on real-time events and information, the plan may change. Several types of changes are possible throughout the lifecycle of a mission: the waypoint order changes; cancellation of a waypoint; and adding ad hoc waypoints.

Figure 69 illustrates a set of waypoints ($WP_1$, $WP_2$, $WP_3$, and $WP_7$) along with their order of operation (called Prosecution Order) indicated in the parenthesis below the WP number. In this example the aircraft is proceeding to waypoint 3 ($WP_3$), so its Prosecution Order is set to zero (0), which signifies the waypoint is the "current" waypoint. Waypoint 2 ($WP_2$) is the next waypoint, so its prosecution order is set to one (1), followed by waypoint 7 ($WP_7$) with Prosecution Order of two (2). The aircraft has already visited waypoint 1 ($WP_1$) so waypoint 1's Prosecution Order is set to negative one (-1). Waypoints with negative values are *historical waypoints*; these may be important for users.

Figure 70 shows a change in the example waypoint plan. In this illustration, waypoint two ($WP_2$) has been removed from the plan, so its Prosecution Order is un-set. Additionally, an ad hoc waypoint ($WP_9$) has been added and inserted as the next waypoint to visit after the current waypoint, therefore waypoint 9's Prosecution Order has been set to (1).

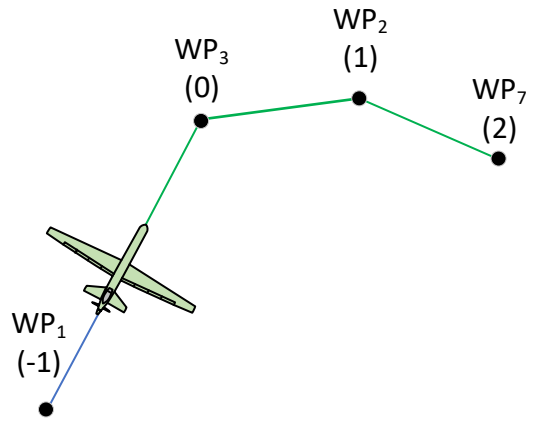


**Figure 69: Waypoint list example**

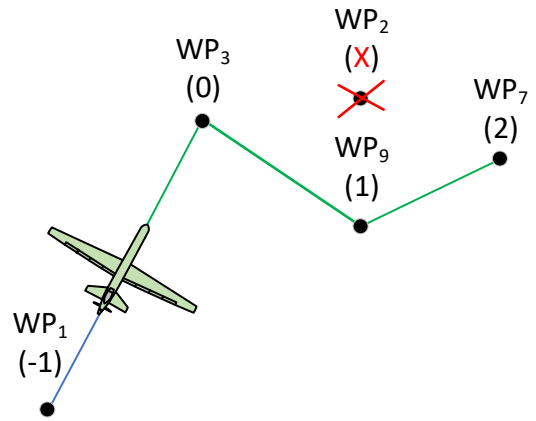


**Figure 70: Waypoint list changed**

The Waypoint List is a list of Waypoint Records encoded as a Variable Length Pack (VLP) to support waypoint management. A Waypoint Record contains: Waypoint ID, Prosecution Order, Info Value, and Location.

- The Waypoint ID is a unique integer identifier for the Waypoint; the value is positive and with each new waypoint the value increments by one. The Waypoint ID uses BER-OID encoding to encode its value.
- The Prosecution Order value is the position in the order of operation list. Planned waypoints are positive (i.e., >0) values. The current waypoint has a value of zero. Historical waypoints have negative values (i.e., <0) in decreasing order. (i.e., each completed waypoint has its Prosecution Order set to the next largest magnitude negative number). To determine the last waypoint, take the min value of all Prosecution Orders. Historical waypoints become static records, requiring updates only once every 30 seconds if retained. When canceling a waypoint set its Prosecution Order to the maximum positive value to indicate cancellation; this is the only value where multiple Waypoint Records can use the same Prosecution Order. The Prosecution Order uses a 2-byte signed integer, which allows for 32766 planned and 32768 historical waypoints. The cancelled waypoint value is 32767 (0x7FFF).
- The Info Value contains two values: Mode and Source. The Mode states the method of control to fly to the waypoint, either automated or manual. The Source is the creation method for the Waypoint, either it was pre-planned, or it was ad hoc. Both Mode and Source are single bits in the Info Value. The least significant bit (lsb) stores the Mode bit. When the Mode bit is zero (0), the Mode is automated; when the Mode bit is one (1) the Mode is manual. The next lsb is the Source bit. When the Source bit is zero (0), the Source is pre-planned; when the Source bit is one (1) the Source is ad hoc. The Info Value is a single byte value stored as a BER-OID value for future values if needed. The remaining bits of the Info Value are set to zero. Figure 71 illustrates the bit values for the Info Value.

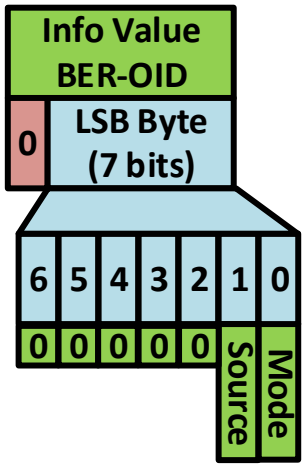


**Figure 71: Info Value bit-values**

- The Location is the geographic point for the Waypoint in latitude, longitude and HAE. The Location value uses the same DLP as the Location value from Tag 130.

Figure 72 shows the four items ordered within a defined length pack.

**Figure 72: Waypoint Record DLP**

Combining a group of Waypoint Records into a VLP, forms the Waypoint List as shown in Figure 73.

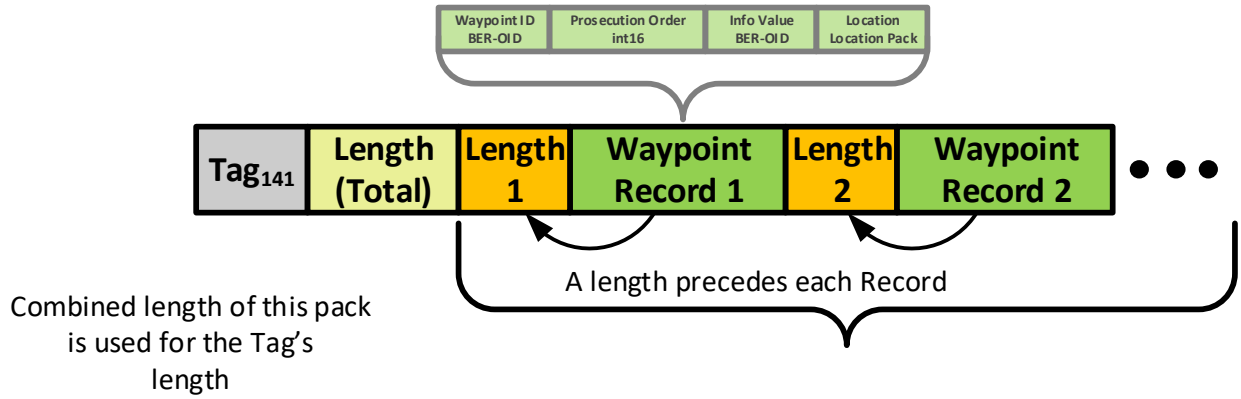


**Figure 73: Waypoint List VLP**

Sending all Waypoint Records in one UAS Datalink LS is not necessary and could contribute to bandwidth compromises. Sending Waypoint Records using multiple UAS Datalink LS's, distributes the metadata and reduces these issues.

Table 24 lists the KLV Universal Labels (UL) for the values defined in the Waypoint Record Pack. The Waypoint List UL is defined in the Tag 141 summary table.

**Table 24: Universal Labels for Waypoint Record Pack values**

| Defined Length Pack Key | Name | | | |
|---|---|---|---|---|
| 06.0E.2B.34.02.05.01.01.0E.01.03.02.0E.00.00.00 (CRC 46211) | Waypoint Record | | | |
| Constituent Elements | | | | |
| Key | Name | Type | Len | M/O |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.22.00.00 (CRC 18764) | Waypoint ID | uint (ber-oid) | v | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.21.00.00 (CRC 4124) | Prosecution Order | Int16 | 2 | M |
| 06.0E.2B.34.01.01.01.01.0E.01.01.02.0A.20.00.00 (CRC 10028) | Info Value | uint (ber-oid) | v | O |
| 06.0E.2B.34.02.05.01.01.0E.01.03.02.0B.00.00.00 (CRC 2246) | Location DLP(1) | vlp | v | O |

(1) See Tag 130 for definition of Location DLP.

## Appendix A – Deprecated Requirements

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 conformance perspective and is in with another requirement specifying the exact 16-byte KLV key to use (REQ-1.02) [REQ-1.02 is now REQ. ST 0601.8-18].

Requirement ST 0601.8-18 was removed per recent MISB practices where Universal Keys are defined within a dictionary and thus not considered requirements.

Requirement ST 0601.8-01 was removed because it is not an implementation requirement nor is it testable.

Requirement ST 0601.8-13 was replaced with two requirements, one specifying the allowed order and a second requirement specifying the required uniqueness.

Requirements ST 0601.8-02, -04, -05, -06, and -07 were moved to ST 0107.3 because they apply to all MISB KLV based metadata.

Requirement ST 0601.8-15 is deprecated because all “TBDs” have been removed from this standard.

Requirements ST 0601.13-25, -26 and ST 0601.14-32, -33, -34 were moved to ST 0107.4 because they apply to all MISB KLV based metadata.

| Requirement(s) | |
|---|---|
| ST 0601.8-18 (Deprecated) | The UAS Datalink Local Set 16-byte Universal Key shall be 06 0E 2B 34 - 02 0B 01 01 – 0E 01 03 01 - 01 00 00 00 (CRC 56773) |
| ST 0601.8-01 (Deprecated) | Any changes to MISB ST 0601 shall be accompanied by a document revision and date change and coordinated with the managing organization. |

| | |
|---|---|
| ST 0601.8-13 (Deprecated) | Excepting the requirements for Tag 2 at the start and Tag 1 at the end of a UAS Datalink LS any instance of the UAS Datalink LS, an instance of an UAS Datalink LS containing any number of properly formatted unique Tags in any order shall be valid. |
| ST 0601.8-02 (Deprecated) | Applications that implement MISB ST 0601 shall allow for metadata elements in the UAS Datalink Local Set that are unknown so that they are forward compatible with future versions of the interface. |
| ST 0601.8-04 (Deprecated) | All UAS Datalink LS metadata shall be formatted in compliance with SMPTE ST 336 [1]. |
| ST 0601.8-05 (Deprecated) | Implementations of MISB ST 0601 shall parse unknown, but properly formatted metadata UAS Datalink Local Set packets, so as to not impact the reading of known Tags within the same instance. |
| ST 0601.8-06 (Deprecated) | All instances of item Tags within a UAS Datalink LS packet shall be BER-OID encoded using the fewest possible bytes in accordance with SMPTE ST 336. |
| ST 0601.8-07 (Deprecated) | All instances of item length fields within a UAS Datalink LS packet shall be BER Short form or BER Long form encoded using the fewest possible bytes in accordance with SMPTE ST 336 [2]. |
| ST 0601.8-15 (Deprecated) | UAS Datalink LS items that have incomplete descriptions (i.e., “TBD”) shall be informative rather than normative. |
| ST 0601.13-25 (Deprecated) | All reportable UAS Data-link LS items which are Known-Changing or Known-Static shall be reported no less than once every thirty (30) seconds. |
| ST 0601.13-26 (Deprecated) | Metadata items which have not been updated within a thirty (30) second period shall be considered Unknown. |
| ST 0601.14-32 (Deprecated) | Required items of a UAS Datalink LS (Tag 1-Checksum, Tag 2-Precision Time Stamp, and Tag 65-UAS Datalink LS Version Number) instance shall always be reported with positive lengths (i.e. Zero-Length Items (ZLI) are not allowed for these items). |
| ST 0601.14-33 (Deprecated) | Where a UAS Data-link LS item has a length of zero, consumers shall interpret the value of the item as "unknown.” |
| ST 0601.14-34 (Deprecated) | A Zero-Length Item (ZLI) shall only be used in packets after a non-ZLI is reported. |